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442

Bobcat®

Service Manual

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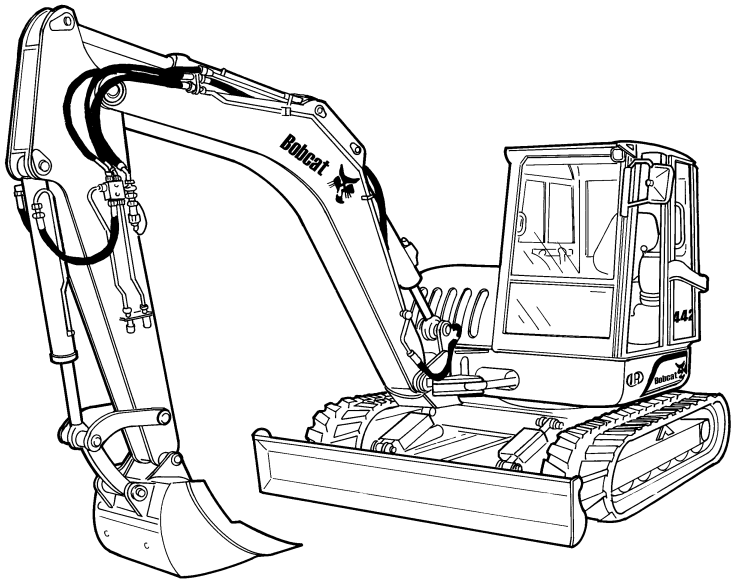

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MAINTENANCE SAFETY

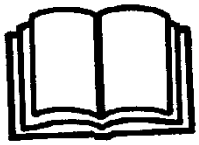
WARNING

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.

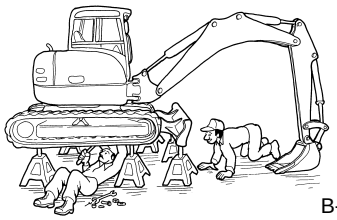
CORRECT



B-10731a

- **Never service the Bobcat Hydraulic Excavator without instructions.**

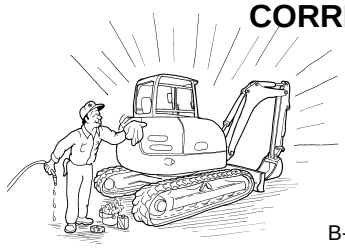
CORRECT



B-16637

- **Use the correct procedure to lift and support the excavator.**
- **Always lift the blade fully before installing jackstands.**

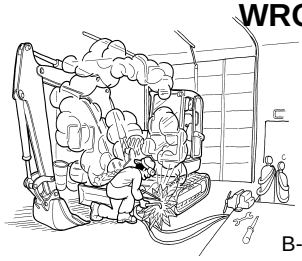
CORRECT



B-16638

- **Cleaning and maintenance are required daily.**

WRONG



B-16672

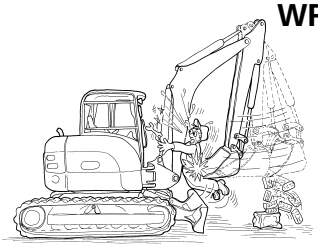
- **Have good ventilation when welding or grinding painted parts.**
- **Wear dust mask when grinding painted parts. Toxic dust and gas can be produced.**

WRONG

B-16673

- **Vent exhaust to outside when engine must be run for service.**
- **Exhaust system must be tightly sealed. Exhaust Fumes can kill without warning.**

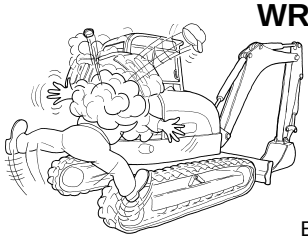
WRONG



B-16671

- **Always lower the bucket and blade to the ground before doing any maintenance.**
- **Never modify equipment or add attachments not approved by Bobcat Company.**

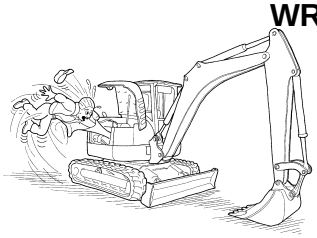
WRONG



B-16670

- **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-16669

- **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 protection approved for type of welding.**
- **Keep tailgate closed except for service, Close and latch tailgate before operating the excavator.**

WRONG

B-6589

- **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.

MSW23-0805

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ALPHABETICAL INDEX

ACCUMULATOR 20-01
AIR CLEANER 10-01, 60-01
AIR CONDITIONING COMPRESSOR BELT 10-01
AIR CONDITIONING SERVICE 70-01
AIR CONDITIONING SYSTEM FLOW 70-01
ALTERNATOR 50-01
ALTERNATOR BELT 10-01
ARM 40-01
ARM CYLINDER 20-01
AUXILIARY HYDRAULIC FLOW CONTROL/ HYDRAULIC BREAKER APPLICATION VALVE 20-01
AUXILIARY HYDRAULIC FLOW CONTROL VALVE 20-01
AUXILIARY HYDRAULICS SELECTOR VALVE 20-01

BASIC TROUBLESHOOTING 70-01
BATTERY 50-01
BATTERY DISCONNECT SWITCH 50-01
BLADE 30-01
BLADE CYLINDER 20-01
BLADE FLOAT VALVE 20-01
BLADE VALVE 20-01
BOOM 40-01
BOOM CYLINDER 20-01
BOOM LOAD HOLDING VALVE 20-01
BOOM OFFSET CYLINDER 20-01
BOOM OFFSET VALVE 20-01
BUCKET 40-01
BUCKET CYLINDER 20-01

CAB 40-01
CAB TILT PROCEDURE 10-01
COMPONENTS 70-01
COMPRESSOR 70-01
CONDENSER 70-01
CONTROL LEVERS 40-01
CONVERSIONS SPEC-01
COOLING SYSTEM 10-01
COUNTER WEIGHT 40-01

DUMP VALVE 20-01

ELECTRICAL SYSTEM INFORMATION 50-01
ENGINE 60-01
ENGINE BOLT TORQUE SPEC-01
ENGINE COMPONENENTS AND TESTING 60-01
ENGINE LUBRICATION SYSTEM 10-01
ENGINE SPECIFICATIONS SPEC-01
ENGINE SPEED CONTROL 40-01
EVAPORATOR/HEATER UNIT 70-01
EXCAVATOR BOLT TORQUE SPEC-01
EXPANSION VALVE 70-01

FAN/FUEL PUMP BELT 10-01
FLOORMAT 40-01
FLYWHEEL 60-01
FRESH AIR FILTER 10-01
FRONT CAB LIGHT 50-01
FUEL COOLANT AND LUBRICANTS SPEC-01
FUEL LEVEL SENDER 50-01
FUEL SYSTEM 10-01
FUEL TANK 40-01

GENERAL AIR CONDITIONING SERVICE GUIDELINES 70-01
GREASE CYLINDER 30-01

HEATER/AC FAN 70-01
HEATER COIL/EVAPORATOR 70-01
HEATER VALVE 70-01
HORN 40-01
HYDRAULIC BREAKER APPLICATION VALVE 20-01
HYDRAULIC EXCAVATOR SPECIFICATIONS SPEC-01
HYDRAULIC FILTER MOUNT 20-01
HYDRAULIC FLUID SPECIFICATIONS SPEC-01
HYDRAULIC GEAR PUMP 20-01
HYDRAULIC PISTON PUMP 20-01
HYDRAULIC PISTON PUMP DRIVE COUPLER 20-01
HYDRAULIC RESERVOIR 20-01
HYDRAULIC SYSTEM 10-01
HYDRAULIC SYSTEM INFORMATION 20-01

INSTRUMENT PANEL 50-01

JOYSTICK CONTROL PATTERN SELECTOR VALVE 20-01
JOYSTICK LOCKOUT/TWO SPEED VALVE 20-01

LEFT CONSOLE 40-01
LEFT CONTROL LEVER (JOYSTICK) 20-01
LIFTING AND BLOCKING THE EXCAVATOR 10-01
LIFTING THE EXCAVATOR 10-01
LOWER TRACK ROLLER 30-01
LUBRICATION OF THE EXCAVATOR 10-01

MUFFLER 60-01

OIL COOLER 20-01
OIL TEMPERATURE REGULATOR 20-01
OPERATOR CAB 10-01

PORT RELIEF VALVES 20-01
PRESSURE REDUCING VALVE 20-01
PRESSURE SWITCH 70-01

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ALPHABETICAL INDEX (CONT'D)

RADIATOR/OIL COOLER..... 60-01
REAR COVER 10-01, 40-01
RECEIVER/DRYER.....70-01
RECONDITIONING THE ENGINE 60-01
REGULAR MAINTENANCE 70-01
RELIEF VALVES.....20-01
RIGHT CONSOLE 40-01
RIGHT CONTROL LEVER (JOYSTICK) 20-01
RIGHT SIDE COVER 10-01, 40-01

SAFETY.....70-01
SEAT AND SEAT MOUNT.....40-01
SECONDARY FRONT AUXILIARY VALVE.....20-01
SERVICE SCHEDULE 10-01
SIX SPOOL HYDRAULIC CONTROL VALVE 20-01
STARTER 50-01
SWING BRAKE RELEASE VALVE.....20-01
SWING BRAKE VALVE 20-01
SWING FRAME 40-01
SWING MOTOR 20-01
SWING MOTOR DRIVE CARRIER 20-01
SWIVEL JOINT.....20-01
SYSTEM CHARGING AND RECLAMATION 70-01
SYSTEM TROUBLESHOOTING CHART 70-01

TEMPERATURE/PRESSURE 70-01
THERMOSTAT.....70-01
THREE SPOOL HYDRAULIC CONTROL VALVE...20-01
TORQUE SPECIFICATIONS FOR BOLTS..... SPEC-01
TRACK DAMAGE IDENTIFICATION.....30-01
TRACK FRAME 30-01
TRACK IDLER 30-01
TRACKS 30-01
TRANSPORTING THE EXCAVATOR.....10-01
TRAVEL LEVER/FOOT PEDAL VALVE 20-01
TRAVEL MOTOR.....10-01, 20-01
TROUBLESHOOTING.....60-01
TWO SPEED SWITCH 50-01

UPPER TRACK ROLLER.....30-01
UPPERSTRUCTURE 40-01
UPGRADED AIR CONDITIONING SYSTEM 70-01

WIPER MOTOR.....50-01

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CONTENTS

FOREWORD III

SAFETY INSTRUCTIONS V

DELIVERY REPORT X

SERIAL NUMBER LOCATIONS IX

BOBCAT EXCAVATOR IDENTIFICATION XI

SAFETY AND MAINTENANCE 10-01

HYDRAULIC SYSTEM 20-01

UNDERCARRIAGE 30-01

UPPERSTRUCTURE & SWING SECTION 40-01

ELECTRICAL SYSTEM AND ANALYSIS 50-01

ENGINE SERVICE 60-01

HEATING, VENTILATION, AIR CONDITIONING 70-01

SPECIFICATIONS SPEC-01

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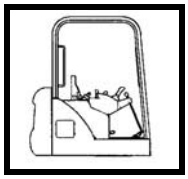
FOREWORD

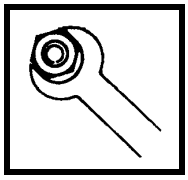
This manual is for the Bobcat Hydraulic Excavator mechanic. It provides necessary servicing and adjustment procedures for the hydraulic excavator and its component parts and systems. Refer to the Operation & Maintenance Manual for operating instructions, starting procedure, daily checks, etc.

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

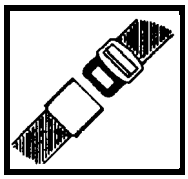
1. Check that the ROPS/TOPS/ FOPS is in good condition and is NOT modified.



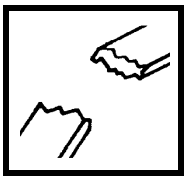
2. Check that ROPS mounting hardware is tightened and is Bobcat approved.



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

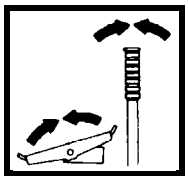


4. Inspect for loose or broken parts or connections.

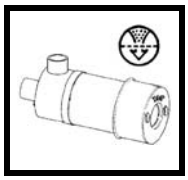


5. Machine signs must be legible and in the correct location.

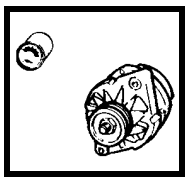
6. Steering levers, control levers and foot pedals must return to neutral. Check that foot pedals lock and control lever locks are in working order.



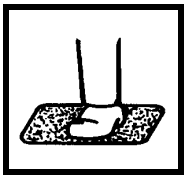
7. Inspect the air cleaner for damage or leaks. Check the condition of the element.



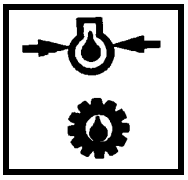
8. Check the electrical charging system.



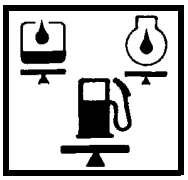
9. Safety treads must be in good condition.



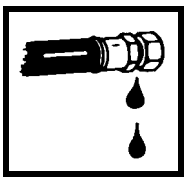
10. Check for correct function of indicator lamps (Optional on some models.



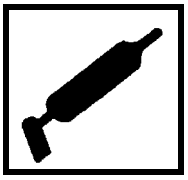
11. Check hydraulic fluid level, engine oil level and fuel supply.



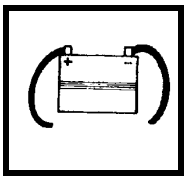
12. Inspect for fuel, oil or hydraulic fluid leaks.



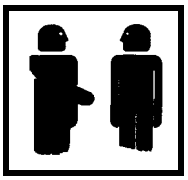
13. Lubricate the excavator.



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.



CALIFORNIA
PROPOSITION 65 WARNING
Diesel engine exhaust and some of its constituents are know to the state of California to cause cancer, birth defects and other reproductive harm.

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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**.

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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

Dial 811 (USA Only)
1-888-258-0808 (USA & Canada)

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

Cutting or drilling concrete containing sand or rock containing quartz may result in exposure to silica dust. Do not exceed Permissible Exposure Limits (PEL) to silica dust as determined by OSHA or other job site Rules and Regulations. Use a respirator, water spray or other means to control dust. Silica dust can cause lung disease and is known to the state of California to cause cancer.

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FIRE PREVENTION

Maintenance

The machine and some attachments have components that are at high temperatures 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 can cause a fire hazard. Clean often to avoid this accumulation. Flammable debris in the engine compartment is a potential fire hazard.

The operator's area, engine compartment and engine cooling system must be inspected every day and cleaned if necessary to prevent fire hazards and overheating.

All fuels, most lubricants and some coolants mixtures are flammable. Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire.

Operation

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

Electrical

Check all electrical wiring and connections for damage. Keep the battery terminals clean and tight. Repair or replace any damaged part or wires that are loose or frayed.

Battery gas can explode and cause serious injury. Use the procedure in the Operation & Maintenance Manual for connecting the battery and for jump staring. Do not jump start or charge a frozen or damaged battery. Keep any open flames or sparks away from batteries. Do not smoke in battery charging area.

Hydraulic System

Check hydraulic tubes, hoses and fittings for damage and leakage. Never use open flame or bare skin to check for leaks. Hydraulic tubes and hoses must be properly routed and have adequate support and secure clamps. 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.

Fueling

Stop the engine and let it cool before adding fuel. No smoking! Do not refuel a machine near open flames or sparks. Fill the fuel tank outdoors.

Starting

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

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

Spark Arrestor Exhaust System

The spark arrestor exhaust system 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.

Check the spark arrestor exhaust system regularly to make sure it is maintained and working properly. Use the procedure in the Operation & Maintenance Manual for cleaning the spark arrestor muffler (if equipped).

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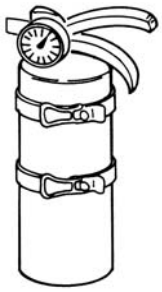
Welding And Grinding

Always clean the machine and attachment, disconnect the battery, and disconnect the wiring from the Bobcat 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 dust mask when grinding painted parts. Toxic dust or gas can be produced.

Dust generated from repairing nonmetallic parts such as hoods, fenders or covers can be flammable or explosive. Repair such components in a well ventilated area away from open flames or sparks.

Fire Extinguishers



Know where fire extinguishers and first aid kits are located and how to use them. Inspect the fire extinguisher and service the fire extinguisher regularly. Obey the recommendations on the instructions plate.

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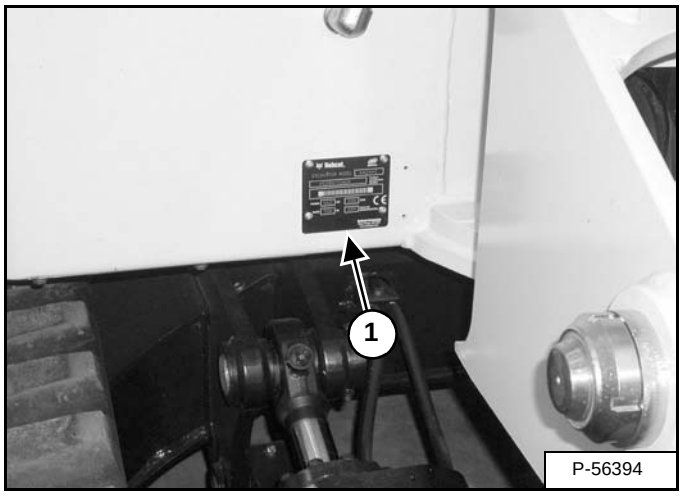
SERIAL NUMBER LOCATIONS

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

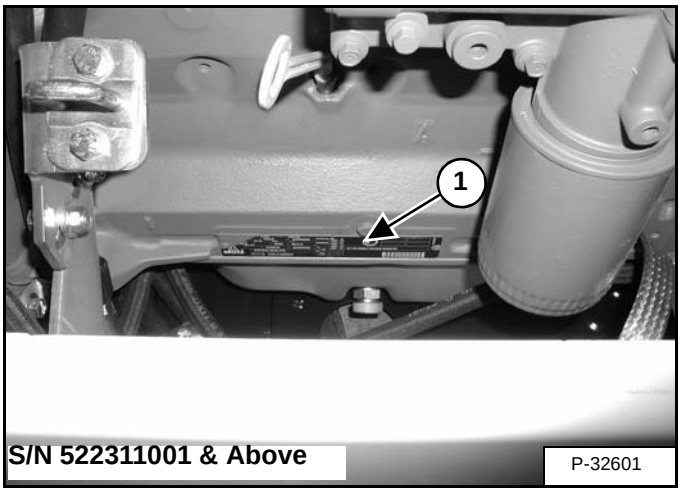
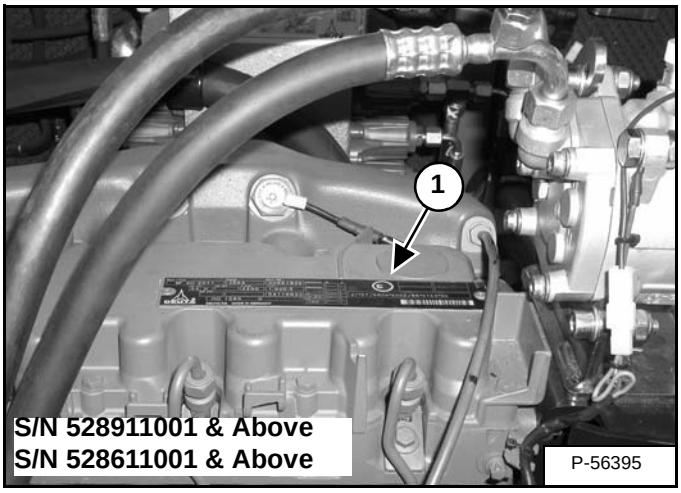


Figure 3



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

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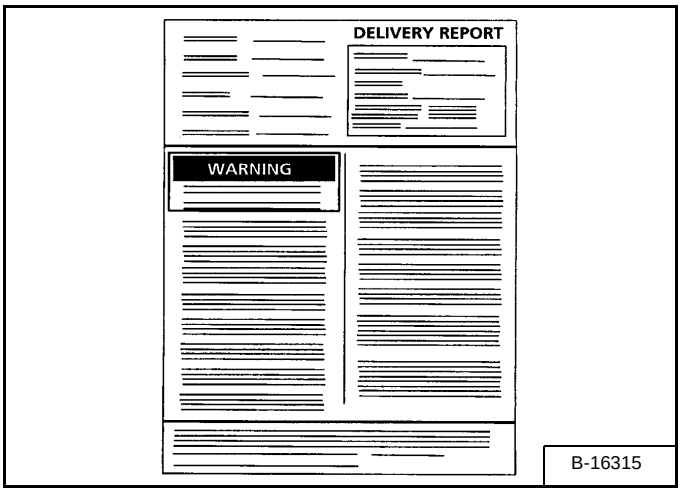
DELIVERY REPORT

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]**.

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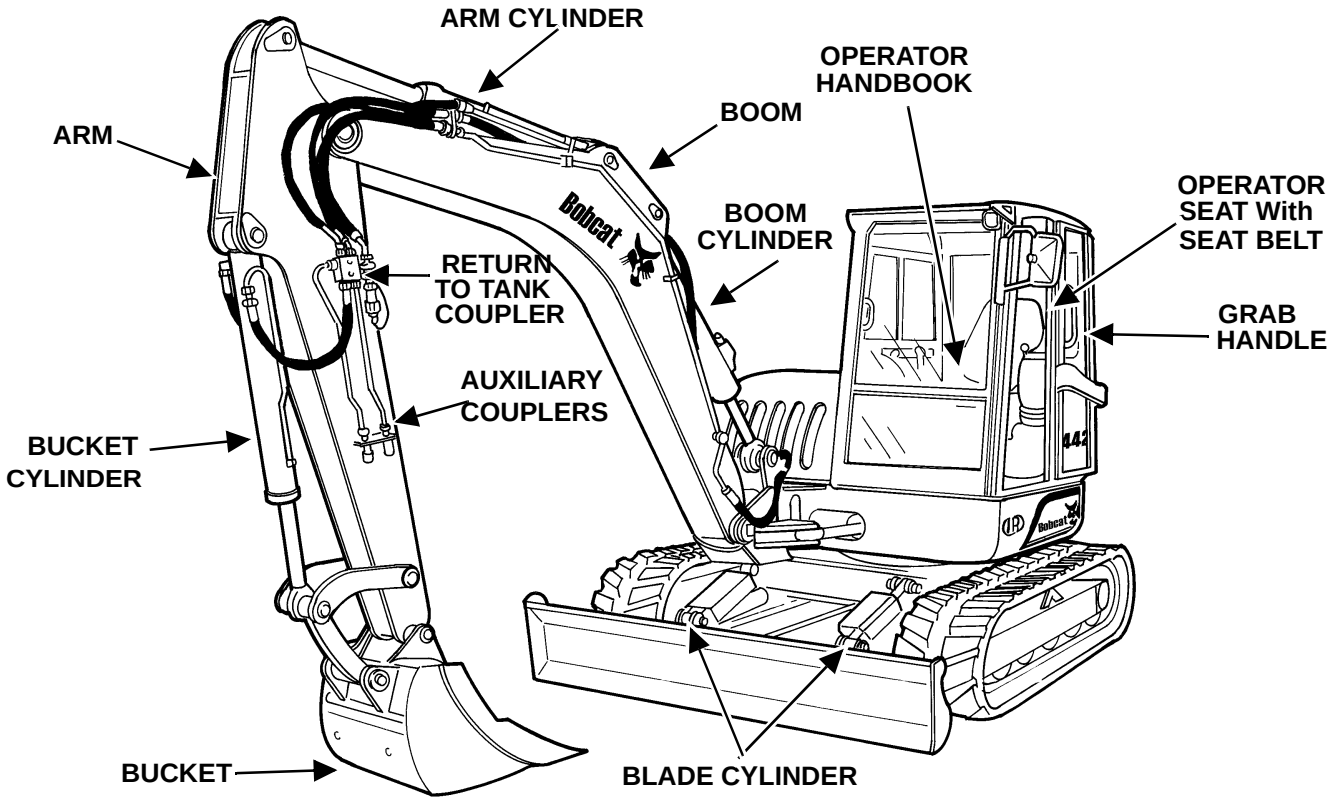
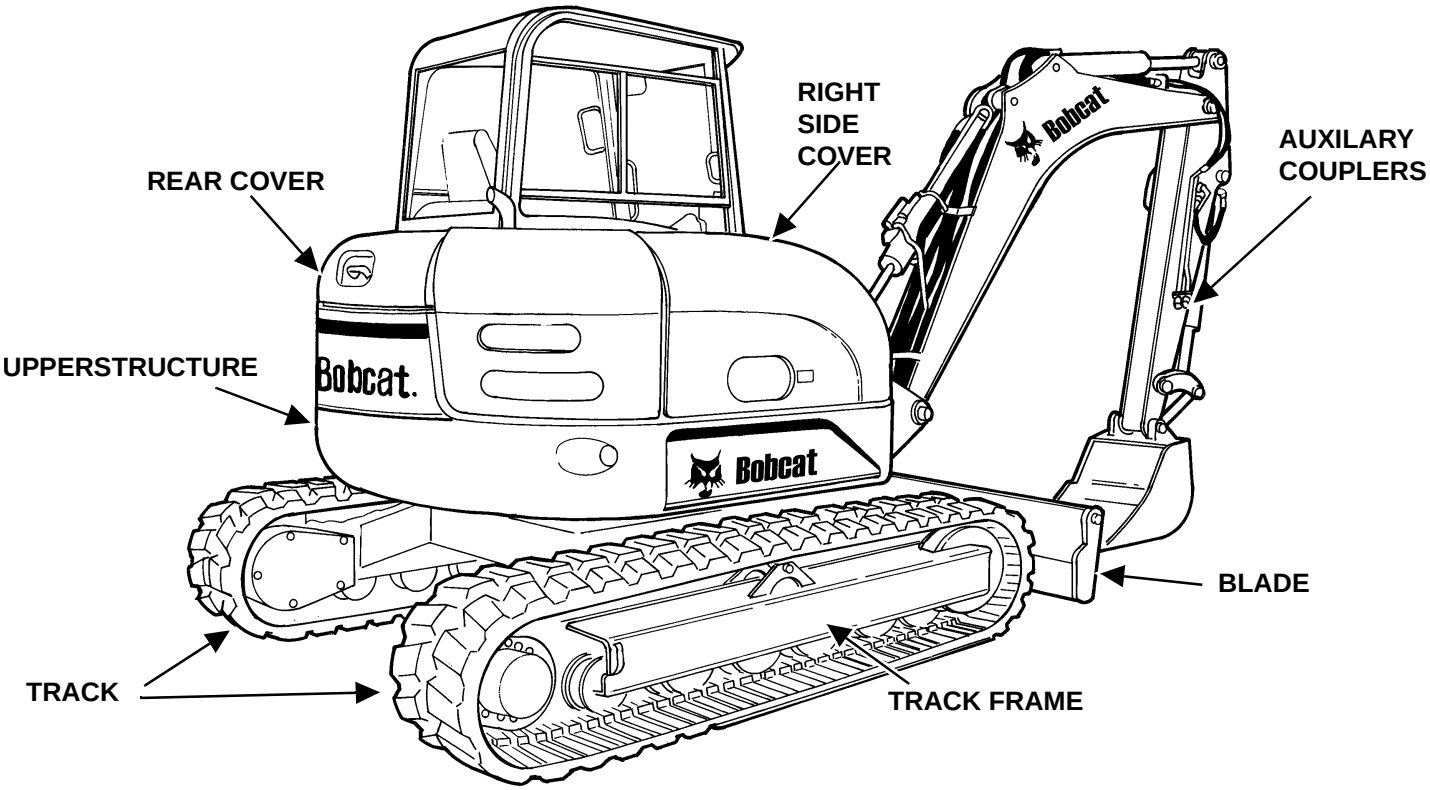
BOBCAT EXCAVATOR IDENTIFICATION



P-16589



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AIR CLEANER 10-60-1
Daily Check 10-60-1
Replacing The Filters 10-60-1

AIR CONDITIONING COMPRESSOR BELT (S/N 522311001 & ABOVE) 10-150-1
Adjusting Belt Tension 10-150-1

AIR CONDITIONING COMPRESSOR BELT (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 10-151-1
Adjusting Belt Tension 10-151-1

ALTERNATOR BELT 10-130-1
Adjusting Belt Tension 10-130-1

CAB TILT PROCEDURE 10-160-1
Installing The Cab Tilt Hinges 10-160-1
Tilting The Cab 10-160-2

COOLING SYSTEM 10-70-1
Checking Coolant Level (S/N 522311001 & Above) 10-70-1
Cleaning The Cooling System 10-70-1
Replacing The Coolant (S/N 522311001 & Above) 10-70-2

ENGINE LUBRICATION SYSTEM 10-90-1
Checking Engine Oil 10-90-1
Replacing Oil And Filter 10-90-2

FAN/FUEL PUMP BELT 10-140-1
Adjusting Belt Tension (S/N 522311001 & Above) 10-140-1

FRESH AIR FILTER (S/N 522311001 & ABOVE) 10-61-1
Removal And Installation 10-61-1

FRESH AIR FILTER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 10-62-1
Removal And Installation 10-62-1

Continued On Next Page

https://www.pdfmanual4trucks.com/

FUEL SYSTEM 10-80-1
Draining The Fuel Tank 10-80-8
Filling The Fuel Tank 10-80-1
Fuel Filter Removal And Installation 10-80-7
Fuel Specifications 10-80-1
Pre-Filter Installation (S/N 522311001 & Above) 10-80-4
Pre-Filter Removal (S/N 522311001 & Above) 10-80-3
Pre-Filter Removal And Installation (S/N 528911001 & Above And S/N 528611001 & Above) 10-80-6
Removing Water From The Pre-Filter (S/N 522311001 & Above) . . . 10-80-2

HYDRAULIC SYSTEM 10-100-1
Checking And Adding Hydraulic Oil 10-100-1
Diagnostic Couplers (S/N 522311001 & Above) 10-100-9
Diagnostic Couplers (S/N 528911001 & Above And S/N 528611001 & Above) 10-100-10
Hydraulic Filter Installation (S/N 522311001 & Above) 10-100-4
Hydraulic Filter Installation (S/N 528911001 & Above And S/N 528611001 & Above) 10-100-7
Hydraulic Filter Removal (S/N 522311001 & Above) 10-100-3
Hydraulic Filter Removal (S/N 528911001 & Above And S/N 528611001 & Above) 10-100-6
Replacing The Hydraulic Oil 10-100-2

LIFTING AND BLOCKING THE EXCAVATOR 10-10-1
Procedure 10-10-1

LIFTING THE EXCAVATOR 1
Procedure 10-11-1

LUBRICATION OF THE EXCAVATOR 10-110-1

OPERATOR CAB 10-20-1
Description 10-20-1
Emergency Exit 10-20-2
Entering And Exiting The Excavator 10-20-1
Raising And Lowering The Left Console 10-20-1

REAR COVER. 10-40-1
Opening And Closing The Rear Cover 10-40-1

RIGHT SIDE COVER 10-41-1
Opening And Closing The Right Side Cover 10-41-1

Continued On Next Page

https://www.pdfmanual4trucks.com/

SERVICE SCHEDULE 10-50-1

TRANSPORTING THE EXCAVATOR 10-30-1

TRAVEL MOTOR 10-120-1
Checking Oil Level 10-120-1
Draining The Travel Motor 10-120-1

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LIFTING AND BLOCKING THE EXCAVATOR

Procedure

Always park the machine on a level surface.

⚠ 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

Raise one side of the machine (approximately 4 inches) using the boom and arm.

Figure 10-10-1

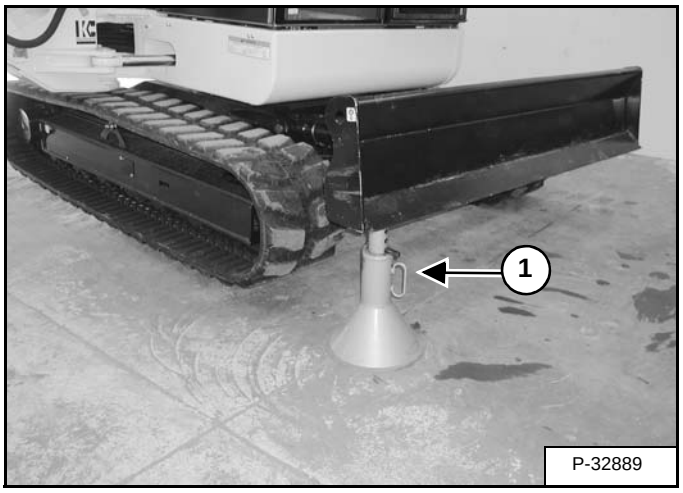
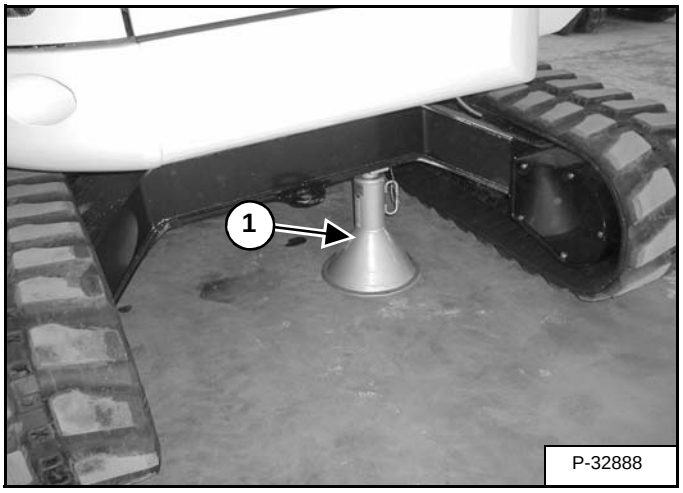


Figure 10-10-2



Raise the blade fully and install jackstands (Item 1) **[Figure 10-10-1]** & **[Figure 10-10-2]** under the blade and the track frame. Lower the machine until all machine weight is on the jackstands.

Stop the engine.

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LIFTING THE EXCAVATOR

Procedure

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.**
- **Never lift with operator on machine.**

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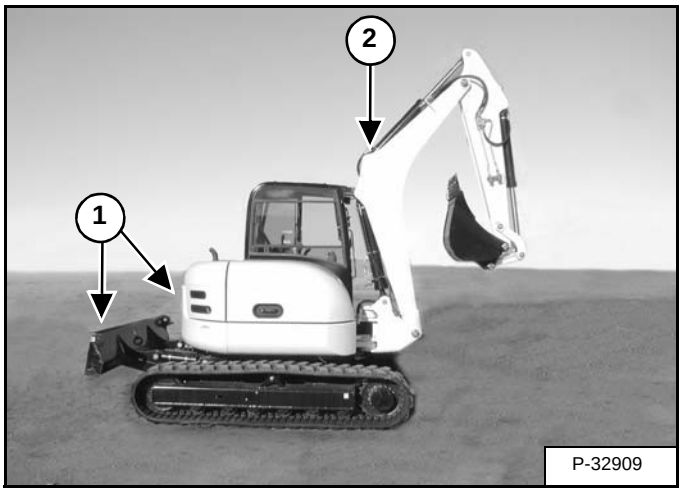
Figure 10-11-1



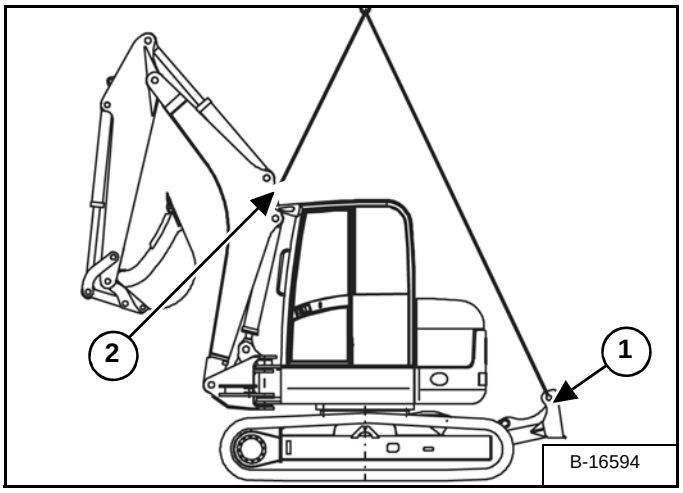
Fully retract the boom cylinder and fully extend the arm and bucket cylinders so the excavator is in the position as shown **[Figure 10-11-1]**.

Raise the blade all the way.

Put all the control levers in neutral.

Stop the engine.

Figure 10-11-2



Fasten chains to the ends of the blade (Item 1) **[Figure 10-11-1]** & **[Figure 10-11-2]** and up to a lifting fixture above the cab. The lifting fixture must extend over the sides of the cab to prevent the chains from hitting the cab **[Figure 10-11-2]**.

Fasten a chain to the boom (Item 2) **[Figure 10-11-1]** & **[Figure 10-11-2]** and up to a lifting fixture.

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OPERATOR CAB

Description

The excavator has an operator cab as standard equipment.

⚠ WARNING

Never modify operator cab by welding, grinding, drilling holes or adding attachments unless instructed to do so by Bobcat.

W-2069-1299

Entering And Exiting The Excavator

Figure 10-20-1

Use the grab handles and track to enter and exit the excavator **[Figure 10-20-1]**.

Raising And Lowering The Left Console

Raise the console before exiting the cab.

Figure 10-20-2

Pull up on the handle (Item 1) **[Figure 10-20-2]** The lift spring will assist in raising the console.

Lower the console before operating the excavator.

Push down on the handle (Item 1) **[Figure 10-20-2]** until the console is in the down position.

NOTE: When the console is raised, the hydraulic and traction systems are locked and will not operate.

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Emergency Exit

The left door and right side window provide exits.

Figure 10-20-3

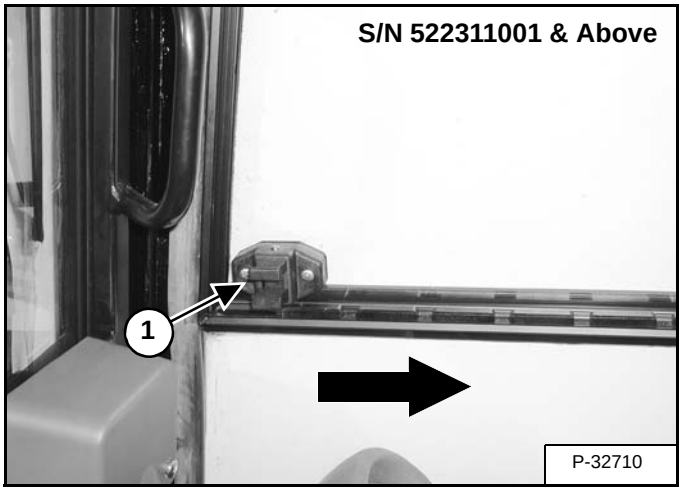
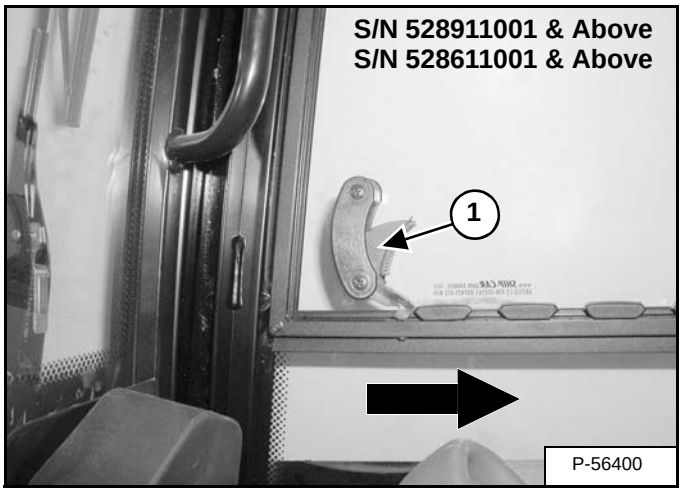


Figure 10-20-4



Press the window latch (Item 1) **[Figure 10-20-3]** & **[Figure 10-20-4]** together and slide the window to the rear of the excavator.

Figure 10-20-5

Exit through the window **[Figure 10-20-5]**.

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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.

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.

Use ramps 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).

Figure 10-30-1

Move the machine forward onto the transport vehicle **[Figure 10-30-1]**.

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 at the front and rear of the tracks.

Figure 10-30-2

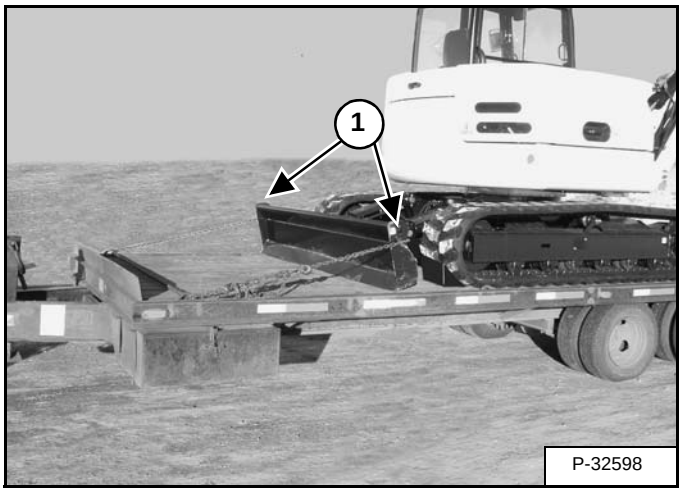
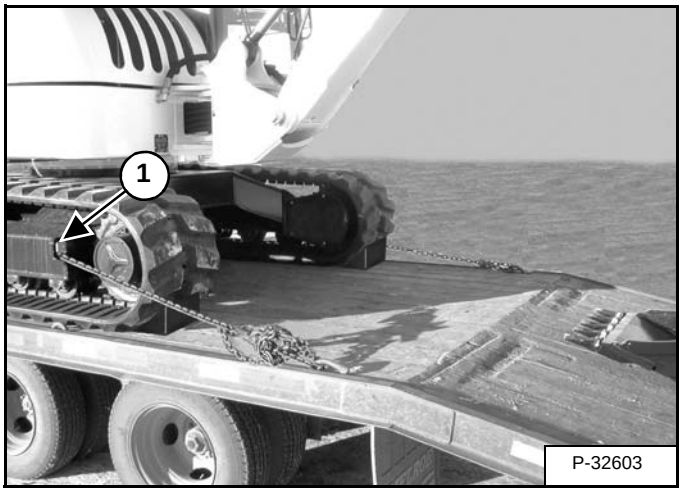


Figure 10-30-3



Fasten chains to the front corners of the blade (Item 1) **[Figure 10-30-2]** and to the tie down loop at the rear track frame (both sides) (Item 1) **[Figure 10-30-3]** 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.

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REAR COVER

Opening And Closing The Rear Cover

WARNING

AVOID INJURY OR DEATH

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

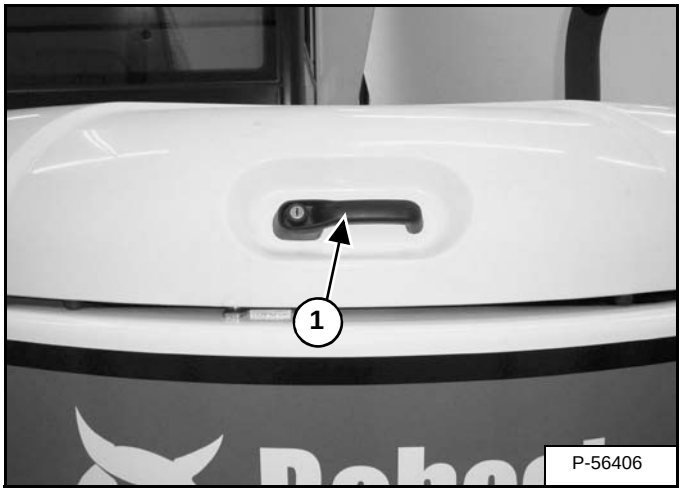
W-2012-0497

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



Push the latch (Item 1) **[Figure 10-40-1]** and raise the rear cover.

Lower the rear cover and push down firmly to close the cover.

NOTE: The start key can be used to lock the rear cover.

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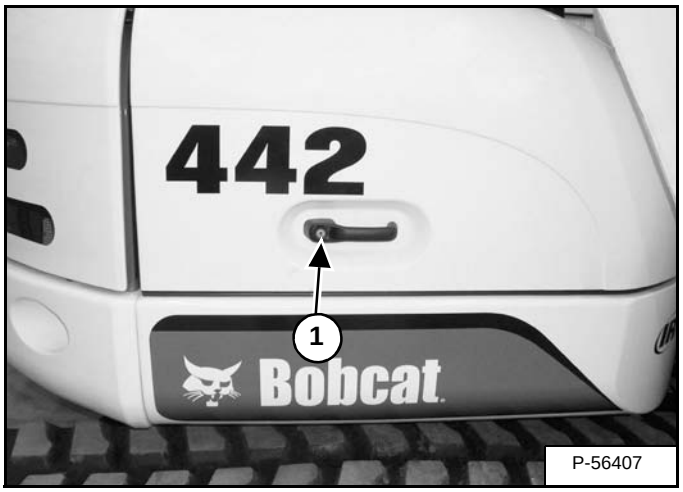
RIGHT SIDE COVER

Opening And Closing The Right Side Cover

Figure 10-41-2



Push the latch (Item 1) **[Figure 10-41-2]** and raise the right side cover.

Lower the right side cover and push down firmly to close the cover.

NOTE: The start key can be used to lock the right side cover.

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SERVICE SCHEDULE

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.

	SERVICE SCHEDULE	HOURS					
ITEM	SERVICE REQUIRED	8-10	50	100	250	500	● 1000
Engine Coolant	Check coolant level. Add coolant as needed. (Water cooled engines only)						
Engine Oil	Check engine oil level and add as needed.						
Hydraulic Fluid Hoses Tube lines and Reservoir Breather Cap	Check the hydraulic fluid level and add as needed. Check for damage and leaks. Repair or replaced as needed.						
Track Tension	Check and adjust track tension.						
Indicators and Lights	Check for correct operation of indicators and lights.						
Operator Cab/Canopy	Check cab/canopy condition and hardware.						
Seat Belt	Check seat belt condition and mounting hardware						
Safety Signs (Decals)	Check for damaged signs (decals). Replace as needed.						
Pivot Points	Grease all machinery pivot points.						
Fuel Tank & Filter	Drain water and sediment from fuel tank and filter.						
Control Console	Check control console lockout for proper operation.						
Swing Circle & Pinion	Grease swing circle and swing pinion.						
Door Hinges	Grease door hinges.						
Battery	Check battery, cables and electrolyte level.						
Belts	Check and adjust bolts.		■				
Travel Motors	Check oil level in both travel motors.						
Hydraulic Oil Cooler, *Engine Oil Cooler, *Radiator, A/C Condenser and Cab Ventilation Filter	Clean radiator/oil cooler fins. Clean A/C condenser. Clean/replace cab filter.			◆			
Hydraulic Filter	Replace hydraulic filter.			◆			
Engine Oil & Filter	Replace engine oil and filter.			◆			
Air Filter Intake	Check/clean air filter intake						
Alternator & Starter	Check alternator and starter connections.						
Fuel Filters	Replace diesel fuel pre-filter and filter.						
Engine Valves	Check and adjust engine valve clearance.						
Travel Motors	Replace oil in both travel motors.			◆			
Engine Cooling System	Drain and flush cooling system. Replace coolant. (Water cooled engines only)						
Hydraulic System	Replace hydraulic fluid and filter. Clean reservoir.						

* If equipped
■ Service at first 50 hours, then as scheduled
◆ Service at first 100 hours, then as scheduled
● 1000 hours or every six months

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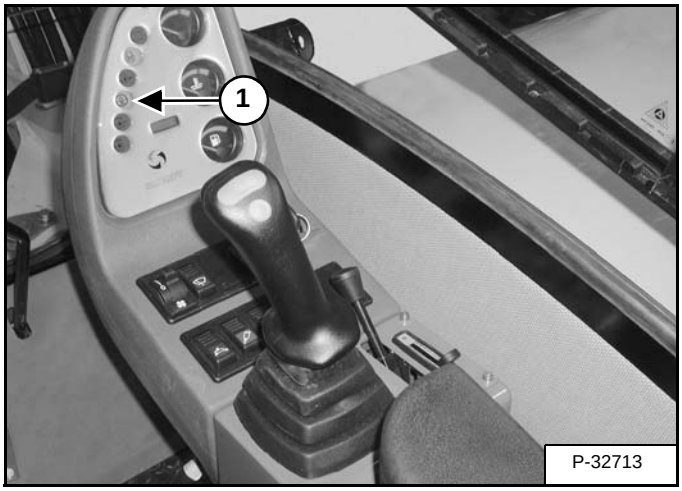
AIR CLEANER

Daily Check

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

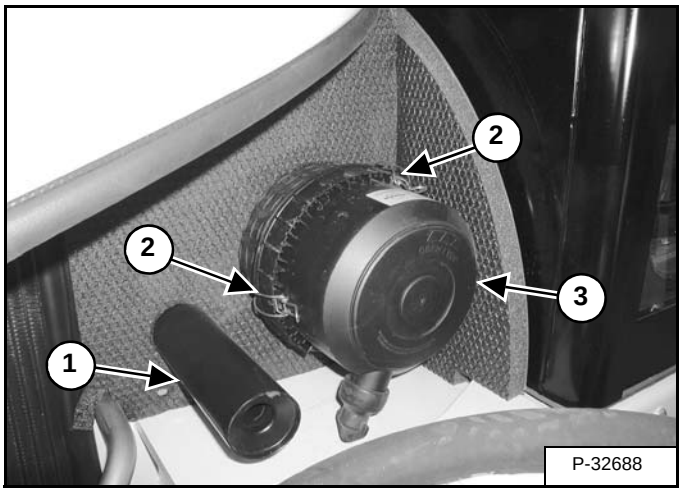
Figure 10-60-1



If the air filter condition indicator (Item 1) **[Figure 10-60-1]** is illuminated, the filter element needs to be replaced.

Open the right side cover. (See RIGHT SIDE COVER on Page 10-41-1.)

Figure 10-60-2



Inspect the air intake (Item 1) **[Figure 10-60-2]** for damage or restrictions.

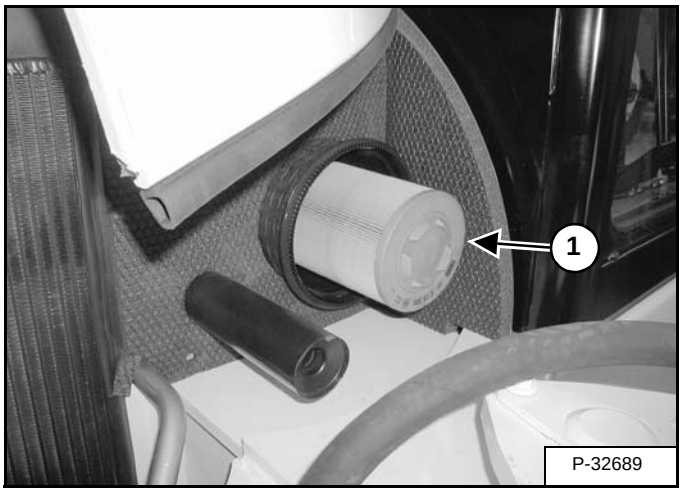
Replacing The Filters

Outer Filter

Unlatch the air filter cover latches (Item 2) **[Figure 10-60-2]**.

Remove the air filter cover (Item 3) **[Figure 10-60-2]**.

Figure 10-60-3



Remove the outer filter (Item 1) **[Figure 10-60-3]**.

Check the housing for damage.

Clean the housing and seal surface. Do not use compressed air.

Install the outer filter.

Install the cover.

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Replacing The Filters (Cont'd)

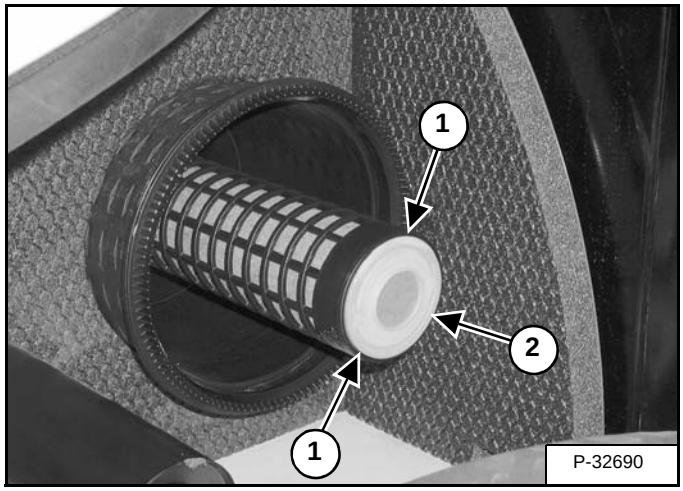
Inner Filter S/N 522311001 & Above

Replace the inner filter every third time the outer filter has been replaced.

Replace the inner filter after the outer filter has been replaced and the air filter indicator is still illuminated.

Remove the air cleaner cover and outer filter.

Figure 10-60-4

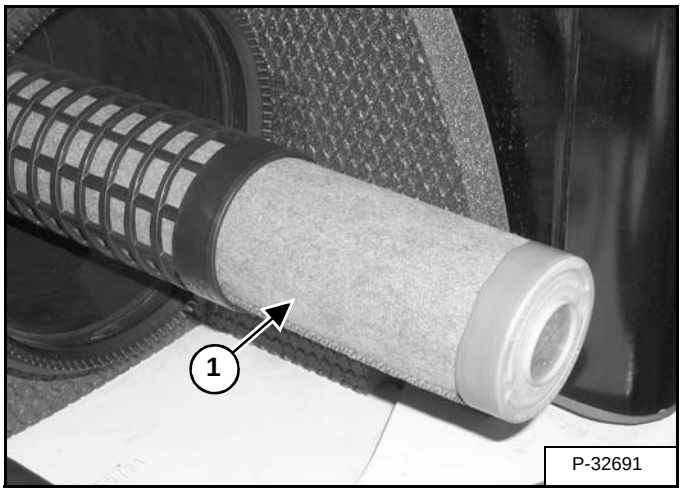


Pry up on the ends of the air filter (Item 1). Pull the air filter (Item 2) **[Figure 10-60-4]** out of the housing.

Discard the inner air filter after it has been removed.

Do not clean or reuse the filter. Make sure all sealing surfaces are free of dirt and debris.

Figure 10-60-5



Install the new inner filter (Item 1) **[Figure 10-60-5]**. Install the outer filter and air cleaner cover.

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Replacing The Filters (Cont'd)

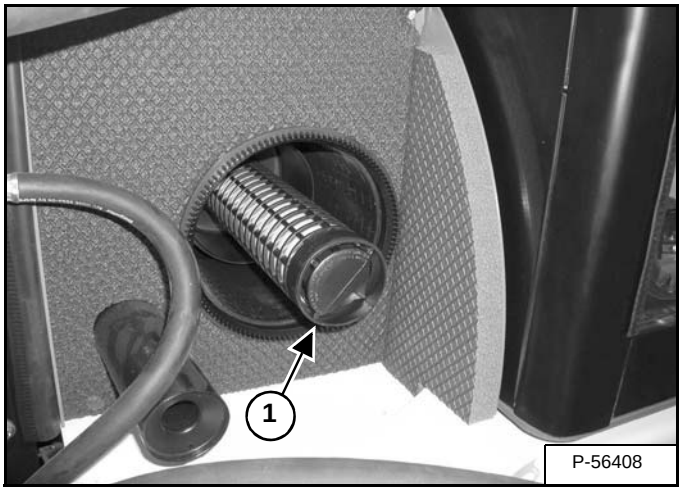
Inner Filter S/N 528911001 & Above and S/N 528611001 & Above

Replace the inner filter every third time the outer filter has been replaced.

Replace the inner filter after the outer filter has been replaced and the air filter indicator is still illuminated.

Remove the air cleaner cover and outer filter.

Figure 10-60-6

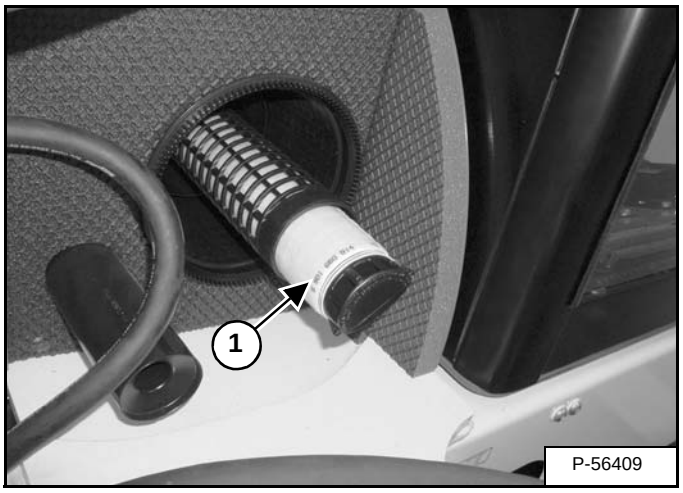


Pull the air filter (Item 1) **[Figure 10-60-6]** out of the housing.

Discard the inner air filter after it has been removed.

Do not clean or reuse the filter. Make sure all sealing surfaces are free of dirt and debris.

Figure 10-60-7



Install the new inner filter (Item 1) **[Figure 10-60-7]**. Install the outer filter and air cleaner cover.

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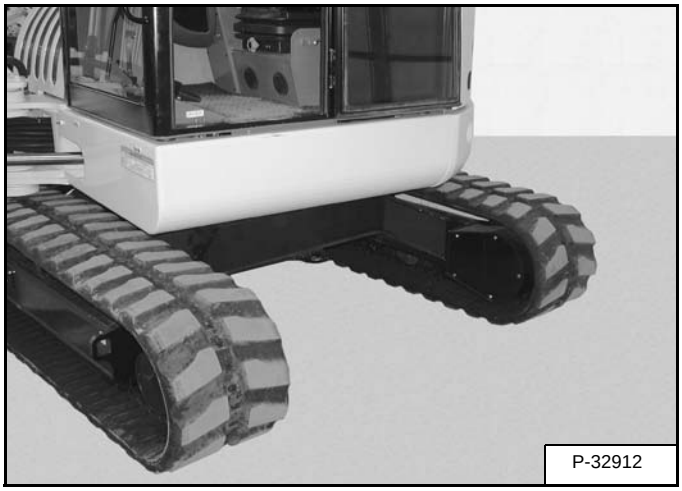
FRESH AIR FILTER (S/N 522311001 & ABOVE)

Removal And Installation

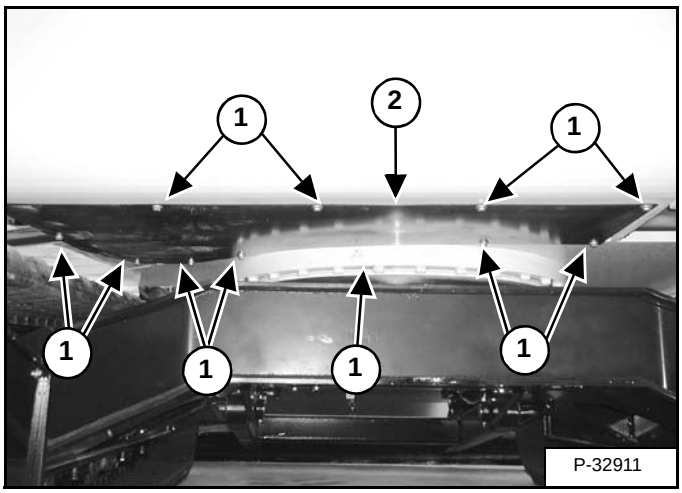
See the Service Schedule for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1.)

Figure 10-61-1



Position the excavator as shown **[Figure 10-61-1]**.

Figure 10-61-2

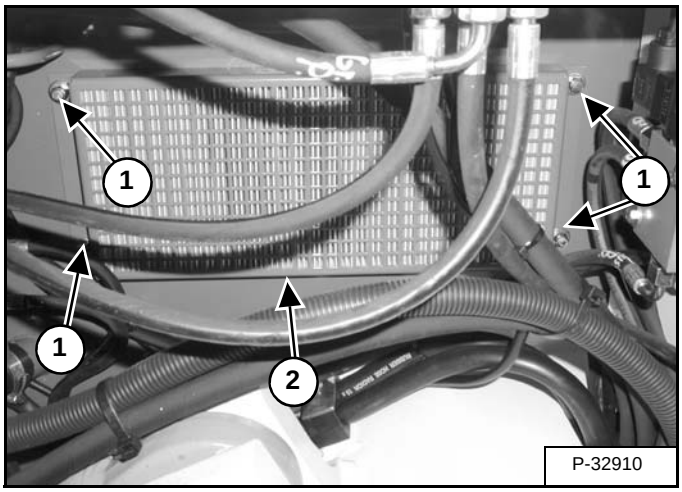


Remove the eleven bolts (Item 1) **[Figure 10-61-2]** and washers.

Installation: Tighten the bolts to 18-19 ft.-lb. (24-26 N•m) torque.

Remove the cover (Item 2) **[Figure 10-61-2]**.

Figure 10-61-3



Remove the bolts (Item 1) **[Figure 10-61-3]**.

Remove the filter (Item 2) **[Figure 10-61-3]**.

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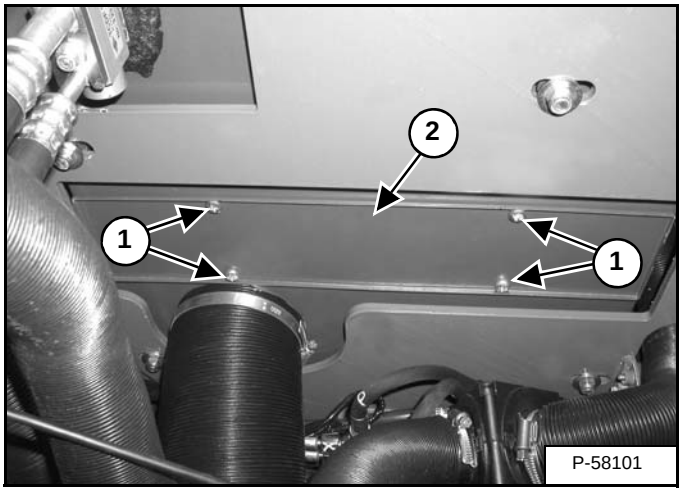
FRESH AIR FILTER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

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

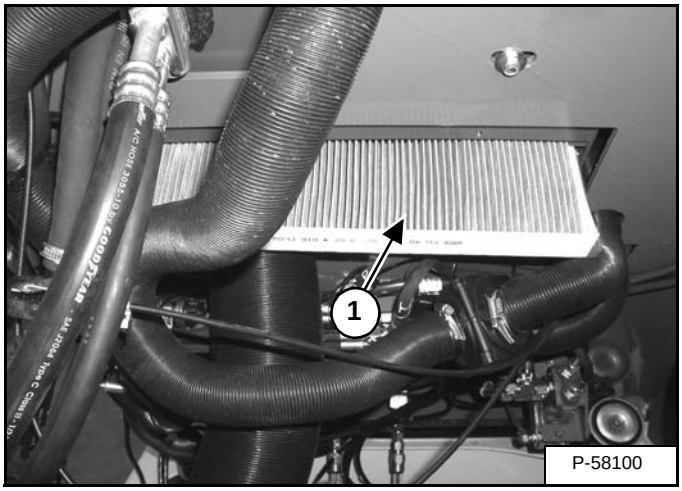
Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 10-62-1



Remove the screws (Item 1) and cover (Item 2) **[Figure 10-62-1]**.

Figure 10-62-2



Remove the filter (Item 1) **[Figure 10-62-2]**.

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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

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

Cleaning The Cooling System

Open the right side cover.

Use air pressure or water pressure to clean the radiator oil cooler. Be careful not to damage the fins when cleaning.

Checking Coolant Level (S/N 522311001 & Above)

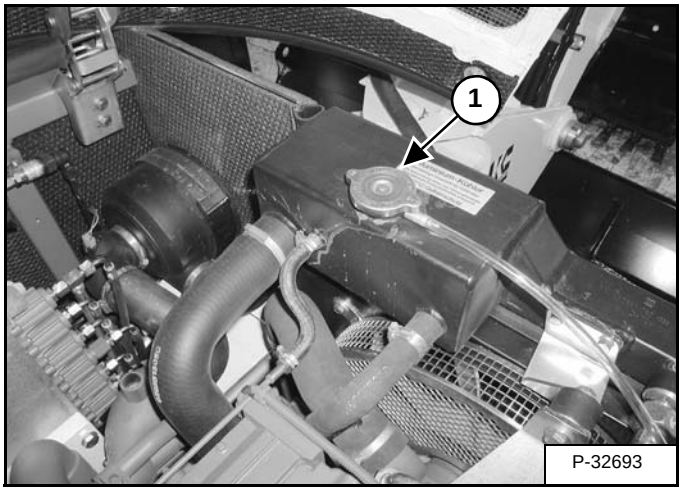
WARNING

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

W-2070-1285

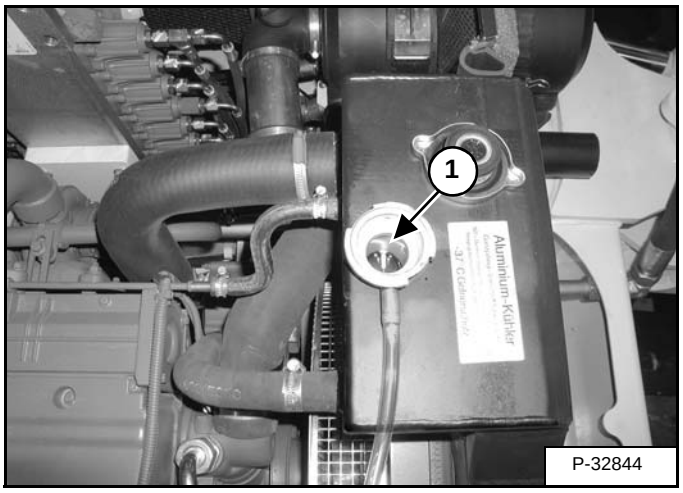
Open the right side cover.

Figure 10-70-1



Check the coolant level in the surge tank (Item 1) **[Figure 10-70-1]**.

Figure 10-70-2



The surge tank (Item 1) **[Figure 10-70-2]** must be half full when the engine is cold.

IMPORTANT

AVOID ENGINE DAMAGE

Always use the correct ratio of water to antifreeze.

To 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.

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Replacing The Coolant (S/N 522311001 & Above)

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

⚠ WARNING

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

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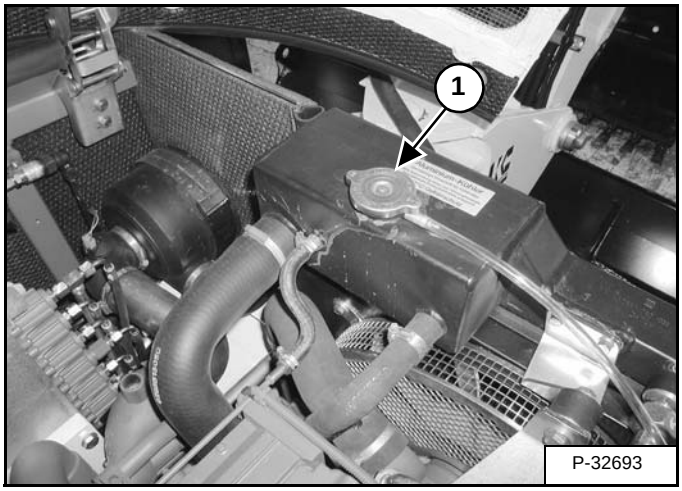
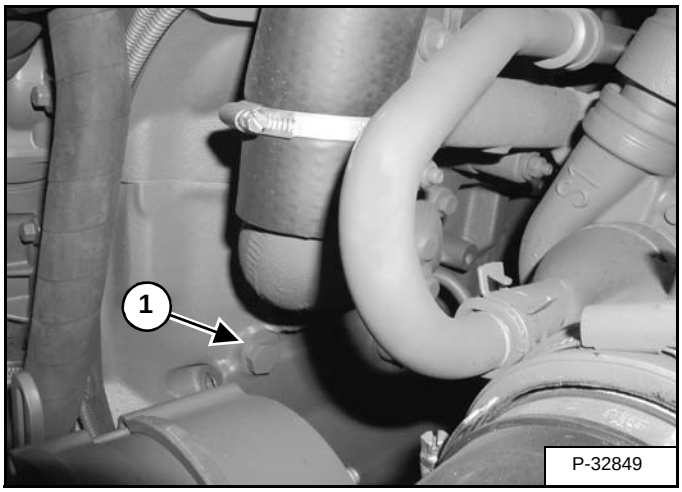
Figure 10-70-3



When the engine is cool, loosen and remove the radiator cap (Item 1) **[Figure 10-70-3]**.

Figure 10-70-4



Remove the plug (Item 1) **[Figure 10-70-4]** from the back side of the engine block.

NOTE: The plug is located next to the alternator mount bracket.

Drain the coolant from the engine.

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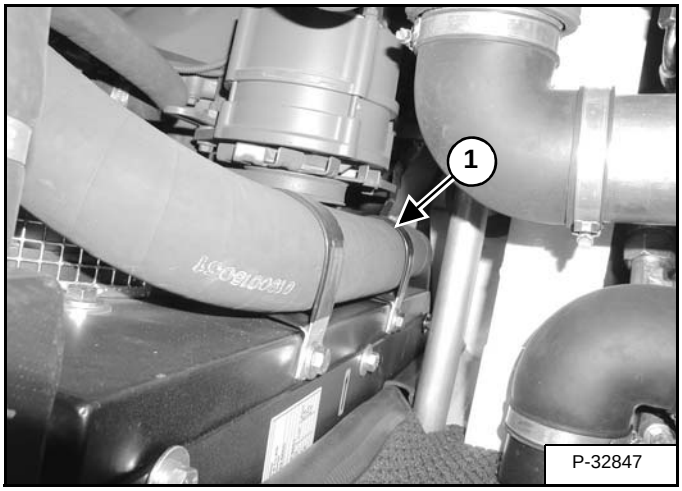
Replacing The Coolant (S/N 522311001 & Above) (Cont'd)

Figure 10-70-5



Remove the lower radiator hose (Item 1) **[Figure 10-70-5]**.

Drain the coolant from the engine.

After the coolant is removed, install the plug (Item 1) **[Figure 10-70-4 on Page 10-70-2]** and lower radiator hose (Item 1) **[Figure 10-70-5]**.

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

Mix the coolant in a separate container.

NOTE: The excavator is factory filled with ethylene glycol coolant.

Add premixed coolant, 50% water and 50% ethylene glycol to the reservoir if the coolant level is low.

One gallon (3,8 L) of ethylene glycol mixed with one gallon (3,8 L) of water is the correct mixture of coolant to provide a -34° F (-37° C) freeze protection.

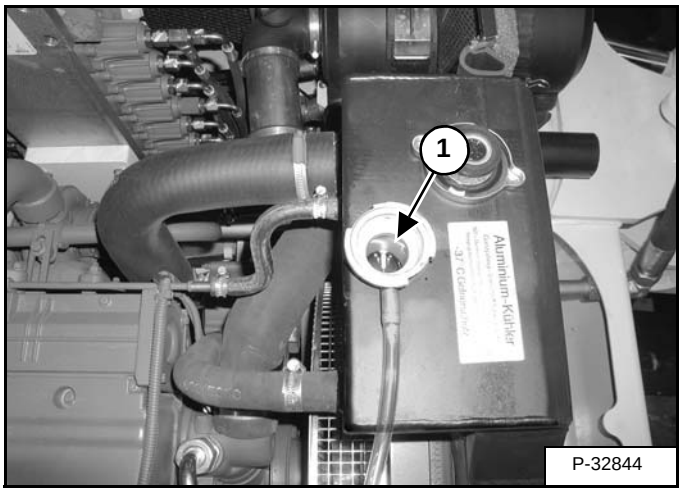
Use a refractometer to check the condition of ethylene glycol in your cooling system.

Fill the radiator with the premixed coolant. Install the radiator cap.

Run the engine until it is at operating temperature.

Stop the engine.

Figure 10-70-6



Check the coolant level (COLD) in the surge tank (Item 1) **[Figure 10-70-6]** when cool.

Add coolant to the tank as needed.

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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 feezing temperatures:

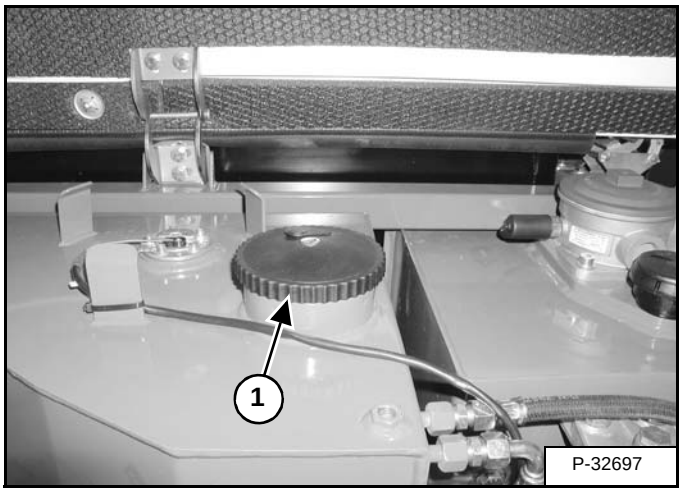
Temp. F° (C°)	No. 2	No. 1
+15° (9°)	100%	0%
Down to -20° (-29°)	50%	50%
Below -20° (-29°)	0%	100%

See your fuel supplier for local recommendations.

Filling The Fuel Tank

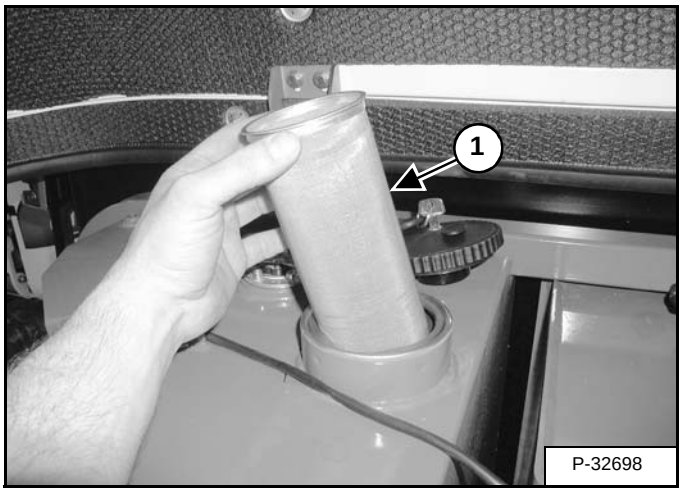
NOTE: The fuel fill cap can be locked. Use the fuel fill cap key to lock and unlock the cap.

Figure 10-80-1



Open the rear cover and remove the fuel fill cap (Item 1) **[Figure 10-80-1]**.

Figure 10-80-2



Check the condition of the fill strainer screen (Item 1) **[Figure 10-80-2]**. Clean or replace as necessary.

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 the fuel pre-filter or replace the fuel pre-filter and fuel filter. (See SERVICE SCHEDULE on Page 10-50-1.)

⚠ WARNING

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

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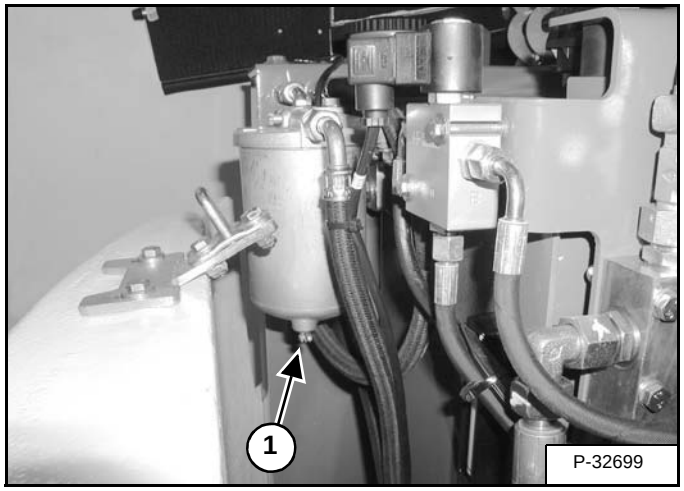
Removing Water From The Pre-Filter (S/N 522311001 & Above)

Open the rear cover.

Figure 10-80-3



Loosen the drain (Item 1) **[Figure 10-80-3]** at the bottom of the filter housing to drain water from the filter.

⚠ 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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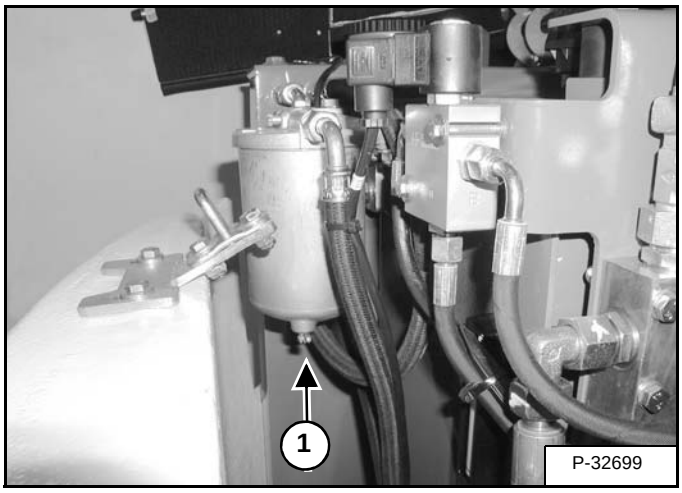
Pre-Filter Removal (S/N 522311001 & Above)

See the Service Schedule for the service interval when to replace the fuel pre-filter. (See SERVICE SCHEDULE on Page 10-50-1.)

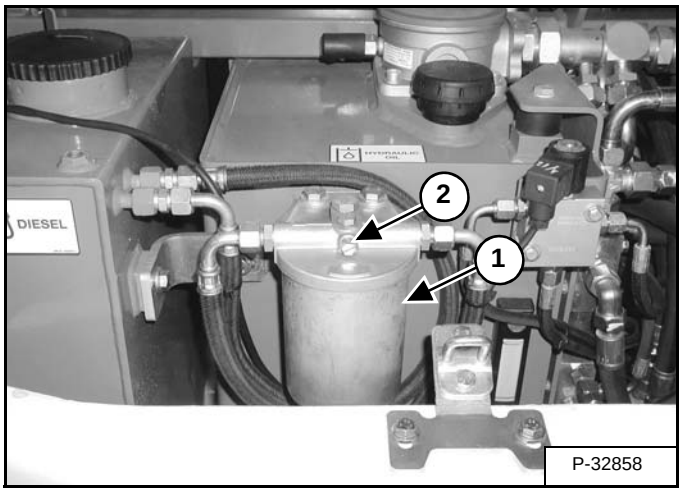
Clean the area around the fuel pre-filter housing.

Figure 10-80-4



Loosen the drain (Item 1) **[Figure 10-80-4]** at the bottom of the filter housing and drain the fuel out of the housing.

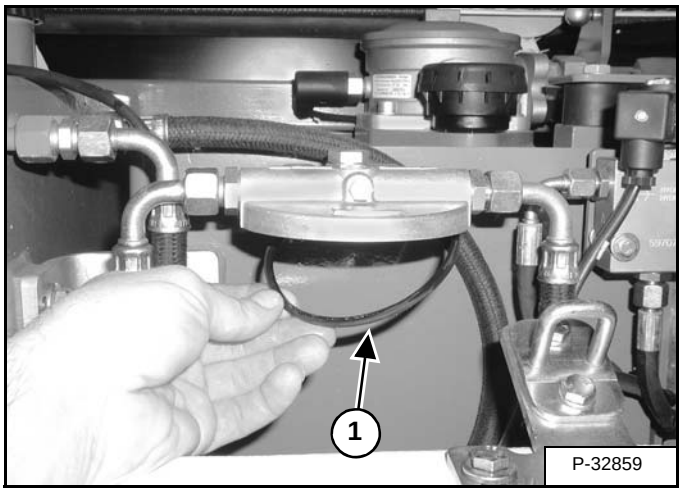
Figure 10-80-5



Support the filter housing (Item 1) and remove the bolt (Item 2) **[Figure 10-80-5]** and washer.

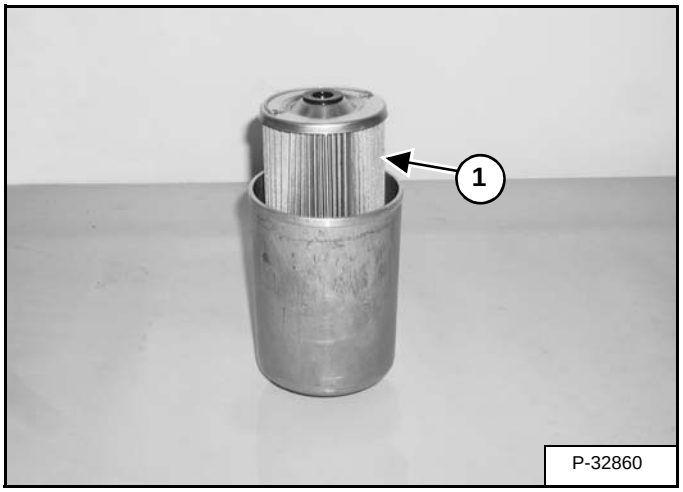
Remove the filter.

Figure 10-80-6



Remove the gasket (Item 1) **[Figure 10-80-6]** from the filter head.

Figure 10-80-7



Remove the filter (Item 1) **[Figure 10-80-7]** from the filter housing.

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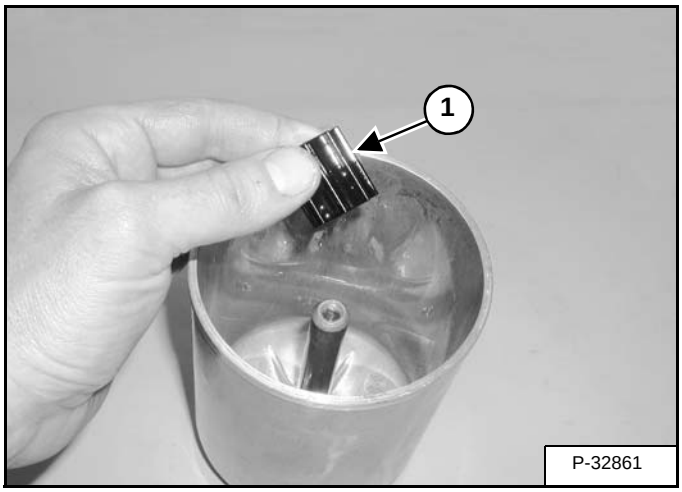
Pre-Filter Removal (S/N 522311001 & Above) (Cont'd)

Figure 10-80-8

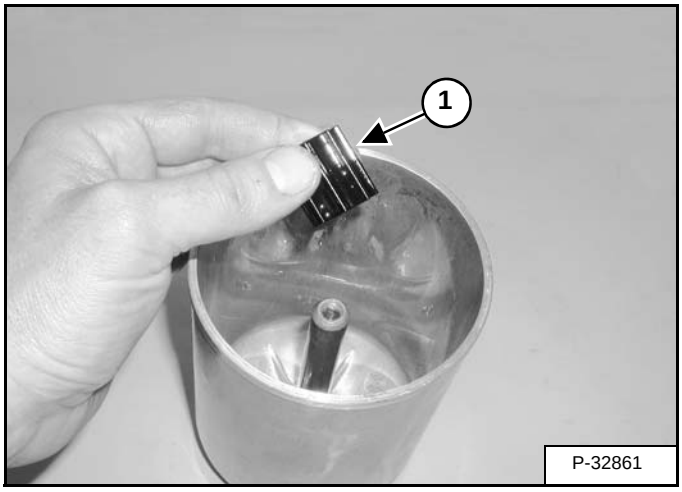


Remove the spacer (Item 1) **[Figure 10-80-8]** from the filter housing.

Pre-Filter Installation (S/N 522311001 & Above)

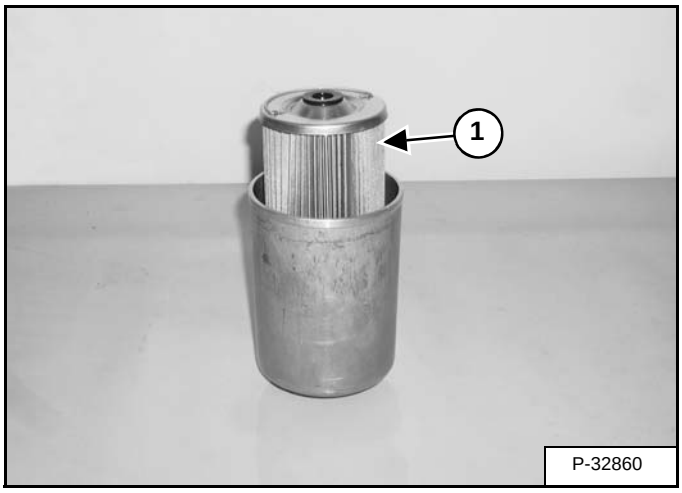
Clean the filter housing in clean solvent and dry with compressed air.

Figure 10-80-9



Install the spacer (Item 1) **[Figure 10-80-9]** in the filter housing.

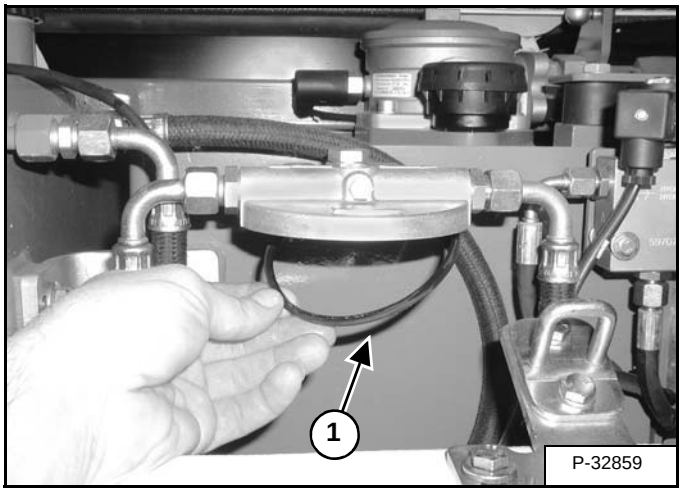
Figure 10-80-10



Install the filter (Item 1) **[Figure 10-80-10]** in the housing.

Apply clean engine oil on both sides of the filter gasket.

Figure 10-80-11



Install the gasket (Item 1) **[Figure 10-80-11]** on the filter head.

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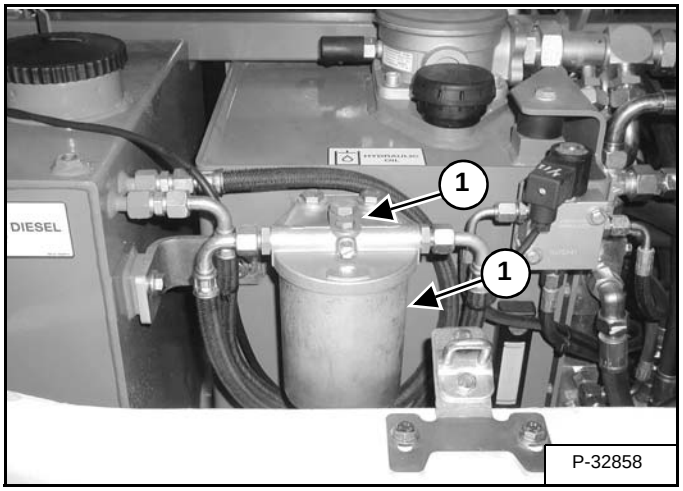
Pre-Filter Installation (S/N 522311001 & Above) (Cont'd)

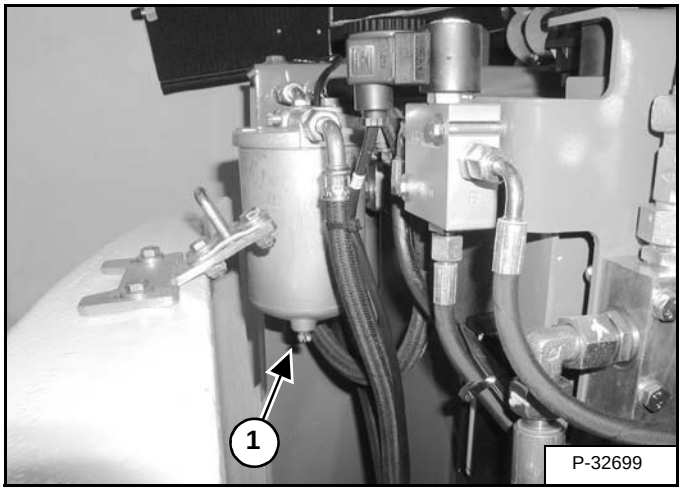
Figure 10-80-12



Install the filter housing (Item 1) and bolt (Item 2) **[Figure 10-80-12]**.

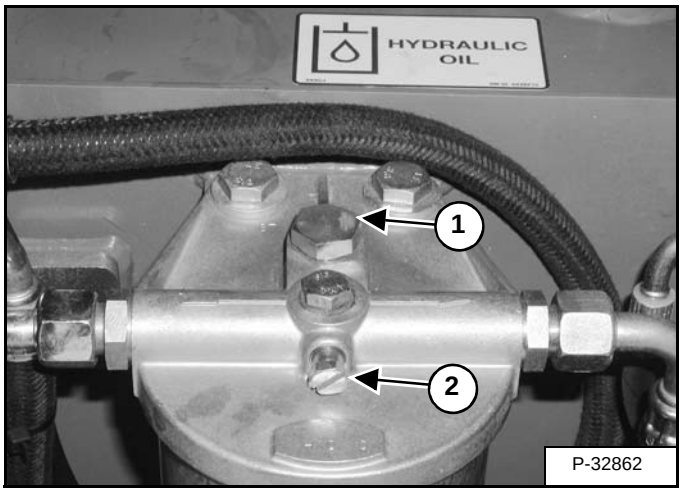
Tighten the bolt to 15-18 ft.-lbs. (20-25 Nm) torque.

Figure 10-80-13



Close the drain (Item 1) **[Figure 10-80-13]** on the bottom of the filter housing.

Figure 10-80-14



Remove the bolt (Item 1) and loosen the vent screw (Item 2) **[Figure 10-80-14]**.

Fill the filter through the bolt hole with clean fuel until fuel flows from the vent with no air bubbles.

Install the bolt (Item 1) **[Figure 10-80-14]**.

Tighten the vent screw (Item 2) **[Figure 10-80-14]**.

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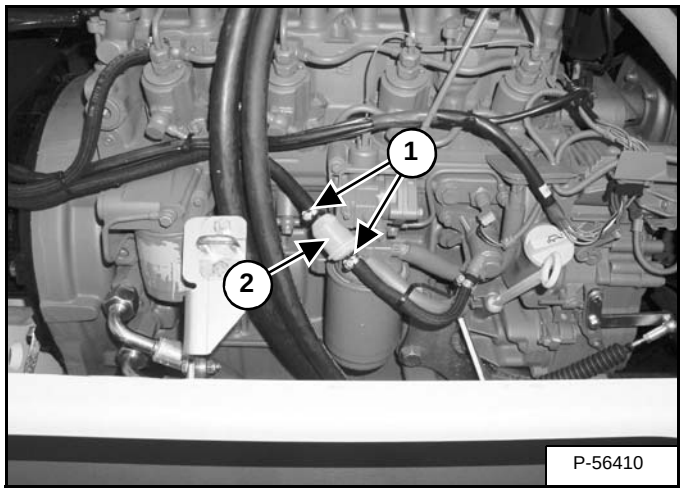
Pre-Filter Removal And Installation (S/N 528911001 & Above And S/N 528611001 & Above)

Figure 10-80-15



Loosen the clamp (Item 1) and remove the filter (Item 2) **[Figure 10-80-15]**.

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Fuel Filter Removal And Installation

See the Service Schedule for the service interval when to replace the fuel filter. (See SERVICE SCHEDULE on Page 10-50-1.)

Clean the area around the filter.

Figure 10-80-16

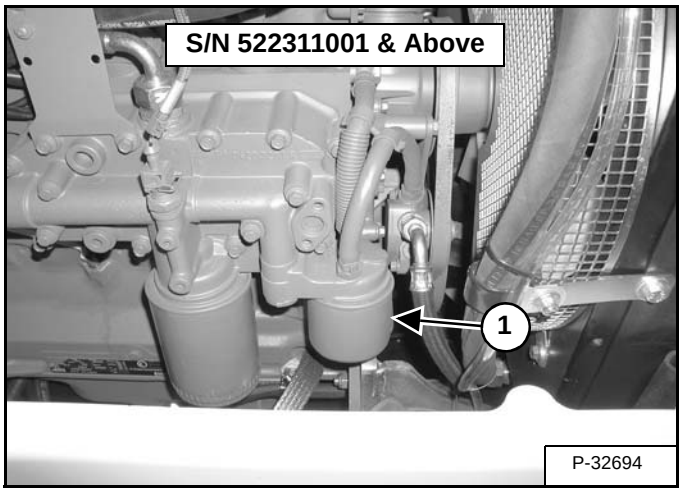
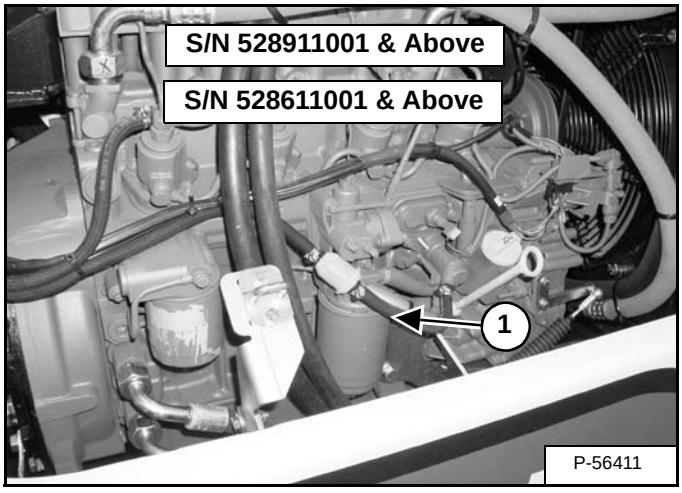


Figure 10-80-17



Remove the filter (Item 1) **[Figure 10-80-16]** & **[Figure 10-80-17]**.

Put clean oil on the seal of the new filter.

Install the filter and hand tighten.

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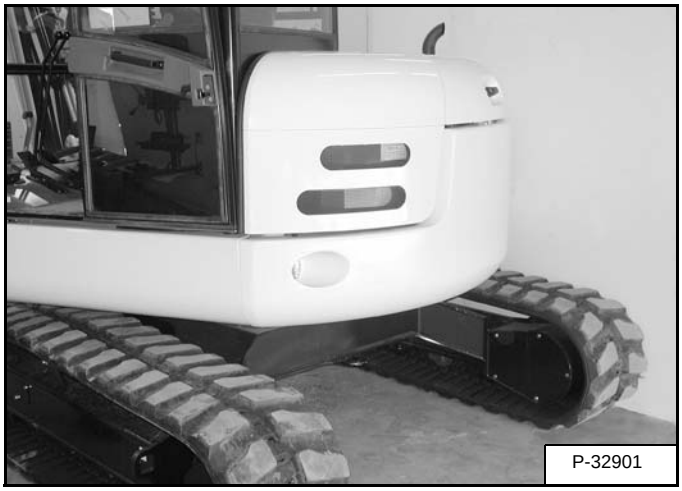
Draining The Fuel Tank

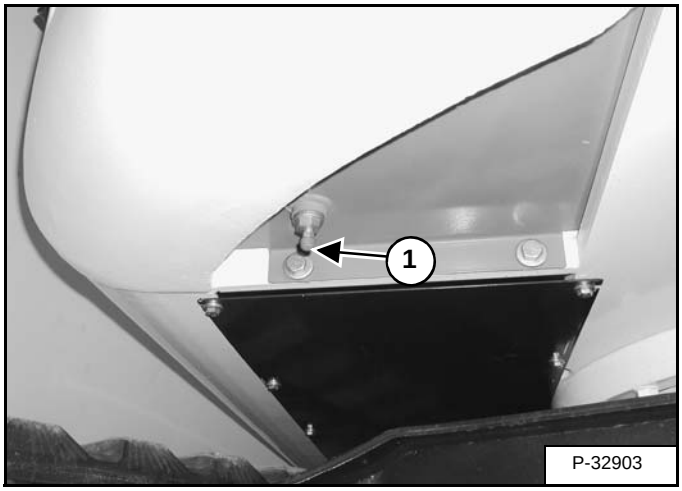
See the Service Schedule for the correct service interval to drain the fuel tank. (See SERVICE SCHEDULE on Page 10-50-1.)

Figure 10-80-18



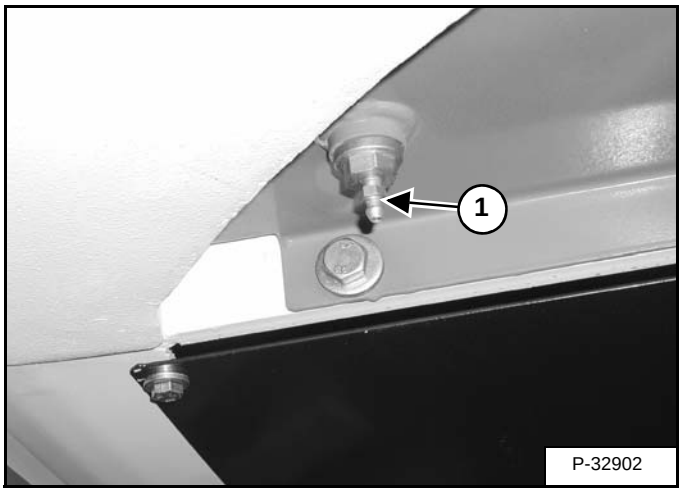
Position the excavator as shown **[Figure 10-80-18]**.

Figure 10-80-19



Remove the cap (Item 1) **[Figure 10-80-19]** from the drain.

Figure 10-80-20



Open the drain (Item 1) **[Figure 10-80-20]** and drain the fuel into a container.

⚠ 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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Checking Engine Oil

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

Figure 10-90-1

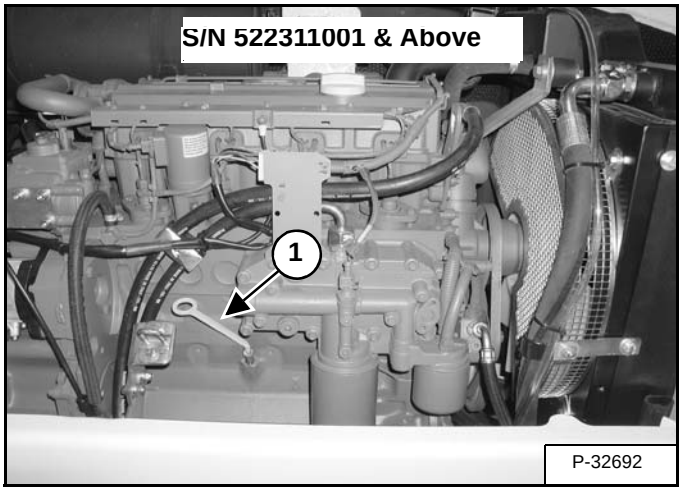
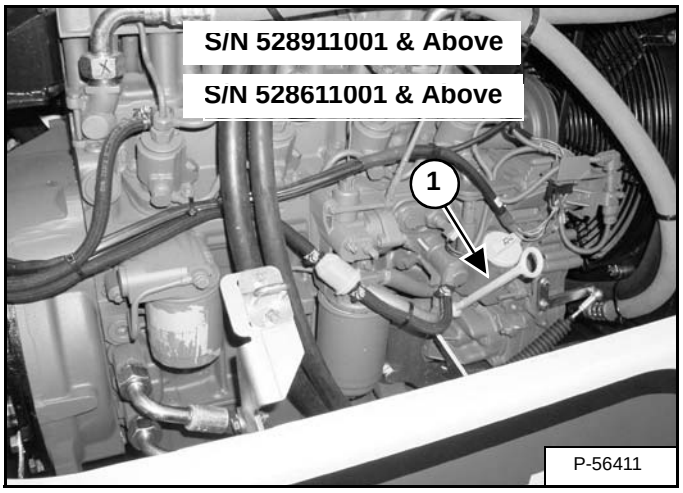


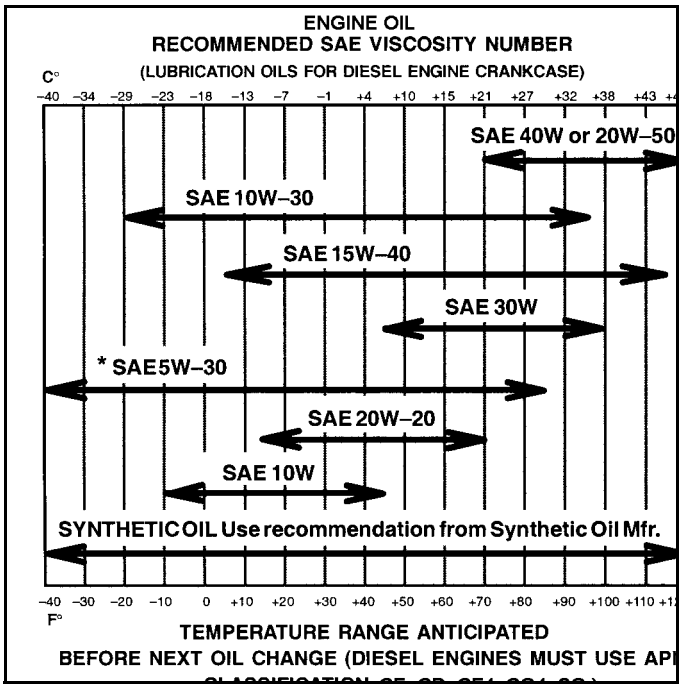
Figure 10-90-2



Open the right side cover and remove the dipstick (Item 1) **[Figure 10-90-1]** & **[Figure 10-90-2]**.

Keep the oil level between the marks on the dipstick.

Figure 10-90-3



Use a good quality motor oil that meets the correct API Service Classification **[Figure 10-90-3]**.

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Replacing Oil And Filter

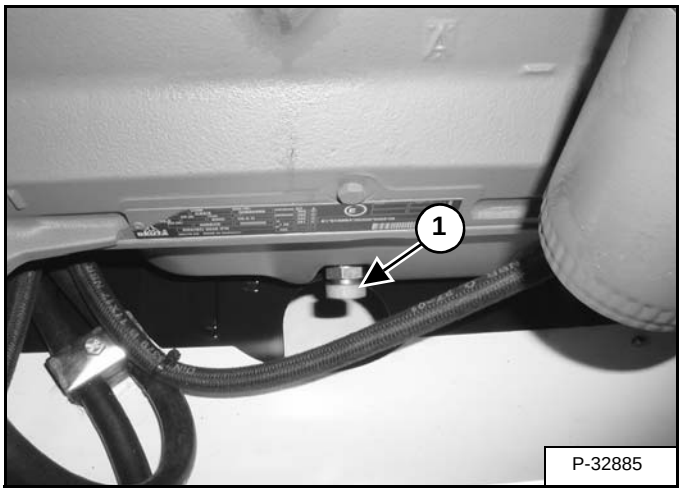
See the Service Schedule for the service interval for replacing the engine oil and filter. (See SERVICE SCHEDULE on Page 10-50-1.)

Figure 10-90-4

Rotate the upperstructure so the right side is positioned between the tracks **[Figure 10-90-4]**. Run the engine until it is at operating temperature. Stop the engine.

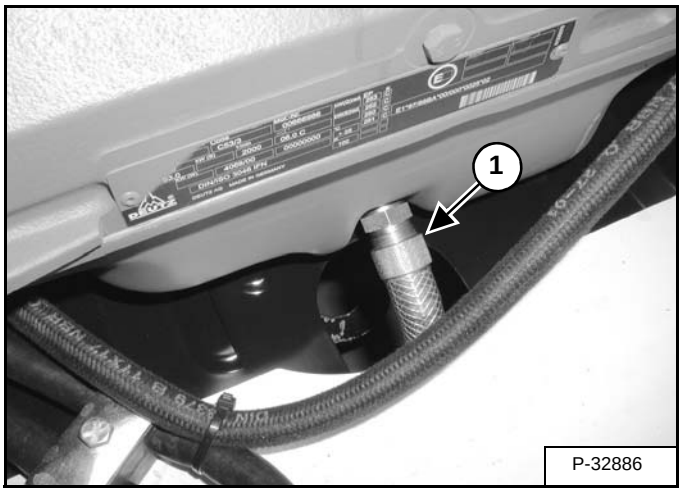
Open the right side cover.

Figure 10-90-5



Remove the cap (Item 1) **[Figure 10-90-5]**.

Figure 10-90-6



Install the drain hose (Item 1) **[Figure 10-90-6]** on the oil pan. Tighten the hose until oil starts to drain from the oil pan.

Drain the oil in a container.

Recycle or dispose of used oil in an environmentally safe manner.

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Replacing Oil And Filter (Cont'd)

Figure 10-90-7

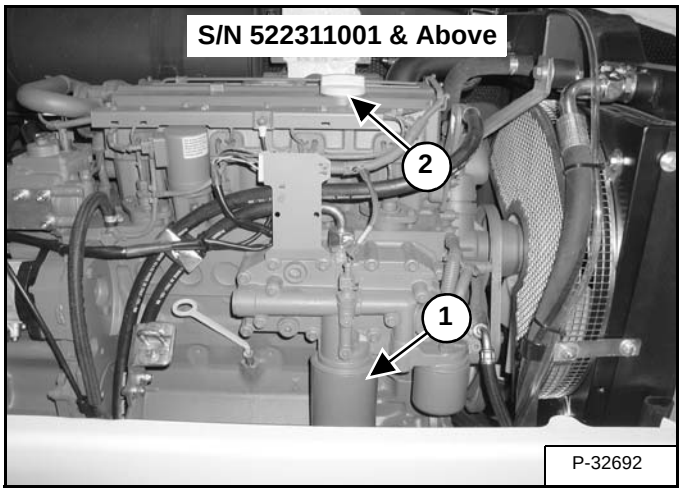
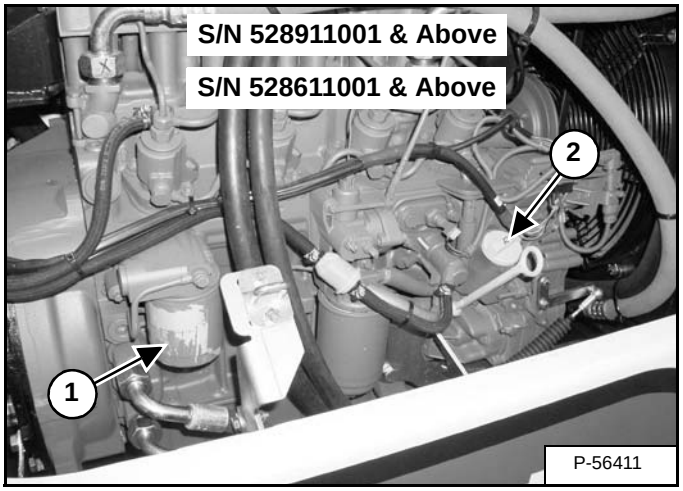


Figure 10-90-8



Remove the oil filter (Item 1) **[Figure 10-90-7]** & **[Figure 10-90-8]** and clean the filter housing surface.

Use a genuine Bobcat replacement oil filter.

Put clean engine oil on the filter gasket. Install the filter and hand tighten.

Remove the drain hose and install the cap on the oil pan after the oil has been completely drained.

Remove the fill cap (Item 2) **[Figure 10-90-7]** & **[Figure 10-90-8]**.

Put oil in the engine. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-70-1.)

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.

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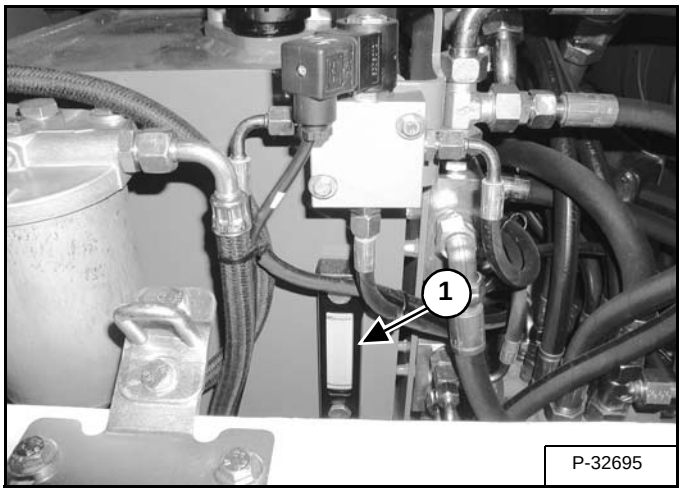
Checking And Adding Hydraulic Oil

Put the machine on a flat level surface.

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

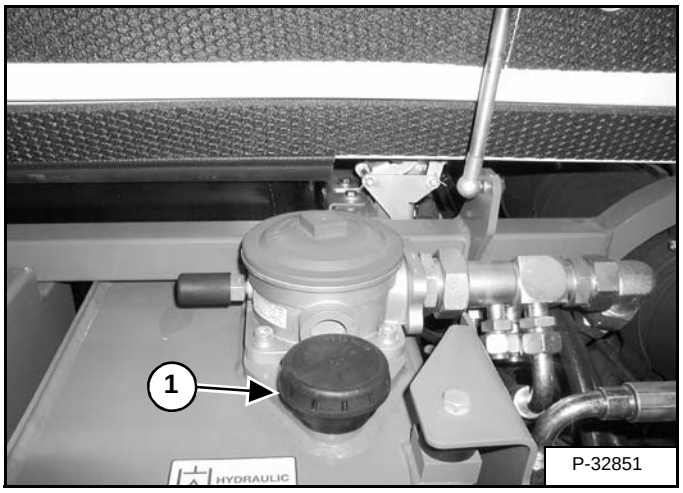
Open the rear cover.

Figure 10-100-1



Check the hydraulic oil level, it must be visible in the sight gauge (Item 1) **[Figure 10-100-1]**.

Figure 10-100-2



Clean the surface around the reservoir (breather) cap and remove the cap from the reservoir (Item 1) **[Figure 10-100-2]**

Add the correct oil to the reservoir until it is visible in the sight gauge. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-70-1.)

Check the breather cap and clean as necessary. Replace the cap if damaged.

Install the reservoir cap.

Close the rear cover.

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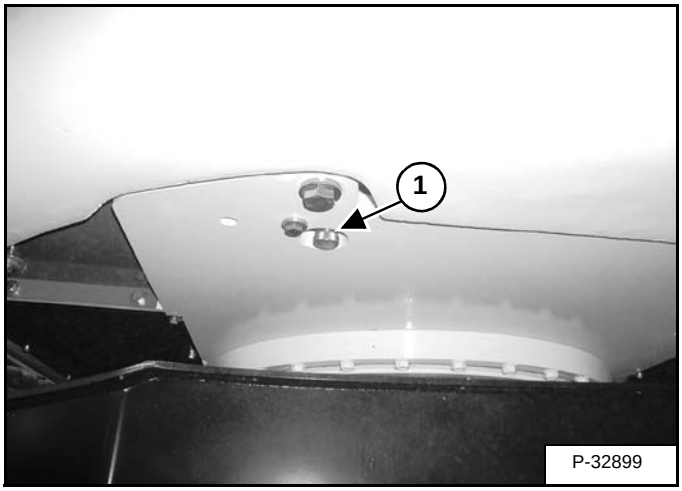
Replacing The Hydraulic Oil

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.

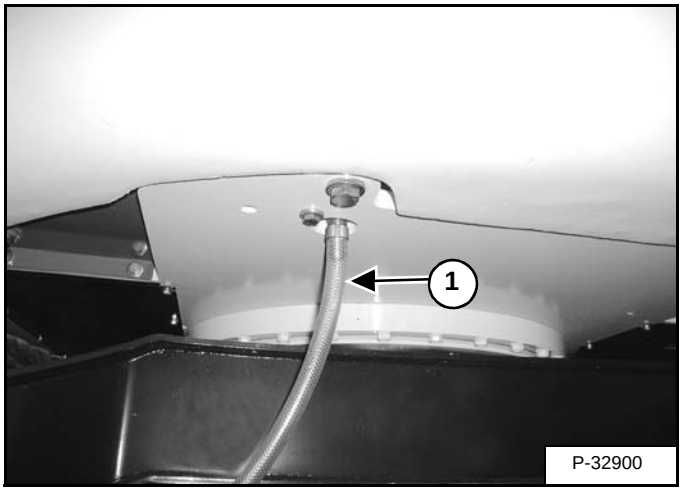
Open the rear cover.

Figure 10-100-3



Remove the cap (Item 1) **[Figure 10-100-3]** from the hydraulic reservoir drain.

Figure 10-100-4



Install the drain hose (Item 1) **[Figure 10-100-4]** on the hydraulic reservoir. Tighten the hose until oil starts to drain from the reservoir.

Drain the fluid into a container.

Recycle or dispose of the fluid in an environmentally safe manner.

Remove the drain hose and install the cap on the hydraulic reservoir.

Add fluid to the reservoir. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-70-1).

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

⚠ 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

⚠ 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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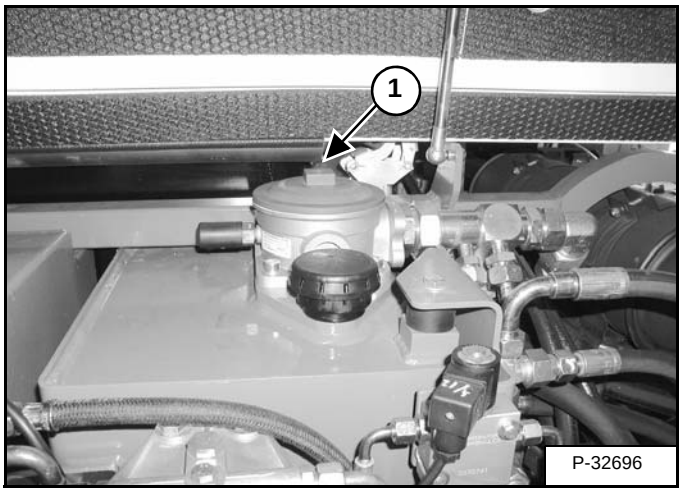
Hydraulic Filter Removal (S/N 522311001 & Above)

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

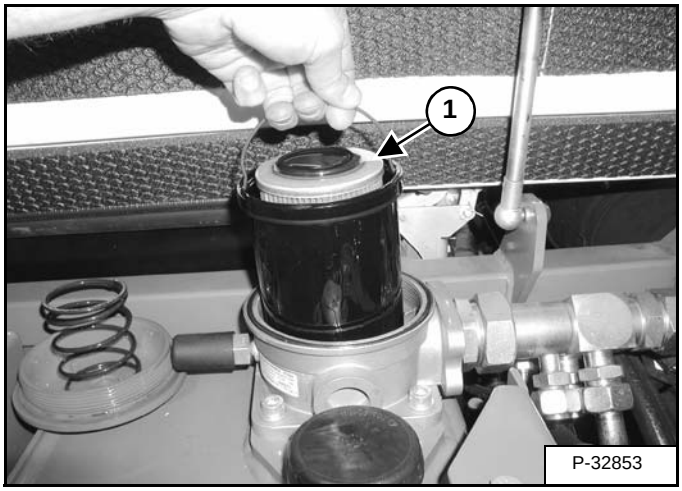
Open the rear cover.

Figure 10-100-5



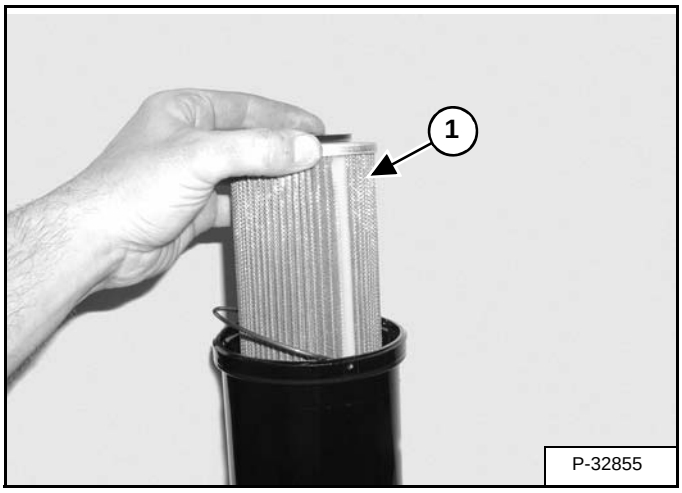
Remove the filter cover (Item 1) **[Figure 10-100-5]** and spring.

Figure 10-100-6



Remove the filter and filter bowl (Item 1) **[Figure 10-100-6]**.

Figure 10-100-7



Remove the filter (Item 1) **[Figure 10-100-7]** from the filter bowl.

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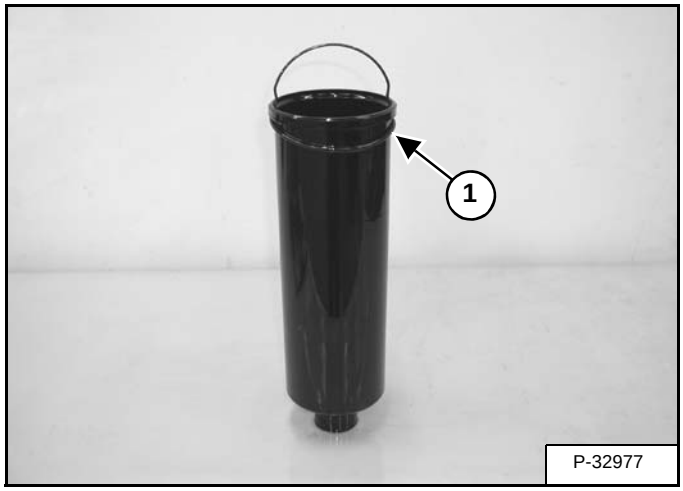
Hydraulic Filter Installation (S/N 522311001 & Above)

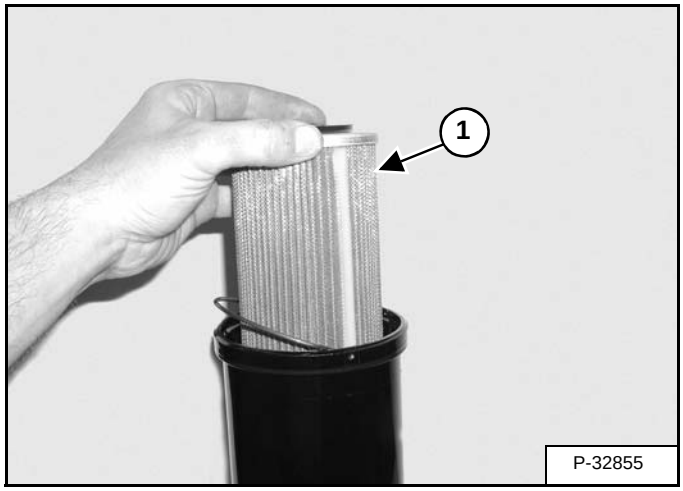
Clean the filter bowl in clean solvent and dry with compressed air.

Figure 10-100-8



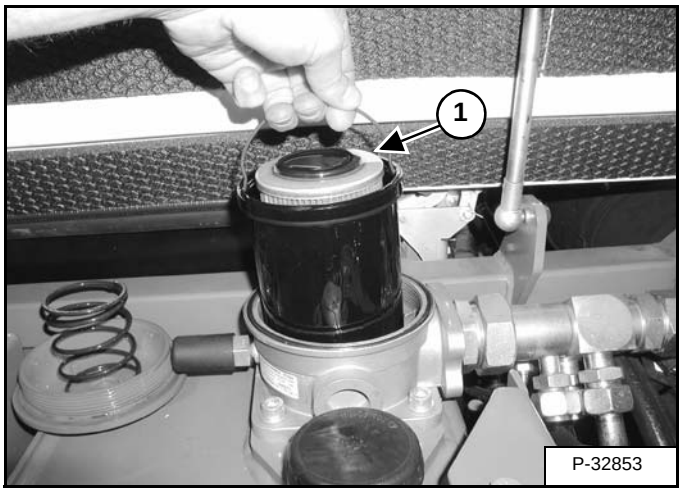
Inspect the O-rings (Item 1) **[Figure 10-100-8]** on the outside and inside bottom of the filter bowl. Replace the O-rings if damaged.

Figure 10-100-9



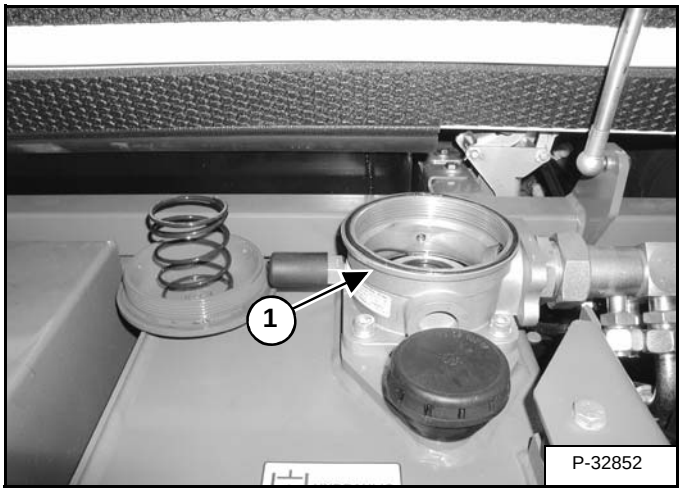
Install a new filter (Item 1) **[Figure 10-100-9]** in the filter bowl.

Figure 10-100-10



Install the filter and filter bowl (Item 1) **[Figure 10-100-10]**.

Figure 10-100-11



Inspect the O-ring (Item 1) **[Figure 10-100-11]** Replace if damaged.

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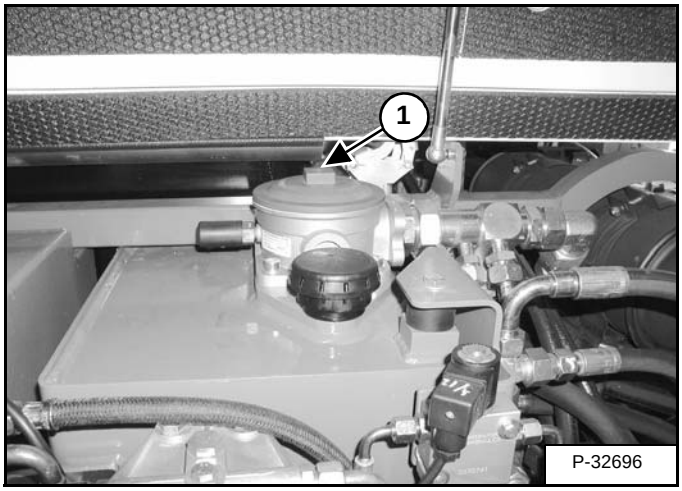
Hydraulic Filter Installation (S/N 522311001 & Above) (Cont'd)

Figure 10-100-12



Install the spring and cover (Item 1) **[Figure 10-100-12]**.

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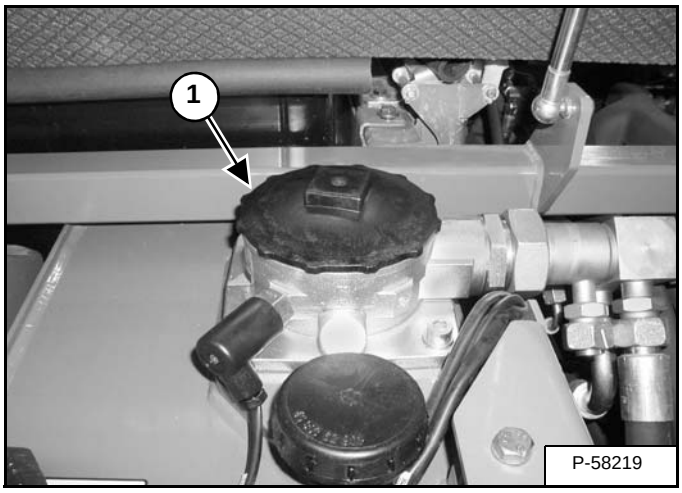
Hydraulic Filter Removal (S/N 528911001 & Above And S/N 528611001 & Above)

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

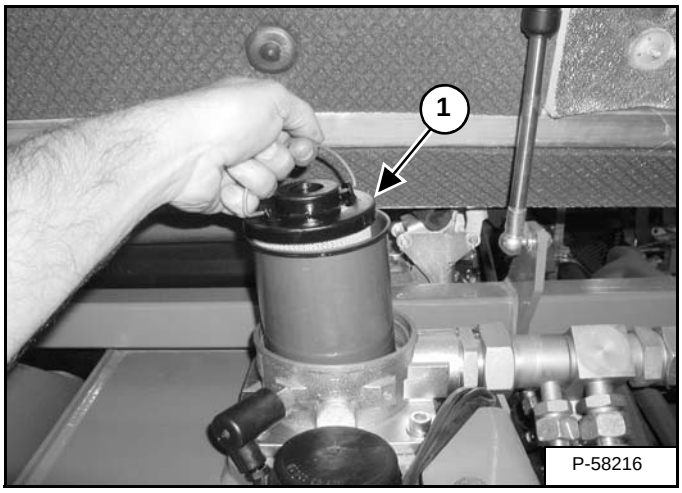
Open the rear cover.

Figure 10-100-13



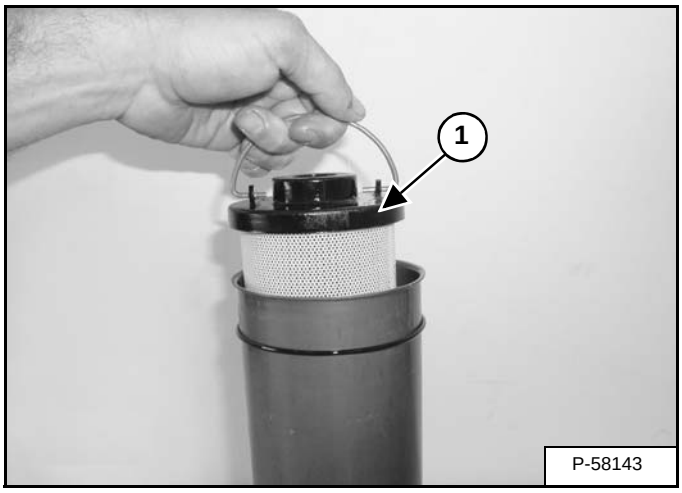
Remove the filter cover (Item 1) **[Figure 10-100-13]** and spring.

Figure 10-100-14



Remove the filter and filter bowl (Item 1) **[Figure 10-100-14]**.

Figure 10-100-15



Remove the filter (Item 1) **[Figure 10-100-15]** from the filter bowl.

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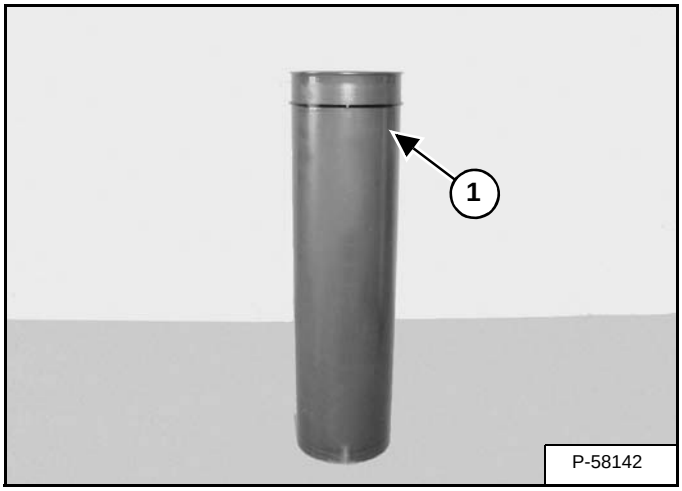
Hydraulic Filter Installation (S/N 528911001 & Above And S/N 528611001 & Above)

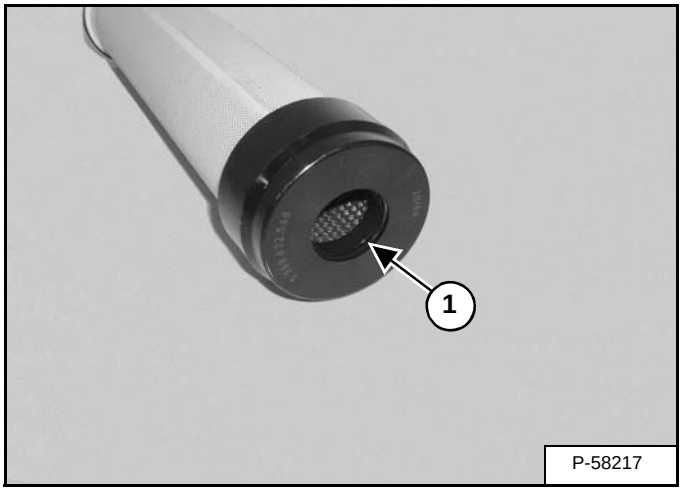
Clean the filter bowl in clean solvent and dry with compressed air.

Figure 10-100-16



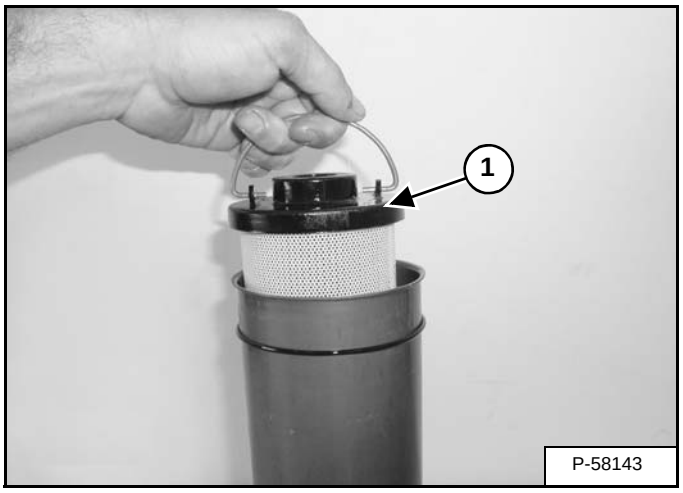
Inspect the O-ring (Item 1) **[Figure 10-100-16]** on the outside of the filter bowl. Replace the O-rings if damaged.

Figure 10-100-17



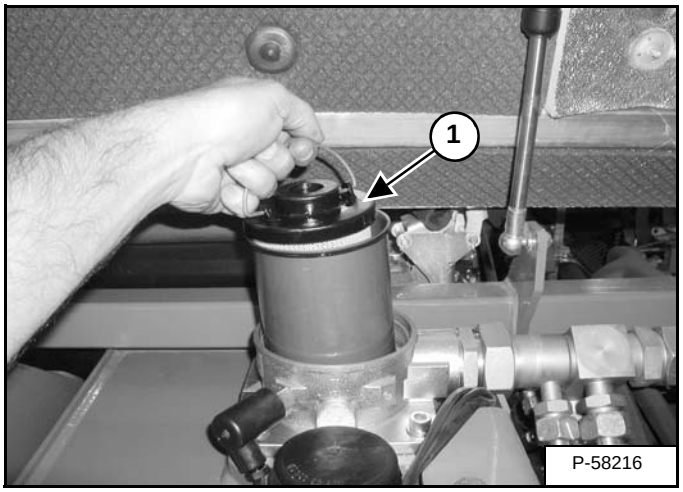
Install the O-ring (Item 1) **[Figure 10-100-17]** in the bottom of the new filter.

Figure 10-100-18



Install the filter (Item 1) **[Figure 10-100-18]** in the filter bowl.

Figure 10-100-19



Install the filter and filter bowl (Item 1) **[Figure 10-100-19]**.

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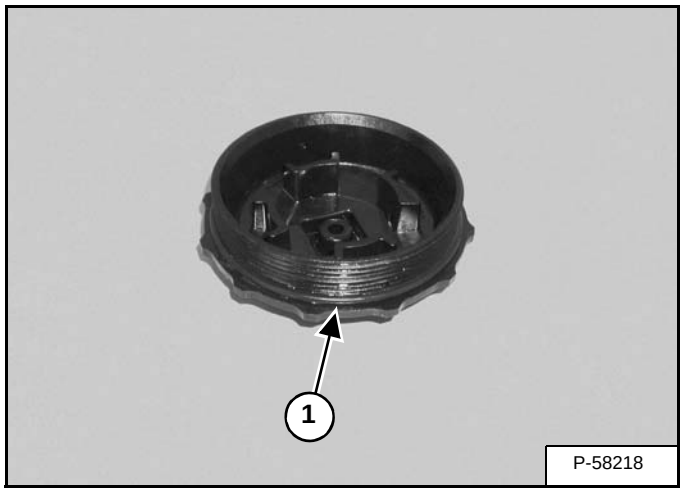
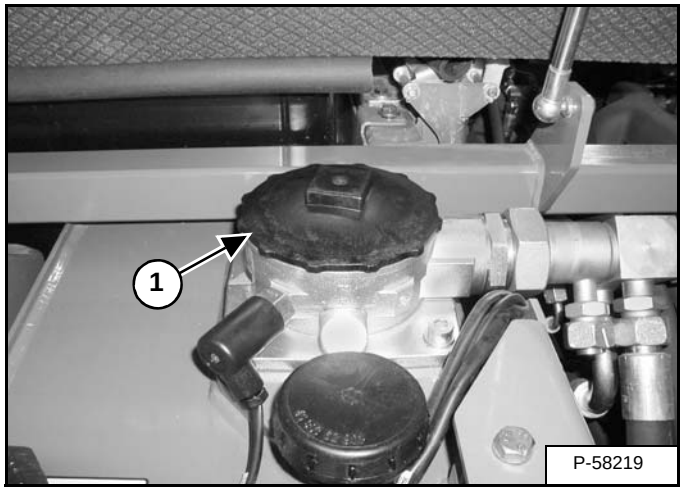
Hydraulic Filter Installation (S/N 528911001 & Above And S/N 528611001 & Above) (Cont'd)

Figure 10-100-20



Inspect the O-ring (Item 1) **[Figure 10-100-20]**. Replace if damaged.

Figure 10-100-21



Install the spring and cover (Item 1) **[Figure 10-100-21]**.

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Diagnostic Couplers (S/N 522311001 & Above)

Open the rear cover and right side cover.

Figure 10-100-22

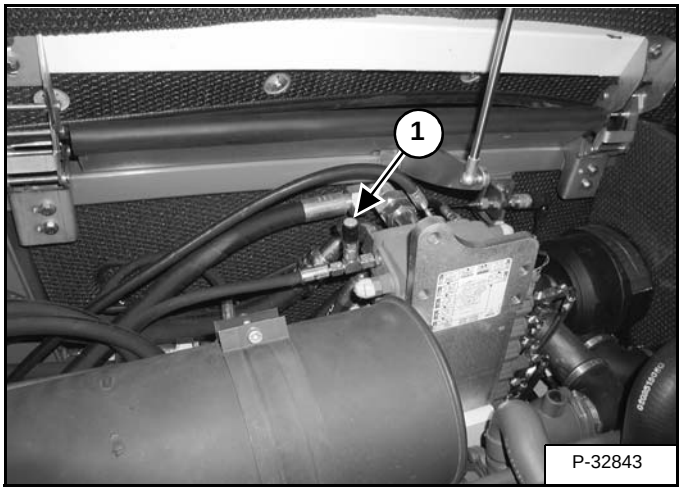


Figure 10-100-23

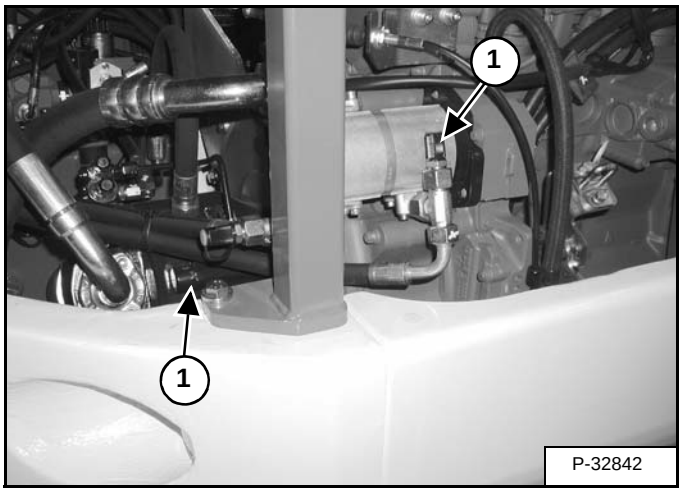
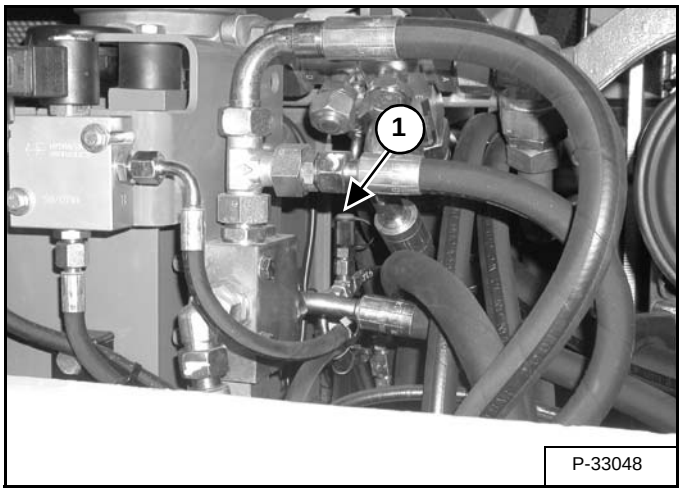


Figure 10-100-24



The four diagnostic couplers (item 1) **[Figure 10-100-22]**, **[Figure 10-100-23]** & **[Figure 10-100-24]** are located on the hydraulic circuitry.

The couplers can be used to check circuit pressures. (See Testing on Page 20-33-1.)

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Diagnostic Couplers (S/N 528911001 & Above And S/N 528611001 & Above)

Open the rear cover and right side cover.

Figure 10-100-25

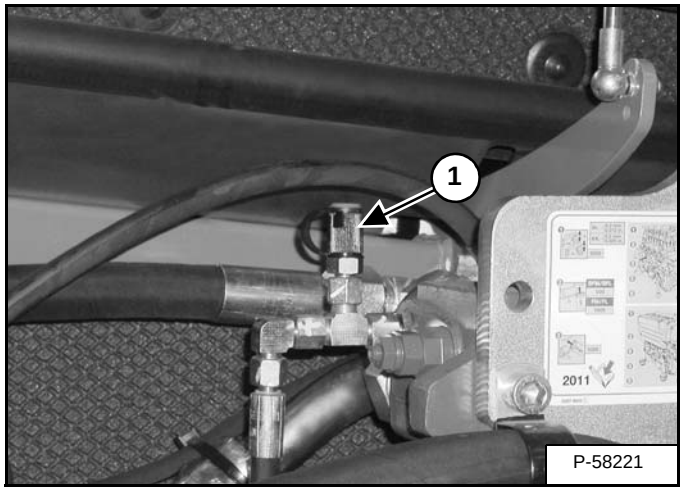


Figure 10-100-26

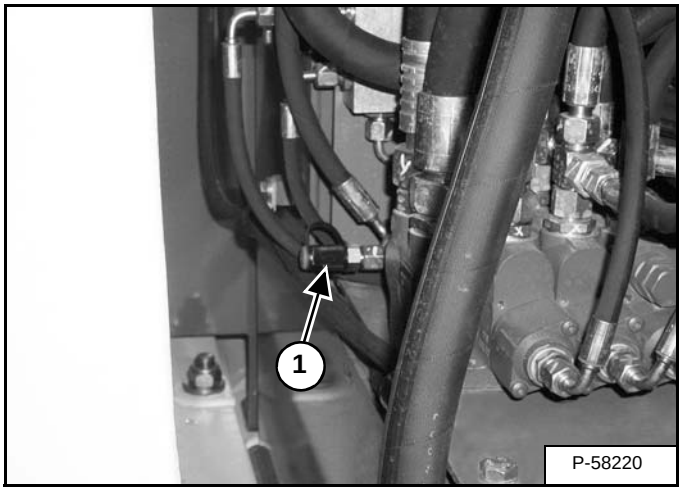
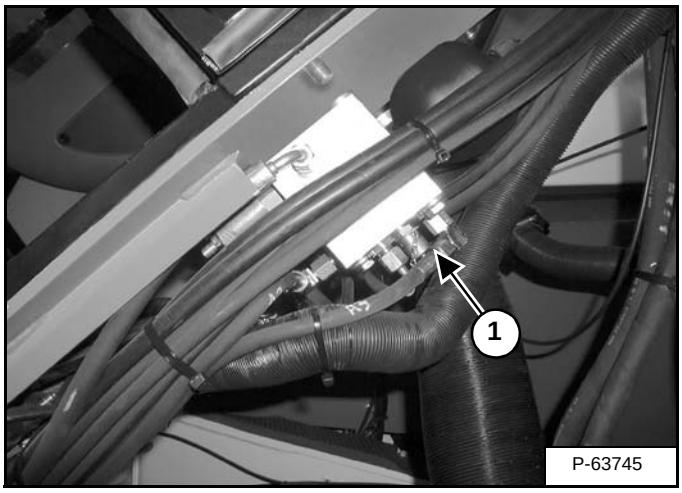


Figure 10-100-27



The three diagnostic couplers (Item 1) **[Figure 10-100-25]**, **[Figure 10-100-26]** and **[Figure 10-100-27]** are located on the hydraulic circuitry.

The couplers can be used to check circuit pressures.

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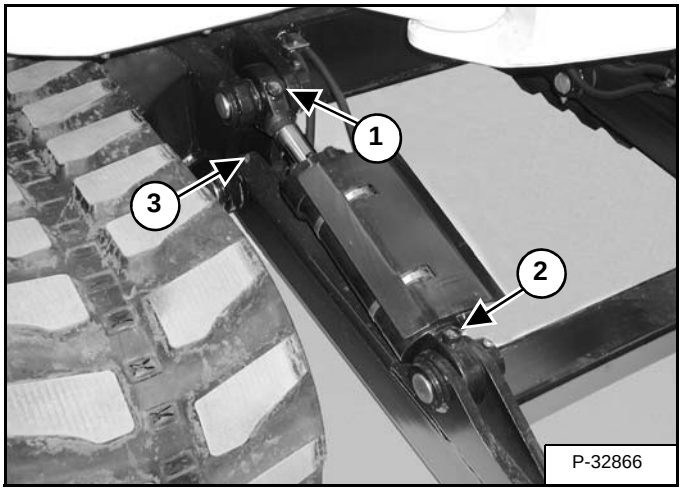
LUBRICATION OF THE EXCAVATOR

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

Always use a good quality lithium based multipurpose grease when lubricating the machine. Apply the lubricant until extra grease shows.

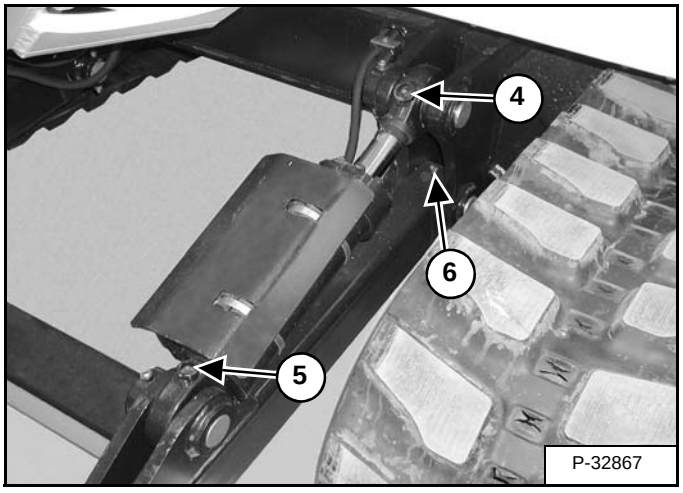
Lubricate the following locations on the excavator EVERY 8-10 HOURS:

Figure 10-110-1



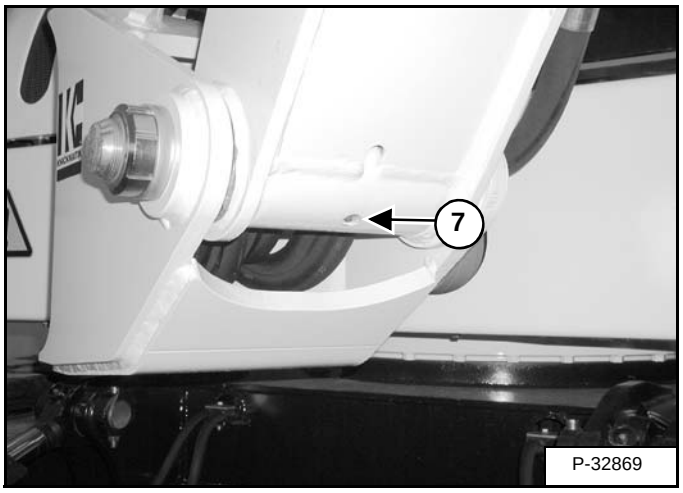
1. Right blade cylinder rod end (1) **[Figure 10-110-1]**
2. Right blade cylinder base end (1) **[Figure 10-110-1]**
3. Right side blade pivot (1) **[Figure 10-110-1]**

Figure 10-110-2



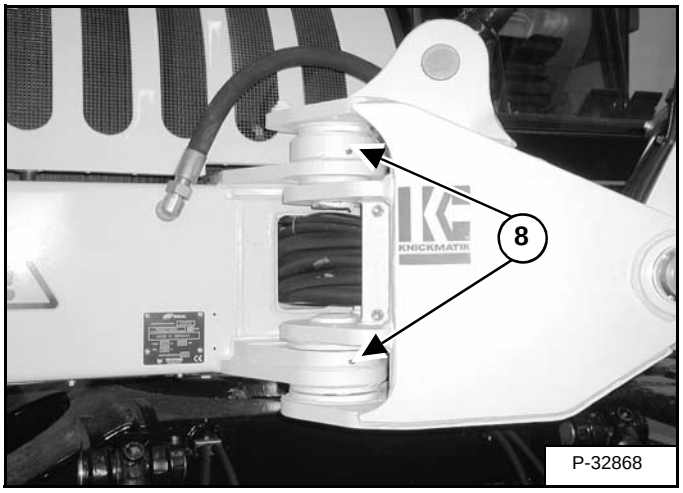
4. Left blade cylinder rod end (1) **[Figure 10-110-2]**
5. Left blade cylinder base end (1) **[Figure 10-110-2]**
6. Left side blade pivot (1) **[Figure 10-110-2]**

Figure 10-110-3



7. Boom pivot (1) **[Figure 10-110-3]**

Figure 10-110-4



8. Boom swing pivot (2) **[Figure 10-110-4]**

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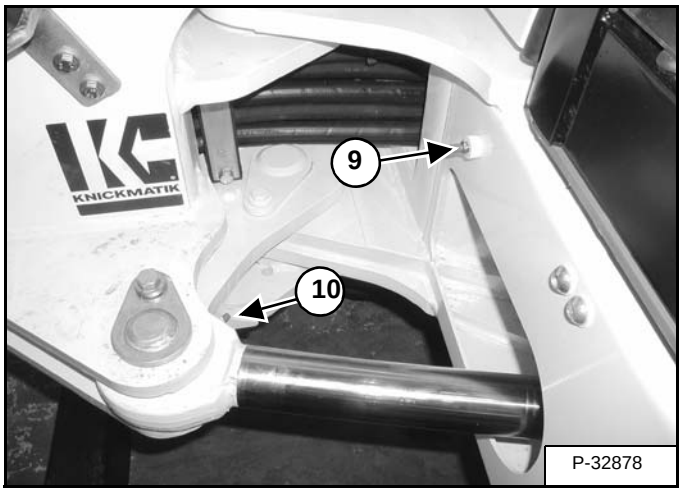
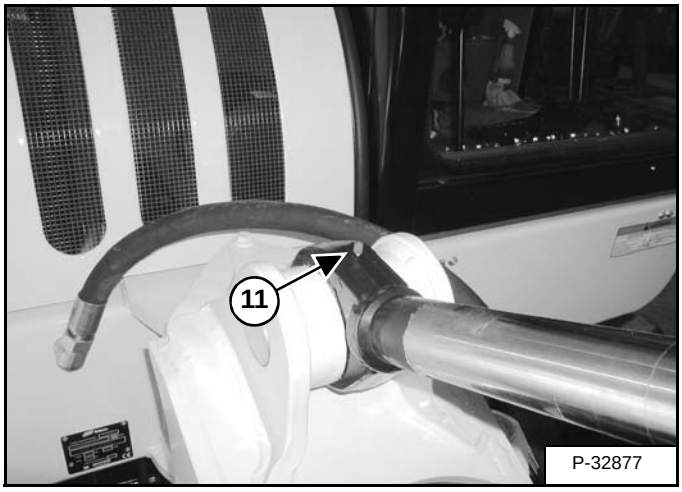
Figure 10-110-5



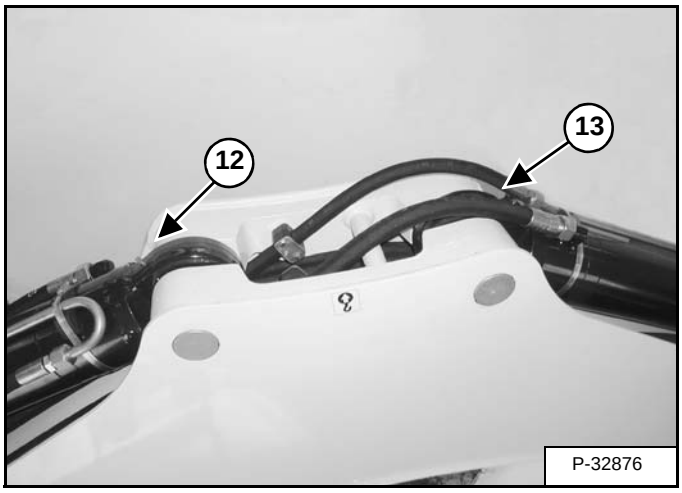
9. Boom swing cylinder base end (1) **[Figure 10-110-5]**
10. Boom swing cylinder rod end (1) **[Figure 10-110-5]**

Figure 10-110-6



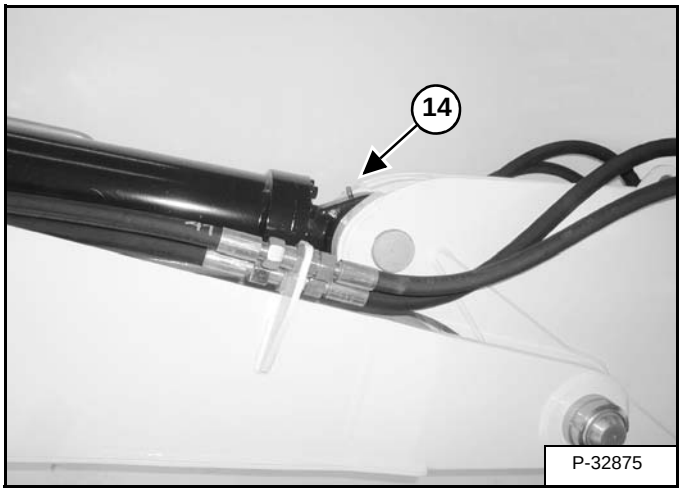
11. Boom cylinder rod end (1) **[Figure 10-110-6]**

Figure 10-110-7



12. Boom cylinder base end (1) **[Figure 10-110-7]**
13. Arm cylinder base end (1) **[Figure 10-110-7]**

Figure 10-110-8



14. Arm cylinder rod end (1) **[Figure 10-110-8]**

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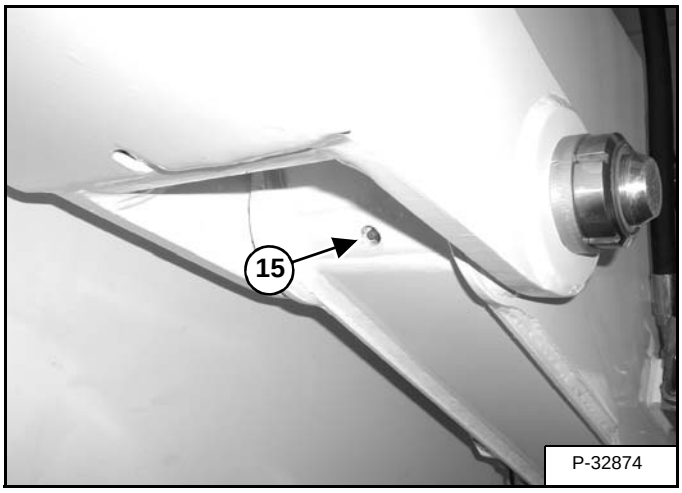
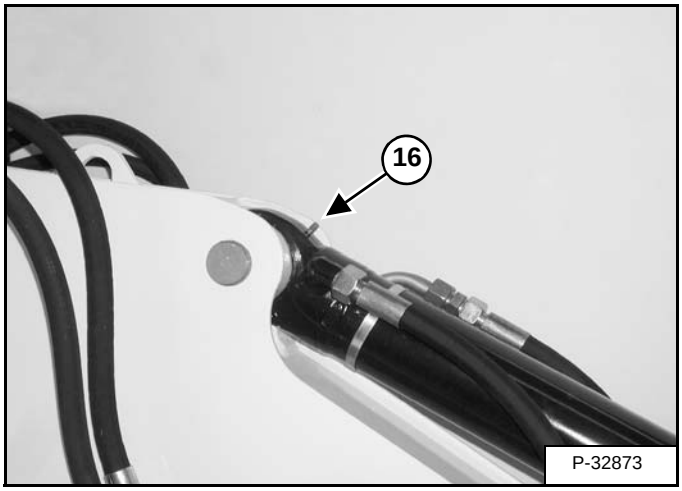
Figure 10-110-9



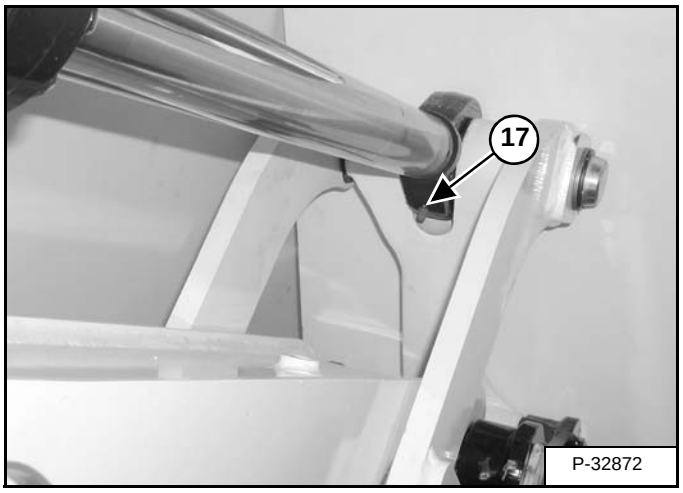
15. Arm pivot (1) **[Figure 10-110-9]**

Figure 10-110-10



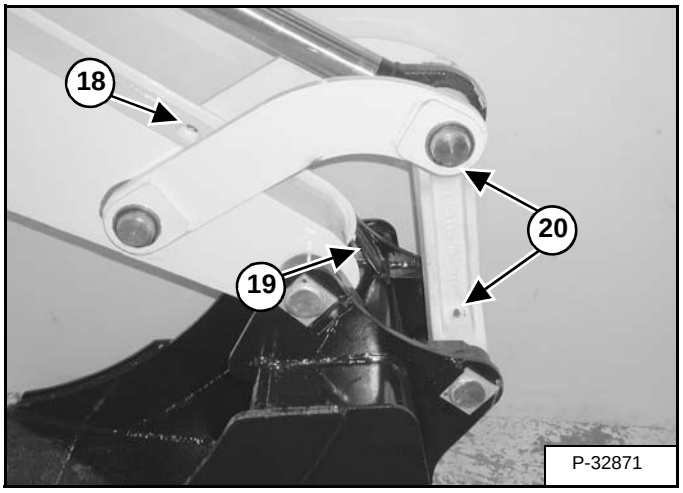
16. Bucket cylinder base end (1) **[Figure 10-110-10]**

Figure 10-110-11



17. Bucket cylinder rod end (1) **[Figure 10-110-11]**

Figure 10-110-12



18. Bucket link pivot (1) **[Figure 10-110-12]**
19. Bucket pivot (1) **[Figure 10-110-12]**
20. Bucket link (2) **[Figure 10-110-12]**

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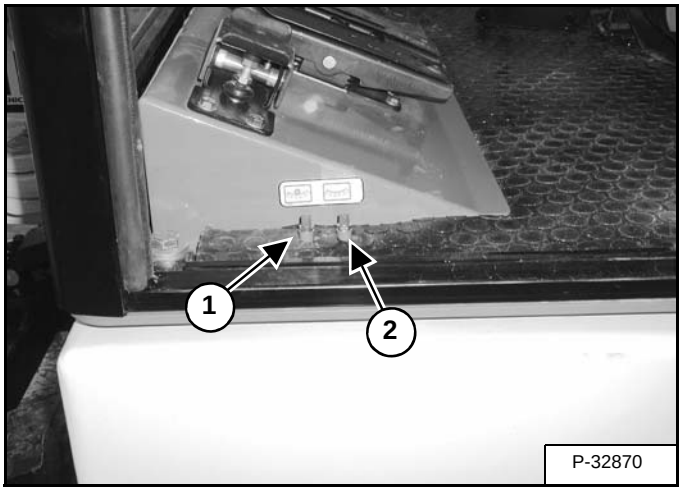
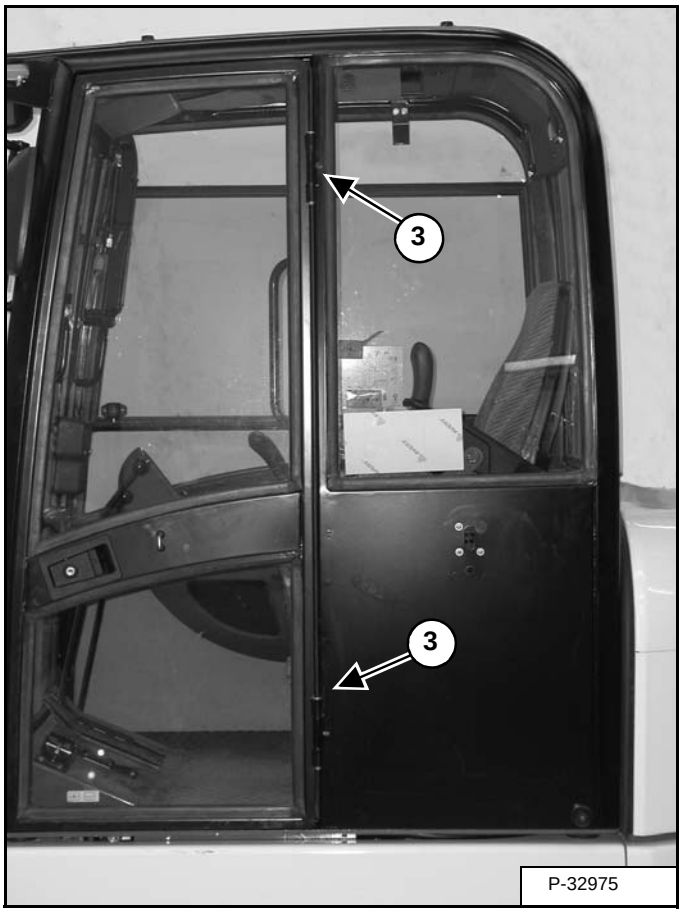
Lubricate the following locations on the excavator EVERY 50 HOURS:

Figure 10-110-13



1. Swing circle bearing (1) **[Figure 10-110-13]**
2. Swing circle pinion (1) **[Figure 10-110-13]**

Figure 10-110-14



3. Door hinges (2) **[Figure 10-110-14]**

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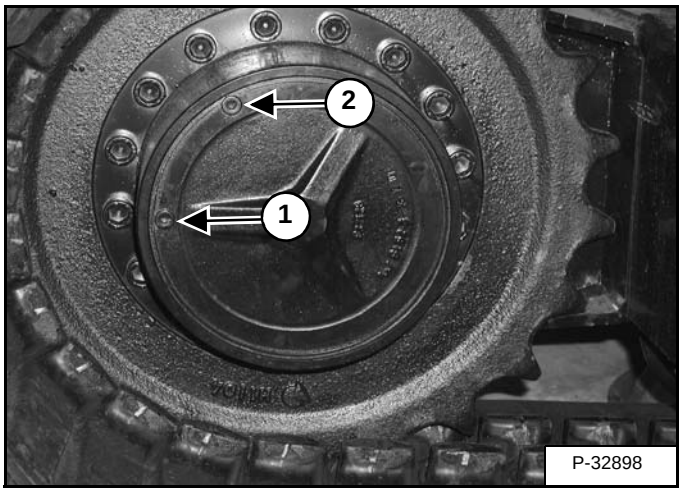
TRAVEL MOTOR

Checking Oil Level

Figure 10-120-1



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

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

Remove the plug (Item 2) **[Figure 10-120-1]** and add gear lube through the hole if the oil level is below the hole (Item 1) **[Figure 10-120-1]**. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-70-1.)

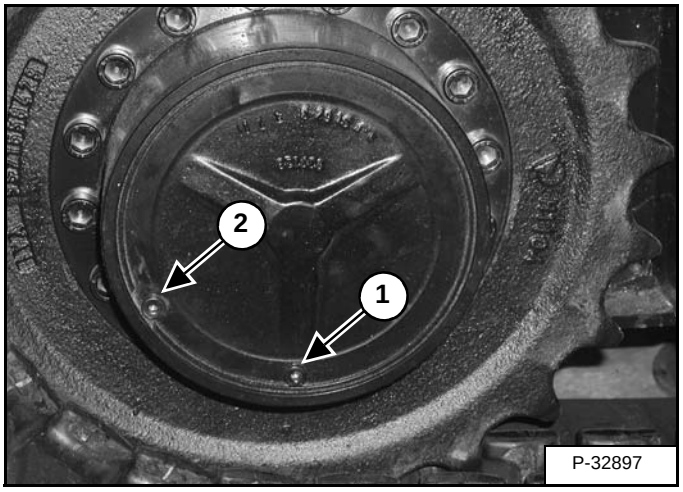
Install both plugs.

Repeat the procedure for the other side.

Draining The Travel Motor

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

Figure 10-120-2



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

Remove both plugs (Items 1 & 2) **[Figure 10-120-2]** and drain into a container. Recycle or dispose of the oil in an environmentally safe manner.

After all the gear lube is removed, rotate the travel motor to the position shown **[Figure 10-120-1]**

Add gear lube to the plug hole (Item 2) until the oil level is at the bottom edge of the plug hole (Item 1) **[Figure 10-120-1]**. Install and tighten the plugs.

Repeat the procedure for the other side.

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ALTERNATOR BELT

Adjusting Belt Tension

Check the alternator belt deflection at the mid span of the belt between the crankshaft pulley and alternator pulley.

Apply approximately 33 lb. (15 Kg) force to the belt. The belt should deflect 0.40 inches (10 mm).

Figure 10-130-1

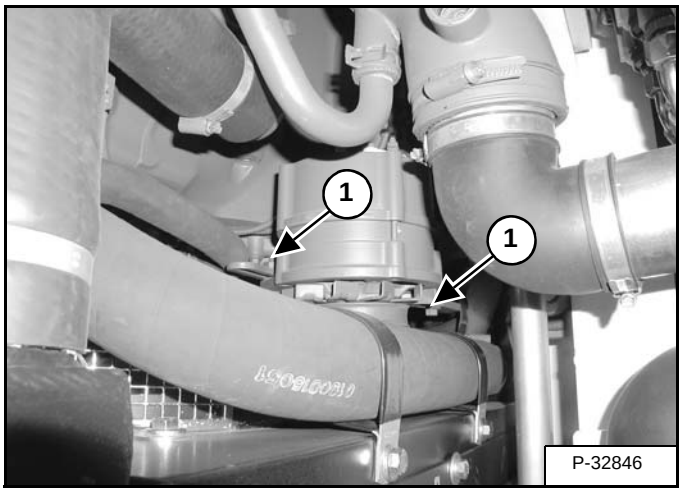
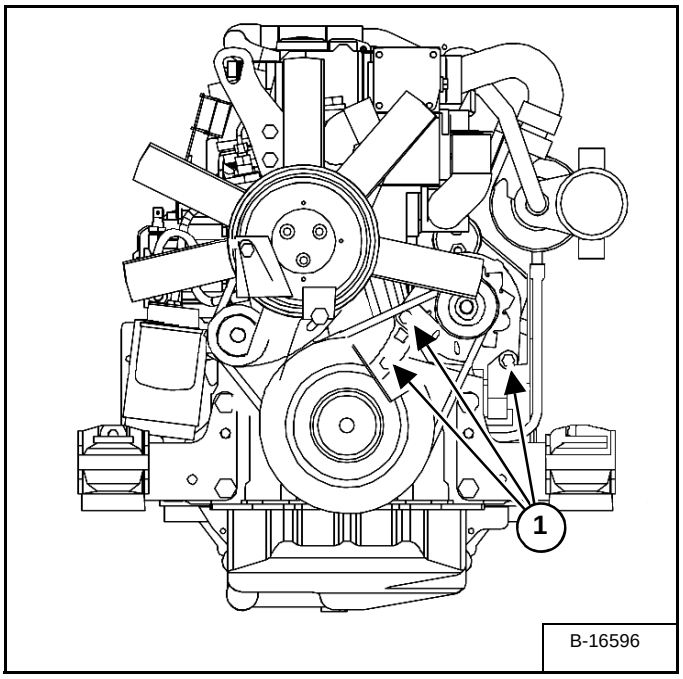


Figure 10-130-2



Loosen the three alternator mount bolts (Item 1) **[Figure 10-130-1]** & (Item 1) **[Figure 10-130-2]** and rotate the alternator until the belt is correctly tensioned.

Tighten the bolts.

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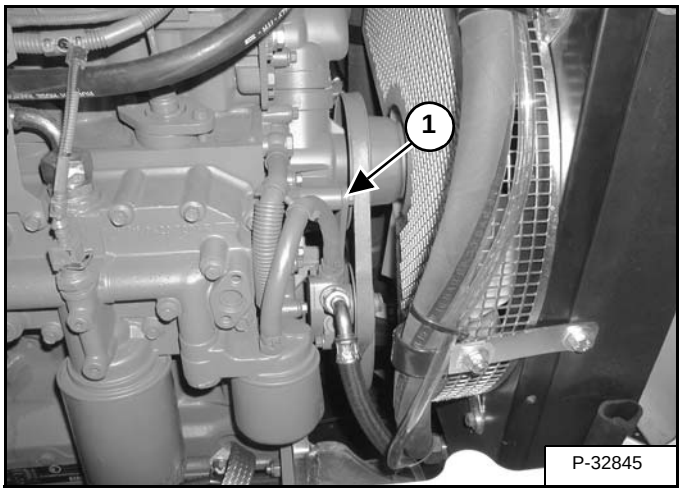
FAN/FUEL PUMP BELT

Adjusting Belt Tension (S/N 522311001 & Above)

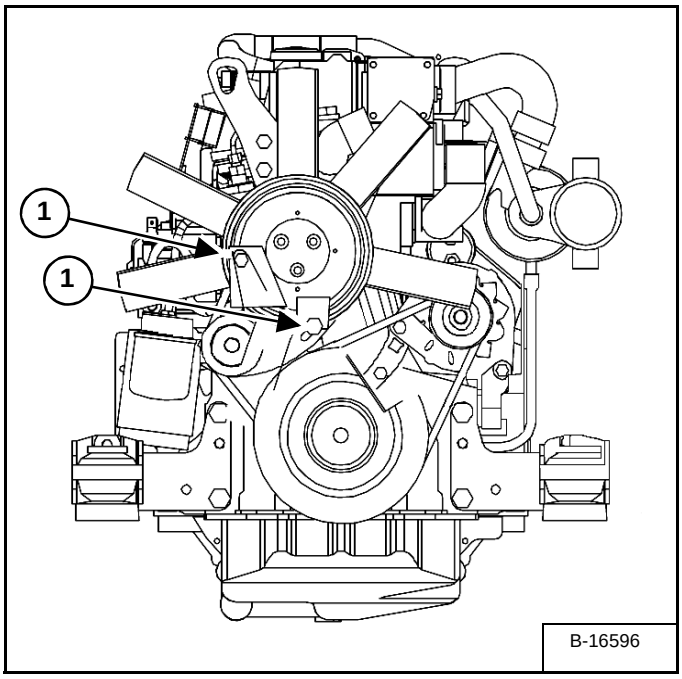
Figure 10-140-1



Check the fan/fuel pump belt deflection mid span of the belt between the crankshaft pulley and the fuel pump pulley (Item 1) **[Figure 10-140-1]**.

Apply approximately 33 lb. (15 Kg) force to the belt. The belt should deflect 0.40 inches (10 mm).

Figure 10-140-2



Loosen the two bolts (Item 1) **[Figure 10-140-2]** on the fuel pump mount. Rotate the fuel pump until the belt is correctly tensioned.

Tighten the bolts.

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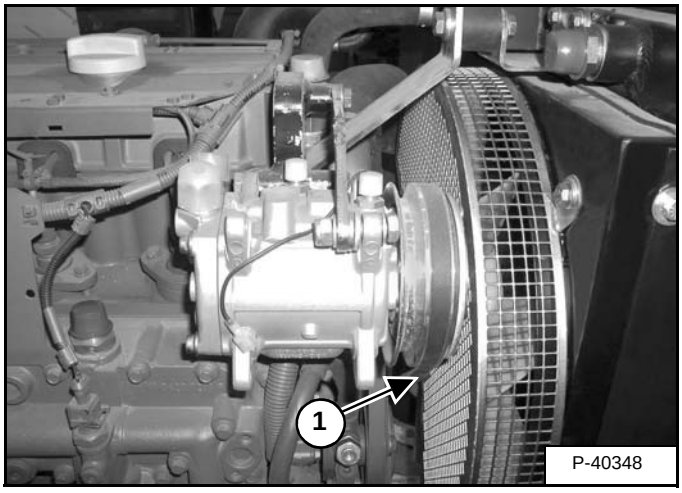
AIR CONDITIONING COMPRESSOR BELT (S/N 522311001 & ABOVE)

Adjusting Belt Tension

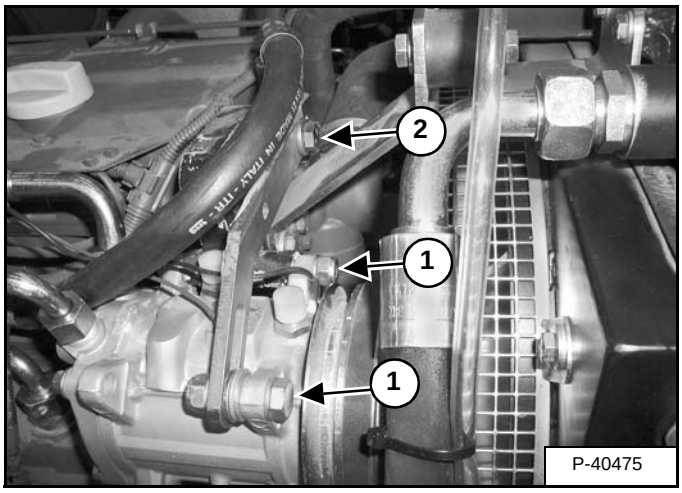
Figure 10-150-1



Check the A/C belt deflection at the mid span of the belt (Item 1) **[Figure 10-150-1]**.

Apply approximately 33 lb. (15 Kg) force to the belt. The belt should deflect 0.40 inches (10 mm).

Figure 10-150-2



Loosen the two bolts (Item 1) **[Figure 10-150-2]** and nuts.

Loosen the bracket bolt (Item 2) **[Figure 10-150-2]**. Rotate the compressor until the belt is correctly tensioned.

Tighten the bolts.

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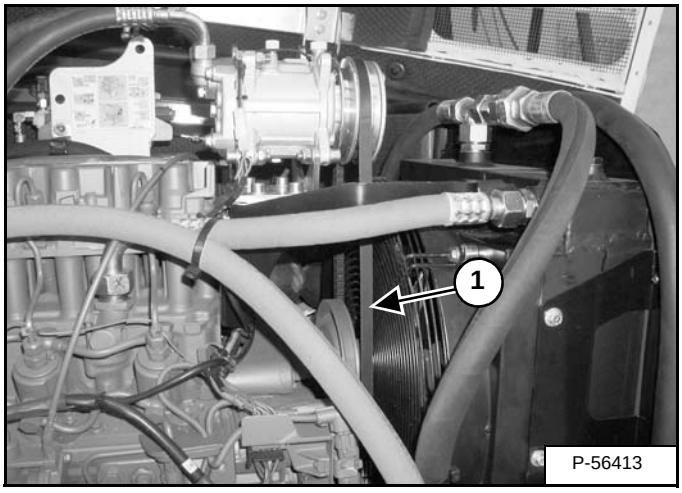
AIR CONDITIONING COMPRESSOR BELT (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Adjusting Belt Tension

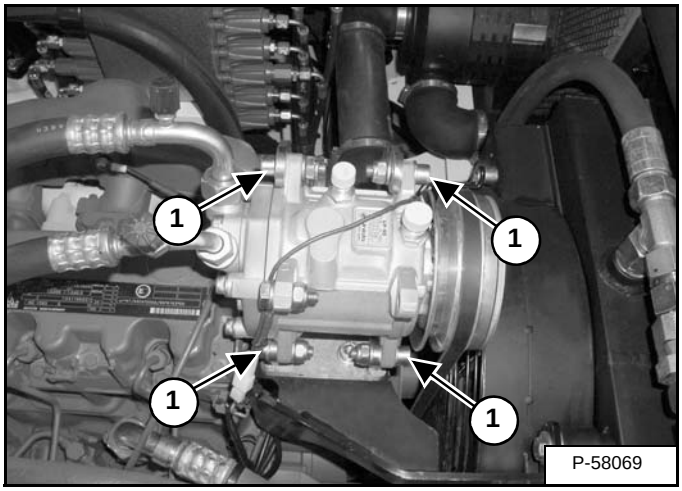
Figure 10-151-3



Check the air conditioning compressor belt deflection mid span of the belt between the crankshaft pulley and the compressor pulley (Item 1) **[Figure 10-151-3]**.

Apply approximately 33 lb. (45 mm) force to the belt. The belt should deflect 0,40 inches (10 mm).

Figure 10-151-4



Loosen the bolts (Item 1) **[Figure 10-151-4]** and rotate the compressor until the belt is correctly tensioned.

Tighten the bolts.

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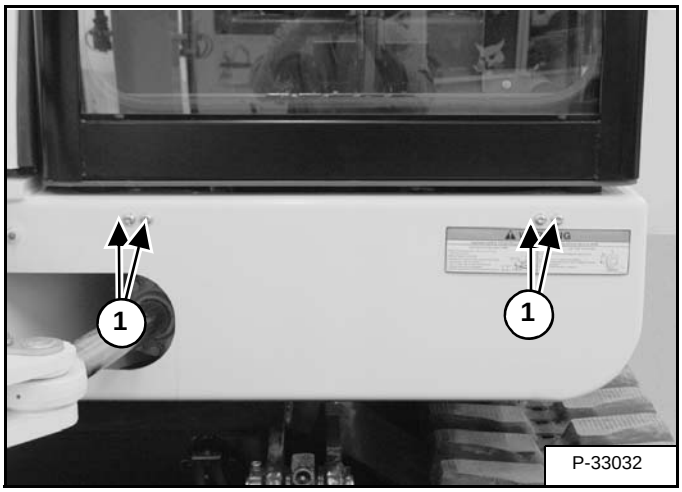
CAB TILT PROCEDURE

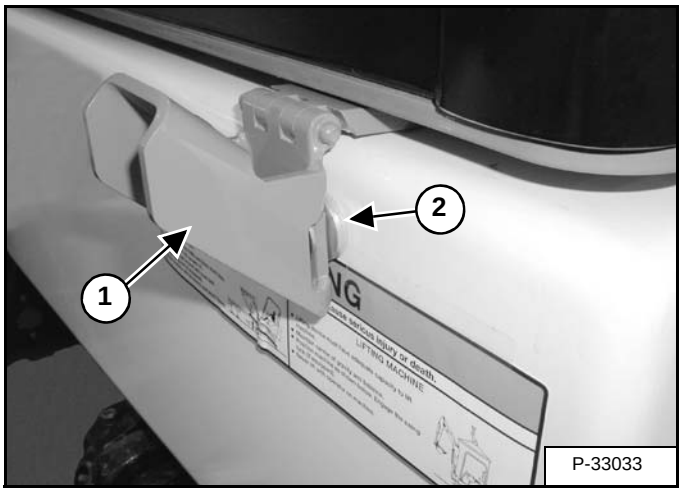
Installing The Cab Tilt Hinges

Figure 10-160-1



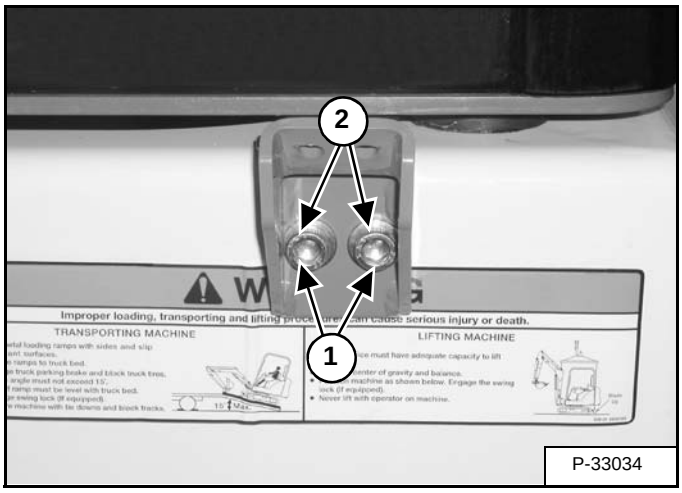
Remove the four bolts (Item 1) **[Figure 10-160-1]** from the front of the excavator.

Figure 10-160-2



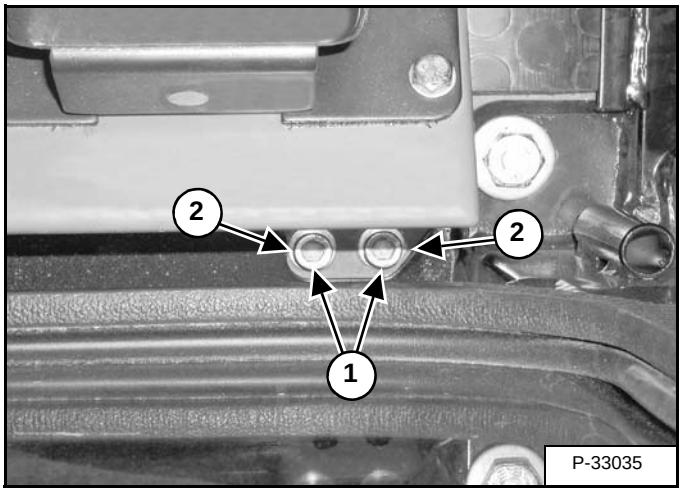
Install the hinge (Item 1) on the excavator frame. Install the washers (Item 2) **[Figure 10-160-2]** between the frame and the hinge.

Figure 10-160-3



Install the bolts (Item 1) and washers (Item 2) **[Figure 10-160-3]**. Do not tighten the bolts at this time.

Figure 10-160-4



Install the bolts (Item 1)and washers (Item 2) **[Figure 10-160-4]**.

Tighten the bolts to 29-37 ft.-lb. (40-50 N•m) torque.

Tighten the front bolts (Item 1) **[Figure 10-160-3]** to 29-37 ft.-lb. (40-50 N•m) torque.

Repeat the procedure for the right hinge.

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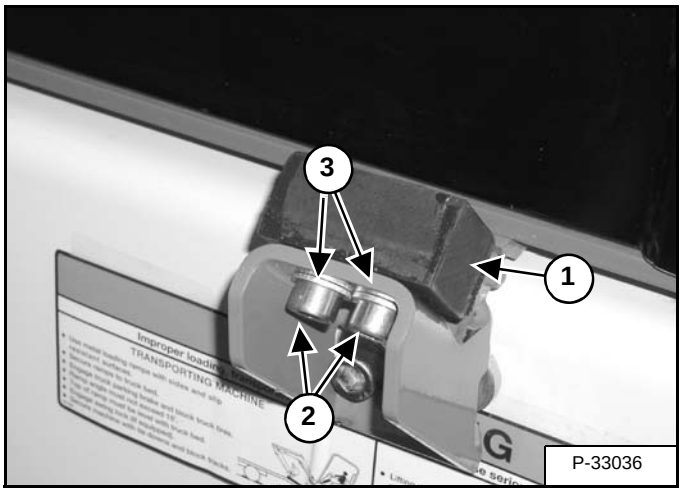
CAB TILT PROCEDURE (CONT'D)

Installing The Cab Tilt Hinges (Cont'd)

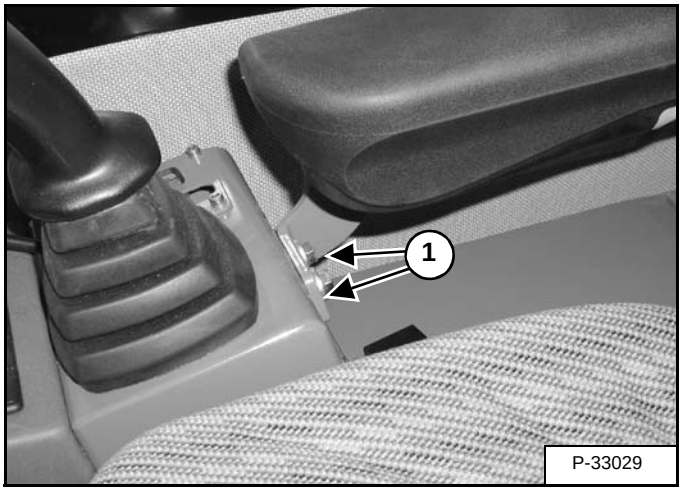
Figure 10-160-5



Install the bumpers (Item 1) on both hinges. Install the two bolts (Item 2) and washers (Item 3) **[Figure 10-160-5]**.

Tilting The Cab

Figure 10-160-6



Remove the two bolts (Item 1) **[Figure 10-160-6]** and washers from the right arm rest. Remove the arm rest.

Figure 10-160-7

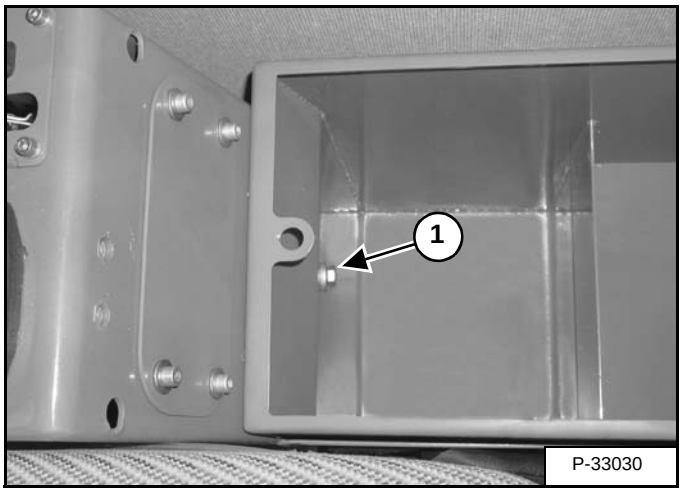
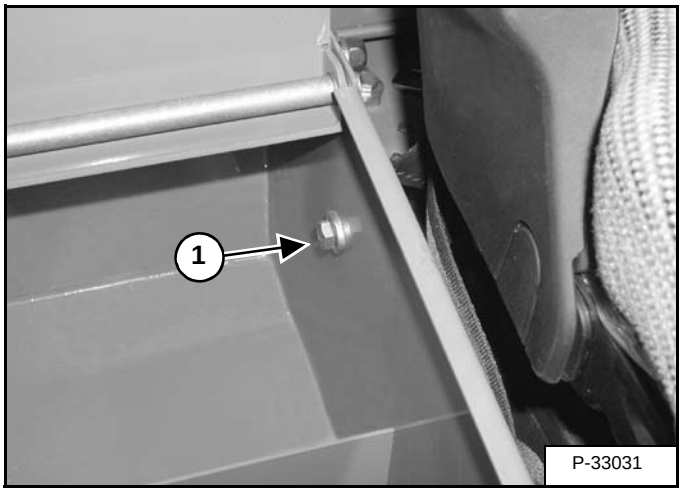


Figure 10-160-8



Remove the two storage compartment bolts (Item 1) **[Figure 10-160-7]** & **[Figure 10-160-8]** and washers. Remove the storage compartment. (If equipped)

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Tilting The Cab (Cont'd)

Figure 10-160-9

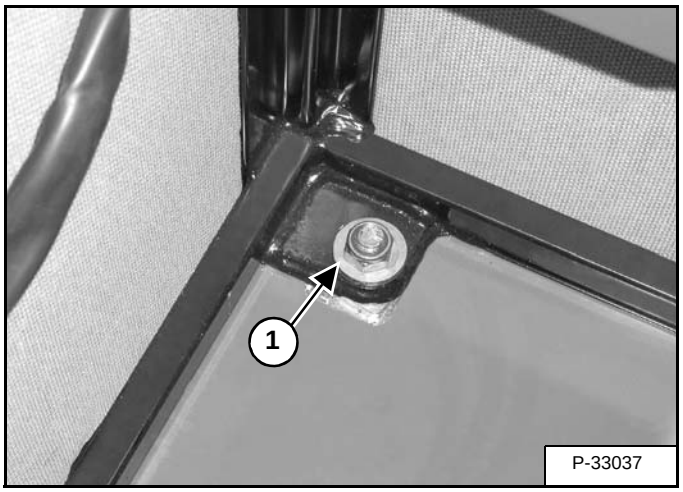
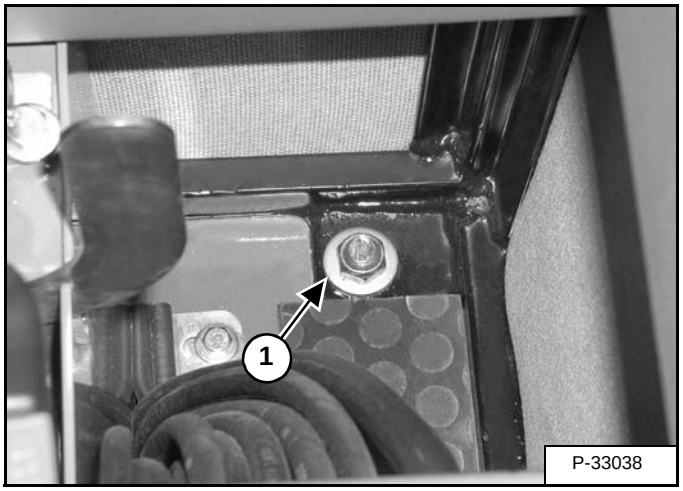


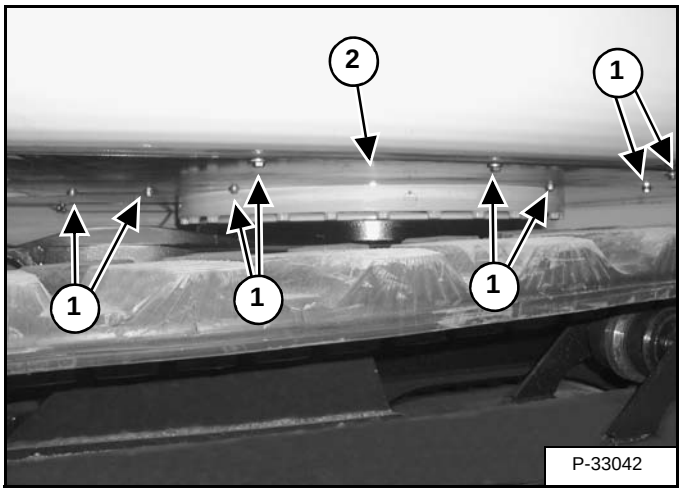
Figure 10-160-10



Remove the rear cab mount nuts (Item 1) **[Figure 10-160-9]** & **[Figure 10-160-10]** and washers.

Installation: Tighten the nuts to 81-92 ft.-lb. (110-125 N•m) torque.

Figure 10-160-11



Remove the 11 bolts (Item 1) and washers. Remove the bottom cover (Item 2) **[Figure 10-160-11]**

Installation: Tighten the bolts to 18-19 ft.-lb. (110-125 N•m) torque.

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Tilting The Cab (Cont'd)

Early Models

Figure 10-160-12

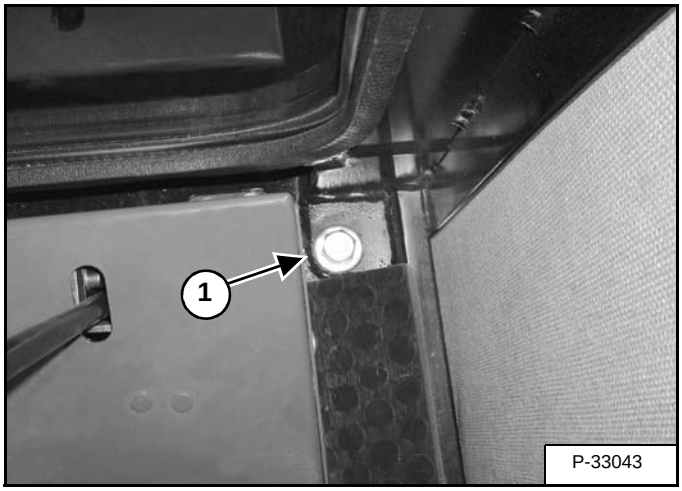
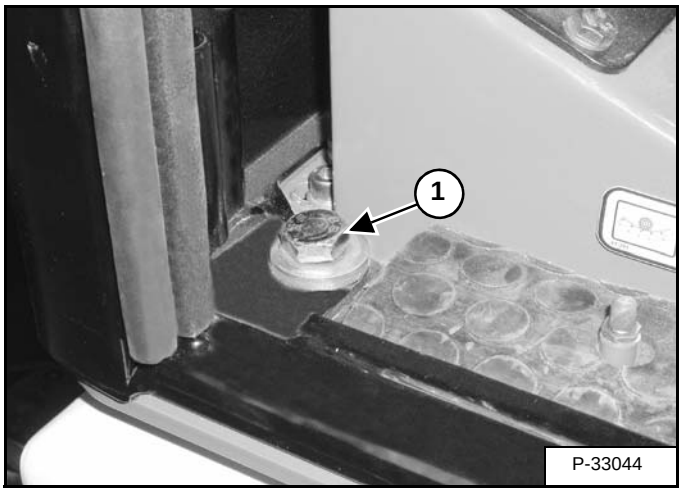


Figure 10-160-13



Remove the front cab mount bolts (Item 1) **[Figure 10-160-12]** & **[Figure 10-160-13]** washers and nuts.

Installation: Tighten the bolts to 81-92 ft.-lb. (110-125 N•m) torque.

Later Models

Figure 10-160-14

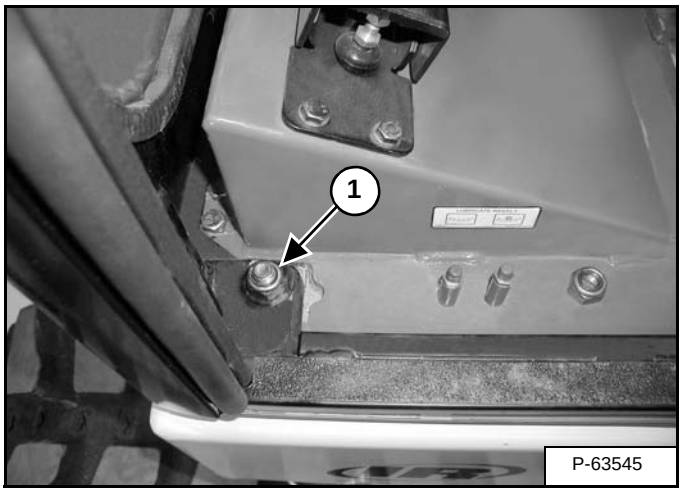
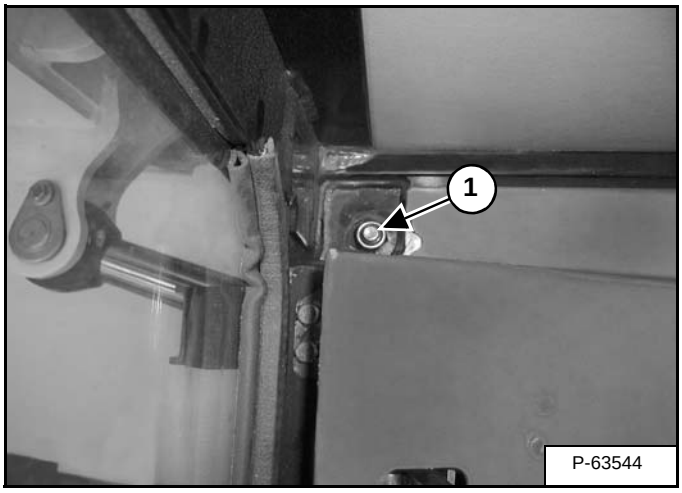


Figure 10-160-15



Remove the nuts (Item 1) **[Figure 10-160-14]** & **[Figure 10-160-15]** and washers.

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Tilting The Cab (Cont'd)

Later Models (Cont'd)

Figure 10-160-16

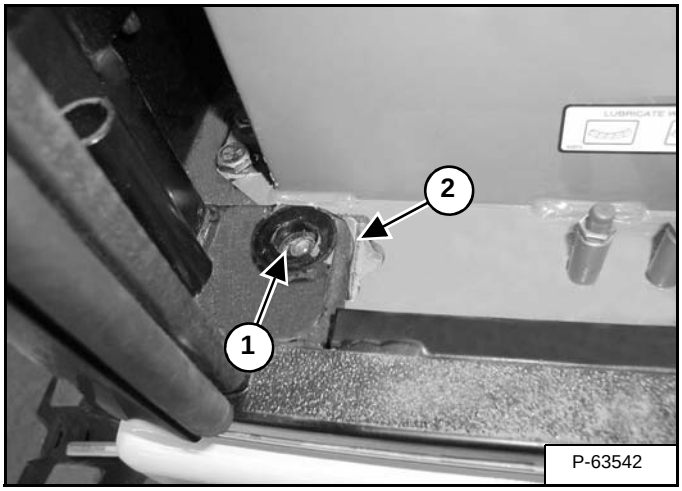
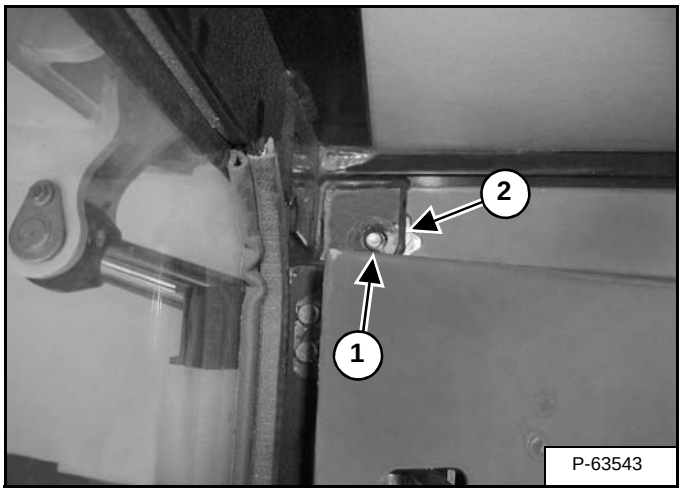


Figure 10-160-17



Turn the bolts (Item 1) down flush with the plate (Item 2) **[Figure 10-160-16]** & **[Figure 10-160-17]**.

All Models

Figure 10-160-18

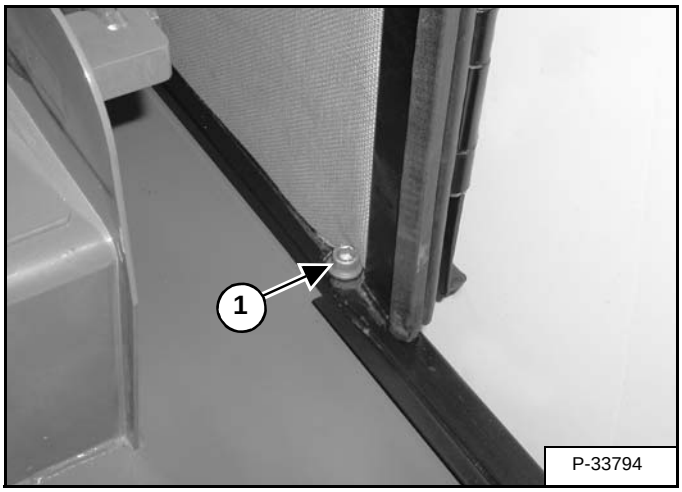
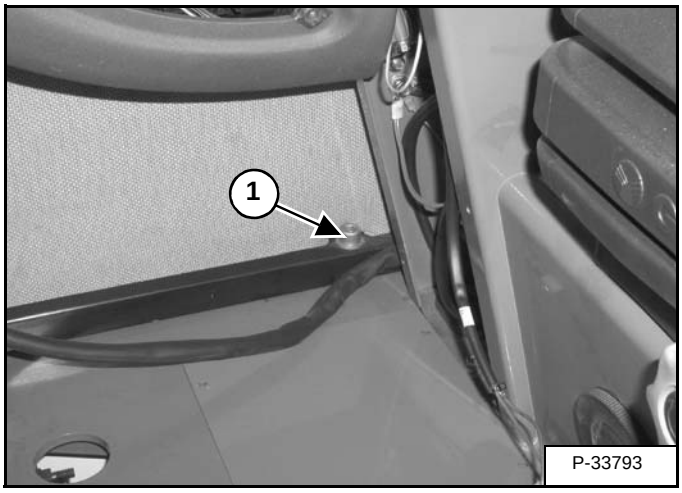


Figure 10-160-19



Do **NOT** remove the side bolts (Item 1) **[Figure 10-160-18]** & **[Figure 10-160-19]**.

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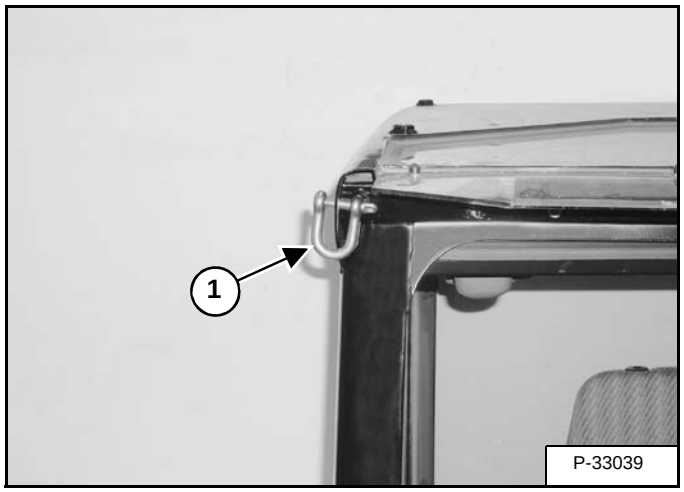
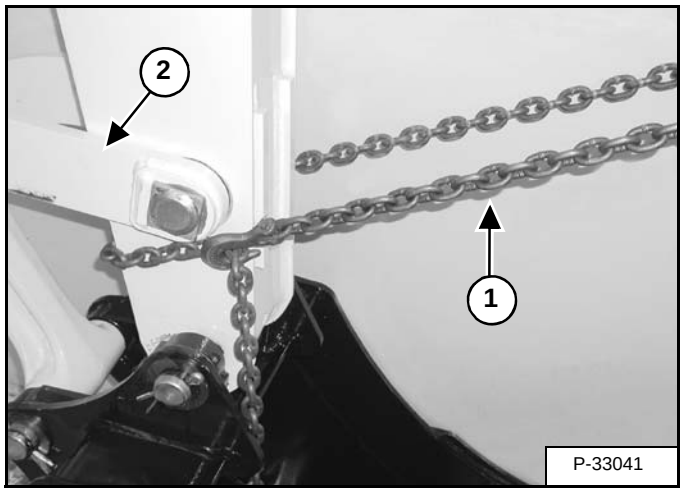
Tilting The Cab (Cont'd)

Figure 10-160-20



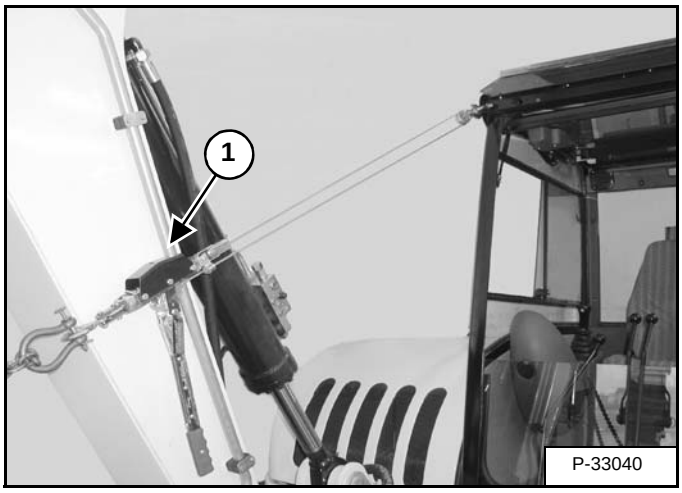
Install the clevis (Item 1) **[Figure 10-160-20]** on the right (as viewed from the operator's seat) corner of the cab.

Figure 10-160-21



Install a chain (Item 1) around the arm between the bucket and the bucket link (Item 2) **[Figure 10-160-21]**.

Figure 10-160-22



Install a winch (Item 1) **[Figure 10-160-22]** to the clevis on the cab. Install the other end of the winch to the chain that was installed on the arm.

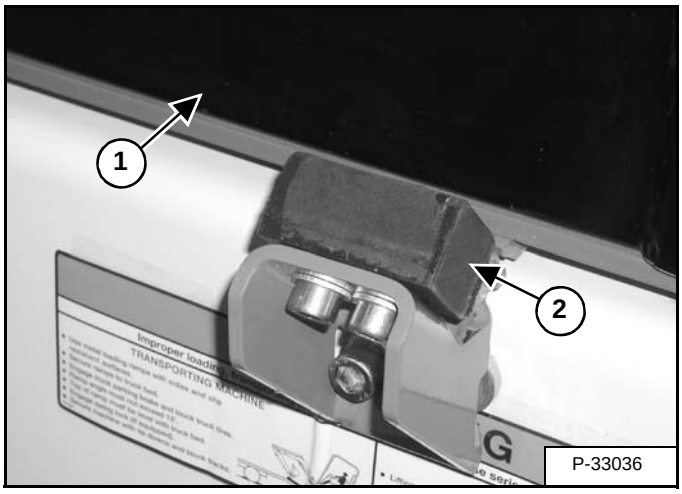
IMPORTANT

When tilting the cab, use winches and chains that are in good condition and of proper weight ratings.

I-2215-0502

Lower the left console and close the cab door.

Figure 10-160-23



Winch the cab forward until the front of the cab (Item 1) contacts the bumpers (Item 2) **[Figure 10-160-23]**.

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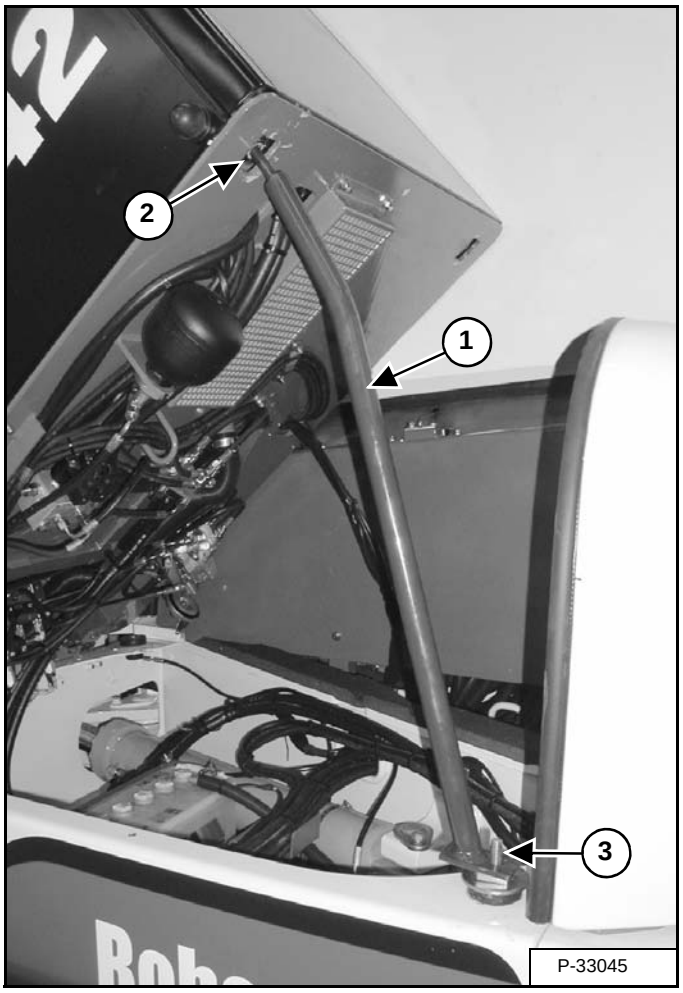
Tilting The Cab (Cont'd)

Figure 10-160-24



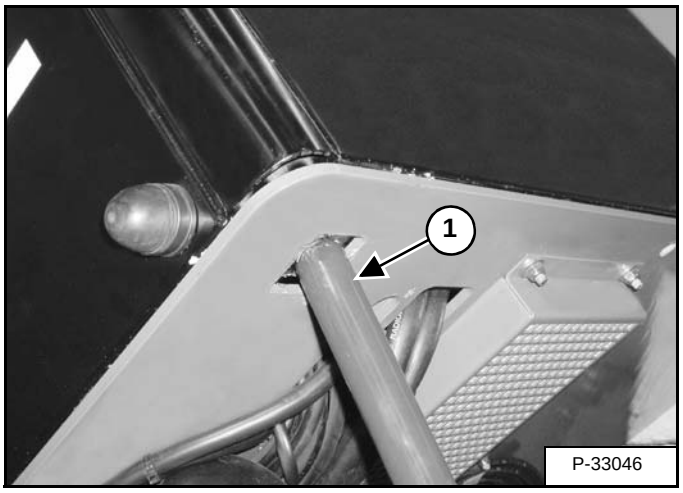
Install an approved cab support device (Item 1) through the cab mount hole (Item 2) and over the rear cab mount stud (Item 3) **[Figure 10-160-24]**.

⚠ WARNING

Avoid injury or death. Never work under the excavator cab without installing an approved cab support device.

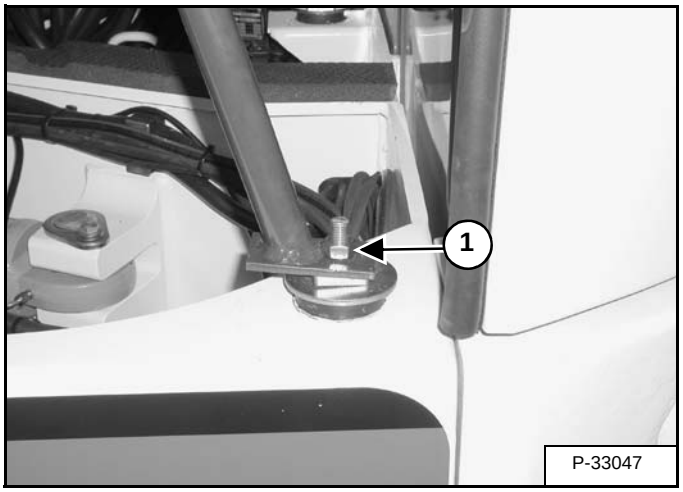
W-2435-0502

Figure 10-160-25



Reverse the direction of the winch and lower the cab until the approved cab support device (Item 1) **[Figure 10-160-25]** fully engages the cab mount hole and the weight of the cab is resting on the support device.

Figure 10-160-26



Install the nut (Item 1) **[Figure 10-160-26]** on the cab mount stud.

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HYDRAULIC SYSTEM

ACCUMULATOR (S/N 522311001 & ABOVE) 20-60-1
Description 20-60-1
Removal And Installation 20-60-1

ACCUMULATOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 20-61-1
Description 20-61-1
Removal And Installation 20-61-1

ARM CYLINDER 20-21-1
Assembly 20-21-11
Disassembly 20-21-6
Parts Identification 20-21-5
Removal And Installation 20-21-1
Testing 20-21-1

AUXILIARY HYDRAULIC FLOW CONTROL/HYDRAULIC BREAKER APPLICATION VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 20-171-1
Disassembly And Assembly 20-171-3
Parts Identification 20-171-2
Removal And Installation 20-171-1

AUXILIARY HYDRAULIC FLOW CONTROL VALVE (S/N 522311001 & ABOVE) 20-170-1
Disassembly And Assembly 20-170-3
Parts Identification 20-170-2
Removal And Installation 20-170-1

AUXILIARY HYDRAULICS SELECTOR VALVE 20-220-1
Removal And Installation 20-220-1

BLADE CYLINDER 20-24-1
Assembly 20-24-10
Disassembly 20-24-5
Parts Identification 20-24-4
Removal And Installation 20-24-2
Testing 20-24-1

BLADE FLOAT VALVE 20-181-1
Disassembly And Assembly 20-181-3
Parts Identification 20-181-2
Removal And Installation 20-181-1

Continued On Next Page

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BLADE VALVE. 20-180-1
Disassembly And Assembly. 20-180-3
Parts Identification 20-180-2
Removal And Installation 20-180-1

BOOM CYLINDER 20-20-1
Assembly 20-20-13
Disassembly. 20-20-8
Parts Identification 20-20-7
Removal And Installation 20-20-3
Testing 20-20-1

BOOM OFFSET VALVE 20-190-1
Disassembly And Assembly. 20-190-3
Parts Identification 20-190-2
Removal And Installation 20-190-1

BOOM OFFSET CYLINDER 20-22-1
Assembly 20-22-13
Disassembly. 20-22-9
Parts Identification 20-22-8
Removal And Installation 20-22-4
Testing 20-22-1

BOOM LOAD HOLDING VALVE 20-200-1
Assembly 20-200-10
Disassembly. 20-200-3
Disassembly. 20-200-3
Removal And Installation 20-200-1

BUCKET CYLINDER. 20-23-1
Assembly 20-23-10
Disassembly. 20-23-6
Parts Identification 20-23-5
Removal And Installation 20-23-1
Testing 20-23-1

Continued On Next Page

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DUMP VALVE 20-34-1
Adjustment 20-34-1
Description 20-34-1
Disassembly And Assembly 20-34-4
Parts Identification 20-34-3
Removal And Installation 20-34-2
Testing 20-34-1

HYDRAULIC BREAKER APPLICATION VALVE (S/N 522311001 & ABOVE) 20-160-1
Disassembly And Assembly 20-160-3
Parts Identification 20-160-2
Removal And Installation 20-160-1

HYDRAULIC FILTER MOUNT 20-120-1
Removal And Installation 20-120-1

HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) 20-51-1
Assembly 20-51-12
Disassembly 20-51-3
Parts Identification 20-51-2
Removal And Installation 20-51-1

HYDRAULIC GEAR PUMP (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 20-53-1
Assembly 20-53-7
Disassembly 20-53-4
Parts Identification 20-53-3
Removal And Installation 20-53-1

HYDRAULIC PISTON PUMP (S/N 522311001 & ABOVE) 20-50-1
Assembly 20-50-48
Coupler Removal And Installation 20-50-18
Disassembly 20-50-39
Hydraulic Pump Work Sheet 20-50-1
Initial Torque Limiter Valve Setting 20-50-29
Parts Identification 20-50-38
Pump Control Disassembly And Assembly 20-50-33
Pump Control Parts Identification 20-50-31
Pump Control Removal And Installation 20-50-32
Pump Testing 20-50-6
Removal And Installation 20-50-15
Testing Information 20-50-4
Torque Limiter Valve Assembly 20-50-25
Torque Limiter Valve Disassembly 20-50-21
Torque Limiter Valve Parts Identification 20-50-19
Torque Limiter Valve Removal and Installation 20-50-20

Continued On Next Page

https://www.pdfmanual4trucks.com/

HYDRAULIC SYSTEM (CONT'D)

HYDRAULIC PISTON PUMP (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE). 20-52-1
- Assembly 20-52-45
- Coupler Removal And Installation 20-52-15
- Disassembly. 20-52-36
- Hydraulic Pump Work Sheet 20-52-1
- Initial Torque Limiter Valve Setting. 20-52-26
- Parts Identification 20-52-35
- Pump Control Disassembly And Assembly 20-52-30
- Pump Control Parts Identification 20-52-28
- Pump Control Removal And Installation 20-52-29
- Pump Testing 20-52-5
- Removal And Installation 20-52-13
- Testing Information. 20-52-4
- Torque Limiter Valve Assembly 20-52-22
- Torque Limiter Valve Disassembly 20-52-18
- Torque Limiter Valve Parts Identification 20-52-16
- Torque Limiter Valve Removal and Installation 20-52-17

HYDRAULIC PISTON PUMP DRIVE COUPLER 20-230-1
- Removal And Installation 20-230-1

HYDRAULIC RESERVOIR 20-130-1
- Removal And Installation 20-130-1

HYDRAULIC SYSTEM INFORMATION 20-10-1
- Description. 20-10-6
- Troubleshooting Chart 20-10-1

JOYSTICK CONTROL PATTERN SELECTOR VALVE. 20-100-1
- Disassembly And Assembly. 20-100-3
- Parts Identification 20-100-2
- Removal And Installation 20-100-1

JOYSTICK LOCKOUT/TWO SPEED VALVE (S/N 522311001 & ABOVE) 20-101-1
- Disassembly And Assembly. 20-101-3
- Parts Identification 20-101-2
- Removal And Installation 20-101-1

JOYSTICK LOCKOUT/TWO SPEED VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 20-102-1
- Disassembly And Assembly. 20-102-4
- Parts Identification 20-102-3
- Removal And Installation 20-102-1

Continued On Next Page

https://www.pdfmanual4trucks.com/

LEFT CONTROL LEVER (JOYSTICK) 20-111-1
Disassembly and Assembly 20-111-6
Handle Removal And Installation 20-111-2
Parts Identification 20-111-5
Removal And Installation 20-111-3
Testing 20-111-1

OIL COOLER 20-140-1
Description 20-140-1

OIL TEMPERATURE REGULATOR 20-210-1
Description 20-210-1
Removal And Installation 20-210-1

PORT RELIEF VALVES 20-31-1
Adjustment Procedure 20-31-1

PRESSURE REDUCING VALVE (S/N 522311001 & ABOVE) . . 20-33-1
Adjustment 20-33-2
Description 20-33-1
Testing 20-33-1

PRESSURE REDUCING VALVE (S/N 528911001 & ABOVE AND 528611001 & ABOVE) 20-32-1
Adjustment 20-32-2
Description 20-32-1
Testing 20-32-1

RELIEF VALVES 20-30-1
Adjusting The Three Spool Control Valve Main Relief Valve . 20-30-2
Description 20-30-1
Testing The Three Spool Control Valve Main Relief Valve . . . 20-30-2

RIGHT CONTROL LEVER (JOYSTICK) 20-110-1
Disassembly And Assembly 20-110-6
Handle Removal And Installation 20-110-2
Parts Identification 20-110-5
Removal And Installation 20-110-3
Testing 20-110-1

SECONDARY FRONT AUXILIARY VALVE 20-150-1
Disassembly And Assembly 20-150-3
Parts Identification 20-150-2
Removal And Installation 20-150-1

Continued On Next Page

https://www.pdfmanual4trucks.com/

SIX SPOOL HYDRAULIC CONTROL VALVE 20-40-1
Boom, Arm, Bucket And Auxiliary Valve Section Disassembly And Assembly 20-40-12
Control Valve Identification 20-40-5
Disassembly And Assembly 20-40-6
Inlet Valve Section Disassembly And Assembly 20-40-17
Left Travel And Right Travel Valve Section Disassembly And Assembly . 20-40-9
Removal And Installation 20-40-1

SWING BRAKE RELEASE VALVE 20-93-1
Disassembly And Assembly 20-93-3
Parts Identification 20-93-2
Removal And Installation 20-93-1

SWING BRAKE VALVE 20-92-1
Disassembly And Assembly 20-92-3
Parts Identification 20-92-2
Removal And Installation 20-92-1

SWING MOTOR 20-90-1
Assembly 20-90-10
Disassembly 20-90-4
Parts Identification 20-90-3
Removal And Installation 20-90-1

SWING MOTOR DRIVE CARRIER 20-91-1
Assembly 20-91-13
Disassembly 20-91-4
Parts Identification 20-91-3
Removal And Installation 20-91-1

SWIVEL JOINT 20-80-1
Disassembly And Assembly 20-80-4
Parts Identification 20-80-3
Removal And Installation 20-80-1

Continued On Next Page

https://www.pdfmanual4trucks.com/

THREE SPOOL HYDRAULIC CONTROL VALVE 20-41-1
Boom Offset And Blade Valve Section Disassembly And Assembly 20-41-6
Disassembly And Assembly. 20-41-4
Inlet/Upperstructure Swing Valve Section Disassembly And Assembly 20-41-10
Parts Identification 20-41-3
Removal And Installation 20-41-1

TRAVEL LEVER/FOOT PEDAL VALVE 20-112-1
Disassembly And Assembly. 20-112-5
Left Travel Lever/Foot Pedal Valve Removal And Installation .20-112-1
Right Travel Lever/Foot Pedal Valve Removal And Installation. . 20-112-2
Parts Identification 20-112-4

TRAVEL MOTOR 20-70-1
Assembly 20-70-20
Disassembly. 20-70-3
Parts Identification 20-70-2
Removal And Installation 20-70-1

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HYDRAULIC/HYDROSTATIC SCHEMATIC
442 EXCAVATOR
(S/N 522311001 AND ABOVE)

(PRINTED APRIL 2005)
MS1422legend

LEGEND

1. BACK-UP RELIEF VALVE
   4350 PSI (300 Bar)
2. LOAD SENSE RELIEF VALVE
   4060 PSI (280 Bar)
3. PORT RELIEF VALVE - Boom Cyl.
   (Rod End) 4350 PSI (300 Bar)
4. PORT RELIEF VALVE - Boom Cyl.
   (Base End) 2610 PSI (180 Bar)
5. PORT RELIEF VALVE - Arm Cyl.
   (Rod End) 4350 PSI (300 Bar)
6. PORT RELIEF VALVE - Arm Cyl.
   (Base End) 4350 PSI (300 Bar)
7. PORT RELIEF VALVE - Bucket Cyl.
   (Rod End) 4350 PSI (300 Bar)
8. PORT RELIEF VALVE - Bucket Cyl.
   (Base End) 4350 PSI (300 Bar)
9. PORT RELIEF VALVE - Auxiliary
   4350 PSI (300 Bar)

   NOTE: With clamp installed - Reset port relief valve to 3625 PSI (250 Bar)
10. PORT RELIEF VALVE - Auxiliary
    4350 PSI (300 Bar)
11. LOAD SENSE BLEED CARTRIDGE
12. MAIN RELIEF VALVE (Gear Pump)
    3335 PSI (230 Bar)
13. PILOTED OPERATED TWO POSITION VALVE
14. CHECK VALVE
15. ORIFICE
16. PORT RELIEF VALVE
    5075 PSI (350 Bar)
17. CROSS PORT RELIEF VALVE - 2 STAGE
    1450 PSI (100 Bar) / 3625 PSI (250 Bar)
18. ANTI-CAVITATION VALVE
19. ORIFICE 0.06 inch (1,5 mm)
20. ORIFICE - One Way Restrictor
    0.0023 inch (0,6 mm)
21. PRESSURE REDUCING VALVE
    508 PSI (35 Bar)
22. ACCUMULATOR 145 PSI (10 Bar)
23. DUMP VALVE - PUMP 2
    1595 PSI (110 Bar)
24. HYDRAULIC PISTON PUMP
    Minimum Displacement
    0.0 GPM (0.0 L/min) @ 2000 RPM
    Maximum Displacement
    37.5 GPM (142 L/min) @ 2000 RPM
25. Torque Limitor
26. PUMP MARGIN SPOOL
    365 PSI (25 Bar)
27. TORQUE LIMITER SUPPLY SPOOL
    290 PSI (20 Bar)
28. OIL TEMPERATURE REGULATOR
    131 degrees F. (55 degrees C.)
29. OIL COOLER
30. HYDRAULIC PUMP # 1 Gear Type
    8.7 GPM (33 L/min.) at 2000 Engine RPM
31. HYDRAULIC PUMP # 2 Gear Type
    8.7 GPM (33 L/min.) at 2000 Engine RPM
32. RETURN BLOCK With Check Valve
    72.5 PSI (5 Bar)
33. MAIN FILTER
34. PRESSURIZED BREATHER / FILL CAP
    5 PSI (0,34 Bar)
35. HYDRAULIC RESERVOIR - PRESSURIZED
    Reservoir Volume 29 gal (110 L)
    System Volume 37 gal (140 L)
36. COMPENSATOR - Standard
    (Boom, Arm, Bucket, Auxiliary, Left Travel and Right Travel)
37. CROSS PORT RELIEF VALVE -
    Travel Motor 4060 PSI (280 Bar)
38. COUNTERBALANCE SPOOL (Travel Motor)
39. TWO SPEED SHIFT SPOOL
40. SHUTTLE VALVE - DRIVE PRESSURE
41. BRAKE CONTROL SPOOL
42. SELECTOR VALVE - MANUAL
    (Bucket Cylinder or Secondary Auxiliaries)
43. CHECK VALVE - Accumulator
44. LOAD CHECK VALVE - Boom Swing
    334 PSI (23 Bar)
45. ISO/STANDARD VALVE
46. CHECK VALVE

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

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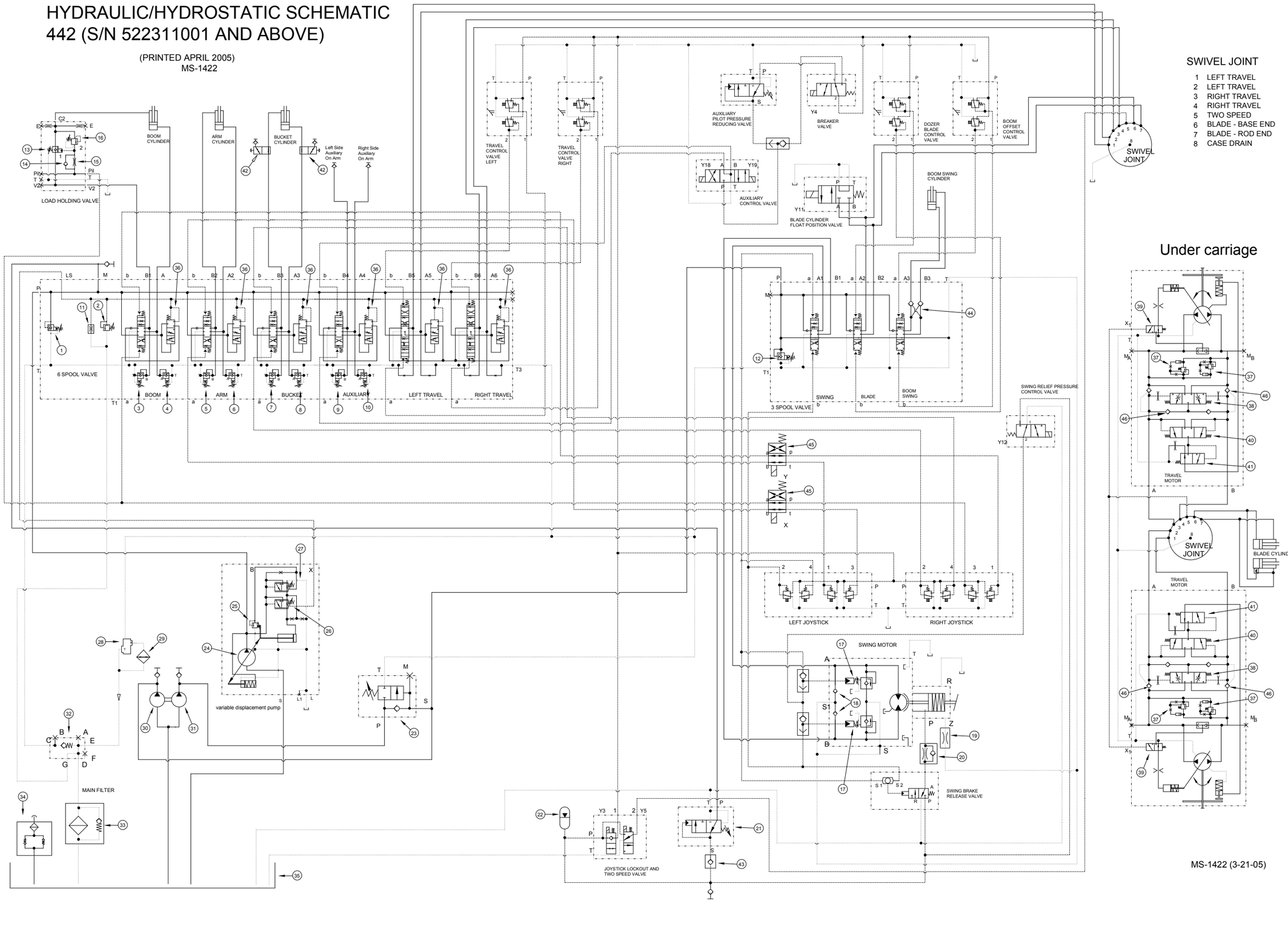
HYDRAULIC/HYDROSTATIC SCHEMATIC
442 (S/N 522311001 AND ABOVE)

(PRINTED APRIL 2005)
MS-1422

SWIVEL JOINT

1 LEFT TRAVEL
2 LEFT TRAVEL
3 RIGHT TRAVEL
4 RIGHT TRAVEL
5 TWO SPEED
6 BLADE - BASE END
7 BLADE - ROD END
8 CASE DRAIN



Under carriage

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HYDRAULIC/HYDROSTATIC SCHEMATIC
442 EXCAVATOR
(S/N 528611001 AND ABOVE)
(S/N 528911001 AND ABOVE)

(PRINTED NOVEMBER 2007)
V-0621legend

LEGEND

(1) BACK-UP RELIEF VALVE
4350 PSI (300 bar)

(2) LOAD SENSE RELIEF VALVE
4060 PSI (280 bar)

(3) PORT RELIEF VALVE - Boom Cyl.
(Rod End) 4350 PSI (300 bar)

(4) PORT RELIEF VALVE - Boom Cyl.
(Base End) 2610 PSI (180 bar)

(5) PORT RELIEF VALVE - Arm Cyl.
(Rod End) 4350 PSI (300 bar)

(6) PORT RELIEF VALVE - Arm Cyl.
(Base End) 4350 PSI (300 bar)

(7) PORT RELIEF VALVE - Bucket Cyl.
(Rod End) 4350 PSI (300 bar)

(8) PORT RELIEF VALVE - Bucket Cyl.
(Base End) 4350 PSI (300 bar)

(9) PORT RELIEF VALVE - Auxiliary
4350 PSI (300 bar)

NOTE: With clamp installed - Reset port relief valve to 3625 PSI (250 bar)

(10) PORT RELIEF VALVE - Auxiliary
4350 PSI (300 bar)

(11) LOAD SENSE BLEED CARTRIDGE

(12) MAIN RELIEF VALVE (Gear Pump)
3335 PSI (230 bar)

(13) PILOTED OPERATED TWO POSITION VALVE (2)

(14) CHECK VALVE (2)

(15) ORIFICE (2)

(16) PORT RELIEF VALVE (2):
5075 PSI (350 bar)

(17) CROSS PORT RELIEF VALVE - 2 STAGE
1450 PSI (100 bar) / 3625 PSI (250 bar)

(18) ANTI-CAVITATION VALVE

(19) ORIFICE 0.003 inch (0,8 mm)

(20) ORIFICE - One Way Restrictor
0.0023 inch (0,6 mm)

(21) PRESSURE REDUCING VALVE
508 PSI (35 bar)

(22) ACCUMULATOR 145 PSI (10 bar)

(23) CHECK VALVE

(24) HYDRAULIC PISTON PUMP
Minimum Displacement
0.0 GPM (0.0 L/min) @ 2200 RPM
Maximum Displacement
41.2 GPM (156 L/min) @ 2200 RPM

(25) TORQUE LIMITOR

(26) PUMP MARGIN SPOOL
365 PSI (25 bar)

(27) TORQUE LIMITER SUPPLY SPOOL
290 PSI (20 bar)

(28) OIL COOLER BY-PASS VALVE
43.5 PSI (3 bar)

(29) OIL COOLER

(30) HYDRAULIC PUMP Gear Type
17.9 GPM (68 L/min.) at 2200 Engine RPM

(31) CONSOLE/JOYSTICK SHUT-OFF SOLENOID VALVE

(32) TWO SPEED SOLENOID VALVE

(33) MAIN FILTER
With 43.5 PSI (3 bar) Filter By-Pass Valve

(34) PRESSURIZED BREATHER / FILL CAP
5 PSI (0,34 bar)

(35) HYDRAULIC RESERVOIR - PRESSURIZED
Reservoir Volume 29 gal (110 L)
System Volume 37 gal (140 L)

(36) COMPENSATOR - Standard
(Boom, Arm, Bucket, Auxiliary, Left Travel and Right Travel)

(37) CROSS PORT RELIEF VALVE -
Travel Motor 4060 PSI (280 bar)

(38) COUNTERBALANCE SPOOL (Travel Motor)

(39) TWO SPEED SHIFT SPOOL

(40) SHUTTLE VALVE - DRIVE PRESSURE

(41) BRAKE CONTROL SPOOL

(42) SELECTOR VALVE - MANUAL
(Bucket Cylinder or Secondary Auxiliaries)

(43) CHECK VALVE (8)

(44) LOAD CHECK VALVE - Boom Swing
334 PSI (23 bar)

(45) ISO/STANDARD VALVE

(46) SLEW BRAKE SOLENOID VALVE

(47) CHECK VALVE
43.5 PSI (3 bar)

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

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HYDRAULIC/HYDROSTATIC SCHEMATIC
442 (S/N 528611001 AND ABOVE)
(S/N 528911001 AND ABOVE)

(PRINTED NOVEMBER 2007)
V-0621

LOAD HOLDING VALVE
LOAD HOLDING VALVE
AUX. COUPLER, DIRECT TO TANK
LEFT SIDE AUX. ON ARM
RIGHT SIDE AUX. ON ARM
TRAVEL CONTROL VALVE LEFT
TRAVEL CONTROL VALVE RIGHT
BREAKER VALVE
DOZER BLADE CONTROL VALVE
BOOM OFFSET CONTROL VALVE
SWIVEL JOINT (TOP PORTS)
DDF
SWIVEL JOINT
1. LEFT TRAVEL
2. LEFT TRAVEL
3. RIGHT TRAVEL
4. RIGHT TRAVEL
5. TWO SPEED
6. BLADE - BASE END
7. BLADE - ROD END
8. CASE DRAIN
BOOM CYLINDER
ARM CYLINDER
BUCKET CYLINDER
BLADE CYLINDER FLOAT POSITION VALVE
BOOM OFFSET CYLINDER
TRAVEL MOTOR
6 SPOOL VALVE
BOOM
ARM
BUCKET
AUX.
LEFT TRAVEL
RIGHT TRAVEL
SWING
BLADE
BOOM OFFSET.
AUXILIARY CONTROL VALVE
LEFT JOYSTICK
RIGHT JOYSTICK
SWING MOTOR
SWING BRAKE RELEASE VALVE
MAIN FILTER
VARIABLE DISPLACEMENT PUMP
ACCUMULATOR
SBO
DDF
SWIVEL JOINT (BOTTOM PORTS)
BLADE CYLINDERS
TRAVEL MOTOR

V-0621 (10-15-07)

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Troubleshooting Chart

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.	Repair or replace.
	Pump pressure too low.	Readjust or replace.
Hydraulic power insufficient to one or more circuits.	Pump pressure setting incorrect.	Readjust or replace.
All hydraulic speed too slow.	Torque limiter supply spool set too low.	Readjust.
	Hydraulic oil level or viscosity incorrect.	Fill to correct level. Use correct viscosity oil.
	Pump margin too low.	Test and adjust.
	Engine RPM reduced.	Readjust or replace.
	Torque limiter set too low/high.	Test and adjust.
	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.	Fill to correct level.
	Non recommended hydraulic oil.	Replace.
	Auxiliary in detent mode.	Use proper operating procedures.
	One or more port relief valves not set correctly.	Readjust or replace.
	Extreme operating conditions. High ambient temperature. (IE: Enclosed structure).	
	Fan belt loose.	Tighten fan belt.
	Piston pump margin too high.	
Pump (Piston) response slow.	Pump minimum displacement set too low.	Readjust.

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Troubleshooting Chart (Cont'd)

TROUBLESHOOTING THE CYLINDER CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
Cylinder inoperable.	Pump torque limiter supply spool not shifting.	Repair or replace.
	Control console raised.	Lower control console.
	Loose fittings or broken hoses.	Repair or replace.
	Low PSI at joystick.	Check, repair or replace pressure reducing valve.
	Control console lockout switch.	Readjust or replace.
	Cylinder internal leakage excessive.	Repair or replace.
	Joystick pressure reducing valve defective.	Repair or replace.
	Joystick internal leakage excessive.	Repair or replace.
	Pump margin spool not shifting.	Repair or replace.
	Load sense relief valve set too low.	Repair or replace.
Cylinder force insufficient. .	Lever linkage incorrectly adjusted.	Readjust.
	Pump pressure too low.	Readjust or replace.
	Pump torque limiter too low.	Readjust or replace.
Cylinder speed too slow.	Engine RPM low.	Check RPM or increase engine speed.
	Cylinder internal leakage excessive.	Repair or replace.
	Main relief valve malfunctioning. (Three spool valve)	Readjust or replace.
	Joystick pressure reducing valve defective.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Joystick internal leakage excessive.	Repair or replace.
	Low or dirty fluid.	Add or replace the hydraulic fluid.
	Load sense relief valve malfunctioning. (Six spool valve)	Readjust or replace.
	Pump margin too low.	Repair or replace.
	Pump torque limiter too low.	Readjust or replace.

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Troubleshooting Chart (Cont'd)

TROUBLESHOOTING THE SWING (SLEW) CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
Swing not operating.	Swing brake not releasing.	Repair or replace.
	Lower control console.	Lower control console.
	Control console lockout switch incorrectly adjusted or defective.	Readjust or replace.
	Swing motor gear defective.	Repair or replace.
	Joystick internal leakage excessive.	Repair or replace.
	Swing motor defective.	Repair or replace.
Swing force.	Pump pressure set too low.	Readjust or replace.
	Swing motor relief valve pressure too low.	Readjust or replace.
Swing speed too slow.	Swing brake not releasing.	Repair, replace or adjust.
	Engine RPM low.	Adjust.
	Pump flow low. (Gear pump)	Check, repair or adjust.
	Blocked or restricted line to swing motor.	Replace.
	Joystick internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive. (Three spool valve)	Repair or replace.
	Swing motor internal leakage excessive.	Repair or replace.
Swing over run excessive.	Control valve spool sticking.	Repair or replace.
	Joystick spool sticking.	Repair or replace.
	Swing motor relief valve set too low.	Repair or replace.
	Swing motor internal leakage excessive.	Repair or replace.
Swing motor seal leakage.	Return line filter plugged.	Inspect, clean or replace.
Swing stop/start too harsh.	Sequence valve shifting too early.	Repair, replace or adjust.

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Troubleshooting Chart (Cont'd)

TROUBLESHOOTING THE TRAVEL CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
Travel system inoperable.	Pilot pressure too low.	Repair or readjust.
	Console switch not closed.	Repair or replace.
	Lever linkage incorrectly adjusted.	Readjust.
	Track tension too tight.	Readjust.
	Defective pump. (Piston pump)	Check, repair or replace.
	Travel motor counter balance 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.
	Pump pressure too low.	Readjust.
Travel power.	Track tension too tight.	Readjust.
	Travel motor check valve leaking.	Readjust or replace.
	Pump pressure too low.	Readjust.
	Torque limiter.	Readjust.
	Swivel joint leaking.	Repair or replace.
	Travel motor counterbalance spool sticking.	Repair or replace.
Travel speed too slow.	Engine RPM low.	Readjust.
	Pilot pressure low.	Readjust.
	Pump margin too low.	Readjust.
	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.
Travel motor seal leakage.	Return line filter plugged.	Inspect, clean or replace.

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Troubleshooting Chart (Cont'd)

TROUBLESHOOTING THE TRAVEL CIRCUIT (CONT'D)		
PROBLEM	**CAUSE**	**CORRECTION**
Machine not running straight.	Straight travel orifice plugged.	Repair or replace.
	Lever linkage incorrectly adjusted.	Readjust.
	Track tension not equal.	Readjust.
	Travel motor internal leakage not equal.	Repair or replace.
	Travel motor counter balance spool sticking.	Repair or replace.
	Pump 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.	Valve compensators not equal.	Repair or replace.
	Track motor counterbalance valve leakage excessive.	Repair or replace.
Blade drops while machine is moving.	Cylinder internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive. (Three spool valve)	Repair or replace.
	Swivel joint internal leakage from travel motor pressure circuit into blade cylinder circuit.	Repair or replace.
High/low gear switch inoperative (2-speed).	Control valve defective.	Replace.
	Torque limiter set too low.	Readjust.
	Pump pressure set too low.	Readjust.
	Switch defective.	Replace.
	Faulty pressure reducing valve.	Repair or replace.
	Bad solenoid.	Replace.

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Description

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.

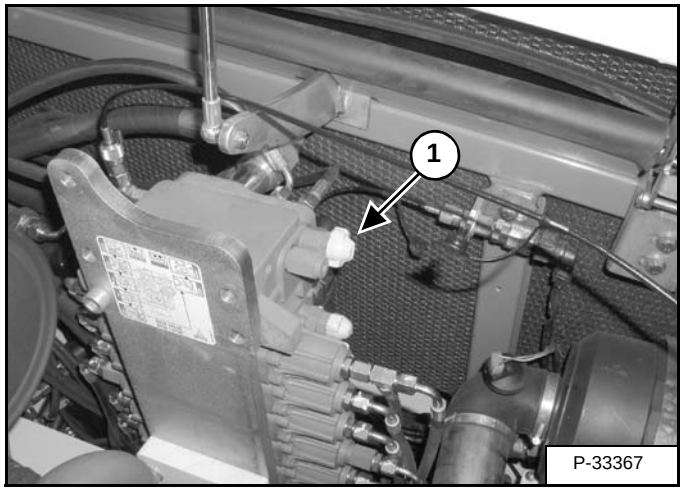
I-2003-0888

The hydraulic system has two separate hydraulic circuits.

The piston pump circuit supplies fluid to the six spool hydraulic control valve.

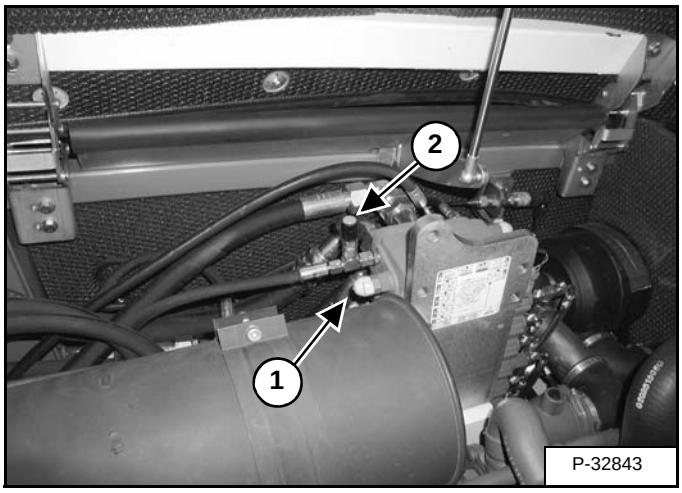
The six spool control valve contains the boom, arm, bucket auxiliary, left and right travel valve sections.

Figure 20-10-1



A load sense relief valve (Item 1) **[Figure 20-10-1]** and safety relief valve (Item 1) **[Figure 20-10-2]** protect the valve from high pressure.

Figure 20-10-2

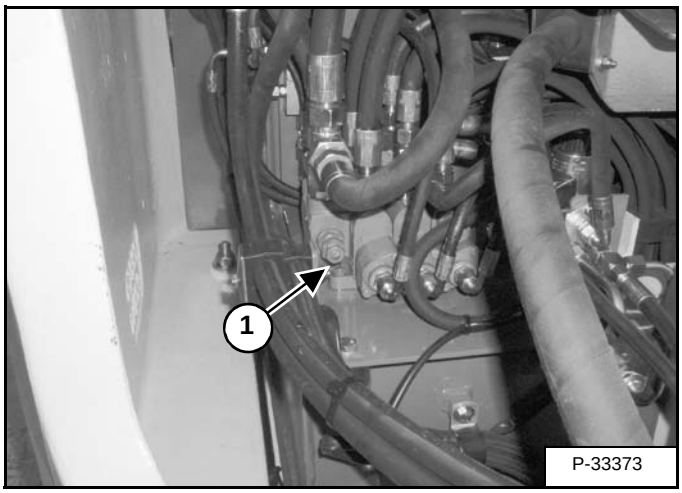


The coupler (Item 2) **[Figure 20-10-2]** is used to check the load sense relief valve, safety relief valve and piston pump torque limiter supply adjustment.

The gear pump circuit supplies fluid to the three spool hydraulic control valve.

The three spool control valve contains the upperstructure swing, blade and boom swing valve sections.

Figure 20-10-3



A main relief valve (Item 1) **[Figure 20-10-3]** protects the valve from high pressure.

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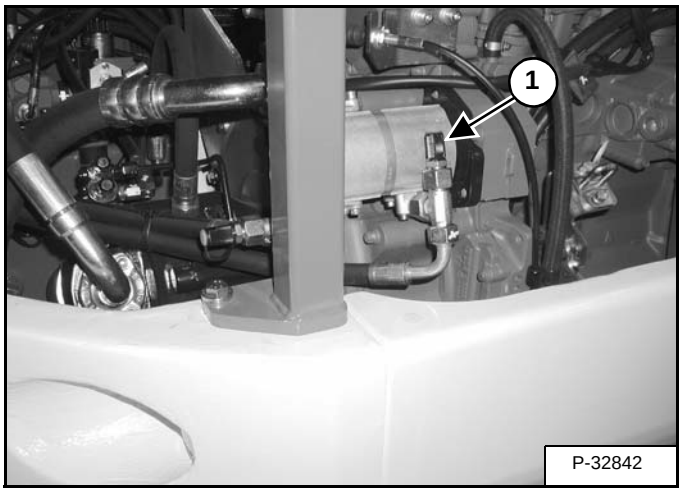
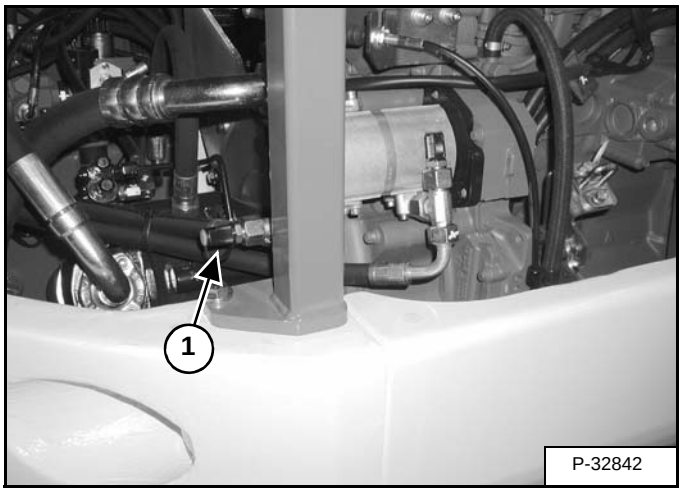
Description (Cont'd)

Figure 20-10-4



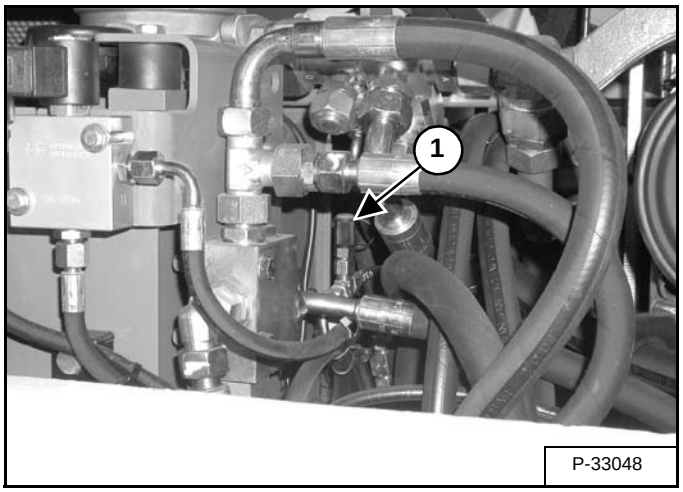
The coupler (Item 1) **[Figure 20-10-4]** is used to check the main relief valve located on the three spool valve.

Figure 20-10-5



The coupler (item 1) **[Figure 20-10-5]** is used to check the pressure cutoff valve.

Figure 20-10-6



The coupler (Item 1) **[Figure 20-10-6]** is used to check the hydraulic controls (joysticks) pilot pressure.

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BOOM CYLINDER

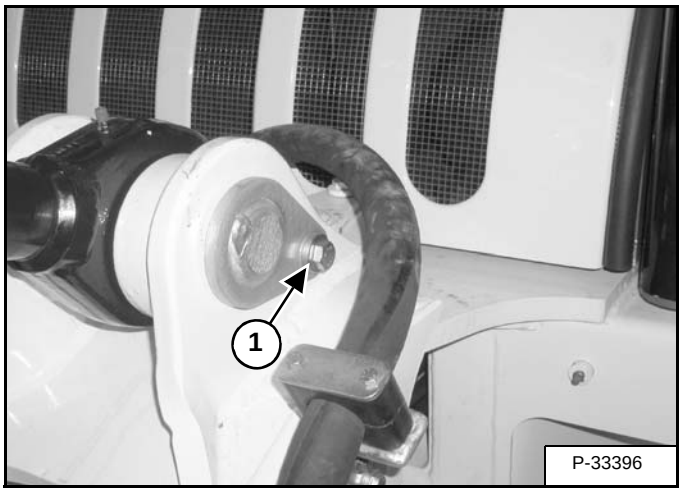
Testing

Fully retract the bucket and arm cylinders.

Lower the boom to the ground.

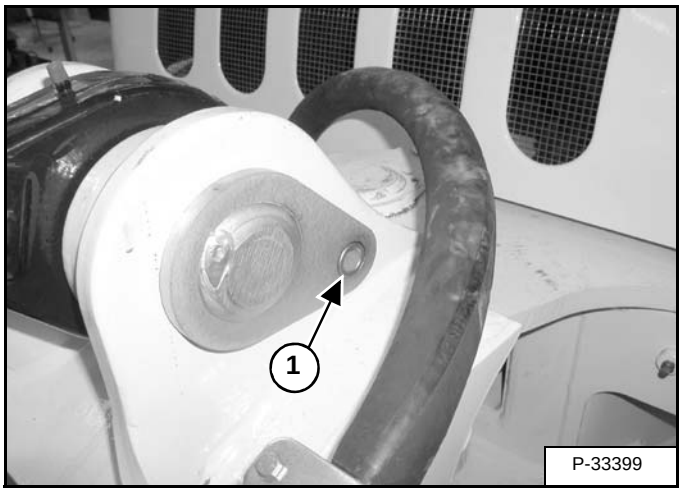
With the engine off and the key in the run position, move the joysticks to relieve hydraulic pressure.

Figure 20-20-1



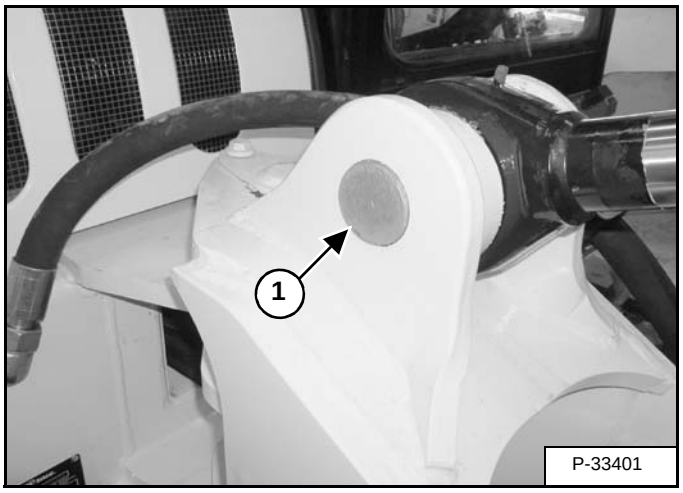
Remove the bolt (Item 1) **[Figure 20-20-1]** from the rod end retaining pin.

Figure 20-20-2



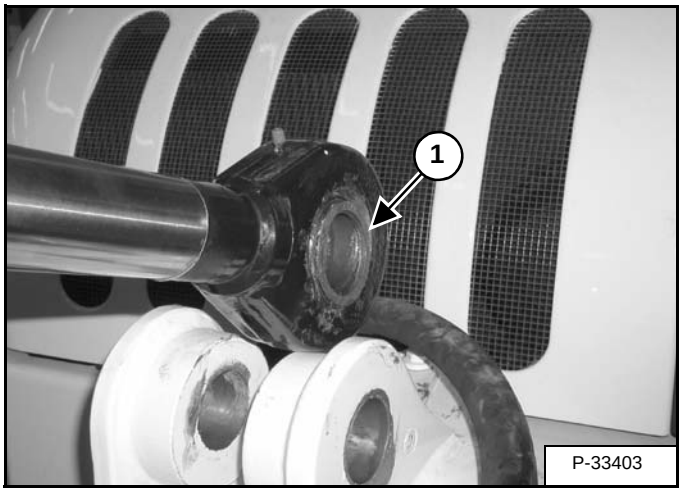
Remove the spacer (Item 1) **[Figure 20-20-2]**.

Figure 20-20-3



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

Figure 20-20-4



Raise the cylinder and remove the shims (Item 1) **[Figure 20-20-4]** from both sides of the rod end.

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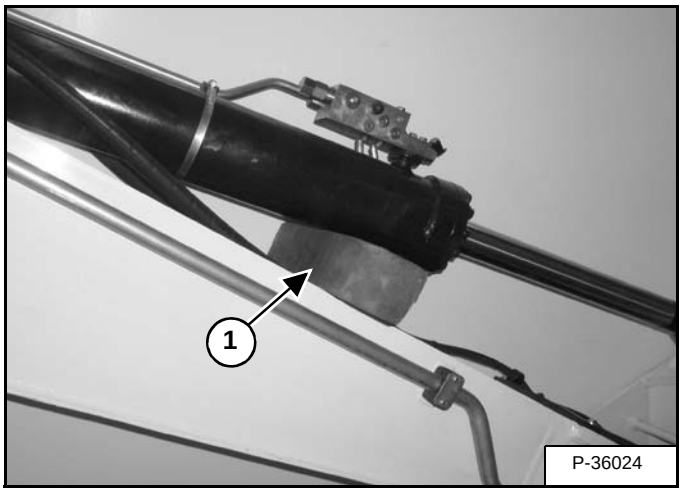
BOOM CYLINDER (CONT'D)

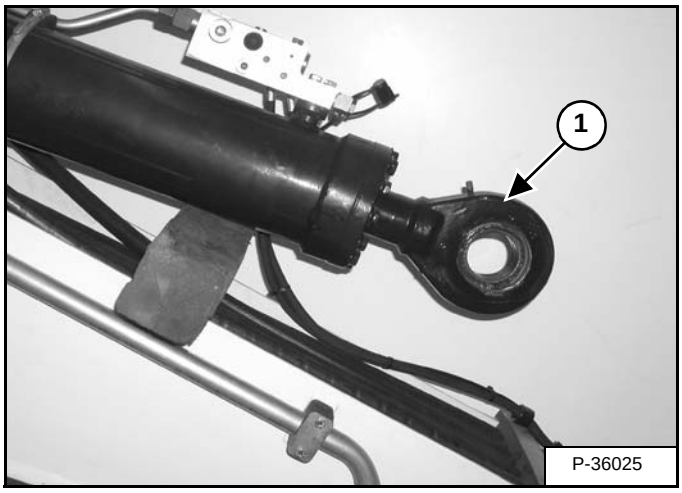
Testing (Cont'd)

Figure 20-20-5



Install a block (Item 1) **[Figure 20-20-5]** under the cylinder housing.

Figure 20-20-6

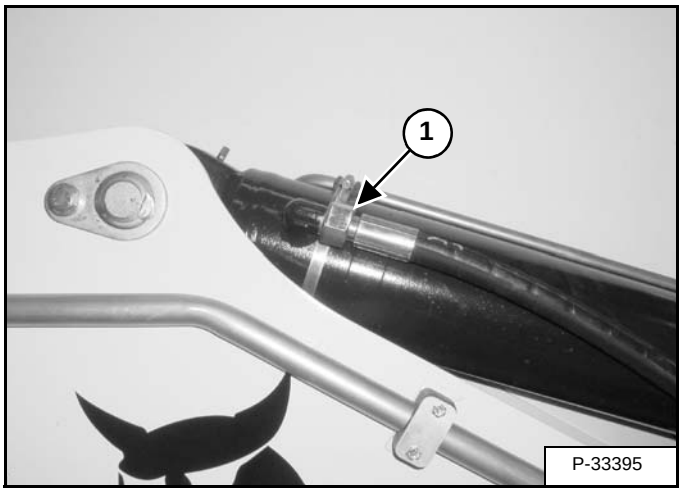


Start the engine and retract the boom cylinder (Item 1) **[Figure 20-20-6]**.

Stop the engine.

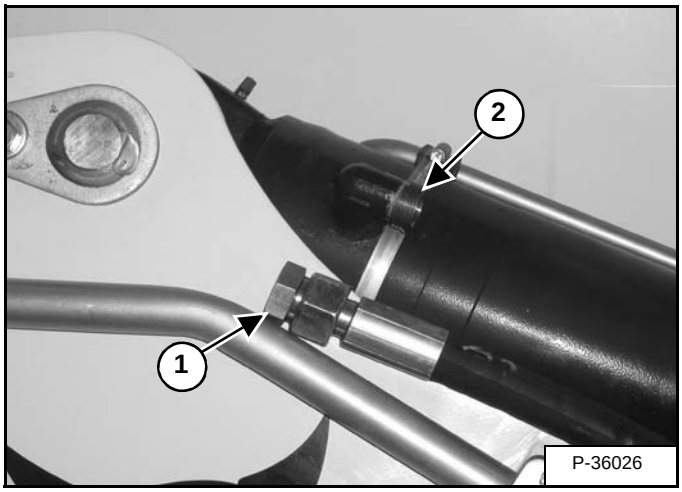
With the engine off and the key in the run position, move the joysticks to relieve hydraulic pressure.

Figure 20-20-7



Remove the hose (Item 1) **[Figure 20-20-7]** from the base end of the boom cylinder.

Figure 20-20-8



Install a plug (Item 1) **[Figure 20-20-8]** on the hose.

Start the engine and retract the boom cylinder.

If there is any oil leakage from the base end fitting (Item 2) **[Figure 20-20-8]** on the boom cylinder, remove the cylinder for repair or replacement.

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Removal And Installation

Fully retract the bucket and arm cylinders.

Lower the boom to the ground.

With the engine off and the key in the run position, move the joysticks 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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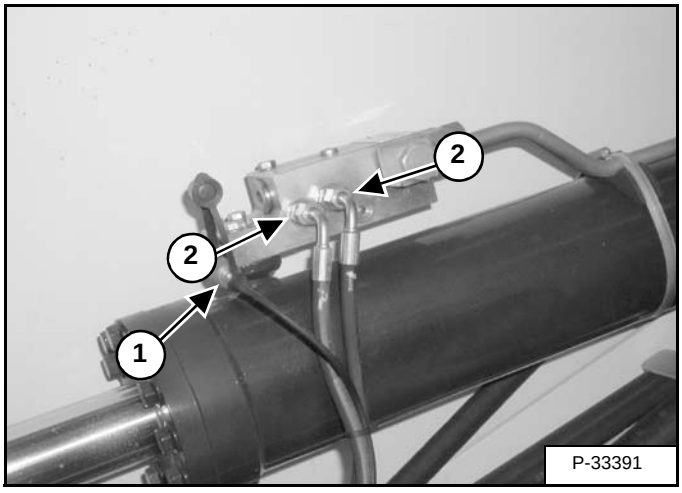
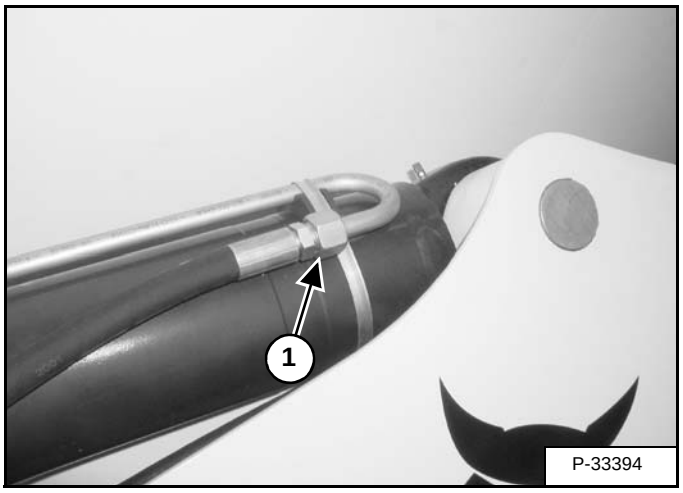
Figure 20-20-9



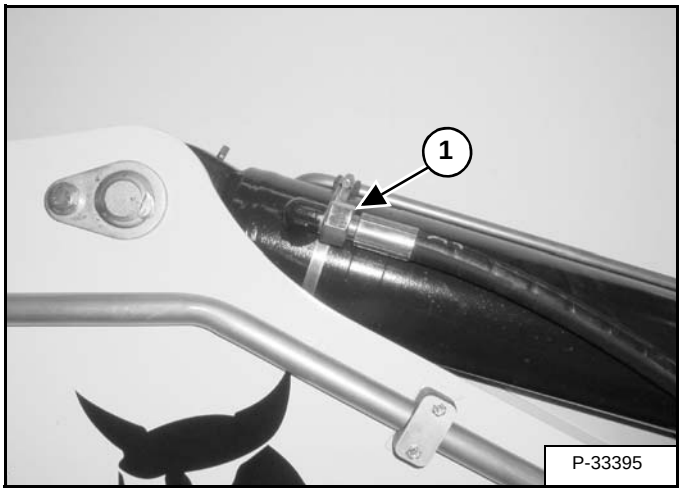
Remove the load sense line (Item 1) and two pilot hoses (Item 2) **[Figure 20-20-9]**.

Figure 20-20-10



Disconnect the hose (Item 1) **[Figure 20-20-10]** from the rod end.

Figure 20-20-11



Disconnect the hose (Item 1) **[Figure 20-20-11]** from the base end.

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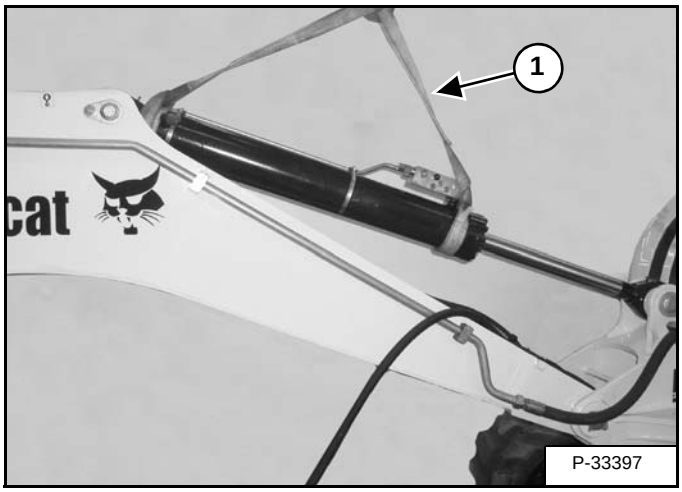
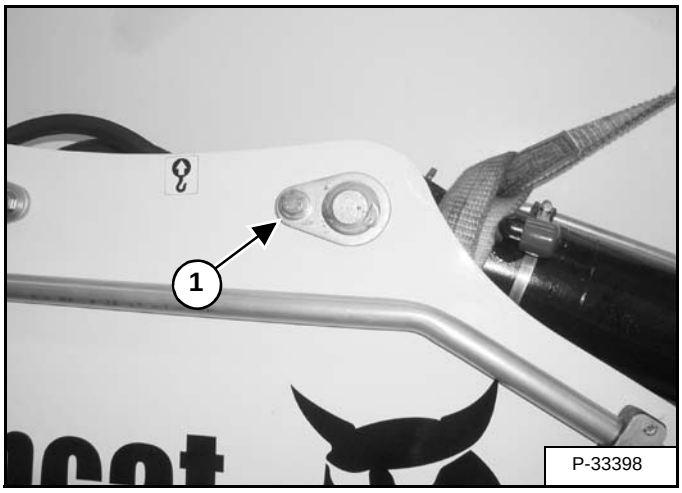
Removal And Installation (Cont'd)

Figure 20-20-12



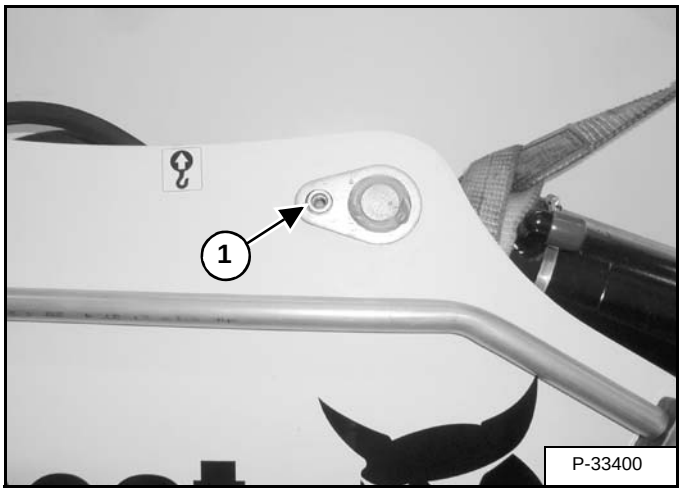
Install a sling (Item 1) **[Figure 20-20-12]** on the cylinder.

Figure 20-20-13



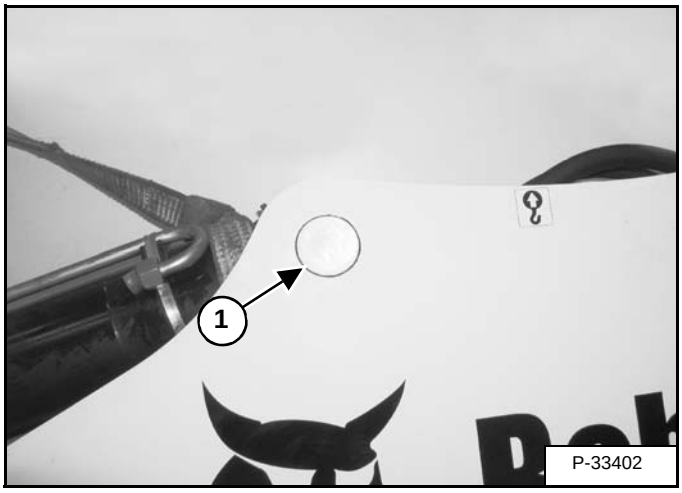
Remove the bolt (Item 1) **[Figure 20-20-13]** from the base end retaining pin.

Figure 20-20-14



Remove the spacer (item 1) **[Figure 20-20-14]**.

Figure 20-20-15



Remove the pin (Item 1) **[Figure 20-20-15]**.

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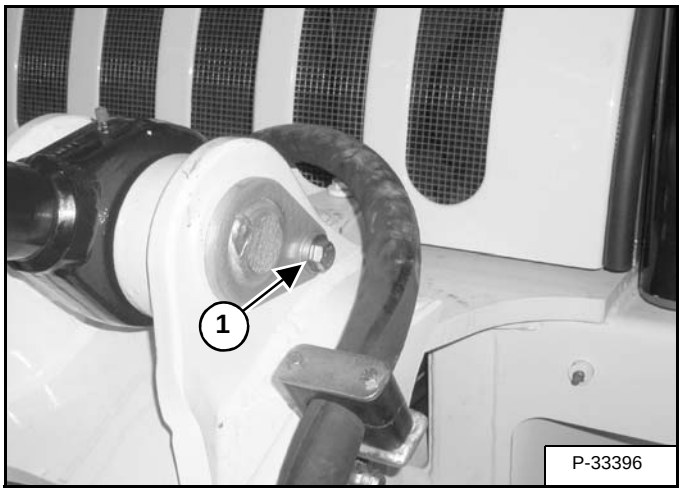
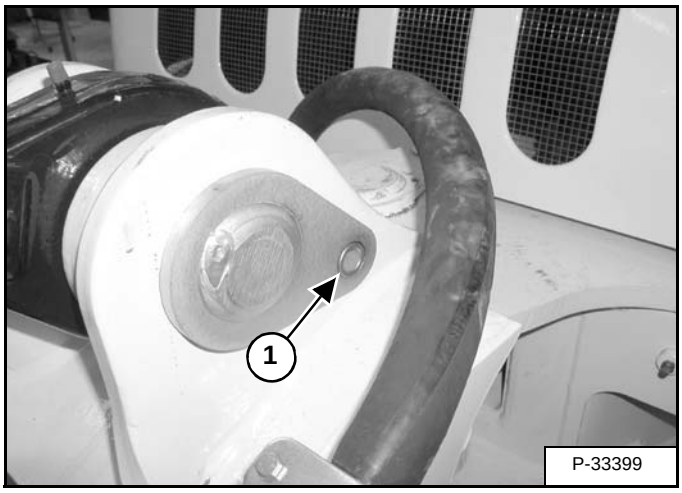
Removal And Installation (Cont'd)

Figure 20-20-16



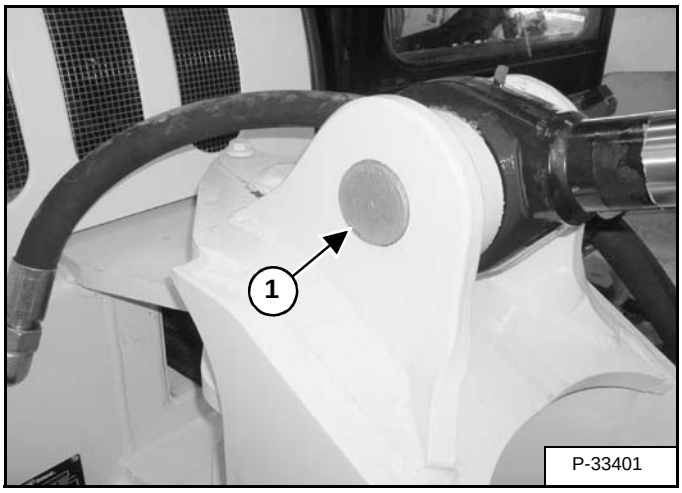
Remove the bolt (Item 1) **[Figure 20-20-16]** from the rod end retaining pin.

Figure 20-20-17



Remove the spacer (Item 1) **[Figure 20-20-17]**.

Figure 20-20-18



Remove the pin (Item 1) **[Figure 20-20-18]**.

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Removal And Installation (Cont'd)

Figure 20-20-19

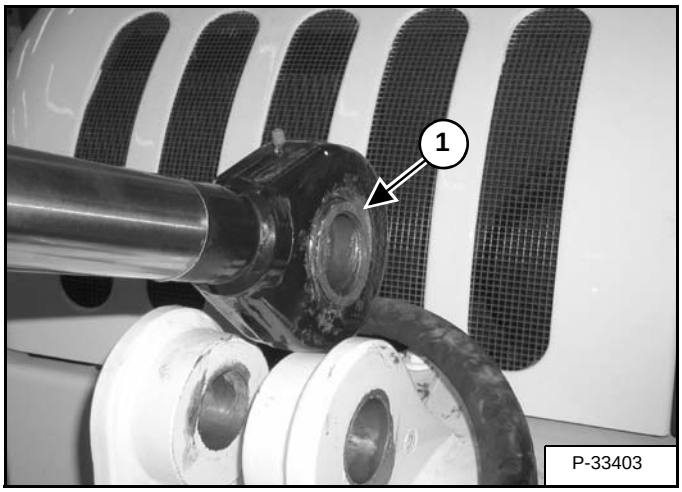
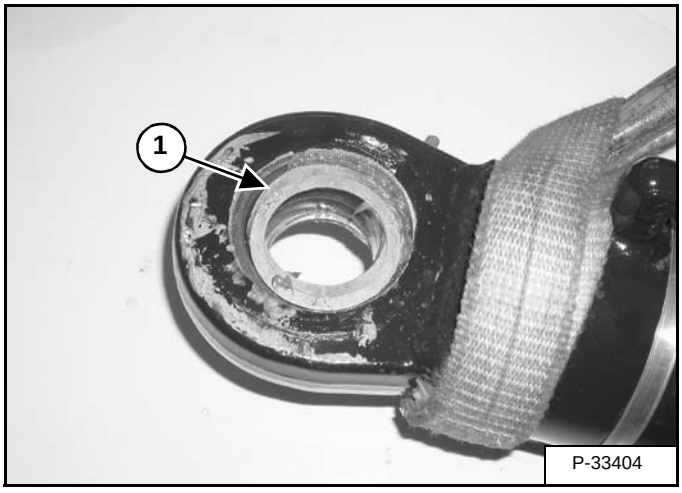
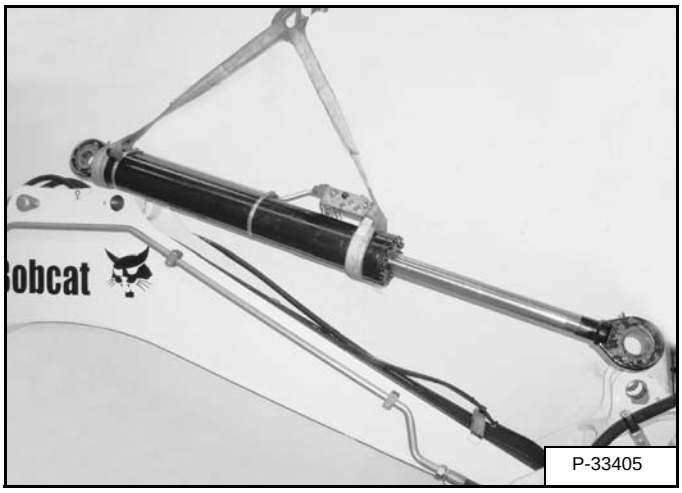


Figure 20-20-20



Raise the hoist and remove the shims (Item 1) **[Figure 20-20-19]** & **[Figure 20-20-20]** from both sides of the rod end and base end of the cylinder.

Figure 20-20-21



Remove the cylinder **[Figure 20-20-21]**.

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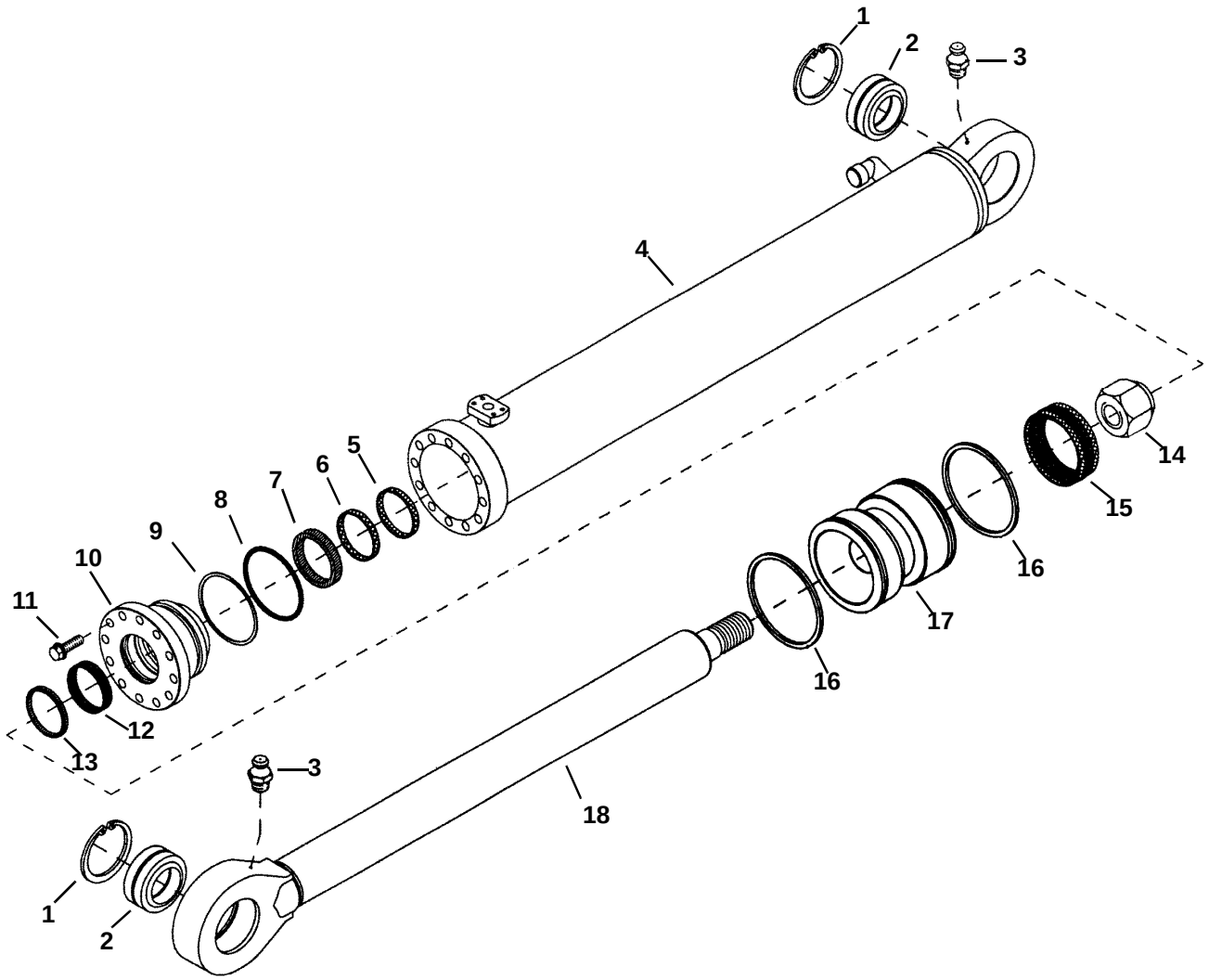
Parts Identification

1. Snap Ring
2. Bearing
3. Grease Fitting
4. Housing
5. Ring
6. Seal
7. Seal
8. O-ring
9. Backup Ring
10. Head
11. Bolt
12. Seal
13. Wiper Seal
14. Nut
15. Piston Seals
16. Steel Ring
17. Piston
18. Rod



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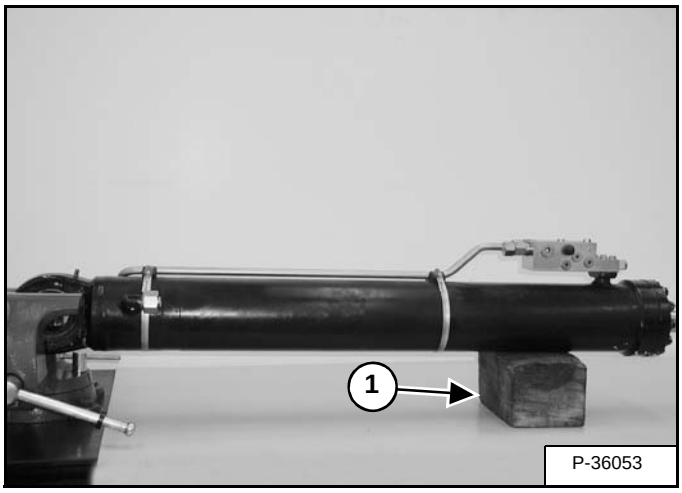
Disassembly

Use the following tools to disassemble the cylinder.

MEL1074-O-Ring Seal Hook

Clamp the base end of the cylinder in a vise.

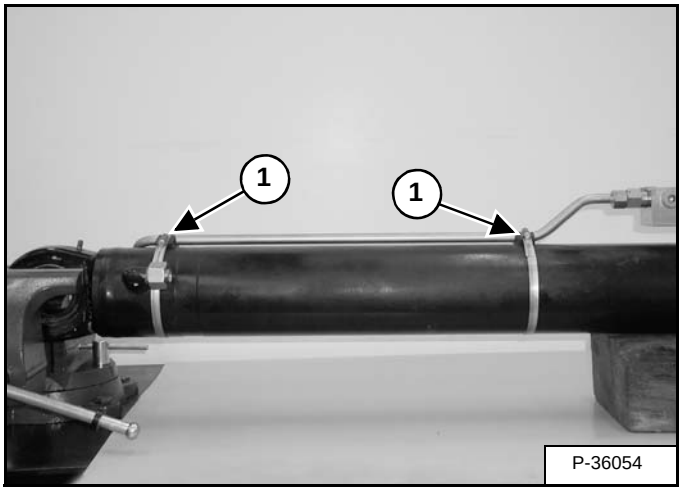
Figure 20-20-22



Install a block (Item 1) **[Figure 20-20-22]** under the end of the cylinder housing.

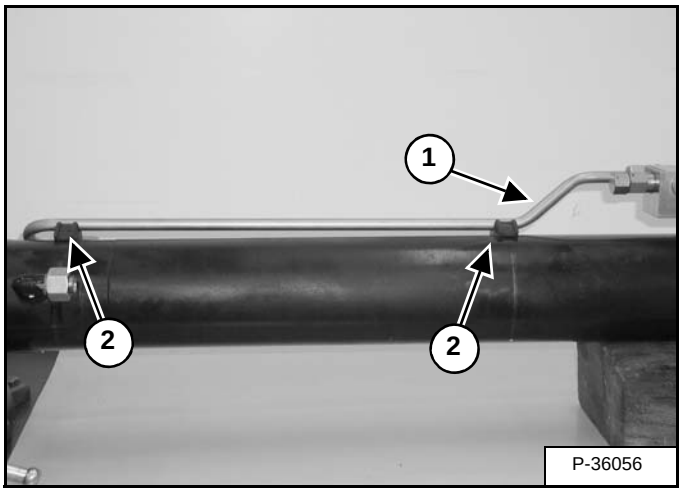
Use care not to damage the cylinder housing.

Figure 20-20-23



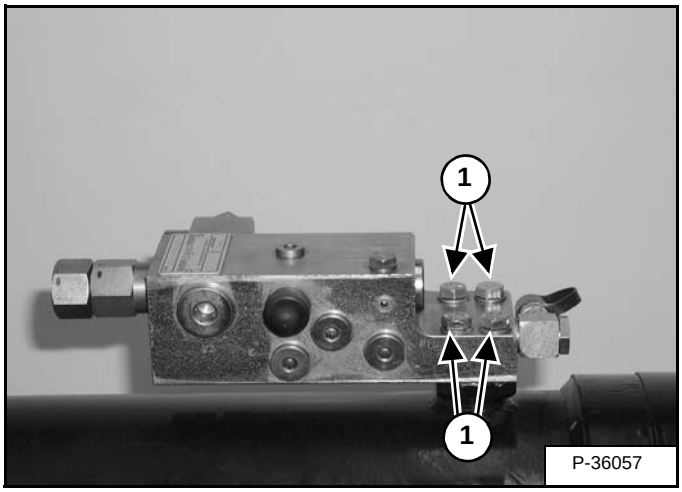
Remove the clamps (Item 1) **[Figure 20-20-23]**.

Figure 20-20-24



Remove the tubeline (Item 1) and blocks (Item 2) **[Figure 20-20-24]**.

Figure 20-20-25



Remove the 4 bolts (Item 1) **[Figure 20-20-25]** and remove the boom load holding valve.

For boom load holding valve disassembly. (See Disassembly on Page 20-200-3.)

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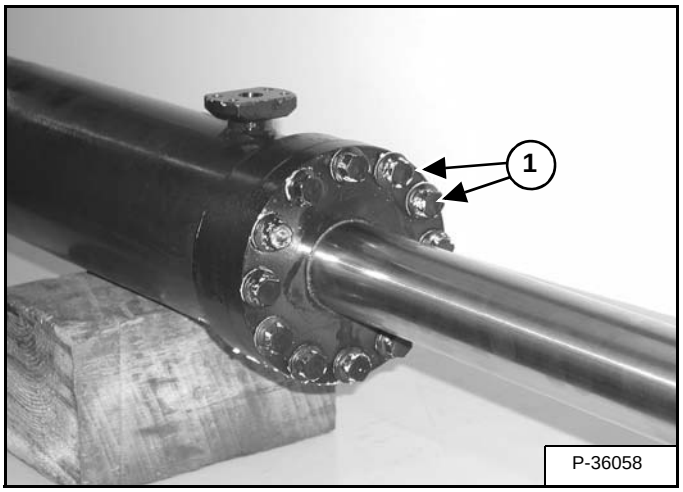
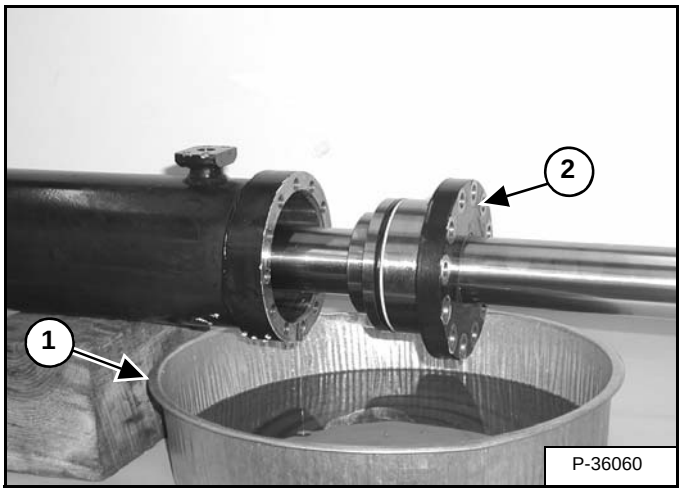
Disassembly (Cont'd)

Figure 20-20-26



Remove the 12 bolts (Item 1) **[Figure 20-20-26]** from the head.

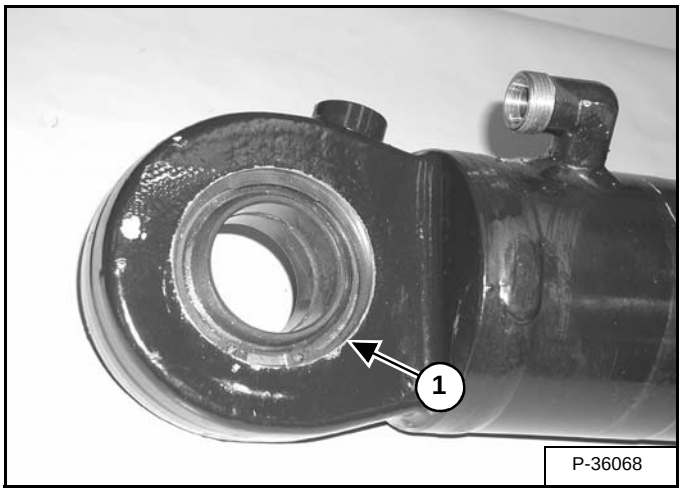
Figure 20-20-27



Install a drain pan (Item 1) under the housing and remove the rod assembly (Item 2) **[Figure 20-20-27]**.

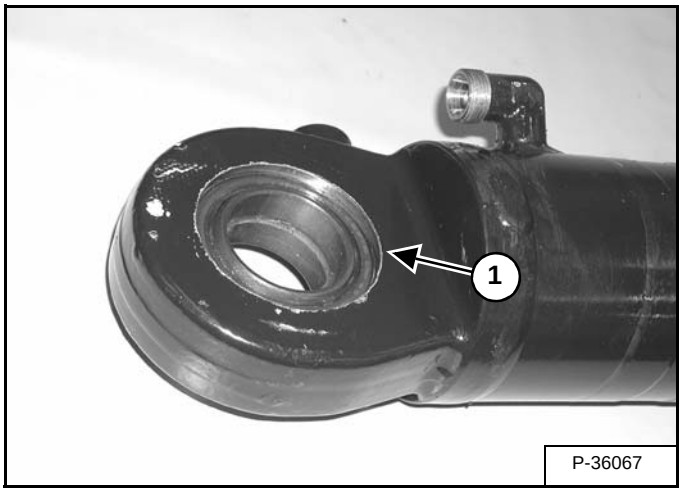
Remove the cylinder from the vise.

Figure 20-20-28



Remove the snap ring (Item 1) **[Figure 20-20-28]** from the base end of the cylinder.

Figure 20-20-29



Remove the bearing (Item 1) **[Figure 20-20-29]**.

NOTE: The bearing can only be removed through the snap ring side of the housing.

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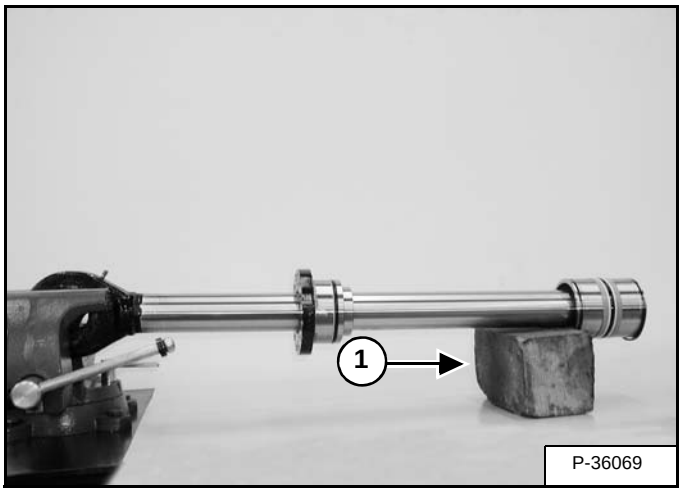
Disassembly (Cont'd)

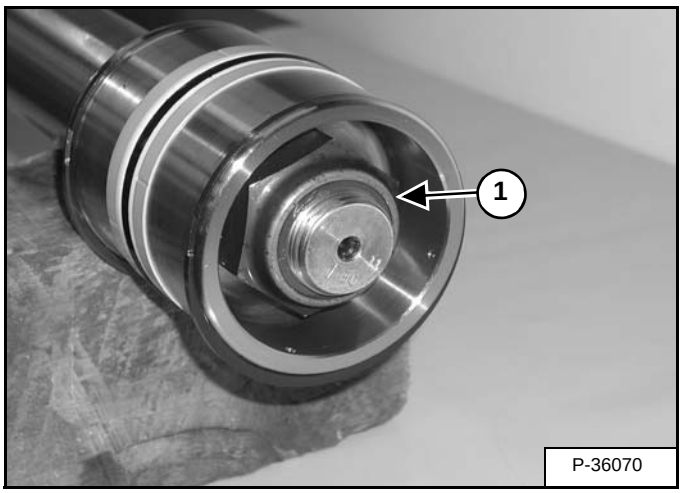
Figure 20-20-30



Clamp the rod end in a vise, support the end of the rod with a wood block (Item 1) **[Figure 20-20-30]**.

Use care not to damage the rod.

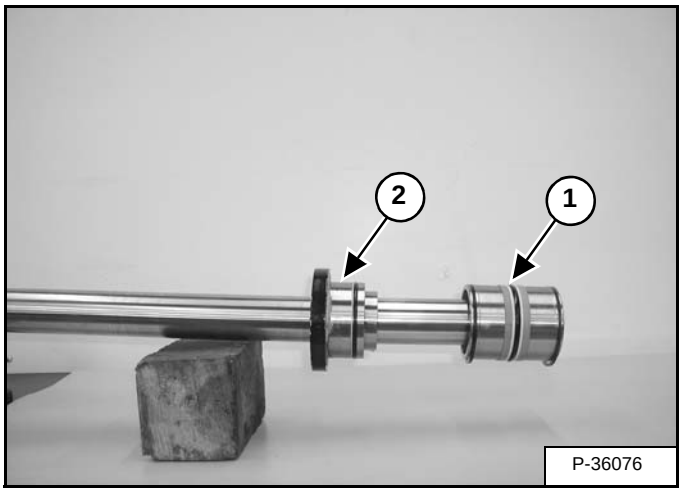
Figure 20-20-31



Apply moderate heat to the nut (Item 1) **[Figure 20-20-31]**.

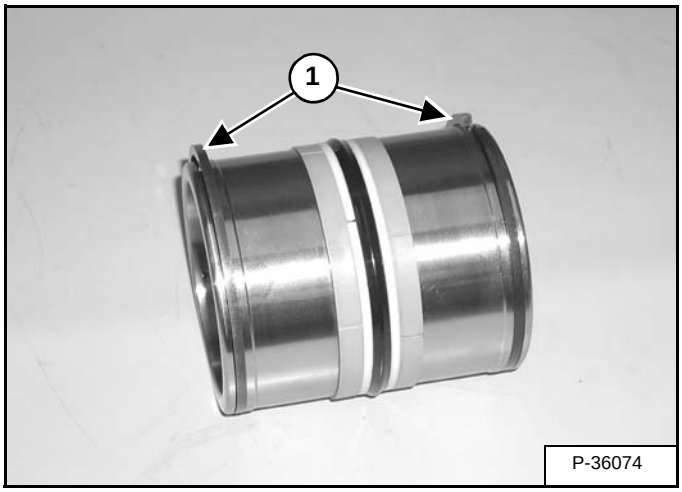
Remove the nut.

Figure 20-20-32



Remove the piston (Item 1) and head (Item 2) **[Figure 20-20-32]**.

Figure 20-20-33



Remove the steel rings (Item 1) **[Figure 20-20-33]** from the piston.

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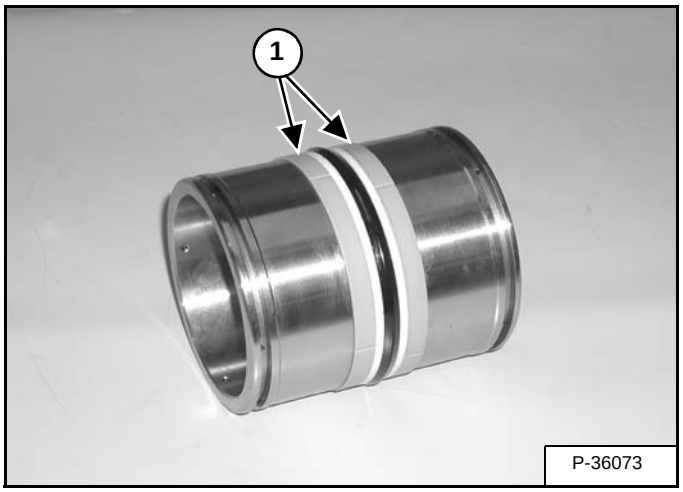
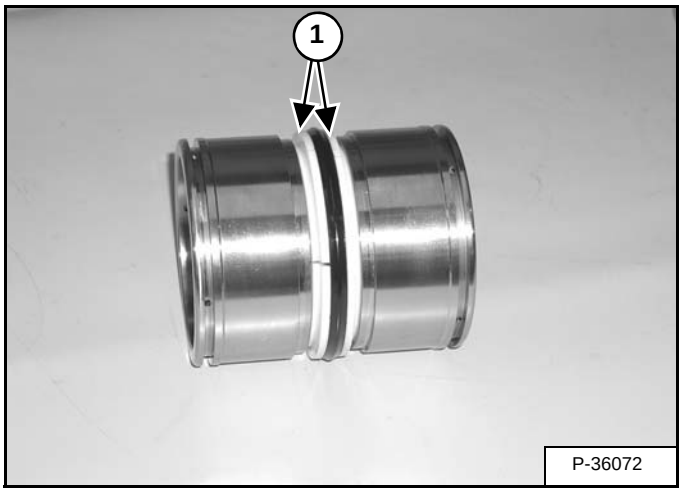
Disassembly (Cont'd)

Figure 20-20-34



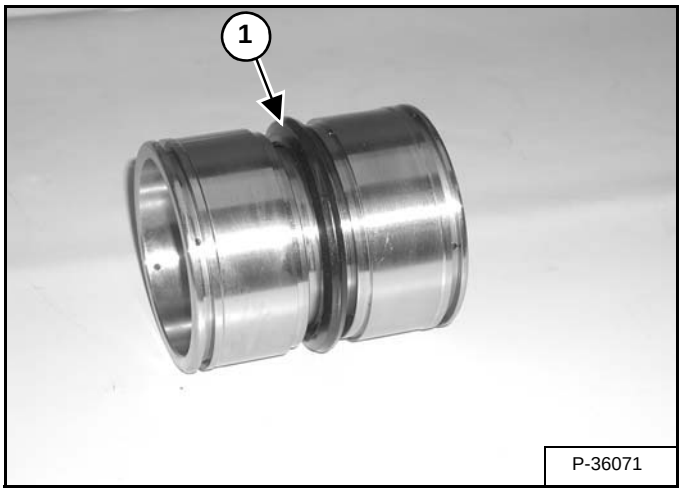
Remove the wear rings (Item 1) **[Figure 20-20-34]**.

Figure 20-20-35



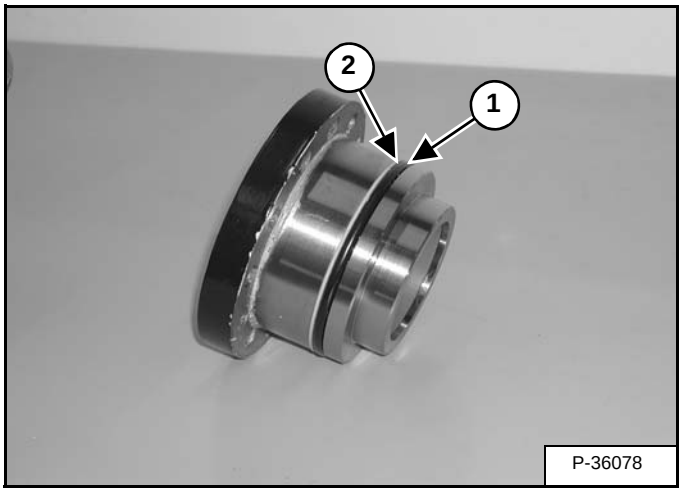
Remove the back-up rings (Item 1) **[Figure 20-20-35]**.

Figure 20-20-36



Remove the seal (Item 1) **[Figure 20-20-36]**.

Figure 20-20-37



Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-20-37]** from the head.

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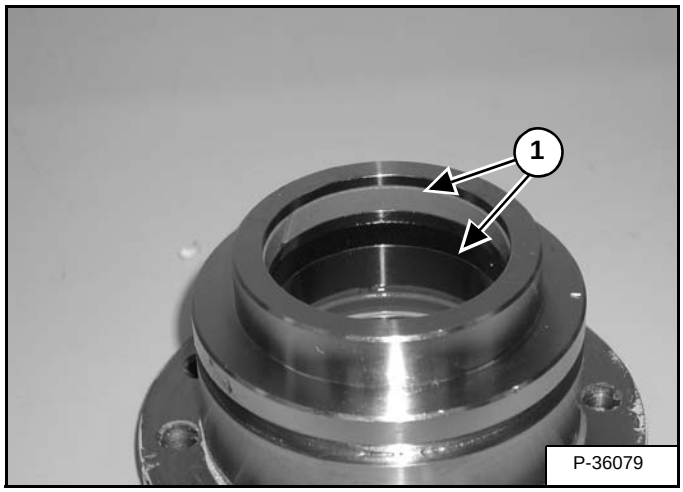
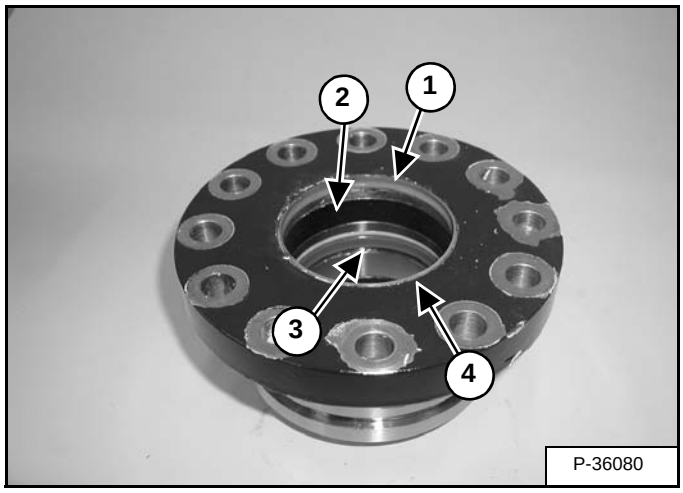
Disassembly (Cont'd)

Figure 20-20-38



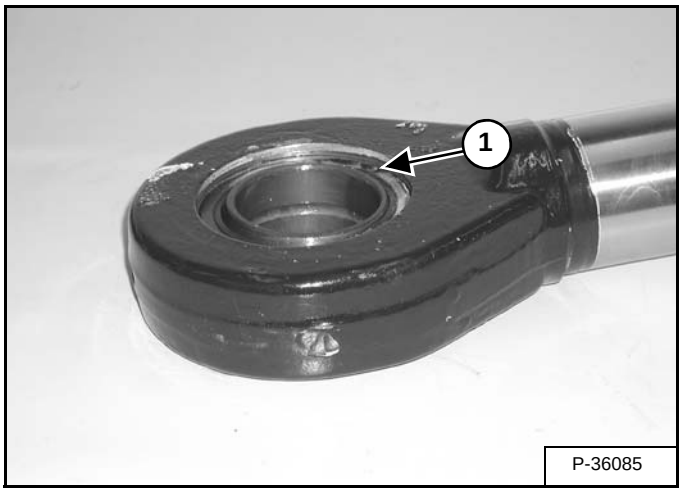
Remove the two wear rings (Item 1) **[Figure 20-20-38]**.

Figure 20-20-39



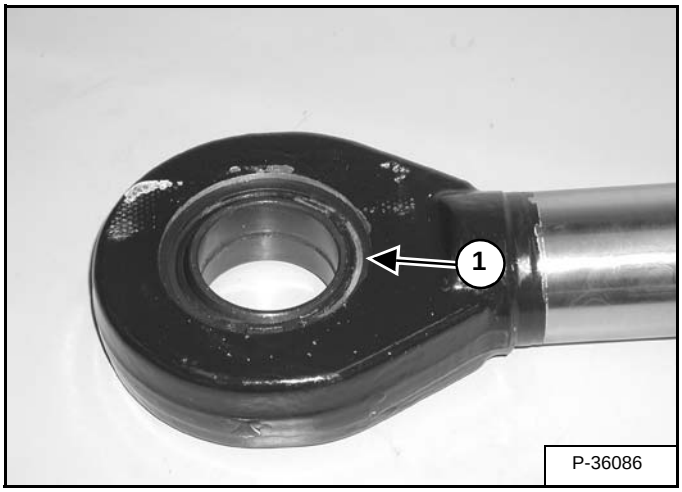
Remove the wiper (Item 1), wear ring (Item 2), seal (Item 3) and back-up ring (Item 4) **[Figure 20-20-39]**.

Figure 20-20-40



Remove the rod from the vise. Remove the snap ring (Item 1) **[Figure 20-20-40]**.

Figure 20-20-41



Remove the bearing (Item 1) **[Figure 20-20-41]**.

NOTE: The bearing can only be removed through the snap ring side of the housing.

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Assembly

Use the following tools to assemble the cylinder.

MEL1396-Universal Seal Expander
MEL1033-Rod Seal Installation Tool
Piston Ring Compressor

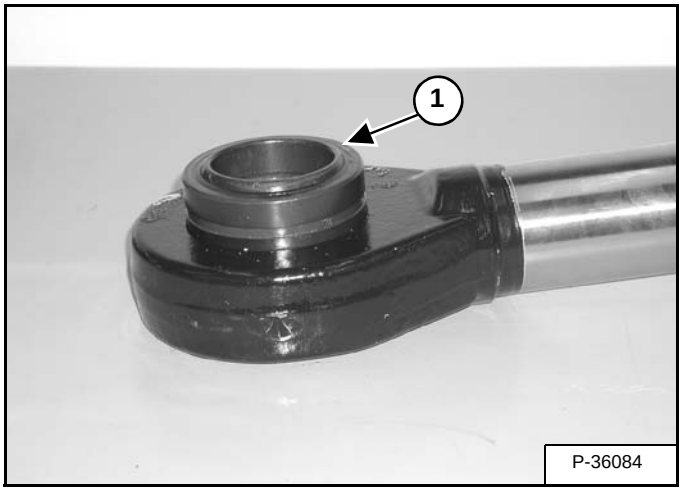
Wash the cylinder parts in clean solvent and dry them with compressed air.

Inspect the cylinder parts for nicks, scratches or other damage. replace any damaged parts.

Always install new O-rings and seals during assembly.

Lubricate all O-rings and seals with hydraulic oil during installation.

Figure 20-20-42



Install the bearing (Item 1) **[Figure 20-20-42]** in the rod end.

NOTE: The bearing can only be installed from the snap ring side of the housing.

Figure 20-20-43

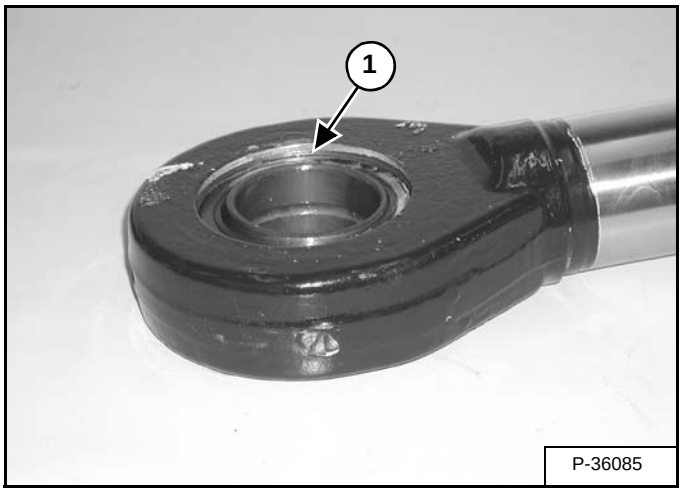
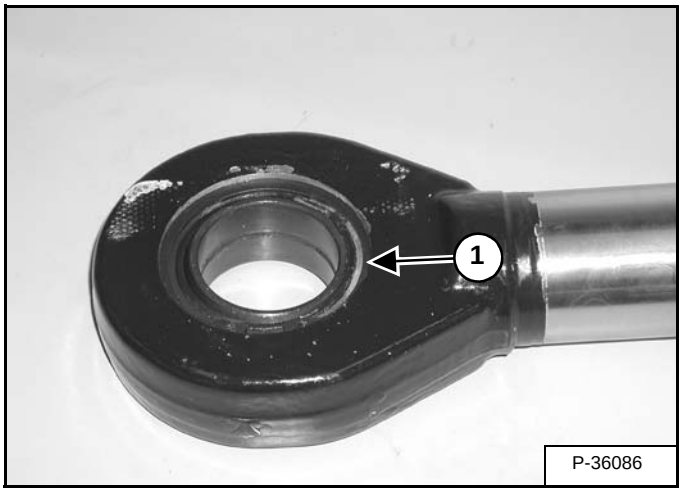


Figure 20-20-44



Make sure the bearing is fully seated in the housing (Item 1) **[Figure 20-20-43]** and install the snap ring (Item 1) **[Figure 20-20-44]**.

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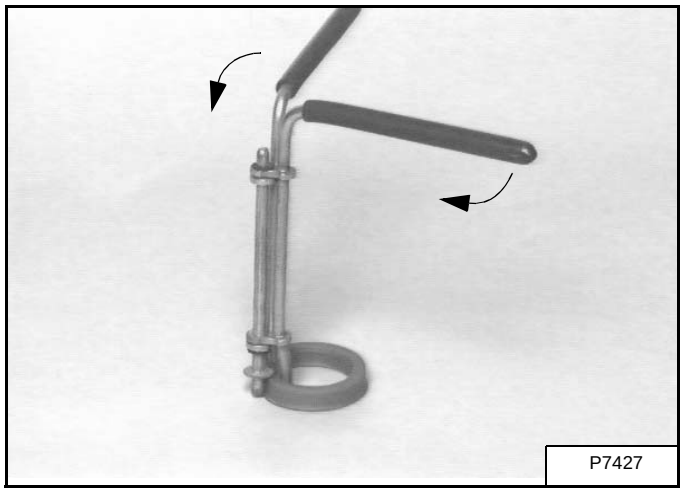
Assembly (Cont'd)

Figure 20-20-45

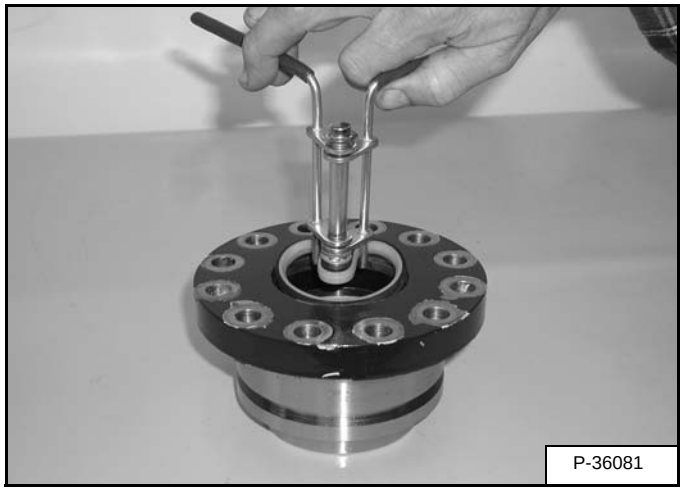


Install the rod seal on the rod seal tool **[Figure 20-20-45]**.

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

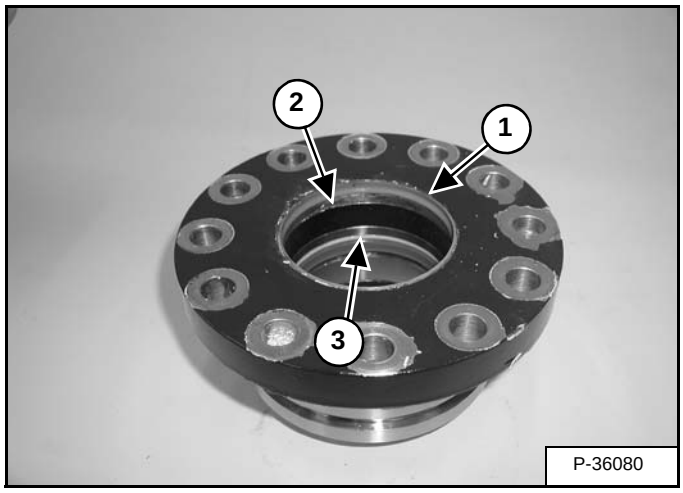
Rotate the handles to collapse the rod seal **[Figure 20-20-45]**.

Figure 20-20-46



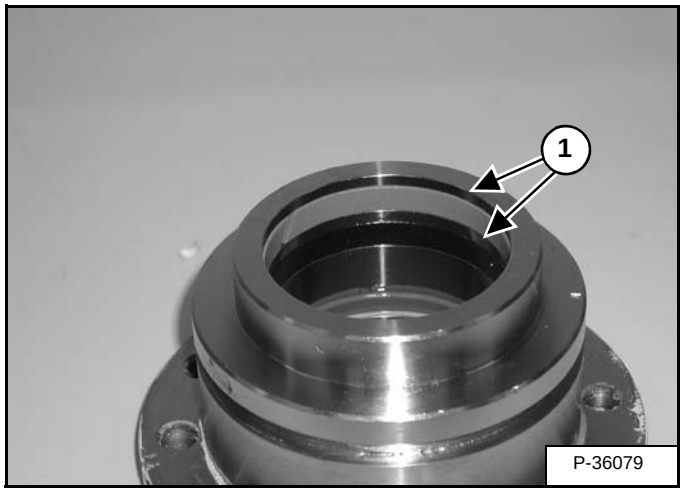
Install the rod seal in the head **[Figure 20-20-46]**.

Figure 20-20-47



Install the wiper (Item 1), wear ring (Item 2) and backup ring (Item 3) **[Figure 20-20-47]**.

Figure 20-20-48



Install the two wear rings (Item 1) **[Figure 20-20-48]**.

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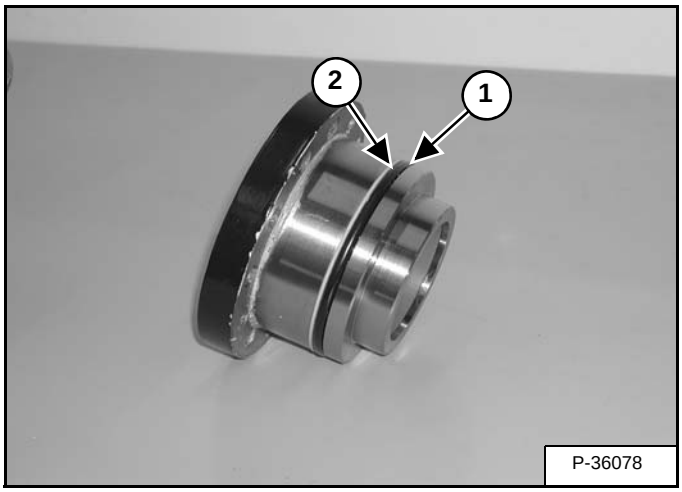
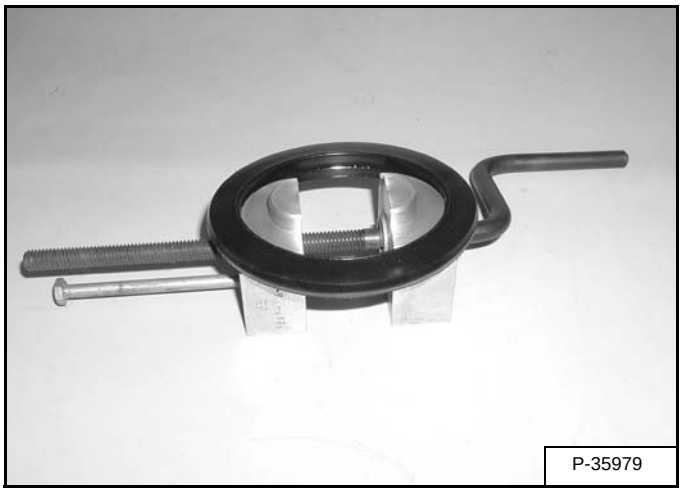
Assembly (Cont'd)

Figure 20-20-49



Install the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-20-49]** on the head.

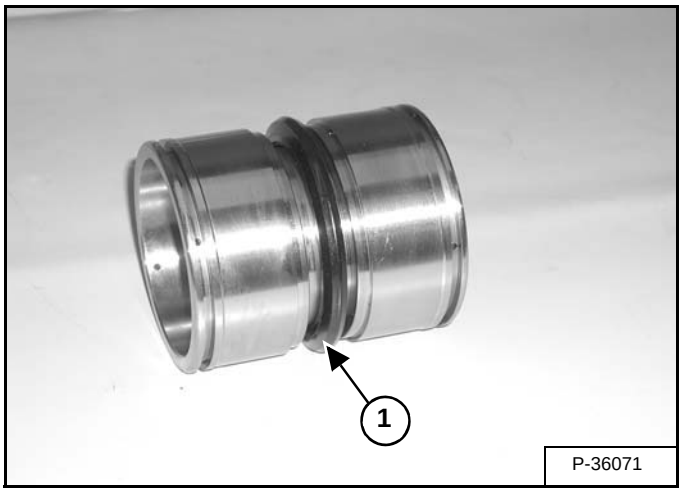
Figure 20-20-50



Install the new seal on the tool and slowly stretch it until it fits the piston **[Figure 20-20-50]**.

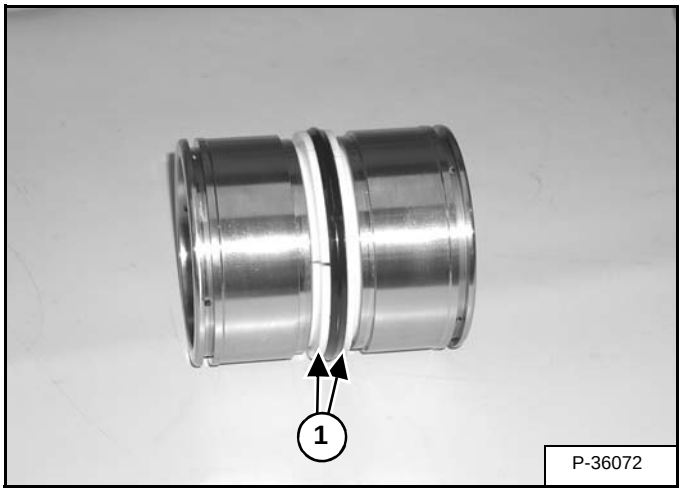
Allow the seal to stretch for thirty seconds before installing it on the piston.

Figure 20-20-51



Install the seal (Item 1) **[Figure 20-20-51]** on the piston.

Figure 20-20-52



Install the back-up rings (Item 1) **[Figure 20-20-52]**.

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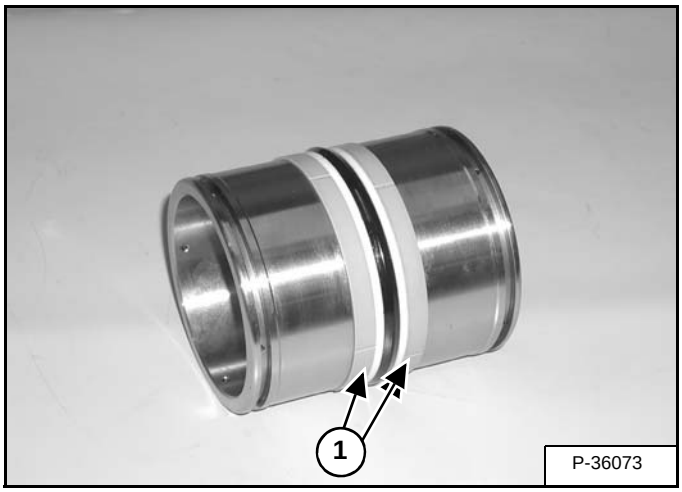
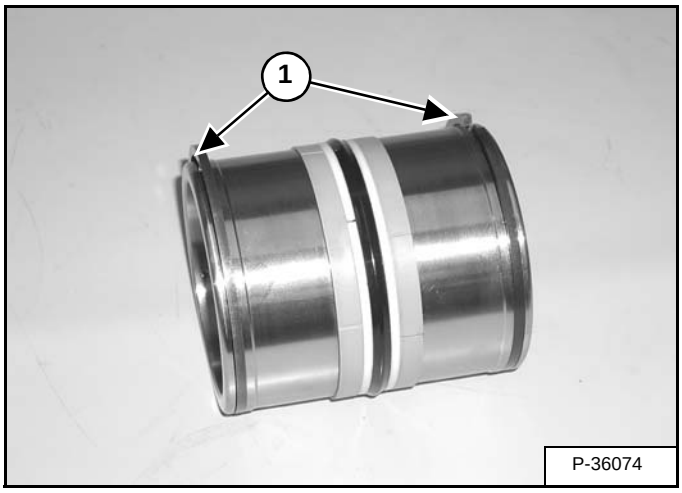
Assembly (Cont'd)

Figure 20-20-53



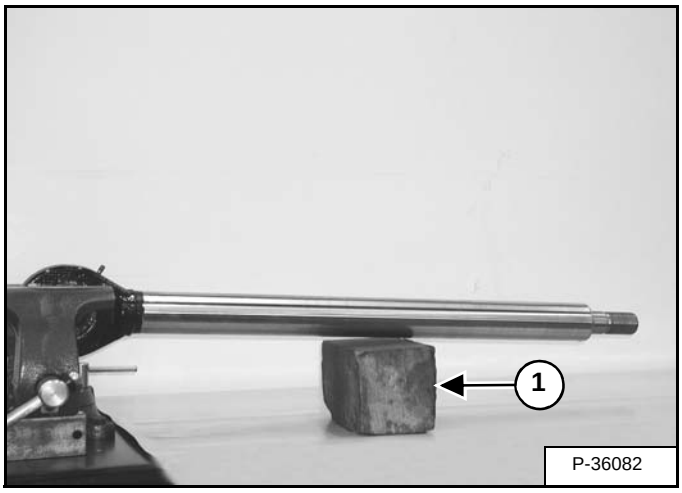
Install the wear rings (Item 1) **[Figure 20-20-53]**.

Figure 20-20-54



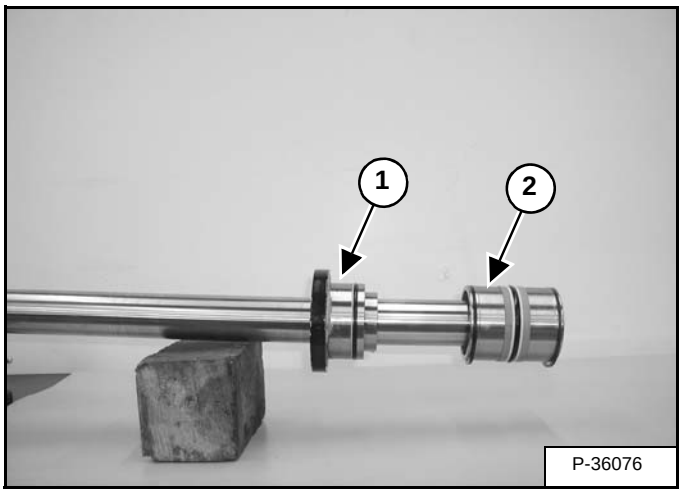
Install the steel rings (Item 1) **[Figure 20-20-54]**.

Figure 20-20-55



Clamp the rod end in a vise. Support the end of the rod with a wood block (Item 1) **[Figure 20-20-55]**. Use care not to damage the rod.

Figure 20-20-56



Install the head (Item 1) and piston (Item 2) **[Figure 20-20-56]**.

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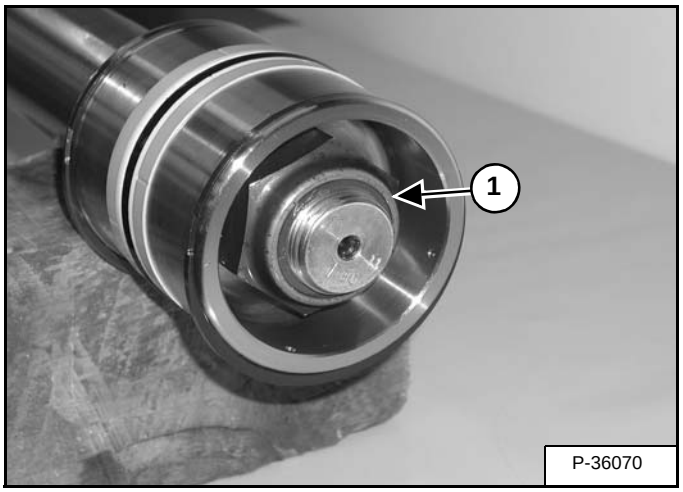
Assembly (Cont'd)

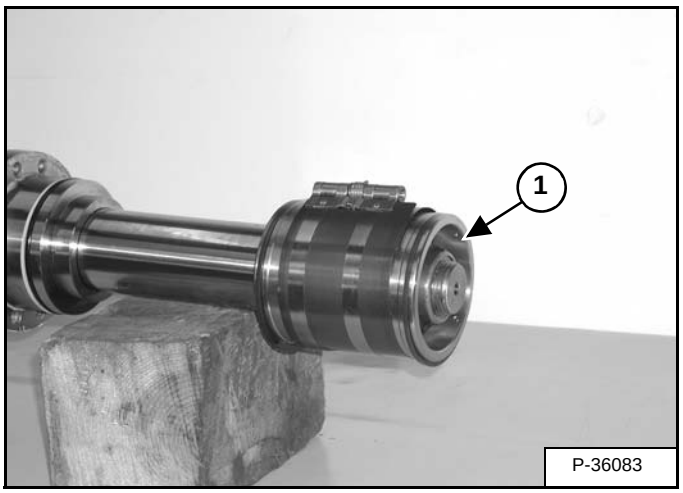
Figure 20-20-57



Apply thread lock adhesive (Loctite™ 270) to the threads and install the nut (Item 1) **[Figure 20-20-57]**.

Tighten the nut to 1512 ft.-lb. (2050 N•m) torque.

Figure 20-20-58

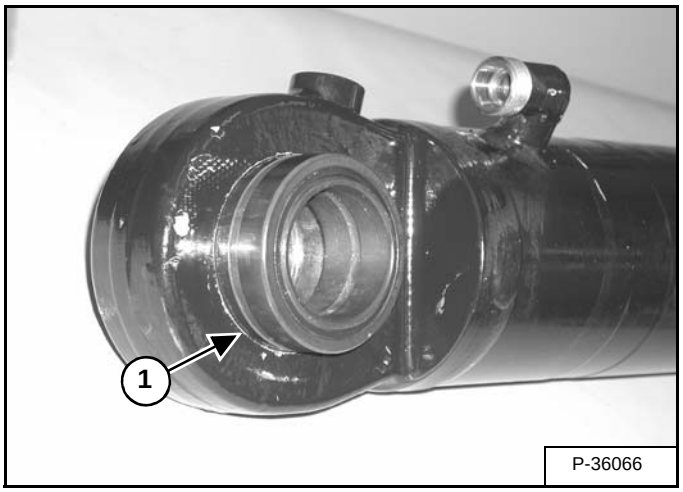


Install a ring compressor on the piston (Item 1) **[Figure 20-20-58]** and compress the seal to the correct size.

Leave the piston in the compressor for about three minutes.

Remove the rod and head assembly from the vise.

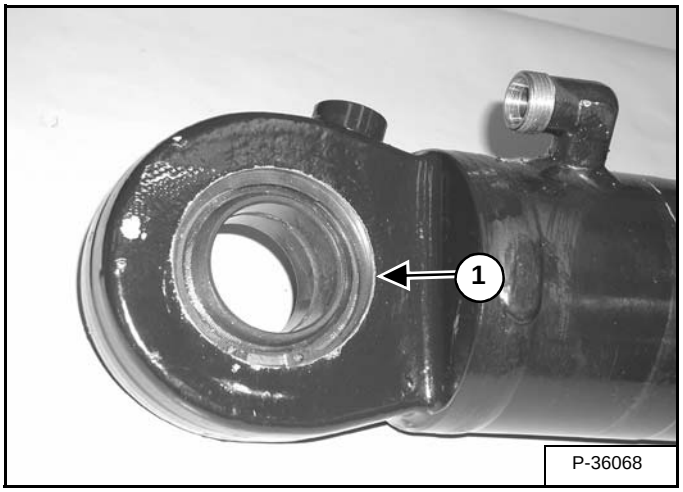
Figure 20-20-59



Install the bearing (Item 1) **[Figure 20-20-59]** into the base end of the cylinder housing.

NOTE: The bearing can only be installed thru the snap ring side of the housing.

Figure 20-20-60



Fully seat the bearing and install the snap ring (Item 1) **[Figure 20-20-60]**.

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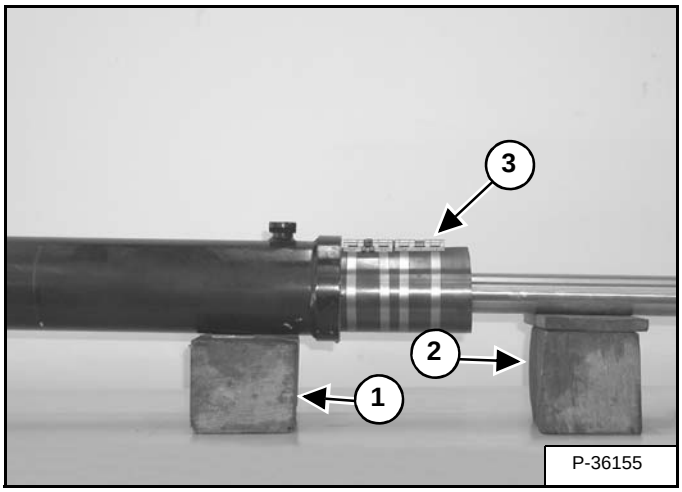
Assembly (Cont'd)

Figure 20-20-61



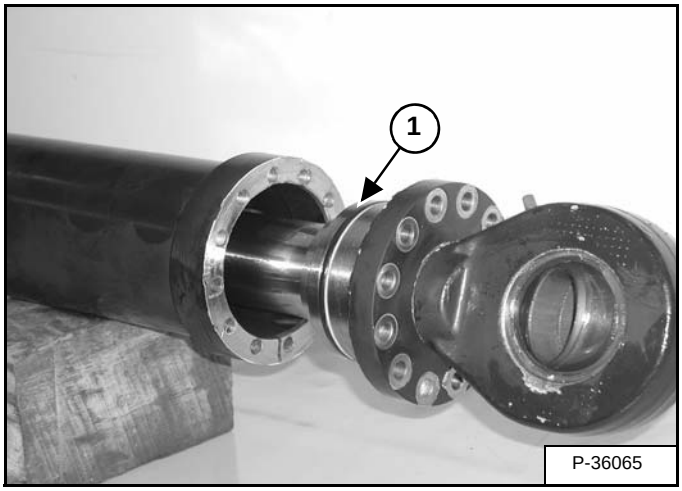
Clamp the base end of the cylinder in a vise and support the end of the housing with a block (Item 1) **[Figure 20-20-61]**. Use care not to damage the cylinder housing.

Support the rod assembly with wood blocks (Item 2) **[Figure 20-20-61]**.

Install a ring compressor (Item 3) **[Figure 20-20-61]** on the piston to compress the steel rings to the correct size.

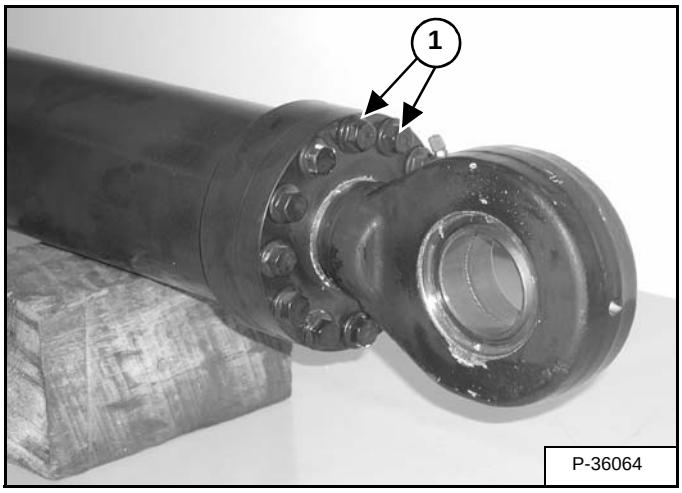
Push the piston into the housing.

Figure 20-20-62



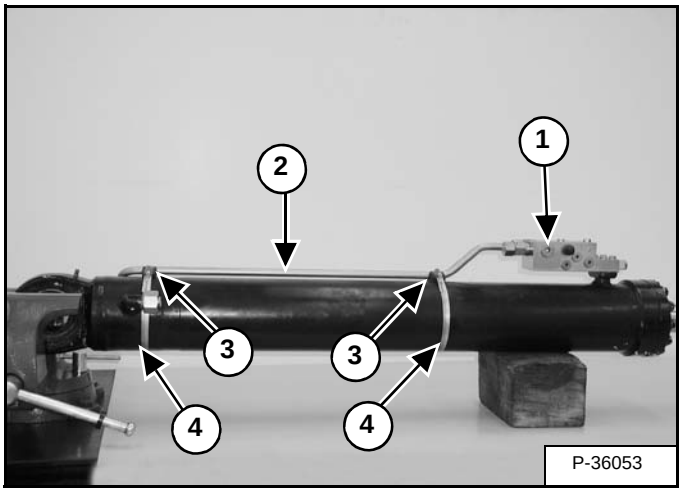
Install the head (Item 1) **[Figure 20-20-62]** in the housing.

Figure 20-20-63



Install the twelve bolts (Item 1) **[Figure 20-20-63]**. Tighten the bolts to 107 ft.-lb. (145 N•m) torque.

Figure 20-20-64



To allow the cylinder rod to be moved during installation do not install the boom load holding valve (Item 1) **[Figure 20-20-64]** until the cylinder has been installed on the excavator.

For boom load holding valve installation on the excavator. (See Removal And Installation on Page 20-200-1).

Install the tubeline (Item 2) blocks (Item 3) and clamps (Item 4) **[Figure 20-20-64]**.

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ARM CYLINDER

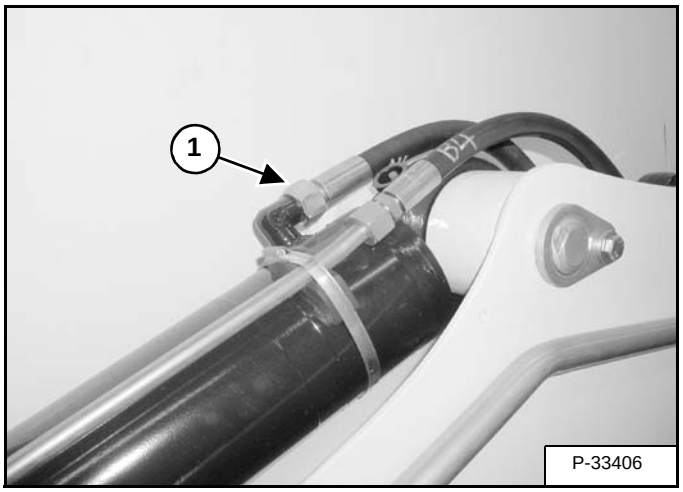
Testing

Fully retract the bucket and arm cylinders.

Lower the boom to the ground.

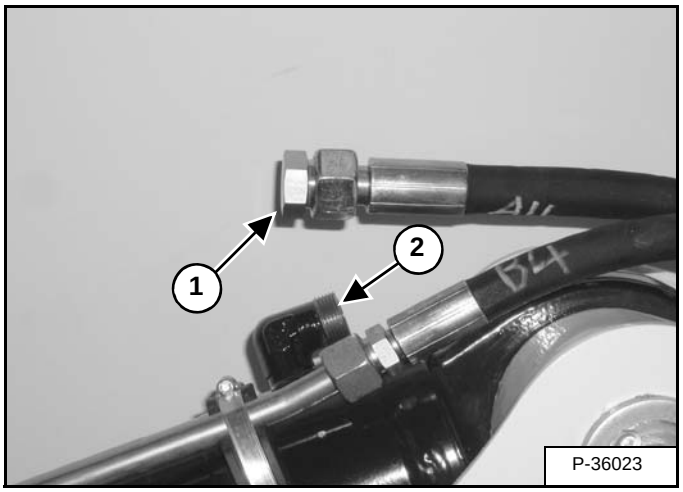
With the engine off and the key in the run position, move the joysticks to relieve hydraulic pressure.

Figure 20-21-1



Remove the hydraulic hose (Item 1) **[Figure 20-21-1]** from the base end of the arm cylinder.

Figure 20-21-2



Install a plug (Item 1) **[Figure 20-21-2]** on the hose.

Start the engine and retract the arm cylinder.

If there is any oil leakage from the base end fitting (Item 2) **[Figure 20-21-2]** on the arm cylinder, remove the cylinder for repair or replacement.

Removal And Installation

Fully retract the bucket and arm cylinders.

Lower the boom to the ground.

With the engine off and the key in the run position, move the joysticks 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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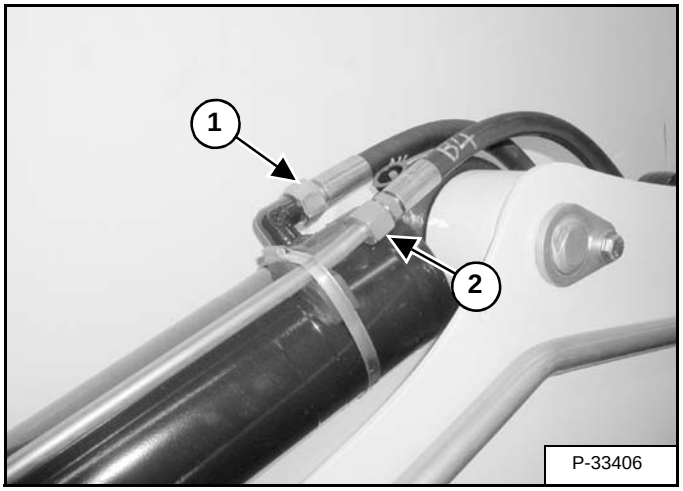
Figure 20-21-3



Remove the hose (Item 1) **[Figure 20-21-3]** from the base end.

Remove the hose (Item 2) **[Figure 20-21-3]** from the rod end.

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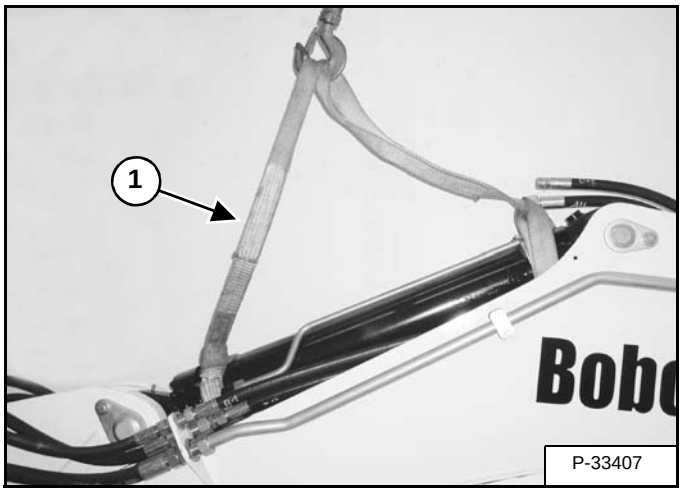
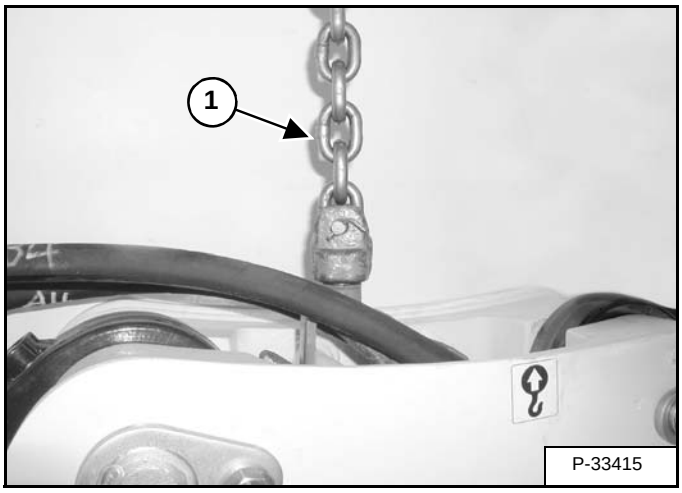
Removal And Installation (Cont'd)

Figure 20-21-4



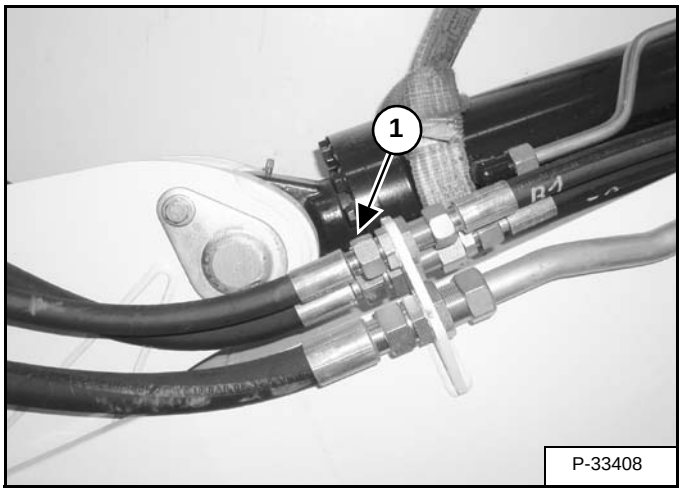
Install a sling (Item 1) **[Figure 20-21-4]** on the cylinder.

Figure 20-21-5



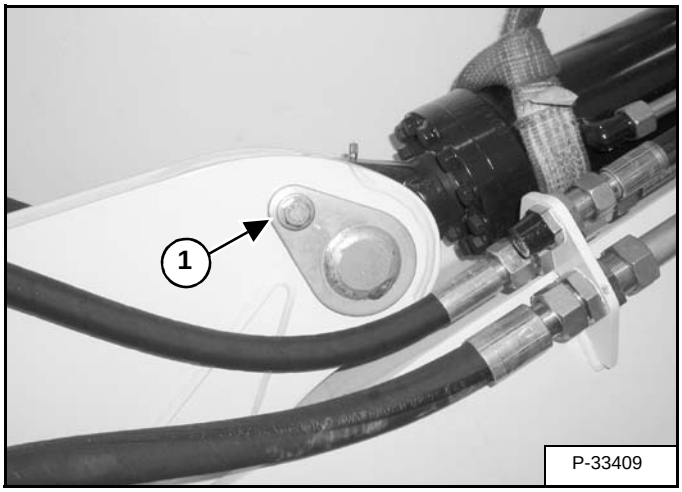
Install a chain hoist (Item 1) **[Figure 20-21-5]** on the boom.

Figure 20-21-6



Remove the auxiliary hydraulic hose (Item 1) **[Figure 20-21-6]**.

Figure 20-21-7



Remove the bolt (Item 1) **[Figure 20-21-7]** from the rod end retaining pin.

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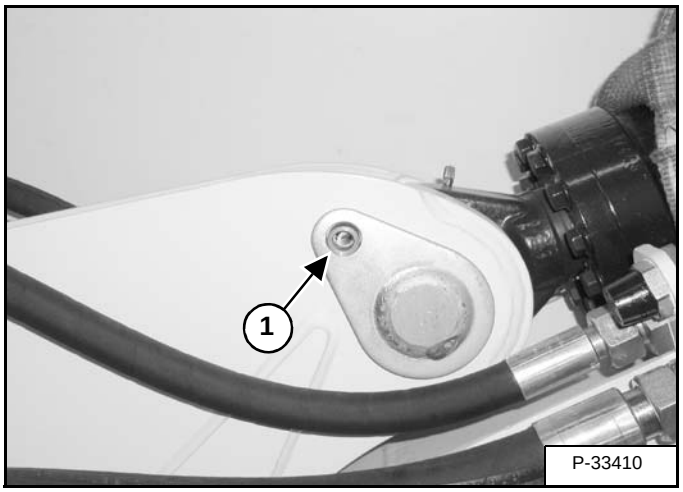
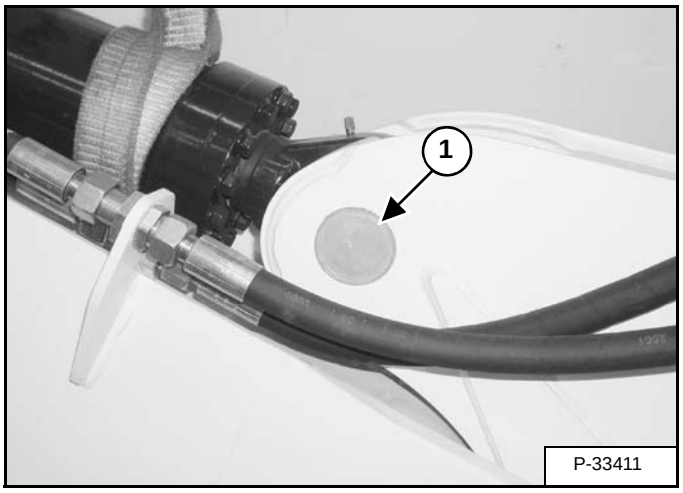
Removal And Installation (Cont'd)

Figure 20-21-8



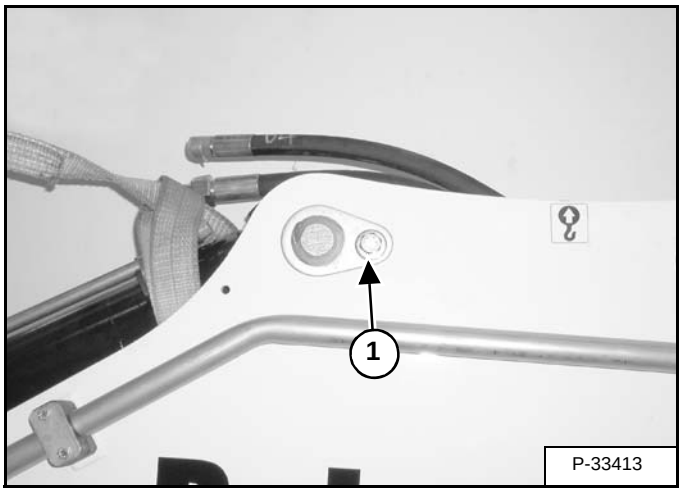
Remove the spacer (Item 1) **[Figure 20-21-8]**.

Figure 20-21-9



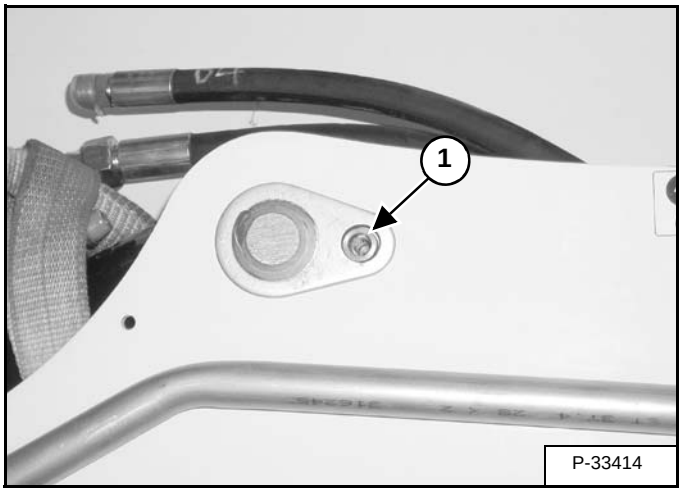
Raise the chain hoist attached to the boom and remove the pin (Item 1) **[Figure 20-21-9]**.

Figure 20-21-10



Remove the bolt (Item 1) **[Figure 20-21-10]** from the base end retaining pin.

Figure 20-21-11



Remove the spacer (Item 1) **[Figure 20-21-11]**.

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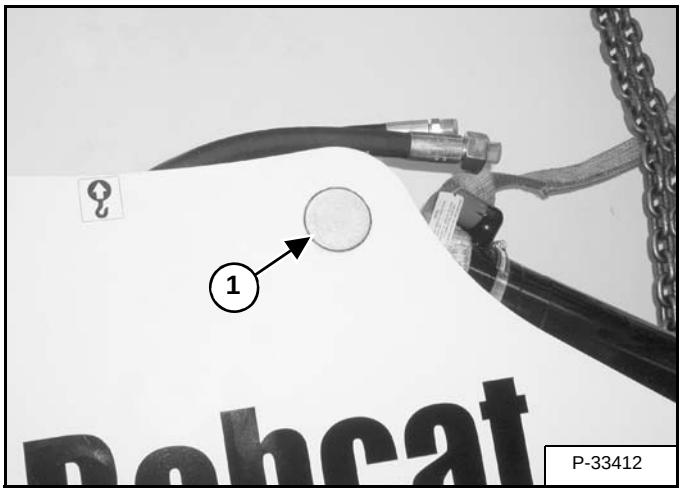
Removal And Installation (Cont'd)

Figure 20-21-12



Remove the pin (Item 1) **[Figure 20-21-12]**.

Figure 20-21-13

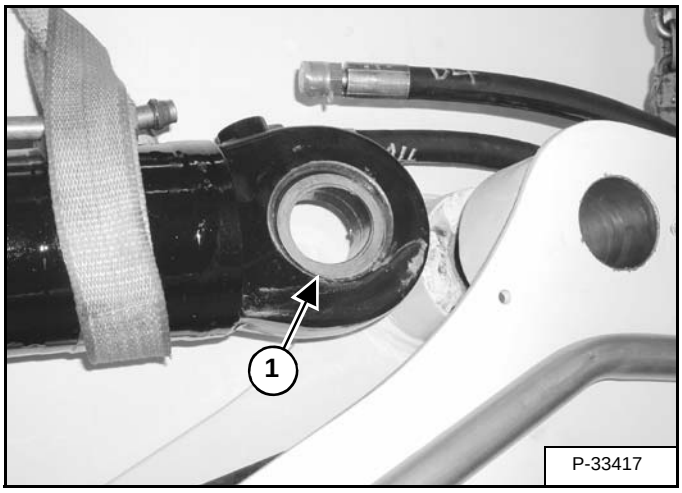
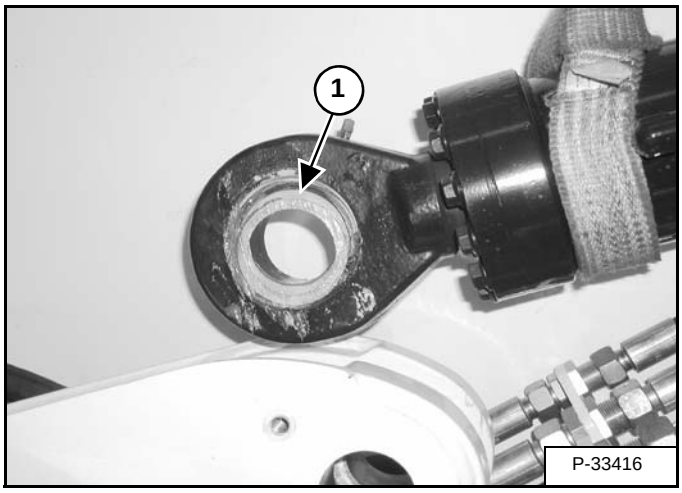
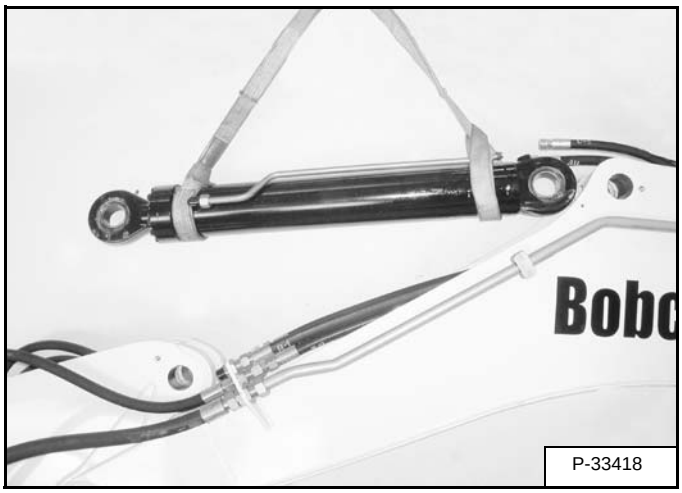


Figure 20-21-14



Raise the hoist and remove the shims (Item 1) **[Figure 20-21-13]** & **[Figure 20-21-14]** from both sides of the rod end and base end of the cylinder.

Figure 20-21-15



Remove the cylinder **[Figure 20-21-15]**.

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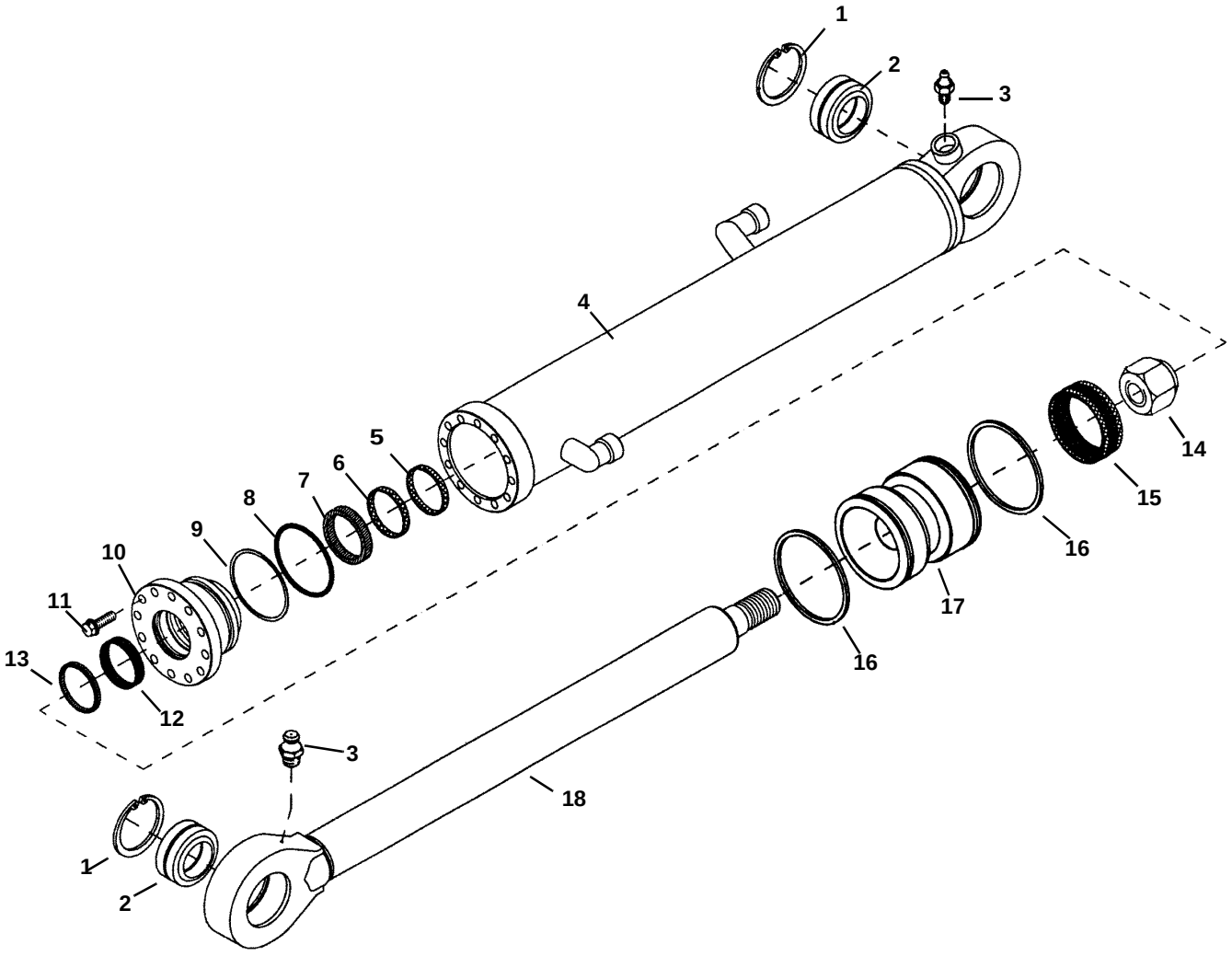
Parts Identification

1.	Snap Ring	10.	Head
2.	Bearing	11.	Bolt
3.	Grease Fitting	12.	Seal
4.	Housing	13.	Wiper Seal
5.	Ring	14.	Nut
6.	Seal	15.	Piston Seals
7.	Seal	16.	Steel Ring
8.	O-Ring	17.	Piston
9.	Backup Ring	18.	Rod



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Disassembly

Use the following tools to disassemble the cylinder.

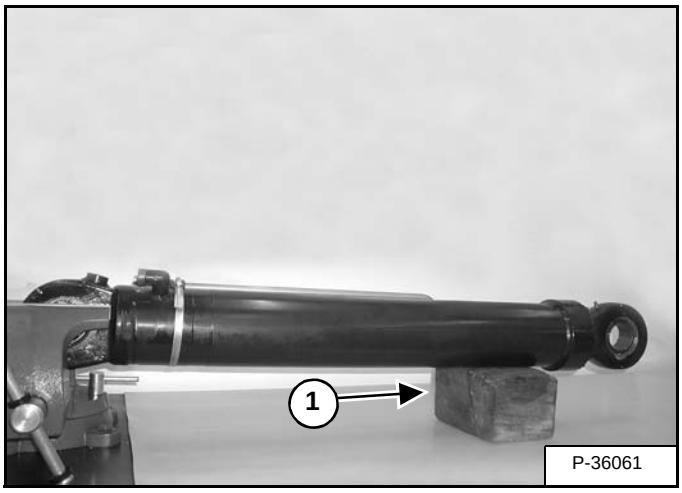
MEL1074-O-ring Seal Hook.

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

Clamp the base end of the cylinder in a vise.

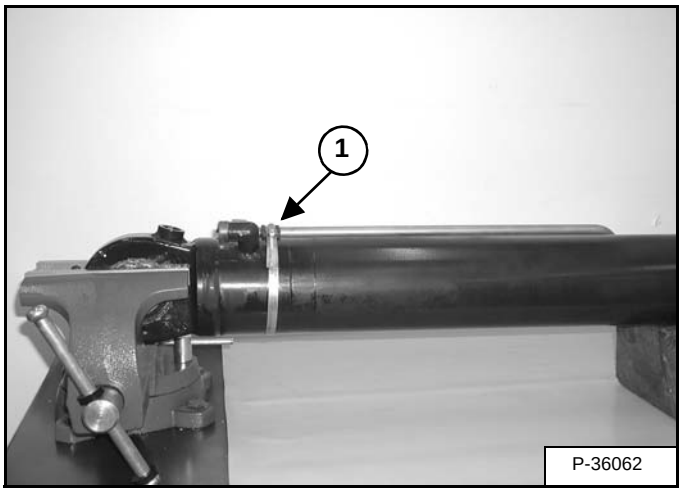
Be careful not to damage the cylinder housing.

Figure 20-21-16



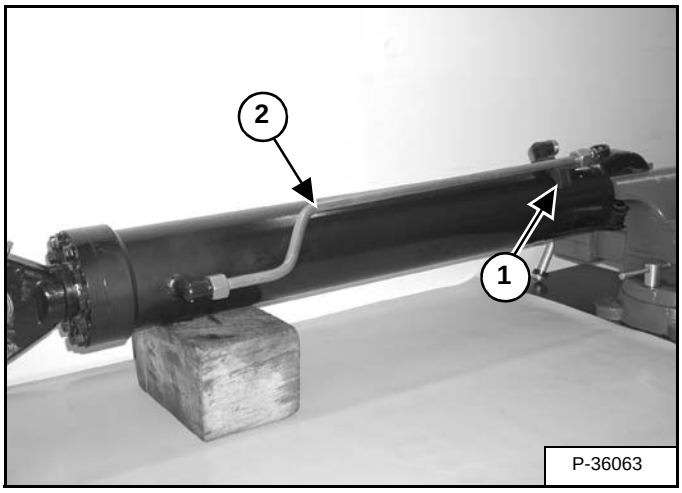
Support the cylinder with a block (Item 1) **[Figure 20-21-16]**.

Figure 20-21-17



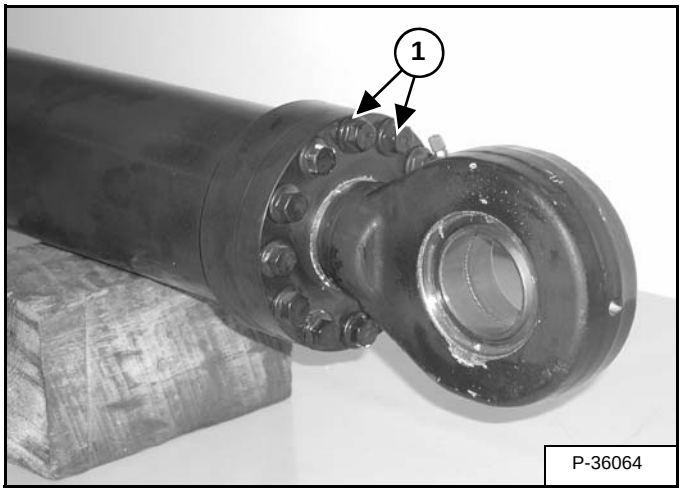
Remove the clamp (Item 1) **[Figure 20-21-17]**.

Figure 20-21-18



Remove the block (Item 1) and tube line (Item 2) **[Figure 20-21-18]**.

Figure 20-21-19



Remove the 12 bolts (Item 1) **[Figure 20-21-19]**.

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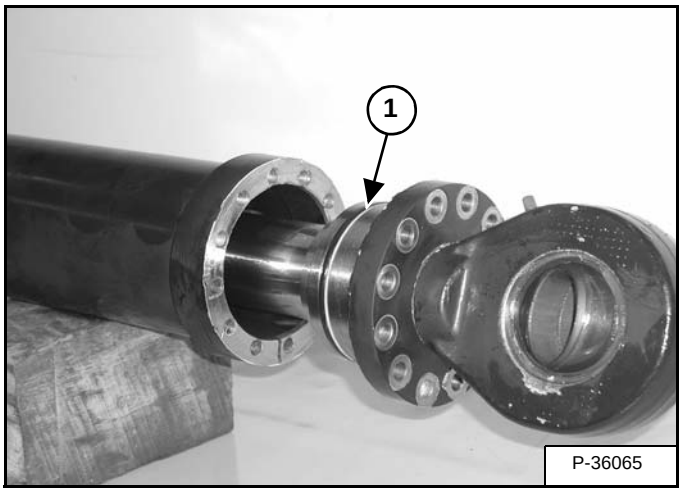
Disassembly (Cont'd)

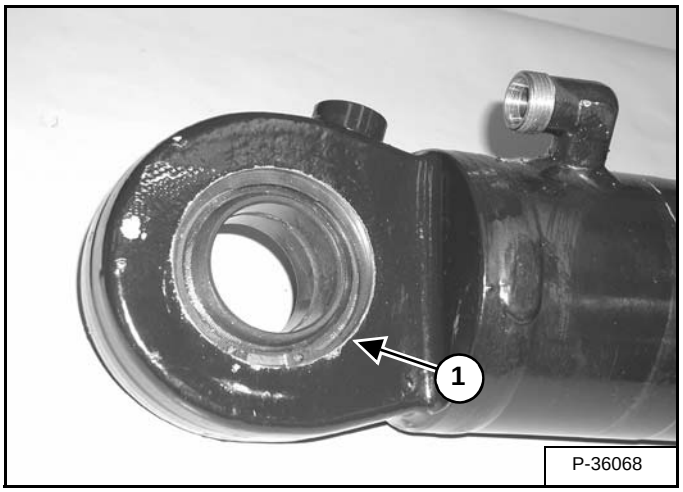
Figure 20-21-20



Remove the rod assembly (Item 1) **[Figure 20-21-20]**.

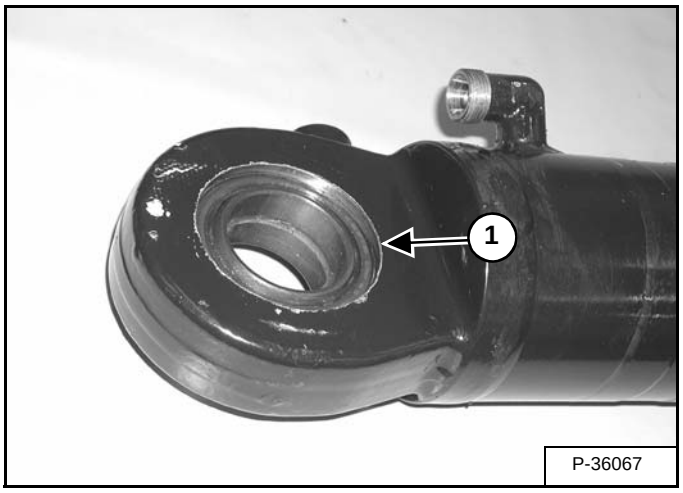
Remove the cylinder housing from the vise.

Figure 20-21-21



Remove the snap ring (Item 1) **[Figure 20-21-21]** from the base end of the cylinder.

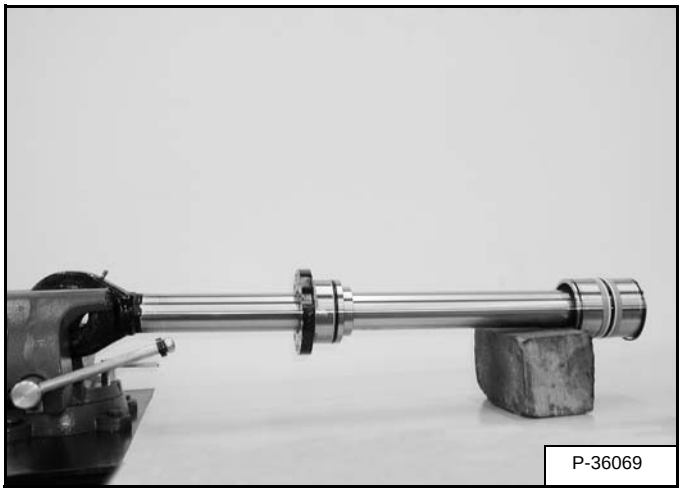
Figure 20-21-22



Remove the bearing (Item 1) **[Figure 20-21-22]**.

NOTE: The bearing can only be removed through the snap ring side of the housing.

Figure 20-21-23



Clamp the rod end in a vise. Support the end of the rod with a wood block (Item 1) **[Figure 20-21-23]**.

Use care not to damage the rod.

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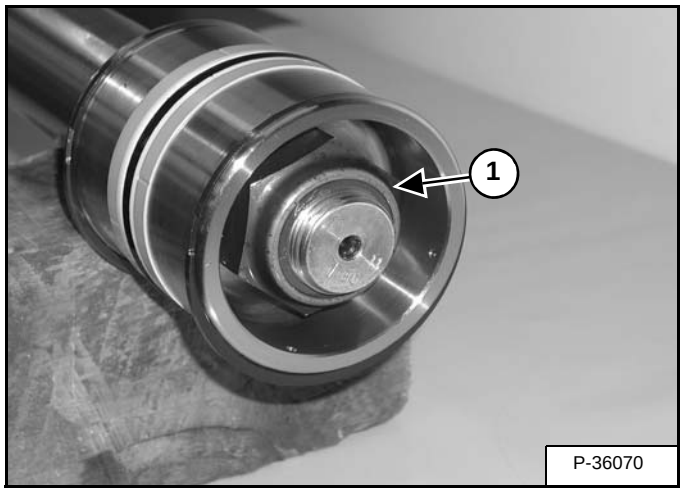
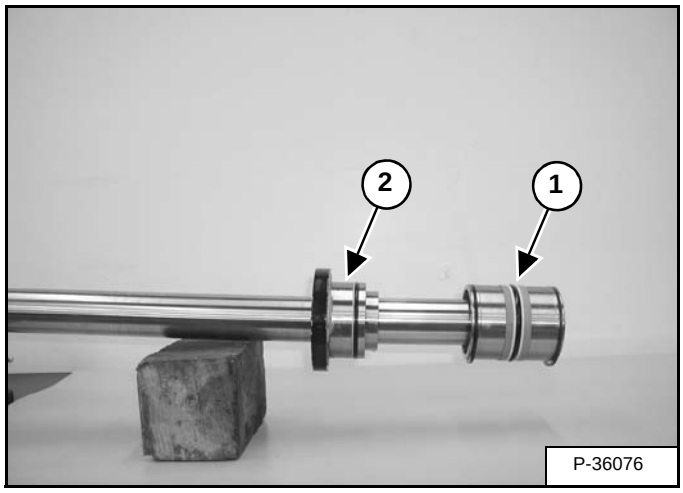
Disassembly (Cont'd)

Figure 20-21-24



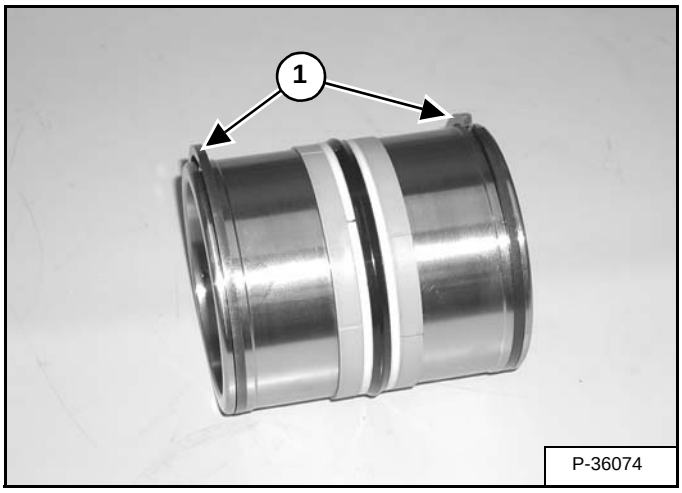
Apply moderate heat to the nut (Item 1) **[Figure 20-21-24]**. Remove the nut.

Figure 20-21-25



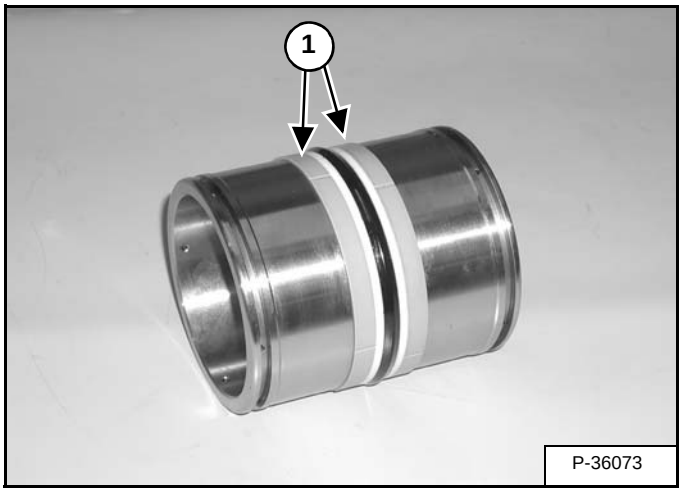
Remove the piston (Item 1) and head (Item 2) **[Figure 20-21-25]**.

Figure 20-21-26



Remove the steel rings (Item 1) **[Figure 20-21-26]** from the piston.

Figure 20-21-27



Remove the wear rings (Item 1) **[Figure 20-21-27]**.

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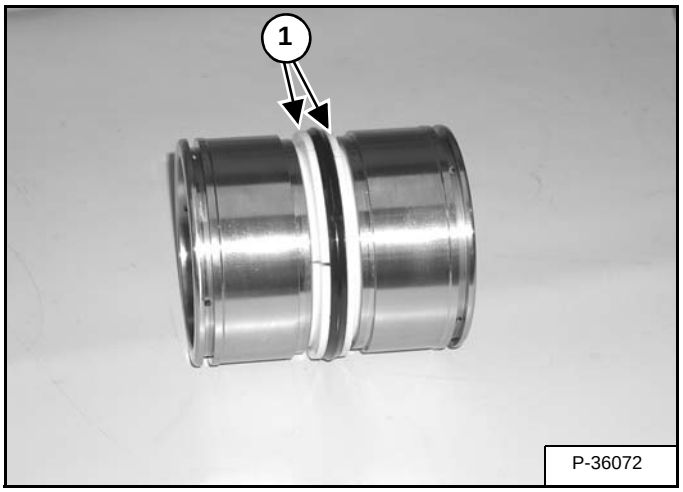
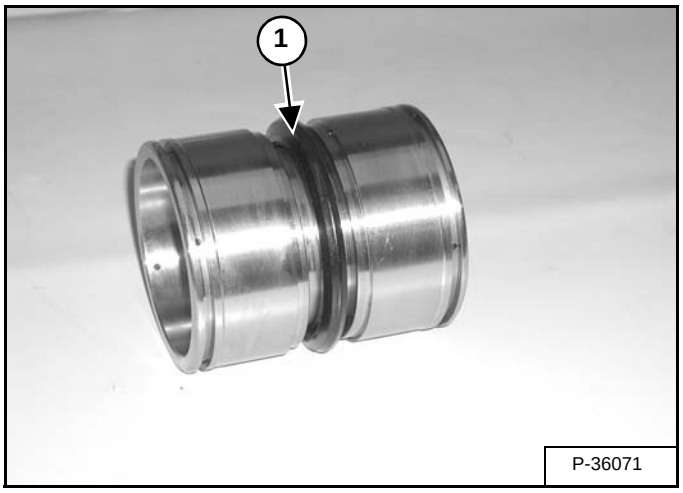
Disassembly (Cont'd)

Figure 20-21-28



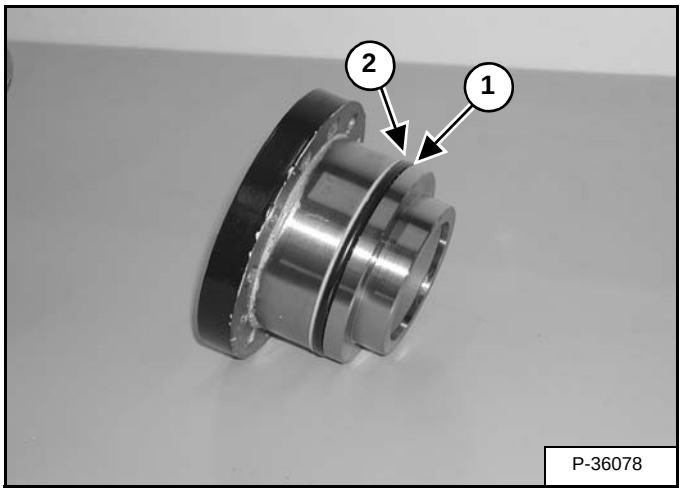
Remove the back-up rings (Item 1) **[Figure 20-21-28]**.

Figure 20-21-29



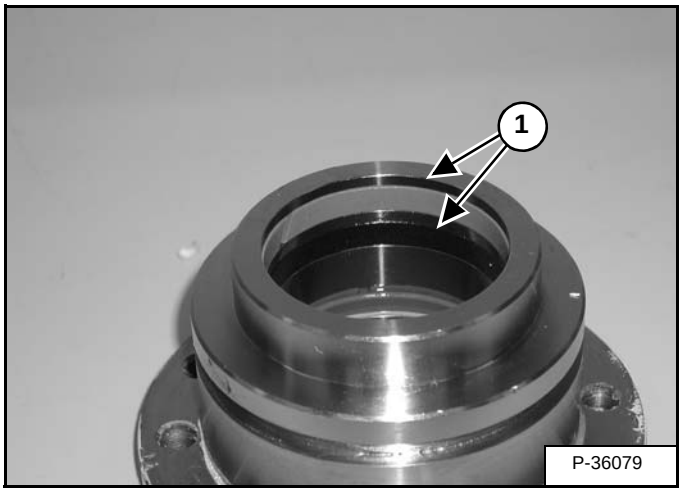
Remove the seal (Item 1) **[Figure 20-21-29]**.

Figure 20-21-30



Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-21-30]** from the head.

Figure 20-21-31



Remove the two wear rings (Item 1) **[Figure 20-21-31]**.

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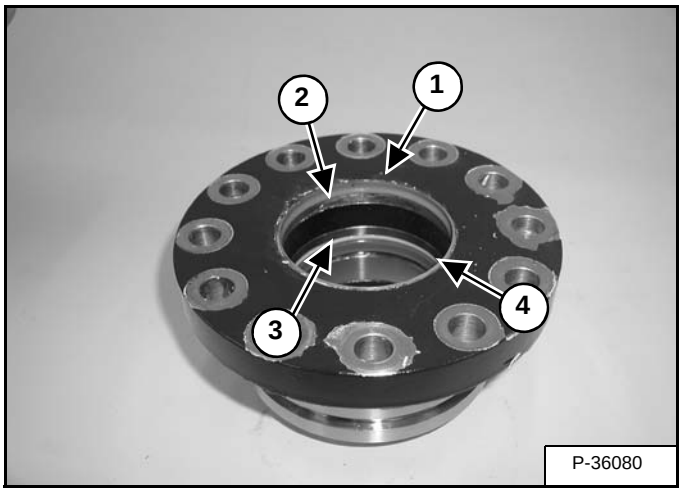
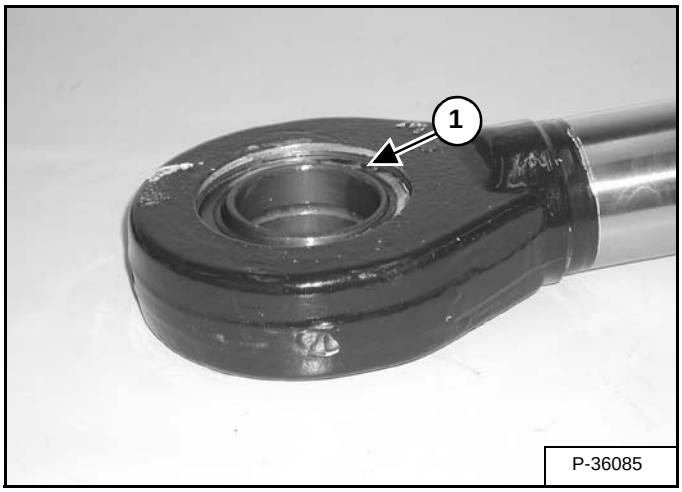
Disassembly (Cont'd)

Figure 20-21-32



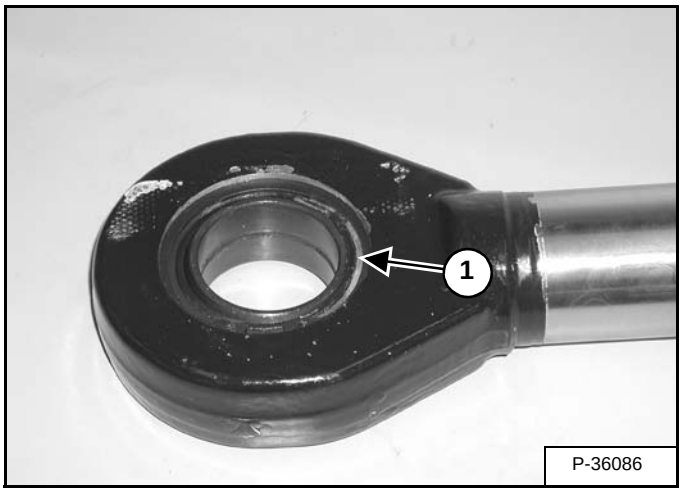
Remove the wiper (Item 1), wear ring (Item 2) seal, (Item 3) and back-up ring (Item 4) **[Figure 20-21-32]**.

Figure 20-21-33



Remove the rod from the vise. Remove the snap ring (Item 1) **[Figure 20-21-33]**.

Figure 20-21-34



Remove the bearing (Item 1) **[Figure 20-21-34]**.

NOTE: The bearing can only be removed through the snap ring side of the housing.

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Assembly

Use the following tools to assemble the cylinder:

MEl1396-Universal Seal Expander
MEL1033-Rod seal Installation Tool
Piston Ring Compressor

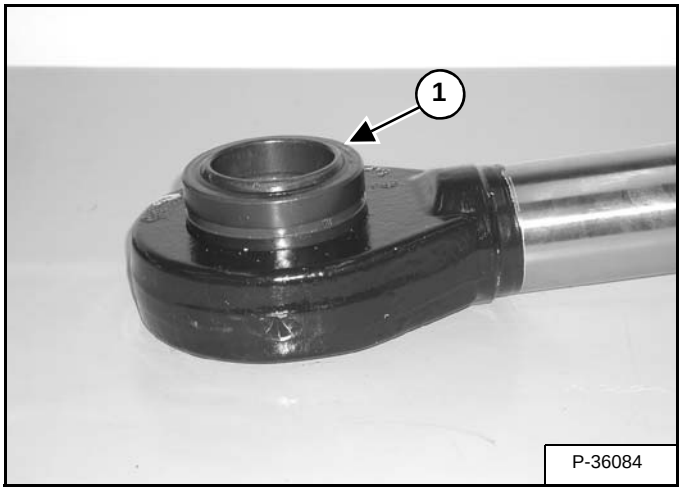
Wash the cylinder parts in clean solvent and dry them with compressed air.

Inspect the cylinder parts for nicks, scratches or other damage. Replace any damaged parts.

Always install new O-rings and seals during assembly.

Lubricate all O-rings and seals with hydraulic oil during installation.

Figure 20-21-35

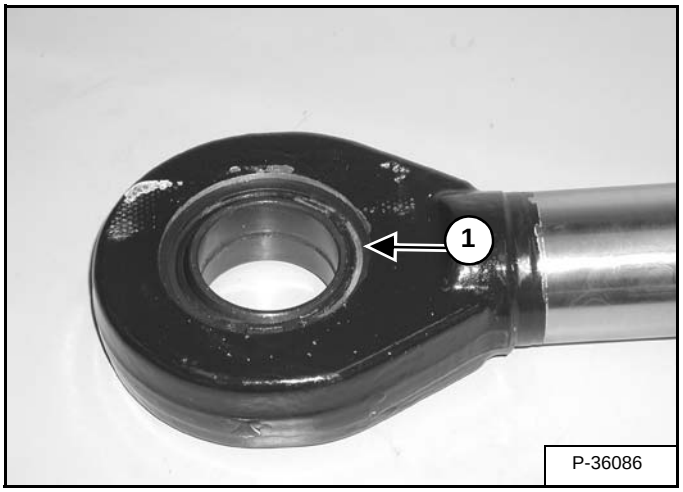


Install the bearing (Item 1) **[Figure 20-21-35]** in the rod end.

NOTE: The bearing can only be installed from the snap ring side of the housing.

Figure 20-21-36

Figure 20-21-37



Make sure the bearing is fully seated in the housing **[Figure 20-21-36]** and install the snap ring (Item 1) **[Figure 20-21-37]**.

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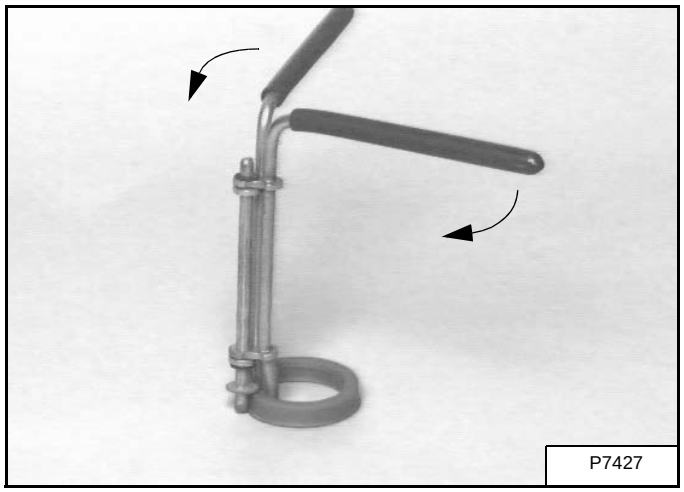
Assembly (Cont'd)

Figure 20-21-38

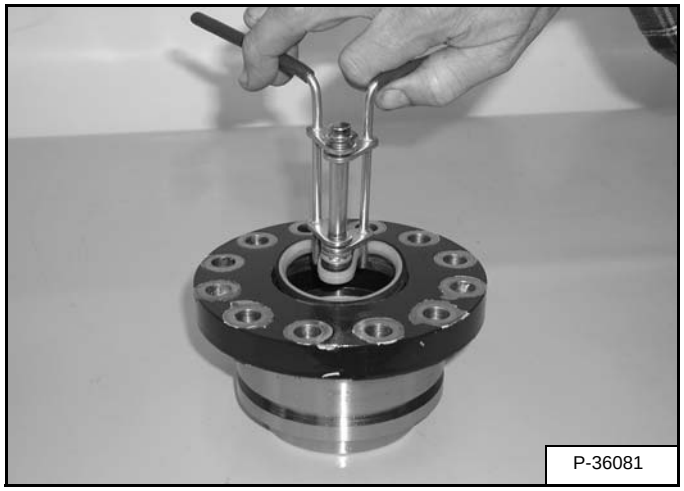


Install the rod seal on the rod seal tool **[Figure 20-21-38]**.

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

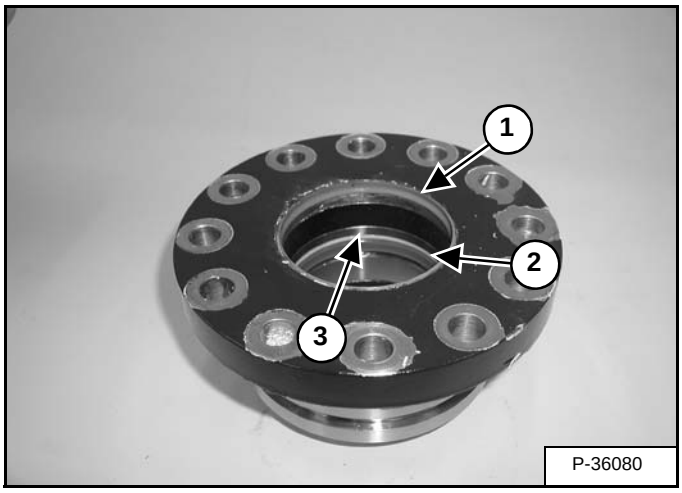
Rotate the handles to collapse the rod seal **[Figure 20-21-38]**.

Figure 20-21-39



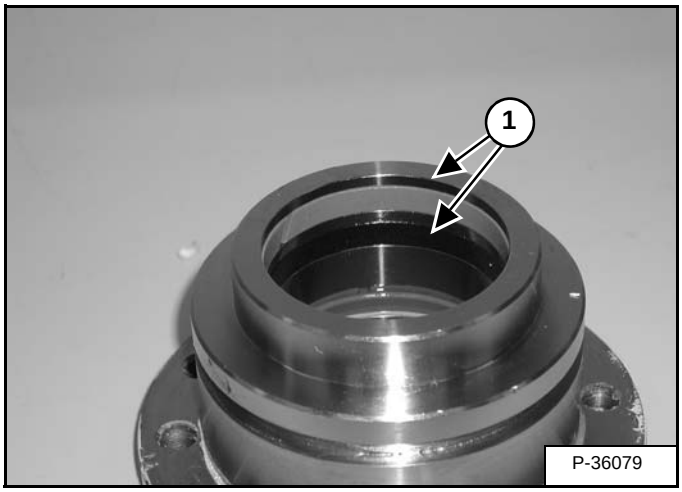
Install the rod seal in the head **[Figure 20-21-39]**.

Figure 20-21-40



Install the wiper (Item 1), wear ring (Item 2) and back-up ring (Item 3) **[Figure 20-21-40]**.

Figure 20-21-41



Install the two wear rings (Item 1) **[Figure 20-21-41]**.

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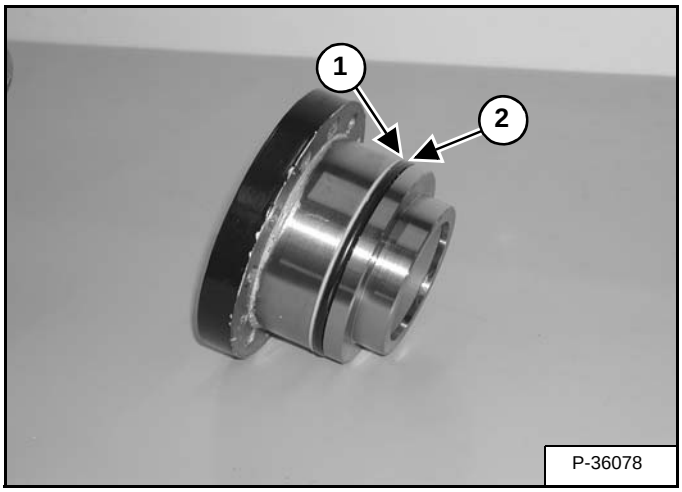
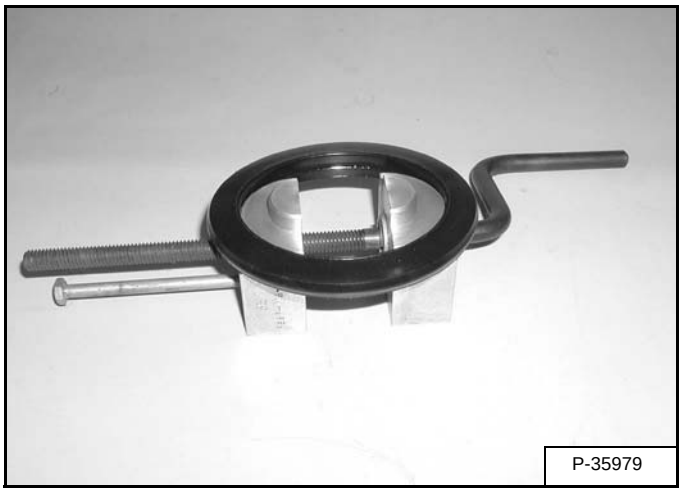
Assembly (Cont'd)

Figure 20-21-42



Install the back-up ring (Item 1) and O- ring (Item 2) **[Figure 20-21-42]** on the head.

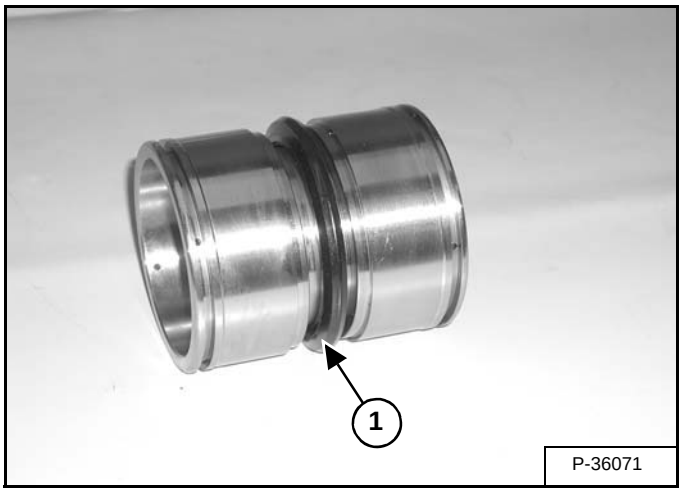
Figure 20-21-43



Install the new seal on the tool and slowly stretch it until it fits the piston **[Figure 20-21-43]**.

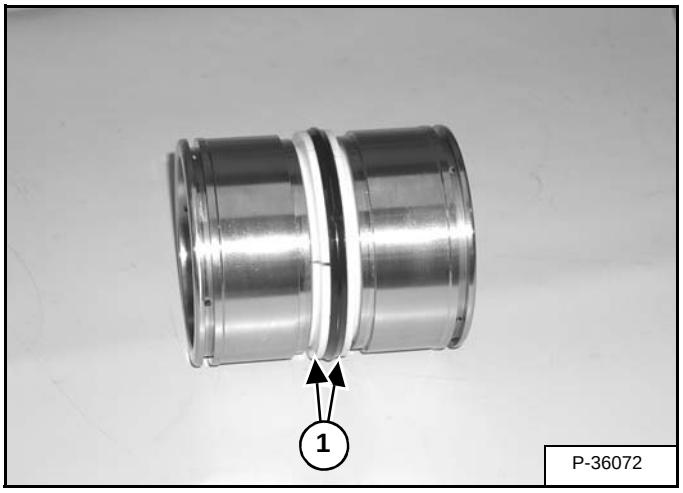
Allow the seal to stretch for 30 seconds before installing it on the piston.

Figure 20-21-44



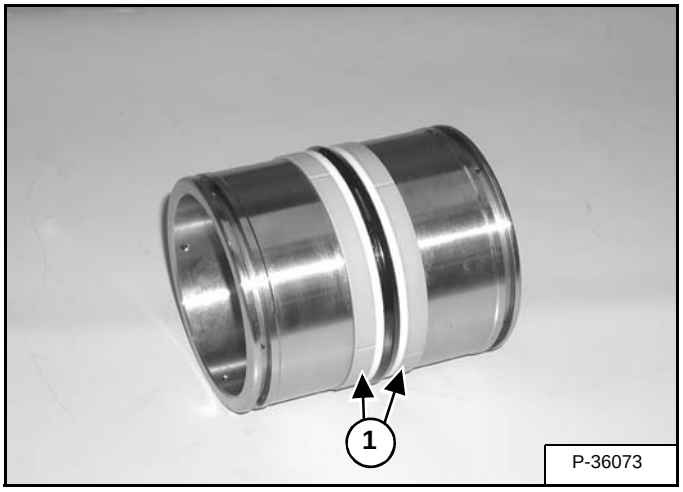
Install the seal (Item 1) **[Figure 20-21-44]** on the piston.

Figure 20-21-45



Install the back-up rings (Item 1) **[Figure 20-21-45]**.

Figure 20-21-46



Install the wear rings (Item 1) **[Figure 20-21-46]**.

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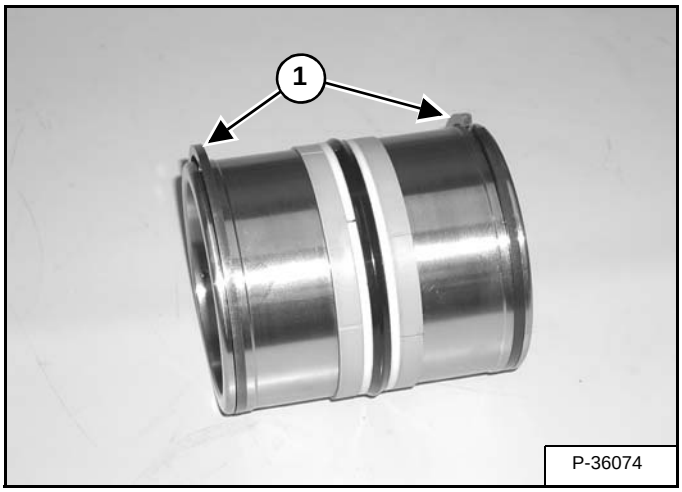
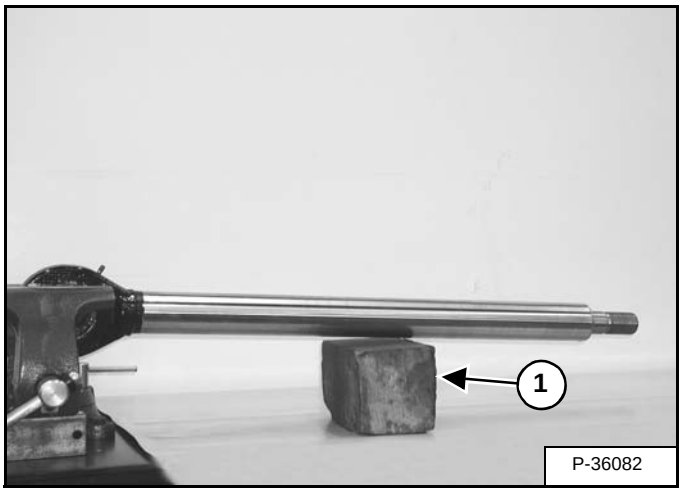
Assembly (Cont'd)

Figure 20-21-47



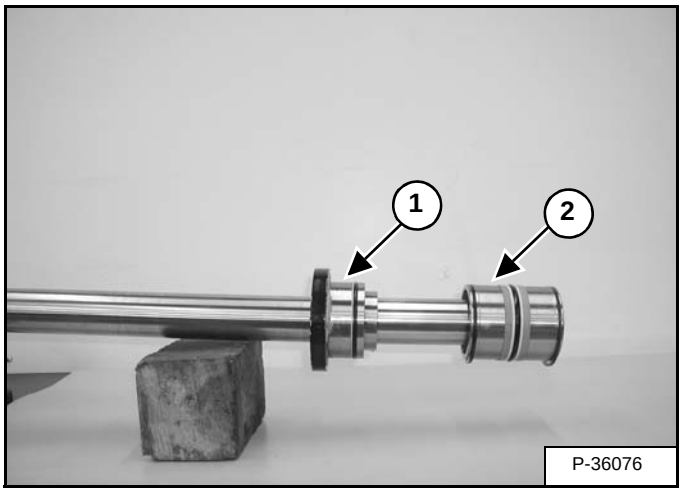
Install the steel rings (Item 1) **[Figure 20-21-47]**.

Figure 20-21-48



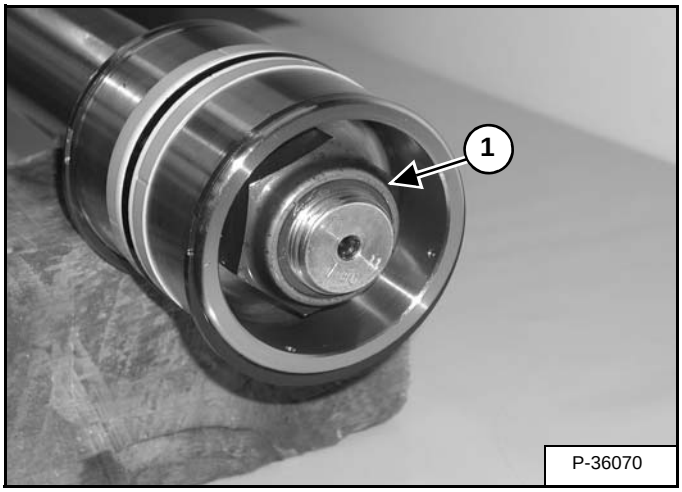
Clamp the rod end in a vise. Support the end of the rod with a wood block (Item 1) **[Figure 20-21-48]**. Use care not to damage the rod.

Figure 20-21-49



Install the head (Item 1) and piston (Item 2) **[Figure 20-21-49]**.

Figure 20-21-50



Apply thread lock adhesive (Loctite™ 270) to the threads and install the nut (Item 1) **[Figure 20-21-50]**.

Tighten the nut to 1364 ft.-lb. (1850 N•m) torque.

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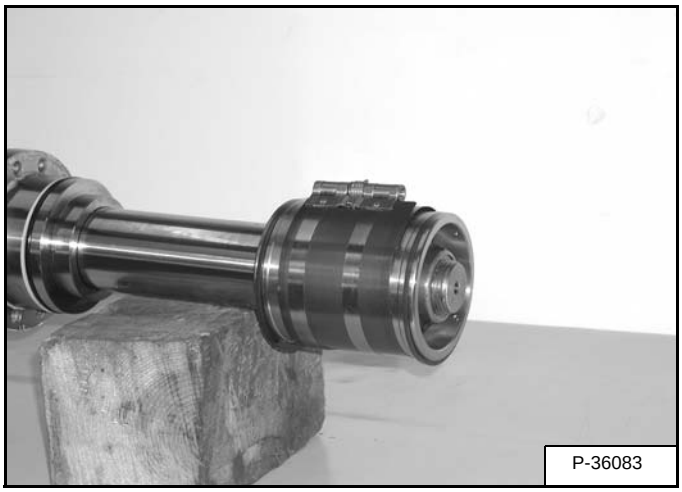
Assembly (Cont'd)

Figure 20-21-51

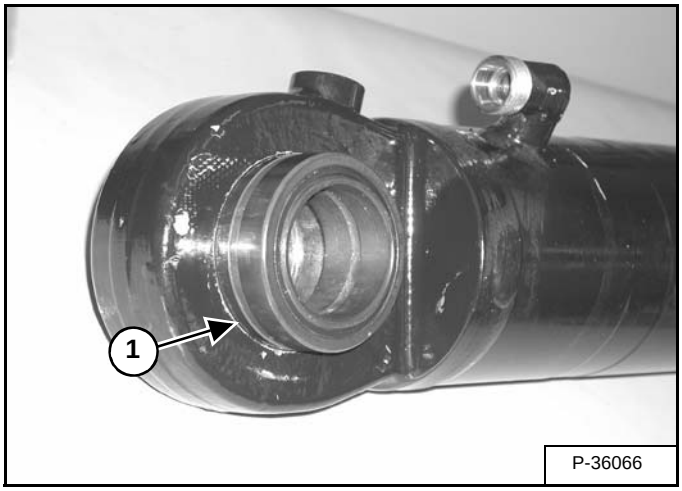


Install a ring compressor on the piston (Item 1) **[Figure 20-21-51]** and compress the seal to the correct size.

Leave the piston in the compressor for three minutes.

Remove the rod and head assembly from the vise.

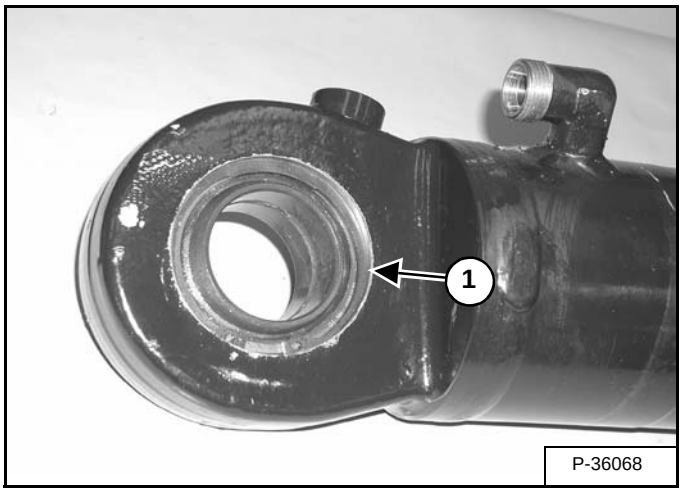
Figure 20-21-52



Install the bearing (Item 1) **[Figure 20-21-52]** into the base end of the cylinder housing.

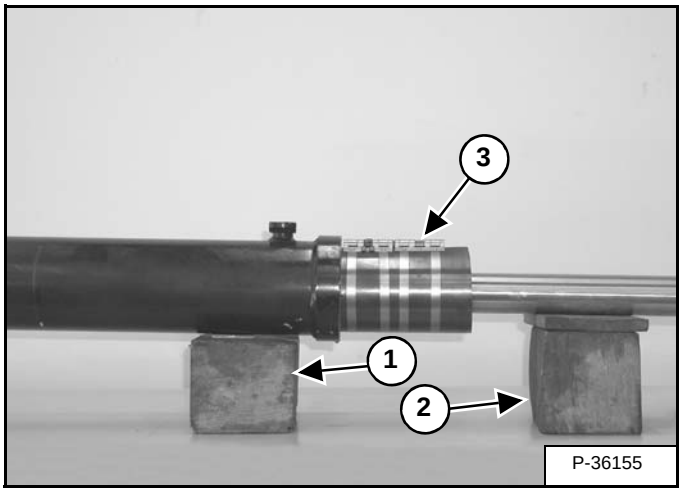
NOTE: The bearing can only be installed through the snap ring side of the housing.

Figure 20-21-53



Fully seat the bearing and install the snap ring (Item 1) **[Figure 20-21-53]**.

Figure 20-21-54



Clamp the base end of the cylinder in a vise and support the end of the housing with a block (Item 1) **[Figure 20-21-54]**.

Use care not to damage the cylinder housing.

Support the rod assembly with wood blocks (Item 2) **[Figure 20-21-54]**.

Install a ring compressor (Item 3) **[Figure 20-21-54]** on the piston to compress the steel rings to the correct size.

Push the piston into the housing.

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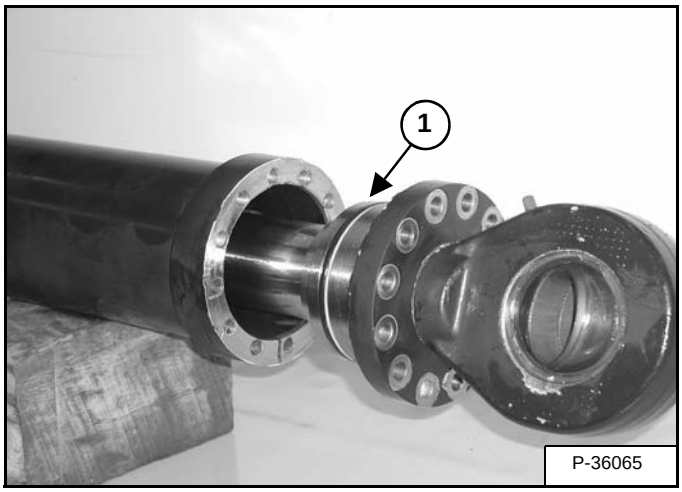
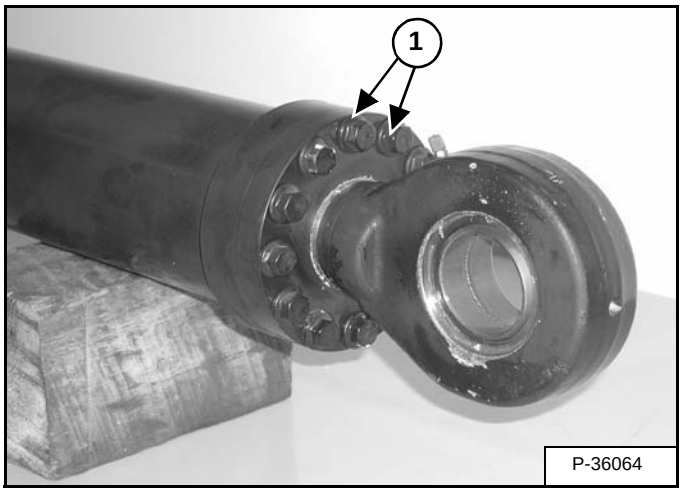
Assembly (Cont'd)

Figure 20-21-55



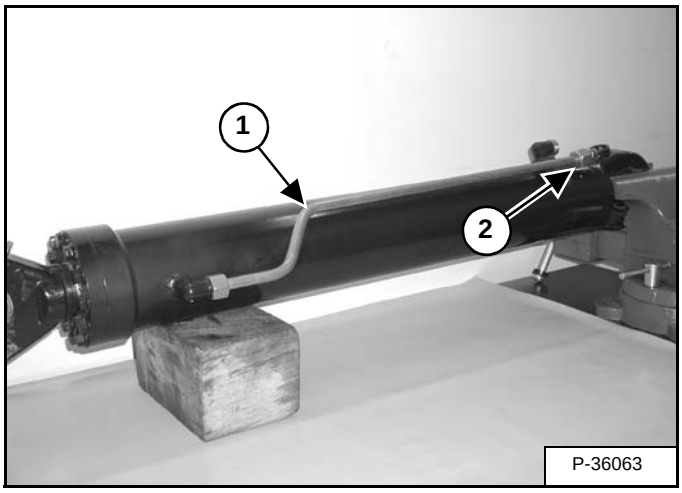
Install the head (Item 1) **[Figure 20-21-55]** in the housing.

Figure 20-21-56



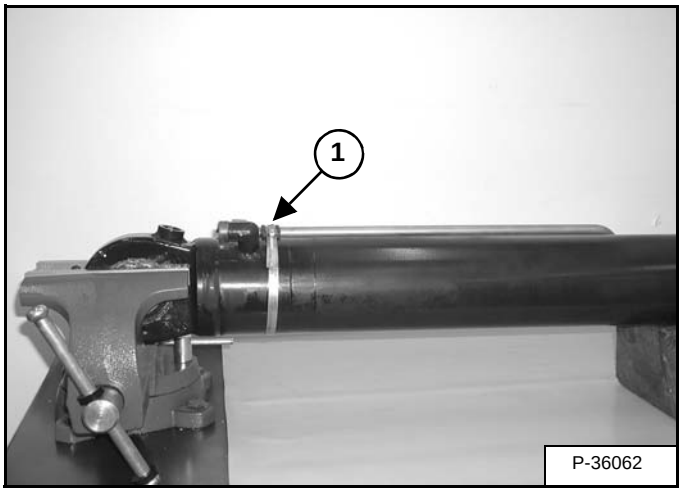
Install the 12 bolts (Item 1) **[Figure 20-21-56]** and tighten to 114 ft.-lb. (155 N•m) torque.

Figure 20-21-57



Install the tubeline (Item 1) and block (Item 2) **[Figure 20-21-57]**.

Figure 20-21-58



Install the clamp (Item 1) **[Figure 20-21-58]**.

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BOOM OFFSET CYLINDER

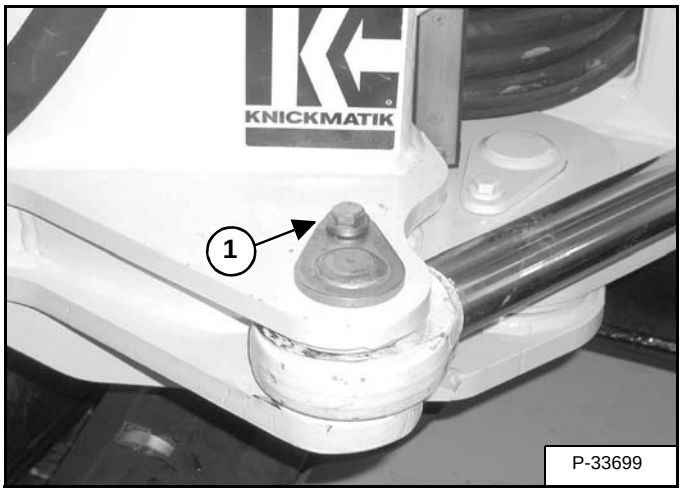
Testing

Swing the boom to the right, fully extending the boom offset cylinder.

Lower the boom/bucket to the ground.

Stop the engine.

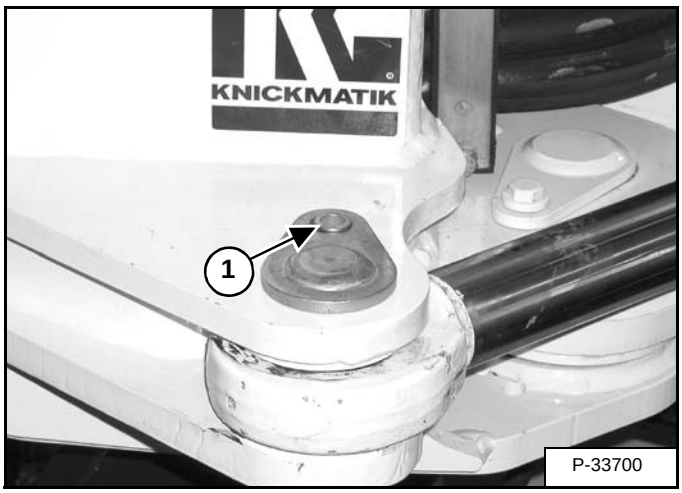
Figure 20-22-1



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

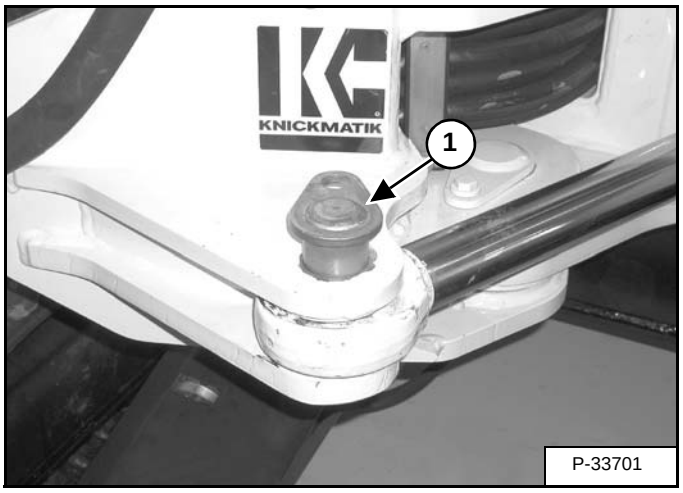
Installation: Tighten the bolt to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 20-22-2



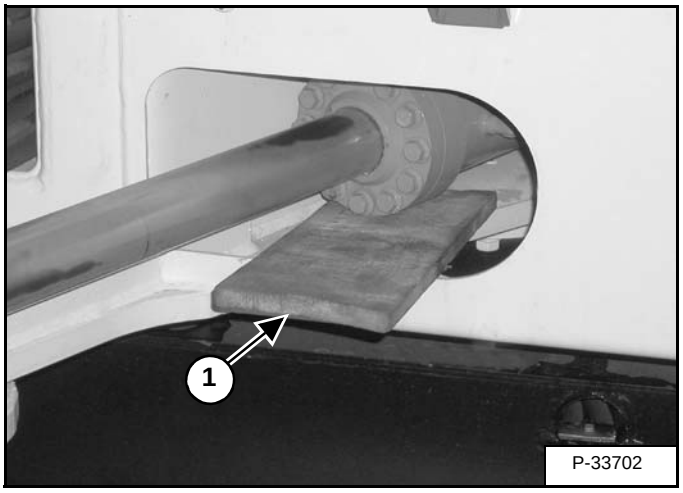
Remove the spacer (Item 1) **[Figure 20-22-2]**.

Figure 20-22-3



Remove the pin (Item 1) **[Figure 20-22-3]**.

Figure 20-22-4



Place a board (Item 1) **[Figure 20-22-4]** between the cylinder and excavator frame.

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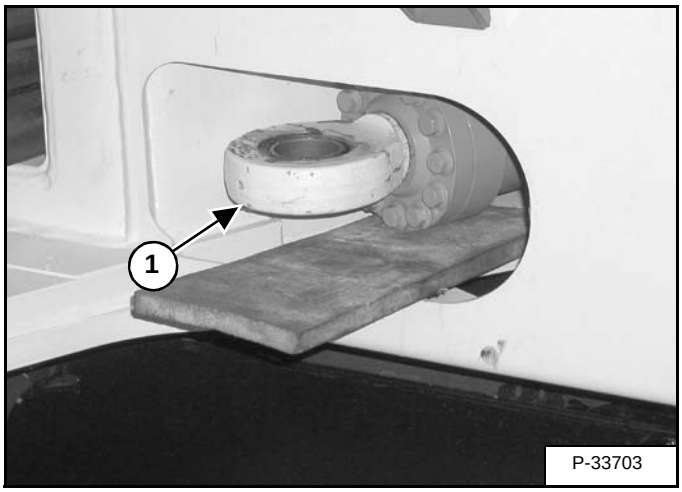
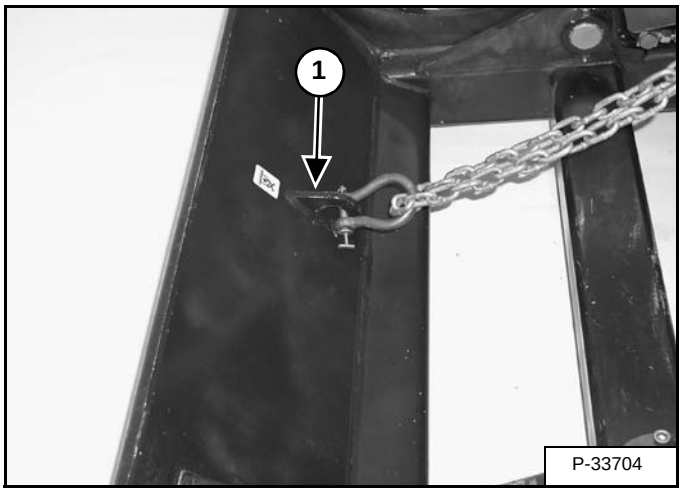
Testing (Cont'd)

Figure 20-22-5



Start the excavator and fully retract the boom offset cylinder (Item 1) **[Figure 20-22-5]**.

Figure 20-22-6



To test the cylinder, the cab must be tilted. Use the blade (Item 1) **[Figure 20-22-6]** as an attaching point for the hand winch and tilt the cab. (See Tilting The Cab on Page 10-160-2).

NOTE: Make sure the blade is not in the float position (if equipped) before tilting the cab.

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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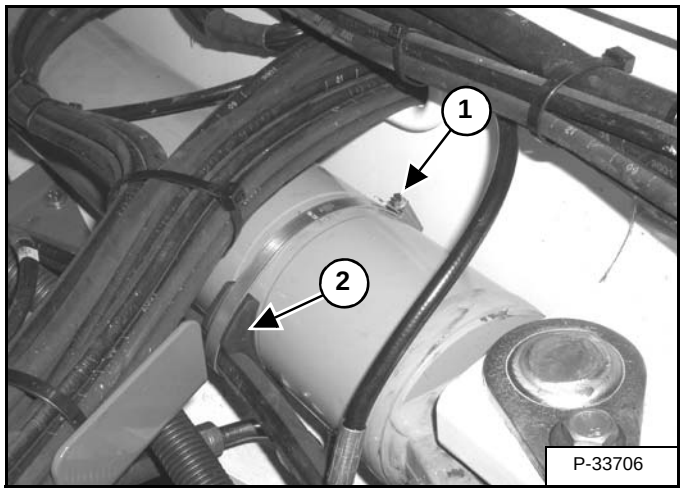
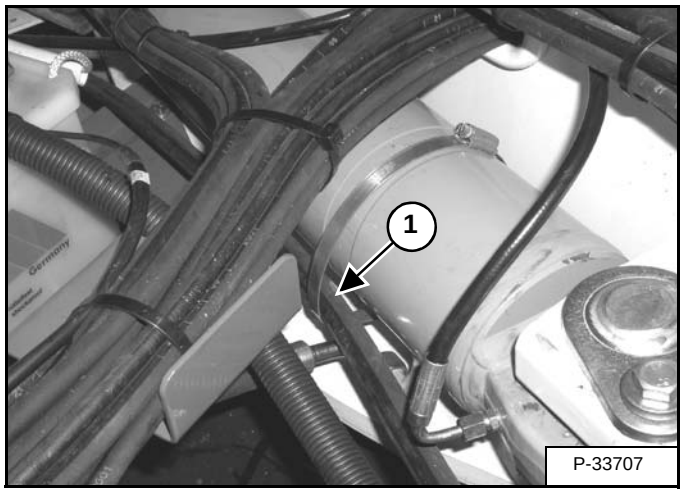
Figure 20-22-7



Loosen the clamp (Item 1) **[Figure 20-22-7]**.

Remove the block (Item 2) **[Figure 20-22-7]**.

Figure 20-22-8



Reposition the rod end hose (Item 1) **[Figure 20-22-8]** from the clamp.

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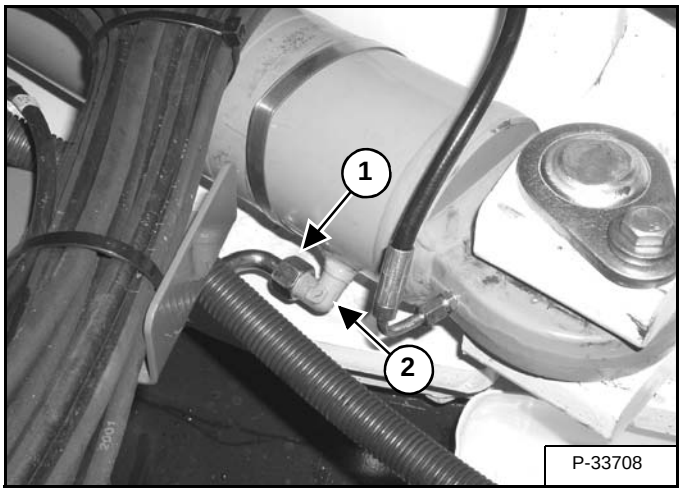
Testing (Cont'd)

Figure 20-22-9



Remove the base end hose (Item 1) **[Figure 20-22-9]**.

Install a plug on the hose. Start the engine.

Retract the cylinder.

If there is any oil leakage from the base end fitting (Item 2) **[Figure 20-22-9]** on the boom offset cylinder, remove the cylinder for repair or replacement.

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BOOM OFFSET CYLINDER

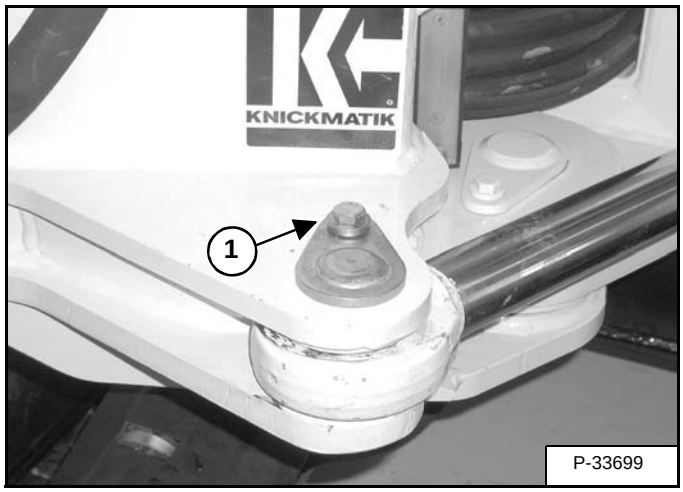
Removal And Installation

Swing the boom to the right, fully extending the boom offset cylinder.

Lower the boom/bucket to the ground.

Stop the engine.

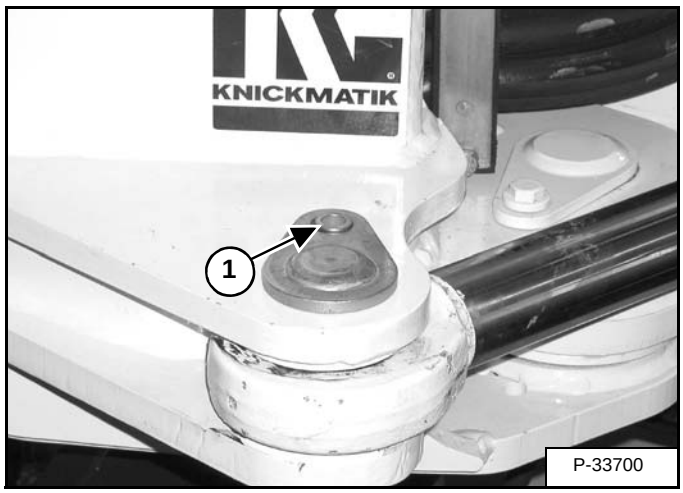
Figure 20-22-10



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

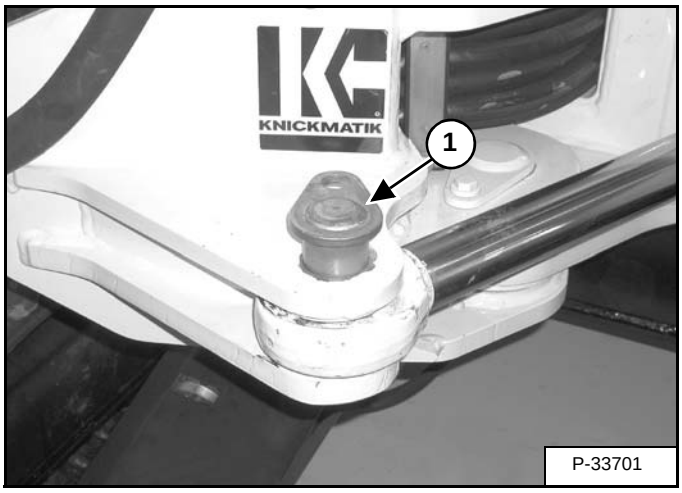
Installation: Tighten the bolt to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 20-22-11



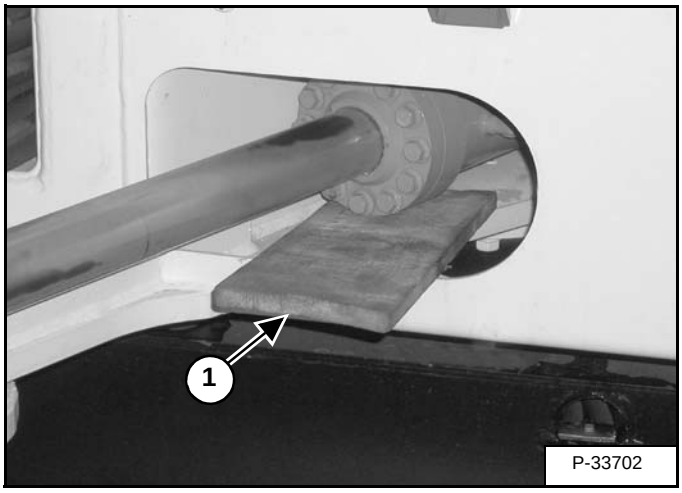
Remove the spacer (Item 1) **[Figure 20-22-11]**.

Figure 20-22-12



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

Figure 20-22-13



Place a board (Item 1) **[Figure 20-22-13]** between the cylinder and excavator frame.

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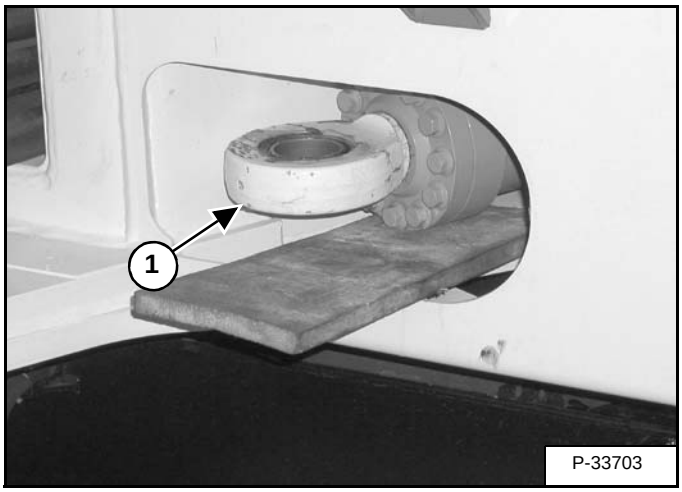
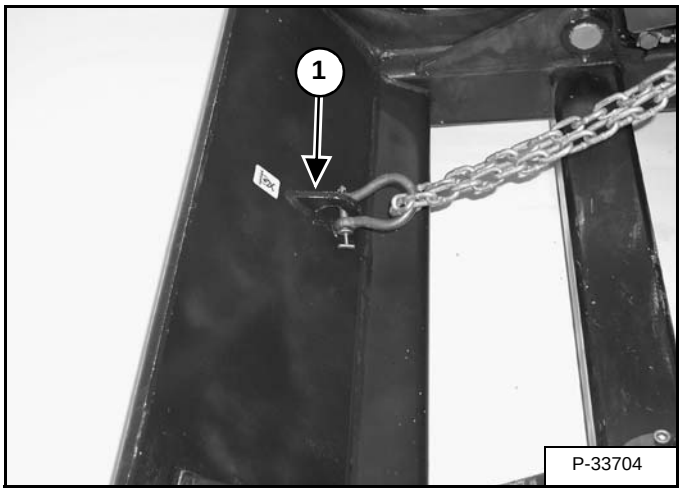
Removal And Installation (Cont'd)

Figure 20-22-14



Start the excavator and fully retract the boom offset cylinder (Item 1) **[Figure 20-22-14]**.

Figure 20-22-15



To remove the cylinder, the cab must be tilted. Use the blade (Item 1) **[Figure 20-22-15]** as an attaching point for the hand winch and tilt the cab. (SSee Tilting The Cab on Page 10-160-2).

NOTE: Make sure the blade is not in the float position (if equipped) before tilting the cab.

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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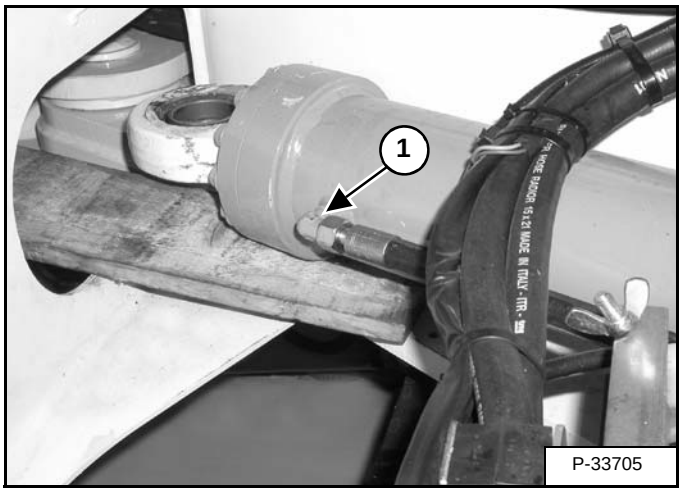
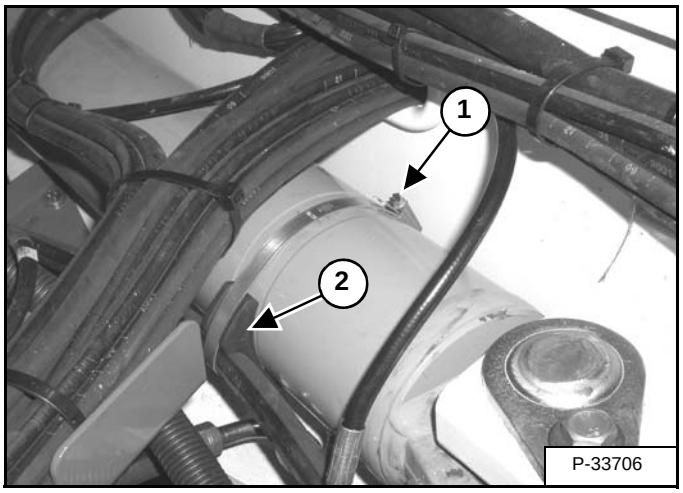
Figure 20-22-16



Remove the rod end hose (Item 1) **[Figure 20-22-16]**.

Figure 20-22-17



Loosen the clamp (Item 1) **[Figure 20-22-17]**.

Remove the block (Item 2) **[Figure 20-22-17]**.

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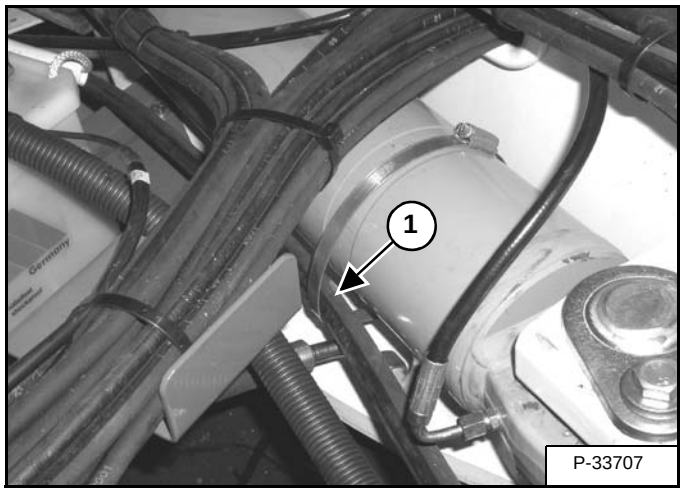
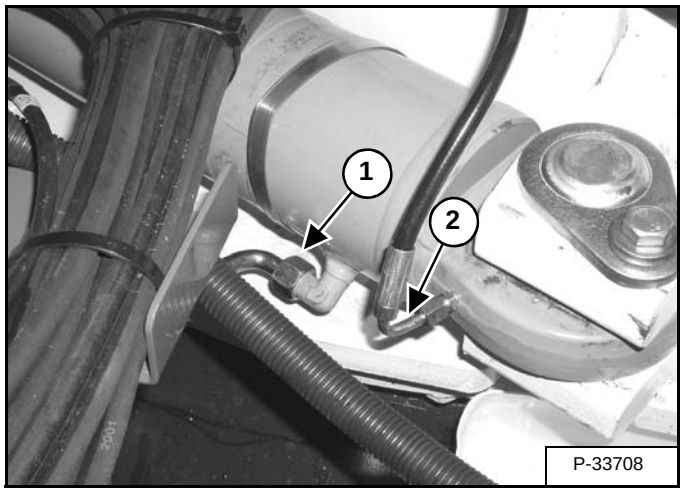
Removal And Installation (Cont'd)

Figure 20-22-18



Remove the rod end hose (Item 1) **[Figure 20-22-18]** from the clamp.

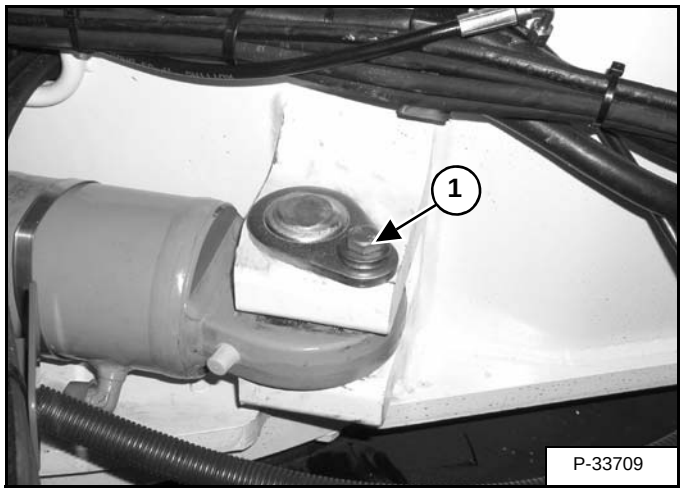
Figure 20-22-19



Remove the base end hose (Item 1) **[Figure 20-22-19]**.

Remove the remote grease hose (Item 2) **[Figure 20-22-19]**.

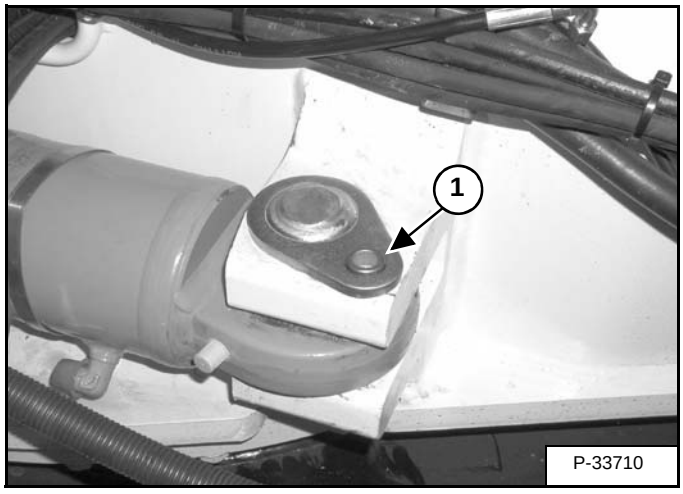
Figure 20-22-20



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

Installation: Tighten the bolt to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 20-22-21



Remove the spacer (Item 1) **[Figure 20-22-21]**.

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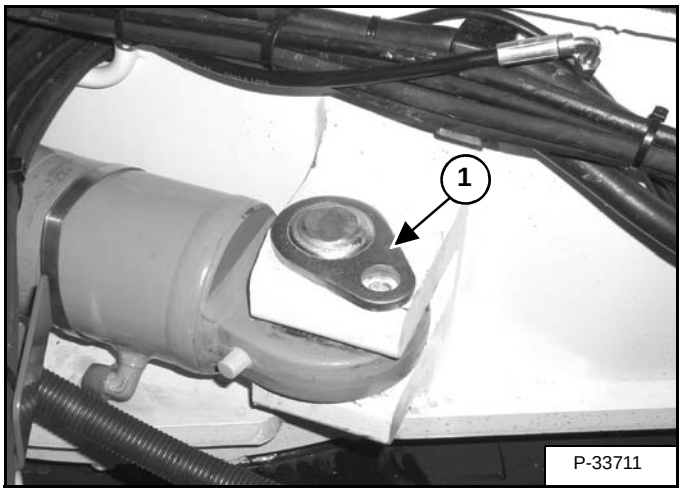
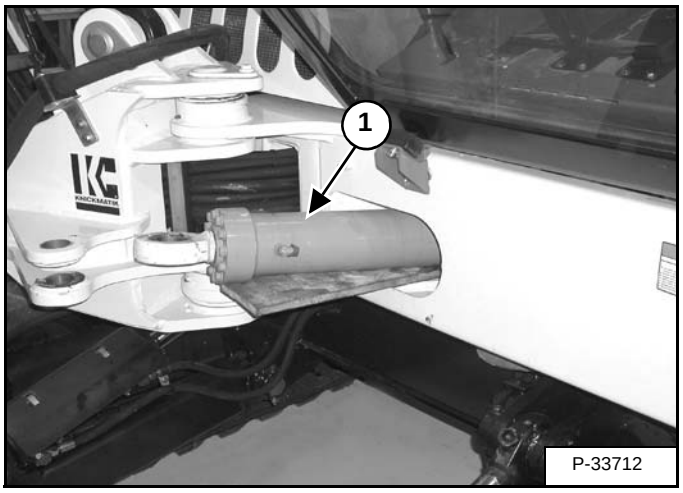
Removal And Installation (Cont'd)

Figure 20-22-22



Remove the pin (item 1) **[Figure 20-22-22]**.

Figure 20-22-23



Slide the cylinder (Item 1) **[Figure 20-22-23]** out the front of the excavator.

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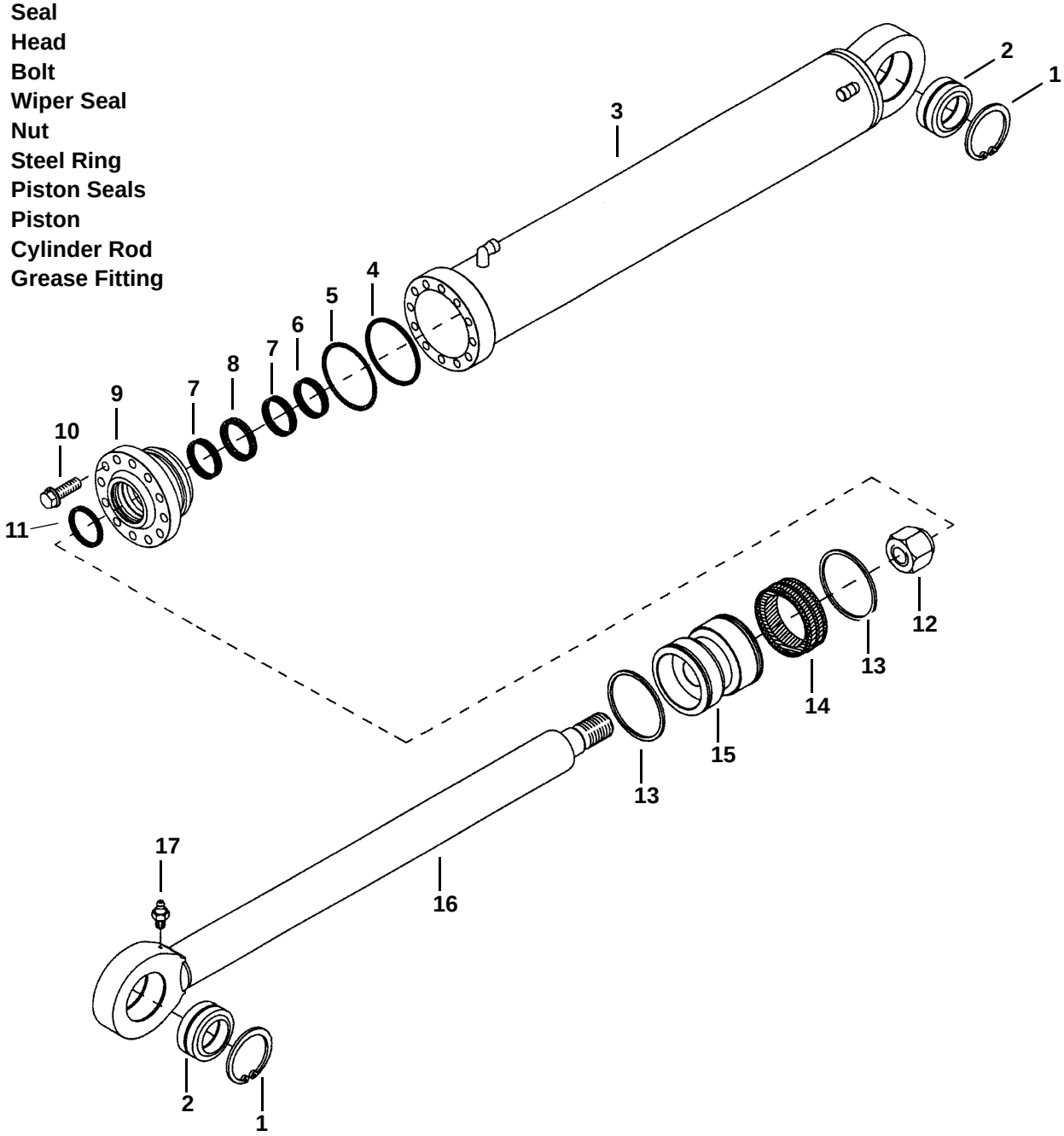
Parts Identification

1. **Snap Ring**
2. **Bearing**
3. **Housing**
4. **O-Ring**
5. **Backup Ring**
6. **Ring**
7. **Seal**
8. **Seal**
9. **Head**
10. **Bolt**
11. **Wiper Seal**
12. **Nut**
13. **Steel Ring**
14. **Piston Seals**
15. **Piston**
16. **Cylinder Rod**
17. **Grease Fitting**



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Disassembly

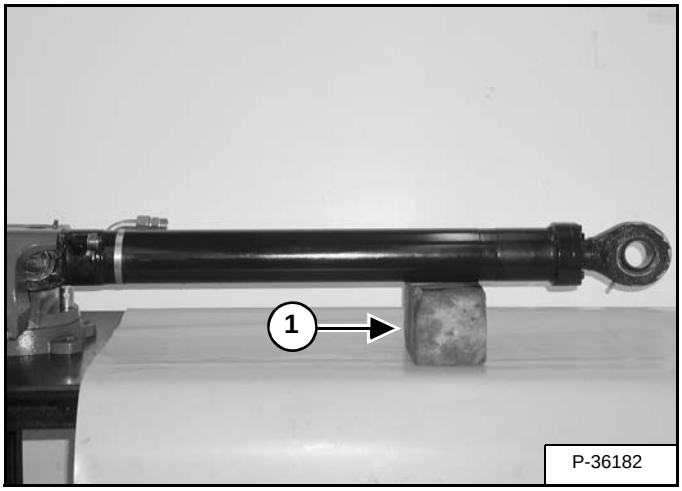
Use the following tools to disassemble the cylinder:

MEL1074-O-ring Seal Hook

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

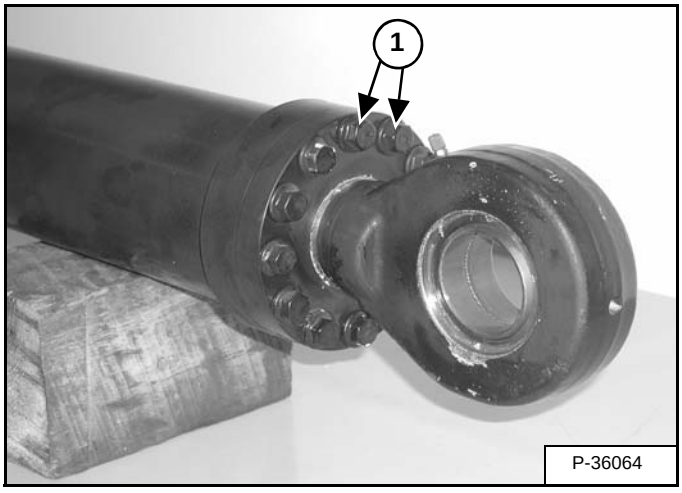
Clamp the base end of the cylinder in a vise.

Figure 20-22-24



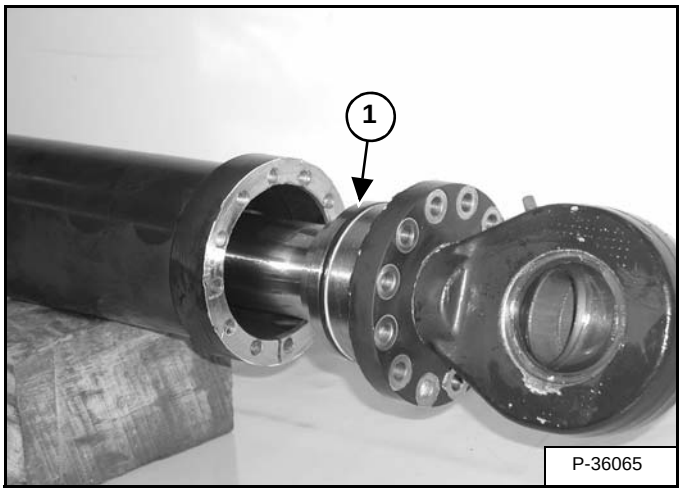
Support the cylinder with a block (Item 1) **[Figure 20-22-24]**. Use care not to damage the cylinder housing.

Figure 20-22-25



Remove the 12 bolts (Item 1) **[Figure 20-22-25]**.

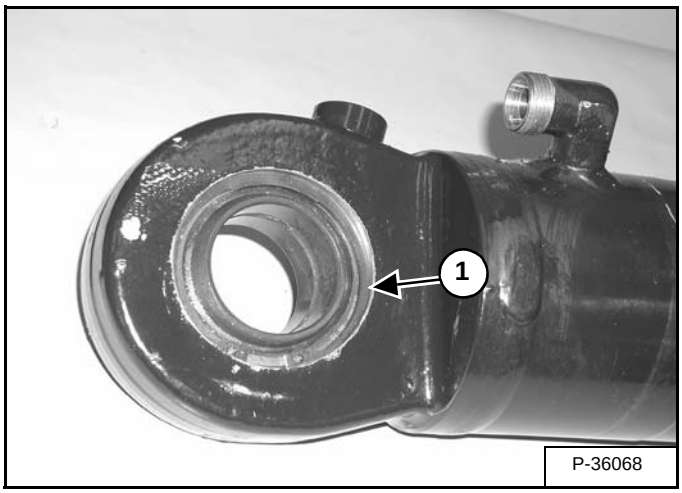
Figure 20-22-26



Remove the rod assembly (Item 1) **[Figure 20-22-26]**.

Remove the cylinder housing from the vise.

Figure 20-22-27



Remove the snap ring (Item 1) **[Figure 20-22-27]** from the base end of the cylinder.

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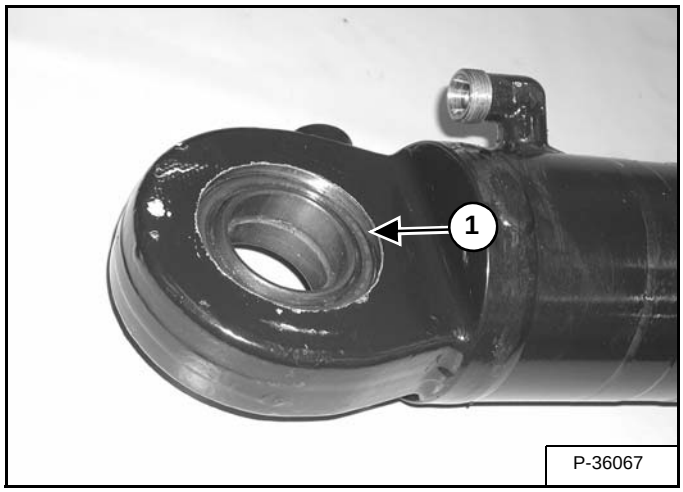
Disassembly (Cont'd)

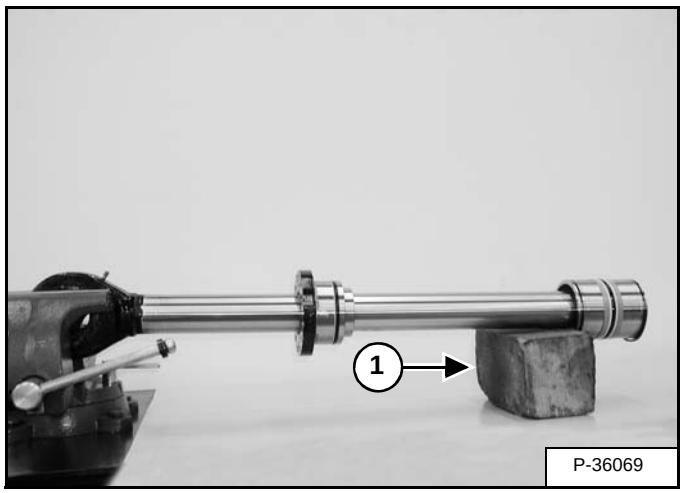
Figure 20-22-28



Remove the bearing (Item 1) **[Figure 20-22-28]**.

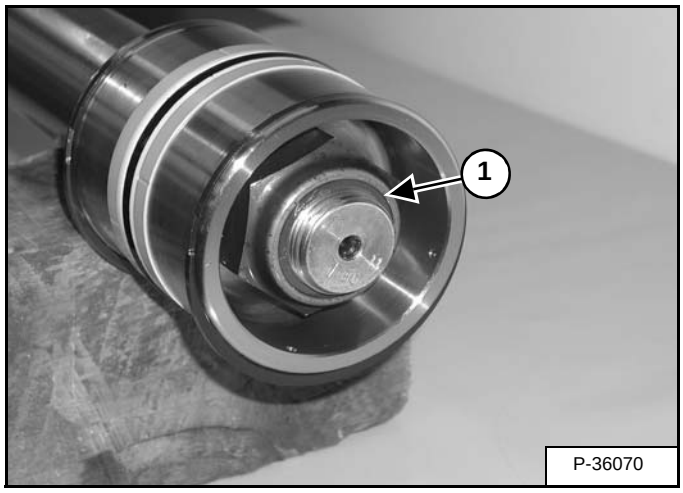
NOTE: The bearing can only be removed through the snap ring side of the housing.

Figure 20-22-29



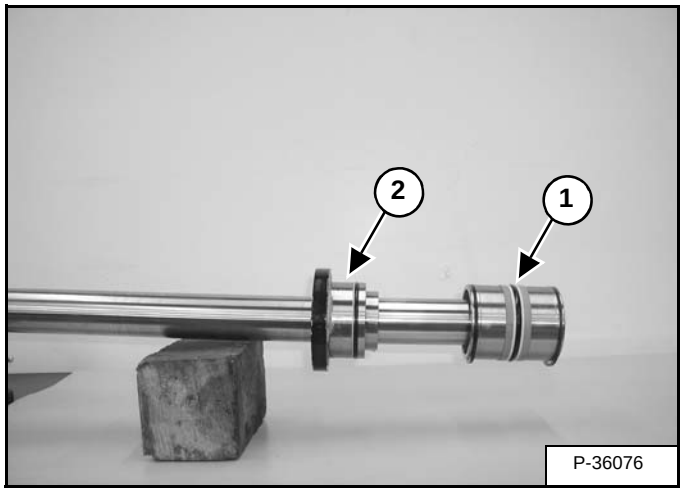
Clamp the rod end in a vise. Support the end of the rod with a wood block (Item 1) **[Figure 20-22-29]**. Use care not to damage the rod.

Figure 20-22-30



Apply moderate heat to the nut (Item 1) **[Figure 20-22-30]**. Remove the nut.

Figure 20-22-31



Remove the piston (Item 1) and head (Item 2) **[Figure 20-22-31]**.

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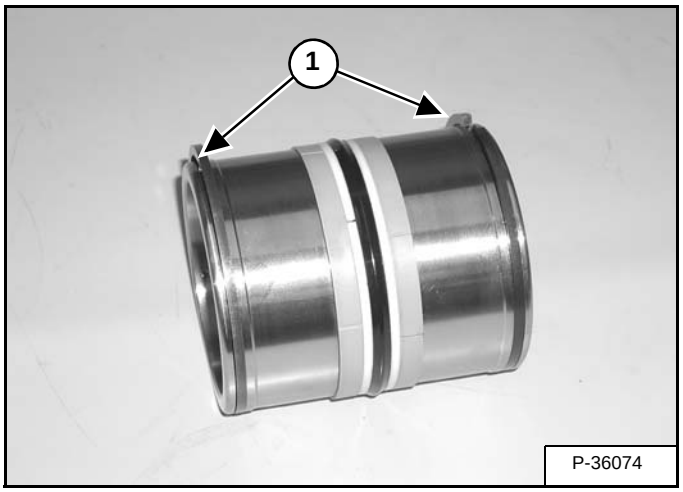
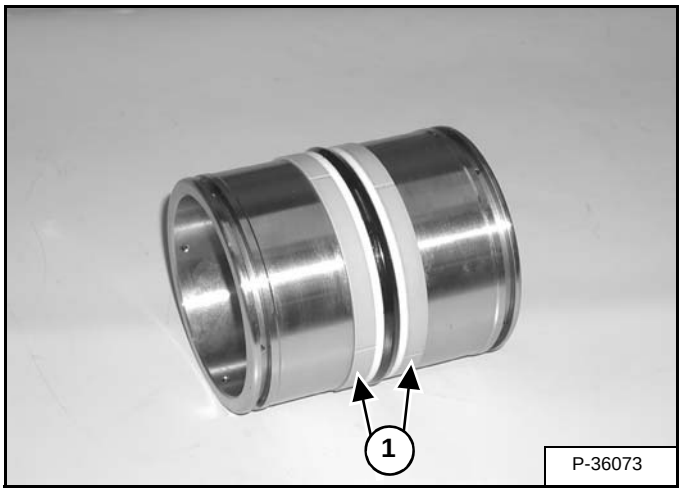
Disassembly (Cont'd)

Figure 20-22-32



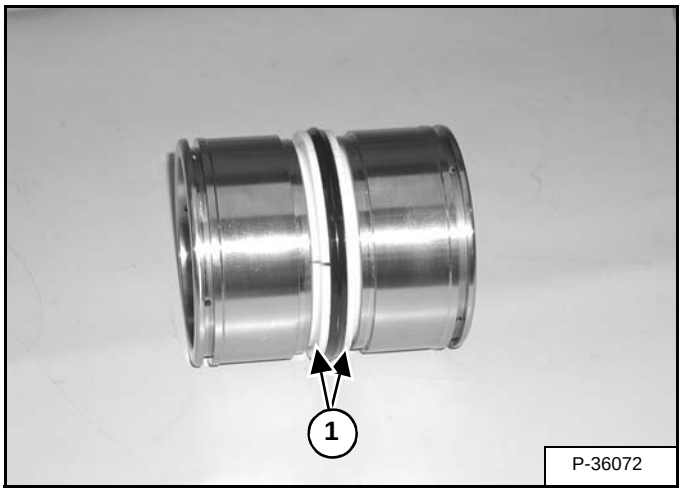
Remove the steel rings (Item 1) **[Figure 20-22-32]** from the piston.

Figure 20-22-33



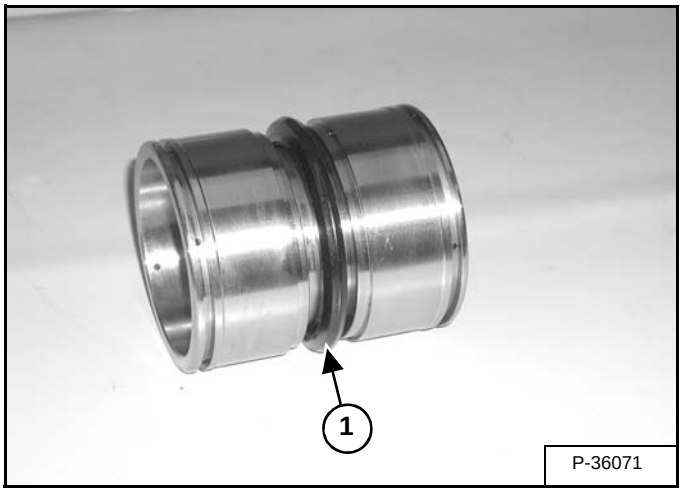
Remove the wear rings (Item 1) **[Figure 20-22-33]**.

Figure 20-22-34



Remove the back-up rings (Item 1) **[Figure 20-22-34]**.

Figure 20-22-35



Remove the seal (Item 1) **[Figure 20-22-35]**.

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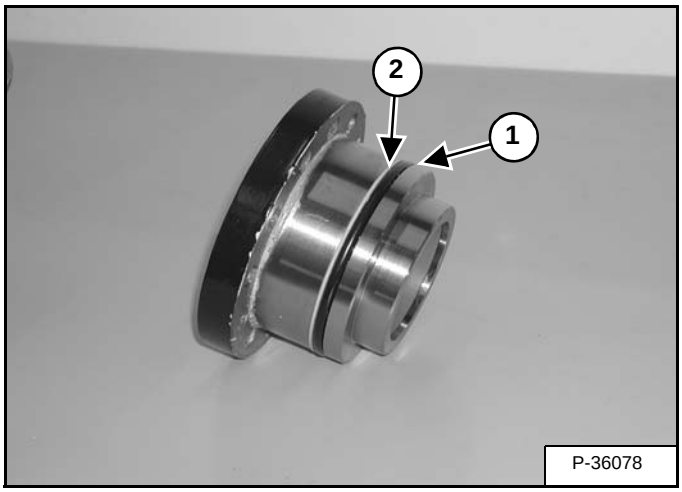
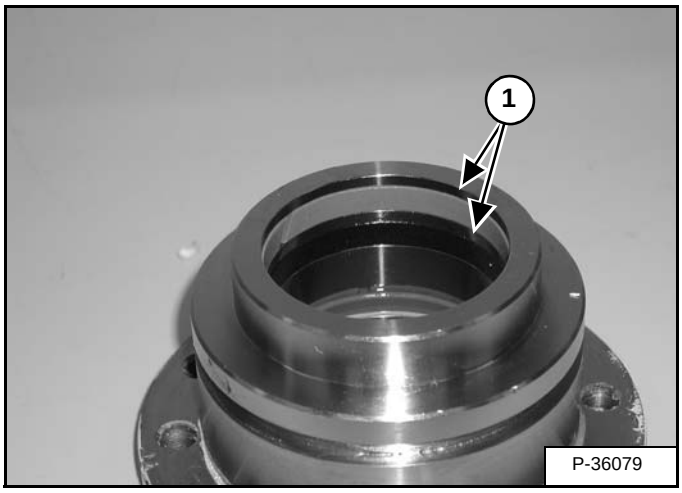
Disassembly (Cont'd)

Figure 20-22-36



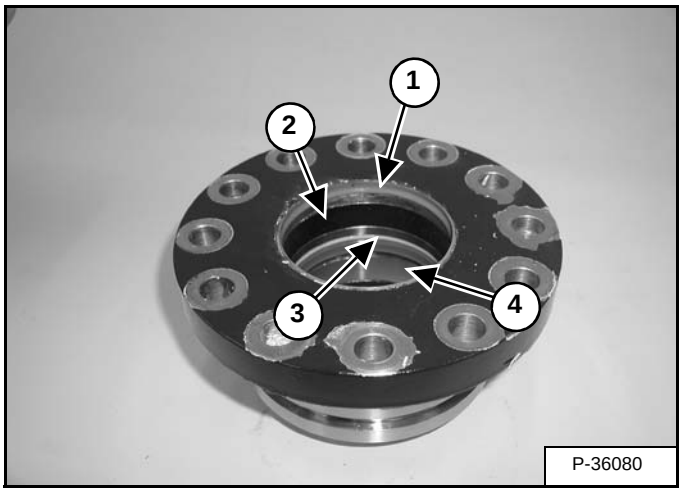
Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-22-36]** from the head.

Figure 20-22-37



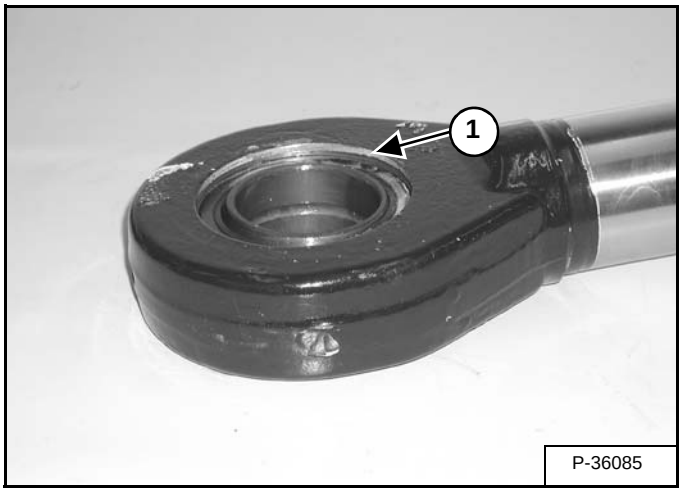
Remove the two wear rings (Item 1) **[Figure 20-22-37]**.

Figure 20-22-38



Remove the wiper (Item 1) wear ring (Item 2), seal (Item 3) and back-up ring (Item 4) **[Figure 20-22-38]**.

Figure 20-22-39



Remove the rod from the vise. Remove the snap ring (Item 1) **[Figure 20-22-39]**.

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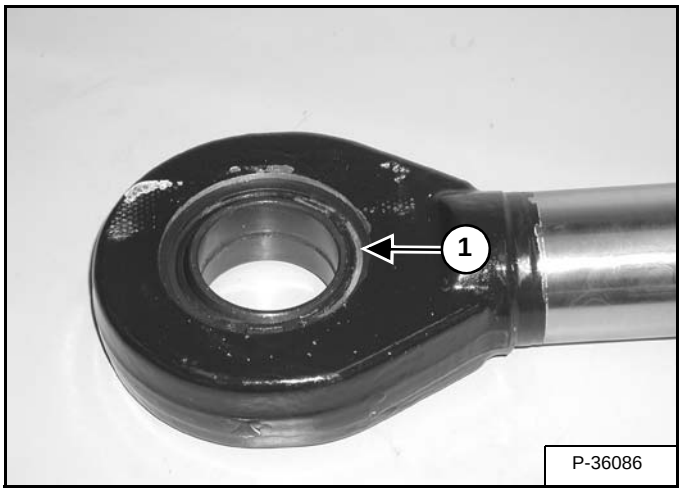
Disassembly (Cont'd)

Figure 20-22-40



Remove the bearing (Item 1) **[Figure 20-22-40]**.

NOTE: The bearing can only be removed through the snap ring side of the housing.

Assembly

Use the following tools to assemble the cylinder.

MEL1396-Universal Seal Expander
MEL1033-Rod Seal Installation Tool
Piston Ring Compressor

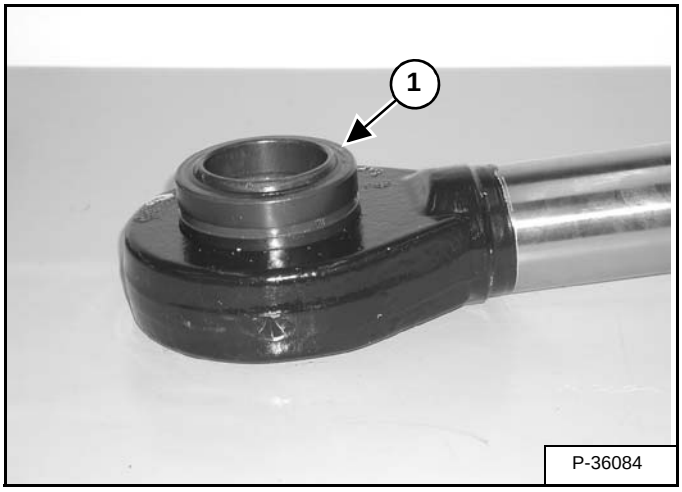
Wash the cylinder parts in clean solvent and dry with compressed air.

Inspect the cylinder parts for nicks, scratches or other damage. Replace any damaged parts.

Always install new O-rings and seals during assembly.

Lubricate all O-rings and seals with hydraulic oil during assembly.

Figure 20-22-41



Install the bearing (Item 1) **[Figure 20-22-41]** in the rod end.

NOTE: The bearing can only be installed from the snap ring side of the housing.

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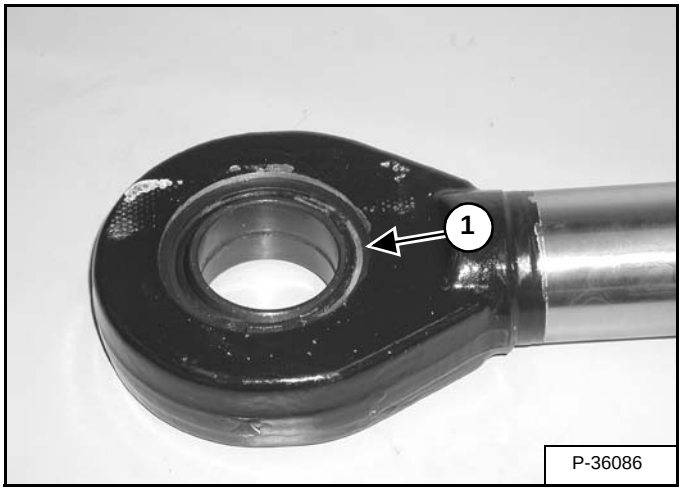
Assembly (Cont'd)

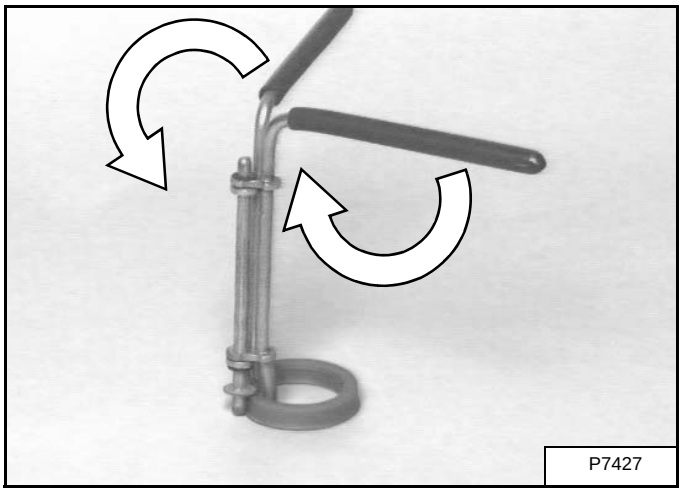
Figure 20-22-42

Figure 20-22-43



Make sure the bearing is fully seated in the housing **[Figure 20-22-42]** and install the snap ring (Item 1) **[Figure 20-22-43]**.

Figure 20-22-44

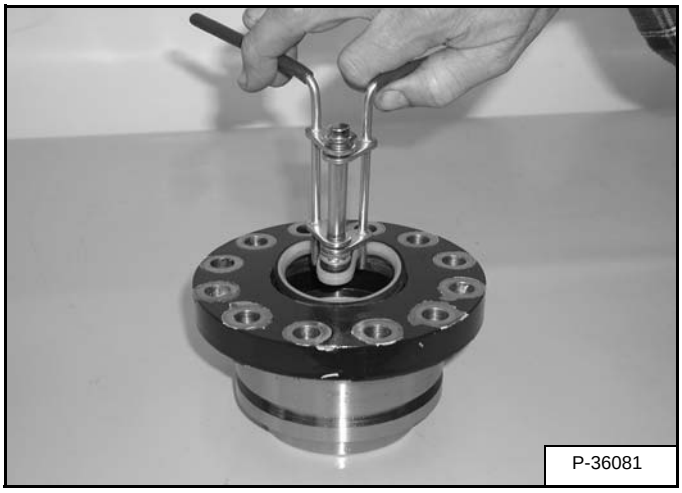


Install the rod seal on the rod seal tool **[Figure 20-22-44]**.

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 20-22-44]**.

Figure 20-22-45



Install the rod seal in the head **[Figure 20-22-45]**.

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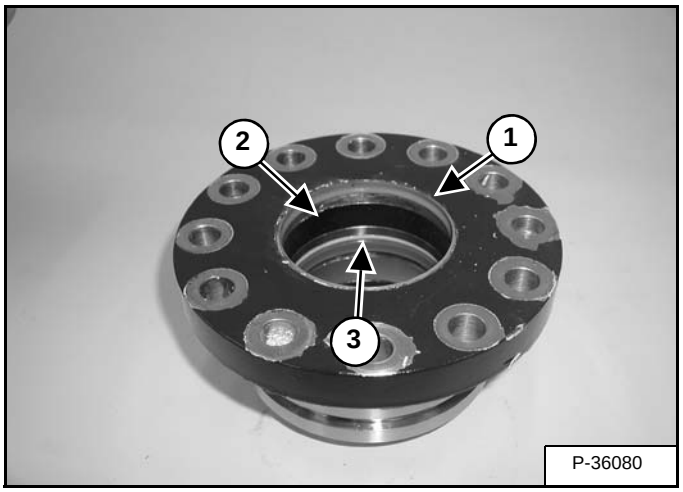
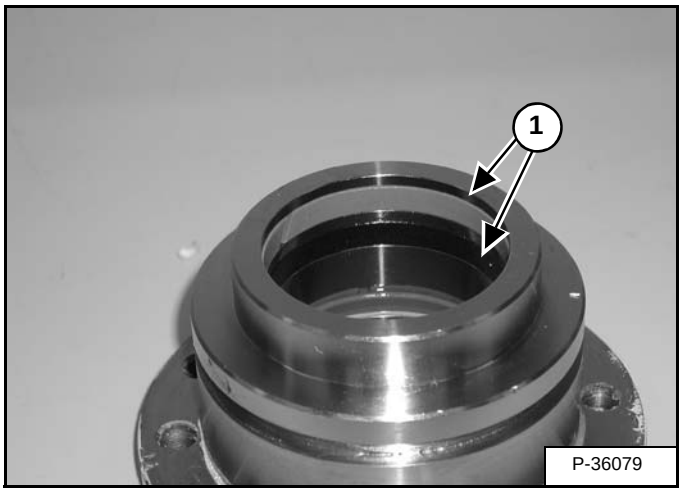
Assembly (Cont'd)

Figure 20-22-46



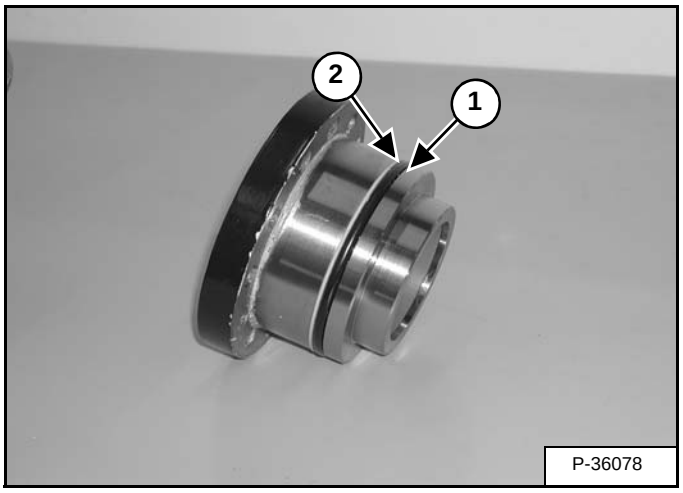
Install the wiper (Item 1), wear ring (Item 2) and back-up ring (Item 3) **[Figure 20-22-46]**.

Figure 20-22-47



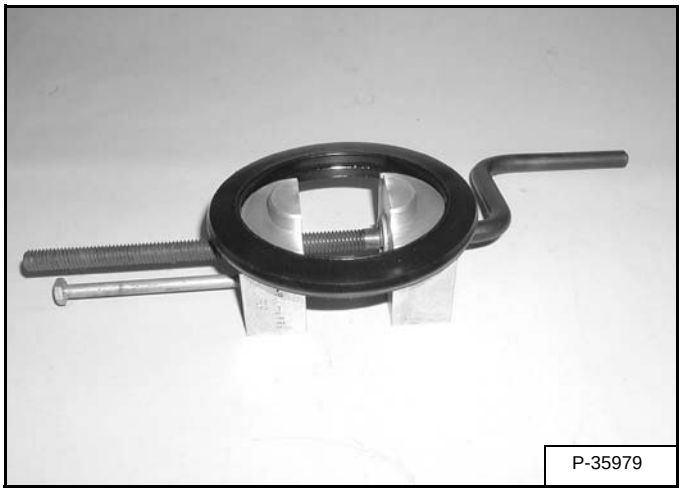
Install the two wear rings (Item 1) **[Figure 20-22-47]**.

Figure 20-22-48



Install the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-22-48]** on the head.

Figure 20-22-49



Install the new seal on the tool and slowly stretch it until it fits the piston **[Figure 20-22-49]**.

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

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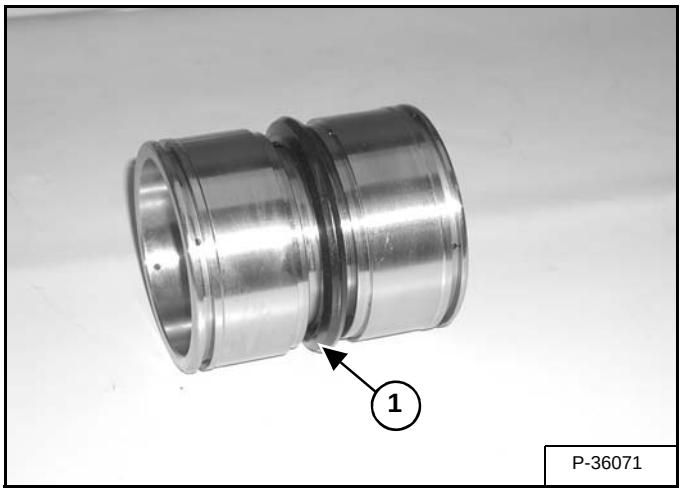
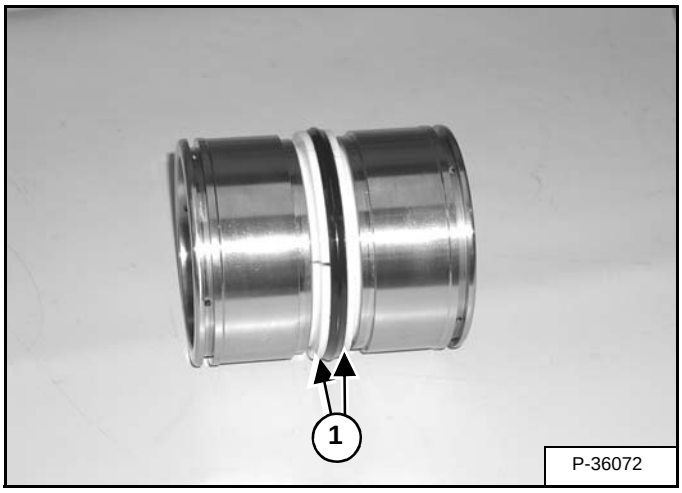
Assembly (Cont'd)

Figure 20-22-50



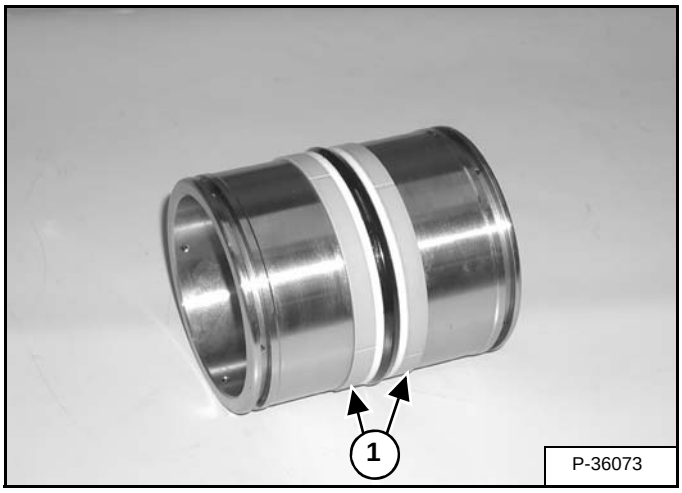
Install the seal (Item 1) **[Figure 20-22-50]** on the piston.

Figure 20-22-51



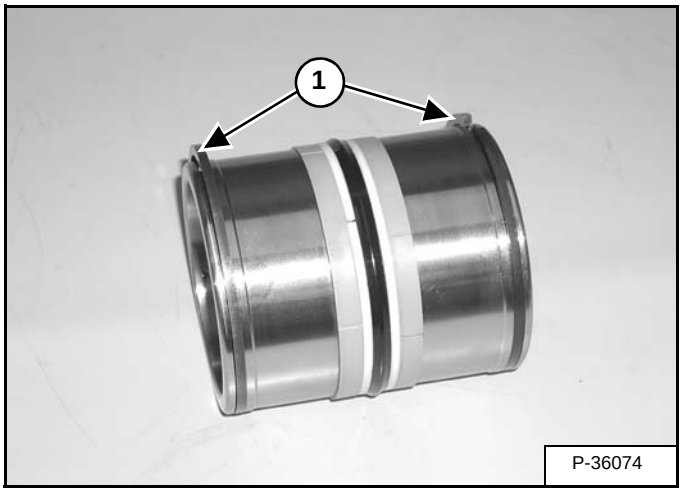
Install the back-up rings (Item 1) **[Figure 20-22-51]**.

Figure 20-22-52



Install the wear rings (Item 1) **[Figure 20-22-52]**.

Figure 20-22-53



Install the steel rings (Item 1) **[Figure 20-22-53]**.

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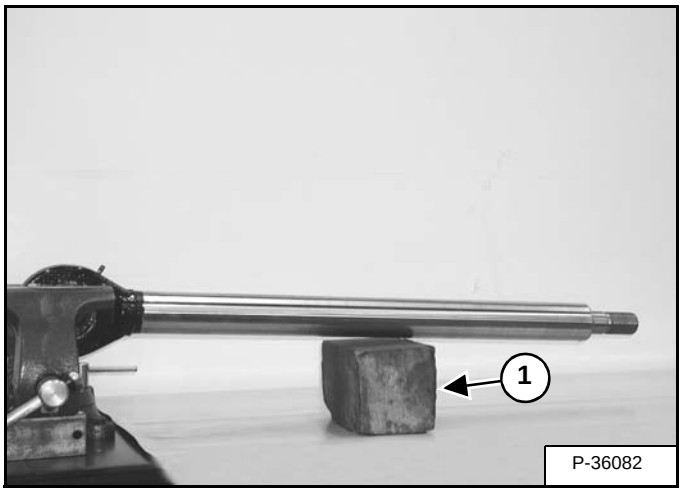
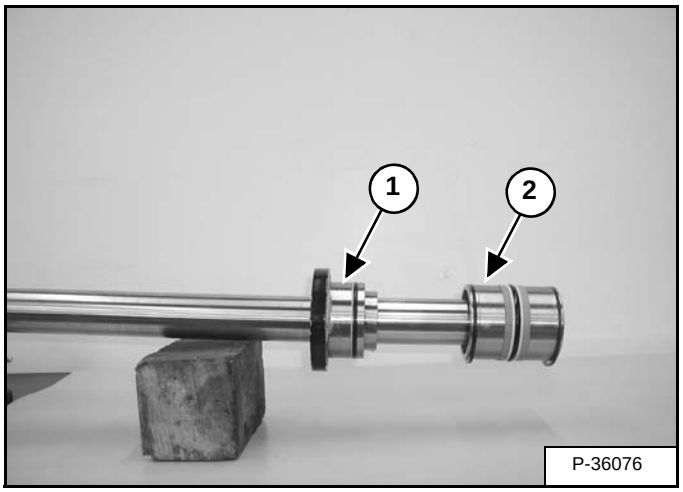
Assembly (Cont'd)

Figure 20-22-54



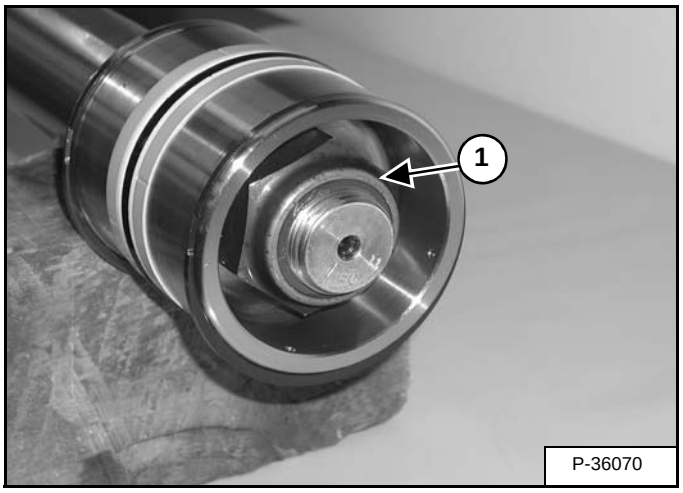
Clamp the rod end in a vise and support the end of the rod with a wood block (Item 1) **[Figure 20-22-54]**. Use care not to damage the rod.

Figure 20-22-55



Install the head (Item 1) and piston (Item 2) **[Figure 20-22-55]**.

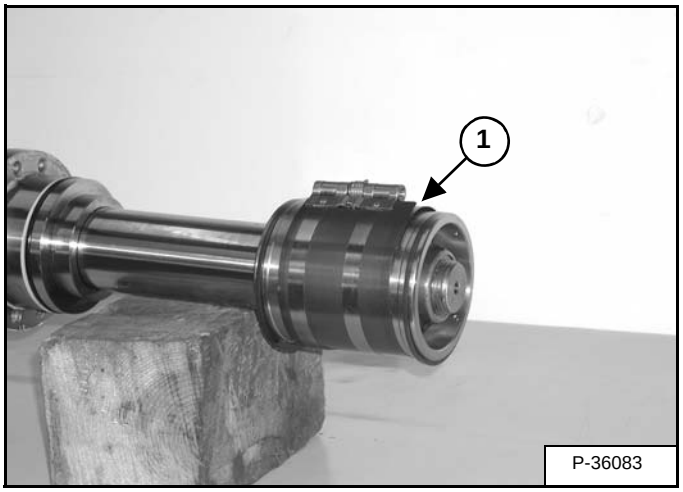
Figure 20-22-56



Apply thread lock adhesive (Loctite™ 270) to the threads and install the nut (Item 1) **[Figure 20-22-56]**.

Tighten the nut to 1143 ft.-lb. (1550 N•m) torque.

Figure 20-22-57



Install a ring compressor on the piston (Item 1) **[Figure 20-22-57]** and compress the seal to the correct size.

Leave the piston in the compressor for three minutes.

Remove the rod and head assembly from the vise.

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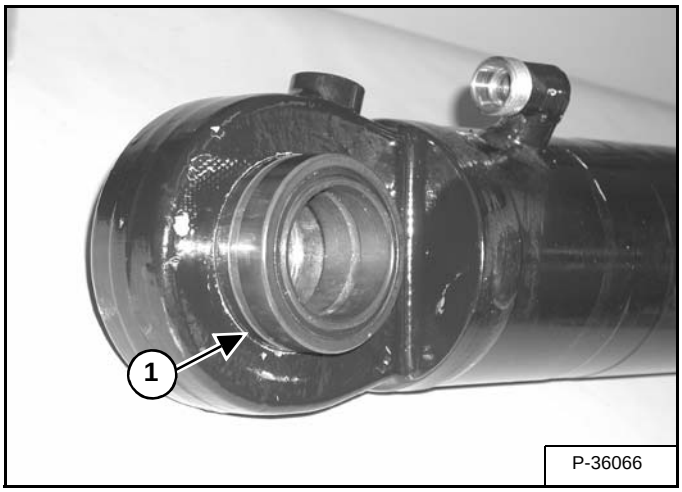
Assembly (Cont'd)

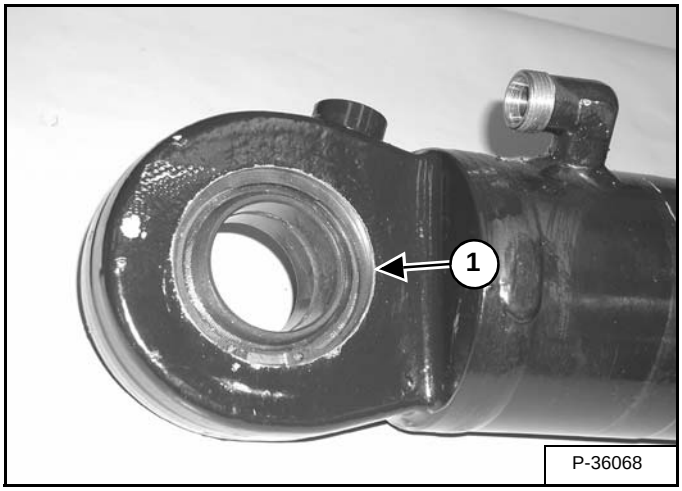
Figure 20-22-58



Install the bearing (Item 1) **[Figure 20-22-58]** in to the base end of the cylinder housing.

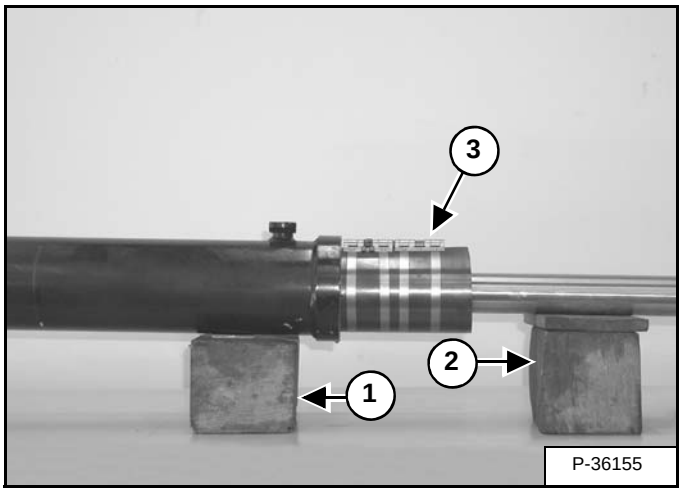
NOTE: The bearing can only be installed through the snap ring side of the housing.

Figure 20-22-59



Fully seat the bearing and install the snap ring (Item 1) **[Figure 20-22-59]**.

Figure 20-22-60



Clamp the base end of the cylinder in a vise and support the end of the housing with a block (Item 1) **[Figure 20-22-60]**. Use care not to damage the cylinder housing.

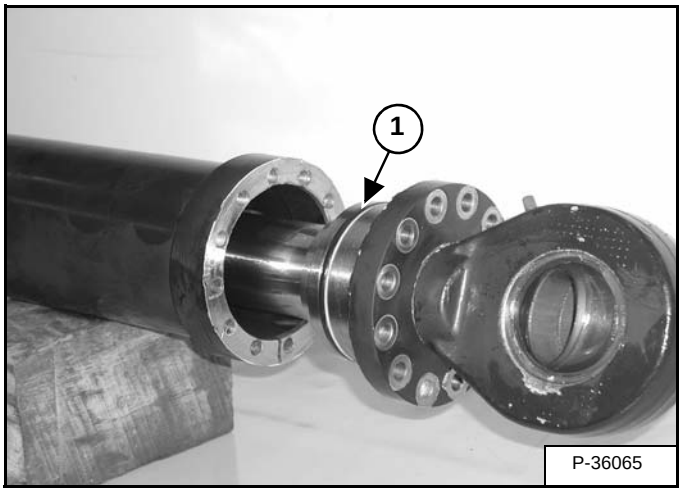
Support the rod assembly with wood blocks (item 2) **[Figure 20-22-60]**.

Install a ring compressor (Item 3) **[Figure 20-22-60]** on the piston to compress the steel rings to the correct size.

Push the piston into the housing.

Remove the ring compressor.

Figure 20-22-61



Install the head (Item 1) **[Figure 20-22-61]** in the housing.

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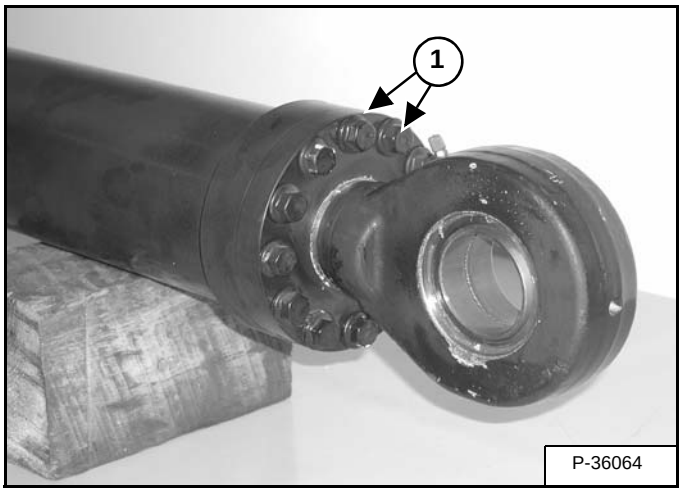
Assembly (Cont'd)

Figure 20-22-62



Install the 12 bolts (Item 1) **[Figure 20-22-62]** and tighten to 114 ft.-lb. (155 N•m) torque.

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BUCKET CYLINDER

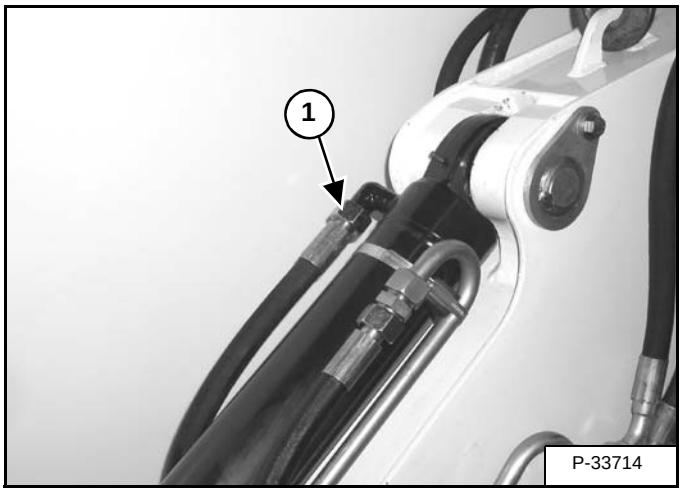
Testing

Fully retract the bucket and arm cylinders.

Lower the boom to the ground.

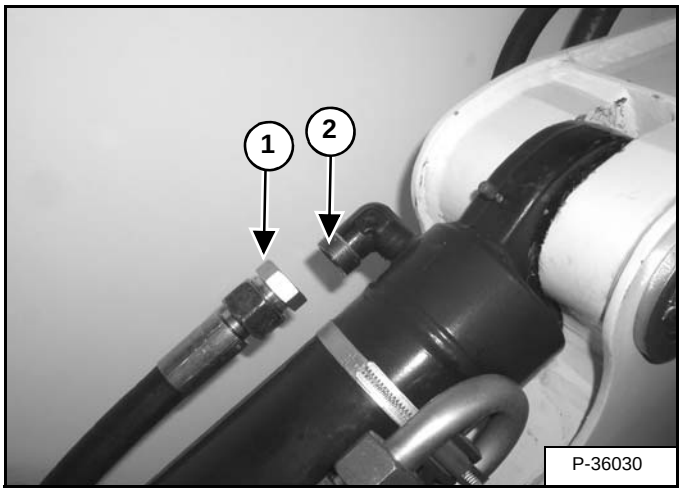
With the engine off and the key in the run position, move the joysticks to relieve hydraulic pressure.

Figure 20-23-63



Remove the hydraulic hose (Item 1) **[Figure 20-23-63]** from the base end of the bucket cylinder.

Figure 20-23-64



Install a plug (Item 1) **[Figure 20-23-64]** on the hose.

Start the engine and retract the bucket cylinder.

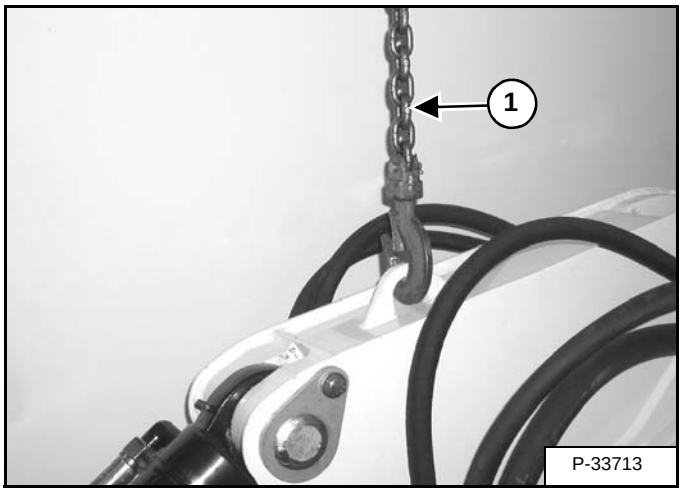
If there is any oil leakage from the base end fitting (Item 2) **[Figure 20-23-64]** on the bucket cylinder, remove the cylinder for repair or replacement.

Removal And Installation

Fully retract the bucket cylinder.

Fully retract the arm cylinder and lower the boom until the bucket is on the ground.

Figure 20-23-65



Support the arm with a chain hoist (Item 1) **[Figure 20-23-65]**.

With the engine off and the key in the run position, move the joysticks 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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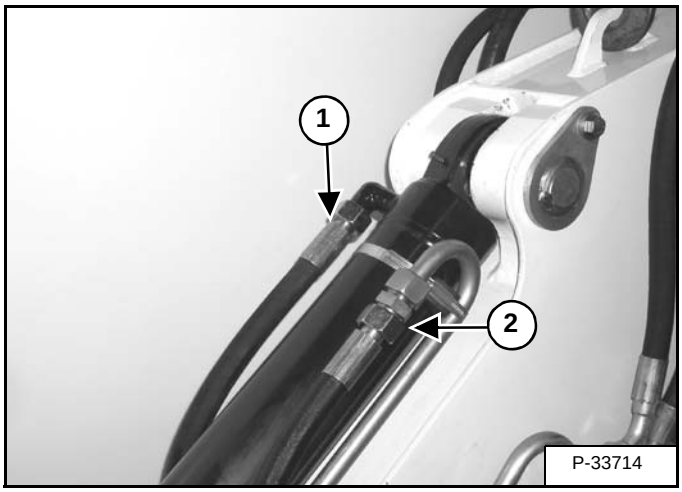
Removal And Installation (Cont'd)

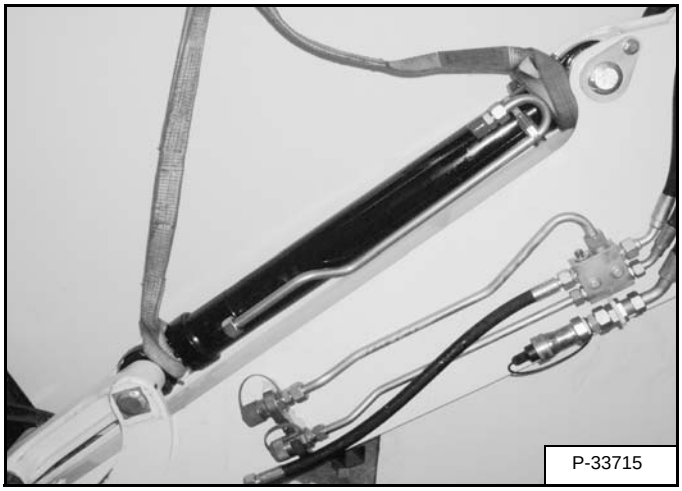
Figure 20-23-66



Remove the hose (Item 1) **[Figure 20-23-66]** from the base end.

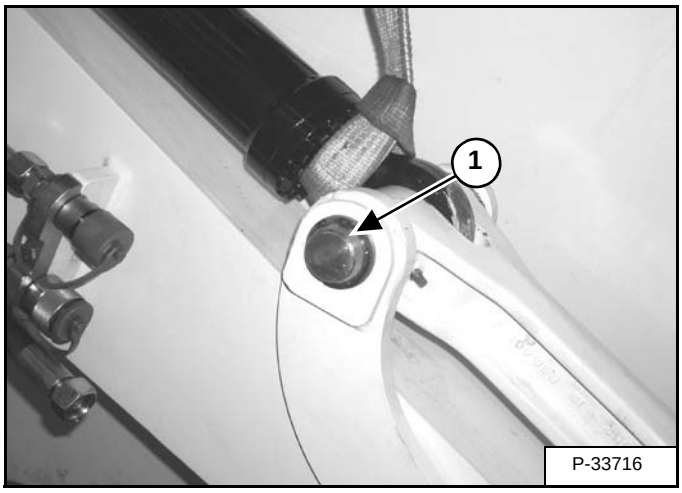
Remove the hose (Item 2) **[Figure 20-23-66]** from the rod end.

Figure 20-23-67



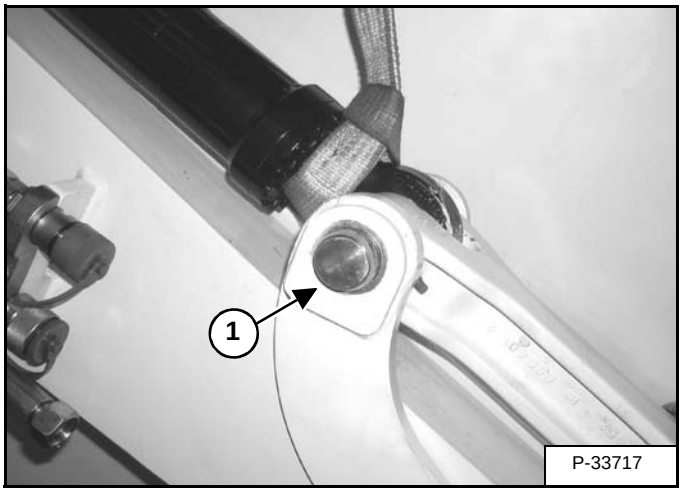
Install a hoist on the cylinder **[Figure 20-23-67]**.

Figure 20-23-68



Remove the snap ring (Item 1) **[Figure 20-23-68]** and two washers from the cylinder rod end pin.

Figure 20-23-69



Remove the pin (Item 1) **[Figure 20-23-69]**.

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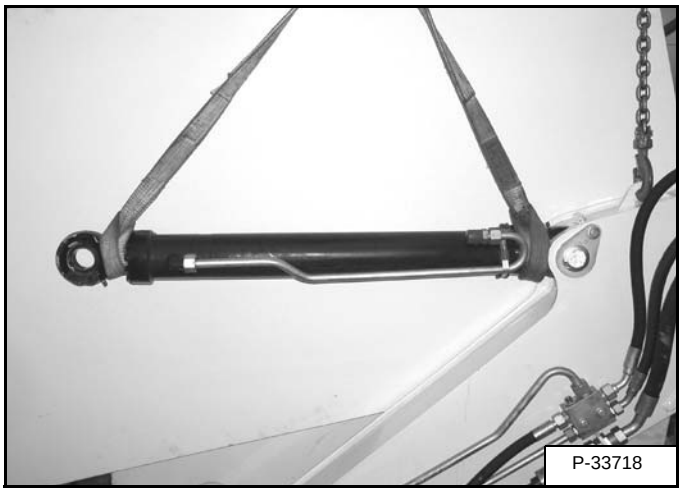
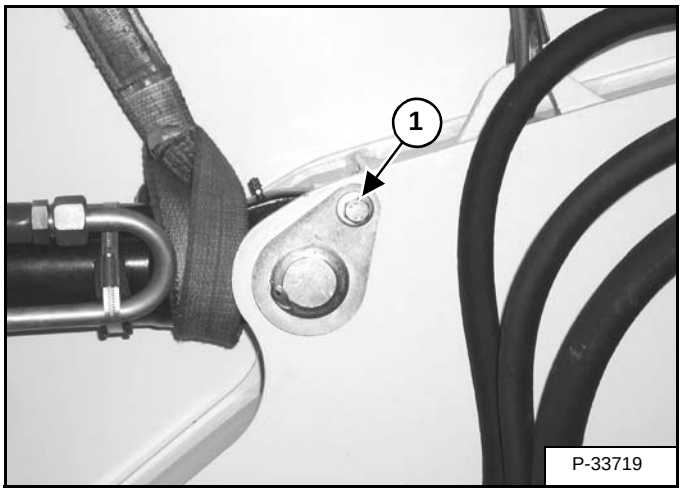
Removal And Installation (Cont'd)

Figure 20-23-70



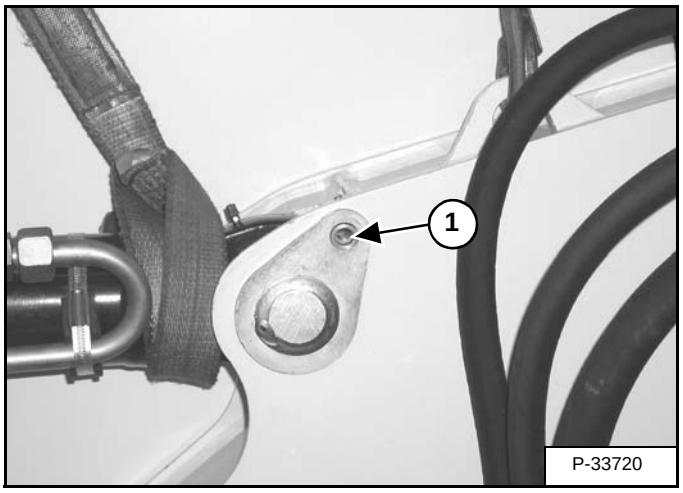
Raise the cylinder **[Figure 20-23-70]**.

Figure 20-23-71



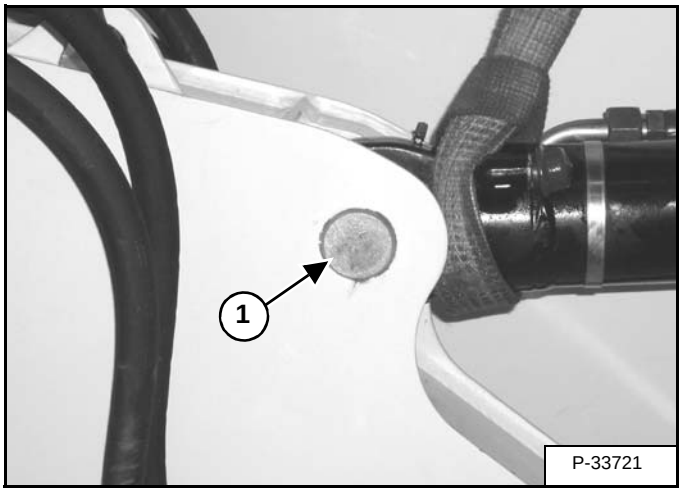
Remove the bolt (Item 1) **[Figure 20-23-71]** and washer.

Figure 20-23-72



Remove the spacer (Item 1) **[Figure 20-23-72]**.

Figure 20-23-73



Remove the pin (Item 1) **[Figure 20-23-73]**.

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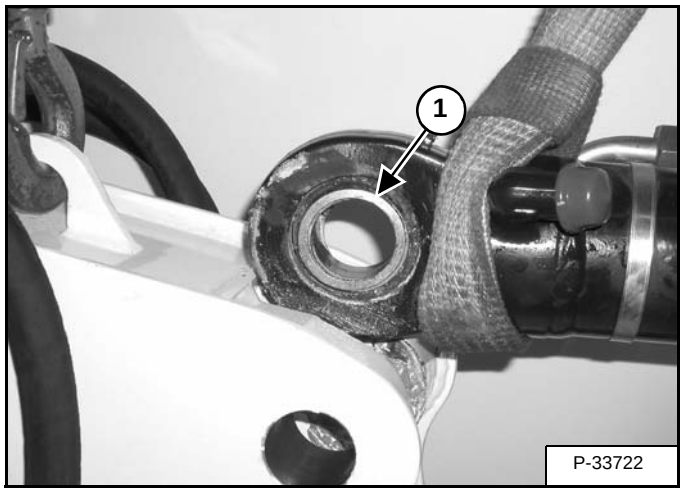
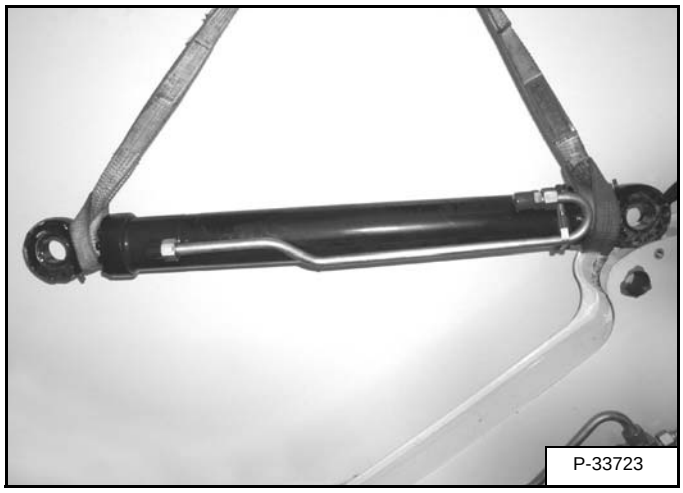
Removal And Installation (Cont'd)

Figure 20-23-74



Raise the hoist and remove the spacers (Item 1) **[Figure 20-23-74]** from both sides of the base end.

Figure 20-23-75



Remove the cylinder **[Figure 20-23-75]**.

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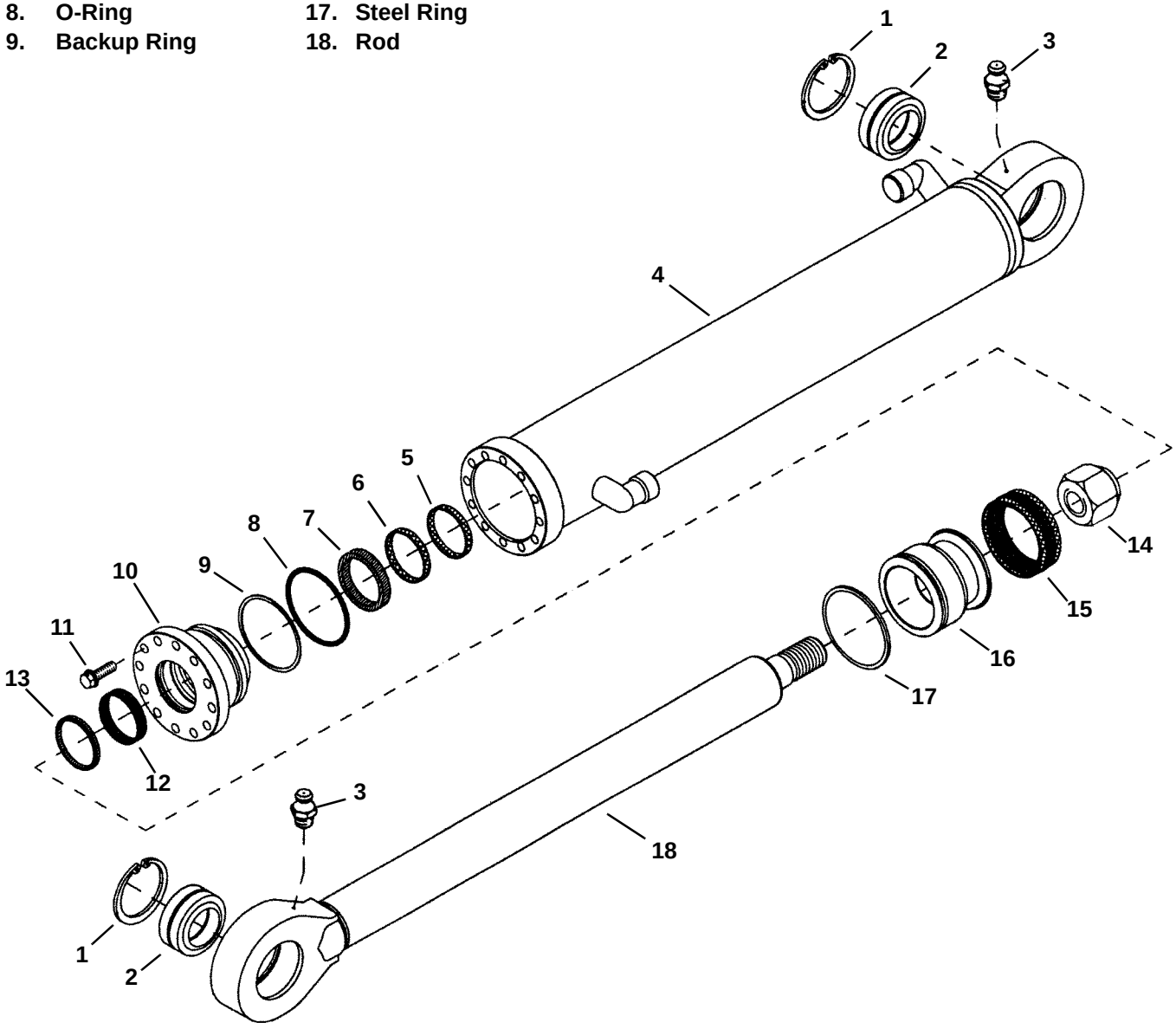
Parts Identification

1. Snap Ring
2. Bearing
3. Grease Fitting
4. Housing
5. Ring
6. Seal
7. Seal
8. O-Ring
9. Backup Ring
10. Head
11. Bolt
12. Seal
13. Wiper Seal
14. Nut
15. Piston Seals
16. Piston
17. Steel Ring
18. Rod



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Disassembly

Use the following tools to disassemble the cylinder.

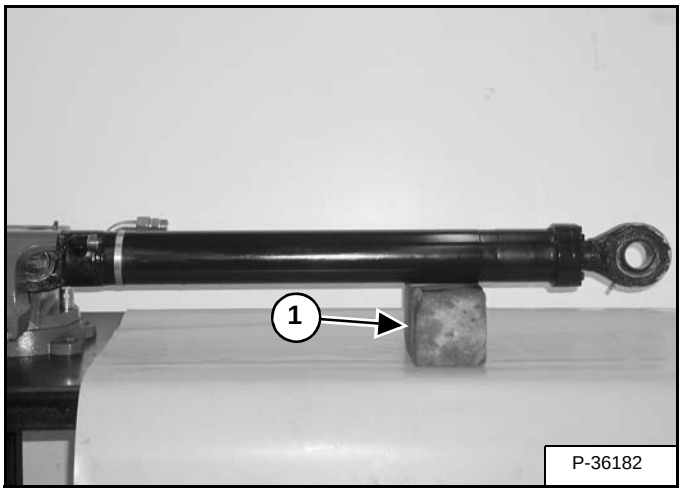
MEL1074 - O-ring Seal Hook

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

Clamp the base end of the cylinder in a vise.

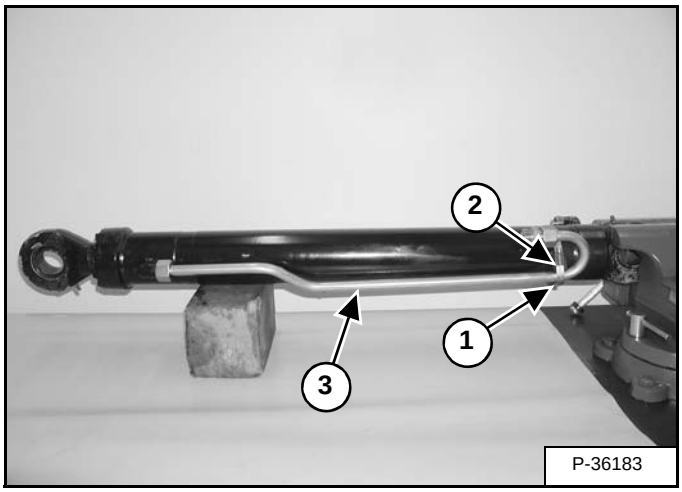
Be careful not to damage the cylinder housing.

Figure 20-23-76



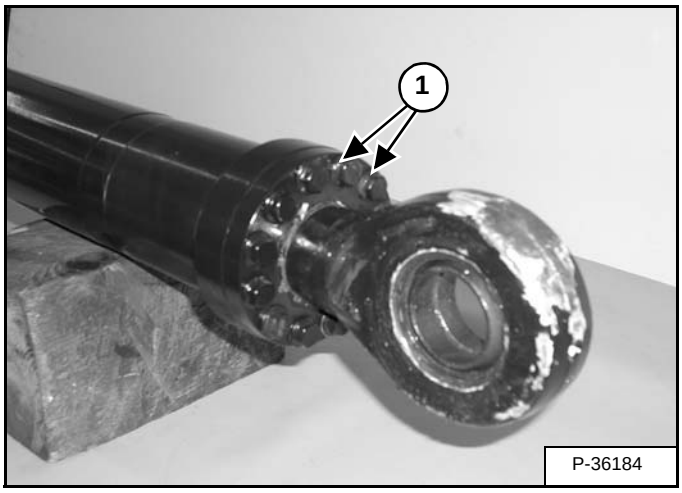
Support the cylinder with a block (Item 1) **[Figure 20-23-76]**.

Figure 20-23-77



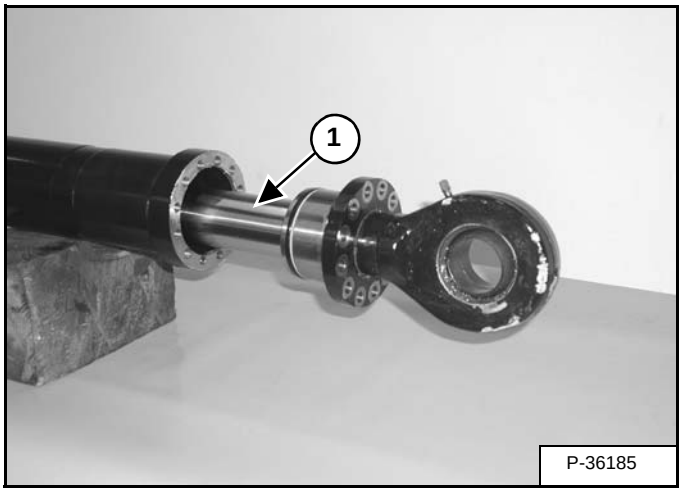
Remove the clamp (Item 1), block (Item 2) and tubeline (Item 3) **[Figure 20-23-77]**

Figure 20-23-78



Remove the 12 bolts (Item 1) **[Figure 20-23-78]**.

Figure 20-23-79



Remove the rod assembly (Item 1) **[Figure 20-23-79]**.

Remove the cylinder housing from the vise.

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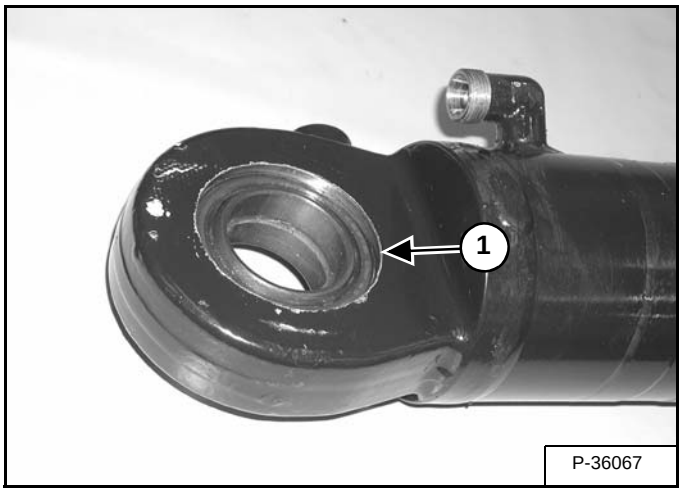
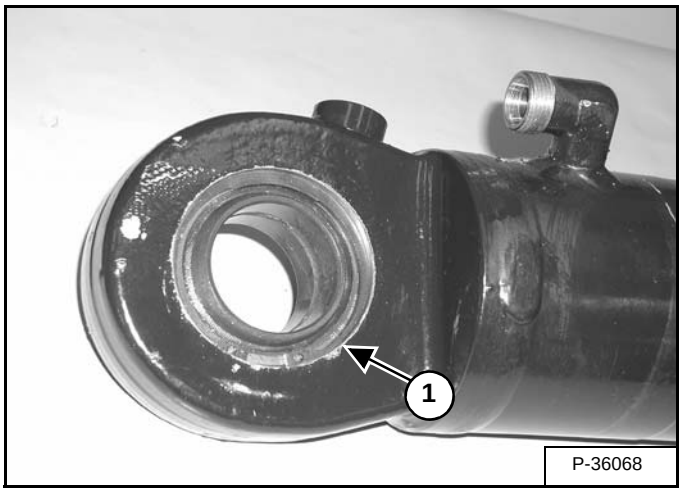
Disassembly (Cont'd)

Figure 20-23-80



Remove the snap ring (Item 1) **[Figure 20-23-80]** from the base end of the cylinder.

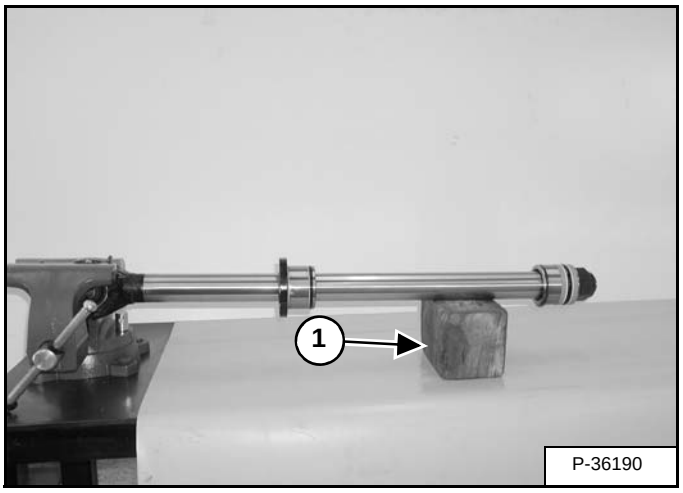
Figure 20-23-81



Remove the bearing (Item 1) **[Figure 20-23-81]**.

NOTE: The bearing can only be removed through the snap ring side of the housing.

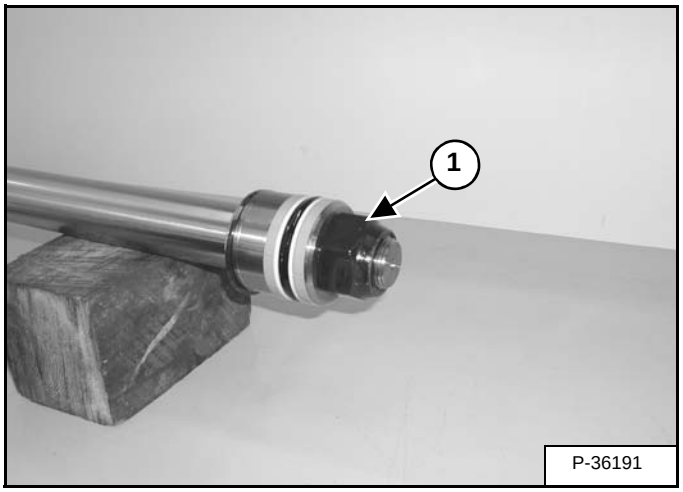
Figure 20-23-82



Clamp the rod end in a vise. Support the end of the rod with a wood block (Item 1) **[Figure 20-23-82]**.

Use care not to damage the rod.

Figure 20-23-83



Apply moderate heat to the nut (Item 1) **[Figure 20-23-83]**.

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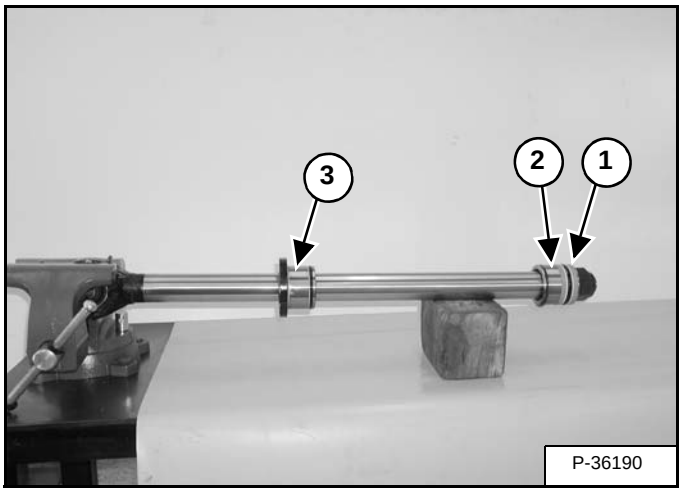
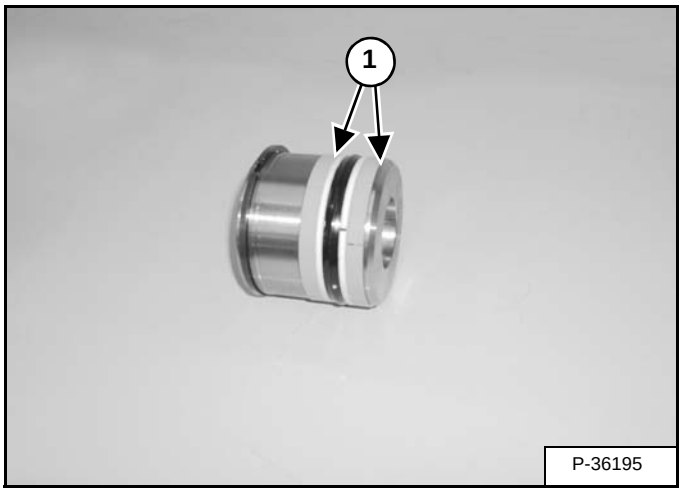
Disassembly (Cont'd)

Figure 20-23-84



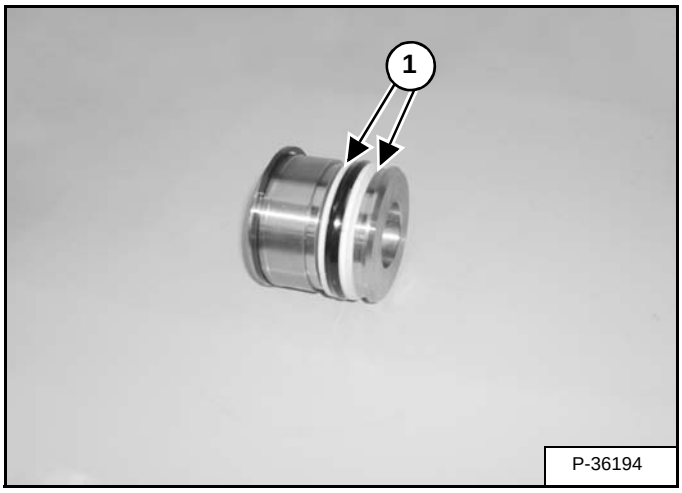
Remove the nut (Item 1), piston (Item 2) and head (Item 3) **[Figure 20-23-84]**.

Figure 20-23-85



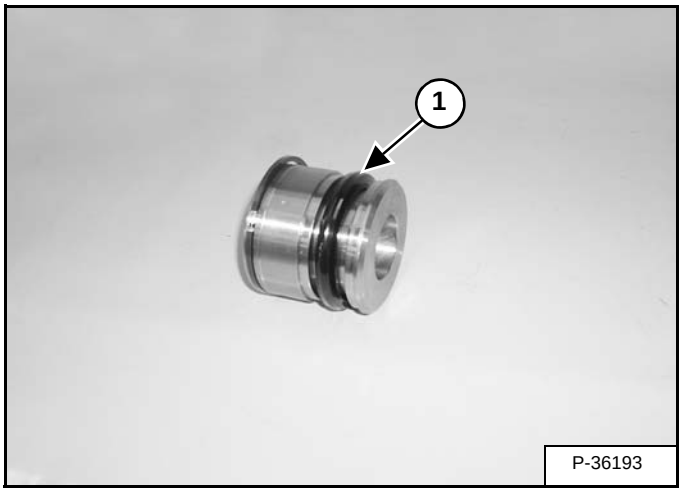
Remove the wear rings (Item 1) **[Figure 20-23-85]** from the piston.

Figure 20-23-86



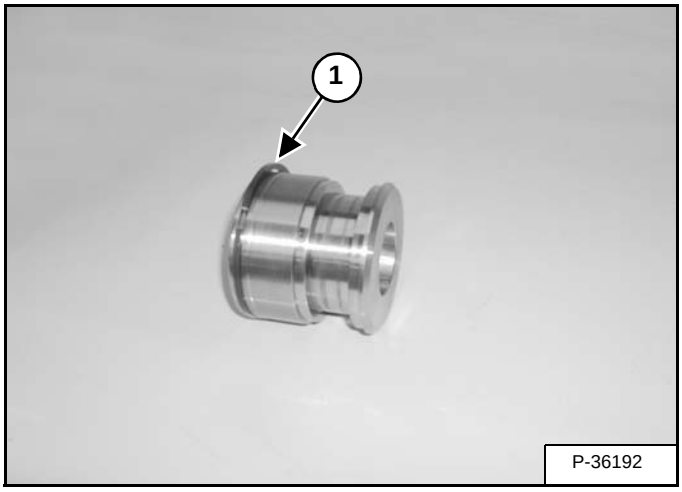
Remove the back-up rings (Item 1) **[Figure 20-23-86]**.

Figure 20-23-87



Remove the seal (Item 1) **[Figure 20-23-87]**.

Figure 20-23-88



Remove the steel ring (Item 1) **[Figure 20-23-88]**.

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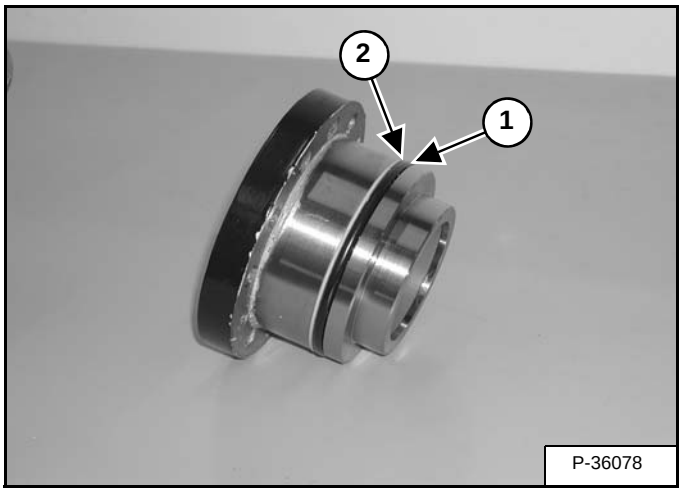
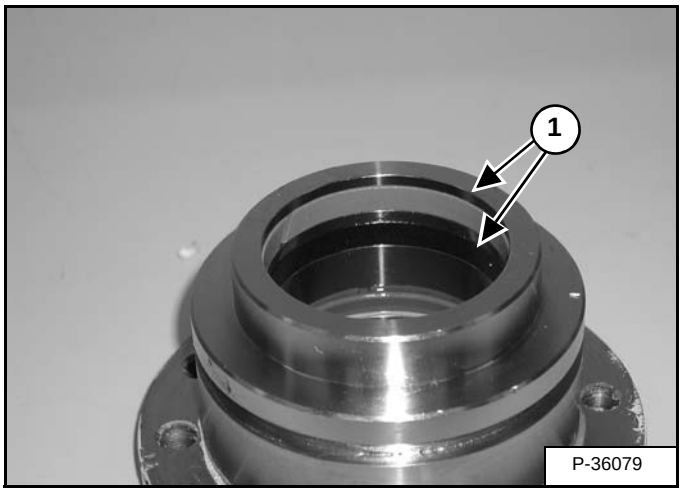
Disassembly (Cont'd)

Figure 20-23-89



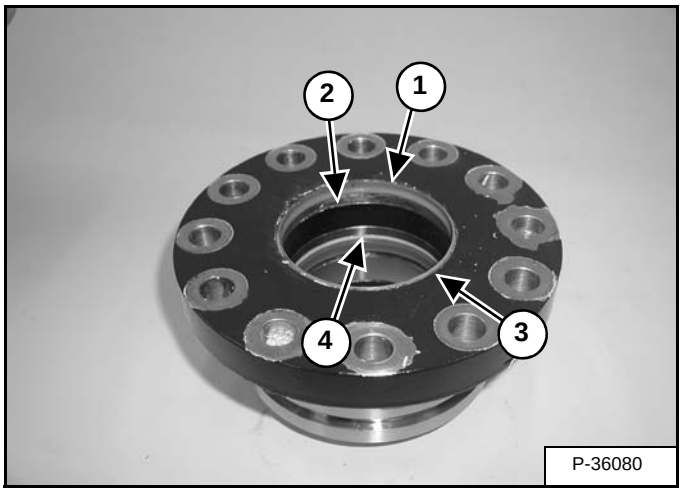
Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-23-89]** from the head.

Figure 20-23-90



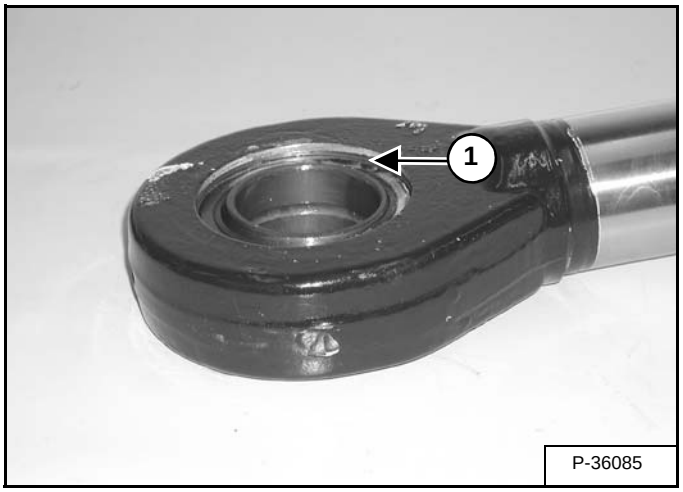
Remove the two wear rings (Item 1) **[Figure 20-23-90]**.

Figure 20-23-91



Remove the wiper (Item 1), wear ring (Item 2), seal (Item 3) and back-up ring (Item 4) **[Figure 20-23-91]**.

Figure 20-23-92



Remove the rod from the vise. Remove the snap ring (Item 1) **[Figure 20-23-92]**.

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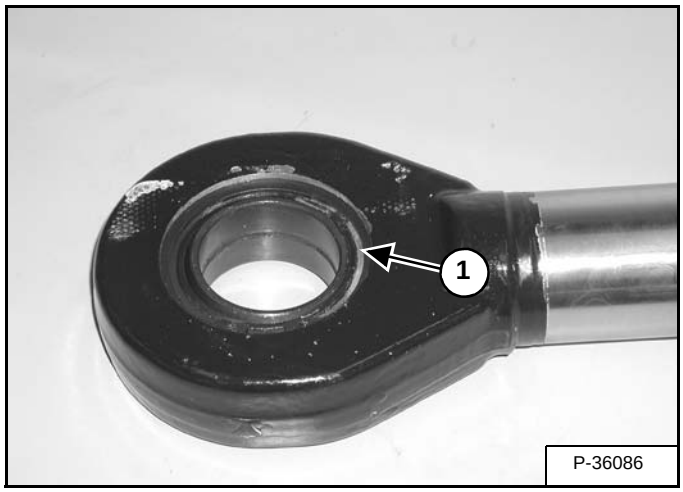
Disassembly (Cont'd)

Figure 20-23-93



Remove the bearing (Item 1) **[Figure 20-23-93]**.

NOTE: The bearing can only be removed through the snap ring side of the housing.

Assembly

Use the following tools to assemble the cylinder.

MEL1396-Universal Seal Expander
MEL1033-Rod Seal Installation Tool
Piston Ring Compressor

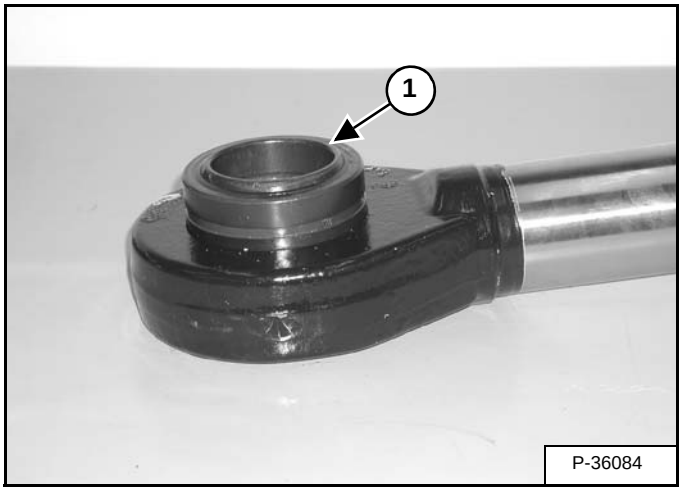
Wash the cylinder parts in clean solvent and dry them with compressed air.

Inspect the cylinder parts for nicks, scratches or other damage. Replace any damaged parts.

Always install new O-rings and seals during assembly.

Lubricate all O-ring and seals with hydraulic oil during installation.

Figure 20-23-94



Install the bearing (Item 1) **[Figure 20-23-94]** in the rod end.

NOTE: The bearing can only be installed from the snap ring side of the housing.

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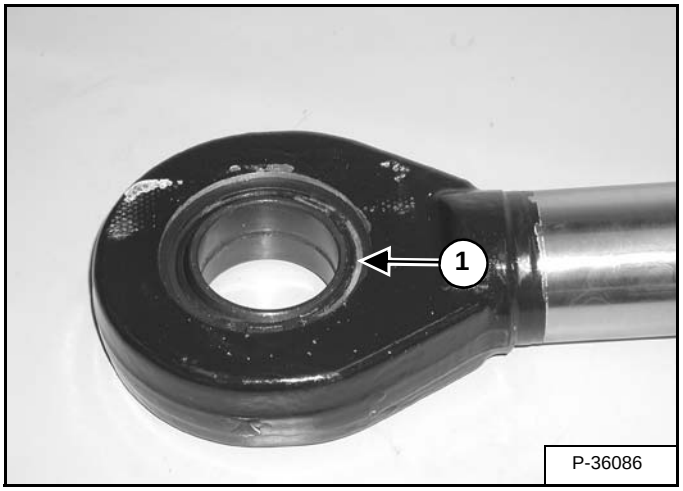
Assembly (Cont'd)

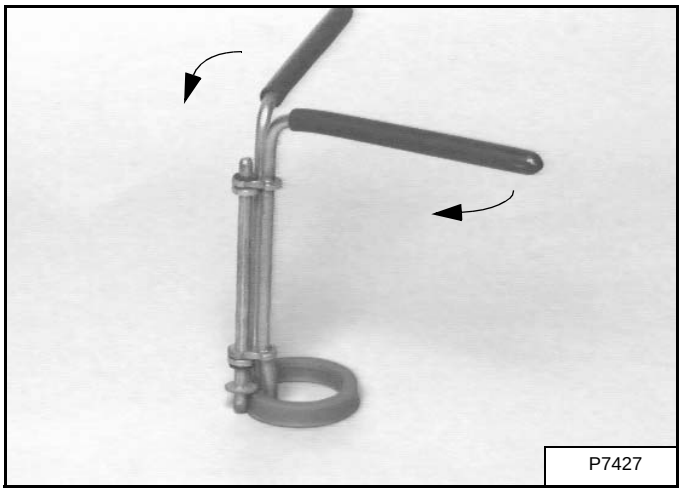
Figure 20-23-95

Figure 20-23-96



Make sure the bearing is fully seated in the housing **[Figure 20-23-95]** and install the snap ring (Item 1) **[Figure 20-23-96]**.

Figure 20-23-97

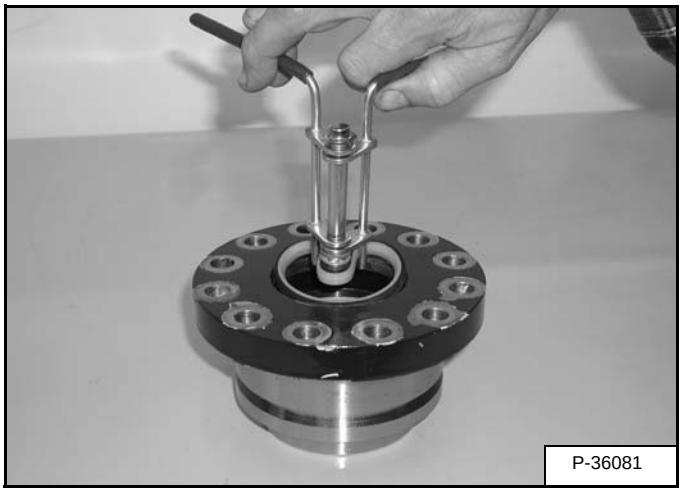


Install the rod seal on the rod seal tool **[Figure 20-23-97]**.

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 20-23-97]**.

Figure 20-23-98



Install the rod seal in the head **[Figure 20-23-98]**.

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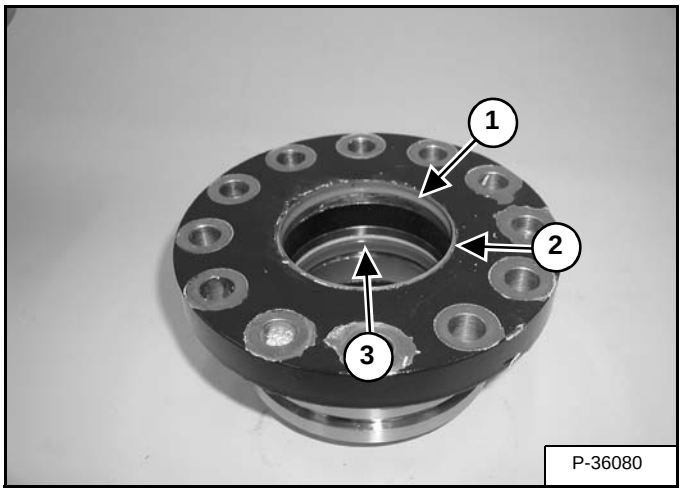
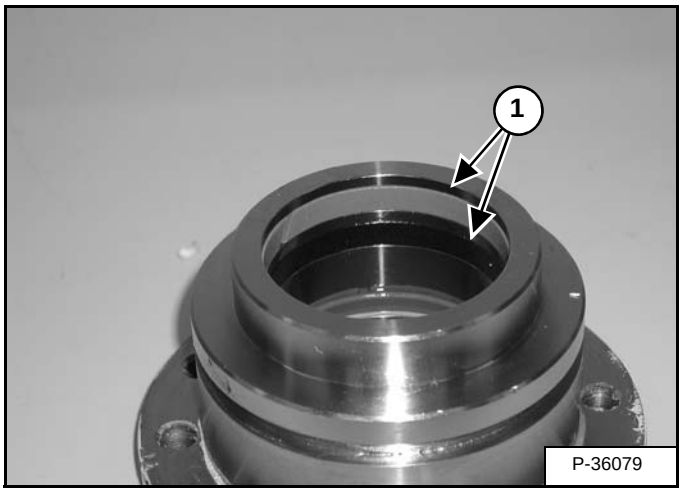
Assembly (Cont'd)

Figure 20-23-99



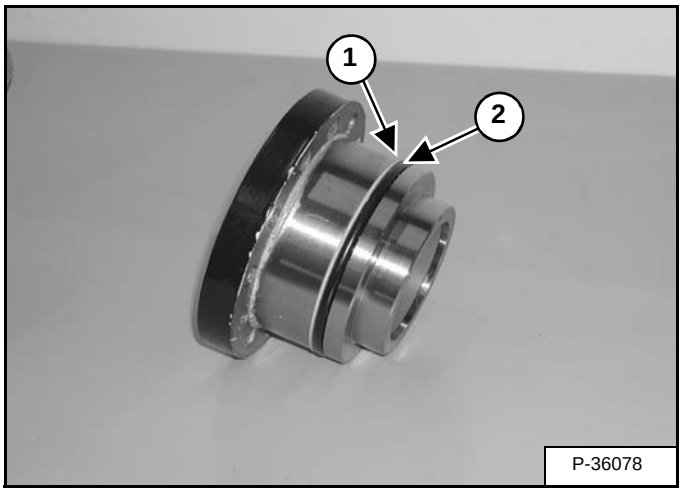
Install the wiper (Item 1), wear ring (Item 2) and back-up ring (Item 3) **[Figure 20-23-99]**.

Figure 20-23-100



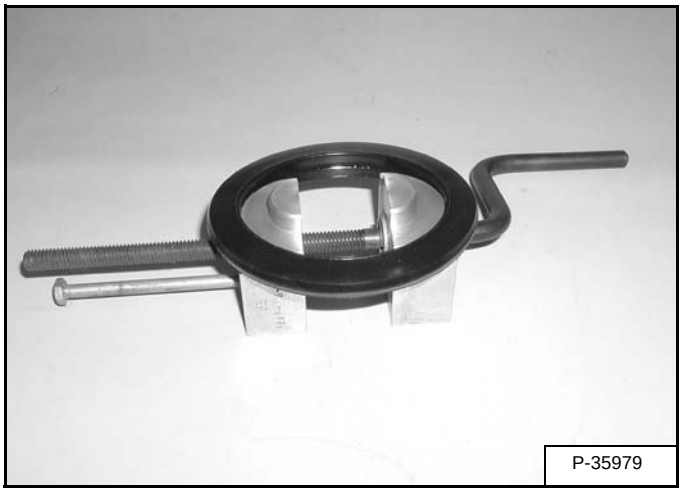
Install the two wear rings (Item 1) **[Figure 20-23-100]**.

Figure 20-23-101



Install the back-up ring (Item 1) and O-ring (Item 2) **[Figure 20-23-101]** on the head.

Figure 20-23-102



Install the new seal on the tool and slowly stretch it until it fits the piston **[Figure 20-23-102]**.

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

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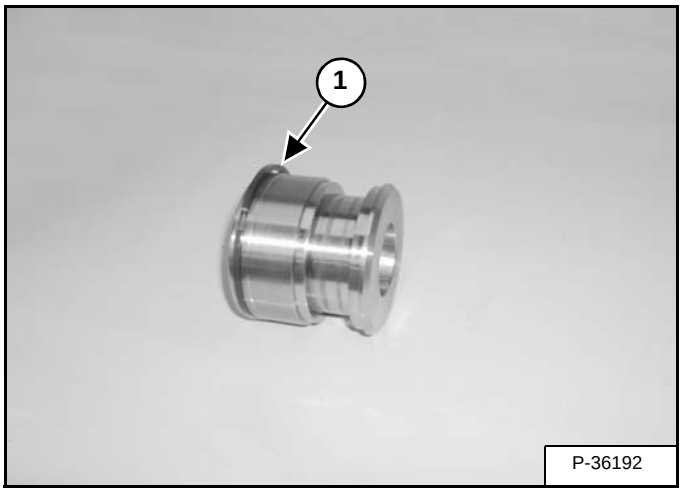
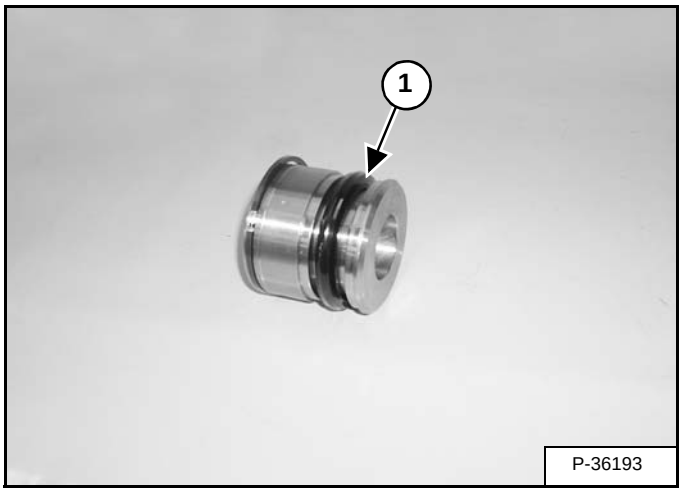
Assembly (Cont'd)

Figure 20-23-103



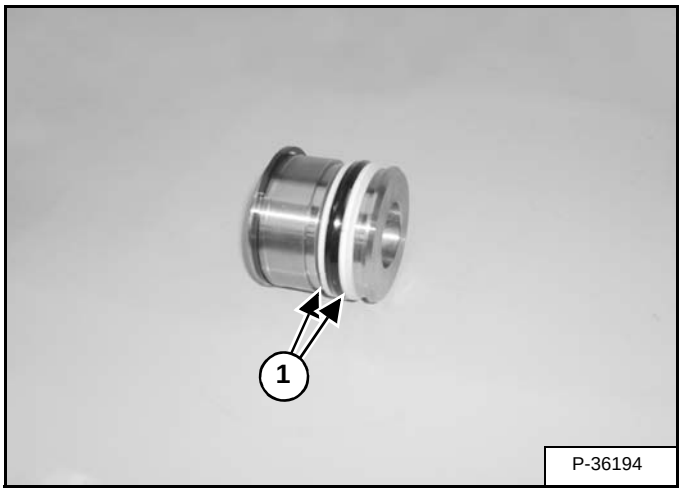
Install the steel ring (Item 1) **[Figure 20-23-103]** on the piston.

Figure 20-23-104



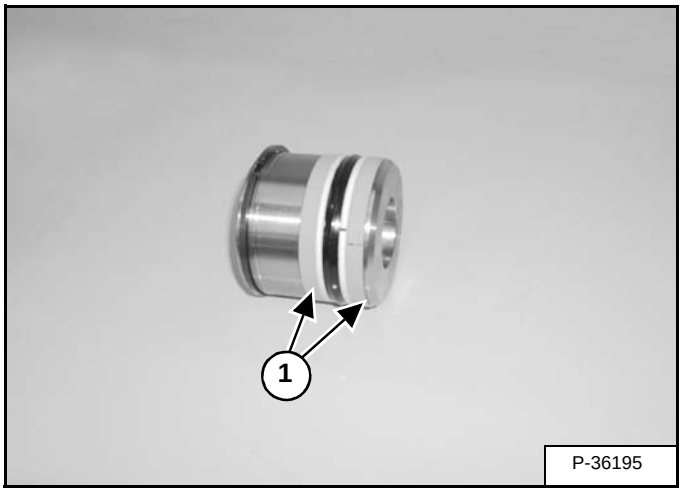
Install the seal (Item 1) **[Figure 20-23-104]**.

Figure 20-23-105



Install the back-up rings (Item 1) **[Figure 20-23-105]**.

Figure 20-23-106



Install the wear rings (Item 1) **[Figure 20-23-106]**.

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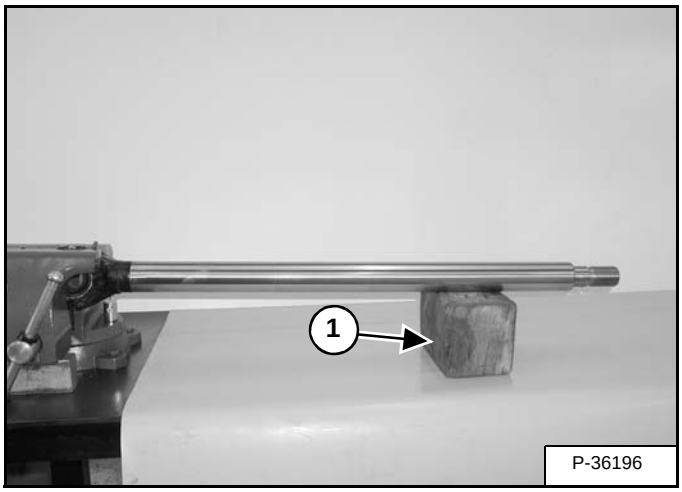
BUCKET CYLINDER (CONT'D)

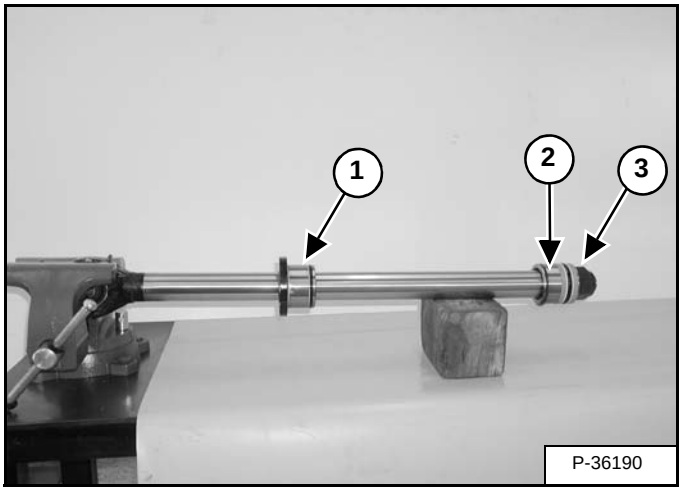
Assembly (Cont'd)

Figure 20-23-107



Clamp the rod end in a vise. Support the end of the rod with a wood block (Item 1) **[Figure 20-23-107]**. Use care not to damage the rod.

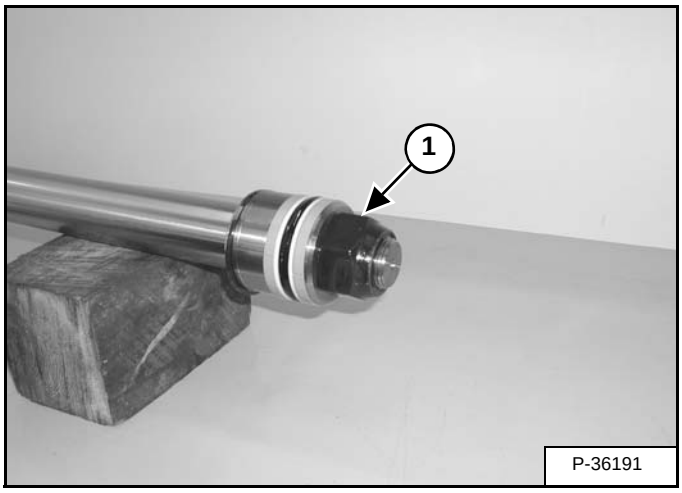
Figure 20-23-108



Install the head (Item 1) and piston (Item 2) **[Figure 20-23-108]**.

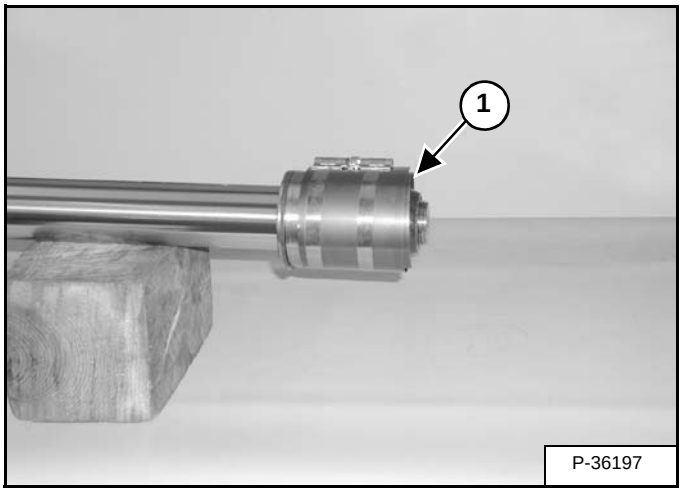
Apply thread lock adhesive (Loctite™ 270) to the rod threads and install the nut (Item 3) **[Figure 20-23-108]**.

Figure 20-23-109



Tighten the nut (Item 1) **[Figure 20-23-109]** to 1364 ft.-lb. (1850 N•m) torque.

Figure 20-23-110



Install a ring compressor on the piston (Item 1) **[Figure 20-23-110]** and compress the seal to the correct size.

Leave the piston in the compressor for three minutes.

Remove the rod assembly from the vise.

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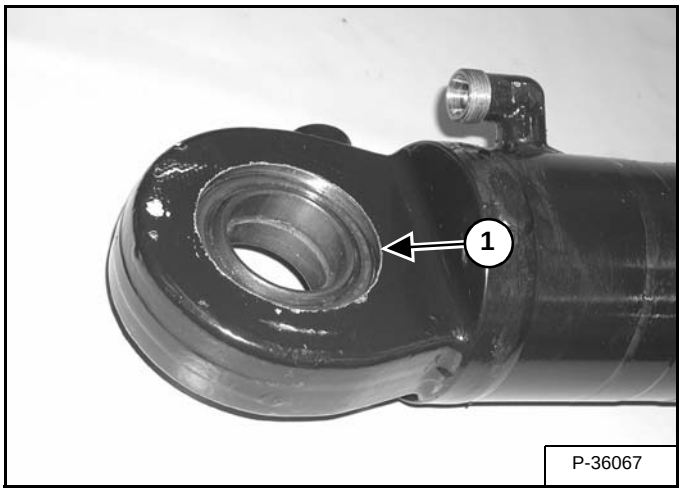
Assembly (Cont'd)

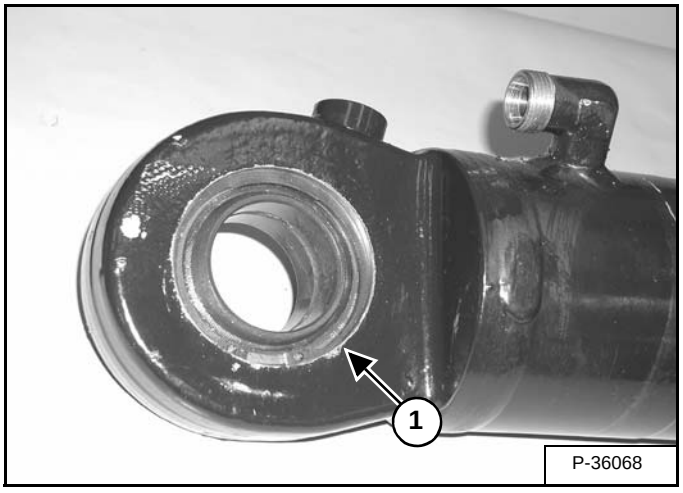
Figure 20-23-111



Install the bearing (Item 1) **[Figure 20-23-111]** into the base end of the cylinder housing.

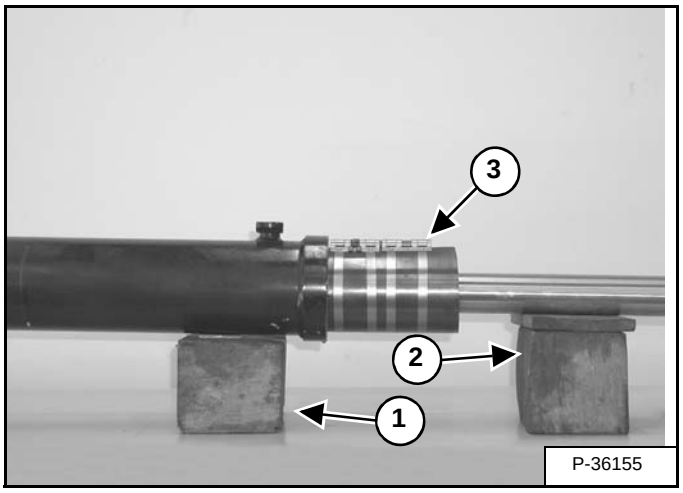
NOTE: The bearing can only be installed through the snap ring side of the housing.

Figure 20-23-112



Fully seat the bearing and install the snap ring (Item 1) **[Figure 20-23-112]**.

Figure 20-23-113



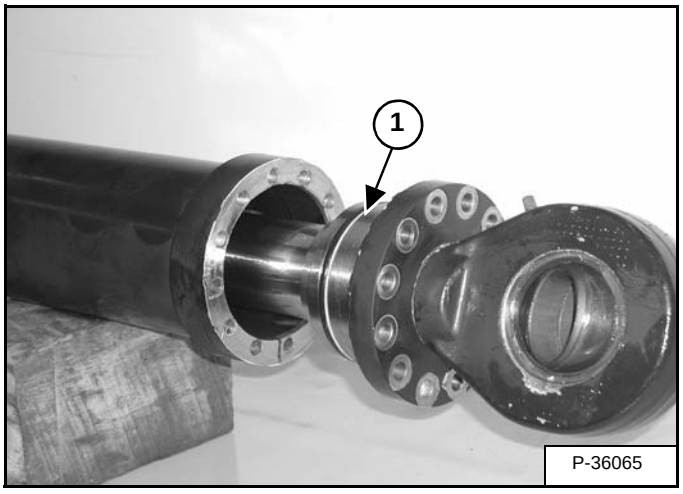
Clamp the base end of the cylinder in a vise and support the end of the housing with a block (Item 1) **[Figure 20-23-113]**. Use care not to damage the cylinder housing.

Support the rod assembly with wood blocks (Item 2) **[Figure 20-23-113]**.

Install a ring compressor (Item 3) **[Figure 20-23-113]** on the piston to compress the steel rings to the correct size.

Push the piston into the housing.

Figure 20-23-114



Install the head (Item 1) **[Figure 20-23-114]** in the housing.

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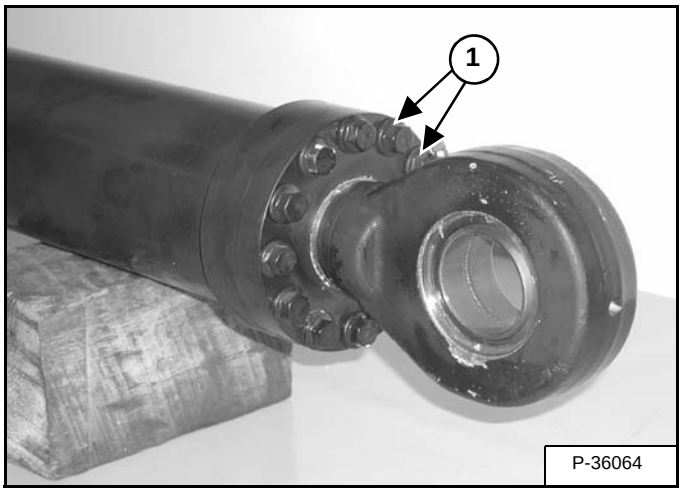
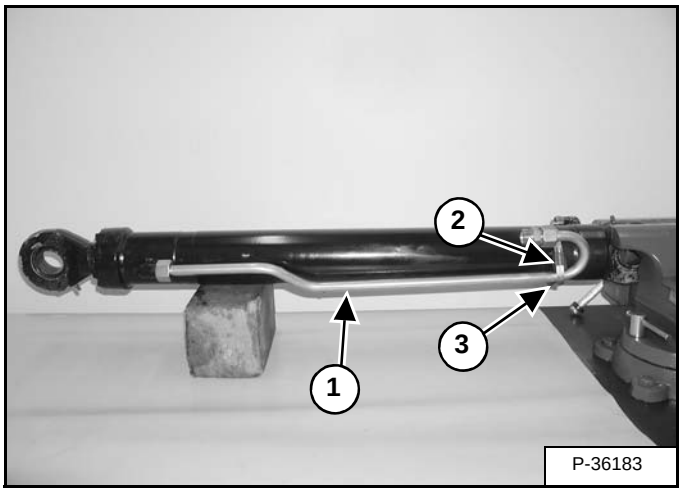
Assembly (Cont'd)

Figure 20-23-115



Install the 12 bolts (Item 1) **[Figure 20-23-115]** and tighten to 53 ft.-lb. (72 N•m) torque

Figure 20-23-116



Install the tubeline (Item 1), block (Item 2) and clamp (Item 3) **[Figure 20-23-116]**.

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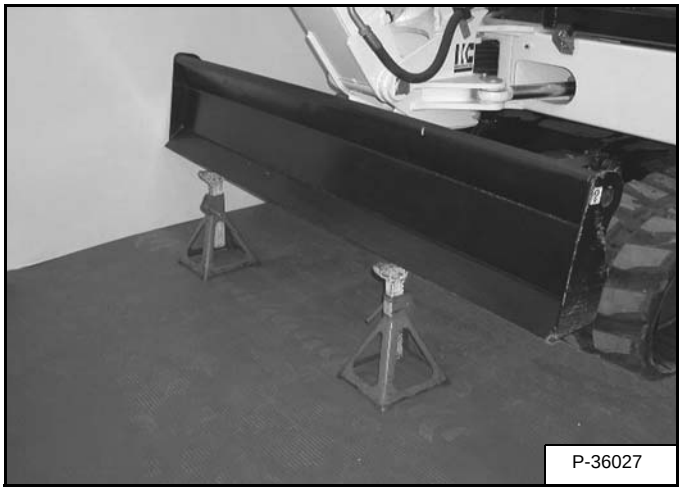
BLADE CYLINDER

Testing

Put the bucket on the ground.

Figure 20-24-1

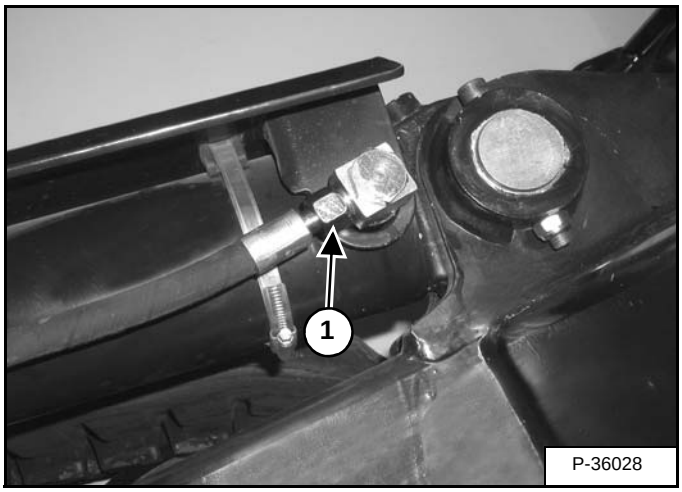


Raise the blade, and support with jack stands **[Figure 20-24-1]**.

Stop the engine.

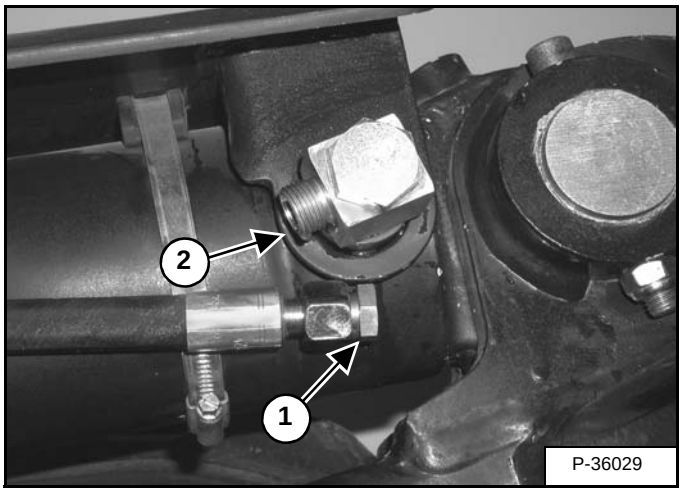
With the engine off and the key in the run position, move the blade lever to relieve hydraulic pressure.

Figure 20-24-2



Remove the hydraulic hose (Item 1) **[Figure 20-24-2]** from the base end of the blade cylinders.

Figure 20-24-3



Install a plug (Item 1) **[Figure 20-24-3]** on the hose.

Start the engine and retract the blade cylinders.

If there is any oil leakage from the base end fitting (Item 2) **[Figure 20-24-3]** on the blade cylinders, remove the cylinders for repair or replacement.

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BLADE CYLINDER (CONT'D)

Removal And Installation

NOTE: The right blade cylinder is shown. The procedure is the same for the left blade cylinder.

Put the blade on the floor.

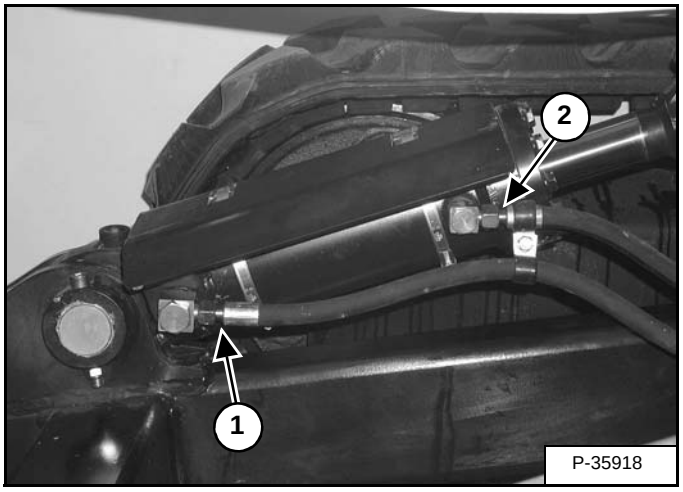
With the engine off and the key in the run position, move the blade lever to relieve hydraulic pressure.

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

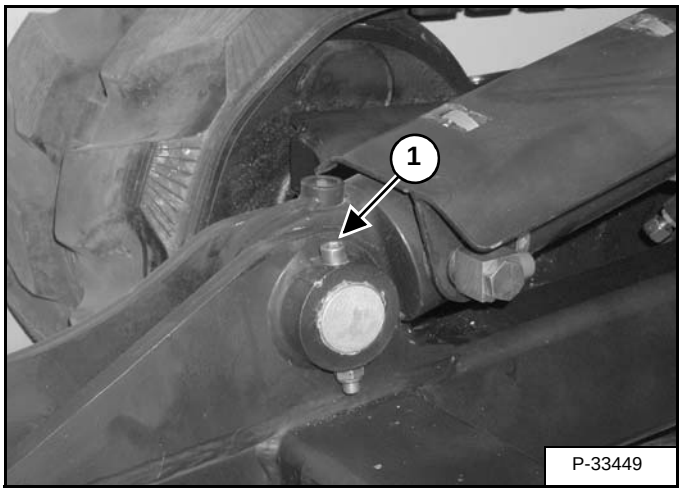
Figure 20-24-4



Remove the hose (Item 1) **[Figure 20-24-4]** from the base end of the cylinder.

Remove the hose (Item 2) **[Figure 20-24-4]** from the rod end of the cylinder.

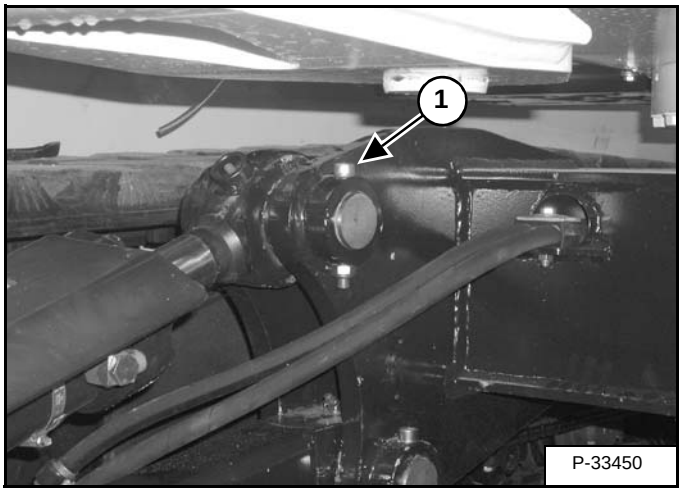
Figure 20-24-5



Remove the bolt (Item 1) **[Figure 20-24-5]** and nut from the base end retaining pin.

Installation: Tighten the bolt to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 20-24-6



Remove the bolt (Item 1) **[Figure 20-24-6]** and nut from the rod end retaining pin.

Installation: Tighten the bolt to 48-55 ft.-lb. (65-75 N•m) torque.

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Removal And Installation (Cont'd)

Figure 20-24-7

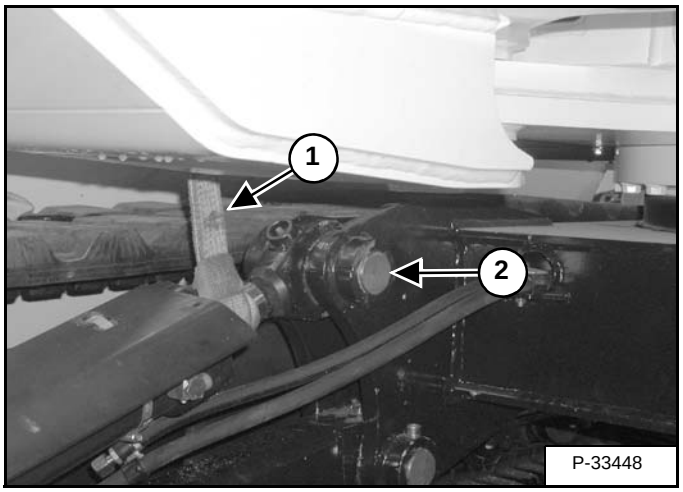
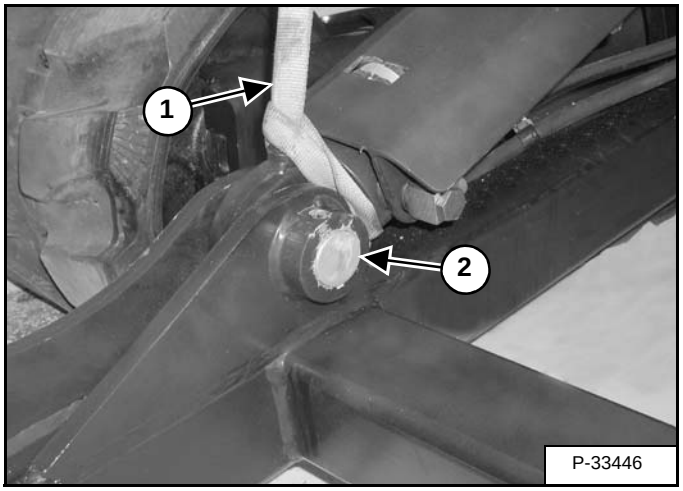


Figure 20-24-8



Install a sling (Item 1) **[Figure 20-24-7]** & **[Figure 20-24-8]** on the rod end and base end of the cylinder.

Remove the pins (Item 2) **[Figure 20-24-7]** & **[Figure 20-24-8]**.

Figure 20-24-9

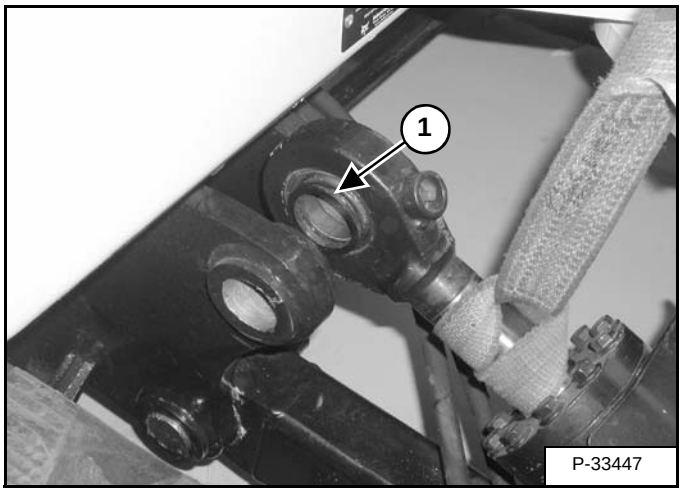
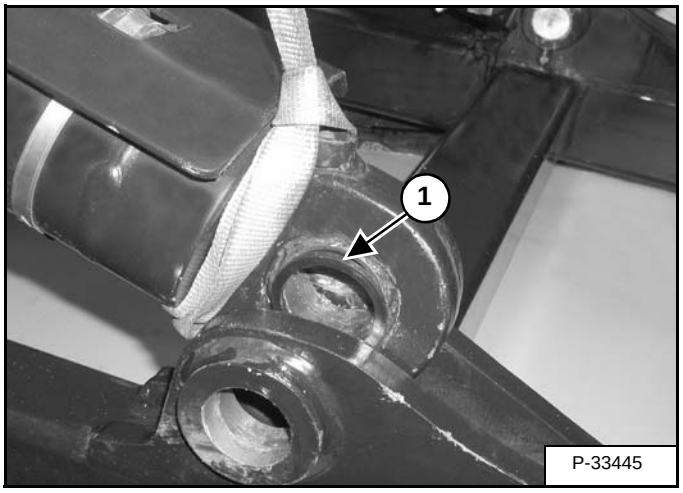


Figure 20-24-10



Raise the hoist and remove the shims (Item 1) **[Figure 20-24-9]** & **[Figure 20-24-10]** from both sides of the rod end and base end of the cylinder.

Figure 20-24-11

Remove the cylinder **[Figure 20-24-11]**

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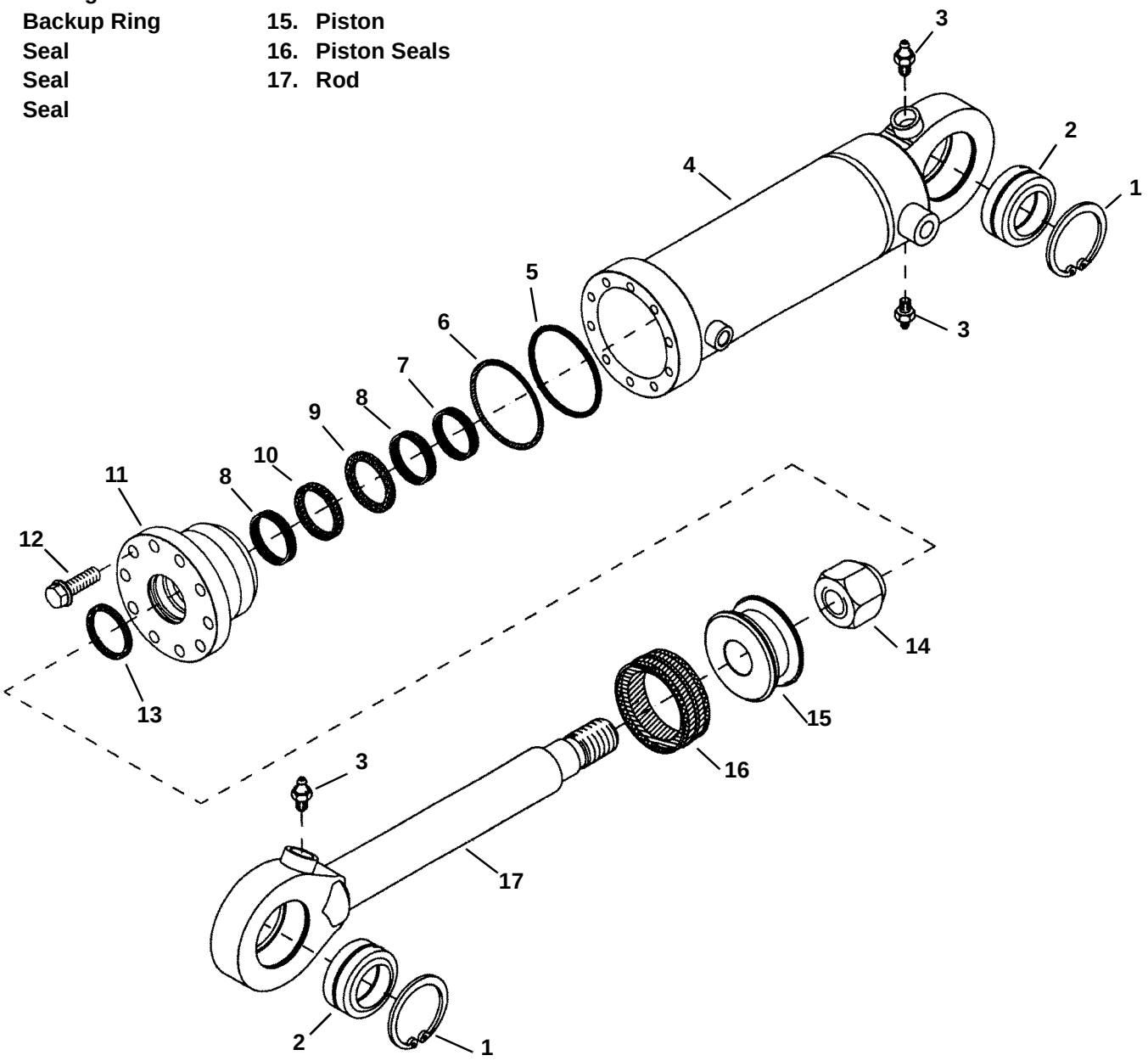
Parts Identification

1. Snap Ring
2. Bearing
3. Grease Fitting
4. Housing
5. O-Ring
6. Backup Ring
7. Seal
8. Seal
9. Seal
10. Wear Ring
11. Head
12 Bolt
13. Wiper Seal
14. Nut
15. Piston
16. Piston Seals
17. Rod



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Disassembly

IMPORTANT

When making repairs on hydraulic system, clean the work area before disassemble 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-2056-0793

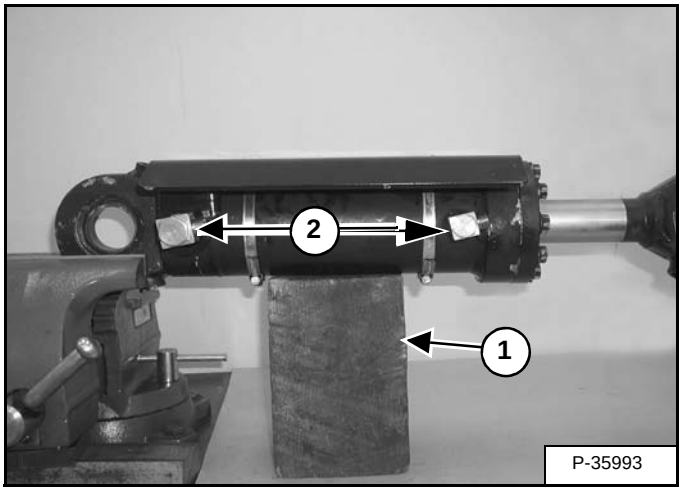
Use the following tools to disassemble the cylinder.

MEL1074-O-Ring Seal Hook

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

NOTE: The blade cylinder on the right side of the excavator has a check valve installed in the base end port which will prevent the hydraulic oil from being drained from the base end of the cylinder.

Figure 20-24-12



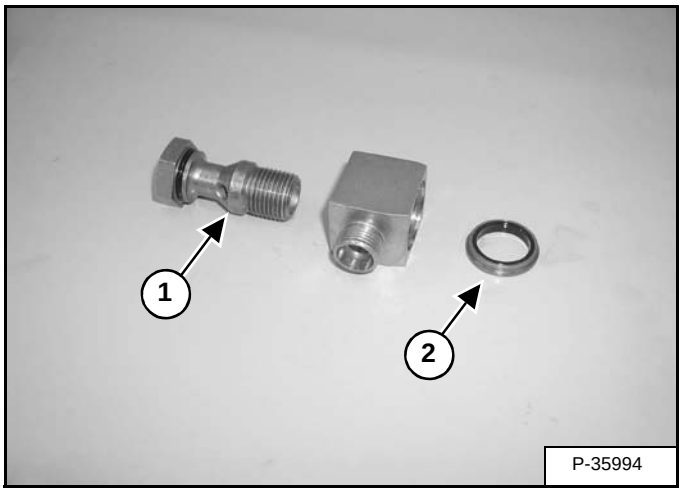
Clamp the base end of the cylinder housing in a vise **[Figure 20-24-12].**

Be careful not to damage the cylinder housing.

Install a block (Item 1) **[Figure 20-24-12]** to support the cylinder.

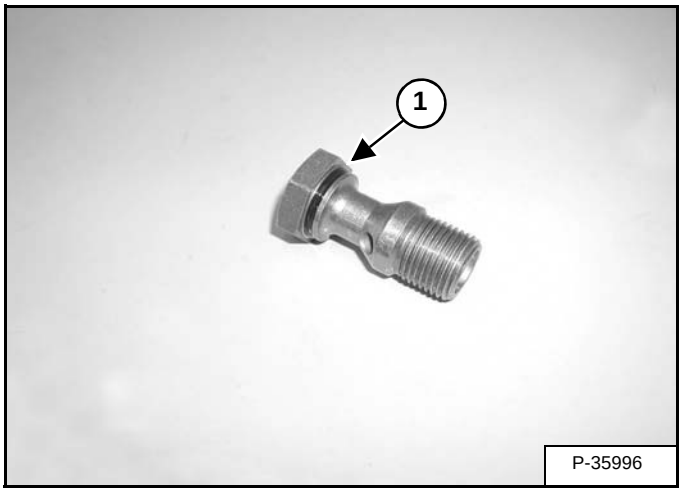
Remove the fittings (Item 2) **[Figure 20-24-12]**.

Figure 20-24-13



Remove the bolt (Item 1) and seal carrier (Item 2) **[Figure 20-24-13]** from the fittings.

Figure 20-24-14



Remove the O-ring (Item 1) **[Figure 20-24-14]** from the bolt.

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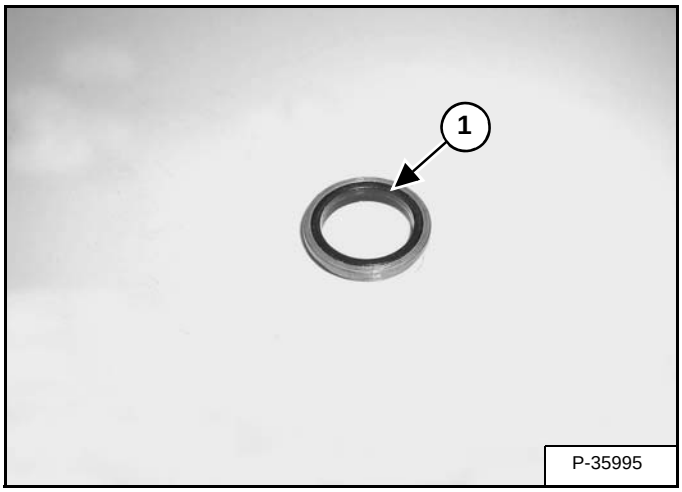
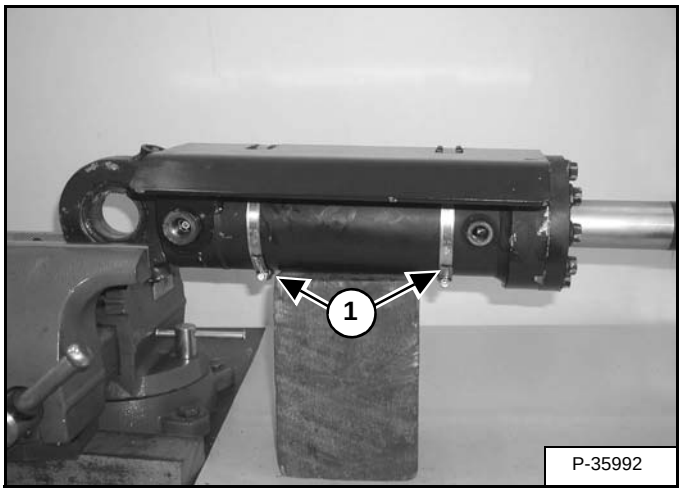
Disassembly (Cont'd)

Figure 20-24-15



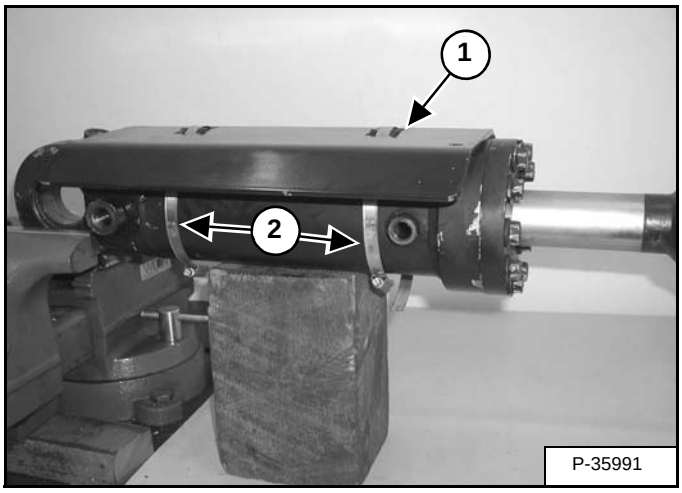
Remove the seal (Item 1) **[Figure 20-24-15]** from the seal carrier.

Figure 20-24-16



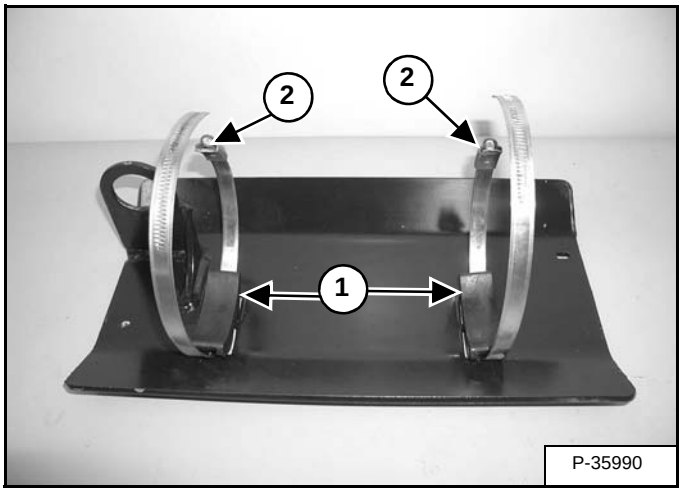
Loosen the hose clamps (Item 1) **[Figure 20-24-16]** until they are fully disconnected.

Figure 20-24-17



Remove the cover (Item 1) and clamps (Item 2) **[Figure 20-24-17]**.

Figure 20-24-18



Remove the blocks (Item 1) and clamps (Item 2) **[Figure 20-24-18]** from the cover.

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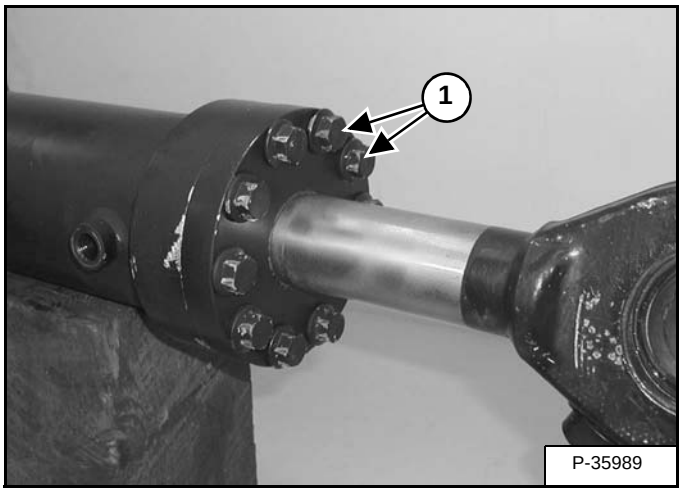
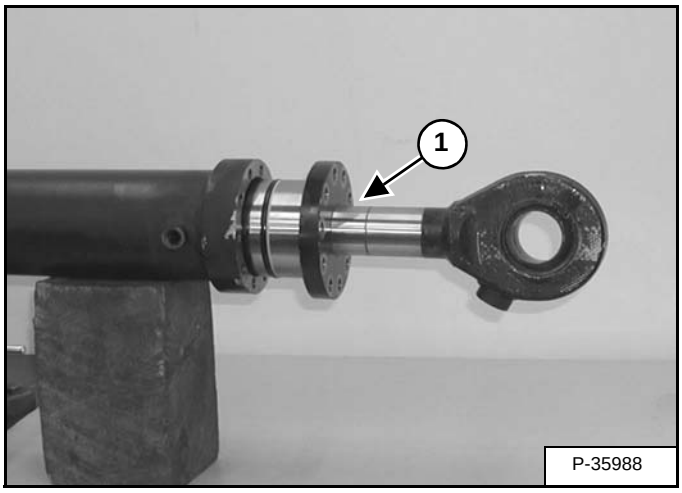
Disassembly (Cont'd)

Figure 20-24-19



Remove the 10 bolts (Item 1) **[Figure 20-24-19]**.

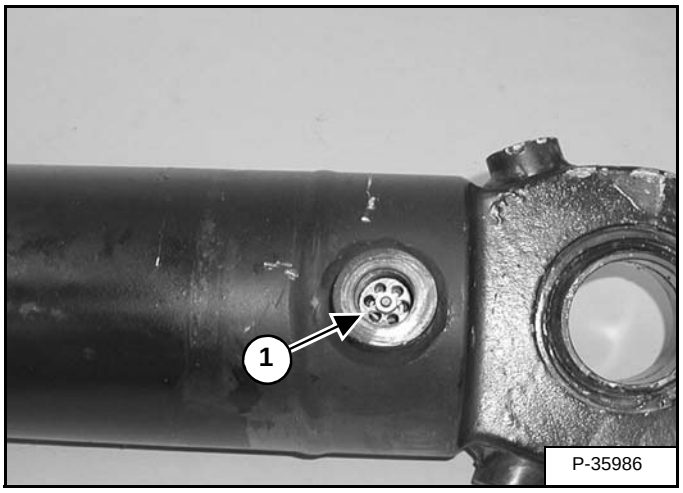
Figure 20-24-20



Remove the rod assembly (Item 1) **[Figure 20-24-20]** from the housing.

NOTE: Place a drain pan under the end of the cylinder housing to catch any undrained hydraulic oil from the base end of the right hand cylinder. (with check valve)

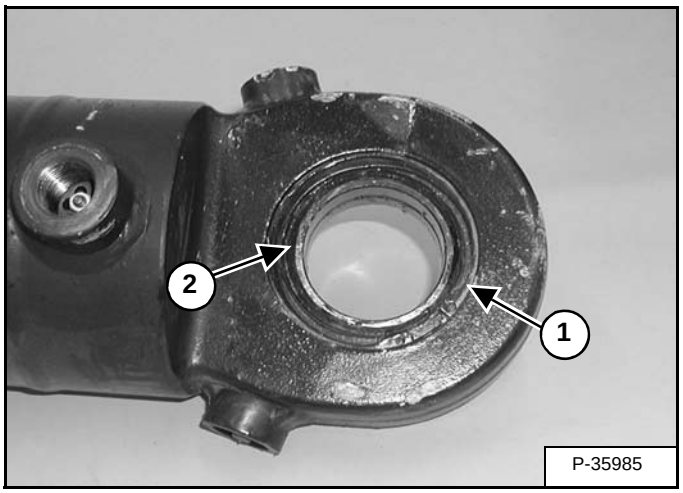
Figure 20-24-21



Remove the check valve (Item 1) **[Figure 20-24-21]**.

Remove the cylinder housing from the vise.

Figure 20-24-22



Remove the snap ring (Item 1) and bearing (Item 2) **[Figure 20-24-22]**.

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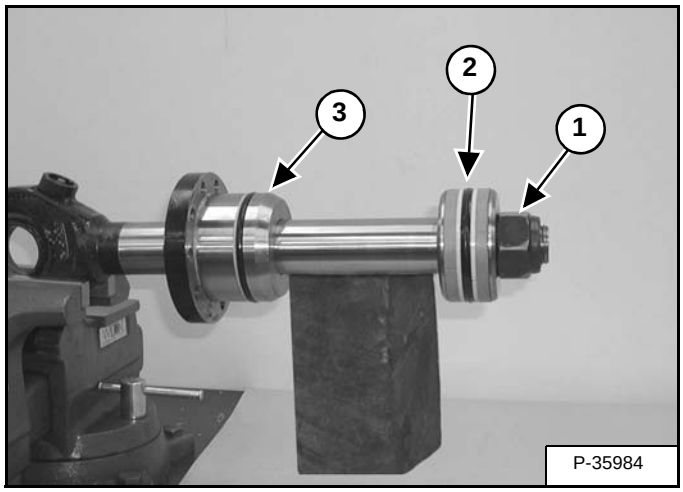
Disassembly (Cont'd)

Figure 20-24-23

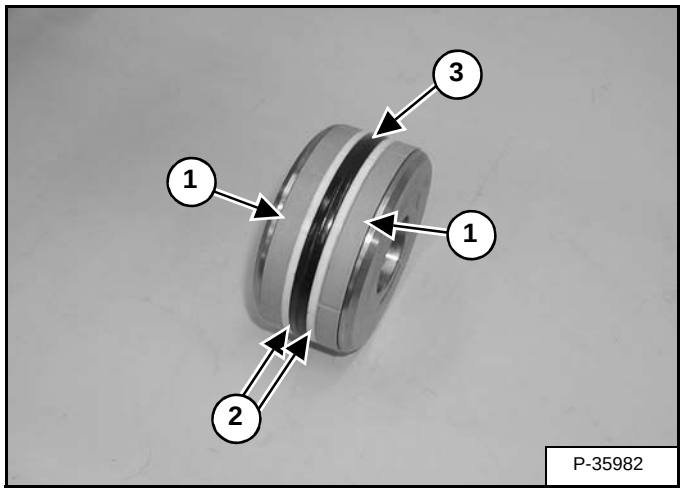


Clamp the rod end in a vise and install a wood block to support the end of the rod **[Figure 20-24-23]**. Use care not to damage the rod.

Apply moderate heat to the nut (Item 1) **[Figure 20-24-23]** and loosen the nut.

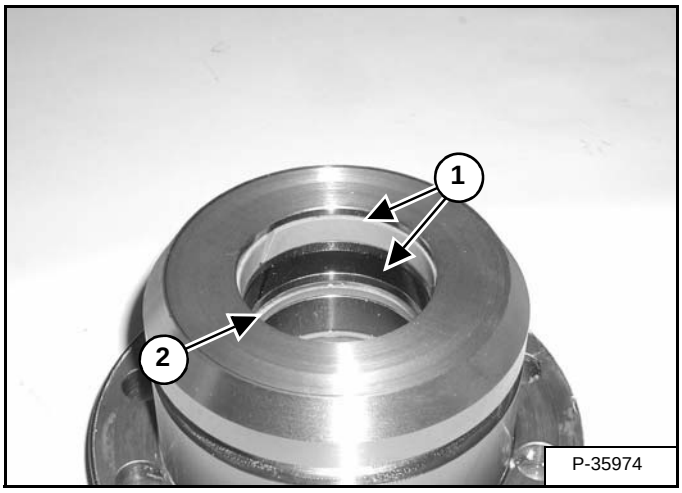
Remove the nut (Item 1), piston (Item 2) and head (Item 3) **[Figure 20-24-23]**

Figure 20-24-24



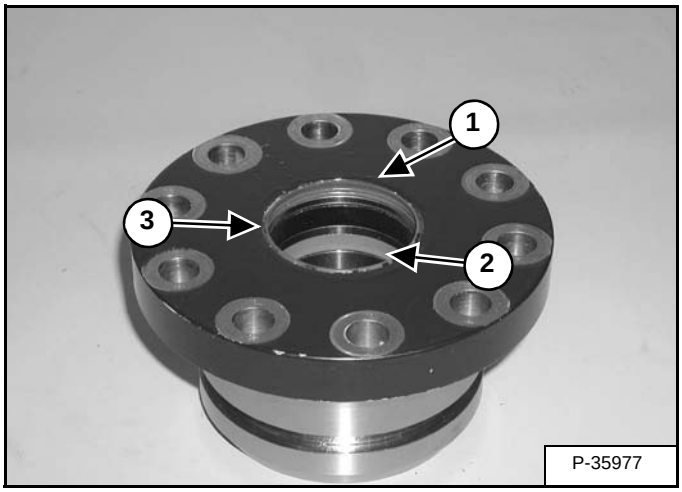
Remove the wear rings (Item 1), back-up rings (Item 2) and seal (Item 3) **[Figure 20-24-24]** from the piston.

Figure 20-24-25



Remove the wear rings (Item 1) and seal (Item 2) **[Figure 20-24-25]** from the head.

Figure 20-24-26



Remove the wiper (Item 1), seal (Item 2) and wear ring (Item 3) **[Figure 20-24-26]**.

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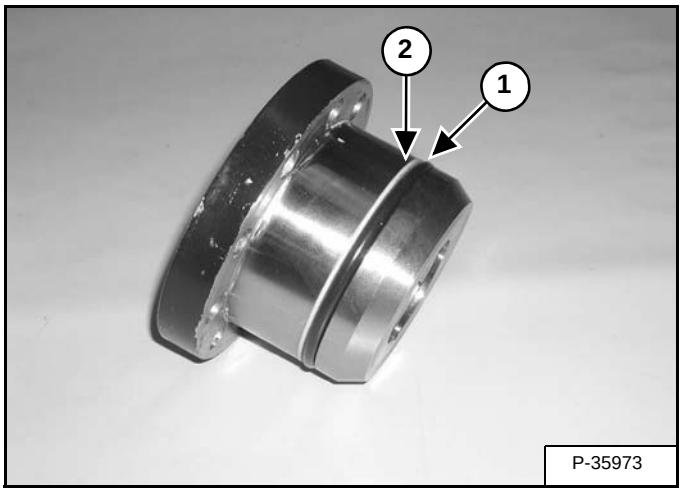
Disassembly (Cont'd)

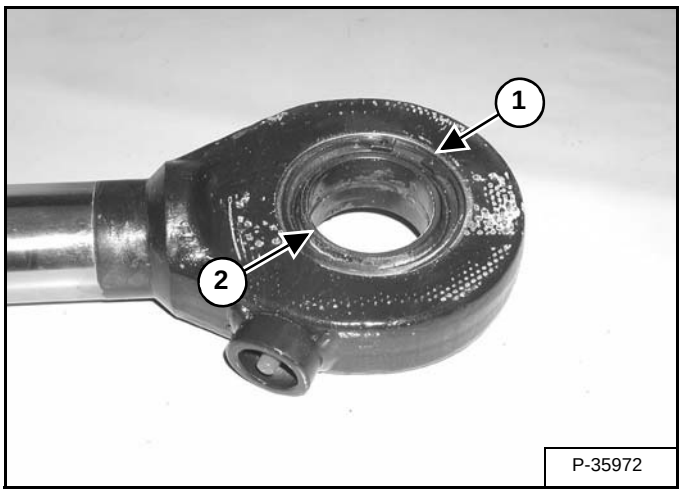
Figure 20-24-27



Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-24-27]**.

Remove the rod from the vise.

Figure 20-24-28



Remove the snap ring (Item 1) and bearing (Item 2) **[Figure 20-24-28]** from the rod.

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Assembly

Use the following tools to assemble the cylinder.

MEL1396 - Universal Seal Expander
MEL1033 - Rod Seal Installation Tool
Piston Ring Compressor

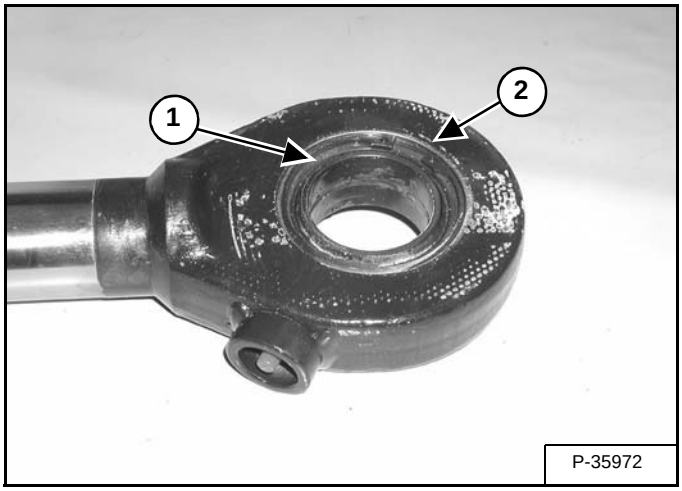
Wash the cylinder parts in clean solvent and dry with compressed air.

Inspect the cylinder parts for nicks, scratches or other damage. Replace any damaged parts.

Always install new O-rings and seals during assembly.

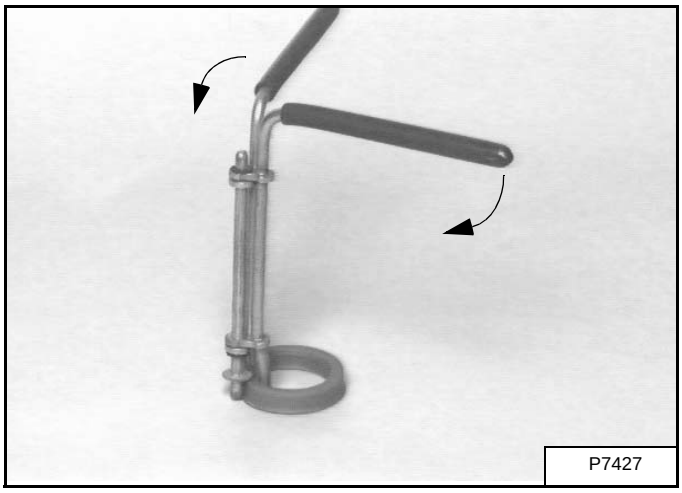
Lubricate all O-rings and seals with hydraulic oil during assembly.

Figure 20-24-29



Install the bearing (Item 1) and snap ring (Item 2) **[Figure 20-24-29]** in the rod.

Figure 20-24-30

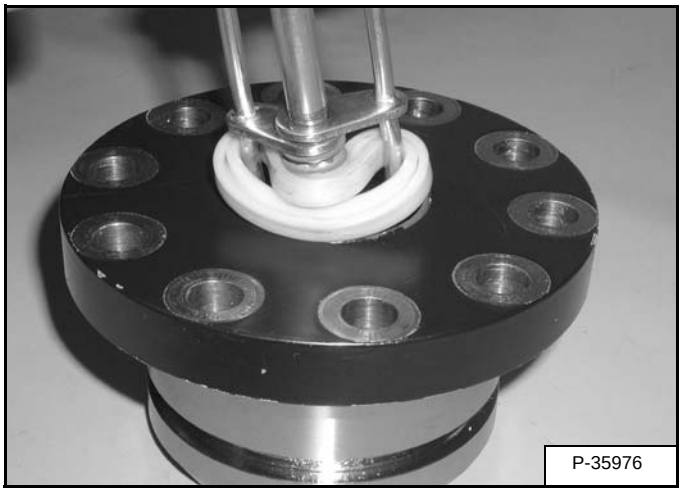


Install the rod seal on the rod seal tool **[Figure 20-24-30]**.

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 20-24-30]**.

Figure 20-24-31



Install the two rod seals in the head **[Figure 20-24-31]**.

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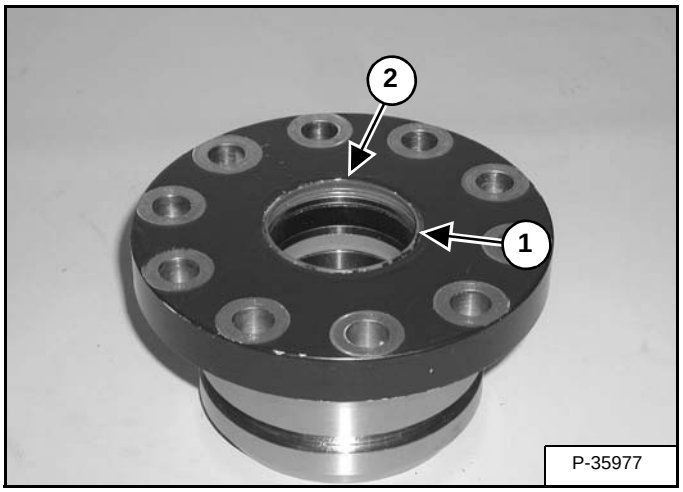
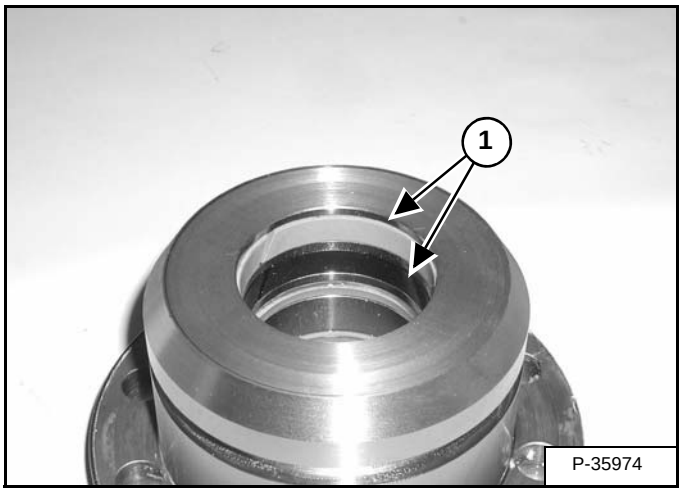
Assembly (Cont'd)

Figure 20-24-32



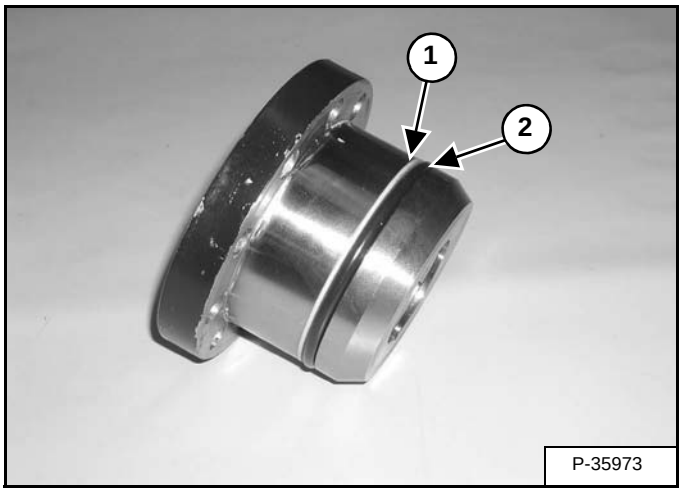
Install the wear ring (Item 1) and wiper (Item 2) **[Figure 20-24-32]**.

Figure 20-24-33



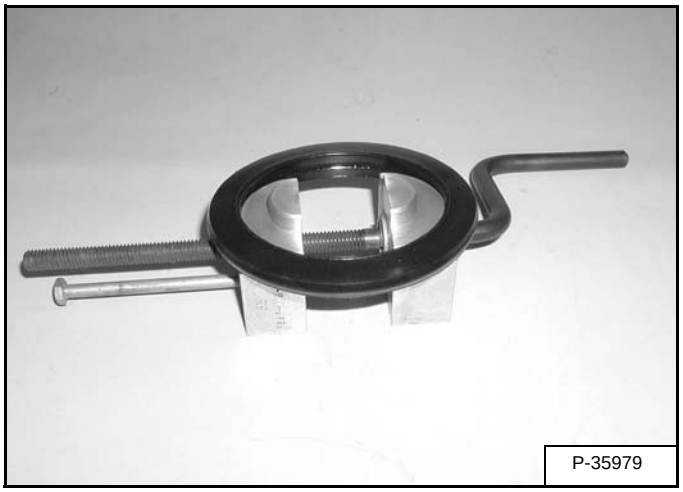
Install the wear rings (Item 1) **[Figure 20-24-33]**.

Figure 20-24-34



Install the back-up ring (Item 1) and O-ring (Item 2) **[Figure 20-24-34]**.

Figure 20-24-35



Install the new seal on the tool and slowly stretch it until it fits the piston **[Figure 20-24-35]**.

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

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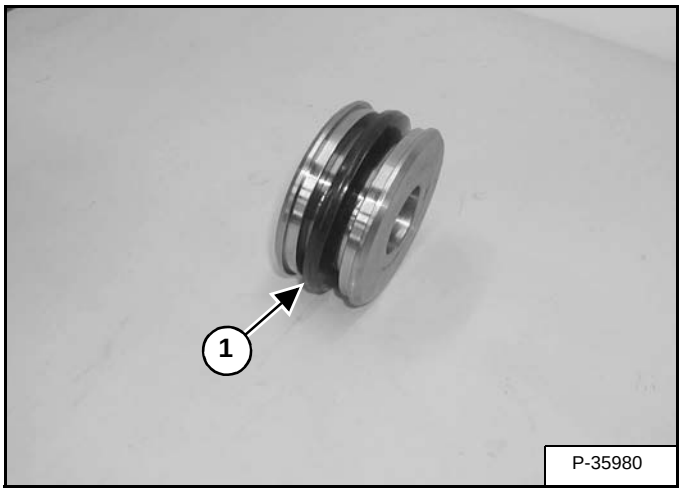
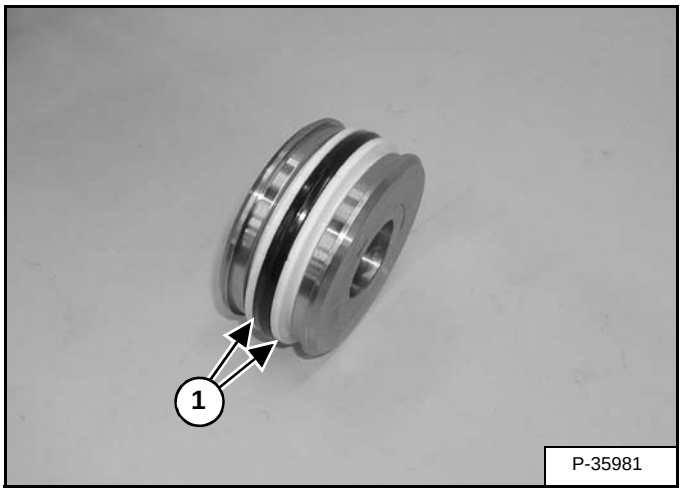
Assembly (Cont'd)

Figure 20-24-36



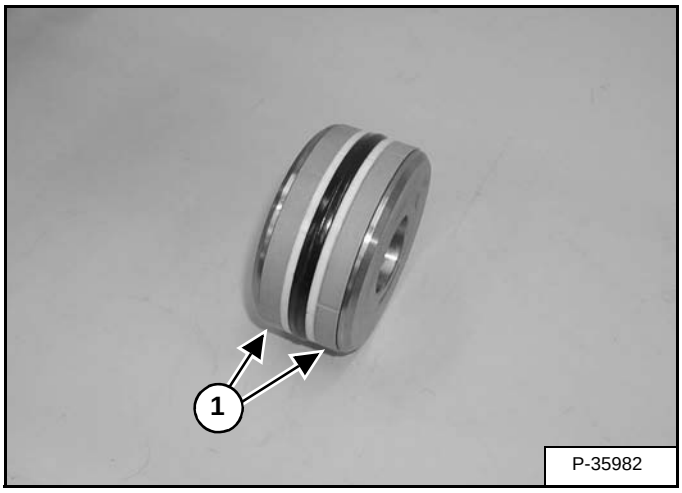
Install the seal (Item 1) **[Figure 20-24-36]** on the piston.

Figure 20-24-37



Install the back-up rings (Item 1) **[Figure 20-24-37]**.

Figure 20-24-38



Install the wear rings (Item 1) **[Figure 20-24-38]**.

Figure 20-24-39

Clamp the rod end in a vise **[Figure 20-24-39]**. Use care not to damage the rod.

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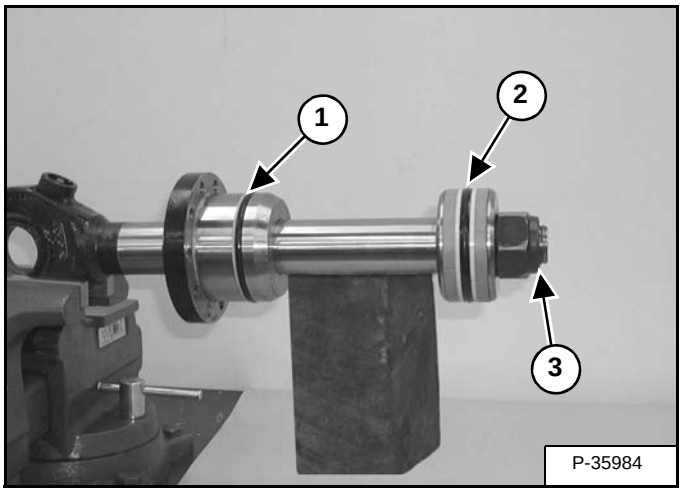
Assembly (Cont'd)

Figure 20-24-40

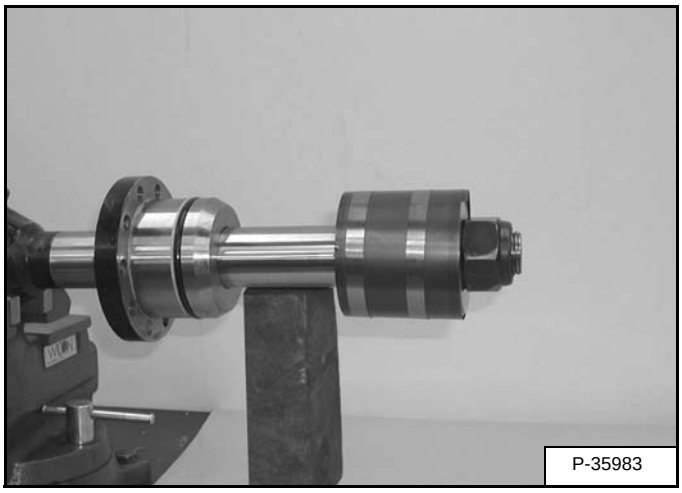


Install the head (Item 1) and piston (Item 2) **[Figure 20-24-40]**.

Apply thread lock adhesive (Loctite™ 270) to the threads of the rod and install the nut (Item 3) **[Figure 20-24-40]**.

Support the rod with a wood block and tighten the nut to 1143 ft.-lb. (1550 N•m) torque.

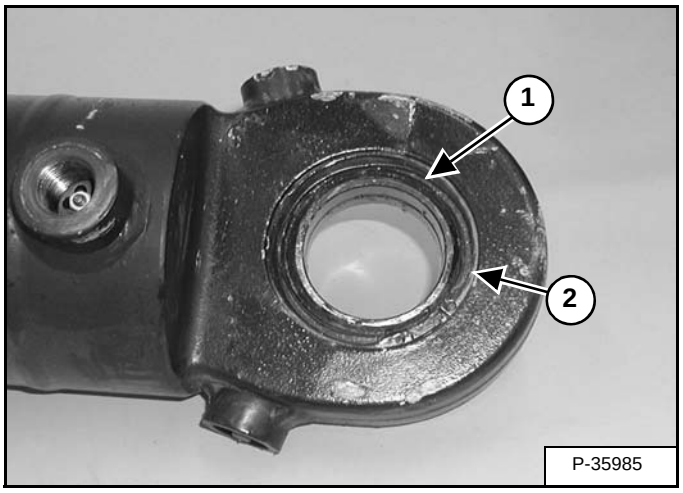
Figure 20-24-41



Use a ring compressor to compress the seal to the correct size. Leave the piston in the compressor for three minutes **[Figure 20-24-41]**.

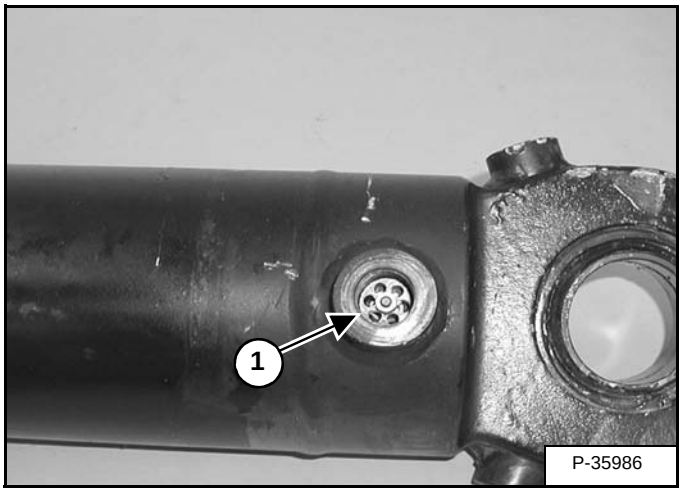
Remove the rod assembly from the vise.

Figure 20-24-42



Install the bearing (Item 1) and snap ring (Item 2) **[Figure 20-24-42]** in the base end of the cylinder.

Figure 20-24-43



Install the check valve (Item 1) **[Figure 20-24-43]**.

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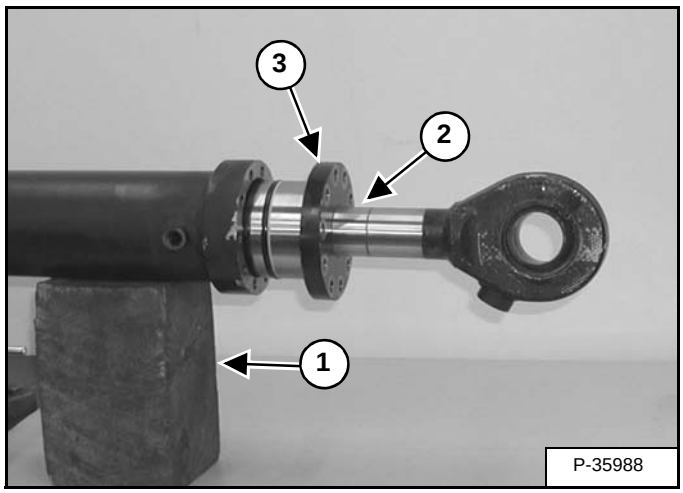
Assembly (Cont'd)

Figure 20-24-44

Clamp the base end of the cylinder housing in a vise **[Figure 20-24-44]**.

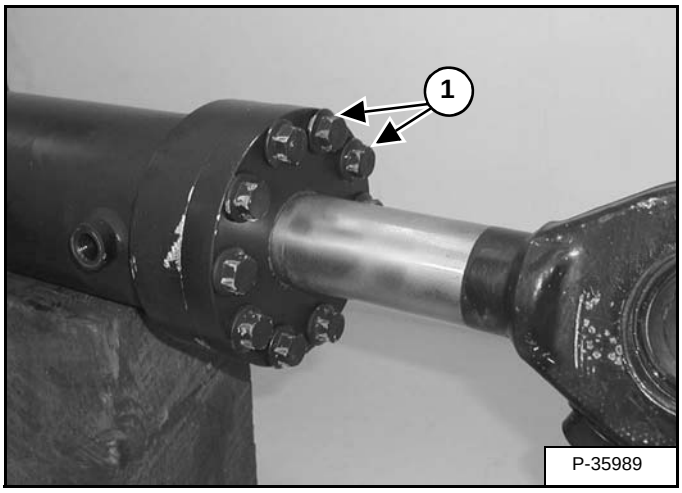
Use care not to damage the cylinder housing.

Figure 20-24-45



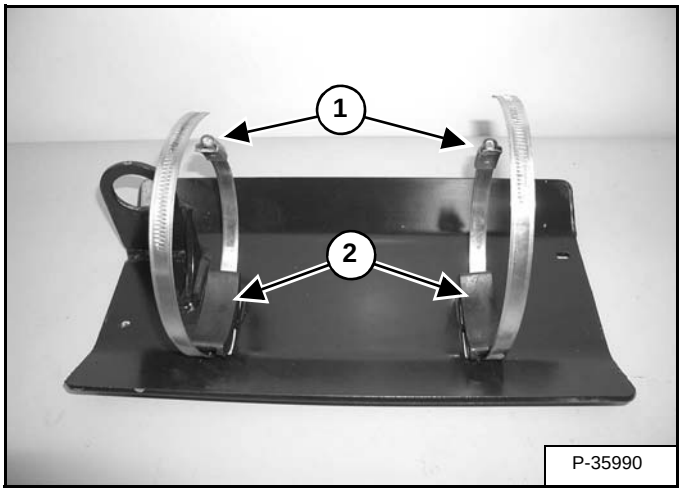
Support the end of the housing with a block (Item 1) and install the rod assembly (Item 2) until the head (Item 3) **[Figure 20-24-45]** is fully seated in the housing.

Figure 20-24-46



Install the ten bolts (Item 1) **[Figure 20-24-46]** and tighten to 114 ft.-lb. (155 N•m) torque.

Figure 20-24-47



Install the clamps (Item 1) and blocks (Item 2) **[Figure 20-24-47]** on the cover.

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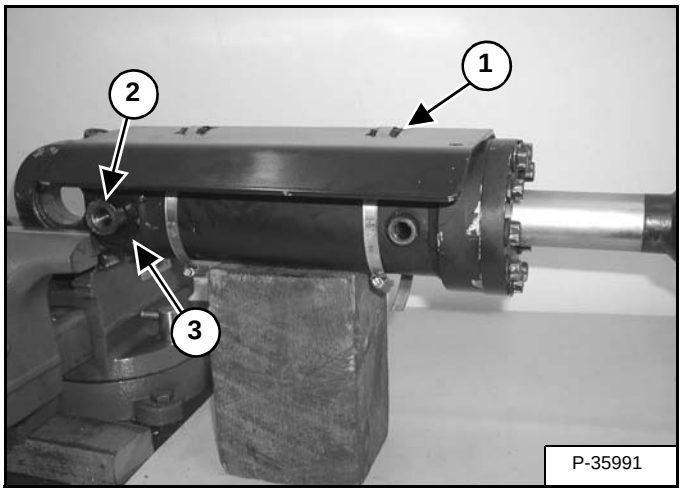
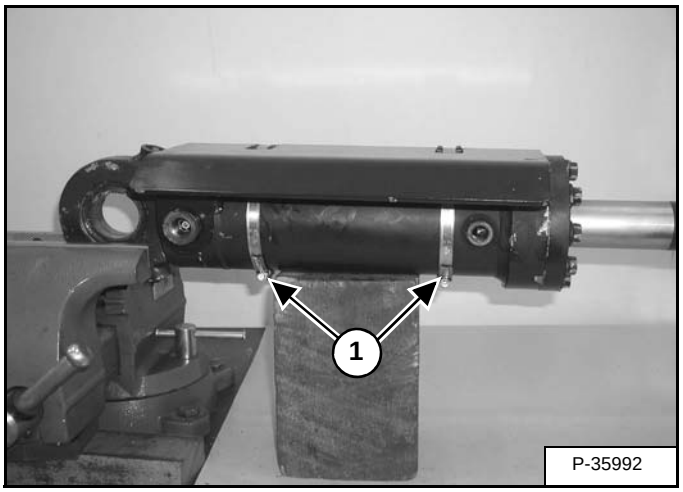
Assembly (Cont'd)

Figure 20-24-48



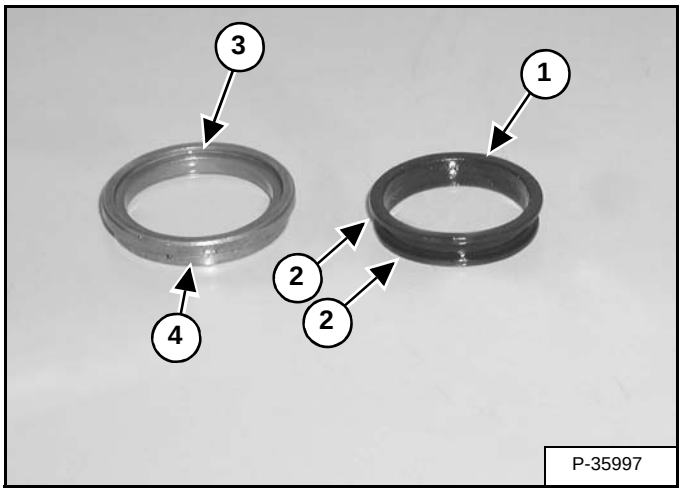
Install the cover (Item 1) on the cylinder housing with the hole (Item 3) over the base end port (Item 2) **[Figure 20-24-48]**.

Figure 20-24-49



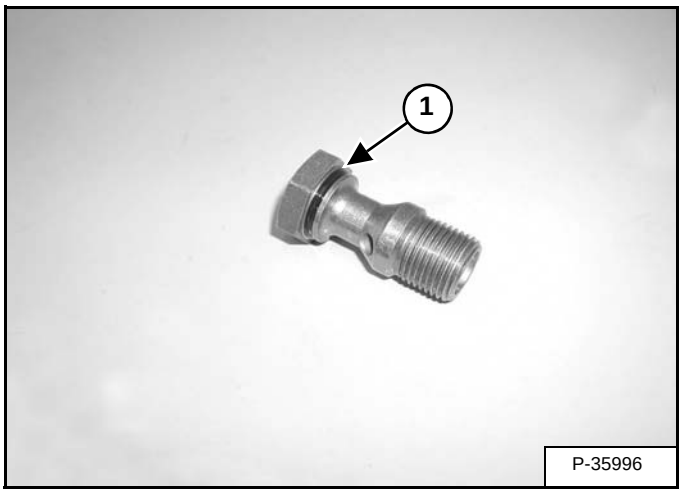
Connect the ends of the clamps (Item 1) **[Figure 20-24-49]** and tighten.

Figure 20-24-50



Install the seal (Item 1) with the lips (Item 2) in the grooves (Item 3) of the seal carrier (Item 4) **[Figure 20-24-50]**.

Figure 20-24-51



Install the O-ring (Item 1) **[Figure 20-24-51]** on the bolt.

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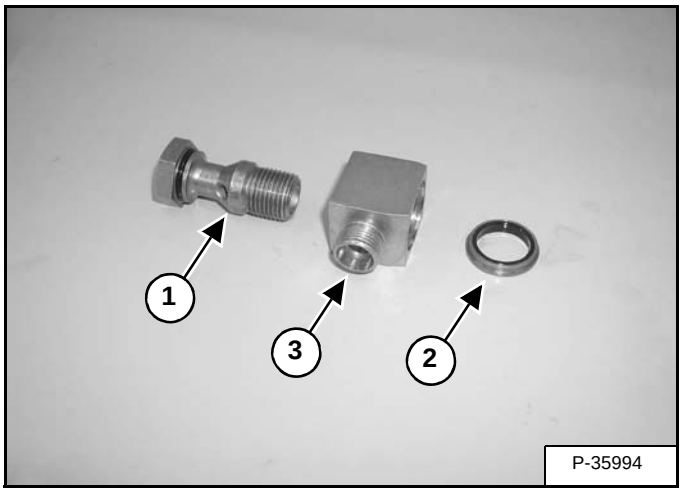
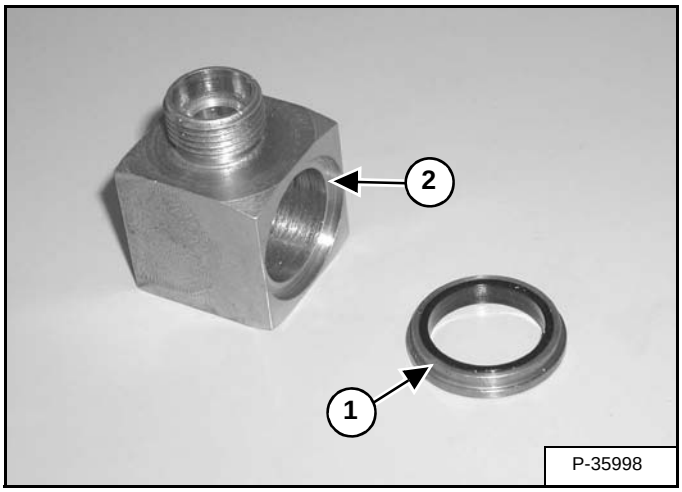
Assembly (Cont'd)

Figure 20-24-52



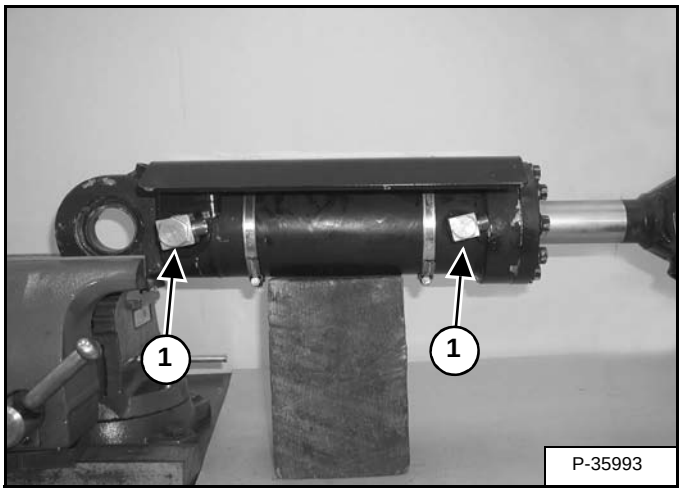
Install the bolt (Item 1) and seal carrier (Item 2) into the fitting (Item 3) **[Figure 20-24-52]**.

Figure 20-24-53



NOTE: The groove (Item 1) on the seal carrier fits into the groove (Item 2) [Figure 20-24-53] in the fitting.

Figure 20-24-54



Install the fittings (Item 1) **[Figure 20-24-54]** in the cylinder housing.

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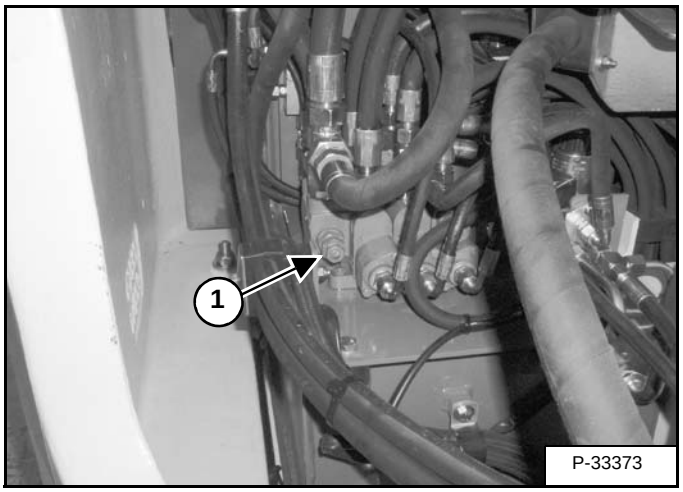
RELIEF VALVES

Description

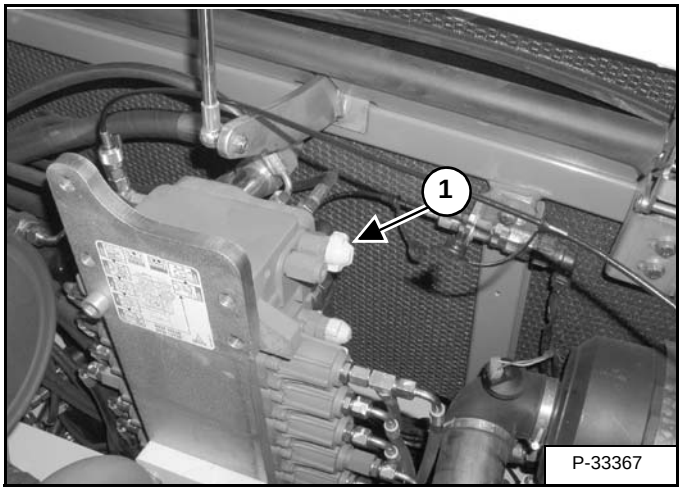
Figure 20-30-1



The gear pump circuit has one main relief valve (Item 1) **[Figure 20-30-1]** located on the three spool valve.

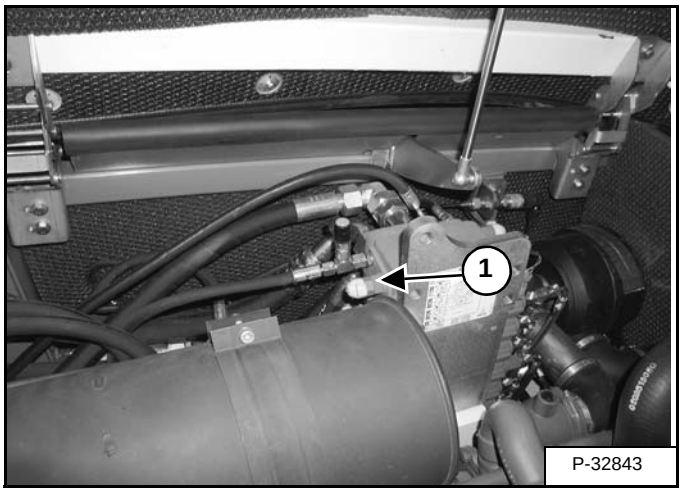
The relief valve is factory set at 3335 PSI (230 bar).

Figure 20-30-2



The piston pump circuit has one load sense relief valve (Item 1) **[Figure 20-30-2]** and one backup relief valve (Item 1) **[Figure 20-30-3]** located on the six spool valve. The load sense relief valve (Item 1) **[Figure 20-30-2]** is factory set at 4060 PSI (280 bar).

Figure 20-30-3



The backup relief valve (Item 1) **[Figure 20-30-3]** is set at 4350 PSI (300 bar), 290 PSI (20 bar) higher than the load sense relief.

The backup relief valve and load sense relief valve are tested and adjusted during the piston pump testing and adjusting. (See Pump Testing on Page 20-50-6 or See Pump Testing on Page 20-52-5.)

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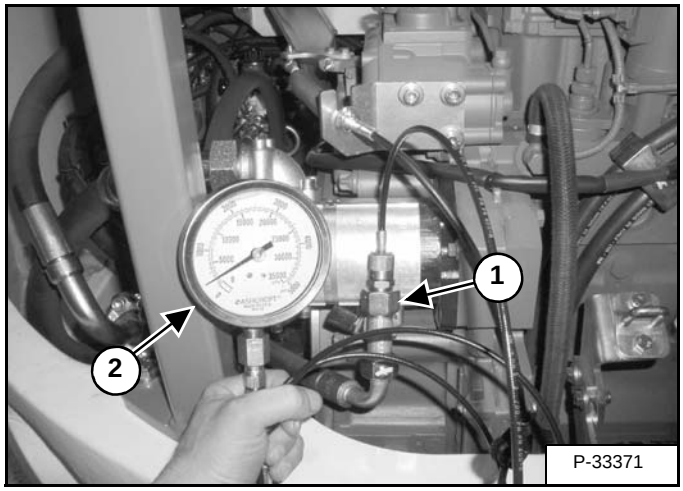
Testing The Three Spool Control Valve Main Relief Valve

Open the right side cover.

Figure 20-30-4



Install a 5000 PSI (345 bar) pressure gauge on the front test coupler (Item 1) **[Figure 20-30-4]** of the gear pump.

Start the excacator and warm the hydraulic oil to operating temperature.

Move the engine speed control to the high speed position.

Raise the blade until the hydraulic cylinders are fully retracted and the relief valve opens.

Record the pressure.

The pressure at the gauge (Item 2) **[Figure 20-30-4]** should be 3335 PSI (230 bar).

Adjusting The Three Spool Control Valve Main Relief Valve

Stop the engine.

Open the rear cover.

Figure 20-30- 5

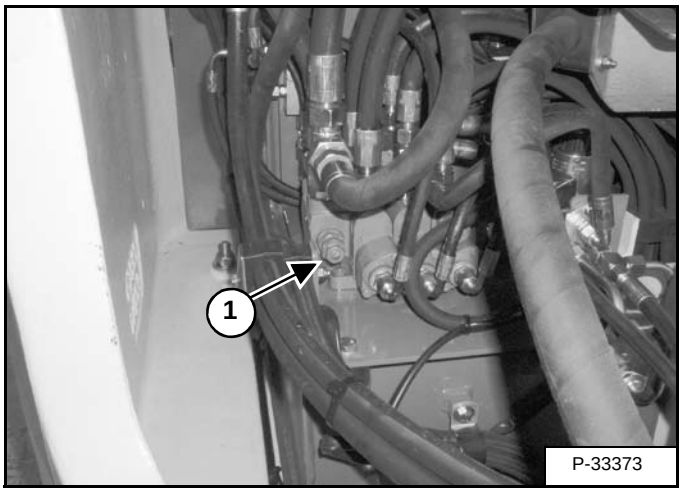
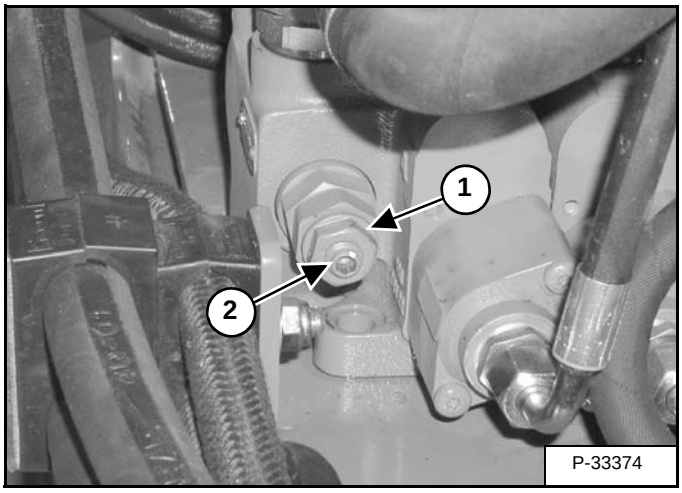


Figure 20-30- 6



Loosen the lock nut (Item 1) **[Figure 20-30- 5]** & **[Figure 20-30- 6]**. Turn the adjustment screw (Item 2) **[Figure 20-30- 6]** in to increase pressure and out to decrease pressure.

NOTE: One quarter turn is approximately 700 psi (48 bar).

Tighten the lock nut and retest the main relief valve.

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PORT RELIEF VALVES

Adjustment Procedure

IMPORTANT

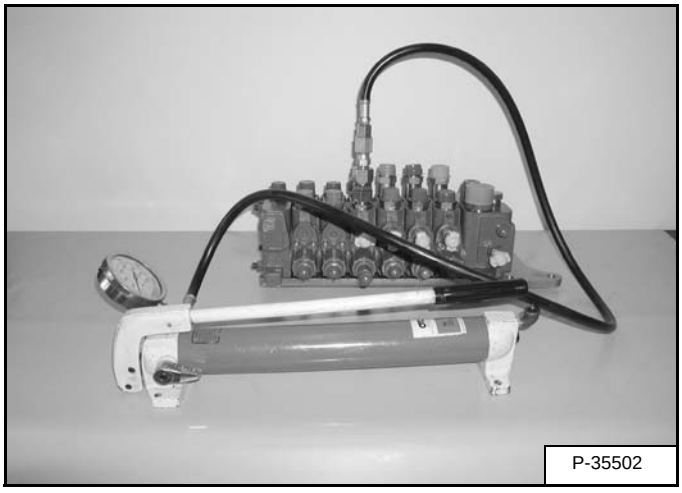
When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I-2003-0888

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.

NOTE: The valve is shown removed from the excavator for photo clarity.

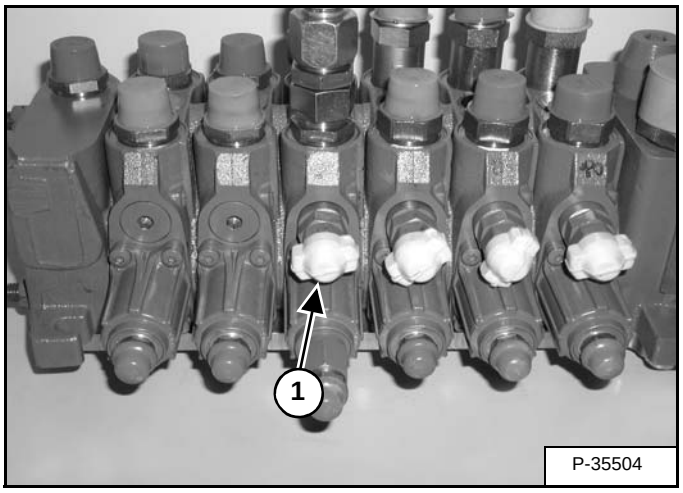
Figure 20-31-1



Install the hand pump, hose and a pressure gauge (minimum of 5000 PSI (345 bar) into the valve section work port in which the port relief valve is located **[Figure 20-31-1]**. Pressurize this section with the hand pump until the port relief valve opens and record the pressure reading.

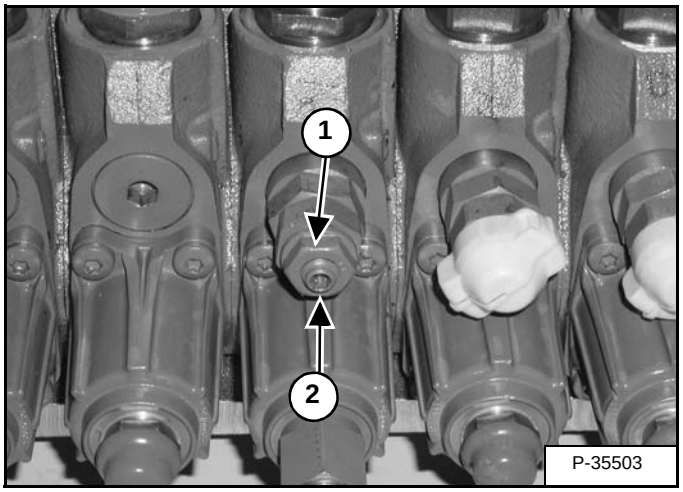
If the port relief pressure setting needs to be adjusted, release the hand pump pressure valve.

Figure 20-31-2



Remove the protective end cap (Item 1) **[Figure 20-31-2]**.

Figure 20-31-3



Loosen the lock nut (Item 1) **[Figure 20-31-3]**.

Turn the adjusting screw (Item 2) **[Figure 20-31-3]** clockwise to increase the pressure and counterclockwise to reduce the pressure.

NOTE: One-quarter turn is approximately 1000 PSI (69 bar). When the correct pressure setting is obtained, tighten the locknut while holding the adjustment screw from turning.

Adjust the port relief valve until the correct setting is obtained.

Install the end cap.

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PRESSURE REDUCING VALVE (S/N 528911001 & ABOVE AND 528611001 & ABOVE)

Description

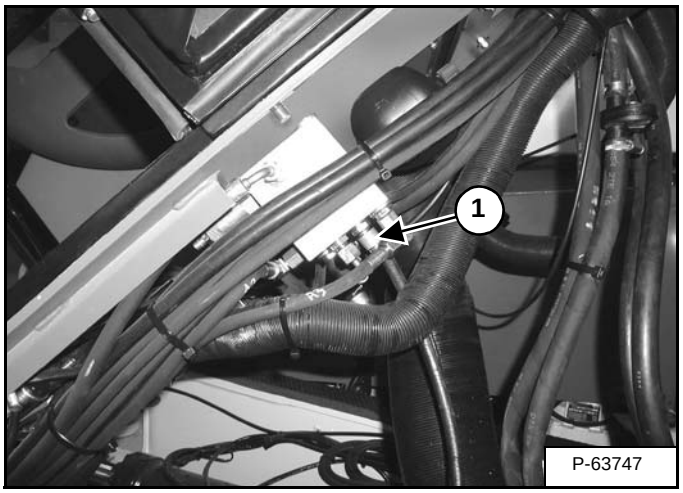
The pressure reducing valve lowers system pressure to 508 PSI (35 bar) for joystick operation.

Testing

Remove the battery access cover.

NOTE: It is not necessary to tilt the cab for this procedure. The cab is shown tilted for photo clarity.

Figure 20-32-1



Install a 1000 PSI (69 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-32-1]**.

Start the engine.

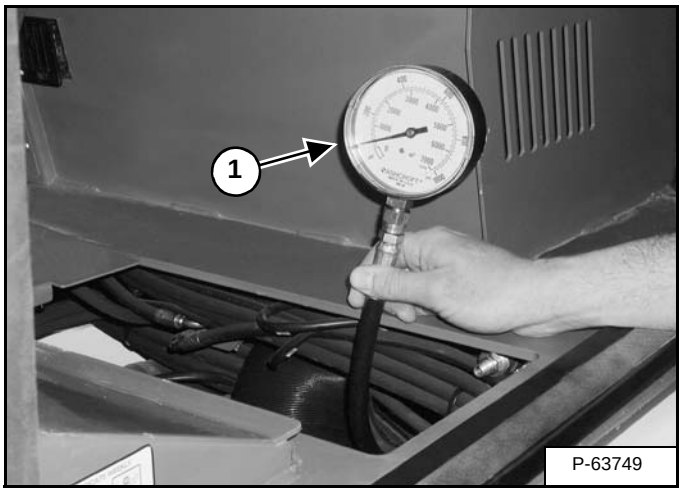
Move the speed control lever to the high speed position.

Lower the left console.

Raise the boom and fully extend the bucket cylinder.

Record the pressure.

Figure 20-32-2



The pressure at the gauge (Item 1) **[Figure 20-32-2]** should be 508 PSI (35 bar).

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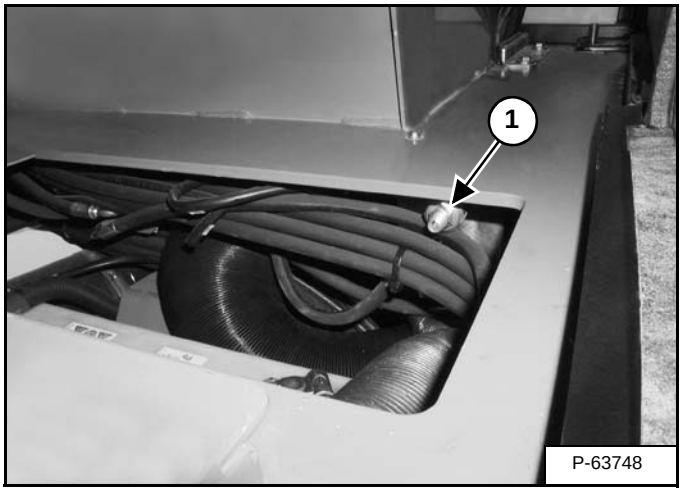
Adjustment

Stop the engine.

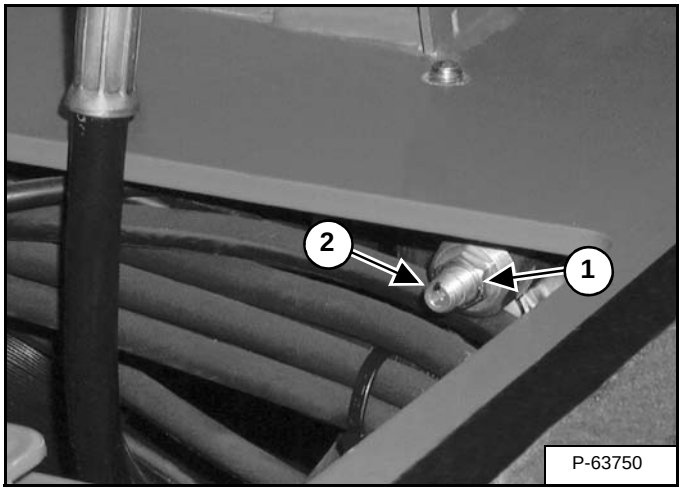
With the engine off and the key in the run position, move the joysticks to relieve hydraulic pressure.

Figure 20-32-3



The pressure reducing valve (Item 1) **[Figure 20-32-3]** is located under the battery access cover.

Figure 20-32-4



Loosen the lock nut (Item 1) **[Figure 20-32-4]**.

Turn the adjustment screw (Item 2) **[Figure 20-32-4]** in to increase the pressure and out to decrease the pressure.

Tighten the lock nut and retest the valve.

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PRESSURE REDUCING VALVE (S/N 522311001 & ABOVE)

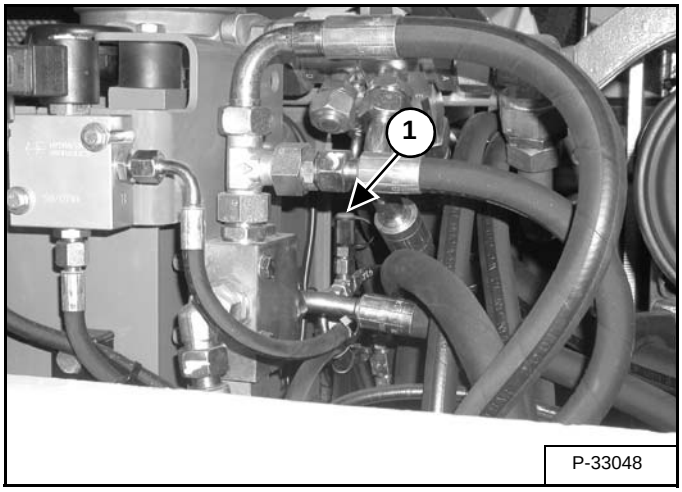
Description

The pressure reducing valve lowers system pressure to 508 PSI (35 bar) for joystick operation.

Testing

Open the rear cover.

Figure 20-33-1



Install a 1000 PSI (69 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-33-1]**.

Start the engine.

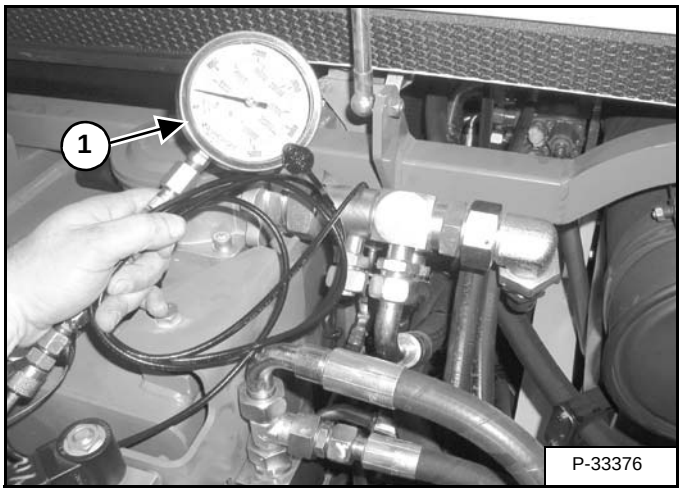
Move the speed control lever to the high speed position.

Lower the left console.

Raise the boom and fully extend the bucket cylinder.

Record the pressure.

Figure 20-33-2



The pressure at the gauge (Item 1) **[Figure 20-33-2]** should be 508 PSI (35 bar).

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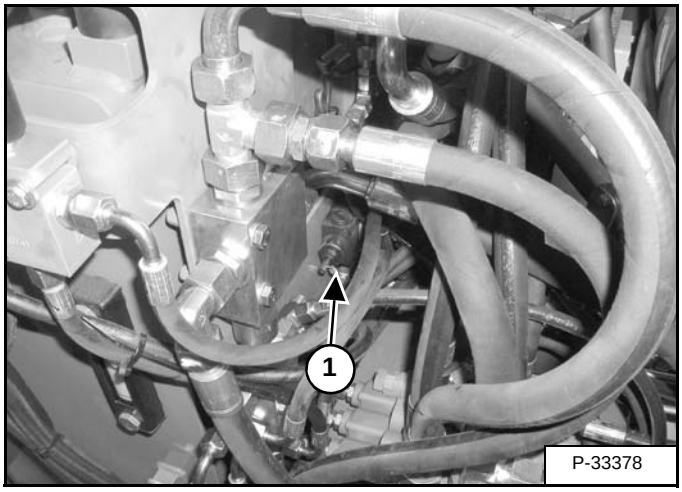
PRESSURE REDUCING VALVE (S/N 522311001 & ABOVE) (CONT'D)

Adjustment

Stop the engine.

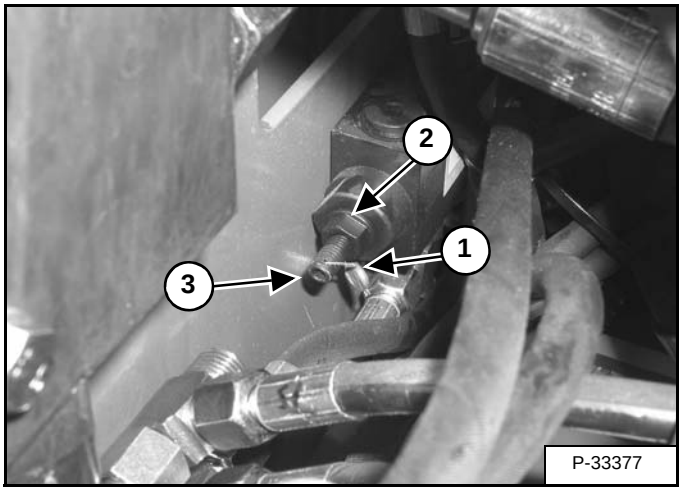
With the engine off and the key in the run position, move the joysticks to relieve hydraulic pressure.

Figure 20-33-3



The pressure reducing valve (Item 1) **[Figure 20-33-3]** is located to the right of the hydraulic reservoir.

Figure 20-33-4



Cut and remove the wire (Item 1) **[Figure 20-33-4]**.

Loosen the lock nut (Item 2) **[Figure 20-33-4]**.

Turn the adjustment screw (Item 3) **[Figure 20-33-4]** in to increase the pressure and out to decrease the pressure.

Tighten the lock nut and retest the valve.

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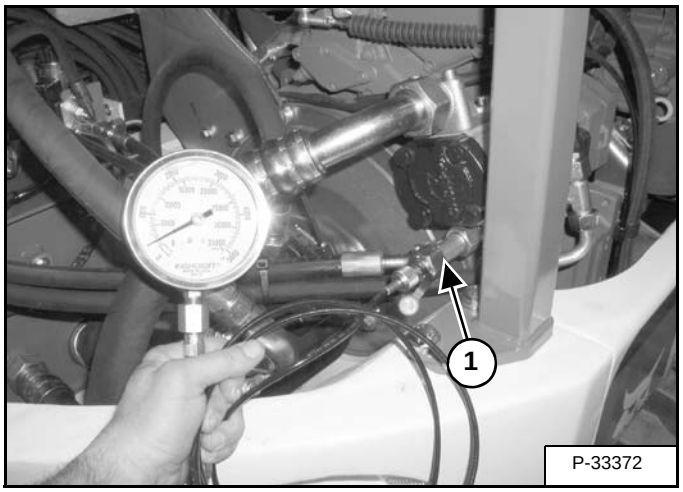
DUMP VALVE

Description

Hydraulic oil from the gear pumps supply the three spool valve. When pressure rises in the valve the dump valve opens and allows oil from one of the gear pumps to flow directly to tank.

Testing

Figure 20-34-1



Install a 5000 PSI (345 bar) gauge on the test port (Item 1) **[Figure 20-34-1]** of the rear gear pump.

Start the excavator and warm the hydraulic oil to operating temperature.

Move the speed control lever to the high speed position.

Lower the left console.

Slowly engage the blade raise circuit. Once the blade is fully raised continue to slowly engage the blade raise circuit.

The pressure will build to 1595 psi (110 bar) and then drop to zero when the unloading valve opens.

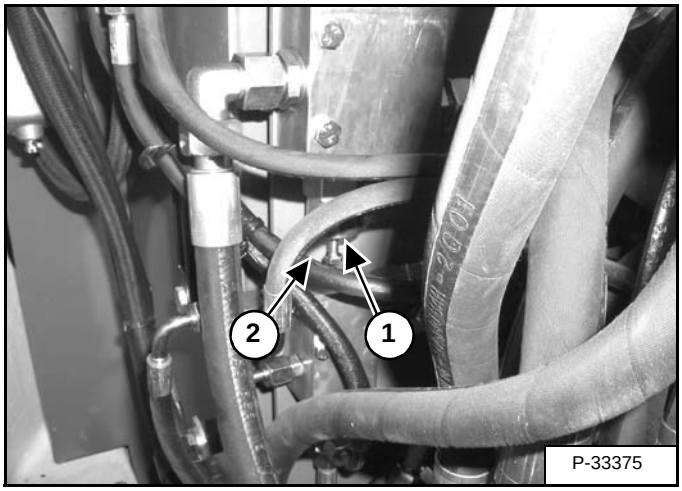
Record the pressure.

NOTE:‘ Repeat the above procedure several times to verify when the unloading valve is opening.

Adjustment

Stop the engine.

Figure 20-34-2



Loosen the lock nut (Item 1) **[Figure 20-34-2]**.

Turn the adjustment screw (Item 2) **[Figure 20-34-2]** in to increase the pressure or out to decrease the pressure.

NOTE: One turn is approximately 150 PSI (10 bar).

Tighten the lock nut and retest the dump 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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DUMP VALVE (CONT'D)

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.

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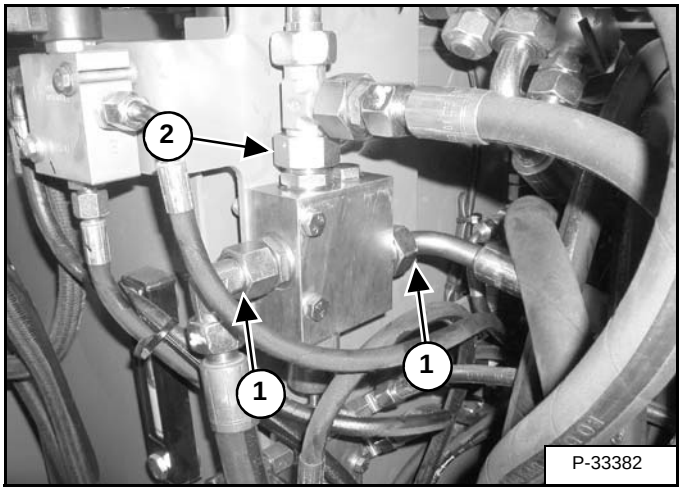
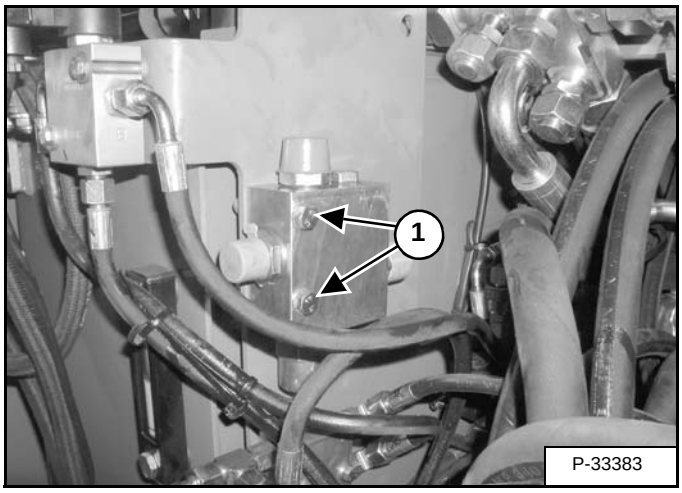
Figure 20-34-3



Remove the hoses (Item 1) and tee fitting (Item 2) **[Figure 20-34-3]**.

Figure 20-34-4



Remove the bolts (Item 1) **[Figure 20-34-4]**.

Installation: Tighten the bolts to 15-18 ft.-lb. (20-25 N•m) torque.

Remove the valve.

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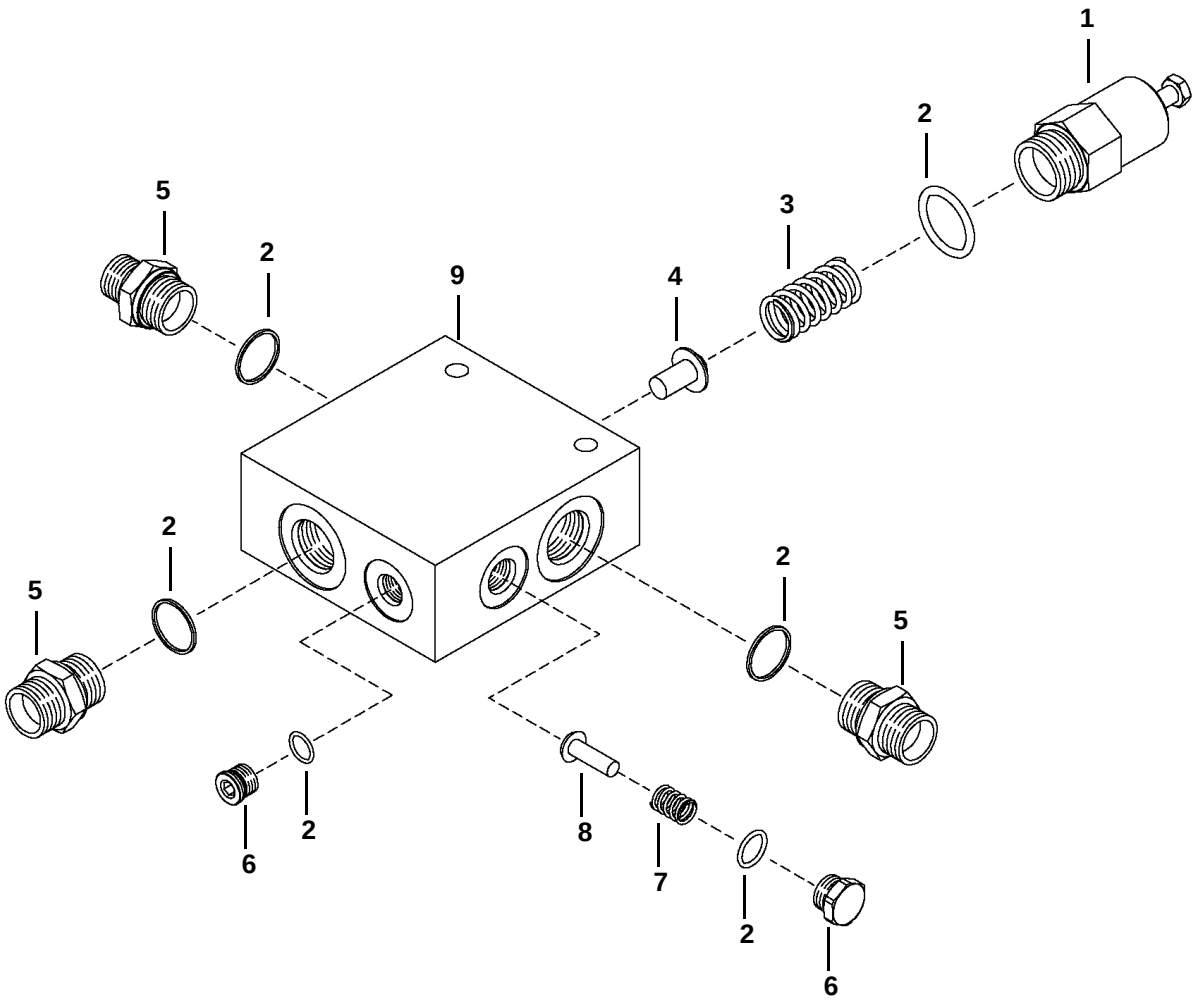
Parts Identification

1 Valve
2 O-Ring
3 Spring
4 Spool
5 Fitting
6 Plug
7 Spring
8 Spring Seat
9 Valve Body



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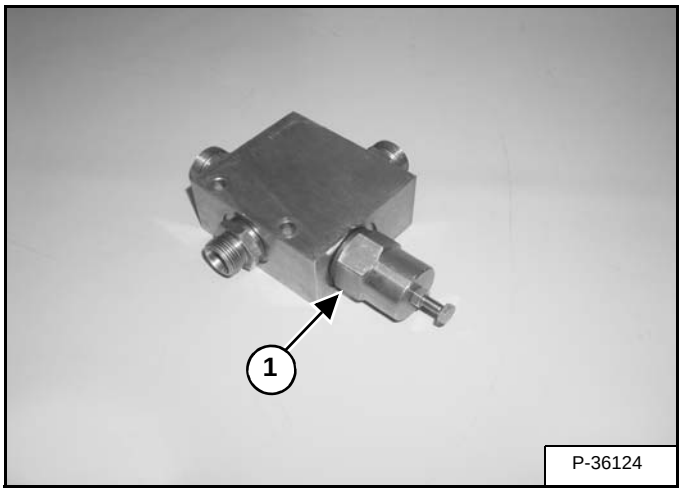
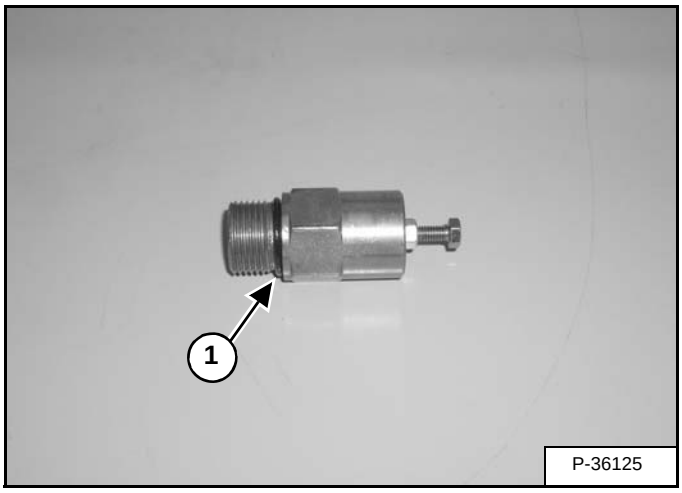
Disassembly And Assembly

Figure 20-34-5



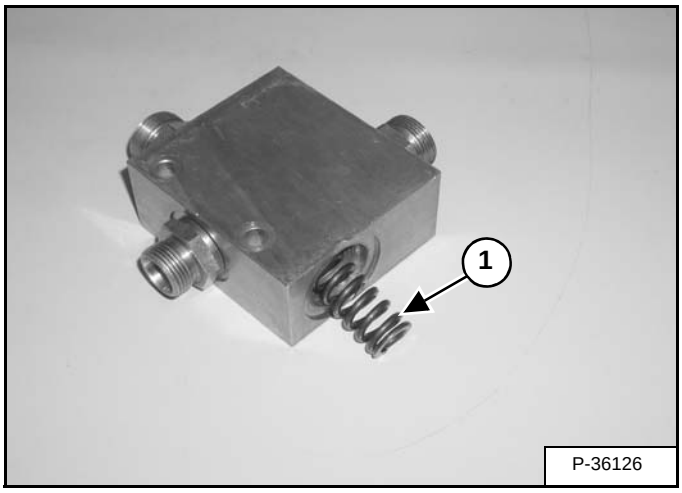
Remove the valve (Item 1) **[Figure 20-34-5]**.

Figure 20-34-6



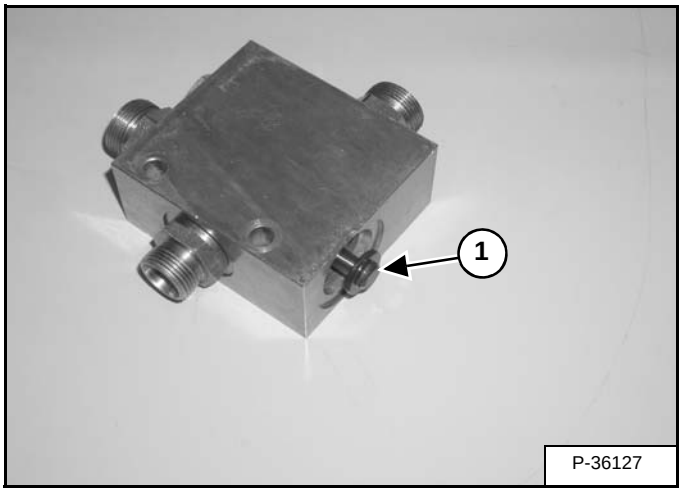
Remove the O-ring (Item 1) **[Figure 20-34-6]**.

Figure 20-34-7



Remove the spring (Item 1) **[Figure 20-34-7]**.

Figure 20-34-8



Remove the spool (Item 1) **[Figure 20-34-8]**.

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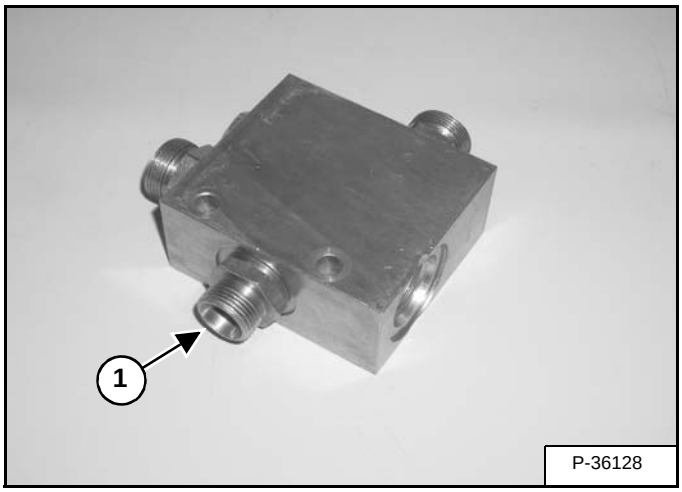
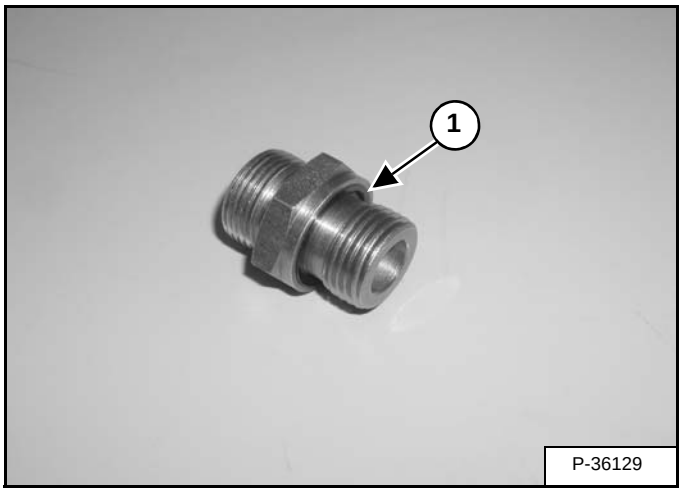
Disassembly And Assembly (Cont'd)

Figure 20-34-9



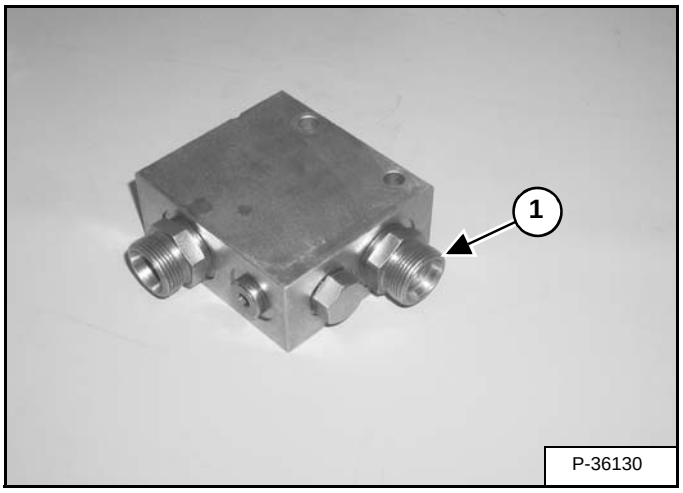
Remove the fitting (Item 1) **[Figure 20-34-9]**.

Figure 20-34-10



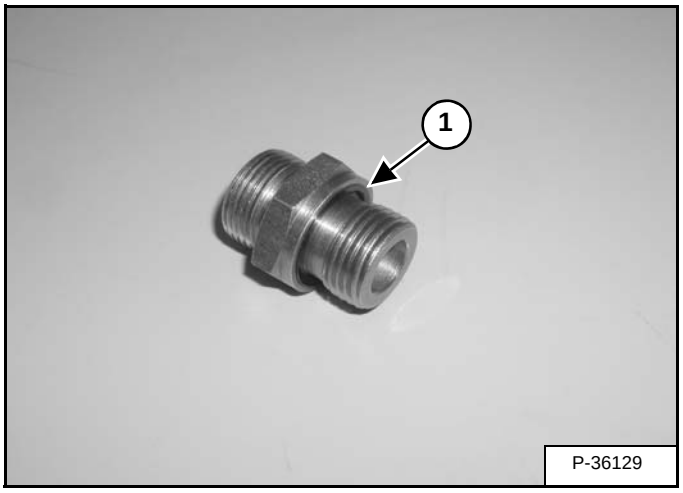
Remove the O-ring (Item 1) **[Figure 20-34-10]**.

Figure 20-34-11



Remove the fitting (Item 1) **[Figure 20-34-11]**.

Figure 20-34-12



Remove the O-ring (Item 1) **[Figure 20-34-12]**.

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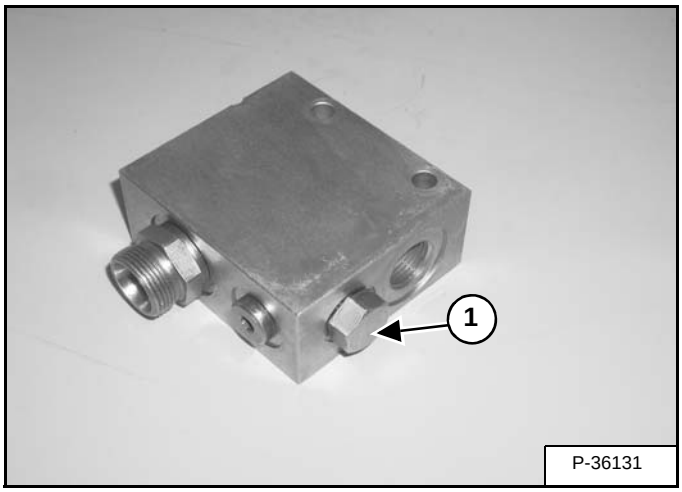
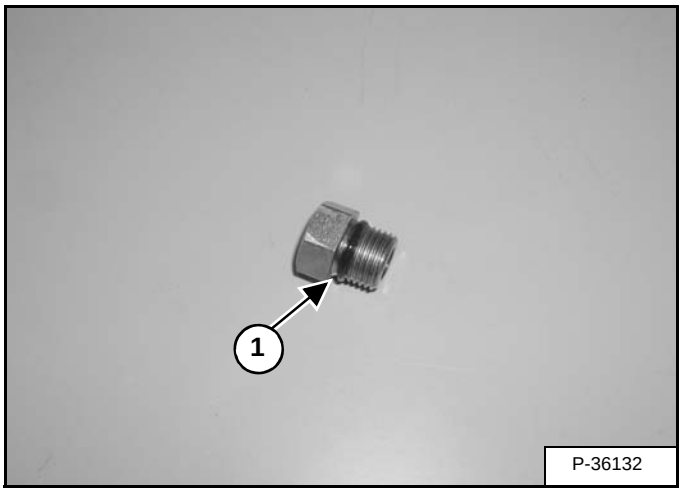
Disassembly And Assembly (Cont'd)

Figure 20-34-13



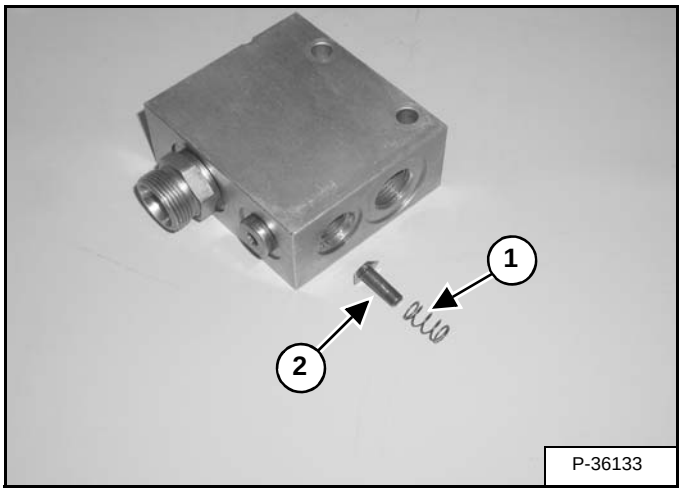
Remove the plug (Item 1) **[Figure 20-34-13]**.

Figure 20-34-14



Remove the O-ring (Item 1) **[Figure 20-34-14]**.

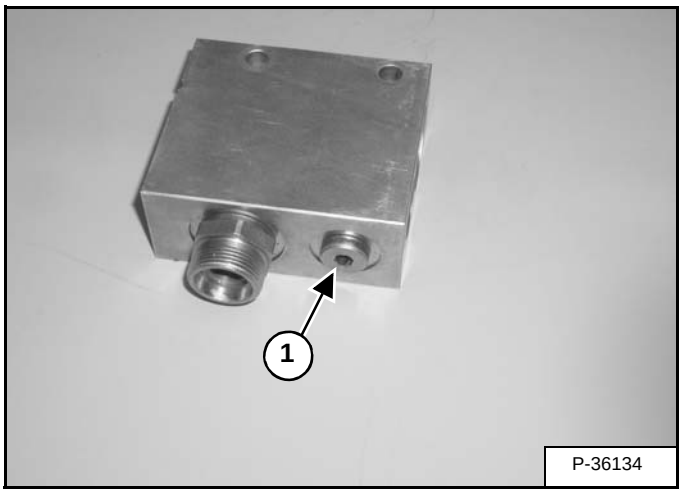
Figure 20-34-15



Remove the spring (Item 1) **[Figure 20-34-15]**.

Remove the spring seat (Item 2) **[Figure 20-34-15]**.

Figure 20-34-16



Remove the plug (Item 1) **[Figure 20-34-16]**.

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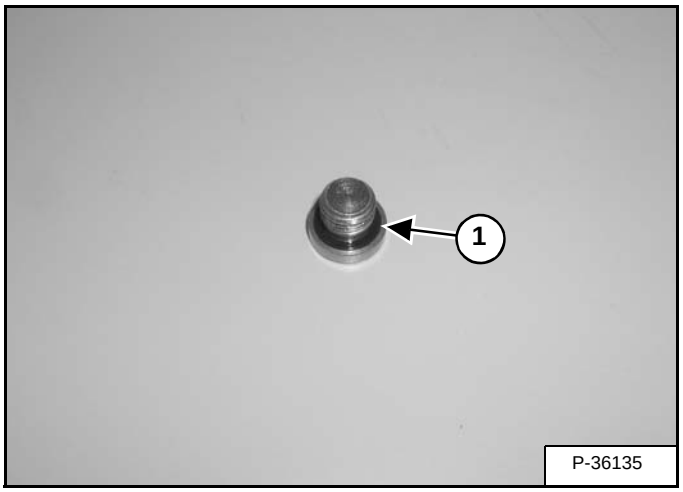
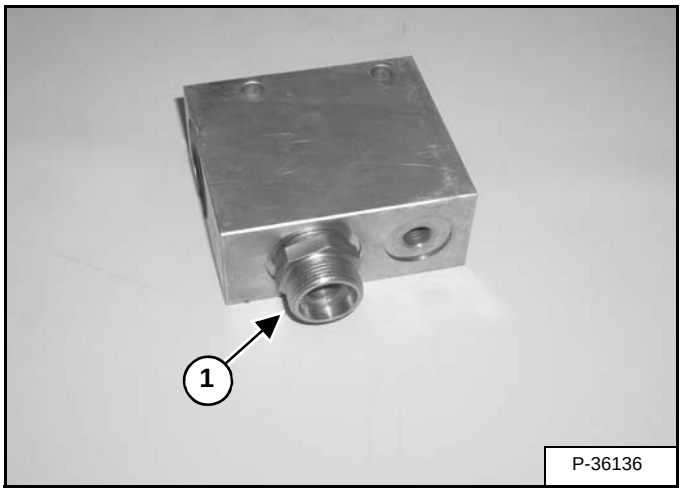
Disassembly And Assembly (Cont'd)

Figure 20-34-17



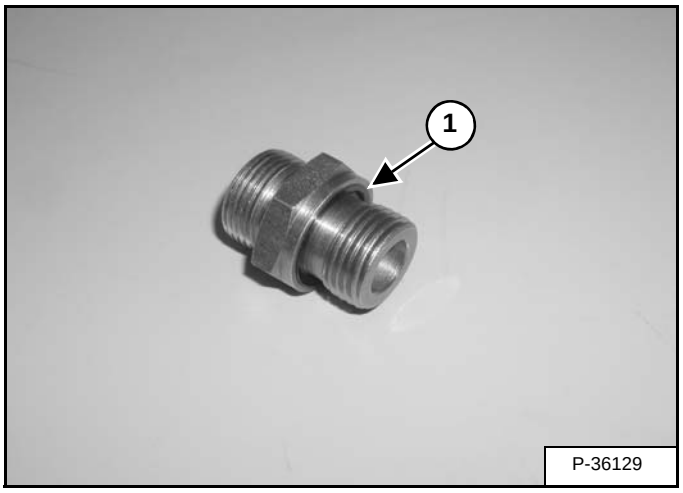
Remove the O-ring (Item 1) **[Figure 20-34-17]**.

Figure 20-34-18



Remove the fitting (Item 1) **[Figure 20-34-18]**.

Figure 20-34-19



Remove the O-ring (Item 1) **[Figure 20-34-19]**.

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SIX SPOOL HYDRAULIC CONTROL VALVE

Removal And Installation

Remove the right side cover. (See RIGHT SIDE COVER on Page 40-160-1.)

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

Figure 20-40-1

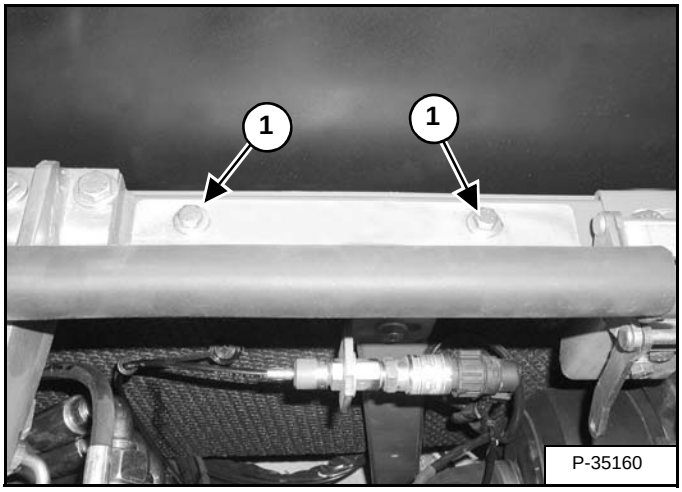
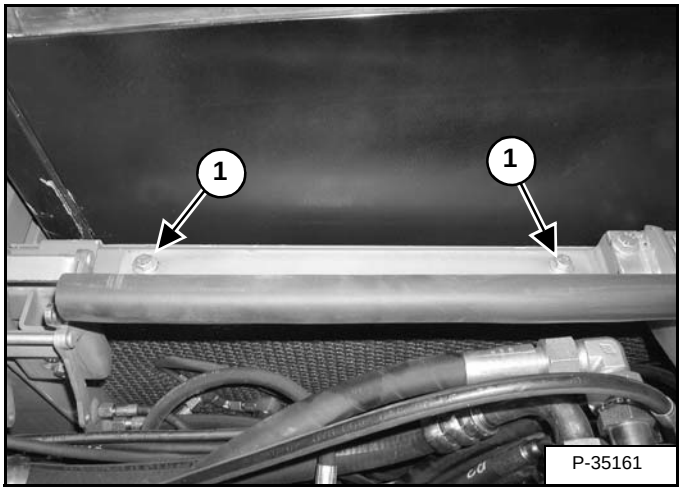
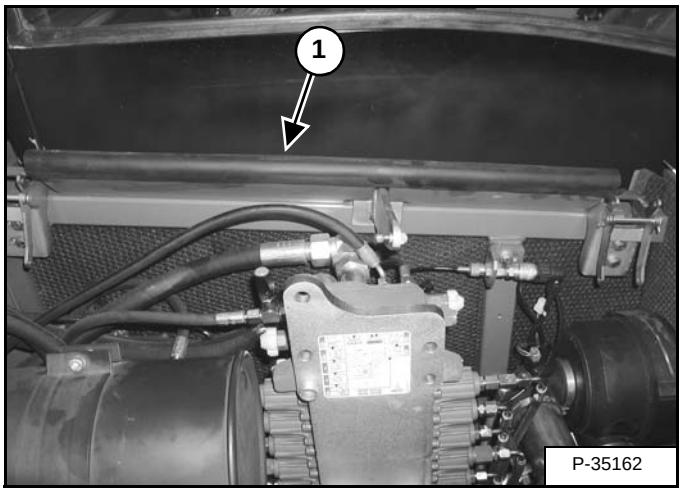


Figure 20-40-2



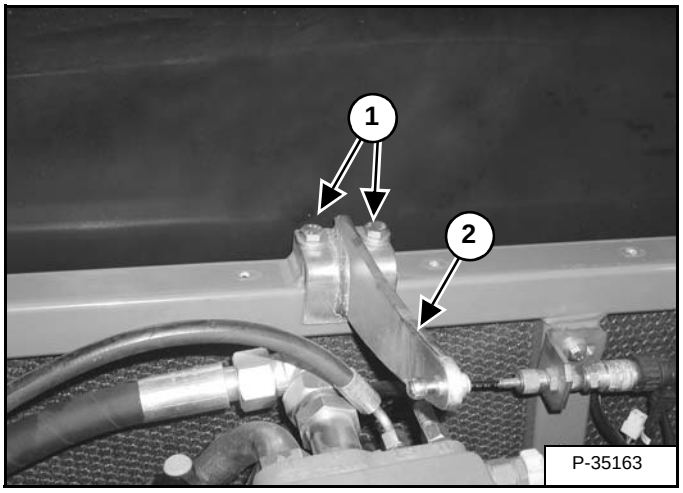
Remove the 4 bolts (Item 1) **[Figure 20-40-1]** & **[Figure 20-40-2]** from the shield.

Figure 20-40-3



Remove the shield (Item 1) **[Figure 20-40-3]**.

Figure 20-40-4



Remove the 2 bolts (Item 1) **[Figure 20-40-4]**.

Remove the gas strut mount (Item 2) **[Figure 20-40-4]**.

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Removal And Installation (Cont'd)

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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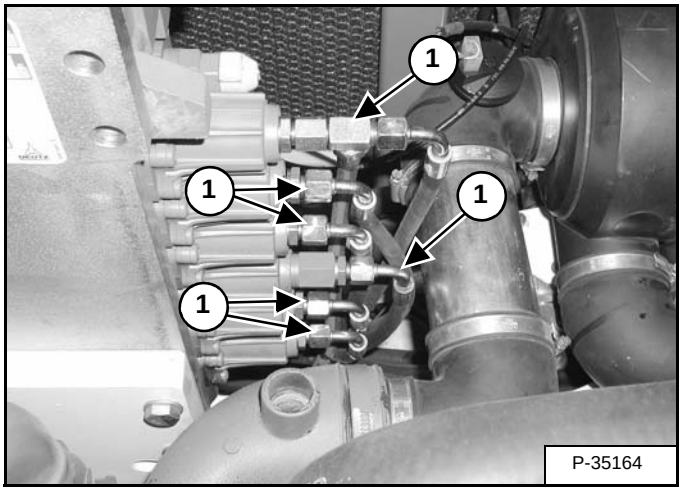
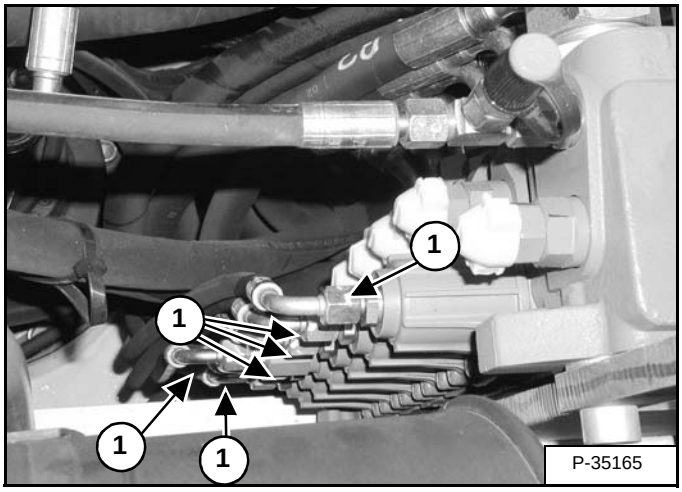
Figure 20-40-5



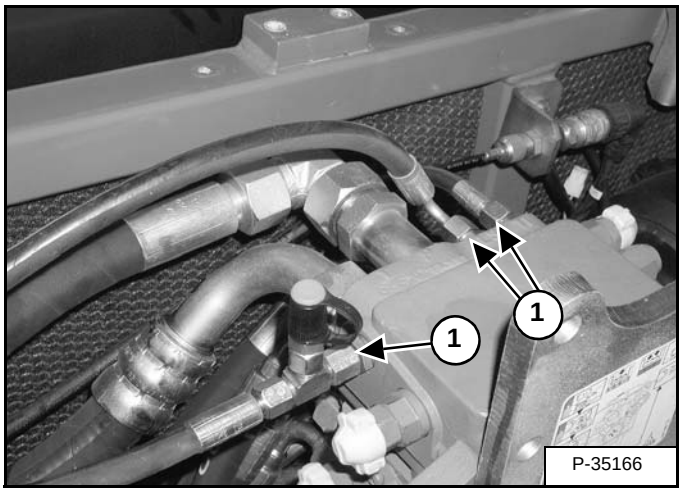
Remove the hoses (Item 1) **[Figure 20-40-5]** from the front of the valve.

Figure 20-40-6



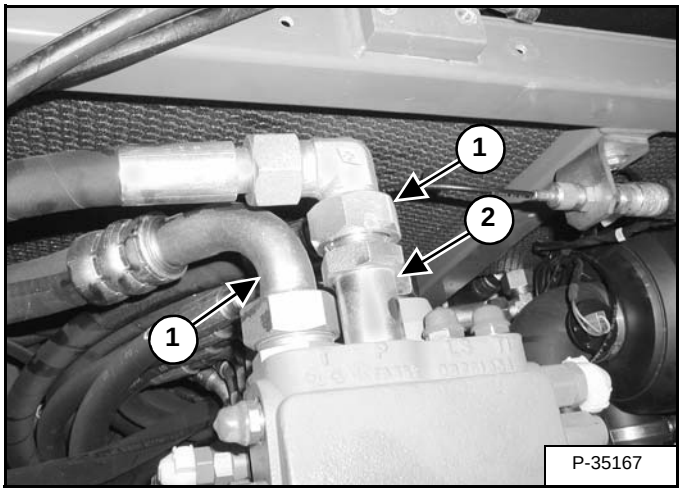
Remove the hoses (Item 1) **[Figure 20-40-6]** from the rear of the valve.

Figure 20-40-7



Remove the 3 hoses (Item 1) **[Figure 20-40-7]**.

Figure 20-40-8



Remove the 2 hoses (Item 1) **[Figure 20-40-8]**.

Remove the fitting (Item 2) **[Figure 20-40-8]**.

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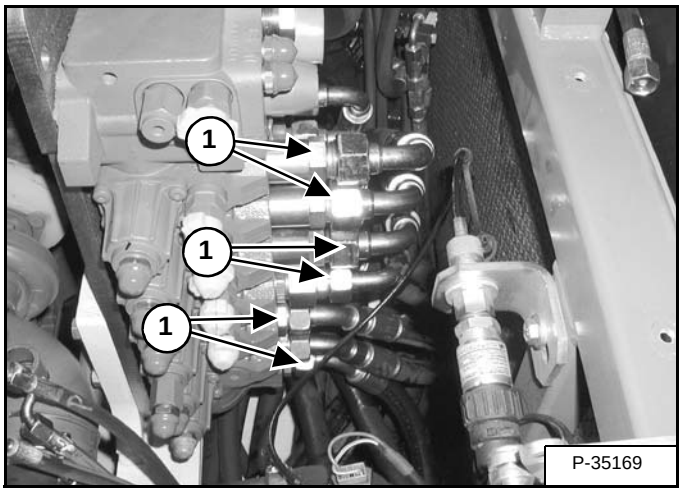
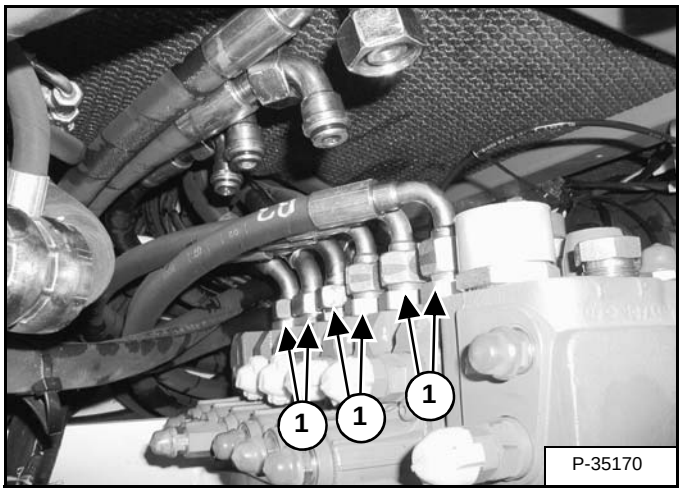
Removal And Installation (Cont'd)

Figure 20-40-9



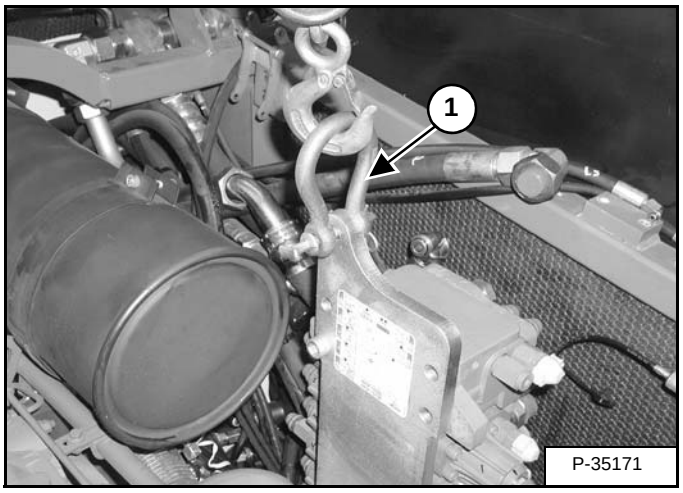
Remove the 7 hoses (Item 1) **[Figure 20-40-9]** from the A ports of the valve.

Figure 20-40-10



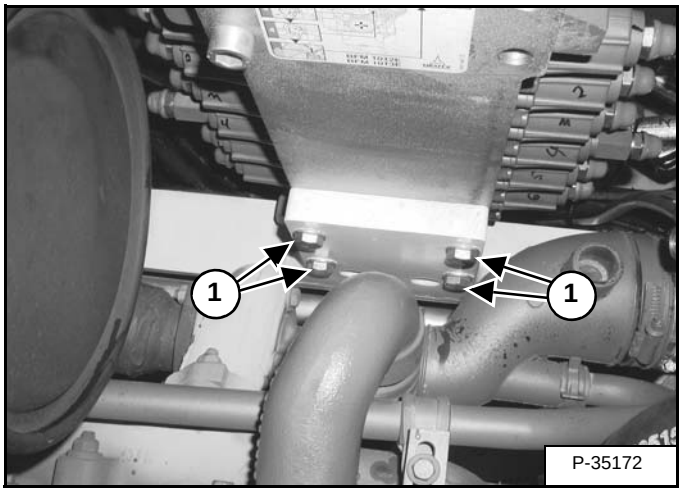
Remove the 6 hoses (Item 1) **[Figure 20-40-10]** from the B ports of the valve.

Figure 20-40-11



Install a hoist (Item 1) **[Figure 20-40-11]** on the valve mount.

Figure 20-40-12



Remove the 4 bolts (Item 1) **[Figure 20-40-12]** and washers.

Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

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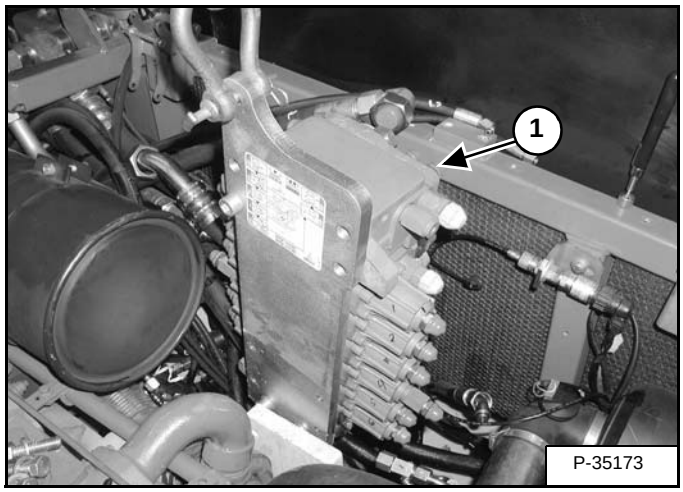
Removal And Installation (Cont'd)

Figure 20-40-13



Remove the valve (Item 1) **[Figure 20-40-13]**.

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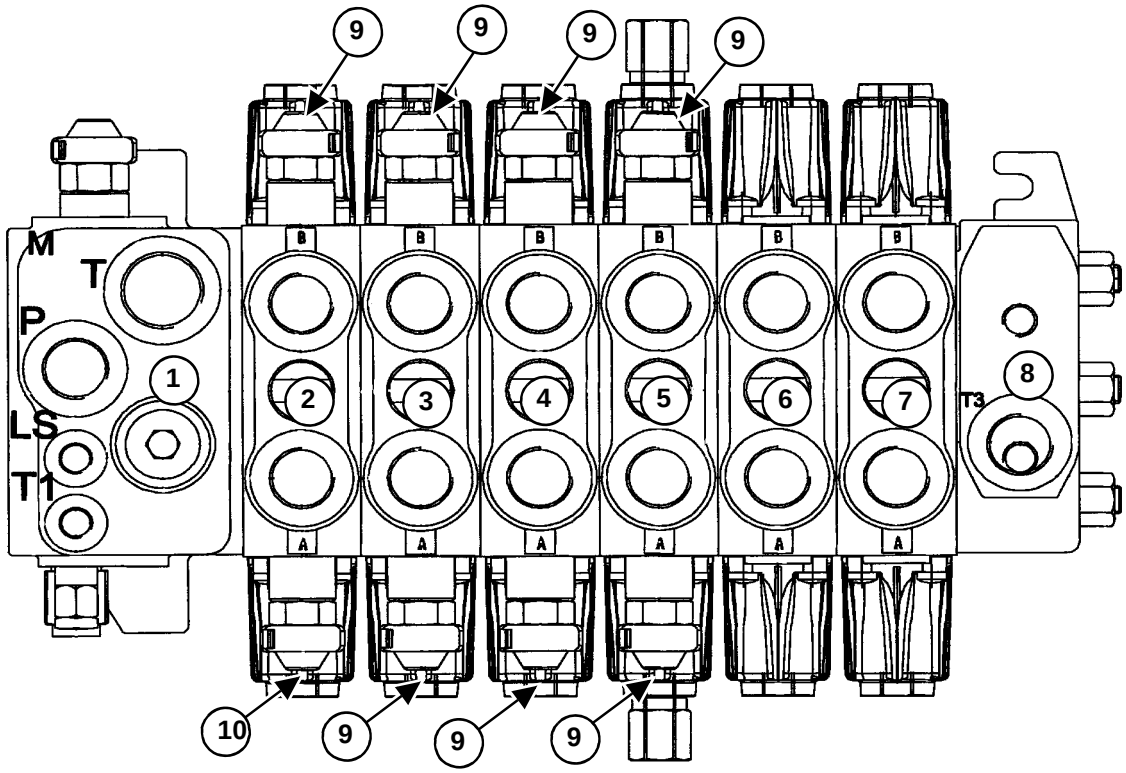
Control Valve Identification

ITEM	DESCRIPTION
1	Inlet Section
2	Boom Section
3	Arm Section
4	Bucket Section
5	Auxiliary Section
6	Left Travel
7	Right Travel
8	Outlet
9	Port Relief 4350 psi (300 bar)
10	Port Relief 2610 psi (180 bar)



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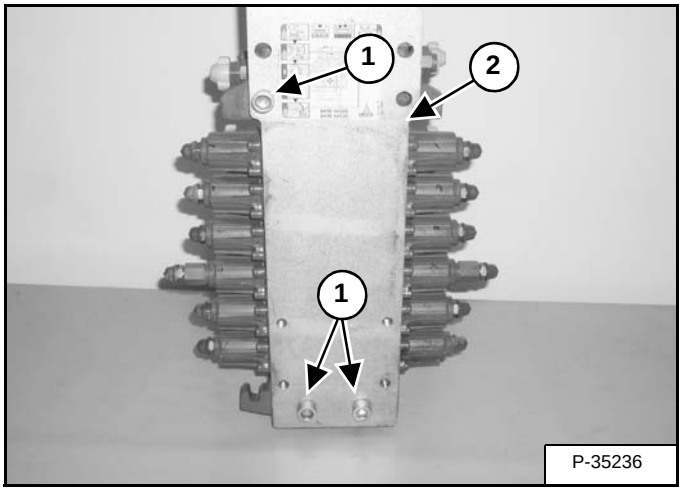
Disassembly And Assembly

Clean the outside of the valve with clean solvent.

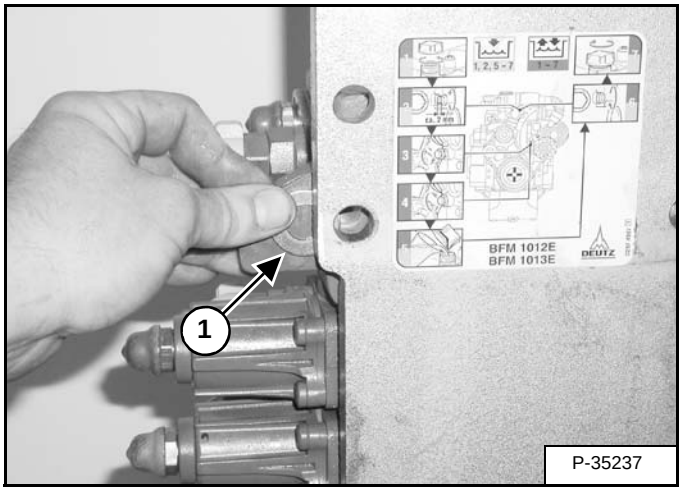
Figure 20-40-14



Remove the 3 bolts (Item 1) **[Figure 20-40-14]**.

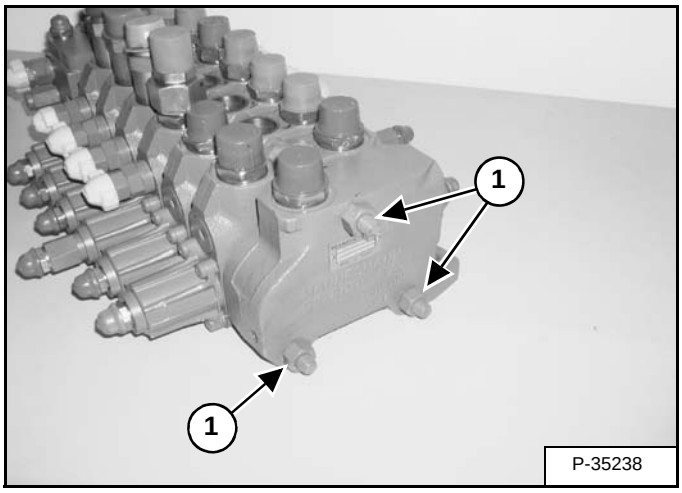
Remove the mount (Item 2) **[Figure 20-40-14]**.

Figure 20-40-15



Installation: Install the washers (Item 1) **[Figure 20-40-15]** between the valve and mount. Tighten the bolts to 111-129 ft.-lb. (150-175 N•m) torque.

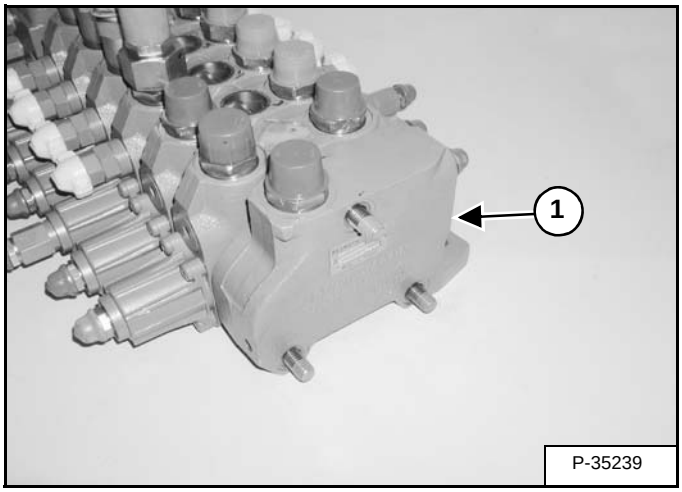
Figure 20-40-16



Remove the tie rod nuts (Item 1) **[Figure 20-40-16]**.

Installation: Tighten the nuts to 18 ft.-lb. (25 N•m) torque.

Figure 20-40-17



Remove the outlet section (Item 1) **[Figure 20-40-17]**.

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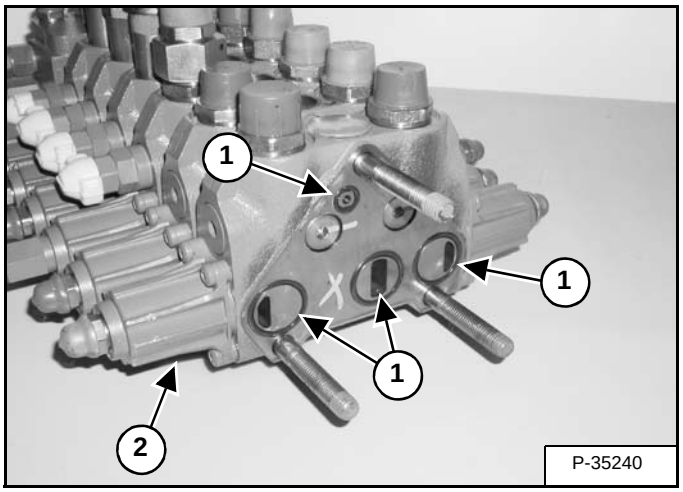
Disassembly And Assembly (Cont'd)

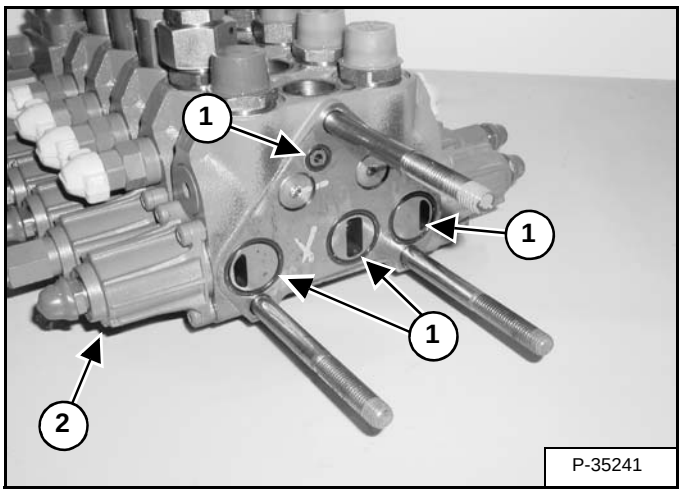
Figure 20-40-18



Remove the O-rings (Item 1) **[Figure 20-40-18]** from the right travel valve section.

Remove the valve section (Item 2) **[Figure 20-40-18]**.

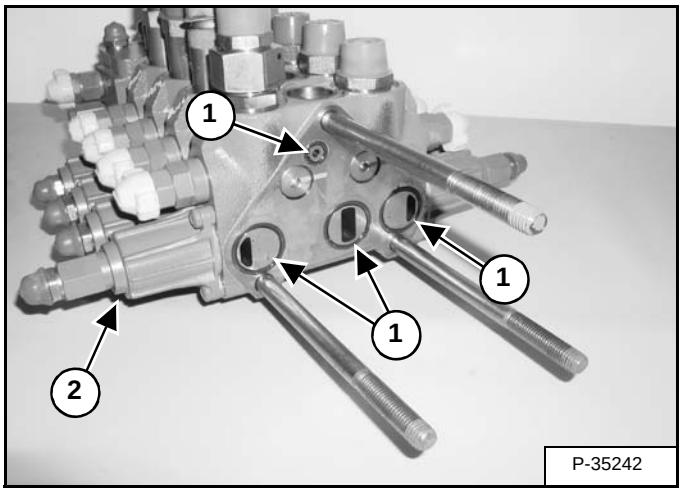
Figure 20-40-19



Remove the O-rings (Item 1) **[Figure 20-40-19]** from the left travel valve section.

Remove the valve section (Item 2) **[Figure 20-40-19]**.

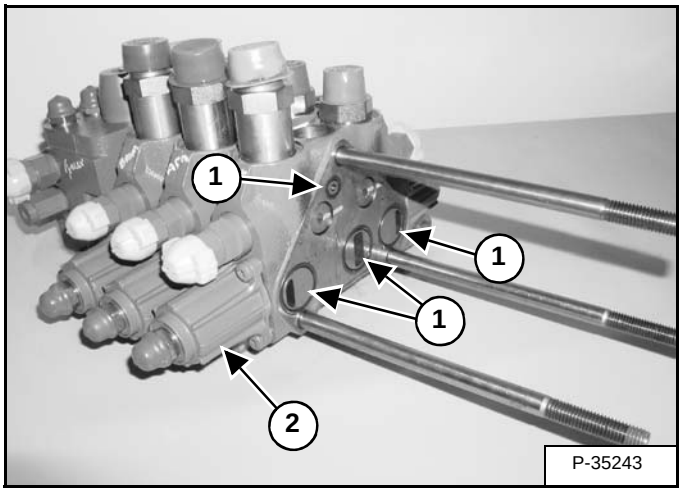
Figure 20-40-20



Remove the O-rings (Item 1) **[Figure 20-40-20]** from the auxiliary valve section.

Remove the valve section (Item 2) **[Figure 20-40-20]**.

Figure 20-40-21



Remove the O-rings (Item 1) **[Figure 20-40-21]** from the bucket valve section.

Remove the valve section (Item 2) **[Figure 20-40-21]**.

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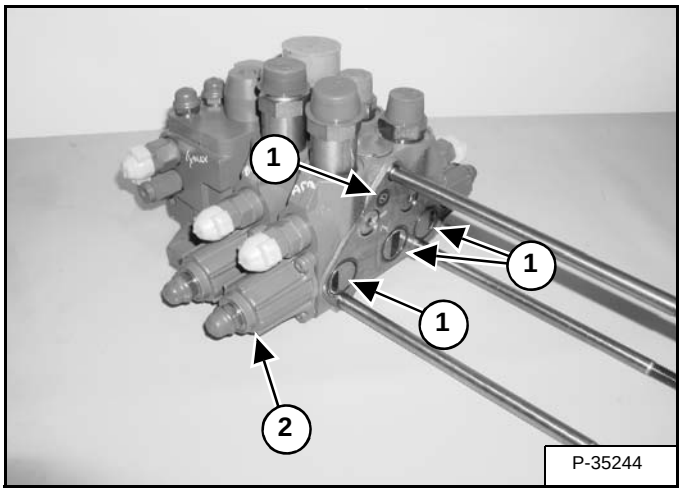
Disassembly And Assembly (Cont'd)

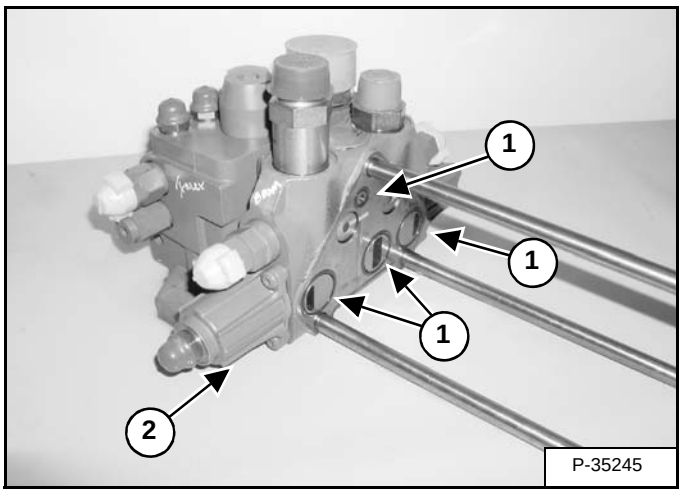
Figure 20-40-22



Remove the O-rings (Item 1) **[Figure 20-40-22]** from the arm valve section.

Remove the valve section (Item 2) **[Figure 20-40-22]**.

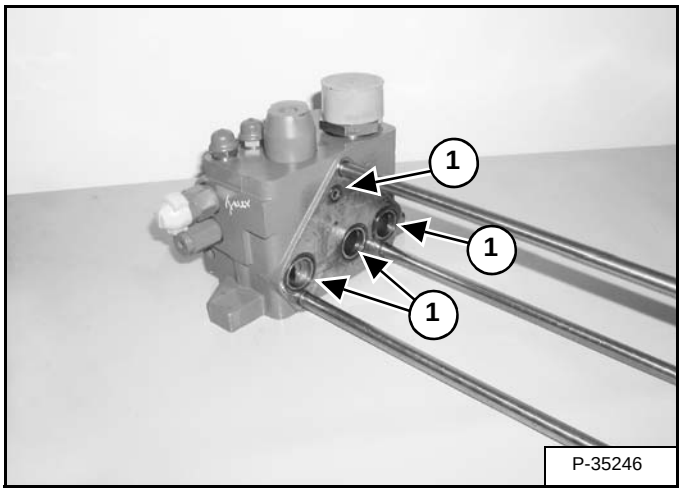
Figure 20-40-23



Remove the O-rings (Item 1) **[Figure 20-40-23]** from the boom valve section.

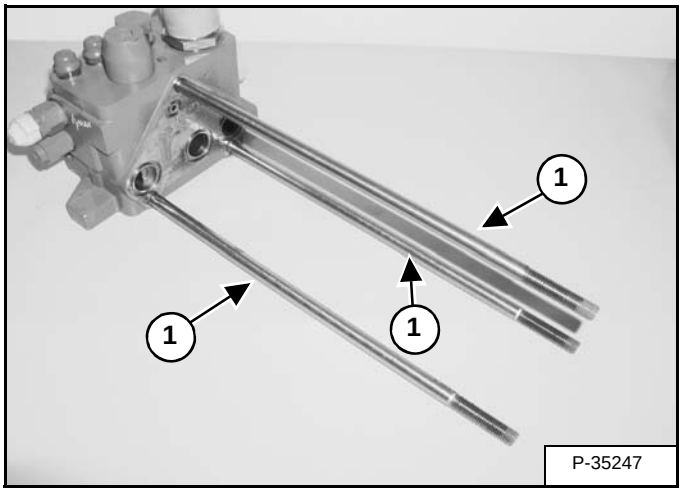
Remove the valve section (Item 2) **[Figure 20-40-23]**.

Figure 20-40-24



Remove the O-rings (Item 1) **[Figure 20-40-24]** from the inlet section.

Figure 20-40-25



Remove the rods (Item 1) **[Figure 20-40-25]** from the inlet section.

Installation: Tighten the rods to 18 ft.-lb. (25 N•m) torque.

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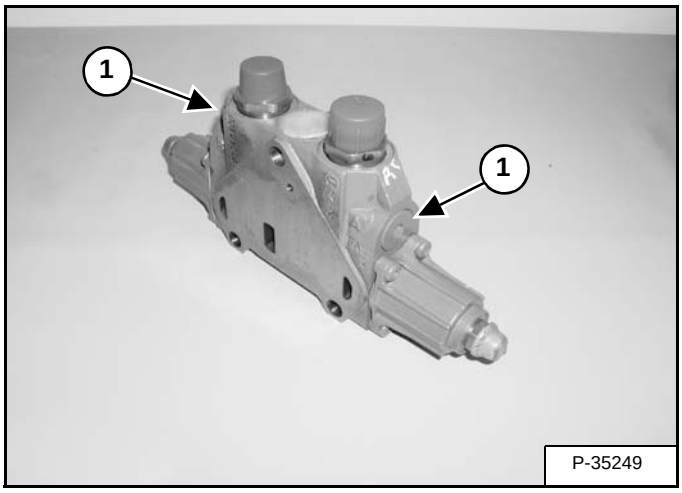
Left Travel And Right Travel Valve Section Disassembly And Assembly

NOTE: The disassembly and assembly procedure is shown on the right travel valve section. The procedure is the same on the left travel valve section.

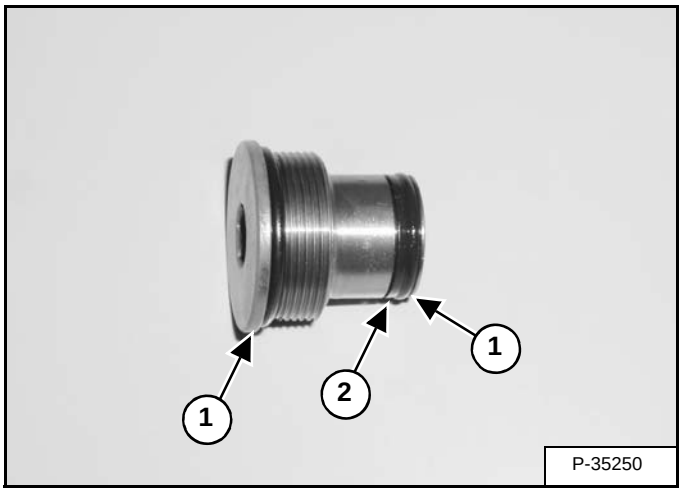
Figure 20-40-26



Remove the plug (Item 1) **[Figure 20-40-26]**. (Both ends)

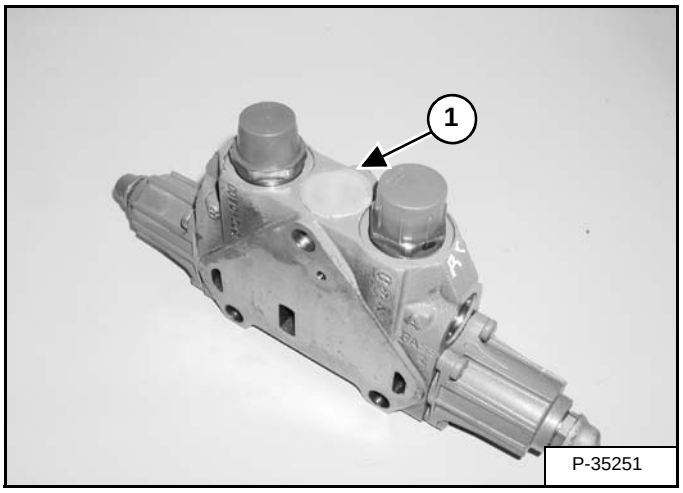
Installation: Tighten the plug to 52 ft.-lbs (70 N•m).

Figure 20-40-27



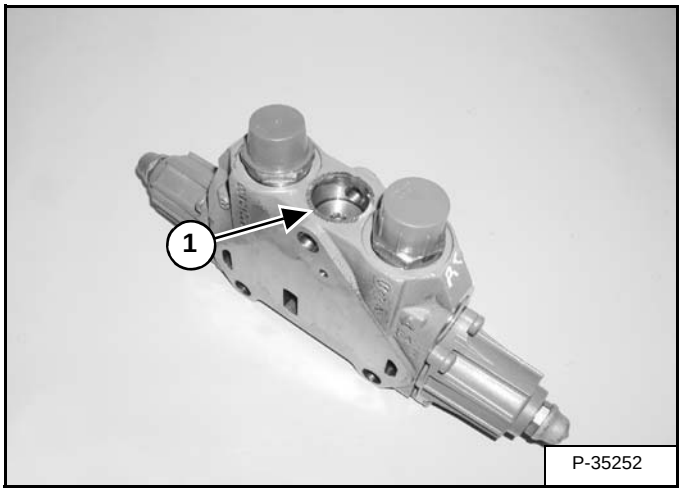
Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-27]**.

Figure 20-40-28



Remove the plastic plug (Item 1) **[Figure 20-40-28]**.

Figure 20-40-29



Remove the plug (Item 1) **[Figure 20-40-29]**.

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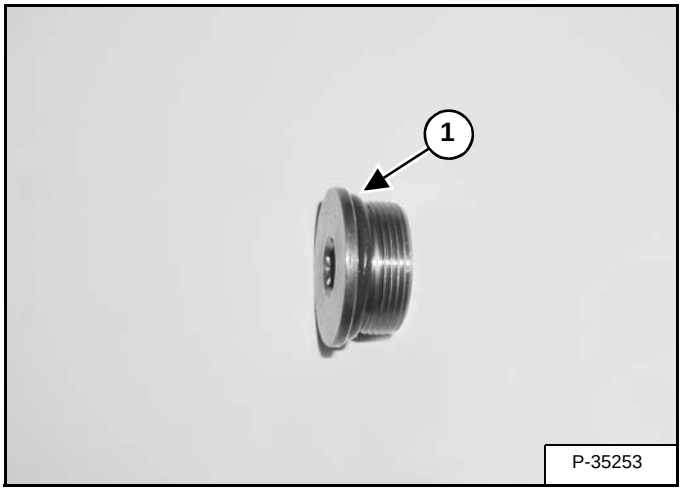
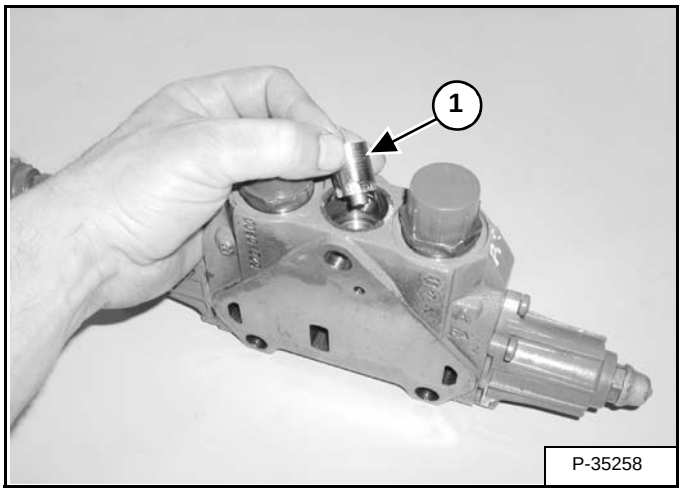
Left Travel And Right Travel Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-30



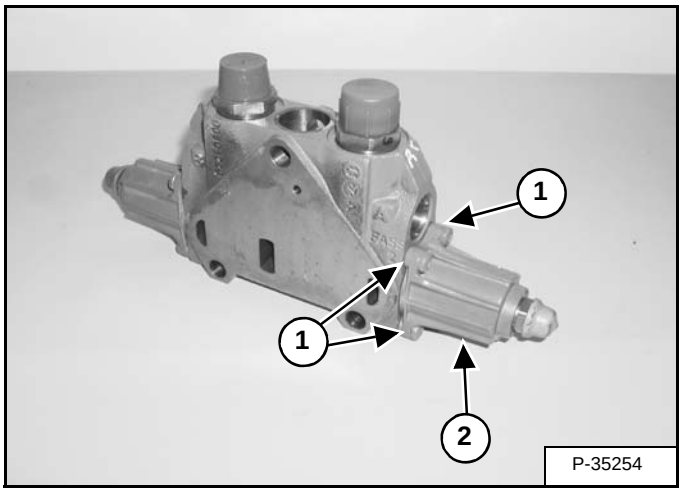
Remove the O-ring (Item 1) **[Figure 20-40-30]**.

Figure 20-40-31



Remove the pressure compensator (Item 1) **[Figure 20-40-31]**.

Figure 20-40-32

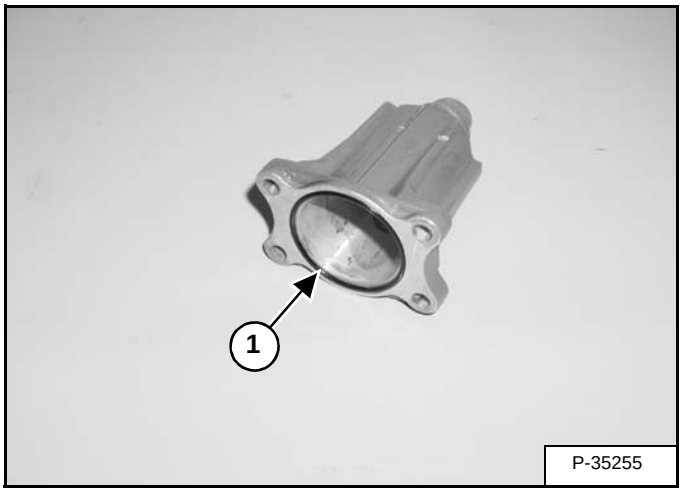


Remove the 4 screws (Item 1) **[Figure 20-40-32]** from both ends.

Installation: Tighten the screws to 18 ft.-lb. (25 N•m) torque.

Remove the valve end cover (Item 2) **[Figure 20-40-32]** from both ends.

Figure 20-40-33



Remove the O-ring (Item 1) **[Figure 20-40-33]**.

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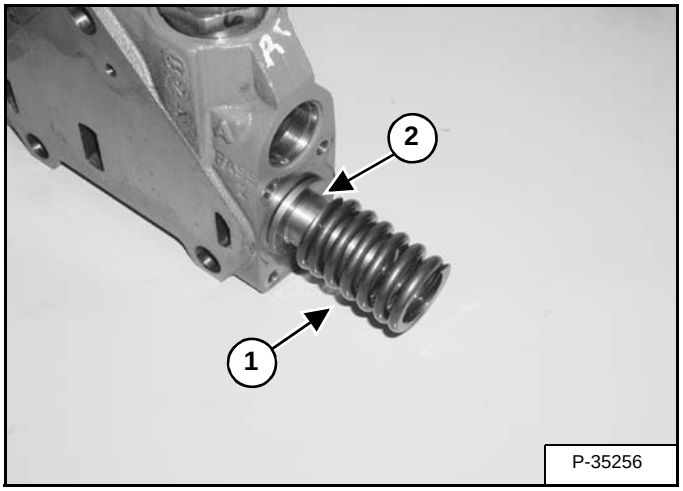
Left Travel and Right Travel Valve Section Disassembly And Assembly (Cont'd)

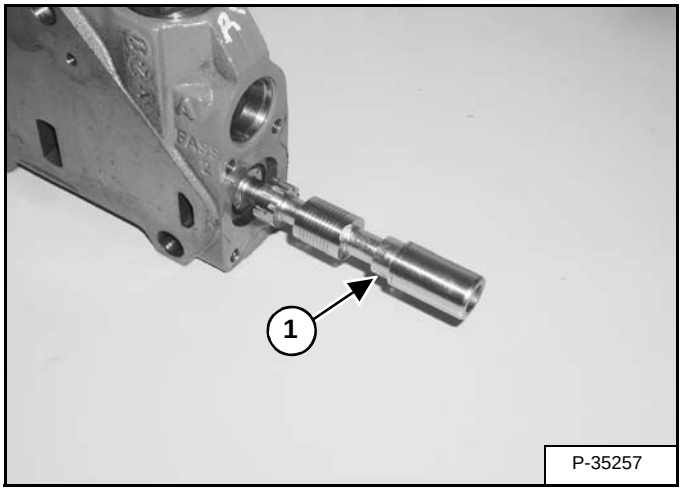
Figure 20-40-34



Remove the centering spring (Item 1) **[Figure 20-40-34]** from both ends.

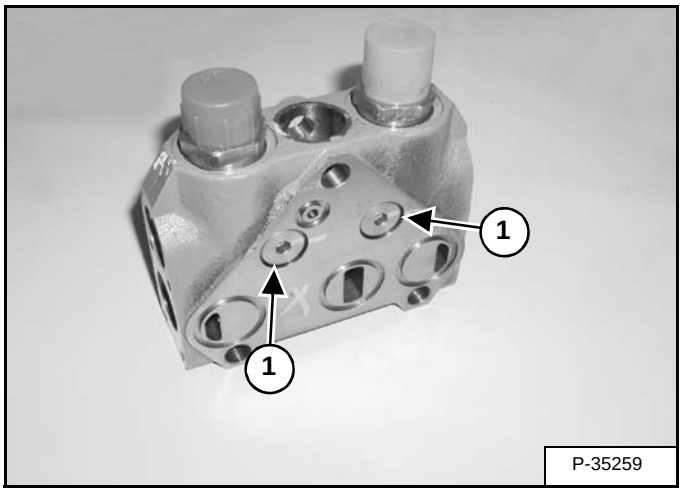
Remove the spring seat (Item 2) **[Figure 20-40-34]** from both ends.

Figure 20-40-35



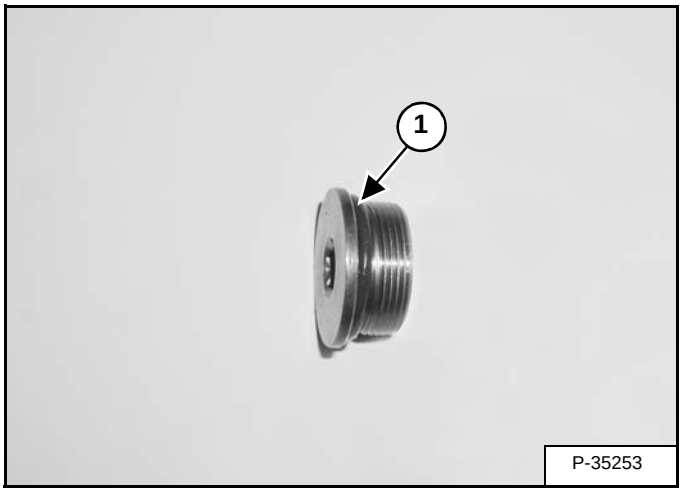
Remove the spool (Item 1) **[Figure 20-40-35]**.

Figure 20-40-36



Remove the plugs (Item 1) **[Figure 20-40-36]**.

Figure 20-40-37



Remove the O-ring (Item 1) **[Figure 20-40-37]**.

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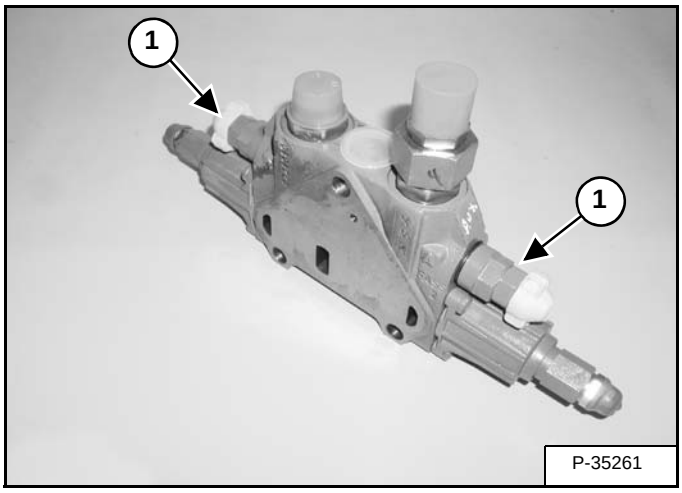
Boom, Arm, Bucket And Auxiliary Valve Section Disassembly And Assembly

NOTE: The disassembly and assembly procedure is shown on the auxiliary valve section. The procedure is the same for all valve sections, except where noted.

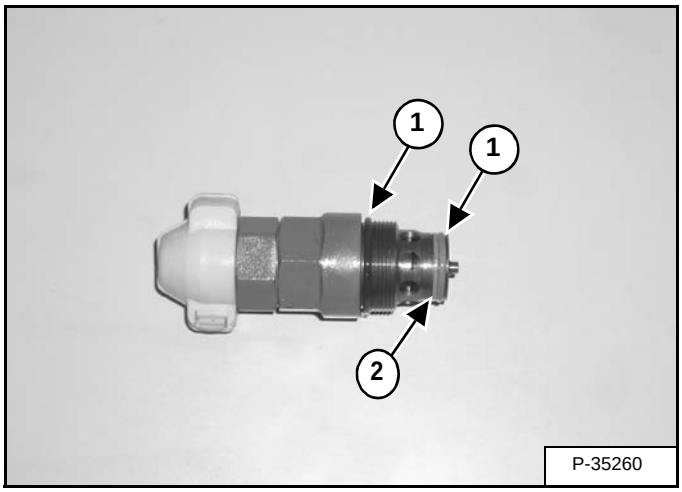
Figure 20-40-38



Remove the relief valves (Item 1) **[Figure 20-40-38]**.

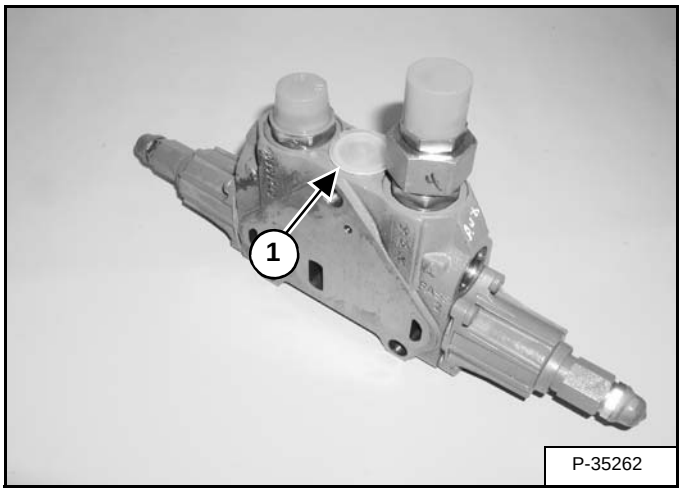
Installation: Tighten the valves to 52 ft.-lb. (70 N•m) torque.

Figure 20-40-39



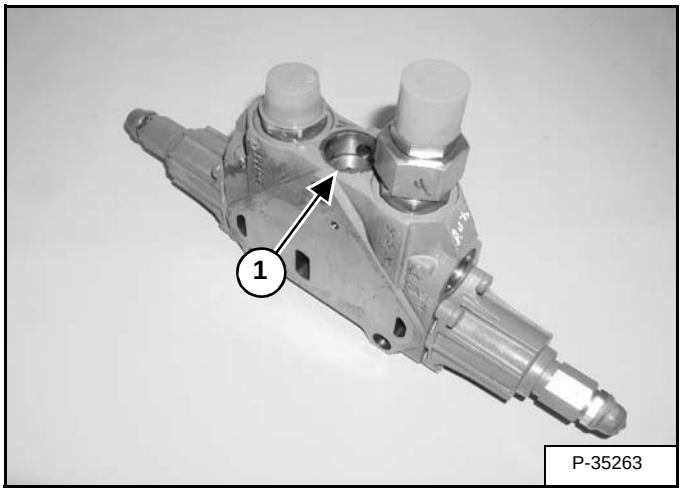
Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-39]**.

Figure 20-40-40



Remove the plastic plug (Item 1) **[Figure 20-40-40]**.

Figure 20-40-41



Remove the plug (Item 1) **[Figure 20-40-41]**.

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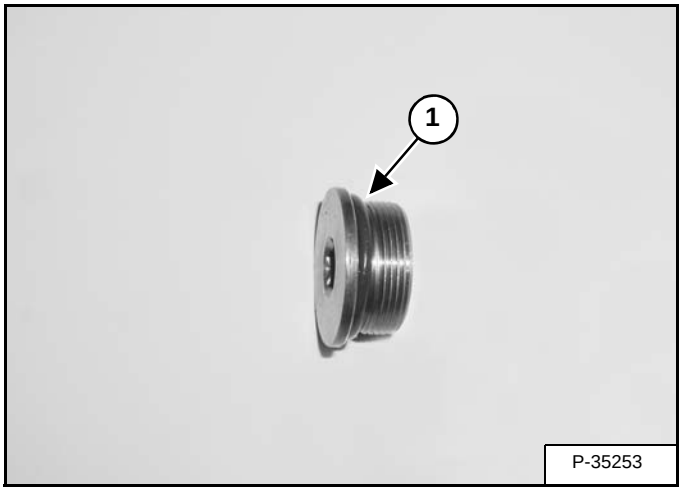
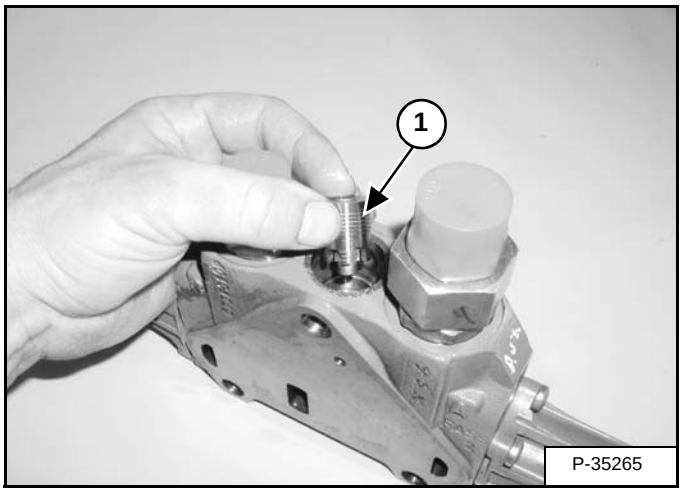
Boom, Arm, Bucket And Auxiliary Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-42



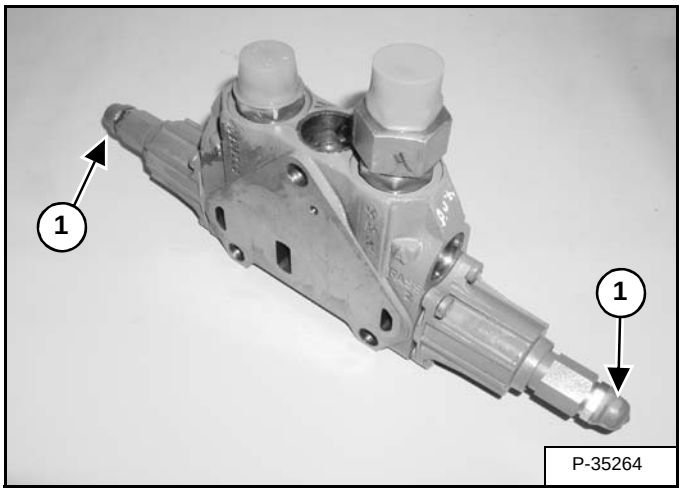
Remove the O-ring (Item 1) **[Figure 20-40-42]**.

Figure 20-40-43



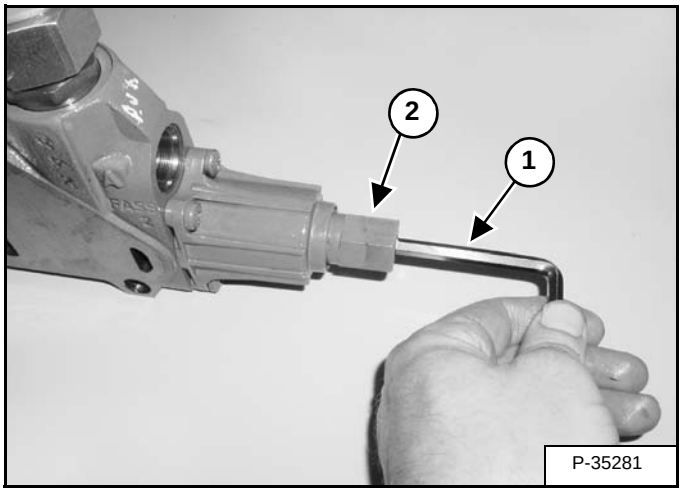
Remove the compensator (Item 1) **[Figure 20-40-43]**.

Figure 20-40-44



Remove the fittings (Item 1) **[Figure 20-40-44]** from both ends of the valve section. (Auxiliary Valve Section only)

Figure 20-40-45



Hold the spool stroke limitation adjustment screw (Item 1) and remove the fitting (Item 2) **[Figure 20-40-45]**. (Auxiliary Valve Section only)

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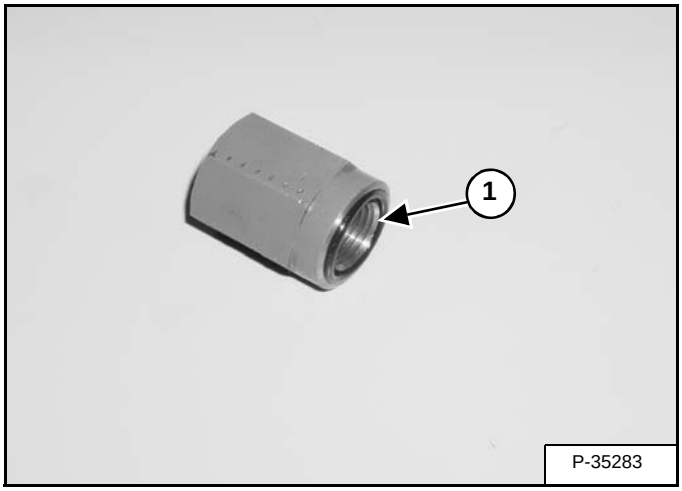
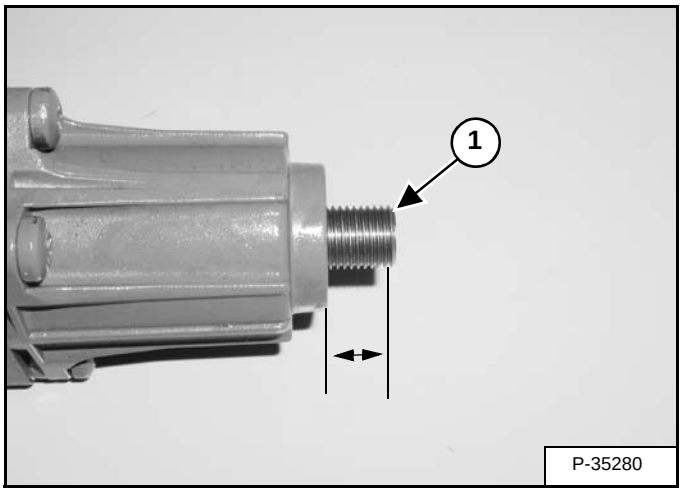
Boom. Arm, Bucket and Auxiliary Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-46



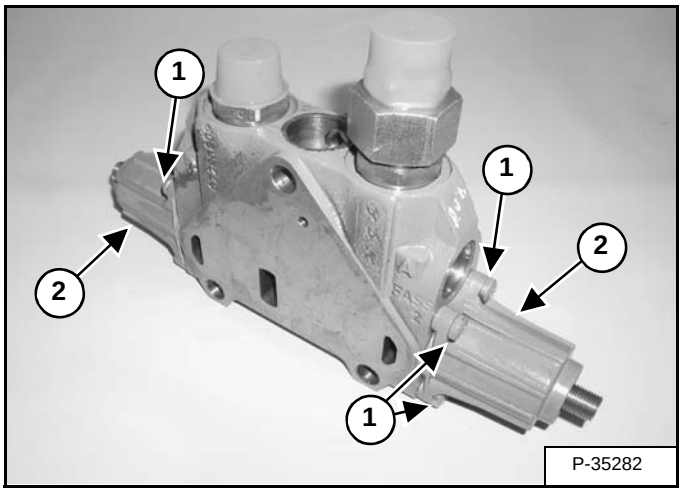
Remove the O-ring (Item 1) **[Figure 20-40-46]**.

Figure 20-40-47



Record the distance of spool stroke limitation adjustment screw (Item 1) **[Figure 20-40-47]** for correct installation. (Auxiliary Valve Section only)

Figure 20-40-48

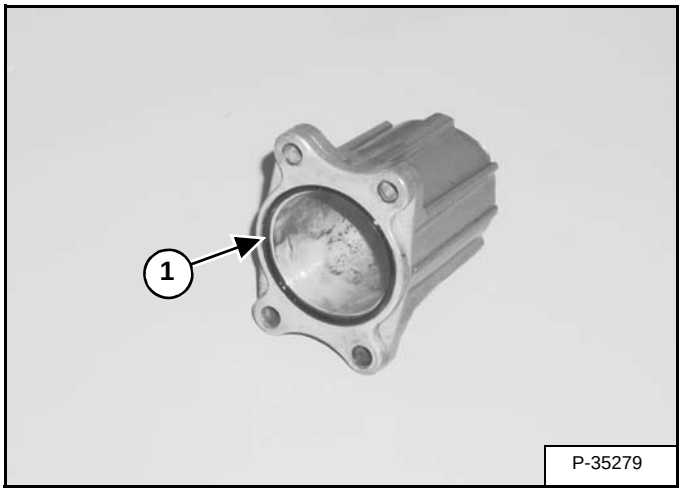


Remove the 4 screws (Item 1) **[Figure 20-40-48]** from both ends.

Installation: Tighten the screws to 18 ft.-lb. (25 N•m) torque.

Remove the valve end cover (Item 2) **[Figure 20-40-48]** from both ends.

Figure 20-40-49



Remove the O-ring (Item 1) **[Figure 20-40-49]**.

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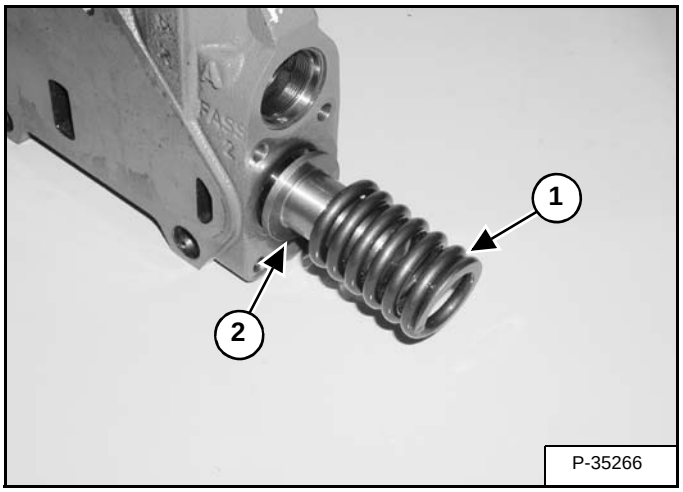
Boom, Arm, Bucket And Auxiliary Valve Section Disassembly And Assembly (Cont'd)

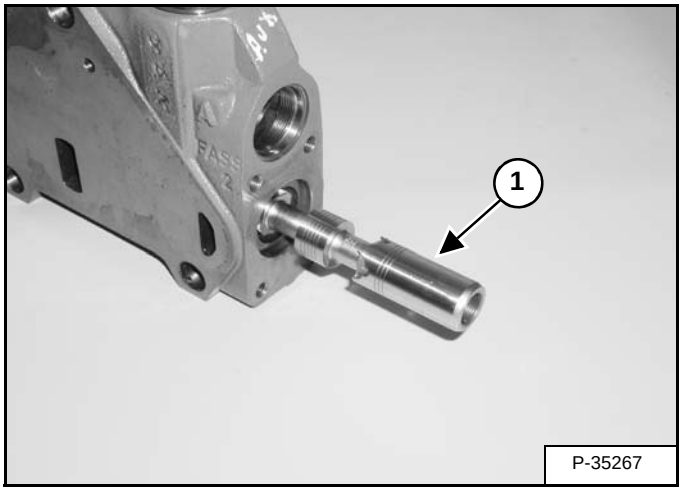
Figure 20-40-50



Remove the centering spring (Item 1) **[Figure 20-40-50]** from both ends.

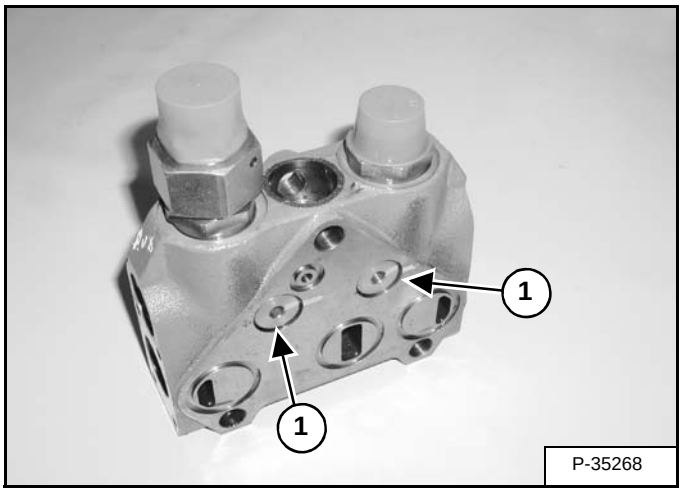
Remove the spring seat (Item 2) **[Figure 20-40-50]** from both ends.

Figure 20-40-51



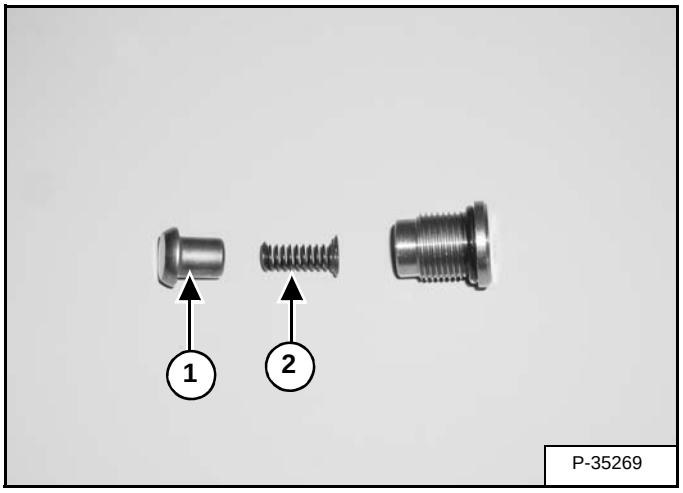
Remove the spool (Item 1) **[Figure 20-40-51]**.

Figure 20-40-52



Remove the check valves (Item 1) **[Figure 20-40-52]**.

Figure 20-40-53



Remove the poppet (Item 1) and spring (Item 2) **[Figure 20-40-53]** from the plug.

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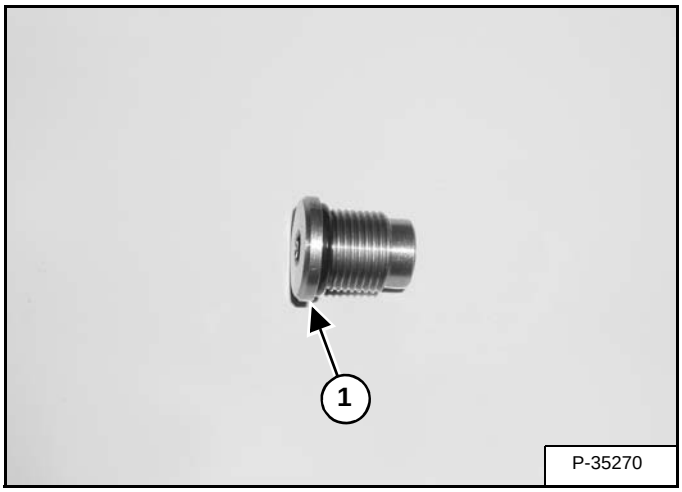
Boom, Arm, Bucket And Auxiliary Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-54



Remove the O-ring (Item 1) **[Figure 20-40-54]**.

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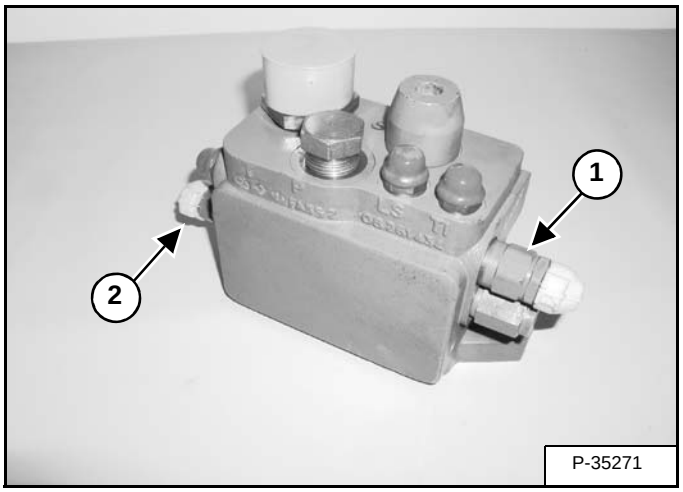
Inlet Valve Section Disassembly And Assembly

Figure 20-40-55



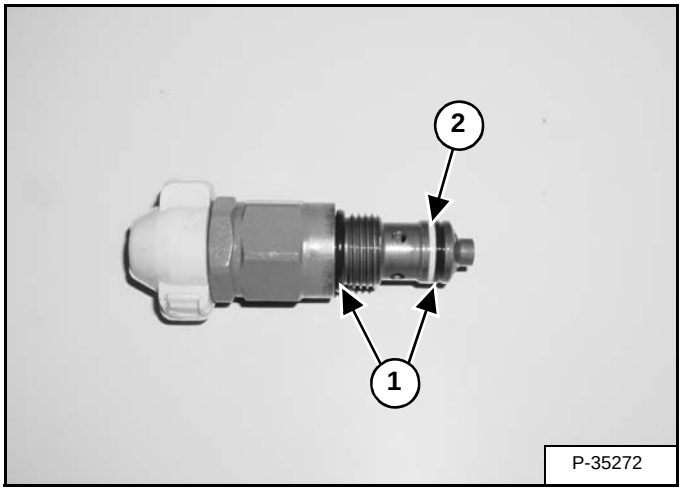
Remove the load sense relief valve (Item 1) **[Figure 20-40-55]**.

Installation: Tighten the load sense valve to 18 ft.-lb. (25 N•m) torque.

Remove the backup relief valve (Item 2) **[Figure 20-40-55]**.

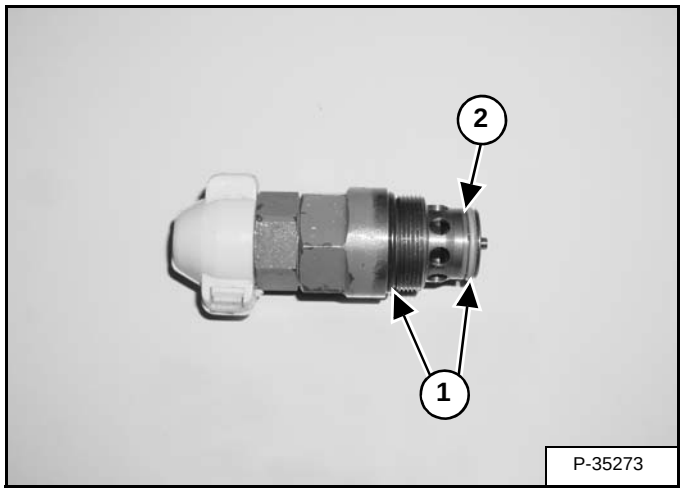
Installation: Tighten the backup relief valve to 52 ft.-lb. (70 N•m) torque.

Figure 20-40-56



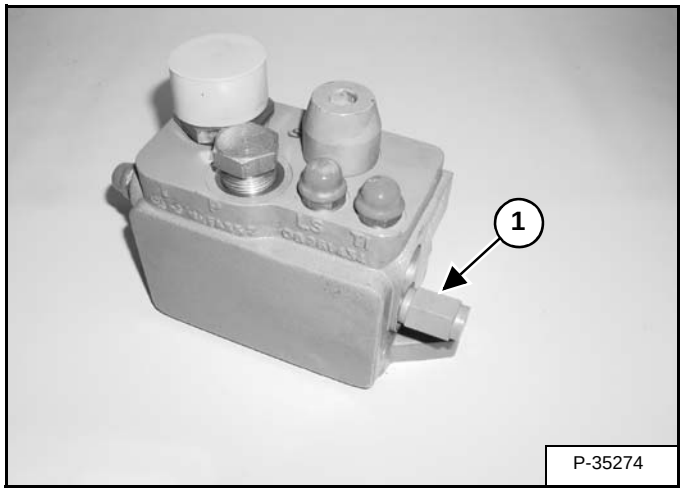
Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-56]** from the load sense relief valve.

Figure 20-40-57



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-57]** from the backup relief valve.

Figure 20-40-58



Remove the load sense bleed cartridge (Item 1) **[Figure 20-40-58]**

Installation: Tighten the cartridge to 15 ft.-lbs. (20 Nm) torque.

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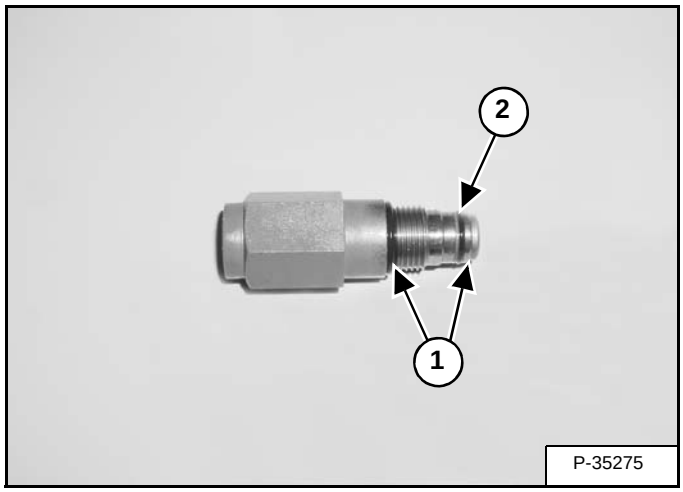
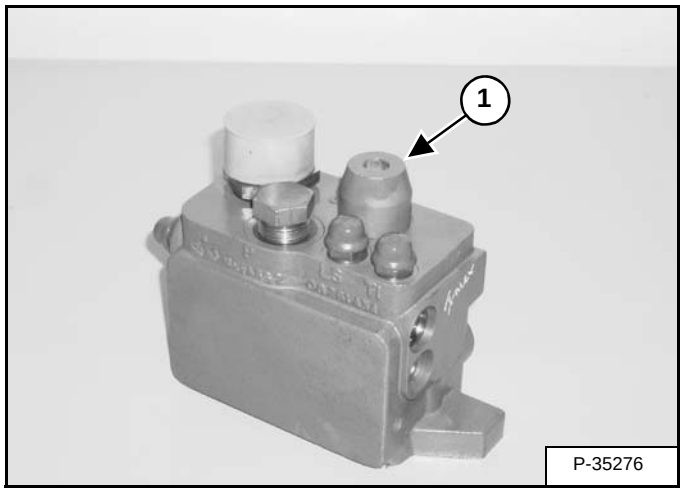
Inlet Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-59



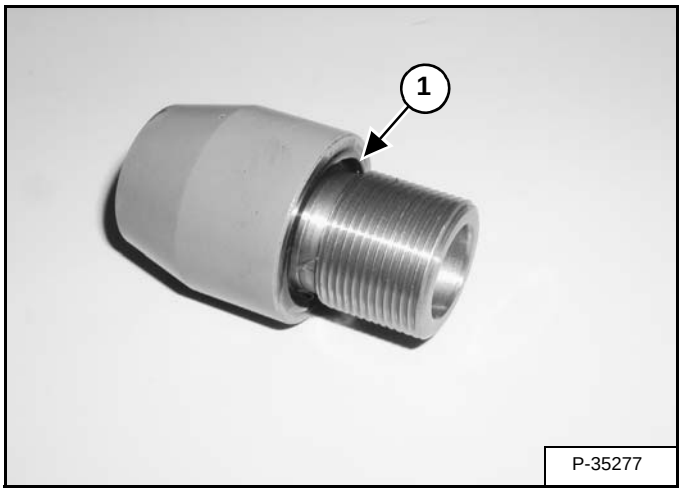
Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-59]**.

Figure 20-40-60



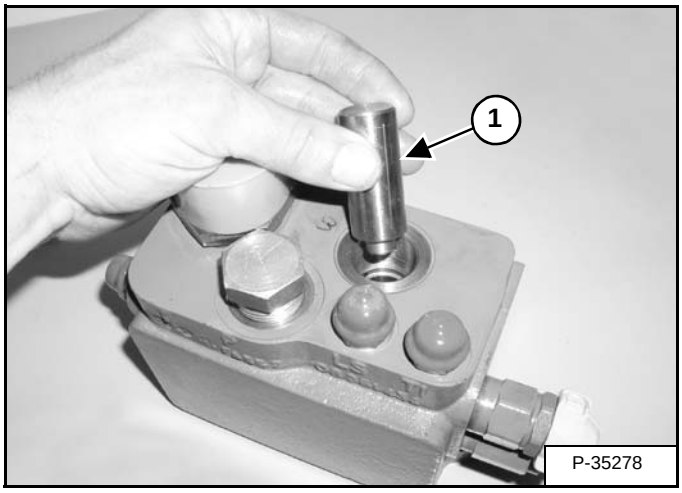
Remove the plug (Item 1) **[Figure 20-40-60]**.

Figure 20-40-61



Remove the O-ring (Item 1) **[Figure 20-40-61]**.

Figure 20-40-62



Remove the spool (Item 1) **[Figure 20-40-62]**.

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THREE SPOOL HYDRAULIC CONTROL VALVE

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.

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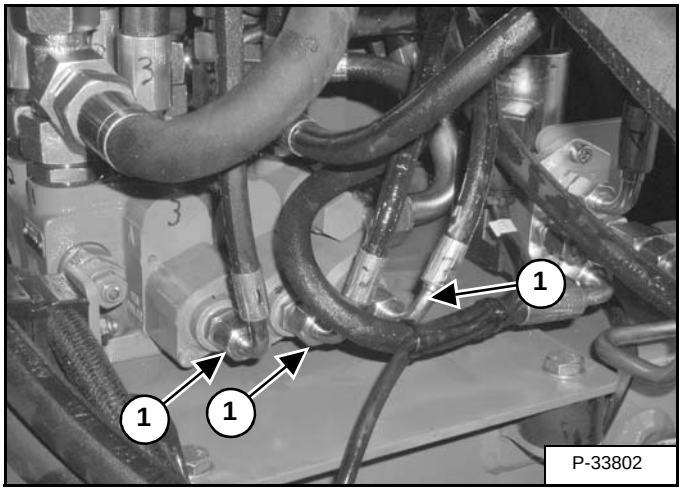
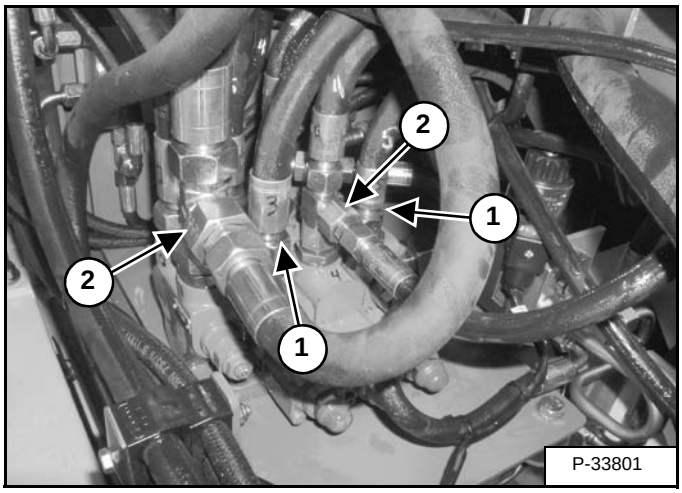
Figure 20-41- 1



Remove the 3 hoses (Item 1) **[Figure 20-41- 1]**.

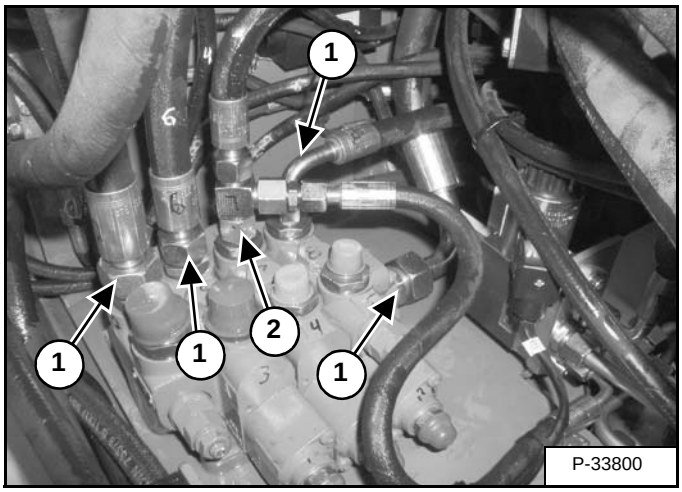
Figure 20-41-2



Remove the 2 hoses (Item 1) **[Figure 20-41-2]**.

Remove the 2 tee fittings (Item 2) **[Figure 20-41-2]**.

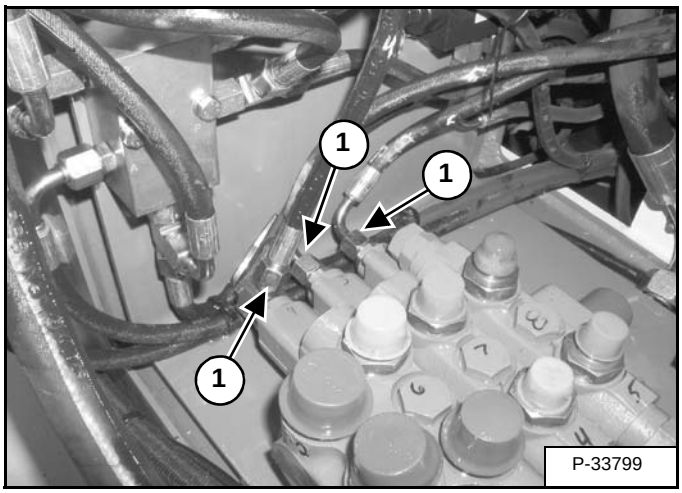
Figure 20-41-3



Remove the 4 hoses (Item 1) **[Figure 20-41-3]**.

Remove the tee fitting (Item 2) **[Figure 20-41-3]**.

Figure 20-41-4



Remove the 3 hoses (Item 1) **[Figure 20-41-4]**.

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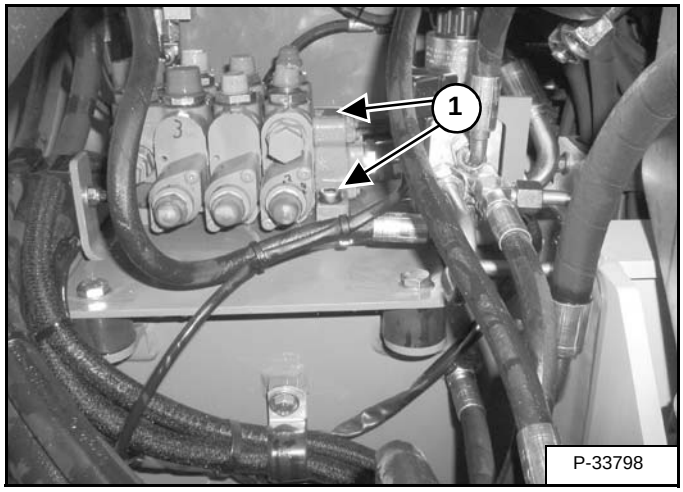
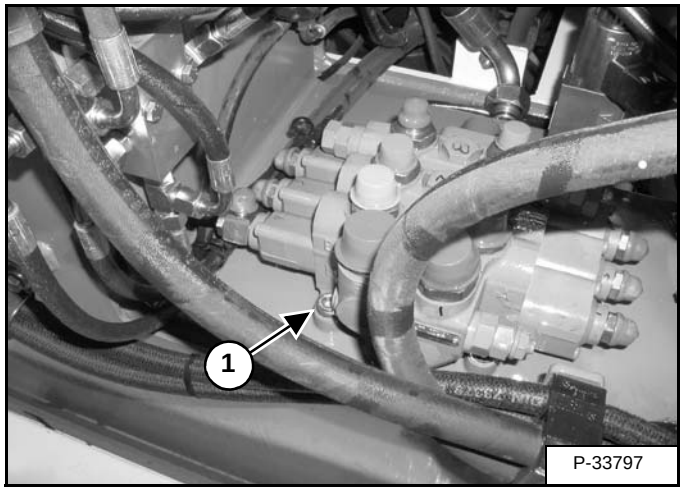
Removal And Installation (Cont'd)

Figure 20-41-5



Remove the front 2 bolts (Item 1) **[Figure 20-41-5]**.

Figure 20-41-6



Remove the rear bolt (Item 1) **[Figure 20-41-6]**.

Remove the valve.

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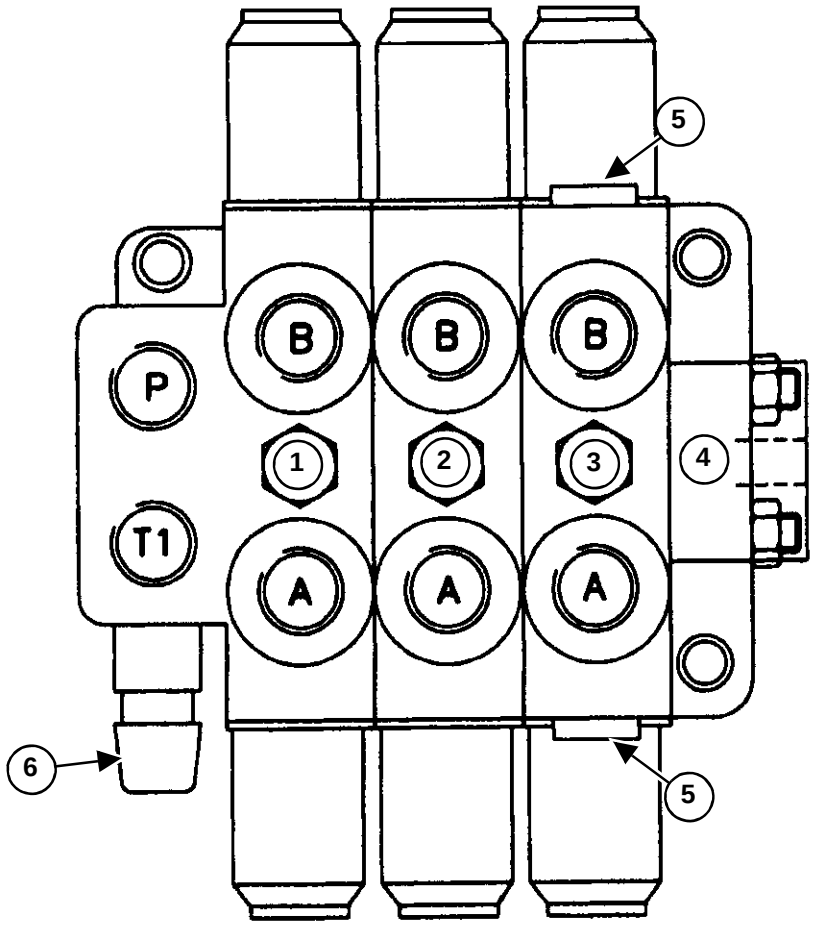
Parts Identification

1. **Swing/Inlet Section**
2. **Blade Section**
3. **Boom Offset Section**
4. **Outlet Section**
5. **Load Check Valve**
6. **Main Relief Valve**



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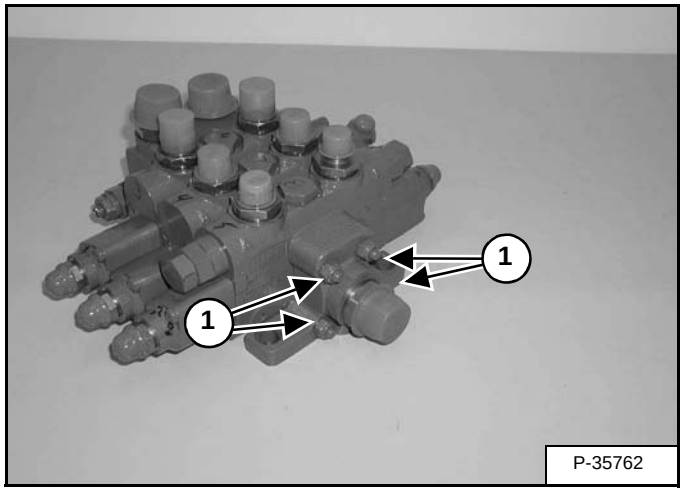
Disassembly And Assembly

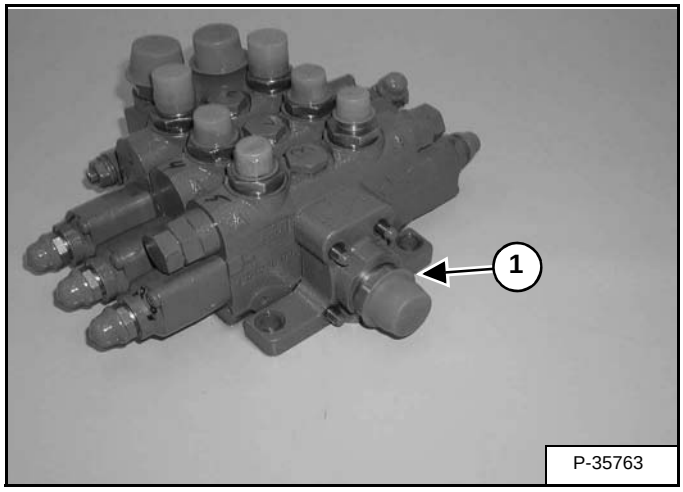
Figure 20-41-7



Remove the 4 tie rod nuts (Item 1) **[Figure 20-41-7]**.

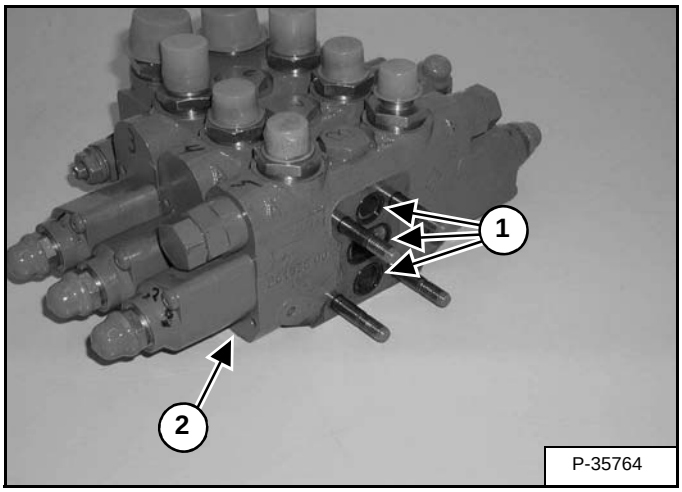
Installation: Tighten the nuts to 16-19 ft.-lb. (22-26 N•m) torque.

Figure 20-41-8



Remove the outlet section (Item 1) **[Figure 20-41-8]**.

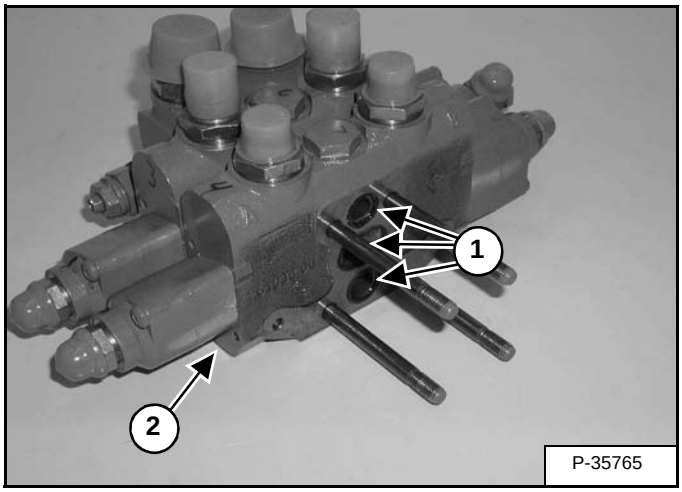
Figure 20-41-9



Remove the3 O-rings (Item 1) **[Figure 20-41-9]** from the boom offset valve section.

Remove the valve section (Item 2) **[Figure 20-41-9]**.

Figure 20-41-10



Remove the 3 O-rings (Item 1) **[Figure 20-41-10]** from the blade valve section.

Remove the valve section (Item 2) **[Figure 20-41-10]**.

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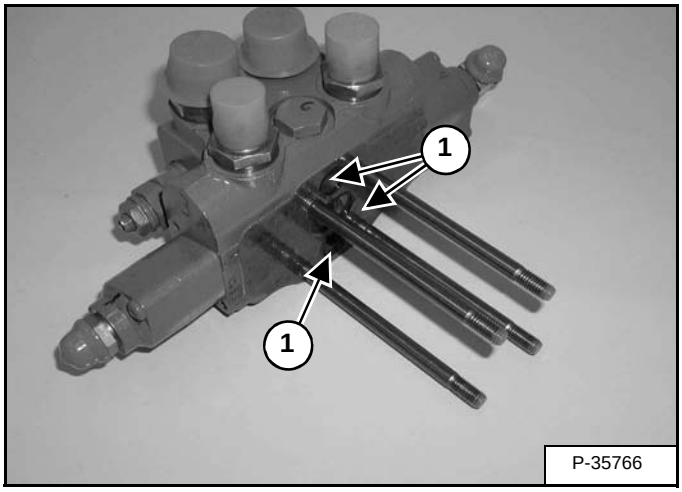
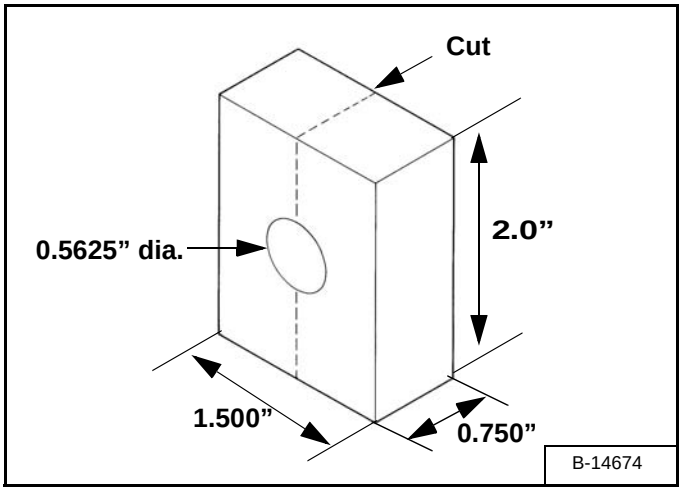
Disassembly And Assembly (Cont'd)

Figure 20-41-11



Remove the 3 O-rings (Item 1) **[Figure 20-41-11]** from the upperstructure swing/inlet section.

Figure 20-41-12



To remove the spring retaining bolt from the spool, a holding fixture will have to be made from a 0.750 inch thick x 1.500 inches wide x 2.0 inches long (19 mm thick x 38 mm wide x 50 mm long) piece of hardwood. Drill a 0.5625 inch (14 mm) hole in the center of the hardwood block. Cut the block lengthwise **[Figure 20-41-12]**.

NOTE: Do not use anything other than hardwood blocks to grip the spool, or the spool will be damaged.

IMPORTANT

Do not use parts from one assembly to repair another assembly. Hydraulic and hydrostatic parts develop specific wear patterns. Used parts must be installed in the exact location that they were removed from.

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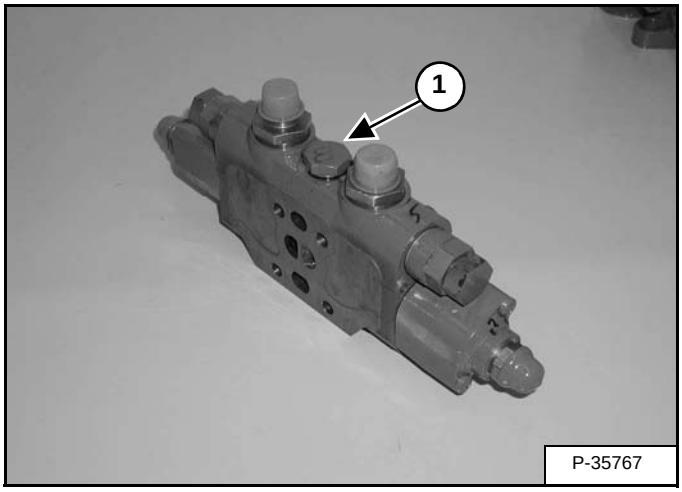
Boom Offset And Blade Valve Section Disassembly And Assembly

NOTE: The disassembly and assembly procedure is shown on the boom offset valve section. The procedure is the same on the blade valve section except where noted.

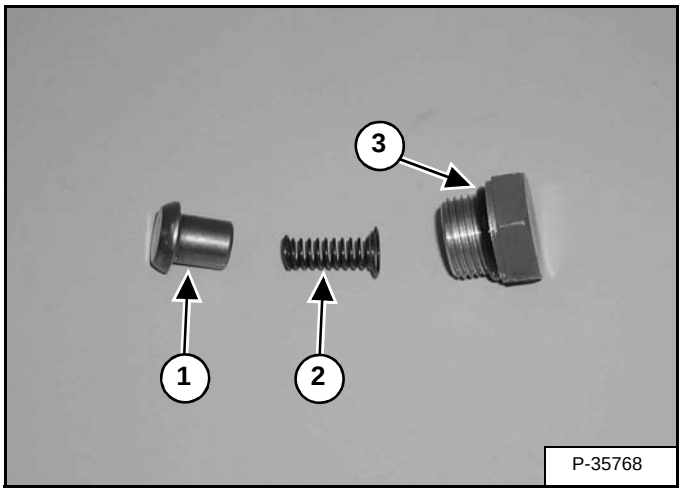
Figure 20-41-13



Remove the plug (Item 1) **[Figure 20-41-13]**.

Installation: Tighten the plug to 46-57 ft.-lb. (63-77 N•m) torque.

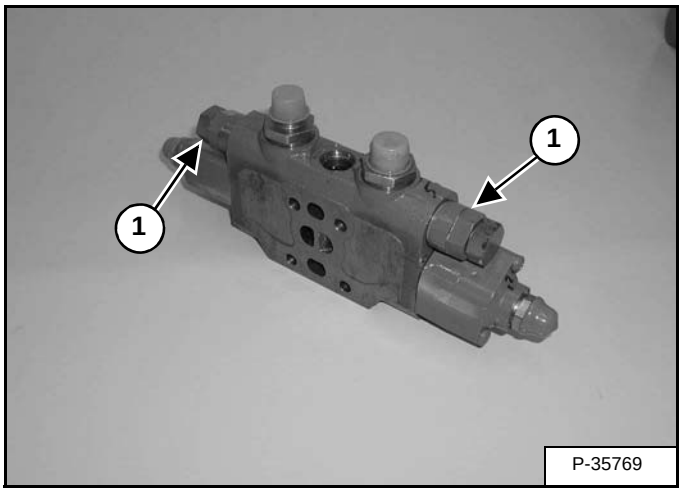
Figure 20-41-14



Remove the seat (Item 1) and spring (Item 2) **[Figure 20-41-14]** from the plug.

Remove the O-ring (Item 3) **[Figure 20-41-14]**.

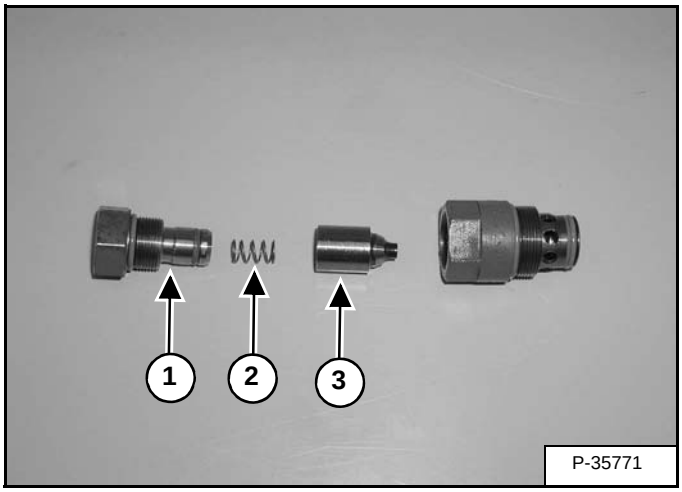
Figure 20-41-15



Remove the load check valves (Item 1) **[Figure 20-41-15]**.

NOTE: The blade valve section is equipped with plugs.

Figure 20-41-16



Remove the plug (Item 1), spring (Item 2) and poppet (Item 3) **[Figure 20-41-16]** from the valve body.

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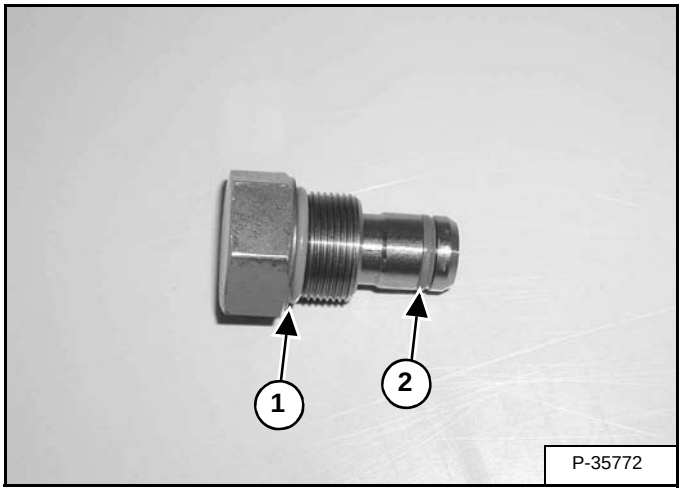
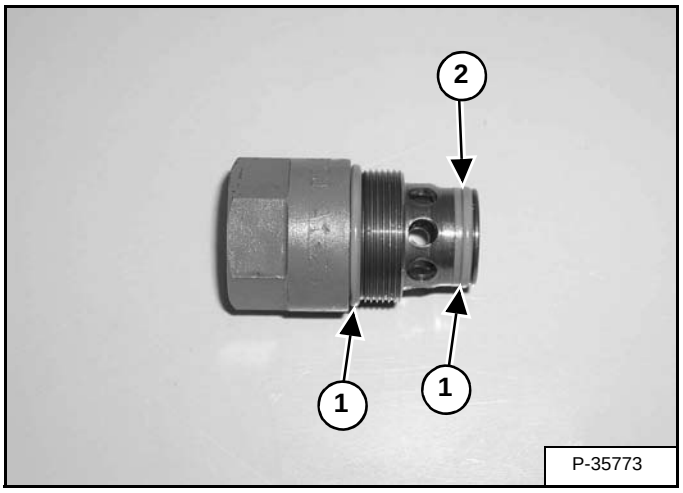
Boom Offset And Blade Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-17



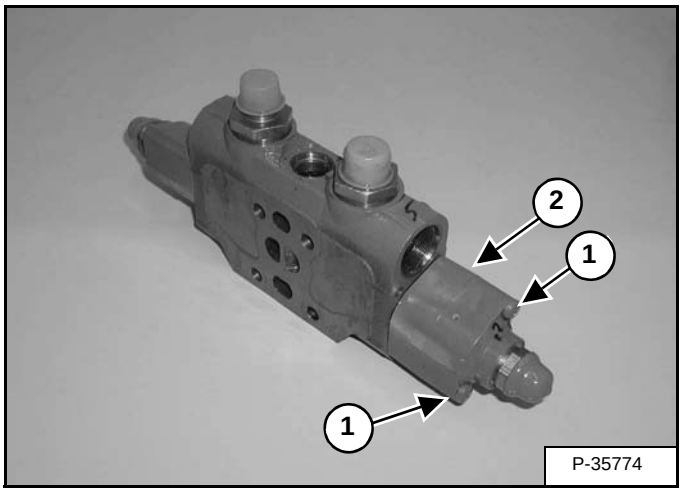
Remove the O-ring (Item 1) and seal ring (Item 2) **[Figure 20-41-17]**.

Figure 20-41-18



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-41-18]**.

Figure 20-41-19

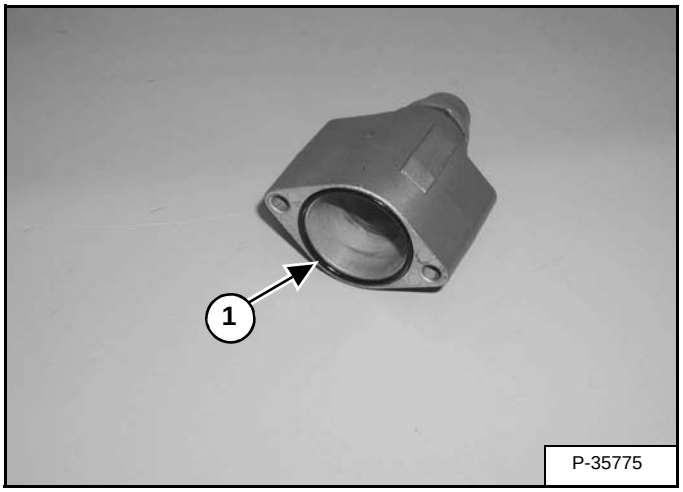


Remove the two screws (Item 1) **[Figure 20-41-19]** from both ends.

Installation: Tighten the screws to 48-58 in.-lb. (5,4-6,6 N•m) torque.

Remove the valve end cover (Item 2) **[Figure 20-41-19]** from both ends.

Figure 20-41-20



Remove the O-ring (Item 1) **[Figure 20-41-20]**.

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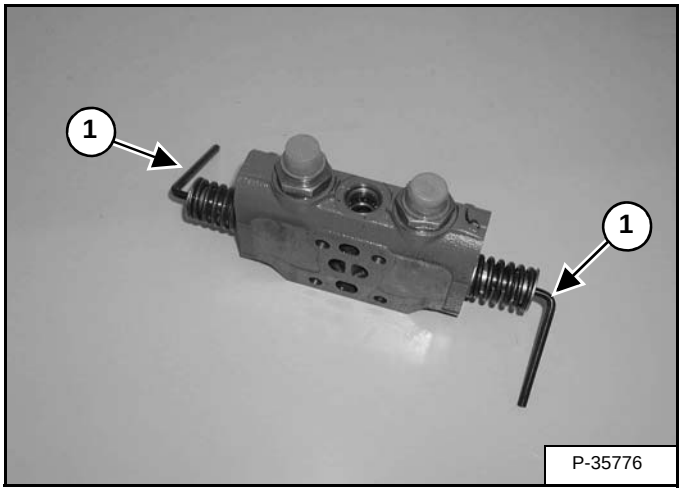
Boom Offset And Blade Valve Section Disassembly And Assembly (Cont'd)

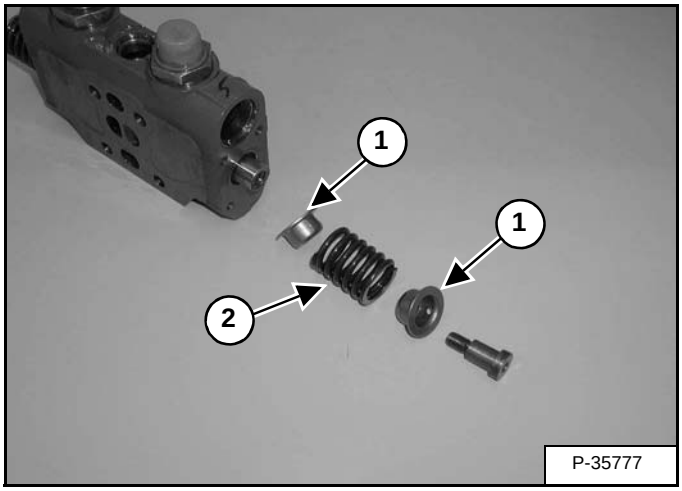
Figure 20-41-21



Install a wrench (Item 1) **[Figure 20-41-21]** on both ends of the spool. Remove the bolt.

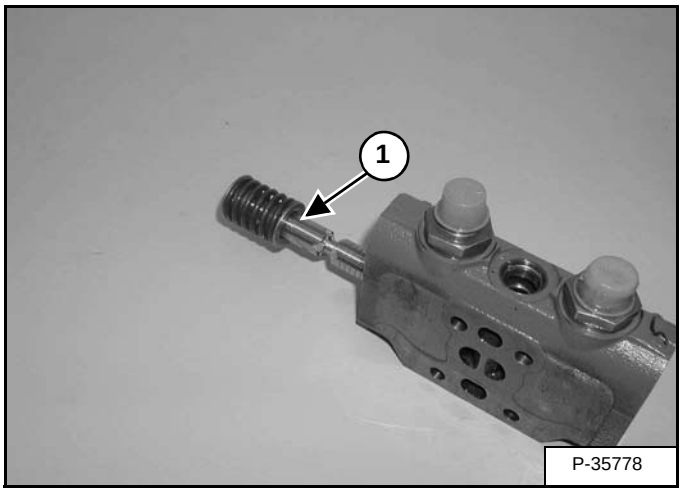
Installation: Tighten the bolt to 80-97 in.-lb. (9-11 N•m) torque.

Figure 20-41-22



Remove the spring seats (Item 1) and spring (Item 2) **[Figure 20-41-22]**.

Figure 20-41-23



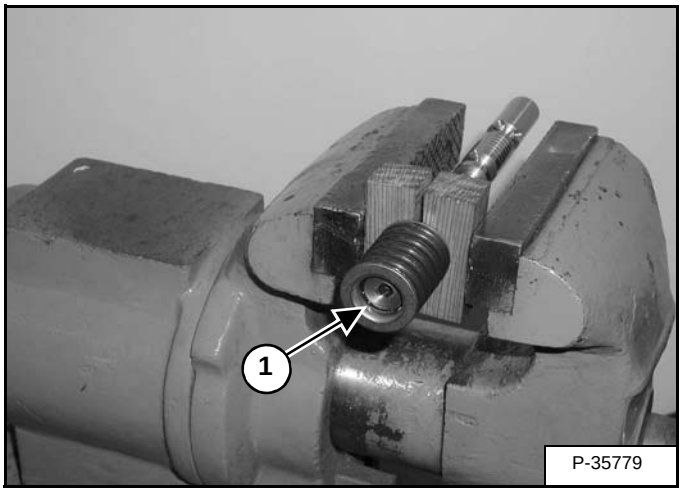
Remove the spool (Item 1) **[Figure 20-41-23]** from the valve.

Place the spool in the hardwood blocks.

Place the spool/blocks in a vise.

NOTE: Do not use anything other than hardwood blocks to grip the spool, or the spool will be damaged.

Figure 20-41-24



Remove the bolt (Item 1) **[Figure 20-41-24]**.

Installation: Tighten the bolt to 80-97 in.-lb. (9-11 N•m) torque.

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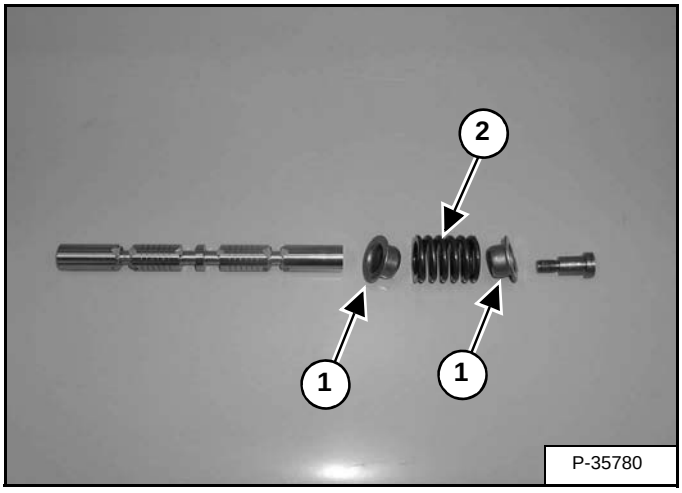
Boom Offset And Blade Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-25



Remove the spring seats (Item 1) and spring (Item 2) **[Figure 20-41-25]** from the spool.

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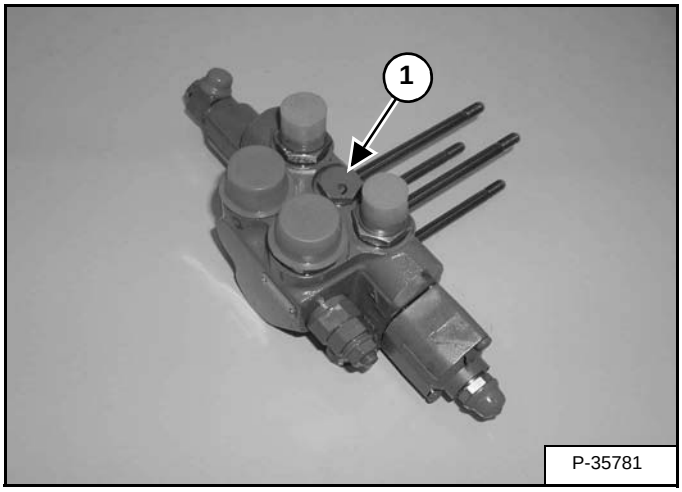
Inlet/Upperstructure Swing Valve Section Disassembly And Assembly

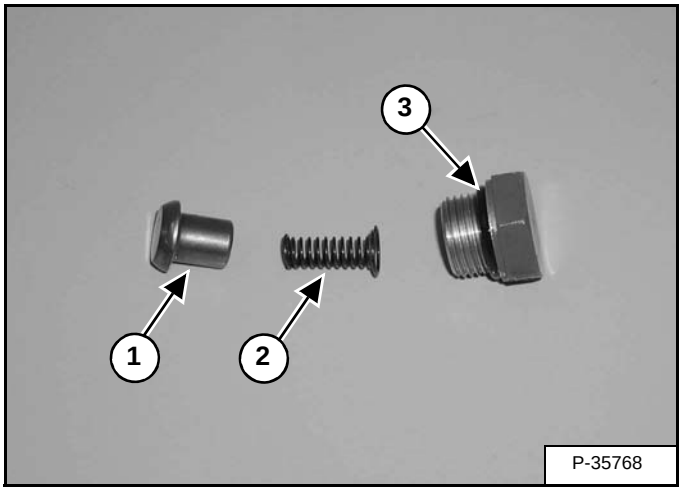
Figure 20-41-26



Remove the plug (Item 1) **[Figure 20-41-26]**.

Installation: Tighten the plug to 46-57 ft.-lb. (63-77 N•m) torque.

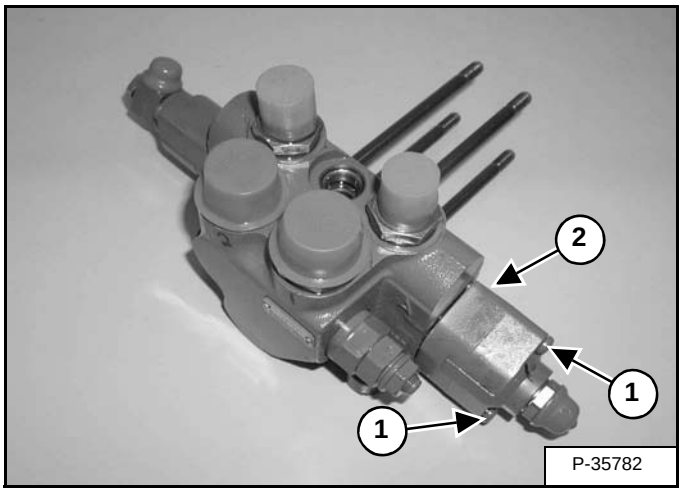
Figure 20-41-27



Remove the seat (Item 1) and spring (Item 2) **[Figure 20-41-27]** from the plug.

Remove the O-ring (Item 3) **[Figure 20-41-27]**.

Figure 20-41-28

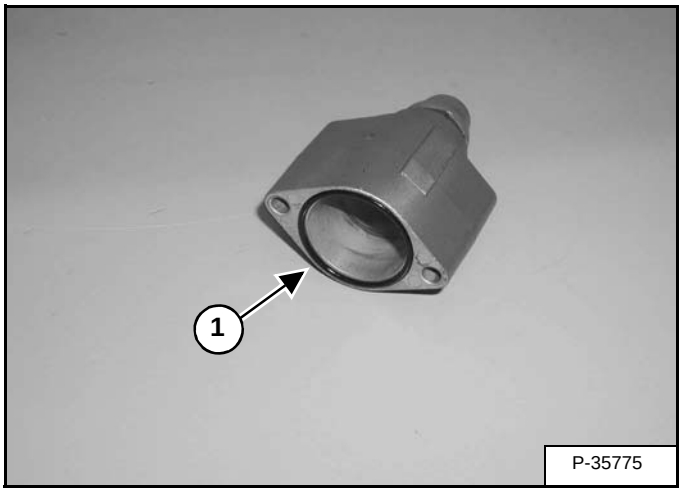


Remove the two screws (Item 1) **[Figure 20-41-28]** from both ends.

Installation: Tighten the screws to 48-58 in.-lb. (5,4-6,6 N•m) torque.

Remove the valve end cover (Item 2) **[Figure 20-41-28]** from both ends.

Figure 20-41-29



Remove the O-ring (Item 1) **[Figure 20-41-29]**.

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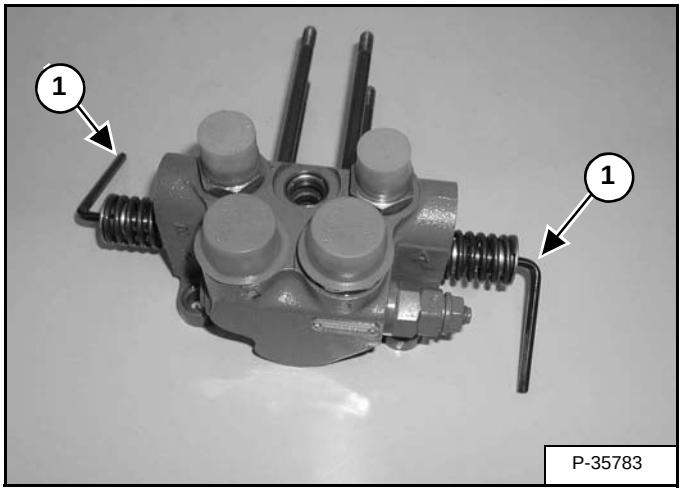
Inlet/Upperstructure Swing Valve Section Disassembly And Assembly (Cont'd)

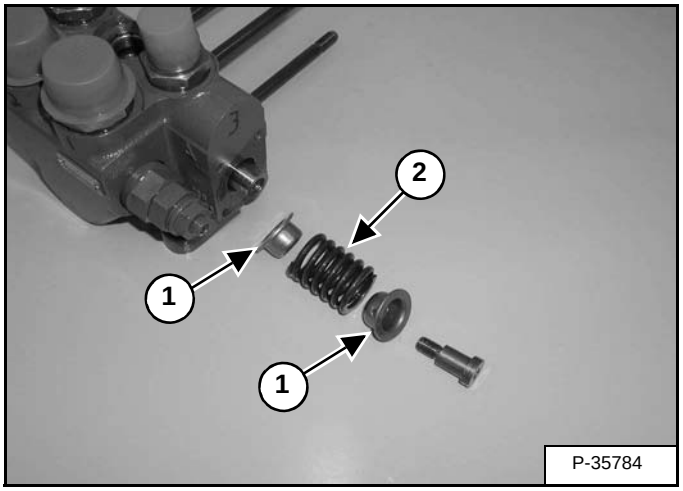
Figure 20-41-30



Install a wrench (Item 1) **[Figure 20-41-30]** on both ends of the spool. Remove the bolt.

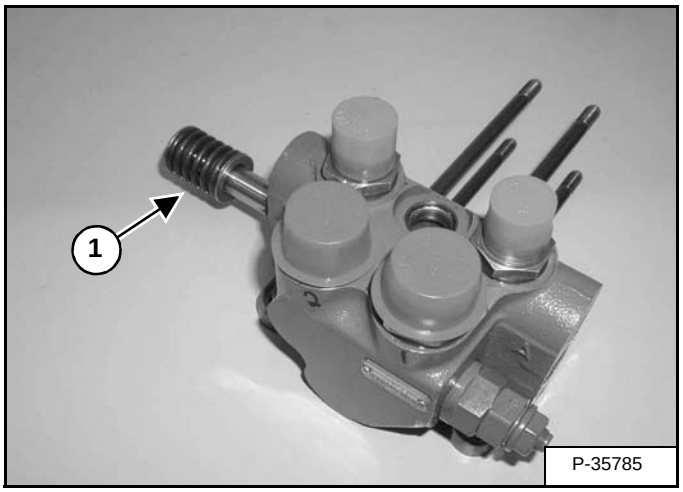
Installation: Tighten the bolt to 80-97 in.-lb. (9-11 N•m) torque.

Figure 20-41-31



Remove the spring seats (Item 1) and spring (Item 2) **[Figure 20-41-31]**.

Figure 20-41-32



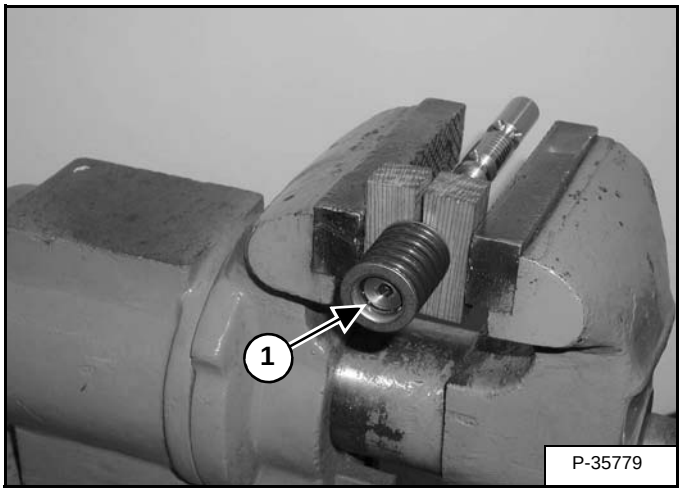
Remove the spool (item 1) **[Figure 20-41-32]** from the valve.

Place the spool in the hardwood blocks.

Place the spool/blocks in a vise.

NOTE: Do not use anything other than hardwood blocks to grip the spool, or the spool will be damaged.

Figure 20-41-33



Remove the bolt (Item 1) **[Figure 20-41-33]**.

Installation: Tighten the bolt to 80-97 in.-lb. (9-11 N•m) torque.

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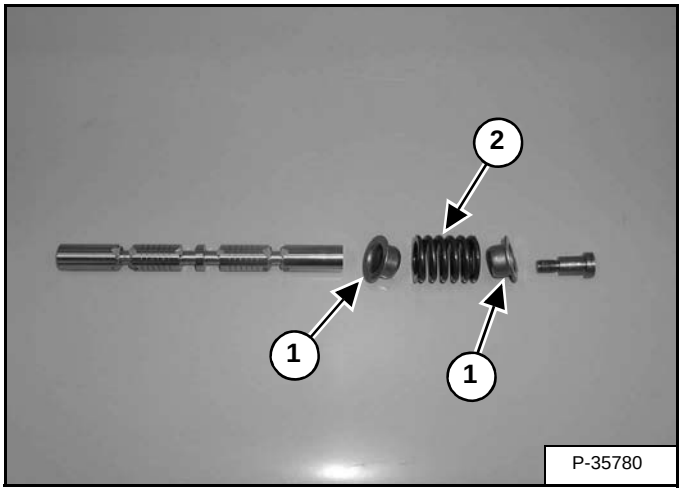
THREE SPOOL HYDRAULIC CONTROL VALVE (CONT'D)

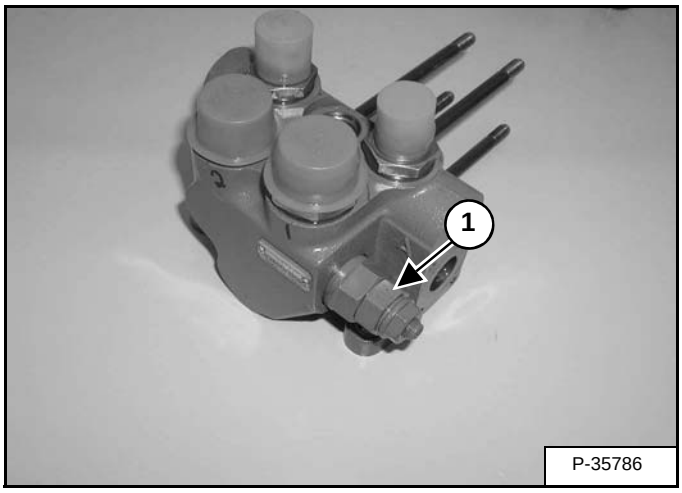
Inlet/Upperstructure Swing Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-34



Remove the spring seats (Item 1) and spring (Item 2) **[Figure 20-41-34]** from the spool.

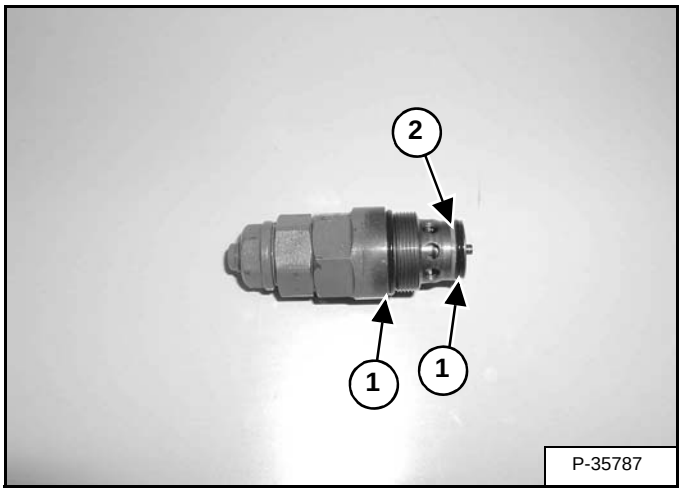
Figure 20-41-35



Remove the main relief valve (Item 1) **[Figure 20-41-35]**.

Installation: Tighten the main relief valve to 46-57 ft.-lb. (63-77 N•m) torque.

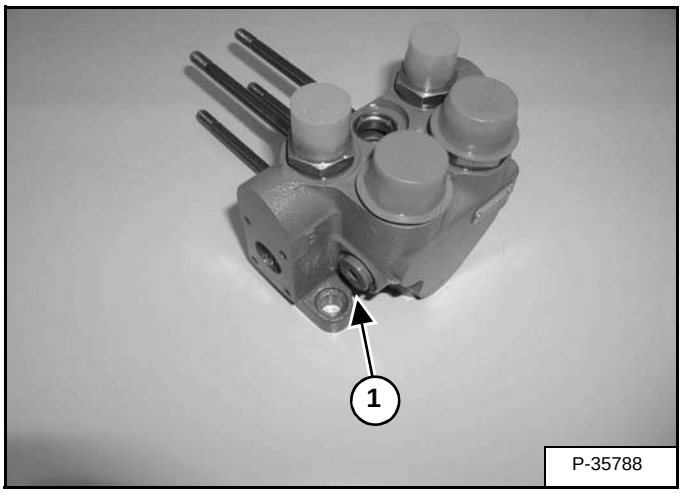
Figure 20-41-36



Remove the O-rings (Item 1) **[Figure 20-41-36]**.

Remove the back-up ring (Item 2) **[Figure 20-41-36]**.

Figure 20-41-37



Remove the plug (Item 1) **[Figure 20-41-37]**.

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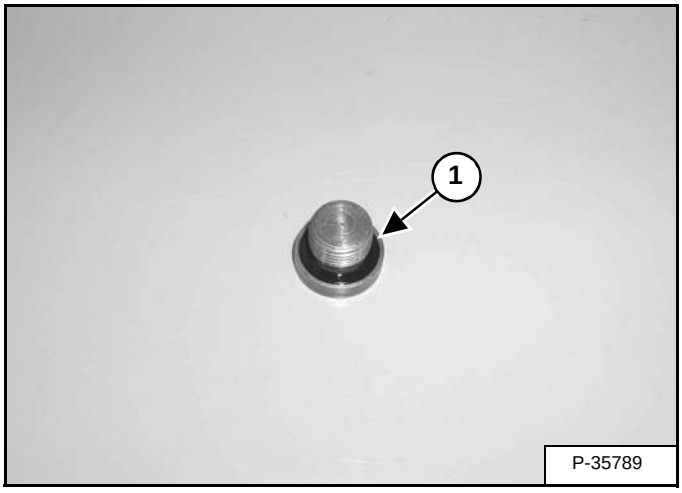
Inlet/Upperstructure Swing Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-38



Remove the O-ring (Item 1) **[Figure 20-41-38]**.

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HYDRAULIC PISTON PUMP (S/N 522311001 & ABOVE)

Hydraulic Pump Work Sheet

(Please review pump procedure as illustrated in "Pump Testing" on page 6**)**

If any of the following adjustments are not obtainable, pump repair is required.

The outline listed below, gives the four adjustments for setting the hydraulic pump. The adjustments are listed in the order in which they ***MUST*** be performed. Below each adjustment is a list of the steps. Behind each adjustment is the page location within the Service Manual for the complete adjustment procedure.

I. "Torque Limiter Supply Pressure Adjustment" on page 6

4. Bottom Out Pump Margin Spool (Approximately 6 Turns In.)
5. Remove the plug and install fitting and hose from the Torque Limit Supply Spool to a drain pan.
6. Install a 725 PSI (50 bar) pressure gauge on the test port on the six spool control valve.
7. Warm hydraulic fluid to 122° - 144° F (50° - 60° C).
8. Run Engine at High Idle
9. Adjust as Necessary to get 290 ± 20 PSI (20 ± 1,38 bar).
10. Record Pressure

_____ **TLS PRESSURE**

11. Remove the Hose and Fitting from the Torque Limiter Supply Spool and Plug the Port
12. Reset Pump Margin Spool (Approximately 6 Turns Out.)

II. "Pump Margin Pressure Adjustment" on page 7

13. Run Engine at High Idle
14. Adjust as Necessary to get 363 ± 20 PSI (25 ± 1,38 bar).
15. Record Pressure

_____ **PM PRESSURE**

16. Remove 725 PSI (50 bar) pressure gauge.

III. "Back-up Relief Valve Adjustment" on page 8

17. Install 5000 PSI (345 bar) gauge ont he test port on the six spool valve.
18. Turn the load sense relief valve in 3/4 turn.
19. Run engine at high idle and curl the bucket until the bucket cylinder is fully extended and the relief valve opens.
20. Adjust back-up relief valve as necessary to get 4350 ± 50 PSI (300 ± 3,45 bar).

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Hydraulic Pump Work Sheet (Cont'd)

21. Record Pressure

_____ **PM PRESSURE**

IV. "Load Sense Relief Valve Adjustment" on page 9

22. Install 5000 PSI (345 bar) Gauge on the test port on the six spool control valve.

23. Run Engine at High Idle and curl the bucket until the bucket cylinder is fully extended and the relief valve opens.

24. Adjust Load Sense Relief Valve as Necessary to get 4060 ± 50 PSI (280 ±3,45 bar).

25. Record Pressure

_____ **PRESSURE**

26. Remove the 5000 PSI Gauge, from the Pump Diagnostic Coupler at the Control Valve.

V. "Torque Limiter Adjustment" on page 10

27. Remove the inlet hose from the six spool hydraulic control valve, install a cap on the valve and install the inlet hose on the inlet side of the hydraulic tester.

28. Route the outlet hose of the hydraulic tester to the hydraulic reservoir.

29. Bottom out the pump margin spool (approximately six turns in)

30. Run engine at high idle.

31. Free flow on the hydraulic tester is 40 GPM (152 L/min)

32. Adjust the hydraulic tester to 1450 PSI (100 bar)

33. Adjust torque limiter to 37 GPM (140 L/min).

34. Record Flow and Engine RPM.

_____ **FLOW**

35. Adjust the Hydraulic Tester to 3480 PSI (240 bar).

36. Adjust the Torque Limiter to obtain 13 GPM (50 L/min)

37. Record Flow and Engine RPM.

_____ **FLOW**

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Hydraulic Pump Work Sheet (Cont'd)

38. Remove the Hydraulic Tester

39. Install the pump outlet hose on the six spool hydraulic control valve.

40. Reset pump margin spool to 363 ± 20 PSI (25 ± 1,38 bar).

ALL PUMP ADJUSTMENTS ARE NOW COMPLETED

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Testing Information

The testing of the piston pump must be done in the following order:

Torque limiter supply pressure
Pump margin pressure
Load sense relief valve
Torque Limiter

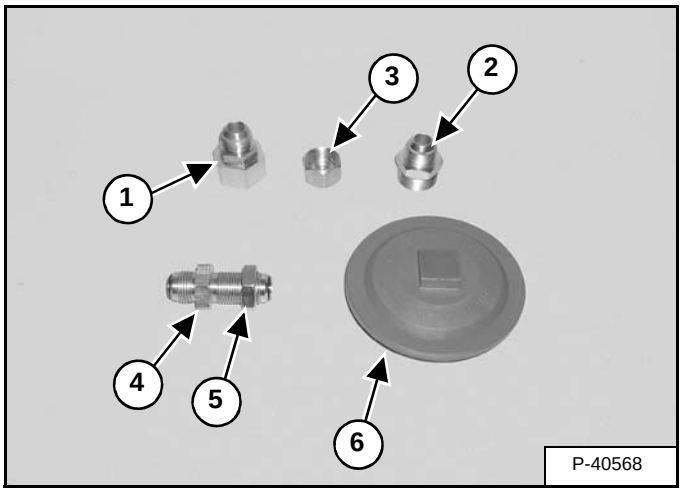
All testing is done with the hydraulic oil at 122° to 140° F (50° to 60° C).

Check and adjust as needed the engine high idle before any hydraulic testing.

The hydraulic hoses, tubelines and fittings on the 442 Excavator are 24° DIN cone metric fittings.

To test the torque limiter, order the following parts to adapt the metric fittings to 37° JIC flare fittings:

Figure 1



Order the following parts from your Bobcat dealer:

Item 1 **[Figure 1]**: Female 24° DIN to male 37° JIC flare Bobcat P/N 6698092.

Item 2 **[Figure 1]**: Male 24° DIN to male 37° JIC flare Bobcat P/N 6698093.

Item 3 **[Figure 1]**: Female 37° JIC flare cap Bobcat P/N 36K-8.

Item 4 **[Figure 1]**: 37° JIC flare union, Bobcat P/N 45KN-8.

Item 5 **[Figure 1]**: Nut Bobcat P/N 86F-8.

Item 6 **[Figure 1]**: Hydraulic reservoir cover, Bobcat P/N 5 380 660 846.

MEL1610 Hose Kit (not shown).

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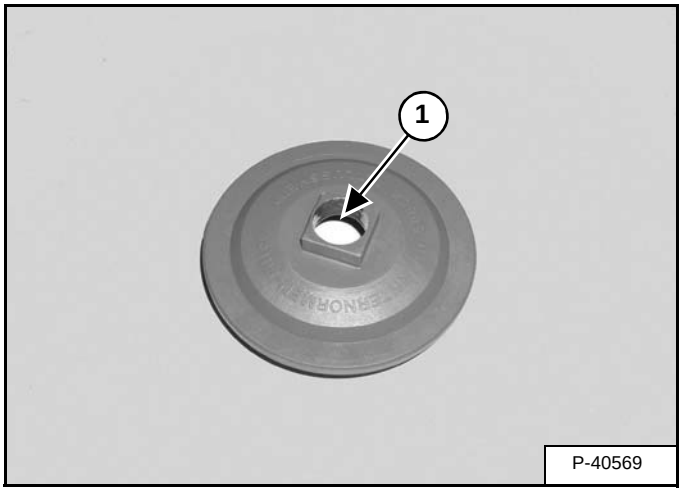
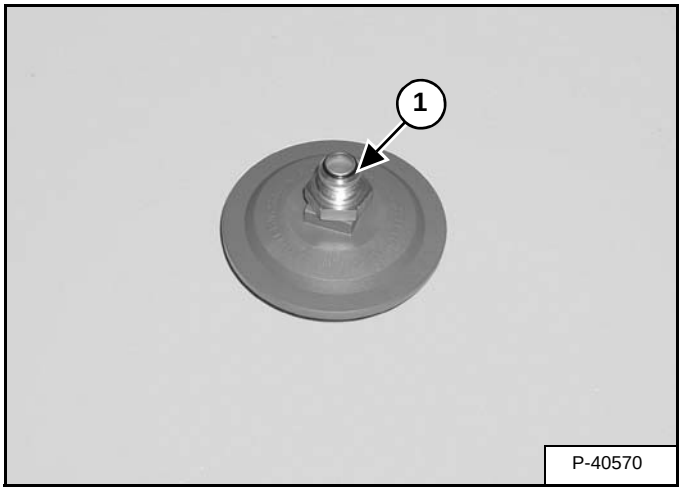
Testing Information (Cont'd)

Figure 20-50-2



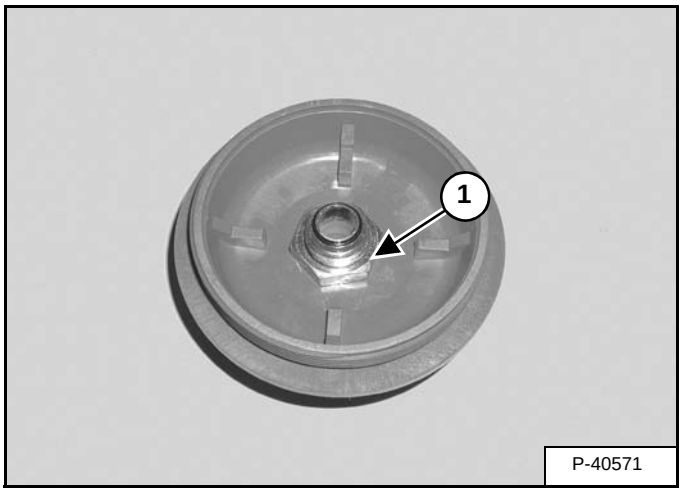
Drill a 1.0625 inch (26 mm) hole in the center of the cover (Item 1) **[Figure 20-50-2]**.

Figure 20-50-3



Install the union (Item 1) **[Figure 20-50-3]** in the cover. (This is (Item 4) **[Figure 1]**.)

Figure 20-50-4



Turn the cover over and install the nut (Item 1) **[Figure 20-50-4]**.

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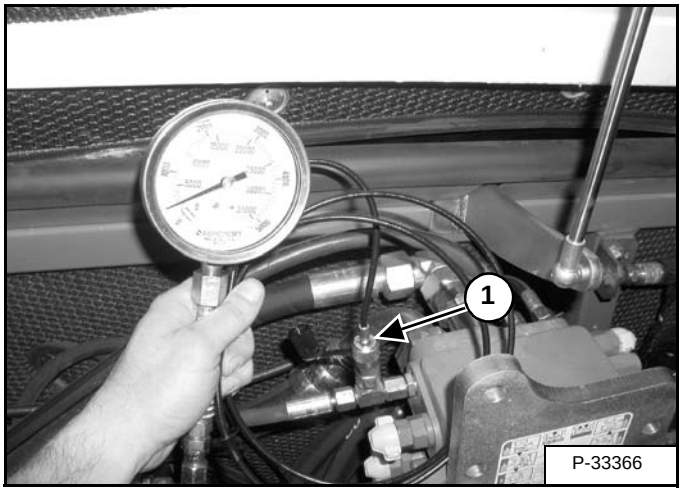
HYDRAULIC PISTON PUMP (S/N 522311001 & ABOVE) (CONT'D)

Pump Testing

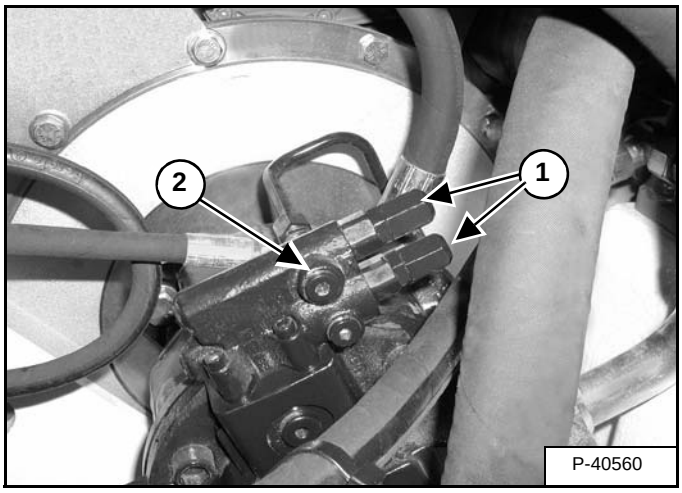
Torque Limiter Supply Pressure Adjustment

Figure 20-50-5



Install a 725 PSI (500 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-50-5]**.

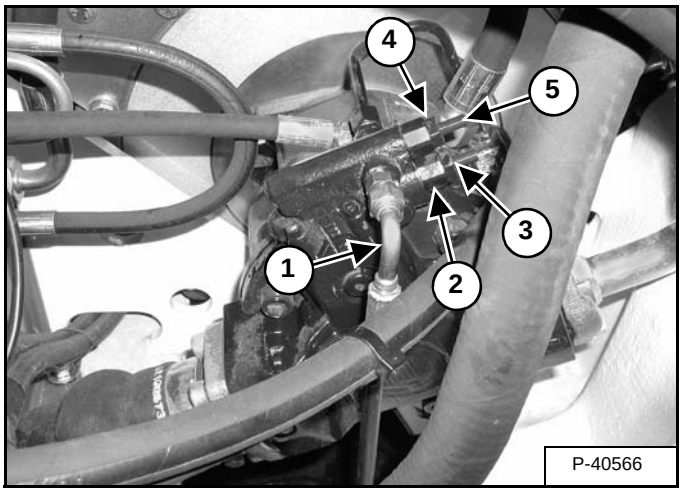
Figure 20-50-6



Remove caps (Item 1) **[Figure 20-50-6]**.

Remove the plug (Item 2) **[Figure 20-50-6]**.

Figure 20-50-7



Install a fitting and drain hose (Item 1) **[Figure 20-50-7]**. Place the other end of the hose in a drain pan.

NOTE: To adjust the Torque Limiter Supply Pressure, the Pump Margin Spool must be temporarily bottomed out.

Loosen the nut (Item 2) **[Figure 20-50-7]**.

Turn the pump margin spool (bottom spool) (Item 3) **[Figure 20-50-7]** all the way in (approximately 6 turns).

Start the engine and run at high idle.

Loosen the nut (Item 4) and adjust the torque limiter supply pressure spool (Item 5) **[Figure 20-50-7]** until the pressure gauge reads 290 PSI (20 bar).

Turn the adjustment screw clockwise to increase pressure and counterclockwise to decrease pressure.

NOTE: 1/4 turn is approximately 35 PSI (2,41 bar).

Tighten the nut (Item 4) **[Figure 20-50-7]**.

Stop the engine.

Repeat the procedure listed above until the pressure is set.

Turn the pump margin spool (bottom spool) (Item 3) **[Figure 20-50-7]** back to its original position (approximately 6 turns).

Tighten the nut (Item 2) **[Figure 20-50-7]**.

Remove the hose (Item 1) **[Figure 20-50-7]** and install the plug.

Install the cap on the torque limiter supply pressure adjustment spool (top spool).

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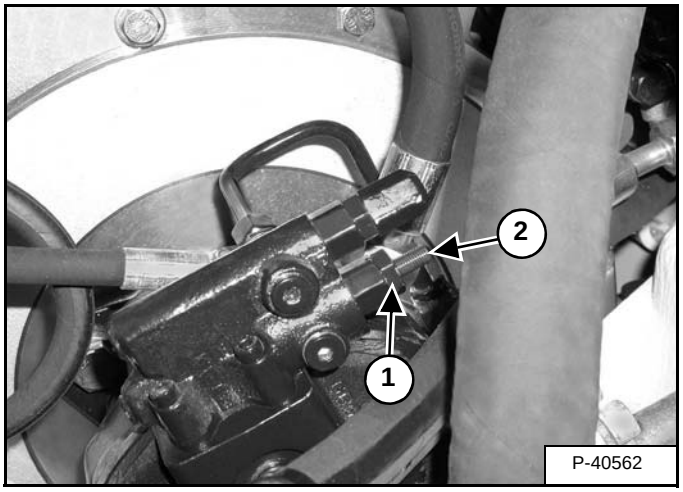
Pump Testing (Cont'd)

Pump Margin Pressure Adjustment

Figure 20-50-8



Start the engine and run at high idle.

Loosen the nut (Item 1) and adjust the pump margin pressure adjustment spool (Item 2) **[Figure 20-50-8]** until the pressure gauge reads 363 PSI (25 bar).

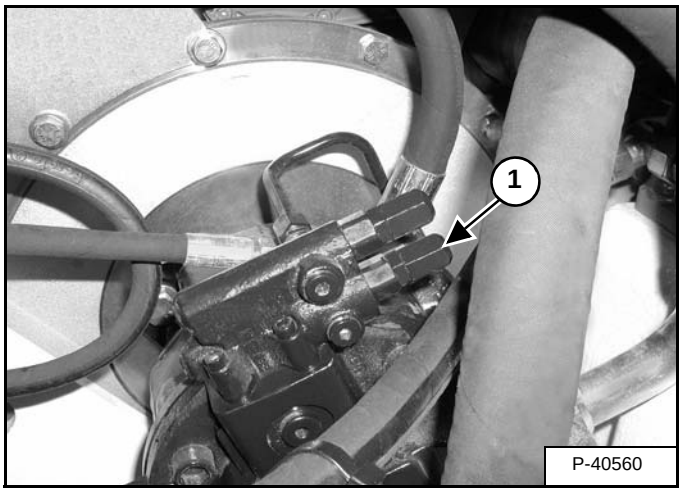
Turn the adjustment screw clockwise to increase pressure and counterclockwise to decrease pressure.

NOTE: 1/4 turn is 50 PSI (3,45 bar).

Tighten the nut (Item 1) **[Figure 20-50-8]**.

Stop the engine.

Figure 20-50-9



Install the cap (Item 1) **[Figure 20-50-9]** on the pump margin pressure adjustment spool (bottom spool).

Remove the gauge from the test coupler.

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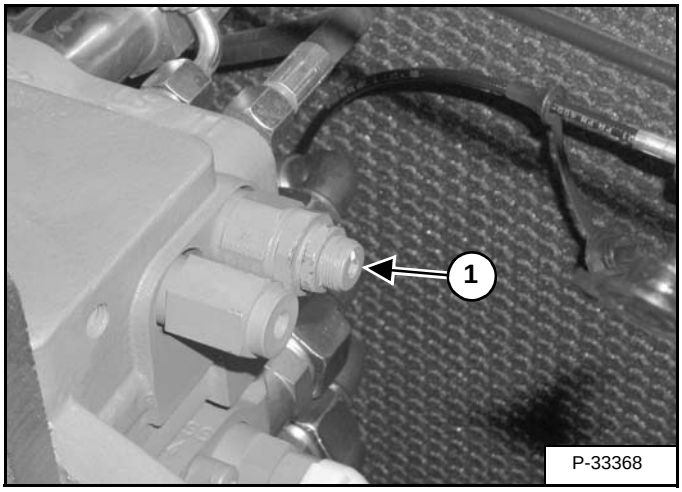
HYDRAULIC PISTON PUMP (S/N 522311001 & ABOVE) (CONT'D)

Pump Testing (Cont'd)

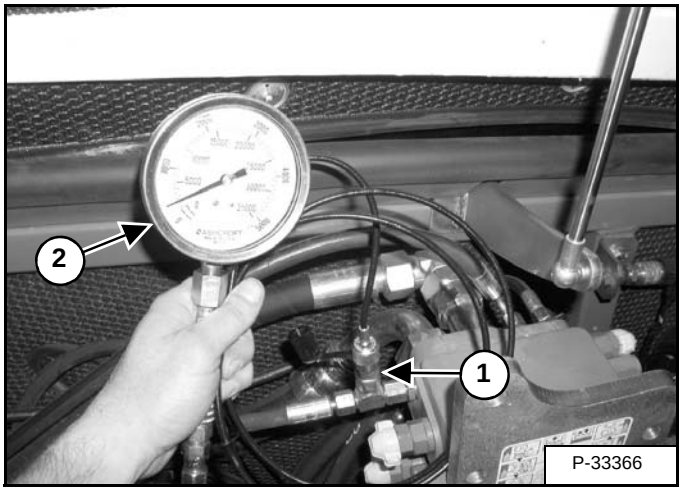
Back-up Relief Valve Adjustment

Figure 20-50-10



Turn the load sense adjustment screw (Item 1) **[Figure 20-50-10]** in 3/4 of a turn, increasing the relief pressure approximately 600 PSI (41,4 bar) to 4660 PSI (321 bar).The load sense relief is now set to a higher pressure than the back-up relief.

Figure 20-50-11



Install a 5000 PSI (345 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-50-11]**.

Start the excavator and warm the hydraulic oil to operating temperature.

Move the engine speed control to the high speed position.

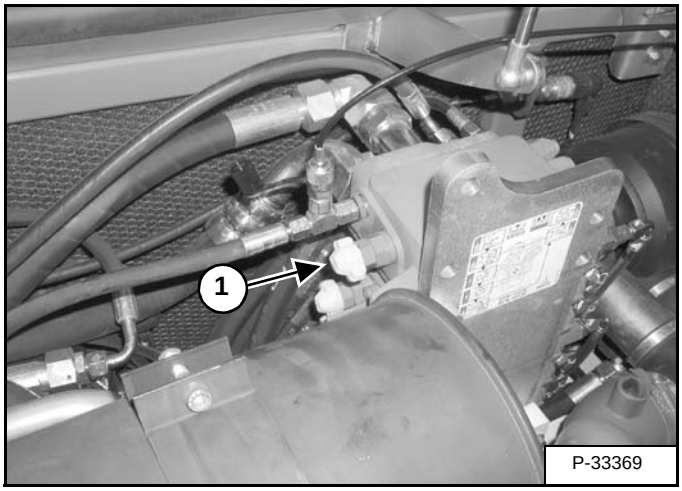
Curl the bucket until the bucket cylinder is fully extended and the relief valve opens.

Record the pressure.

The pressure at the gauge (Item 2) **[Figure 20-50-11]** should be 4350 PSI (300 bar).

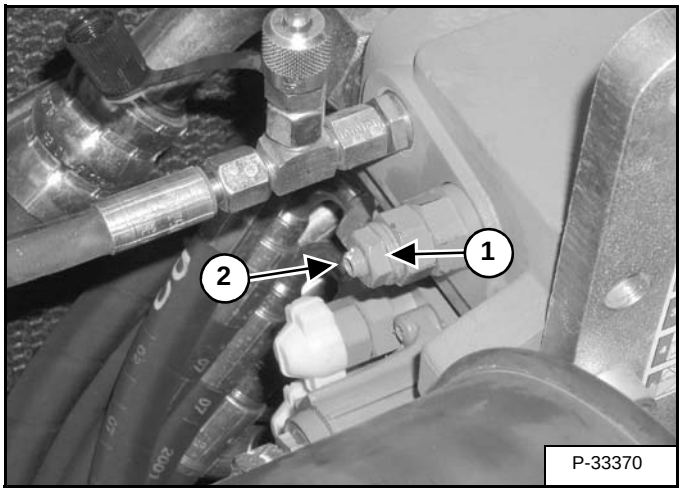
Stop the engine.

Figure 20-50-12



Remove the plastic cap (Item 1) **[Figure 20-50-12]**.

Figure 20-50-13



Loosen the lock nut (Item 1) **[Figure 20-50-13]**.

Turn the adjustment screw (Item 2) **[Figure 20-50-13]** in to increase pressure and out to decrease pressure.

NOTE: One quarter turn is approximately 200 PSI (13,8 bar).

Tighten the nut and retest the back-up relief valve.

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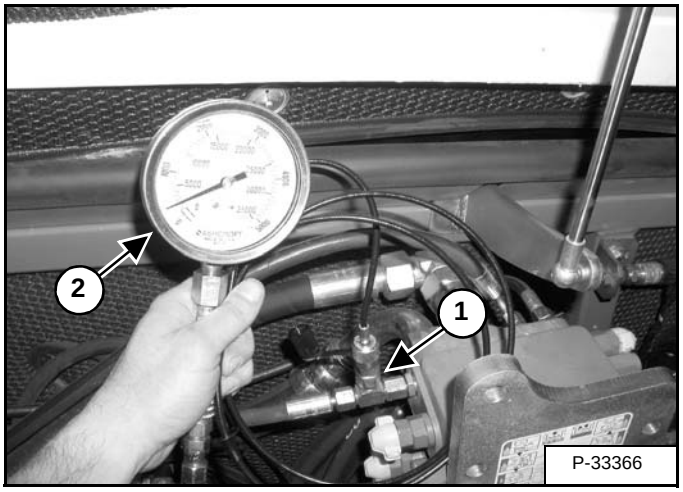
Pump Testing (Cont'd)

Load Sense Relief Valve Adjustment

Figure 20-50-14



Install a 5000 PSI (345 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-50-14]**.

Move the engine speed control to the high idle position.

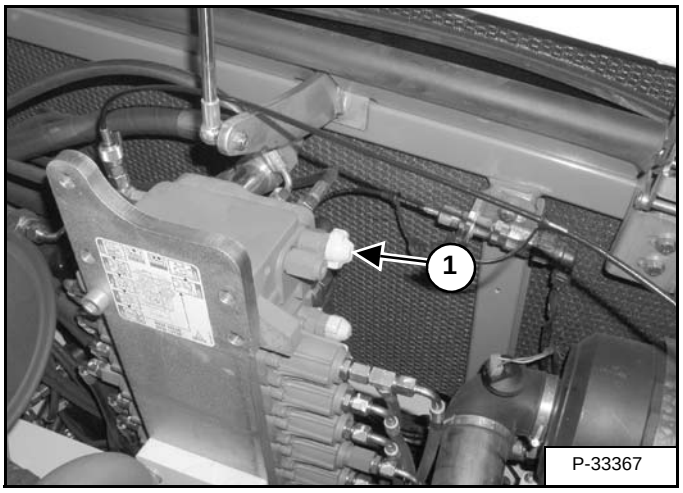
Curl the bucket until the bucket cylinder is fully extended and the relief valve opens.

Record the pressure.

The pressure at the gauge (Item 2) **[Figure 20-50-14]** should be 4060 PSI (280 bar).

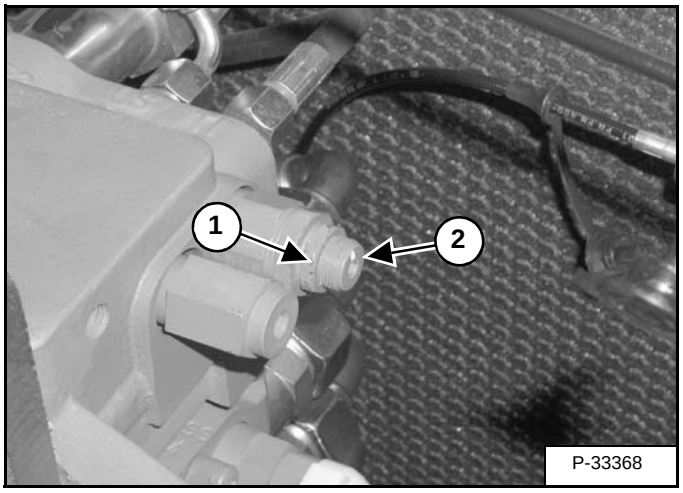
Stop the engine.

Figure 20-50-15



Remove the plastic cap (Item 1) **[Figure 20-50-15]**.

Figure 20-50-16



Loosen the lock nut (Item 1) **[Figure 20-50-16]**.

Turn the adjustment screw (Item 2) **[Figure 20-50-16]** in to increase pressure and out to decrease pressure.

NOTE: One quarter turn is approximately 200 PSI (13,8 bar).

Tighten the lock nut and retest the load sense relief valve.

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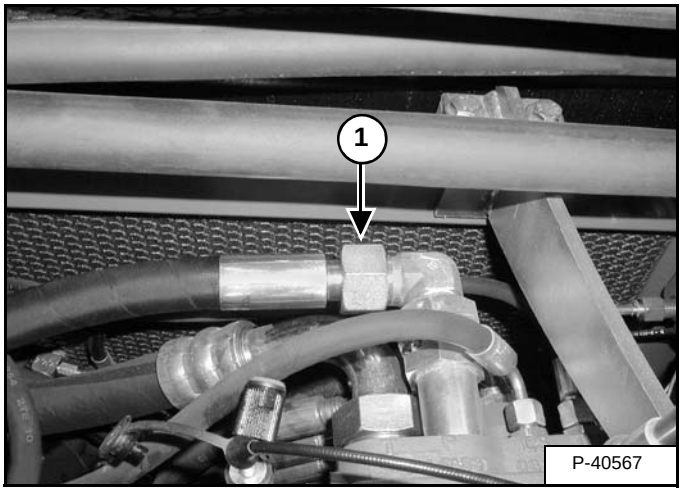
Pump Testing (Cont'd)

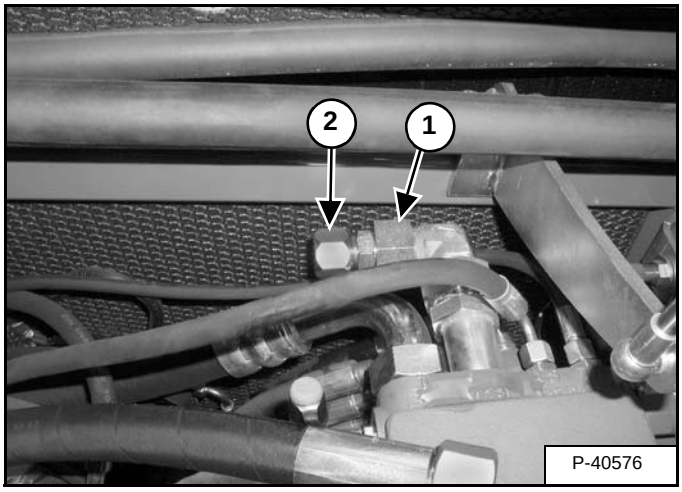
Torque Limiter Adjustment

Figure 20-50-17



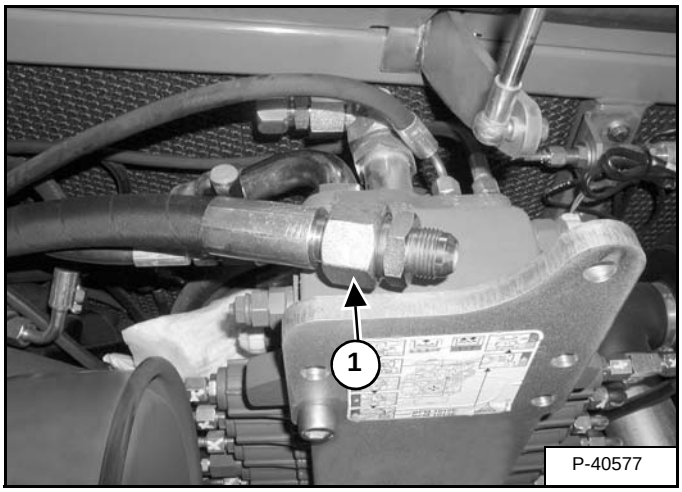
Remove the inlet hose (Item 1) **[Figure 20-50-17]** from the hydraulic control valve.

Figure 20-50-18



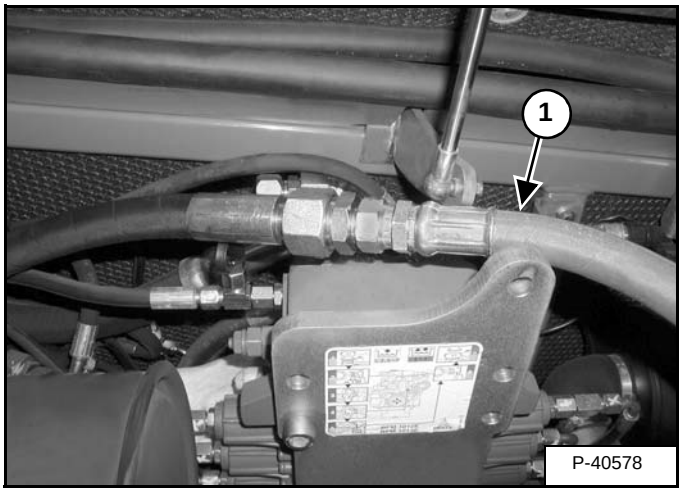
Install the adapter (Gates P/N 87957) (Item 1) and cap (Bobcat P/N 36K-8) (Item 2) **[Figure 20-50-18]**.

Figure 20-50-19



Install the adapter (Gates P/N 87945) (Item 1) **[Figure 20-50-19]** on the inlet hose.

Figure 20-50-20



Connect the inlet hose to the **INLET** side of the hydraulic tester (Item 1) **[Figure 20-50-20]**.

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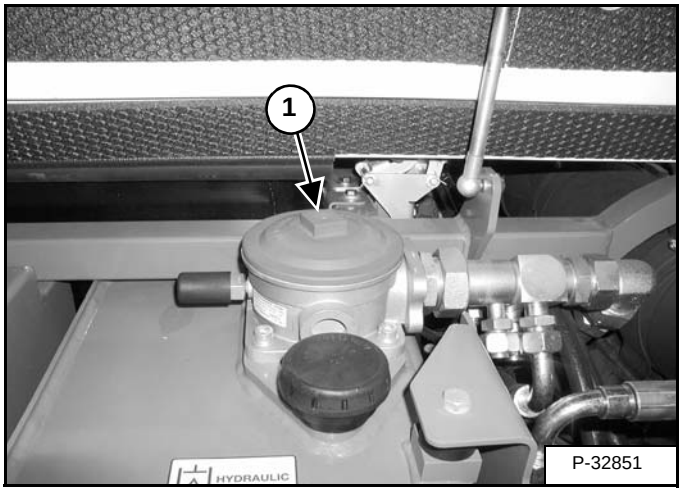
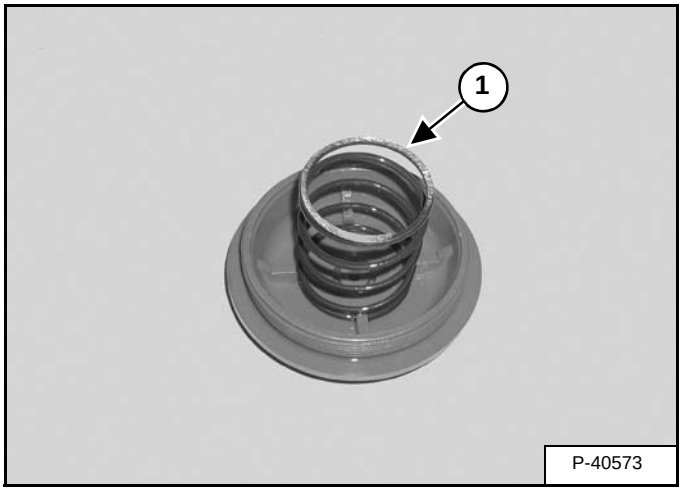
Pump Testing (Cont'd)

Figure 20-50-21



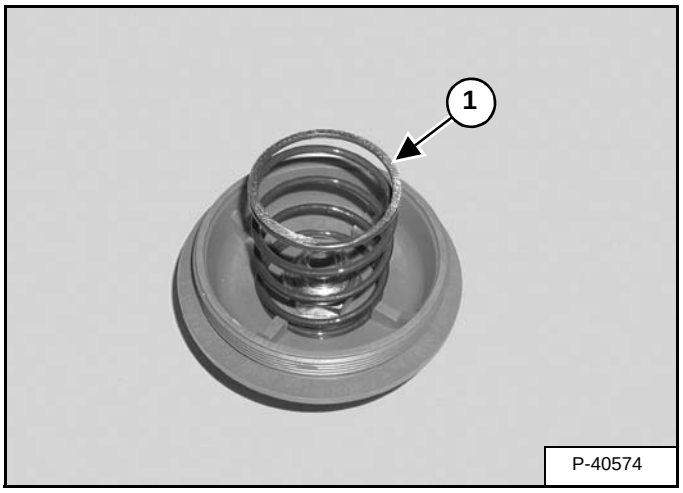
Remove the hydraulic reservoir cover (Item 1) **[Figure 20-50-21]**.

Figure 20-50-22



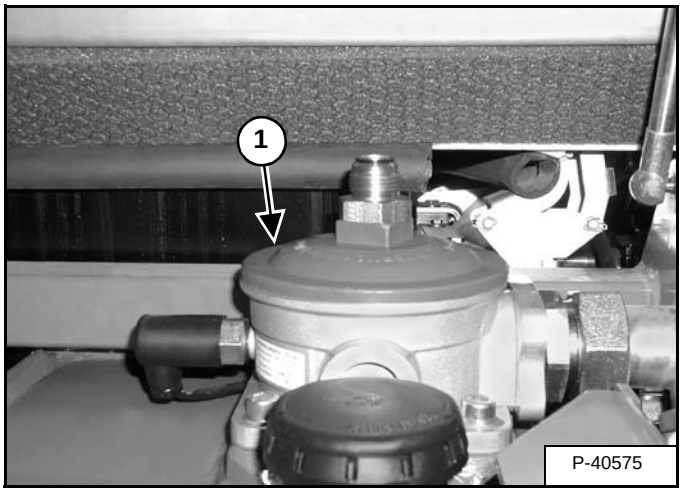
Remove the spring (Item 1) **[Figure 20-50-22]**.

Figure 20-50-23



Install the spring (Item 1) **[Figure 20-50-23]** on the modified cover.

Figure 20-50-24



Install the modified cover (Item 1) **[Figure 20-50-24]** on the hydraulic reservoir.

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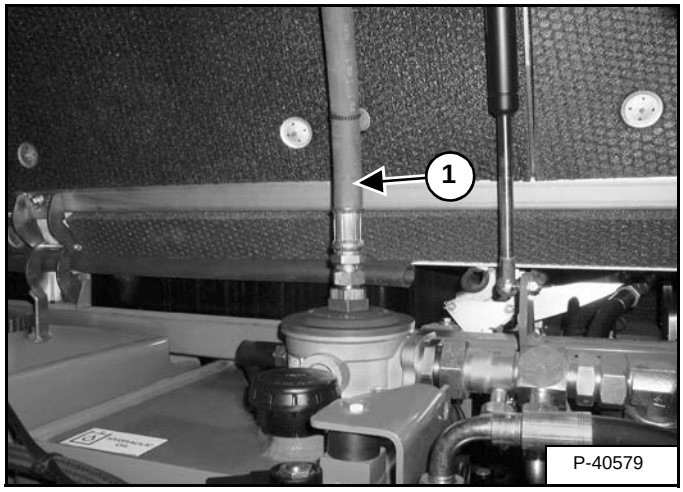
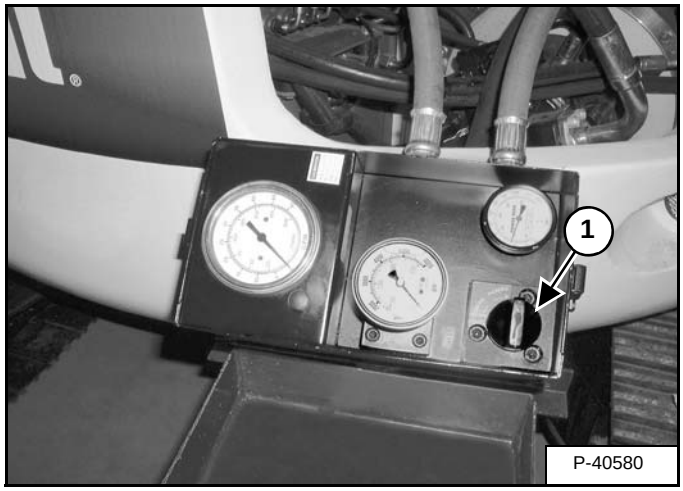
Pump Testing (Cont'd)

Figure 20-50-25



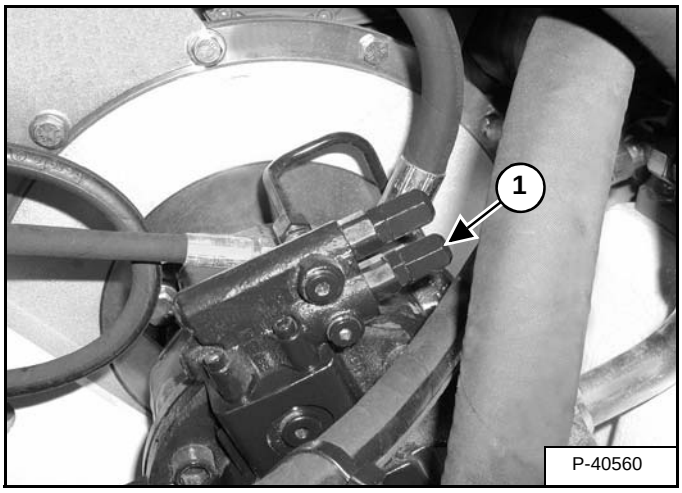
Connect the **OUTLET** side of the hydraulic tester (Item 1) **[Figure 20-50-25]** to the reservoir cover.

Figure 20-50-26



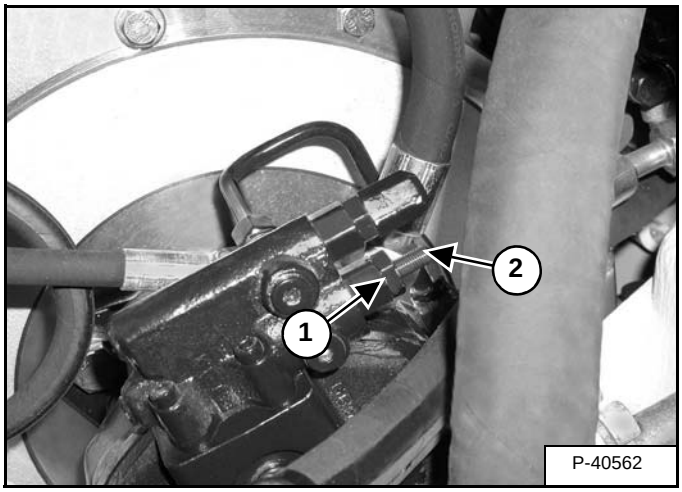
Fully open the hydraulic tester flow control (Item 1) **[Figure 20-50-26]**.

Figure 20-50-27



Remove the cap (Item 1) **[Figure 20-50-27]** from the pump margin spool (bottom spool).

Figure 20-50-28



Loosen the nut (Item 1) and turn the adjustment screw (Item 2) **[Figure 20-50-28]** all the way in (approximately 6 turns).

Start the engine and run at high idle.

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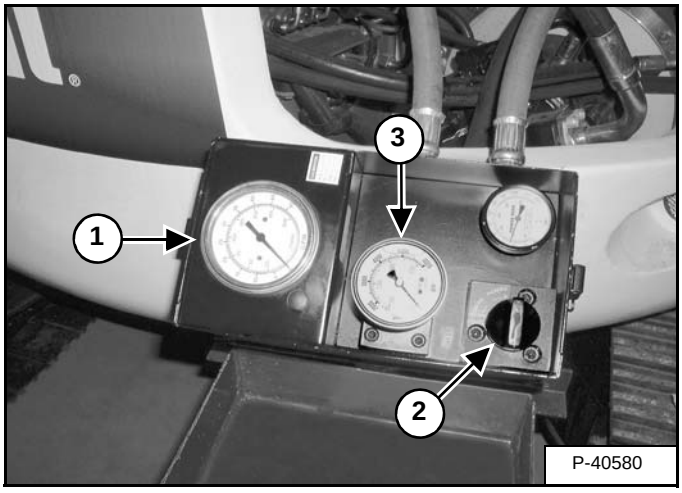
Pump Testing (Cont'd)

Figure 20-50-29

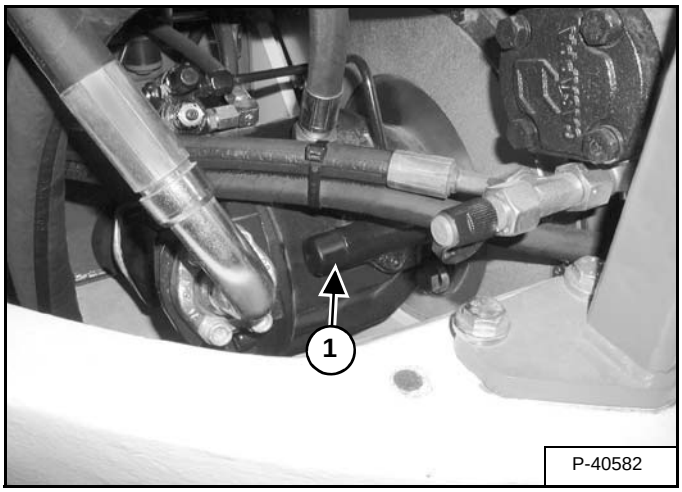


The flow should be 40 GPM (152 L/mm) on the flow tester (Item 1) **[Figure 20-50-29]**.

Turn the hydraulic tester flow control (Item 2) clockwise until the gauge (Item 3) **[Figure 20-50-29]** shows 1450 PSI (100 bar).

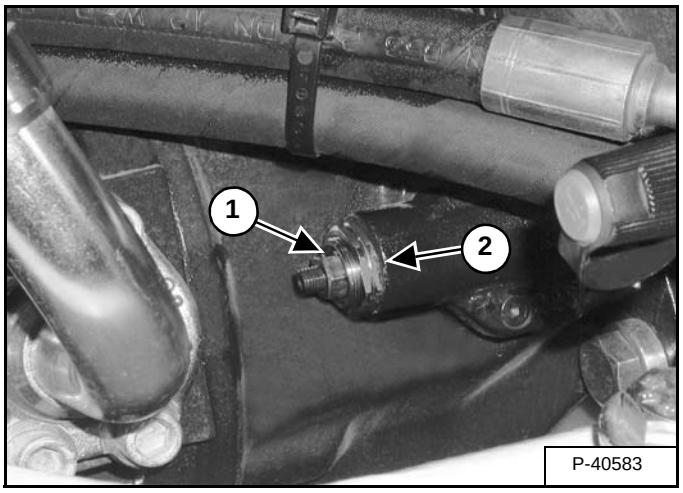
The gauge (Item 1) **[Figure 20-50-29]** should show 37 GPM (140 L/min) which is *flow at low pressure*.

Figure 20-50-30



Remove the dust cover (Item 1) **[Figure 20-50-30]**.

Figure 20-50-31



Check the 13 mm nut (Item 1) **[Figure 20-50-31]** to be sure it is locked in place.

Adjust the flow at the hydraulic pump torque limiter by loosening the 27 mm nut (Item 2) **[Figure 20-50-31]** With an Allen wrench adjust the *flow at low pressure*.

When the proper flow is obtained, 37 GPM (140 L/min) at 1450 PSI (100 bar), lock the 27 mm nut (Item 2) **[Figure 20-50-31]**.

NOTE: Changing the flow at low pressure (27 mm nut) will affect flow at high pressure (13 mm nut).

Turn the hydraulic tester flow control (Item 2) clockwise until the gauge (Item 3) **[Figure 20-50-29]** reads 3480 PSI (240 bar).

NOTE: Do not exceed 4350 PSI (300 bar) with the hydraulic tester or the pump will be damaged.

The gauge should show 13 GPM (50 L/min) which is *flow at high pressure.*

Adjust the flow at the hydraulic pump torque limiter. Loosen the 13 mm nut (Item 1) **[Figure 20-50-31]** and with an Allen wrench adjust the *flow at high pressure*.

When the proper flow is obtained, 13 GPM (50 L/min) at 3480 PSI (240 bar), lock the 13 mm nut (Item 1) **[Figure 20-50-31]**.

NOTE: If adjustments were made to *flow at high pressure* **verify the** *flow at low pressure***.**

Install the protective cap on the hydraulic pump torque limiter.

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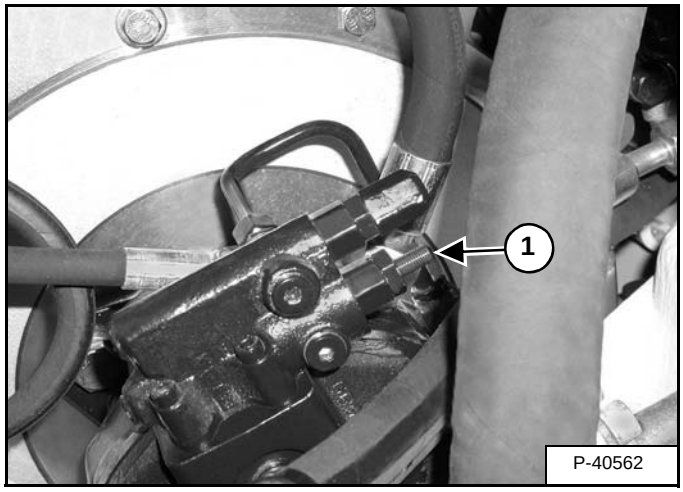
Pump Testing (Cont'd)

Remove the hydraulic tester, fittings and hydraulic reservoir cover.

Install the original reservoir cover.

Install the supply hose on the hydraulic control valve.

Figure 20-50-32



Adjust the pump margin spool (Item 1) **[Figure 20-50-32]** back to the original position (approximately 6 turns out).

Retest and adjust the pump margin spool as needed. See "Pump Margin Pressure Adjustment" on page 7.

ALL PUMP ADJUSTMENTS ARE NOW COMPLETED

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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.

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Open the rear cover. (See Opening And Closing The Rear Cover on Page 10-40-1.)

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

Figure 20-50-33

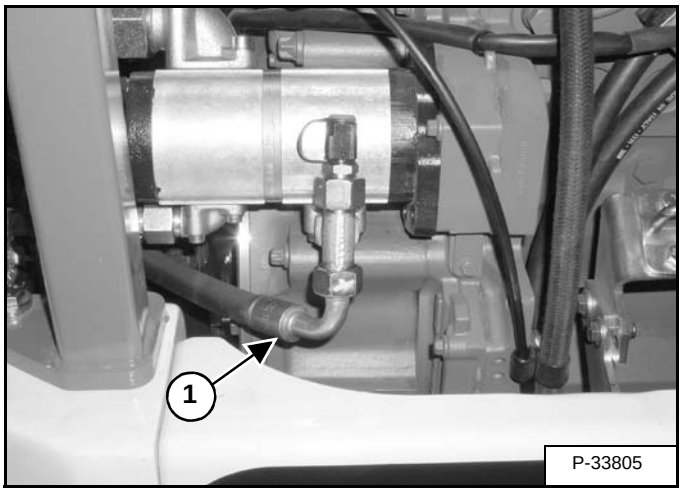
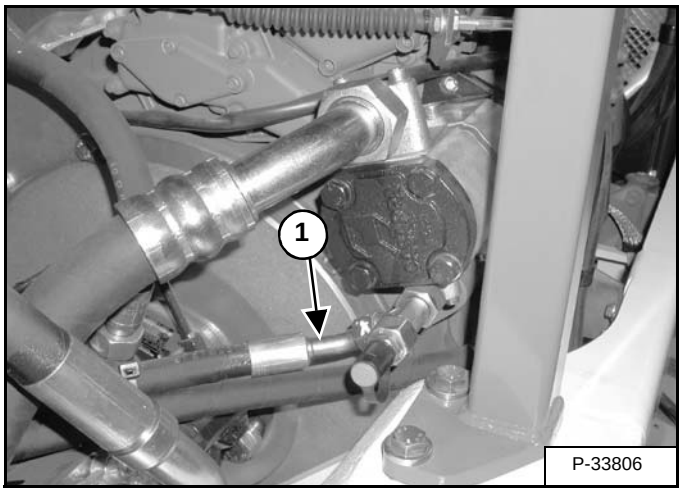
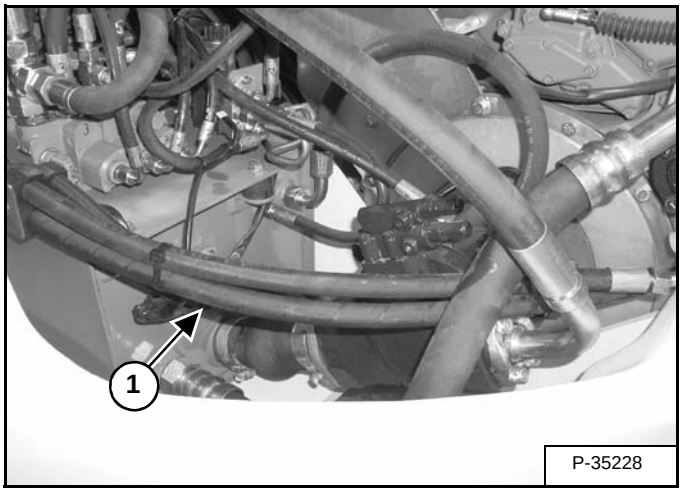


Figure 20-50-34



Remove the hoses (Item 1) **[Figure 20-50-33]** & **[Figure 20-50-34]** from the gear pump.

Figure 20-50-35



Reposition the hoses (Item 1) **[Figure 20-50-35]** to gain access to the piston pump.

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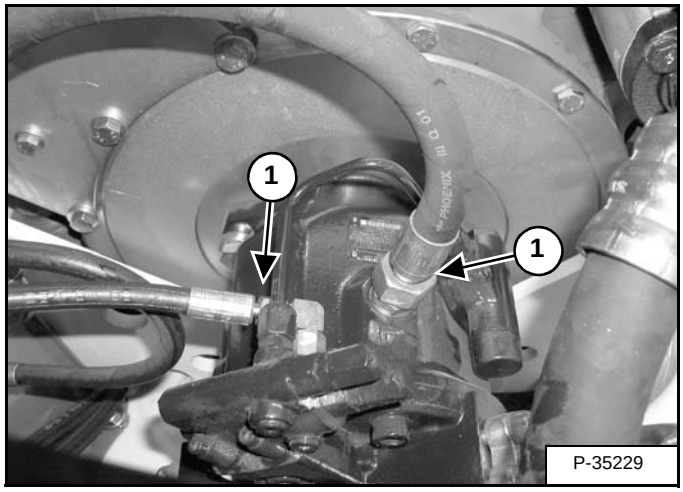
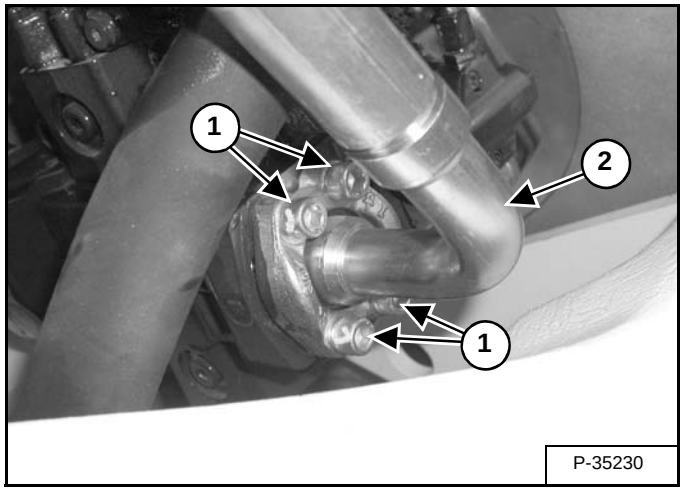
Removal And Installation (Cont'd)

Figure 20-50-36



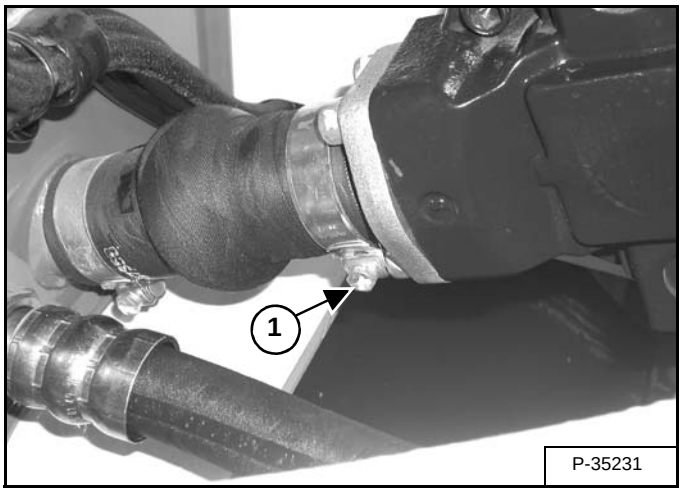
Remove the hoses (Item 1) **[Figure 20-50-36]** from the pump.

Figure 20-50-37



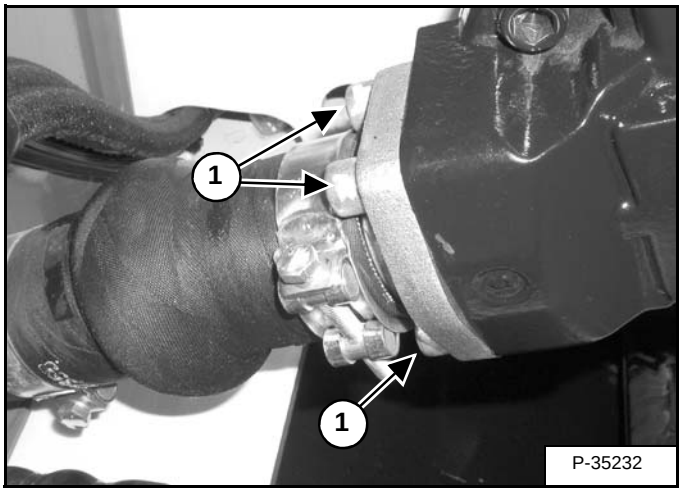
Remove the 4 bolts (Item 1) and remove the hose (Item 2) **[Figure 20-50-37]**.

Figure 20-50-38



Loosen the clamp (Item 1) **[Figure 20-50-38]**. Rotate the clamp to provide clearance to the suction fitting bolts.

Figure 20-50-39



Remove the 4 bolts (Item 1) **[Figure 20-50-39]**.

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Removal And Installation (Cont'd)

Figure 20-50-40

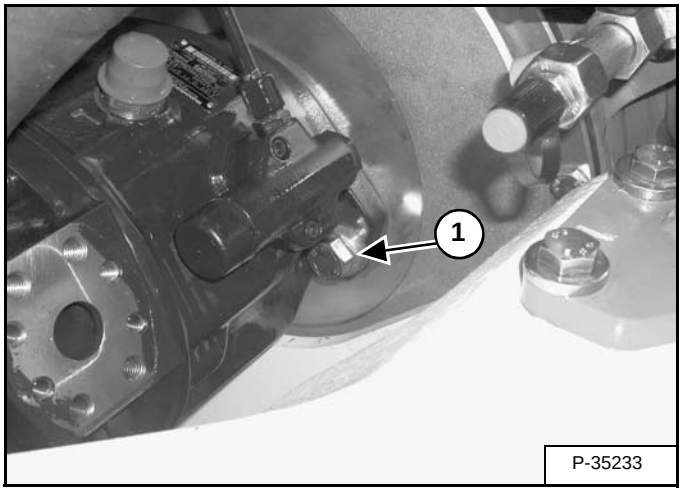
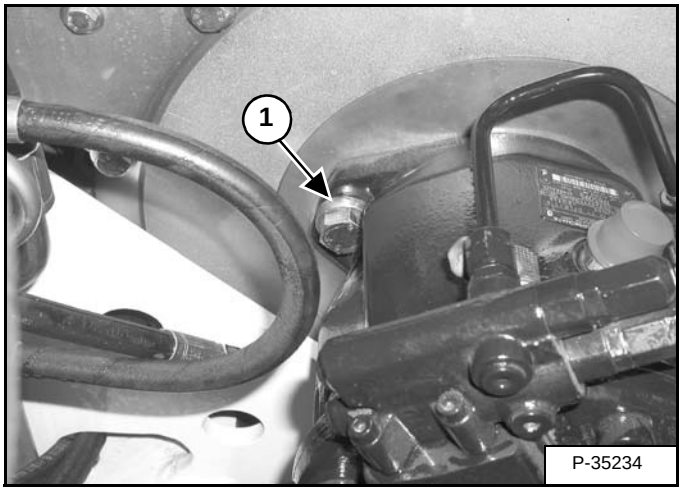


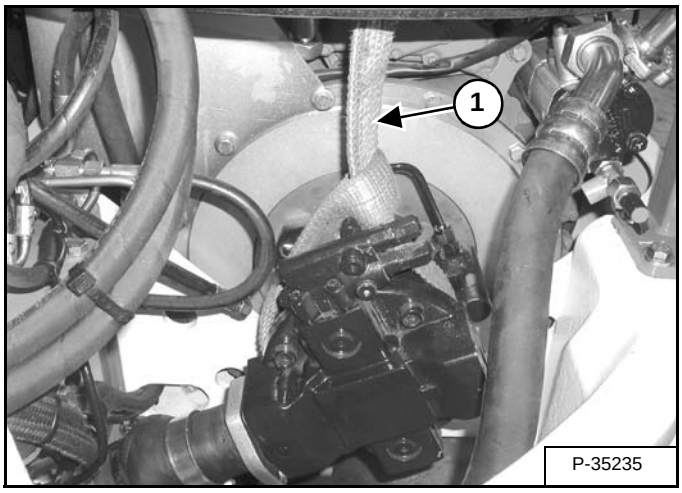
Figure 20-50-41



Remove the bolts (Item 1) **[Figure 20-50-40]** & **[Figure 20-50-41]** and washers.

Installation: Tighten the bolts to 125-140 ft.-lb. (170-190 N•m) torque.

Figure 20-50-42



Install a sling (Item 1) **[Figure 20-50-42]** on the pump.

Separate the pump from the engine and remove the pump.

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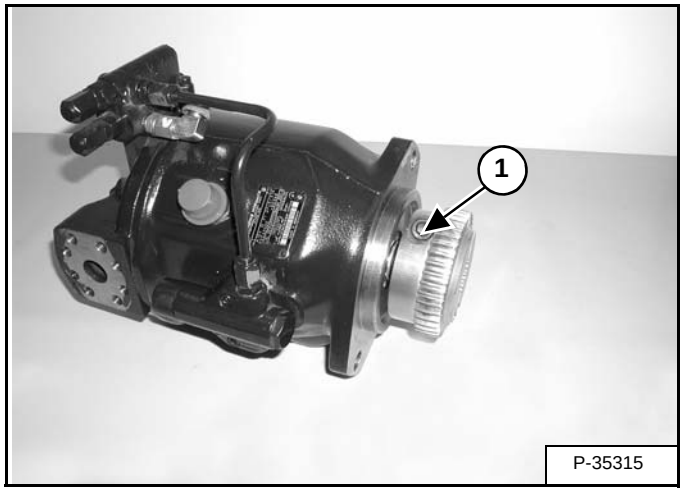
Coupler Removal And Installation

Figure 20-50-43



Remove the bolt (Item 1) **[Figure 20-50-43]** from the coupler. Slide the coupler off the pump shaft.

Installation: Tighten the bolt to 63 ft.-lb. (86 N•m) torque.

Figure 20-50-44

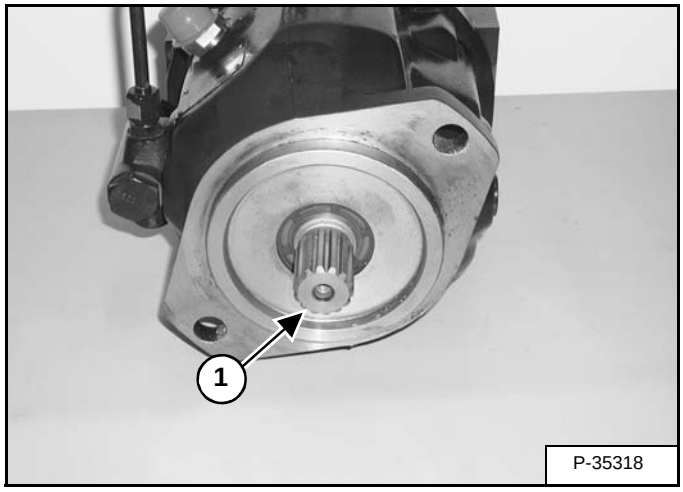
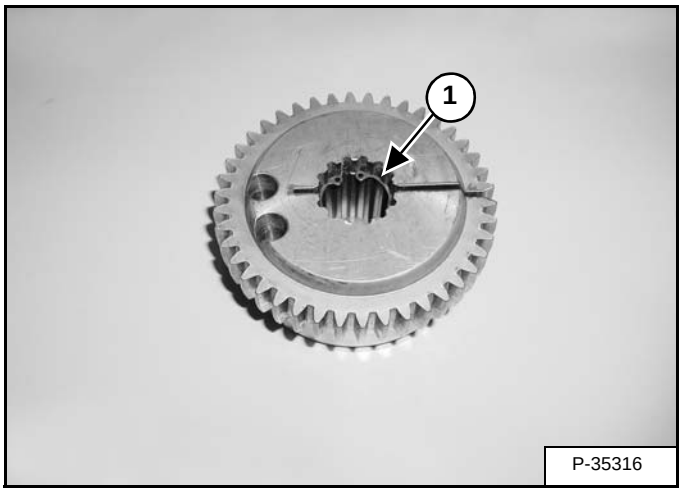


Figure 20-50-45



Installation: Slide the coupler on the pump shaft (Item 1) **[Figure 20-50-44]** until the coupler snap ring (Item 1) **[Figure 20-50-45]** is tight against the shaft.

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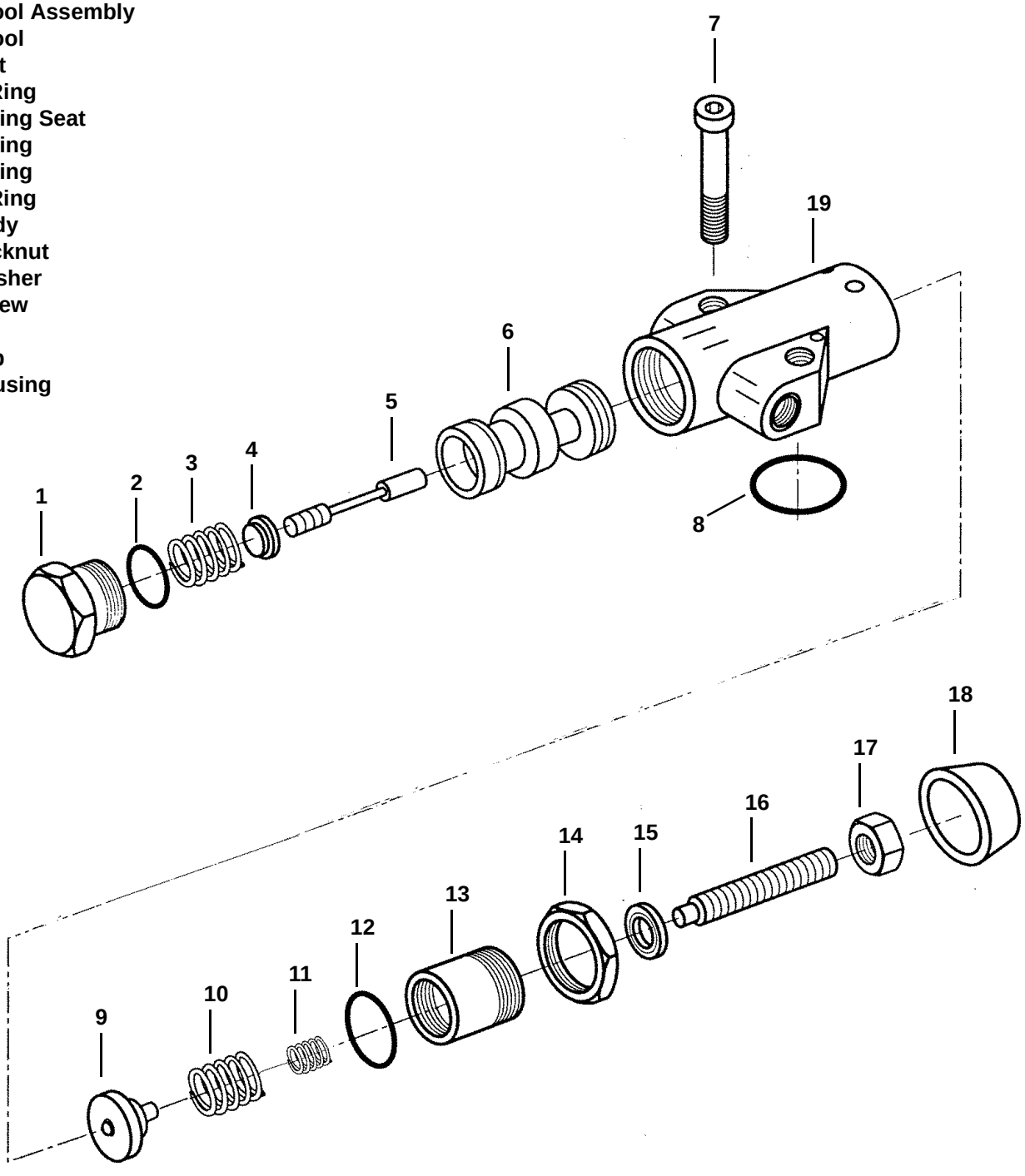
Torque Limiter Valve Parts Identification

1. Plug
2. O-Ring
3. Spring
4. Spring Seat
5. Spool Assembly
6. Spool
7. Bolt
8. O-Ring
9. Spring Seat
10. Spring
11. Spring
12. O-Ring
13. Body
14. Locknut
15. Washer
16. Screw
17. Nut
18. Cap
19. Housing



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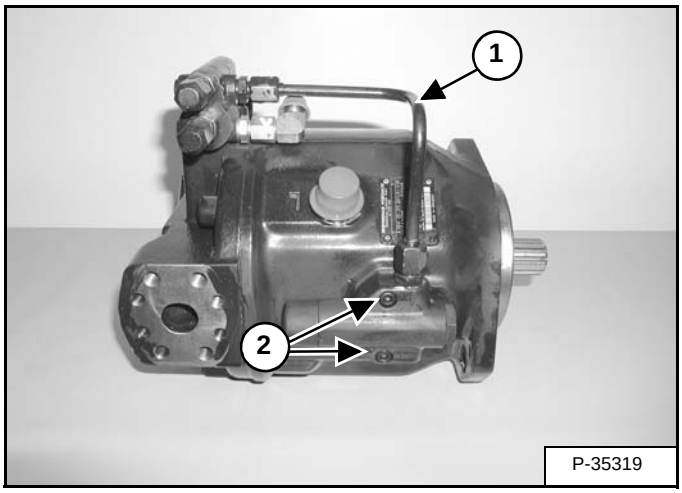
Torque Limiter Valve Removal and Installation

Clean the outside of the pump with clean solvent and dry with compressed air before removing any components from the pump.

Figure 20-50-46



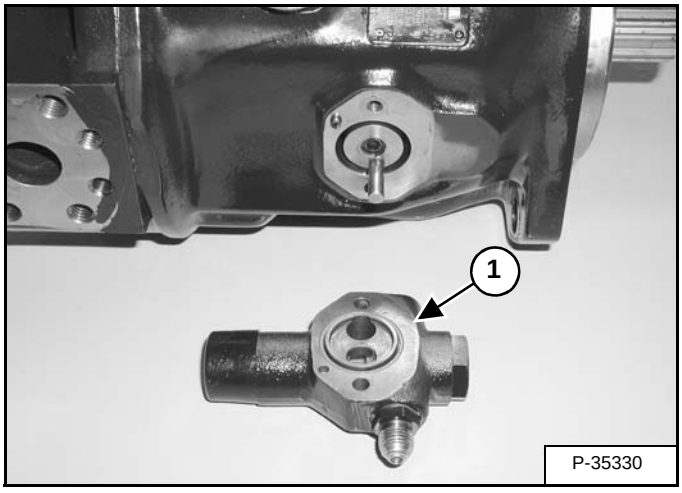
Remove the tubeline (Item 1) **[Figure 20-50-46]** from the pump control and torque limiter vale.

NOTE: Mark the tubeline for correct installation.

Loosen and remove the two mount bolts (Item 2) **[Figure 20-50-46]** from the torque limiter valve.

Installation: Tighten the mount bolts to 7.0-7.5 ft.-lb. (9,5-10,5 N•m) torque.

Figure 20-50-47



Remove the torque limiter (Item 1) **[Figure 20-50-47]** from the pump.

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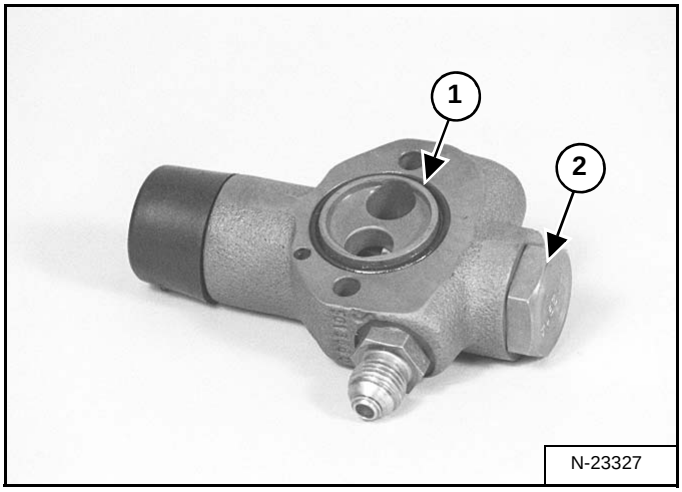
Torque Limiter Valve Disassembly

Figure 20-50-48



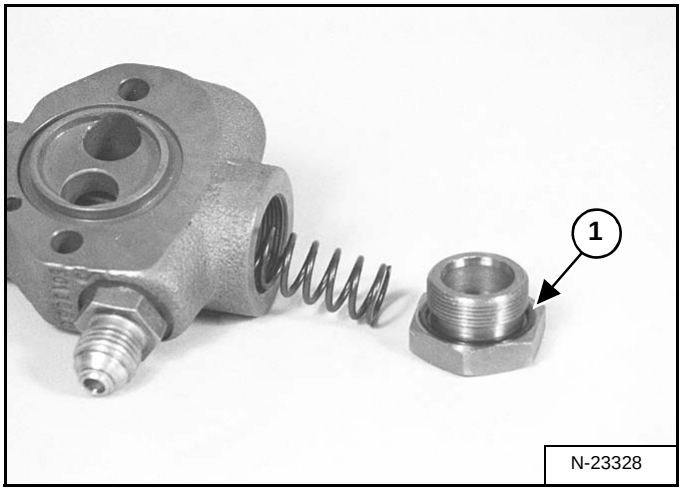
Remove the O-ring (Item 1) **[Figure 20-50-48]** from the torque limiter valve.

NOTE: Do not scratch or damage the mounting surface on the valve body.

Remove the plug (Item 2) **[Figure 20-50-48]**.

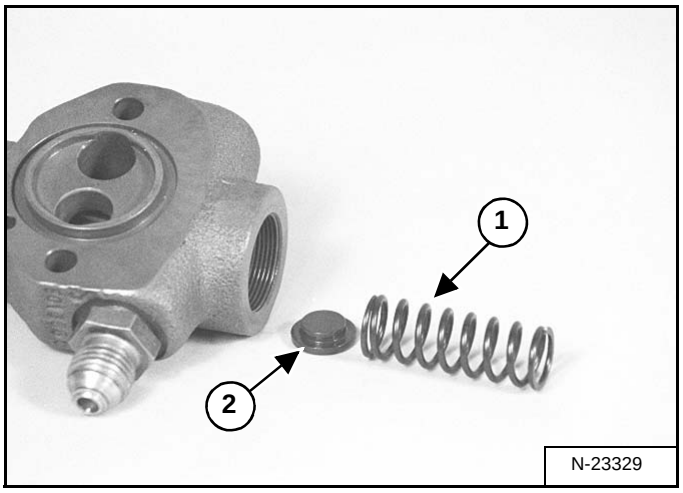
NOTE: The plug (Item 2) [Figure 20-50-48] is under spring pressure.

Figure 20-50-49



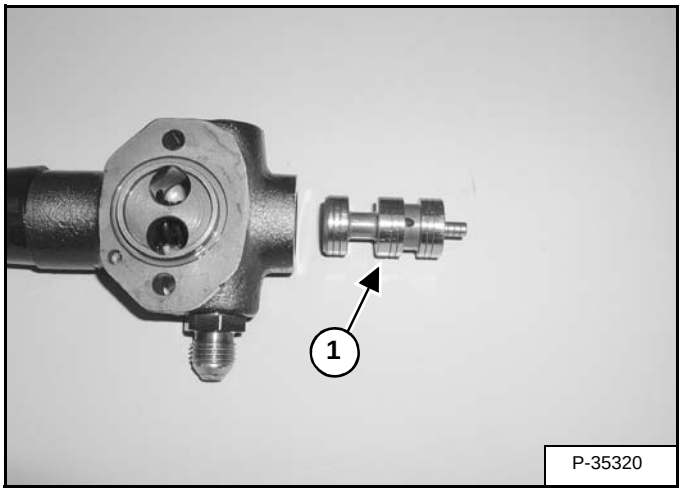
Remove the O-ring (Item 1) **[Figure 20-50-49]**.

Figure 20-50-50



Remove the spring (Item 1) and spring seat (Item 2) **[Figure 20-50-50]**.

Figure 20-50-51



Remove the control spool assembly (Item 1) **[Figure 20-50-51]**.

NOTE: Use care not to scratch or damage the spool. Scratches in the spool can cause internal leakage.

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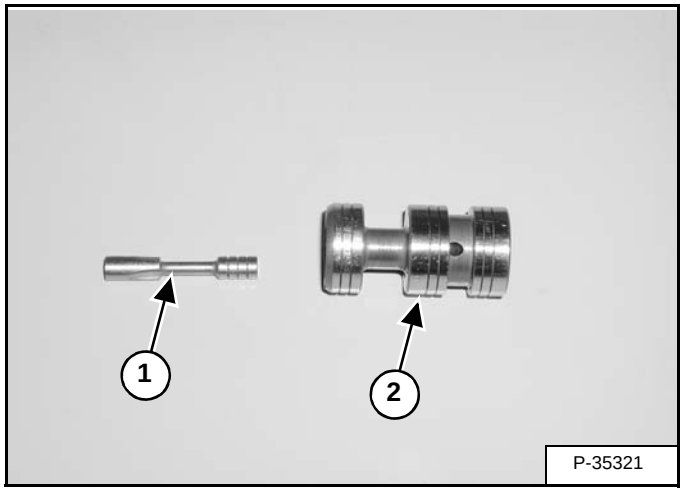
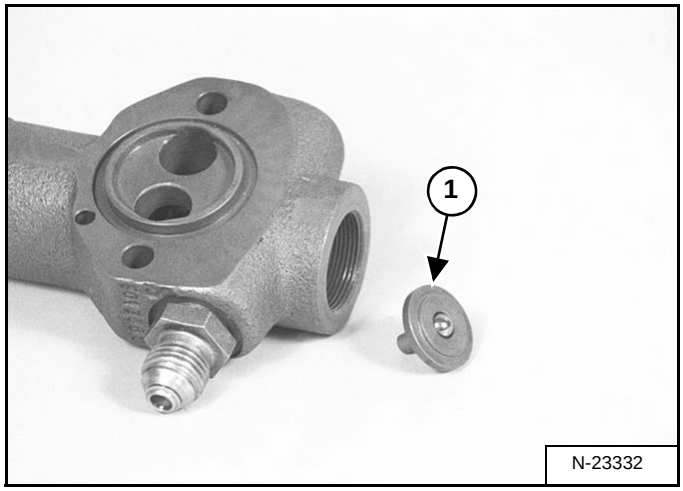
Torque Limiter Valve Disassembly (Cont'd)

Figure 20-50-52



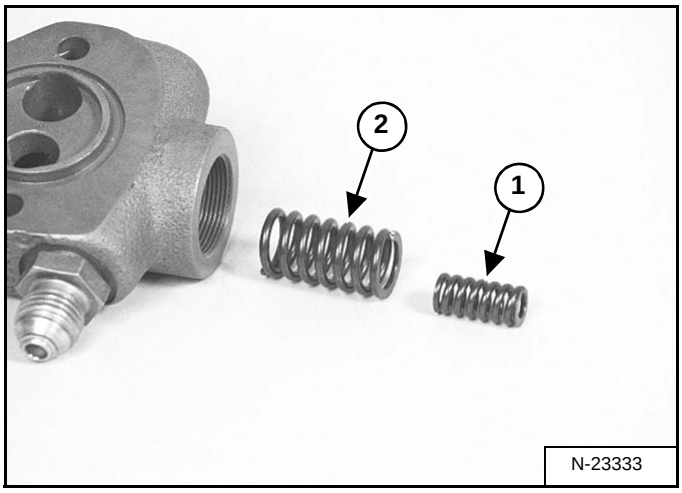
Remove the metering spool (Item 1) from the control spool (Item 2) **[Figure 20-50-52]**.

Figure 20-50-53



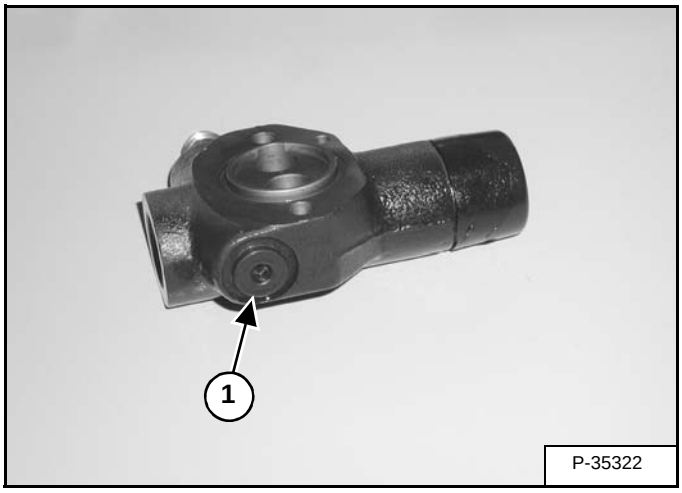
Remove the spring retainer (Item 1) **[Figure 20-50-53]** from the torque limiter valve.

Figure 20-50-54



Remove the two springs (Items 1 & 2) **[Figure 20-50-54]**.

Figure 20-50-55



Remove the plug (Item 1) **[Figure 20-50-55]**.

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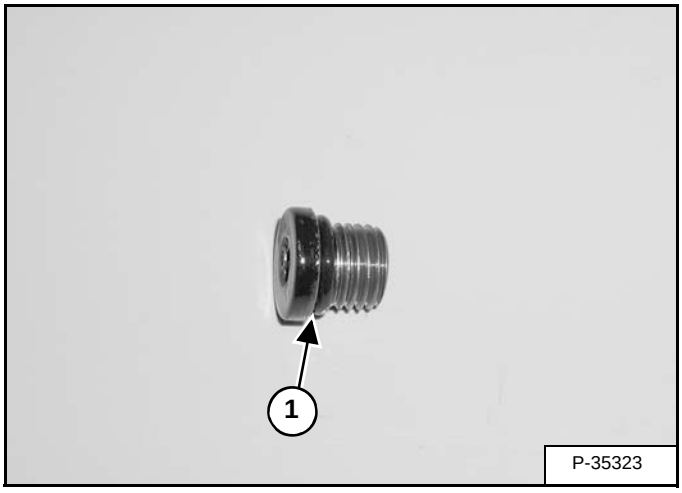
Torque Limiter Valve Disassembly (Cont'd)

Figure 20-50-56

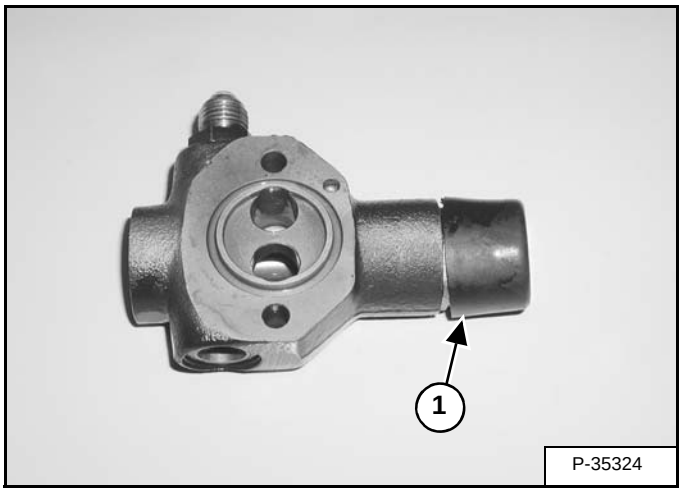


Remove the O-ring (Item 1) **[Figure 20-50-56]**.

The following procedures are only used if the adjustment assembly is removed.

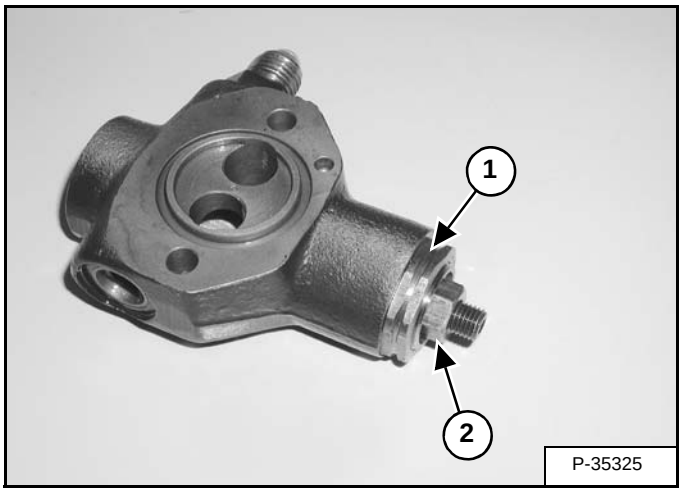
NOTE: If the adjustment assembly is removed and/or disassembled, the torque limiter must be tested and adjusted after the pump assembly is installed in the machine. See "Initial Torque Limiter Valve Setting" on page 29. for torque limiter adjustment)

Figure 20-50-57



Remove the dust cap (Item 1) **[Figure 20-50-57]**.

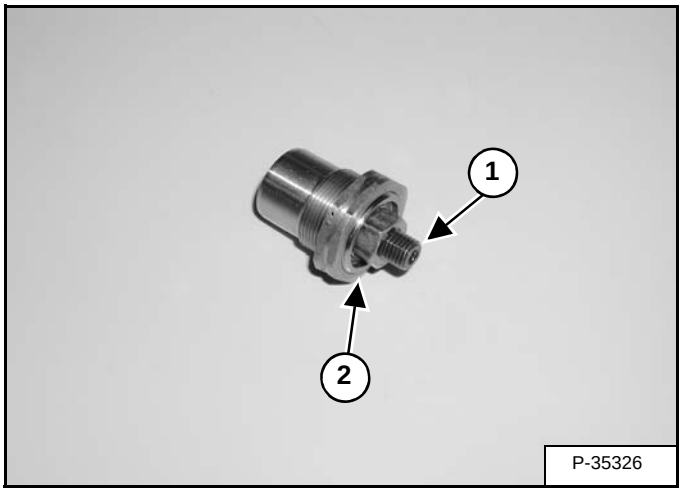
Figure 20-50-58



Loosen the large nut (Item 1) **[Figure 20-50-58]**.

Turn the small nut (Item 2) **[Figure 20-50-58]** to remove the adjustment body.

Figure 20-50-59



With an Allen wrench hold the adjustment bolt (Item 1) and loosen the nut (Item 2) **[Figure 20-50-59]**.

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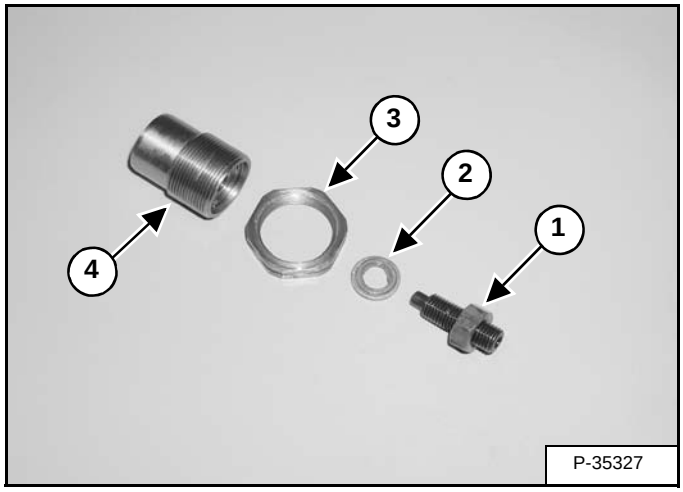
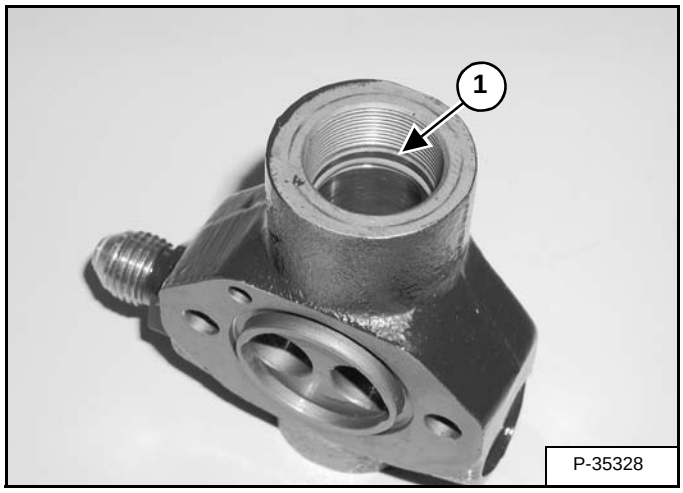
Torque Limiter Valve Disassembly (Cont'd)

Figure 20-50-60



Remove the adjustment screw (Item 1), O-ring washer (Item 2) and large nut (Item 3) from the adjustment body (Item 4) **[Figure 20-50-60]**.

Figure 20-50-61



Remove the O-ring (Item 1) **[Figure 20-50-61]** from the torque limiter valve body.

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Torque Limiter Valve Assembly

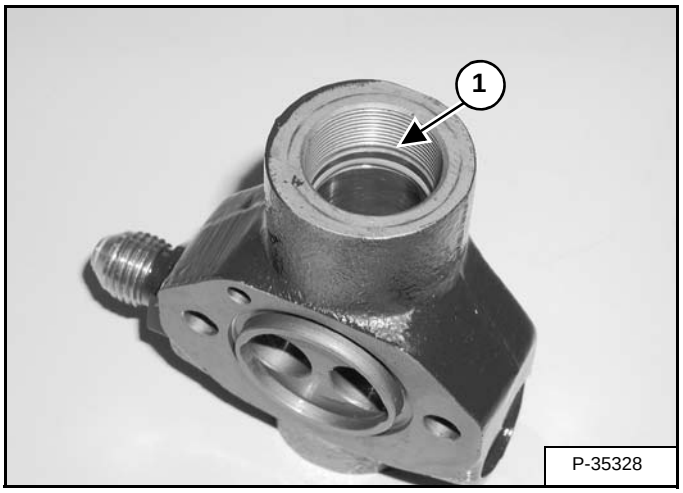
Clean all the parts in solvent and dry with compressed air.

Inspect seats and spools for wear.

Apply clean oil to new O-rings and spools.

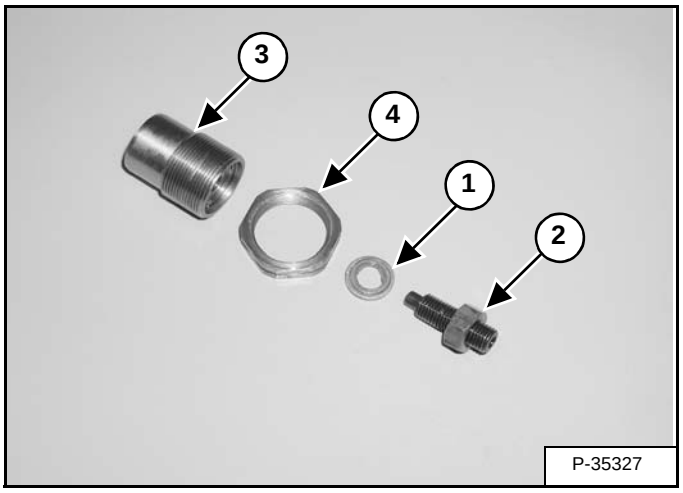
The following procedures are only used if the adjustment assembly is removed.

Figure 20-50-62



Install the O-ring (Item 1) **[Figure 20-50-62]** in the torque motor valve body.

Figure 20-50-63

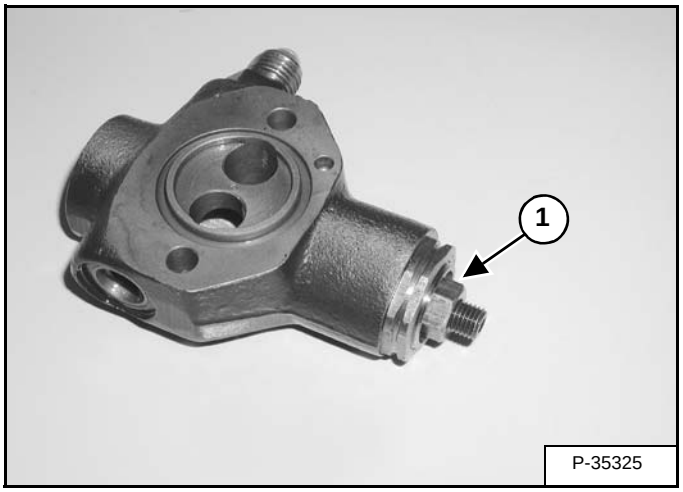


Install the O-ring washer (Item 1) on the adjustment screw (Item 2) **[Figure 20-50-63]**.

Install the adjustment screw (Item 2) in the adjustment body (Item 3) **[Figure 20-50-63]**.

Install the nut (Item 4) **[Figure 20-50-63]** on the adjustment body.

Figure 20-50-64



Install the adjustment screw/adjustment body (Item 1) **[Figure 20-50-64]** assembly into the valve body.

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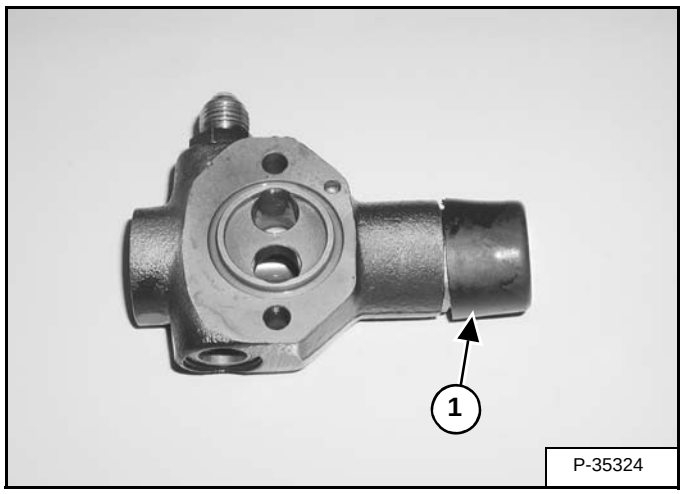
HYDRAULIC PISTON PUMP (S/N 522311001 & ABOVE) (CONT'D)

Torque Limiter Valve Assembly (Cont'd)

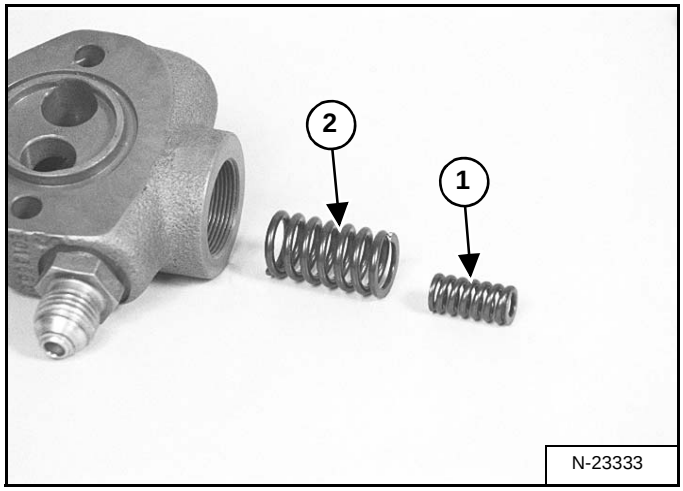
Figure 20-50-65



Install the dust cap (Item 1) **[Figure 20-50-65]**.

NOTE: After the pump assembly is installed in the machine, the torque motor must be tested and adjusted. See "Initial Torque Limiter Valve Setting" on page 29. for torque limiter adjustment)

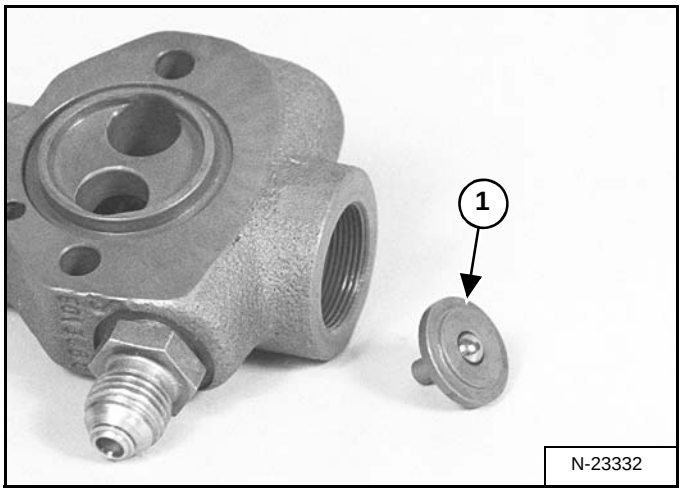
Figure 20-50-66



Install the two springs (Items 1 & 2) **[Figure 20-50-66]** in the valve body.

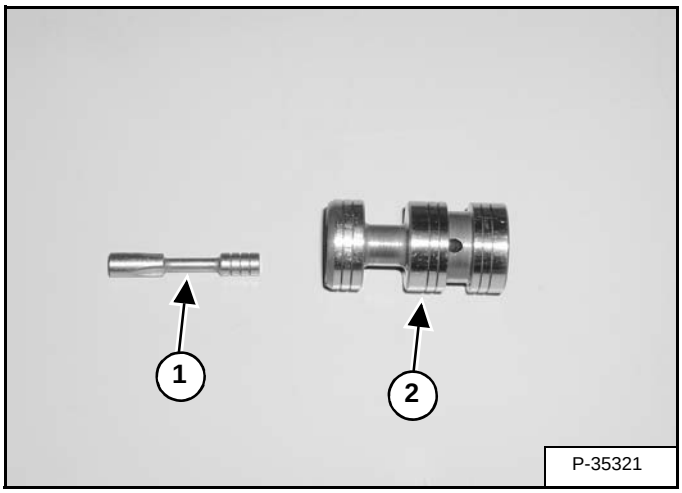
NOTE: Install the big spring first and the small spring second.

Figure 20-50-67



Install the spring seat (Item 1) **[Figure 20-50-67]** in the valve body with the ball side facing toward the control spool.

Figure 20-50-68



Put oil on the metering spool (Item 1) and install in the control spool (Item 2) **[Figure 20-50-68]**.

NOTE: The end of the metering spool with the three rings enters the control spool first.

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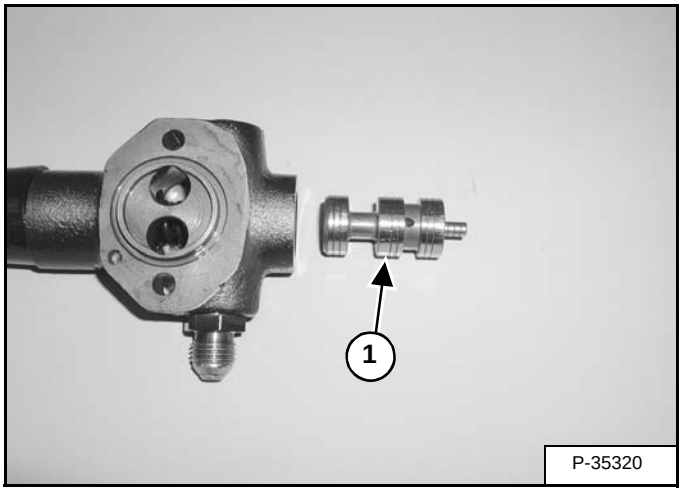
Torque Limiter Valve Assembly (Cont'd)

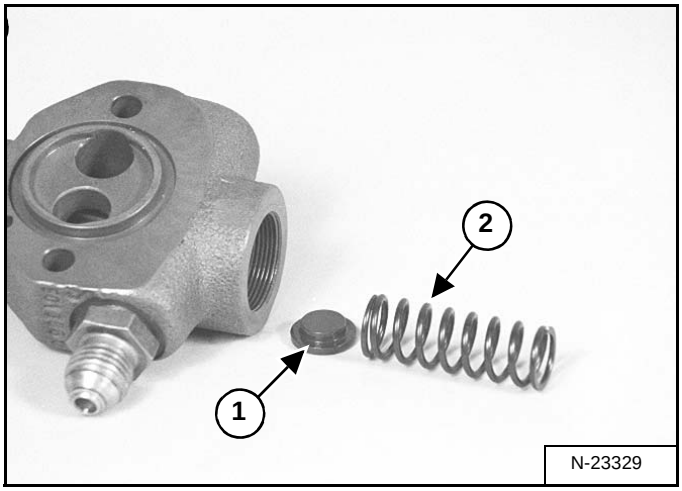
Figure 20-50-69



Install the control spool assembly (Item 1) **[Figure 20-50-69]** in the valve body.

NOTE: Use care not to scratch or damage the spool (Item 1) [Figure 20-50-69]. Scratches in the spool can cause internal leakage.

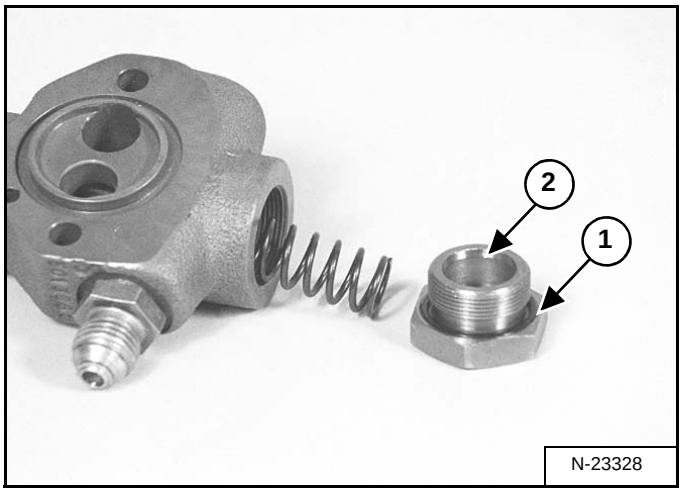
Figure 20-50-70



Install the spring seat (Item 1) **[Figure 20-50-70]** in the valve body, with the smaller diameter end toward the spring.

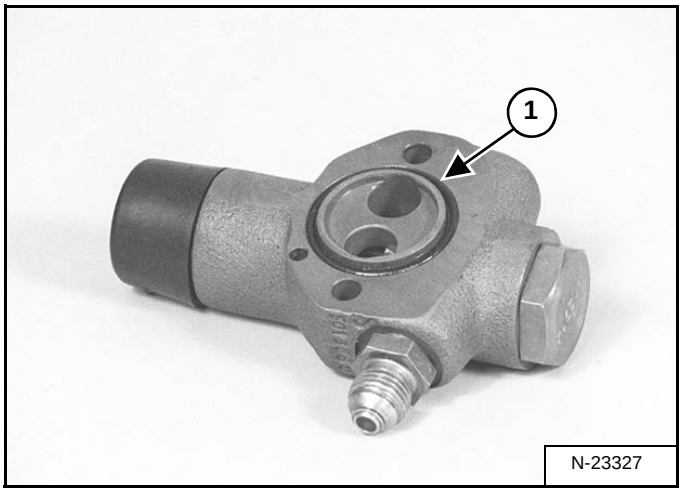
Install the spring (Item 2) **[Figure 20-50-70]** in the valve body.

Figure 20-50-71



Install the O-ring (Item 1) on the plug. Install the plug (Item 2) **[Figure 20-50-71]**.

Figure 20-50-72



Install the O-ring (Item 1) **[Figure 20-50-72]**.

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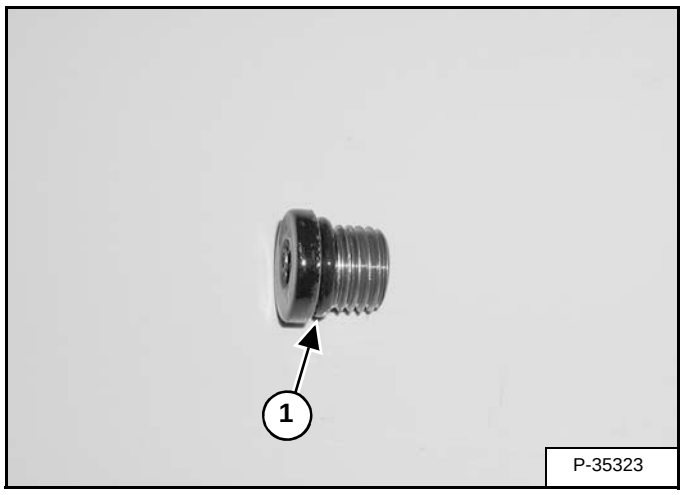
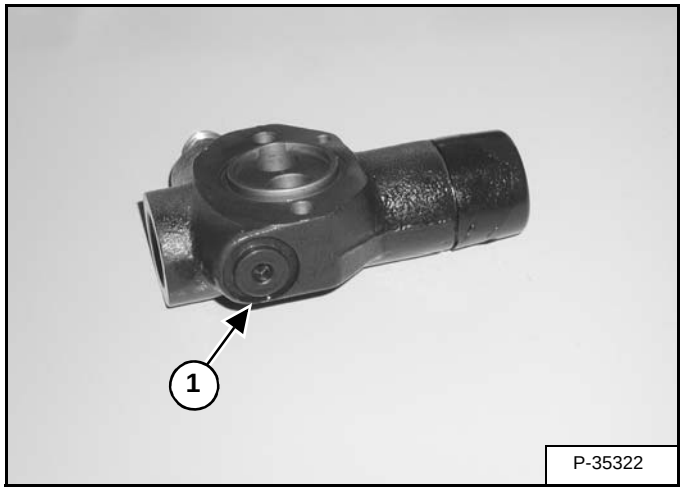
Torque Limiter Valve Assembly (Cont'd)

Figure 20-50-73



Install the O-ring (Item 1) **[Figure 20-50-73]** on the plug.

Figure 20-50-74



Install the plug (Item 1) **[Figure 20-50-74]**.

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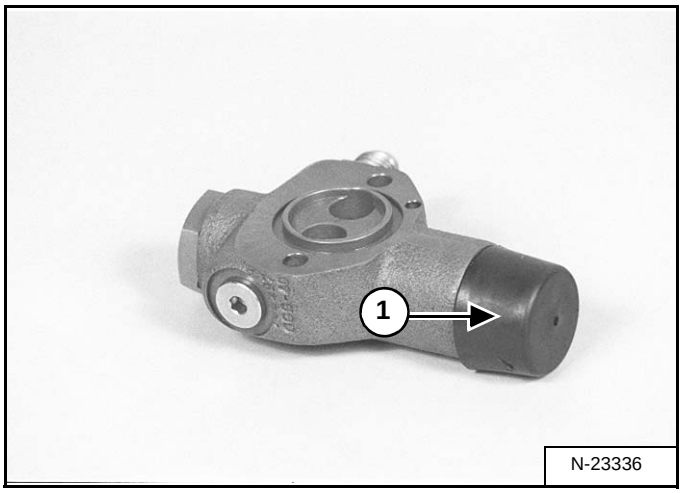
Initial Torque Limiter Valve Setting

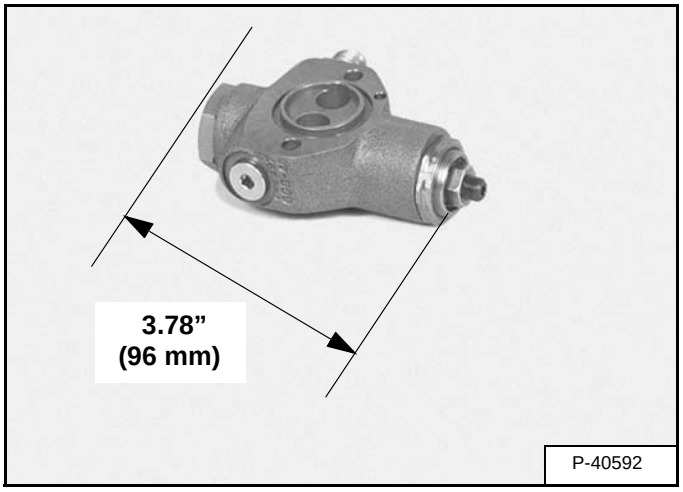
The following procedures are only used if the adjustment assembly is removed.

Figure 20-50-75



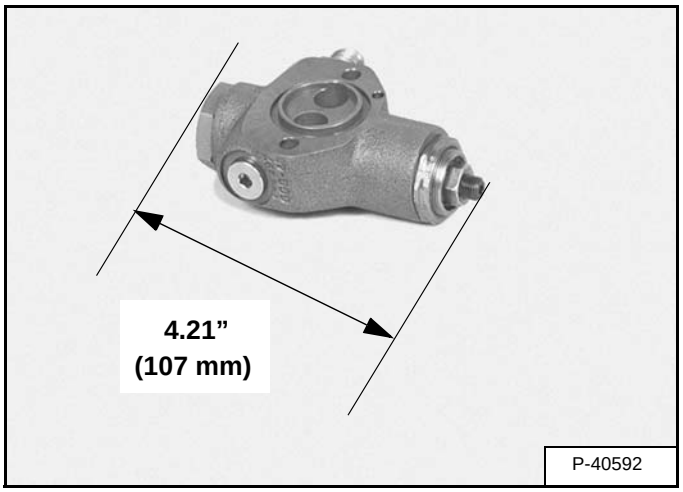
Remove the dust cap (Item 1) **[Figure 20-50-75]**.

Figure 20-50-76



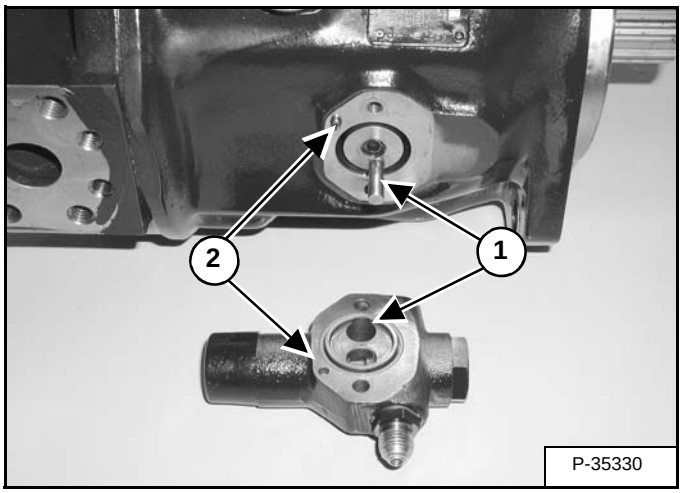
Measure from the cap to the top of the large adjustment screw. Set the large adjustment screw to 3.78 inches (96 mm) **[Figure 20-50-76]**.

Figure 20-50-77



Measure from the cap to the top of the small adjusting screw **[Figure 20-50-77]**. Set the small adjustment screw to 4.21 inches (107 mm).

Figure 20-50-78



Align the linkage pin (Item 1) on the hydraulic piston pump into the hole (Item 1) **[Figure 20-50-78]** in the torque limiter valve.

Turn the valve slightly to align the dowel pin (Item 2) on the hydraulic piston pump into the hole (Item 2) **[Figure 20-50-78]** in the torque limiter valve.

NOTE: Care should be taken not to scratch or damage the valve spool.

NOTE: Before tightening the bolts, make sure the dowel pin is aligned with the housing.

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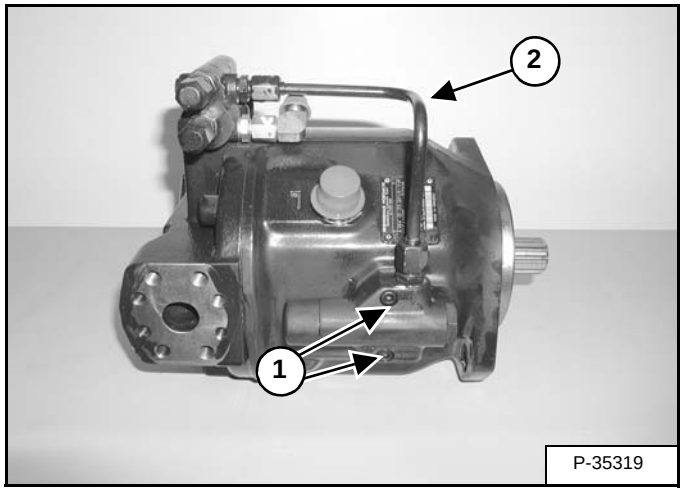
Initial Torque Limiter Valve Setting (Cont'd)

Figure 20-50-79



Tighten the mount bolts (Item 1) **[Figure 20-50-79]** to 7.0-7.5 ft.-lb. (9,5-10,5 N•m) torque.

Install the tubeline (Item 2) **[Figure 20-50-79]** and tighten.

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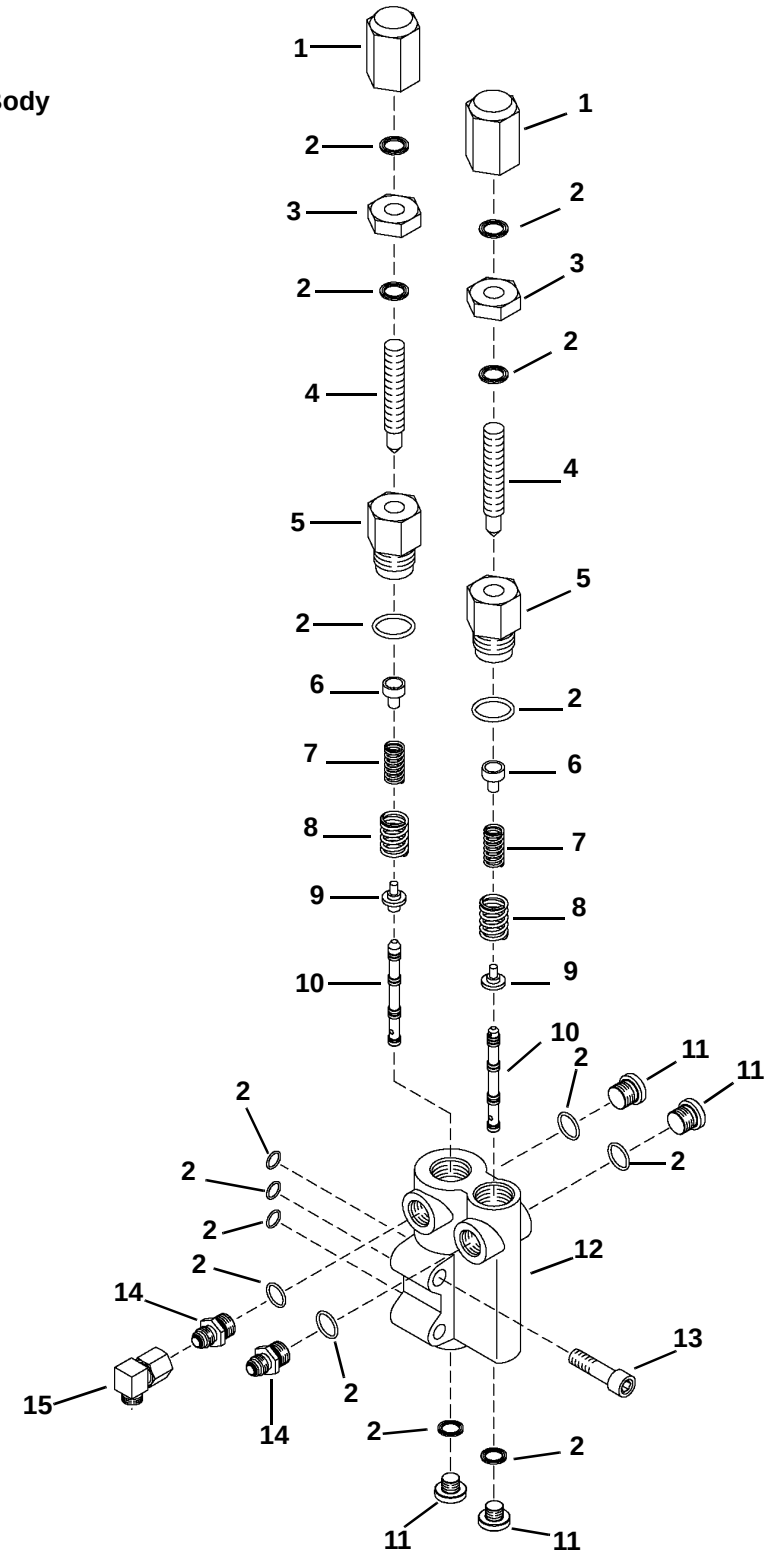
Pump Control Parts Identification

1. Cap
2. O-Ring
3. Nut
4. Adjusting Screw
5. Adjustment Screw Body
6. Spring Seat
7. Spring
8. Spring
9. Spring Seat
10. Spool
11. Plug
12. Valve Body
13. Bolt
14. Fitting
15. Elbow



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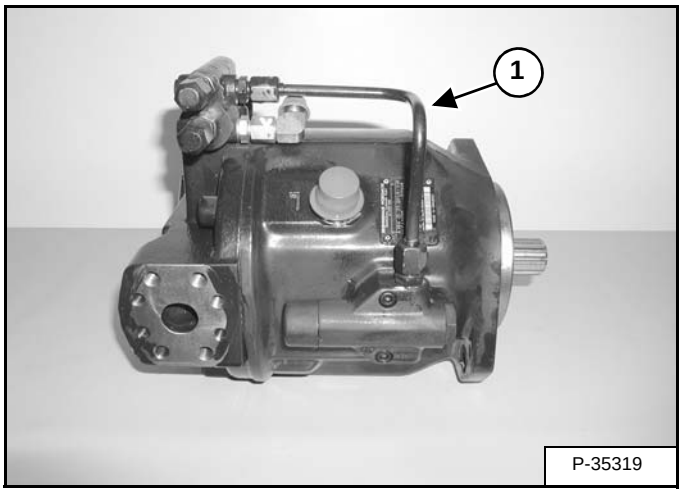
Pump Control Removal And Installation

Clean the outside of the pump with clean solvent and dry with compressed air before removing any components from the pump.

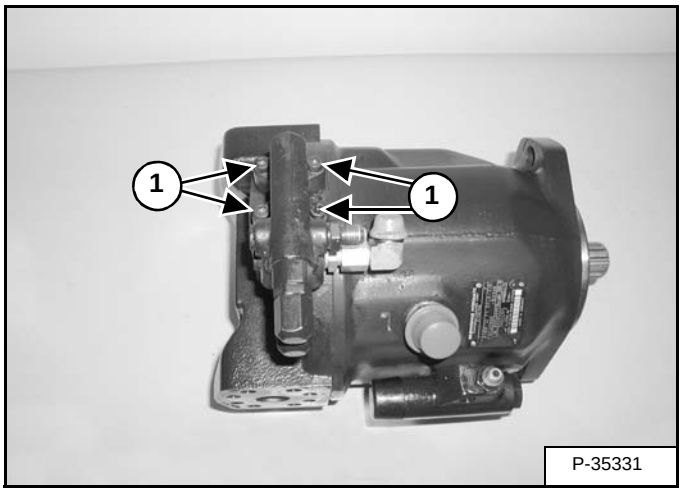
Figure 20-50-80



Mark the tubeline (Item 1) **[Figure 20-50-80]** for correct assembly.

Loosen and remove the tubeline (Item 1) **[Figure 20-50-80]** from the pump control and torque limiter valve.

Figure 20-50-81



Loosen and remove the 4 bolts (Item 1) and remove the pump control (Item 2) **[Figure 20-50-81]** from the hydraulic piston pump.

Installation: Tighten the bolts to 10 ft.-lb. (13 N•m) torque.

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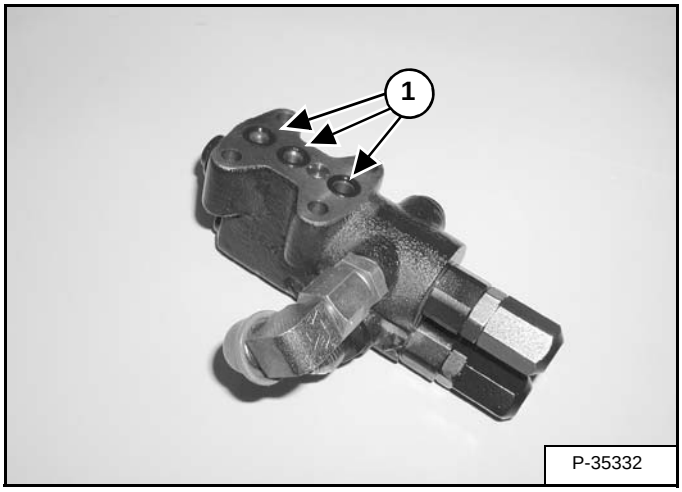
Pump Control Disassembly And Assembly

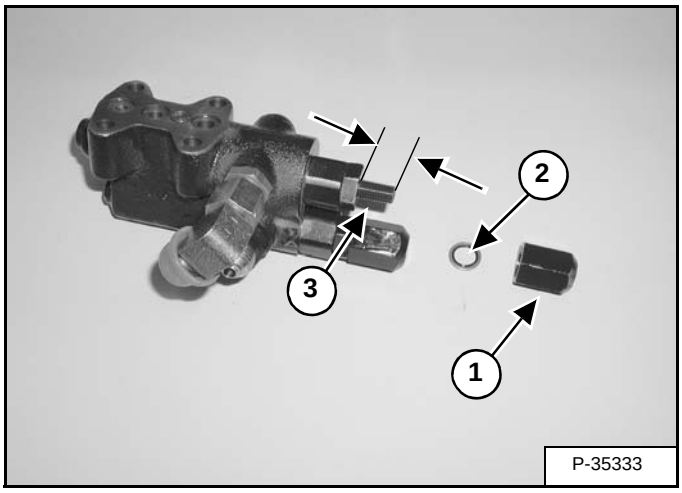
Figure 20-50-82



Remove the three O-rings (Item 1) **[Figure 20-50-82]** from the valve.

Pump Margin Control

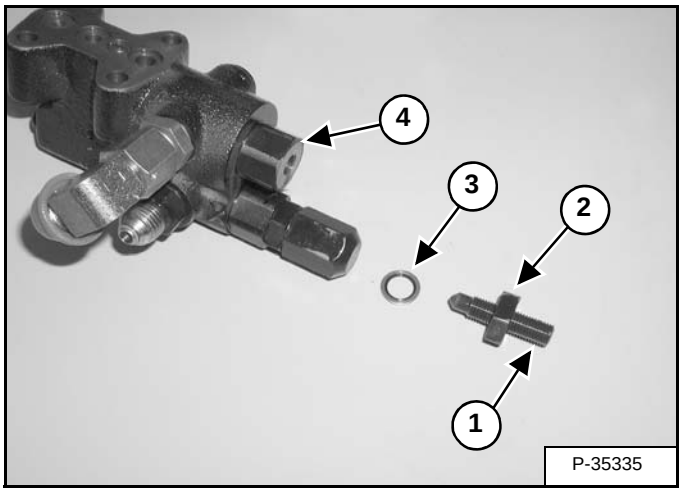
Figure 20-50-83



Before disassembling the pump margin control, remove the cap (Item 1) and O-ring washer (Item 2) **[Figure 20-50-83]** from the adjustment assembly.

Measure the adjustment screw (Item 3) **[Figure 20-50-83]** thread length for the correct initial adjustment.

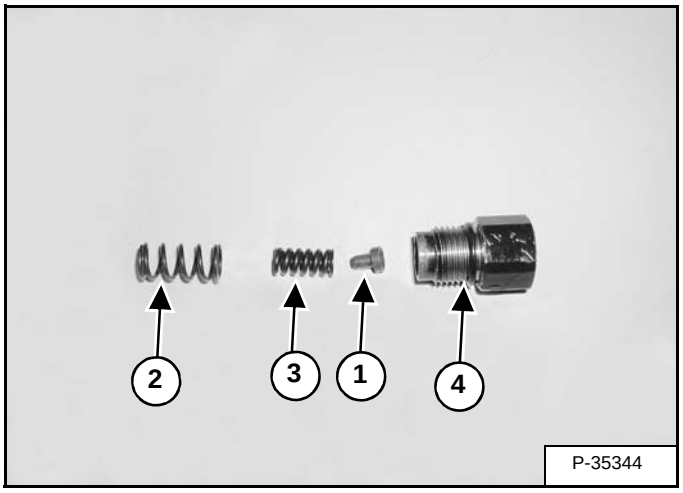
Figure 20-50-84



Remove the adjustment screw (Item 1), nut (Item 2), and O-ring washer (Item 3) from the adjustment assembly (Item 4) **[Figure 20-50-84]**.

Remove the adjustment assembly (Item 4) **[Figure 20-50-84]**.

Figure 20-50-85



Remove the adjustment seat (Item 1), large spring (Item 2), and the small spring (Item 3) **[Figure 20-50-85]** from the adjustment assembly.

Remove the O-ring (Item 4) **[Figure 20-50-85]**.

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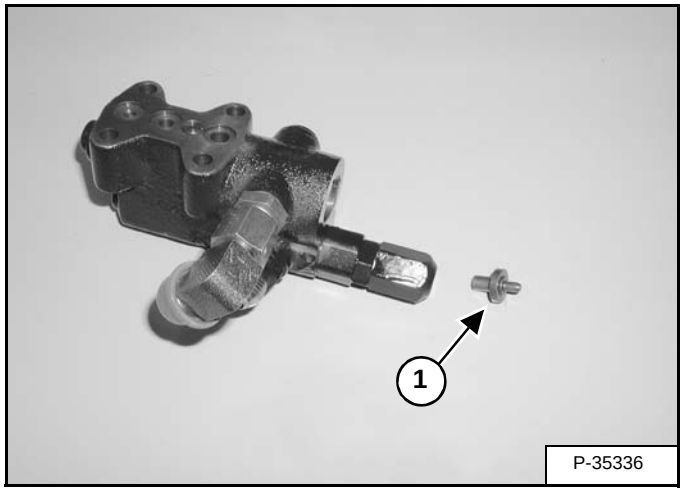
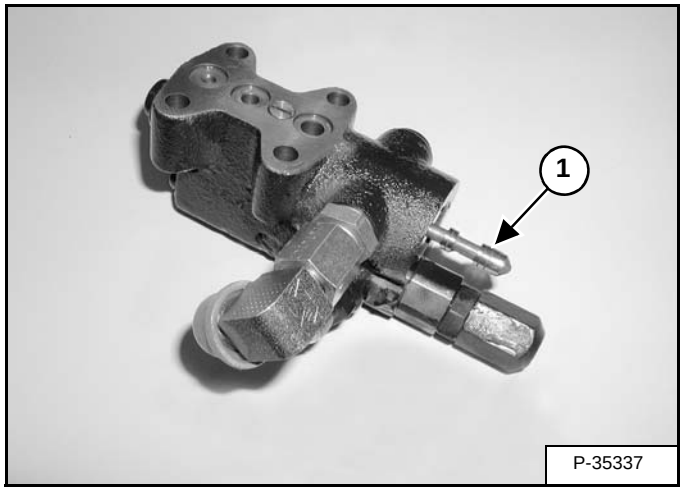
Pump Control Disassembly And Assembly (Cont'd)

Figure 20-50-86



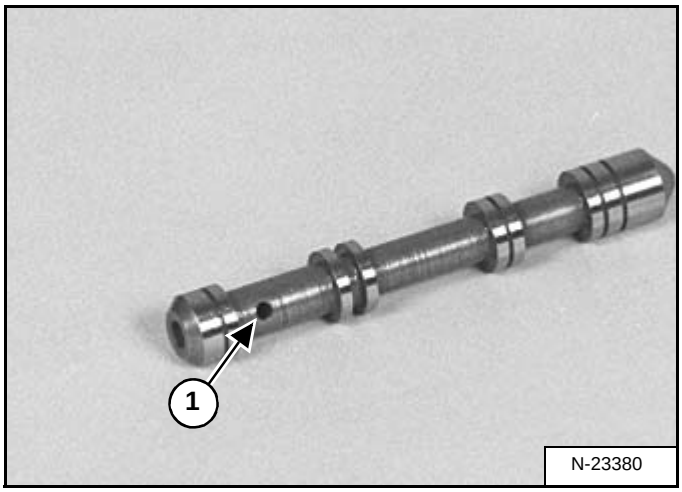
Remove the spring seat (Item 1) **[Figure 20-50-86]**.

Figure 20-50-87



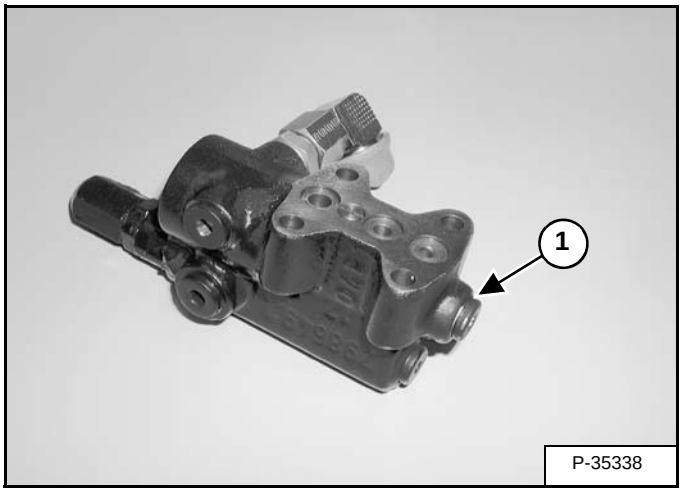
Remove the spool (Item 1) **[Figure 20-50-87]**.

Figure 20-50-88



Check the spool for scratches and be sure the orifice (Item 1) **[Figure 20-50-88]** is not plugged.

Figure 20-50-89



Remove the plug (Item 1) **[Figure 20-50-89]**.

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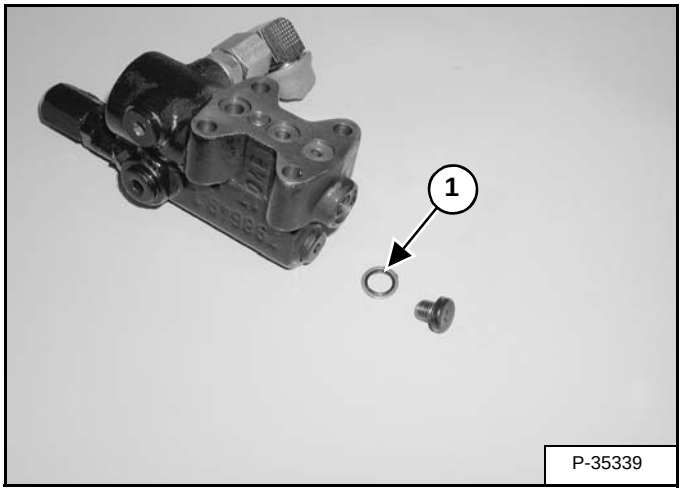
Pump Control Disassembly And Assembly (Cont'd)

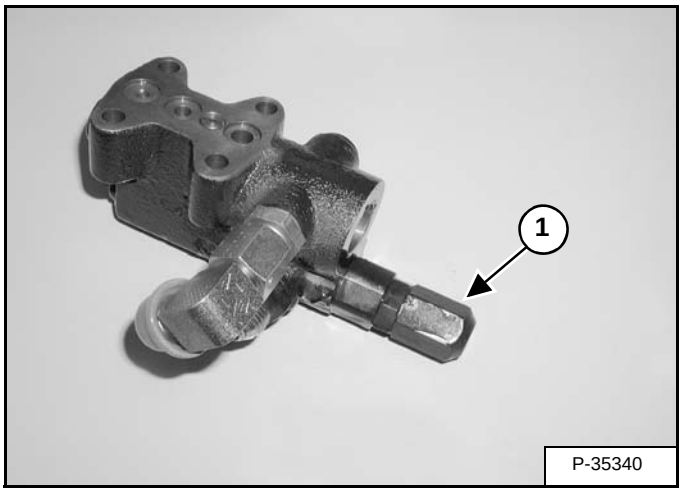
Figure 20-50-90



Remove the O-ring washer (Item 1) **[Figure 20-50-90]**.

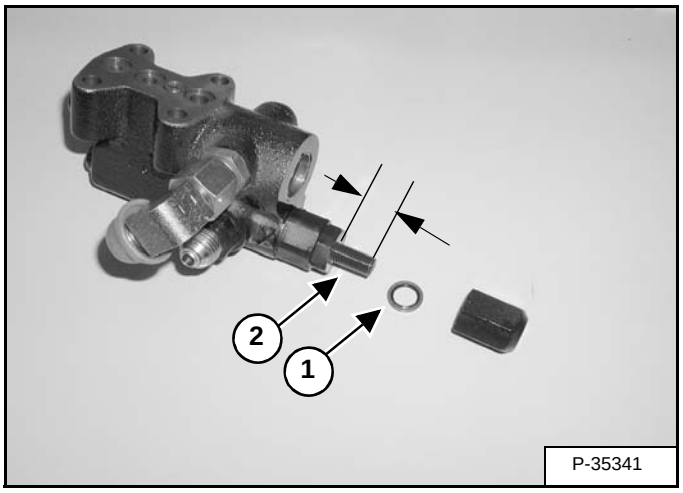
Torque Limiter Supply Control

Figure 20-50-91



Remove the cap (Item 1) **[Figure 20-50-91]** from the torque limiter supply control.

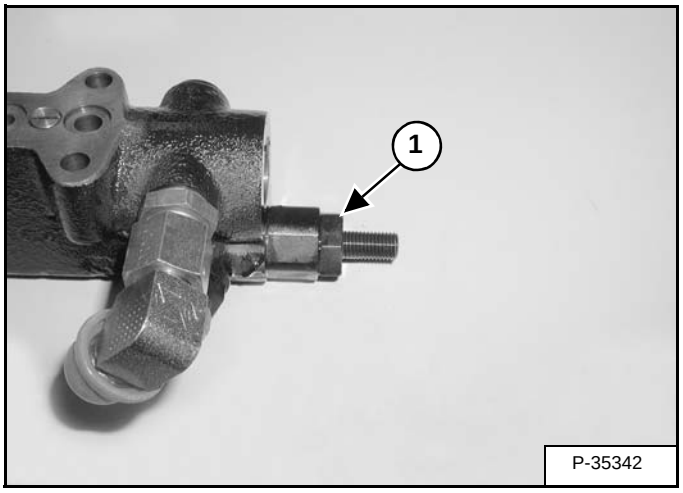
Figure 20-50-92



Before disassembling the torque limiter supply control, remove the O-ring washer (Item 1) **[Figure 20-50-92]** from the adjustment assembly.

Measure the adjustment screw (Item 2) **[Figure 20-50-92]**, thread length for the correct initial adjustment.

Figure 20-50-93



Loosen the nut (Item 1) **[Figure 20-50-93]**.

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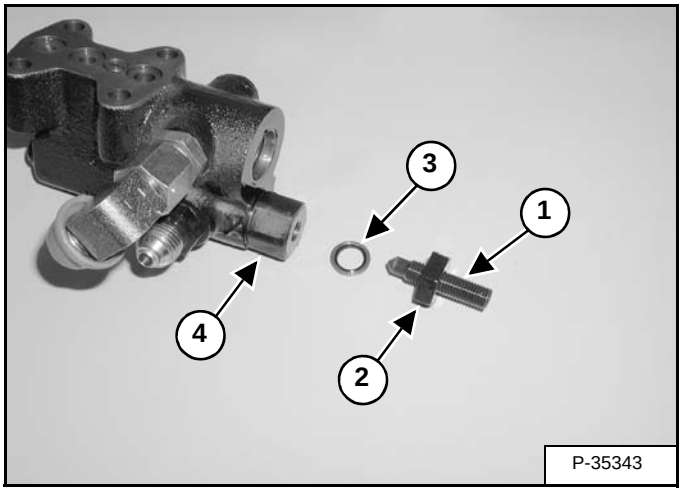
Pump Control Disassembly And Assembly (Cont'd)

Torque Limiter Supply Control (Cont'd)

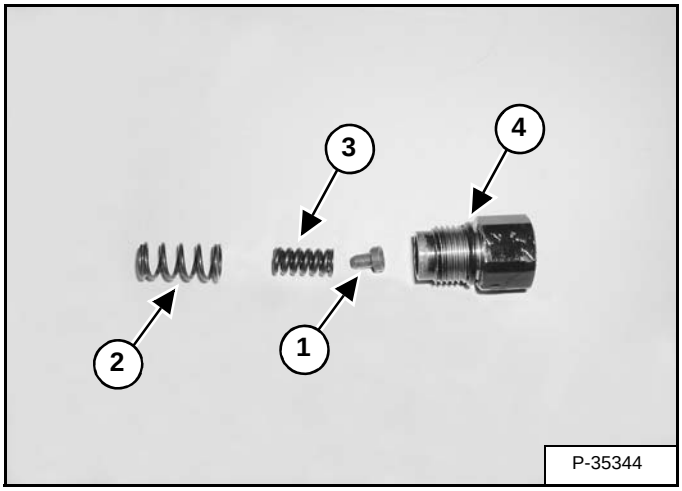
Figure 20-50-94



Remove the adjustment screw (Item 1) nut (Item 2), and O-ring washer (Item 3) from the adjustment assembly (Item 4) **[Figure 20-50-94]**.

Remove the adjustment assembly (Item 4) **[Figure 20-50-94]**.

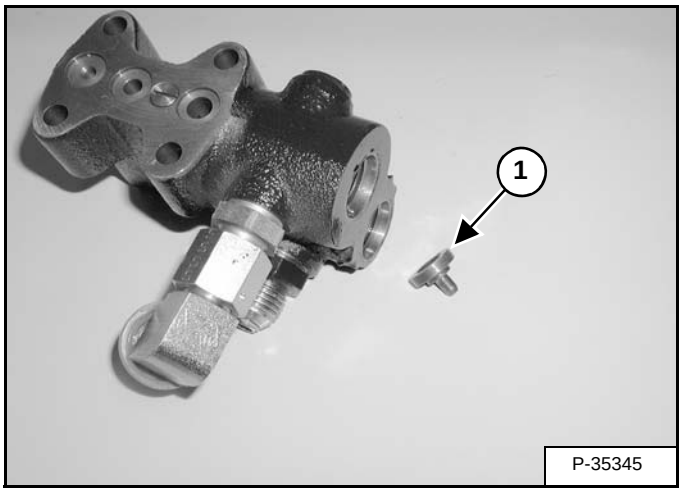
Figure 20-50-95



Remove the adjustment seat (Item 1) large spring (Item 2) **[Figure 20-50-95]** and small spring (Item 3) from the adjustment assembly.

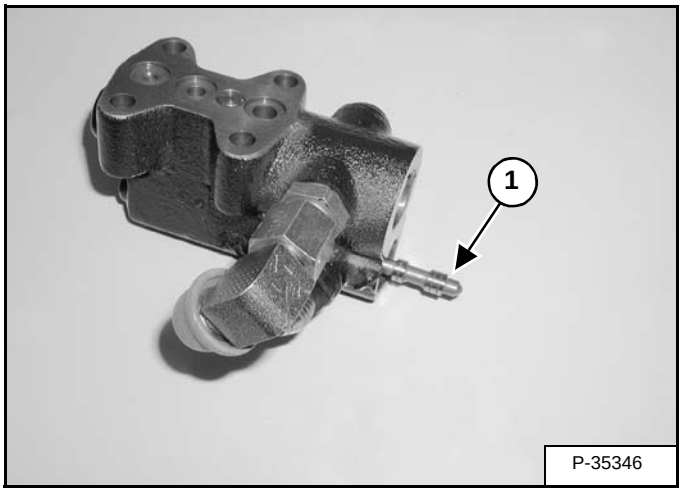
Remove the O-ring (Item 4) **[Figure 20-50-95]**.

Figure 20-50-96



Remove the spring seat (Item 1) **[Figure 20-50-96]**.

Figure 20-50-97



Remove the spool (Item 1) **[Figure 20-50-97]**.

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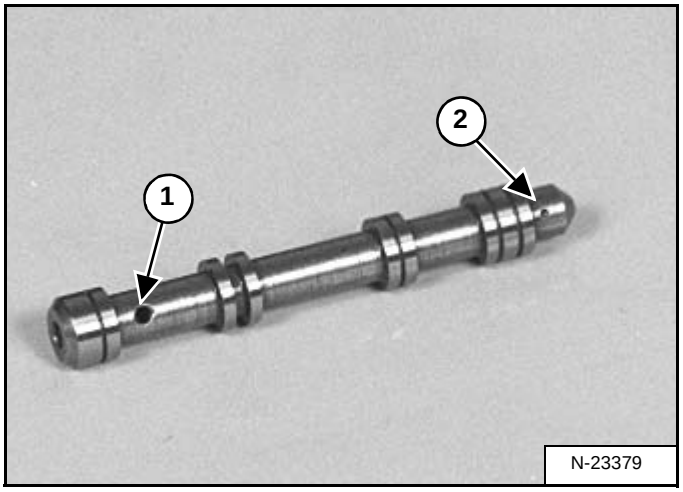
Pump Control Disassembly And Assembly (Cont'd)

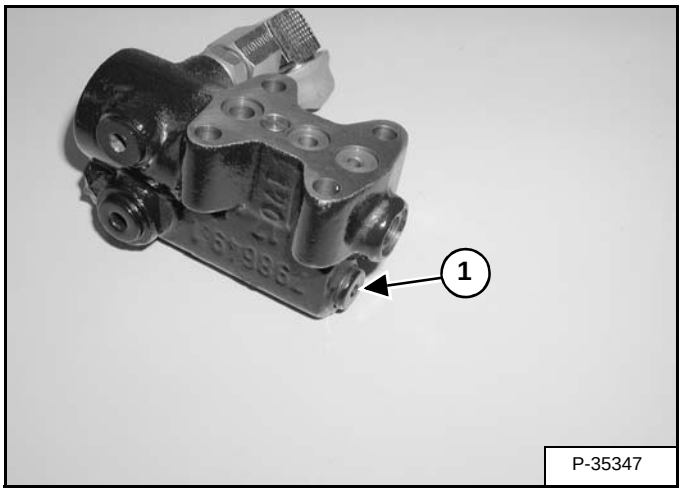
Torque Limiter Supply Control (Cont'd)

Figure 20-50-98



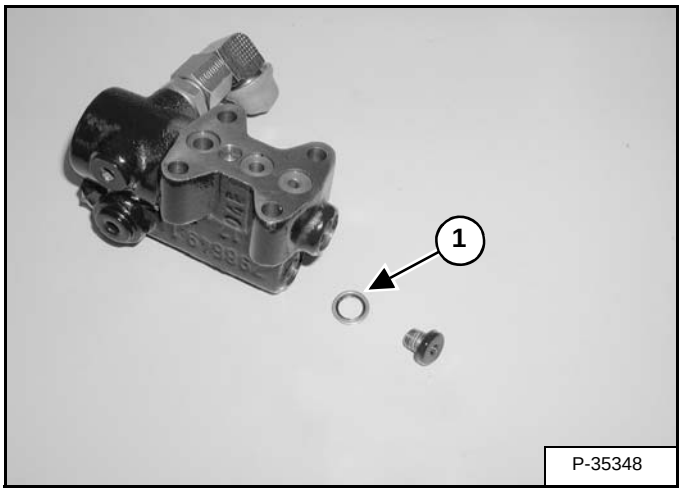
Check the spool for scratches and be sure the orifice (Items 1 & 2) **[Figure 20-50-98]** are not plugged.

Figure 20-50-99



Remove the plug (Item 1) **[Figure 20-50-99]**.

Figure 20-50-100



Remove the O-ring washer (Item 1) **[Figure 20-50-100]**.

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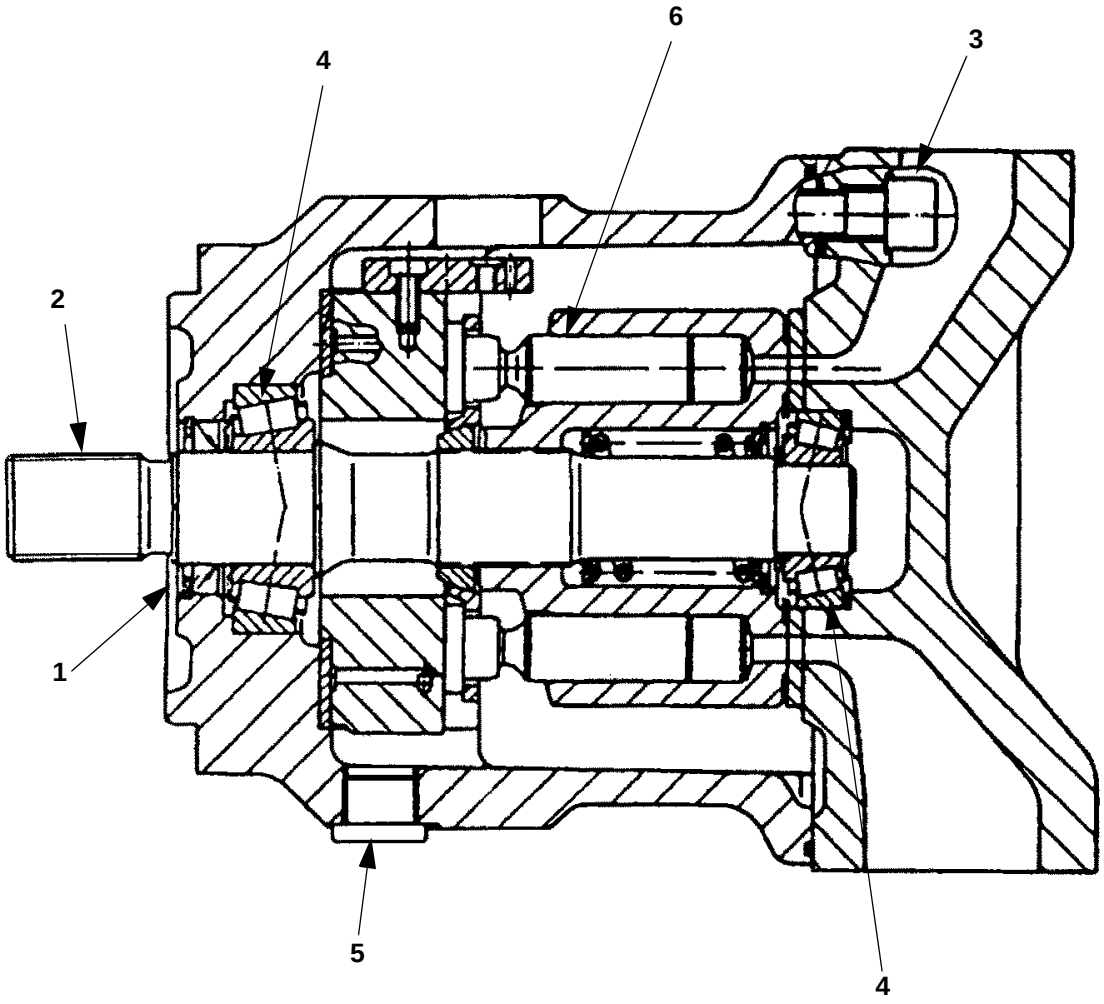
Parts Identification

1. **Seal**
2. **Shaft**
3. **Bolt**
4. **Bearing**
5. **Plug**
6. **Piston**



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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

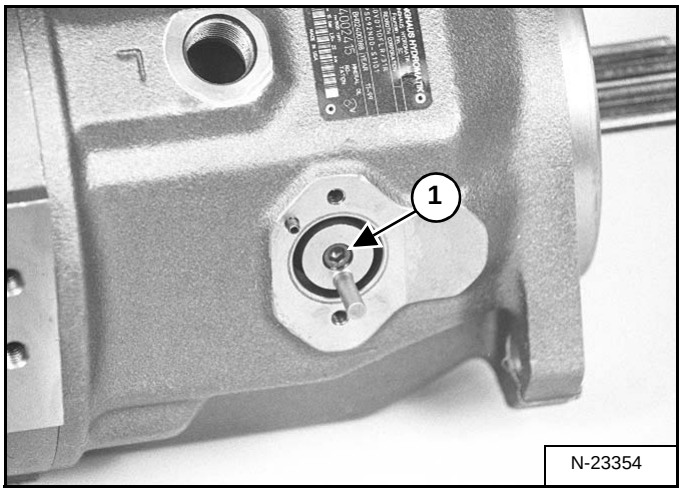
Clean the outside of the hydraulic piston pump with solvent and dry with compressed air.

Remove the torque limiter valve.(See "Torque Limiter Valve Removal and Installation" on page 20.

Remove the pump control assembly. See "Pump Control Removal And Installation" on page 32.

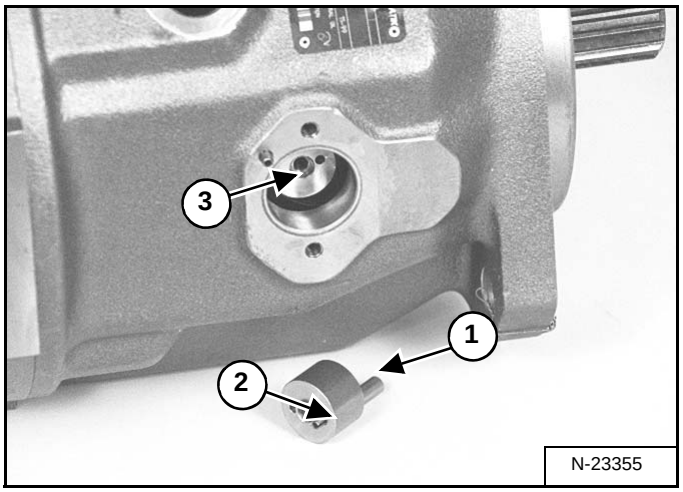
Remove the pump coupler. See "Coupler Removal And Installation" on page 18.

Figure 20-50-101



Remove the screw (Item 1) **[Figure 20-50-101]** from the pin assembly.

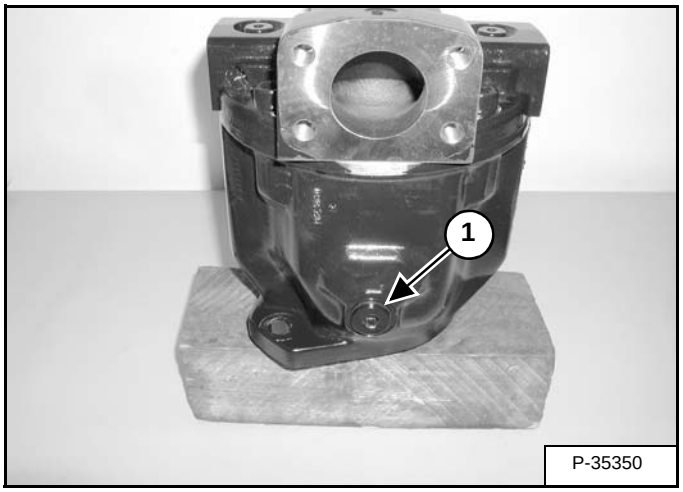
Figure 20-50-102



Remove the pin assembly (Item 1) **[Figure 20-50-102]**.

NOTE: The position of the dowel pin (Item 2) on the pin assembly, with the locating hole on the swash plate cradle (Item 3) [Figure 20-50-102].

Figure 20-50-103



Remove the plug (Item 1) **[Figure 20-50-103]** from the pump housing and drain the oil.

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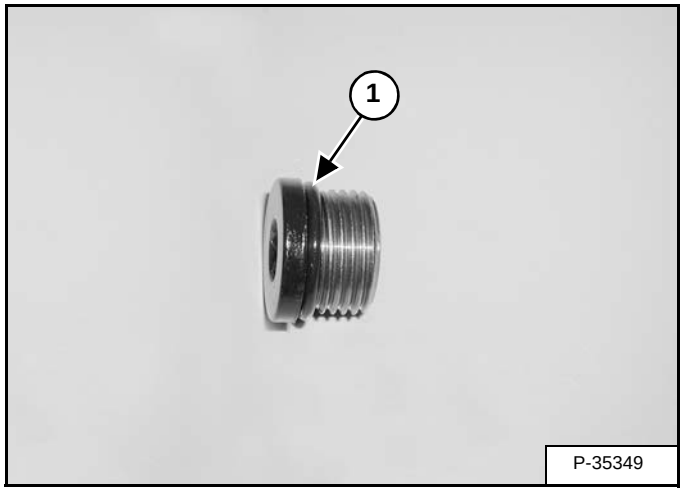
Disassembly (Cont'd)

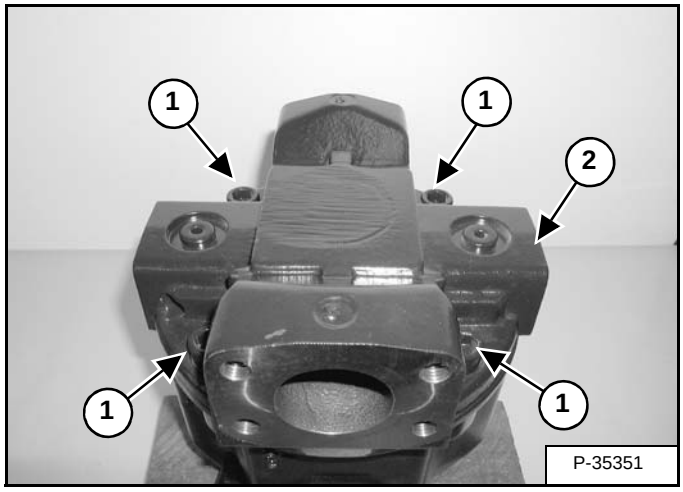
Figure 20-50-104



Remove the O-ring (Item 1) **[Figure 20-50-104]** from the plug.

Mark the pump housing for proper installation.

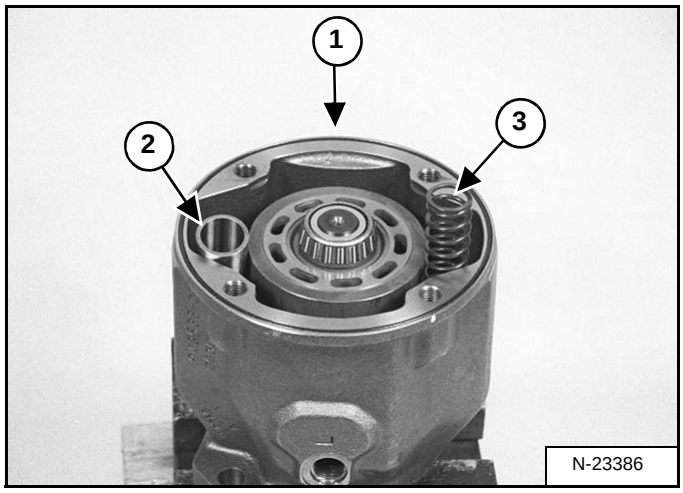
Figure 20-50-105



Loosen and remove the four bolts (Item 1) **[Figure 20-50-105]**.

Remove the port block assembly (Item 2) **[Figure 20-50-105]** from the pump.

Figure 20-50-106

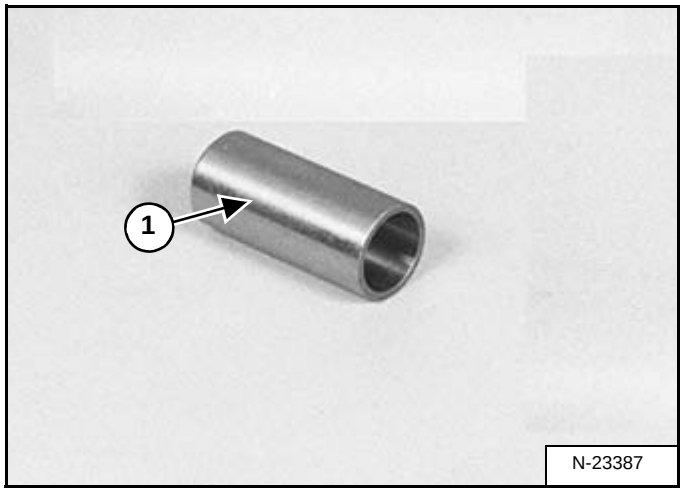


Remove the O-ring (Item 1) **[Figure 20-50-106]**.

Remove the destroking piston (Item 2) **[Figure 20-50-106]**.

Remove the stroking piston/spring assembly (Item 3) **[Figure 20-50-106]**.

Figure 20-50-107



Inspect the destroking piston (Item 1) **[Figure 20-50-107]** for scratches and replace as needed.

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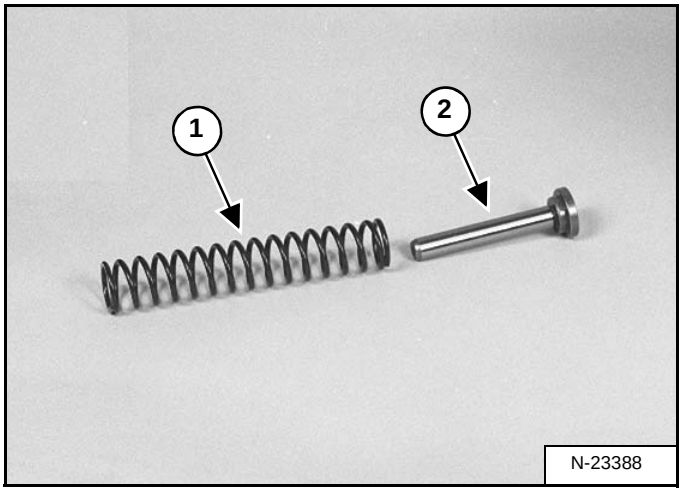
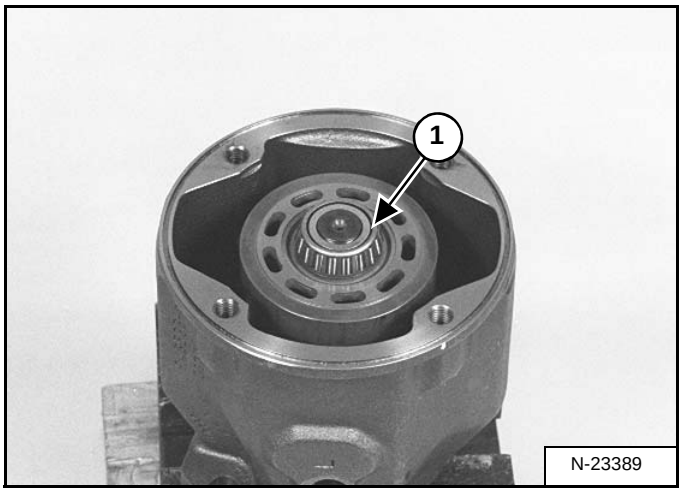
Disassembly (Cont'd)

Figure 20-50-108



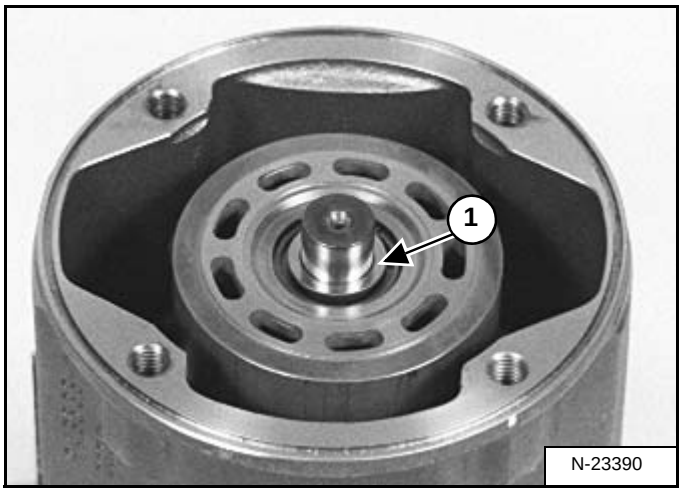
Remove the spring (Item 1) from the stroking piston (Item 2) **[Figure 20-50-108]**. Inspect all parts and replace as needed.

Figure 20-50-109



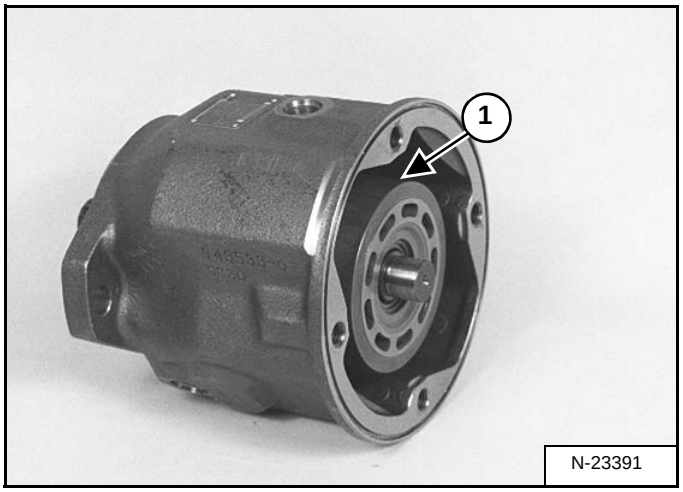
Remove the bearing (Item 1) **[Figure 20-50-109]**.

Figure 20-50-110



Remove the adjustment spacer(s) (Item 1) **[Figure 20-50-110]** from the pump shaft.

Figure 20-50-111



Lay the pump assembly on its side and remove the rotary group, swash plate, and shaft (Item 1) **[Figure 20-50-111]** from the housing.

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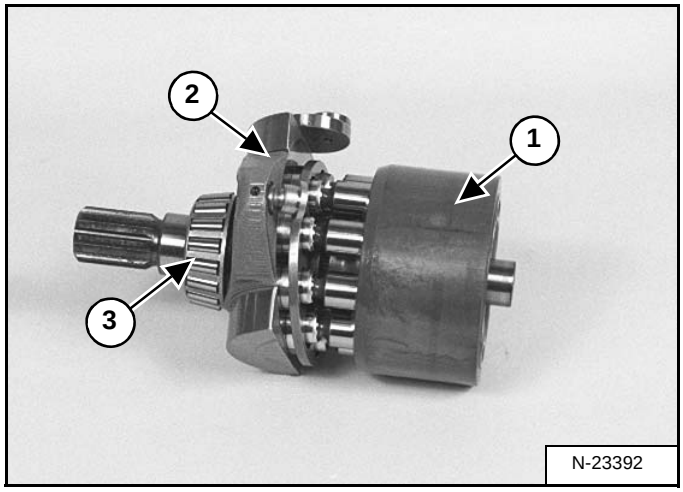
Disassembly (Cont'd)

Figure 20-50-112

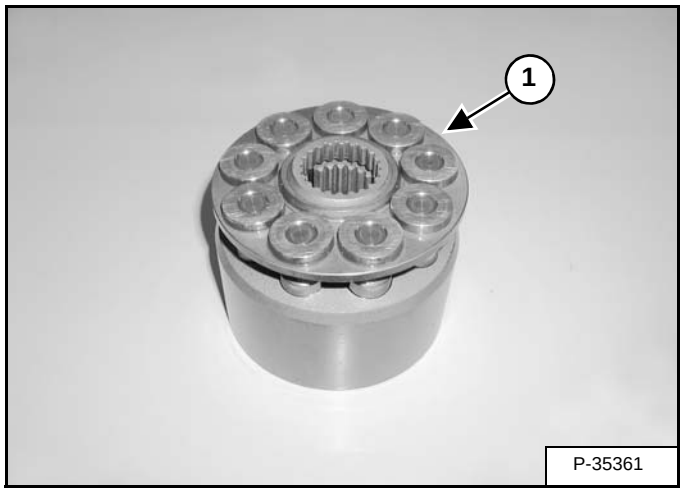


Slide the rotary group (Item 1) and swash plate (Item 2) from the shaft assembly (Item 3) **[Figure 20-50-112]**.

NOTE: It is NOT important that the pistons are installed in their original positions.

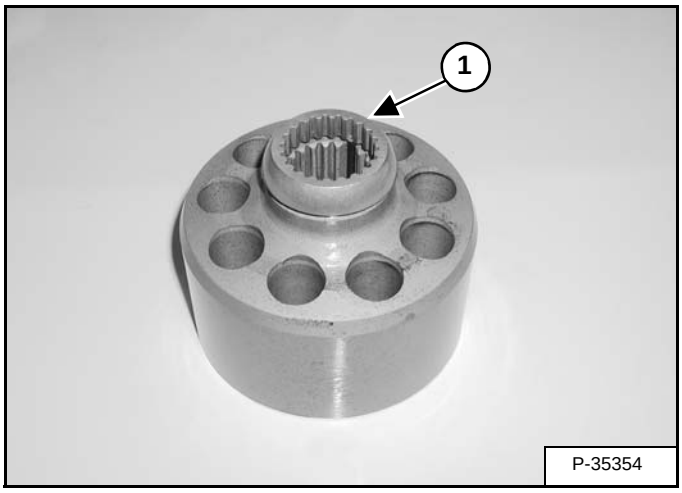
NOTE: Check that there are no scratches or metal deposits on the sliding surface. (Pistons must be replaced in sets.)

Figure 20-50-113



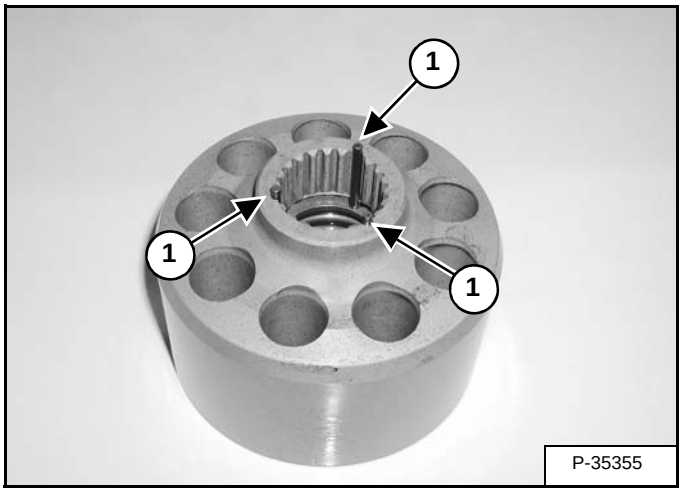
Remove the retainer plate and pistons (Item 1) **[Figure 20-50-113].**

Figure 20-50-114



Remove the retaining ball (Item 1) **[Figure 20-50-114]**.

Figure 20-50-115



Inspect the 3 pins (Item 1) **[Figure 20-50-115]** for wear and/or damage.

NOTE: The following procedure shown is to disassemble the rotating group for inspection only. The rotating group parts can not be ordered separately and must be ordered as an assembly.

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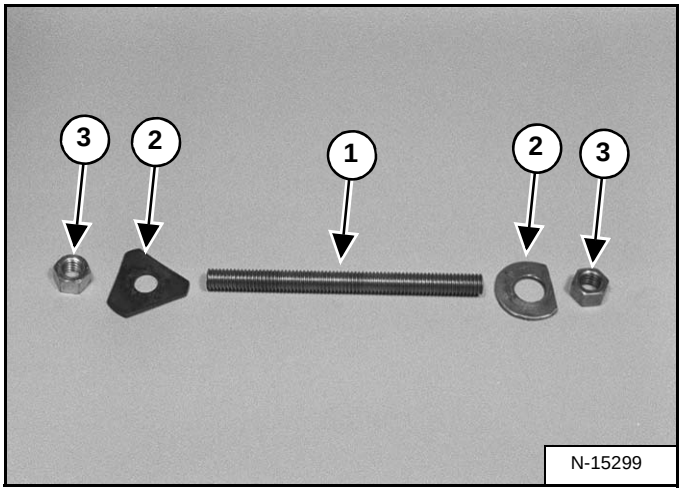
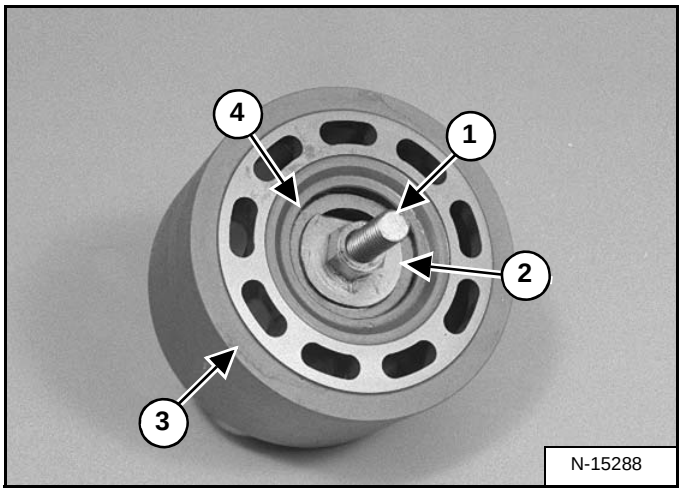
Disassembly (Cont'd)

Figure 20-50-116



To remove the spring from inside the cylinder block, use a threaded rod (or bolt) (Item 1) 2 trimmed washers (Item 2) and 2 nuts (Item 3) **[Figure 20-50-116]**.

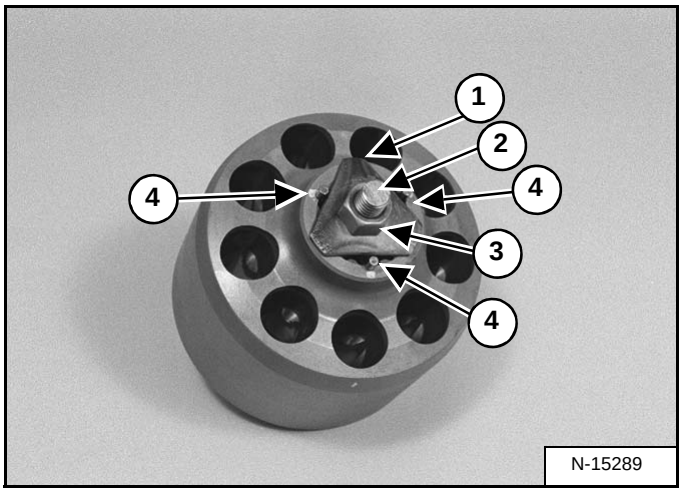
Figure 20-50-117



Install the threaded rod and nut (Item 1) through the trimmed washer (Item 2) and through the block assembly (Item 3) **[Figure 20-50-117]**.

NOTE: The modified washer (Item 2) must fit over the spring but must also fit inside the snap ring (Item 4) [Figure 20-50-117].

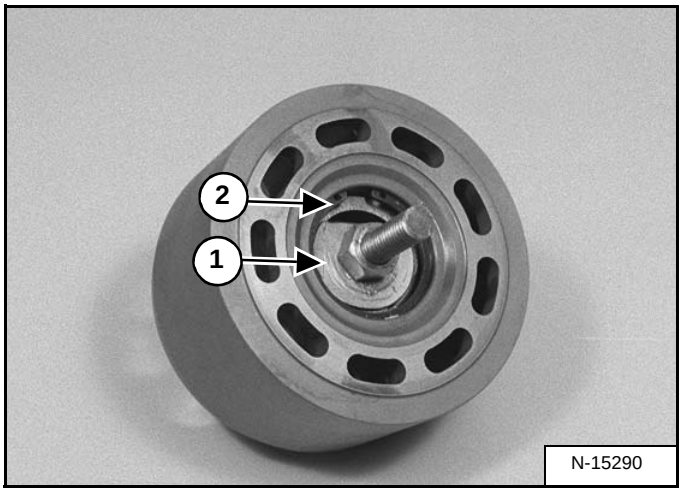
Figure 20-50-118



Install the second trimmed washer (Item 1) over the threaded rod (Item 2) install the nut (Item 3) **[Figure 20-50-118]**.

NOTE: The modified washer (Item 1) must fit between the 3 pins (Item 4) [Figure 20-50-118].

Figure 20-50-119



Tighten the nut (Item 1) until the spring is compressed enough to remove the snap ring (Item 2) **[Figure 20-50-119]**.

Loosen the nut to release the tension on the spring and remove the bolts and washers.

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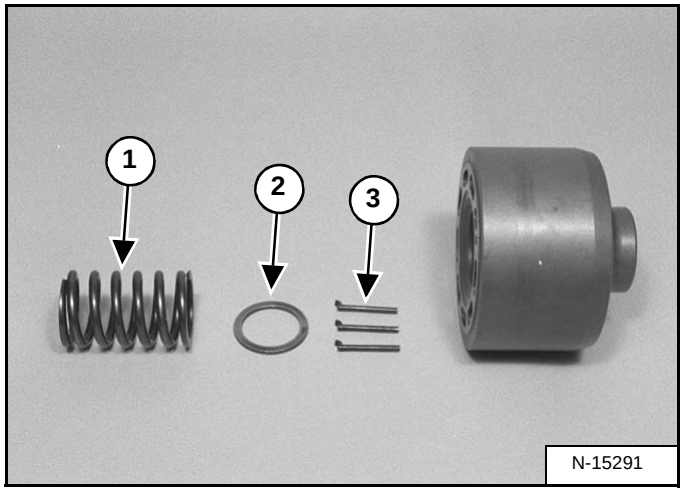
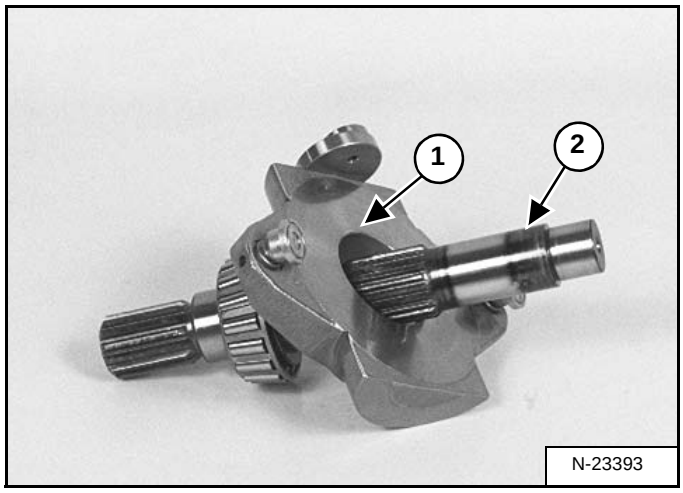
Disassembly (Cont'd)

Figure 20-50-120



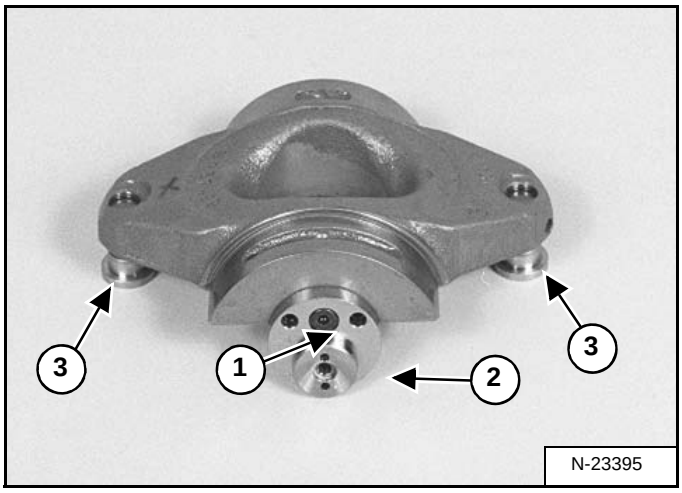
Remove the spring (Item 1), washer (Item 2) and the three pins (Item 3) **[Figure 20-50-120]** from the cylinder block.

Figure 20-50-121



Remove the swash plate (Item 1) from the shaft (Item 2) **[Figure 20-50-121]**.

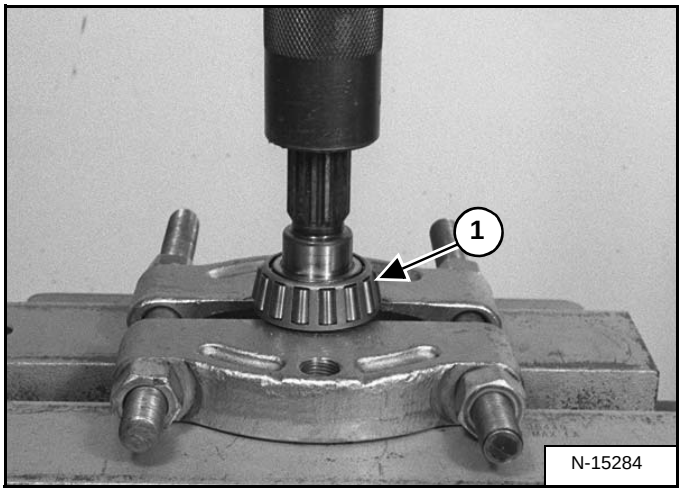
Figure 20-50-122



Loosen and remove the bolt (Item 1) and remove the torque limiter plate (Item 2) **[Figure 20-50-122]**.

NOTE: The caps (Item 3) [Figure 20-50-122] cannot be replaced, a new cradle must be ordered.

Figure 20-50-123



Press the bearing (Item 1) **[Figure 20-50-123]** off of the shaft.

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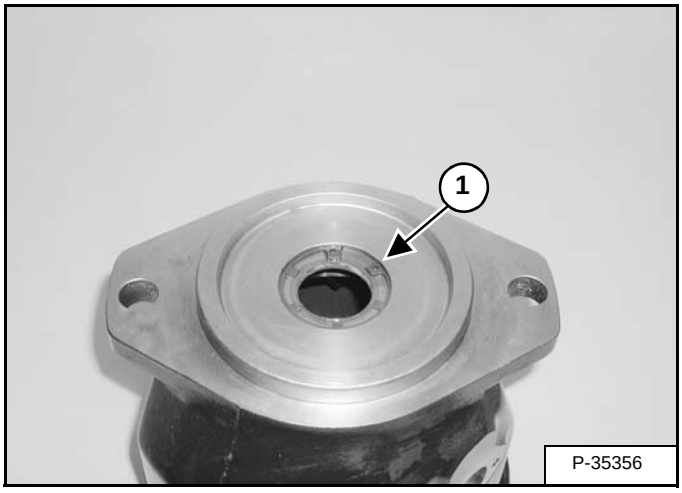
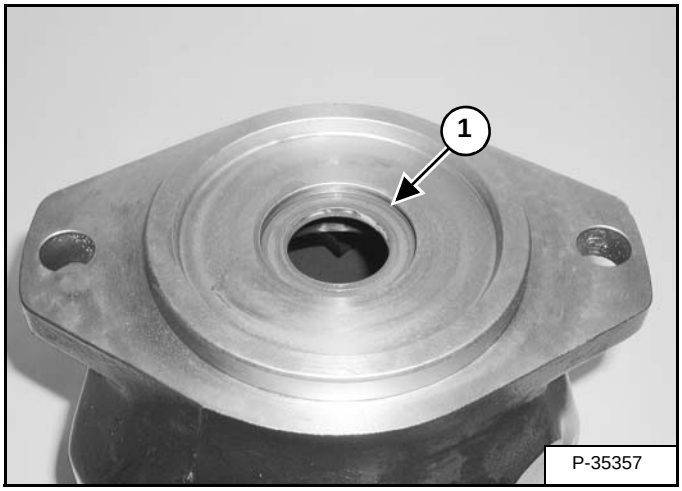
Disassembly (Cont'd)

Figure 20-50-124



Remove the snap ring (Item 1 **[Figure 20-50-124]** from the housing.

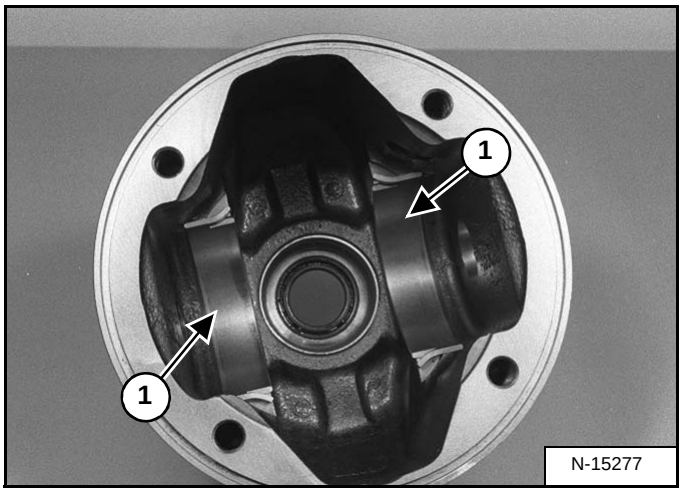
Figure 20-50-125



Remove the seal (Item 1) **[Figure 20-50-125]** from the housing.

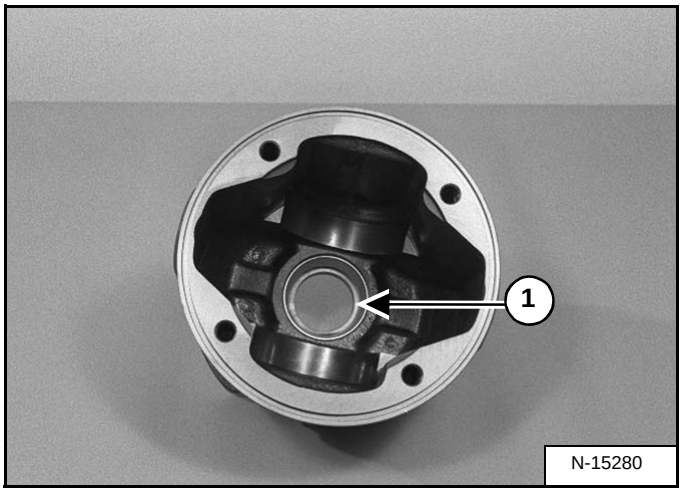
NOTE: The shaft seal can be removed without removing the shaft.

Figure 20-50-126



Remove the 2 brass bearings (Item 1) **[Figure 20-50-126]** from the housing.

Figure 20-50-127



Remove the race (Item 1) **[Figure 20-50-127]** from the housing.

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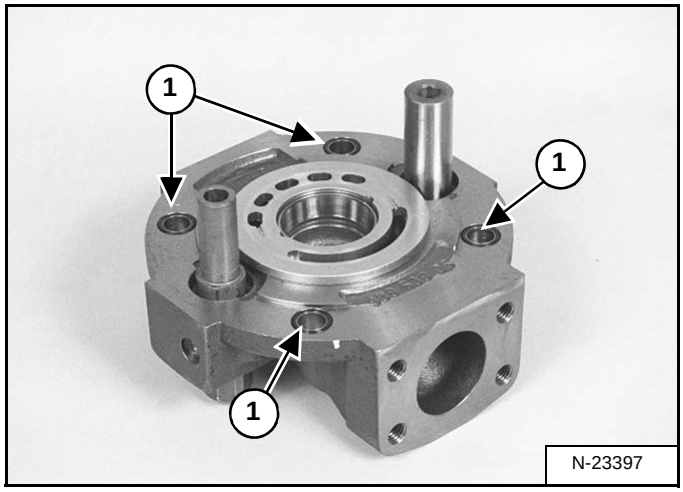
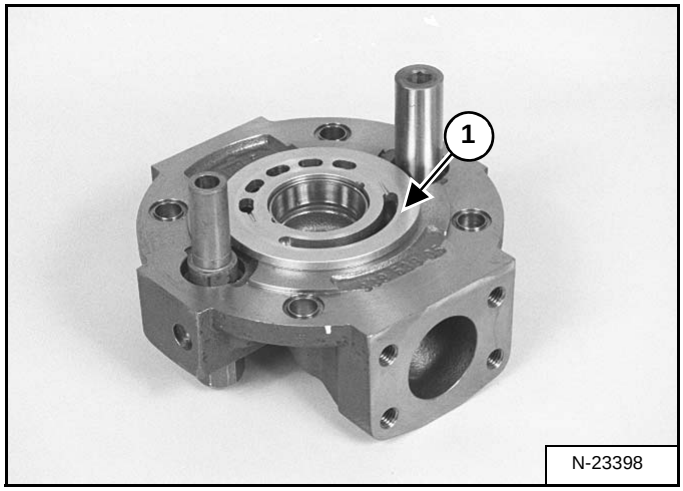
Disassembly (Cont'd)

Figure 20-50-128



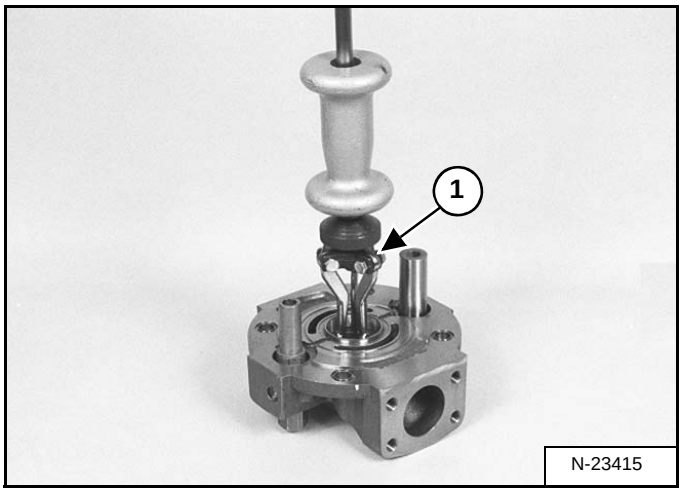
Remove the 4 O-rings (Item 1) **[Figure 20-50-128]**.

Figure 20-50-129



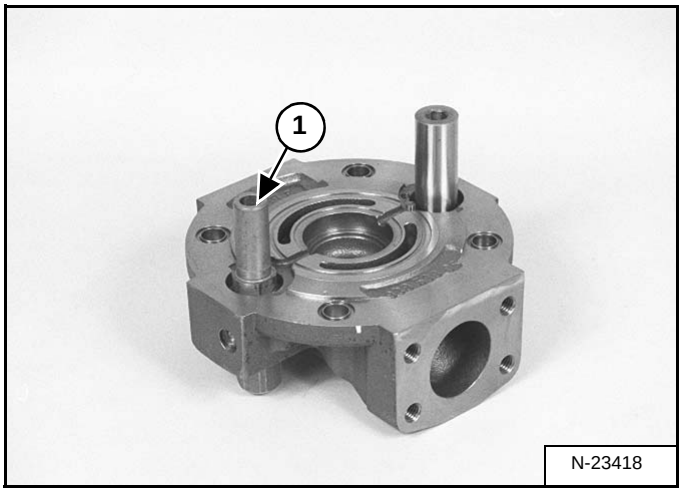
Remove the valve plate (Item 1) **[Figure 20-50-129]**.

Figure 20-50-130



With a bearing puller (Item 1) **[Figure 20-50-130]** remove the bearing race from the port block assembly.

Figure 20-50-131



Remove the stroking piston (Item 1) **[Figure 20-50-131]**. (Spring Side)

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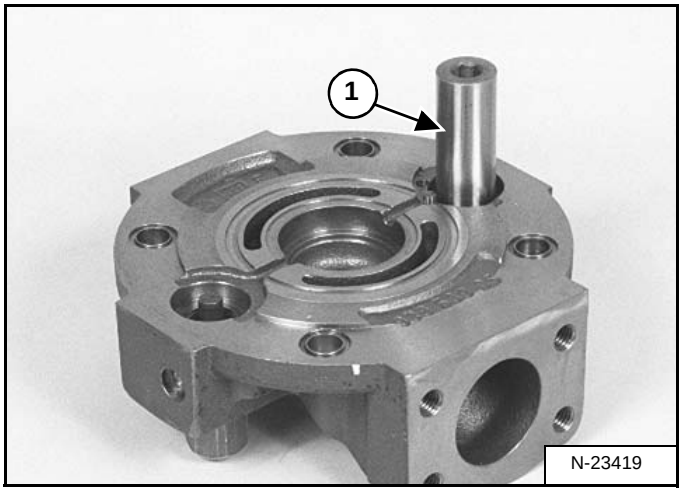
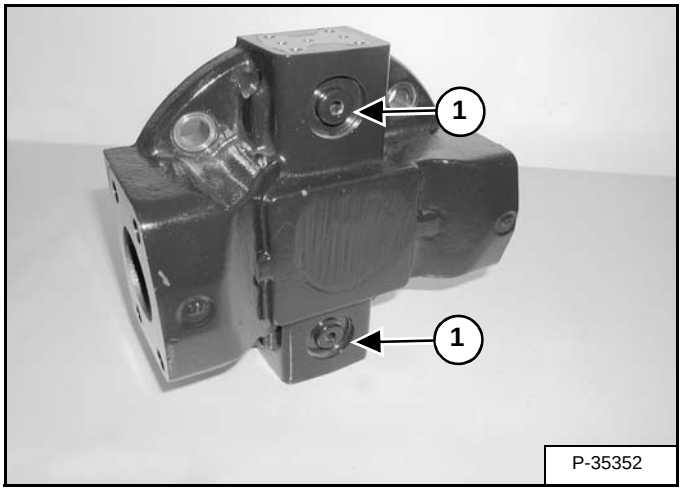
Disassembly (Cont'd)

Figure 20-50-132



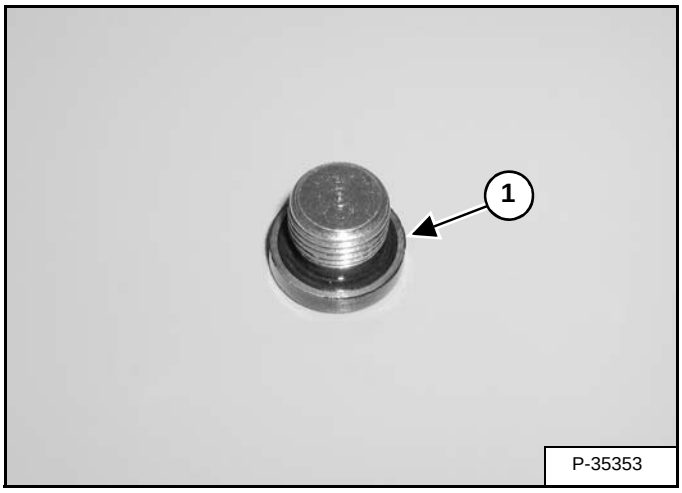
Remove the destroking piston (Item 1) **[Figure 20-50-132]**.

Figure 20-50-133



Remove the plugs (Item 1) **[Figure 20-50-133]**.

Figure 20-50-134



Remove the O-ring (Item 1) **[Figure 20-50-134]** from both plugs.

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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.

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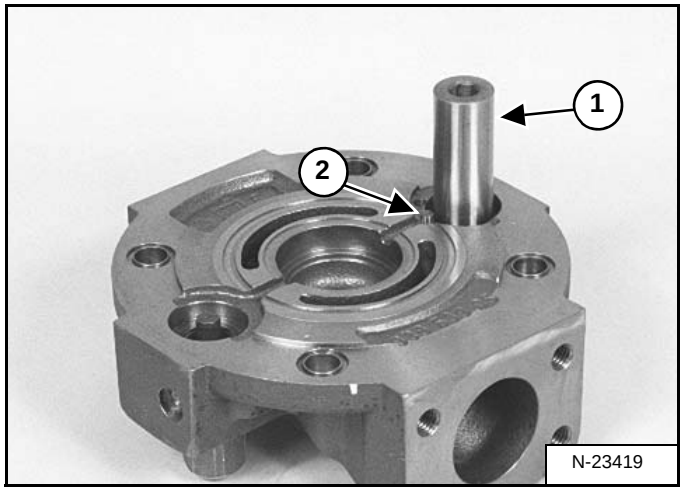
Clean parts in solvent and dry with compressed air.

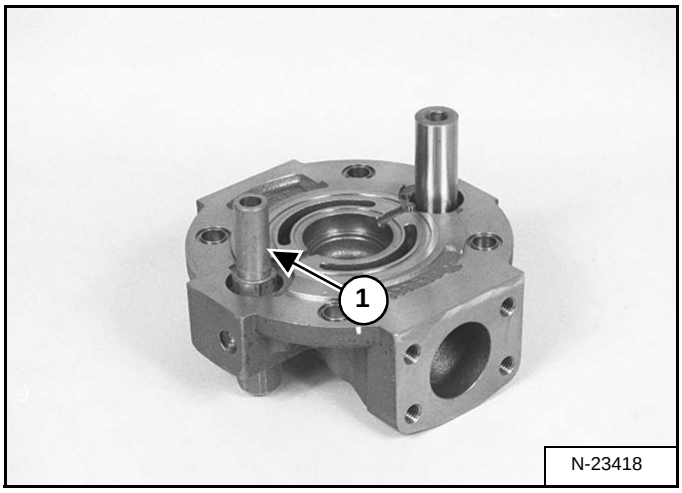
Replace any worn or damaged parts.

Figure 20-50-135



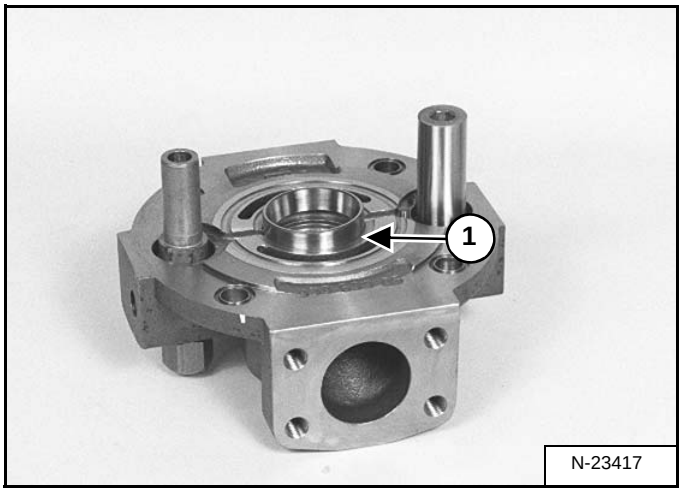
Apply Loctite™ 241 on the threads and install the destroking piston (Item 1) in the hole next to the alignment pin (Item 2) **[Figure 20-50-135]** and tighten.

Figure 20-50-136



Apply Loctite™ 241 on the threads and install the stroking piston (Item 1) **[Figure 20-50-136]** in the hole and tighten.

Figure 20-50-137



Install the bearing race (Item 1) **[Figure 20-50-137]** in the port block assembly.

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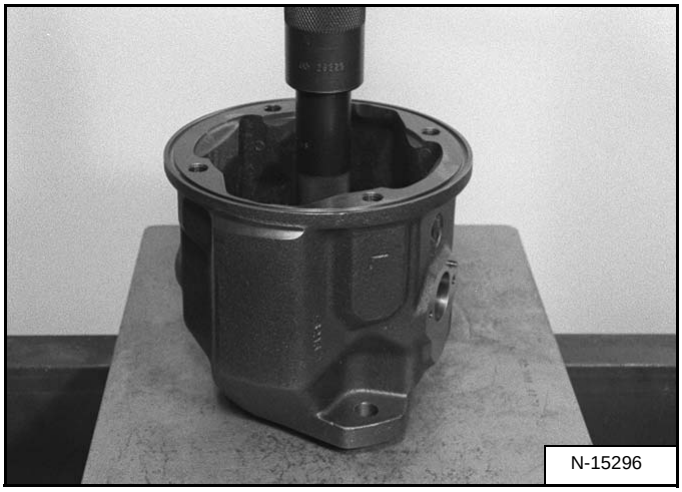
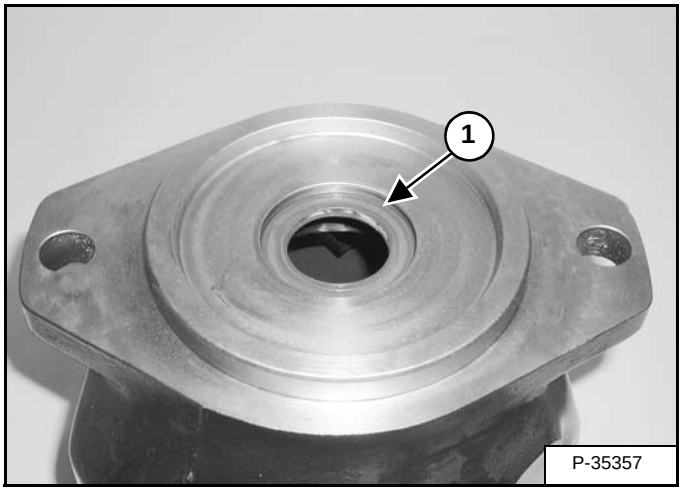
Assembly (Cont'd)

Figure 20-50-138



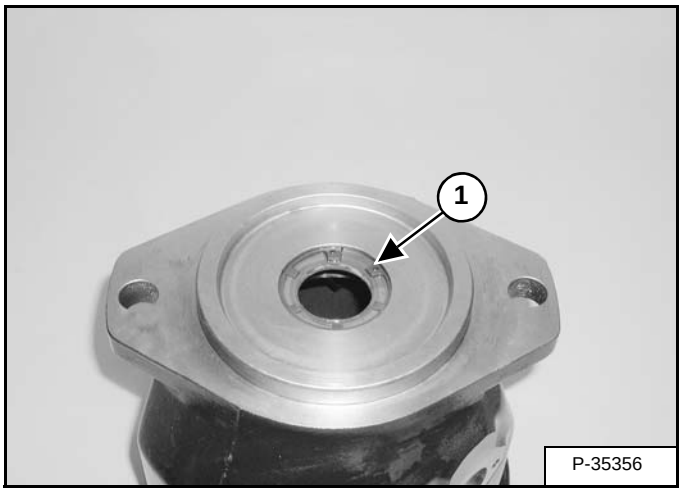
Press the race into the housing **[Figure 20-50-138]**.

Figure 20-50-139



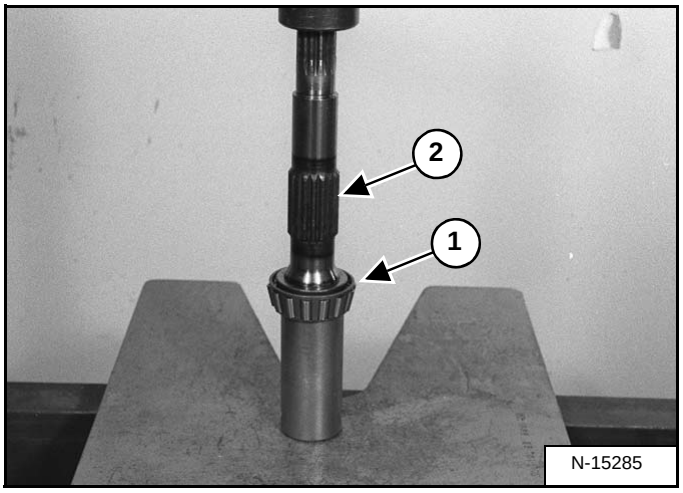
Install the shaft seal (Item 1) **[Figure 20-50-139]**.

Figure 20-50-140



Install the snap ring (Item 1) **[Figure 20-50-140]**.

Figure 20-50-141



Press the bearing (Item 1) on the shaft (Item 2) **[Figure 20-50-141]**.

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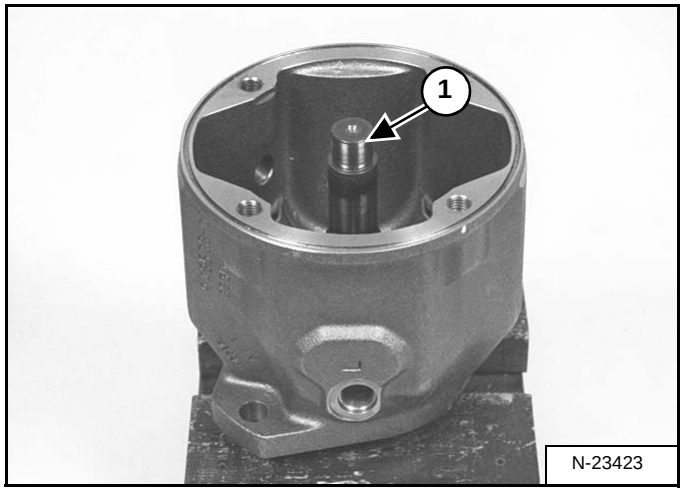
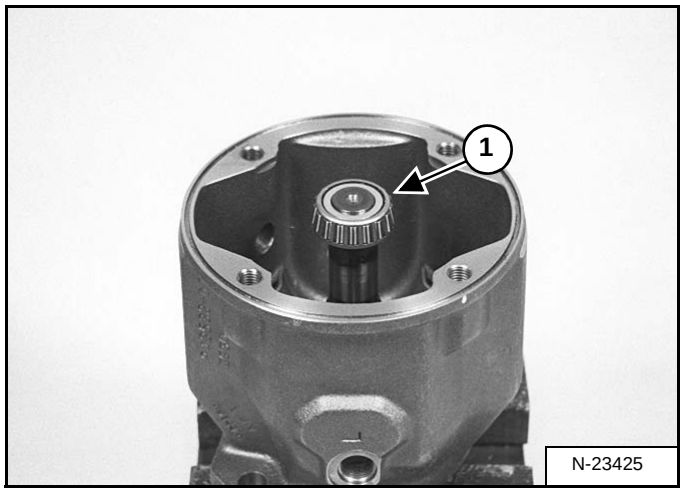
Assembly (Cont'd)

Figure 20-50-142



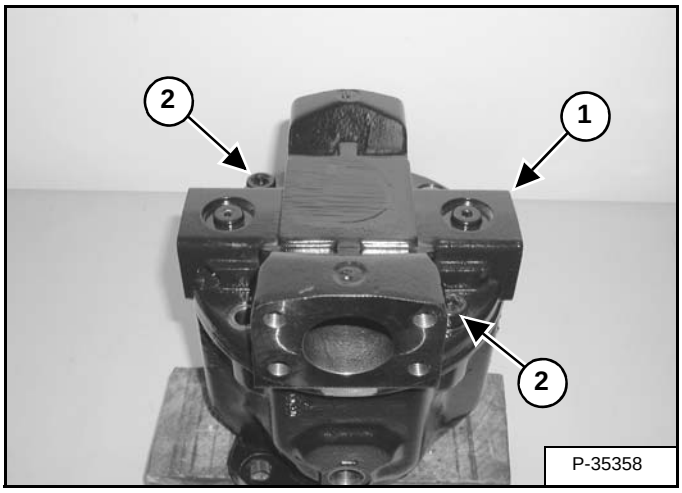
To find the correct shim washer thickness for bearing end play, the shaft/bearing assembly (Item 1) **[Figure 20-50-142]** must be installed in the housing.

Figure 20-50-143



Install the bearing (Item 1) **[Figure 20-50-143]** on the shaft.

Figure 20-50-144



Install the port block (Item 1) **[Figure 20-50-144]**.

Install and tighten the bolts (Item 2) **[Figure 20-50-144]**.

Figure 20-50-145

Turn the pump assembly over **[Figure 20-50-145]**.

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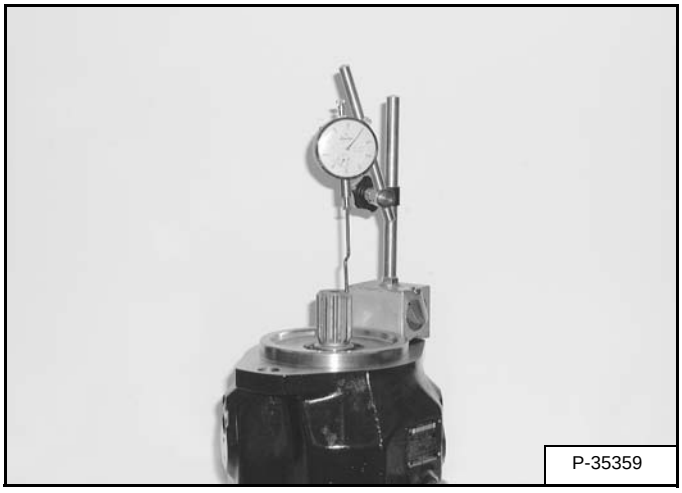
Assembly (Cont'd)

Figure 20-50-146



Install a dial indicator on the housing as shown **[Figure 20-50-146]** and set it to zero.

Pull the shaft up as far as it will go and record the reading on the dial indicator. Repeat the procedure several times. The reading must be the same each time.

Add the nominal pre-load of 0.001 inch (0,025 mm), the actual pre-load is 0.000 inch (0,000 mm) to 0.002 inch (0,050 mm) to the reading found on the dial indicator **[Figure 20-50-146]**.

Example: (In Inches)

0.150 Measured movement of shaft

0.001 Nominal Pre-load

= 0.151 ± thickness of the spacer needed. (See Assembly (Cont'd) on Page 20-50-50.)

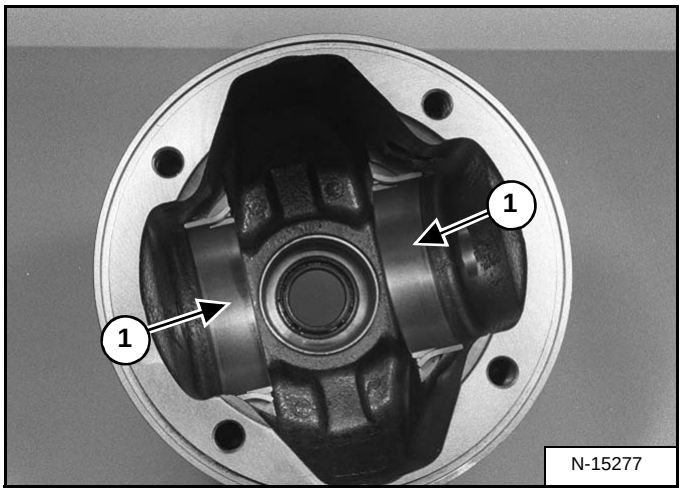
When the proper thickness of shim washer is determined, remove the dial indicator from the pump housing.

Remove the two mounting bolts.

Remove the port block.

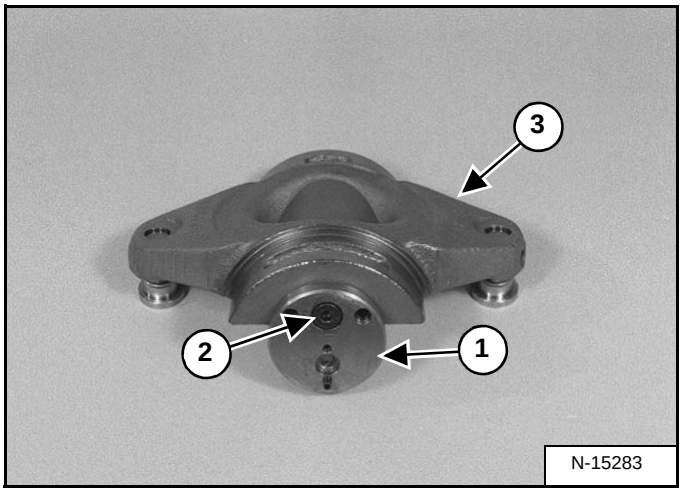
Remove the bearing and shaft from the pump housing.

Figure 20-50-147



Install the two brass bearings (Item 1) **[Figure 20-50-147]**.

Figure 20-50-148



Apply Loctite™ 241 and install the torque limiter plate (Item 1) and bolt (Item 2) on the swash plate (Item 3) **[Figure 20-50-148]**.

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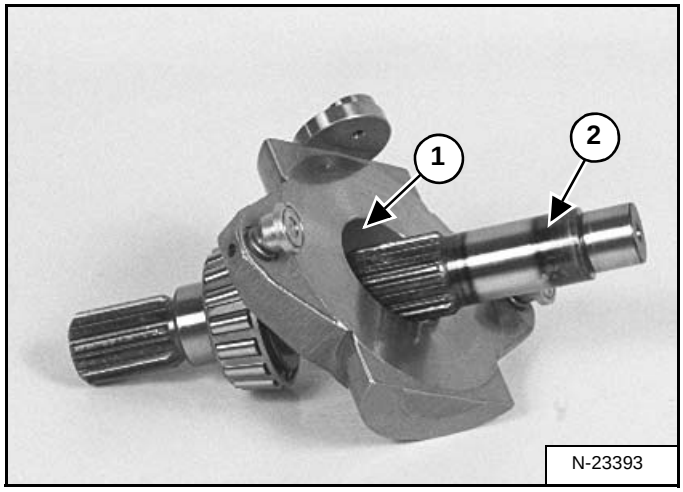
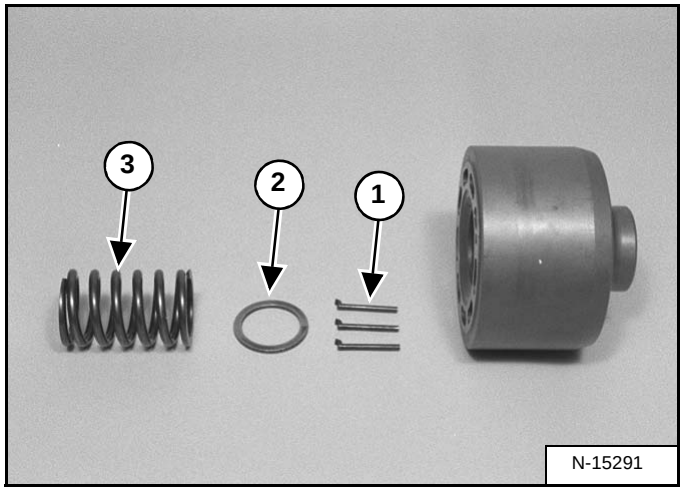
Assembly (Cont'd)

Figure 20-50-149



Install the swash plate (Item 1) on the shaft (Item 2) **[Figure 20-50-149]**.

Figure 20-50-150

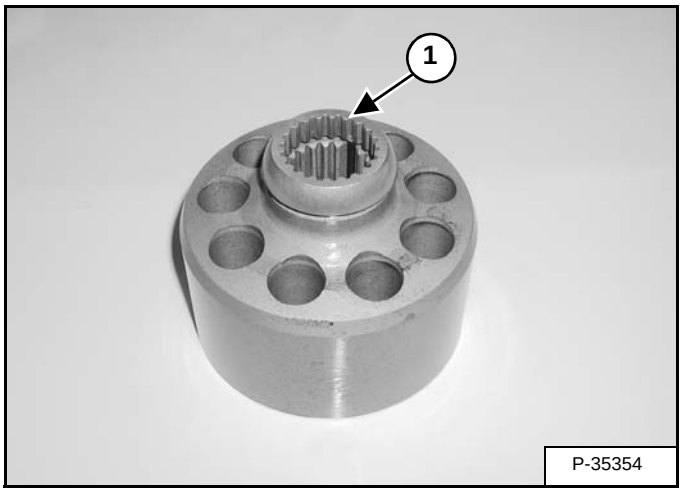


Apply clean grease to the three pins (Item 1) **[Figure 20-50-150]** and install them in the appropriate groove.

Install the washer (Item 2) and the spring (Item 3) **[Figure 20-50-150]**.

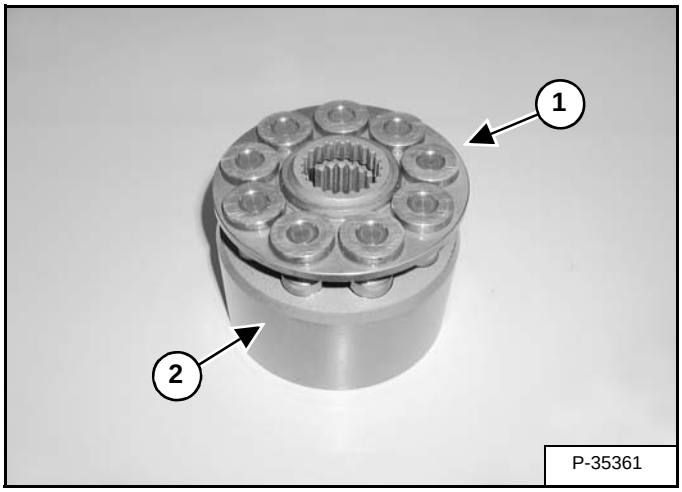
NOTE: If the rotating group is damaged, the parts can not be order separately and must be ordered as an assembly.

Figure 20-50-151



Install the retaining ball (Item 1) **[Figure 20-50-151]** on the three pins.

Figure 20-50-152



Install the retainer and piston assembly (Item 1) in the cylinder block (Item 2) **[Figure 20-50-152]**.

NOTE: It is NOT important that the pistons are installed in their original positions.

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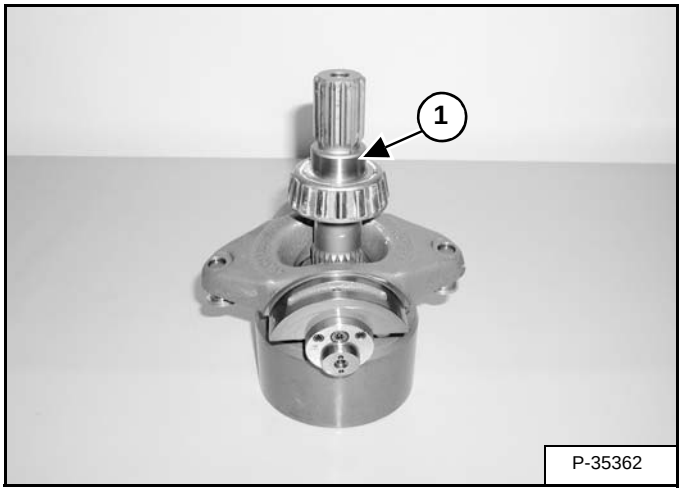
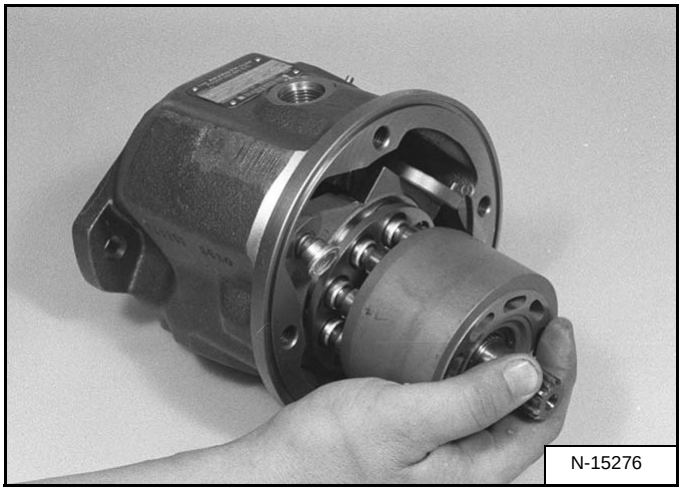
Assembly (Cont'd)

Figure 20-50-153



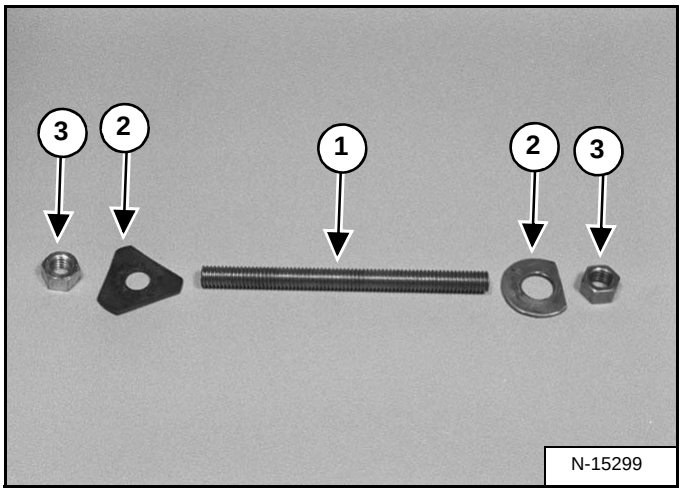
Install the shaft/swash plate assembly (Item 1) **[Figure 20-50-153]** in the cylinder block.

Figure 20-50-154



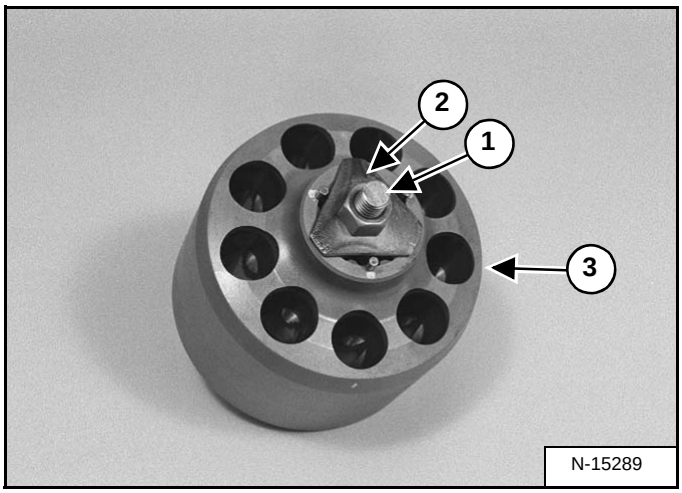
Lay the pump housing on its side and install the rotary group assembly, swash plate, and shaft in the housing **[Figure 20-50-154]**.

Figure 20-50-155



To compress the spring inside the cylinder block, use a threaded rod (or bolt) (Item 1), 2 trimmed washers (Item 2) and 2 nuts (Item 3) **[Figure 20-50-155]**.

Figure 20-50-156



Install the threaded rod and nut (Item 1) through the modified washer (Item 2) and the block assembly (Item 3) **[Figure 20-50-156]**.

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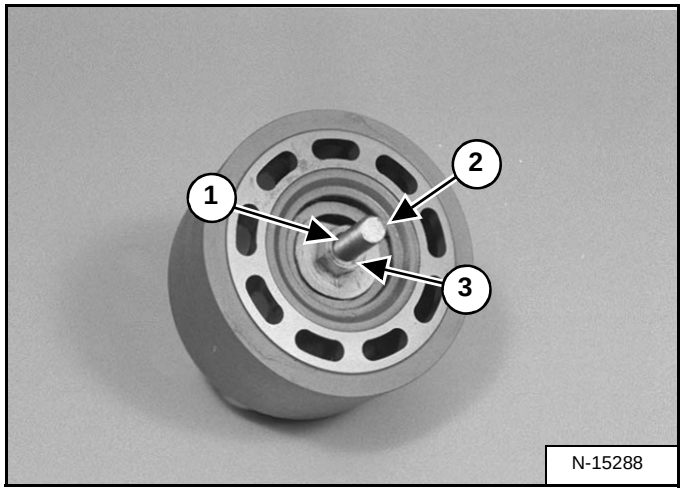
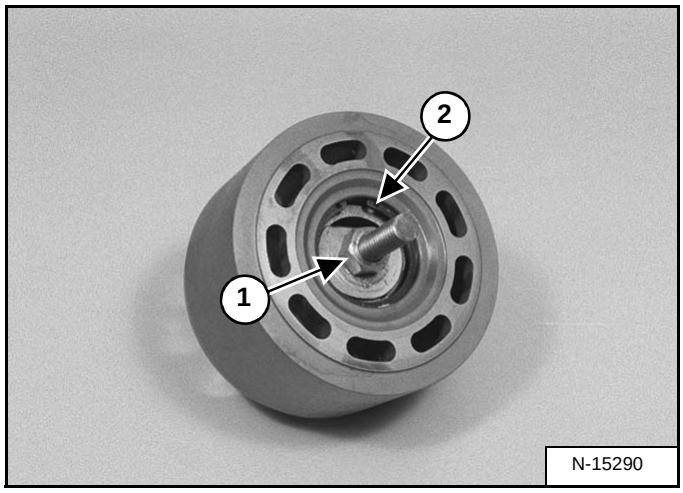
Assembly (Cont'd)

Figure 20-50-157



NOTE: The modified washer (Item 1) must fit over the spring, but must also fit inside the snap ring (Item 2) [Figure 20-50-157].

Figure 20-50-158

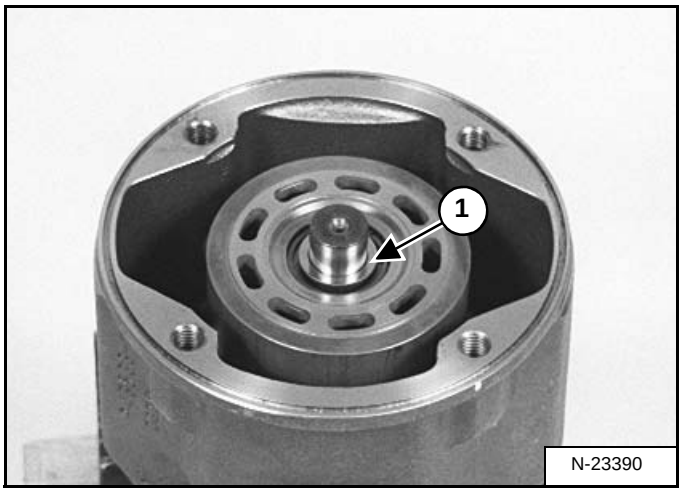


Tighten the nut (Item 1) until the spring is compressed enough to install the snap ring (Item 2) **[Figure 20-50-158]**.

Remove the threaded rod/washer assembly.

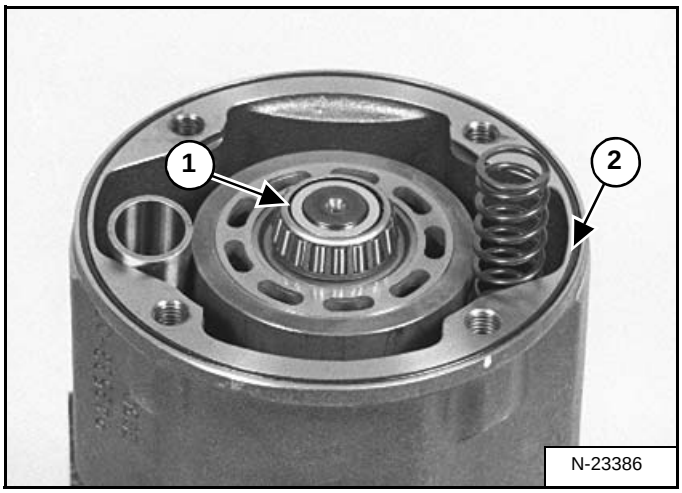
Set the pump housing in the up-right position.

Figure 20-50-159



Install the shim washer (Item 1) **[Figure 20-50-159]** See "Assembly" on page 48. for procedure to determine shim washer thickness.)

Figure 20-50-160



Install the bearing (Item 1) **[Figure 20-50-160]** on the shaft.

Install a new O-ring (Item 2) **[Figure 20-50-160]**.

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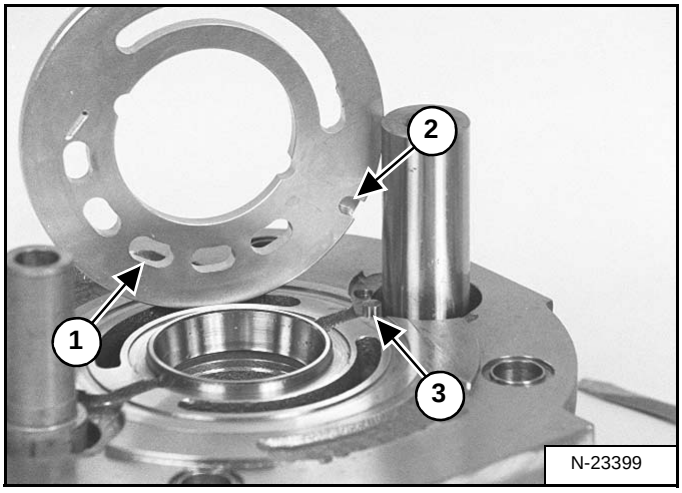
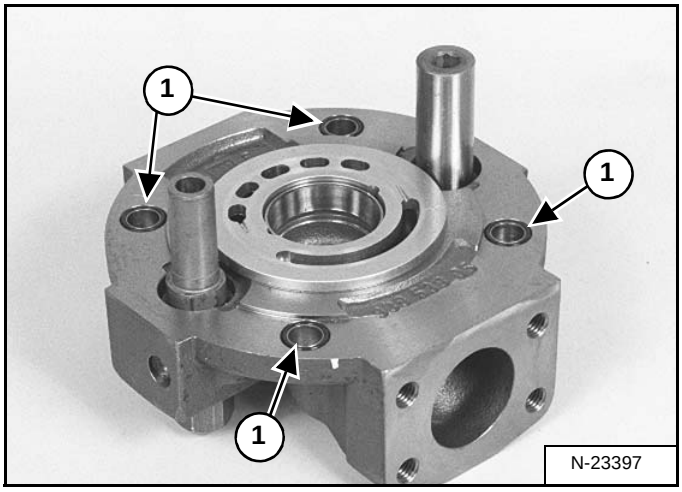
Assembly (Cont'd)

Figure 20-50-161



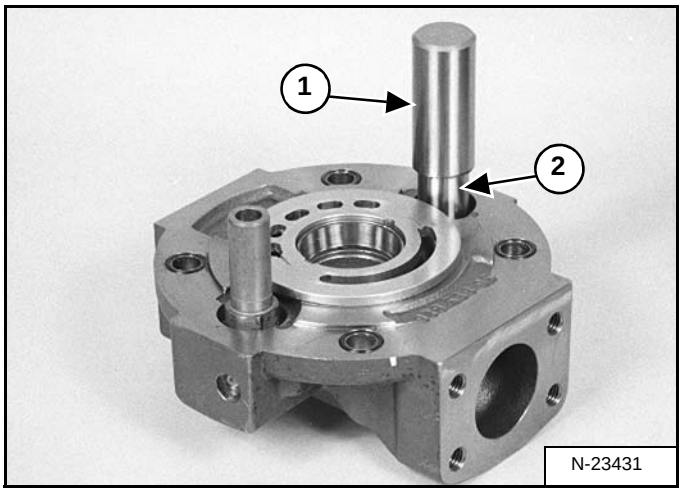
Install the valve plate (Item 1) on the port block assembly. The valve plate can only be installed one way by aligning the groove (Item 2) with the pin (Item 3) **[Figure 20-50-161]**.

Figure 20-50-162



Install the O-rings (Item 1) **[Figure 20-50-162]**.

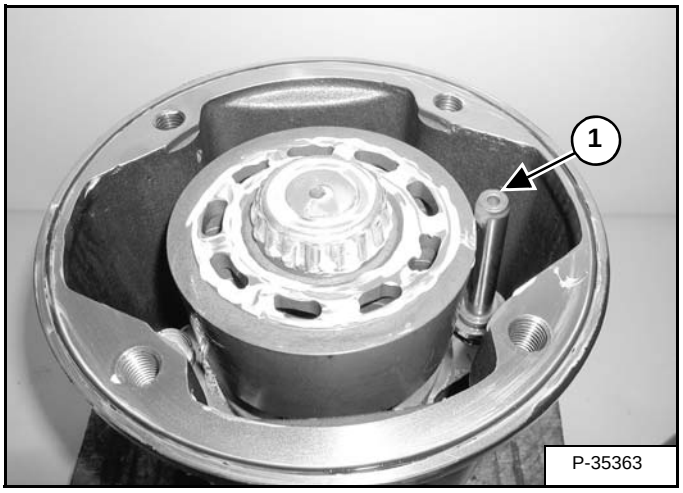
Figure 20-50-163



Grease the inside of the control piston (Item 1) **[Figure 20-50-163]**.

Install the control piston on the control piston shaft (Item 2) **[Figure 20-50-163]**.

Figure 20-50-164



Install the stroking piston (Item 1) **[Figure 20-50-164]**.

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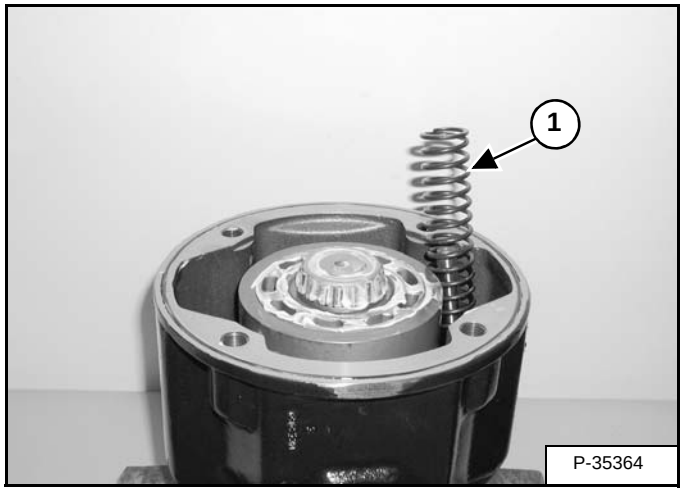
HYDRAULIC PISTON PUMP (S/N 522311001 & ABOVE) (CONT'D)

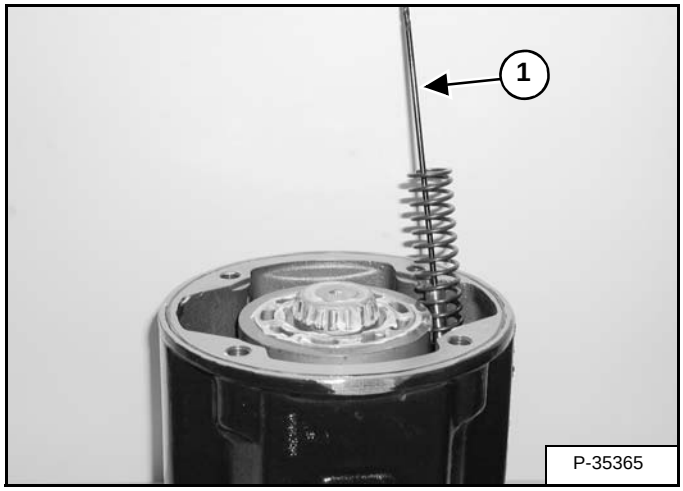
Assembly (Cont'd)

Figure 20-50-165



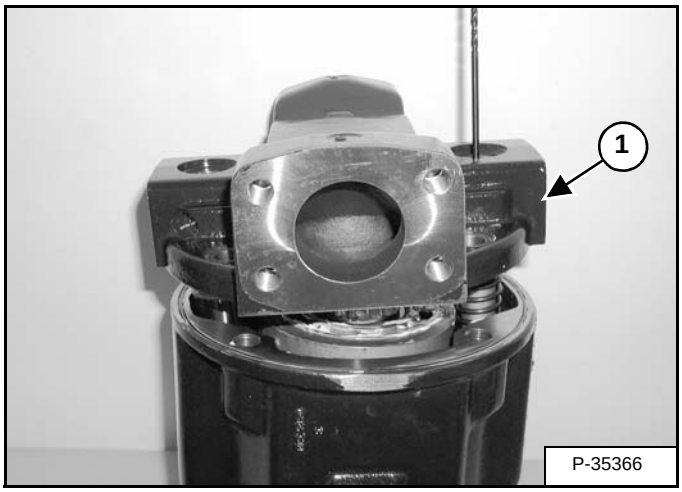
Install the spring (Item 1) **[Figure 20-50-165]** on the piston.

Figure 20-50-166



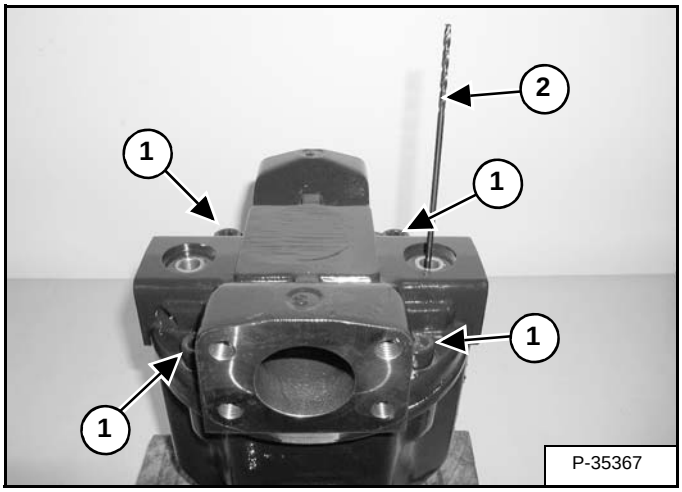
Install a 0.1835 inch (4,76 mm) rod (Item 1) **[Figure 20-50-166]** through the spring and into the hole of the piston.

Figure 20-50-167



Align the marks and install the port block assembly (Item 1) **[Figure 20-50-167]** on the pump housing.

Figure 20-50-168



Install the 4 mounting bolts (Item 1) **[Figure 20-50-168]** and tighten to 88 ft.-lbs. (119 Nm) torque.

Remove the aligning rod (Item 2) **[Figure 20-50-168]** from the pump housing.

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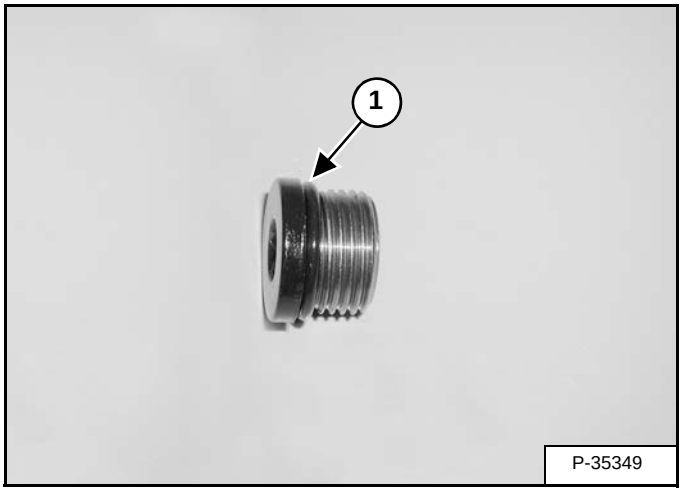
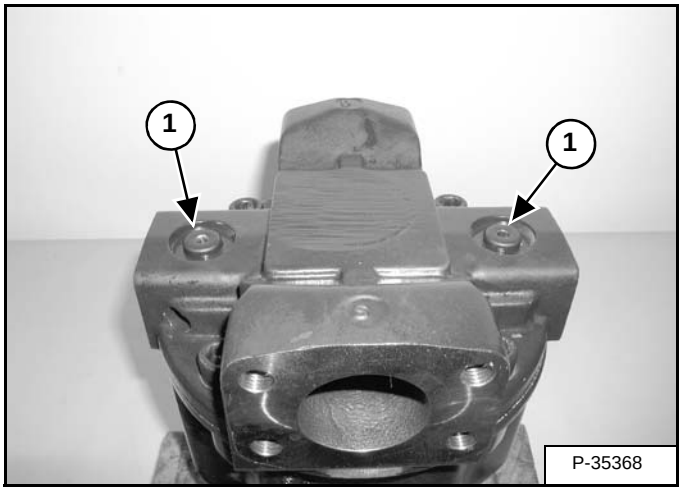
Assembly (Cont'd)

Figure 20-50-169



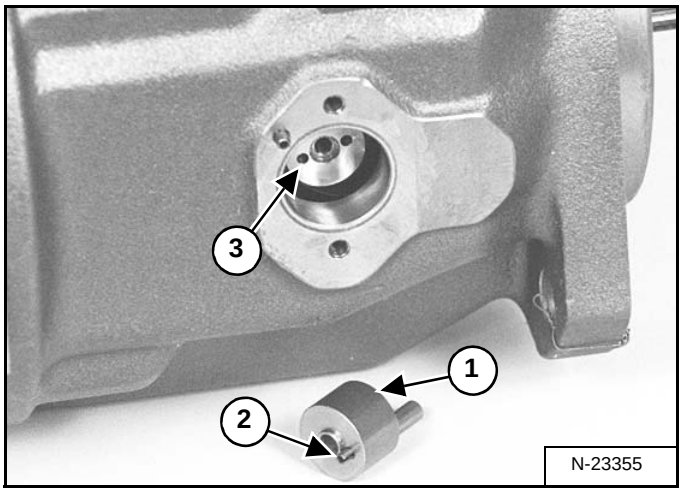
Install the O-ring (Item 1) **[Figure 20-50-169]** on the plug.

Figure 20-50-170



Install the plugs (Item 1) **[Figure 20-50-170]**.

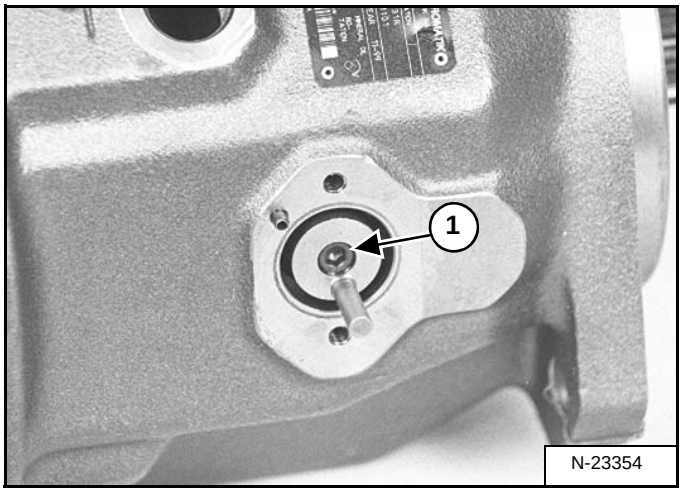
Figure 20-50-171



Install the pin assembly (Item 1) **[Figure 20-50-171]**.

Make sure the dowel pin (Item 2) is fully seated in the hole (Item 3) **[Figure 20-50-171]** on the swash plate.

Figure 20-50-172



Apply Loctite™ 241 on the bolt (Item 1) **[Figure 20-50-172]**. Tighten the bolt to 10 ft.-lbs. (13 Nm) torque.

Install the torque limiter valve. See "Torque Limiter Valve Removal and Installation" on page 20.

Install the pump control assembly. See "Pump Control Removal And Installation" on page 32.

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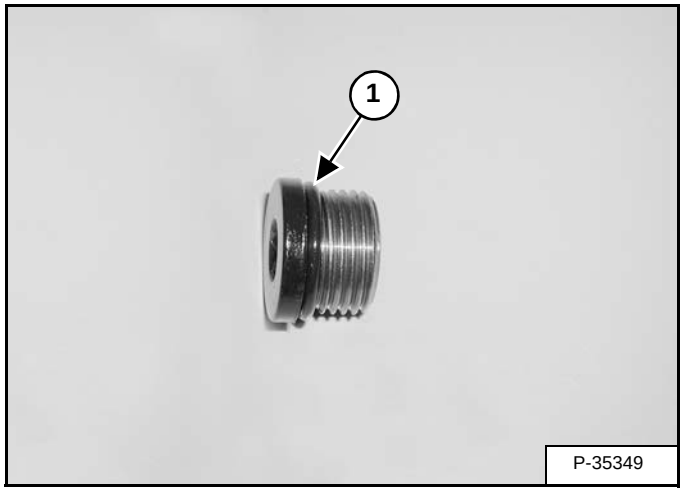
Assembly (Cont'd)

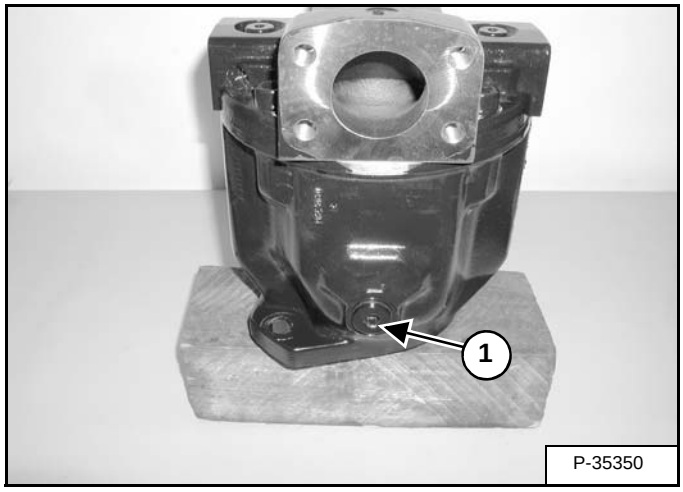
Figure 20-50-173



Install the O-ring (Item 1) **[Figure 20-50-173]** on the plug.

Place the pump on its side and fill approximately half full with clean hydraulic fluid.

Figure 20-50-174



Install the plug (Item 1) **[Figure 20-50-174]** in the pump and tighten.

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HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE)

Removal And Installation

IMPORTANT

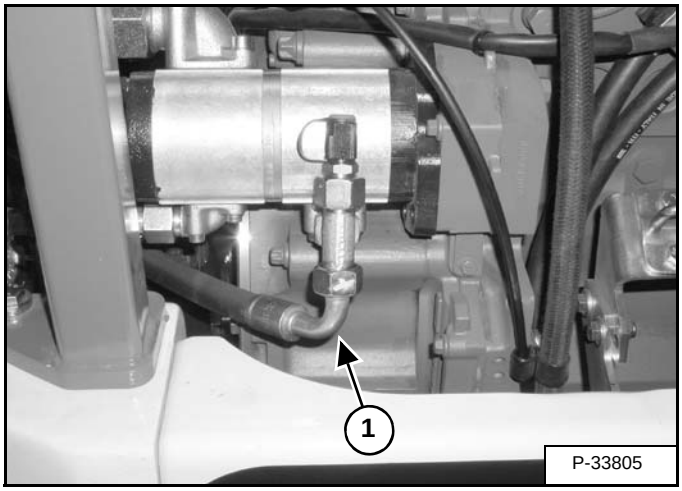
When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I-2003-0888

Open the rear cover. (See Opening And Closing The Rear Cover on Page 10-40-1.)

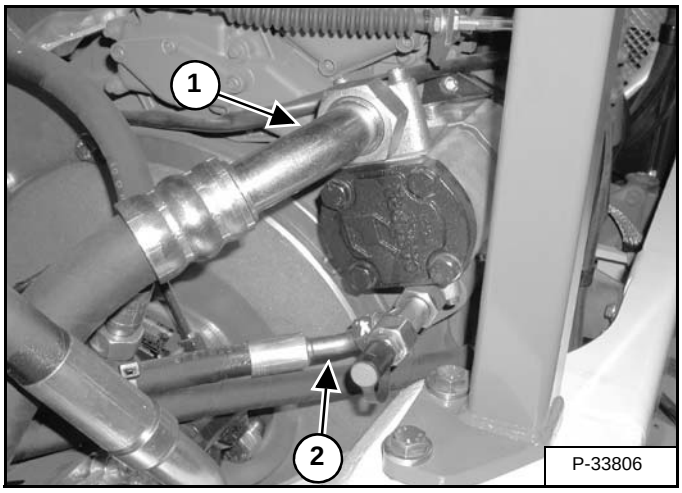
Open the right side cover. (See Opening And Closing The Right Side Cover on Page 10-41-1.)

Figure 20-51-1



Remove the hose (Item 1) **[Figure 20-51-1]**.

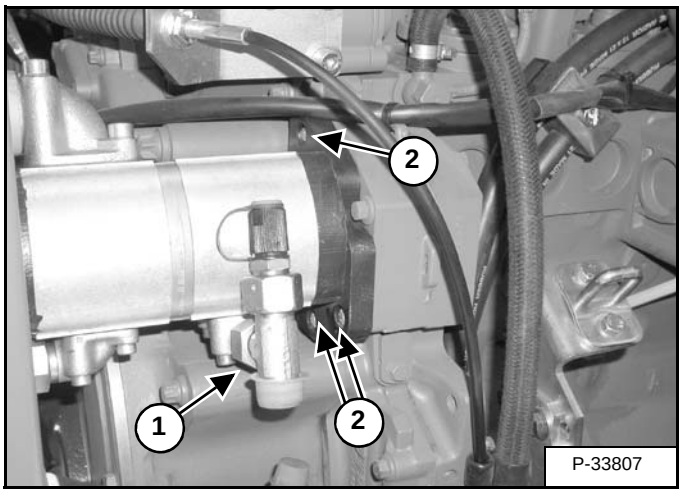
Figure 20-51- 2



Remove the supply hose (Item 1) **[Figure 20-51- 2]**.

Remove the hose (Item 2) **[Figure 20-51- 2]**.

Figure 20-51- 3



Remove the tee fitting (Item 1) **[Figure 20-51- 3]**.

Remove the three mount bolts (Item 2) **[Figure 20-51- 3]**

Installation: Tighten the bolts to 22-26 ft.-lb. (30-35 N•m) torque.

Remove the pump.

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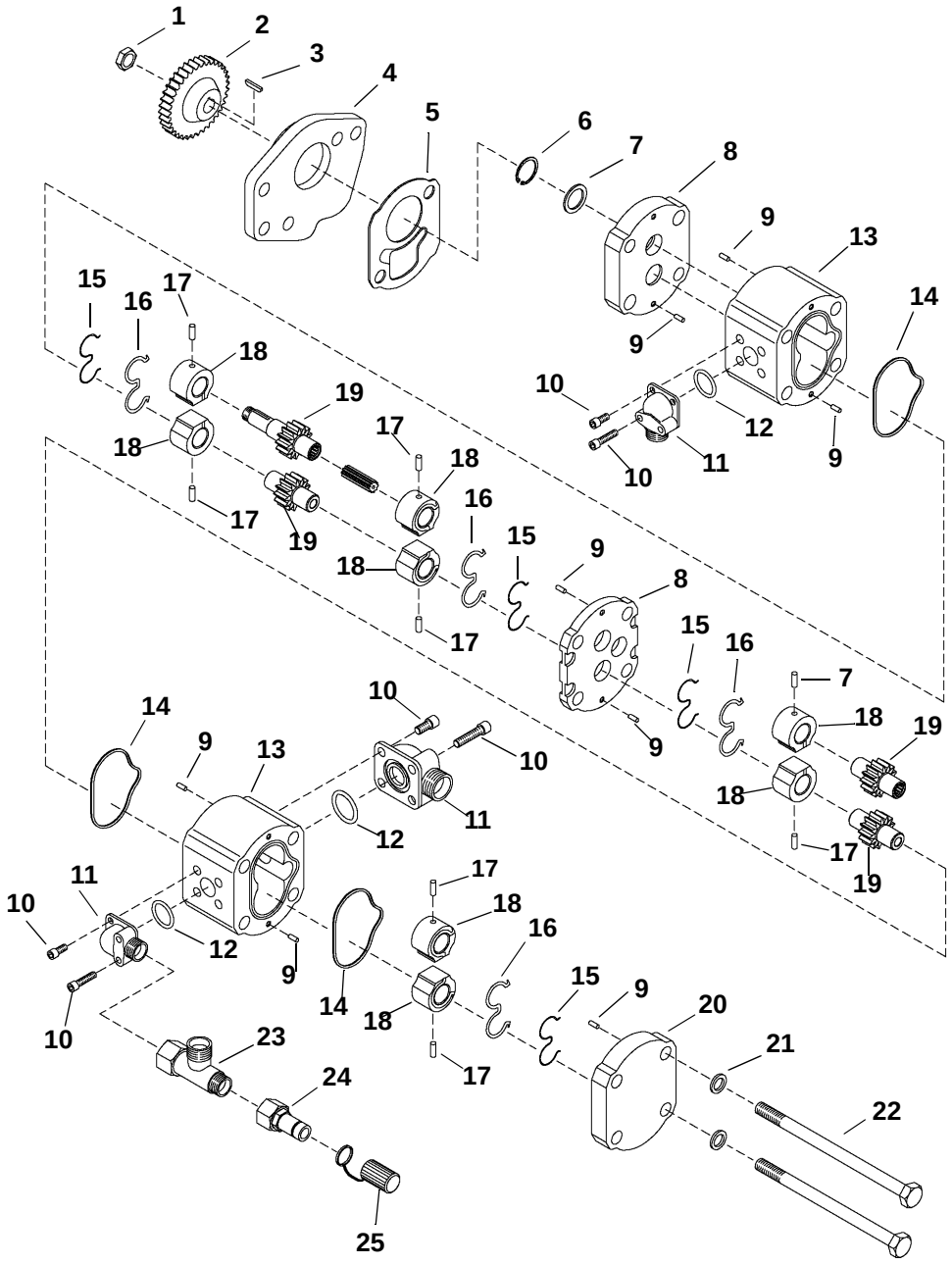
Parts Identification

1 Nut
2 Gear
3 Key
4 Plate Mount
5 Gasket
6 Snap Ring
7 Seal
8 Plate
9 Dowel Pin
10 Bolt
11 Fitting
12 O-Ring
13 Housing
14 O-Ring
15 Load Seal
16 Load Seal Backup Ring
17 Plug
18 Bearing
19 Gear
20 End Cap
21 Washer
22 Bolt
23 Tee Fitting
24 Diagnostic Coupler
25 Cap



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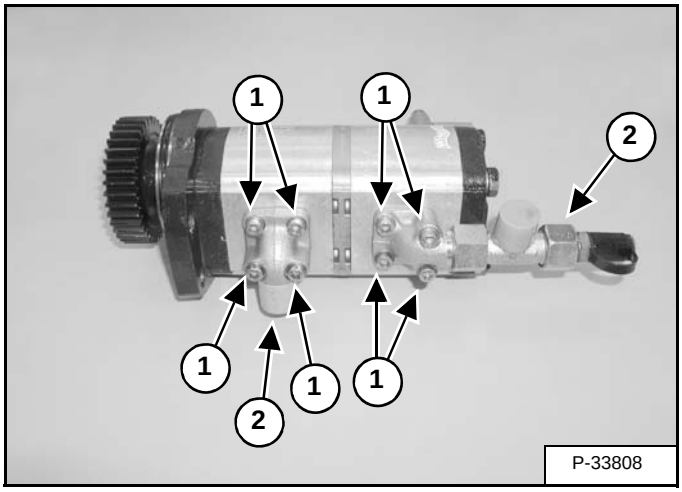
HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) (CONT'D)

Disassembly

Figure 20-51- 4



Mark and remove the bolts (Item 1) and remove the fittings (Item 2) **[Figure 20-51- 4]**.

NOTE: Two different bolt lengths are used. Mark the bolts before removal for correct installation.

Figure 20-51- 5

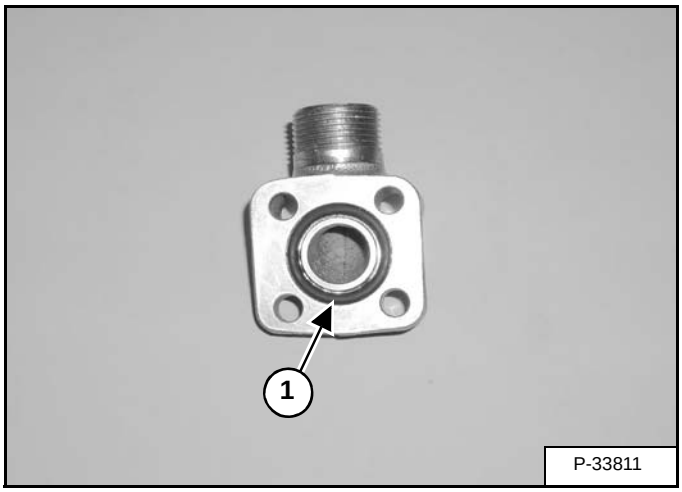
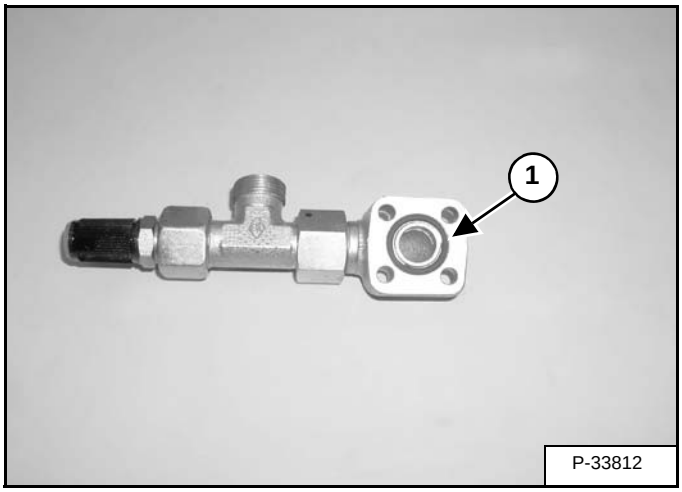


Figure 20-51- 6



Remove the O-ring (Item 1) **[Figure 20-51- 5]** & **[Figure 20-51- 6]**.

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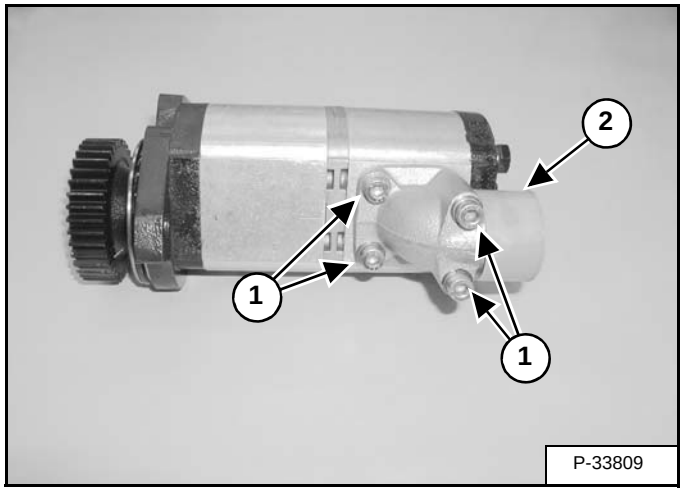
HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) (CONT'D)

Disassembly (Cont'd)

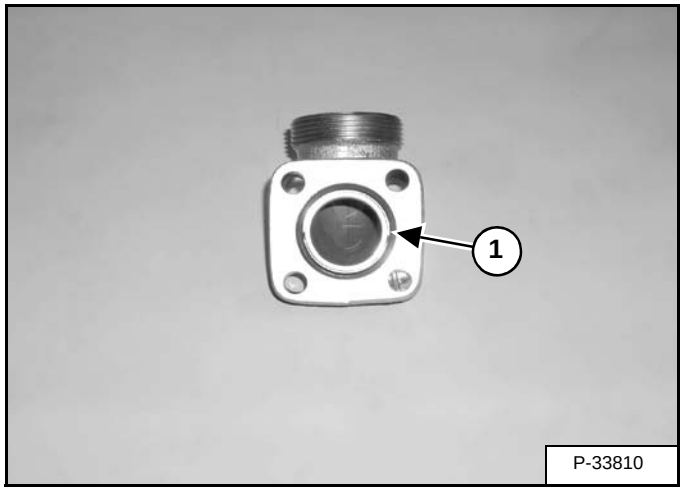
Figure 20-51- 7



Mark and remove the bolts (Item 1) and remove the supply line fitting (Item 2) **[Figure 20-51- 7]**.

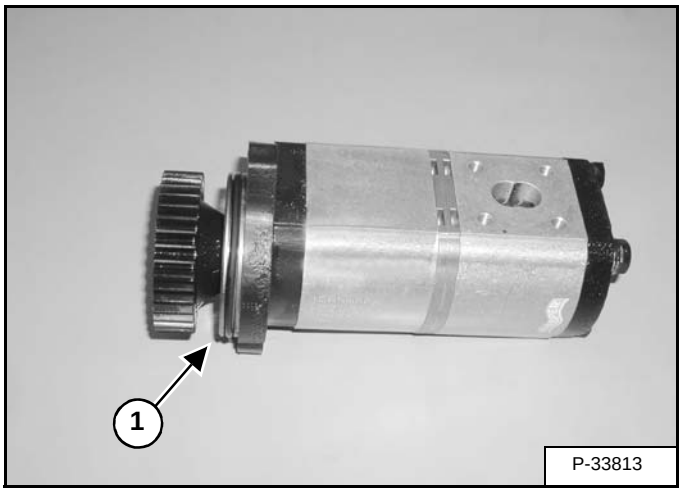
NOTE: Two different bolt lengths are used. Mark the bolts before removal for correct installation.

Figure 20-51- 8



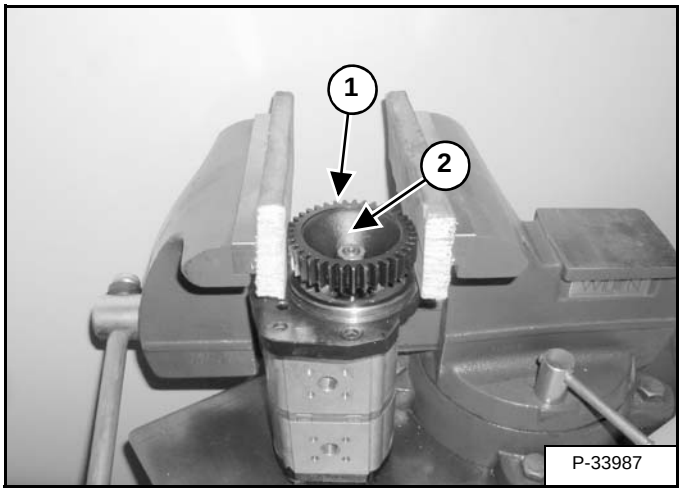
Remove the O-ring (Item 1) **[Figure 20-51- 8]** from the supply hose fitting.

Figure 20-51- 9



Remove the O-ring (Item 1) **[Figure 20-51- 9]** from the pump.

Figure 20-51- 10



Place the pump coupler (Item 1) **[Figure 20-51- 10]** in a vise that is equipped with soft jaws.

Loosen the nut (Item 2) **[Figure 20-51- 10]**.

Remove the pump from the vise and remove the nut.

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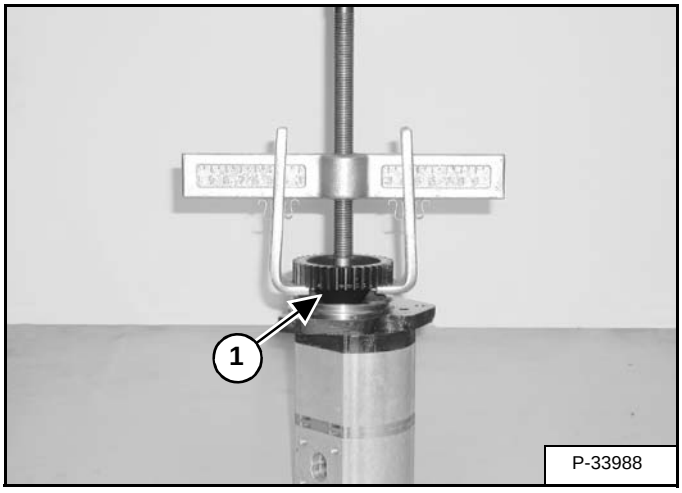
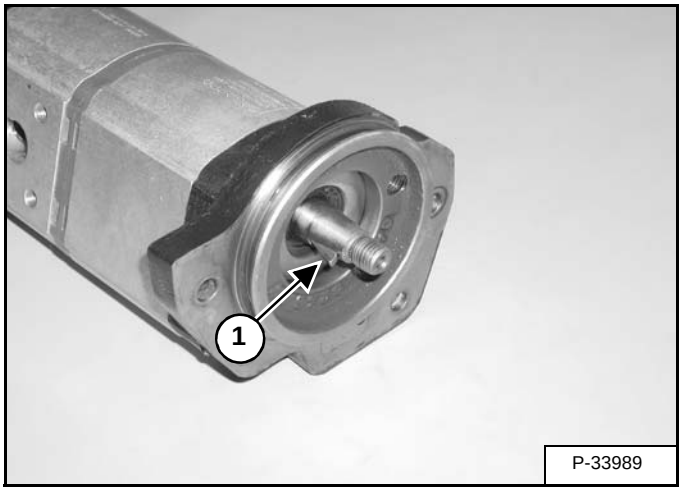
Disassembly (Cont'd)

Figure 20-51- 11



Use a puller to remove the pump coupler (Item 1) **[Figure 20-51- 11]**.

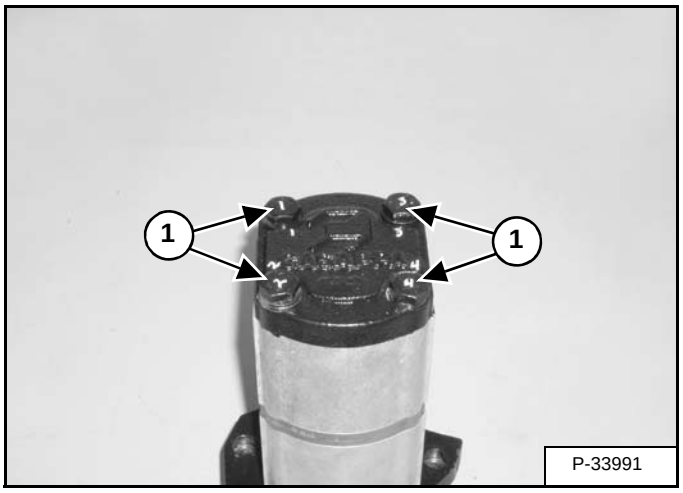
Figure 20-51- 12



Remove the key (Item 1) **[Figure 20-51- 12]** from the pump shaft.

Mark the pump sections for ease of assembly.

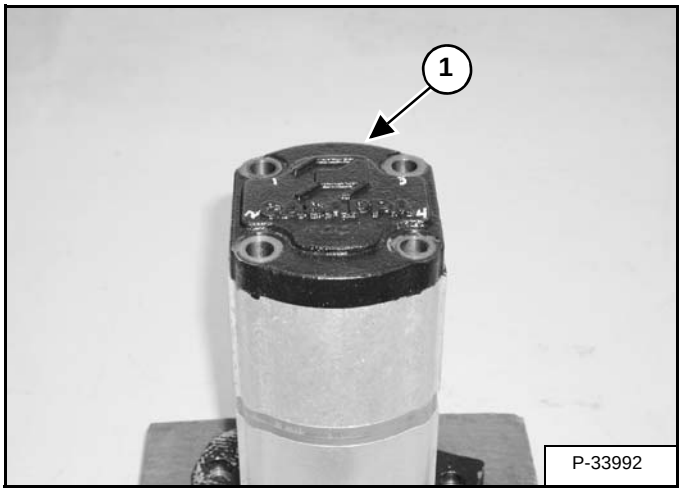
Figure 20-51- 13



Mark and remove the bolts (Item 1) **[Figure 20-51- 13]** and washers.

NOTE: Different length bolts are used. Mark the bolts before removal for correct installation.

Figure 20-51- 14



Remove the end cap (Item 1) **[Figure 20-51- 14]**.

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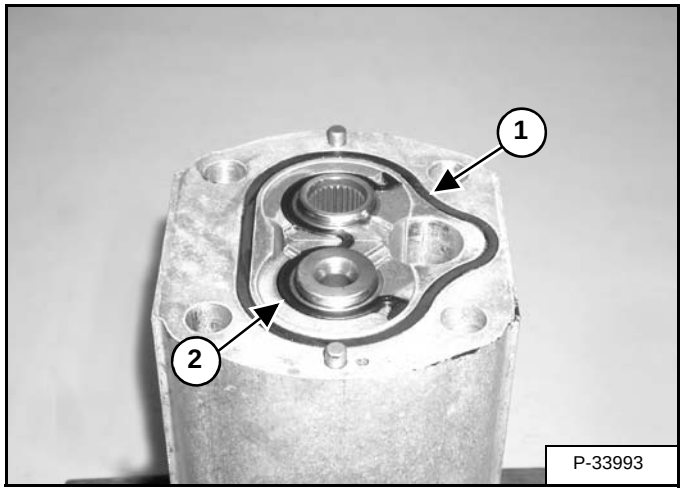
HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) (CONT'D)

Disassembly (Cont'd)

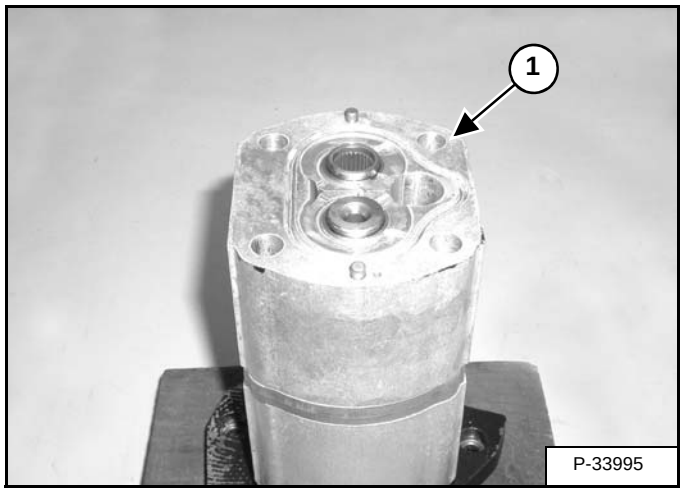
Figure 20-51- 15



Remove the O-ring (Item 1) **[Figure 20-51- 15]**.

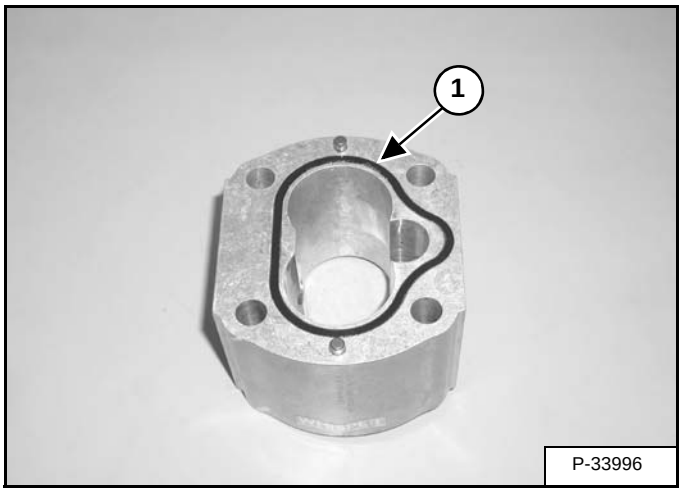
Remove the load seal and load seal backup ring (Item 2) **[Figure 20-51- 15]**.

Figure 20-51- 16



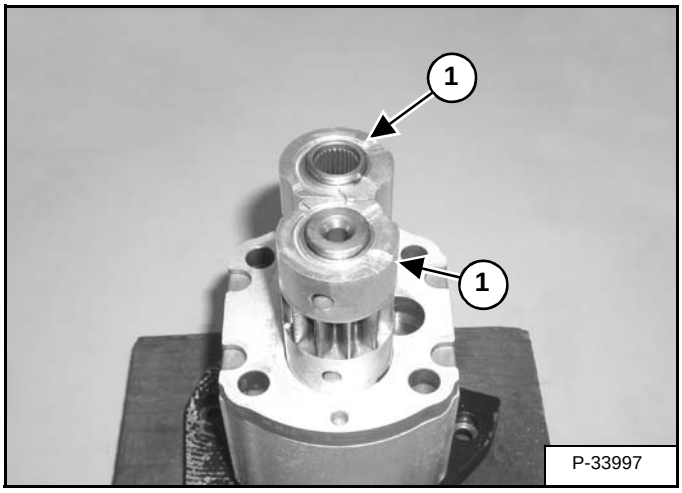
Remove the housing (Item 1) **[Figure 20-51- 16]**.

Figure 20-51- 17



Remove the O-ring (Item 1) **[Figure 20-51- 17]**.

Figure 20-51- 18



Remove the bearings (Item 1) **[Figure 20-51- 18]**.

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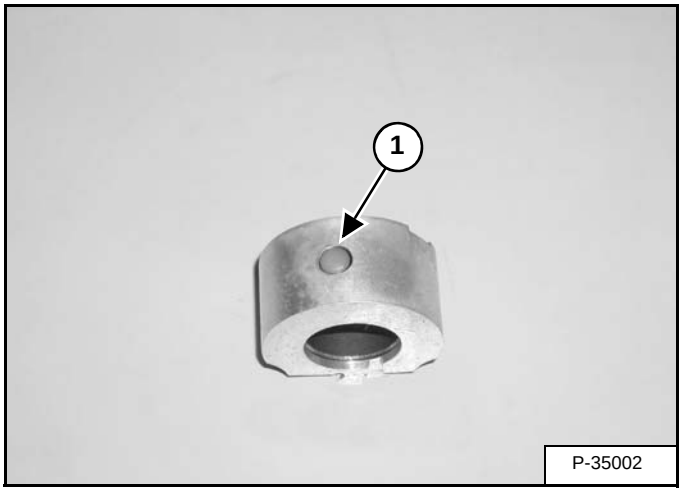
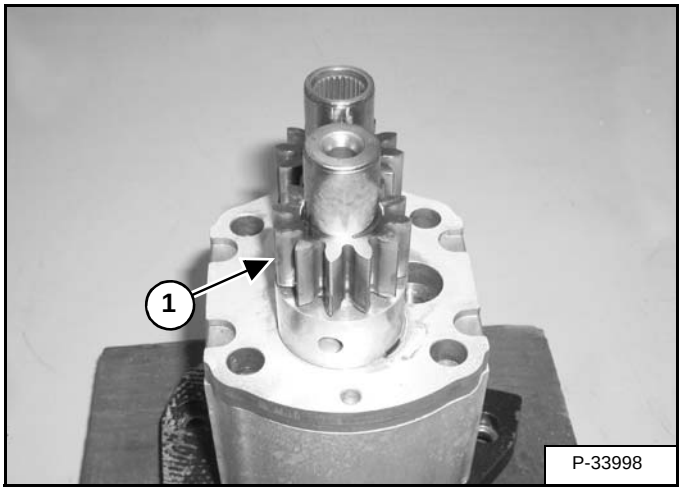
Disassembly (Cont'd)

Figure 20-51- 19



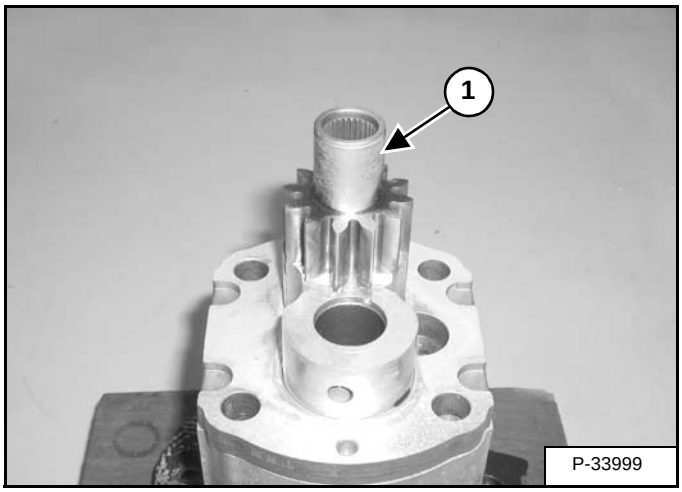
Remove the plug (Item 1) **[Figure 20-51- 19]** from both bearings.

Figure 20-51- 20



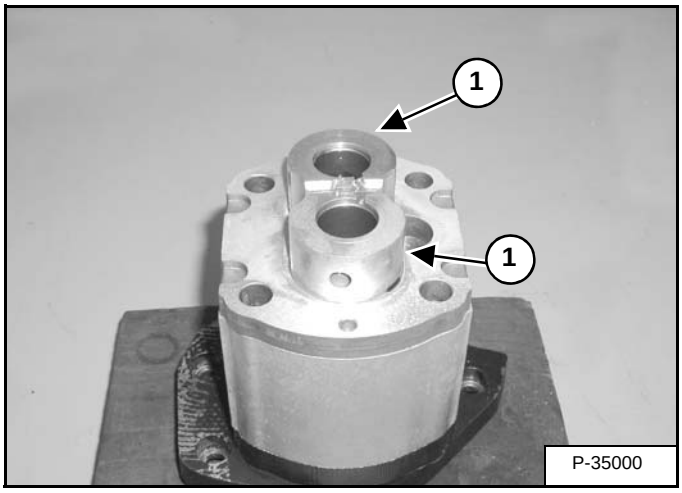
Remove the gear (Item 1) **[Figure 20-51- 20]**.

Figure 20-51- 21



Remove the gear (Item 1) **[Figure 20-51- 21]**.

Figure 20-51- 22



Remove the bearings (Item 1) **[Figure 20-51- 22]**.

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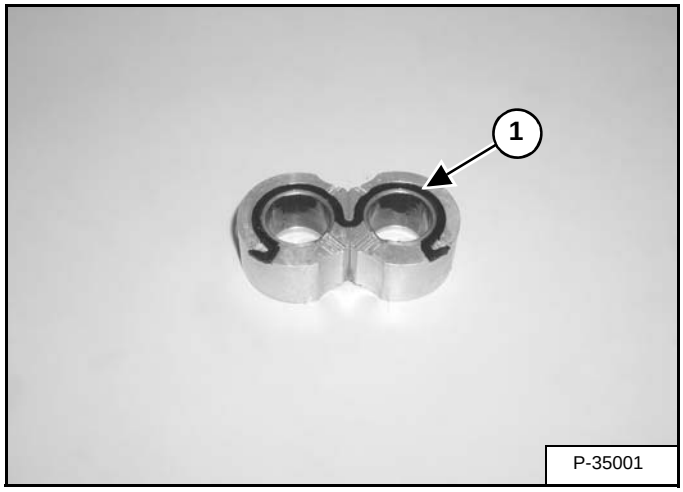
HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) (CONT'D)

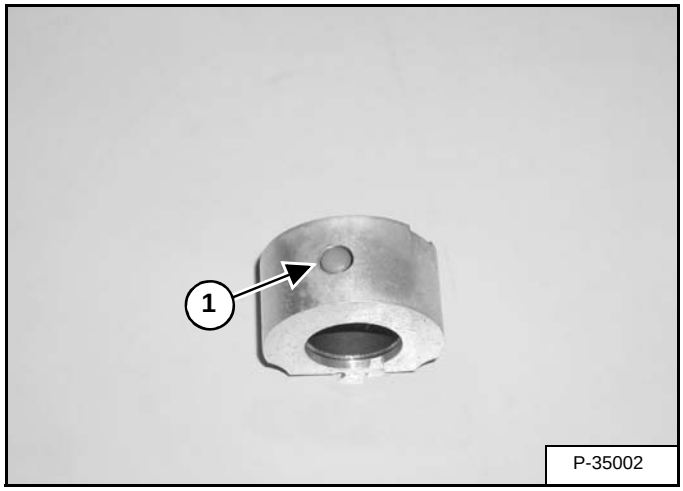
Disassembly (Cont'd)

Figure 20-51- 23



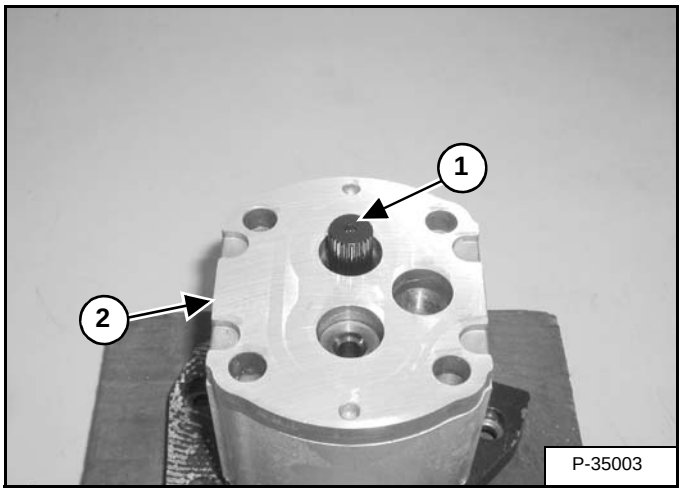
Remove the load seal and load seal back-up ring (Item 1) **[Figure 20-51- 23]**.

Figure 20-51- 24



Remove the plug (Item 1) **[Figure 20-51- 24]** from both bearings.

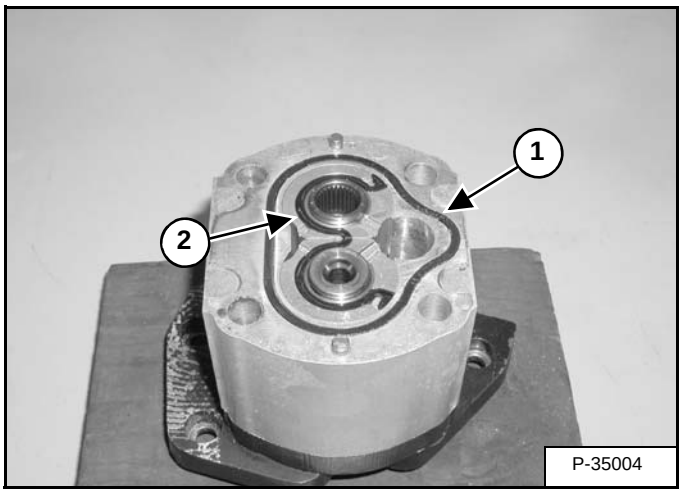
Figure 20-51- 25



Remove the drive shaft (Item 1) **[Figure 20-51- 25]**.

Remove the plate (Item 2) **[Figure 20-51- 25]**.

Figure 20-51- 26



Remove the O-ring (Item 1) **[Figure 20-51- 26]**.

Remove the load seal and load seal back-up ring (Item 2) **[Figure 20-51- 26]**.

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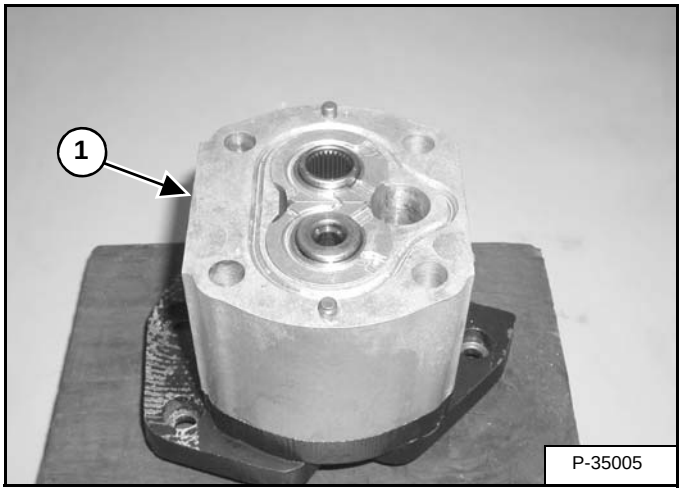
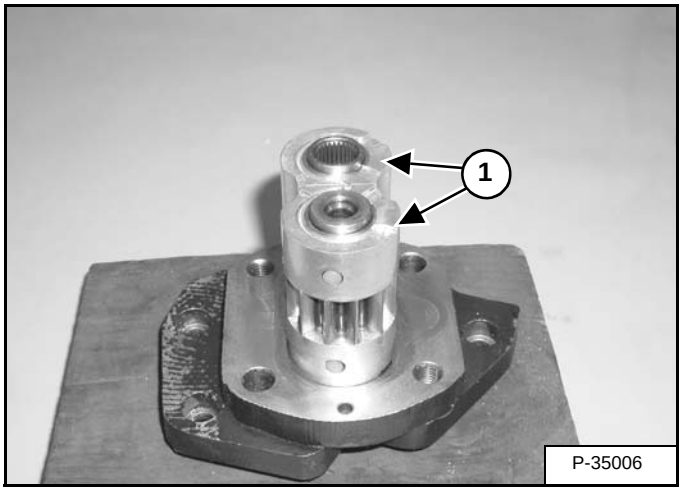
Disassembly (Cont'd)

Figure 20-51- 27



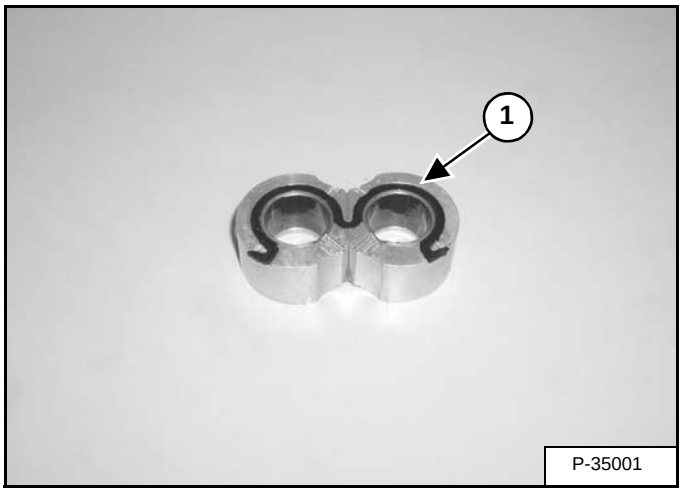
Remove the housing (Item 1) **[Figure 20-51- 27]**.

Figure 20-51- 28



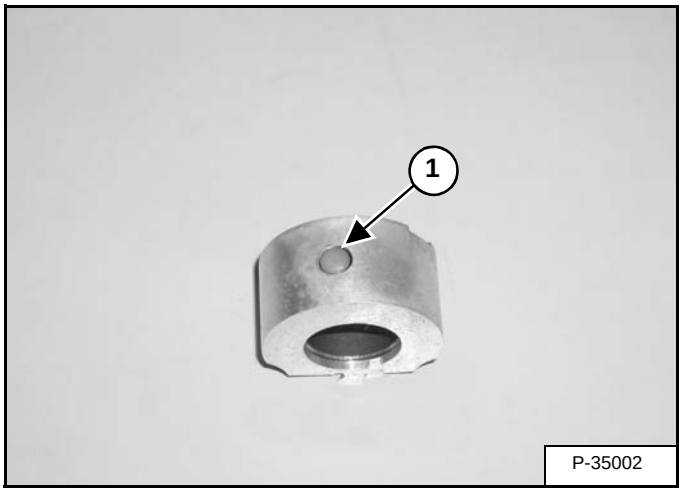
Remove the bearings (Item 1) **[Figure 20-51- 28]**.

Figure 20-51- 29



Remove the load seal and load seal back-up ring (Item 1) **[Figure 20-51- 29]**.

Figure 20-51- 30



Remove the plug (Item 1) **[Figure 20-51- 30]** from both bearings.

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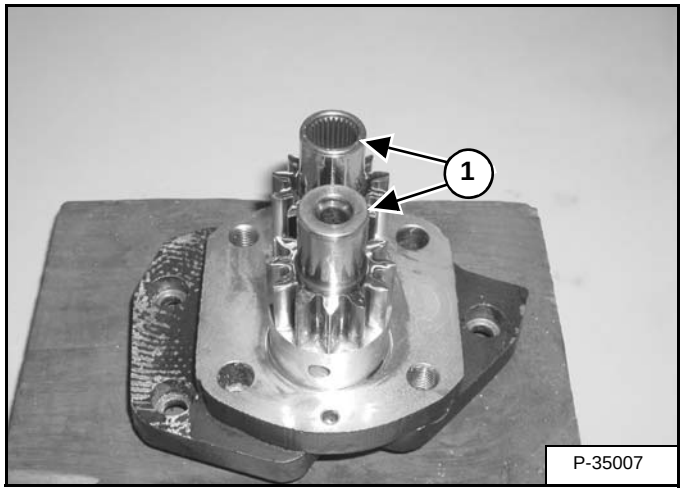
HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) (CONT'D)

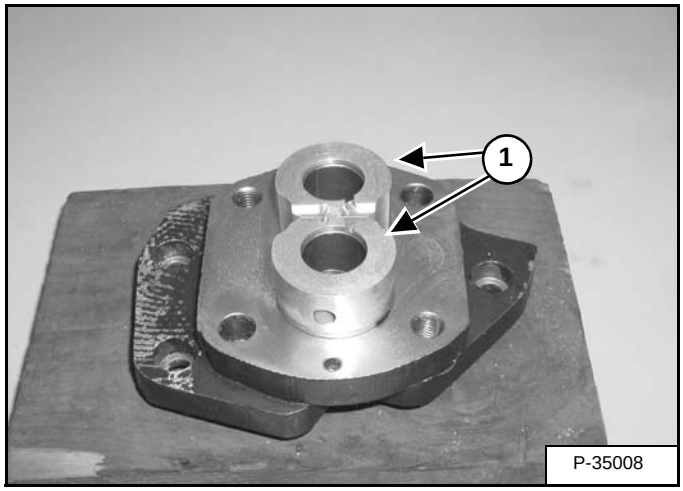
Disassembly (Cont'd)

Figure 20-51- 31



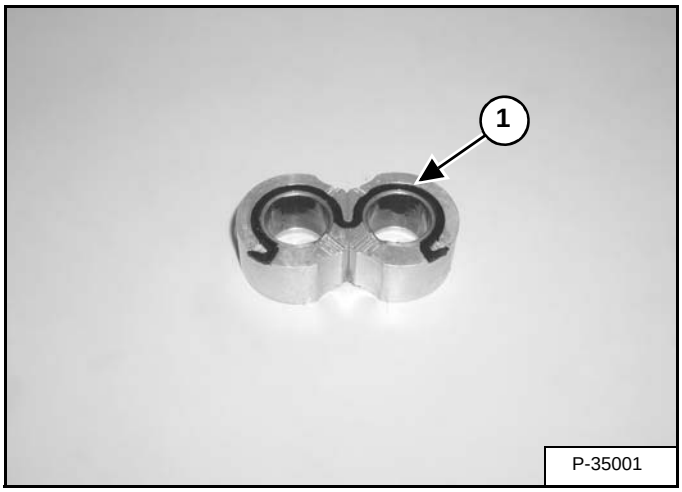
Remove the gears (Item 1) **[Figure 20-51- 31]**.

Figure 20-51- 32



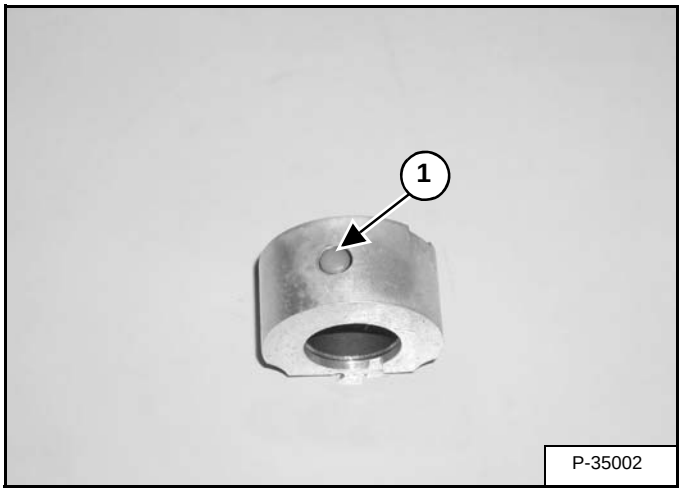
Remove the bearings (Item 1) **[Figure 20-51- 32]**.

Figure 20-51- 33



Remove the load seal and load seal back-up ring (Item 1) **[Figure 20-51- 33]**.

Figure 20-51- 34



Remove the plug (Item 1) **[Figure 20-51- 34]** from both bearings.

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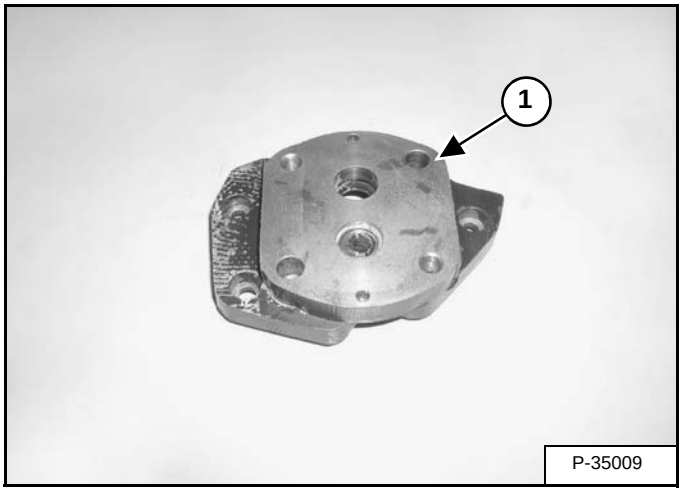
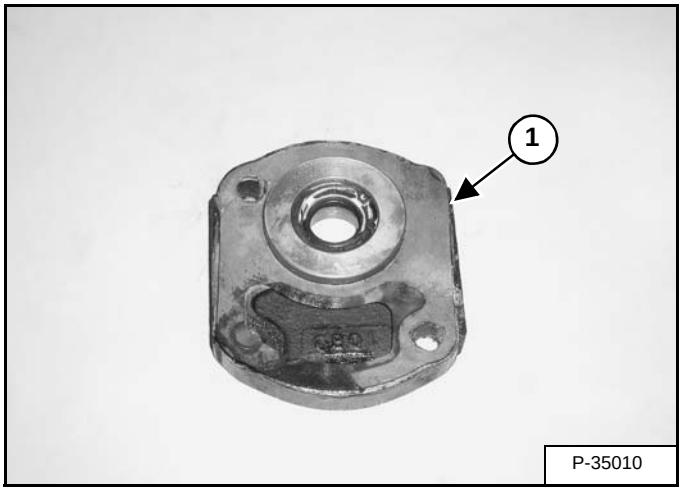
Disassembly (Cont'd)

Figure 20-51- 35



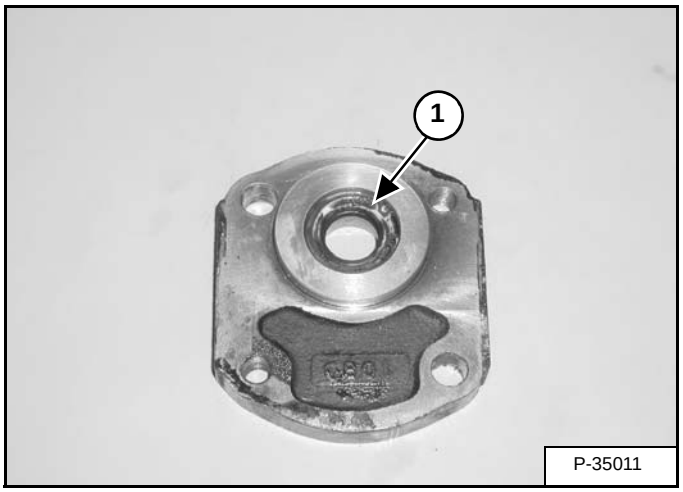
Remove the plate (Item 1) **[Figure 20-51- 35]** from the mount.

Figure 20-51- 36



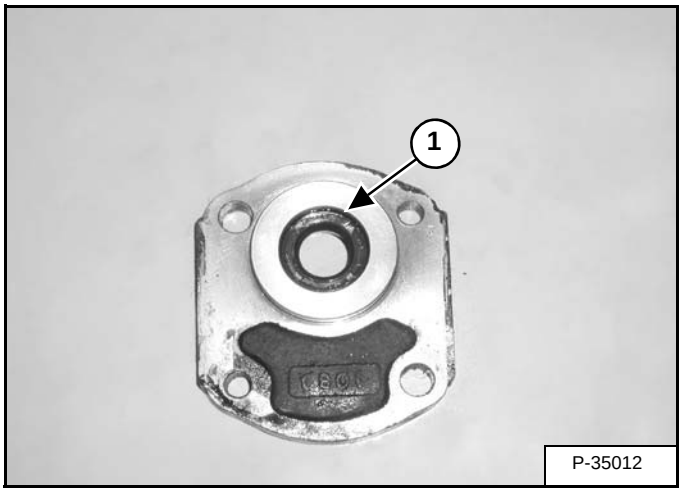
Remove the gasket (Item 1) **[Figure 20-51- 36]**.

Figure 20-51- 37



Remove the snap ring (Item 1) **[Figure 20-51- 37]**.

Figure 20-51- 38



Remove the seal (Item 1) **[Figure 20-51- 38]**.

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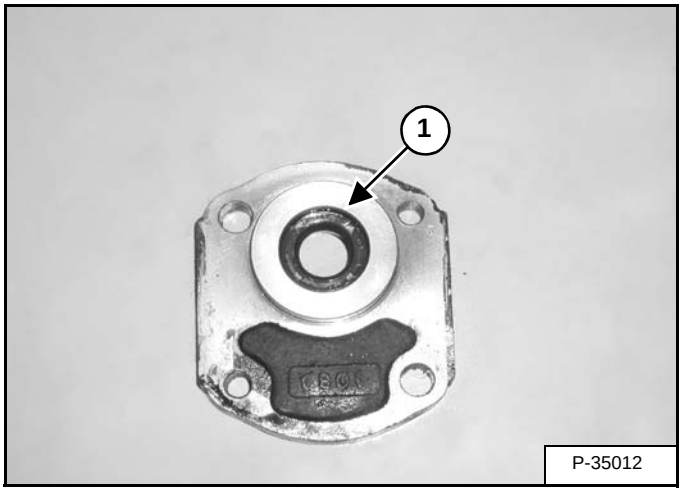
Assembly

Clean all parts in solvent and dry with compressed air.

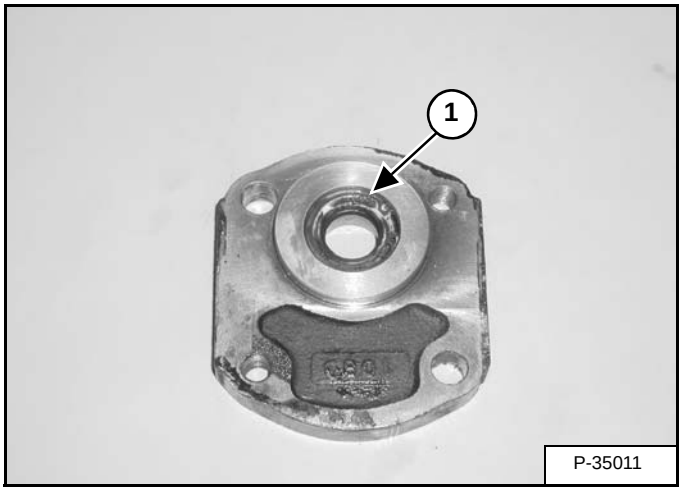
Apply clean hydraulic oil or assembly lube on the new O-rings and seals.

Figure 20-51- 39



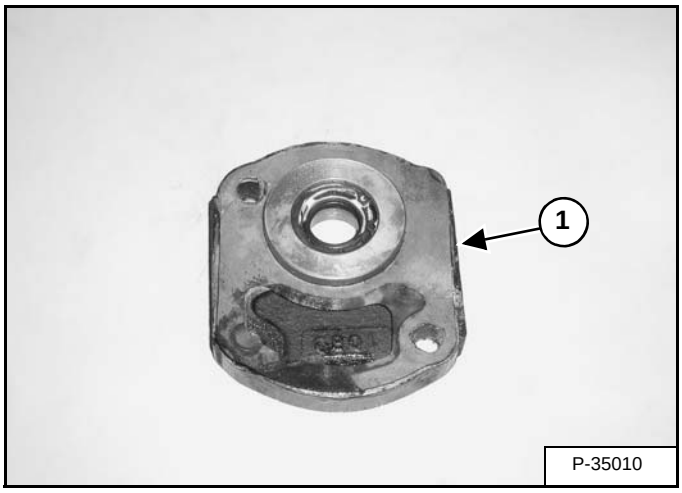
Install the seal (Item 1) **[Figure 20-51- 39]**.

Figure 20-51- 40



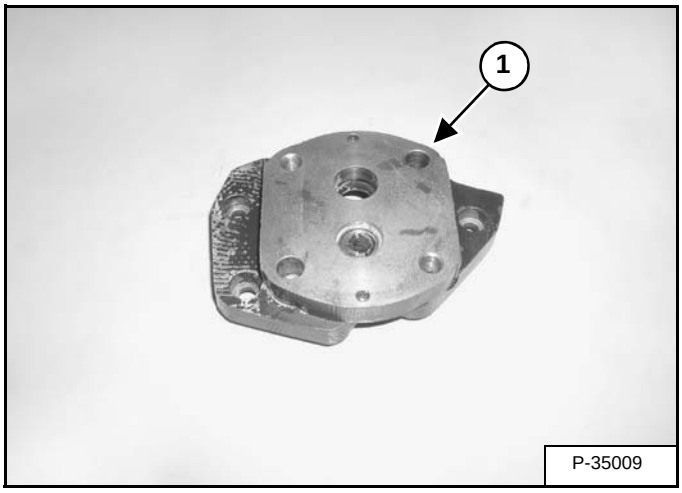
Install the snap ring (Item 1) **[Figure 20-51- 40]**.

Figure 20-51- 41



Install the gasket (Item 1) **[Figure 20-51- 41]**.

Figure 20-51- 42



Install the plate (Item 1) **[Figure 20-51- 42]**.

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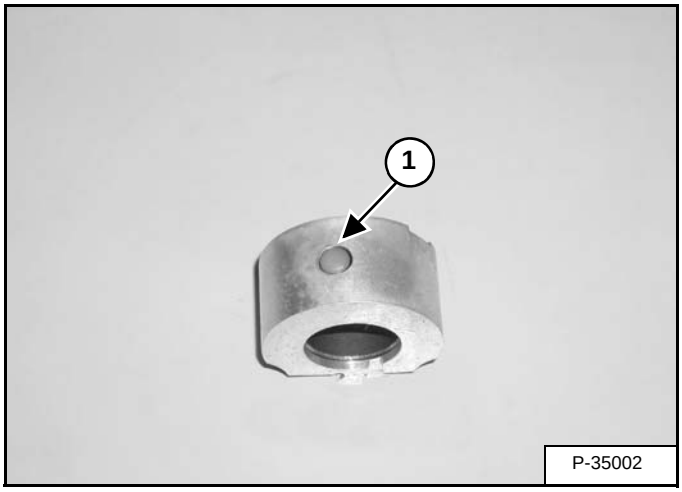
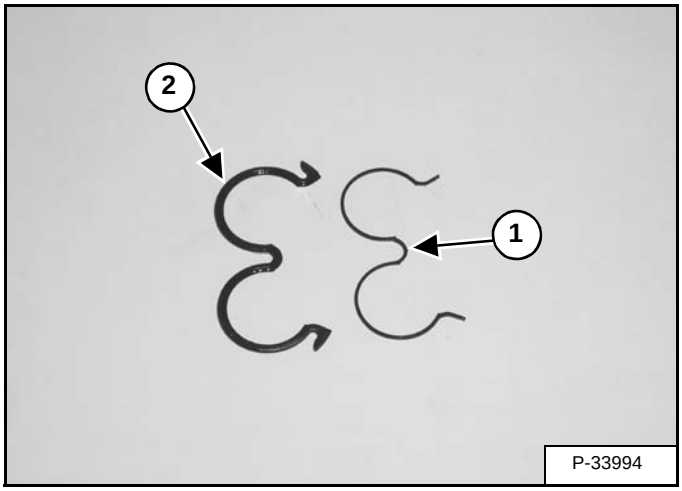
Assembly (Cont'd)

Figure 20-51- 43



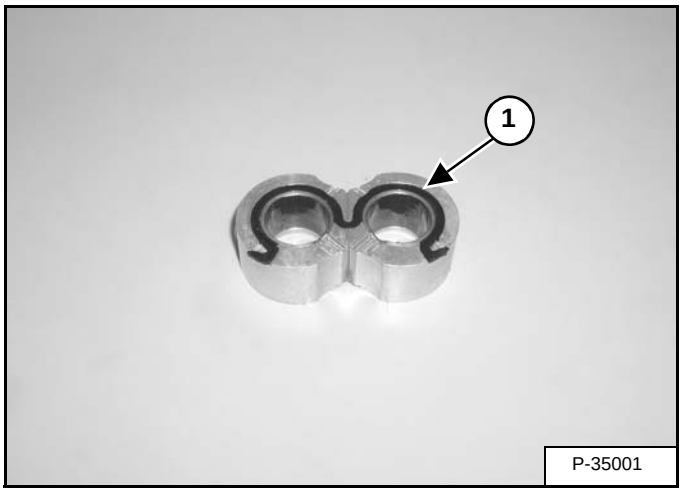
Install the plug (Item 1) **[Figure 20-51- 43]** in the bearings.

Figure 20-51- 44



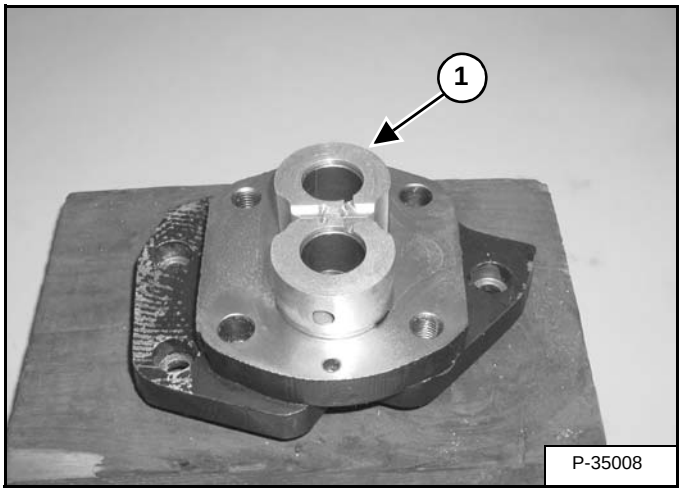
Install the load seal back-up ring (Item 1) in the groove of the load seal (Item 2) **[Figure 20-51- 44]**.

Figure 20-51- 45



Position the bearings as shown and install the load seal and load seal back-up ring (Item 1) **[Figure 20-51- 45]**.

Figure 20-51- 46



Turn the bearing assembly over and install the bearings (Item 1) **[Figure 20-51- 46]** on the plate.

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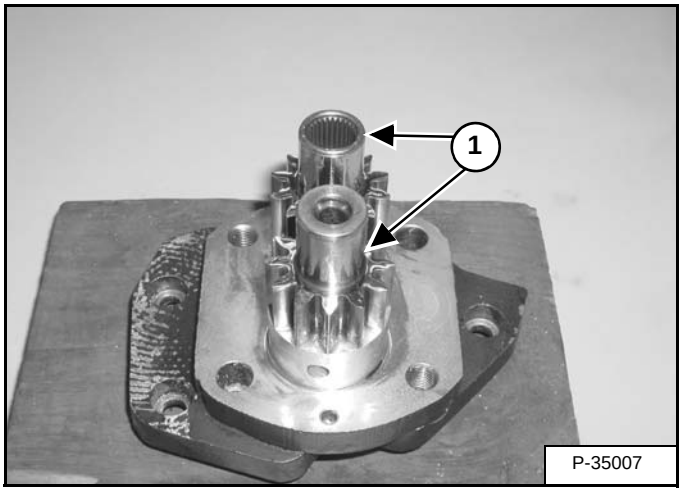
HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) (CONT'D)

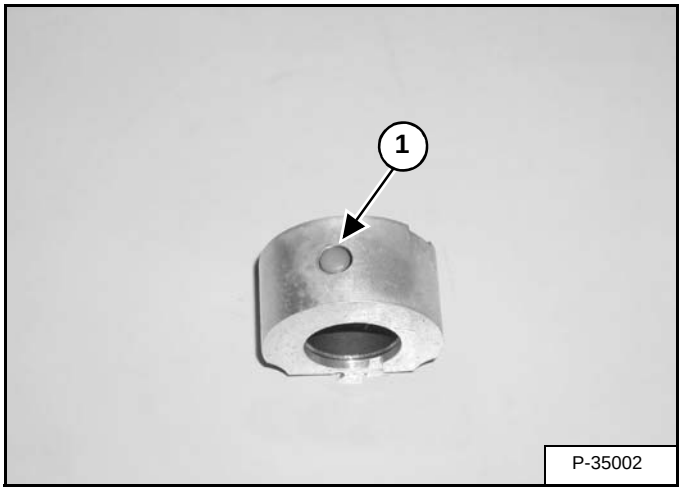
Assembly (Cont'd)

Figure 20-51- 47



Install the gears (Item 1) **[Figure 20-51- 47]**.

Figure 20-51- 48



Install the plug (Item 1) **[Figure 20-51- 48]** in the bearings.

Figure 20-51- 49

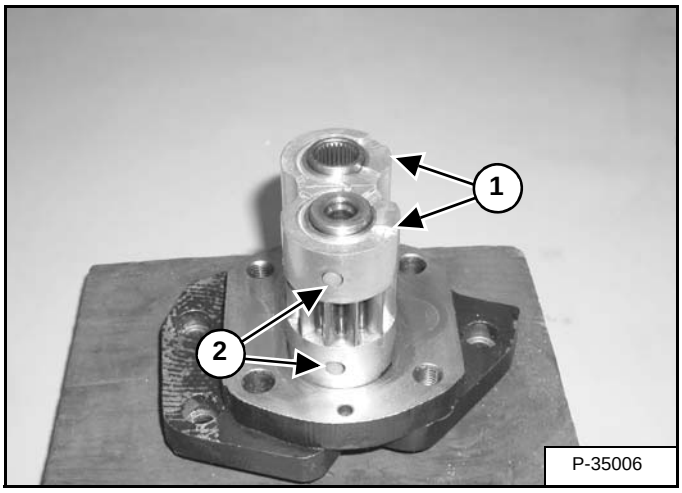
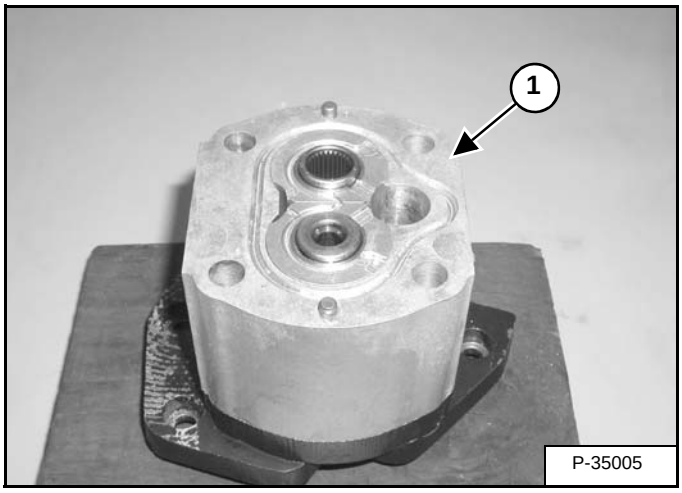


Figure 20-51- 50



Install the bearings (Item 1) Press in on the plugs (Item 2) **[Figure 20-51- 49]** and install the housing (Item 1) **[Figure 20-51- 50]**.

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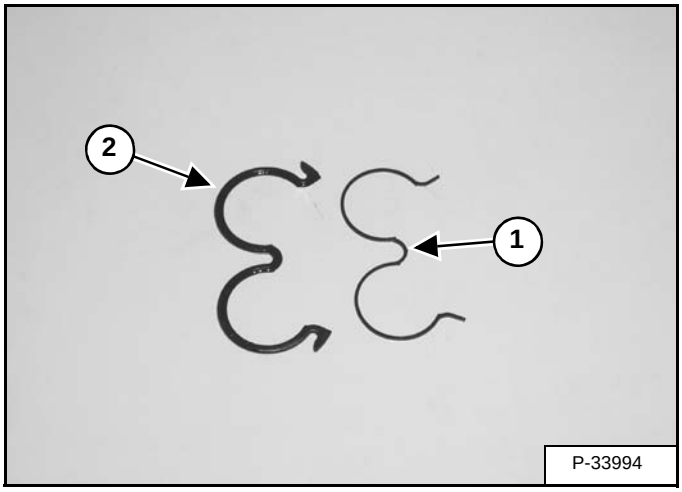
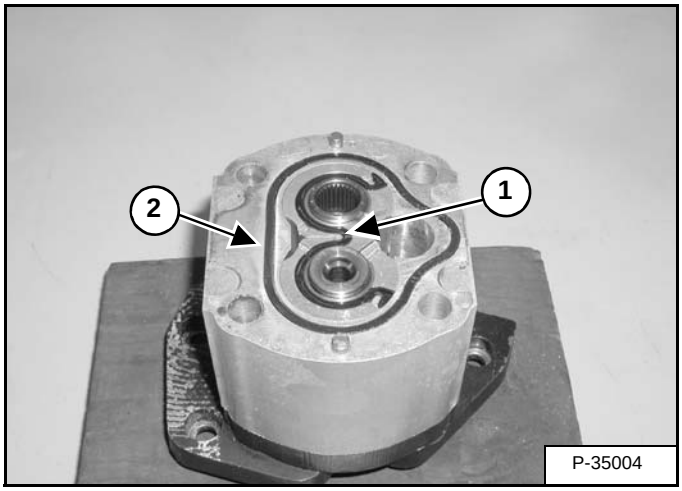
Assembly (Cont'd)

Figure 20-51- 51



Install the load seal back-up ring (Item 1) in the groove of the load seal (Item 2) **[Figure 20-51- 51]**.

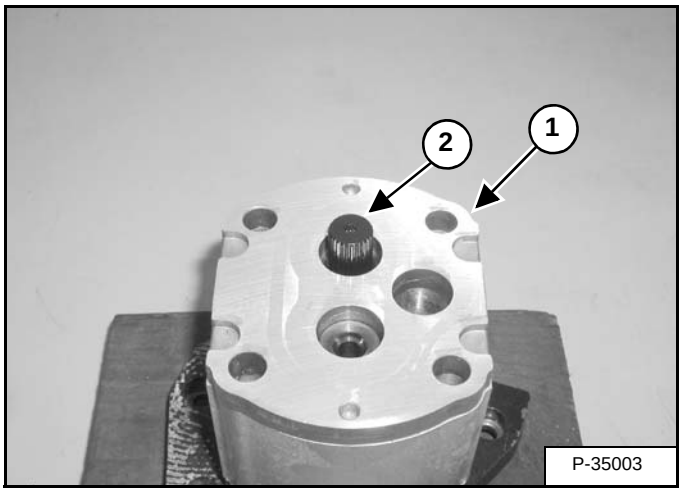
Figure 20-51- 52



Install the load seal and load seal back-up ring (Item 1) **[Figure 20-51- 52]**.

Install the O-ring (Item 2) **[Figure 20-51- 52]**.

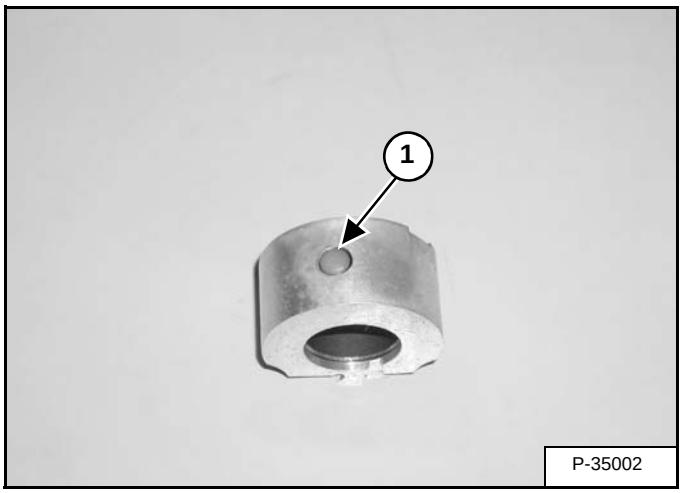
Figure 20-51- 53



Install the plate (Item 1) **[Figure 20-51- 53]**.

Install the driveshaft (Item 2) **[Figure 20-51- 53]**.

Figure 20-51- 54



Install the plug (Item 1) **[Figure 20-51- 54]** in both bearings.

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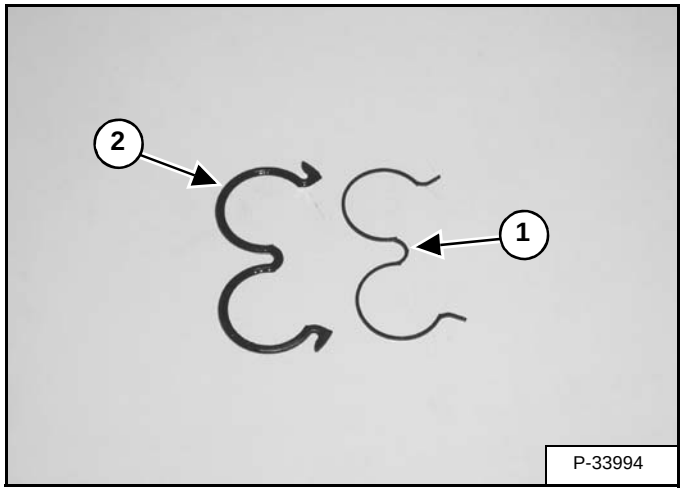
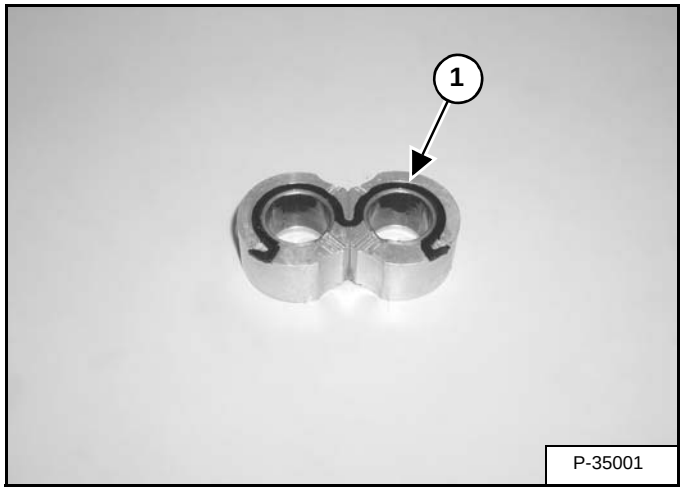
Assembly (Cont'd)

Figure 20-51- 55



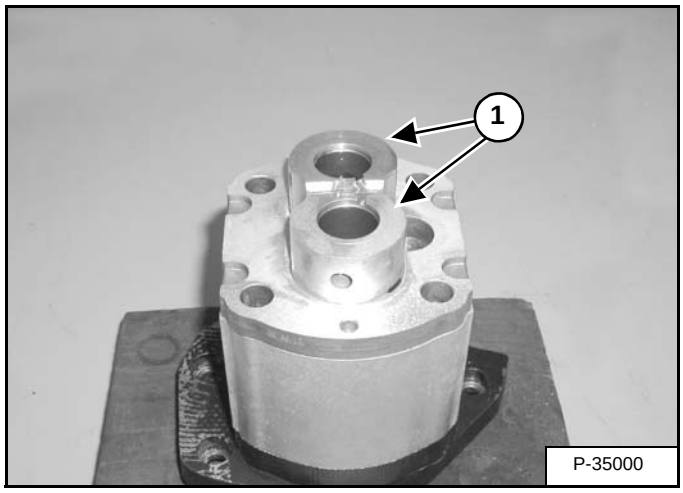
Install the load seal back-up ring (Item 1) in the groove of the load seal (Item 2) **[Figure 20-51- 55]**.

Figure 20-51- 56



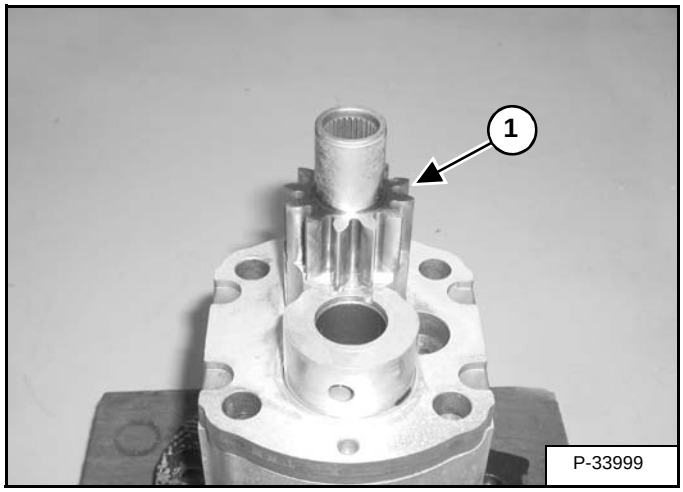
Position the bearings as shown and install the load seal and load seal back-up ring (Item 1) **[Figure 20-51- 56]**.

Figure 20-51- 57



Turn the bearing assembly over and install the bearings (Item 1) **[Figure 20-51- 57]** on the plate.

Figure 20-51- 58



Install the gear (Item 1) **[Figure 20-51- 58]**.

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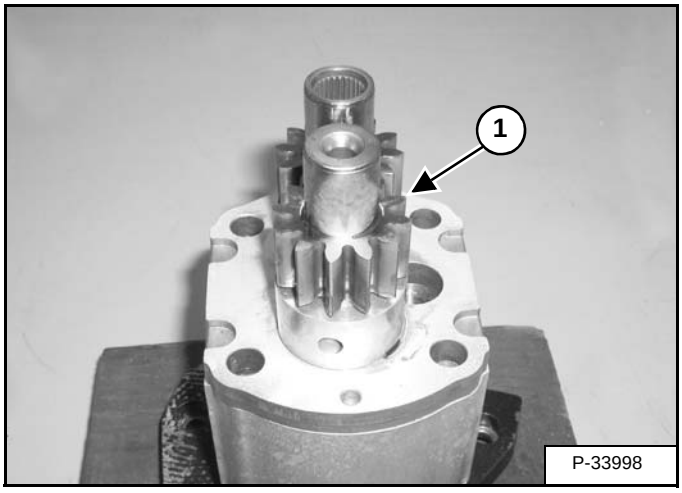
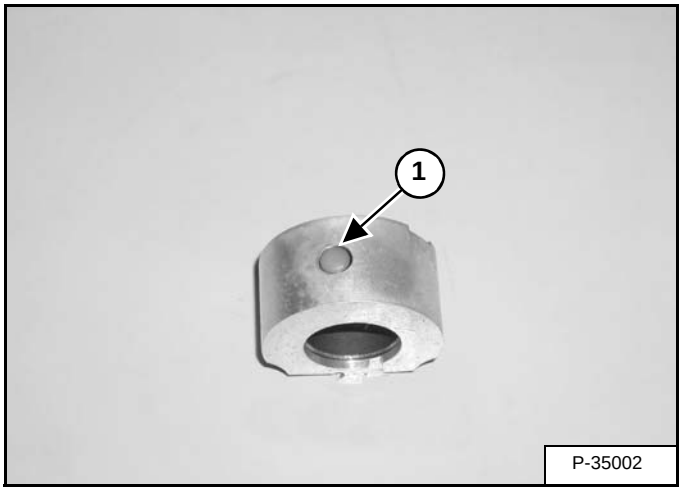
Assembly (Cont'd)

Figure 20-51- 59



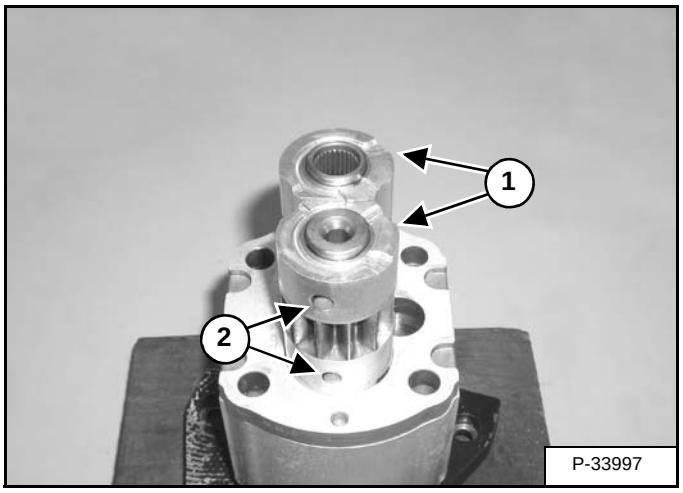
Install the gear (Item 1) **[Figure 20-51- 59]**.

Figure 20-51- 60



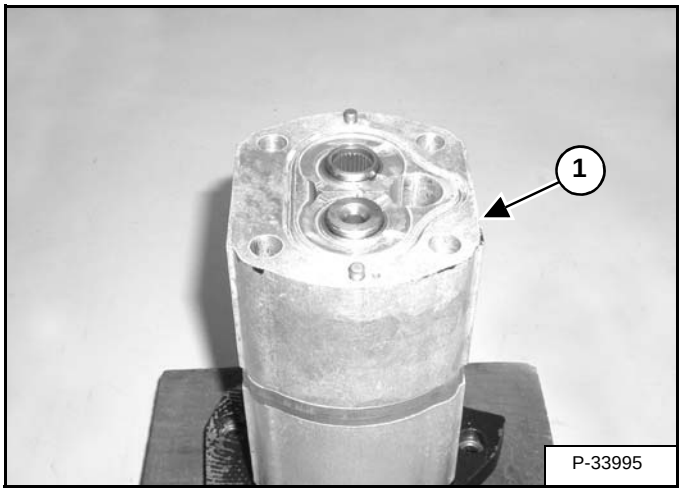
Install the plug (Item 1) **[Figure 20-51- 60]** in both bearings.

Figure 20-51- 61



Install the bearings (Item 1) **[Figure 20-51- 61]**.

Figure 20-51- 62



Press in on the plugs (Item 2) **[Figure 20-51- 61]** and install the housing (Item 1) **[Figure 20-51- 62]**.

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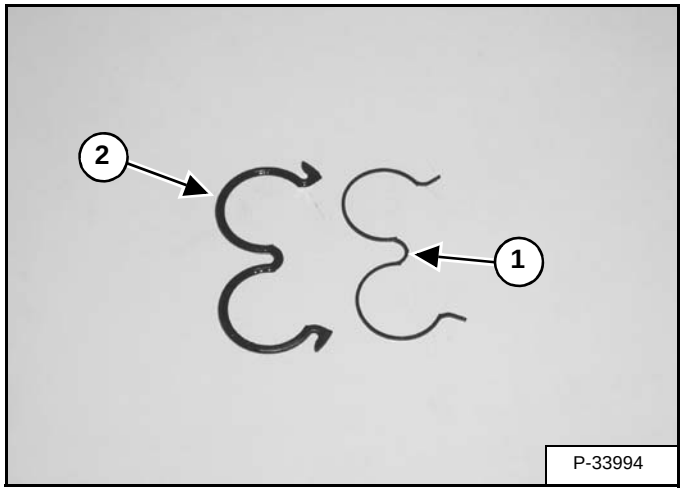
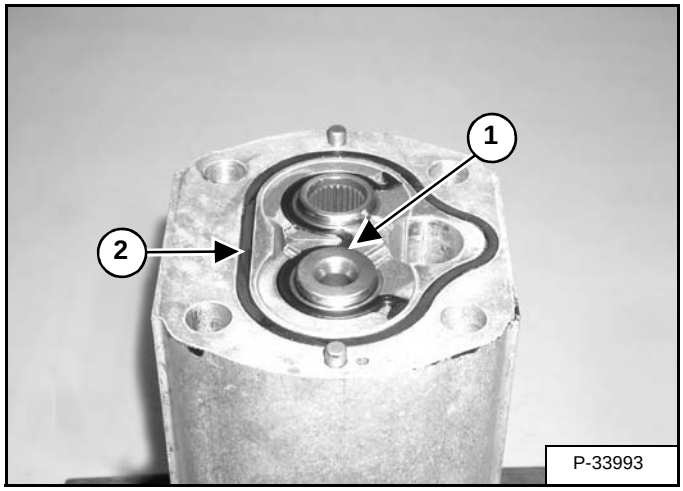
Assembly (Cont'd)

Figure 20-51- 63



Install the load seal back-up ring (Item 1) in the groove of the load seal (Item 2) **[Figure 20-51- 63]**.

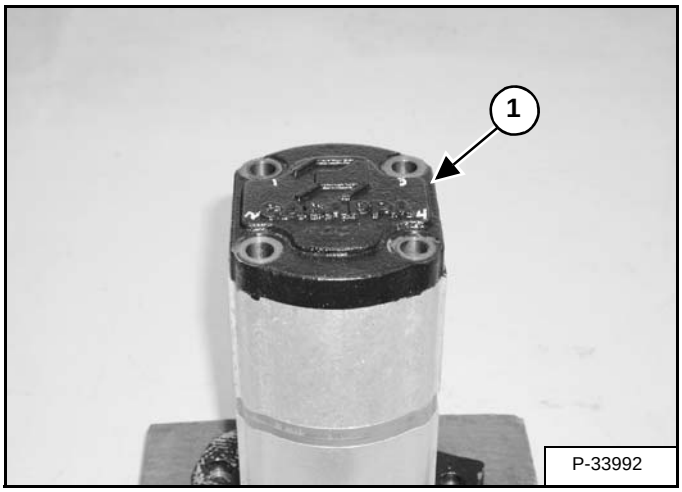
Figure 20-51- 64



Install the load seal and load seal back-up ring (Item 1) **[Figure 20-51- 64]**.

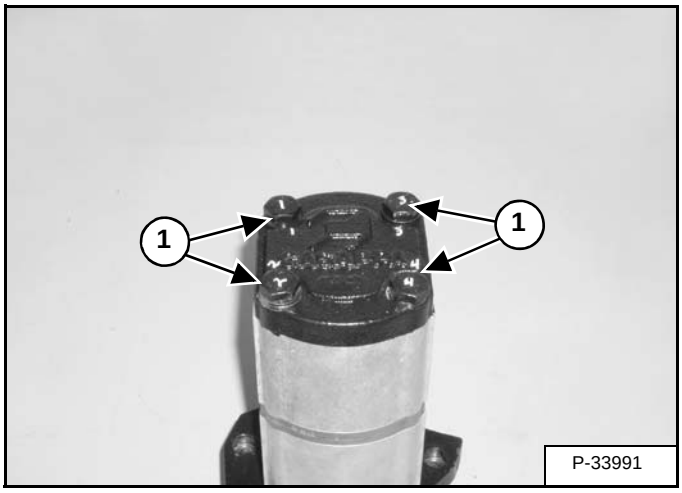
Install the O-ring (Item 2) **[Figure 20-51- 64]**.

Figure 20-51- 65



Install the end cap (Item 1) **[Figure 20-51- 65]**.

Figure 20-51- 66



Install the bolts and washers (Item 1) **[Figure 20-51- 66]**.

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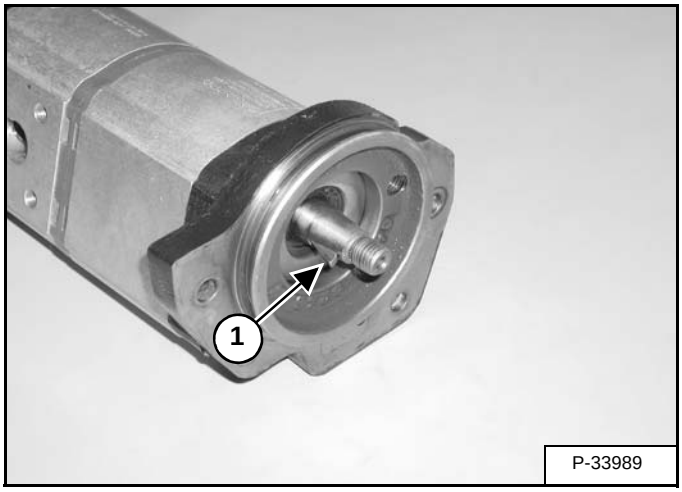
Assembly (Cont'd)

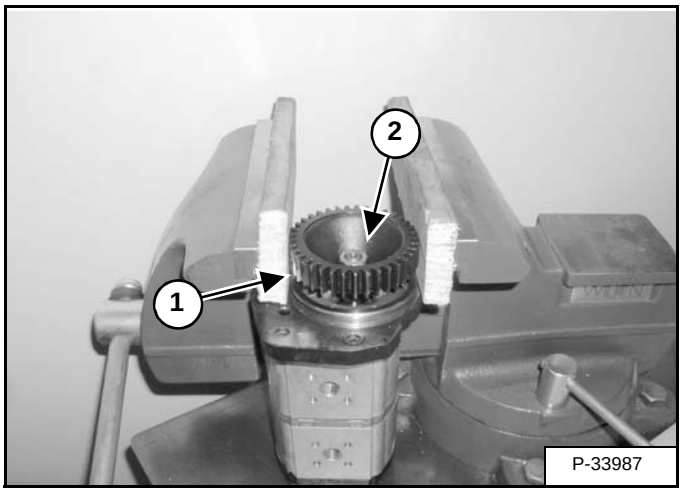
Figure 20-51- 67



Install the key (Item 1) **[Figure 20-51- 67]** on the shaft.

Install the pump coupler on the shaft.

Figure 20-51- 68



Place the pump coupler (Item 1) **[Figure 20-51- 68]** in a vise that is equipped with padded jaws.

Install the nut (Item 2) **[Figure 20-51- 68]**.

Remove the pump from the vise.

Figure 20-51- 69

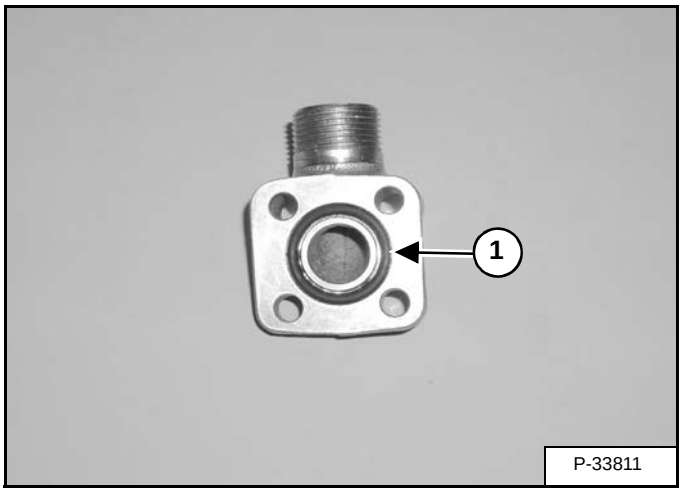
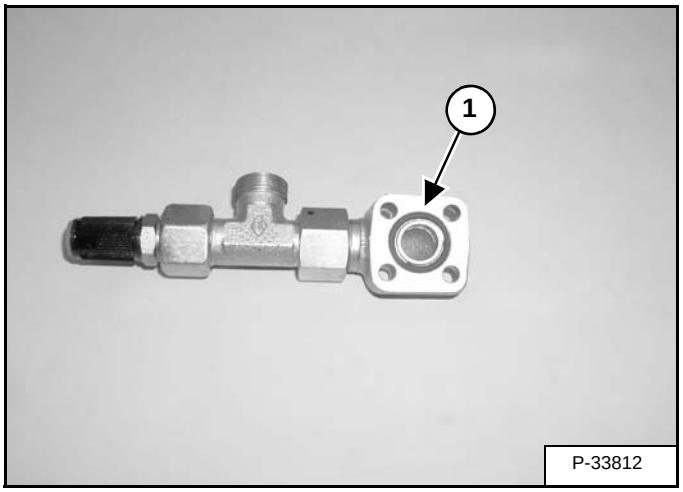


Figure 20-51- 70



Install the O-rings (Item 1) **[Figure 20-51- 69]** & **[Figure 20-51- 70]** on the high pressure fittings.

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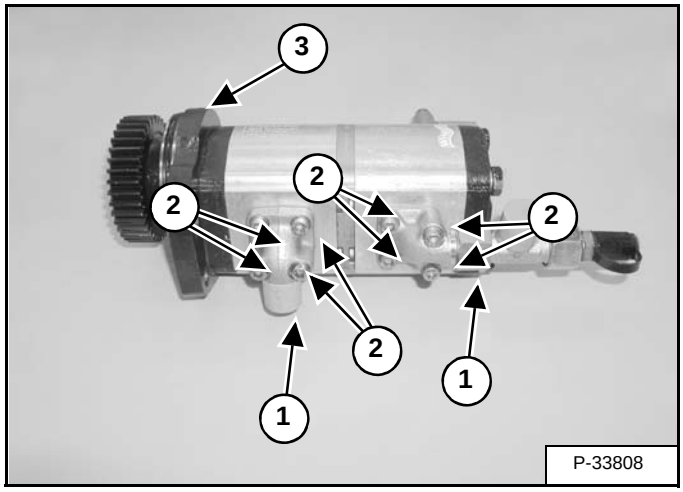
HYDRAULIC GEAR PUMP (S/N 522311001 & ABOVE) (CONT'D)

Assembly (Cont'd)

Figure 20-51- 71

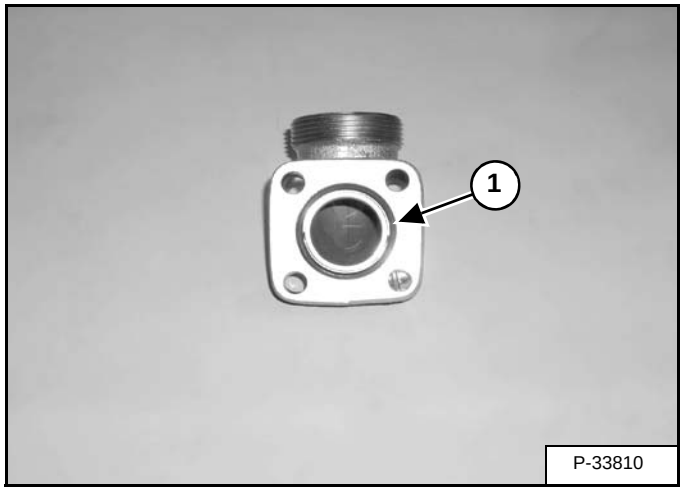


Install the fittings (Item 1) **[Figure 20-51- 71]** on the pump.

Install the bolts (Item 2) **[Figure 20-51- 71]**.

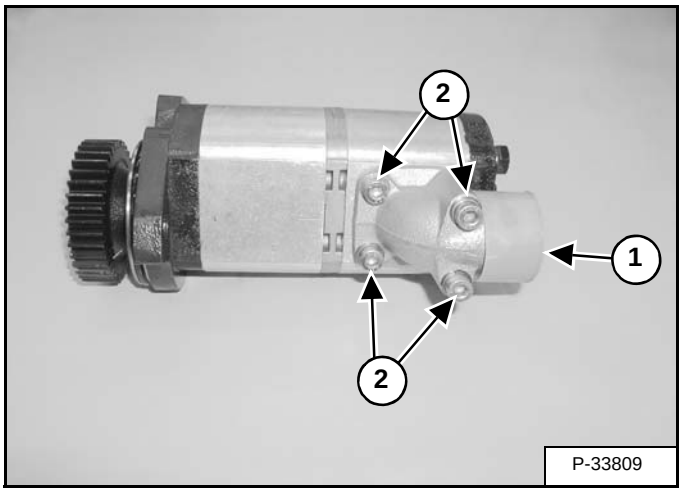
Install the O-ring (Item 3) **[Figure 20-51- 71]**.

Figure 20-51- 72



Install the O-ring (Item 1) **[Figure 20-51- 72]** on the supply line fitting.

Figure 20-51- 73



Install the fitting (Item 1) **[Figure 20-51- 73]** on the pump.

Install the bolts (Item 2) **[Figure 20-51- 73]**.

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HYDRAULIC PISTON PUMP (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Hydraulic Pump Work Sheet

(Please review pump procedure as illustrated in “Pump Testing” on page 5**)**

If any of the following adjustments are not obtainable, pump repair is required.

The outline listed below, gives the four adjustments for setting the hydraulic pump. The adjustments are listed in the order in which they ***MUST*** be performed. Below each adjustment is a list of the steps. Behind each adjustment is the page location within the Service Manual for the complete adjustment procedure.

I. “Torque Limiter Supply Pressure Adjustment” on page 5

41. Bottom Out Pump Margin Spool (Approximately 6 Turns In.)

42. Remove the plug and install fitting and hose from the Torque Limit Supply Spool to a drain pan.

43. Install a 725 psi (50 bar) pressure gauge on the test port on the six spool control valve.

44. Warm hydraulic fluid to 122° - 144° F (50° - 60° C).

45. Run Engine at High Idle

46. Adjust as Necessary to get 290 ± 20 PSI (20 ± 1,4 bar).

47. Record Pressure

_____ **TLS PRESSURE**

48. Remove the Hose and Fitting from the Torque Limiter Supply Spool and Plug the Port

49. Reset Pump Margin Spool (Approximately 6 Turns Out.)

II. “Pump Margin Pressure Adjustment” on page 6

50. Run Engine at High Idle

51. Adjust as Necessary to get 363 ± 20 PSI (25 ± 1,4 bar).

52. Record Pressure

_____ **PM PRESSURE**

53. Remove 725 PSI (50 bar) pressure gauge.

III. “Back-up Relief Valve Adjustment” on page 6

54. Install 5000 PSI (345 bar) gauge on the test port on the six spool valve.

55. Turn the load sense relief valve in 3/4 turn.

56. Run engine at high idle and curl the bucket until the bucket cylinder is fully extended and the relief valve opens.

57. Adjust backup relief valve as necessary to get 4350 ± 50 PSI (300 ± 3,4 bar).

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Hydraulic Pump Work Sheet (Cont'd)

58. Record Pressure

_____ **PM PRESSURE**

IV. "Load Sense Relief Valve Adjustment" on page 8

59. Install 5000 PSI (345 bar) Gauge on the test port on the six spool control valve.

60. Run Engine at High Idle and curl the bucket until the bucket cylinder is fully extended and the relief valve opens.

61. Adjust Load Sense Relief Valve as Necessary to get 4060 ± 50 PSI (280 ± 3,4 bar).

62. Record Pressure

_____ **PRESSURE**

63. Remove the 5000 PSI (345 bar) Gauge, from the Pump Diagnostic Coupler at the Control Valve.

V. "Torque Limiter Adjustment" on page 9

64. Remove the inlet hose from the six spool hydraulic control valve, install a cap on the valve and install the inlet hose on the inlet side of the hydraulic tester.

65. Route the outlet hose of the hydraulic tester to the hydraulic reservoir.

66. Bottom out the pump margin spool (approximately six turns in)

67. Run engine at high idle.

68. Free flow on the hydraulic tester is 40 GPM (152 L/min)

69. Adjust the hydraulic tester to 1450 PSI (100 bar)

70. Adjust torque limiter to 41 GPM (155 L/min).

71. Record Flow and Engine RPM.

_____ **FLOW**

72. Adjust the Hydraulic Tester to 3480 PSI (240 bar).

73. Adjust the Torque Limiter to obtain 19 GPM (72 L/min)

74. Record Flow and Engine RPM.

_____ **FLOW**

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Hydraulic Pump Work Sheet (Cont'd)

75. Remove the Hydraulic Tester.

76. Install the pump outlet hose on the six spool hydraulic control valve.

77. Reset pump margin spool to 363 ± 20 PSI (25 ± 1,4 bar).

ALL PUMP ADJUSTMENTS ARE NOW COMPLETED

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Testing Information

The testing of the piston pump must be done in the following order:

Torque limiter supply pressure
Pump margin pressure
Load sense relief valve
Torque Limiter

All testing is done with the hydraulic oil at 122° to 140° F (50° to 60° C).

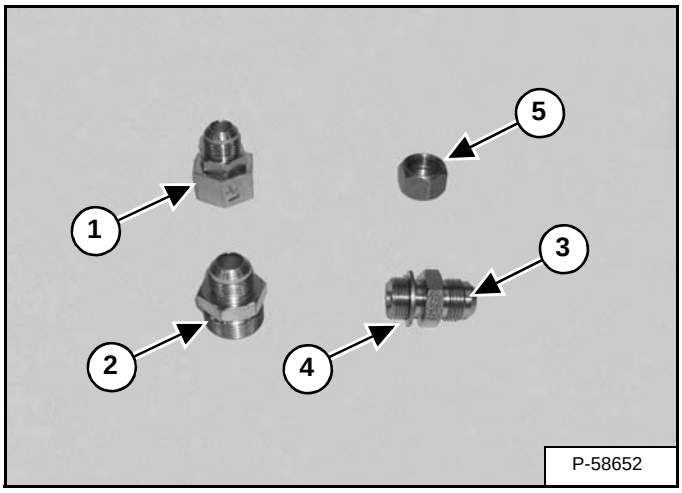
Check and adjust as needed the engine high idle before any hydraulic testing.

The hydraulic hoses, tubelines and fittings on the 442 Excavator are 24° DIN cone metric fittings.

To test the torque limiter order the following parts to adapt the metric fittings to 37° JIC flare fittings:

Order the following parts from your Bobcat dealer:

Figure 20-52-1



Item 1 **[Figure 20-52-1]**: Female 24° DIN to male 37° JIC flare P/N 6698092.

Item 2 **[Figure 20-52-1]**: Male 24° DIN to male 37° JIC flare P/N 6698093.

Item 3 **[Figure 20-52-1]**: Male British pipe thread to male 37° JIC flare P/N 6698094.

Item 4 **[Figure 20-52-1]**: British bonded seal P/N 6698095.

Item 5 **[Figure 20-52-1]**: Female 37° JIC flare cap P/N 36K-8.

MEL1610 Hose Kit (not shown).

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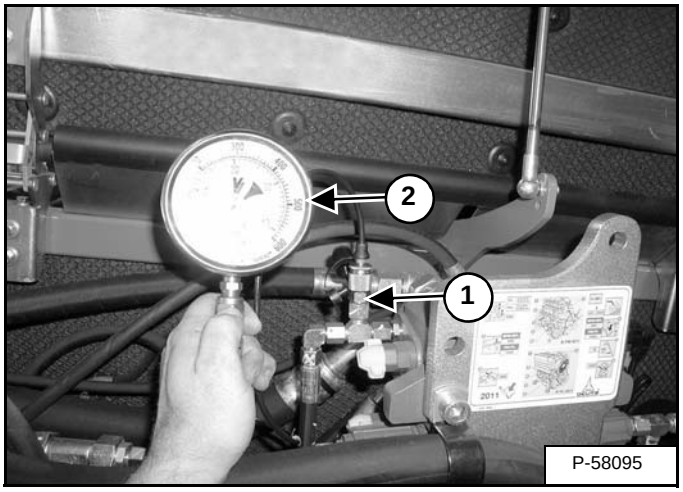
Pump Testing

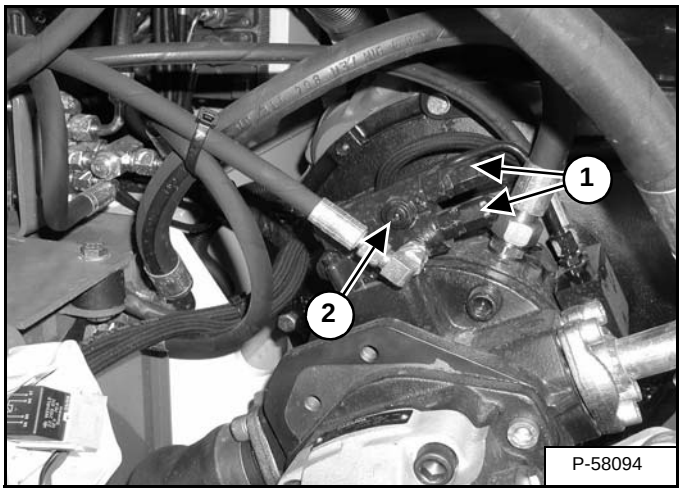
Torque Limiter Supply Pressure Adjustment

Figure 20-52-2



Install a 725 PSI (500 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-52-2]**.

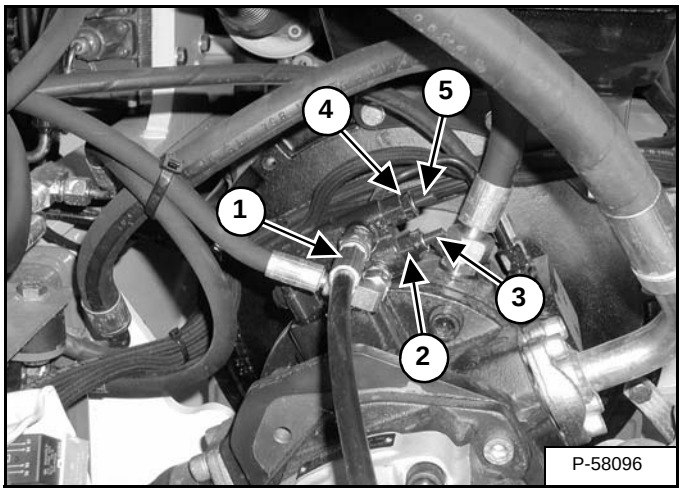
Figure 20-52-3



Remove caps (Item 1) **[Figure 20-52-3]**.

Remove the plug (Item 2) **[Figure 20-52-3]**.

Figure 20-52-4



Install a fitting and drain hose (Item 1) **[Figure 20-52-4]**. Place the other end of the hose in a drain pan.

NOTE: To adjust the Torque Limiter Supply Pressure, the Pump Margin Spool must be temporarily bottomed out.

Loosen the nut (Item 2) **[Figure 20-52-4]**.

Turn the pump margin spool (bottom spool) (Item 3) **[Figure 20-52-4]** all the way in. (Approximately 6 turns)

Start the engine and run at high idle.

Loosen the nut (Item 4) and adjust the torque limiter supply pressure spool (Item 5) **[Figure 20-52-4]** until the pressure gauge reads 290 PSI (20 bar).

Turn the adjustment screw clockwise to increase pressure and counterclockwise to decrease pressure.

NOTE: 1/4 turn is approximately 35 PSI (2,4 bar).

Repeat the procedure listed above until the pressure is set.

Tighten the nut (Item 4) **[Figure 20-52-4]**.

Stop the engine.

Turn the pump margin spool (bottom spool) (Item 3) **[Figure 20-52-4]** back to its original position. (Approximately 6 turns)

Tighten the nut (Item 2) **[Figure 20-52-4]**.

Remove the hose (Item 1) **[Figure 20-52-4]** and install the plug.

Install the cap on the torque limiter supply pressure adjustment spool (top spool).

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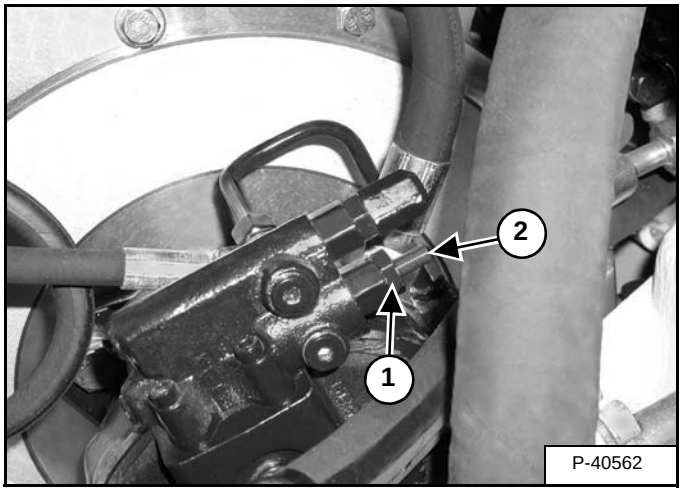
Pump Testing (Cont'd)

Pump Margin Pressure Adjustment

Figure 20-52-5



Start the engine and run at high idle.

Loosen the nut (Item 1) and adjust the pump margin pressure adjustment spool (Item 2) **[Figure 20-52-5]** until the pressure gauge reads 363 PSI (25 bar).

Turn the adjustment screw clockwise to increase pressure and counterclockwise to decrease pressure.

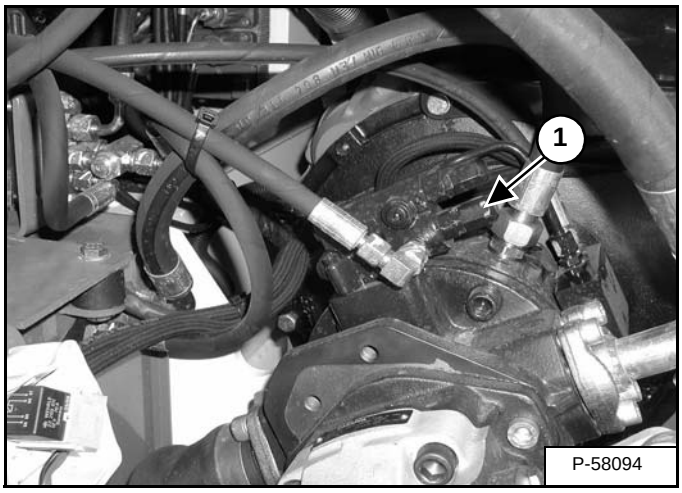
NOTE: 1/4 turn is 50 PSI (3,4 bar).

Tighten the nut (Item 1) **[Figure 20-52-5]**.

Repeat the procedure listed above until the pressure is set.

Stop the engine.

Figure 20-52-6

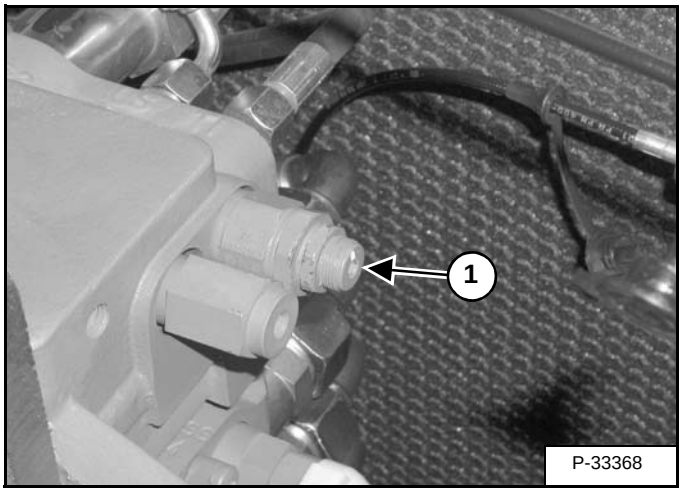


Install the cap (Item 1) **[Figure 20-52-6]** on the pump margin pressure adjustment spool (bottom spool).

Remove the gauge from the test coupler.

Back-up Relief Valve Adjustment

Figure 20-52-7



Turn the load sense adjustment screw (Item 1) **[Figure 20-52-7]** in 3/4 of a turn, increasing the relief pressure approximately 600 PSI (41,3 bar) to 4660 PSI (321 bar).The load sense relief is now set to a higher pressure than the backup relief.

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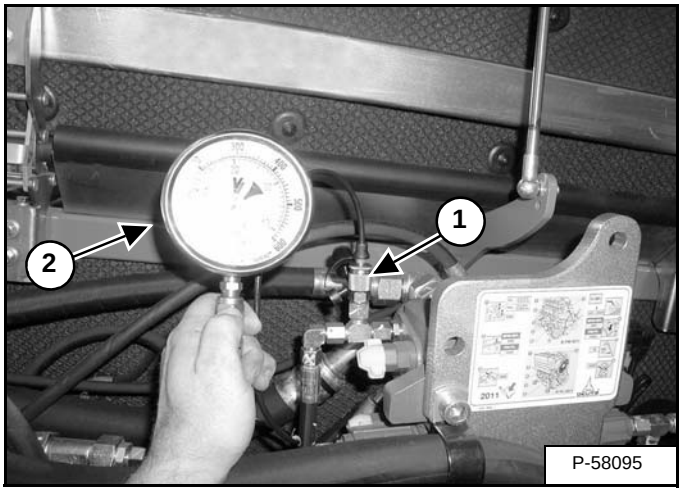
Pump Testing (Cont'd)

Pump Margin Pressure Adjustment (Cont'd)

Figure 20-52-8



Install a 5000 PSI (345 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-52-8]**.

Start the excavator and warm the hydraulic oil to operating temperature.

Move the engine speed control to the high speed position.

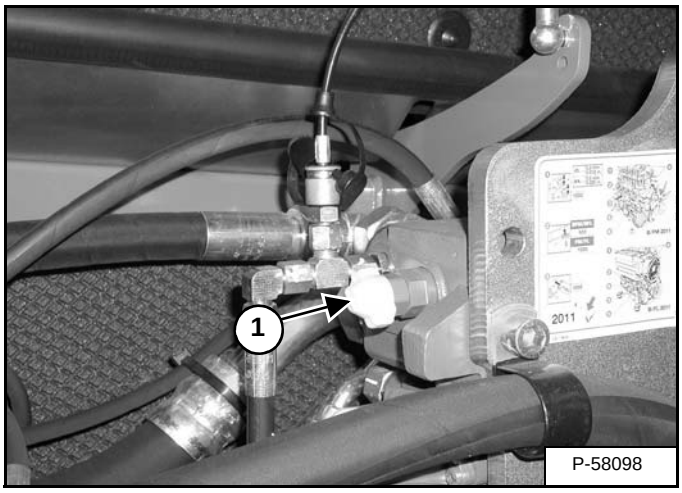
Curl the bucket until the bucket cylinder is fully extended and the relief valve opens.

Record the pressure.

The pressure at the gauge (Item 2) **[Figure 20-52-8]** should be 4350 PSI (300 bar).

Stop the engine.

Figure 20-52-9



Remove the plastic cap (Item 1) **[Figure 20-52-9]**.

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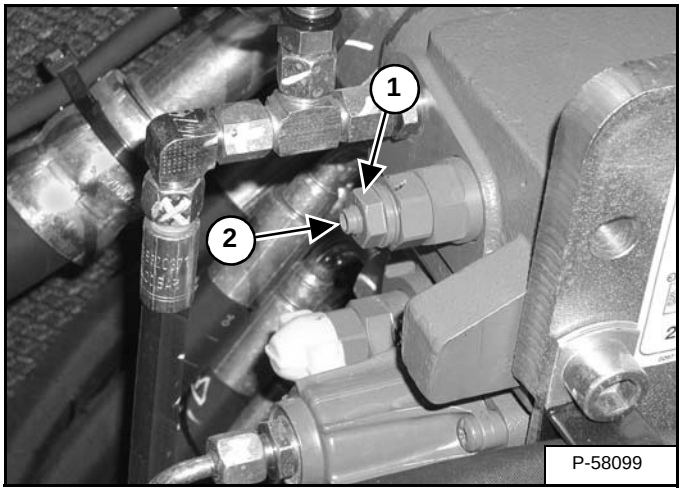
HYDRAULIC PISTON PUMP (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) (CONT'D)

Pump Testing (Cont'd)

Back-up Relief Valve Adjustment (Cont'd)

Figure 20-52-10



Loosen the lock nut (Item 1) **[Figure 20-52-10]**.

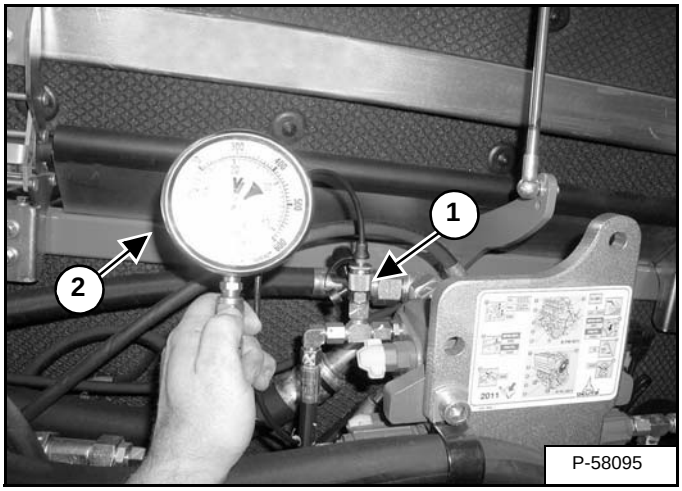
Turn the adjustment screw (Item 2) **[Figure 20-52-10]** in to increase pressure and out to decrease pressure.

NOTE: One quarter turn is approximately 200 PSI (13,8 bar).

Tighten the nut and retest the backup relief valve.

Load Sense Relief Valve Adjustment

Figure 20-52-11



Install a 5000 PSI (345 bar) pressure gauge on the test coupler (Item 1) **[Figure 20-52-11]**.

Move the engine speed control to the high idle position.

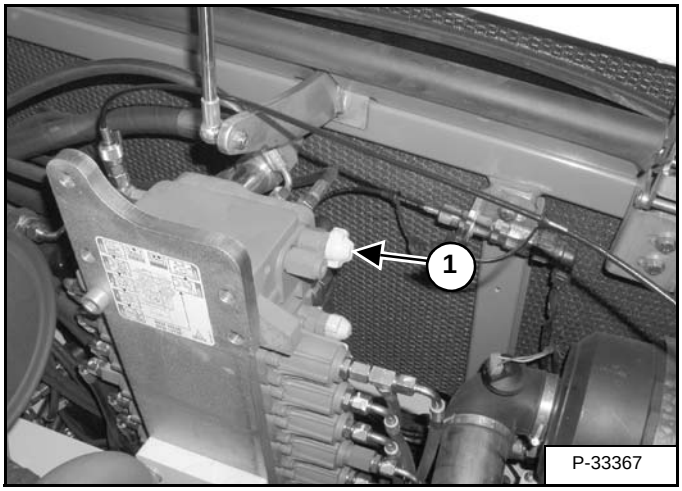
Curl the bucket until the bucket cylinder is fully extended and the relief valve opens.

Record the pressure.

The pressure at the gauge (Item 2) **[Figure 20-52-11]** should be 4060 PSI (280 bar).

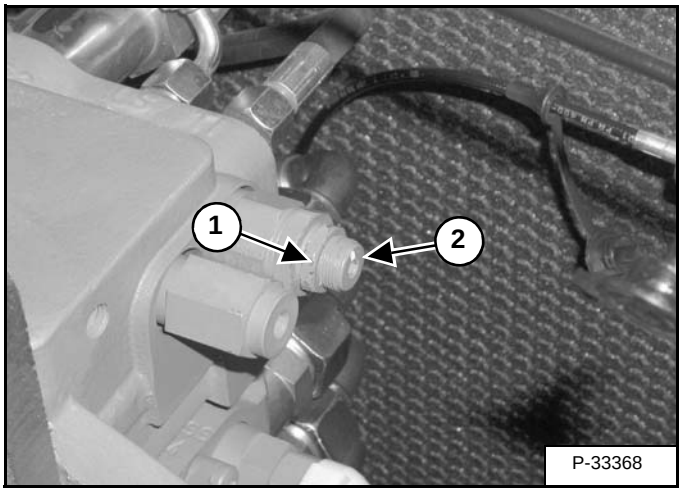
Stop the engine.

Figure 20-52-12



Remove the plastic cap (Item 1) **[Figure 20-52-12]**.

Figure 20-52-13



Loosen the lock nut (Item 1) **[Figure 20-52-13]**.

Turn the adjustment screw (Item 2) **[Figure 20-52-13]** in to increase pressure and out to decrease pressure.

NOTE: One quarter turn is approximately 200 PSI (13,8 bar).

Tighten the lock nut and retest the load sense relief valve.

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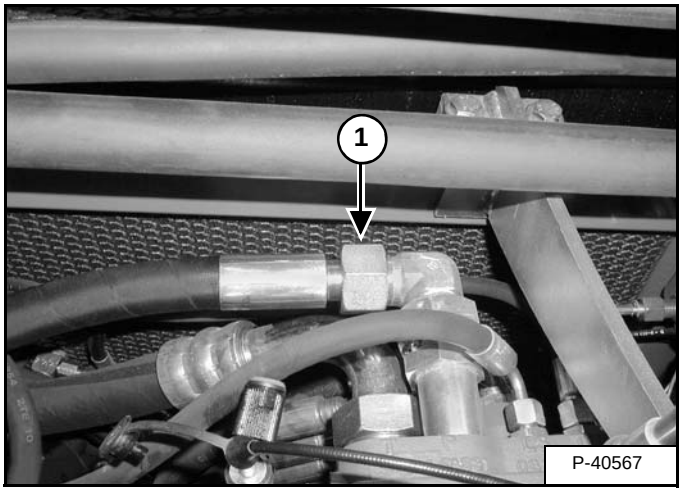
Pump Testing (Cont'd)

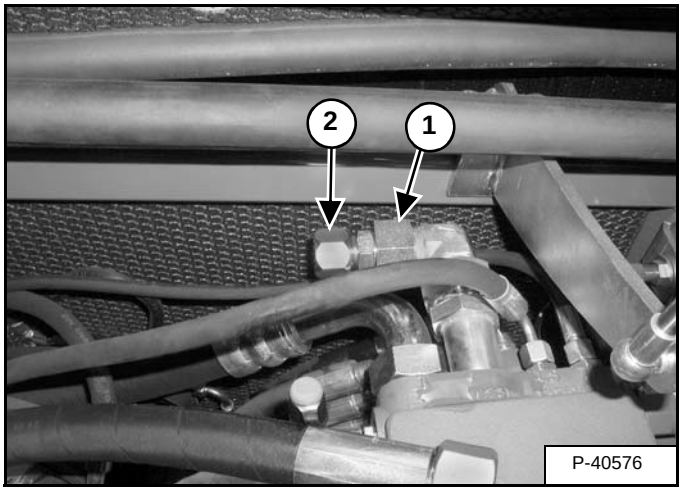
Torque Limiter Adjustment

Figure 20-52-14



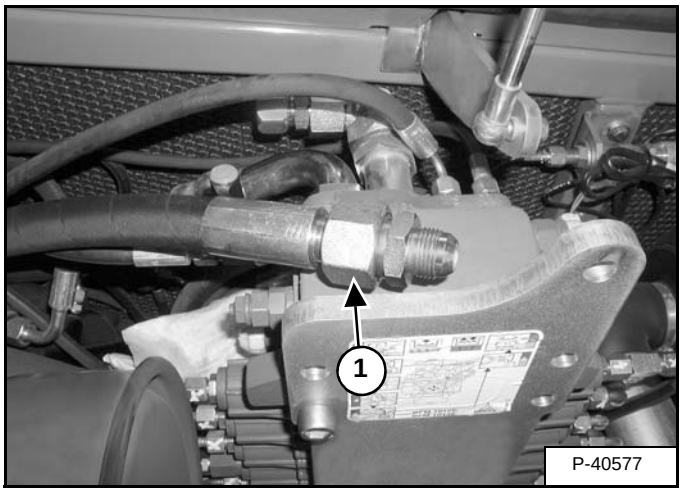
Remove the inlet hose (Item 1) **[Figure 20-52-14]** from the hydraulic control valve.

Figure 20-52-15



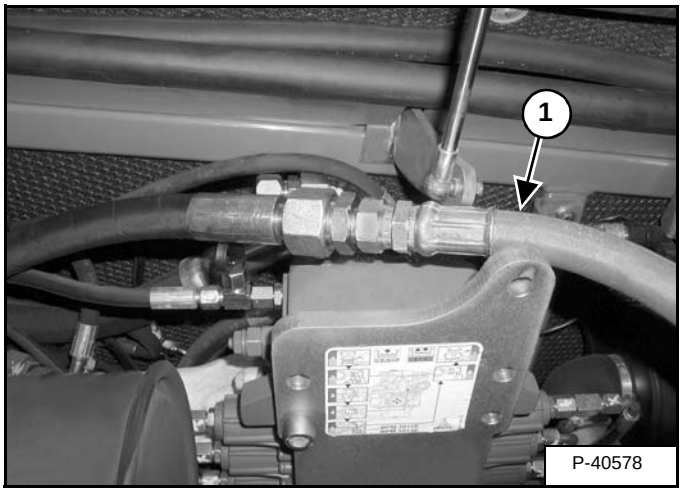
Install the adapter (Gates P/N 87957) (Item 1) and cap (Bobcat P/N 36K-8) (Item 2) **[Figure 20-52-15]**.

Figure 20-52-16



Install the adapter (Gates P/N 87945) (Item 1) **[Figure 20-52-16]** on the inlet hose.

Figure 20-52-17



Connect the inlet hose to the **INLET** side of the hydraulic tester (Item 1) **[Figure 20-52-17]**.

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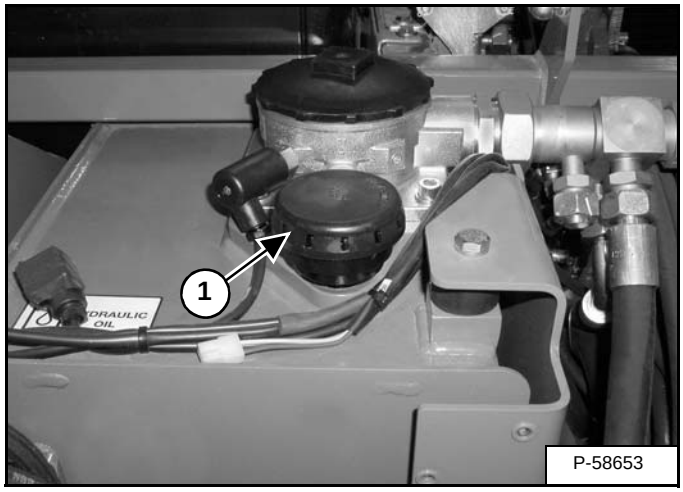
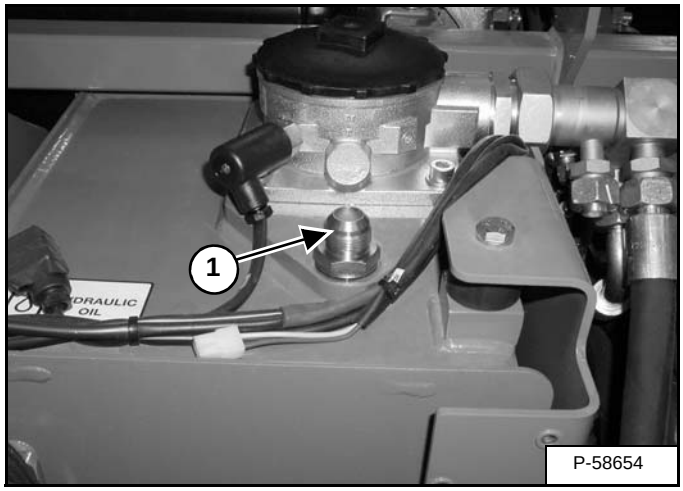
Pump Testing (Cont'd)

Figure 20-52-18



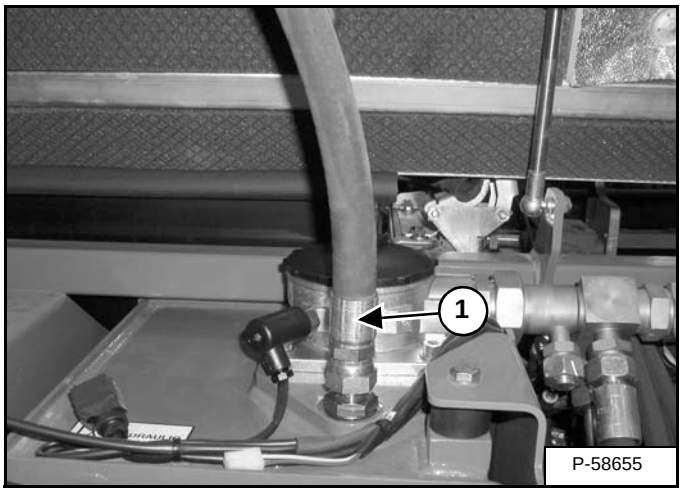
Remove the hydraulic reservoir breather (Item 1) **[Figure 20-52-18]**.

Figure 20-52-19



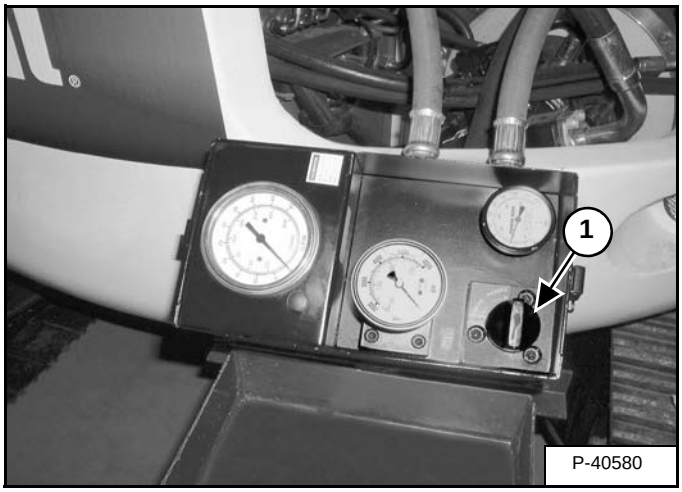
Install a fitting (Item 1) **[Figure 20-52-19]** into the reservoir breather hole.

Figure 20-52-20



Connect the **OUTLET** side of the hydraulic tester (Item 1) **[Figure 20-52-20]** to the fitting.

Figure 20-52-21



Fully open the hydraulic tester flow control (Item 1) **[Figure 20-52-21]**.

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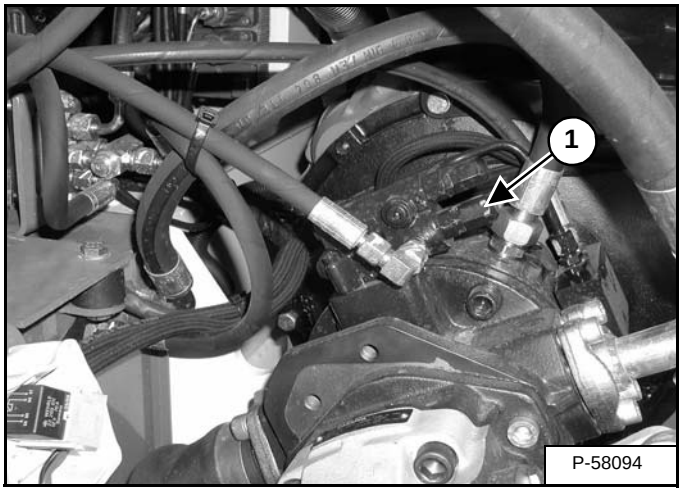
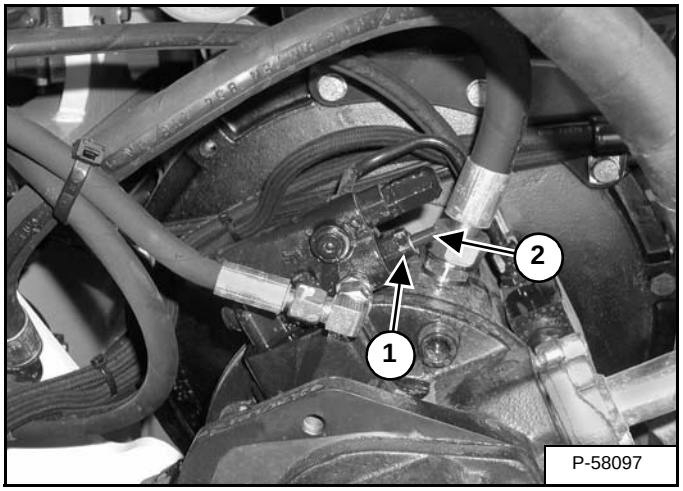
Pump Testing (Cont'd)

Figure 20-52-22



Remove the cap (Item 1) **[Figure 20-52-22]** from the pump margin spool (bottom spool).

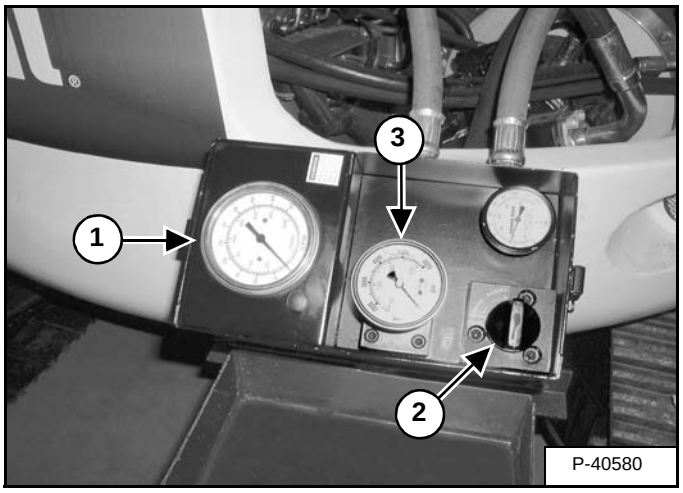
Figure 20-52-23



Loosen the nut (Item 1) and turn the adjustment screw (Item 2) **[Figure 20-52-23]** all the way in (approximately 6 turns).

Start the engine and run at high idle.

Figure 20-52-24

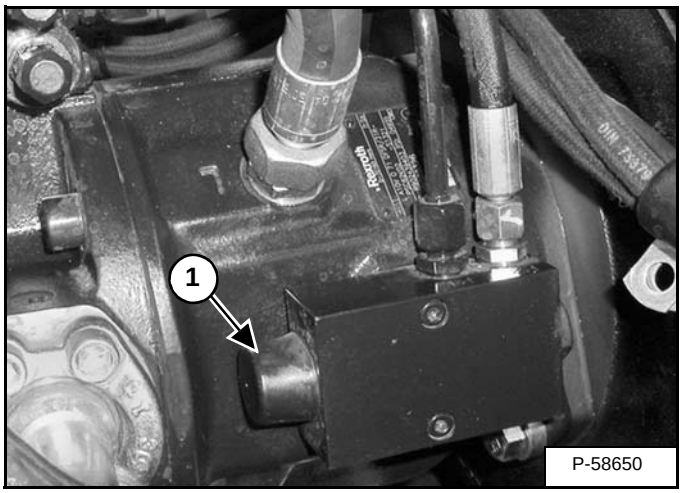


The flow should be 43 GPM (163 L/mm) on the flow tester (Item 1) **[Figure 20-52-24]**.

Turn the hydraulic tester flow control (Item 2) clockwise until the gauge (Item 3) **[Figure 20-52-24]** shows 1450 PSI (100 bar).

The gauge (Item 1) **[Figure 20-52-24]** should show 41 GPM (155 L/min) which is *flow at low pressure*.

Figure 20-52-25



Remove the dust cover (Item 1) **[Figure 20-52-25]**.

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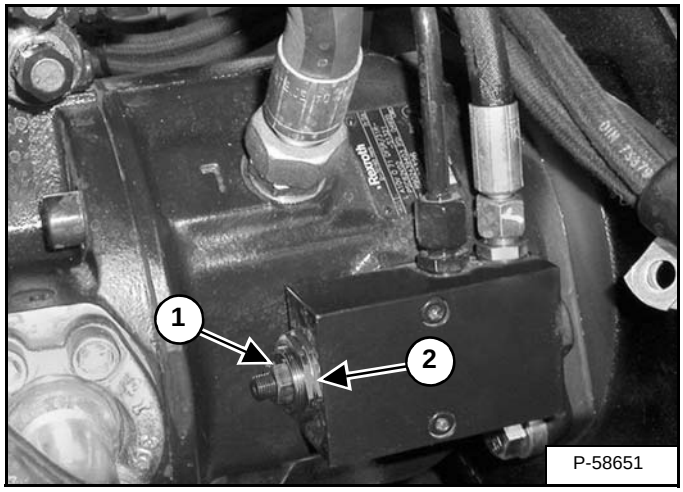
Pump Testing (Cont'd)

Figure 20-52-26



Check the 13 mm nut (Item 1) **[Figure 20-52-26]** to be sure it is locked in place.

Adjust the flow at the hydraulic pump torque limiter by loosening the 27 mm nut (Item 2) **[Figure 20-52-26]** With an Allen wrench adjust the *flow at low pressure*.

When the proper flow is obtained, 41 GPM (155 L/min) at 1450 PSI (100 bar), lock the 27 mm nut (Item 2) **[Figure 20-52-26]**.

NOTE: Changing the flow at low pressure (27 mm nut) will affect flow at high pressure (13 mm nut).

Turn the hydraulic tester flow control (Item 2) clockwise until the gauge (Item 3) **[Figure 20-52-24 on Page 11]** reads 3480 PSI (240 bar).

NOTE: Do not exceed 4350 PSI (300 bar) with the hydraulic tester or the pump will be damaged.

The gauge should show 19 GPM (72 L/min) which is *flow at high pressure.*

Adjust the flow at the hydraulic pump torque limiter. Loosen the 13 mm nut (Item 1) **[Figure 20-52-26]** and with an Allen wrench adjust the *flow at high pressure*.

When the proper flow is obtained, 19 GPM (72 L/min) at 3480 PSI (240 bar), lock the 13 mm nut (Item 1) **[Figure 20-52-26]**.

NOTE: If adjustments were made to *flow at high pressure* **verify the** *flow at low pressure***.**

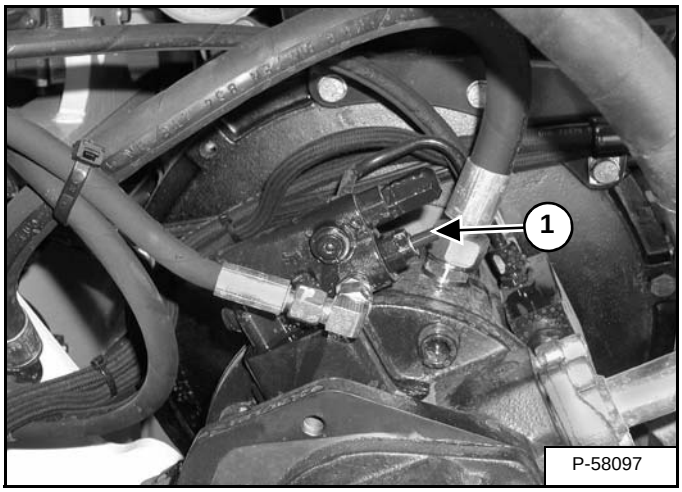
Install the protective cap on the hydraulic pump torque limiter.

Remove the hydraulic tester and fittings.

Install the reservoir breather.

Install the supply hose on the hydraulic control valve.

Figure 20-52-27



Adjust the pump margin spool (Item 1) **[Figure 20-52-27]** back to the original position (approximately 6 turns out).

Retest and adjust the pump margin spool as needed. (See Pump Margin Pressure Adjustment on Page 20-52-6.)

ALL PUMP ADJUSTMENTS ARE NOW COMPLETED.

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Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

Remove the muffler. (See MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-21-1.)

Remove the gear pump. (See Removal And Installation on Page 20-53-1.)

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.

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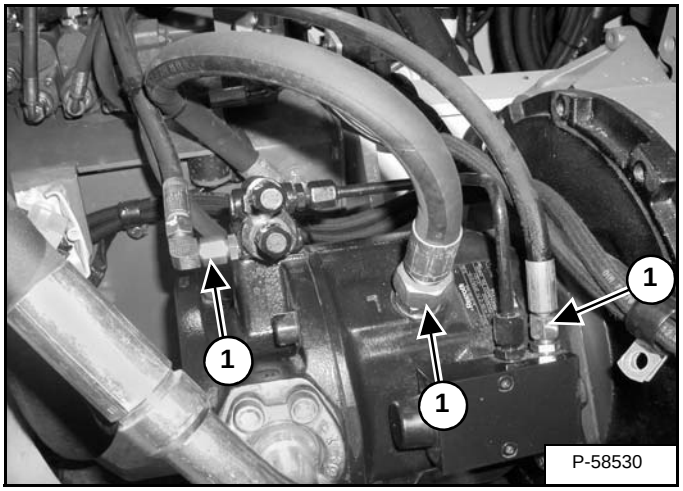
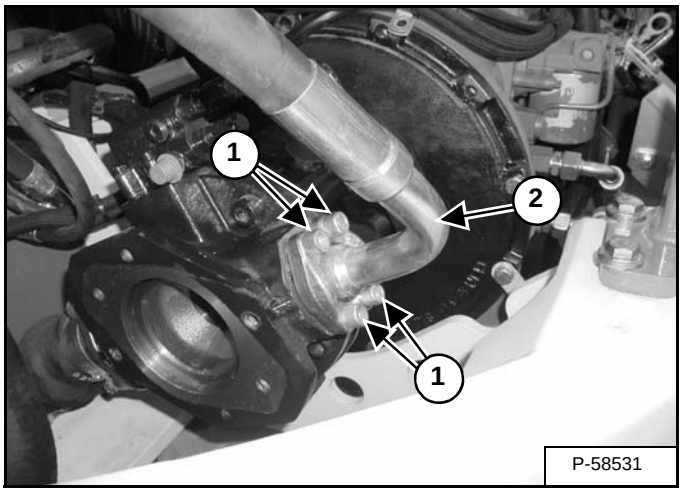
Figure 20-52-28



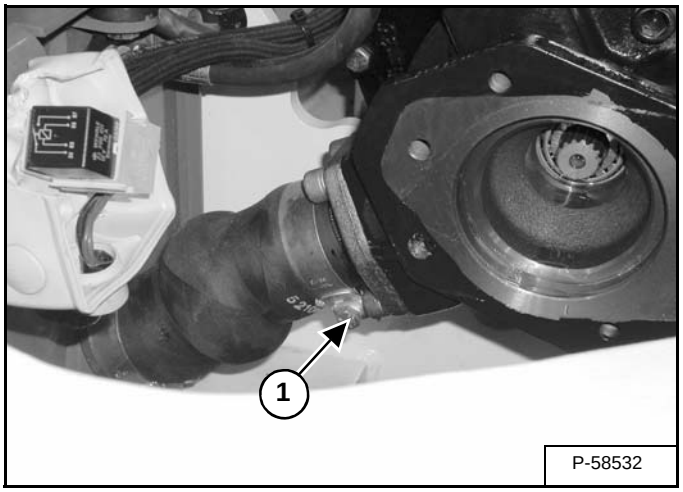
Remove the hoses (Item 1) **[Figure 20-52-28]**.

Figure 20-52-29



Remove the bolts (Item 1) and hose (Item 2) **[Figure 20-52-29]**.

Figure 20-52-30



Loosen the hose clamp (Item 1) **[Figure 20-52-30]**.

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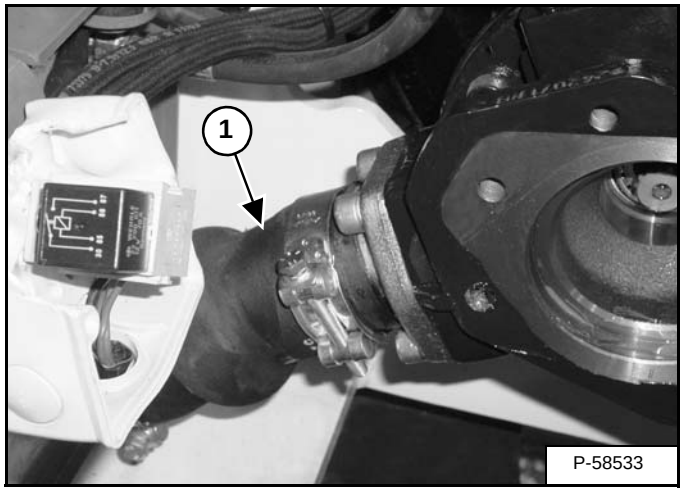
Removal And Installation (Cont'd)

Figure 20-52-31



The hose (Item 1) **[Figure 20-52-31]** will be removed from the inlet fitting as the pump is removed.

Figure 20-52-32

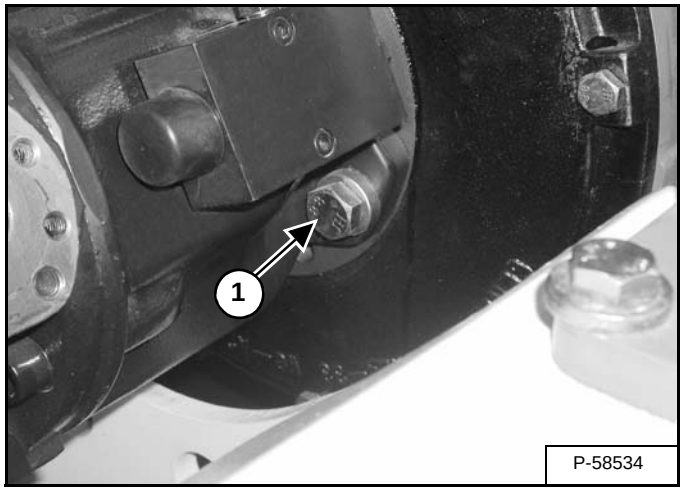
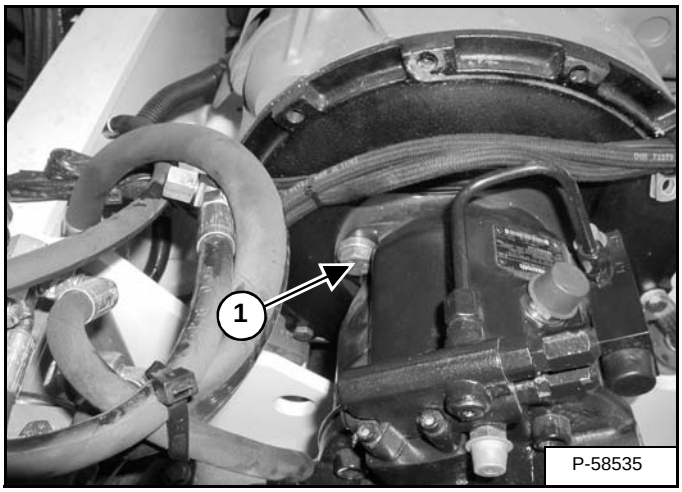


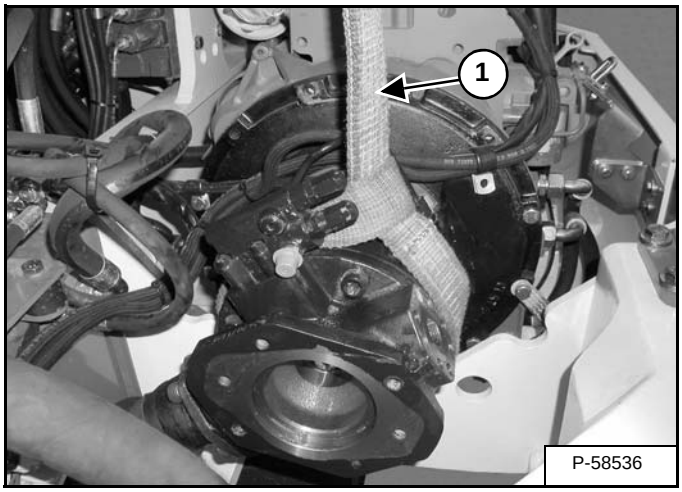
Figure 20-52-33



Remove the bolts (Item 1) **[Figure 20-52-32]** & **[Figure 20-52-33]** and washers.

Installation: Tighten the bolts to 125-140 ft.-lb. (170-190 N•m) torque.

Figure 20-52-34



Install a sling (Item 1) **[Figure 20-52-34]** on the pump.

Separate the pump from the engine and remove the pump.

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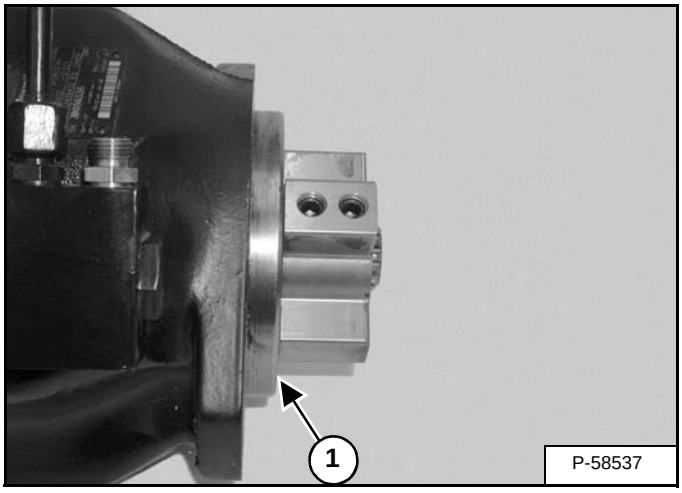
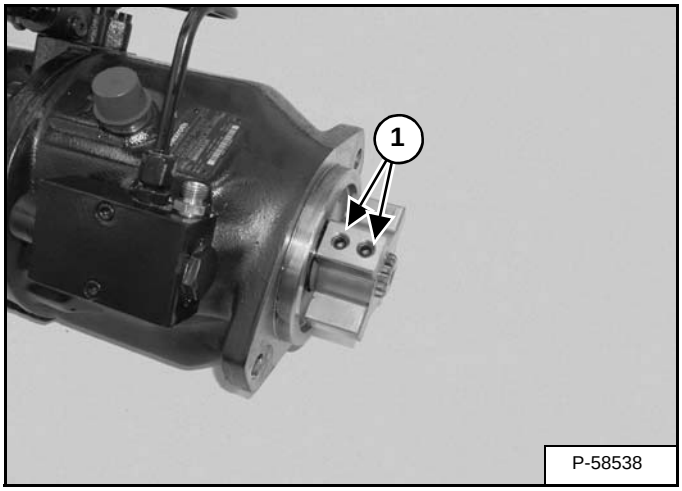
Coupler Removal And Installation

Figure 20-52-35



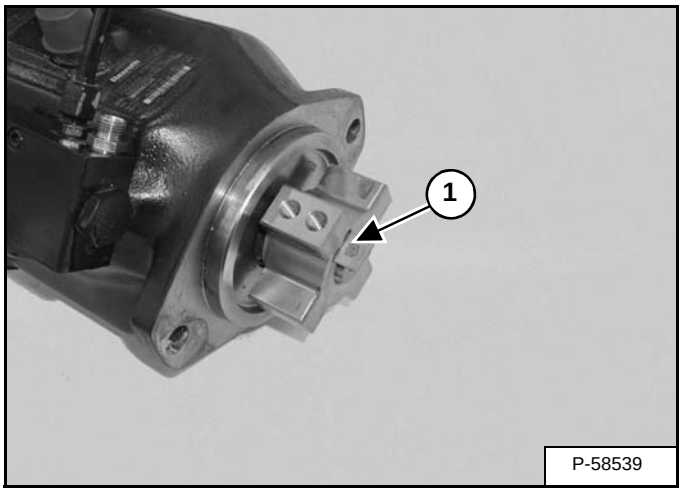
Measure and record the distance (Item 1) **[Figure 20-52-35]** between the coupler and pump pilot flange.

Figure 20-52-36



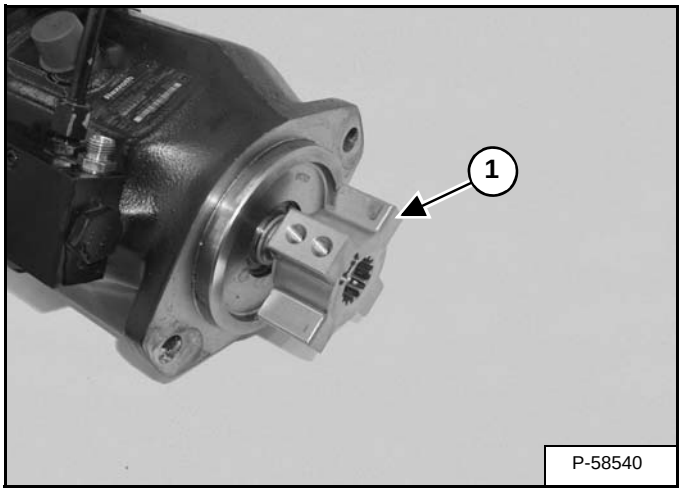
Remove the bolts (Item 1) **[Figure 20-52-36]**.

Figure 20-52-37



Remove the plate (Item 1) **[Figure 20-52-37]**.

Figure 20-52-38



Slide the coupler (Item 1) **[Figure 20-52-38]** off the shaft.

Installation: Slide the coupler on the shaft to the measurement recorded earlier.

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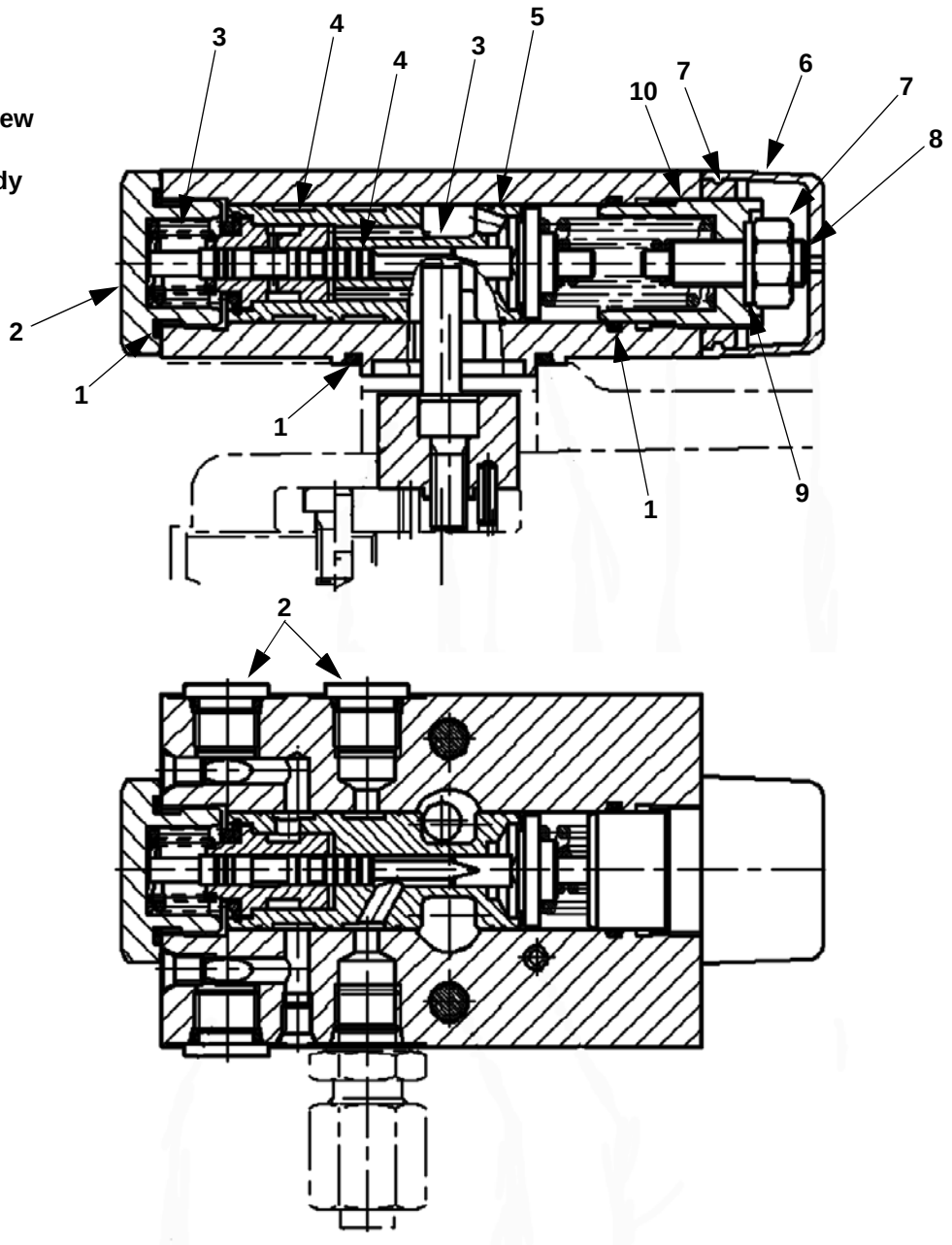
Torque Limiter Valve Parts Identification

1. O-Ring
2. Plug
3. Spring
4. Spool
5. Spring Seat
6. Cap
7. Nut
8. Adjustment Screw
9. Washer
10. Adjustment Body



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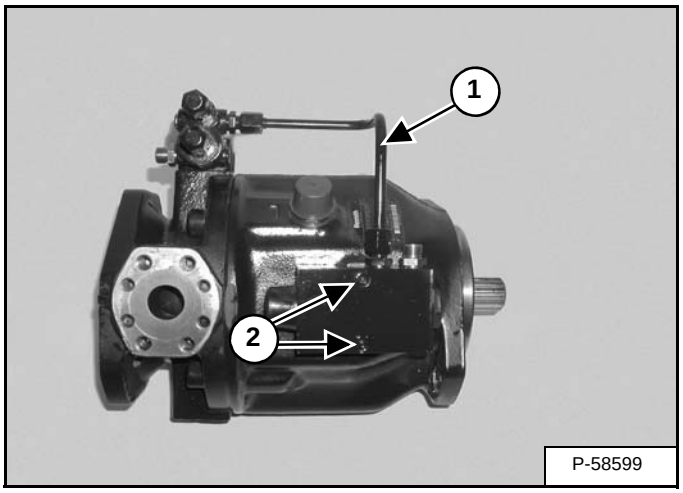
Torque Limiter Valve Removal and Installation

Clean the outside of the pump with clean solvent and dry with compressed air before removing any components from the pump.

Figure 20-52-39



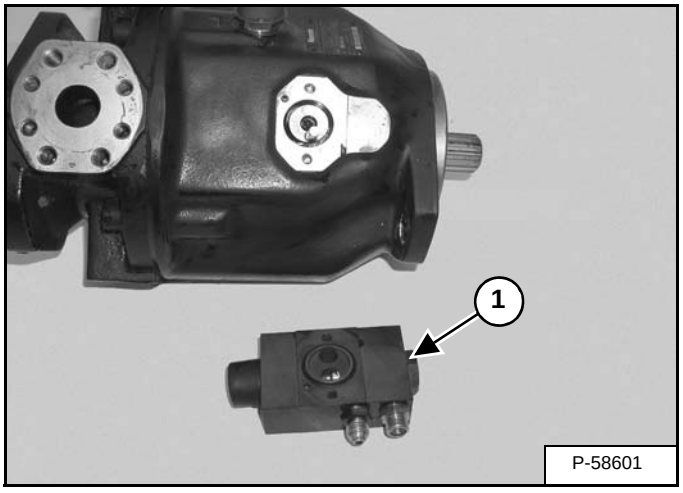
Remove the tubeline (Item 1) **[Figure 20-52-39]** from the pump control and torque limiter vale.

NOTE: Mark the tubeline for correct installation.

Remove the bolts (Item 2) **[Figure 20-52-39]** from the torque limiter valve.

Installation: Tighten the mount bolts to 7.0-7.5 ft.-lb. (9,5-10,5 N•m) torque.

Figure 20-52-40



Remove the torque limiter (Item 1) **[Figure 20-52-40]** from the pump.

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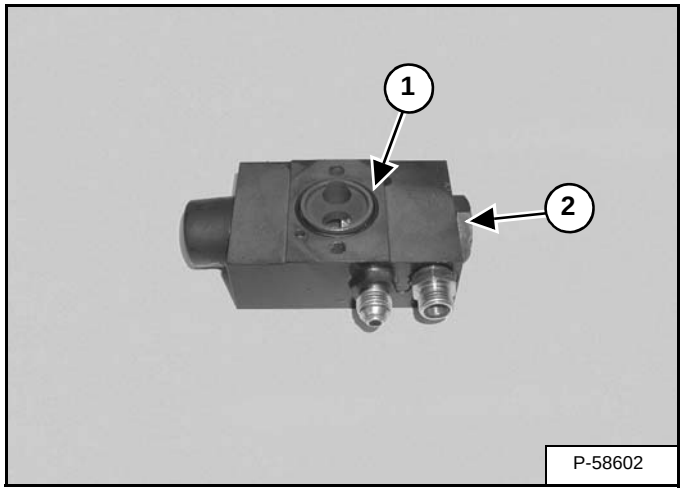
Torque Limiter Valve Disassembly

Figure 20-52-41



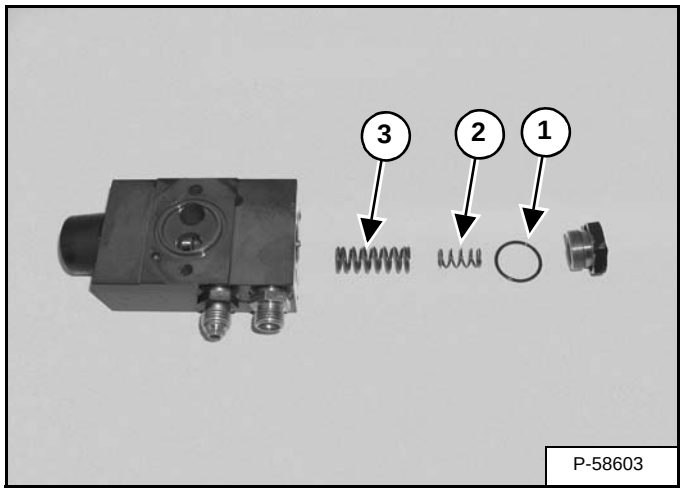
Remove the O-ring (Item 1) **[Figure 20-52-41]** from the torque limiter valve.

NOTE: Do not scratch or damage the mounting surface on the valve body.

Remove the plug (Item 2) **[Figure 20-52-41]**.

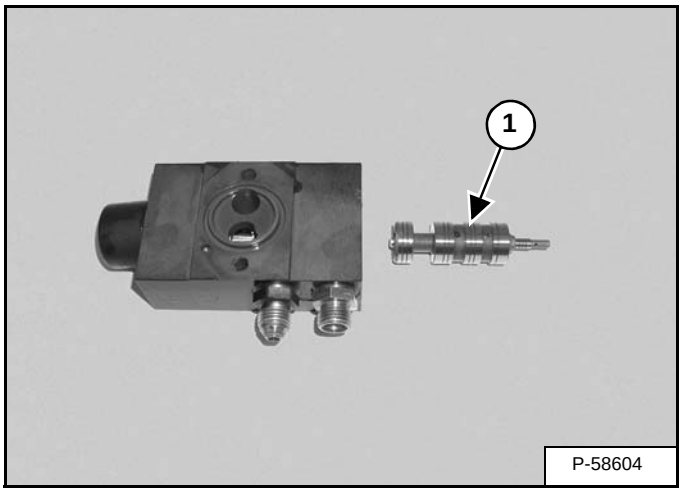
NOTE: The plug (Item 2) [Figure 20-52-41] is under spring pressure.

Figure 20-52-42



Remove the O-ring (Item 1) from the plug. Remove the two springs (Items 2 & 3) **[Figure 20-52-42]**.

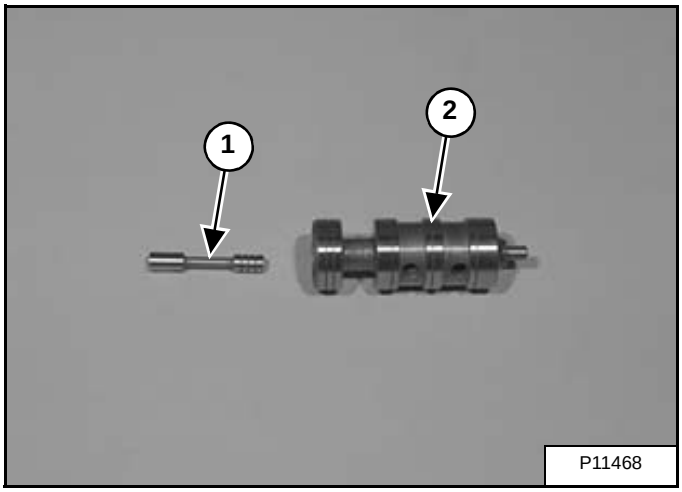
Figure 20-52-43



Remove the control spool assembly (Item 1) **[Figure 20-52-43]**.

NOTE: Use care not to scratch or damage the spool. Scratches in the spool can cause internal leakage.

Figure 20-52-44



Remove the metering spool (Item 1) from the control spool (Item 2) **[Figure 20-52-44]**.

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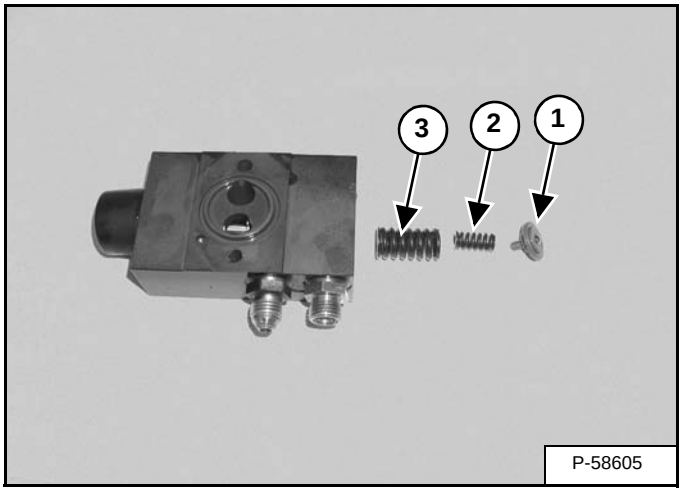
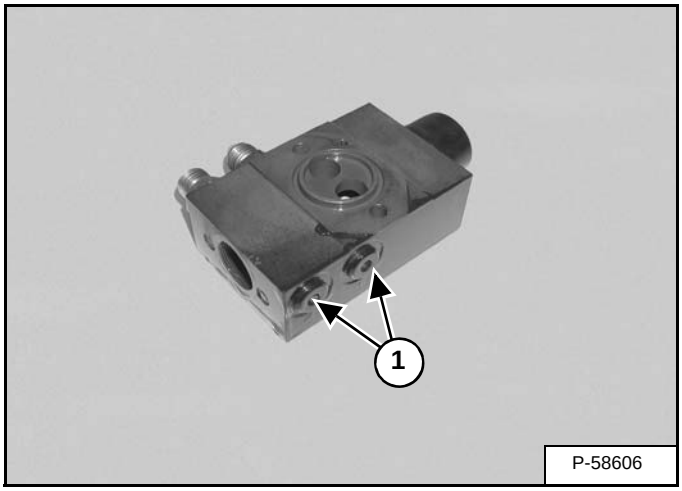
Torque Limiter Valve Disassembly (Cont'd)

Figure 20-52-45



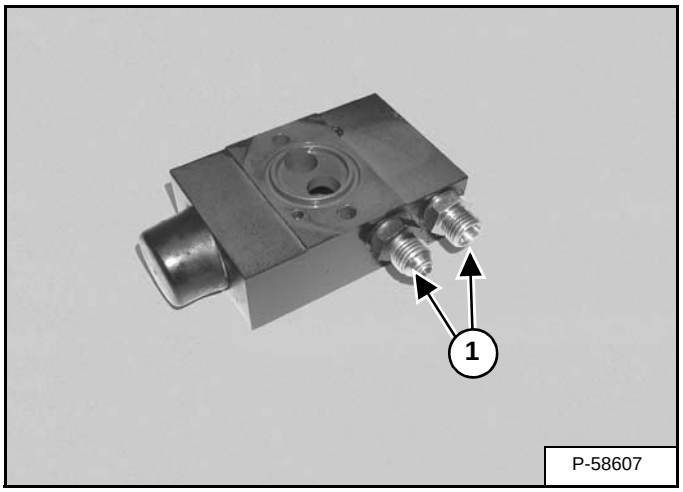
Remove the spring seat (Item 1). Remove the two springs (Item 2 & 3) **[Figure 20-52-45]**.

Figure 20-52-46



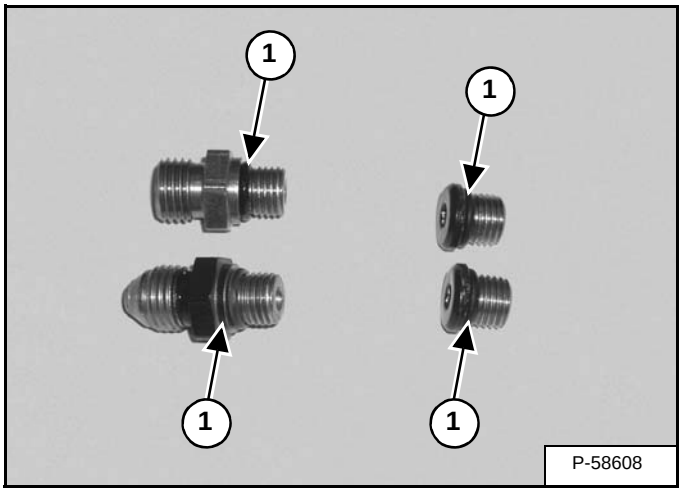
Remove the plugs (Items) **[Figure 20-52-46]**.

Figure 20-52-47



Remove the fittings (Item 1) **[Figure 20-52-47]**.

Figure 20-52-48



Remove the O-rings (Item 1) **[Figure 20-52-48]** from the fittings and plugs.

The following procedures are only used if the adjustment assembly is removed.

NOTE: If the adjustment assembly is removed and/or disassembled, the torque limiter must be tested and adjusted after the pump assembly is installed in the machine. See "Initial Torque Limiter Valve Setting" on page 26.)

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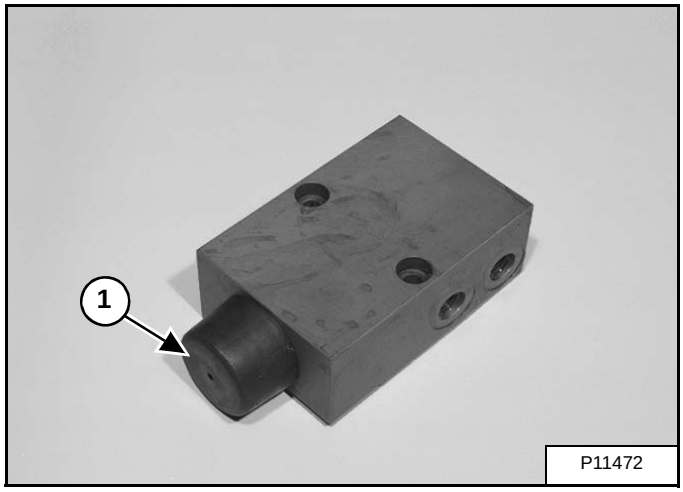
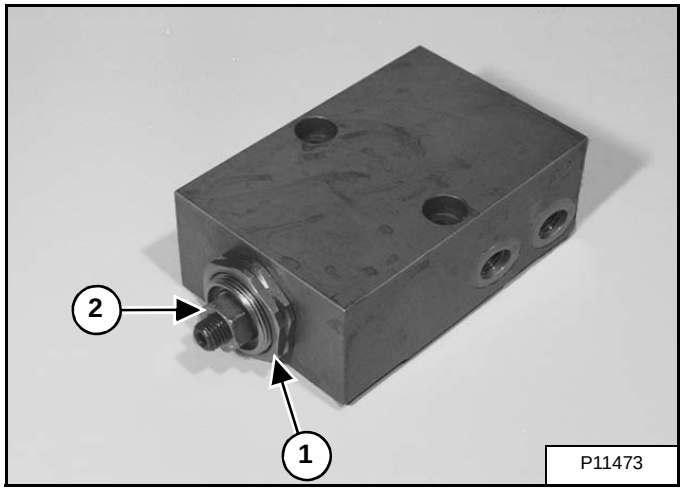
Torque Limiter Valve Disassembly (Cont'd)

Figure 20-52-49



Remove the dust cap (Item 1) **[Figure 20-52-49]**.

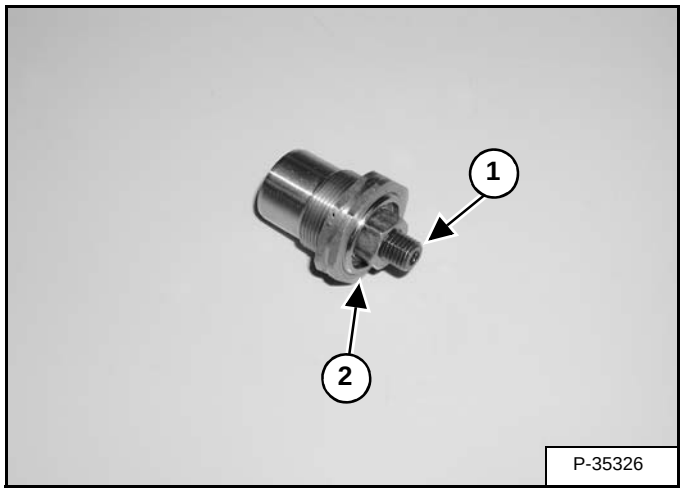
Figure 20-52-50



Loosen the large nut (Item 1) **[Figure 20-52-50]**.

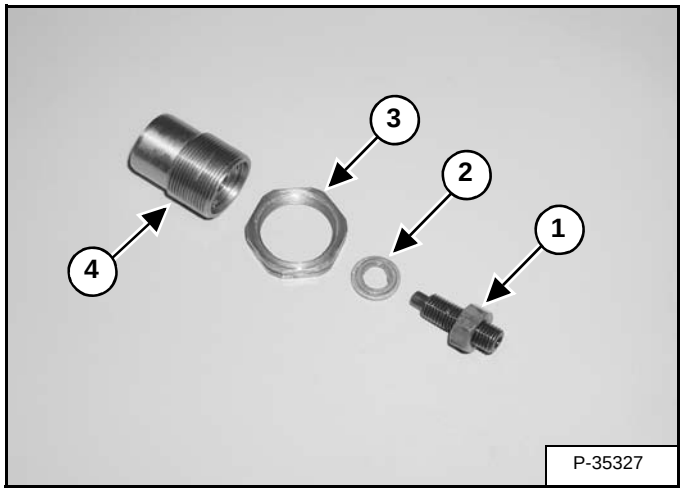
Turn the small nut (Item 2) **[Figure 20-52-50]** to remove the adjustment body.

Figure 20-52-51



With an Allen wrench hold the adjustment bolt (Item 1) and loosen the nut (Item 2) **[Figure 20-52-51]**.

Figure 20-52-52



Remove the adjustment screw (Item 1), O-ring washer (Item 2) and large nut (Item 3) from the adjustment body (Item 4) **[Figure 20-52-52]**.

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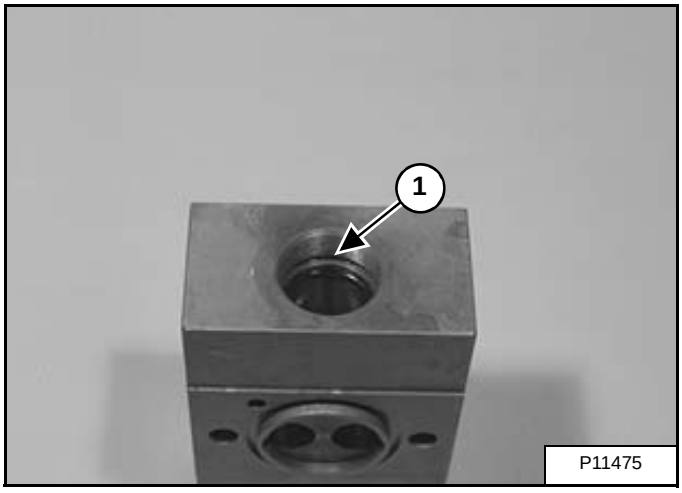
Torque Limiter Valve Disassembly (Cont'd)

Figure 20-52-53



Remove the O-ring (Item 1) **[Figure 20-52-53]** from the torque limiter valve body.

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Torque Limiter Valve Assembly

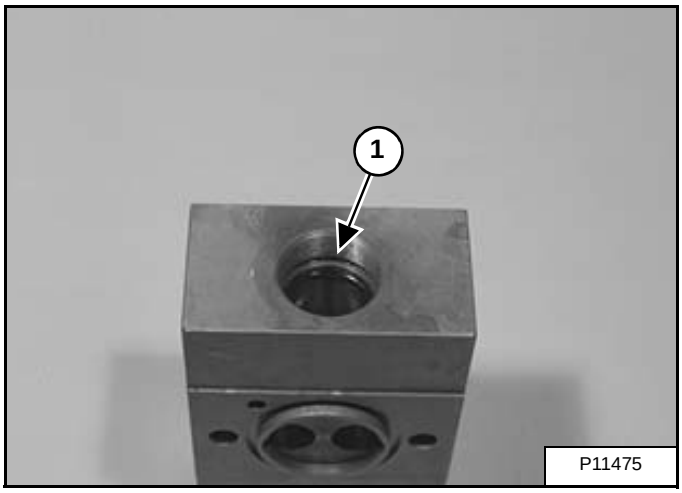
Clean all the parts in solvent and dry with compressed air.

Inspect seats and spools for wear.

Apply clean oil to new O-rings and spools.

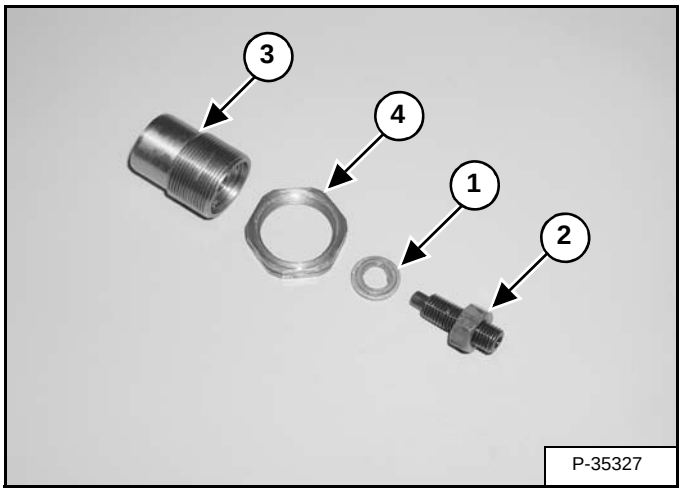
The following procedures are only used if the adjustment assembly is removed.

Figure 20-52-54



Install the O-ring (Item 1) **[Figure 20-52-54]** in the torque limiter valve body.

Figure 20-52-55

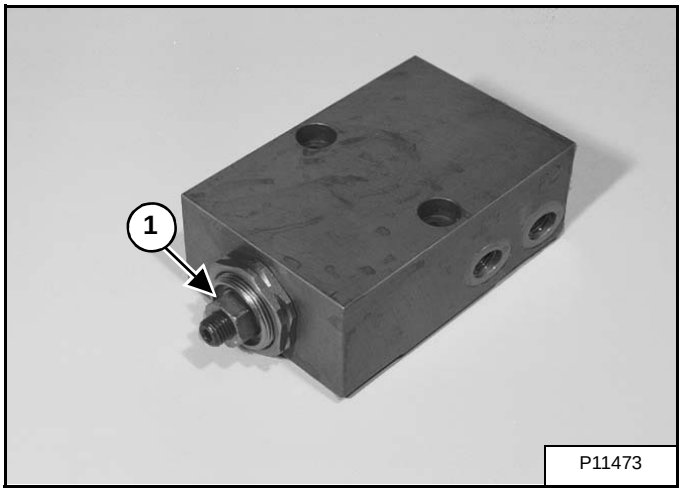


Install the O-ring washer (Item 1) on the adjustment screw (Item 2) **[Figure 20-52-55]**.

Install the adjustment screw (Item 2) in the adjustment body (Item 3) **[Figure 20-52-55]**.

Install the nut (Item 4) **[Figure 20-52-55]** on the adjustment body.

Figure 20-52-56



Install the adjustment screw/adjustment body (Item 1) **[Figure 20-52-56]** assembly into the valve body.

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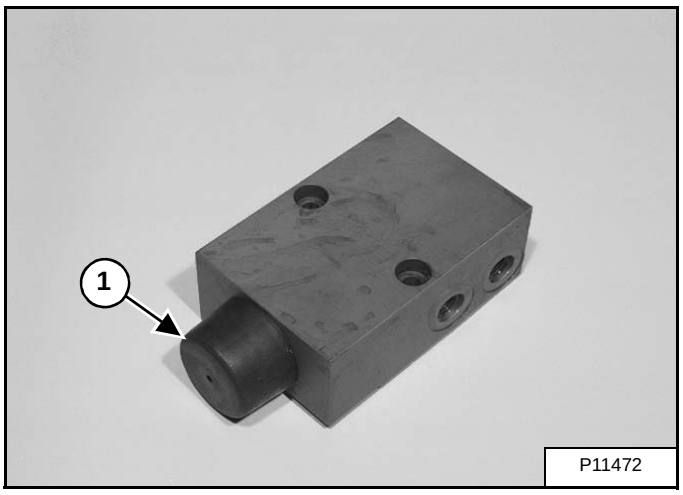
Torque Limiter Valve Assembly (Cont'd)

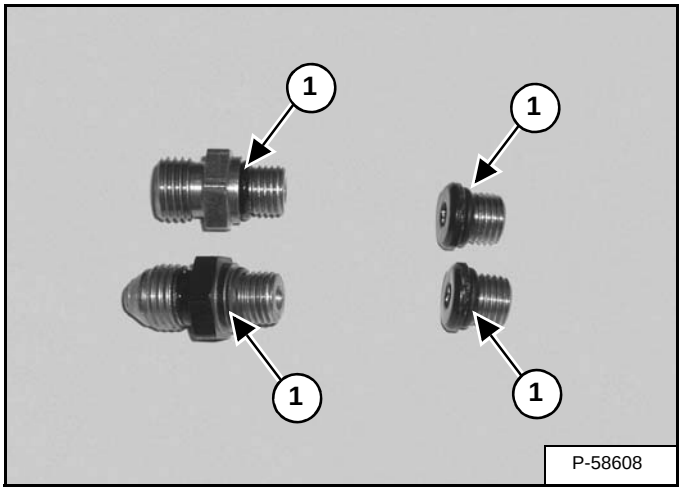
Figure 20-52-57



Install the dust cap (Item 1) **[Figure 20-52-57]**.

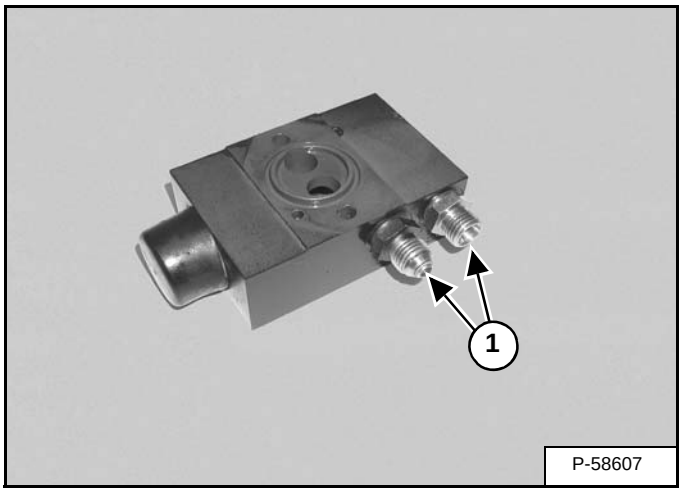
NOTE: After the pump assembly is installed in the machine, the torque limiter must be tested and adjusted. See "Initial Torque Limiter Valve Setting" on page 26.

Figure 20-52-58



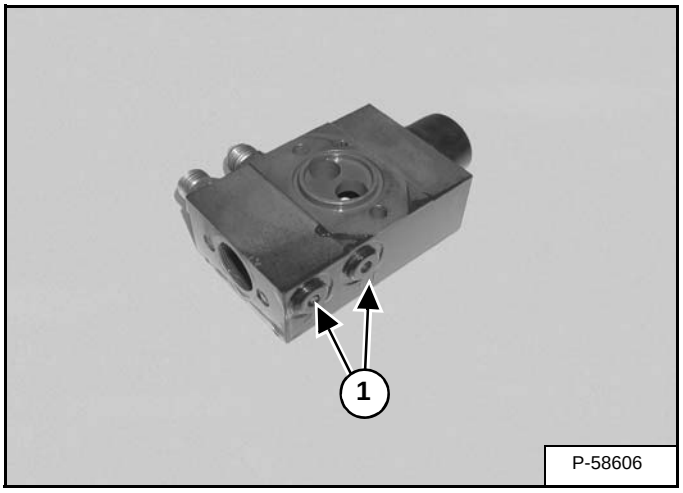
Install the O-rings (Items 1) **[Figure 20-52-58]** on the plugs and fittings.

Figure 20-52-59



Install the fittings (Item 1) **[Figure 20-52-59]**.

Figure 20-52-60



Install the plugs (Item 1) **[Figure 20-52-60]**.

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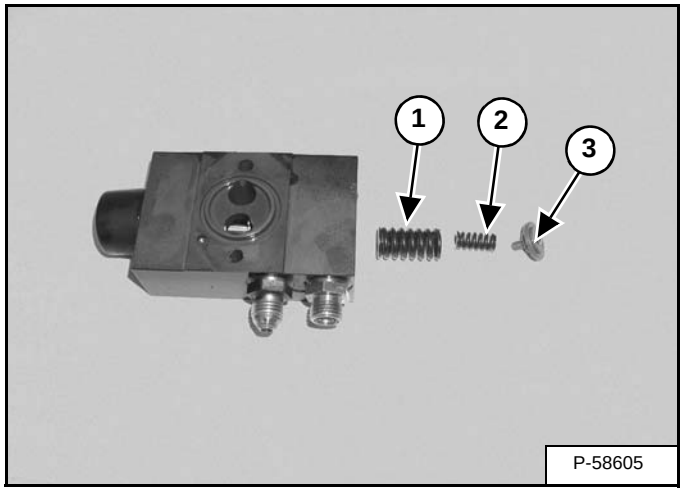
Torque Limiter Valve Assembly (Cont'd)

Figure 20-52-61

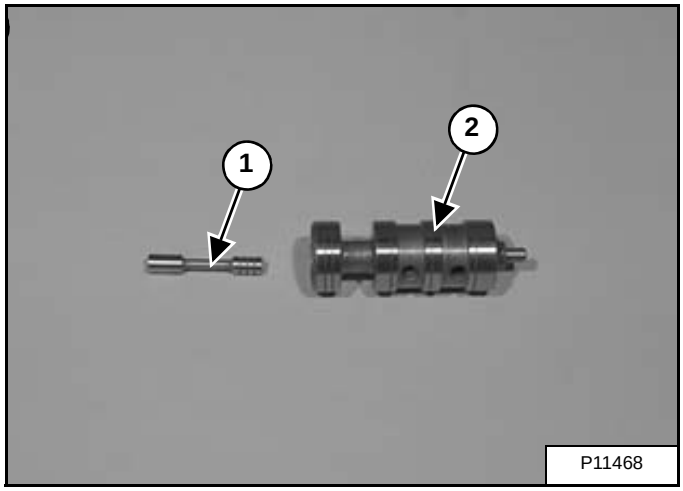


Install the two springs (Items 1 & 2) **[Figure 20-52-61]**.

NOTE: Install the big spring first and the small spring second.

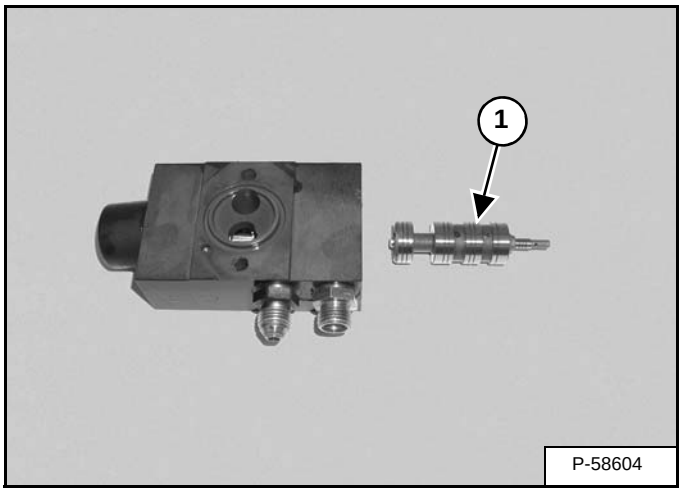
Install the spring seat (Item 3) **[Figure 20-52-61]**.

Figure 20-52-62



Install the metering spool (Item 1) in the control spool (Item 2) **[Figure 20-52-62]**.

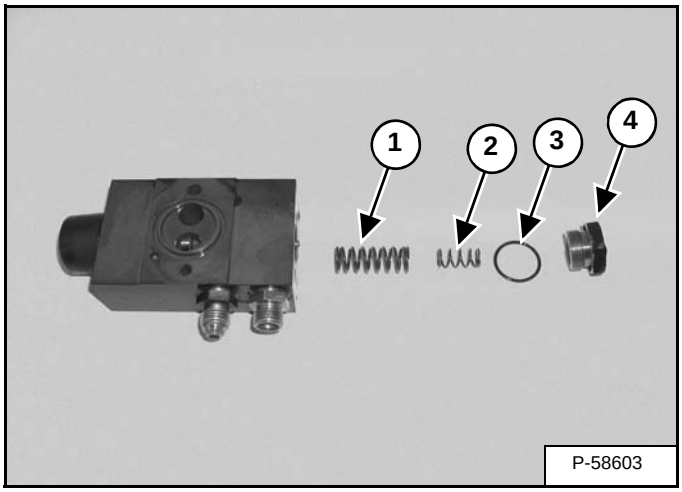
Figure 20-52-63



Install the control spool (Item 1) **[Figure 20-52-63]**.

NOTE: Use care not to scratch or damage the spool. Scratches in the spool can cause internal leakage.

Figure 20-52-64



Install the springs (Items 1 & 2). Install the O-ring (Item 3) on the plug (Item 4) **[Figure 20-52-64]**.

Install the plug in the valve body.

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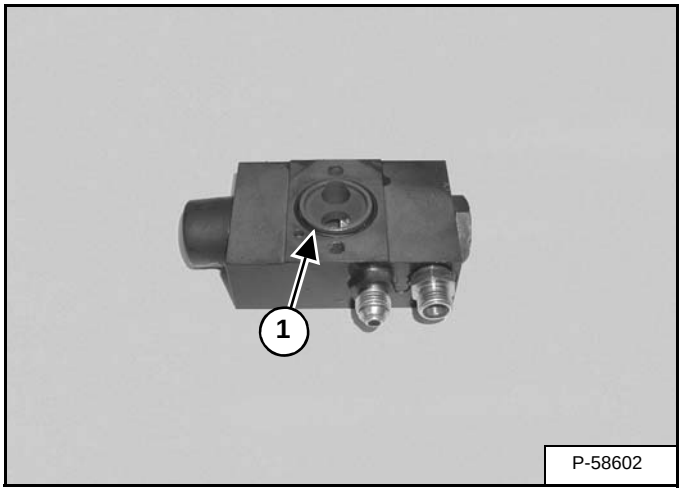
Torque Limiter Valve Assembly (Cont'd)

Figure 20-52-65



Install the O-ring (Item 1) **[Figure 20-52-65]**.

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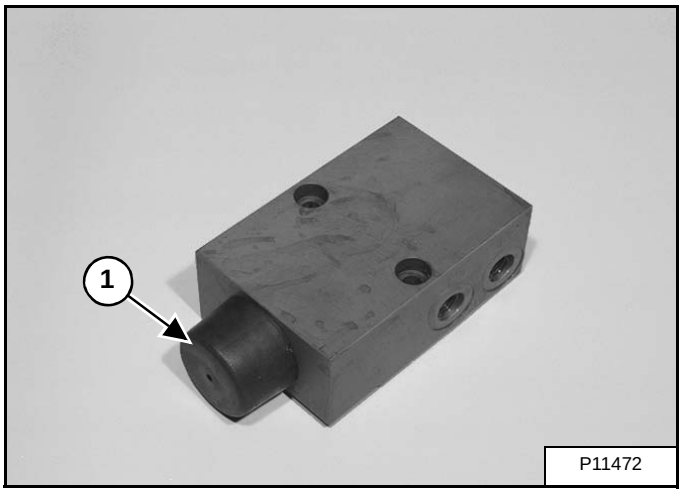
Initial Torque Limiter Valve Setting

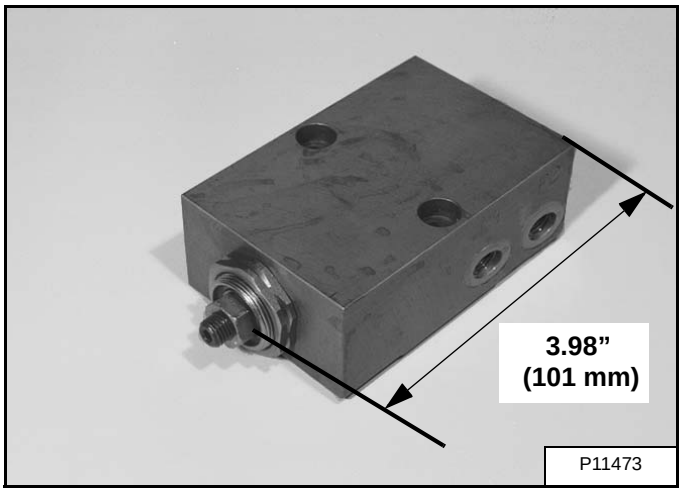
The following procedures are only used if the adjustment assembly is removed.

Figure 20-52-66



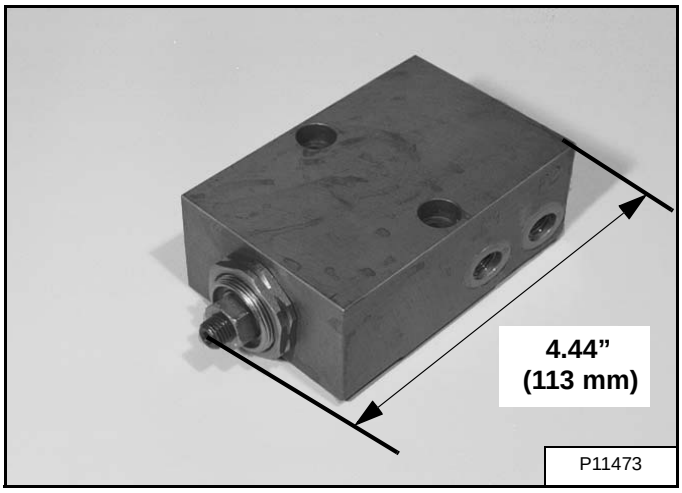
Remove the dust cap (Item 1) **[Figure 20-52-66]**.

Figure 20-52-67



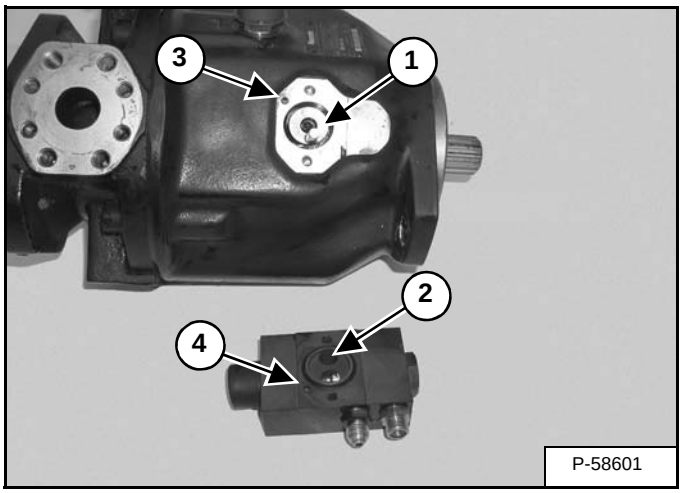
Measure from the cap to the top of the large adjustment screw. Set the large adjustment screw to 3.98 inches (101 mm) **[Figure 20-52-67]**.

Figure 20-52-68



Measure from the cap to the top of the small adjusting screw **[Figure 20-52-68]**. Set the small adjustment screw to 4.44 inches (113 mm).

Figure 20-52-69



Align the linkage pin (Item 1) on the hydraulic piston pump into the hole (Item 2) **[Figure 20-52-69]** in the torque limiter valve.

Turn the valve slightly to align the dowel pin (Item 3) on the hydraulic piston pump into the hole (Item 4) **[Figure 20-52-69]** in the torque limiter valve.

NOTE: Care should be taken not to scratch or damage the valve spool.

NOTE: Before tightening the bolts, make sure the dowel pin is aligned with the housing.

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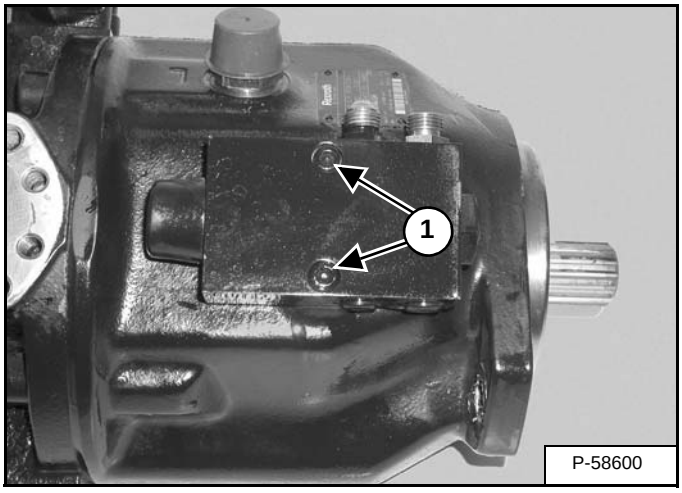
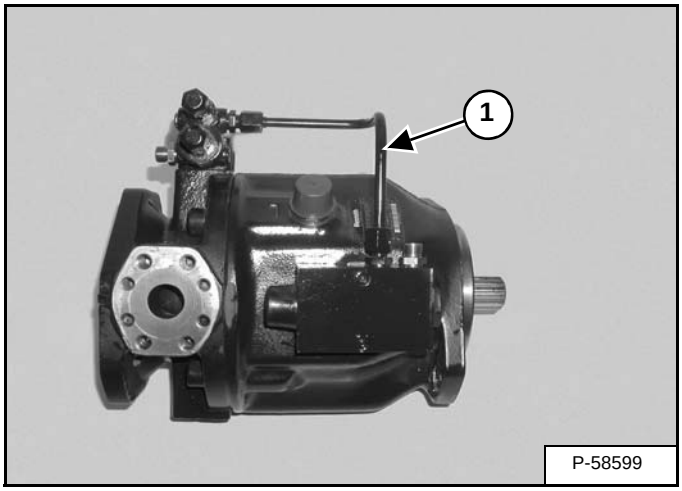
Initial Torque Limiter Valve Setting (Cont'd)

Figure 20-52-70



Install the bolts (Item 1) **[Figure 20-52-70]**. Tighten the bolts to 7.0-7.5 ft.-lb. (9,5-10,5 N•m) torque.

Figure 20-52-71



Install the tubeline (Item 1) **[Figure 20-52-71]**.

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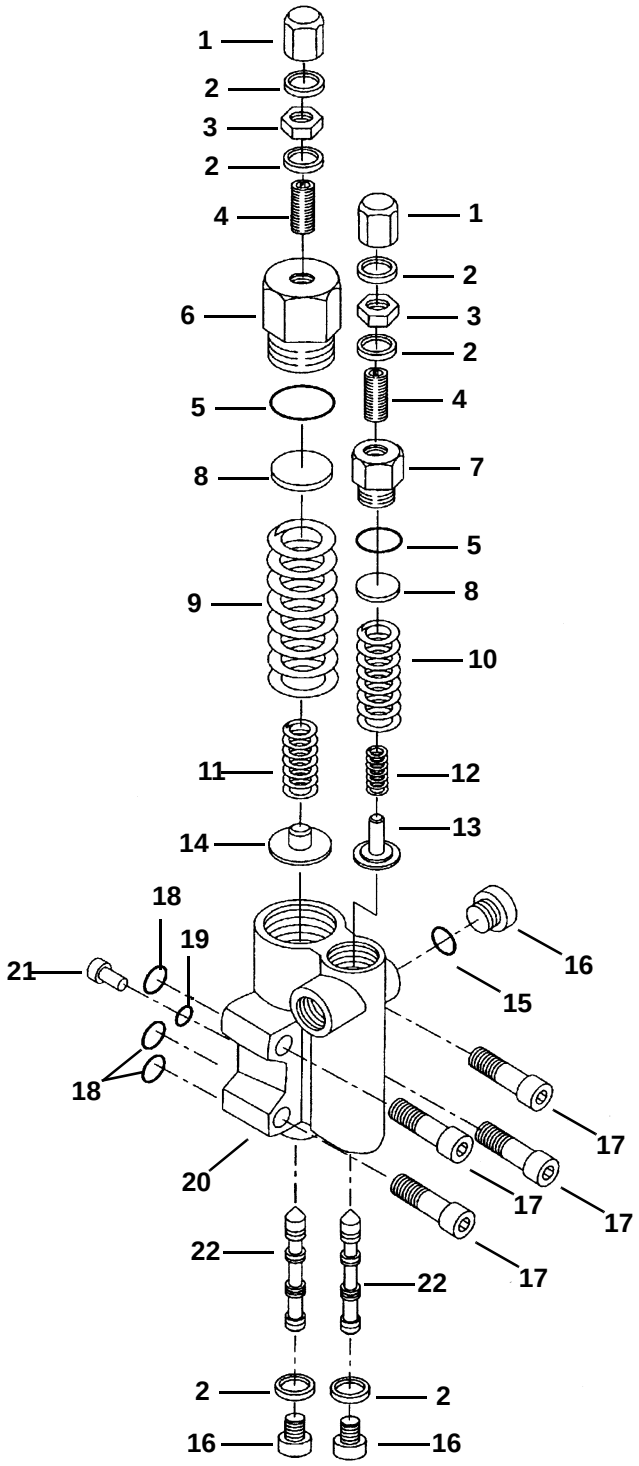
Pump Control Parts Identification

1. Cap
2. O-Ring
3. Jam Nut
4. Adjusting Screw
5. O-Ring
6. Adjustment Assembly
7. Adjustment Assembly
8. Disc
9. Spring
10. Spring
11. Spring
12. Spring
13. Spring Retainer
14. Spring Retainer
15. O-Ring
16. Plug
17. Bolt
18. O-Ring
19. O-Ring
20. Housing
21. Orifice
22. Spool



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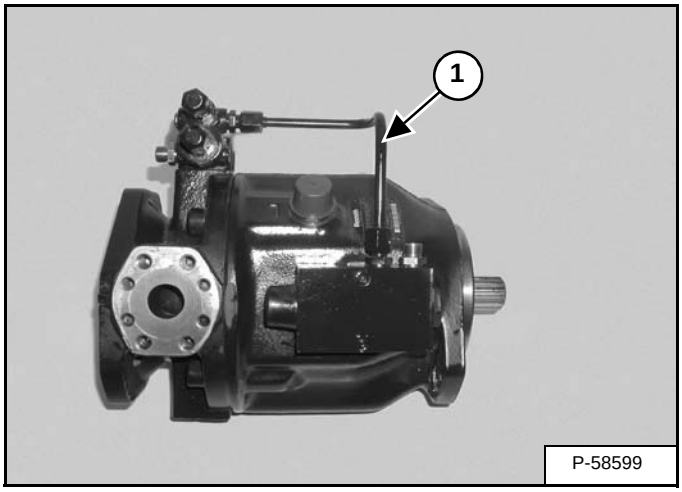
Pump Control Removal And Installation

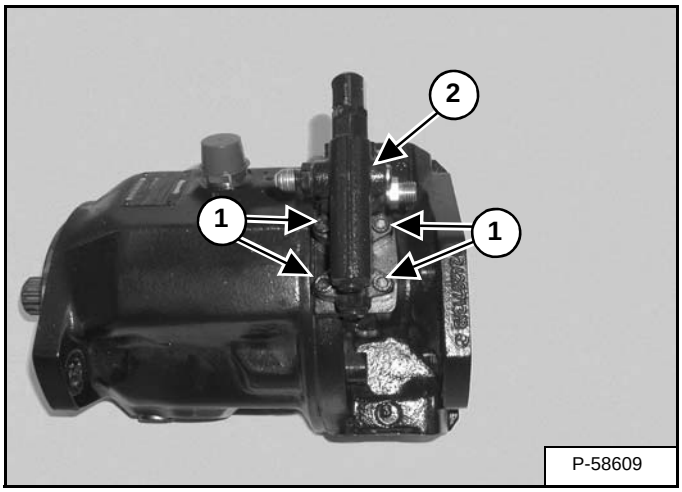
Figure 20-52-72



Mark the tubeline (Item 1) **[Figure 20-52-72]** for correct assembly.

Loosen and remove the tubeline (Item 1) **[Figure 20-52-72]** from the pump control and torque limiter valve.

Figure 20-52-73



Remove the 4 bolts (Item 1) and remove the pump control (Item 2) **[Figure 20-52-73]** from the hydraulic piston pump.

Installation: Tighten to 10 ft.-lb. and (13 N•m) torque.

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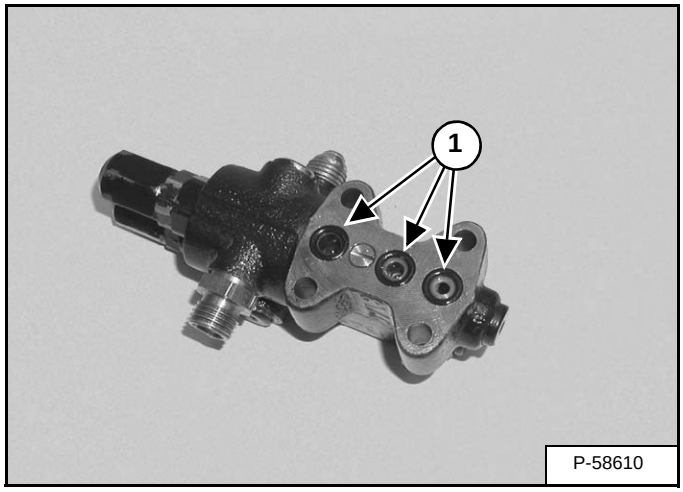
Pump Control Disassembly And Assembly

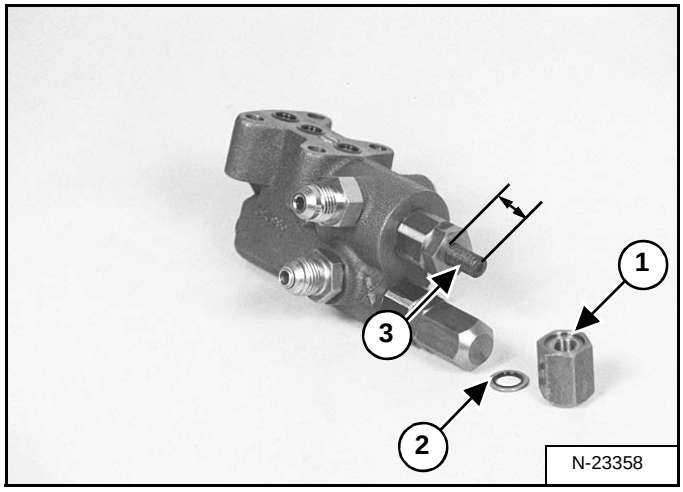
Figure 20-52-74



Remove the 3 O-rings (Item 1) **[Figure 20-52-74]** from the valve.

Pump Margin Control

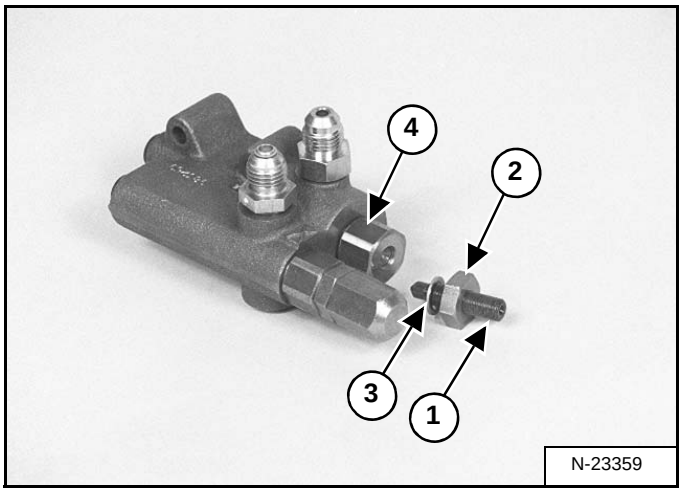
Figure 20-52-75



Before disassembling the pump margin control, remove the cap (Item 1) and O-ring washer (Item 2) **[Figure 20-52-75]** from the adjustment assembly.

Measure the adjustment screw (Item 3) **[Figure 20-52-75]**, thread length for the correct initial adjustment.

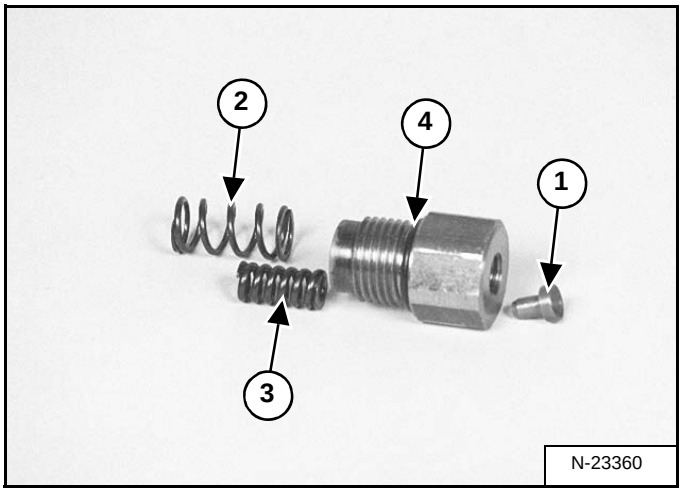
Figure 20-52-76



Remove the adjustment screw (Item 1) jam nut (Item 2), and O-ring washer (Item 3) from the adjustment assembly (Item 4) **[Figure 20-52-76]**.

Remove the adjustment assembly (Item 4) **[Figure 20-52-76]** from the pump control assembly.

Figure 20-52-77



Remove the adjustment seat (Item 1) **[Figure 20-52-77]** from the adjustment assembly.

Remove the large spring (Item 2) and the small spring (Item 3) **[Figure 20-52-77]** from the adjustment assembly.

Replace the O-ring (Item 4) **[Figure 20-52-77]** before installation.

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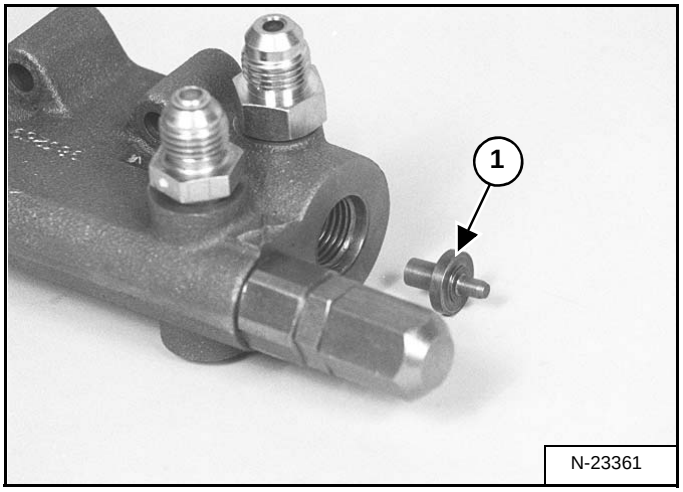
Pump Control Disassembly And Assembly (Cont'd)

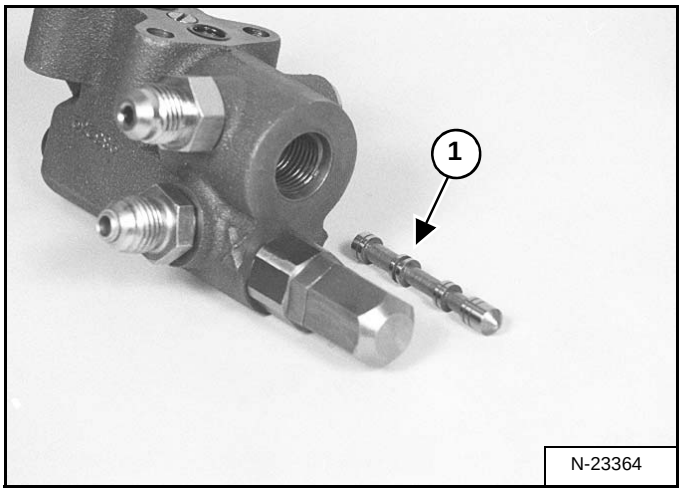
Pump Margin Control (Cont'd)

Figure 20-52-78



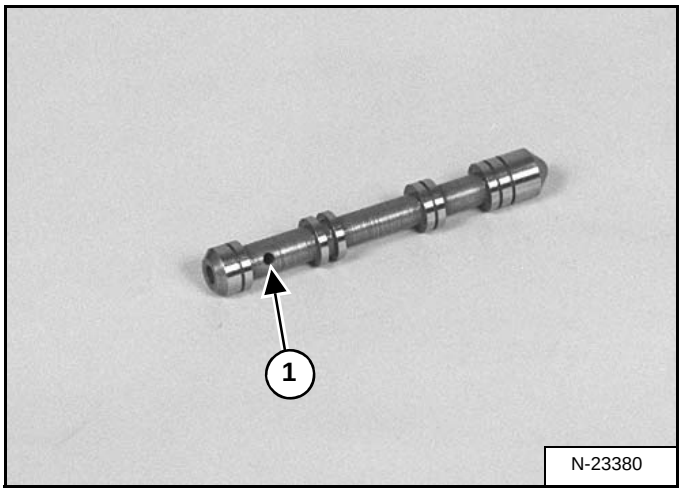
Remove the spring guide (Item 1) **[Figure 20-52-78]** from the pump control assembly.

Figure 20-52-79



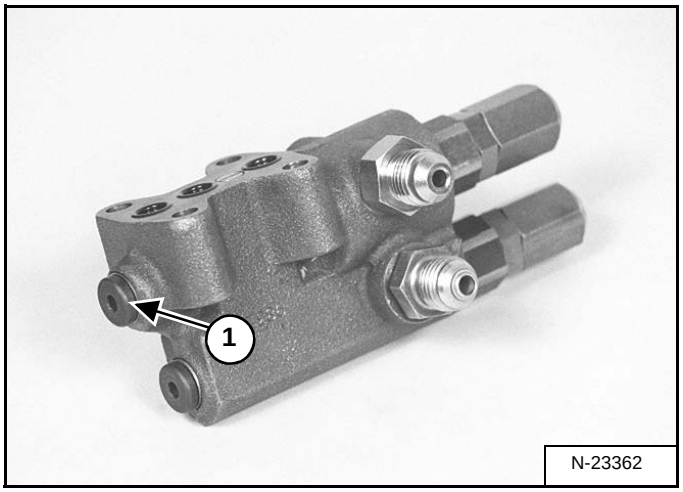
Remove the spool (Item 1) **[Figure 20-52-79]** from the pump control assembly.

Figure 20-52-80



Check the spool for scratches and be sure the orifice (Item 1) **[Figure 20-52-80]** is not plugged.

Figure 20-52-81



Remove the plug (Item 1) **[Figure 20-52-81]** from the pump control.

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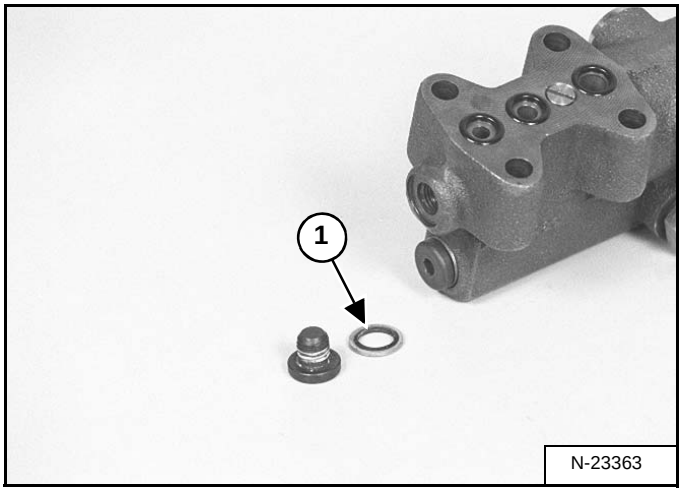
Pump Control Disassembly And Assembly (Cont'd)

Pump Margin Control (Cont'd)

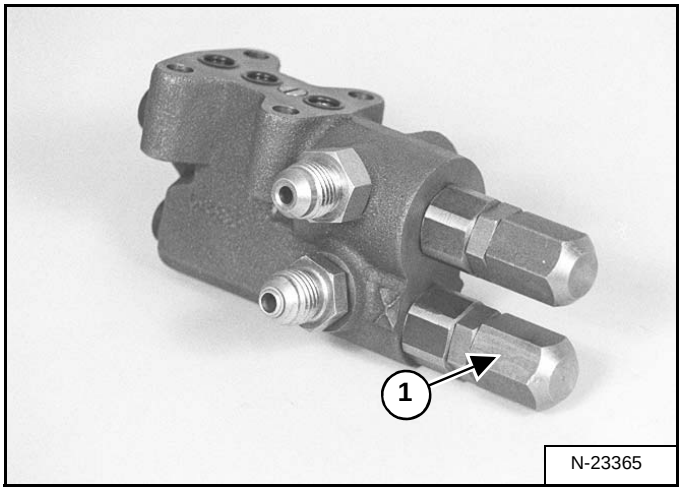
Figure 20-52-82



Check the O-ring washer (Item 1) **[Figure 20-52-82]** and replace as needed.

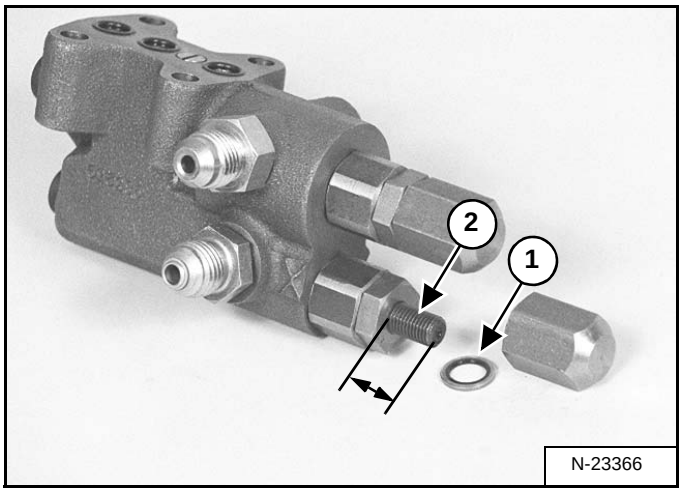
Torque Limiter Supply Control

Figure 20-52-83



Remove the cap (Item 1) **[Figure 20-52-83]**.

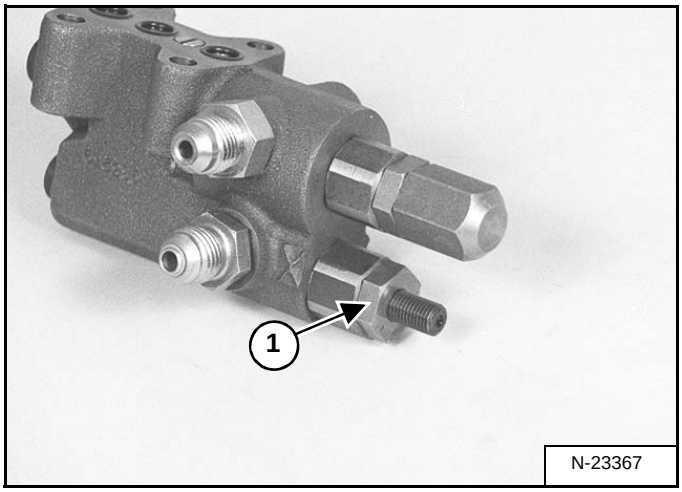
Figure 20-52-84



Before disassembling the torque limiter supply control, remove the O-ring washer (Item 1) **[Figure 20-52-84]** from the adjustment assembly.

Measure the adjustment screw (Item 2) **[Figure 20-52-84]**, thread length for the correct initial adjustment.

Figure 20-52-85



Loosen the jam nut (Item 1) **[Figure 20-52-85]**.

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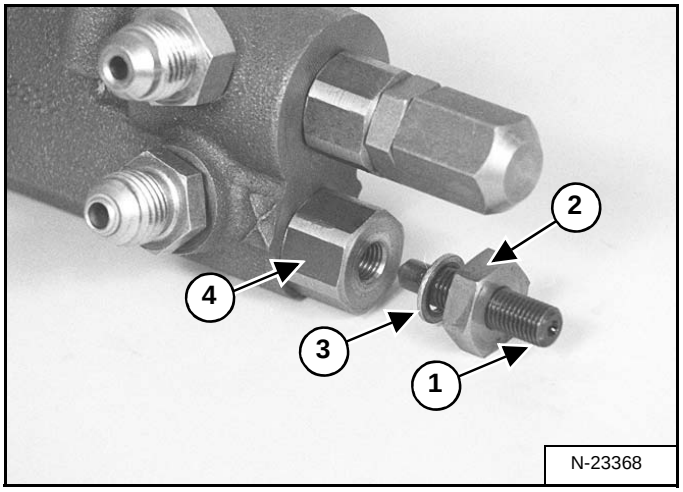
Pump Control Disassembly And Assembly (Cont'd)

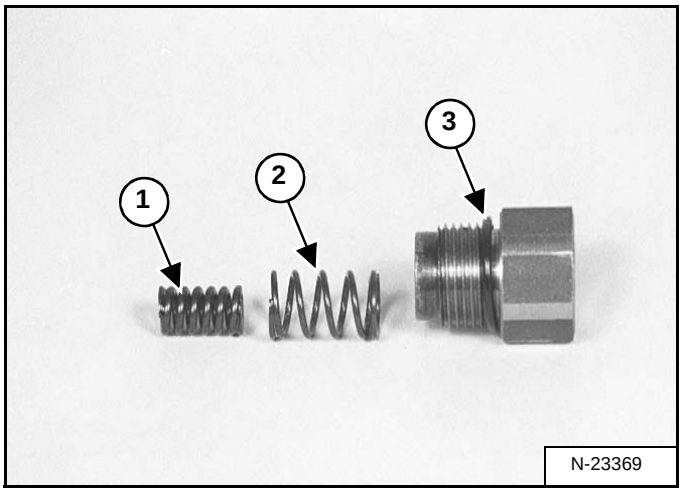
Torque Limiter Supply Control (Cont'd)

Figure 20-52-86



Remove the adjustment screw (Item 1), jam nut (Item 2), and O-ring washer (Item 3) from the adjustment assembly (Item 4) **[Figure 20-52-86]**.

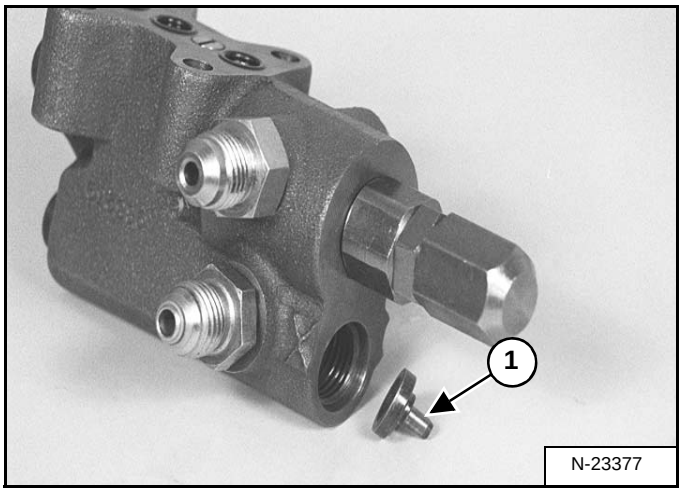
Figure 20-52-87



Remove the small spring (Item 1) and the large spring (Item 2) **[Figure 20-52-87]** from the adjustment assembly.

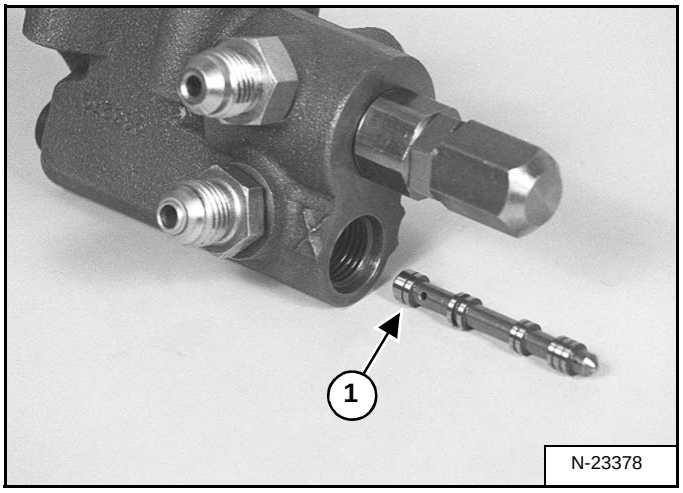
Replace the O-ring (Item 3) **[Figure 20-52-87]** before installation.

Figure 20-52-88



Remove the spring guide (Item 1) **[Figure 20-52-88]**.

Figure 20-52-89



Remove the spool (Item 1) **[Figure 20-52-89]**.

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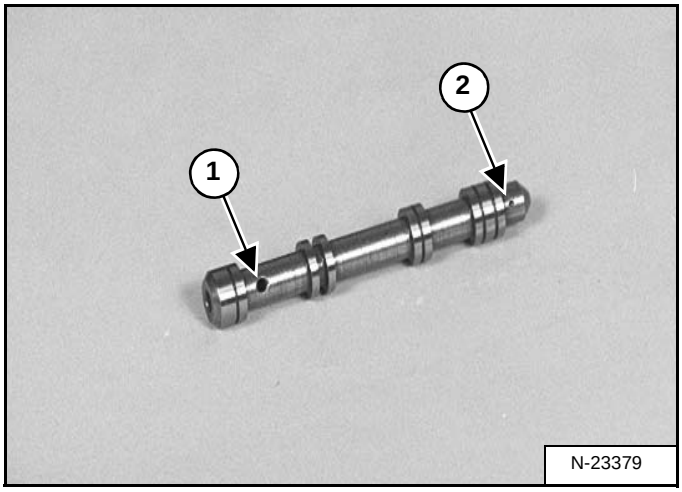
Pump Control Disassembly And Assembly (Cont'd)

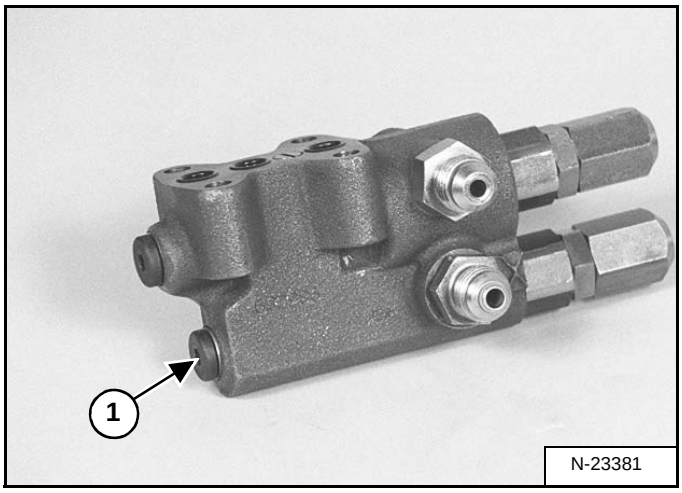
Torque Limiter Supply Control (Cont'd)

Figure 20-52-90



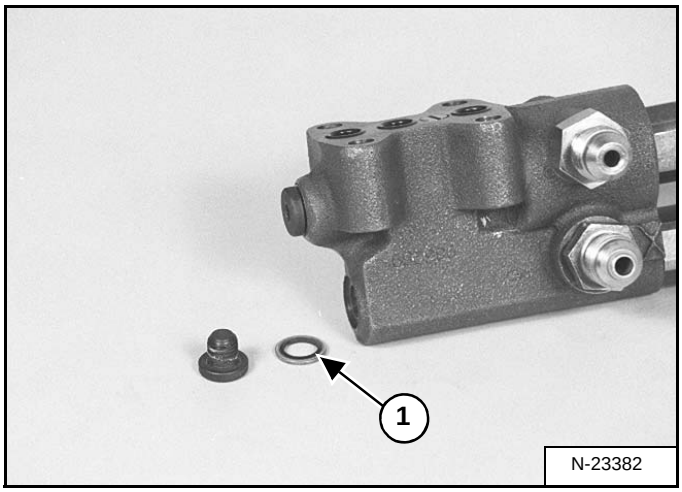
Check the spool for scratches and be sure the orifice (Items 1 & 2) **[Figure 20-52-90]** are not plugged.

Figure 20-52-91



Remove the plug (Item 1) **[Figure 20-52-91]** from the pump control.

Figure 20-52-92



Check the O-ring washer (Item 1) **[Figure 20-52-92]** and replace as needed.

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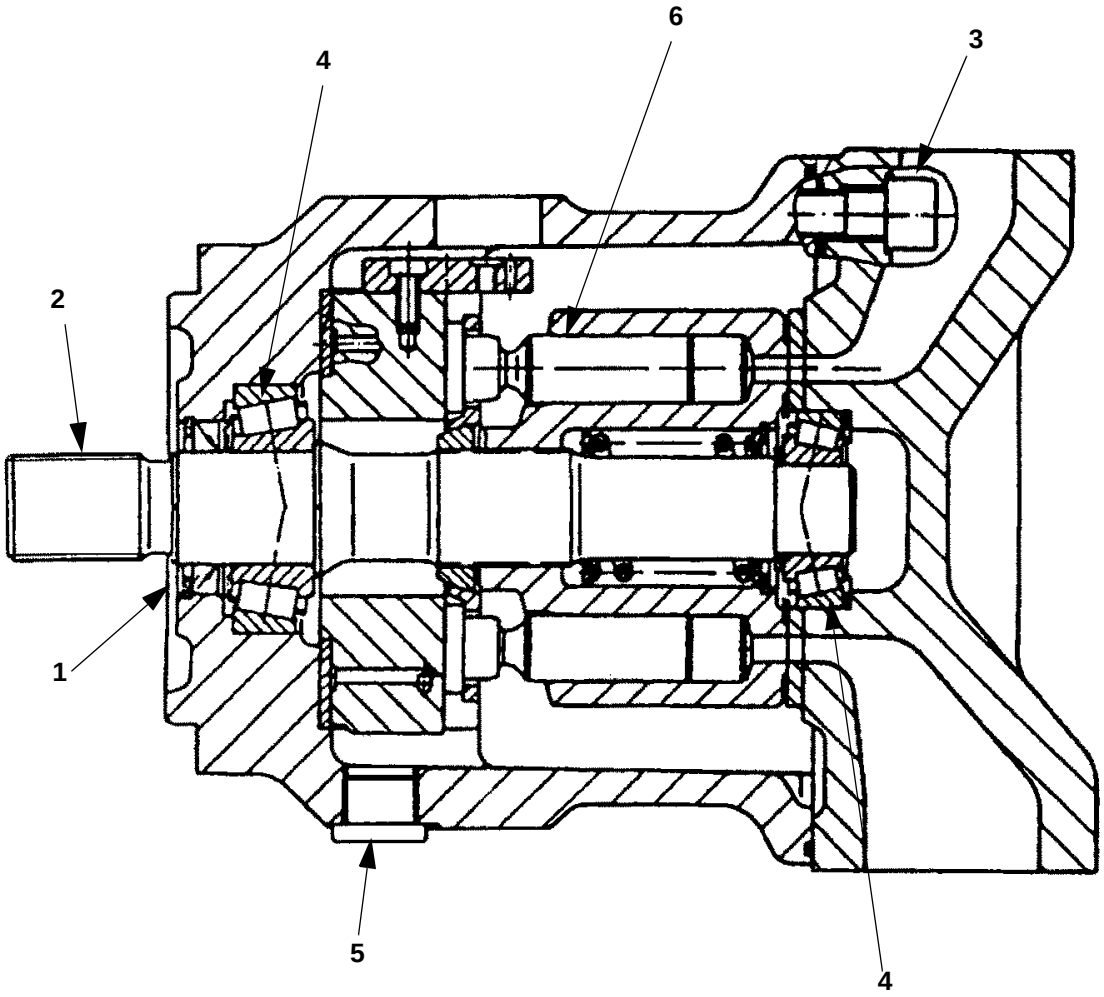
Parts Identification

1. Seal
2. Shaft
3. Bolt
4. Bearing
5. Plug
6. Piston



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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.

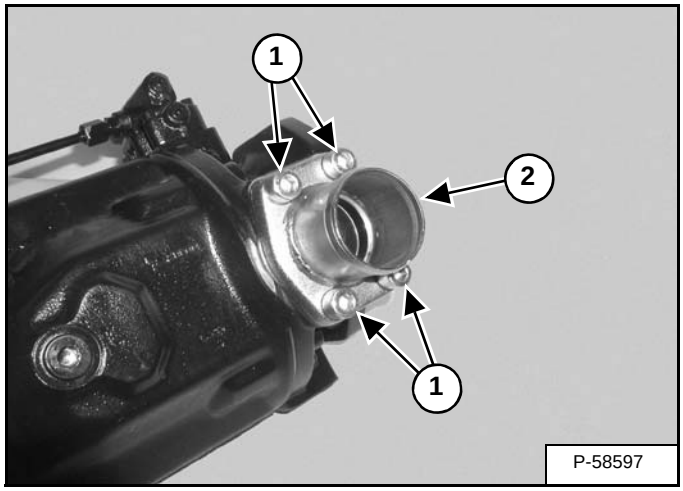
I-2003-0888

Clean the outside of the hydraulic piston pump.

Remove the torque limiter valve. See "Torque Limiter Valve Removal and Installation" on page 17.

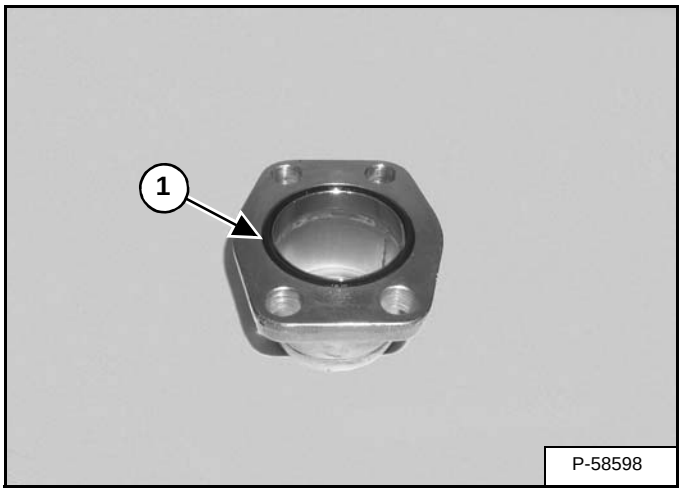
Remove the pump control assembly. See "Pump Control Removal And Installation" on page 29.

Figure 20-52-93



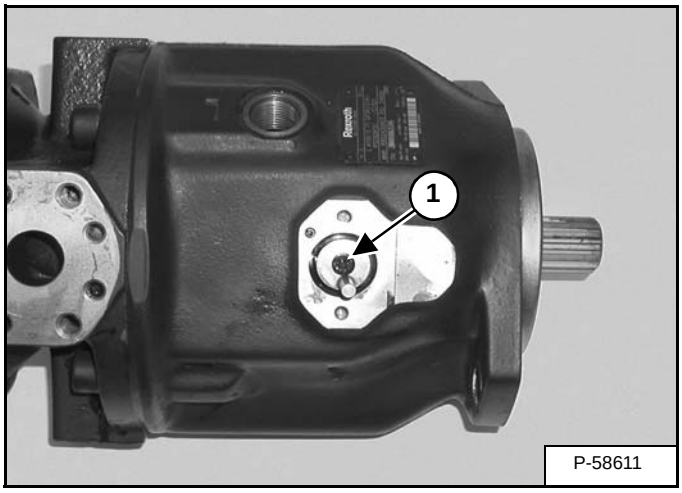
Remove the bolts (Item 1) and inlet fitting (Item 2) **[Figure 20-52-93]**.

Figure 20-52-94



Remove the O-ring (Item 1) **[Figure 20-52-94]**.

Figure 20-52-95



Remove the screw (Item 1) **[Figure 20-52-95]** from the pin assembly.

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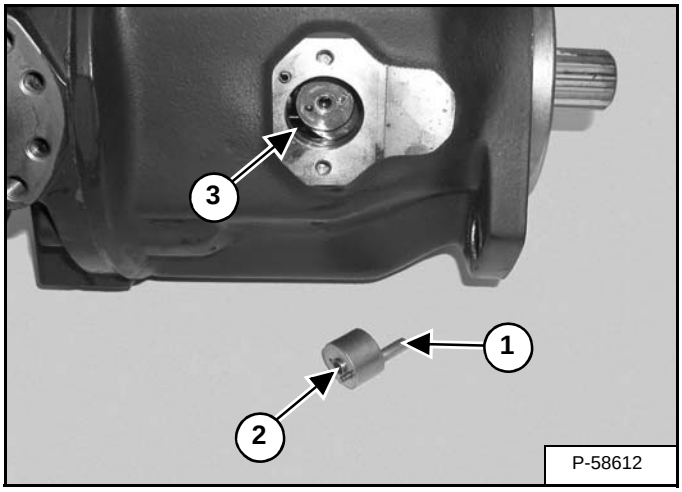
Disassembly (Cont'd)

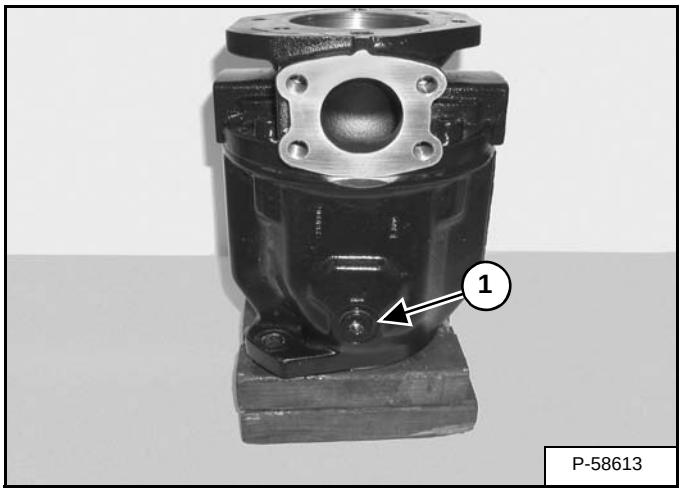
Figure 20-52-96



Remove the pin assembly (Item 1) **[Figure 20-52-96]**.

NOTE: The position of the dowel pin (Item 2) on the pin assembly, with the locating hole on the swash plate cradle (Item 3) [Figure 20-52-96].

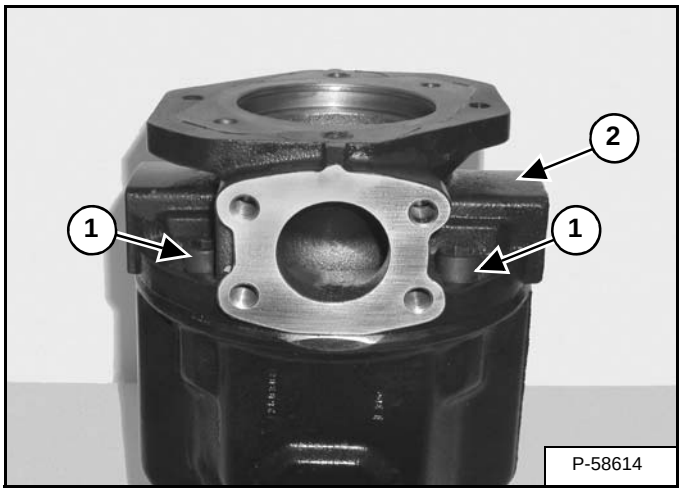
Figure 20-52-97



Remove the plug (Item 1) **[Figure 20-52-97]** from the pump housing and drain the oil.

Mark the pump housing for proper installation.

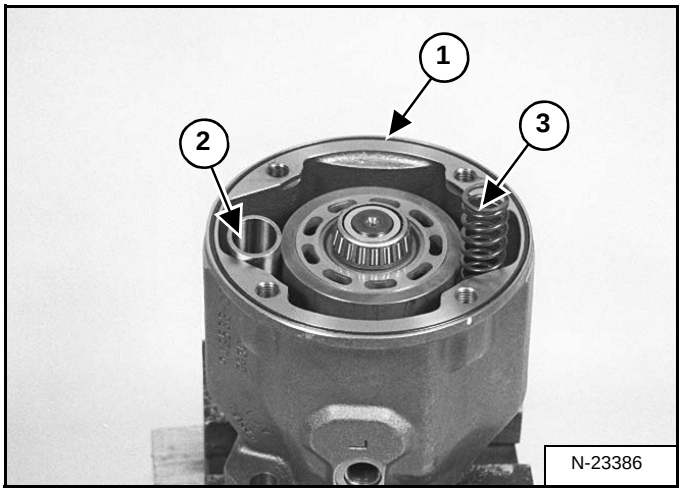
Figure 20-52-98



Remove the 4 bolts (Item 1) **[Figure 20-52-98]**.

Remove the block port assembly (Item 2) **[Figure 20-52-98]** from the pump.

Figure 20-52-99



Remove the O-ring (Item 1) **[Figure 20-52-99]**.

Remove the destroking piston (Item 2) **[Figure 20-52-99]**.

Remove the stroking piston/spring assembly (Item 3) **[Figure 20-52-99]**.

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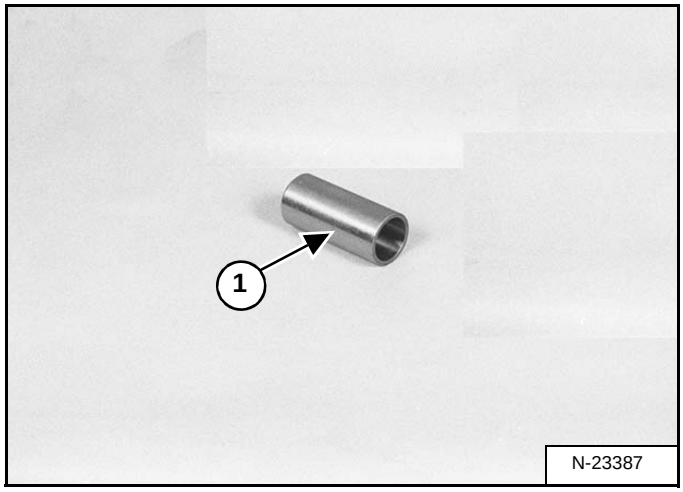
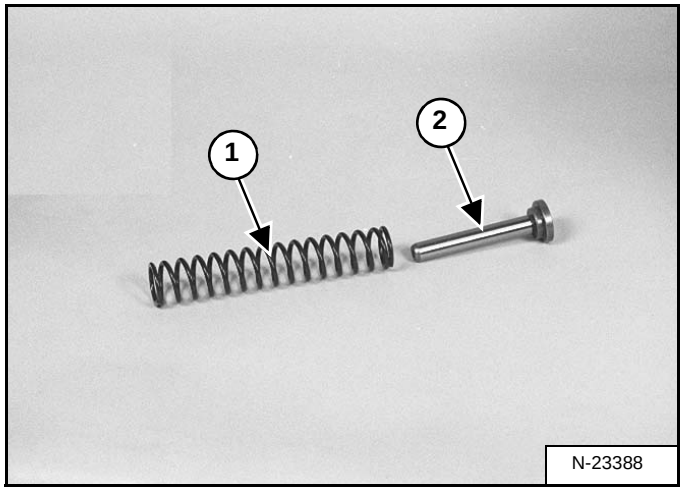
Disassembly (Cont'd)

Figure 20-52-100



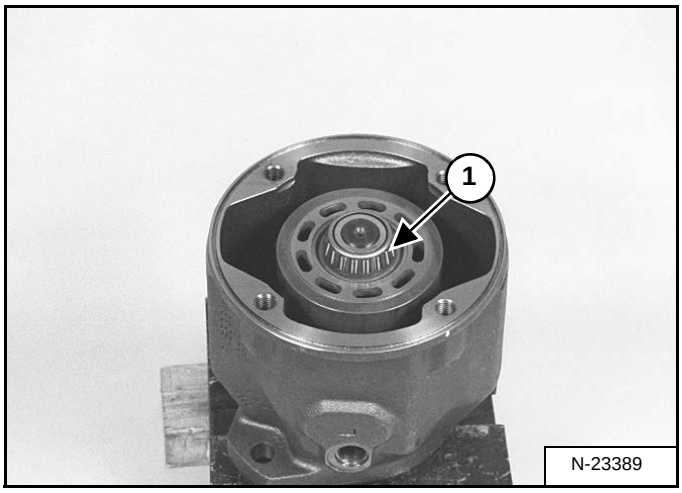
Inspect the destroking piston (Item 1) **[Figure 20-52-100]** for scratches and replace as needed.

Figure 20-52-101



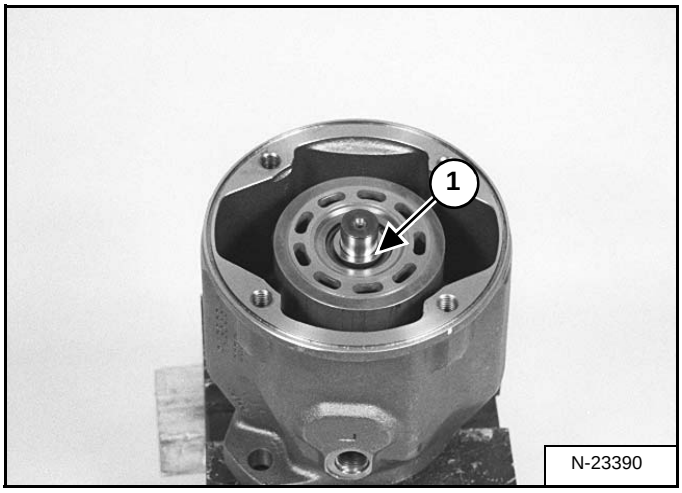
Remove the spring (Item 1) from the stroking piston (Item 2) **[Figure 20-52-101]**, inspect all parts and replace as needed.

Figure 20-52-102



Remove the bearing (Item 1) **[Figure 20-52-102]**.

Figure 20-52-103



Remove the adjustment spacer(s) (Item 1) **[Figure 20-52-103]** from the pump shaft.

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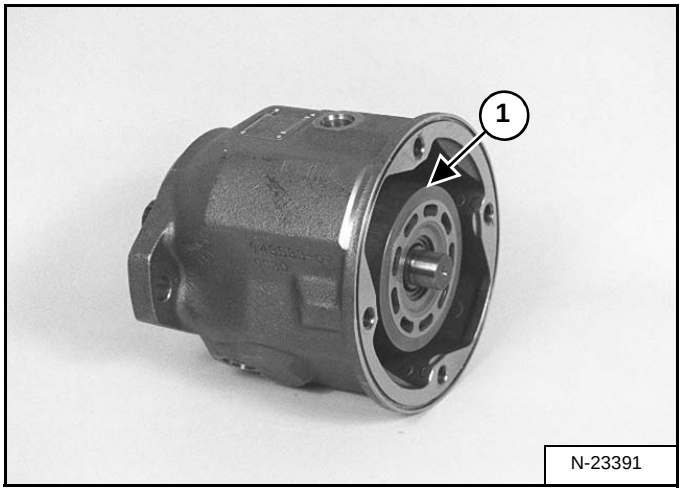
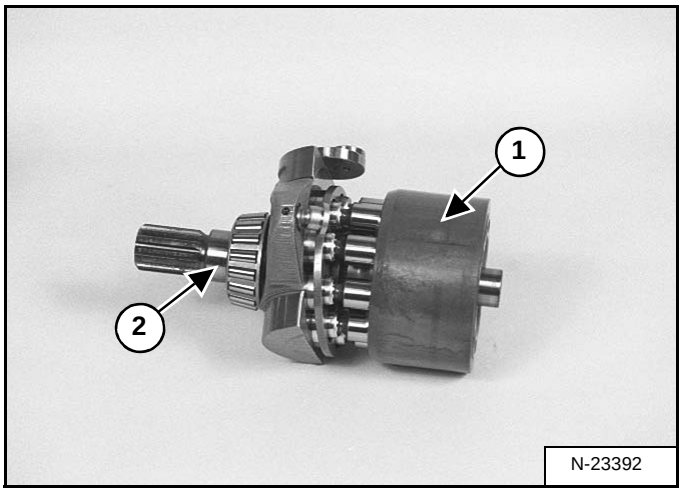
Disassembly (Cont'd)

Figure 20-52-104



Lay the pump assembly on its side and remove the rotary group, cradle, and shaft (Item 1) **[Figure 20-52-104]** from the housing.

Figure 20-52-105

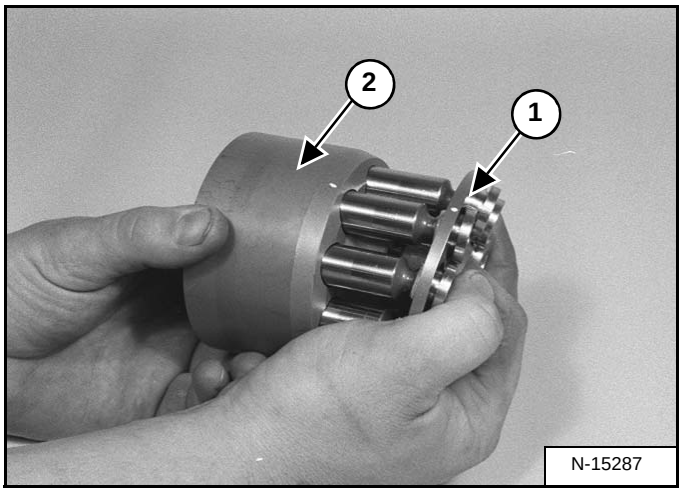


Slide the rotary group (Item 1) from the shaft assembly (Item 2) **[Figure 20-52-105]**.

NOTE: It is NOT important that the pistons are installed in their original positions.

NOTE: Check that there are no scratches or metal deposits on the sliding surface. (Pistons must be replaced in sets).

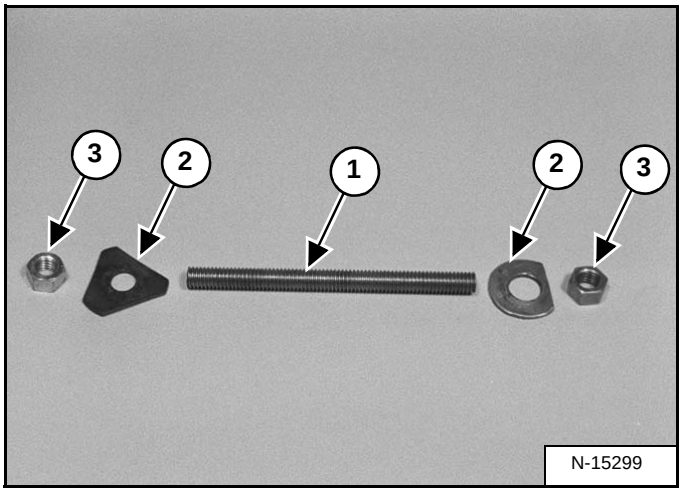
Figure 20-52-106



Remove the retainer plate and pistons (Item 1) from the cylinder block (Item 2) **[Figure 20-52-106]**.

NOTE: The following procedure shown is to disassemble the rotating group for inspection only. The rotating group parts can not be ordered separately and must be ordered as an assembly.

Figure 20-52-107



To remove the spring from inside the cylinder block, use a threaded rod (or bolt) (Item 1) two trimmed washers (Item 2) and two nuts (Item 3) **[Figure 20-52-107]**.

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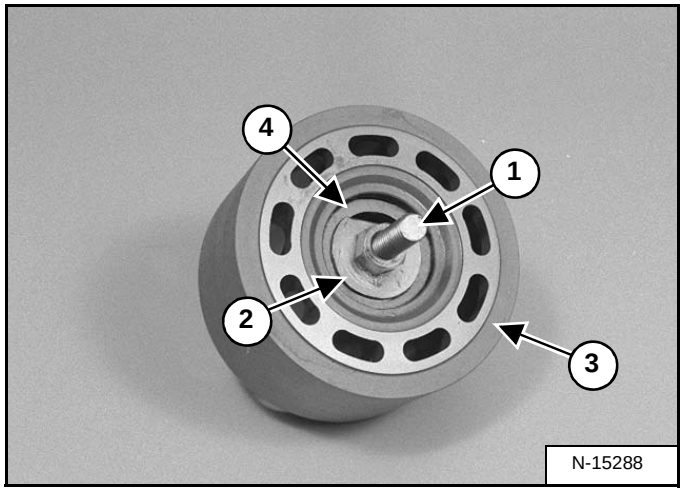
Disassembly (Cont'd)

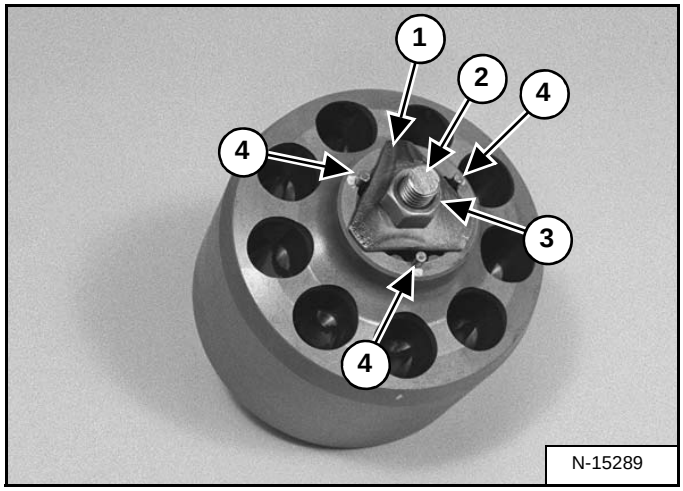
Figure 20-52-108



Install the threaded rod and nut (Item 1) through the trimmed washer (Item 2) and through the block assembly (Item 3) **[Figure 20-52-108]**.

NOTE: The modified washer (Item 2) must fit over the spring but must also fit inside the snap ring (Item 4) [Figure 20-52-108].

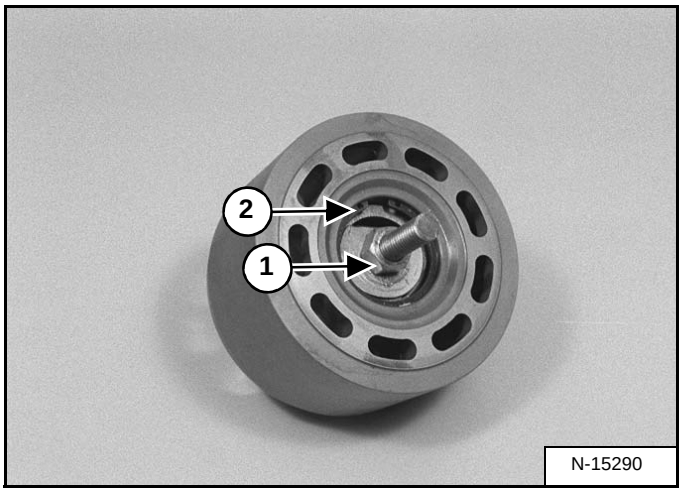
Figure 20-52-109



Install the second trimmed washer (Item 1) over the threaded rod (Item 2) install the nut (Item 3) **[Figure 20-52-109]**.

NOTE: The modified washer (Item 1) must fit between the three pins (Item 4) [Figure 20-52-109].

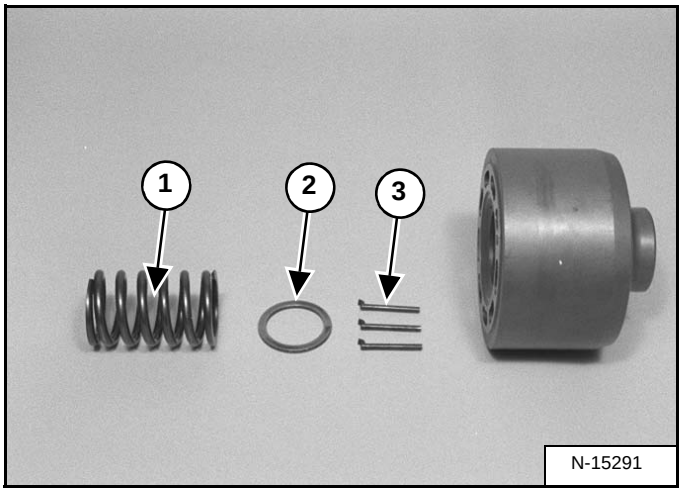
Figure 20-52-110



Tighten the nut (Item 1) until the spring is compressed enough to remove the snap ring (Item 2) **[Figure 20-52-110]**.

Loosen the nut to release the tension on the spring and remove the bolts and washers.

Figure 20-52-111



Remove the spring (Item 1) the washer (Item 2) and the 3 pins (Item 3) **[Figure 20-52-111]** from the cylinder block.

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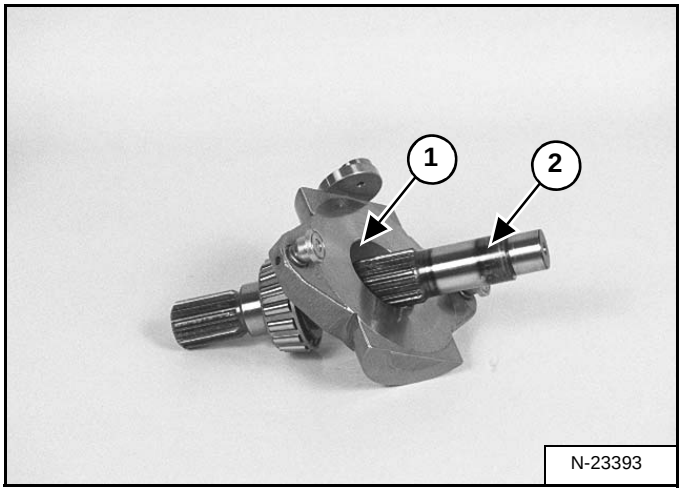
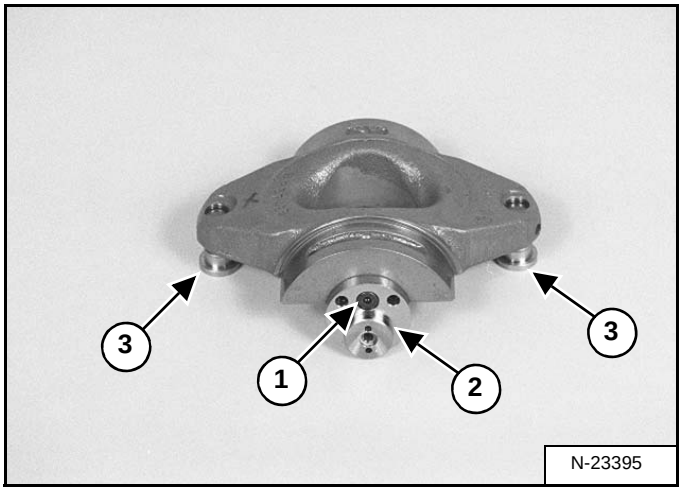
Disassembly (Cont'd)

Figure 20-52-112



Remove the cradle (Item 1) from the shaft (Item 2) **[Figure 20-52-112]**.

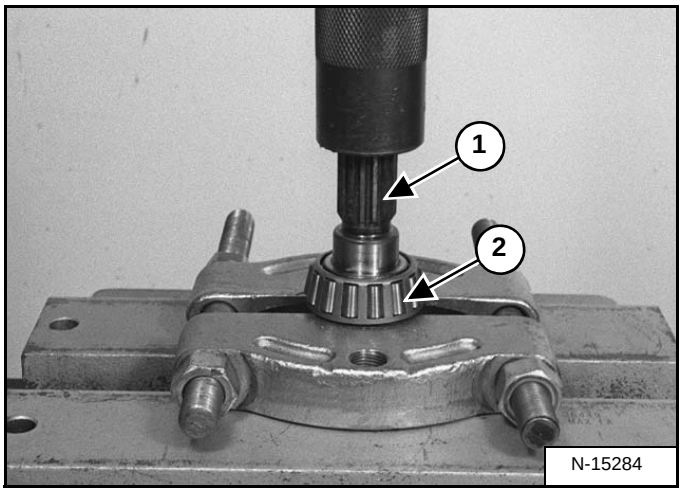
Figure 20-52-113



Loosen and remove the bolt (Item 1) and remove the torque limiter plate (Item 2) **[Figure 20-52-113]**.

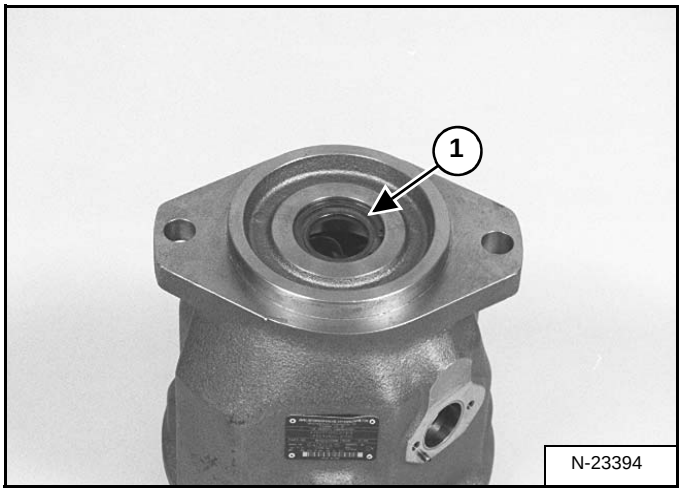
NOTE: The caps (Item 3) [Figure 20-52-113] cannot be replaced, a new cradle must be ordered.

Figure 20-52-114



Press the shaft (Item 1) from the bearing (Item 2) **[Figure 20-52-114]**.

Figure 20-52-115



Remove the snap ring (Item 1) **[Figure 20-52-115]** from the housing.

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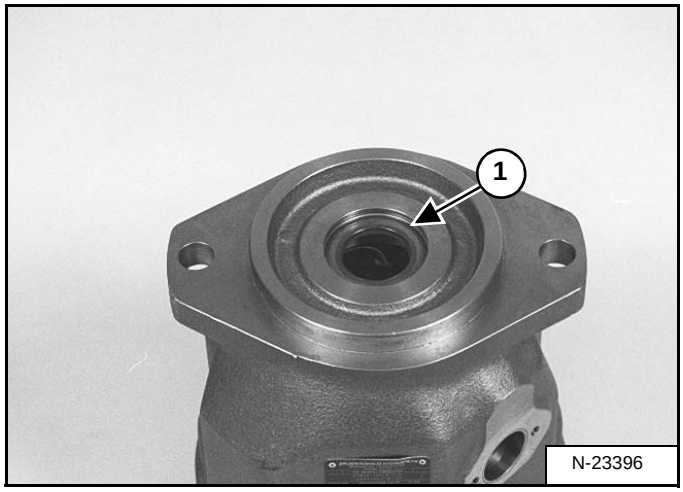
Disassembly (Cont'd)

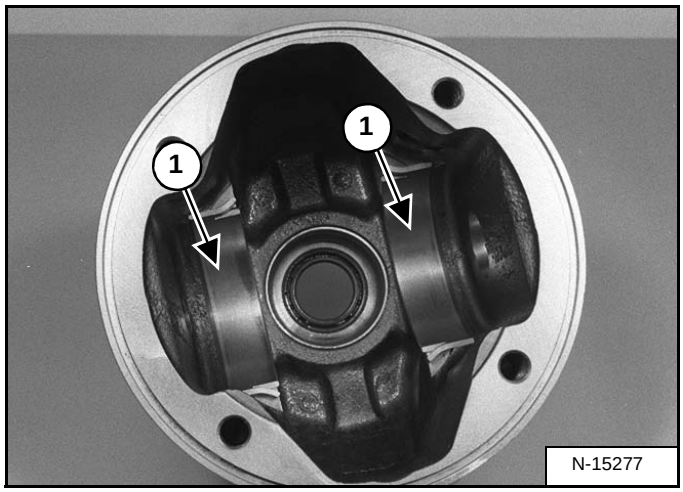
Figure 20-52-116



Remove the seal (Item 1) **[Figure 20-52-116]** from the housing.

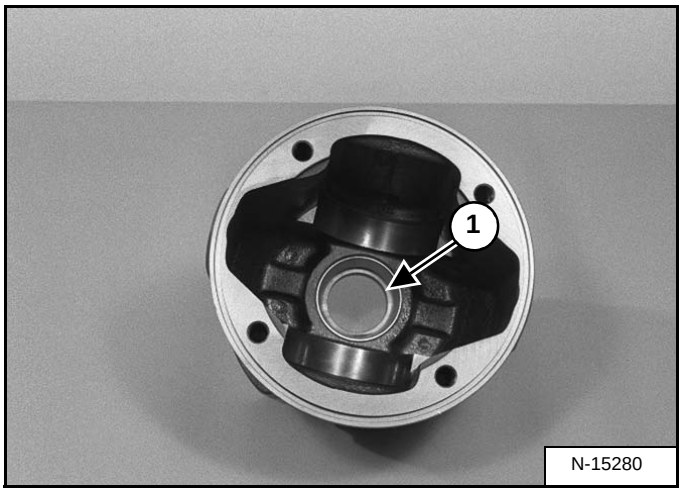
NOTE: The shaft seal can be removed without removing the shaft.

Figure 20-52-117



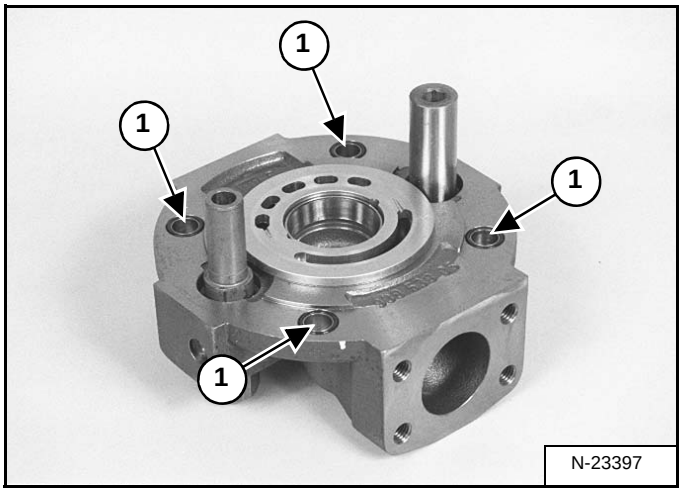
Remove the 2 brass bearings (Item 1) **[Figure 20-52-117]** from the housing.

Figure 20-52-118



Remove the race (Item 1) **[Figure 20-52-118]** from the housing.

Figure 20-52-119



Remove the 4 O-rings (Item 1) **[Figure 20-52-119]**.

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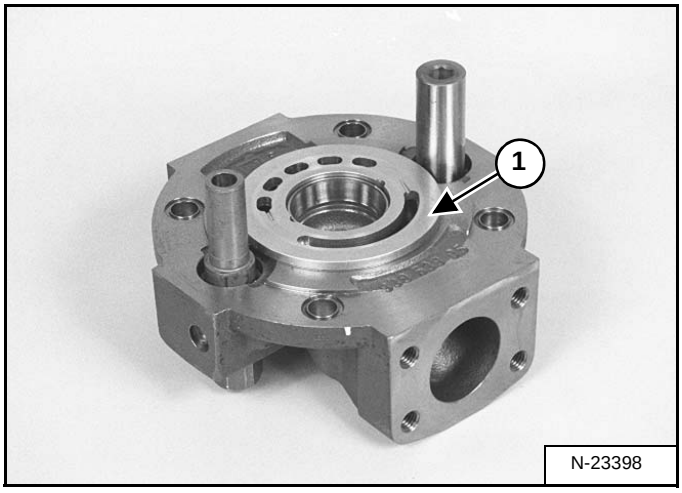
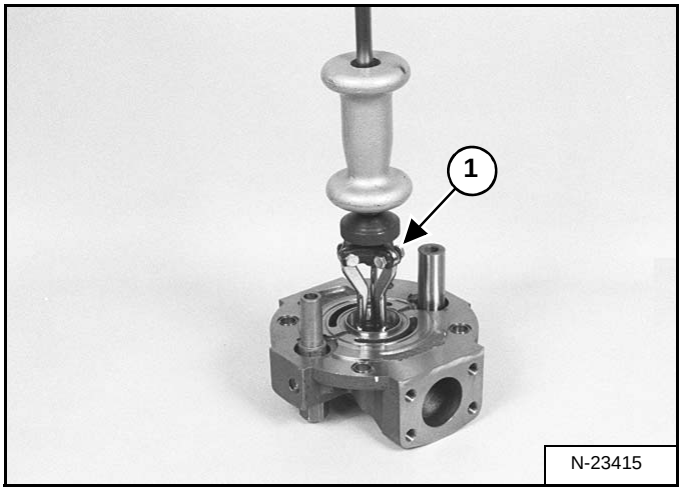
Disassembly (Cont'd)

Figure 20-52-120



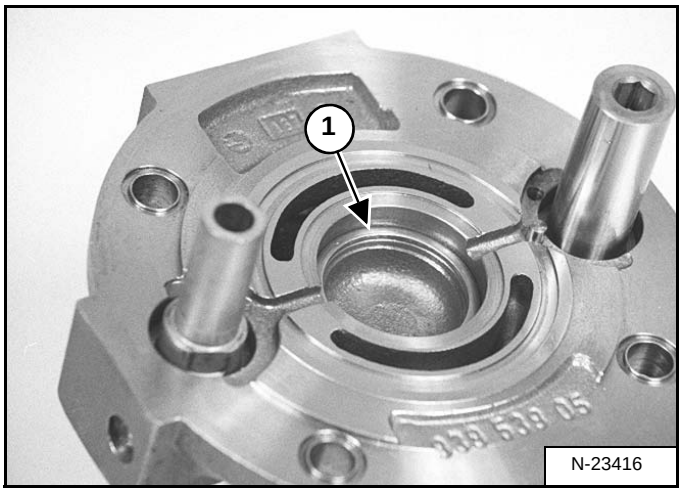
Remove the valve plate (Item 1) **[Figure 20-52-120]** from the housing.

Figure 20-52-121



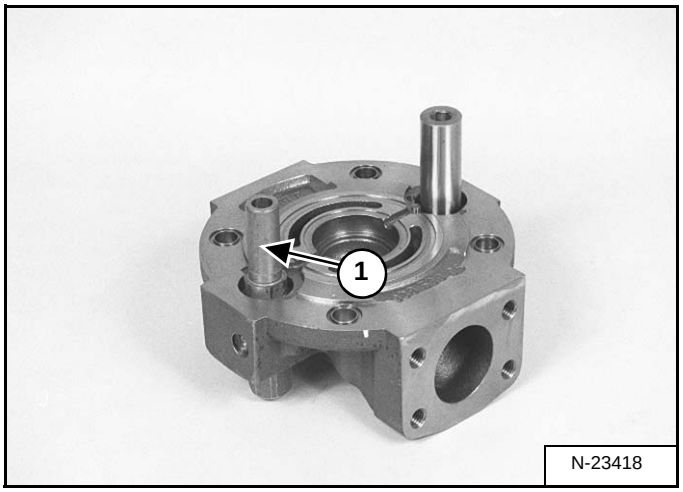
With a bearing puller (Item 1) **[Figure 20-52-121]** remove the bearing race from the back port assembly.

Figure 20-52-122



Remove the spacer (Item 1) **[Figure 20-52-122]** from the back port assembly.

Figure 20-52-123



Remove the stroking piston (Item 1) **[Figure 20-52-123]**. (Spring Side)

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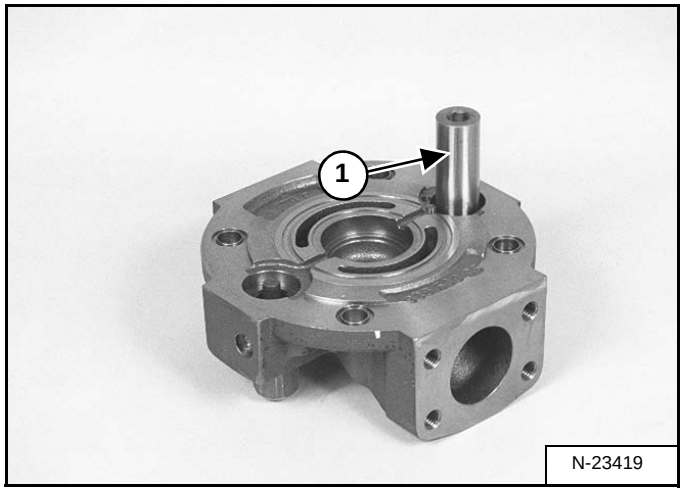
Disassembly (Cont'd)

Figure 20-52-124



Remove the destroking piston (Item 1) **[Figure 20-52-124]**.

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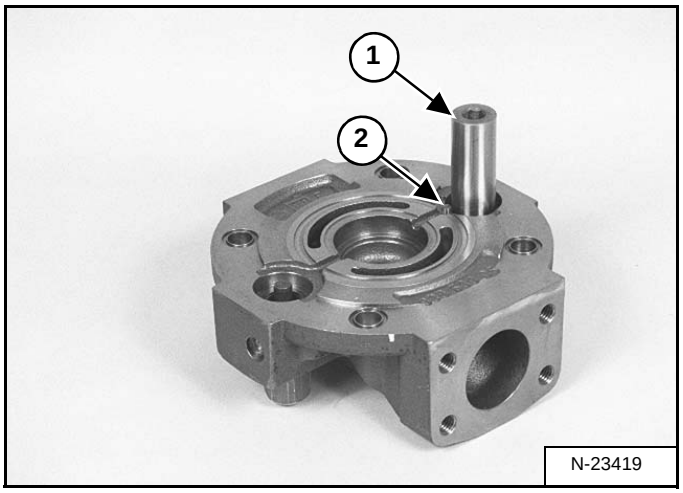
Assembly

Clean parts in solvent and dry with compressed air.

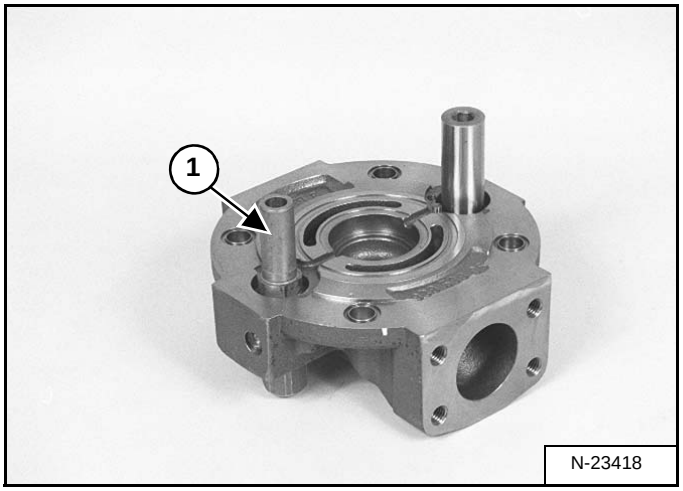
Apply oil or assembly lube to new O-rings.

Figure 20-52-125



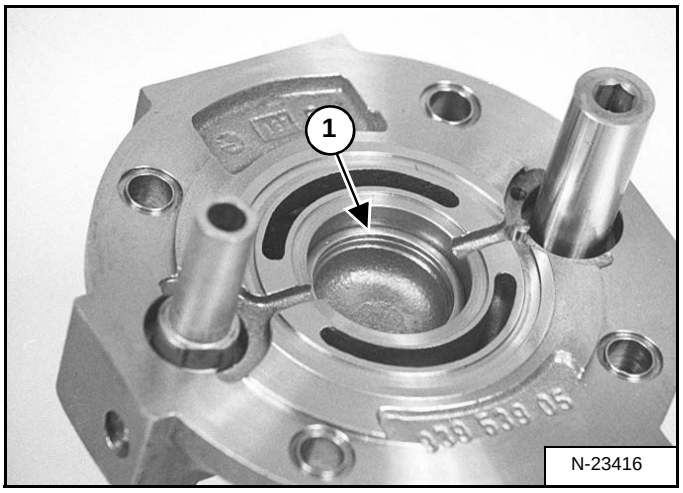
Apply Loctite™ 241 on the threads and install the destroking piston (Item 1) in the hole next to the alignment pin (Item 2) **[Figure 20-52-125]** and tighten.

Figure 20-52-126



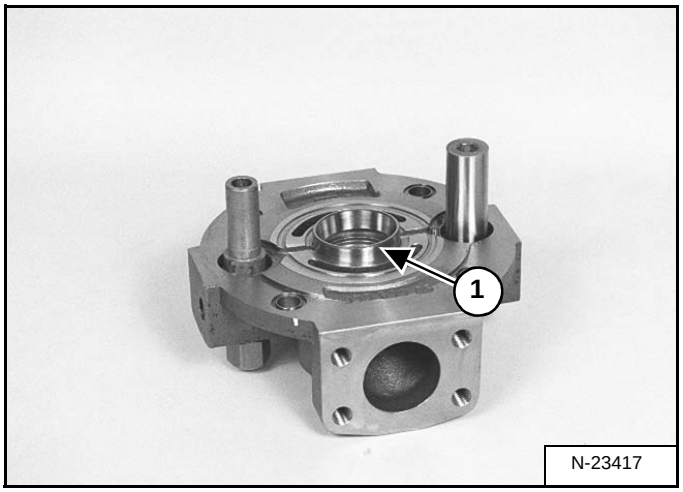
Apply Loctite™ 241 on the threads and install the stroking piston (Item 1) **[Figure 20-52-126]** in the hole and tighten.

Figure 20-52-127



Install the spacer (Item 1) **[Figure 20-52-127]** in the back port assembly.

Figure 20-52-128



Install the bearing race (Item 1) **[Figure 20-52-128]** in the back port assembly.

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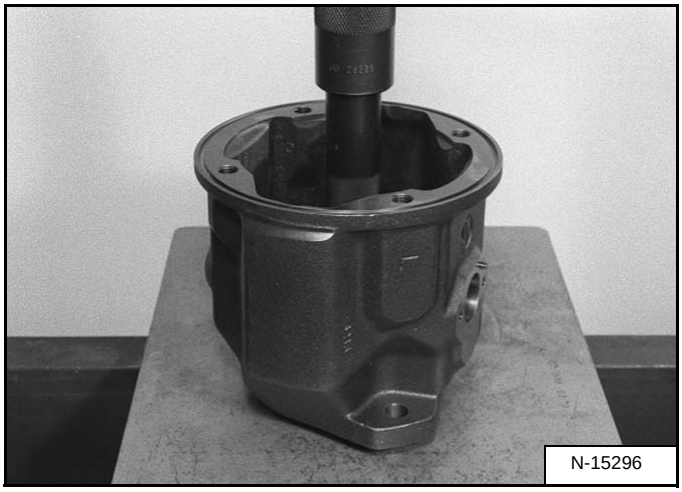
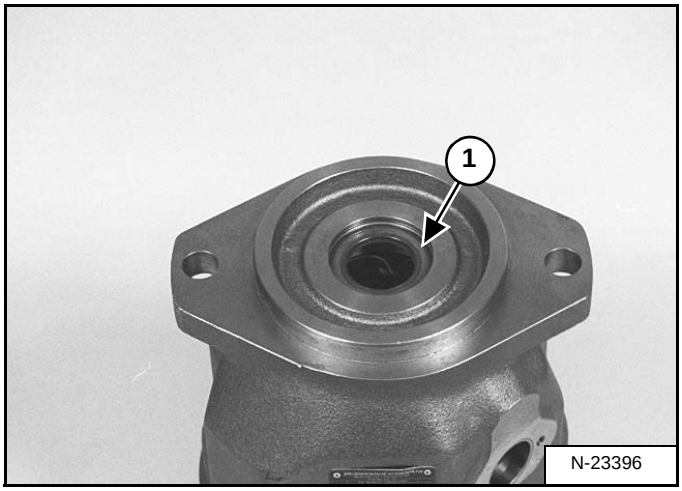
Assembly (Cont'd)

Figure 20-52-129



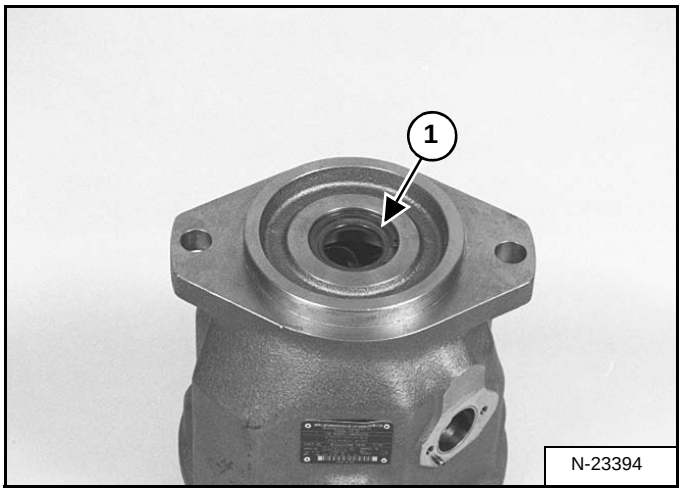
Press the race into the housing **[Figure 20-52-129]**.

Figure 20-52-130



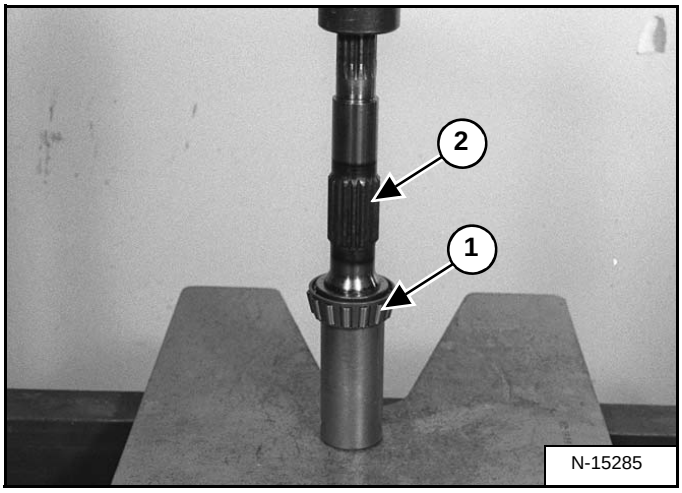
Install the shaft seal (Item 1) **[Figure 20-52-130]** in the housing.

Figure 20-52-131



Install the snap ring (Item 1) **[Figure 20-52-131]**.

Figure 20-52-132



Press the bearing (Item 1) onto the shaft (Item 2) **[Figure 20-52-132]**.

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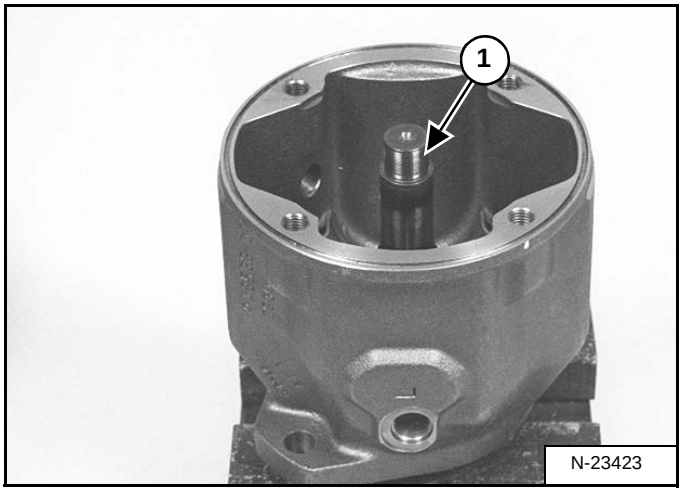
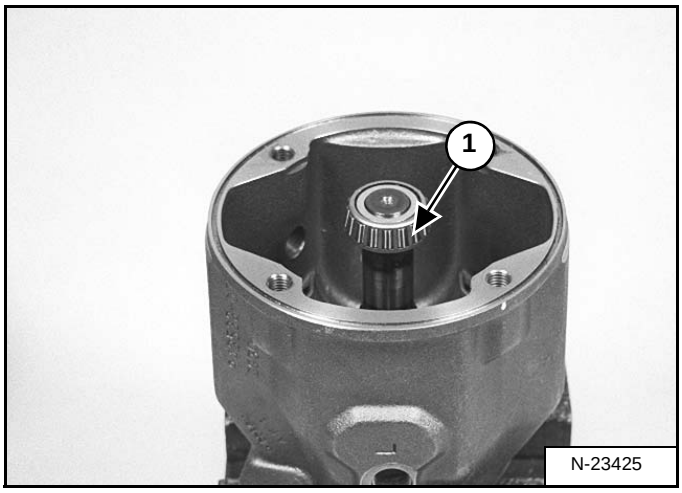
Assembly (Cont'd)

Figure 20-52-133



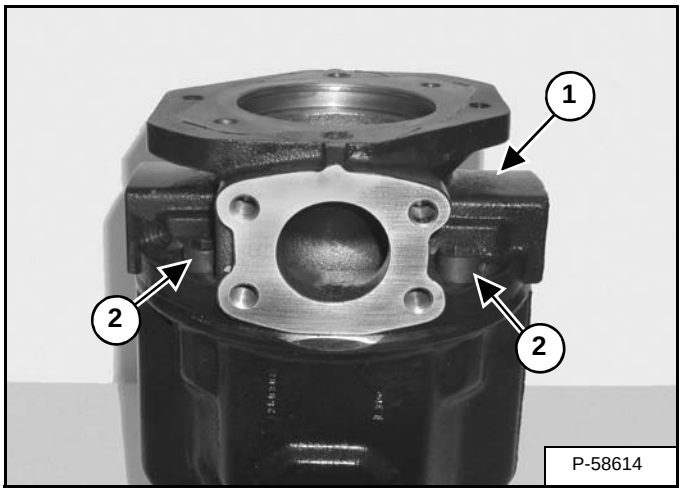
To find the correct shim washer thickness for bearing end play, the shaft/bearing assembly (Item 1) **[Figure 20-52-133]** must be installed in the housing.

Figure 20-52-134



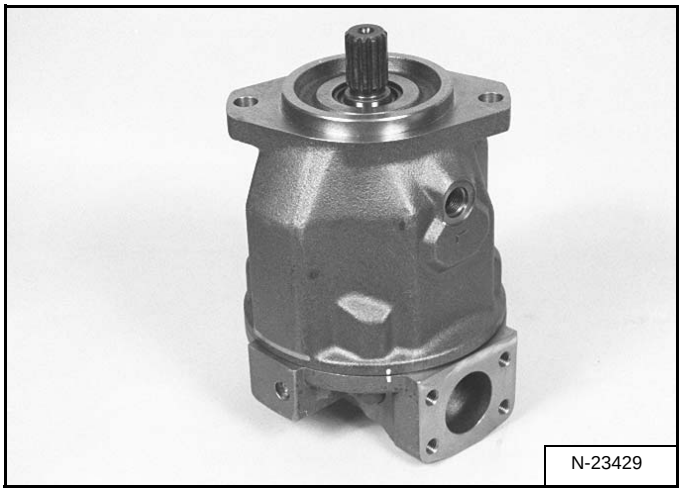
Install the bearing (Item 1) **[Figure 20-52-134]** on the shaft.

Figure 20-52-135



Install the end plate (Item 1) and bolts (Item 2) **[Figure 20-52-135]** on the housing.

Figure 20-52-136



Turn the housing over **[Figure 20-52-136]**.

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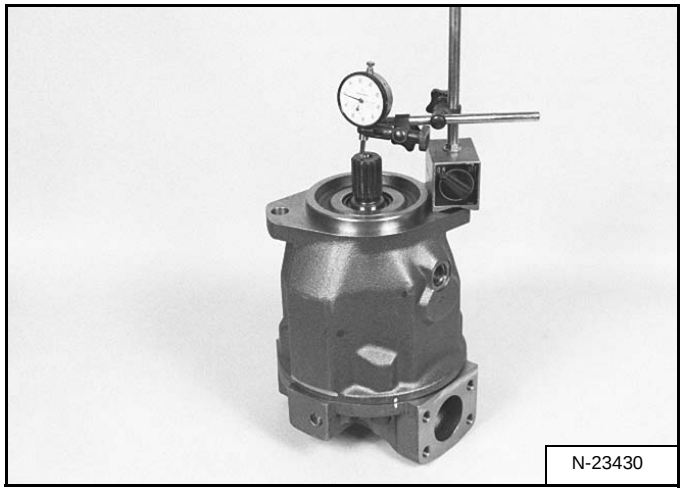
Assembly (Cont'd)

Figure 20-52-137



Install a dial indicator on the housing as shown **[Figure 20-52-137]** and set it to zero.

Pull the shaft up as far as it will go and record the reading on the dial indicator. Repeat the procedure several times. The reading must be the same each time.

Add the nominal pre-load of 0.001 inch (0,025 mm), the actual pre-load is 0.000 inch (0,000 mm) to 0.002 inch (0,050 mm) to the reading found on the dial indicator **[Figure 20-52-137]**.

Example: (In Inches):

0.150 Measure movement of shaft

0.001 Nominal Pre-load

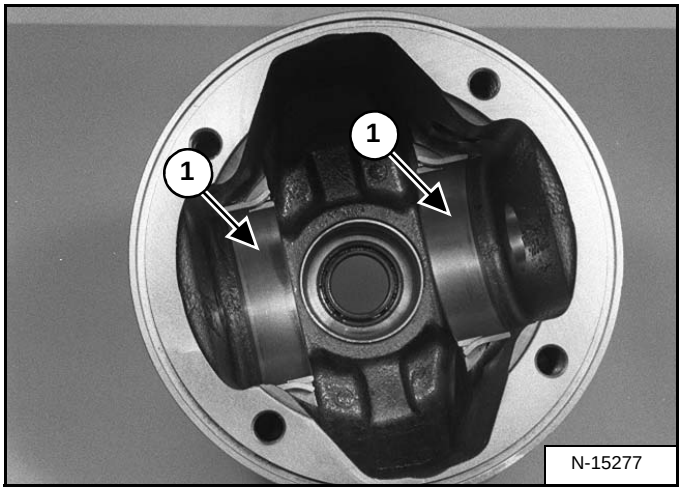
= 0.151 ± thickness of the spacer needed.

When the proper thickness of shim washer is determined, remove the dial indicator from the pump housing.

Remove the two end plate mounting bolts from the pump.

Remove the shaft/bearing assembly from the pump housing.

Figure 20-52-138



Install the 2 brass bearings (Item 1) **[Figure 20-52-138]** into the pump housing.

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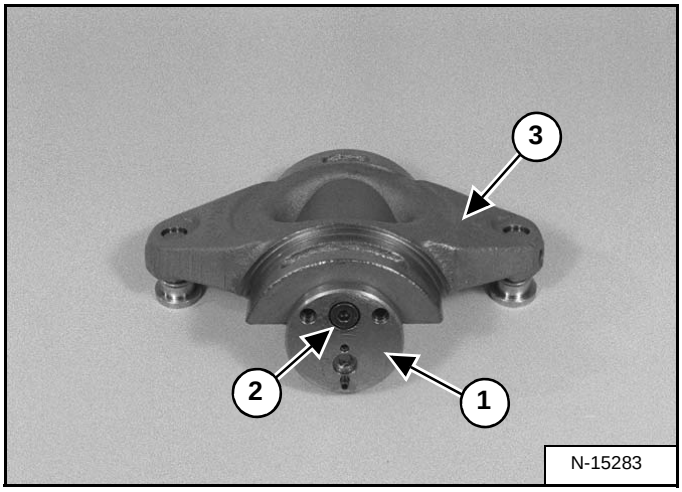
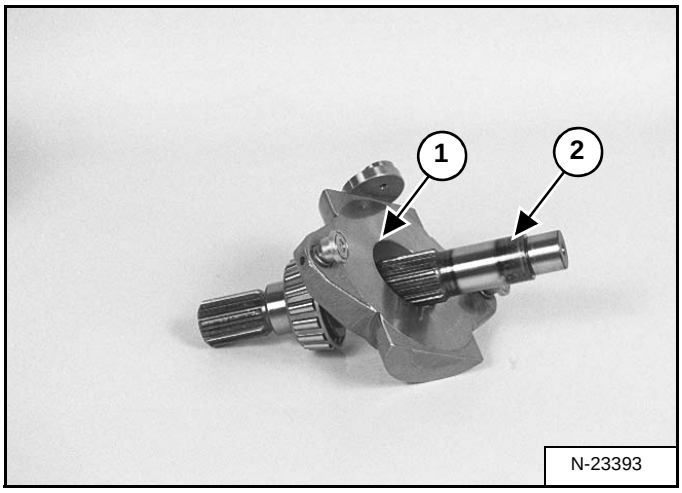
Assembly (Cont'd)

Figure 20-52-139



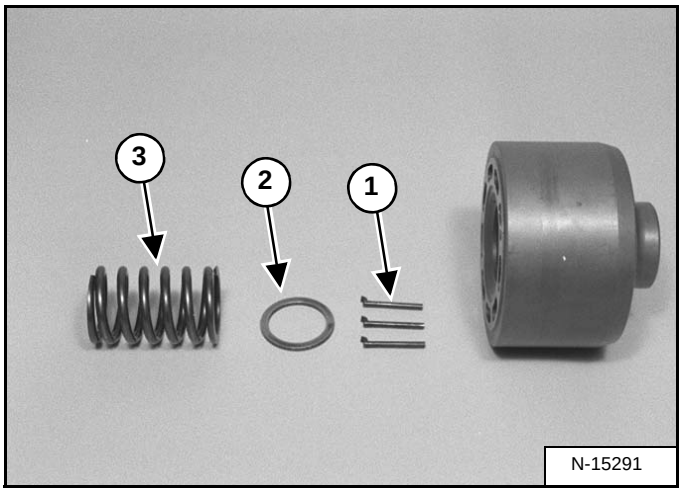
Apply Loctite™ 241 and install the torque limiter plate (Item 1) and bolt (Item 2) on the swash plate (Item 3) **[Figure 20-52-139]**.

Figure 20-52-140



Install the cradle (Item 1) on the shaft (Item 2) **[Figure 20-52-140]**.

Figure 20-52-141

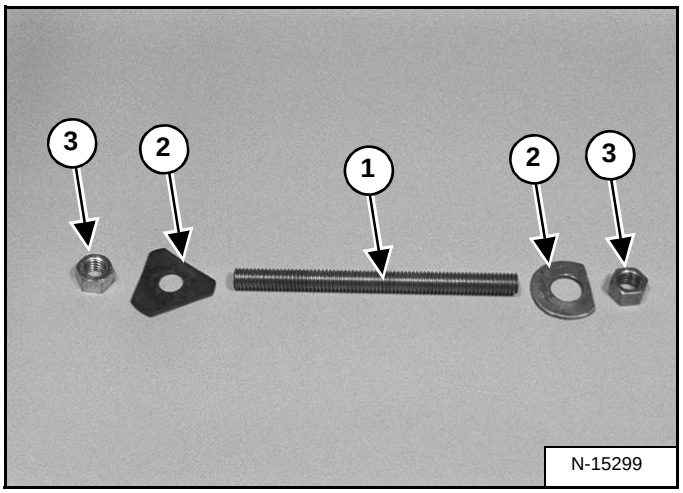


Apply clean grease to the three pins (Item 1) **[Figure 20-52-141]** and install them in the appropriate groove.

Install the washer (Item 2) and the spring (Item 3) **[Figure 20-52-141]**.

NOTE: If the rotating group is damaged, the parts can not be ordered separately and must be order as an assembly.

Figure 20-52-142



To compress the spring inside the cylinder block, use a threaded rod (or bolt) (Item 1), 2 trimmed washers (Item 2) and 2 nuts (Item 3) **[Figure 20-52-142]**.

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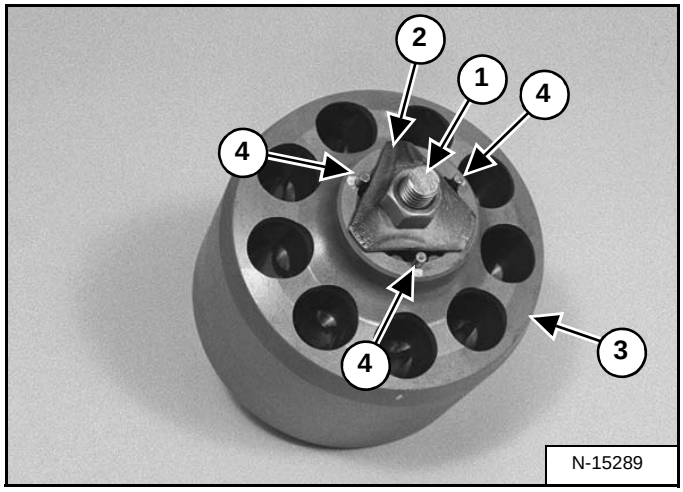
Assembly (Cont'd)

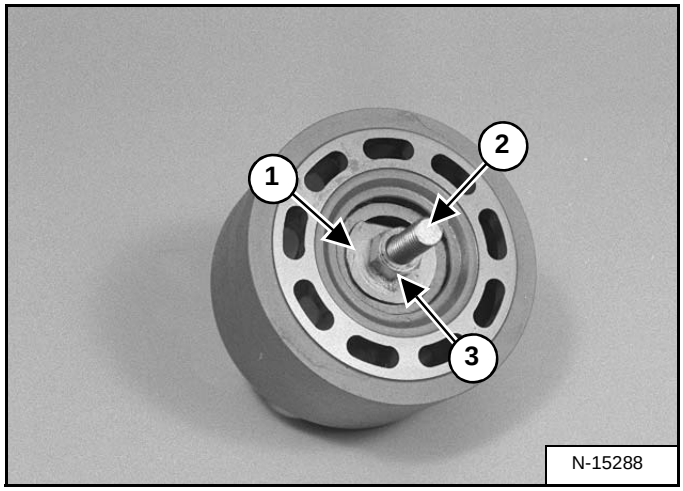
Figure 20-52-143



Install the threaded rod and nut (Item 1) through the modified washer (Item 2) and the block assembly (Item 3) **[Figure 20-52-143]**.

NOTE: The modified washer (Item 2) must fit between the three pins (Item 4) [Figure 20-52-143].

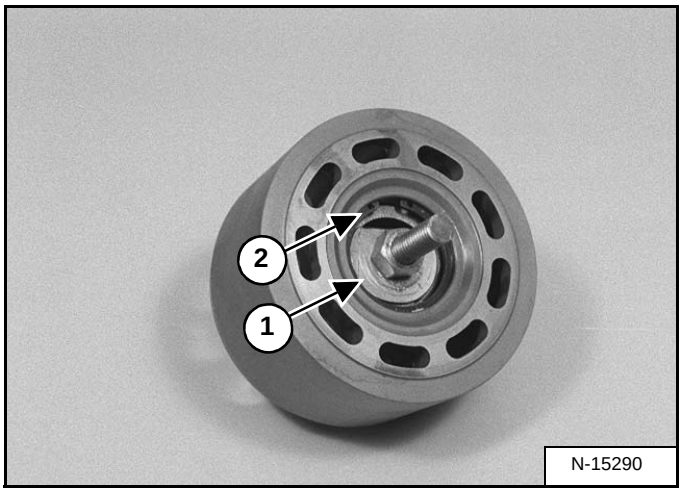
Figure 20-52-144



Install the second modified washer (Item 1) over the threaded rod (Item 2) **[Figure 20-52-144]**.

Install the nut (Item 3) **[Figure 20-52-144]** on the threaded rod.

Figure 20-52-145

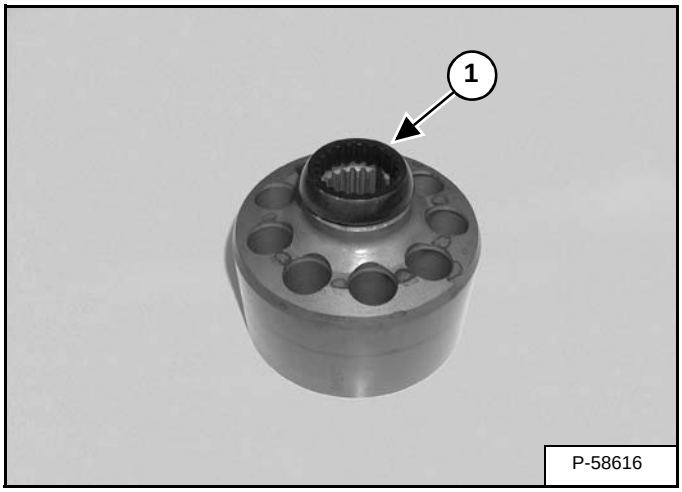


NOTE: The modified washer (Item 1) [Figure 20-52-144] must fit over the spring, but must also fit inside the snap ring (Item 2) [Figure 20-52-145].

Tighten the nut (Item 1) until the spring is compressed enough to install the snap ring (Item 2) **[Figure 20-52-145]**.

Remove the threaded rod/washer assembly.

Figure 20-52-146



Install the retainer (Item 1) **[Figure 20-52-146]**.

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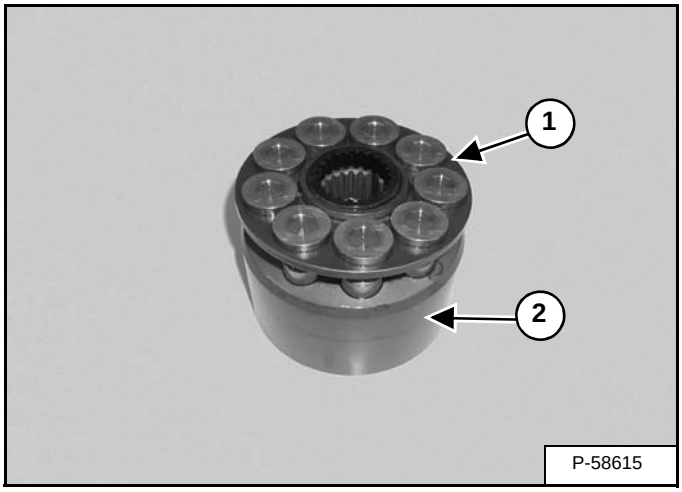
Assembly (Cont'd)

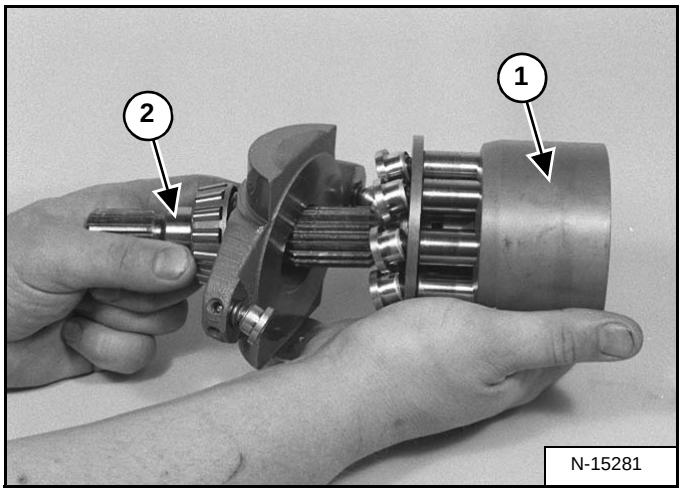
Figure 20-52-147



Install the piston assembly (Item 1) in the cylinder block (Item 2) **[Figure 20-52-147]**.

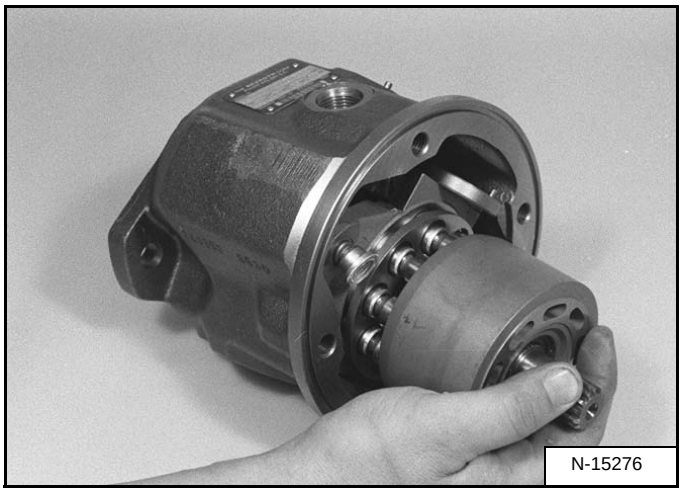
NOTE: It is NOT important that the pistons are installed in their original positions.

Figure 20-52-148



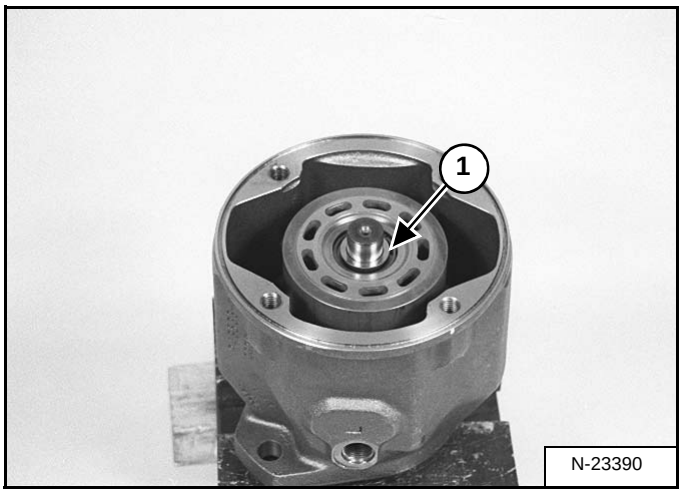
Slide the rotary group assembly (Item 1) on the shaft (Item 2) **[Figure 20-52-148]**.

Figure 20-52-149



Lay the pump housing on its side and install the rotary group assembly, swash plate, and shaft in the housing **[Figure 20-52-149]**.

Figure 20-52-150



Set the pump housing in the up-right position **[Figure 20-52-150]**.

Install the shim washer (Item 1) **[Figure 20-52-150]**. For procedure to determine shim washer thickness see **[Figure 20-52-137 on Page 48]**.

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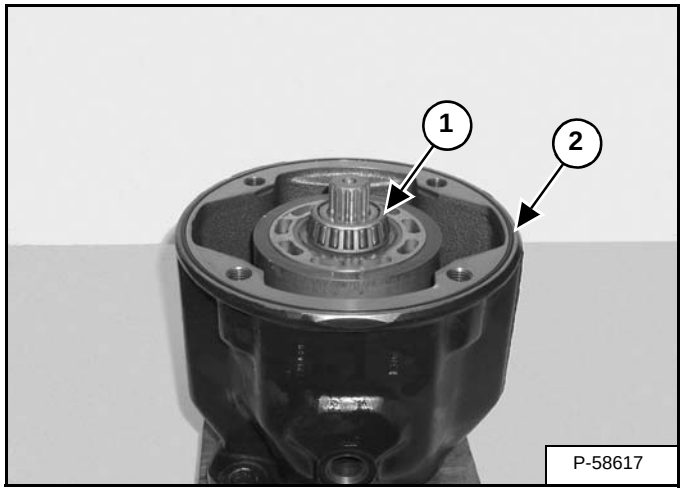
Assembly (Cont'd)

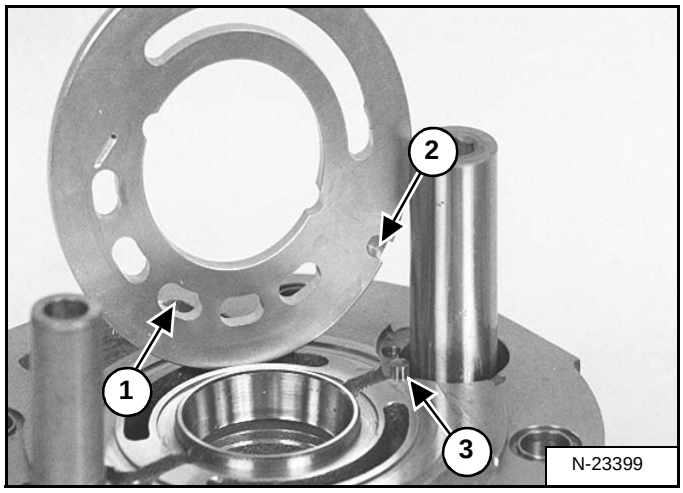
Figure 20-52-151



Install the bearing (Item 1) **[Figure 20-52-151]** on the shaft.

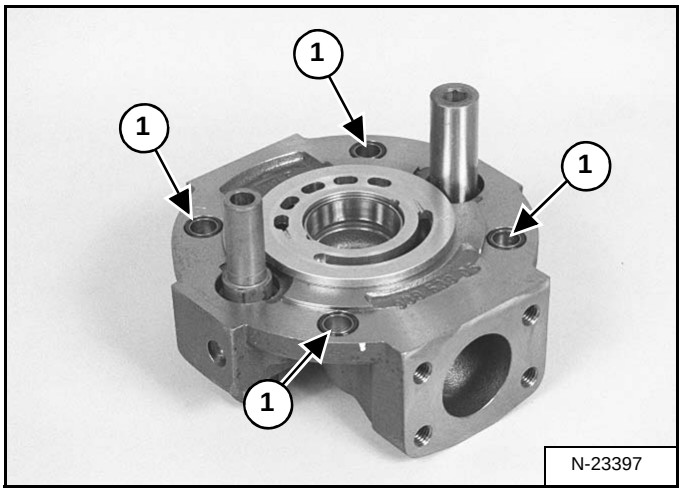
Install the O-ring (Item 2) **[Figure 20-52-151]**.

Figure 20-52-152



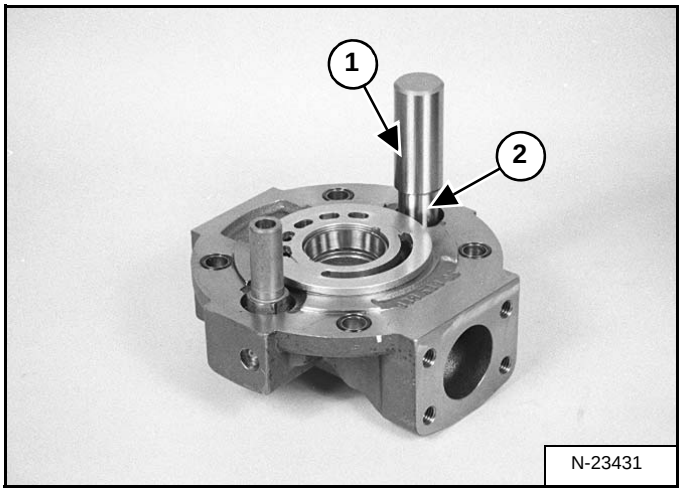
Install the valve plate (Item 1) on the back port assembly. The valve plate can only be installed one way by aligning the groove (Item 2) with the pin (Item 3) **[Figure 20-52-152]**.

Figure 20-52-153



Install the 4 O-rings (Item 1) **[Figure 20-52-153]** on the back port assembly.

Figure 20-52-154



Grease the inside of the control piston (Item 1) **[Figure 20-52-154]**.

Slide it over the control piston shaft (Item 2) **[Figure 20-52-154]**.

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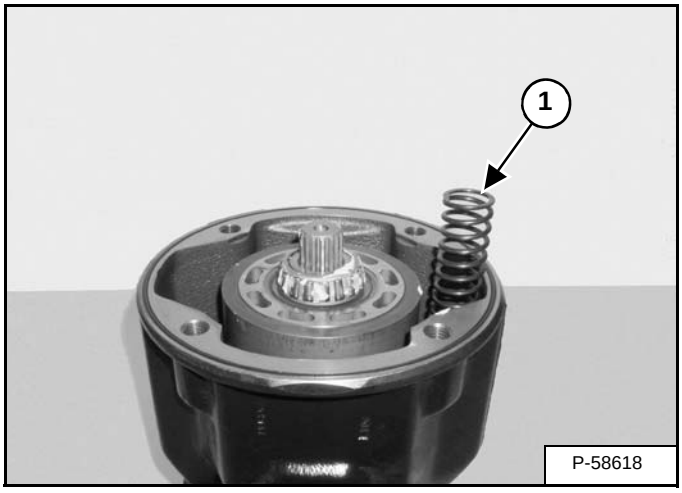
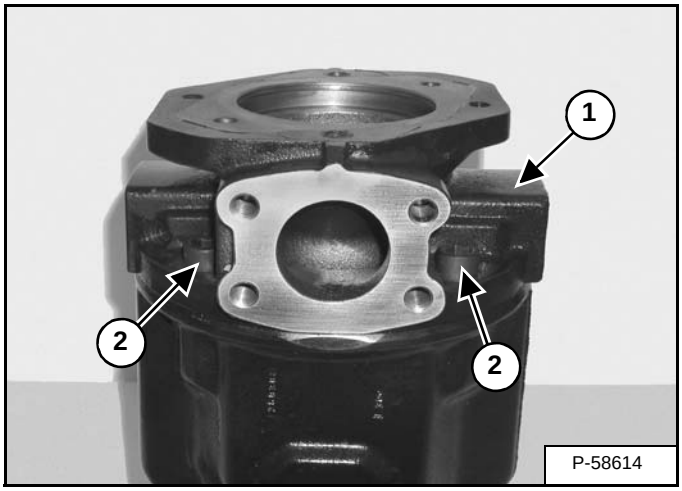
Assembly (Cont'd)

Figure 20-52-155



Install the stroking piston and spring (Item 1) **[Figure 20-52-155]**.

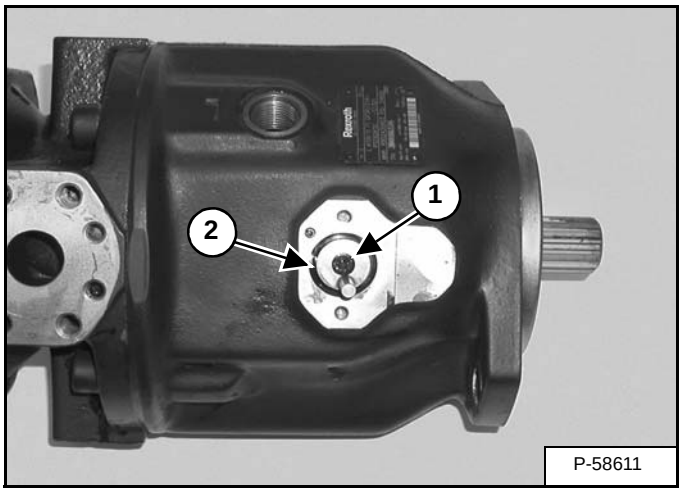
Figure 20-52-156



Align the marks and install the back port assembly (Item 1) **[Figure 20-52-156]** on the pump housing.

Install the 4 bolts (Item 2) **[Figure 20-52-156]**. Tighten the bolts to 88 ft.-lb. (119 N•m) torque.

Figure 20-52-157



Apply Loctite™ 241 on the bolt (Item 1) and install the load sensing assembly (Item 2) **[Figure 20-52-157]**. Tighten to 10 ft.-lbs. (13 Nm) torque.

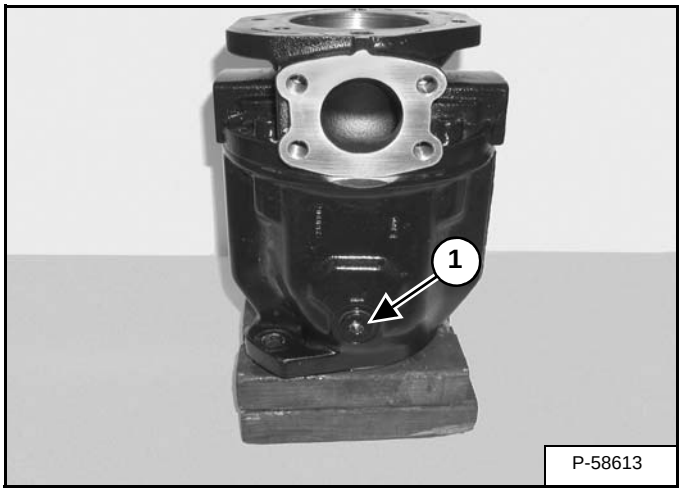
Install the torque limiter valve. (See Torque Limiter Valve Removal and Installation on Page 20-52-17.)

Install the pump control assembly. (See Pump Control Removal And Installation on Page 20-52-29.)

Place the hydraulic piston pump on its side and fill approximately half full.

Install a new O-ring on the plug.

Figure 20-52-158



Install the plug (Item 1) **[Figure 20-52-158]** in the pump and tighten.

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HYDRAULIC GEAR PUMP (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

Remove the muffler and muffler mount. (See Removal And Installation on Page 60-21-1.)

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.

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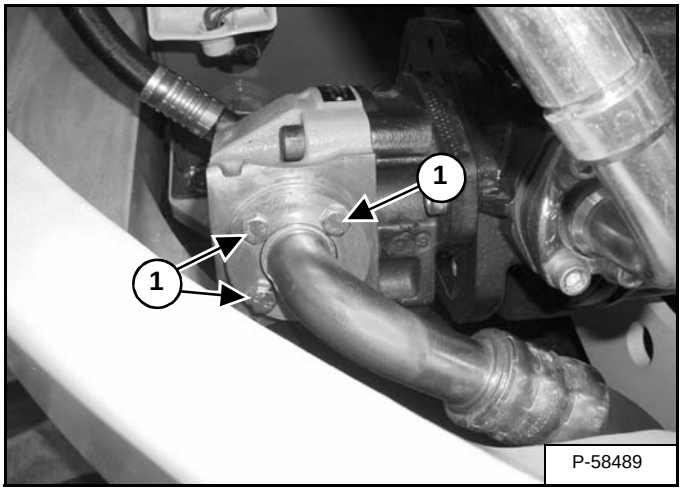
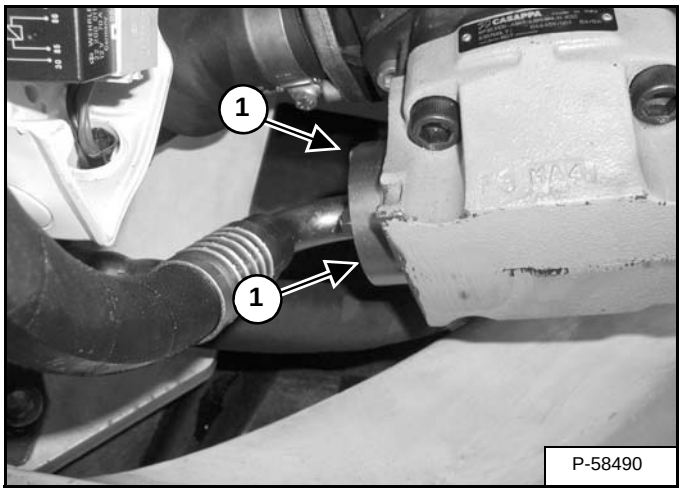
Figure 20-53-1



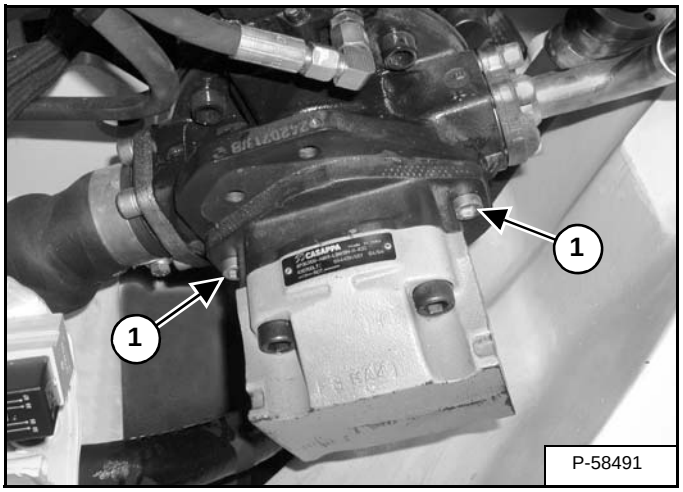
Remove the 4 bolts (Item 1) **[Figure 20-53-1]** and remove the hose.

Figure 20-53-2



Remove the 4 bolts (Item 1) **[Figure 20-53-2]** and the hose.

Figure 20-53-3



Remove the 2 bolts (Item 1) **[Figure 20-53-3]**.

Installation: Apply thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

Remove the pump.

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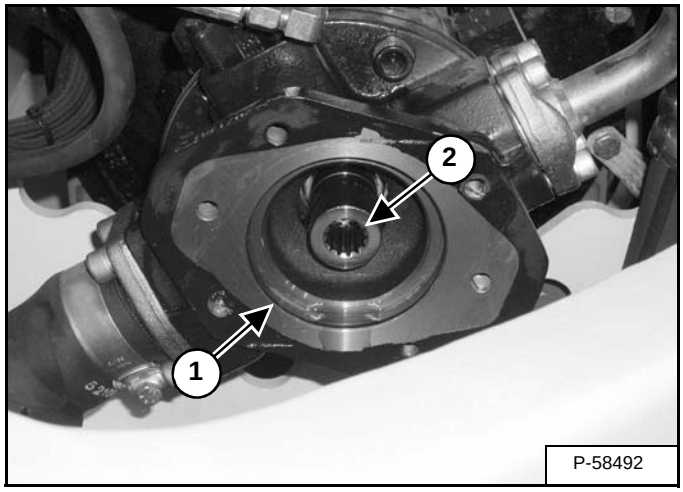
Removal And Installation (Cont'd)

Figure 20-53-4



Remove the O-ring (Item 1) and pump coupler (Item 2) **[Figure 20-53-4]**.

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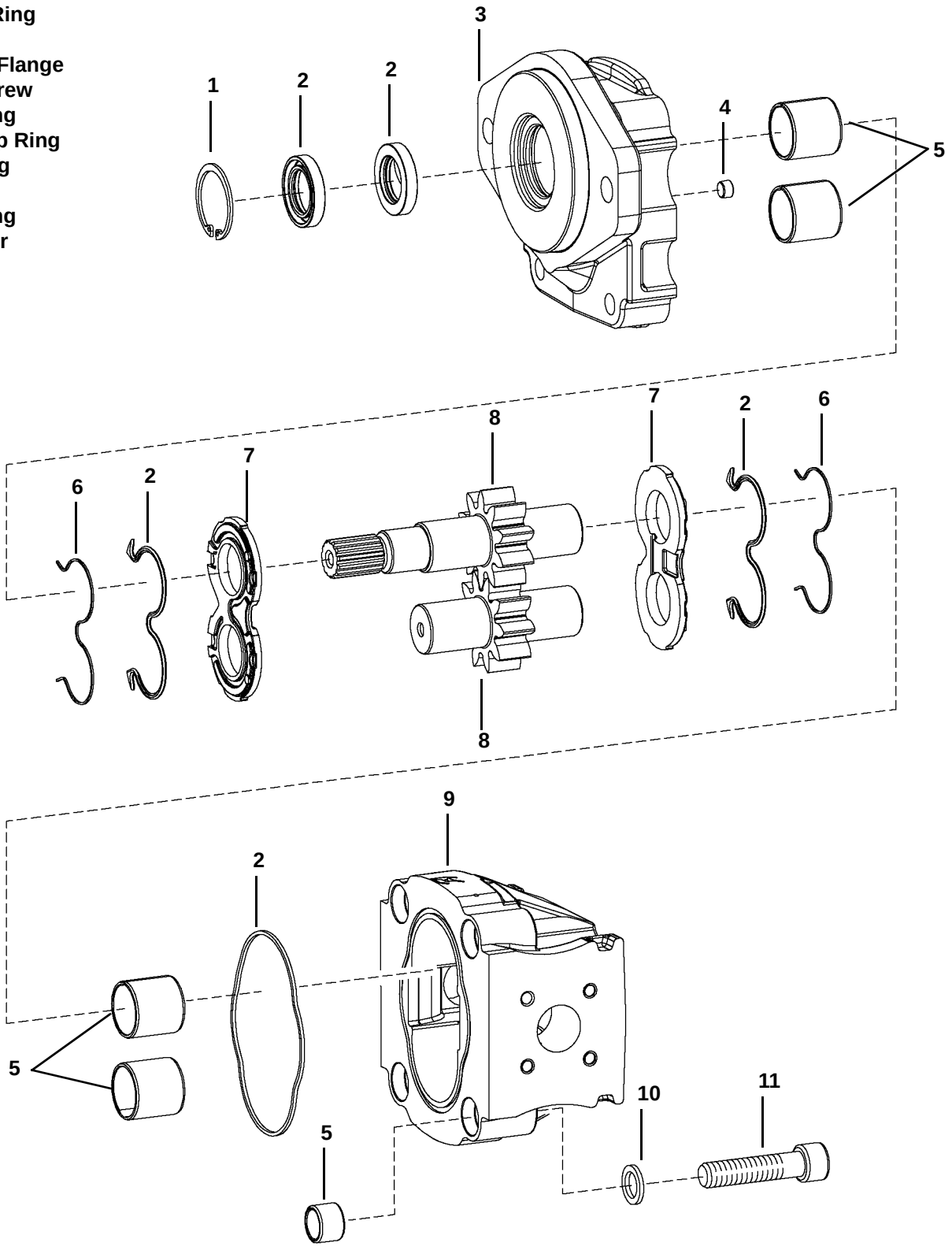
Parts Identification

1. Snap Ring
2. Seal
3. Pump Flange
4. Set Screw
5. Bushing
6. Backup Ring
7. Bearing
8. Gear
9. Housing
10. Washer
11. Bolt



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Disassembly

Mark the pump body to pump flange for ease of assembly.

Figure 20-53-5

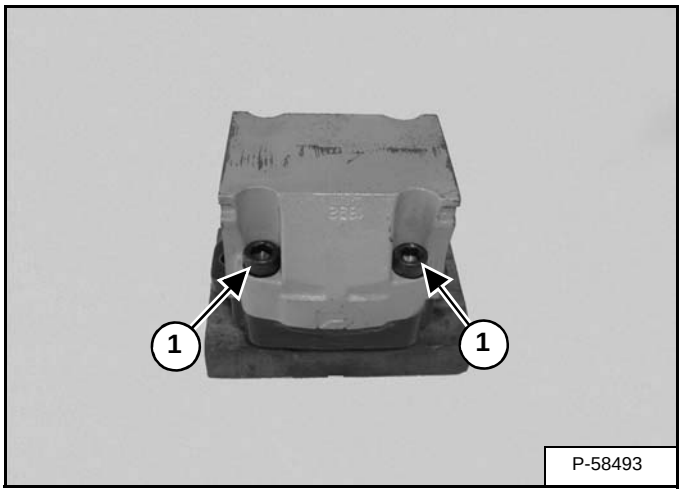
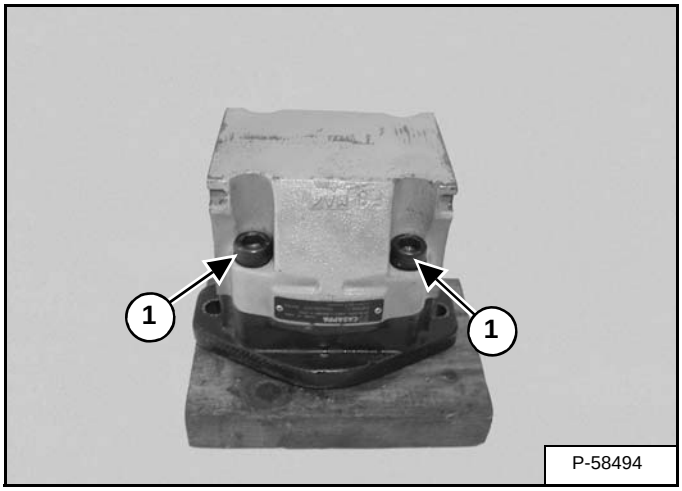


Figure 20-53-6



Remove the 2 bolts (Item 1) **[Figure 20-53-5]** & **[Figure 20-53-6]** and washers.

Figure 20-53-7

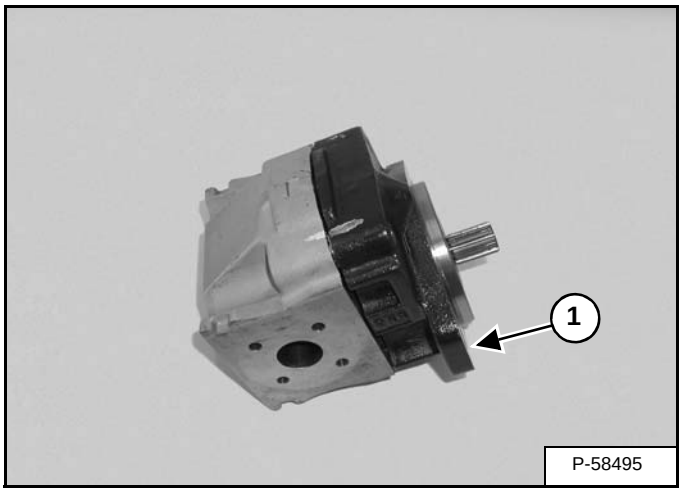
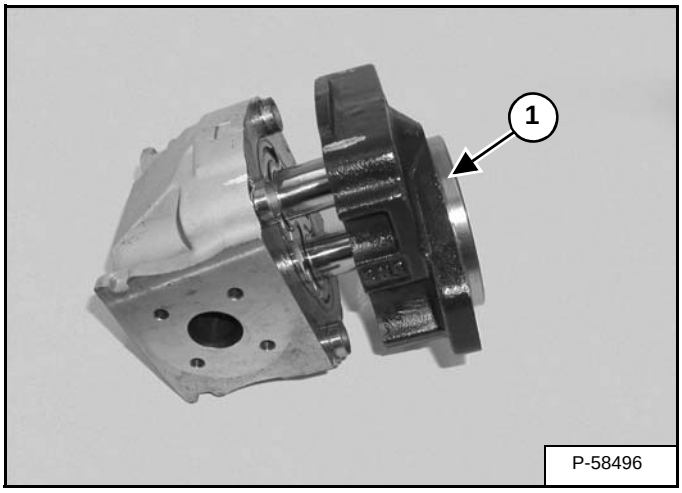


Figure 20-53-8



Separate and remove the flange (Item 1) **[Figure 20-53-7]** & **[Figure 20-53-8]** from the pump body.

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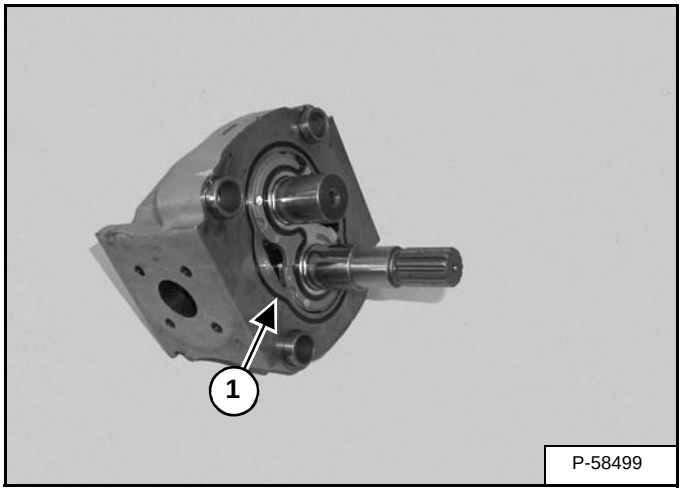
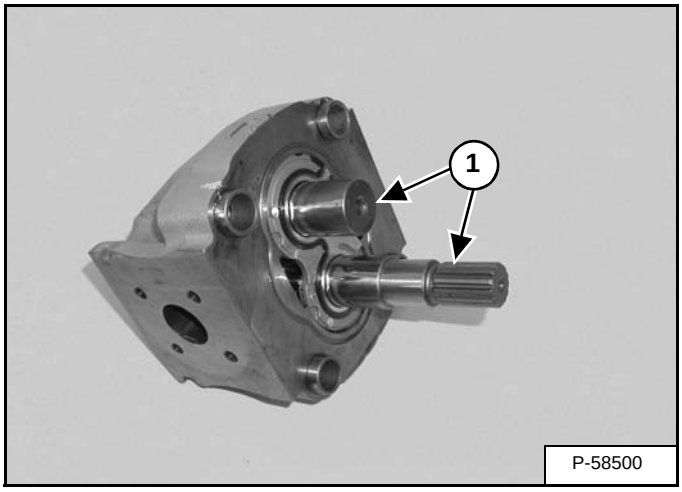
Disassembly (Cont'd)

Figure 20-53-9



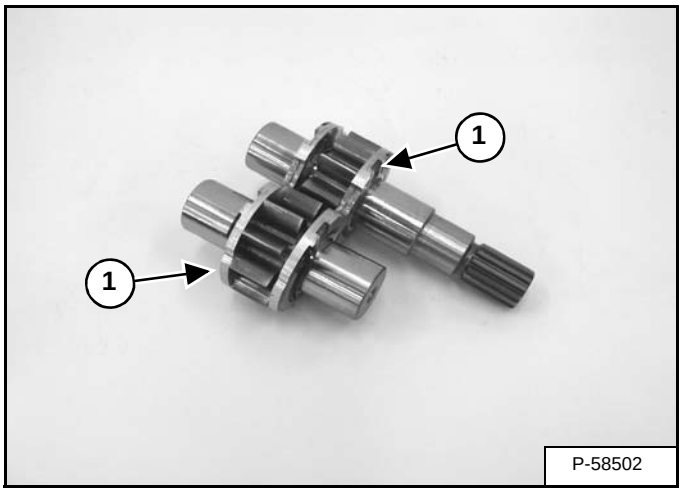
Remove the seal (Item 1) **[Figure 20-53-9]**.

Figure 20-53-10



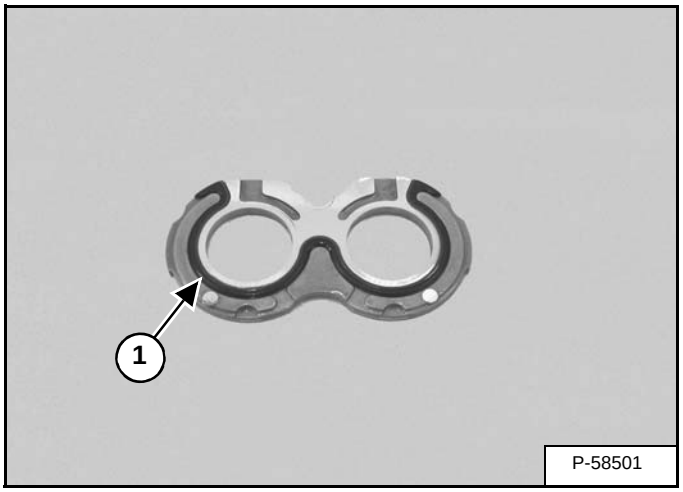
Remove the bearing/gear assembly (Item 1) **[Figure 20-53-10]**.

Figure 20-53-11



Remove the bearings (Item 1) **[Figure 20-53-11]** from the gears.

Figure 20-53-12



Remove the seal (Item 1) **[Figure 20-53-12]** and back-up ring from the bearings.

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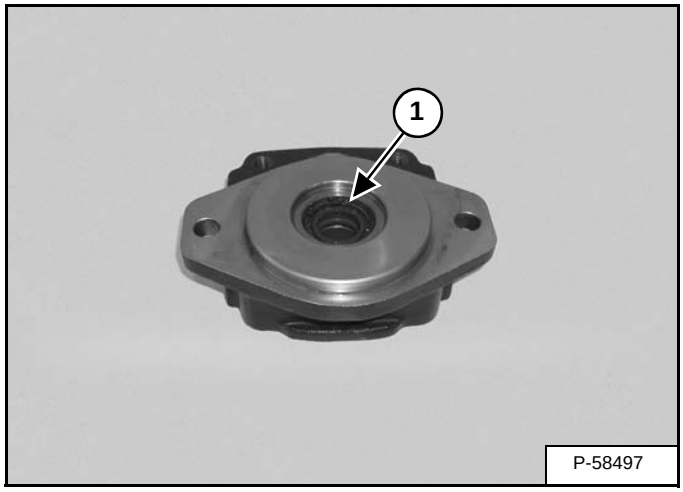
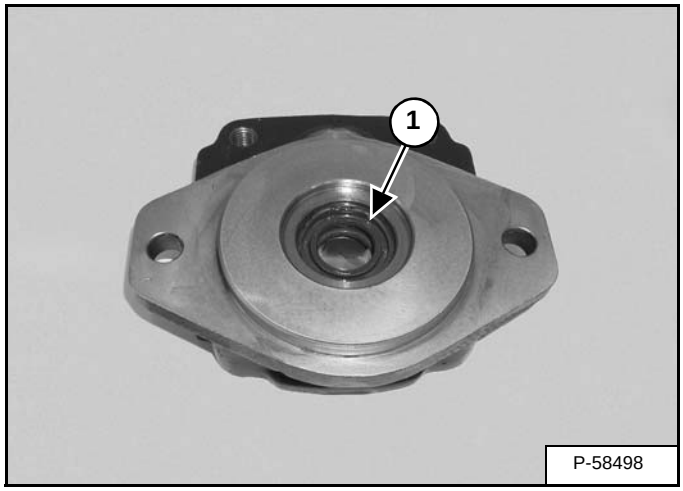
Disassembly (Cont'd)

Figure 20-53-13



Remove the snap ring (Item 1) **[Figure 20-53-13]**.

Figure 20-53-14



Remove the seal (Item 1) **[Figure 20-53-14]**.

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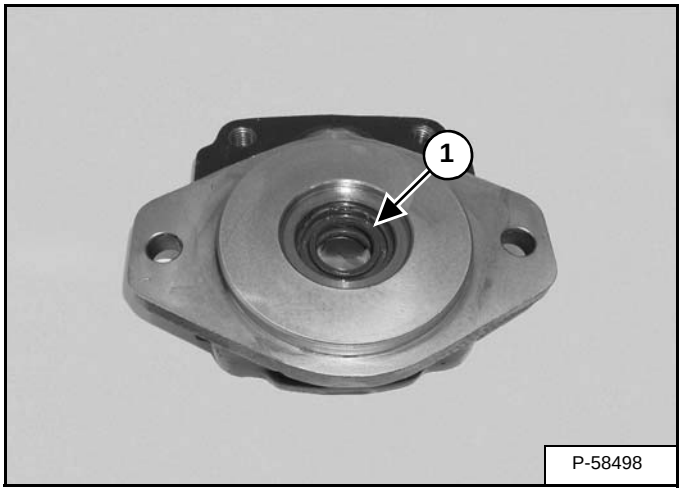
Assembly

Clean all parts in solvent and dry with compressed air.

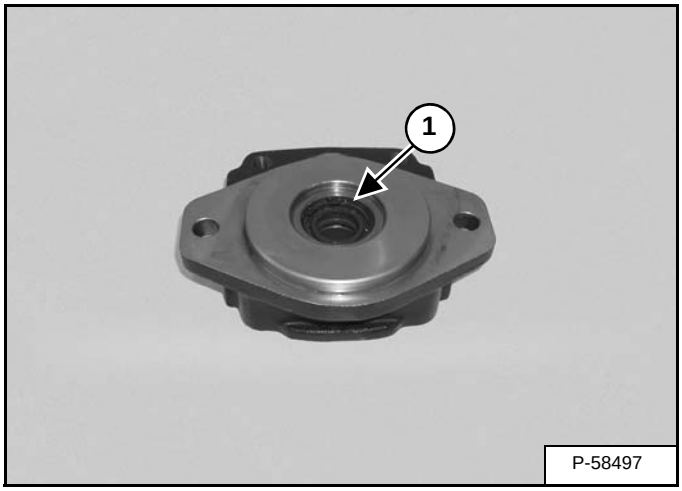
Apply clean hydraulic oil or assembly lube on the new O-rings and seals.

Figure 20-53-15



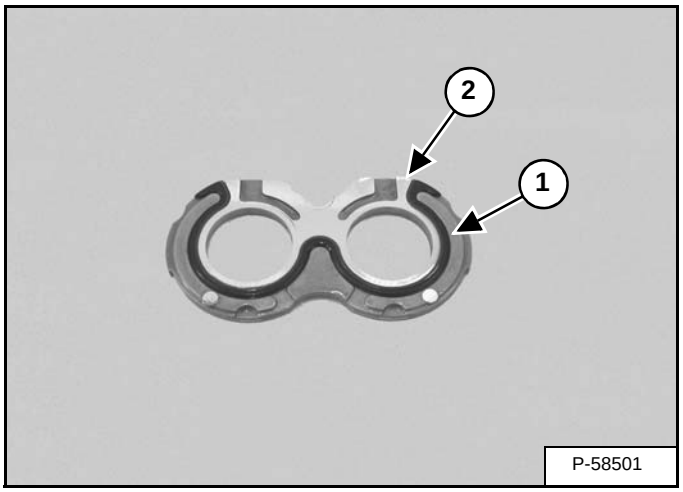
Install the seal (Item 1) **[Figure 20-53-15]**.

Figure 20-53-16



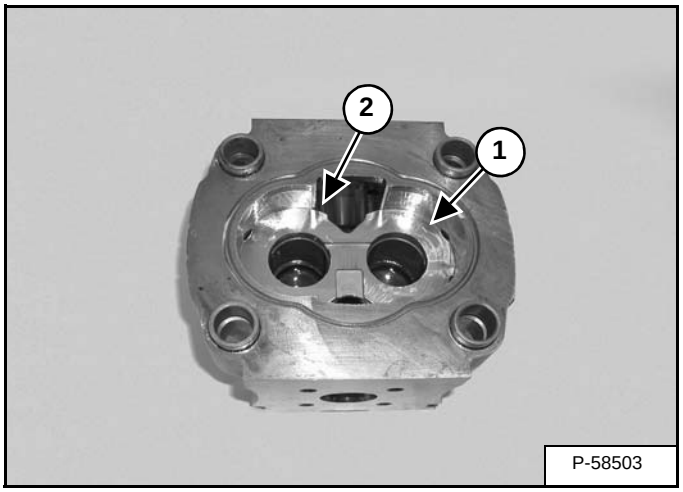
Install the snap ring (Item 1) **[Figure 20-53-16]**.

Figure 20-53-17



Install the seal (Item 1) and back-up ring (Item 2) **[Figure 20-53-17]** on both bearings.

Figure 20-53-18



Install the bottom bearing (Item 1) **[Figure 20-53-18]** in the housing.

NOTE: The position of the V portion (Item 2) on the bearing plate (Item 1) [Figure 20-53-18] must point towards the pressure port on the housing.

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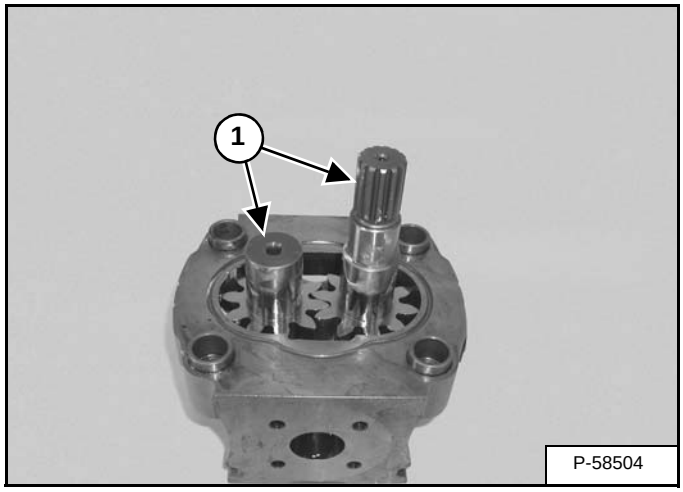
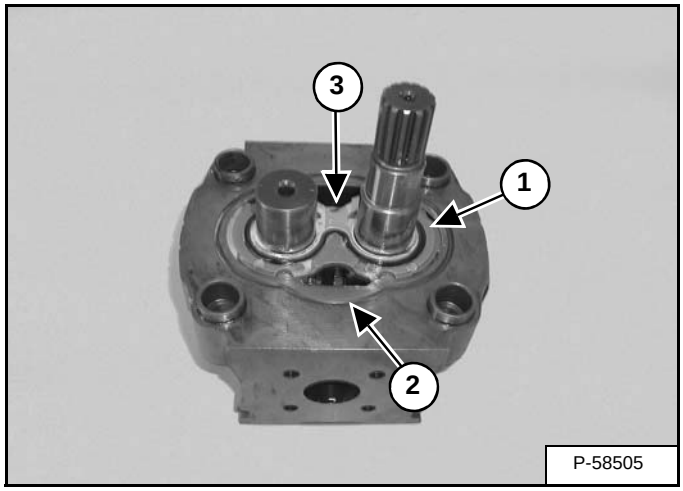
Assembly (Cont'd)

Figure 20-53-19



Install the gears (Item 1) **[Figure 20-53-19]**.

Figure 20-53-20

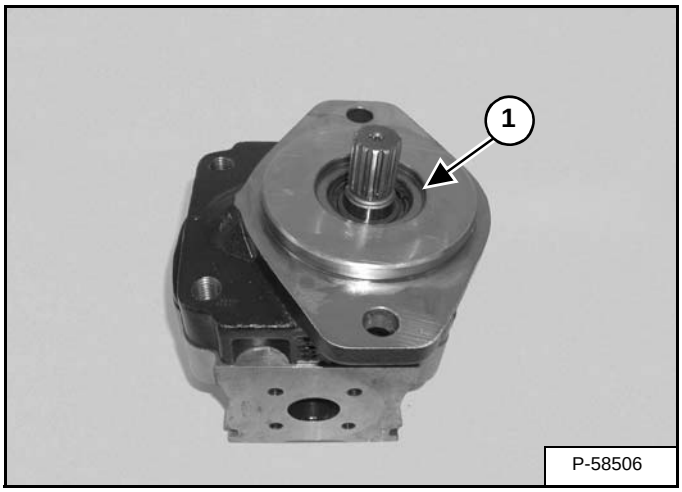


Install the bearing (Item 1) **[Figure 20-53-20]**.

NOTE: The position of the V portion (Item 3) on the bearing plate (Item 1) [Figure 20-53-20] must point towards the pressure port on the housing.

Install the seal (Item 2) **[Figure 20-53-20]**.

Figure 20-53-21



Install the pump flange (Item 1) **[Figure 20-53-21]** on the pump body.

Fully seat the flange on the alignment pins (Item 2) **[Figure 20-53-20]**

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Assembly (Cont'd)

Figure 20-53-22

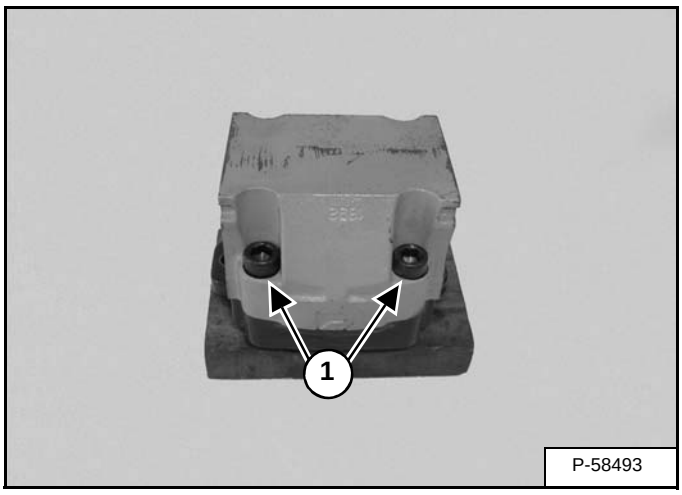
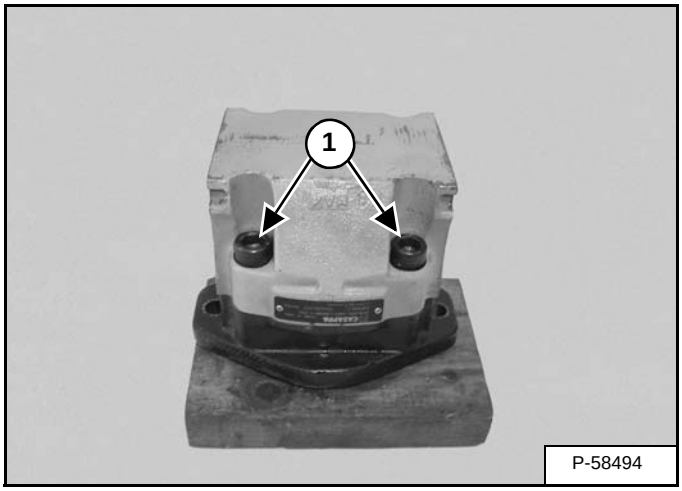


Figure 20-53-23



Turn the pump over and install the washers and bolts (Item 1) **[Figure 20-53-22]** & **[Figure 20-53-23]**.

Tighten the bolts to 133-155 ft.-lb. (180-210 N•m) torque.

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ACCUMULATOR (S/N 522311001 & ABOVE)

Description

The accumulator provides short term reserve pressure for joystick function with the engine off and the key in the run position.

Removal And Installation

With the engine off and the key in the run position, move the control levers to relieve hydraulic pressure.

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

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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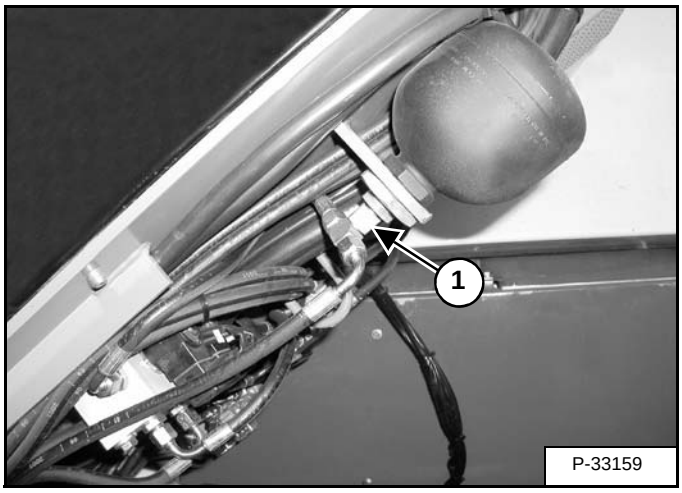
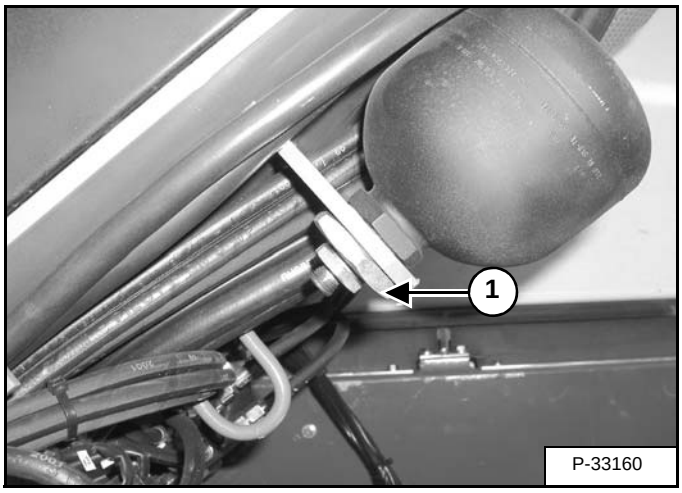
Figure 20-60-1



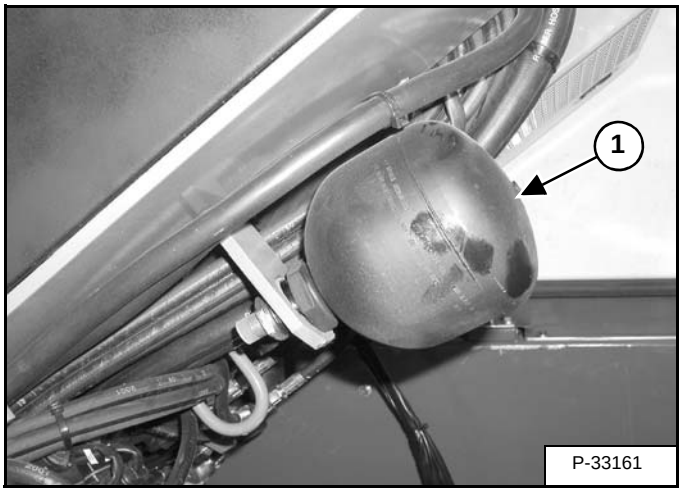
Remove the tee fitting (Item 1) **[Figure 20-60-1]**.

Figure 20-60-2



Remove the nut (Item 1) **[Figure 20-60-2]**.

Figure 20-60-3



Remove the accumulator (Item 1) **[Figure 20-60-3]**.

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ACCUMULATOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Description

The accumulator provides short term reserve pressure for joystick function with the engine off and the key in the run position.

Removal And Installation

With the engine off and the key in the run position, move the control levers to relieve hydraulic pressure.

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

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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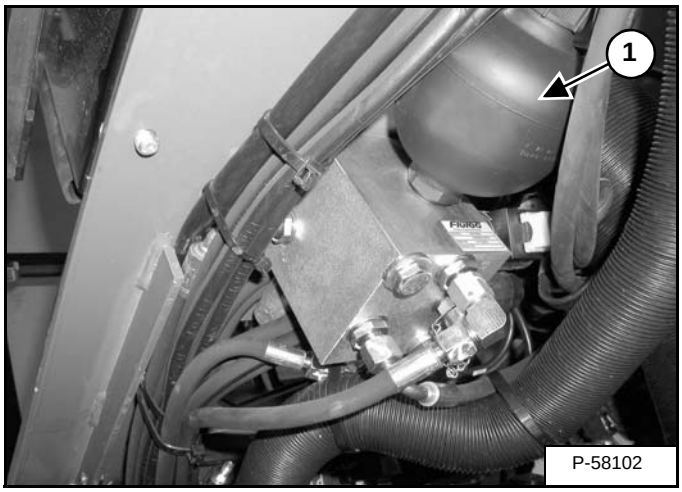
Figure 20-61-4



Remove the accumulator (Item 1) **[Figure 20-61-4]**.

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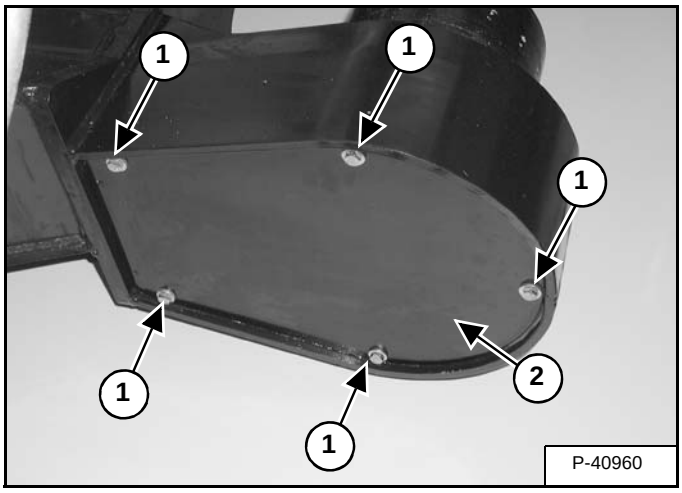
TRAVEL MOTOR

Removal And Installation

Remove the track. (See Rubber Track Removal And Installation on Page 30-20-6.)

Remove the drive sprocket. (See Drive Sprocket Removal And Installation on Page 30-30-5.)

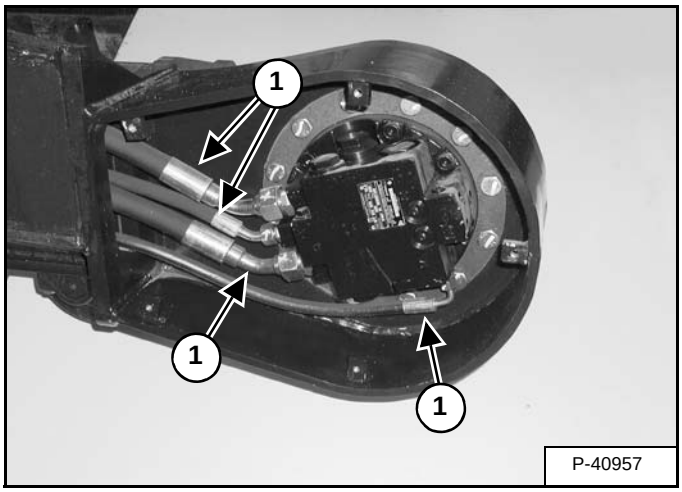
Figure 20-70-1



Remove the 5 bolts (Item 1) and washers from the cover (Item 2) **[Figure 20-70-1]**.

Remove the cover.

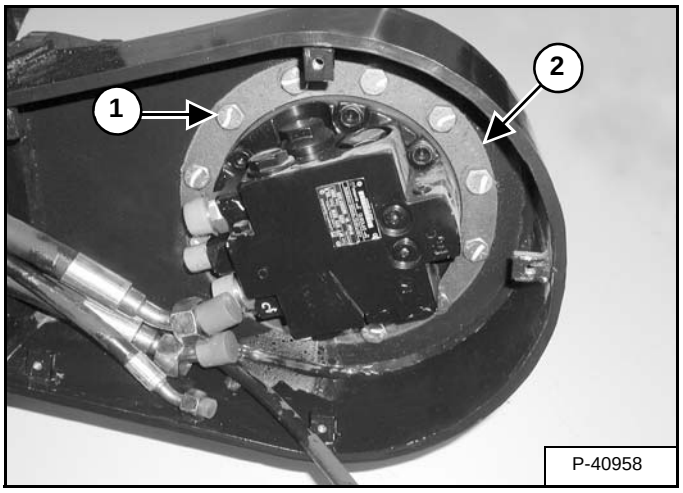
Figure 20-70-2



Remove the four hoses (Item 1) **[Figure 20-70-2]**.

Install caps and plugs.

Figure 20-70-3



Remove the bolts (Item 1) from the flange (Item 2) **[Figure 20-70-3]**.

Installation: Clean and dry the threads. Apply thread lock adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 118-133 ft.-lb. (160-180 N•m) torque.

Remove the flange.

Remove the travel motor.

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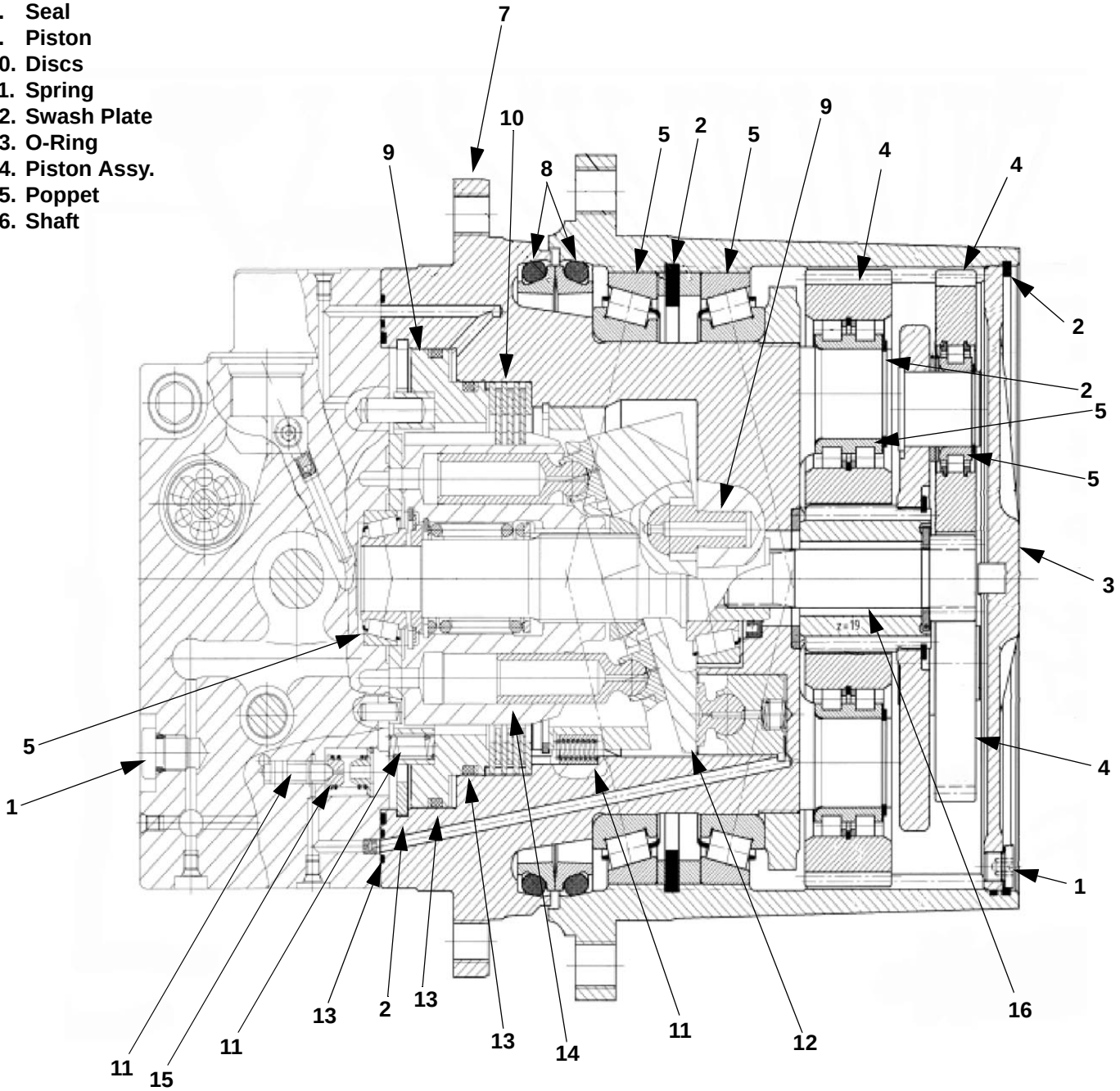
TRAVEL MOTOR (CONT'D)

Parts Identification

1. Plug
2. Snap Ring
3. End Cover
4. Gear
5. Bearing
6. Nut
7. Housing
8. Seal
9. Piston
10. Discs
11. Spring
12. Swash Plate
13. O-Ring
14. Piston Assy.
15. Poppet
16. Shaft



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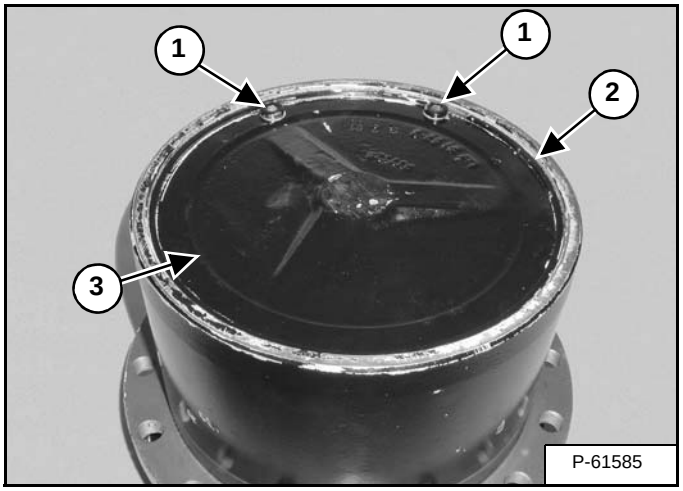
Disassembly

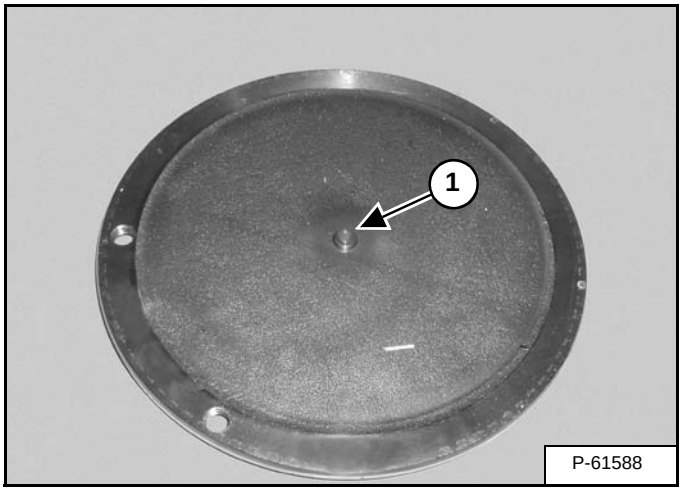
Drain the travel motor oil. (See Draining The Travel Motor on Page 10-120-1.)

Figure 20-70-4



Remove the drain plugs (Item 1), snap ring (Item 2) and cover (Item 3) **[Figure 20-70-4]**.

Figure 20-70-5

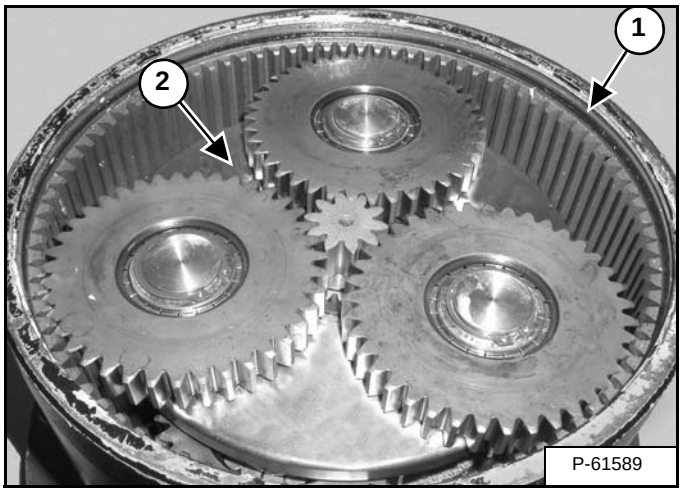


Drill a hole in the center of the bushing (Item 1) **[Figure 20-70-5]** using a number 3 drill bit.

Thread the hole using a 1/4 x 28 inch N.F. tap.

Install a 1/4 x 28 inch bolt in the bushing, and pull the bushing out.

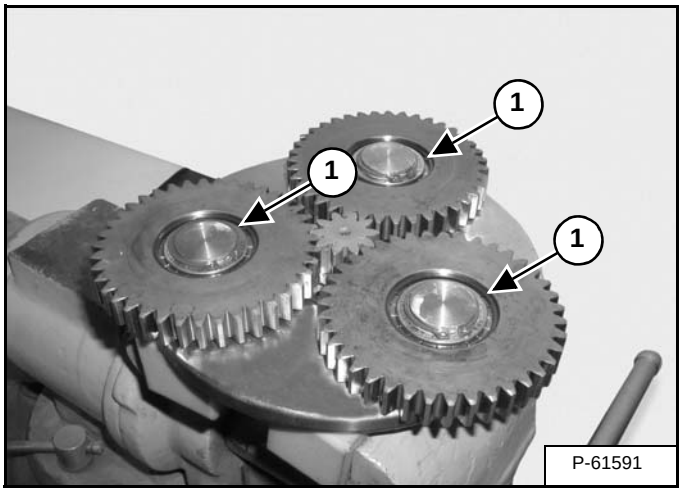
Figure 20-70-6



Remove the O-ring (Item 1) and planetary carrier (Item 2) **[Figure 20-70-6]**.

Place the carrier in a vice equipped with padded jaws.

Figure 20-70-7



Remove the snap rings (Item 1) **[Figure 20-70-7]**.

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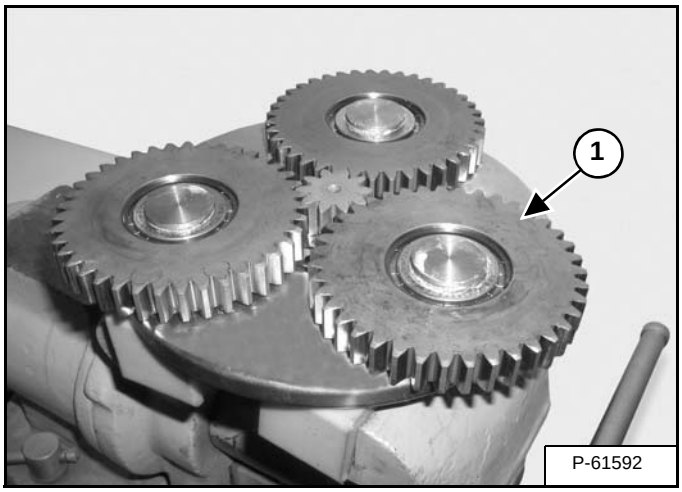
Disassembly (Cont'd)

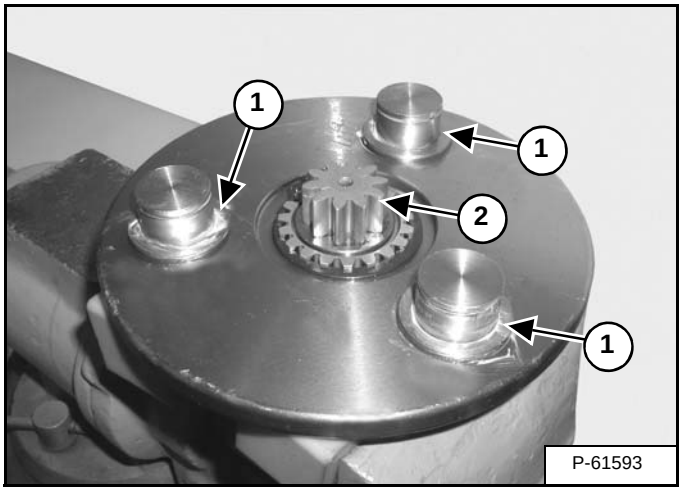
Figure 20-70-8



Pry the planetary gears (Item 1) **[Figure 20-70-8]** off of the carrier.

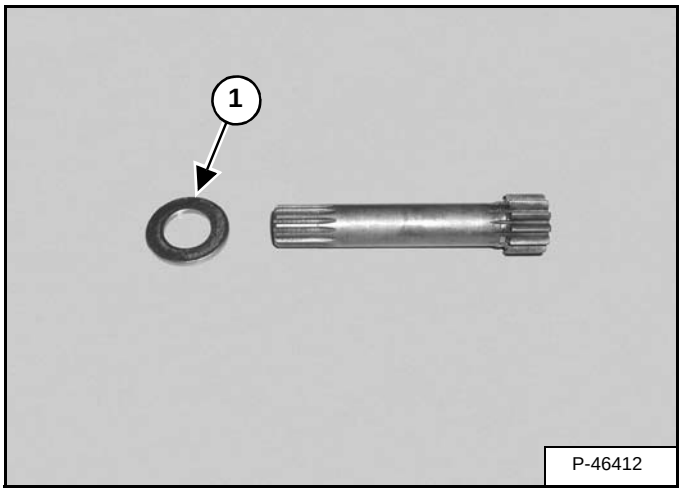
Record the orientation of the gear/bearing assembly. The gear/bearing assembly can only be installed in one direction.

Figure 20-70-9



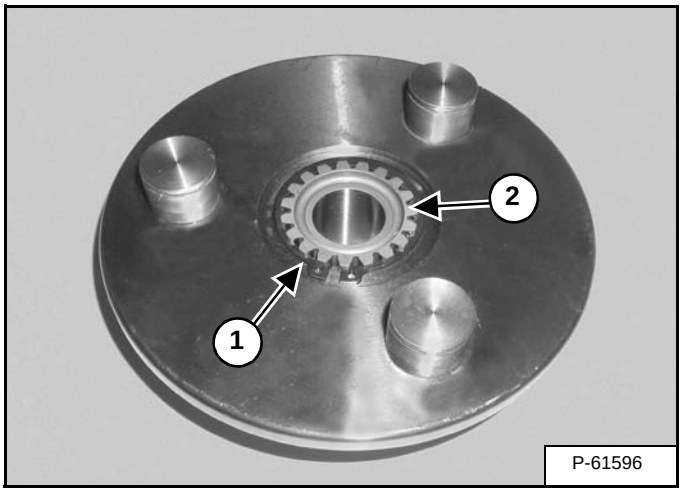
Remove the washers (Item 1). Remove the drive shaft (Item 2) **[Figure 20-70-9]**.

Figure 20-70-10



Remove the washer (Item 1) **[Figure 20-70-10]** from the drive shaft.

Figure 20-70-11



Remove the snap ring (Item 1). Remove the sun gear (Item 2) **[Figure 20-70-11]**.

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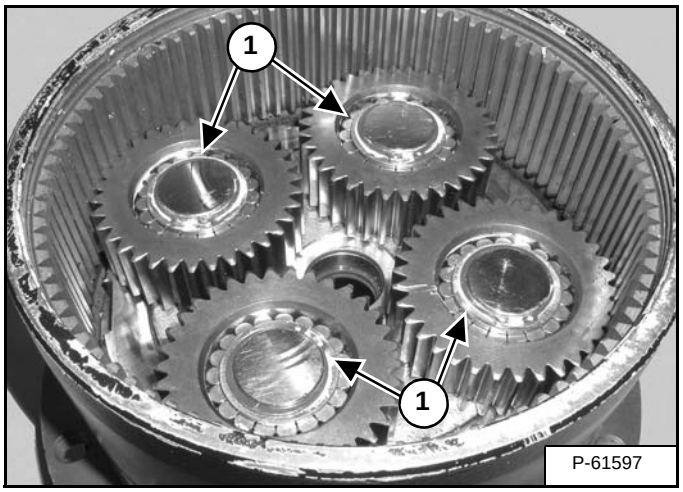
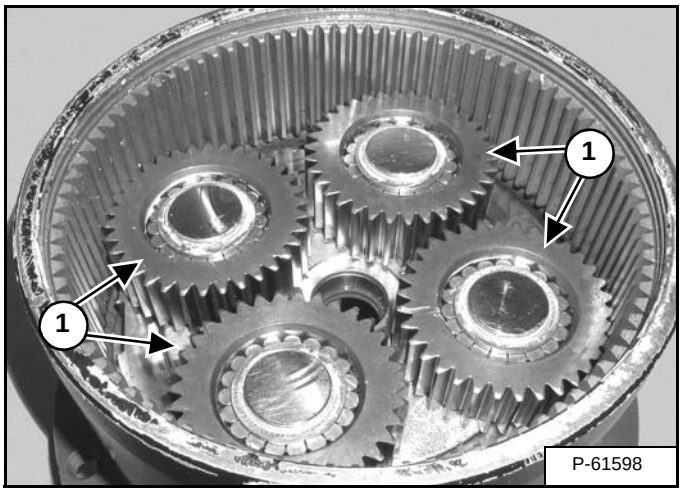
Disassembly (Cont'd)

Figure 20-70-12



Remove the snap rings (Item 1) **[Figure 20-70-12]**.

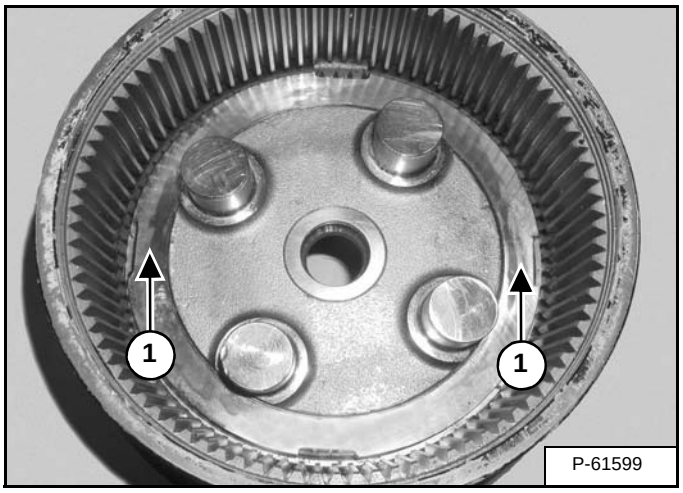
Figure 20-70-13



Pry the planetary gears (Item 1) **[Figure 20-70-13]** off of the carrier.

Record the orientation of the gear/bearing assembly. The gear/bearing assembly can only be installed in one direction.

Figure 20-70-14

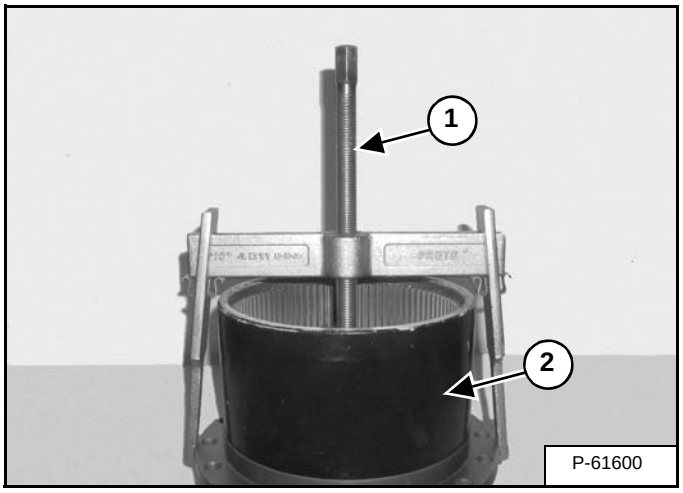


Center punch and drill the nut where shown (Item 1) **[Figure 20-70-14]**.

Split and remove the nut.

NOTE: The nut will be destroyed and a NEW nut must be installed.

Figure 20-70-15



Install a puller (Item 1) on the ring gear (Item 2) **[Figure 20-70-15]**.

Remove the ring gear.

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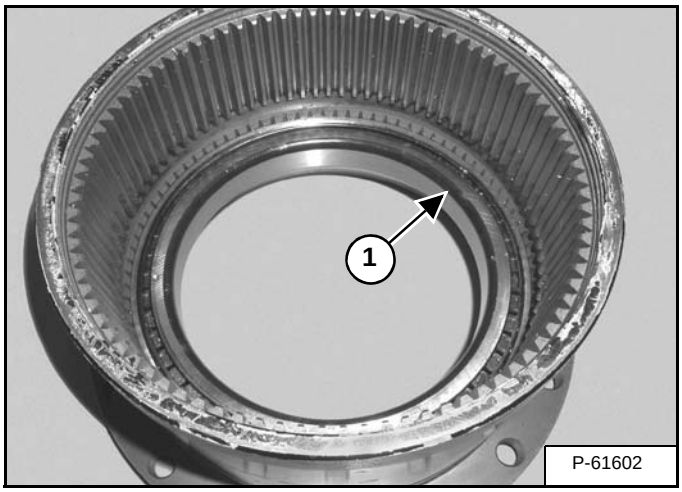
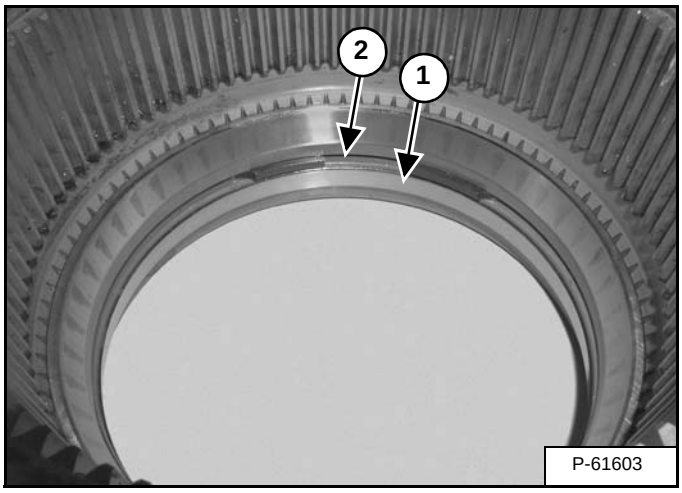
Disassembly (Cont'd)

Figure 20-70-16



Remove the bearing (Item 1) **[Figure 20-70-16]**.

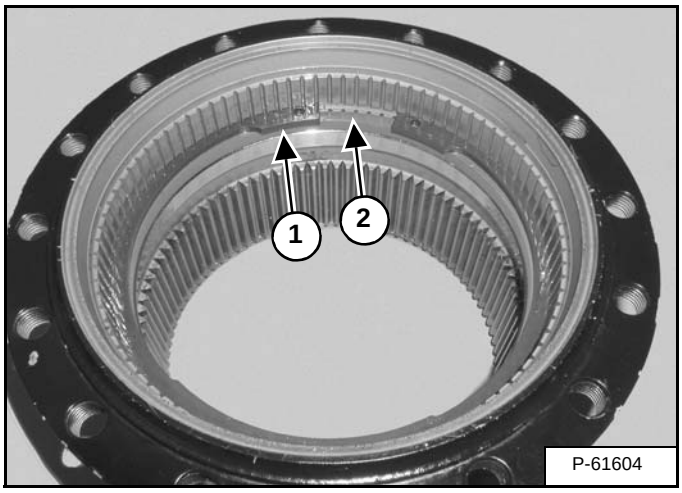
Figure 20-70-17



Remove the bearing race (Item 1) and spacer (Item 2) **[Figure 20-70-17]**.

Turn the ring gear over.

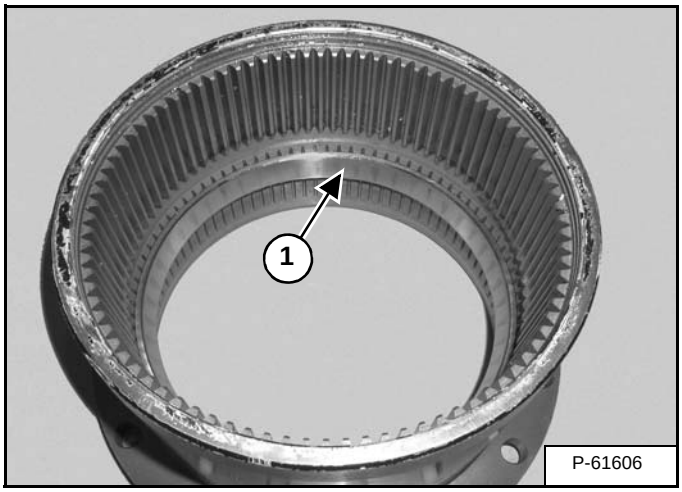
Figure 20-70-18



Remove the snap ring (Item 1) and spacer (Item 2) **[Figure 20-70-18]**.

Turn the ring gear over.

Figure 20-70-19



Remove the bearing race (Item 1) **[Figure 20-70-19]**.

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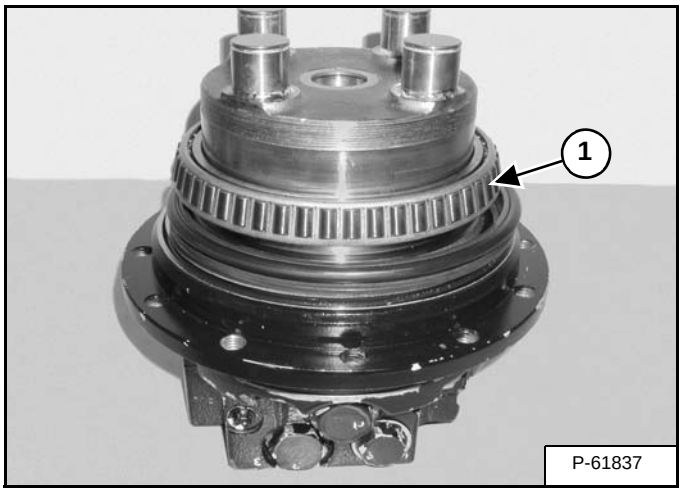
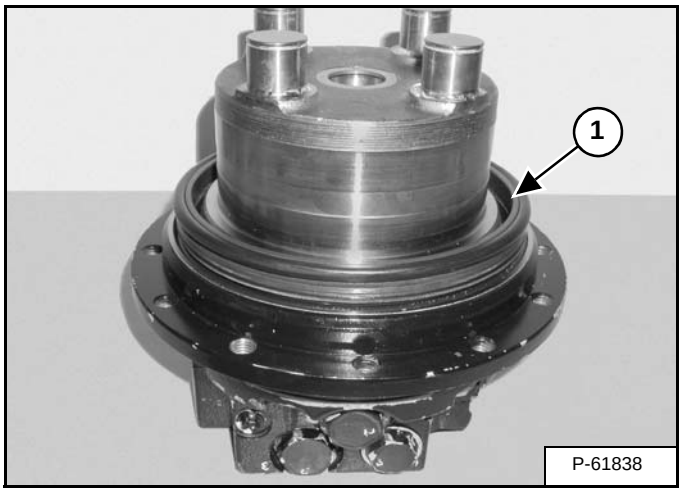
Disassembly (Cont'd)

Figure 20-70-20



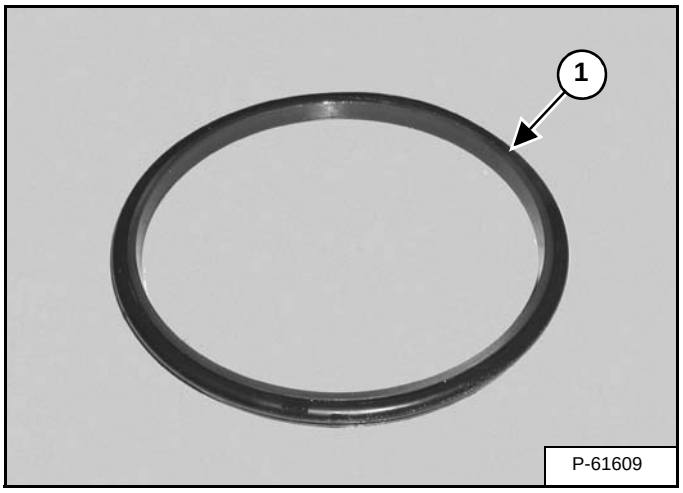
Remove the bearing (Item 1) **[Figure 20-70-20]**.

Figure 20-70-21



Remove the upper and lower seal ring assembly (Item 1) **[Figure 20-70-21]**.

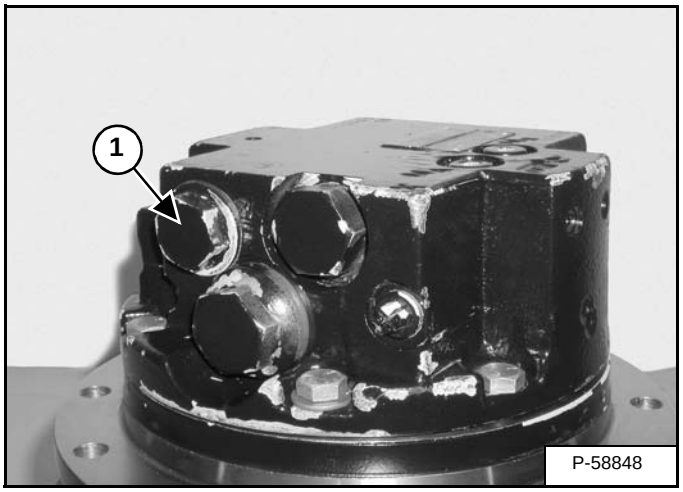
Figure 20-70-22



Remove the O-ring (Item 1) **[Figure 20-70-22]** from both seal rings.

Turn the travel motor over.

Figure 20-70-23



Remove the plug (Item 1) **[Figure 20-70-23]**.

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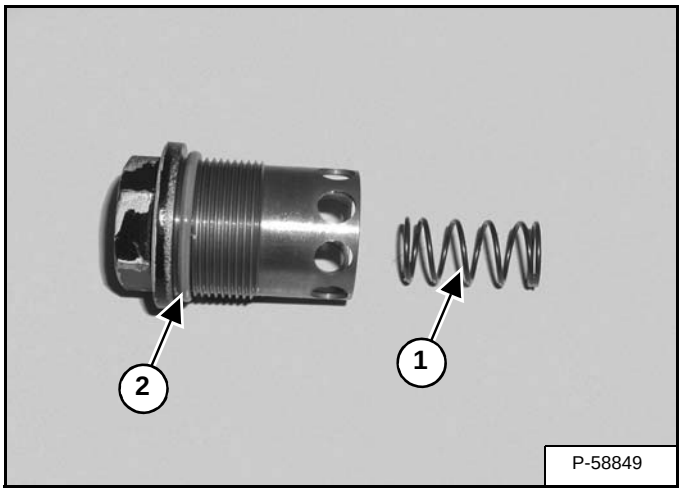
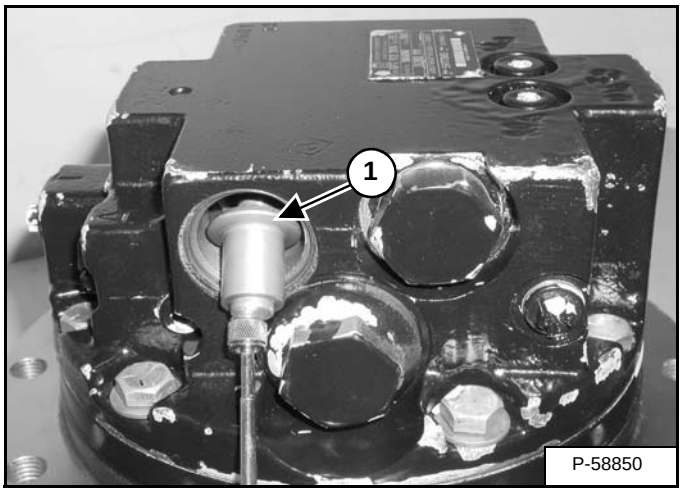
Disassembly (Cont'd)

Figure 20-70-24



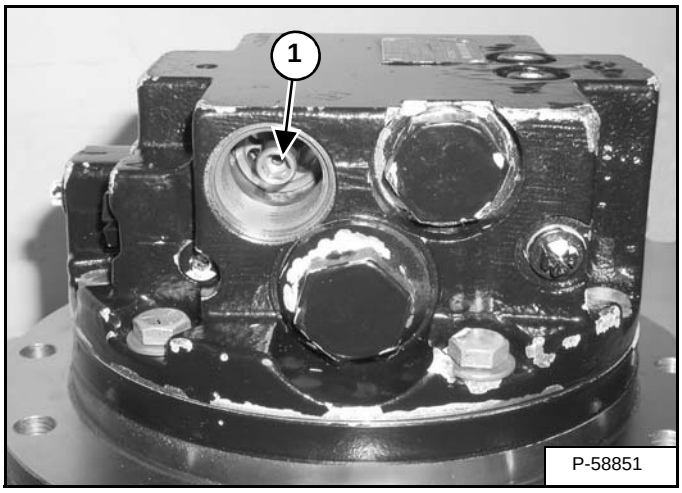
Remove the spring (Item 1) and O-ring (Item 2) **[Figure 20-70-24]**.

Figure 20-70-25



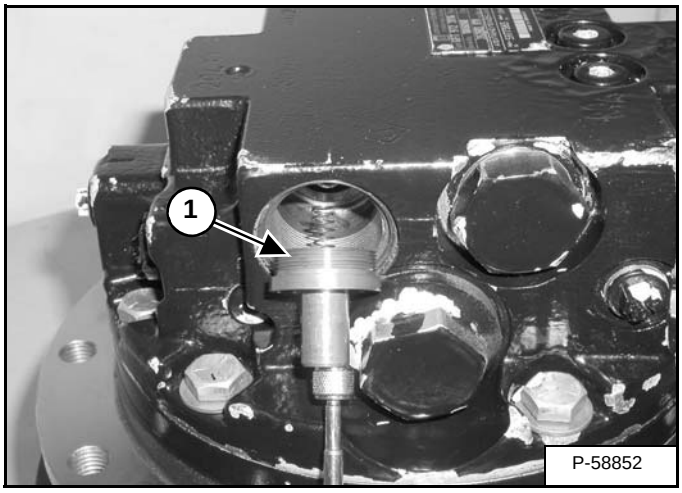
Remove the spring seat (Item 1) **[Figure 20-70-25]**.

Figure 20-70-26



Loosen the retainer (Item 1) **[Figure 20-70-26]**.

Figure 20-70-27



Remove the retainer and spring (Item 1) **[Figure 20-70-27]**.

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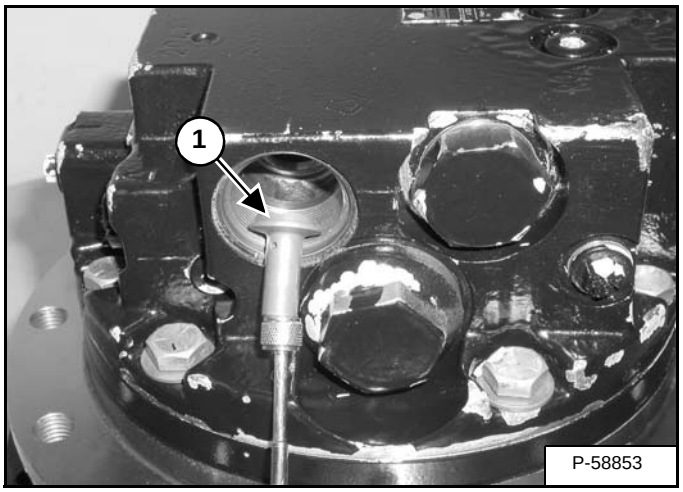
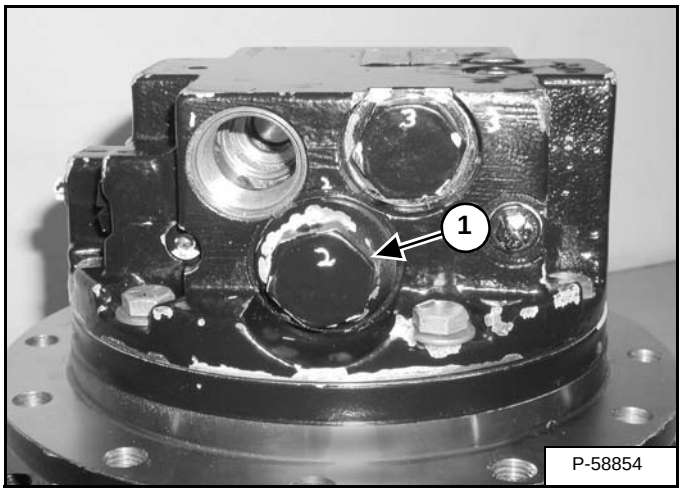
Disassembly (Cont'd)

Figure 20-70-28



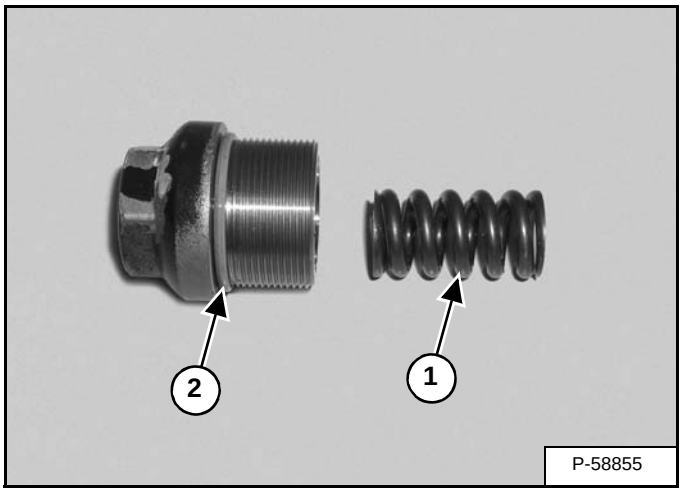
Remove the poppet (Item 1) **[Figure 20-70-28]**.

Figure 20-70-29



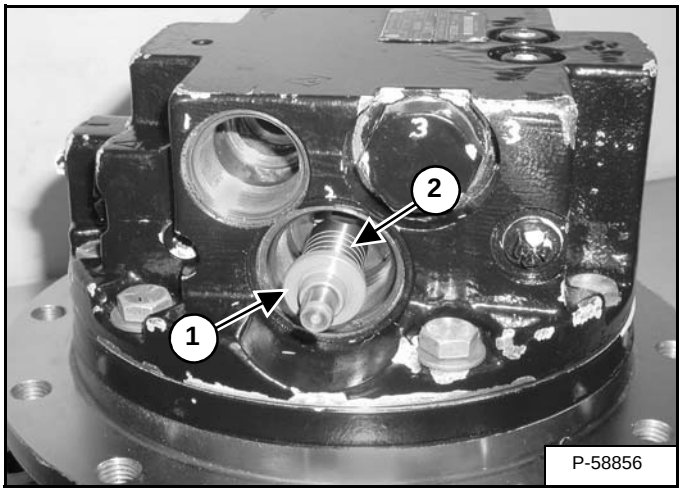
Remove the plug (Item 1) **[Figure 20-70-29]**.

Figure 20-70-30



Remove the spring (Item 1) and O-ring (Item 2) **[Figure 20-70-30]**.

Figure 20-70-31



Remove the spring seat (Item 1) and spool (Item 2) **[Figure 20-70-31]**.

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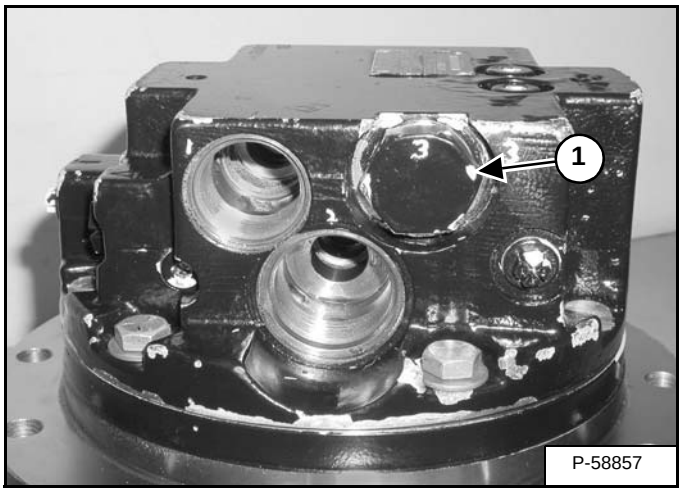
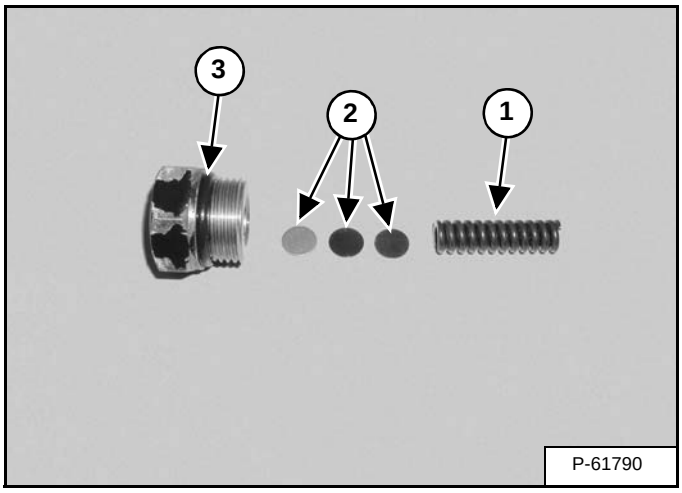
Disassembly (Cont'd)

Figure 20-70-32



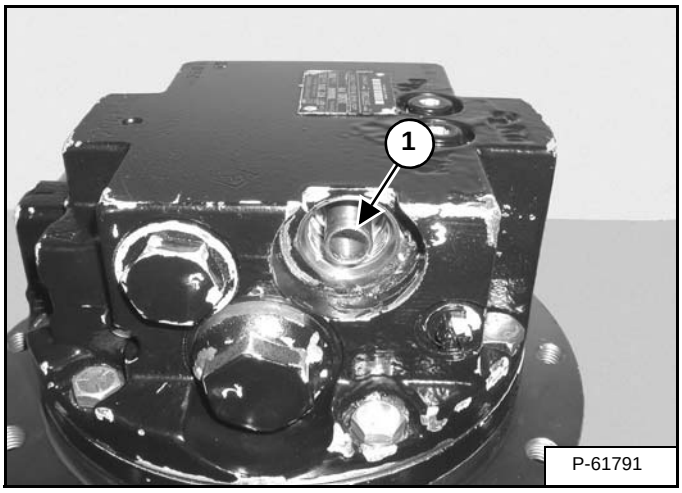
Remove the plug (Item 1) **[Figure 20-70-32]**.

Figure 20-70-33



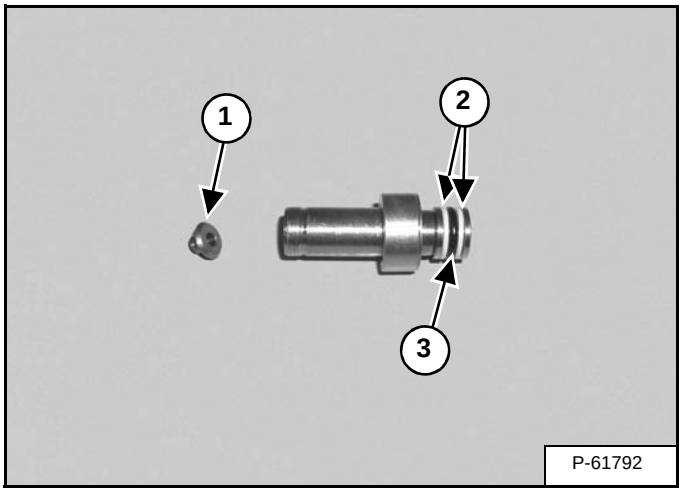
Remove the spring (Item 1), shims (Item 2) and O-ring (Item 3) **[Figure 20-70-33]**.

Figure 20-70-34



Remove the spool (Item 1) **[Figure 20-70-34]**.

Figure 20-70-35



Remove the poppet (Item 1), backup rings (Item 2) and O-ring (Item 3) **[Figure 20-70-35]**.

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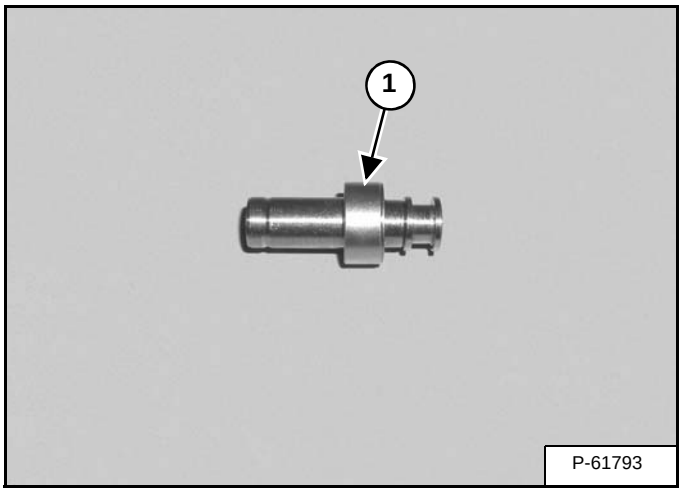
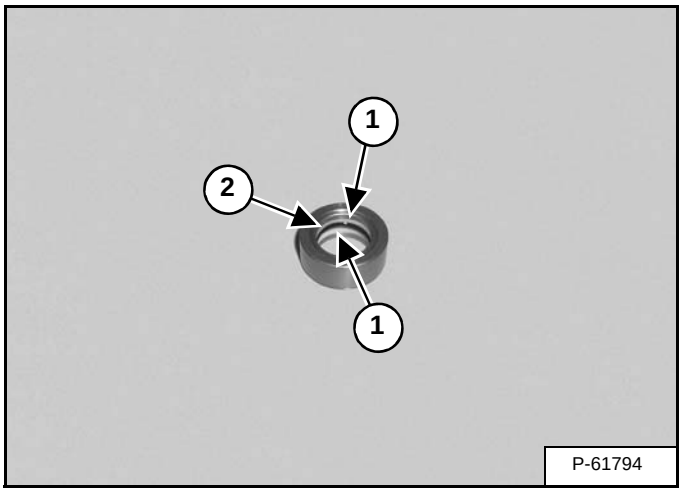
Disassembly (Cont'd)

Figure 20-70-36



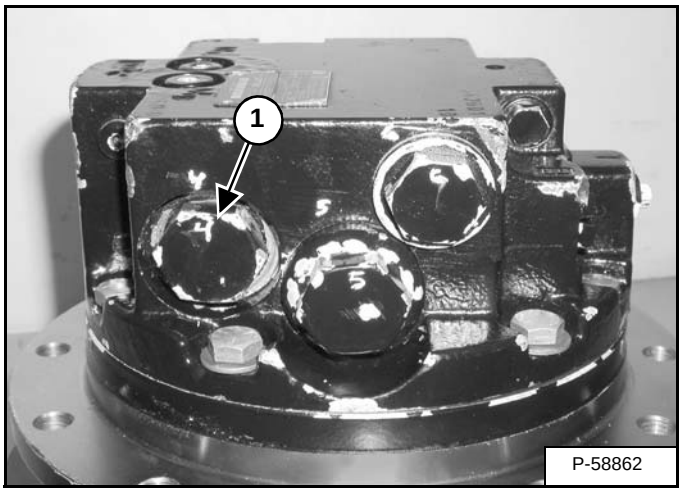
Remove the spool guide (Item 1) **[Figure 20-70-36]**.

Figure 20-70-37



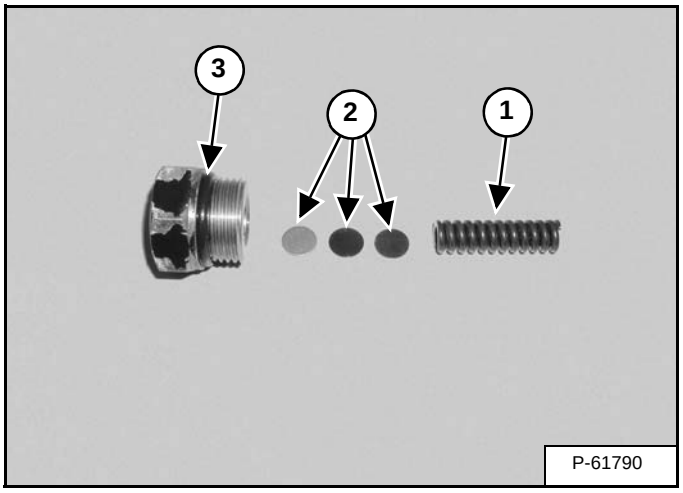
Remove the back-up rings (Item 1) and O-ring (Item 2) **[Figure 20-70-37]**.

Figure 20-70-38



Remove the plug (Item 1) **[Figure 20-70-38]**.

Figure 20-70-39



Remove the spring (Item 1), shims (Item 2) and O-ring (Item 3) **[Figure 20-70-39]**.

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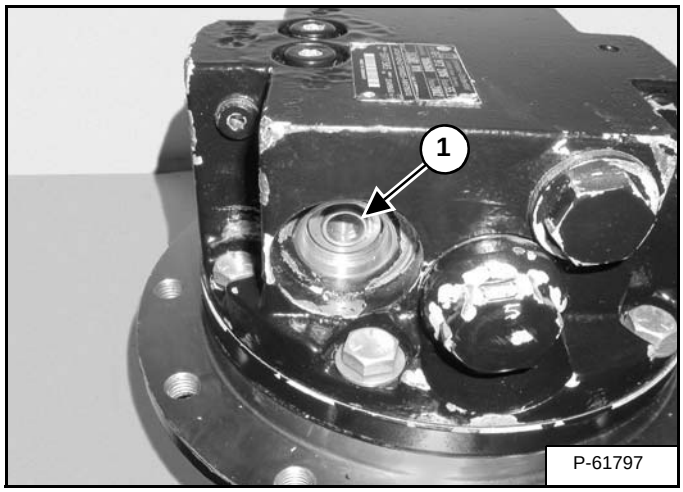
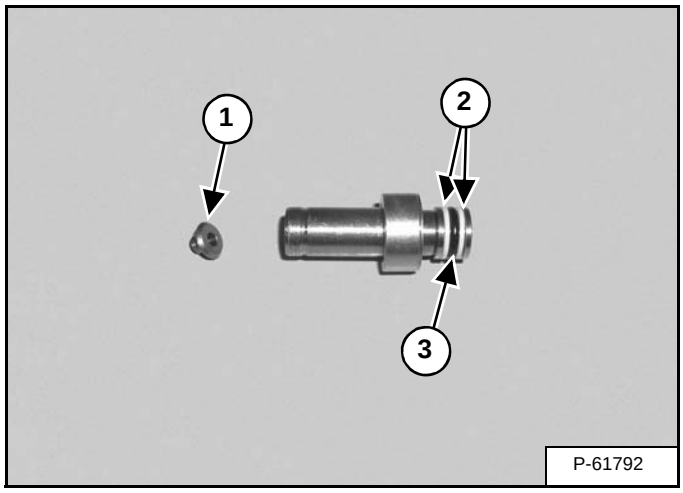
Disassembly (Cont'd)

Figure 20-70-40



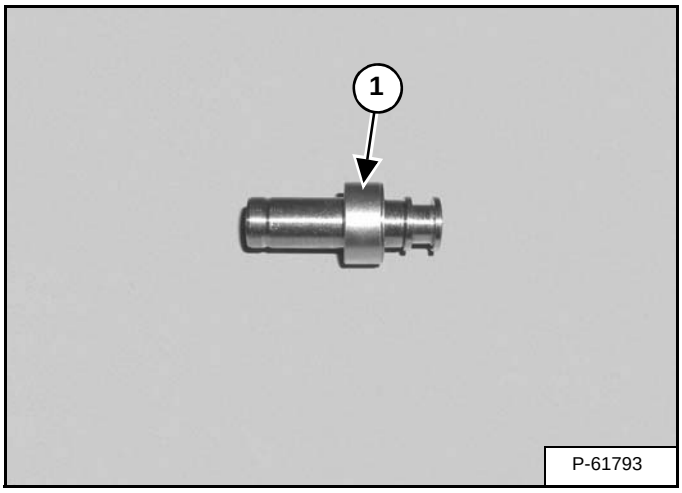
Remove the spool (Item 1) **[Figure 20-70-40]**.

Figure 20-70-41



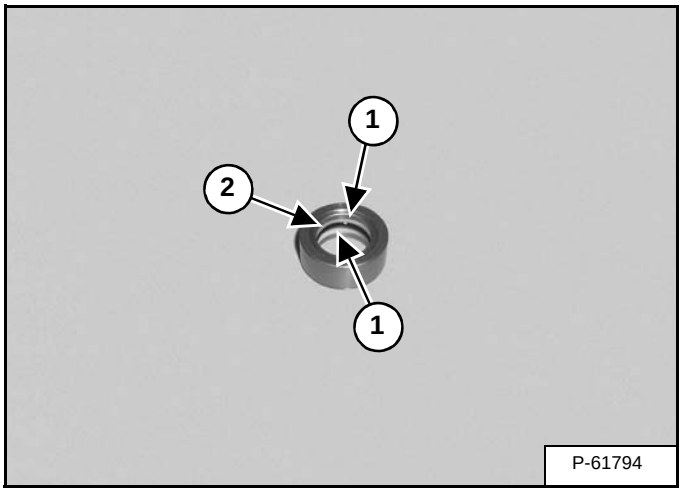
Remove the poppet (Item 1), back-up rings (Item 2), and O-ring (Item 3) **[Figure 20-70-41]**.

Figure 20-70-42



Remove the spool guide (Item 1) **[Figure 20-70-42]**.

Figure 20-70-43



Remove the back-up rings (Item 1) and O-ring (Item 2) **[Figure 20-70-43]**.

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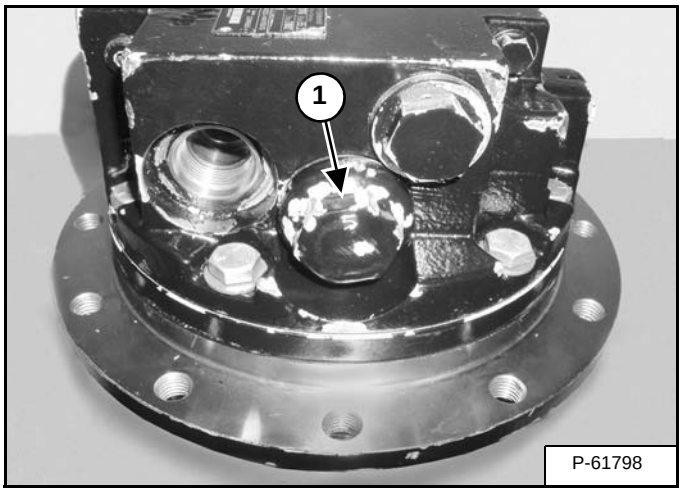
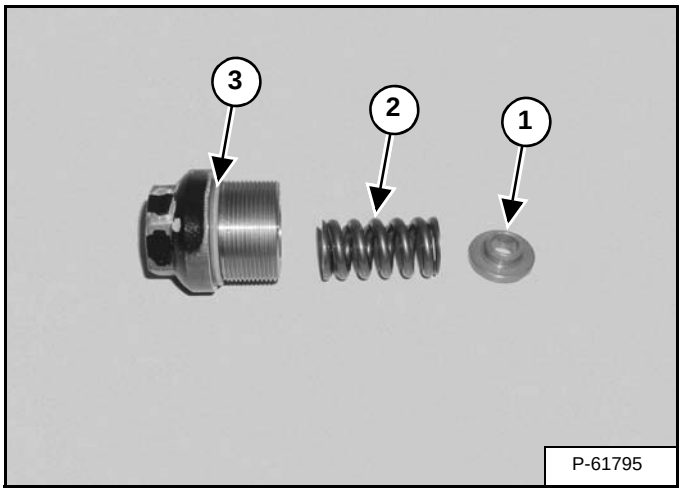
Disassembly (Cont'd)

Figure 20-70-44



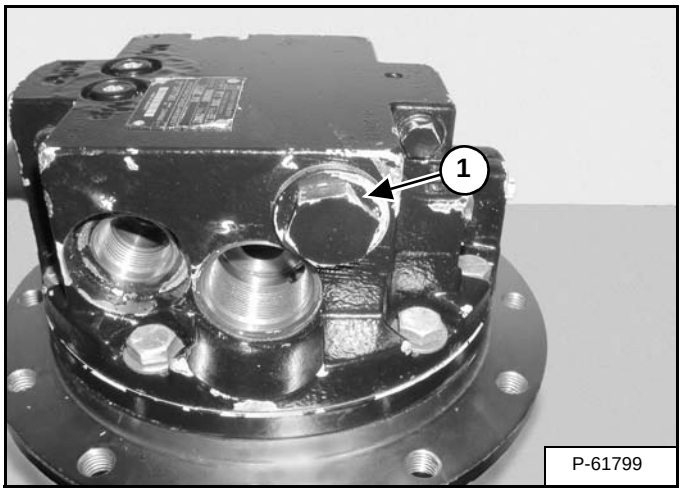
Remove the plug (Item 1) **[Figure 20-70-44]**.

Figure 20-70-45



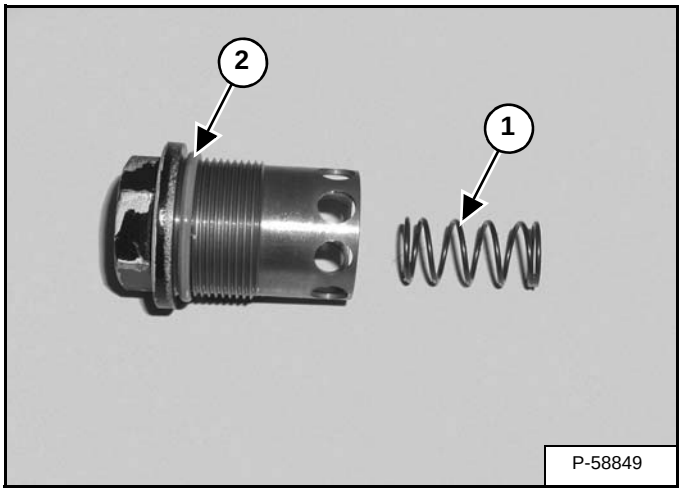
Remove the spring seat (Item 1), spring (Item 2) and O-ring (Item 3) **[Figure 20-70-45]**.

Figure 20-70-46



Remove the plug (Item 1) **[Figure 20-70-46]**.

Figure 20-70-47



Remove the spring (Item 1) and O-ring (Item 2) **[Figure 20-70-47]**.

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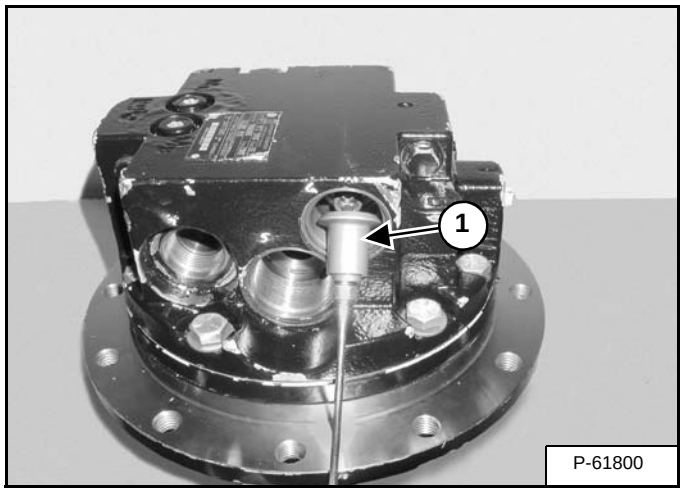
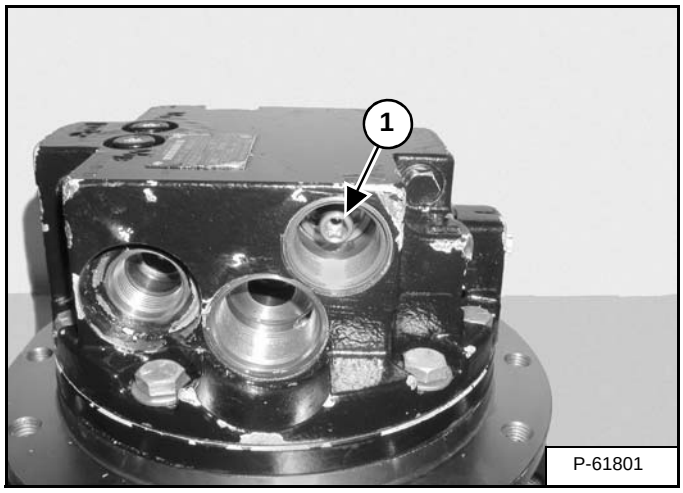
Disassembly (Cont'd)

Figure 20-70-48



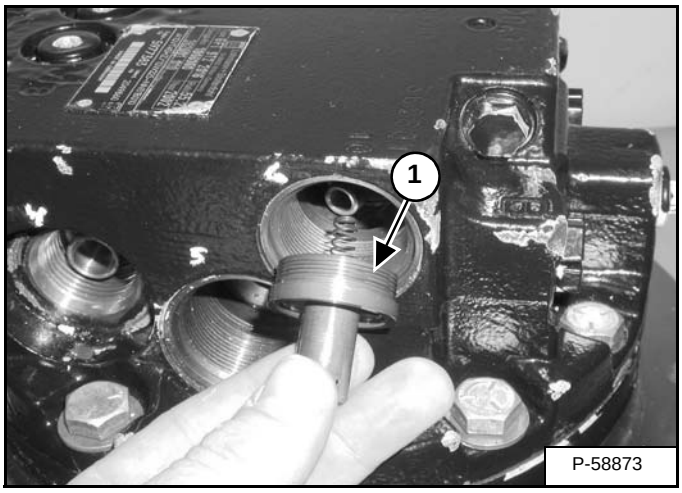
Remove the spring seat (Item 1) **[Figure 20-70-48]**.

Figure 20-70-49



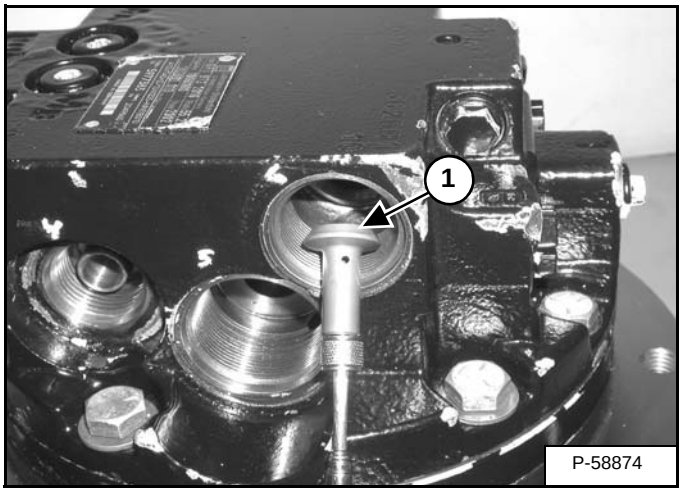
Loosen the retainer (Item 1) **[Figure 20-70-49]**.

Figure 20-70-50



Remove the retainer and spring (Item 1) **[Figure 20-70-50]**.

Figure 20-70-51



Remove the poppet (Item 1) **[Figure 20-70-51]**.

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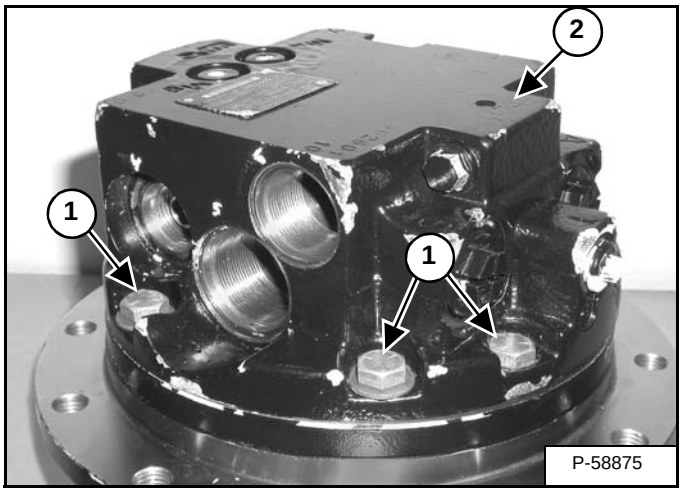
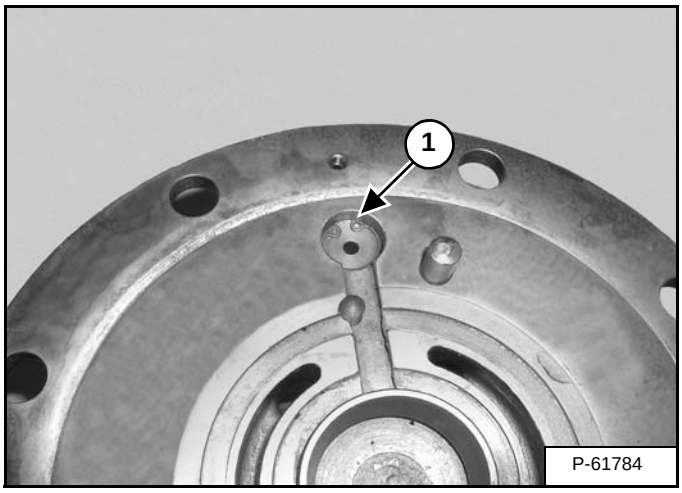
Disassembly (Cont'd)

Figure 20-70-52



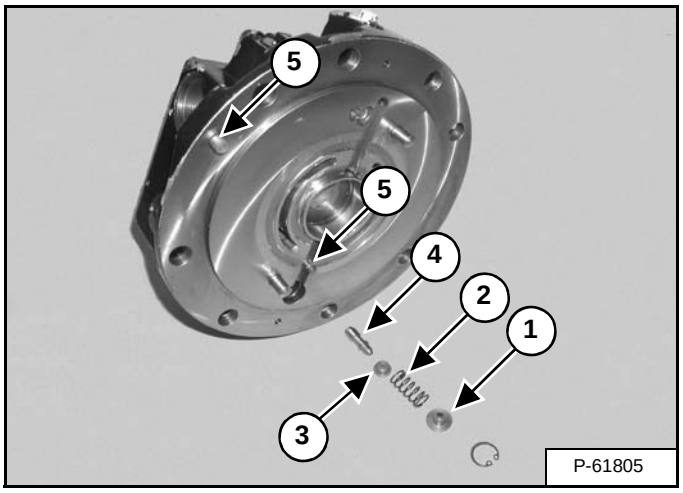
Remove the 8 bolts (Item 1), and lock valve (Item 2) **[Figure 20-70-52]**.

Figure 20-70-53



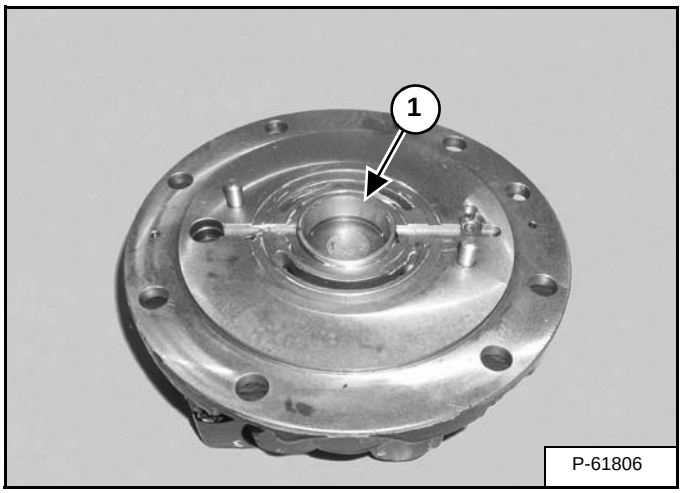
Turn the lock valve over. Remove the snap ring (Item 1) **[Figure 20-70-53]**.

Figure 20-70-54



Remove the spring seat (Item 1), spring (Item 2), spring seat (Item 3), spool (Item 4) and alignment pins (Item 5) **[Figure 20-70-54]**.

Figure 20-70-55



Remove the bearing race (Item 1) **[Figure 20-70-55]**.

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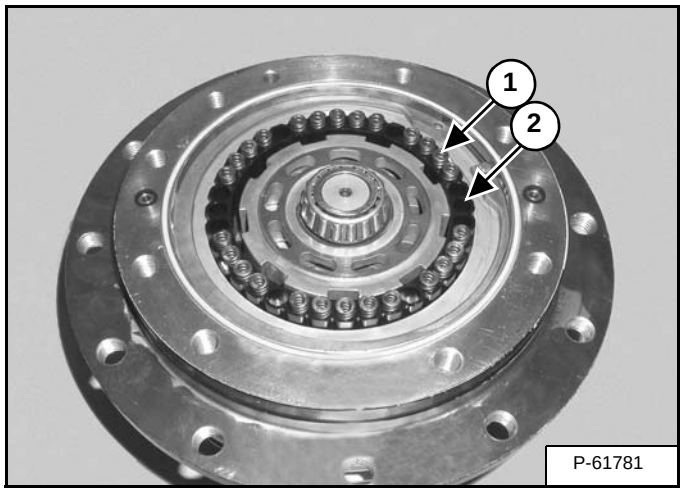
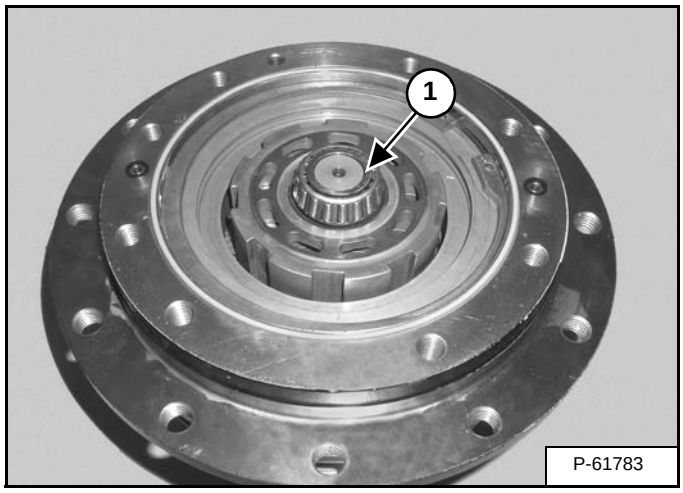
Disassembly (Cont'd)

Figure 20-70-56



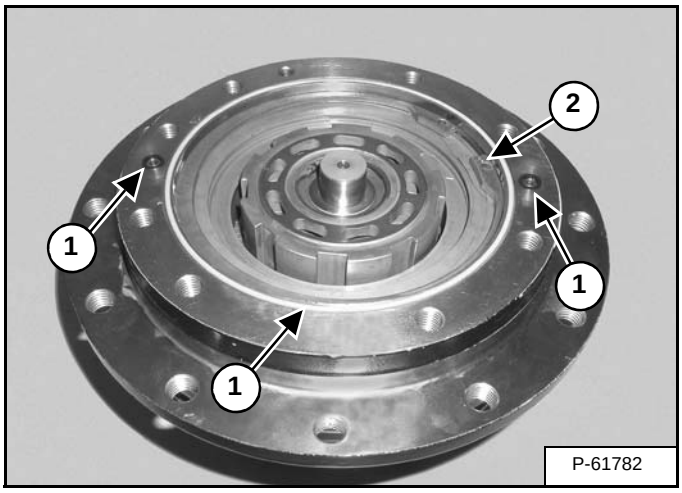
Remove the 26 springs (Item 1) and spring retainer (Item 2) **[Figure 20-70-56]**.

Figure 20-70-57



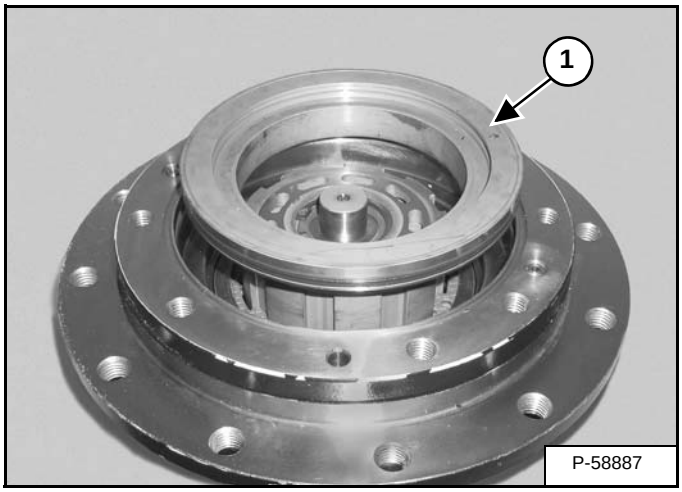
Remove the bearing and washer (Item 1) **[Figure 20-70-57]**.

Figure 20-70-58



Remove the3 O-rings (Item 1) and snap ring (Item 2) **[Figure 20-70-58]**.

Figure 20-70-59



Remove the brake piston (Item 1) **[Figure 20-70-59]**.

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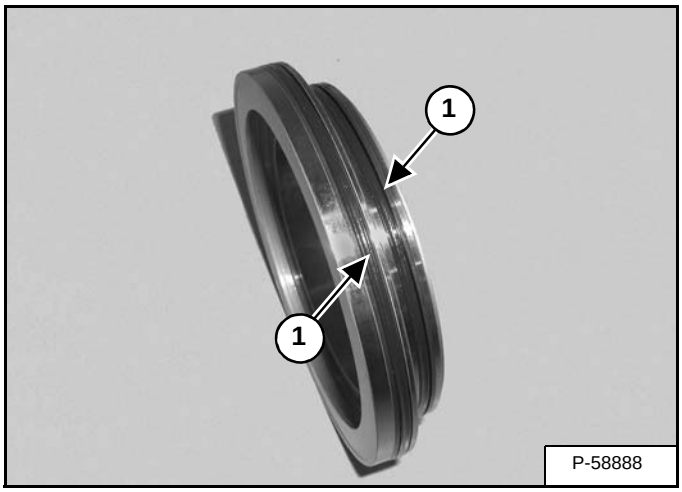
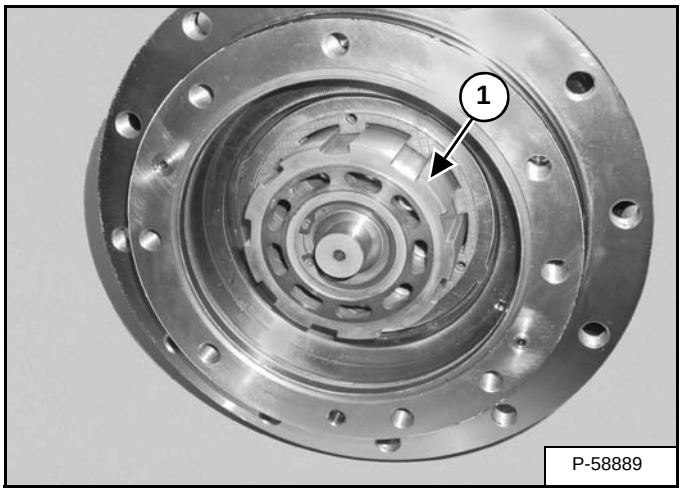
Disassembly (Cont'd)

Figure 20-70-60



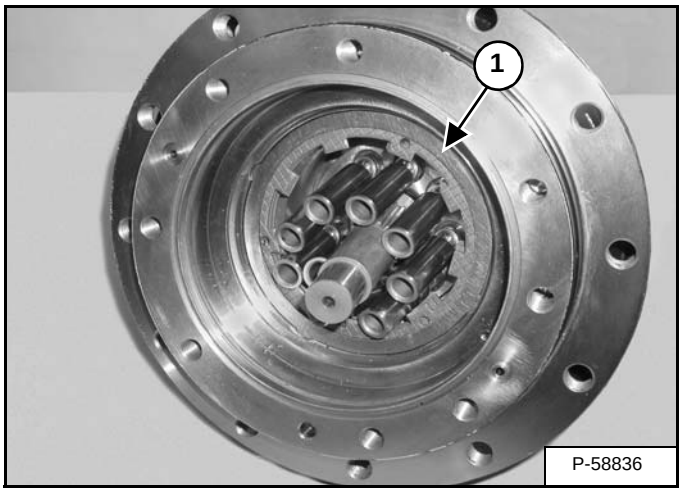
Remove the quadrings (Item 1) **[Figure 20-70-60]**.

Figure 20-70-61



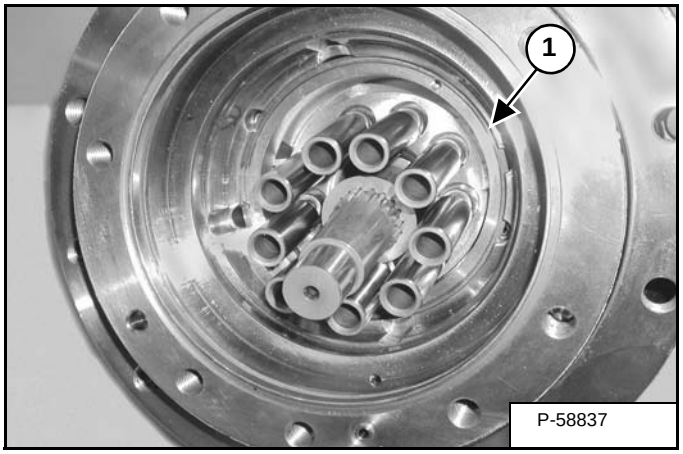
Remove the cylinder block (Item 1) **[Figure 20-70-61]**.

Figure 20-70-62



Remove the brake discs (Item 1) **[Figure 20-70-62]**.

Figure 20-70-63



Remove the snap ring (Item 1) **[Figure 20-70-63]**.

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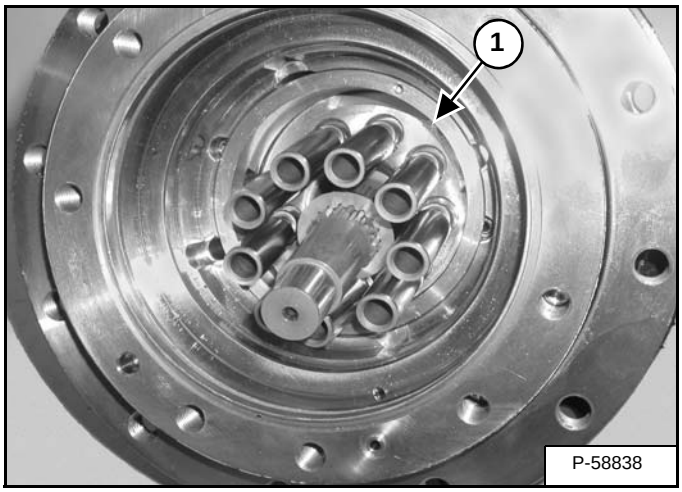
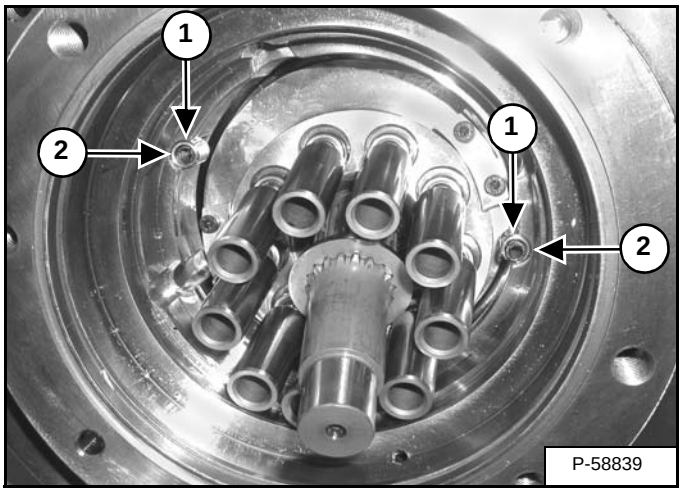
Disassembly (Cont'd)

Figure 20-70-64



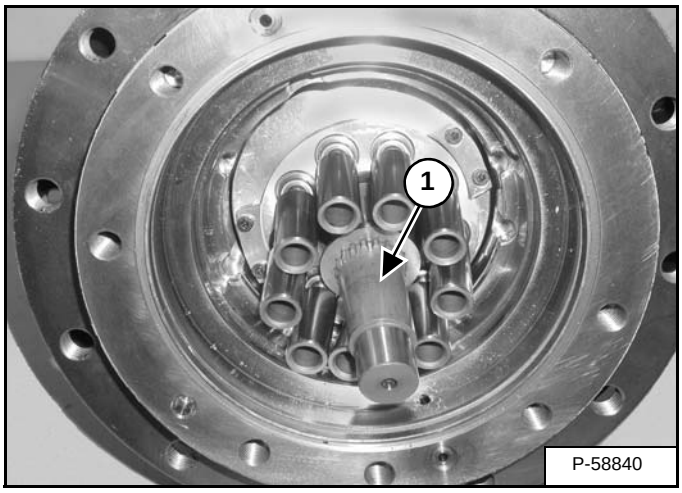
Remove the brake disc stop (Item 1) **[Figure 20-70-64]**.

Figure 20-70-65



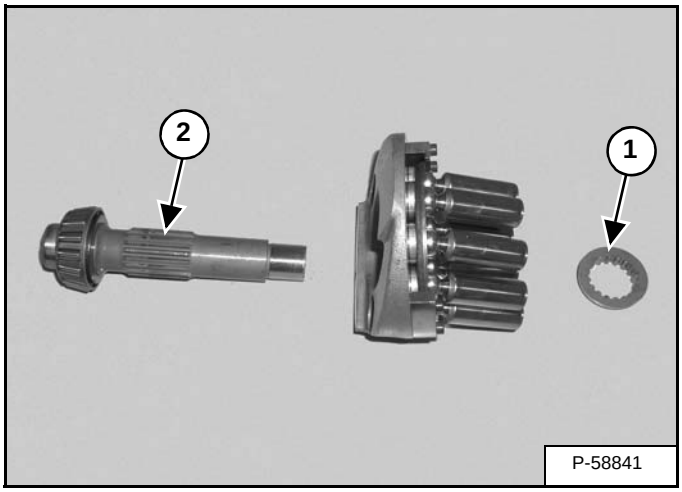
Remove the sleeves (Item 1) and springs (Item 2) **[Figure 20-70-65]**.

Figure 20-70-66



Remove the shaft and piston assembly (Item 1) **[Figure 20-70-66]**.

Figure 20-70-67



Remove the piston plate pivot (Item 1) and shaft (Item 2) **[Figure 20-70-67]**.

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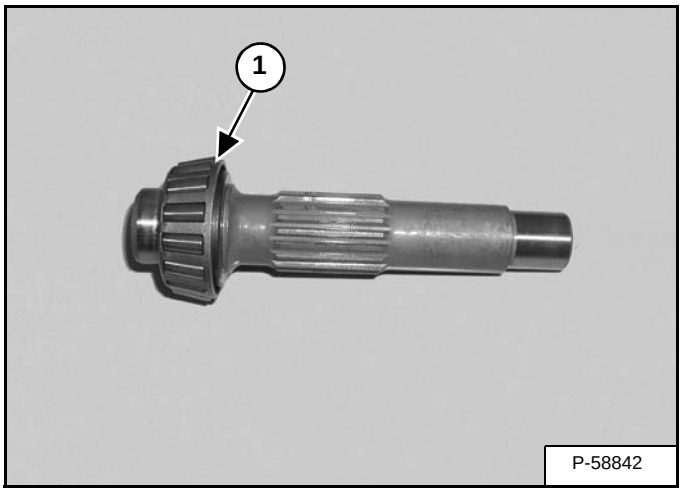
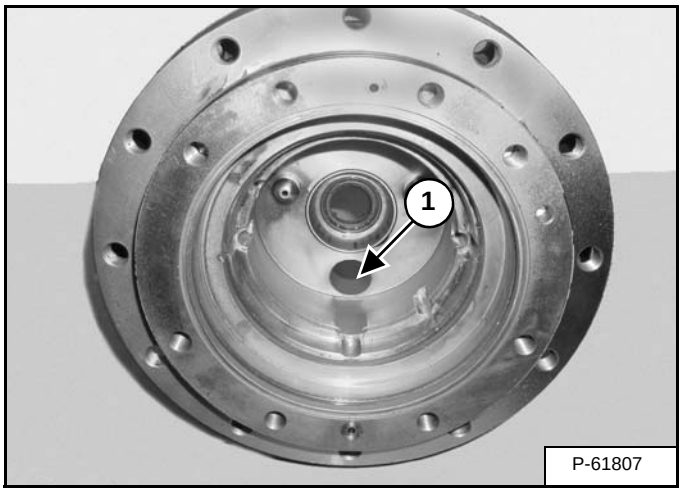
Disassembly (Cont'd)

Figure 20-70-68



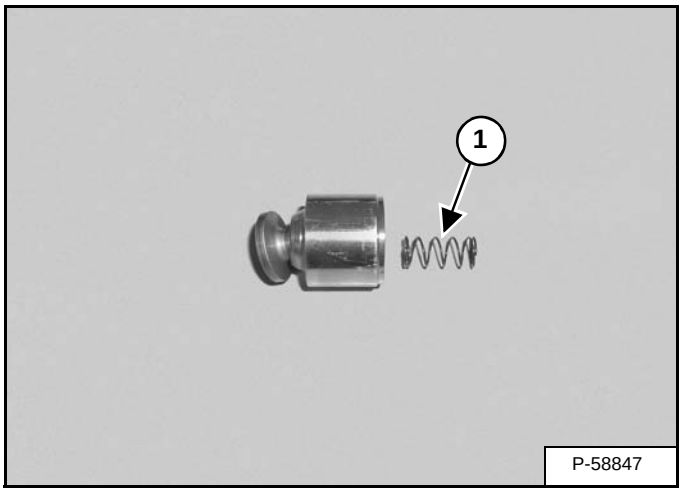
Remove the bearing (Item 1) **[Figure 20-70-68]**.

Figure 20-70-69



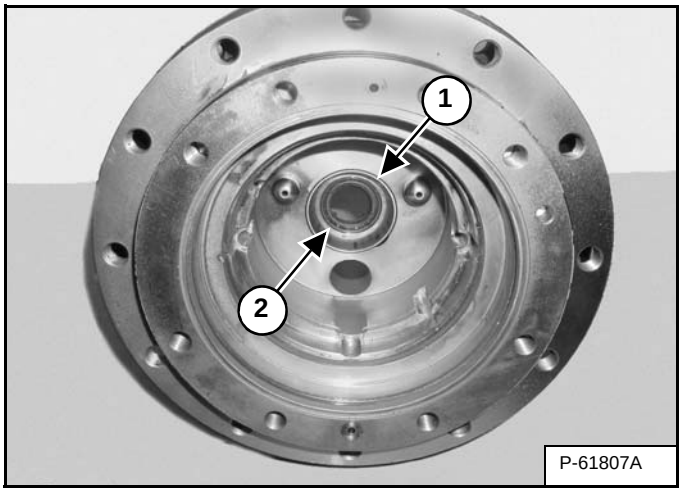
Remove the piston assembly (Item 1) **[Figure 20-70-69]**.

Figure 20-70-70



Remove the spring (Item 1) **[Figure 20-70-70]**.

Figure 20-70-71



Remove the bearing race (Item 1) and seal (Item 2) **[Figure 20-70-71]**.

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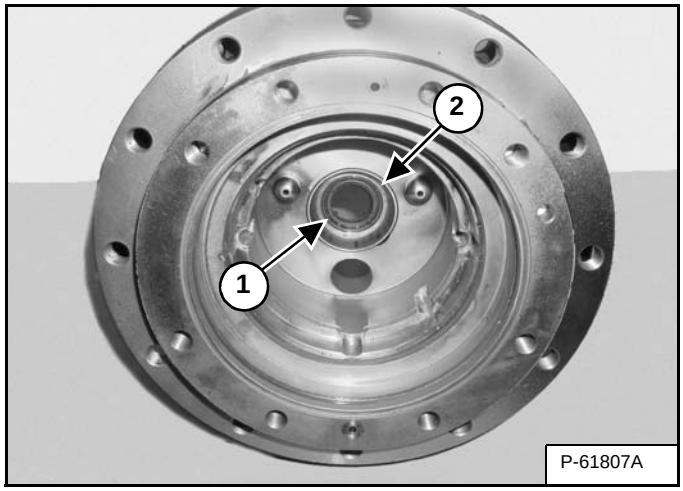
Assembly

The tools listed will be needed to assemble the travel motor:

MEL XXXX Spanner Wrench.

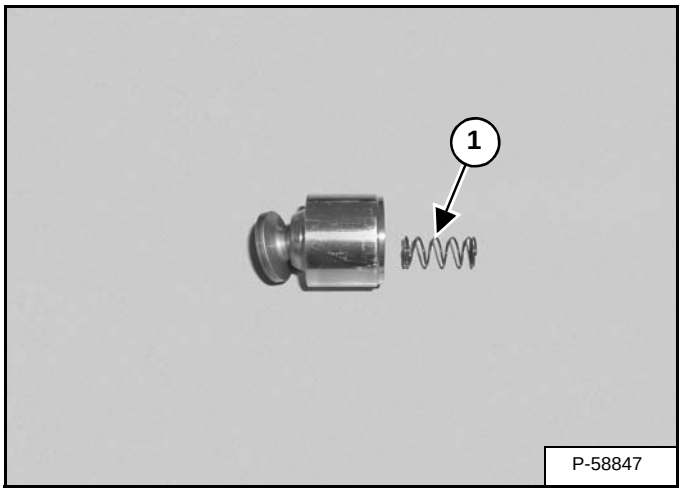
Clean all parts in solvent and dry with compressed air. Inspect all parts and replace any that are damaged. If any of the planetary gears are damaged, replace all the planetary gears and sun gear from the planetary assembly that is damaged. One damaged gear can cause a microscopic fatigue crack in mating teeth and cause premature failure after servicing. Apply oil to all O-rings (as noted) and assembly lube to the bearings before installation.

Figure 20-70-72



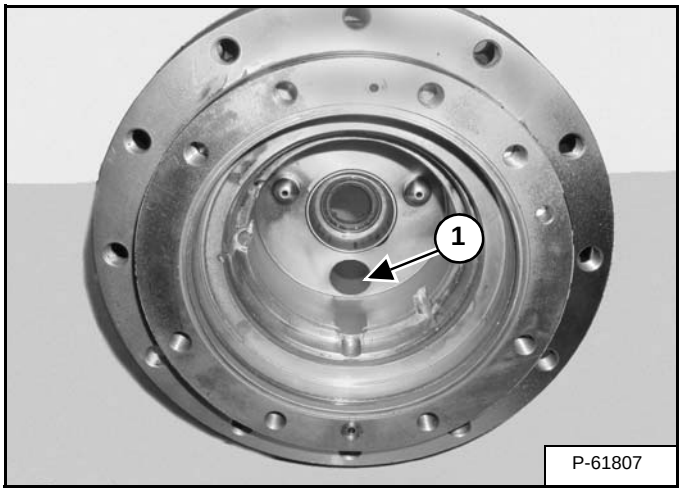
Install the seal (Item 1). Install the bearing race (Item 2) **[Figure 20-70-72]**.

Figure 20-70-73



Install the spring (Item 1) **[Figure 20-70-73]** in the piston.

Figure 20-70-74



Install the piston assembly (Item 1) **[Figure 20-70-74]**.

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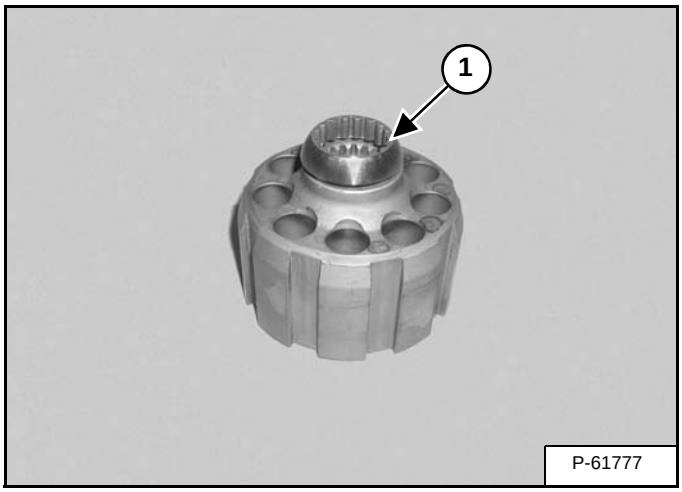
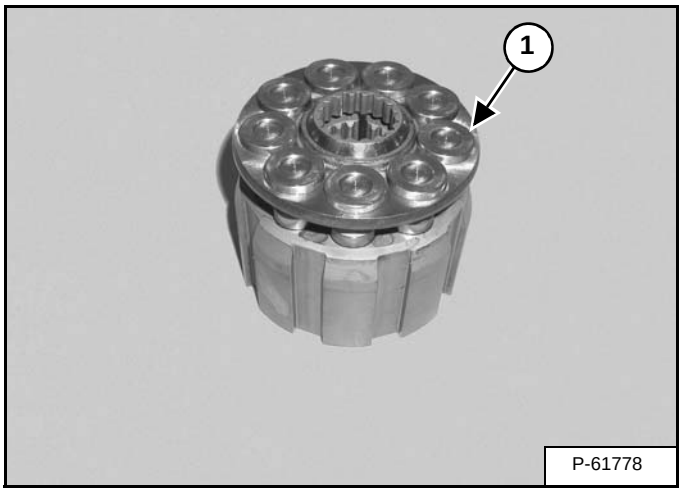
Assembly (Cont'd)

Figure 20-70-75



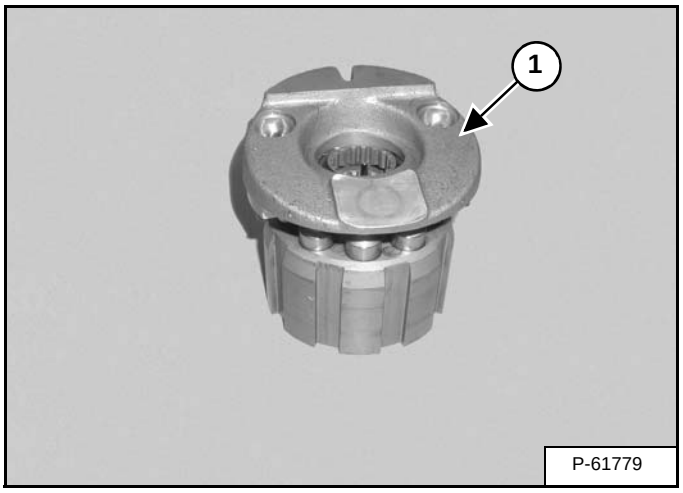
Install the piston pivot plate (Item 1) **[Figure 20-70-75]**.

Figure 20-70-76



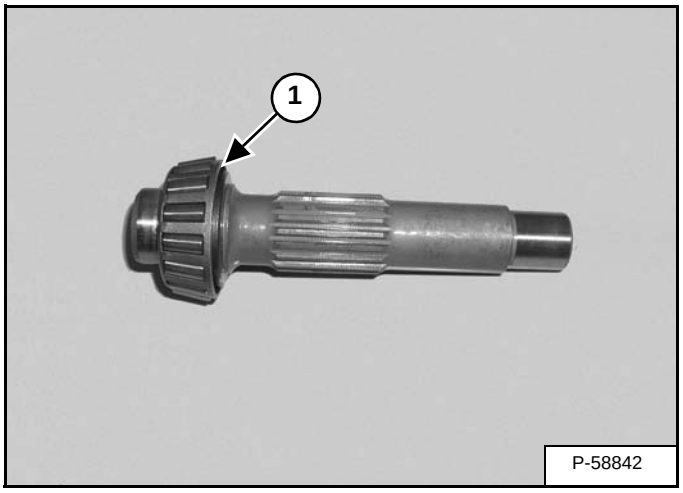
Install the piston assembly (Item 1) **[Figure 20-70-76]**.

Figure 20-70-77



Install the swash plate (Item 1) **[Figure 20-70-77]**.

Figure 20-70-78



Install the bearing (Item 1) **[Figure 20-70-78]**.

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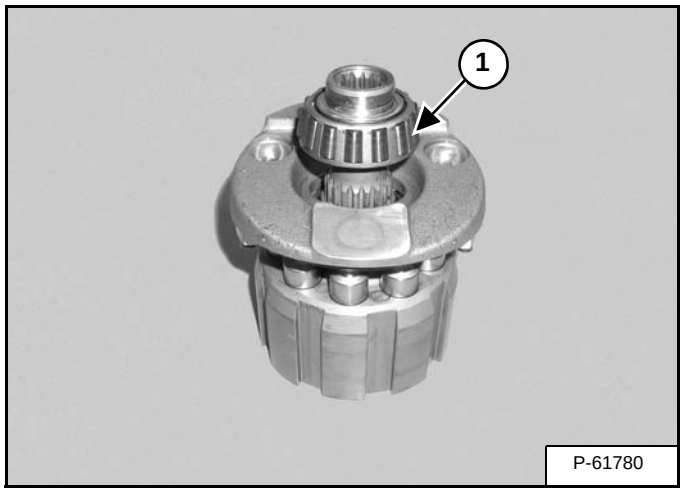
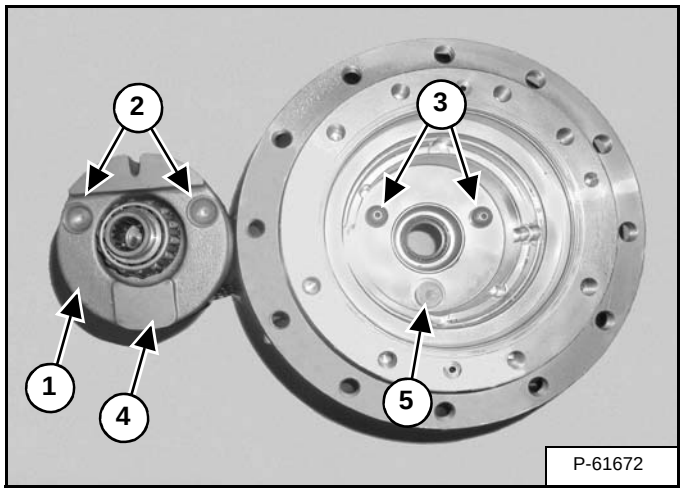
Assembly (Cont'd)

Figure 20-70-79



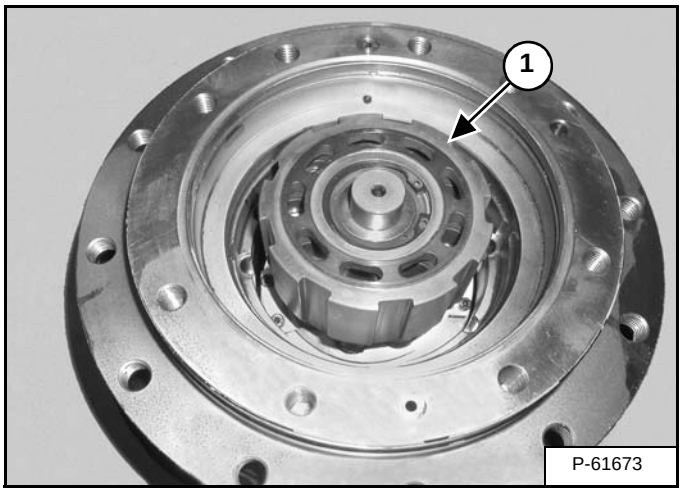
Install the shaft (Item 1) **[Figure 20-70-79]**.

Figure 20-70-80



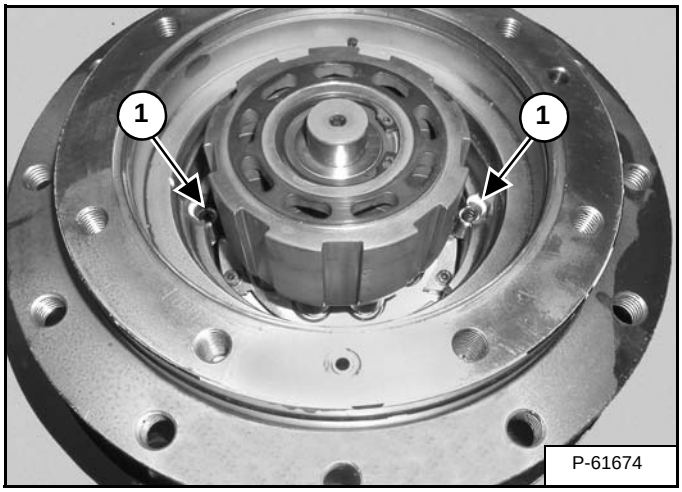
Install the swash plate (Item 1) with sockets (Item 2) on the plate engaging the studs (Item 3) of the hub, and the flat surface (Item 4) of the plate resting on the piston assembly (Item 5) **[Figure 20-70-80]**.

Figure 20-70-81



Install the swash plate/cylinder block assembly (Item 1) **[Figure 20-70-81]**.

Figure 20-70-82



Apply assembly lube to the sleeves and springs (Item 1) **[Figure 20-70-82]** and install.

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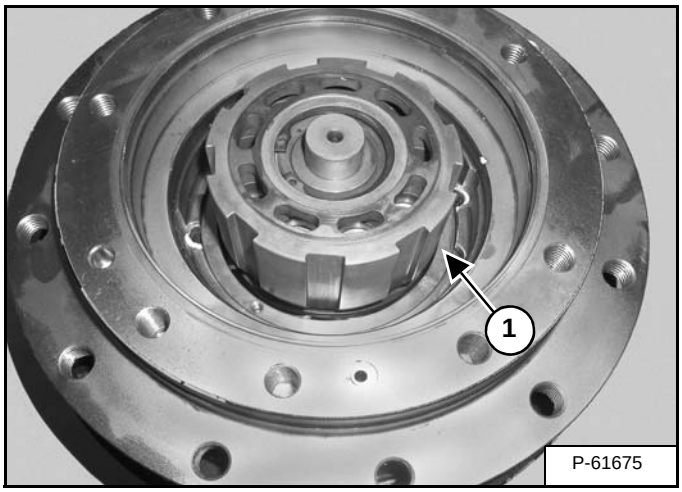
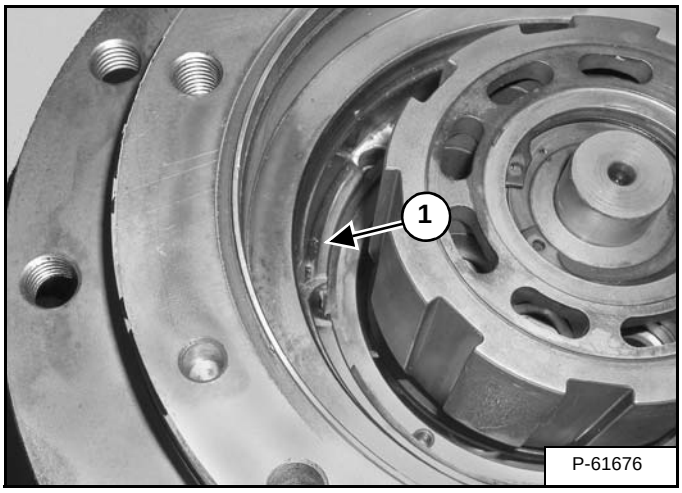
Assembly (Cont'd)

Figure 20-70-83



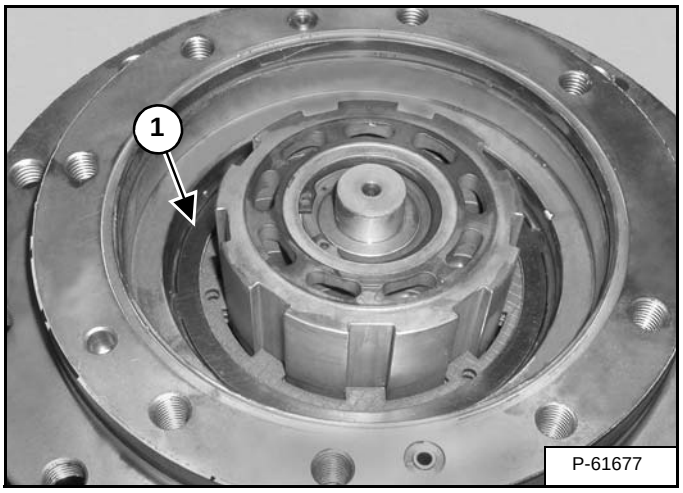
Install the brake disc stop (Item 1) **[Figure 20-70-83]**.

Figure 20-70-84



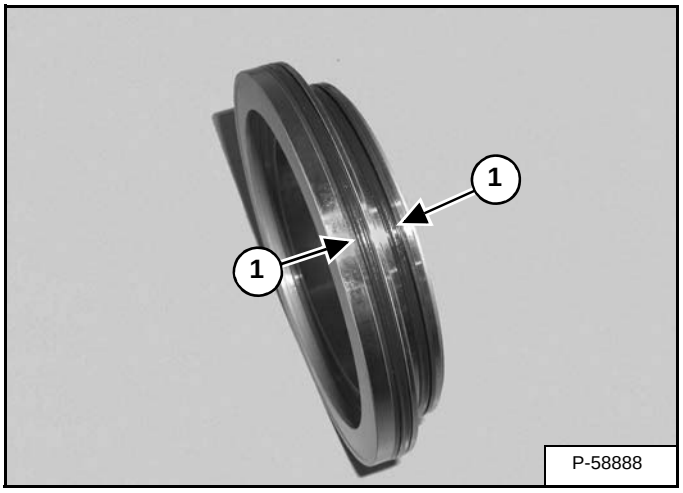
Install the snap ring (Item 1) **[Figure 20-70-84]**.

Figure 20-70-85



Install the brake discs (Item 1) **[Figure 20-70-85]**.

Figure 20-70-86



Install the quad rings (Item 1) **[Figure 20-70-86]**.

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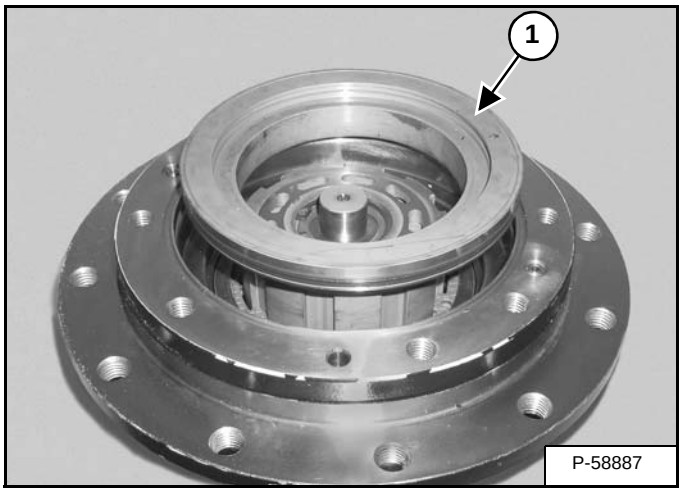
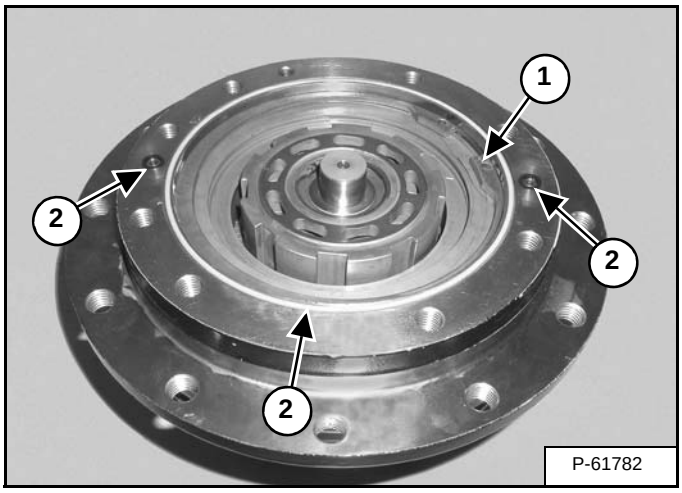
Assembly (Cont'd)

Figure 20-70-87



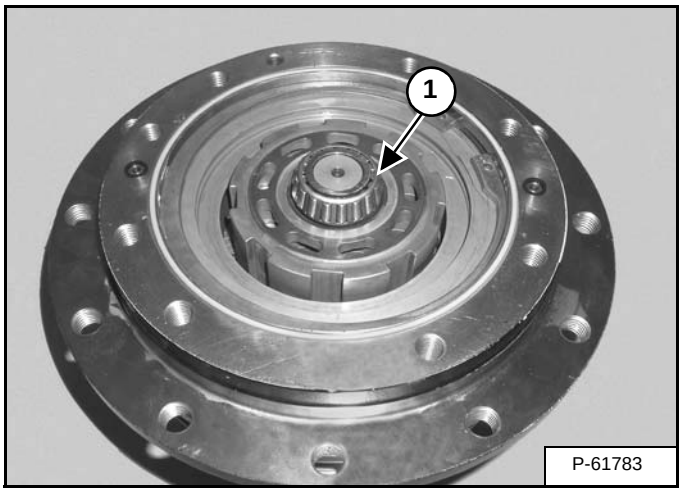
Install the brake piston (Item 1) **[Figure 20-70-87]**.

Figure 20-70-88



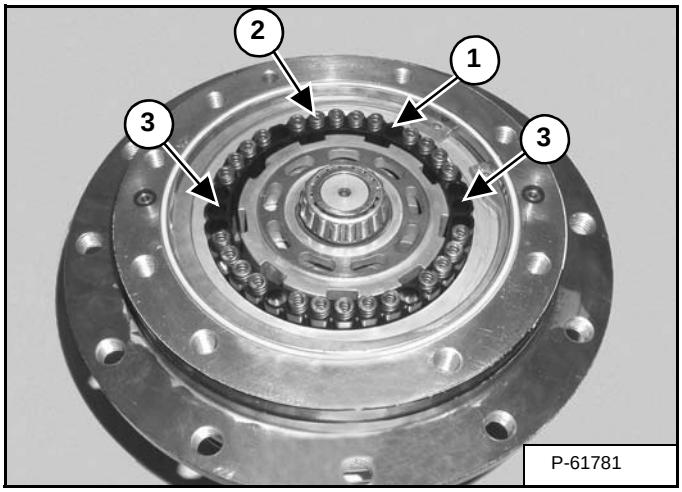
Install the snap ring (Item 1) and three O-rings (Item 2) **[Figure 20-70-88]**.

Figure 20-70-89



Install the washer and bearing (Item 1) **[Figure 20-70-89]**.

Figure 20-70-90



Install the spring retainer (Item 1) and springs (Item 2) **[Figure 20-70-90]** as shown.

The lock valve alignment pins must engage the open spring slots (Item 3) **[Figure 20-70-90]** leaving one open spring slot on each side of the alignment pins.

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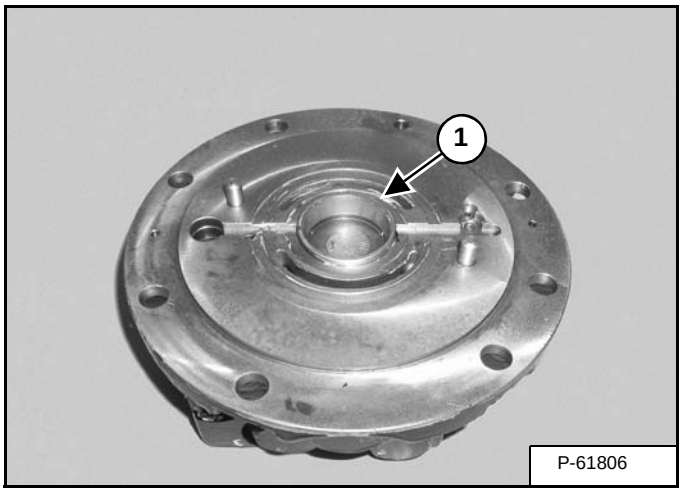
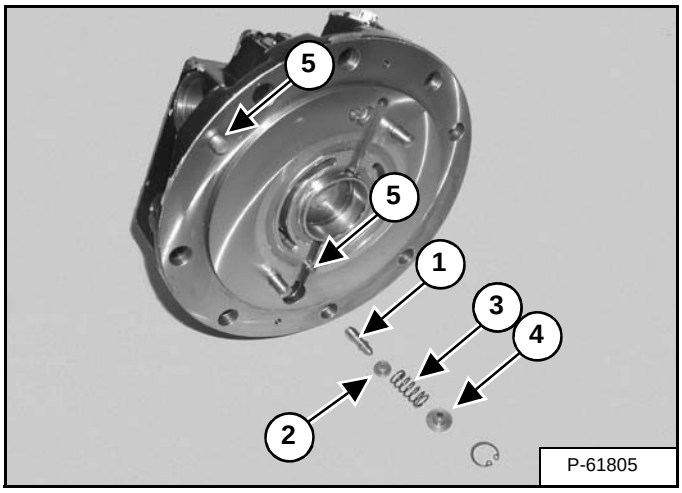
Assembly (Cont'd)

Figure 20-70-91



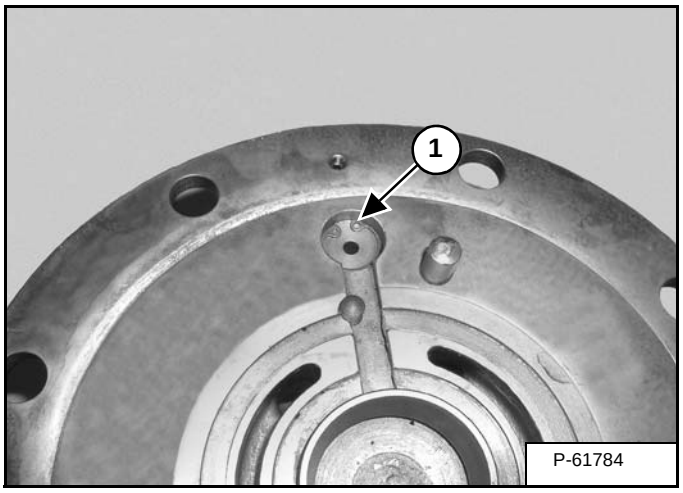
Install the bearing race (Item 1) **[Figure 20-70-91]**.

Figure 20-70-92



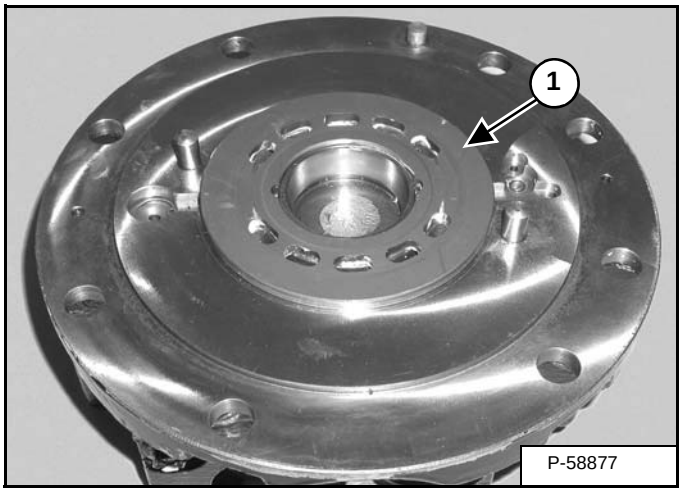
Install the spool (Item 1), spring seat (Item 2), spring (Item 3), spring seat (Item 4), and alignment pins (Item 5) **[Figure 20-70-92]**.

Figure 20-70-93



Install the snap ring (Item 1) **[Figure 20-70-93]**.

Figure 20-70-94



Apply assembly lube to the valve plate (Item 1) **[Figure 20-70-94]** and install.

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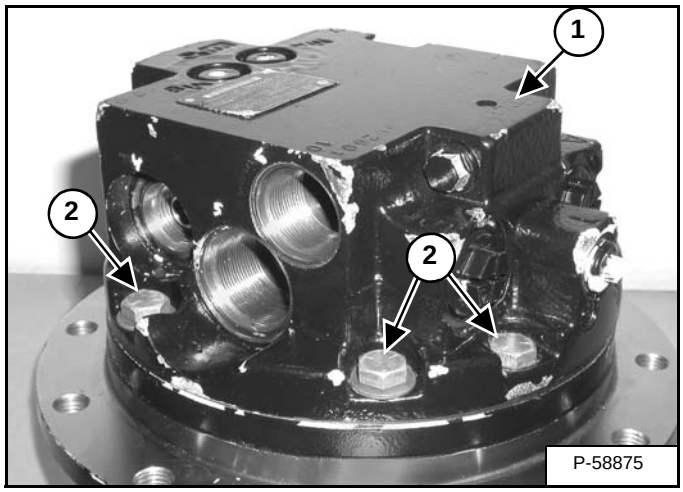
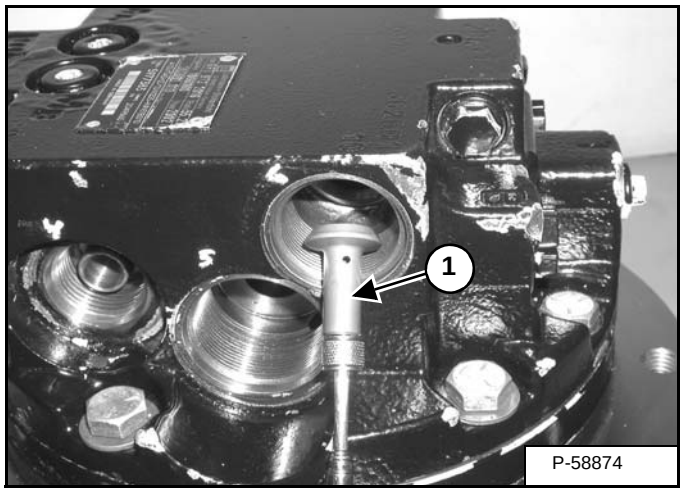
Assembly (Cont'd)

Figure 20-70-95



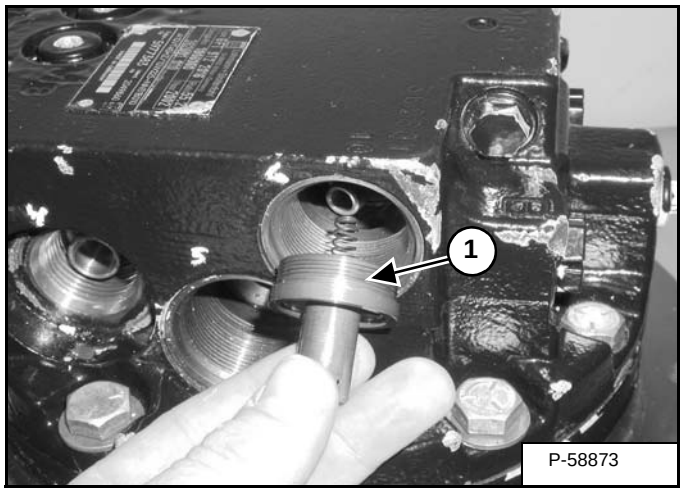
Install the lock valve (Item 1) on the hub. Install the eight bolts (Item 2) **[Figure 20-70-95]** and tighten to 55-60 ft.-lb. (75-85 N•m) torque.

Figure 20-70-96



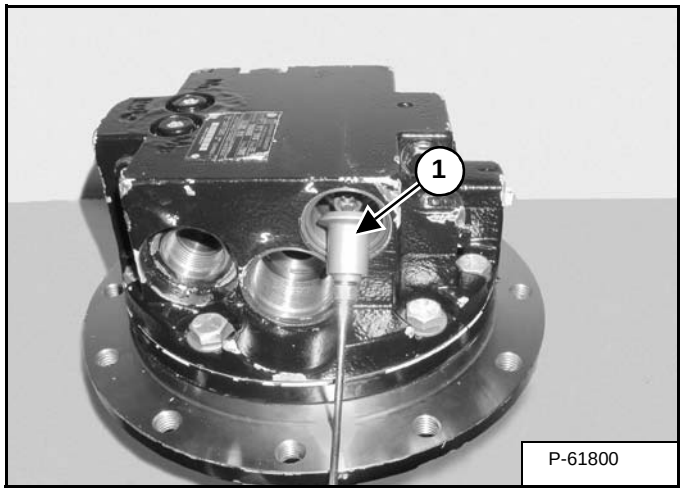
Install the poppet (Item 1) **[Figure 20-70-96]**.

Figure 20-70-97



Install the spring and retainer (Item 1) **[Figure 20-70-97]** and tighten.

Figure 20-70-98



Install the spring seat (Item 1) **[Figure 20-70-98]**.

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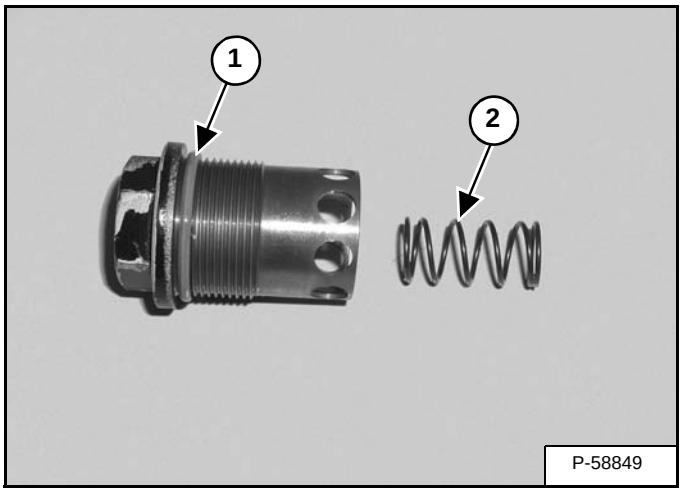
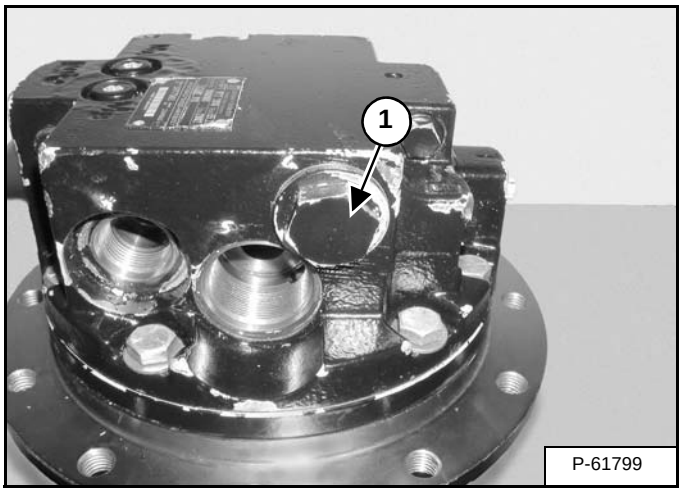
Assembly (Cont'd)

Figure 20-70-99



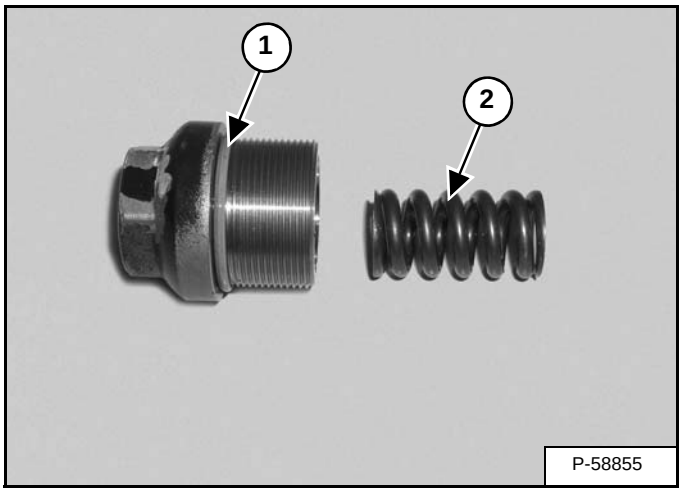
Install the O-ring (Item 1) and spring (Item 2) **[Figure 20-70-99]**.

Figure 20-70-100



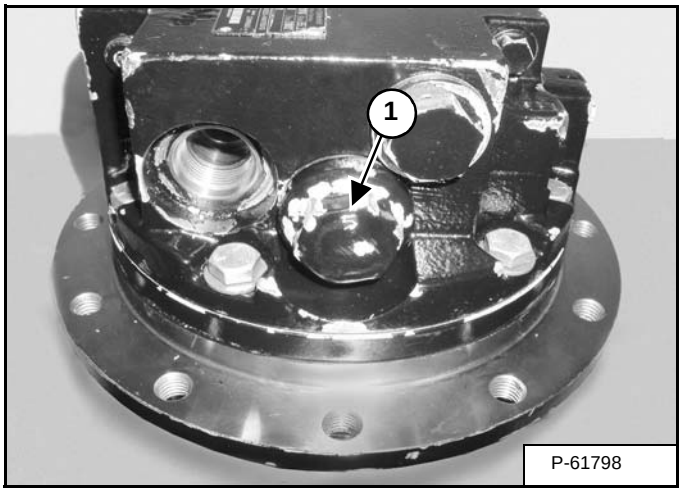
Install the plug (Item 1) **[Figure 20-70-100]**.

Figure 20-70-101



Install the O-ring (Item 1) and spring (Item 2) **[Figure 20-70-101]**.

Figure 20-70-102



Install the plug (Item 1) **[Figure 20-70-102]**.

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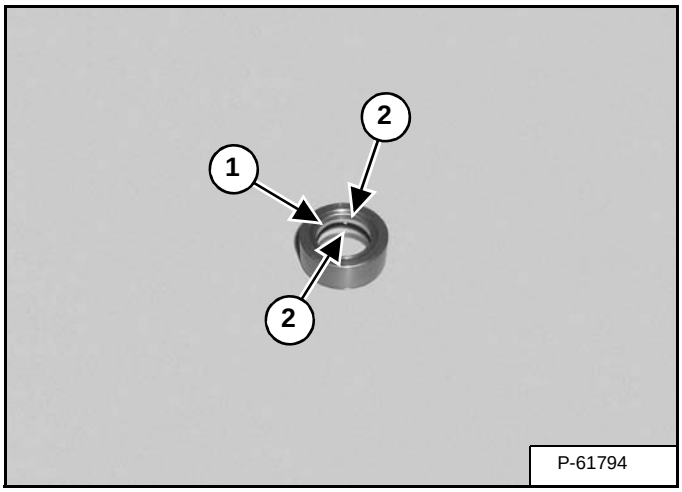
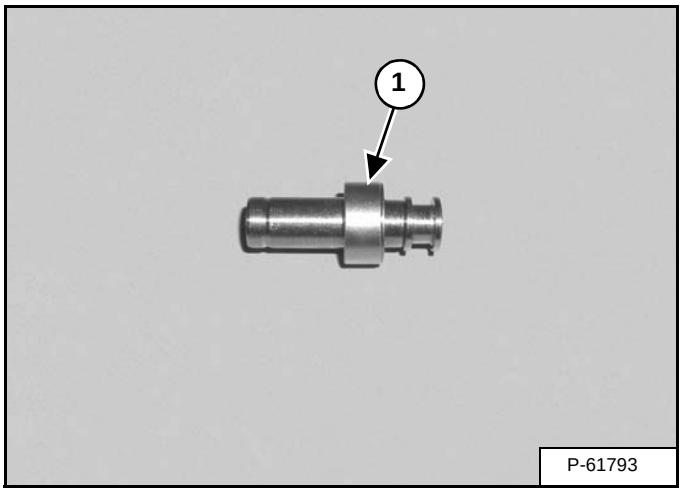
Assembly (Cont'd)

Figure 20-70-103



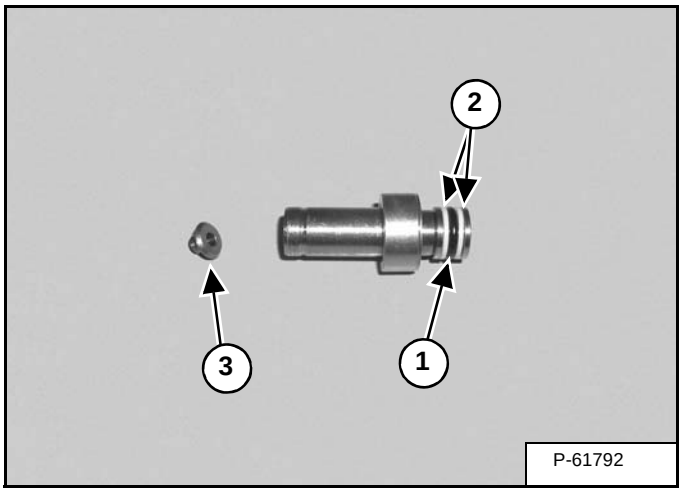
Install the O-ring (Item 1) and back-up rings (Item 2) **[Figure 20-70-103]**.

Figure 20-70-104



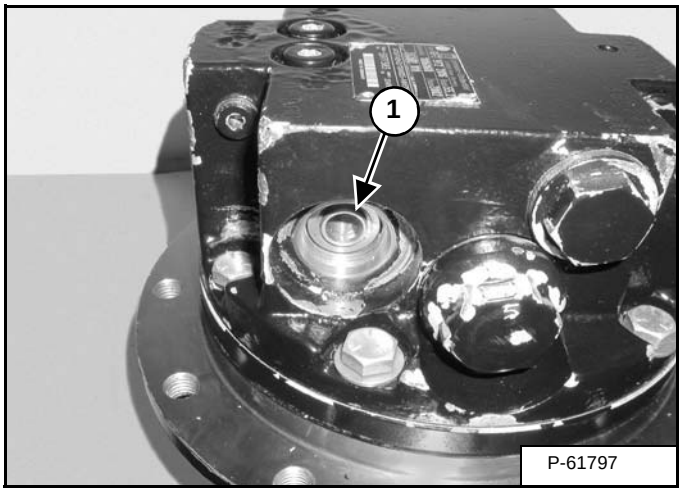
Install the spool guide (Item 1) **[Figure 20-70-104]**.

Figure 20-70-105



Install the O-ring (Item 1), back-up rings (Item 2) and poppet (Item 3) **[Figure 20-70-105]**.

Figure 20-70-106



Install the spool (Item 1) **[Figure 20-70-106]**.

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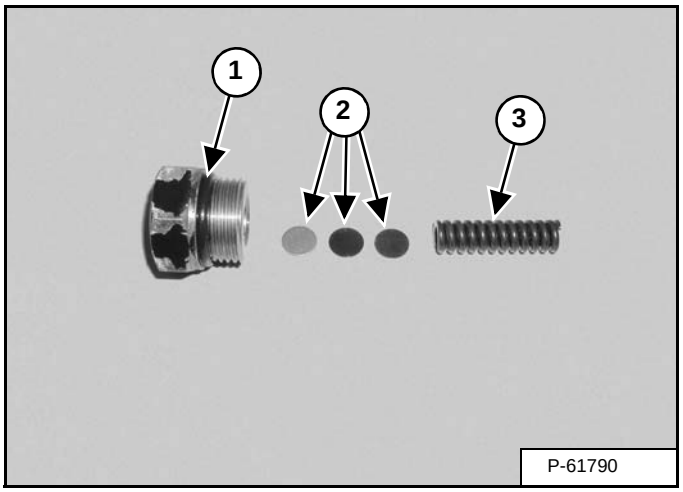
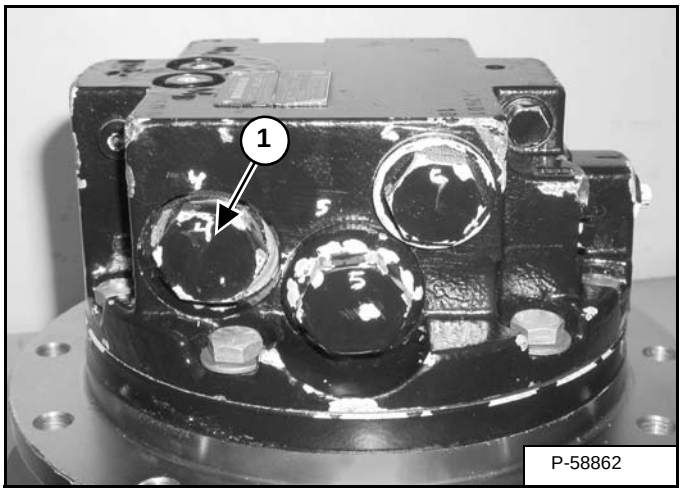
Assembly (Cont'd)

Figure 20-70-107



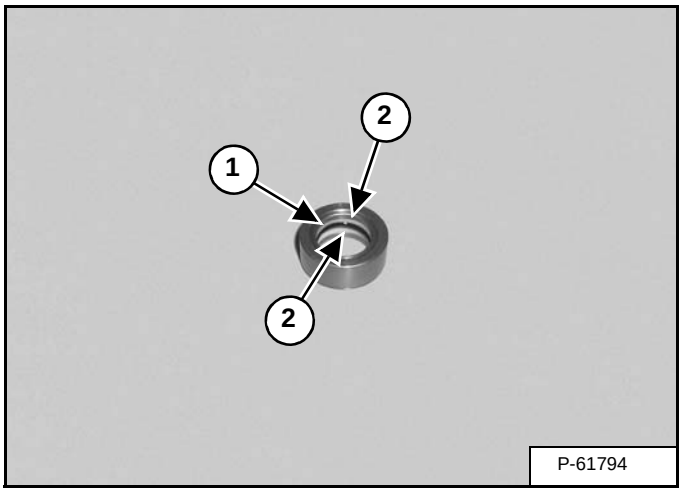
Install the O-ring (Item 1), shims (Item 2), and spring (Item 3) **[Figure 20-70-107]**.

Figure 20-70-108



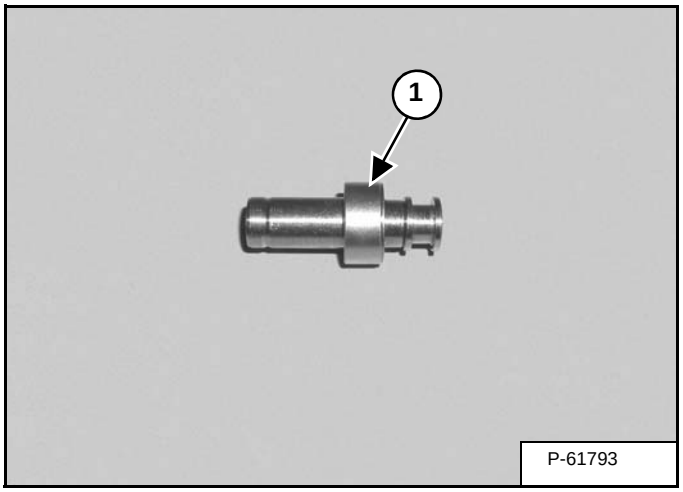
Install the plug (Item 1) **[Figure 20-70-108]**.

Figure 20-70-109



Install the O-ring (Item 1) and back-up rings (Item 2) **[Figure 20-70-109]**.

Figure 20-70-110



Install the spool guide (Item 1) **[Figure 20-70-110]**.

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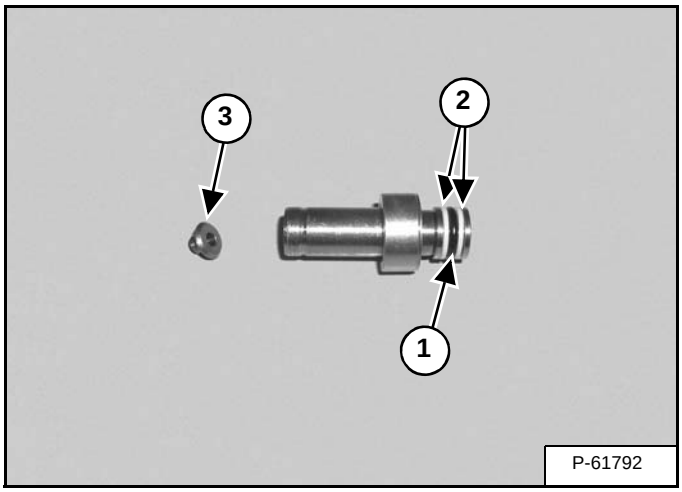
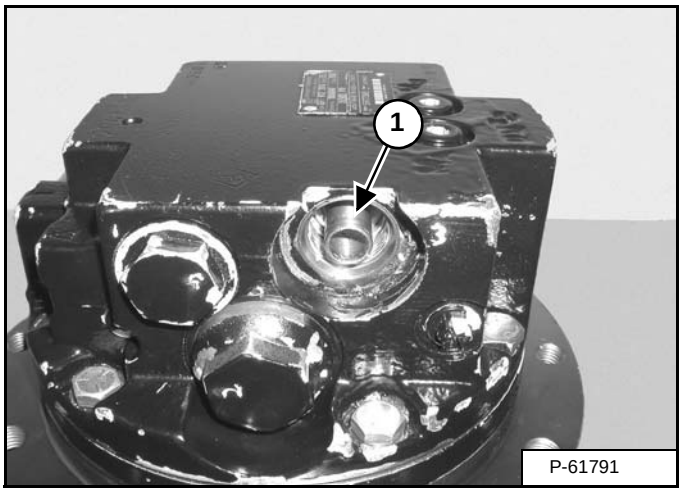
Assembly (Cont'd)

Figure 20-70-111



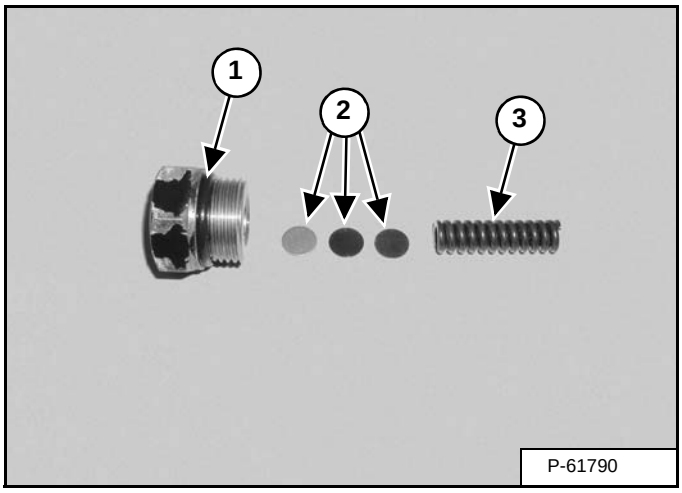
Install the O-ring (Item 1), back-up rings (Item 2), and poppet (Item 3) **[Figure 20-70-111]**.

Figure 20-70-112



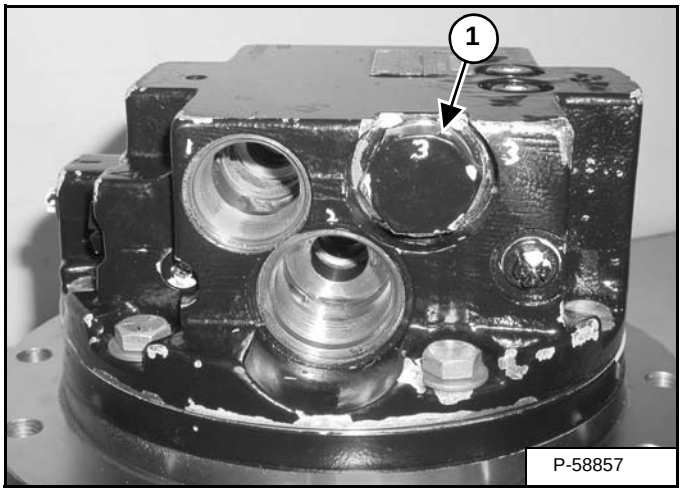
Install the spool (Item 1) **[Figure 20-70-112]**.

Figure 20-70-113



Install the O-ring (Item 1), shims (Item 2) and spring (Item 3) **[Figure 20-70-113]**.

Figure 20-70-114



Install the plug (Item 1) **[Figure 20-70-114]**.

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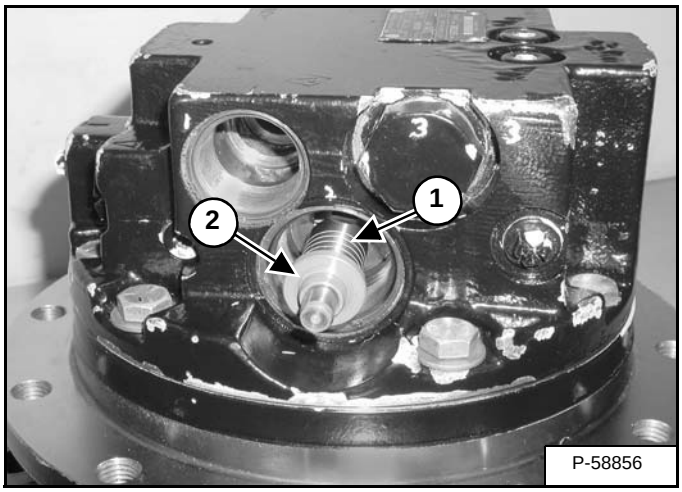
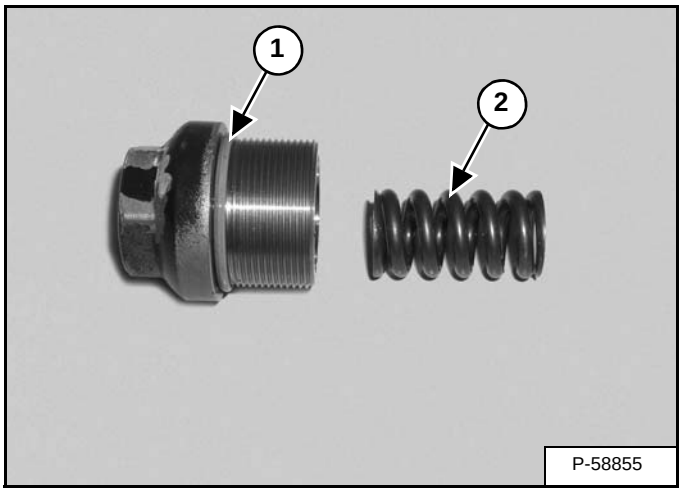
Assembly (Cont'd)

Figure 20-70-115



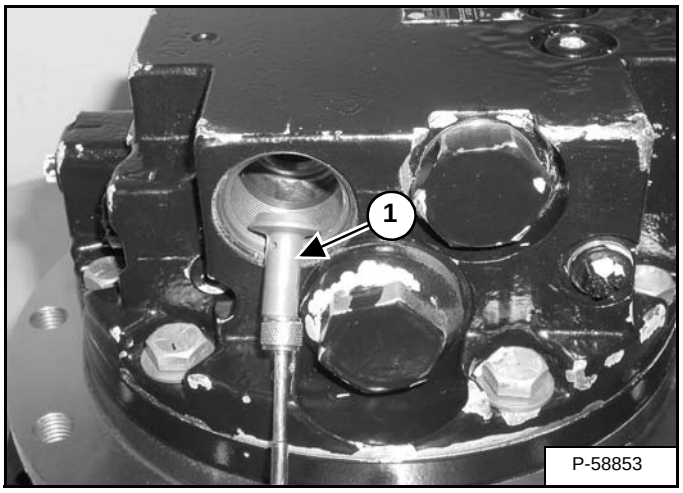
Install the spool (Item 1) and spring seat (Item 2) **[Figure 20-70-115]**.

Figure 20-70-116



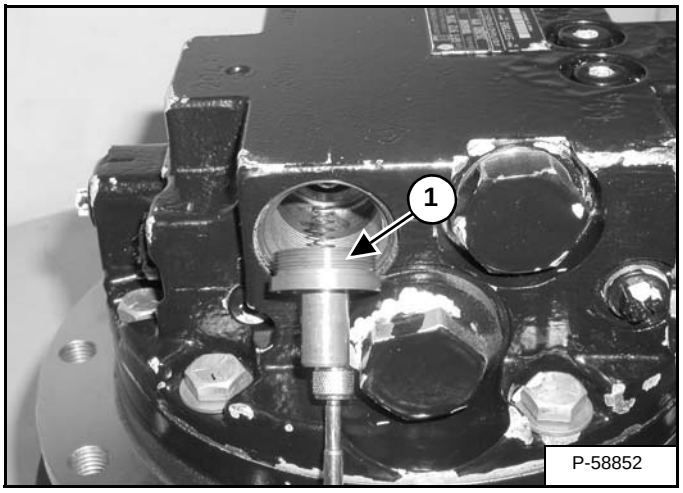
Install the O-ring (Item 1) and spring (Item 2) **[Figure 20-70-116]**.

Figure 20-70-117



Install the poppet (Item 1) **[Figure 20-70-117]**.

Figure 20-70-118



Install the spring and retainer (Item 1) **[Figure 20-70-118]**.

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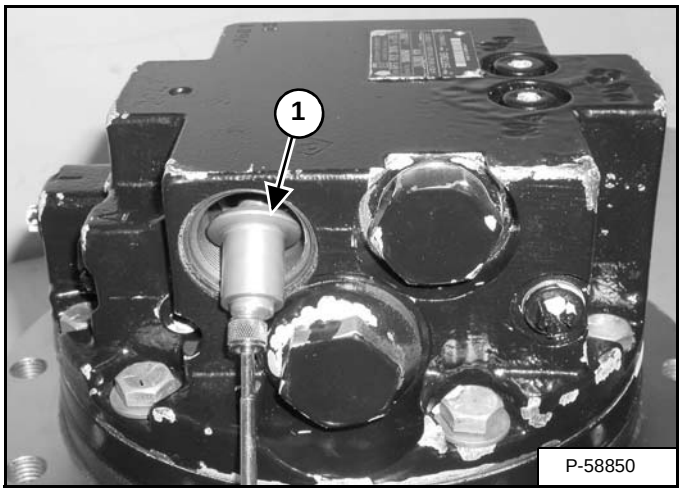
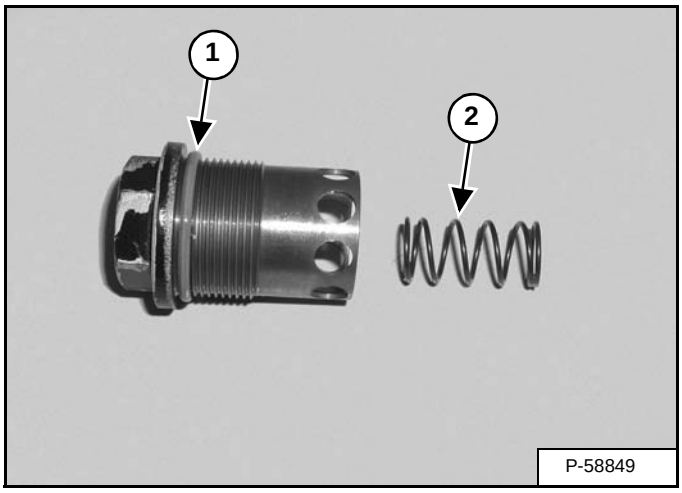
Assembly (Cont'd)

Figure 20-70-119



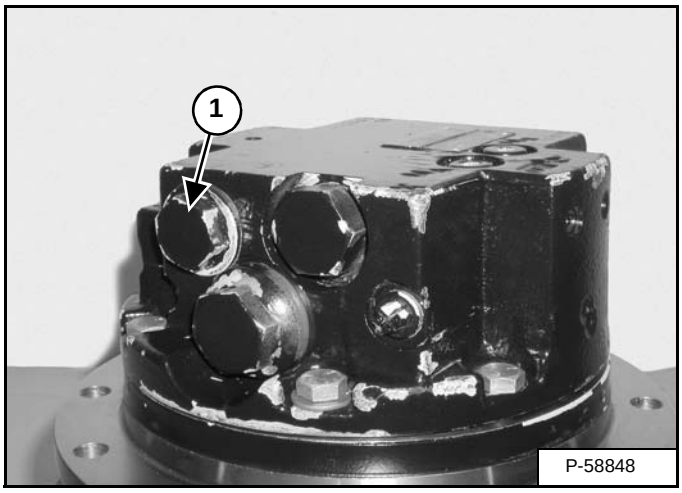
Install the poppet (Item 1) **[Figure 20-70-119]**.

Figure 20-70-120



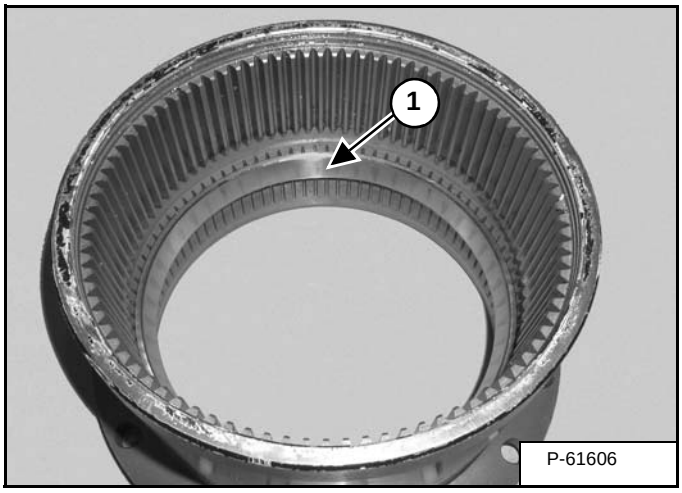
Install the O-ring (Item 1) and spring (Item 2) **[Figure 20-70-120]**.

Figure 20-70-121



Install the plug (Item 1) **[Figure 20-70-121]**.

Figure 20-70-122



Install the bearing race (Item 1) **[Figure 20-70-122]**.

Turn the ring gear over.

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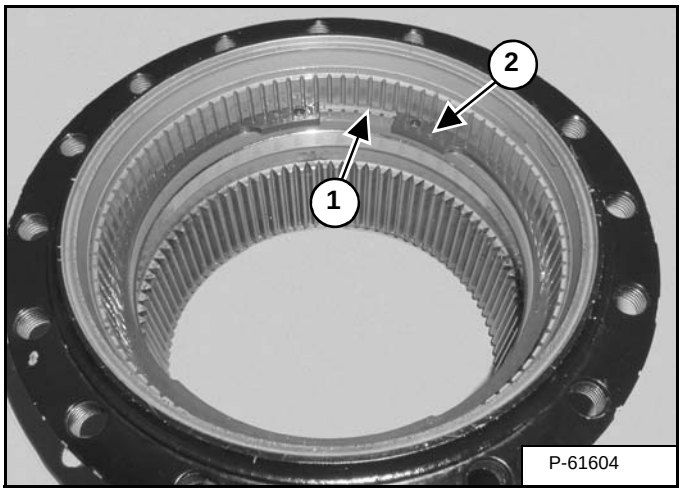
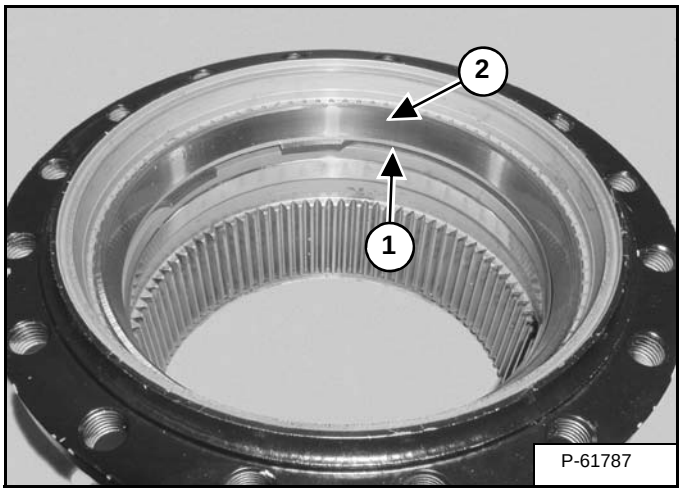
Assembly (Cont'd)

Figure 20-70-123



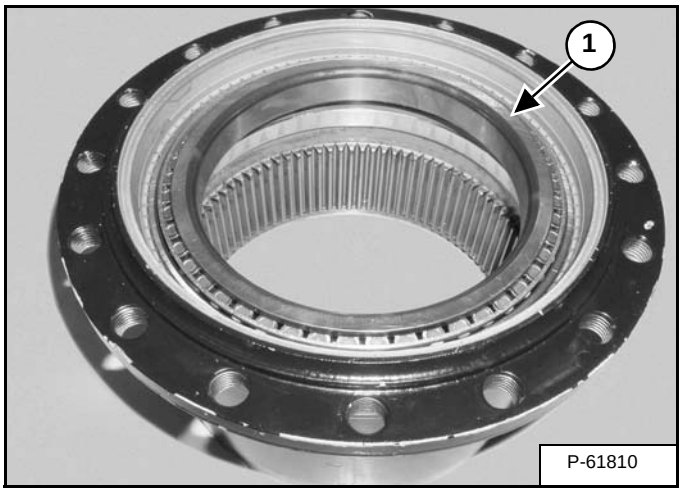
Install the spacer (Item 1) and snap ring (Item 2) **[Figure 20-70-123]**.

Figure 20-70-124



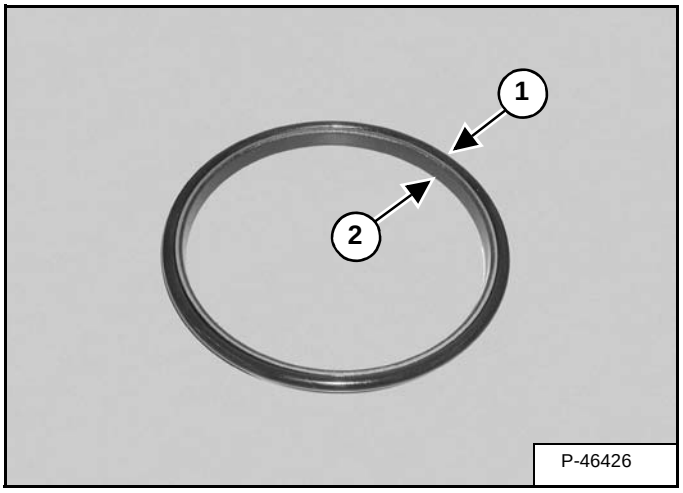
Install the spacer (Item 1) and bearing race (Item 2) **[Figure 20-70-124]**.

Figure 20-70-125



Install the bearing (Item 1) **[Figure 20-70-125]**.

Figure 20-70-126



Install the O-ring (Item 1) on both seal rings (Item 2) **[Figure 20-70-126]**.

NOTE: Inspect the seal ring for burrs before installing the O-ring. Install the O-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, hub assembly, and bearing carrier must be clean and free of any dust, oil film, or foreign matter.

The O-ring and seal ring assembly has to be lubricated with rubbing alcohol, so the O-ring will slip past the housing retaining ring and seal uniformly in the housing radius.

Dip the O-ring and seal ring assembly in a pan of alcohol.

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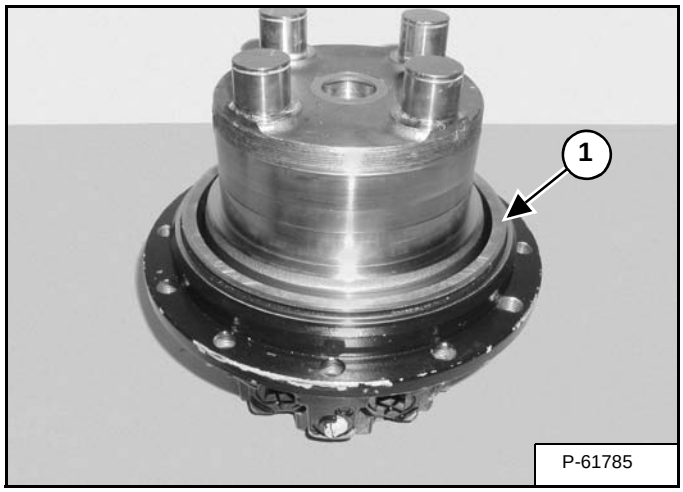
Assembly (Cont'd)

Figure 20-70-127



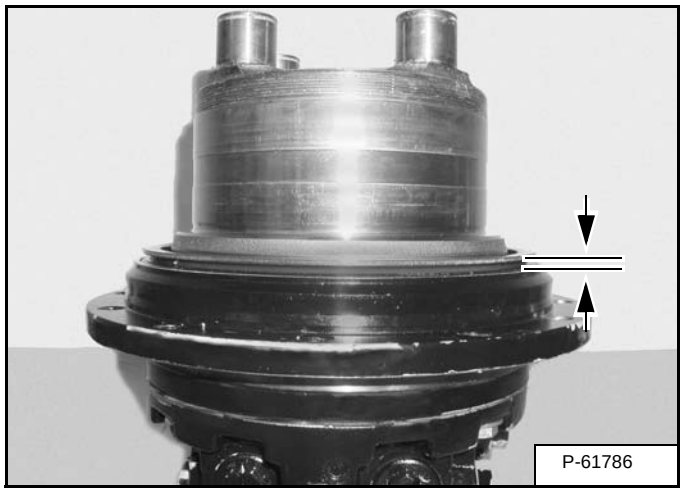
Shake off the excess alcohol and install the seal ring assembly (Item 1) **[Figure 20-70-127]** on the hub.

Use firm even pressure to *pop* the O-ring into the housing.

Apply a light film of oil to the metal seal ring.

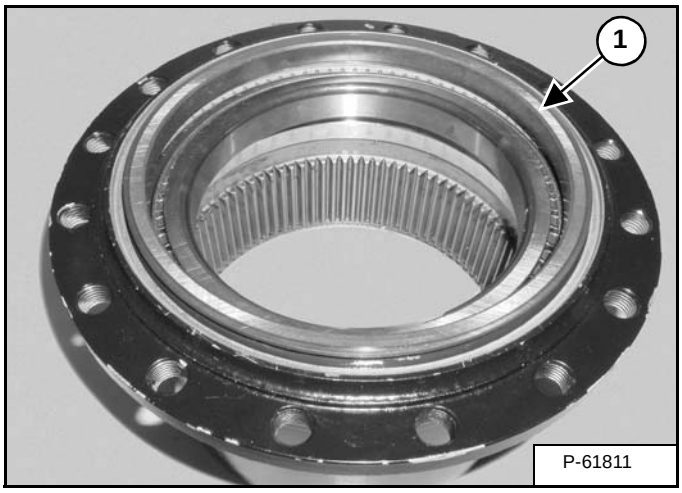
NOTE: Do not get any oil on the rubber O-ring.

Figure 20-70-128



Check the seal stand off height. The stand off height must be uniform with no twists in the O-ring **[Figure 20-70-128]**.

Figure 20-70-129



Shake off the excess alcohol and install the seal ring assembly (Item 1) **[Figure 20-70-129]**.

Use firm even pressure to *pop* the O-ring into the housing.

Apply a light film of oil to the metal seal ring.

NOTE: Do not get any oil on the rubber O-ring.

Figure 20-70-130

Check the seal stand off height. The stand off height must be uniform with no twists in the O-ring **[Figure 20-70-130]**.

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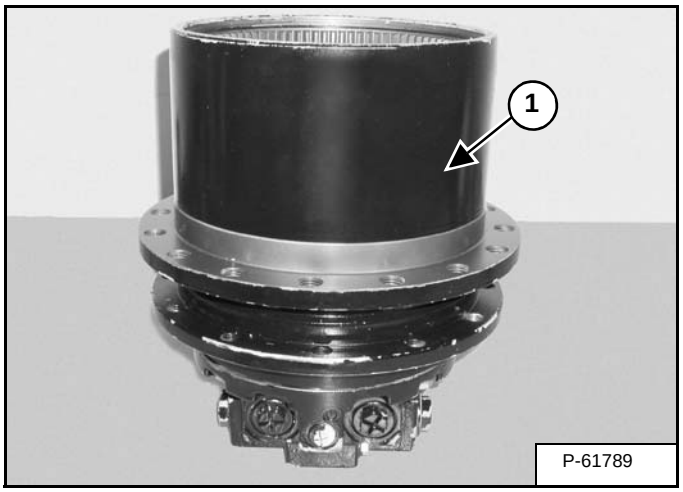
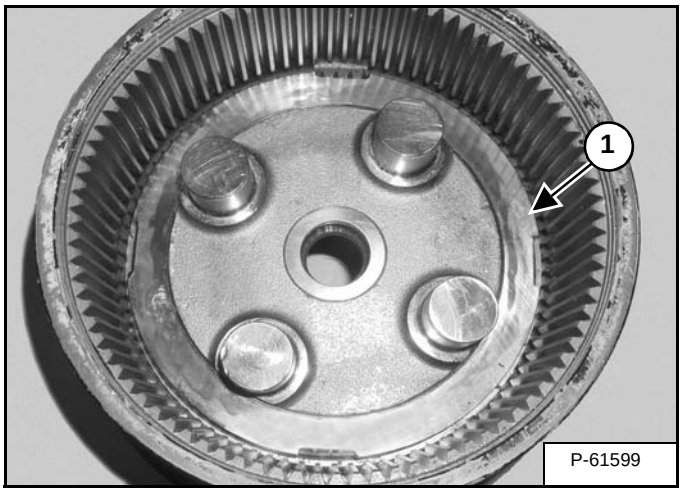
Assembly (Cont'd)

Figure 20-70-131



Install the ring gear (Item 1) **[Figure 20-70-131]**.

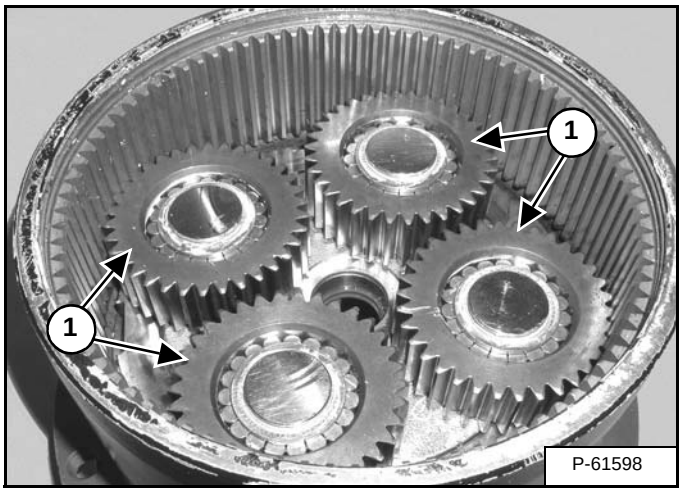
Figure 20-70-132



Apply Loctite™ 270 to the new nut (Item 1) **[Figure 20-70-132]** and install.

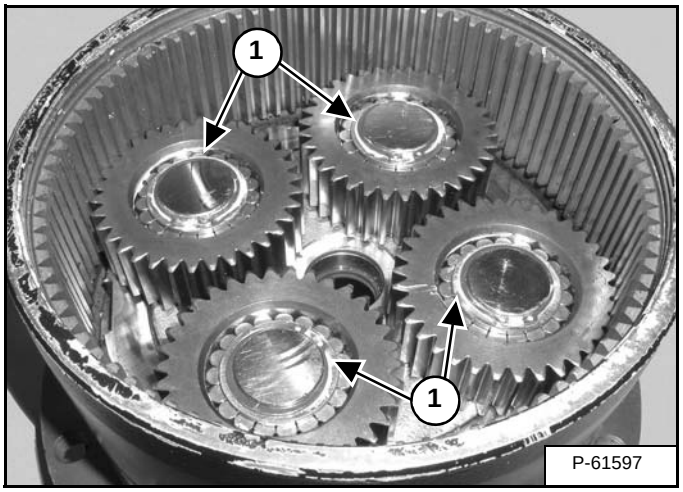
Use a spanner wrench (MEL XXXX) and tighten the nut to 1290 ft.-lb. (1750 N•m) torque.

Figure 20-70-133



Install the gear/bearing assemblies (Item 1) **[Figure 20-70-133]**.

Figure 20-70-134



Install the snap rings (Item 1) **[Figure 20-70-134]**.

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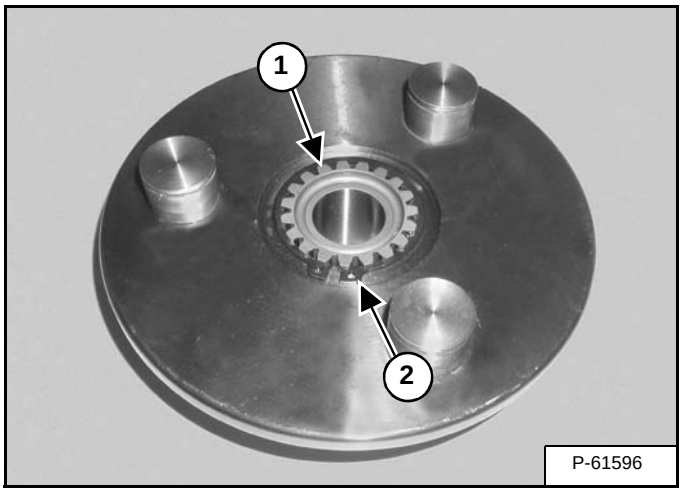
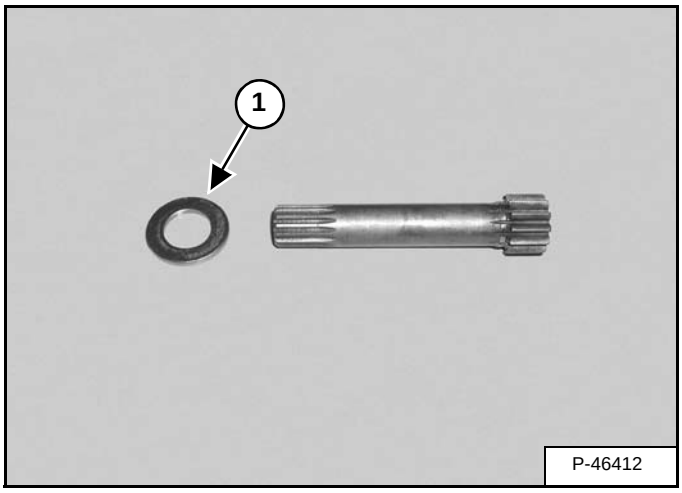
Assembly (Cont'd)

Figure 20-70-135



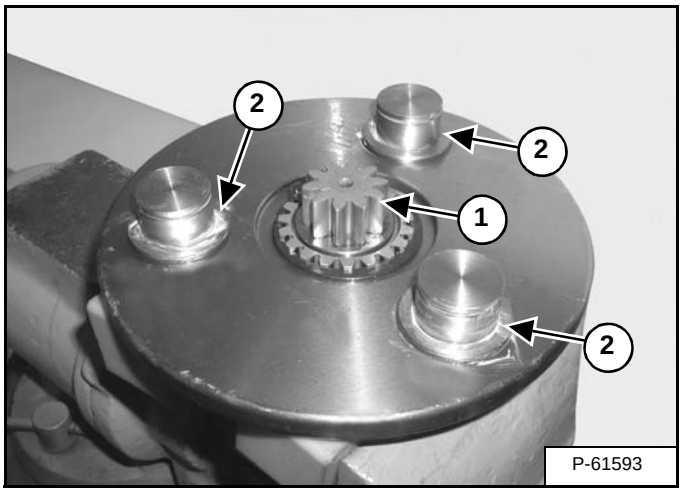
Install the sungear (Item 1) and snap ring (Item 2) **[Figure 20-70-135]**.

Figure 20-70-136



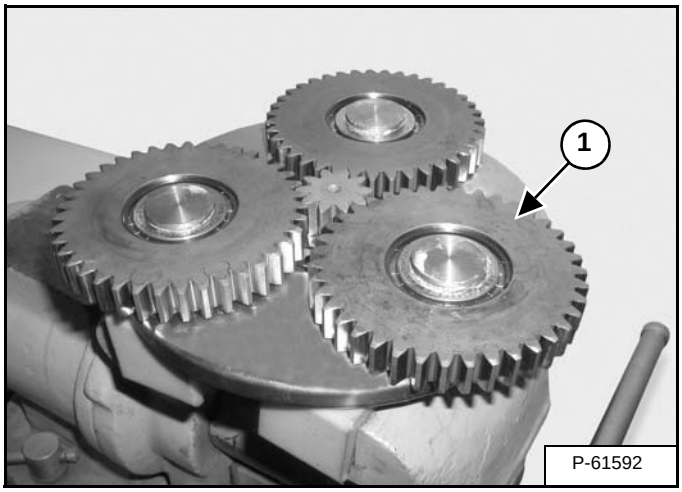
Install the washer (Item 1) **[Figure 20-70-136]**.

Figure 20-70-137



Install the driveshaft (Item 1) and washers (Item 2) **[Figure 20-70-137]**.

Figure 20-70-138



Install the planetary gears (Item 1) **[Figure 20-70-138]**.

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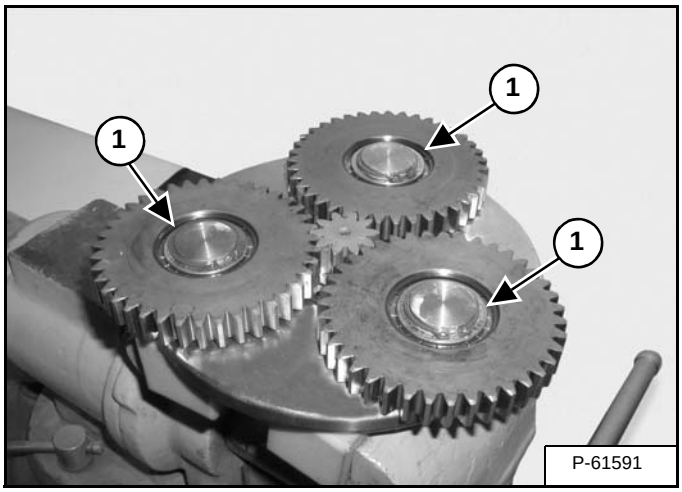
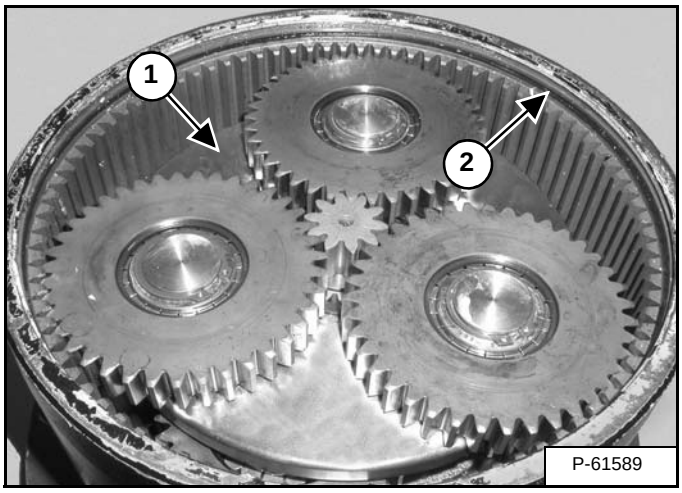
Assembly (Cont'd)

Figure 20-70-139



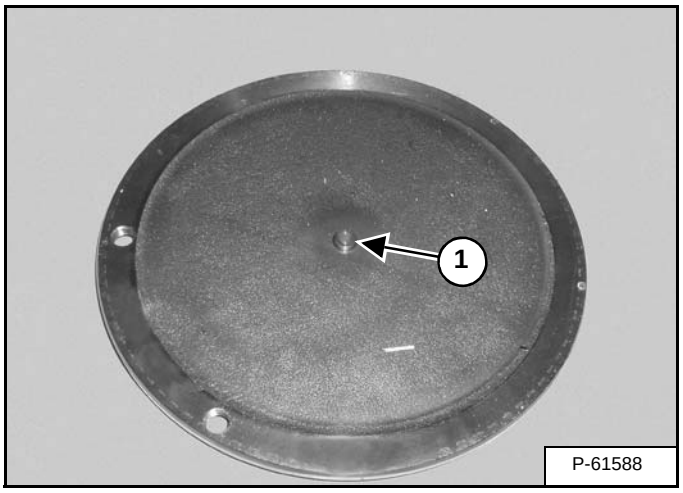
Install the snap rings (Item 1) **[Figure 20-70-139]**.

Figure 20-70-140



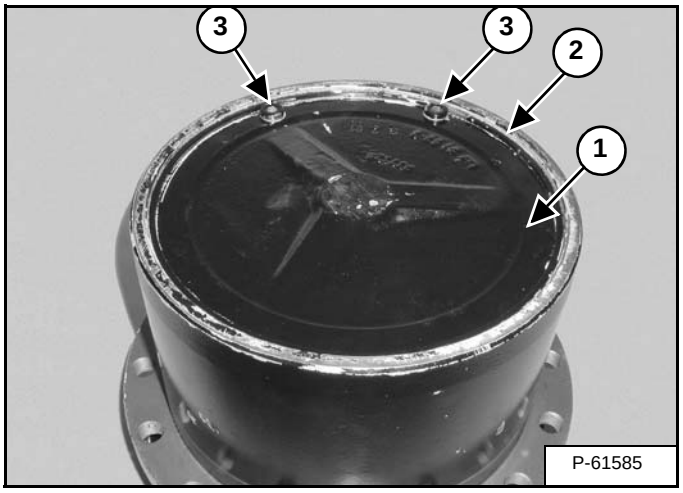
Install the planetary carrier (Item 1) and O-ring (Item 2) **[Figure 20-70-140]**.

Figure 20-70-141



Install a new bushing (Item 1) **[Figure 20-70-141]**.

Figure 20-70-142



Install the cover (Item 1), snap ring (Item 2) and drain plugs (Item 3) **[Figure 20-70-142]**.

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SWIVEL JOINT

Removal And Installation

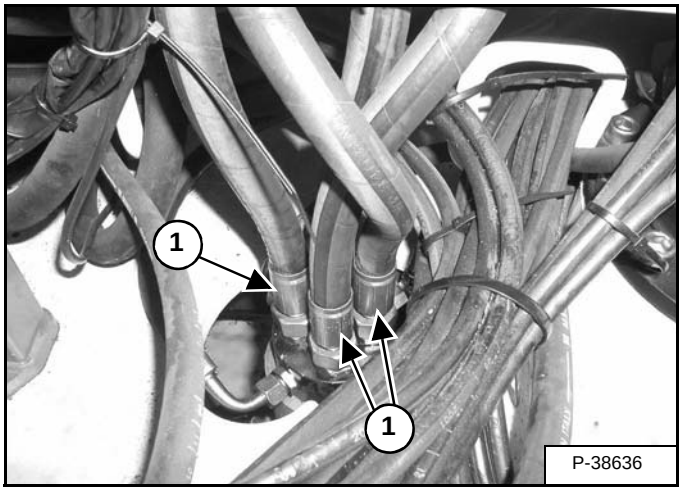
IMPORTANT

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

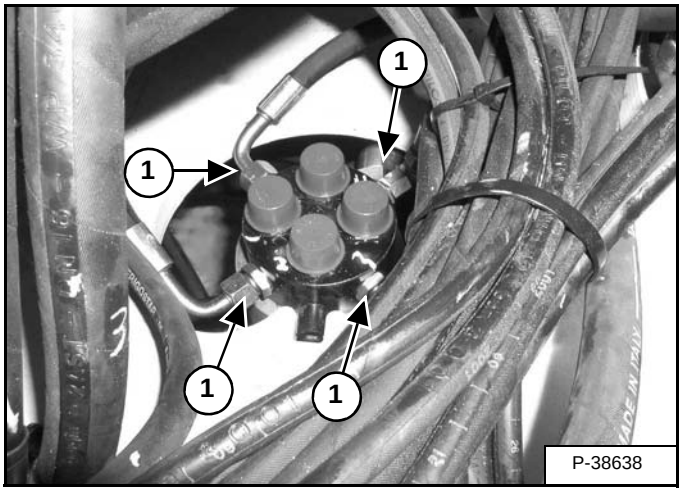
Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-80-1



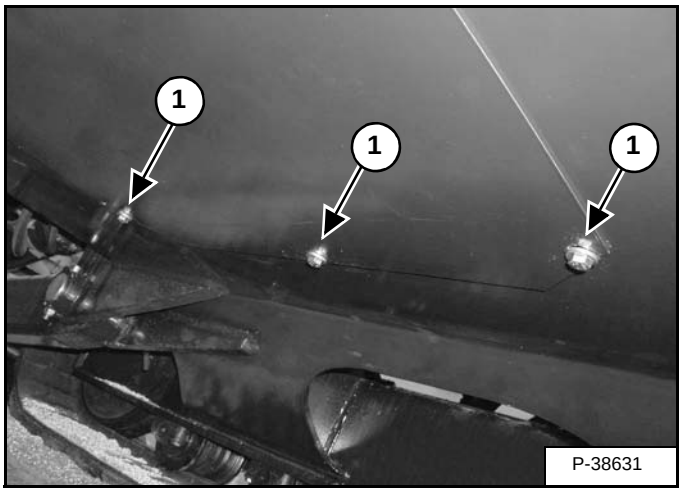
Mark and remove the 4 hoses (Item 1) **[Figure 20-80-1]** from the top of the swivel joint.

Figure 20-80-2



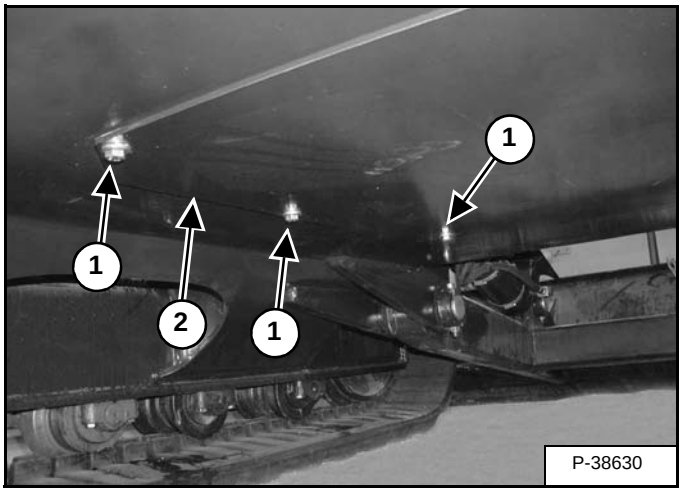
Mark and remove the 4 hoses (Item 1) **[Figure 20-80-2]** from the side of the swivel joint.

Figure 20-80-3



Loosen the 3 right bolts (Item 1) **[Figure 20-80-3]**.

Figure 20-80-4



Remove the 3 left bolts (Item 1) **[Figure 20-80-4]** and washers.

Remove the cover (Item 2) **[Figure 20-80-4]**.

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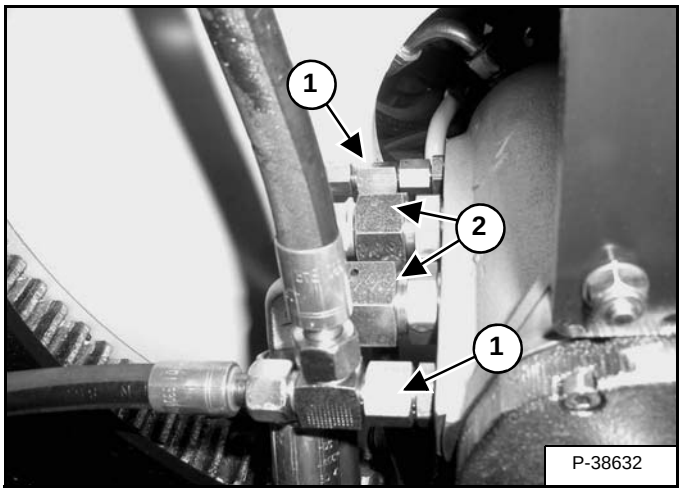
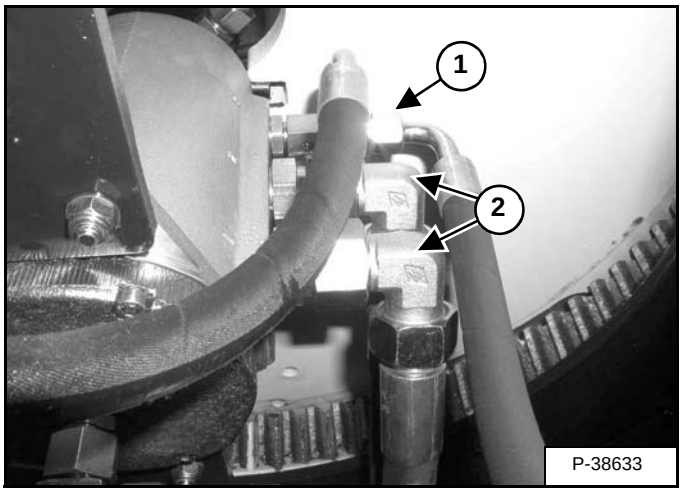
Removal And Installation (Cont'd)

Figure 20-80-5



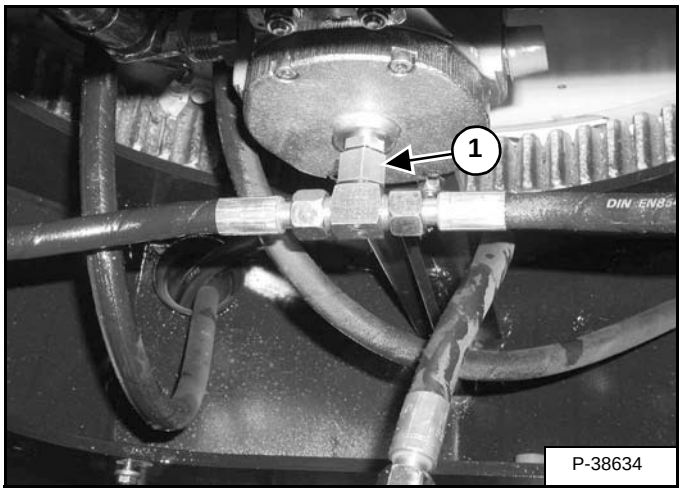
Mark and remove the 2 tees (Item 1) and 2 hoses (Item 2) **[Figure 20-80-5]**

Figure 20-80-6



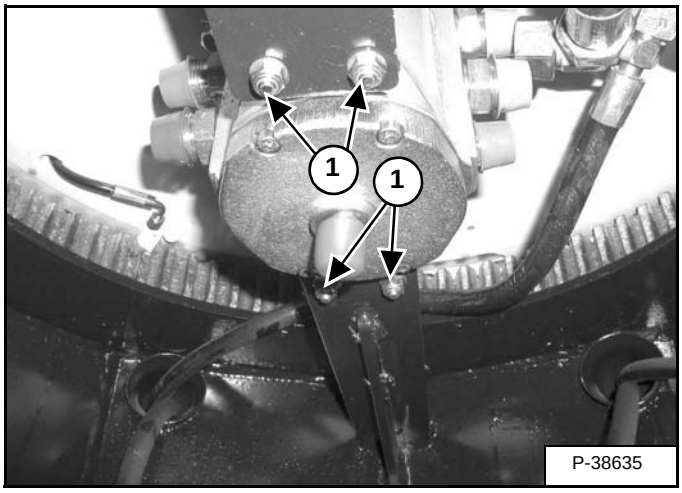
Mark and remove the tee (Item 1) and 2 hoses (Item 2) **[Figure 20-80-6]**.

Figure 20-80-7



Remove the tee fitting (Item 1) **[Figure 20-80-7]**.

Figure 20-80-8



Remove the 4 bolts and nuts (Item 1) **[Figure 20-80-8]**.

Rotate and lower the swivel joint from the excavator.

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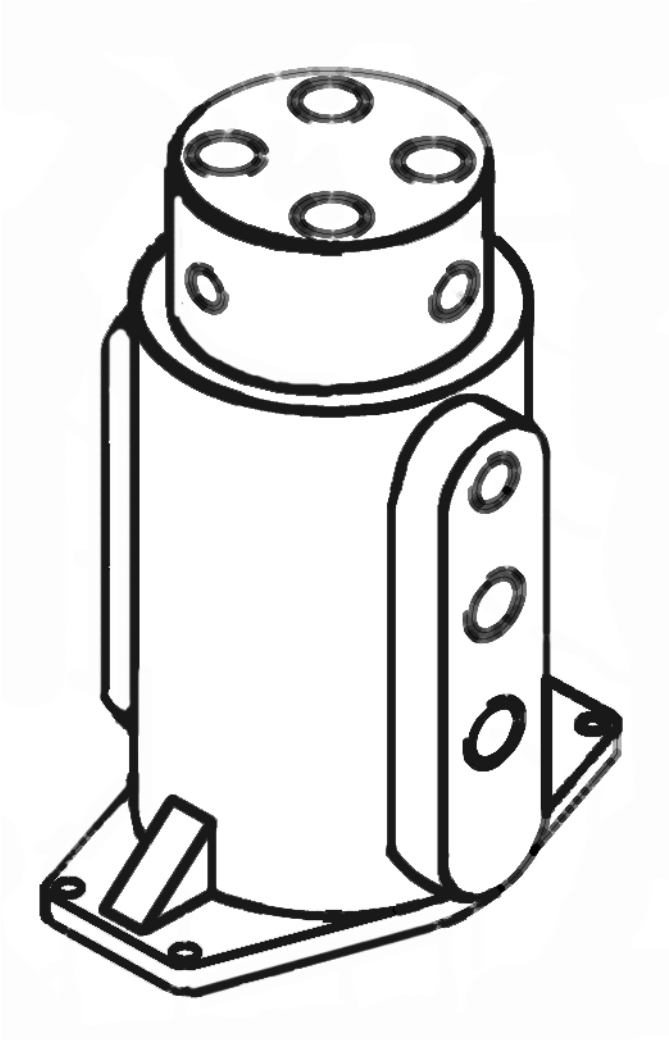
Parts Identification



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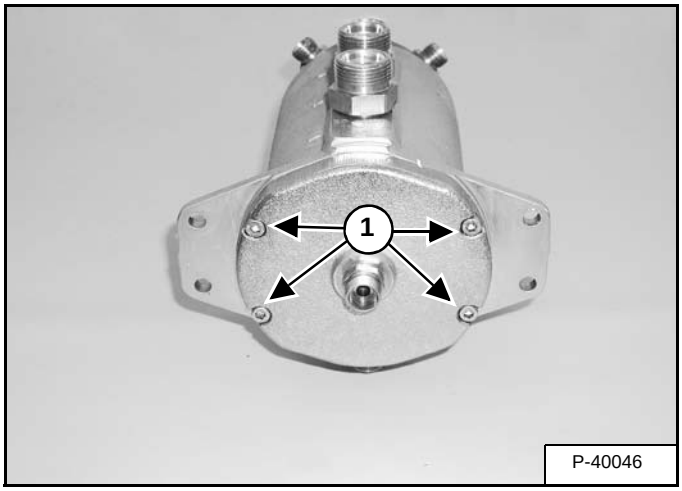
Disassembly And Assembly

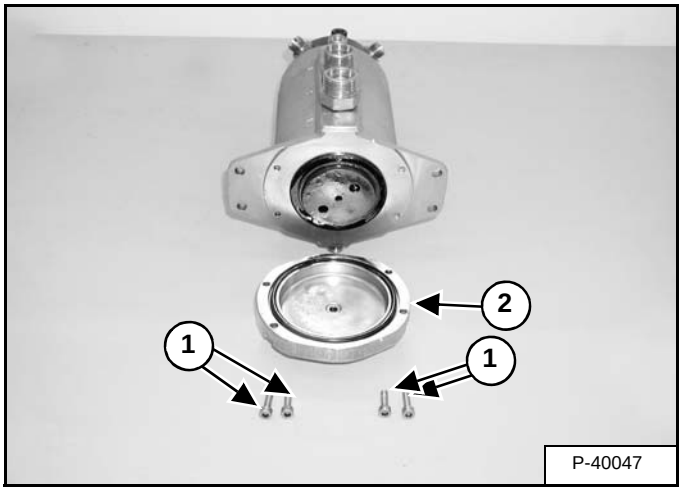
Mark the rotor and body for ease of assembly.

Figure 20-80-9



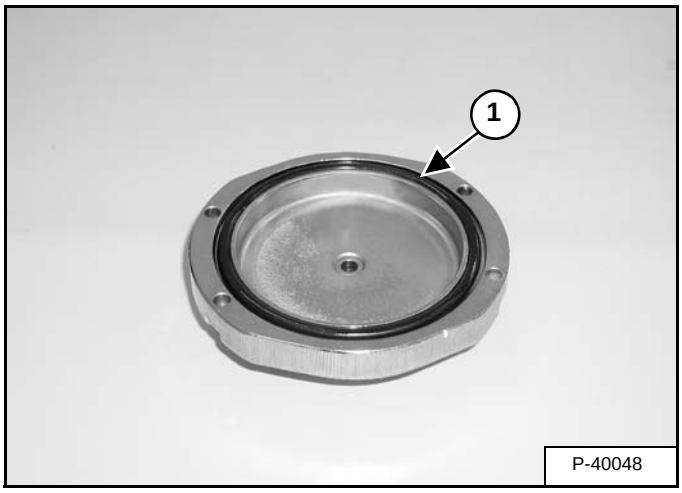
Loosen the 4 bolts (Item 1) **[Figure 20-80-9]**.

Figure 20-80-10



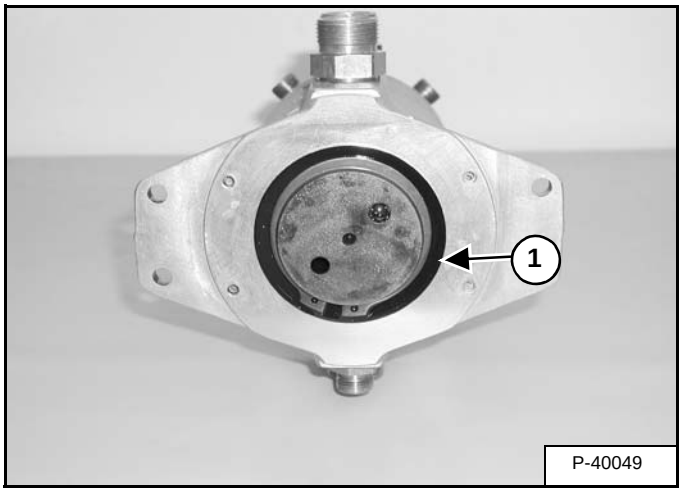
Remove the bolts (Item 1) and end cap (Item 2) **[Figure 20-80-10]**.

Figure 20-80-11



Remove the O-ring (Item 1) **[Figure 20-80-11]** from the end cap.

Figure 20-80-12



Remove the snap ring (Item 1) **[Figure 20-80-12]**.

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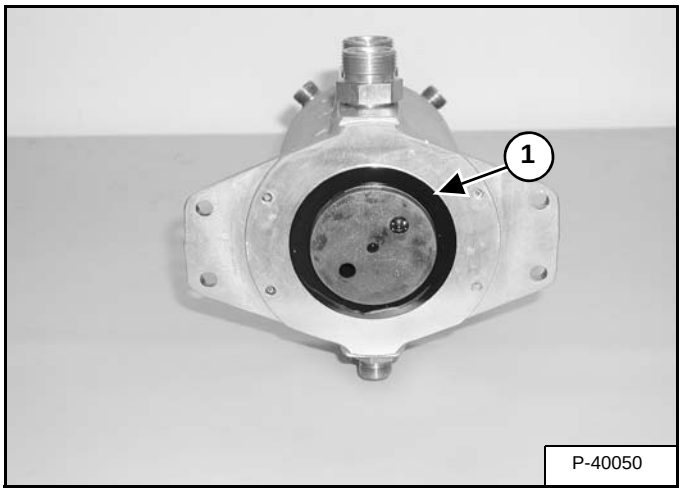
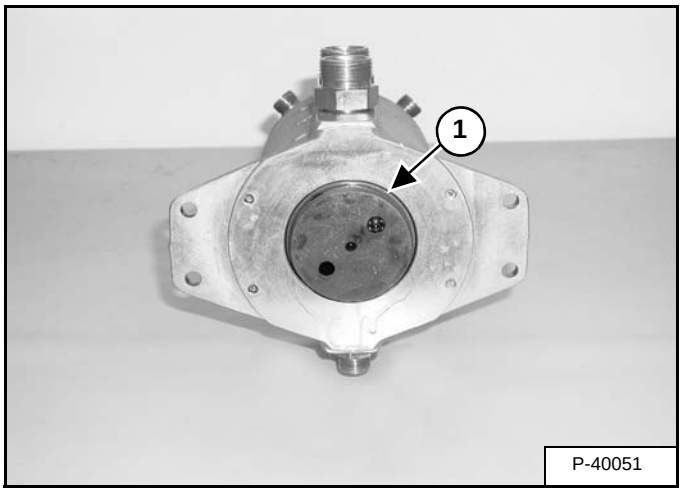
Disassembly And Assembly (Cont'd)

Figure 20-80-13



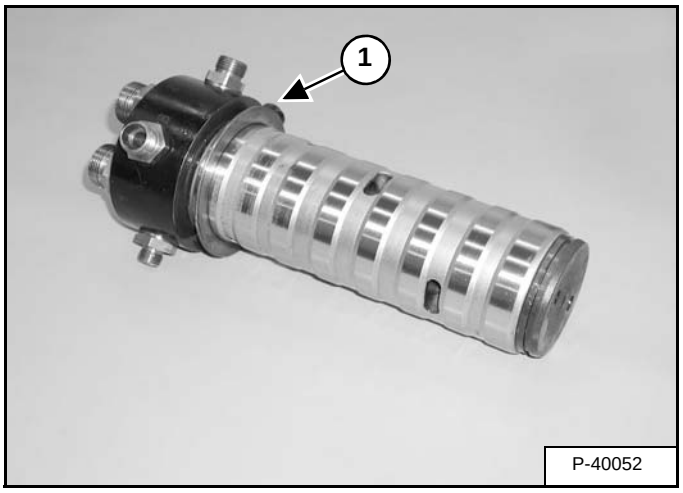
Remove the washer (Item 1) **[Figure 20-80-13]**.

Figure 20-80-14



With a soft faced hammer drive the rotor (Item 1) **[Figure 20-80-14]** from the housing.

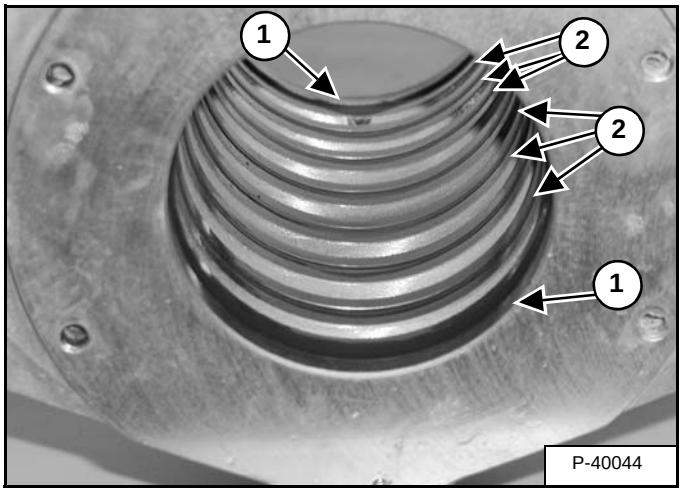
Figure 20-80-15



Remove the washer (Item 1) **[Figure 20-80-15]** from the rotor.

NOTE: Use care not to scratch the rotor surface as damage to the finished surface could cause internal leakage.

Figure 20-80-16



Remove the 2 seals (Item 1) and 6 O-rings (Item 2) **[Figure 20-80-16]**.

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SWING MOTOR

Removal And Installation

Remove the right side cover. (See RIGHT SIDE COVER on Page 40-160-1.)

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-90-1

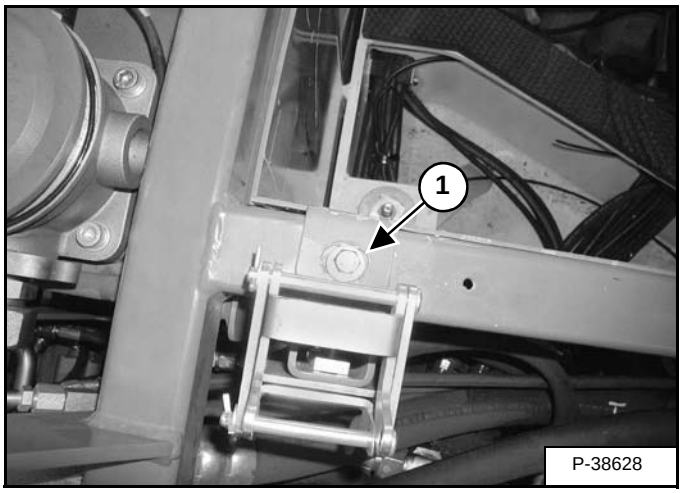
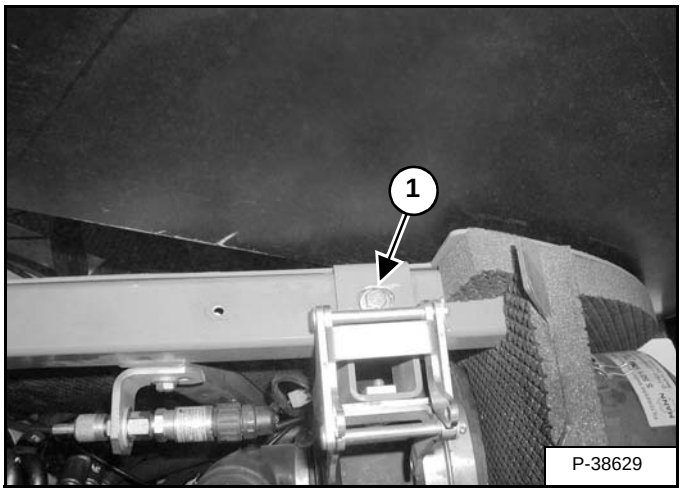
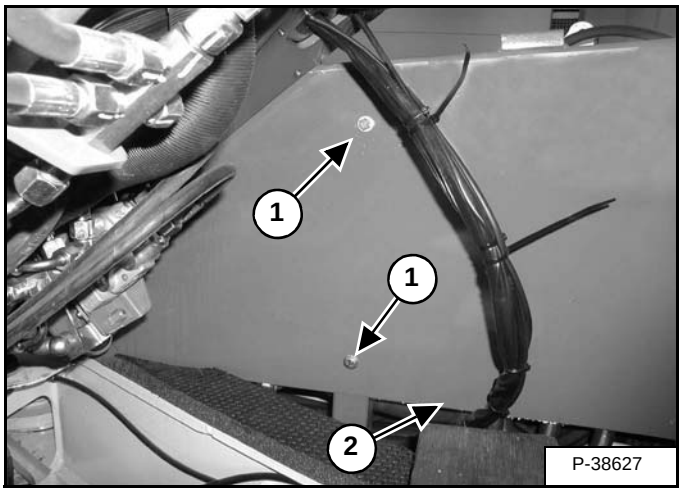


Figure 20-90-2



Remove the 2 bolts (Item 1) **[Figure 20-90-1]** and **[Figure 20-90-2]** and washers from the top of the center panel.

Figure 20-90-3



Remove the 2 bolts (Item 1) **[Figure 20-90-3]** and washers from the side of the center panel.

Remove the panel (Item 2) **[Figure 20-90-3]**.

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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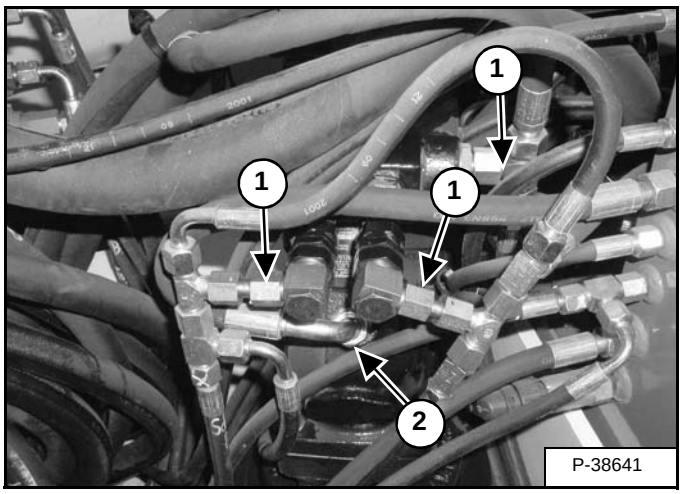
Figure 20-90-4



Mark and remove the 3 tee fittings (Item 1) **[Figure 20-90-4]**.

Mark and remove the hose (Item 2) **[Figure 20-90-4]**.

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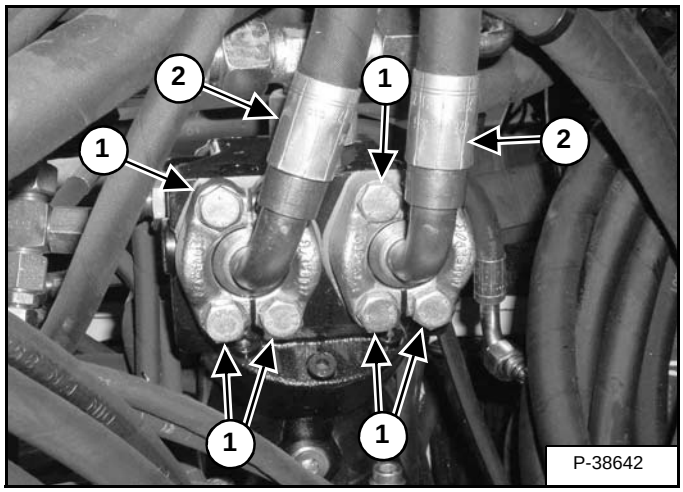
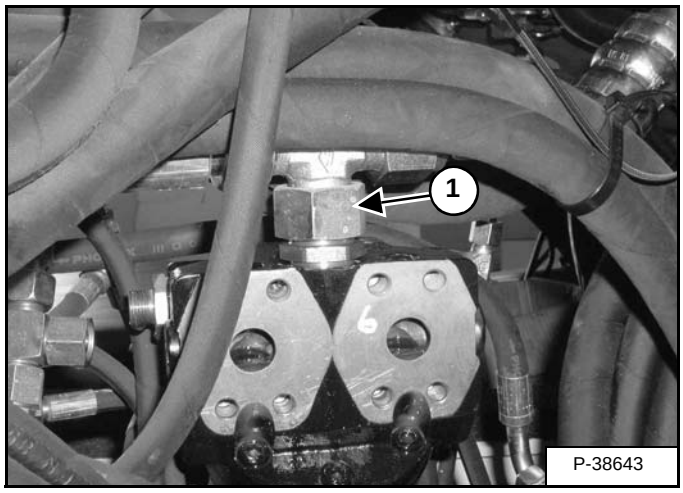
Removal And Installation (Cont'd)

Figure 20-90-5



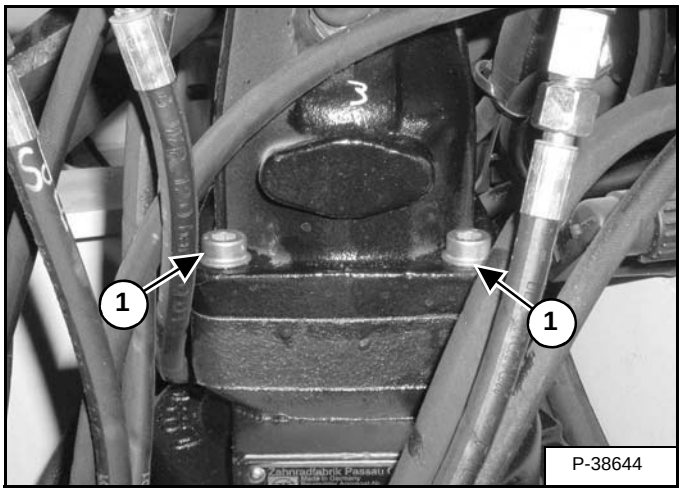
Mark and remove the 4 bolts (Item 1). Remove the split flange hoses (Item 2) **[Figure 20-90-5]**.

Figure 20-90-6



Remove the tee fitting (Item 1) **[Figure 20-90-6]**.

Figure 20-90-7

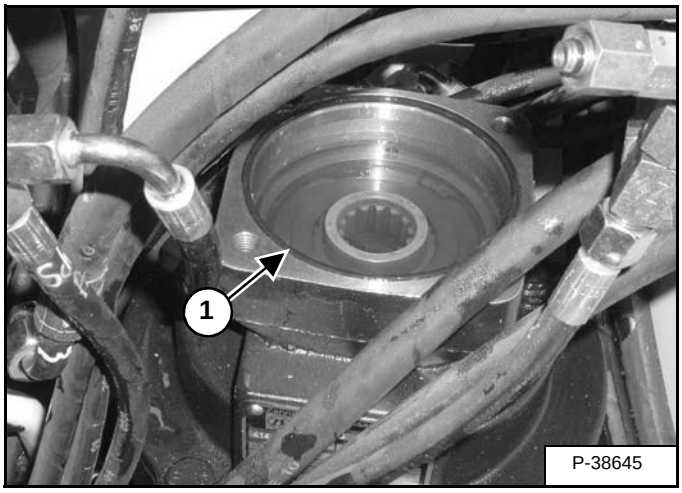


Remove the 4mount bolts (Item 1) **[Figure 20-90-7]**.

Installation: Tighten the bolts to 53 ft.-lb. (72 N•m) torque.

Remove the motor.

Figure 20-90-8



Remove the O-ring (Item 1) **[Figure 20-90-8]** from the swing motor drive carrier.

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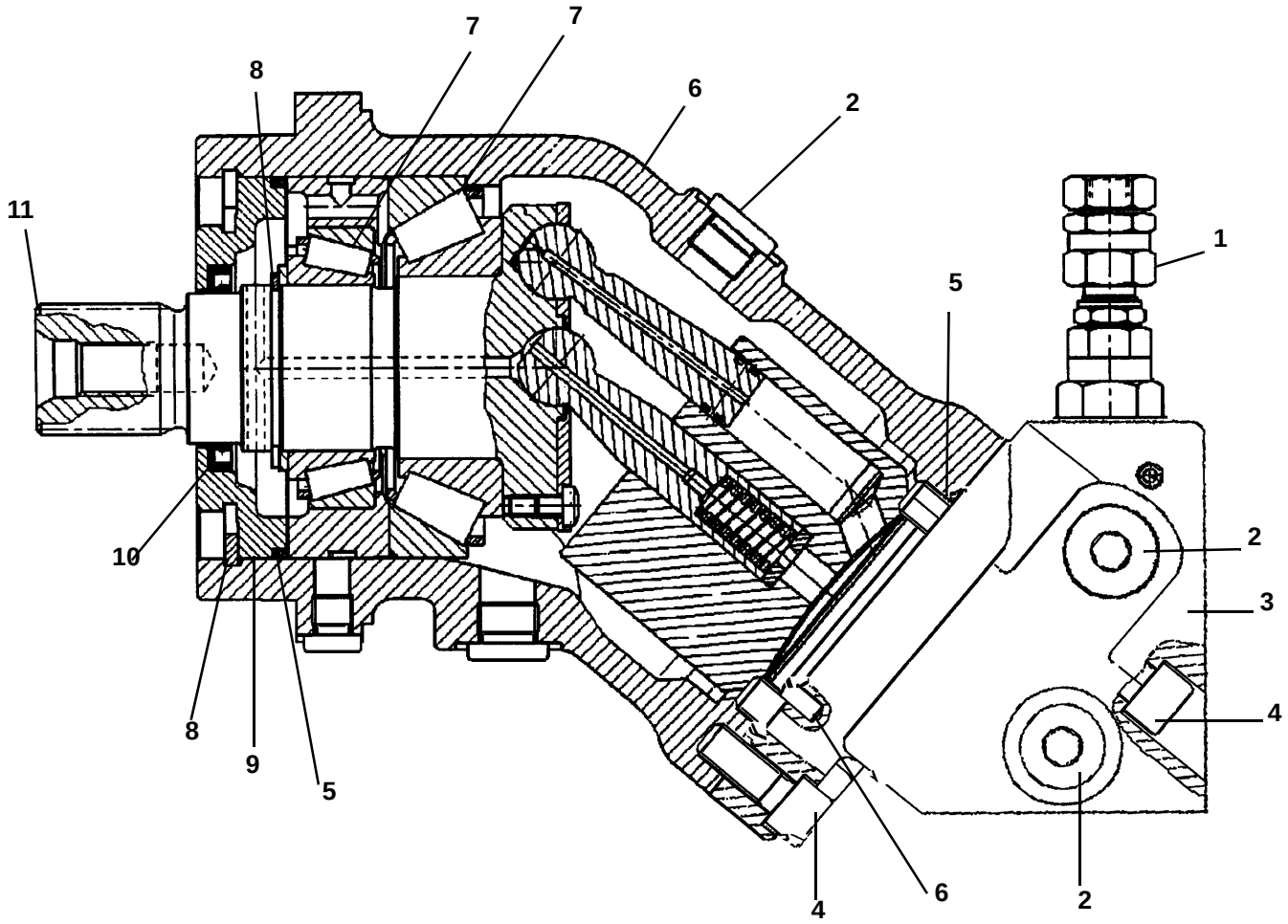
Parts Identification

1	Valve
2	Plug
3	End Cap
4	Bolt
5	O-ring
6	Pin
7	Bearing
8	Snap Ring
9	Locking Ring
10	Seal
11	Drive Shaft



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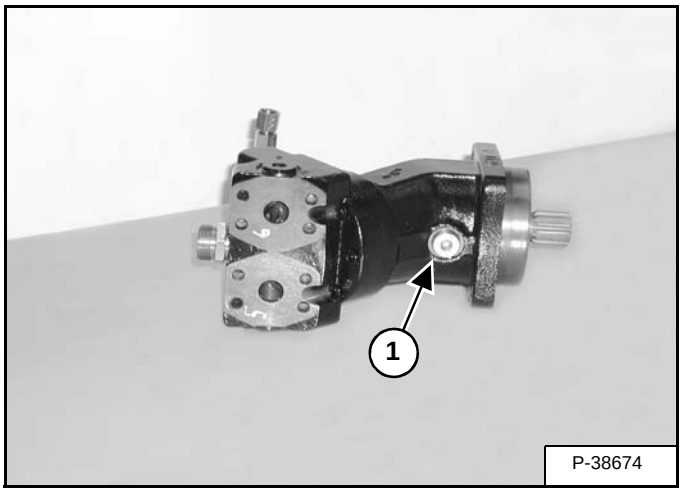
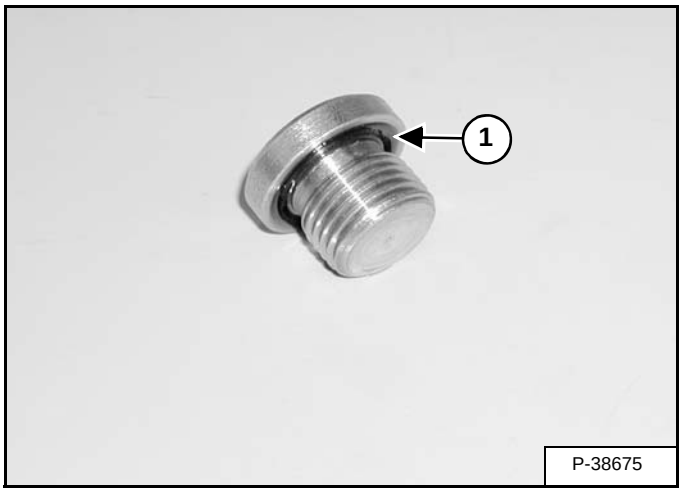
Disassembly

Figure 20-90-9



Remove the plug (Item 1) **[Figure 20-90-9]** and drain the oil from the swing motor.

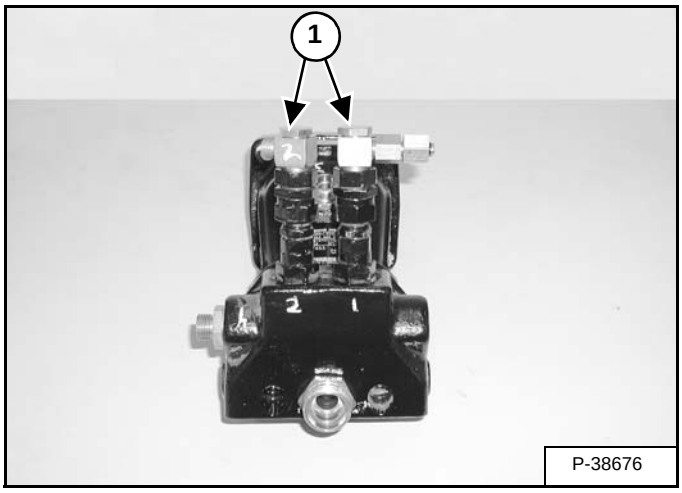
Figure 20-90-10



Remove the O-ring (Item 1) **[Figure 20-90-10]** from the plug.

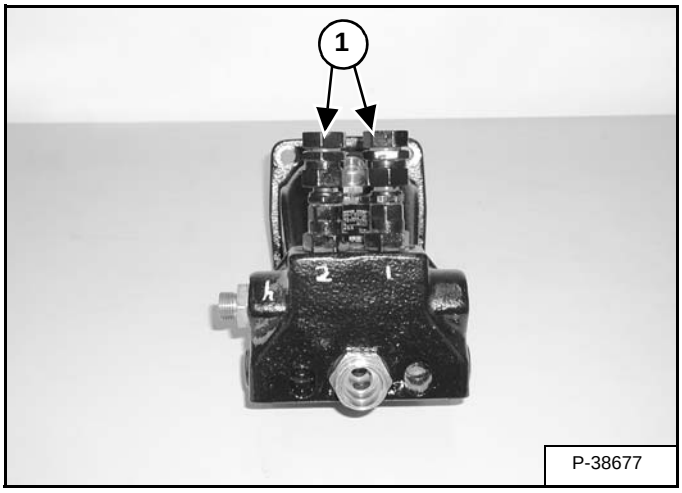
Mark the motor sections for proper installation.

Figure 20-90-11



Remove the fittings (Item 1) **[Figure 20-90-11]**.

Figure 20-90-12



Remove the crossport relief valves (Item 1) **[Figure 20-90-12]**.

NOTE: Do not interchange the crossport relief valves.

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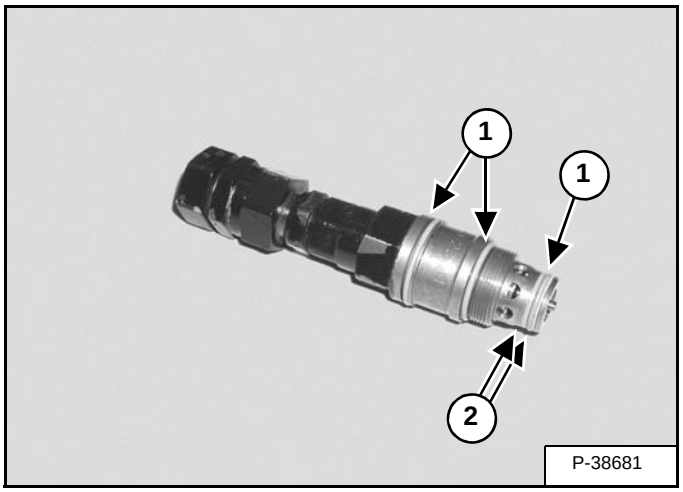
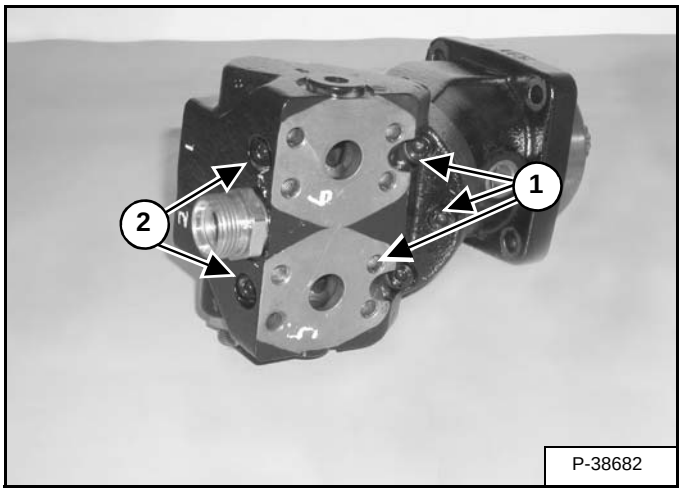
Disassembly (Cont'd)

Figure 20-90-13



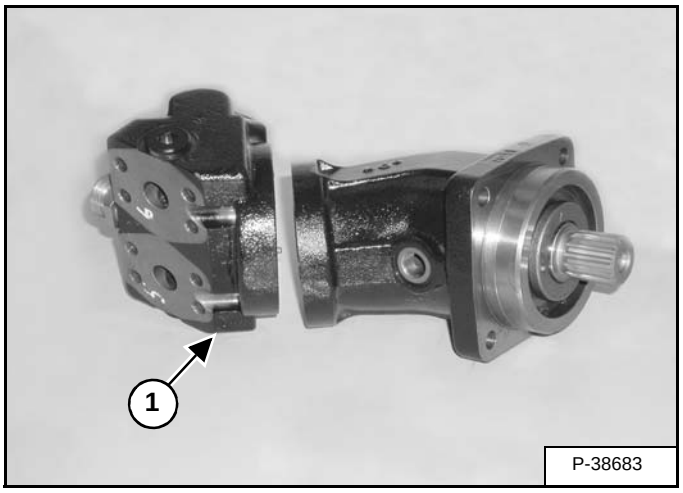
Remove the O-rings (Item 1) and back-up rings (Item 2) **[Figure 20-90-13]**.

Figure 20-90-14



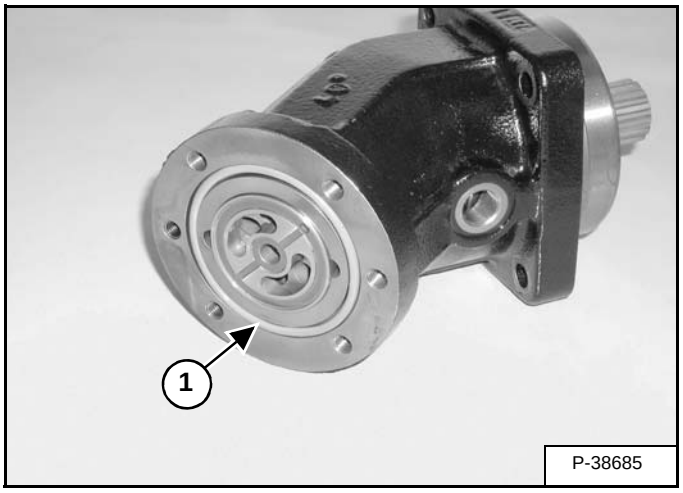
Remove the 3 short bolts (Item 1) and 2 long bolts (Item 2) **[Figure 20-90-14]**.

Figure 20-90-15



Remove the end cap (Item 1) **[Figure 20-90-15]**.

Figure 20-90-16



Remove the O-ring (Item 1) **[Figure 20-90-16]**.

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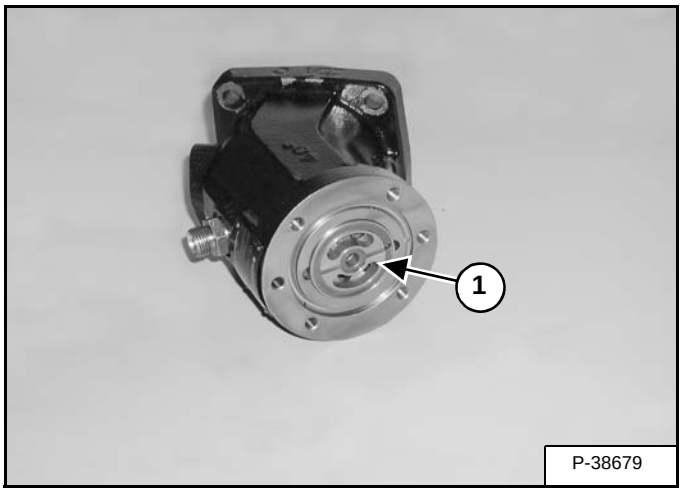
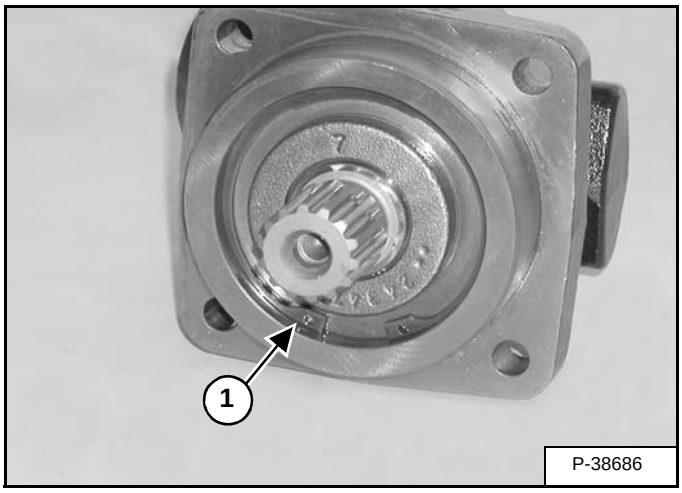
Disassembly (Cont'd)

Figure 20-90-17



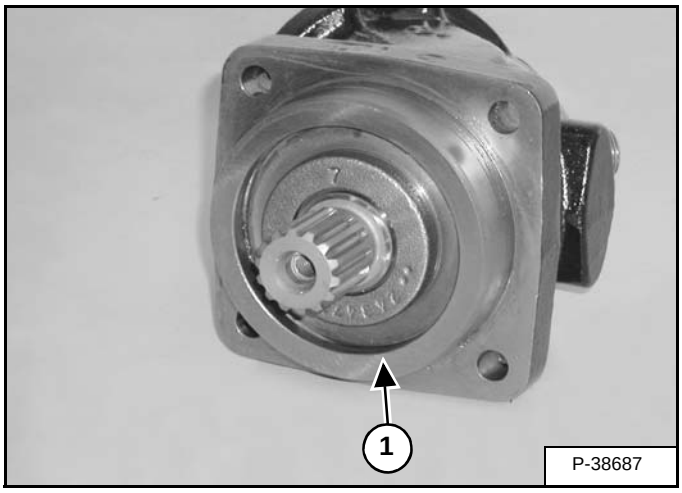
Remove the valve plate (Item 1) **[Figure 20-90-17]**.

Figure 20-90-18



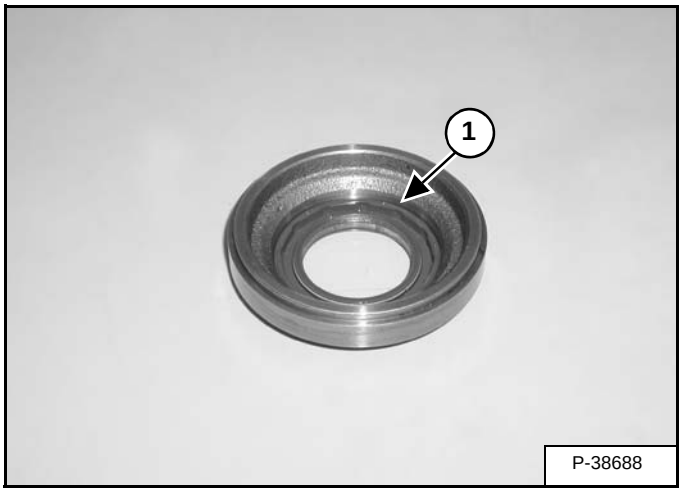
Remove the snap ring (Item 1) **[Figure 20-90-18]**.

Figure 20-90-19



Remove the retainer (Item 1) **[Figure 20-90-19]**.

Figure 20-90-20



Remove the seal (Item 1) **[Figure 20-90-20]** from the retainer.

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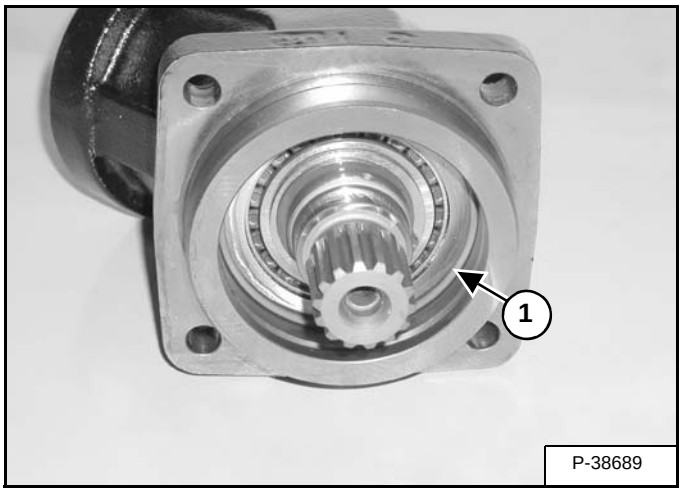
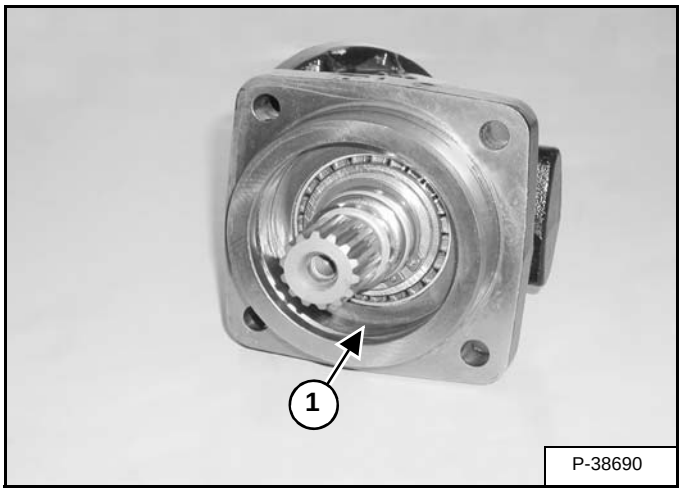
Disassembly (Cont'd)

Figure 20-90-21



Remove the O-ring (Item 1) **[Figure 20-90-21]**.

Figure 20-90-22



Remove the shims (Item 1) **[Figure 20-90-22]**.

Figure 20-90-23

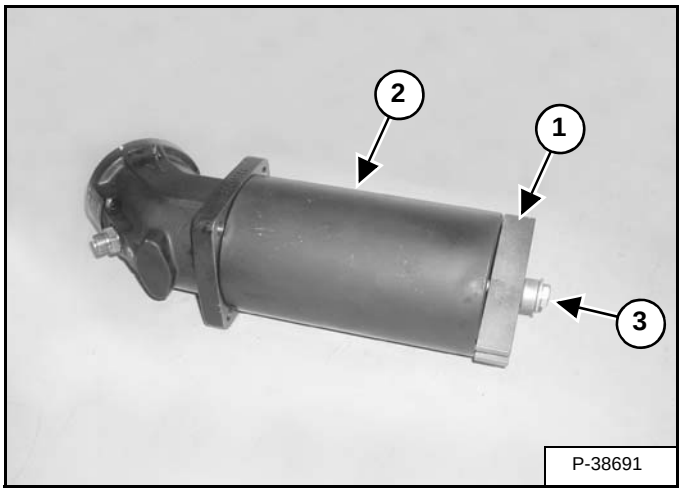
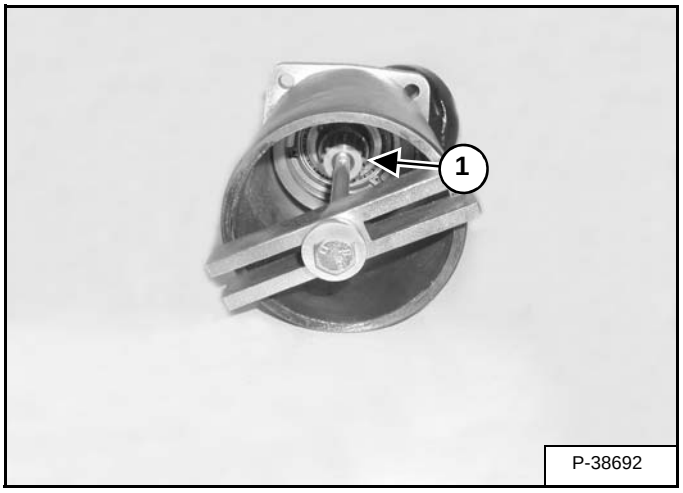


Figure 20-90-24



Install a puller (Item 1) **[Figure 20-90-23]** and sleeve (Item 2) **[Figure 20-90-23]** by threading a bolt (Item 3) **[Figure 20-90-23]** into the end of the shaft (Item 1) **[Figure 20-90-24]**.

Tighten the bolt to remove the rotary assembly.

NOTE: Add spacers between the head of the bolt and puller as needed to remove the rotary assembly.

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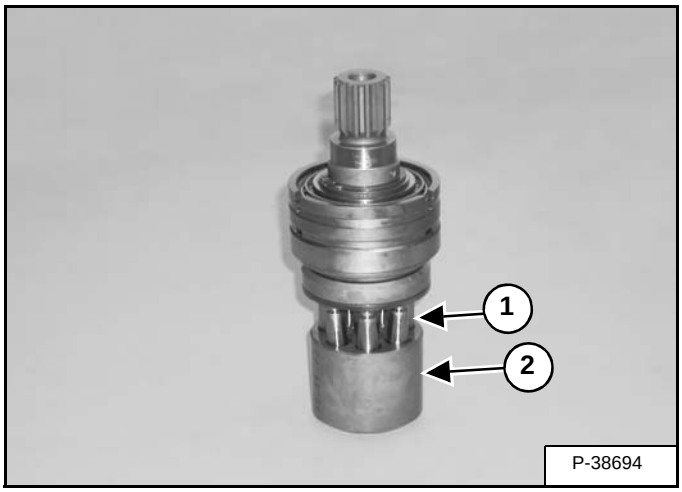
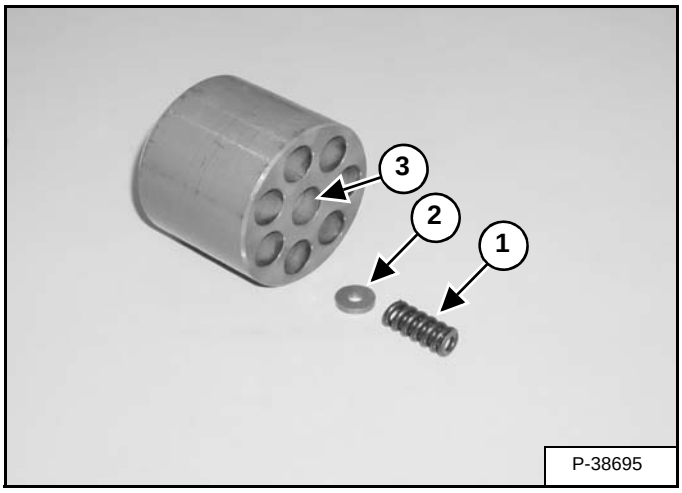
Disassembly (Cont'd)

Figure 20-90-25



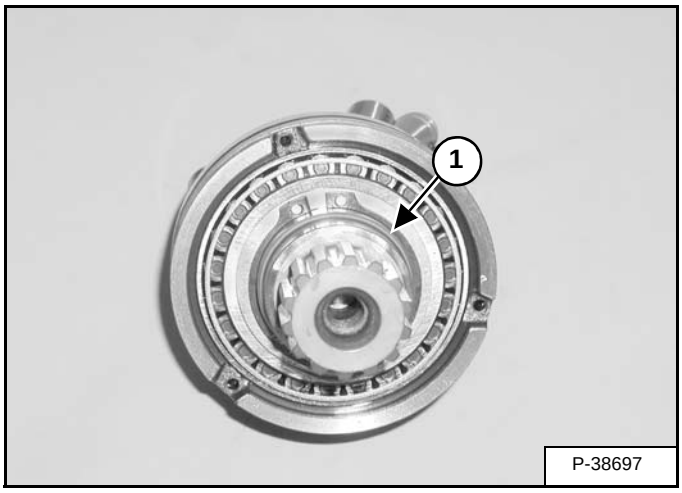
Remove the pistons (Item 1) from the cylinder (Item 2) **[Figure 20-90-25]**.

Figure 20-90-26



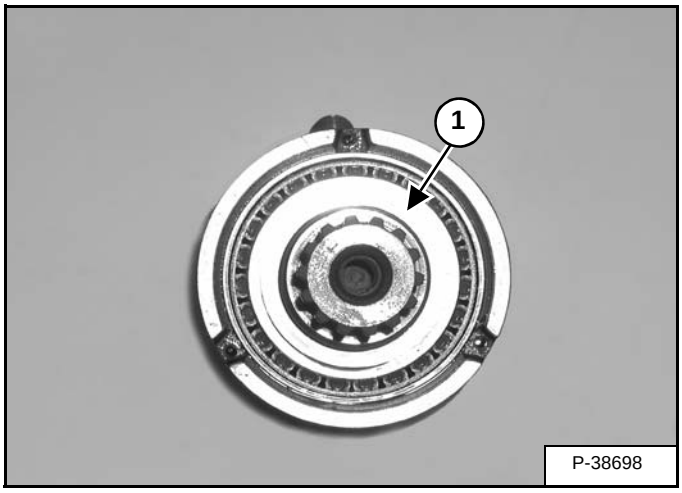
Remove the spring (Item 1) and shim (Item 2) from the center bore (Item 3) **[Figure 20-90-26]** of the cylinder.

Figure 20-90-27



Remove the snap ring (Item 1) **[Figure 20-90-27]**.

Figure 20-90-28



Remove the washer (Item 1) **[Figure 20-90-28]**.

Put the shaft and bearing assembly in a press.

Use care not to damage the control plate or shaft.

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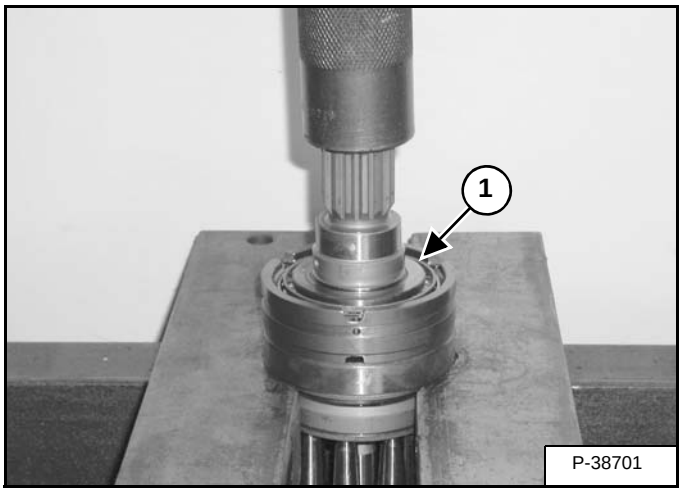
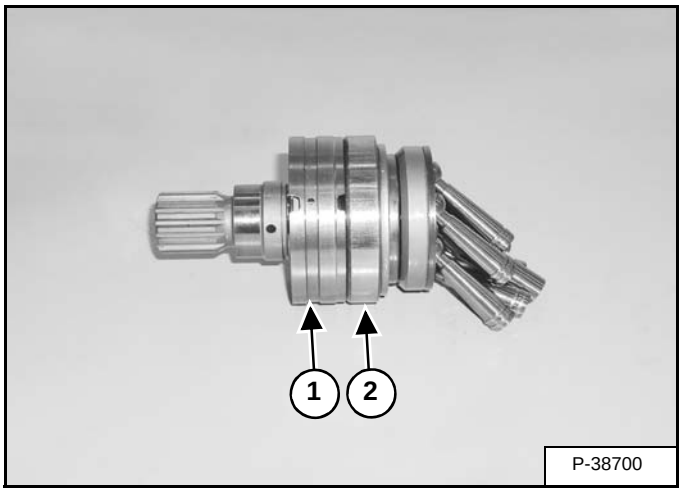
Disassembly (Cont'd)

Figure 20-90-29



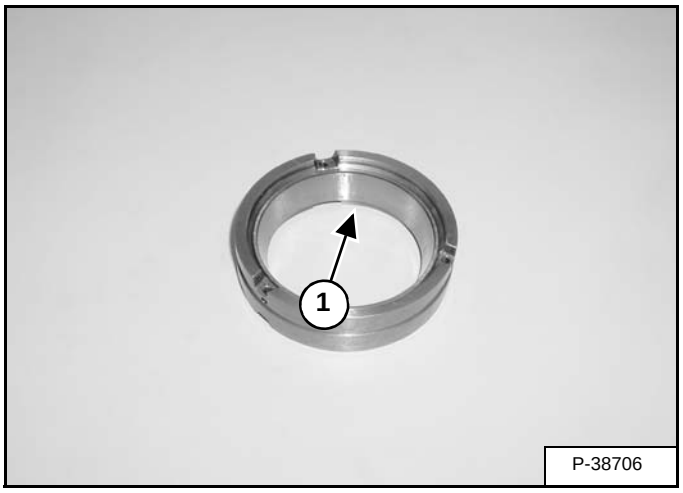
Remove the outer bearing (Item 1) **[Figure 20-90-29]**.

Figure 20-90-30



Remove the carrier (Item 1) and bearing race (Item 2) **[Figure 20-90-30]**

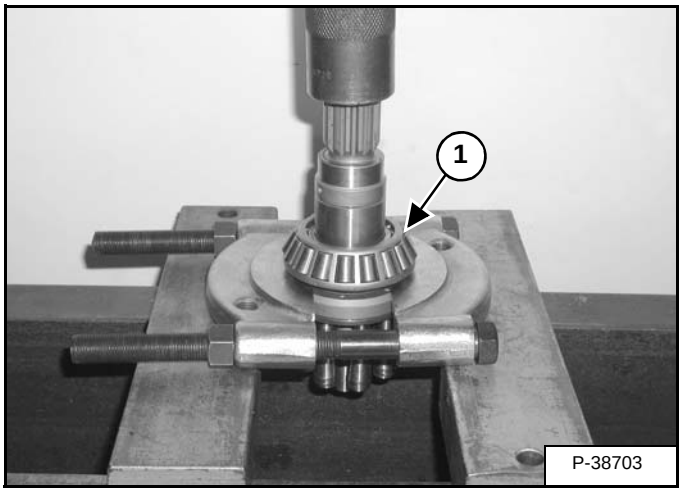
Figure 20-90-31



Remove the bearing race (Item 1) **[Figure 20-90-31]** from the carrier.

Put the shaft and bearing assembly in a press.

Figure 20-90-32



Remove the inner bearing (Item 1) **[Figure 20-90-32]**.

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Assembly

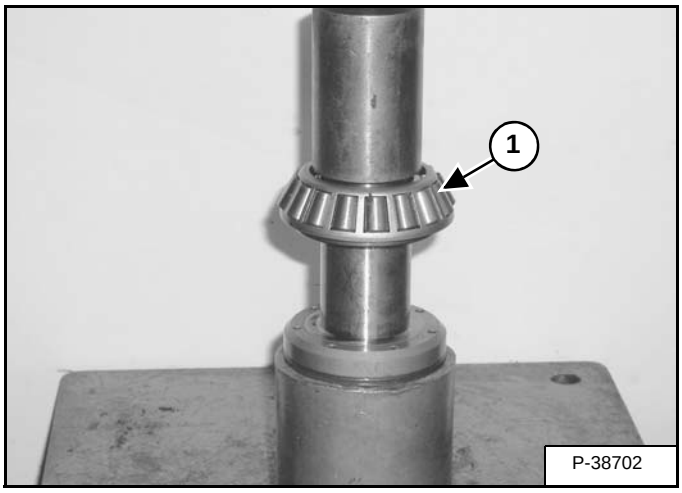
Clean all parts in solvent and dry with compressed air. Do not use cloth or paper because small pieces of material can get into the system and cause damage.

Check all parts for rough surfaces and wear, replace any worn or damaged parts.

Install new seals, O-rings and bearings.

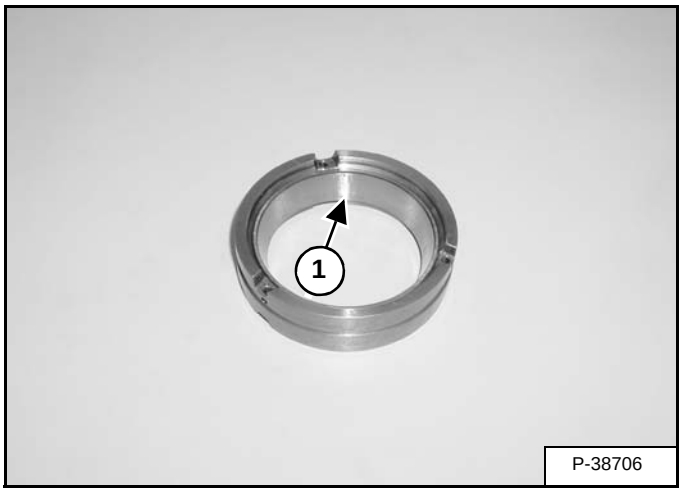
Lubricate the parts with clean hydraulic oil during assembly.

Figure 20-90-33



Put the shaft assembly in a vise and install the inner bearing (Item 1) **[Figure 20-90-33]**.

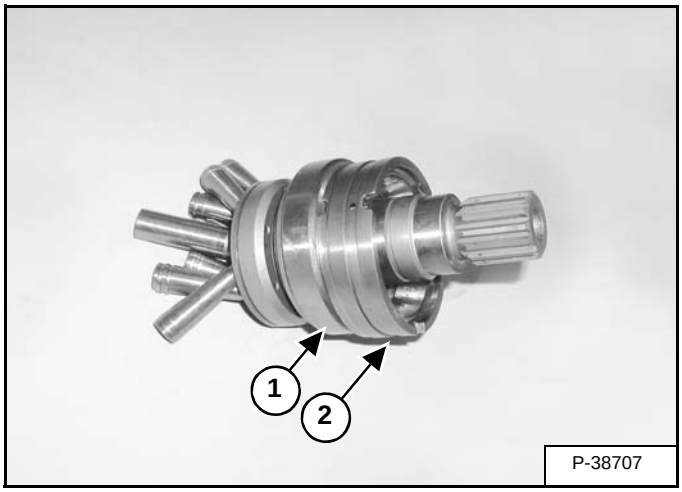
Figure 20-90-34



Install the outer bearing race (Item 1) in the carrier (Item 2) **[Figure 20-90-34]**.

Install the outer bearing race (Item 1) in the carrier (Item 2) **[Figure 20-90-34]**.

Figure 20-90-35



Install the inner bearing race (Item 1) and bearing carrier (Item 2) **[Figure 20-90-35]** on the shaft assembly.

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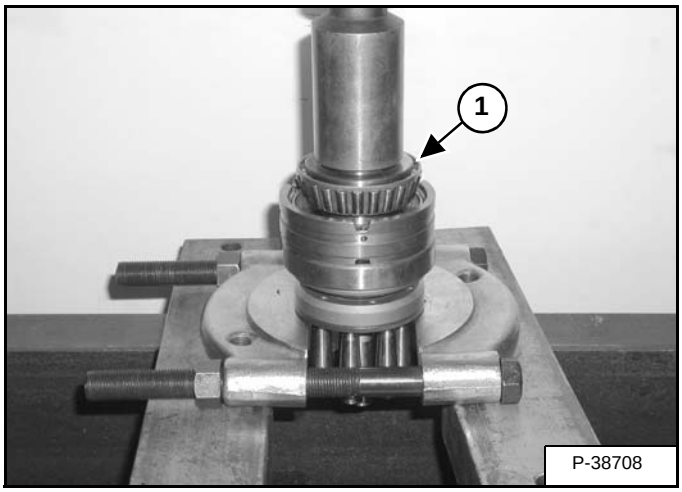
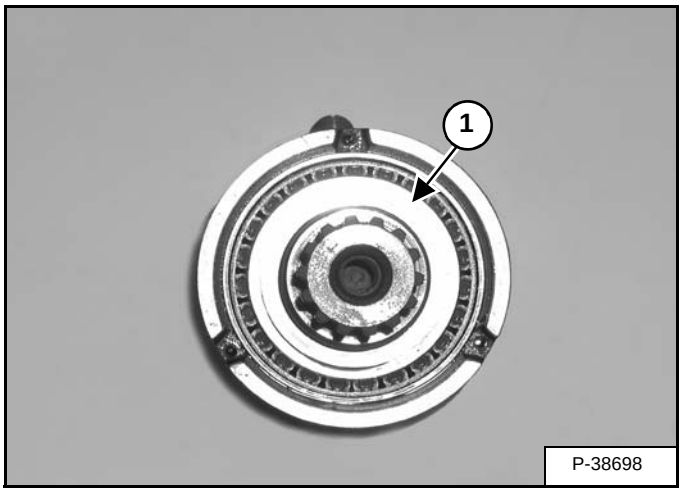
Assembly (Cont'd)

Figure 20-90-36



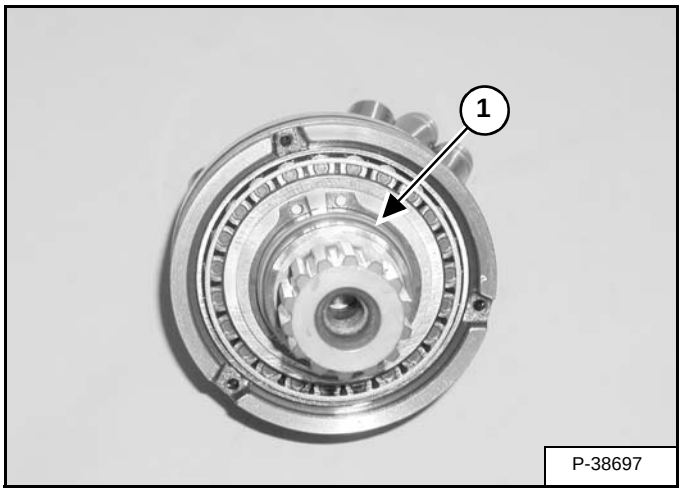
Put the shaft assembly in a vise and install the outer bearing (Item 1) **[Figure 20-90-36]**.

Figure 20-90-37



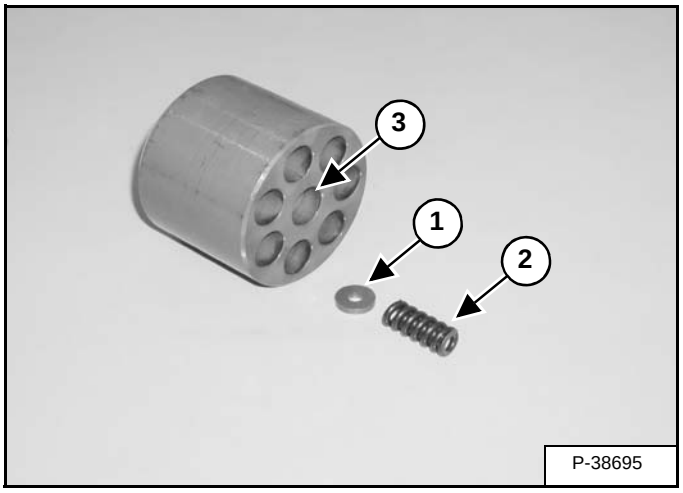
Install the washer (Item 1) **[Figure 20-90-37]**.

Figure 20-90-38



Install the snap ring (Item 1) **[Figure 20-90-38]**.

Figure 20-90-39



Install the shim (Item 1) and spring (Item 2) in the center bore (Item 3) **[Figure 20-90-39]** cylinder.

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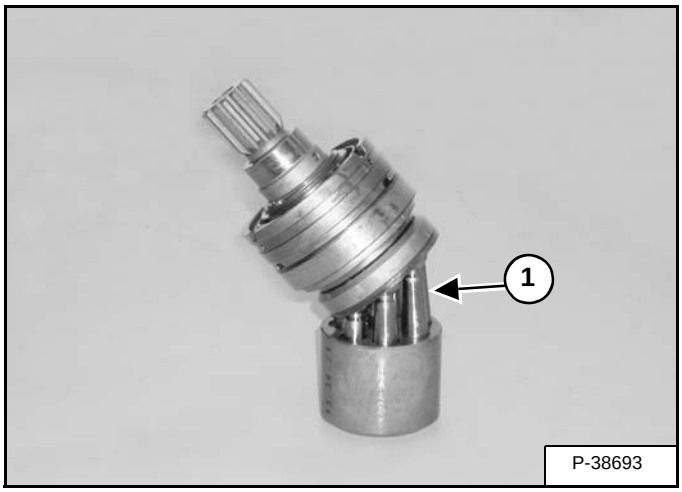
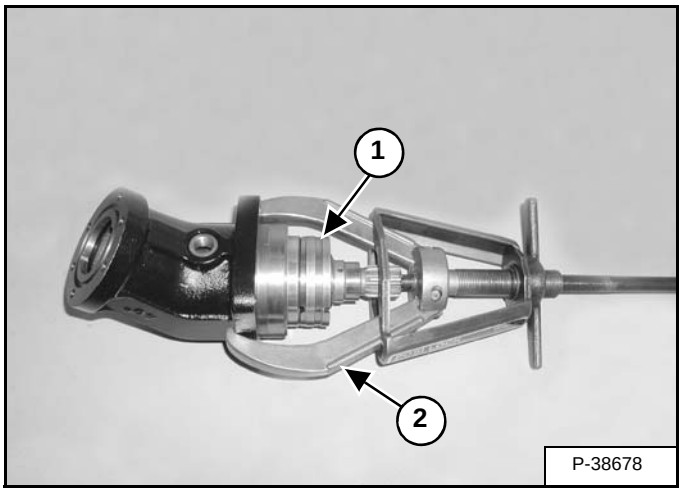
Assembly (Cont'd)

Figure 20-90-40



Install the pistons (Item 1) **[Figure 20-90-40]** in the cylinder.

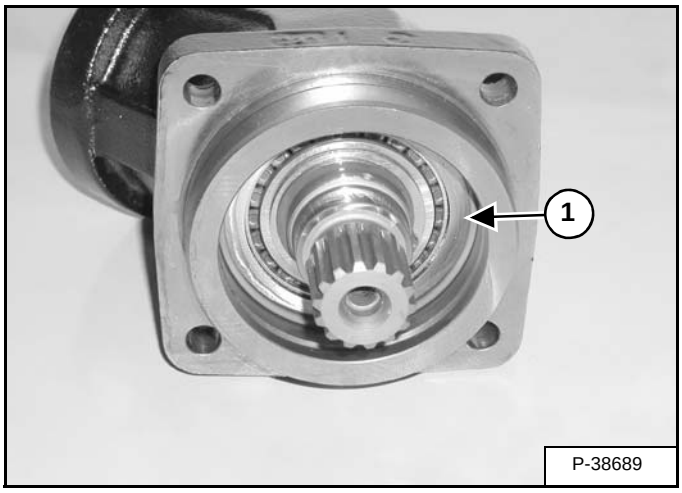
Figure 20-90-41



Install the rotary assembly (Item 1) with a puller (Item 2) **[Figure 20-90-41]**.

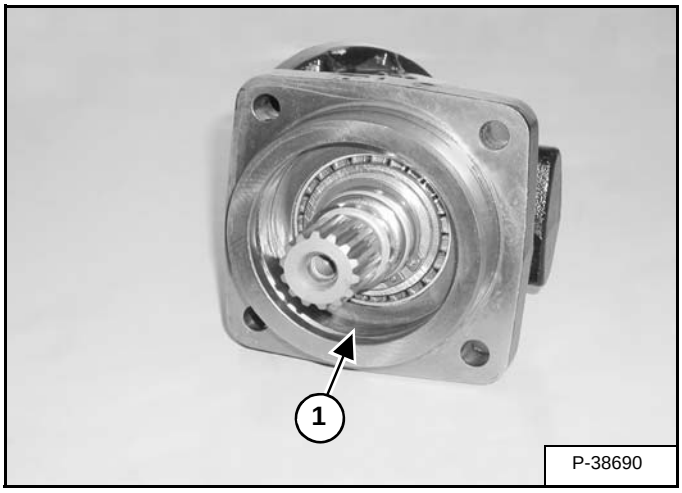
NOTE: Ensure the rotary assembly rotates freely and does not bind during installation.

Figure 20-90-42



Install the shims (Item 1) **[Figure 20-90-42]**.

Figure 20-90-43



Install the O-ring (Item 1) **[Figure 20-90-43]**.

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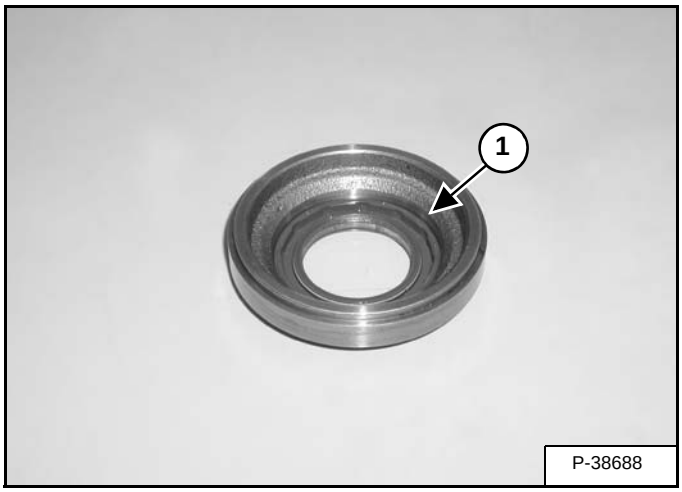
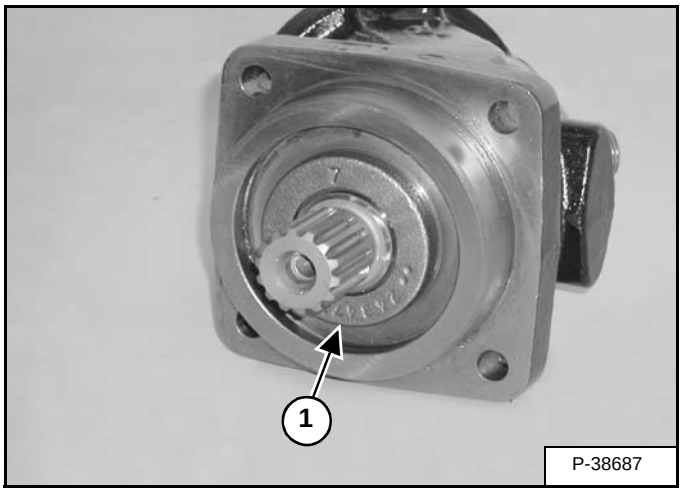
Assembly (Cont'd)

Figure 20-90-44



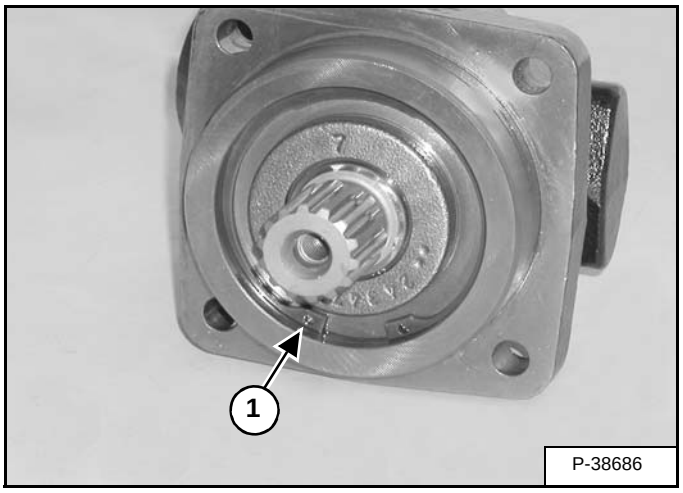
Install the seal (Item 1) on the retainer (Item 2) **[Figure 20-90-44]**.

Figure 20-90-45



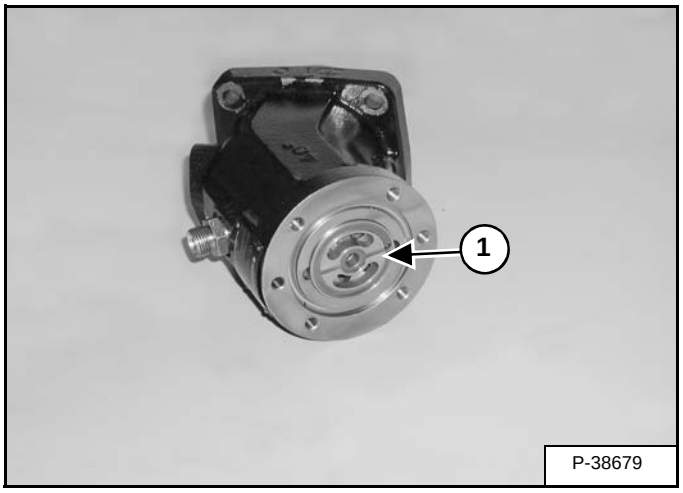
Install the retainer (Item 1) **[Figure 20-90-45]**.

Figure 20-90-46



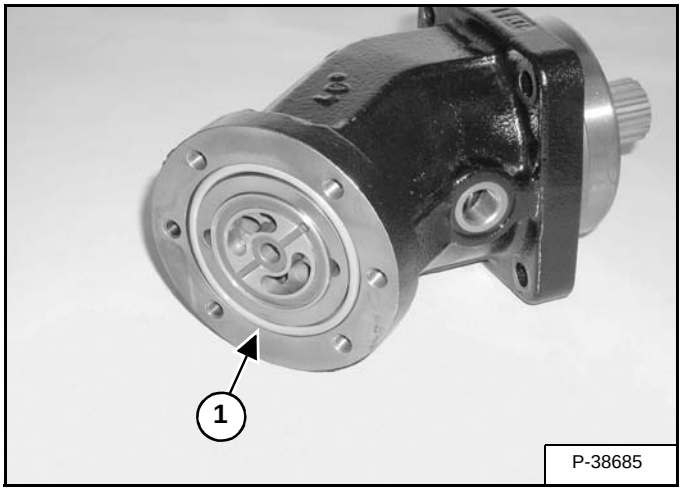
Install the snap ring (Item 1) **[Figure 20-90-46]**.

Figure 20-90-47



Install the valve plate (Item 1) **[Figure 20-90-47]**.

Figure 20-90-48



Install the O-ring (Item 1) **[Figure 20-90-48]**.

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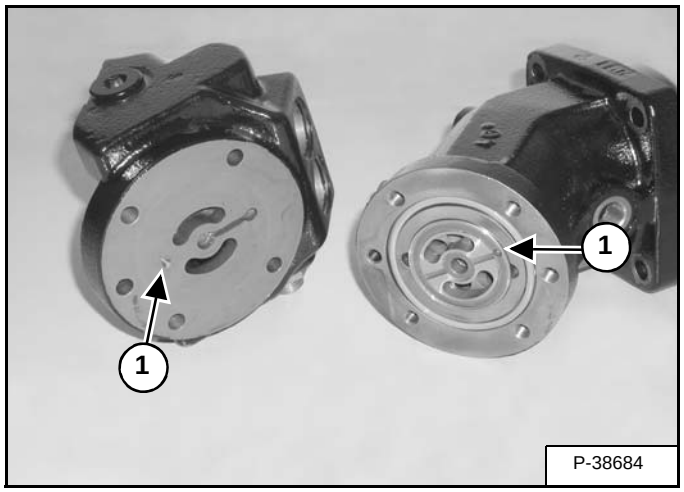
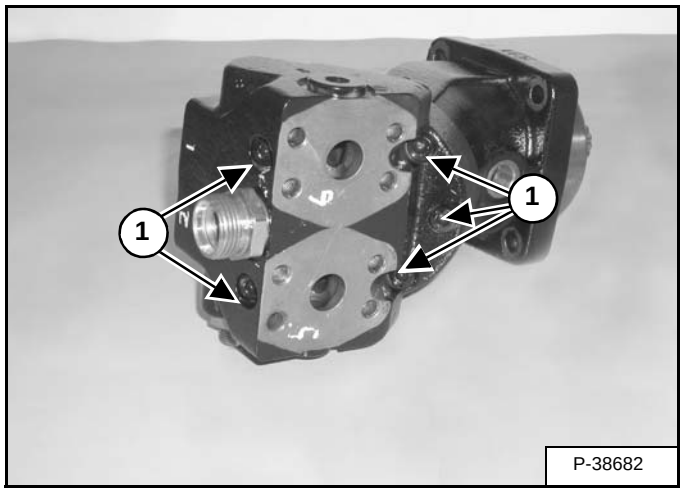
Assembly (Cont'd)

Figure 20-90-49



Align the dowel pin (Item 1) in the end cap with the hole (Item 2) **[Figure 20-90-49]** in the valve plate. Install the end cap on the housing.

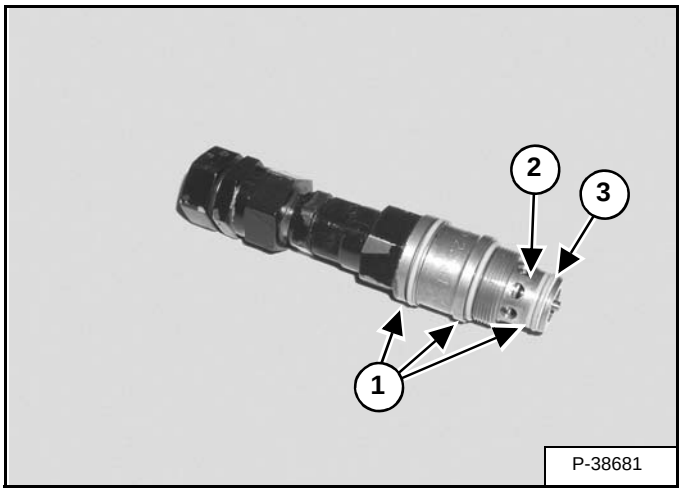
Figure 20-90-50



Install the 2 long bolts (Item 1) and 3 short bolts (Item 2) **[Figure 20-90-50]**.

Tighten the bolts to ___ ft.-lb. (__ N•m) torque.

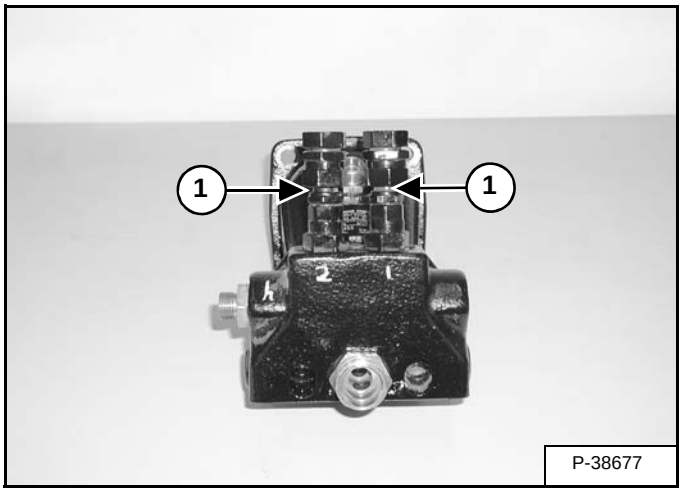
Figure 20-90-51



Install the 3 O-rings (Item 1) and 2 back-up rings (Items 2 & 3) **[Figure 20-90-51]** on the two crossport relief valves.

NOTE: The back-up ring (Item 2) is thicker than the back-up ring (Item 3) [Figure 20-90-51].

Figure 20-90-52



Install the crossport relief valves (Item 1) **[Figure 20-90-52]** and tighten to __ ft.-lb. (__ N•m) torque.

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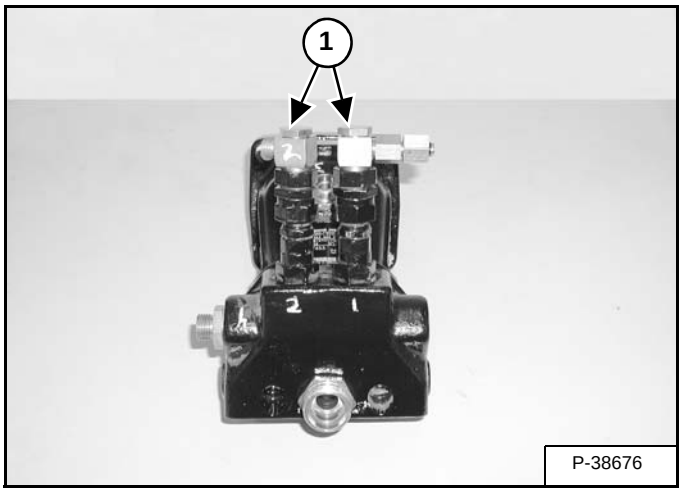
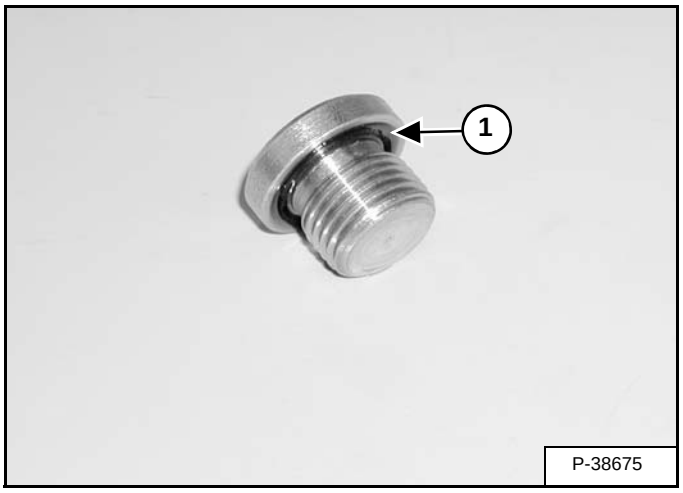
Assembly (Cont'd)

Figure 20-90-53



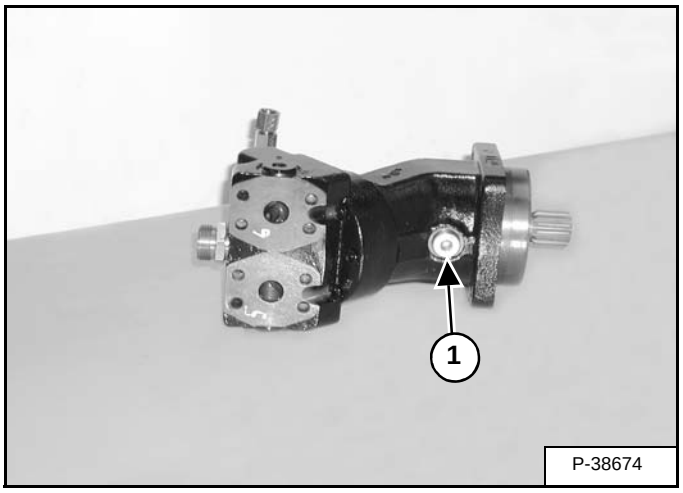
Install the fittings (Item 1) **[Figure 20-90-53]**.

Figure 20-90-54



Install the O-ring (Item 1) **[Figure 20-90-54]** on the plug.

Figure 20-90-55



Install the plug (Item 1) **[Figure 20-90-55]**.

Fill the swing motor with clean hydraulic fluid before installation to provide startup lubrication.

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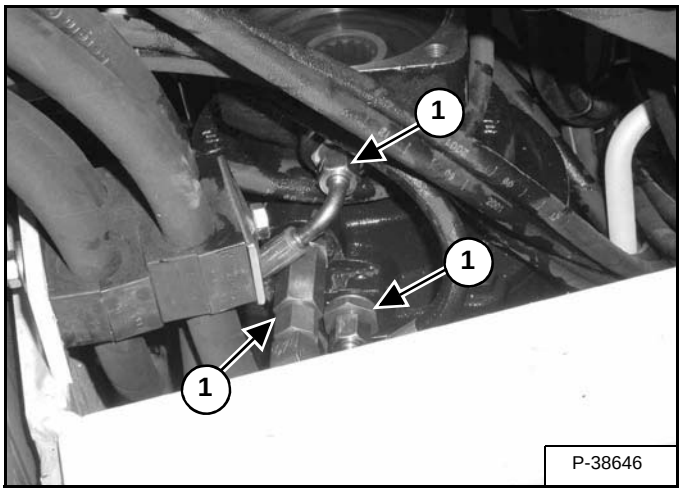
SWING MOTOR DRIVE CARRIER

Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

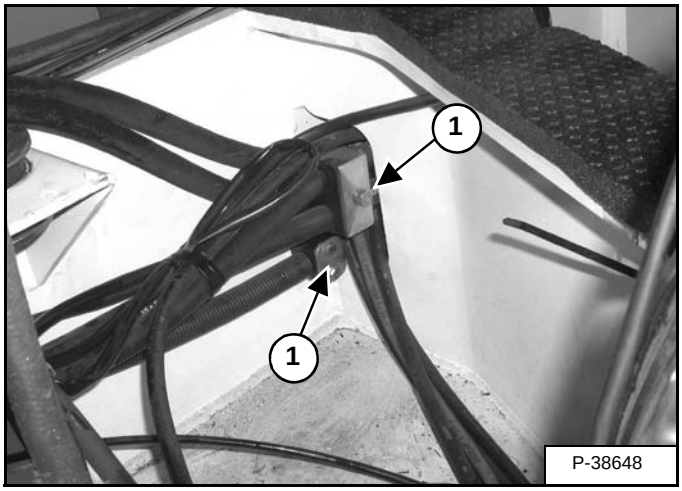
Remove swing motor. (See Removal And Installation on Page 20-90-1)

Figure 20-91-1



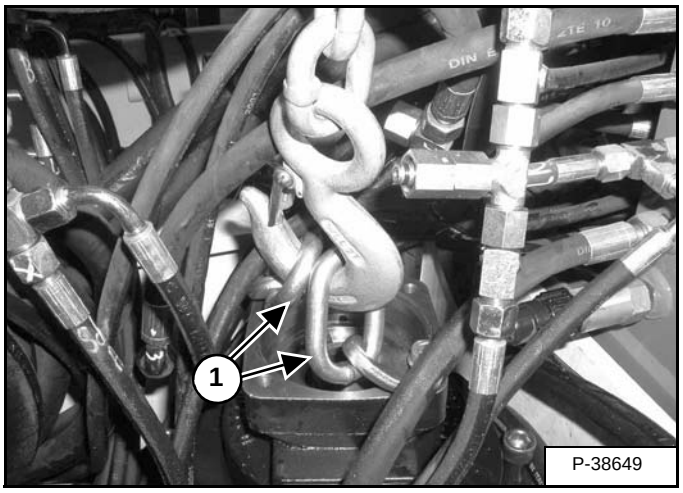
Remove the 3 hoses (Item 1) **[Figure 20-91-1]**.

Figure 20-91-2



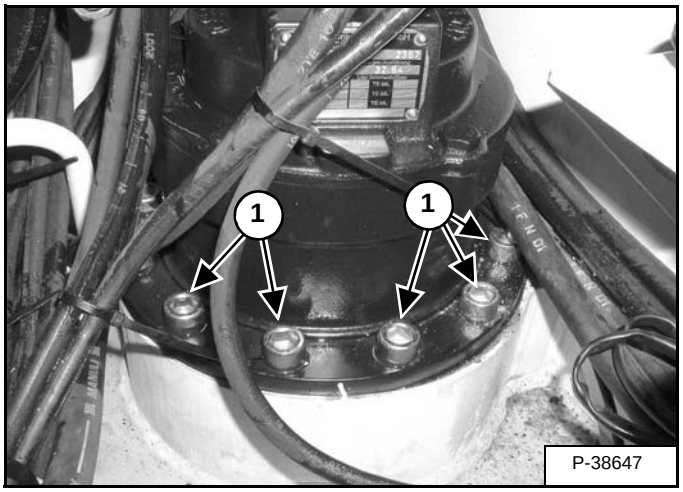
Remove the hose clamps (Item 1) **[Figure 20-91-2]** to reposition the hoses.

Figure 20-91-3



Install lifting brackets (Item 1) **[Figure 20-91-3]** and a chain hoist on the carrier.

Figure 20-91-4



Remove the 12 bolts (Item 1) **[Figure 20-91-4]**.

Installation: Tighten the bolts to 144 ft.-lb. (195 N•m) torque.

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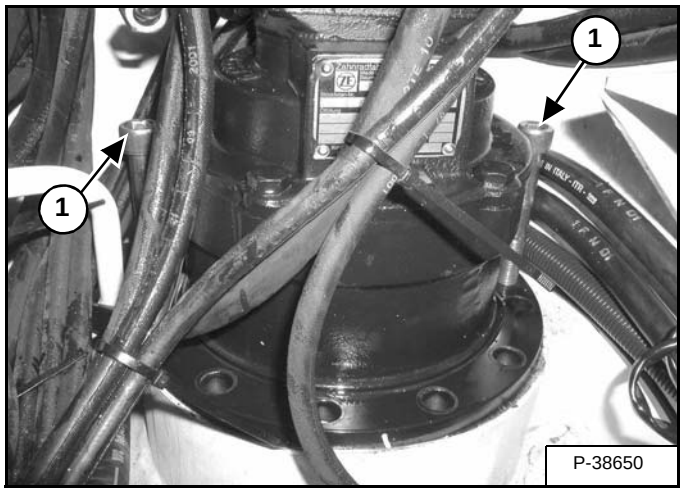
Removal And Installation (Cont'd)

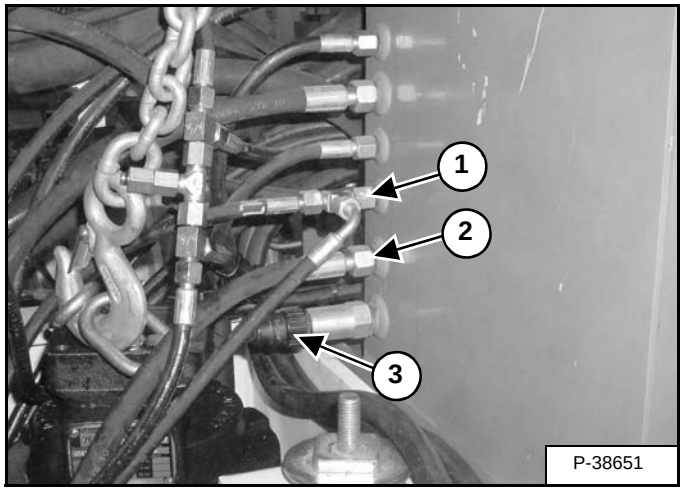
Figure 20-91-5



Install two mount bolts (Item 1) **[Figure 20-91-5]** in the threaded holes of the carrier.

Tighten the bolts evenly to push the carrier off of the upper structure.

Figure 20-91-6



Remove the tee (Item 1) and hose (Item 2) **[Figure 20-91-6]** from the hydraulic reservoir.

Remove the wire harness (Item 3) **[Figure 20-91-6]** from the hydraulic reservoir.

Remove the carrier.

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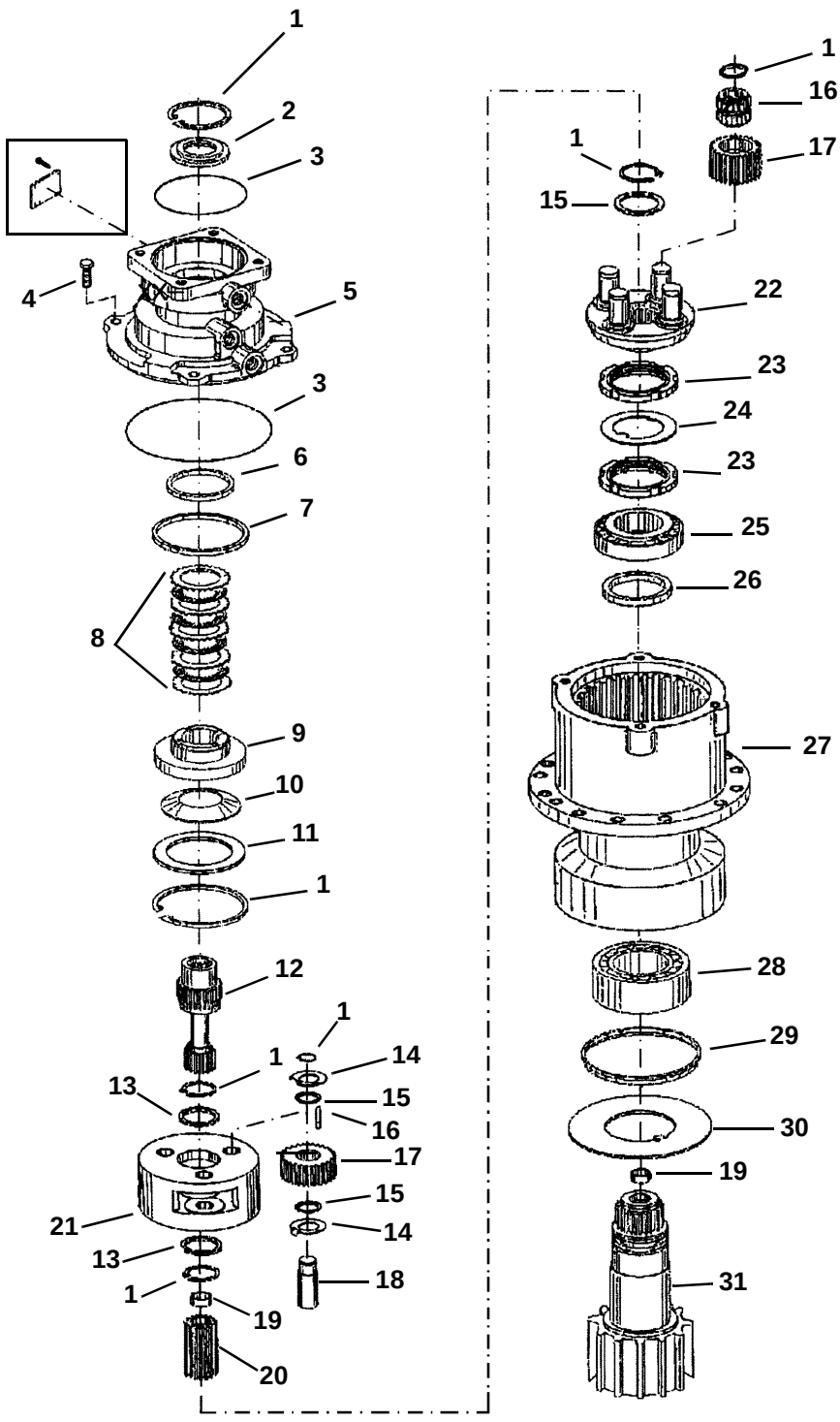
Parts Identification

1	Snap Ring
2	Plunger Disc
3	O-Ring
4	Bolt
5	Brake Housing
6	Seal
7	Seal
8	Brake Disc
9	Piston
10	Belleville Spring
11	Spring Support
12	Driveshaft
13	Shim
14	Thrust Washer
15	Shim
16	Bearing
17	Gear
18	Pin
19	Bearing
20	Sun Gear
21	Pinion Cage
22	Planetary Gear
23	Nut
24	Locking Plate
25	Bearing
26	Seal
27	Drive Housing
28	Bearing
29	Seal
30	Washer
31	Pinion



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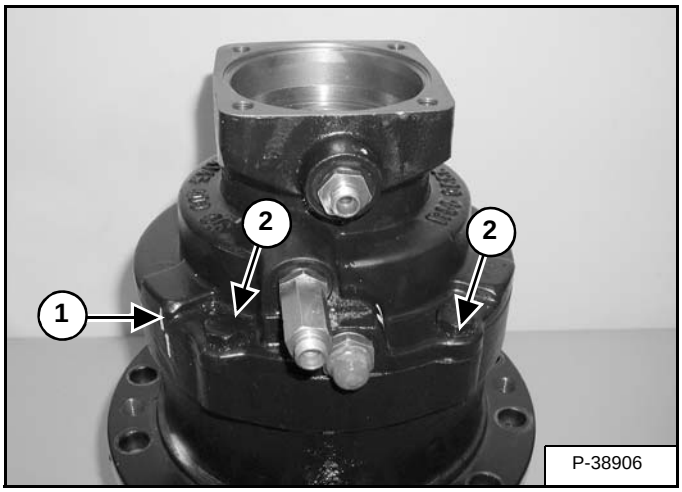
Disassembly

Figure 20-91-7

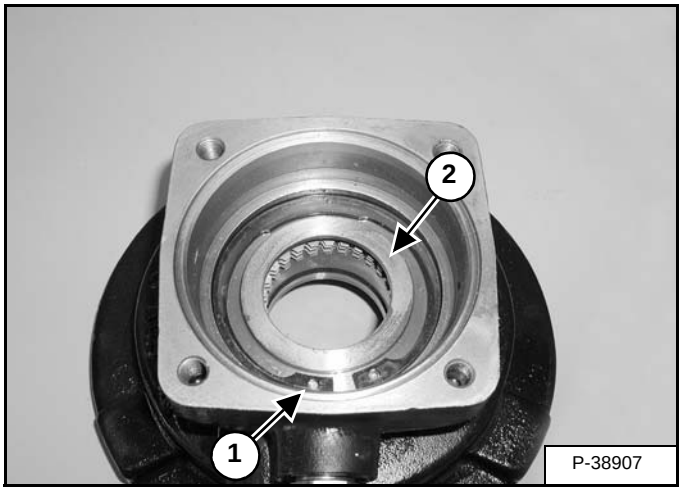


Mark the brake housing (Item 1) **[Figure 20-91-7]** for ease of assembly.

Remove the 4 bolts (Item 2) **[Figure 20-91-7]**.

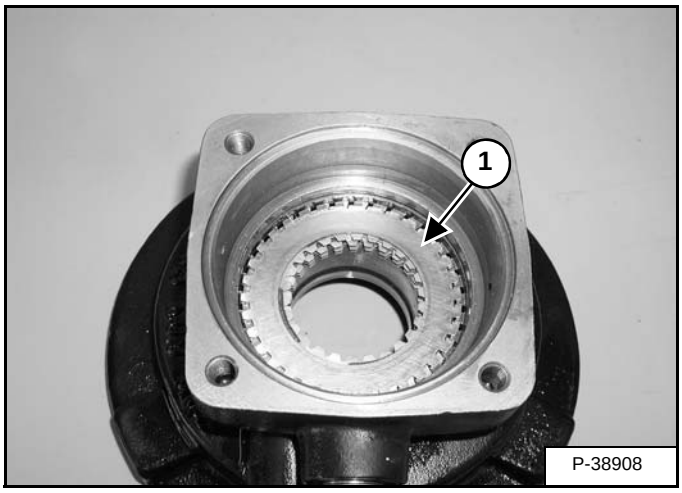
Remove the brake housing.

Figure 20-91-8



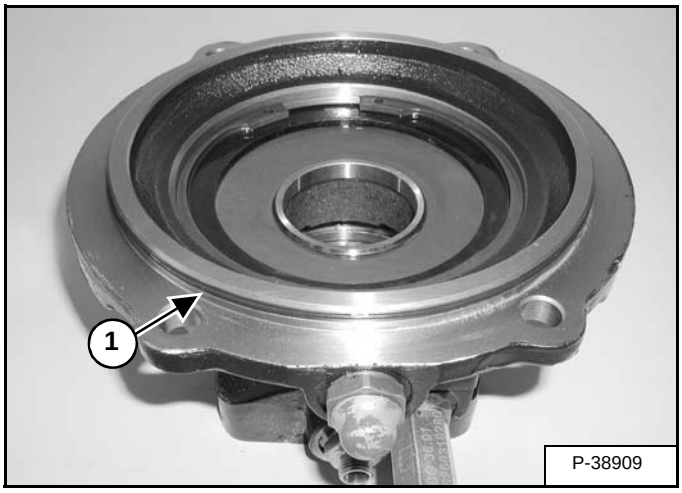
Remove the snap ring (Item 1) and plunger disc (Item 2) **[Figure 20-91-8]**.

Figure 20-91-9



Remove the brake discs (Item 1) **[Figure 20-91-9]**.

Figure 20-91-10



Turn the brake housing over and remove the O-ring (Item 1) **[Figure 20-91-10]**.

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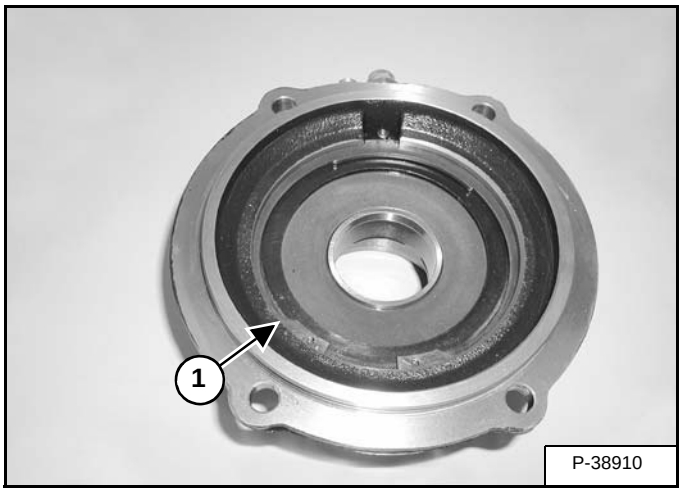
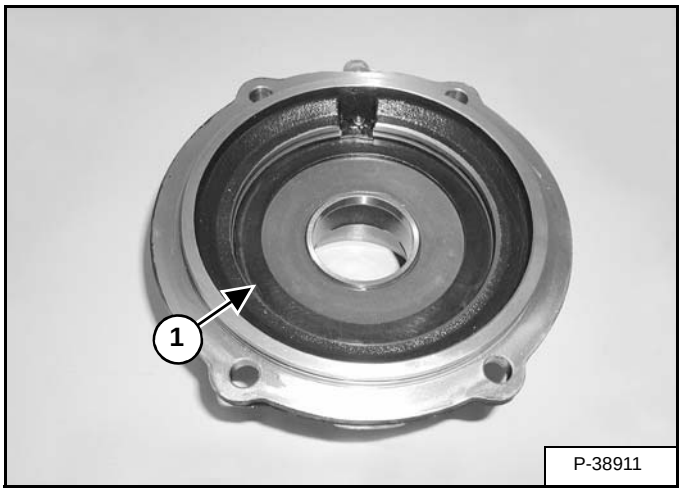
Disassembly (Cont'd)

Figure 20-91-11



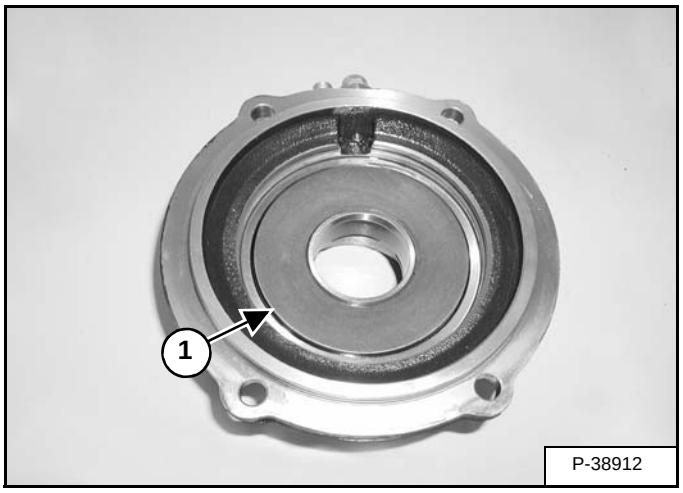
Remove the snap ring (Item 1) **[Figure 20-91-11]**.

Figure 20-91-12



Remove the support disc (Item 1) **[Figure 20-91-12]**.

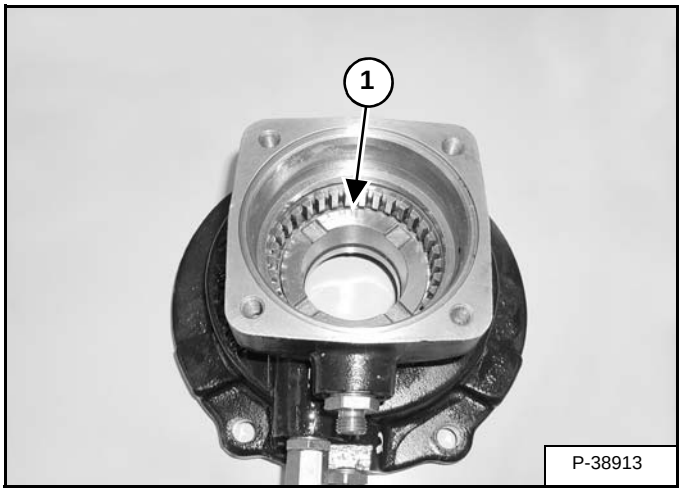
Figure 20-91-13



Note the orientation of the belleville spring (Item 1) **[Figure 20-91-13]**.

Remove the spring.

Figure 20-91-14



Turn the brake housing over and tap the piston out **[Figure 20-91-14]**.

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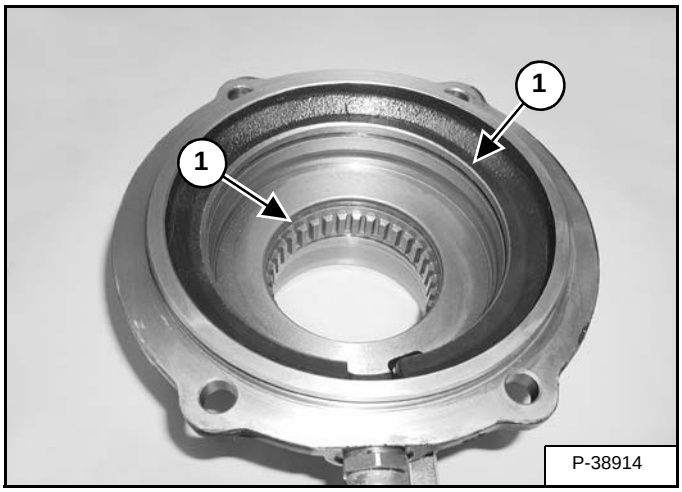
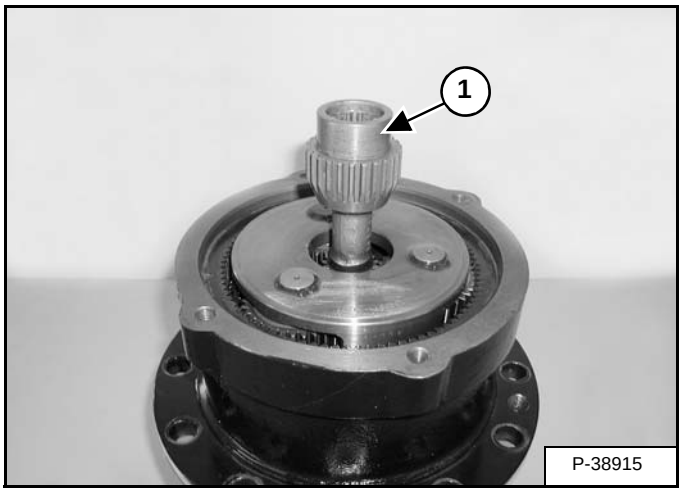
Disassembly (Cont'd)

Figure 20-91-15



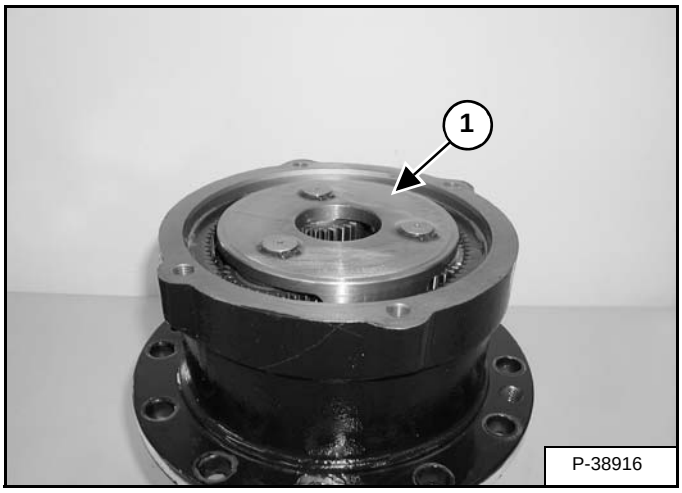
Turn the brake housing over and remove the two seals (Item 1) **[Figure 20-91-15]**.

Figure 20-91-16



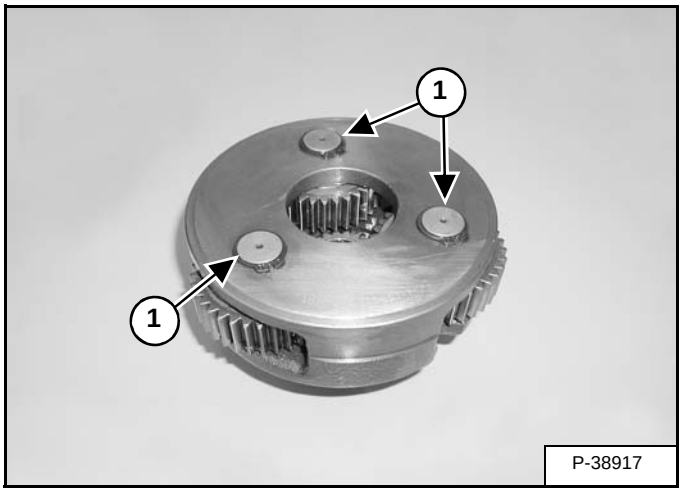
Remove the driveshaft (Item 1) **[Figure 20-91-16]**.

Figure 20-91-17



Remove the pinion cage (Item 1) **[Figure 20-91-17]**.

Figure 20-91-18



Remove the snap rings (Item 1) **[Figure 20-91-18]**.

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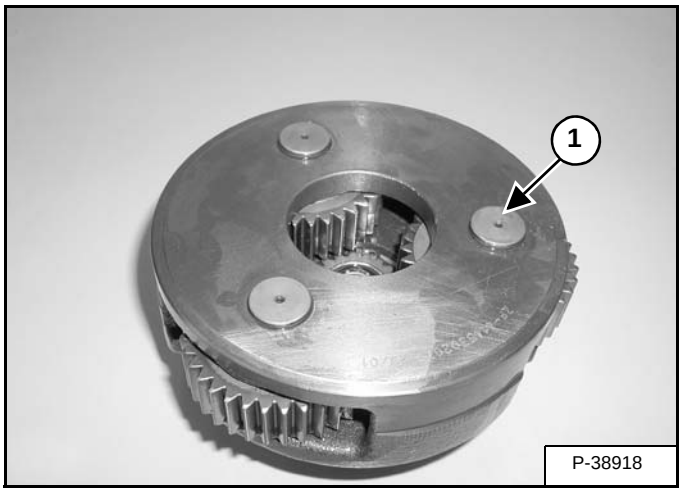
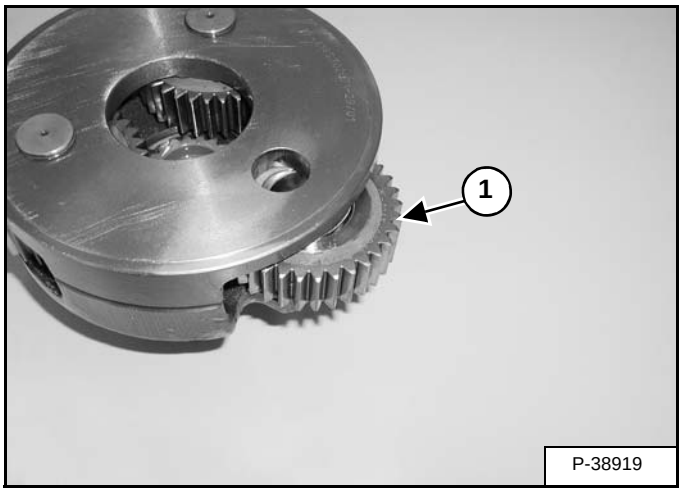
Disassembly (Cont'd)

Figure 20-91-19



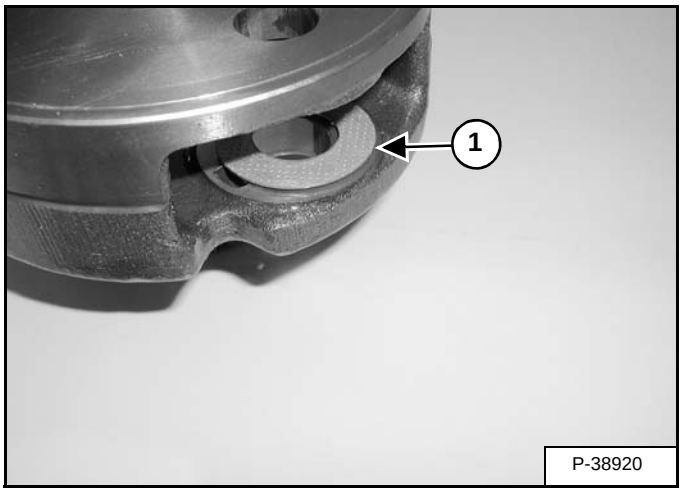
Drive the pin (Item 1) **[Figure 20-91-19]** out the bottom of the carrier.

Figure 20-91-20



Remove the gear and bearing assembly (Item 1) **[Figure 20-91-20]**.

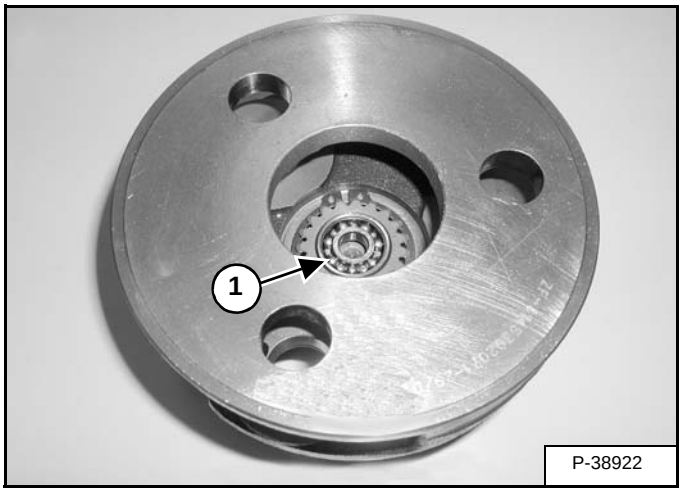
Figure 20-91-21



Remove the top and bottom thrust washers (Item 1) **[Figure 20-91-21]**.

Repeat the procedure for the remaining two pins and gear/bearing assemblies.

Figure 20-91-22



Remove the bearing (Item 1) **[Figure 20-91-22]**.

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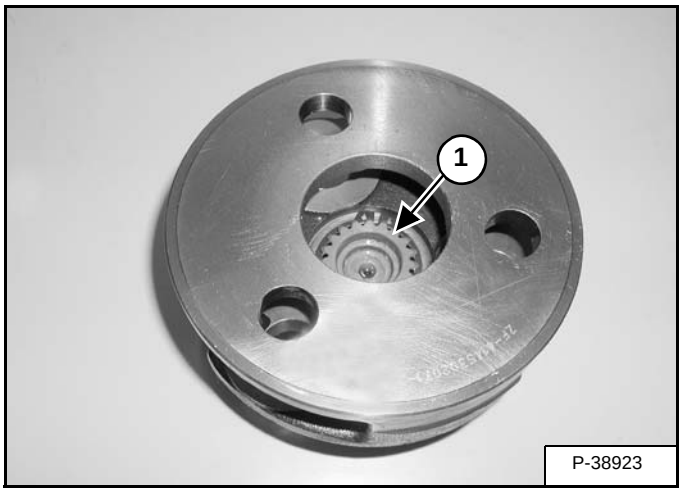
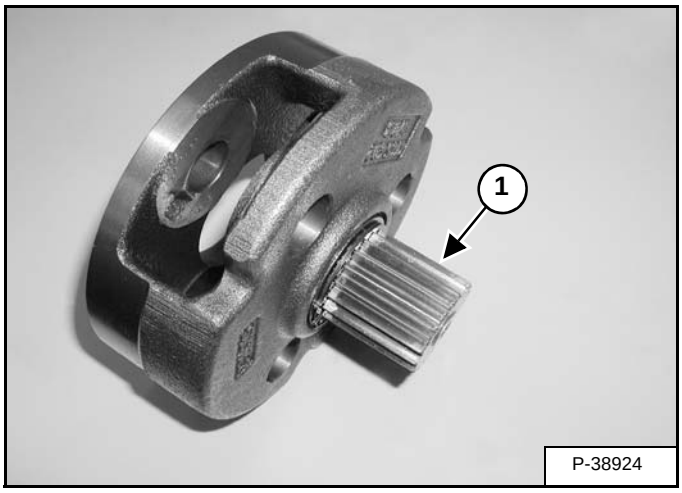
Disassembly (Cont'd)

Figure 20-91-23



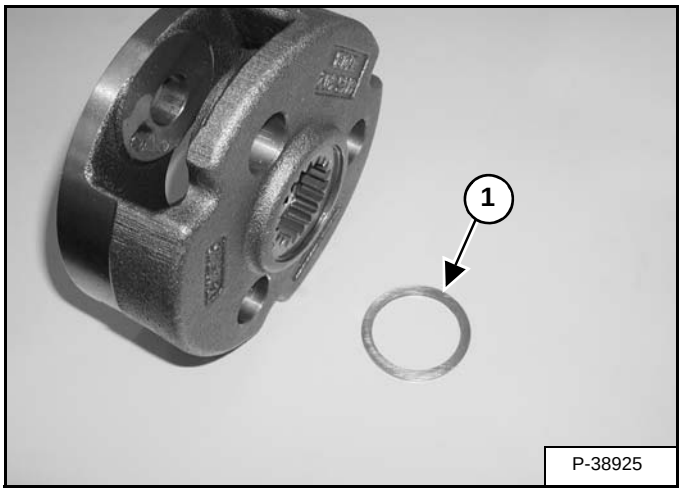
Remove the snap ring (Item 1) **[Figure 20-91-23]** and washer.

Figure 20-91-24



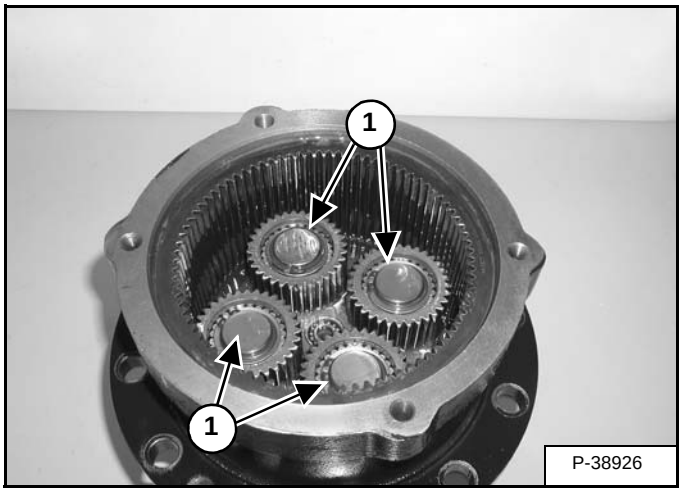
Remove the sun gear (Item 1) **[Figure 20-91-24]**.

Figure 20-91-25



Remove the washer (Item 1) **[Figure 20-91-25]** from the carrier.

Figure 20-91-26



Remove the 4 snap rings (Item 1) **[Figure 20-91-26]**.

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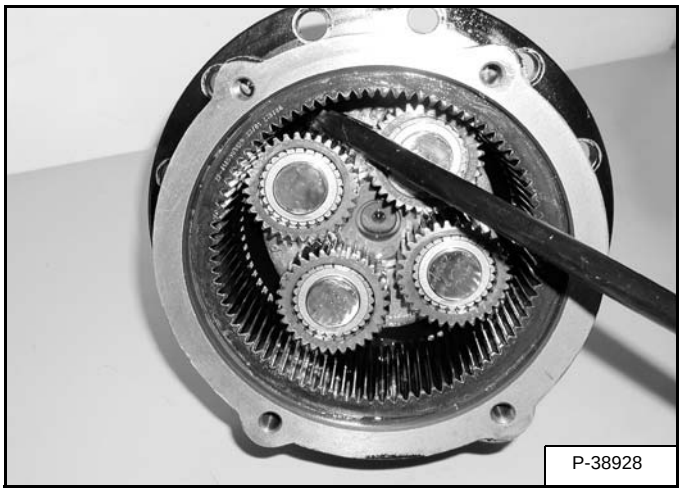
Disassembly (Cont'd)

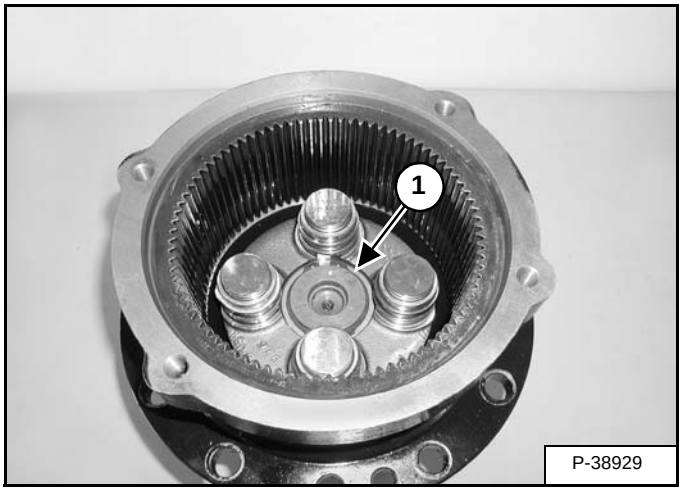
Figure 20-91-27



Use a pry bar to remove the planetary gear and bearing assembly **[Figure 20-91-27]**.

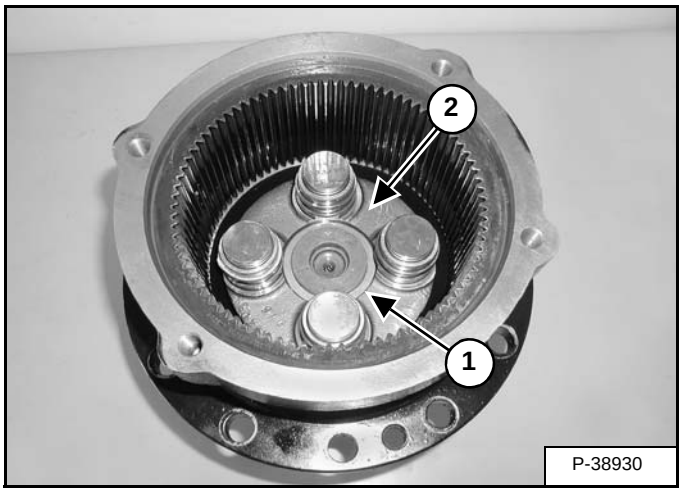
NOTE: The bearings are not caged. There are 52 roller bearings per gear.

Figure 20-91-28



Remove the snap ring (Item 1) **[Figure 20-91-28]**.

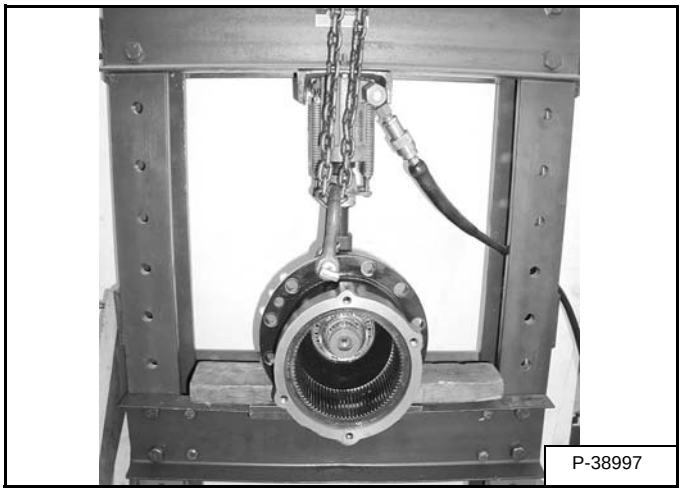
Figure 20-91-29



Remove the washer (Item 1) **[Figure 20-91-29]**.

Remove the planetary gear carrier (Item 2) **[Figure 20-91-29]**.

Figure 20-91-30



Support the carrier in a press. Clamp the carrier shaft with approximately 800 lb. (1085 N•m) of force **[Figure 20-91-30]**.

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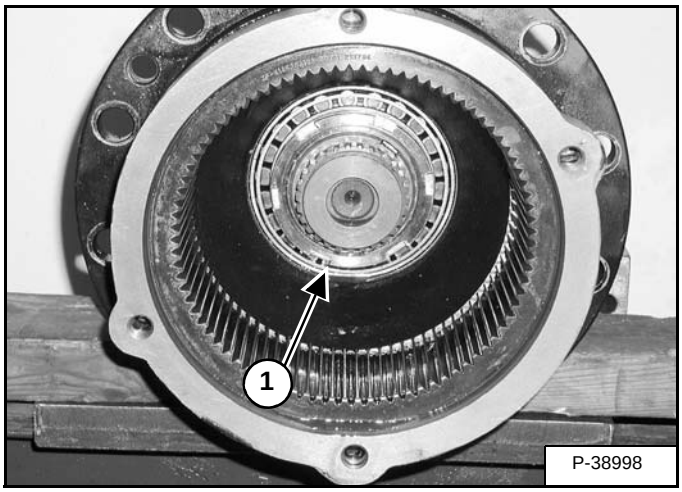
Disassembly (Cont'd)

Figure 20-91-31

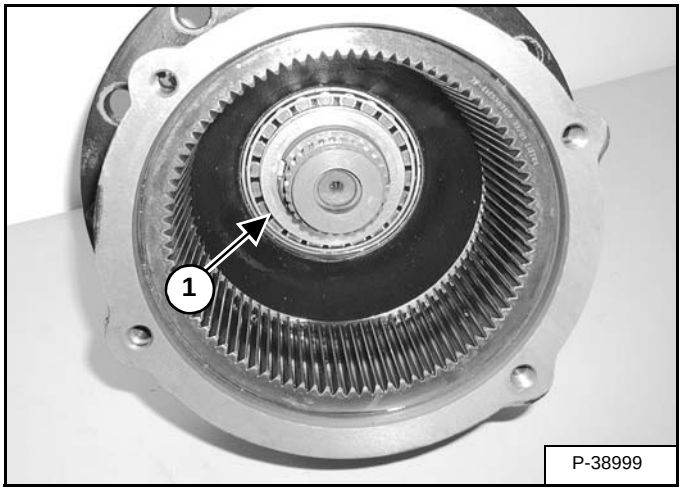


Remove the nut (Item 1) **[Figure 20-91-31]**.

NOTE: The nut is torqued to 480-550 ft.-lb. (651-746 N•m) of torque.

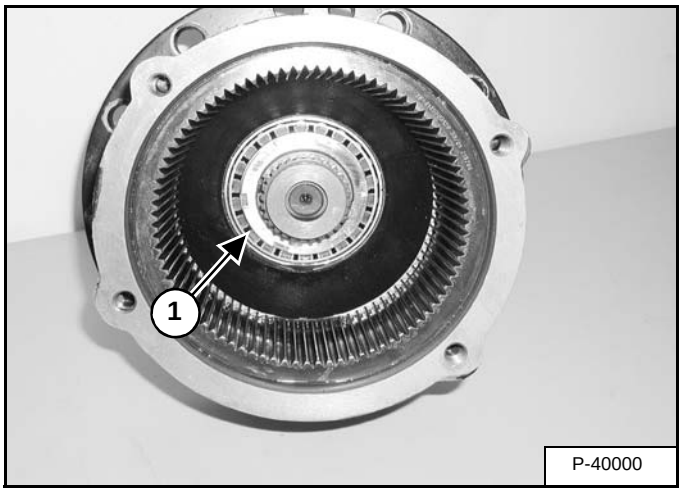
Remove the carrier from the press.

Figure 20-91-32



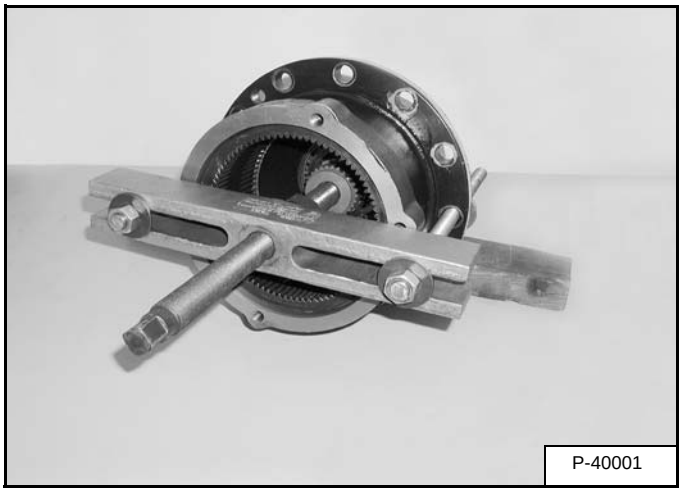
Remove the lock washer (Item 1) **[Figure 20-91-32]**.

Figure 20-91-33



Remove the nut (Item 1) **[Figure 20-91-33]**.

Figure 20-91-34



Press the pinion out the bottom of the carrier **[Figure 20-91-34]**.

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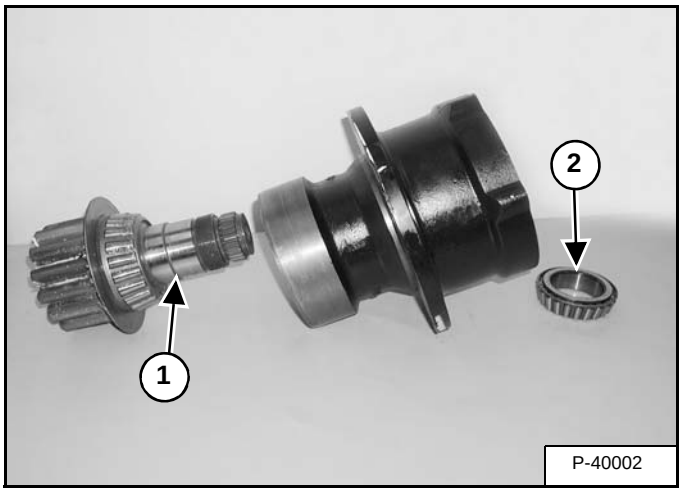
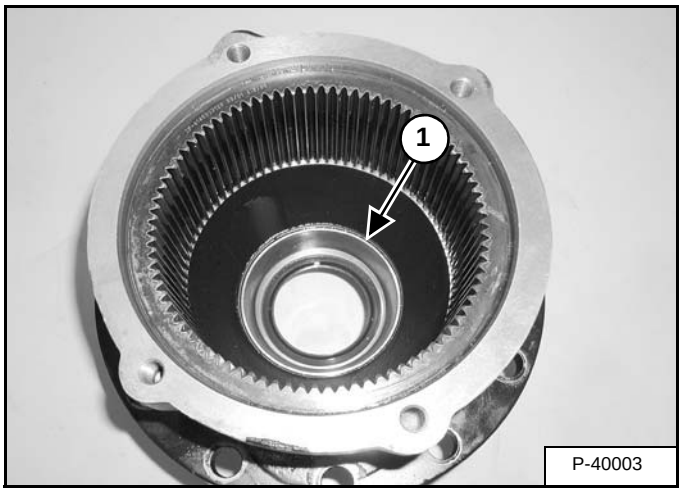
Disassembly (Cont'd)

Figure 20-91-35



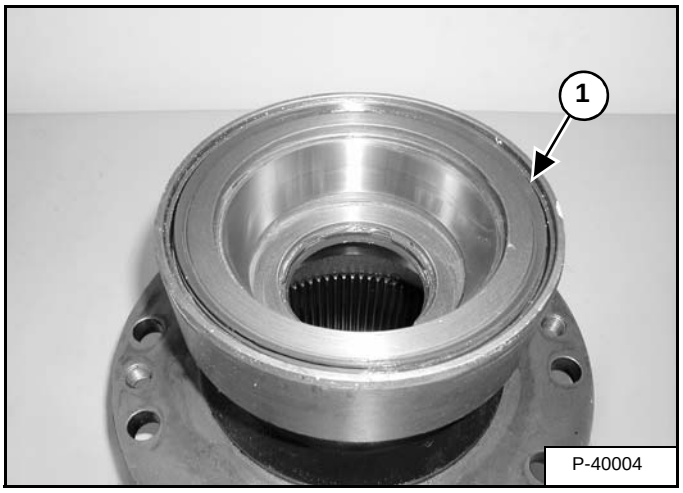
Remove the pinion (item 1) and top bearing (Item 2) **[Figure 20-91-35]**.

Figure 20-91-36



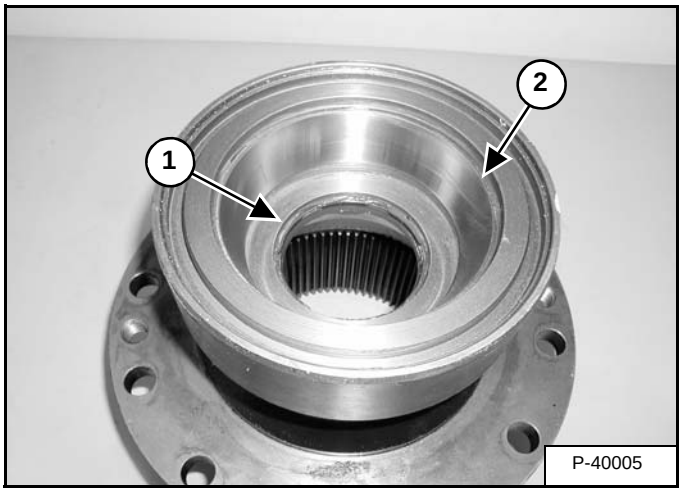
Remove the top bearing race (Item 1) **[Figure 20-91-36]**.

Figure 20-91-37



Turn the carrier over and remove the scraper seal (Item 1) **[Figure 20-91-37]**.

Figure 20-91-38



Remove the seal (Item 1) and bottom bearing race (Item 2) **[Figure 20-91-38]**.

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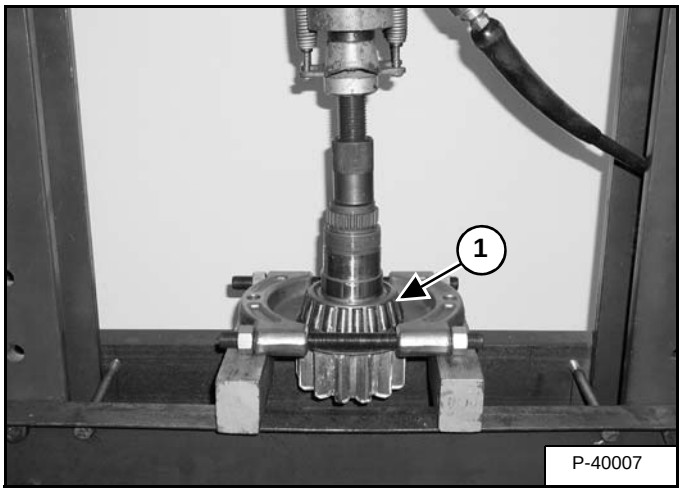
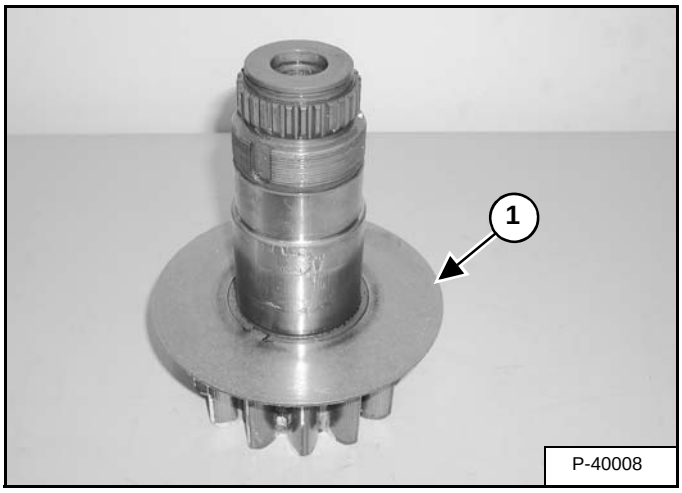
Disassembly (Cont'd)

Figure 20-91-39



Press the lower bearing (Item 1) **[Figure 20-91-39]** off the shaft.

Figure 20-91-40



Remove the washer (Item 1) **[Figure 20-91-40]**.

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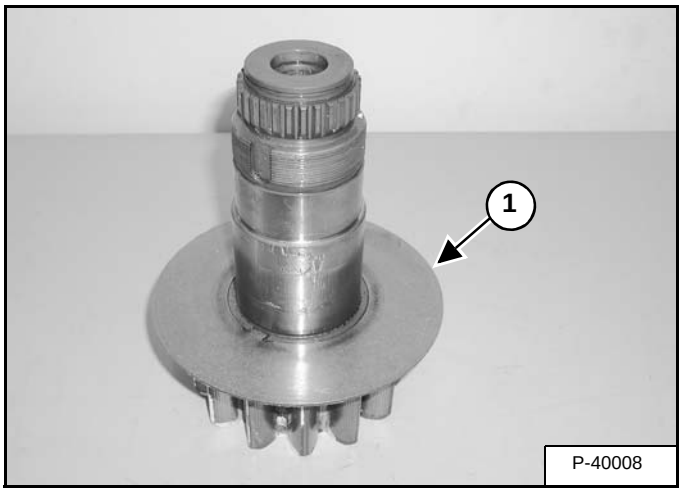
Assembly

Clean all components in solvent and dry with compressed air.

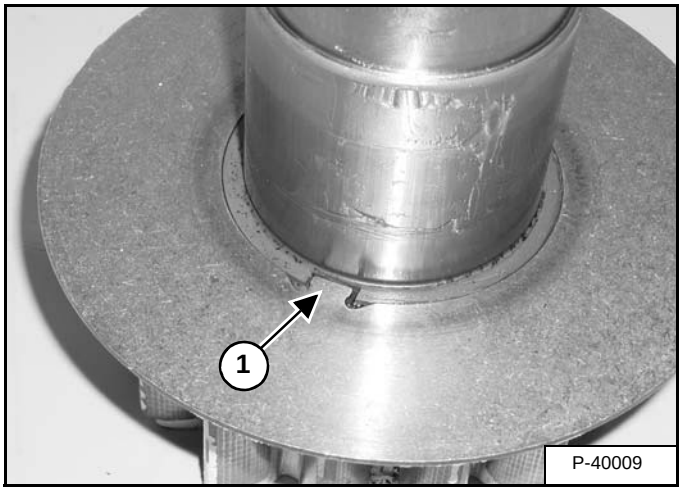
Replace all seals and components that are worn or damaged.

Figure 20-91-41



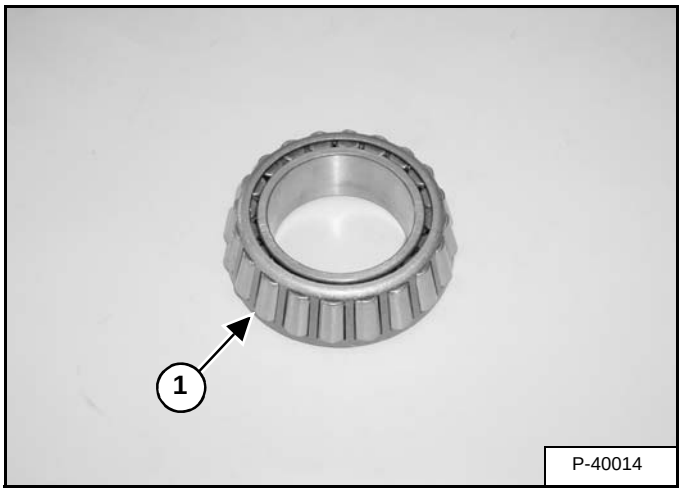
Install the washer (Item 1) **[Figure 20-91-41]**.

Figure 20-91-42



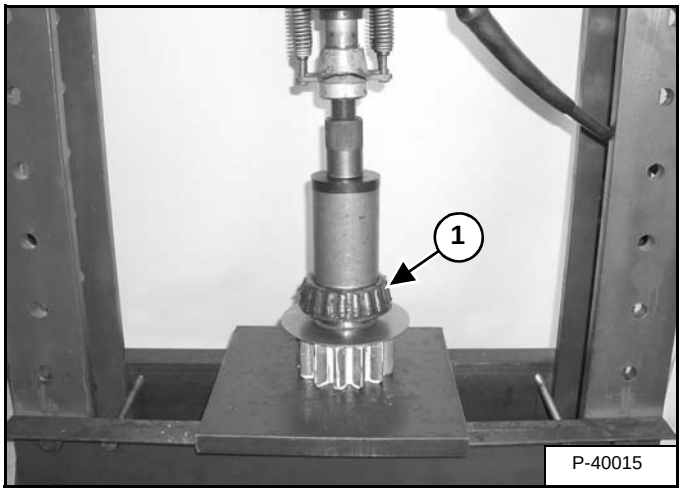
NOTE: Make sure the tab (Item 1) [Figure 20-91-42] is installed in the slot of the shaft.

Figure 20-91-43



Pack the lower bearing (Item 1) **[Figure 20-91-43]** with a good quality high temperature NLGI grease.

Figure 20-91-44



Press the bearing (Item 1) **[Figure 20-91-44]** on the shaft.

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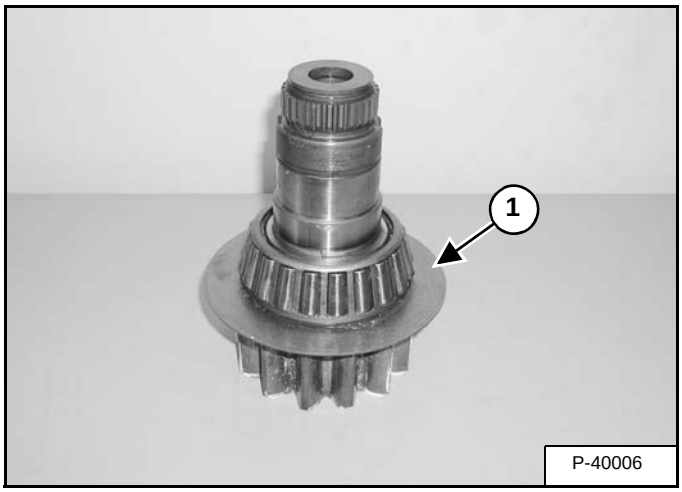
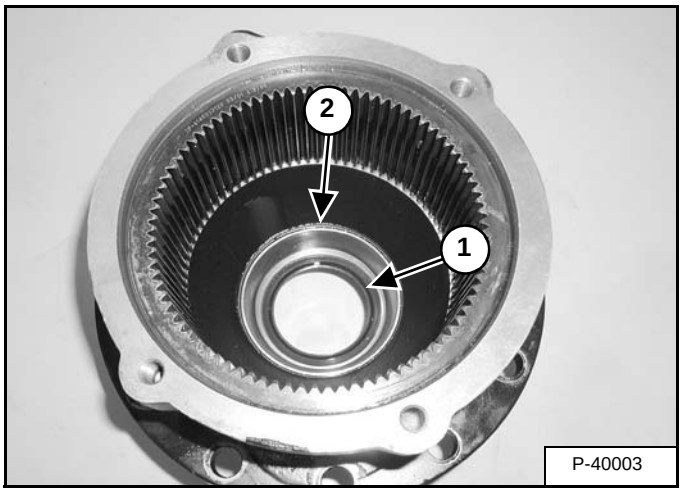
Assembly (Cont'd)

Figure 20-91-45



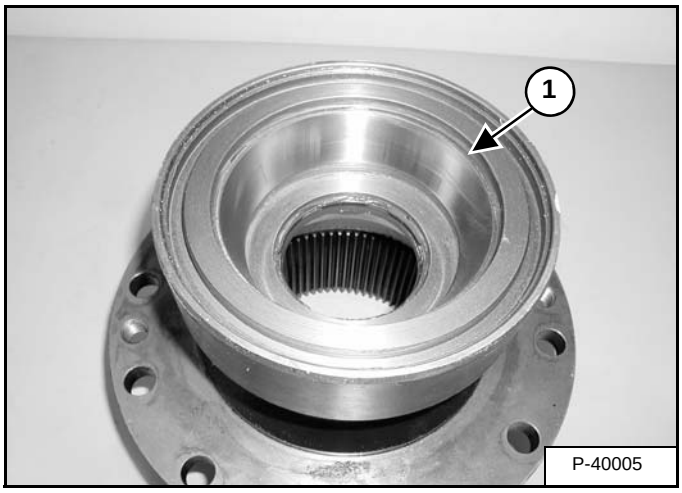
Apply a light coat of grease to the bearing side of the washer (Item 1) **[Figure 20-91-45]**.

Figure 20-91-46



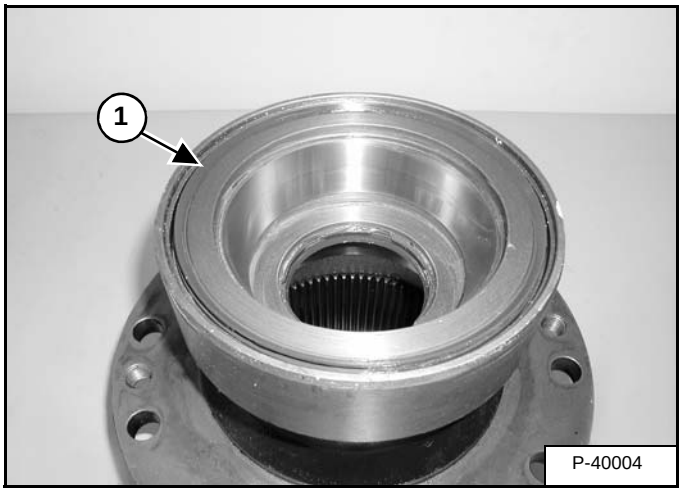
Install the seal (Item 1) and bearing race (Item 2) **[Figure 20-91-46]**.

Figure 20-91-47



Turn the carrier over and install the bearing race (Item 1) **[Figure 20-91-47]**.

Figure 20-91-48



Install the seal (Item 1) **[Figure 20-91-48]**.

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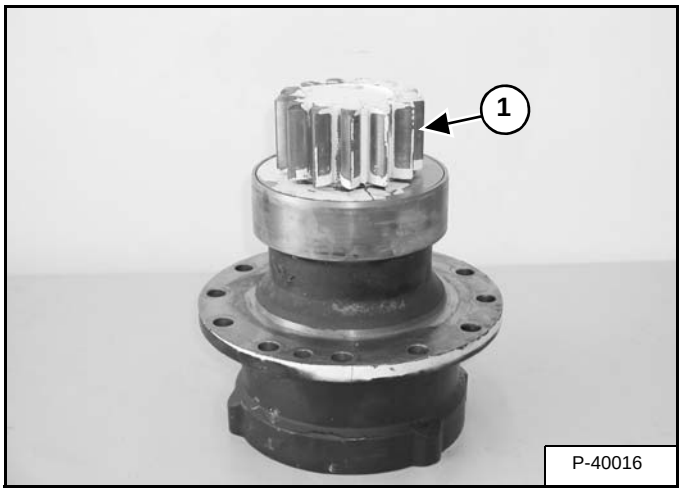
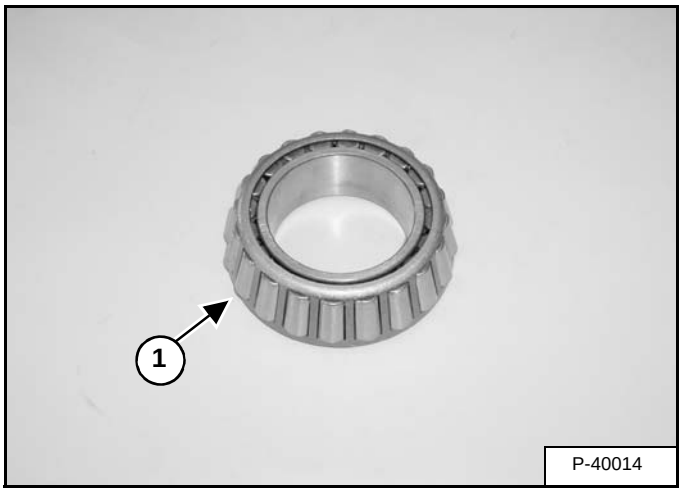
Assembly (Cont'd)

Figure 20-91-49



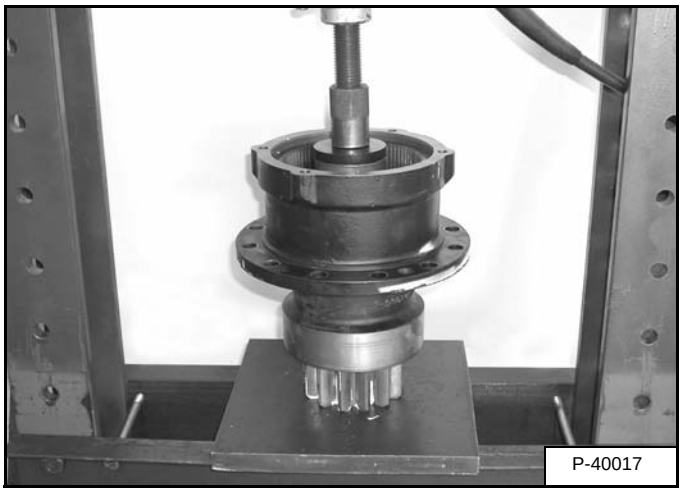
Install the shaft (Item 1) **[Figure 20-91-49]** in the carrier.

Figure 20-91-50



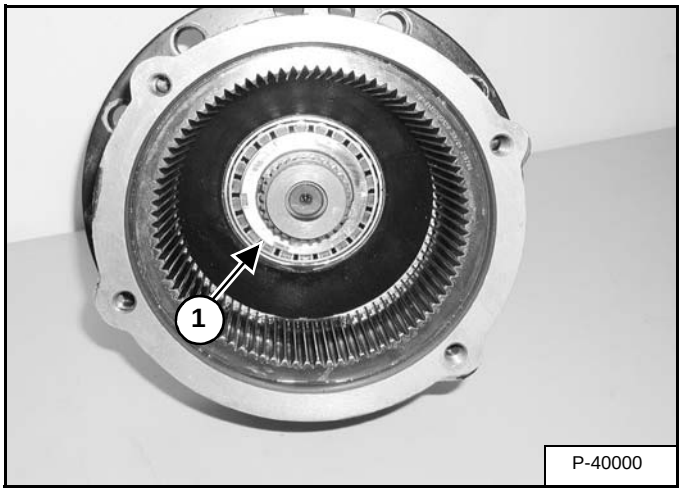
Apply clean hydraulic fluid or assembly lube to the top bearing (Item 1) **[Figure 20-91-50]**.

Figure 20-91-51



Press the top bearing on the shaft **[Figure 20-91-51]**.

Figure 20-91-52



Install the inner nut (Item 1) **[Figure 20-91-52]**. Tighten the nut to 147-221 ft.-lb. (200-300 N•m) torque to seat the bearings.

Loosen the nut 15 to 30 degrees after the inner nut has been installed. The shaft should turn when 1.5-3.7 ft.-lb. (2-5 N•m) of force is applied to the shaft.

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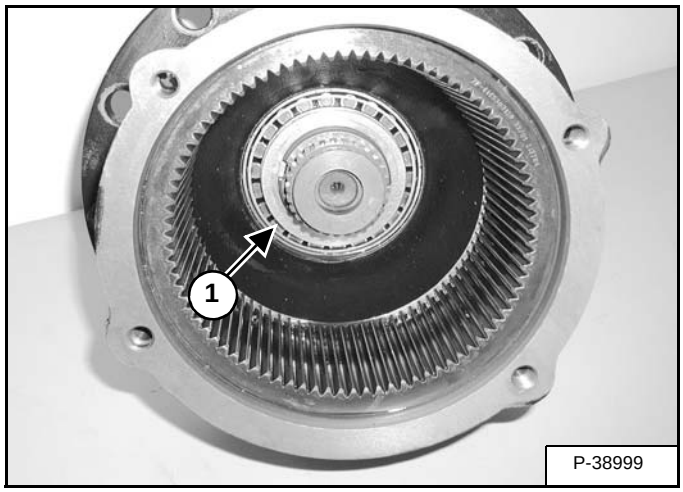
Assembly (Cont'd)

Figure 20-91-53

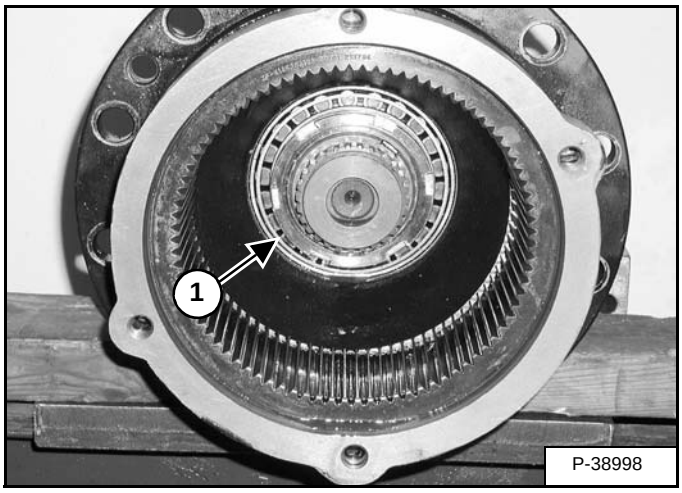


Install the washer (Item 1) **[Figure 20-91-53]**.

Figure 20-91-54

Support the carrier in a press. Clamp the carrier shaft with approximately 800 lb. (1085 N•m) of force **[Figure 20-91-54]**.

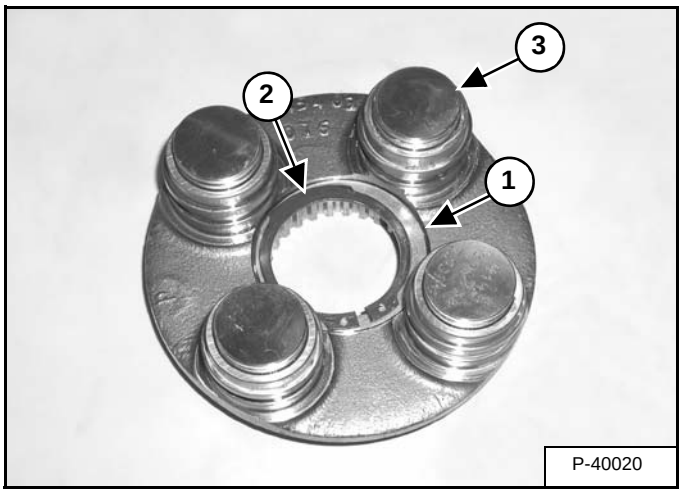
Figure 20-91-55



Install the outer nut (Item 1) **[Figure 20-91-55]**.

Tighten the nut to 480-550 ft.-lb. (650-750 N•m) torque.

Figure 20-91-56



Place the washer (Item 1) and snap ring (Item 2) **[Figure 20-91-56]** on the planetary carrier.

Apply assembly lube to the bottom of the planetary gear stud (Item 3) **[Figure 20-91-56]**.

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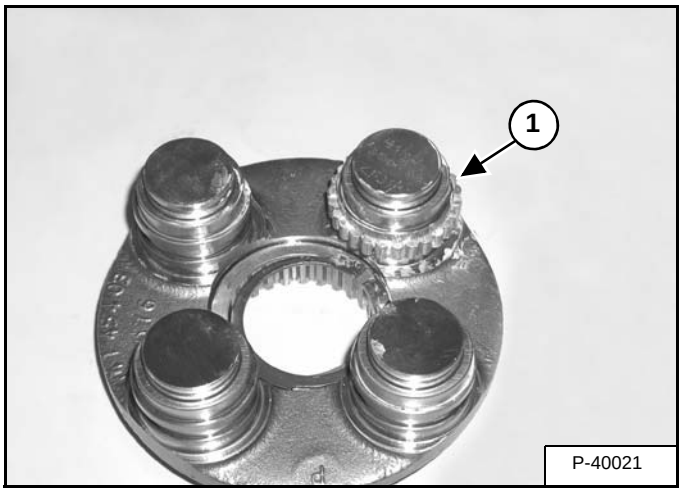
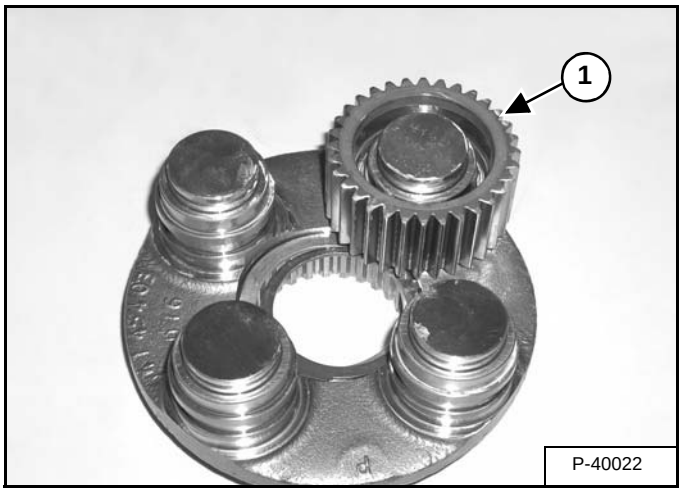
Assembly (Cont'd)

Figure 20-91-57



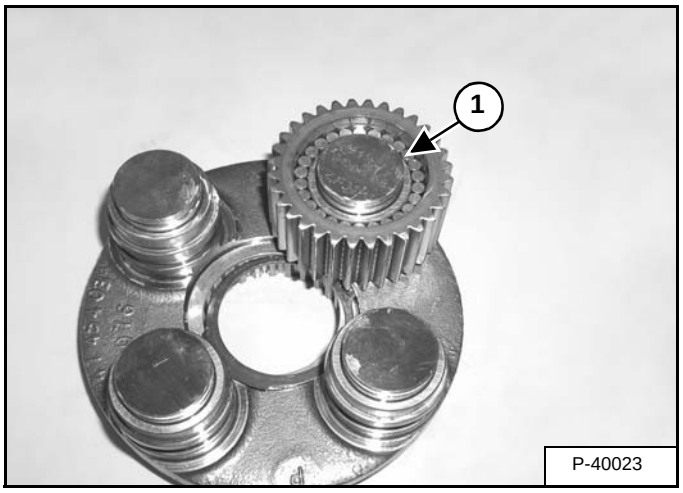
Install the bottom roller bearings (Item 1) **[Figure 20-91-57]** on the stud.

Figure 20-91-58



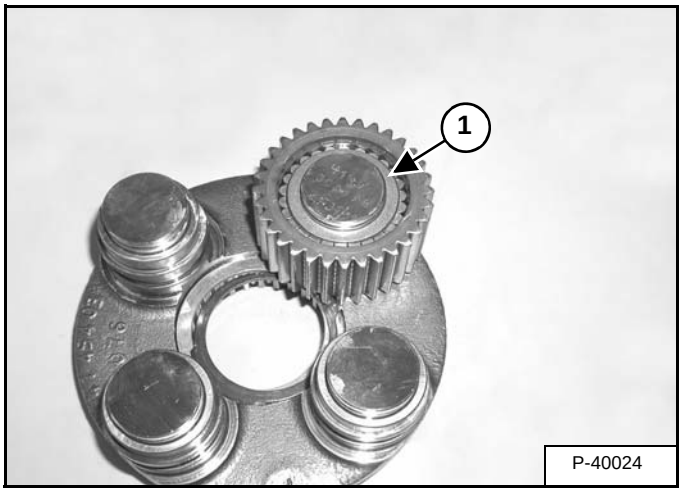
Install the gear (Item 1) **[Figure 20-91-58]**.

Figure 20-91-59



Install the top roller bearings (Item 1) **[Figure 20-91-59]**.

Figure 20-91-60



Install the washer (Item 1) **[Figure 20-91-60]** and snap ring.

Repeat the procedure for two additional planetary gear studs.

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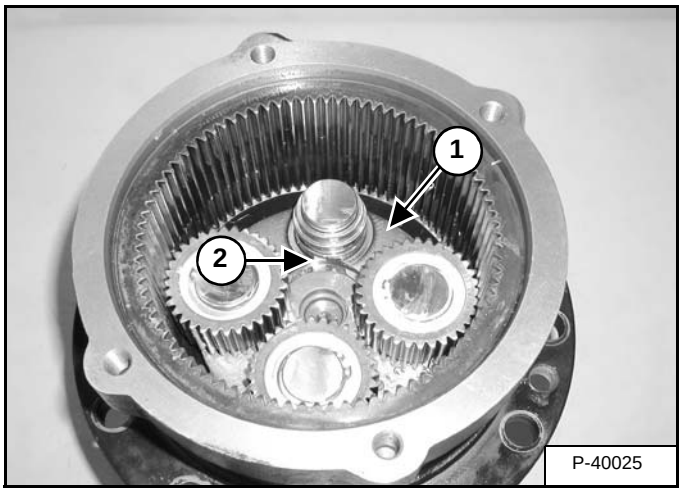
Assembly (Cont'd)

Figure 20-91-61

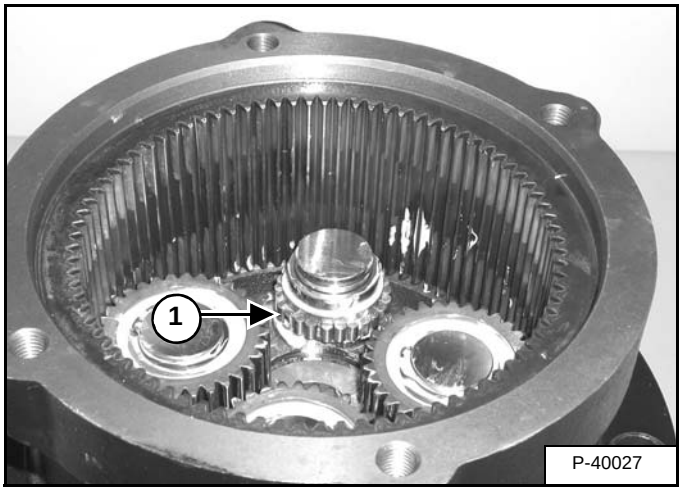


Install the planetary carrier (Item 1) **[Figure 20-91-61]** in the drive housing.

Install the snap ring (Item 2) **[Figure 20-91-61]**.

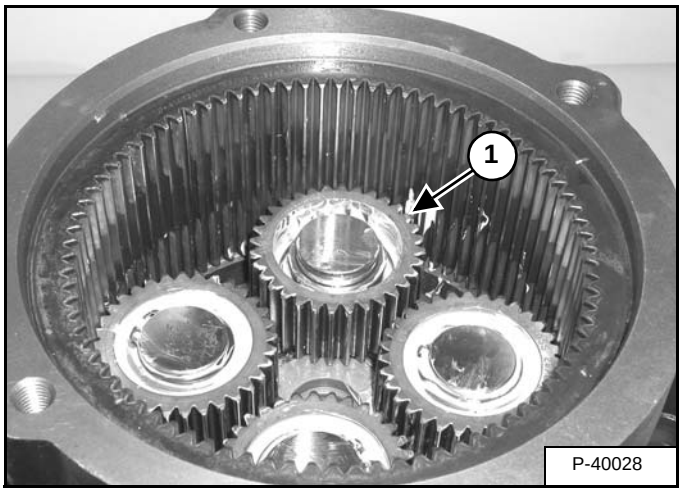
Apply assembly lube to the bottom of the planetary gear stud.

Figure 20-91-62



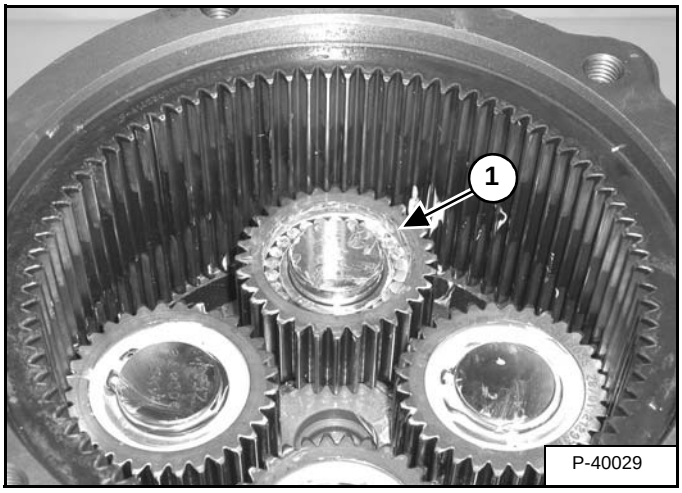
Install the bottom roller bearings (Item 1) **[Figure 20-91-62]**.

Figure 20-91-63



Install the gear (Item 1) **[Figure 20-91-63]**.

Figure 20-91-64



Install the top roller bearings (Item 1) **[Figure 20-91-64]**.

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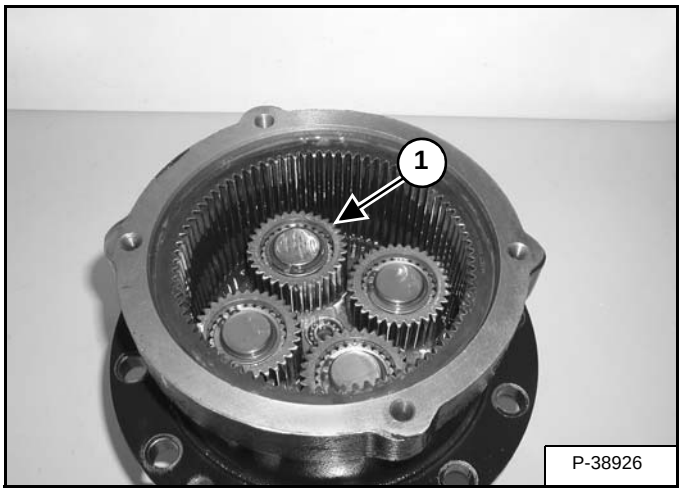
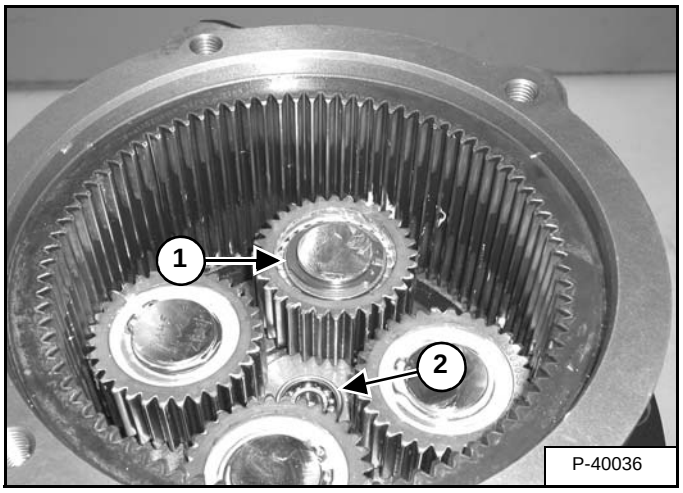
Assembly (Cont'd)

Figure 20-91-65



Install the washer (Item 1) **[Figure 20-91-65]**.

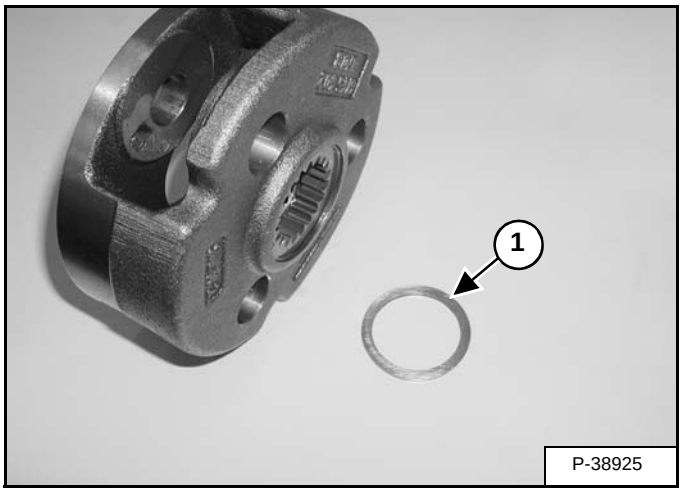
Figure 20-91-66



Install the snap ring (Item 1) **[Figure 20-91-66]**.

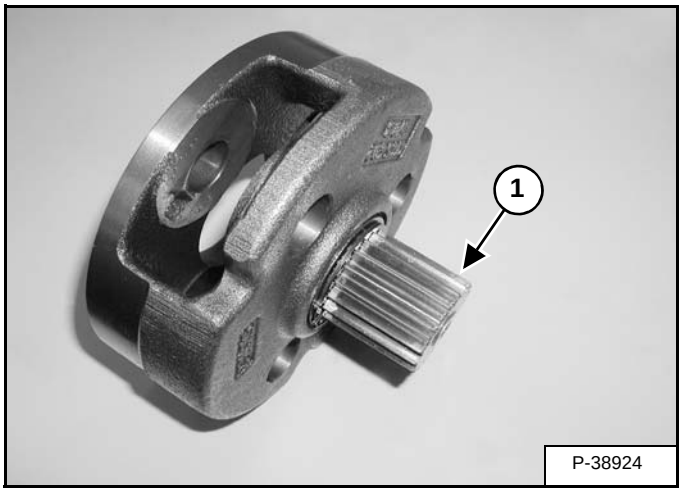
Apply assembly lube to the bearing (Item 2) **[Figure 20-91-66]** and install the bearing.

Figure 20-91-67



Install the washers (Item 1) **[Figure 20-91-67]** on either side of the pinion cage.

Figure 20-91-68



Install the shaft (Item 1) **[Figure 20-91-68]**.

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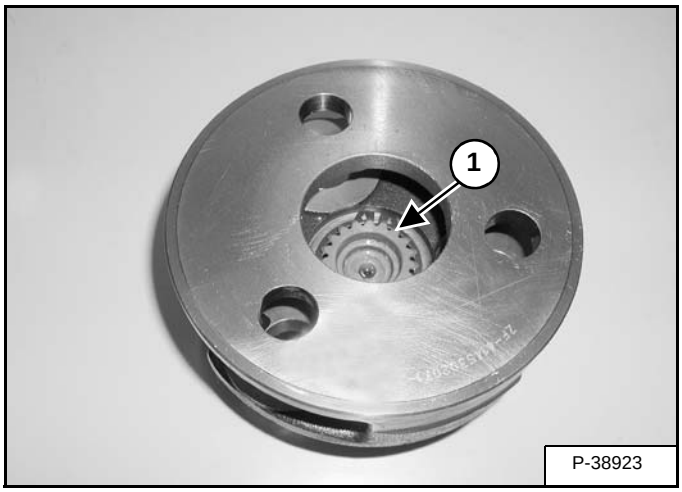
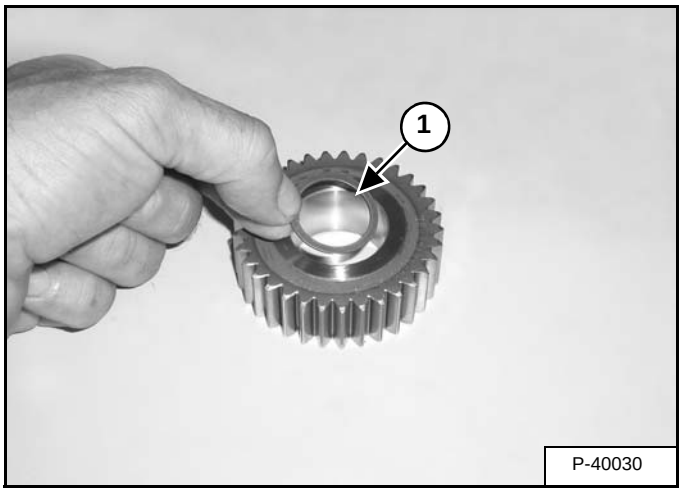
Assembly (Cont'd)

Figure 20-91-69



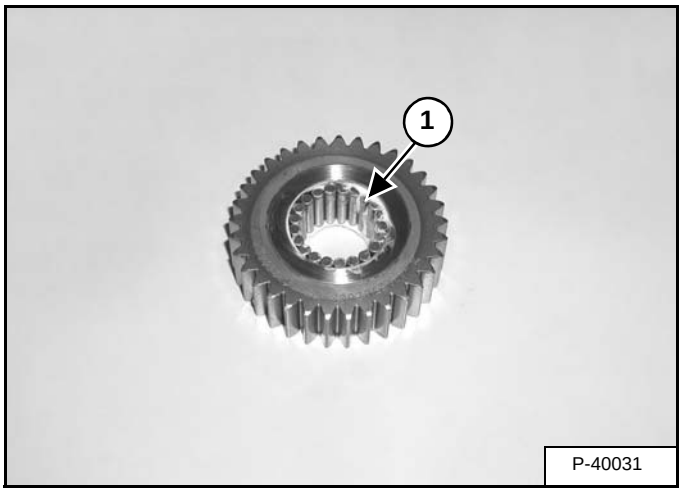
Install the snap ring (Item 1) **[Figure 20-91-69]**.

Figure 20-91-70



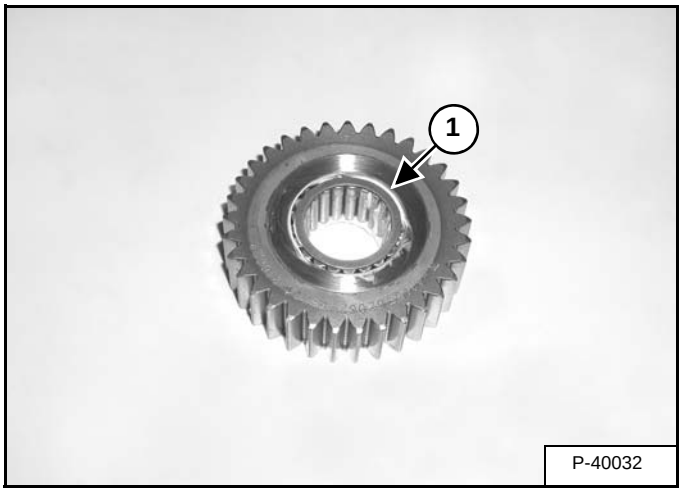
Install the bottom washer (Item 1) **[Figure 20-91-70]**.

Figure 20-91-71



Apply assembly lube to the roller bearings and install the bearings (Item 1) **[Figure 20-91-71]** in the gear.

Figure 20-91-72



Install the top washer (Item 1) **[Figure 20-91-72]**.

Turn the pinion cage over.

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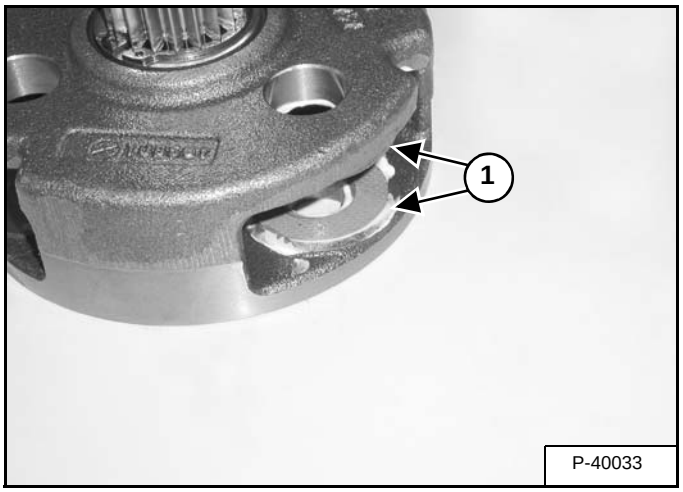
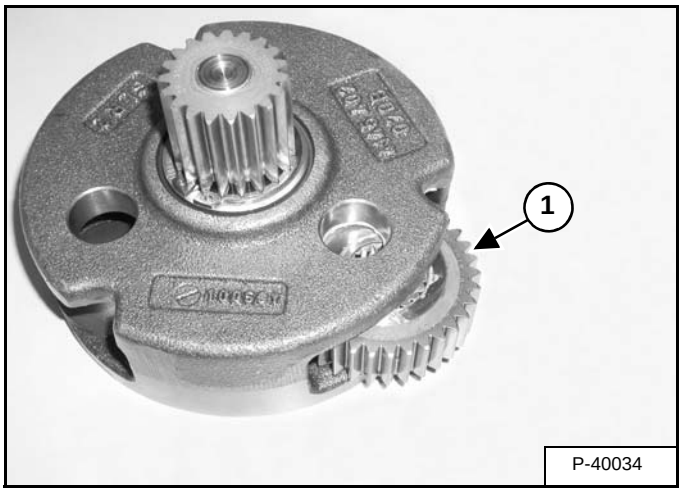
Assembly (Cont'd)

Figure 20-91-73



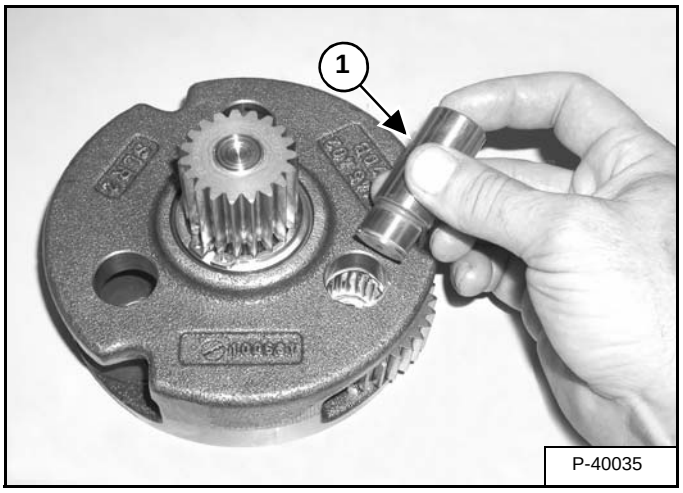
Apply assembly lube to the thrust washers and install the top and bottom washers (Item 1) **[Figure 20-91-73]**.

Figure 20-91-74



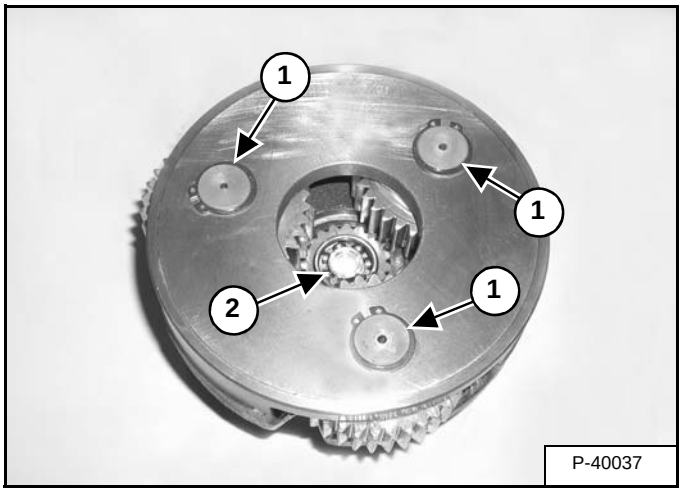
Install the gear/bearing assembly (Item 1) **[Figure 20-91-74]**.

Figure 20-91-75



Install the pin (Item 1) **[Figure 20-91-75]**. Repeat the procedure for two remaining pinion cage gears.

Figure 20-91-76



Turn the pinion cage over and install the snap rings (Item 1) **[Figure 20-91-76]**.

Apply assembly lube to the bearing and install the bearing (Item 2) **[Figure 20-91-76]**.

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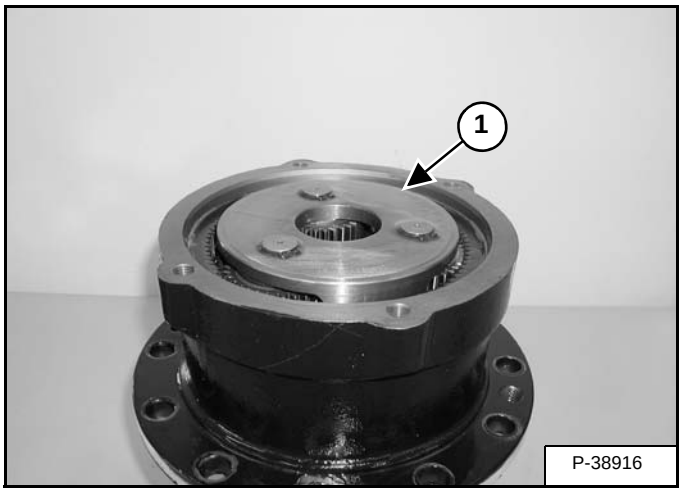
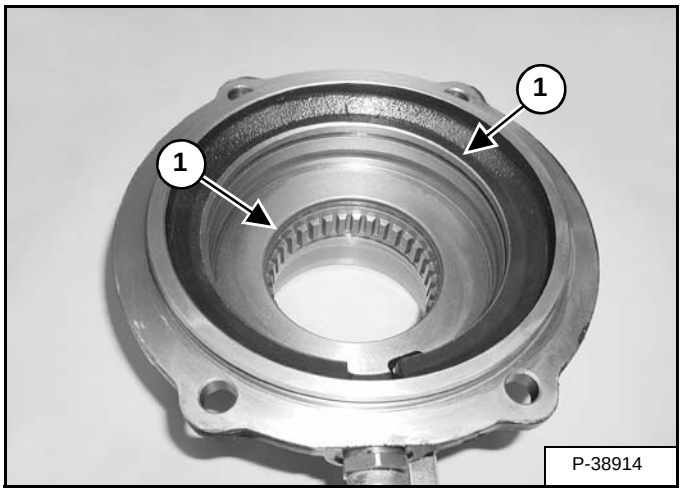
Assembly (Cont'd)

Figure 20-91-77



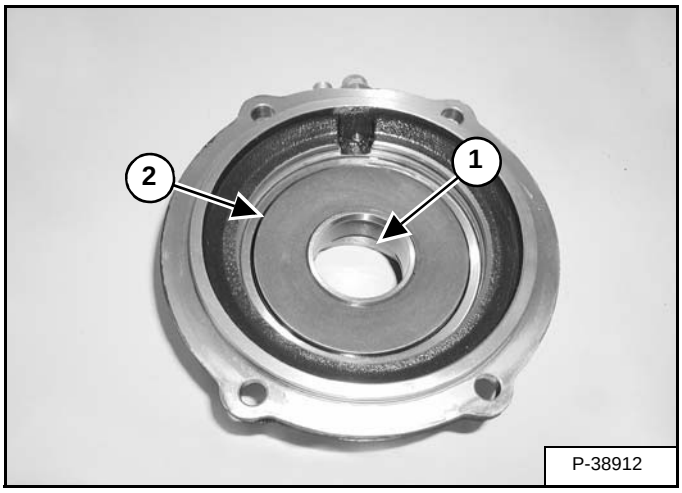
Install the pinion cage (Item 1) **[Figure 20-91-77]**.

Figure 20-91-78



Install the 2 seals (Item 1) **[Figure 20-91-78]** in the brake housing.

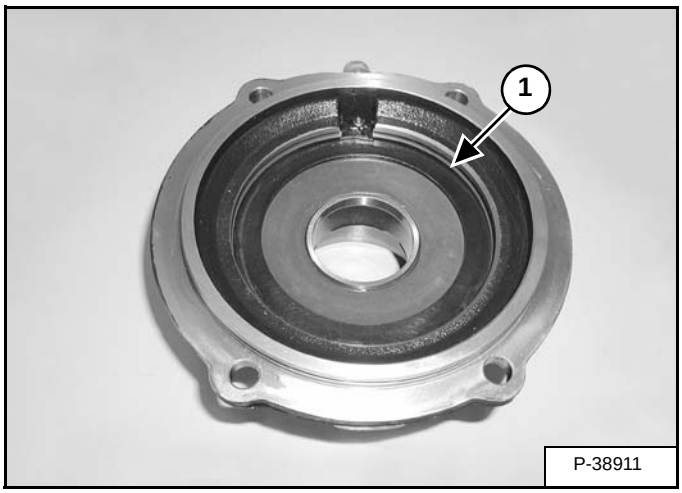
Figure 20-91-79



Install the piston (Item 1) **[Figure 20-91-79]**.

Install the belleville spring (Item 2) **[Figure 20-91-79]**.

Figure 20-91-80



Install the spring support (Item 1) **[Figure 20-91-80]**.

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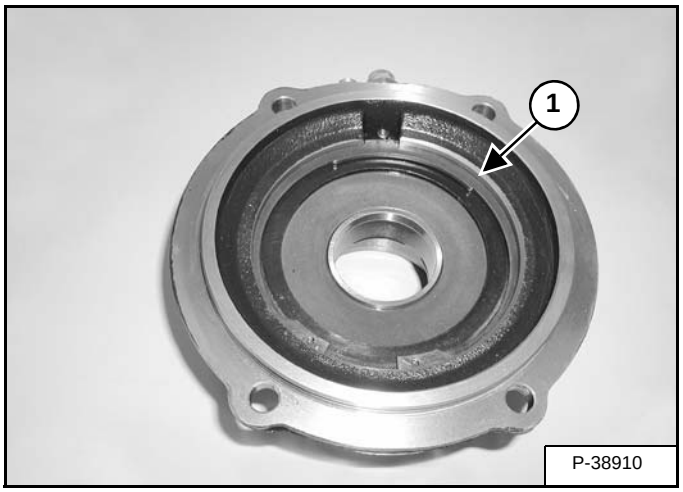
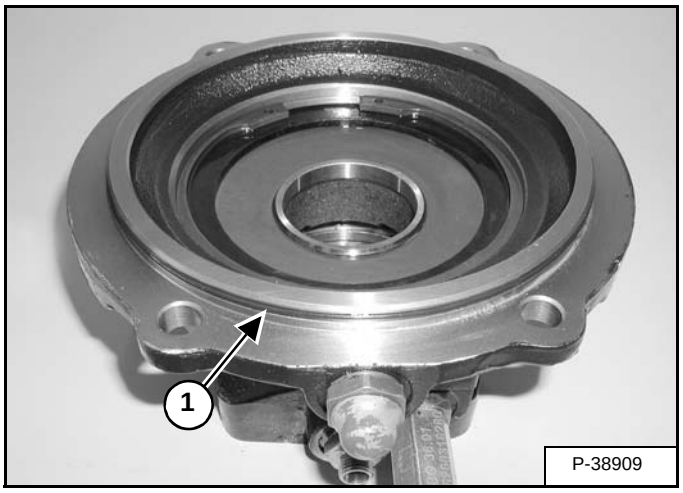
Assembly (Cont'd)

Figure 20-91-81



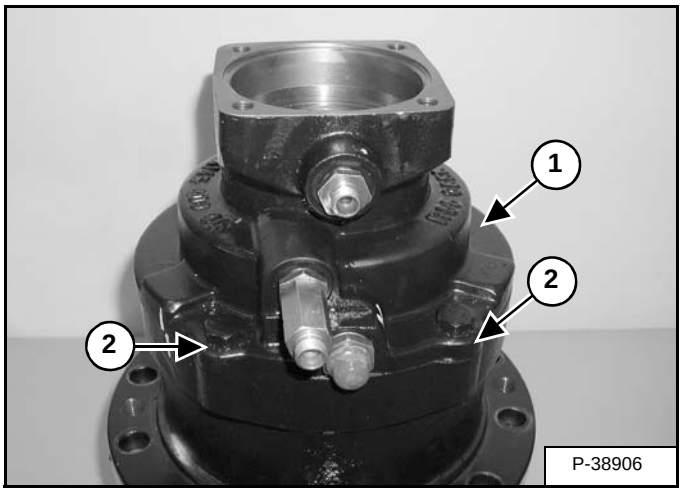
Install the snap ring (Item 1) **[Figure 20-91-81]**.

Figure 20-91-82



Install the O-ring (Item 1) **[Figure 20-91-82]**.

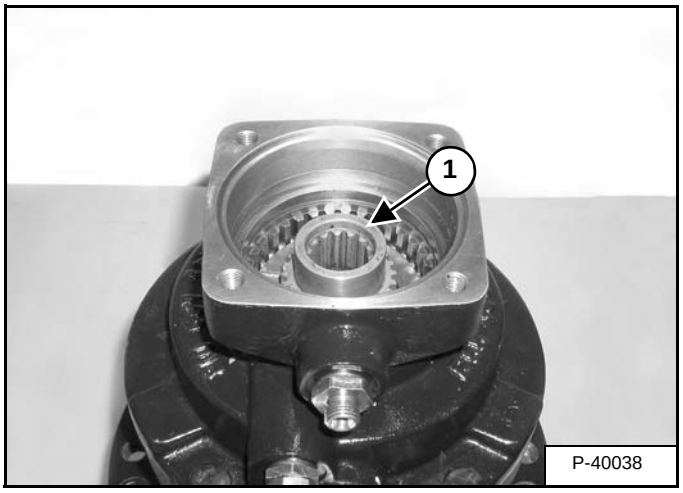
Figure 20-91-83



Install the brake housing (Item 1) **[Figure 20-91-83]** on the carrier.

Install the four bolts (Item 2) **[Figure 20-91-83]**. Tighten the bolts to 63 ft.-lb. (86 N•m) torque.

Figure 20-91-84



Install the driveshaft (Item 1) **[Figure 20-91-84]**.

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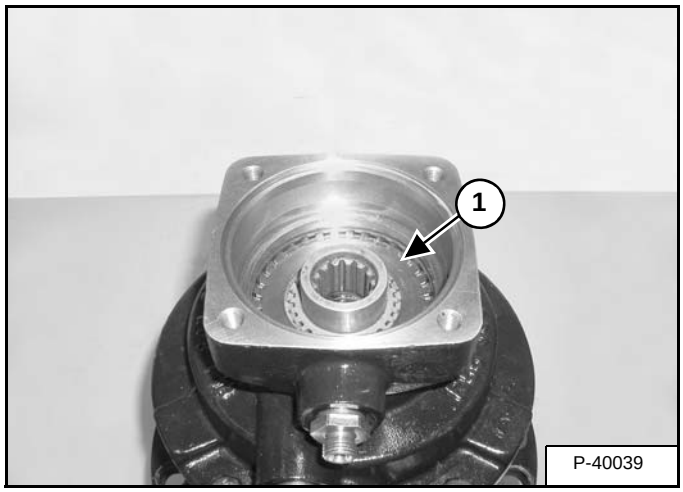
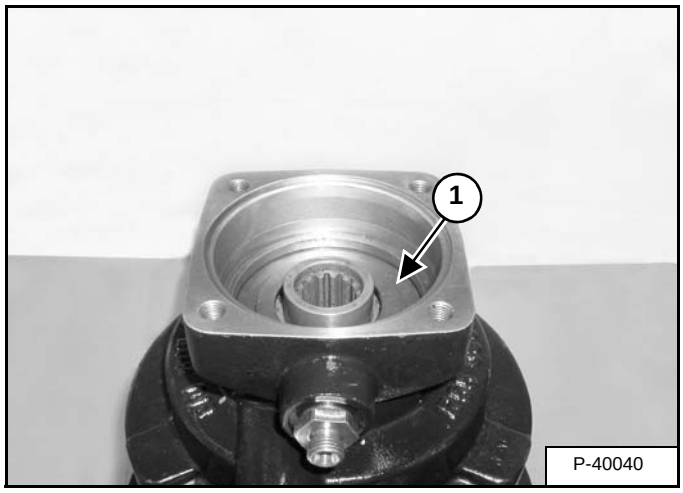
Assembly (Cont'd)

Figure 20-91-85



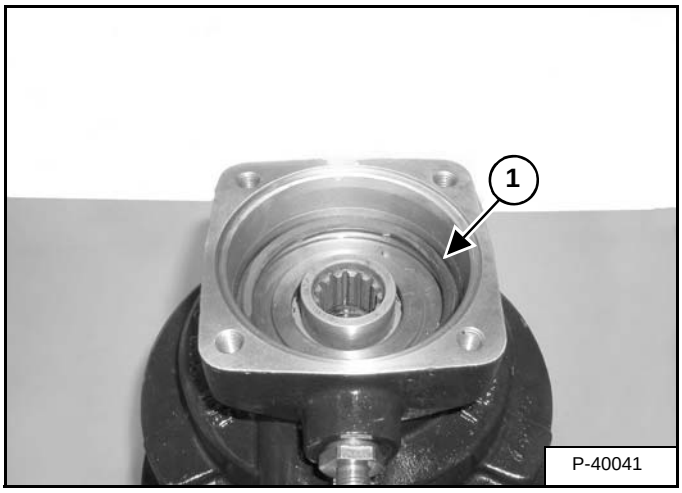
Install the internal and external brake discs (Item 1) **[Figure 20-91-85]**.

Figure 20-91-86



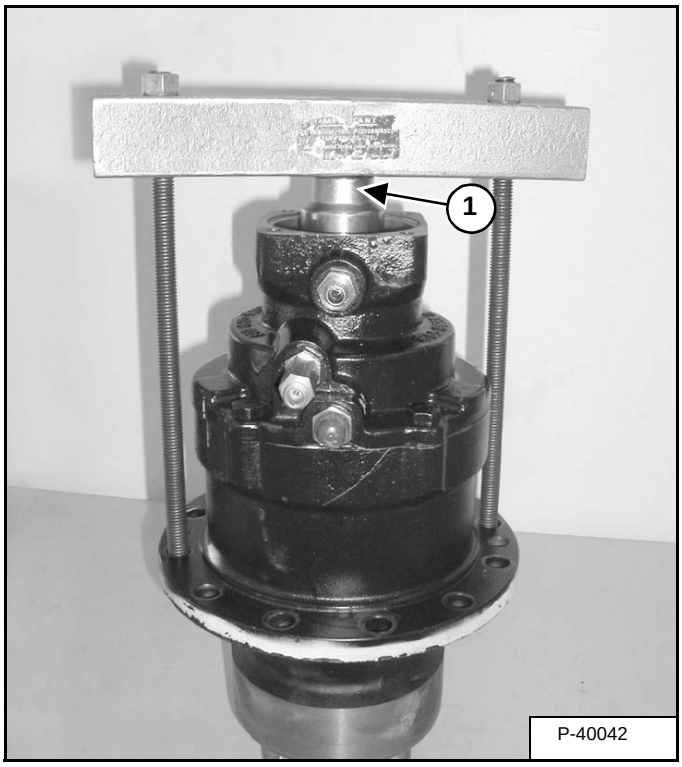
Install the plunger disc (Item 1) **[Figure 20-91-86]**.

Figure 20-91-87



Lay the snap ring (Item 1) **[Figure 20-91-87]** in the brake housing.

Figure 20-91-88



Using a 2.0 inch ID x 2.25 inch OD x 2.750 inch long (50.8 mm ID x 57.2 mm OD x 69.9 mm long) steel tubing (Item 1) **[Figure 20-91-88]** Press down on the plunger disc to compress the brake discs and belleville spring.

NOTE: The top external brake disc does not fully engage the brake carrier splines when first installed. Use care when compressing the discs to not damage the top disc.

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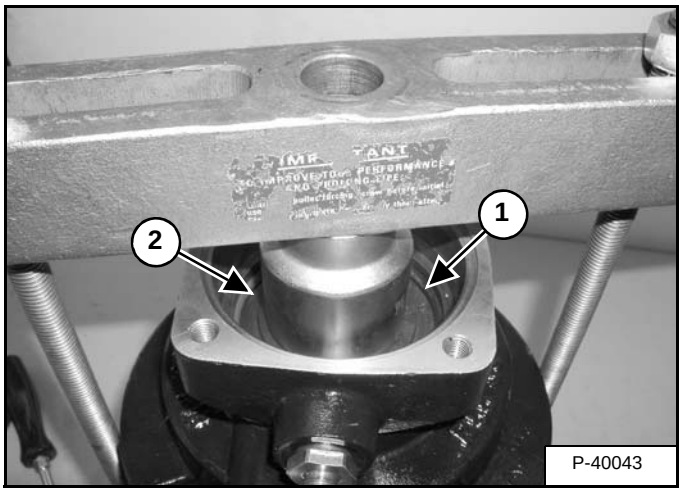
Assembly (Cont'd)

Figure 20-91-89



Install the snap ring (Item 1). Remove the tube (Item 2) **[Figure 20-91-89]** and press assembly from the carrier.

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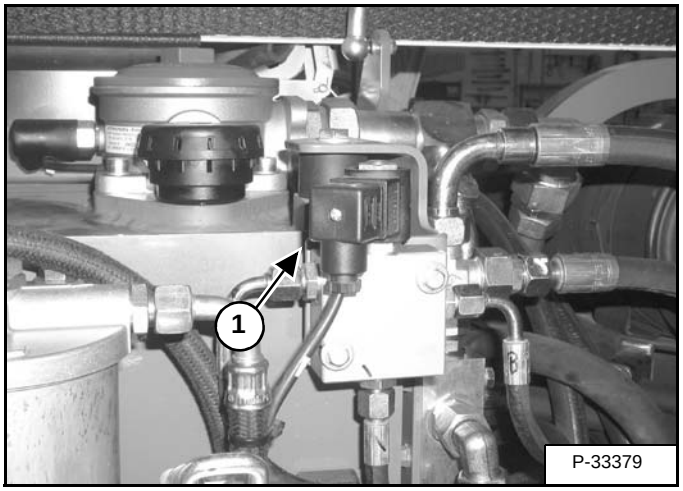
SWING BRAKE VALVE

Removal And Installation

Open the rear cover.

Figure 20-92-1



Remove the wire harness (Item 1) **[Figure 20-92-1]**.

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.

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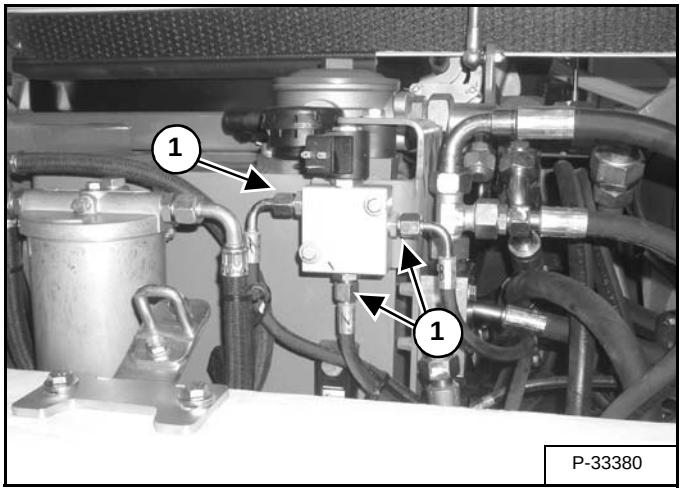
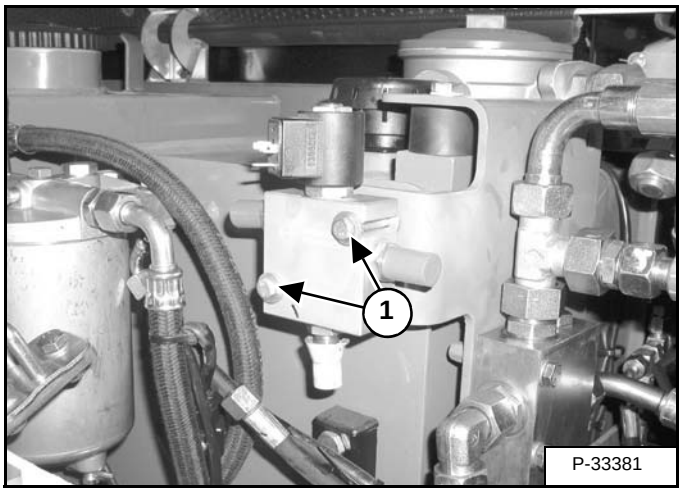
Figure 20-92-2



Mark and remove the three hoses (Item 1) **[Figure 20-92-2]**.

Figure 20-92-3



Remove the 2 bolts (Item 1) **[Figure 20-92-3]** and washers.

Installation: Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

Remove the valve.

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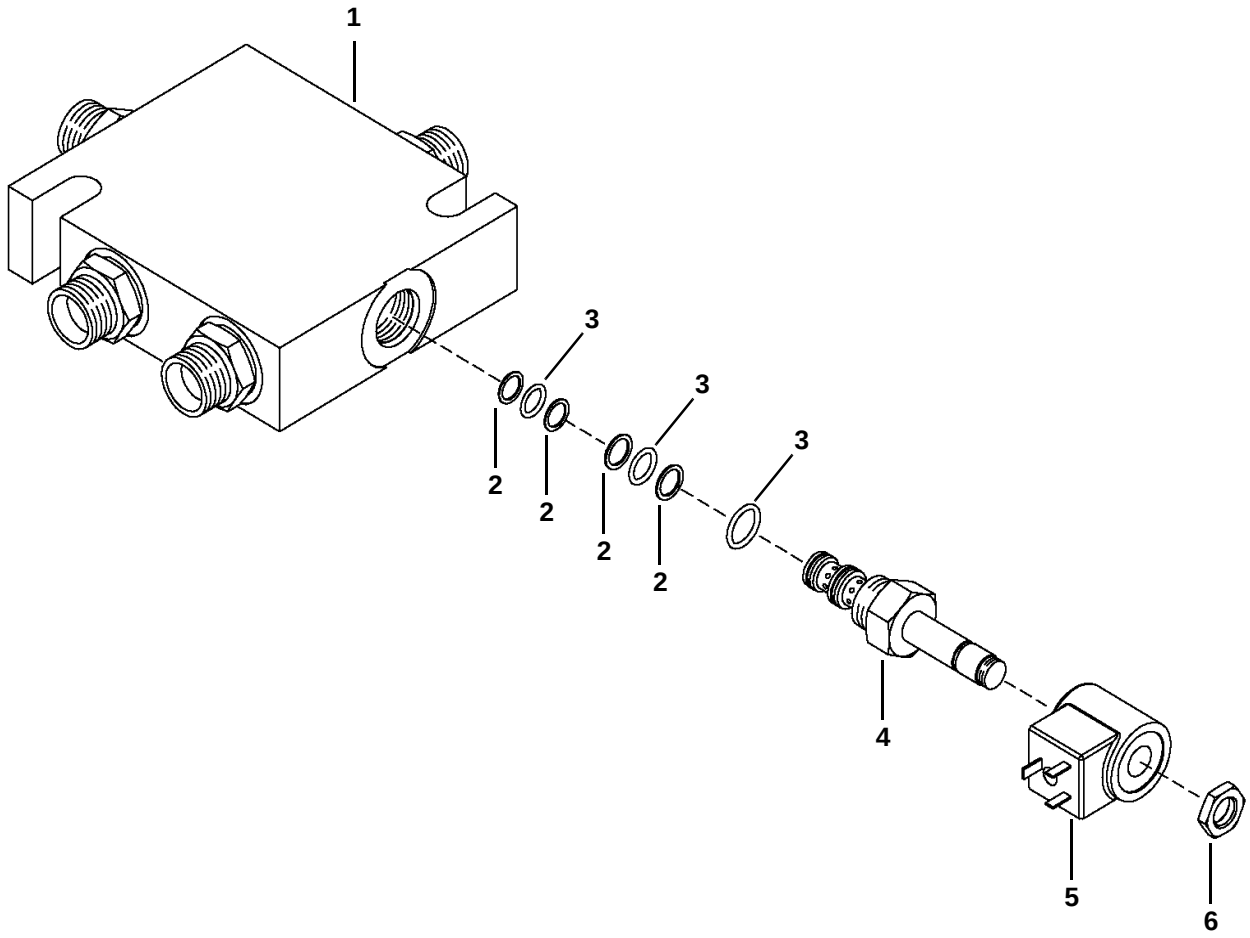
Parts Identification

1. **Housing**
2. **Back-up Ring**
3. **O-Ring**
4. **Solenoid Valve**
5. **Coil**
6. **Nut**



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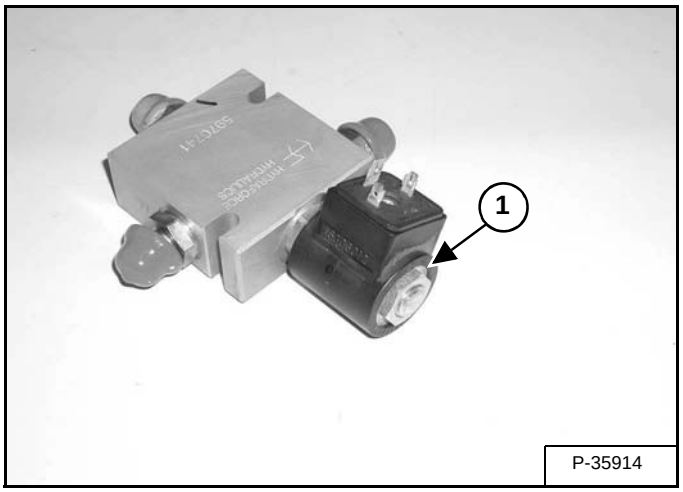
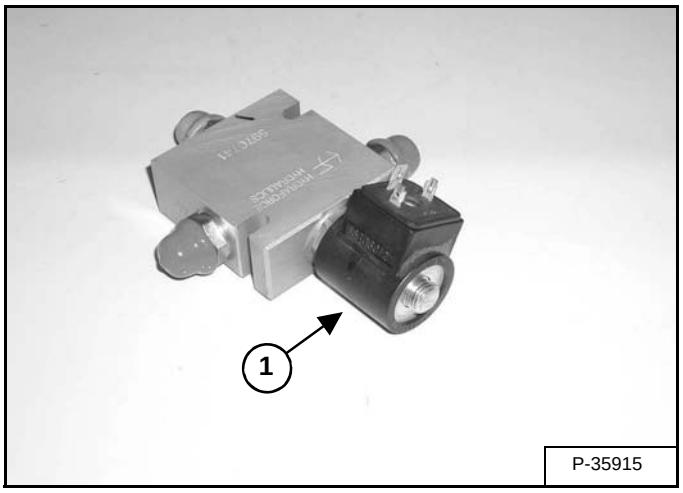
Disassembly And Assembly

Figure 20-92-4



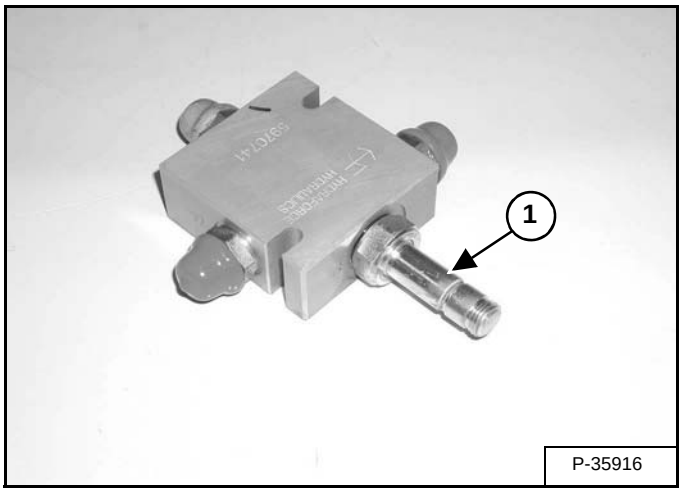
Remove the nut (Item 1) **[Figure 20-92-4]**.

Figure 20-92-5



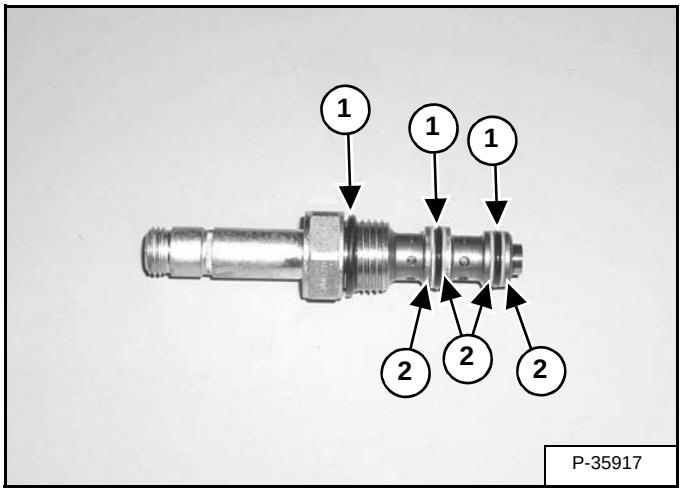
Remove the coil (Item 1) **[Figure 20-92-5]**.

Figure 20-92-6



Remove the solenoid valve (Item 1) **[Figure 20-92-6]**.

Figure 20-92-7



Remove the O-rings (Item 1) and back-up rings (Item 2) **[Figure 20-92-7]**.

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SWING BRAKE RELEASE VALVE

Removal And Installation

Open the rear cover.

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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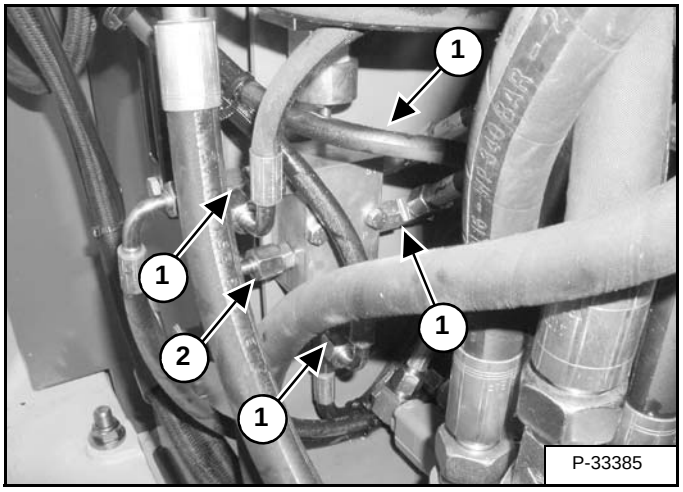
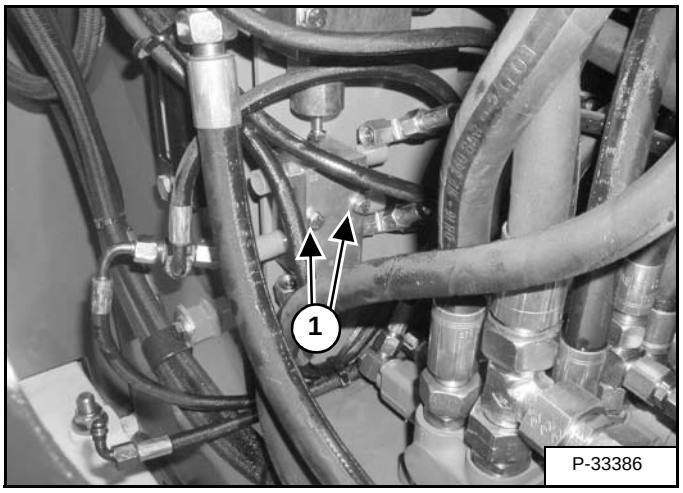
Figure 20-93-1



Mark and remove the four tees (Item 1) **[Figure 20-93-1]**.

Remove the hose (Item 2) **[Figure 20-93-1]**.

Figure 20-93-2



Remove the two bolts (Item 1) **[Figure 20-93-2]**.

Installation: Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

Remove the valve.

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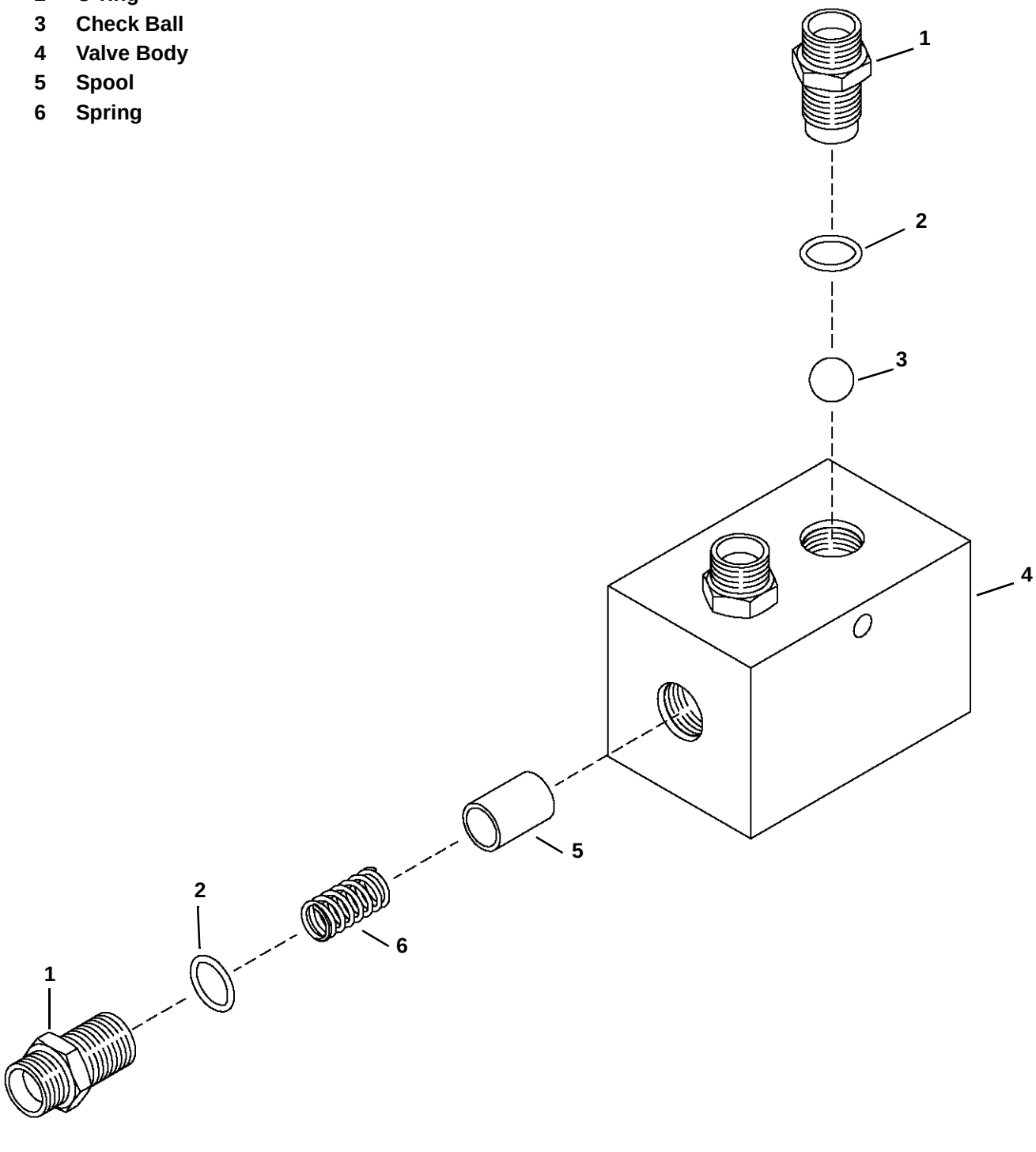
Parts Identification

1 Fitting
2 O-ring
3 Check Ball
4 Valve Body
5 Spool
6 Spring



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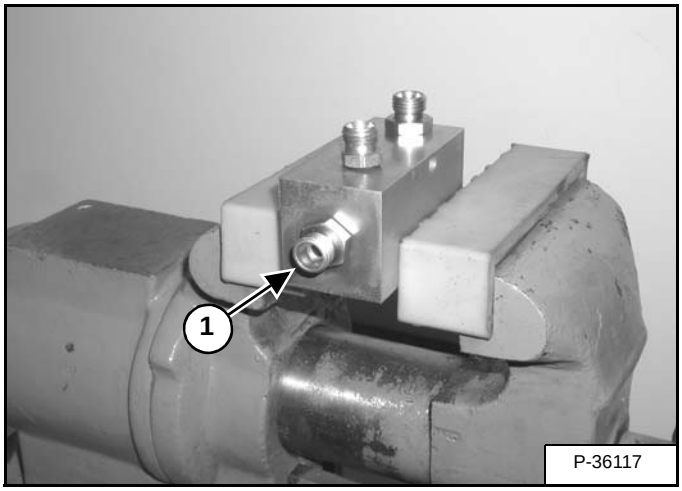
Disassembly And Assembly

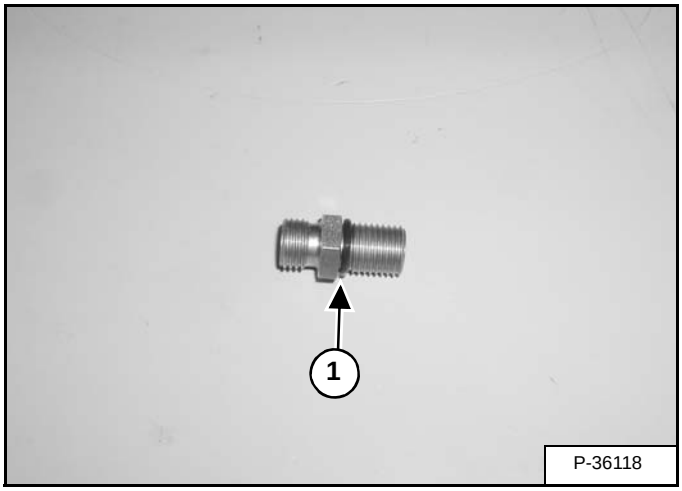
Place the valve in a vise that is equipped with soft jaws.

Figure 20-93-3



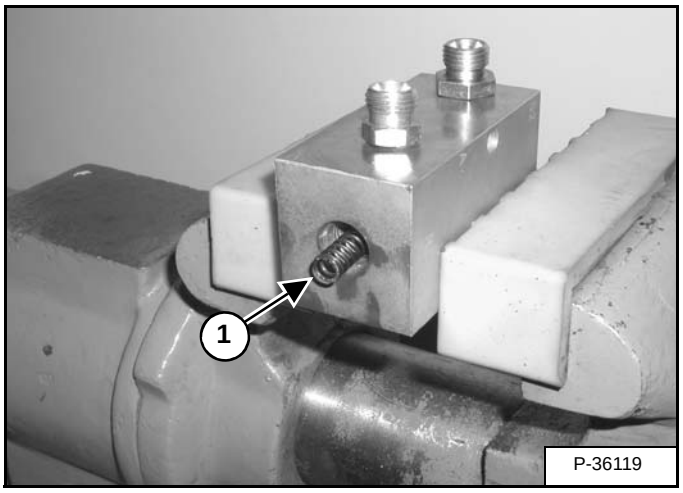
Remove the fitting (Item 1) **[Figure 20-93-3]** from the "R" port.

Figure 20-93-4



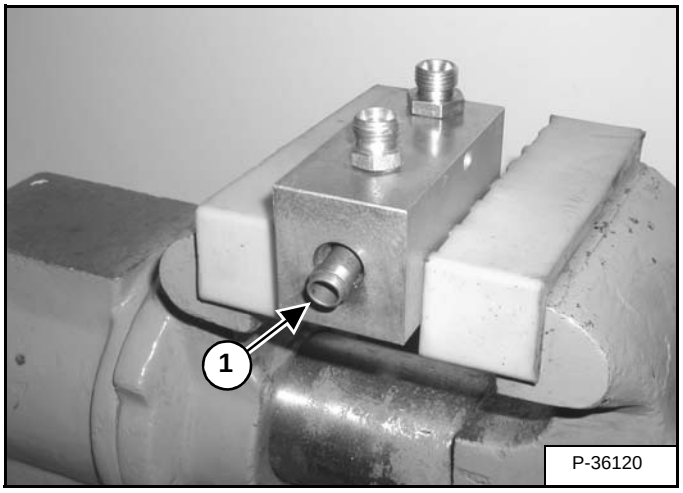
Remove the O-ring (Item 1) **[Figure 20-93-4]** from the fitting.

Figure 20-93-5



Remove the spring (Item 1) **[Figure 20-93-5]**.

Figure 20-93-6



Remove the spool (Item 1) **[Figure 20-93-6]**.

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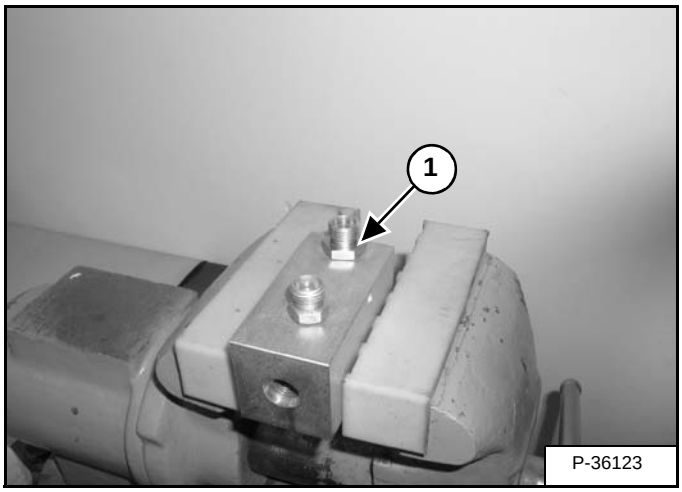
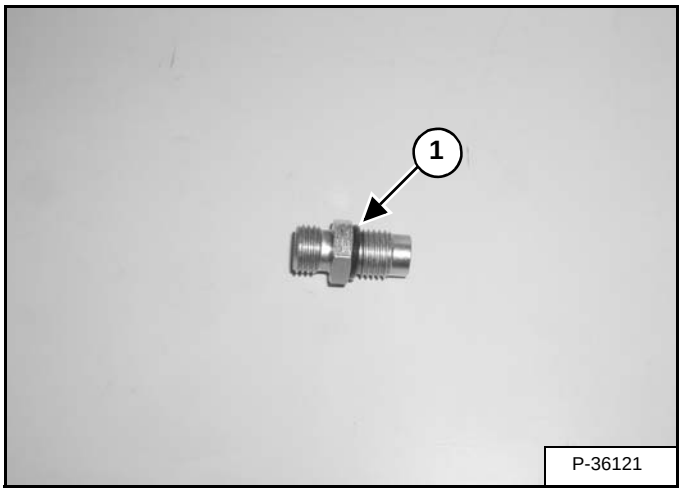
Disassembly And Assembly (Cont'd)

Figure 20-93-7



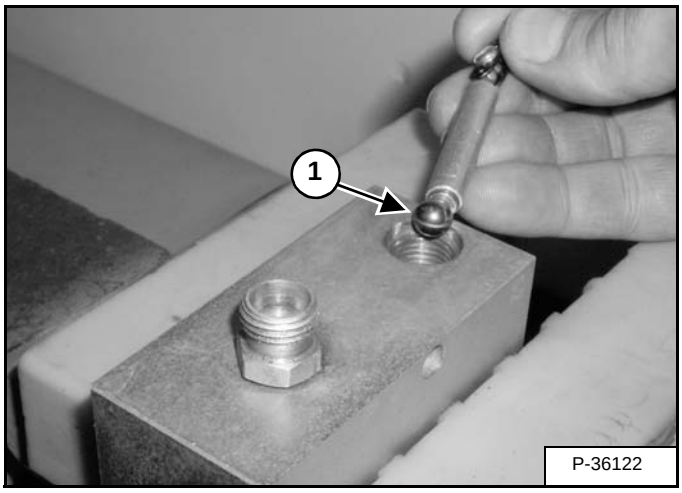
Remove the fitting (Item 1) **[Figure 20-93-7]** from the "S2" port.

Figure 20-93-8



Remove the O-ring (Item 1) **[Figure 20-93-8]**.

Figure 20-93-9



Remove the check ball (Item 1) **[Figure 20-93-9]**.

NOTE: Do not remove the fittings from the A, P or S1 ports. The fittings are welded to the valve block. Removing the fittings will damage the block and fittings.

Clean all parts in solvent and dry with compressed air before assembly.

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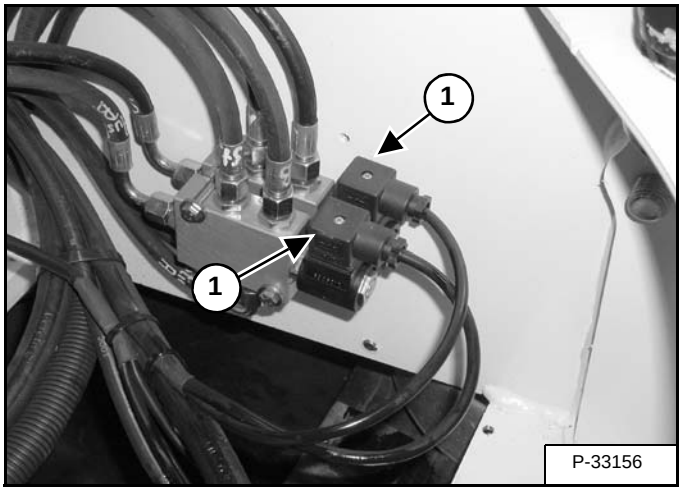
JOYSTICK CONTROL PATTERN SELECTOR VALVE

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-100-1



Mark and remove the wire harness (Item 1) **[Figure 20-100-1]**.

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.

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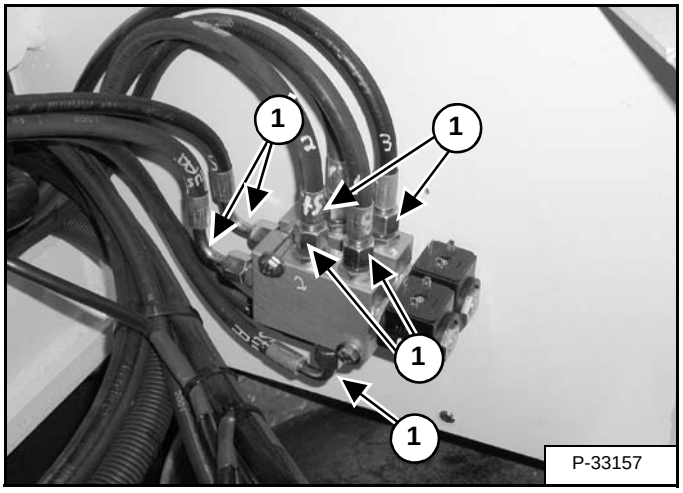
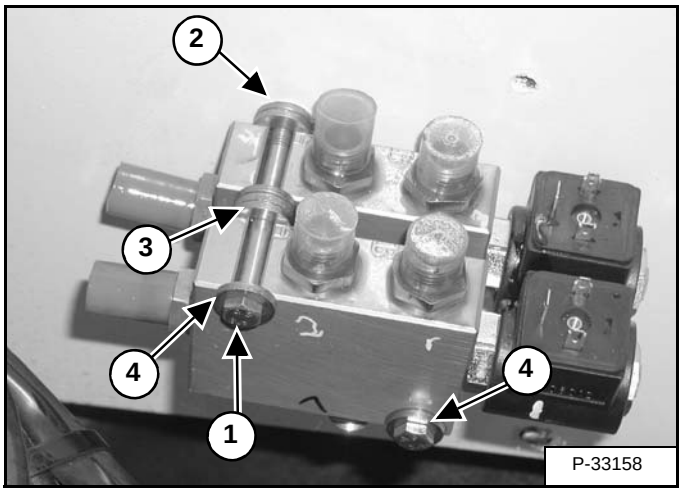
Figure 20-100-2



Mark and remove the 8 hoses (Item 1) **[Figure 20-100-2]**.

Figure 20-100-3



Remove the two bolts (Item 1) **[Figure 20-100-3]**.

Installation: Install 2 washers (Item 2) between the frame and valve. Install 3 washers (Item 3) between the valves and install 1 washer (Item 4) **[Figure 20-100-3]** on the bolts. Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

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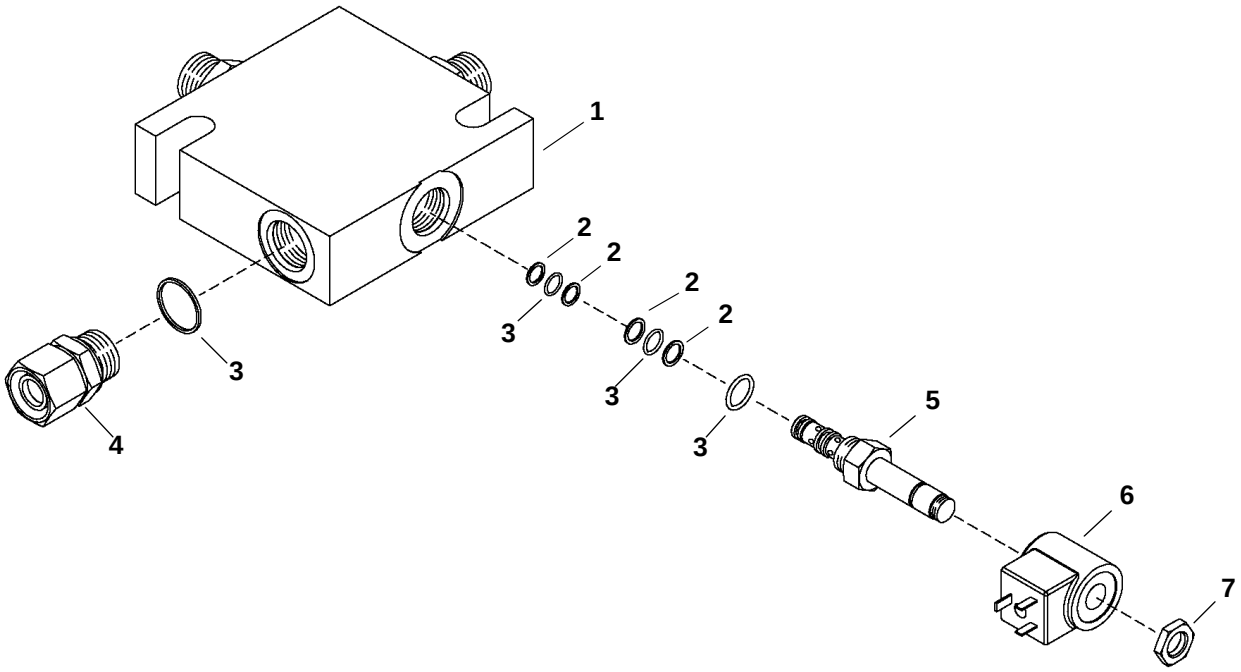
Parts Identification

1 **Valve Body**
2 **Back up Ring**
3 **O-ring**
4 **Fitting**
5 **Spool**
6 **Coil**
7 **Nut**



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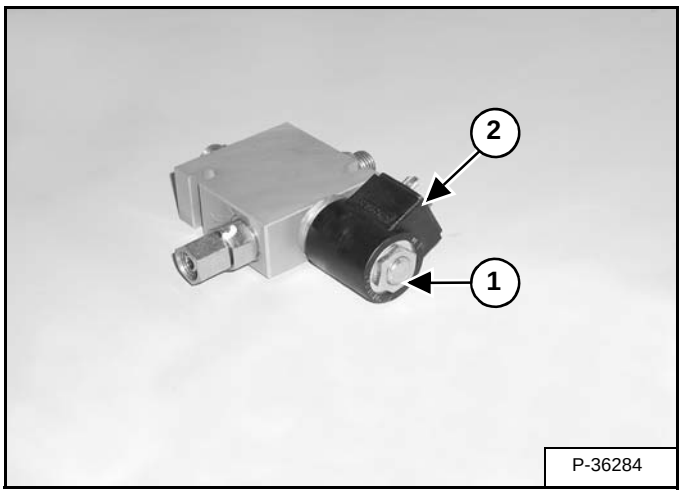
Disassembly And Assembly

Figure 20-100-4

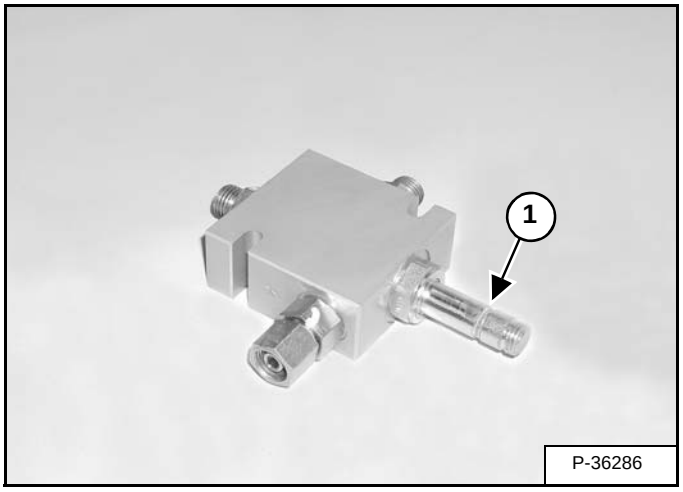


Remove the nut (Item 1) and coil (Item 2) **[Figure 20-100-4]** from the spool.

Installation: Tighten the nut to 3-5 ft.-lb. (4-7 N•m) torque.

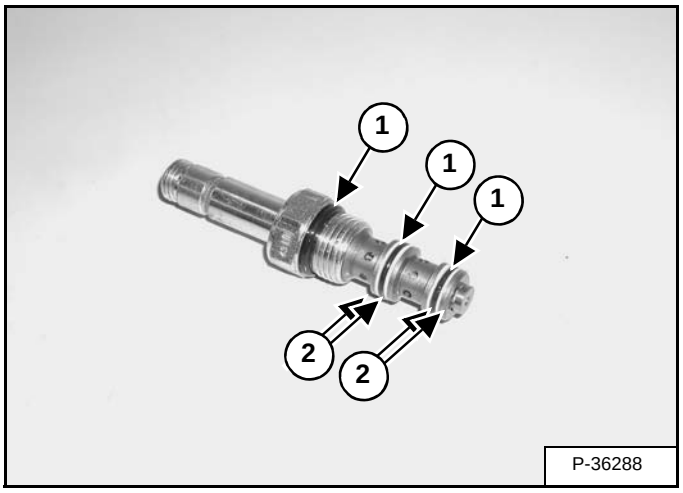
NOTE: Overtightening the coil nut may cause spool or coil failure.

Figure 20-100-5



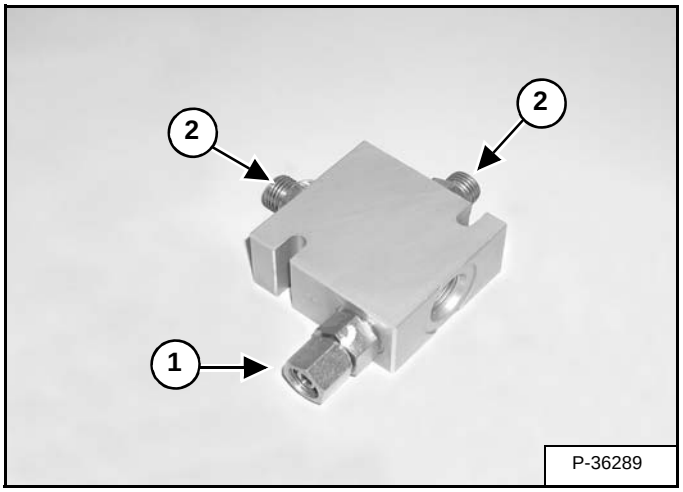
Remove the spool (Item 1) **[Figure 20-100-5]**.

Figure 20-100-6



Remove the O-rings (Item 1) and back-up rings (Item 2) **[Figure 20-100-6]** from the spool.

Figure 20-100-7



Remove the fitting (Item 1) **[Figure 20-100-7]**.

NOTE: Do not remove the fittings (Item 2) [Figure 20-100-7] The fittings are welded to the valve block. Removing the fittings will damage the fittings and valve block.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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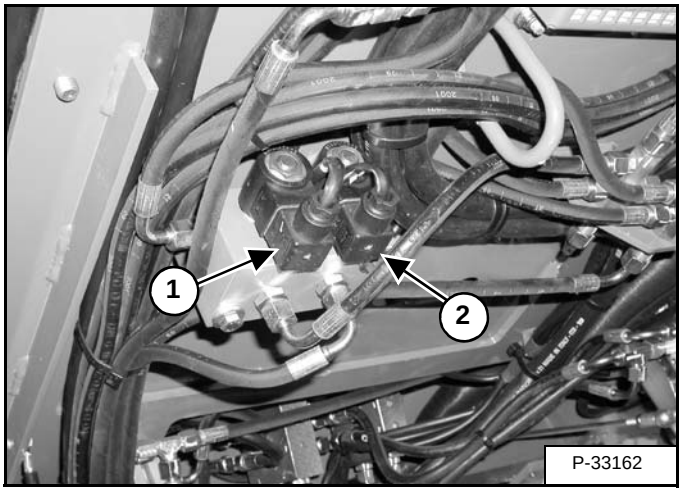
JOYSTICK LOCKOUT/TWO SPEED VALVE (S/N 522311001 & ABOVE)

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-101-1



Mark and remove the wire harness (Item 1) **[Figure 20-101-1]**.

Mark and remove the two speed wire harness (Item 2) **[Figure 20-101-1]**.

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.

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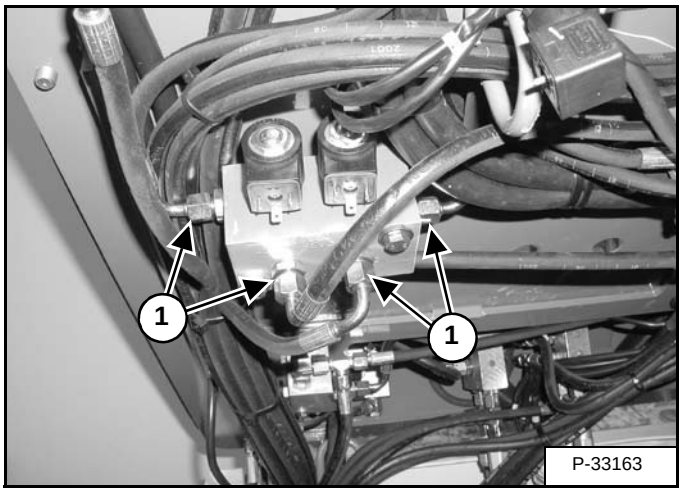
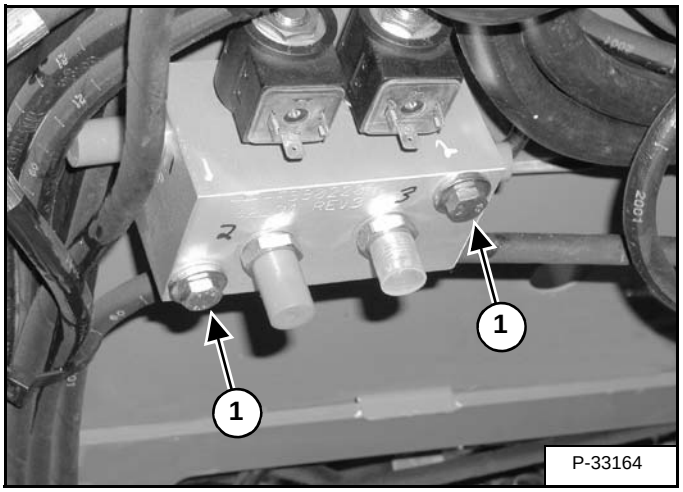
Figure 20-101-2



Mark and remove the 4 hoses (Item 1) **[Figure 20-101-2]**.

Figure 20-101-3



Remove the 2 bolts (Item 1) **[Figure 20-101-3]** and washers.

Installation: Tighten the bolts to 15-18 ft.-lb. (20-25 N•m) torque.

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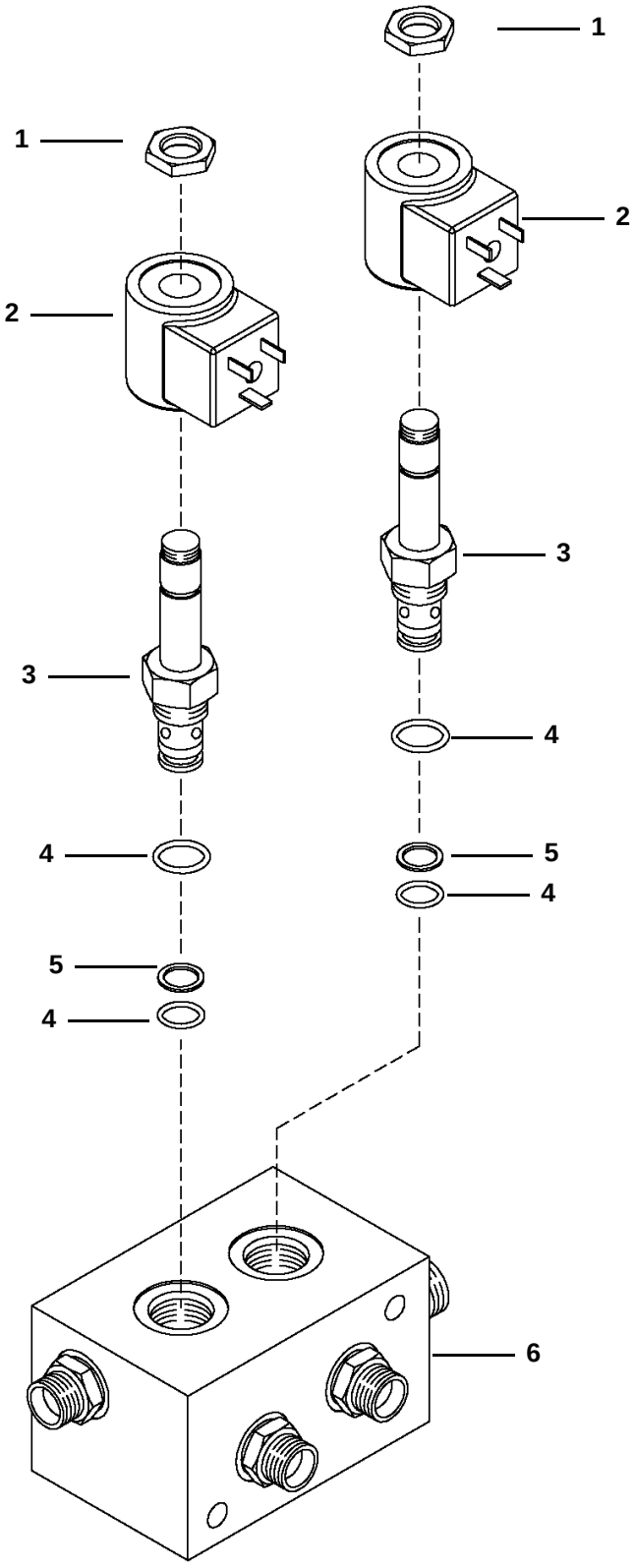
Parts Identification

1 Nut
2 Coil
3 Spool
4 O-Ring
5 Back-up Ring
6 Valve Body



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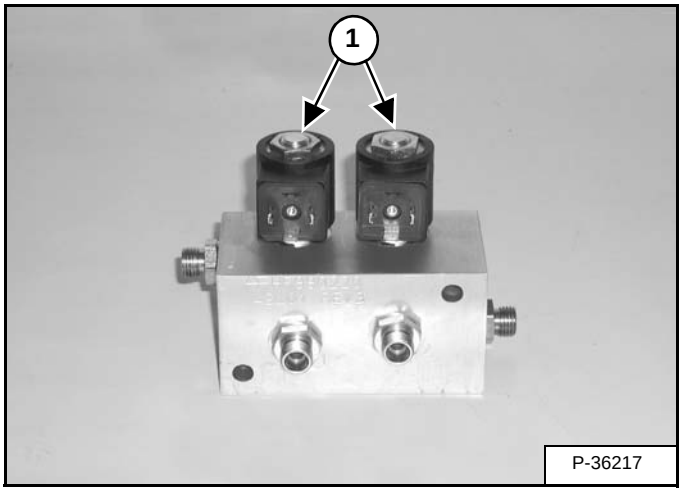
Disassembly And Assembly

Figure 20-101-4

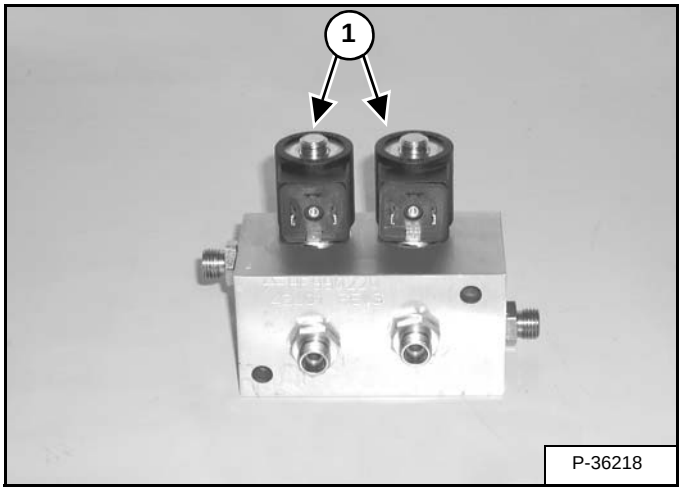


Remove the nuts (Item 1) **[Figure 20-101-4]** from the spools.

Installation: Tighten the nuts to 3-5 ft.-lbs (4-7 N•m) torque.

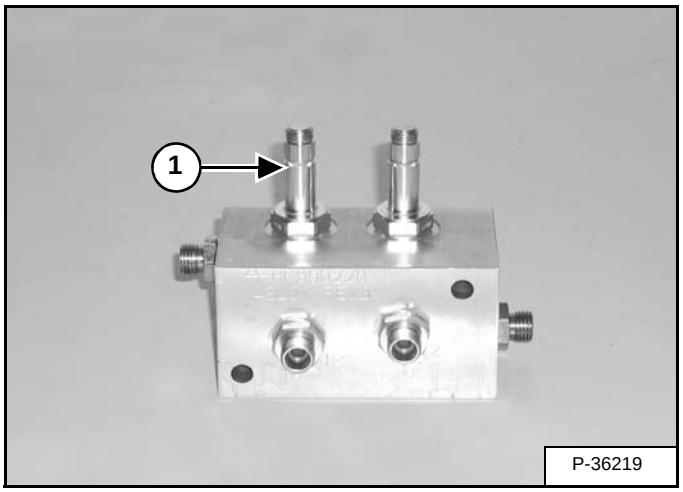
NOTE: Overtightening the coil nuts may cause spool or coil failure.

Figure 20-101-5



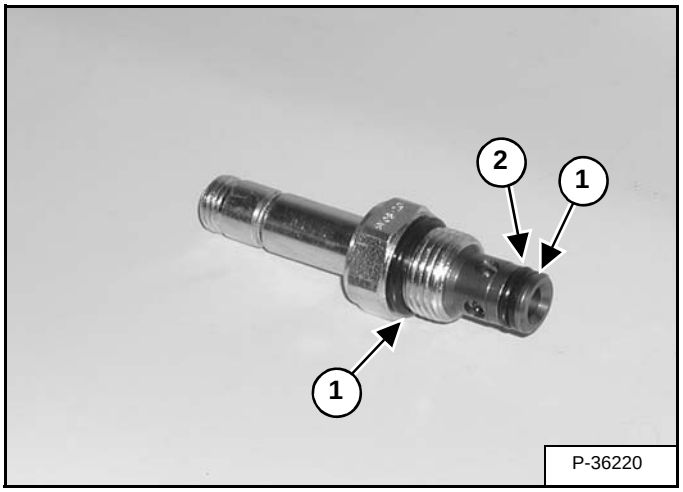
Remove the coils (Item 1) **[Figure 20-101-5]**.

Figure 20-101-6



Remove the spool (Item 1) **[Figure 20-101-6]**.

Figure 20-101-7



Remove the 2 O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-101-7]**.

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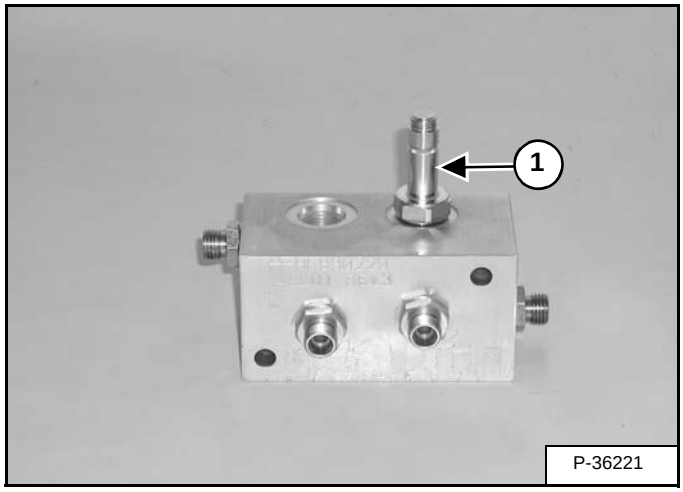
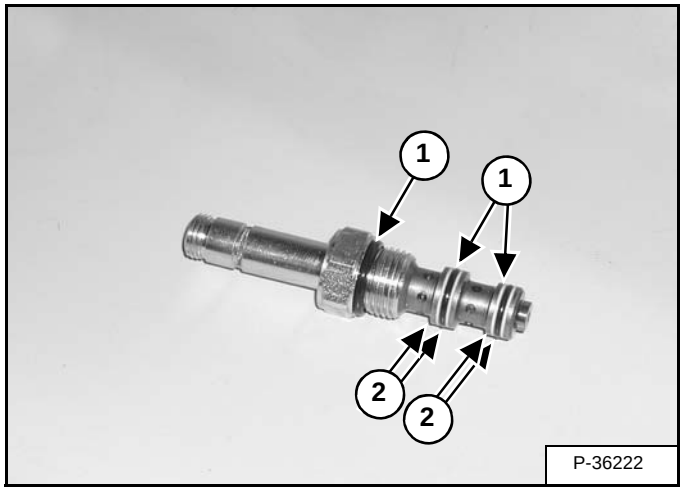
Disassembly And Assembly (Cont'd)

Figure 20-101-8



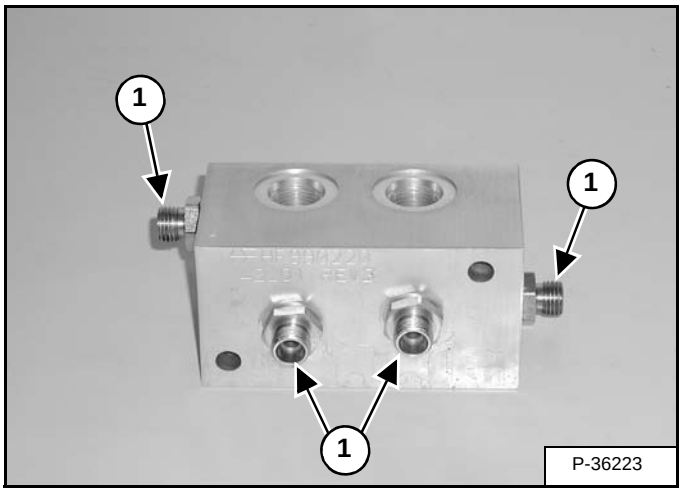
Remove the spool (Item 1) **[Figure 20-101-8]**

Figure 20-101-9



Remove the 3 O-rings (Item 1) and 4 back-up rings (Item 2) **[Figure 20-101-9]**.

Figure 20-101-10



NOTE: Do not remove the 4 fittings (Item 1) [Figure 20-101-10]. The fittings are welded to the valve block. Removing the fittings will damage the fittings and valve block.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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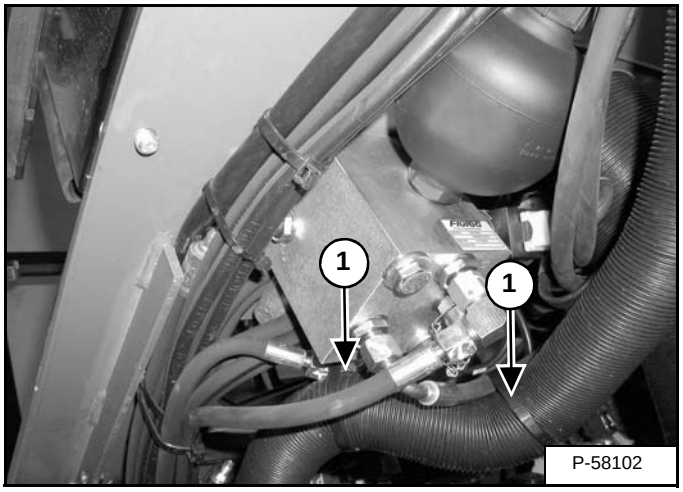
JOYSTICK LOCKOUT/TWO SPEED VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-102-1



Cut and remove the tie straps (Item 1) **[Figure 20-102-1]**.

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.

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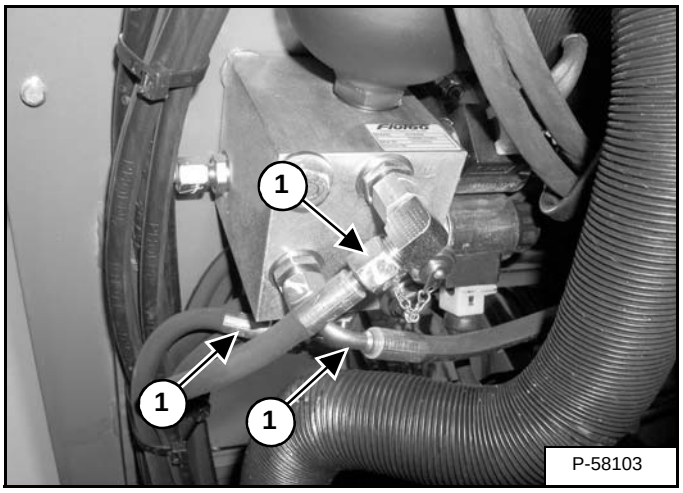
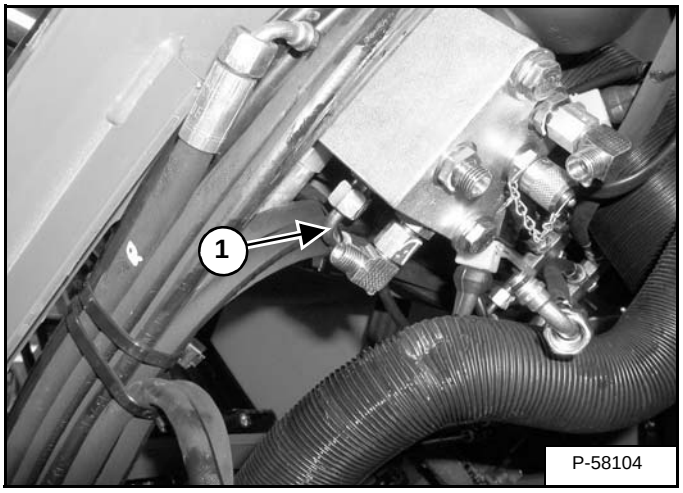
Figure 20-102-2



Mark and remove the hoses (Item 1) **[Figure 20-102-2]**.

Figure 20-102-3



Mark and remove the hose (Item 1) **[Figure 20-102-3]**.

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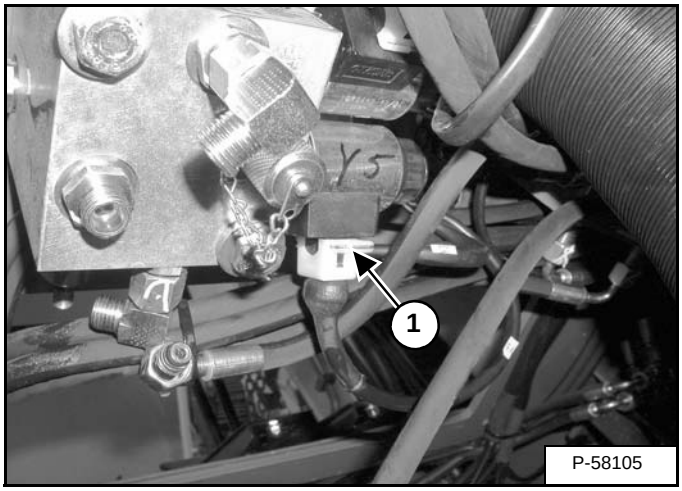
Removal And Installation (Cont'd)

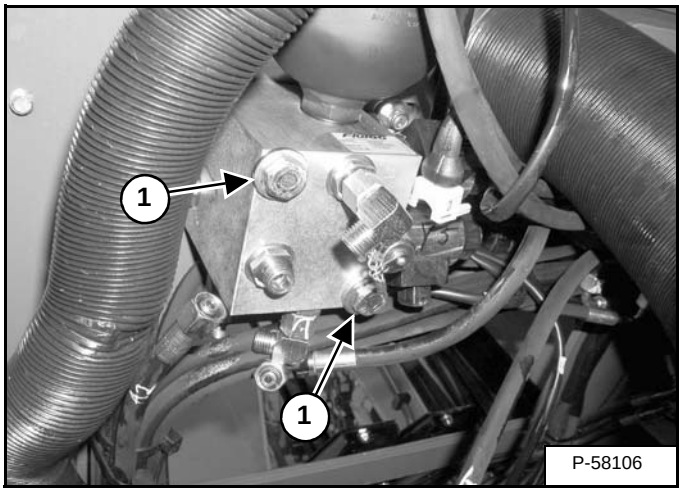
Mark the 3 wire harness connectors for ease of installation.

Figure 20-102-4



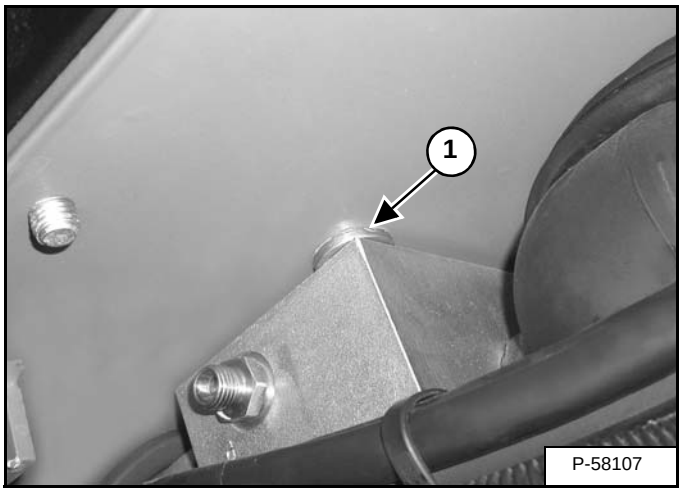
Compress the wire retainer (Item 1) **[Figure 20-102-4]** to remove the wire harness connectors from the 3 solenoids.

Figure 20-102-5



Remove the bolts (Item 1) **[Figure 20-102-5]** and washers. Remove the valve.

Figure 20-102-6



Installation: Install the washers (Item 1) **[Figure 20-102-6]** between the floor plate and valve.

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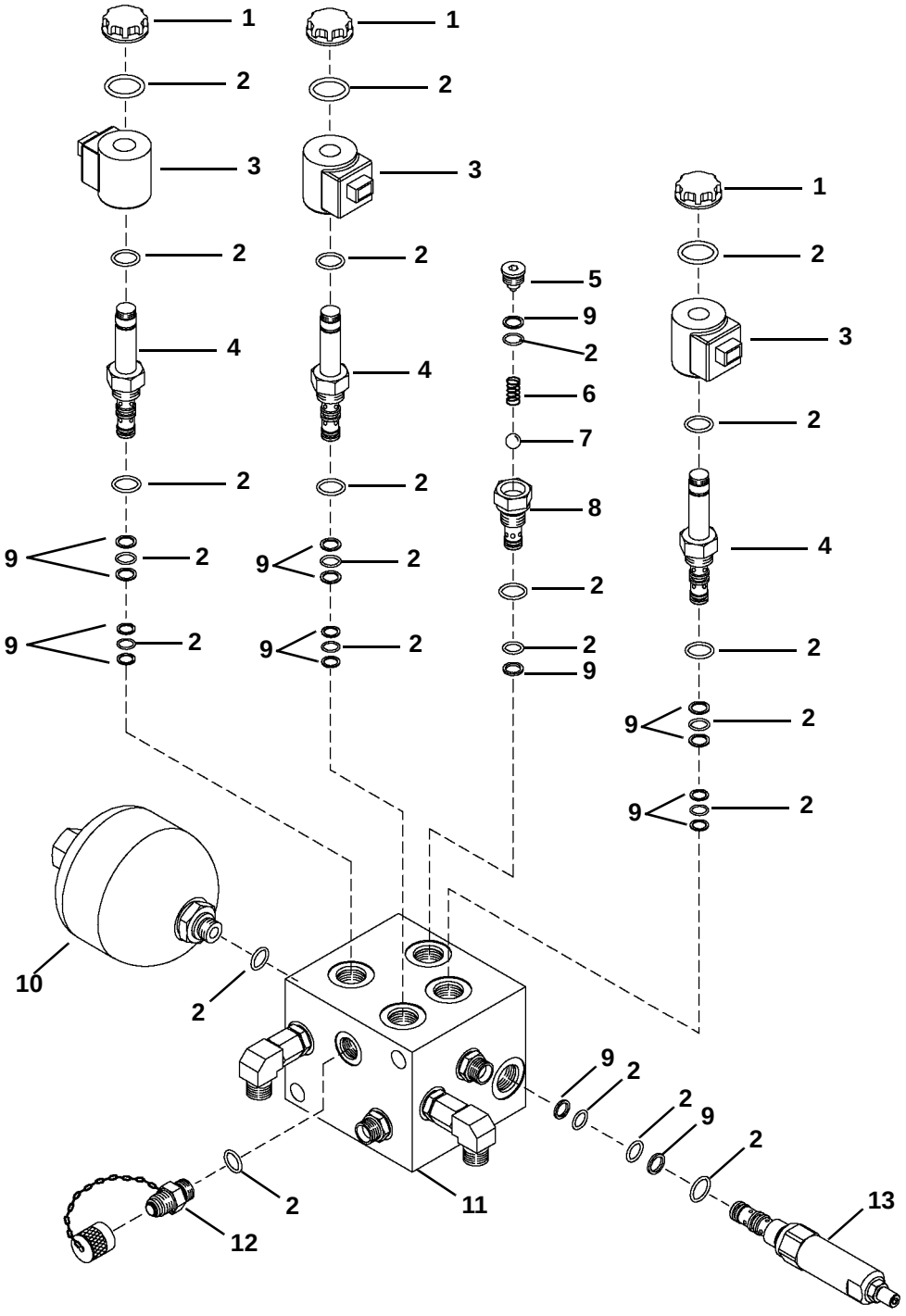
Parts Identification

1. Nut
2. O-Ring
3. Coil
4. Spool
5. Plug
6. Spring
7. Ball
8. Valve Body
9. Back-up Ring
10. Accumulator
11. Valve Block
12. Test Fitting W/Cap
13. Pressure Reducing Valve



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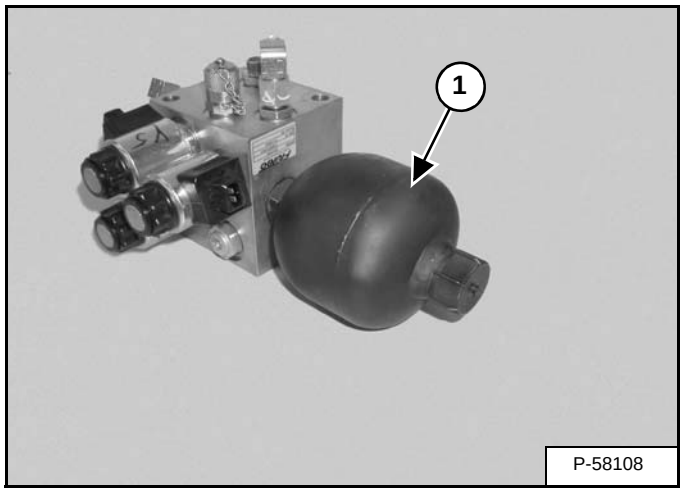
JOYSTICK LOCKOUT/TWO SPEED VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) (CONT'D)

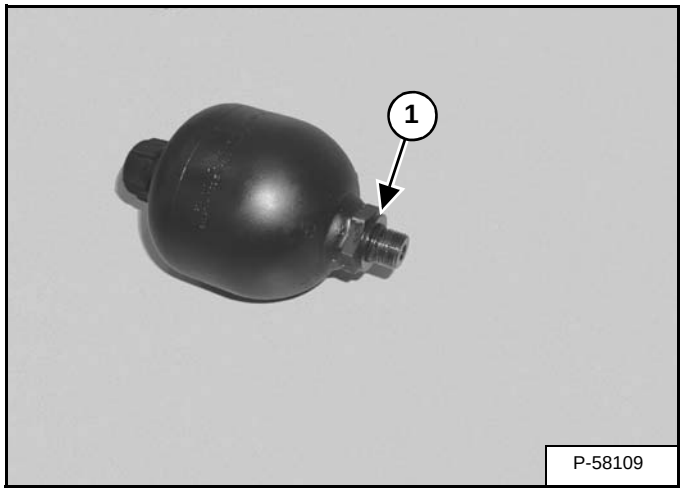
Disassembly And Assembly

Figure 20-102-7



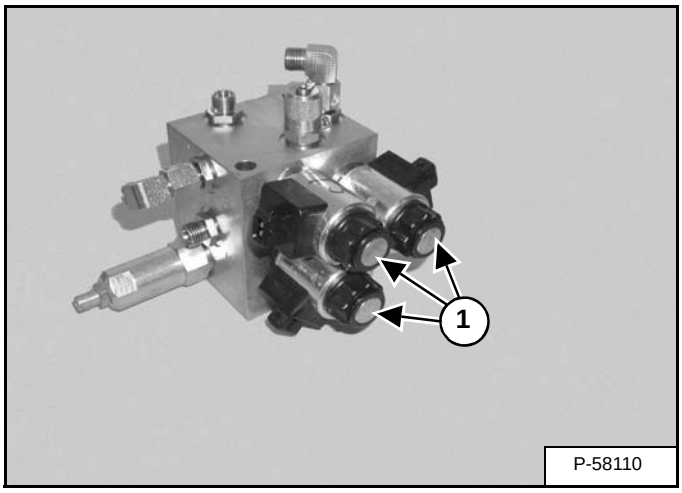
Remove the accumulator (Item 1) **[Figure 20-102-7]**.

Figure 20-102-8



Remove the O-ring (Item 1) **[Figure 20-102-8]**.

Figure 20-102-9

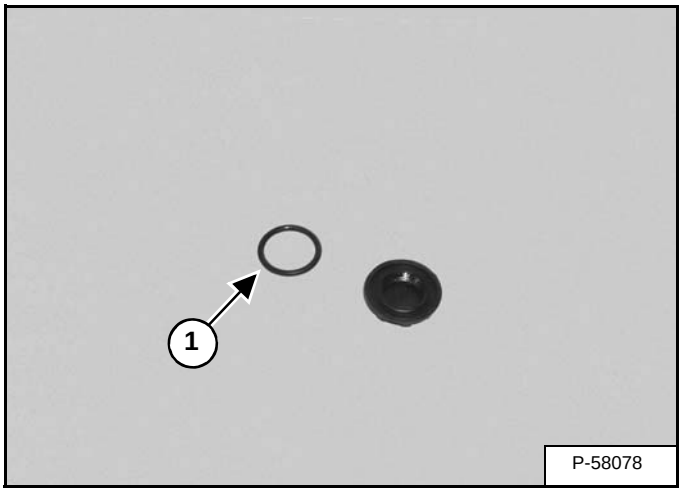


Remove the nuts (Item 1) **[Figure 20-102-9]**.

Installation: Tighten the nuts to 3-5 ft.-lb. (4-7 N•m) torque.

NOTE: Overtightening the coil nuts may cause spool or coil failure.

Figure 20-102-10



Remove the O-ring (Item 1) **[Figure 20-102-10]** from the nuts.

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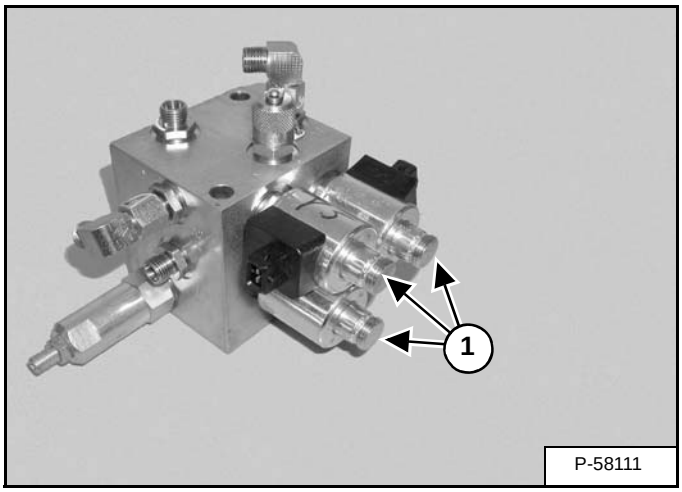
JOYSTICK LOCKOUT/TWO SPEED VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) (CONT'D)

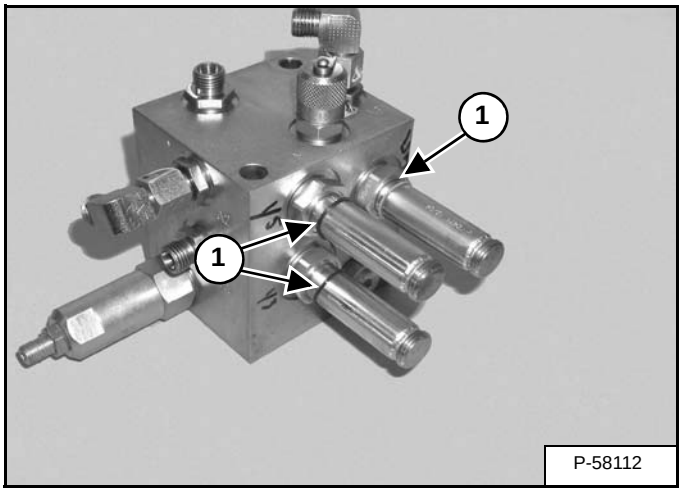
Disassembly And Assembly (Cont'd)

Figure 20-102-11



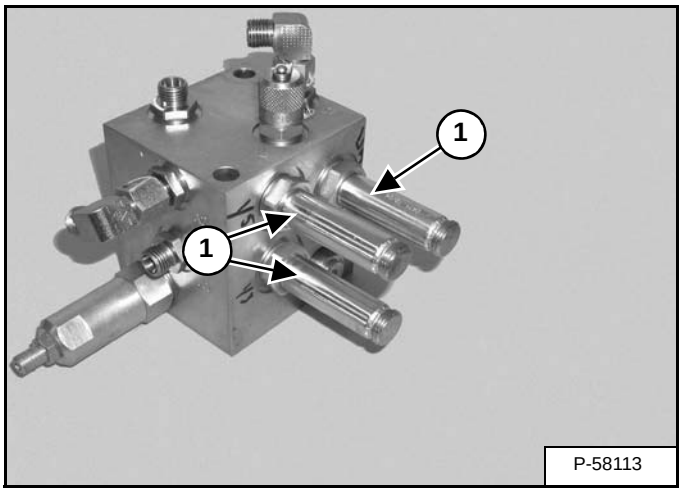
Mark and remove the coils (Item 1) **[Figure 20-102-11]**.

Figure 20-102-12



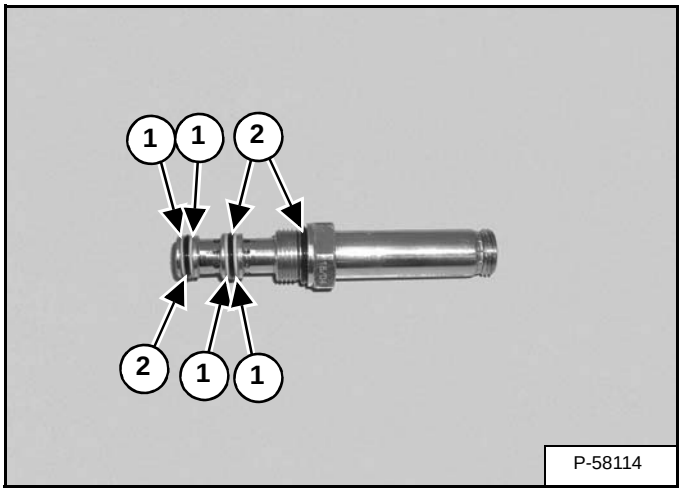
Remove the O-rings (Item 1) **[Figure 20-102-12]** from the spools.

Figure 20-102-13



Remove the spools (Item 1) **[Figure 20-102-13]**.

Figure 20-102-14



Remove the back-up rings (Item 1) and O-rings (Item 2) **[Figure 20-102-14]**.

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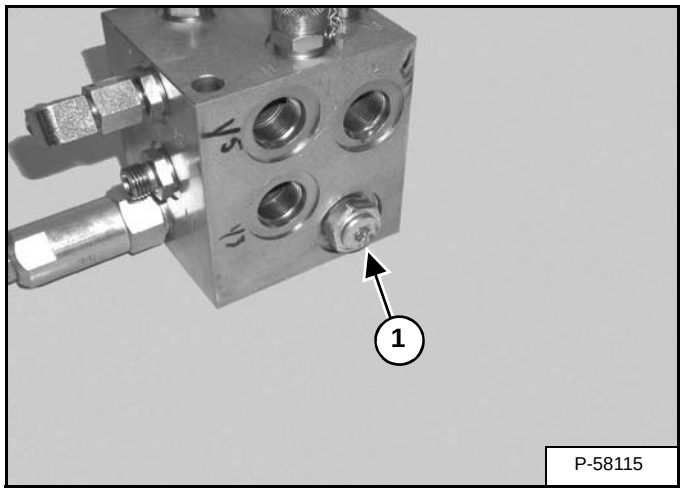
JOYSTICK LOCKOUT/TWO SPEED VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) (CONT'D)

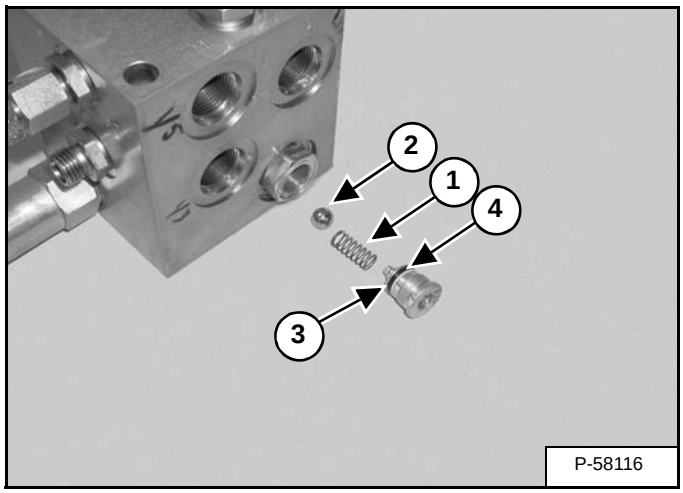
Disassembly And Assembly (Cont'd)

Figure 20-102-15



Remove the plug (Item 1) **[Figure 20-102-15]**.

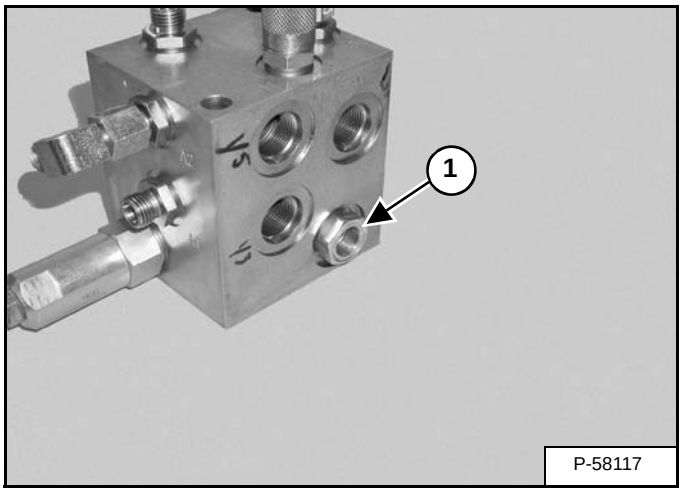
Figure 20-102-16



Remove the spring (Item 1) and ball (Item 2) **[Figure 20-102-16]**.

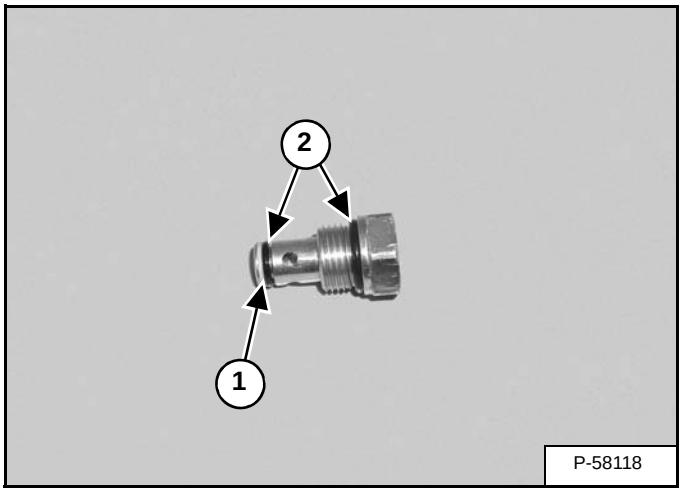
Remove the O-ring (Item 3) and back-up ring (Item 4) **[Figure 20-102-16]** from the plug.

Figure 20-102-17



Remove the valve body (Item 1) **[Figure 20-102-17]**.

Figure 20-102-18



Remove the back-up ring (Item 1) and O-rings (Item 2) **[Figure 20-102-18]**.

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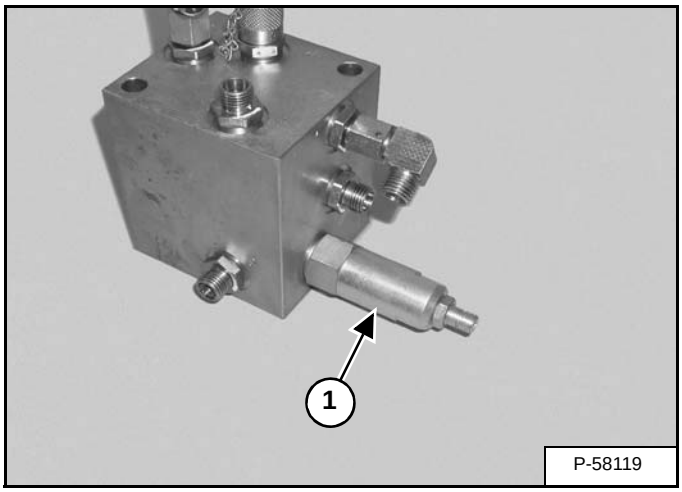
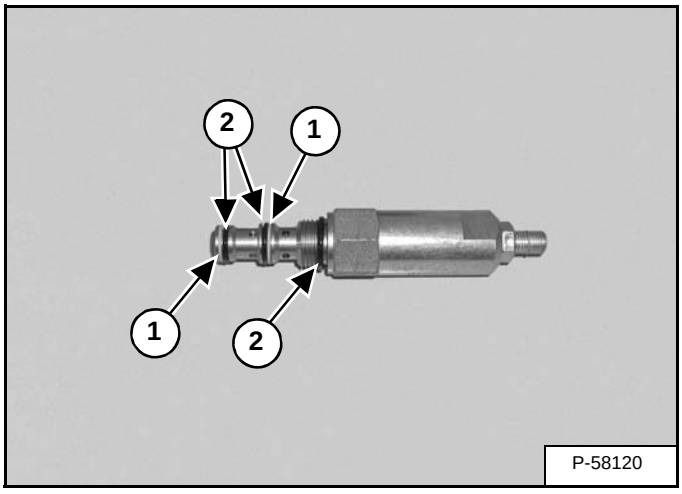
Disassembly And Assembly (Cont'd)

Figure 20-102-19



Remove the pressure reducing valve (Item 1) **[Figure 20-102-19]**.

Figure 20-102-20



Remove the back-up rings (Item 1) and O-rings **[Figure 20-102-20]**.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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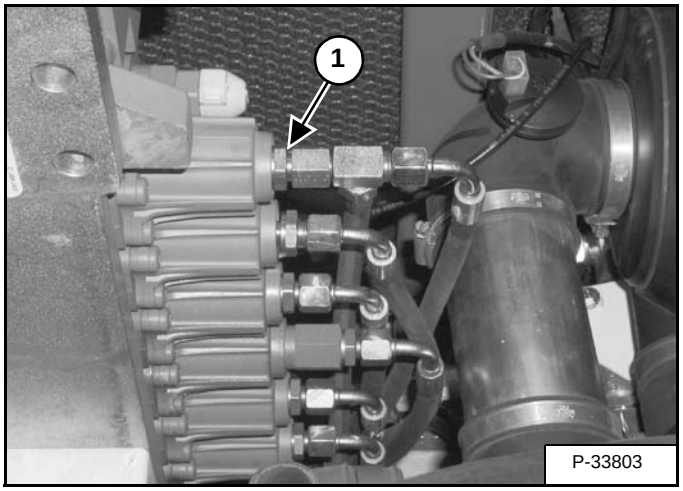
RIGHT CONTROL LEVER (JOYSTICK)

Testing

Stop the engine.

Open the right side cover.

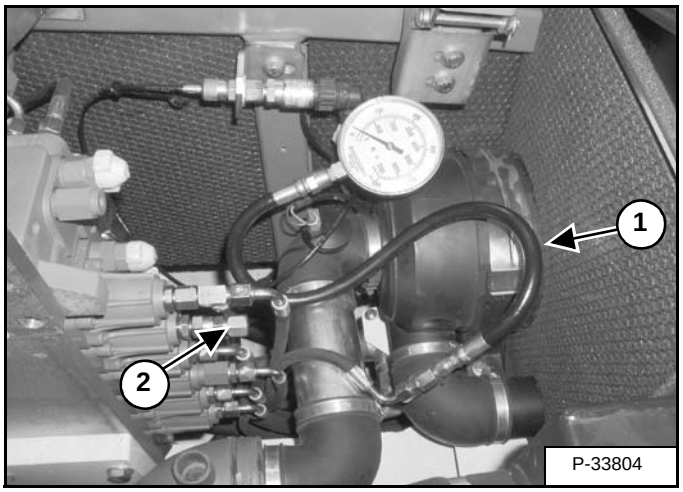
Figure 20-110-1



At the 6 spool hydraulic control valve (Item 1) **[Figure 20-110-1]**, find the pilot line of the control lever (joystick) that is to be checked (boom, arm or bucket).

Remove the hose from the control valve.

Figure 20-110-2



Install a 1000 PSI (69 bar) gauge (Item 1) **[Figure 20-110-2]** on the hose.

Install a plug (Item 2) **[Figure 20-110-2]** on the valve section.

Start the excavator and warm the hydraulic oil to operating temperature.

Engage the circuit to be tested and record the operating pressure.

The operating pressure should be approximately 507 PSI (35 bar).

If the operating pressure is correct, check the valve section spool for proper operation.

If the operating pressure is incorrect, adjust the pressure reducing valve. (See PRESSURE REDUCING VALVE (S/N 522311001 & ABOVE) on Page 20-33-1 or See PRESSURE REDUCING VALVE (S/N 528911001 & ABOVE AND 528611001 & ABOVE) on Page 20-32-1.)

If the operating pressure is still incorrect, repair or replace the pressure reducing valve.

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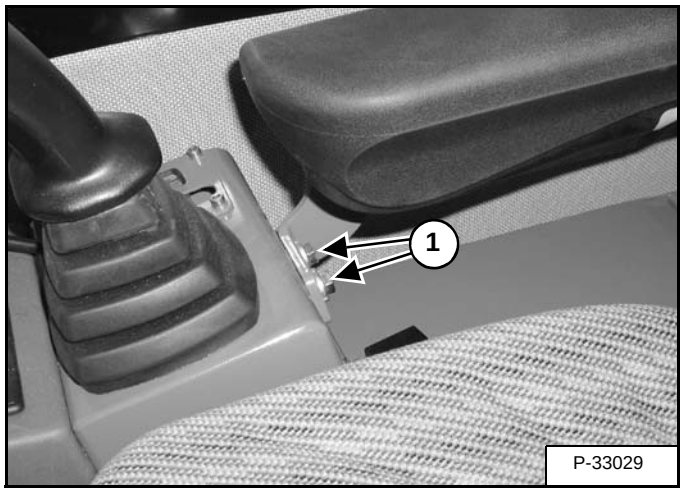
RIGHT CONTROL LEVER (JOYSTICK) (CONT'D)

Handle Removal And Installation

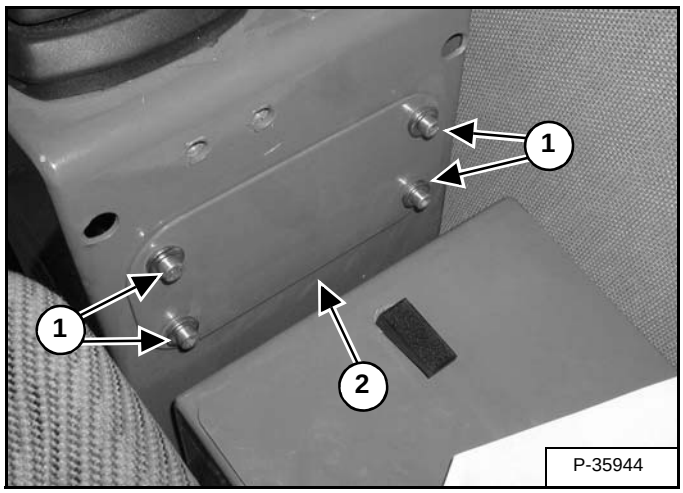
Figure 20-110-3



Remove the 2 bolts (Item 1) **[Figure 20-110-3]** and washers.

Remove the right arm rest.

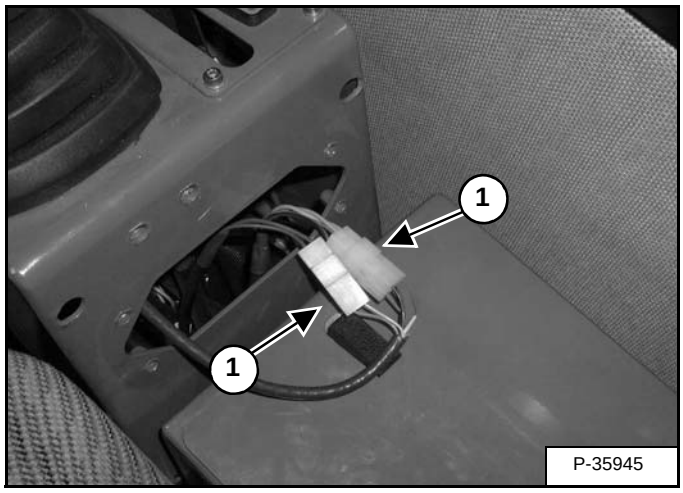
Figure 20-110-4



Remove the 4 bolts (Item 1) **[Figure 20-110-4]** and washers.

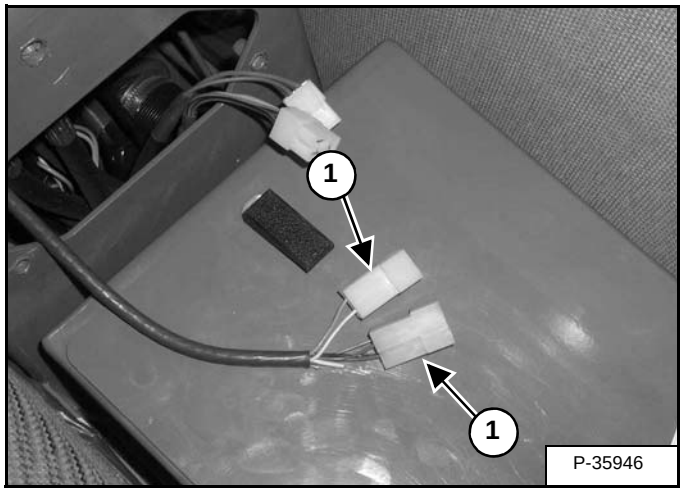
Remove the cover (Item 2) **[Figure 20-110-4]**.

Figure 20-110-5



Disconnect the wire harness (Item 1) **[Figure 20-110-5]**.

Figure 20-110-6



Mark the wires to the connector bodies (Item 1) **[Figure 20-110-6]**.

Use a small flat blade screwdriver to depress the wire terminal tabs, and remove the individual wires from the connector body.

Installation: Use a small flat blade screwdriver to rebend the wire terminal tabs on each wire before installing the individual wires in the connector bodies.

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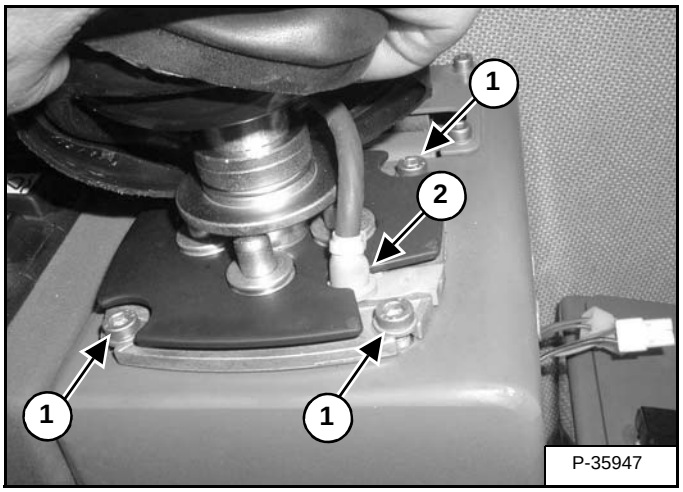
Handle Removal And Installation (Cont'd)

Figure 20-110-7

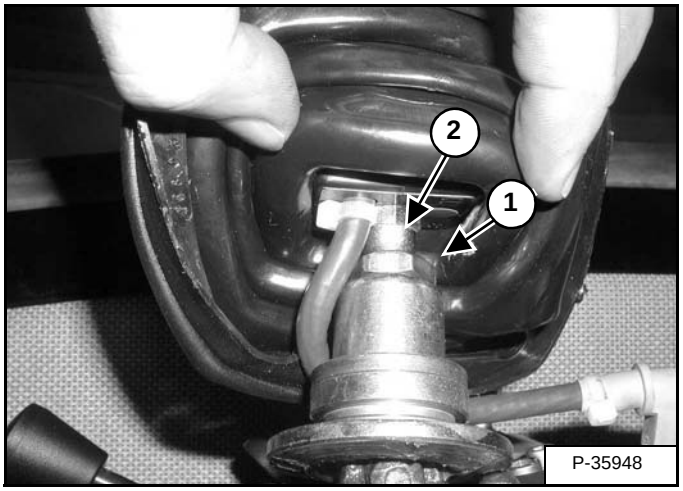


Pull up on the joystick boot, and loosen the four mount bolts (Item 1) **[Figure 20-110-7]**.

Remove the grommet and wire harness (Item 2) **[Figure 20-110-7]** from the joystick body.

Pull up on the joystick boot.

Figure 20-110-8

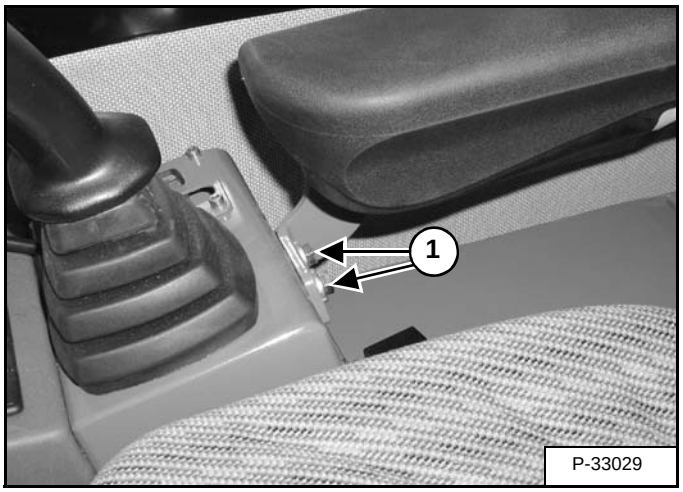


Loosen the nut (Item 1) **[Figure 20-110-8]**.

Remove the handle (Item 2) **[Figure 20-110-8]**.

Removal And Installation

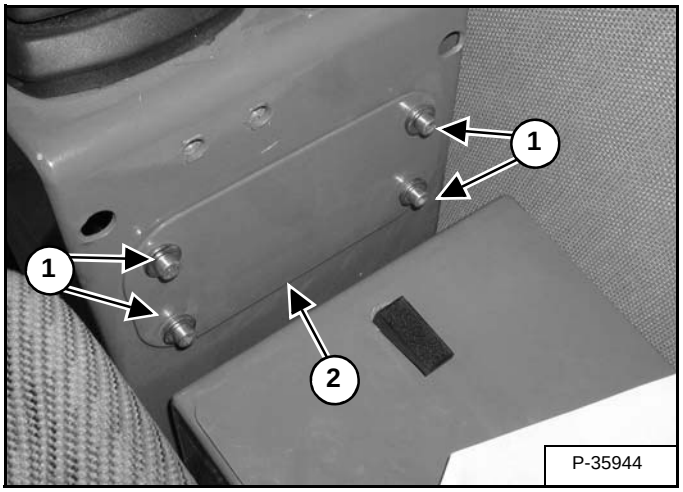
Figure 20-110-9



Remove the 2 bolts (Item 1) **[Figure 20-110-9]** and washers.

Remove the arm rest.

Figure 20-110-10



Remove the 4 bolts (Item 1) **[Figure 20-110-10]** and washers.

Remove the cover (Item 2) **[Figure 20-110-10]**.

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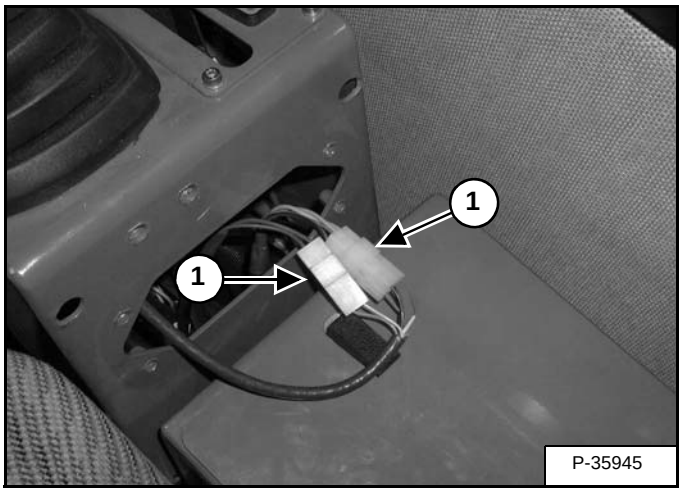
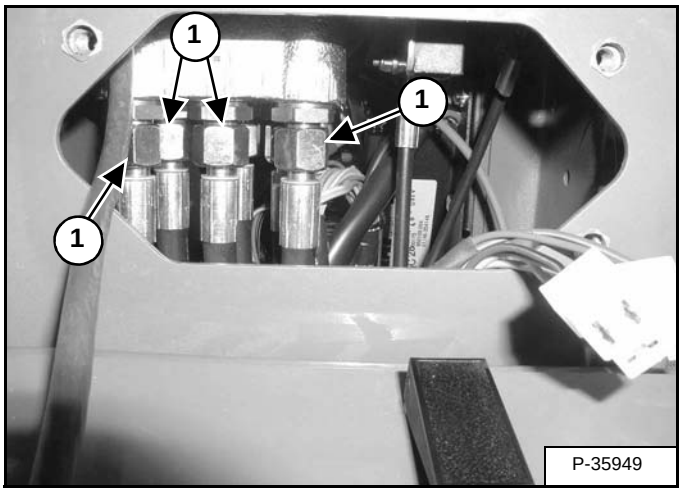
Removal And Installation (Cont'd)

Figure 20-110-11



Disconnect the wire harness (Item 1) **[Figure 20-110-11]**.

Figure 20-110-12



Mark and remove the 6 hoses (Item 1) **[Figure 20-110-12]**.

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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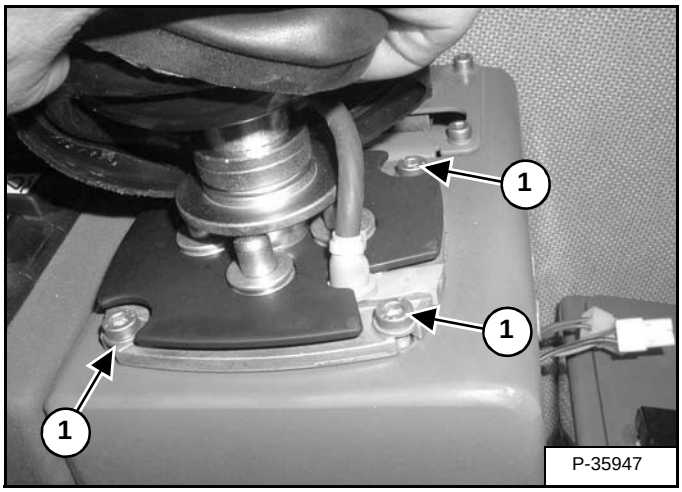
Figure 20-110-13



Pull up on the joystick boot and remove the 4 mount bolts (Item 1) **[Figure 20-110-13]** and washers.

Remove the joystick.

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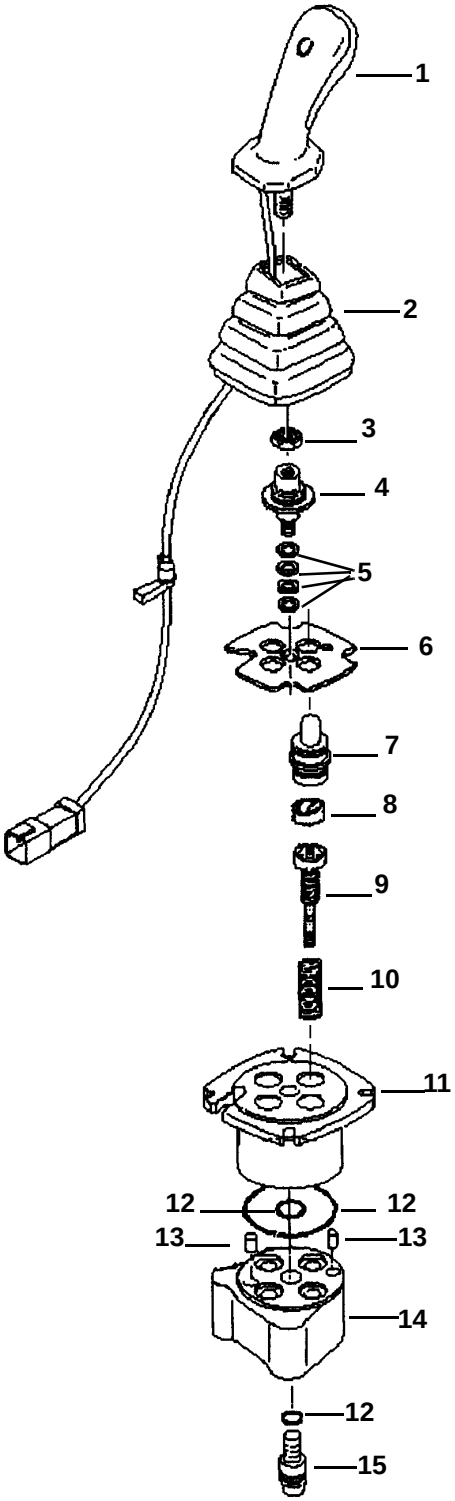
Parts Identification

1. **Handle**
2. **Dust Boot**
3. **Nut**
4. **Swivel Joint/Bolt**
5. **Washers**
6. **Plate**
7. **Plunger Assembly**
8. **Seal**
9. **Spool Assembly**
10. **Spring**
11. **Valve Body (Top)**
12. **O-Ring**
13. **Alignment Pin**
14. **Valve Body (Bottom)**
15. **Bolt**



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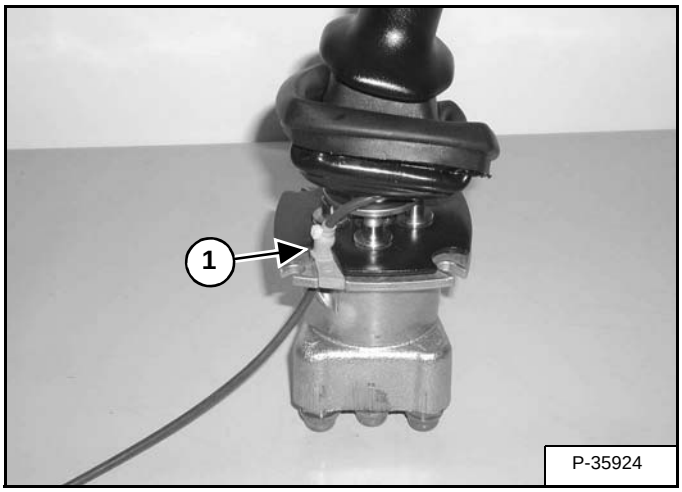
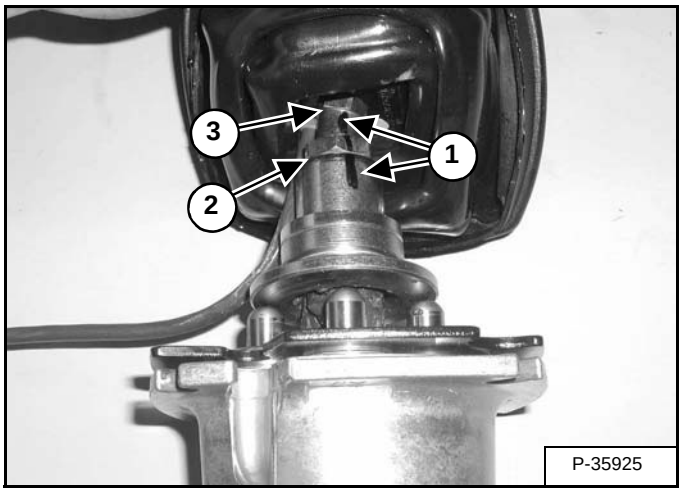
Disassembly And Assembly

Figure 20-110-14



Remove the grommet and wire harness (Item 1) **[Figure 20-110-14]**.

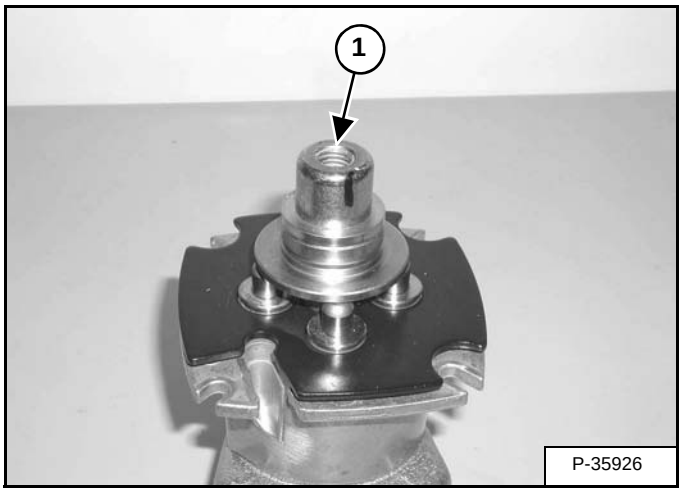
Figure 20-110-15



Mark the lever and swivel joint (Item 1) **[Figure 20-110-15]** for correct orientation of the handle during assembly.

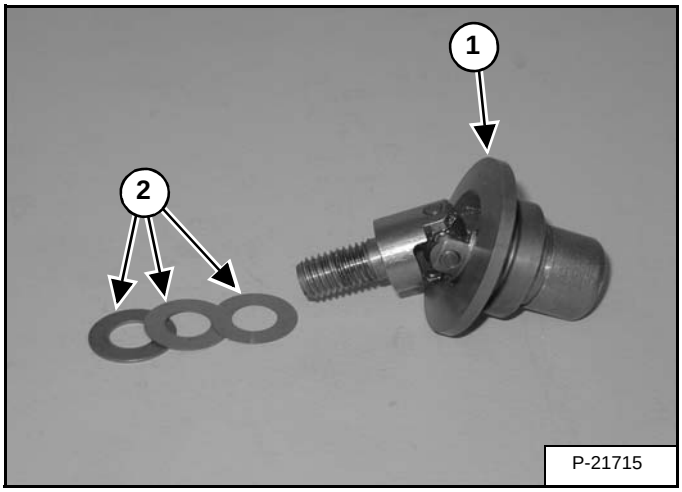
Loosen the nut (Item 2) and remove the handle (Item 3) **[Figure 20-110-15]**.

Figure 20-110-16



Remove the bolt (Item 1) **[Figure 20-110-16]** from inside the swivel joint.

Figure 20-110-17



Remove the swivel joint (Item 1) and washers (Item 2) **[Figure 20-110-17]**.

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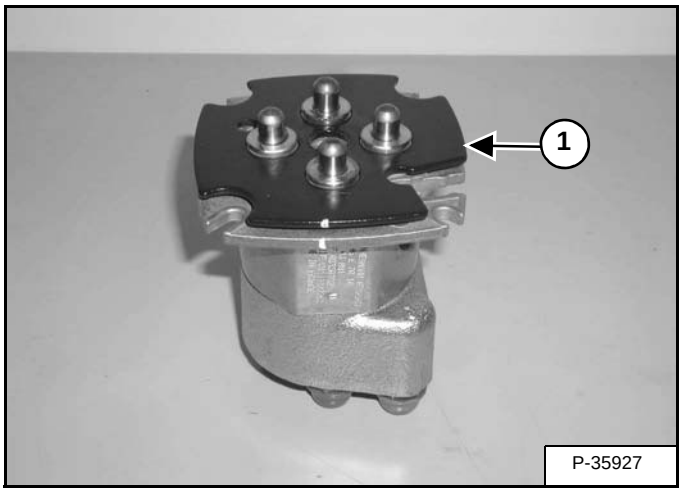
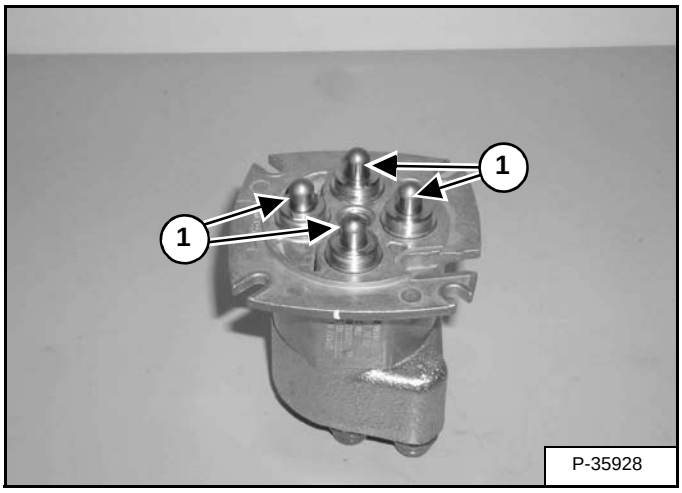
Disassembly And Assembly (Cont'd)

Figure 20-110-18



Remove the plate (Item 1) **[Figure 20-110-18]**.

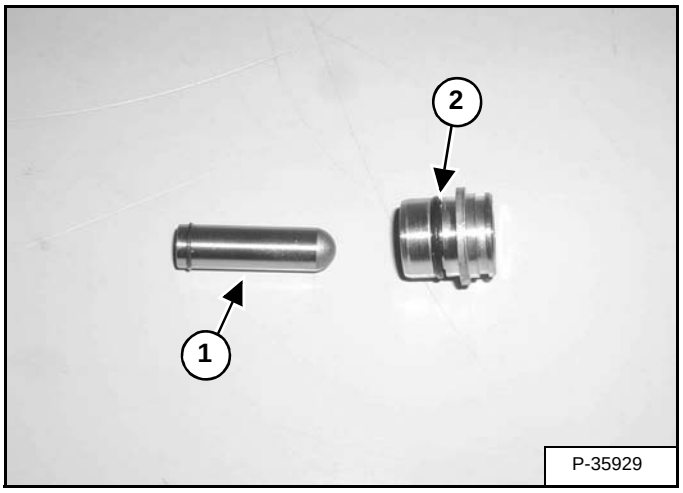
Figure 20-110-19



Mark and remove the plunger assemblies (Item 1) **[Figure 20-110-19]**.

NOTE: Install the plunger assemblies in the same bore the plungers were removed from.

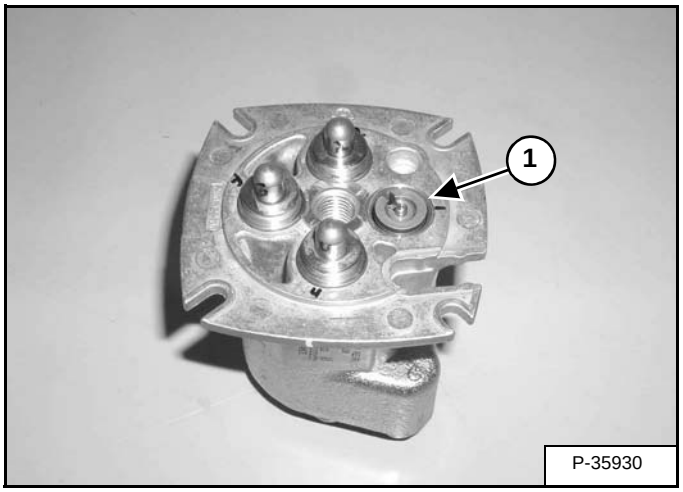
Figure 20-110-20



Remove the push rod (Item 1) **[Figure 20-110-20]** from the plunger body.

Remove the O-ring (Item 2) **[Figure 20-110-20]**.

Figure 20-110-21



Remove the spool assemblies (Item 1) **[Figure 20-110-21]**.

NOTE: Install the spool assemblies in the same bore the spools were removed from.

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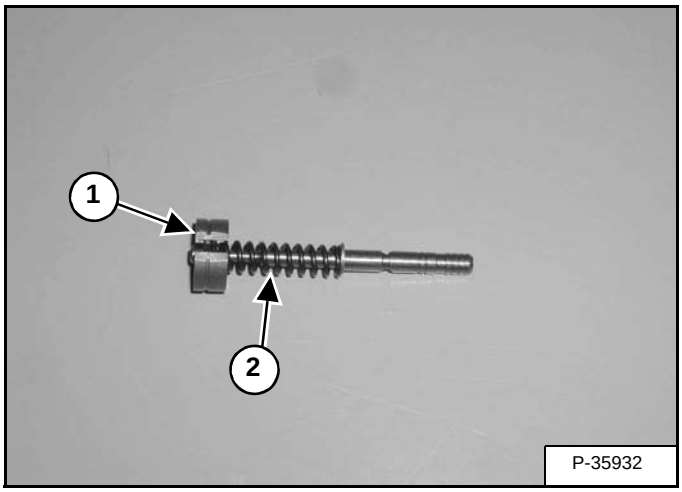
Disassembly And Assembly (Cont'd)

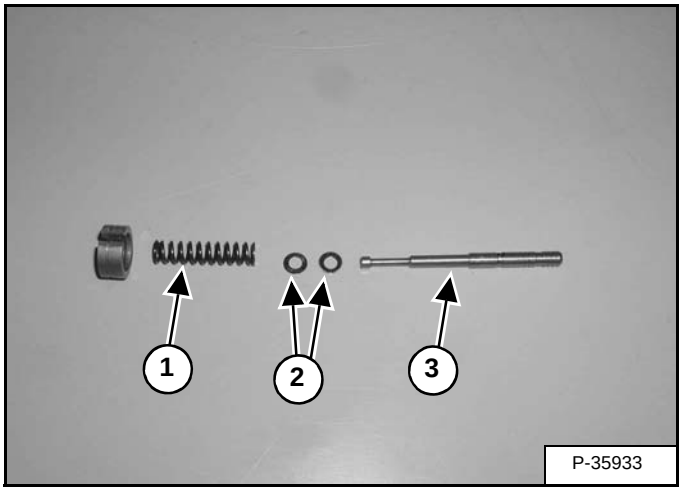
Figure 20-110-22



Mark the top of the spring seat (Item 1) **[Figure 20-110-22]**.

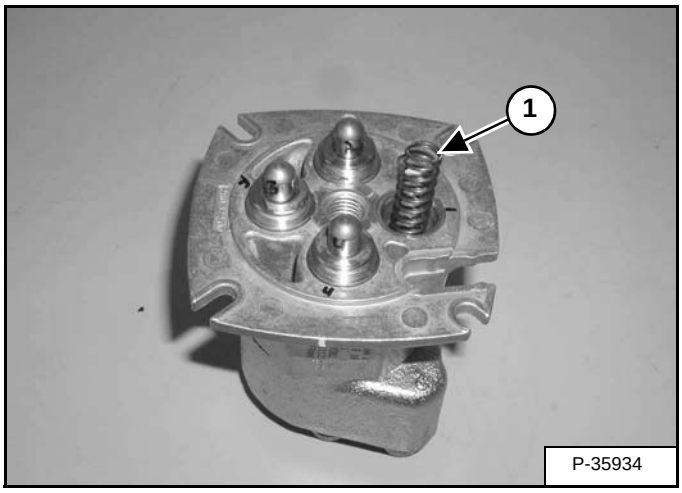
Compress the spring (Item 2) and remove the spring seat (Item 1) **[Figure 20-110-22]**.

Figure 20-110-23



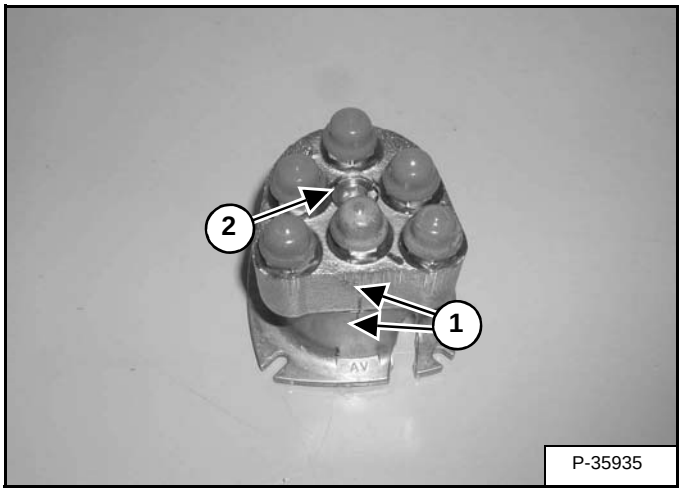
Remove the spring (Item 1) and washers (Item 2) from the spool (Item 3) **[Figure 20-110-23]**.

Figure 20-110-24



Remove the spring (Item 1) **[Figure 20-110-24]**.

Figure 20-110-25



Mark the joystick body (Item 1) **[Figure 20-110-25]** for ease of assembly.

Remove the bolt (Item 2) **[Figure 20-110-25]**.

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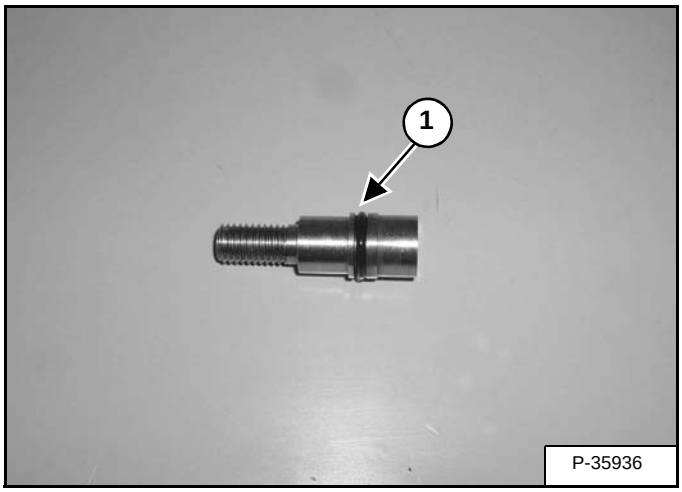
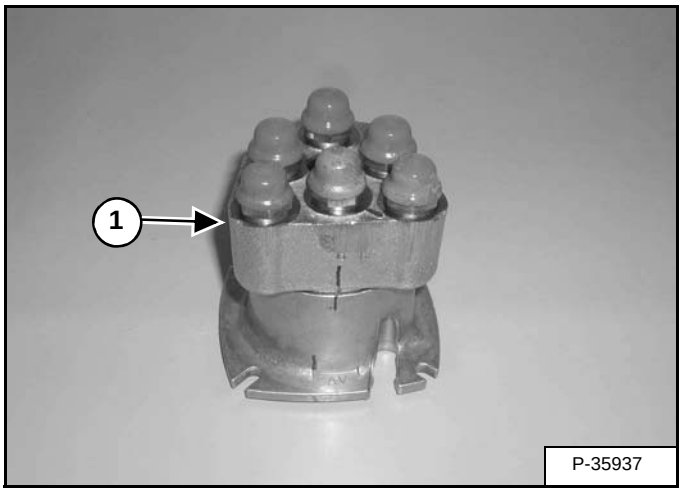
Disassembly And Assembly (Cont'd)

Figure 20-110-26



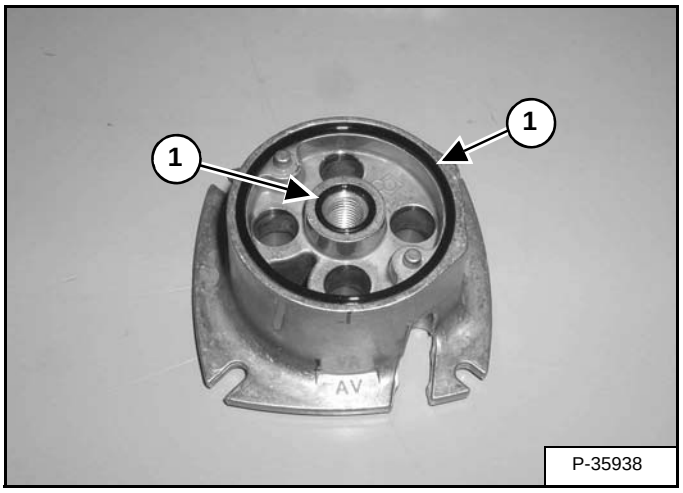
Remove the O-ring (Item 1) **[Figure 20-110-26]**.

Figure 20-110-27



Remove the bottom of the valve body (Item 1) **[Figure 20-110-27]**.

Figure 20-110-28



Remove the 2 O-rings (Item 1) **[Figure 20-110-28]**.

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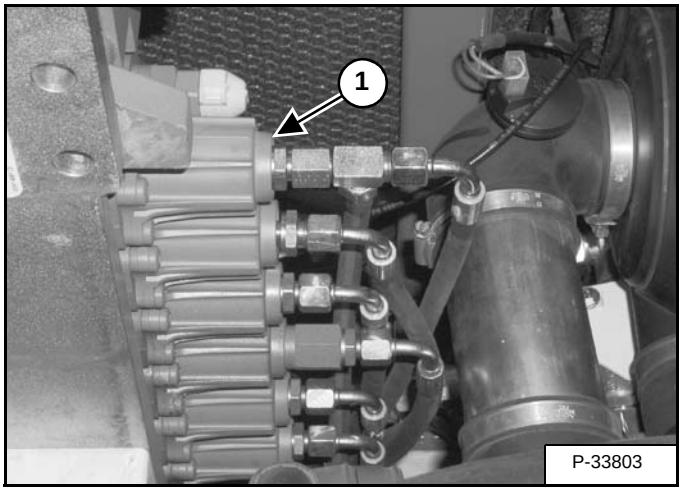
LEFT CONTROL LEVER (JOYSTICK)

Testing

Stop the engine.

Open the right side cover.

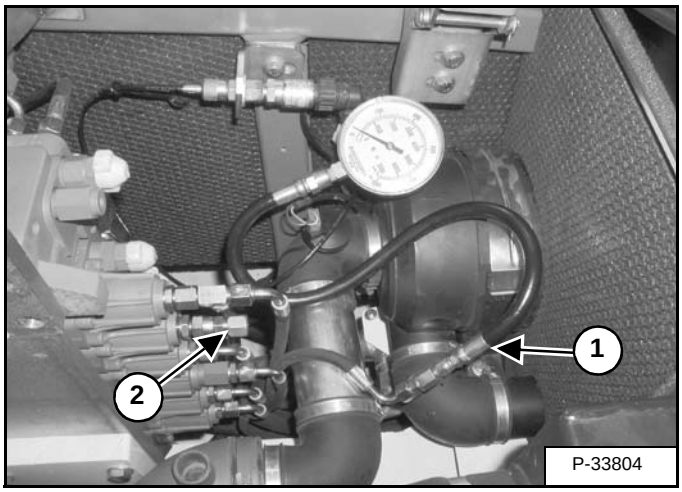
Figure 20-111-1



At the six spool hydraulic control valve (Item 1) **[Figure 20-111-1]**, find the pilot line of the control lever (joystick) that is to be checked (boom, arm or bucket).

Remove the hose from the control valve.

Figure 20-111-2



Install a 1000 PSI (69 bar) gauge (Item 1) **[Figure 20-111-2]** on the hose.

Install a plug (Item 2) **[Figure 20-111-2]** on the valve section.

Start the excavator and warm the hydraulic oil to operating temperature.

Engage the circuit to be tested and record the operating pressure.

The operating pressure should be approximately 507 PSI (35 bar).

If the operating pressure is correct, check the valve section spool for proper operation.

If the operating pressure is incorrect, adjust the pressure reducing valve. (See PRESSURE REDUCING VALVE (S/N 522311001 & ABOVE) on Page 20-33-1 or See PRESSURE REDUCING VALVE (S/N 528911001 & ABOVE AND 528611001 & ABOVE) on Page 20-32-1.)

If the operating pressure is still incorrect, repair or replace the pressure reducing valve.

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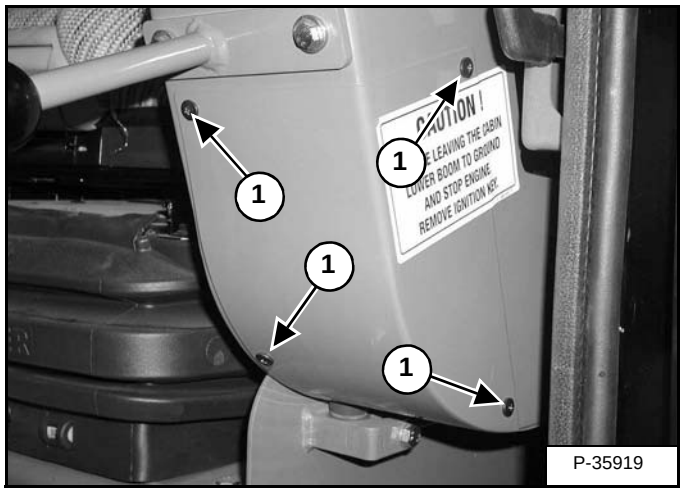
Handle Removal And Installation

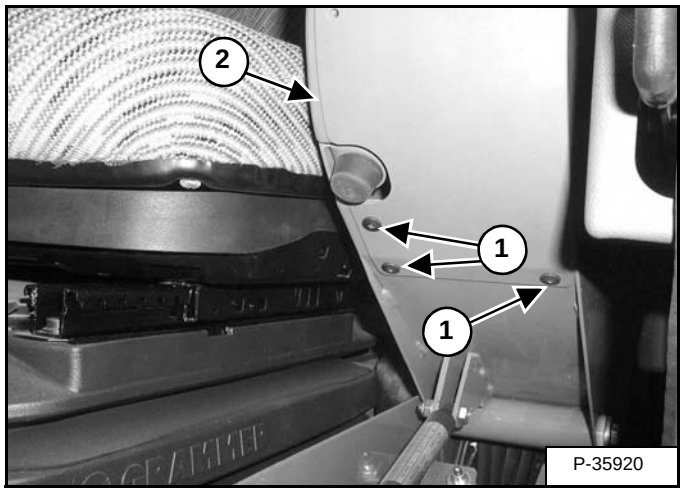
Figure 20-111-3



Remove the 4 screws (Item 1) **[Figure 20-111-3]**.

Raise the console.

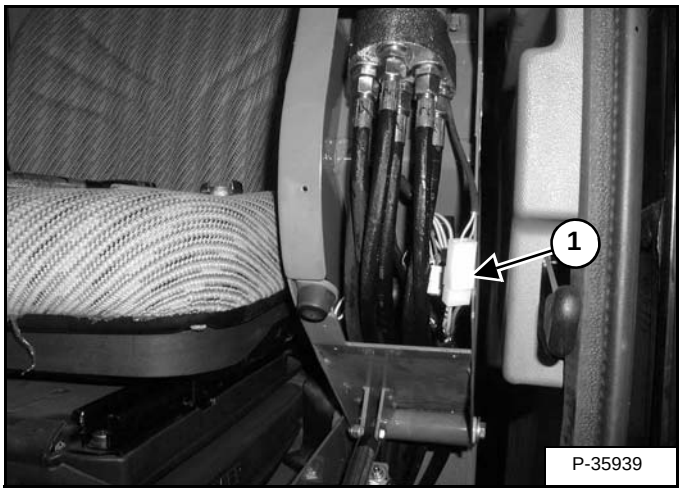
Figure 20-111-4



Remove the 3 screws (Item 1) **[Figure 20-111-4]**.

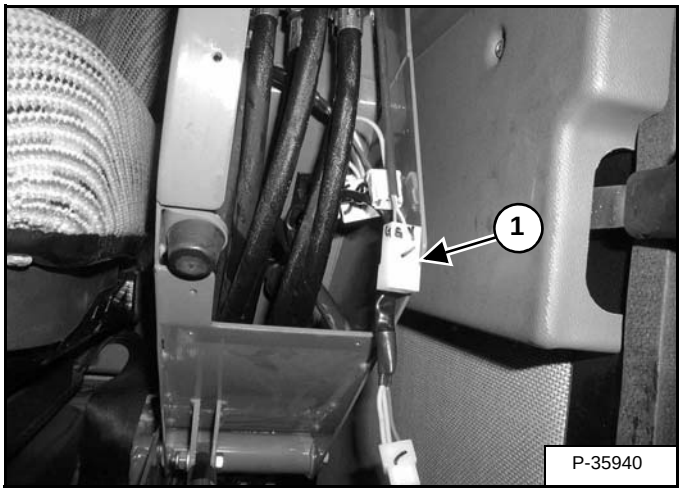
Remove the lower console cover (Item 2) **[Figure 20-111-4]**.

Figure 20-111-5



Disconnect the wire harness (Item 1) **[Figure 20-111-5]**.

Figure 20-111-6



Mark the wires to the connector body (Item 1) **[Figure 20-111-6]**.

Use a small flat blade screwdriver to depress the wire terminal tabs, and remove the individual wires from the connector body.

Installation: Use a small flat blade screwdriver to rebend the wire terminal tabs on each wire before installing the individual wires in the connector body.

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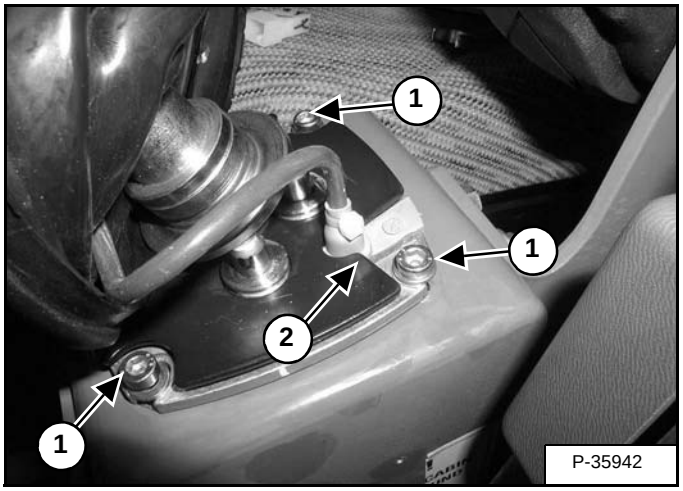
Handle Removal And Installation (Cont'd)

Lower the console.

Figure 20-111-7

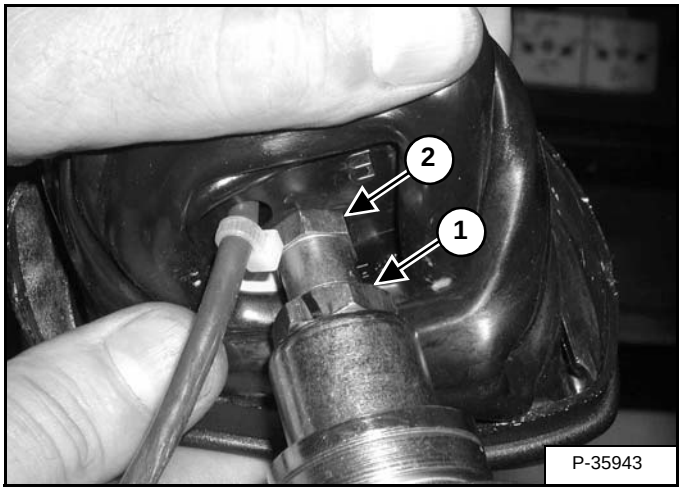


Pull up on the joystick boot and loosen the 4 mount bolts (Item 1) **[Figure 20-111-7]**.

Remove the grommet and wire harness (Item 2) **[Figure 20-111-7]** from the joystick body.

Pull up on the joystick boot.

Figure 20-111-8



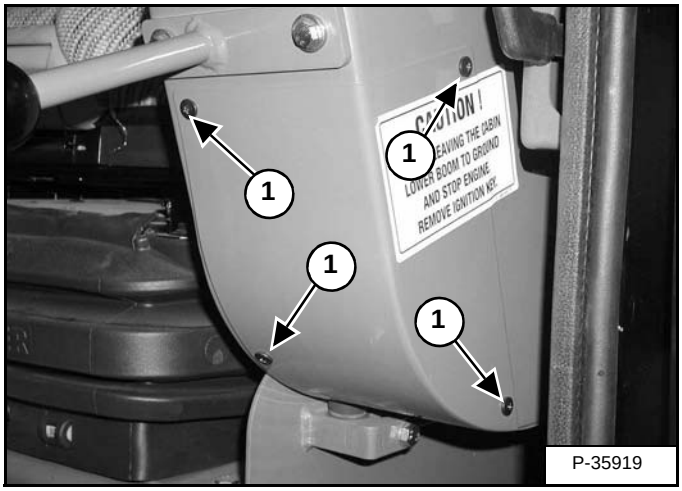
Loosen the nut (Item 1) **[Figure 20-111-8]**.

Remove the handle (Item 2) **[Figure 20-111-8]**.

Removal And Installation

Lower the console.

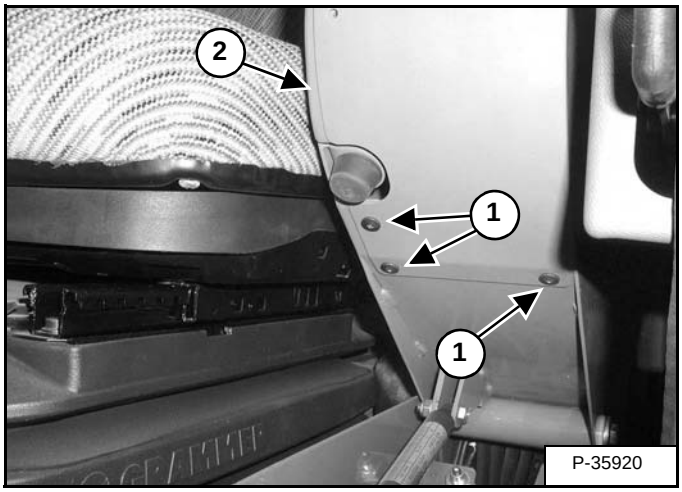
Figure 20-111-9



Remove the 4 screws (Item 1) **[Figure 20-111-9]**.

Raise the console.

Figure 20-111-10



Remove the 3 screws (Item 1) **[Figure 20-111-10]**.

Remove the lower console cover (Item 2) **[Figure 20-111-10]**.

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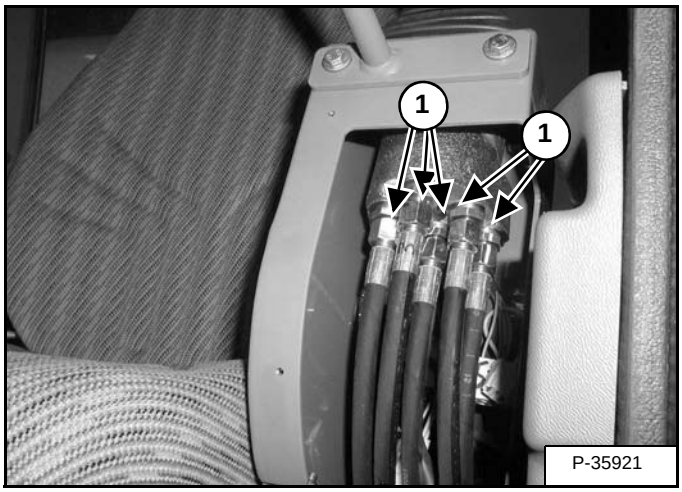
Removal And Installation (Cont'd)

Figure 20-111-11



Mark and remove the 6 hoses (Item 1) **[Figure 20-111-11]**.

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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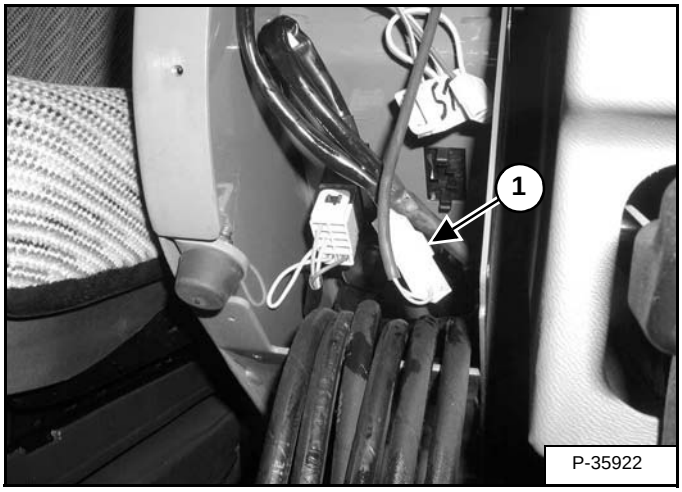
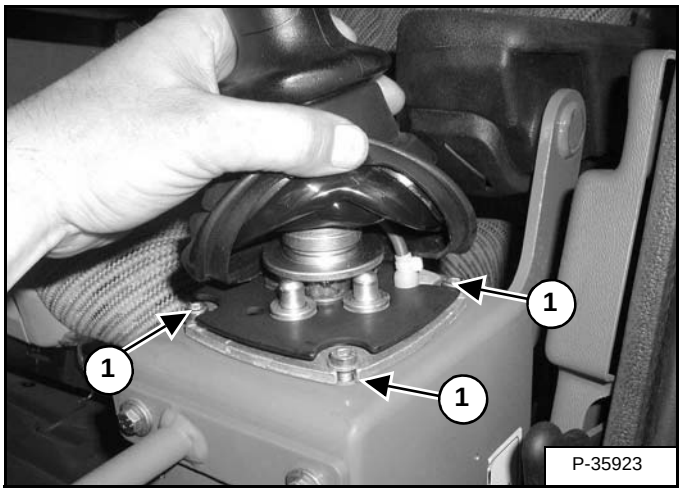
Figure 20-111-12



Disconnect the wire harness (Item 1) **[Figure 20-111-12]**

Lower the console.

Figure 20-111-13



Pull up on the joystick boot and remove the 4 bolts (Item 1) **[Figure 20-111-13]** and washers.

Remove the joystick.

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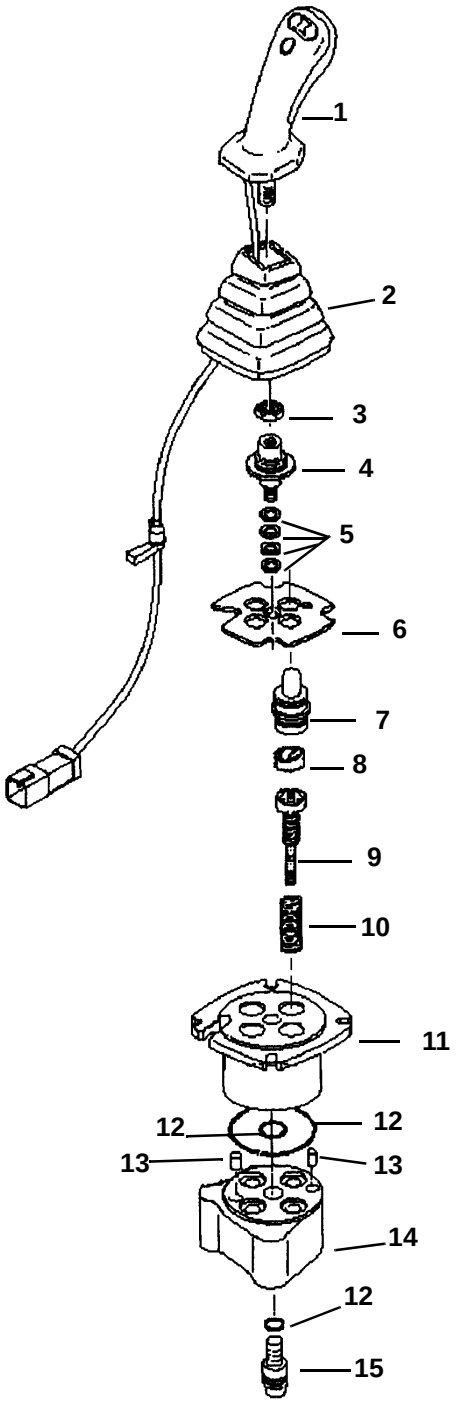
Parts Identification

1. Handle
2. Dust Boot
3. Nut
4. Swivel Joint/Bolt
5. Washers
6. Plate
7. Plunger Assembly
8. Seal
9. Spool Assembly
10. Spring
11. Valve Body (Top)
12. O-Ring
13. Alignment Pin
14. Valve Body (Bottom)
15. Bolt



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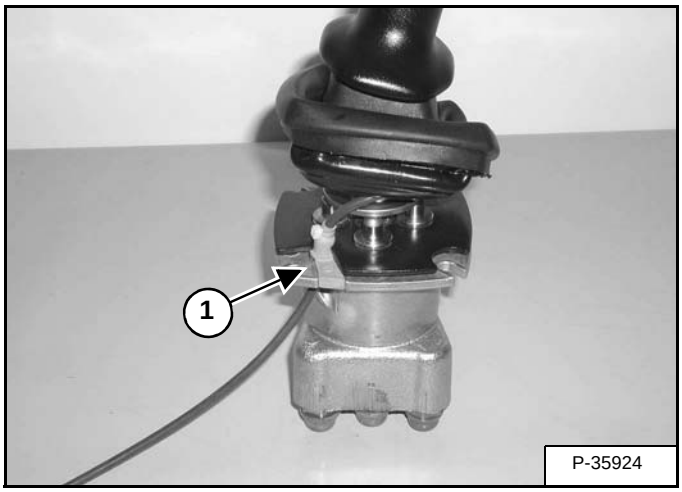
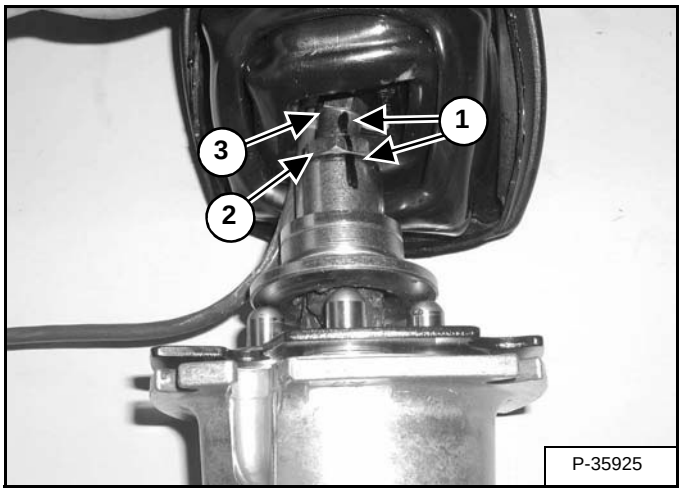
Disassembly and Assembly

Figure 20-111-14



Remove the grommet and wire harness (Item 1) **[Figure 20-111-14]**.

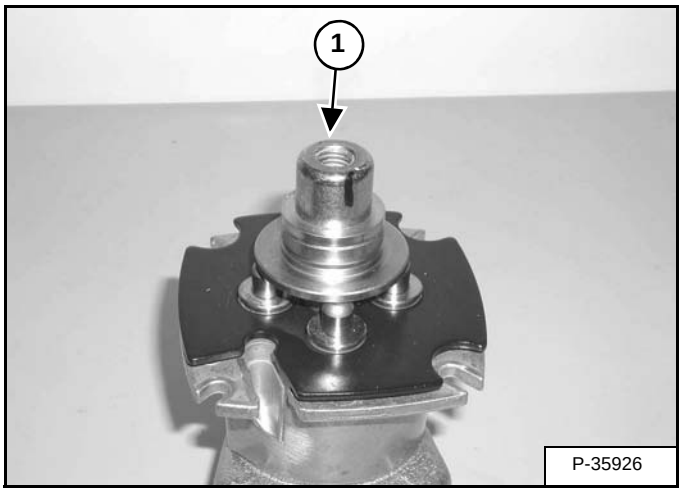
Figure 20-111-15



Mark the lever and swivel joint (Item 1) **[Figure 20-111-15]** for correct orientation of the handle during assembly.

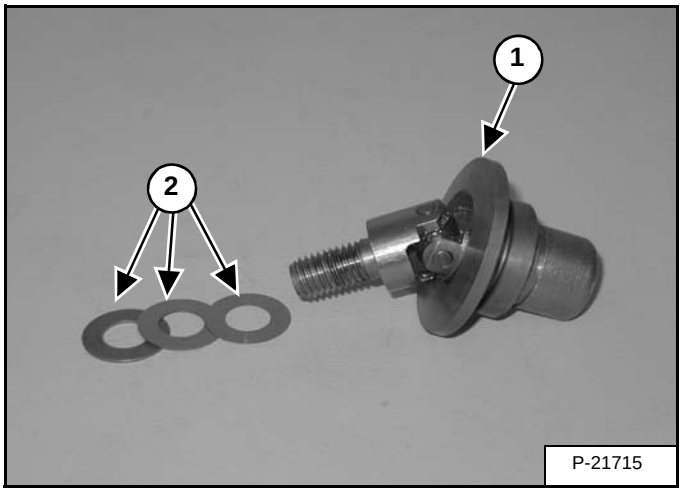
Loosen the nut (Item 2) and remove the handle (Item 3) **[Figure 20-111-15]**.

Figure 20-111-16



Remove the bolt (Item 1) **[Figure 20-111-16]** from inside the swivel joint.

Figure 20-111-17



Remove the swivel joint (Item 1) and washers (Item 2) **[Figure 20-111-17]**.

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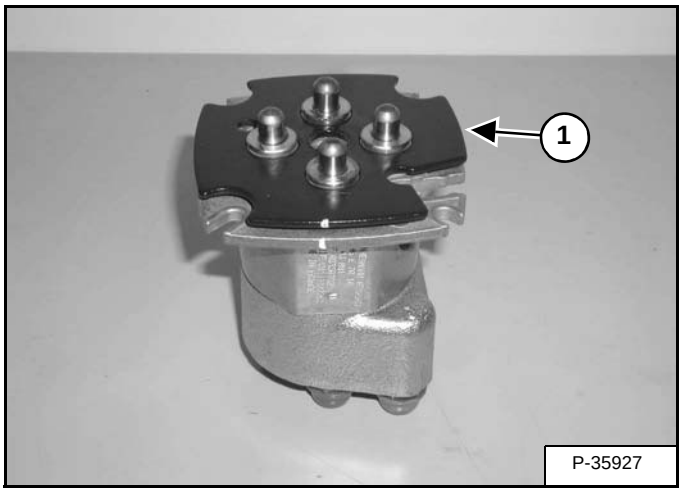
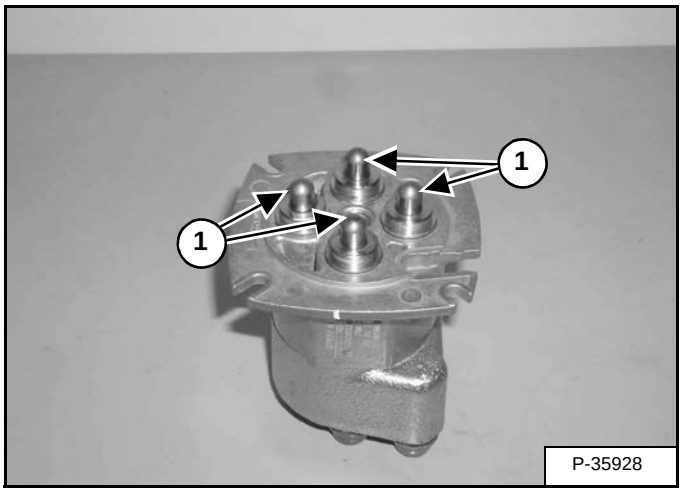
Disassembly And Assembly (Cont'd)

Figure 20-111-18



Remove the plate (Item 1) **[Figure 20-111-18]**.

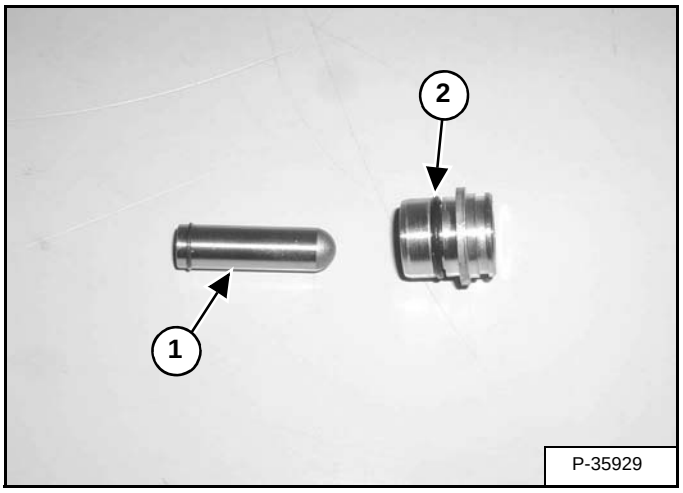
Figure 20-111-19



Mark and remove the plunger assemblies (Item 1) **[Figure 20-111-19]**.

NOTE: Install the plunger assemblies in the same bore the plungers were removed from.

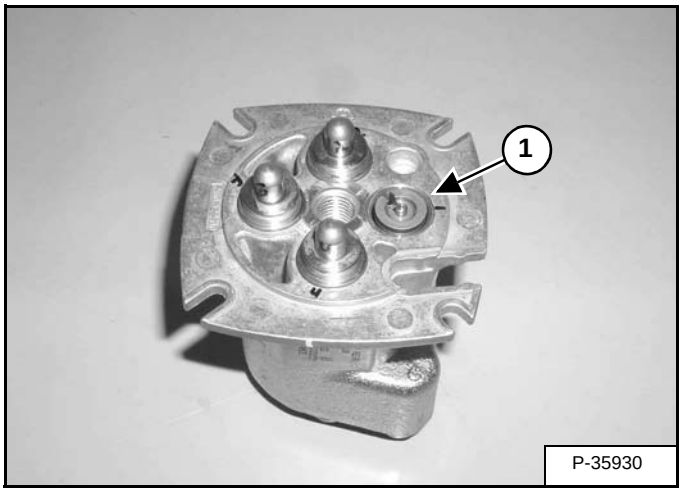
Figure 20-111-20



Remove the push rod (Item 1) **[Figure 20-111-20]** from the plunger body.

Remove the O-ring (Item 2) **[Figure 20-111-20]**.

Figure 20-111-21



Remove the spool assemblies (Item 1) **[Figure 20-111-21]**.

NOTE: Install the spool assemblies in the same bore the spools were removed from.

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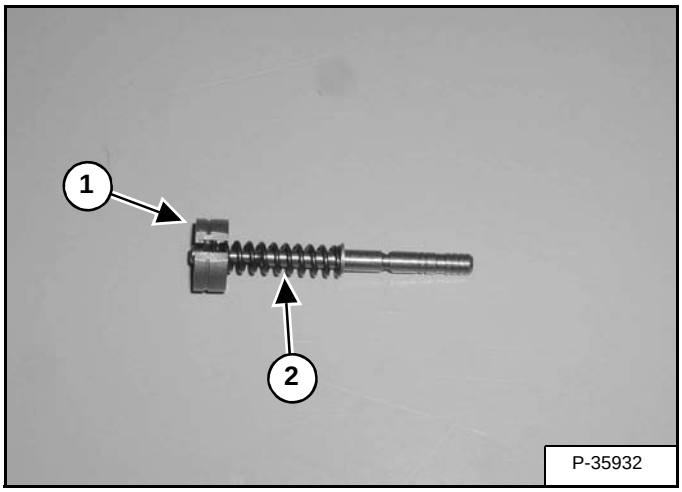
Disassembly And Assembly (Cont'd)

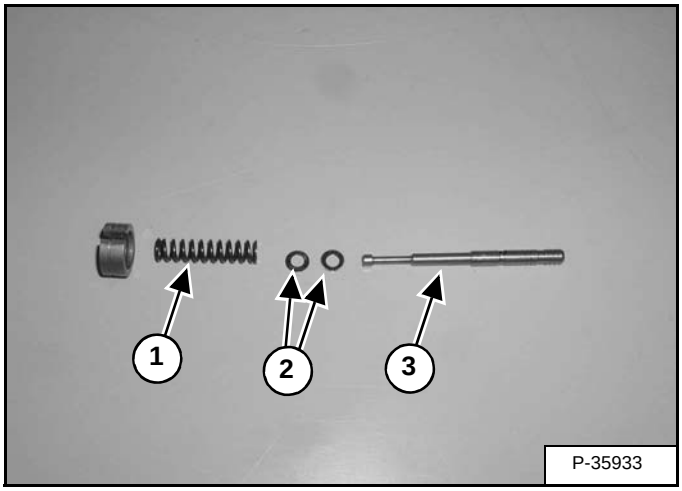
Figure 20-111-22



Mark the top of the spring seat (Item 1) **[Figure 20-111-22]**.

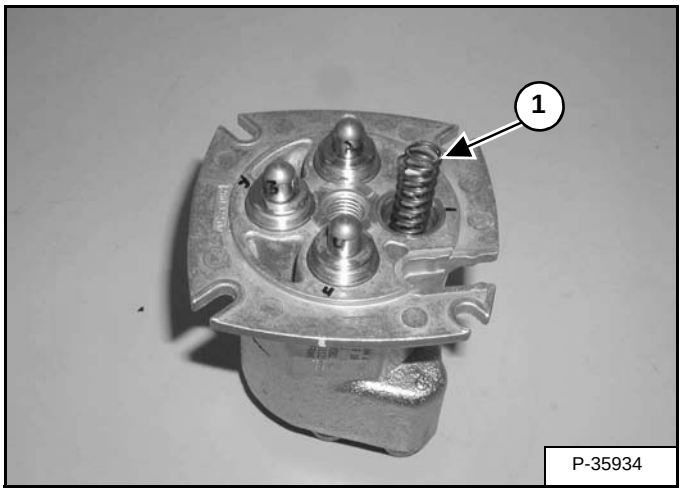
Compress the spring (Item 2) and remove the spring seat (Item 1) **[Figure 20-111-22]**.

Figure 20-111-23



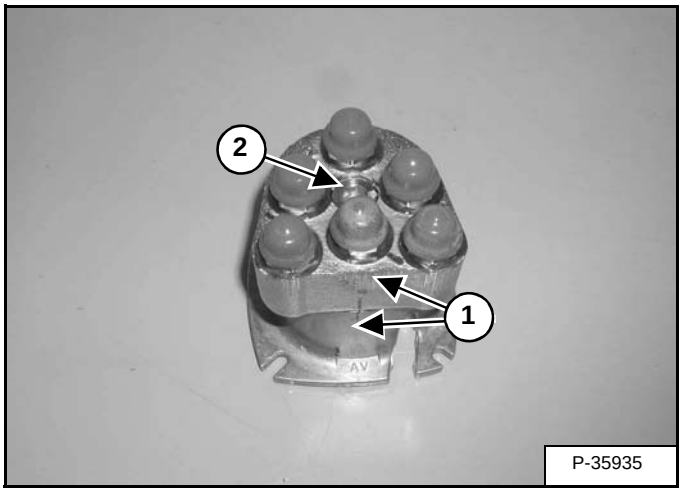
Remove the spring (Item 1) and washers (Item 2) from the spool (Item 3) **[Figure 20-111-23]**.

Figure 20-111-24



Remove the spring (Item 1) **[Figure 20-111-24]**.

Figure 20-111-25



Mark the joystick body (Item 1) **[Figure 20-111-25]** for ease of assembly.

Remove the bolt (Item 2) **[Figure 20-111-25]**.

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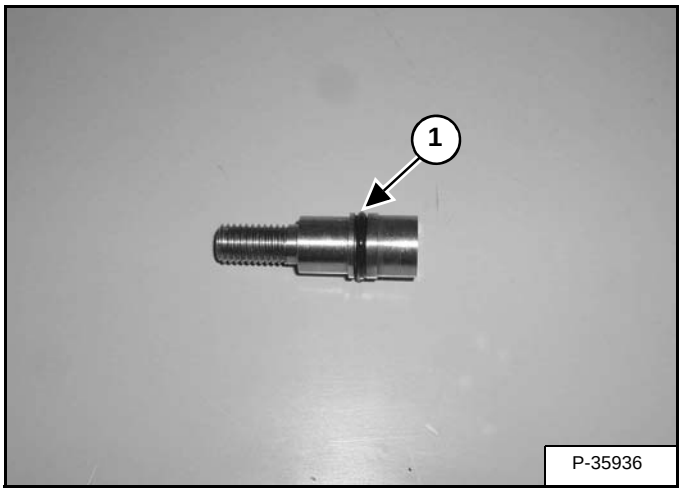
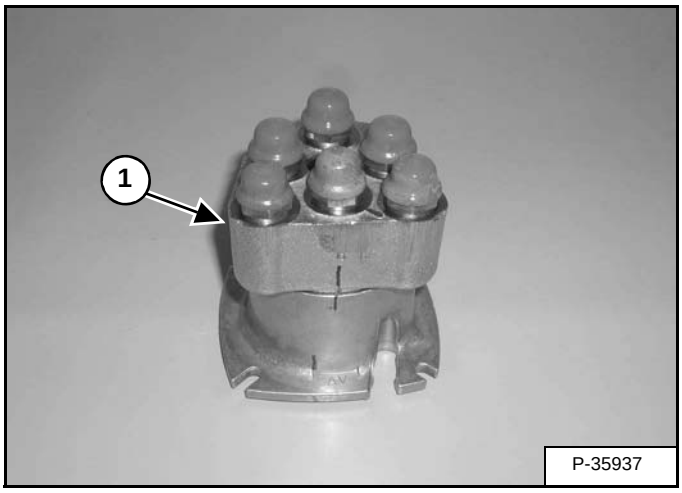
Disassembly And Assembly (Cont'd)

Figure 20-111-26



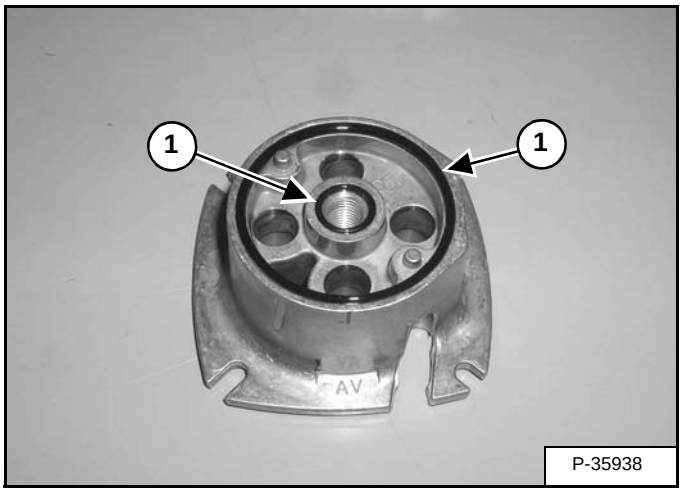
Remove the O-ring (Item 1) **[Figure 20-111-26]**.

Figure 20-111-27



Remove the bottom of the valve body (Item 1) **[Figure 20-111-27]**.

Figure 20-111-28



Remove the 2 O-rings (Item 1) **[Figure 20-111-28]**.

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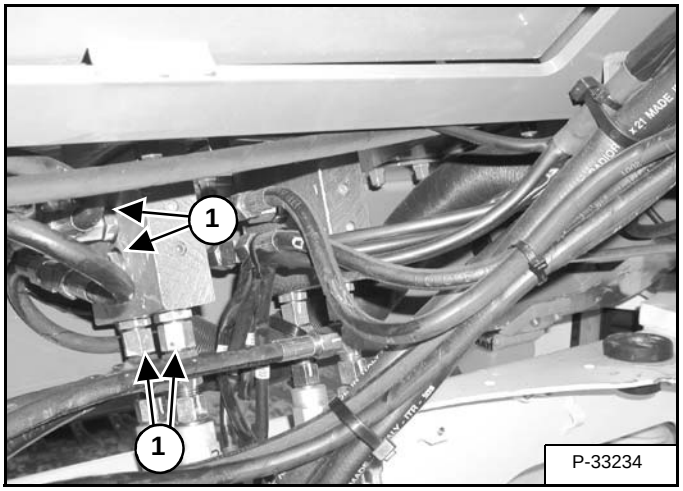
TRAVEL LEVER/FOOT PEDAL VALVE

Left Travel Lever/Foot Pedal Valve Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-112-1



Mark and remove the four tee fittings (Item 1) **[Figure 20-112-1]**.

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.

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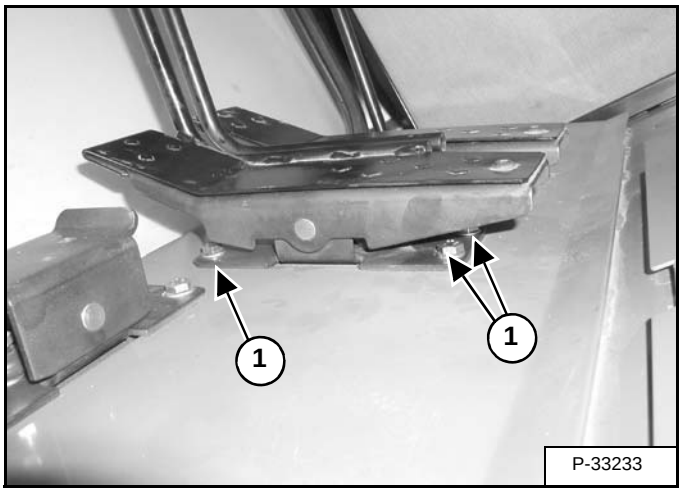
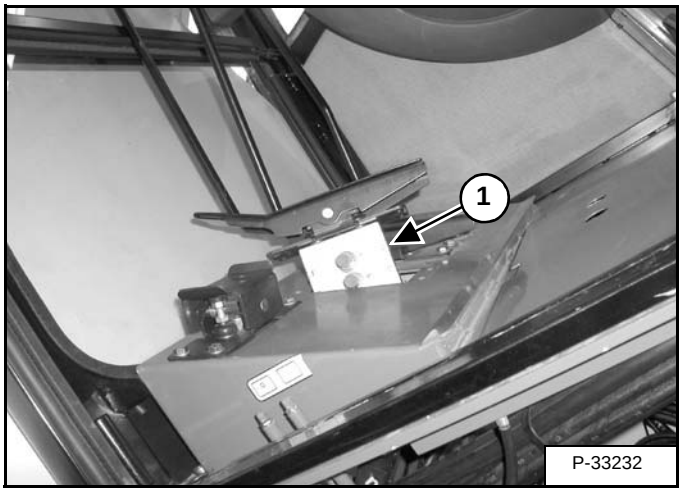
Figure 20-112-2



Remove the 4 bolts (Item 1) **[Figure 20-112-2]** and washers.

Installation: Tighten the bolts to 15-18 ft.-lb. (20-25 N•m) torque.

Figure 20-112-3



Remove the valve (Item 1) **[Figure 20-112-3]**.

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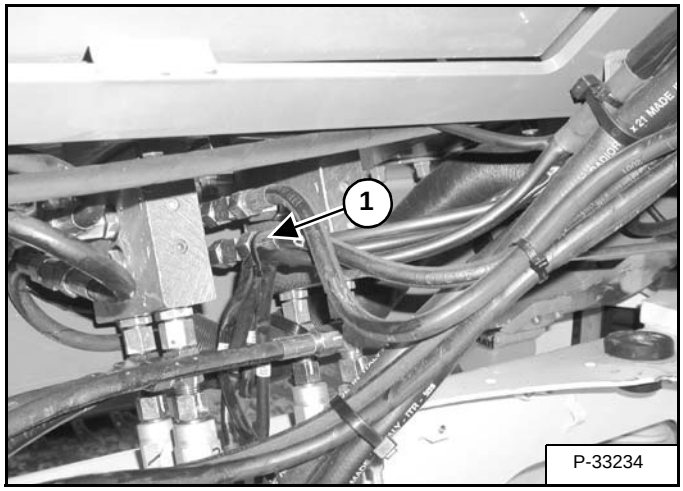
Right Travel Lever/Foot Pedal Valve Removal And Installation

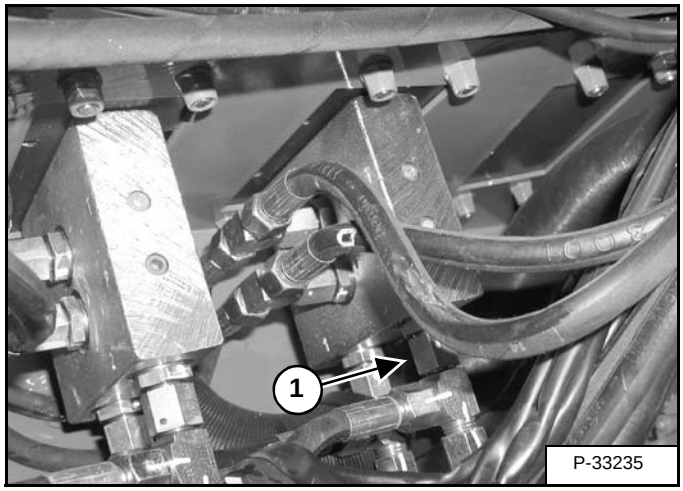
Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-112-4



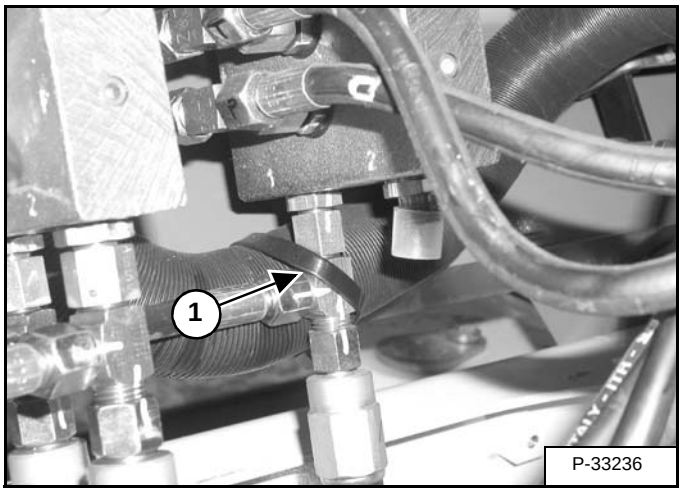
Cut and remove the cable tie (Item 1) **[Figure 20-112-4]**. Reposition the hoses to gain access to the valve hoses.

Figure 20-112-5



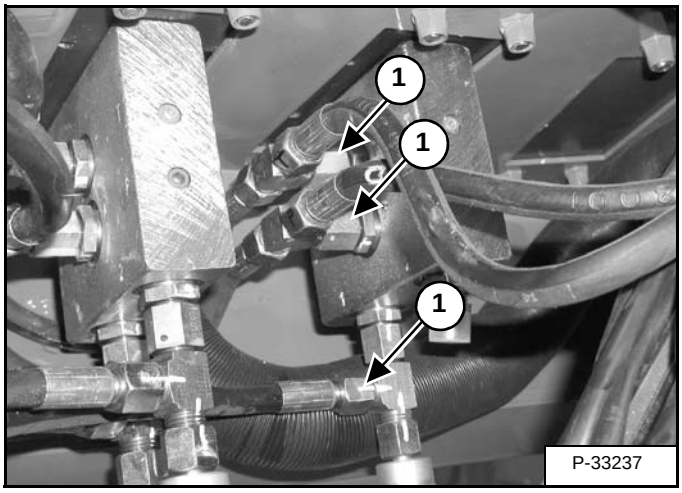
Mark and remove the tee fitting (Item 1) **[Figure 20-112-5]**.

Figure 20-112-6



Cut and remove the tie strap (Item 1) **[Figure 20-112-6]**.

Figure 20-112-7



Mark and remove the 3 tee fittings (Item 1) **[Figure 20-112-7]**

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Right Travel Lever/Foot Pedal Valve Removal And Installation (Cont'd)

Figure 20-112-8

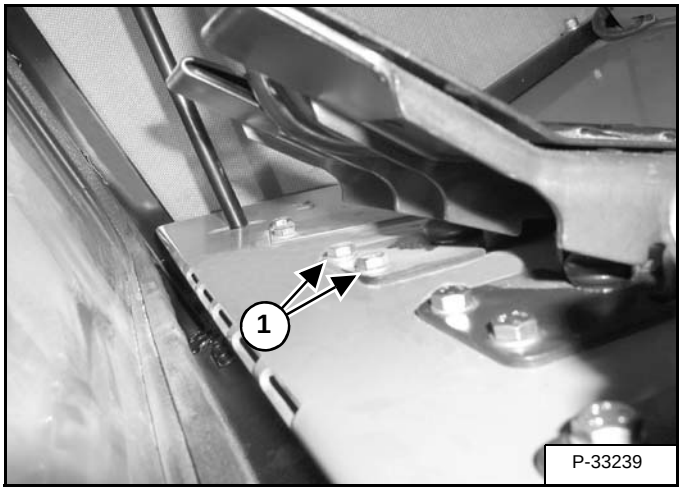
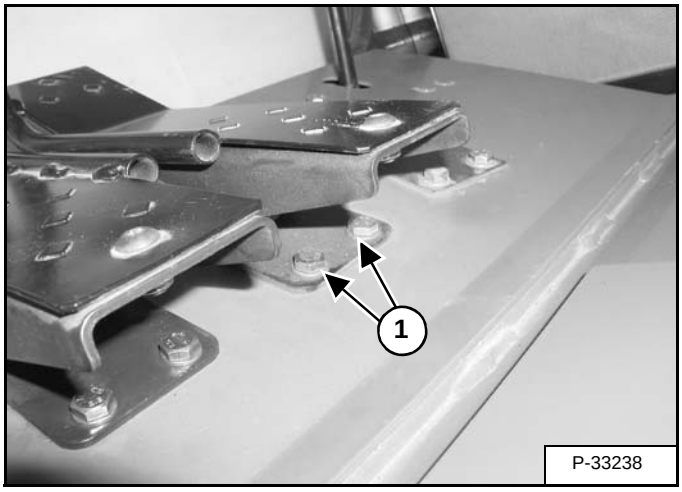


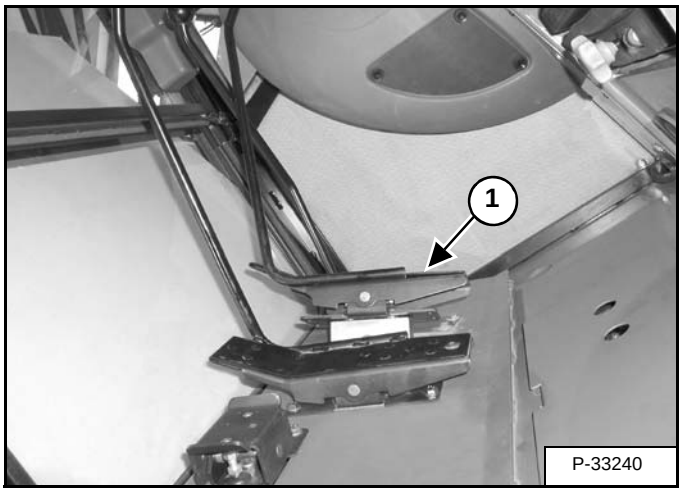
Figure 20-112-9



Remove the 4 bolts (Item 1) **[Figure 20-112-8]** & **[Figure 20-112-9]** and washers.

Installation: Tighten the bolts to 15-18 ft.-lb. (20-25 N•m) torque.

Figure 20-112-10



Remove the valve (Item 1) **[Figure 20-112-10]**.

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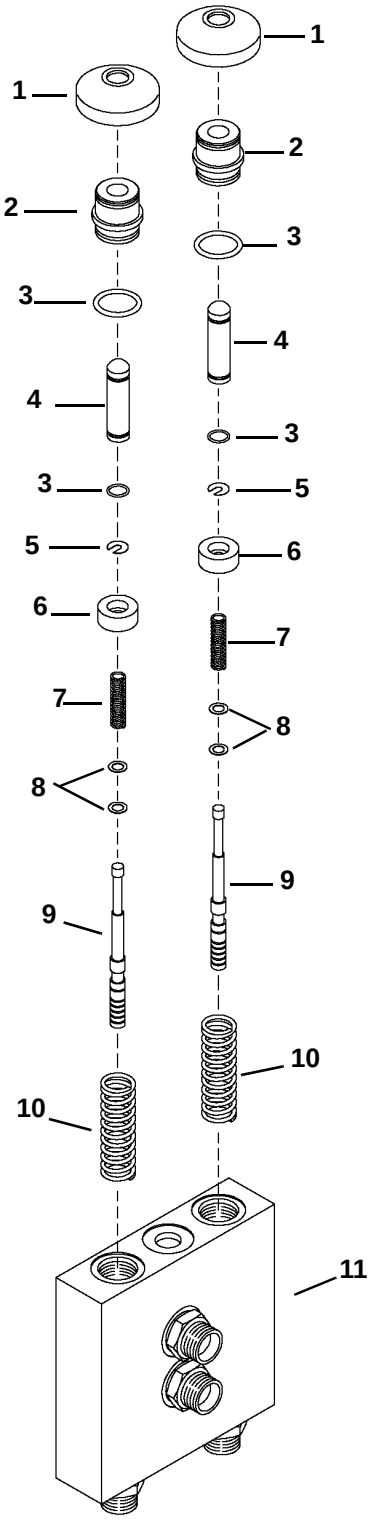
Parts Identification

1 Dust Boot
2 Plunger Body
3 O-Ring
4 Push Rod
5 Retainer
6 Piston
7 Spring
8 Shim
9 Spool
10 Spring
11 Valve Body



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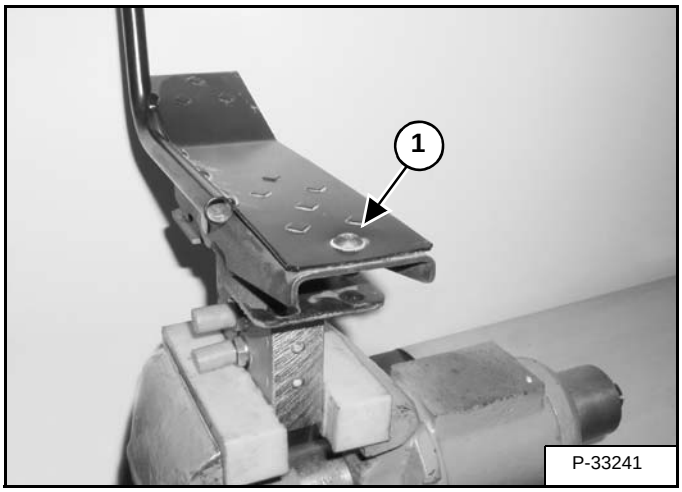
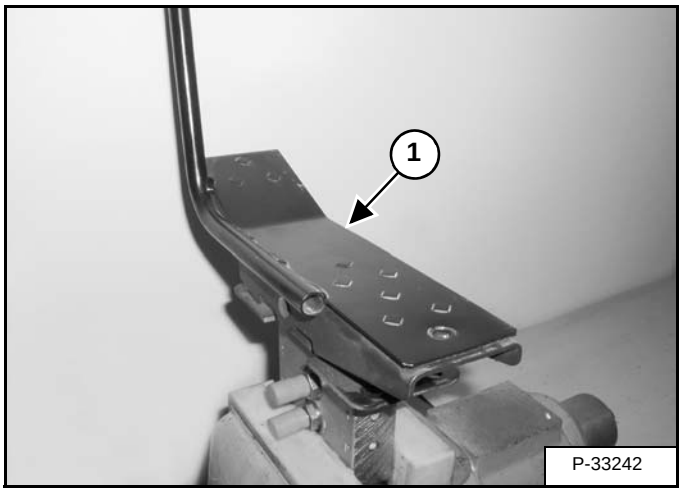
Disassembly And Assembly

Figure 20-112-11



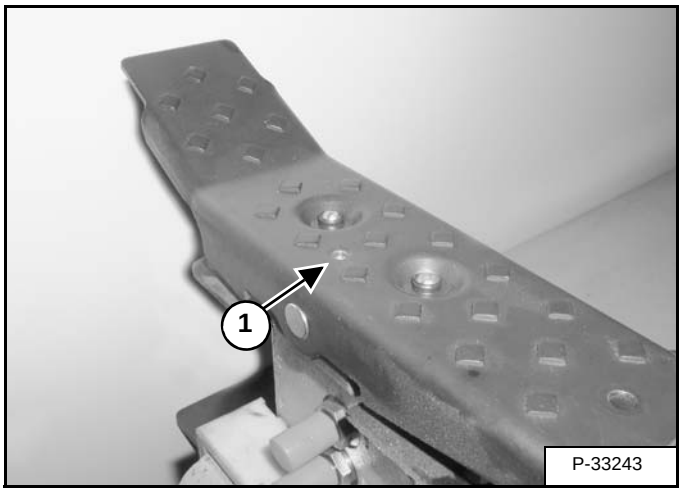
Remove the bolt (Item 1) **[Figure 20-112-11]** from the pedal.

Figure 20-112-12



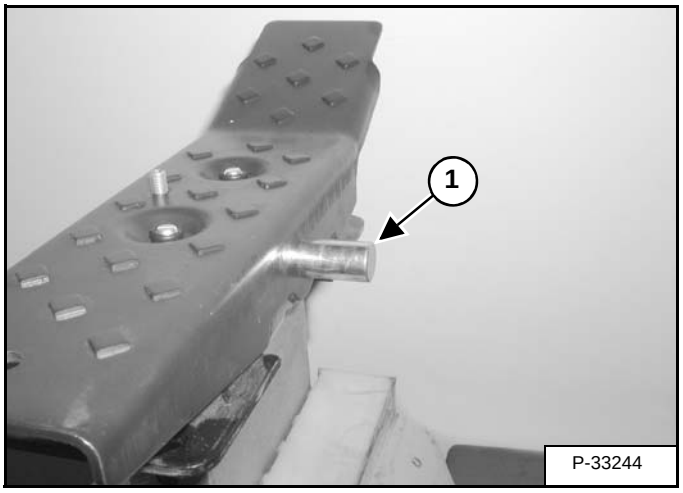
Slide the plate (Item 1) **[Figure 20-112-12]** and remove the plate and handle assembly.

Figure 20-112-13



Loosen the set screw (Item 1) **[Figure 20-112-13]**.

Figure 20-112-14



Remove the pin (Item 1) **[Figure 20-112-14]**.

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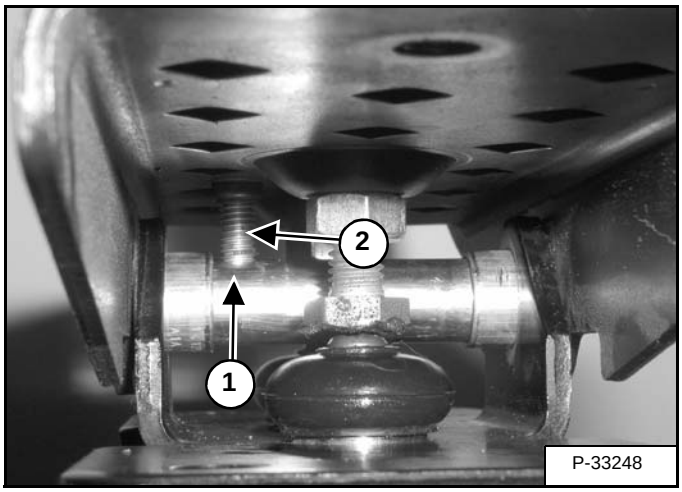
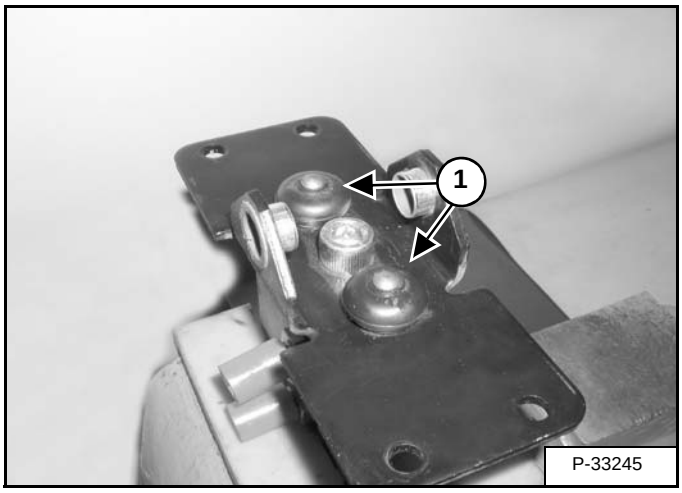
Disassembly And Assembly (Cont'd)

Figure 20-112-15



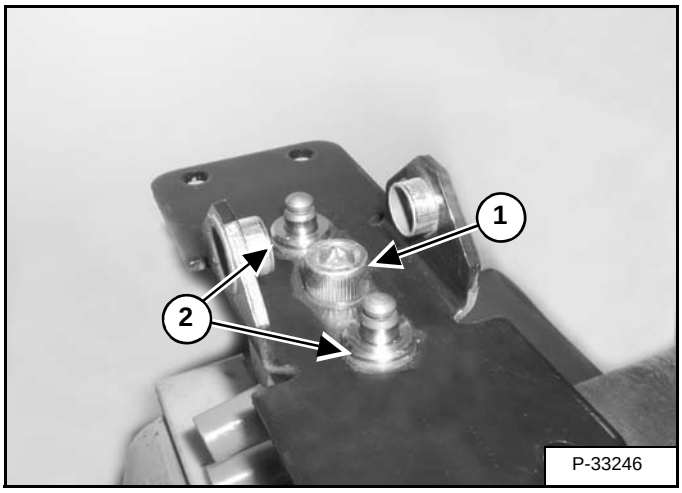
Installation: Align the hole (Item 1) in the pin with the set screw (Item 2) **[Figure 20-112-15]**.

Figure 20-112-16



Remove the dust boots (Item 1) **[Figure 20-112-16]**.

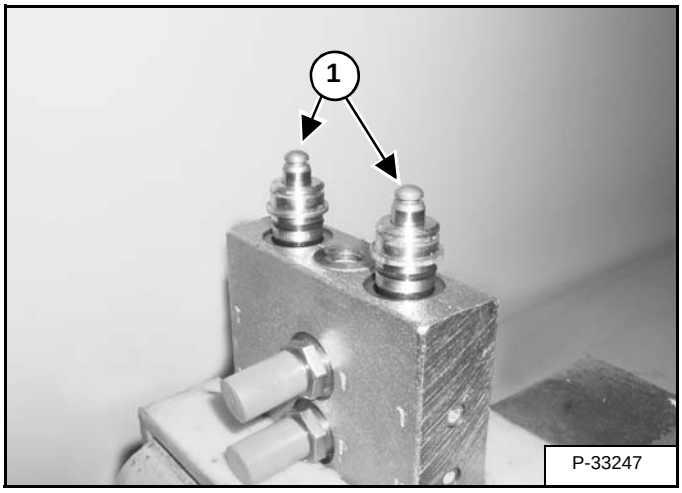
Figure 20-112-17



Remove the bolt (Item 1) **[Figure 20-112-17]**.

NOTE: Use care when removing the bolt, the plunger assemblies (Item 2) [Figure 20-112-17] are spring loaded.

Figure 20-112-18



Remove the plunger assemblies (Item 1) **[Figure 20-112-18]**.

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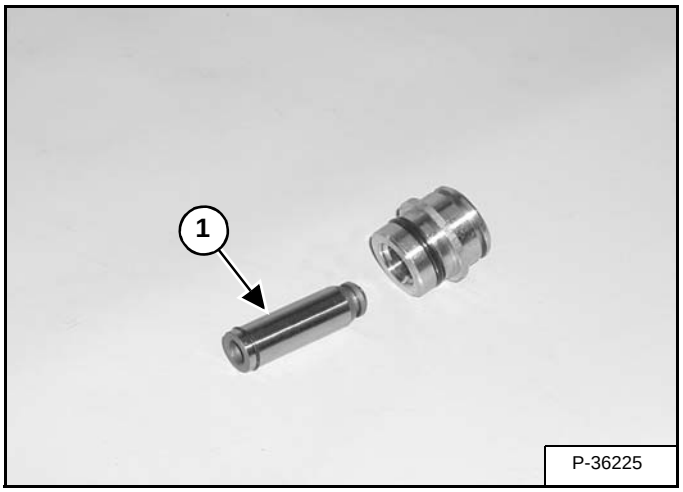
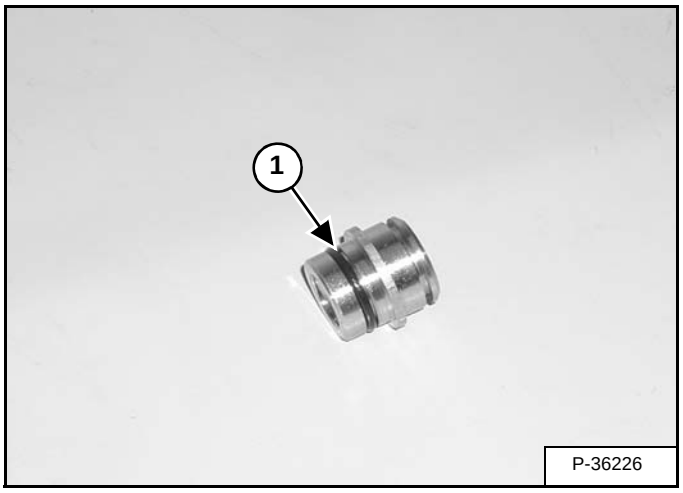
Disassembly And Assembly (Cont'd)

Figure 20-112-19



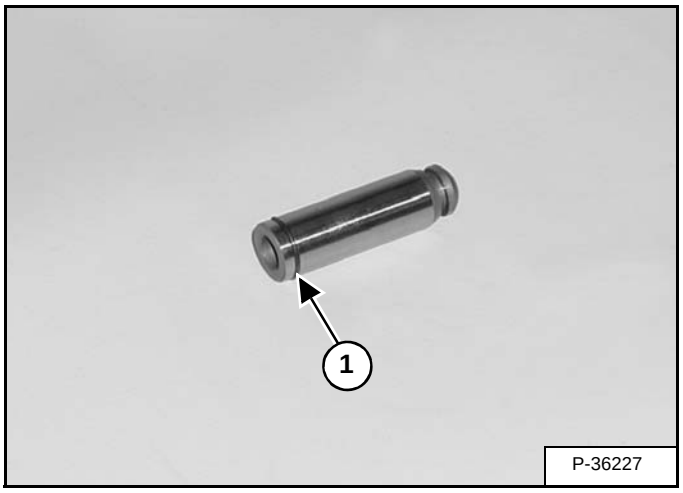
Remove the push rod (Item 1) **[Figure 20-112-19]** from the plunger body.

Figure 20-112-20



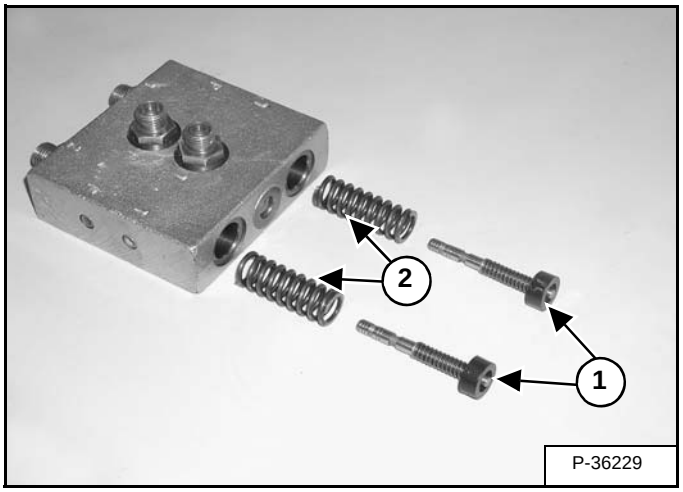
Remove the O-ring (Item 1) **[Figure 20-112-20]** from the plunger body.

Figure 20-112-21



Remove the seal (Item 1) **[Figure 20-112-21]** from the push rod.

Figure 20-112-22



Remove the spool assemblies (Item 1) and springs (Item 2) **[Figure 20-112-22]**.

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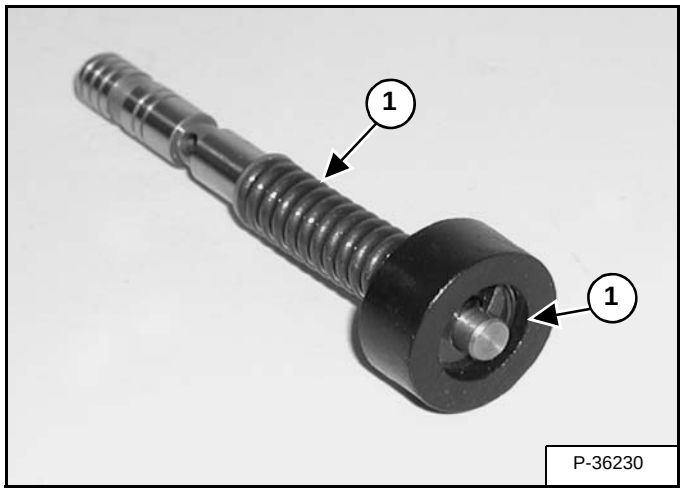
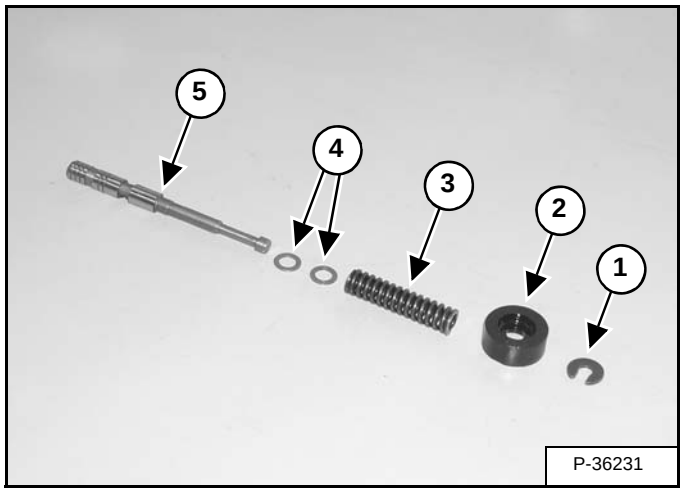
Disassembly And Assembly (Cont'd)

Figure 20-112-23



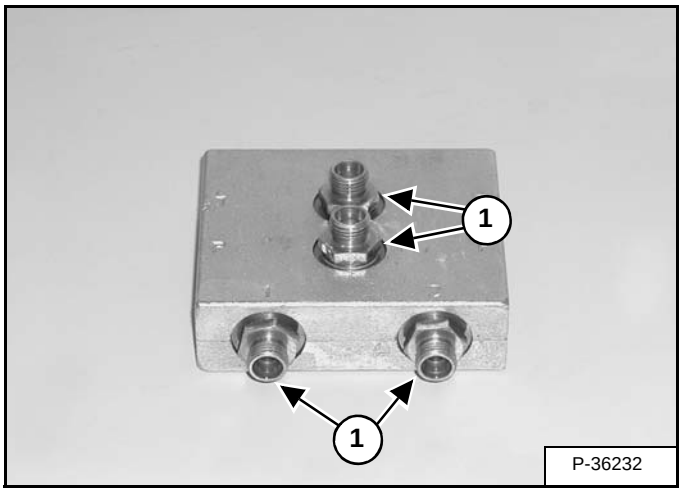
Compress the spring (Item 1) until the retainer (Item 2) **[Figure 20-112-23]** can be removed.

Figure 20-112-24



Remove the retainer (Item 1), piston (Item 2), spring (Item 3) and shims (Item 4) from the spool (Item 5) **[Figure 20-112-24]**.

Figure 20-112-25



Do not remove the 4 fittings (Item 1) **[Figure 20-112-25]**, the fittings are welded to the valve block. Removing the fittings will damage the block and fittings.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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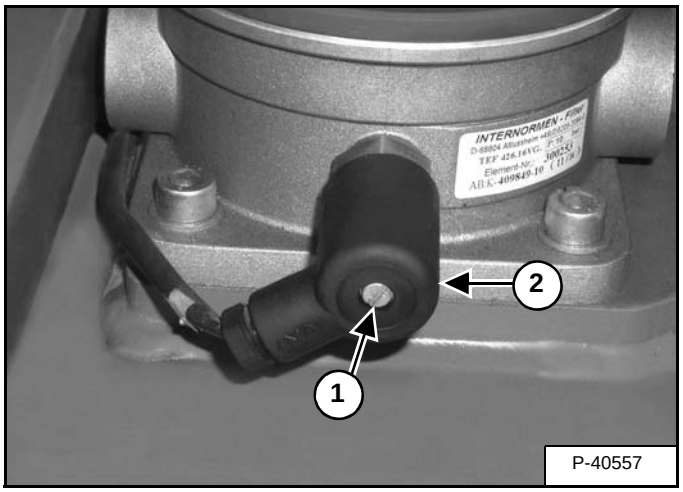
HYDRAULIC FILTER MOUNT

Removal And Installation

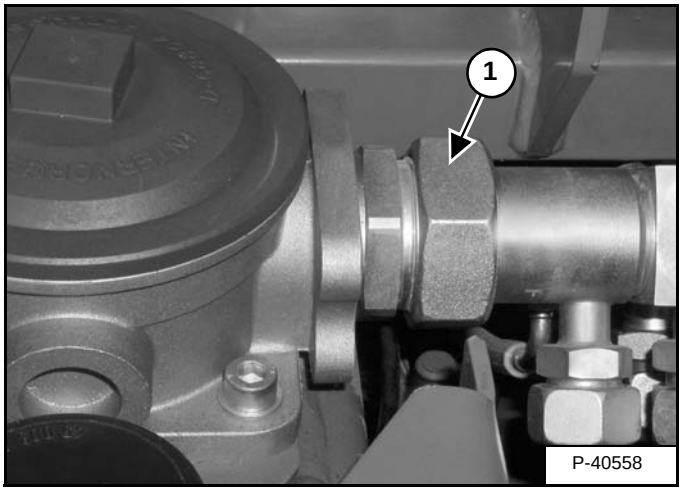
Figure 20-120-1



Remove the screw (Item 1) from the electrical connector (Item 2) **[Figure 20-120-1]**. Remove the electrical connector.

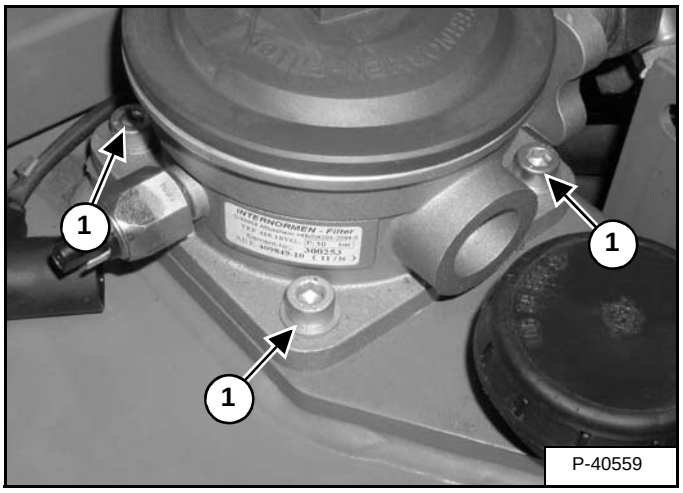
Installation: Do not overtighten the screw.

Figure 20-120-2



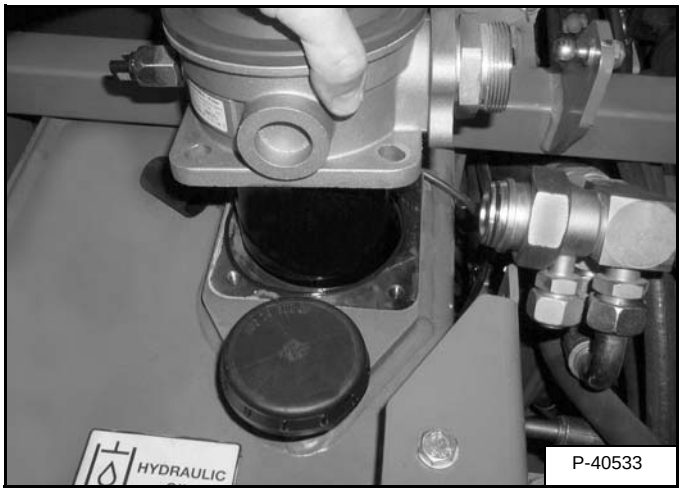
Remove the tube line (Item 1) **[Figure 20-120-2]**.

Figure 20-120-3



Remove the 4 bolts (Item 1) **[Figure 20-120-3]** and washers.

Figure 20-120-4



Remove the filter mount **[Figure 20-120-4]**.

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HYDRAULIC RESERVOIR

Removal And Installation

Remove the rear cover. (See REAR COVER on Page 40-150-1.)

Remove the right side cover. (See RIGHT SIDE COVER on Page 40-160-1.)

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Remove the counterweight. (See COUNTERWEIGHT on Page 40-170-1.)

Remove the filter mount. (See HYDRAULIC FILTER MOUNT on Page 20-120-1.)

Figure 20-130-1

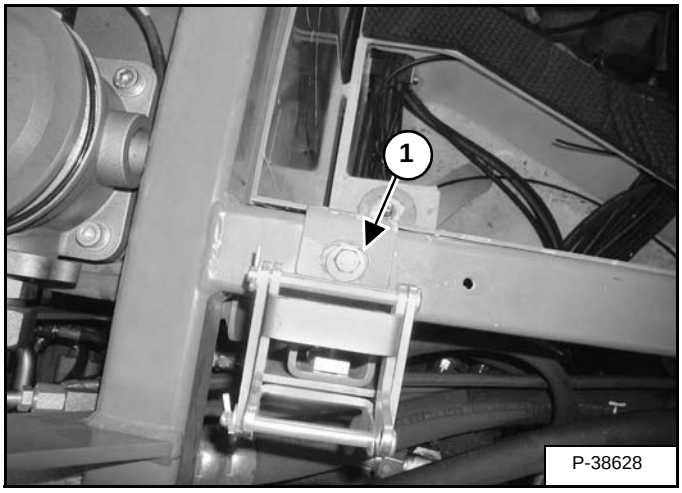
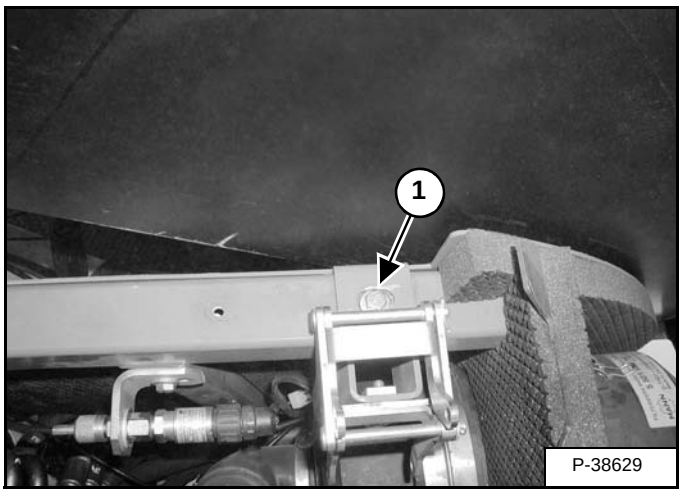
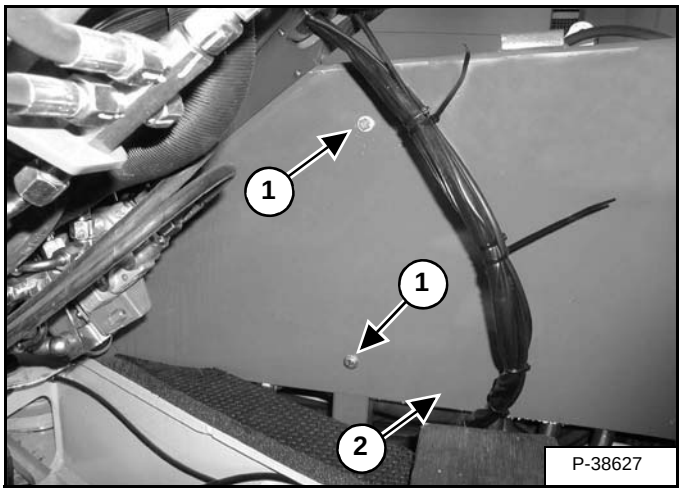


Figure 20-130-2



Remove the 2 bolts (Item 1) and **[Figure 20-130-2]** and washers from the top of the center panel.

Figure 20-130-3



Remove the 2 bolts (Item 1) **[Figure 20-130-3]** and washers from the side of the center panel.

Remove the panel (Item 2) **[Figure 20-130-3]**.

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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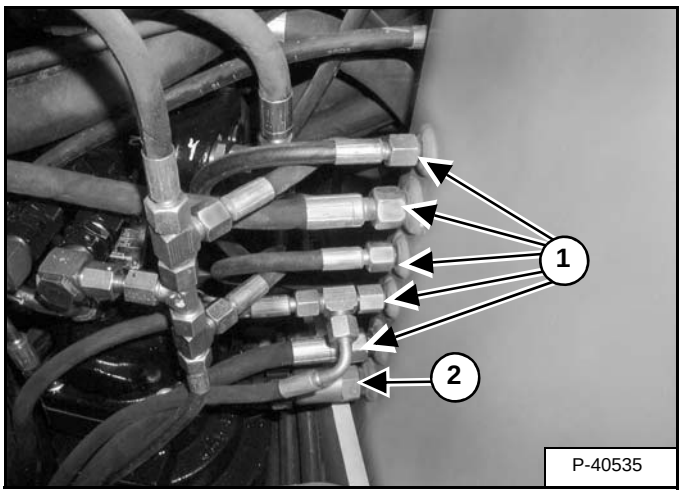
Figure 20-130-4



Mark and remove the 5 hoses (Item 1) and disconnect the wire harness (Item 2) **[Figure 20-130-4]**.

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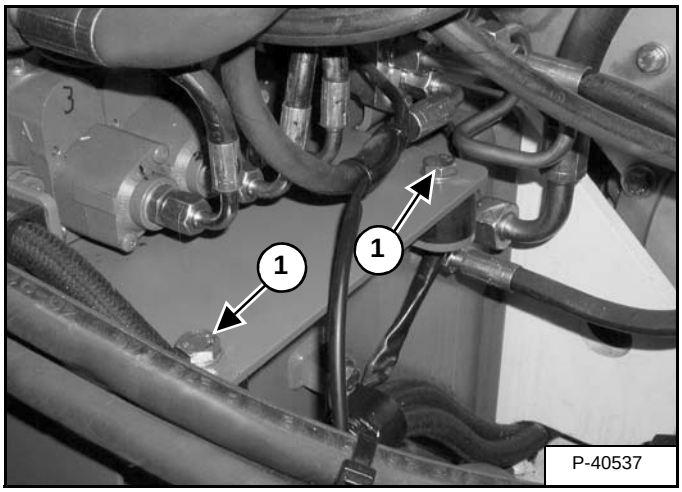
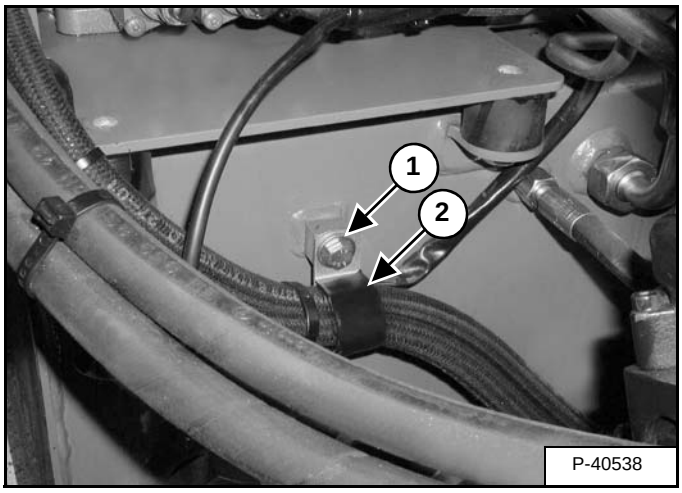
Removal And Installation (Cont'd)

Figure 20-130-5



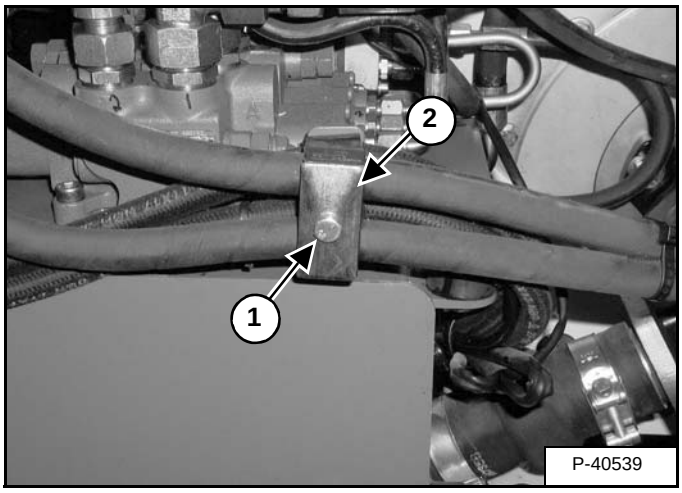
Remove the 2 bolts (Item 1) **[Figure 20-130-5]** on the right side of the mount bracket.

Figure 20-130-6



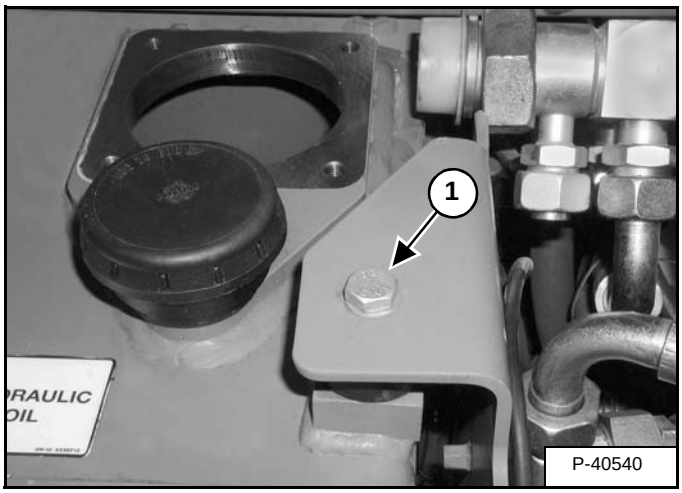
Remove the bolt (Item 1) and hose clamp (Item 2) **[Figure 20-130-6]** from the right hand side of the hydraulic reservoir.

Figure 20-130-7



Remove the bolt (Item 1) and hose clamp (Item 2) **[Figure 20-130-7]** from the rear of the hydraulic reservoir.

Figure 20-130-8



Remove the mount bolt (Item 1) **[Figure 20-130-8]** from the top of the hydraulic reservoir.

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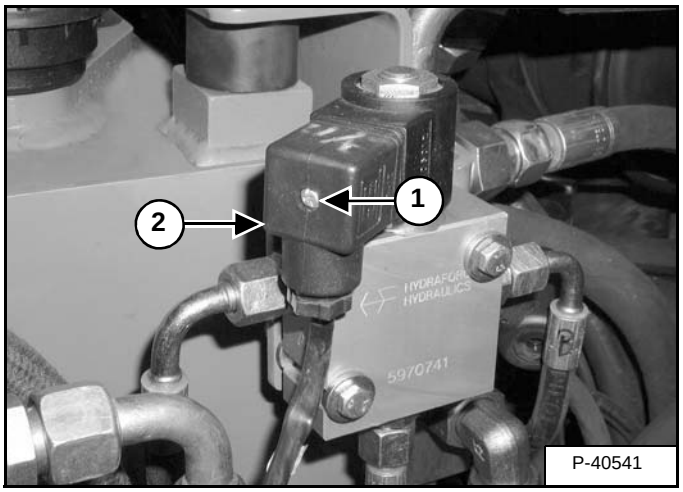
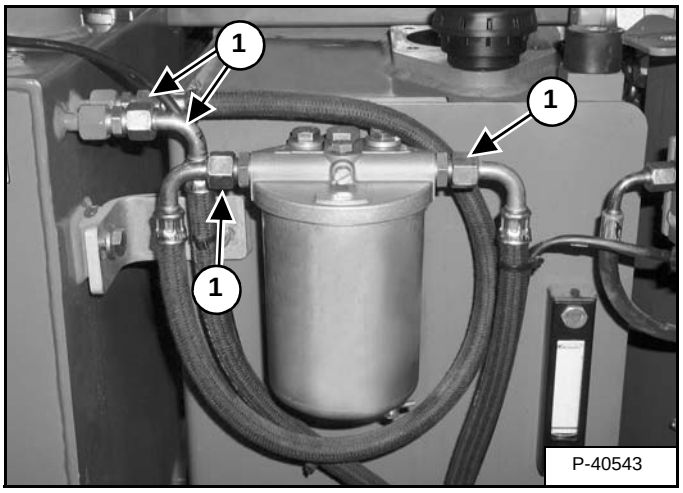
Removal And Installation (Cont'd)

Figure 20-130-9



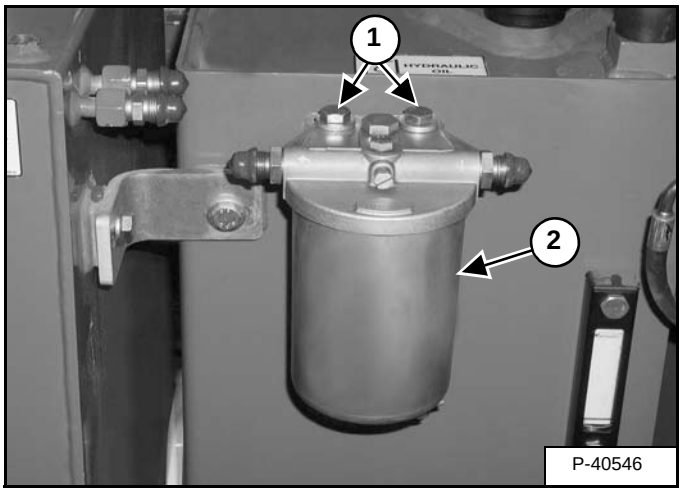
Remove the screw (Item 1) and disconnect the electrical connector (Item 2) **[Figure 20-130-9]**.

Figure 20-130-10



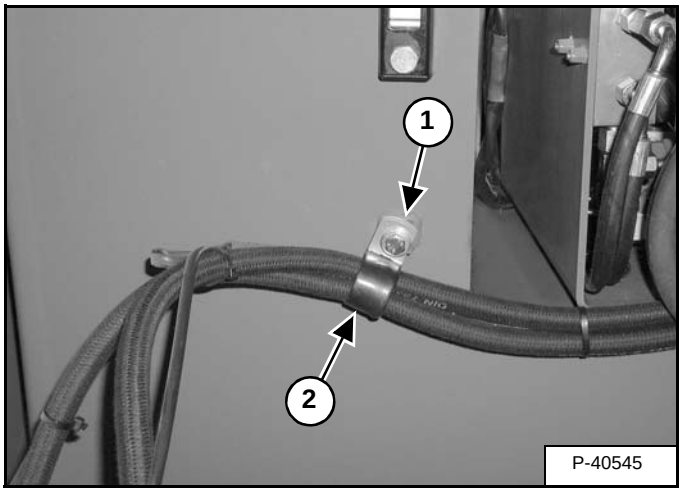
Mark and remove the 4 hoses (Item 1) **[Figure 20-130-10]** from the fuel filter.

Figure 20-130-11



Remove the 2 bolts (Item 1) and nuts from the fuel filter (Item 2) **[Figure 20-130-11]**. Remove the fuel filter.

Figure 20-130-12



Remove the bolt (Item 1) and hose clamp (Item 2) **[Figure 20-130-12]**.

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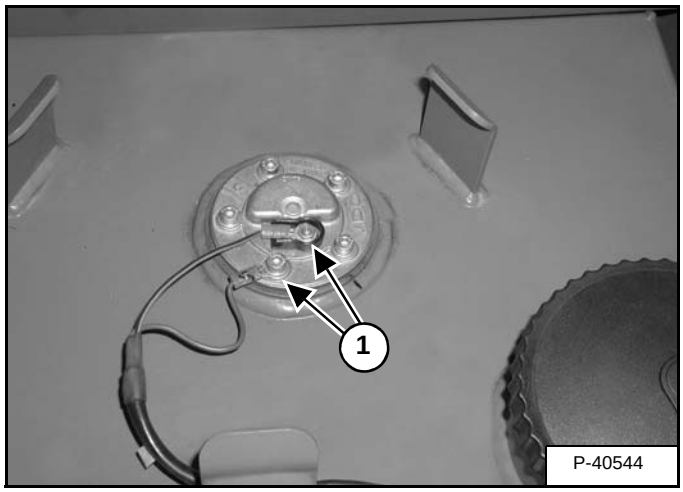
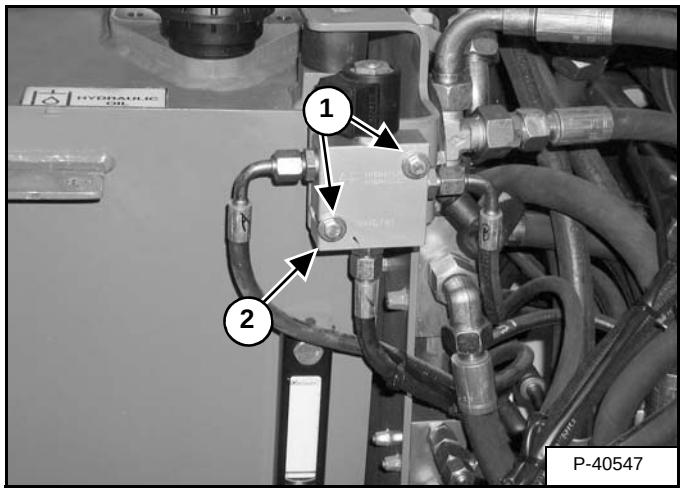
Removal And Installation (Cont'd)

Figure 20-130-13



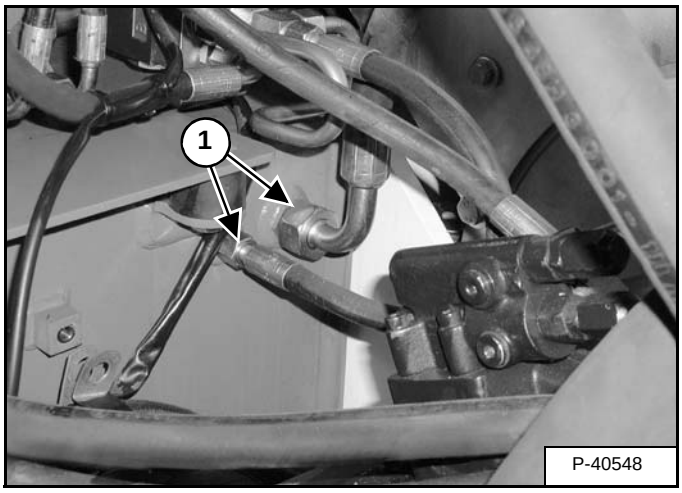
Mark and remove the 2 wires (Item 1) **[Figure 20-130-13]** from the fuel sending unit.

Figure 20-130-14



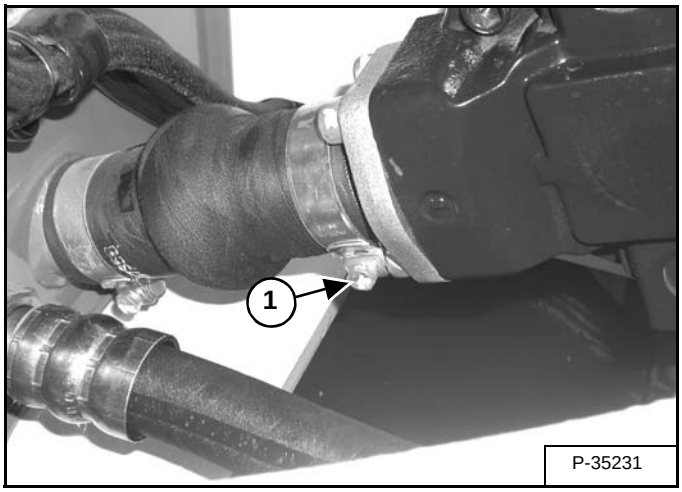
Remove the 2 bolts (Item 1) and nuts from the swing brake valve (Item 2) **[Figure 20-130-14]**. Remove the swing brake valve.

Figure 20-130-15



Mark and remove the 2 hoses (Item 1) **[Figure 20-130-15]** from the right hand side of the hydraulic reservoir.

Figure 20-130-16



Loosen the clamp (Item 1) **[Figure 20-130-16]**. Rotate the clamp to provide clearance to the suction fitting bolts.

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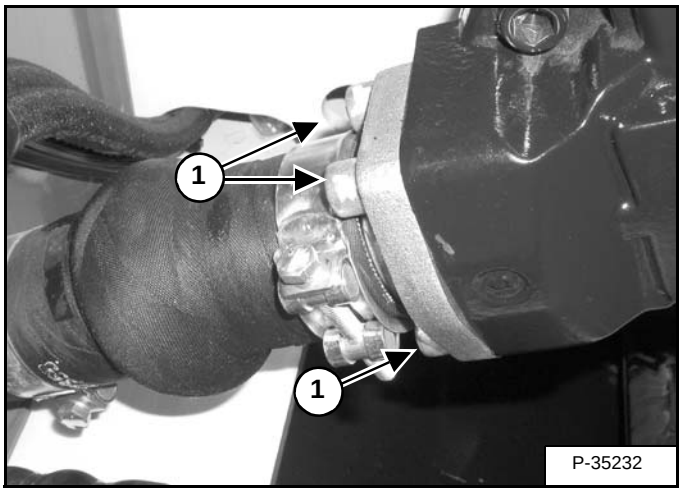
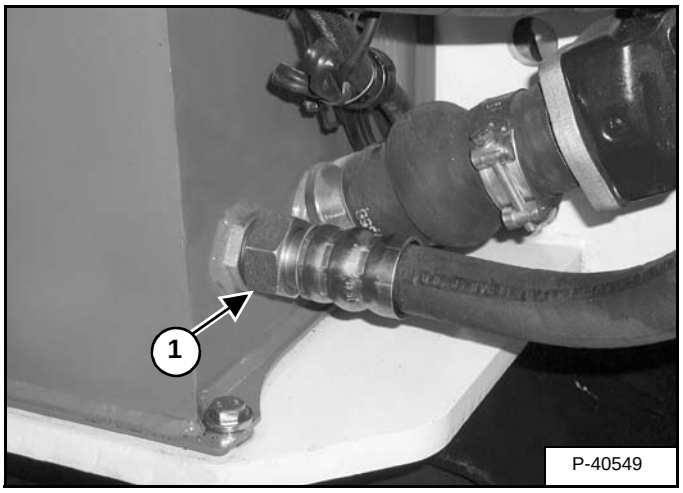
Removal And Installation (Cont'd)

Figure 20-130-17



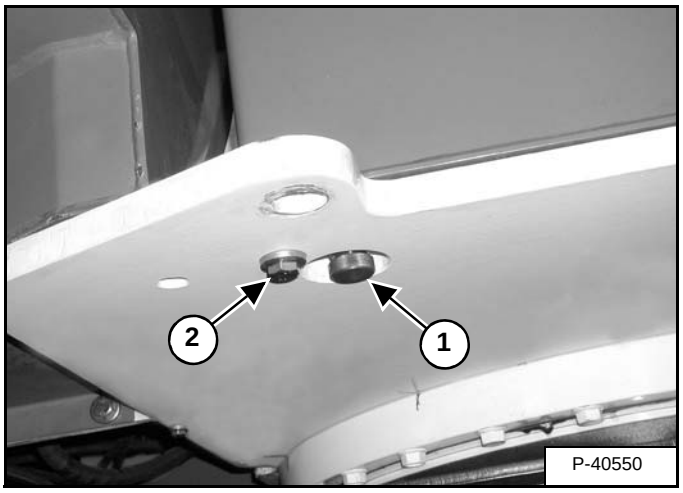
Remove the 4 bolts (Item 1) **[Figure 20-130-17]**.

Figure 20-130-18



Mark and remove the hose (Item 1) **[Figure 20-130-18]**.

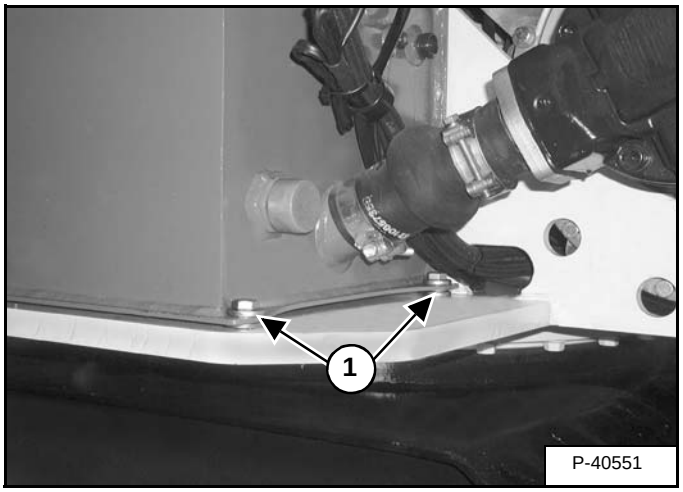
Figure 20-130-19



Remove the plug and fitting (Item 1) **[Figure 20-130-19]** from the bottom of the hydraulic reservoir.

Remove the bolt (Item 2) **[Figure 20-130-19]** and washer.

Figure 20-130-20



Remove the 2 mount bolts (Item 1) **[Figure 20-130-20]** and washers from the right hand side of the hydraulic reservoir.

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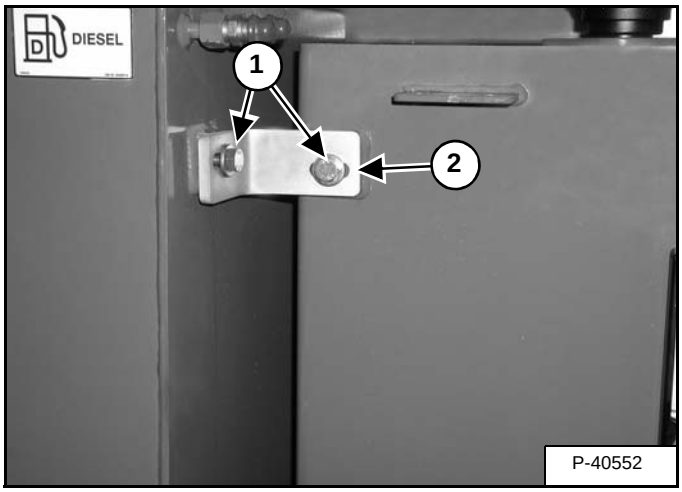
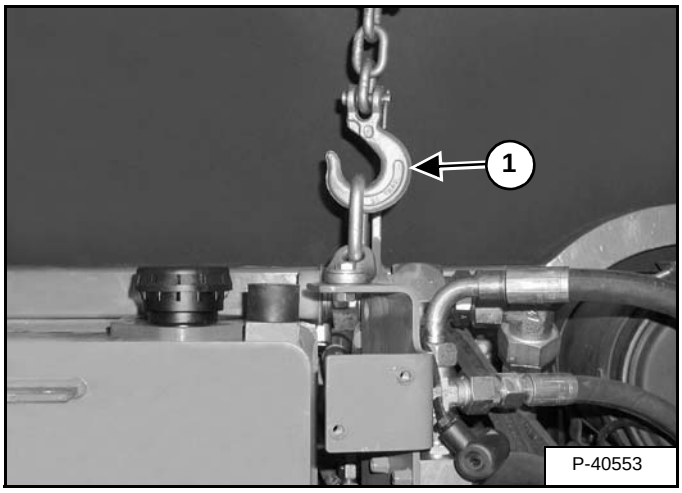
Removal And Installation (Cont'd)

Figure 20-130-21



Remove the 2 mount bolts (Item 1) and bracket (Item 2) **[Figure 20-130-21]**.

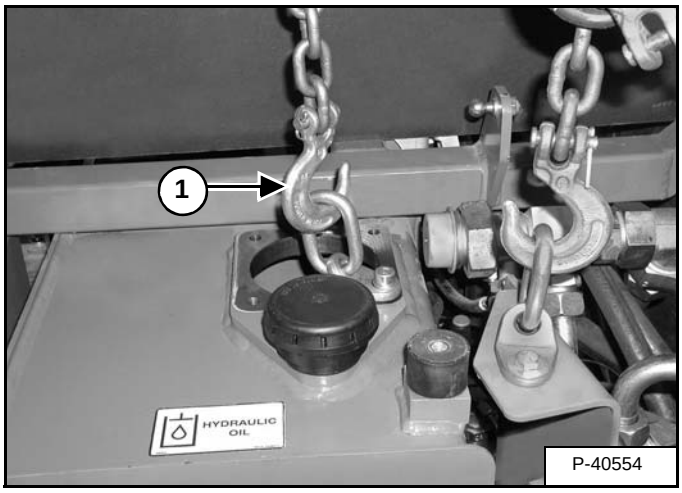
Figure 20-130-22



Install a hoist (Item 1) **[Figure 20-130-22]** on the mount bracket.

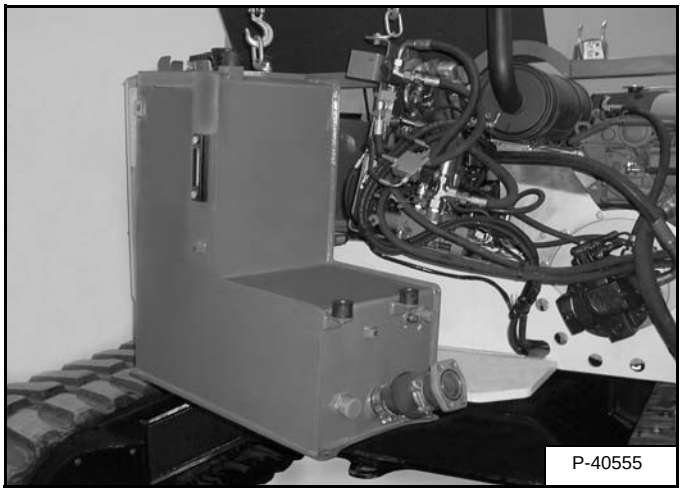
Raise the mount bracket up and to the right to provide clearance for the hydraulic reservoir to be removed.

Figure 20-130-23



Install a hoist (Item 1) **[Figure 20-130-23]** on the hydraulic reservoir.

Figure 20-130-24



Raise the hoist and slide the hydraulic reservoir out the rear of the excavator **[Figure 20-130-24]**.

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OIL COOLER

Description

The oil cooler is a combined radiator/oil cooler. See Radiator/Oil Cooler Removal And Installation. (See RADIATOR/OIL COOLER (S/N 522311001 & ABOVE) on Page 60-40-1 or See RADIATOR/OIL COOLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-41-1.)

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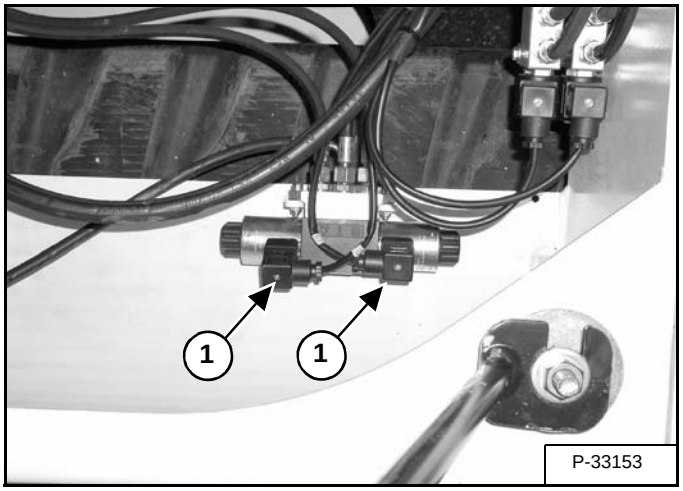
SECONDARY FRONT AUXILIARY VALVE

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-150-1



Mark and remove the wire harness (Item 1) **[Figure 20-150-1]**.

⚠ WARNING

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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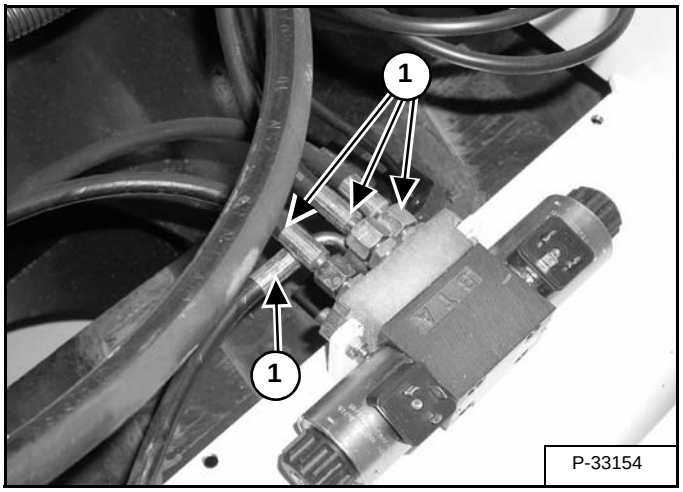
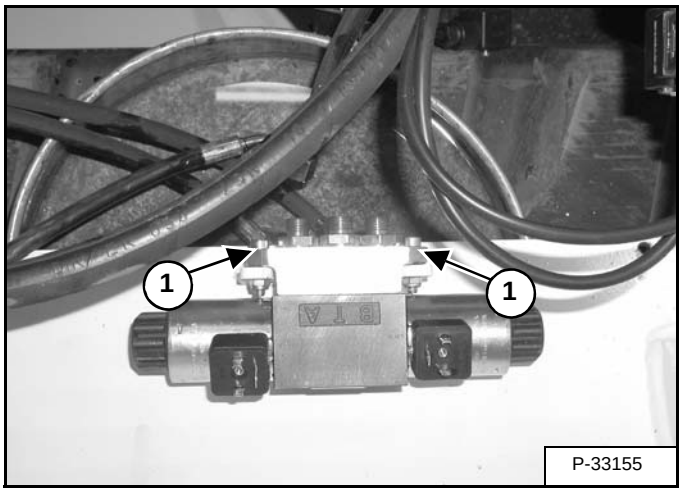
Figure 20-150-2



Mark and remove the 4 hoses (Item 1) **[Figure 20-150-2]**.

Figure 20-150-3



Remove the 2 bolts (Item 1) **[Figure 20-150-3]** and nuts. Remove the valve.

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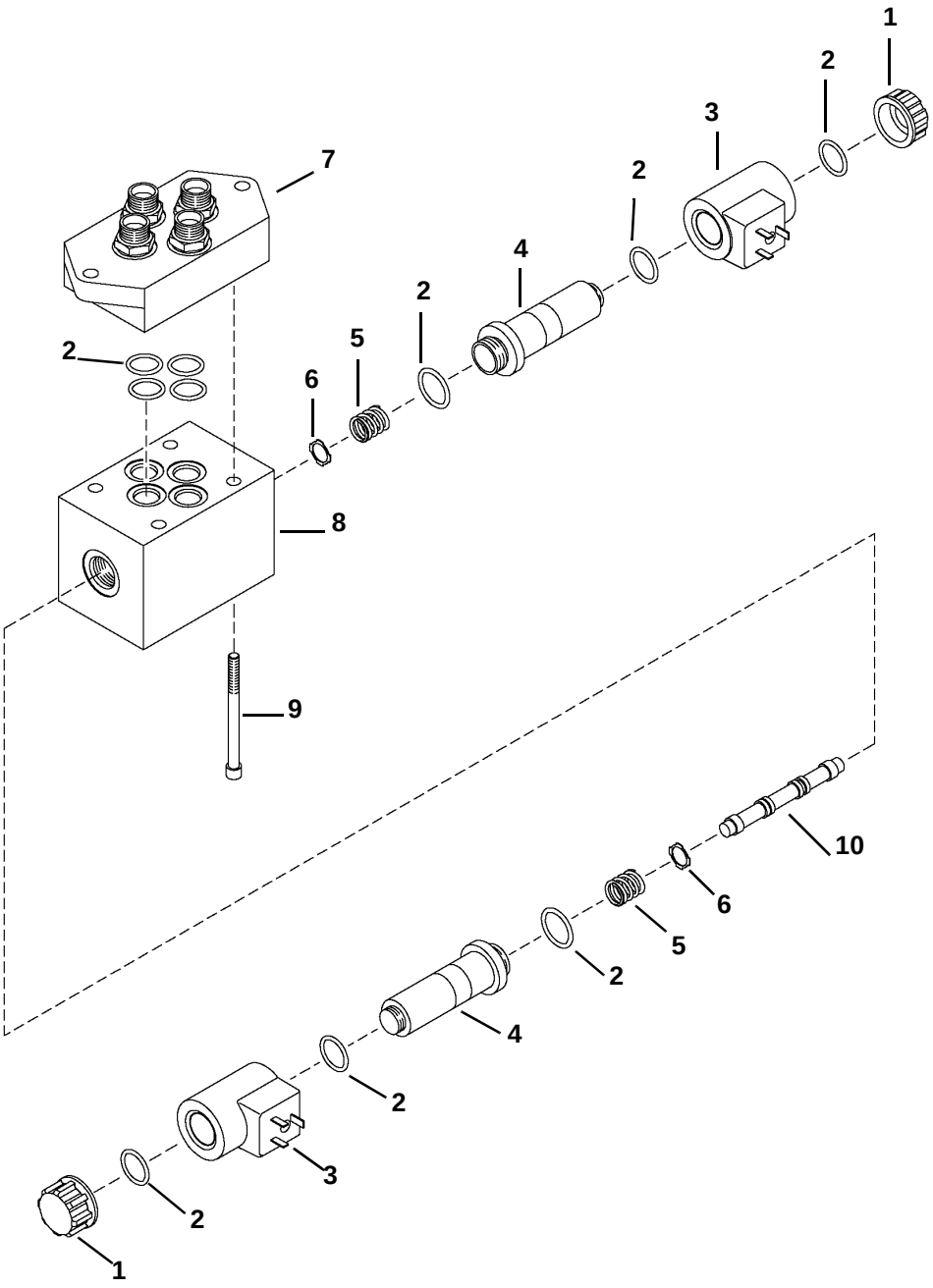
Parts Identification

1 Nut
2 O-Ring
3 Coil
4 Actuators
5 Spring
6 Spring Retainer
7 Plate
8 Valve Body
9 Bolt
10 Spool



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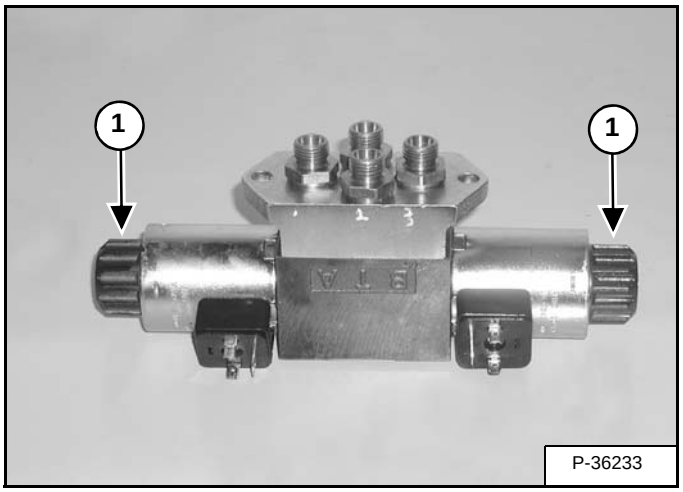
Disassembly And Assembly

Figure 20-150-4

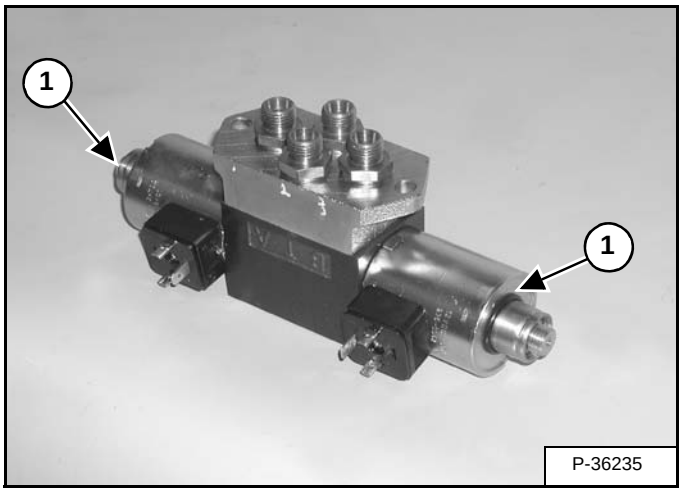


Remove the nuts (Item 1) **[Figure 20-150-4]** from the spools.

Installation: Tighten the nuts to 3-5 ft.-lbs (4-7 N•m) torque.

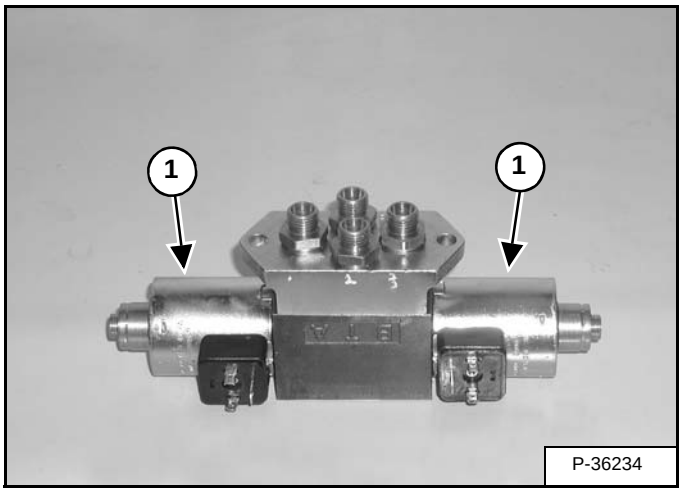
NOTE: Overtightening the coil nuts may cause spool or coil failure.

Figure 20-150-5



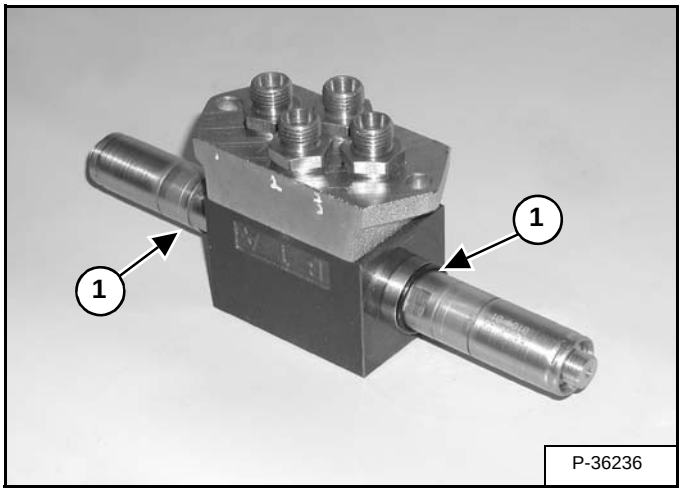
Remove the O-rings (Item 1) **[Figure 20-150-5]**.

Figure 20-150-6



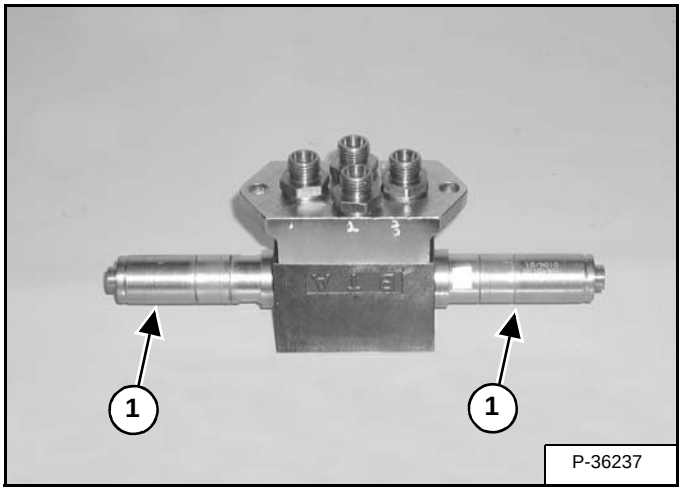
Remove the coils (Item 1) **[Figure 20-150-6]**.

Figure 20-150-7



Remove the O-rings (Item 1) **[Figure 20-150-7]**.

Figure 20-150-8



Loosen the actuators (Item 1) **[Figure 20-150-8]**.

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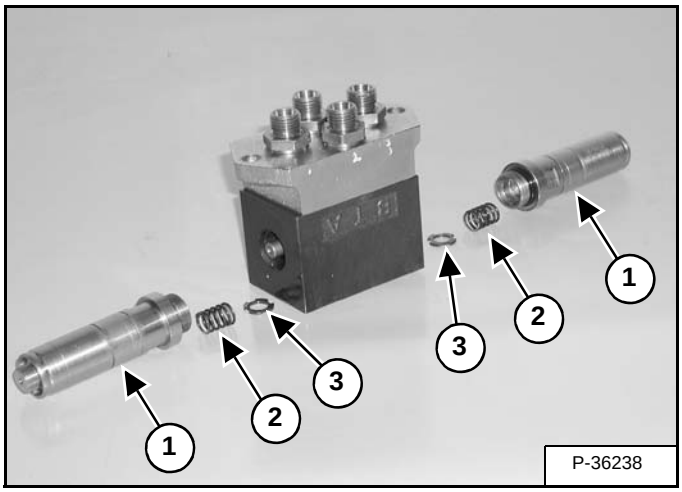
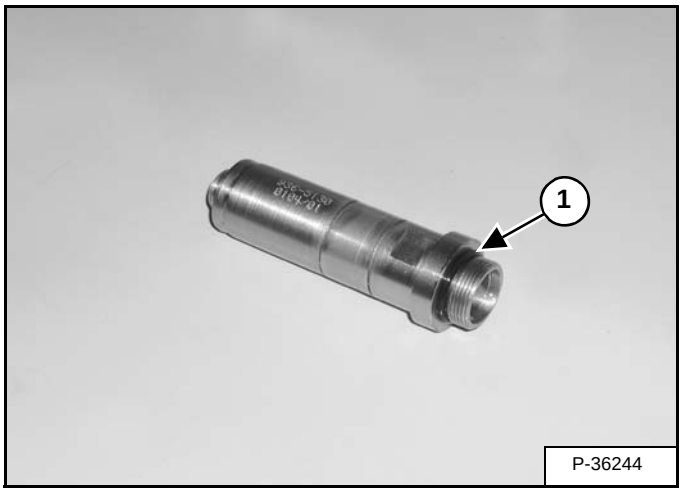
Disassembly And Assembly (Cont'd)

Figure 20-150-9



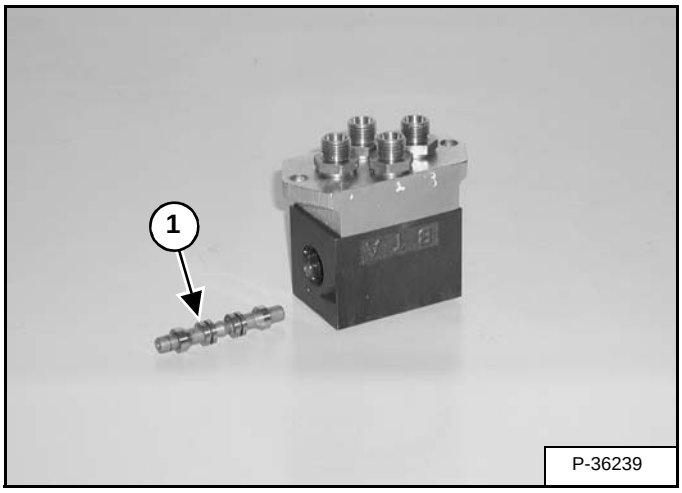
Remove the actuators (Item 1), springs (Item 2) and spring retainers (Item 3) **[Figure 20-150-9]**.

Figure 20-150-10



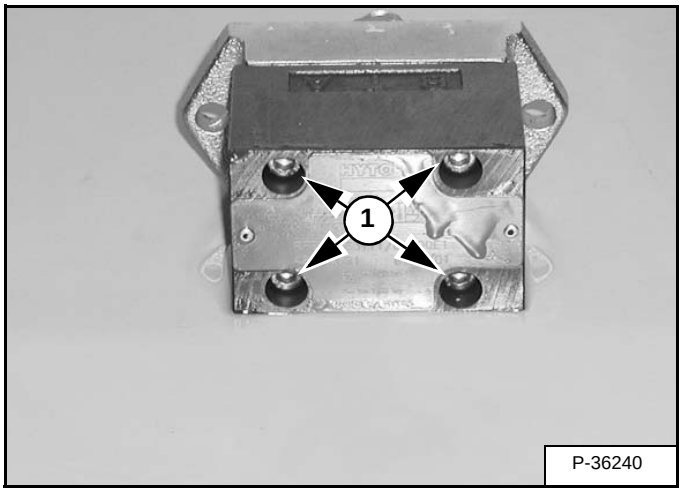
Remove the O-ring (Item 1) **[Figure 20-150-10]** from the actuators.

Figure 20-150-11



Remove the spool (Item 1) **[Figure 20-150-11]**.

Figure 20-150-12



Loosen the 4 bolts (Item 1) **[Figure 20-150-12]**.

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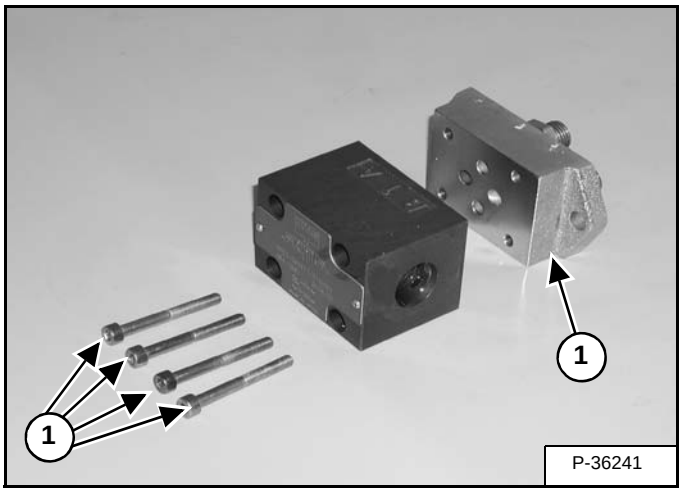
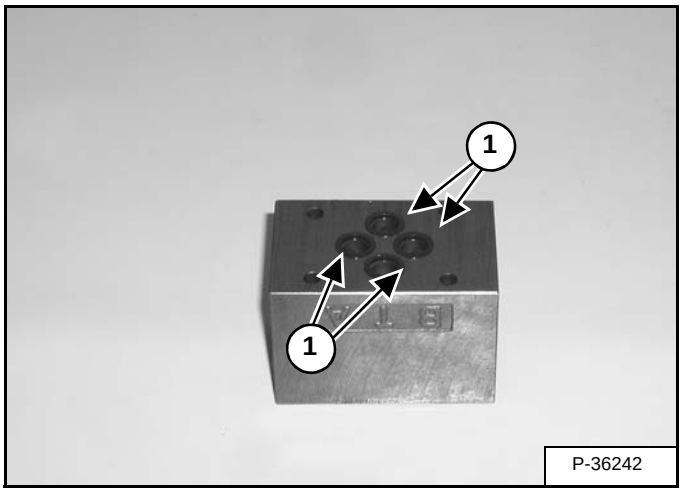
Disassembly And Assembly (Cont'd)

Figure 20-150-13



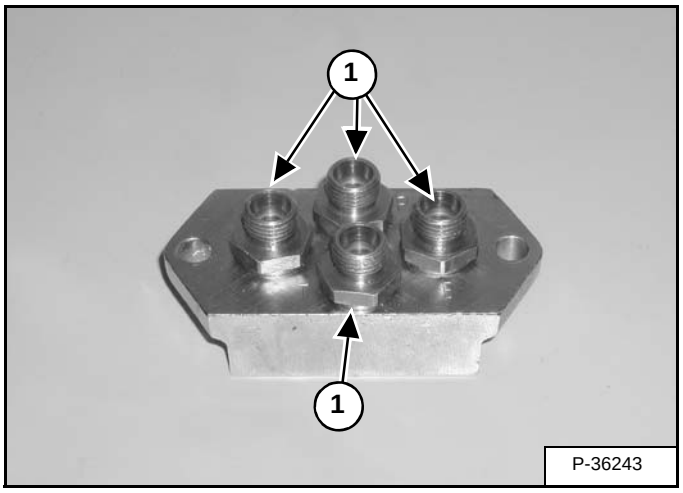
Remove the 4 bolts (Item 1) and plate (Item 2) **[Figure 20-150-13]** from the valve body.

Figure 20-150-14



Remove the 4 O-rings (Item 1) **[Figure 20-150-14]** from the valve body.

Figure 20-150-15



Do not remove the 4 fittings (Item 1) **[Figure 20-150-15]**. The fittings are welded to the valve block. Removing the fittings will damage the fittings and valve block.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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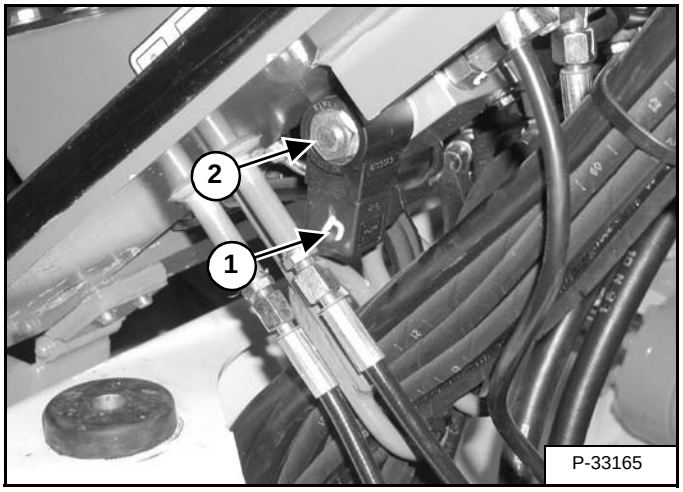
HYDRAULIC BREAKER APPLICATION VALVE (S/N 522311001 & ABOVE)

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-160-1



Remove the wire harness (Item 1) **[Figure 20-160-1]** from the solenoid.

NOTE: The solenoid nut (Item 2) [Figure 20-160-1] may have to be loosened and the solenoid turned to access the screw to remove the wire harness.

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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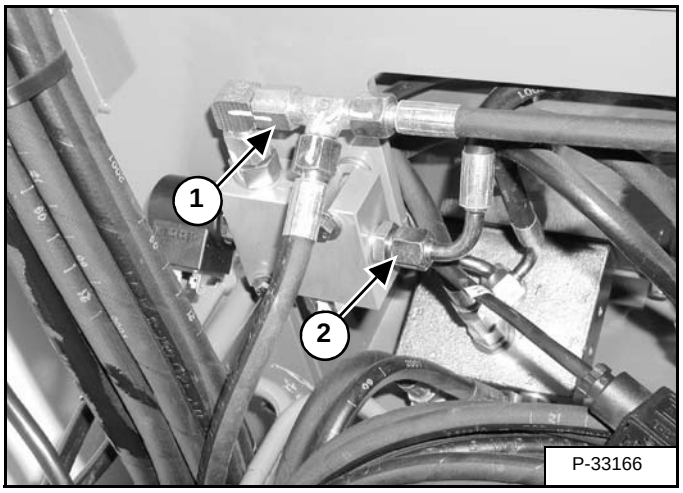
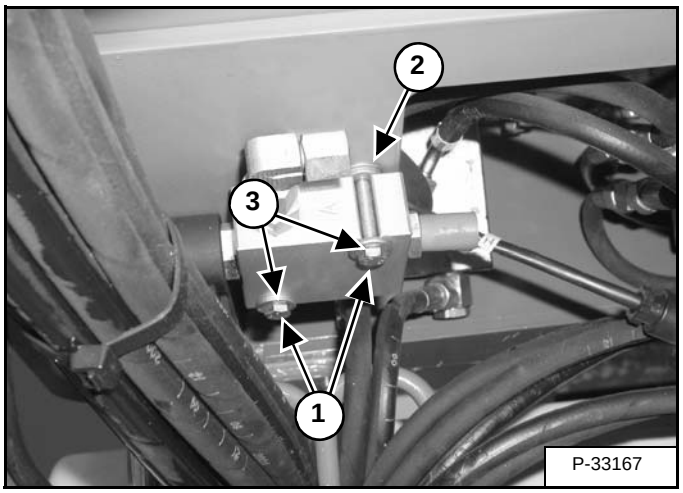
Figure 20-160-2



Remove the tee fitting (Item 1) **[Figure 20-160-2]**.

Remove the hose (Item 2) **[Figure 20-160-2]**.

Figure 20-160-3



Remove the bolts (Item 1) **[Figure 20-160-3]** and washers.

Installation: Install 2 washers (Item 2) between the cab and valve. Install 1 washer (Item 3) **[Figure 20-160-3]** on the bolts. Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

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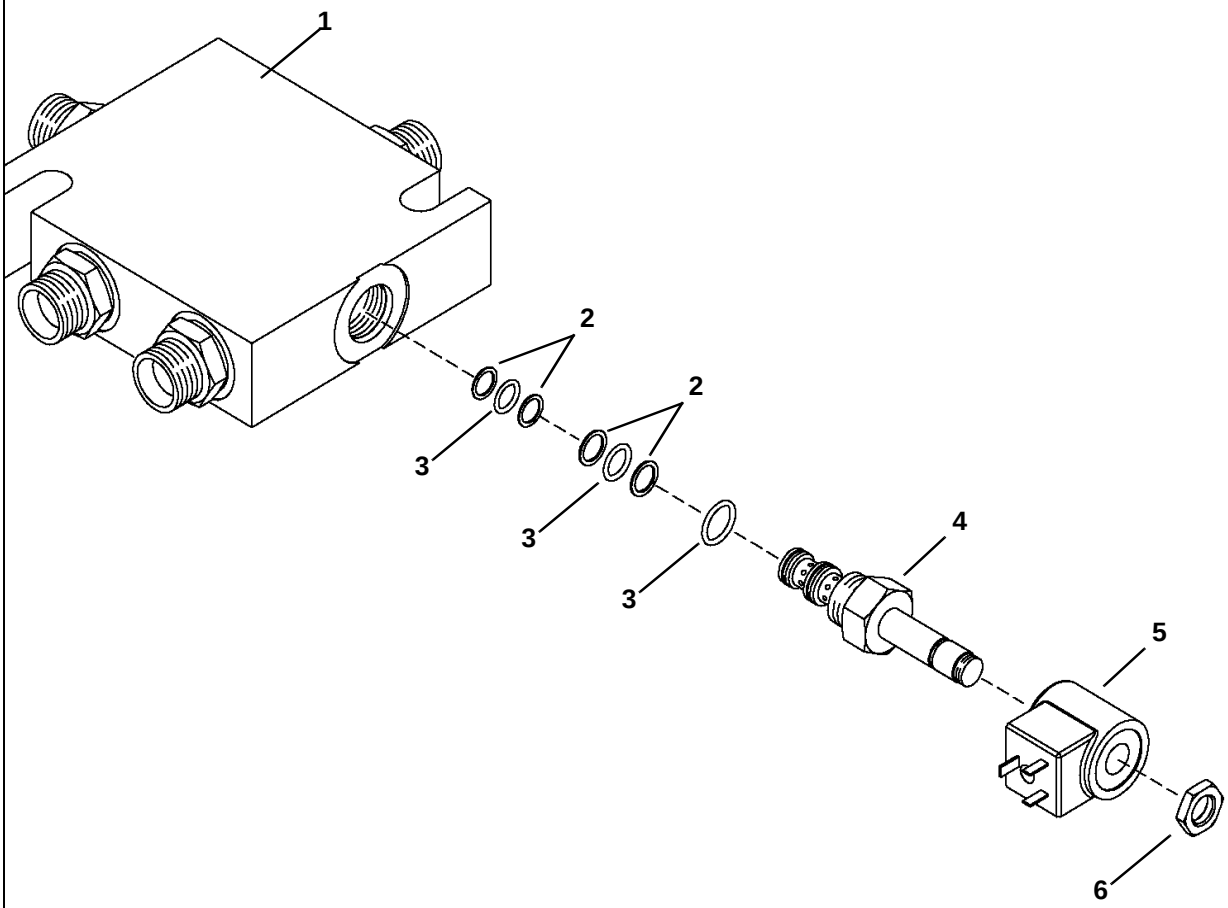
Parts Identification

1. **Valve Body**
2. **Back-up Ring**
3. **O-Ring**
4. **Spool**
5. **Coil**
6. **Nut**



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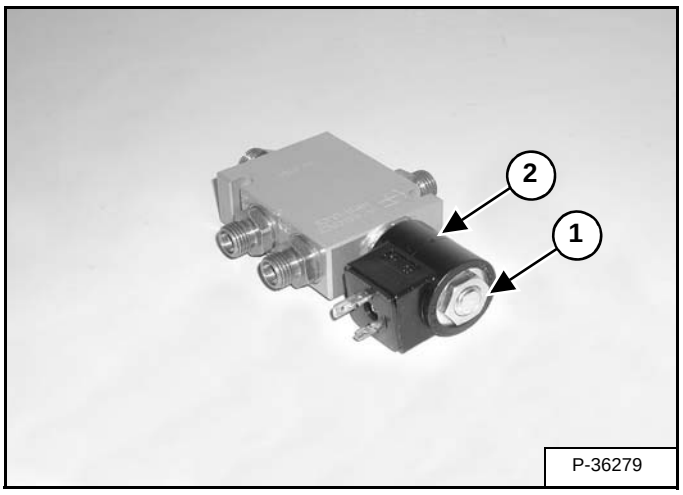
Disassembly And Assembly

Figure 20-160-4

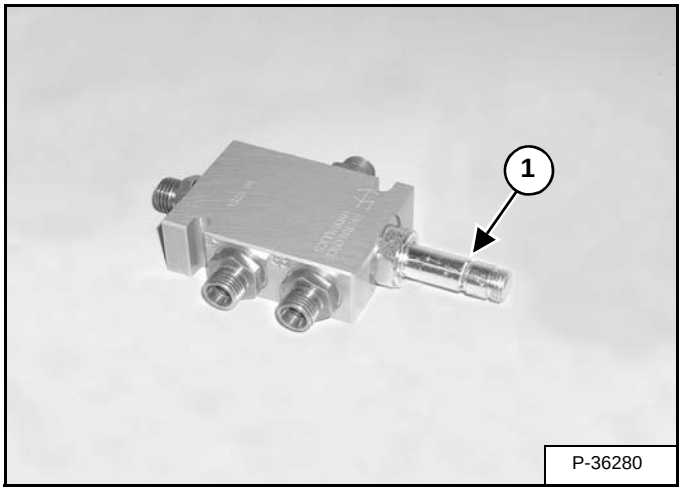


Remove the nut (Item 1) and coil (Item 2) **[Figure 20-160-4]** from the spool.

Installation: Tighten the nut to 3-5 ft.-lb. (4-7 N•m) torque.

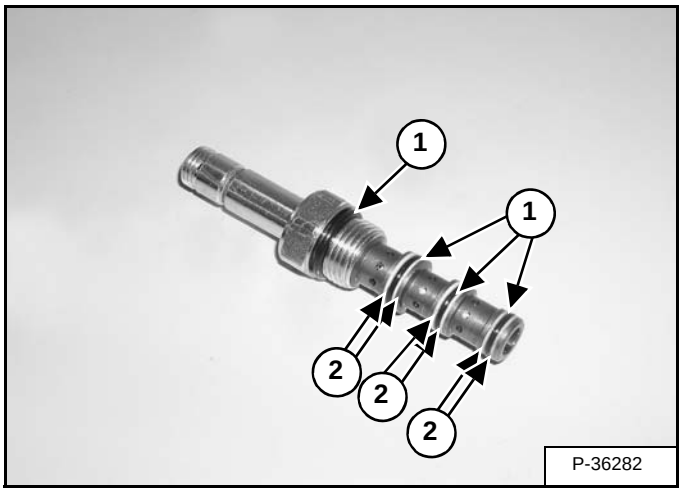
NOTE: Overtightening the coil nut may cause spool or coil failure.

Figure 20-160-5



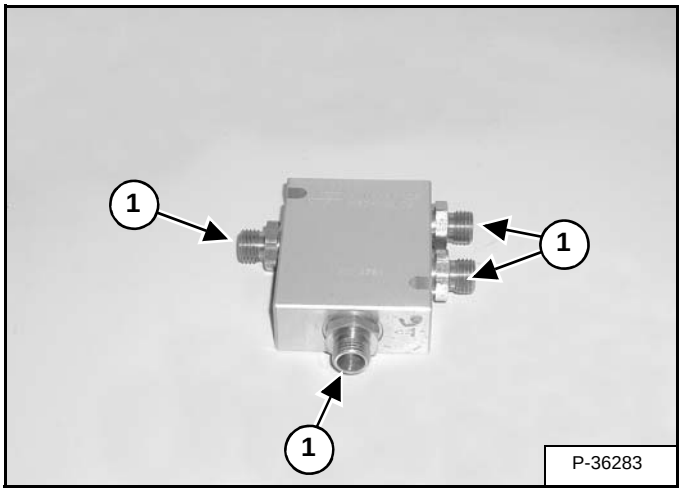
Remove the spool (Item 1) **[Figure 20-160-5]**.

Figure 20-160-6



Remove the O-rings (Item 1) and back-up rings (Item 2) **[Figure 20-160-6]** from the spool.

Figure 20-160-7



NOTE: Do not remove the 4 fittings (Item 1) [Figure 20-160-7] The fittings are welded to the valve block. Removing the fittings will damage the block and fittings.

Installation: Clean all components with solvent and dry with compressed air.

Check all components for burrs, scratches or other damage and replace if necessary.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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AUXILIARY HYDRAULIC FLOW CONTROL VALVE (S/N 522311001 & ABOVE)

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

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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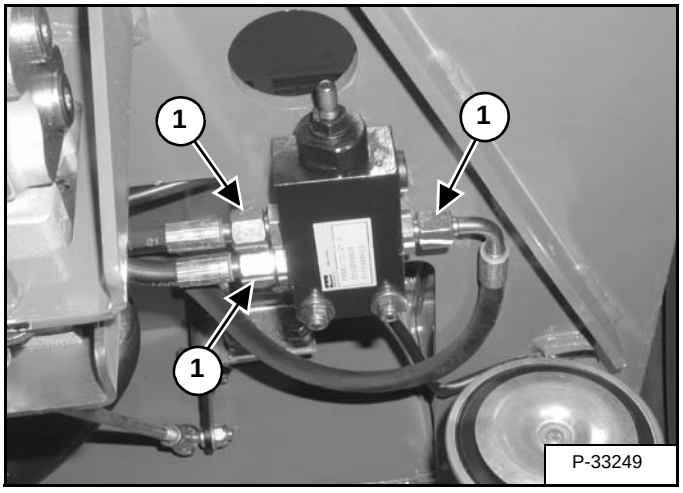
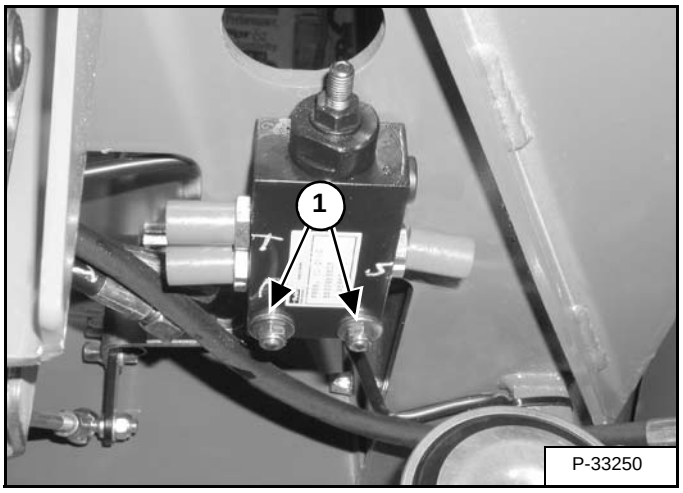
Figure 20-170-1



Mark and remove the 3 hoses (Item 1) **[Figure 20-170-1]**.

Figure 20-170-2



Remove the 2 nuts (Item 1) **[Figure 20-170-2]** and washers. Remove the valve.

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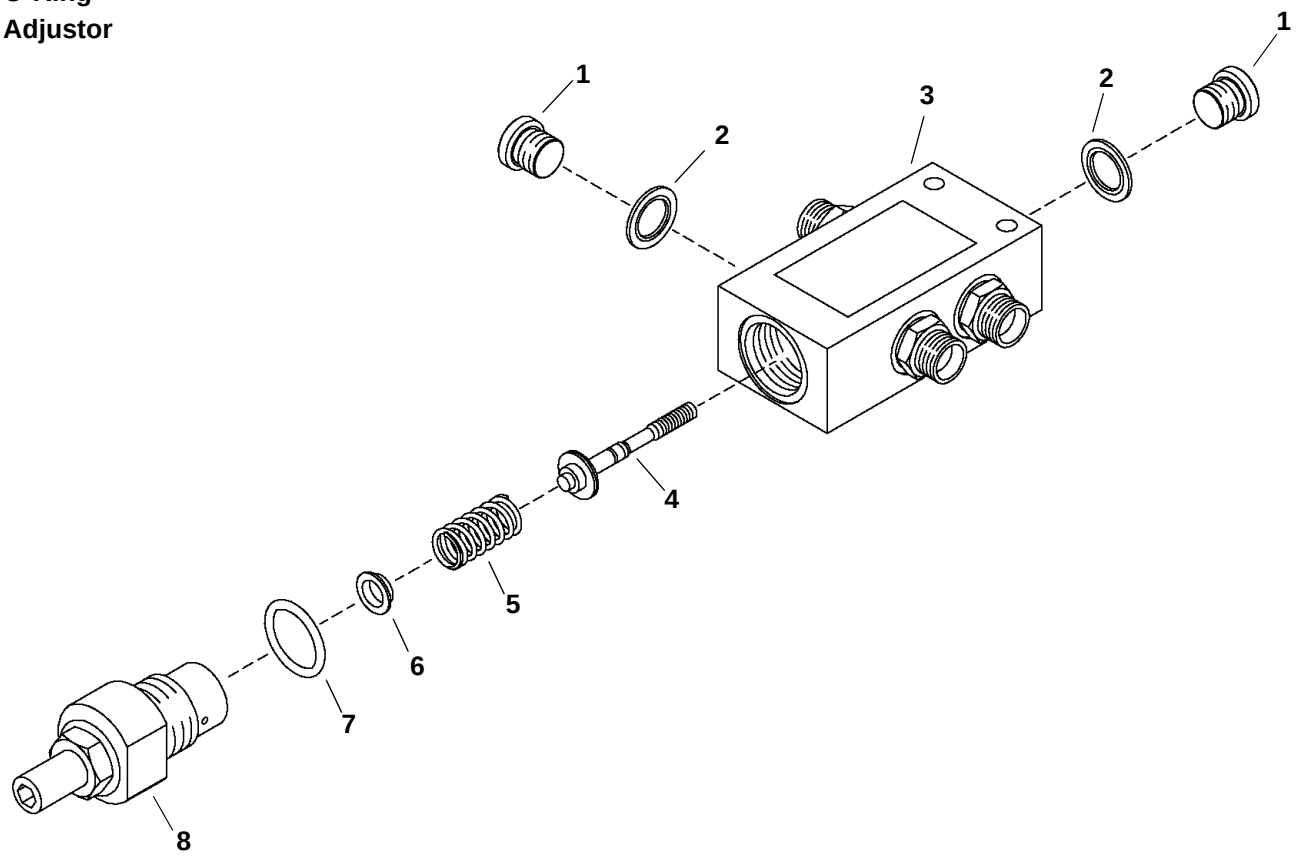
Parts Identification

1 Plug
2 Seal
3 Valve Body
4 Spool
5 Spring
6 Spring Seat
7 O-Ring
8 Adjustor



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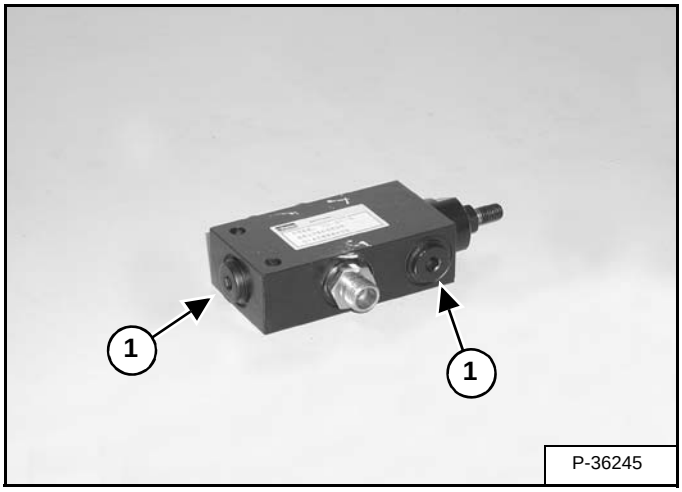
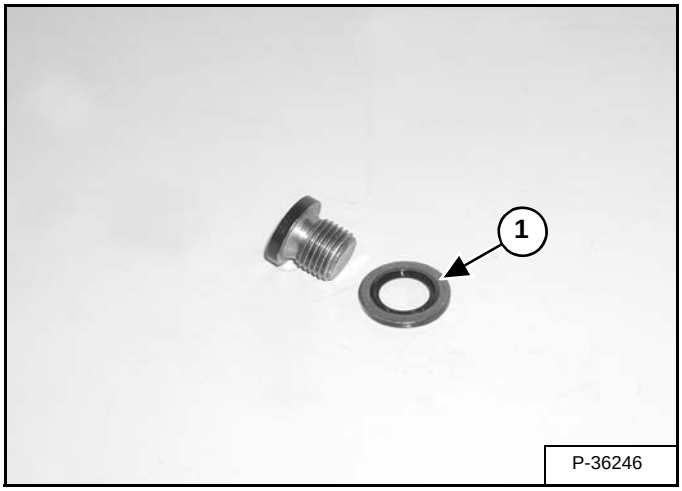
Disassembly And Assembly

Figure 20-170-3



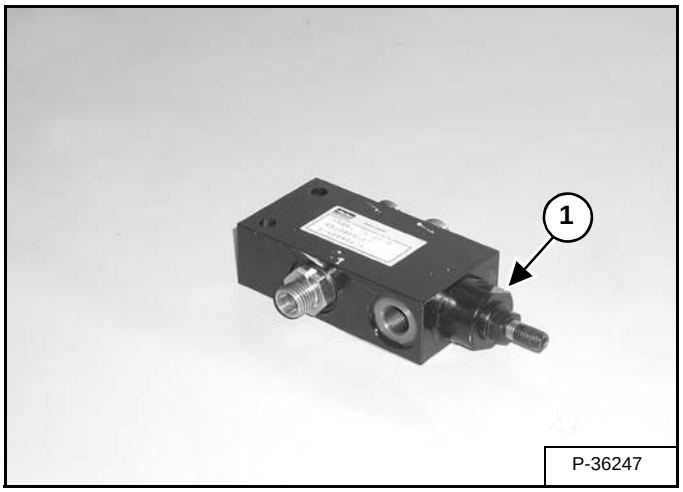
Remove the 2 plugs (Item 1) **[Figure 20-170-3]**.

Figure 20-170-4



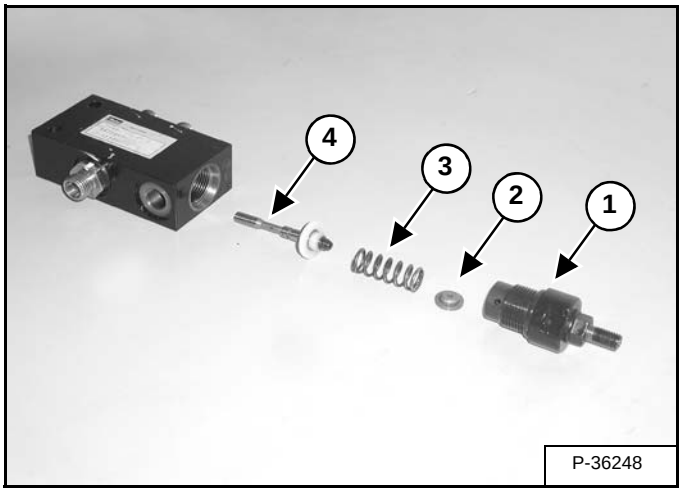
Remove the seals (Item 1) **[Figure 20-170-4]** from the plugs.

Figure 20-170-5



Loosen the adjustor (Item 1) **[Figure 20-170-5]**.

Figure 20-170-6



Remove the adjustor (Item 1), spring seat (Item 2), spring (Item 3) and spool (Item 4) **[Figure 20-170-6]**.

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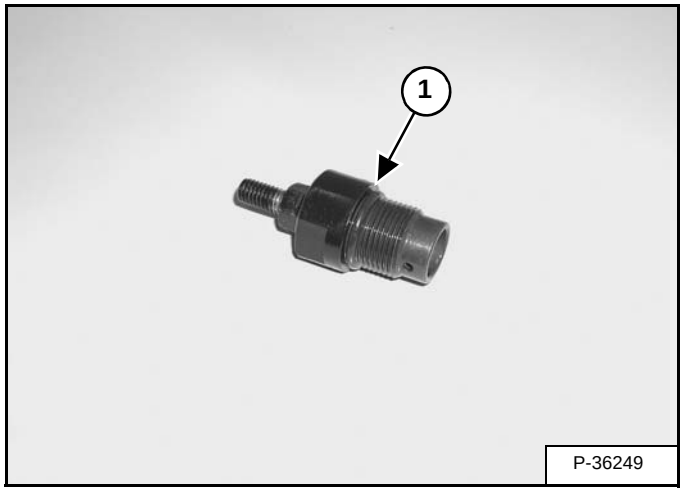
AUXILIARY HYDRAULIC FLOW CONTROL VALVE (S/N 522311001 & ABOVE) (CONT'D)

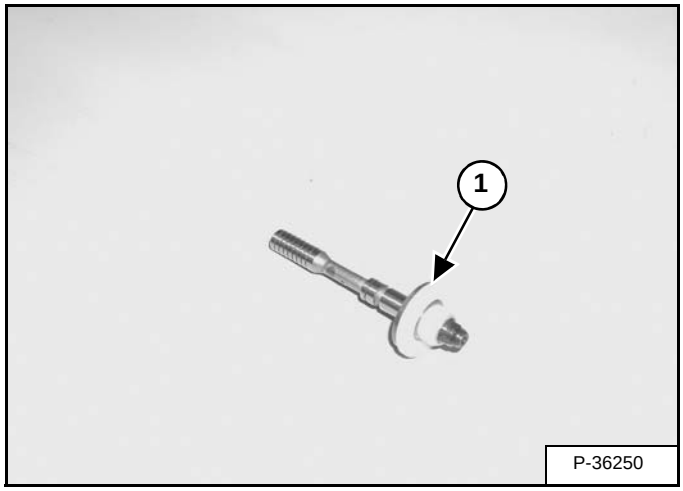
Disassembly And Assembly (Cont'd)

Figure 20-170-7



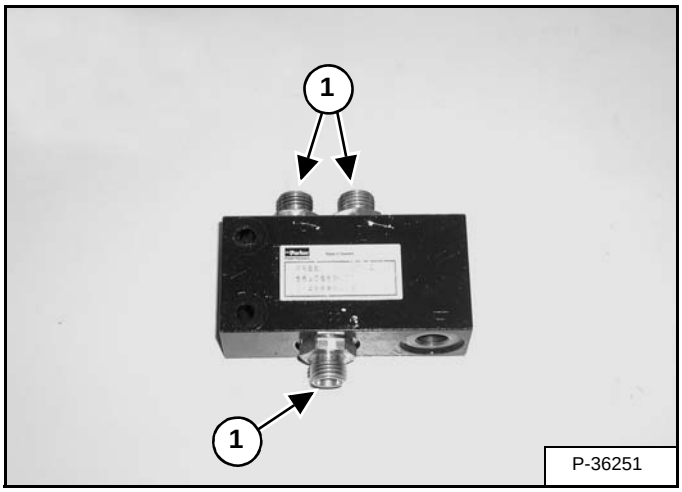
Remove the O-ring (Item 1) **[Figure 20-170-7]** from the adjustor.

Figure 20-170-8



Remove the seal (Item 1) **[Figure 20-170-8]** from the spool.

Figure 20-170-9



NOTE: Do not remove the 3 fittings (Item 1) [Figure 20-170-9]. The fittings are welded to the valve block. Removing the fittings will damage the block and fittings.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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AUXILIARY HYDRAULIC FLOW CONTROL/ HYDRAULIC BREAKER APPLICATION VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

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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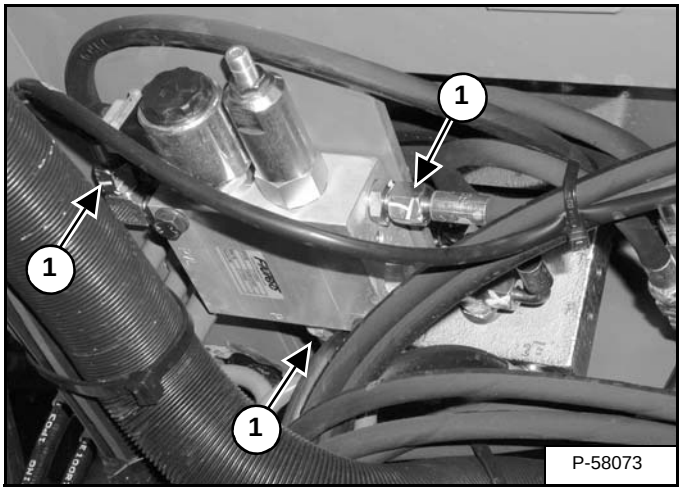
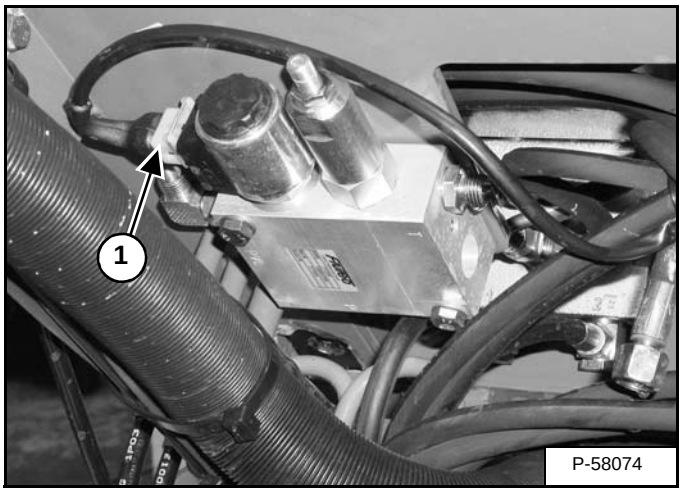
Figure 20-171-1



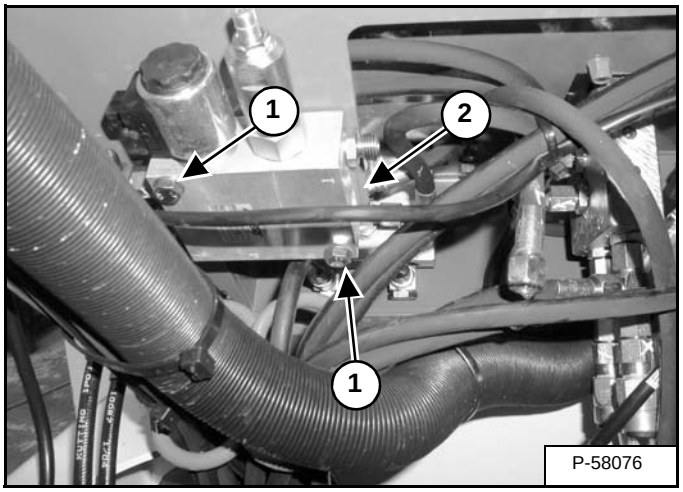
Mark and remove the hoses (Item 1) **[Figure 20-171-1]**.

Figure 20-171-2



Compress the wire retainer (Item 1) **[Figure 20-171-2]** to remove the wire harness connector from the solenoid.

Figure 20-171-3



Remove the bolts (Item 1) and washers. Remove the valve (Item 2) **[Figure 20-171-3]**.

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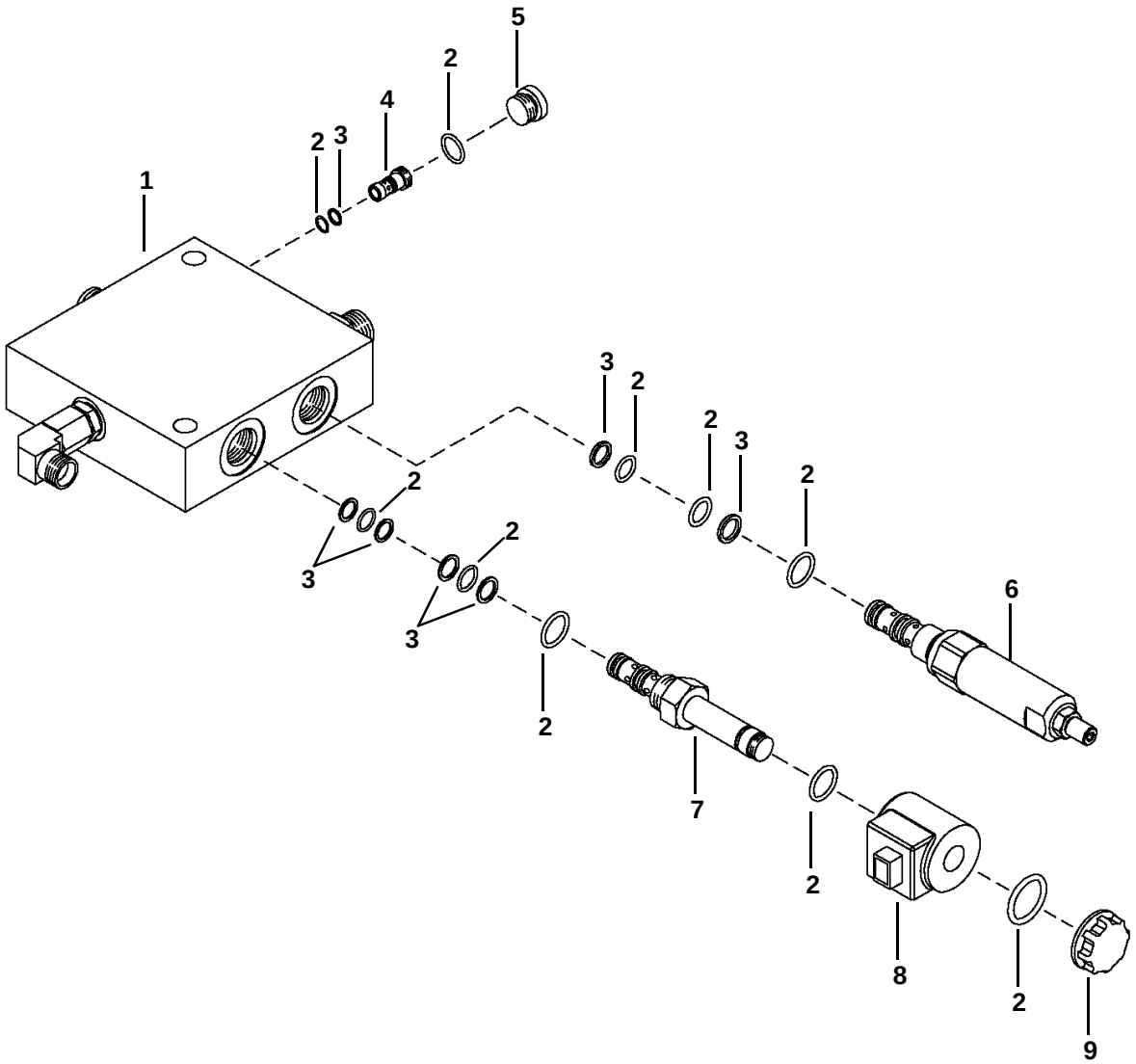
Parts Identification

1. **Valve Block**
2. **O-Ring**
3. **Back-up Ring**
4. **Spool**
5. **Plug**
6. **Flow Regulator**
7. **Spool**
8. **Coil**
9. **Nut**



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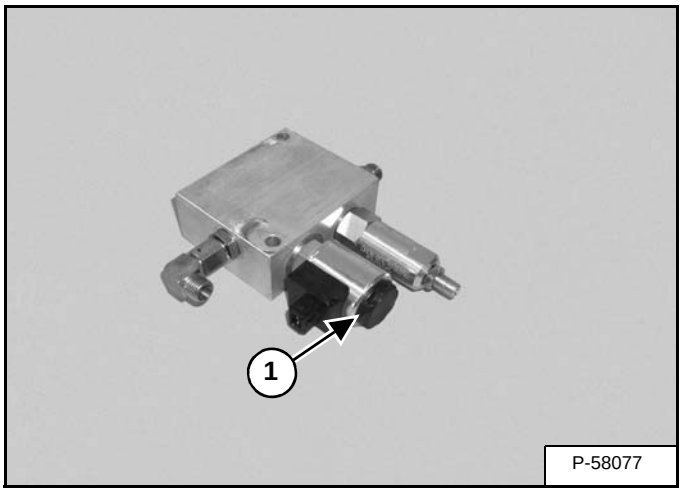
AUXILIARY HYDRAULIC FLOW CONTROL/ HYDRAULIC BREAKER APPLICATION VALVE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) (CONT'D)

Disassembly And Assembly

Figure 20-171-4

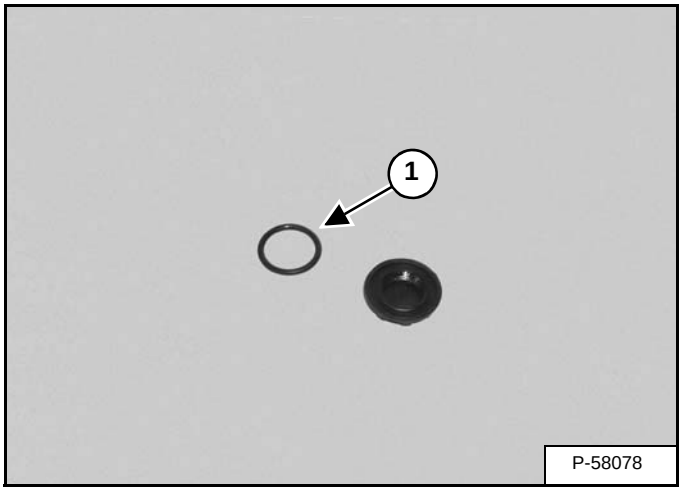


Remove the nut (Item 1) **[Figure 20-171-4]**.

Installation: Tighten the nut to 3-5 ft.-lbs (4-7 N•m) torque.

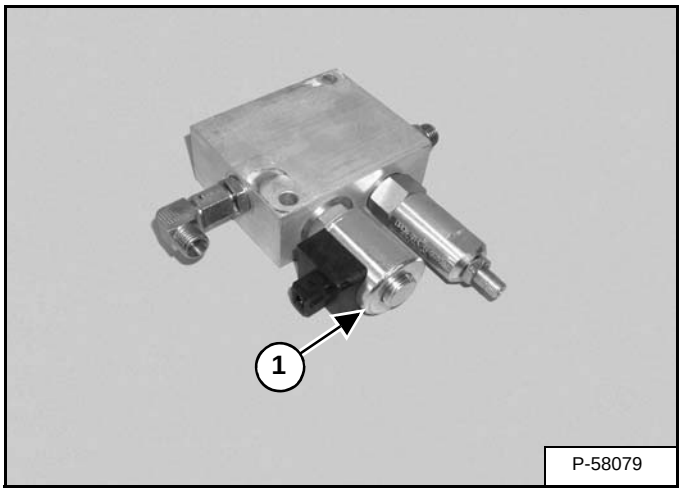
NOTE: Overtightening the coil nut may cause spool or coil failure.

Figure 20-171-5



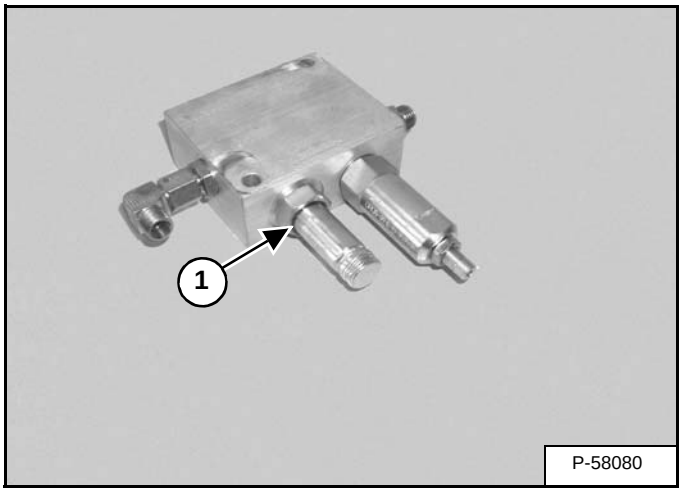
Remove the O-ring (Item 1) **[Figure 20-171-5]**.

Figure 20-171-6



Remove the coil (Item 1) **[Figure 20-171-6]**.

Figure 20-171-7



Remove the O-ring **[Figure 20-171-7]**.

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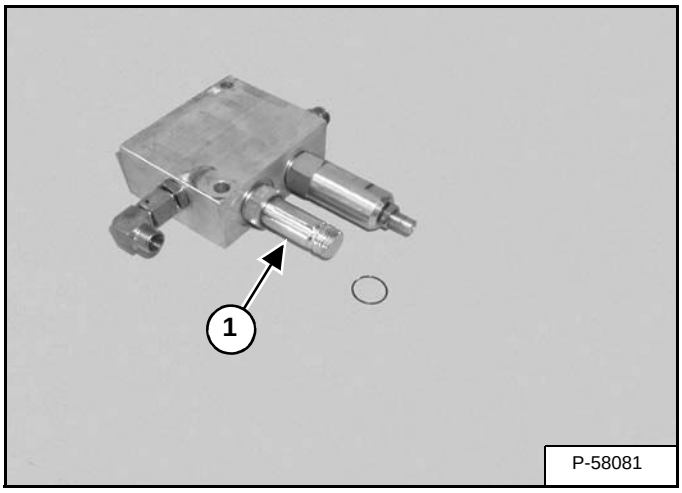
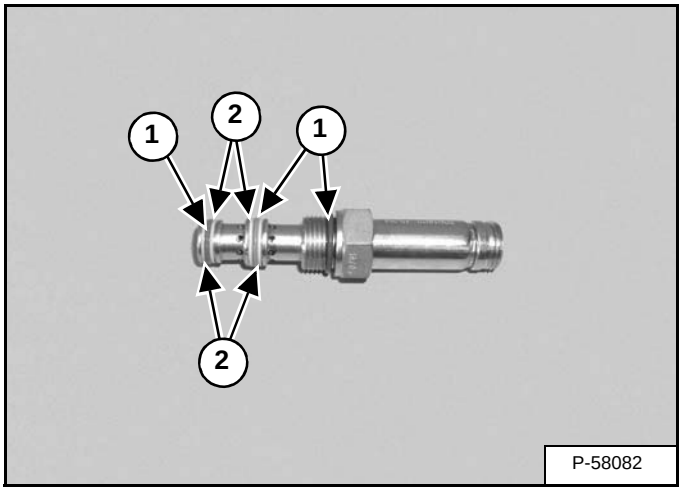
Disassembly And Assembly (Cont'd)

Figure 20-171-8



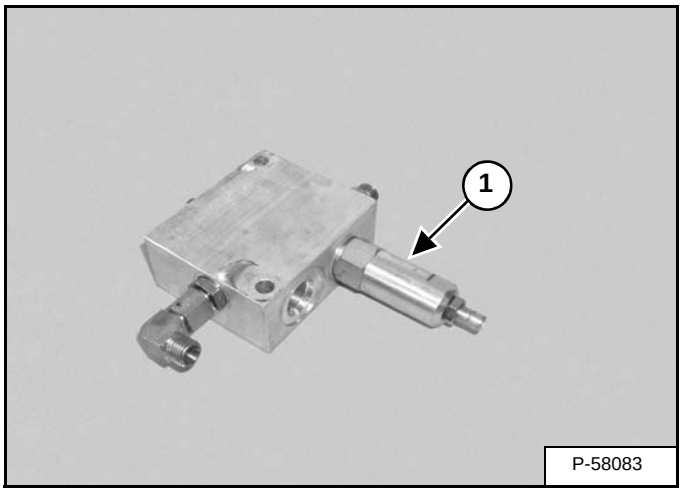
Remove the spool (Item 1) **[Figure 20-171-8]**.

Figure 20-171-9



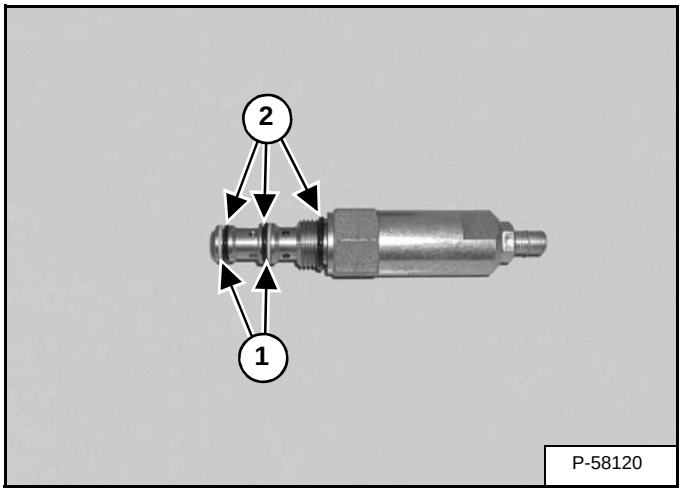
Remove the O-rings (Item 1) and back-up rings (Item 2) **[Figure 20-171-9]**.

Figure 20-171-10



Remove the flow regulator (Item 1) **[Figure 20-171-10]**.

Figure 20-171-11



Remove the back-up rings (Item 1) and O-rings (Item 2) **[Figure 20-171-11]**.

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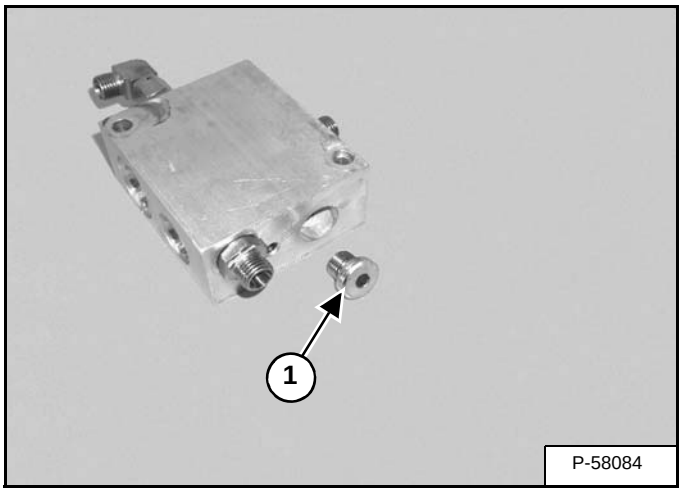
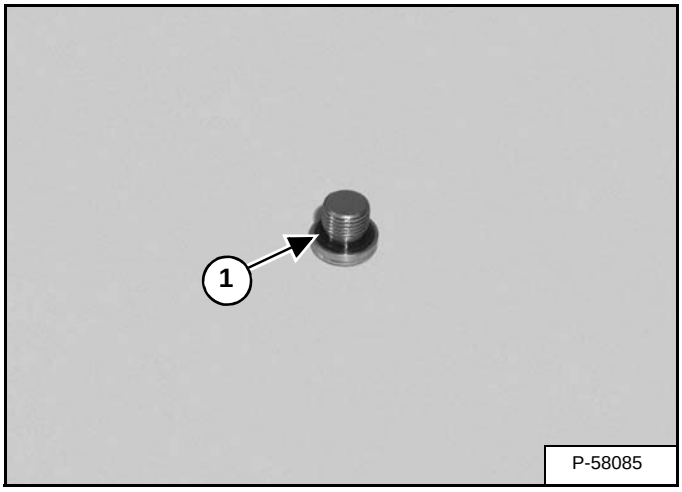
Disassembly And Assembly (Cont'd)

Figure 20-171-12



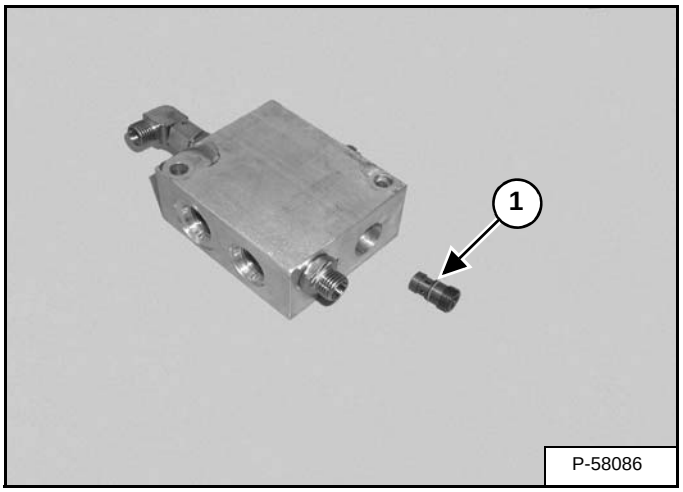
Remove the plug (Item 1) **[Figure 20-171-12]**.

Figure 20-171-13



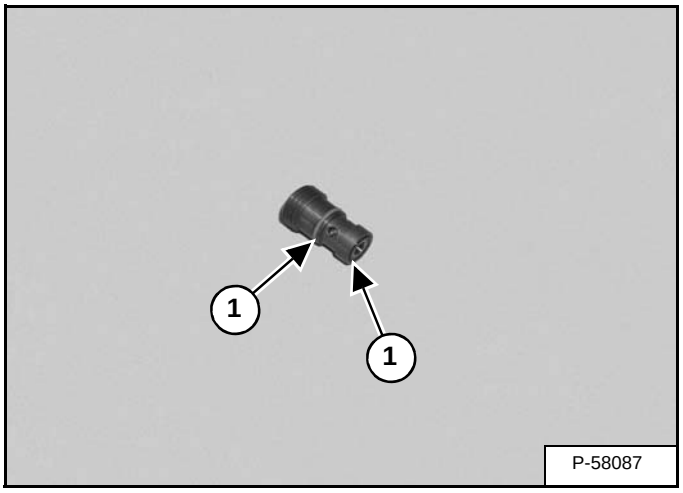
Remove the O-ring (Item 1) **[Figure 20-171-13]**.

Figure 20-171-14



Remove the spool (Item 1) **[Figure 20-171-14]**.

Figure 20-171-15



Remove the O-rings (Item 1) **[Figure 20-171-15]**.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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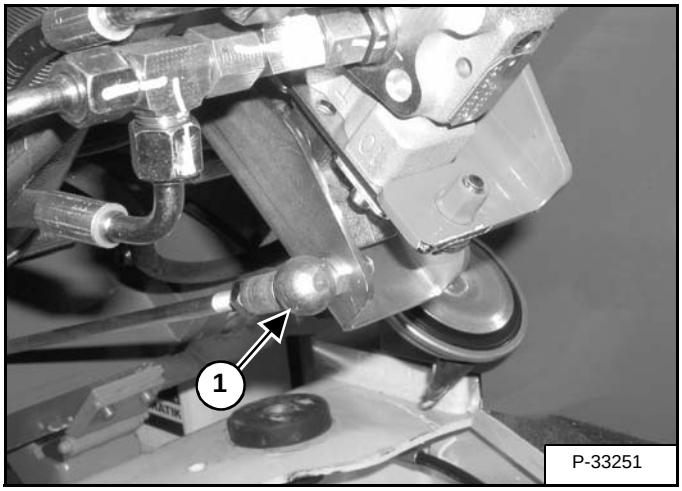
BLADE VALVE

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Figure 20-180-1



Remove the linkage (Item 1) **[Figure 20-180-1]** from the valve.

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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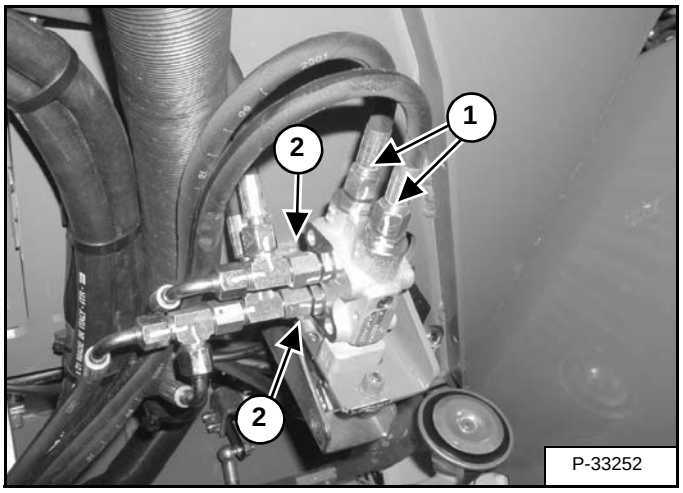
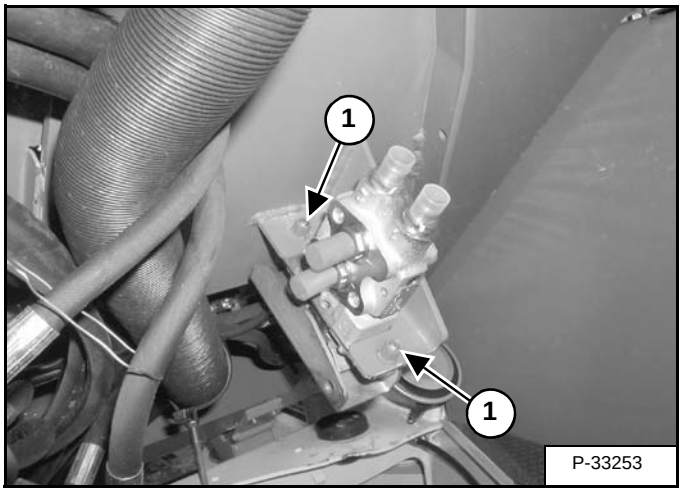
Figure 20-180-2



Mark and remove the 2 hoses (Item 1) **[Figure 20-180-2]**.

Mark and remove the 2 tee fittings (Item 2) **[Figure 20-180-2]**.

Figure 20-180-3



Remove the 2 bolts (Item 1) **[Figure 20-180-3]**.

Remove the valve.

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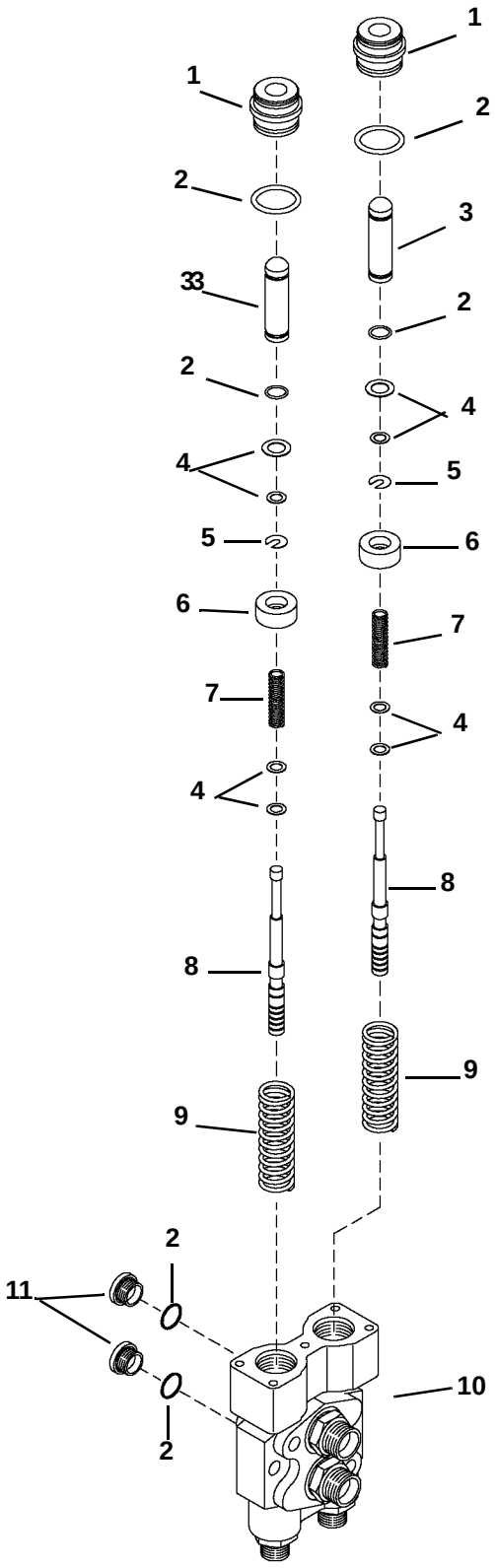
Parts Identification

1 Plunger Body
2 O-Ring
3 Push Rod
4 Shim
5 Retainer
6 Piston
7 Spring
8 Spool
9 Spring
10 Valve Body
11 Plug



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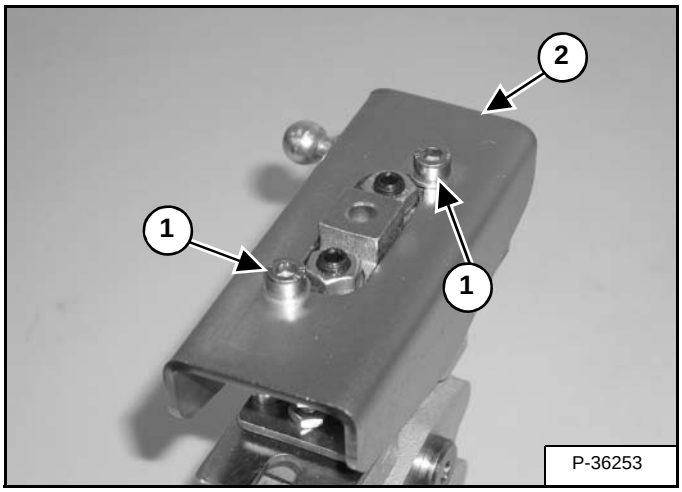
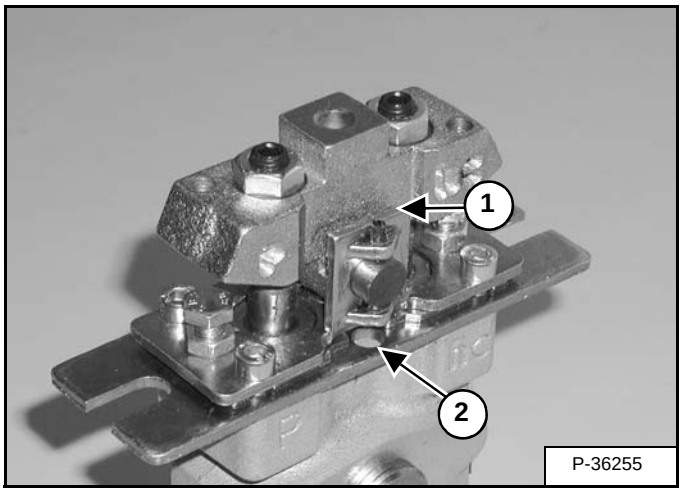
Disassembly And Assembly

Figure 20-180-4



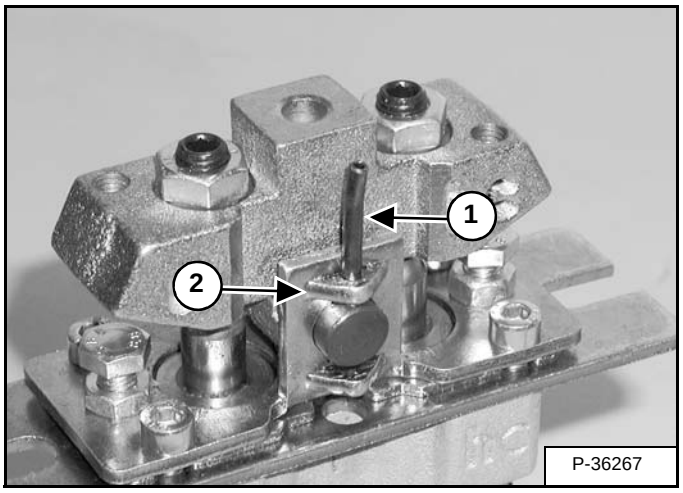
Remove the 2 bolts (Item 1) from the plate (Item 2) **[Figure 20-180-4]**. Remove the plate.

Figure 20-180-5



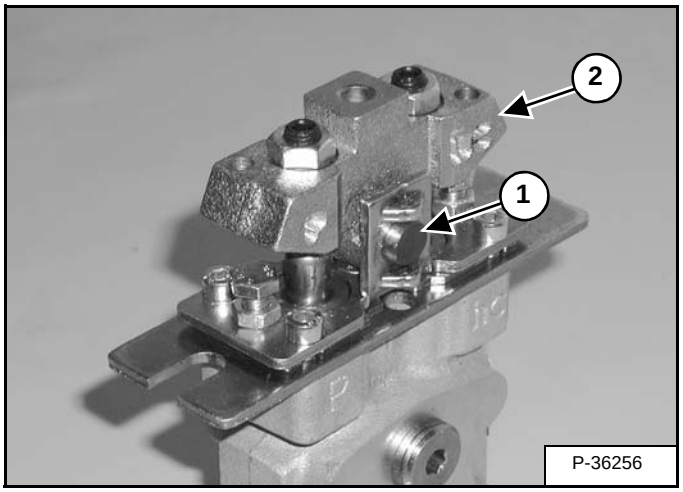
Remove the roll pin (Item 1) through the hole (Item 2) **[Figure 20-180-5]** in the bottom plate.

Figure 20-180-6



Installation: Install the roll pin (Item 1) through the tab (Item 2) **[Figure 20-180-6]** on the top of the block.

Figure 20-180-7



Remove the pin (Item 1) and block (Item 2) **[Figure 20-180-7]**.

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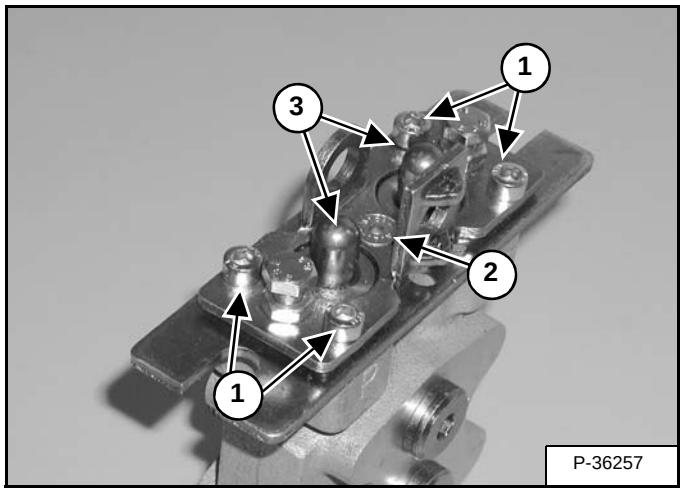
Disassembly And Assembly (Cont'd)

Figure 20-180-8

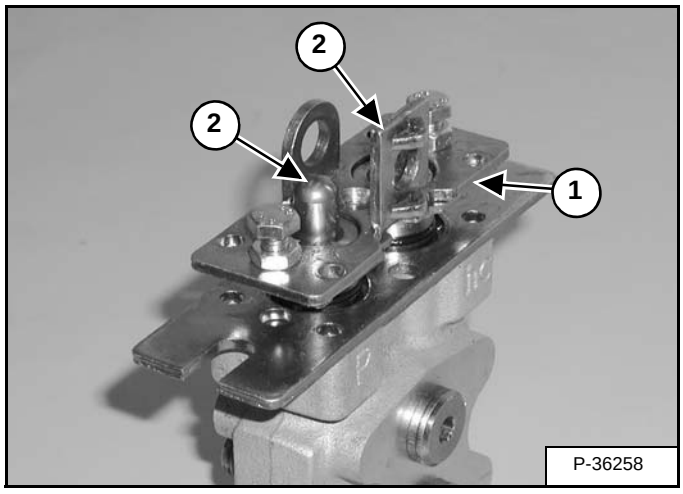


Remove the 4 outside bolts (Item 1) and center bolt (Item 2) **[Figure 20-180-8]**.

NOTE: Use care when removing the bolts. The plunger assemblies (Item 3) [Figure 20-180-8] are spring loaded.

Installation: Install the center bolt (Item 2) **[Figure 20-180-8]** first to retain the plunger assemblies in proper alignment.

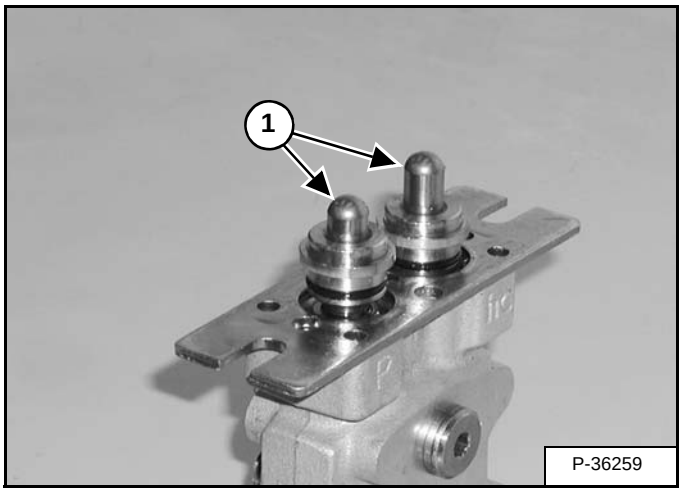
Figure 20-180-9



Remove the plate (Item 1) **[Figure 20-180-9]**.

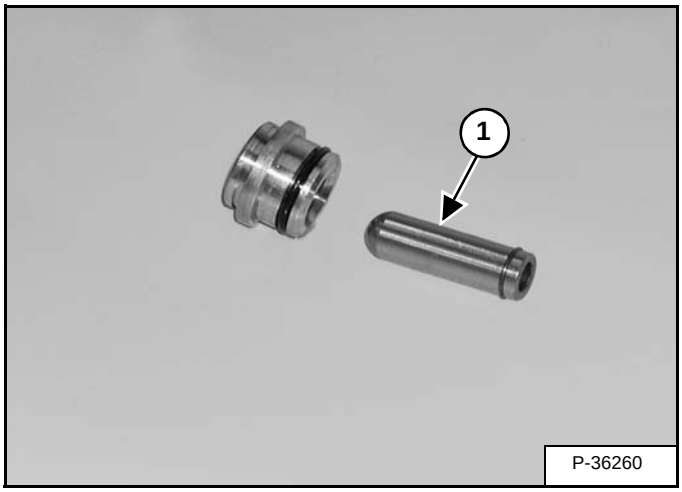
Installation: Use care not to dislodge the plunger assemblies (Item 2) **[Figure 20-180-9]** until the plate (Item 1) **[Figure 20-180-9]** is secured by the center bolt (Item 2) **[Figure 20-180-8]**.

Figure 20-180-10



Remove the plunger assemblies (Item 1) **[Figure 20-180-10]**.

Figure 20-180-11



Remove the push rod (Item 1) **[Figure 20-180-11]** from the plunger body.

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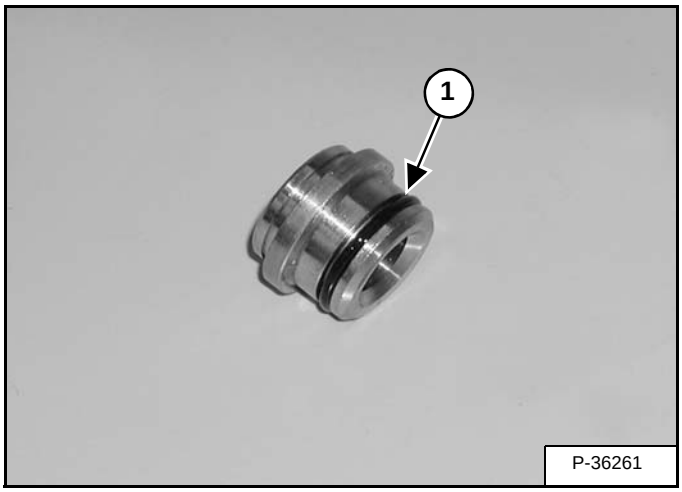
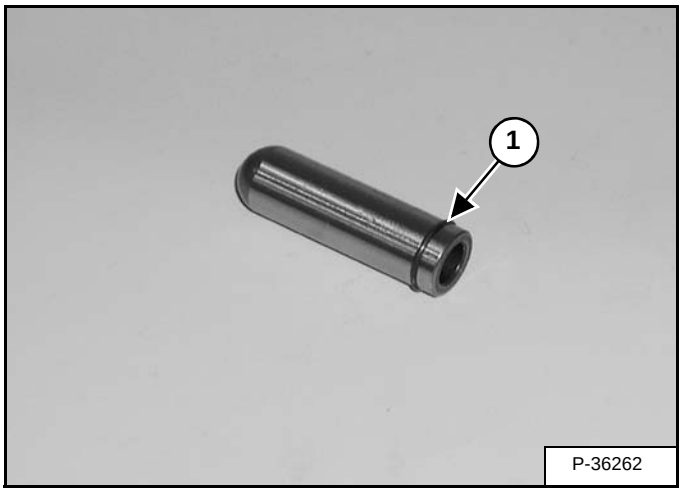
Disassembly And Assembly (Cont'd)

Figure 20-180-12



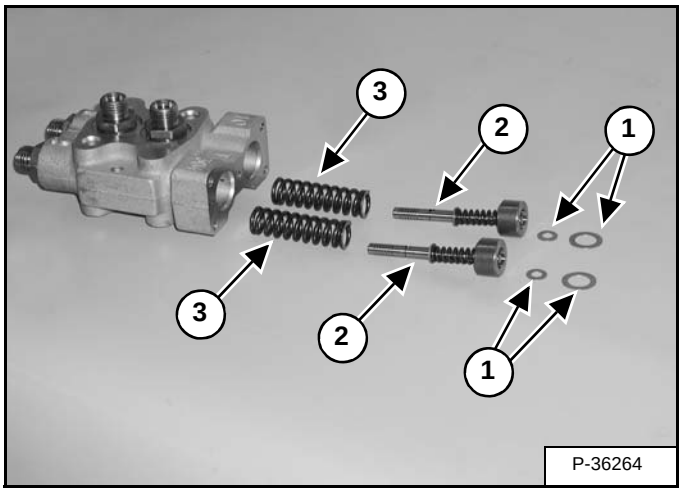
Remove the O-ring (Item 1) **[Figure 20-180-12]** from the plunger body.

Figure 20-180-13



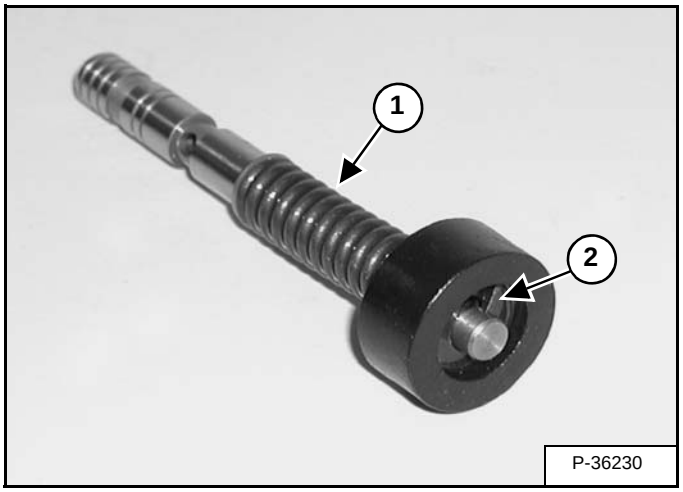
Remove the O-ring (Item 1) **[Figure 20-180-13]** from the push rod.

Figure 20-180-14



Remove the shims (Item 1), spool assemblies (Item 2) and springs (Item 3) **[Figure 20-180-14]**.

Figure 20-180-15



Compress the spring (Item 1) until the retainer (Item 2) **[Figure 20-180-15]** can be removed from the spool.

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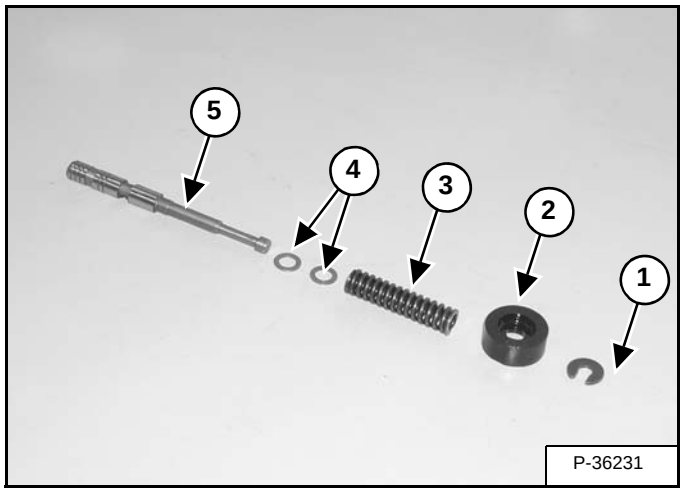
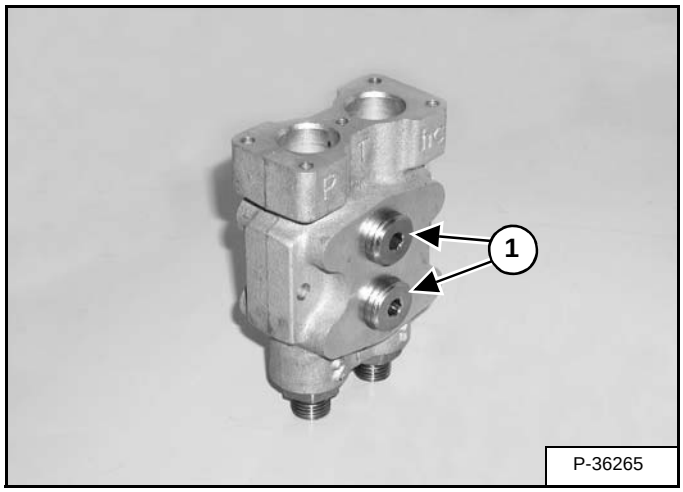
Disassembly And Assembly (Cont'd)

Figure 20-180-16



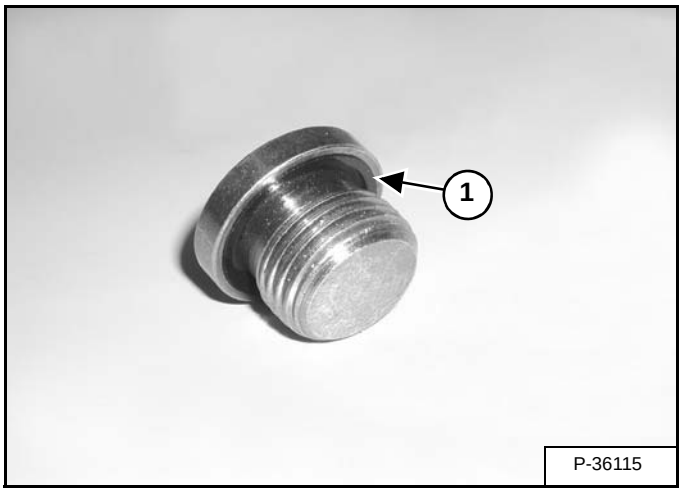
Remove the retainer (Item 1), piston (Item 2), spring (Item 3), and shims (Item 4) from the spool (Item 5) **[Figure 20-180-16]**.

Figure 20-180-17



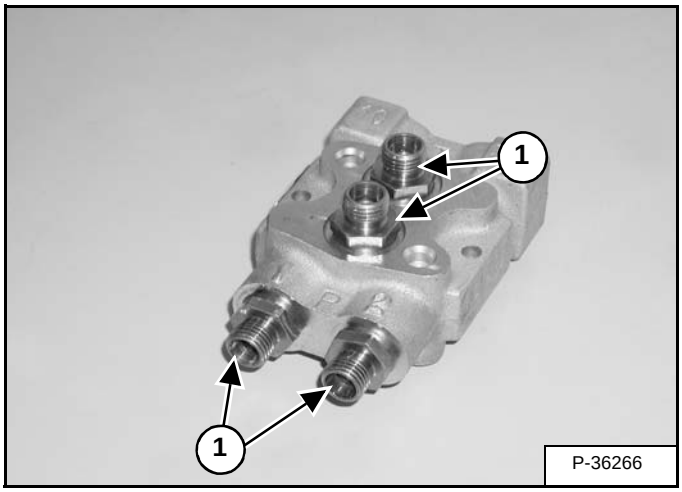
Remove the 2 plugs (Item 1) **[Figure 20-180-17]**.

Figure 20-180-18



Remove the O-ring (Item 1) **[Figure 20-180-18]** from the plugs.

Figure 20-180-19



NOTE: Do not remove the 4 fittings (Item 1) [Figure 20-180-19] The fittings are welded to the valve block. Removing the fittings will damage the block and fittings.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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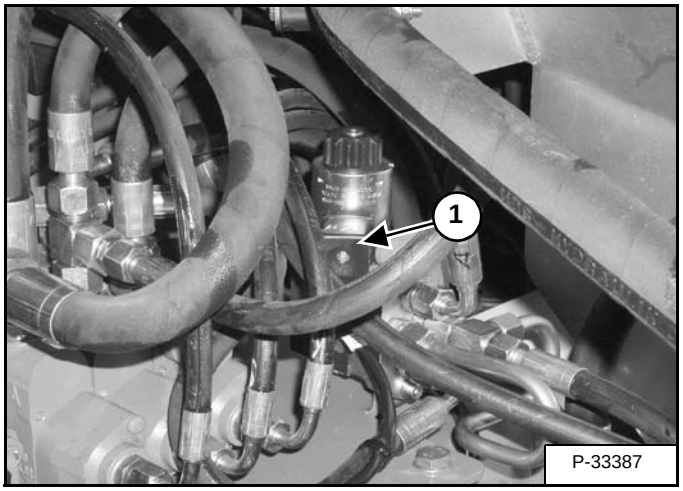
BLADE FLOAT VALVE

Removal And Installation

Open the rear cover.

Figure 20-181-1



Remove the wire harness (Item 1) **[Figure 20-181-1]**.

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.

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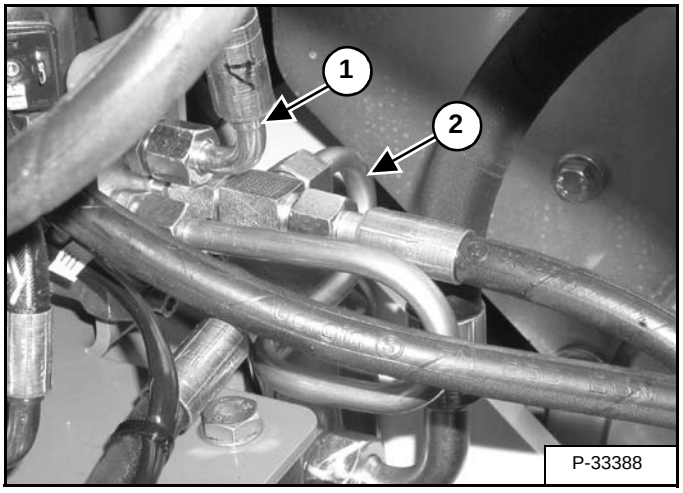
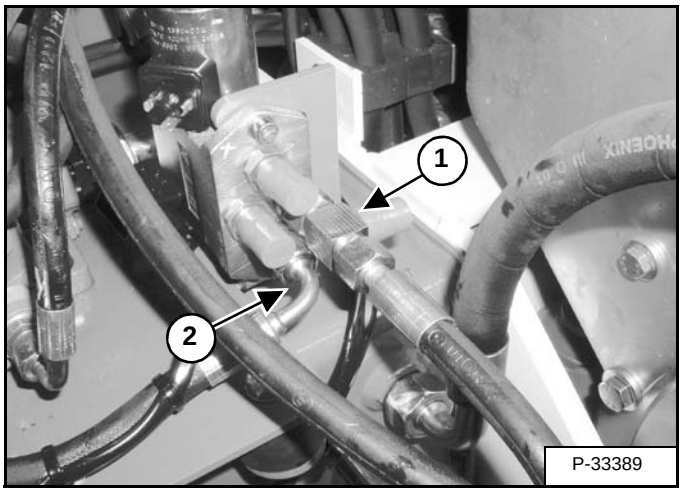
Figure 20-181-2



Remove the hose (Item 1) **[Figure 20-181-2]**.

Remove the tubeline (Item 2) **[Figure 20-181-2]**.

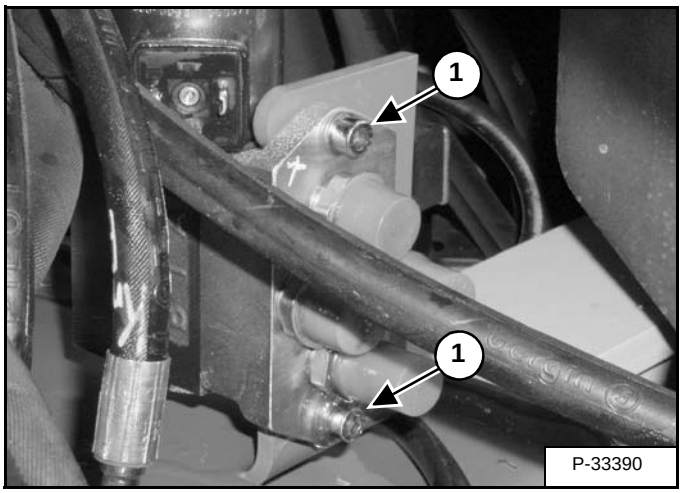
Figure 20-181-3



Remove the tee (Item 1) **[Figure 20-181-3]**.

Remove the hose (Item 2) **[Figure 20-181-3]**.

Figure 20-181-4



Remove the 2 bolts (Item 1) **[Figure 20-181-4]** and nuts.

Remove the valve.

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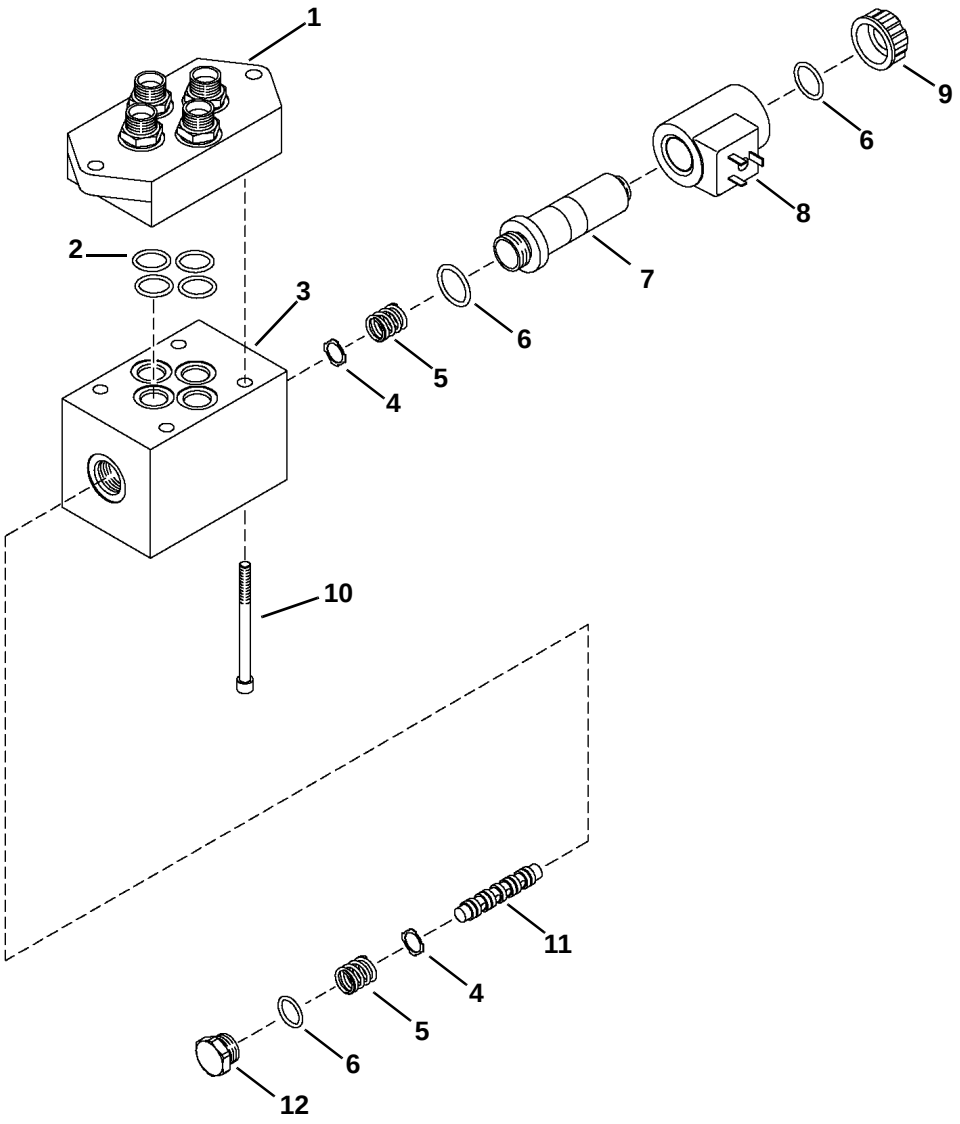
Parts Identification

1 Plate
2 O-Ring
3 Valve Body
4 Spring Retainer
5 Spring
6 O-Ring
7 Solenoid Valve
8 Coil
9 Nut
10 Bolt
11 Spool
12 Plug



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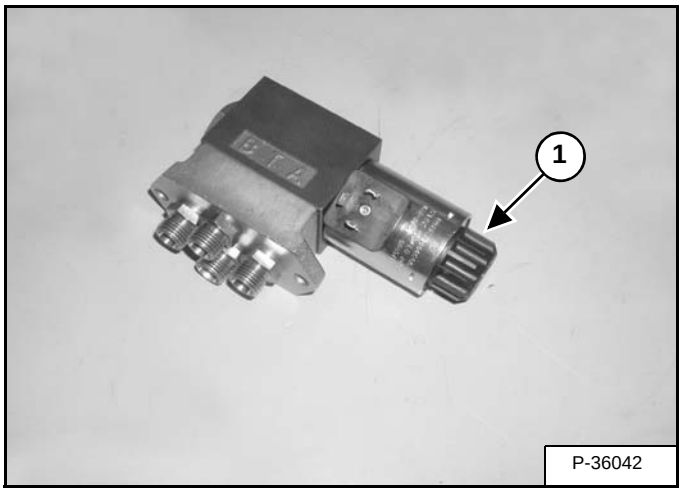
Disassembly And Assembly

Figure 20-181-5

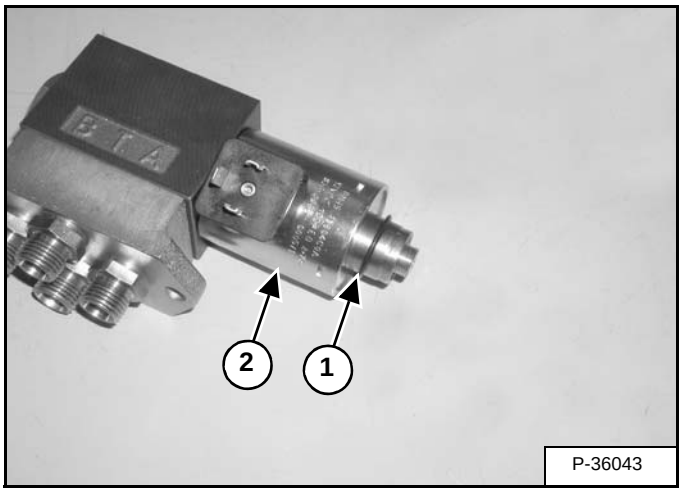


Remove the nut (Item 1) **[Figure 20-181-5]** from the solenoid valve.

Installation: Tighten the nut to 3-5 ft.-lb. (4-7 N•m) torque.

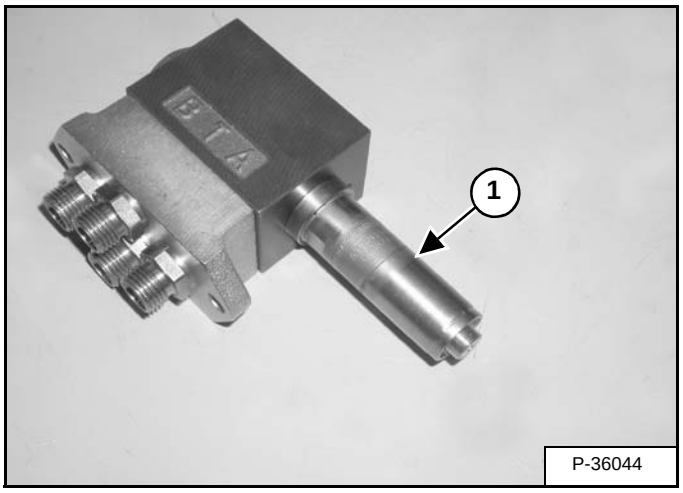
NOTE: Overtightening the coil nuts (Item 1) [Figure 20-181-5] may cause spool or coil failure.

Figure 20-181-6



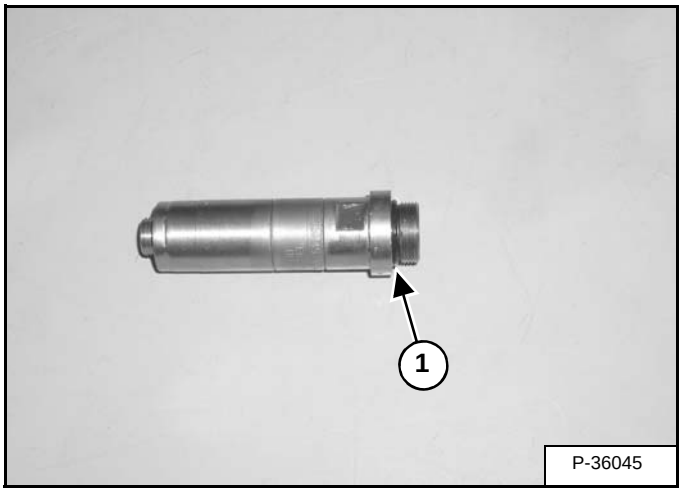
Remove the O-ring (Item 1) and coil (Item 2) **[Figure 20-181-6]**.

Figure 20-181-7



Remove the solenoid valve (Item 1) **[Figure 20-181-7]**.

Figure 20-181-8



Remove the O-ring (Item 1) **[Figure 20-181-8]**.

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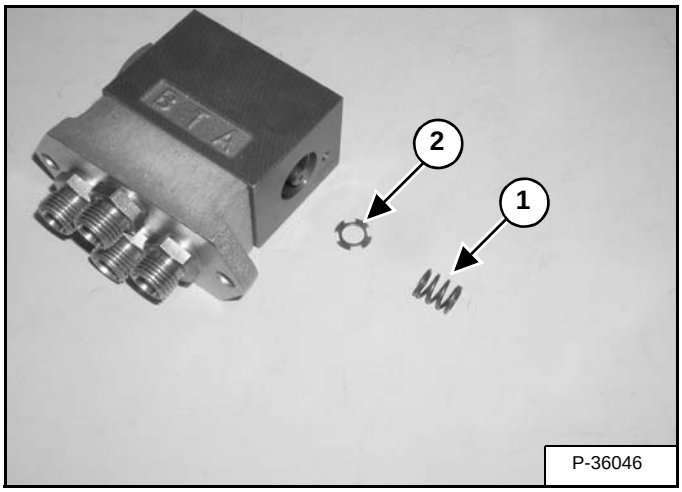
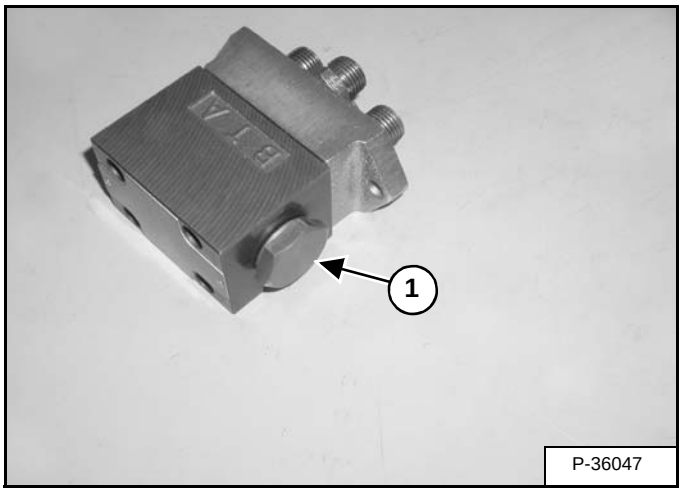
Disassembly And Assembly (Cont'd)

Figure 20-181-9



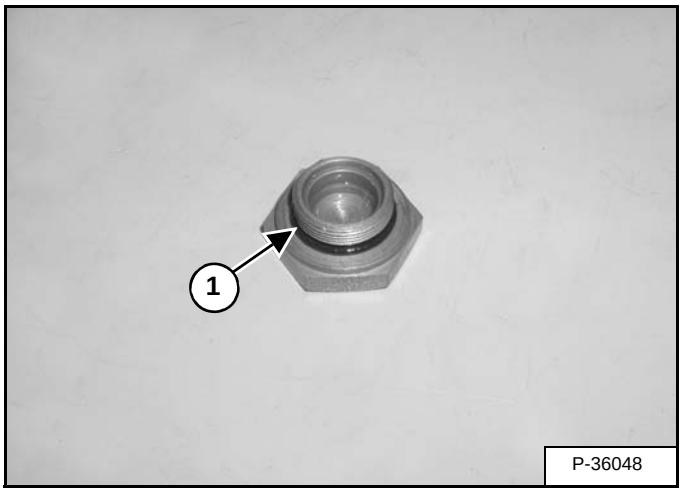
Remove the spring (Item 1) and spring seat (Item 2) **[Figure 20-181-9]**.

Figure 20-181-10



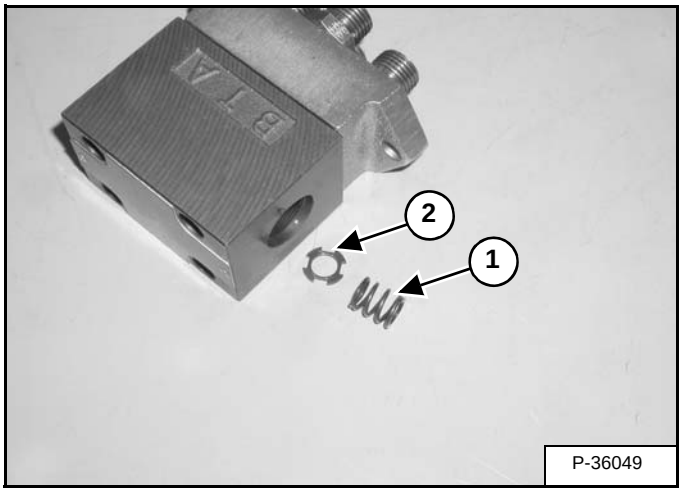
Remove the plug (Item 1) **[Figure 20-181-10]** from the opposite end of the valve.

Figure 20-181-11



Remove the O-ring (Item 1) **[Figure 20-181-11]**.

Figure 20-181-12



Remove the spring (item 1) and spring seat (Item 2) **[Figure 20-181-12]**.

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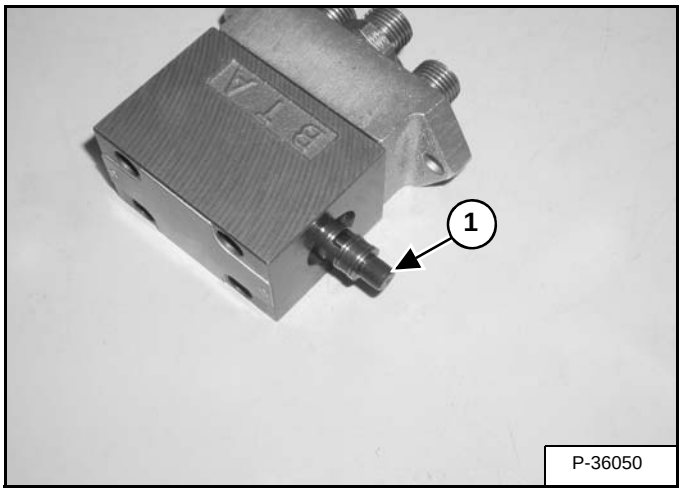
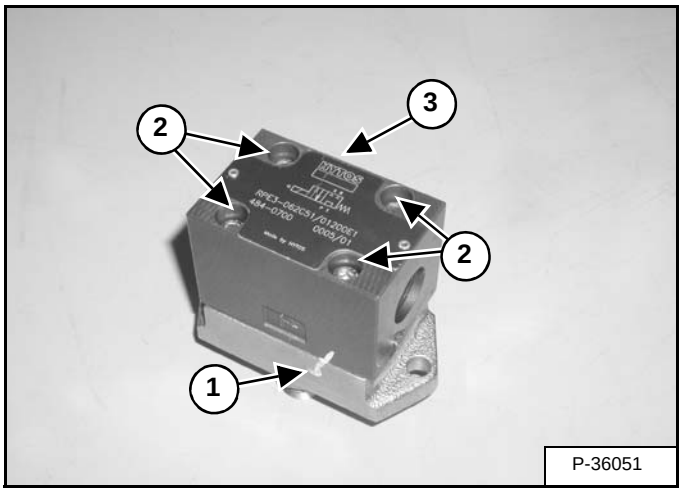
Disassembly And Assembly (Cont'd)

Figure 20-181-13



Remove the spool (Item 1) **[Figure 20-181-13]**.

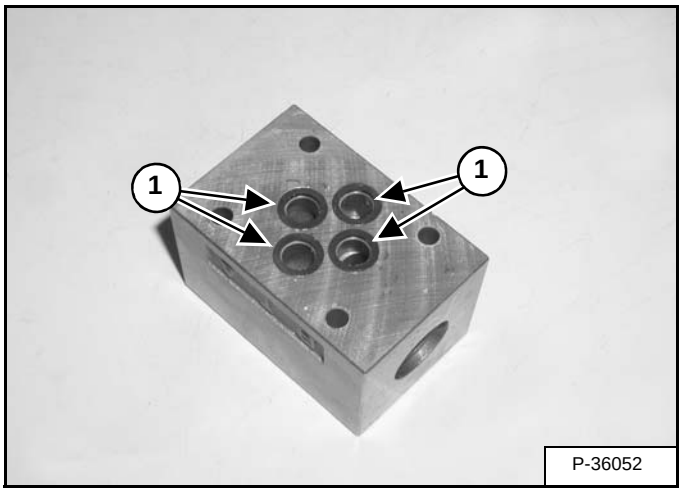
Figure 20-181-14



Mark the valve body (Item 1) **[Figure 20-181-14]** for ease of assembly.

Remove the 4 bolts (Item 2) and remove the block (Item 3) **[Figure 20-181-14]**.

Figure 20-181-15



Remove the 4 O-rings (Item 1) **[Figure 20-181-15]**.

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BOOM OFFSET VALVE

Removal And Installation

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

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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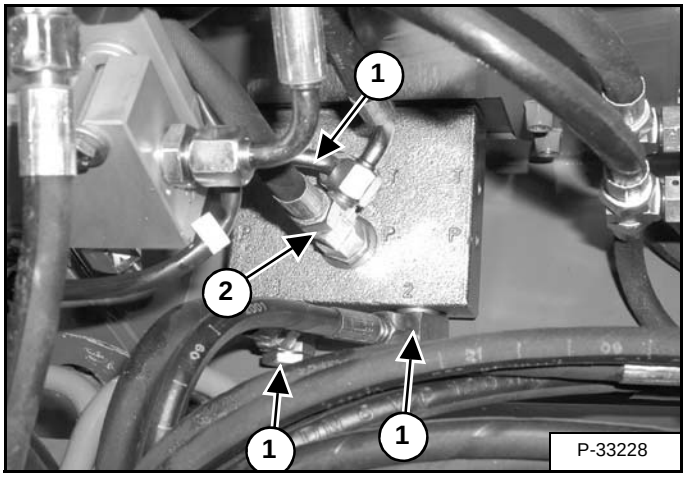
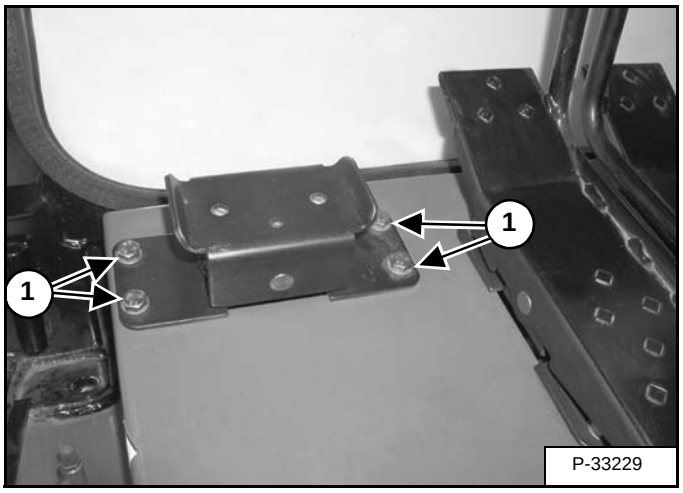
Figure 20-190-16



Mark and remove the hoses (Item 1) **[Figure 20-190-16]**.

Remove the tee fitting (Item 2) **[Figure 20-190-16]**.

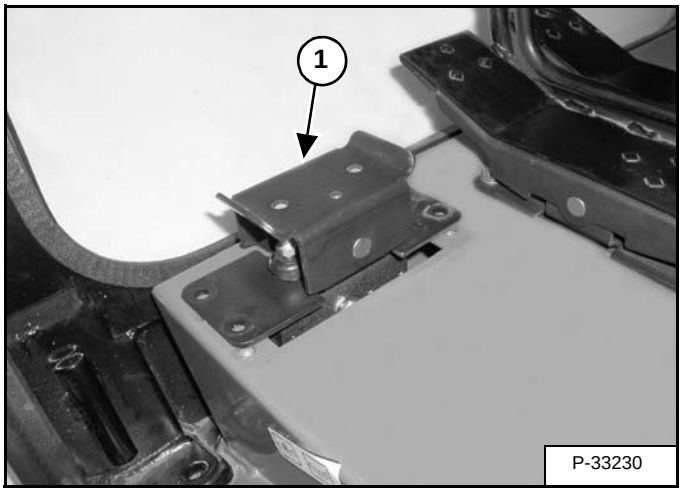
Figure 20-190-17



Remove the 4 bolts (Item 1) **[Figure 20-190-17]** and washers.

Installation: Tighten the bolts to 15-18 ft.-lb. (20-25 N•m) torque.

Figure 20-190-18



Remove the valve (Item 1) **[Figure 20-190-18]**.

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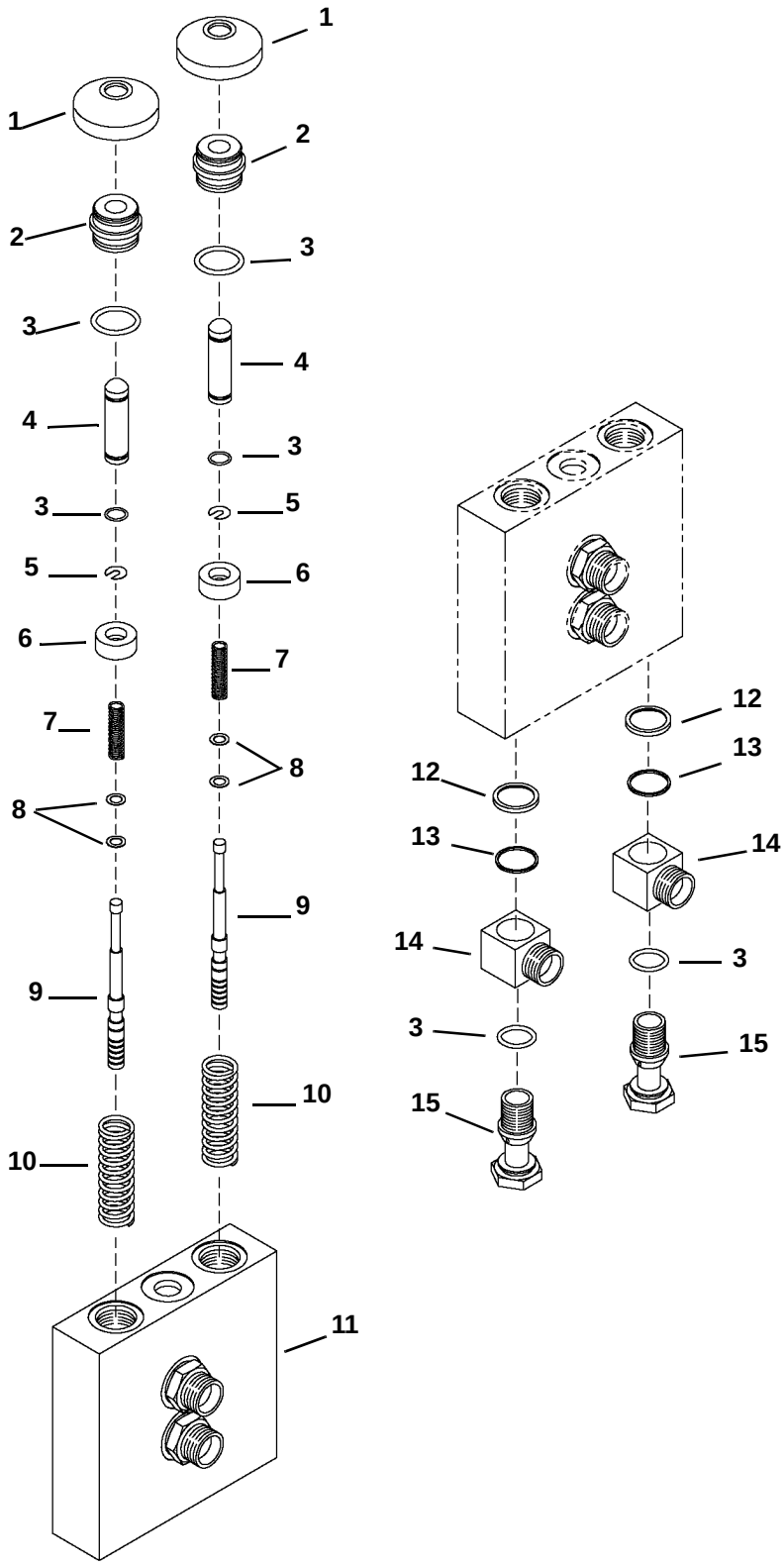
BOOM OFFSET VALVE (CONT'D)

Parts Identification

1 Dust Boot
2 Plunger Body
3 O-Ring
4 Push Rod
5 Retainer
6 Piston
7 Spring
8 Shim
9 Spool
10 Spring
11 Valve body
12 Seal Carrier
13 Seal
14 Fitting
15 Bolt



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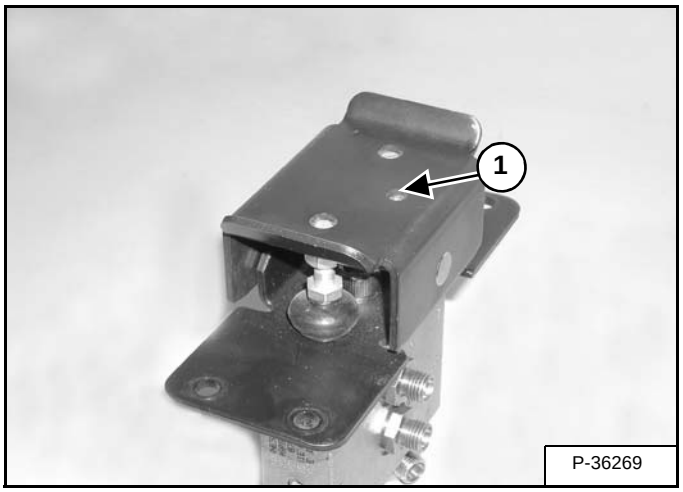
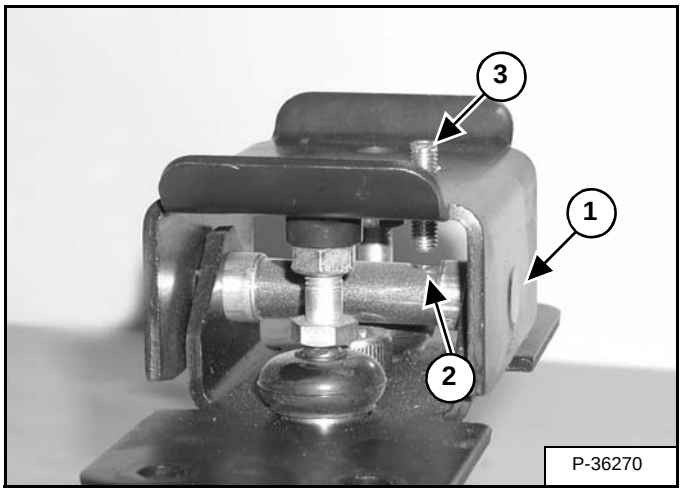
Disassembly And Assembly

Figure 20-190-19



Loosen the set screw (Item 1) **[Figure 20-190-19]**.

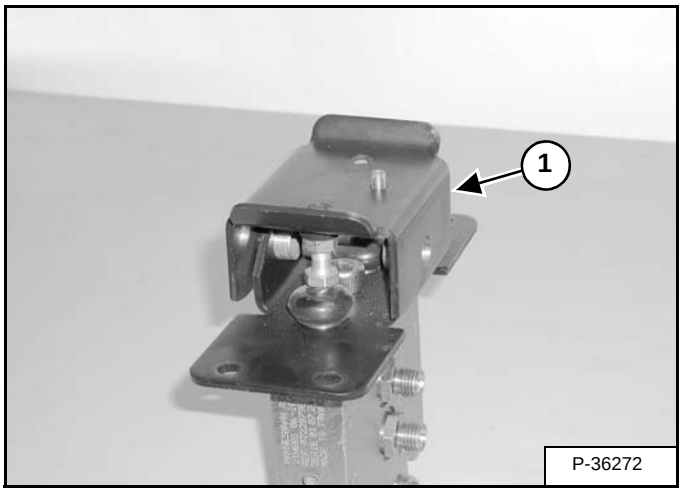
Figure 20-190-20



Remove the pin (Item 1) **[Figure 20-190-20]**.

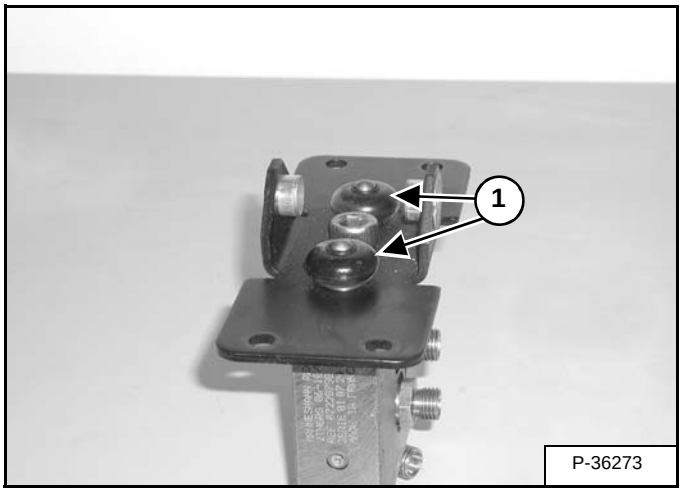
Installation: Align the hole (Item 2) with the set screw (Item 3) **[Figure 20-190-20]**. Tighten the set screw.

Figure 20-190-21



Remove the plate (Item 1) **[Figure 20-190-21]**.

Figure 20-190-22



Remove the dust boots (Item 1) **[Figure 20-190-22]**.

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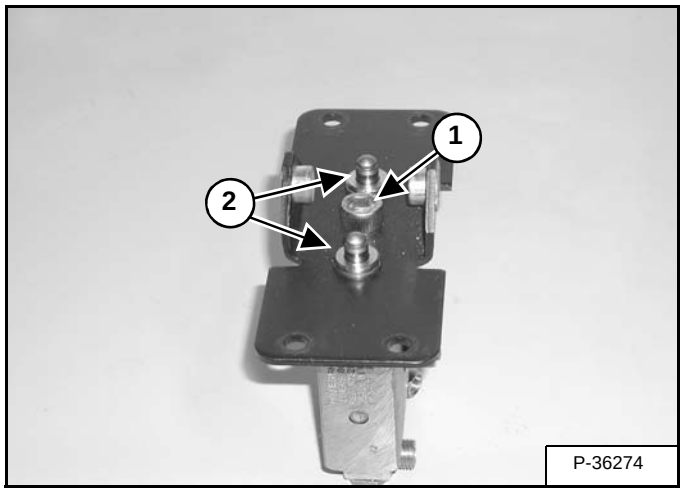
Disassembly And Assembly (Cont'd)

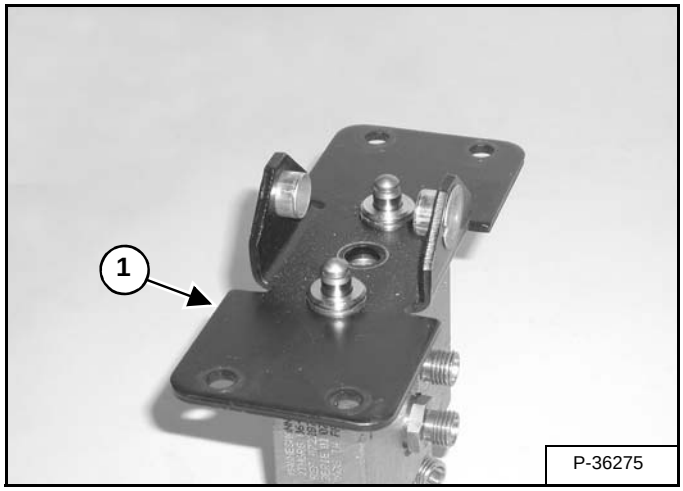
Figure 20-190-23



Remove the bolt (Item 1) **[Figure 20-190-23]**.

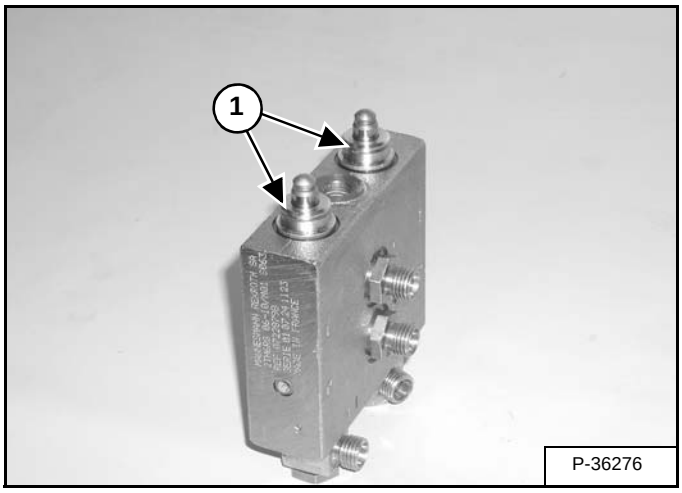
NOTE: Use caution when removing the bolt. The plunger assemblies (Item 2) [Figure 20-190-23] are spring loaded.

Figure 20-190-24



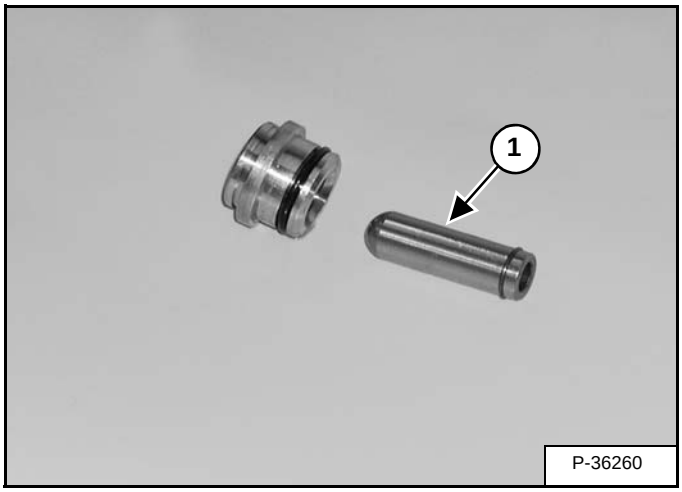
Remove the plate (Item 1) **[Figure 20-190-24]**.

Figure 20-190-25



Remove the plunger assemblies (Item 1) **[Figure 20-190-25]**.

Figure 20-190-26



Remove the push rod (Item 1) **[Figure 20-190-26]** from the plunger body.

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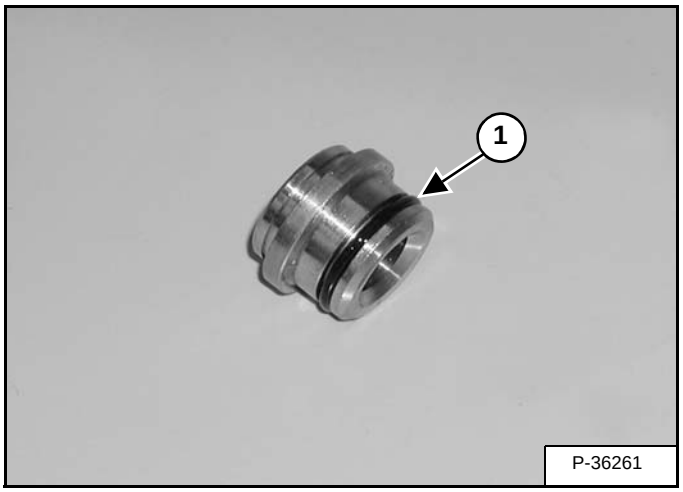
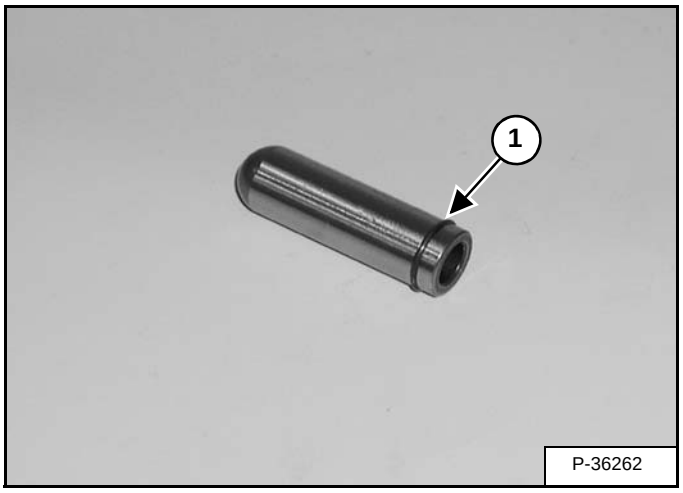
Disassembly And Assembly (Cont'd)

Figure 20-190-27



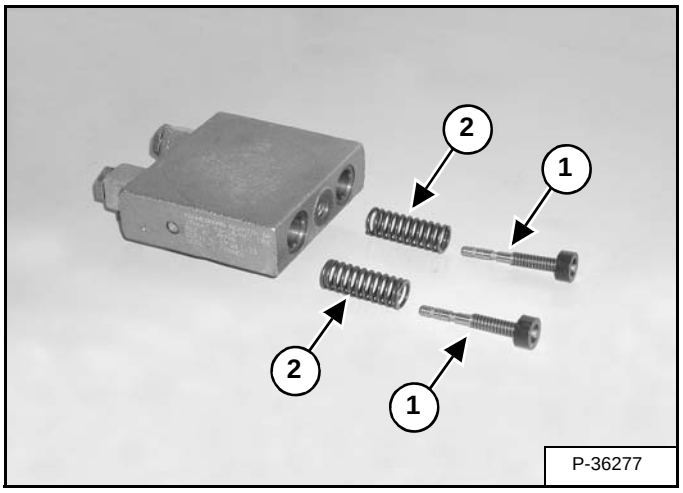
Remove the O-ring (Item 1) **[Figure 20-190-27]** from the plunger body.

Figure 20-190-28



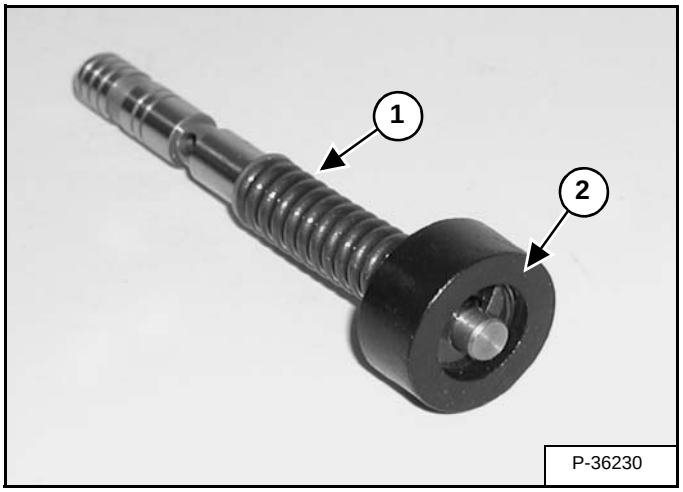
Remove the O-ring (Item 1) **[Figure 20-190-28]** from the push rod.

Figure 20-190-29



Remove the spool assembly (Item 1) and spring (Item 2) **[Figure 20-190-29]**.

Figure 20-190-30



Compress the spring (Item 1) until the retainer (Item 2) **[Figure 20-190-30]** can be removed.

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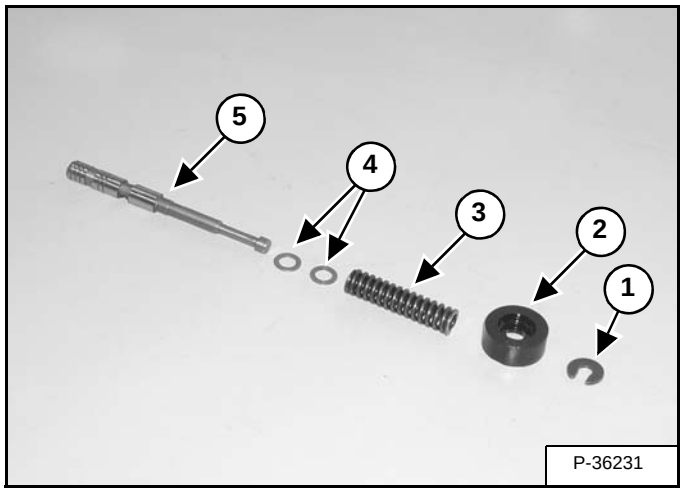
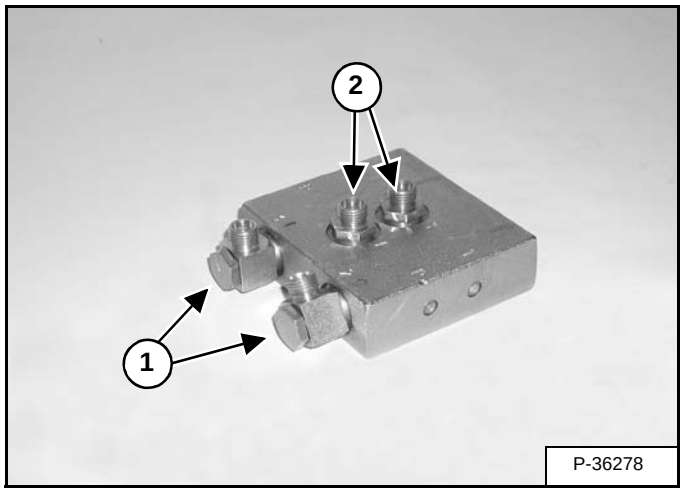
Disassembly And Assembly (Cont'd)

Figure 20-190-31



Remove the retainer (Item 1), piston (Item 2) spring (Item 3) and shims (Item 4) from the spool (Item 5) **[Figure 20-190-31]**.

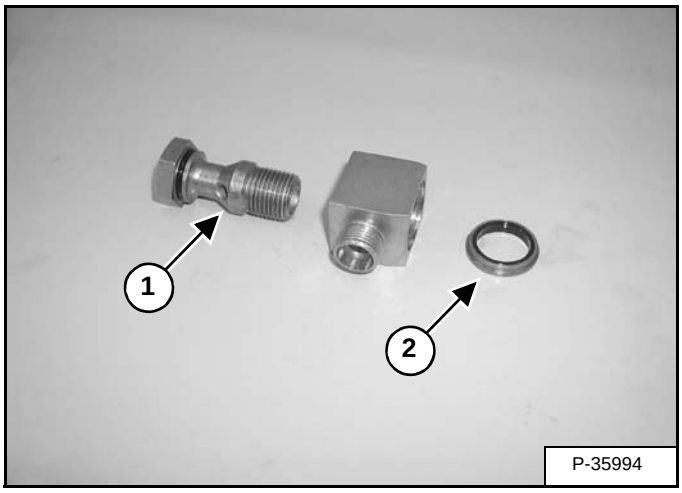
Figure 20-190-32



Remove the two fittings (Item 1) **[Figure 20-190-32]** from the end of the valve body.

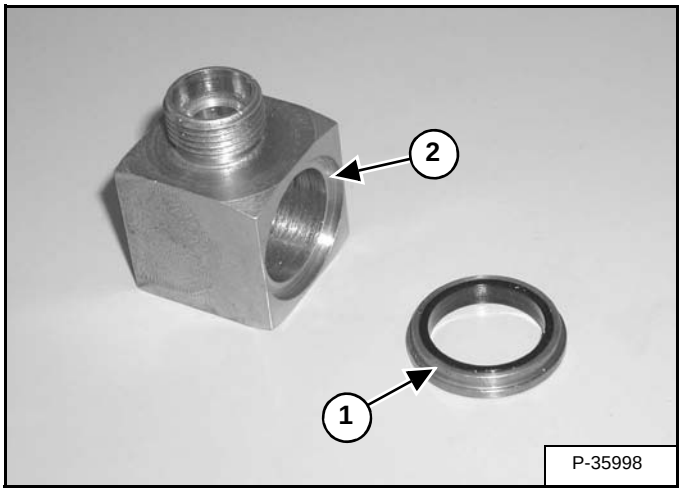
NOTE: Do not remove the 2 fittings (Item 2) [Figure 20-190-32]. The fittings are welded to the valve block. Removing the fittings will damage the block and fittings.

Figure 20-190-33



Remove the bolt (Item 1) and seal carrier (Item 2) **[Figure 20-190-32]** from the fittings.

Figure 20-190-34



Installation: The lip (Item 1) on the seal carrier must fit in the groove (Item 2) **[Figure 20-190-34]** in the housing.

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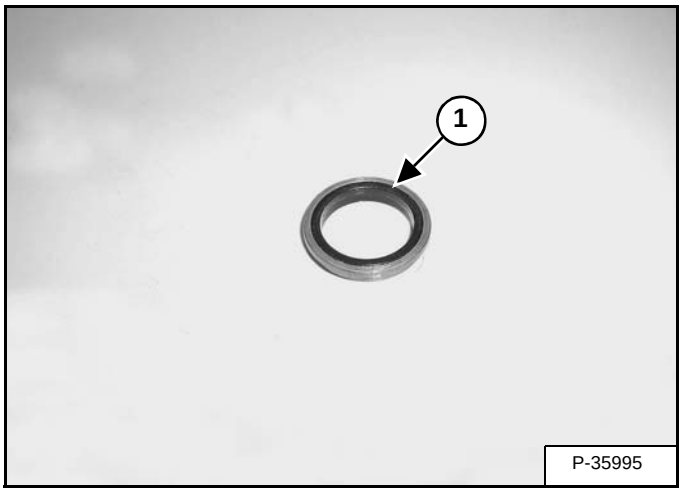
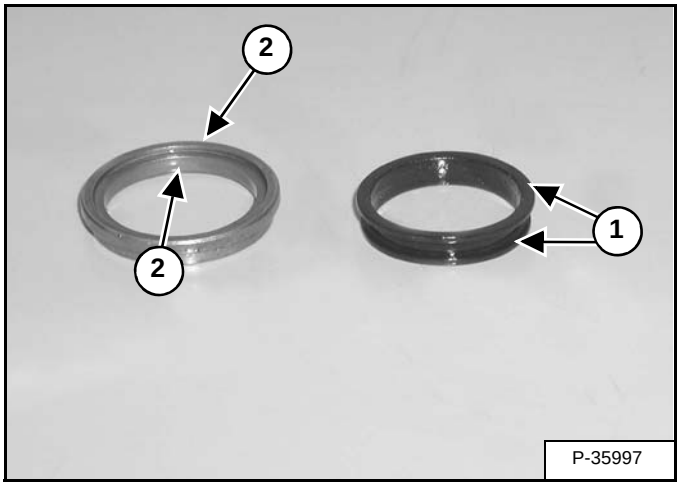
Disassembly And Assembly (Cont'd)

Figure 20-190-35



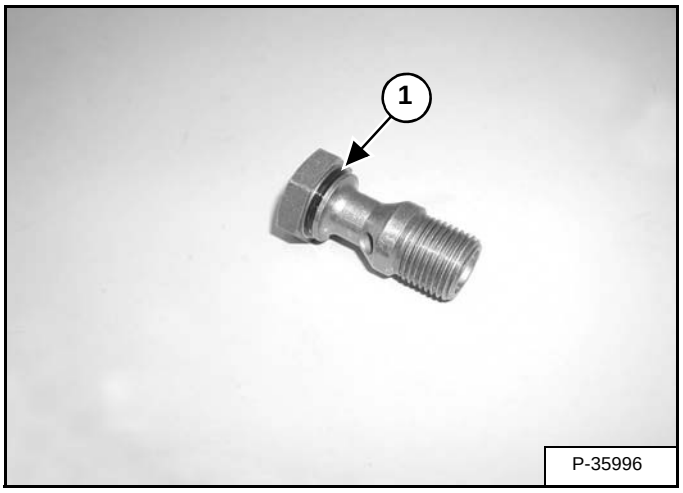
Remove the seal (Item 1) **[Figure 20-190-35]** from the seal carrier.

Figure 20-190-36



Installation: Make sure the lips (Item 1) on the seal fit into the grooves (Item 2) **[Figure 20-190-36]** on the seal carrier.

Figure 20-190-37



Remove the O-ring (Item 1) **[Figure 20-190-37]** from the bolt.

Installation: Clean all components with solvent and dry with compressed air.

Inspect all parts and replace any that are damaged.

Use new O-rings and back-up rings.

Apply clean hydraulic oil to the O-rings and back-up rings during assembly.

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BOOM LOAD HOLDING VALVE

Removal And Installation

Fully retract the bucket and arm cylinders.

Lower the boom until the bucket is on the ground.

With the engine off and the key in the run position, move the joysticks 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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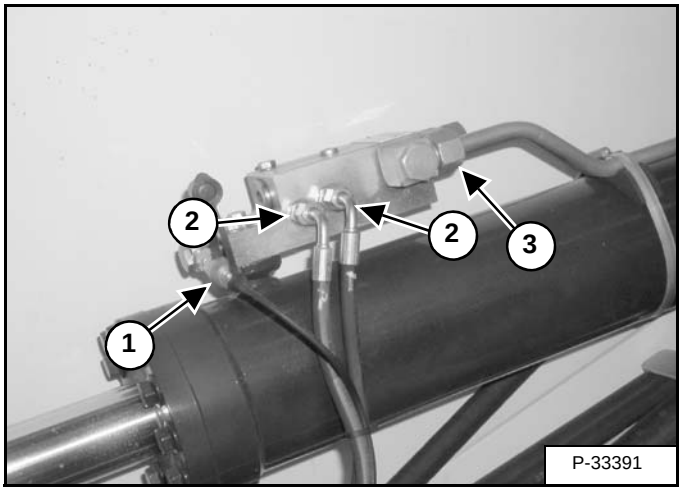
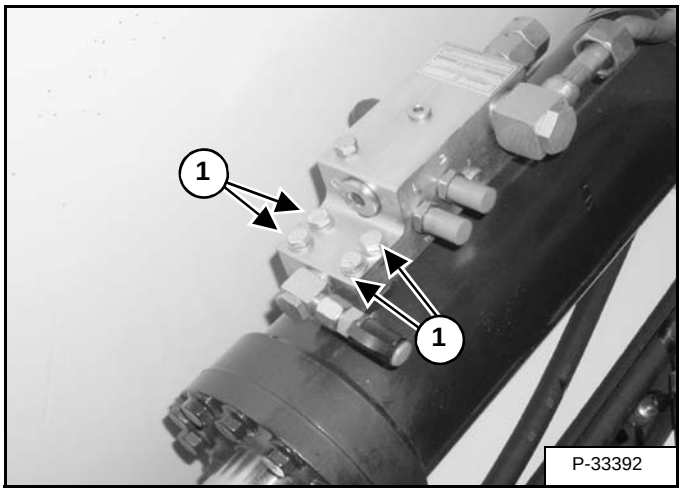
Figure 20-200-38



Remove the load sense line (Item 1) Mark and remove the pilot pressure lines (Item 2) **[Figure 20-200-38].**

Remove the tubeline (Item 3) **[Figure 20-200-38]**.

Figure 20-200-39

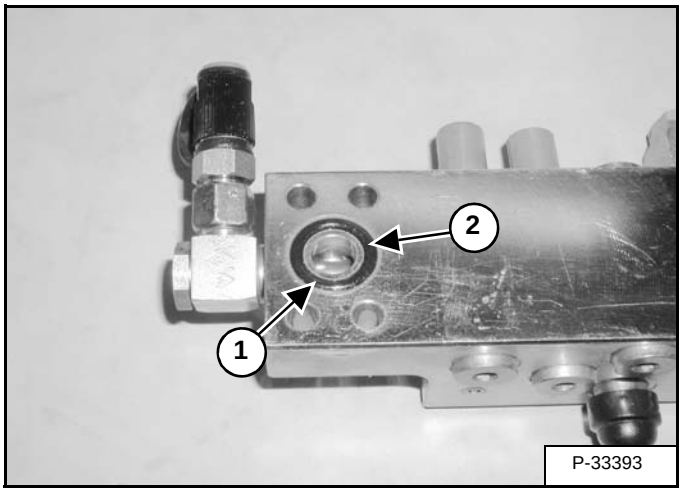


Remove the 4 bolts (Item 1) **[Figure 20-200-39]**.

Installation: Tighten the bolts to 15-18 ft.-lb. (20-25 N•m) torque.

Remove the valve.

Figure 20-200-40



Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-200-40]** from the valve.

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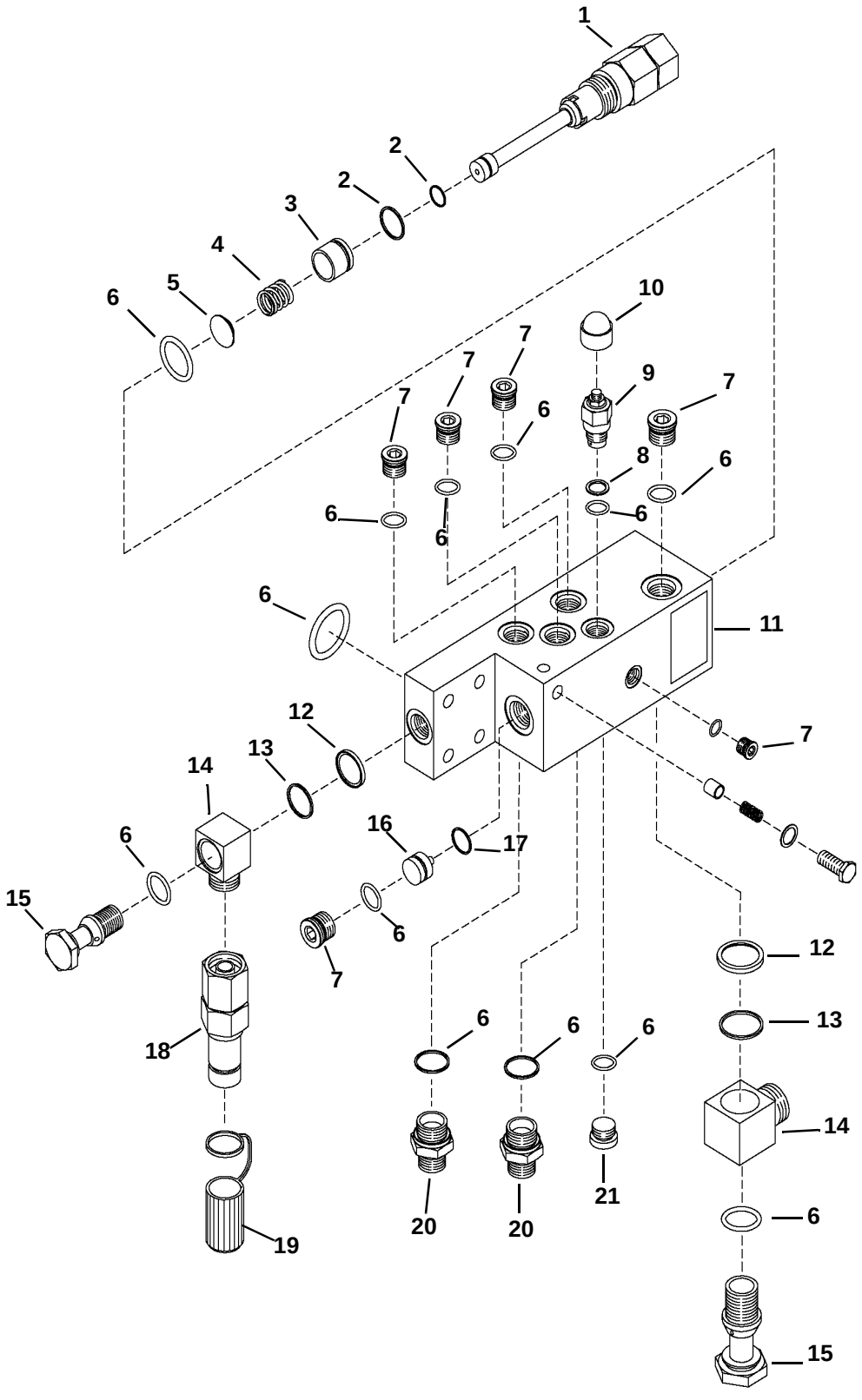
BOOM LOAD HOLDING VALVE (CONT'D)

Parts Identification

1 Relief Valve
2 Seal
3 Piston
4 Spring
5 Spring Seat
6 O-Ring
7 Plug
8 Back-up Ring
9 Relief Valve
10 Cap
11 Valve Body
12 Seal Carrier
13 Seal
14 Fitting
15 Bolt
16 Poppet
17 Seal
18 Coupler
19 Cap
20 Fitting
21 Plug



MS1539

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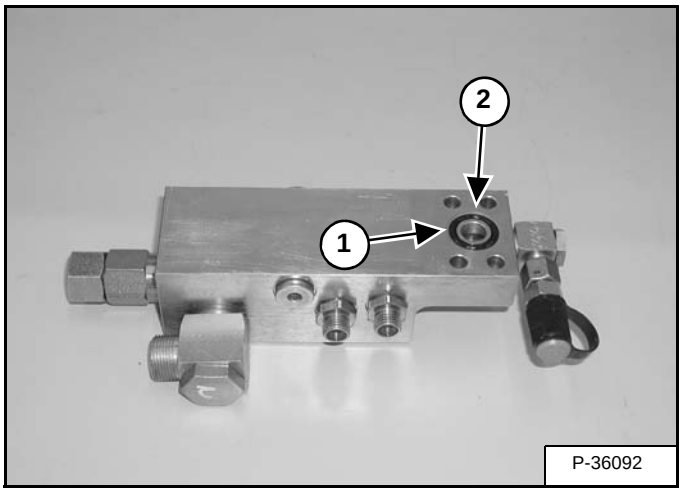
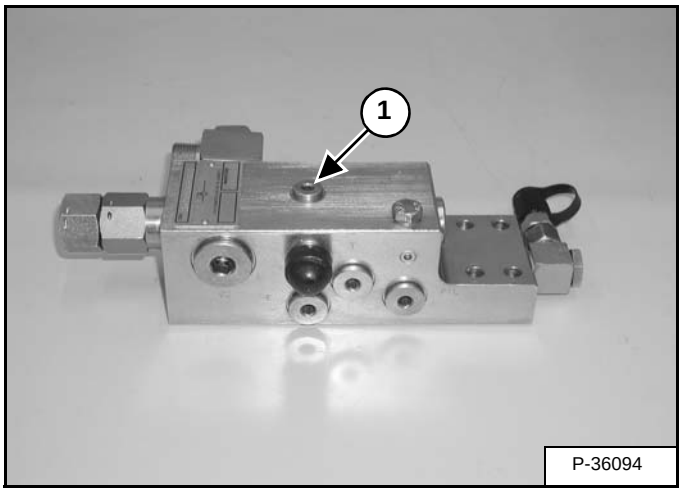
Disassembly

Figure 20-200-41



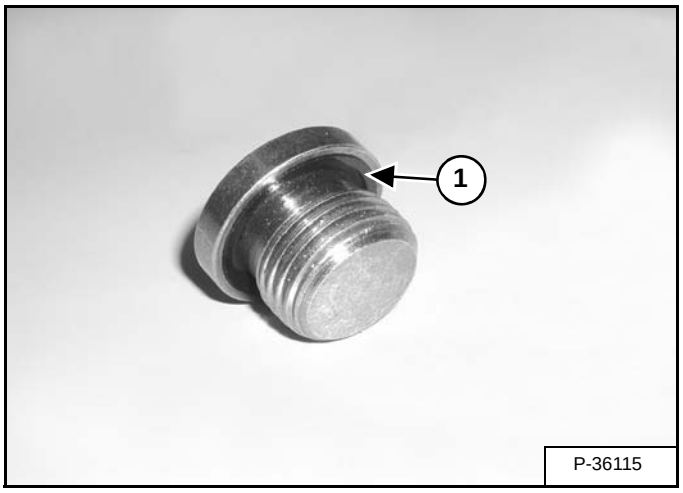
Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-200-41]**.

Figure 20-200-42



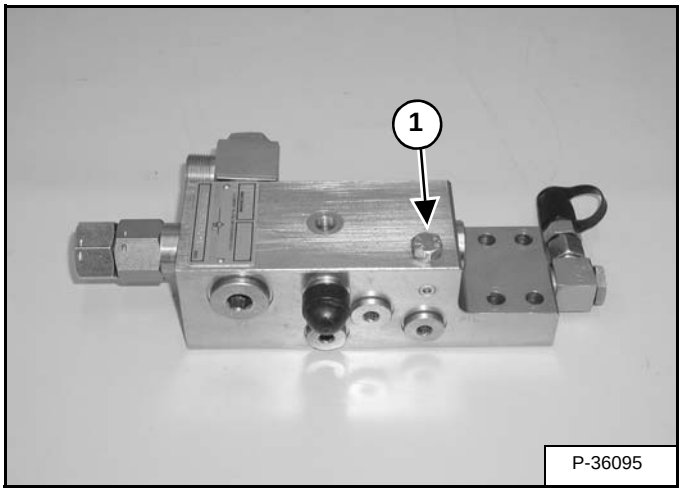
Remove the plug (Item 1) **[Figure 20-200-42]**.

Figure 20-200-43



Remove the O-ring (Item 1) **[Figure 20-200-43]**.

Figure 20-200-44



Loosen the bolt (Item 1) **[Figure 20-200-44]**.

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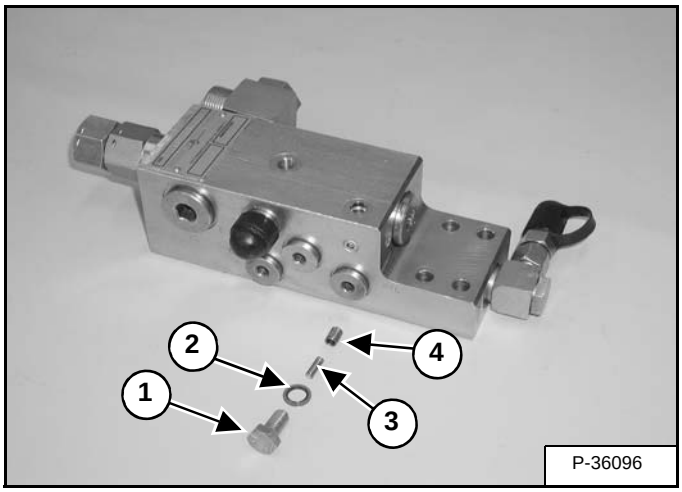
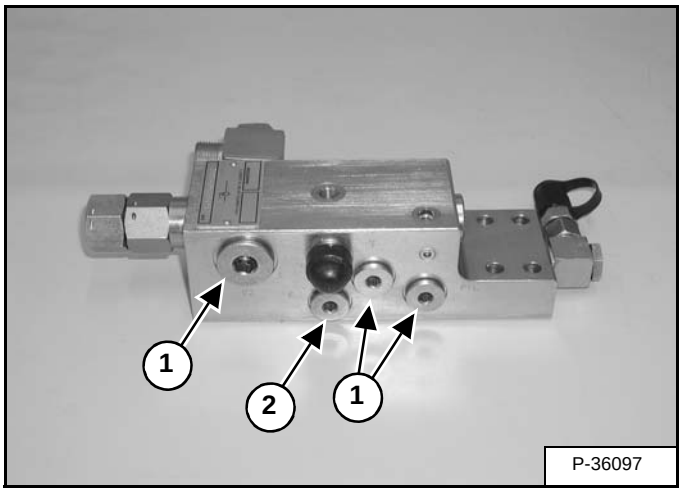
Disassembly (Cont'd)

Figure 20-200-45



Remove the bolt (Item 1), washer (Item 2), spring (Item 3) and poppet (Item 4) **[Figure 20-200-45]**.

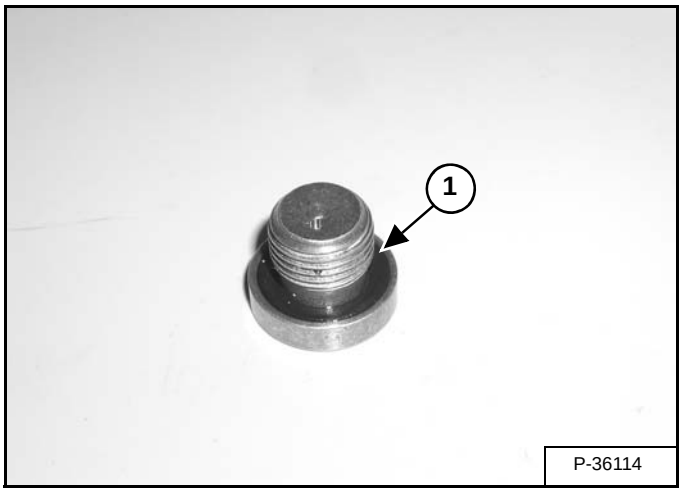
Figure 20-200-46



Remove the 3 plugs (Item 1). Mark and remove the ported plug (Item 2) **[Figure 20-200-46]**.

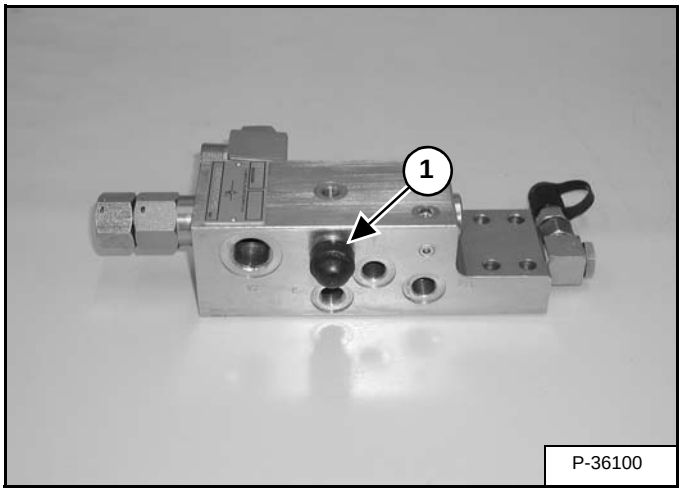
NOTE: Make sure the ported plug is installed in the original location.

Figure 20-200-47



Remove the O-ring (Item 1) **[Figure 20-200-47]** from the 4 plugs. (Ported plug shown.)

Figure 20-200-48



Remove the cap (Item 1) **[Figure 20-200-48]** from the relief valve.

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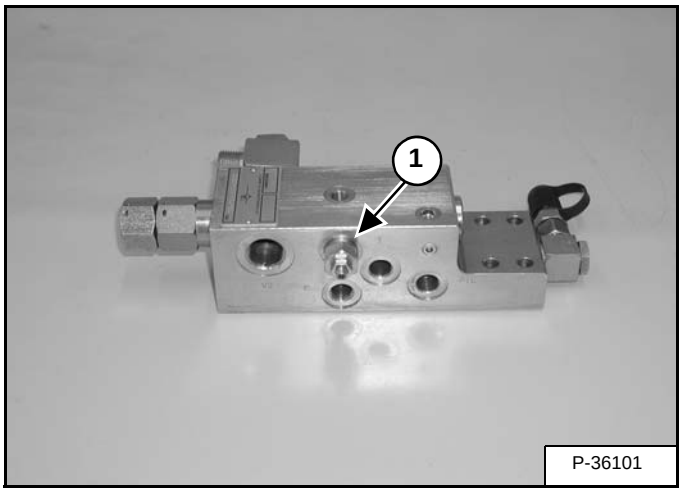
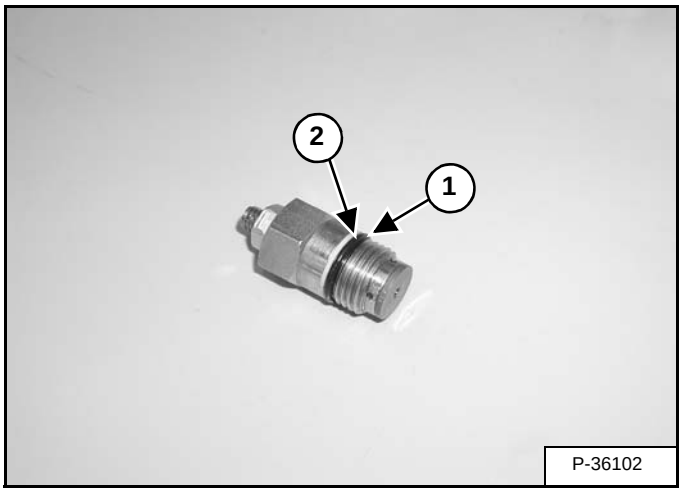
Disassembly (Cont'd)

Figure 20-200-49



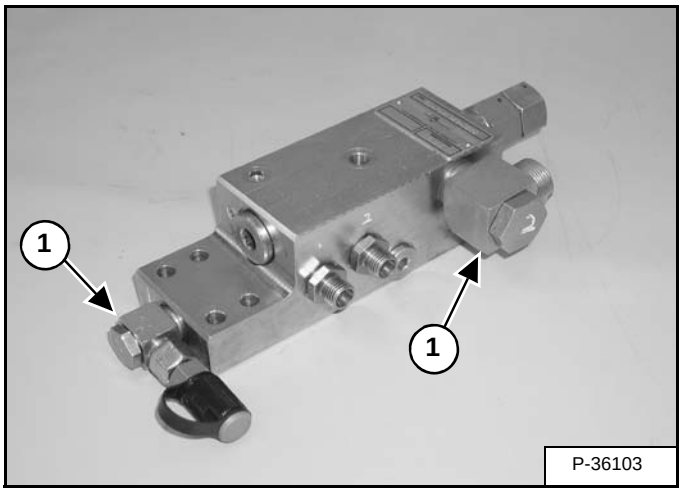
Remove the relief valve (Item 1) **[Figure 20-200-49]**.

Figure 20-200-50



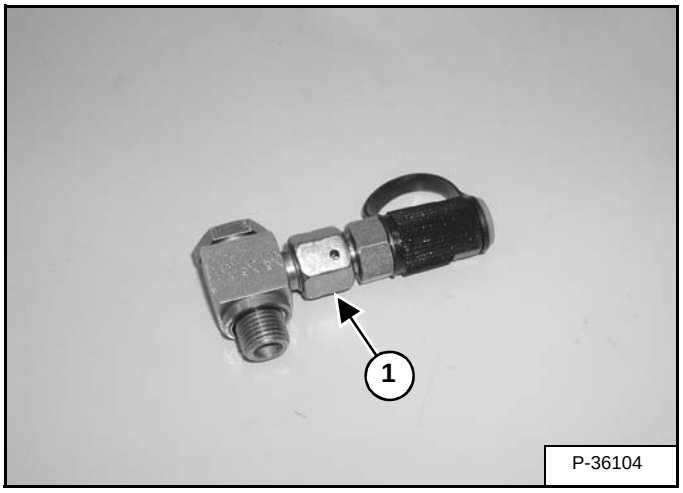
Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-200-50]**.

Figure 20-200-51



Remove the fittings (Item 1) **[Figure 20-200-51]**.

Figure 20-200-52



Remove the coupler (Item 1) **[Figure 20-200-52]** from the fitting.

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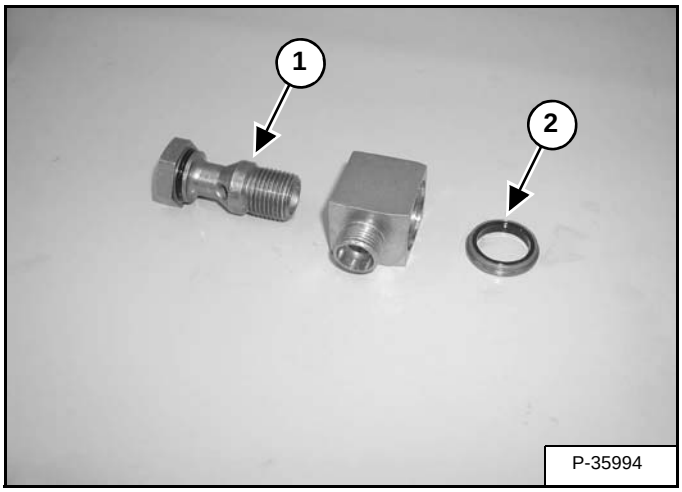
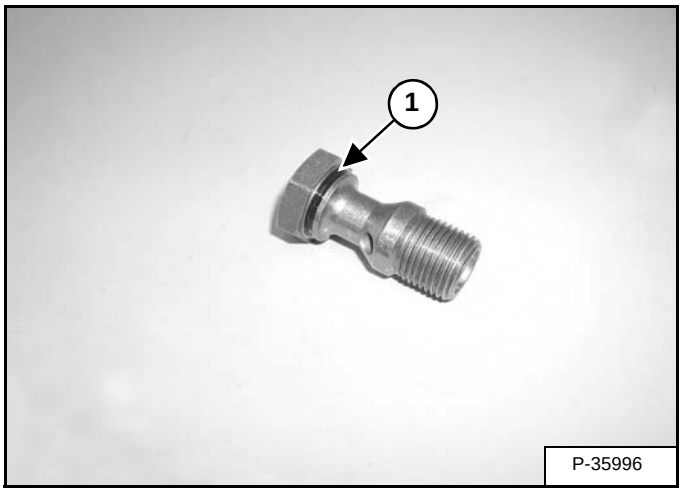
Disassembly (Cont'd)

Figure 20-200-53



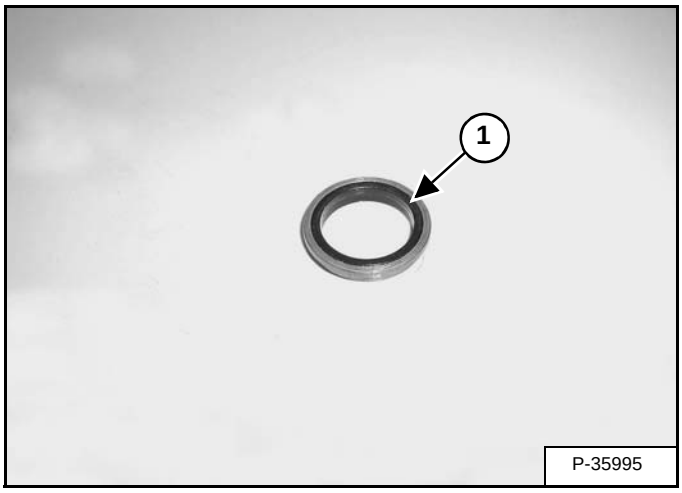
Remove the bolt (Item 1) and seal carrier (Item 2) **[Figure 20-200-53]** from the two fittings.

Figure 20-200-54



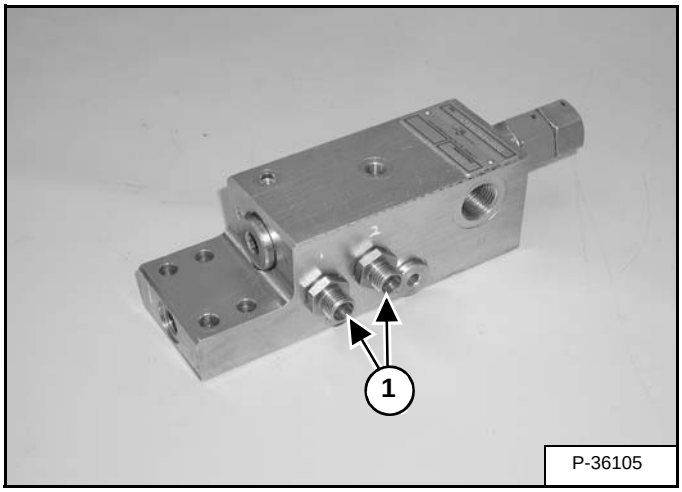
Remove the O-ring (Item 1) **[Figure 20-200-54]** from the bolt.

Figure 20-200-55



Remove the seal (Item 1) **[Figure 20-200-55]** from the seal carrier.

Figure 20-200-56



Remove the 2 fittings (Item 1) **[Figure 20-200-56]**.

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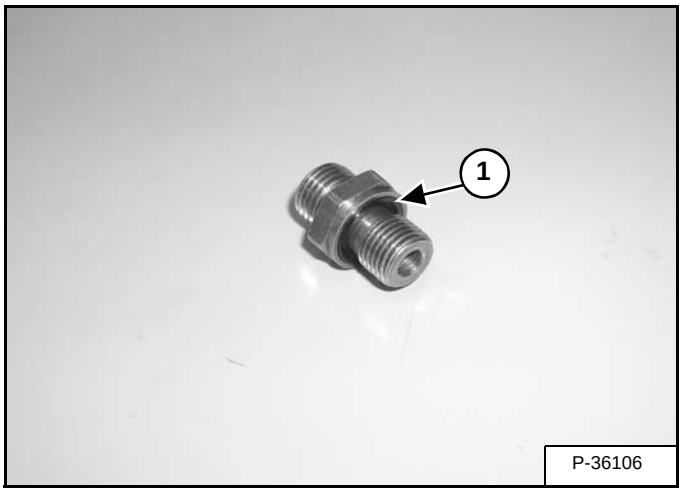
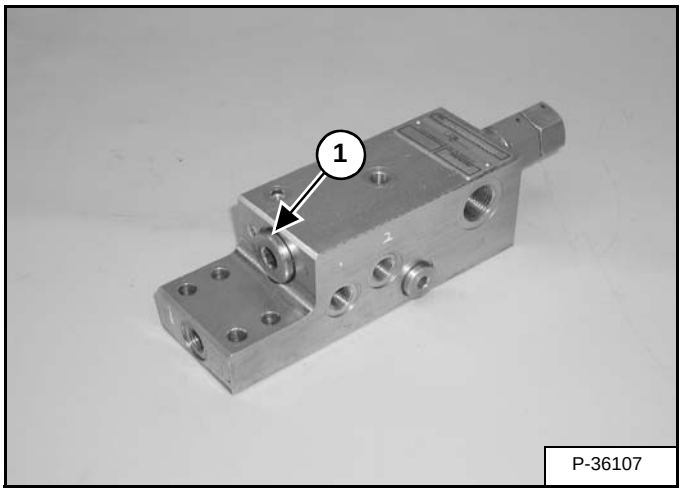
Disassembly (Cont'd)

Figure 20-200-57



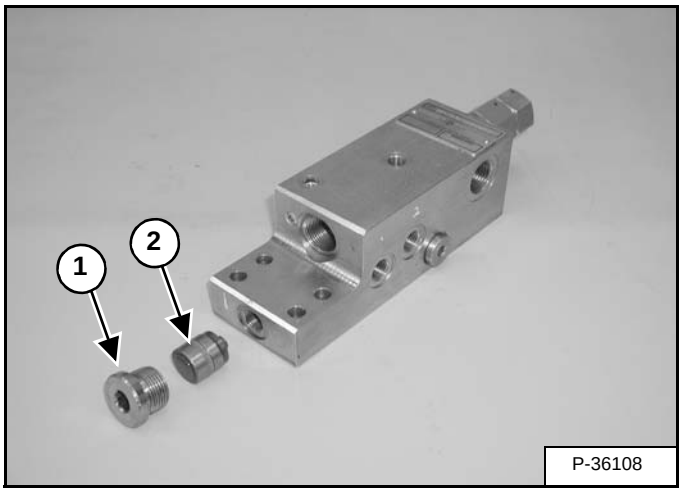
Remove the O-ring (Item 1) **[Figure 20-200-57]** from the fittings.

Figure 20-200-58



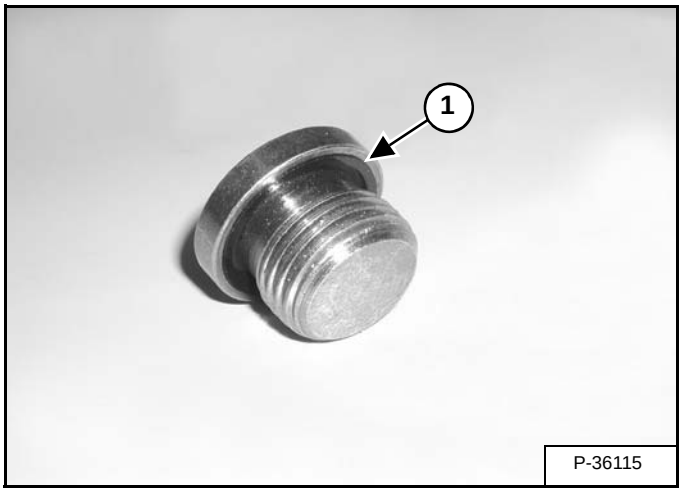
Loosen the plug (Item 1) **[Figure 20-200-58]**.

Figure 20-200-59



Remove the plug (Item 1) and poppet (Item 2) **[Figure 20-200-59]**.

Figure 20-200-60



Remove the O-ring (Item 1) **[Figure 20-200-60]** from the plug.

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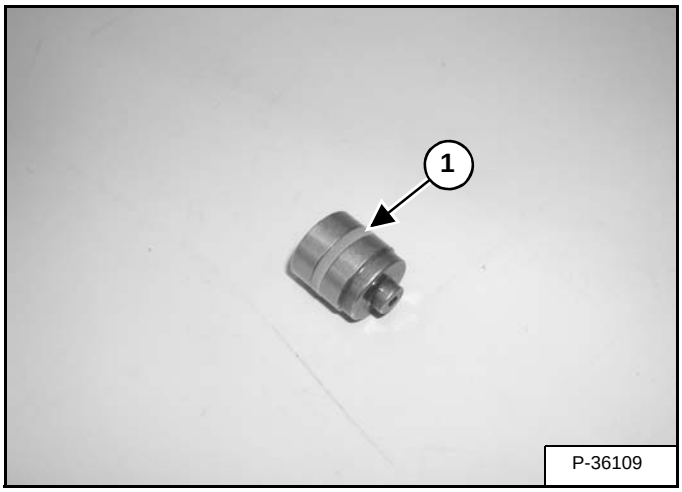
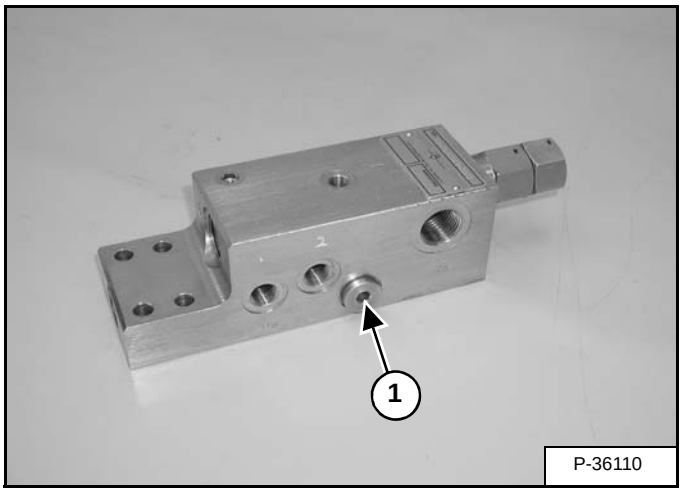
Disassembly (Cont'd)

Figure 20-200-61



Remove the seal (Item 1) **[Figure 20-200-61]** from the poppet.

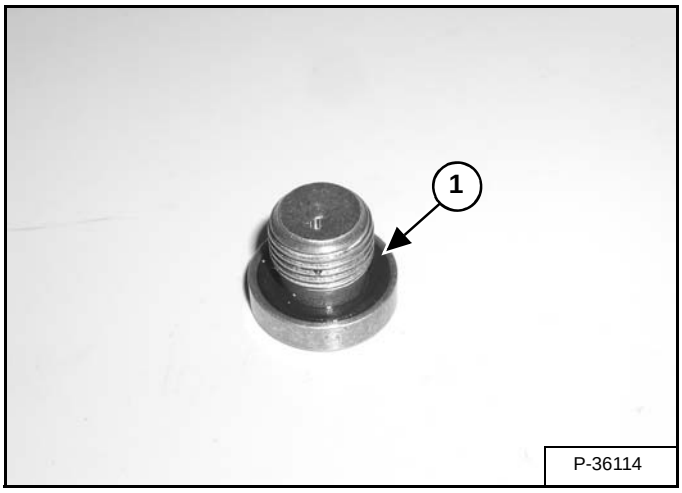
Figure 20-200-62



Mark and remove the plug (Item 1) **[Figure 20-200-62]**.

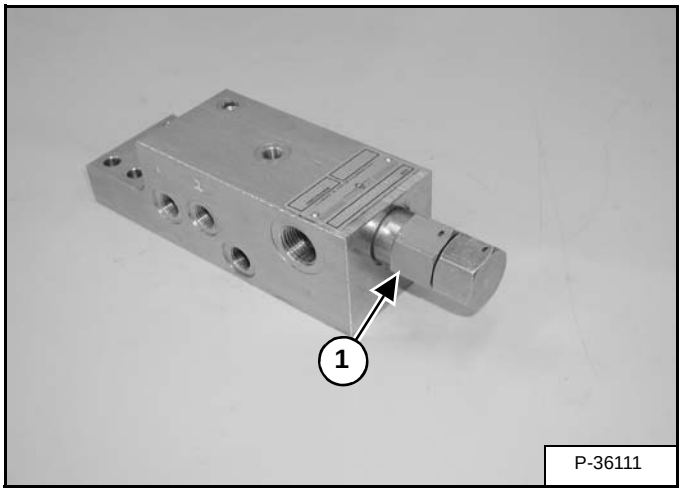
NOTE: The plug is ported and must be installed in the original location.

Figure 20-200-63



Remove the O-ring (Item 1) **[Figure 20-200-63]** from the plug.

Figure 20-200-64



Loosen the relief valve (Item 1) **[Figure 20-200-64]**.

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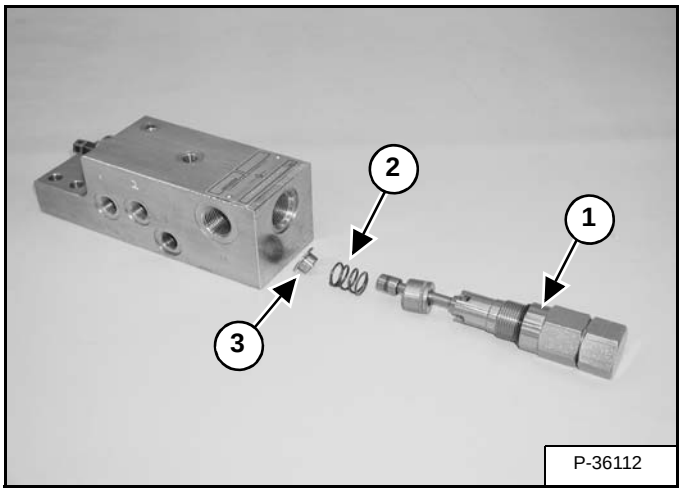
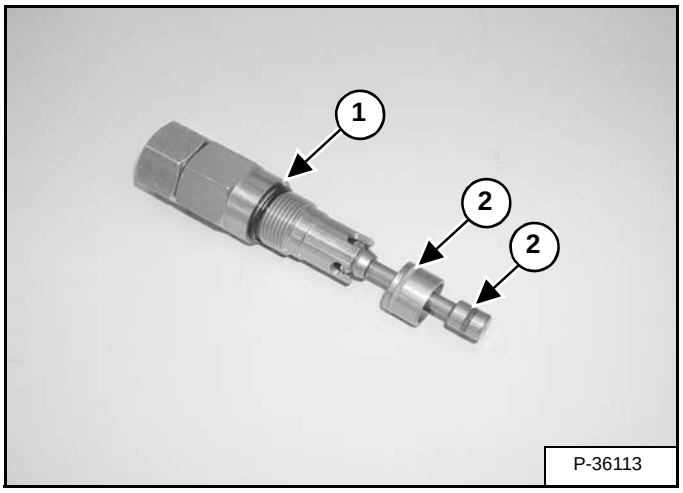
Disassembly (Cont'd)

Figure 20-200-65



Remove the relief valve (Item 1), spring (Item 2) and spring seat (Item 3) **[Figure 20-200-65]**.

Figure 20-200-66



Remove the O-ring (Item 1) and seals (Item 2) **[Figure 20-200-66]** from the relief valve.

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Assembly

Clean all components with solvent and dry with compressed air.

Check all components for wear or damage. Replace as needed.

Always use new O-rings, back-up rings and seals.

Apply clean hydraulic oil to the components during assembly.

IMPORTANT

When making repairs on hydraulic system, clean the work area before disassemble 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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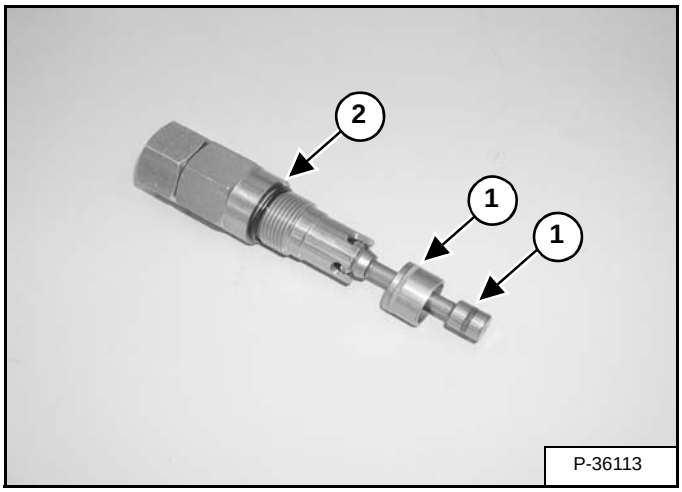
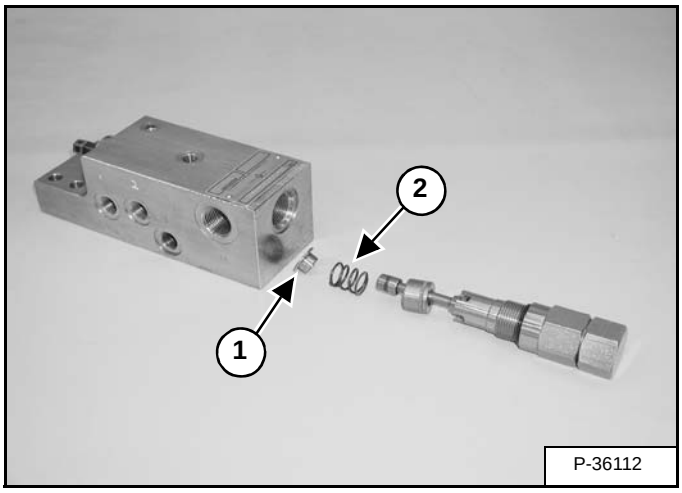
Figure 20-200-67



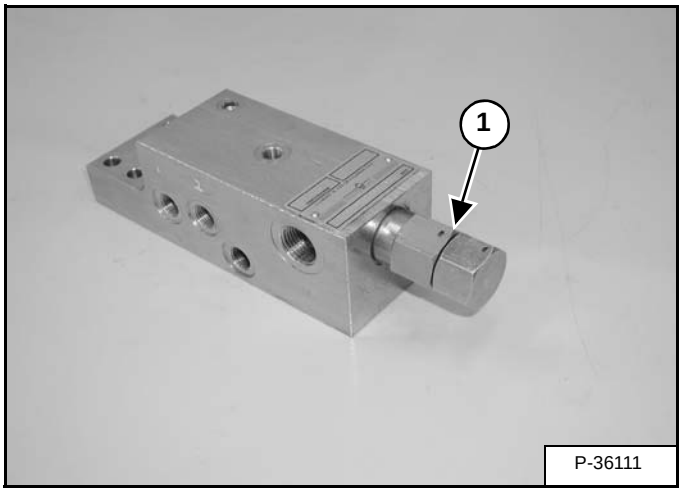
Install the seals (Item 1) and O-ring (Item 2) **[Figure 20-200-67]** on the relief valve.

Figure 20-200-68



Install the spring retainer (Item 1) spring (Item 2) **[Figure 20-200-68]** in the housing.

Figure 20-200-69



Install the relief valve (Item 1) **[Figure 20-200-69]**.

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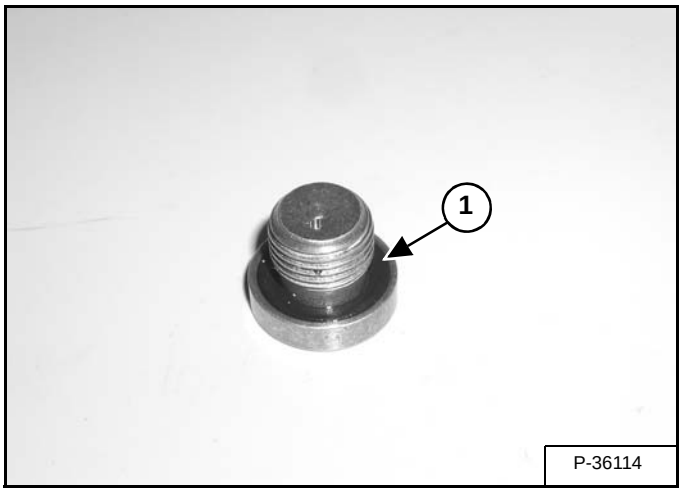
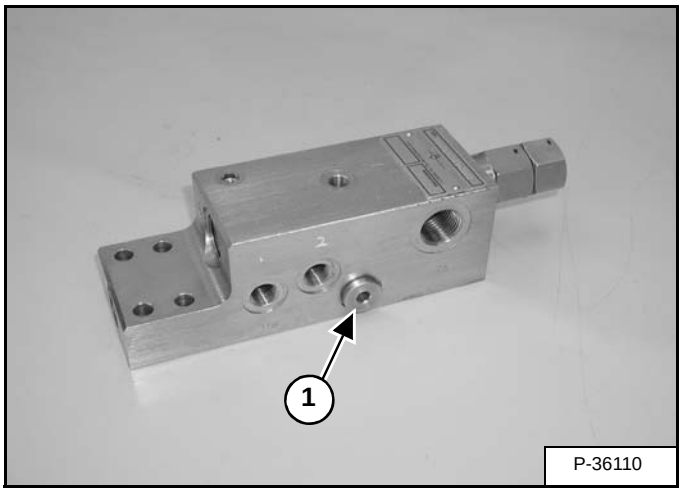
Assembly (Cont'd)

Figure 20-200-70



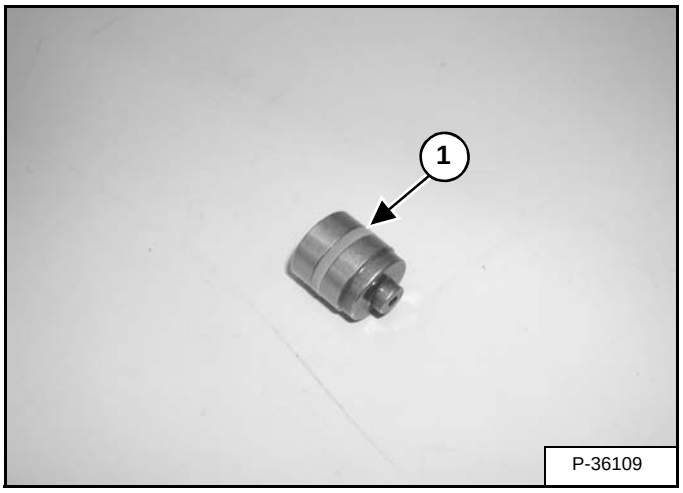
Install the O-ring (Item 1) **[Figure 20-200-70]** in the ported plug.

Figure 20-200-71



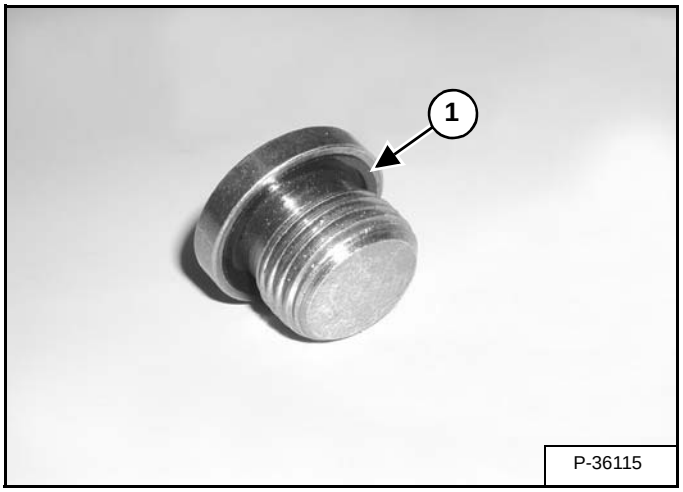
Install the ported plug (Item 1) **[Figure 20-200-71]** in the port marked "E".

Figure 20-200-72



Install the seal (Item 1) **[Figure 20-200-72]** on the poppet.

Figure 20-200-73



Install the O-ring (Item 1) **[Figure 20-200-73]** on the plug.

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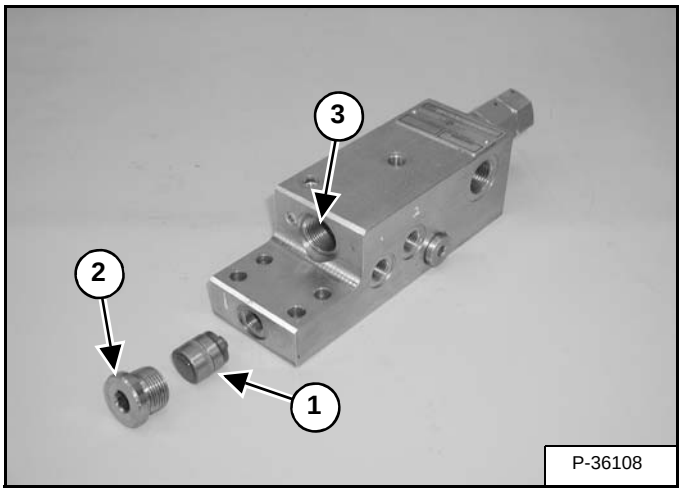
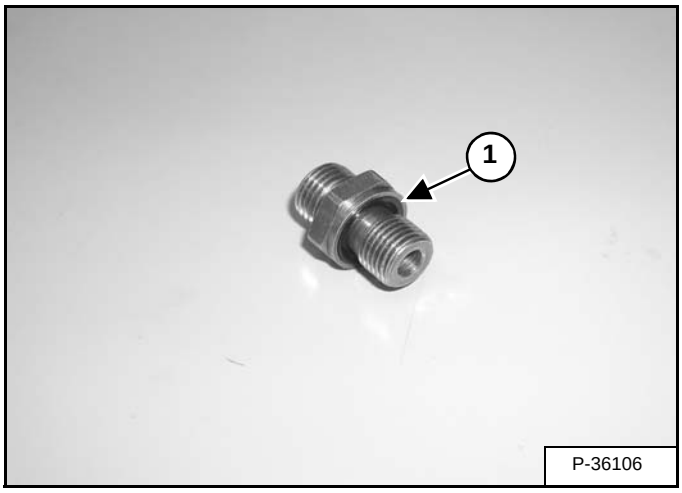
Assembly (Cont'd)

Figure 20-200-74



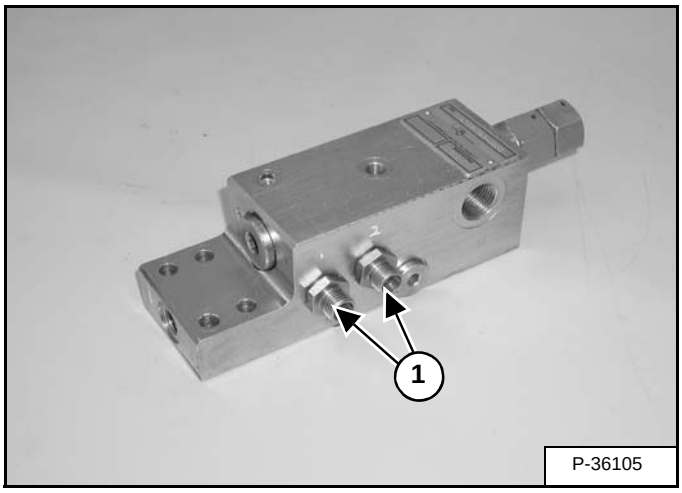
Install the poppet (Item 1) and plug (Item 2) in the port (Item 3) **[Figure 20-200-74]**.

Figure 20-200-75



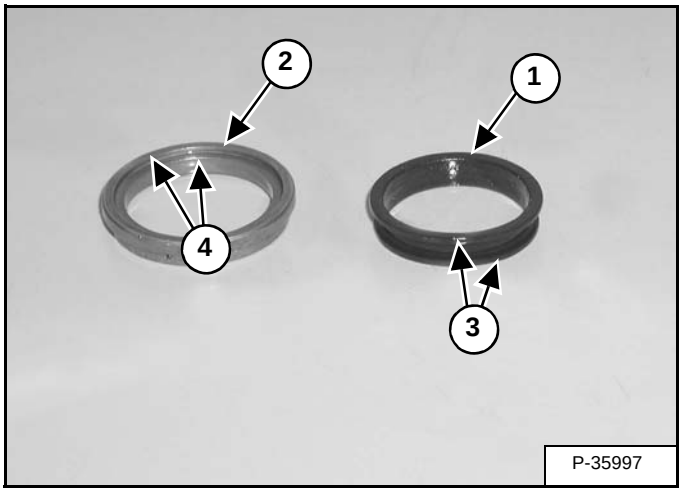
Install the O-ring (Item 1) **[Figure 20-200-75]** on the fittings.

Figure 20-200-76



Install the 2 fittings (Item 1) **[Figure 20-200-76]**.

Figure 20-200-77



Install the seal (Item 1) in the seal carriers (Item 2) **[Figure 20-200-77]**.

NOTE: Make sure the lips (Item 3) fit into the grooves (Item 4) [Figure 20-200-77] on the seal carrier.

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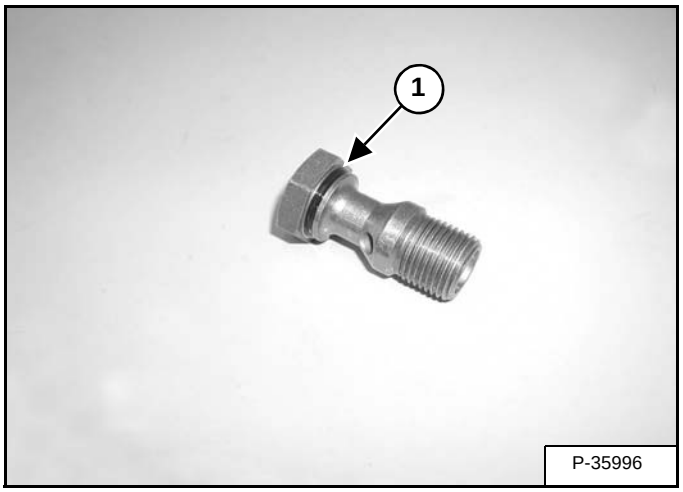
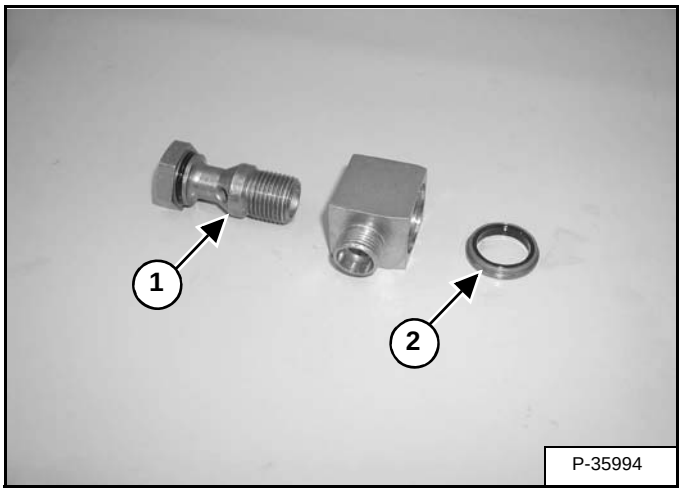
Assembly (Cont'd)

Figure 20-200-78



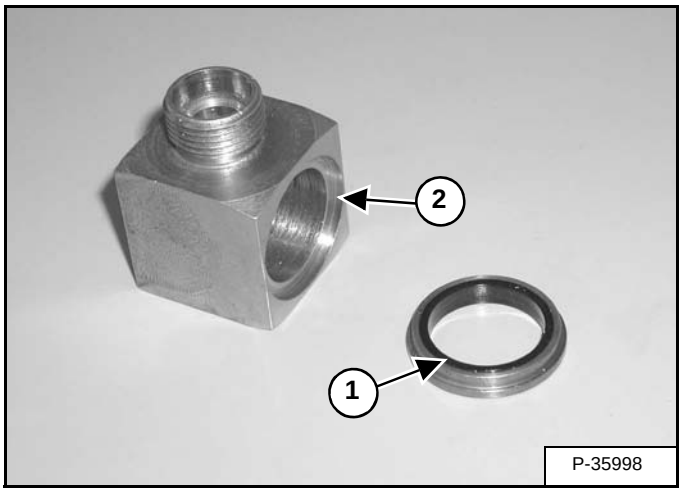
Install the O-ring (Item 1) **[Figure 20-200-78]** on the bolts.

Figure 20-200-79



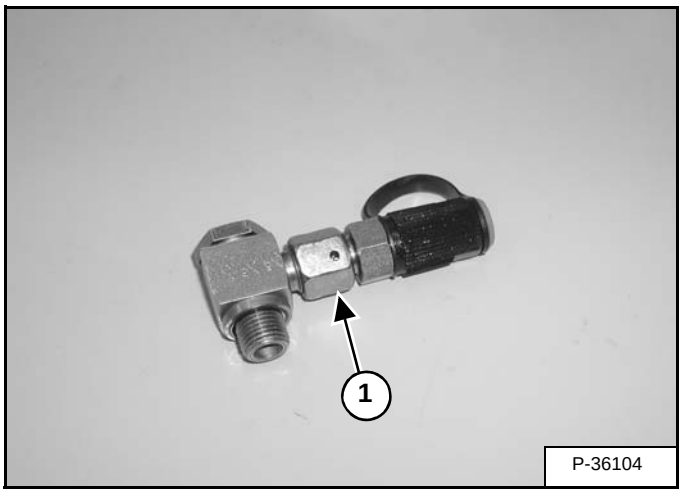
Install the bolt (Item 1) and seal carrier (Item 2) **[Figure 20-200-79]** in the fittings.

Figure 20-200-80



NOTE: Make sure the lip (Item 1) on the seal carrier fits in the groove (Item 2) [Figure 20-200-80] of the fitting.

Figure 20-200-81



Install the coupler (Item 1) **[Figure 20-200-81]** on the fitting.

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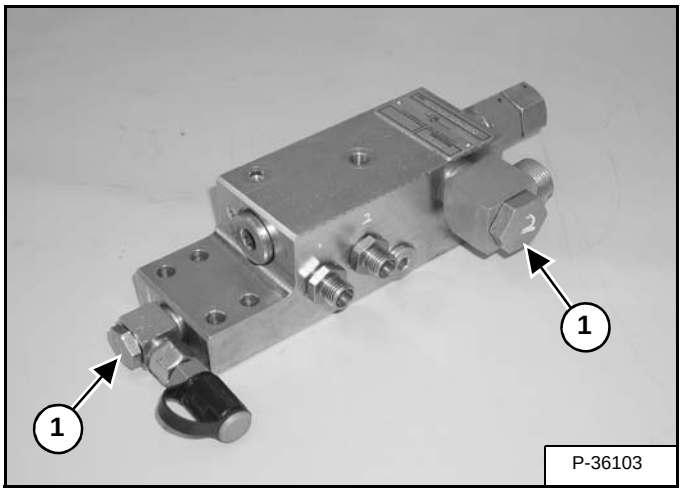
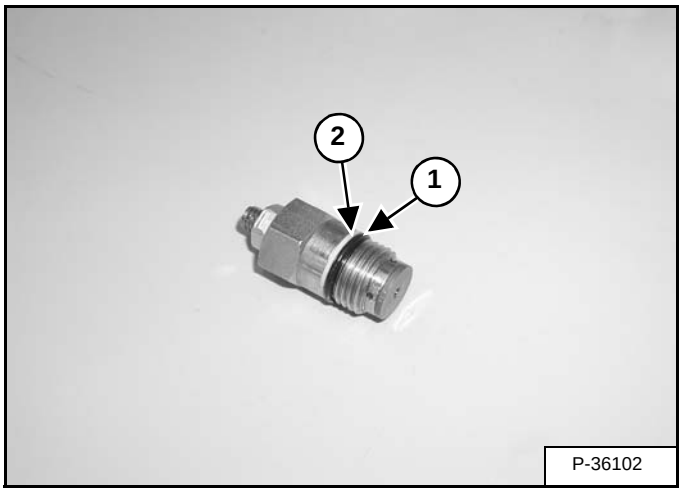
Assembly (Cont'd)

Figure 20-200-82



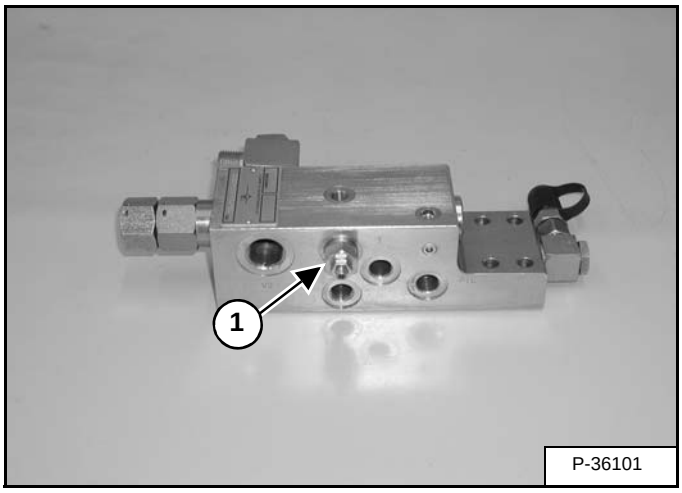
Install the fittings (Item 1) **[Figure 20-200-82]**.

Figure 20-200-83



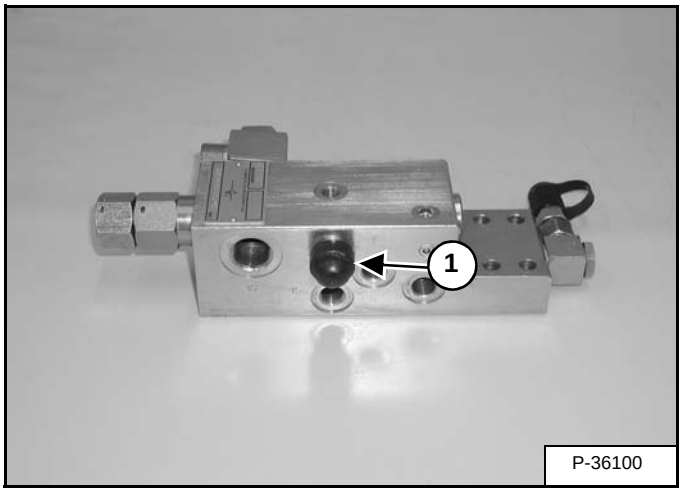
Install the O-ring (Item 1) and back-up ring (Item 2) **[Figure 20-200-83]** on the relief valve.

Figure 20-200-84



Install the relief valve (Item 1) **[Figure 20-200-84]** in the housing.

Figure 20-200-85



Install the cap (Item 1) **[Figure 20-200-85]** on the relief valve.

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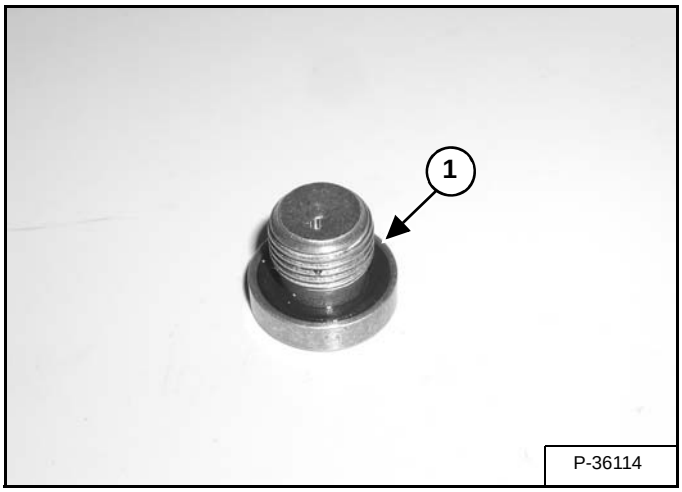
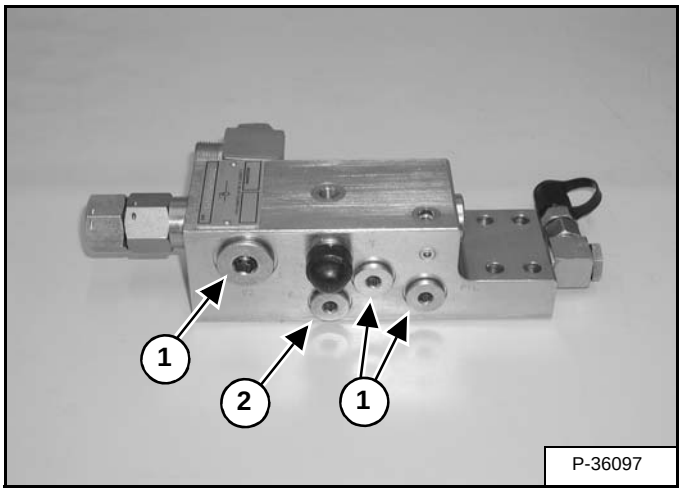
Assembly (Cont'd)

Figure 20-200-86



Install the O-ring (Item 1) **[Figure 20-200-86]** on the plugs. (Ported plug shown.)

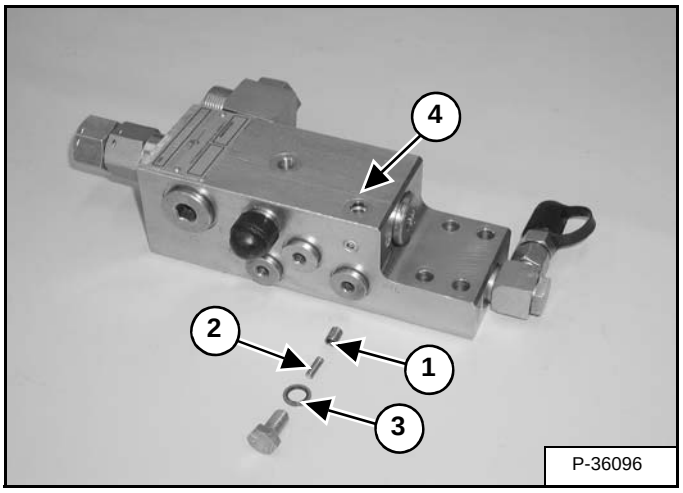
Figure 20-200-87



Install the 3 plugs (Item 1) and ported plug (Item 2) **[Figure 20-200-87]**.

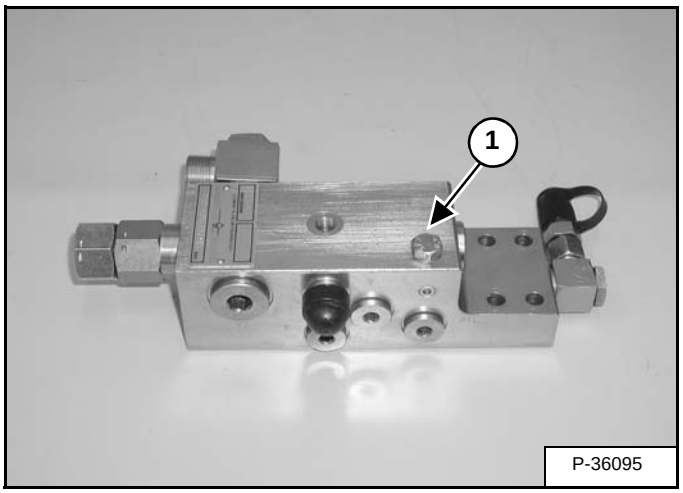
NOTE: Make sure the ported plug is installed in the port marked "E".

Figure 20-200-88



Install the poppet (Item 1), spring (Item 2) and washer (Item 3) into the port (Item 4) **[Figure 20-200-88]** in the housing.

Figure 20-200-89



Install the bolt (Item 1) **[Figure 20-200-89]**.

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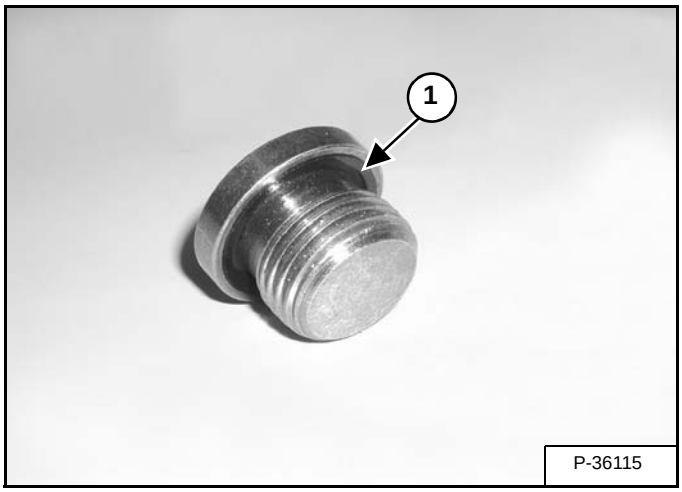
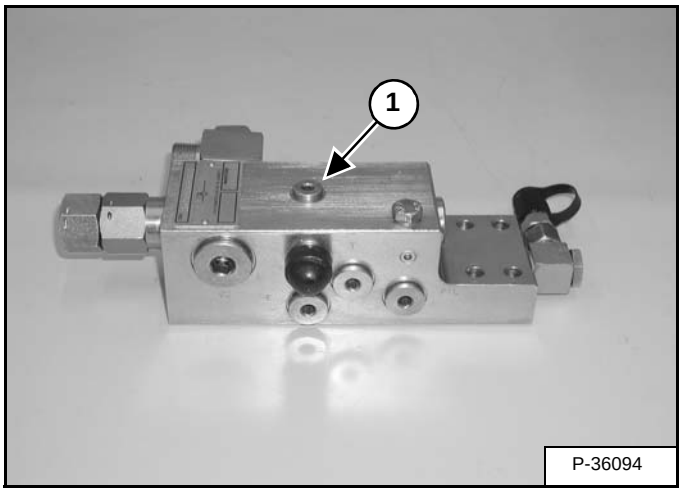
Assembly (Cont'd)

Figure 20-200-90



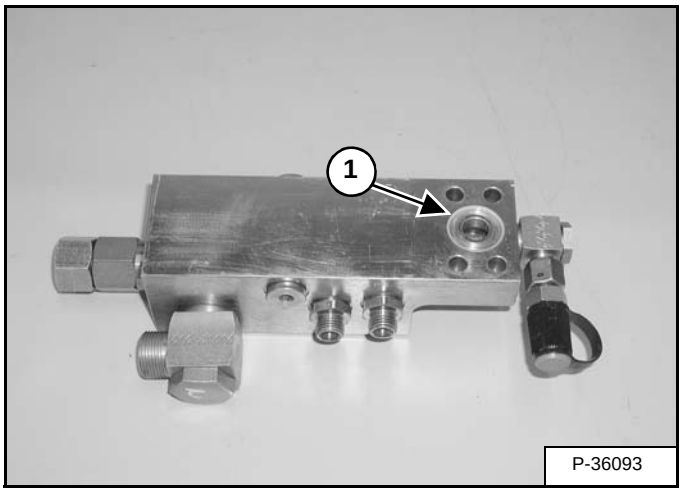
Install the O-ring (Item 1) **[Figure 20-200-90]** on the plug.

Figure 20-200-91



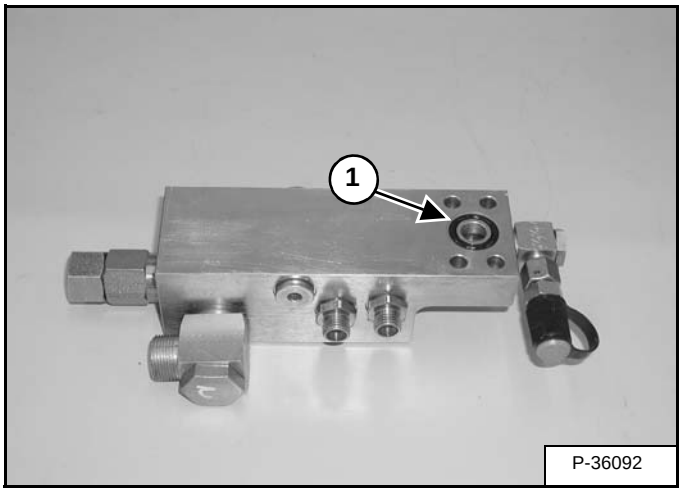
Install the plug (Item 1) **[Figure 20-200-91]** in the housing.

Figure 20-200-92



Install the back-up ring (Item 1) **[Figure 20-200-92]**.

Figure 20-200-93



Install the O-ring (Item 1) **[Figure 20-200-93]**.

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OIL TEMPERATURE REGULATOR

Description

The oil temperature regulator, when closed, diverts hydraulic oil from the oil cooler to the hydraulic tank. The regulator opens at 131° F (55° C) allowing oil to flow through the cooler then to tank.

Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

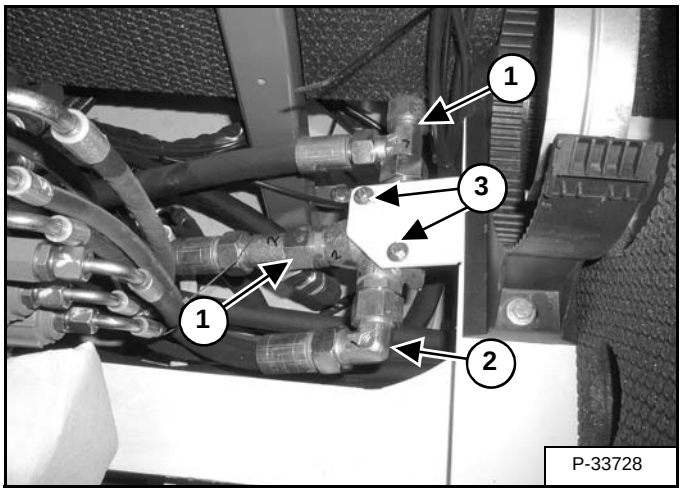
Remove the air cleaner. (See AIR CLEANER on Page 60-30-1.)

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 20-210-1



Remove the 2 tee fittings (Item 1) **[Figure 20-210-1]**.

Remove the hose (Item 2) **[Figure 20-210-1]**.

Remove the 2 bolts (Item 3) **[Figure 20-210-1]**.

Installation: Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

Remove the valve.

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AUXILIARY HYDRAULICS SELECTOR VALVE

Removal And Installation

The procedure is the same for both right and left auxiliary hydraulic selector valves. The left side is shown.

Place the bucket on 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

Stop the engine.

With the engine off, and the key in the run position, move the control levers to relieve hydraulic pressure.

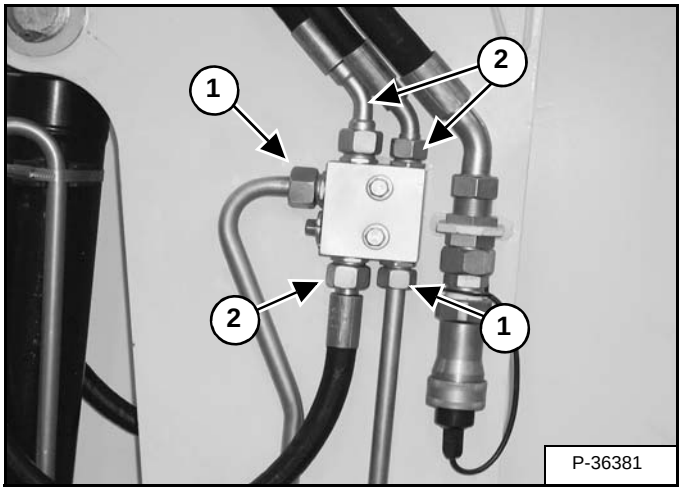
IMPORTANT

When making repairs on hydraulic system, clean the work area before disassemble 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-2056-0793

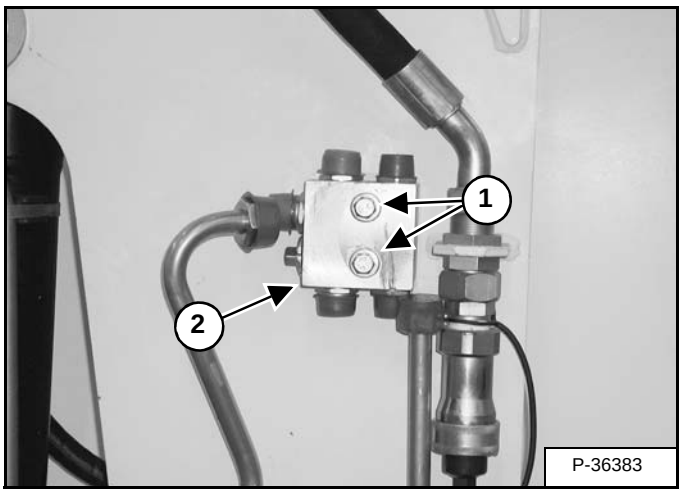
Mark the hoses and tubelines for correct installation.

Figure 20-220-2



Remove the tubelines (Item 1) and hoses (Item 2) **[Figure 20-220-2]**.

Figure 20-220-3



Remove the 2 bolts (Item 1) **[Figure 20-220-3]**.

Installation: Tighten the bolts to 29-37 ft.-lb. (40-50 N•m) torque.

Remove the auxiliary hydraulics selector valve (Item 2) **[Figure 20-220-3]**.

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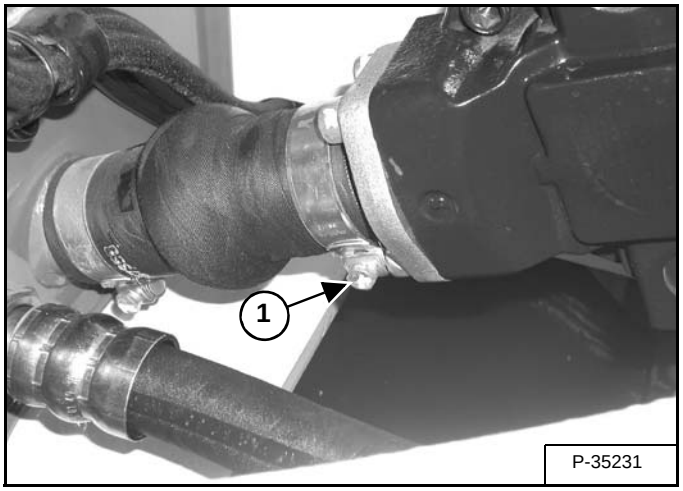
HYDRAULIC PISTON PUMP DRIVE COUPLER

Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

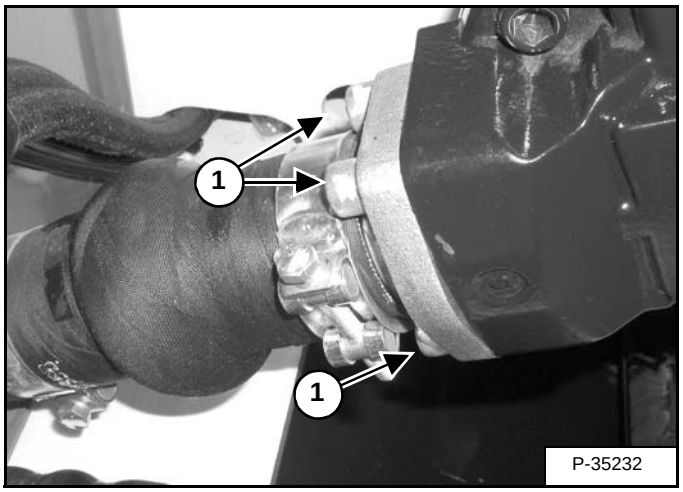
Remove the muffler. (See MUFFLER (S/N 522311001 & ABOVE) on Page 60-20-1 or See MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-21-1.)

Figure 20-230-4



Loosen the clamp (Item 1) **[Figure 20-230-4]**. Rotate the clamp to provide clearance to the suction fitting bolts.

Figure 20-230-5



Remove the 4 bolts (Item 1) **[Figure 20-230-5]**.

Figure 20-230-6

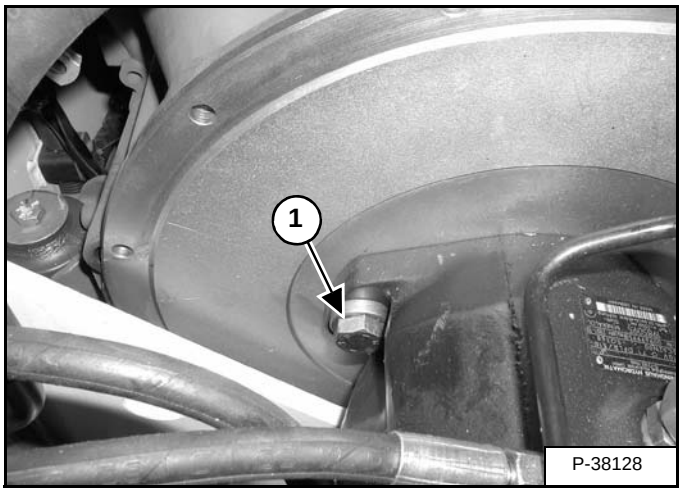
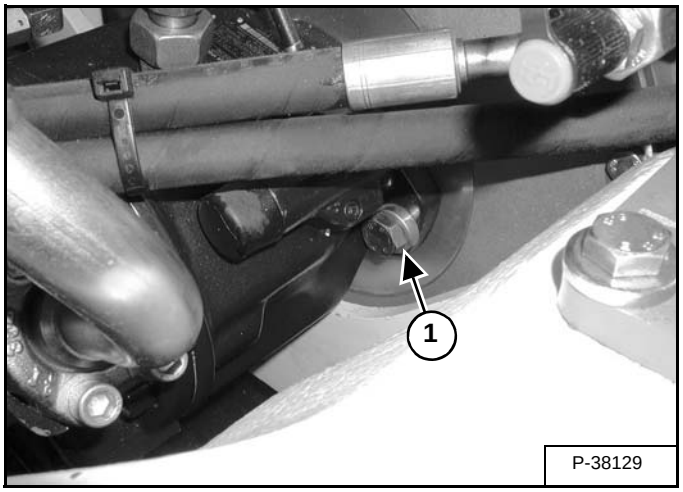


Figure 20-230-7



Remove the 2 pump mount bolts (Item 1) **[Figure 20-230-6]** & **[Figure 20-230-7]** and washers.

Installation: Tighten the bolts to 125-140 ft.-lb. (170-190 N•m) torque.

Slide the pump away from the engine.

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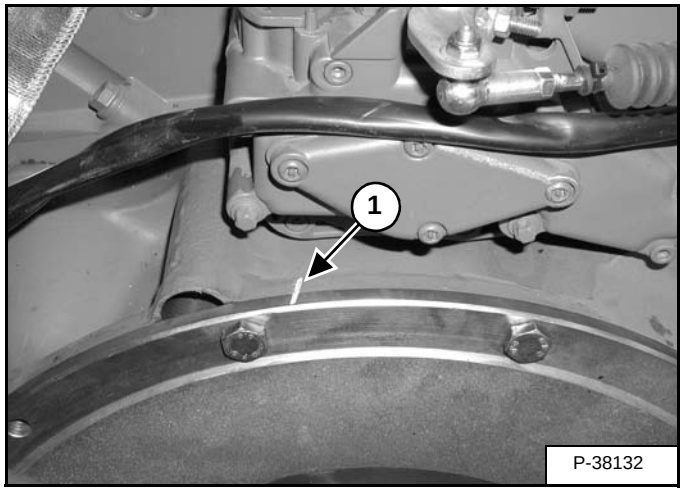
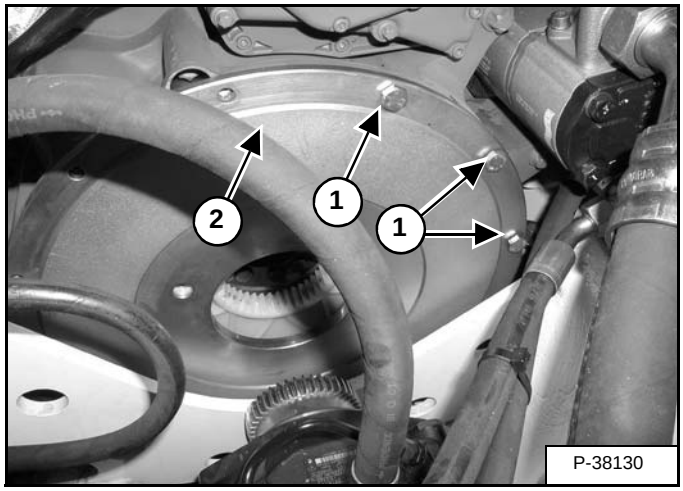
Removal And Installation (Cont'd)

Figure 20-230-8



Mark the flywheel cover to engine block (Item 1) **[Figure 20-230-8]** for ease of assembly.

Figure 20-230-9

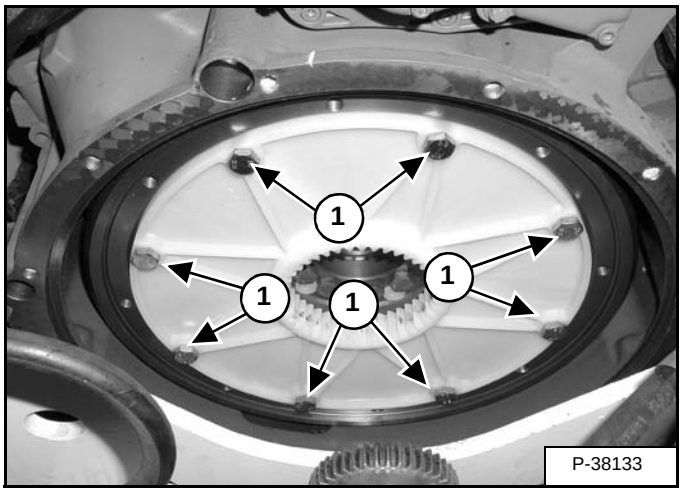


Remove the 9 remaining bolts (Item 1) **[Figure 20-230-9]**.

Installation: Apply a medium strength thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 29-37 ft.-lb. (40-50 N•m) torque.

Remove the cover (Item 2) **[Figure 20-230-9]**.

Figure 20-230-10



Remove the eight bolts (Item 1) **[Figure 20-230-10]**.

Installation: Apply a medium strength thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 29-37 ft.-lb. (40-50 N•m) torque.

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UNDERCARRIAGE

BLADE. 30-10-1
Removal And Installation 30-10-1

GREASE CYLINDER 30-70-1
Assembly 30-70-3
Disassembly. 30-70-2
Parts Identification 30-70-1

LOWER TRACK ROLLER. 30-60-1
Assembly 30-60-5
Disassembly. 30-60-2
Parts Identification 30-60-1

TRACK DAMAGE IDENTIFICATION 30-80-1
Abrasion Of Embedded Metals 30-80-2
Abrasion Of The Track Roller Side 30-80-9
Cracks And Cuts On The Lug Side Rubber. 30-80-8
Cracks On The Lug Side Rubber Due To Fatigue 30-80-6
Cuts On The Edges Of Track Roller Side 30-80-10
Cuts On The Lug Side Rubber. 30-80-5
Cutting Of Steel Cords 30-80-1
Lug Abrasion 30-80-7
Separation Of Embedded Metals. 30-80-3
Separation Of Embedded Metals Due To Corrosion 30-80-4

TRACK FRAME. 30-30-1
Disassembly And Assembly. 30-30-1
Drive Sprocket Removal And Installation. 30-30-5

TRACK IDLER. 30-40-1
Assembly 30-40-5
Disassembly. 30-40-2
Parts Identification 30-40-1

TRACKS 30-20-1
Rubber Track Clearance 30-20-2
Rubber Track Removal And Installation. 30-20-6
Steel Track Clearance 30-20-3
Track Adjustment 30-20-4
Track Lug Height 30-20-1

UPPER TRACK ROLLER 30-50-1
Assembly 30-50-4
Disassembly. 30-50-2
Parts Identification 30-50-1

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BLADE

Removal And Installation

Lower the blade to the ground.

Remove the blade cylinders. (See BLADE CYLINDER on Page 20-24-1.)

Figure 30-10-1

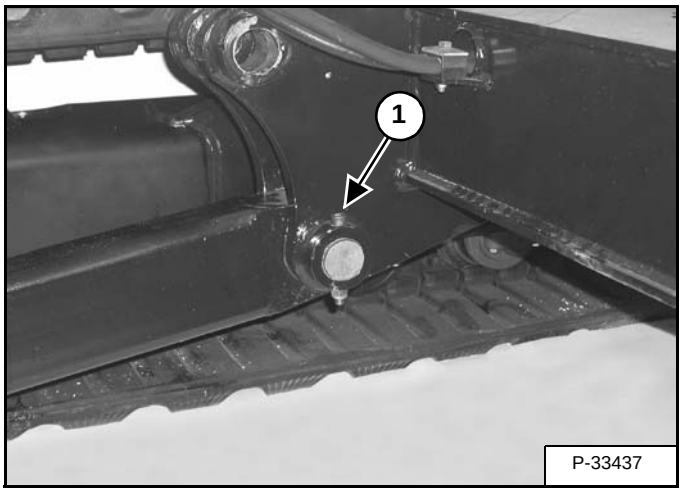
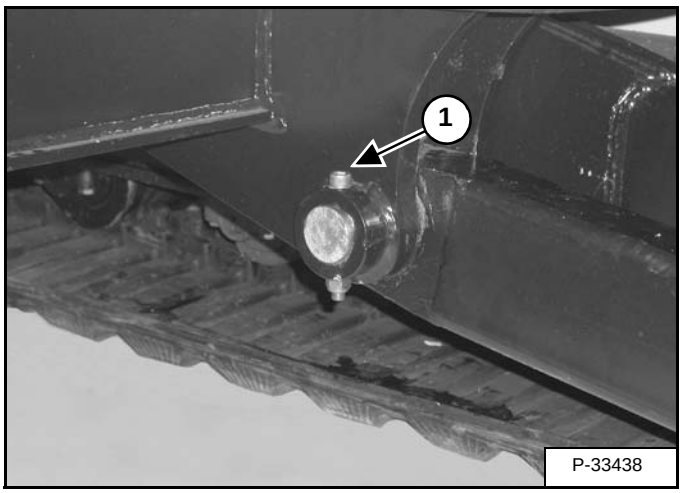


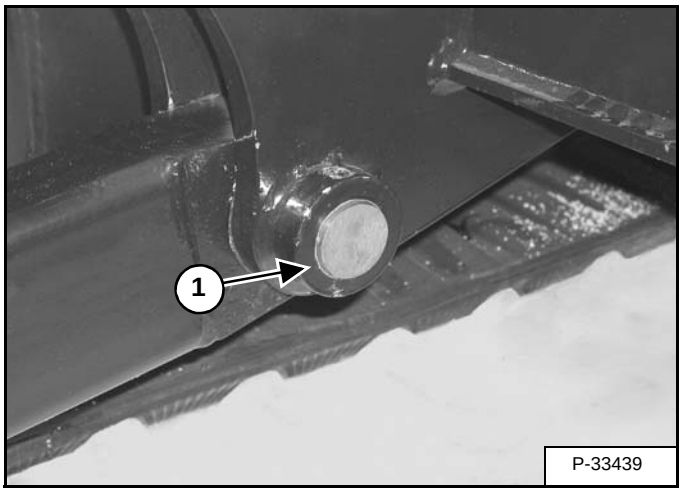
Figure 30-10-2



Remove the right and left pivot pin retaining nut and bolt (Item 1) **[Figure 30-10-1]** & **[Figure 30-10-2]**.

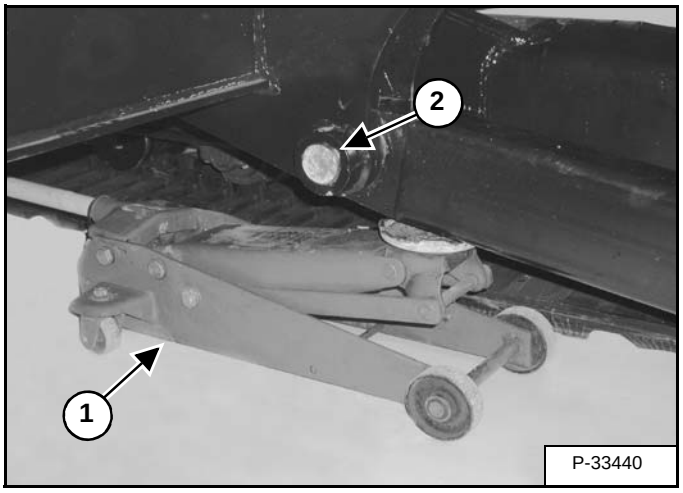
Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 30-10-3



Remove the right pivot pin (Item 1) **[Figure 30-10-3]**.

Figure 30-10-4



Place a hydraulic jack (Item 1) **[Figure 30-10-4]** under the left arm of the blade.

Remove the pivot pin (Item 2) **[Figure 30-10-4]**.

⚠ 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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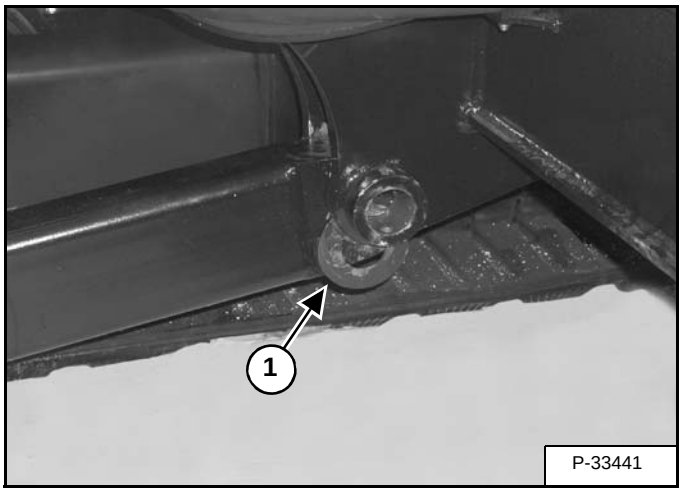
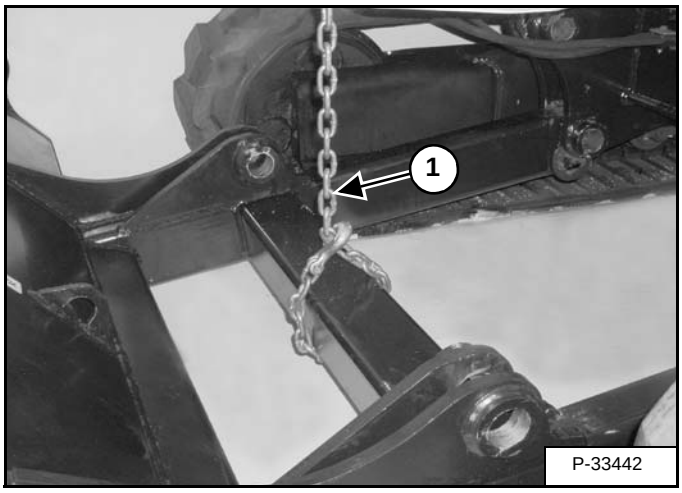
Removal And Installation (Cont'd)

Figure 30-10-5



Lower the jack and remove the shims (Item 1) **[Figure 30-10-5]** from both sides on both of the blade arms.

Figure 30-10-6



Install a chain hoist (Item 1) **[Figure 30-10-6]** in the center of the blade crossmember.

Lift and remove the blade.

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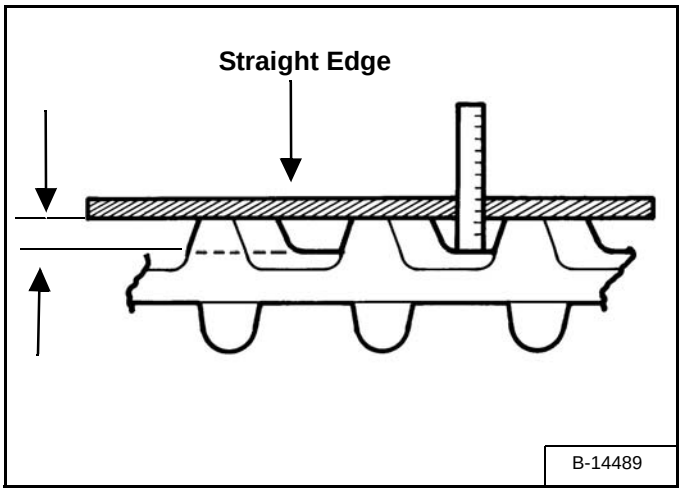
Track Lug Height

Rubber Track

The lug height of a new rubber track is 1.1406 inch (29,0 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 0.9125 inch (23,18 mm)

$$\frac{0.9125}{1.1406} \times 100 = 80$$

80% of the track lug is remaining with 20% wear on the track lugs.

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Rubber Track Clearance

NOTE: The wear of the pins and bushings on the undercarriage vary with the working conditions and the different types of soil conditions. It is necessary to inspect track tension and maintain the correct tension. (See SERVICE SCHEDULE on Page 10-50-1 for the correct service interval)

NOTE: On new excavators or on excavators with new rubber tracks installed, check and adjust as needed the rubber track clearance two to three times on the first day of operation.

Raise one side of the machine (approximately four inches) using the boom and arm.

Figure 30-20-2

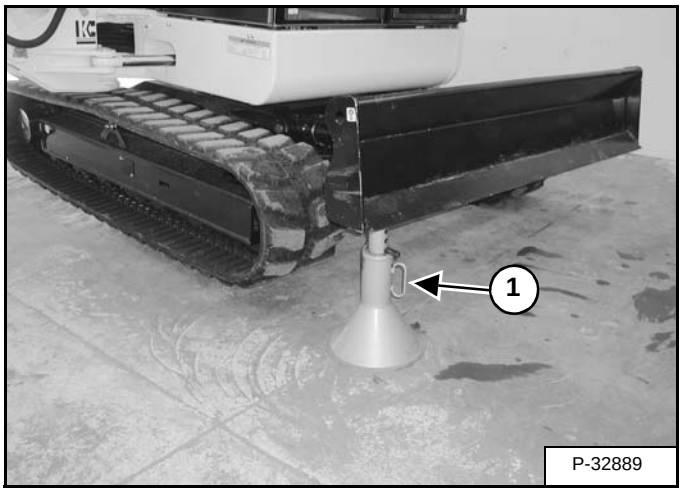
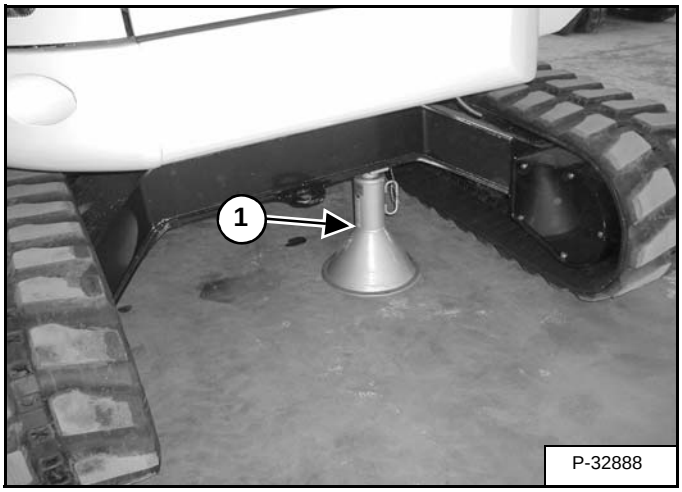


Figure 30-20-3



Raise the blade fully and install jack stands (Item 1) **[Figure 30-20-2]** & **[Figure 30-20-3]** under the blade and track frame. Lower the boom until all machine weight is on the jack stands.

Stop the engine

⚠ WARNING

AVOID INJURY OR DEATH

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

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Rubber Track Clearance (Cont'd)

Figure 30-20-4

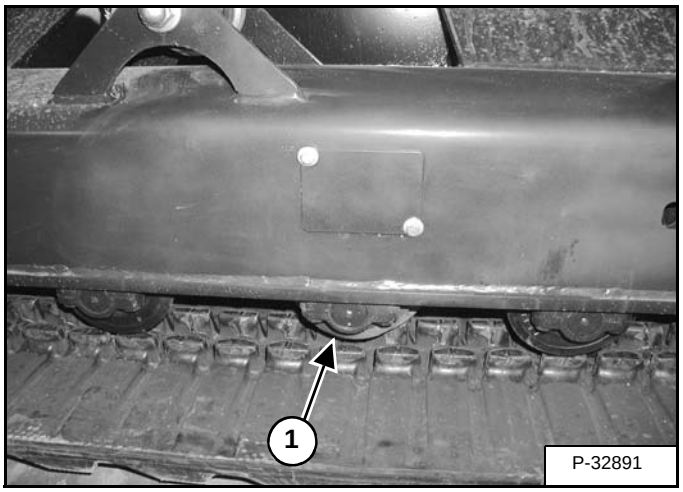
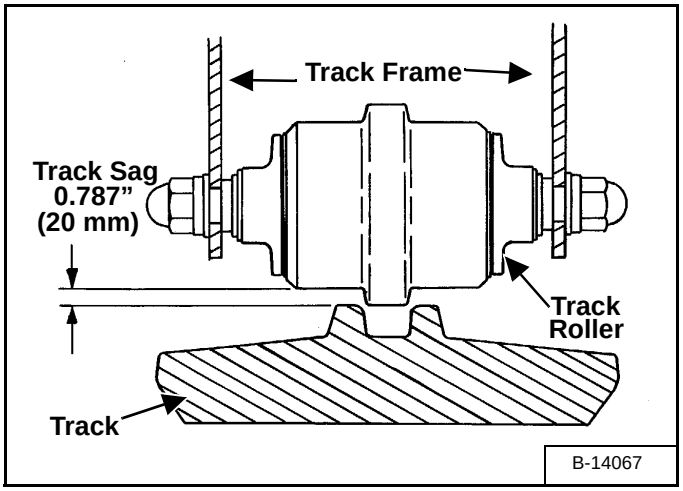


Figure 30-20-5



Measure the track sag at the third roller (Item 1) **[Figure 30-20-4]** from the front of the track frame. Do not get fingers in pinch points between the track and track roller. Use a bolt or dowel of the appropriate size to check the gap between the amount contact edge of the roller and the top edge of the track guide lug **[Figure 30-20-5]**.

Rubber track clearance 0.787 inches (20 mm).

⚠ WARNING

AVOID INJURY

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

W-2142-0189

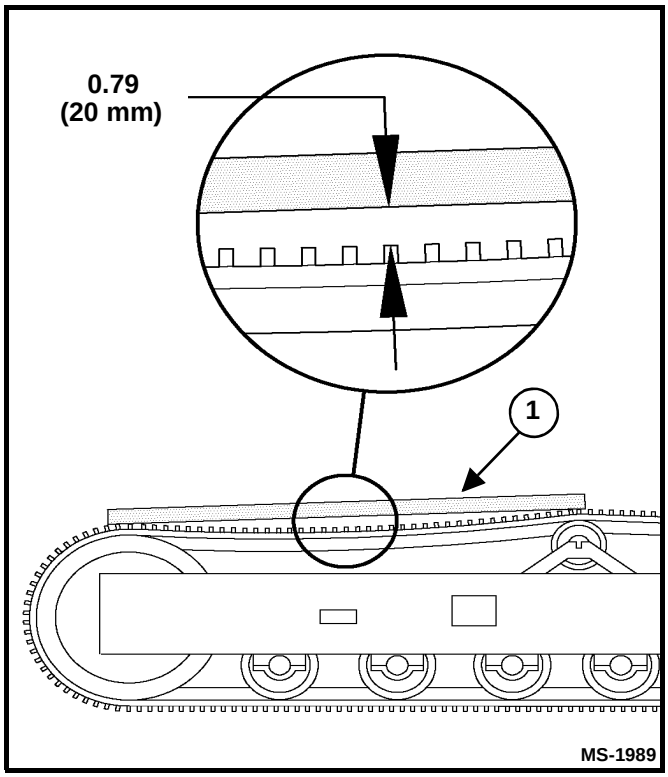
Steel Track Clearance

NOTE: The wear of the pins and bushings on the undercarriage vary with the working conditions and the different types of soil conditions. It is necessary to inspect track tension and maintain the correct tension. (See SERVICE SCHEDULE on Page 10-50-1 for the correct service interval.).

NOTE: On new excavators or on excavators with new steel tracks installed, check and adjust as needed the steel track clearance two to three times on the first day of operation.

Park the excavator on a flat and level surface.

Figure 30-20-6



Put a straight edge (Item 1) on the top of the track surface between the rear sprocket and the top idler wheel. Measure between the top of the track and the bottom of the straight edge **[Figure 30-20-6]**.

Steel track clearance 0.79 inches (20 mm).

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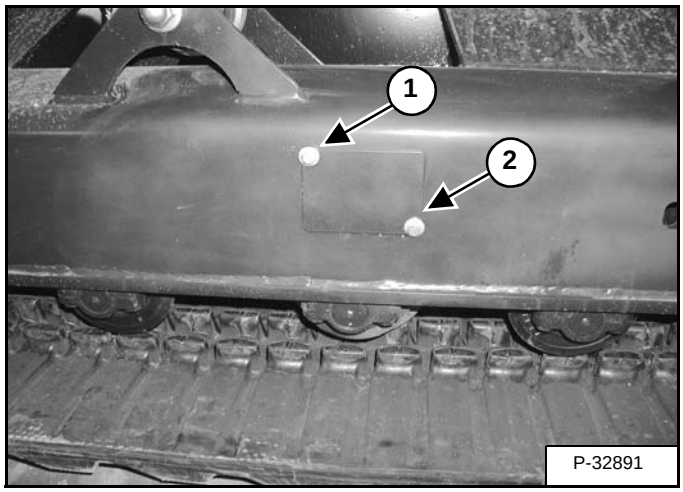
Track Adjustment

Figure 30-20-7

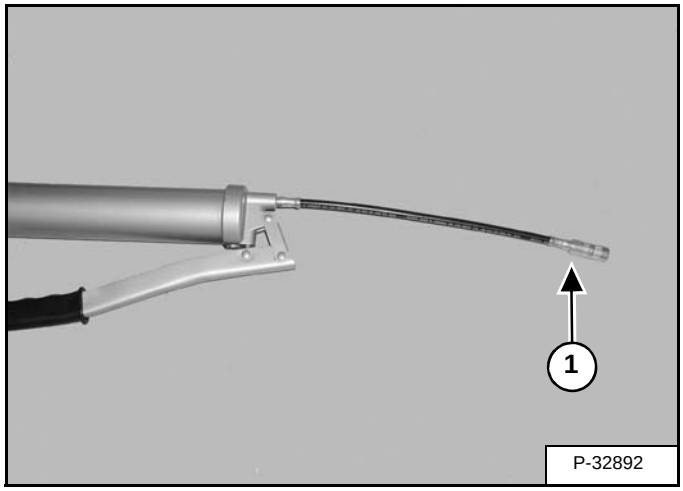


Loosen the top bolt (Item 1) **[Figure 30-20-7]**.

Remove the bottom bolt and washer (Item 2) **[Figure 30-20-7]**.

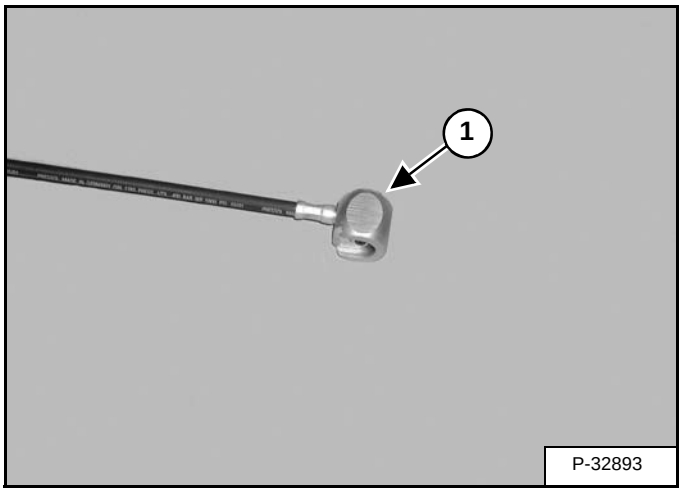
Pivot the cover out of the way.

Figure 30-20-8



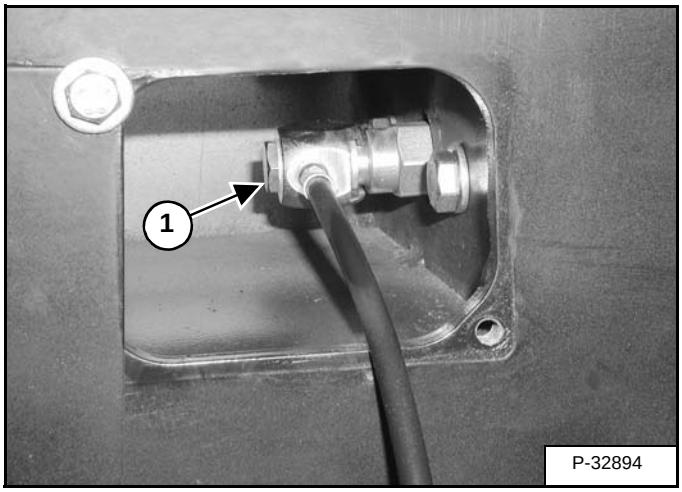
Remove the grease fitting adapter (Item 1) **[Figure 30-20-8]** from the end of a grease gun.

Figure 30-20-9



Install the track tensioning adapter (Item 1) **[Figure 30-20-9]** on the end of a grease gun.

Figure 30-20-10



Install the adapter (Item 1) **[Figure 30-20-10]** on the track tensioner.

⚠ 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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Track Adjustment (Cont'd)

Figure 30-20-11

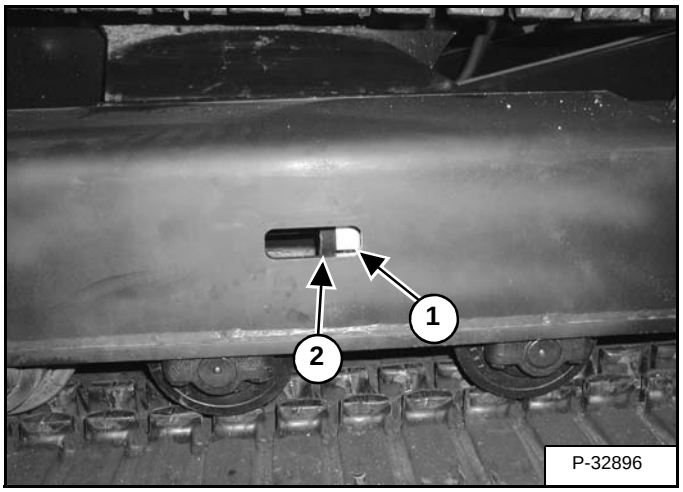
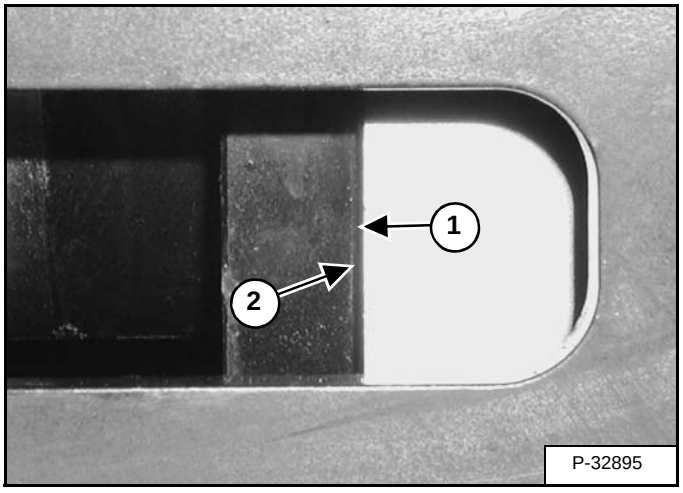
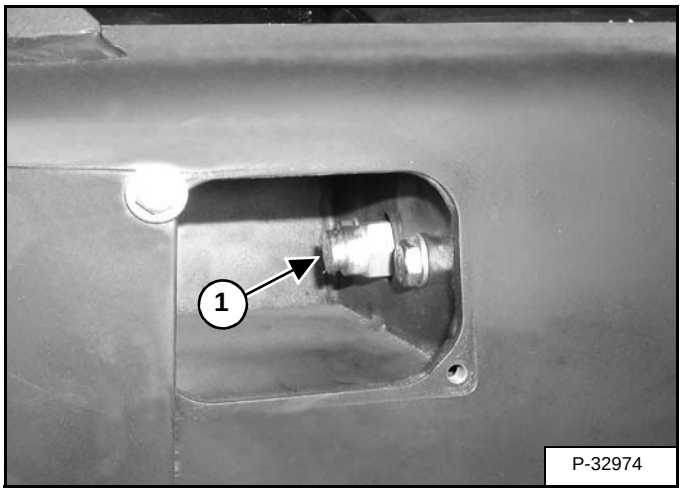


Figure 30-20-12



Add grease to the track tensioner until the track tension indicator (Item 1) **[Figure 30-20-11]** & **[Figure 30-20-12]** is flush with the cylinder edge (Item 2) **[Figure 30-20-11]** & **[Figure 30-20-12]**.

Figure 30-20-13



To release track tension, loosen the tensioner (Item 1) **[Figure 30-20-13]**. Do not remove the tensioner.

After track tension has been released, remove all grease from the tensioner area.

Repeat the procedure for the other track.

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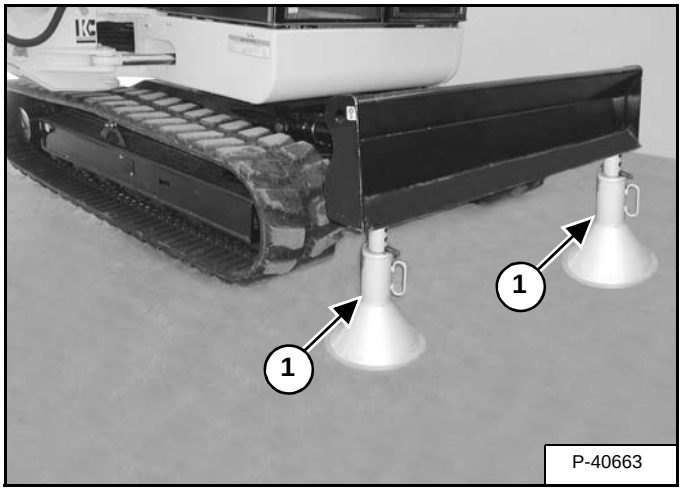
Rubber Track Removal And Installation

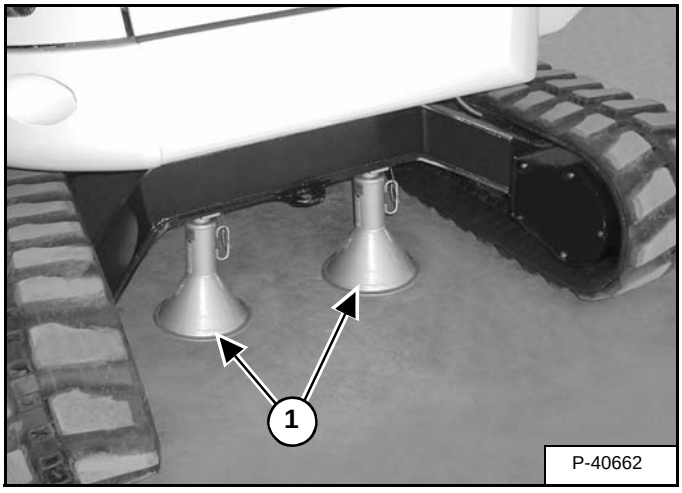
Fully raise the blade.

Figure 30-20-14



Use the boom and arm to lift the blade end of the machine and install jack stands (Item 1) **[Figure 30-20-14]** under the blade.

Figure 30-20-15



Swing the upperstructure 180× and use the boom and arm to lift the opposite end of the track frame and install jack stands (Item 1) **[Figure 30-20-15]** under the frame.

⚠ WARNING

Put jack stands 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.

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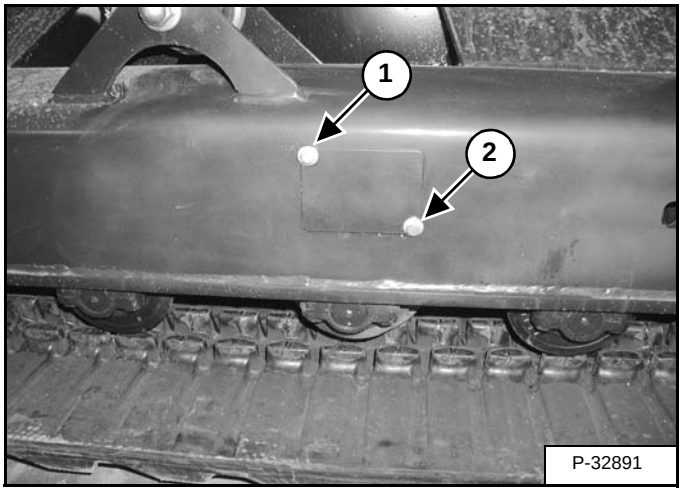
Stop the engine and exit the excavator.

Figure 30-20-16



Loosen the top bolt (Item 1) **[Figure 30-20-16]**.

Remove the bottom bolt and washer (Item 2) **[Figure 30-20-16]**.

Pivot the cover out of the way.

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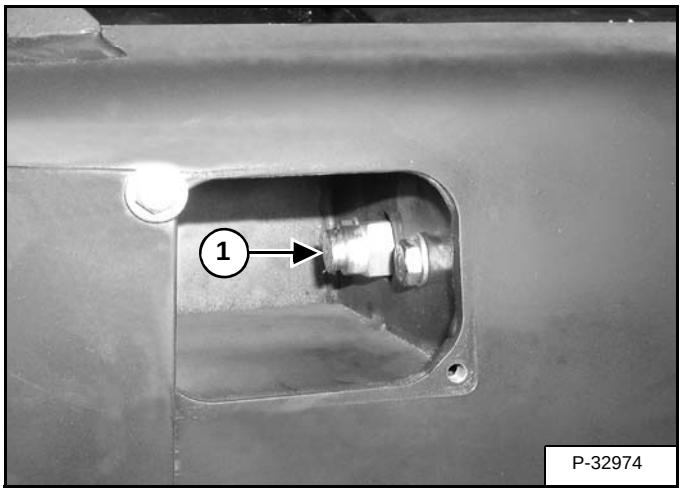
Rubber Track Removal And Installation (Cont'd)

Figure 30-20-17



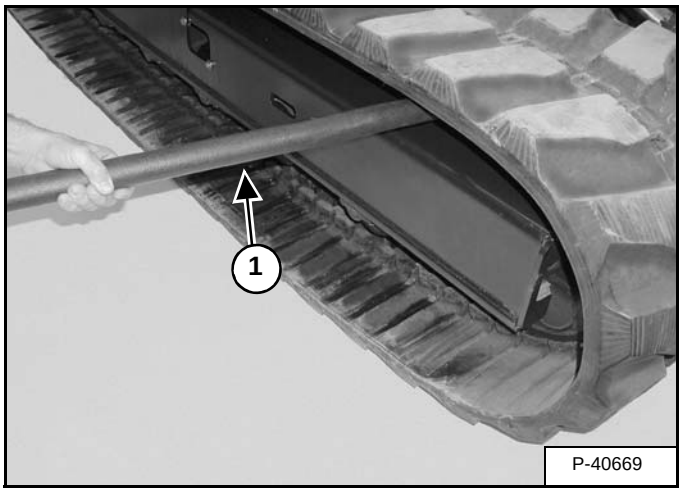
To release track tension, loosen the tensioner (Item 1) **[Figure 30-20-17]**. Do not remove the tensioner.

After track tension has been released, remove all grease from the tensioner area.

Start the engine.

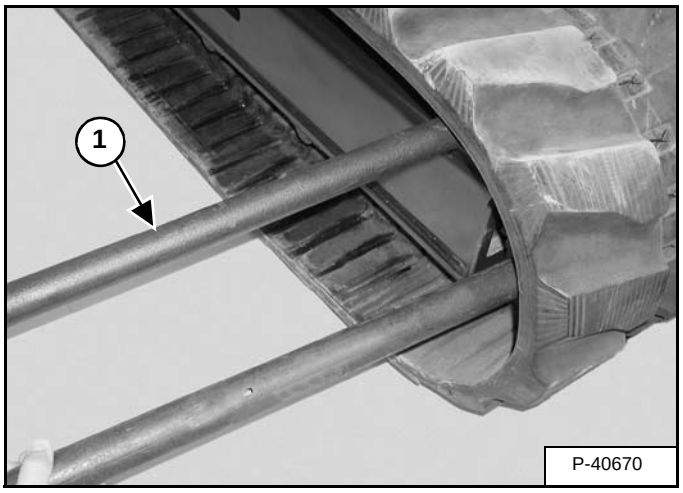
Slowly turn the track in the forward direction.

Figure 30-20-18



Insert a steel rod or pipe (Item 1) **[Figure 30-20-18]** (approximately 1.750 inch [44.5 mm] diameter) between the track and track frame.

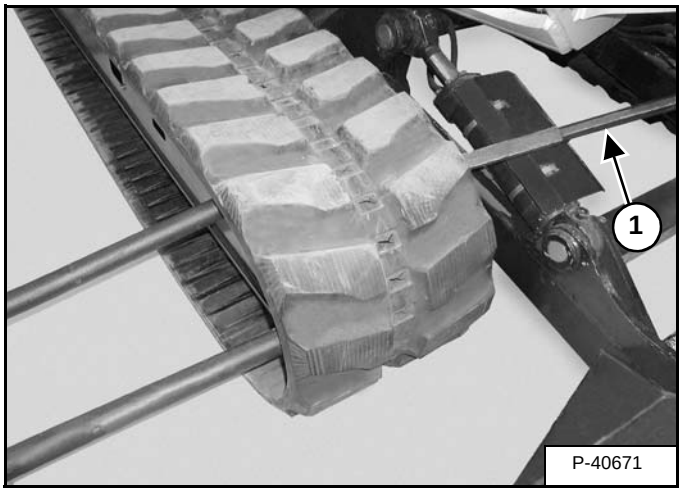
Figure 30-20-19



Insert a second steel rod or pipe (Item 1) **[Figure 30-20-19]**, at a distance of two lugs, between the track and the idler wheel. Continue to turn the track until the first pipe contacts the track frame.

Stop the engine.

Figure 30-20-20



Insert a pry bar (Item 1) **[Figure 30-20-20]** between the track and the idler wheel and pry out on the track until the track slides off the idler wheel.

Remove both steel rods.

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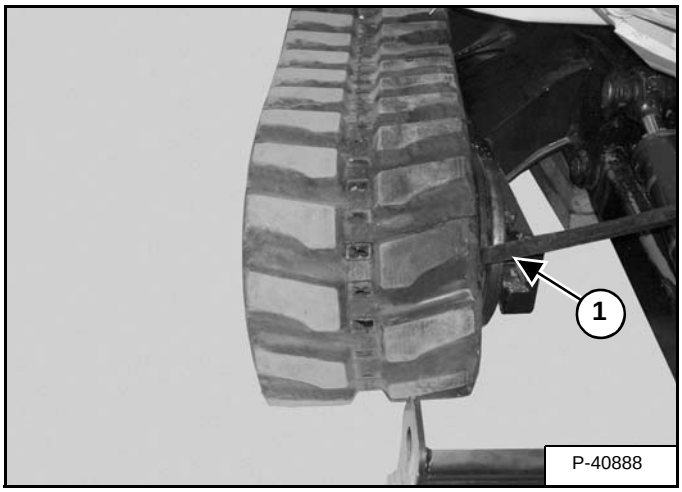
Rubber Track Removal And Installation (Cont'd)

Figure 30-20-21



Pry the track off of the track frame **[Figure 30-20-21]**.

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 Track Adjustment for adding grease to the grease spring and for checking track tension. (See Track Adjustment on Page 30-20-4)

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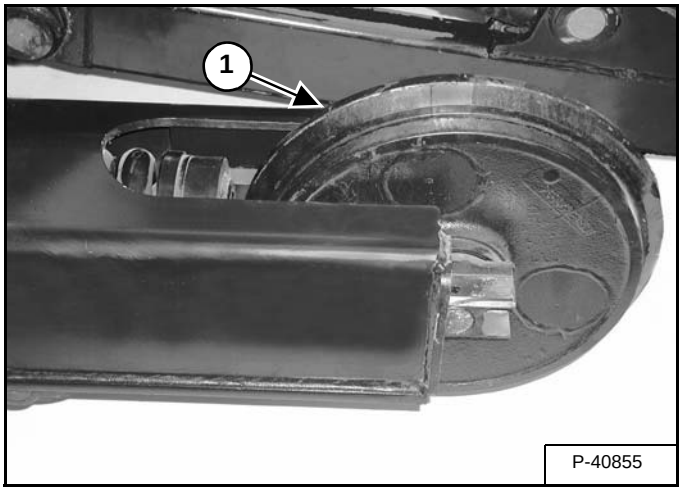
Disassembly And Assembly

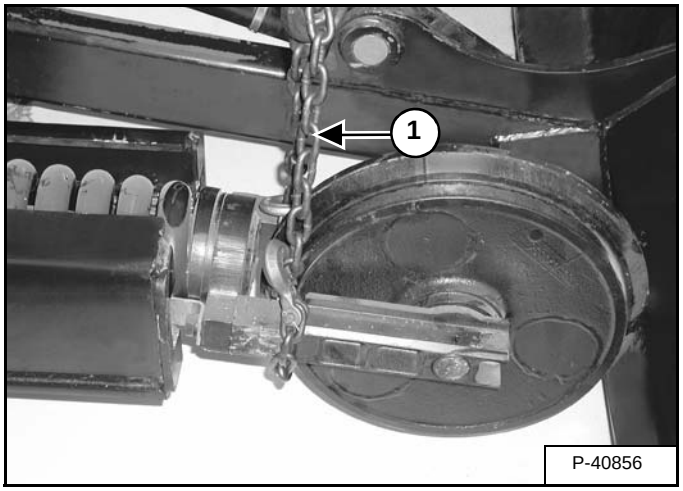
Remove the track. (See Rubber Track Removal And Installation on Page 30-20-6.)

Figure 30-30-1



Slide the idler (Item 1) **[Figure 30-30-1]** towards the front of the track frame.

Figure 30-30-2



Install a lifting chain (Item 1) **[Figure 30-30-2]** and hoist on the idler assembly.

DO NOT DISASSEMBLE OR REPAIR THE COIL SPRING ASSEMBLY (Item 3) **[Figure 30-30-3]**.

⚠ WARNING

P-62574

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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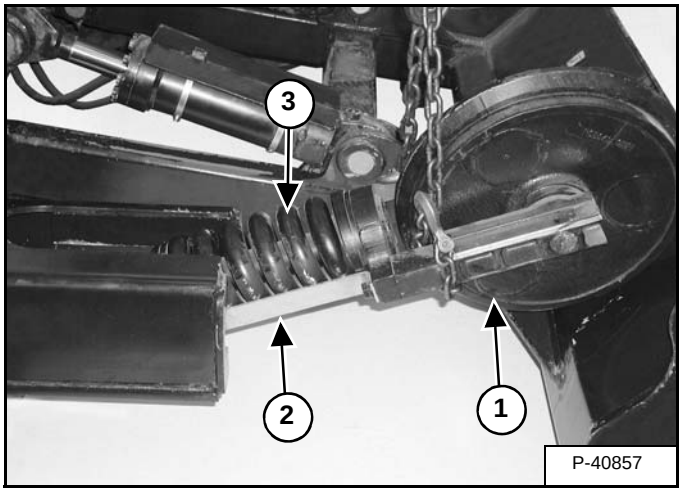
Figure 30-30-3



Raise the hoist and remove the idler assembly (Item 1) **[Figure 30-30-3]**.

Assembly: Install the idler assembly with the track tension guide (Item 2) **[Figure 30-30-3]** towards the outside of the track frame.

(See TRACK IDLER on Page 30-40-1.)

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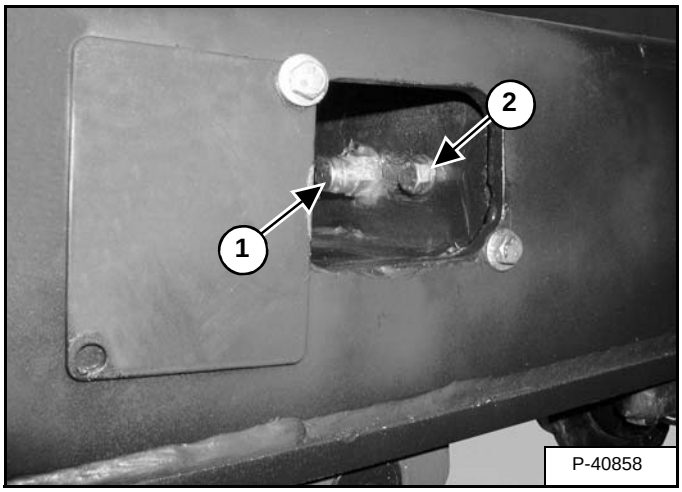
Disassembly And Assembly (Cont'd)

Figure 30-30-4

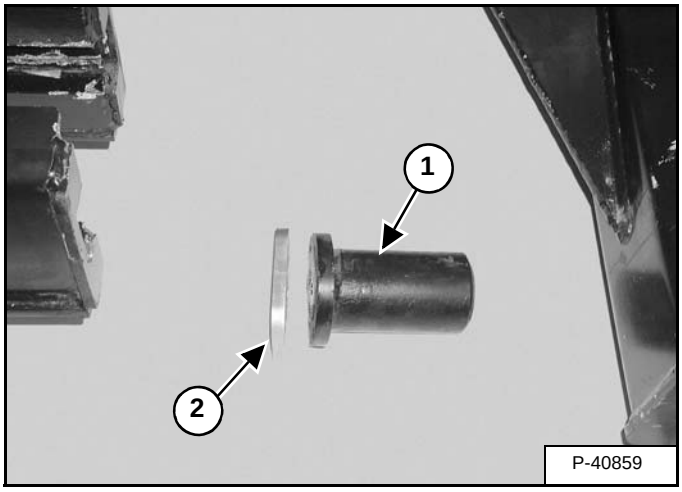


Remove the track tension fitting (Item 1) **[Figure 30-30-4]**.

Remove the two bolts (Item 2) **[Figure 30-30-4]**.

Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 30-30-5



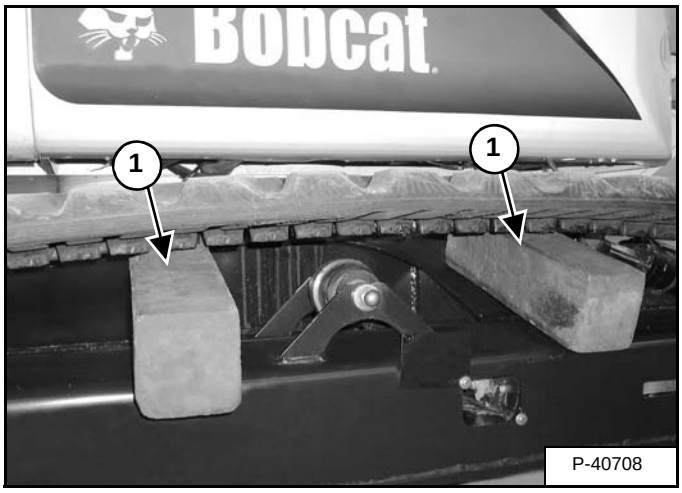
Remove the grease cylinder (Item 1) and plate (Item 2) **[Figure 30-30-5]**.

See Grease Cylinder Disassembly And Assembly. (See GREASE CYLINDER on Page 30-70-1)

NOTE: The track does not need to be removed to remove and install the top or bottom rollers.

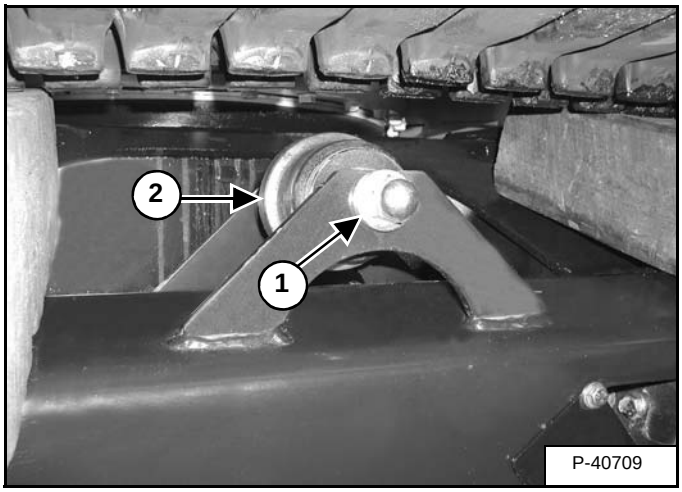
If the track is installed, lift and block the excavator and relieve track tension. (See Track Adjustment on Page 30-20-4.)

Figure 30-30-6



Use wood blocks (Item 1) **[Figure 30-30-6]** to support the track.

Figure 30-30-7



Remove the nut (Item 1) **[Figure 30-30-7]** and washer from both sides of the roller.

Installation: Tighten the nut to 125-140 ft.-lb. (170-190 N•m) torque.

Remove the roller (Item 2) **[Figure 30-30-7]**.

See Upper Roller Disassembly And Assembly. (See UPPER TRACK ROLLER on Page 30-50-1.)

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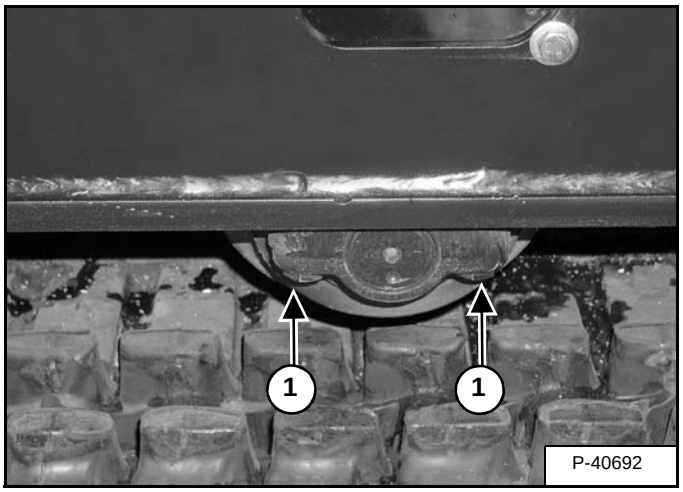
Disassembly And Assembly (Cont'd)

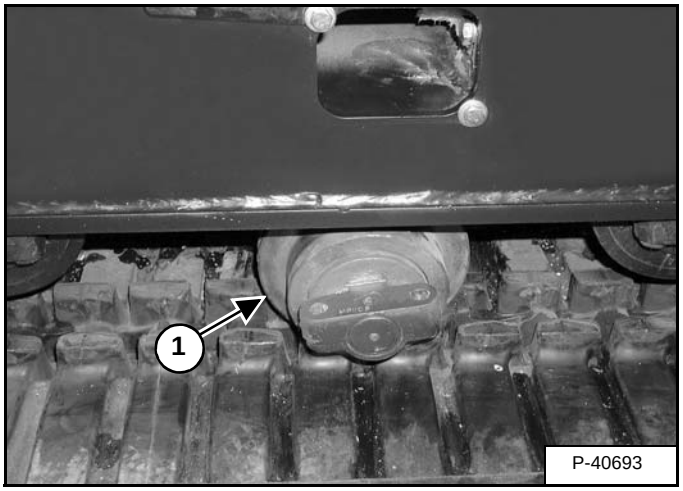
Figure 30-30-8



Remove the four bolts (Item 1) **[Figure 30-30-8]**.

Installation: Apply thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 48-55 ft.-lbs (65-75 N•m) torque.

Figure 30-30-9



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

See Lower Roller Disassembly And Assembly. (See LOWER TRACK ROLLER on Page 30-60-1.)

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Disassembly And Assembly (Cont'd)

DO NOT DISASSEMBLE OR REPAIR THE COIL SPRING ASSEMBLY (Item 2) [Figure 30-30-10].

⚠ WARNING

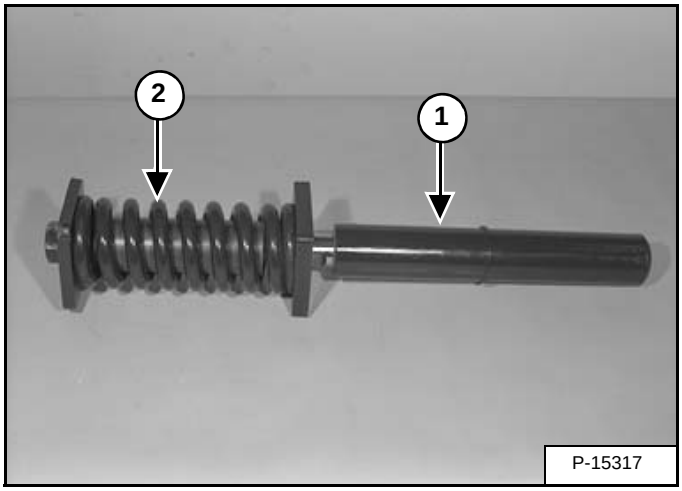
P-62574

AVOID INJURY OR DEATH

- **Spring loaded components under pressure can cause serious injury or death.**
- **Do not disassemble the coil spring assembly.**

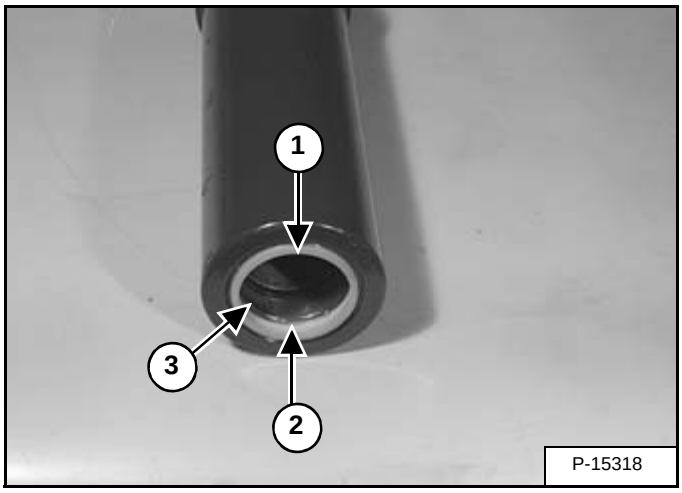
W-2617-1004

Figure 30-30-10



Remove the cylinder (Item 1) from the coil spring assembly (Item 2) **[Figure 30-30-10]**.

Figure 30-30-11



Remove the seal (Item 1), back-up ring (Item 2) and O-ring (Item 3) **[Figure 30-30-11]** from the cylinder.

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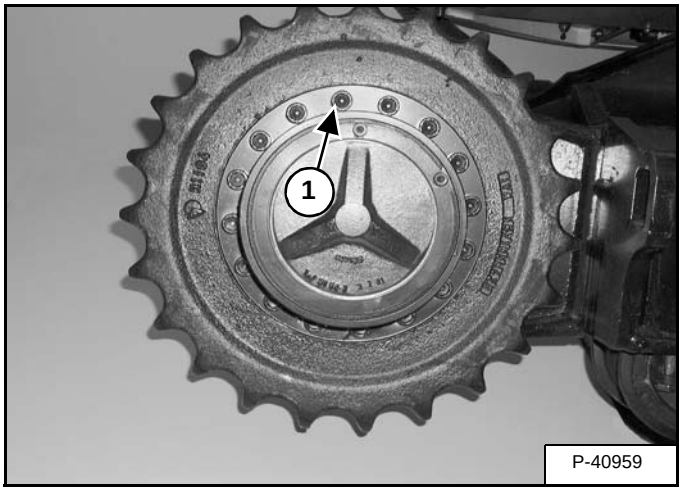
Drive Sprocket Removal And Installation

Remove the track. (See Rubber Track Removal And Installation on Page 30-20-6.)

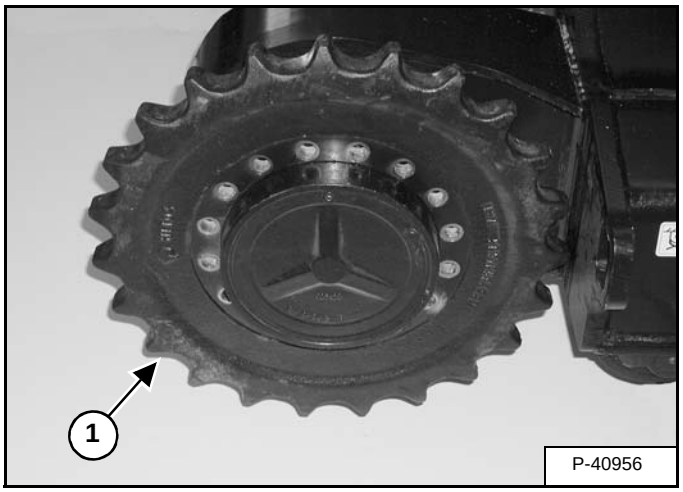
Figure 30-30-12



Remove the sixteen bolts (Item 1) **[Figure 30-30-12]**.

Installation: Apply thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 177-203 ft.-lb. (240-275 N•m) torque.

Figure 30-30-13



Remove the drive sprocket (Item 1) **[Figure 30-30-13]**.

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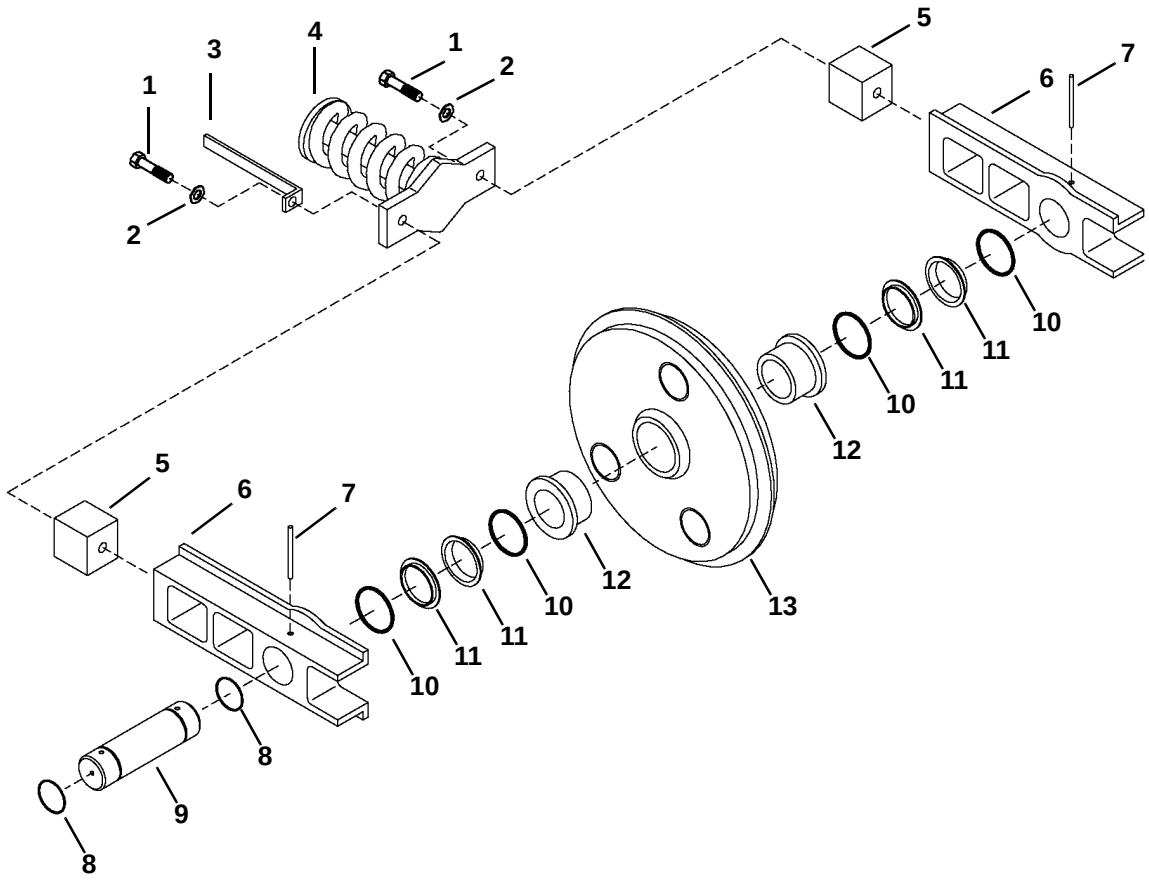
TRACK IDLER

Parts Identification

1. Bolt
2. Washer
3. Track Tension Guide
4. Recoil Spring Assembly
5. Block
6. Mount
7. Roll Pin
8. O-Ring
9. Shaft
10. O-Ring
11. Seal
12. Bushing
13. Idler Wheel



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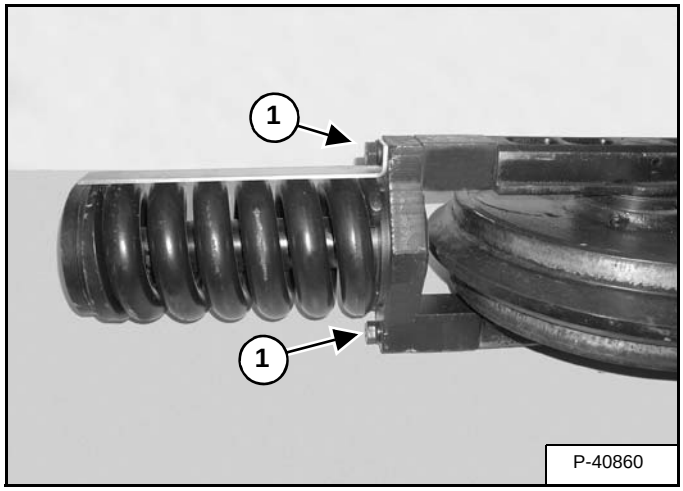
Disassembly

Mark the recoil spring to idler for correct assembly.

Figure 30-40-1



Loosen the two bolts (Item 1) **[Figure 30-40-1]**.

DO NOT DISASSEMBLE OR REPAIR THE COIL SPRING ASSEMBLY (ITEM 1) [Figure 30-40-2].

WARNING

P-62574

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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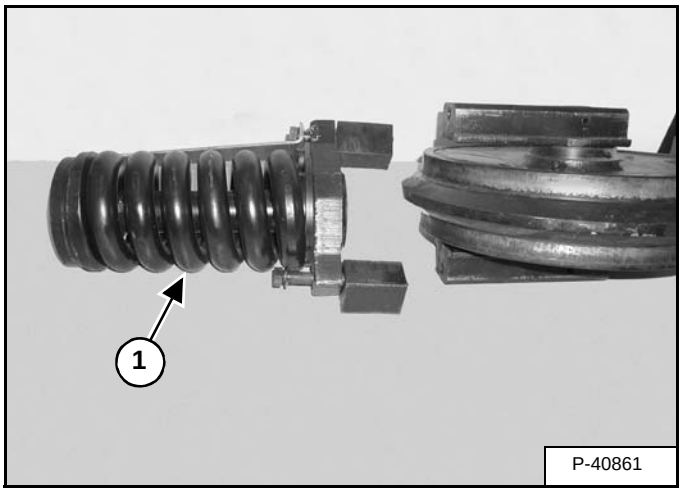
Figure 30-40-2



Remove the recoil spring assembly (Item 1) **[Figure 30-40-2]**.

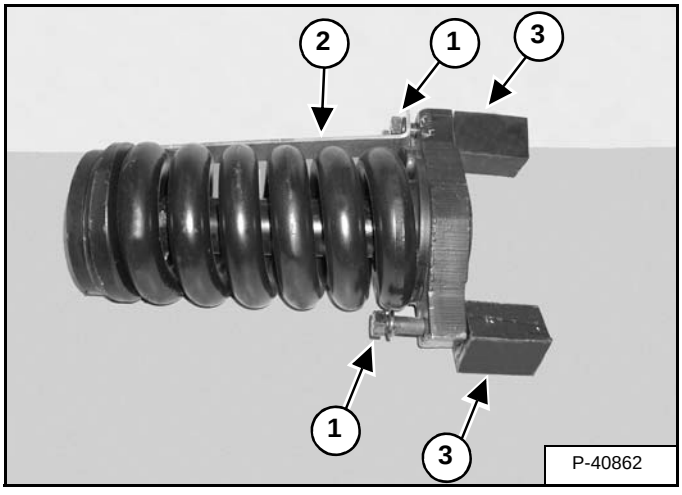
WARNING

AVOID INJURY OR DEATH

- **Spring loaded components under pressure can cause serious injury or death.**
- **Do not disassemble the coil spring assembly.**

W-2617-1004

Figure 30-40-3



Remove the bolts and washers (Item 1) track tension guide (Item 2) and blocks (Item 3) **[Figure 30-40-3]**.

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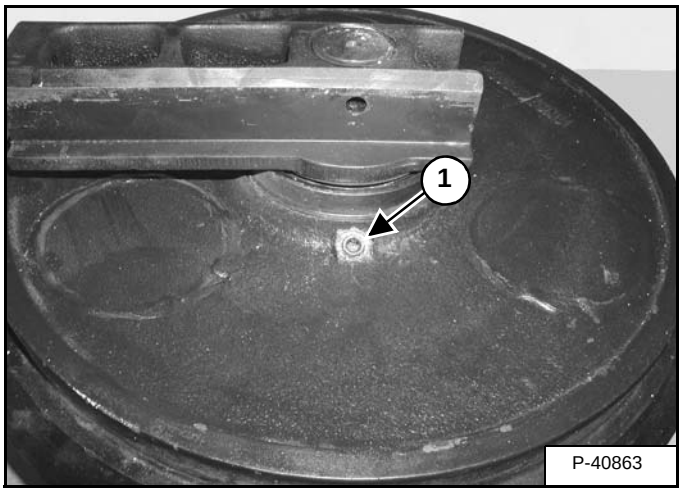
Disassembly (Cont'd)

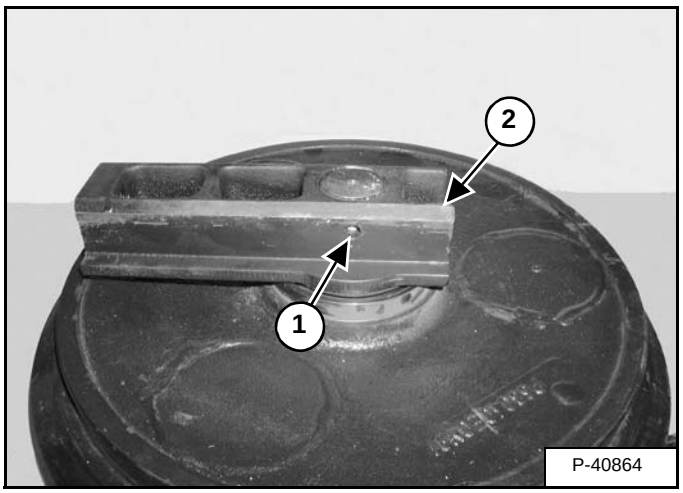
Figure 30-40-4



Apply moderate heat to the plug (Item 1) **[Figure 30-40-4]** to melt the thread adhesive and remove the plug.

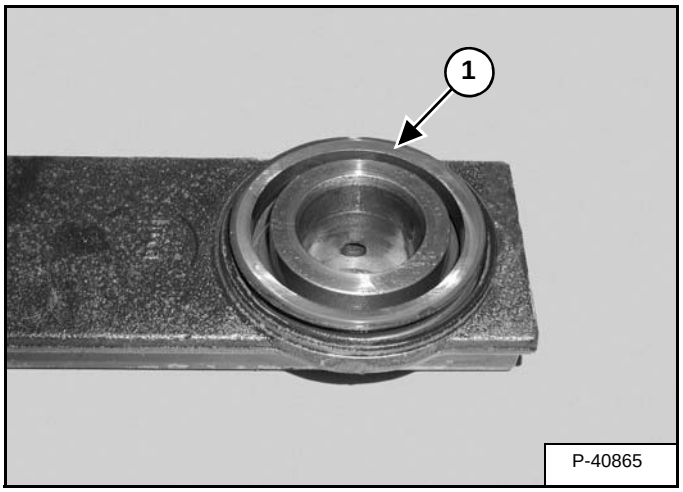
Drain the oil from the idler.

Figure 30-40-5



Remove the roll pin (Item 1) and mount (Item 2) **[Figure 30-40-5]** from both sides of the idler.

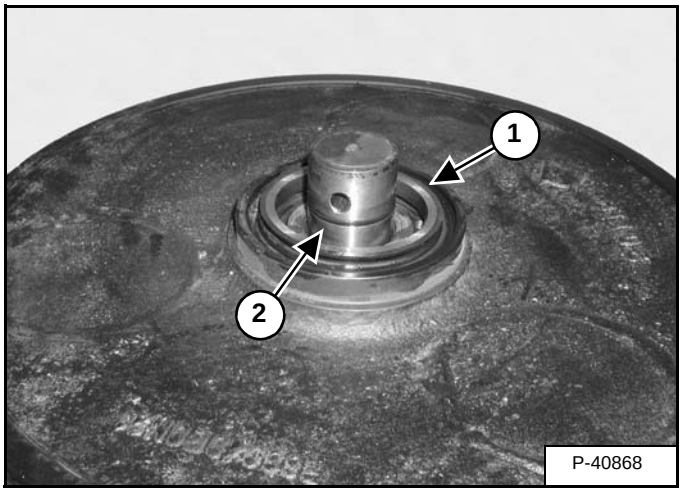
Figure 30-40-6



Remove the seal/O-ring assembly (Item 1) **[Figure 30-40-6]** from both mounts.

NOTE: The steel seals are a matched set. Always install the outer seal so it will run against the original inner seal. If replacing seals, always install a matched set.

Figure 30-40-7



Remove the seal/O-ring assembly (Item 1) **[Figure 30-40-7]** from both sides of the idler.

Remove the O-ring (Item 2) **[Figure 30-40-7]** from both ends of the shaft.

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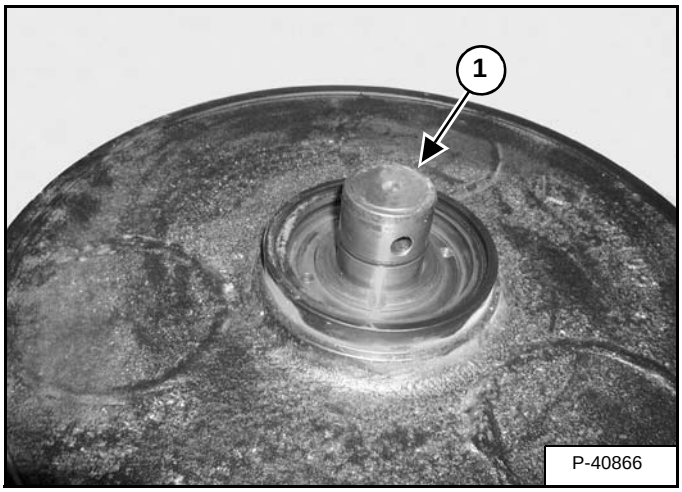
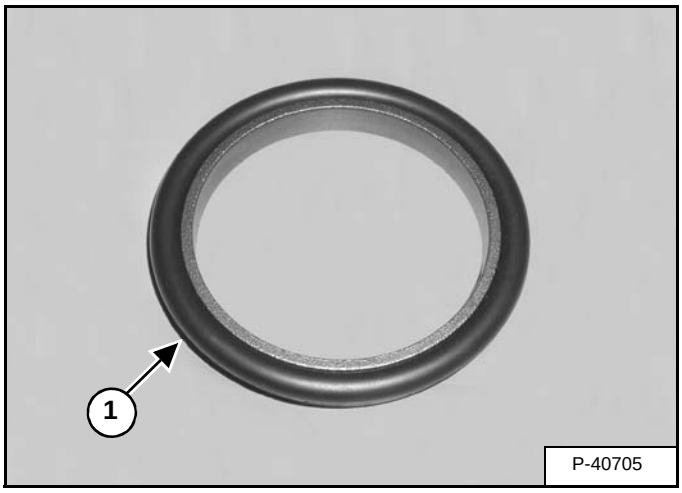
Disassembly (Cont'd)

Figure 30-40-8



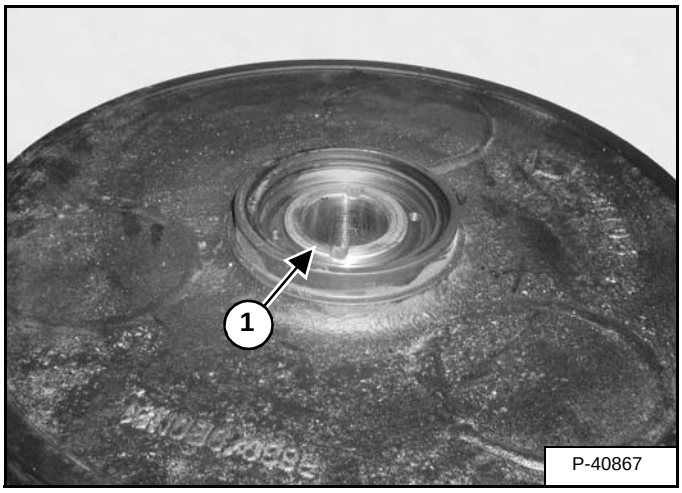
Remove the shaft (Item 1) **[Figure 30-40-8]**.

Figure 30-40-9



Remove the O-ring (Item 1) **[Figure 30-40-9]** from the seal.

Figure 30-40-10



Remove the bushings (Item 1) **[Figure 30-40-10]** from both sides of the idler.

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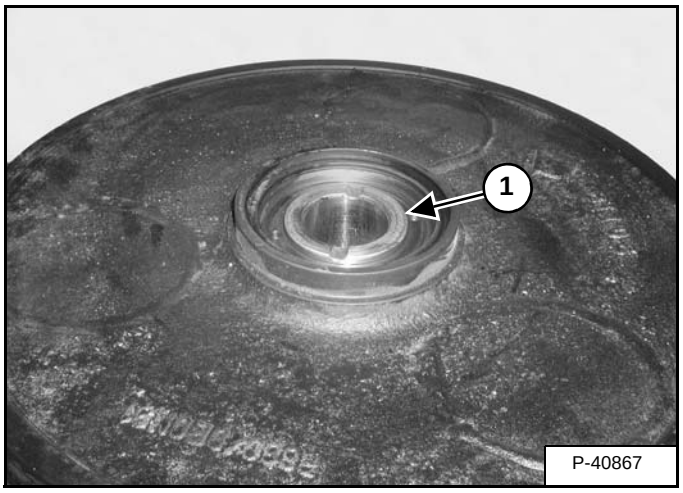
Assembly

Clean all parts in solvent and dry with compressed air.

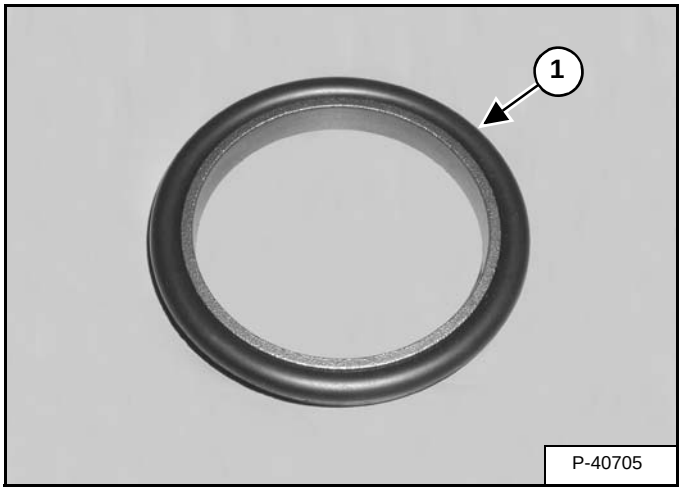
The seal assemblies are a matched set and must be replaced in pairs.

Figure 30-40-11



Install the bushings (Item 1) **[Figure 30-40-11]** in the idler.

Figure 30-40-12

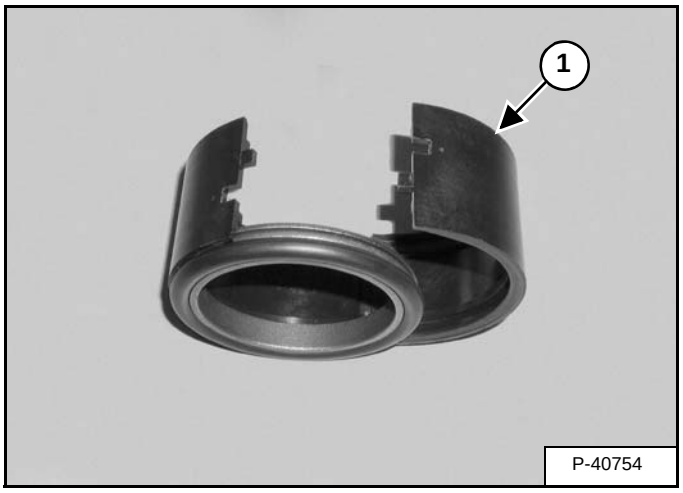


Install the O-ring (Item 1) **[Figure 30-40-12]** on the seal ring. Repeat this procedure all four seal assemblies.

The O-ring and seal ring must be clean and free of any dust, oil film or foreign matter.

NOTE: Inspect the seal ring for burrs before installing the O-ring. Install the O-ring making sure it is not twisted. To remove any twists, gently pull a section of the O-ring and let it snap back.

Figure 30-40-13

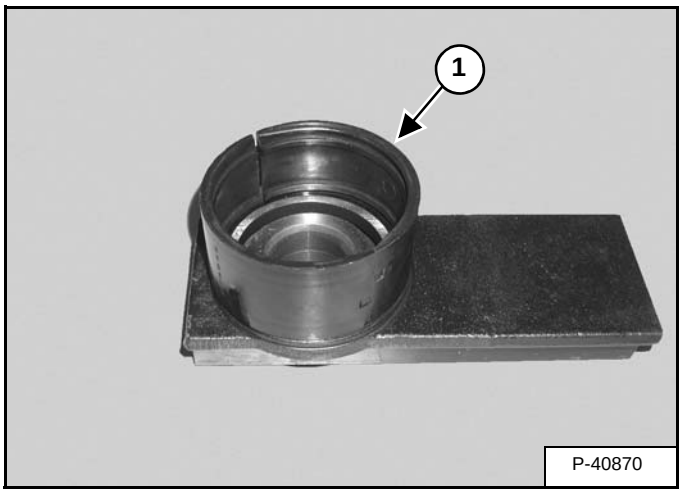


Place the seal assembly in the installation tool (Item 1) **[Figure 30-40-13]**.

The O-ring and seal ring assembly has to be lubricated with alcohol, so the O-ring will slip past the housing retaining ring and seal uniformly in the motor housing radius.

Dip the seal assembly in a pan of alcohol.

Figure 30-40-14



Shake off the excess alcohol and install the seal assembly (Item 1) **[Figure 30-40-14]** in the mount.

Use firm even pressure on the installation tool to *pop* the O-ring into the housing.

Remove the installation tool.

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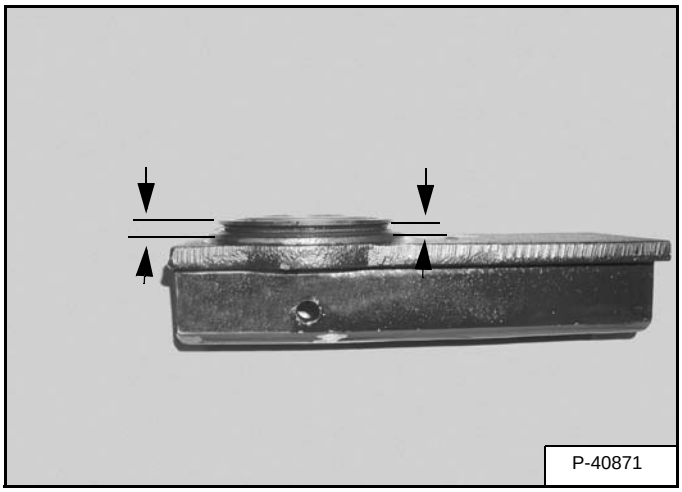
Assembly (Cont'd)

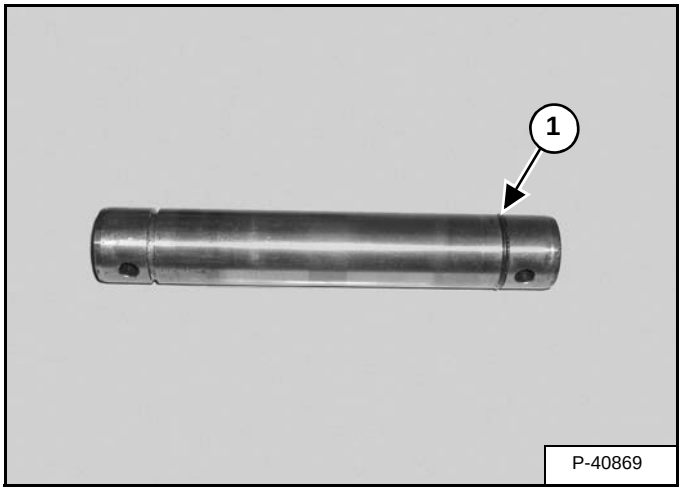
Figure 30-40-15



The seal assembly stand off height must be equal and the O-ring must not be twisted **[Figure 30-40-15]**.

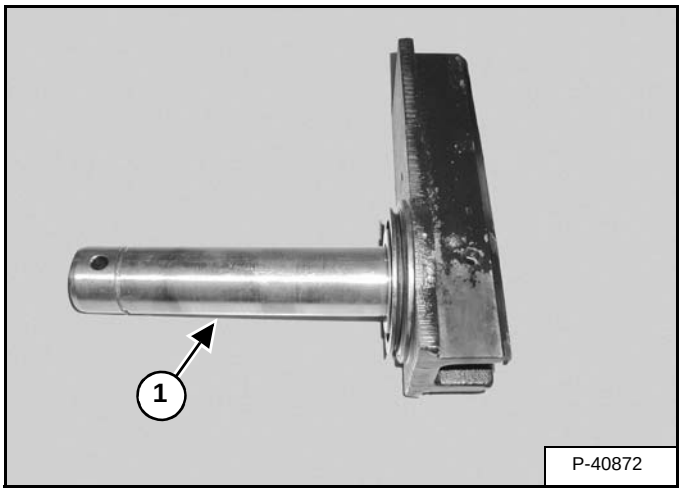
Repeat the seal assembly installation for the second mount.

Figure 30-40-16



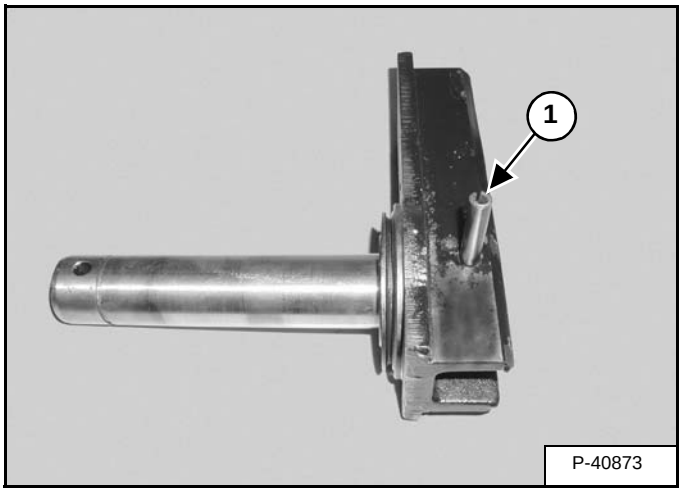
Install the O-ring (Item 1) **[Figure 30-40-16]** on the shaft.

Figure 30-40-17



Install the shaft (Item 1) **[Figure 30-40-17]** in the mount.

Figure 30-40-18



Install the roll pin (Item 1) **[Figure 30-40-18]**.

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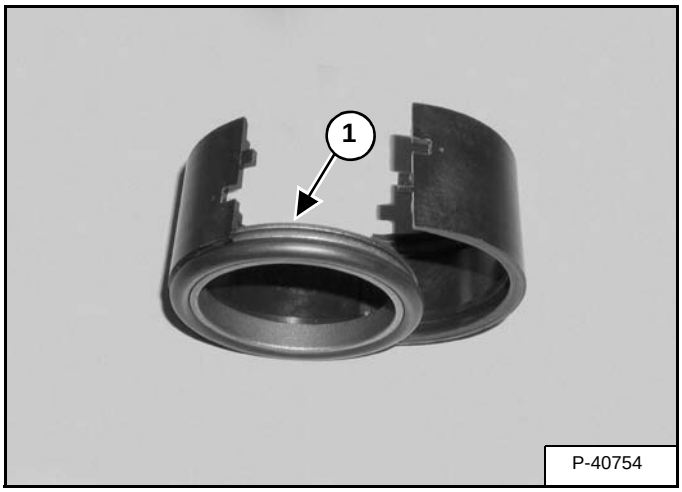
Assembly (Cont'd)

Figure 30-40-19

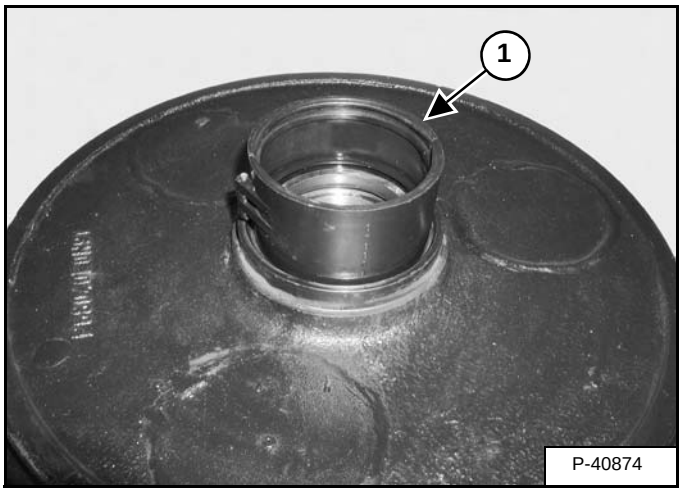


Place the seal assembly (Item 1) **[Figure 30-40-19]** in the installation tool.

The O-ring and seal ring assembly has to be lubricated with alcohol, so the O-ring will slip past the housing retaining ring and seal uniformly in the housing radius.

Dip the O-ring and seal ring assembly in a pan of alcohol.

Figure 30-40-20



Shake off the excess alcohol and install the seal assembly (Item 1) **[Figure 30-40-20]** in the idler.

Use firm even pressure on the installation tool to *pop* the O-ring into the housing.

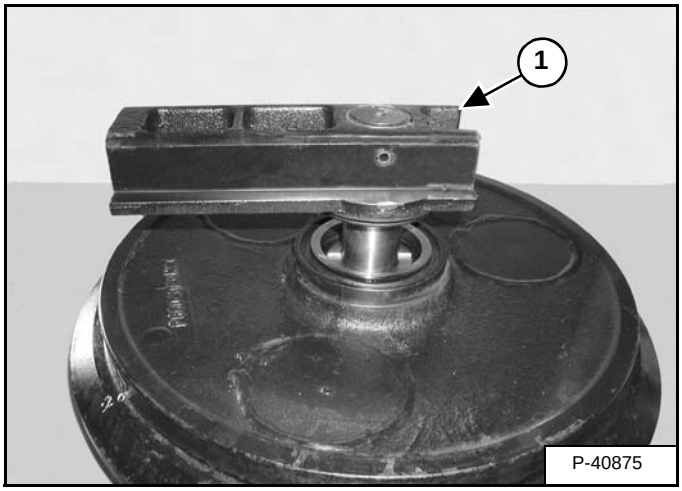
Remove the installation tool.

The seal assembly stand off height must be equal and the O-ring must not be twisted.

Apply a light film of oil to both metal seal rings.

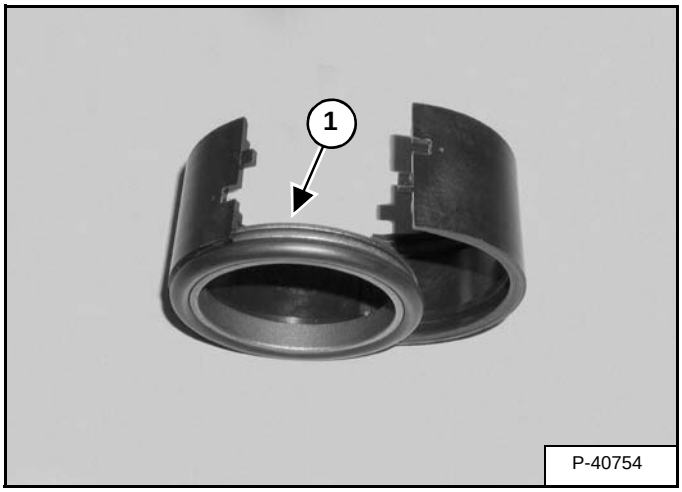
NOTE: Do not get any oil on the rubber O-rings.

Figure 30-40-21



Install the shaft/mount assembly (Item 1) **[Figure 30-40-21]** in the idler.

Figure 30-40-22



Place the seal assembly (Item 1) **[Figure 30-40-22]** in the installation tool.

The O-ring and seal ring assembly has to be lubricated with alcohol, so the O-ring will slip past the housing retaining ring and seal uniformly in the housing radius.

Dip the O-ring and seal ring assembly in a pan of alcohol.

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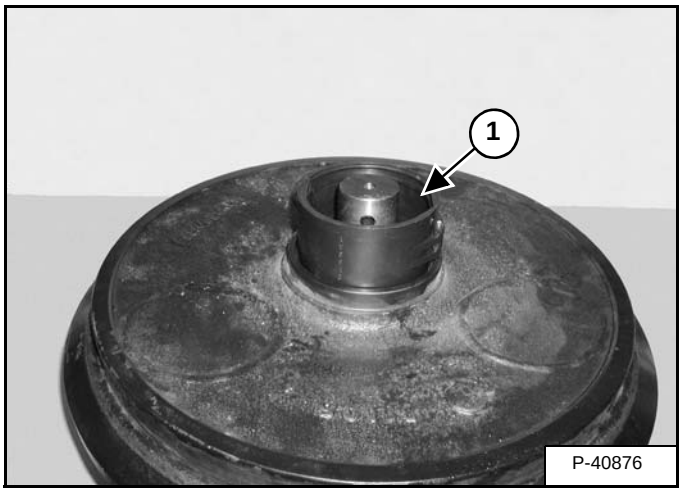
Assembly (Cont'd)

Figure 30-40-23

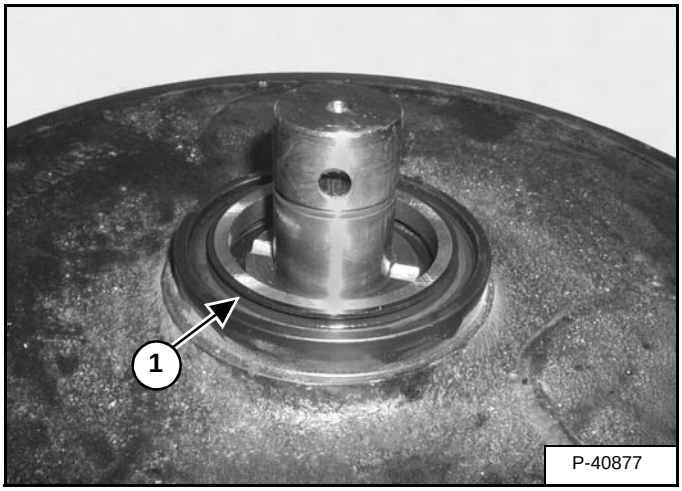


Shake off the excess alcohol and install the seal ring assembly (Item 1) **[Figure 30-40-23]** in the idler.

Use firm even pressure on the installation tool to *pop* the O-ring into the housing.

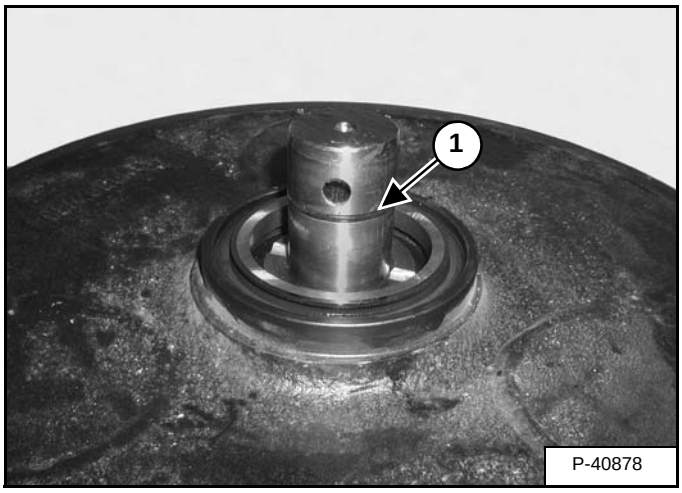
Remove the installation tool.

Figure 30-40-24



The seal assembly stand off height must be equal and the O-ring (Item 1) **[Figure 30-40-24]** must not be twisted.

Figure 30-40-25

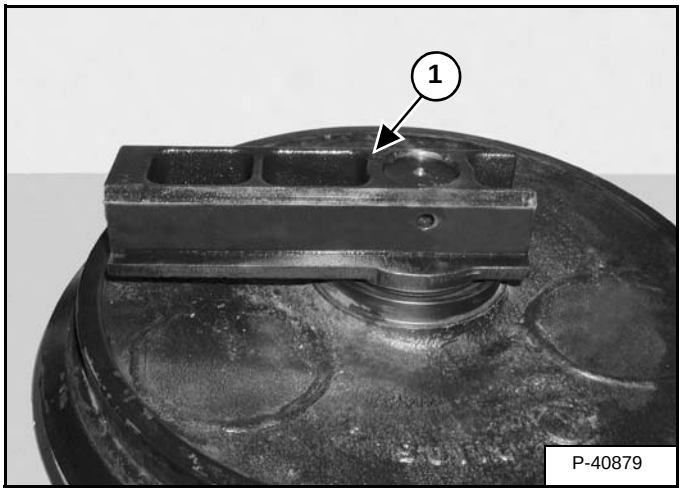


Install the O-ring (Item 1) **[Figure 30-40-25]** on the shaft.

Apply a light film of oil to both metal seal rings.

NOTE: Do not get any oil on the rubber O-rings.

Figure 30-40-26



Install the mount (Item 1) **[Figure 30-40-26]** on the shaft.

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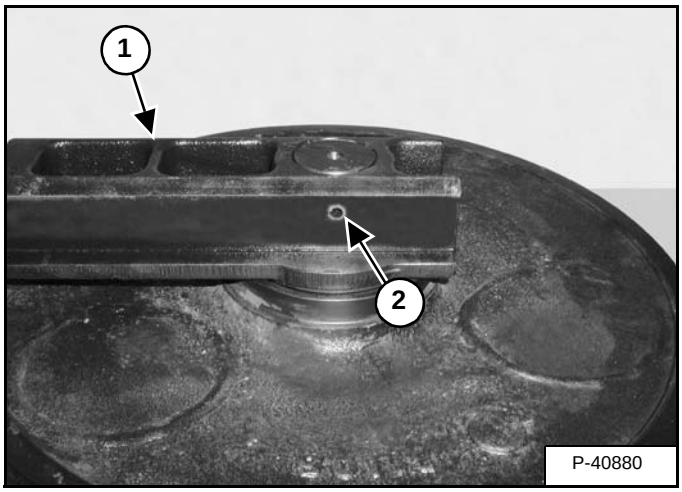
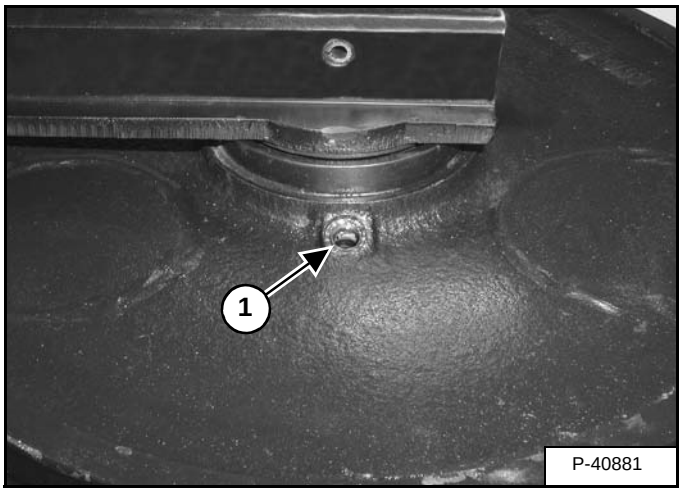
Assembly (Cont'd)

Figure 30-40-27



Press down on the mount (Item 1) and install the roll pin (Item 2) **[Figure 30-40-27]**.

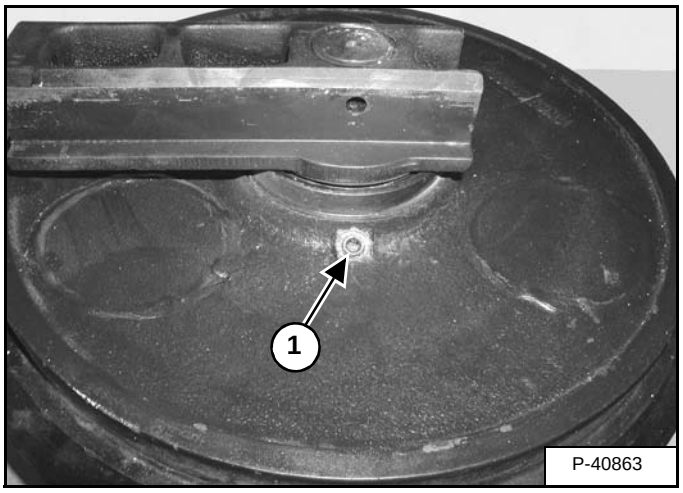
Figure 30-40-28



Add 12 oz. (0.35 L) of 80 w/90 gear oil through the fill hole (Item 1) **[Figure 30-40-28]**.

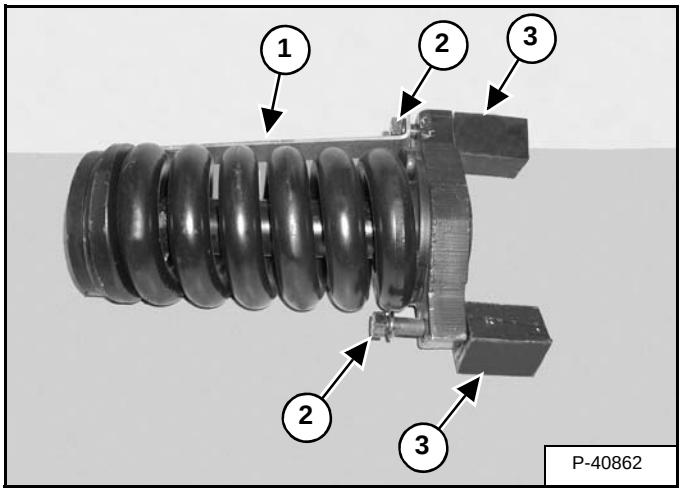
Apply thread adhesive (Loctite™ 242) to the threads of the plug.

Figure 30-40-29



Install the plug (Item 1) **[Figure 30-40-29]**.

Figure 30-40-30



Install the track tension guide (Item 1) **[Figure 30-40-30]** on the bolt and washer.

Install the bolts and washers (Item 2) **[Figure 30-40-30]** through the recoil spring frame.

Install the spacer blocks (Item 3) **[Figure 30-40-30]** on the bolts.

Install the recoil spring assembly on the idler mounts.

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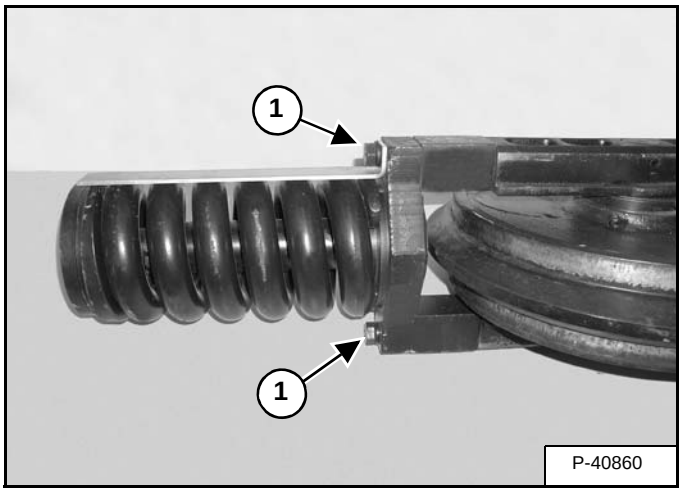
Assembly (Cont'd)

Figure 30-40-31



Tighten the bolts (Item 1) **[Figure 30-40-31]** to 125-140 ft.-lb. (170-190 N•m) torque.

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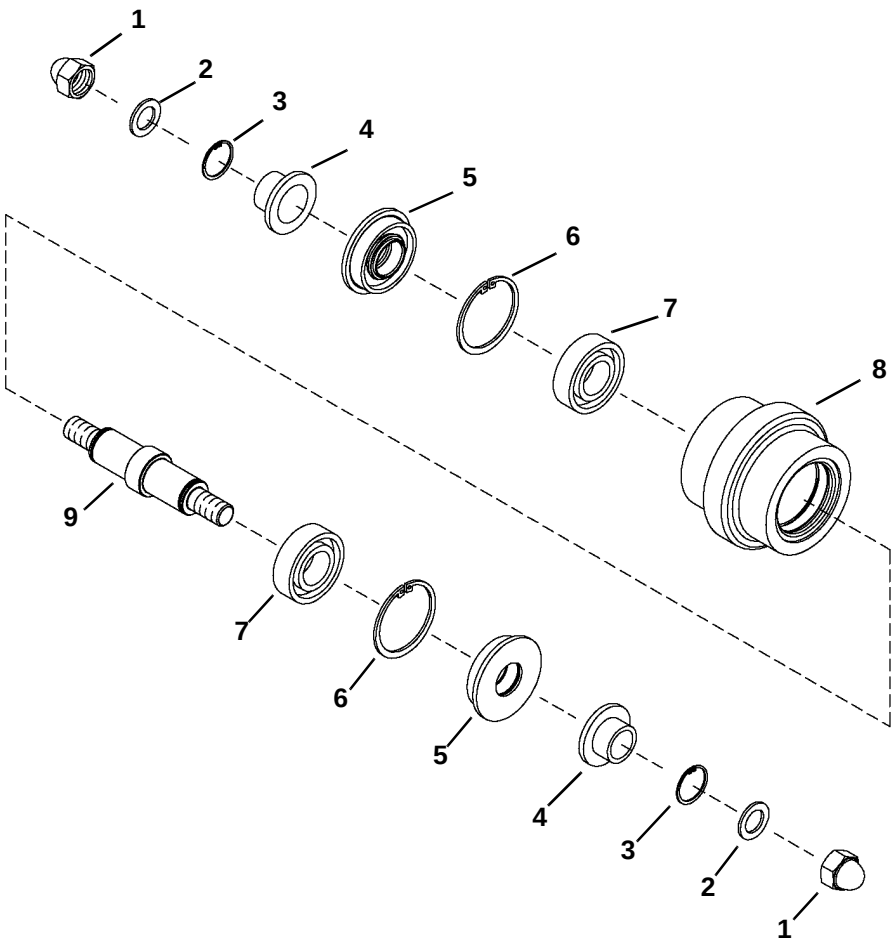
UPPER TRACK ROLLER

Parts Identification

1. NUT
2. WASHER
3. SNAP RING
4. SEAL COVER
5. SEAL (TWO PIECE)
6. SNAP RING
7. BEARING
8. ROLLER
9. SHAFT



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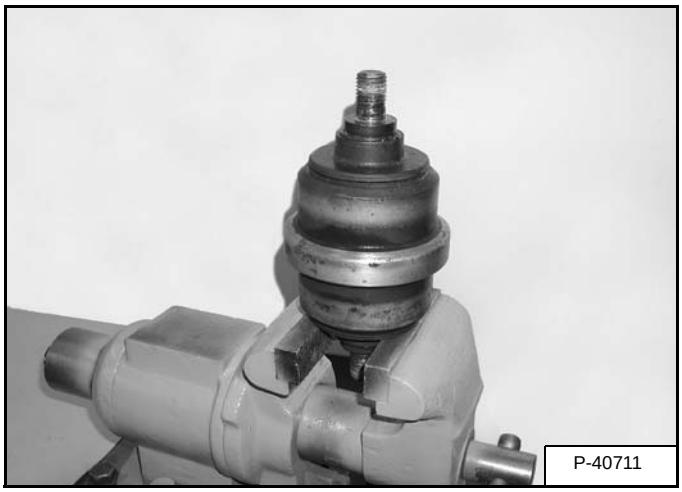
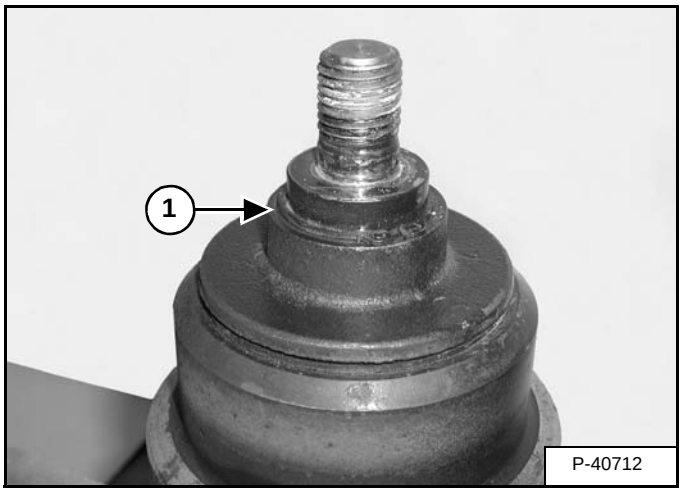
Disassembly

Figure 30-50-1



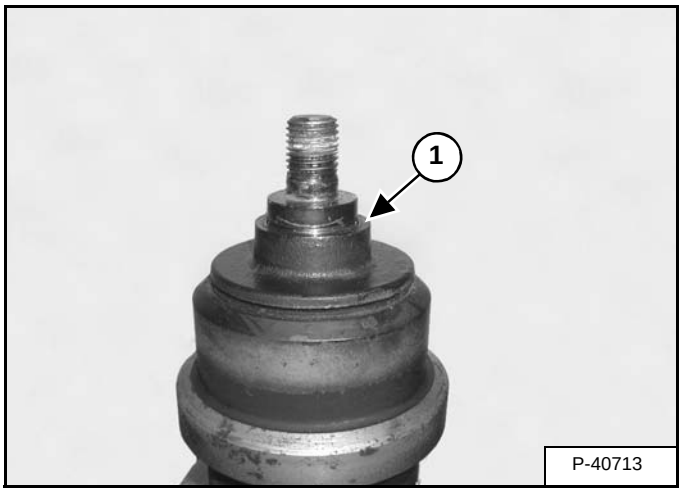
Clamp the roller in a vise **[Figure 30-50-1]**.

Figure 30-50-2



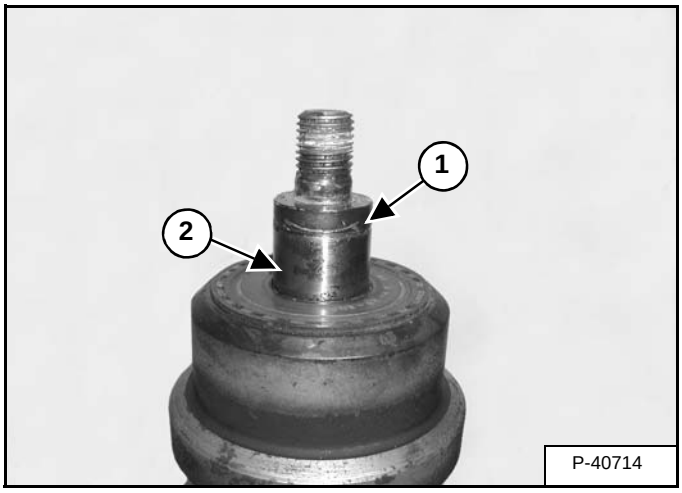
Remove the snap ring (Item 1) **[Figure 30-50-2]**.

Figure 30-50-3



Remove the seal cover (Item 1) **[Figure 30-50-3]**.

Figure 30-50-4



Clean any rust and corrosion from the end of the shaft (Item 1) **[Figure 30-50-4]** to ease removal of the inner seal.

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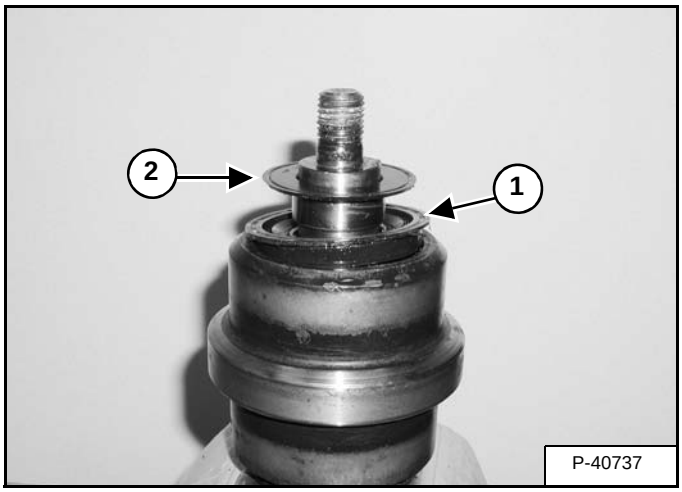
Disassembly (Cont'd)

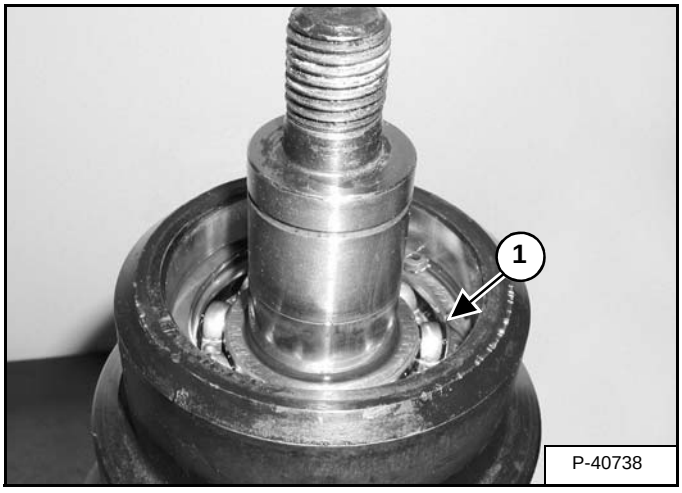
Figure 30-50-5



The roller is equipped with a two piece seal. Pry up on the outer seal (Item 1) until the inner seal (Item 2) **[Figure 30-50-5]** is separated from the outer seal.

Remove both seals.

Figure 30-50-6

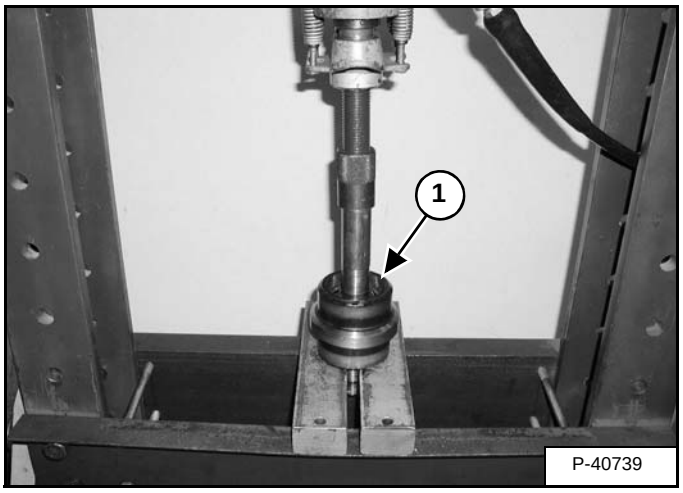


Remove the snap ring (Item 1) **[Figure 30-50-6]**.

Remove the roller from the vise and drain the oil.

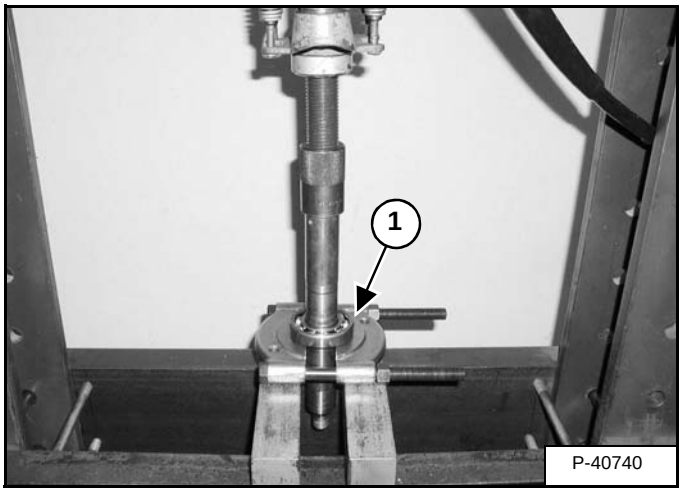
Turn the roller over and remove the external snap ring seal cover, inner and outer seal and internal snap ring.

Figure 30-50-7



Press the shaft (Item 1) **[Figure 30-50-7]** out of the roller.

Figure 30-50-8



Press the shaft (Item 1) **[Figure 30-50-8]** off the shaft.

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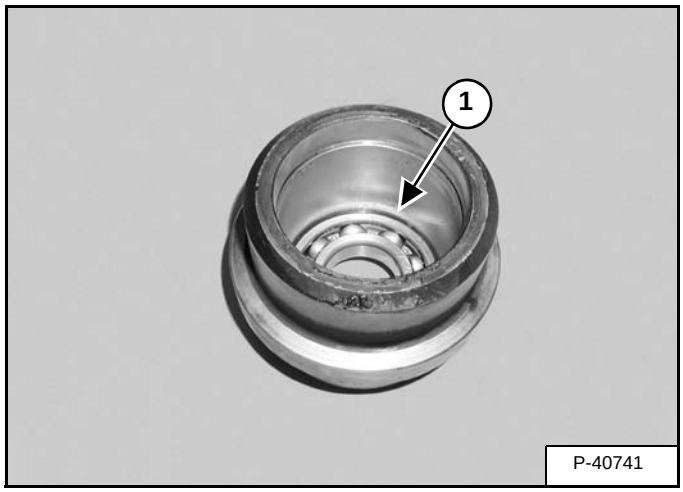
Disassembly (Cont'd)

Figure 30-50-9

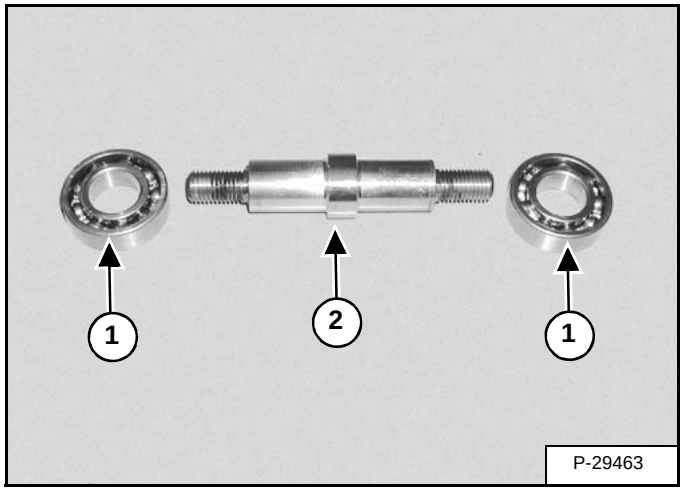


Remove the bearing (Item 1) **[Figure 30-50-9]** from inside the roller.

Assembly

Clean all parts in solvent and dry with compressed air.

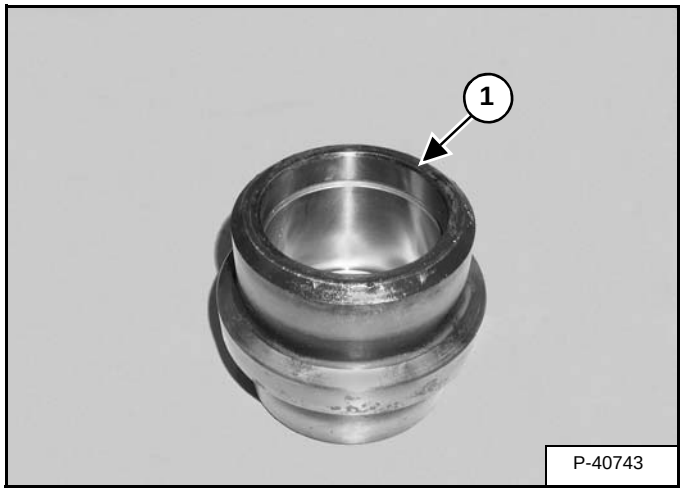
Figure 30-50-10



Inspect the bearings (Item 1) and shaft (Item 2) **[Figure 30-50-10]** for wear or damage.

Replace any worn parts.

Figure 30-50-11



Remove all paint and corrosion from the seal surface (Item 1) **[Figure 30-50-11]** on both sides of the roller.

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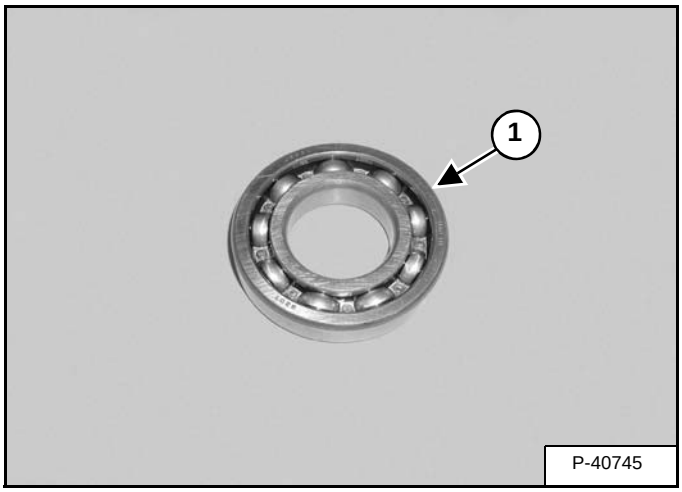
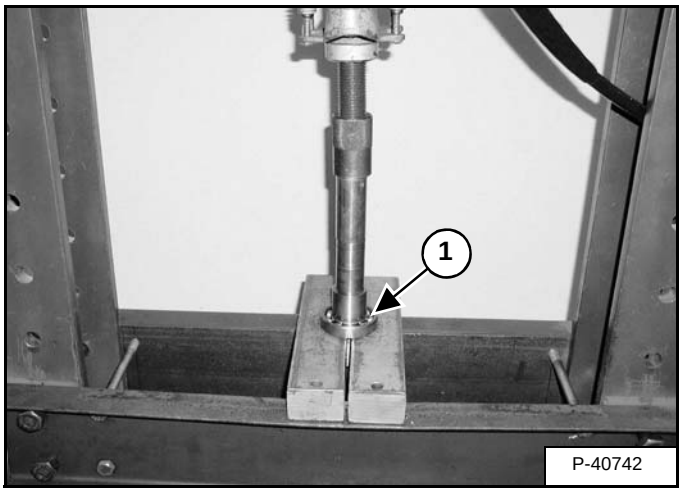
Assembly (Cont'd)

Figure 30-50-12



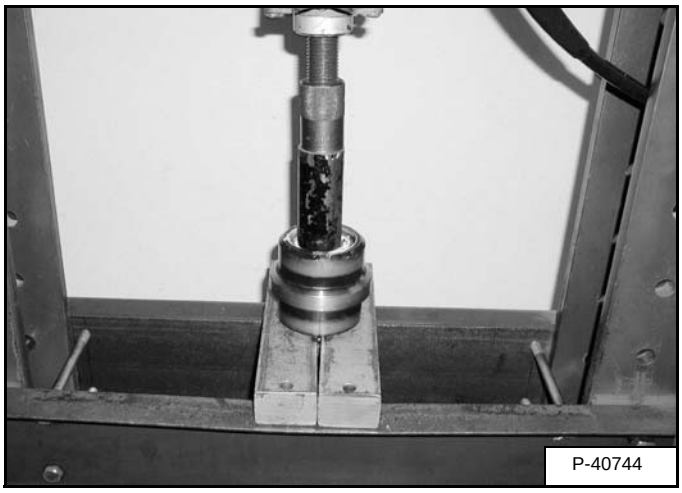
Apply assembly lube to both bearings (Item 1) **[Figure 30-50-12]**.

Figure 30-50-13



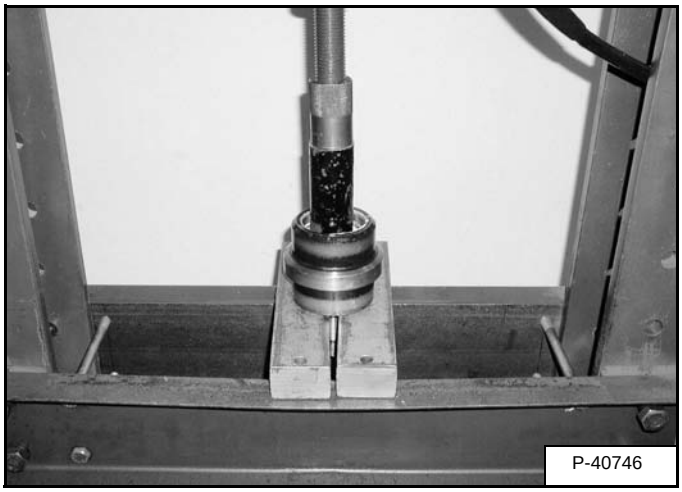
Press the bearing (Item 1) **[Figure 30-50-13]** on the shaft.

Figure 30-50-14



Press the shaft/bearing assembly into the roller **[Figure 30-50-14]**.

Figure 30-50-15



Turn the roller over and press the bearing over the shaft and in to the roller **[Figure 30-50-15]**.

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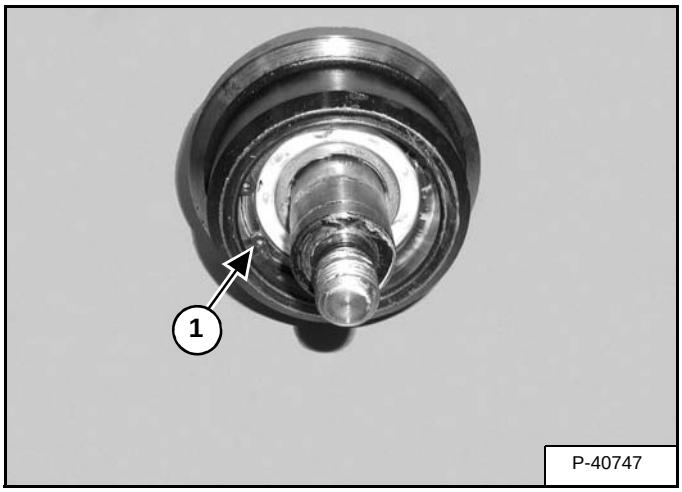
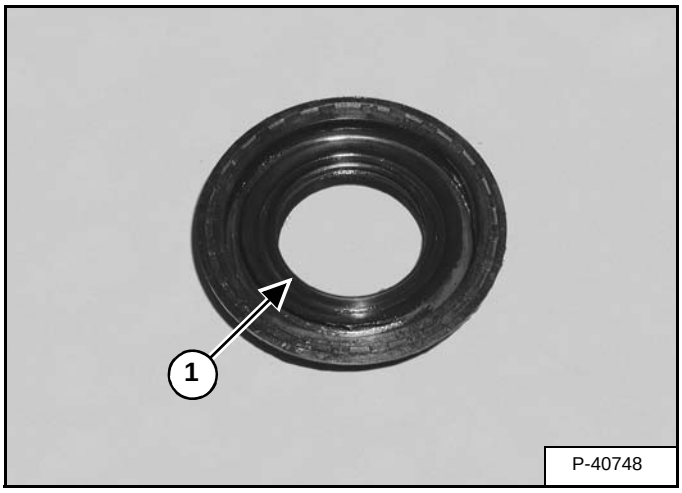
Assembly (Cont'd)

Figure 30-50-16



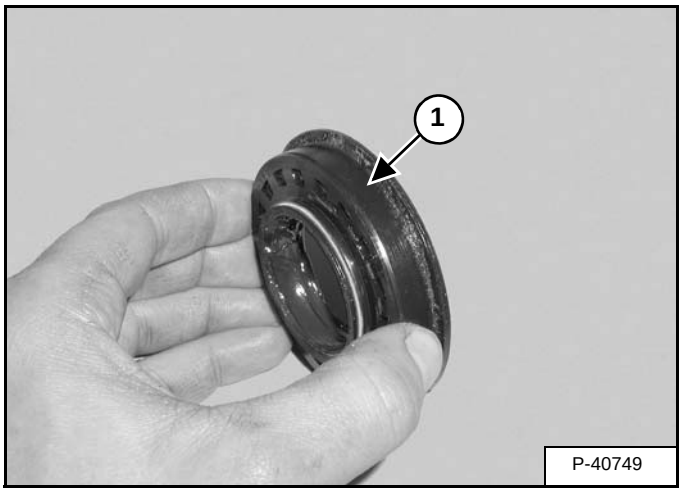
Install the snap ring (Item 1) **[Figure 30-50-16]** on both sides of the roller.

Figure 30-50-17



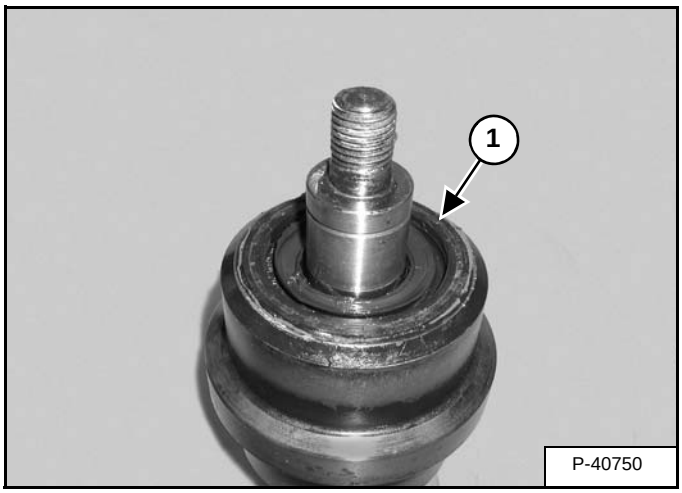
Apply grease to the ID (Item 1) **[Figure 30-50-17]** of the outer seal.

Figure 30-50-18



Apply a small bead of high temperature silicone sealant around the OD (Item 1) **[Figure 30-50-18]** of the outer seal.

Figure 30-50-19



Install the outer seal (Item 1) **[Figure 30-50-19]**.

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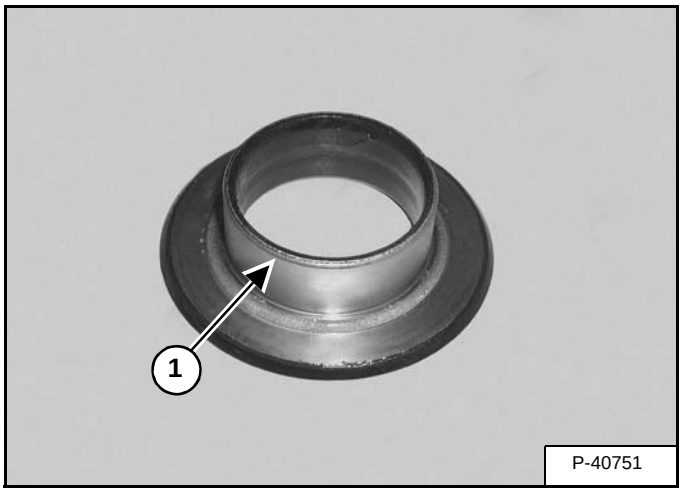
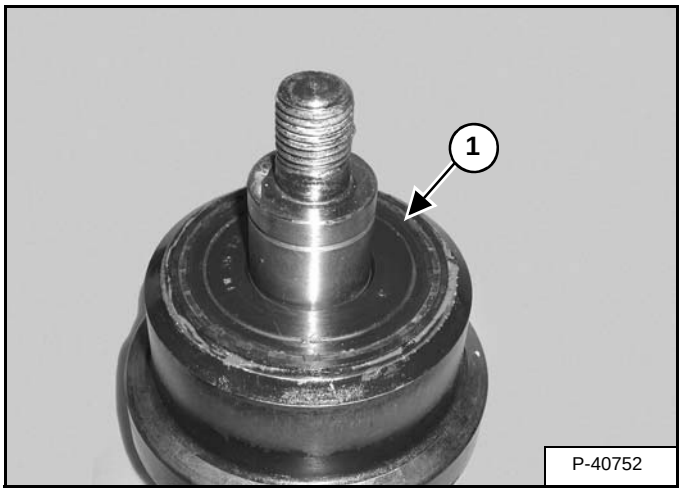
Assembly (Cont'd)

Figure 30-50-20



Apply a light coat of grease to the outside of the inner seal (Item 1) **[Figure 30-50-20]**.

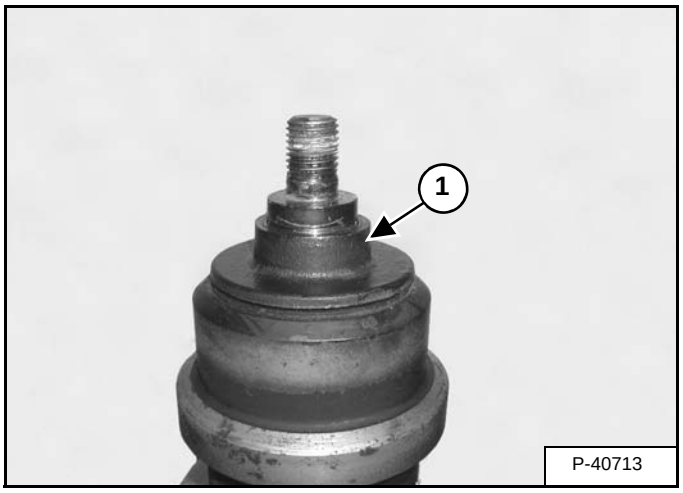
Figure 30-50-21



Install the inner seal (Item 1) **[Figure 30-50-21]**.

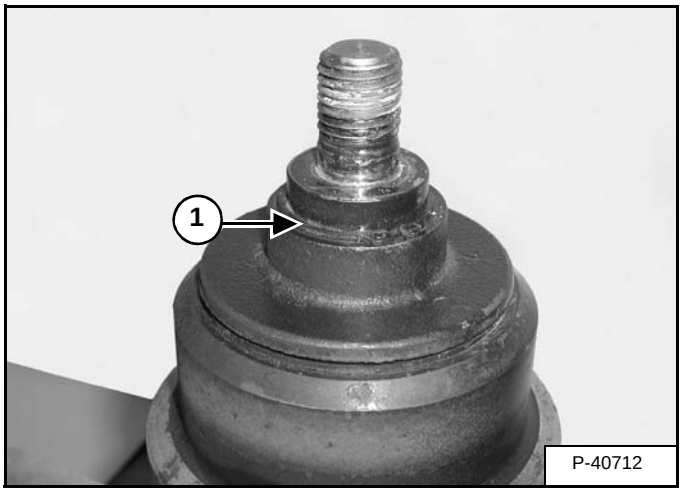
NOTE: The inner seal must be fully seated in the outer seal to prevent any leaks.

Figure 30-50-22



Install the seal cover (Item 1) **[Figure 30-50-22]**.

Figure 30-50-23



Install the snap ring (Item 1) **[Figure 30-50-23]**.

Turn the roller over and add 4 oz. (0.12 L) of 10W-30 oil to the assembly.

Install the outer seal, inner seal, seal cover and external snap ring.

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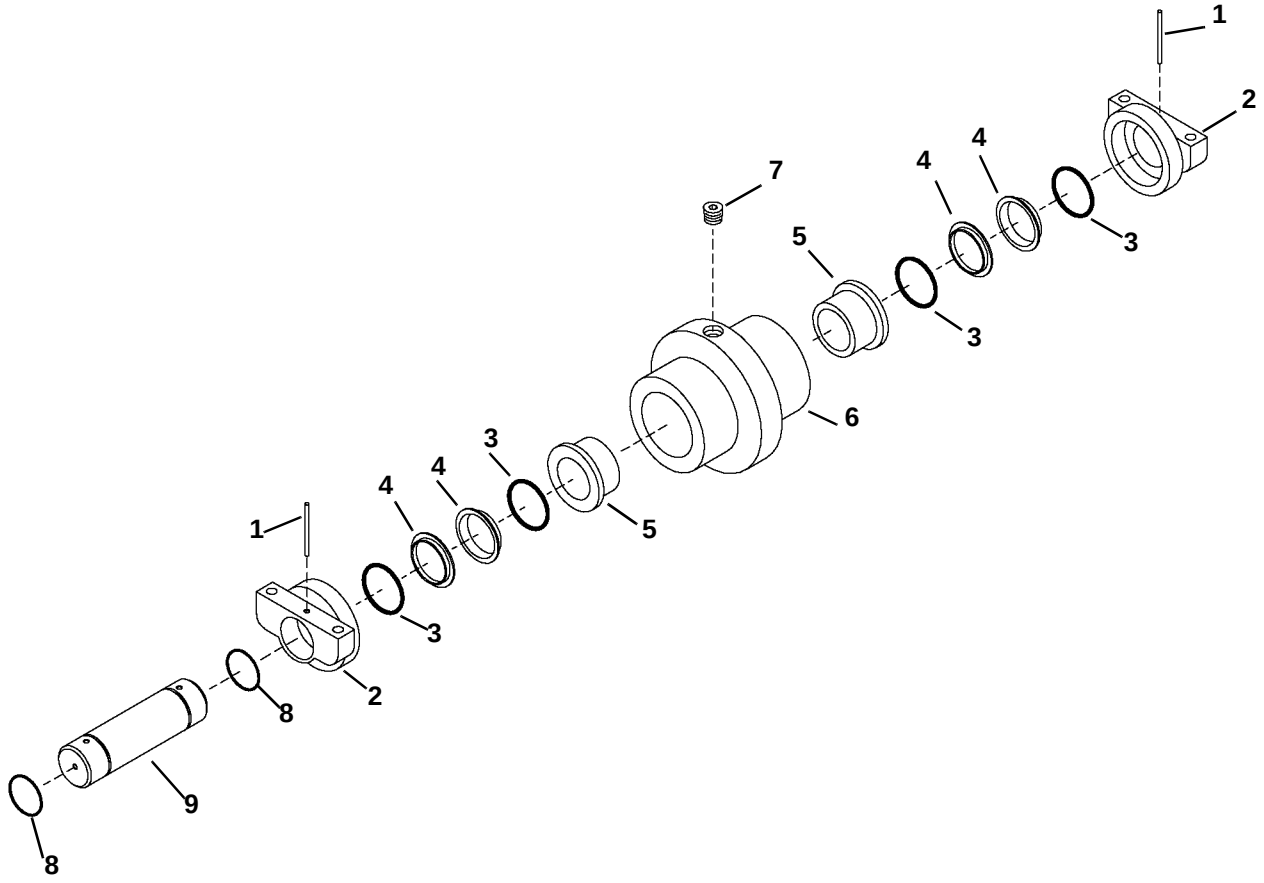
LOWER TRACK ROLLER

Parts Identification

1. ROLL PIN
2. MOUNT
3. O- RING
4. SEAL
5. BUSHING
6. ROLLER
7. PLUG
8. O-RING
9. SHAFT



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Disassembly

Figure 30-60-1

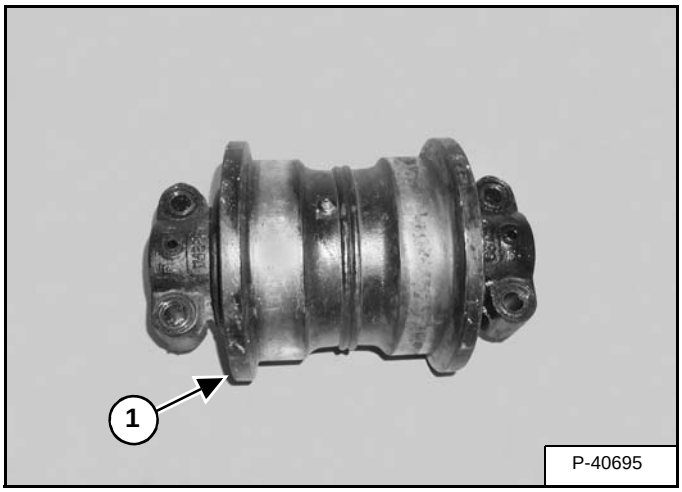
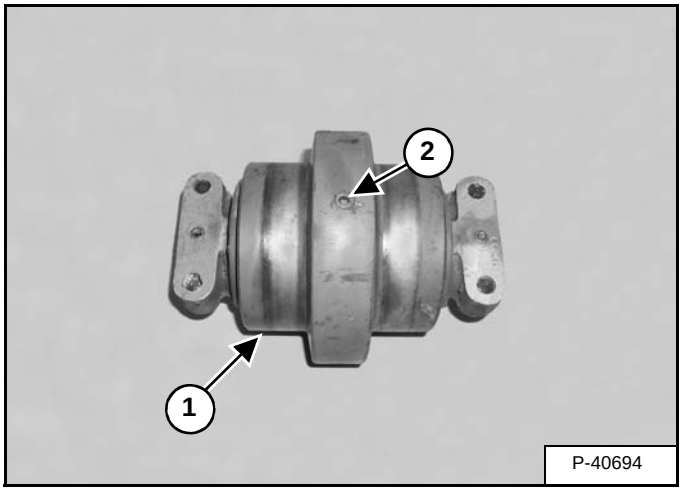


Figure 30-60-2



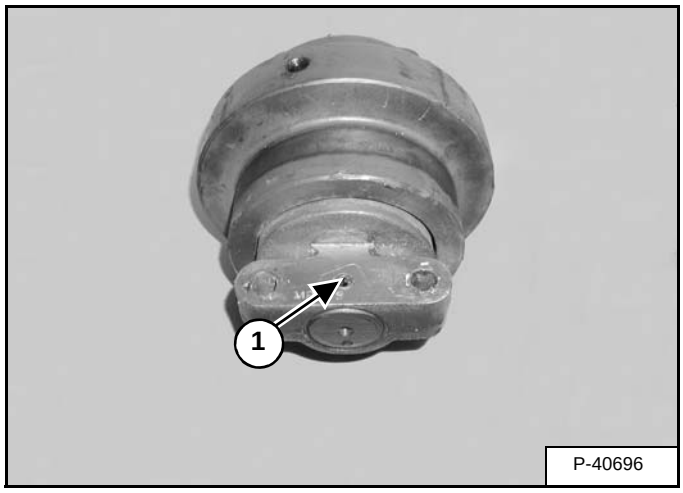
The track frame is equipped with four external guide rollers (Item 1) **[Figure 30-60-1]** and two internal guide rollers (Item 1) **[Figure 30-60-2]** per side.

The disassembly procedure is shown on the internal guide roller. The procedure is the same for both rollers.

Apply moderate heat to the plug (Item 2) **[Figure 30-60-2]** to melt the thread adhesive and remove the plug.

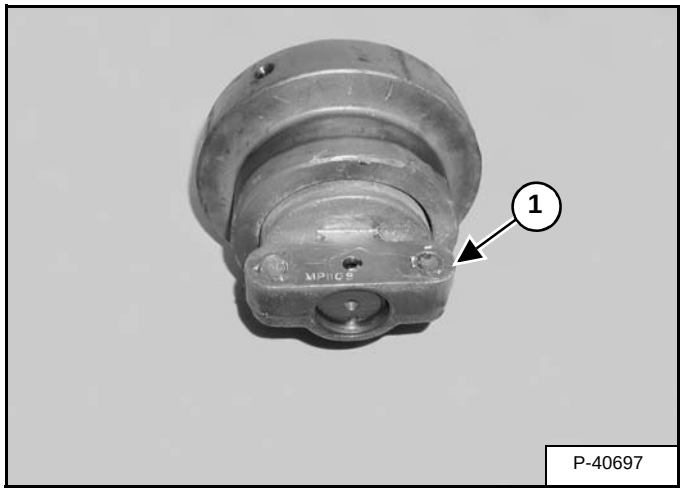
Drain the oil from the roller.

Figure 30-60-3



Remove the roll pin (Item 1) **[Figure 30-60-3]** from both sides of the roller.

Figure 30-60-4



Remove the mount (Item 1) **[Figure 30-60-4]** from both sides of the roller.

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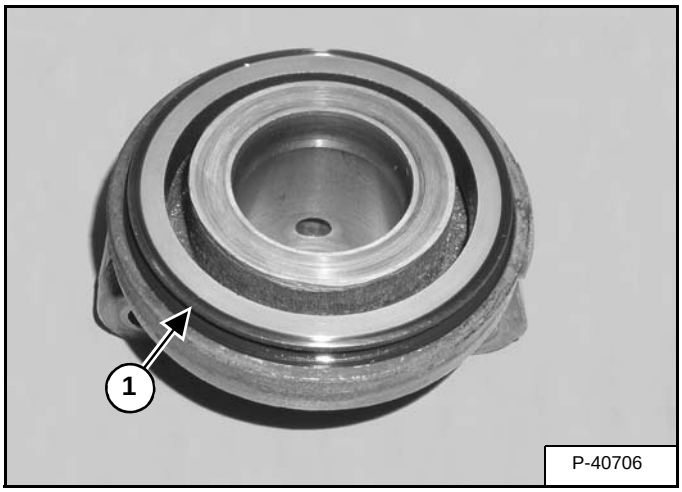
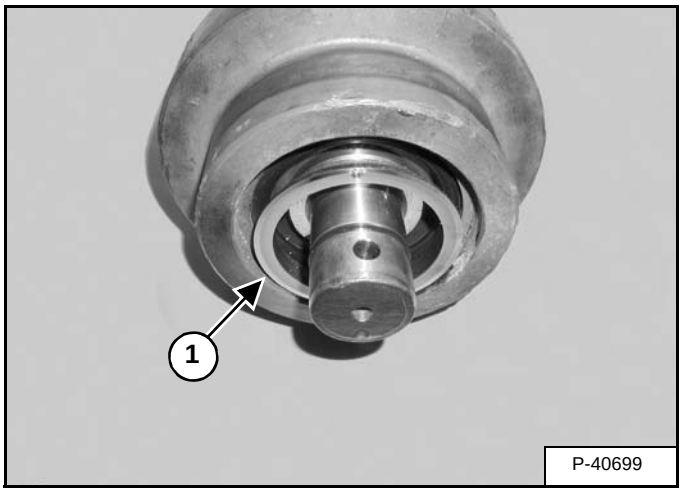
Disassembly (Cont'd)

Figure 30-60-5



Remove the seal/O-ring assembly (Item 1) **[Figure 30-60-5]** from both mounts.

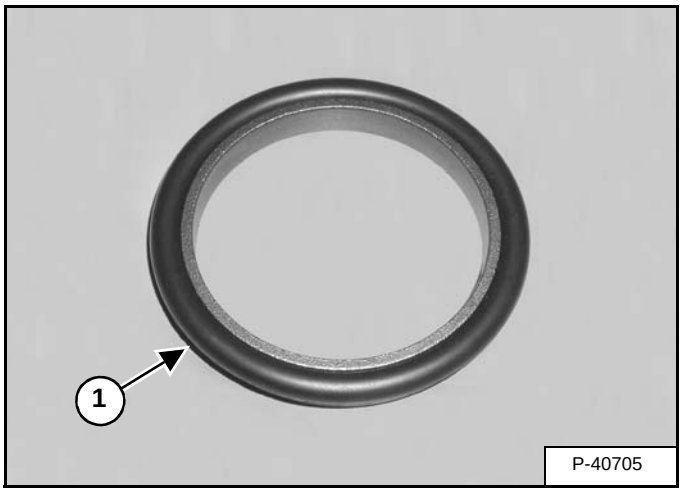
Figure 30-60-6



Remove the seal/O-ring assembly (Item 1) **[Figure 30-60-6]** from both sides of the roller.

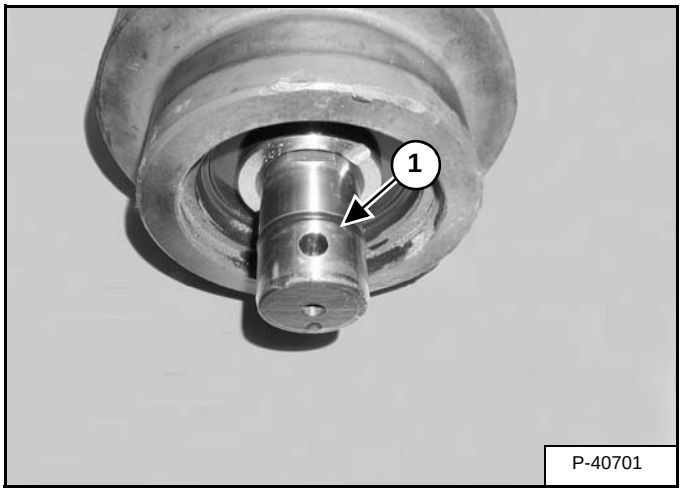
NOTE: The steel seals are a matched set. Always install the outer seal so it will run against the original inner seal. If replacing seals, always install a matched set.

Figure 30-60-7



Remove the O-ring (Item 1) **[Figure 30-60-7]** from all four seal assemblies.

Figure 30-60-8



Remove the O-ring (Item 1) **[Figure 30-60-8]** from both ends of the shaft.

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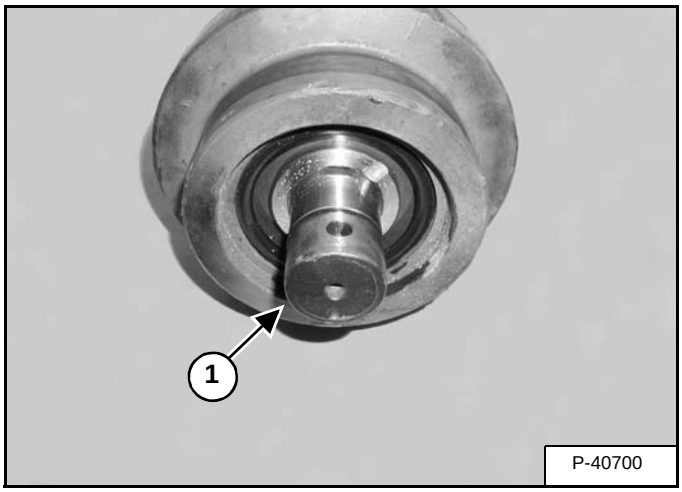
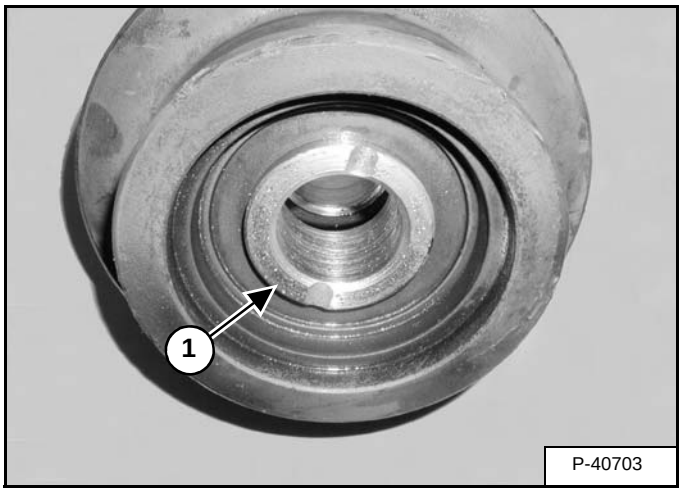
Disassembly (Cont'd)

Figure 30-60-9



Remove the shaft (Item 1) **[Figure 30-60-9]**.

Figure 30-60-10



Remove the bushings (Item 1) **[Figure 30-60-10]** from both sides of the roller.

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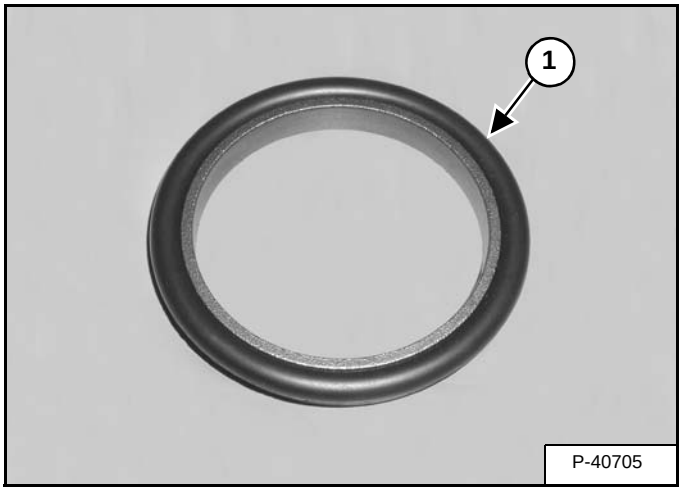
Assembly

Clean all parts in solvent and dry with compressed air.

The seal assemblies are a matched set and must be replaced in pairs.

Install the bushings (Item 1) **[Figure 30-60-10 on Page 4]**

Figure 30-60-11

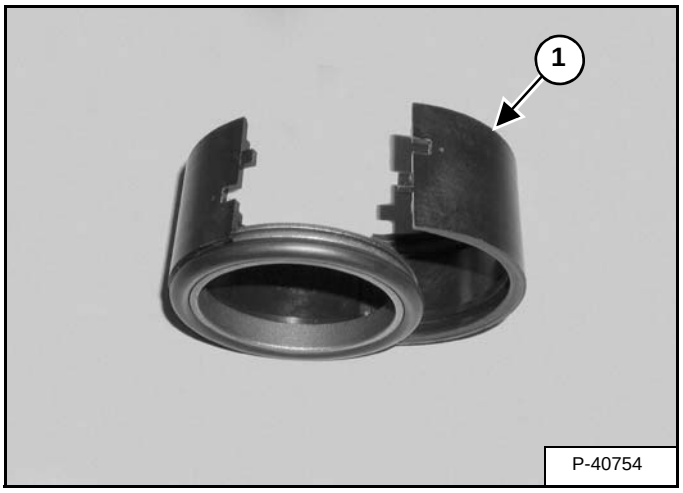


Install the O-ring (Item 1) **[Figure 30-60-11]** on the seal ring. Repeat this procedure all four seal assemblies.

The O-ring and seal ring must be clean and free of any dust, oil film or foreign matter.

NOTE: Inspect the seal ring for burrs before installing the O-ring. Install the O-ring making sure it is not twisted. To remove any twists, gently pull a section of the O-ring and let it snap back.

Figure 30-60-12



Place the seal assembly in the installation tool (Item 1) **[Figure 30-60-12]**.

The O-ring and seal ring assembly has to be lubricated with alcohol, so the O-ring will slip past the housing retaining ring and seal uniformly in the housing radius.

Dip the seal assembly in a pan of alcohol.

Figure 30-60-13

Shake off the excess alcohol and install the seal assembly (Item 1) **[Figure 30-60-13]** in the mount.

Use firm even pressure on the installation tool to *pop* the O-ring in to the mount.

Remove the installation tool.

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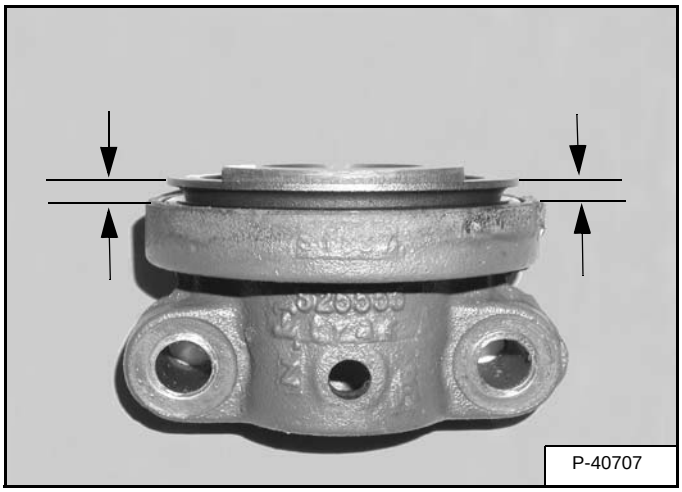
Assembly (Cont'd)

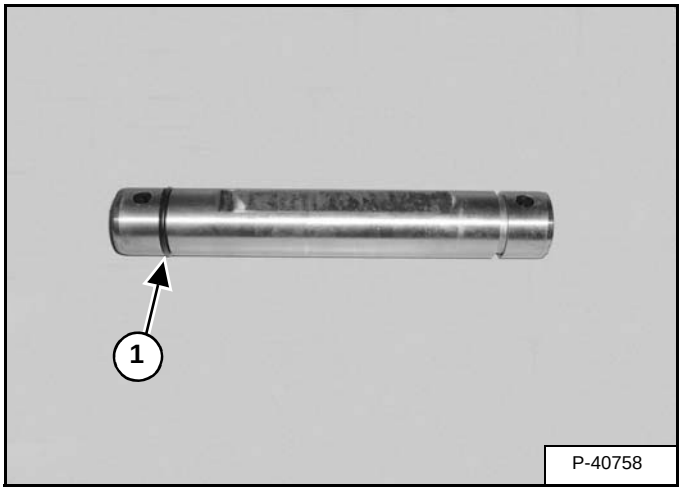
Figure 30-60-14



The seal assembly stand off height must be equal and the O-ring must not be twisted **[Figure 30-60-14]**.

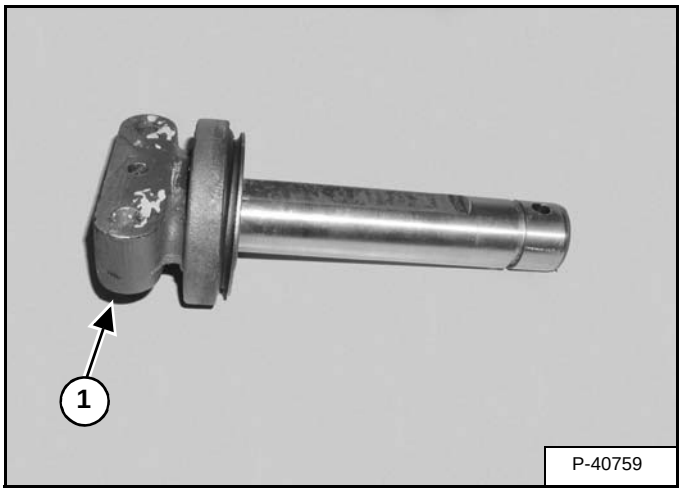
Repeat the seal assembly installation for the second mount.

Figure 30-60-15



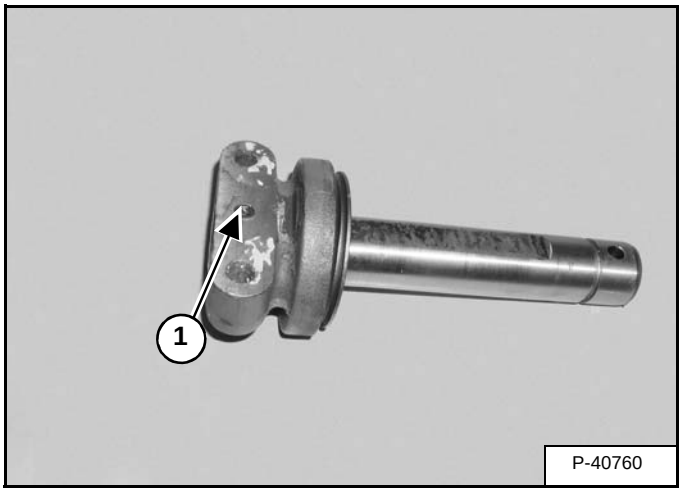
Install the O-ring (Item 1) **[Figure 30-60-15]** on the shaft.

Figure 30-60-16



Install the mount (Item 1) **[Figure 30-60-16]** on the shaft.

Figure 30-60-17



Install the roll pin (Item 1) **[Figure 30-60-17]**.

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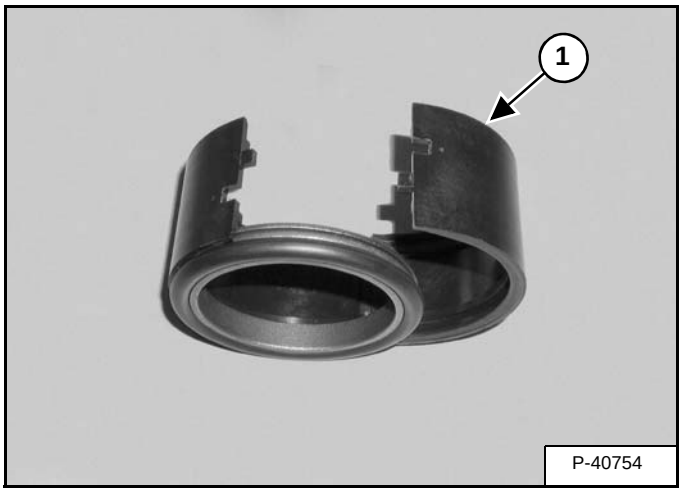
Assembly (Cont'd)

Figure 30-60-18

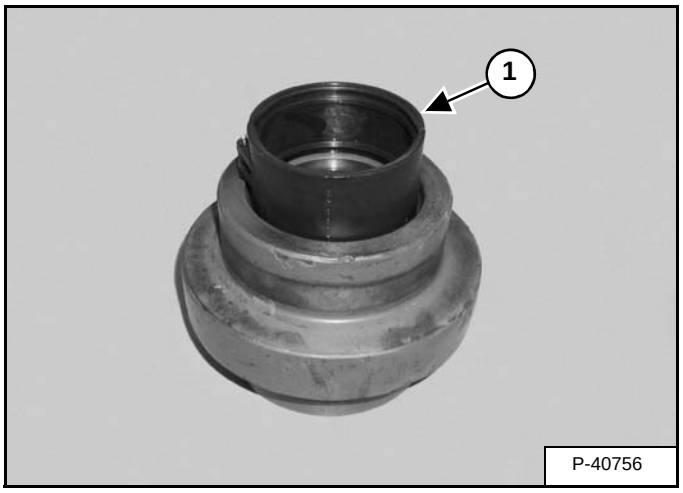


Place the seal assembly (Item 1) **[Figure 30-60-18]** in the installation tool.

The O-ring and seal ring assembly has to be lubricated with alcohol, so the O-ring will slip past the housing retaining ring and seal uniformly in the housing radius.

Dip the O-ring and seal ring assembly in a pan of alcohol.

Figure 30-60-19

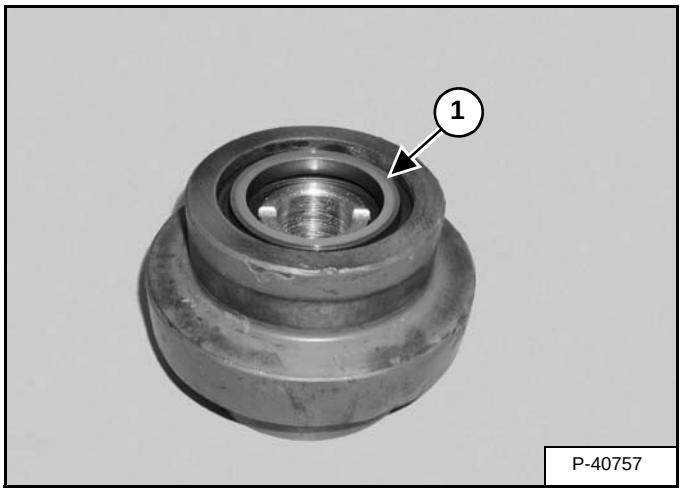


Shake off the excess alcohol and install the seal assembly (Item 1) **[Figure 30-60-19]** in the roller.

Use firm even pressure on the installation tool to *pop* the O-ring into the motor housing.

Remove the installation tool.

Figure 30-60-20



The seal assembly (Item 1) **[Figure 30-60-20]** stand off height must be equal and the O-ring must not be twisted.

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Assembly (Cont'd)

Figure 30-60-21

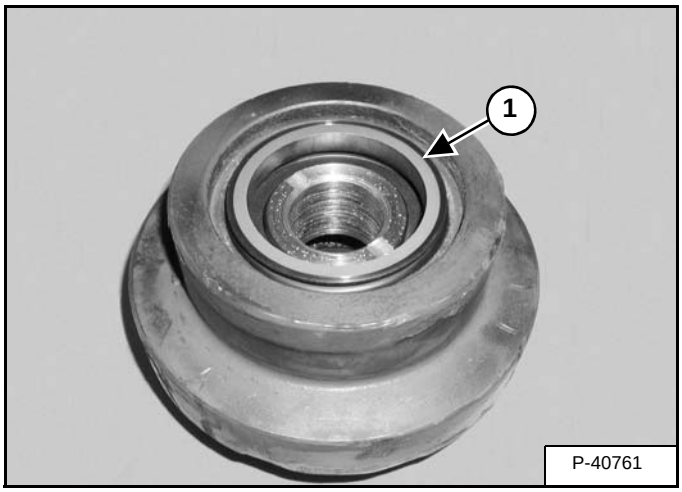
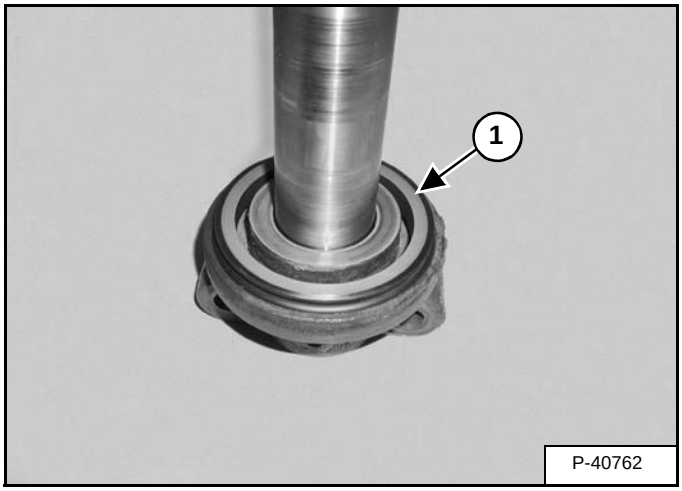


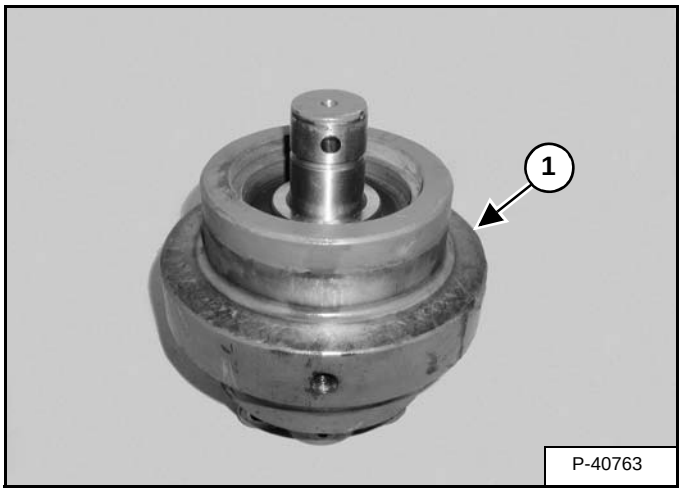
Figure 30-60-22



Apply a light film of oil to both metal seal rings (Item 1) **[Figure 30-60-21]** & **[Figure 30-60-22]**.

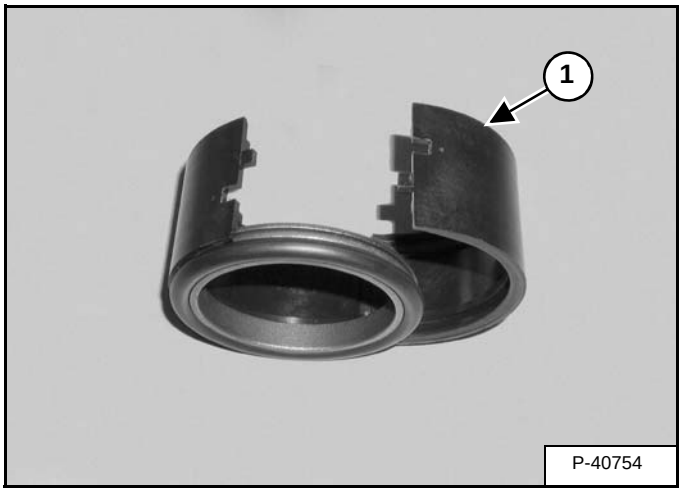
NOTE: Do not get any oil on the rubber O-rings.

Figure 30-60-23



Install the roller (Item 1) **[Figure 30-60-23]** over the shaft.

Figure 30-60-24



Place the seal assembly in the installation tool (Item 1) **[Figure 30-60-24]**.

The O-ring and seal ring assembly has to be lubricated with alcohol, so the O-ring will slip past the housing retaining ring and seal uniformly in the housing radius.

Dip the O-ring and seal ring assembly in a pan of alcohol.

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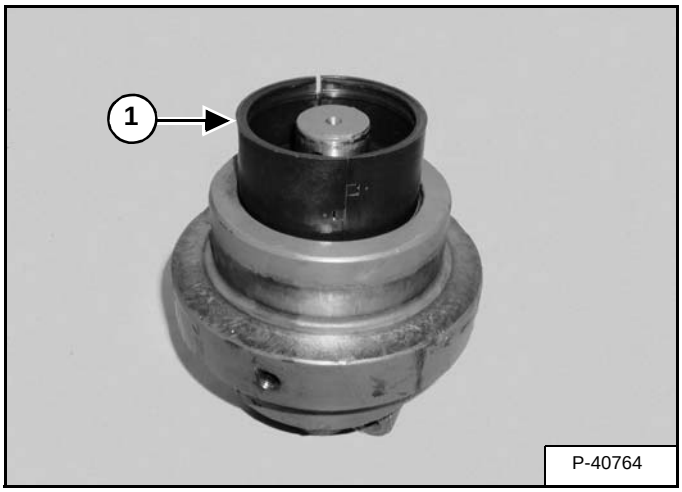
Assembly (Cont'd)

Figure 30-60-25

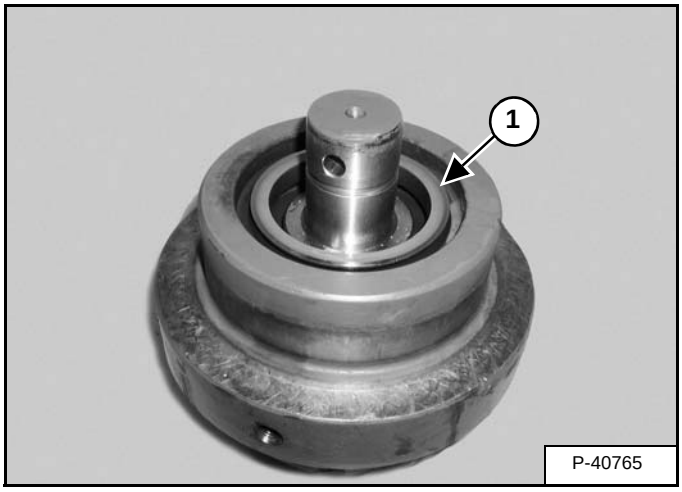


Shake off the excess alcohol and install the seal assembly (Item 1) **[Figure 30-60-25]** in the idler.

Use firm even pressure on the installation tool to *pop* the O-ring into the roller.

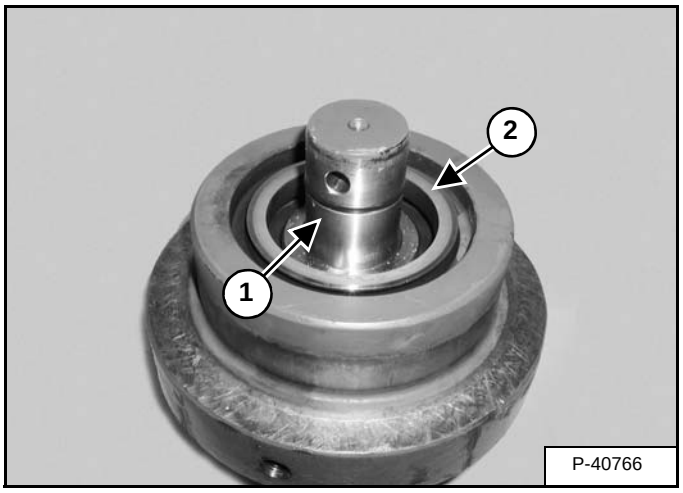
Remove the installation tool.

Figure 30-60-26



The seal assembly stand off height must be equal and the O-ring (Item 1) **[Figure 30-60-26]** must not be twisted.

Figure 30-60-27

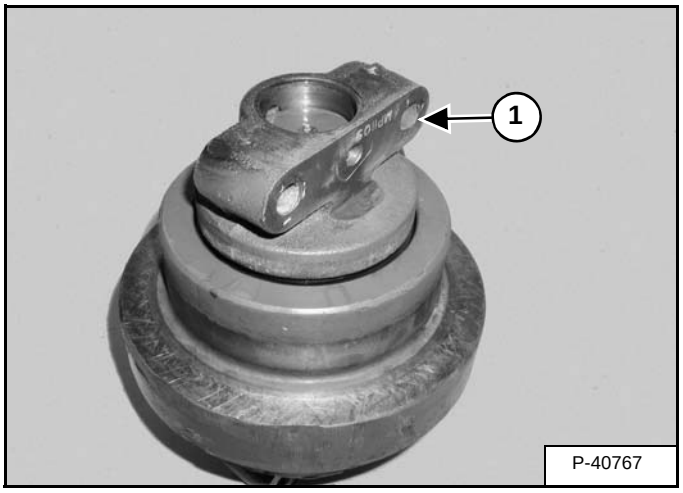


Install the O-ring (Item 1) **[Figure 30-60-27]** on the shaft.

Apply a light film of oil to both metal seals (Item 2) **[Figure 30-60-27]**.

NOTE: Do not get any oil on the rubber O-rings.

Figure 30-60-28



Install the mount (Item 1) **[Figure 30-60-28]** on the shaft.

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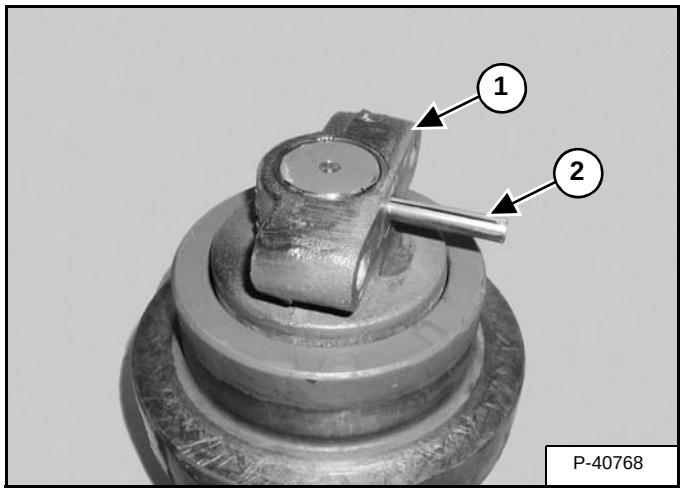
Assembly (Cont'd)

Figure 30-60-29

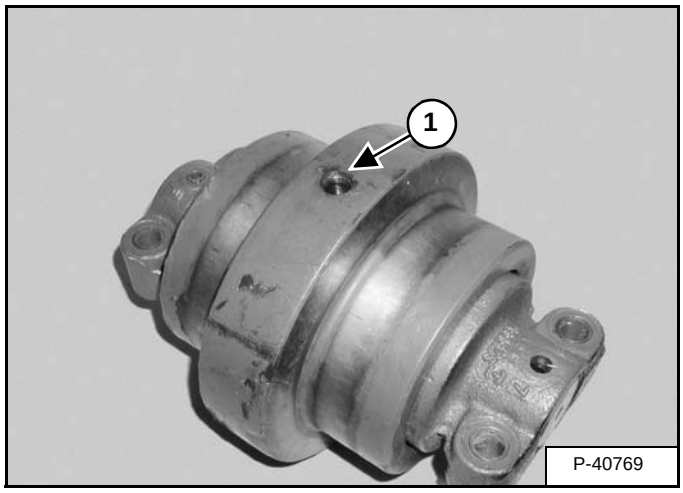


Press down on the mount (Item 1) and install the roll pin (Item 2) **[Figure 30-60-29]**.

Add 13 oz. (.38L) 80W/90 gear oil to the internal guide rollers.

Add 6 oz. (.18 L) 80/W90 gear oil to the external guide rollers.

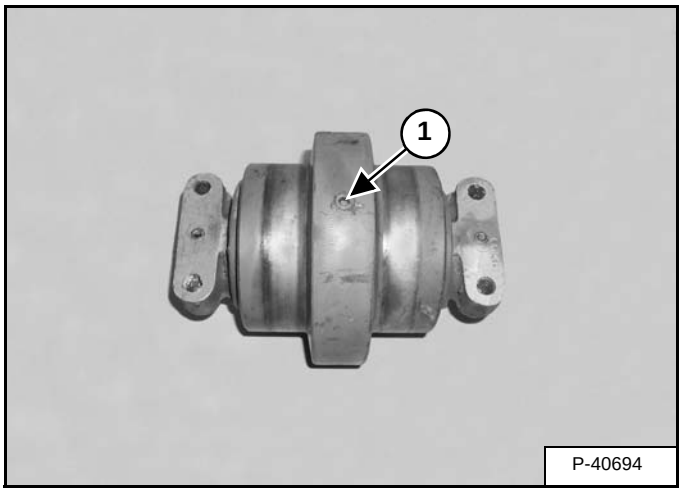
Figure 30-60-30



Add the oil through the fill hole (Item 1) **[Figure 30-60-30]**.

Apply thread adhesive (Loctite™ 242) to the plug.

Figure 30-60-31



Install the plug (Item 1) **[Figure 30-60-31]**.

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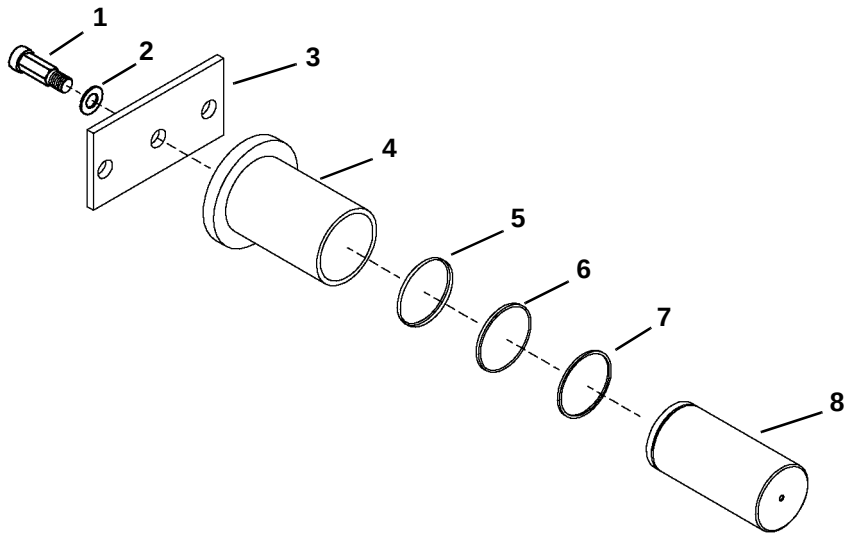
GREASE CYLINDER

Parts Identification

1. ADJUSTER
2. WASHER
3. PLATE
4. HOUSING
5. SEAL
6. SEAL
7. BACK-UP RING
8. CYLINDER



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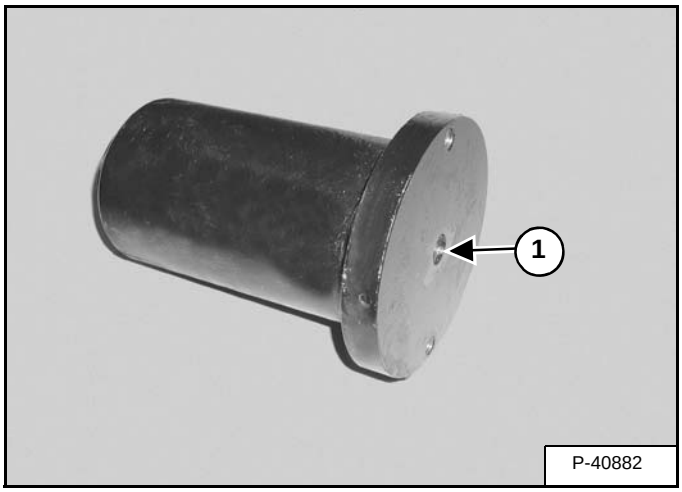
Disassembly

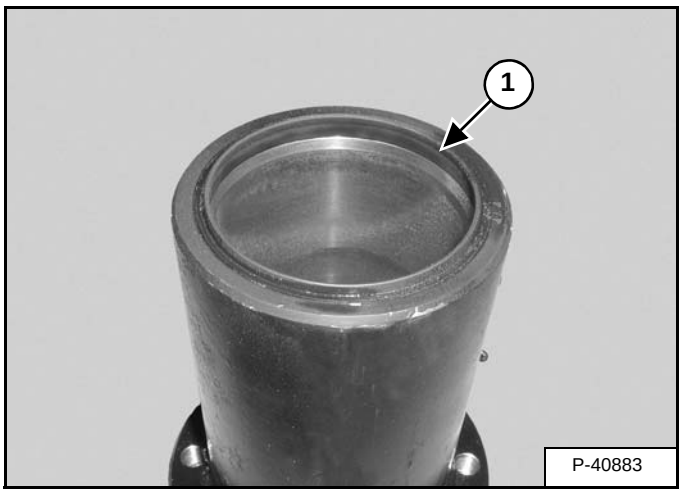
Figure 30-70-1



Install a brass drift through the track tensioner mount (Item 1) **[Figure 30-70-1]**.

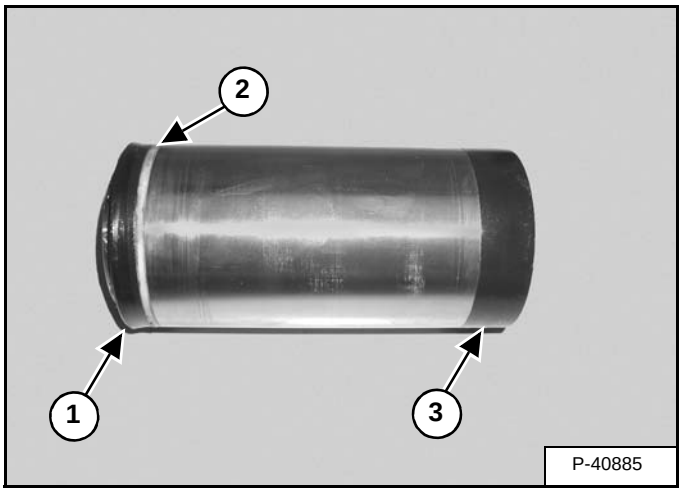
Tap the cylinder out of the housing.

Figure 30-70-2



Remove the seal (Item 1) **[Figure 30-70-2]**.

Figure 30-70-3



Remove the seal (Item 1) and backup ring (Item 2) **[Figure 30-70-3]**.

Remove any corrosion or paint (Item 3) **[Figure 30-70-3]** from the end of the cylinder.

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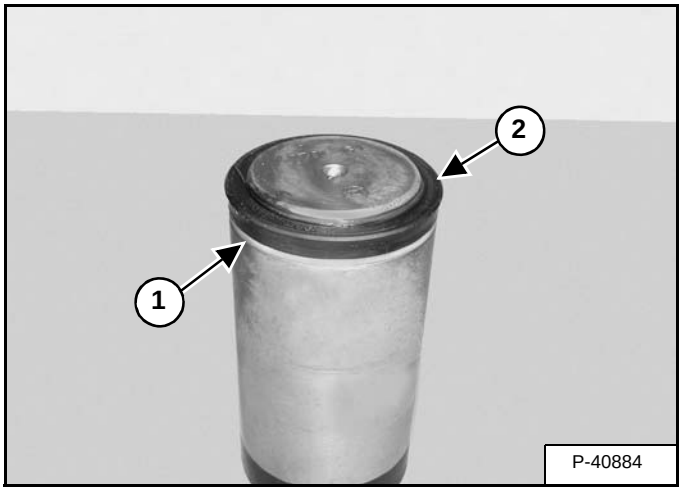
Assembly

Clean all parts in solvent and dry with compressed air.

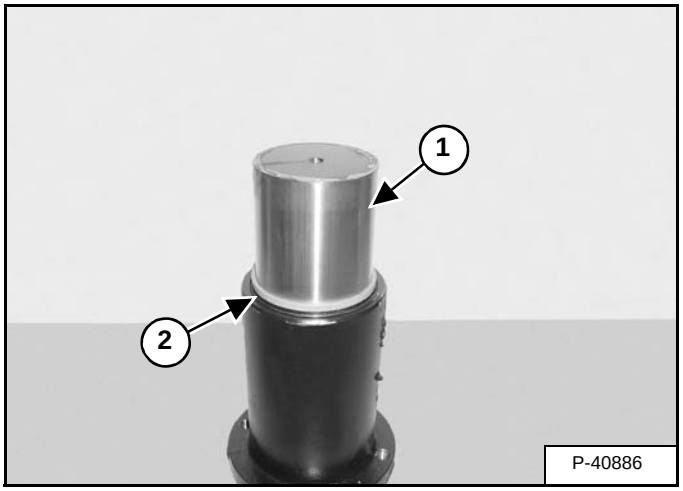
Figure 30-70-4



Install the back-up ring (Item 1) **[Figure 30-70-4]**.

Install the seal (Item 2) **[Figure 30-70-4]**. Apply clean hydraulic fluid to the OD of the seal.

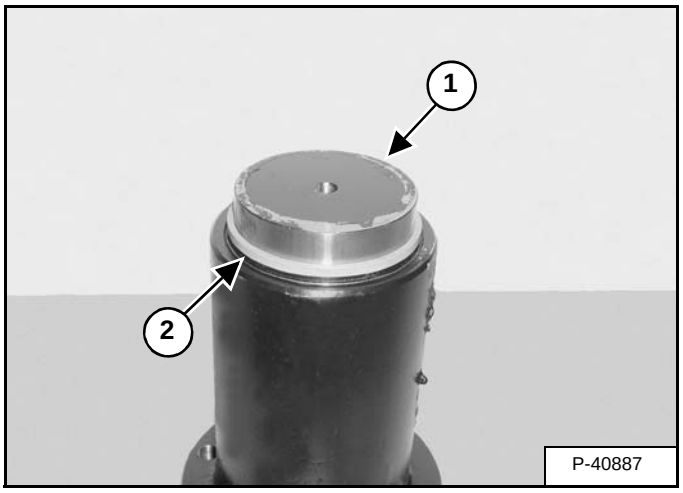
Figure 30-70-5



Install the cylinder (Item 1) **[Figure 30-70-5]** in the housing.

Install the housing seal (Item 2) **[Figure 30-70-5]** over the cylinder.

Figure 30-70-6



Fully seat the cylinder (Item 1) **[Figure 30-70-6]**.

Install the seal (Item 2) **[Figure 30-70-6]** into the seal bore of the housing.

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TRACK DAMAGE IDENTIFICATION

Cutting Of Steel Cords

The following pages show photos and illustrations of track damage and the probable cause of the damage. It is intended to be used for identifying the reason for track damage and how to avoid future track damage.

Damage:

Figure 30-80-1

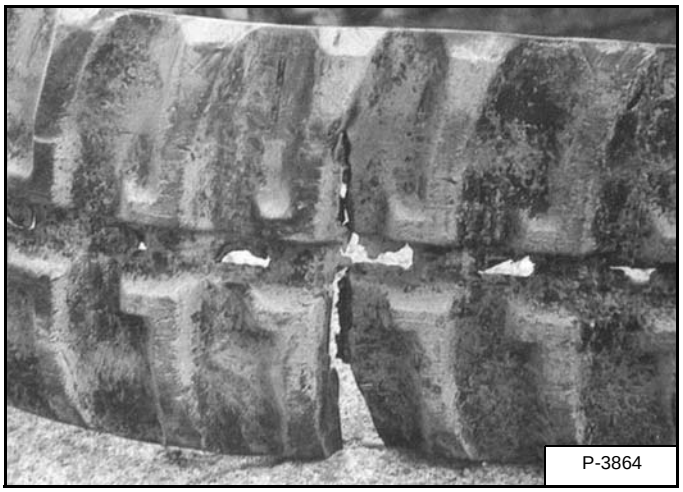
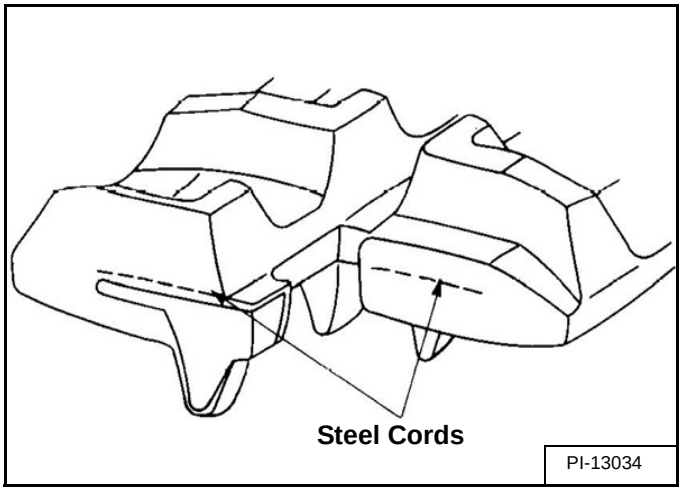


Figure 30-80-2



Embedded steel cords are cut off **[Figure 30-80-1]** & **[Figure 30-80-2]**.

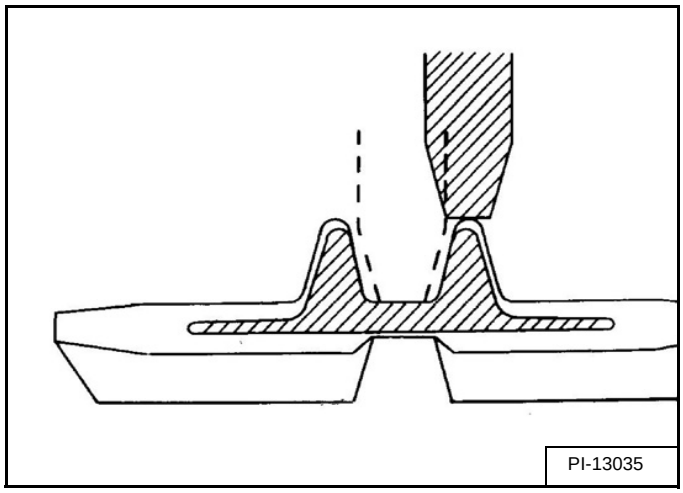
Replacement:

Replacement is required **[Figure 30-80-1]** & **[Figure 30-80-2]**.

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 30-80-3



When the rubber track is detracting, the idler or sprocket rides on the projections of the embedded metal **[Figure 30-80-3]**.

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.

Furthermore, when moisture invades 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:

Periodical checking on site of the recommended track tension. (See TRACKS on Page 30-20-1.)

Avoiding quick turns on bumpy and rocky fields.

Drive carefully to avoid having stones and other articles clog the rubber tracks.

Driving over sharp objects should be avoided. If this is impossible, do not make turns while driving over sharp objects.

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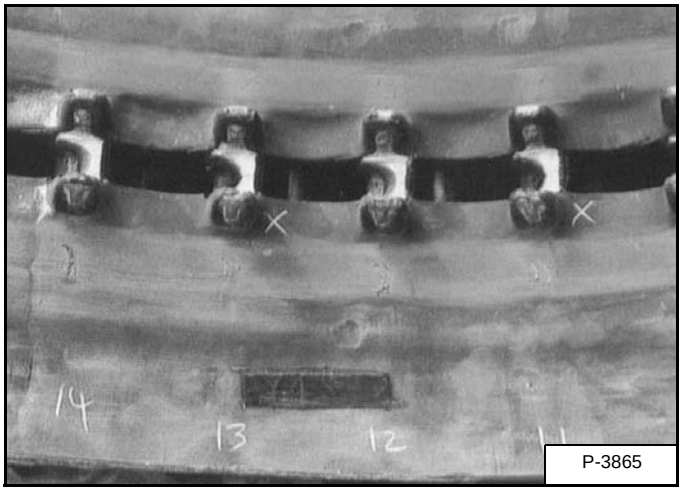
TRACK DAMAGE IDENTIFICATION (CONT'D)

Abrasion Of Embedded Metals

Damage:

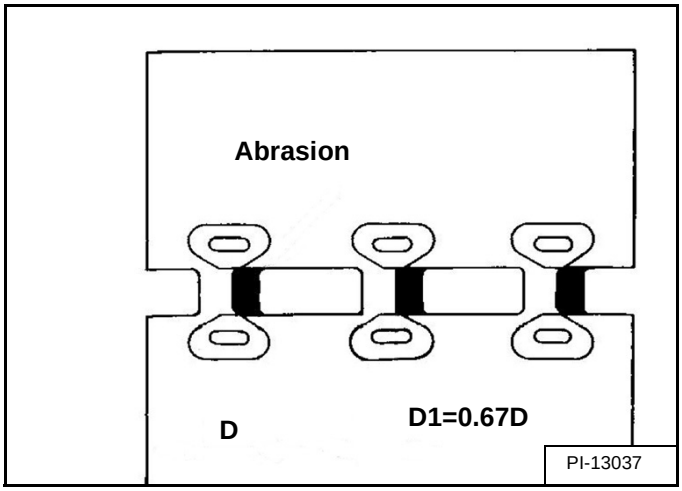
Figure 30-80-4



In proportion to the service time, embedded metals will gradually wear away by friction **[Figure 30-80-4]**.

Replacement:

Figure 30-80-5



Replacement is required when the width of the embedded metals (D1) becomes 67% of their original width (D) **[Figure 30-80-5]**.

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 their 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.

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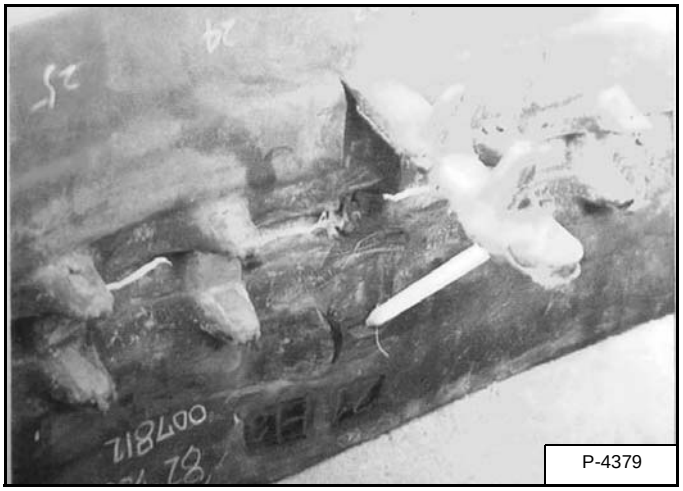
Separation Of Embedded Metals

Damage:

Figure 30-80-6



Extraordinary outer forces applied to embedded metals cause their separation from the rubber track's body **[Figure 30-80-6]**.

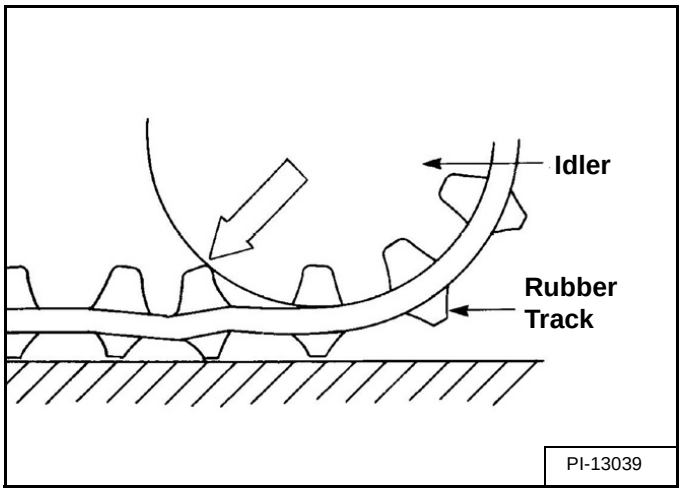
Replacement:

Even a partial separation of embedded metals requires replacement of the track.

Causes Of The Damage:

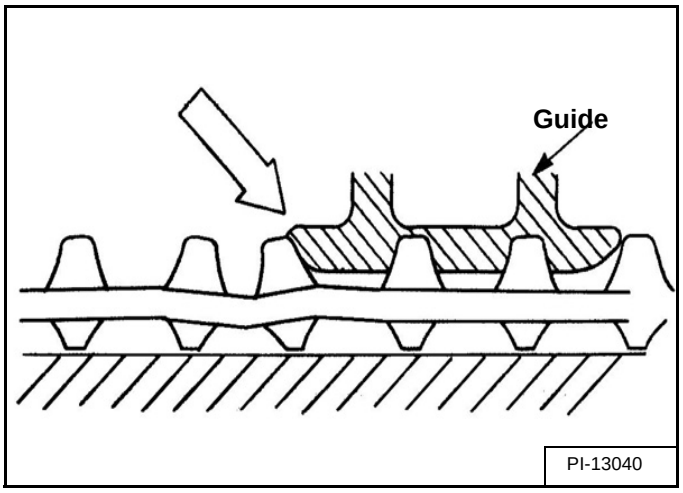
Embedded metals are adhered between the steel cords and the rubber body. The following cases generate external forces greater than the adhesion strength, causing separation of the embedded metals:

Figure 30-80-7



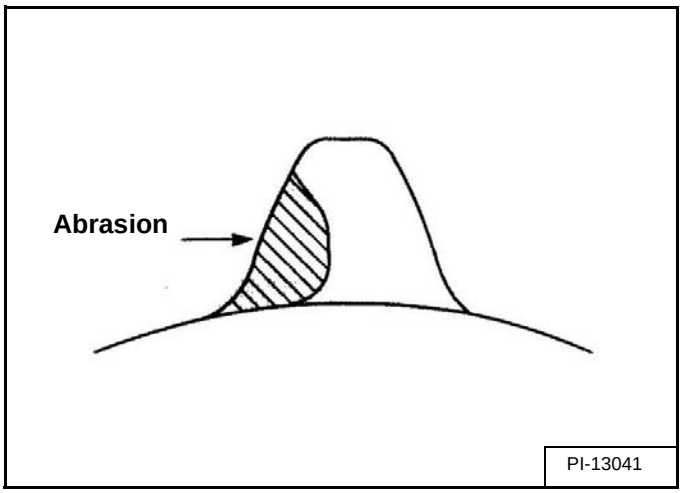
When the idler continually rides on the projections of embedded metals, the embedded metals will eventually peel off **[Figure 30-80-7]**.

Figure 30-80-8



When a rubber track is detracted, it becomes stuck between the guide or the undercarriage frame, causing the separation of embedded metals **[Figure 30-80-8]**.

Figure 30-80-9



Abnormally worn sprockets as shown will pull embedded metals out **[Figure 30-80-9]**.

Prevention:

Similar to the prevention against the cutting of the steel cords:

Recommended track tension should be periodically checked. (See TRACKS on Page 30-20-1.)

Quick turns on bumpy and rocky fields should be avoided.

If abnormal wear of sprockets is observed, they should be immediately replaced.

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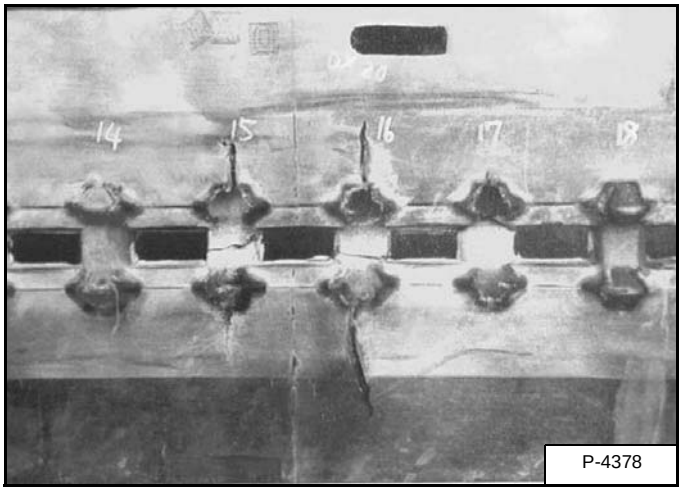
Separation Of Embedded Metals Due To Corrosion

Damage:

Figure 30-80-10



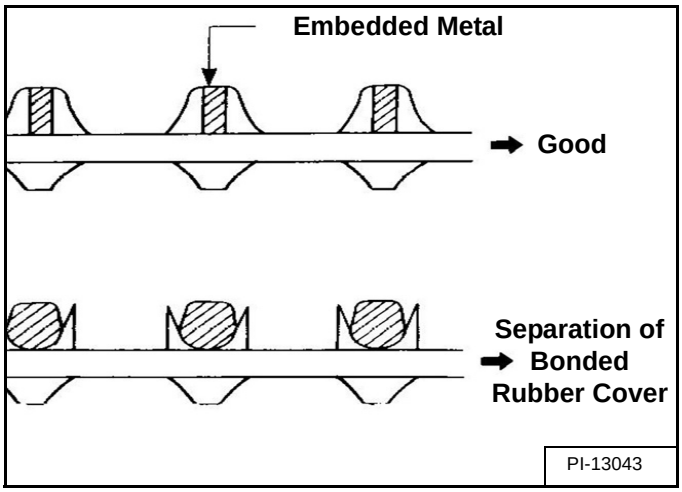
Due to corrosion of embedded metals, the adhesion to the rubber body deteriorates, resulting in complete separation **[Figure 30-80-10]**.

Replacement:

Even a partial separation of embedded metals requires a rubber track replacement.

Causes Of The Damage:

Figure 30-80-11



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 30-80-11]**.

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.

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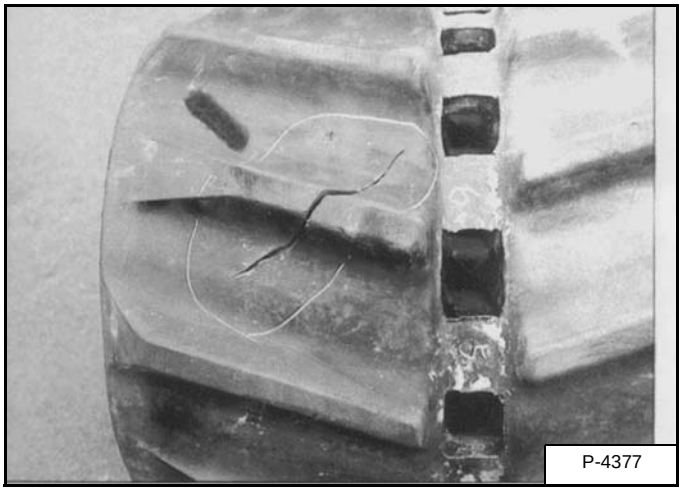
Cuts On The Lug Side Rubber

Damage:

Figure 30-80-12



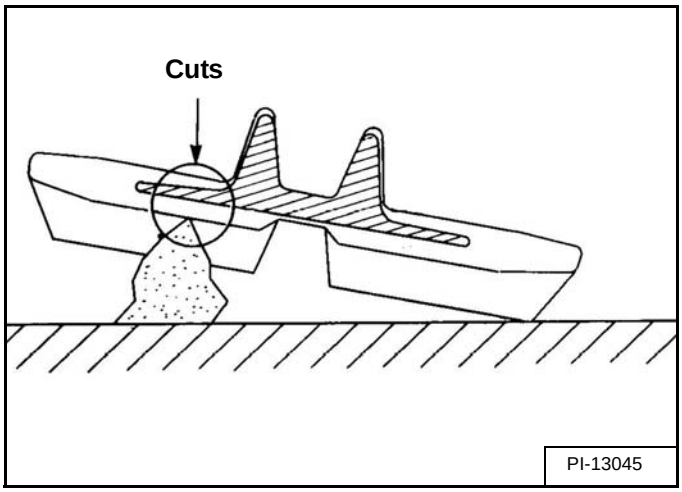
Cuts on the lug side rubber often occurs as one of the most typical failure modes **[Figure 30-80-12]**

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 30-80-13



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 steel cords' breakage due to their corrosion. It is highly recommended to repair the cuts with cold vulcanization rubber as soon as they are observed **[Figure 30-80-13]**.

Prevention:

Machine operators are requested to drive with great attention to the ground's 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, high speed, quick turns and overloading should be avoided.

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Cracks On The Lug Side Rubber Due To Fatigue

Damage:

Figure 30-80-14

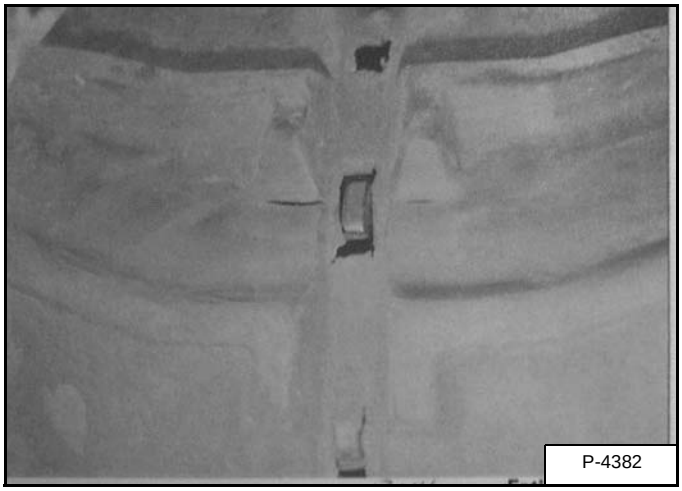
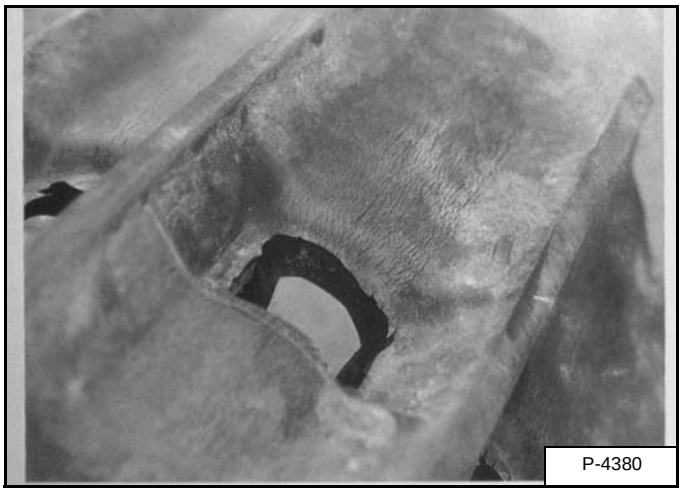


Figure 30-80-15



Small cracks around the root of the lug as a result from operation fatigue **[Figure 30-80-14]** & **[Figure 30-80-15]**.

Replacement:

When the cracks reach so deep that they 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 injuries on the lug side rubber sometimes cause more chance of cracking. Machine operators should observe soil conditions when driving, so as not to cause external injuries to the lug side rubber. In order to minimize the occurrence of ozone cracks, attention should be paid to the following instructions for maintenance:

Avoid exposing stored tracks to direct sun light.

Avoid exposing stored tracks to direct rain and snow fall.

Store tracks in well ventilated warehouses.

Use the tracks at least once a month.

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Lug Abrasion

Prevention:

Figure 30-80-16

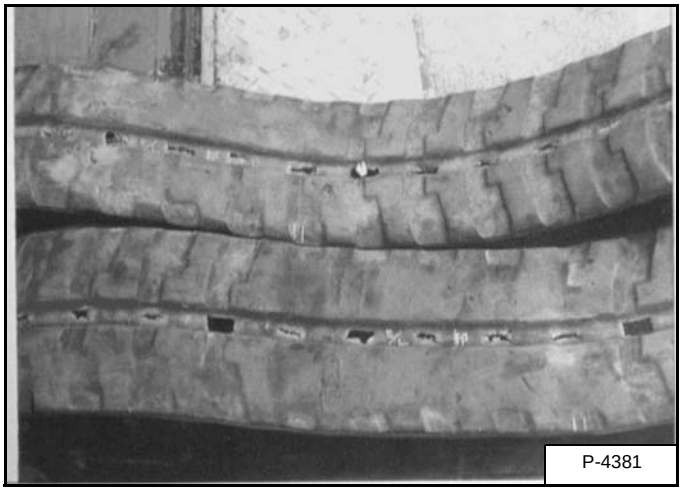
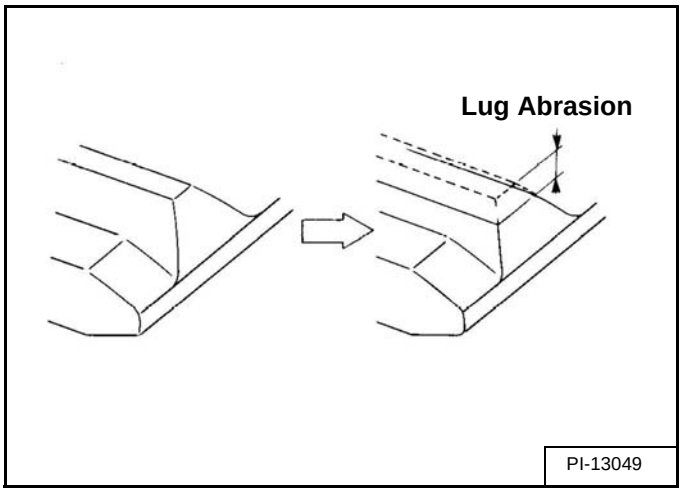


Figure 30-80-17



As its service time proceeds, the lug side inevitably undergoes abrasion **[Figure 30-80-16]** & **[Figure 30-80-17]**.

Replacement:

No replacement is required.

Causes Of The Damage:

Lug abrasion is more or less inevitable. Even if lug abrasion is proceeding, the rubber track can be used. However, as the traction performance deteriorates accordingly, it is highly recommended to replace the abraded tracks with new ones when the lug height becomes less than 0.197 in (5 mm).

Prevention:

In order to prevent the rubber track from abnormal or premature abrasion, 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

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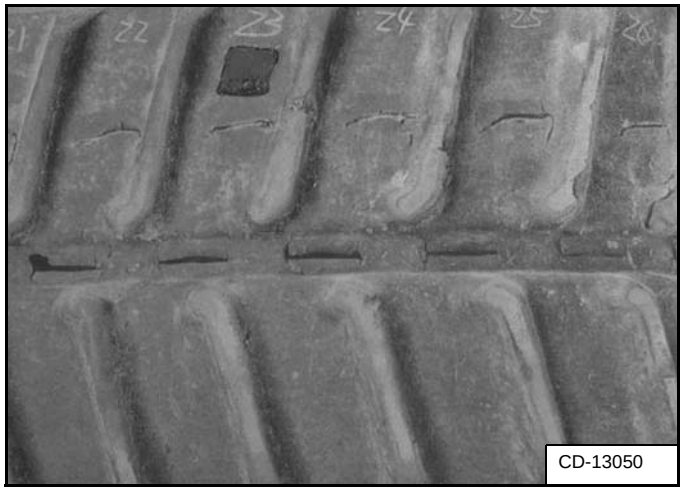
Cracks And Cuts On The Lug Side Rubber

Damage:

Figure 30-80-18



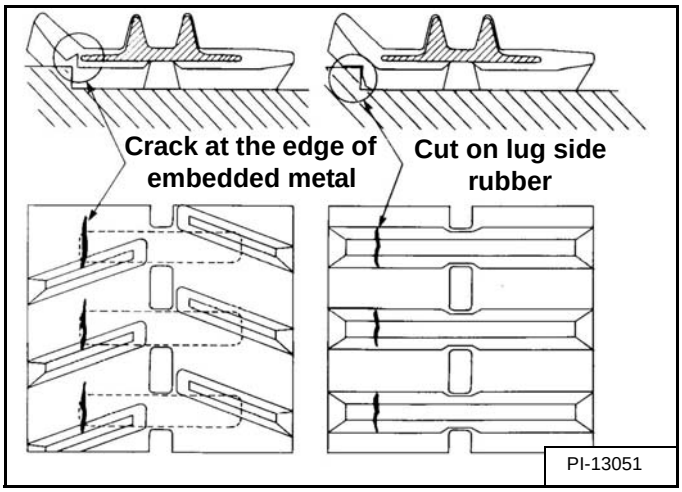
Sometimes cracks and cuts on the lug side rubber at the edges of the embedded metals can be observed **[Figure 30-80-18]**.

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 30-80-19



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 30-80-19]**.

Prevention:

To avoid extensive stress applied to the lug root where metals are embedded, machine operators are requested to avoid driving over stumps and ridges.

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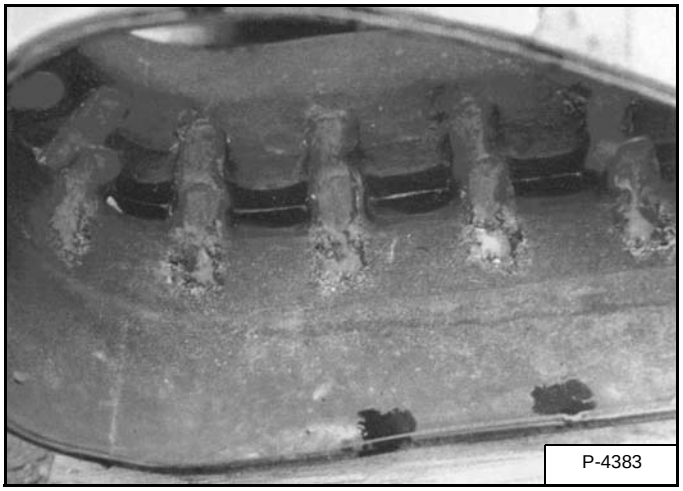
Abrasion Of The Track Roller Side

Damage:

Figure 30-80-20



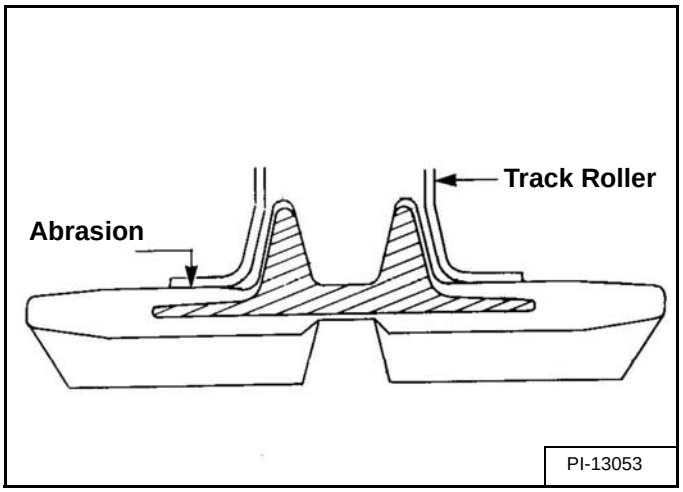
The rubber surface on which track rollers run is gradually abraded. It will end in the exposure of the embedded metals **[Figure 30-80-20]**.

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 30-80-21



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 30-80-21]**.

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.

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Cuts On The Edges Of Track Roller Side

Damage:

Figure 30-80-22

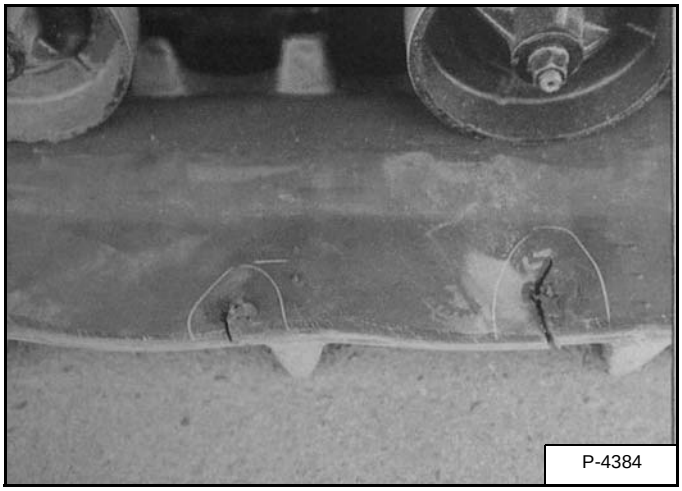
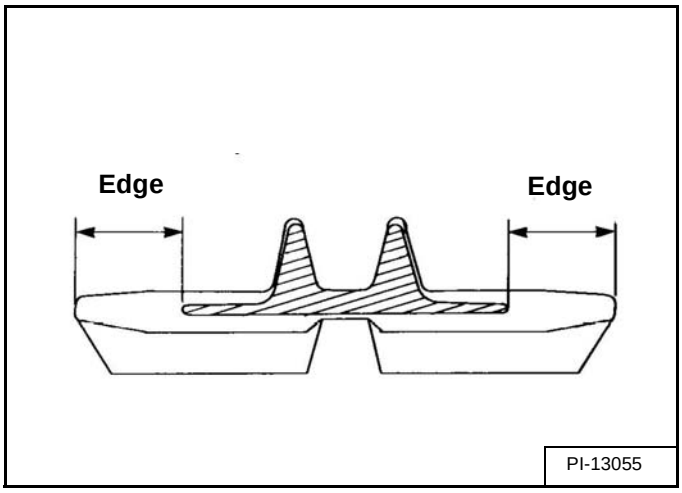


Figure 30-80-23



Both edges of a rubber track have no special reinforcements. It sometimes occurs during operation that they are cut or torn off **[Figure 30-80-22]** & **[Figure 30-80-23]**.

Replacement:

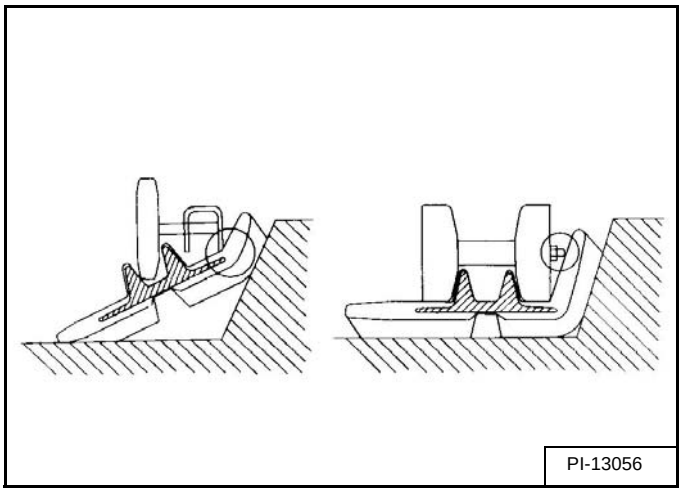
In such case, the rubber track does not have to be replaced.

Causes Of The Damage:

This damage is caused by objects on the field or by interference with the machine frame.

In case of damage by objects on the operating ground:

Figure 30-80-24



The edges of rubber track are often deformed largely due to a bumpy ground surface, stones and other objects, which cause extensive stress on the edges resulting in the damage. Especially, when a machine drives over concrete ridges, this type of damage easily occurs **[Figure 30-80-24]**.

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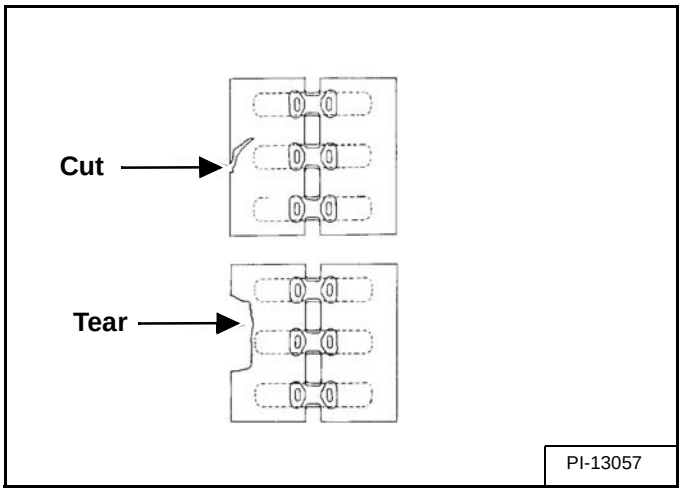
Cuts On The Edges Of Track Roller Side (Cont'd)

In case of damage by interference with the machine frame:

Figure 30-80-25



If a machine continues operating with rubber tracks being detracted, 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 30-80-25]**.

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.

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UPPERSTRUCTURE & SWING SECTION

ARM 40-130-1
Bushing Removal And Installation 40-130-4
Removal And Installation 40-130-1

BOOM 40-120-1
Bushing Removal And Installation 40-120-8
Removal And Installation 40-120-1

BUCKET 40-140-1
Removal And Installation 40-140-1

CAB 40-20-1
Cab Visor Removal And Installation 40-20-23
Door, Left Side, Right Side And Rear Window Installation 40-20-21
Door, Left Side, Right Side And Rear Window Removal . 40-20-20
Door Removal And Installation 40-20-8
Front Window Disassembly And Assembly (S/N 522311001 & Above) 40-20-14
Front Window Gas Strut Removal And Installation 40-20-17
Front Window Pivot Frame Removal And Installation . . . 40-20-18
Front Window Removal And Installation 40-20-9
Lower Front Widow Removal And Installation 40-20-19
Removal And Installation 40-20-1
Top Window Removal And Installation. 40-20-24

CONTROL LEVERS 40-70-1
Description 40-70-1

COUNTERWEIGHT 40-170-1
Removal And Installation 40-170-1

ENGINE SPEED CONTROL. 40-60-1
Disassembly And Assembly. 40-60-3
Removal And Installation 40-60-1

FLOOR MAT 40-110-1
Removal And Installation 40-110-1

FUEL TANK. 40-80-1
Removal And Installation 40-80-1

HORN 40-90-1
Removal And Installation 40-90-1

Continued On Next Page

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LEFT CONSOLE 40-50-1
Console Lockout Switch Removal And Installation 40-50-8
Disassembly And Assembly 40-50-6
Removal And Installation 40-50-1

REAR COVER 40-150-1
Removal And Installation 40-150-1

RIGHT CONSOLE 40-40-1
Description 40-40-1

RIGHT SIDE COVER 40-160-1
Removal And Installation 40-160-1

SEAT AND SEAT MOUNT 40-30-1
Removal And Installation 40-30-1

SWING FRAME 40-100-1
Bushing Removal And Installation 40-100-5
Removal And Installation 40-100-1

UPPERSTRUCTURE 40-10-1
Removal And Installation 40-10-1
Swing Bearing Removal And Installation 40-10-6

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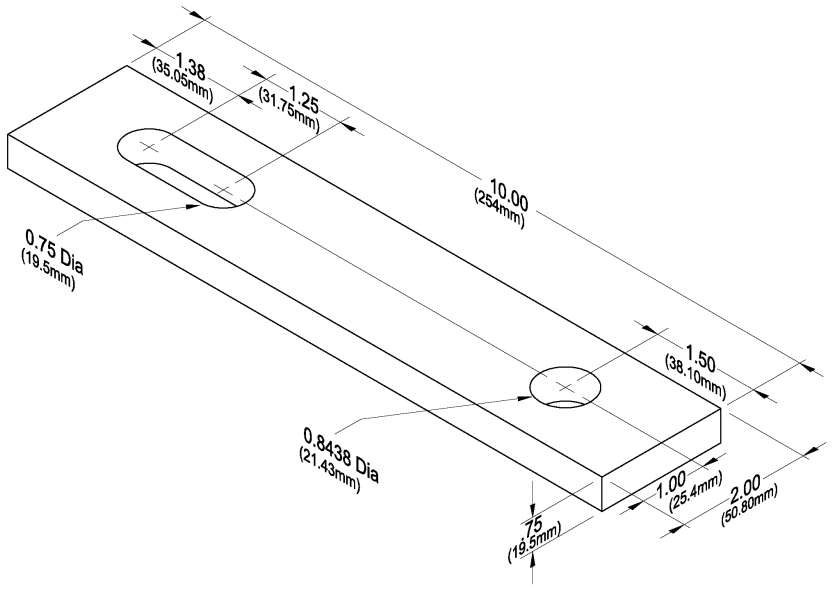
UPPERSTRUCTURE

Removal And Installation

Build the service lifting brackets used to remove and install the upperstructure **[Figure 40-10-1]** & **[Figure 40-10-2]**.

Figure 40-10-1

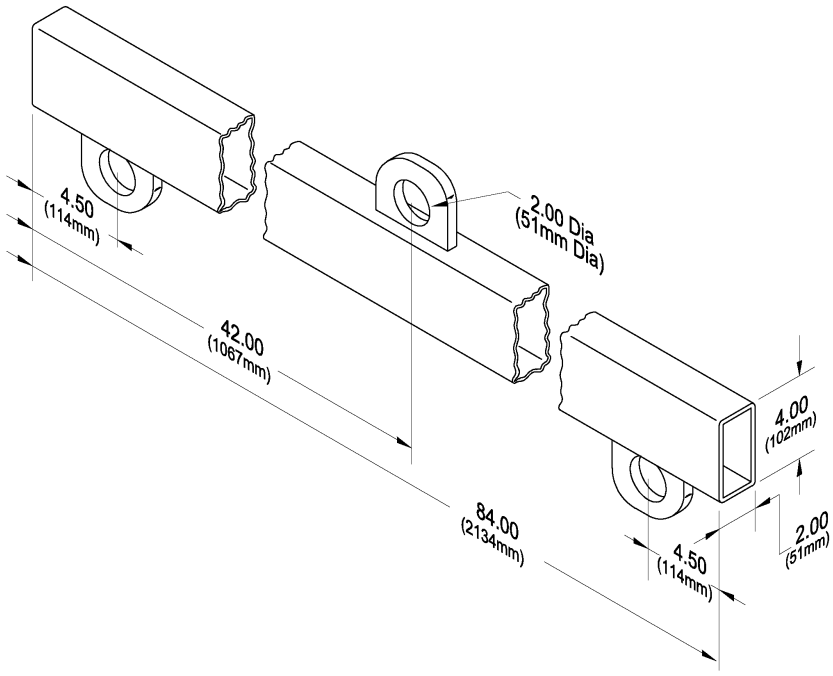
Lifting Bracket (two needed)



MS1570

Figure 40-10-2

Spreader Bar



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Removal And Installation (Cont'd)

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

Drain the fuel tank. (See Draining The Fuel Tank on Page 10-80-8.)

Remove the swing motor. (See SWING MOTOR on Page 20-90-1.)

Remove the swivel joint. (See SWIVEL JOINT on Page 20-80-1.)

Remove the arm. (See ARM on Page 40-130-1.)

Remove the boom. (See BOOM on Page 40-120-1)

Remove the cab. (See CAB on Page 40-20-1.)

Remove the right side cover. (See RIGHT SIDE COVER on Page 40-160-1.)

Remove the rear cover. (See REAR COVER on Page 40-150-1.)

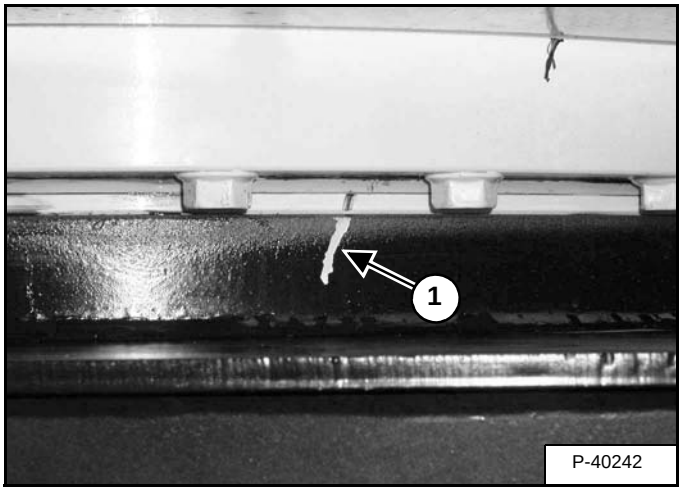
Remove the seat. (See SEAT AND SEAT MOUNT on Page 40-30-1.)

Remove the engine. (See ENGINE (S/N 522311001 & ABOVE) on Page 60-60-1 or See ENGINE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-61-1.)

Remove the counterweight. (See COUNTERWEIGHT on Page 40-170-1.)

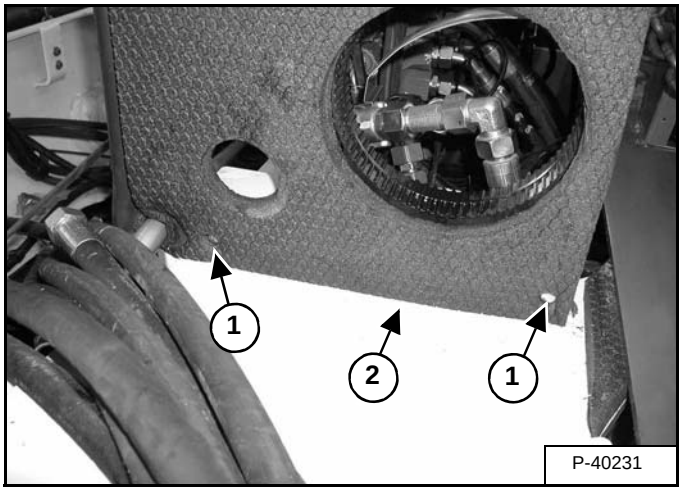
Remove the air cleaner. (See AIR CLEANER on Page 60-30-1.)

Figure 40-10-3



Mark the track frame to swing bearing (Item 1) **[Figure 40-10-3]**.

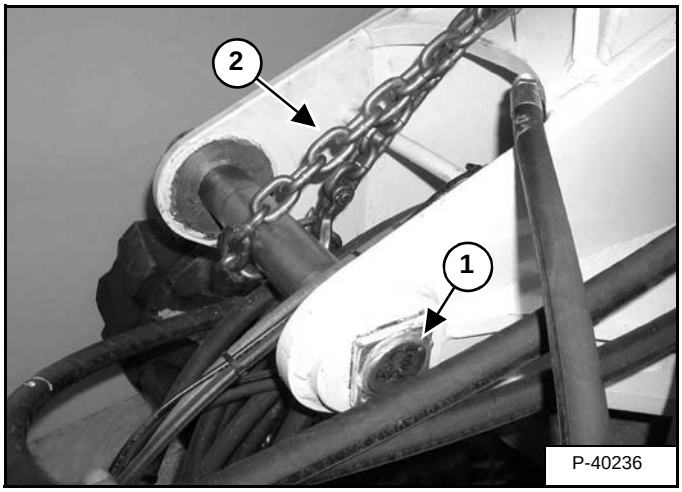
Figure 40-10-4



Remove the two bolts (Item 1) **[Figure 40-10-4]**.

Remove the air cleaner mount (Item 2) **[Figure 40-10-4]**.

Figure 40-10-5



Install the boom pivot pin (Item 1). Install a chain (Item 2) **[Figure 40-10-5]** on the pivot pin.

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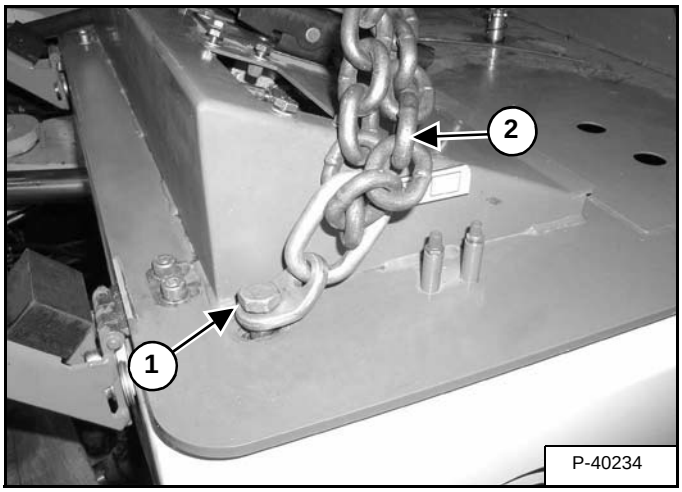
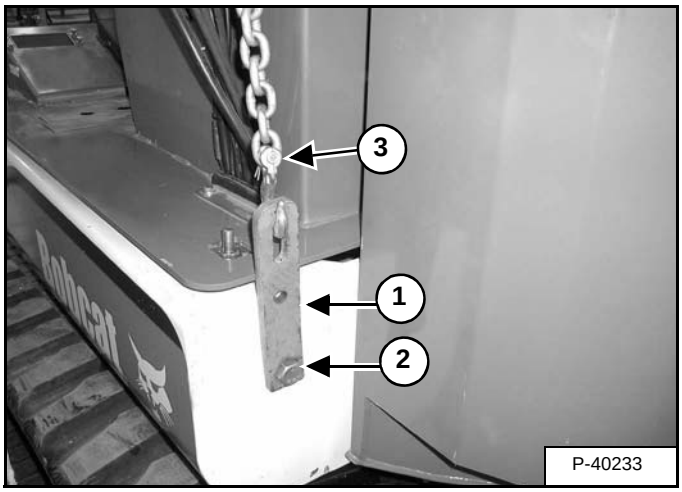
Removal And Installation (Cont'd)

Figure 40-10-6



Install a lifting bracket (Item 1) on the left front cab mount. Install a chain (Item 2) **[Figure 40-10-6]** on the lifting bracket.

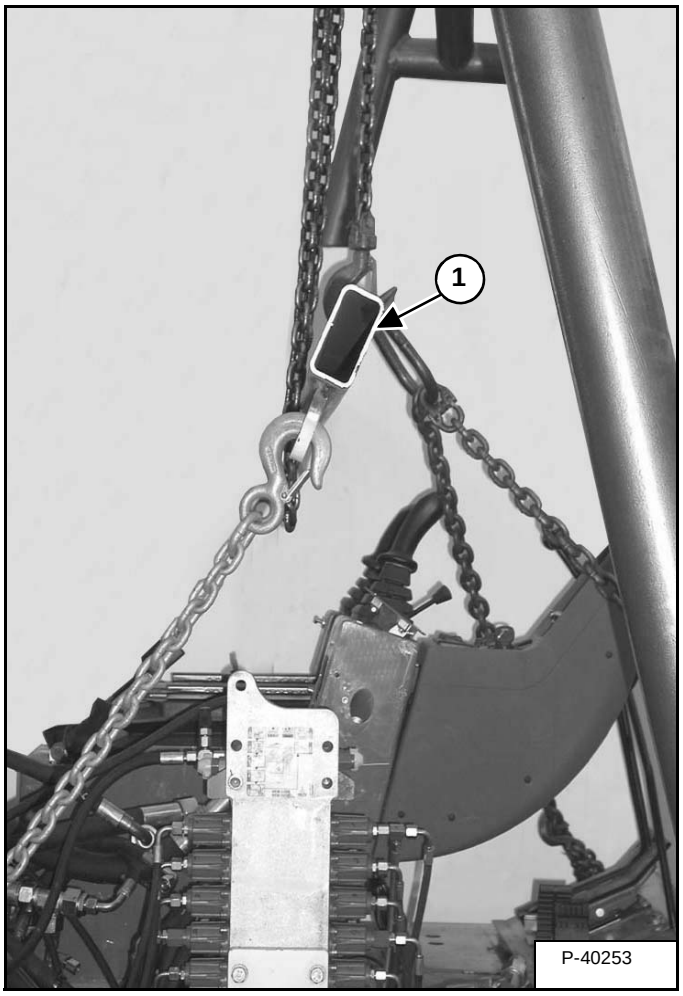
Figure 40-10-7



Install the rear lifting brackets (Item 1) using the counterweight bolt holes. Use two 20 mm x 64 mm MC grade 8.8 bolts (Item 2) **[Figure 40-10-7]** to install the brackets.

Install the chains (Item 3) **[Figure 40-10-7]** to the lifting brackets.

Figure 40-10-8



Position the spreader bar (Item 1) **[Figure 40-10-8]** as shown and attach the lifting chains to the bar.

NOTE: The chain hoist the spreader bar and lifting chains are attached to must have a swivel hook to allow the upperstructure to be turned.

Apply a small amount of lifting pressure to the upperstructure with the chain hoist.

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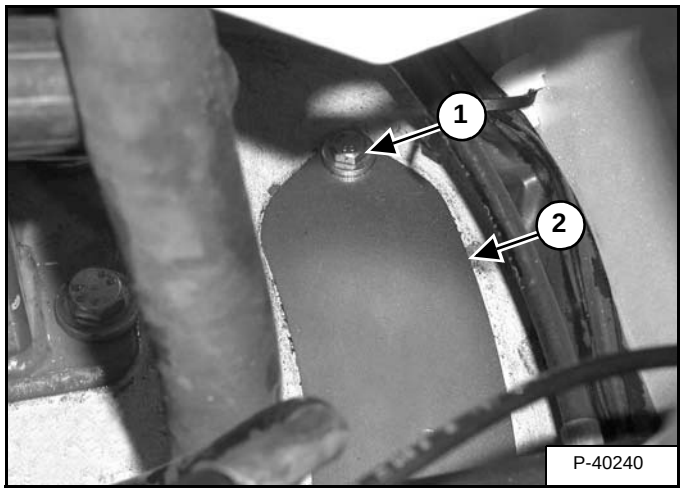
Removal And Installation (Cont'd)

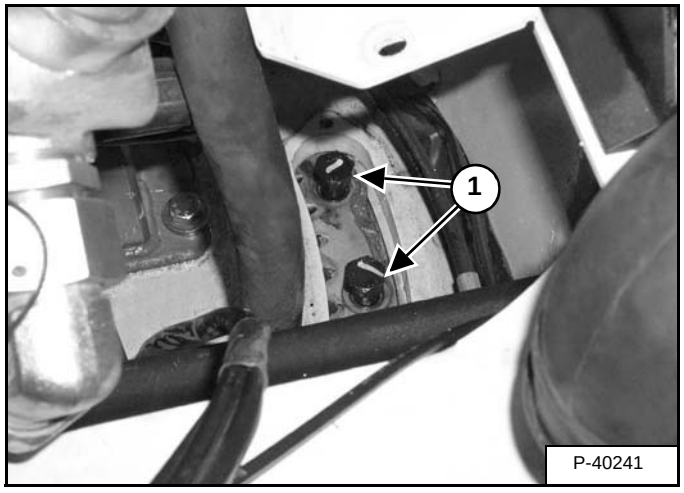
Figure 40-10-9



Remove the two bolts (Item 1) and washers. Remove the cover (Item 2) **[Figure 40-10-9]**.

NOTE: The cover is located below the air cleaner mount.

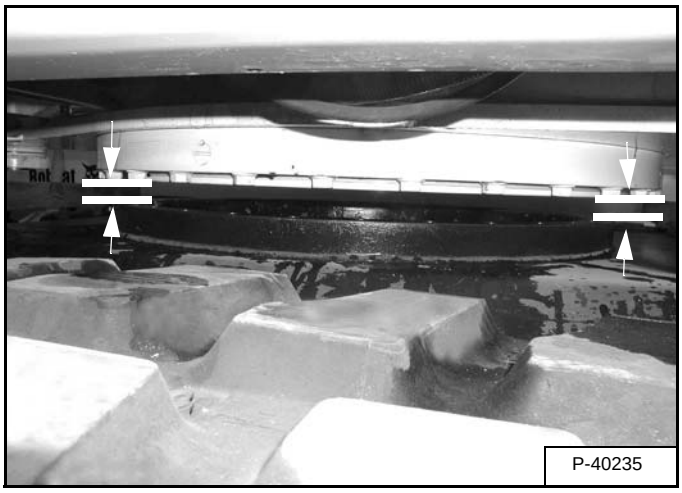
Figure 40-10-10



Remove the bolts (Item 1) **[Figure 40-10-10]**. Rotate the upperstructure by hand and continue removing the bolts.

NOTE: The upperstructure is mounted to the track frame with 30 bolts.

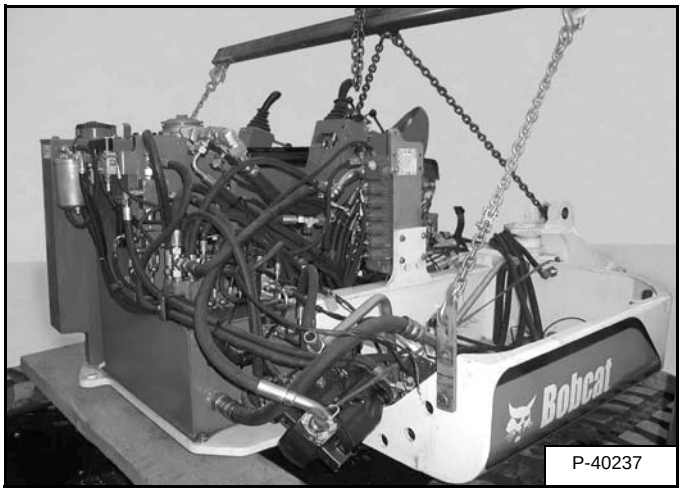
Figure 40-10-11



Raise the upperstructure. Make sure the upperstructure is level as it is being raised **[Figure 40-10-11]**.

Lower the upperstructure and adjust the lifting chains as needed to pull the upperstructure squarely off of the track frame.

Figure 40-10-12



Remove the upperstructure **[Figure 40-10-12]**. Position the upperstructure on suitable support stands or blocks.

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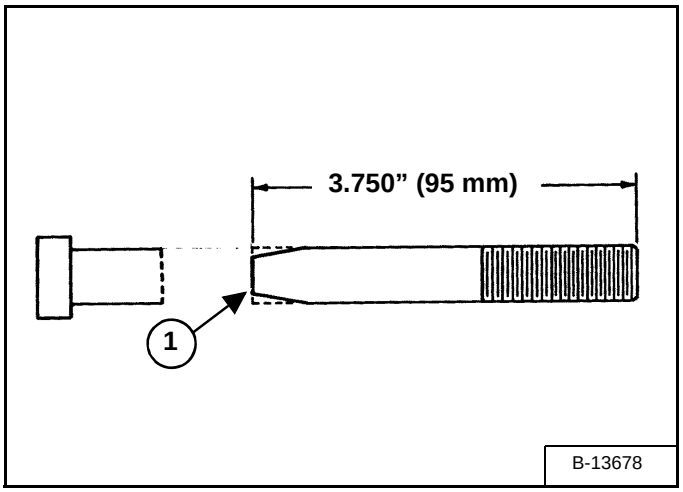
Removal And Installation (Cont'd)

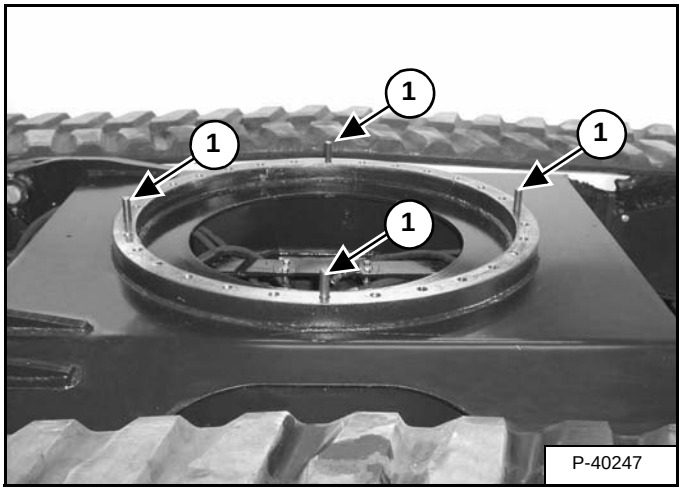
Figure 40-10-13



Make four alignment pins by using 16 mm x 100 mm long MC bolts. Cut the head off of the bolts at 3.750 inches (95 mm), then taper the end **[Figure 40-10-13]**.

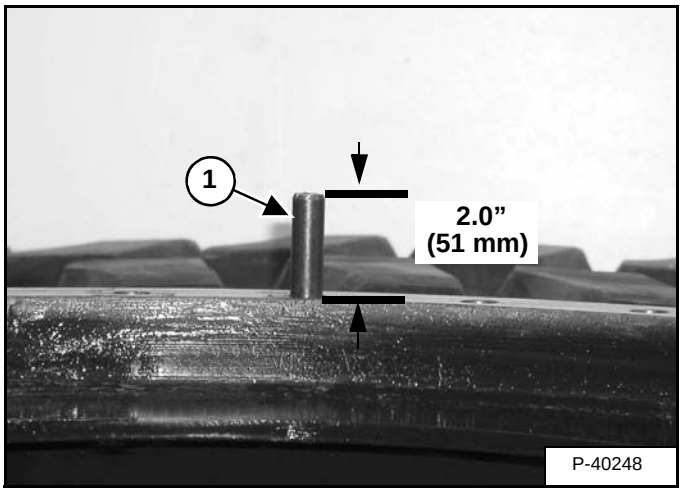
Cut a slot (Item 1) **[Figure 40-10-13]** in the end of the bolts so the bolts can be removed with a flat blade screwdriver.

Figure 40-10-14



Install the bolts (Item 1) **[Figure 40-10-14]** approximately 90× apart in the track frame.

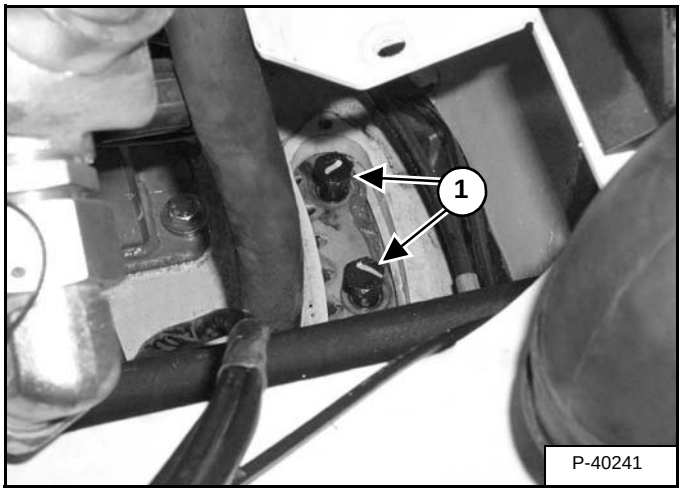
Figure 40-10-15



Install the bolts (Item 1) **[Figure 40-10-15]** until the bolt is 2.0 inches (51 mm) above the track frame.

Lower the upperstructure on to the track frame.

Figure 40-10-16



Install the bolts (Item 1) **[Figure 40-10-16]**. Do not tighten the bolts at this time.

Turn the upperstructure by hand and continue installing the bolts. Remove the alignment pins as the bolts are installed. After all thirty bolts have been installed, tighten the bolts to 206 ft.-lb. (279 N•m) torque.

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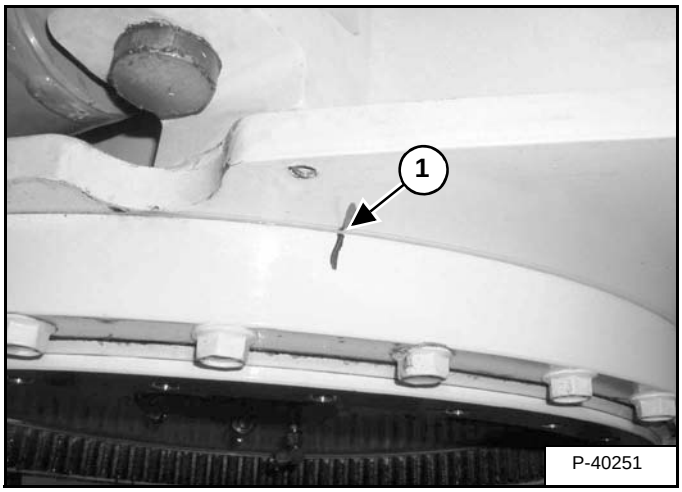
Swing Bearing Removal And Installation

Figure 40-10-17



Mark the swing bearing to upperstructure (Item 1) **[Figure 40-10-17]**.

Figure 40-10-18

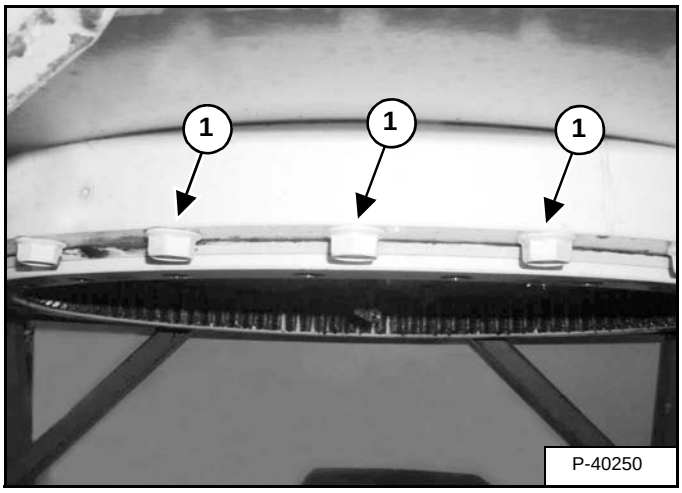
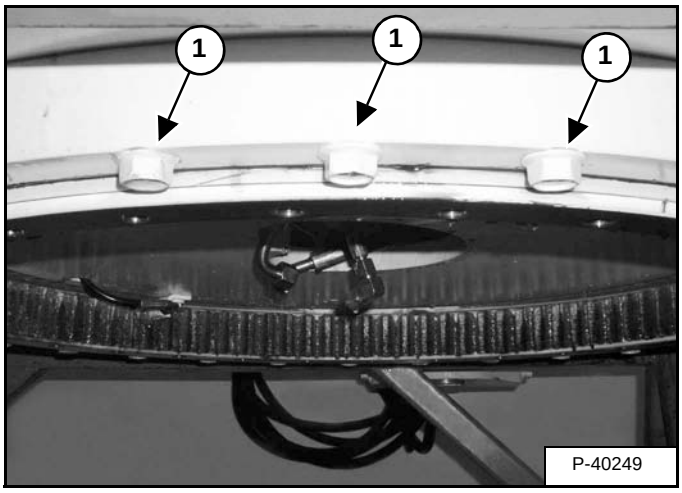


Figure 40-10-19



Mark and remove three bolts (Item 1) **[Figure 40-10-18]** & **[Figure 40-10-19]** from the front and rear of the swing bearing.

NOTE: The swing bearing is installed with twenty seven bolts that are 70 mm in length and three bolts that are 80 mm in length.

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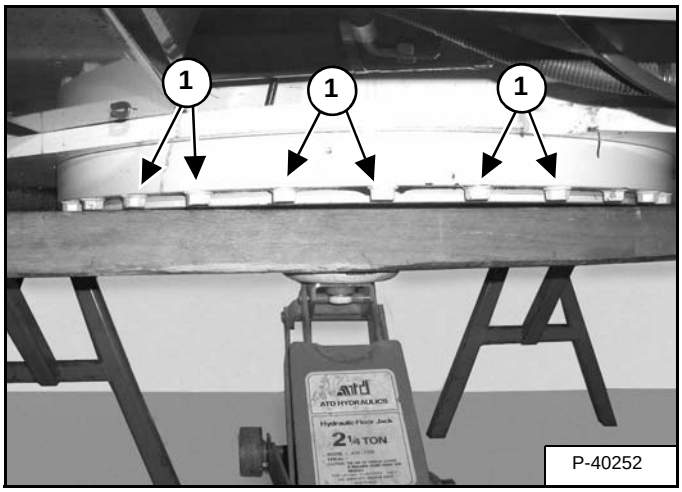
Swing Bearing Removal And Installation (Cont'd)

Figure 40-10-20

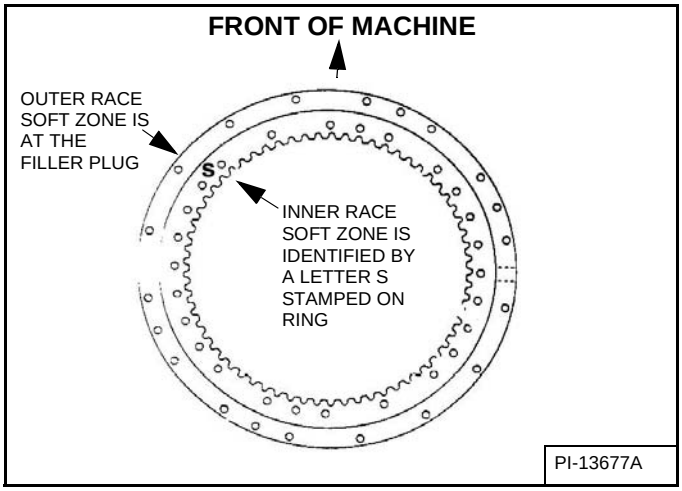


Support the swing bearing with a jack and remove the bolts (Item 1) **[Figure 40-10-20]**.

Installation: Tighten the bolts to 240 ft.-lb. (325 N•m) torque.

Lower the swing bearing away from the upperstructure.

Figure 40-10-21



If a new swing bearing is being installed, locate the soft zone area **[Figure 40-10-21]**.

Install the swing bearing so that the soft zone is positioned to the left hand side of the excavator.

NOTE: DO NOT locate the soft zone to the front or rear of excavator.

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CAB

Removal And Installation

Build the service lifting brackets used to remove and install the cab **[Figure 40-20-1]** & **[Figure 40-20-2]**.

Figure 40-20-1

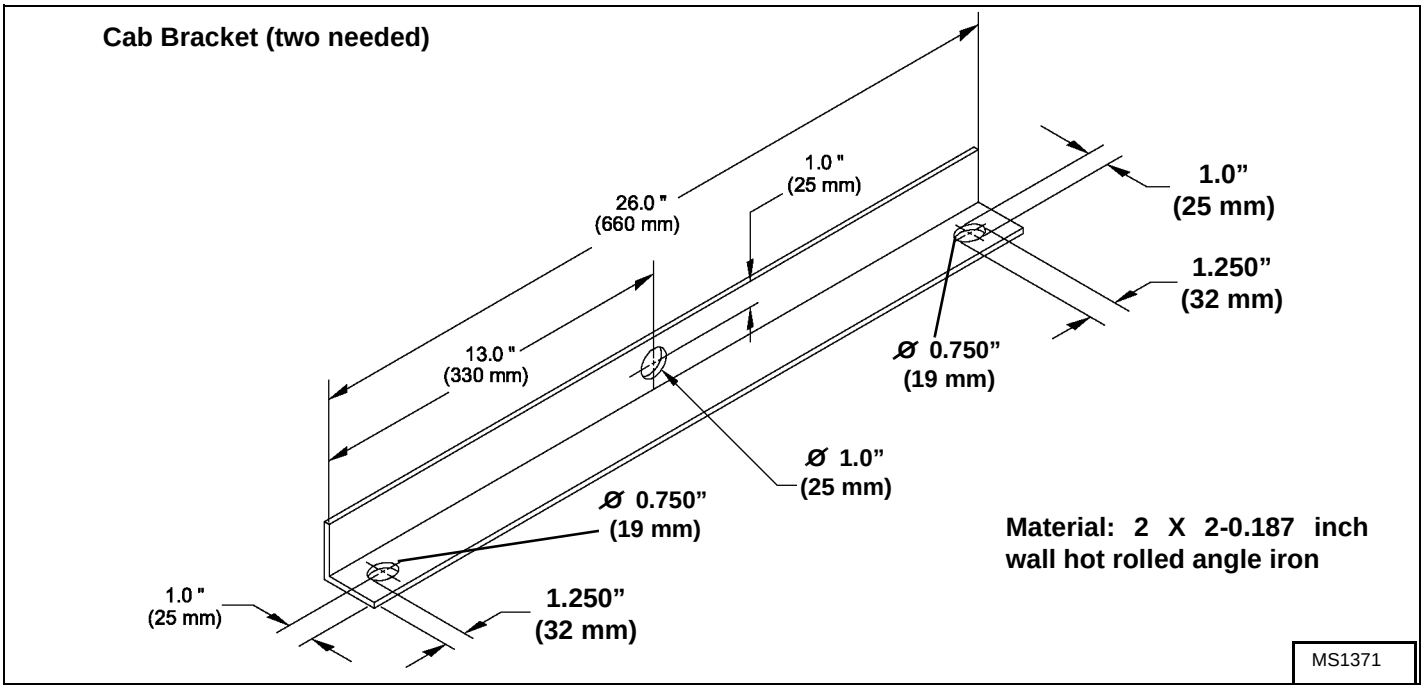
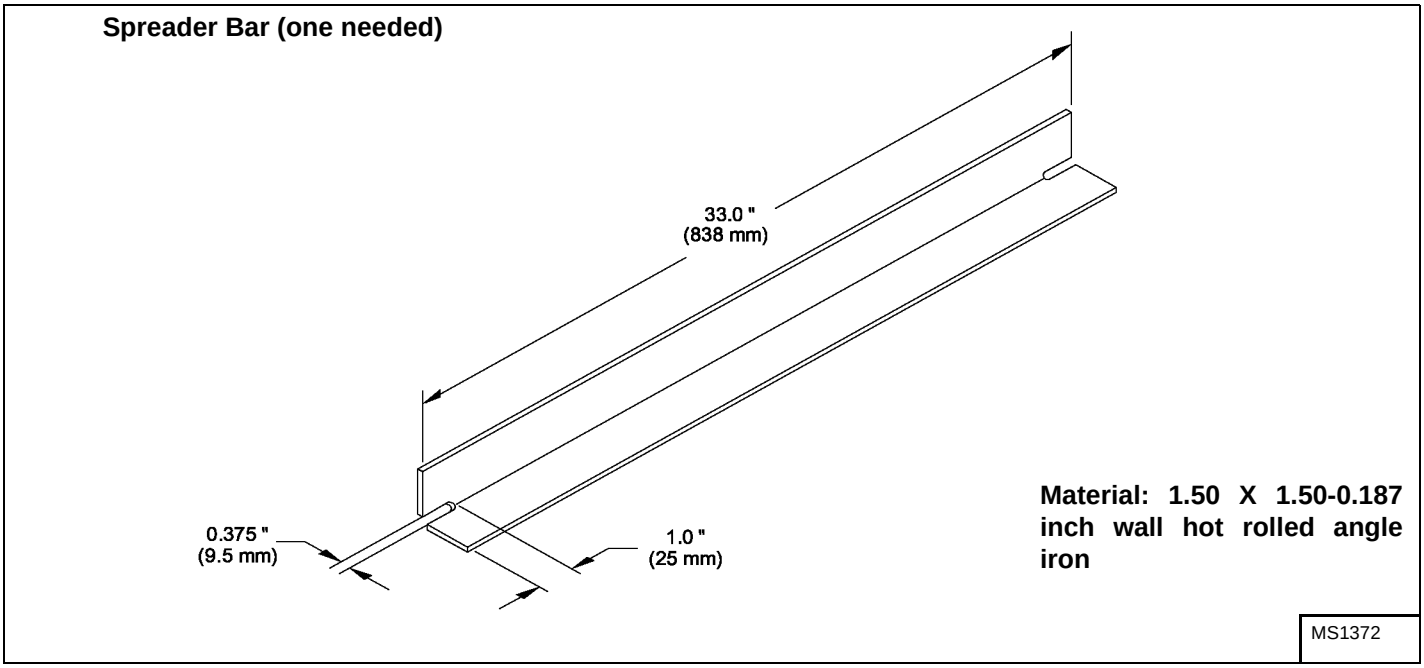


Figure 40-20-2



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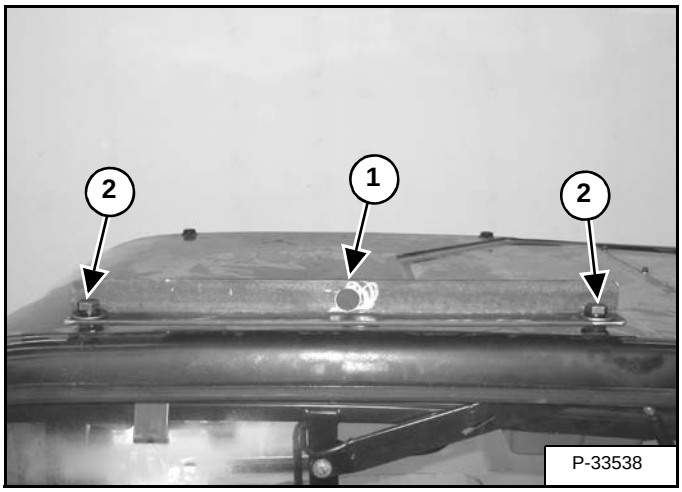
Removal And Installation (Cont'd)

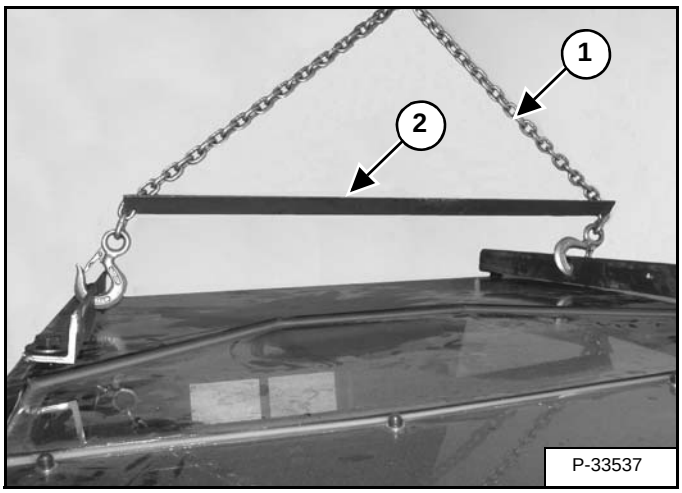
Figure 40-20-3



Install the brackets (Item 1) **[Figure 40-20-3]** on the cab.

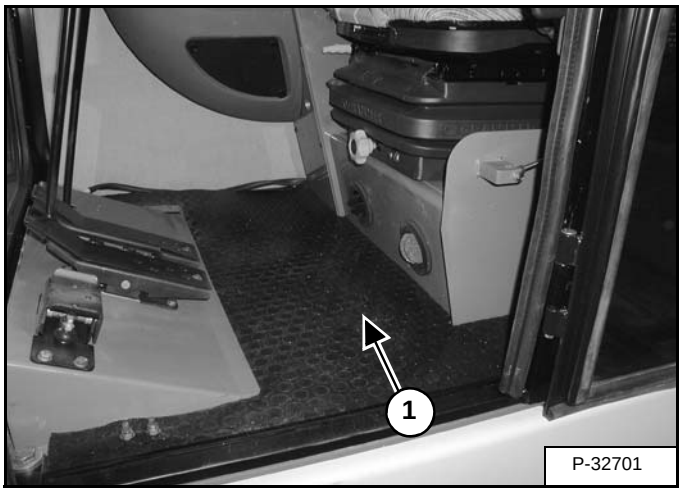
Use four grade 10.9 bolts (Item 2) **[Figure 40-20-3]** to fasten the brackets to the cab.

Figure 40-20-4



Install the lifting chain (Item 1) and spreader bar (Item 2) **[Figure 40-20-4]**.

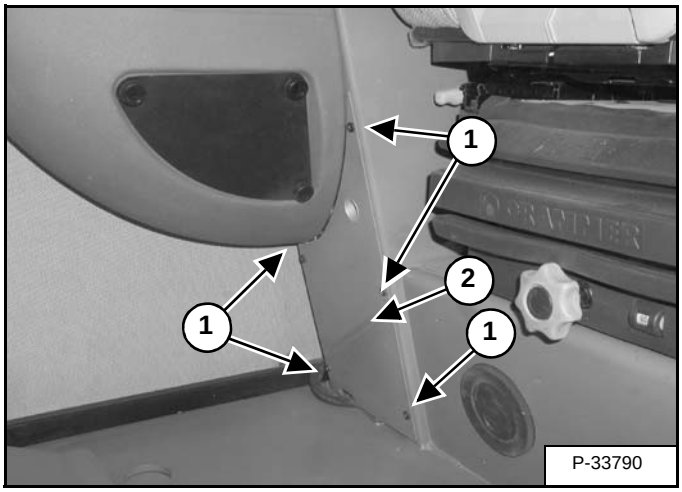
Figure 40-20-5



Remove the floor mat (Item 1) **[Figure 40-20-5]**.

Excavators S/N 522311001 & Above use **[Figure 40-20-6]**, **[Figure 40-20-7]** *and* **[Figure 40-20-8]**

Figure 40-20-6



Remove the five screws (Item 1) and right console front cover (Item 2) **[Figure 40-20-6]**.

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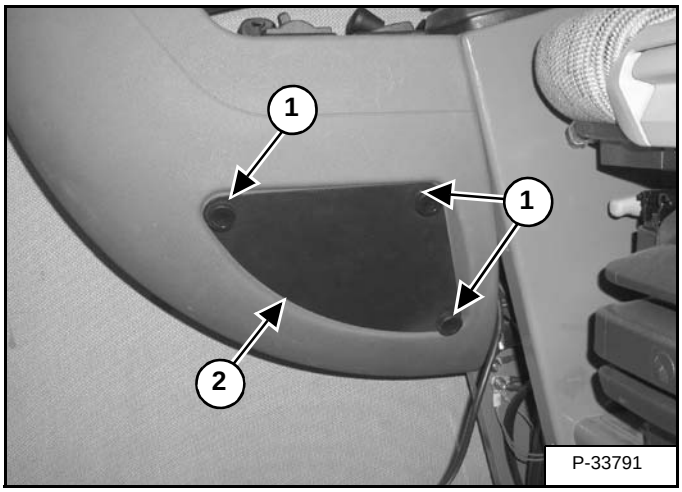
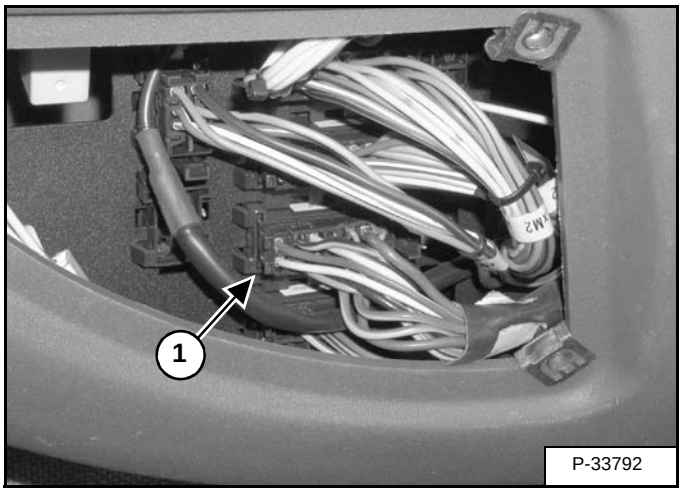
Removal And Installation (Cont'd)

Figure 40-20-7



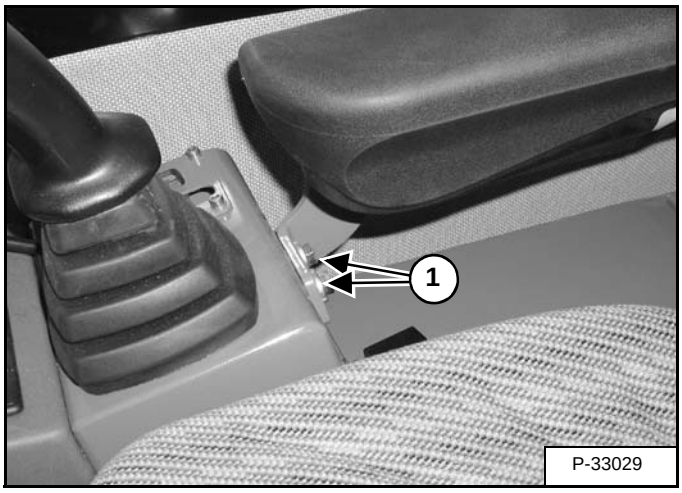
Remove the three screws (Item 1) and remove the cover (Item 2) **[Figure 40-20-7]**.

Figure 40-20-8



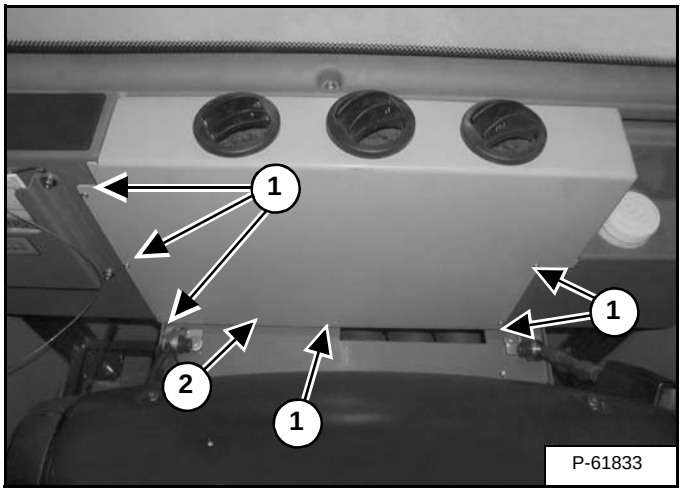
Disconnect the cab wire harness (Item 1) **[Figure 40-20-8]** from the fuse panel. Pull the harness out of the right console.

Figure 40-20-9



Remove the two bolts (Item 1) **[Figure 40-20-9]** and washers from the right arm rest. Remove the arm rest.

Figure 40-20-10



Remove the six screws (Item 1) and cover (Item 2) **[Figure 40-20-10]**.

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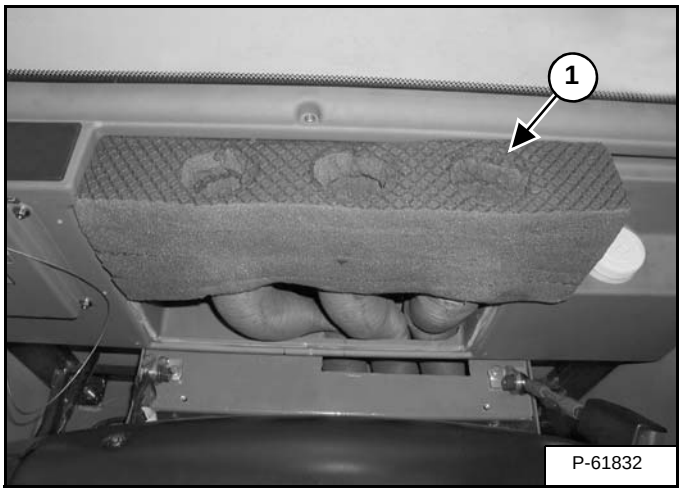
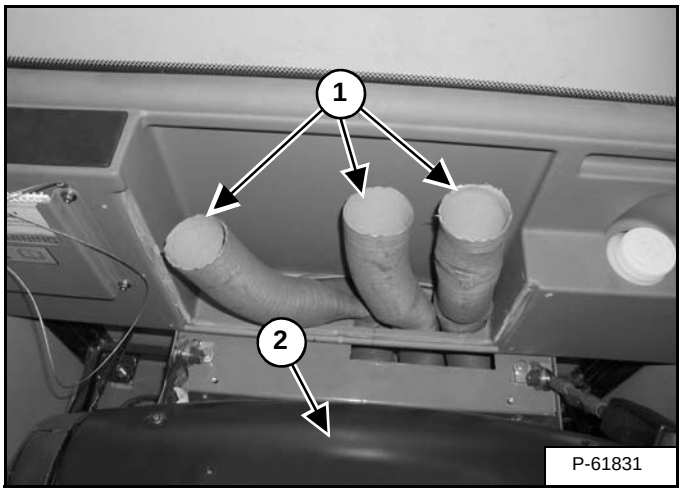
Removal And Installation (Cont'd)

Figure 40-20-11



Remove the foam (Item 1) **[Figure 40-20-11]**.

Figure 40-20-12



Remove the tubes (Item 1) from the back of the heater unit (Item 2) **[Figure 40-20-12]**.

Figure 40-20-13

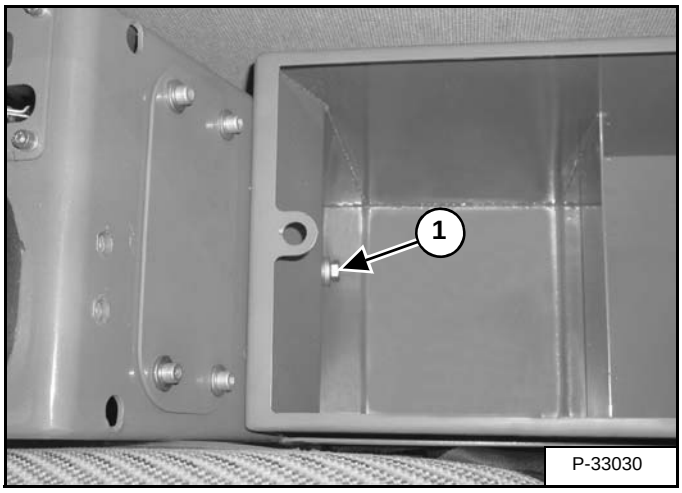
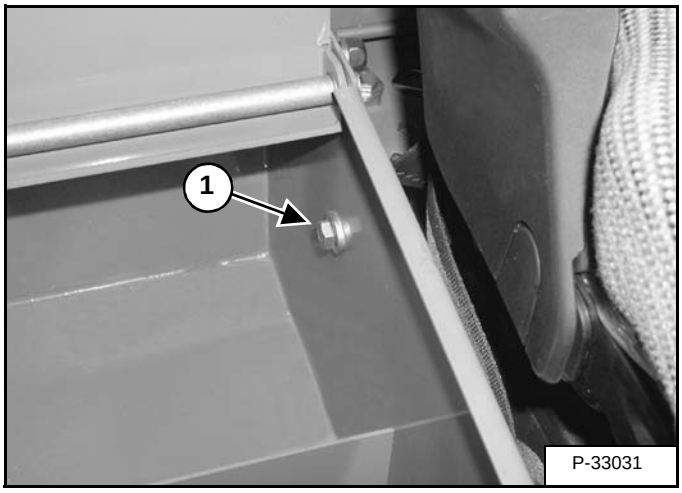


Figure 40-20-14



Remove the two storage compartment bolts (Item 1) **[Figure 40-20-13]** & **[Figure 40-20-14]** and washers. Remove the storage compartment. (If equipped)

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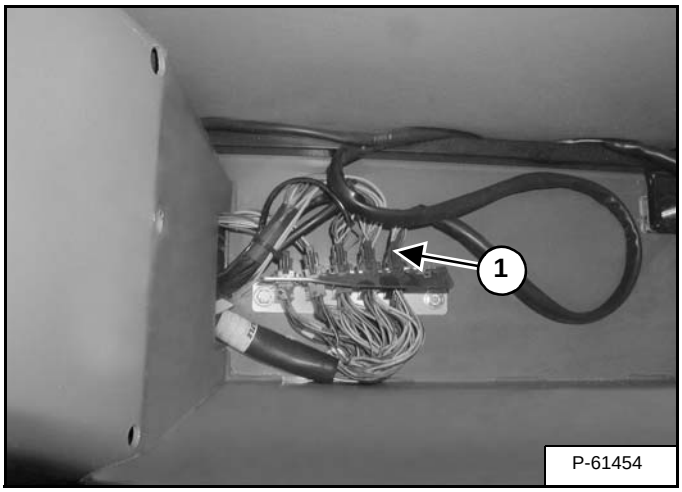
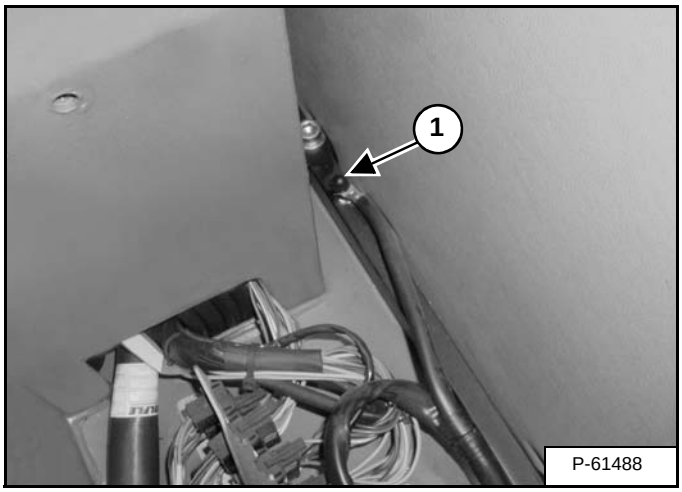
Removal And Installation (Cont'd)

Figure 40-20-15



Excavators S/N 528911001 & Above & S/N 528611001 & Above only: Disconnect the wire harness (Item 1) **[Figure 40-20-15]**.

Figure 40-20-16



Remove the ground cable (Item 1) **[Figure 40-20-16]**.

Figure 40-20-17

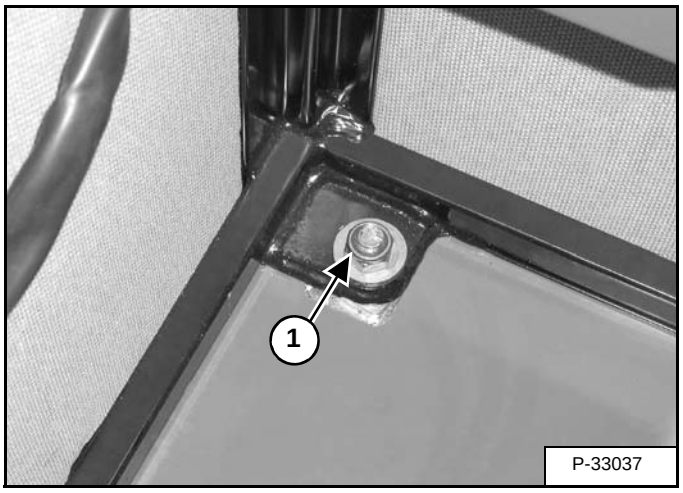
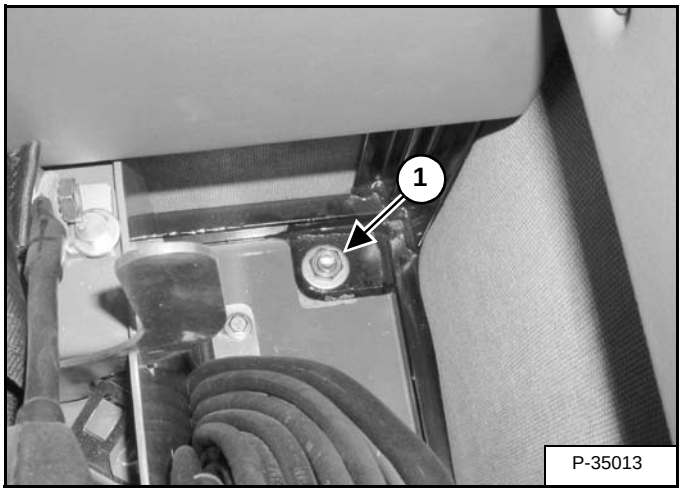


Figure 40-20-18



Remove the rear cab mount nuts (Item 1) **[Figure 40-20-17]** & **[Figure 40-20-18]** and washers.

Installation: Tighten the nuts to 81-92 ft.-lb. (110-125 N•m) torque.

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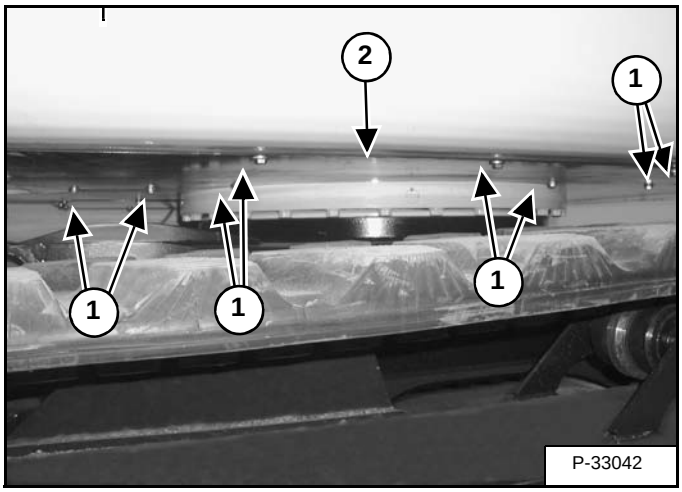
Removal And Installation (Cont'd)

Figure 40-20-19



Excavators S/N 522311001 & Above Only: Remove the eleven bolts (Item 1) and washers. Remove the bottom cover (Item 2) **[Figure 40-20-19]**.

Installation: Tighten the bolts to 18-19 ft.-lb. (110-125 N•m) torque.

Figure 40-20-20

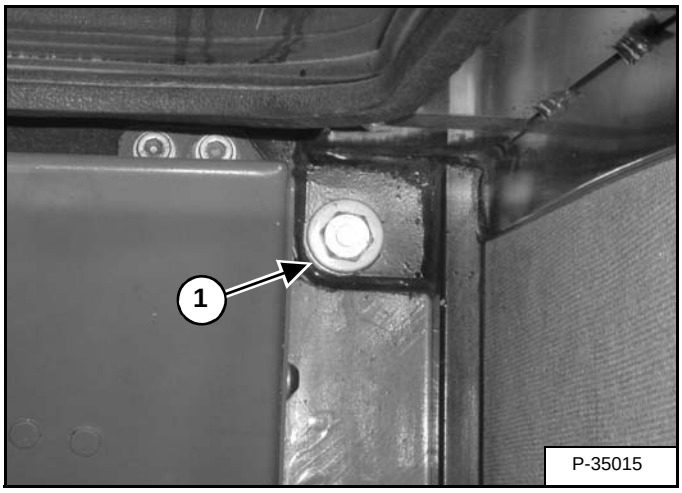
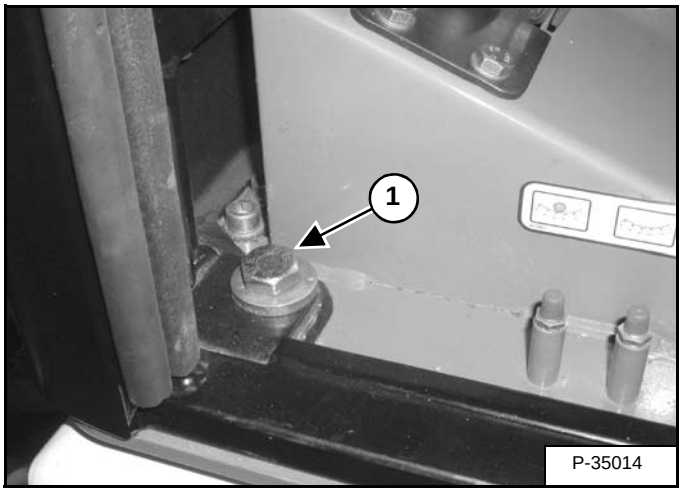


Figure 40-20-21



Remove the front cab mount bolts (Item 1) **[Figure 40-20-20]** & **[Figure 40-20-21]** washers and nuts.

Installation: Tighten the bolts to 81-92 ft.-lb. (110-125 N•m) torque.

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Removal And Installation (Cont'd)

Figure 40-20-22

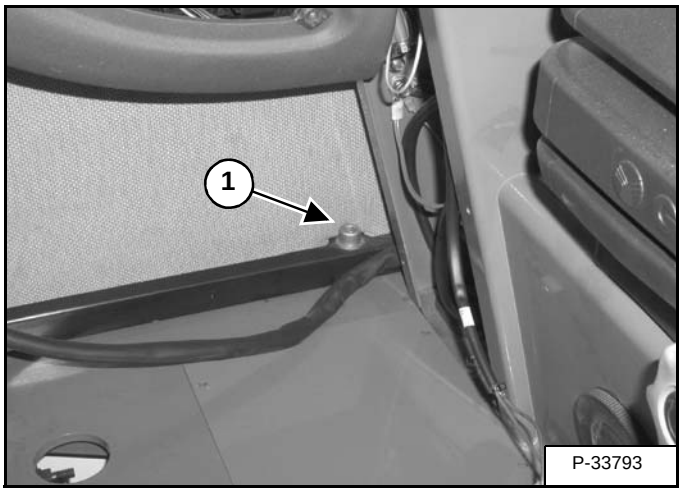
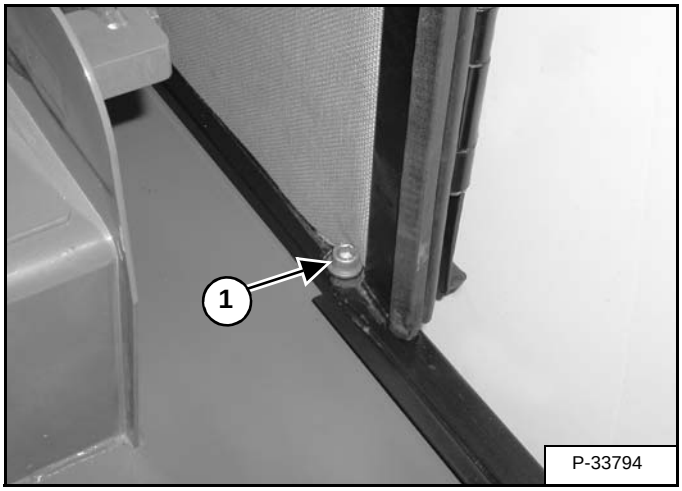


Figure 40-20-23



Remove the side cab mount bolts (Item 1) **[Figure 40-20-22]** & **[Figure 40-20-23]**.

Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 40-20-24

Install a chain hoist and remove the cab **[Figure 40-20-24]**.

NOTE: Use a chain hoist of sufficient capacity.

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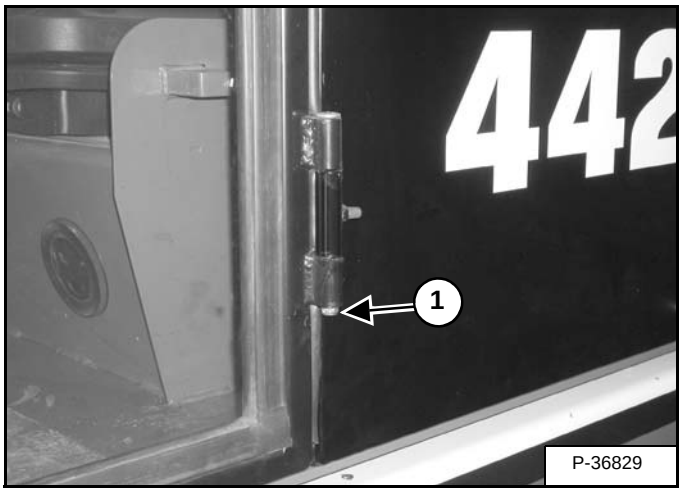
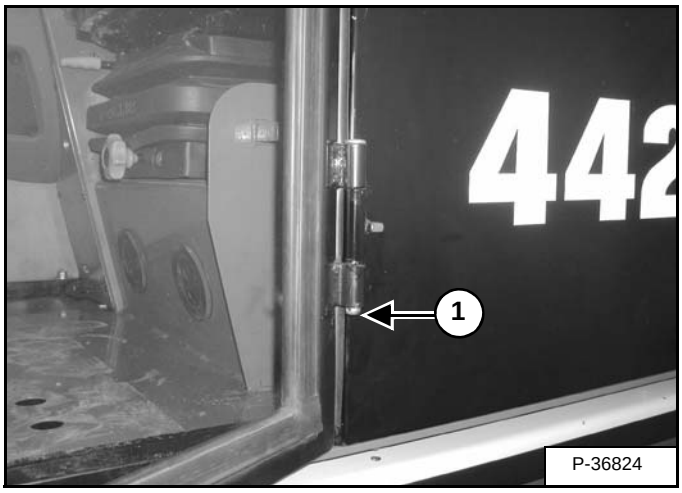
Door Removal And Installation

Figure 40-20-25



Remove the roll pin (Item 1) **[Figure 40-20-25]** from the top and bottom door hinge pin.

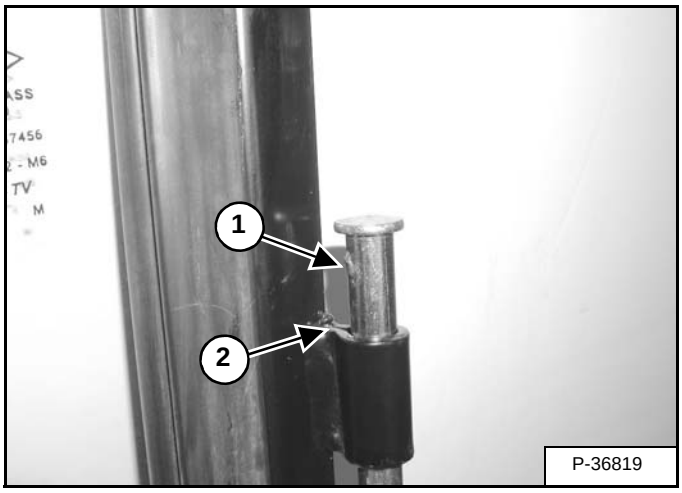
Figure 40-20-26



Have an assistant support the door and remove top and bottom door hinge pin (Item 1) **[Figure 40-20-26]**.

Remove the door.

Figure 40-20-27



Installation: The tab (Item 1) must fit in the slot (Item 2) **[Figure 40-20-27]** of the hinge.

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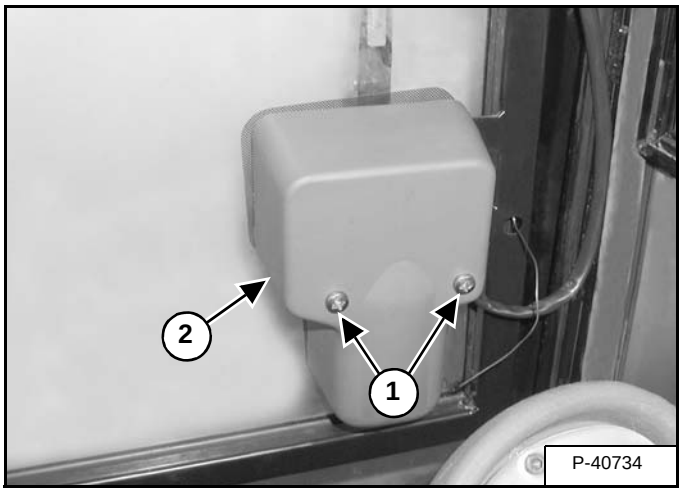
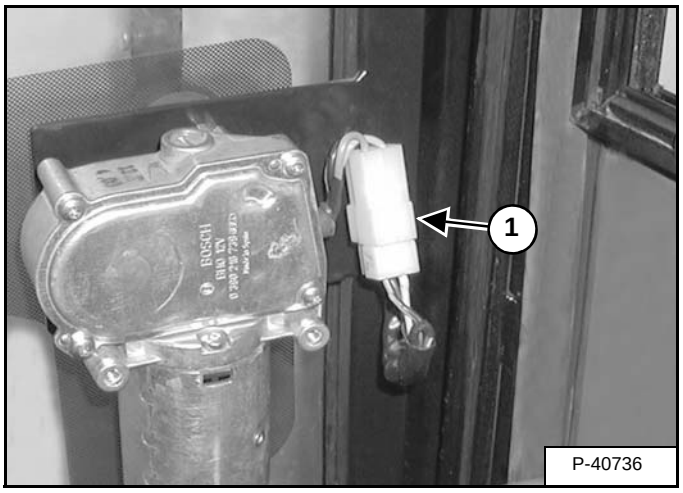
Front Window Removal And Installation

Figure 40-20-28



Remove the two screws (Item 1) and wiper motor cover (Item 2) **[Figure 40-20-28]**.

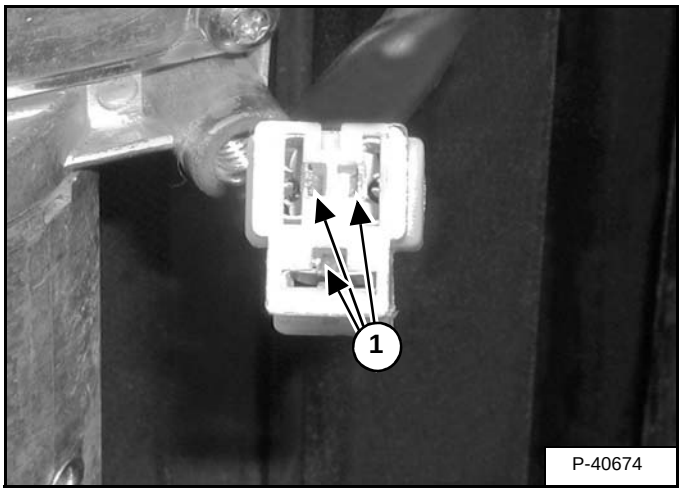
Figure 40-20-29



Disconnect the electrical connector (Item 1) **[Figure 40-20-29]**.

Mark the wires for correct installation.

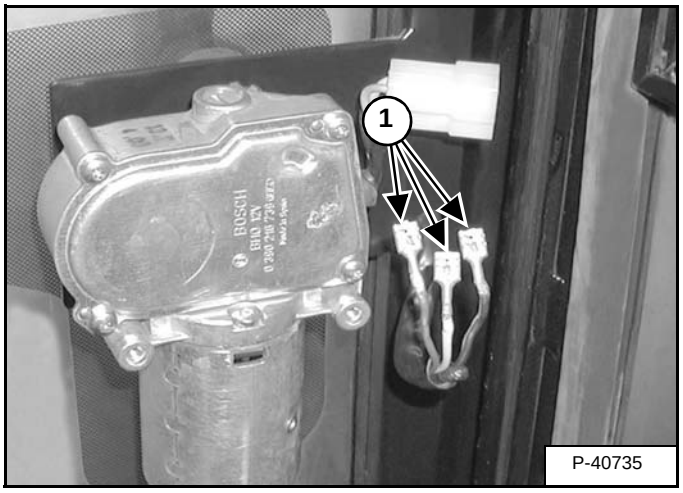
Figure 40-20-30



Use a small blade screw driver to depress the wire terminal tabs (Item 1) **[Figure 40-20-30]**.

Remove the individual wires from the back of the electrical connector.

Figure 40-20-31



Remove the wire terminals (Item 1) **[Figure 40-20-31]** from the wires.

Installation: Install new wire terminals on the wires.

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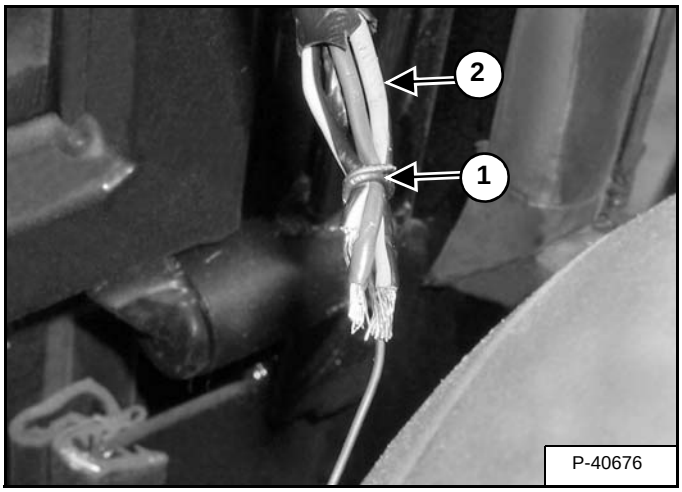
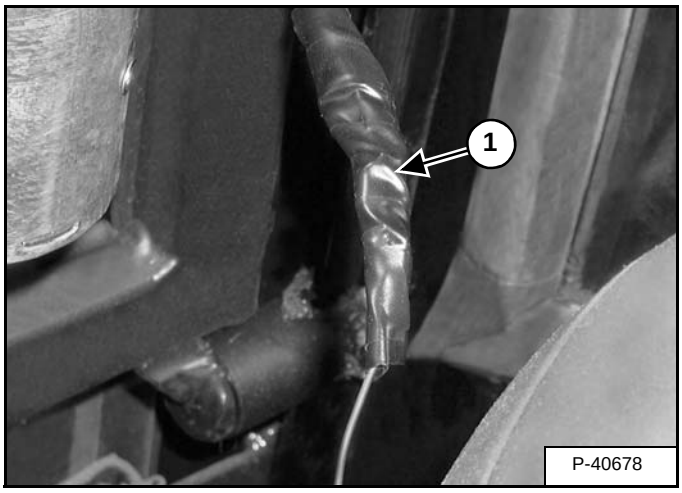
Front Window Removal And Installation (Cont'd)

Figure 40-20-32



Wrap a wire (Item 1) securely around the electrical harness wires (Item 2) **[Figure 40-20-32]**.

Figure 40-20-33



Wrap the wires with electrical tape (Item 1) **[Figure 40-20-33]**.

Figure 40-20-34

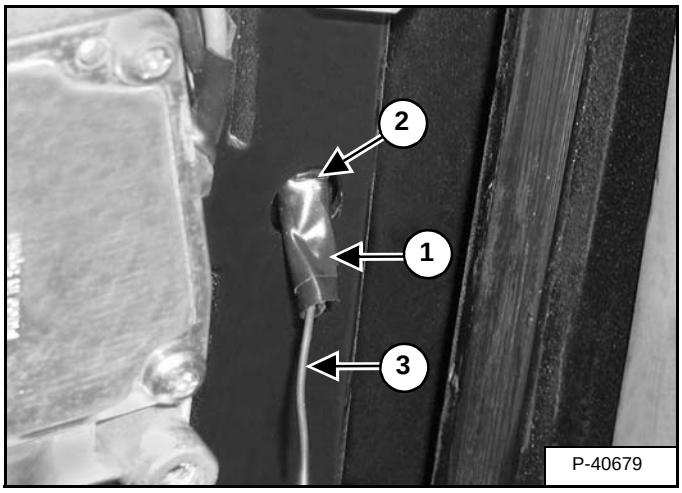
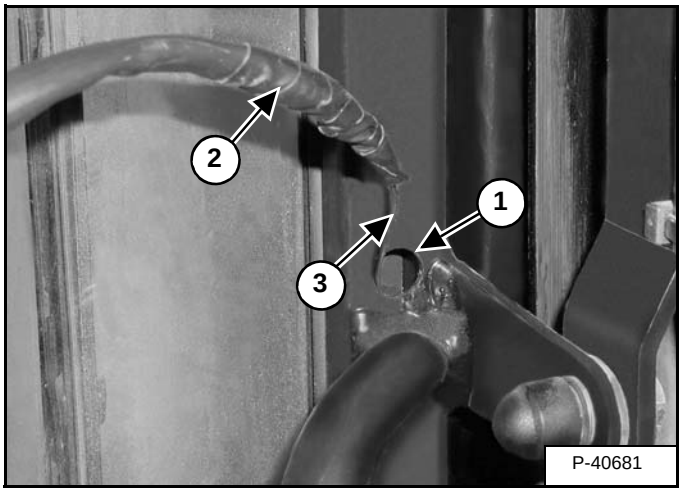


Figure 40-20-35



Position the wires (Item 1) in the bottom hole (Item 2) **[Figure 40-20-34]** and pull the wire harness up and through the upper hole (Item 1) **[Figure 40-20-35]**.

NOTE: Do not remove the wire (Item 3) [Figure 40-20-34] and [Figure 40-20-35] from the upper or lower holes. The wire will be used to reinstall the wire harness.

Remove the electrical tape (Item 2) **[Figure 40-20-35]**.

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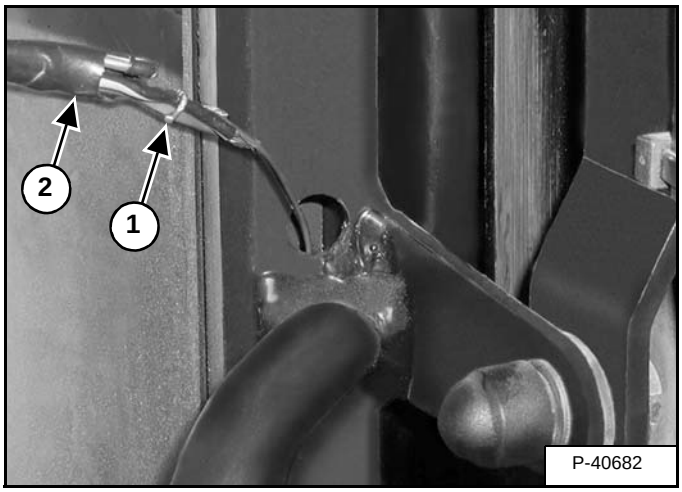
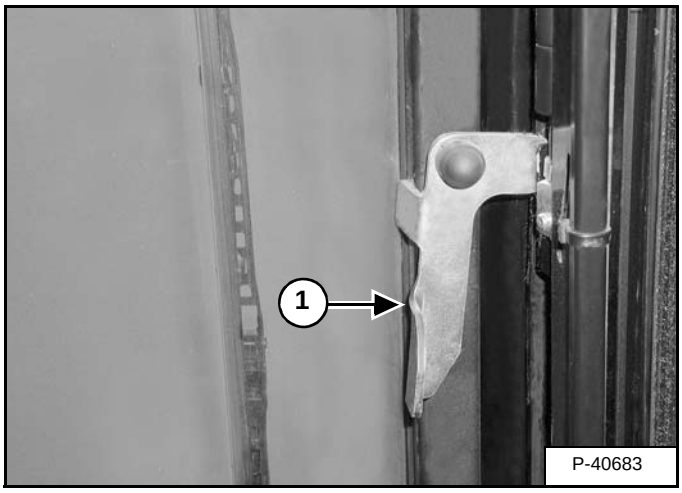
Front Window Removal And Installation (Cont'd)

Figure 40-20-36



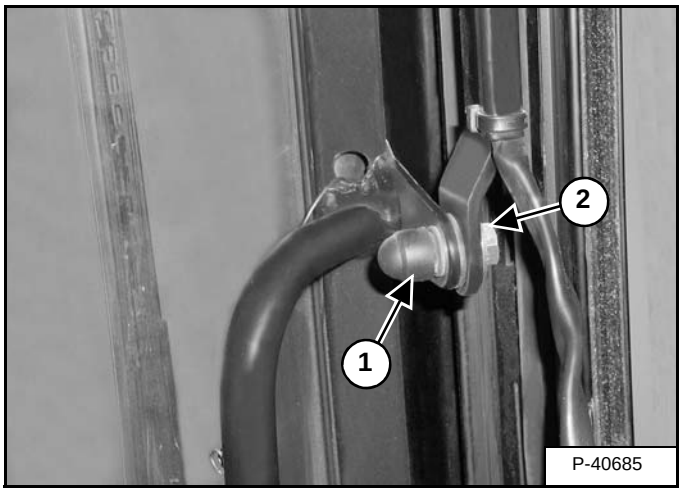
Remove the wire (Item 1) from the wire harness (Item 2) **[Figure 40-20-36]**.

Figure 40-20-37



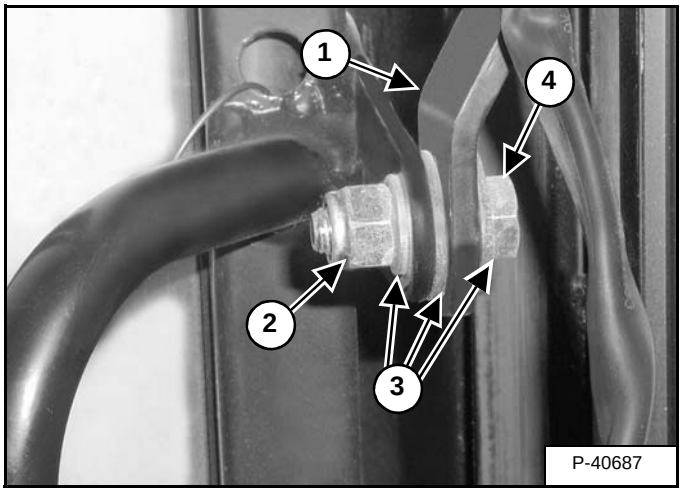
Make sure the front window latches (Item 1) **[Figure 40-20-37]** are in the latched position. (Both Sides)

Figure 40-20-38



Remove the caps (Item 1) from the pivot bolts (Item 2) **[Figure 40-20-38]**. (Both Sides)

Figure 40-20-39



With the help of a second person, support the lift arms (Item 1) and remove the lock nut (Item 2) washers (Item 3) and bolt (Item 4) **[Figure 40-20-39]**. (Both Sides)

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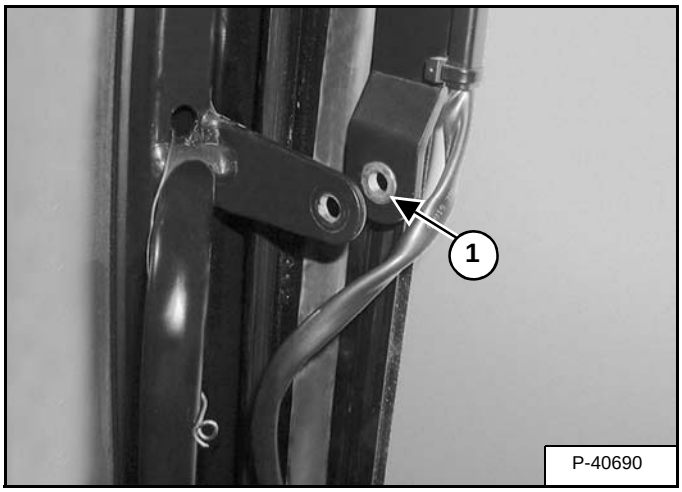
Front Window Removal And Installation (Cont'd)

Figure 40-20-40

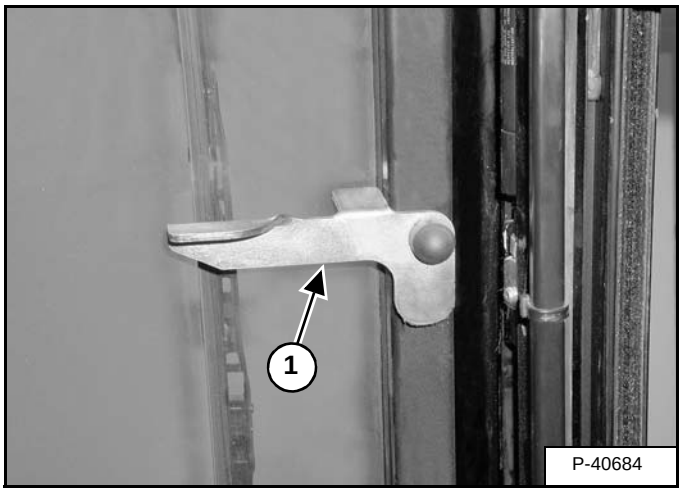


Remove the bushing (Item 1) **[Figure 40-20-40]**. (Both Sides)

Figure 40-20-41

Carefully raise the lift arms to the fully raised position **[Figure 40-20-41]**.

Figure 40-20-42



Support the front window and turn the latches (Item 1) **[Figure 40-20-42]** to the unlatched position. (Both Sides)

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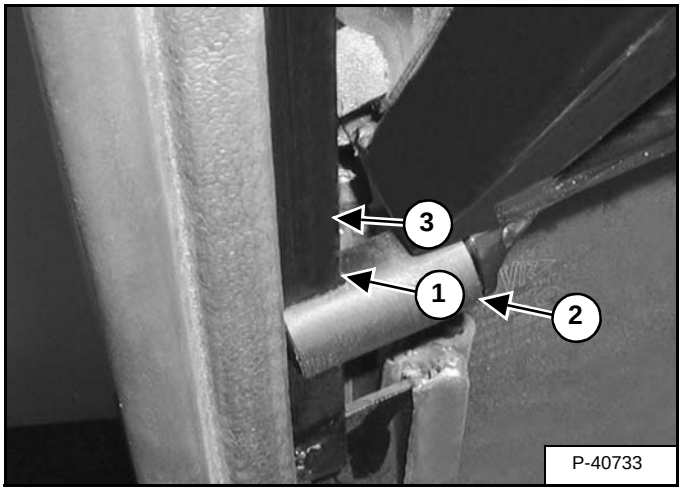
Front Window Removal And Installation (Cont'd)

Figure 40-20-43

Figure 40-20-44



With the help of a second person, raise and tilt the window **[Figure 40-20-43]** until the groove (Item 1) in the guide (Item 2) is disengaged from the track (Item 3) **[Figure 40-20-44]** on the cab frame. (Both sides)

Installation: Align the groove in the guide with the track.

Remove the front window.

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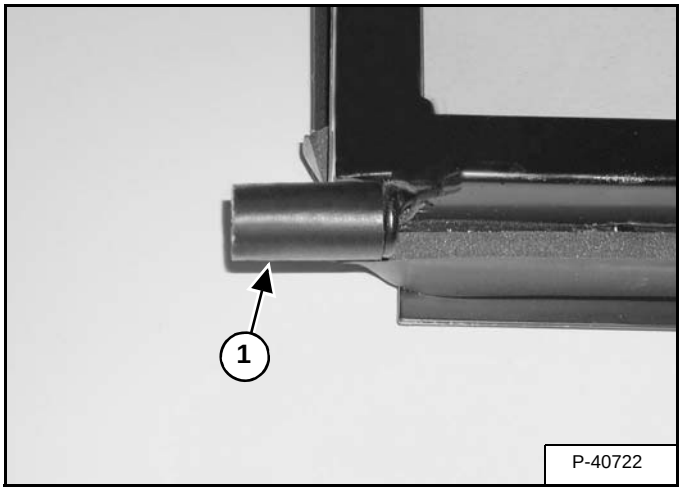
Front Window Disassembly And Assembly (S/N 522311001 & Above)

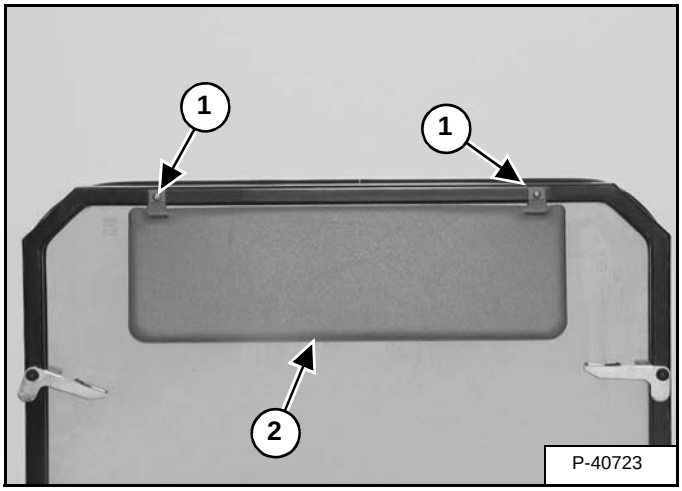
Remove the front window. (See Front Window Removal And Installation on Page 40-20-9)

Figure 40-20-45



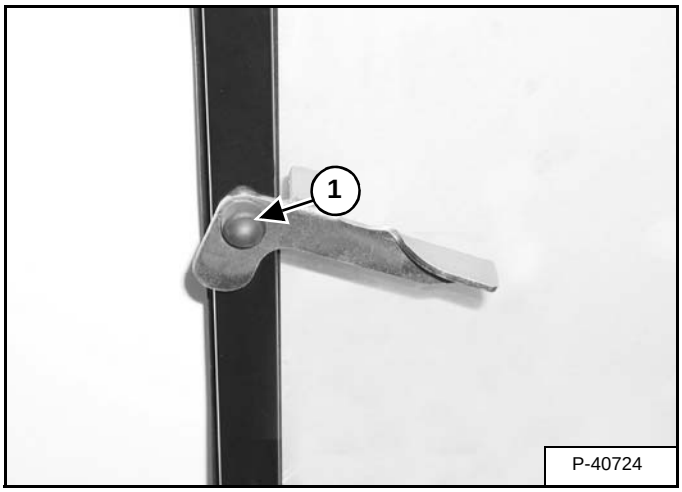
Remove the guide (Item 1) **[Figure 40-20-45]**. (Both Sides)

Figure 40-20-46



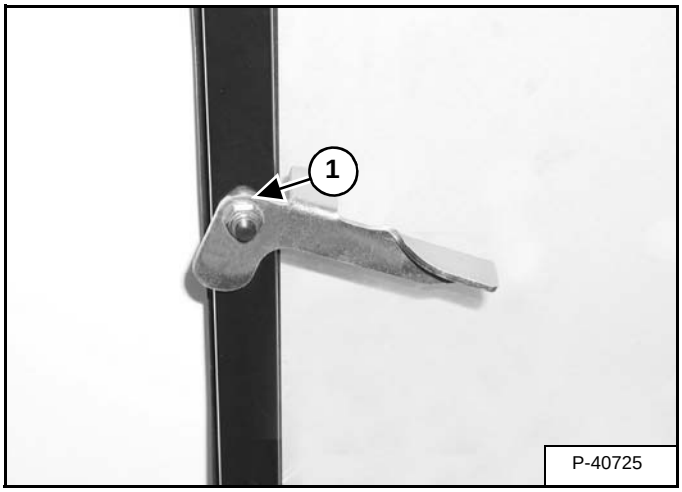
Remove the two screws (Item 1) from the visor (Item 2) **[Figure 40-20-46]**. Remove the visor.

Figure 40-20-47



Remove the cap (Item 1) **[Figure 40-20-47]** from the window latch pivot bolt. (Both Sides)

Figure 40-20-48



Loosen the lock nut (Item 1) **[Figure 40-20-48]**. (Both Sides)

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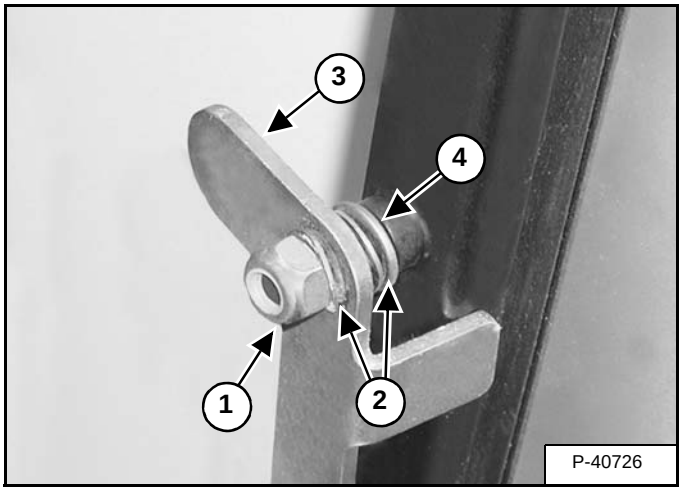
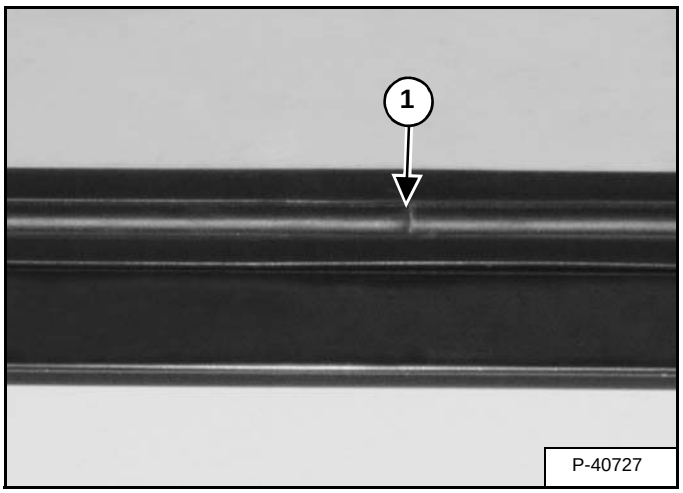
Front Window Disassembly And Assembly (S/N 522311001 & Above) (Cont'd)

Figure 40-20-49



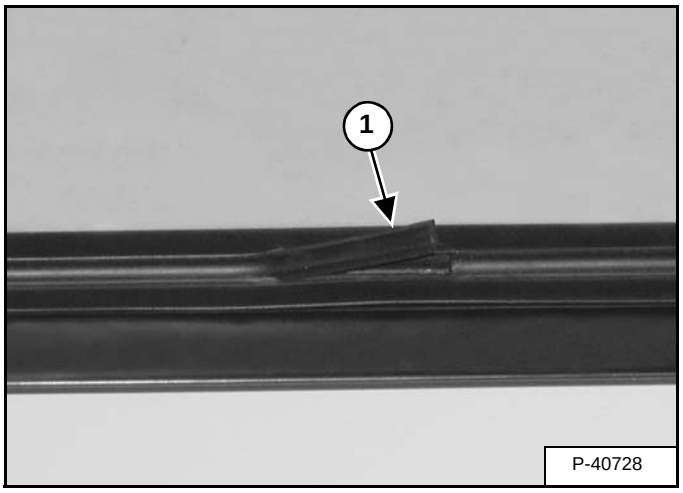
Remove the lock nut (Item 1), wave washers (Item 2) latch (Item 3), and washer (Item 4) **[Figure 40-20-49]** (Both Sides)

Figure 40-20-50



Locate the end of the rubber cord (Item 1) **[Figure 40-20-50]**.

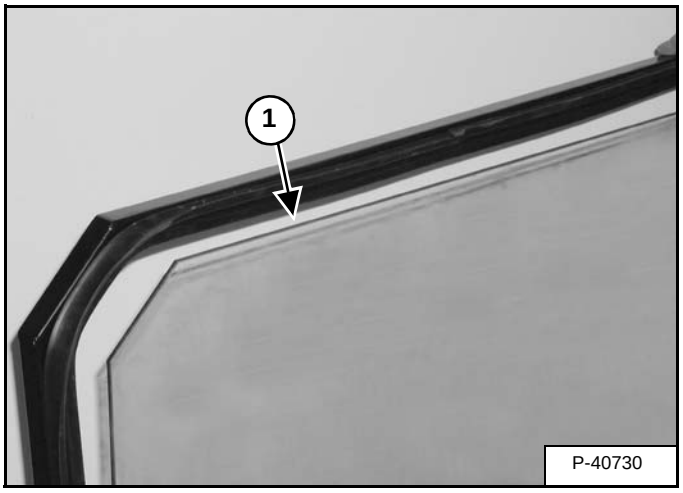
Figure 40-20-51



Remove the rubber cord (Item 1) **[Figure 40-20-51]**.

Installation: Install the rubber cord with the rounded side facing out. Do not stretch or cut the rubber cord during installation. The cord will shrink to its original length leaving a gap.

Figure 40-20-52



Remove the window (Item 1) **[Figure 40-20-52]**.

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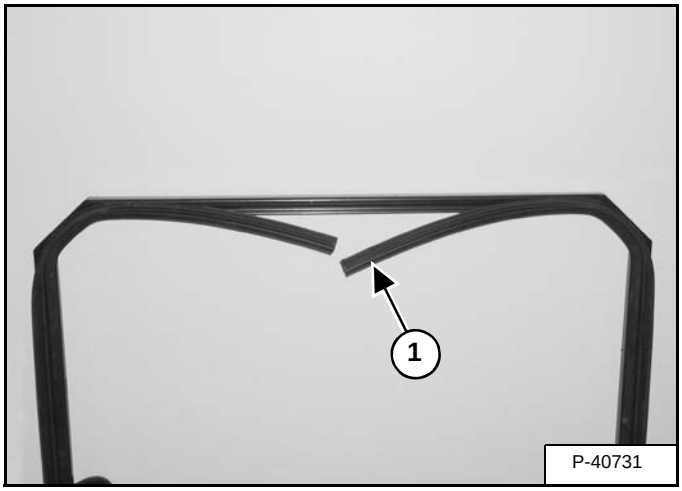
Front Window Disassembly And Assembly (S/N 522311001 & Above) (Cont'd)

Figure 40-20-53

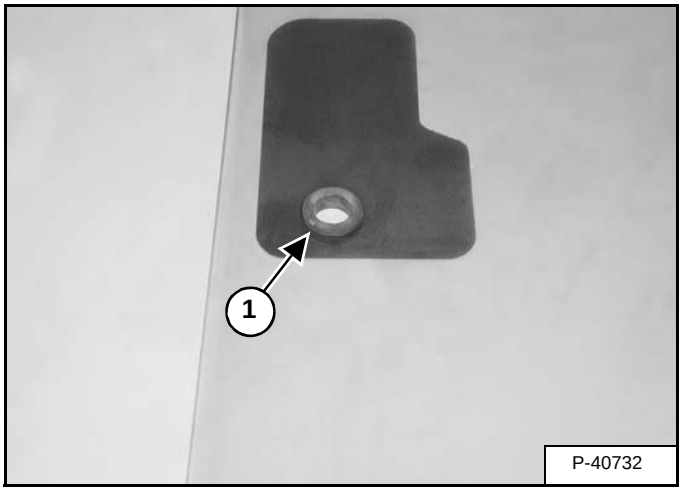


Remove the rubber seal (Item 1) **[Figure 40-20-53]**.

Installation: Install the rubber seal with the groove for the rubber cord to the outside of the frame.

Apply window cleaner as a lubricant to the rubber seal for ease of installation.

Figure 40-20-54



Remove the grommet (Item 1) **[Figure 40-20-54]** from the window.

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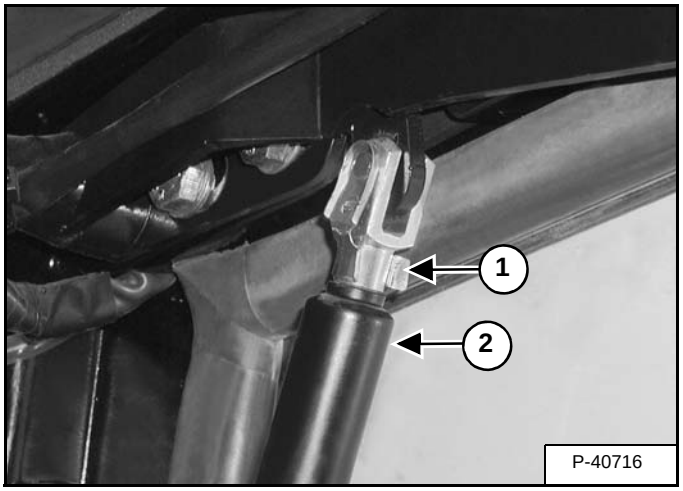
Front Window Gas Strut Removal And Installation

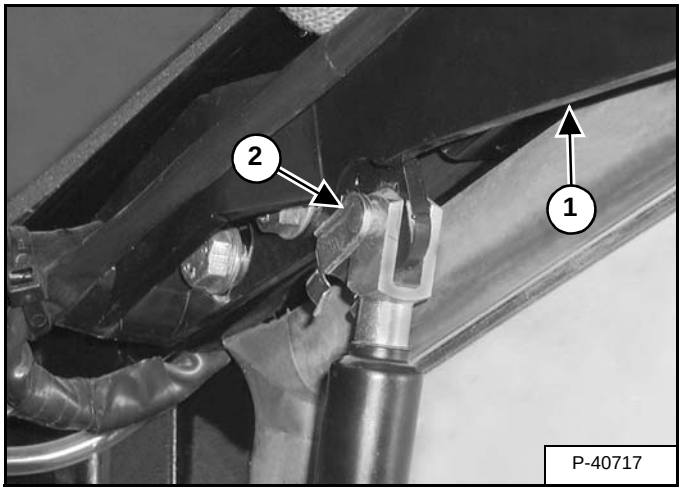
Remove the front window. (See Front Window Removal And Installation on Page 40-20-9.)

Figure 40-20-55



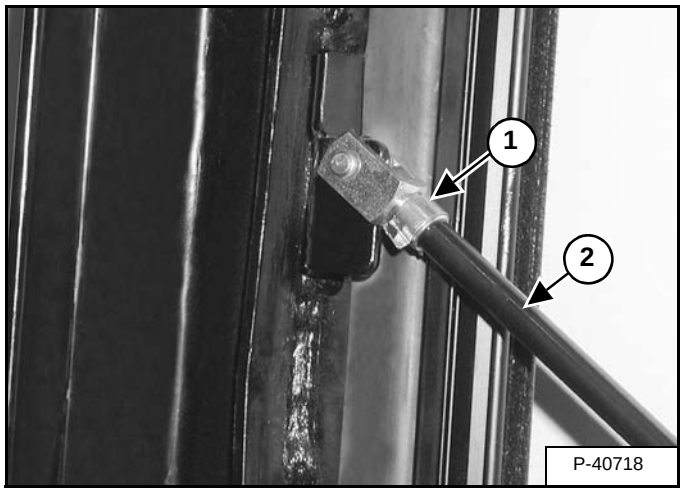
Pivot the retainer (Item 1) away from the gas strut (Item 2) **[Figure 40-20-55]**. (Both Sides)

Figure 40-20-56



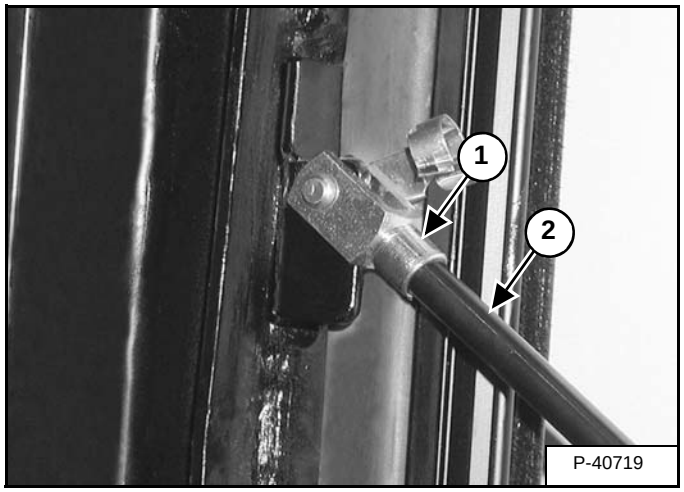
Support the pivot frame (Item 1) and remove the retainer (Item 2) **[Figure 40-20-56]**. (Both Sides)

Figure 40-20-57



Pivot the retainer (Item 1) away from the gas strut (Item 2) **[Figure 40-20-57]**. (Both Sides)

Figure 40-20-58



Remove the retainer (Item 1) **[Figure 40-20-58]**. (Both Sides)

Remove the gas struts (Item 2) **[Figure 40-20-58]**. (Both Sides)

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Front Window Pivot Frame Removal And Installation

Remove the front window. (See Front Window Removal And Installation on Page 40-20-9.)

Remove the front window gas struts. (See Front Window Gas Strut Removal And Installation on Page 40-20-17.)

Figure 40-20-59

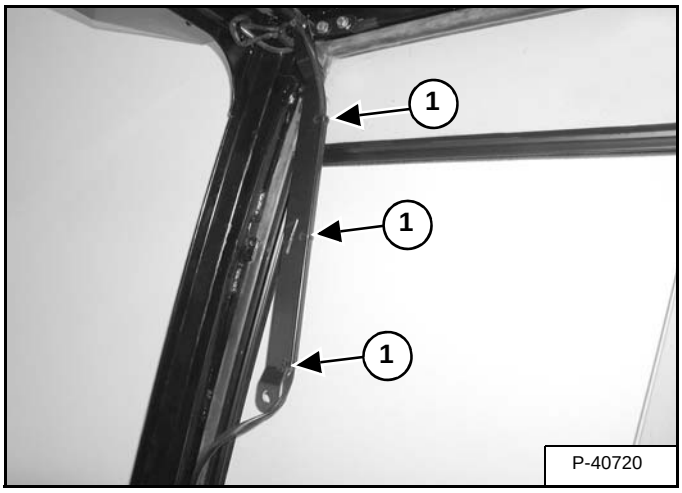
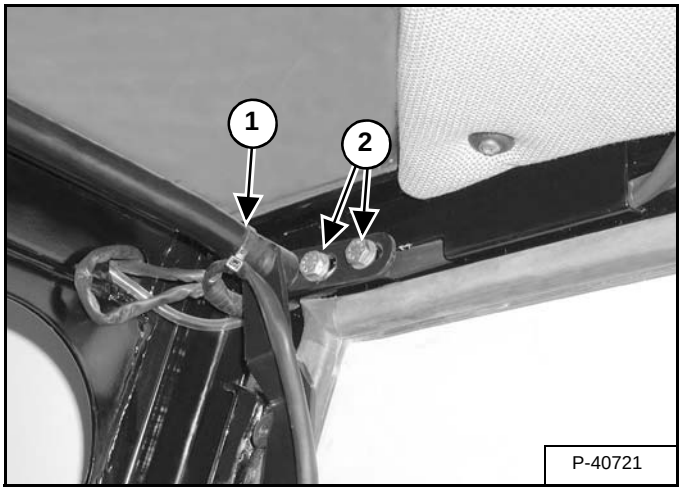


Figure 40-20-60



Remove the tie straps (Item 1) **[Figure 40-20-59]** and **[Figure 40-20-60]**.

Remove the bolts (Item 2) **[Figure 40-20-60]**. (Both Sides)

Remove the frame.

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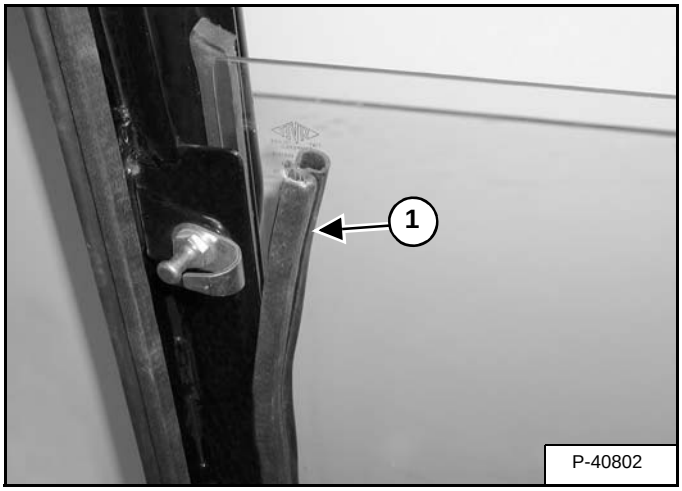
Lower Front Widow Removal And Installation

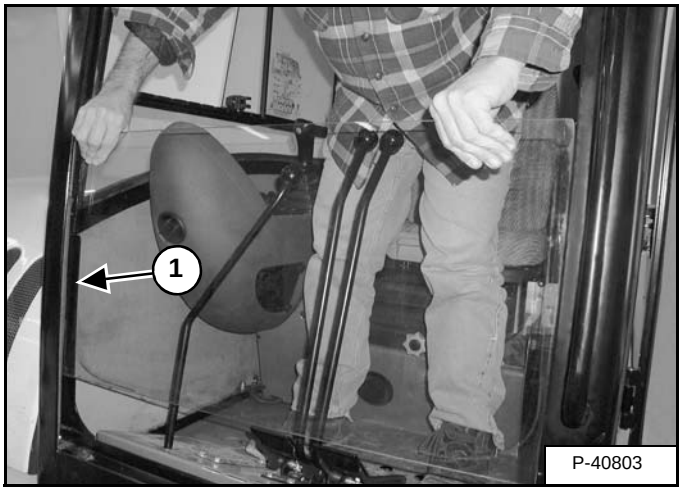
Raise the front window.

Figure 40-20-61



Remove the rubber seal (Item 1) **[Figure 40-20-61]**.

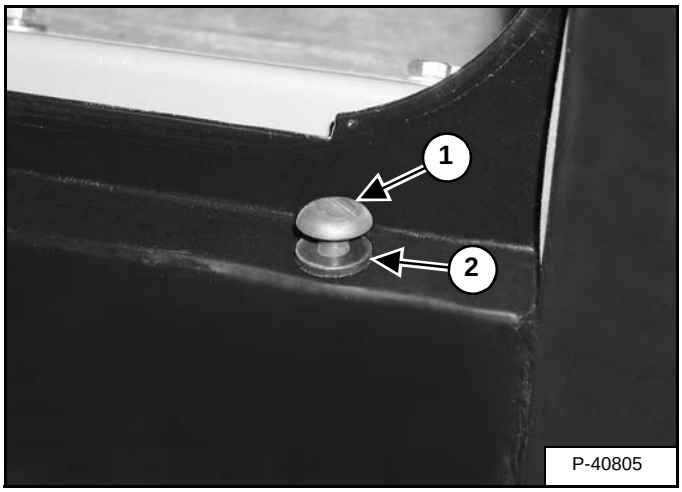
Figure 40-20-62



Lift the window from the channel (Item 1) **[Figure 40-20-62]**.

Remove the window.

Figure 40-20-63



Remove the pad (Item 1) and washer (Item 2) **[Figure 40-20-63]**.

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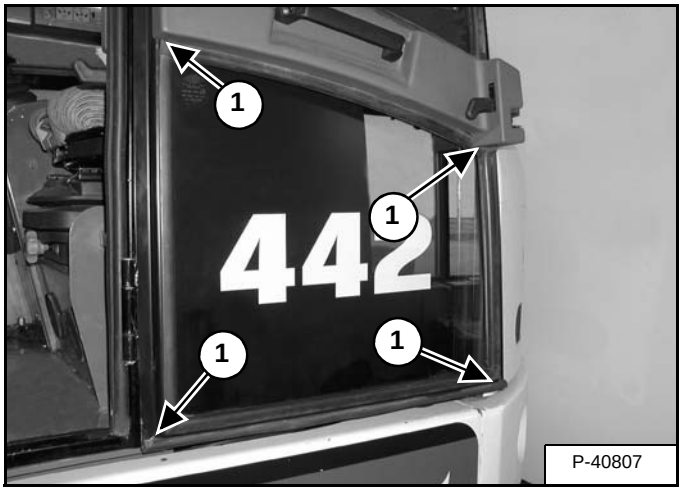
Door, Left Side, Right Side And Rear Window Removal

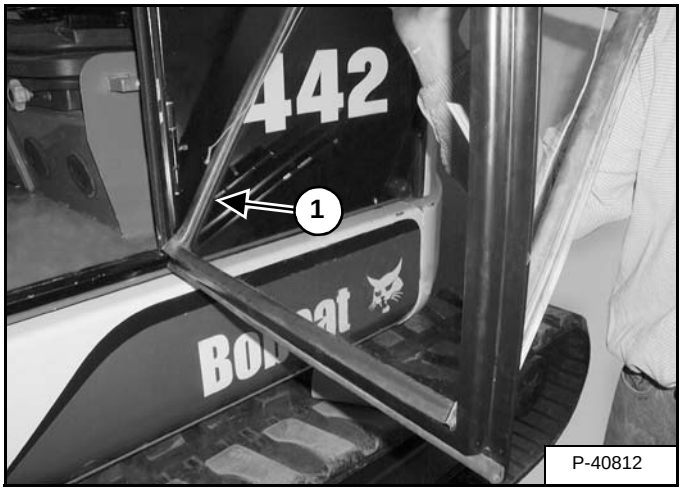
The procedure is the same for all the windows. The lower door window is shown.

Figure 40-20-64



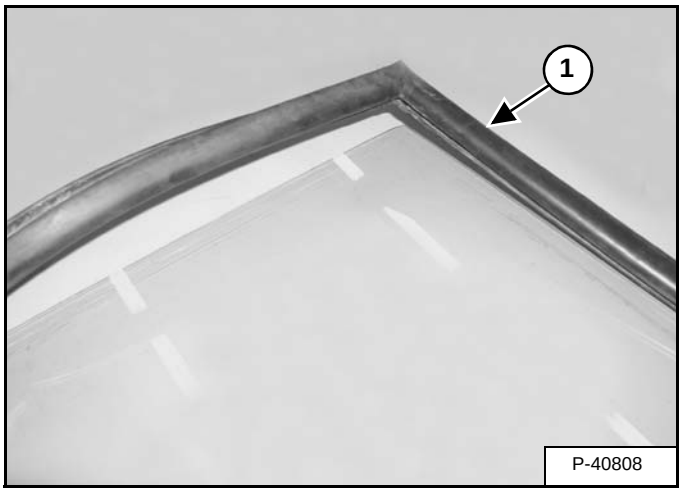
Loosen the adhesive on the corners of the rubber seal (Item 1) **[Figure 40-20-64]**.

Figure 40-20-65



With the aid of a second person, support the window and bend the inner lip of the rubber seal (Item 1) **[Figure 40-20-65]** away from the frame and press the window and seal out.

Figure 40-20-66



Remove the rubber seal (Item 1) **[Figure 40-20-66]** from the window.

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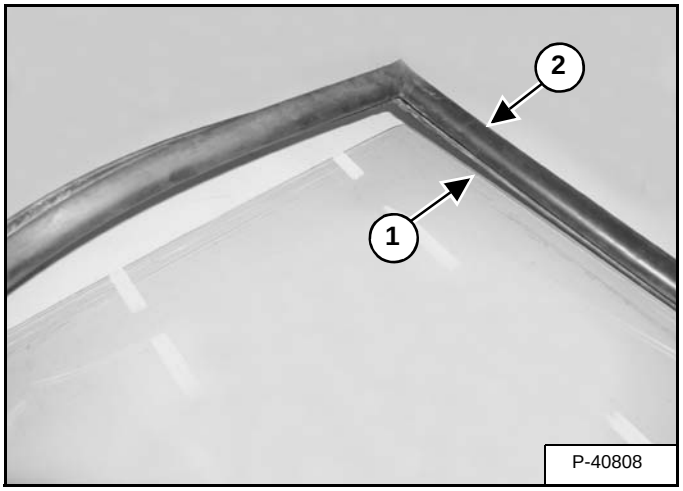
Door, Left Side, Right Side And Rear Window Installation

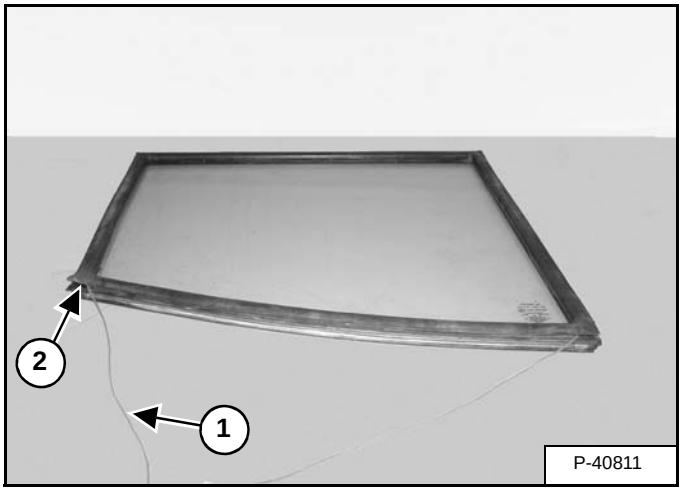
The procedure is the same for all the windows. The lower door window is shown.

Figure 40-20-67



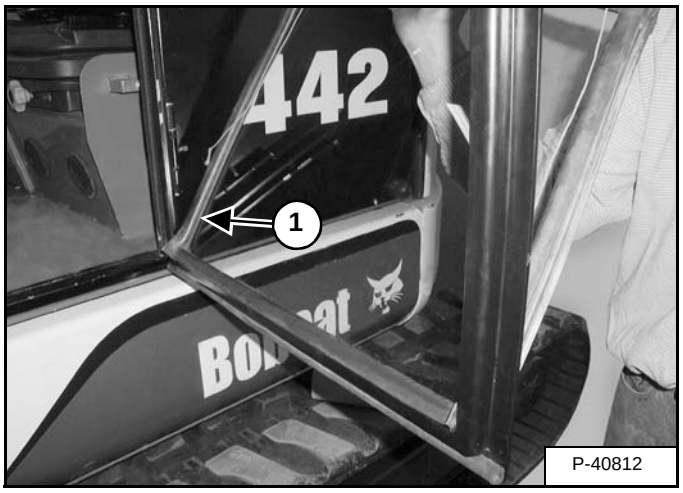
Install the window (Item 1) in the rubber seal (Item 2) **[Figure 40-20-67]**.

Figure 40-20-68



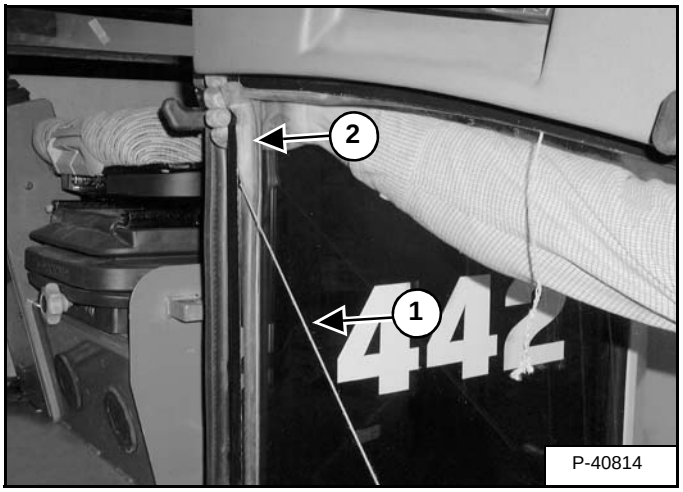
Install a cord (Item 1) in the groove (Item 2) **[Figure 40-20-68]** around the rubber seal.

Figure 40-20-69



With the aid of a second person, place the window in the frame **[Figure 40-20-69]**.

Figure 40-20-70



Pull the cord (Item 1) bending the rubber seal (Item 2) **[Figure 40-20-70]** in past the window frame until all sides of the rubber seal are installed.

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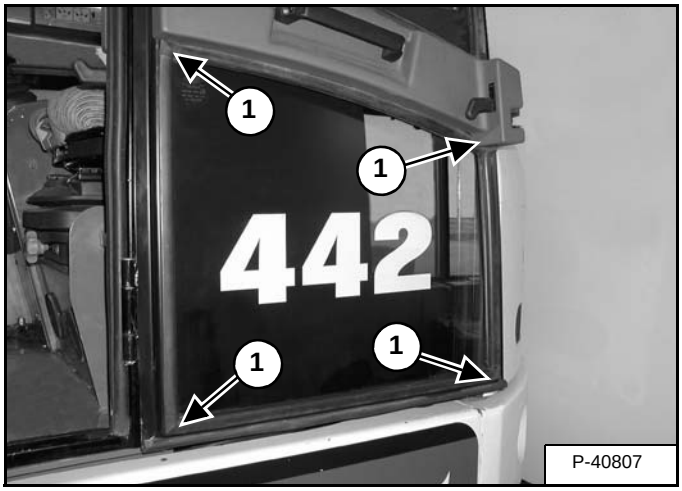
Door, Left Side, Right Side And Rear Window Installation (Cont'd)

Figure 40-20-71



Clean and dry the corners of the window (Item 1) **[Figure 40-20-71]**. Apply urethane adhesive (P/N 6808882) to the corners.

NOTE: The urethane adhesive has a four hour initial cure time and will achieve full strength after twenty four hours at 72 F (22 C) and fifty percent humidity. The cure time will be longer with lower temperatures and/or lower humidity.

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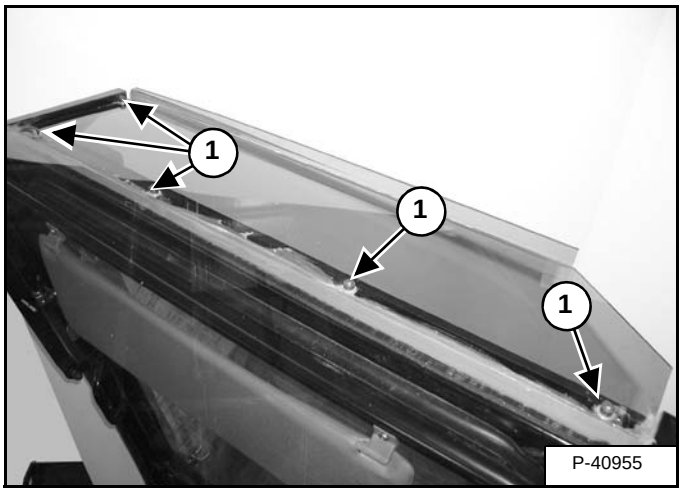
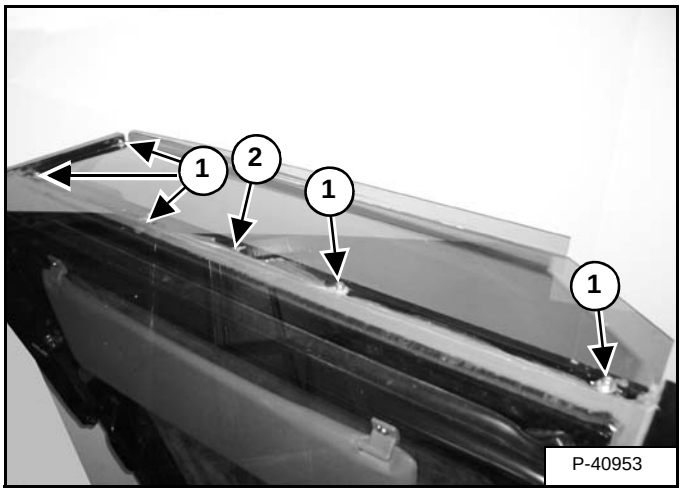
Cab Visor Removal And Installation

Figure 40-20-72



Remove the caps (Item 1) **[Figure 40-20-72]** from the bolts.

Figure 40-20-73



Remove the five bolts (Item 1) nuts and washers. Remove the urethane adhesive (Item 2) **[Figure 40-20-73]** and remove the cab visor.

Installation: Clean and dry the surface. Apply urethane adhesive (P/N 6808882).

NOTE: The urethane adhesive has a four hour initial cure time and will achieve full strength after twenty four hours at 72 F (22 C) and fifty percent humidity. The cure time will be longer with lower temperatures and/or lower humidity.

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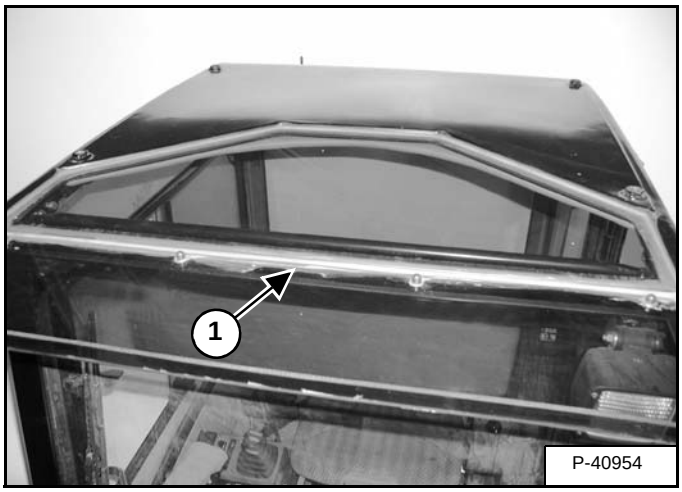
Top Window Removal And Installation

Figure 40-20-74



Remove the urethane adhesive (Item 1) **[Figure 40-20-74]** around the outside diameter of the window. Remove the window.

Installation: Clean and dry the surface around the window opening. Apply urethane adhesive (P/N 6808882).

NOTE: The urethane adhesive has a four hour initial cure time and will achieve full strength after twenty four hours at 72 F (22 C) and fifty percent humidity. The cure time will be longer with lower temperatures and/or lower humidity.

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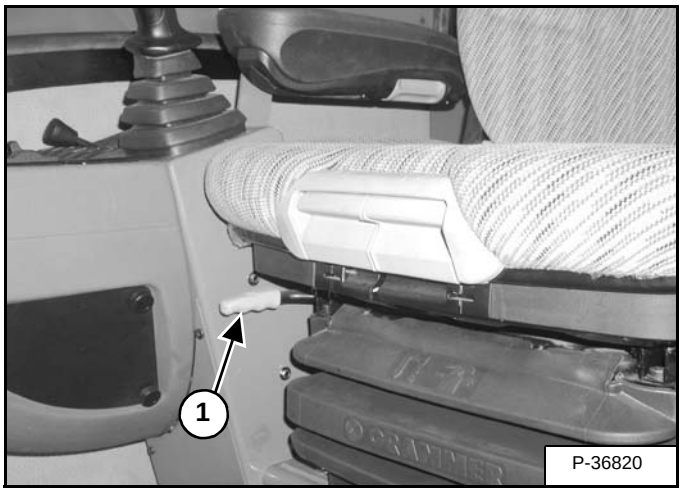
SEAT AND SEAT MOUNT

Removal And Installation

Figure 40-30-1



Pull the slide handle (Item 1) **[Figure 40-30-1]** up and slide the seat forward, off of the seat rails.

Figure 40-30-2

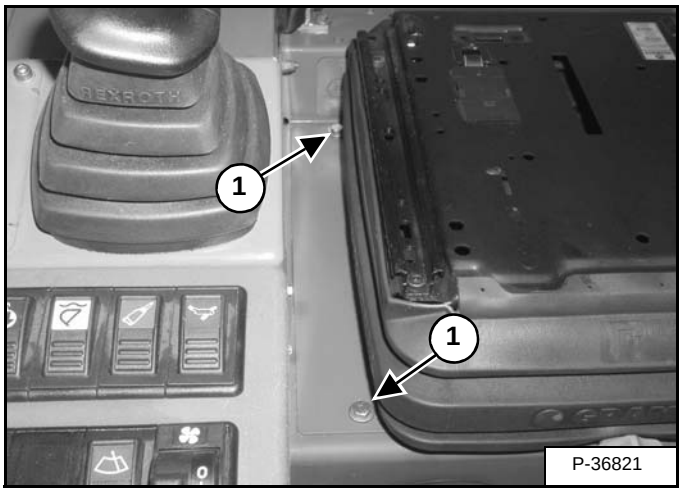
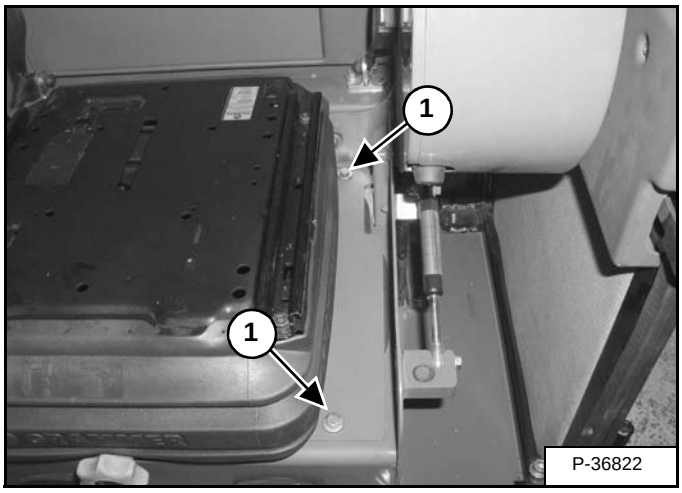


Figure 40-30-3



Remove the four bolts (Item 1) **[Figure 40-30-2]** & **[Figure 40-30-3]** and washers from the seat mount.

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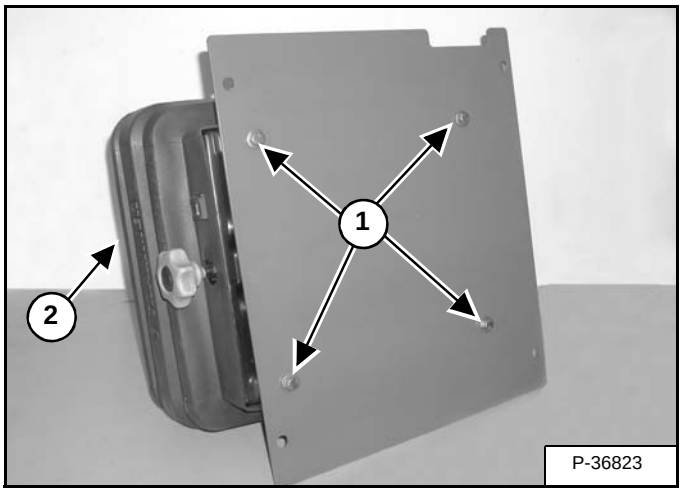
Removal And Installation (Cont'd)

Figure 40-30-4



Remove the four bolts (Item 1) and washers. Remove the bottom of the seat (Item 2) **[Figure 40-30-4]** from the seat mount.

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RIGHT CONSOLE

Description

The right console is a welded on component of the floor pan and is not removable.

See instrument panel removal and installation. (See INSTRUMENT PANEL on Page 50-100-1.)

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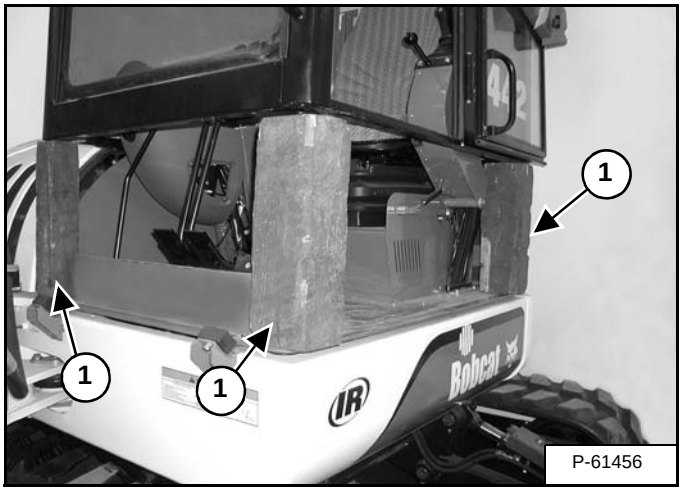
LEFT CONSOLE

Removal And Installation

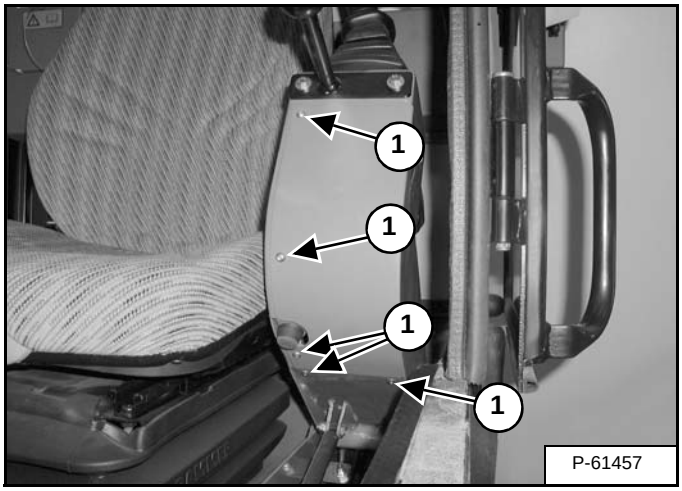
The cab must be removed or raised approximately 24” (610 mm) to remove the left console. (See CAB on Page 40-20-1.)

Figure 40-50-5



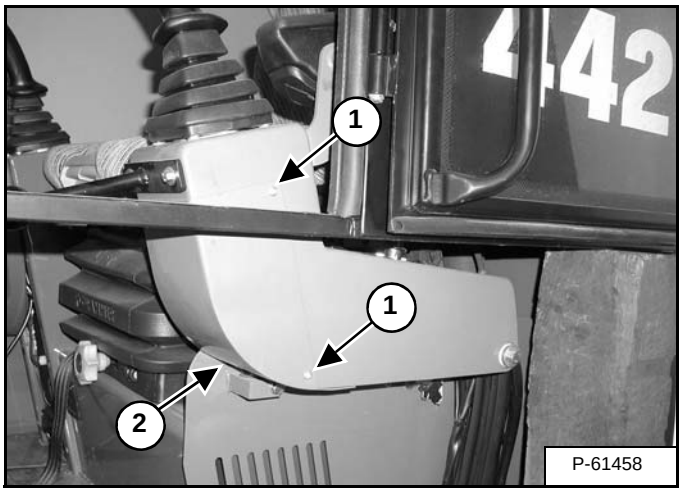
Install blocks (Item 1) **[Figure 40-50-5]** to support the cab if the cab is not removed.

Figure 40-50-6



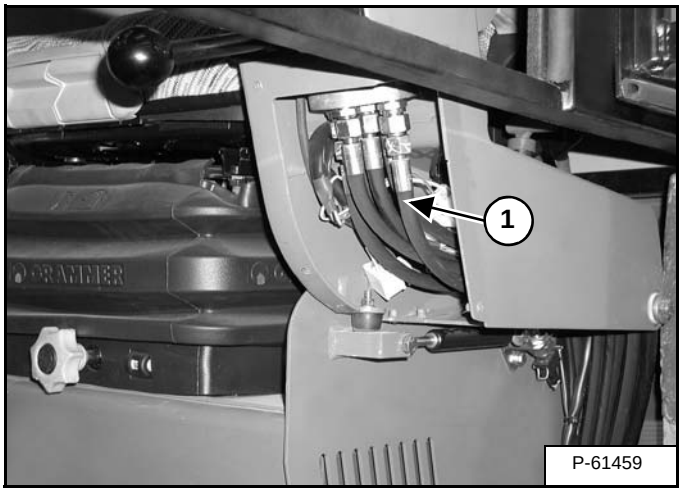
Remove the five screws (Item 1) **[Figure 40-50-6]**.

Figure 40-50-7



Lower the console and remove the two screws (Item 1). Remove the cover (Item 2) **[Figure 40-50-7]**.

Figure 40-50-8



Remove the six hoses (Item 1) **[Figure 40-50-8]** from the joystick.

NOTE: Mark the hoses for correct installation.

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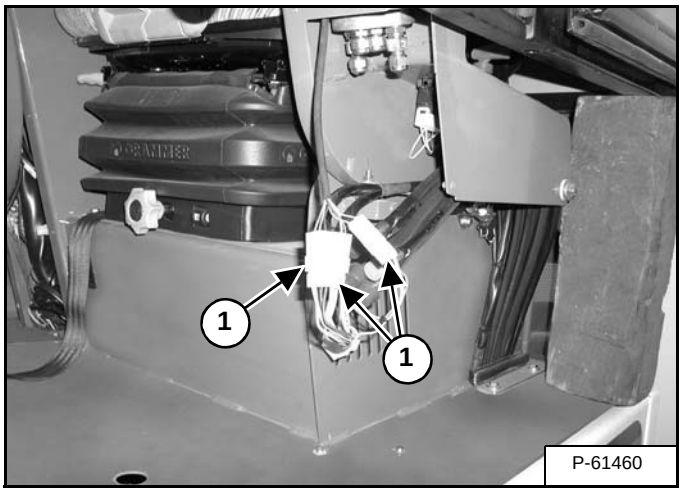
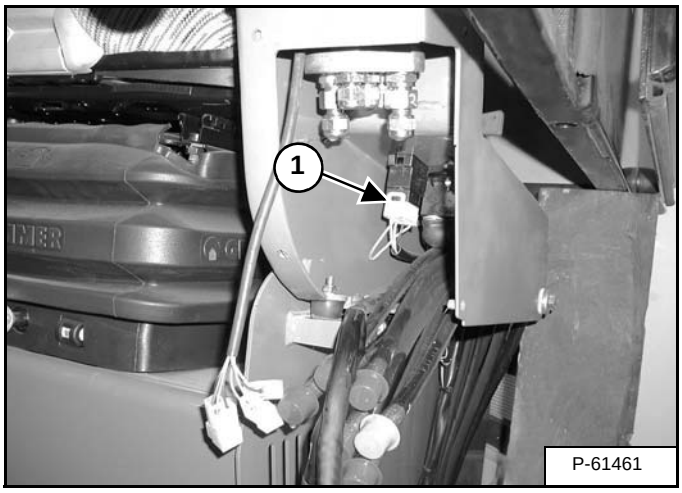
Removal And Installation (Cont'd)

Figure 40-50-9



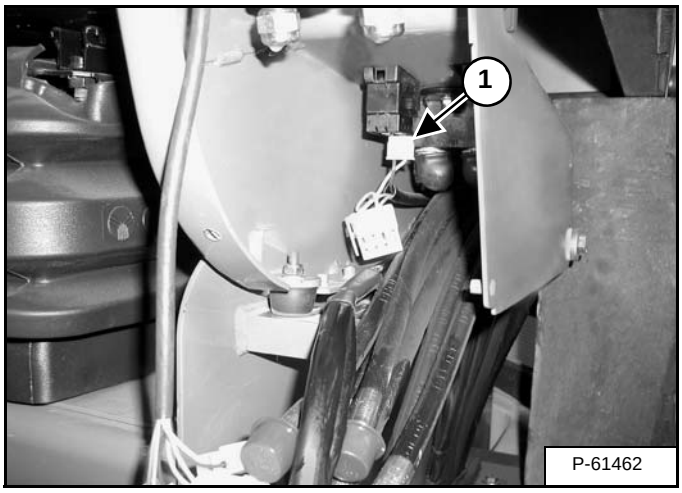
Disconnect the three wire harnesses (Item 1) **[Figure 40-50-9]**.

Figure 40-50-10



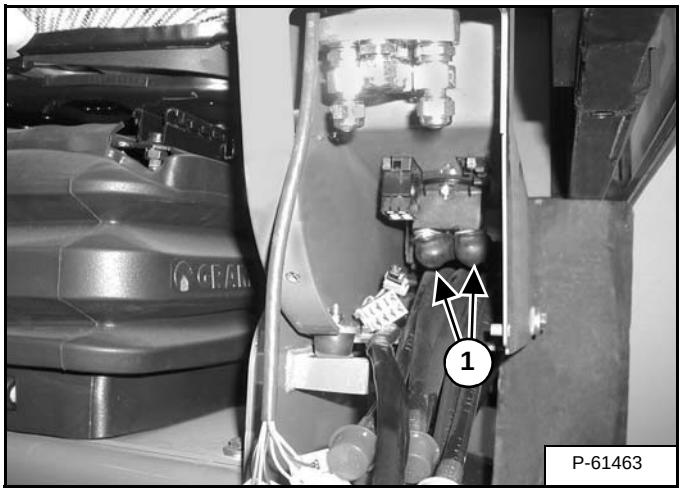
Disconnect the wire harness (Item 1) **[Figure 40-50-10]**.

Figure 40-50-11



Disconnect the wire harness (Item 1) **[Figure 40-50-11]**.

Figure 40-50-12



Remove the dust boots (Item 1) **[Figure 40-50-12]** from the battery disconnect switch.

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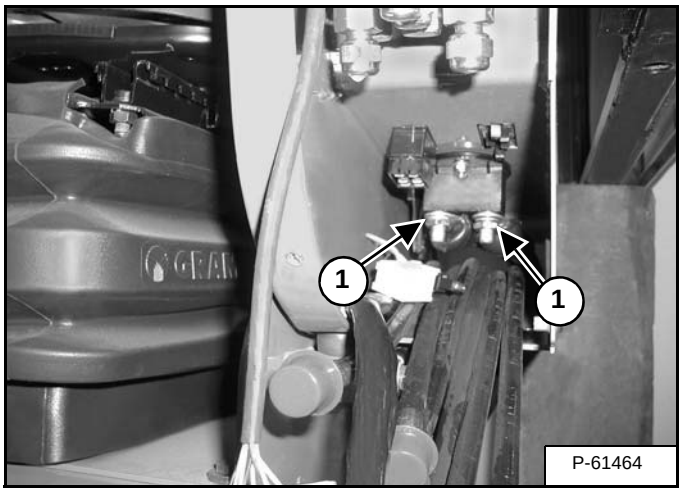
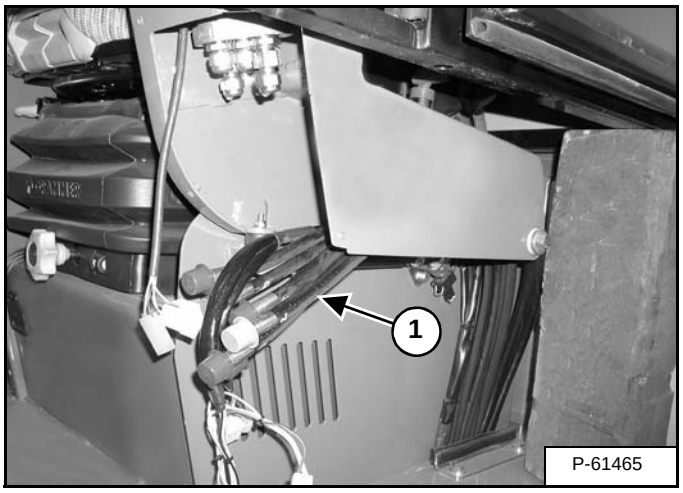
Removal And Installation (Cont'd)

Figure 40-50-13



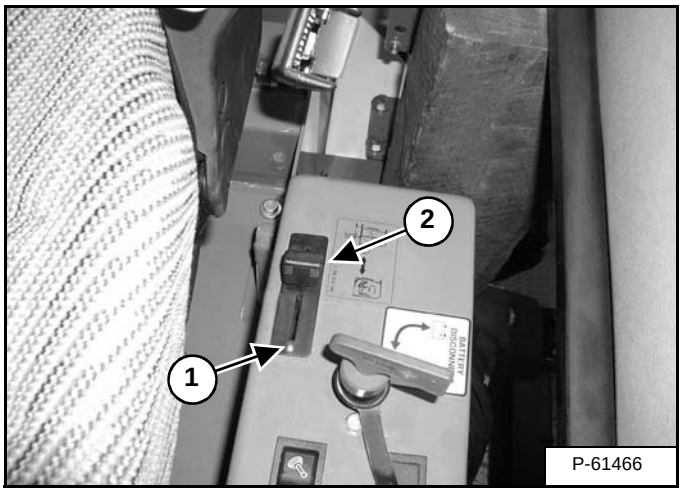
Mark and remove the battery cables (Item 1) **[Figure 40-50-13]** from the battery disconnect switch.

Figure 40-50-14



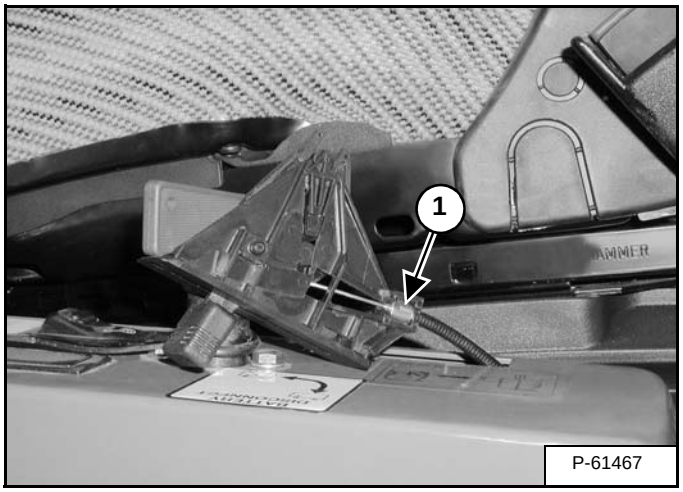
Remove the cables, wire harnesses and hoses (Item 1) **[Figure 40-50-14]** from the console.

Figure 40-50-15



Remove the screw (Item 1) and lift the bracket (Item 2) **[Figure 40-50-15]** from the console.

Figure 40-50-16



Remove the cable housing (Item 1) **[Figure 40-50-16]** from the bracket.

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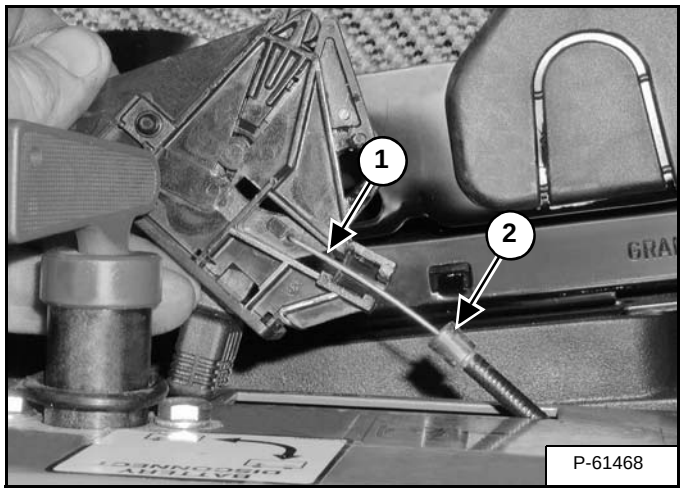
Removal And Installation (Cont'd)

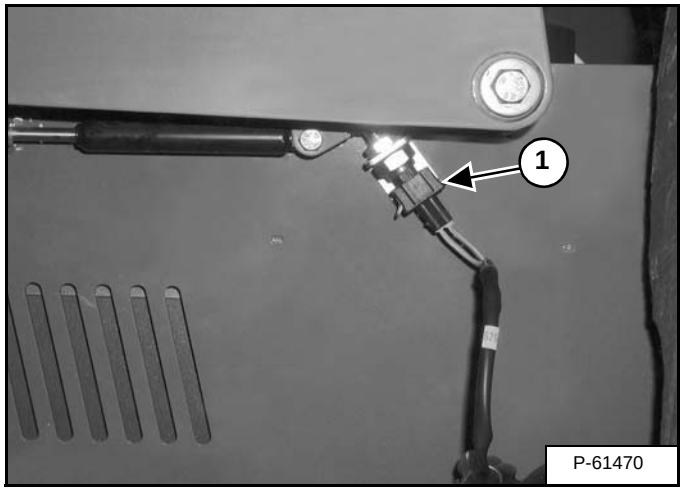
Figure 40-50-17



Remove the control cable wire (Item 1) **[Figure 40-50-17]** from the bracket.

Remove the control cable (Item 2) **[Figure 40-50-17]** from the console.

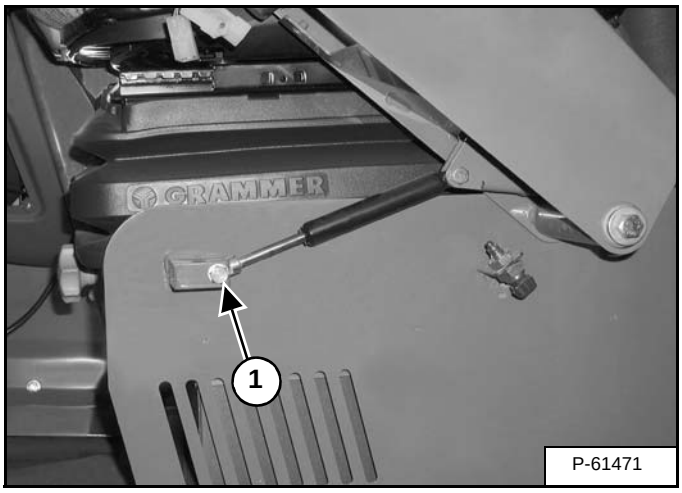
Figure 40-50-18



Disconnect the wire harness (Item 1) **[Figure 40-50-18]** from the console switch.

Raise and support the console.

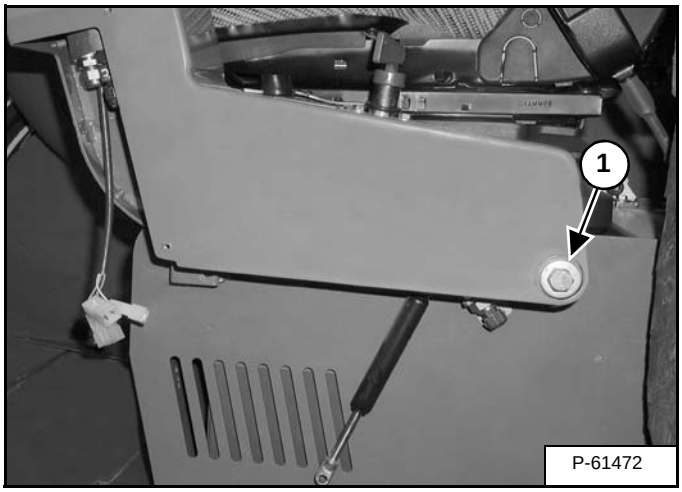
Figure 40-50-19



Remove the bolt (Item 1) **[Figure 40-50-19]** and washer from the gas strut.

Lower the console.

Figure 40-50-20



Remove the bolt (Item 1) **[Figure 40-50-20]** and washers.

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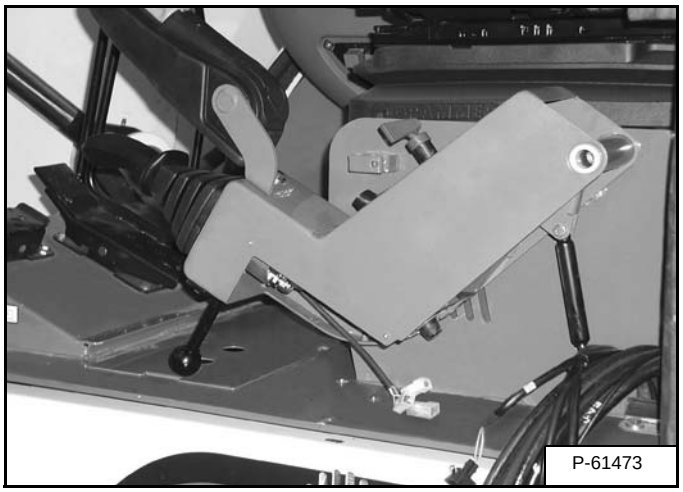
Removal And Installation (Cont'd)

Figure 40-50-21



Remove the console **[Figure 40-50-21]**.

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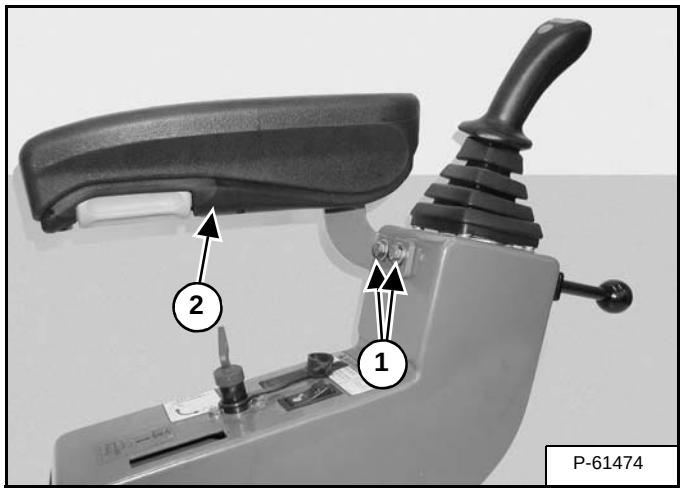
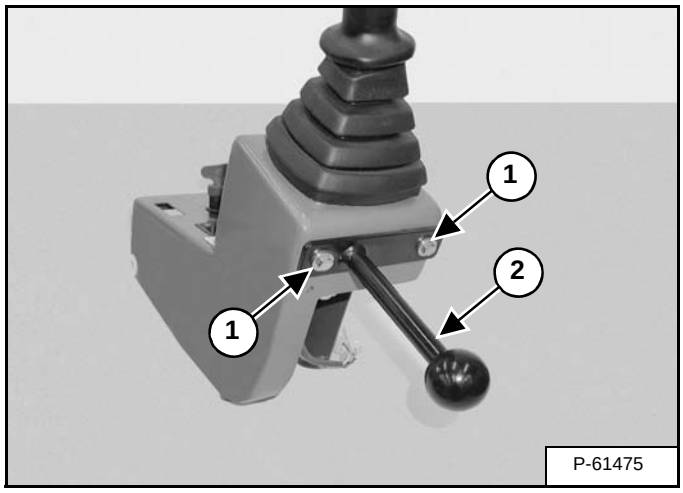
Disassembly And Assembly

Figure 40-50-22



Remove the two bolts (Item 1) and remove the arm rest (Item 2) **[Figure 40-50-22]**.

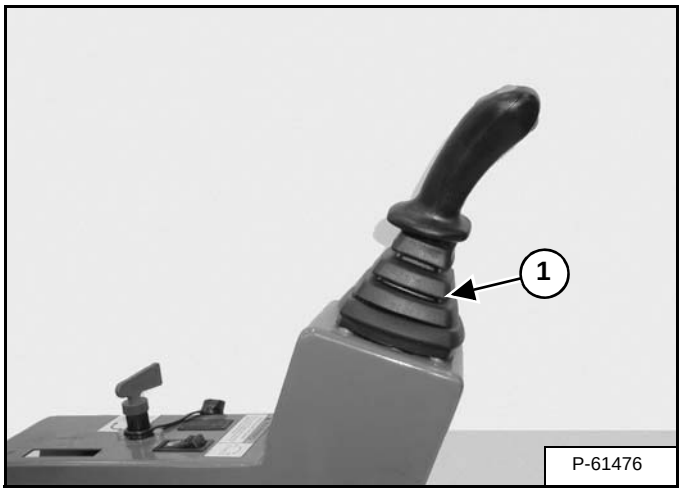
Figure 40-50-23



Remove the two bolts (Item 1) and washers from the handle (Item 2) **[Figure 40-50-23]**.

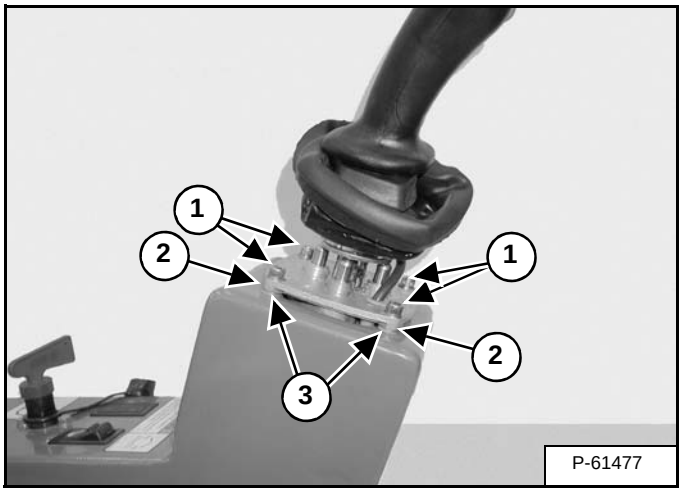
Remove the handle.

Figure 40-50-24



Raise the dust boot (Item 1) **[Figure 40-50-24]**.

Figure 40-50-25



Remove the four bolts (Item 1), four washers (Item 2) and four nylon washers (Item 3) **[Figure 40-50-25]**.

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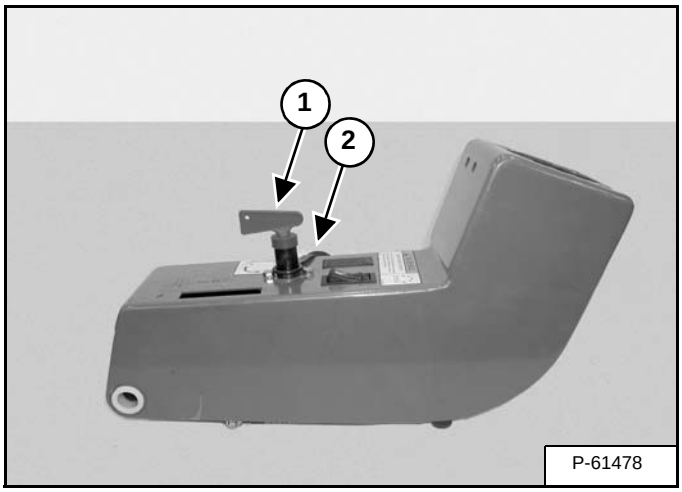
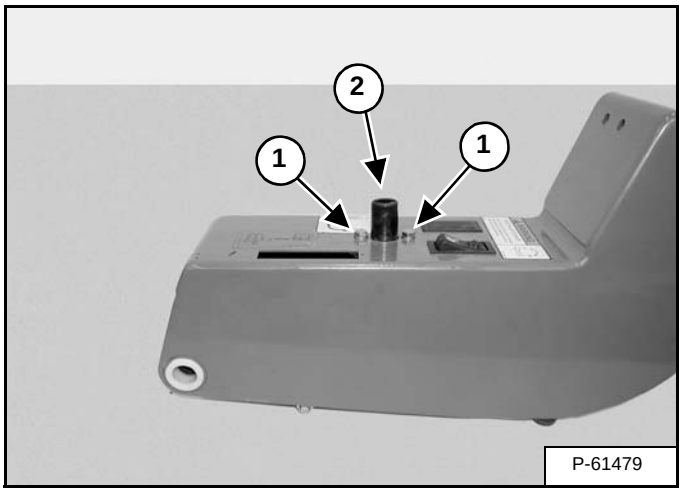
Disassembly And Assembly (Cont'd)

Figure 40-50-26



Remove the key (Item 1) and dust cover (Item 2) **[Figure 40-50-26]** from the battery disconnect.

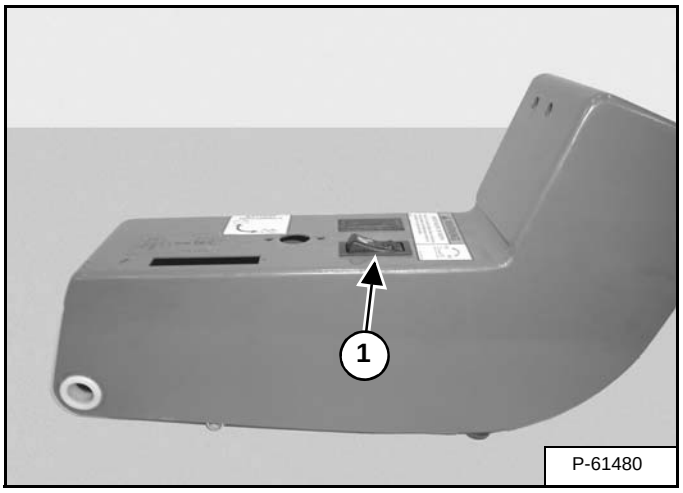
Figure 40-50-27



Remove the two screws (Item 1) from the battery disconnect (Item 2) **[Figure 40-50-27]**.

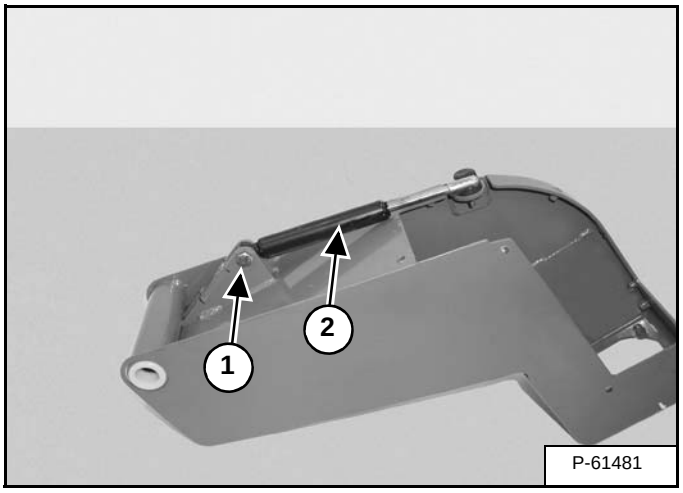
Remove the battery disconnect.

Figure 40-50-28



Remove the switch (Item 1) **[Figure 40-50-28]**.

Figure 40-50-29



Remove the bolt (Item 1), washer, and nut from the gas strut (Item 2) **[Figure 40-50-29]**.

Remove the gas strut.

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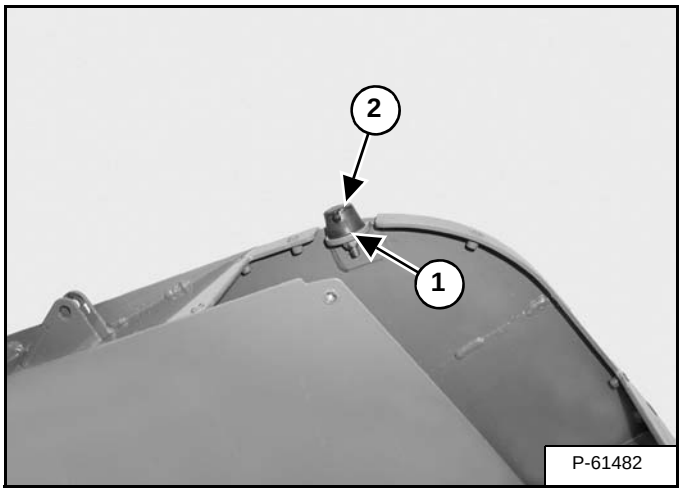
Disassembly And Assembly (Cont'd)

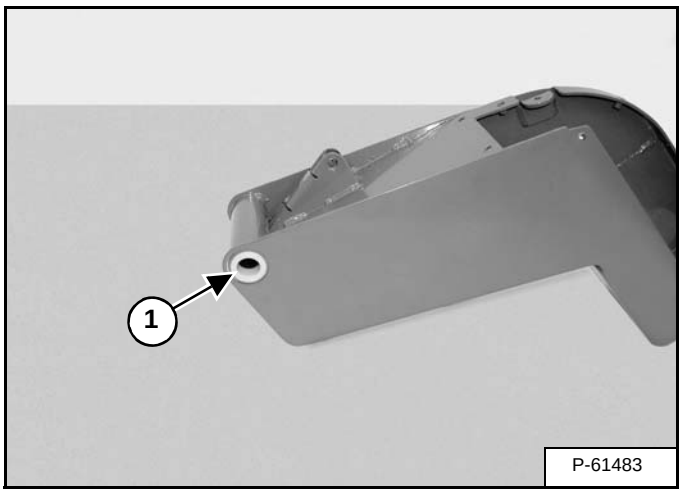
Figure 40-50-30



Remove the nut (Item 1) from the bumper (Item 2) **[Figure 40-50-30]**.

Remove the bumper.

Figure 40-50-31

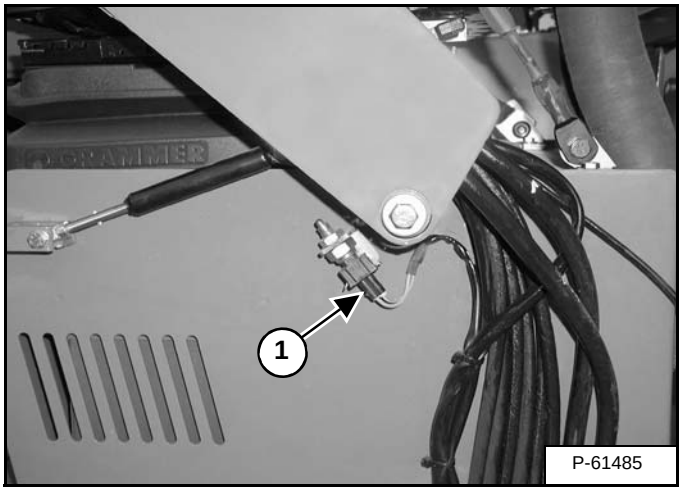


Remove the bushing (Item 1) **[Figure 40-50-31]** from both sides of the console.

Console Lockout Switch Removal And Installation

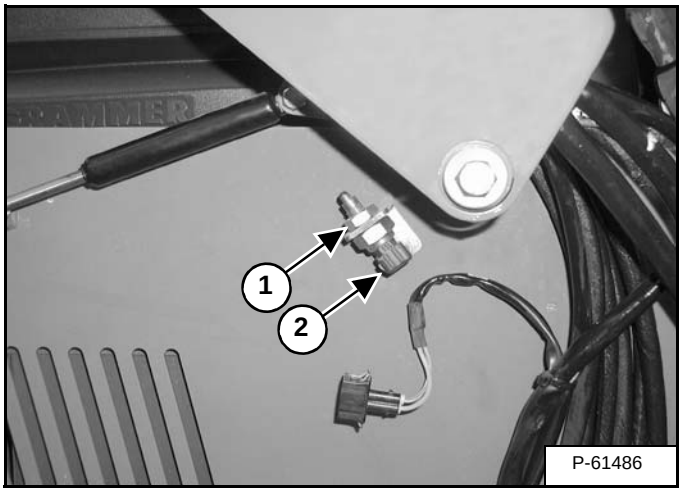
The cab is shown removed for photo clarity.

Figure 40-50-32



Disconnect the wire harness (Item 1) **[Figure 40-50-32]**.

Figure 40-50-33



Remove the nut (Item 1) from the console switch (Item 2) **[Figure 40-50-33]**.

Remove the console lockout switch.

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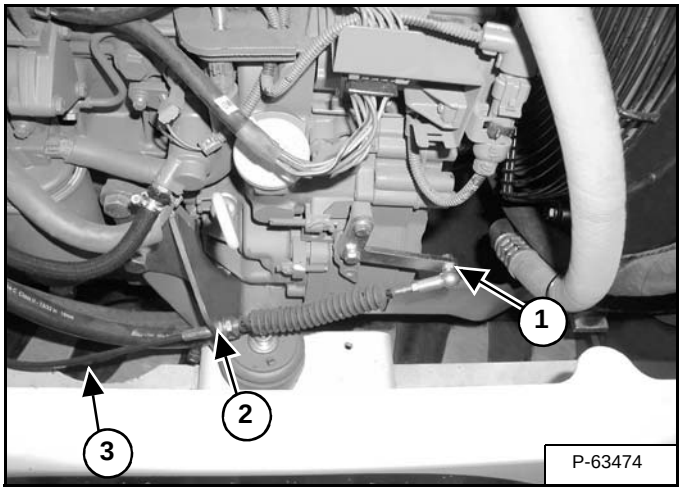
ENGINE SPEED CONTROL

Removal And Installation

Open the right side cover.

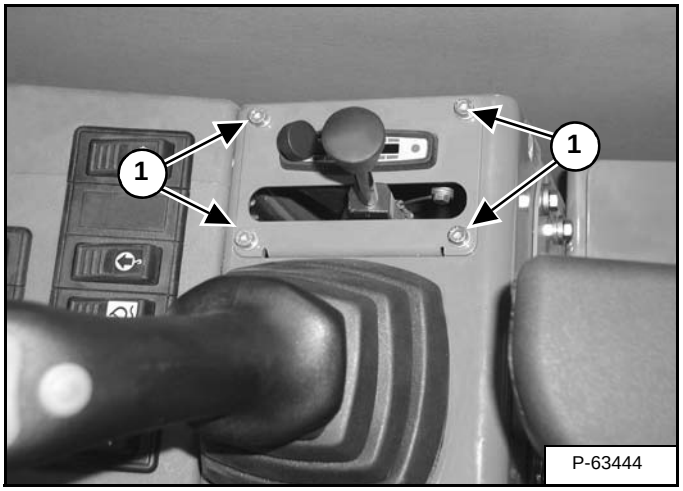
Figure 40-60-1



Remove the nut (Item 1). Loosen the nut (Item 2) **[Figure 40-60-1]**.

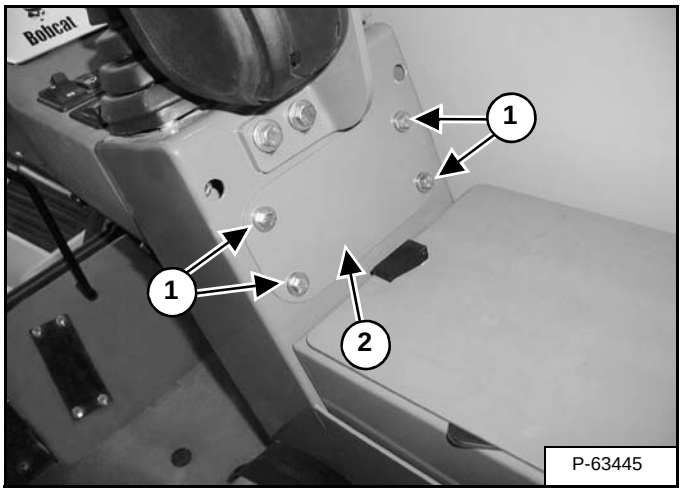
Remove all tie straps from the speed control cable (Item 3) **[Figure 40-60-1]**.

Figure 40-60-2



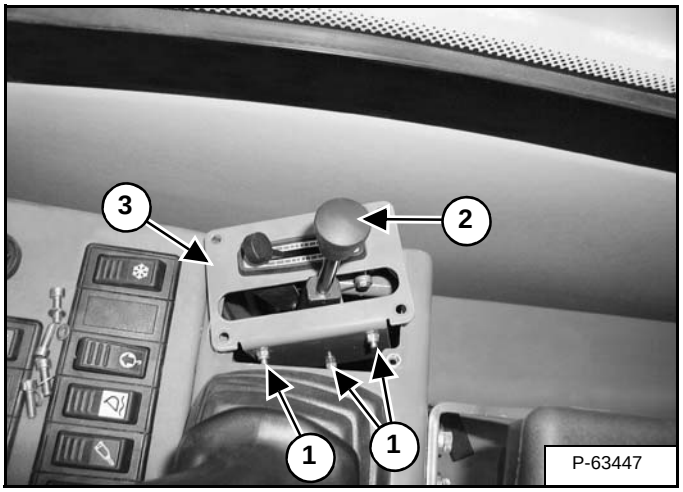
Remove the 4 screws (Item 1) **[Figure 40-60-2]**.

Figure 40-60-3



Remove the 4 screws (Item 1) and cover (Item 2) **[Figure 40-60-3]**.

Figure 40-60-4



Remove the 3 bolts and nuts (Item 1), knob (Item 2) and plate (Item 3) **[Figure 40-60-4]**.

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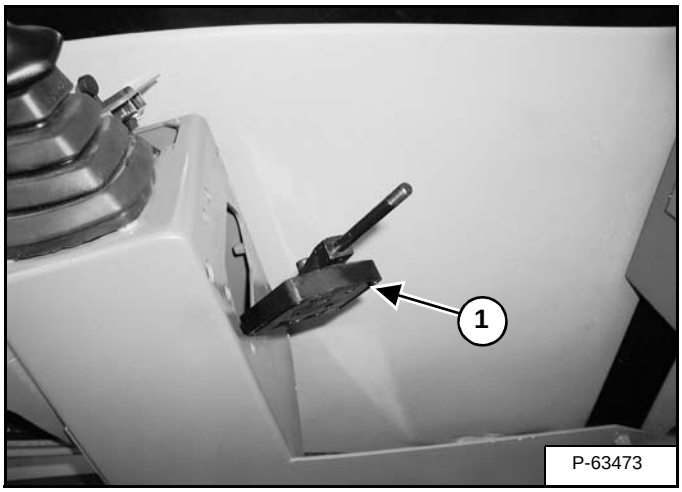
Removal And Installation (Cont'd)

Figure 40-60-5



Remove the engine speed control (Item 1) **[Figure 40-60-5]**.

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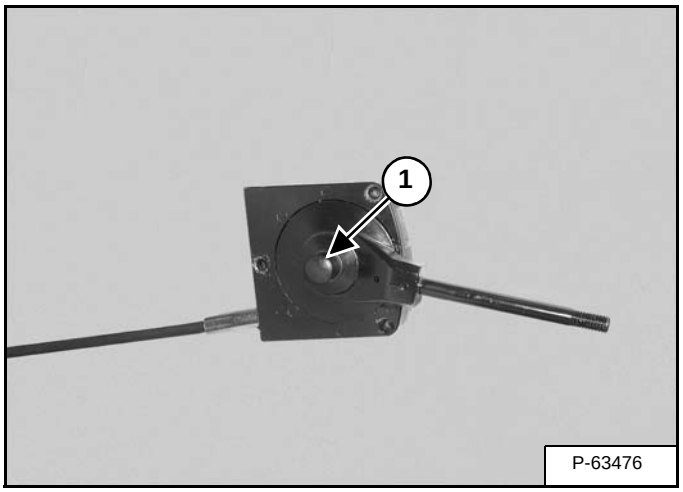
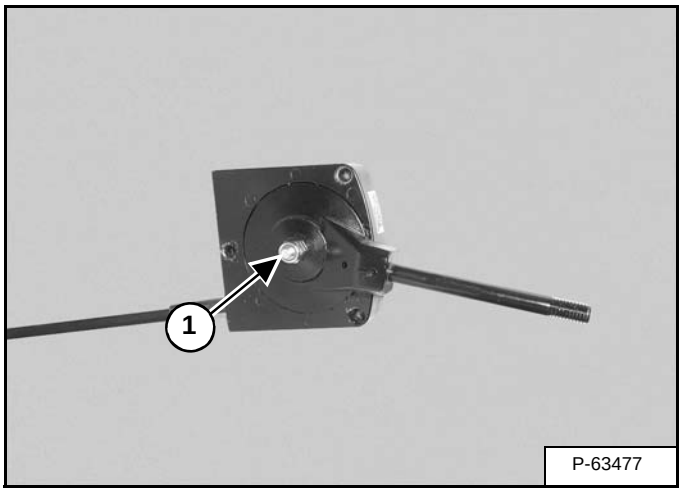
Disassembly And Assembly

Figure 40-60-6



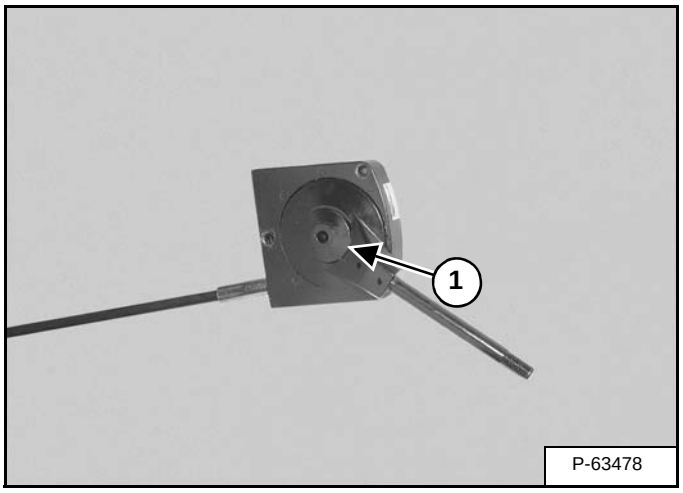
Remove the cap (Item 1) **[Figure 40-60-6]**.

Figure 40-60-7



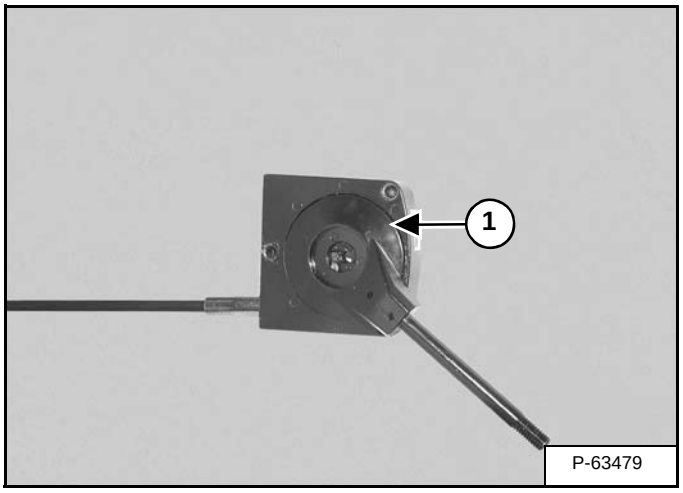
Remove the nut and bolt (Item 1) **[Figure 40-60-7]**.

Figure 40-60-8



Remove the washer (Item 1) **[Figure 40-60-8]**.

Figure 40-60-9



Remove the handle assembly (Item 1) **[Figure 40-60-9]**.

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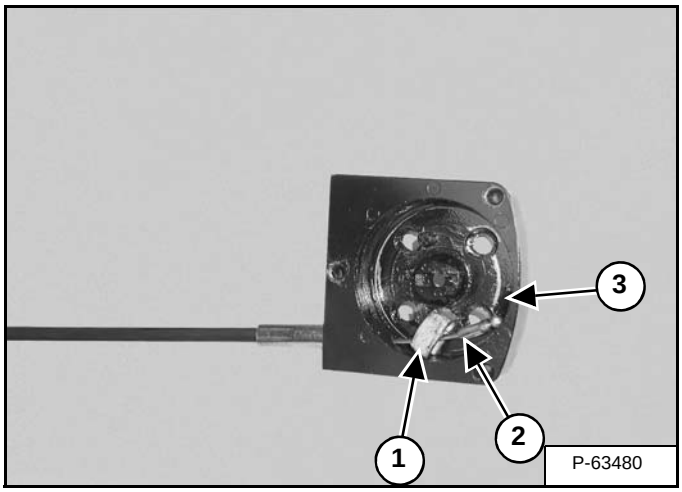
Disassembly And Assembly (Cont'd)

Figure 40-60-10



Remove the retainer (Item 1) **[Figure 40-60-10]**.

Assembly: Install the retainer (Item 1) over the cable (Item 2). Seat the retainer in the notch (Item 3) **[Figure 40-60-10]**.

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CONTROL LEVERS

Description

The travel (See TRAVEL LEVER/FOOT PEDAL VALVE on Page 20-112-1), boom offset (See BOOM OFFSET VALVE on Page 20-190-1) and blade control levers (See BLADE VALVE on Page 20-180-1) are removed with the respective valve.

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FUEL TANK

Removal And Installation

Drain the fuel tank. (See Draining The Fuel Tank on Page 10-80-8.)

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

Remove the right side cover. (See RIGHT SIDE COVER on Page 40-160-1.)

Remove the rear cover. (See REAR COVER on Page 40-150-1.)

Figure 40-80-1

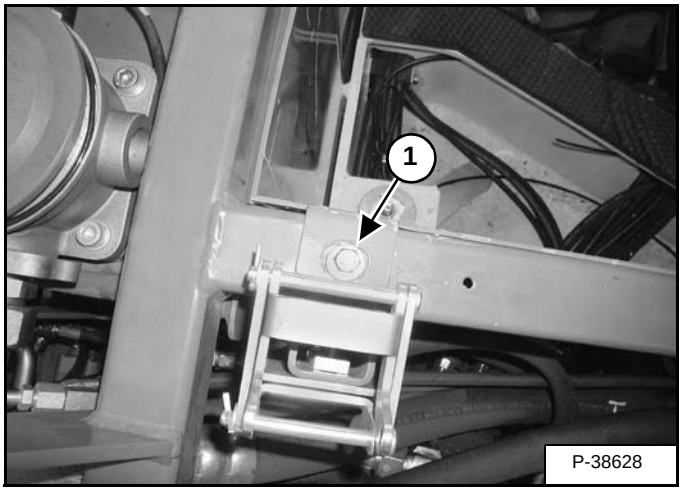
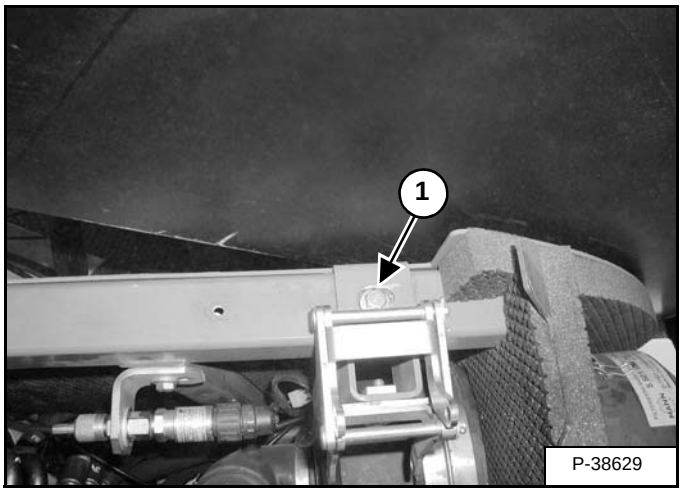
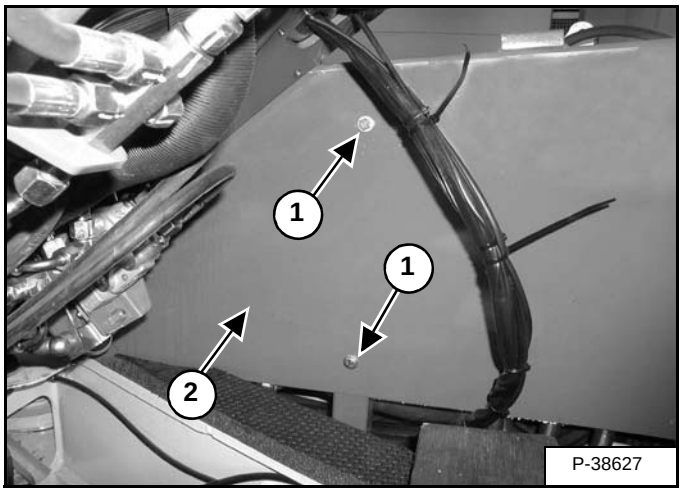


Figure 40-80-2



Remove the two bolts (Item1) **[Figure 40-80-1]** and **[Figure 40-80-2]** and washers from the top of the center panel.

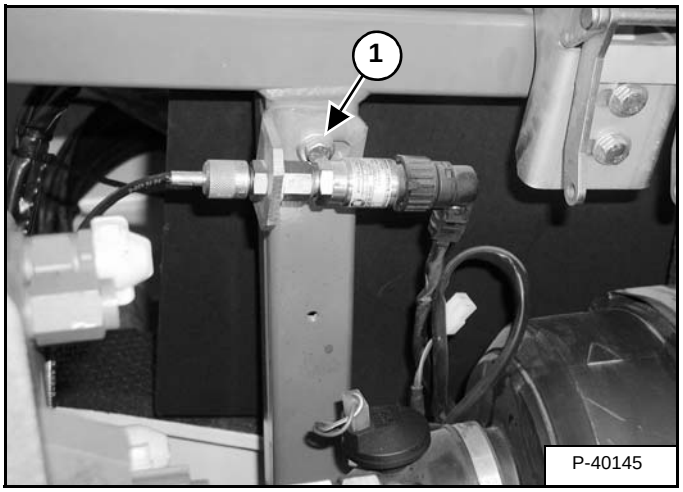
Figure 40-80-3



Remove the two bolts (Item 1) **[Figure 40-80-3]** and washers from the side of the center panel.

Remove the panel (Item 2) **[Figure 40-80-3]**.

Figure 40-80-4



Remove the bolt (Item 1) **[Figure 40-80-4]** and washer from the electrical connector mount bracket.

Remove the mount bracket.

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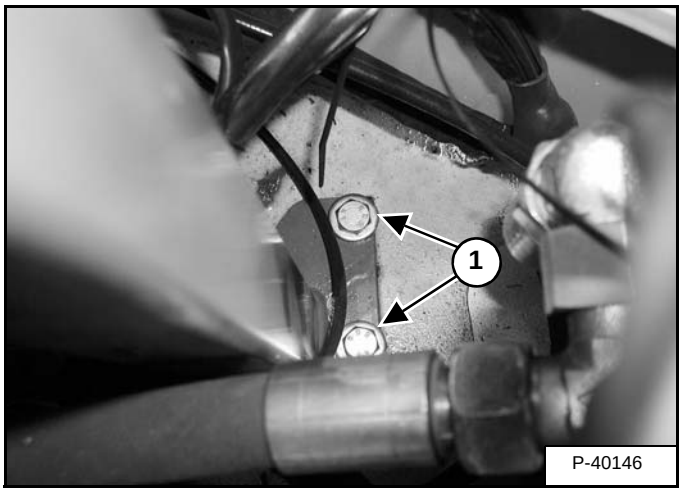
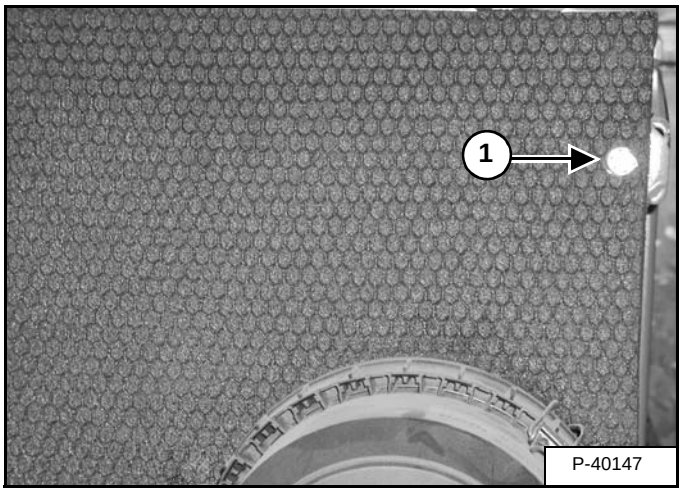
Removal And Installation (Cont'd)

Figure 40-80-5



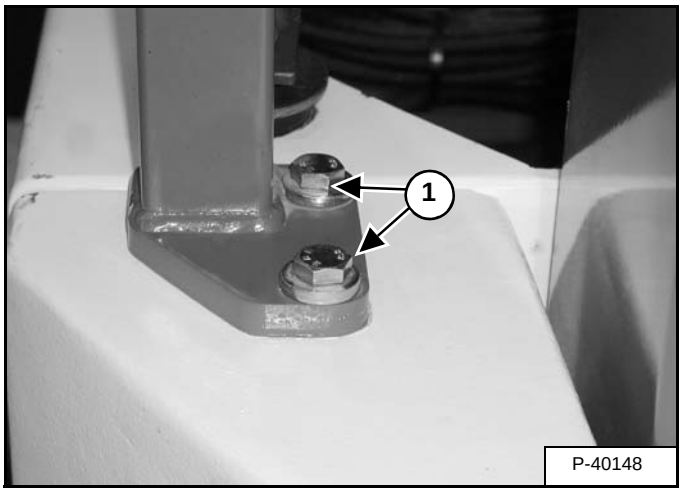
Remove the two bolts (Item 1) **[Figure 40-80-5]** and washers from the front leg of the support bracket.

Figure 40-80-6



Remove the bolt (Item 1) **[Figure 40-80-6]** and washer from the front of the support bracket.

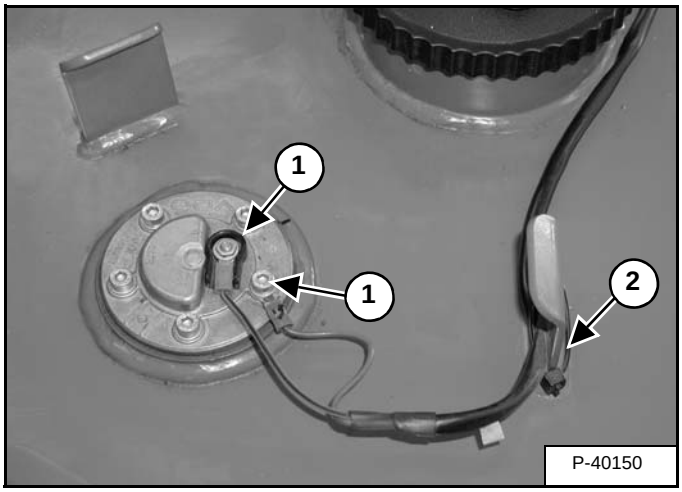
Figure 40-80-7



Remove the two bolts (Item 1) **[Figure 40-80-7]** and washers from both rear legs of the support bracket.

Remove the support bracket.

Figure 40-80-8



Mark and disconnect the wires (Item 1) **[Figure 40-80-8]** from the sending unit.

Remove the tie strap (Item 2) **[Figure 40-80-8]**.

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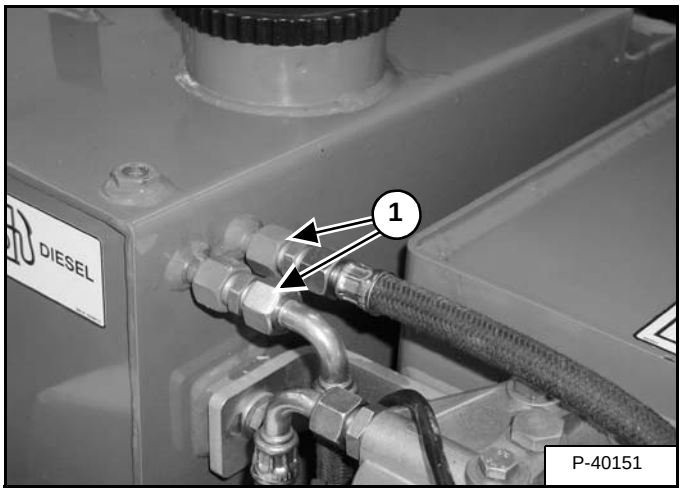
Removal And Installation (Cont'd)

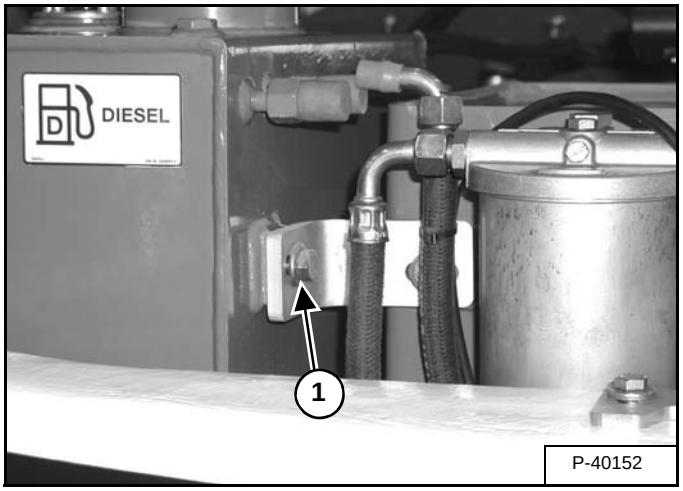
Figure 40-80-9



Mark and remove the hoses (Item 1) **[Figure 40-80-9]**.

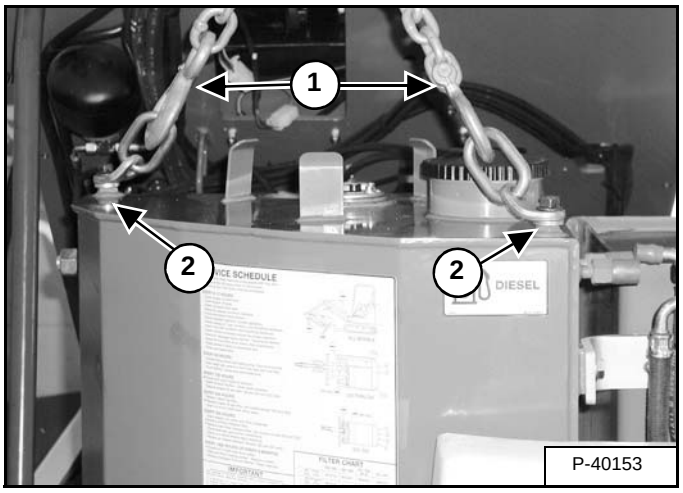
Install caps and plugs.

Figure 40-80-10



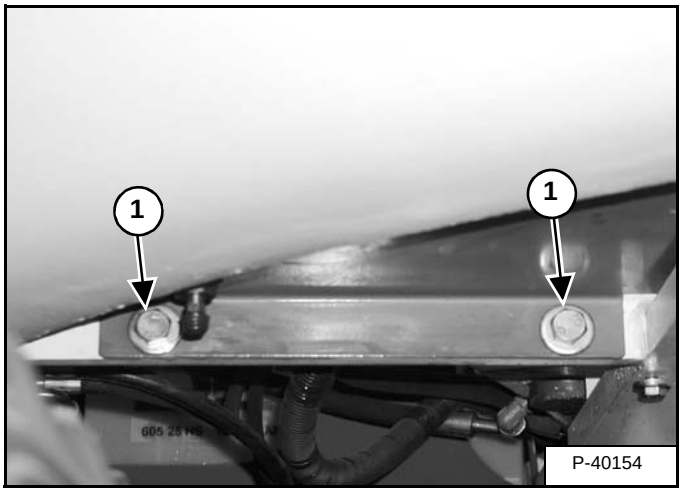
Remove the bolt (Item 1) **[Figure 40-80-10]** and washer from the mount bracket.

Figure 40-80-11



Install a hoist (Item 1) using the threaded holes (Item 2) **[Figure 40-80-11]**.

Figure 40-80-12



Remove the two bolts (Item 1) **[Figure 40-80-12]** and washers from the bottom of the fuel tank.

Raise the hoist and remove the fuel tank.

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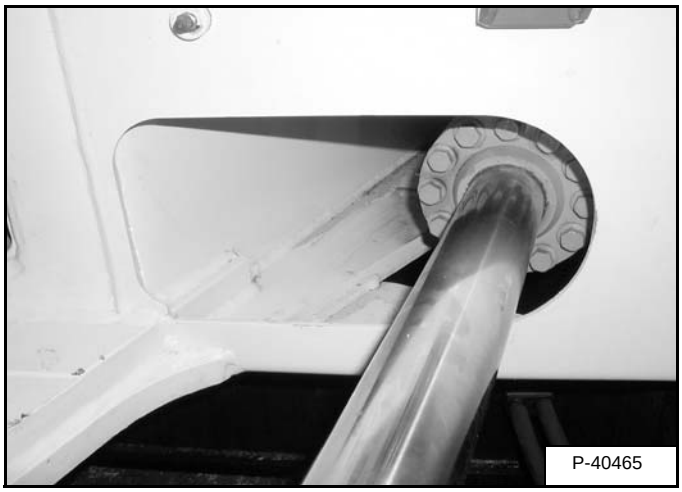
HORN

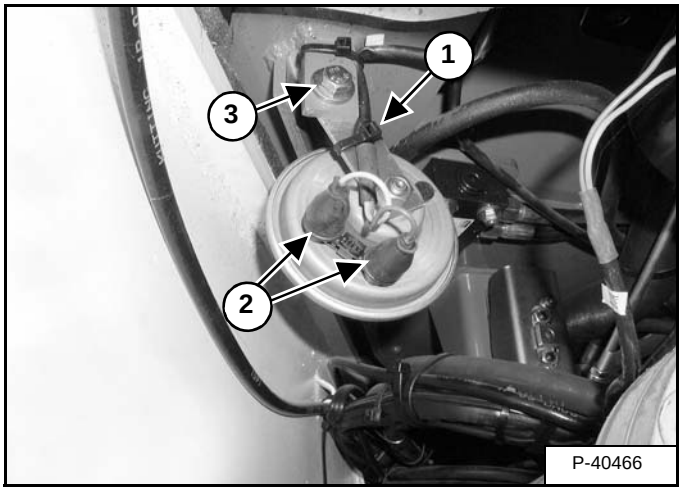
Removal And Installation

Figure 40-90-1



Access to the horn is through the front of the upperstructure, behind the boom offset cylinder **[Figure 40-90-1]**.

Figure 40-90-2



Cut and remove the tie straps (Item 1) **[Figure 40-90-2]**.

Remove the wires (Item 2) **[Figure 40-90-2]**.

Remove the bolt (Item 3) **[Figure 40-90-2]**, washer and nut. Remove the horn.

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SWING FRAME

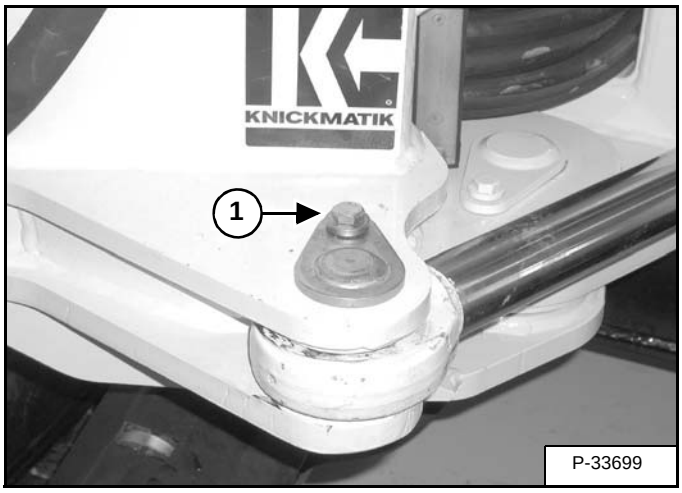
Removal And Installation

Remove the bucket. (See BUCKET on Page 40-140-1.)

Remove the arm. (See ARM on Page 40-130-1.)

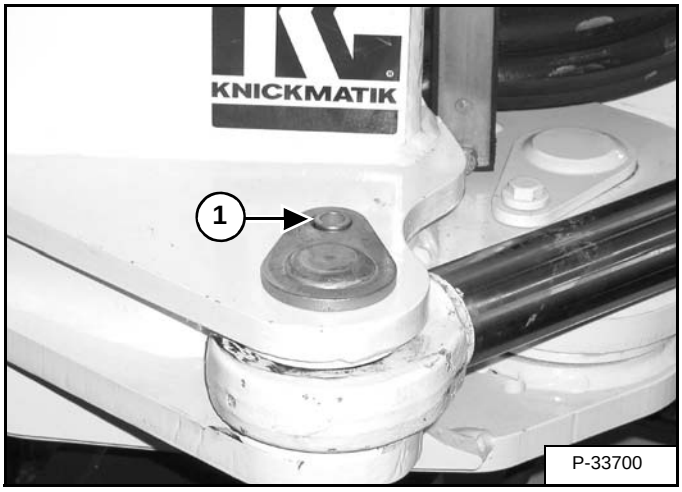
Remove the boom. (See BOOM on Page 40-120-1.)

Figure 40-100-1



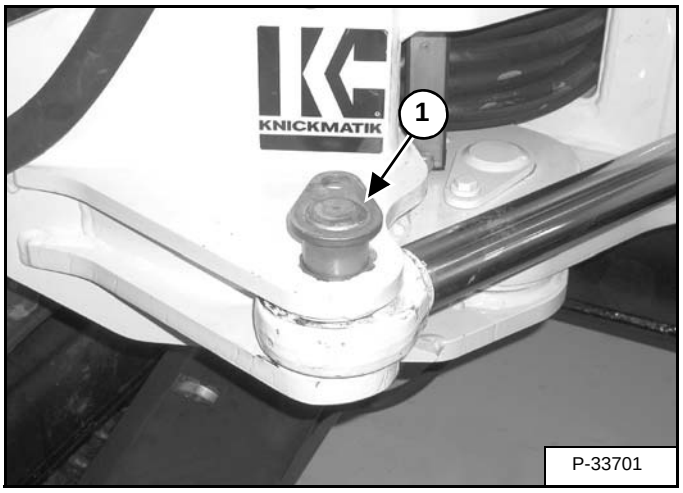
Remove the bolt (Item 1) **[Figure 40-100-1]** and washer.

Figure 40-100-2



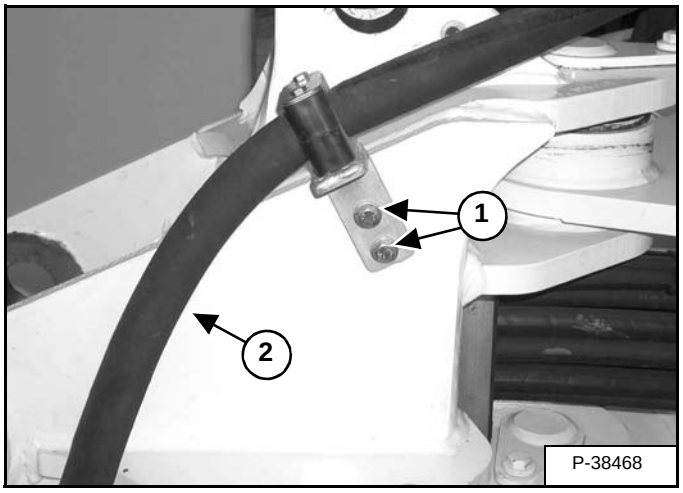
Remove the spacer (Item 1) **[Figure 40-100-2]**.

Figure 40-100-3



Remove the pin (Item 1) **[Figure 40-100-3]**.

Figure 40-100-4



Remove the two return to tank hose bracket bolts (Item 1) **[Figure 40-100-4]**.

Reposition the return to tank hose (Item 2) **[Figure 40-100-4]**.

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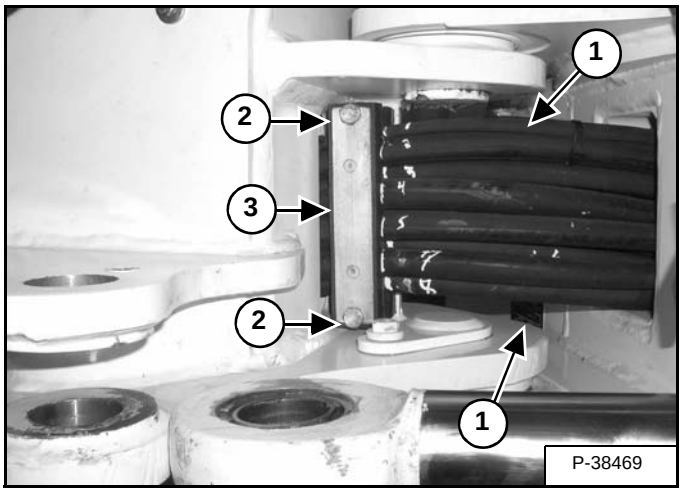
Removal And Installation (Cont'd)

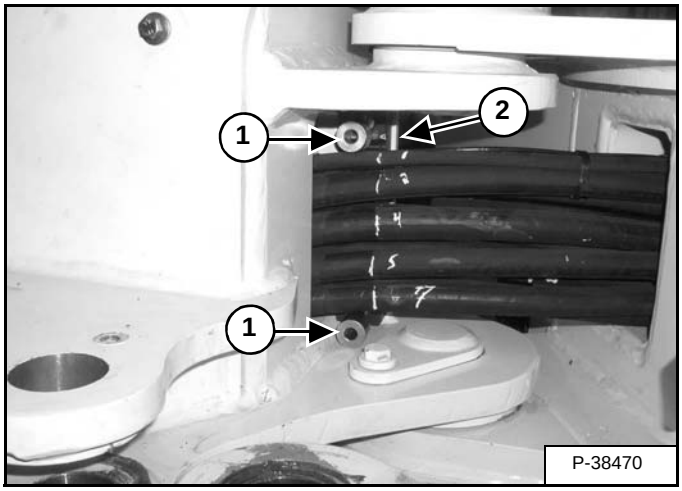
Figure 40-100-5



Mark the hoses (Item 1) **[Figure 40-100-5]** for correct length and orientation.

Remove the two bolts (Item 2), washers and clamp (Item 3) **[Figure 40-100-5]**.

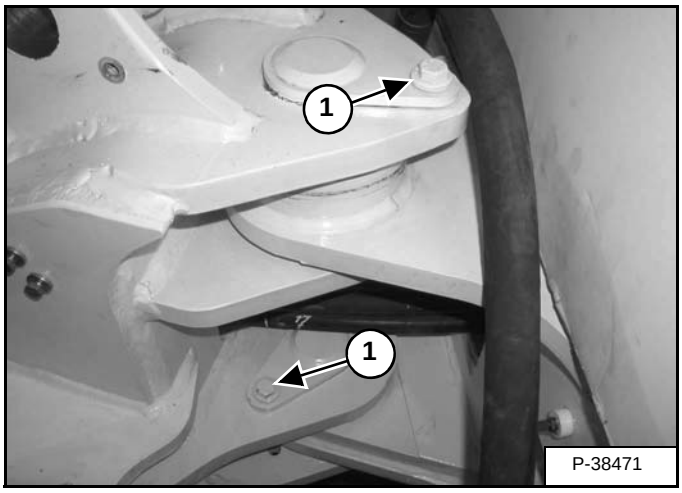
Figure 40-100-6



Remove the two spacers (Item 1) **[Figure 40-100-6]**.

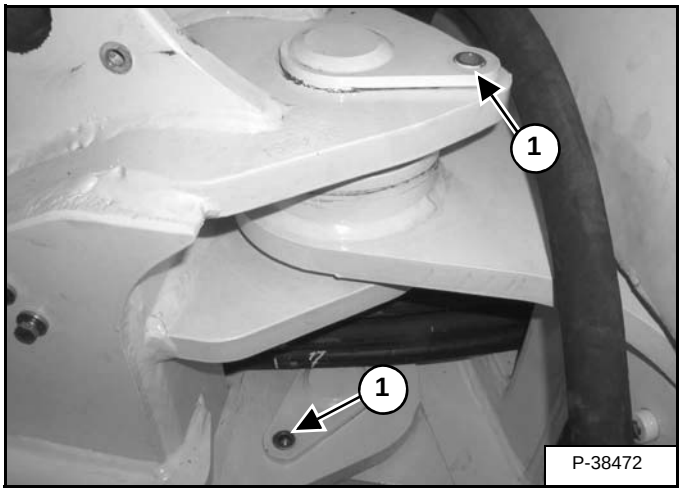
Remove the clamp (Item 2) **[Figure 40-100-6]**.

Figure 40-100-7



Remove the bolts (Item 1) **[Figure 40-100-7]** and washers from the top and bottom pivot pins.

Figure 40-100-8



Remove the spacers (Item 1) **[Figure 40-100-8]**.

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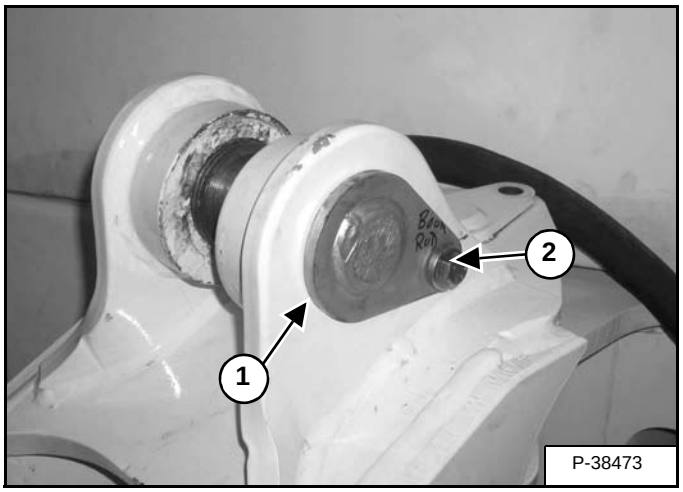
Removal And Installation (Cont'd)

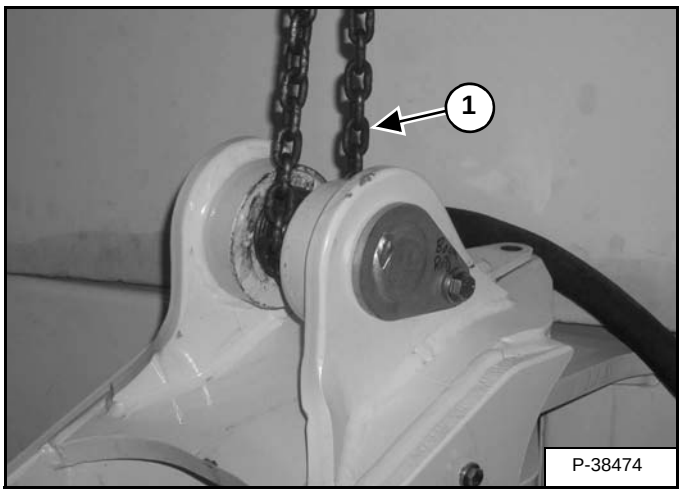
Figure 40-100-9



Install the boom cylinder pin (Item 1) **[Figure 40-100-9]**.

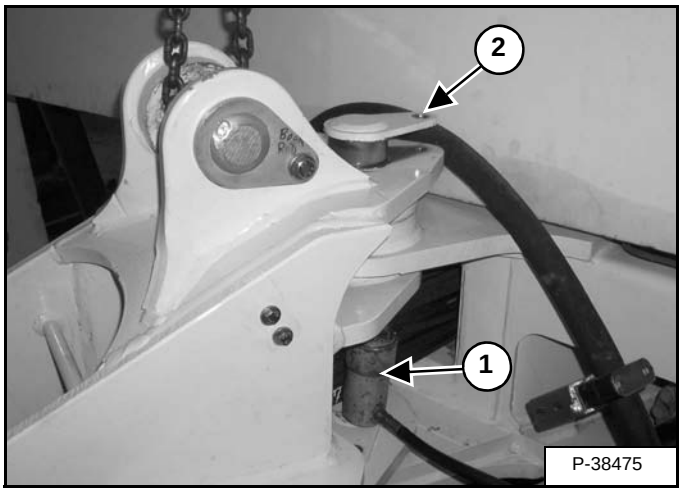
Install the spacer, washer and bolt (Item 2) **[Figure 40-100-9]**.

Figure 40-100-10



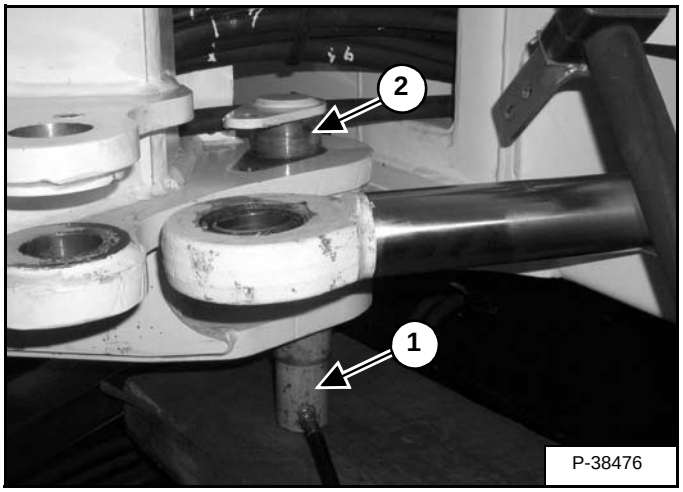
Install a chain hoist (Item 1) **[Figure 40-100-10]** on the pin.

Figure 40-100-11



Use a porta power (Item 1) to remove the top pin (Item 2) **[Figure 40-100-11]**.

Figure 40-100-12



Use a porta power (Item 1) to remove the bottom pin (Item 2) **[Figure 40-100-12]**.

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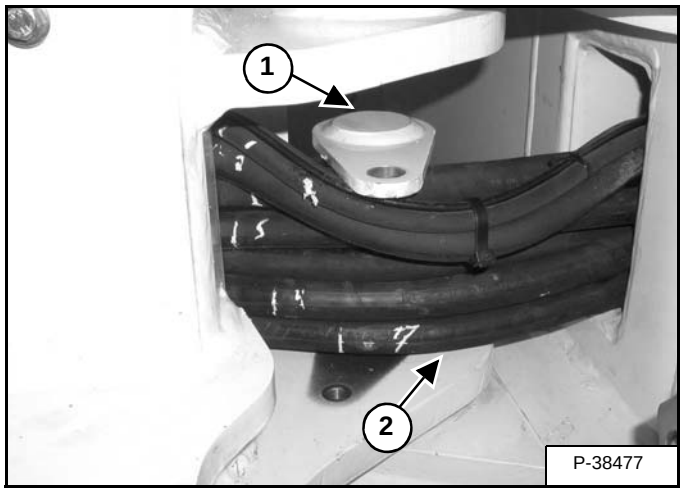
Removal And Installation (Cont'd)

Figure 40-100-13

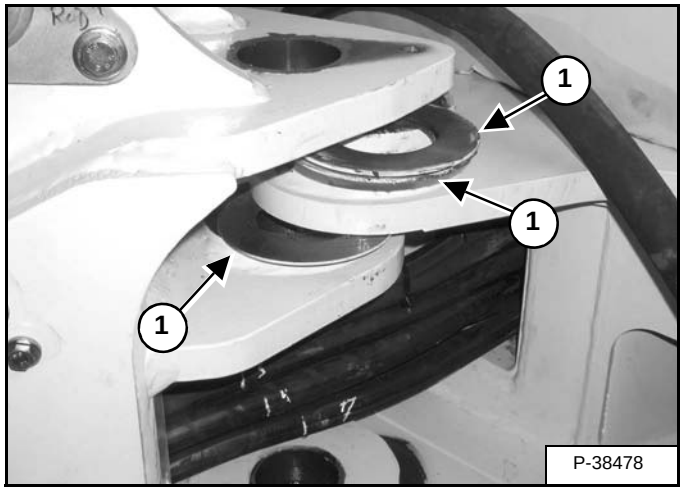


As the lower pin (Item 1) is being removed, reposition the hoses (Item 2) **[Figure 40-100-13]** to gain pin clearance.

Remove the lower pin.

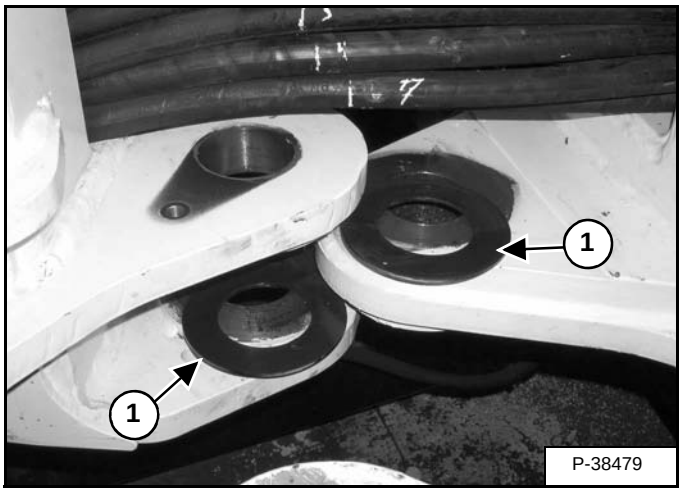
Separate the swing frame from the excavator.

Figure 40-100-14



Mark and remove the shims (Item 1) **[Figure 40-100-14]** from the top of the swing frame.

Figure 40-100-15

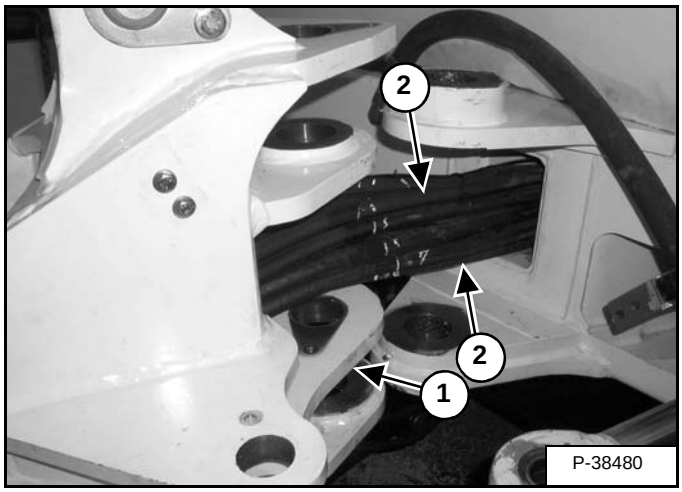


Mark and remove the shims (Item 1) **[Figure 40-100-15]** from the bottom of the swing frame.

NOTE: The top and bottom of the swing bracket uses three different shim thickness.

0.079 inch (2 mm)
0.098 inch (2.5 mm)
0.118 inch (3 mm)

Figure 40-100-16



Pull the swing frame (Item 1) away from the excavator and remove the hoses (Item 2) **[Figure 40-100-16]** from the swing frame.

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Bushing Removal And Installation

Figure 40-100-17

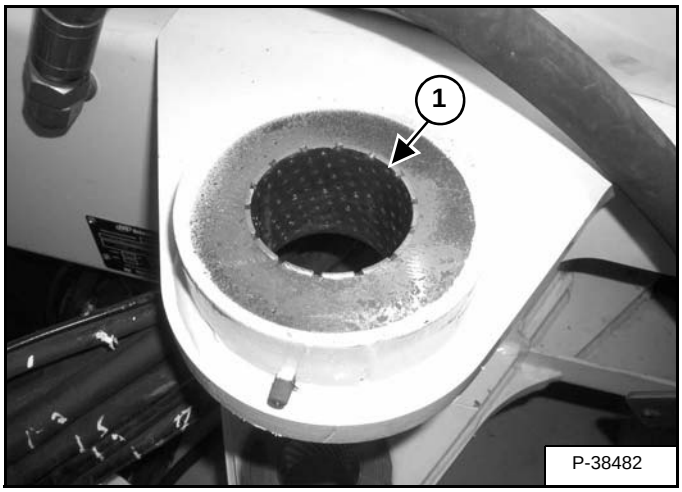
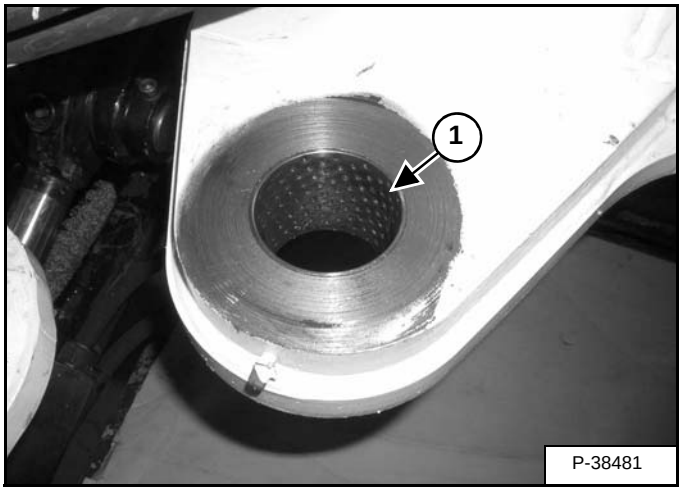


Figure 40-100-18



Remove the top bushing (Item 1) **[Figure 40-100-17]** and bottom bushing (Item 1) **[Figure 40-100-18]**.

Installation: Install the bushings until the bushings are flush with the bushing mounts.

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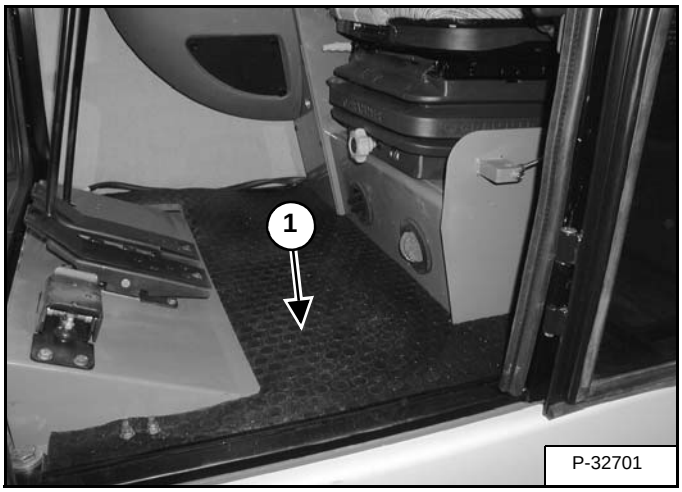
FLOOR MAT

Removal And Installation

Figure 40-110-1



Pull up on and remove the floormat (Item 1) **[Figure 40-110-1]**.

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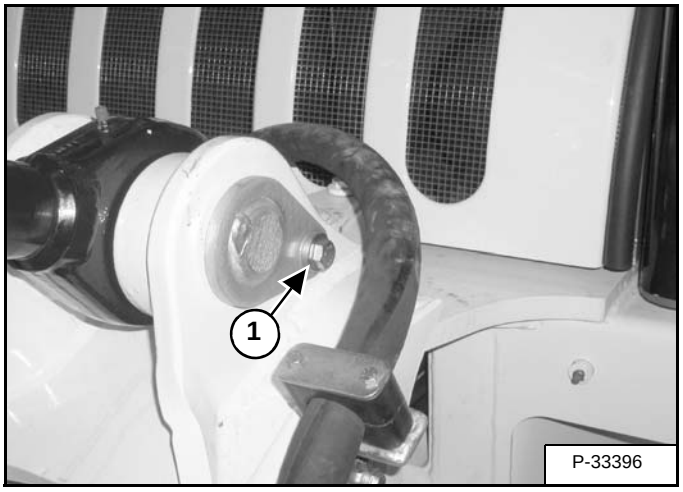
BOOM

Removal And Installation

Remove the bucket. (See BUCKET on Page 40-140-1.)

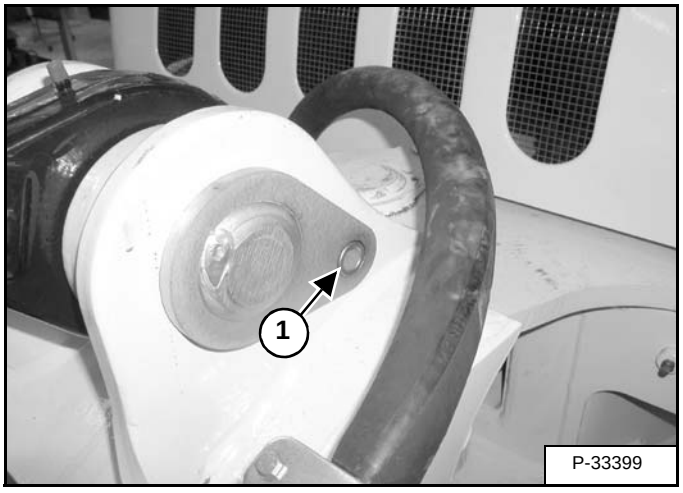
Remove the arm. (See ARM on Page 40-130-1.)

Figure 40-120-1



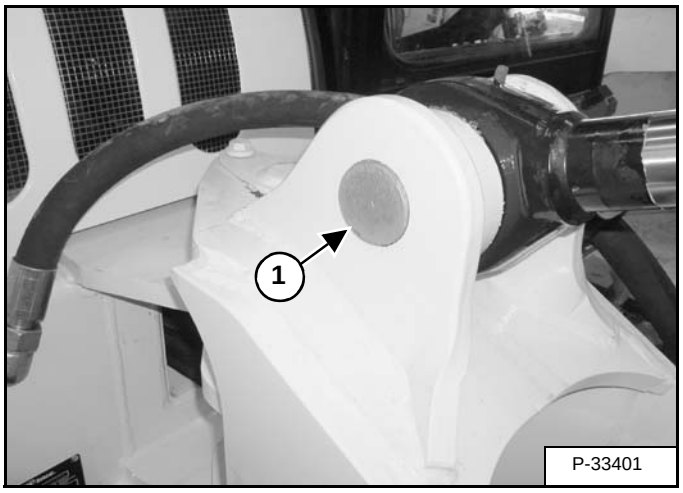
Remove the bolt (Item 1) **[Figure 40-120-1]** from the rod end retaining pin.

Figure 40-120-2



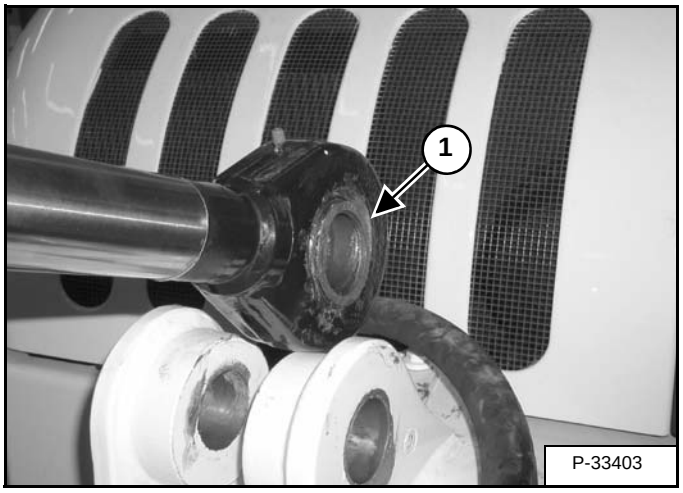
Remove the spacer (Item 1) **[Figure 40-120-2]**.

Figure 40-120-3



Remove the pin (Item 1) **[Figure 40-120-3]**.

Figure 40-120-4



Raise the cylinder and remove the shims (Item 1) **[Figure 40-120-4]** from both sides of the rod end.

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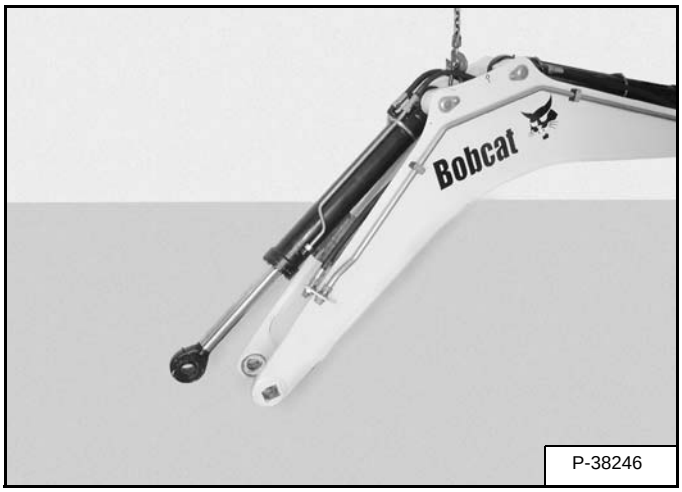
Removal And Installation (Cont'd)

Figure 40-120-5



Lower the chain hoist until the boom is on the ground **[Figure 40-120-5]**.

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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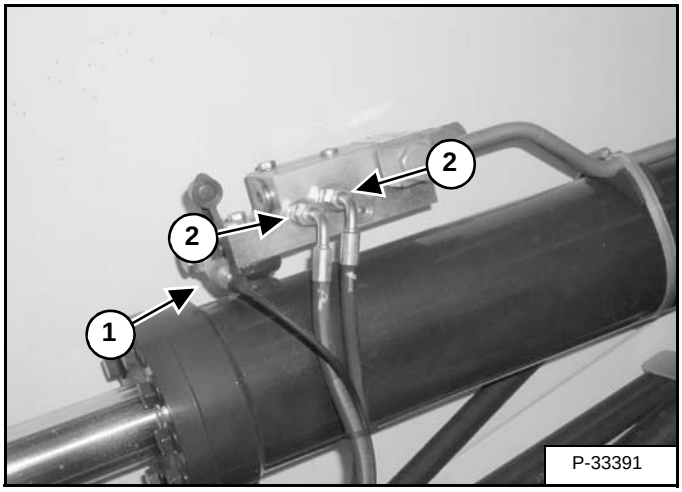
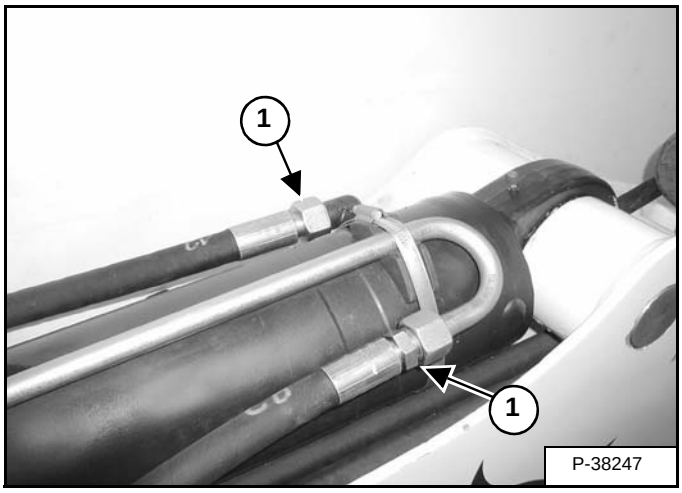
Figure 40-120-6



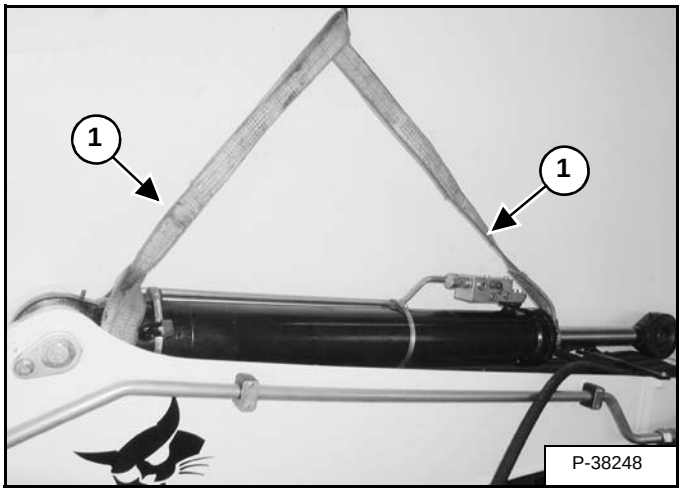
Remove the load sense line (Item 1) and two pilot hoses (Item 2) **[Figure 40-120-6]**.

Figure 40-120-7



Remove the hoses (Item 1) **[Figure 40-120-7]** from the boom cylinder base and rod end.

Figure 40-120-8



Install a sling (Item 1) **[Figure 40-120-8]** on the boom cylinder.

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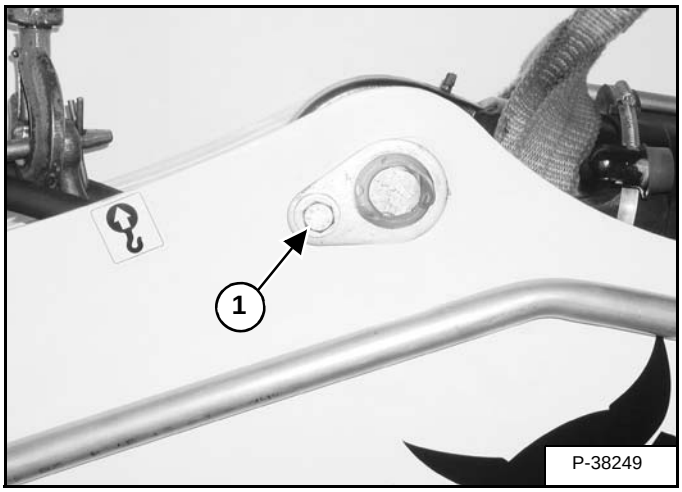
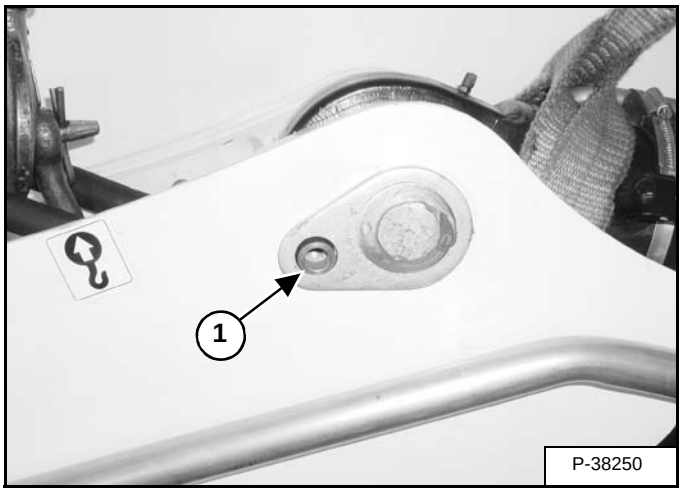
Removal And Installation (Cont'd)

Figure 40-120-9



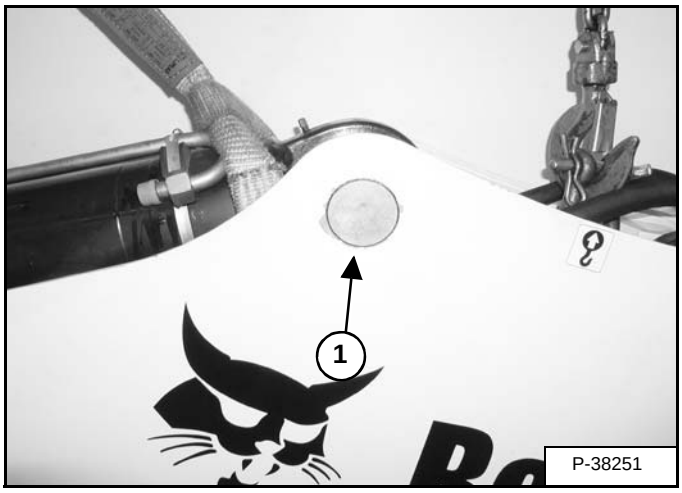
Remove the bolt (Item 1) **[Figure 40-120-9]** and washer.

Figure 40-120-10



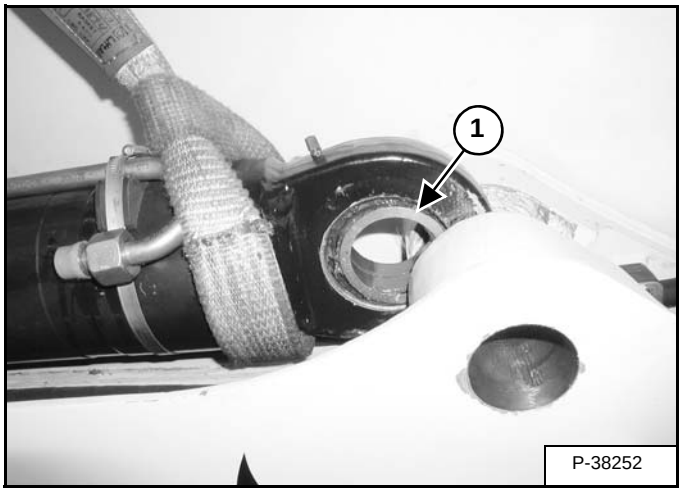
Remove the spacer (Item 1) **[Figure 40-120-10]**.

Figure 40-120-11



Remove the pin (Item 1) **[Figure 40-120-11]**.

Figure 40-120-12



Raise the hoist and remove the shims (Item 1) **[Figure 40-120-12]** from both sides of the base end of the cylinder.

Remove the cylinder.

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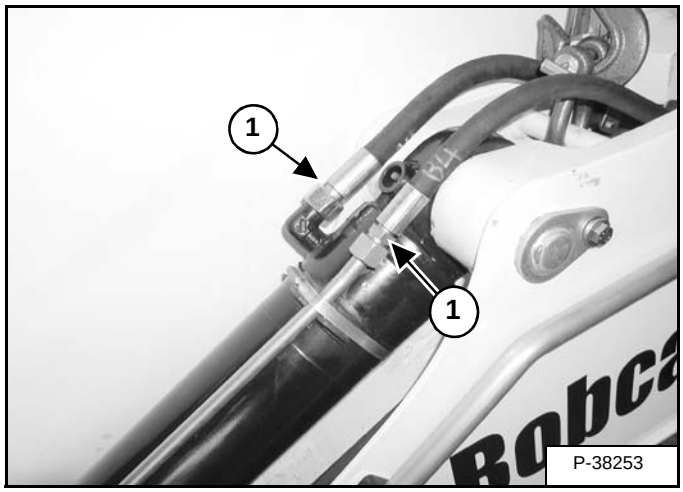
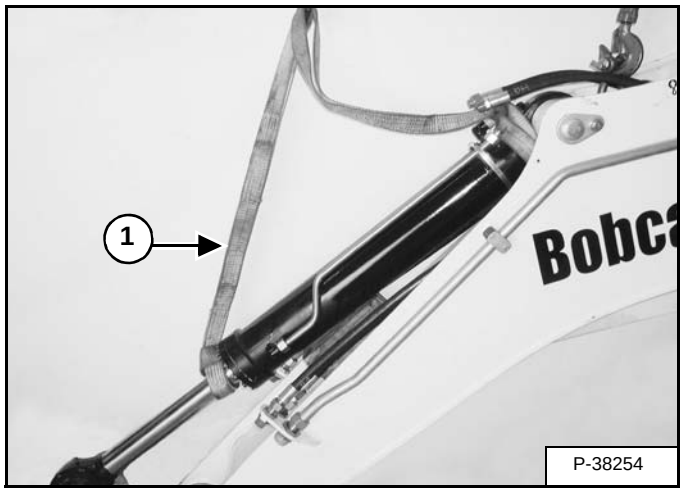
Removal And Installation (Cont'd)

Figure 40-120-13



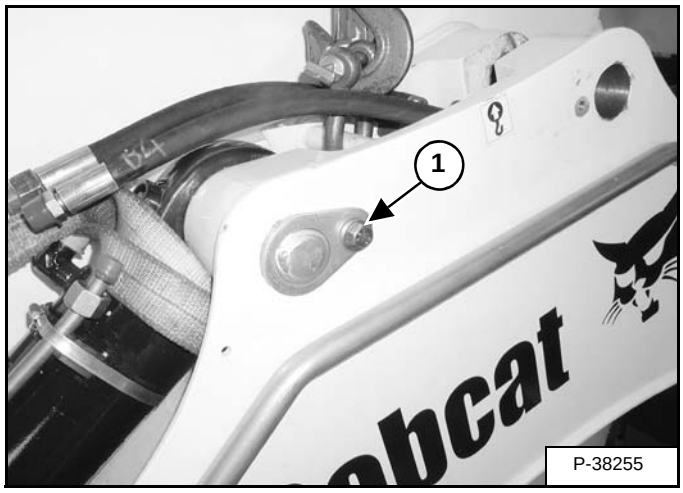
Remove the hoses (Item 1) **[Figure 40-120-13]** from the base and rod end of the arm cylinder.

Figure 40-120-14



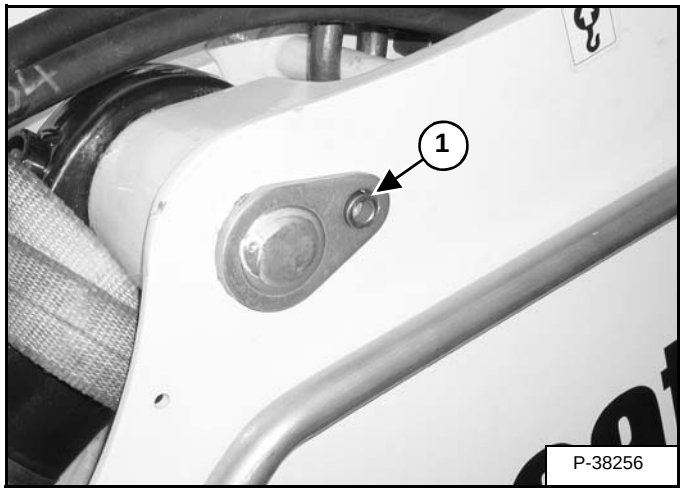
Install a sling (Item 1) **[Figure 40-120-14]** on the cylinder.

Figure 40-120-15



Remove the bolt (Item 1) **[Figure 40-120-15]** and washer.

Figure 40-120-16



Remove the spacer (Item 1) **[Figure 40-120-16]**.

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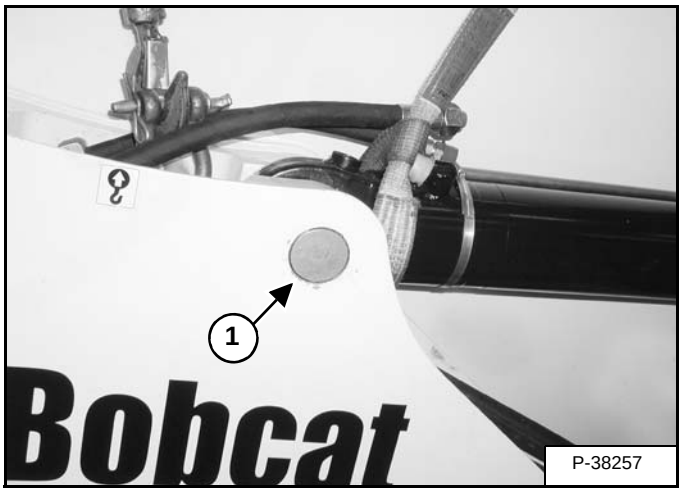
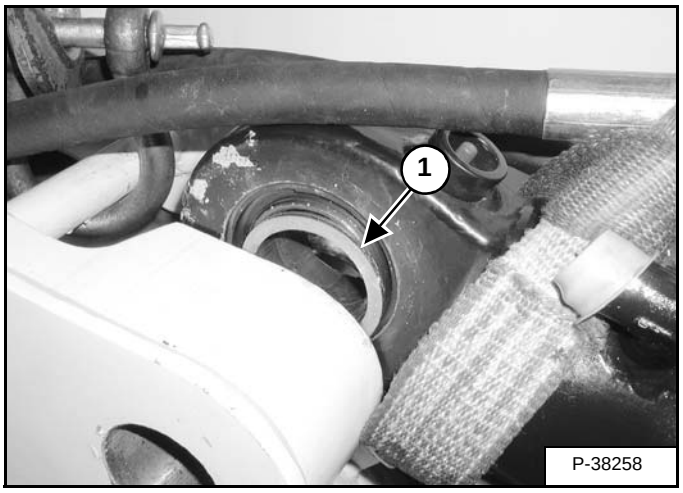
Figure 40-120-17



Raise the cylinder and remove the pin (Item 1) **[Figure 40-120-17]**.

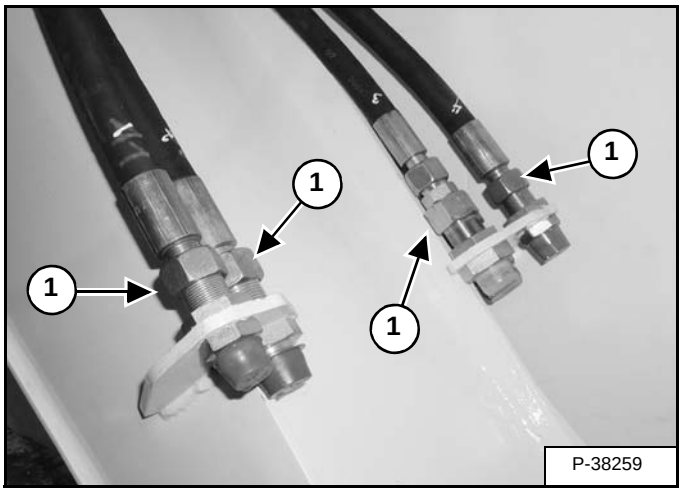
Figure 40-120-18



Raise the cylinder and remove the shims (Item 1) **[Figure 40-120-18]** from both sides of the cylinder.

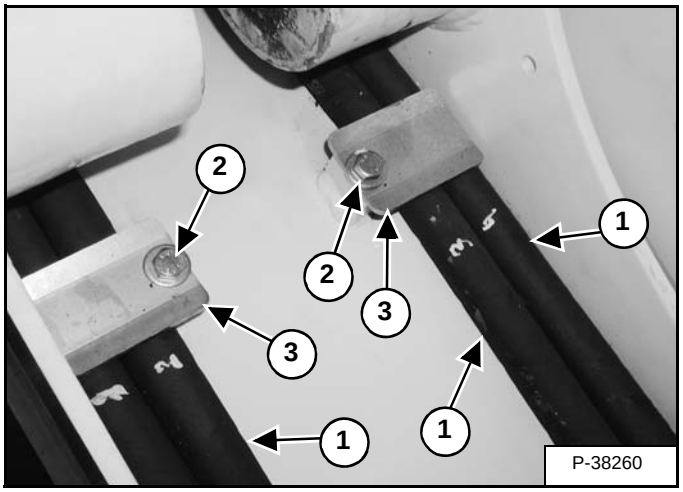
Remove the cylinder.

Figure 40-120-19



Mark and remove the bucket cylinder and auxiliary hoses (Item 1) **[Figure 40-120-19]** from the end of the boom.

Figure 40-120-20



Mark the hoses (Item 1) and remove the bolts (Item 2), washers and hose guides (Item 3) **[Figure 40-120-20]**.

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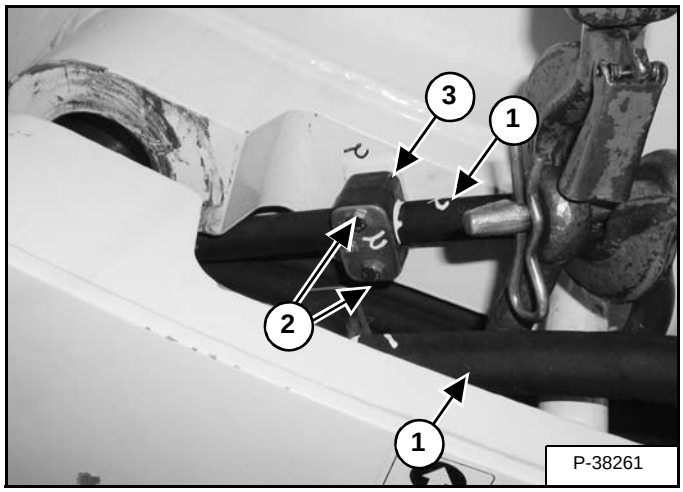
Removal And Installation (Cont'd)

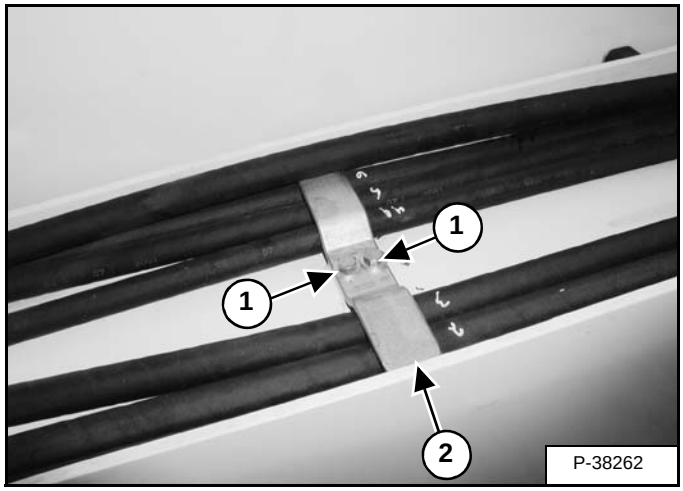
Figure 40-120-21



Mark the hoses (Item 1) **[Figure 40-120-21]** for correct length and orientation.

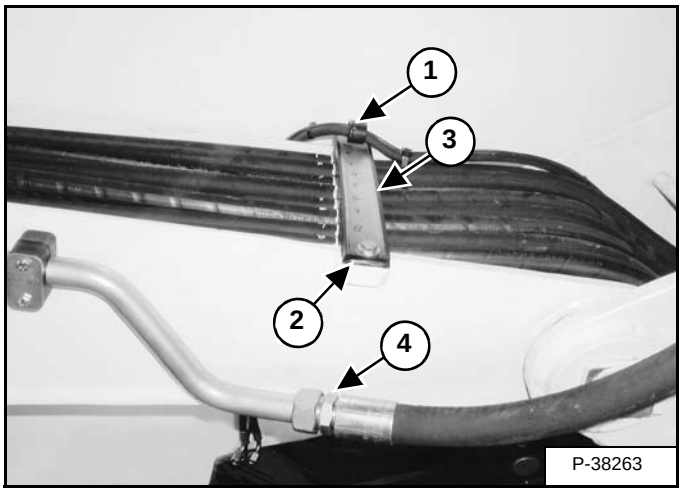
Remove the bolts (Item 2) and hose clamps (Item 3) **[Figure 40-120-21]** from both sides of the boom.

Figure 40-120-22



Mark the hoses and remove the two bolts (Item 1) washers and hose guide (Item 2) **[Figure 40-120-22]**.

Figure 40-120-23

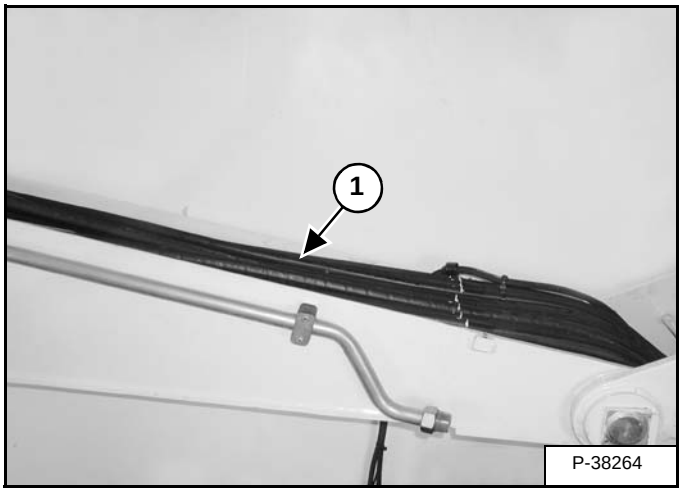


Mark the hoses for correct length and orientation. Remove the bolt (Item 1) **[Figure 40-120-23]** and clamp.

Remove the bolt (Item 2) washer and hose clamp (Item 3) **[Figure 40-120-23]**.

Remove the return to tank hose (Item 4) **[Figure 40-120-23]**.

Figure 40-120-24



Remove the hoses (Item 1) **[Figure 40-120-24]** from the boom.

Remove the chain hoist from the boom.

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Removal And Installation (Cont'd)

Figure 40-120-25

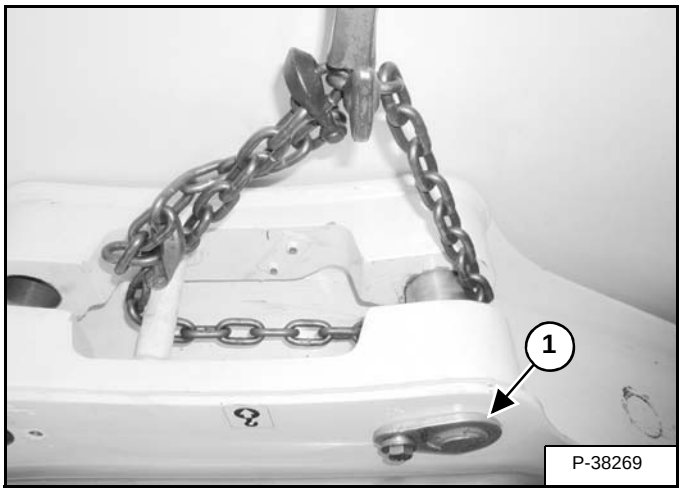
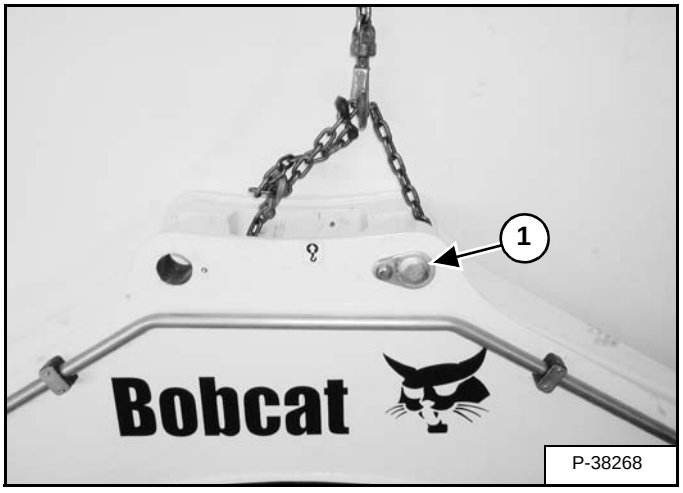


Figure 40-120-26

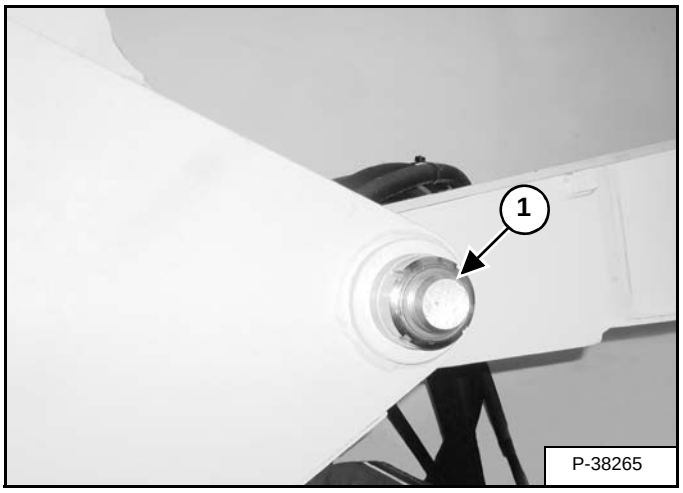


Install the boom cylinder base end retaining pin (Item 1) **[Figure 40-120-25]** & **[Figure 40-120-26]** and bolt.

Install the hoist as shown **[Figure 40-120-25]** & **[Figure 40-120-26]**. The boom will be balanced when the chain hoist is raised.

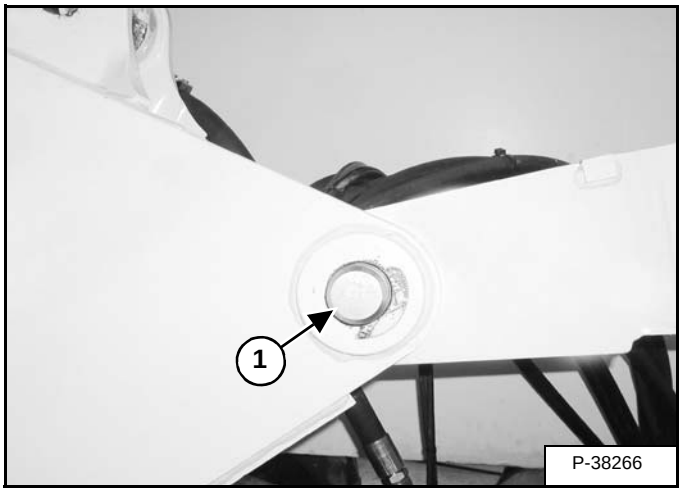
Raise the boom until the arm end of the boom is approximately 37 inches (940 mm) above the ground.

Figure 40-120-27



Remove the boom pivot pin nut (Item 1) **[Figure 40-120-27]** and washer.

Figure 40-120-28



Remove the boom pivot pin (Item 1) **[Figure 40-120-28]**.

Move the boom away from the swing frame.

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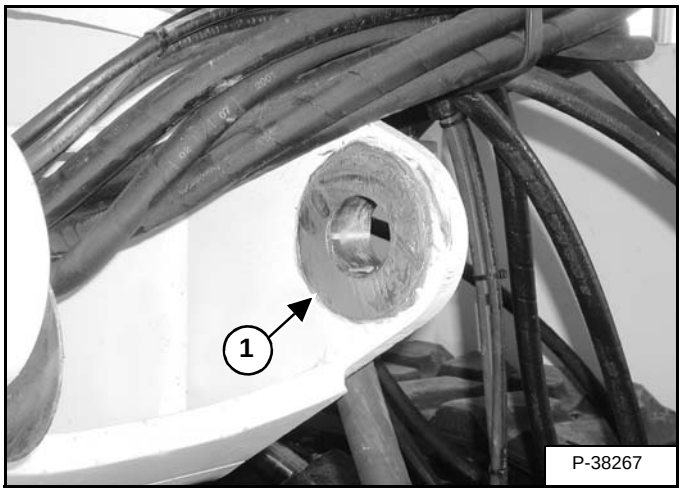
Removal And Installation (Cont'd)

Figure 40-120-29

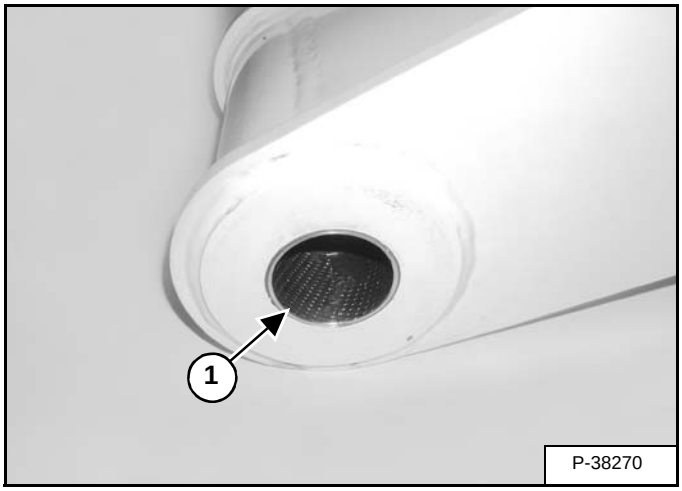


Remove the shims (Item 1) **[Figure 40-120-29]** from both sides of the boom swing frame.

NOTE: The shims may stay on the boom when the boom is removed.

Bushing Removal And Installation

Figure 40-120-30



Remove the bushing (Item 1) **[Figure 40-120-30]** from both sides of the boom.

Installation: Install the bushings until they are flush with the side of the boom.

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ARM

Removal And Installation

Remove the bucket. (See BUCKET on Page 40-140-1.)

Lower the boom/arm to the ground.

Figure 40-170-1

Support the boom with a chain hoist (Item 1) **[Figure 40-170-1]**.

With the engine off, the start key in the run position and the left console lowered, move the joysticks to relieve hydraulic pressure.

Figure 40-170-2

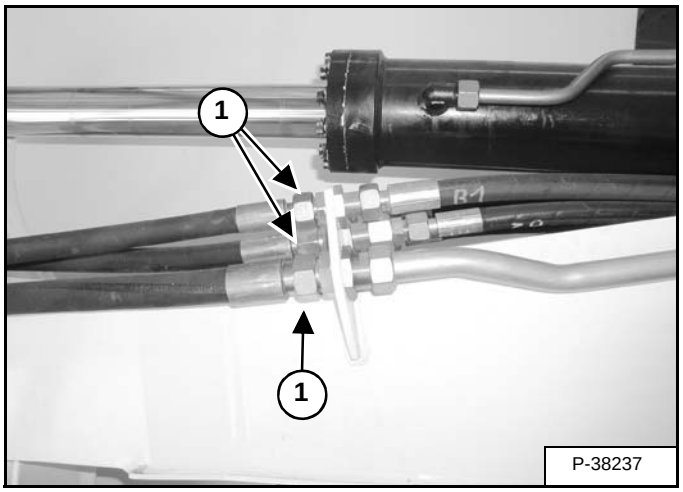
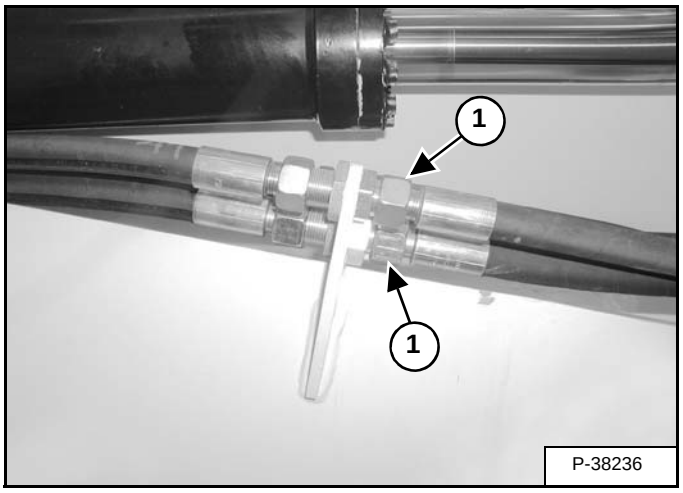


Figure 40-170-3



Remove the bucket/auxiliary hoses (Item 1) **[Figure 40-170-2]** & **[Figure 40-170-3]** from both sides of the boom.

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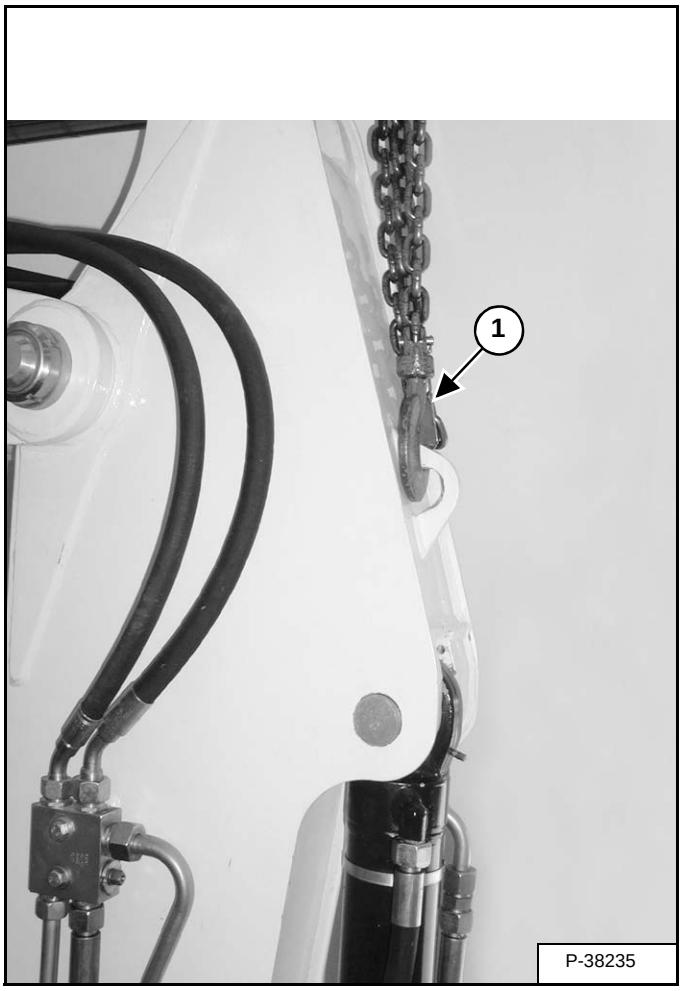
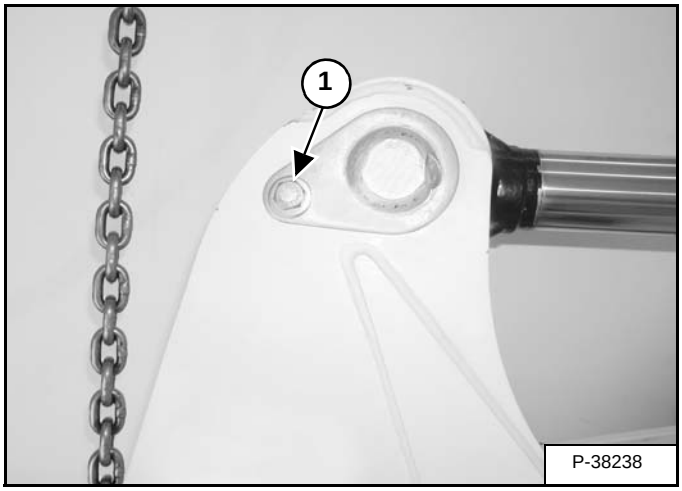
Removal And Installation (Cont'd)

Figure 40-170-4



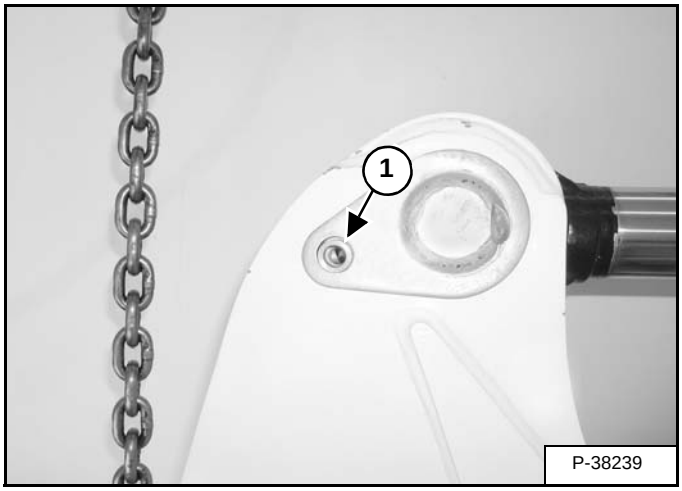
Install a chain hoist (Item 1) **[Figure 40-170-4]** on the arm.

Figure 40-170-5



Remove the bolt (Item 1) **[Figure 40-170-5]** and washer from the rod end of the arm cylinder.

Figure 40-170-6



Remove the spacer (Item 1) **[Figure 40-170-6]**.

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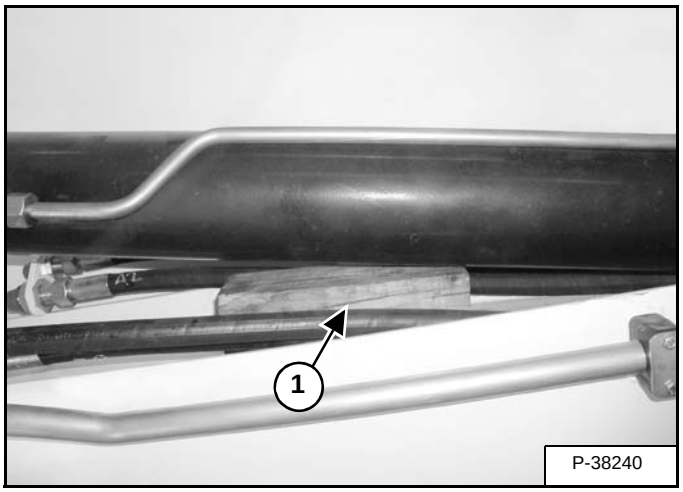
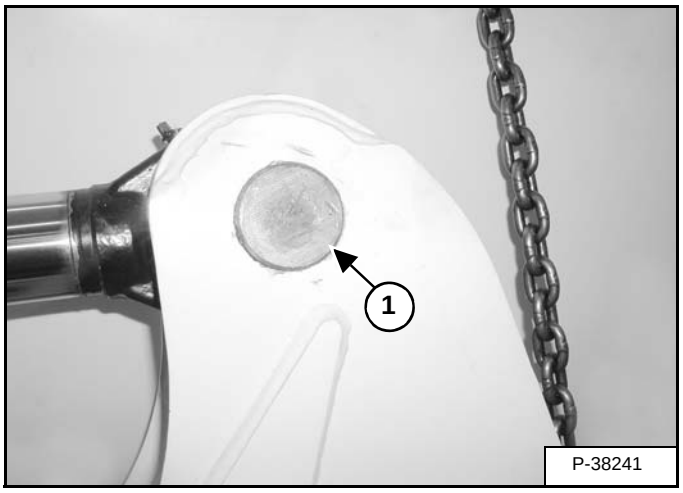
Removal And Installation (Cont'd)

Figure 40-170-7



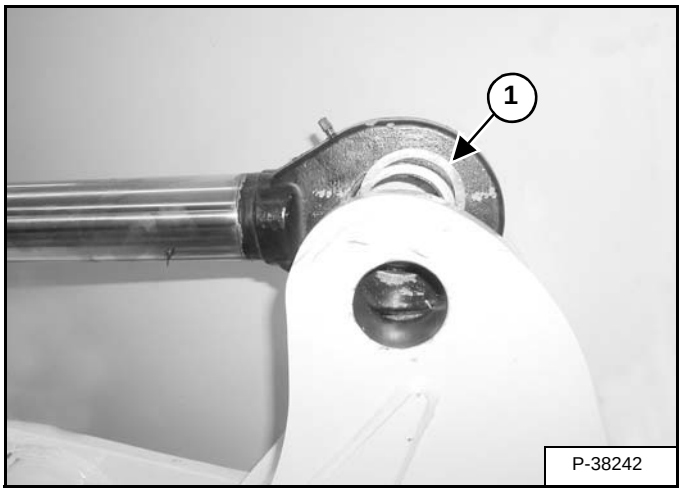
Place a block (item 1) **[Figure 40-170-7]** under the arm cylinder.

Figure 40-170-8



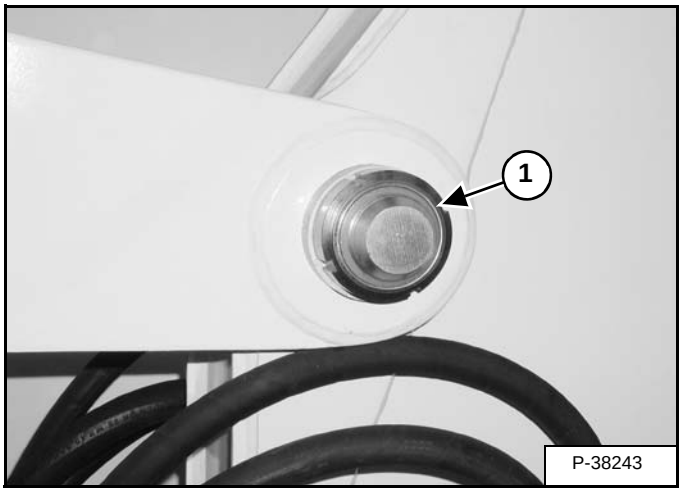
Remove the rod end retaining pin (Item 1) **[Figure 40-170-8]**.

Figure 40-170-9



Remove the shims (Item 1) **[Figure 40-170-9]** from both sides of the cylinder rod end.

Figure 40-170-10



Remove the arm pivot pin nut (Item 1) **[Figure 40-170-10]** and washer.

Installation: Tighten the nut until it is seated against the boom. Do not overtighten the nut and deflect the boom mounting plates. The arm must pivot freely.

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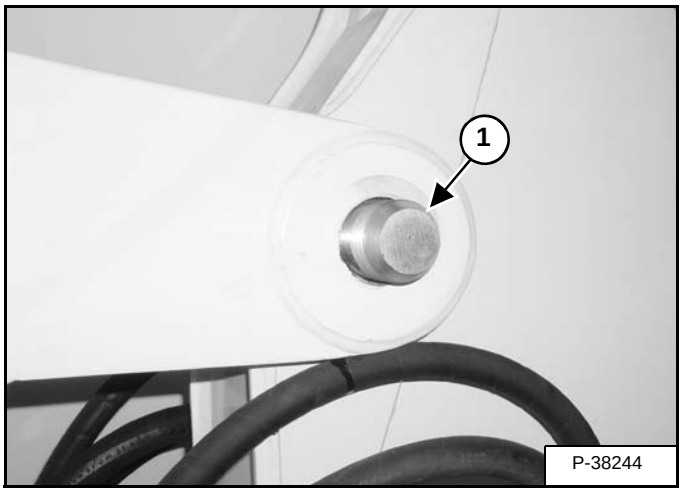
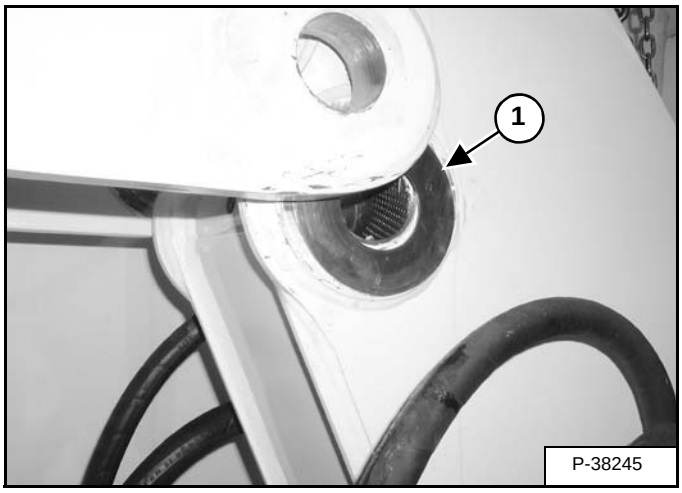
Removal And Installation (Cont'd)

Figure 40-170-11



Remove the pivot pin (Item 1) **[Figure 40-170-11]**.

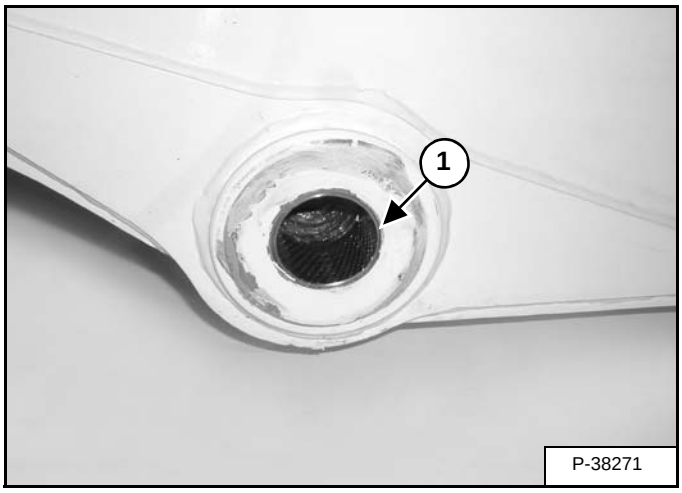
Figure 40-170-12



Move the arm away from the boom. Remove the shims (Item 1) **[Figure 40-170-12]** from both sides of the arm.

Bushing Removal And Installation

Figure 40-170-13



Remove the bushing (Item 1) **[Figure 40-170-13]** from both sides of the arm.

Installation: Install the bushing until it is flush with the outside of the arm.

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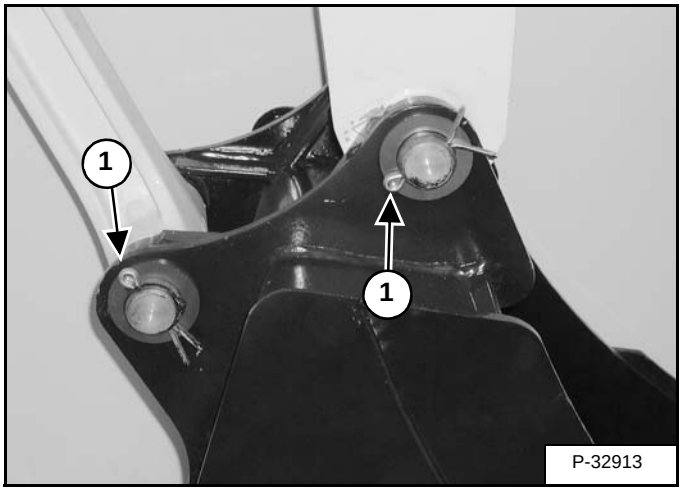
BUCKET

Removal And Installation

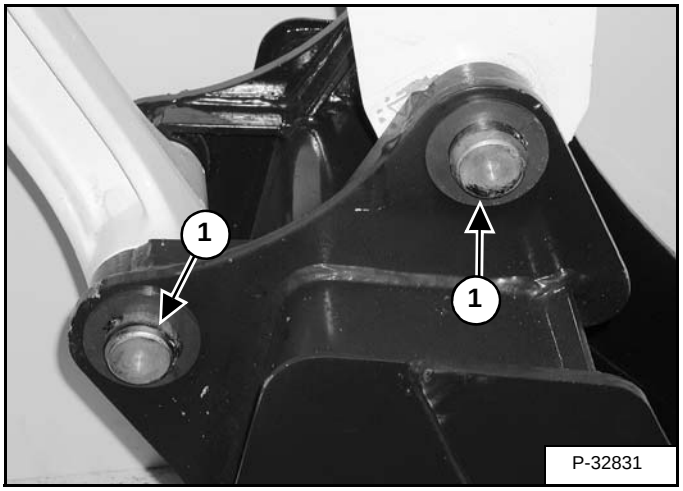
Stop the excavator on a flat level surface. Put the bucket on the ground.

Figure 40-140-1



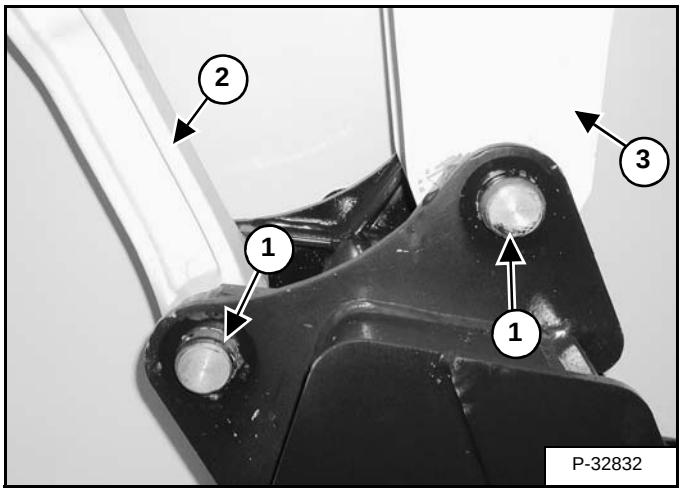
Remove the cotter pins (Item 1) **[Figure 40-140-1]** from both pins.

Figure 40-140-2



Remove the washers (Item 1) **[Figure 40-140-2]** from both pins.

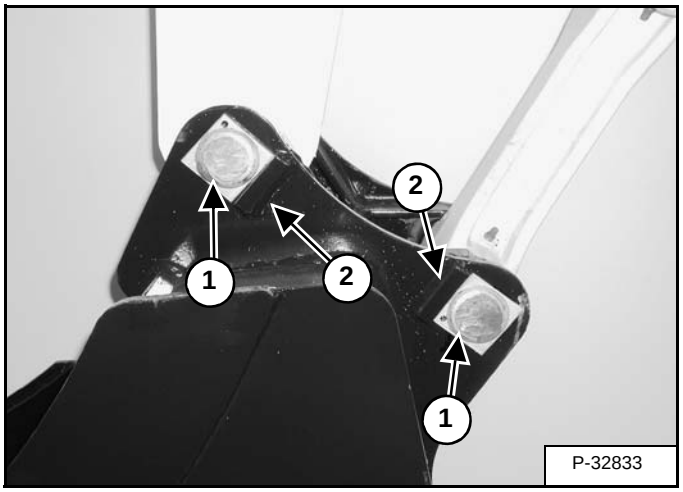
Figure 40-140-3



Remove the pins (Item 1) **[Figure 40-140-3]**.

Retract the bucket link (Item 2) and raise the arm (Item 3) **[Figure 40-140-3]**.

Figure 40-140-4



Installation: The pins (Item 1) must seat against the anti-rotation stops (Item 2) **[Figure 40-140-4]**.

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REAR COVER

Removal And Installation

Figure 40-150-1

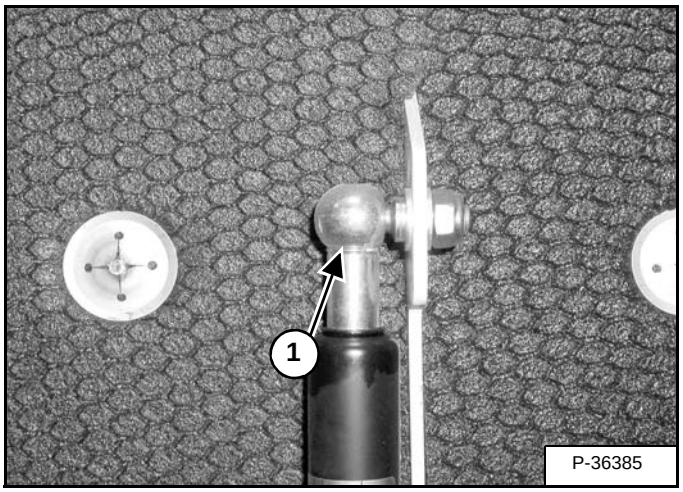
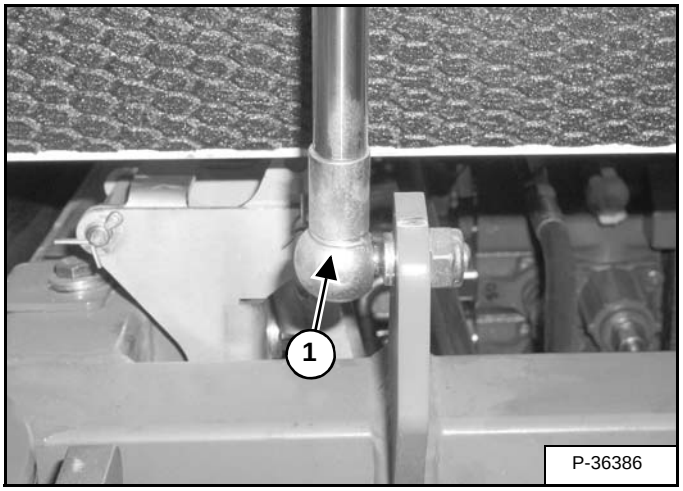
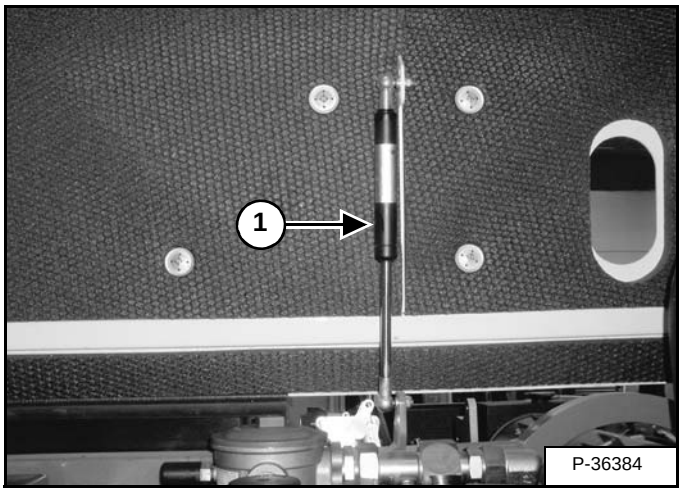


Figure 40-150-2



Remove the retainer clip (Item 1) **[Figure 40-150-1]** & **[Figure 40-150-2]** from the top and bottom of the gas strut.

Figure 40-150-3



Support the cover and remove the gas strut (Item 1) **[Figure 40-150-3]**.

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Removal And Installation (Cont'd)

Figure 40-150-4

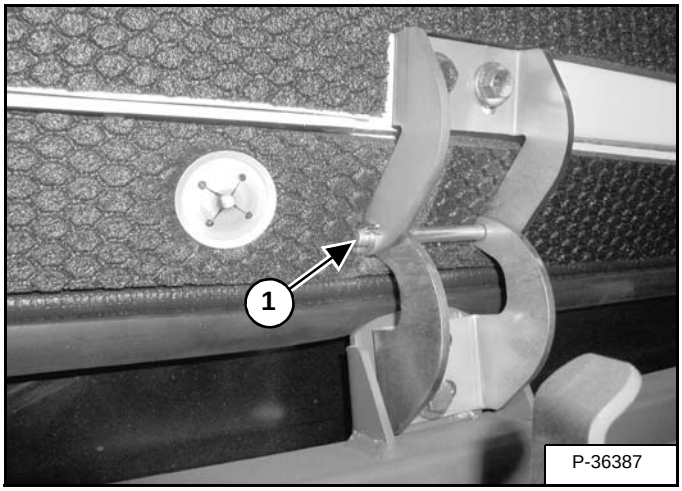
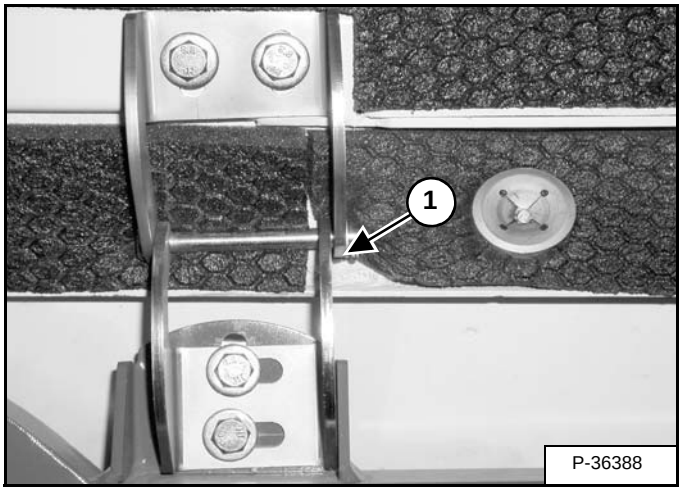


Figure 40-150-5



Remove the cotter pin (Item 1) **[Figure 40-150-4]** & **[Figure 40-150-5]** and washer from the left and right hinge pins.

Figure 40-150-6

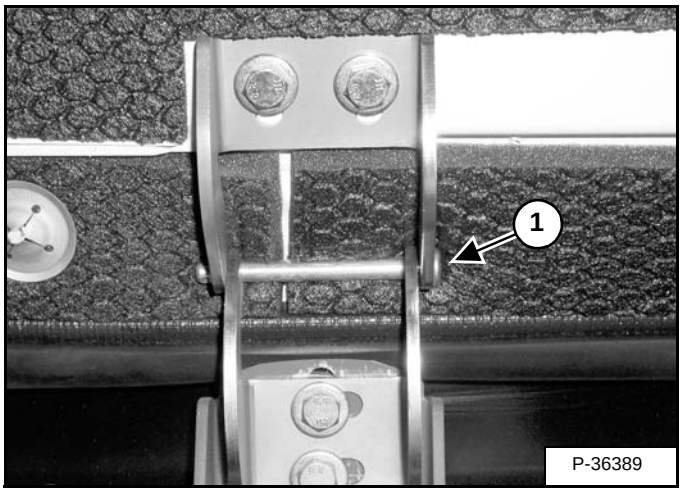
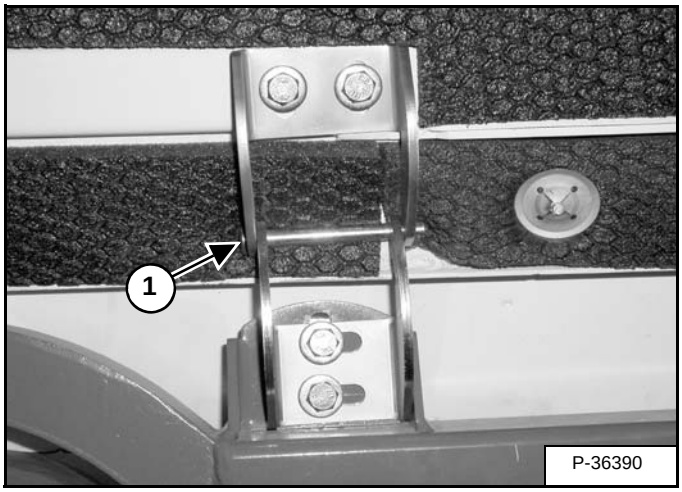


Figure 40-150-7



Have an assistant support the cover, and remove the left and right hinge pins (Item 1) **[Figure 40-150-6]** & **[Figure 40-150-7]**.

Remove the cover

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RIGHT SIDE COVER

Removal And Installation

Open the right side cover.

Figure 40-160-8

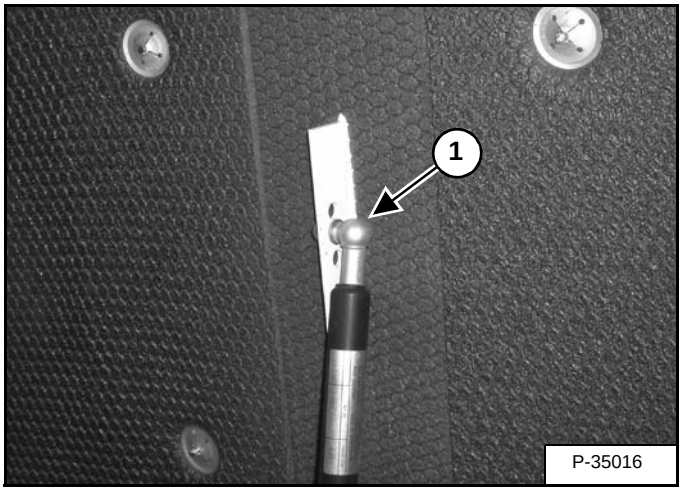
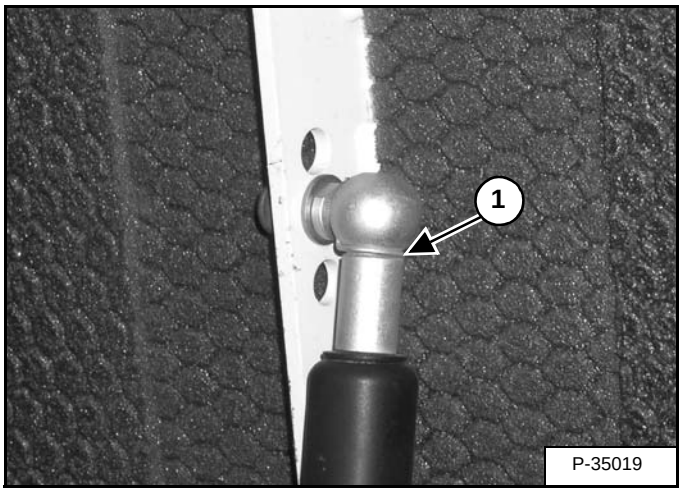


Figure 40-160-9



Remove the retainer clip (Item 1) **[Figure 40-160-8]** & **[Figure 40-160-9]** from the top of the gas strut.

Figure 40-160-10

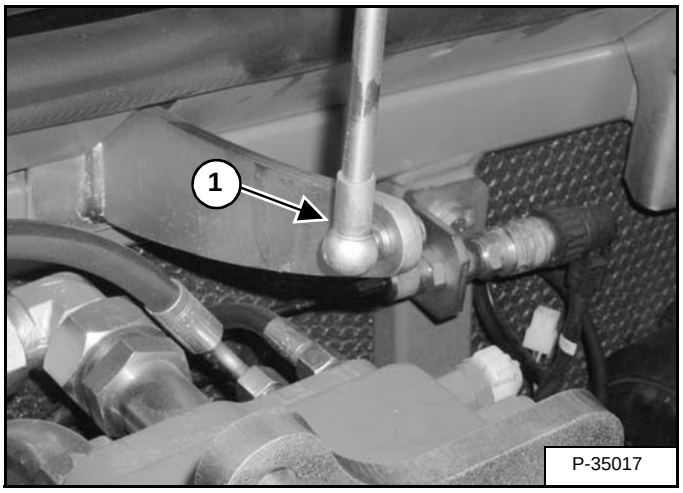
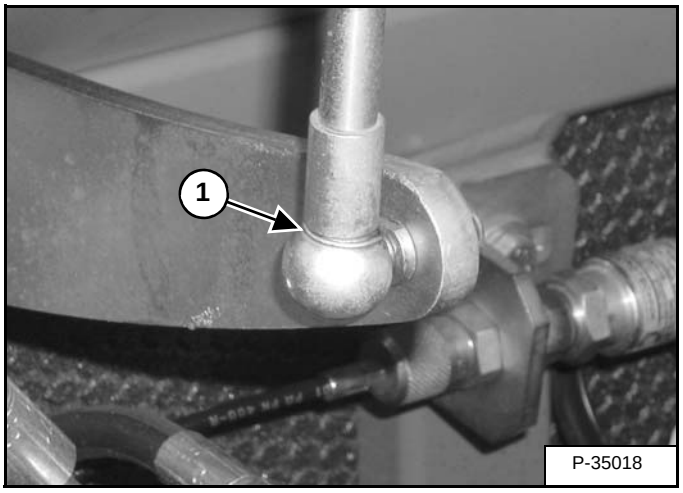


Figure 40-160-11



Remove the retainer clip (Item 1) **[Figure 40-160-10]** & **[Figure 40-160-11]** from the bottom of the gas strut.

Support the cover and remove the gas strut.

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Removal And Installation (Cont'd)

Figure 40-160-12

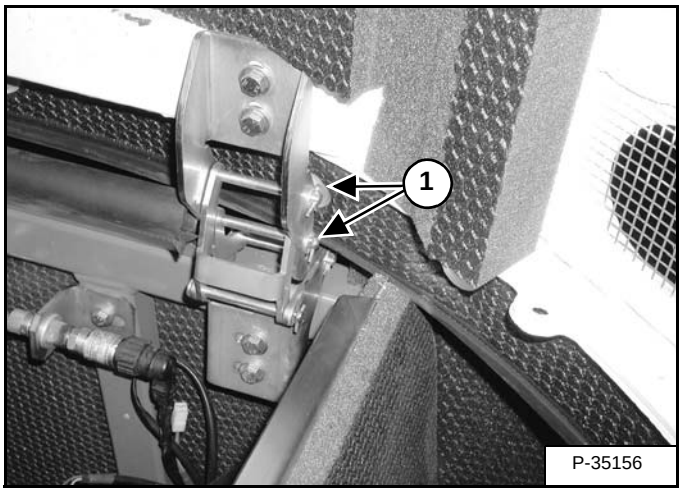
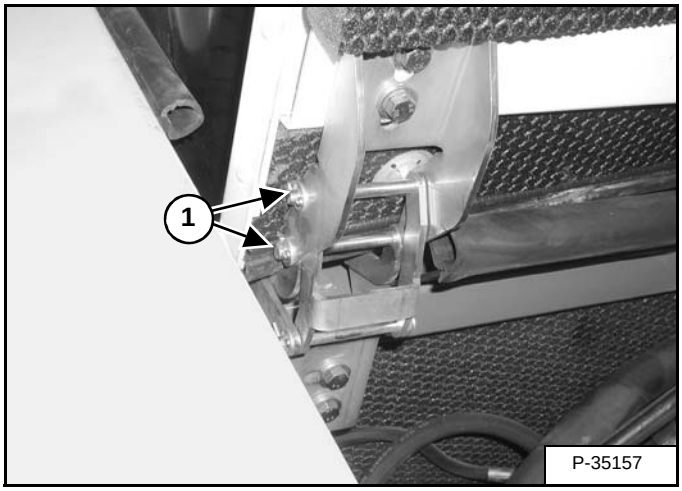


Figure 40-160-13



Remove the cotter pin (Item 1) **[Figure 40-160-12]** & **[Figure 40-160-13]** from the front and rear hinge pins.

Figure 40-160-14

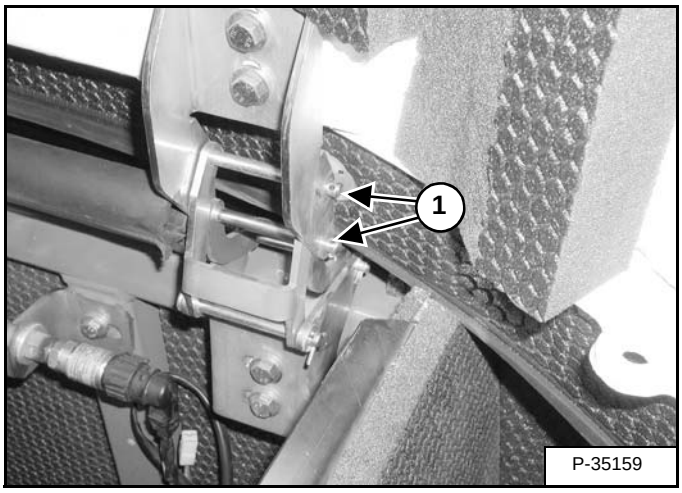
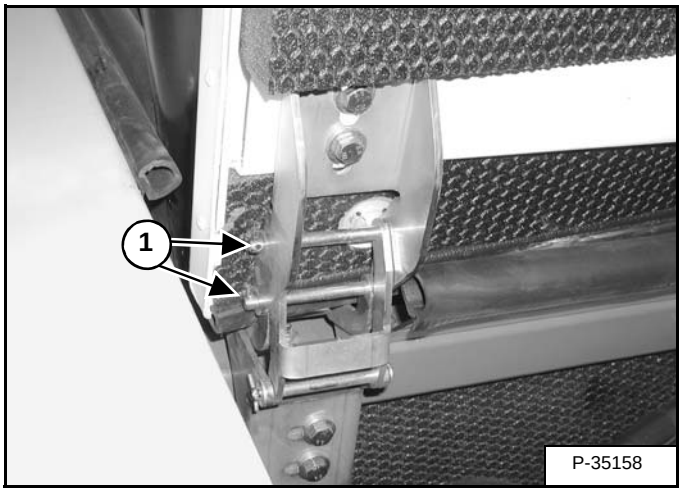


Figure 40-160-15



Have an assistant support the cover, and remove the front and rear hinge pins (Item 1) **[Figure 40-160-14]** & **[Figure 40-160-15]**.

Remove the cover.

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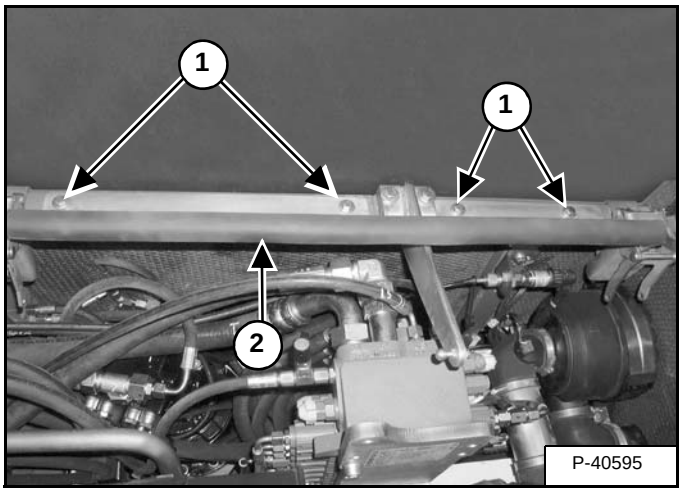
Removal And Installation (Cont'd)

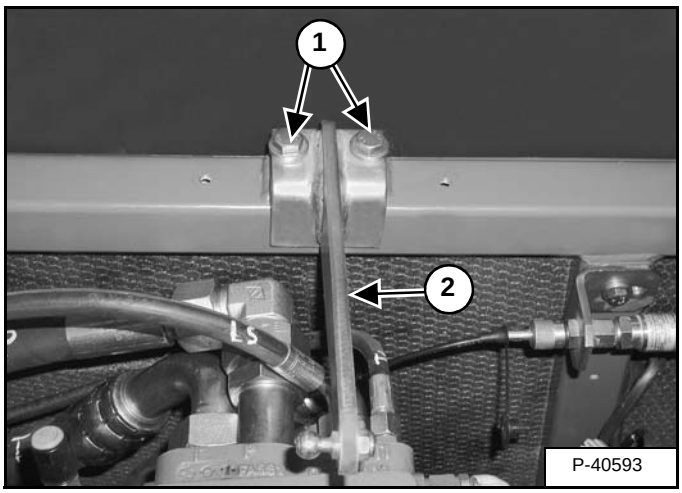
Figure 40-160-16



Remove the four bolts (Item 1) and washers from the dust seal (Item 2) **[Figure 40-160-16]**.

Remove the dust seal.

Figure 40-160-17



Remove the two bolts (Item 1) and washers from the bracket (Item 2) **[Figure 40-160-17]**.

Remove the bracket.

Remove the right side cover.

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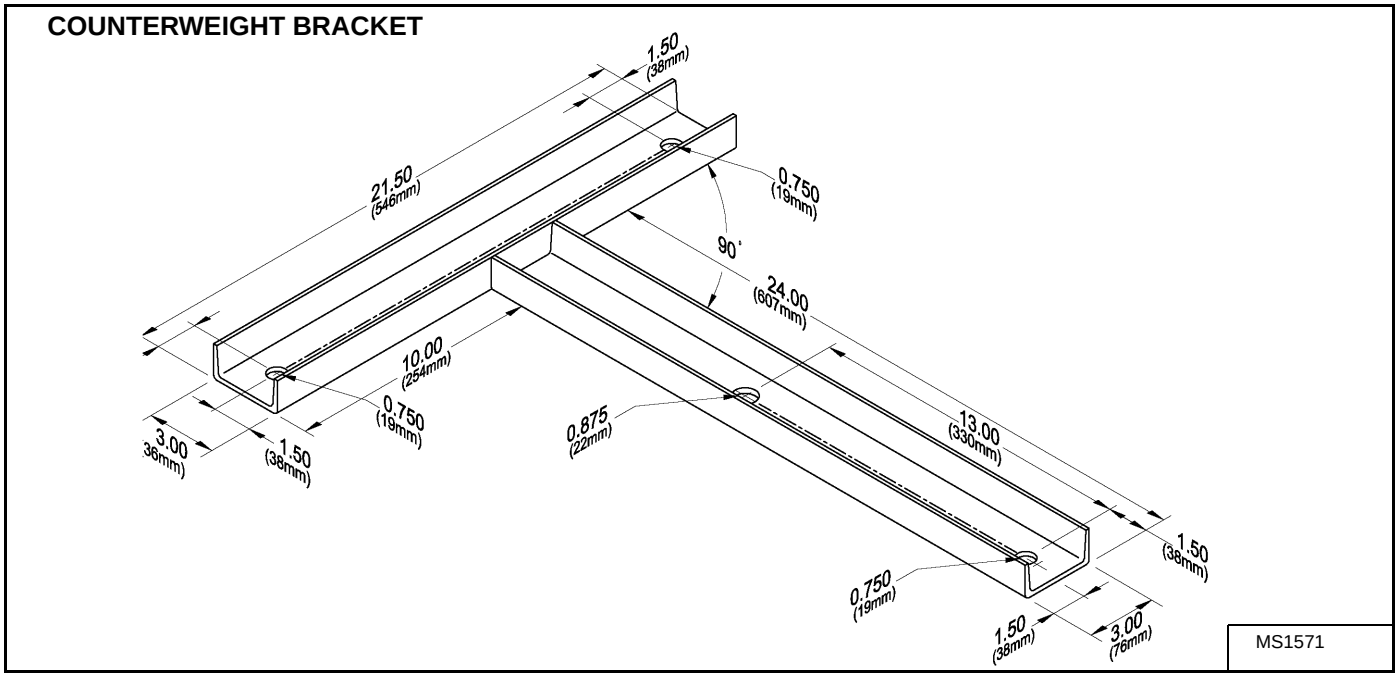
COUNTERWEIGHT

Removal And Installation

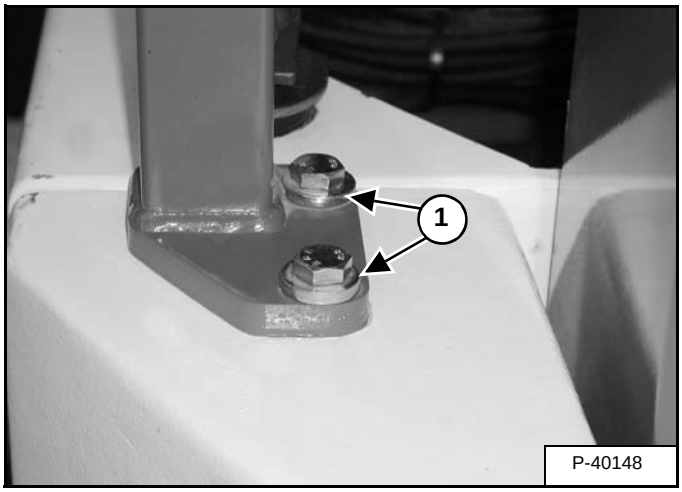
Figure 40-170-1



Build the service lifting bracket **[Figure 40-170-1]** used to remove and install the counterweight.

Remove the rear cover. (See REAR COVER on Page 40-150-1.)

Figure 40-170-2



Remove the two bolts (Item 1) **[Figure 40-170-2]** and washers from both rear legs of the support bracket.

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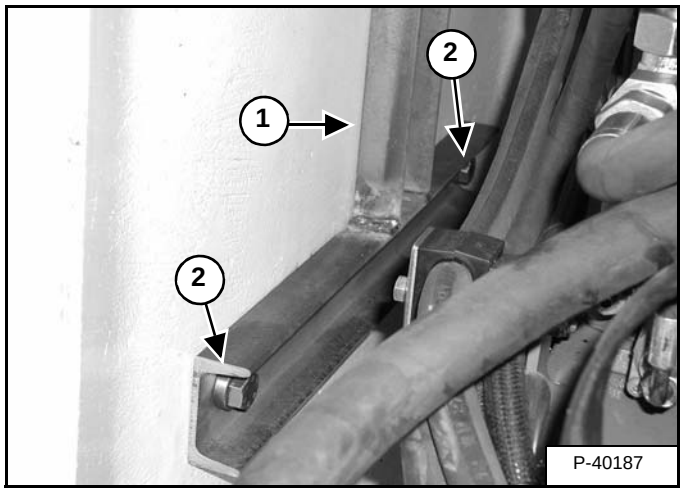
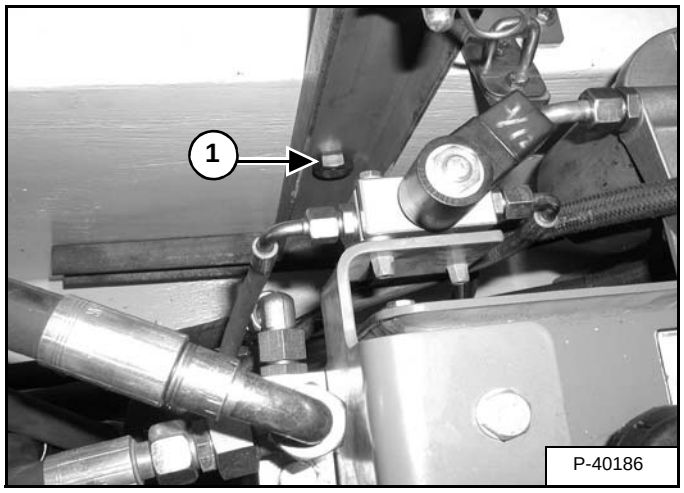
Removal And Installation (Cont'd)

Figure 40-170-3



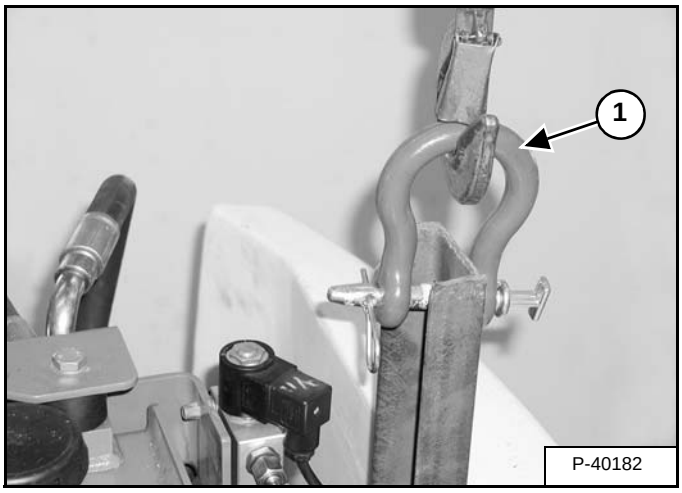
Install the counterweight service lifting bracket (Item 1) **[Figure 40-170-3]** on the counterweight.

Figure 40-170-4



Use two bolts (Item 2) **[Figure 40-170-3]** 16 mm x 35 mm MC Grade 8,8 and one bolt (Item 1) **[Figure 40-170-4]** 20 mm x 35 mm MC Grade 8,8 to fasten the lifting bracket to the counterweight.

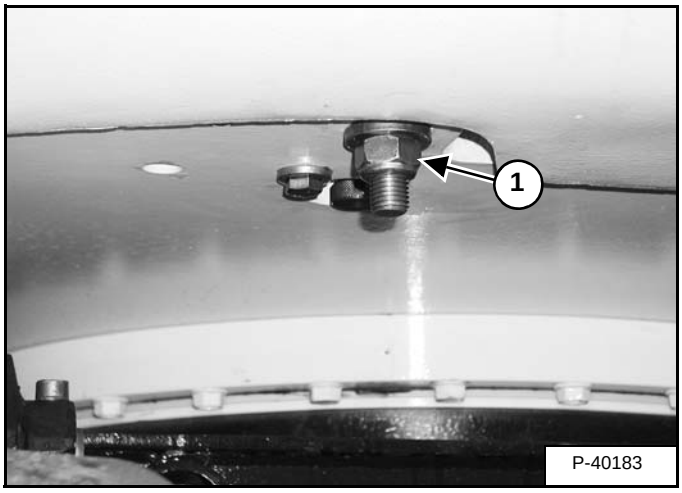
Figure 40-170-5



Install a chain hoist (Item 1) **[Figure 40-170-5]** on the counterweight service lifting bracket.

NOTE: Use a lifting device of sufficient capacity. Raise the hoist until the weight of the counterweight is supported by the hoist.

Figure 40-170-6



Remove the lock nut (Item 1) **[Figure 40-170-6]** washers and bolt from the bottom of the counterweight.

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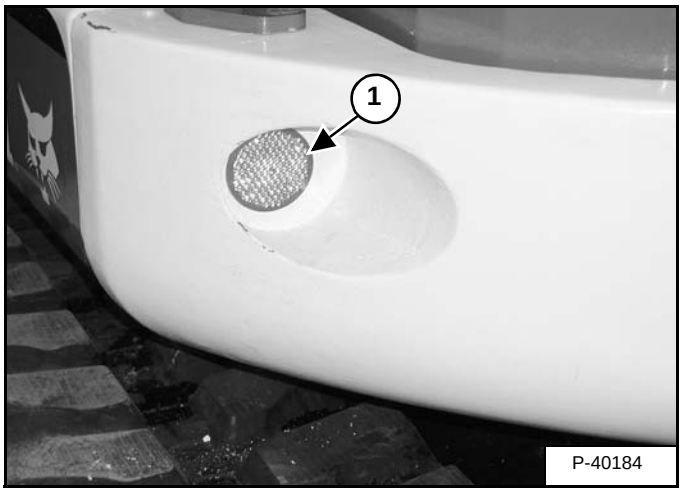
Removal And Installation (Cont'd)

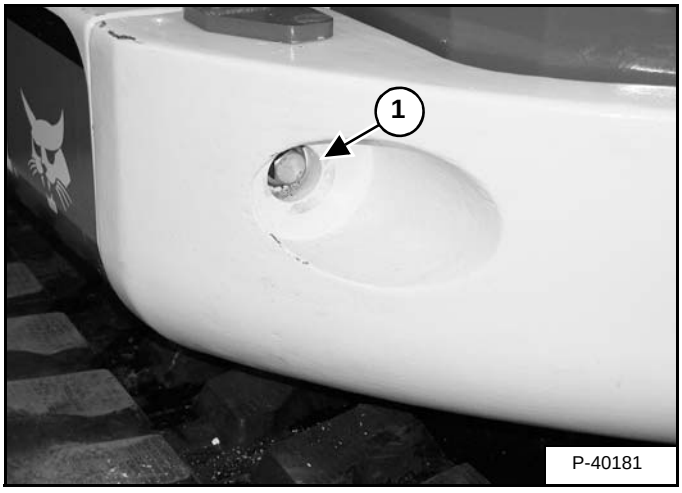
Figure 40-170-7



Remove the reflector (Item 1) **[Figure 40-170-7]** from both sides of the counterweight.

NOTE: The reflectors are held on by an adhesive. Clean and dry the surface before installing new reflectors.

Figure 40-170-8



Remove the bolt (Item 1) **[Figure 40-170-8]** and washer from both sides of the counterweight.

Raise the hoist and remove the counterweight.

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ELECTRICAL SYSTEM AND ANALYSIS

ALTERNATOR 50-30-1
Alternator Identification 50-30-6
Assembly 50-30-18
Capacitor Continuity Test 50-30-17
Charging System Check 50-30-6
Disassembly 50-30-10
Parts Identification 50-30-5
Rectifier Continuity (Diode) Test 50-30-8
Removal And Installation (S/N 522311001 & Above) 50-30-1
Removal And Installation (S/N 528911001 & Above And 528611001 & Above) 50-30-3
Rotor Continuity Test 50-30-16
Rotor Ground Test 50-30-17
Stator Continuity Test 50-30-16
Stator Ground Test 50-30-16

BATTERY 50-20-1
Removal And Installation 50-20-2
Servicing 50-20-1
Using A Booster Battery (Jump Starting) 50-20-4

BATTERY DISCONNECT SWITCH 50-90-1
Removal And Installation 50-90-1

ELECTRICAL SYSTEM INFORMATION 50-10-1
Description 50-10-2
Fuse And Relay Location (S/N 522311001 & Above) 50-10-3
Fuse And Relay Location (S/N 528911001 & Above And S/N 528611001 & Above) 50-10-5
Troubleshooting Chart 50-10-1

FRONT CAB LIGHT 50-50-1
Disassembly And Assembly 50-50-2
Removal And Installation 50-50-1

FUEL LEVEL SENDER 50-70-1
Removal And Installation 50-70-1

INSTRUMENT PANEL 50-100-1
E-Prom Information 50-100-2
Removal And Installation 50-100-1

Continued On Next Page

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STARTER 50-40-1
Assembly (All Models) 50-40-14
Disassembly (All Models). 50-40-4
Inspection And Repair (All Models) 50-40-12
Parts Identification (All Models) 50-40-3
Removal And Installation (S/N 522311001 & Above). 50-40-1
Removal And Installation (S/N 528911001 & Above And S/N 528611001 & Above) 50-40-1

TWO SPEED SWITCH 50-60-1
Removal And Installation 50-60-1

WIPER MOTOR 50-80-1
Removal And Installation 50-80-1

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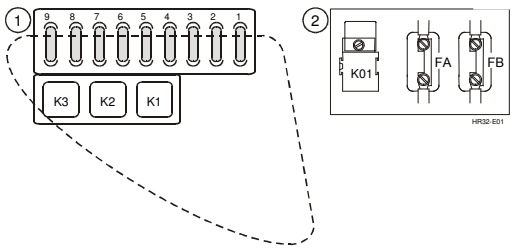
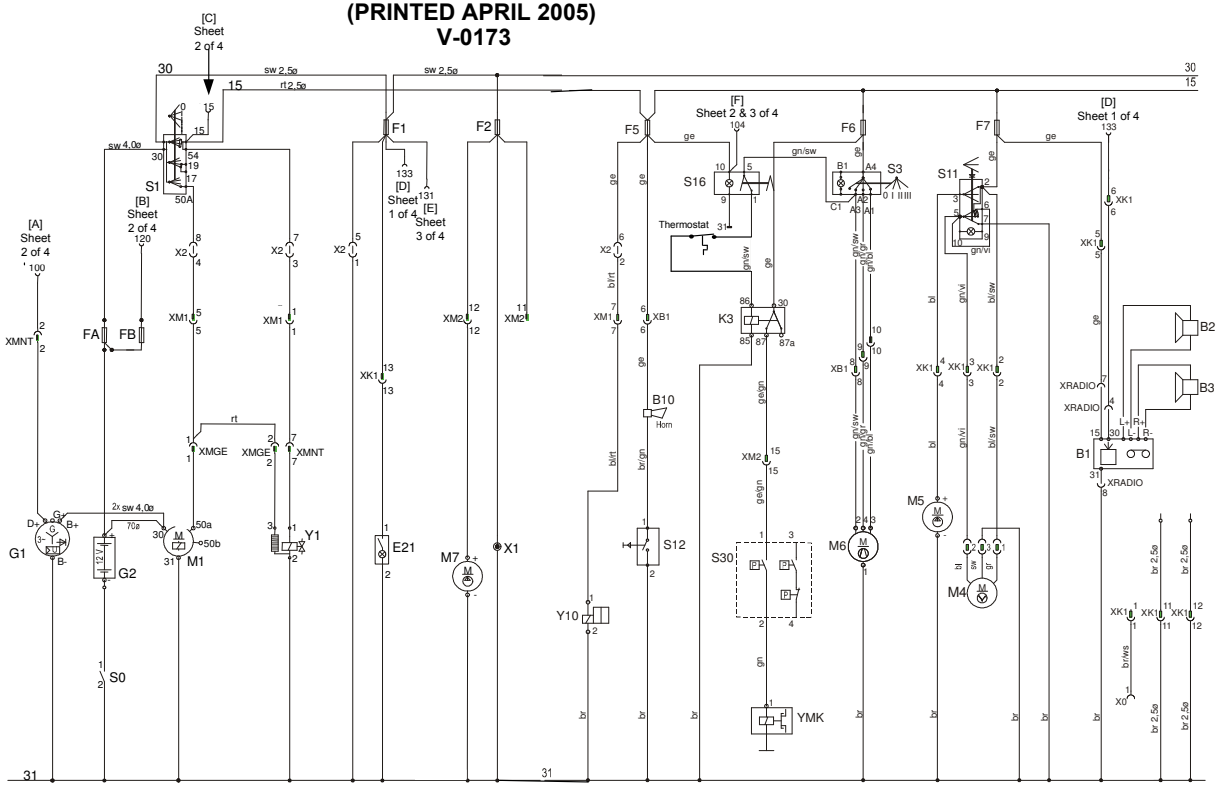
WIRING SCHEMATIC

442 EXCAVATOR
(S/N 522311001 AND ABOVE)
(PRINTED APRIL 2005)
V-0173





Fuses		
Item	**Ampere**	**Assigned to**
F 1	15	Interior light, radio, immobilizer, rotating beacon
F 2	20	Socket, refueling pump, additional heating (option)
F 3	15	Working floodlight, front
F 4	15	Working floodlight, rear
F 5	10	Horn, switch light, immobilizer
F 6	15	Heater fan
F 7	10	Wiper/washer system
F 8	5	Control module signal input
F 9	-	Additional heating (option) Working floodlight(s) (option)
FA	30	Main fuse
FB	60	Pre-heating

Relay	
Position	*Function*
K 01	Pre-heat relay
K 1	Working floodlight, front
K 2	Working floodlight, rear
K 3	Air Conditioner

Desig-nation	Device	Desig-nation	Device
	Power supply		***Shut-off***
G1	Generator	Y1	Shut-off
FA	Fuse		***Interior light***
FB	Fuse	F1	Fuse
G2	Battery	E21	Interior light
SO	Battery disconnecting switch		***Socket, refueling pump***
	Start-up system	F2	Fuse
S1	Pre-heat/ starter switch	M7	Refueling pump
M1	Starter	X1	Socket

Desig-nation	Device	Desig-nation	Device
	Horn	M6	Heater fan
F5	Fuse	S3	Heater fan switch
B10	Horn		***Wash/ wipe system***
S12	Fuse, horn button	M5	Washer pump
Y10	Solenoid valve, immobilizer	S11	Wash/ wipe switch
	Heater fan/ air conditioner	F7	Fuse
S16	Air conditioner switch	M4	Wiper motor
K3	Relay		***Radio***
S30	Pressure switch air conditioner	B1	Radio
YMK	Magnetic coupling compressor	B2	Loudspeaker
F6	Fuse	B3	Loudspeaker

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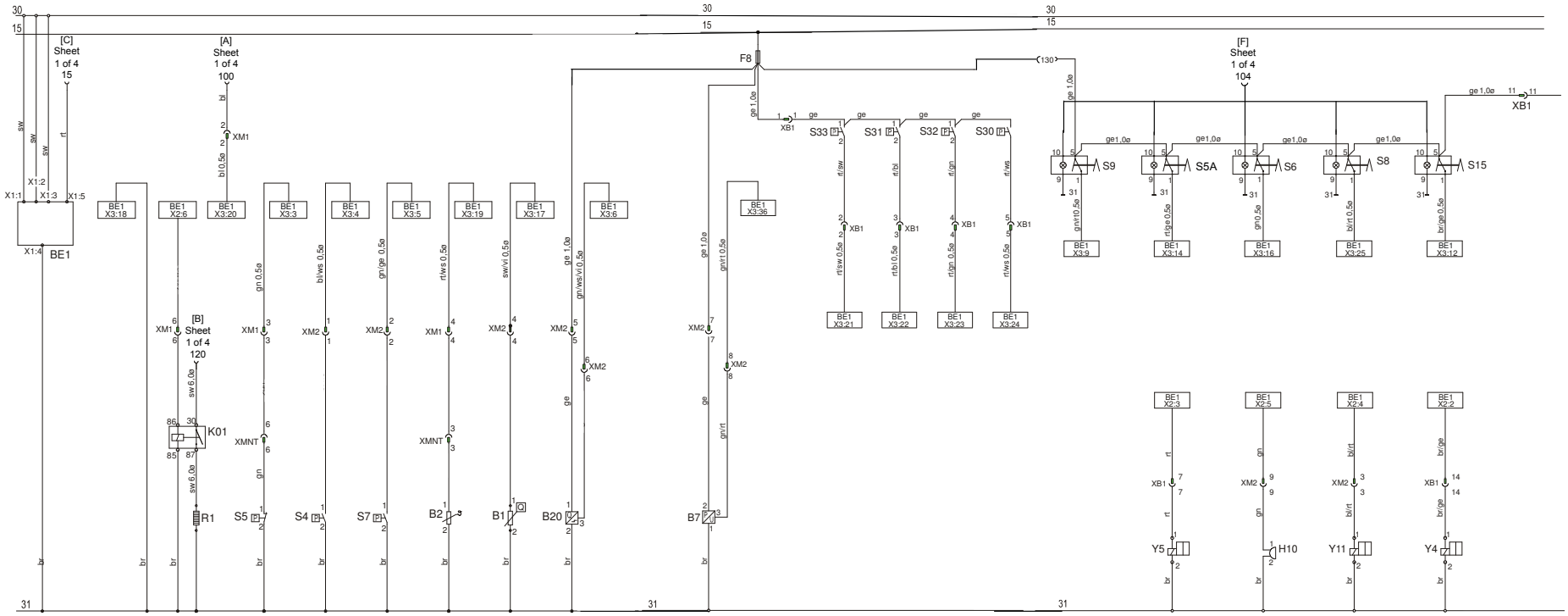
WIRING SCHEMATIC

442 EXCAVATOR
(S/N 522311001 AND ABOVE)
(PRINTED APRIL 2005)
V-0173

(Sheet 2 of 4)



Desig-nation	Device	Desig-nation	Device
	Check module		***Display units***
BE1	Control module	S5	Oil pressure switch
	Pre-heat	S4	Maintenance, air filter
K01	Pre-heat relay	S7	Hydraulic oil filter
R1	Glow plugs	B2	Coolant temperature
		B1	Fuel gauge transmitter
		B20	Hydraulic oil level
		F8	Fuse

Desig-nation	Device	Desig-nation	Device
	Load warning sensor		***Pressure switch travel***
F8	Fuse	S33	Pressure switch forward/left
B7	Load warning signal	S31	Pressure switch reverse/left
		S32	Pressure switch forward/right
		S30	Pressure switch reverse/right

Desig-nation	Device	Desig-nation	Device
	Load warning device		**Float position, breaker**
S9	Shut-off - load warning device	S8	Float position
	Travel	Y11	Valve float position
S5A	Fast/ slow	S15	Breaker
Y5	Valve, fast	Y4	Valve breaker
S6	Travel alarm		
H10	Travel alarm		

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WIRING SCHEMATIC

442 EXCAVATOR
(S/N 522311001 AND ABOVE)
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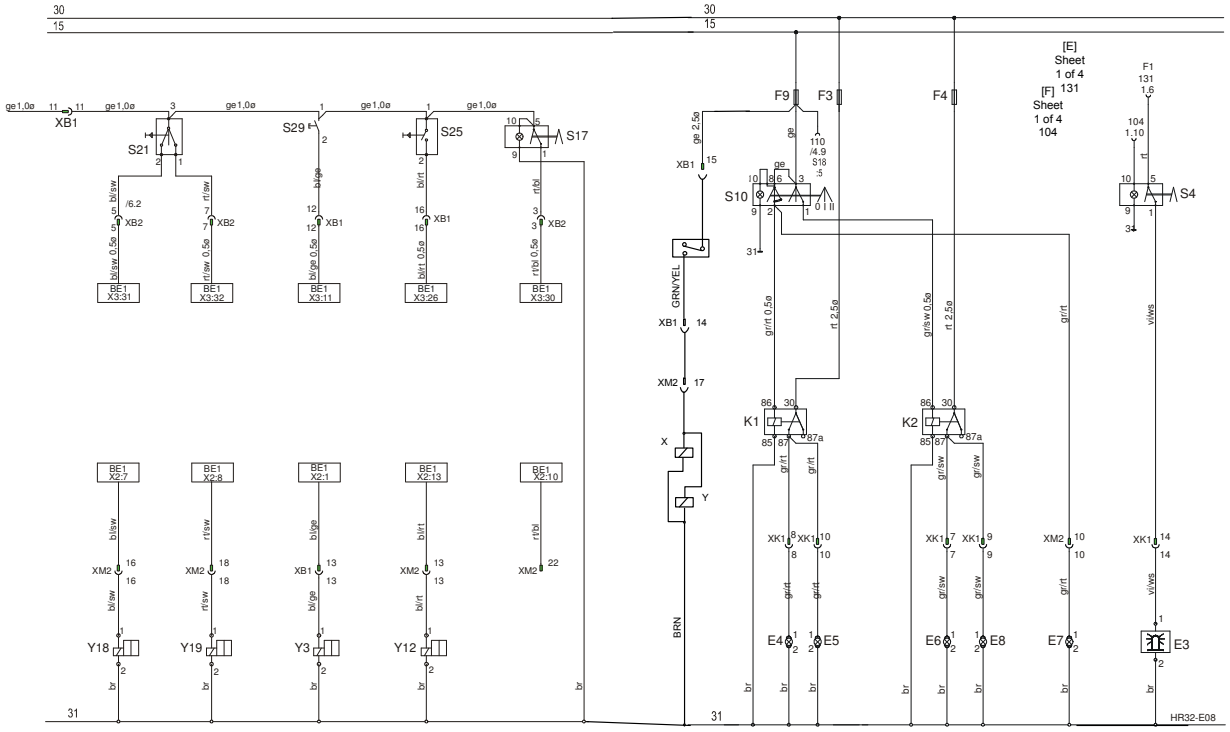
V-0173



Designation	Device	Desig-nation	Device
	Joystick		***High torque swing drive***
S21	Pushbutton additional control circuit	S25	High torque swing drive
Y18	Valve additional control circuit	Y12	Valve high torque swing drive
Y19	Valve additional control circuit		***Option***
	Working hydraulics	S17	Option
S29	Armrest switch		
Y3	Working hydraulics		

Desig-nation	Device	Desig-nation	Device
	Working floodlights	K2	Relay
F9	Fuse	E6	Working floodlight rear
S10	Working floodlights	E8	Working floodlight rear
K1	Relay	E7	Boom-mounted work. floodlight
E4	Working floodlight front	S4	Switch rotating beacon
F3	Fuse	E3	Rotating beacon
E5	Working floodlight front	X	ISO/STD Valve Solenoid
F4	Fuse	Y	ISO/STD Valve Solenoid

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442 EXCAVATOR
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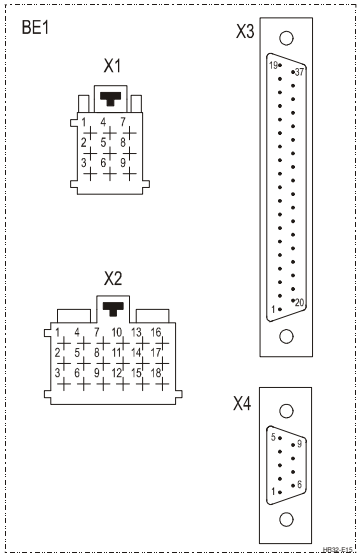
Control module



X1	Power supply
1	Power supply terminal 30
2	Power supply terminal 30
3	Power supply terminal 30
4	Ground
5	Power supply terminal 15
6	--
7	--
8	--
9	--

X2	Signal outlets
1	Working hydraulics
2	Breaker
3	Quick – slow
4	Float position
5	Back-up alarm
6	Pre-glow
7	Valve additional control circuit
8	Valve additional control circuit
9	---
10	Option
11	Boom cut-off
12	Intermediate boom cut-off
13	High torque swing drive
14	Valve additional control circuit 2
15	--
16	--
17	--
18	--

X3	Signal inlets
1	--
2	--
3	Oil pressure switch
4	Air filter contamination
5	Hydraulic oil filter contamination
6	Hydraulic oil level switch
7	--
8	--
9	Load warning switch
10	--
11	Armrest switch
12	Breaker switch
13	--
14	Quick – slow switch
15	--
16	Back-up alarm switch
17	Tank transmitter
18	Ground
19	Coolant temperature
20	Load control
21	Pressure switch travel forward left
22	Pressure switch travel reverse left
23	Pressure switch travel forward right
24	Pressure switch travel reverse right
25	Float position switch
26	High torque swing drive
27	Proximity switch boom
28	Proximity switch intermediate boom
29	Option
30	Option
31	Additional control circuit – pushbutton
32	Additional control circuit – pushbutton
33	--
34	--
35	--
36	Load warning signal
37	--

X4	Interface	

Cable colors	Terminal	Significance
black	30/49	Battery, positive, reverse, flasher
red	15	Glow starter, positive
brown	31	Ground, negative
blue	D+/61	Generator, working hour meter
white	56a	High beam
yellow	15	Switched positive output
green		Oil pressure - engine
grey		Switch forward - rectifier
beige		Board check system
black / red	54	Brake lights, stop light switch
black / blue		Additional valve
black / white	L	Flasher left, flasher check, terminal C
black / green	R	Flasher right
black / yellow		Parking brake - charge indicator light
black / white / green	49a	Flasher switch
black / grey	C2	Flasher indicator light
black / violet	G	Fuel level gauge
black / brown		Warning buzzer
red / black		Axle lock
red / white		Temperature indicator
red / yellow		Hand brake switch - cabin lamp
red / blue		Steering inversion
red / green		4-wheel steering - crab
red / brown		4-wheel steering - round
brown / red		Hydr.oil cooler / transmitter / engine
brown / white	17/31b	Warning lamp pre-glow / wiper motor
brown / yellow		V-belt check, valve-breaker
brown / green		Horn
blue / red		Hydraulic pressure
blue / brown		Diesel fuel heat., charge press. (fuel)
blue / white		Air filter check
blue / yellow		Armrest switch - pilot control
blue / black		Electr. engine shut-off, wiper motor
white / yellow	56b	Low beam
white / grey	3	Light switch
yellow / black		Heater fan switch - motor
yellow / green		Hydr. filter clogging indicator
green / red		Engine oil temperature light (Deutz)
green / white		Hydraulic oil temperature
green / violet		Windscreen wiper
green / grey		Heater fan
green / blue		Heater fan
green / black		Heater fan
grey / black		Side marker lamp left
grey / red		Side marker lamp right, panel lamps / working floodlights
violet / white		Rotating beacon
green / white / red		Cooling water level
green / black / white		Engine oil level
green / white / violet		Hydraulic oil level
orange		Slew limitation
blue / green		Wiper switch
blue / yellow / green		Steering lock angle rear

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442 EXCAVATOR

(S/N 528611001 AND ABOVE)

(S/N 528911001 AND ABOVE)

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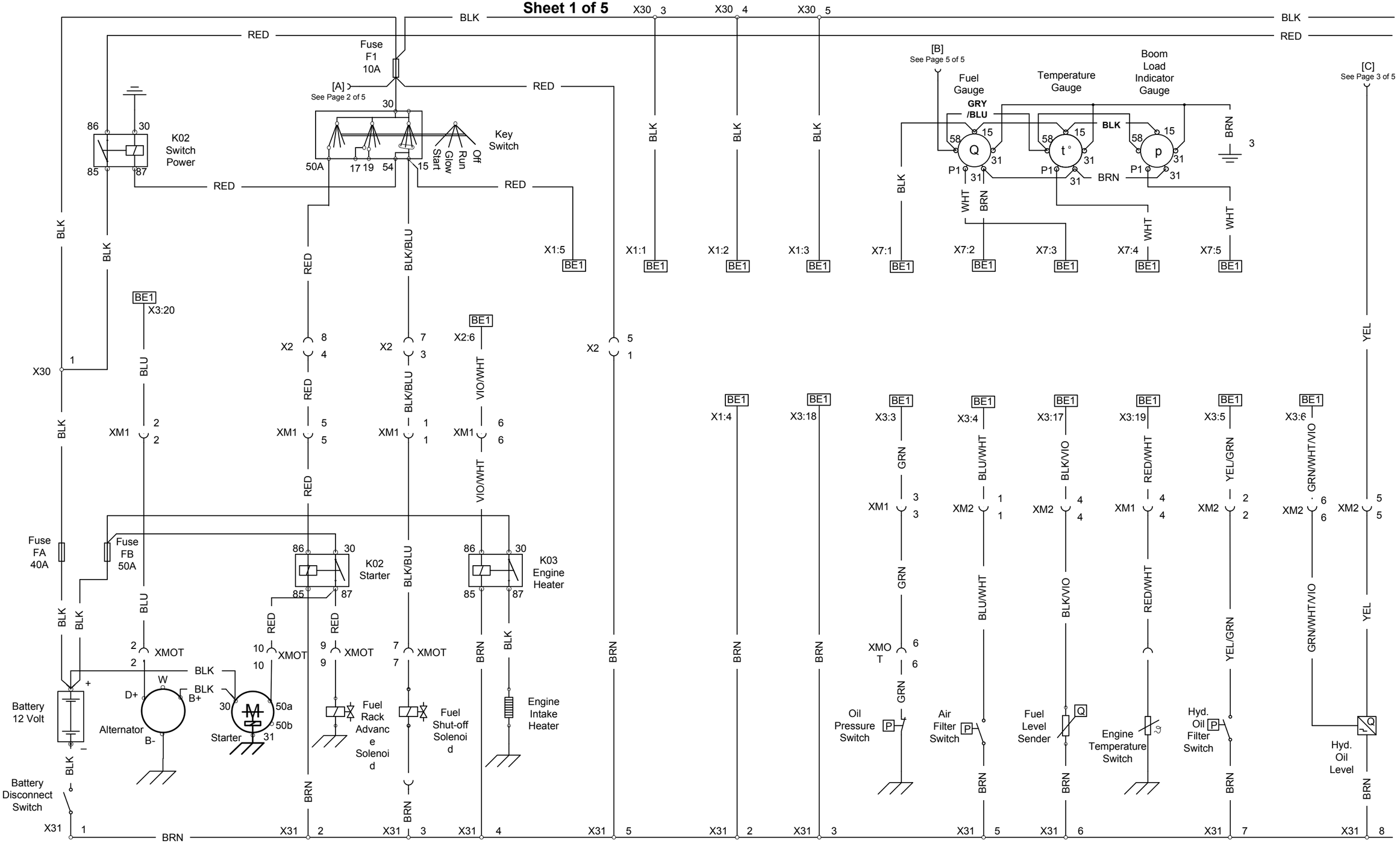
V-0616

Sheet 1 of 5



V-0616 (10-15-07)

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442 EXCAVATOR

(S/N 528611001 AND ABOVE)

(S/N 528911001 AND ABOVE)

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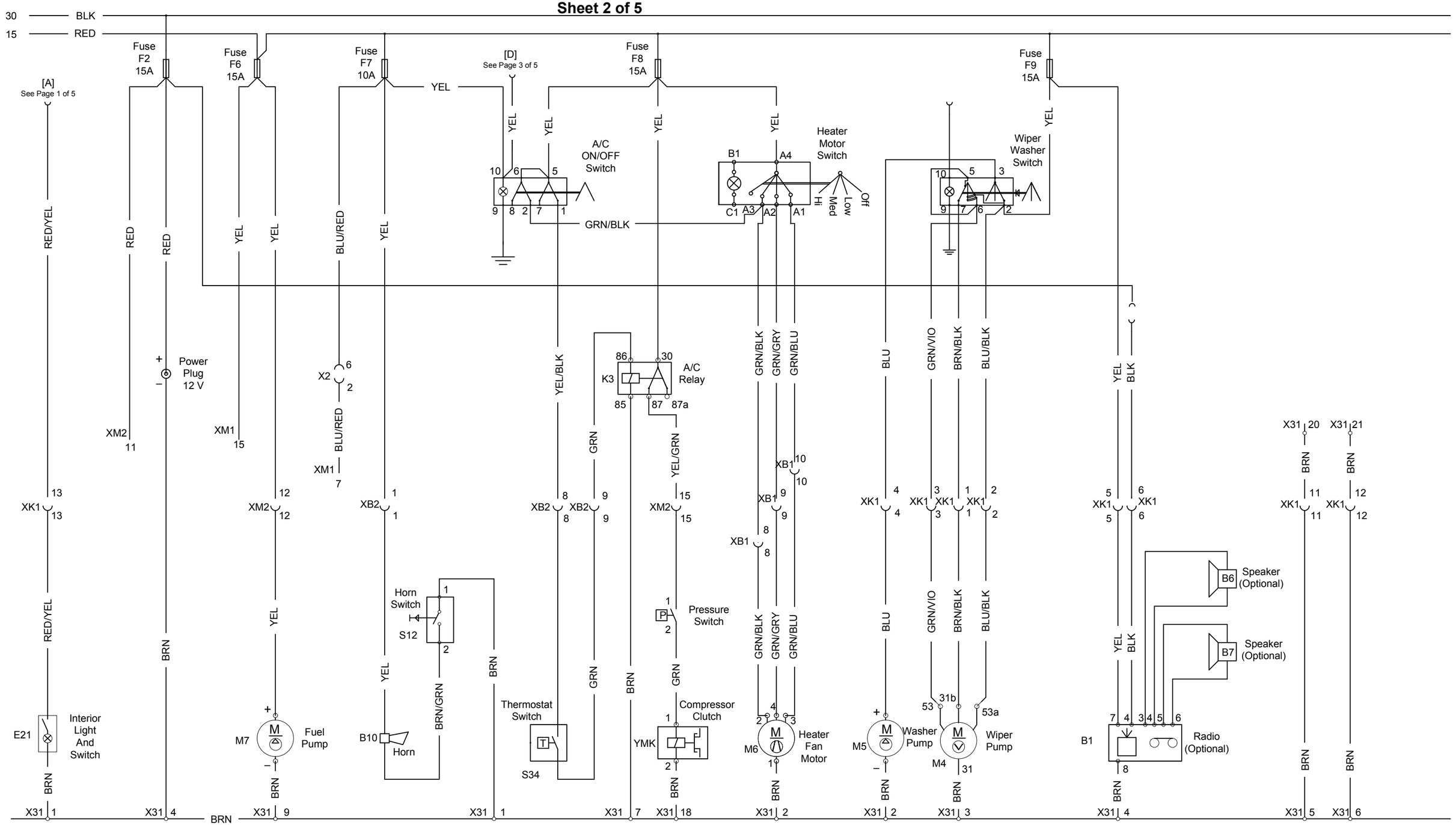
V-0617

Sheet 2 of 5



V-0617 (10-15-07)

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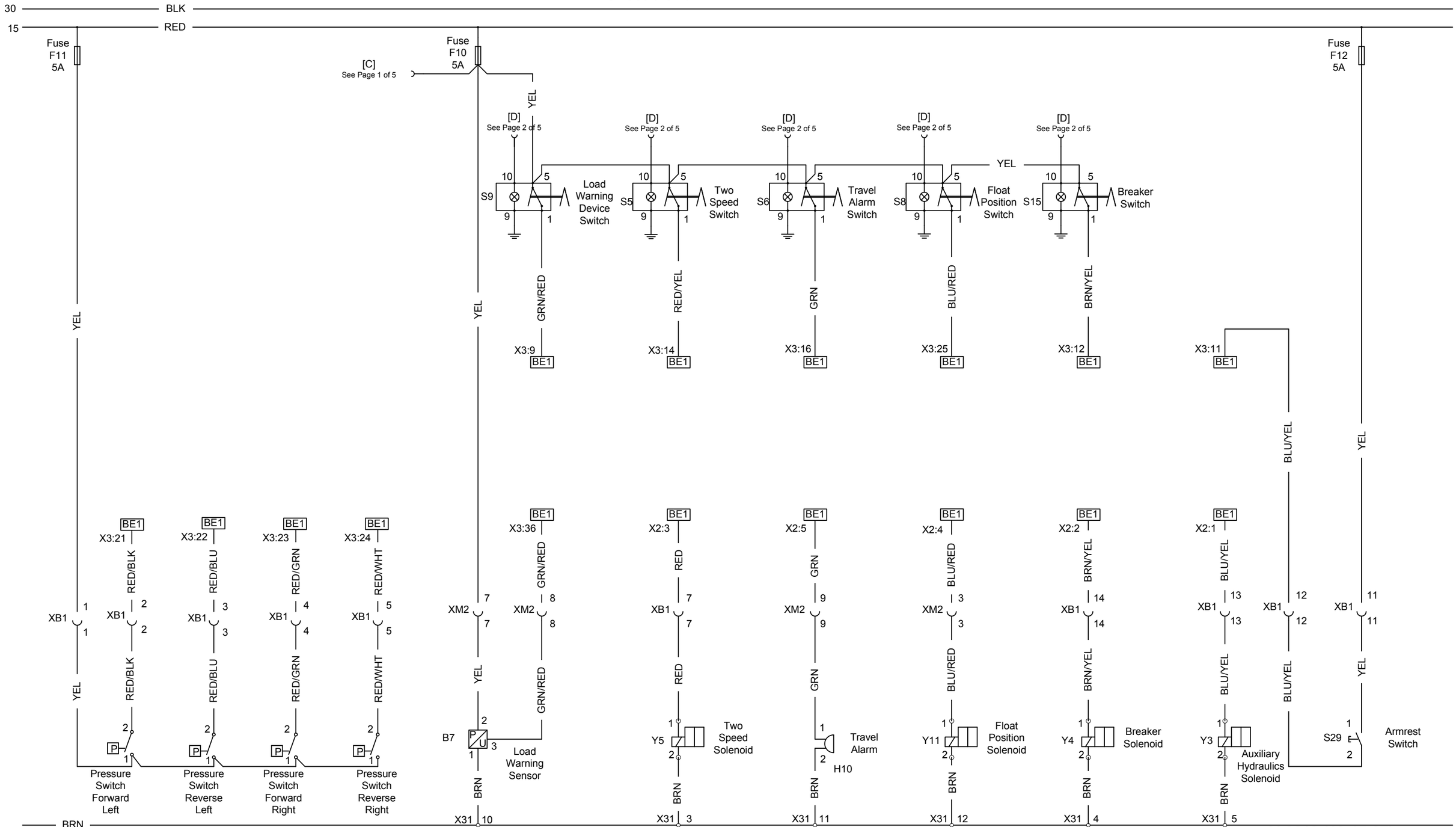

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WIRING SCHEMATIC

442 EXCAVATOR
(S/N 528611001 AND ABOVE)
(S/N 528911001 AND ABOVE)

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V-0619

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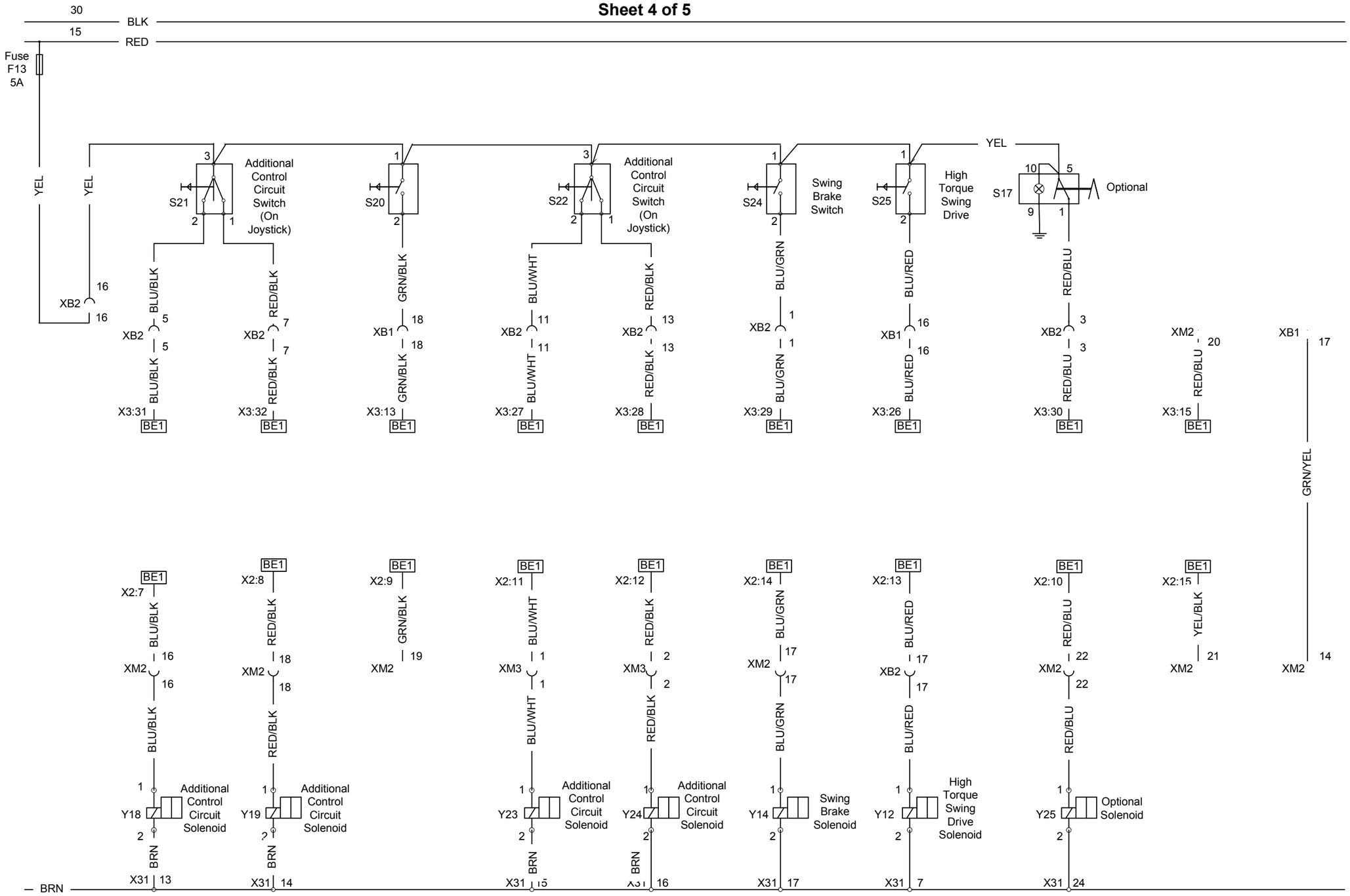

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WIRING SCHEMATIC

442 EXCAVATOR

(S/N 528611001 AND ABOVE)
(S/N 528911001 AND ABOVE)
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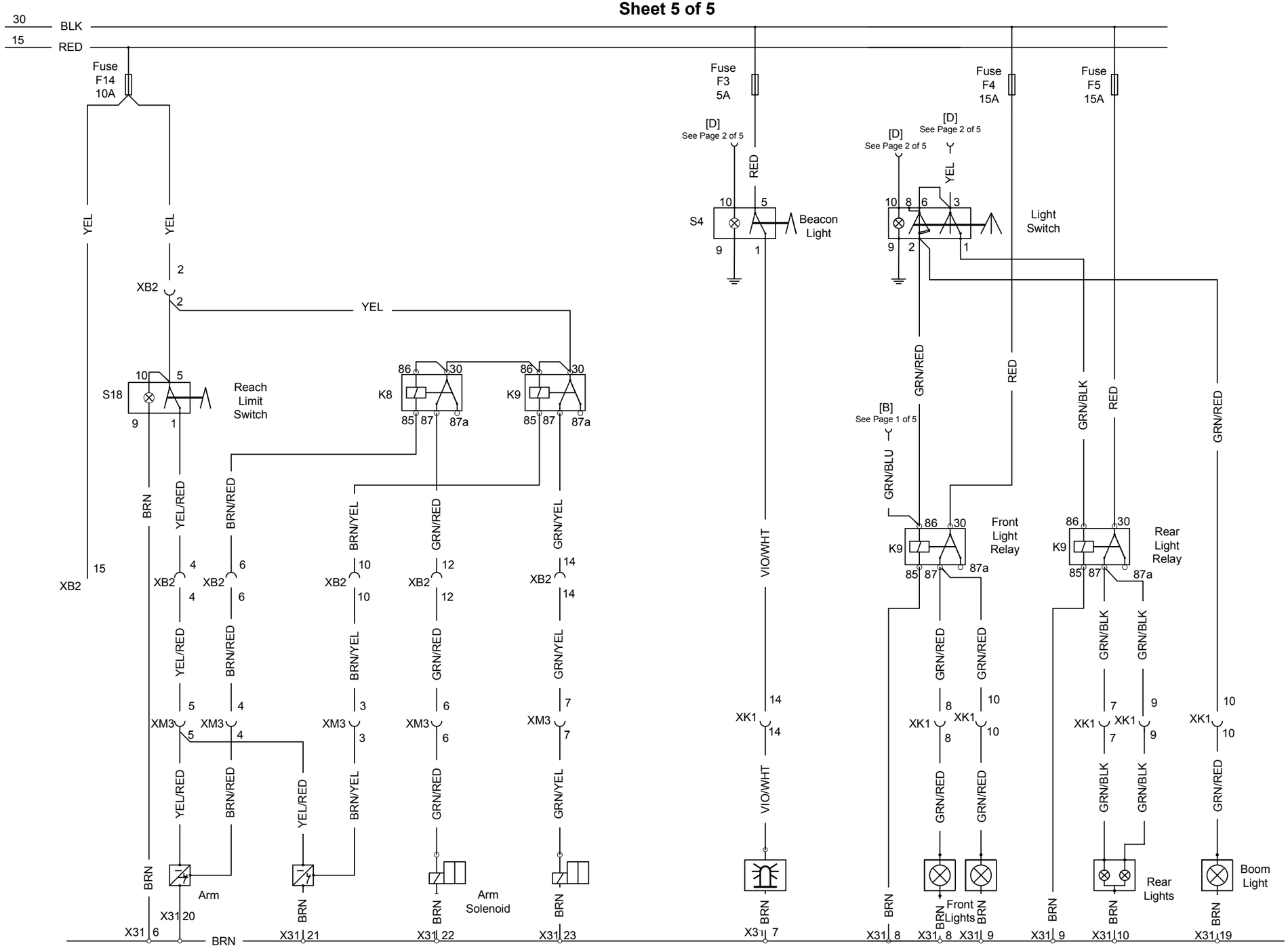
V-0620
Sheet 5 of 5



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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, 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-2003-00903

PROBLEM	CAUSE
Battery will not take a charge.	1, 2, 3, 4, 5
Alternator will not charge.	1, 2, 5
Starter will not turn the engine.	2, 3, 4, 6, 7, 8, 9

KEY TO CORRECT THE CAUSE
1. Alternator 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.

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Description

Figure 50-10-1

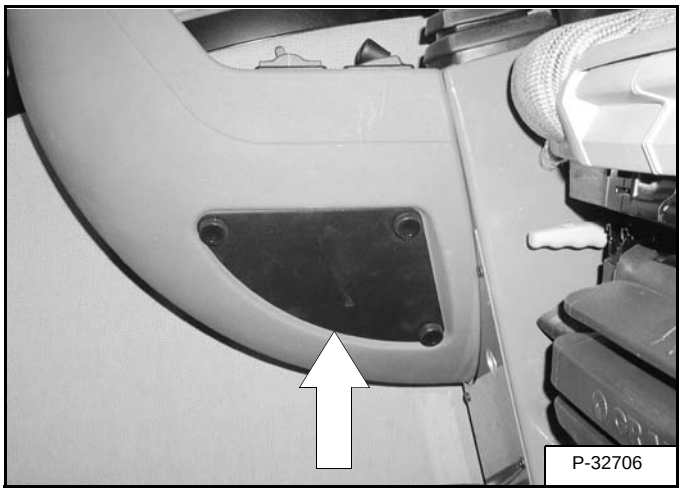
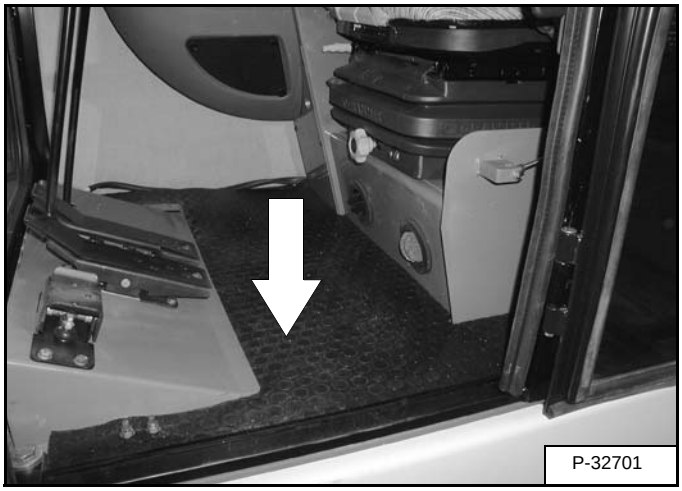


Figure 50-10-2



The excavator has a 12 volt, negative ground electrical system. The electrical system is protected by fuses located in the right console and beside the battery **[Figure 50-10-1]** & **[Figure 50-10-2]**. 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.

The battery cables must be clean and tight. Check the electrolyte level in the battery. Add distilled water as needed. Remove acid or corrosion from the battery and cables with a sodium bicarbonate and water solution.

⚠ 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.

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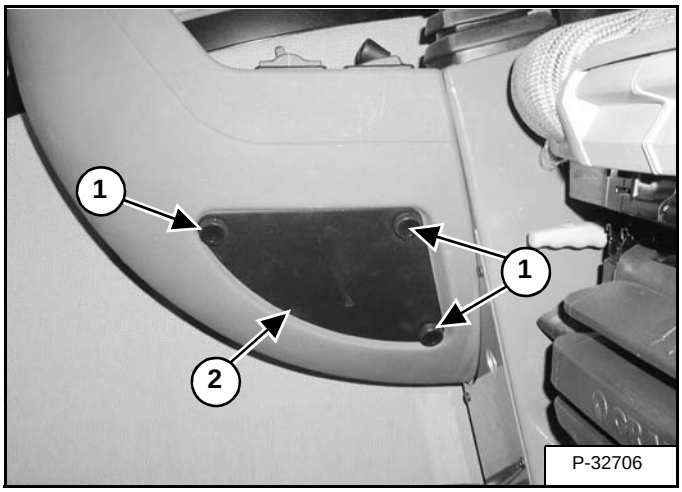
Fuse And Relay Location (S/N 522311001 & Above)

Figure 50-10-3



To check or replace the fuses in the right console, remove the three screws (Item 1) and remove the cover (Item 2) **[Figure 50-10-3]**.

Figure 50-10-4

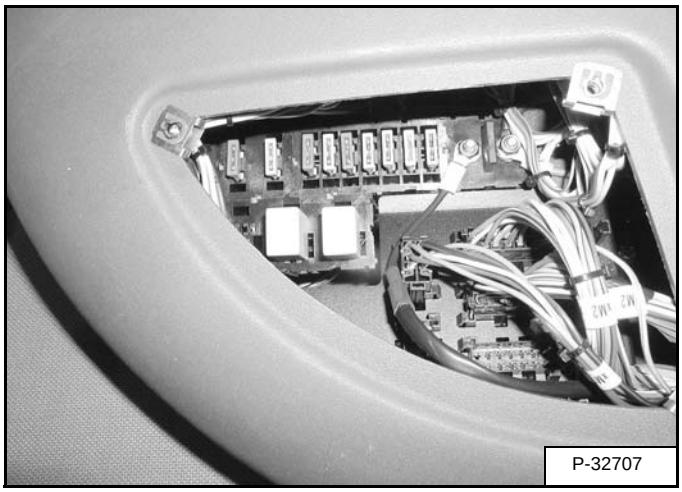
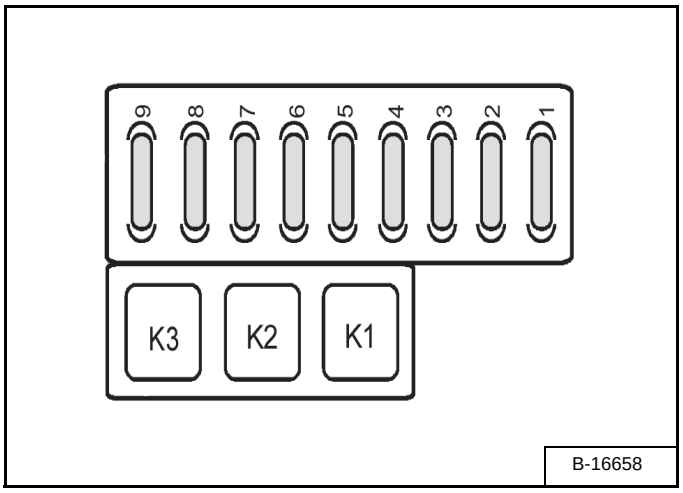


Figure 50-10-5



The location and sizes are shown below and **[Figure 50-10-4]** & **[Figure 50-10-5]**.

REF.	DESCRIPTION	AMPERAGE.
1	Interior light, radio	5
2	Auxiliary power outlet	20
3	Front lights	15
4	Rear work lights	15
5	Horn	10
6	Heater fan motor	15
7	Wiper/Washer	10
8	Control module signal input	5
9	Optional work lights and heating	
K1	Front work lights	relay
K2	Rear work lights	relay
K3	Air conditioning	relay

Always replace fuses with the same type and capacity.

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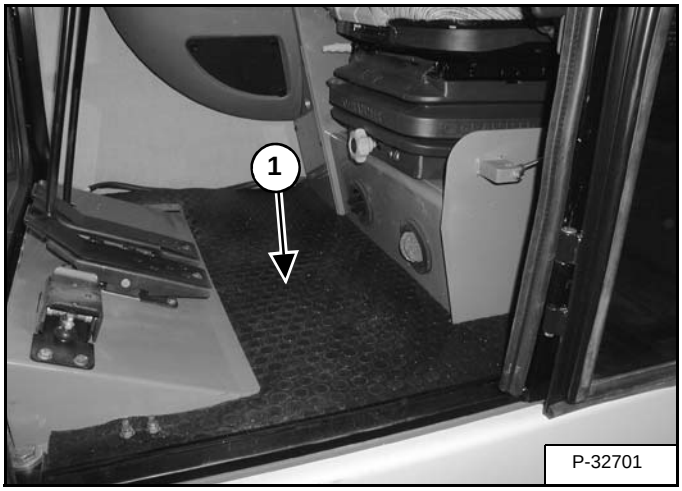
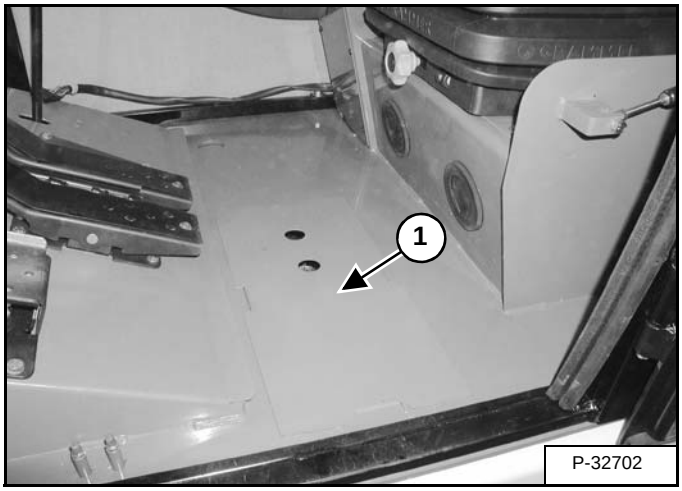
Fuse And Relay Location (S/N 522311001 & Above) (Cont'd)

Figure 50-10-6



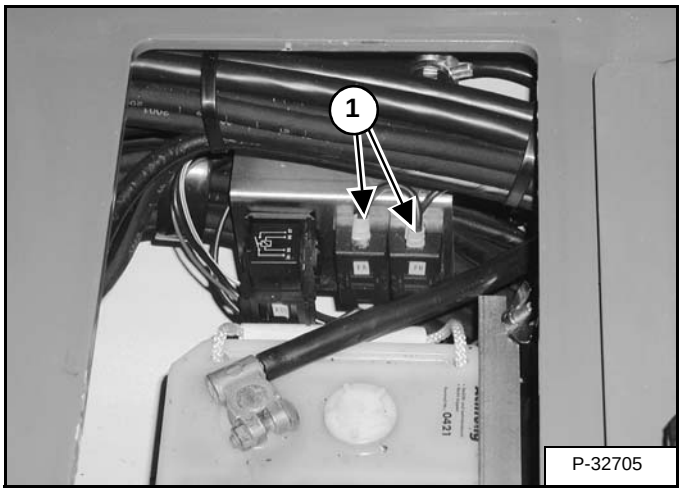
To check or replace fuses beside the battery, pull up on and remove the floor mat (Item 1) **[Figure 50-10-6]**.

Figure 50-10-7



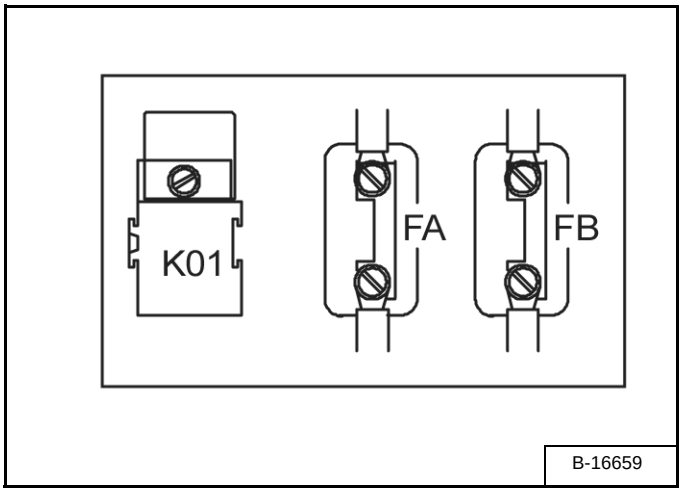
Remove the battery compartment cover (Item 1) **[Figure 50-10-7]**.

Figure 50-10-8



Remove the covers (Item 1) **[Figure 50-10-8]** for access to the two fuses.

Figure 50-10-9



The location and sizes are shown below **[Figure 50-10-8]** & **[Figure 50-10-9]**.

REF.	DESCRIPTION	AMPERAGE.
1 (FA)	Main fuse	30
2 (FB)	Pre-Heat	60
3 (K01)	Pre-Heat	relay

Always replace fuses with the same type and capacity.

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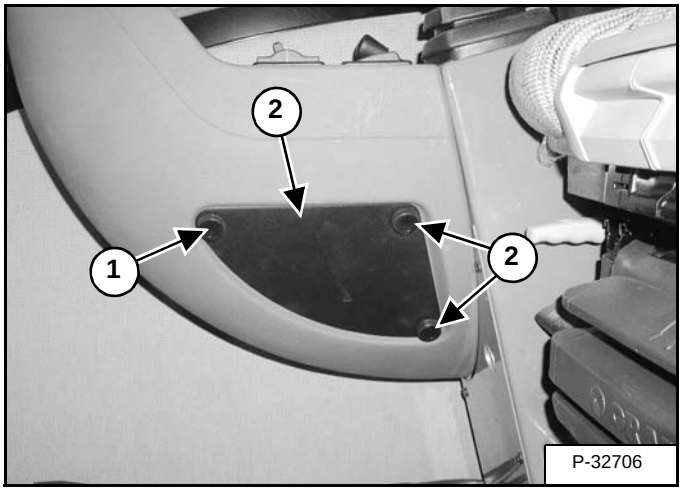
Fuse And Relay Location (S/N 528911001 & Above And S/N 528611001 & Above)

Figure 50-10-10



To check or replace the fuses in the right console, remove the screws (Item 1) and remove the cover (Item 2) **[Figure 50-10-10]**.

Figure 50-10-11

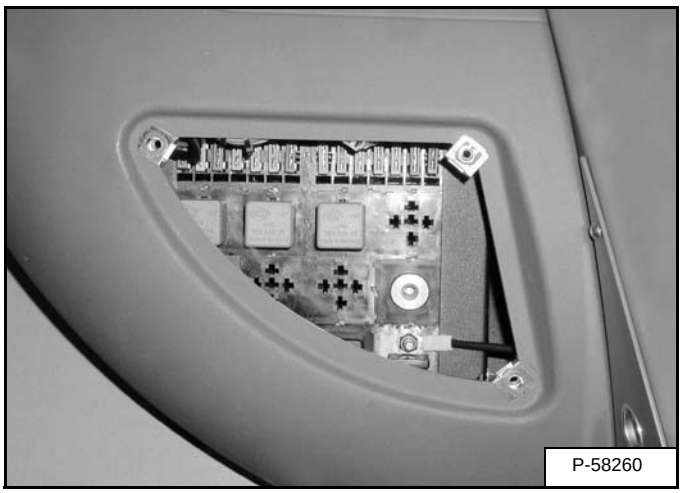
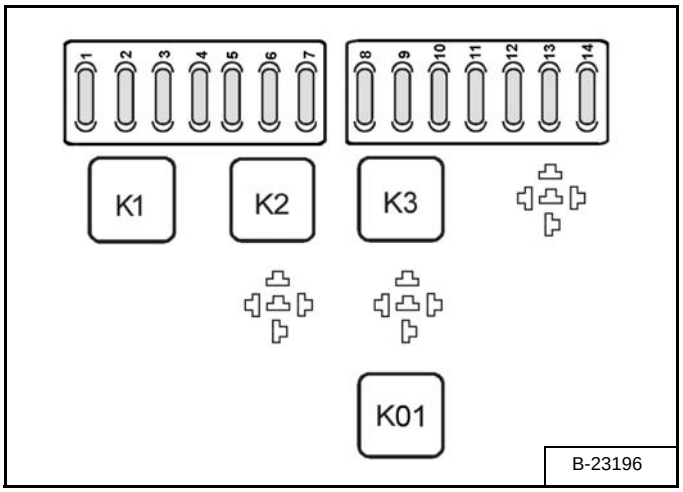


Figure 50-10-12



The location and sizes are shown below **[Figure 50-10-11]** & **[Figure 50-10-12]**.

REF.	DESCRIPTION	AMPERAGE
1	Key switch, interior light, security ignition (If equipped)	10A
2	Aux power outlet, radio, heater	15A
3	Rotating beacon (If equipped)	10A
4	Flood light (Front)	15S
5	Flood light (Back)	15A
6	Fuel pump	15A
7	Horn, panel light, security ignition (If equipped)	10A
8	Heater fan	15A
9	Wiper/washer, radio	15A
10	Hyd. oil level, hyd functions, overload warning	5A
11	Travel pressure switch	5A
12	Main hyd. system	5A
13	Left and right joystick	5A
14	Air conditioning box	10A
K1	Flood light (Front)	Relay
K2	Flood light (Rear)	Relay
K3	Open	Relay
K01	Switch power	Relay

Always replace fuses with the same type and capacity.

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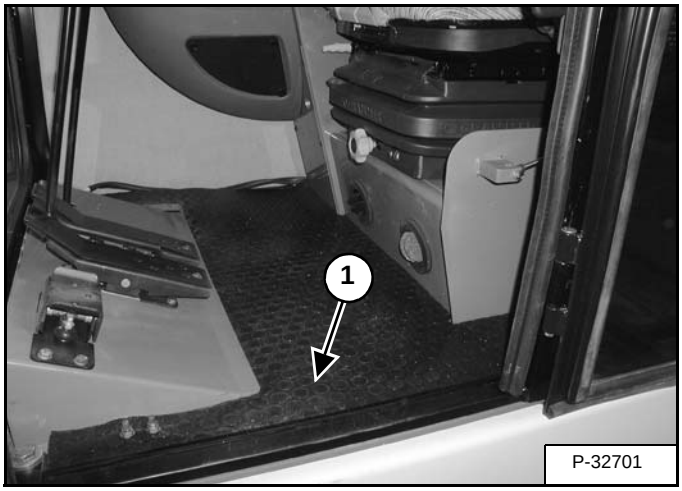
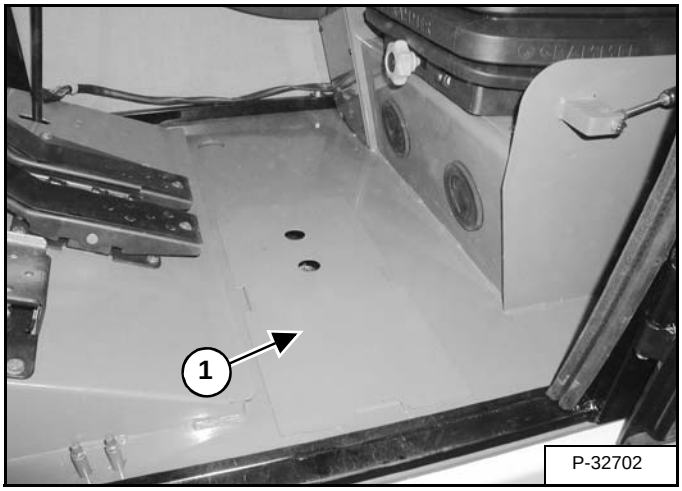
Fuse And Relay Location (S/N 528911001 & Above And S/N 528611001 & Above) (Cont'd)

Figure 50-10-13



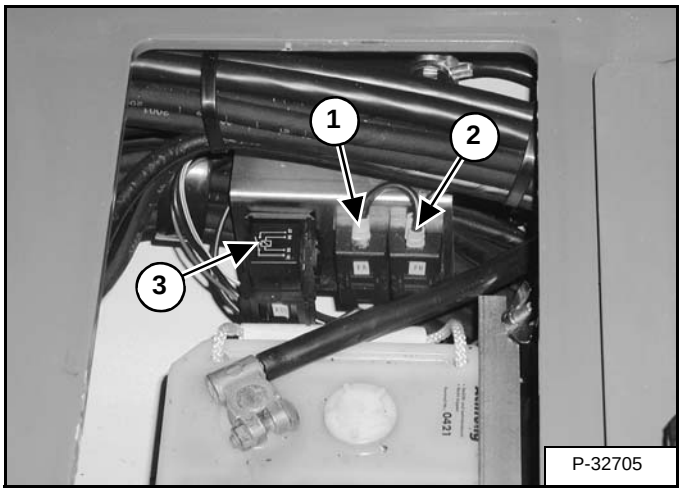
To check or replace fuses beside the battery, pull up on and remove the floor mat (Item 1) **[Figure 50-10-13]**.

Figure 50-10-14



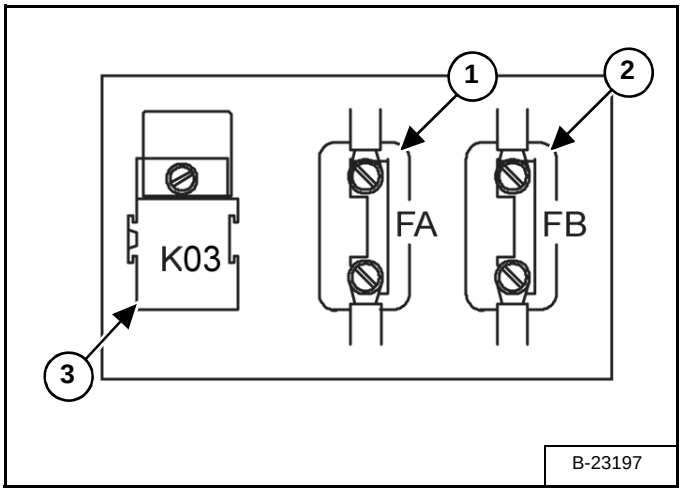
Remove the battery compartment cover (Item 1) **[Figure 50-10-14]**.

Figure 50-10-15



Remove the covers (Item 1) for access to the two fuses **[Figure 50-10-15]**.

Figure 50-10-16



The location and sizes are shown below (Item 1) **[Figure 50-10-15]** & **[Figure 50-10-16]**.

REF.	DESCRIPTION	AMPERAGE
1 (FA)	Main fuse	40
2 (FB)	Pre-Heat	40
3 (K03)	Intake air heat	relay

Always replace fuses with the same type and capacity.

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Fuse And Relay Location (S/N 528911001 & Above And S/N 528611001 & Above) (Cont'd)

Open the right side cover.

Figure 50-10-17

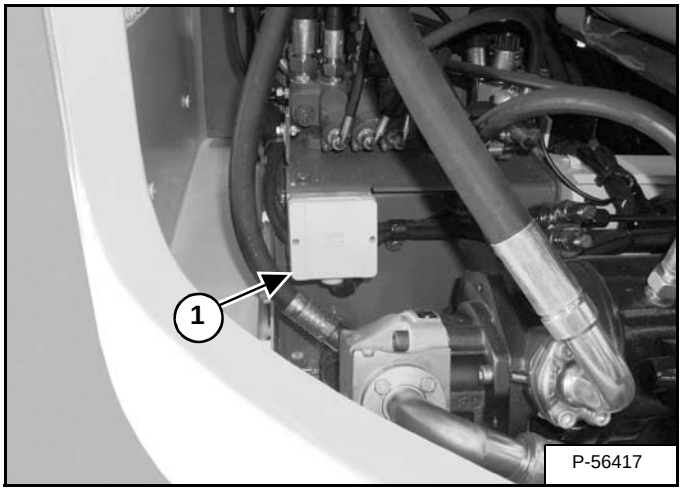
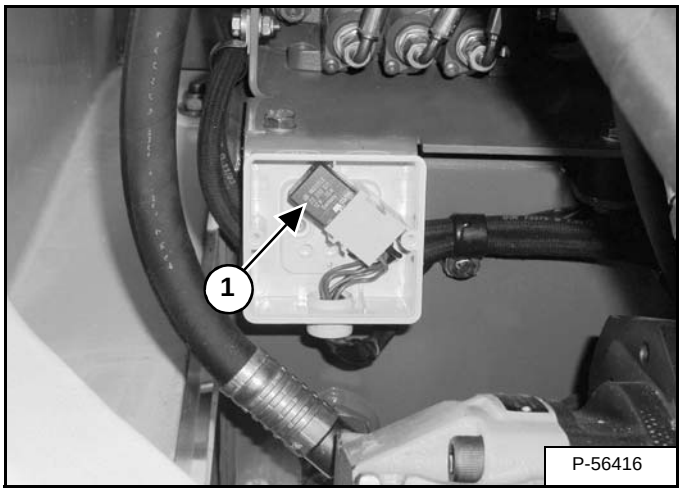


Figure 50-10-18



The location is shown above **[Figure 50-10-17]** & **[Figure 50-10-18]**.

REF.	DESCRIPTION	AMPERAGE
1 (K02)	Starter, additional fueling	Relay

Always replace relays with the same type and capacity.

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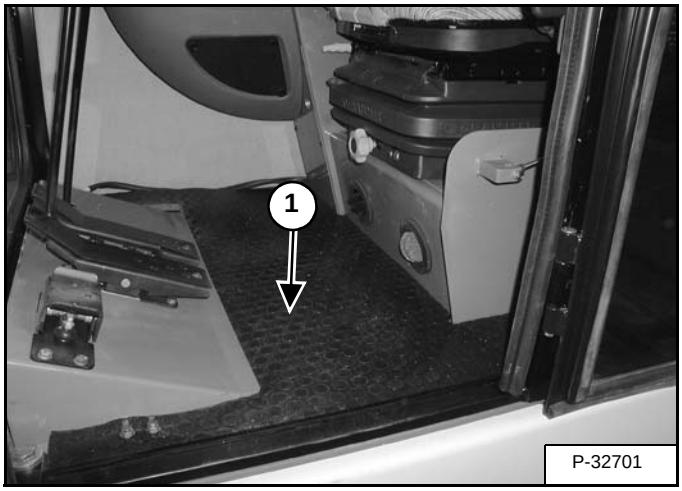
BATTERY

Servicing

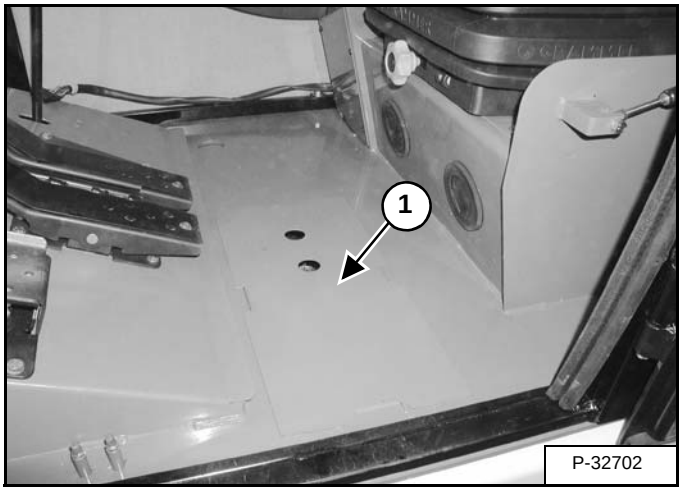
The battery is located under the cab floor.

Figure 50-20-1



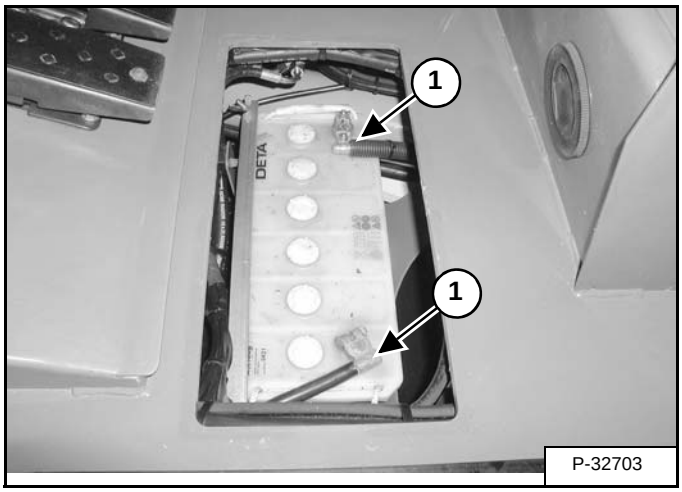
Pull up on and remove the floormat (Item 1) **[Figure 50-20-1]**.

Figure 50-20-2



Remove the battery compartment cover (Item 1) **[Figure 50-20-2]**.

Figure 50-20-3



The battery cables (Item 1) **[Figure 50-20-3]** must be clean and tight. 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.

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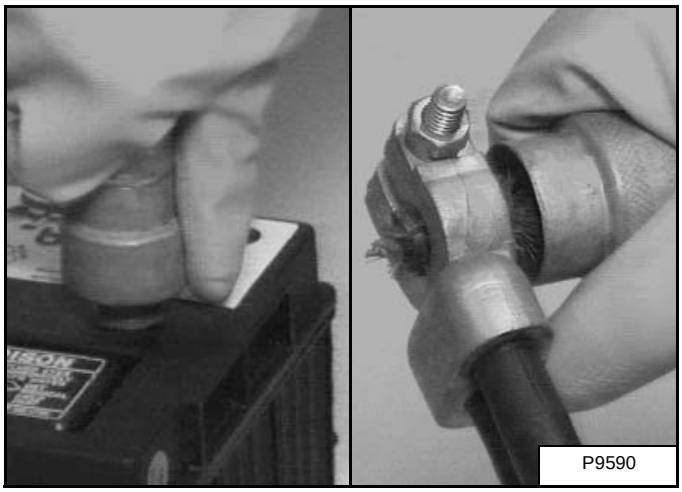
Servicing (Cont'd)

Figure 50-20-4



Clean the battery terminals and cable ends even when installing a new battery **[Figure 50-20-4]**.

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.

If electrolyte level is lower than 1/2 inch (13 mm) above the plates, add distilled water only.

Put Battery Saver or grease on the battery terminals and cable ends to prevent corrosion.

⚠ WARNING

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

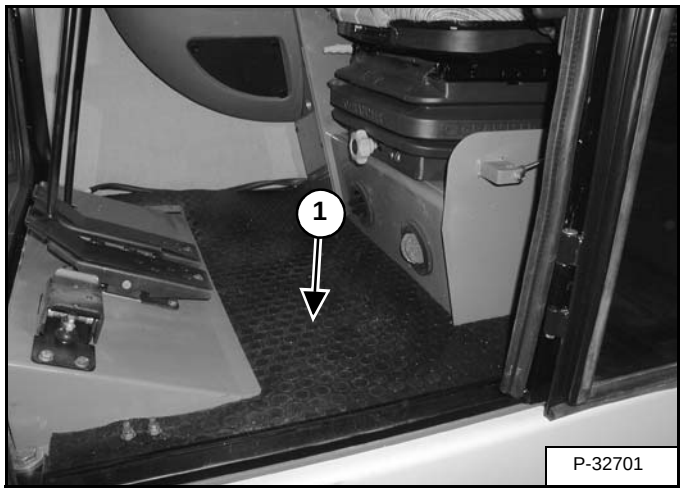
In case of acid contact, wash immediately with water. In case of eye contact get prompt medical attention and wash eye with clean, cool water for at least 15 minutes.

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

W-2065-1296

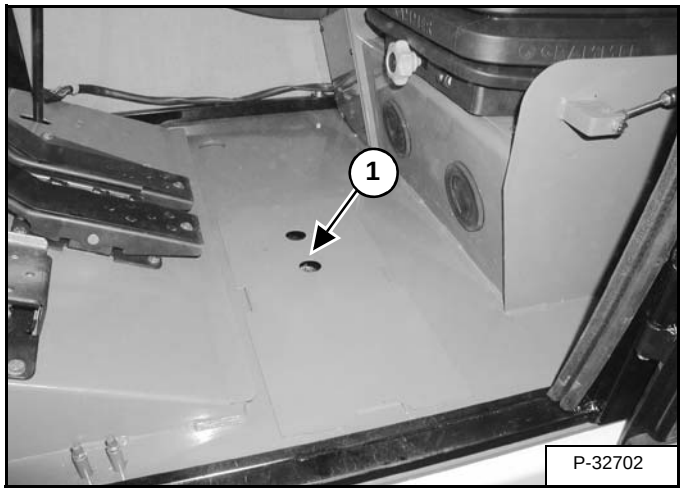
Removal And Installation

Figure 50-20-5



Pull up on and remove the floormat (Item 1) **[Figure 50-20-5]**.

Figure 50-20-6



Remove the battery compartment cover (Item 1) **[Figure 50-20-6]**.

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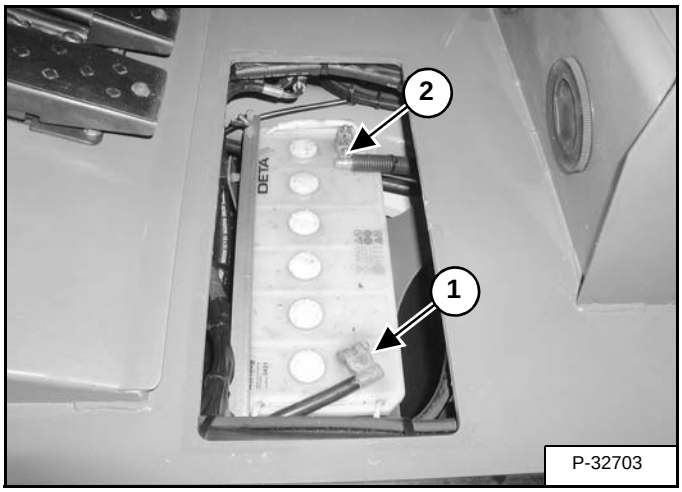
Removal And Installation (Cont'd)

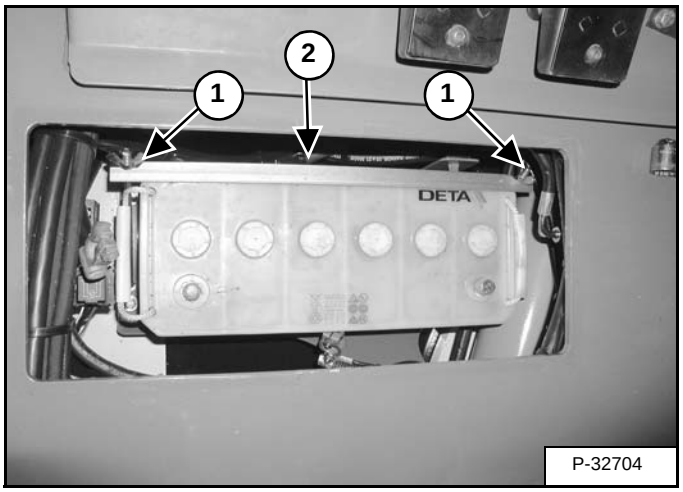
Figure 50-20-7



Disconnect the negative (-) cable (Item 1) **[Figure 50-20-7]** first.

Disconnect the positive (+) cable (Item 2) **[Figure 50-20-7]**.

Figure 50-20-8



Remove the nuts (Item 1) and remove the hold down clamp (Item 2) **[Figure 50-20-8]**.

Remove the battery.

Always clean the terminals and the cable ends.

Install the battery. Install the hold down clamp and tighten the bolts.

Connect the battery cables. Connect the negative (-) cable (Item 1) **[Figure 50-20-7]** 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

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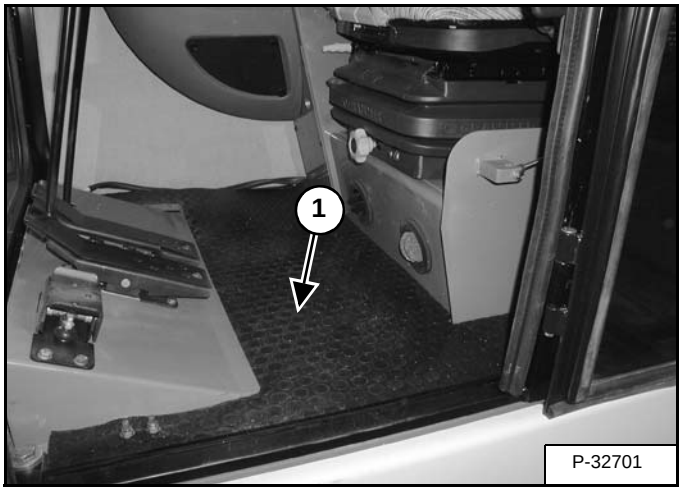
Using A Booster Battery (Jump Starting)

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.

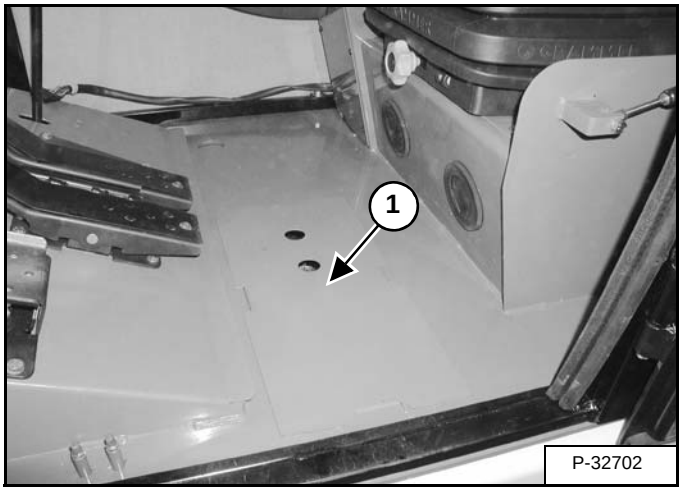
Be sure the key switch is OFF. The booster battery must be 12 volt.

Figure 50-20-9



Pull up on and remove the floor mat (Item 1) **[Figure 50-20-9]**.

Figure 50-20-10



Remove the battery compartment cover (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

⚠ WARNING

Keep arcs, sparks flames and lighted tobacco away from batteries. When *jumping* from booster battery make final connection (negative) at engine frame.

Do not jump start or charge a frozen or damaged battery. Warm battery to 60°F (16°C) before connecting to a charger. Unplug charger before connecting or disconnecting cables to battery. Never lean over battery while boosting, testing or charging.

Battery gas can explode and cause serious injury.

W-2066-1296

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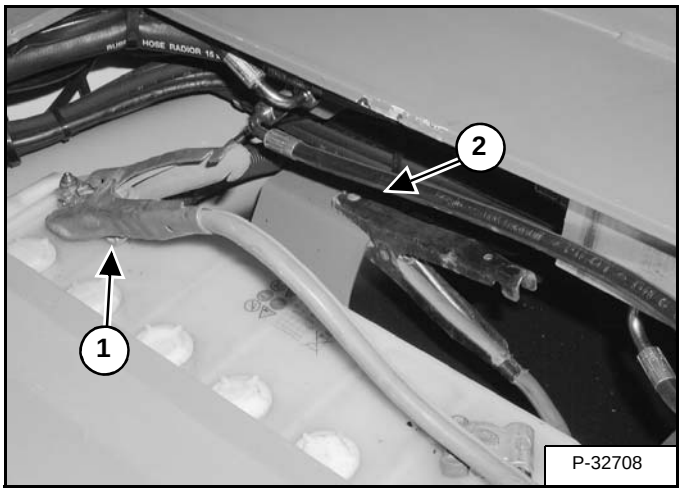
Using A Booster Battery (Jump Starting) (Cont'd)

Figure 50-20-11



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 50-20-11]** of the excavator battery.

Connect the end of the second cable to the negative (-) terminal of the booster battery. Connect the other end of the same cable to the excavator frame (Item 2) **[Figure 50-20-11]** (away from the battery).

NOTE: See Cold Temperature Starting Procedure, in the correct Operation & Maintenance Manual.

Start the engine. After the engine has started, remove the ground (-) cable first (Item 2) **[Figure 50-20-11]**.

Disconnect the cable from the excavator battery (Item 1) **[Figure 50-20-11]**.

IMPORTANT

If jump starting the excavator from a second machine:

When jump starting the excavator from a battery installed in a 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

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

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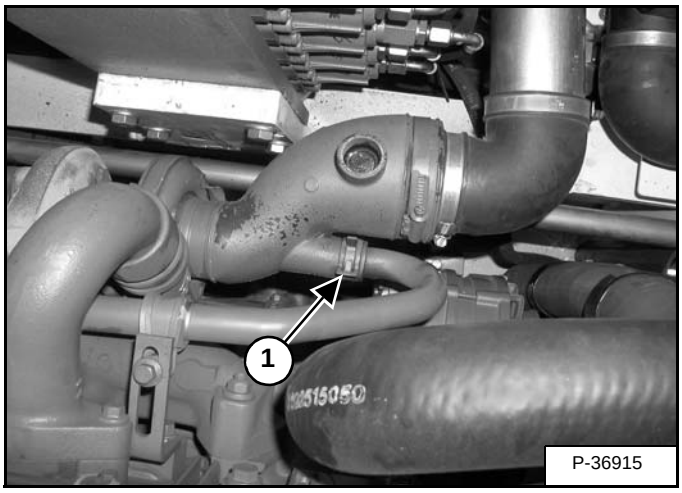
ALTERNATOR

Removal And Installation (S/N 522311001 & Above)

Disconnect the battery. (See BATTERY on Page 50-20-1.)

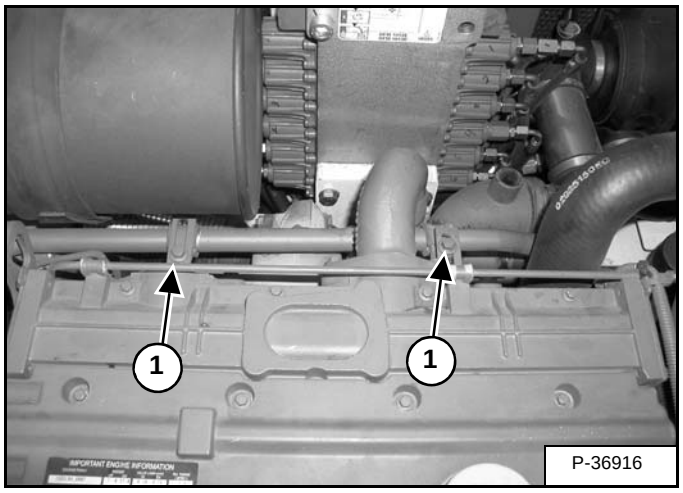
Open the right side cover.

Figure 50-30-1



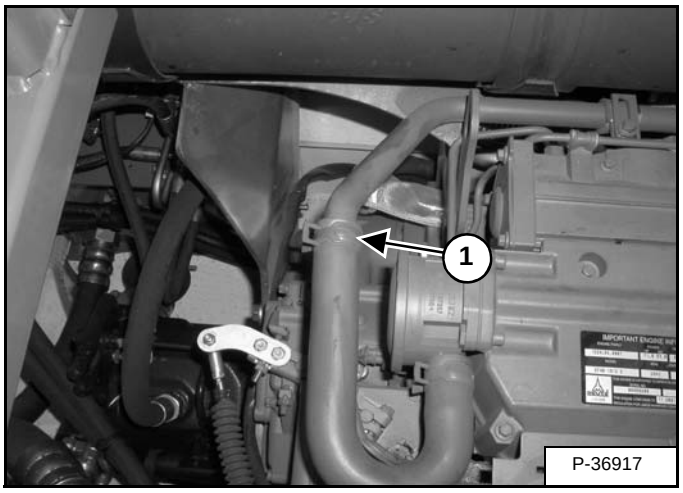
Remove the clamp (Item 1) **[Figure 50-30-1]**.

Figure 50-30-2



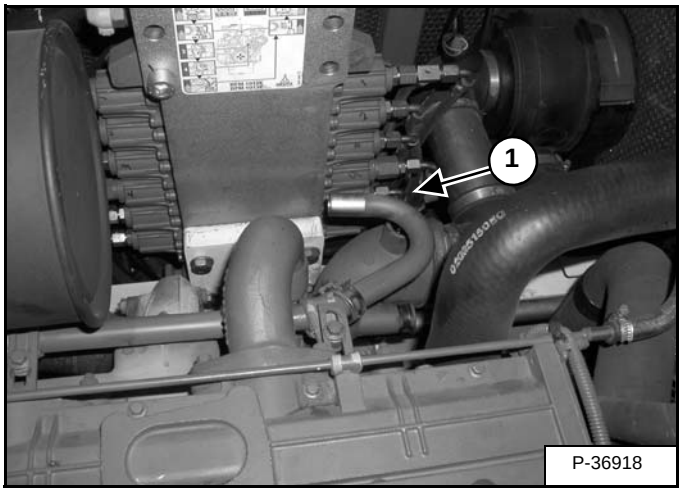
Loosen the two clamps (Item 1) **[Figure 50-30-2]**.

Figure 50-30-3



Remove the clamp (Item 1) **[Figure 50-30-3]**.

Figure 50-30-4



Remove the air tube (Item 1) **[Figure 50-30-4]** from the air intake and slide the tube towards the rear of the excavator.

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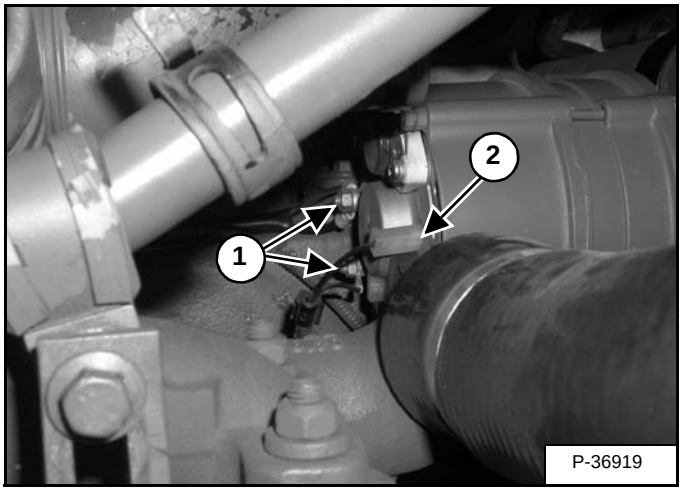
Removal And Installation (S/N 522311001 & Above) (Cont'd)

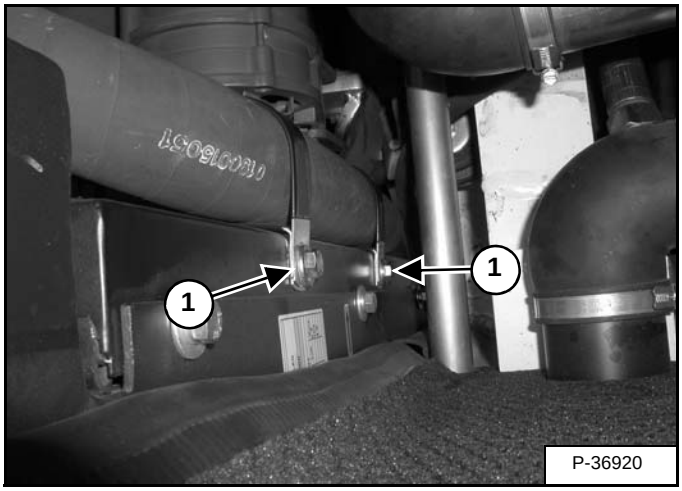
Figure 50-30-5



Remove the nuts (Item 1) **[Figure 50-30-5]** from the alternator studs. Remove the wire harness from both studs.

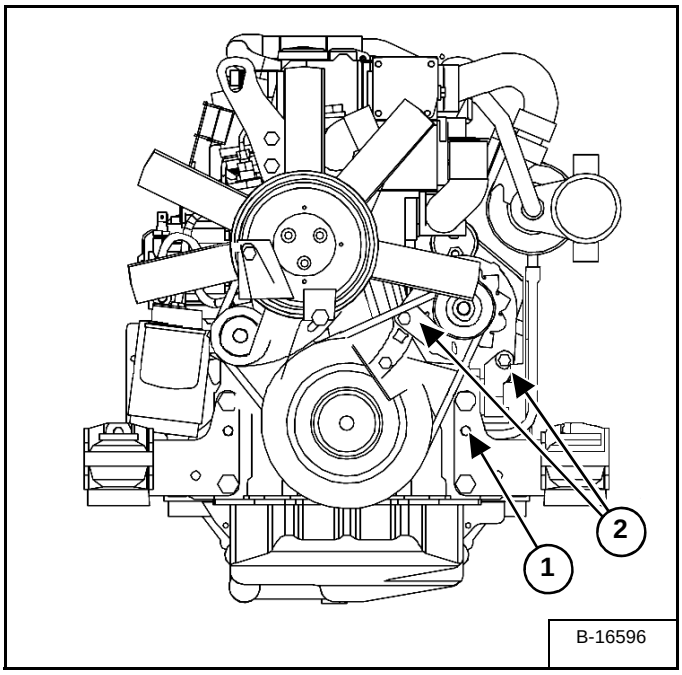
Disconnect the wire connector (Item 2) **[Figure 50-30-5]** from the back of the alternator.

Figure 50-30-6



Remove the bolts (Item 1) **[Figure 50-30-6]** from the lower radiator hose clamps. Reposition the hose to gain clearance to remove the alternator.

Figure 50-30-7



Loosen the adjustment bolt (Item 1) **[Figure 50-30-7]**.

Loosen the mount bolts (Item 2) **[Figure 50-30-7]** and remove the alternator belt.

Remove the two mount bolts and remove the alternator.

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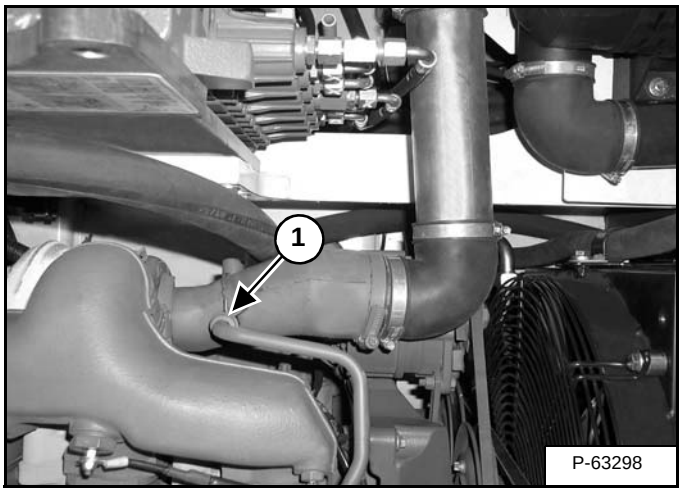
Removal And Installation (S/N 528911001 & Above And 528611001 & Above)

Disconnect the battery. (See BATTERY on Page 50-20-1.)

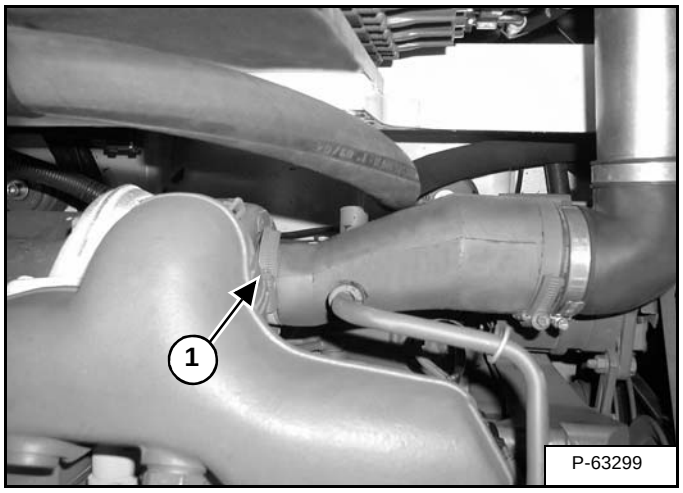
Open the right side cover.

Figure 50-30-8



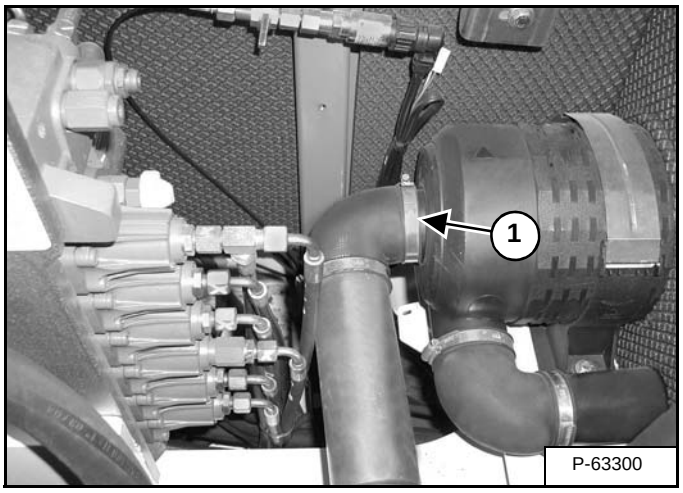
Remove the clamp (Item 1) **[Figure 50-30-8]**.

Figure 50-30-9



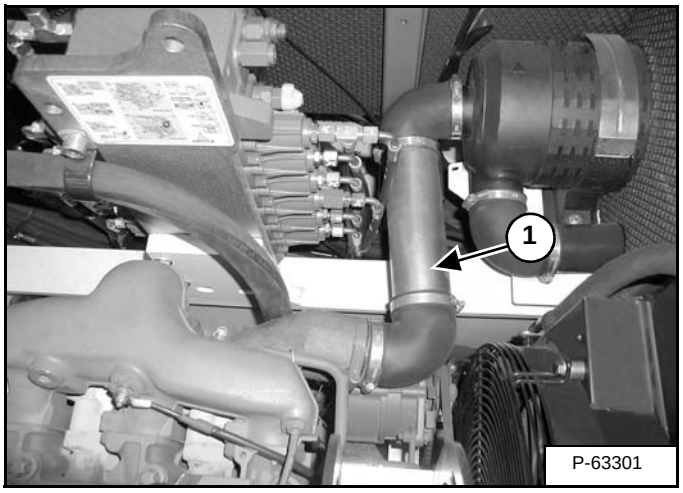
Loosen the clamp (Item 1) **[Figure 50-30-9]**.

Figure 50-30-10



Loosen the clamp (Item 1) **[Figure 50-30-10]**.

Figure 50-30-11



Remove the air tube (Item 1) **[Figure 50-30-11]** from the air intake and filter housing. Reposition the air tube.

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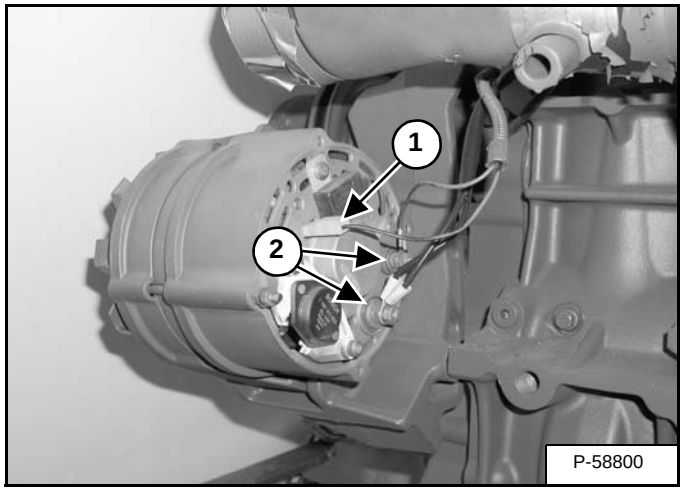
ALTERNATOR (CONT'D)

Removal And Installation (S/N 528911001 & Above And 528611001 & Above) (Cont'd)

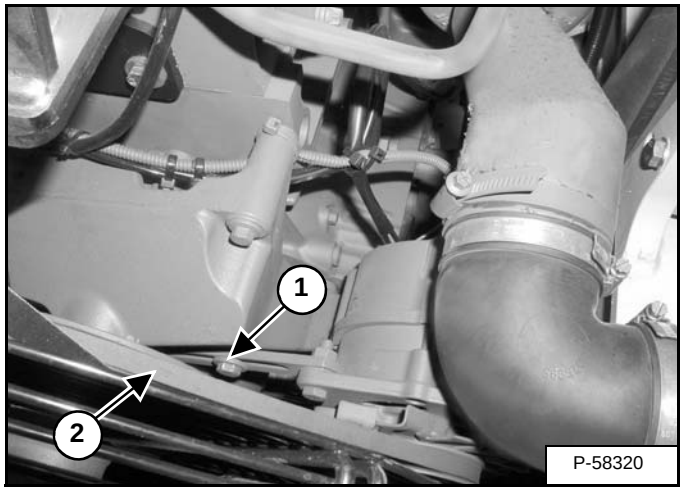
Figure 50-30-12



Disconnect the wire connector (Item 1) **[Figure 50-30-12]** from the alternator.

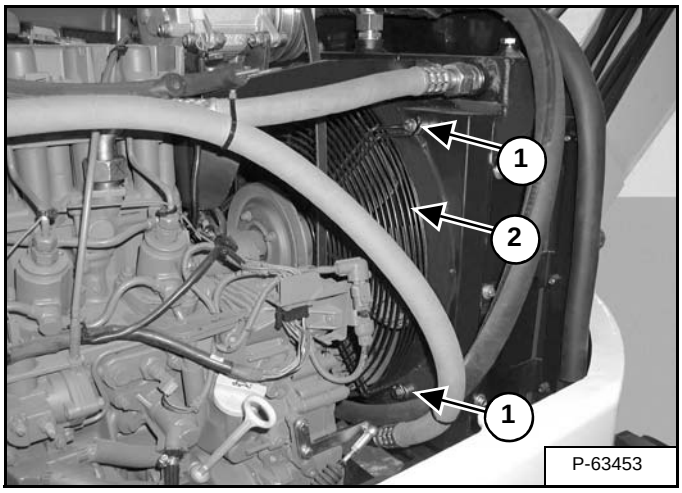
Remove the nuts and wire connectors (Item 2) **[Figure 50-30-12]**.

Figure 50-30-13



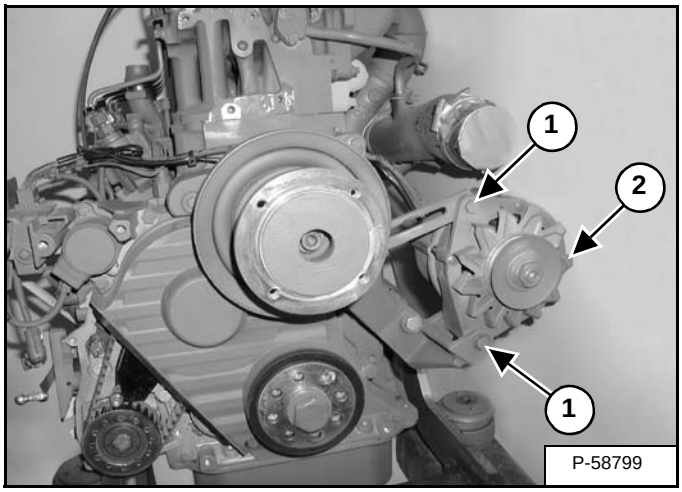
Loosen the bolt (Item 1). Remove the belt (Item 2) **[Figure 50-30-13]**.

Figure 50-30-14



Remove the 4 bolts, washers, and spacers (Item 1) from the guard (Item 2) **[Figure 50-30-14]**. Relocate the guard.

Figure 50-30-15



Remove the 2 bolts (Item 1) from the alternator (Item 2) **[Figure 50-30-15]**.

NOTE: The engine, fan and pulley are shown removed for photo clarity.

Remove the alternator.

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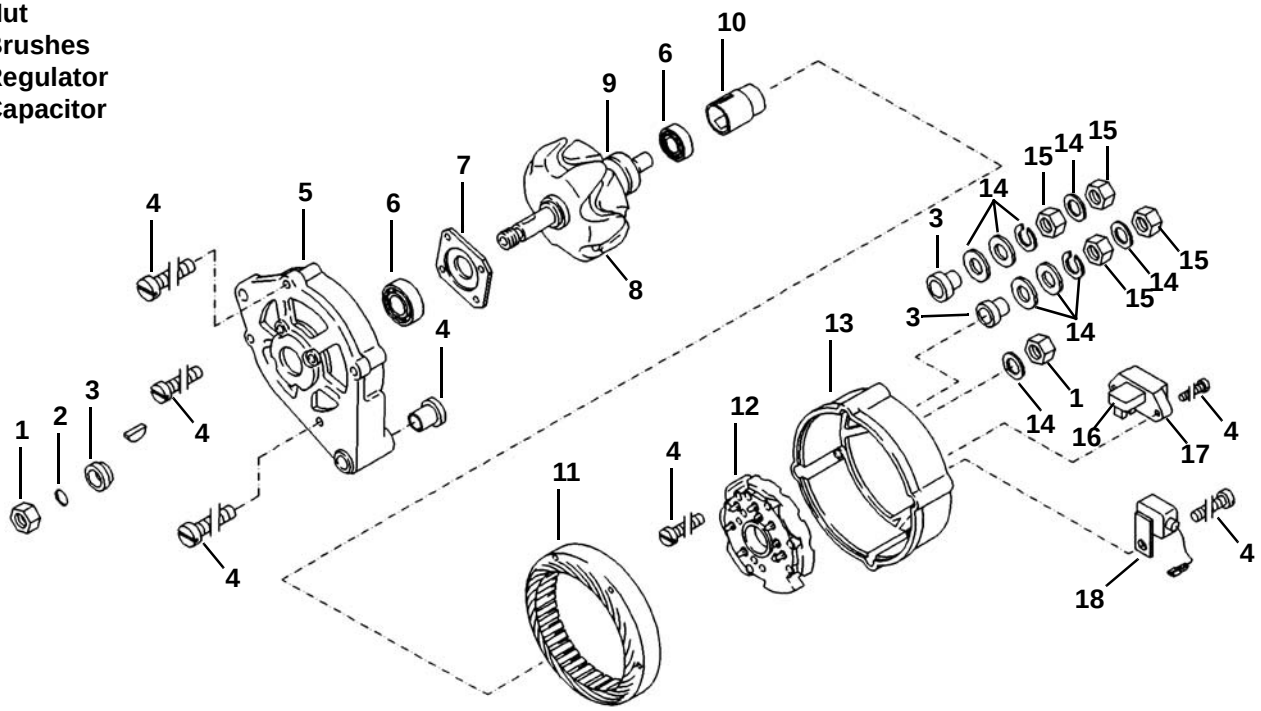
Parts Identification

1. Nut
2. Wave Washer
3. Bushing
4. Screw
5. Bracket
6. Bearing
7. Cover
8. Rotor
9. Slip Ring
10. Cover
11. Stator
12. Rectifier
13. Cover
14. Washer
15. Nut
16. Brushes
17. Regulator
18. Capacitor



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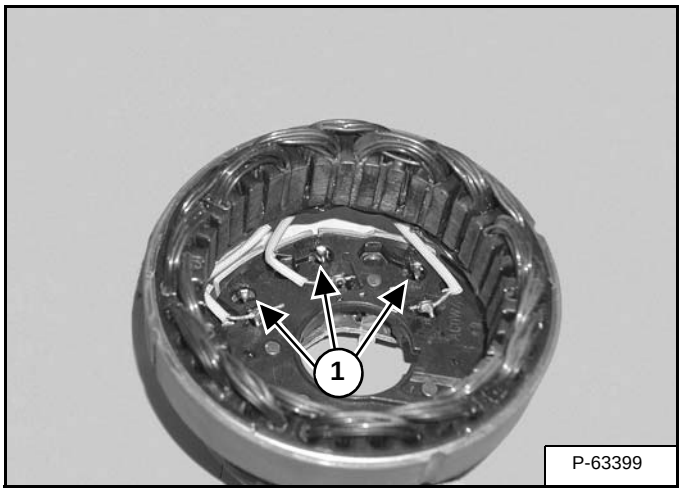
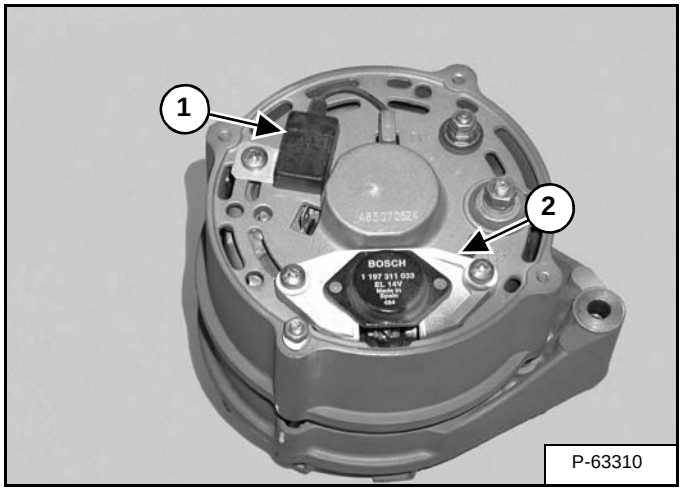
Alternator Identification

Figure 50-30-16



The back cover has been removed to show alternator rectifier assembly **[Figure 50-30-16]**.

Figure 50-30-17



The alternator contains field diodes (Item 1) **[Figure 50-30-16]** a capacitor (Item 1) and brush holder (Item 2) **[Figure 50-30-17]**.

Charging System Check

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-2023-1285

If the charging system malfunctions check the following:

Check the condition and tension of the fan/fuel pump drive belt. (See FAN/FUEL PUMP BELT on Page 10-140-1) If belt is worn or deteriorated replace.

Inspect the alternator wiring harness and connectors at alternator. Harness and connectors must be clean and tight.

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

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

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

Make sure all wiring harness leads are connected. Turn all accessories OFF

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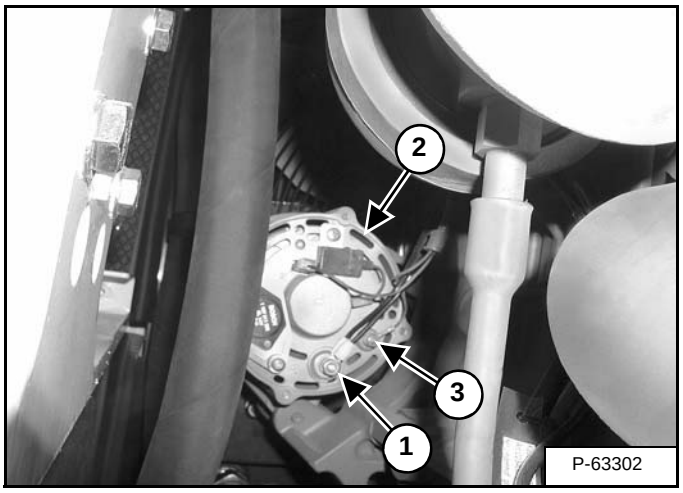
Figure 50-30-18



Connect the positive lead from the voltmeter to the B+ terminal (Item 1) on the alternator. Connect the negative lead from the voltmeter to the alternator housing (ground) (Item 2) **[Figure 50-30-18]**. If the reading on the voltmeter is lower than battery voltage or has a zero reading, check and make repairs to the wiring between the B+ terminal of the alternator and the battery.

Connect the positive lead from the voltmeter to the D+ terminal (Item 3). Connect the negative lead from the voltmeter to the alternator housing (ground) (Item 2) **[Figure 50-30-18]**. If the reading on the voltmeter is zero check the alternator.

⚠ 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

ALTERNATOR (CONT'D)

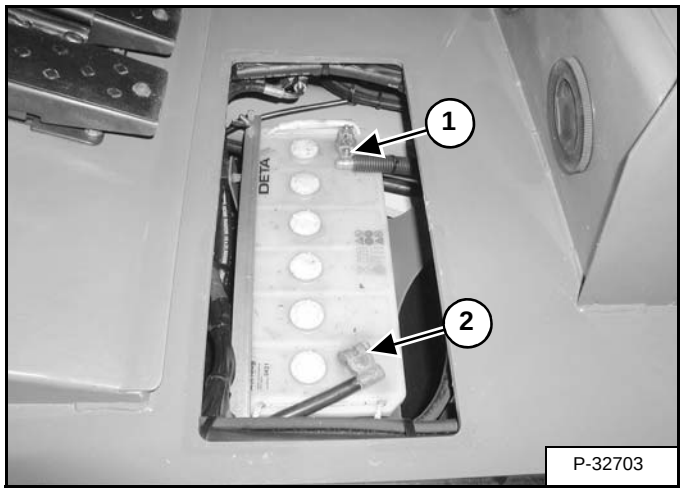
Charging System Check (Cont'd)

⚠ WARNING

Keep arcs, sparks, flames and lighted tobacco away from batteries. When jumping from booster battery make final connection (negative) at engine frame.
Do not jump start or charge a frozen or damaged battery. Warm battery to 60°F. (16°C.) before connecting to a charger. Unplug charger before connecting or disconnecting cables to battery. Never lean over battery while boosting, testing or charging. Battery gas can explode and cause serious injury.

W-2066-1296

Figure 50-30-19



Run the engine at rated speed. Check to make sure that all accessories are turned OFF. Connect the positive lead of the voltmeter to the positive terminal (Item 1) of the battery. Connect the negative lead of the volt meter to the negative terminal (Item 2) **[Figure 50-30-19]**. If the reading on the voltmeter is 15 volts or more, disassembly the alternator and check the components.

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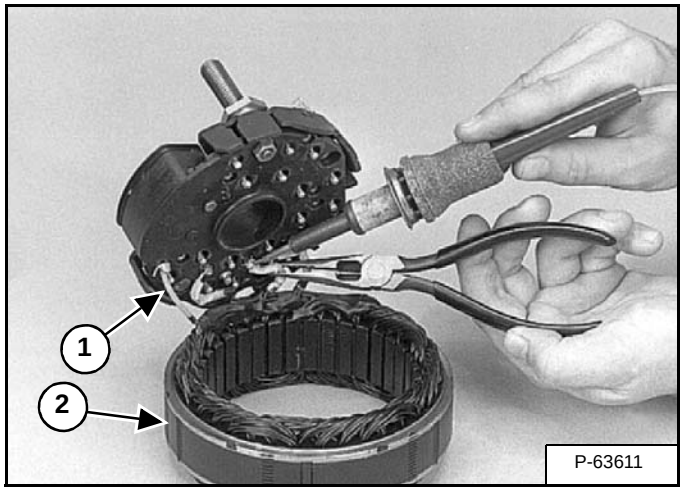
Rectifier Continuity (Diode) Test

NOTE: The photos may appear different. The procedure is the same.

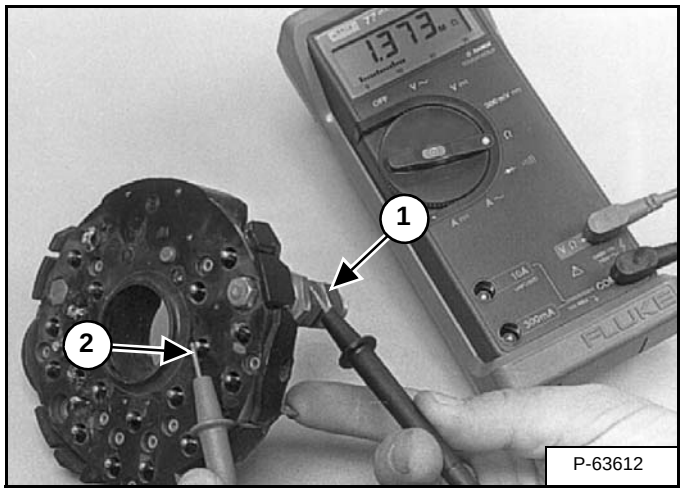
Figure 50-30-20



Unsolder the stator coil at the connections (Item 1) to the rectifier bridge. Remove the stator (Item 2) **[Figure 50-30-20]**.

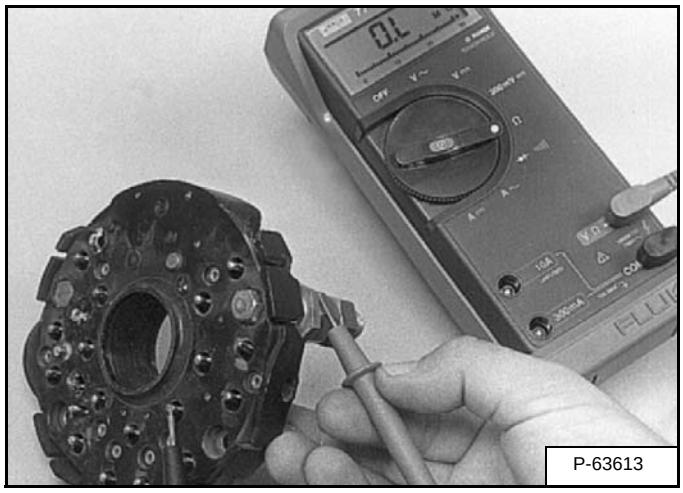
NOTE: Bend phase lead-out wires as little as possible.

Figure 50-30-21



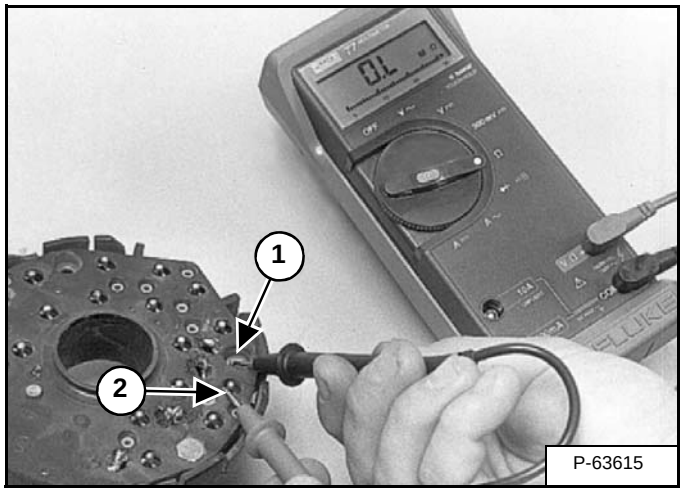
Test the positive diodes in the rectifier bridge. Connect the negative lead of the ohmmeter to the output B+ terminal (Item 1). Connect the positive lead of the ohm meter to one of the leads (Item 2) **[Figure 50-30-21]** for the positive diodes. The positive diodes are the diodes closest to the B+ terminal.

Figure 50-30-22



Reverse the ohmmeter leads. Read the ohmmeter. There must be resistance in one direction and an open in the other. If the readings are the same, replace the rectifier bridge. Repeat this step for the other diodes **[Figure 50-30-22]**.

Figure 50-30-23



Check the negative diodes in the rectifier bridge. Connect the negative lead of the ohmmeter to the surface of the diode plate (Item 1) that is not painted. Connect the positive lead of the ohm meter to one of the leads for the negative diodes (Item 2) **[Figure 50-30-23]** The negative diodes are the diodes on the side of the rectifier bridge opposite the B+ terminal.

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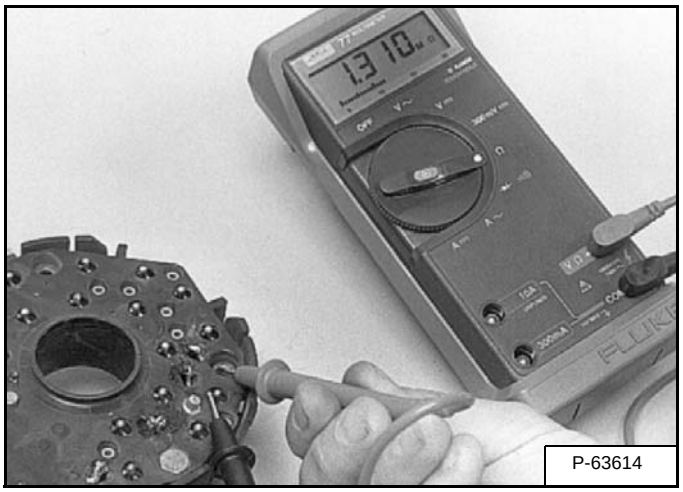
Rectifier Continuity (Diode) Test (Cont’d)

Figure 50-30-24



Reverse the ohmmeter leads. Read the ohmmeter. There must be resistance in one direction and an open in the other. If the readings are the same, replace the rectifier bridge. Repeat this step for the other diodes **[Figure 50-30-24]**.

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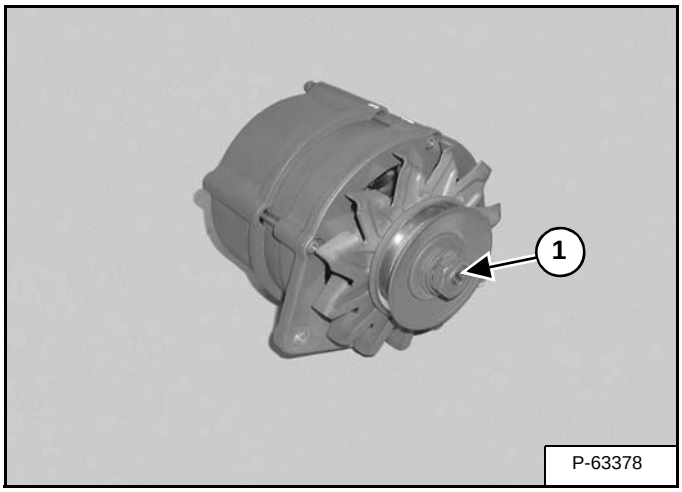
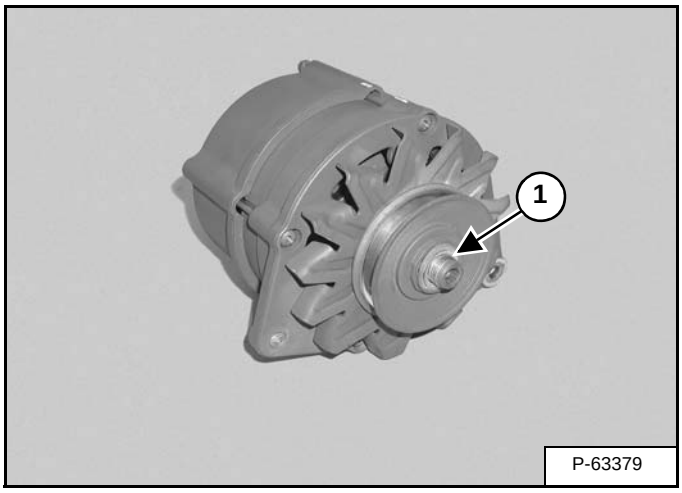
Disassembly

Figure 50-30-25



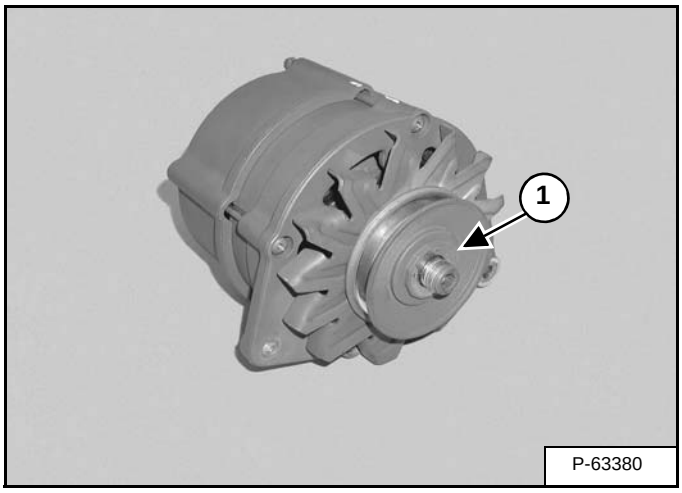
Remove the nut (Item 1) **[Figure 50-30-25]**.

Figure 50-30-26



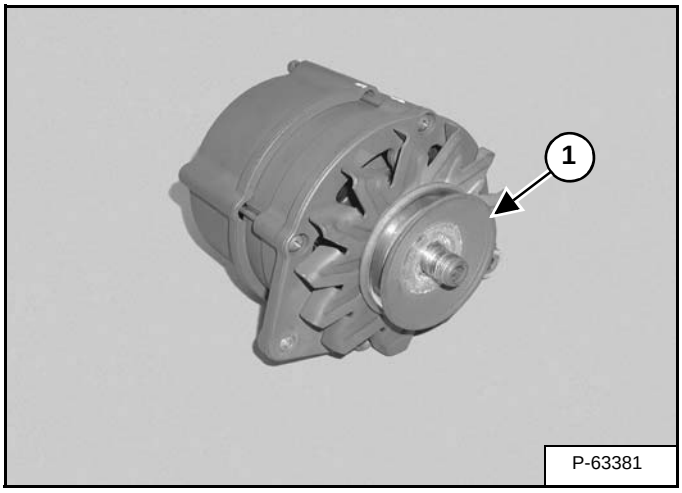
Remove the washer (Item 1) **[Figure 50-30-26]**.

Figure 50-30-27



Remove the retainer (Item 1) **[Figure 50-30-27]**.

Figure 50-30-28



Remove the pulley sheave (Item 1) **[Figure 50-30-28]**.

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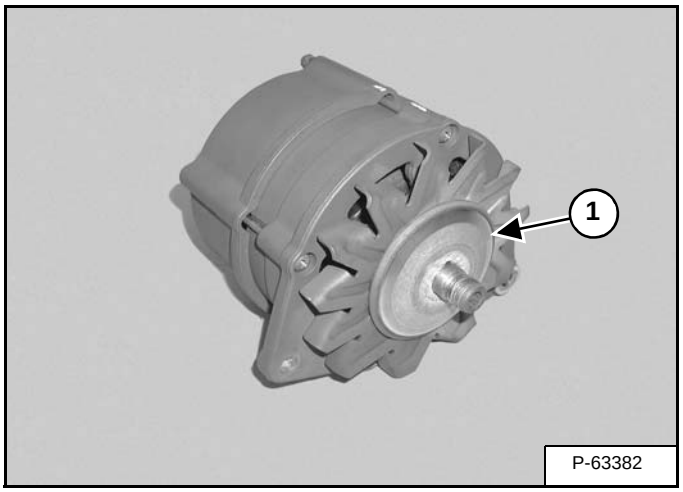
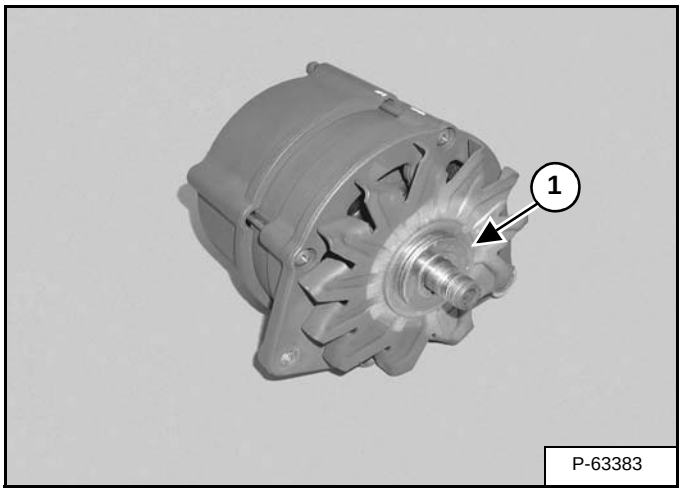
Disassembly (Cont'd)

Figure 50-30-29



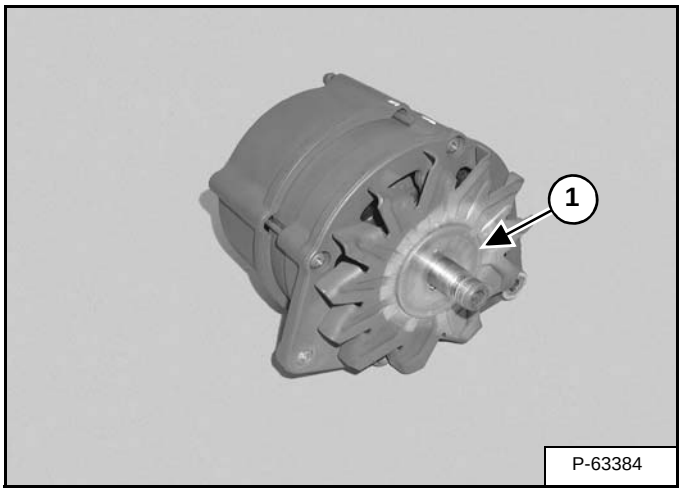
Remove the pulley sheave (Item 1) **[Figure 50-30-29]**.

Figure 50-30-30



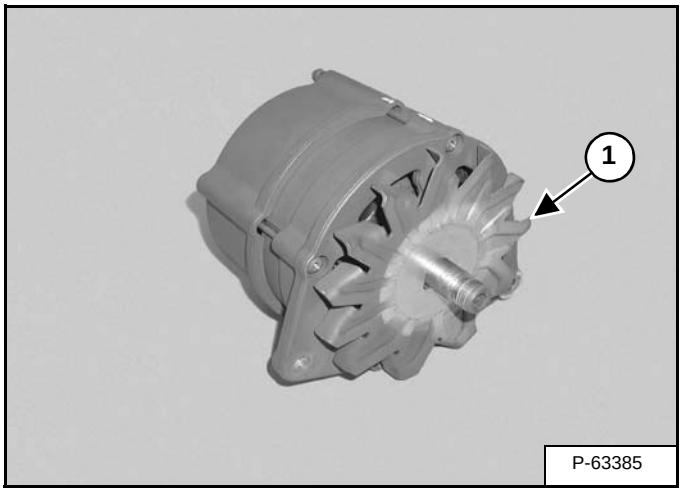
Remove the spacer (Item 1) **[Figure 50-30-30]**.

Figure 50-30-31



Remove the washer (Item 1) **[Figure 50-30-31]**.

Figure 50-30-32



Remove the cooling fins (Item 1) **[Figure 50-30-32]**.

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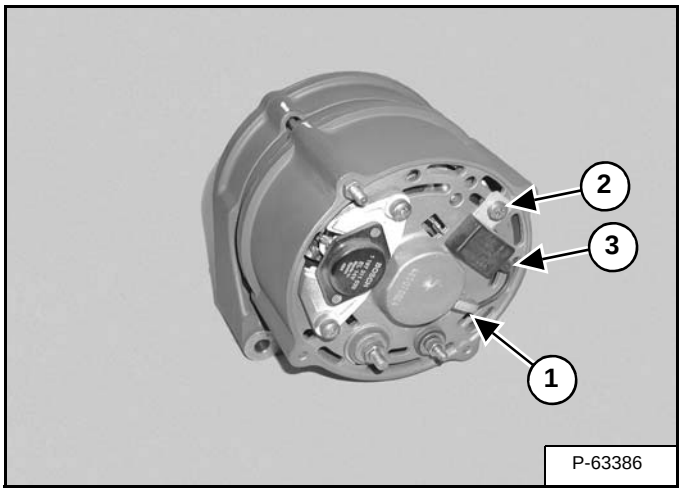
ALTERNATOR (CONT'D)

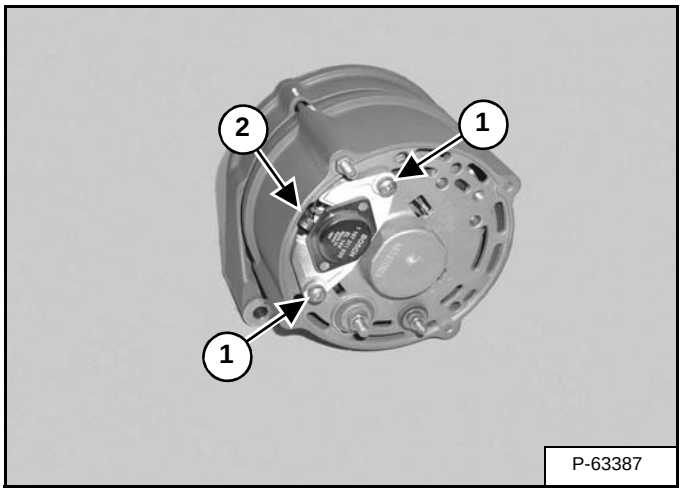
Disassembly (Cont'd)

Figure 50-30-33



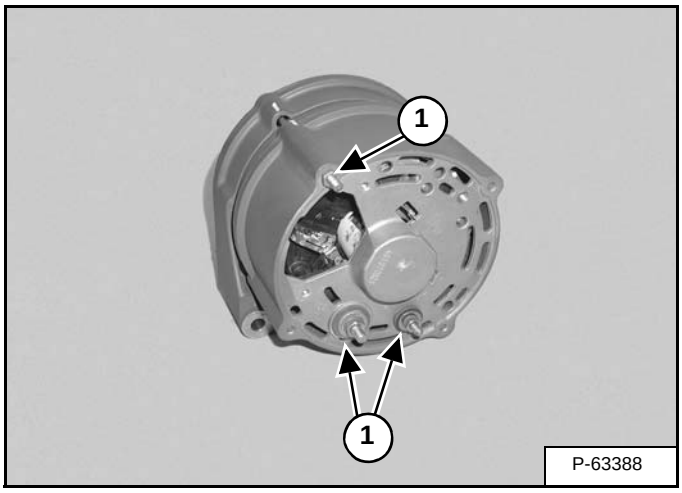
Disconnect the wire (Item 1). Remove the bolt (Item 2). Remove the capacitor (Item 3) **[Figure 50-30-33]**.

Figure 50-30-34



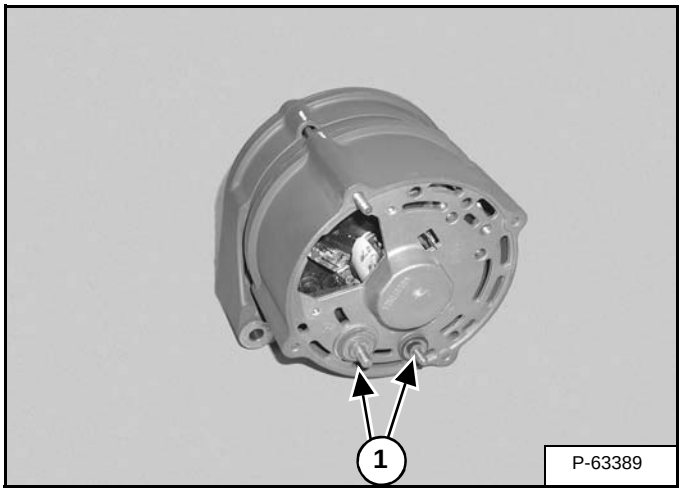
Remove the 2 bolts (Item 1) and brush holder (Item 2) **[Figure 50-30-34]**.

Figure 50-30-35



Remove the 3 nuts (Item 1) **[Figure 50-30-35]**.

Figure 50-30-36



Remove the washers (Item 1) **[Figure 50-30-36]**.

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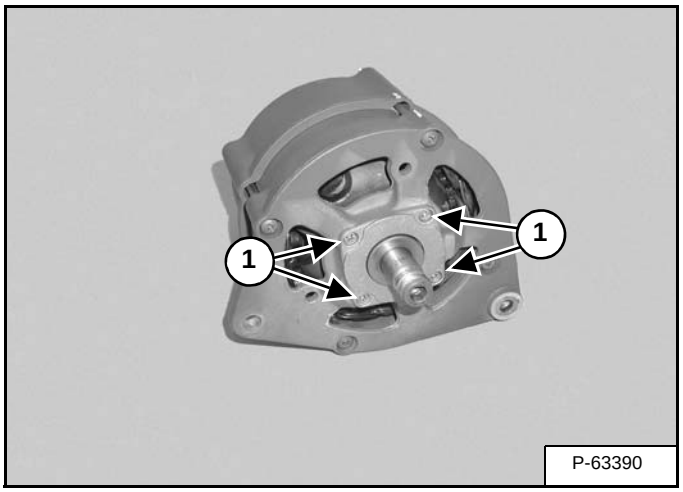
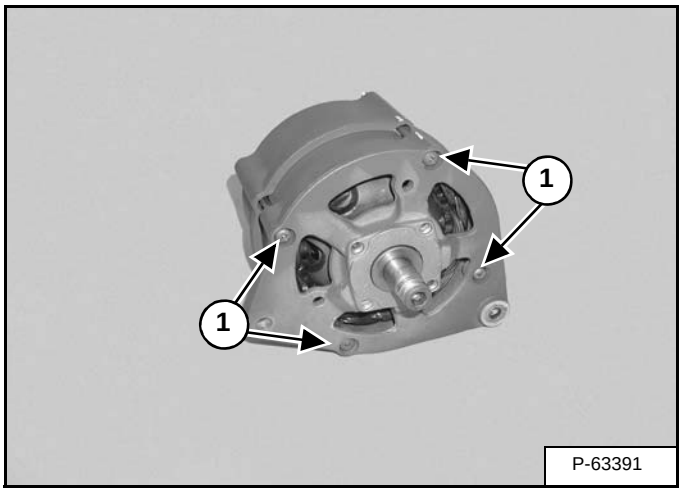
Disassembly (Cont'd)

Figure 50-30-37



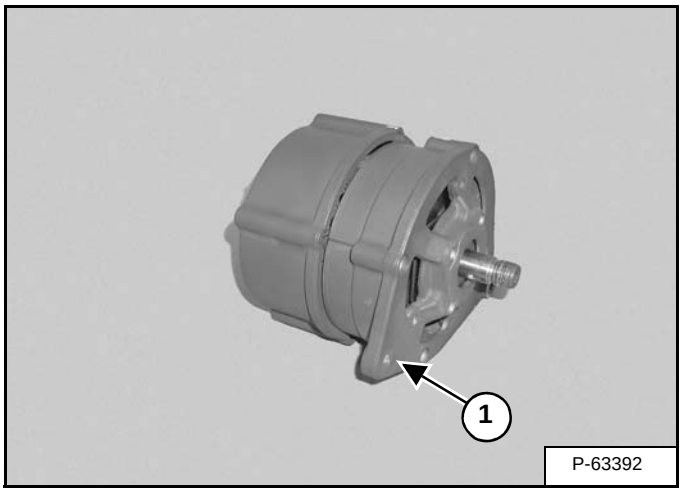
Remove the 4 screws (Item 1) **[Figure 50-30-37]**.

Figure 50-30-38



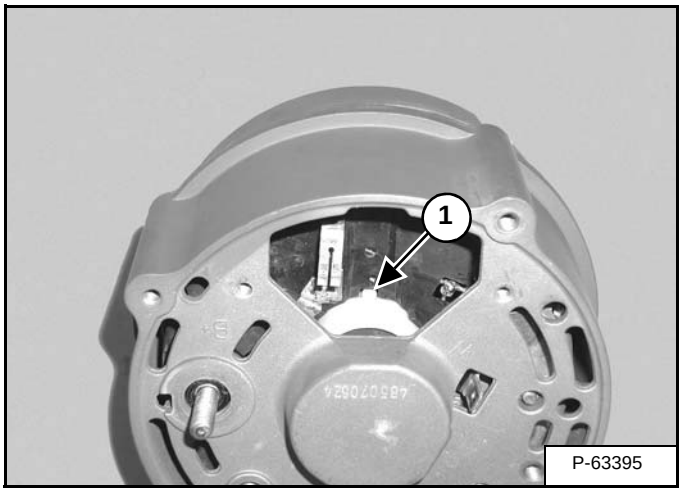
Remove the 4 screws (Item 1) **[Figure 50-30-38]**.

Figure 50-30-39



Remove the face plate (Item 1) **[Figure 50-30-39]**.

Figure 50-30-40



Align the notch with the tab on the cover (Item 1) **[Figure 50-30-40]**.

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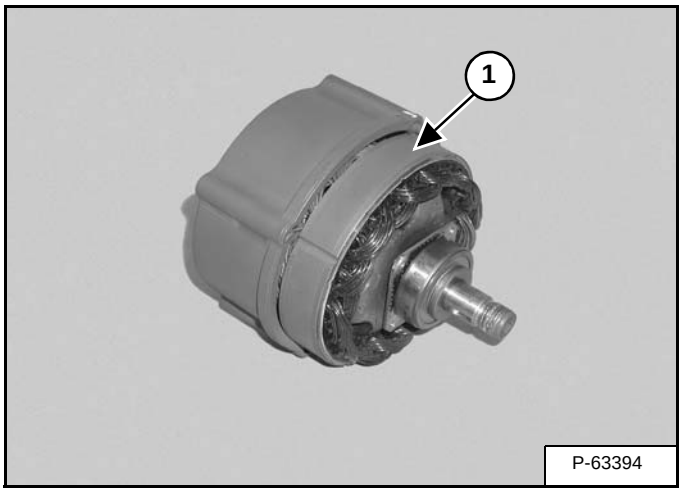
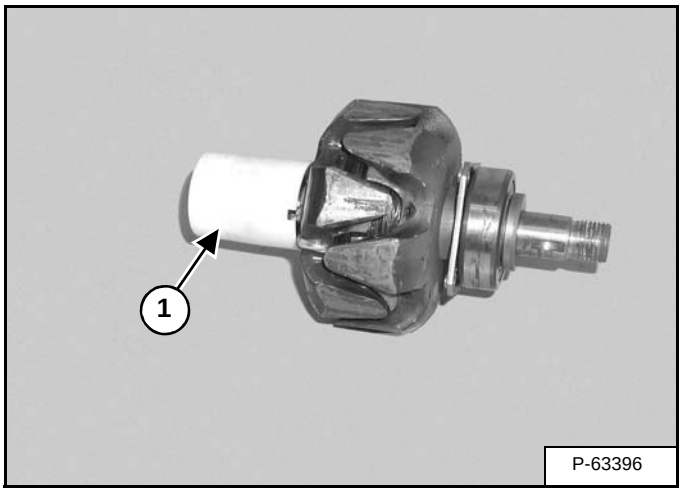
Disassembly (Cont'd)

Figure 50-30-41



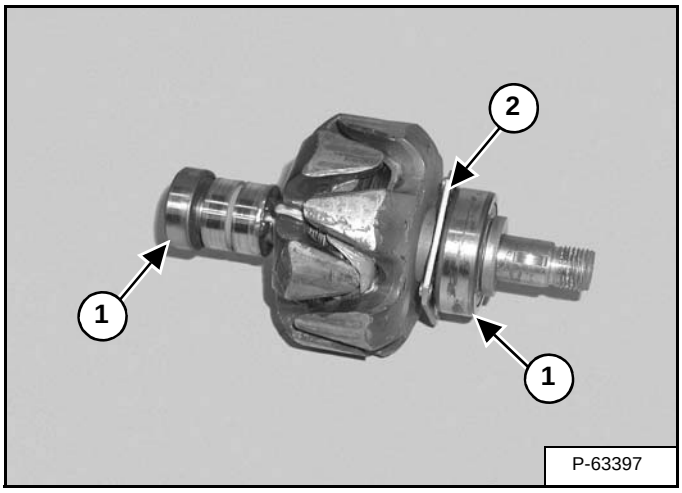
Remove the rotor (Item 1) **[Figure 50-30-41]**.

Figure 50-30-42



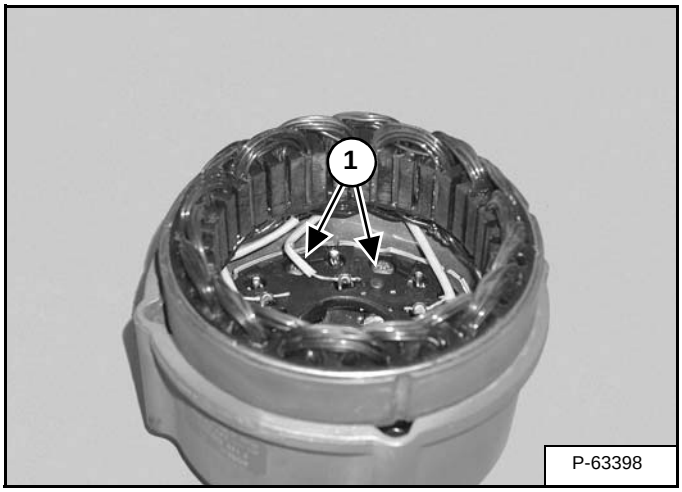
Remove the cover (Item 1) **[Figure 50-30-42]**.

Figure 50-30-43



Remove the bearings (Item 1) and plate (Item 2) **[Figure 50-30-43]**.

Figure 50-30-44



Remove the 2 screws (Item 1) **[Figure 50-30-44]**.

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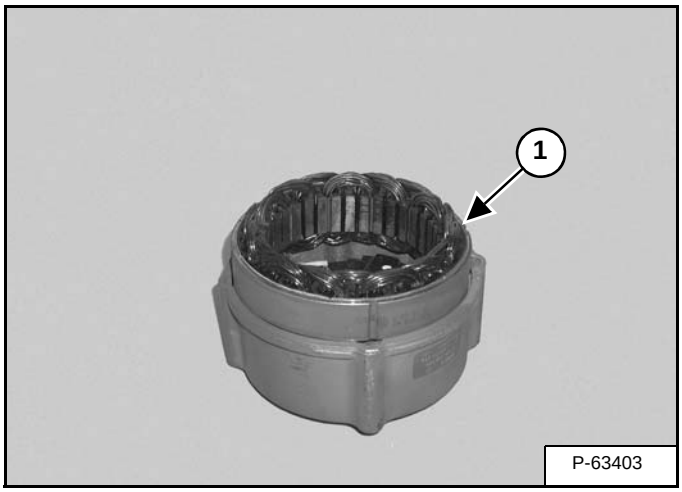
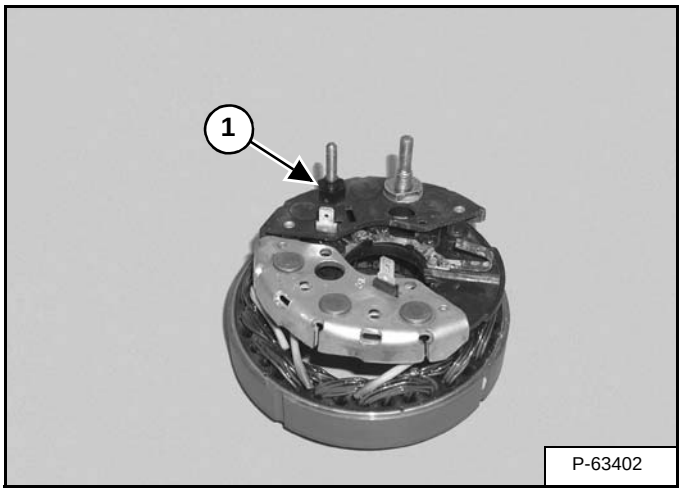
Disassembly (Cont'd)

Figure 50-30-45



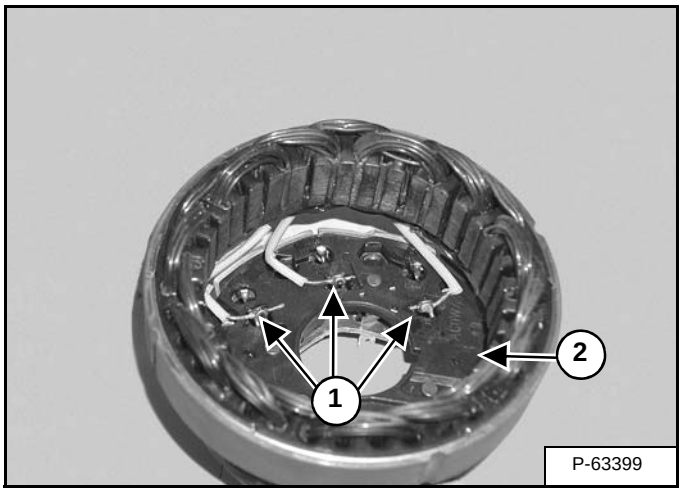
Remove the stator (Item 1) **[Figure 50-30-45]**.

Figure 50-30-46



Remove the bushing (Item 1) **[Figure 50-30-46]**.

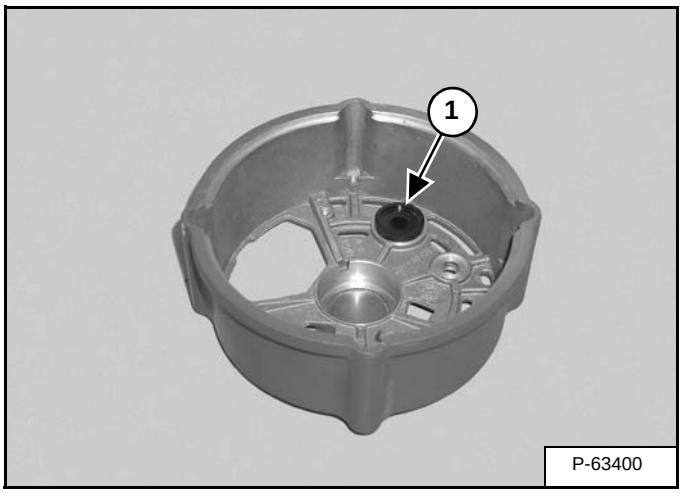
Figure 50-30-47



Unsolder the 3 wires (Item 1) **[Figure 50-30-47]**.

Remove the rectifier (Item 2) **[Figure 50-30-47]**.

Figure 50-30-48



Remove the bushing (Item 1) **[Figure 50-30-48]**.

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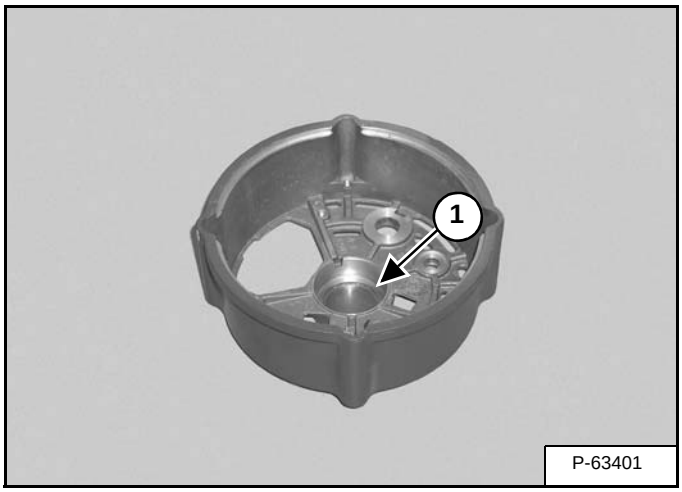
Disassembly (Cont'd)

Figure 50-30-49

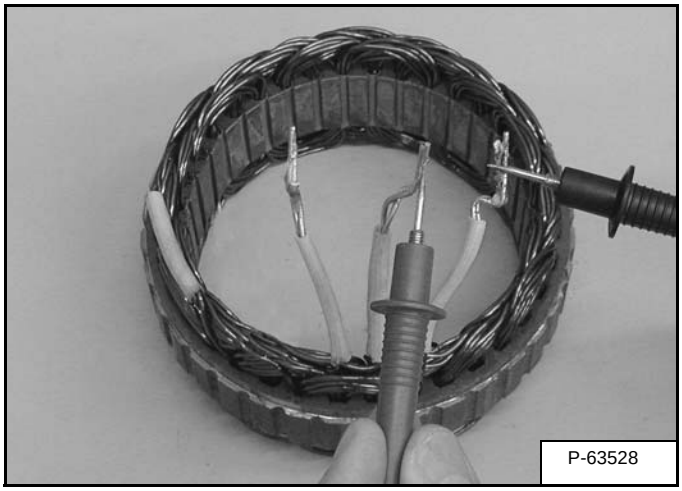


Remove the bushing (Item 1) **[Figure 50-30-49]**.

Stator Continuity Test

Use an ohmmeter to test the stator.

Figure 50-30-50



Touch the probes to two of the bare stator wires **[Figure 50-30-50]**.

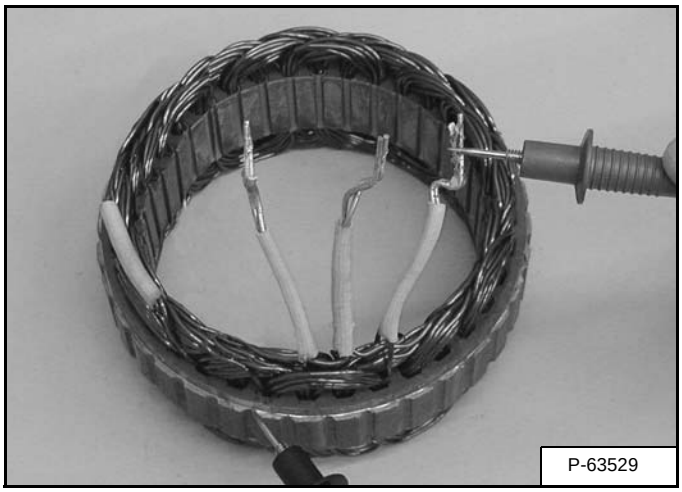
Move one of the probes to the third wire.

The readings should be the same.

If there is no continuity, replace the stator.

Stator Ground Test

Figure 50-30-51



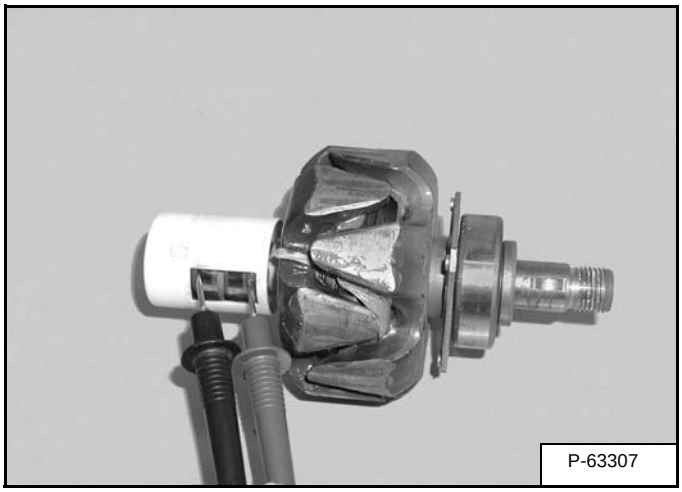
Touch one probe to a bare stator lead and the other probe to the bare metal surface of the stator **[Figure 50-30-51]**.

There should be no continuity.

Replace the stator if there is continuity.

Rotor Continuity Test

Figure 50-30-52



Touch the probes to the slip rings **[Figure 50-30-52]**.

The ohmmeter should read between 3.0 - 4.0 ohms.

If there is no continuity replace the rotor.

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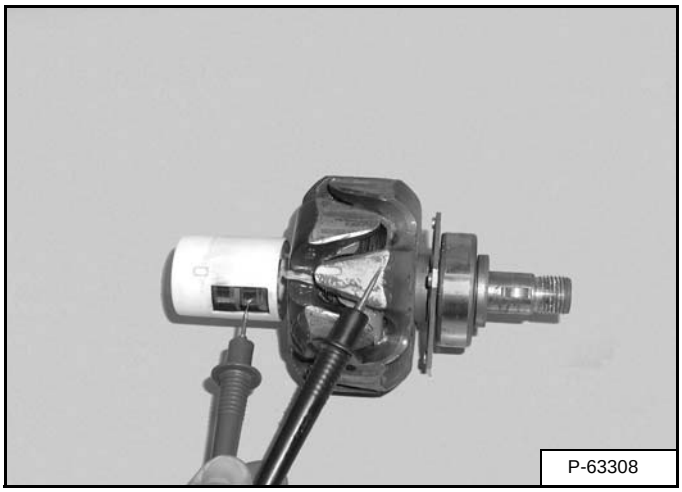
Rotor Ground Test

Figure 50-30-53



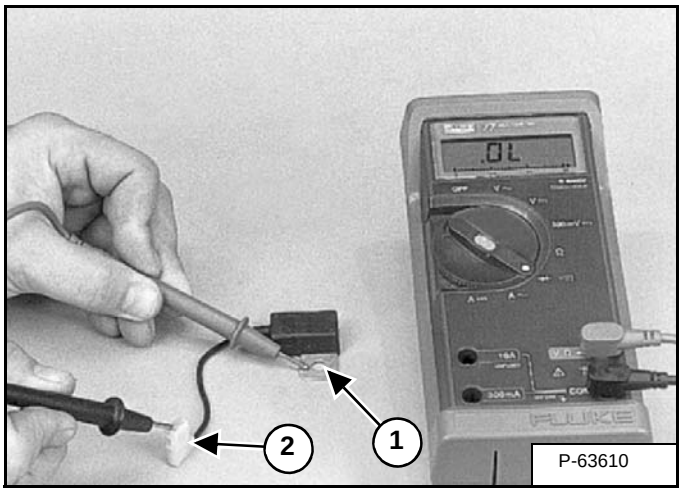
Touch one probe to one of the slip rings and the other probe to the rotor shaft **[Figure 50-30-53]**.

There should be no continuity.

Replace the rotor if there is continuity.

Capacitor Continuity Test

Figure 50-30-54



Check the capacitor for continuity between the mounting tab (Item 1) and the lead (Item 2) **[Figure 50-30-54]**. If there is continuity the capacitor is bad. Check the capacitor by connecting an ohmmeter between the mounting tab and the lead. The ohmmeter will initially show movement and then return to indicating no continuity as the capacitor is charged. Discharge the capacitor by grounding the lead to the tab before installation.

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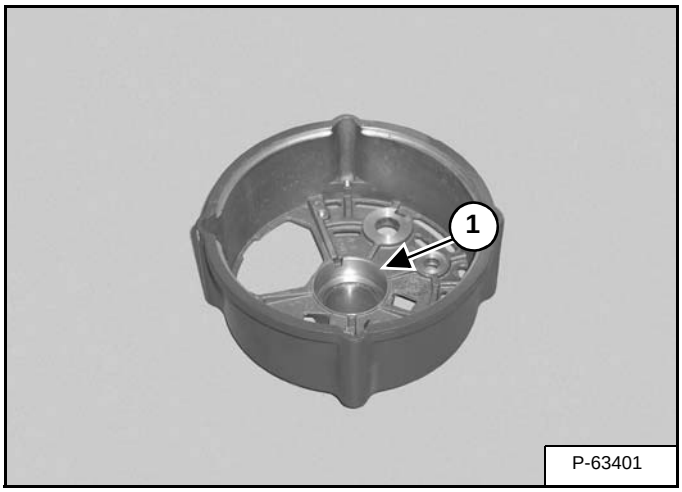
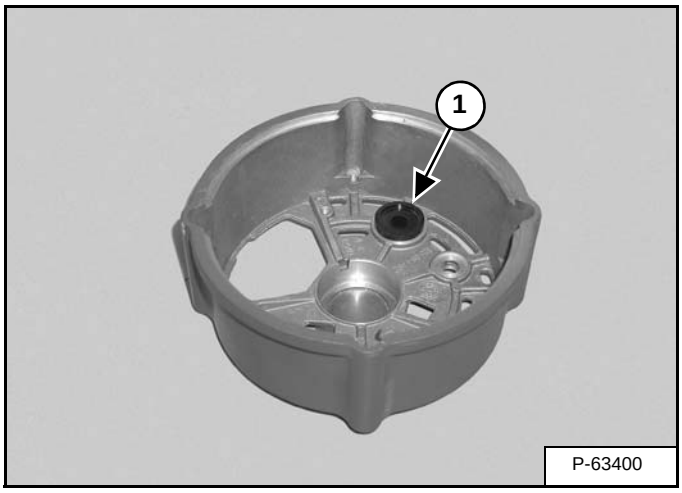
Assembly

Figure 50-30-55



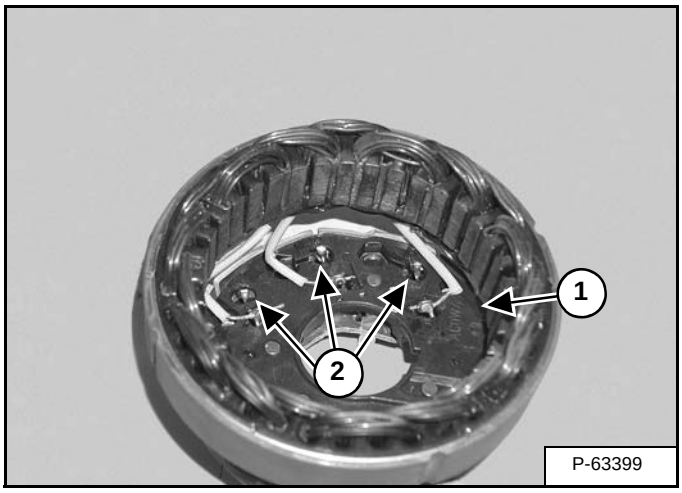
Install the bushing (Item 1) **[Figure 50-30-55]**.

Figure 50-30-56



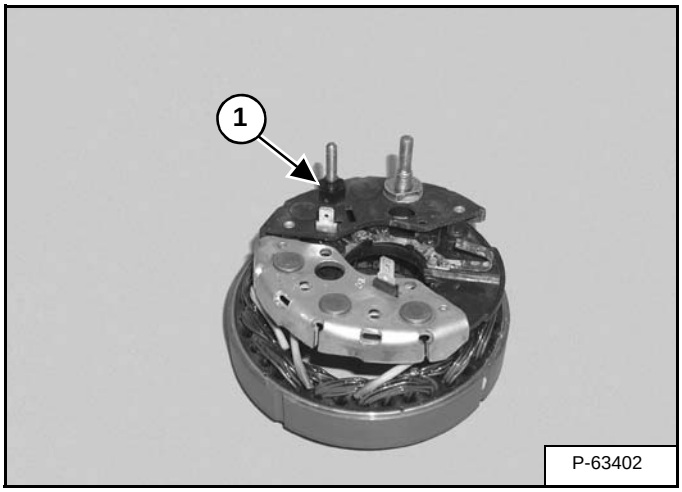
Install the bushing (Item 1) **[Figure 50-30-56]**.

Figure 50-30-57



Install the rectifier (Item 1). Solder the 3 wires (Item 2) **[Figure 50-30-57]**.

Figure 50-30-58



Install the bushing (Item 1) **[Figure 50-30-58]**.

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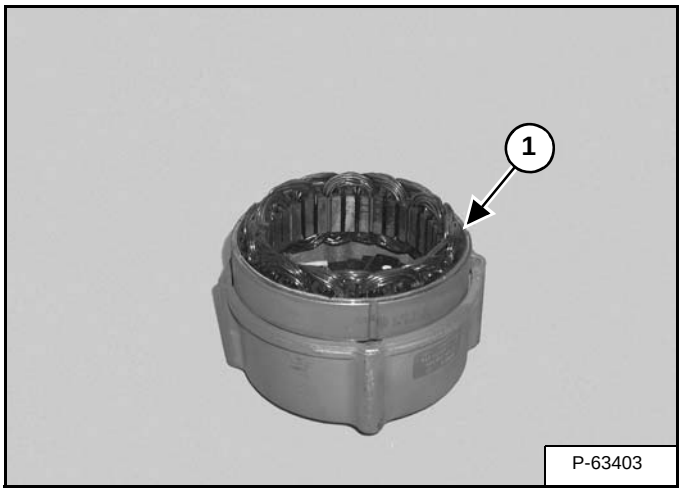
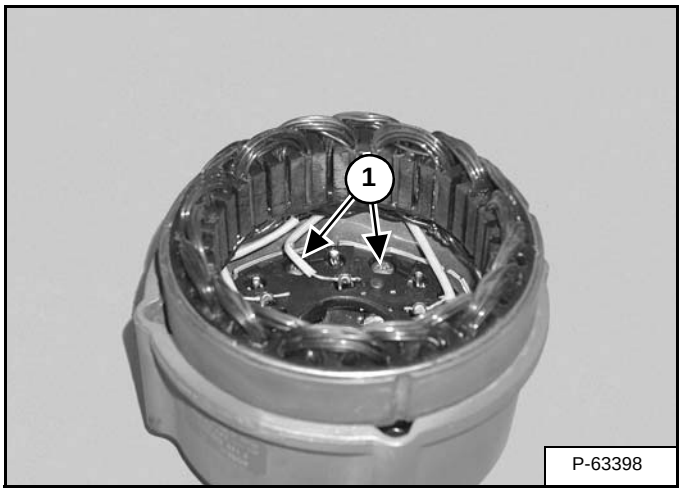
Assembly (Cont'd)

Figure 50-30-59



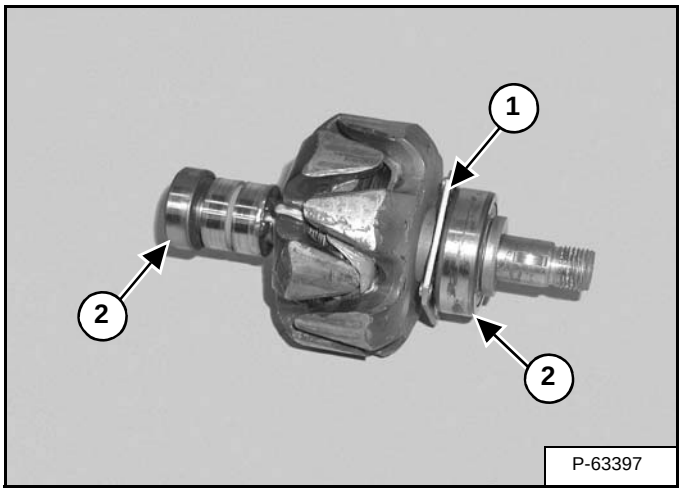
Install the stator (Item 1) **[Figure 50-30-59]**.

Figure 50-30-60



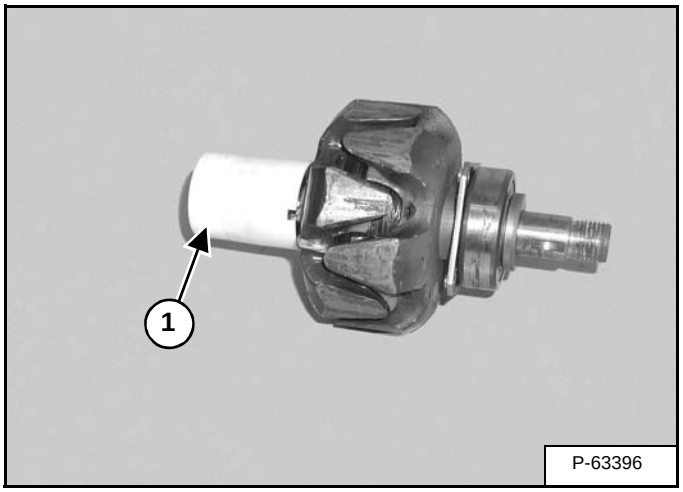
Install the 2 screws (Item 1) **[Figure 50-30-60]**.

Figure 50-30-61



Install the plate (Item 1) and 2 bearings (Item 2) **[Figure 50-30-61]**.

Figure 50-30-62



Install the cover (Item 1) **[Figure 50-30-62]**.

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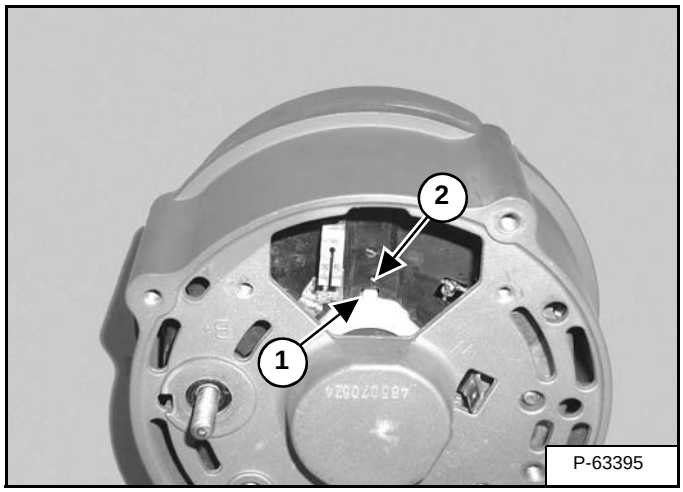
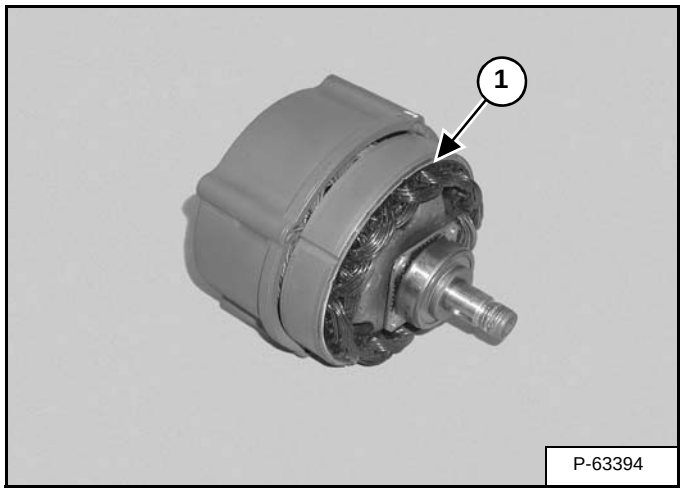
Assembly (Cont'd)

Figure 50-30-63



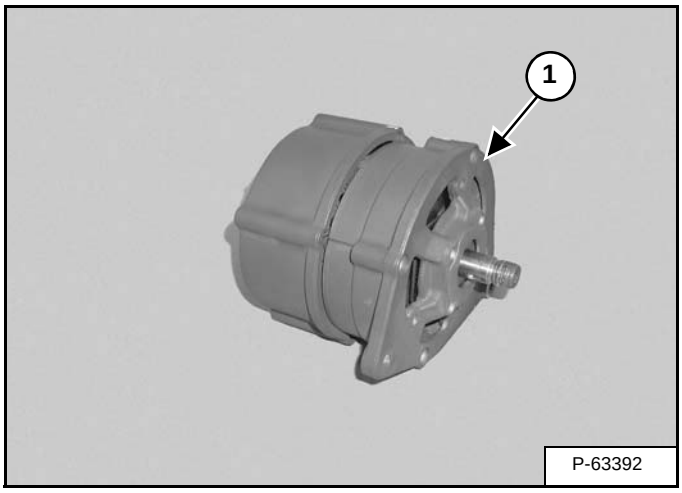
Align the tab on the cover (Item 1) with the notch in the rectifier (Item 2) **[Figure 50-30-63]**.

Figure 50-30-64



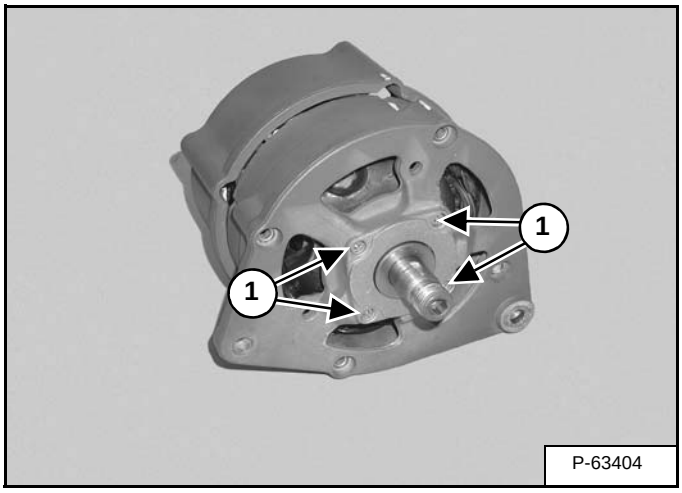
Install the rotor (Item 1) **[Figure 50-30-64]**.

Figure 50-30-65



Install the face plate (Item 1) **[Figure 50-30-65]**.

Figure 50-30-66



Install the 4 screws (Item 1) **[Figure 50-30-66]**.

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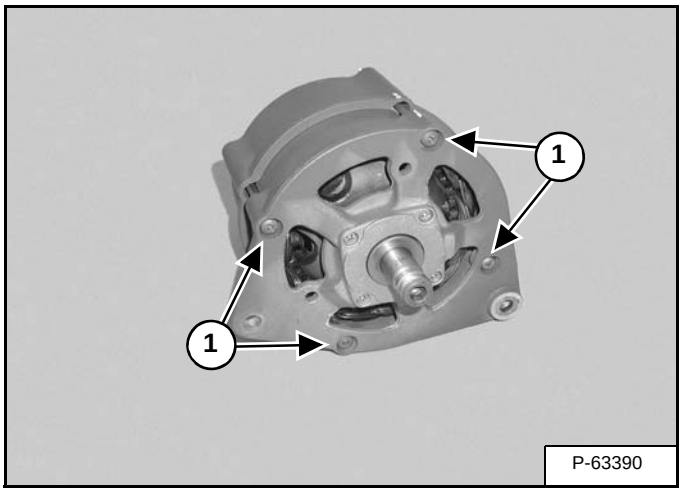
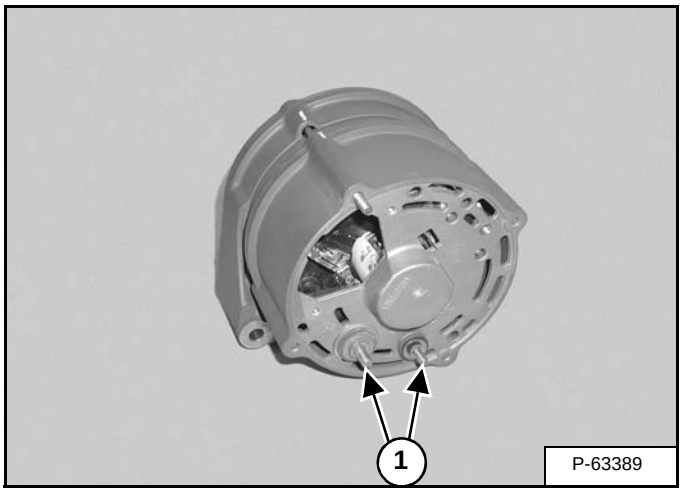
Assembly (Cont'd)

Figure 50-30-67



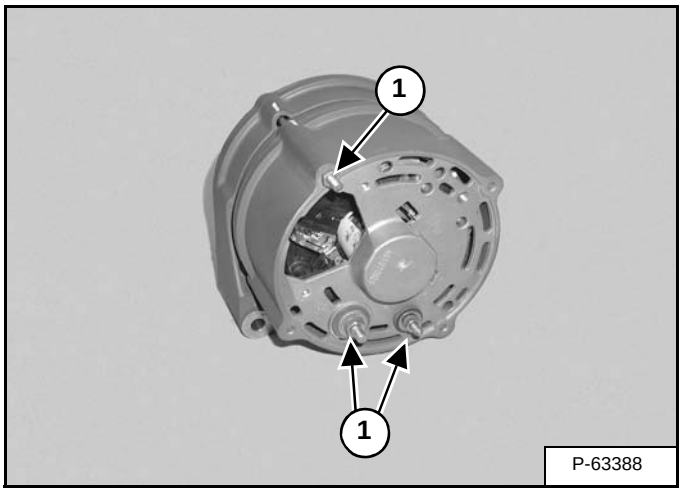
Install the 4 screws (Item 1) **[Figure 50-30-67]**.

Figure 50-30-68



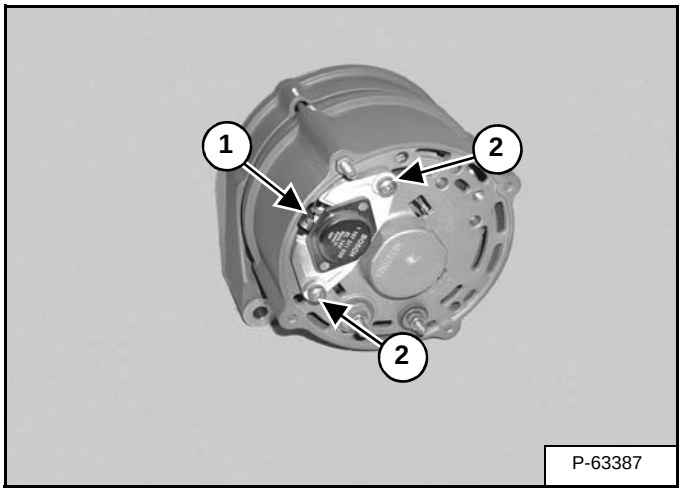
Install the washers (Item 1) **[Figure 50-30-68]**.

Figure 50-30-69



Install the 3 nuts (Item 1) **[Figure 50-30-69]**.

Figure 50-30-70



Install the brush holder (Item 1) with 2 bolts (Item 2) **[Figure 50-30-70]**.

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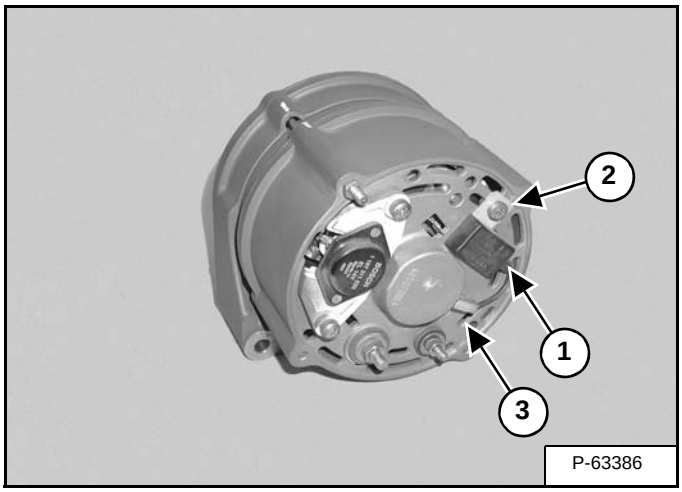
ALTERNATOR (CONT'D)

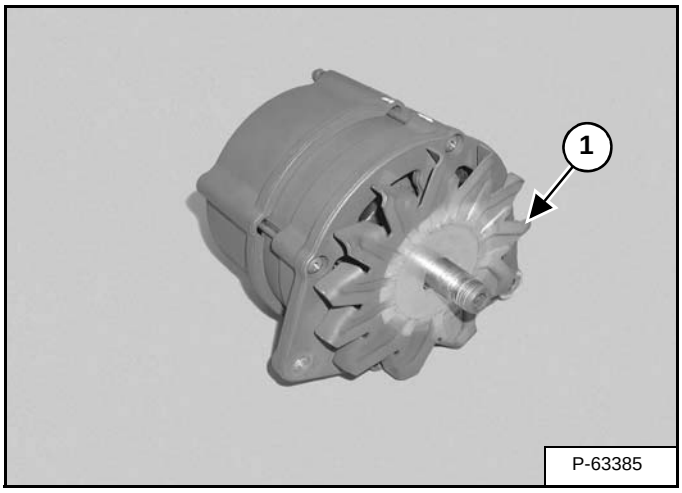
Assembly (Cont'd)

Figure 50-30-71



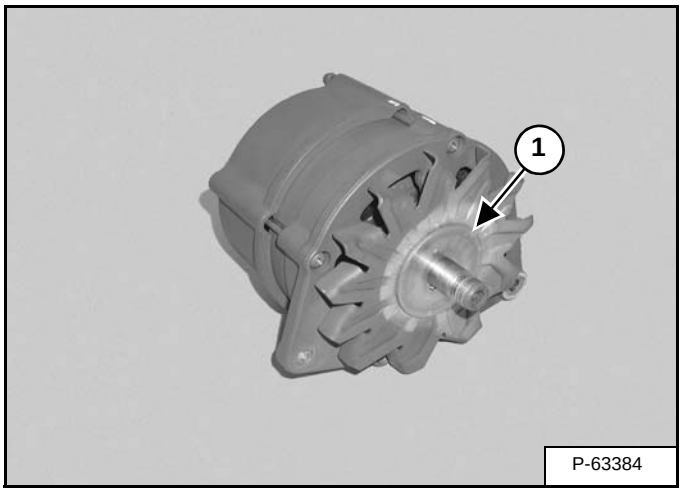
Install the capacitor (Item 1) with the screw (Item 2). Connect the wire (Item 3) **[Figure 50-30-71]**.

Figure 50-30-72



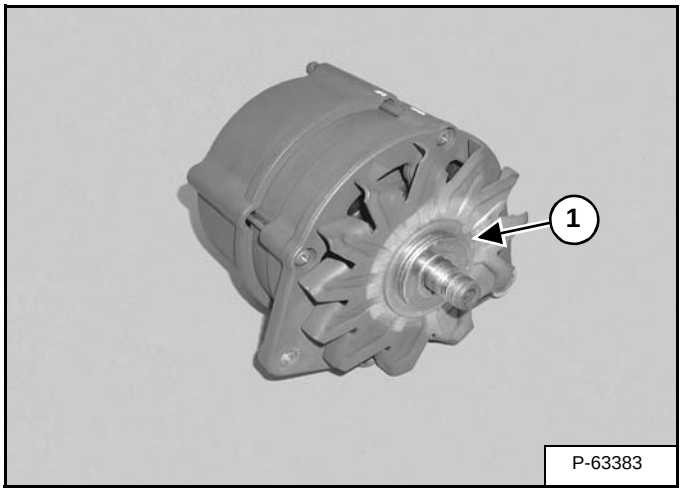
Install the cooling fin (Item 1) **[Figure 50-30-72]**.

Figure 50-30-73



Install the washer (Item 1) **[Figure 50-30-73]**.

Figure 50-30-74



Install the spacer (Item 1) **[Figure 50-30-74]**.

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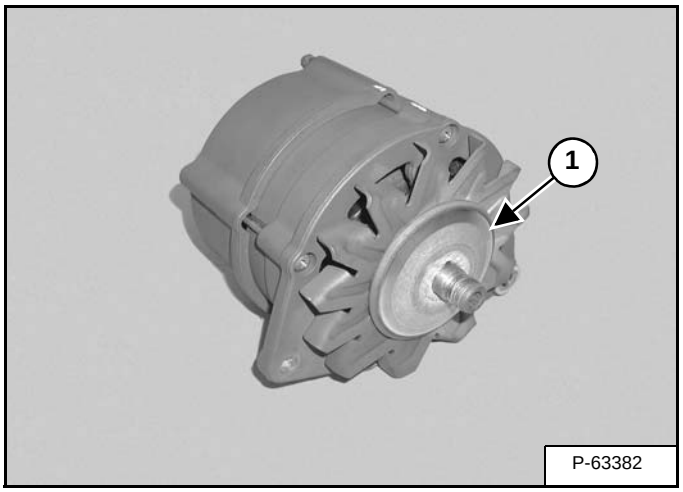
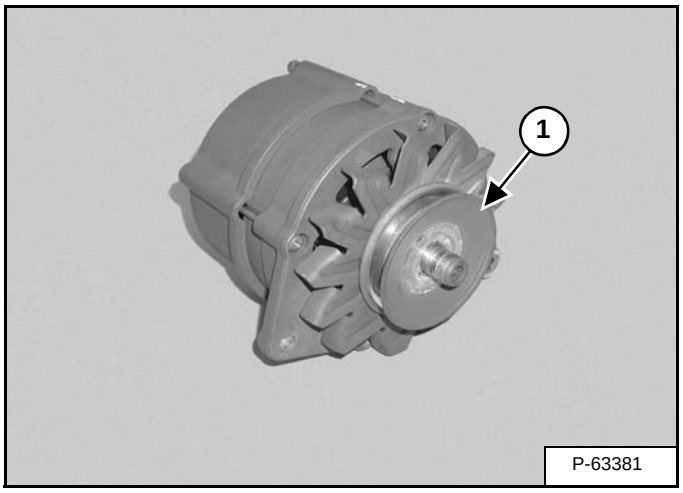
Assembly (Cont'd)

Figure 50-30-75



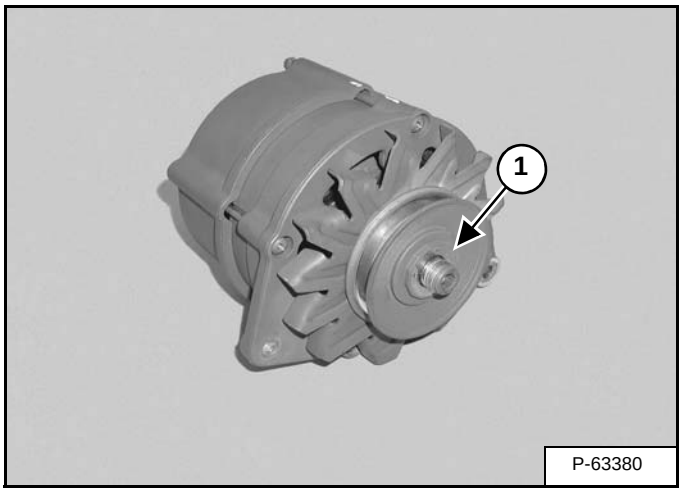
Install the pulley sheave (Item 1) **[Figure 50-30-75]**.

Figure 50-30-76



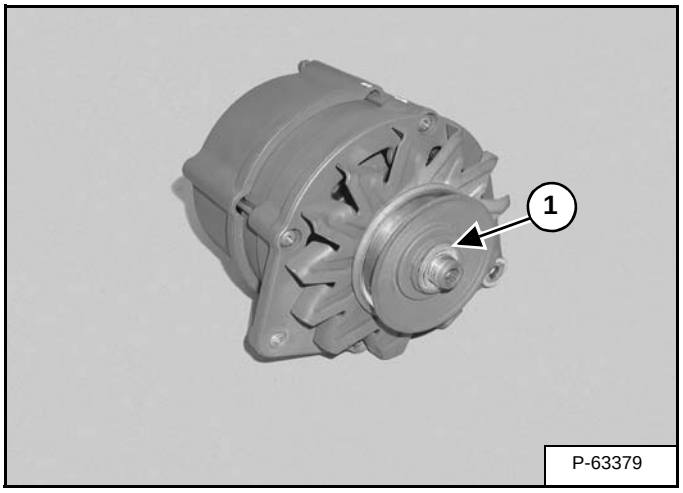
Install the pulley sheave (Item 1) **[Figure 50-30-76]**.

Figure 50-30-77



Install the retainer (Item 1) **[Figure 50-30-77]**.

Figure 50-30-78



Install the washer (Item 1) **[Figure 50-30-78]**.

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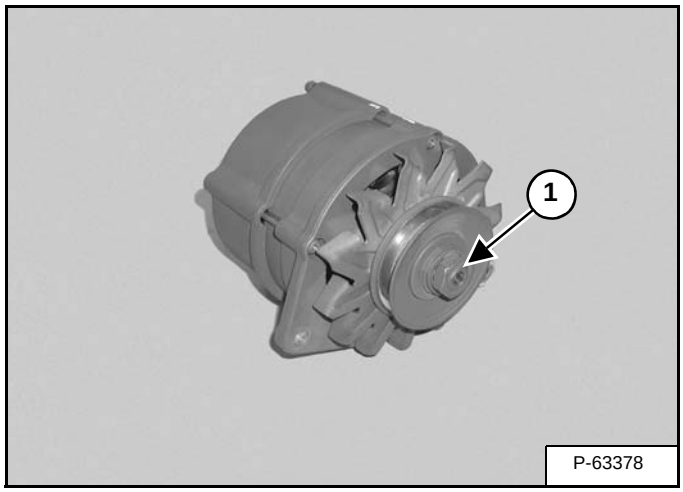
Assembly (Cont'd)

Figure 50-30-79



Install the nut (Item 1) **[Figure 50-30-79]**.

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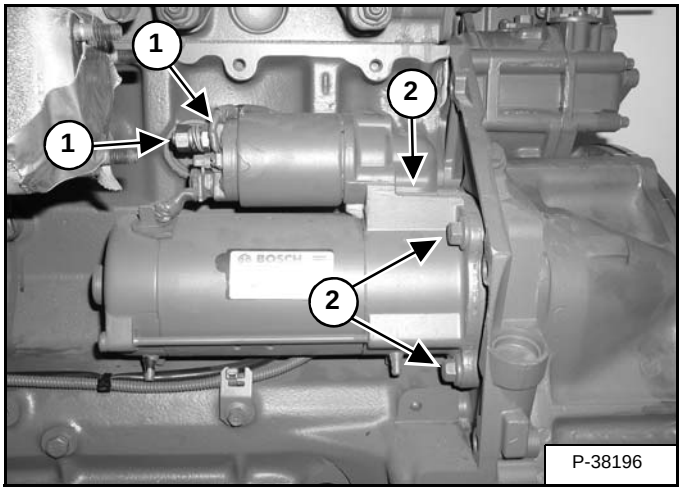
Removal And Installation (S/N 522311001 & Above)

The engine is shown removed for photo clarity.

Shut off the battery disconnect switch. (See Servicing on Page 50-20-1.)

Remove the muffler. ((See MUFFLER (S/N 522311001 & ABOVE) on Page 60-20-1.).)

Figure 50-40-1



Disconnect the wires (Item 1) **[Figure 50-40-1]**.

Remove the three bolts (Item 2) **[Figure 50-40-1]**.

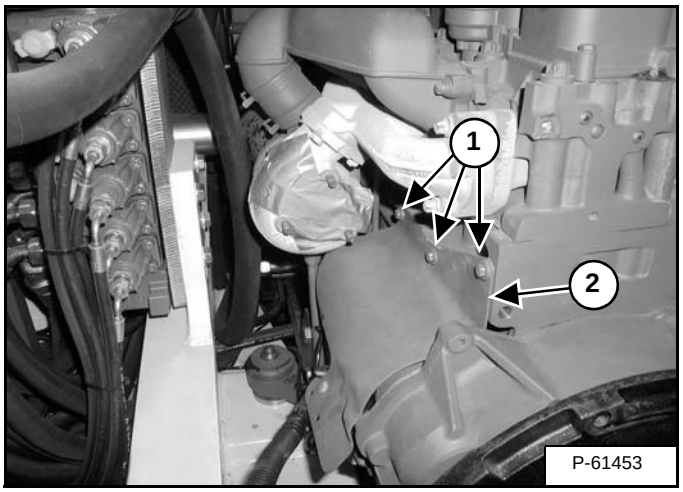
Remove the starter.

Removal And Installation (S/N 528911001 & Above And S/N 528611001 & Above)

Remove the muffler. ((See MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-21-1.).)

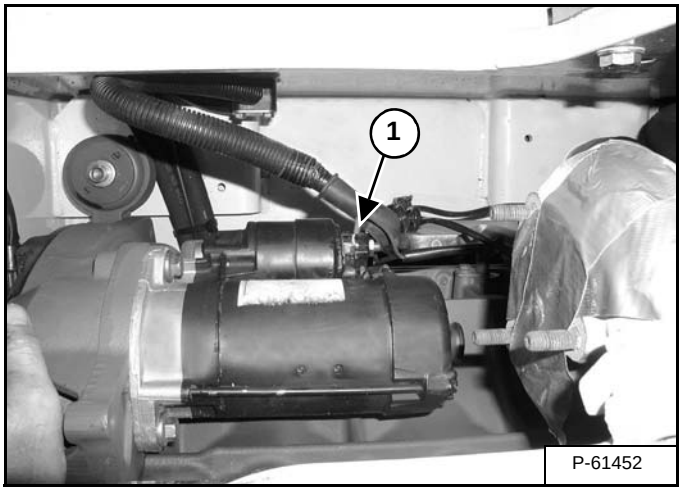
Disconnect the battery. (See Servicing on Page 50-20-1.)

Figure 50-40-2



Remove the three bolts (Item 1) and shield (Item 2) **[Figure 50-40-2]**.

Figure 50-40-3



Remove the wires (Item 1) **[Figure 50-40-3]** from the starter.

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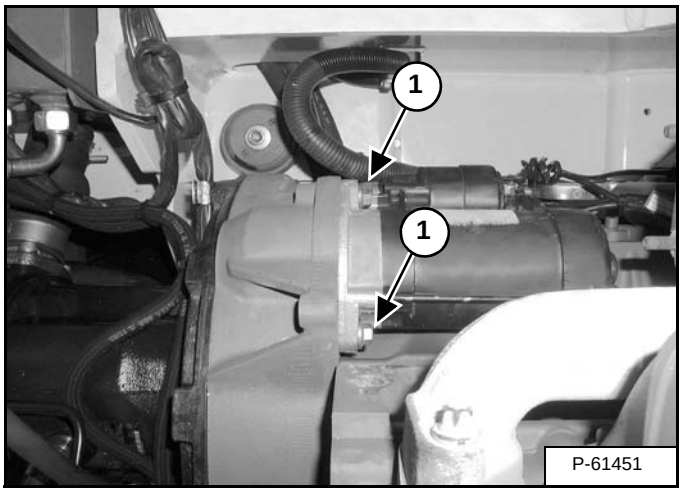
Figure 50-40-4



Remove the two bolts (Item 1) **[Figure 50-40-4]** from the starter.

Remove the starter.

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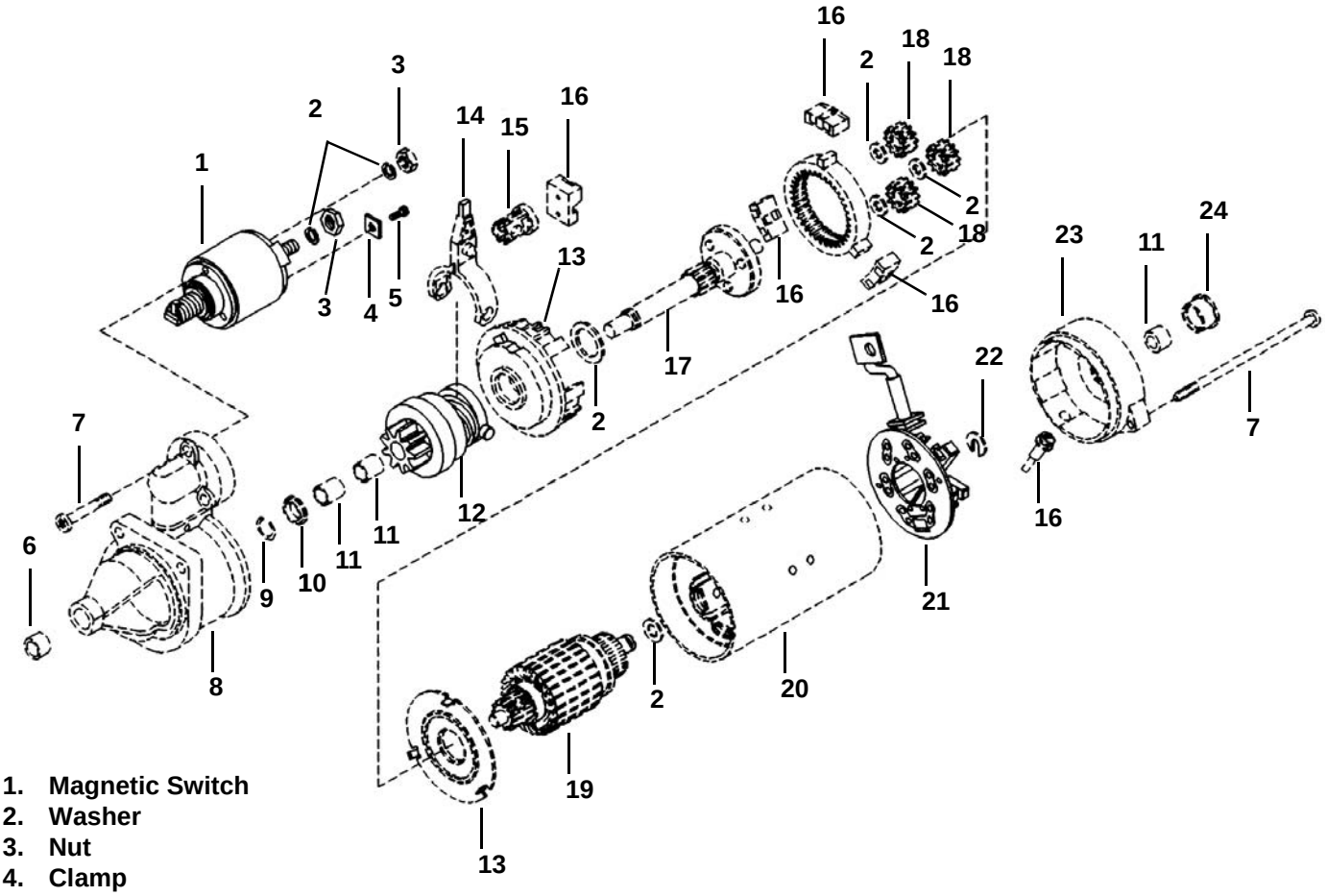
Parts Identification (All Models)



1. Magnetic Switch
2. Washer
3. Nut
4. Clamp
5. Screw
6. Bearing
7. Bolt
8. Housing
9. Snap Ring
10. Collar
11. Bushing
12. Pinion
13. Plate
14. Yoke
15. Pivot
16. Seal
17. Shaft
18. Gear
19. Armature
20. Frame
21. Brush Holder
22. Retainer
23. Cover
24. Cap

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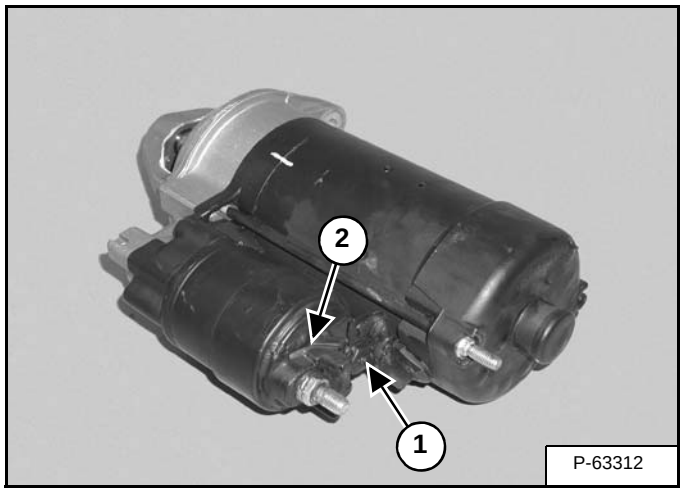
Disassembly (All Models)

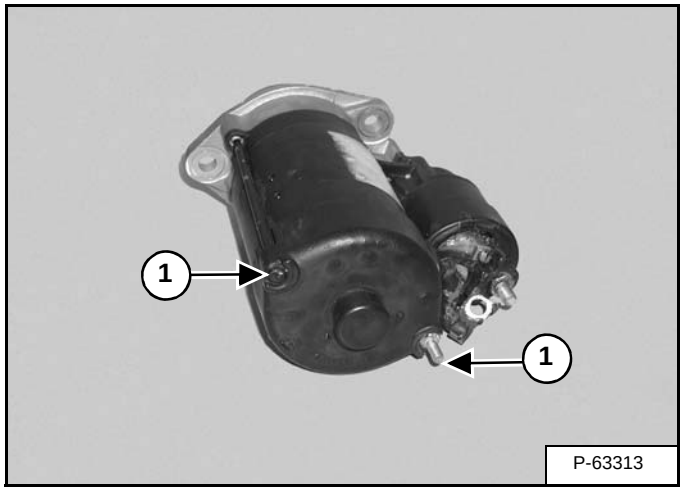
Figure 50-40-5



Remove the cable (Item 1) **[Figure 50-40-5]** from the magnetic switch.

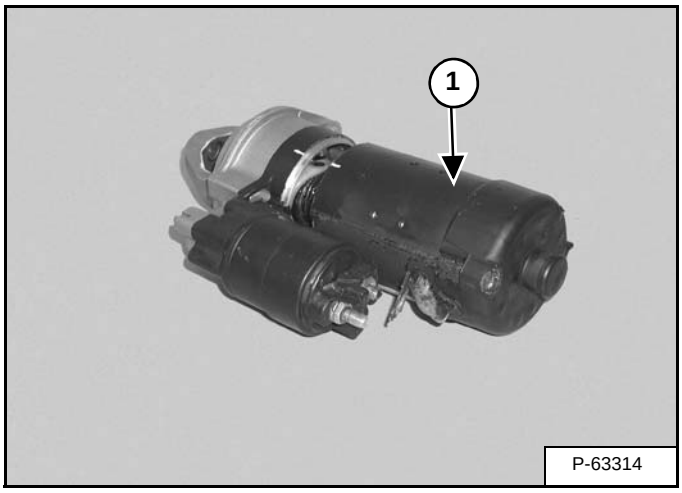
Mark the frame and magnetic switch (Item 2) **[Figure 50-40-5]** for ease of assembly.

Figure 50-40-6



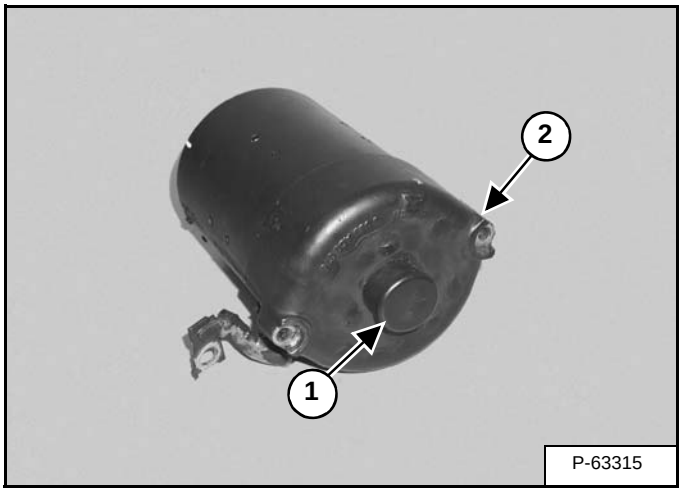
Remove the bolts (Item 1) **[Figure 50-40-6]**.

Figure 50-40-7



Remove the frame (Item 1) **[Figure 50-40-7]** from the magnetic switch.

Figure 50-40-8



Remove the cap (Item 1) from the cover (Item 2) **[Figure 50-40-8]**.

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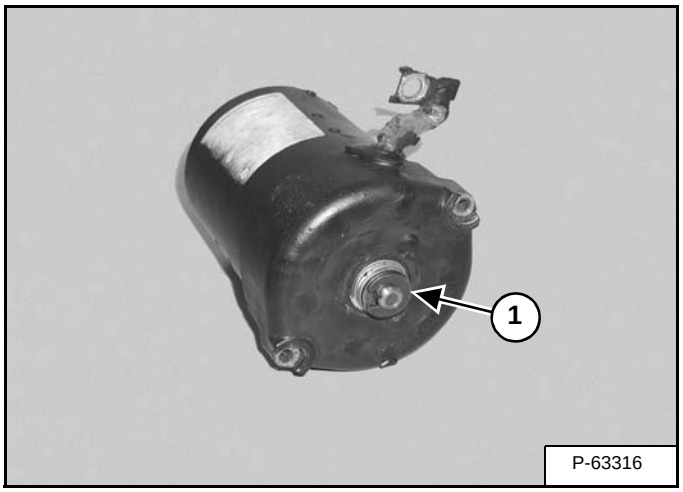
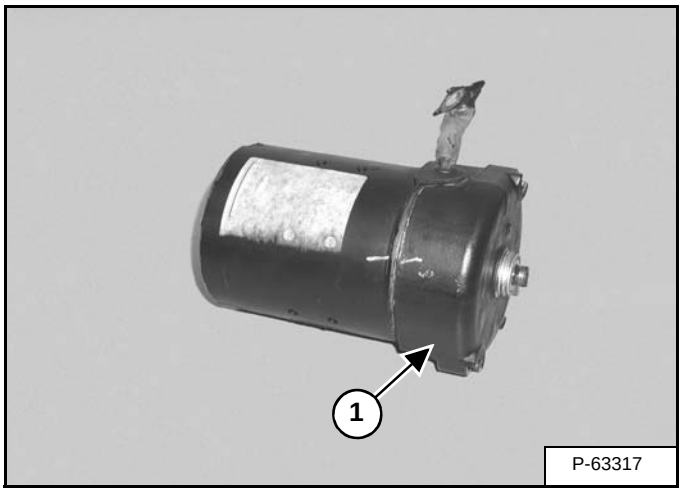
Disassembly (All Models) (Cont'd)

Figure 50-40-9



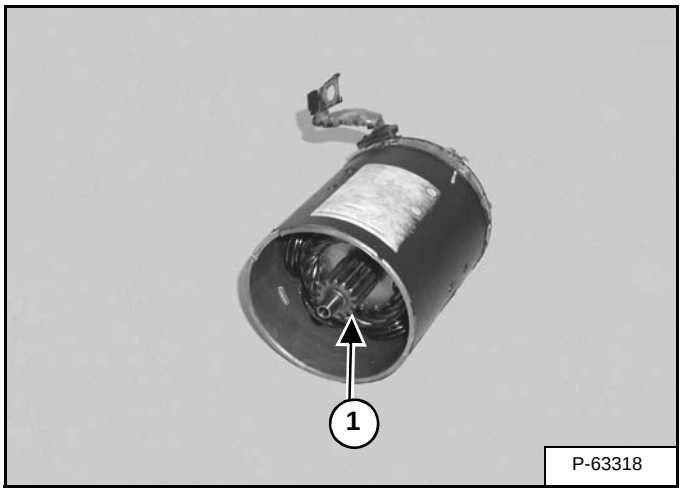
Remove the retainer (Item 1) **[Figure 50-40-9]** and washer.

Figure 50-40-10



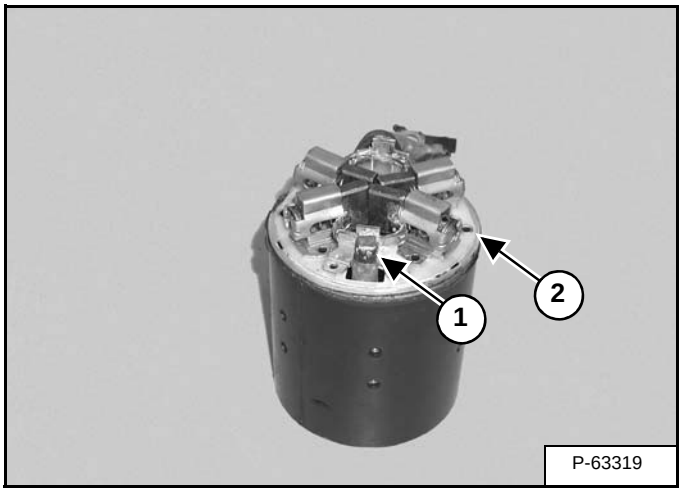
Remove the cover (Item 1) **[Figure 50-40-10]**.

Figure 50-40-11



Remove the armature (Item 1) **[Figure 50-40-11]** from the frame.

Figure 50-40-12



The brushes are non-replaceable. If the brushes are worn, remove the wire (Item 1) from the brush holder (Item 2) **[Figure 50-40-12]** and replace the brush holder.

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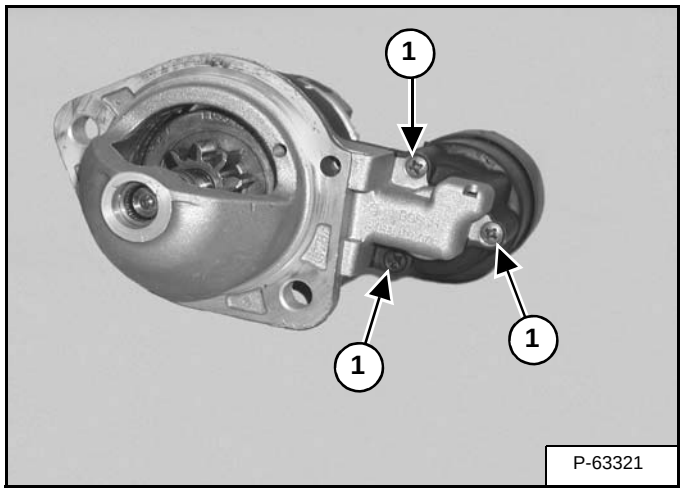
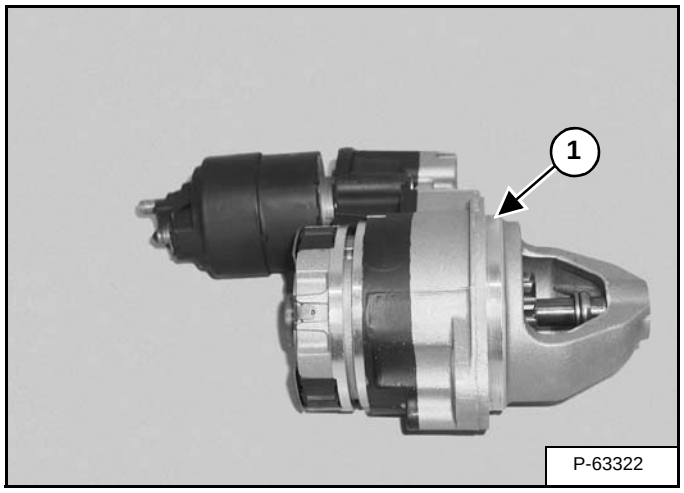
Disassembly (All Models) (Cont'd)

Figure 50-40-13



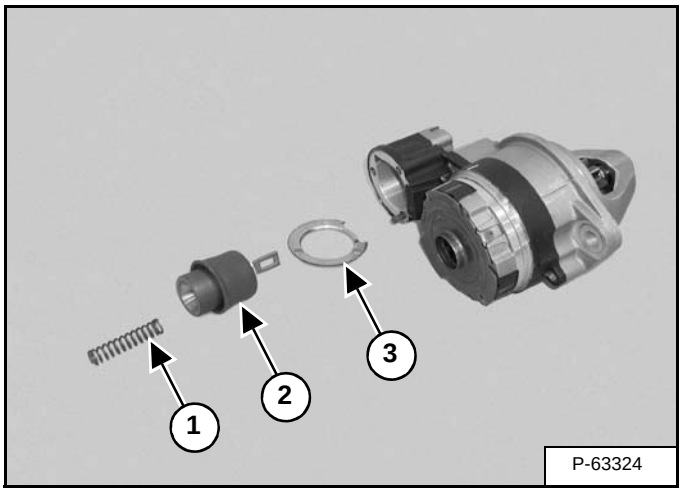
Remove the screws (Item 1) **[Figure 50-40-13]** from the housing.

Figure 50-40-14



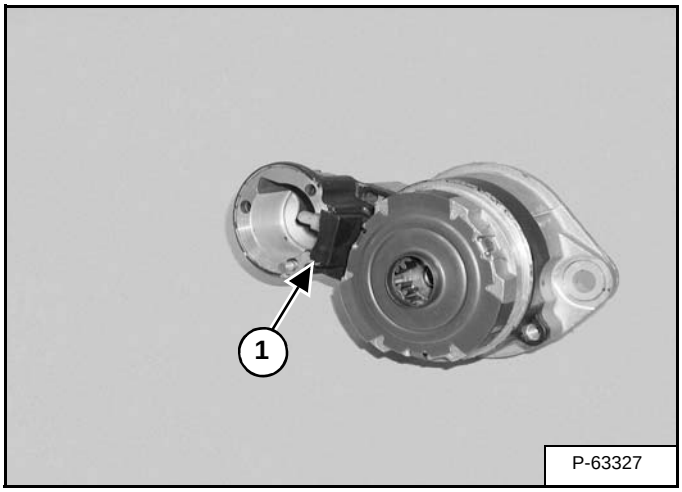
Remove the starter housing (Item 1) **[Figure 50-40-14]** from the magnetic switch housing.

Figure 50-40-15



Remove the spring (Item 1), poppet (Item 2) and flange (Item 3) **[Figure 50-40-15]**.

Figure 50-40-16



Remove the seal (Item 1) **[Figure 50-40-16]**.

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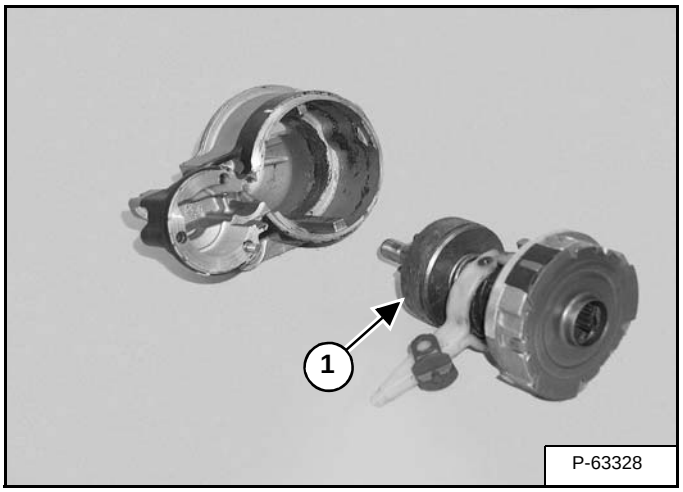
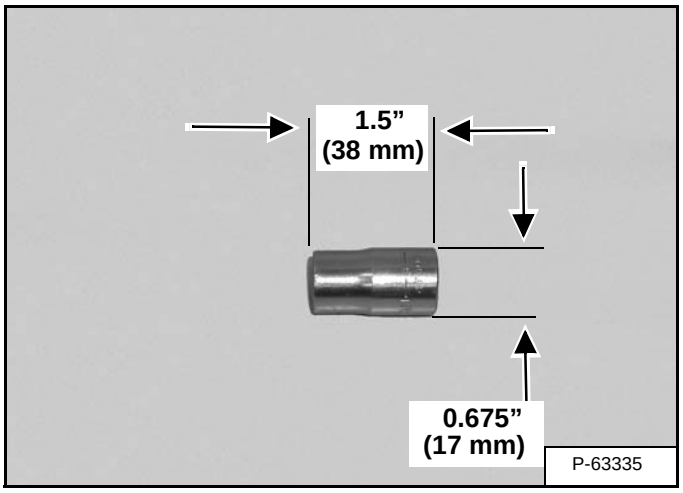
Disassembly (All Models) (Cont'd)

Figure 50-40-17



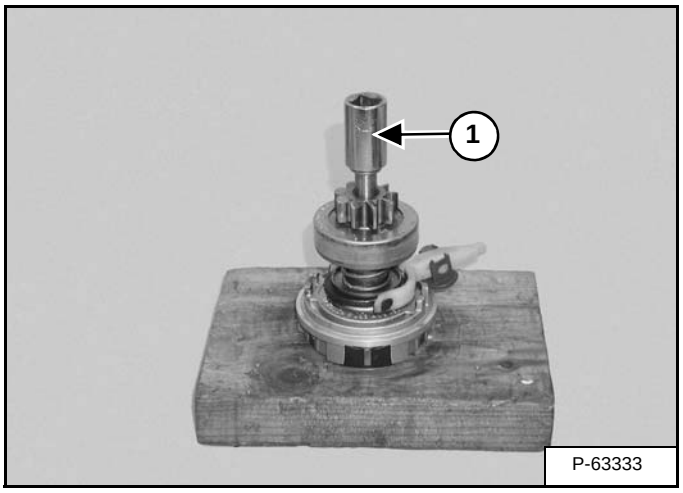
Remove the pinion (Item 1) **[Figure 50-40-17]**.

Figure 50-40-18



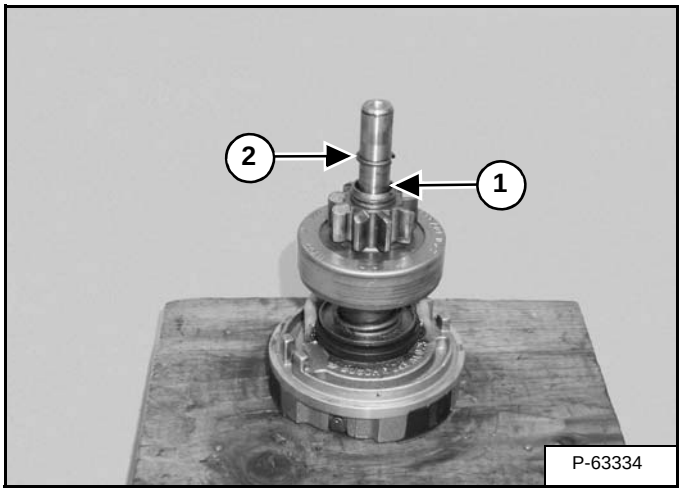
In order to remove the snap ring from the pinion shaft, a tube 0.675 inches (17 mm) in diameter by 1.5 inches (38 mm) in length is needed **[Figure 50-40-18]**.

Figure 50-40-19



Install the tube (Item 1) **[Figure 50-40-19]** over the retainer, and tap gently.

Figure 50-40-20



Press the collar (Item 1) down to gain access to the snap ring (Item 2) **[Figure 50-40-20]**.

Remove the snap ring.

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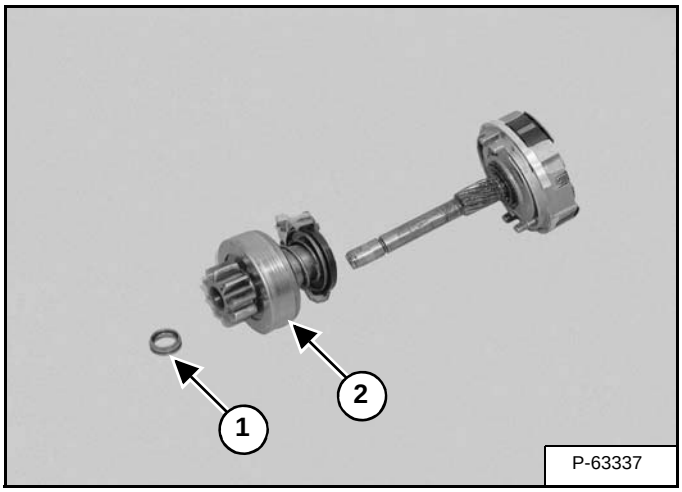
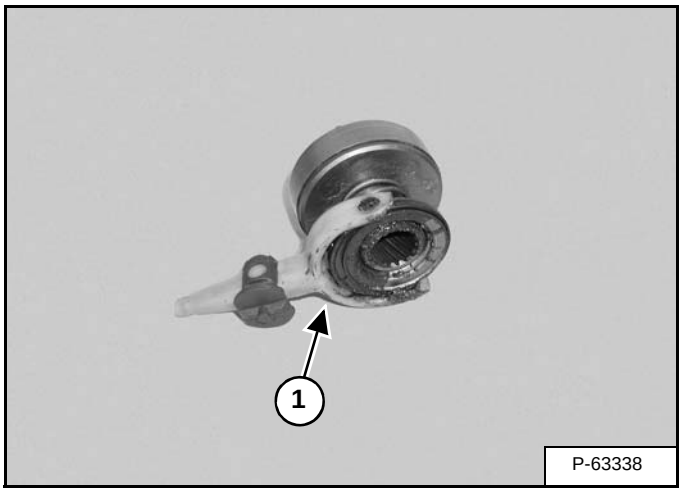
Disassembly (All Models) (Cont'd)

Figure 50-40-21



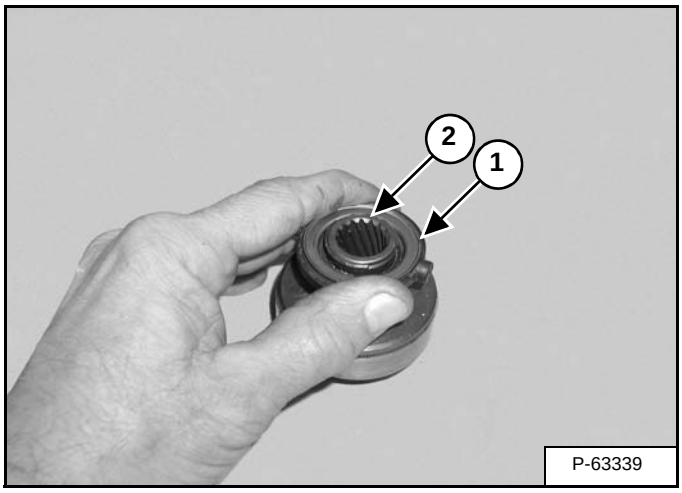
Remove the collar (Item 1) and pinion (Item 2) **[Figure 50-40-21]**.

Figure 50-40-22



Remove the yoke (Item 1) **[Figure 50-40-22]**.

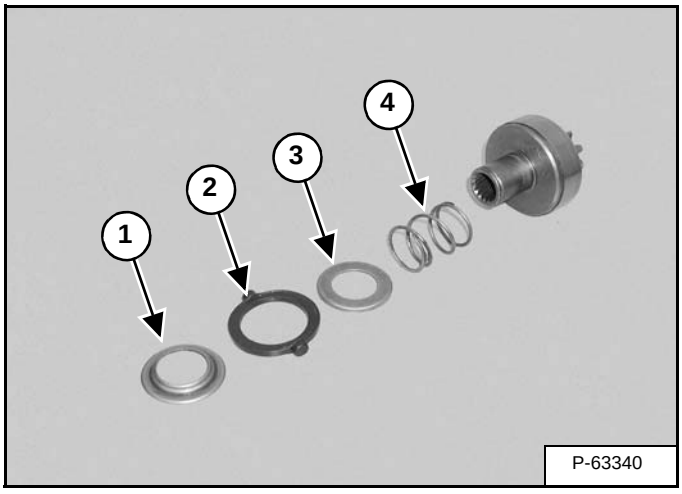
Figure 50-40-23



Press down on the over running clutch (Item 1) **[Figure 50-40-23]**.

Remove the snap ring (Item 2) **[Figure 50-40-23]**.

Figure 50-40-24



Remove the snap ring retainer (Item 1), yoke retainer (Item 2), spring retainer (Item 3) and spring (Item 4) **[Figure 50-40-24]**.

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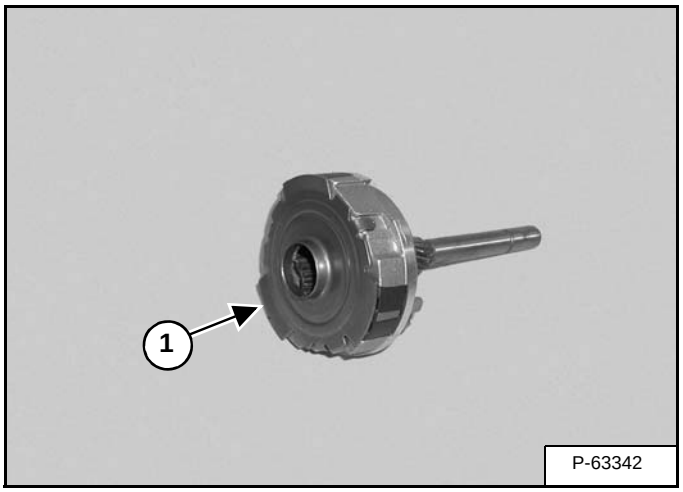
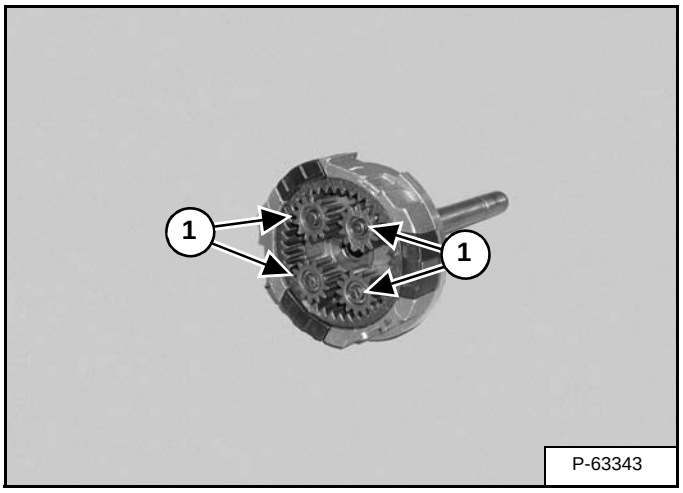
Disassembly (All Models) (Cont'd)

Figure 50-40-25



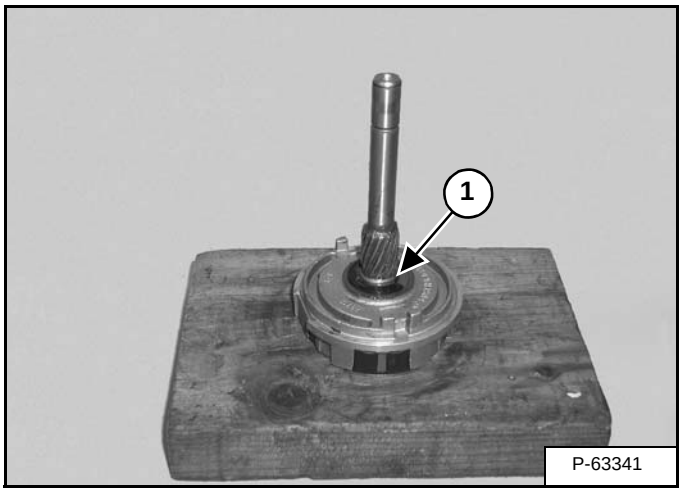
Remove the plate (Item 1) **[Figure 50-40-25]**.

Figure 50-40-26



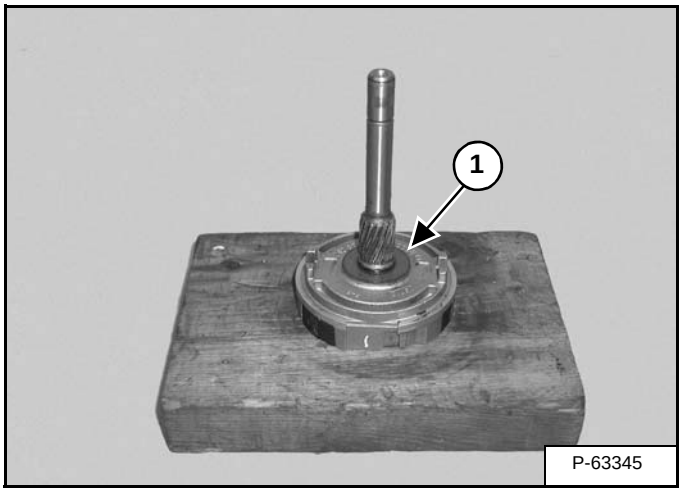
Remove the gears (Item 1) **[Figure 50-40-26]**.

Figure 50-40-27



Remove the snap ring (Item 1) **[Figure 50-40-27]**.

Figure 50-40-28



Remove the washer (Item 1) **[Figure 50-40-28]**.

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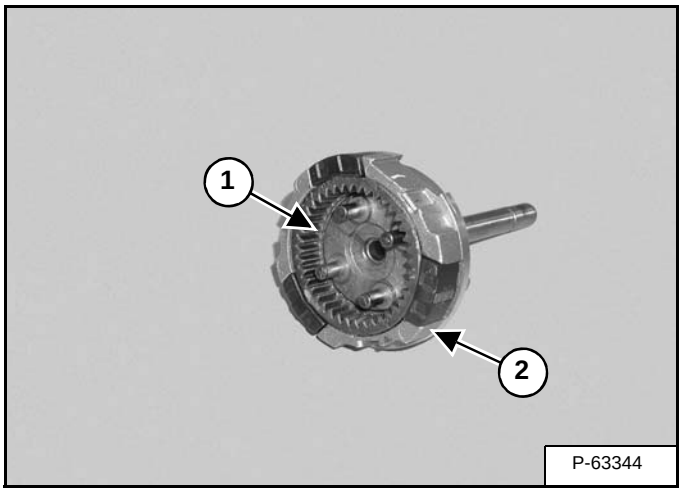
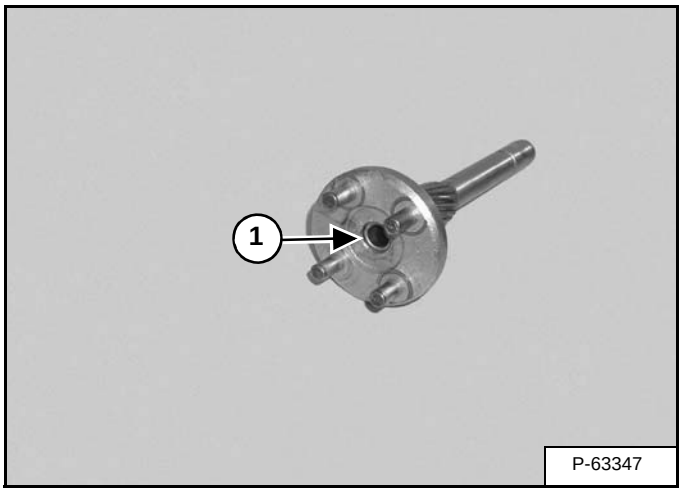
Disassembly (All Models) (Cont'd)

Figure 50-40-29



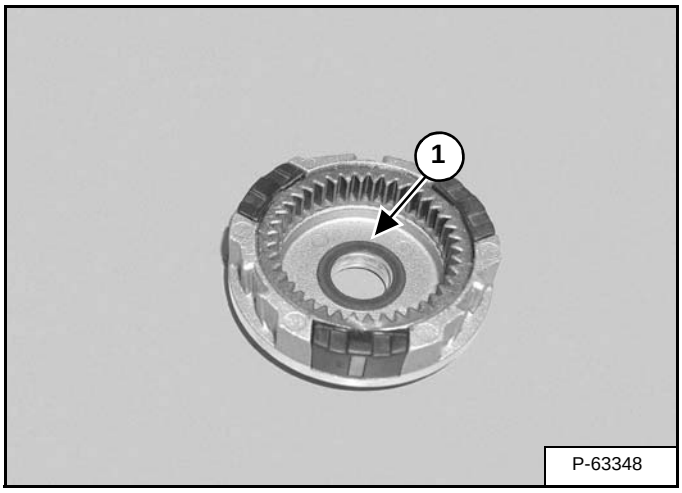
Remove the shaft assembly (Item 1) from the gear assembly (Item 2) **[Figure 50-40-29]**.

Figure 50-40-30



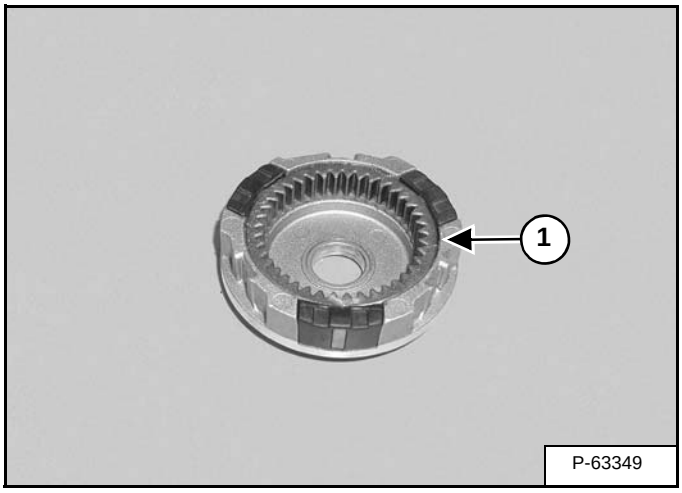
Remove the bushing (Item 1) **[Figure 50-40-30]**.

Figure 50-40-31



Remove the washer (Item 1) **[Figure 50-40-31]**.

Figure 50-40-32



Remove the gear (Item 1) **[Figure 50-40-32]**.

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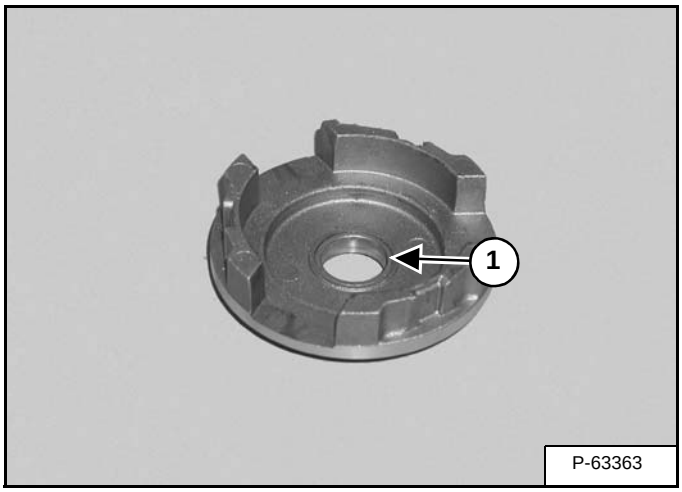
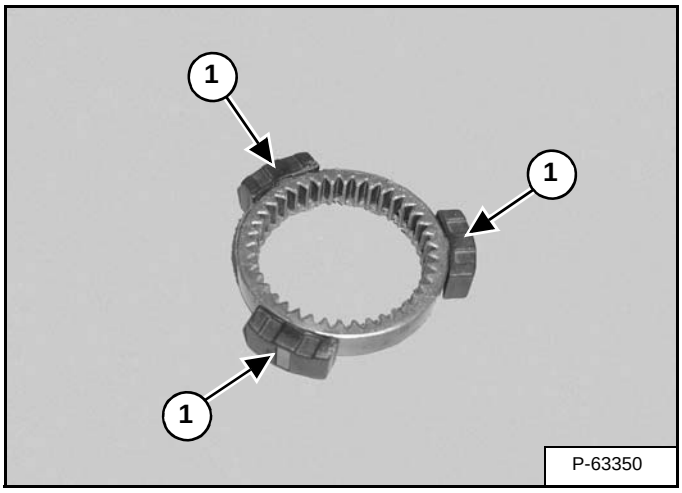
Disassembly (All Models) (Cont'd)

Figure 50-40-33



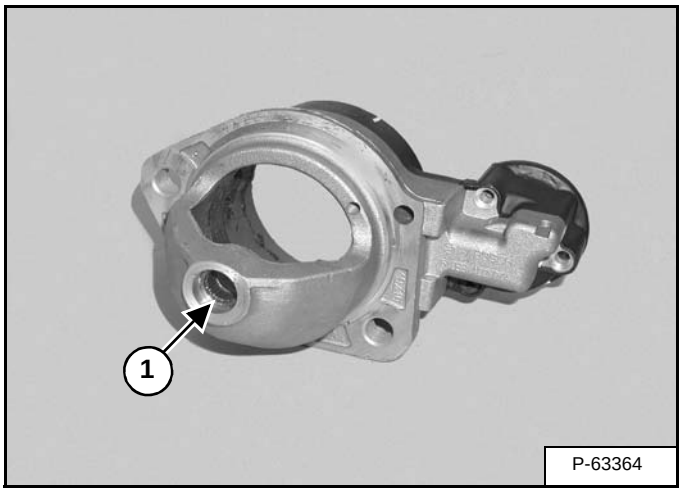
Remove the bushing (Item 1) **[Figure 50-40-33]**.

Figure 50-40-34



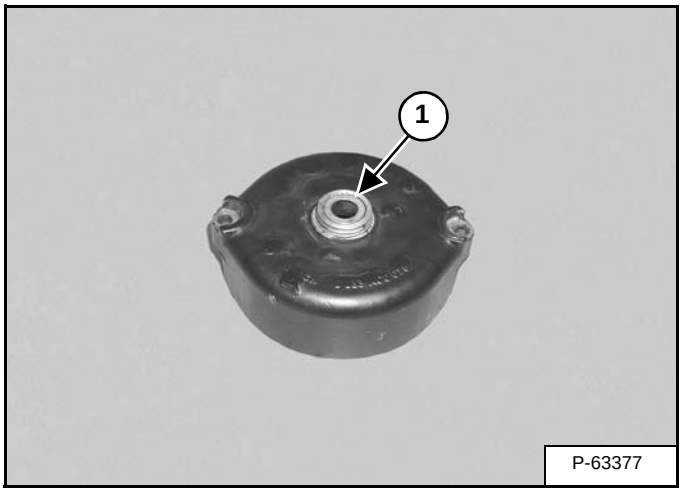
Remove the seals (Item 1) **[Figure 50-40-34]**.

Figure 50-40-35



Remove the bearing (Item 1) **[Figure 50-40-35]**.

Figure 50-40-36



Remove the bushing (Item 1) **[Figure 50-40-36]**.

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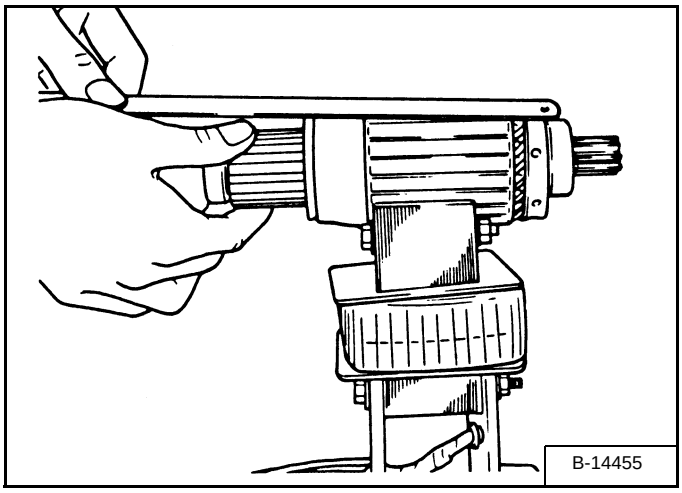
Inspection And Repair (All Models)

Inspect the brush cover for discoloration, indicating the starter has been overheated.

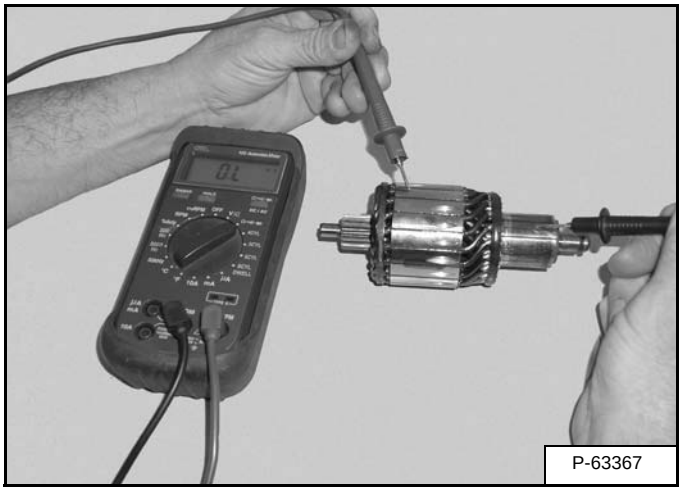
Inspect the pinion teeth for wear and damage.

Figure 50-40-37



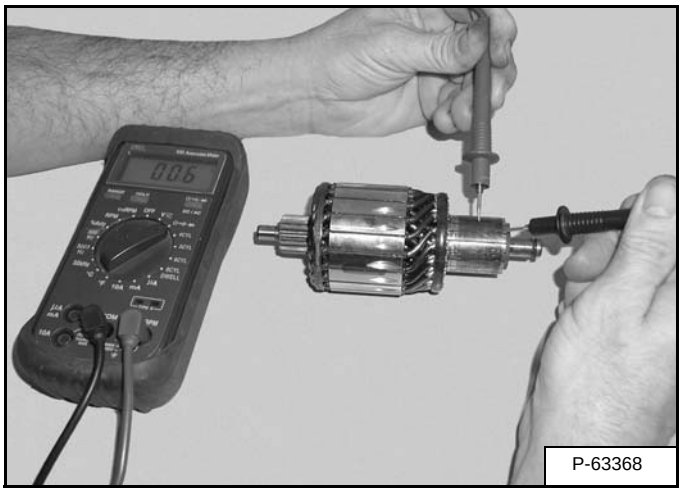
Armature Short-Circuit Test: Use a growler tester, put the armature on the growler and hold a hack saw blade against the armature core while slowly rotating the armature **[Figure 50-40-37]**. A short-circuited armature causes the blade to vibrate and be attracted to the core. An armature which is short-circuited must be replaced.

Figure 50-40-38



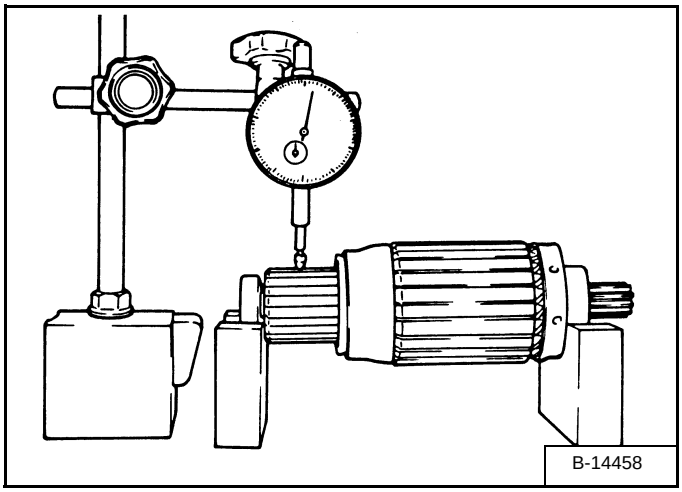
Armature Winding Ground Test: Use a circuit tester, touch one probe to a commutator segment and the other probe to the armature core **[Figure 50-40-38]**. There should be no continuity. If there is continuity, the armature is grounded and must be replaced.

Figure 50-40-39



Armature Winding Continuity Test: Use a circuit tester, touch the probes to two commutator segments **[Figure 50-40-39]**. There must be continuity at any point. If there is no continuity, the winding is open-circuited, replace the armature.

Figure 50-40-40



Commutator Run-Out Test: Check the commutator run-out as shown in **[Figure 50-40-40]**.

Service Limit - 0.020 inch (0,4 mm)

If the commutator exceeds the service limit, repair as needed.

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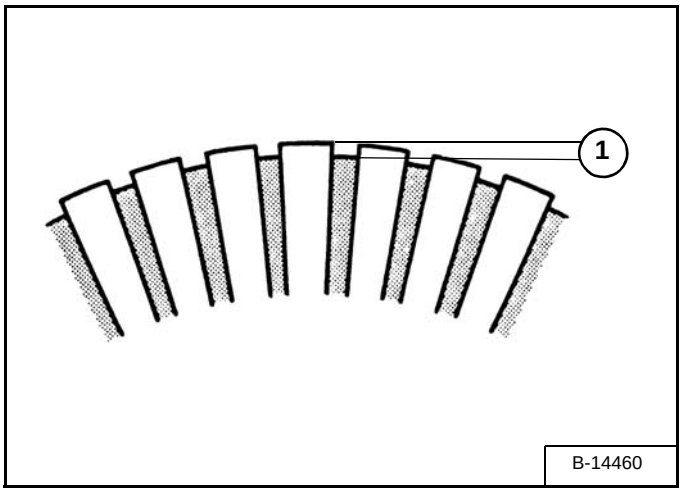
Inspection And Repair (All Models) (Cont'd)

Figure 50-40-41



Measure the segment mica depth (Item 1) **[Figure 50-40-41]**.

Service Limit - 0.008 inch (0,2 mm)

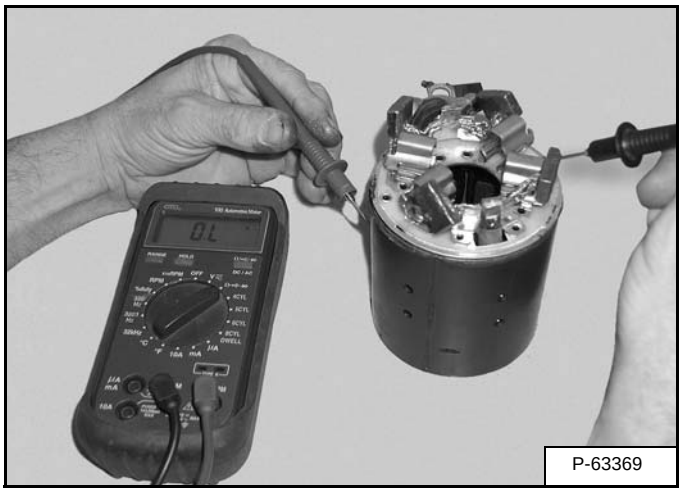
If it is worn, replace the armature.

Check the commutator surface for burned spots which usually indicates an open-circuit, and correct it using #400 sand paper.

Check the field windings for wear and damage.

Check all the connections for clean and tight solder joints.

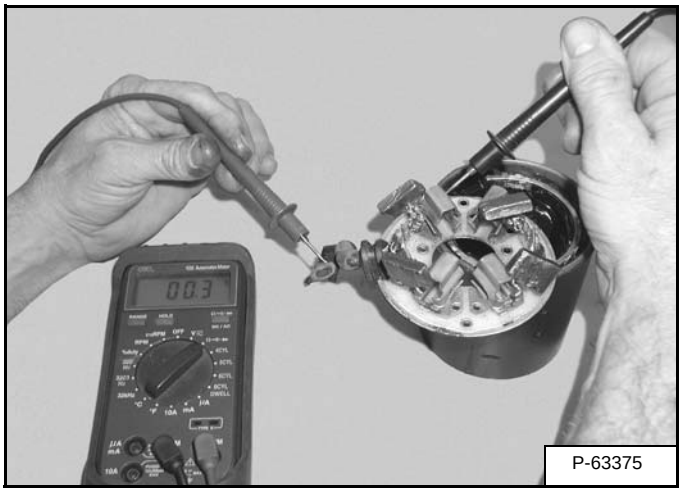
Figure 50-40-42



Field Winding Ground Test: Use a circuit tester, touch one probe to the field winding end of the brush and the other probe to the surface of the frame **[Figure 50-40-42]**. There should be no continuity. If there is continuity, the field windings are grounded.

Replace the field windings.

Figure 50-40-43



Field Windings Continuity Test: Use a circuit tester, touch one probe to the wire and the other probe to the brush **[Figure 50-40-43]**. There must be continuity. If there is no continuity, the field windings are open-circuited. Replace the yoke if the field windings have an open circuit.

Inspect the brushes for wear and damage.

Replace the brush holder or yoke assembly if the brushes are worn or damaged.

Check brush springs, for damage or rust. Replace as needed.

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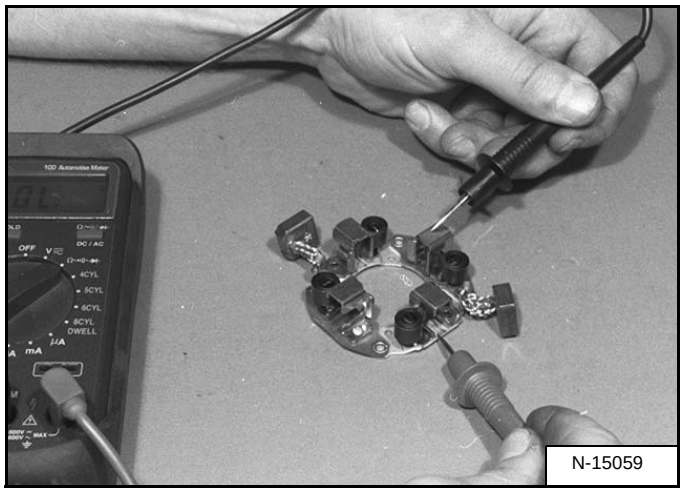
Inspection And Repair (All Models) (Cont'd)

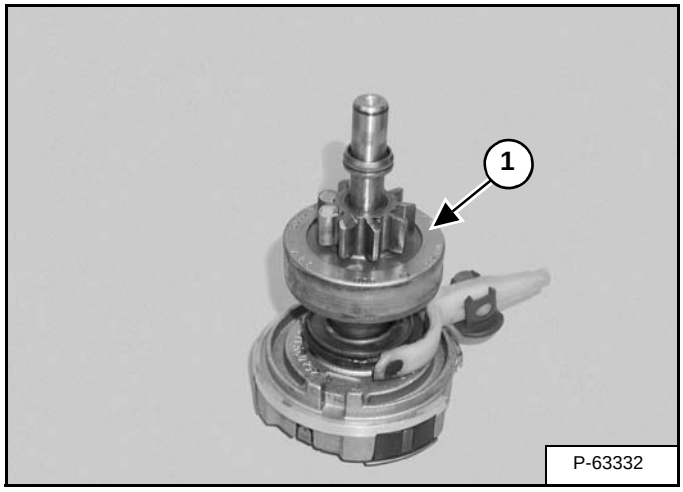
Figure 50-40-44



Brush Holder Insulation Test: Use a circuit tester, touch one probe to the positive brush holder plate and the other probe to the holder plate **[Figure 50-40-44]**. There should be no continuity. If there is continuity, replace or repair.

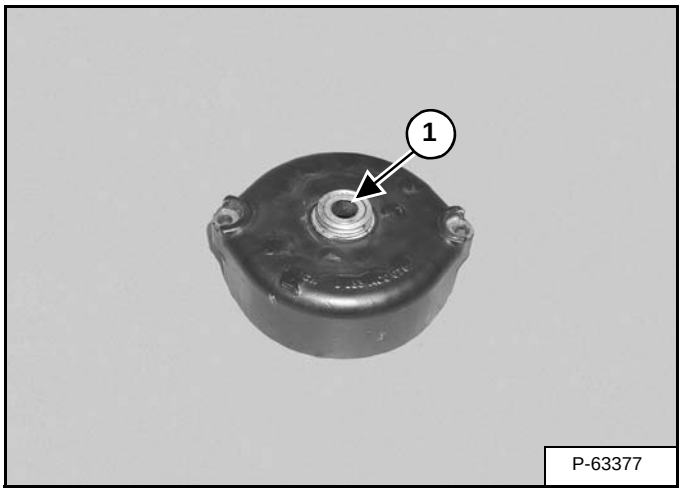
Assembly (All Models)

Figure 50-40-45



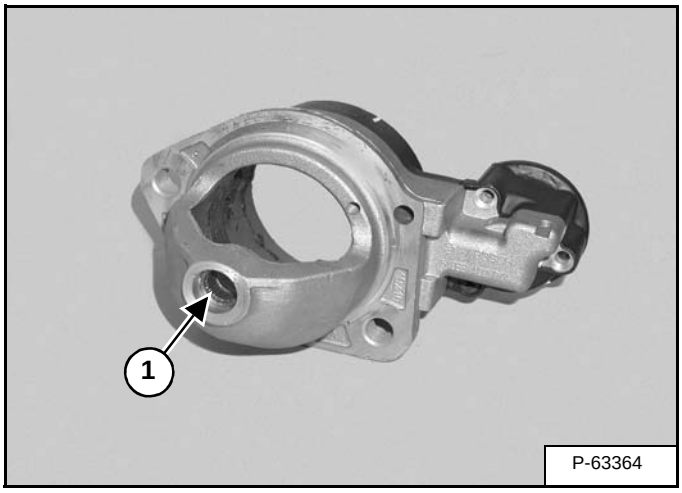
Inspect the over running clutch (Item 1) **[Figure 50-40-45]**, it must rotate freely in the direction of the starter rotation and locked in the opposite rotation.

Figure 50-40-46



Install the bushing (Item 1) **[Figure 50-40-46]**.

Figure 50-40-47



Install the bearing (Item 1) **[Figure 50-40-47]**.

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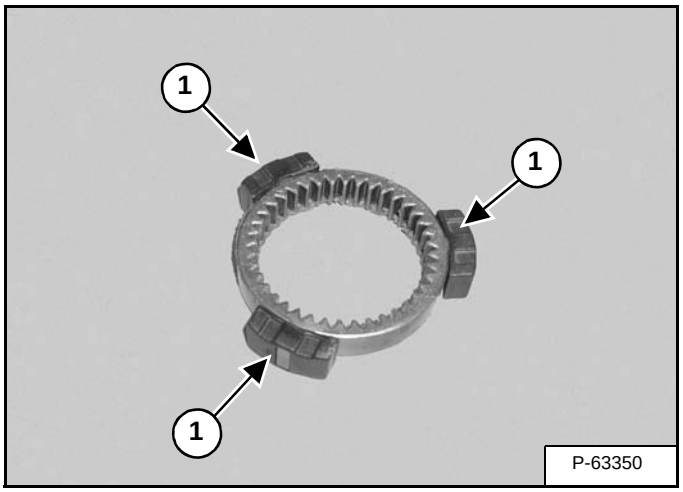
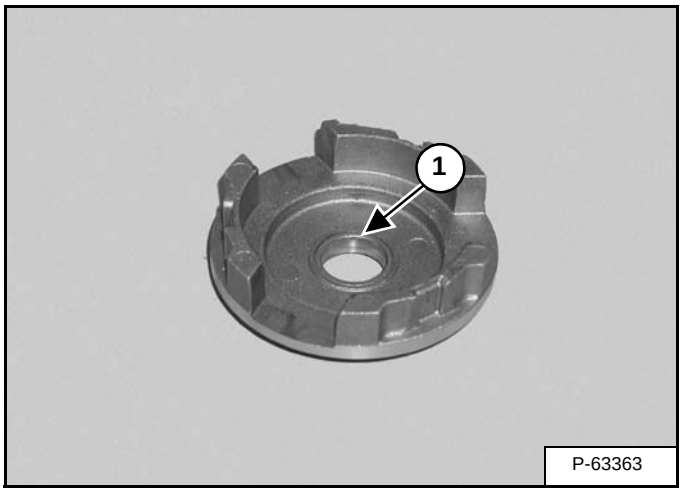
Assembly (All Models) (Cont'd)

Figure 50-40-48



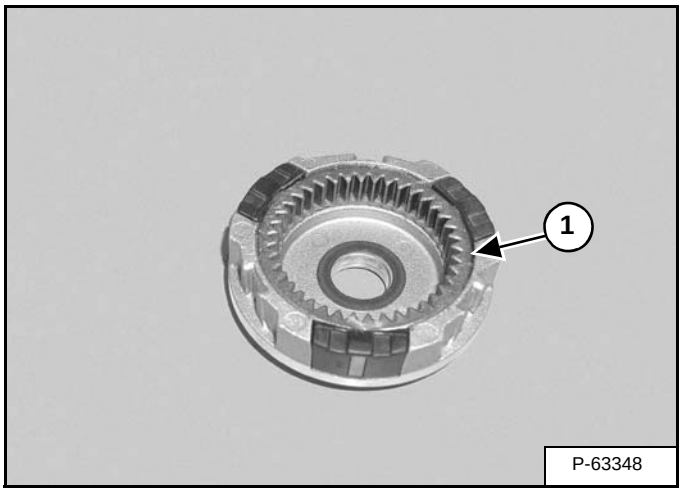
Install the seals (Item 1) **[Figure 50-40-48]**.

Figure 50-40-49



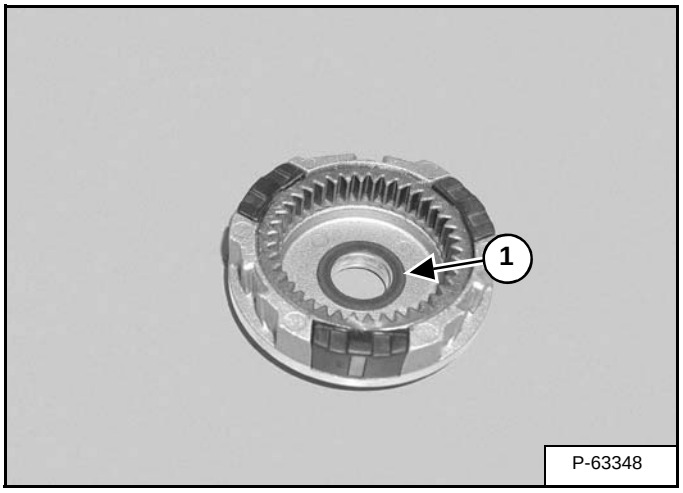
Install the bushing (Item 1) **[Figure 50-40-49]**.

Figure 50-40-50



Install the gear (Item 1) **[Figure 50-40-50]**.

Figure 50-40-51



Install the washer (Item 1) **[Figure 50-40-51]**.

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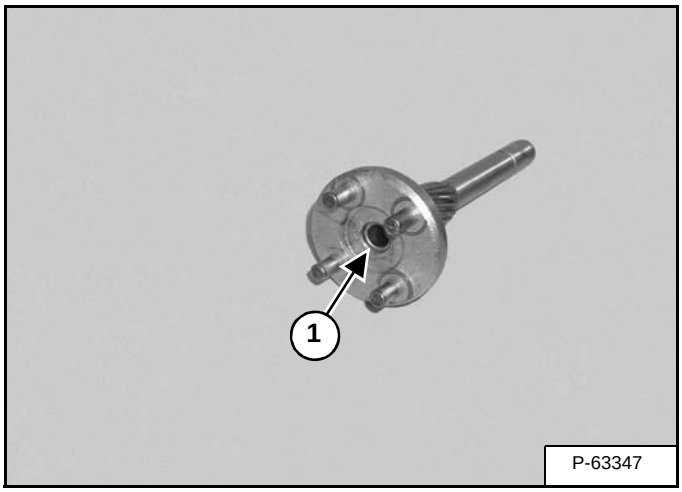
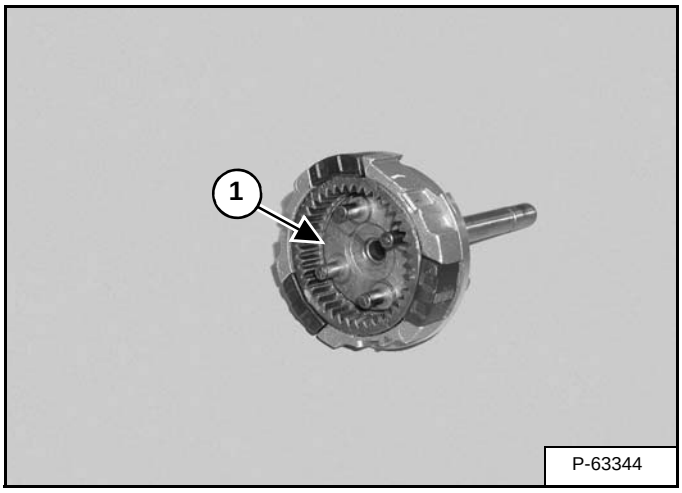
Assembly (All Models) (Cont'd)

Figure 50-40-52



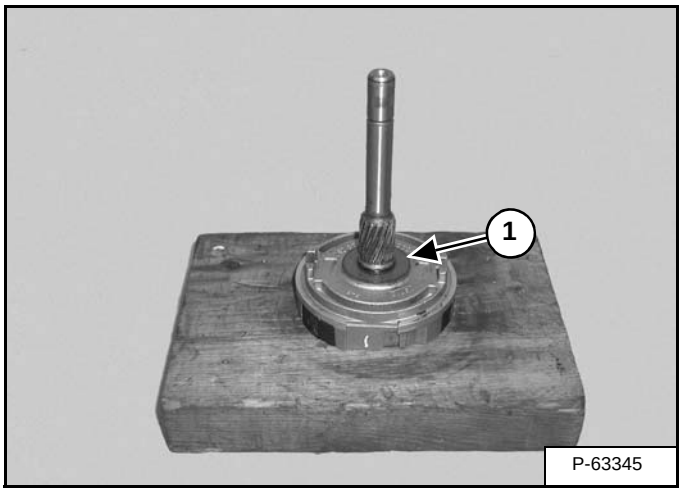
Install the bushing (Item 1) **[Figure 50-40-52]** in the shaft assembly.

Figure 50-40-53



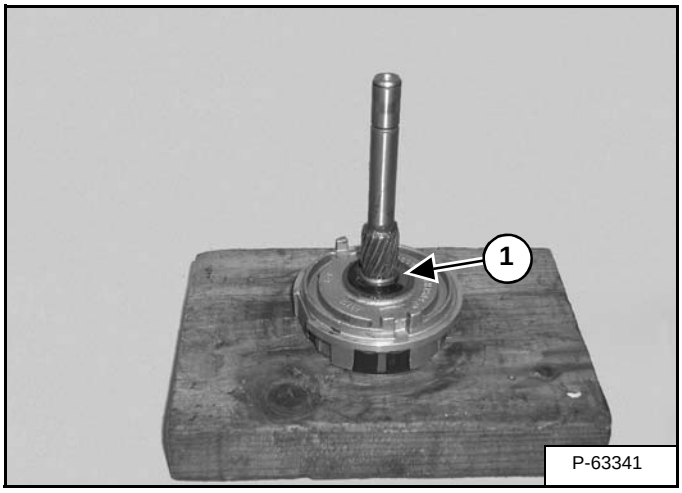
Install the shaft assembly (Item 1) **[Figure 50-40-53]**.

Figure 50-40-54



Install the washer (Item 1) **[Figure 50-40-54]**.

Figure 50-40-55



Install the snap ring (Item 1) **[Figure 50-40-55]**.

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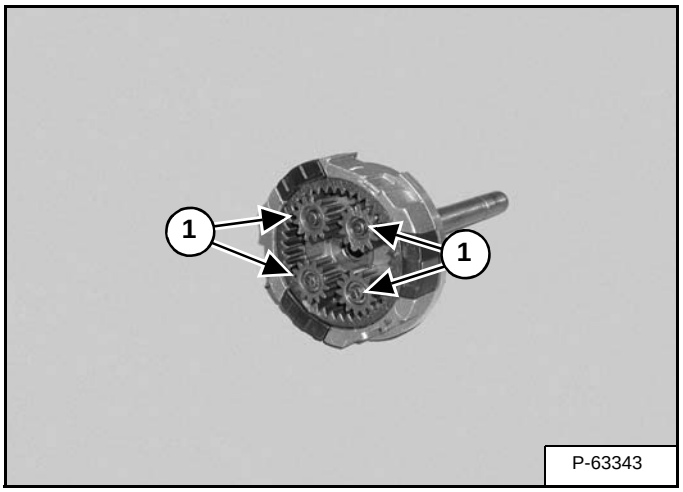
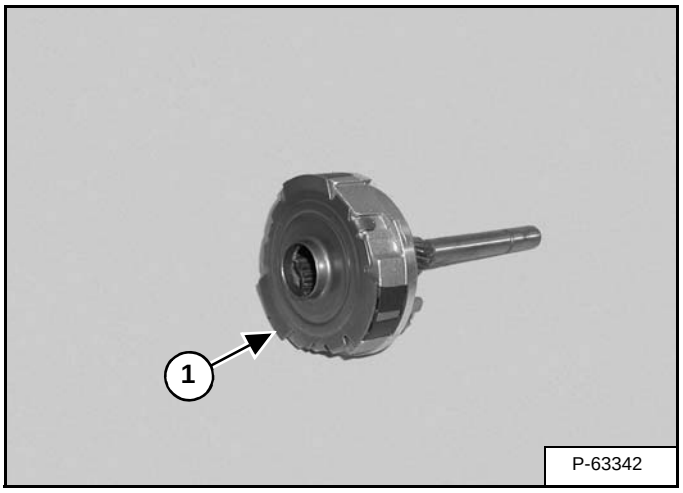
Assembly (All Models) (Cont'd)

Figure 50-40-56



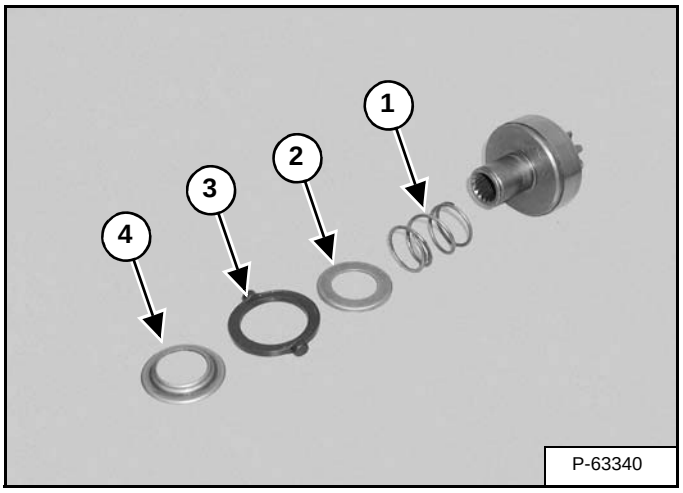
Install the gears (Item 1) **[Figure 50-40-56]**.

Figure 50-40-57



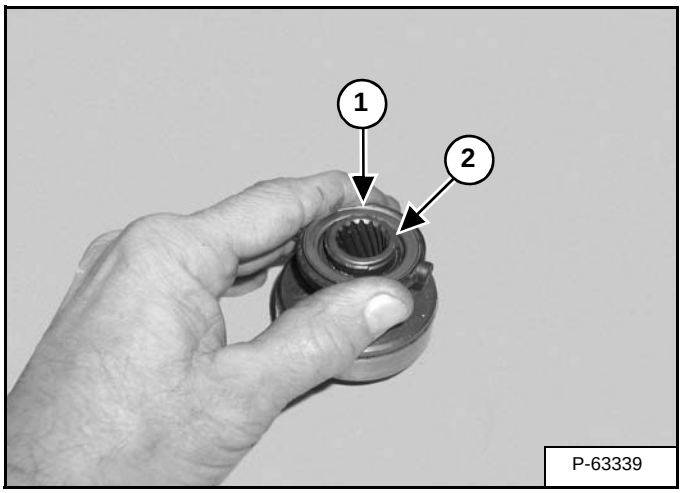
Install the plate (Item 1) **[Figure 50-40-57]**.

Figure 50-40-58



Install the spring (Item 1), spring retainer (Item 2), yoke retainer (Item 3) and snap ring retainer (Item 4) **[Figure 50-40-58]**.

Figure 50-40-59



Press down on the snap ring retainer (Item 1) and install the snap ring (Item 2) **[Figure 50-40-59]**.

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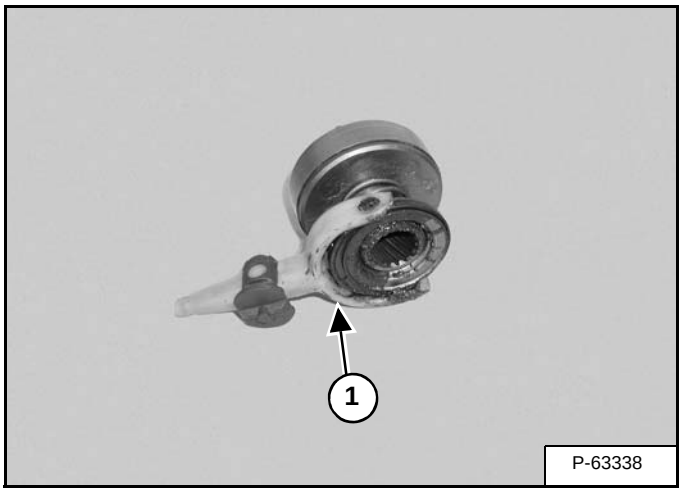
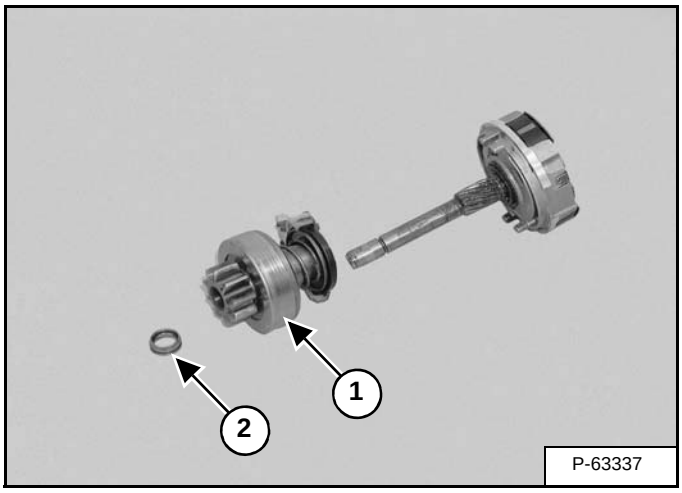
Assembly (All Models) (Cont'd)

Figure 50-40-60



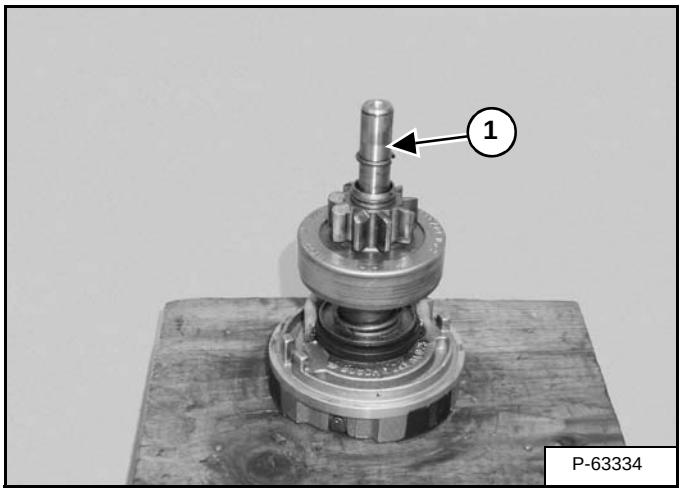
Install the yoke (Item 1) **[Figure 50-40-60]**.

Figure 50-40-61



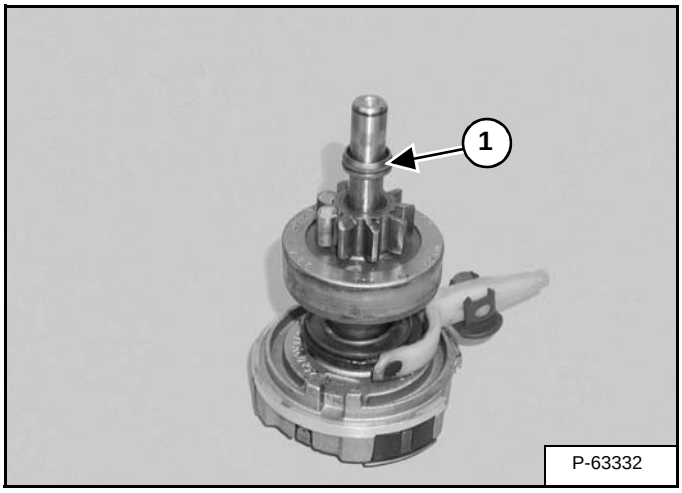
Install the pinion (Item 1) and collar (Item 2) **[Figure 50-40-61]**.

Figure 50-40-62



Install the snap ring (Item 1) **[Figure 50-40-62]**.

Figure 50-40-63



Install the collar (Item 1) **[Figure 50-40-63]** over the snap ring.

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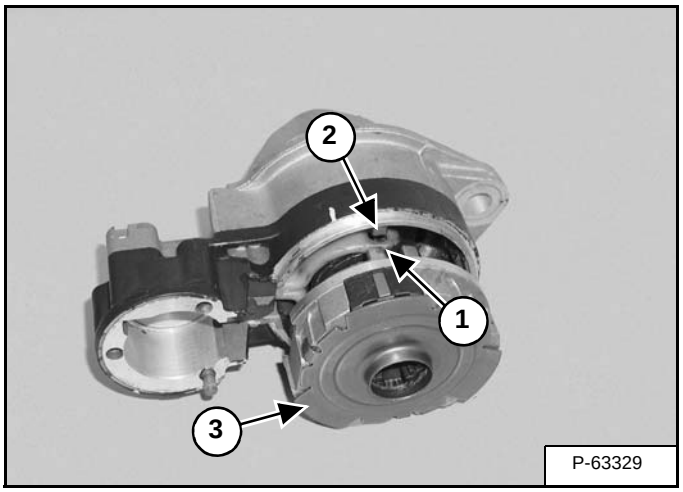
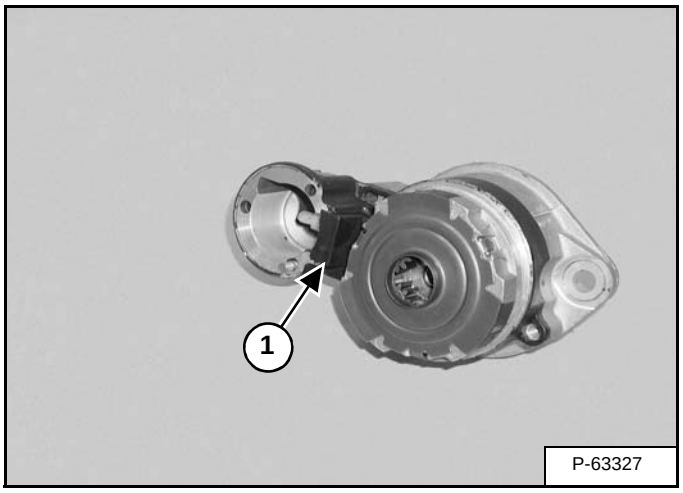
Assembly (All Models) (Cont'd)

Figure 50-40-64



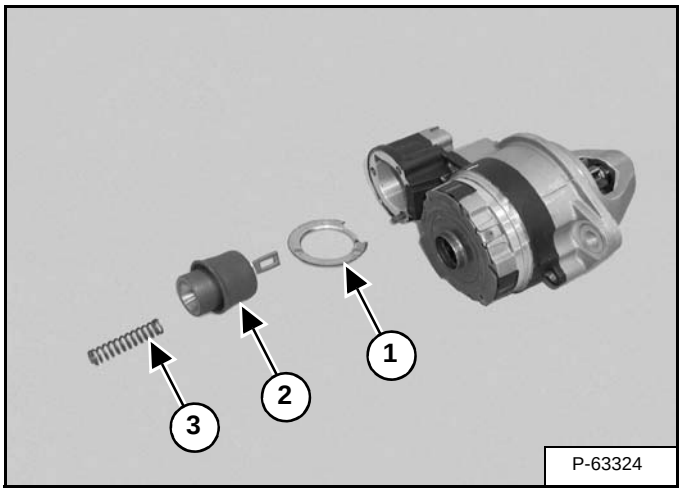
Align the notch (Item 1) with the tab (Item 2). Install the pinion (Item 3) **[Figure 50-40-64]**.

Figure 50-40-65



Install the seal (Item 1) **[Figure 50-40-65]**.

Figure 50-40-66



Install the flange (Item 1), poppet (Item 2) and spring (Item 3) **[Figure 50-40-66]**.

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Assembly (All Models) (Cont'd)

Figure 50-40-67

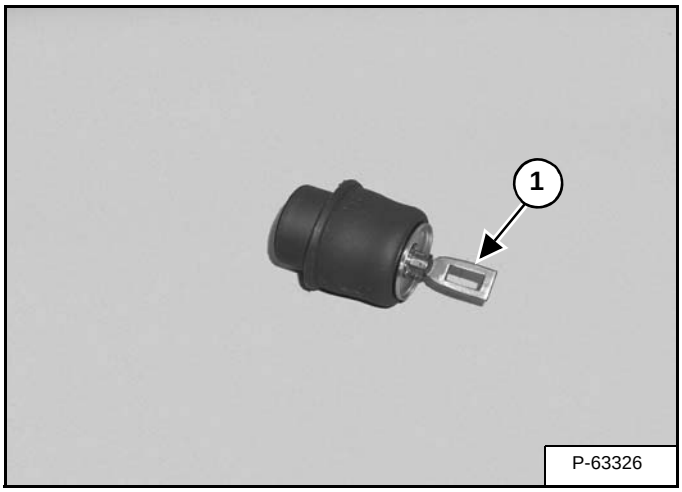
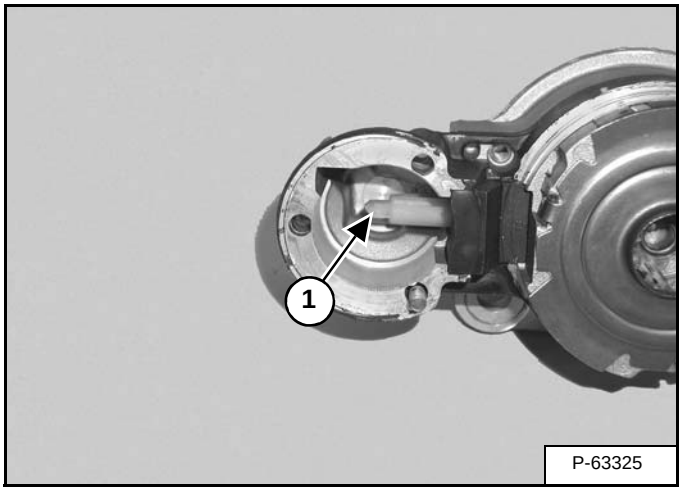
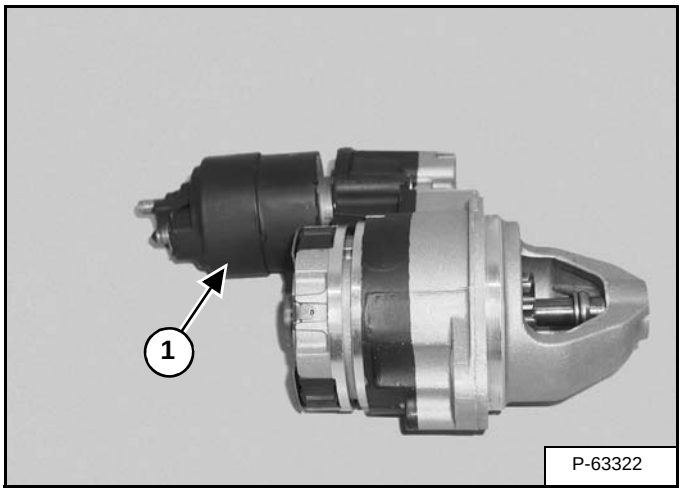


Figure 50-40-68



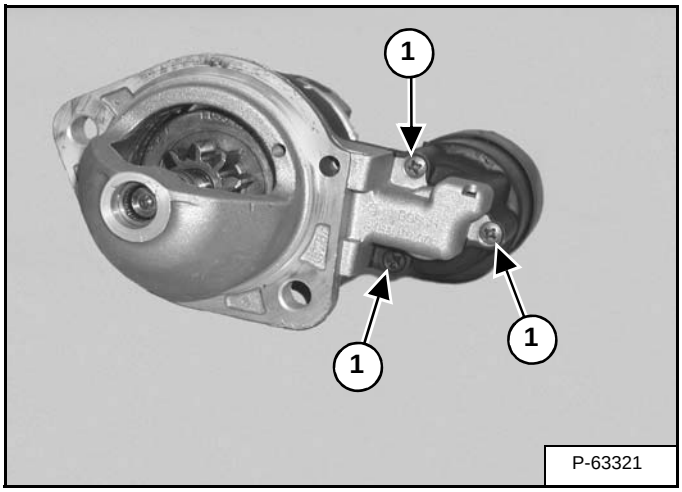
The end of the poppet (Item 1) **[Figure 50-40-67]** must fit over the end of the yoke (Item 1) **[Figure 50-40-68]**.

Figure 50-40-69



Install the magnetic switch housing (Item 1) **[Figure 50-40-69]**.

Figure 50-40-70



Install the screws (Item 1) **[Figure 50-40-70]**.

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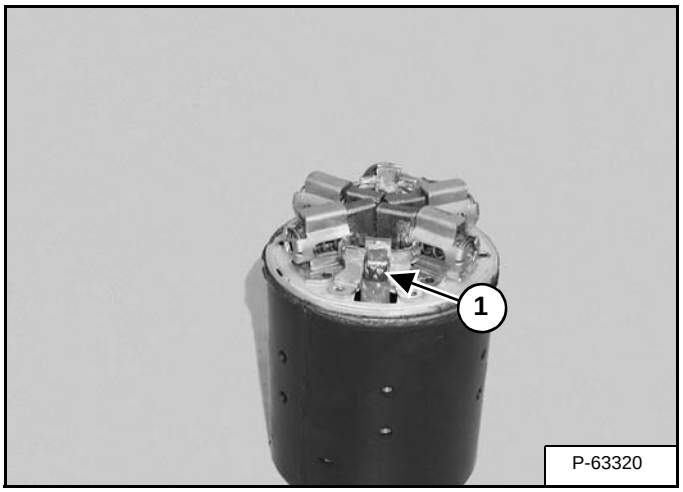
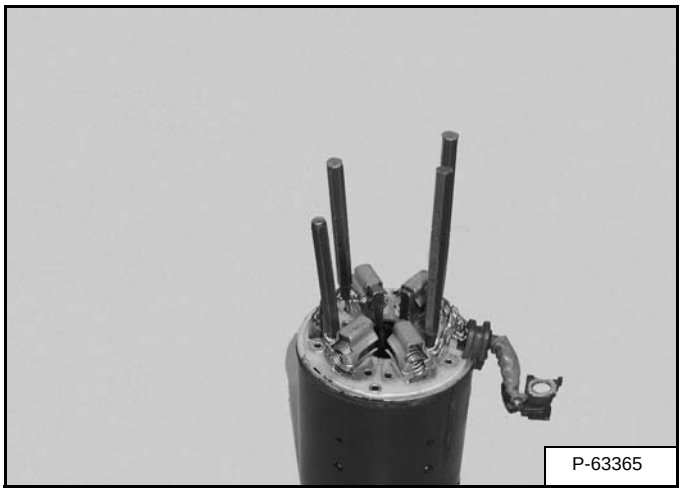
Assembly (All Models) (Cont'd)

Figure 50-40-71



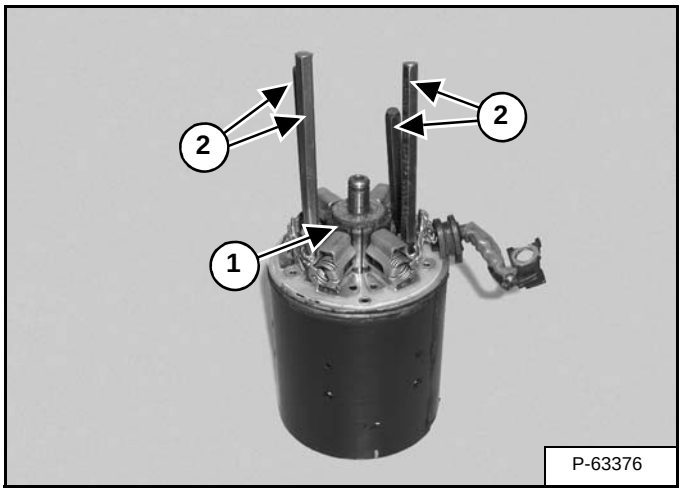
Solder the wire (Item 1) **[Figure 50-40-71]** if the brush holder assembly has been replaced.

Figure 50-40-72



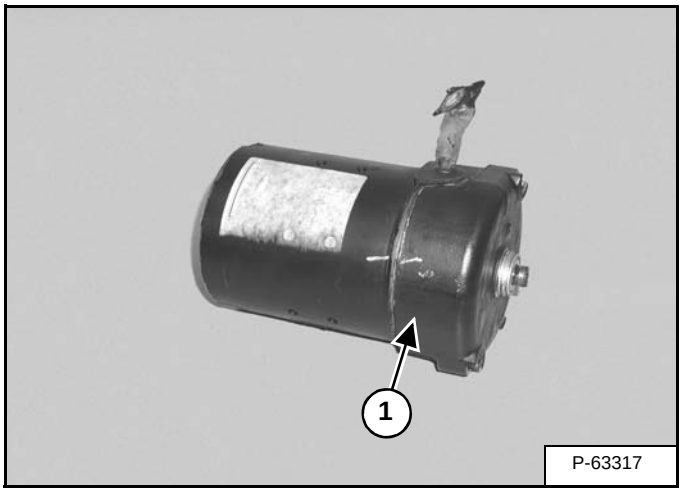
Push the brushes into the brush holders. Use small punches to hold the brushes in place **[Figure 50-40-72]**.

Figure 50-40-73



Install the armature (Item 1). Remove the punches (Item 2) **[Figure 50-40-73]**.

Figure 50-40-74



Install the cover (Item 1) **[Figure 50-40-74]**.

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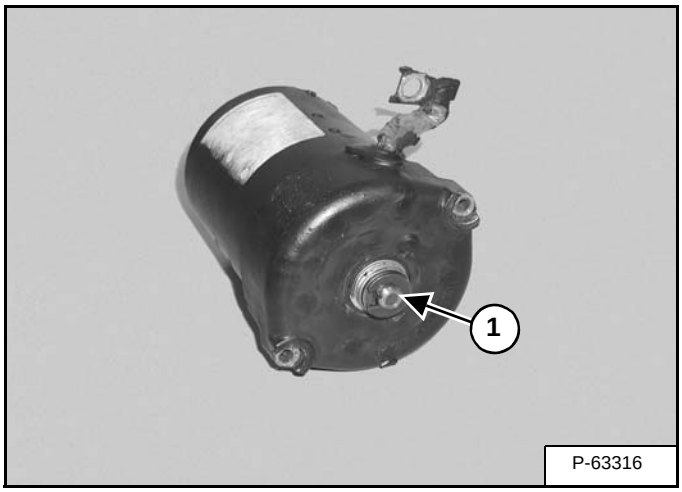
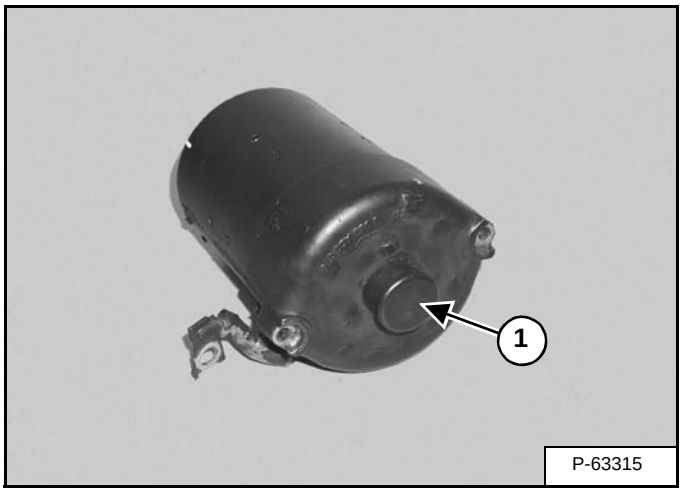
Assembly (All Models) (Cont'd)

Figure 50-40-75



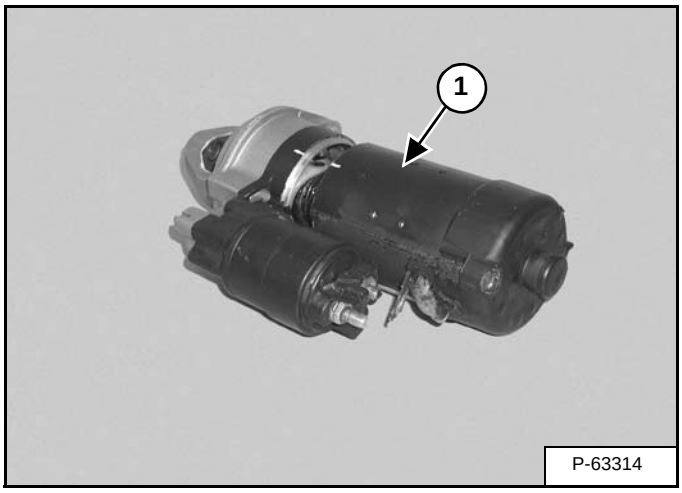
Install the washer and retainer (Item 1) **[Figure 50-40-75]**.

Figure 50-40-76



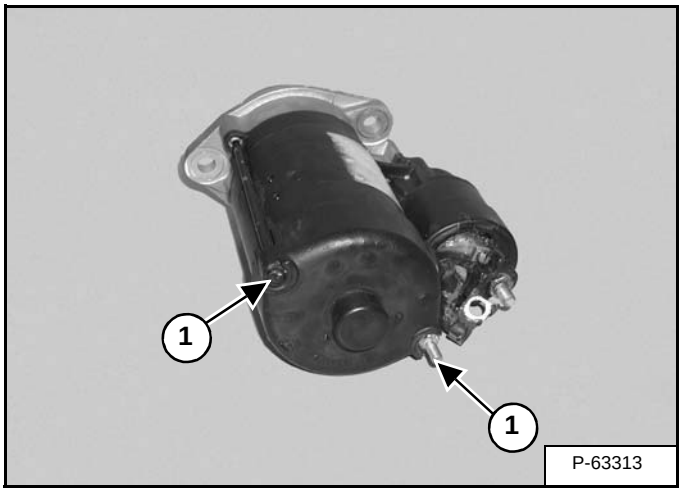
Install the cap (Item 1) **[Figure 50-40-76]**.

Figure 50-40-77



Install the frame (Item 1) **[Figure 50-40-77]**.

Figure 50-40-78



Install the bolts (Item 1) **[Figure 50-40-78]**.

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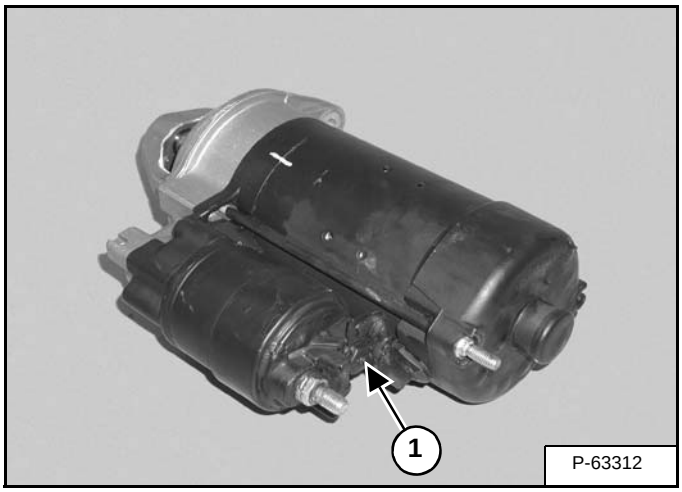
Assembly (All Models) (Cont'd)

Figure 50-40-79



Install the cable (Item 1) **[Figure 50-40-79]** on the terminal.

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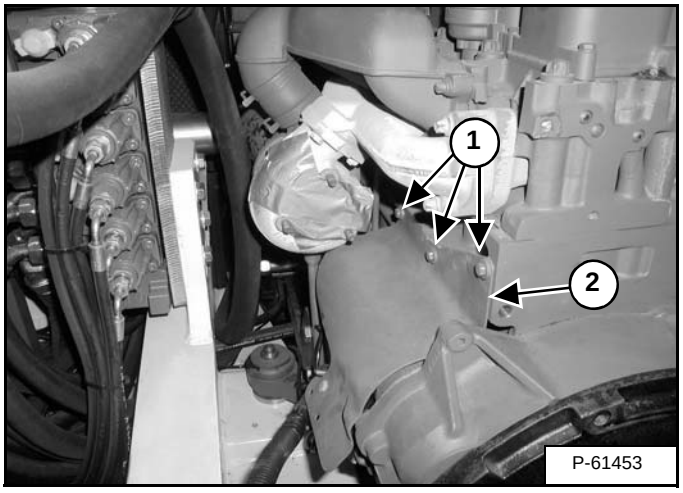
STARTER (S/N 528911001 & ABOVE & S/N 528611001 & ABOVE)

Removal And Installation

Remove the muffler. (See MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-21-1.)

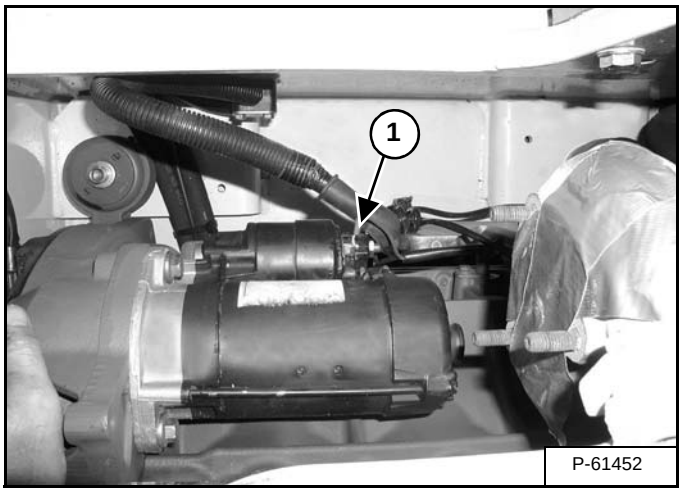
Disconnect the battery. (See BATTERY on Page 50-20-1.)

Figure 50-41-80



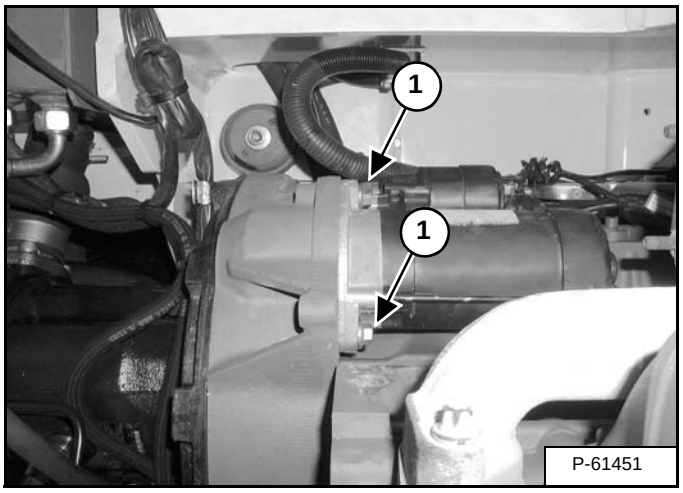
Remove the three bolts (Item 1) and shield (Item 2) **[Figure 50-41-80]**.

Figure 50-41-81



Remove the wires (Item 1) **[Figure 50-41-81]** from the starter.

Figure 50-41-82



Remove the two bolts (Item 1) **[Figure 50-41-82]** from the starter.

Remove the starter.

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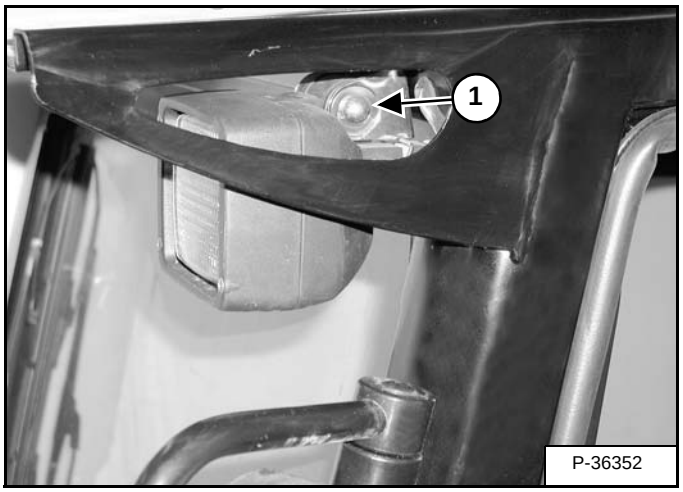
FRONT CAB LIGHT

Removal And Installation

Figure 50-50-1



Remove the bolt (Item 1) **[Figure 50-50-1]** nut and flat washer.

Figure 50-50-2

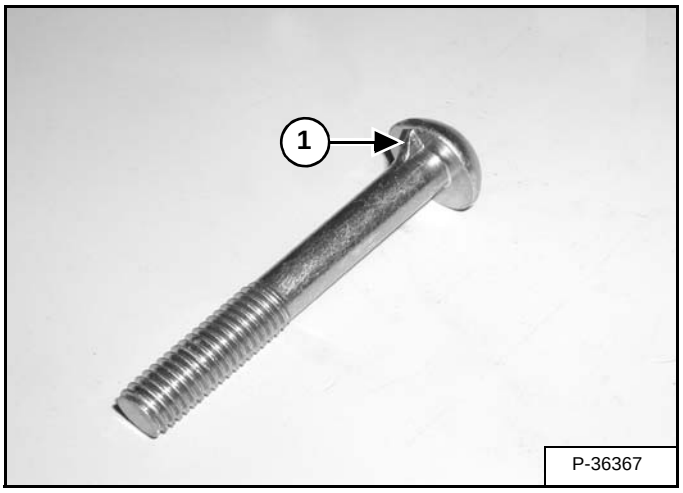
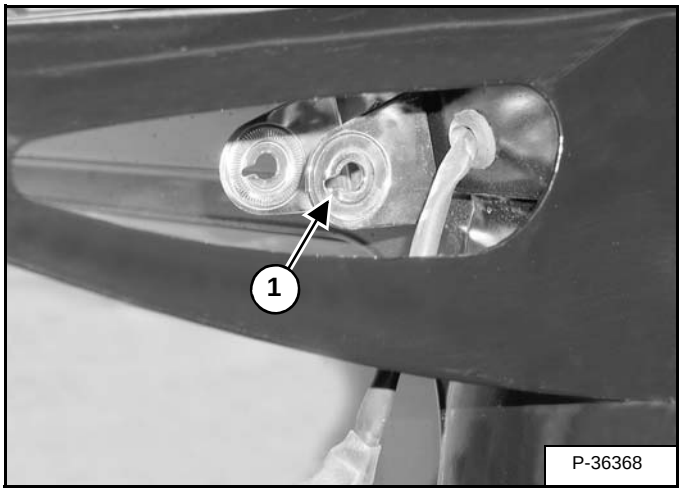


Figure 50-50-3



Installation: Align the notch (Item 1) **[Figure 50-50-2]** on the bolt with the notch (Item 1) **[Figure 50-50-3]** in the mount bracket.

Tighten the bolt enough to prevent the light from pivoting in the bracket.

NOTE: Do not overtighten the bolt. The housing may be damaged.

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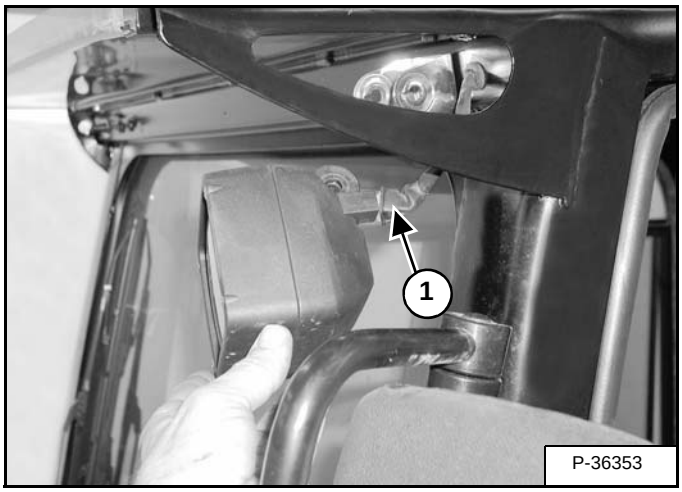
Removal And Installation

Figure 50-50-4

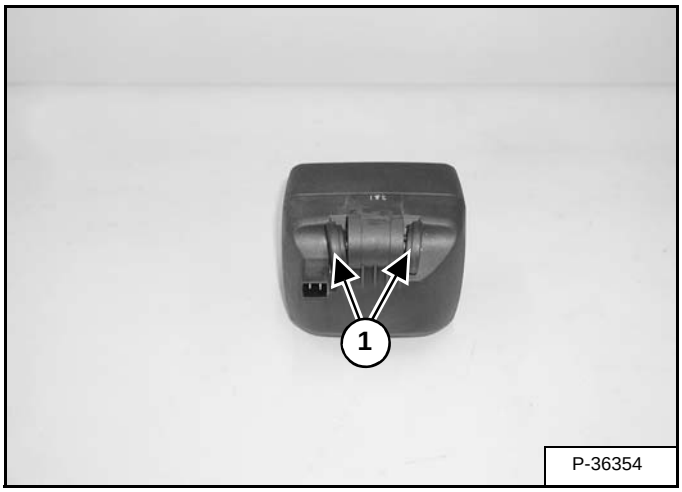


Unplug the wire connector (Item 1) **[Figure 50-50-4]**.

Installation: The wire connector can only be plugged in one way.

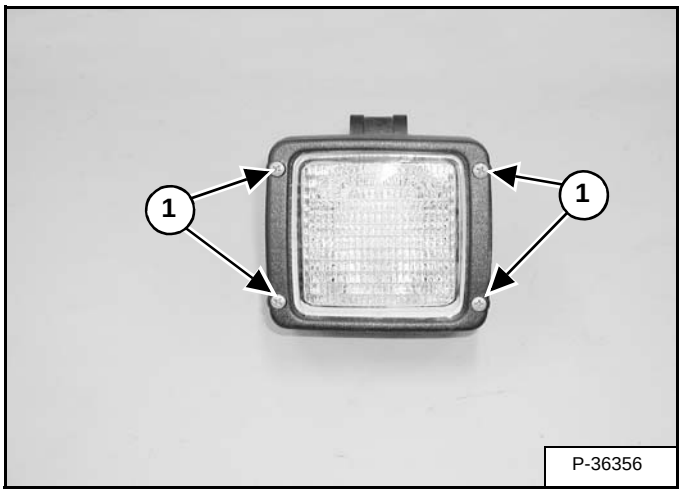
Disassembly And Assembly

Figure 50-50-5



Remove the two bushings (Item 1) **[Figure 50-50-5]**.

Figure 50-50-6



Loosen the four screws (Item 1) **[Figure 50-50-6]**.

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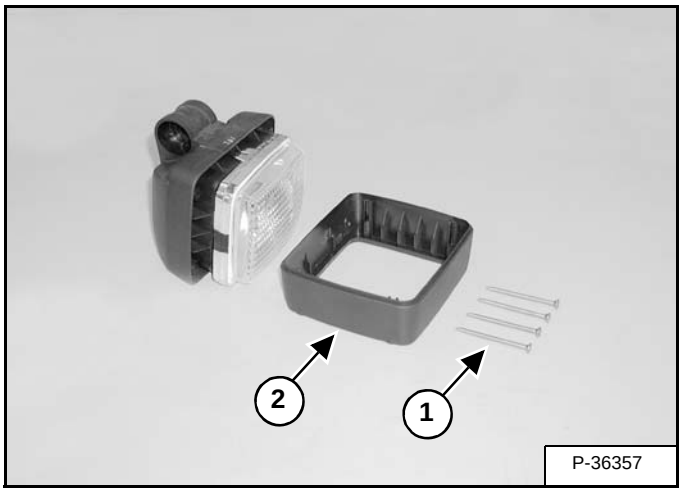
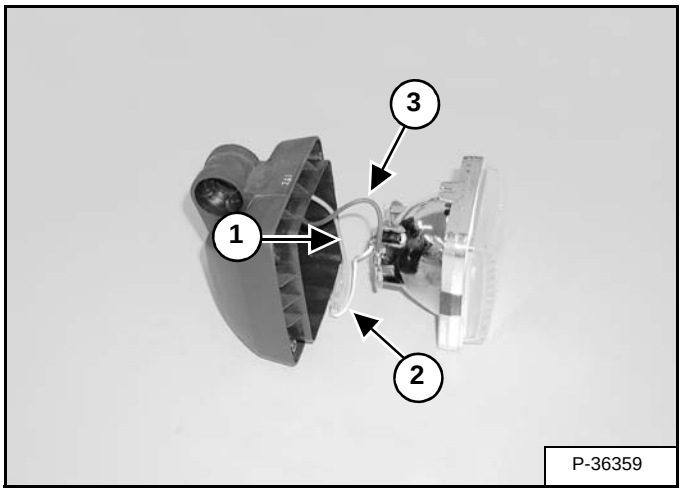
Disassembly And Assembly (Cont'd)

Figure 50-50-7



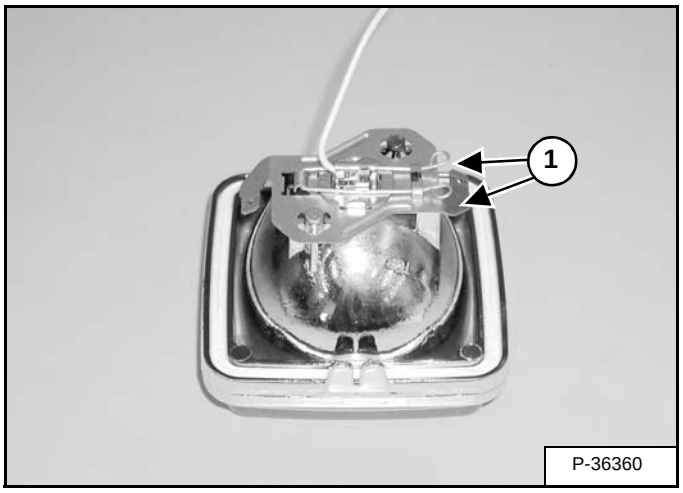
Remove the four screws (Item 1) and cover (Item 2) **[Figure 50-50-7]**.

Figure 50-50-8



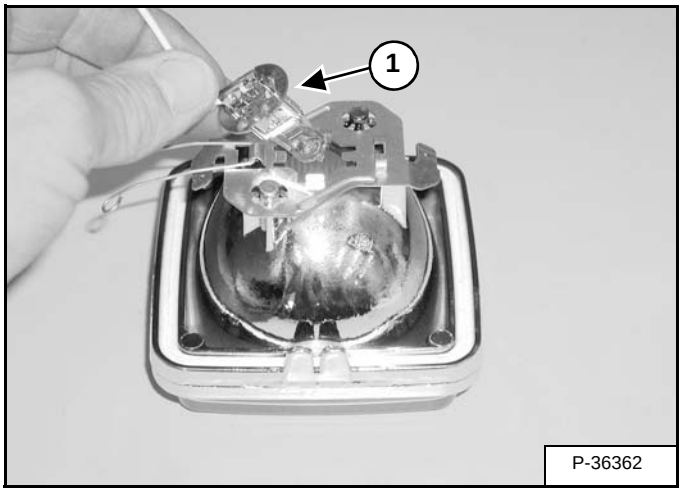
Disconnect the red wire (Item 1) from the white wire (Item 2). Remove the black wire (Item 3) **[Figure 50-50-8]** from the housing.

Figure 50-50-9



Squeeze the ends of the retainer clip (Item 1) **[Figure 50-50-9]** and pivot the retainer clip to the side.

Figure 50-50-10



Remove the bulb (Item 1) **[Figure 50-50-10]**.

NOTE: Do not touch the bulb. If the bulb needs to be cleaned use a clean lint free cloth. Any dirt or oil on the bulb will shorten the service life of the bulb.

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Disassembly And Assembly (Cont'd)

Figure 50-50-11

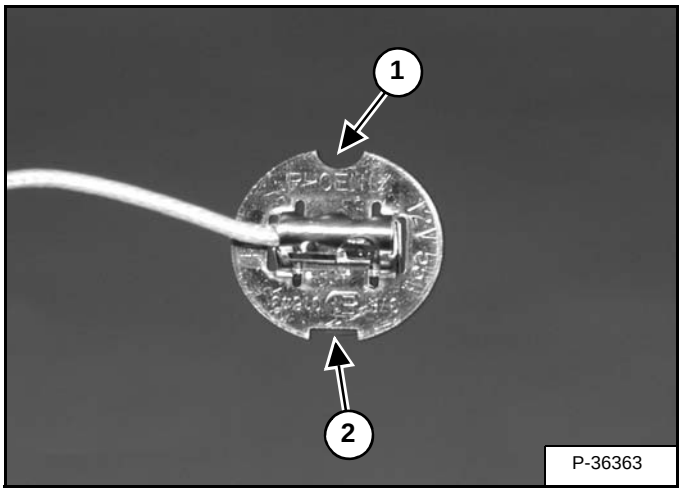
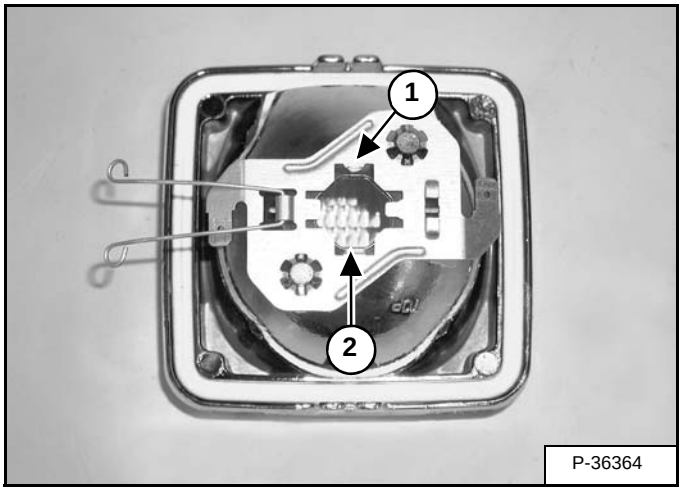


Figure 50-50-12



Installation: Align the notches (Item 1 & 2) **[Figure 50-50-11]** on the bulb with the notches (Item 1 & 2) **[Figure 50-50-12]** in the housing

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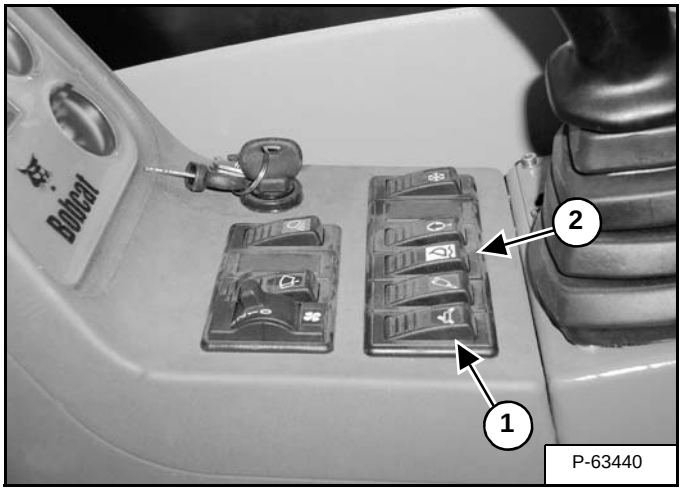
TWO SPEED SWITCH

Removal And Installation

Turn the battery disconnect switch to the off position.

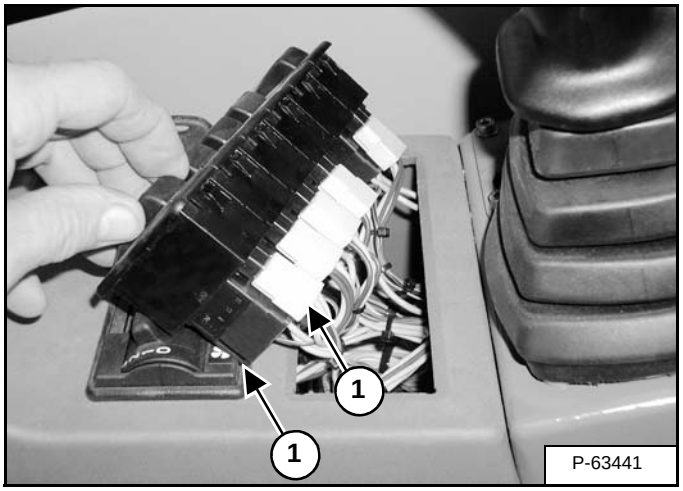
Figure 50-60-1



The two-speed switch (Item 1) **[Figure 50-60-1]** is located on the right console.

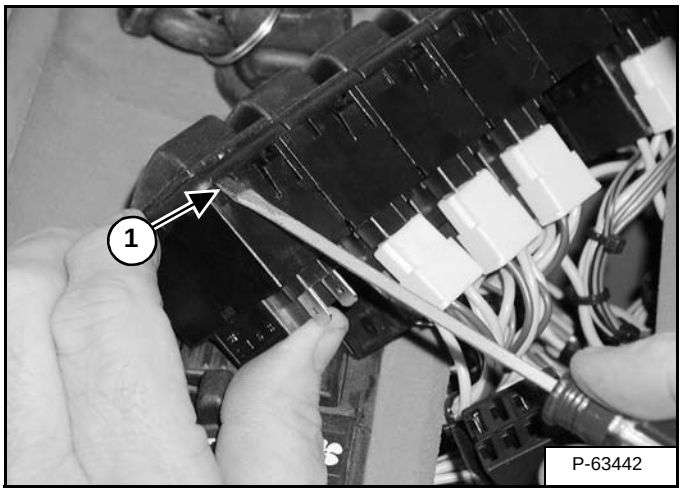
Raise the panel (Item 2) **[Figure 50-60-1]**.

Figure 50-60-2



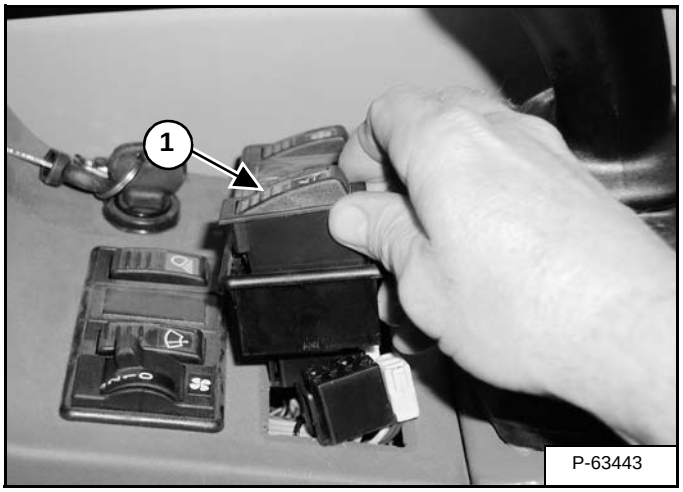
Disconnect the 2 wire connectors (Item 1) **[Figure 50-60-2]**.

Figure 50-60-3



Press in on the tab (Item 1) **[Figure 50-60-3]**. (Both ends)

Figure 50-60-4



Remove the two speed switch (Item 1) **[Figure 50-60-4]**.

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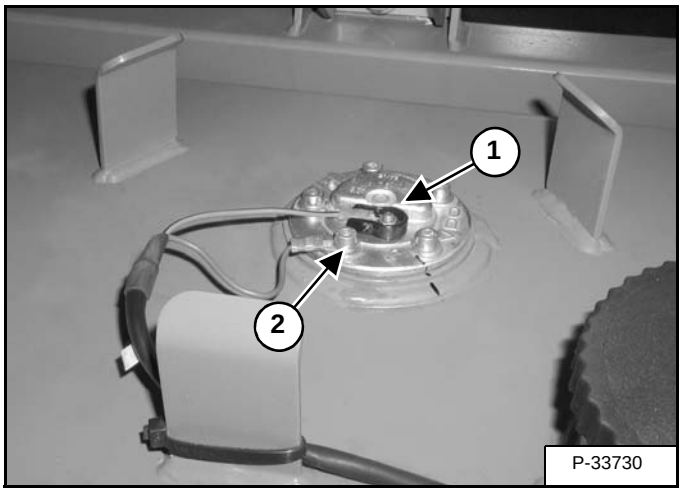
FUEL LEVEL SENDER

Removal And Installation

Disconnect the negative battery cable. (See BATTERY on Page 50-20-1.)

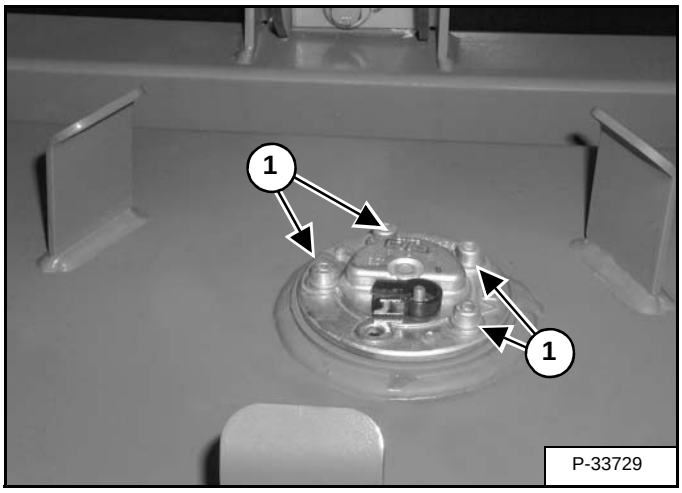
Remove the rear cover. (See REAR COVER on Page 40-150-1.)

Figure 50-70-1



Remove the power wire (Item 1) and ground wire (Item 2) **[Figure 50-70-1]**.

Figure 50-70-2



Remove the four bolts (Item 1) **[Figure 50-70-2]**.

Remove the sender.

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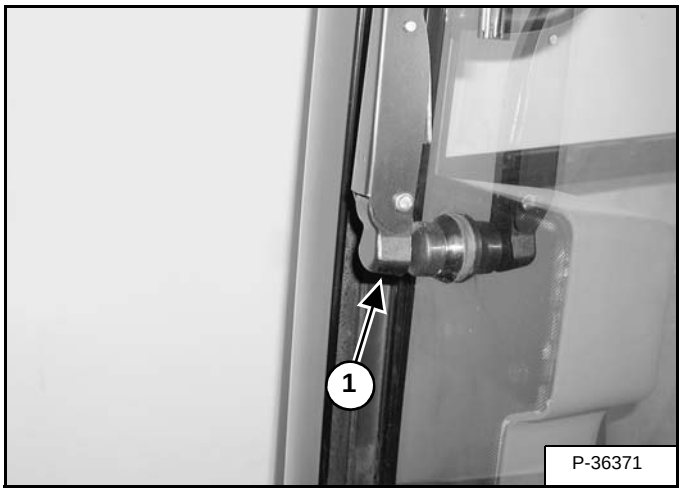
WIPER MOTOR

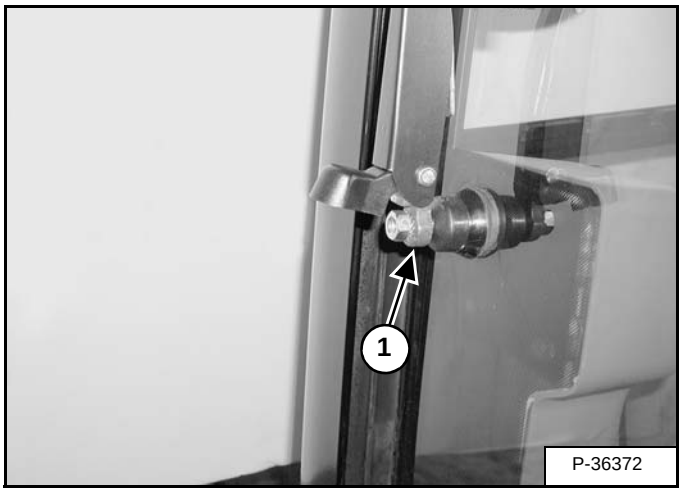
Removal And Installation

Figure 50-80-1



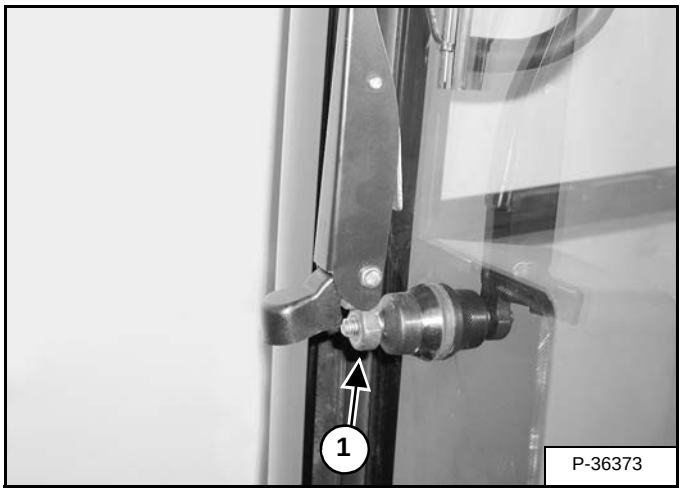
Open the cover (Item 1) **[Figure 50-80-1]**.

Figure 50-80-2



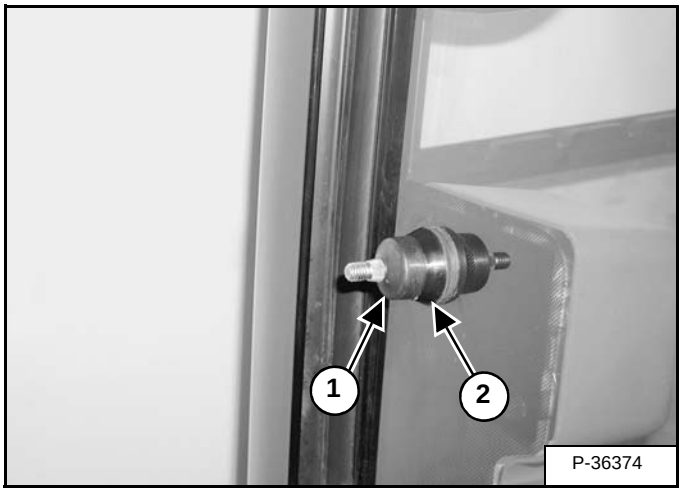
Remove the nut (Item 1) **[Figure 50-80-2]** and washer.

Figure 50-80-3



Remove the wiper arm (Item 1) **[Figure 50-80-3]**.

Figure 50-80-4



Remove the nut (Item 1) and spacer (Item 2) **[Figure 50-80-4]**.

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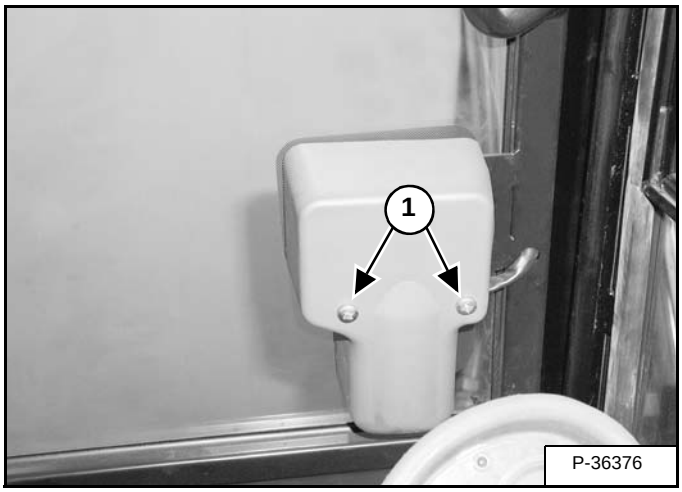
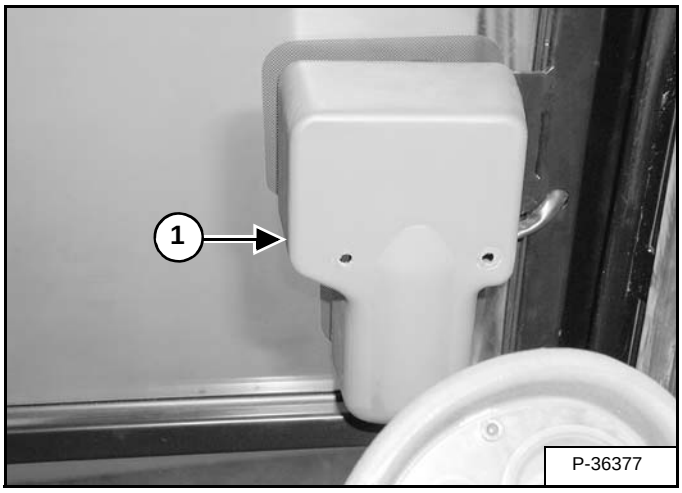
Removal And Installation (Cont'd)

Figure 50-80-5



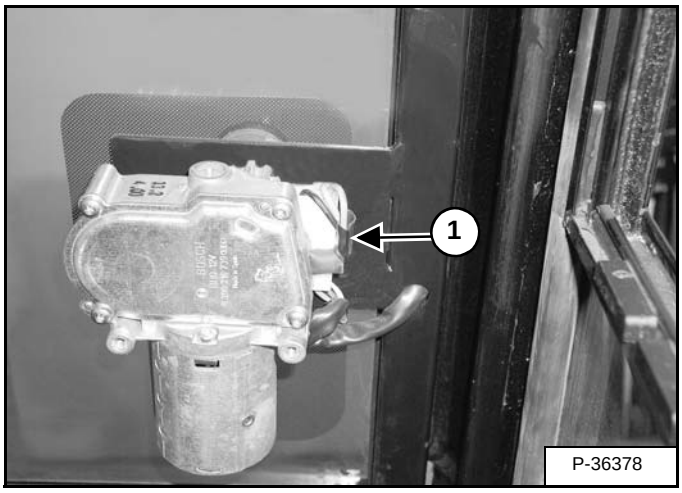
Remove the two screws (Item 1) **[Figure 50-80-5]** from the cover.

Figure 50-80-6



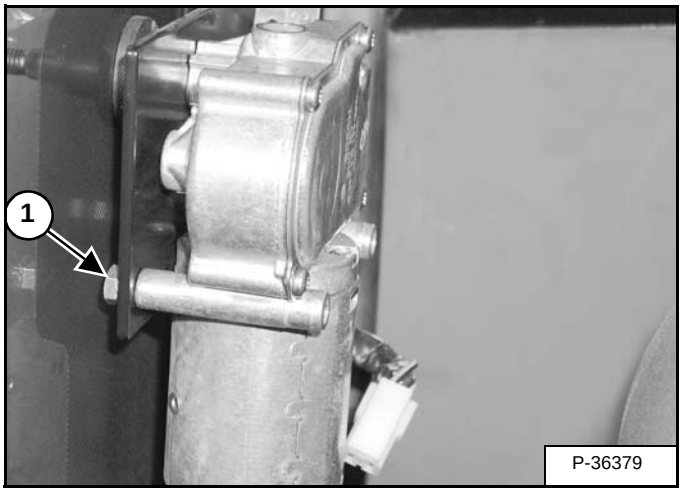
Remove the cover (Item 1) **[Figure 50-80-6]**.

Figure 50-80-7



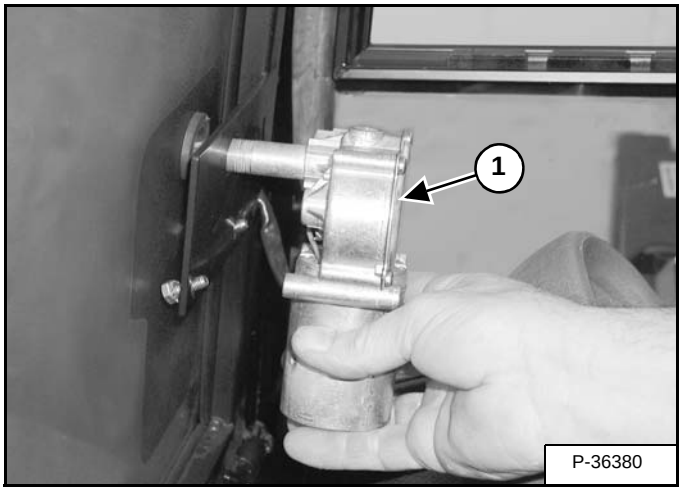
Disconnect the wire harness (Item 1) **[Figure 50-80-7]**.

Figure 50-80-8



Remove the two bolts (Item 1) **[Figure 50-80-8]**.

Figure 50-80-9



Remove the wiper motor (Item 1) **[Figure 50-80-9]**.

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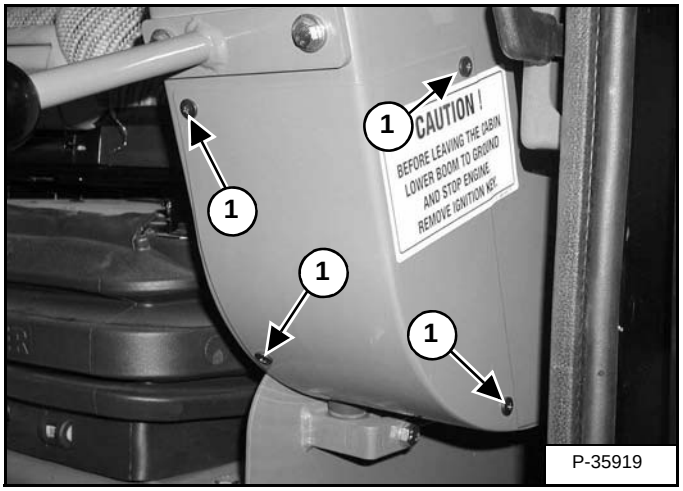
BATTERY DISCONNECT SWITCH

Removal And Installation

Disconnect the battery. (See Servicing on Page 50-20-1.)

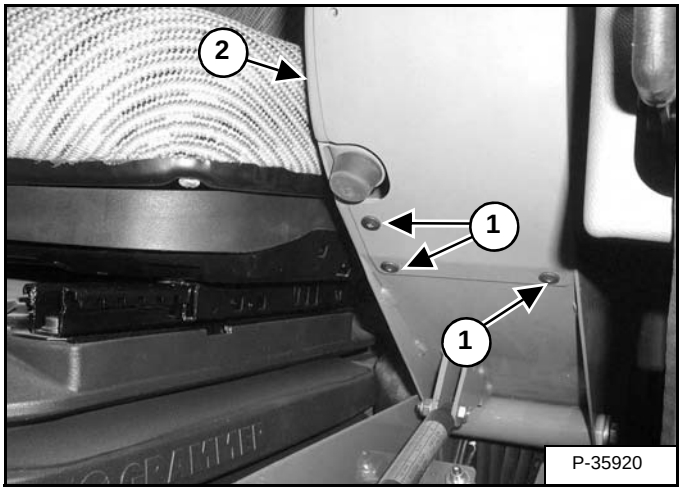
Figure 50-90-1



Remove the four screws (Item 1) **[Figure 50-90-1]**.

Raise the left console.

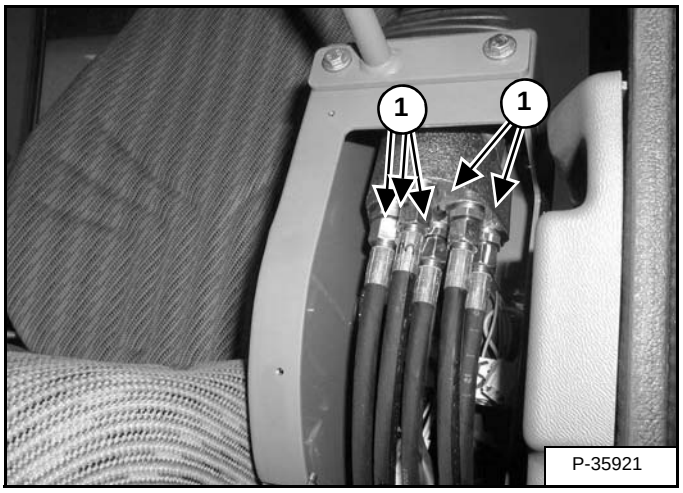
Figure 50-90-2



Remove the three screws (Item 1) **[Figure 50-90-2]**.

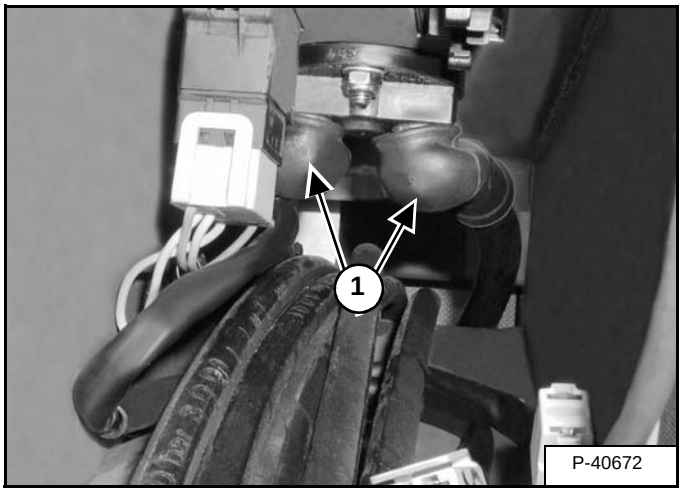
Remove the lower console cover (Item 2) **[Figure 50-90-2]**.

Figure 50-90-3



Mark and remove the six hoses (Item 1) **[Figure 50-90-3]**. Install caps and plugs.

Figure 50-90-4



Remove the dust covers (Item 1) **[Figure 50-90-4]**.

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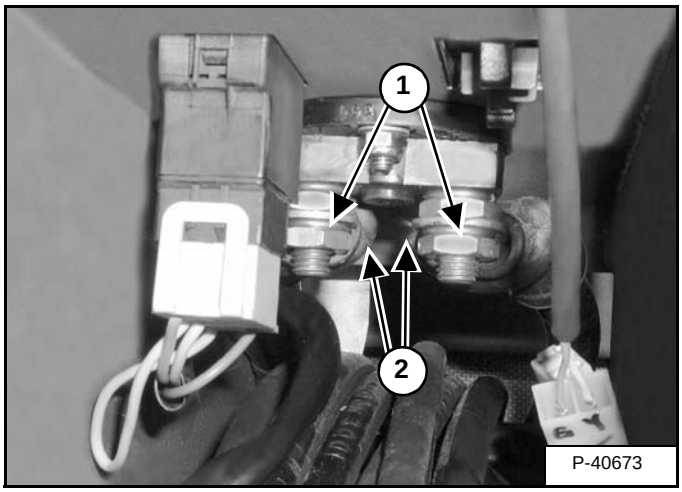
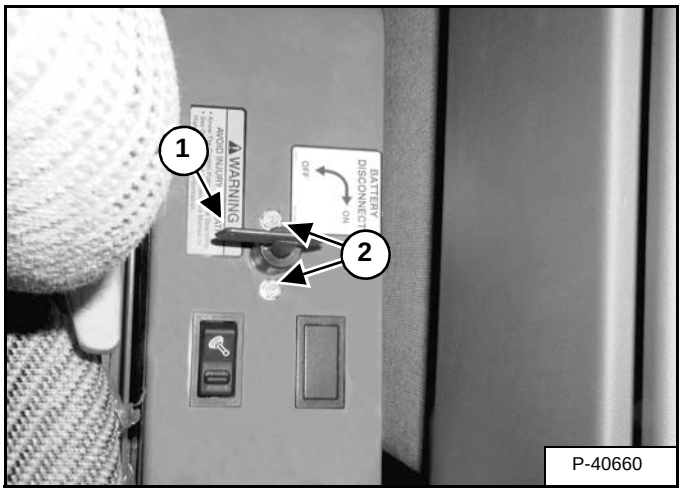
Removal And Installation (Cont'd)

Figure 50-90-5



Remove the two nuts (Item 1) and cables (Item 2) **[Figure 50-90-5]**.

Figure 50-90-6



Remove the key (Item 1) and two bolts (Item 2) **[Figure 50-90-6]** and locknuts.

Remove the switch.

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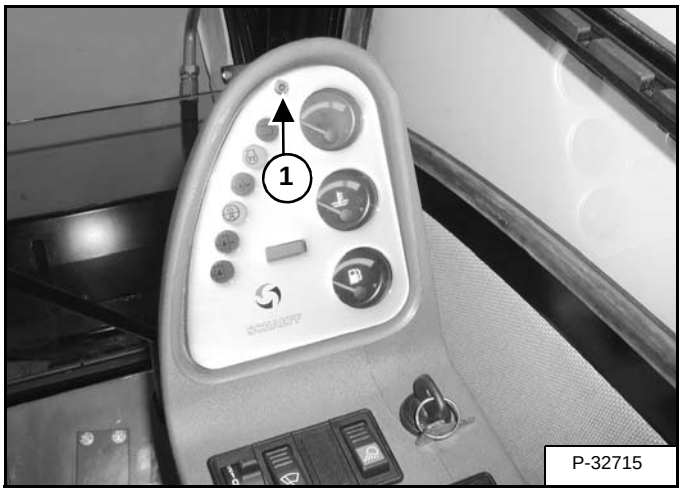
INSTRUMENT PANEL

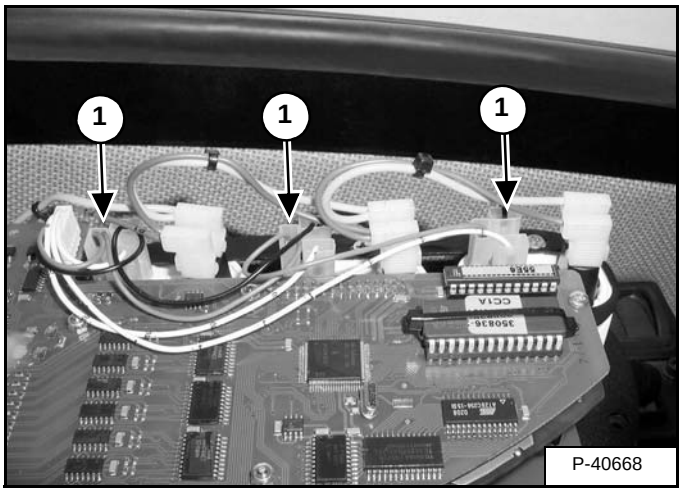
Removal And Installation

Figure 50-100-1



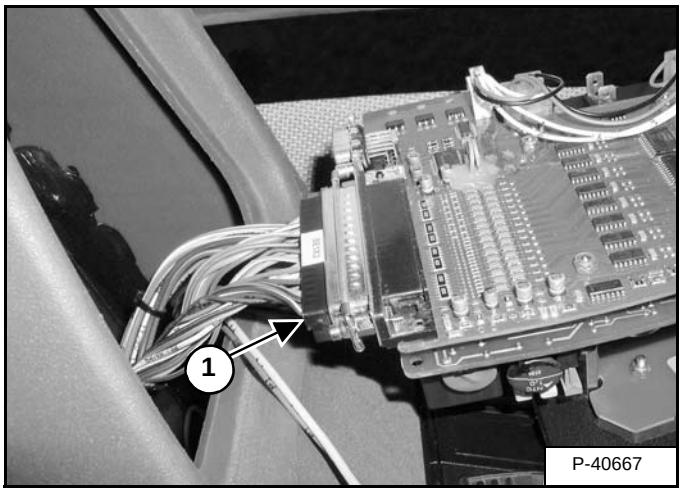
Remove the screw (Item 1) **[Figure 50-100-1]**.

Figure 50-100-2



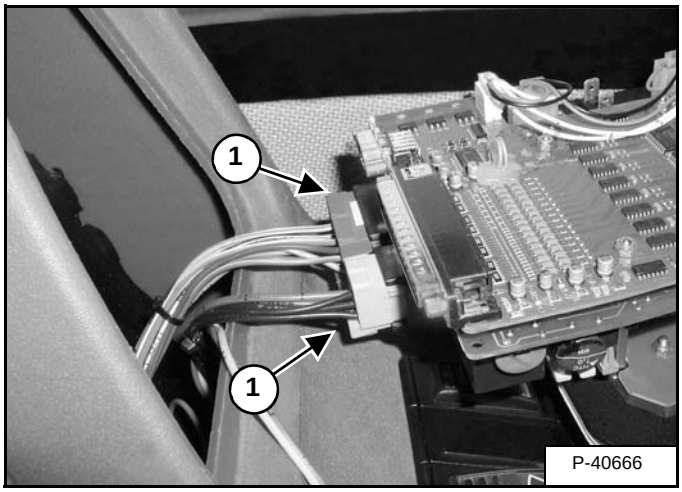
Tip the instrument panel back and remove the gauge light harness connectors (Item 1) **[Figure 50-100-2]**.

Figure 50-100-3



Loosen the wire harness screws and remove the wire harness (Item 1) **[Figure 50-100-3]**.

Figure 50-100-4



Remove the two wire harness connectors (Item 1) **[Figure 50-100-4]**.

Remove the instrument panel.

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E-Prom Information

Figure 50-100-5

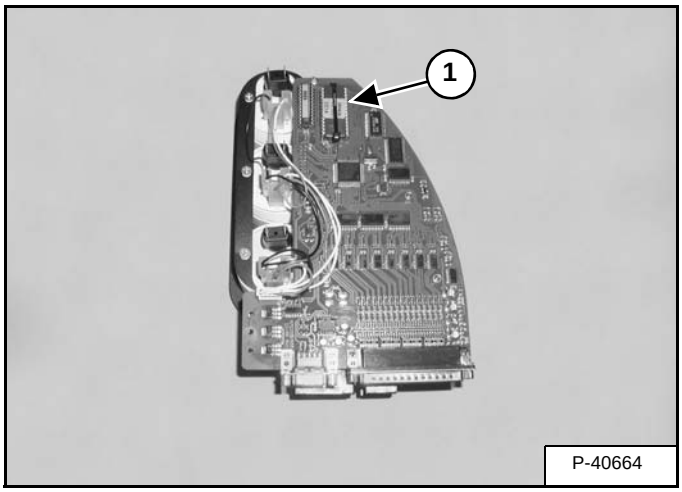
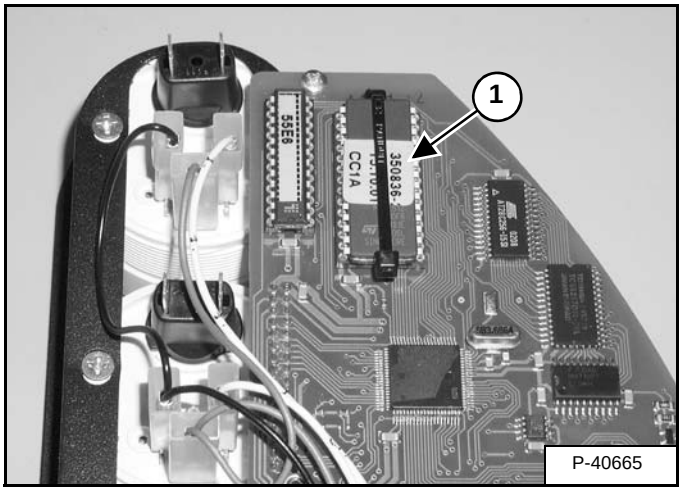


Figure 50-100-6



The E-prom (Item 1) **[Figure 50-100-5]** & **[Figure 50-100-6]** is located on the back of the instrument panel.

The E-prom is not dealer serviceable and the complete instrument panel must be sent to Bobcat Company for service.

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ENGINE SERVICE

AIR CLEANER 60-30-1
Removal And Installation 60-30-1

ENGINE (S/N 522311001 & ABOVE) 60-60-1
Removal And Installation 60-60-1

ENGINE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) . . 60-61-1
Removal And Installation 60-61-1

ENGINE COMPONENTS AND TESTING (S/N 522311001 & ABOVE) . . 60-50-1
Checking the Glow Plugs. 60-50-3
Engine Compression Checking 60-50-1
Fuel Injection Pump Installation. 60-50-15
Fuel Injection Pump Removal 60-50-7
Fuel Injection Pump Timing 60-50-9
Fuel Injector Assembly. 60-50-21
Fuel Injector, Checking 60-50-18
Fuel Injector Disassembly 60-50-19
Fuel Shutoff Solenoid Checking. 60-50-5
Fuel Shutoff Solenoid Removal And Installation 60-50-6
Glow Plug Removal And Installation 60-50-4
Thermostat. 60-50-24
Valve Clearance Adjustment 60-50-23

ENGINE COMPONENTS AND TESTING (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE). 60-51-1
Aneroid Device. 60-51-34
Checking the Manifold Heater 60-51-3
Engine Compression Checking 60-51-1
Fuel Injector Assembly. 60-51-17
Fuel Injector, Checking 60-51-14
Fuel Injector Disassembly 60-51-15
Fuel Injector Removal And Installation 60-51-13
Fuel Injection Pump Installation. 60-51-10
Fuel Injection Pump Removal 60-51-7
Fuel Injection Pump Timing 60-51-9
Fuel Shutoff Solenoid Checking. 60-51-5
Fuel Shutoff Solenoid Removal And Installation 60-51-6
Manifold Heater Removal And Installation. 60-51-4
Thermostat, Oil Pressure Control Valves & Heater Connections. . . . 60-51-31
Timing Belt Inspection 60-51-19
Timing Belt Installation. 60-51-22
Timing Belt Removal 60-51-20
Valve Clearance Adjustment 60-51-28
Valve Timing, Checking 60-51-29

Continued On Next Page

https://www.pdfmanual4trucks.com/

FLYWHEEL (S/N 522311001 & ABOVE) 60-70-1
Flywheel Ring Gear 60-70-2
Removal And Installation 60-70-1

FLYWHEEL (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) . . 60-71-1
Flywheel Ring Gear 60-71-2
Removal And Installation 60-71-1

MUFFLER (S/N 522311001 & ABOVE) 60-20-1
Removal And Installation 60-20-1

MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) . . . 60-21-1
Removal And Installation 60-21-1

RADIATOR/OIL COOLER (S/N 522311001 & ABOVE) 60-40-1
Removal And Installation 60-40-1

RADIATOR/OIL COOLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 60-41-1
Hydraulic Check Valve Removal And Installation 60-41-5
Hydraulic Check Valve Disassembly And Assembly 60-41-6
Removal And Installation 60-41-1

Continued On Next Page

https://www.pdfmanual4trucks.com/

RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) 60-80-1
Assembly 60-80-9
Balancing Shaft Bearing, Checking (If Equipped) 60-80-50
Balancing Shaft Bearing, Removal And Installation 60-80-51
Camshaft Bearing, Checking 60-80-48
Camshaft Bearing, Removal And Installation 60-80-49
Connecting Rod, Checking 60-80-58
Control Rod Guide Bushing Installation 60-80-52
Crankshaft, Checking 60-80-56
Cylinder, Checking 60-80-47
Cylinder Head Assembly 60-80-68
Cylinder Head Disassembly 60-80-65
Disassembly 60-80-2
Deutz Engine Tools Identification Chart 60-80-1
Front Cover Assembly 60-80-71
Front Cover Disassembly 60-80-70
Piston, Checking 60-80-61
Piston Installation On The Connecting Rod 60-80-64
Piston Pin, Checking 60-80-62
Piston Rings Installation 60-80-63
Rear Cover Seal Removal And Installation 60-80-54
Rocker Arm And Bracket, Checking 60-80-69
Turbo Charger Removal and Installation 60-80-72
Valves, Checking 60-80-66
Valve Clearance Adjustment 60-80-67

Continued On Next Page

https://www.pdfmanual4trucks.com/

RECONDITIONING THE ENGINE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) 60-81-1
Assembly 60-81-9
Camshaft Bearing, Checking 60-81-29
Camshaft Bearing, Removal And Installation. 60-81-30
Connecting Rod, Checking 60-81-41
Control Rod Guide Bushing Installation 60-81-33
Control Rod Guide Bushing Removal 60-81-31
Crankshaft, Checking. 60-81-39
Crankshaft Gear Mounting Bolt Torque Procedure 60-81-72
Cylinder, Checking 60-81-28
Cylinder Head Assembly 60-81-51
Cylinder Head Disassembly. 60-81-48
Disassembly. 60-81-2
Deutz Engine Tools Identification Chart 60-81-1
Front Cover Assembly 60-81-60
Front Cover Disassembly. 60-81-54
Piston, Checking 60-81-44
Piston Installation On The Connecting Rod 60-81-47
Piston Pin, Checking 60-81-45
Piston Rings Installation. 60-81-46
Rear Cover Seal Removal And Installation 60-81-38
Rocker Arm And Bracket, Checking 60-81-53
Turbo Charger Removal and Installation 60-81-70
Valves, Checking 60-81-49
Valve Clearance Adjustment 60-81-50

TROUBLESHOOTING 60-10-1
Chart 60-10-1

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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, 18, 20, 21, 22, 23, 27, 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, 46, 47
Low oil pressure.	4, 31, 32, 33, 34, 35, 37, 38, 39, 45, 48
Engine knocking.	13, 15, 16, 19, 22, 24, 25, 27, 29, 31, 40, 41, 49
Engine running rough.	7, 8, 9, 10, 11, 12, 13, 17, 18, 22, 24, 25, 26, 29, 40, 49
Vibration.	2, 13, 17, 21, 22, 25, 26, 29, 40, 42, 43
High oil pressure warning.	4, 33, 36
Overheating.	10, 12, 13, 15, 16, 20, 21, 32, 40, 44, 47
Too much crankcase pressure.	22, 27, 29, 46
Poor compression.	10, 16, 21, 24, 25, 27, 28, 29, 30, 41, 49
Start and stop	9, 10, 11

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Chart (Cont'd)

KEY TO CORRECT THE CAUSE	
1. Battery capacity low.	26. Incorrect high pressure fuel lines.
2. Bad electrical connections.	27. Worn cylinder bores.
3. Faulty starter motor.	28. Worn valves and seat.
4. Incorrect grade of oil.	29. Broken, worn or sticking piston rings.
5. Low cranking speed.	30. Worn valve stems or guides.
6. Fuel tank empty.	31. Worn or damaged bearings.
7. Faulty stop control operation.	32. Not enough oil in the oil pan.
8. Plugged fuel line.	33. Switch/sensor is defective.
9. Plugged fuel filter.	34. Oil pump worn.
10. Restriction in the air cleaner.	35. Pressure relief valve is sticking open.
11. Air in the fuel system.	36. Pressure relief valve is sticking closed.
12. Faulty fuel injection pump.	37. Broken relief valve spring.
13. Faulty fuel injectors.	38. Faulty suction pipe.
14. Broken injection pump drive.	39. Plugged oil filter.
15. Incorrect injection pump timing.	40. Piston seizure.
16. Incorrect valve timing.	41. Incorrect piston height.
17. Poor compression.	42. Faulty engine mounting.
18. Plugged fuel tank vent.	43. Incorrect alignment of flywheel.
19. Incorrect grade of fuel.	44. Faulty thermostat.
20. Exhaust pipe restriction.	45. Plugged oil cooler
21. Cylinder head gasket leaking.	46. Plugged PCV system
22. Overheating.	47. Damaged valve stem oil deflectors.
23. Cold running.	48. Plugged oil pump pipe strainer.
24. Incorrect tappet adjustment.	49. Broken valve spring.
25. Sticking valves.	

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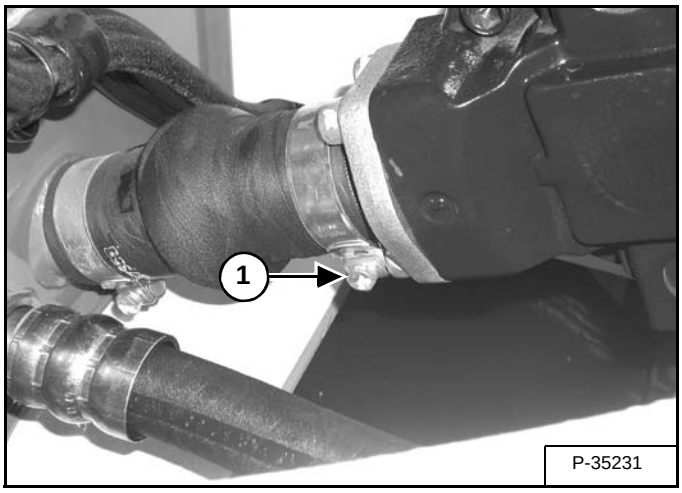
MUFFLER (S/N 522311001 & ABOVE)

Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

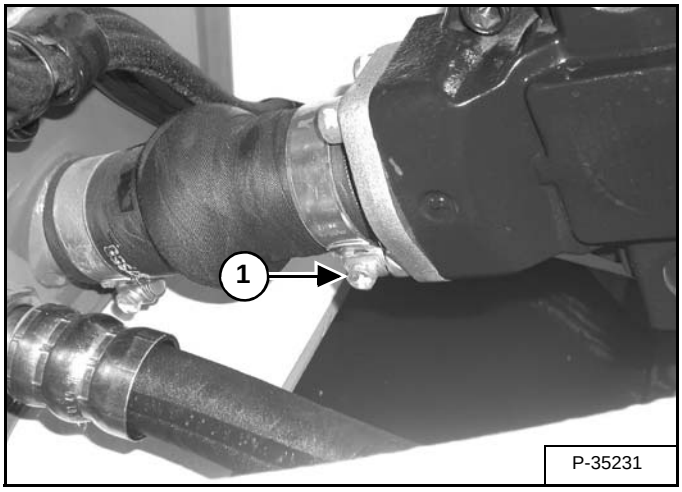
Remove the rear cover. (See REAR COVER on Page 40-150-1.)

Figure 60-20-1



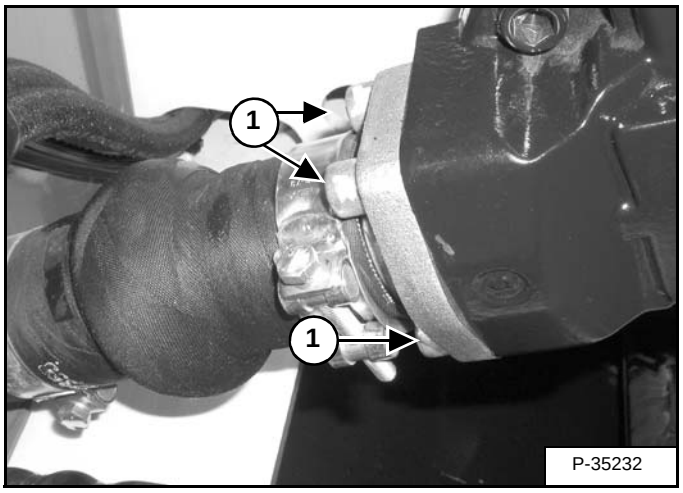
Remove the two bolts (Item 1) **[Figure 60-20-1]** and hose clamps.

Figure 60-20-2



Loosen the clamp (Item 1) **[Figure 60-20-2]**. Rotate the clamp to provide clearance to the suction fitting bolts.

Figure 60-20-3



Remove the four bolts (Item 1) **[Figure 60-20-3]**.

Figure 60-20-4

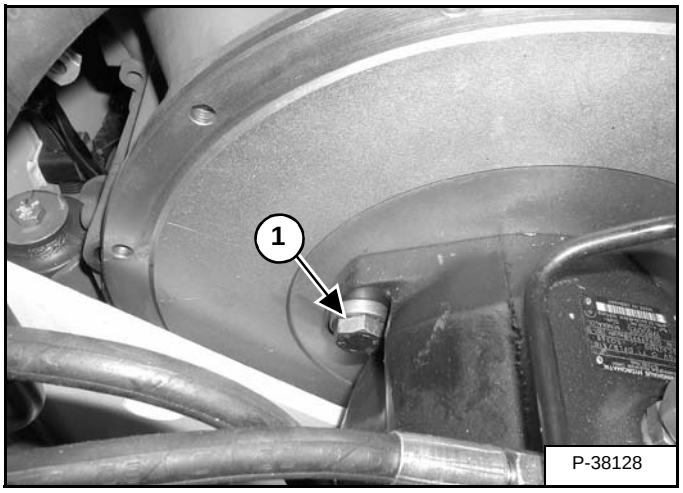
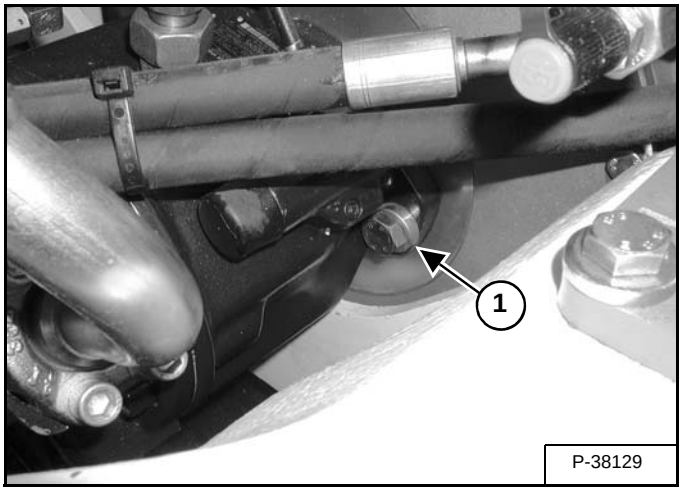


Figure 60-20-5



Remove the two pump mount bolts (Item 1) **[Figure 60-20-4]** and **[Figure 60-20-5]** and washers.

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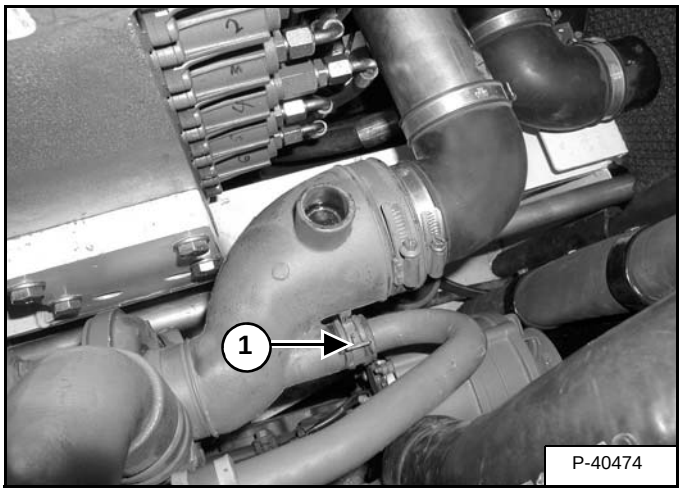
Removal And Installation (Cont'd)

Installation: Tighten the bolts to 125-140 ft.-lb. (170-190 N•m) torque.

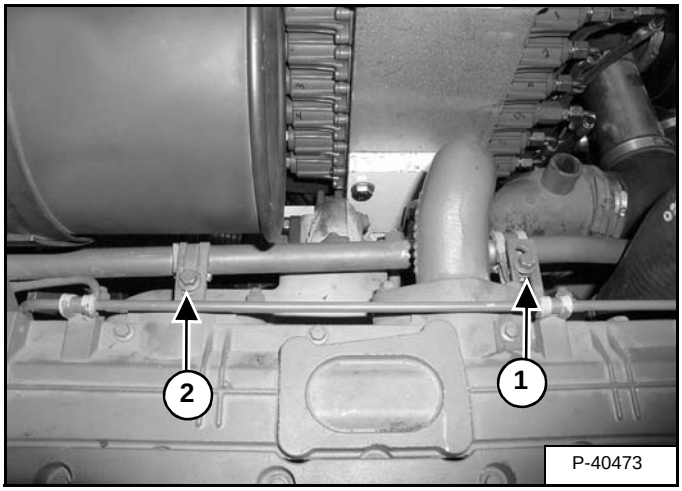
Slide the pump away from the engine.

Figure 60-20-6



Remove the clamp (Item 1) **[Figure 60-20-6]**.

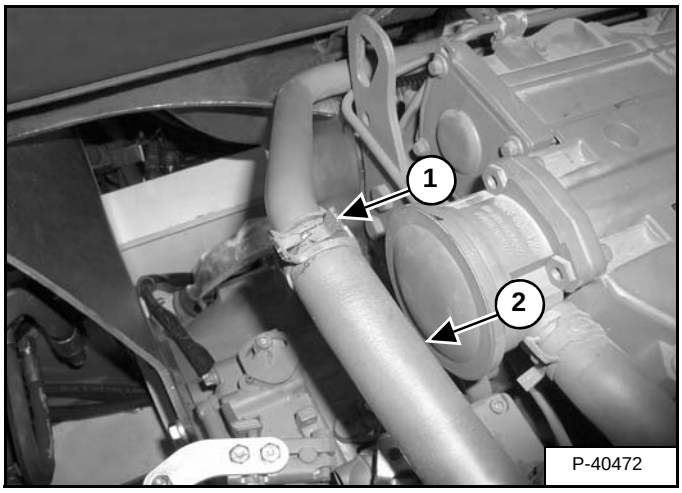
Figure 60-20-7



Remove the bolt (Item 1) **[Figure 60-20-7]**, spacer and nut.

Remove the bolt (Item 2) **[Figure 60-20-7]** and nut.

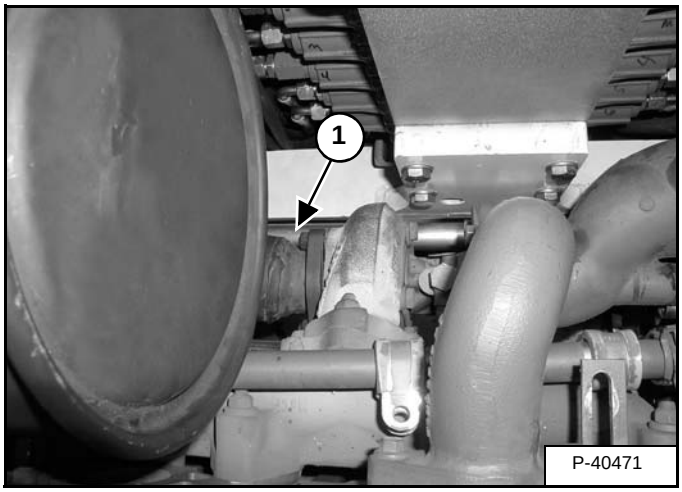
Figure 60-20-8



Remove the clamp (Item 1) **[Figure 60-20-8]**.

Reposition the tubeline (Item 2) **[Figure 60-20-8]** for clearance when removing the muffler.

Figure 60-20-9



Remove the three nuts (Item 1) **[Figure 60-20-9]**.

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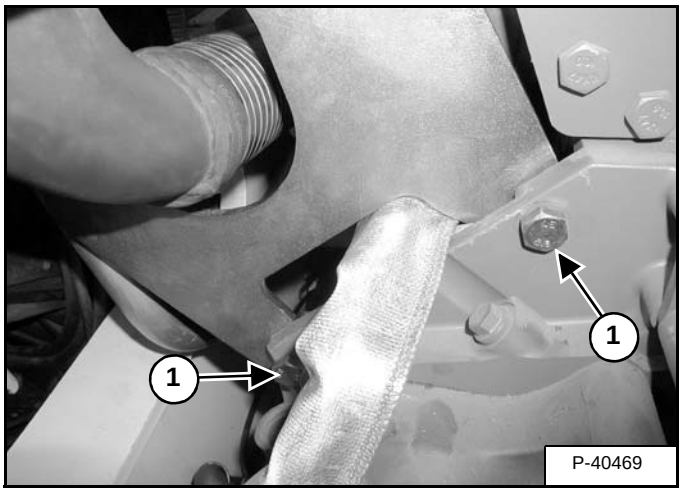
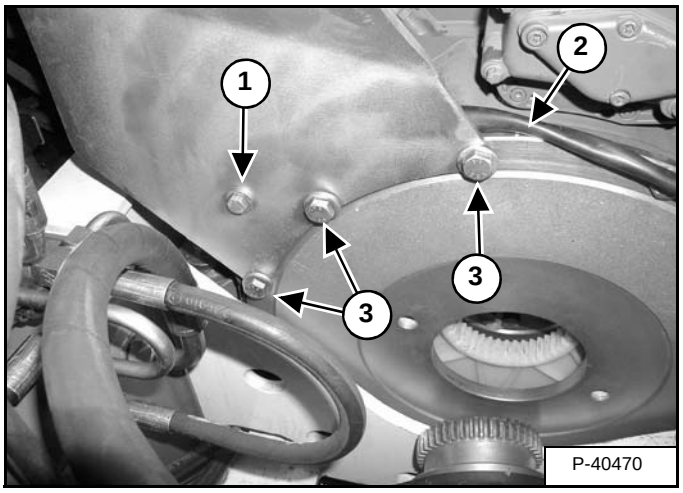
Removal And Installation (Cont'd)

Figure 60-20-10



Remove the bolts (Item 1) **[Figure 60-20-10]** and nuts.

Figure 60-20-11



Remove the bolt (Item 1), washer wire harness clamp and nut. Reposition the wire harness (Item 2) **[Figure 60-20-11]** to prevent damage to the harness when removing the muffler.

Remove the bolts (Item 3) **[Figure 60-20-11]** and washers.

Installation: Apply medium strength thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 33 ft.-lb. (45 N•m) torque.

Remove the muffler and mount assembly.

Figure 60-20-12

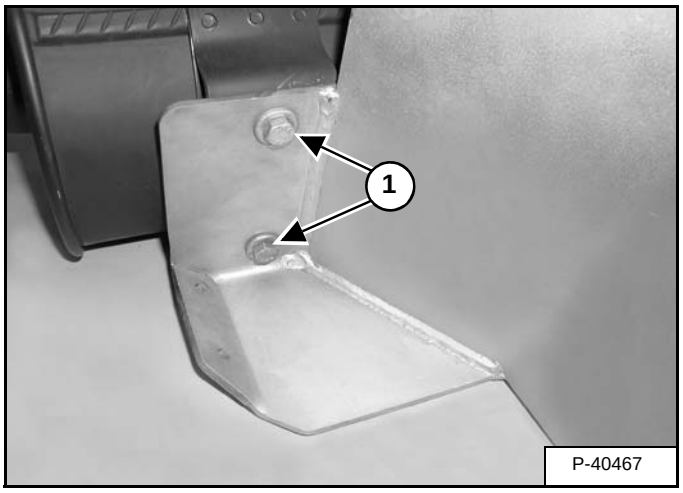
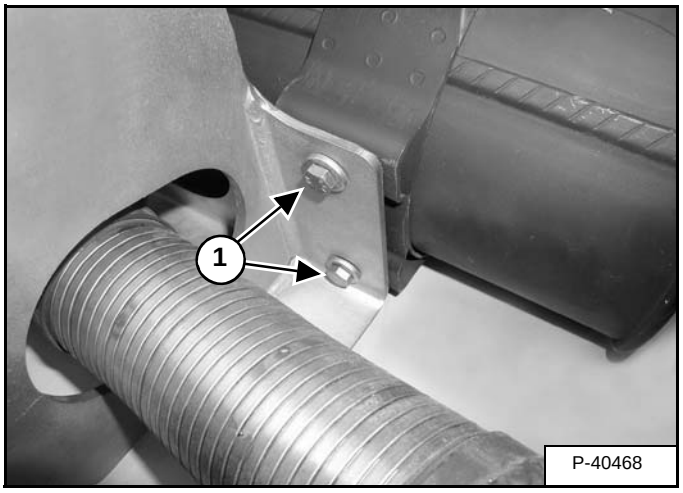


Figure 60-20-13



Remove the four bolts (Item 1) **[Figure 60-20-12]** & **[Figure 60-20-13]** and washers.

Remove the muffler from the mount.

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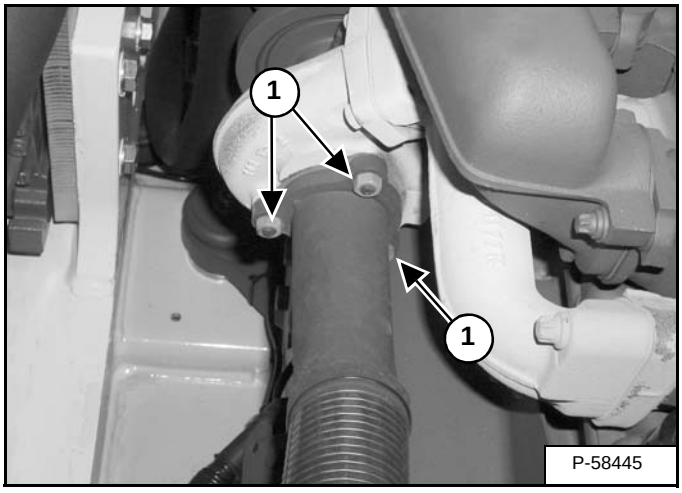
MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

Figure 60-21-1



Remove the nuts (Item 1) **[Figure 60-21-1]**.

Figure 60-21-2

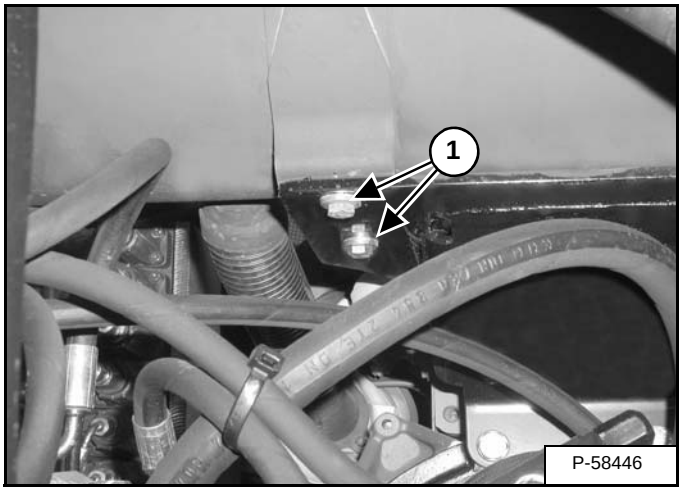
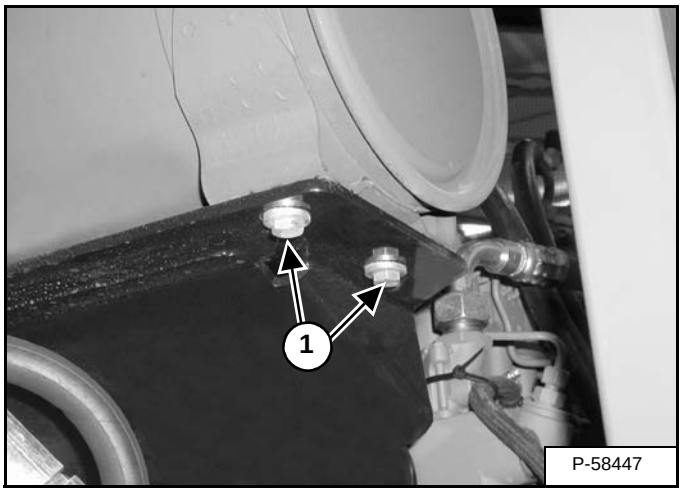


Figure 60-21-3



Remove the bolts (Item 1) **[Figure 60-21-2]** & **[Figure 60-21-3]** and washers.

Remove the muffler.

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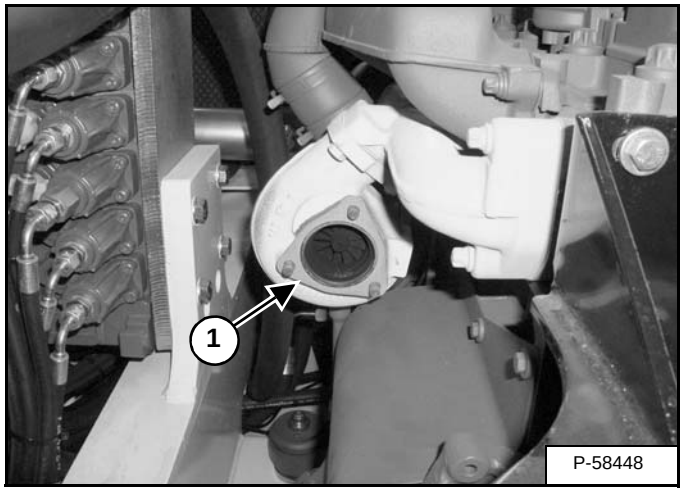
Removal And Installation (Cont'd)

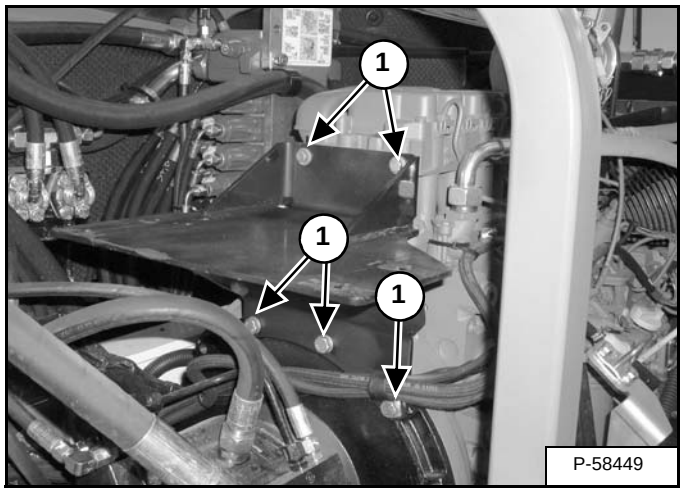
Figure 60-21-4



Remove the gasket (Item 1) **[Figure 60-21-4]** from the turbo.

NOTE: Plug the turbo to prevent any contamination from entering the engine.

Figure 60-21-5



Remove the bolts (Item 1) and washers. Remove the mount **[Figure 60-21-5]**.

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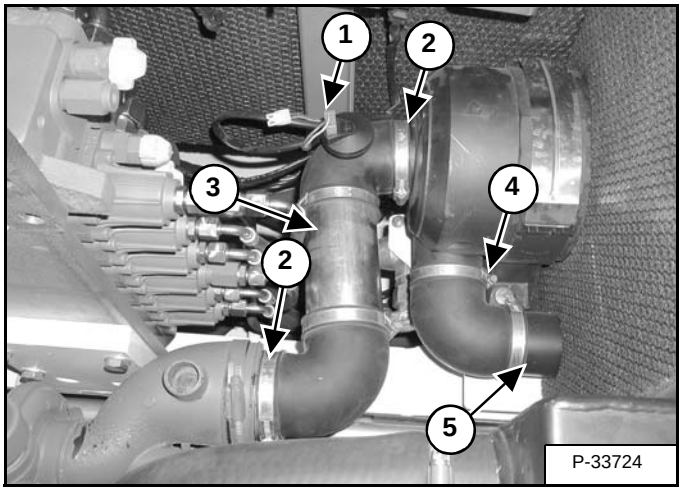
AIR CLEANER

Removal And Installation

Open the right side cover.

Figure 60-30-1



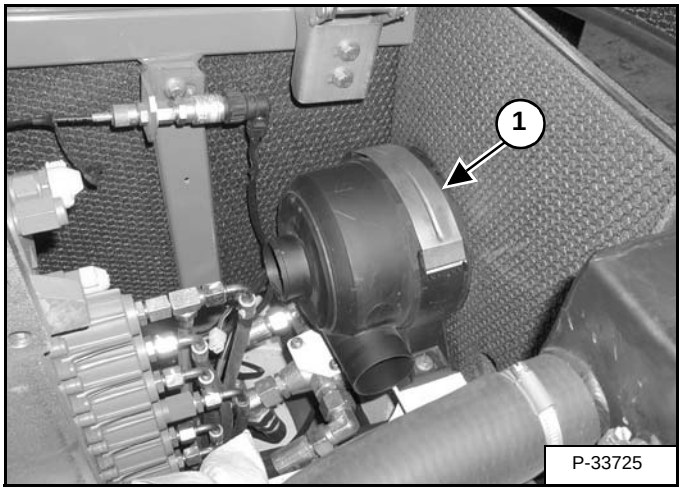
Remove the wire harness (Item 1) **[Figure 60-30-1]**.

Loosen the clamps (Item 2). Remove the tube (Item 3) **[Figure 60-30-1]** and elbows.

NOTE: Plug the intake to keep contamination out of the engine.

Loosen the clamp (Item 4) and remove the air intake (Item 5) **[Figure 60-30-1]**.

Figure 60-30-2



Remove the clamp (Item 1) **[Figure 60-30-2]**.

Figure 60-30-3

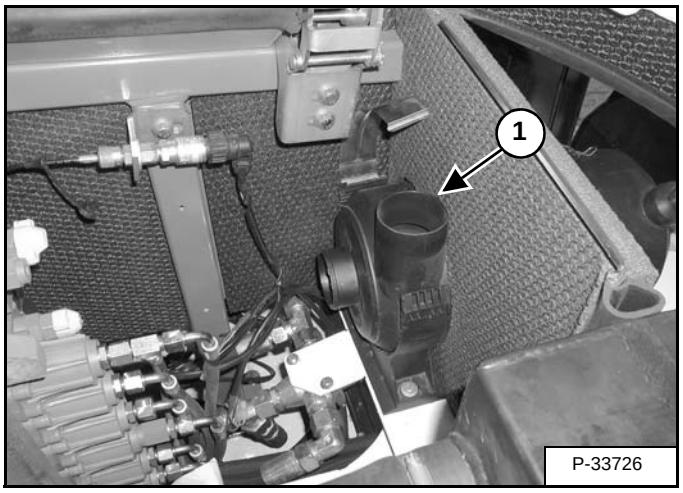
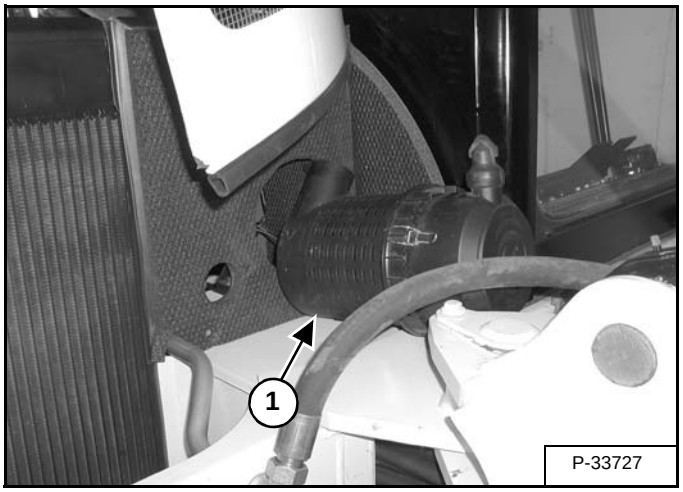


Figure 60-30-4



Slide the air cleaner (Item 1) **[Figure 60-30-3]** & **[Figure 60-30-4]** out the front of the excavator.

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RADIATOR/OIL COOLER (S/N 522311001 & ABOVE)

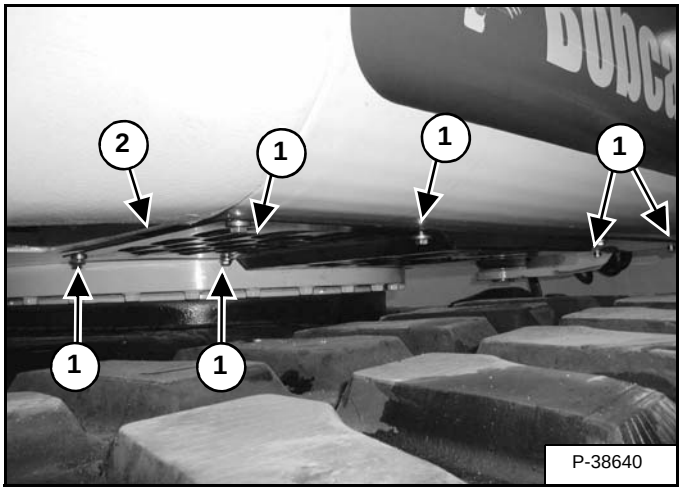
Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

Remove the right side cover. (See RIGHT SIDE COVER on Page 40-160-1.)

Remove the air conditioning condenser. (See CONDENSER (S/N 522311001 & ABOVE) on Page 70-150-1 or See CONDENSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 70-151-1.)

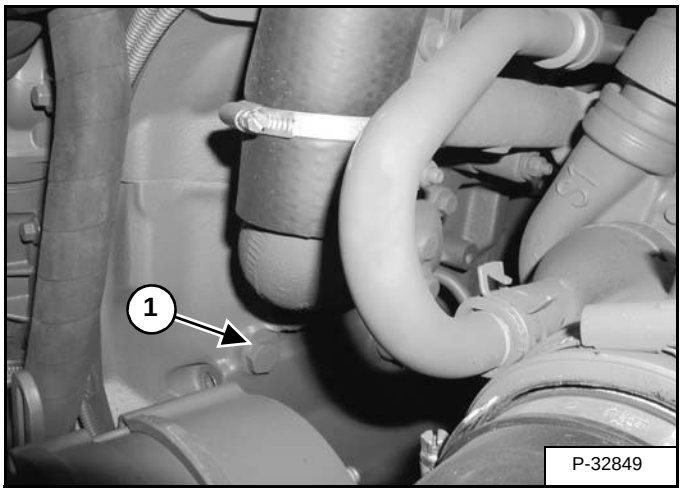
Figure 60-40-1



Remove the eleven bolts (Item 1) **[Figure 60-40-1]** and washers.

Remove the cover (Item 2) **[Figure 60-40-1]**.

Figure 60-40-2

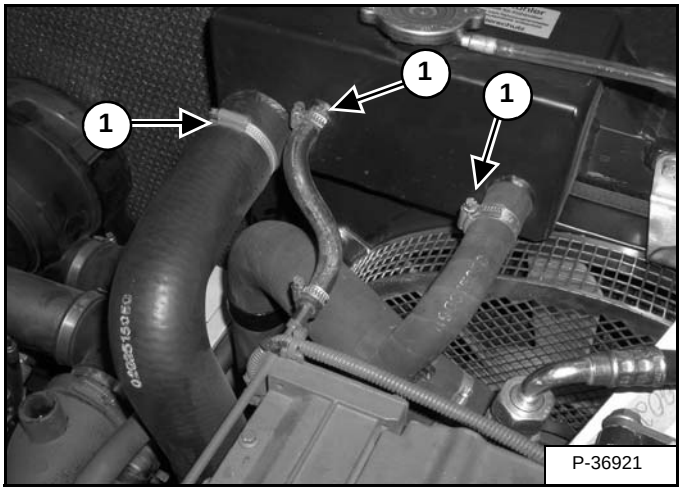


Remove the plug (Item 1) **[Figure 60-40-2]** from the back side of the engine block.

NOTE: The plug is located next to the alternator mount bracket.

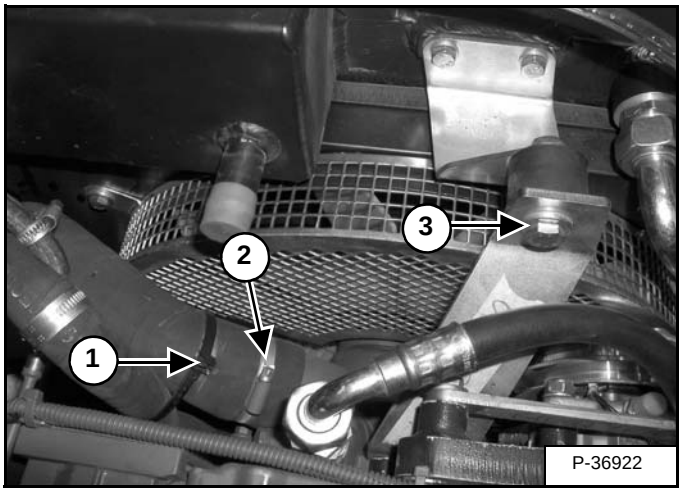
Drain the coolant from the engine.

Figure 60-40-3



Loosen the hose clamps (Item 1) **[Figure 60-40-3]** and remove the hoses from the radiator/oil cooler.

Figure 60-40-4



Cut and remove the cable tie (Item 1) **[Figure 60-40-4]** from the lower radiator hose.

NOTE: The lower hose will be removed with the radiator.

Loosen the hose clamp (Item 2) **[Figure 60-40-4]** and remove the hose from the engine.

Remove the bolt (Item 3) **[Figure 60-40-4]** and washer.

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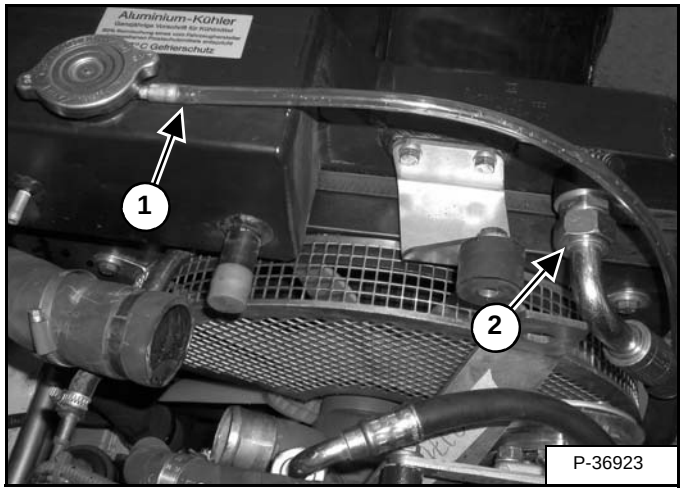
Removal And Installation (Cont'd)

Figure 60-40-5



Remove the hose (Item 1) **[Figure 60-40-5]**.

Remove the top oil hose (Item 2) **[Figure 60-40-5]**.

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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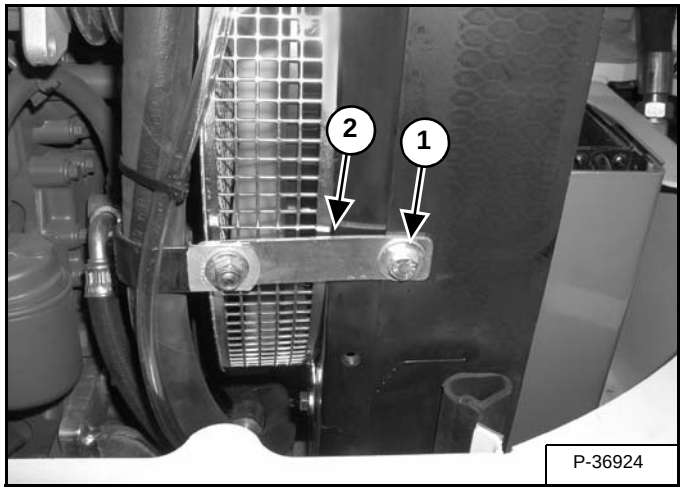
Figure 60-40-6

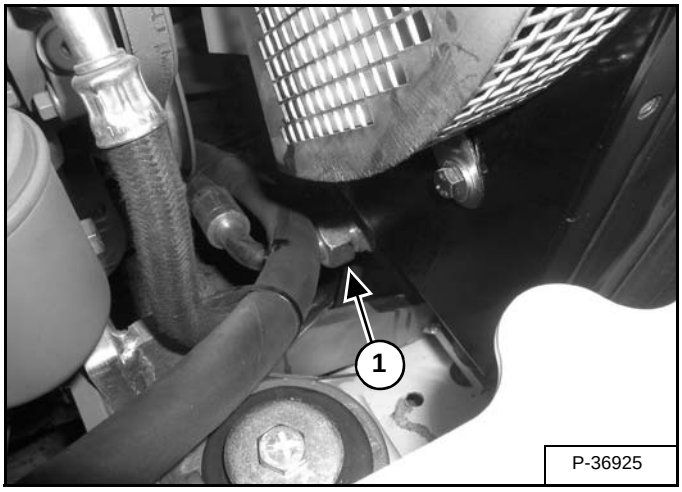


Remove the bolt (Item 1) **[Figure 60-40-6]** and washer.

Position the hose and bracket (Item 2) **[Figure 60-40-6]** towards the rear of the excavator.

Reinstall the bolt (Item 1) **[Figure 60-40-6]**.

Figure 60-40-7



Remove the bottom oil hose (Item 1) **[Figure 60-40-7]**.

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Removal And Installation (Cont'd)

Figure 60-40-8

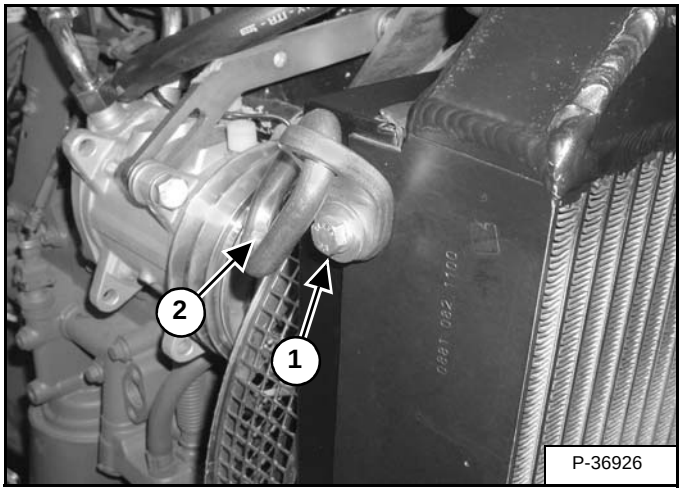
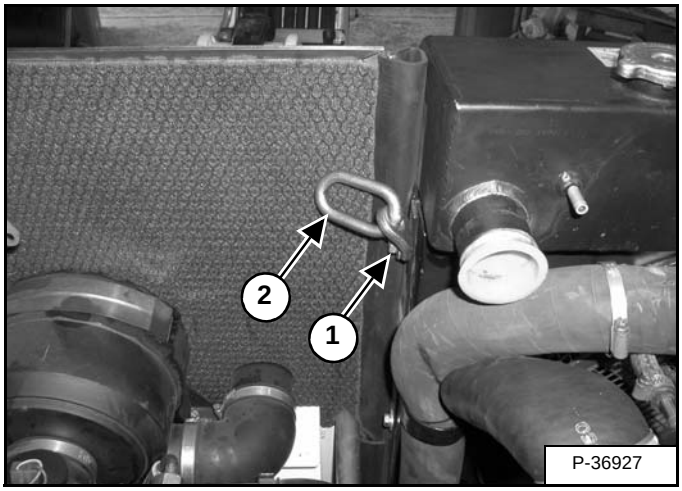


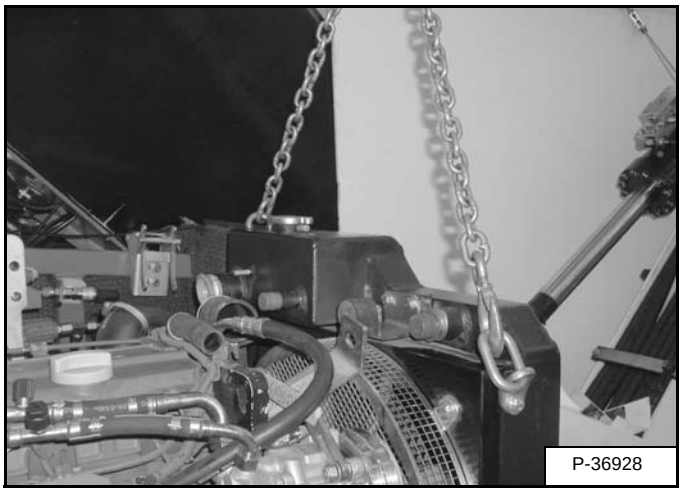
Figure 60-40-9



Remove the top fan shroud mount bolts (Item 1) **[Figure 60-40-8]** & **[Figure 60-40-9]** from both sides.

Install lifting brackets (Item 2) **[Figure 60-40-8]** & **[Figure 60-40-9]** on the bolts, and reinstall the bolts.

Figure 60-40-10



Install a lifting chain and hoist on the lifting brackets **[Figure 60-40-10]**.

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Removal And Installation (Cont'd)

Figure 60-40-11

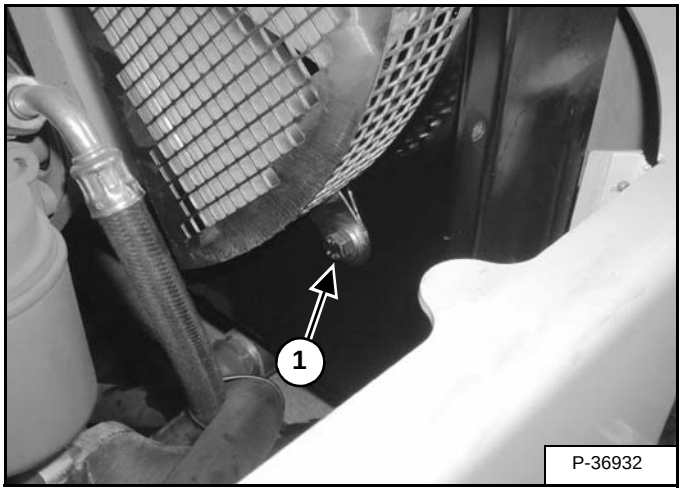


Figure 60-40-12

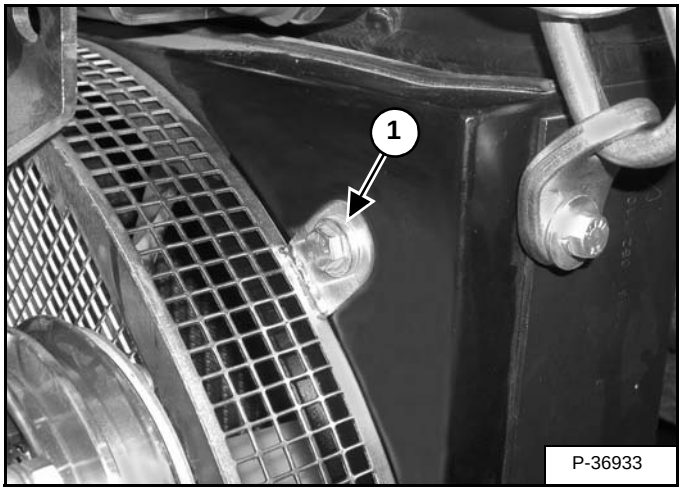
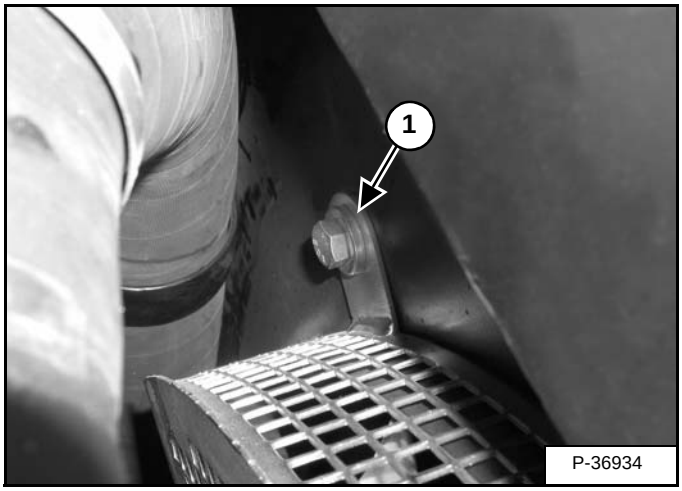


Figure 60-40-13



Remove the three bolts (Item 1) **[Figure 60-40-11]**, **[Figure 60-40-12]** & **[Figure 60-40-13]** and washers.

Figure 60-40-14

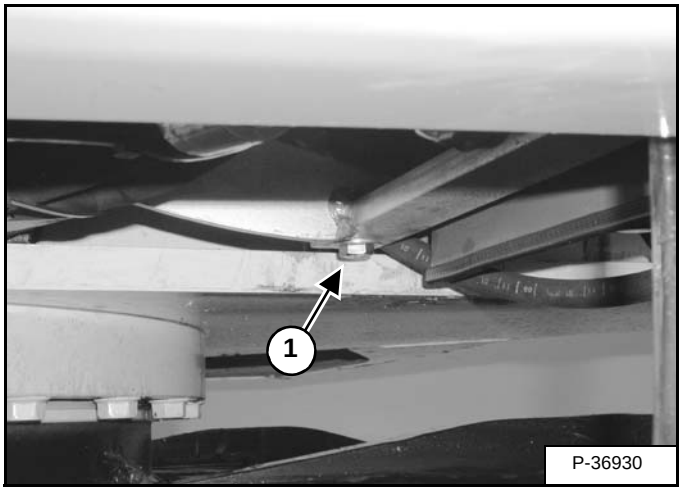
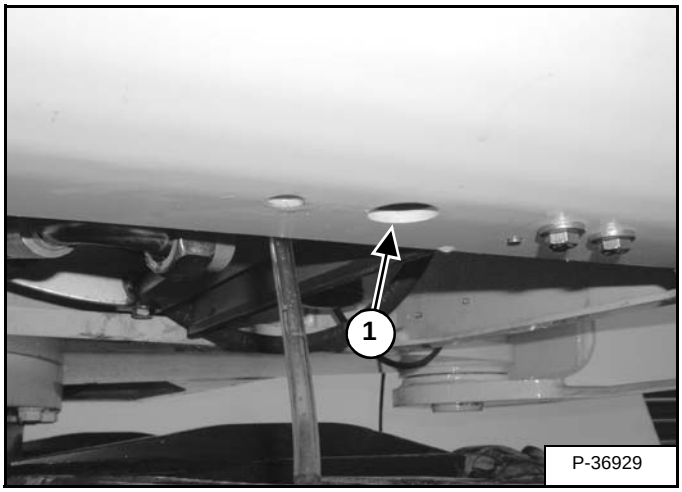


Figure 60-40-15



Remove the two radiator mount bolts (Item 1) **[Figure 60-40-14]** & **[Figure 60-40-15]** and washers.

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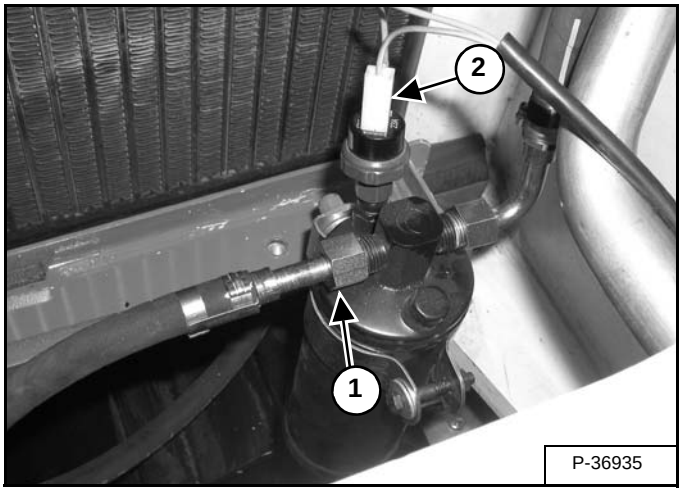
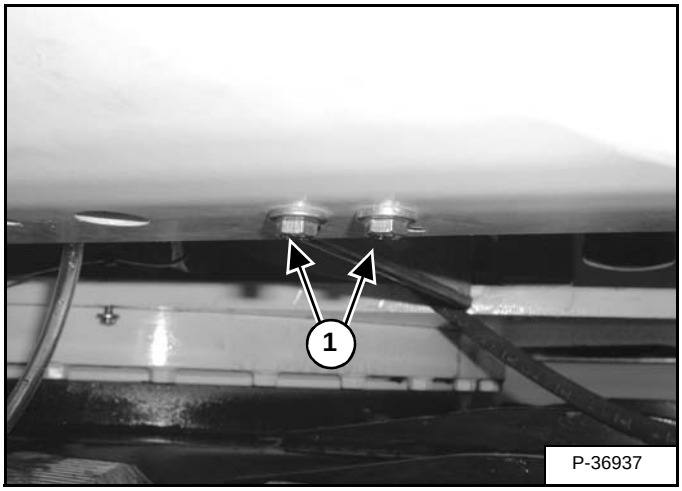
Removal And Installation (Cont'd)

Figure 60-40-16



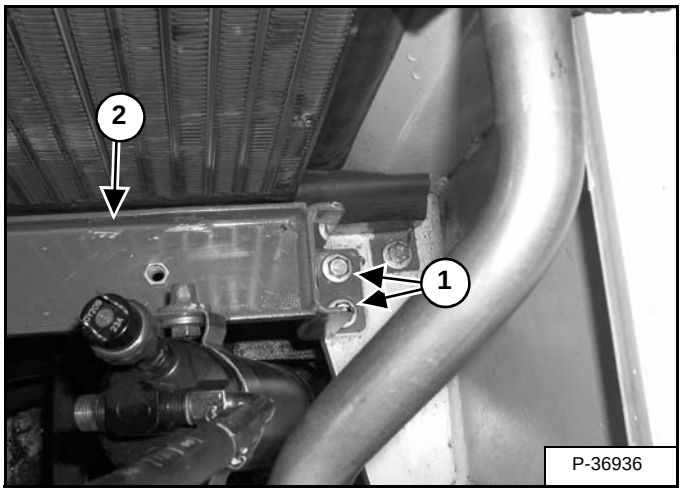
Remove the hose (Item 1) and wire harness (Item 2) **[Figure 60-40-16]** from the receiver/dryer.

Figure 60-40-17



Remove the bottom condenser bolts (Item 1) **[Figure 60-40-17]** and washers.

Figure 60-40-18



Remove the top condenser bolts (Item 1) **[Figure 60-40-18]** and washers. Remove the mount.

NOTE: The receiver/dryer will be removed with the mount.

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Removal And Installation (Cont'd)

Figure 60-40-19

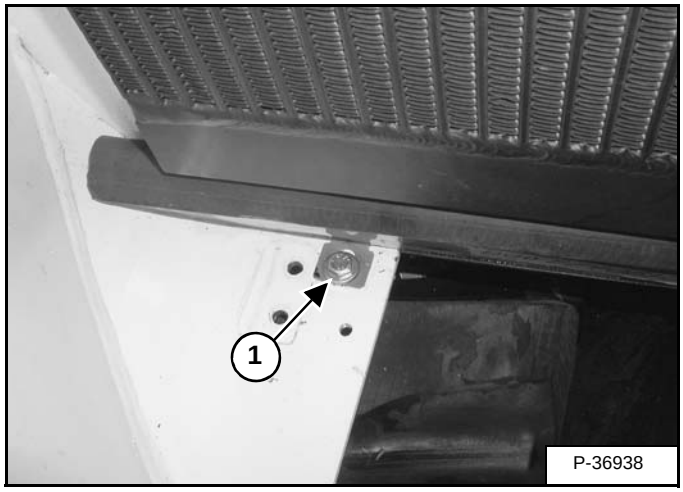
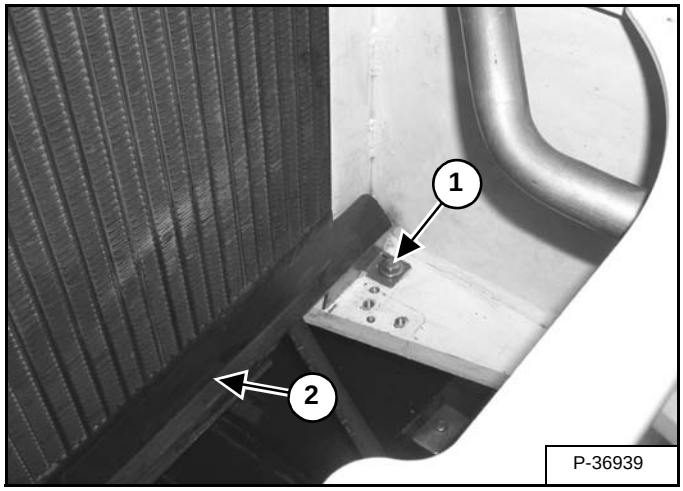


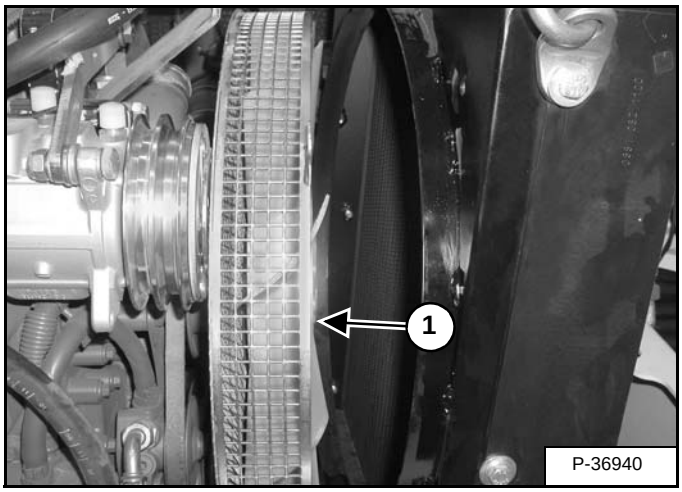
Figure 60-40-20



Remove the two bolts (Item 1) **[Figure 60-40-19]** & **[Figure 60-40-20]** and washers.

Remove the plate (Item 2) **[Figure 60-40-20]**.

Figure 60-40-21



Raise the hoist and slide the radiator towards the front of the excavator. Remove the fan guard (Item 1) **[Figure 60-40-21]**.

Remove the radiator.

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Removal And Installation (Cont'd)

Figure 60-40-22

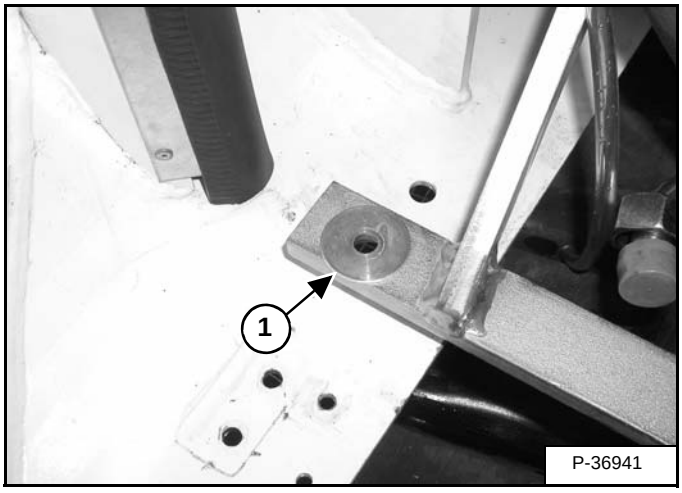
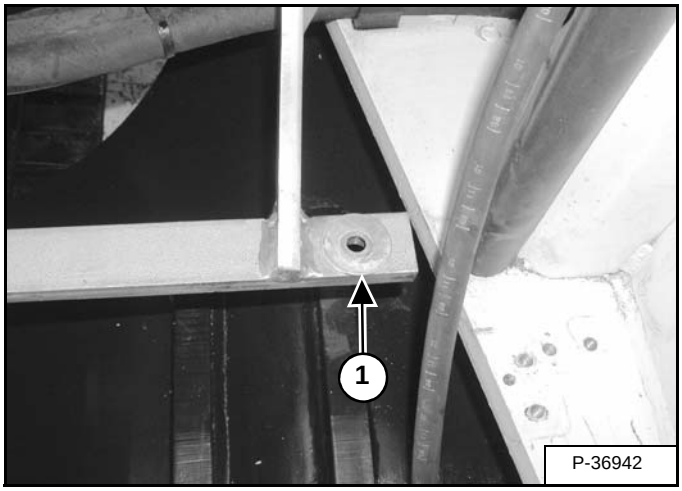
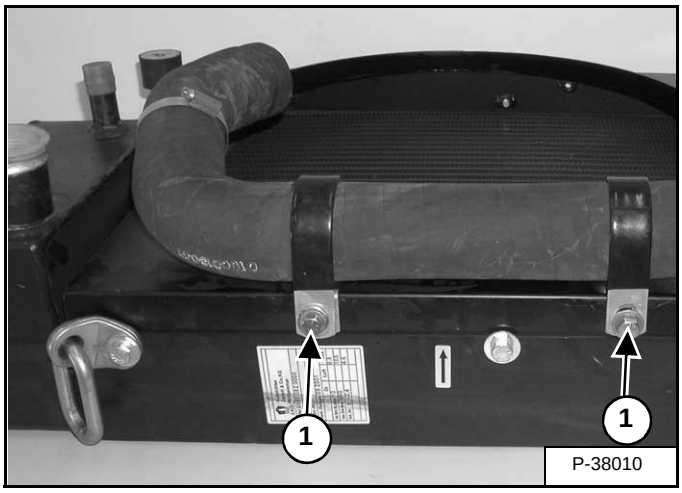


Figure 60-40-23



Remove the washers (Item 1) **[Figure 60-40-22]** & **[Figure 60-40-23]** from the radiator mount.

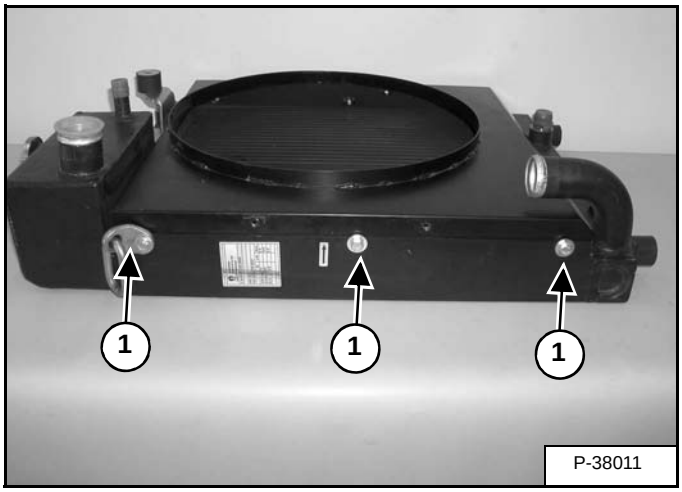
Figure 60-40-24



Remove the bolts (Item 1) **[Figure 60-40-24]** and washers.

Loosen the hose clamp and remove the lower radiator hose.

Figure 60-40-25



Remove the bolts (Item 1) **[Figure 60-40-25]** and washers from both sides of the fan shroud.

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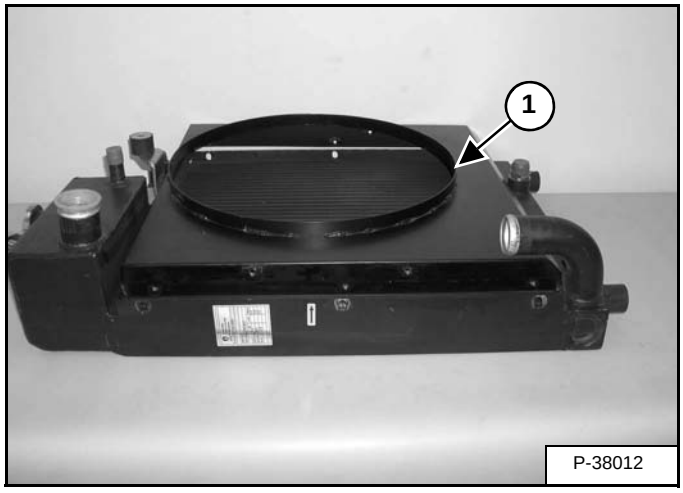
Removal And Installation (Cont'd)

Figure 60-40-26



Remove the fan shroud (Item 1) **[Figure 60-40-26]**.

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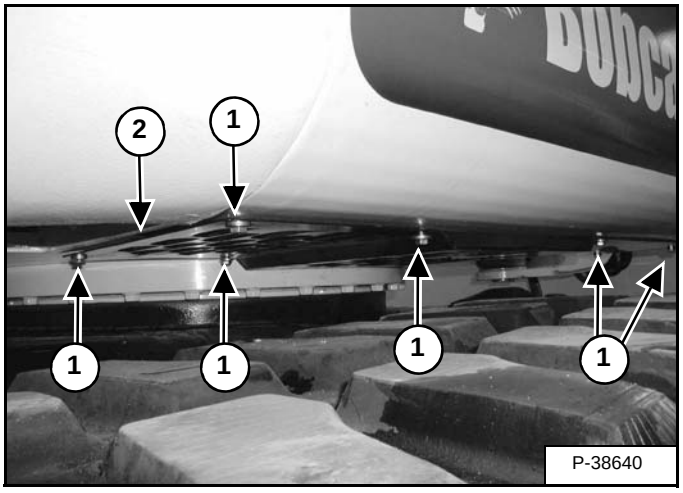
RADIATOR/OIL COOLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

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

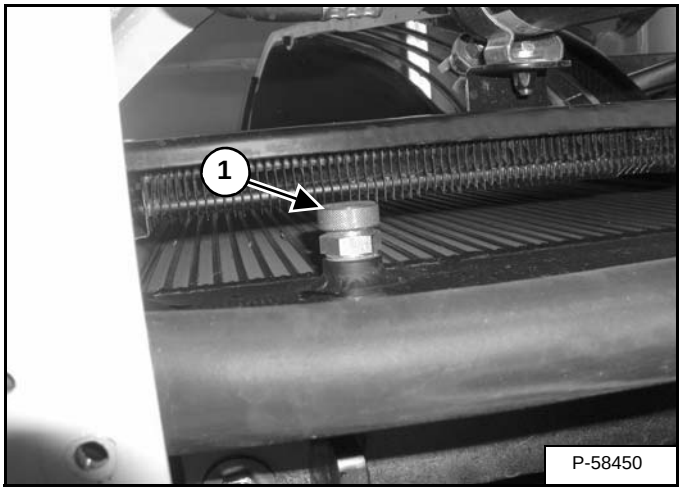
Figure 60-41-1



Remove the eleven bolts (Item 1) **[Figure 60-41-1]** and washers.

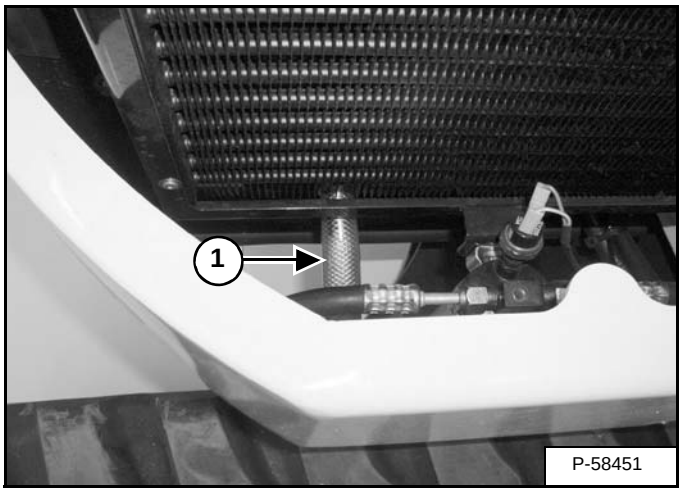
Remove the cover (Item 2) **[Figure 60-41-1]**.

Figure 60-41-2



Remove the cap (Item 1) **[Figure 60-41-2]** from the bottom of the cooler.

Figure 60-41-3



Install the drain hose (Item 1) **[Figure 60-41-3]**. Tighten the hose until oil starts to drain from the radiator.

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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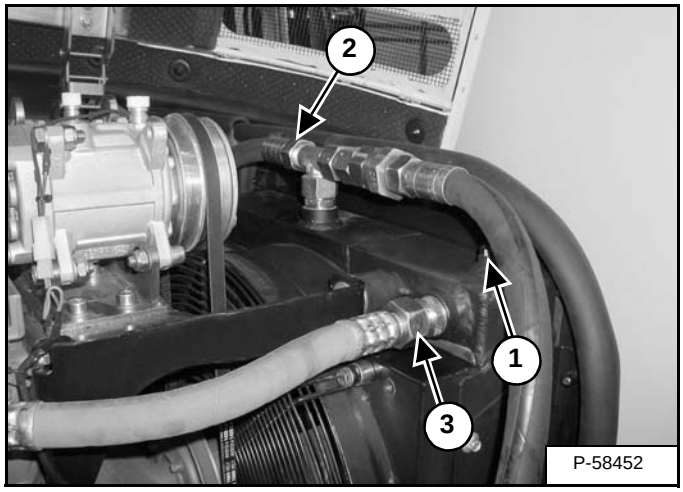
Removal And Installation (Cont'd)

Figure 60-41-4

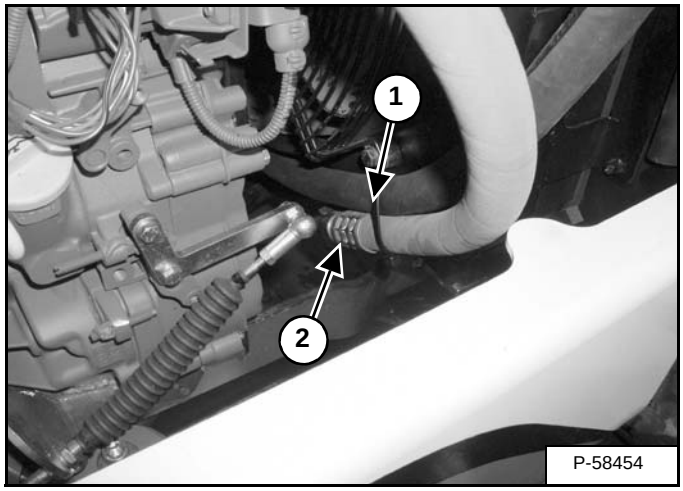


Remove the plug (Item 1) **[Figure 60-41-4]** and washer to assist draining the radiator.

Install the plug and washer. Remove the drain hose after the radiator is drained.

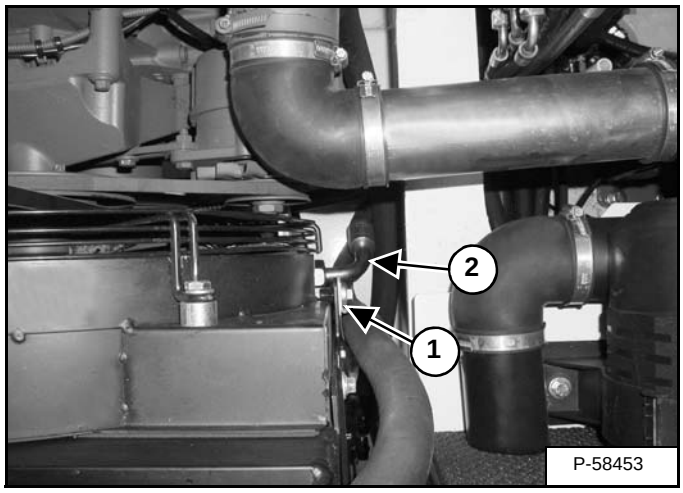
Remove the upper hydraulic cooler hose (Item 2) and upper radiator hose (Item 3) **[Figure 60-41-4]**.

Figure 60-41-5



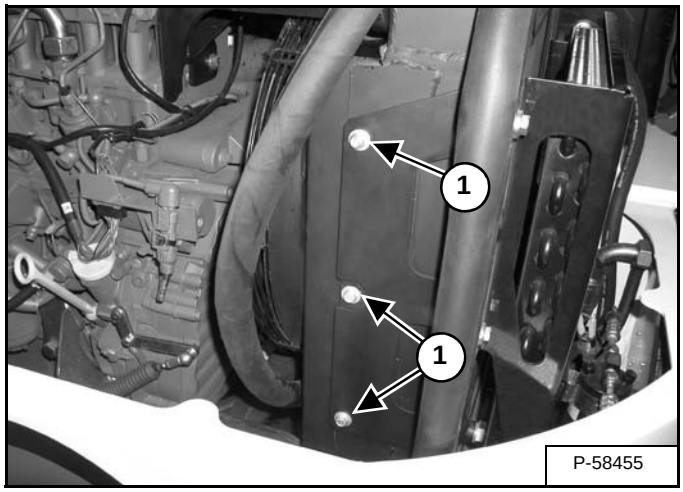
Remove the tie strap (Item 1). Remove the lower radiator hose (Item 2) **[Figure 60-41-5]**.

Figure 60-41-6



Remove the bolt (Item 1) and clamp. Remove the lower hydraulic cooler hose (Item 2) **[Figure 60-41-6]**.

Figure 60-41-7



Remove the six bolts (Item 1) **[Figure 60-41-7]** and washers. (Three per side)

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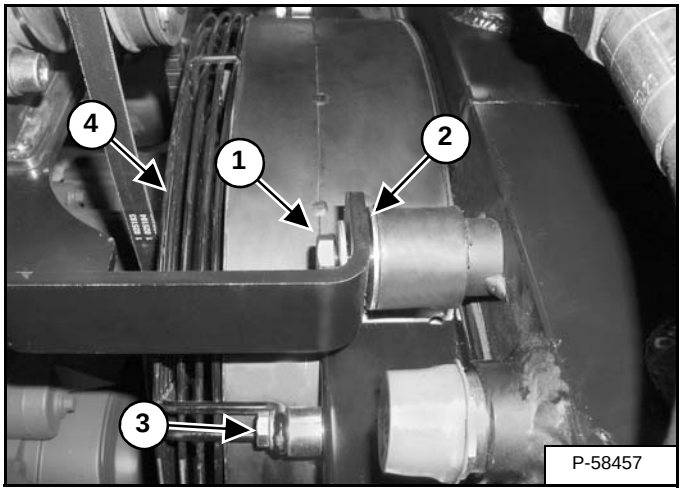
Removal And Installation (Cont'd)

Figure 60-41-8

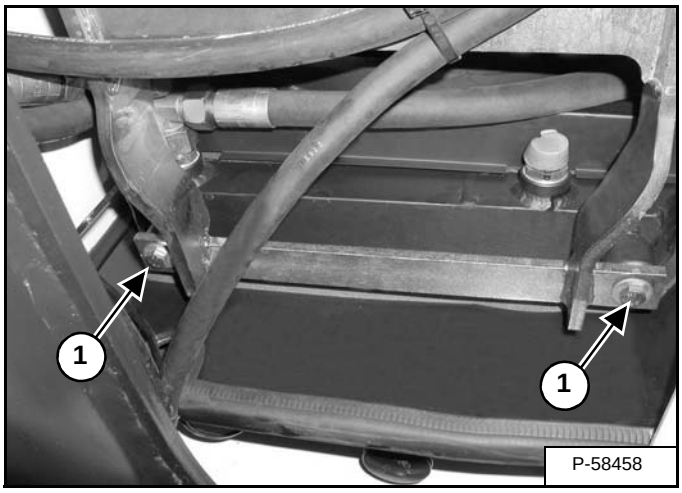


Remove the top bolt (Item 1) and washer. Remove the washer (Item 2) **[Figure 60-41-8]** from between the mount and bracket.

Remove the four bolts (Item 3) **[Figure 60-41-8]**, washers, and spacers.

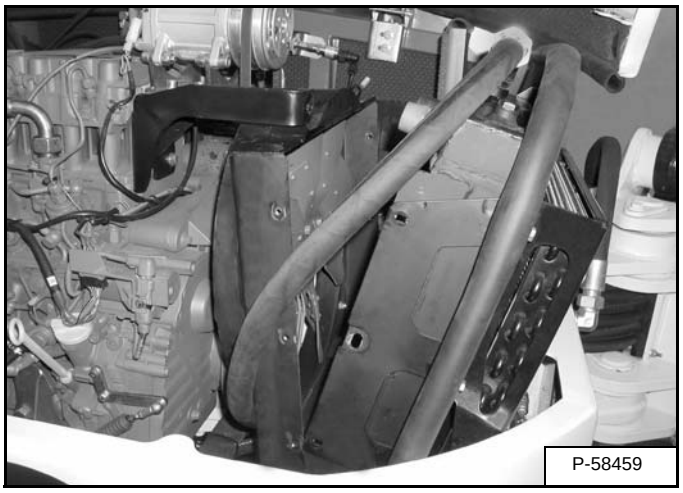
Rotate and remove the fan guard (Item 4) **[Figure 60-41-8]**.

Figure 60-41-9



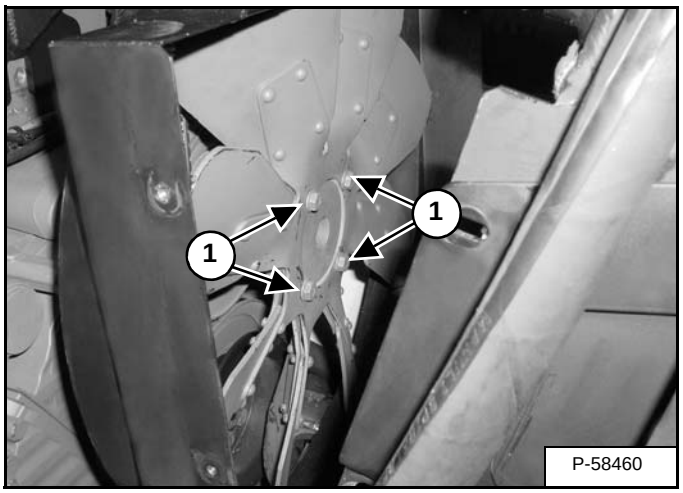
Remove the bolts (Item 1) **[Figure 60-41-9]** and washers from the bottom of the radiator / oil cooler.

Figure 60-41-10



Tilt the radiator/cooler towards the front of the excavator and position the fan shroud over the fan **[Figure 60-41-10]**.

Figure 60-41-11



Remove the fan bolts (Item 1) **[Figure 60-41-11]**.

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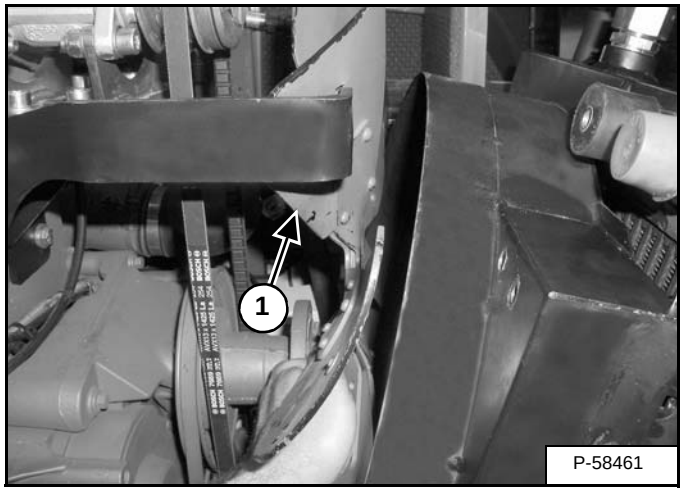
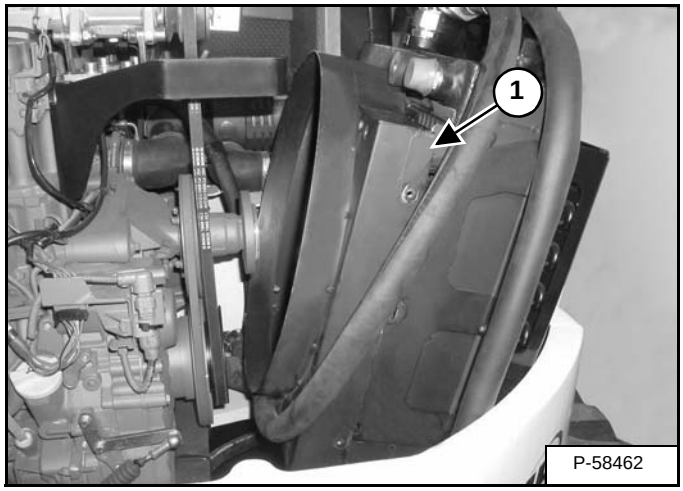
Removal And Installation (Cont'd)

Figure 60-41-12



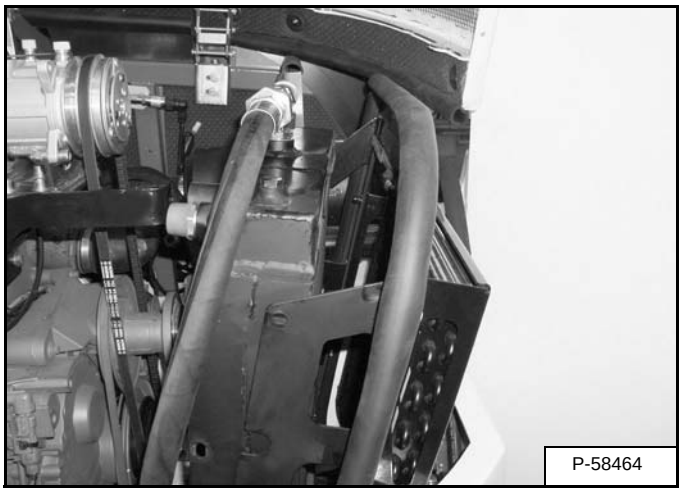
Tilt the fan shroud forward and remove the fan (Item 1) **[Figure 60-41-12]**.

Figure 60-41-13



Remove the shroud (Item 1) **[Figure 60-41-13]**.

Figure 60-41-14



Separate the radiator / oil cooler from the condenser mount and remove the cooler **[Figure 60-41-14]**.

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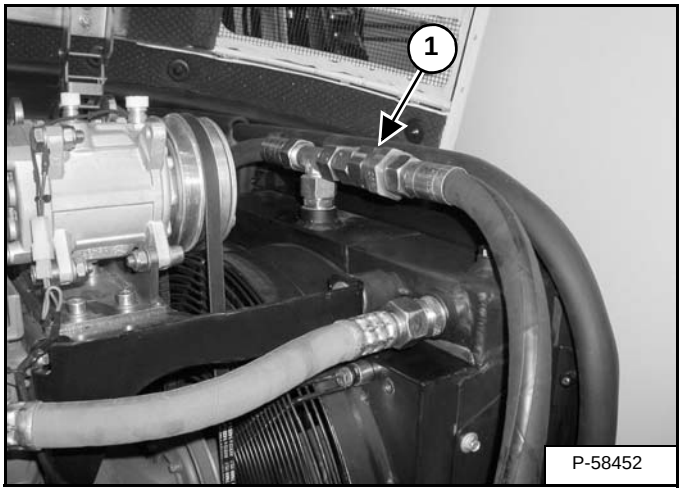
Hydraulic Check Valve Removal And Installation

Figure 60-41-15



There is a 14.5 PSI (1 bar) check valve (Item 1) **[Figure 60-41-15]** installed on the top of the oil cooler.

The valve removal is shown with the radiator / oil cooler removed. The procedure can be done with the cooler installed in the excavator.

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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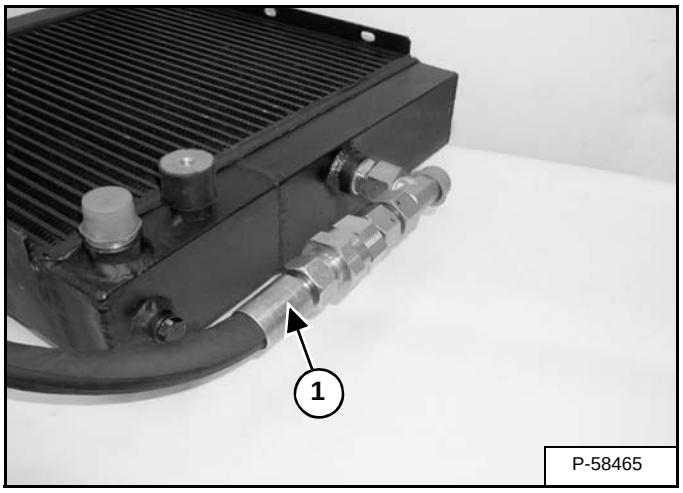
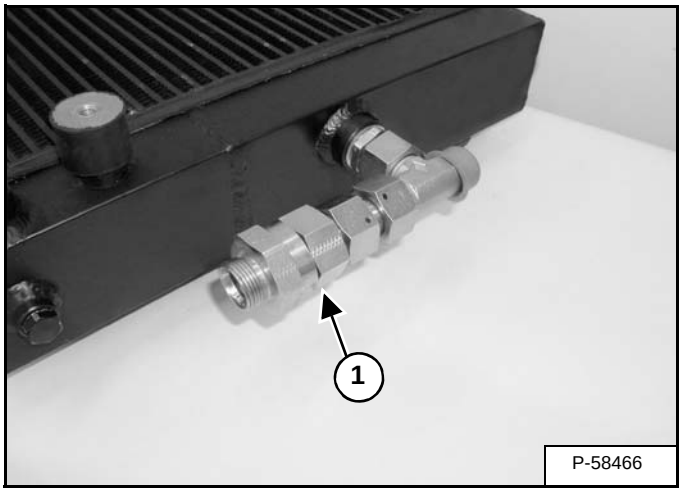
Figure 60-41-16



Remove the bypass hose (Item 1) **[Figure 60-41-16]**.

Figure 60-41-17



Remove the check valve (Item 1) **[Figure 60-41-17]**.

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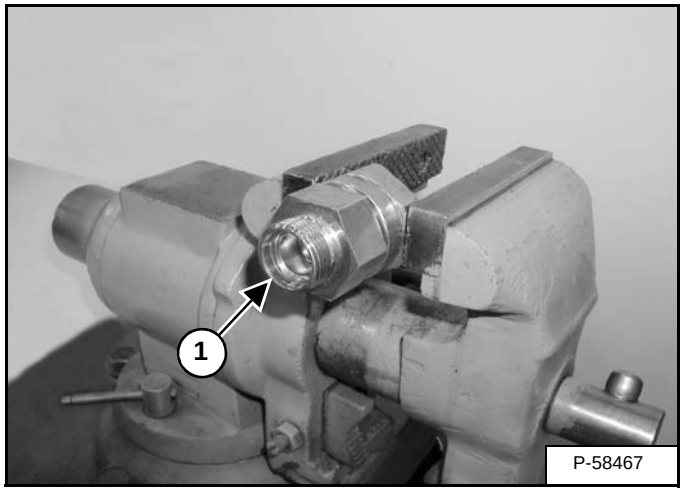
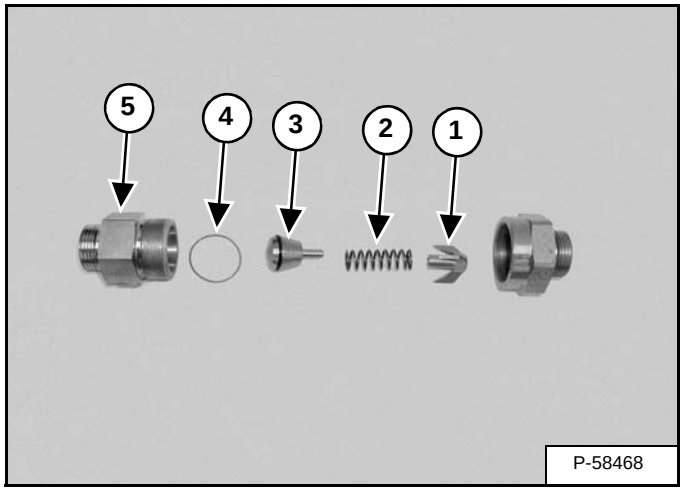
Hydraulic Check Valve Disassembly And Assembly

Figure 60-41-18



Remove the fitting (Item 1) **[Figure 60-41-18]**.

Figure 60-41-19



Remove the spring seat (Item 1), spring (Item 2), check valve (Item 3), and O-ring (Item 4) from the check valve body (Item 5) **[Figure 60-41-19]**.

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ENGINE COMPONENTS AND TESTING (S/N 522311001 & ABOVE)

Engine Compression Checking

Check and adjust the valve clearance as needed. (See Valve Clearance Adjustment on Page 60-50-23)

The tools listed will be needed to do the following procedure:

MEL 10630 - Engine Compression Tester
MEL 1489 - Compression Test Adapter

IMPORTANT

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

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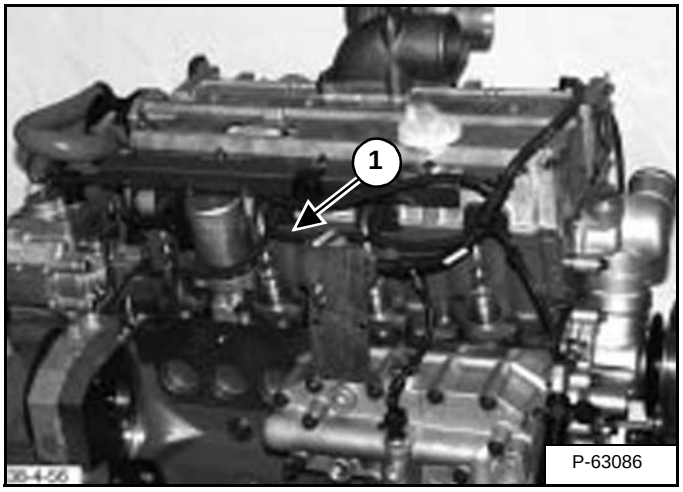
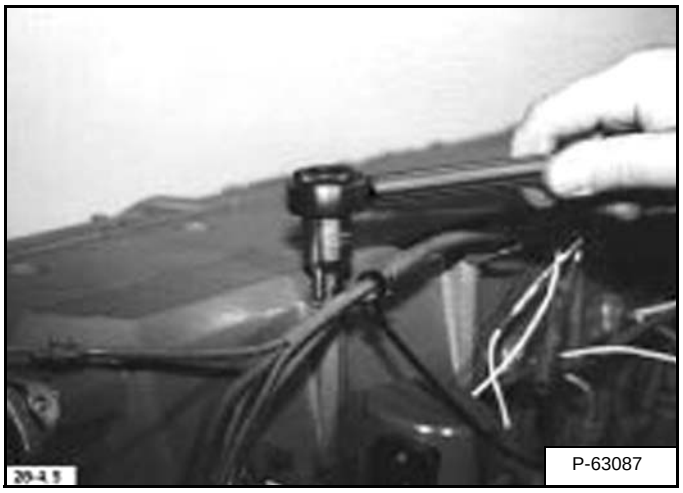
Figure 60-50-1



Disconnect the wire harness (Item 1) **[Figure 60-50-1]** from the fuel shut off solenoid.

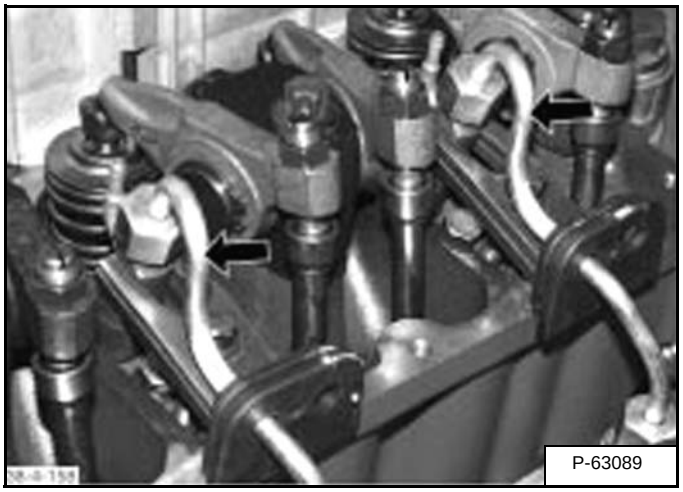
Figure 60-50-2



Remove the valve cover **[Figure 60-50-2]**.

Installation: Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

Figure 60-50-3



Remove the fuel injector lines from the fuel pump and fuel injector **[Figure 60-50-3]**.

Installation: Preload the injector cap nuts to 4 ft.-lb. (5 N•m) torque. Final tighten the nuts to 18-21 ft.-lb. (25-28,5 N•m) torque.

NOTE: Do not rebend or reuse fuel injector lines.

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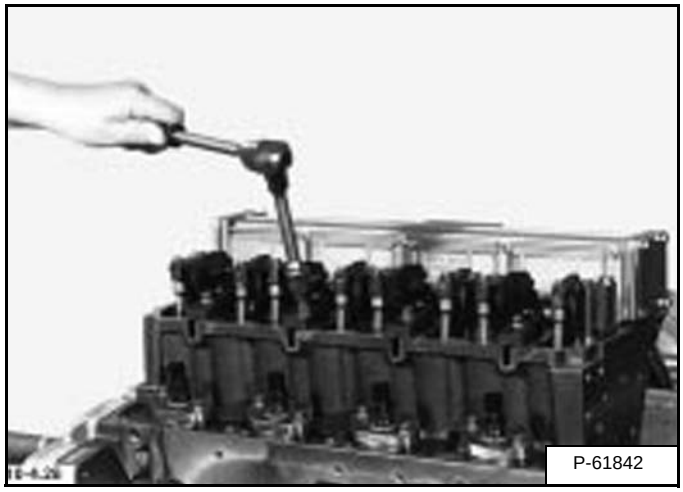
Engine Compression Checking (Cont'd)

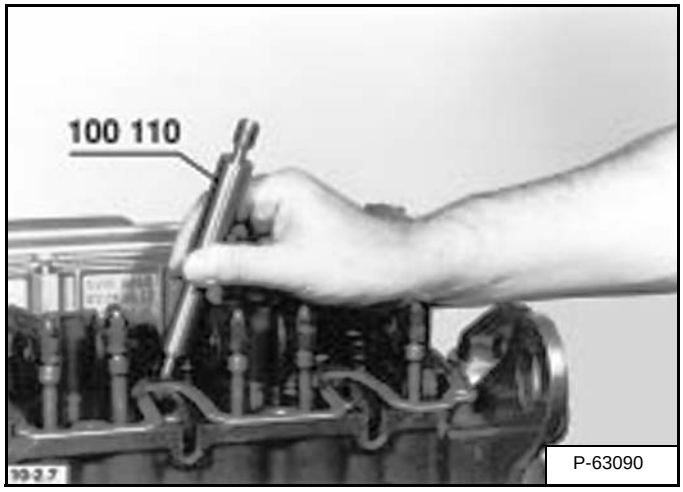
Figure 60-50-4



Remove the injector **[Figure 60-50-4]**.

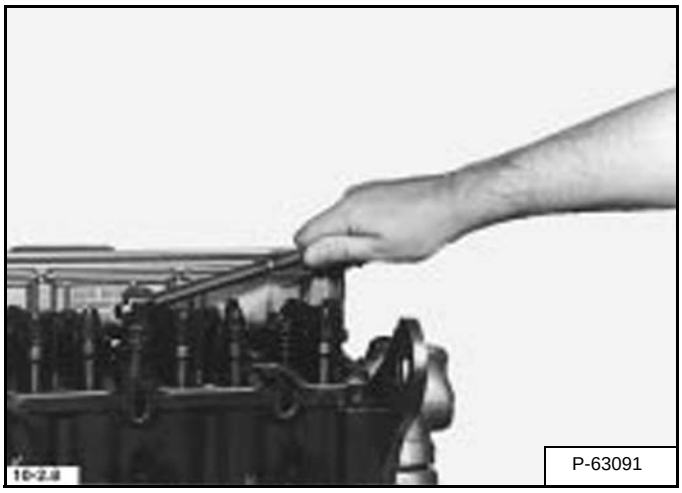
Installation: Tighten the injector to 12-15 ft.-lb. (16-21 N•m) torque.

Figure 60-50-5



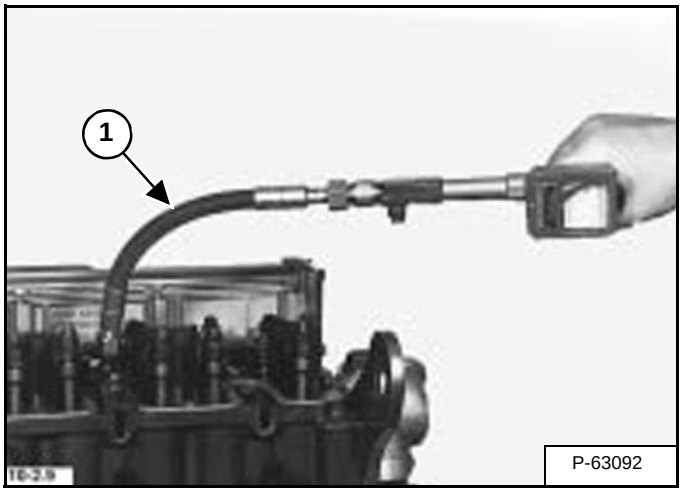
Install the compression adapter tool **[Figure 60-50-5]**.

Figure 60-50-6



Install the injector retainer and bolt **[Figure 60-50-6]**.

Figure 60-50-7



Connect the compression gauge (Item 1) **[Figure 60-50-7]** to the adapter.

Turn the engine with the starter at 200 to 300 RPM. Run the test for each cylinder two times at 5 to 10 seconds each time and take the average reading.

The correct compression of the engine is 406-479 PSI (28-33 bar) with no more than 15% difference between the cylinders.

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Checking the Glow Plugs

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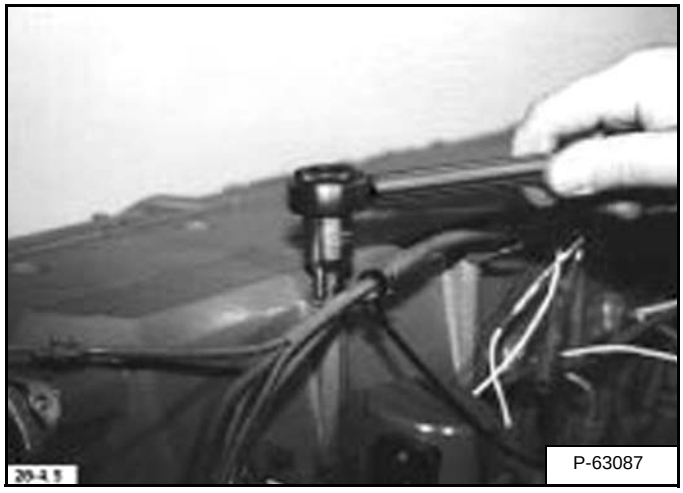
Glow Plug Removal And Installation

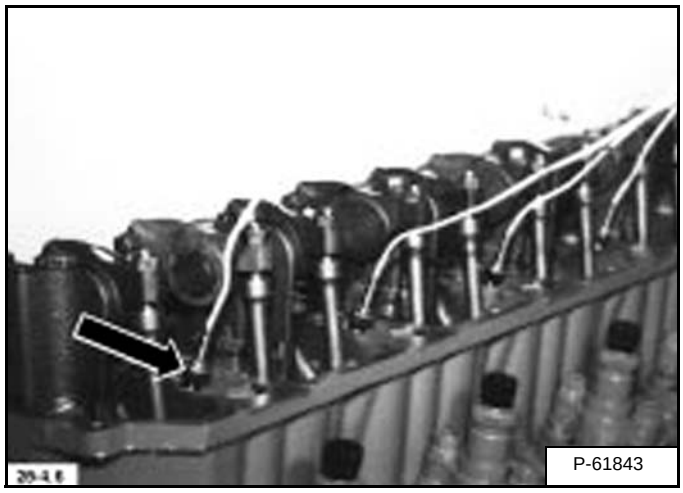
Figure 60-50-8



Remove the valve cover **[Figure 60-50-8]**.

Installation: Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

Figure 60-50-9



Remove the glow plugs **[Figure 60-50-9]**.

Installation: Tighten the glow plugs to 13-16 ft.-lb. (18-22 N•m) torque.

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Fuel Shutoff Solenoid Checking

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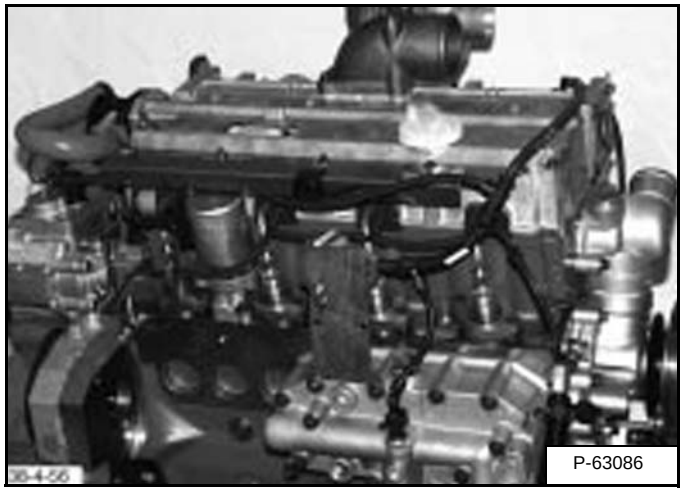
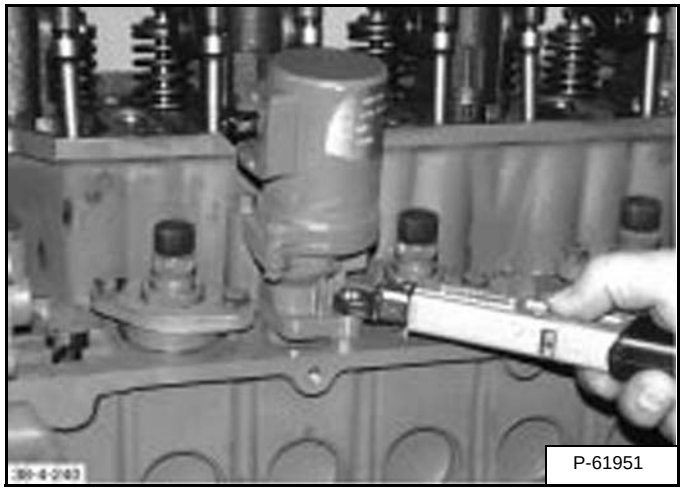
Fuel Shutoff Solenoid Removal And Installation

Figure 60-50-10



Disconnect the wire harness **[Figure 60-50-10]**.

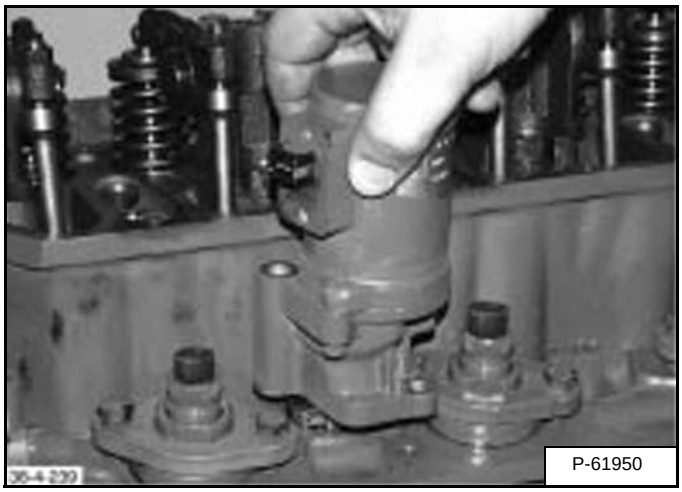
Figure 60-50-11



Remove the two bolts **[Figure 60-50-11]**.

Installation: Tighten the bolts to 15 ft.-lb. (21 N•m) torque.

Figure 60-50-12



Remove the solenoid **[Figure 60-50-12]**.

Installation: Press and hold the control rod in the stop position. Install the solenoid.

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Fuel Injection Pump Removal

IMPORTANT

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

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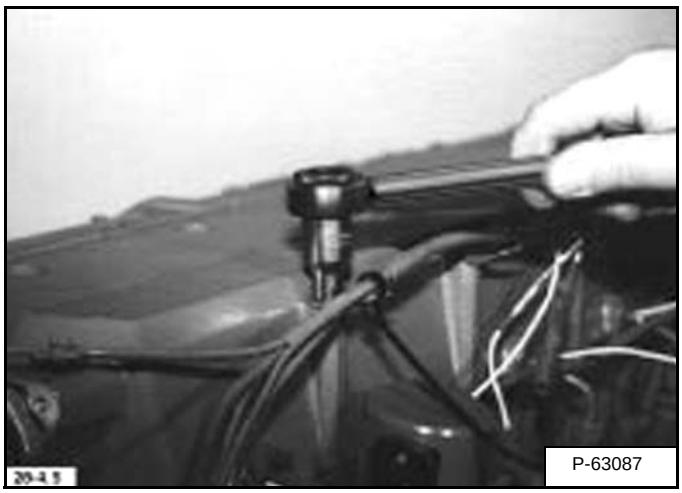
The injection pump(s) contain parts which have a very close tolerance and its operation has a direct effect on the performance of the engine.

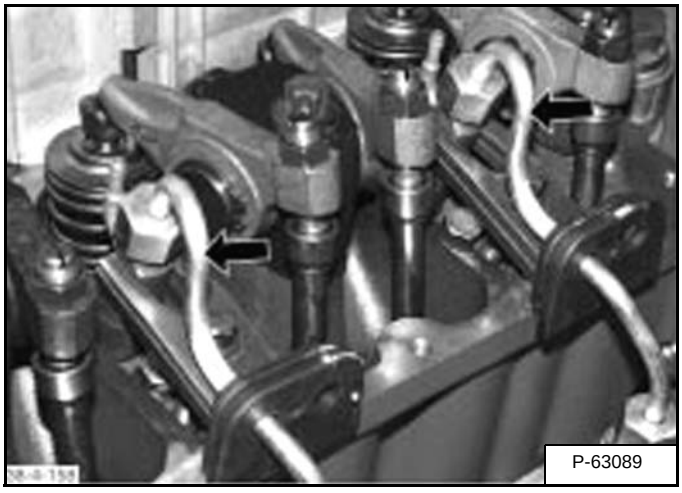
Figure 60-50-13



Remove the valve cover **[Figure 60-50-13]**.

Installation: Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

Figure 60-50-14



Remove the fuel injector lines from the fuel pump and fuel injectors **[Figure 60-50-14]**.

Installation: Preload the injector cap nuts to 4 ft.-lb. (5 N•m). Final tighten the bolts to 18-21 ft.-lb. (25-28,5 N•m) torque.

NOTE: Do not rebend or reuse fuel injector lines.

Figure 60-50-15

Remove the bolts **[Figure 60-50-15]**.

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Fuel Injection Pump Removal (Cont'd)

Figure 60-50-16

Remove the flange **[Figure 60-50-16]**.

Figure 60-50-17

Remove the injection pump and shims **[Figure 60-50-17]**.

NOTE: The shim(s) are used to time the injection pump, keep the same thickness for each injection pump.

Figure 60-50-18

Remove the tappet and shim(s) **[Figure 60-50-18]**.

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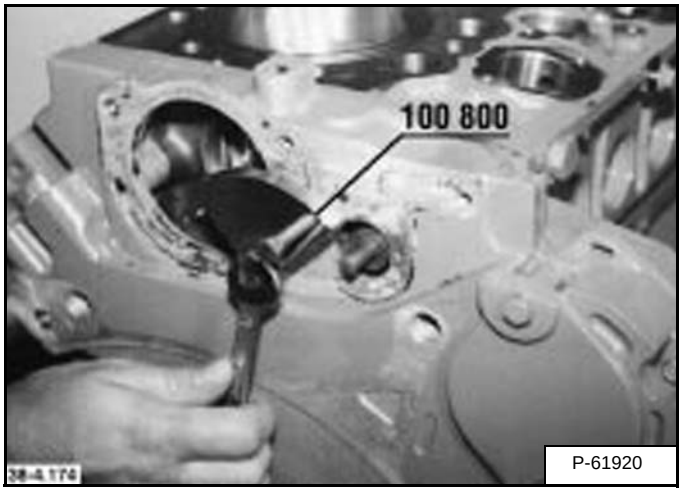
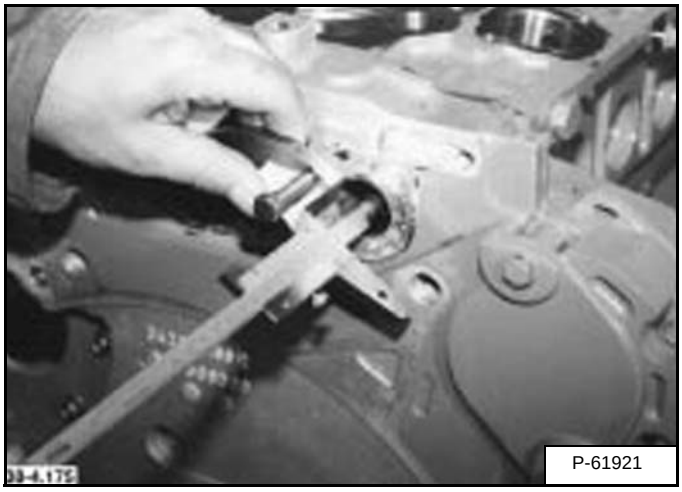
Fuel Injection Pump Timing

Figure 60-50-19



Install the control rod locking tool (MEL-XXX) **[Figure 60-50-19]**.

Figure 60-50-20



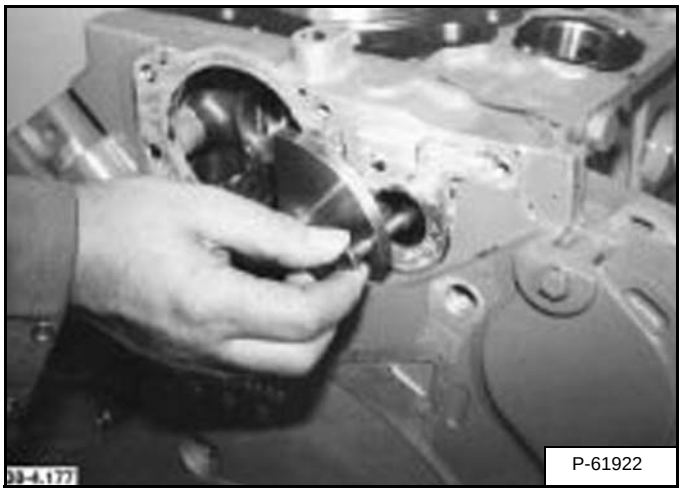
Measure and record the distance from the locking tool to the stop position of the control rod **[Figure 60-50-20]**.

Measure and record the distance from the locking tool to the start position of the control rod.

The difference in the distance between the start and stop position is the control rod travel.

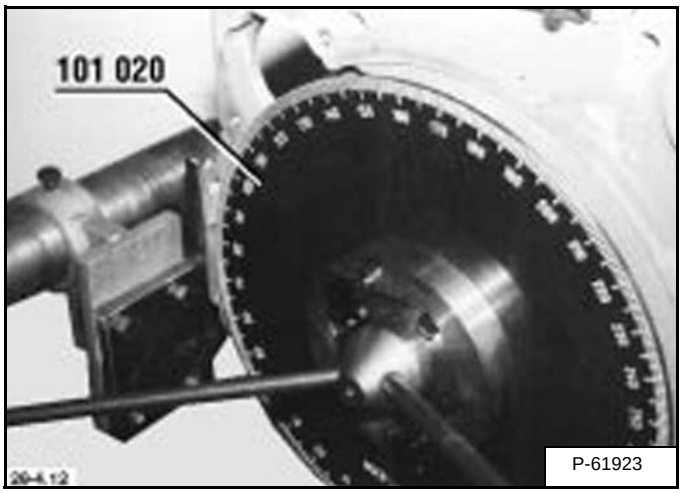
The allowable range for control rod travel is 0.669-0.689 in. (17-17,5 mm)

Figure 60-50-21



Turn the locking tool. Move the control rod to the stop position by pressing in on the setscrew **[Figure 60-50-21]**.

Figure 60-50-22



Install the graduated disc MEL XXX on the flywheel flange **[Figure 60-50-22]**.

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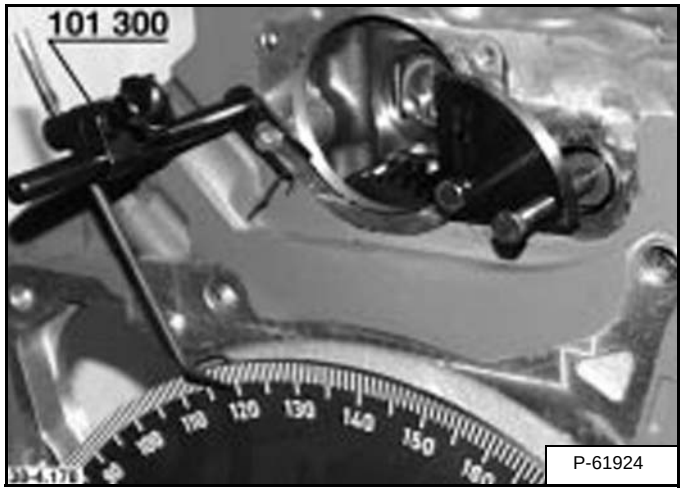
Fuel Injection Pump Timing (Cont'd)

Figure 60-50-23



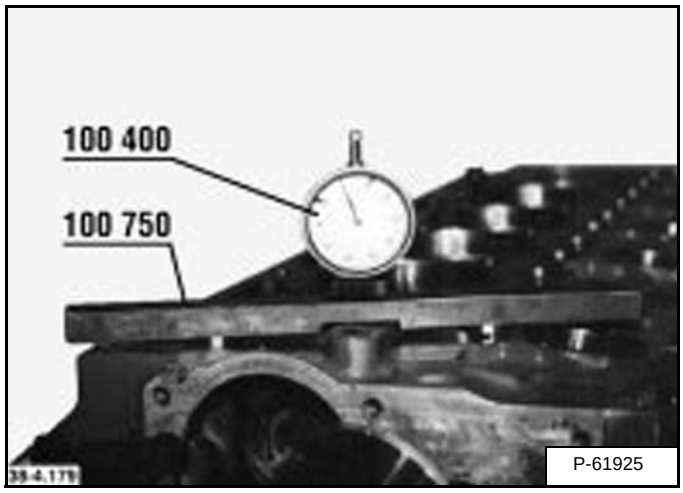
Install the pointer MEL XXX **[Figure 60-50-23]**.

Install the TDC measuring bar MEL XXX and washers MEL XXX.

Install a dial indicator on the measuring bar.

Turn the crankshaft in the direction of engine rotation until the dial indicator reaches it's reversal point.

Figure 60-50-24

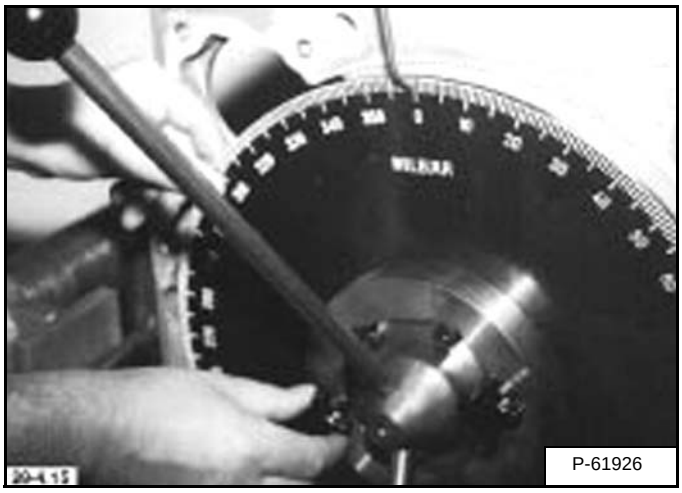


Set the dial indicator to zero **[Figure 60-50-24]**.

Turn the crankshaft in the direction of engine rotation approximately 90°. Turn the crankshaft against the direction of engine rotation to 0.315 in. (8 mm) before TDC.

The dial indicator reads zero.

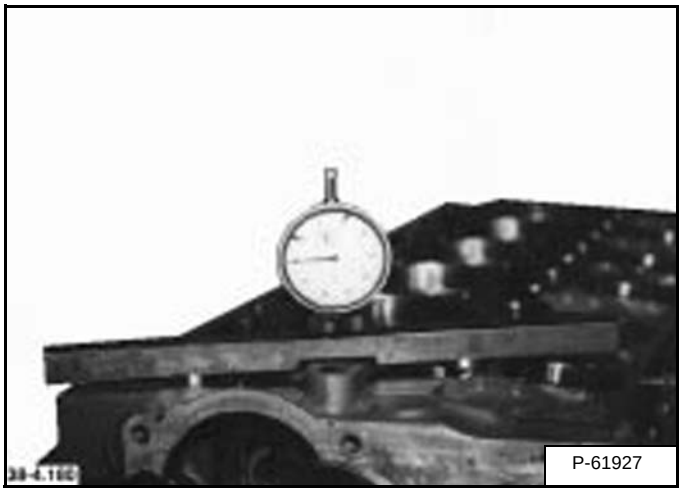
Figure 60-50-25



Set the graduated disc to zero before TDC. **[Figure 60-50-25]**.

Turn the crankshaft in the direction of engine rotation approximately 90°.

Figure 60-50-26



Turn the crankshaft against direction of engine rotation to 0.315 (8 mm) before TDC. The dial indicator reads zero **[Figure 60-50-26]**.

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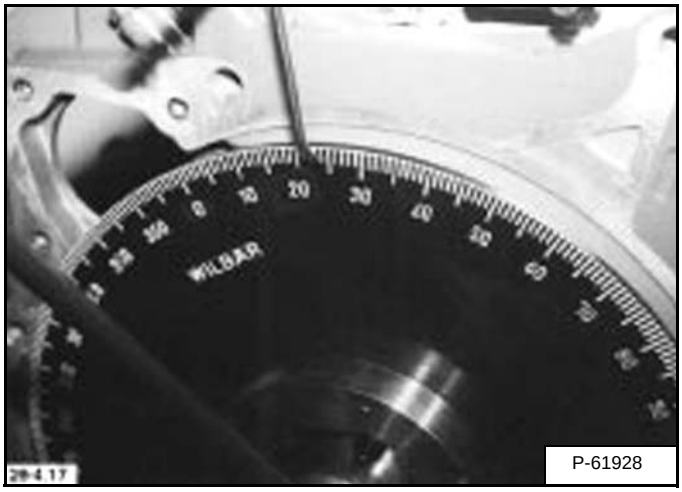
Fuel Injection Pump Timing (Cont'd)

Record the measurement on the disc (Determined value). Divide the measurement by 2 (Actual value).

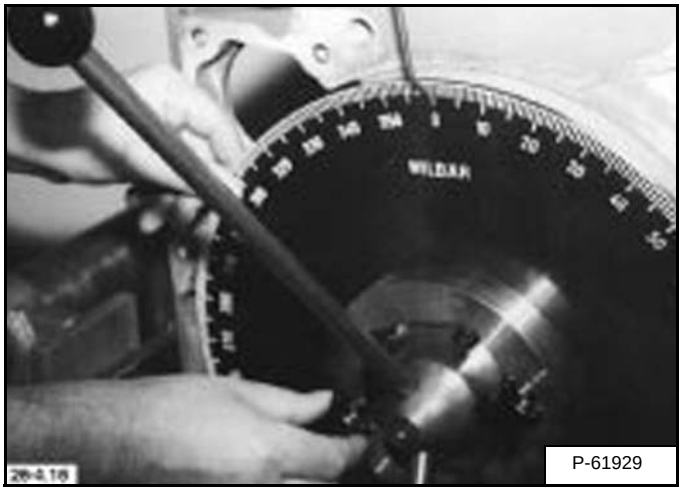
Turn the crankshaft until the actual value is reached on the disc.

Figure 60-50-27



Example: 50 (Determined value) divided by 2 = 25 (Actual value) **[Figure 60-50-27]**.

Figure 60-50-28



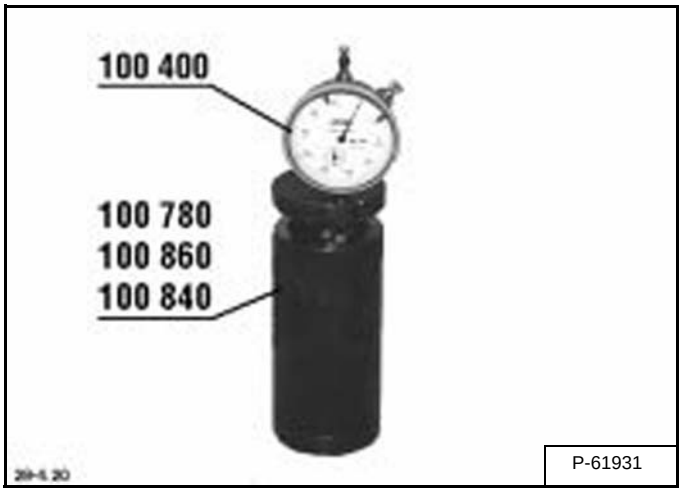
Loosen the two screws and reset the graduated disc to zero **[Figure 60-50-28]**.

Figure 60-50-29

Install the tappet **[Figure 60-50-29]**.

The fuel pump opening pressure and type of camshaft are stamped on the engine rating plate.

Figure 60-50-30



Install a dial indicator on the measuring device MEL XXX. Set the dial to zero **[Figure 60-50-30]**.

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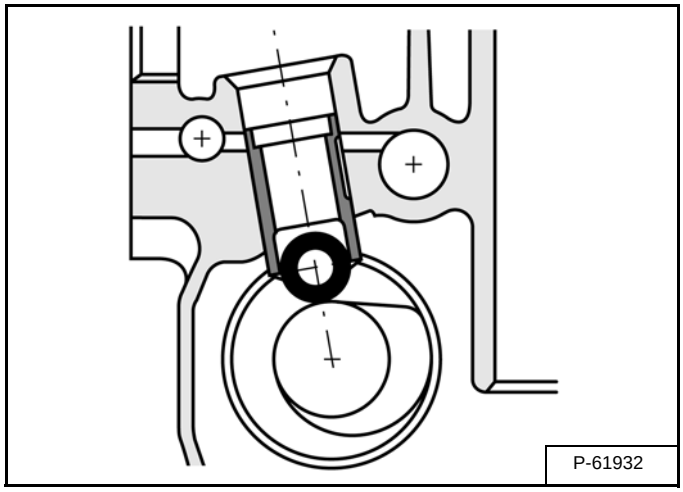
Fuel Injection Pump Timing (Cont'd)

Figure 60-50-31

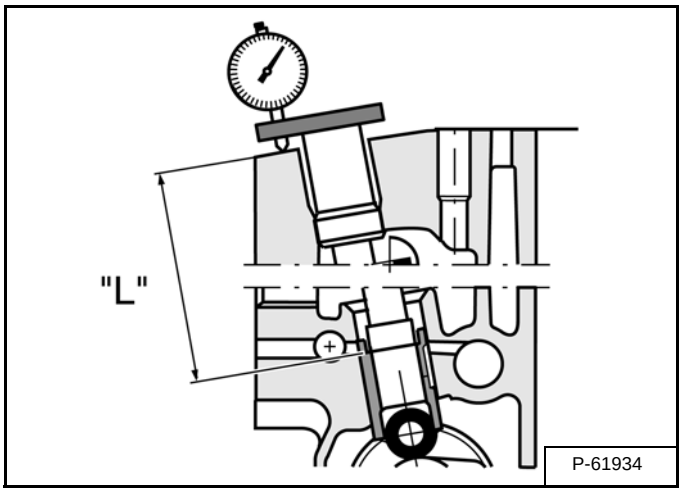


Position the tappet, of the injector pump to be timed, on the base circle. Turn the crankshaft 180° opposite the direction of engine rotation **[Figure 60-50-31]**.

Figure 60-50-32

Carefully install the measuring device **[Figure 60-50-32]**.

Figure 60-50-33



Measure and record dimension "L" **[Figure 60-50-33]**.

Enter the measurement in Table 1 **[Figure 60-50-34 on Page 13]**.

Example: -116.26 mm-

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Fuel Injection Pump Timing (Cont'd)

Figure 60-50-34

Table 1

Engine type	Commencement of delivery (FB) (° C/A BTDC)	Camshaft type	Pre-stroke (Vh) Nom. value (mm)	Pre-stroke correction factor (mm/° C/A)	Standard dimensions inj. pump (Lo) (mm)
BFM 1012	6	C	5,16	0,1	109 / 119
BFM 1012	7	C	4,98	0,1	109 / 119
BFM 1012	8	C	4,80	0,1	109 / 119
BFM 1012/ C	9	C	4,63	0,1	109 / 119
BFM 1012/ C	10	C	4,47	0,1	109 / 119
BFM 1012/ C	11	C	4,30	0,1	109 / 119
BFM 1012	12	C	4,14	0,1	109 / 119
BFM 1012	13	C	4,00	0,1	109 / 119

Table 2

Theor. thickness "T_S" (mm)	Shim-thickness "S_S" (mm)	Theor. thickness "T_S" (mm)	Shim-thickness "S_S" (mm)
0,95 - 1,049	1,0	2,45 - 2,549	2,5
1,05 - 1,149	1,1	2,55 - 2,649	2,6
1,15 - 1,249	1,2	2,65 - 2,749	2,7
1,25 - 1,349	1,3	2,75 - 2,849	2,8
1,35 - 1,449	1,4	2,85 - 2,949	2,9
1,45 - 1,549	1,5	2,95 - 3,049	3,0
1,55 - 1,649	1,6	3,05 - 3,149	3,1
1,65 - 1,749	1,7	3,15 - 3,249	3,2
1,75 - 1,849	1,8	3,25 - 3,349	3,3
1,85 - 1,949	1,9	3,35 - 3,449	3,4
1,95 - 2,049	2,0	3,45 - 3,549	3,5
2,05 - 2,149	2,1	3,55 - 3,649	3,6
2,15 - 2,249	2,2	3,65 - 3,749	3,7
2,25 - 2,349	2,3		
2,35 - 2,449	2,4		

Table 3

E_K (mm)	Code EP	E_K (mm)	Code EP	E_K (mm)	Code EP	E_K (mm)	Code EP	E_K (mm)	Code EP
110,0		110,6		111,2	049	111,8	073	112,4	097
110,025		110,625		111,225	050	111,825	074	112,425	098
110,05		110,65		111,25	051	111,85	075	112,45	099
110,075		110,675		111,275	052	111,875	076	112,475	100
110,1		110,7		111,3	053	111,9	077	112,5	101
110,125		110,725		111,325	054	111,925	078	112,525	102
110,15		110,75	031	111,35	055	111,95	079	112,55	103
110,175		110,775	032	111,375	056	111,975	080	112,575	104
110,2		110,8	033	111,4	057	112,0	081	112,6	105
110,225		110,825	034	111,425	058	112,025	082	112,625	106
110,25		110,85	035	111,45	059	112,05	083	112,65	
110,275		110,875	036	111,475	060	112,075	084	112,675	
110,3		110,9	037	111,5	061	112,1	085	112,7	
110,325		110,925	038	111,525	062	112,125	086	112,725	
110,35		110,95	039	111,55	063	112,15	087	112,75	
110,375		110,975	040	111,575	064	112,175	088	112,775	
110,4		111,0	041	111,6	065	112,2	089	112,8	
110,425		111,025	042	111,625	066	112,225	090	112,825	
110,45		111,05	043	111,65	067	112,25	091	112,85	
110,475		111,075	044	111,675	068	112,275	092	112,875	
110,5		111,1	045	111,7	069	112,3	093	112,9	
110,525		111,125	046	111,725	070	112,325	094	112,925	
110,55		111,15	047	111,75	071	112,35	095	112,95	
110,575		111,175	048	111,775	072	112,375	096	112,975	

Calculation example:						
Cylinder No.		0	1	2	3	4
Injection pump No.		xxx				
FB measured	°C/A	8				
FB nom. from table 1	°C/A	9				
Vh corr. factor from table 1	mm/°C/A	0.1				
Vh nom. from table 1	mm	4.63				
L0 nom. from table 1	mm	**109**				
A/100 of inj. pump	mm	0.53				
L measured	mm	116.26				
E1 = FB act. - FB nom	°C/A	-1				
E2 = E1 x Vh corr. factor	mm	-0.1				
E3 = E2 + Vh nom.	mm	4.53				
E4 = E3 + L0	mm	113.53				
E5 = E4 + A/100	mm	114.06				
Ts = L - E5	mm	2.20				
"Ss" from table 2	mm	**2.2**				

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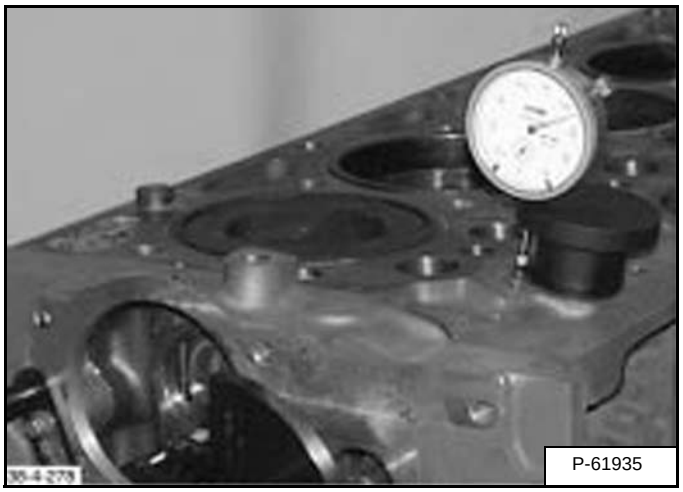
Figure 60-50-35



P-61935

Reset the dial indicator to -0- **[Figure 60-50-35]**.

NOTE: Do not change the direction of rotation after the pre-stroke position has been reached.

Turn the crankshaft in the direction of the engine rotation until the dial indicator reaches the pre-stroke dimension (See Table 1 **[Figure 60-50-34]**).

Example: Commencement of delivery -9°-
Camshaft type -C-
Prestroke -4.63 mm-

Figure 60-50-36

P-61937

Read the actual commencement of delivery **[Figure 60-50-36]**. Record in Table 1 **[Figure 60-50-34]**.

Example: -8°-

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Fuel Injection Pump Timing (Cont'd)

Figure 60-50-37

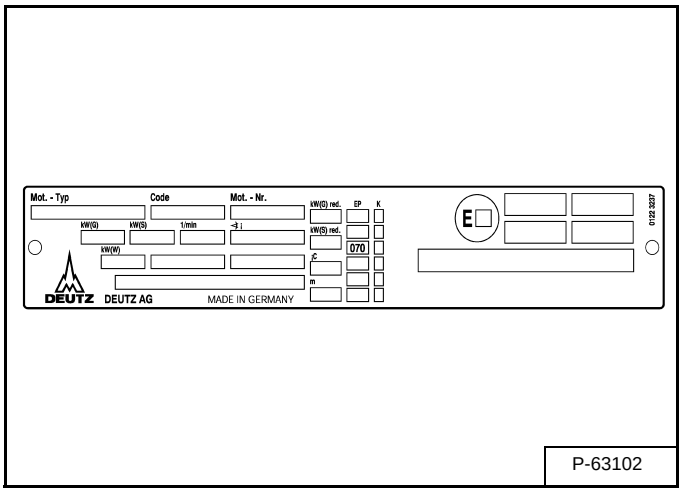
Read the code for injection pump length -A- **[Figure 60-50-37]**. Enter in Table 1 **[Figure 60-50-34 on Page 13]**.

Example: -53-

Figure 60-50-38

Remove the dial indicator **[Figure 60-50-38]**.

Figure 60-50-39



Select the proper shim as follows **[Figure 60-50-39]**:

Example: The injection cylinder 3 is to be replaced.

Procedure:

Read off EP code for cylinder 3 from nameplate under column “EP”, e.g. 070. (Reading sequence: line 1=cyl 1, line 2=cyl 2, etc.

Take corrected injection pump installation dimension (Ek) from Table 3 **[Figure 60-50-34 on Page 13]** according to EP code. e.g. 111.725 mm

Take code for injection pump length (A) from new injection pump. e.g. 53.

Take standard dimension of injection pump (Lo) from Table 1 **[Figure 60-50-34 on Page 13]**, e.g. 109 mm.

Determine theoretical shim thickness (Ts):

Ts = Ek-(Lo+A/100)
Ts = 111.725 mm - (109 mm +53/100 mm)
Ts = 2.195 mm = Ss 2.2 mm

Select shim thickness (S) according to Table 2 **[Figure 60-50-34 on Page 13]**.

Ts 2.195 mm = Ss 2.2 mm

Repeat the procedure for each injection pump.

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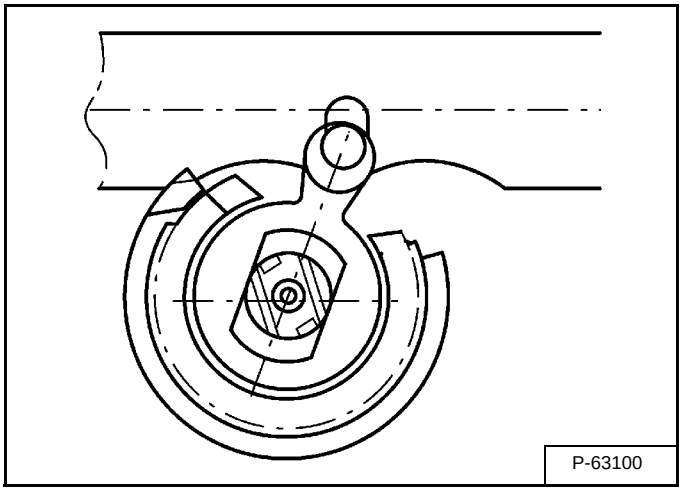
Fuel Injection Pump Installation

Figure 60-50-40

Install the proper shim on the tappet **[Figure 60-50-40]**.

NOTE: To determine the proper shim see .

Figure 60-50-41



Turn the injection pump linkage to the middle position **[Figure 60-50-41]**.

Position the roller tappet on the base circle.

Lightly oil the O-rings on the injector pump and crankcase bore.

Figure 60-50-42

Carefully install the linkage lever into the control rod **[Figure 60-50-42]**.

Figure 60-50-43

Install the flange **[Figure 60-50-43]**.

NOTE: The chamfer on the flange must face the injection pump.

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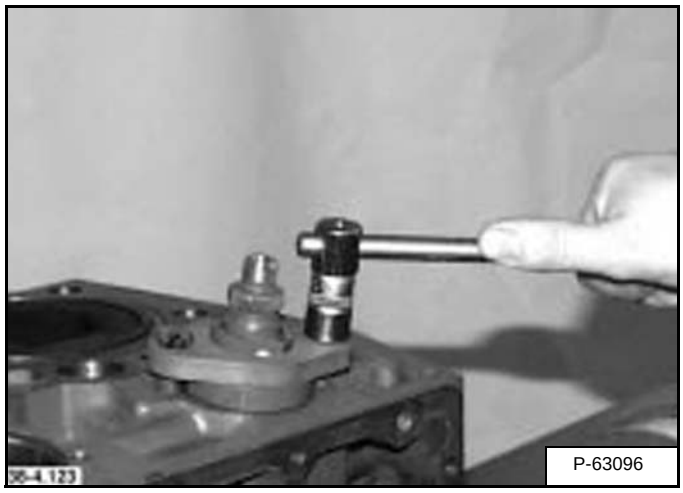
Fuel Injection Pump Installation (Cont'd)

Figure 60-50-44

Install the bolts **[Figure 60-50-44]**.

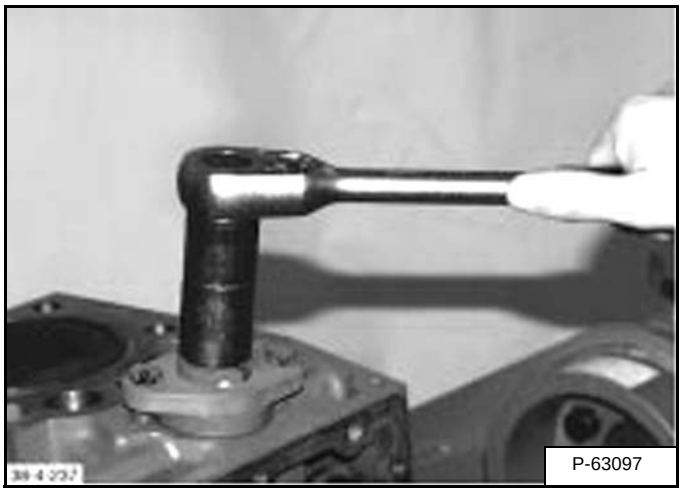
Tighten the bolts to 4 ft.-lb. (5 N•m) torque.

Figure 60-50-45



Loosen the bolts 60° **[Figure 60-50-45]**.

Figure 60-50-46



Turn the injection carefully counter-clockwise until it stops **[Figure 60-50-46]**.

Figure 60-50-47

Tighten the bolts as follows **[Figure 60-50-47]**:

Initial torque60°
Second stage torque5 ft.-lb. (7 N•m)
Third stage torque7 ft.-lb. (10 N•m)
Final stage torque22 ft.-lb. (30 N•m)

NOTE: Alternately torque the bolts starting with the outer bolt.

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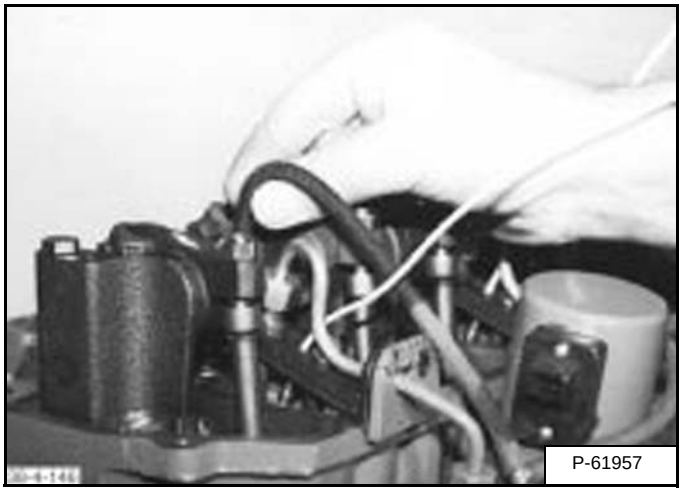
Fuel Injection Pump Installation (Cont'd)

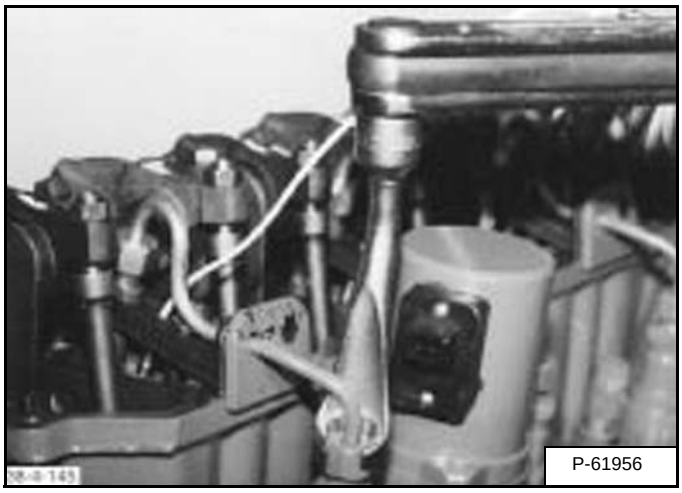
Figure 60-50-48



Remove the fuel return lines **[Figure 60-50-48]**.

NOTE: Do not reuse the fuel return lines.

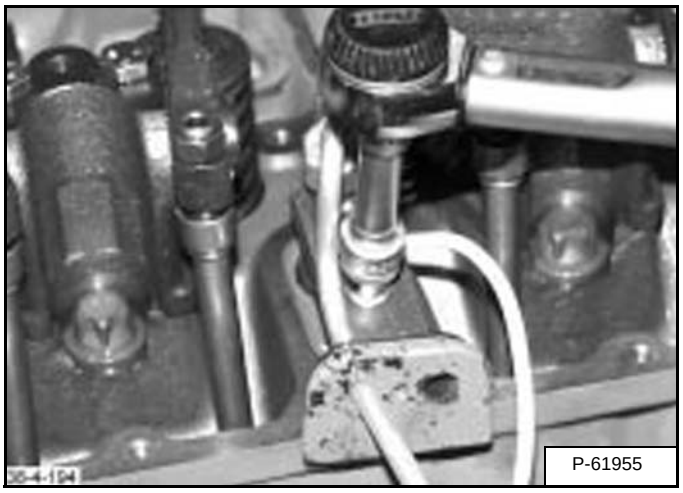
Figure 60-50-49



Remove the fuel line cap nuts **[Figure 60-50-49]**.

Installation: Preload the cap nuts to 4 ft.-lb. (5 N•m) torque. Tighten the cap nuts to 18-21 ft.-lb. (25-28,5 N•m) torque.

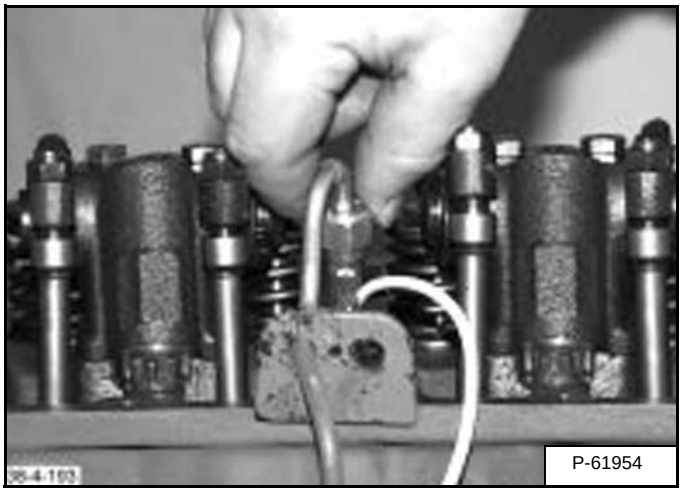
Figure 60-50-50



Loosen the injector clamp bolts **[Figure 60-50-50]**.

Installation: Tighten the injector clamp bolts to 12-15 ft.-lb. (16-21 N•m) torque.

Figure 60-50-51



Remove the injector high pressure fuel lines **[Figure 60-50-51]**.

Installation: Install a new seal on the fuel lines and hand tighten.

NOTE: Do not rebend or reuse the fuel injector lines.

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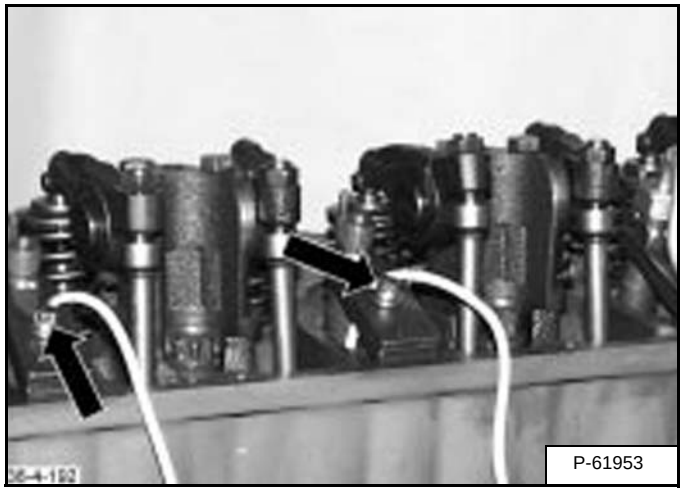
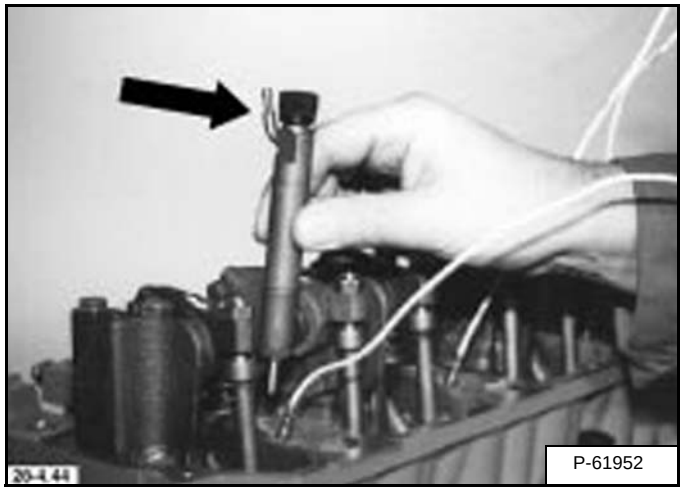
Fuel Injection Pump Installation (Cont'd)

Figure 60-50-52



Remove the fuel injector clamps and bolts **[Figure 60-50-52]**.

Figure 60-50-53



Remove the injectors **[Figure 60-50-53]**.

Installation: Lightly grease the seal on the injectors.

NOTE: The return line fitting must face the exhaust side.

Fuel Injector, Checking

IMPORTANT

Do not disassemble or test the fuel injector nozzles unless you have the correct service and testing tools.

⚠ 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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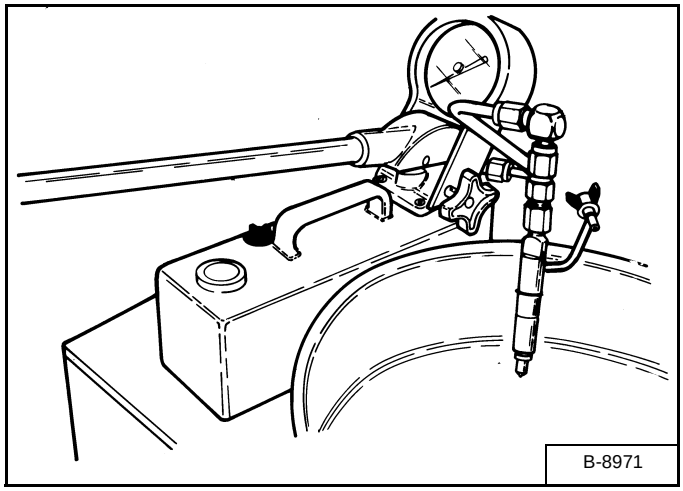
The tools listed will be needed to do the following procedure:

OEM1064 - Injection Nozzle Test
OEM1065 - Accessory Set

Figure 60-50-54



Connect the nozzle to the test pump, in a down position **[Figure 60-50-54]**.

Operate the test pump until the nozzle valve opens:

Injection Pressure:3625-3741 PSI. (250-258 bar)

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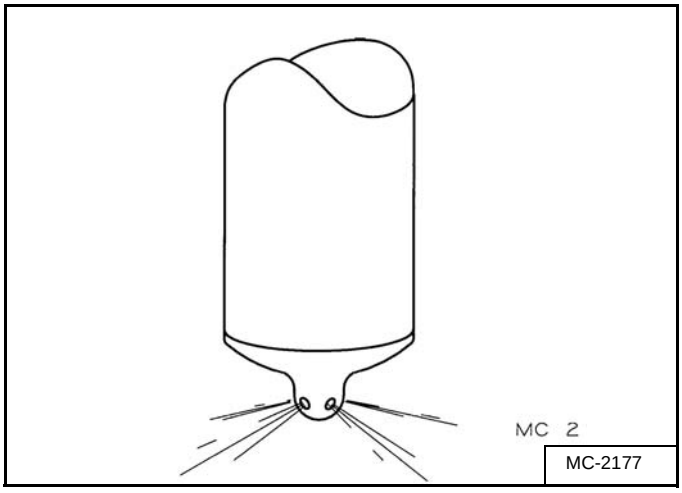
Fuel Injector Disassembly

Figure 60-50-55



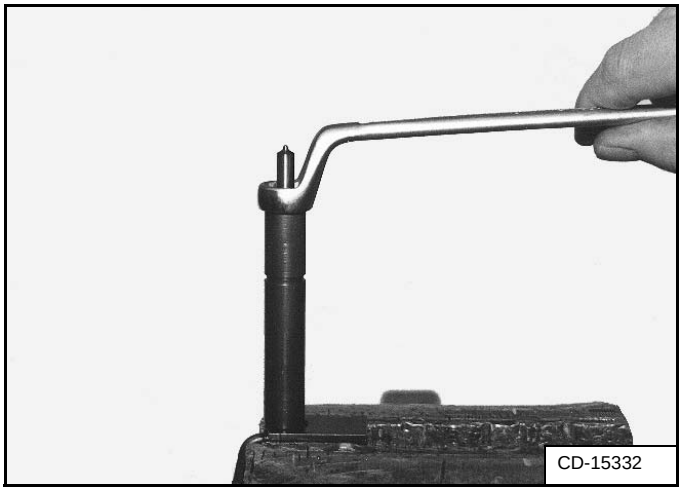
Check nozzles spray pattern **[Figure 60-50-55]**:

The spray pattern must be uniform from all four holes of the nozzle.

The nozzles are dirty or defective:

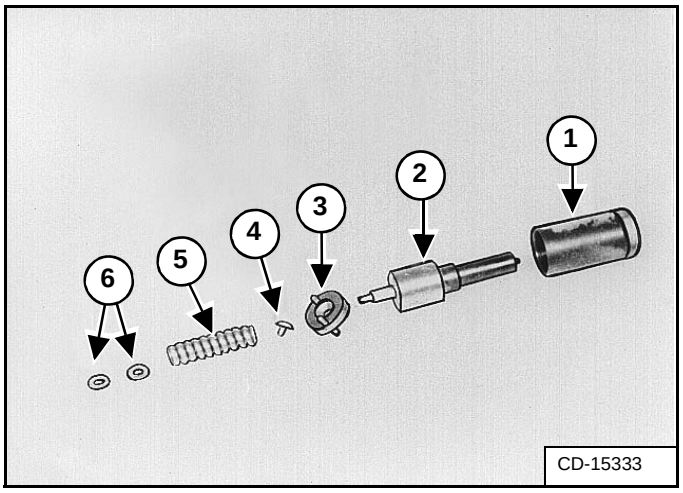
- If the spray pattern is not uniform.
- If fuel drips from the end of the nozzle.
- If the spray is a solid stream instead of a mist.

Figure 60-50-56



Remove the nozzle cap nut **[Figure 60-50-56]**.

Figure 60-50-57

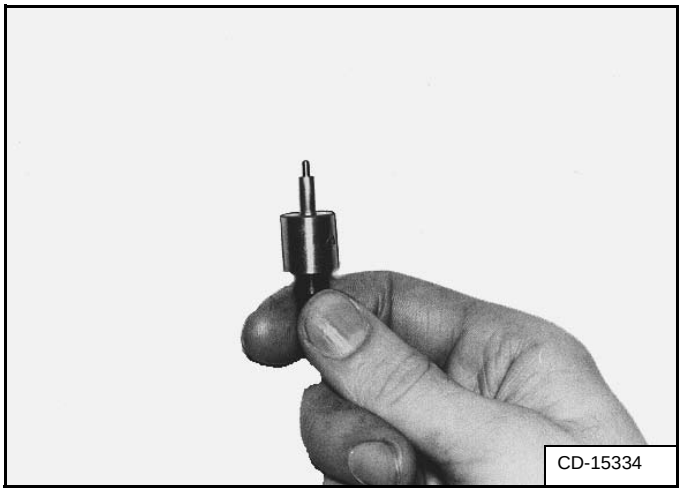


Disassemble the parts as shown in **[Figure 60-50-57]**.

1. Nozzle Cap Nut
2. Injector Nozzle
3. Adapter
4. Thrust Pin
5. Spring
6. Shim(s)

Wash all the parts in clean diesel fuel and blow dry using compressed air.

Figure 60-50-58



The nozzle needle and body **[Figure 60-50-58]** are lapped together and can not be exchanged with other nozzle parts.

DO NOT touch the nozzle needle with your fingers.

When the nozzle body is held in the upright position, the needle should by its own weight slide slowly and smoothly on its seat **[Figure 60-50-58]**.

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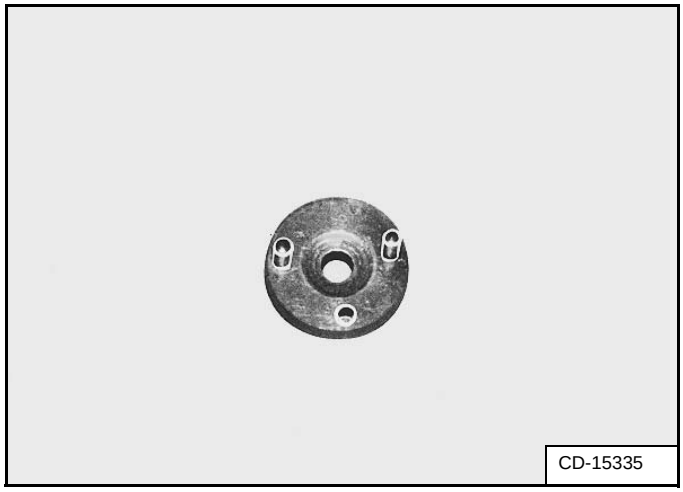
Fuel Injector Disassembly (Cont'd)

NOTE: If the nozzle needle does not slide smoothly, wash the injector nozzle parts again in clean diesel fuel. Blow dry with compressed air. Re-do the procedure again. Replace the injectors as needed. Wash all new injectors in clean diesel fuel before installation.

Figure 60-50-59



Check the seat surface of the adapter for wear. Make sure the centering pins are in place **[Figure 60-50-59]**.

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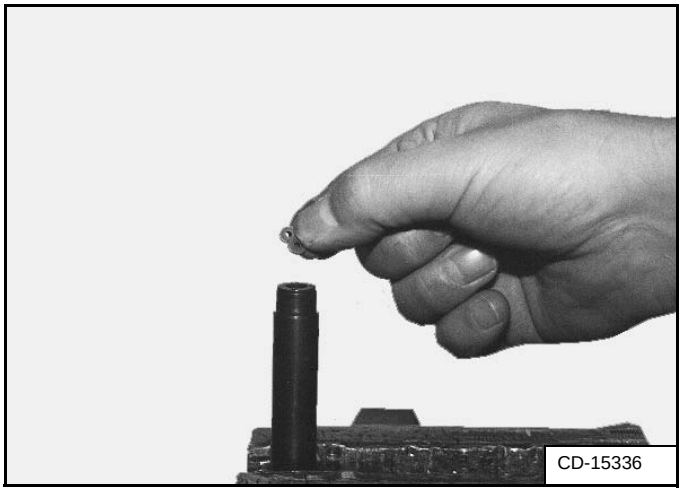
Fuel Injector Assembly

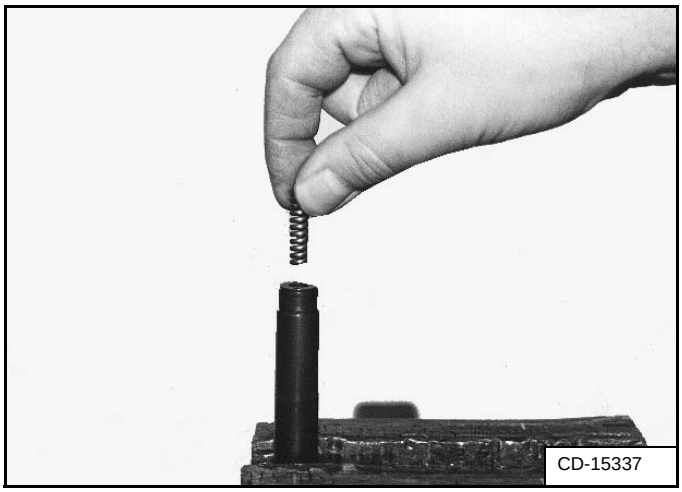
Figure 60-50-60



Install the shim(s) **[Figure 60-50-60]**.

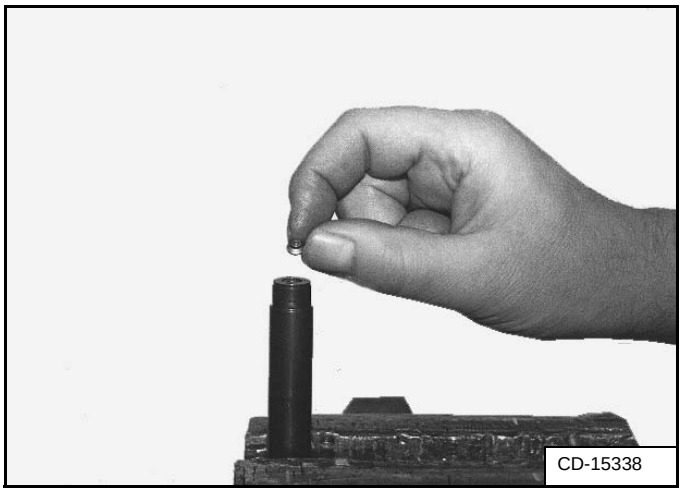
The injector opening pressure is adjusted by selecting the correct amount of shim(s). A thicker shim will increase the opening pressure at the injector nozzle.

Figure 60-50-61



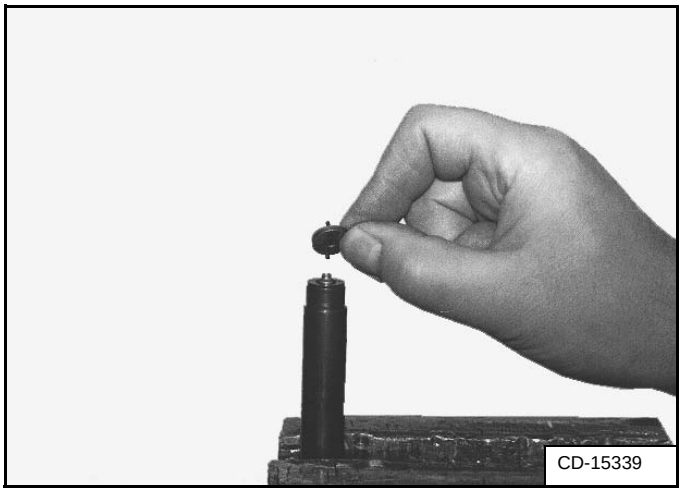
Install the compression spring **[Figure 60-50-61]**.

Figure 60-50-62



Install the thrust pin with the centering collar facing toward the compression spring **[Figure 60-50-62]**.

Figure 60-50-63



Install the adapter with the centering pins toward the thrust pin **[Figure 60-50-63]**.

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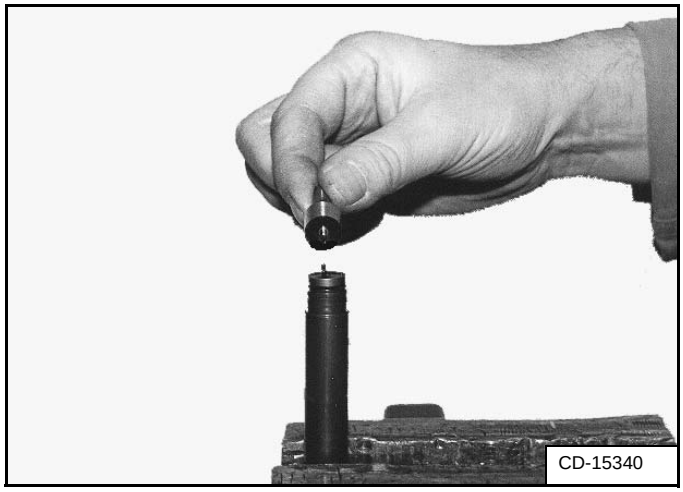
Fuel Injector Assembly (Cont'd)

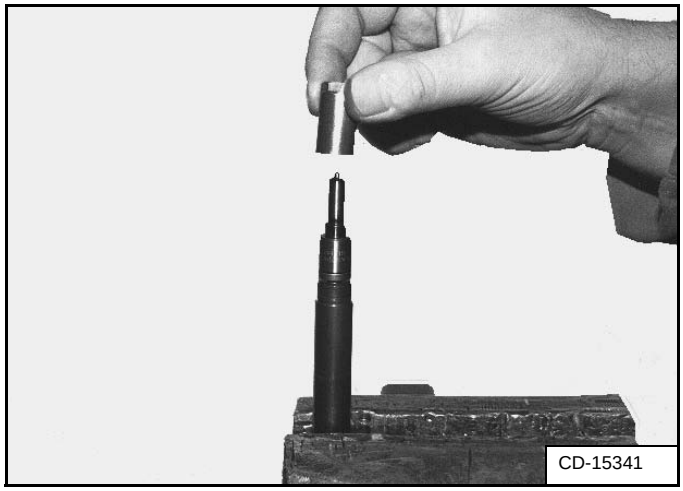
Figure 60-50-64



Install the injector nozzle, make sure the center bore fits over the centering pins of the adapter **[Figure 60-50-64]**.

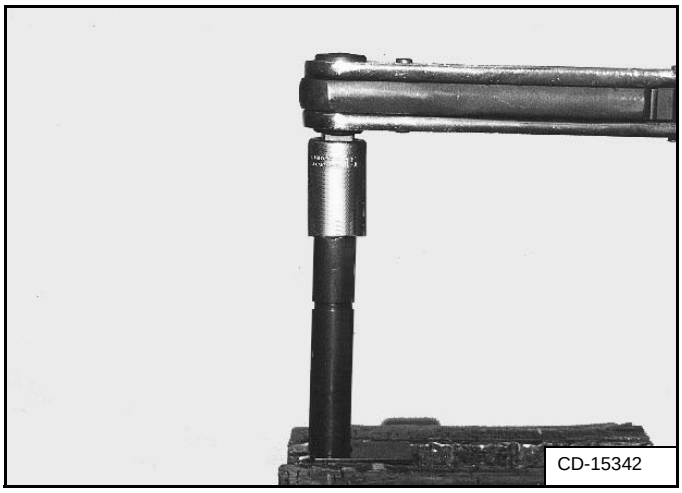
NOTE: Be careful that the nozzle needle does not fall out of the nozzle body.

Figure 60-50-65



Install the nozzle cap nut **[Figure 60-50-65]**.

Figure 60-50-66



Tighten the cap nut to 29-37 ft.-lb. (40-50 N•m) torque **[Figure 60-50-66]**.

Check the injector nozzle on the nozzle tester before installation. (See Fuel Injector, Checking on Page 60-50-18.)

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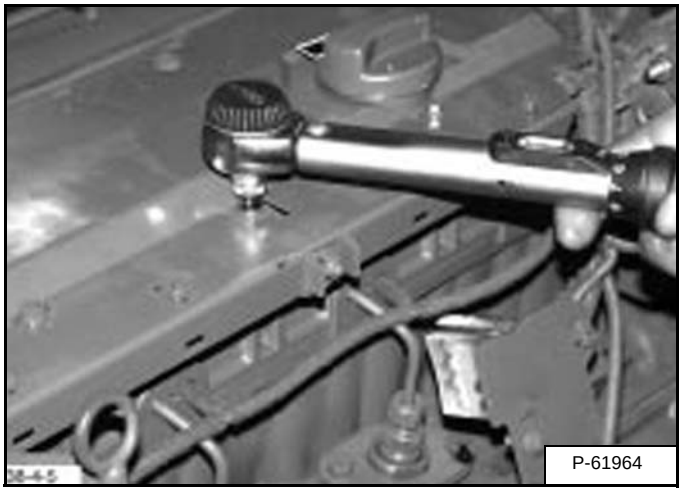
Valve Clearance Adjustment

Make the valve clearance adjustment with the engine stopped and cold.

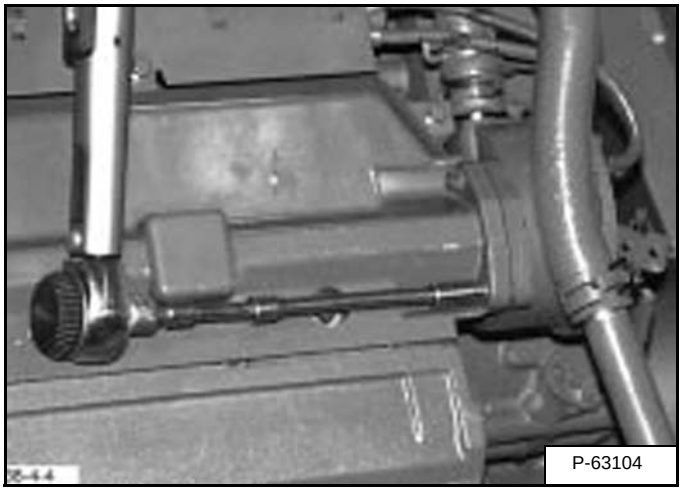
Remove the valve cover and crankcase breather.

Figure 60-50-67



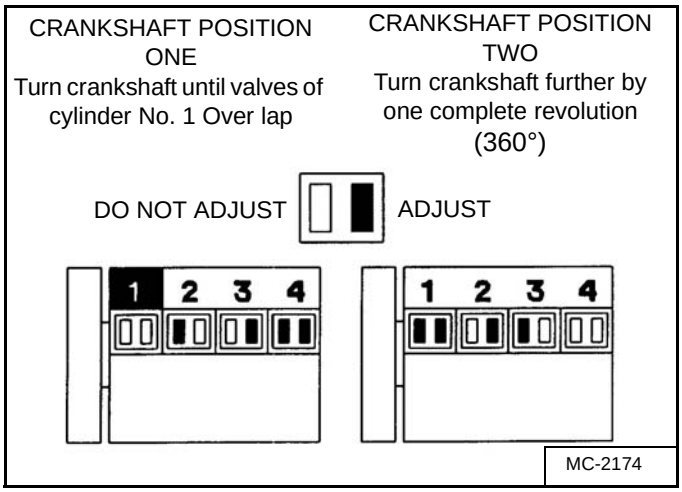
When installing the valve cover bolts, tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque **[Figure 60-50-67]**.

Figure 60-50-68



When installing the crankcase breather bolts, tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque **[Figure 60-50-68]**.

Figure 60-50-69



Use the following sequence as shown in **[Figure 60-50-69]** to set the valve clearance.

Turn the crankshaft until the valves of cylinder No. 1 over-lap **[Figure 60-50-69]**.

Turn the crankshaft by one complete revolution (360°) and set the other valves.

Figure 60-50-70

Loosen the locknut and turn the set screw until the clearance is correct **[Figure 60-50-70]**.

Intake - 0.012 inch (0.3 mm)
Exhaust - 0.020 inch (0.5 mm)

Tighten the locknut to 13-16 ft.-lb. (18-22 N•m) torque.

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Thermostat

Figure 60-50-71

Press down on the thermostat and remove from the housing **[Figure 60-50-71]**.

Installation: Press down and turn the thermostat into the housing.

NOTE: The yoke must engage the housing.

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ENGINE COMPONENTS AND TESTING (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Engine Compression Checking

Check and adjust the valve clearance as needed. (See Valve Clearance Adjustment on Page 60-51-28.)

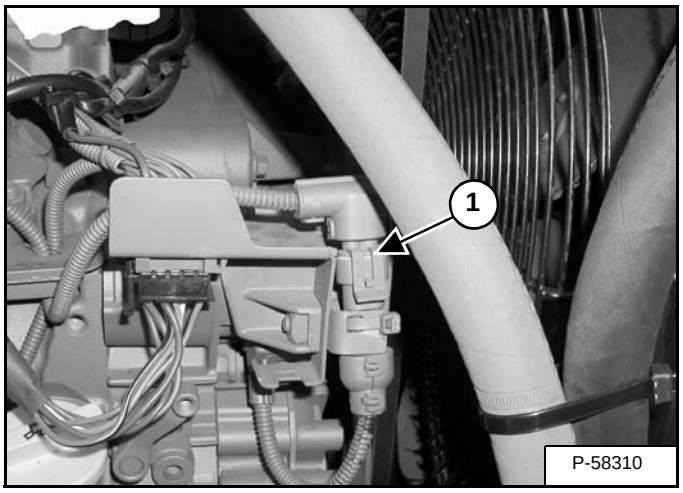
The tools listed will be needed to do the following procedure:

MEL 10630 - Engine Compression Tester
MEL 1433 - Compression Test Adapter

Warm the engine.

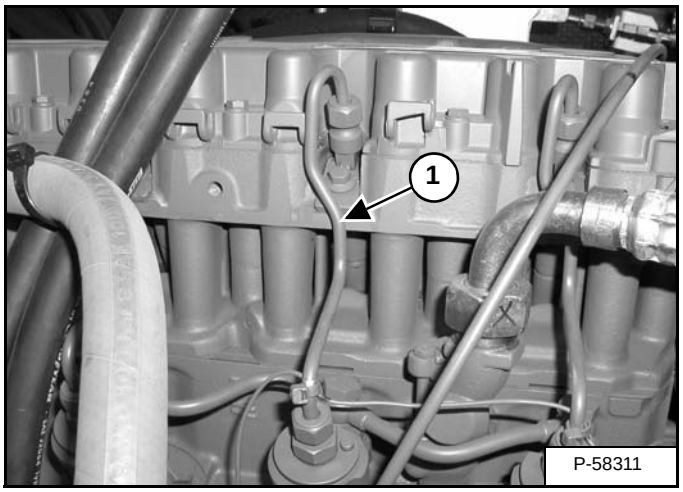
Clean the area around the fuel injection pump and injectors.

Figure 60-51-1



Disconnect the wire harness (Item 1) **[Figure 60-51-1]** from the fuel shutoff solenoid.

Figure 60-51-2



Remove the high pressure fuel line (Item 1) **[Figure 60-51-2]** from the fuel pump and fuel injector.

IMPORTANT

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

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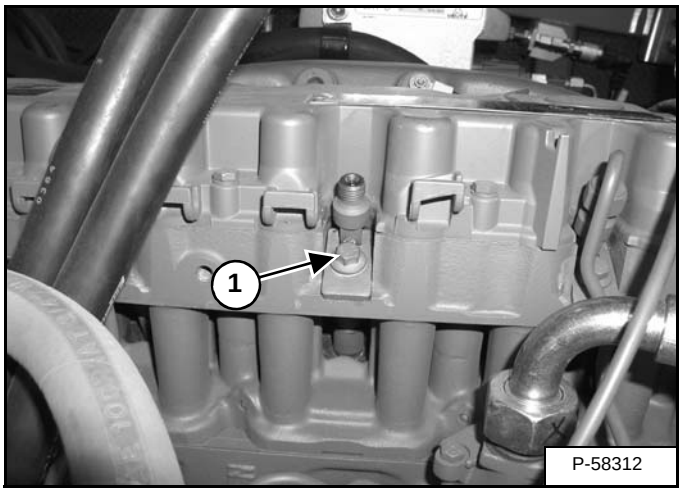
Installation: Tighten the fuel line nuts to 10-12 ft.-lb. (13.5 - 16.5 N•m) torque.

Figure 60-51-3



Remove the bolt (Item 1) **[Figure 60-51-3]** and injector retainer.

Installation: Tighten the bolt to 16 ft.-lb. (21 N•m) torque.

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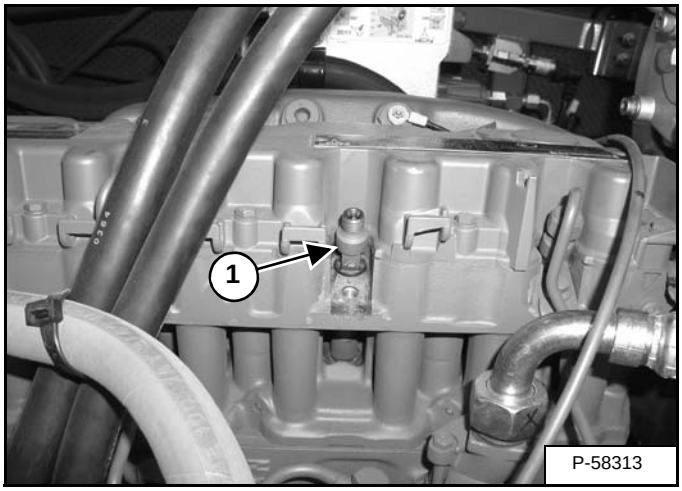
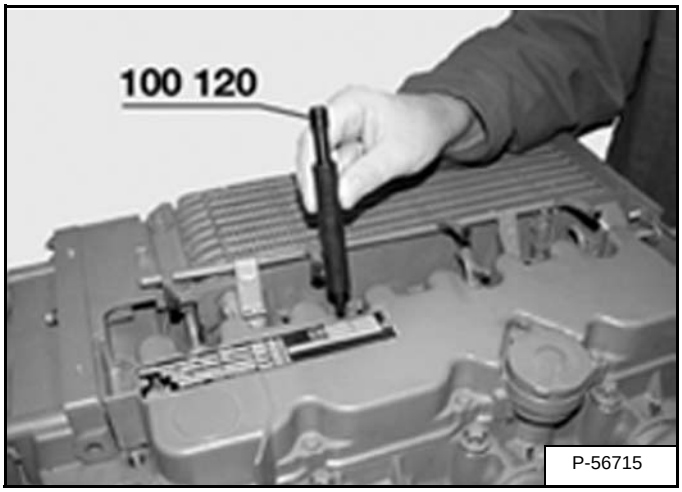
Engine Compression Checking (Cont'd)

Figure 60-51-4



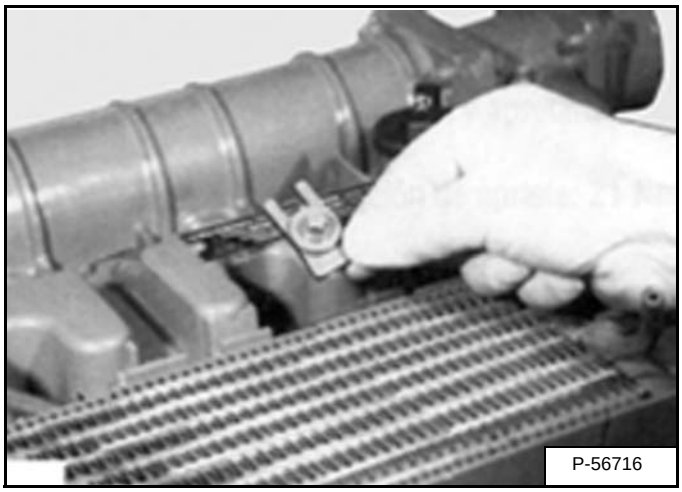
Remove the injector (Item 1) **[Figure 60-51-4]**.

Figure 60-51-5



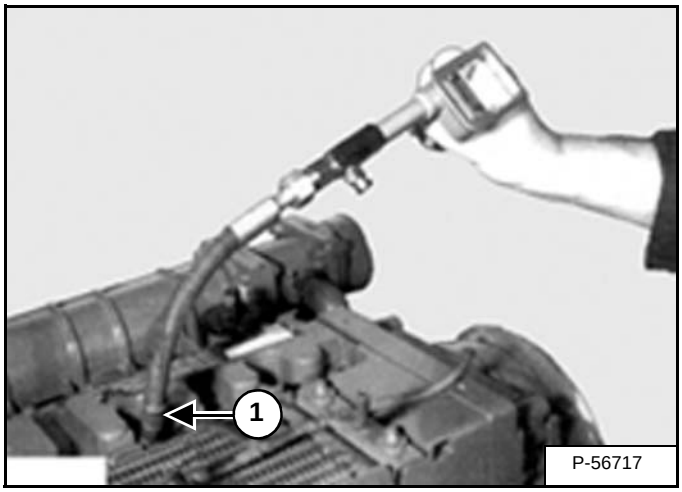
Install the compression adapter tool MEL-1433 **[Figure 60-51-5]**.

Figure 60-51-6



Install the injector retainer (Item 1) **[Figure 60-51-6]** and bolt.

Figure 60-51-7



Connect the compression gauge (Item 1) **[Figure 60-51-7]** to the adapter.

Turn the engine with the starter at 200 to 300 RPM. Run the test for each cylinder two times at 5 to 10 seconds each time and take the average reading.

The correct compression of the engine is 319 - 392 PSI (22 - 27 bar) with no more than 15% difference between the cylinders.

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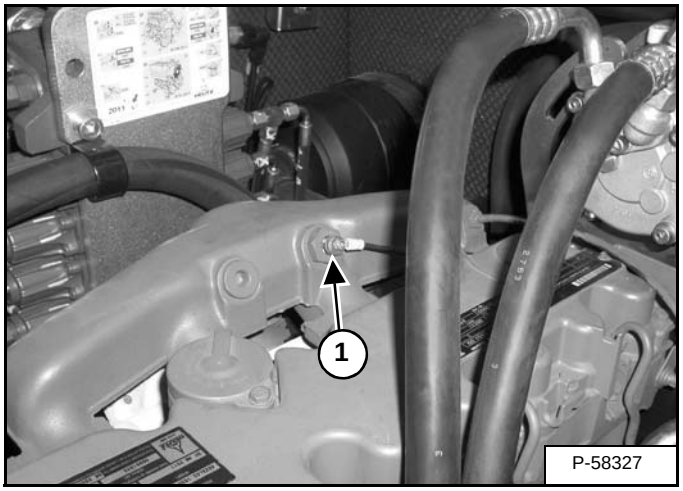
Checking the Manifold Heater

Open the right side cover.

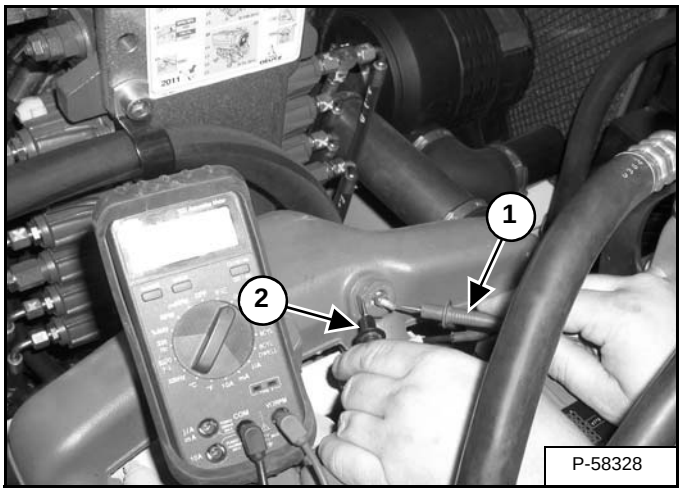
Figure 60-51-8



Remove the nut, washer and wire harness (Item 1) **[Figure 60-51-8]** from the manifold heater.

Use a multimeter to measure the resistance of the heater.

Figure 60-51-9



Connect one lead from the multimeter to the terminal (Item 1) **[Figure 60-51-9]**.

Connect the other lead to the base of the heater (Item 2) **[Figure 60-51-9]**.

The reading must be approximately 0.5 ohms.

If the resistance is zero ohms, the heater has a short circuit and must be replaced.

If the resistance is infinite, the coil of the heater is broken and the heater must be replaced.

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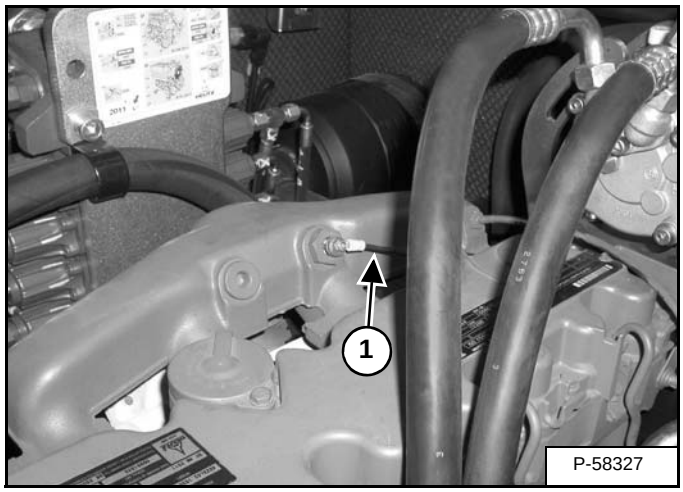
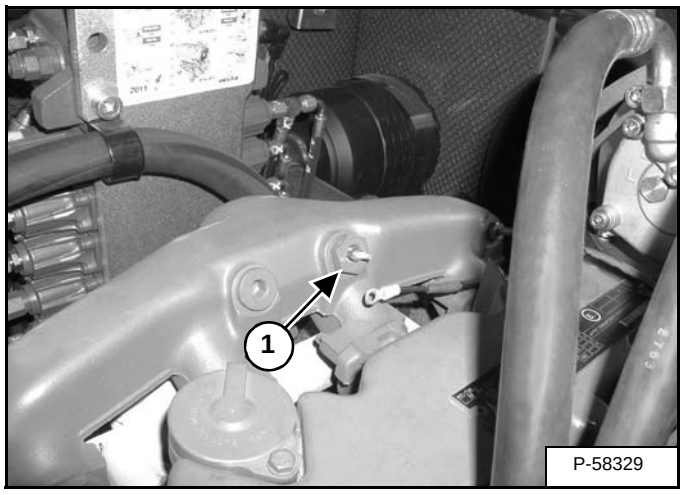
Manifold Heater Removal And Installation

Figure 60-51-10



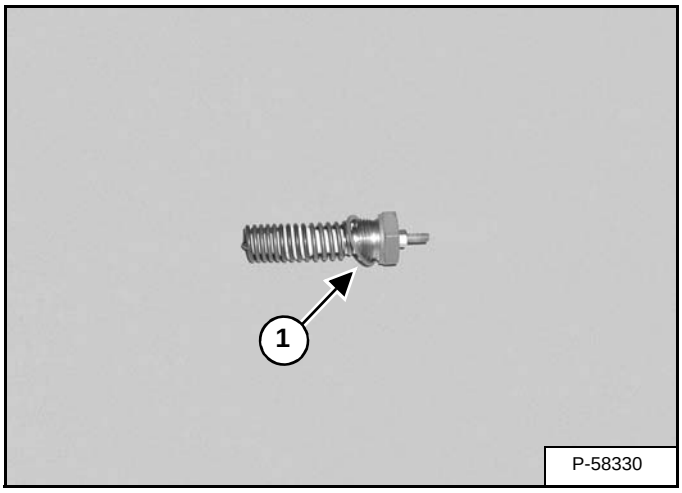
Remove the nut, washer and wire harness (Item 1) **[Figure 60-51-10]** and second washer.

Figure 60-51-11



Remove the heater (Item 1) **[Figure 60-51-11]**.

Figure 60-51-12



Remove the copper washer (Item 1) **[Figure 60-51-12]**.

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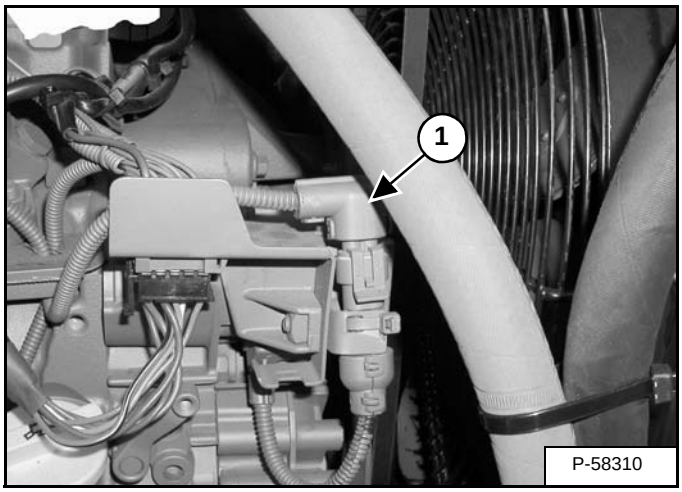
Fuel Shutoff Solenoid Checking

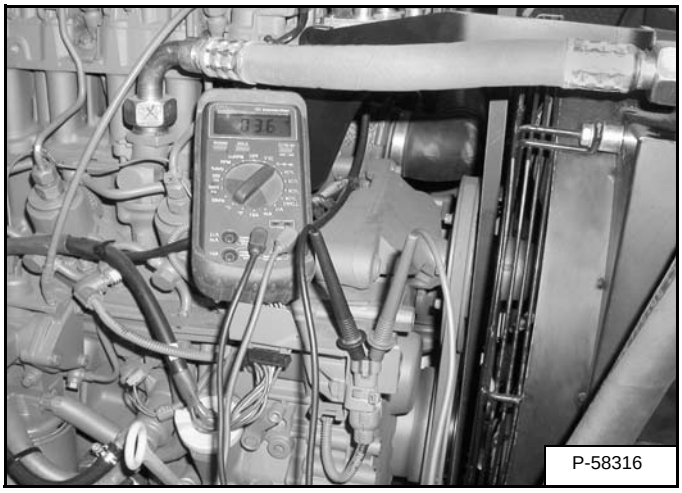
Figure 60-51-13



Disconnect the wire harness (Item 1) **[Figure 60-51-13]** from the fuel shutoff solenoid.

Use a multi meter to measure the resistance of the fuel shutoff solenoid.

Figure 60-51-14



Connect the meter leads (Item 1) **[Figure 60-51-14]** to the terminals.

The reading must be approximately 3.5 ohms.

If the resistance is zero ohms the solenoid has a short circuit.

If the resistance is infinite, the coil in the solenoid is broken.

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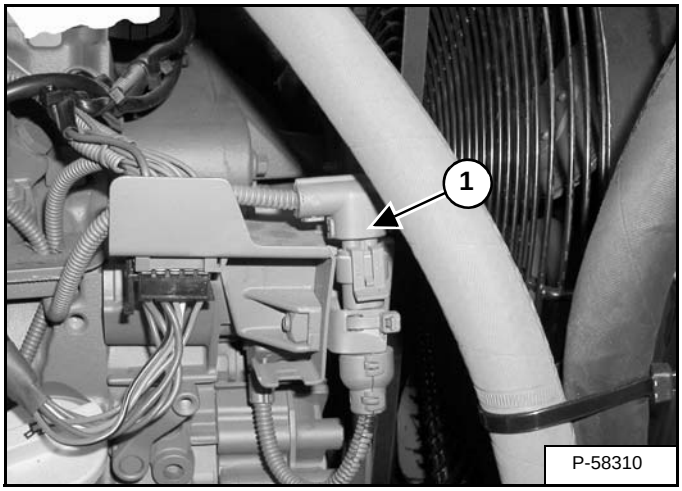
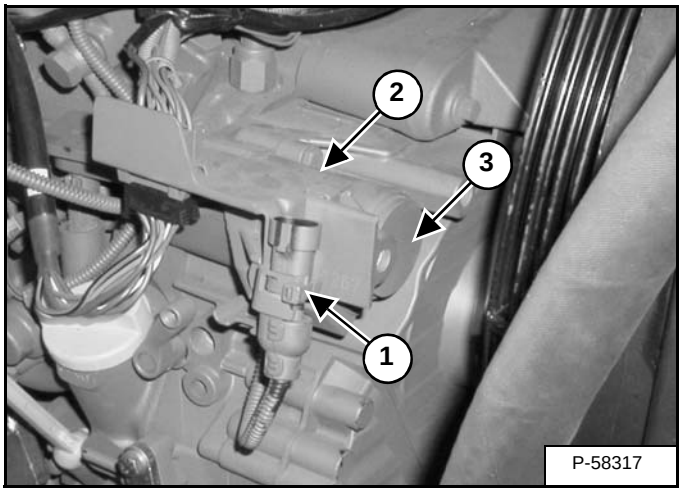
Fuel Shutoff Solenoid Removal And Installation

Figure 60-51-15



Disconnect the wire harness (Item 1) **[Figure 60-51-15]**.

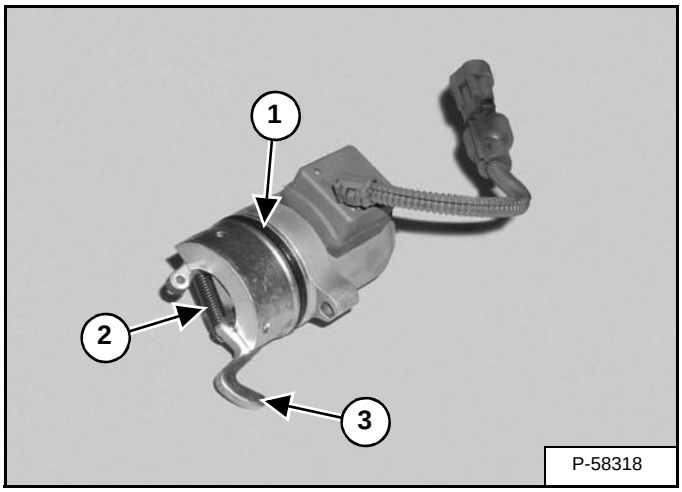
Figure 60-51-16



Cut and remove the cable tie (Item 1). Remove the two bolts (Item 2) and remove the solenoid (Item 3) **[Figure 60-51-16]**.

Installation: Tighten the bolts to 10-12 ft.-lb. (13.5-16.3 N•m) torque.

Figure 60-51-17



Remove the O-ring (Item 1) **[Figure 60-51-17]**.

Check the solenoid spring (Item 2) and linkage (Item 3) **[Figure 60-51-17]**.

NOTE: When installing the fuel shutoff solenoid in the engine, the linkage (Item 3) [Figure 60-51-17] must engage the fuel control rack.

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Fuel Injection Pump Removal

IMPORTANT

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

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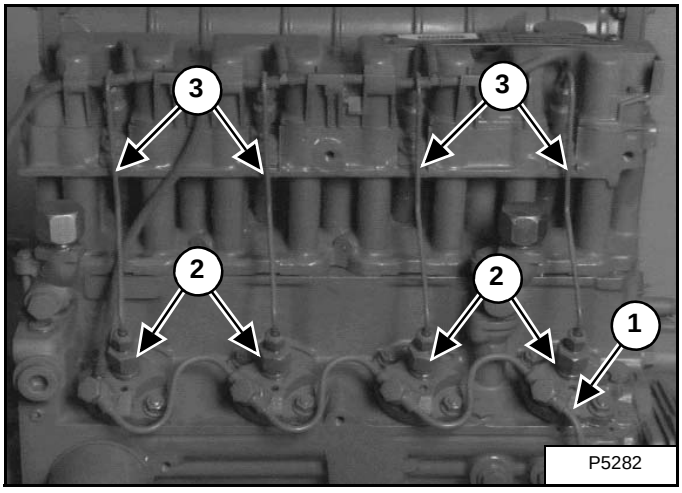
The injection pump(s) contain parts which have a very close tolerance and its operation has a direct effect on the performance of the engine.

Figure 60-51-18



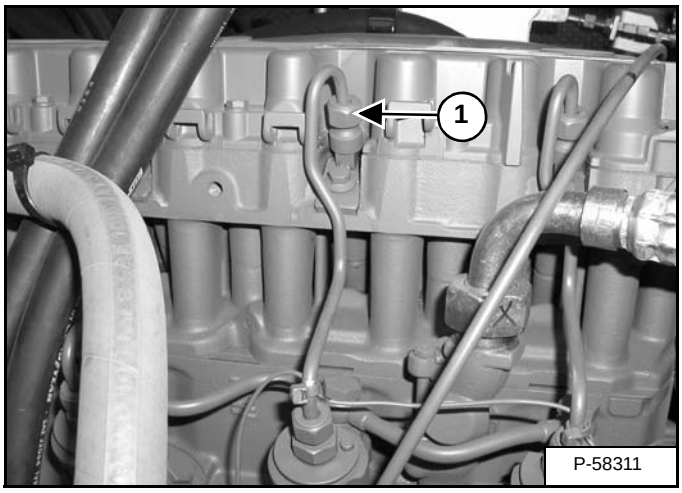
Remove the fuel tubeline (Item 1) to the fuel injection pumps (Item 2) **[Figure 60-51-18]**.

Disconnect the respective high pressure fuel line (Item 3) **[Figure 60-51-18]** from the injection pump to be removed and fuel injector.

IMPORTANT

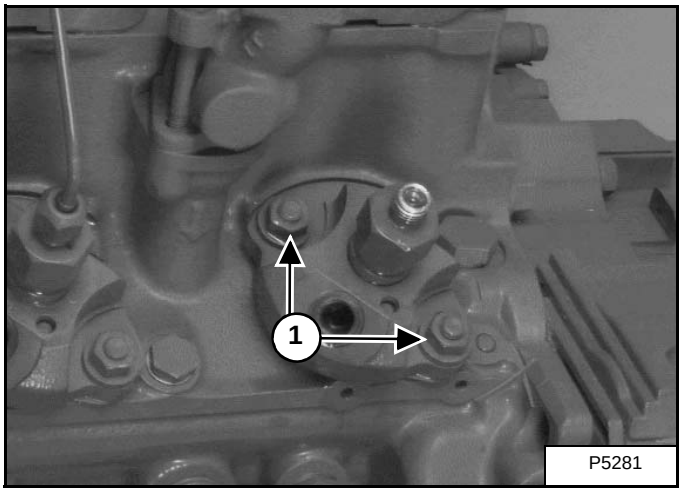
Do not bend the high pressure fuel injection tubes when removing or installing them.

Figure 60-51-19



Use a flare nut wrench (Item 1) **[Figure 60-51-19]** to loosen the high pressure fuel line nut.

Figure 60-51-20



Remove the two mounting nuts (Item 1) **[Figure 60-51-20]** from the injection pump.

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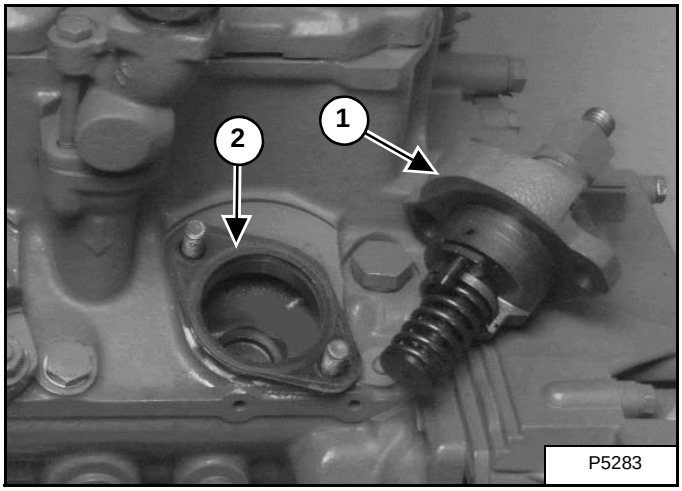
Fuel Injection Pump Removal (Cont'd)

Figure 60-51-21

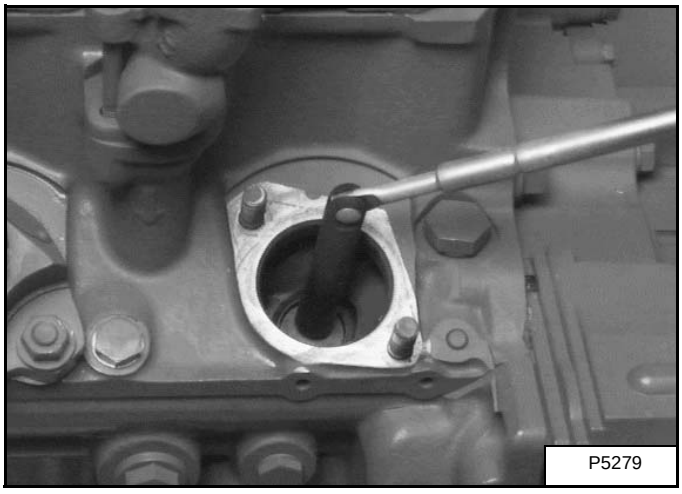


Remove the fuel injection pump (Item 1) **[Figure 60-51-21]**.

Remove the shim (Item 2) **[Figure 60-51-21]**.

NOTE: The shim(s) are used to time the injection pump, keep the same thickness for each injection pump.

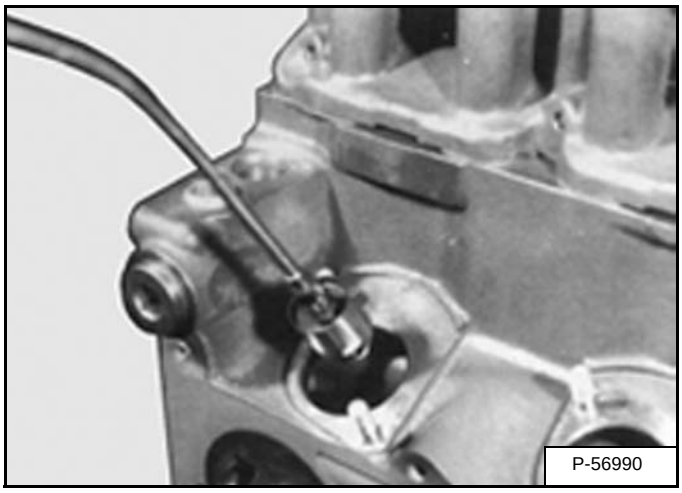
Figure 60-51-22



Use a magnet to remove the injection pump tappet **[Figure 60-51-22]**.

Inspect the tappet for wear or damage, replace as needed.

Figure 60-51-23



Install the tappet into its respective bore **[Figure 60-51-23]**.

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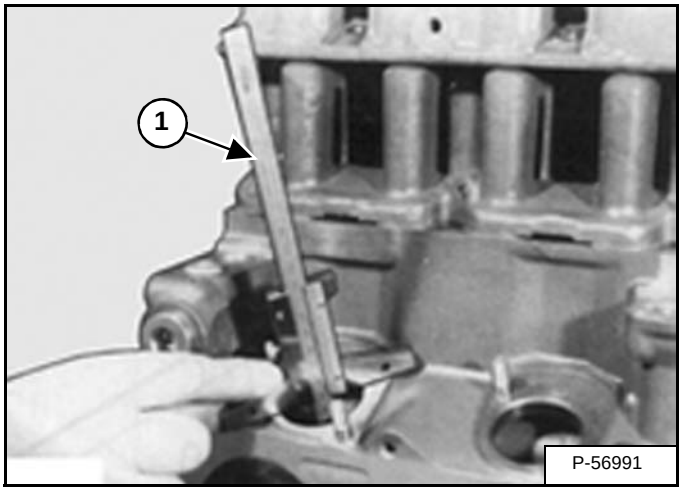
Fuel Injection Pump Timing

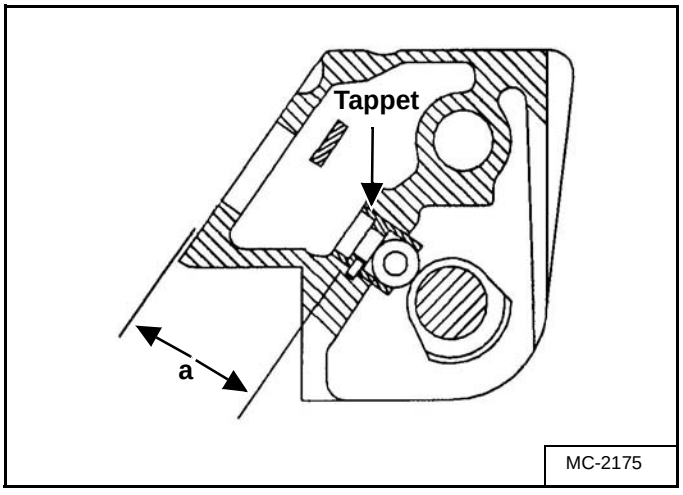
The fuel injection pump does not need to be timed if the tappet, shim(s) and the camshaft are not changed.

Figure 60-51-24



Install a depth micrometer (Item 1) **[Figure 60-51-24]** and record the measurement.

Figure 60-51-25



Measure the distance between the engine block surface (without shim) and surface of the tappet **[Figure 60-51-25]**.

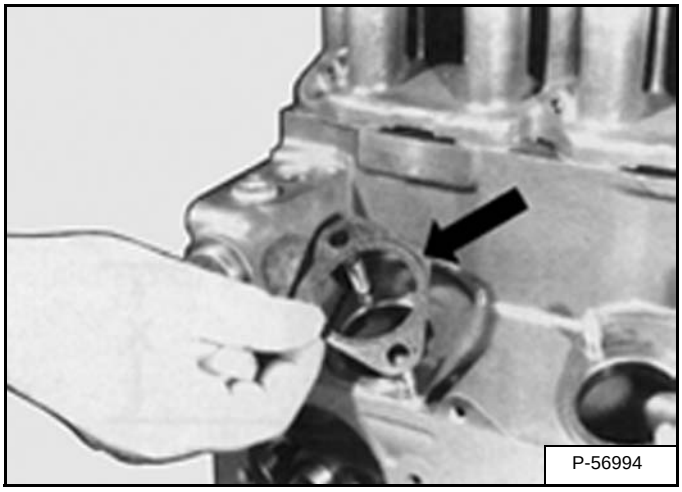
Installation dimension of the injection pump is 2.36 inch (60 mm).

EXAMPLE:

Specifications:
Installation Depth2.36 inch. (60 mm)
Measured Depth 2.29 inch. (58.16 mm)
Difference0.070 inch. (1,78 mm)

Determine the number of shim(s) needed to get the correct installation height.

Figure 60-51-26



Install the appropriate number of shims on the engine block surface. **[Figure 60-51-26]**.

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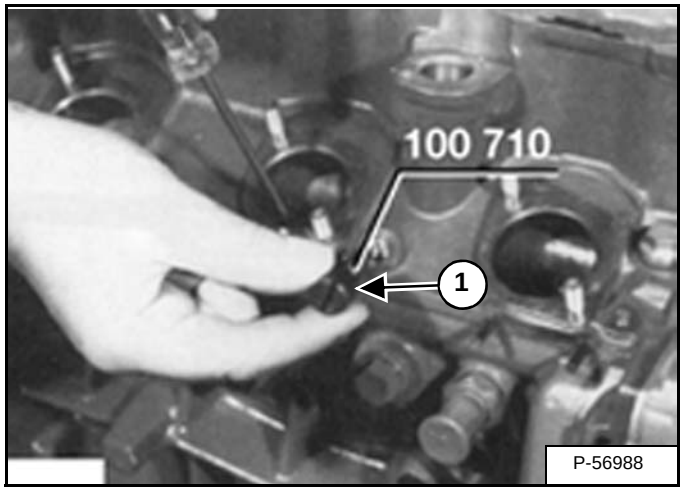
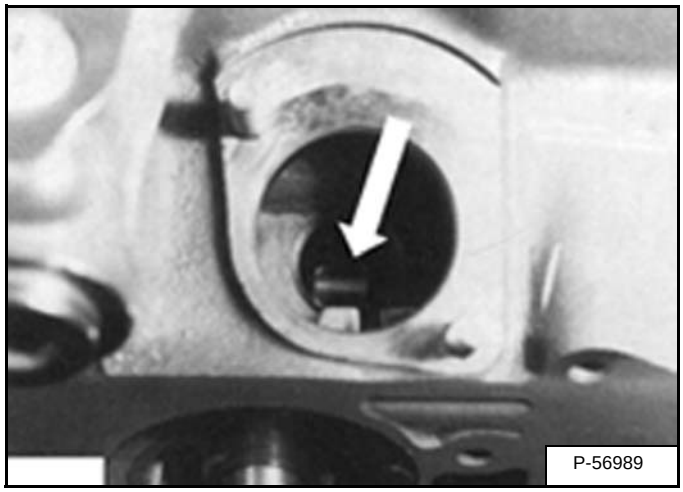
Fuel Injection Pump Installation

Figure 60-51-27



Remove the plug from the engine block. Install control rack locating pin MEL-1459 (Item 1) **[Figure 60-51-27]**.

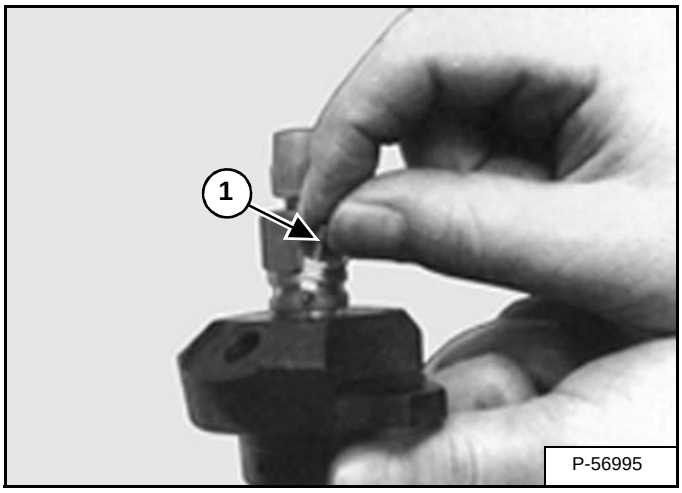
Figure 60-51-28



Rotate the camshaft until the tappet stroke is at B.D.C. **[Figure 60-51-28]**.

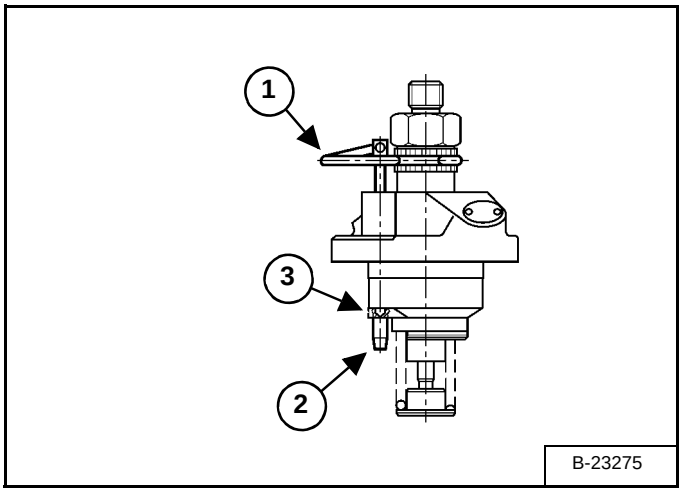
Tighten the locating pin.

Figure 60-51-29



Use the centering pin MEL-1467 to remove the press-in plug (Item 1) **[Figure 60-51-29]** from the injection pump.

Figure 60-51-30



Install the centering pin (Item 1) into the injection pump and into the control lever (Item 2). Align the marks (Item 3) **[Figure 60-51-30]** on the pump body and the control lever. Make sure the control lever is in the center position.

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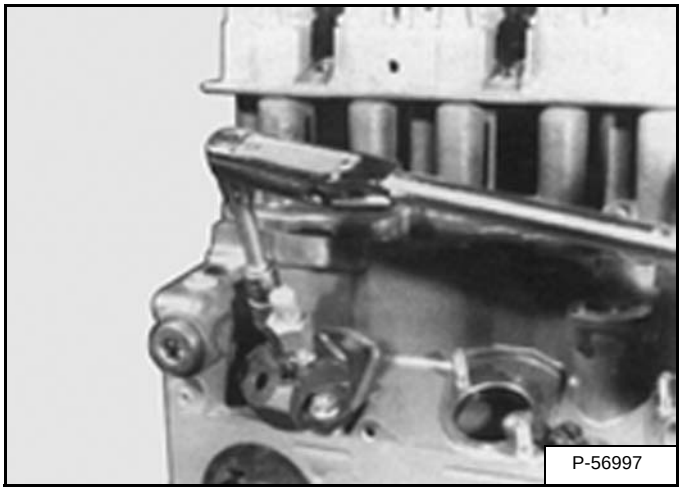
Fuel Injection Pump Installation (Cont'd)

Install the injection pump into the engine block. Make sure the control lever goes into the slot on the fuel control rack.

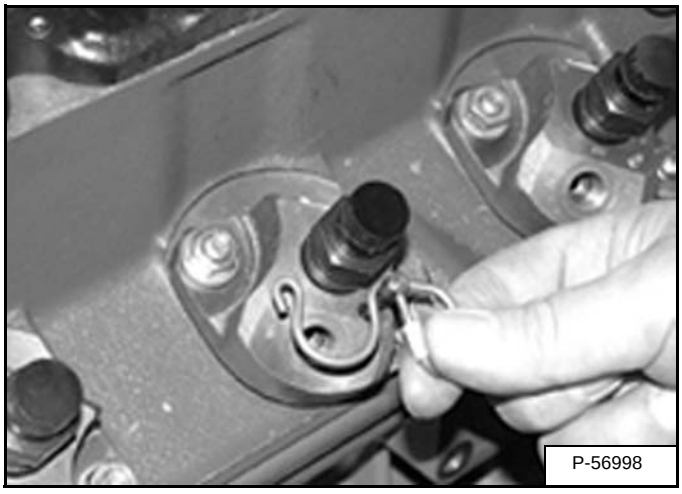
Install the two nuts.

Figure 60-51-31



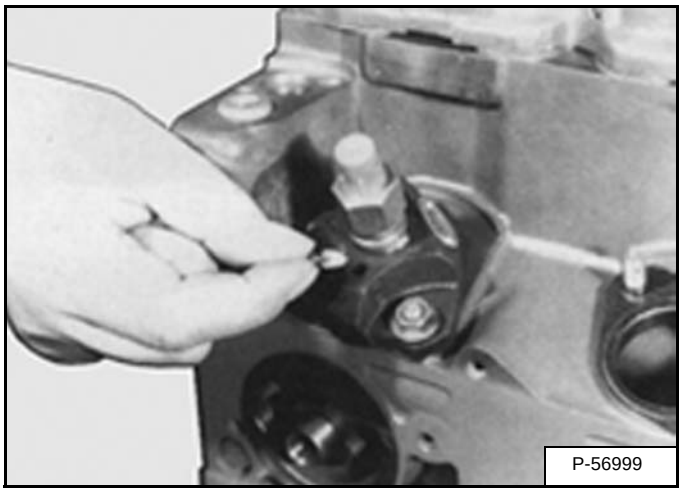
Tighten the mounting nuts to 15 ft.-lb. (21 N•m) torque **[Figure 60-51-31]**.

Figure 60-51-32



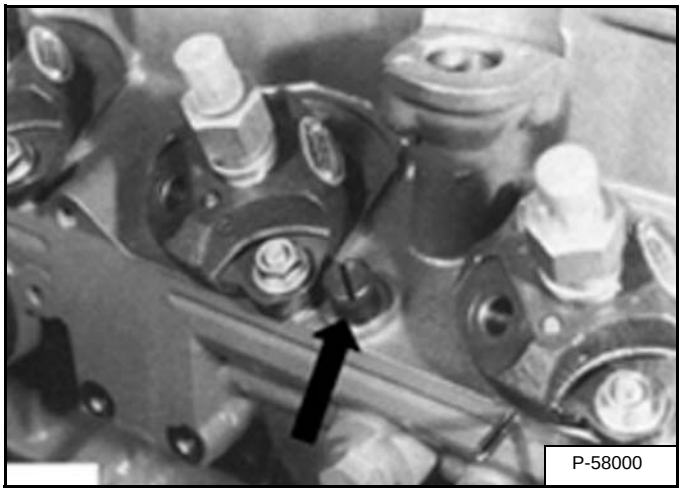
Remove the centering pin **[Figure 60-51-32]**.

Figure 60-51-33



Install the press in plug **[Figure 60-51-33]**.

Figure 60-51-34



Remove the locating pin **[Figure 60-51-34]**.

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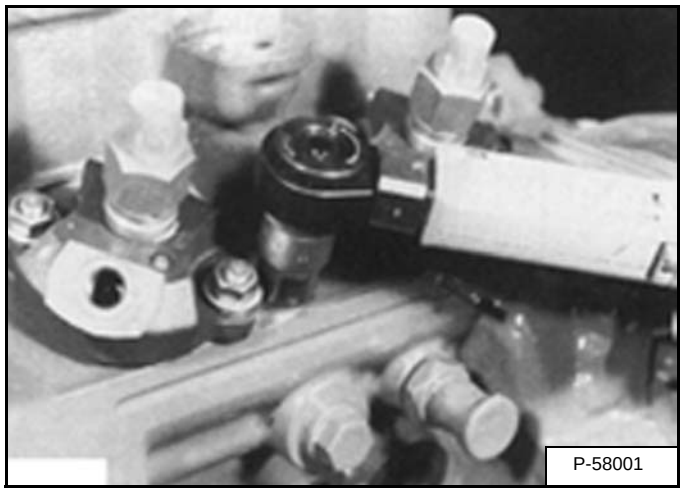
Fuel Injection Pump Installation (Cont'd)

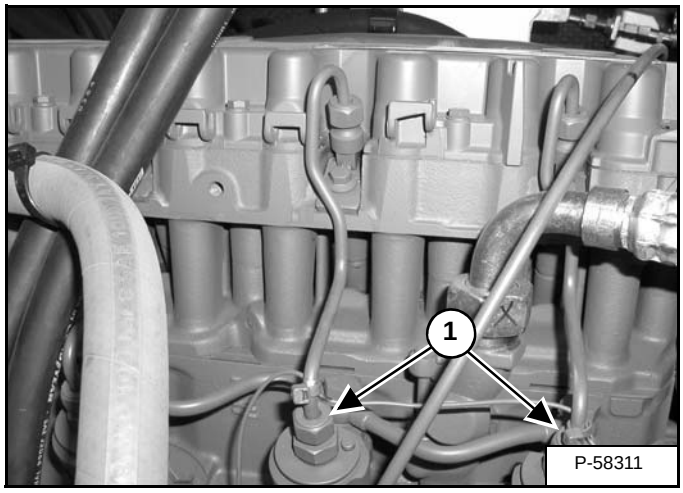
Figure 60-51-35



Install the plug **[Figure 60-51-35]**. Tighten the plug to 14 ft.-lb. (18 N•m) torque.

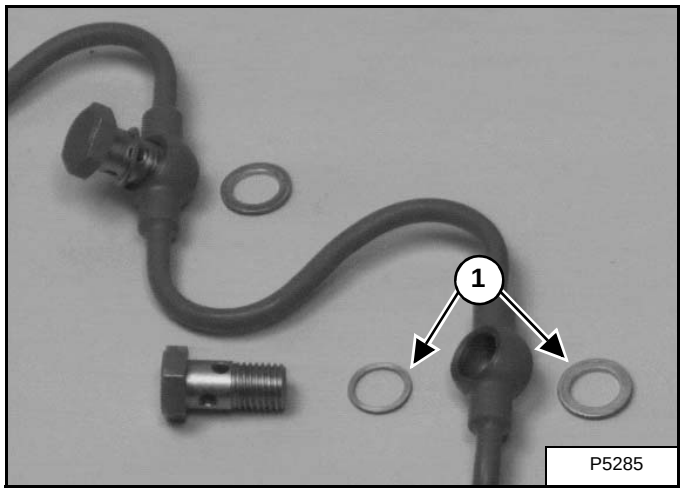
Install the high pressure fuel line.

Figure 60-51-36



Tighten the fuel line nut (Item 1) to 10-12 ft.-lb. (13,5 - 16,5 N•m) torque **[Figure 60-51-36]**.

Figure 60-51-37



Install new washers (Item 1) **[Figure 60-51-37]** on the fuel line bolts.

Install the fuel line on the injection pumps and tighten to 20-23 ft.-lb. (27-31 N•m) torque.

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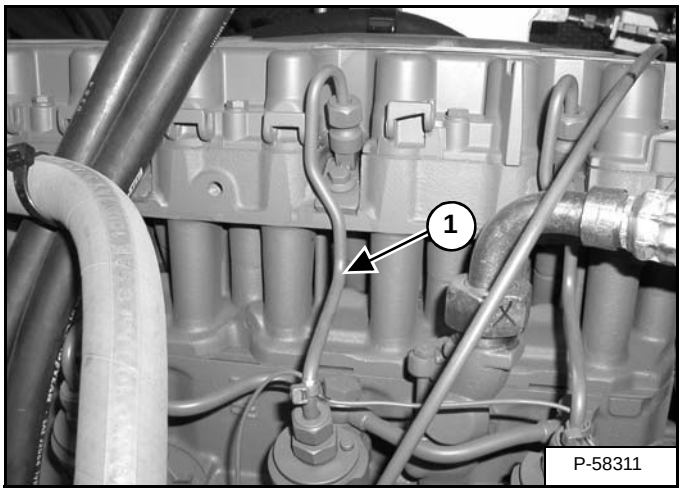
Fuel Injector Removal And Installation

Figure 60-51-38



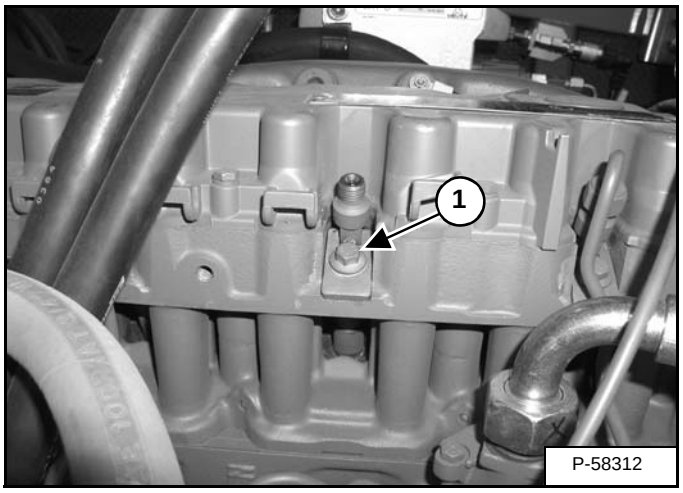
Remove the high pressure fuel line (Item 1) **[Figure 60-51-38]** from fuel injector to be removed and fuel injection pump.

IMPORTANT

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

Installation: Tighten the fuel line nut to 10-12 ft.-lb. (13,5-16,5 N•m) torque.

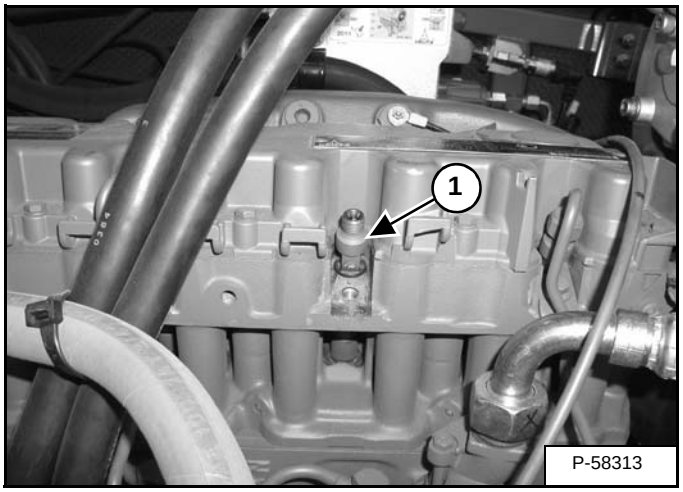
Figure 60-51-39



Remove the bolt (Item 1) **[Figure 60-51-39]** and holddown clamp from the fuel injector.

Installation: Tighten the bolt to 16 ft.-lb. (21 N•m) torque.

Figure 60-51-40



Remove the fuel injector (Item 1) **[Figure 60-51-40]**.

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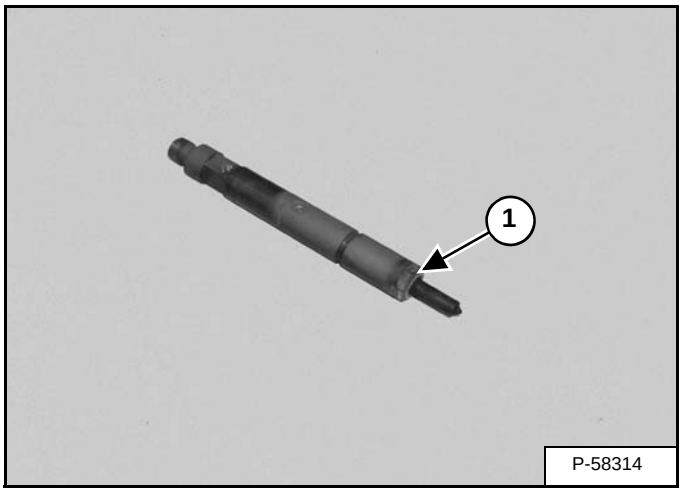
Fuel Injector Removal And Installation (Cont'd)

Figure 60-51-41



Remove the washer (Item 1) **[Figure 60-51-41]** from the injector.

Fuel Injector, Checking

IMPORTANT

Do not disassemble or test the fuel injector nozzles unless you have the correct service and testing tools.

⚠ 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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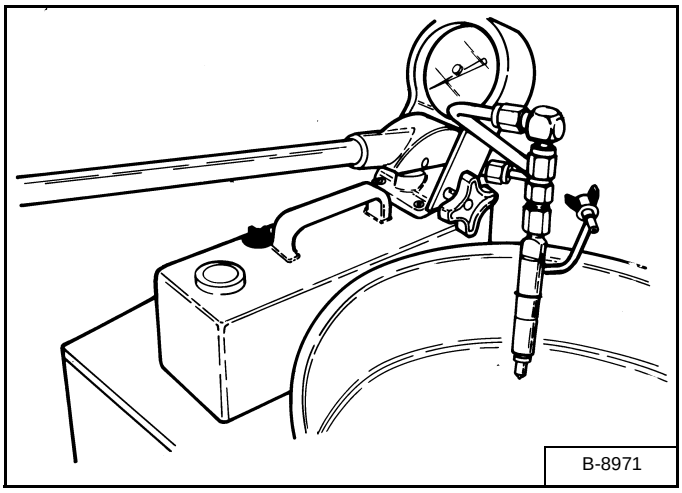
The tools listed will be needed to do the following procedure:

OEM1064 - Injection Nozzle Test
OEM1065 - Accessory Set

Figure 60-51-42



Connect the nozzle to the test pump, in a down position **[Figure 60-51-42]**.

Operate the test pump until the nozzle valve opens:

Injection Pressure:3045-3161 PSI. (210-218 bar)

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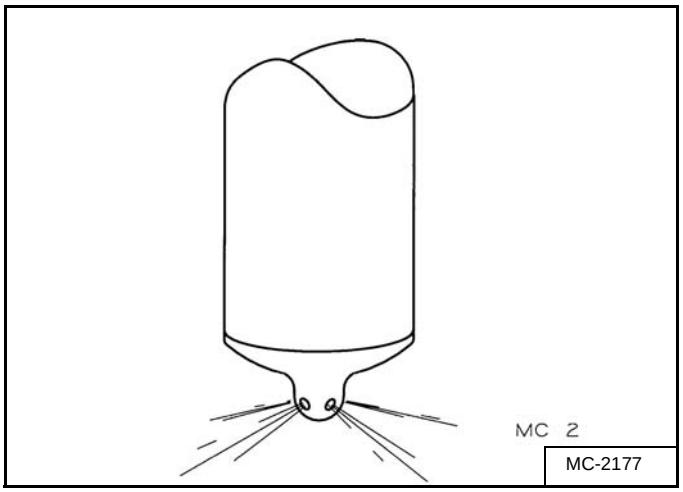
Fuel Injector Disassembly

Figure 60-51-43



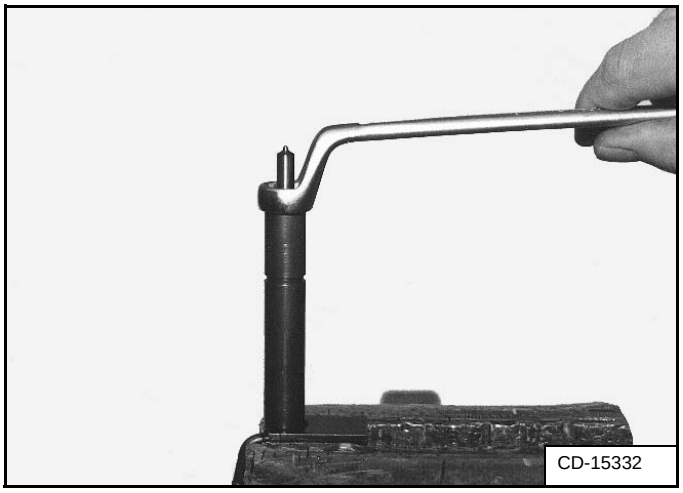
Check nozzles spray pattern **[Figure 60-51-43]**:

The spray pattern must be uniform from all four holes of the nozzle.

The nozzles are dirty or defective:

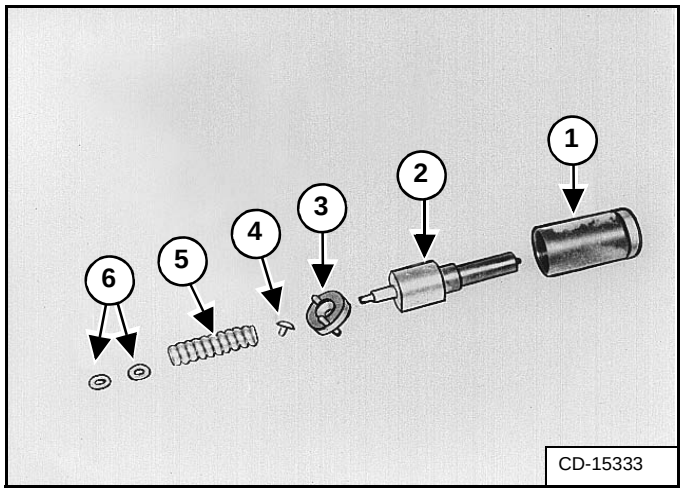
- If the spray pattern is not uniform.
- If fuel drips from the end of the nozzle.
- If the spray is a solid stream instead of a mist.

Figure 60-51-44



Remove the nozzle cap nut **[Figure 60-51-44]**.

Figure 60-51-45

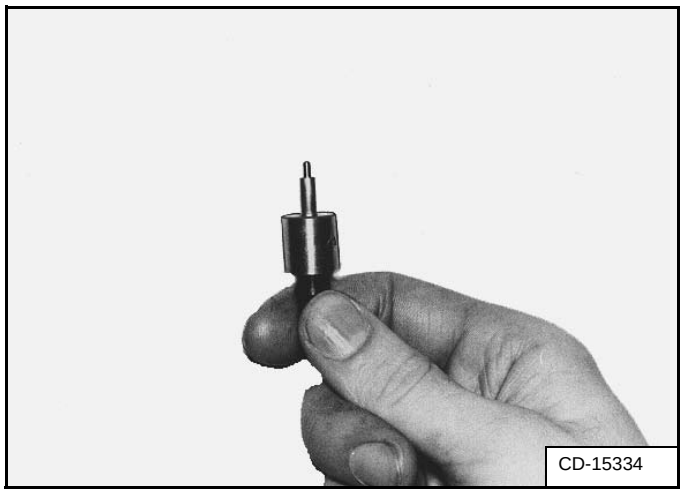


Disassemble the parts as shown in **[Figure 60-51-45]**.

1. Nozzle Cap Nut
2. Injector Nozzle
3. Adapter
4. Thrust Pin
5. Spring
6. Shim(s)

Wash all the parts in clean diesel fuel and blow dry using compressed air.

Figure 60-51-46



The nozzle needle and body **[Figure 60-51-46]** are lapped together and can not be exchanged with other nozzle parts.

DO NOT touch the nozzle needle with your fingers.

When the nozzle body is held in the upright position, the needle should by its own weight slide slowly and smoothly on its seat **[Figure 60-51-46]**.

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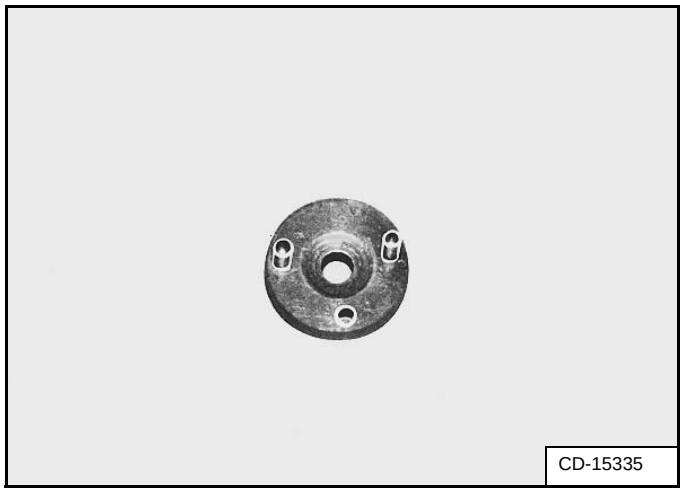
Fuel Injector Disassembly (Cont'd)

NOTE: If the nozzle needle does not slide smoothly, wash the injector nozzle parts again in clean diesel fuel. Blow dry with compressed air. Re-do the procedure again. Replace the injectors as needed. Wash all new injectors in clean diesel fuel before installation.

Figure 60-51-47



Check the seat surface of the adapter for wear. Make sure the centering pins are in place **[Figure 60-51-47]**.

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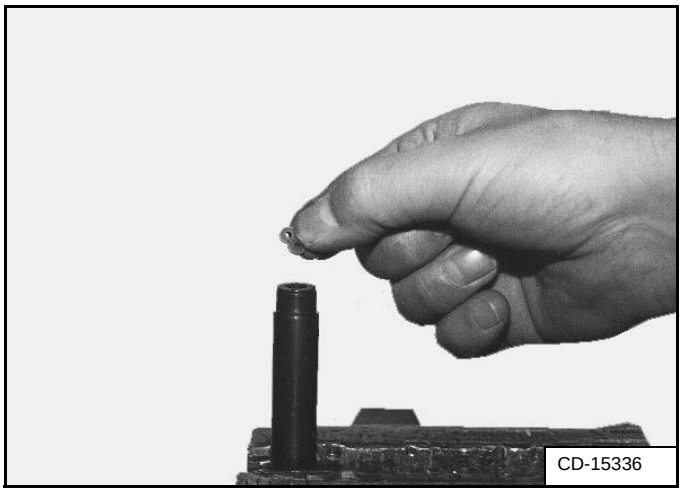
Fuel Injector Assembly

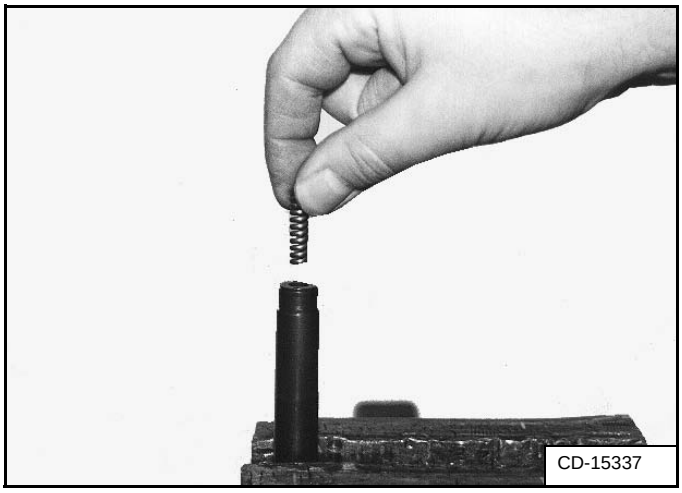
Figure 60-51-48



Install the shim(s) **[Figure 60-51-48]**.

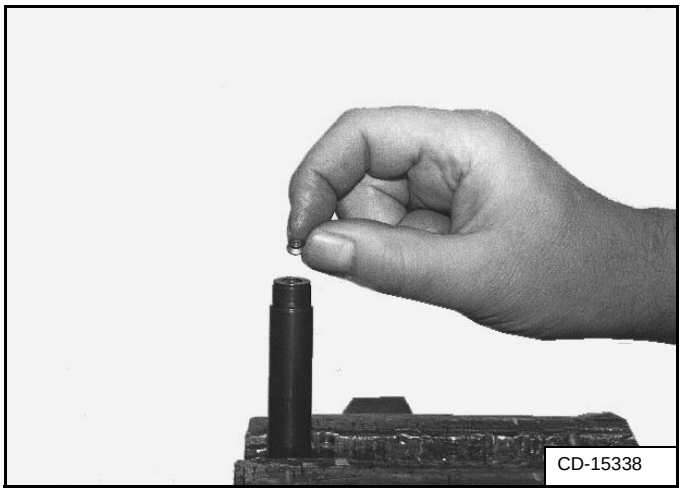
The injector opening pressure is adjusted by selecting the correct amount of shim(s). A thicker shim will increase the opening pressure at the injector nozzle.

Figure 60-51-49



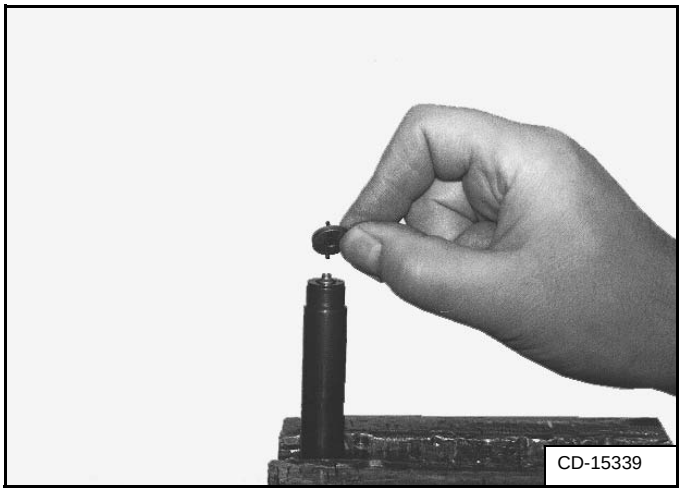
Install the compression spring **[Figure 60-51-49]**.

Figure 60-51-50



Install the thrust pin with the centering collar facing toward the compression spring **[Figure 60-51-50]**.

Figure 60-51-51



Install the adapter with the centering pins toward the thrust pin **[Figure 60-51-51]**.

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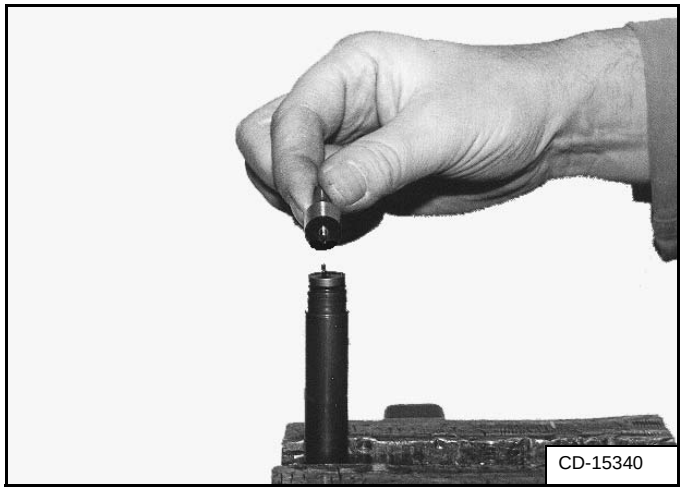
Fuel Injector Assembly (Cont'd)

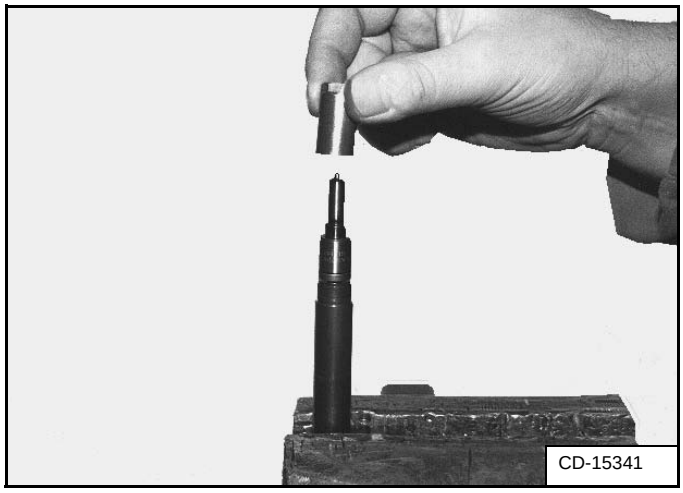
Figure 60-51-52



Install the injector nozzle, make sure the center bore fits over the centering pins of the adapter **[Figure 60-51-52]**.

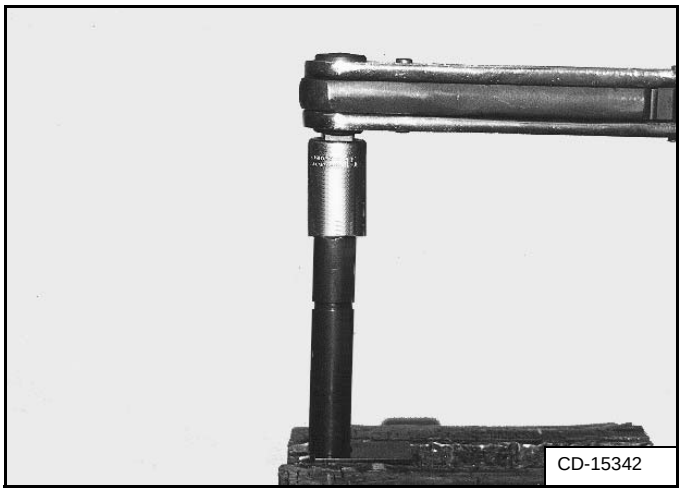
NOTE: Be careful that the nozzle needle does not fall out of the nozzle body.

Figure 60-51-53



Install the nozzle cap nut **[Figure 60-51-53]**.

Figure 60-51-54



Tighten the cap nut to 29-37 ft.-lb. (40-50 N•m) torque **[Figure 60-51-54]**.

Check the injector nozzle on the nozzle tester before installation. (See Fuel Injector, Checking on Page 60-51-14.)

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Timing Belt Inspection

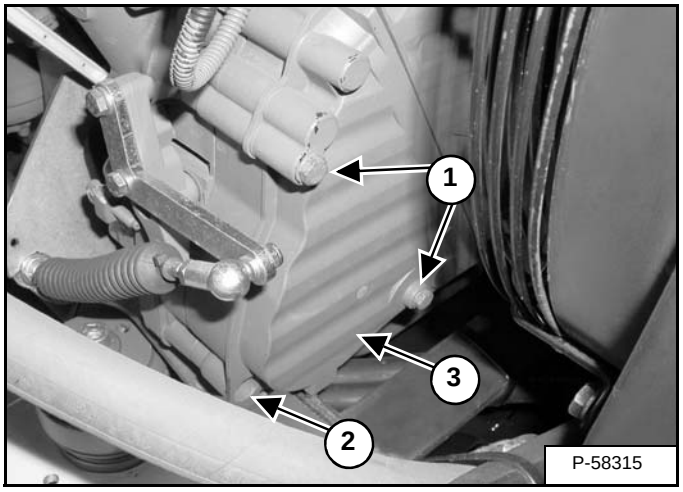
NOTE: The timing belt is maintenance free. Timing belts that are in operation do not need to be re-tensioned. The timing belt, belt tensioner and mount bolt must be replaced every 3000 operating hours or every 5 years. A repair kit is available.

NOTE: If the timing belt has to be removed before 200 hours of engine operation, the timing belt can be re-used and re-tensioned according to the procedure listed.

To do the following procedure you need the following tool:

ME-1552 - Torx Bit

Figure 60-51-55

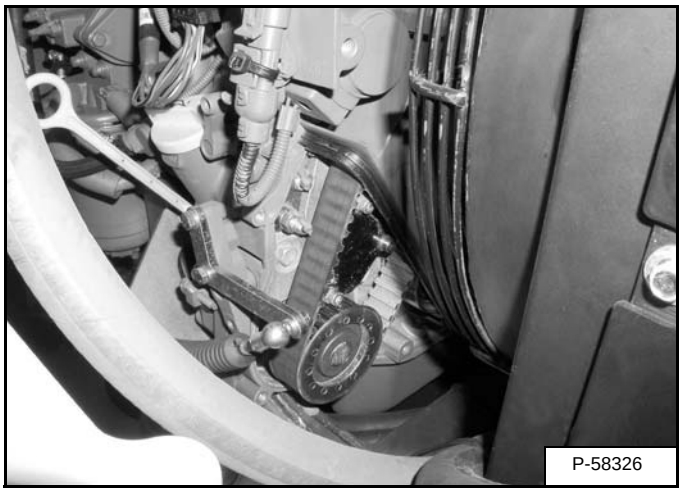


Remove the bolts (Item 1) **[Figure 60-51-55]** from the timing belt inspection cover.

Remove the torx bolt (Item 2) **[Figure 60-51-55]**.

Remove the cover (Item 3) **[Figure 60-51-55]**.

Figure 60-51-56



Check the timing belt, sprockets and tensioner for wear, cracks or damage **[Figure 60-51-56]**.

Check the timing belt in detail for the following conditions, replace as needed.

1. Oil deposits
2. Hardened back rubber surfaces
3. Cracked
4. Badly worn teeth
5. Missing tooth
6. Side of belt badly worn
7. Side of belt cracked

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Timing Belt Removal

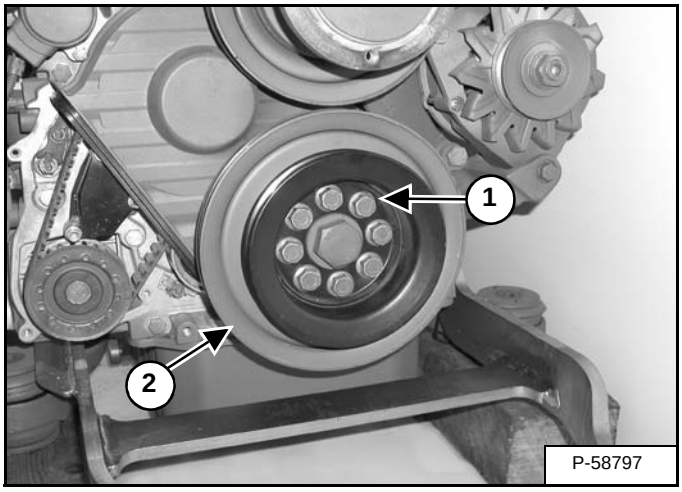
NOTE: The timing belt can be replaced in the excavator. The procedure is shown with the engine removed for photo clarity. To remove the belt with the engine installed, remove the radiator/oil cooler. (See RADIATOR/OIL COOLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-41-1.)

Remove the bolts (Item 1) **[Figure 60-51-55 on Page 19]** from the timing belt inspection cover.

Remove the torx bolt (Item 2) **[Figure 60-51-55 on Page 19]**.

Remove the cover (Item 3) **[Figure 60-51-55 on Page 19]**.

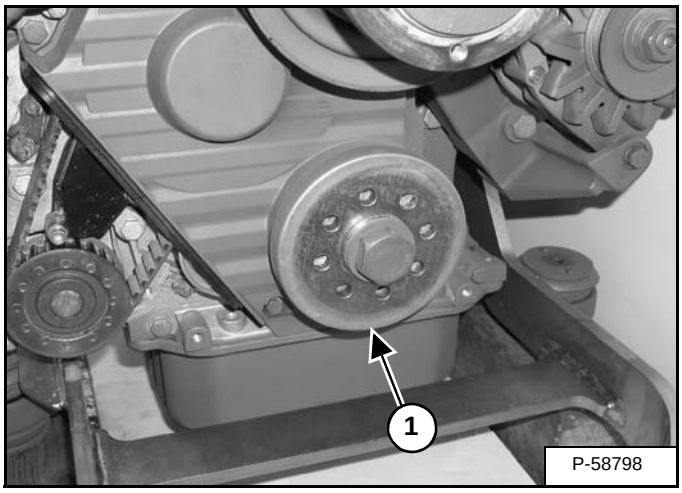
Figure 60-51-57



Remove the bolts (Item 1) from the V-belt pulley (Item 2) **[Figure 60-51-57]**.

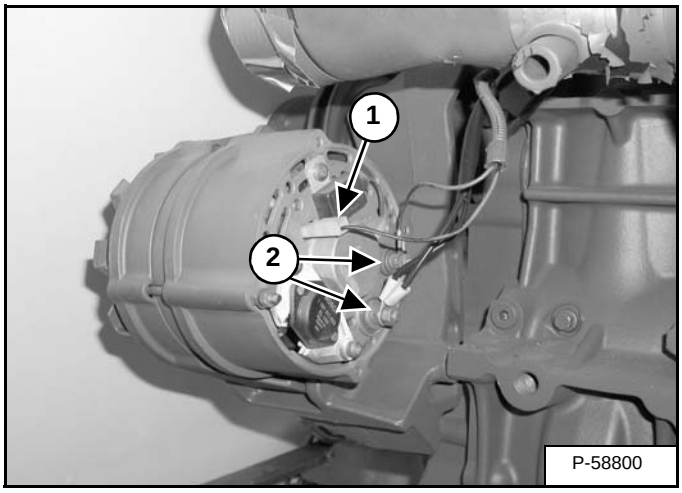
Remove the V-belt pulley.

Figure 60-51-58



Remove the shield (Item 1) **[Figure 60-51-58]**.

Figure 60-51-59



Disconnect the wire harness (Item 1) **[Figure 60-51-59]** from the alternator.

Remove the nuts and wire harness (Item 2) **[Figure 60-51-59]**.

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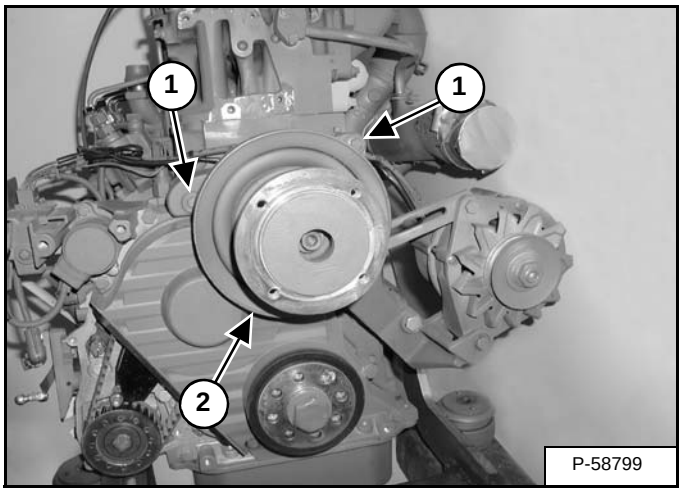
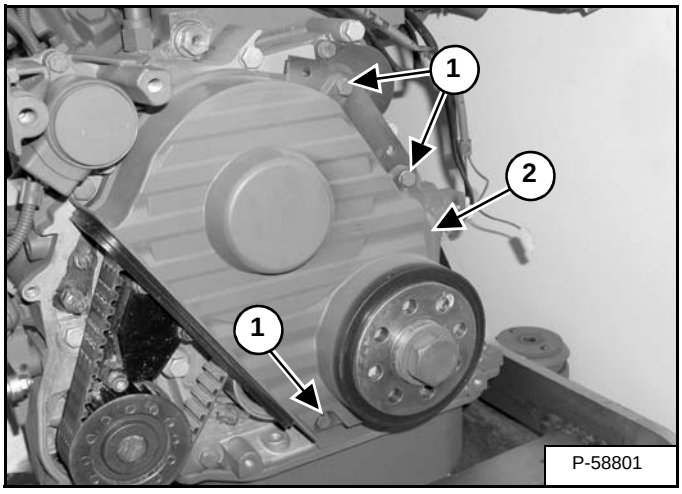
Timing Belt Removal (Cont'd)

Figure 60-51-60



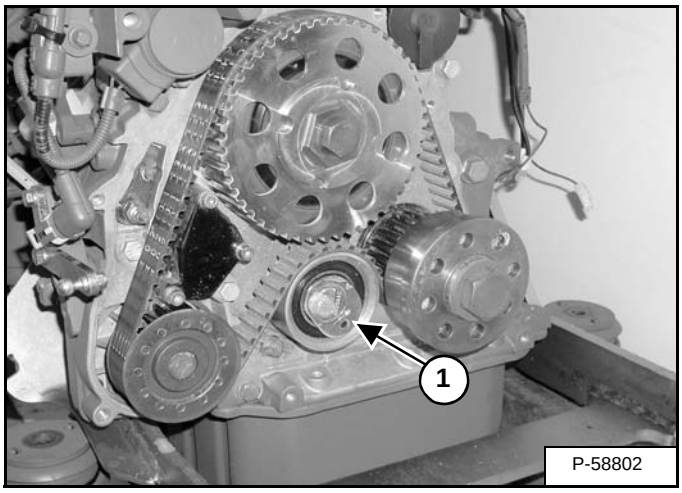
Remove the two bolts (Item 1). Remove the fan mount/ alternator assembly (Item 2) **[Figure 60-51-60]**.

Figure 60-51-61



Remove the bolts (Item 1) and remove the cover (Item 2) **[Figure 60-51-61]**.

Figure 60-51-62



Loosen the belt tensioner mounting bolt (Item 1) **[Figure 60-51-62]**.

Loosen the belt tensioner.

Remove the timing belt.

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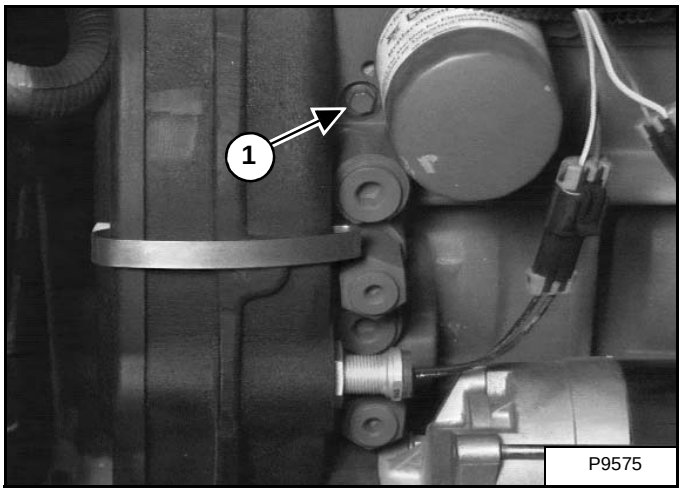
Timing Belt Installation

Figure 60-51-63



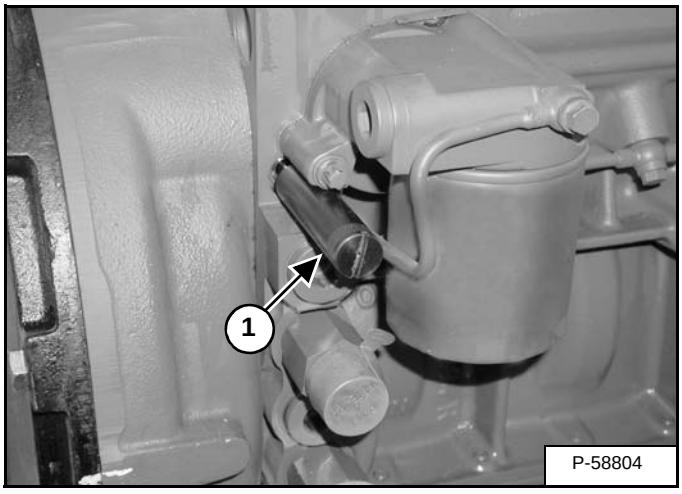
The camshaft plug is located at the rear of the engine block (Item 1) **[Figure 60-51-63]** on the fuel injection pump side.

NOTE: Remove the fuel injectors from the cylinder head. (See Fuel Injector Removal And Installation on Page 60-51-13). This will allow the crankshaft turn easier for timing belt installation.

Remove the plug.

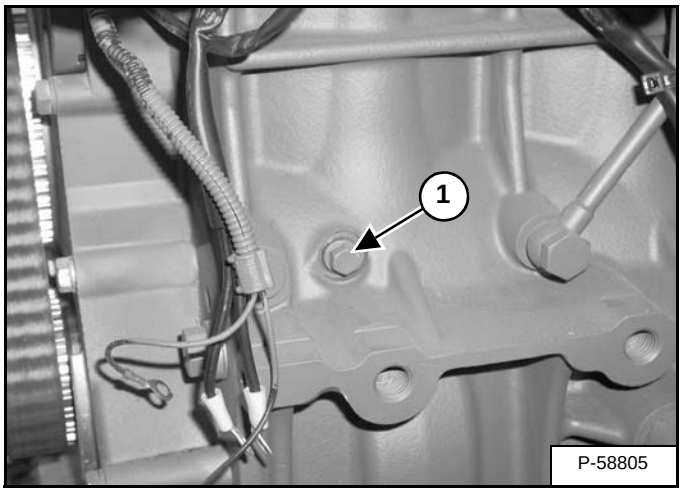
Rotate the camshaft until the notch in the camshaft can be seen through the plug hole.

Figure 60-51-64



Install the timing tool MEL-1458 (Item 1) **[Figure 60-51-64]** and tighten.

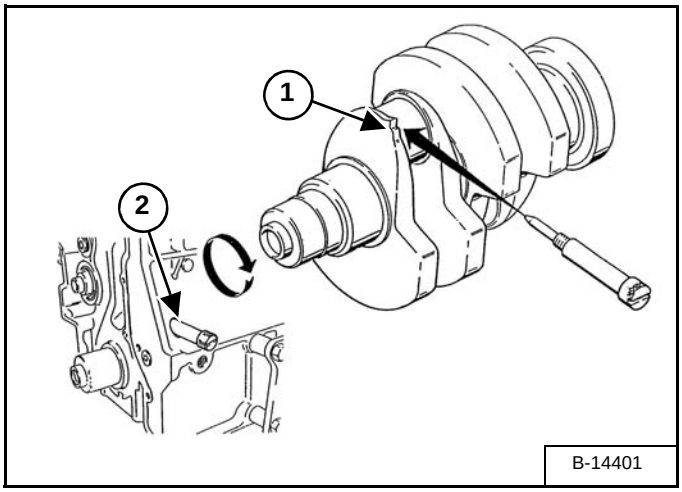
Figure 60-51-65



The crankshaft plug is located at the front of the engine block (Item 1) **[Figure 60-51-65]** on the exhaust manifold side.

Remove the plug.

Figure 60-51-66



Rotate the crankshaft until the flat spot on the crankshaft throw (Item 1) can be seen through the plug hole. Turn the crankshaft back a small amount. Install the timing tool (Item 2) **[Figure 60-51-66]** and tighten.

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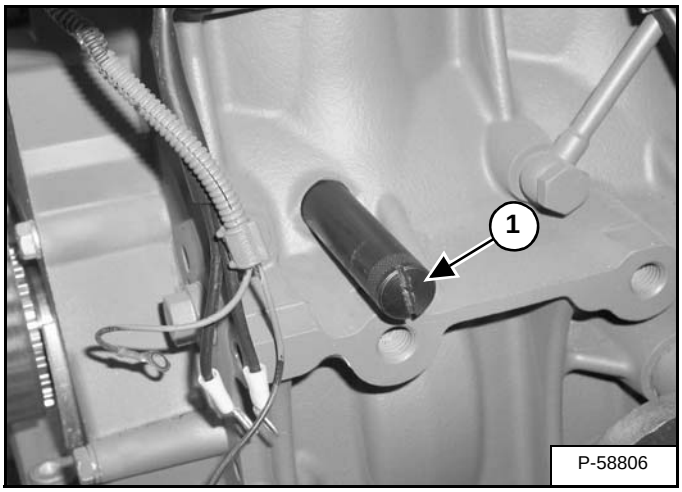
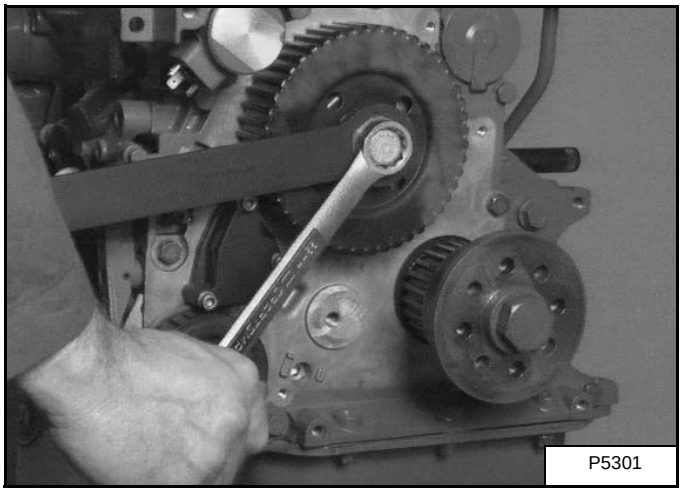
Timing Belt Installation (Cont'd)

Figure 60-51-67



Rotate the crankshaft until it hits the timing tool (Item 1) **[Figure 60-51-67]** and stops.

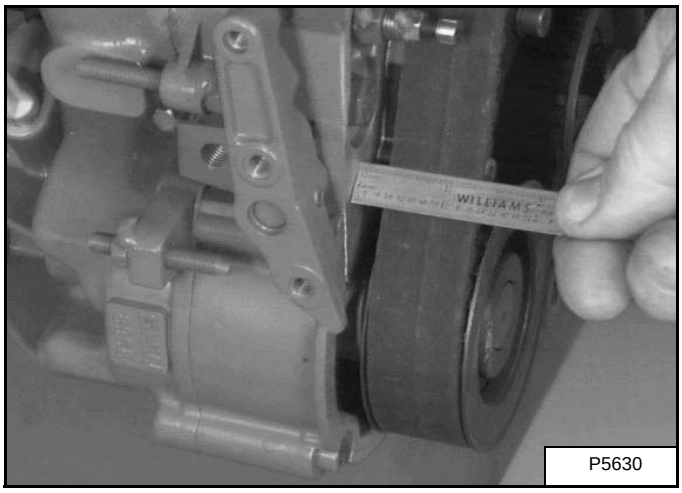
Figure 60-51-68



Loosen the nut at the camshaft gear using MEL-1466 Tool **[Figure 60-51-68]**.

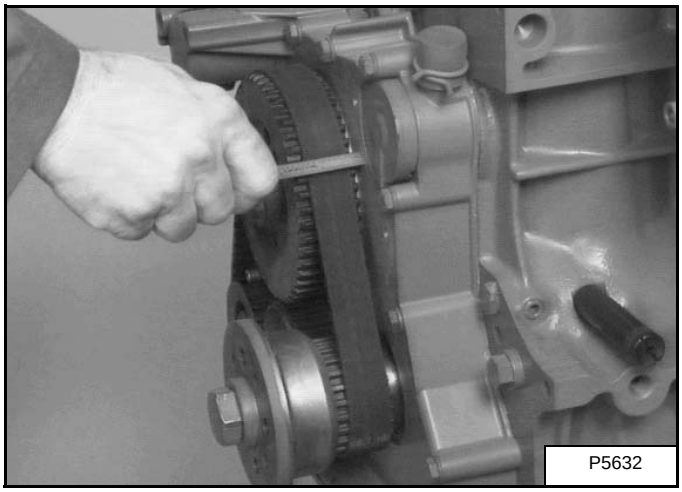
Install the new timing belt.

Figure 60-51-69



Measure the distance from the edge of the belt to the front cover surface **[Figure 60-51-69]**.

Figure 60-51-70



Using the dimension, align the timing belt to make sure it is at an equal distance from the front cover **[Figure 60-51-70]**.

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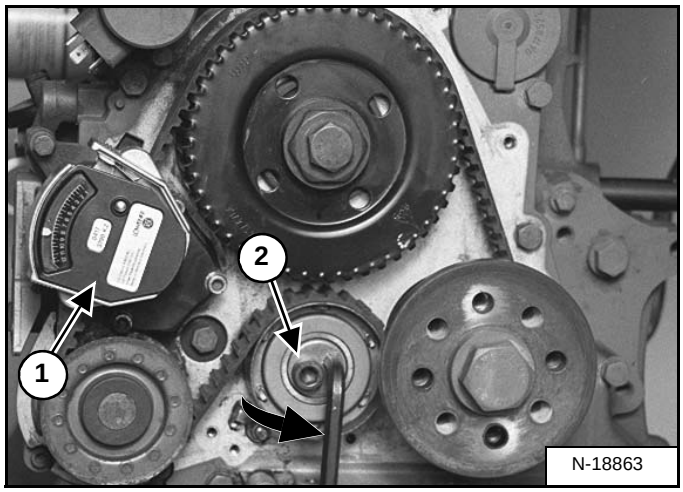
Timing Belt Installation (Cont'd)

Figure 60-51-71

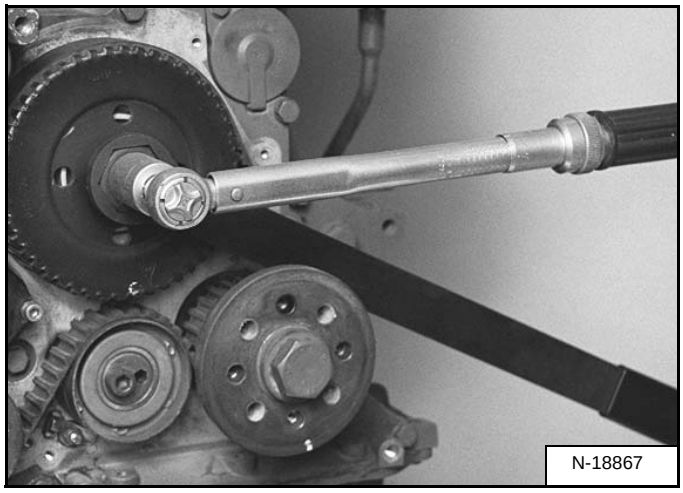


Install the belt tension tool MEL-1460 (Item 1) **[Figure 60-51-71]**.

Turn the idler tensioner pulley in counterclockwise direction to obtain a scale reading of 3.0-3.5. Tighten the idler tensioner pulley nut (Item 2) **[Figure 60-51-71]** to 14-17 ft.-lb. (19-23 N•m) torque.

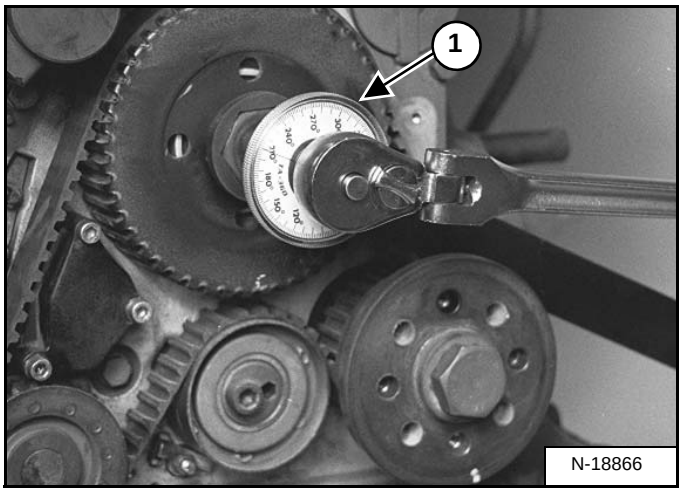
Remove the belt tension tool.

Figure 60-51-72



Initially tighten camshaft bolt to 22 ft.-lb. (30 N•m) **[Figure 60-51-72]**.

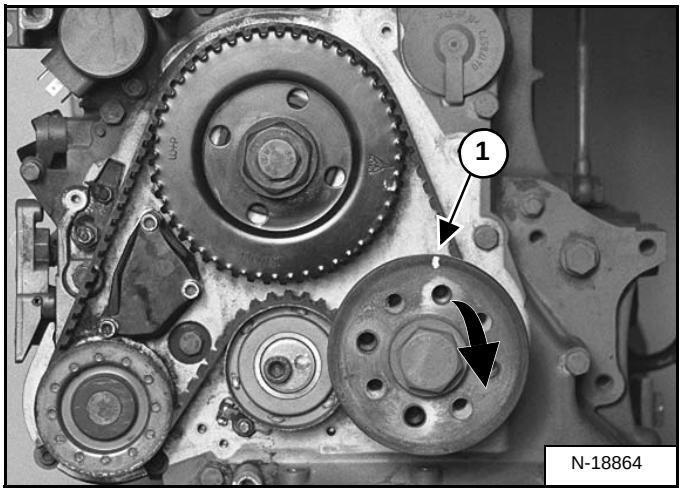
Figure 60-51-73



With a torque degree wheel (Item 1) **[Figure 60-51-73]** tighten the camshaft bolt an additional 210°.

Remove the camshaft and crankshaft locating pins.

Figure 60-51-74



Mark the crankshaft pulley (Item 1) **[Figure 60-51-74]**.

Make four complete crankshaft revolutions in a clockwise direction of engine rotation. Bring the mark on the crankshaft pulley back to the same position.

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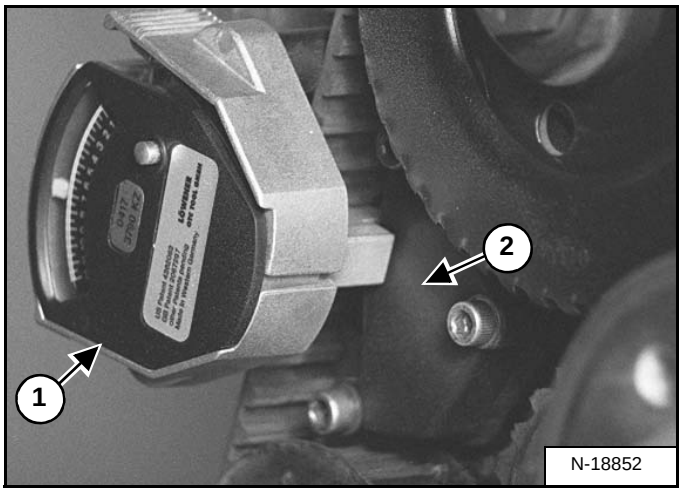
Timing Belt Installation (Cont'd)

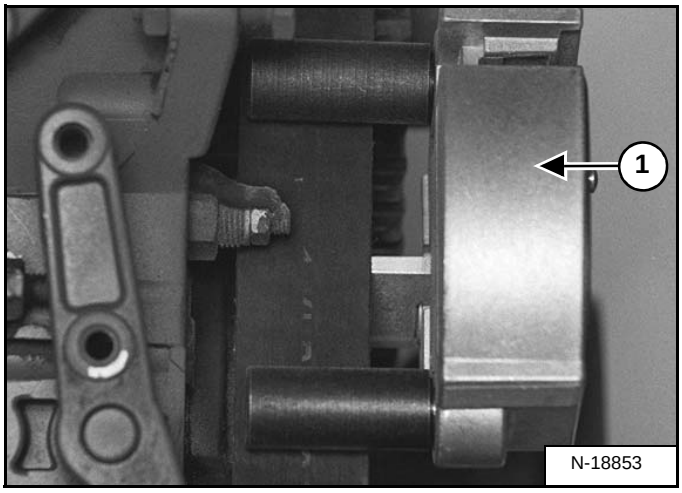
Figure 60-51-75



Install the belt tension tool (Item 1) **[Figure 60-51-75]**.

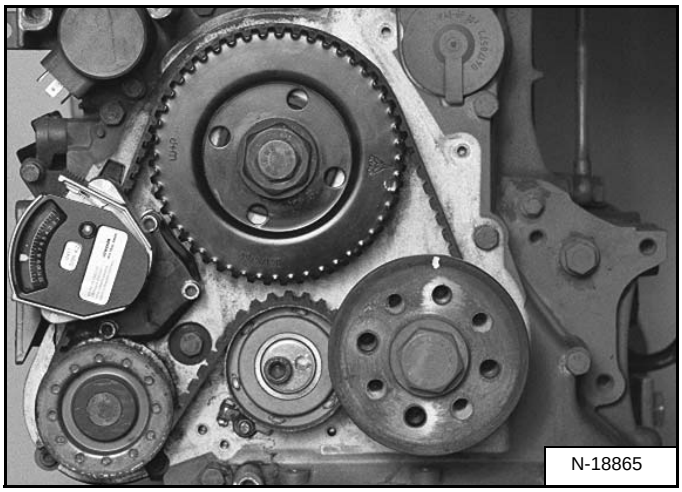
NOTE: The belt tension tool may touch the governor linkage cover (Item 2) [Figure 60-51-75], but will not affect the belt tightening procedure.

Figure 60-51-76



Check the position of the belt tension tool (Item 1) **[Figure 60-51-76]** on the belt.

Figure 60-51-77



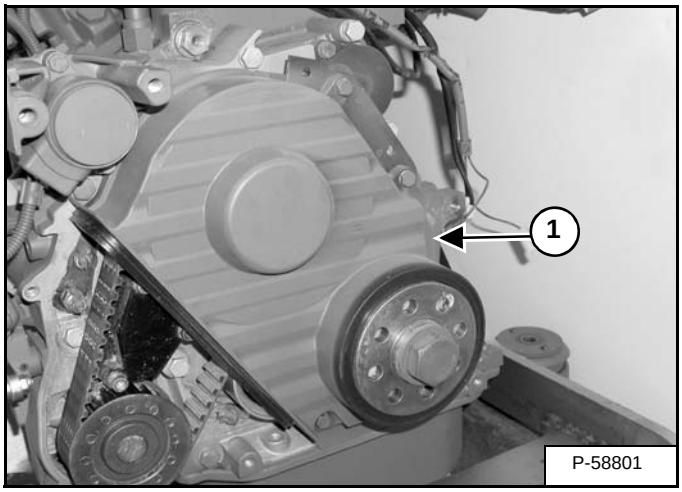
Measure the belt tension. The reading should be 6.5-9.5 **[Figure 60-51-77]**.

NOTE: If the specified scale reading is not obtained, repeat the installation procedure starting with [Figure 60-51-63 on Page 22].

Remove the belt tension tool.

NOTE: See Valve Timing before installing the timing belt cover. (See Valve Timing, Checking on Page 60-51-29)

Figure 60-51-78



Install the belt cover (Item 1) **[Figure 60-51-78]** and tighten the bolts.

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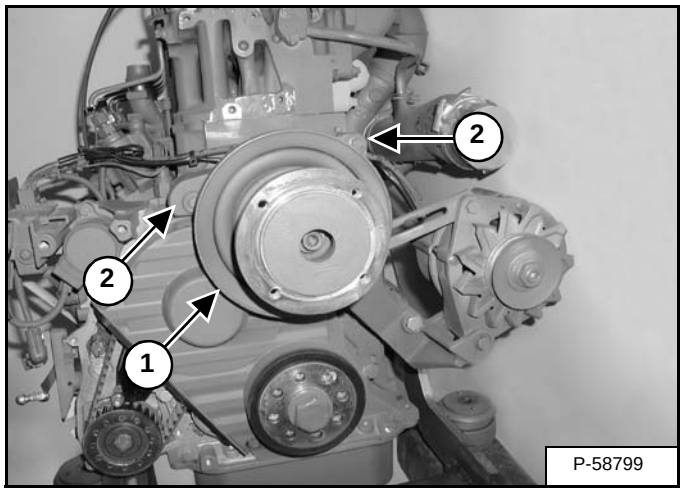
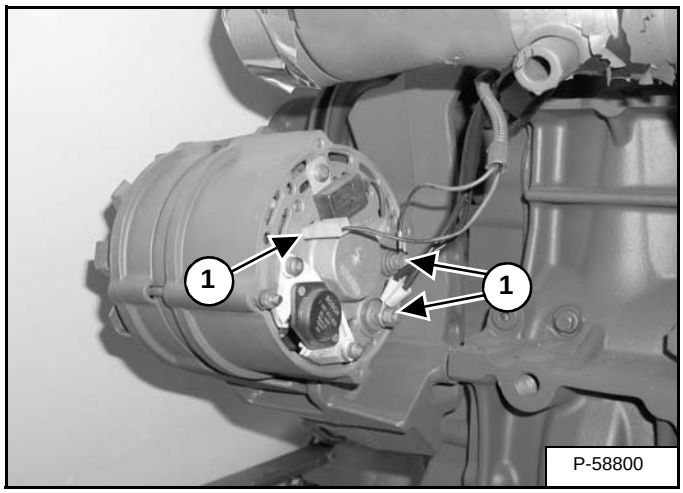
Timing Belt Installation (Cont'd)

Figure 60-51-79



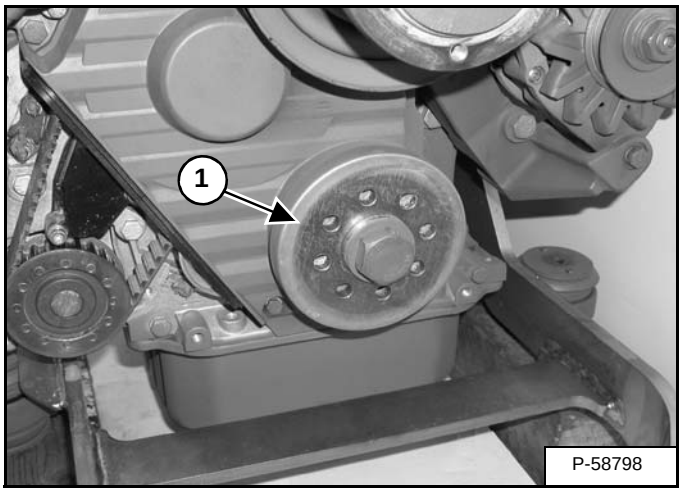
Install the fan mount/alternator assembly (Item 1) and bolts (Item 2) **[Figure 60-51-79]**.

Figure 60-51-80



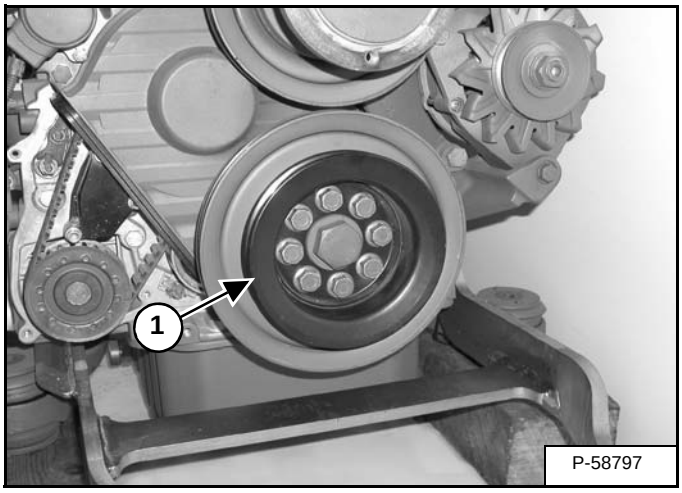
Install the wire harness (Item 1) **[Figure 60-51-80]** on the alternator.

Figure 60-51-81



Install the shield (Item 1) **[Figure 60-51-81]**.

Figure 60-51-82



Install the V-belt pulleys (Item 1) **[Figure 60-51-82]**. Tighten the bolts to 28-34 ft.-lb. (38-46 N•m) torque.

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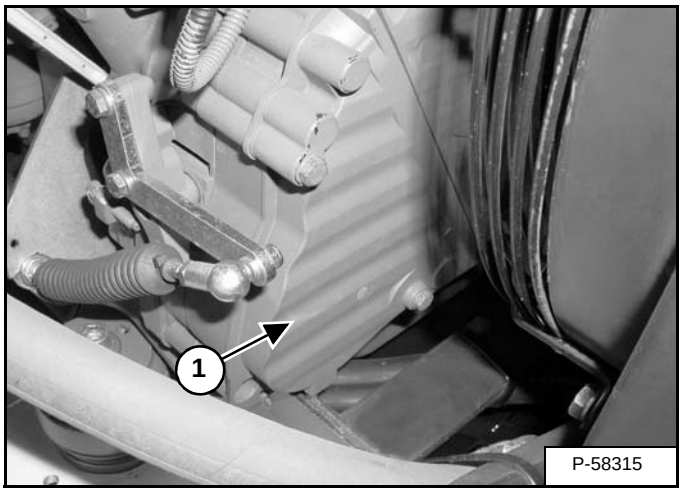
Timing Belt Installation (Cont'd)

Figure 60-51-83



Install the timing belt inspection cover (Item 1) **[Figure 60-51-83]** and tighten the bolts.

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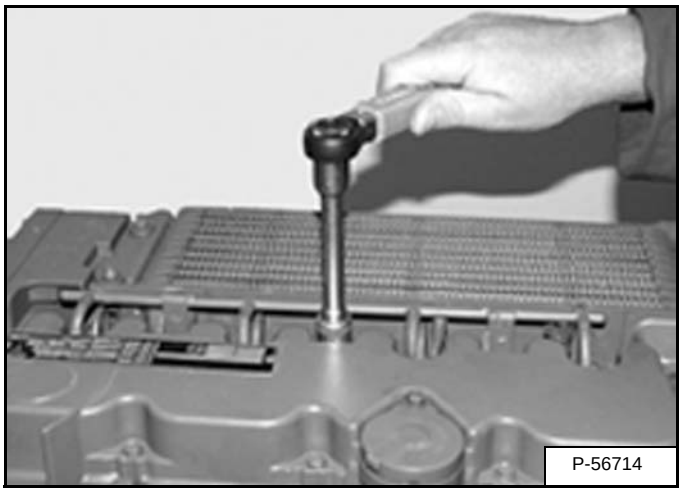
Valve Clearance Adjustment

Make the valve clearance adjustment with engine stopped and cold.

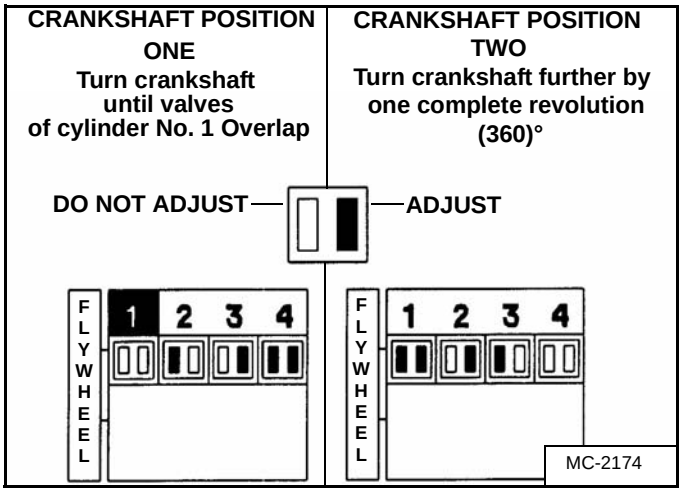
Remove the valve cover.

Figure 60-51-84



When installing the valve cover bolts, tighten to 75 in.-lb. (8.5 N•m) torque **[Figure 60-51-84]**.

Figure 60-51-85

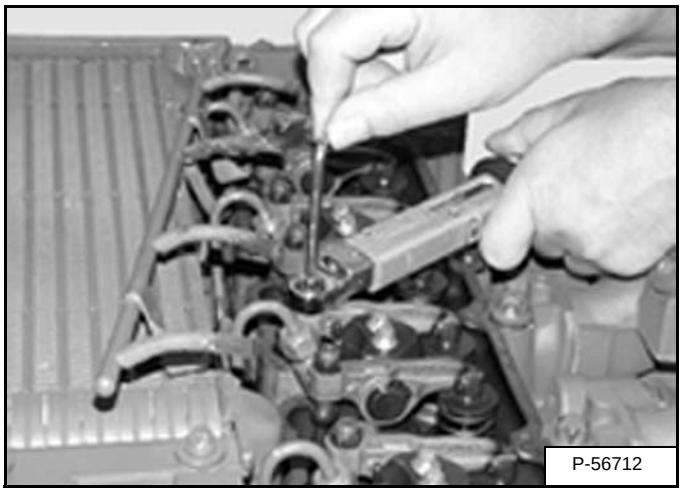


Use the following sequence as shown in **[Figure 60-51-85]** to set the valve clearance.

Turn the crankshaft until the valves of cylinder No. 1 overlap **[Figure 60-51-84]**.

Turn the crankshaft by one complete revolution (360°) and set the other valves.

Figure 60-51-86



Loosen the locknut and turn the set screw until the clearance is correct **[Figure 60-51-86]**.

Intake - 0.012 inch (0.3 mm)
Exhaust - 0.020 inch (0.5 mm)
Tighten the locknut to 13-16 ft.-lb. (18-22 N•m) torque.

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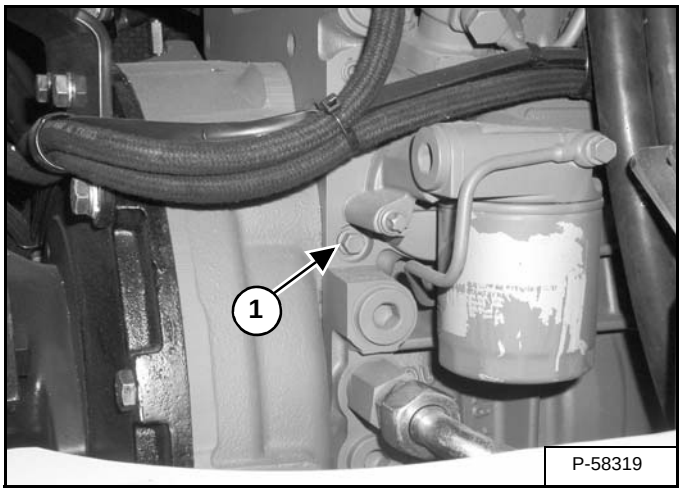
Valve Timing, Checking

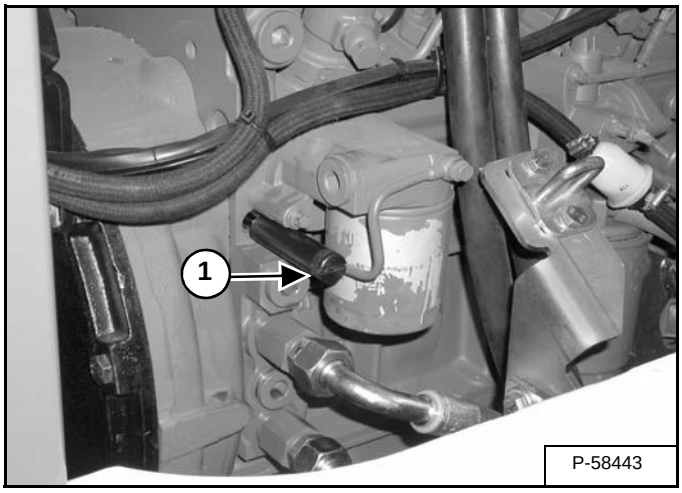
Figure 60-51-87



Remove the camshaft access plug (Item 1) **[Figure 60-51-87]**.

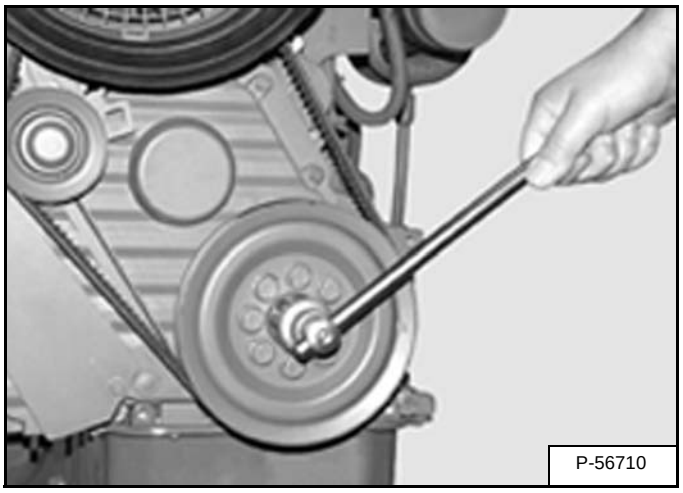
Rotate the crankshaft/camshaft until the notch in the camshaft can be seen through the plug hole.

Figure 60-51-88



Install the timing tool (Item 1) **[Figure 60-51-88]**.

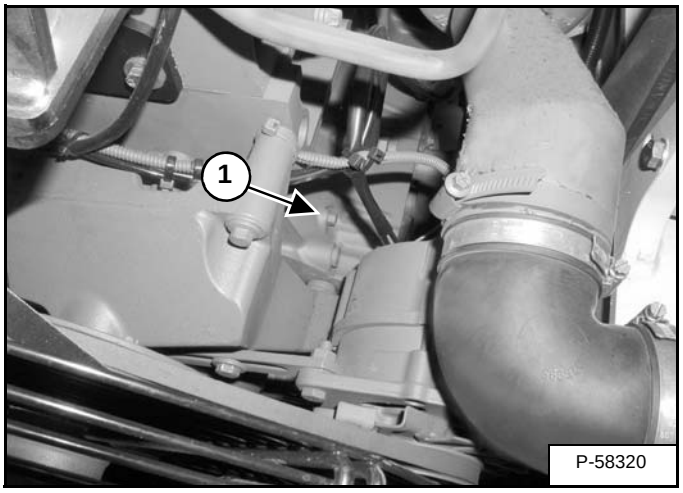
Figure 60-51-89



At the crankshaft pulley bolt, install a torque wrench and turn the engine in the direction of rotation to 30 ft.-lb. (40 N•m) torque **[Figure 60-51-89]**.

Remove the torque wrench, DO NOT change the crankshaft position.

Figure 60-51-90



Remove the crankshaft access plug (Item 1) **[Figure 60-51-90]**.

NOTE: The access plug is located on the front of the crankcase, below the turbocharger and just above the right side front engine mount.

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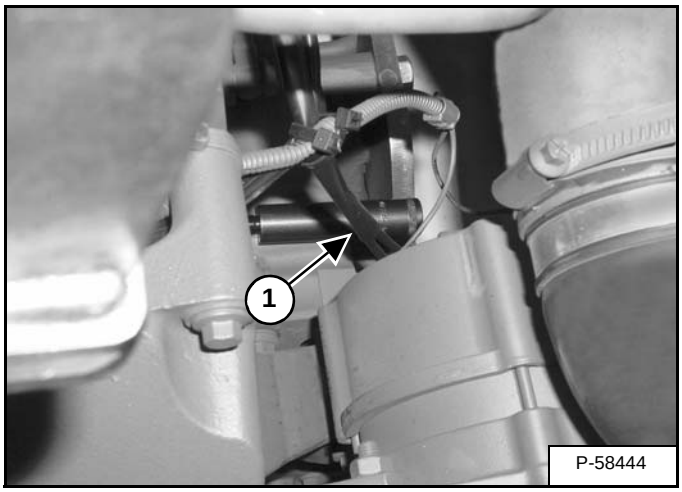
Valve Timing, Checking, (Cont'd)

Figure 60-51-91



Turn the crankshaft timing tool MEL-1458 (Item 1) **[Figure 60-51-91]** into the crankcase until it makes slight contact with the crankshaft.

Mark the position of the timing tool.

The valve timing is correct if the timing tool can be turned into the crankcase another 3/4 to 2-1/4 turns until it stops.

If the timing tool can not be turned into the crankcase the required turns, the camshaft (valve timing) setting will have to be redone.

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Thermostat, Oil Pressure Control Valves & Heater Connections

Figure 60-51-92

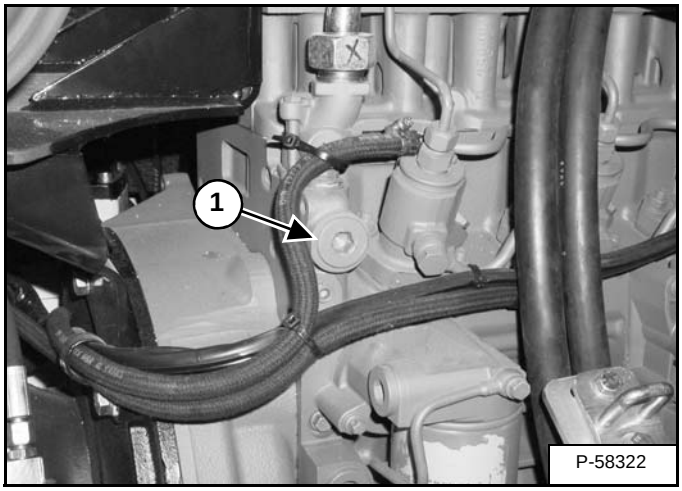


Figure 60-51-93

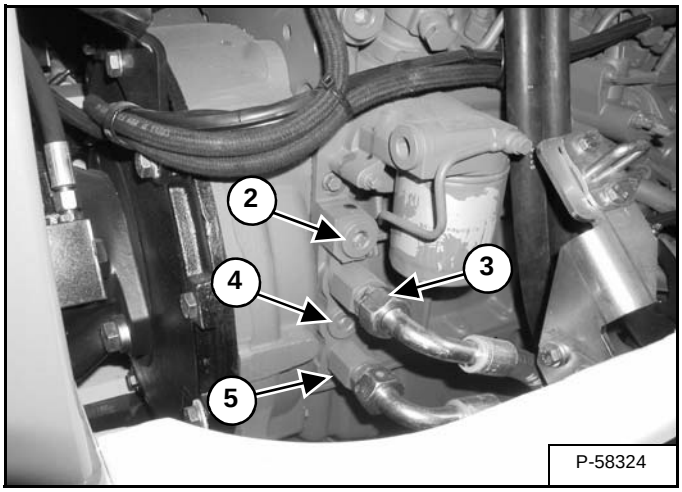
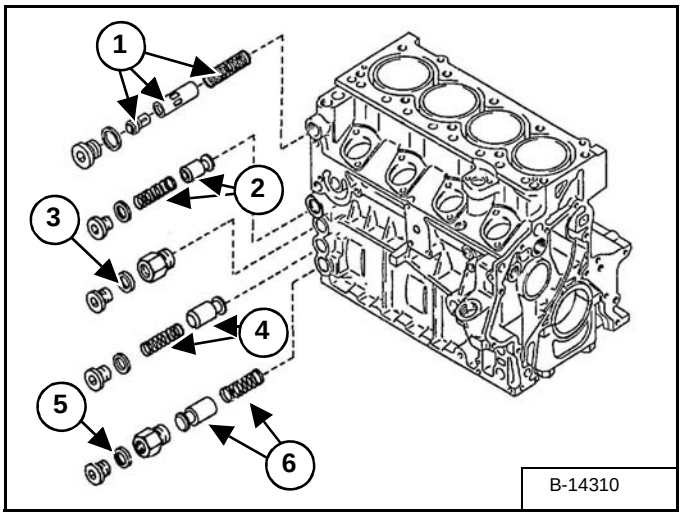


Figure 60-51-94



Remove the plug and O-ring (Item 1) **[Figure 60-51-92]**. Remove the thermostat and spring assembly (Item 1) **[Figure 60-51-94]** from the engine block.

Installation: Install the plug and tighten to 82 ft.-lb. (111 N•m) torque.

Remove the plug and O-ring (Item 2) **[Figure 60-51-93]** and remove the spring and oil pressure control valve (Item 2) **[Figure 60-51-94]** from the engine block.

Installation: Install the plug and tighten to 82 ft.-lb. (111 N•m) torque.

Remove the heater hose, fitting (Item 3) **[Figure 60-51-93]**, and O-ring (Item 3) **[Figure 60-51-94]**.

Installation: Install the fitting and tighten to 82 ft.-lb. (111 N•m) torque.

Remove the plug and O-ring (Item 4) **[Figure 60-51-93]** Remove the spring and oil pressure control valve (Item 4) **[Figure 60-51-94]** from the engine block.

Installation: Install the plug and tighten to 82 ft.-lb. (111 N•m) torque.

Remove the heater hose, fitting (Item 5) **[Figure 60-51-93]**, and O-ring (Item 5) **[Figure 60-51-94]**.

Remove the valve and spring (Item 6) **[Figure 60-51-94]** from the engine block.

Installation: Install the fitting and/or plug and tighten to 82 ft.-lb. (111 N•m) torque.

NOTE: Be sure the valve and spring (Item 6) [Figure 60-51-94] is installed as shown.

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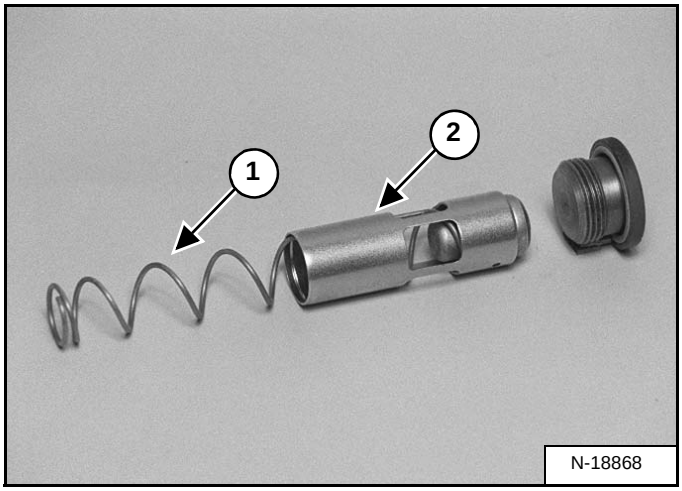
Thermostat, Oil Pressure Control Valves & Heater Connections (Cont'd)

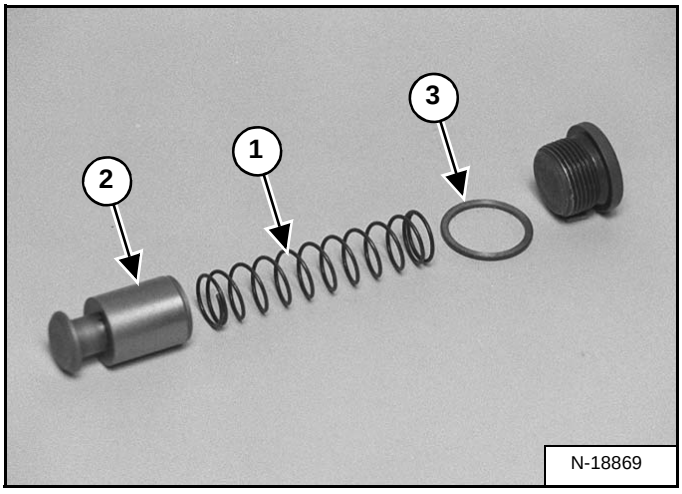
Figure 60-51-95



Remove the thermostat spring (Item 1) from the thermostat (Item 2) **[Figure 60-51-95]**, inspect all parts and replace as needed.

Installation: See "Thermostat, Oil Pressure Control Valves & Heater Connections" on page 31. **[Figure 60-51-94 on Page 31]** for location on the engine block.

Figure 60-51-96

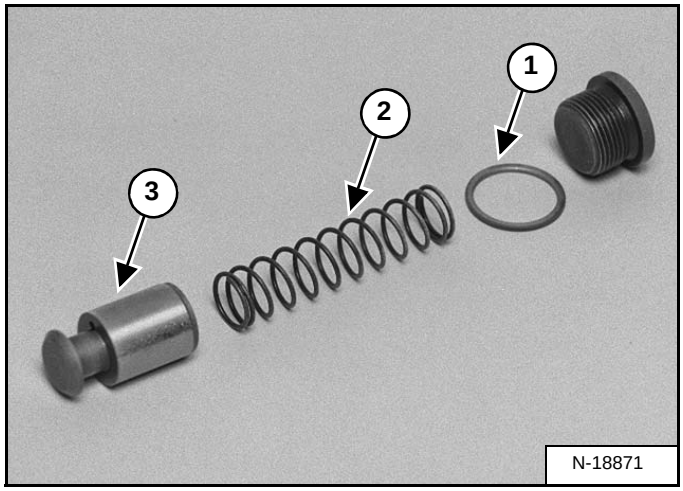


Remove the spring (Item 1) from the oil pressure control valve (Item 2). Replace the O-ring (Item 3) **[Figure 60-51-96]**.

The spring is marked with a yellow mark, for proper installation. If the yellow mark is missing, the spring coil diameter is 0.047 inch (1,2 mm).

Installation: See "Thermostat, Oil Pressure Control Valves & Heater Connections" on page 31. **[Figure 60-51-94]** for location on the engine block.

Figure 60-51-97



Replace the O-ring (Item 1). Remove the spring (Item 2) from the oil pressure control valve (Item 3) **[Figure 60-51-97]**.

The spring is marked with a red mark, for proper installation. If the red mark is missing, the spring coil diameter is 0.055 inch (1,4 mm).

Installation: See "Thermostat, Oil Pressure Control Valves & Heater Connections" on page 31. **[Figure 60-51-94 on Page 31]** for location on the engine block.

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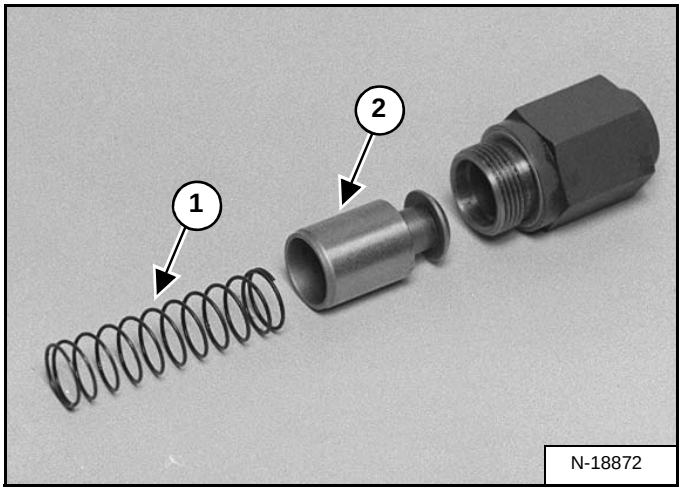
Thermostat, Oil Pressure Control Valves & Heater Connections (Cont'd)

Figure 60-51-98



Remove the spring (Item 1) from the valve (Item 2) **[Figure 60-51-98]**.

The spring is marked with a blue mark, for proper installation. If the blue mark is missing, the spring coil diameter is 0..039 inch (1,0 mm).

Installation: See "Thermostat, Oil Pressure Control Valves & Heater Connections" on page 31. **[Figure 60-51-94 on Page 31]** for location on the engine block.

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Aneroid Device

Description

The aneroid device is used to control exhaust smoke during acceleration or when a sudden load is placed on a turbo-charged engine. This is accomplished by delaying the fuel control rack from moving into the higher fuel setting until the turbo-charger has time to provided sufficient intake manifold pressure to assure the correct "air fuel mixture" to the combustion chambers. If the intake manifold pressure is low, the fuel delivery will be reduced to prevent exhaust smoke. Once the intake manifold pressure has reached a predetermined pressure, the aneroid device will allow the injection pump control rack to move to a higher fuel setting and enable the engine to produce more power, while controlling exhaust smoke output.

The only time the aneroid device should be tested or adjusted is if excessive loss of engine RPM is evident when a hydraulic pump load is applied to the engine. This condition can occur when two hydraulic functions are required at the same time (one of these functions must work the gear pump). Example: engaging the swing circuit and the blade circuit at the same time.

Testing

Use the following information to determine if the aneroid needs adjustment:

NOTE: Two people will be required for doing this procedure. One person must stay in the excavator cab to operate the machine, the second person to monitor gauges at the engine.

Before checking the aneroid function, make sure that the engine is operating correctly. Make sure the fuel filters are clean and fuel lines are not restricting fuel flow. Are the air filters clean and no damage to the intake system. Check to make sure the engine speed control lever is adjusted to reach it's maximum stop so full engine RPM is available. Check exhaust system for leaks, damage or restrictions.

⚠ WARNING

Turbochargers, operate at high speed and high temperatures. Keep fingers, tools and other objects away from the inlet and outlet ports. Avoid contact with hot surfaces.

W-2257-1196

⚠ WARNING

Rotating fan blade can cause serious injury or death. Keep away from fan and moving parts. Do not operate with guard removed.

Hot surfaces can cause injury. Do not touch. Allow to cool before servicing.

W-2521-0106

The following components will be needed for testing the aneroid device for proper function:

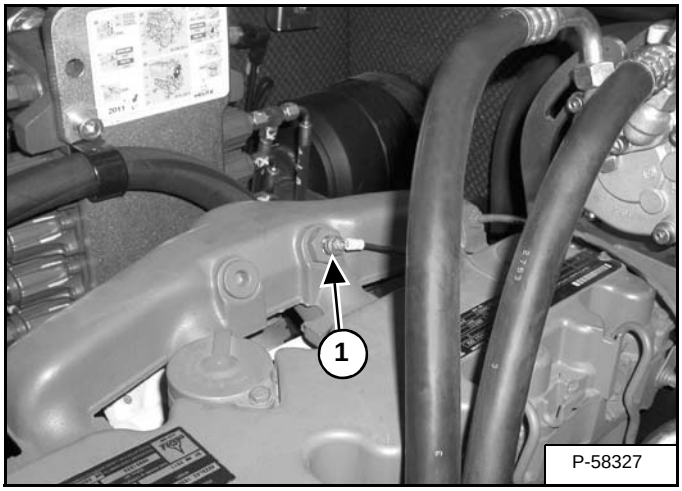
Fuel Pressure Gauge - 0 - 30 PSI (0 - 60" HG)

Boost Pressure Gauge (must also fabricate an adapter to go from the gauge threads to fit into the manifold threads)

Infrared Heat Sensor [must read a minimum 1000° F. (538 ° C.)]

Photo tach

Figure 60-51-99



Remove the nut, washer and wire harness (Item 1) **[Figure 60-51-8]** from the manifold heater and remove the manifold heater. (Tape the end of the manifold heater wire so that it does not ground out during the test.)

Install an adapter and the Boost Pressure Gauge into the manifold heater opening.

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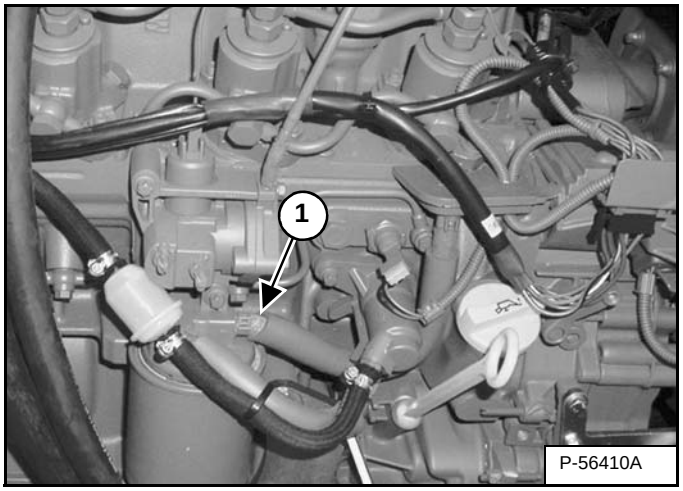
Aneroid Device (Cont'd)

Testing (Cont'd)

Figure 60-51-100



Disconnect the fuel line (Item 1) **[Figure 60-51-98]** at the filter and install the fuel pressure gauge at this location.

This test must be done with the engine and the hydraulic fluid at operating temperature, 150° F. (66° C.).

⚠ WARNING

Turbochargers, operate at high speed and high temperatures. Keep fingers, tools and other objects away from the inlet and outlet ports. Avoid contact with hot surfaces.

W-2257-1196

⚠ WARNING

Rotating fan blade can cause serious injury or death. Keep away from fan and moving parts. Do not operate with guard removed.

Hot surfaces can cause injury. Do not touch. Allow to cool before servicing.

W-2521-0106

With the second person in the excavator cab, start the engine and bring the excavator to operating temperature.

1. Bring the engine to high idle (approximately 2400 RPM) and verify the engine speed with the photo tach.

2. Check fuel pressure, the fuel pressure should be between 8 - 12 PSI (0,55 - 0,82 bar). This will be difficult to read as the pressure gauge will be pulsing due to the transfer pump.

3. Read the intake manifold pressure. The reading should be between 9 - 12 PSI (0,62 - 0,82 bar) or 20 - 24" HG. If these readings can be obtained, the engine is operating properly, continue to step 4. If these readings can not be obtained, further engine evaluation is needed to determine fuel restrictions, air restrictions, etc..

4. Take an exhaust temperature reading at 2 - 3 in. from the exhaust outlet of the turbo-charger. The temperature should be between 850 - 900° F. (455 - 482° C.)

5. Have the operator in the cab raise the boom and the blade fully until both the relief valves goes over relief.

6. The second person should note the manifold pressure, the fuel pressure and monitor the engine RPM.

7. If the manifold pressure starts to drop off and the engine RPM starts to fall, and black exhaust smoke is present, this is an indication that an adjustment to the aneroid is needed. (IF the engine pulls down for a short period of time and then start to recover without producing black smoke, the aneroid is set correctly.)

8. Decrease engine RPM, lower boom fully and lower blade to the ground. Stop the engine and remove the key.

9. If aneroid adjustment is needed, proceed to the adjustment procedure. If no adjustment is needed, remove the gauges and reinstall all the existing components.

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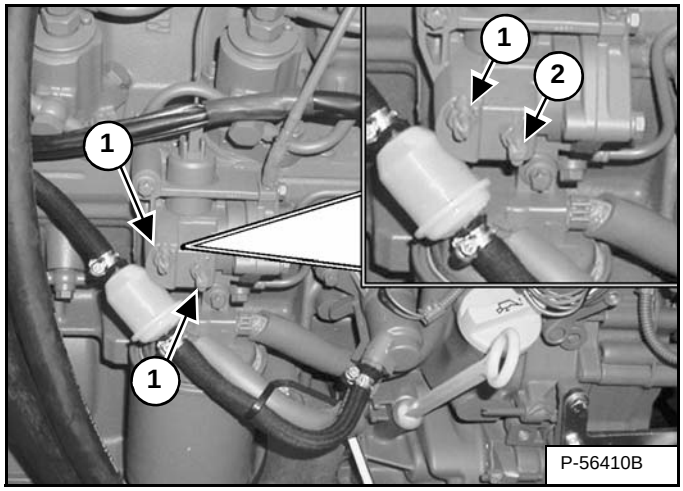
Aneroid Device (Cont'd)

Adjustment

The aneroid is located in the fuel filter housing. There are two lock nuts and adjustment screws on the filter housing. Make sure you are adjusting the correct screw as shown below.

Figure 60-51-101



NOTE: Before making any adjustment, mark the adjustment screw so that it can be returned to the original setting if required.

Loosen the lock nut (Item 1) **[Figure 60-51-101]** and turn the adjustment screw

DO NOT adjust (Item 2) **[Figure 60-51-101]**.

Turn the adjustment screw IN 1/2 turn and tighten the lock nut (Item 1) **[Figure 60-51-101]**.

Repeat the test procedure.

Decrease engine RPM, lower boom fully and lower blade to the ground. Stop the engine and remove the key

If further adjustment is needed, Loosen the lock nut (Item 1) **[Figure 60-51-101]** and turn the adjustment screw an additional 1/2 turn IN. Tighten the lock nut.

Repeat this procedure until the correct adjustment is reached. DO NOT turn the adjustmrnt screw IN more than five full turns. If adjustment is not possible before the five full turns, return the adjustment screw to the original setting and contact your Bobcat dealer.

Once the correct adjustment has been reached, the engine will pull down for a short period of time and will start to recover without producing black smoke.

When adjustment is complete: remove all test equipment and reinstall all the original components that were previously removed.

Start the engine and run at high idle for a few minutes. Return engine to low idle and stop the engine. Check for leaks and repair or replace as necessary.

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ENGINE (S/N 522311001 & ABOVE)

Removal And Installation

Drain the hydraulic reservoir. (See Replacing The Hydraulic Oil on Page 10-100-2.)

Disconnect the battery. (See BATTERY on Page 50-20-1.)

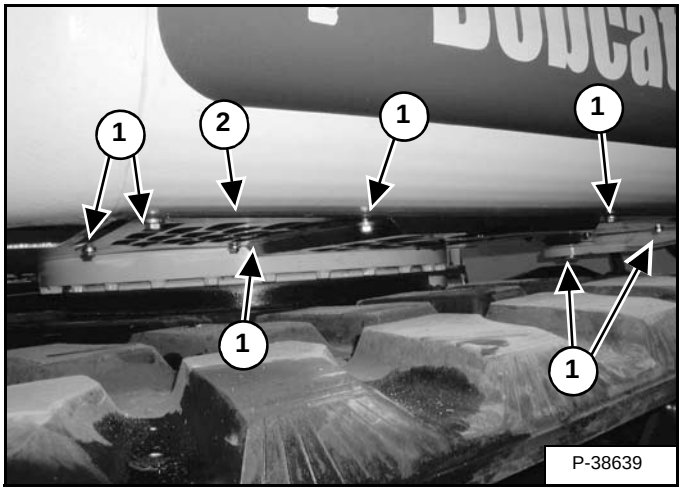
Remove the right side cover. (See RIGHT SIDE COVER on Page 40-160-1.)

Remove the muffler. (See MUFFLER (S/N 522311001 & ABOVE) on Page 60-20-1.)

Discharge the air conditioning system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

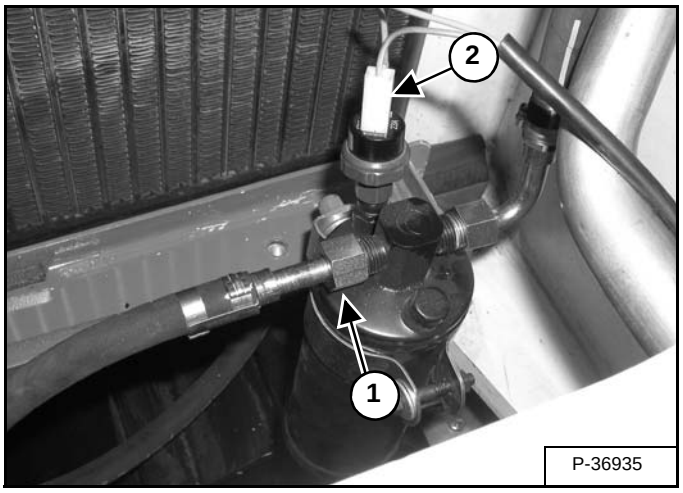
Remove the air conditioning condenser. (See CONDENSER (S/N 522311001 & ABOVE) on Page 70-150-1 or See CONDENSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 70-151-1.)

Figure 60-60-1



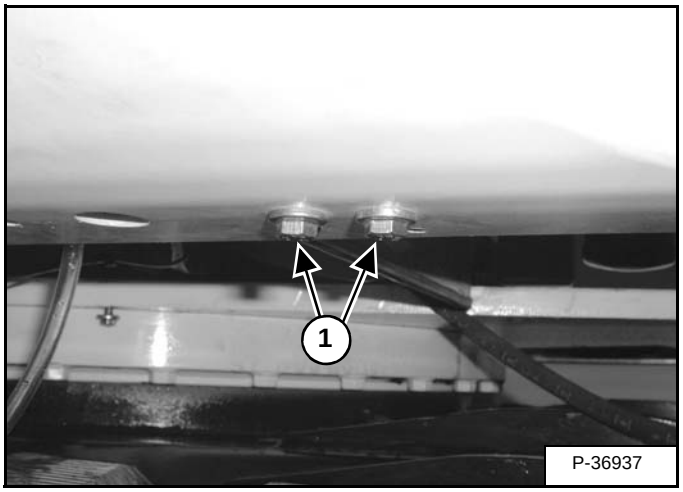
Remove the eleven bolts (Item 1) and bottom panel (Item 2) **[Figure 60-60-1]**.

Figure 60-60-2



Remove the hose (Item 1) and wire harness (Item 2) **[Figure 60-60-2]** from the receiver/dryer.

Figure 60-60-3



Remove the two bottom condenser mount bolts (Item 1) **[Figure 60-60-3]** and washers.

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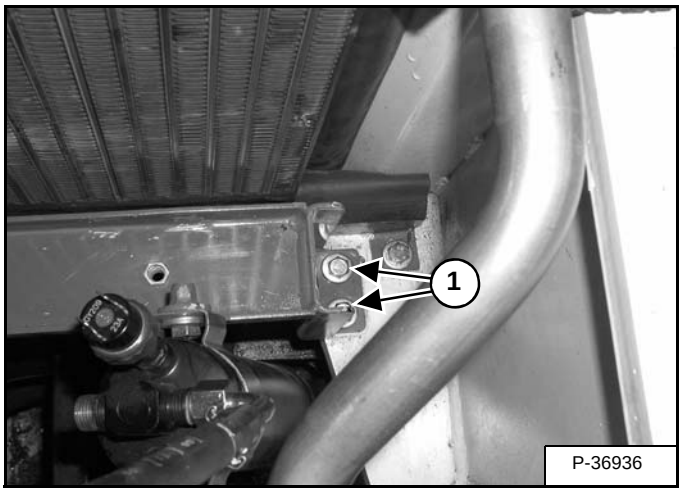
Removal And Installation (Cont'd)

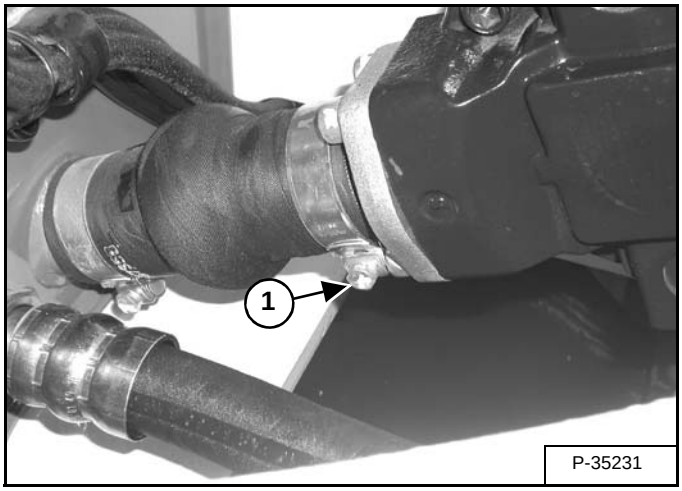
Figure 60-60-4



Remove the two top condenser mount bolts (Item 1) **[Figure 60-60-4]** and washers. Remove the mount.

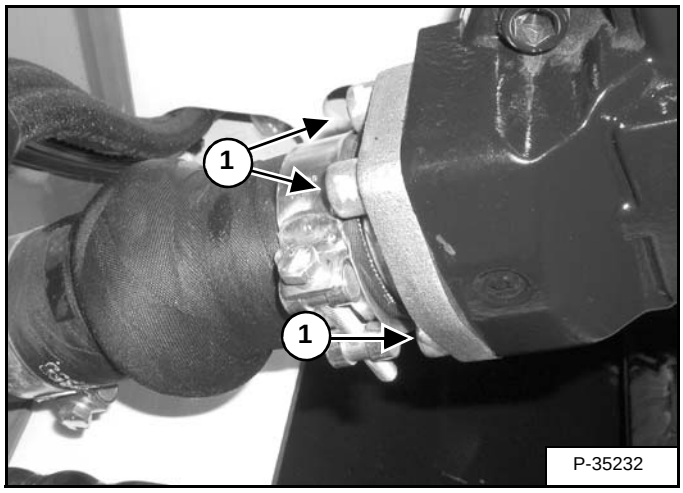
NOTE: The receiver/dryer will be removed with the mount.

Figure 60-60-5



Loosen the clamp (Item 1) **[Figure 60-60-5]**. Rotate the clamp to provide clearance to the suction fitting bolts.

Figure 60-60-6



Remove the four bolts (Item 1) **[Figure 60-60-6]**.

Figure 60-60-7

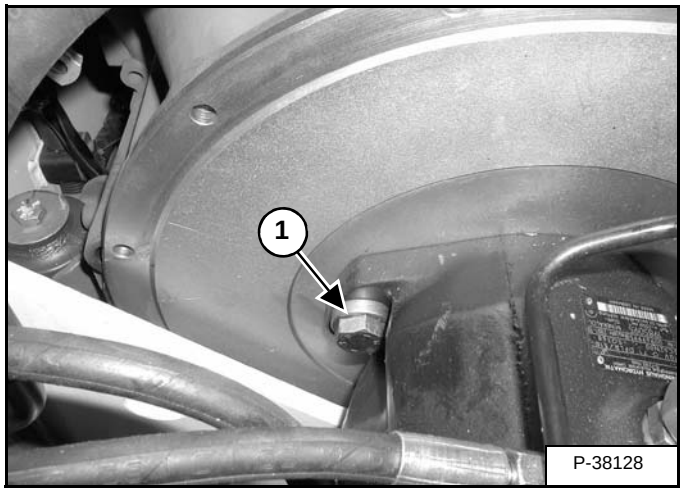
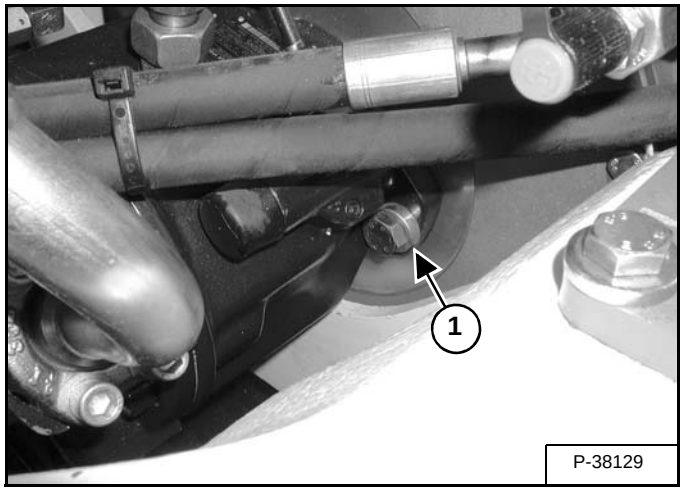


Figure 60-60-8



Remove the two pump mount bolts (Item 1) **[Figure 60-60-7]** and **[Figure 60-60-8]** and washers.

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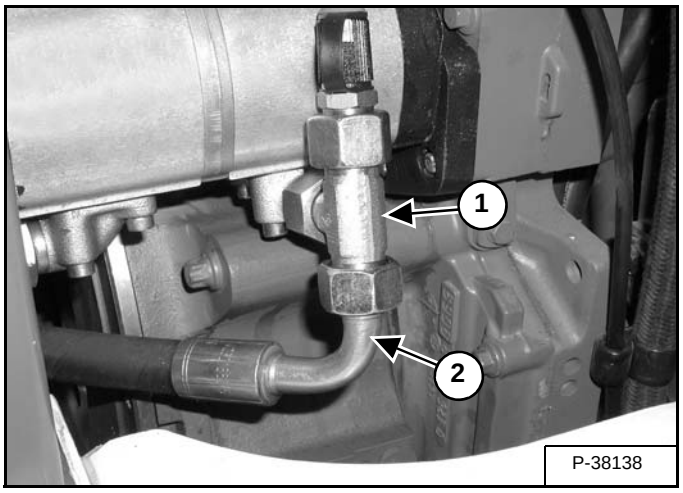
Removal And Installation (Cont'd)

Installation: Tighten the bolts to 125-140 ft.-lb. (170-190 N•m) torque.

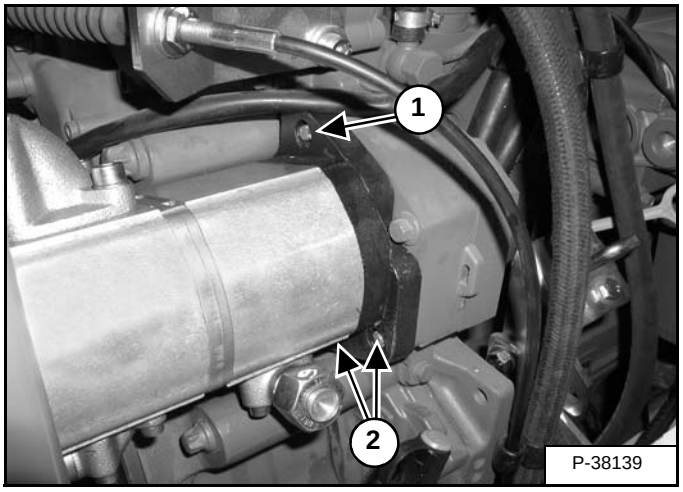
Slide the pump away from the engine.

Figure 60-60-9



Remove the test fitting (Item 1) and hose (Item 2) **[Figure 60-60-9]** from the gear pump.

Figure 60-60-10

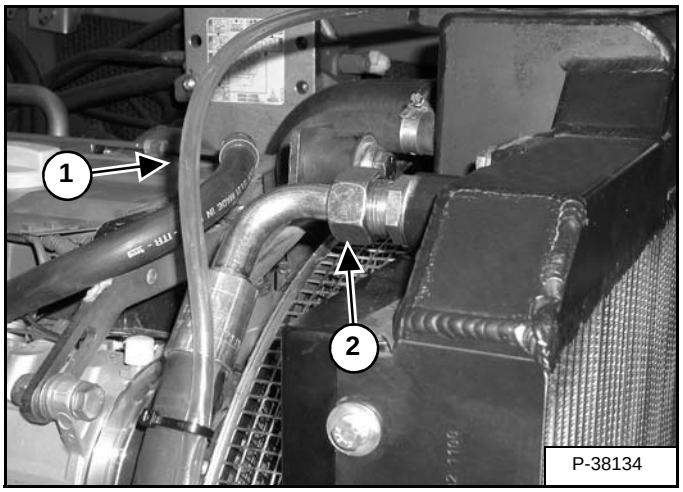


Remove the top bolt (Item 1) and two bottom bolts (Item 2) **[Figure 60-60-10]**.

Installation: Tighten the bolts to 22-26 ft.-lb. (30-35 N•m) torque.

Slide the pump away from the engine.

Figure 60-60-11



Remove the radiator overflow hose (Item 1) **[Figure 60-60-11]**.

Remove the top oil cover hose (Item 2) **[Figure 60-60-11]**.

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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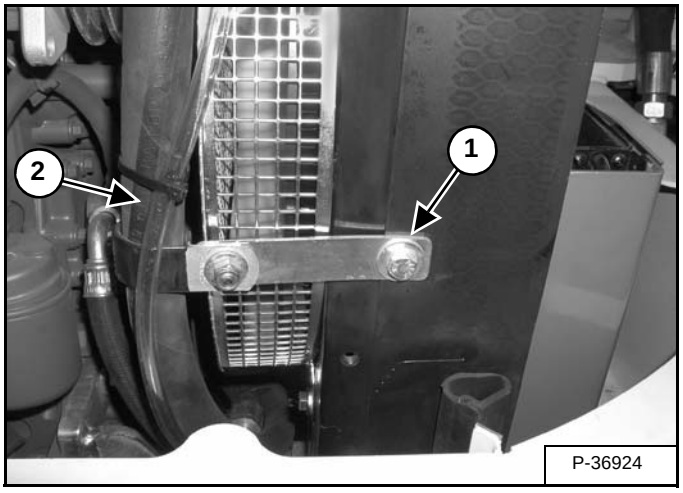
Figure 60-60-12



Remove the bolt (Item 1) **[Figure 60-60-12]**.

Reposition the hose (Item 2) **[Figure 60-60-12]** towards the bottom of the engine.

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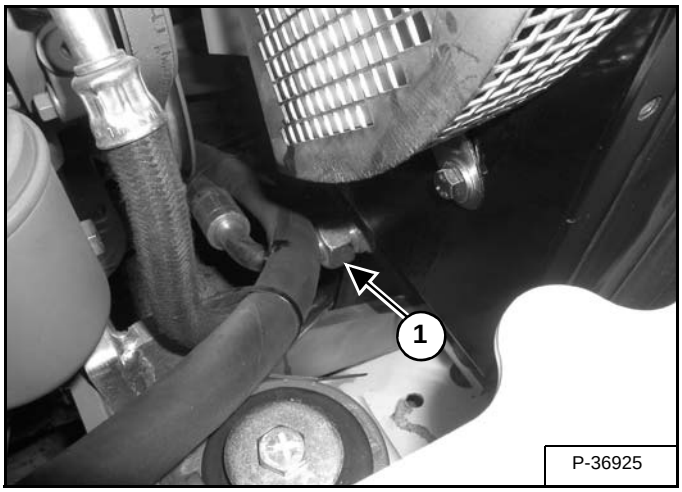
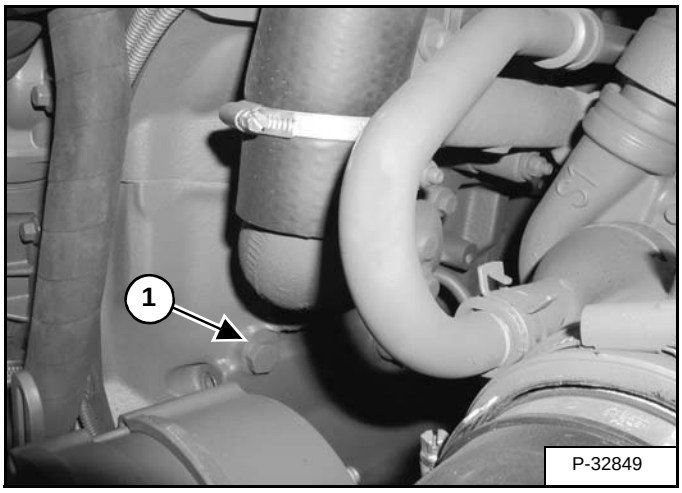
Removal And Installation (Cont'd)

Figure 60-60-13



Remove the bottom oil cooler hose (Item 1) **[Figure 60-60-13]**.

Figure 60-60-14

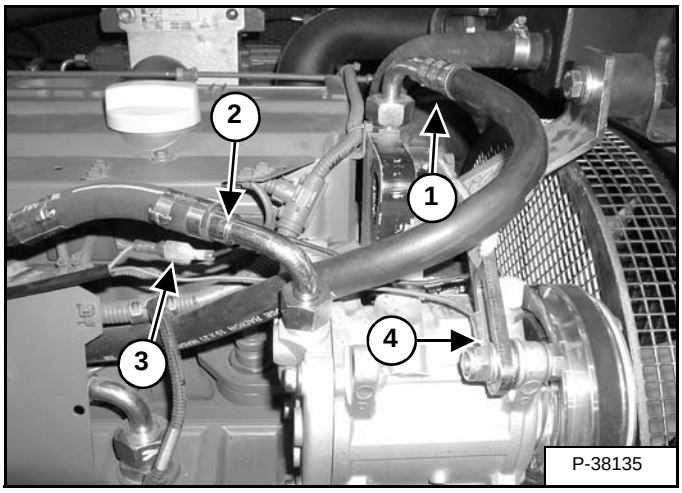


Remove the plug (Item 1) **[Figure 60-60-14]** from the back side of the engine block.

NOTE: The plug is located next to the alternator mount bracket.

Drain the coolant from the engine.

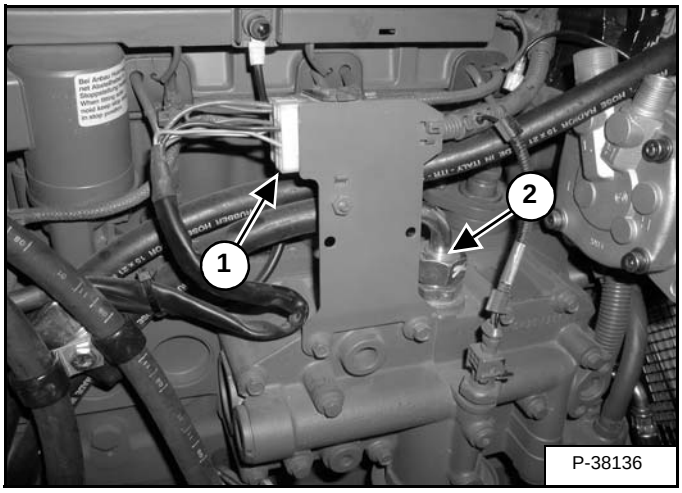
Figure 60-60-15



Remove the top heater hose (Item 1) and both air conditioning hoses (Item 2) **[Figure 60-60-15]**.

Disconnect the electrical connector (Item 3). Remove the ground wire (Item 4) **[Figure 60-60-15]** from the air conditioning pump.

Figure 60-60-16



Disconnect the two wiring connectors (Item 1) Remove the bottom heater hose (Item 2) **[Figure 60-60-16]**.

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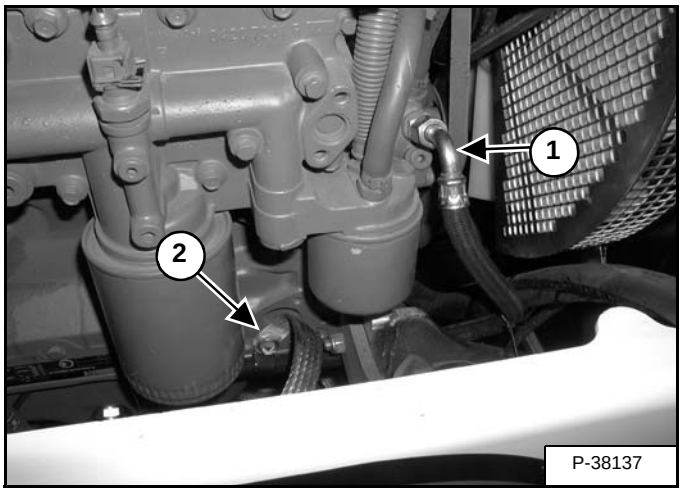
Removal And Installation (Cont'd)

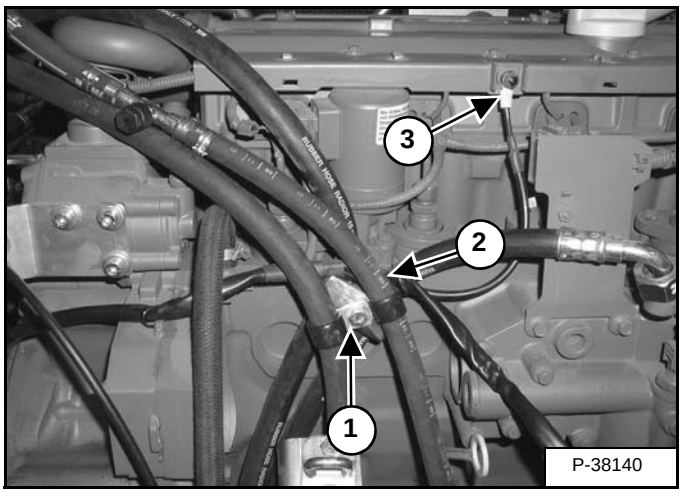
Figure 60-60-17



Remove the fuel line (Item 1) **[Figure 60-60-17]**.

Remove the engine ground/fuel line clamp bolt (Item 2) **[Figure 60-60-17]**.

Figure 60-60-18

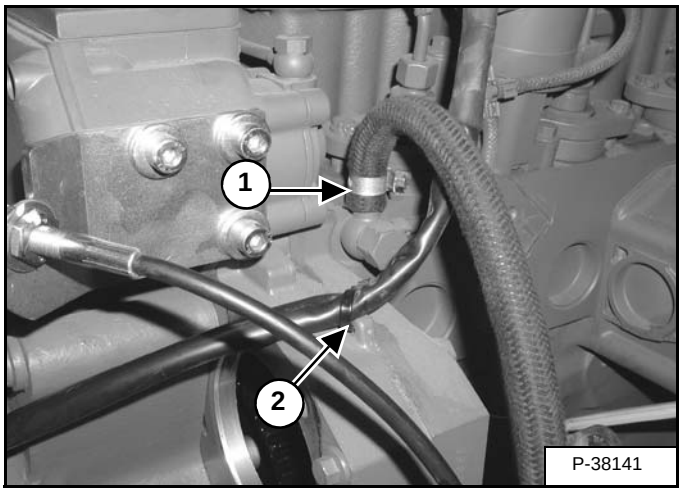


Remove the bolt (Item 1) **[Figure 60-60-18]**.

Cut and remove the cable tie (Item 2) **[Figure 60-60-18]**.

Remove the wire (Item 3) **[Figure 60-60-18]** from the glow plug terminal.

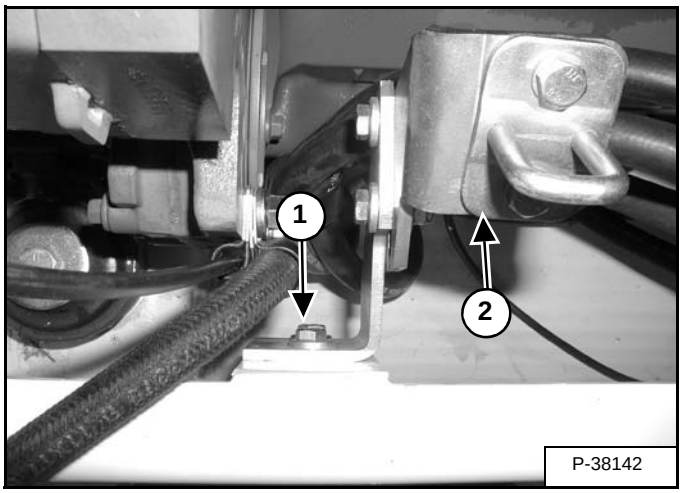
Figure 60-60-19



Remove the return fuel line (Item 1) **[Figure 60-60-19]**.

Cut and remove the cable tie (Item 2) **[Figure 60-60-19]**.

Figure 60-60-20



Remove the two bolts (Item 1) and remove the right side cover striker (Item 2) **[Figure 60-60-20]**.

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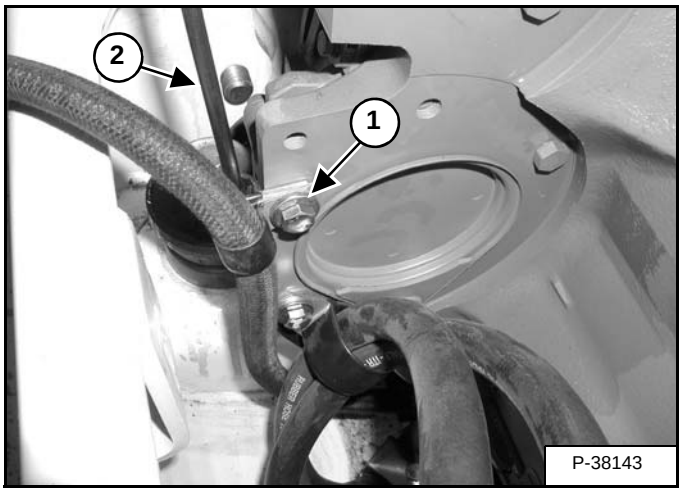
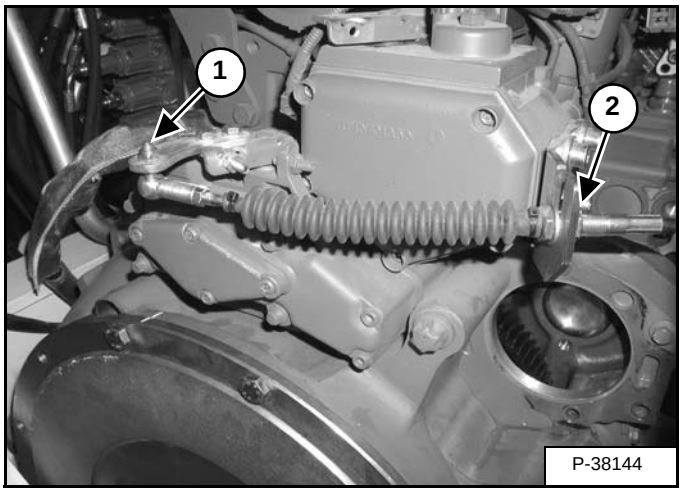
Removal And Installation (Cont'd)

Figure 60-60-21



Remove the bolt (Item 1) from the fuel line/engine speed control cable (Item 2) **[Figure 60-60-21]**.

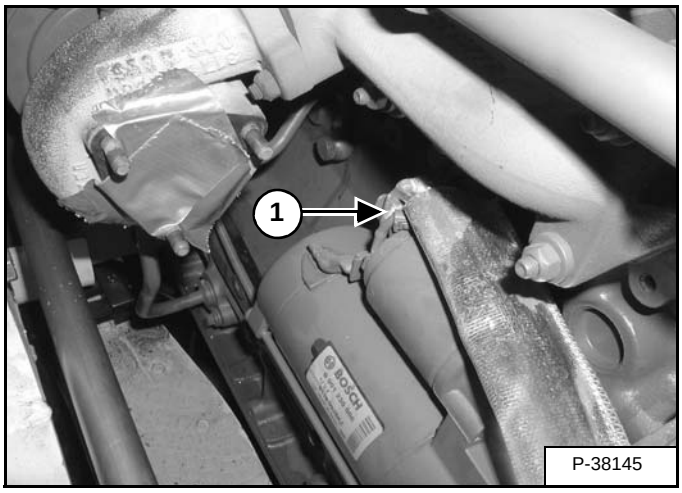
Figure 60-60-22



Remove the engine speed control cable (Item 1) **[Figure 60-60-22]**.

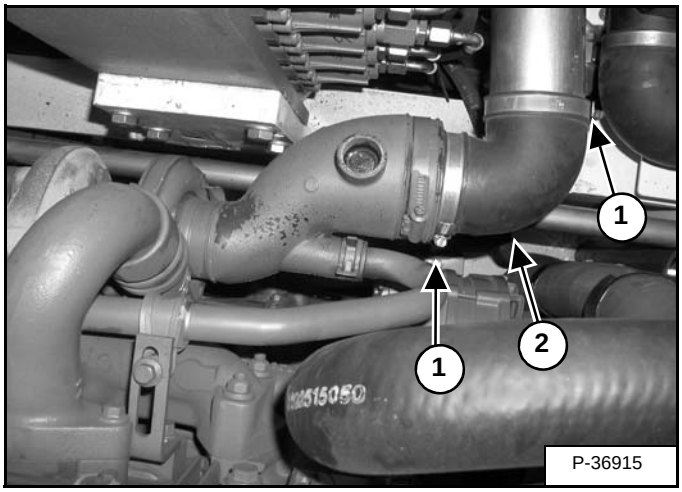
Loosen the cable mount nut (Item 2) **[Figure 60-60-22]** and remove the cable from the mount.

Figure 60-60-23



Remove the battery cable (Item 1) **[Figure 60-60-23]** from the starter.

Figure 60-60-24



Loosen the clamps (Item 1) and remove the air intake hose (Item 2) **[Figure 60-60-24]**.

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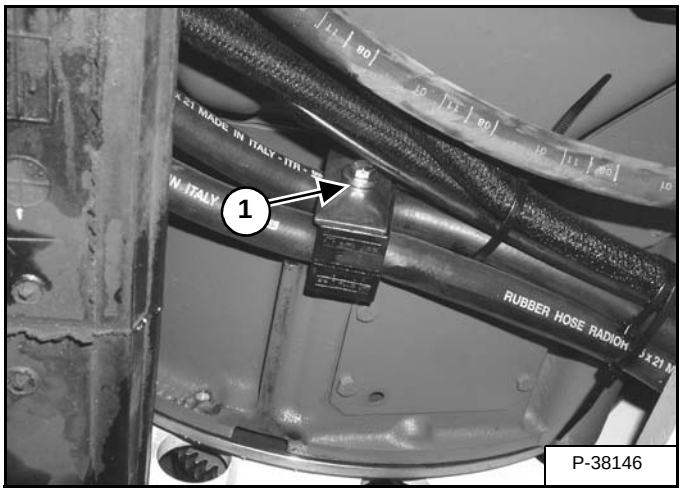
Removal And Installation (Cont'd)

Figure 60-60-25



Remove the bolt (Item 1) **[Figure 60-60-25]** and remove the hose clamps.

Figure 60-60-26

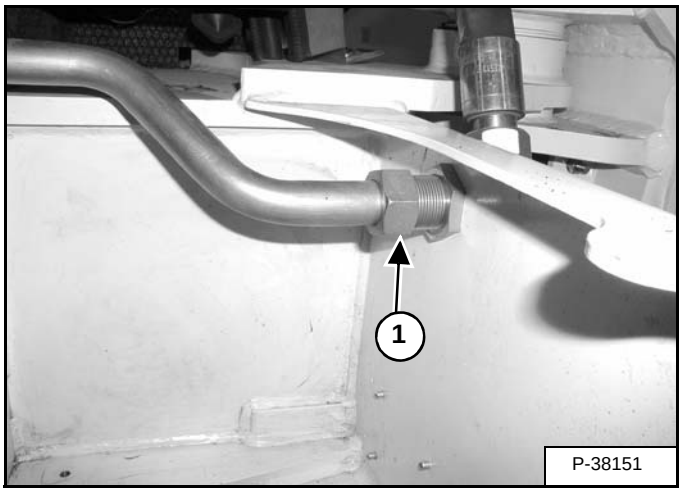
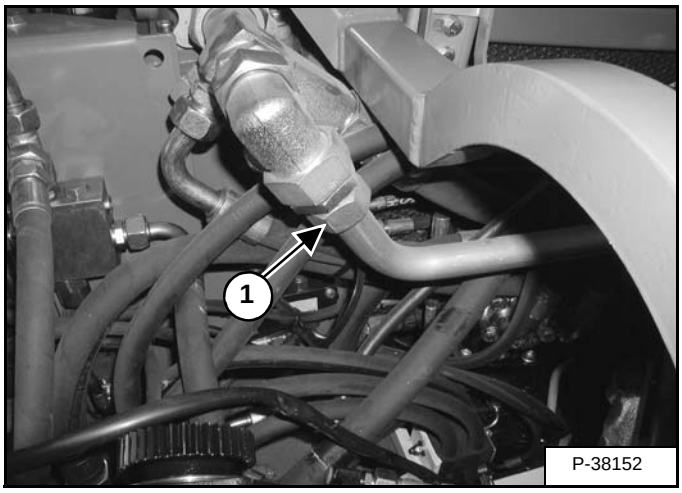


Figure 60-60-27



Disconnect both ends of the auxiliary hydraulic direct to tank line (Item 1) **[Figure 60-60-26]** & **[Figure 60-60-27]**.

Reposition the line to gain clearance for removing the engine.

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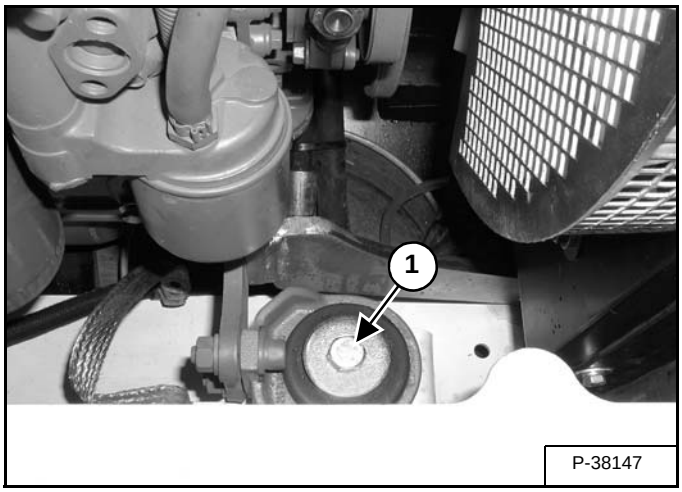
Removal And Installation (Cont'd)

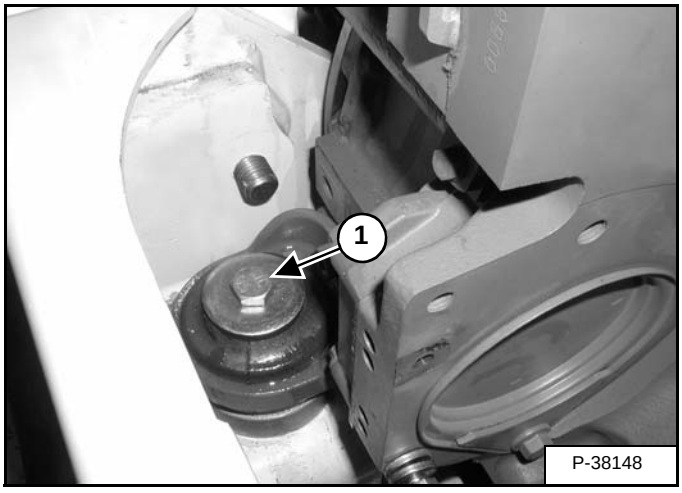
Figure 60-60-28



Remove the front two engine mount bolts (Item 1) **[Figure 60-60-28]**.

Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

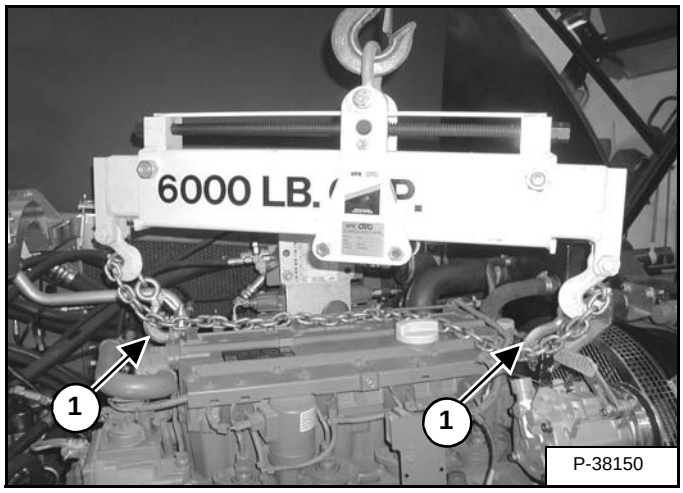
Figure 60-60-29



Remove the rear two engine mount bolts (Item 1) **[Figure 60-60-29]**.

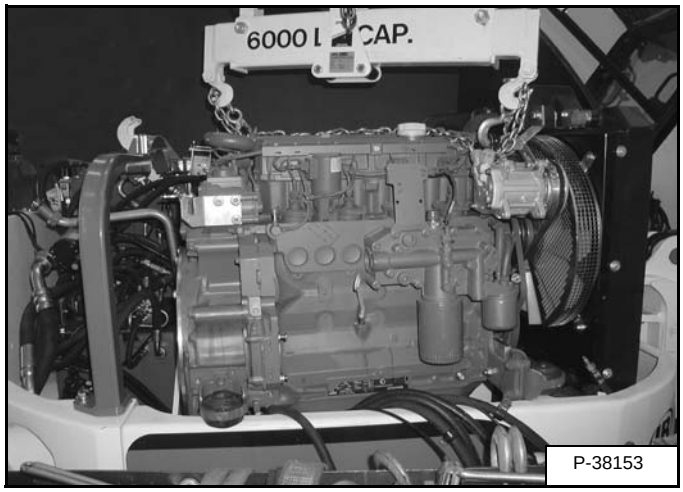
Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 60-60-30



Install a hoist on the engine lift mounts (Item 1) **[Figure 60-60-30]**.

Figure 60-60-31



Remove the engine **[Figure 60-60-31]**.

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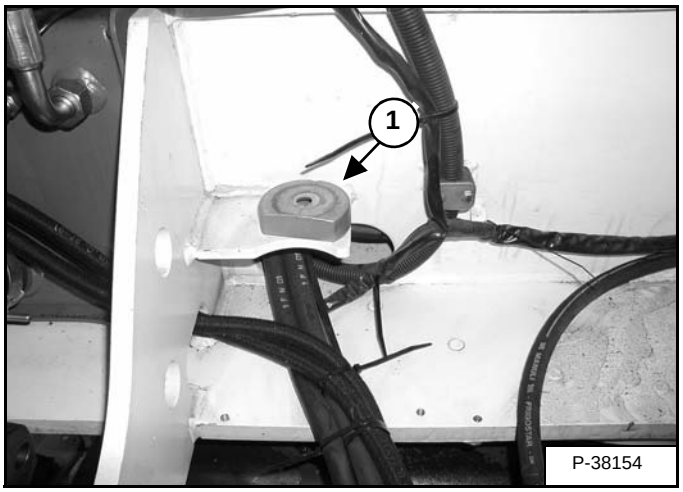
Removal And Installation (Cont'd)

Figure 60-60-32



Remove the four engine mount spacers (Item 1) **[Figure 60-60-32]**.

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ENGINE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

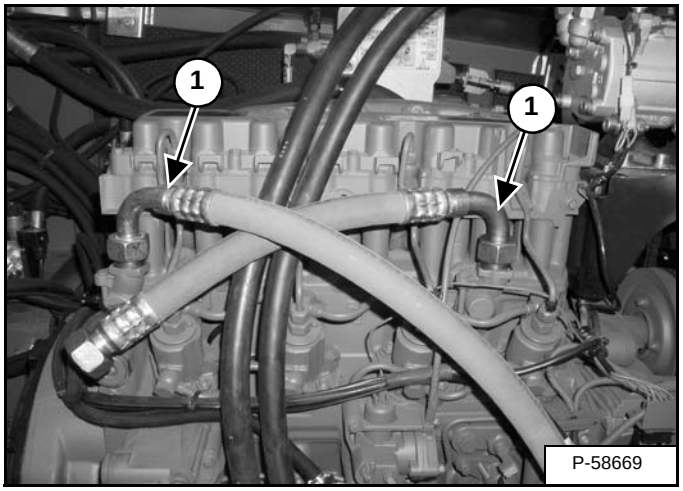
Disconnect the battery. (See BATTERY on Page 50-20-1.)

Remove the muffler. (See MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-21-1.)

Remove the hydraulic piston pump and gear pump. (See HYDRAULIC PISTON PUMP (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 20-52-1 and See HYDRAULIC GEAR PUMP (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 20-53-1.)

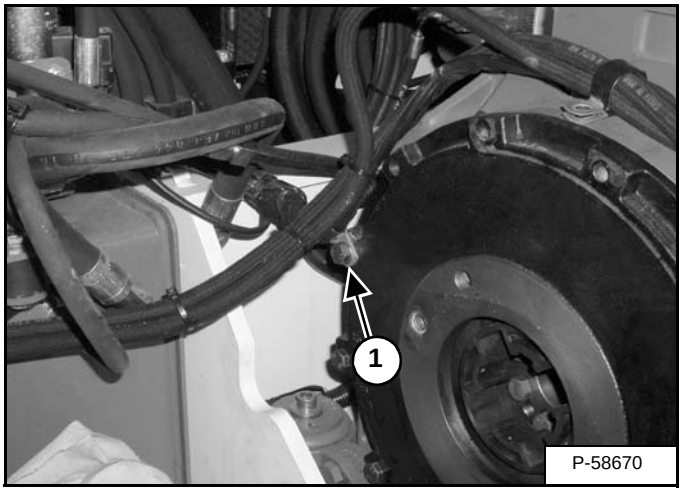
Remove the radiator/oil cooler. (See RADIATOR/OIL COOLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-41-1.)

Figure 60-61-1



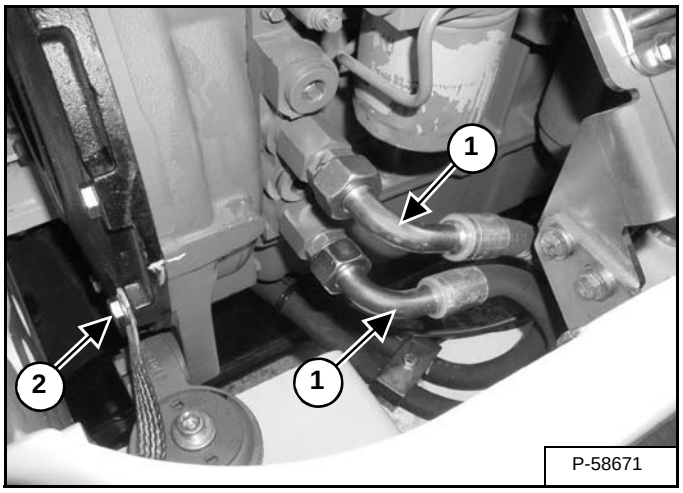
Mark and remove the engine coolant hoses (Item 1) **[Figure 60-61-1]**.

Figure 60-61-2



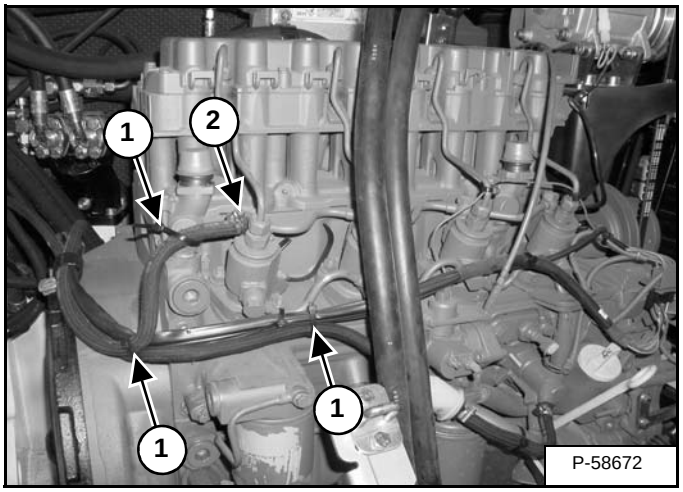
Remove the bolt (Item 1) **[Figure 60-61-2]**.

Figure 60-61-3



Mark and remove the heater hoses (Item 1). Remove the bolt and ground strap (Item 2) **[Figure 60-61-3]**.

Figure 60-61-4



Remove the three cable ties (Item 1). Loosen the hose clamp (Item 2) **[Figure 60-61-4]** and remove the return fuel line.

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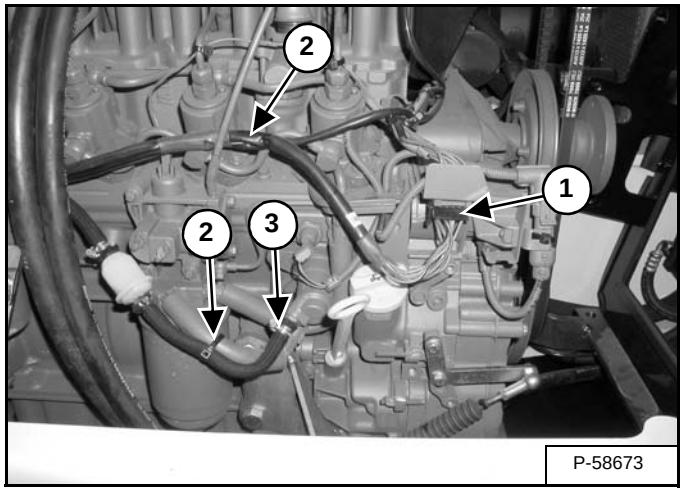
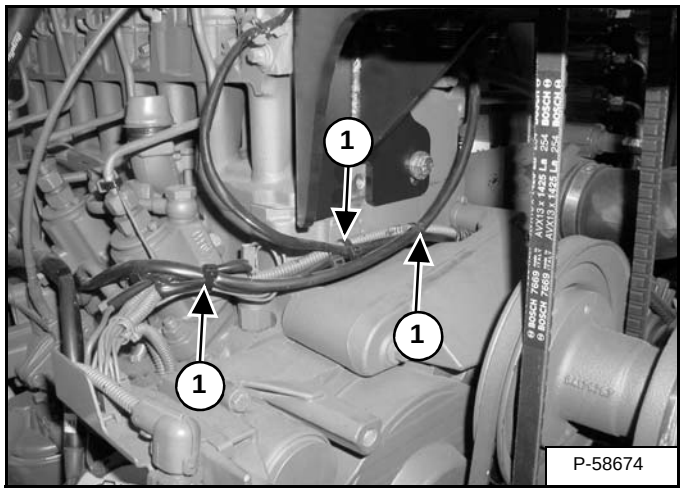
Removal And Installation (Cont'd)

Figure 60-61-5



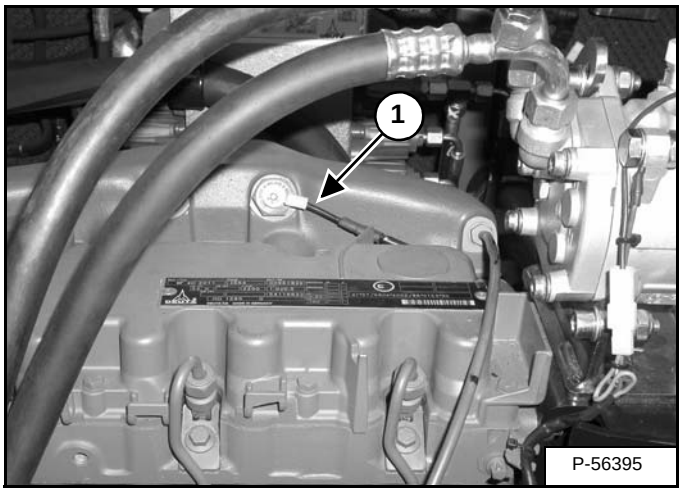
Disconnect the wire harness (Item 1). Remove the cable ties (Item 2). Loosen the hose clamp (Item 3) **[Figure 60-61-5]** and remove the fuel line.

Figure 60-61-6



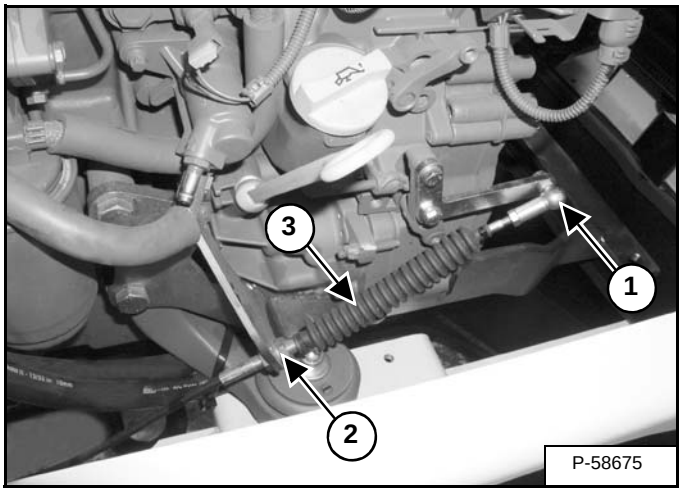
Remove the three cable ties (Item 1) **[Figure 60-61-6]**.

Figure 60-61-7



Remove the nut, washer and wire harness (Item 1) **[Figure 60-61-7]** from the intake air heater.

Figure 60-61-8



Remove the speed control cable retainer (Item 1). Loosen the nut (Item 2) and remove the cable (Item 3) **[Figure 60-61-8]**.

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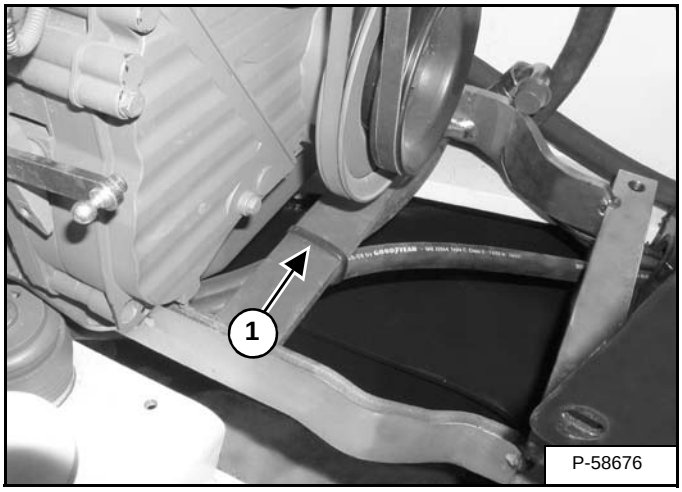
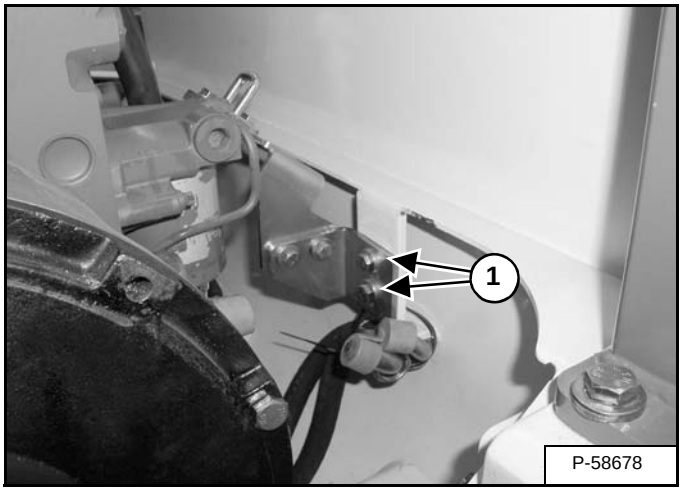
Removal And Installation (Cont'd)

Figure 60-61-9



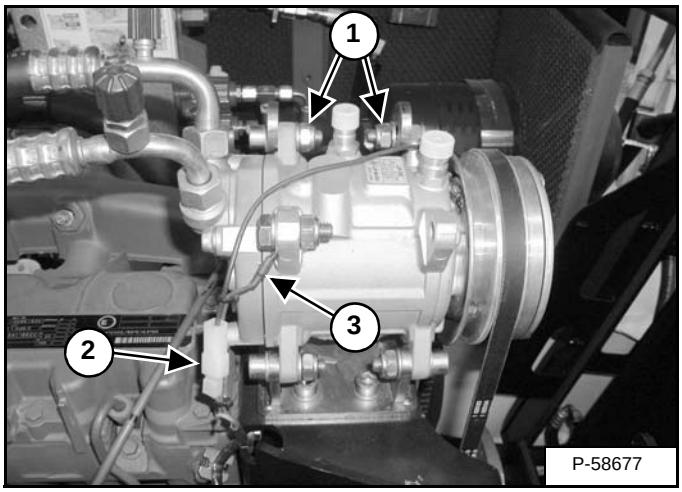
Remove the cable tie (Item 1) **[Figure 60-61-9]** from the A/C hoses.

Figure 60-61-10



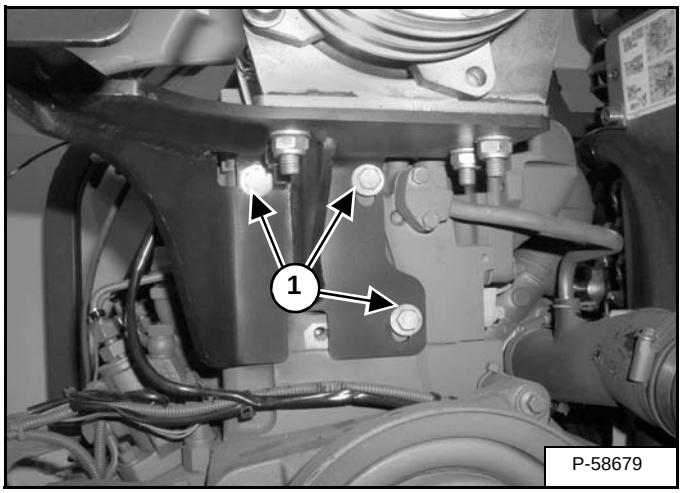
Remove the bolts (Item 1) **[Figure 60-61-10]** and right side cover latch.

Figure 60-61-11



Loosen the A/C compressor bolts (Item 1) and remove the belt. Disconnect the wire harness (Item 2). Remove the bolt, nut and ground wire (Item 3) **[Figure 60-61-11]**.

Figure 60-61-12



Remove the bolts (Item 1) **[Figure 60-61-12]** and washers. Reposition the A/C compressor and mount.

NOTE: Do not allow the hoses to support the compressor.

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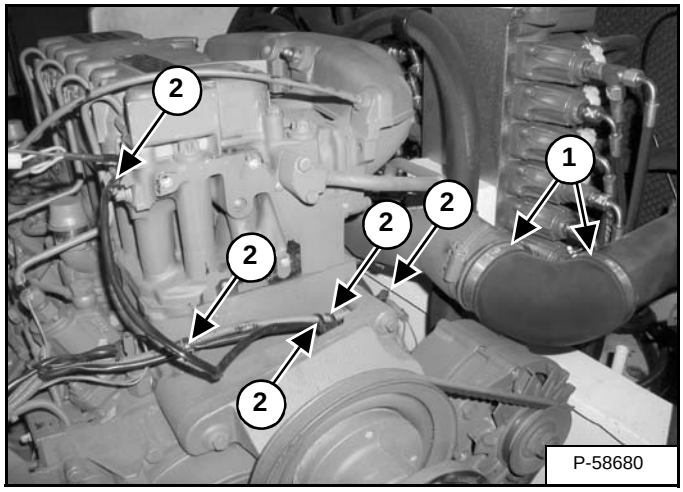
Removal And Installation (Cont'd)

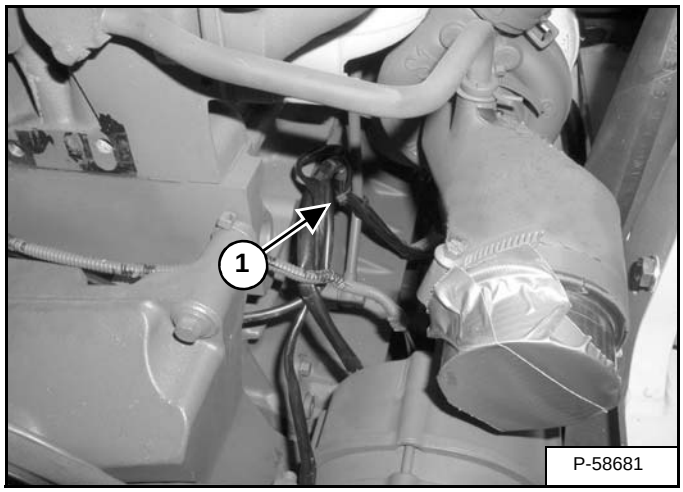
Figure 60-61-13



Loosen the clamps (Item 1) and remove the air intake hose. Remove the cable ties (Item 2) **[Figure 60-61-13]**.

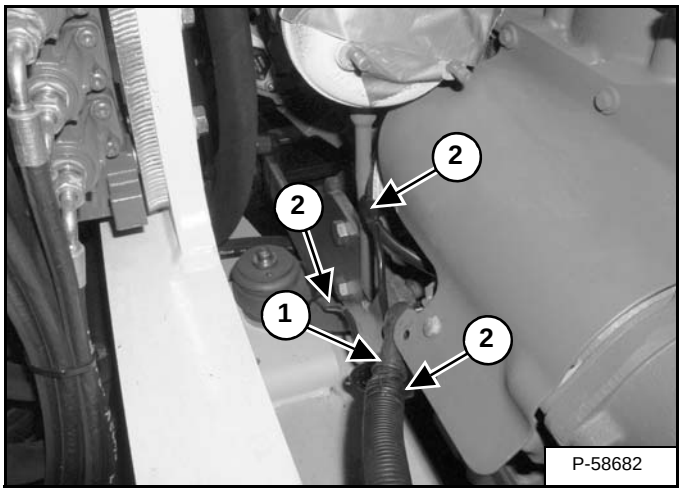
NOTE: Plug the air intake to prevent contamination from entering the engine.

Figure 60-61-14



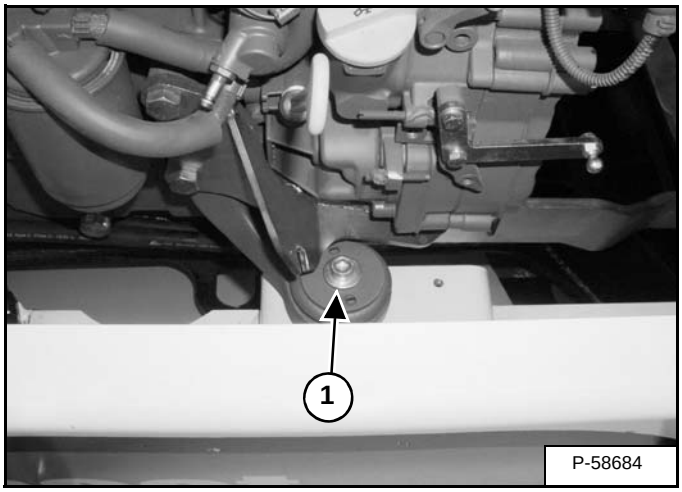
Remove the cable tie (Item 1) **[Figure 60-61-14]** from the A/C wire harness.

Figure 60-61-15



Remove the nut, washer, and positive (+) battery cable (Item 1) from the starter. Remove the three cable ties (Item 2) **[Figure 60-61-15]** from the back side of the engine block.

Figure 60-61-16



Remove the front two engine mount bolts (Item 2) **[Figure 60-61-16]**.

Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

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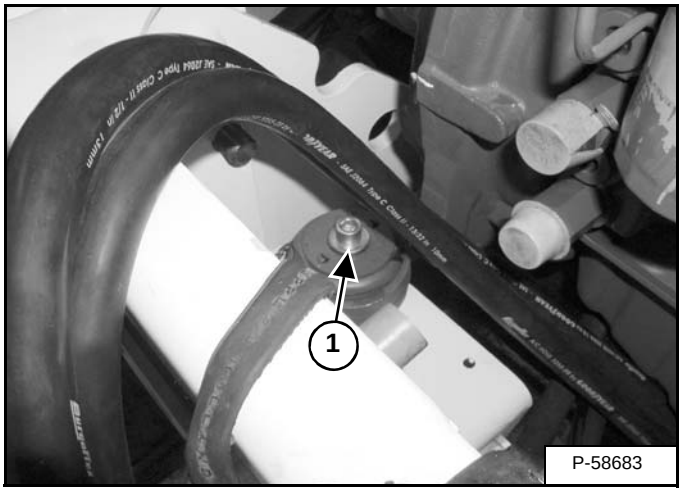
Removal And Installation (Cont'd)

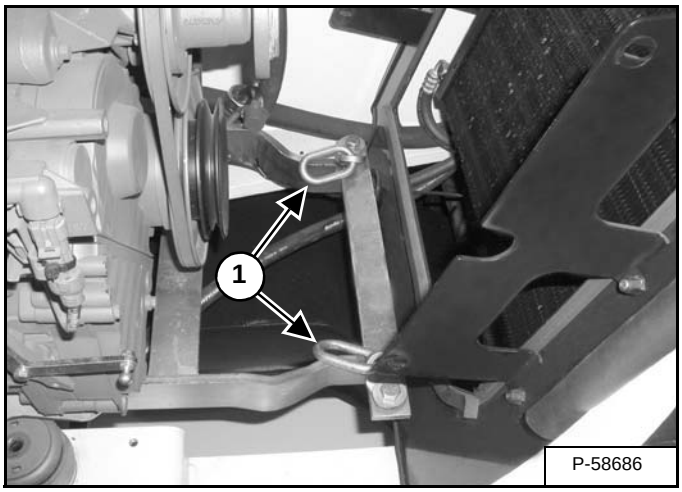
Figure 60-61-17



Remove the rear two engine mount bolts (Item 1) **[Figure 60-61-17]**.

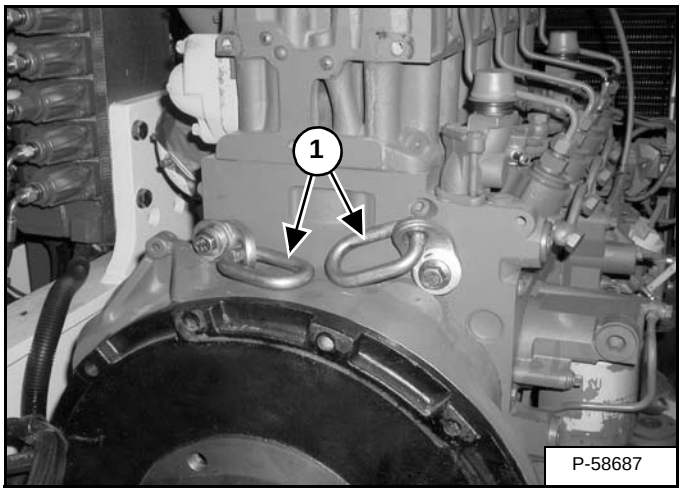
Installation: Tighten the bolts to 48-55 ft.-lb. (65-75 N•m) torque.

Figure 60-61-18



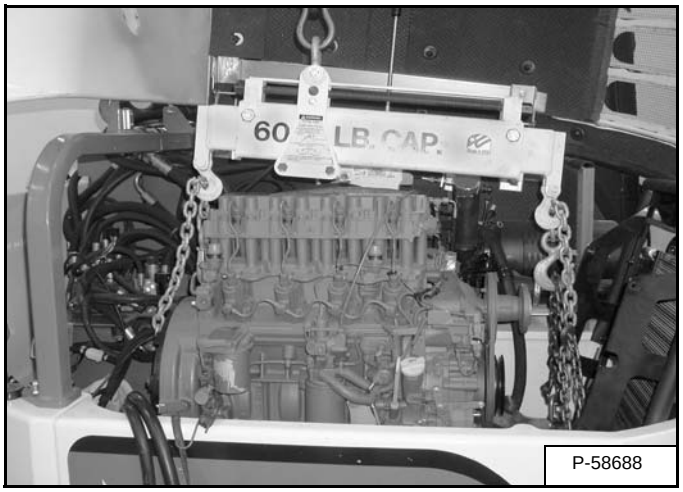
Install lifting brackets (Item 1) **[Figure 60-61-18]** on the front of the engine cradle.

Figure 60-61-19



Install lifting brackets (Item 1) **[Figure 60-61-19]** on the rear of the engine.

Figure 60-61-20



Install a hoist on the lifting brackets **[Figure 60-61-20]**.

Remove the engine.

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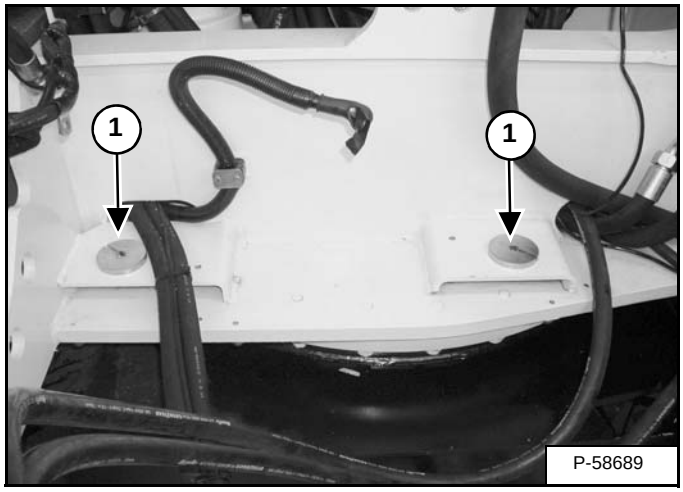
Removal And Installation (Cont'd)

Figure 60-61-21



Remove the four washers (Item 1) **[Figure 60-61-21]** from the engine mounts.

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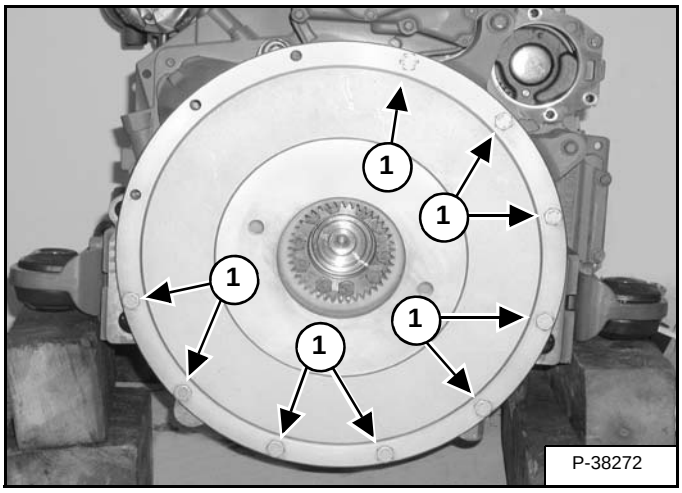
FLYWHEEL (S/N 522311001 & ABOVE)

Removal And Installation

Remove the engine. (See ENGINE (S/N 522311001 & ABOVE) on Page 60-60-1.)

Mark the flywheel cover to engine block for ease of assembly.

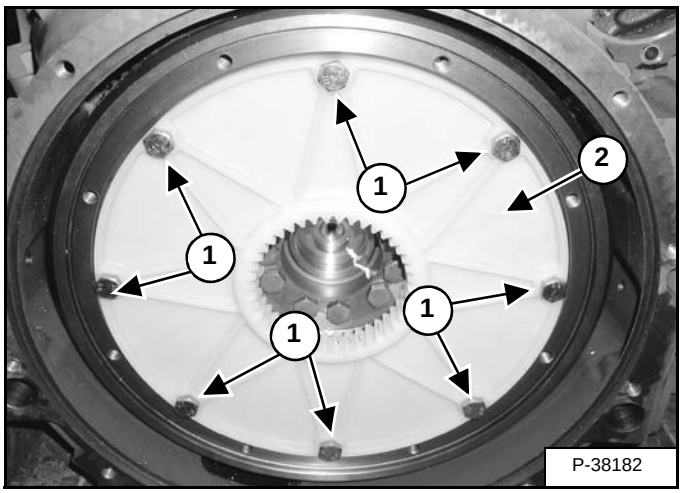
Figure 60-70-1



Remove the nine bolts (Item 1) **[Figure 60-70-1]**.

Installation: Apply medium strength thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 33 ft.-lb. (45 N•m) torque.

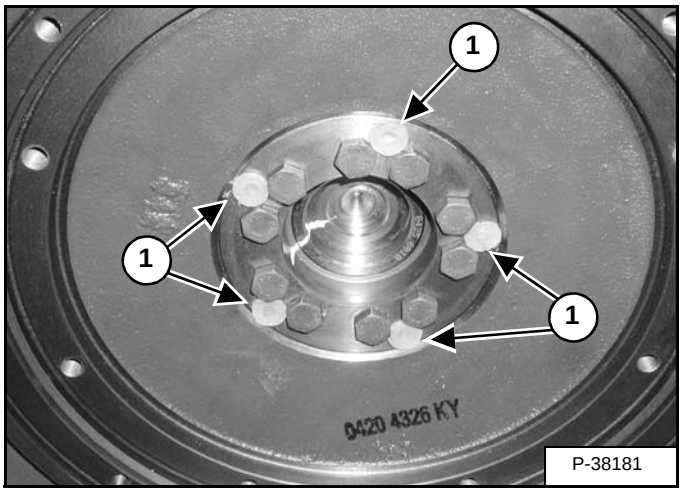
Figure 60-70-2



Remove the bolts (Item 1) and pump coupler (Item 2) **[Figure 60-70-2]**.

Installation: Apply medium strength thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 36 ft.-lb. (49 N•m) torque.

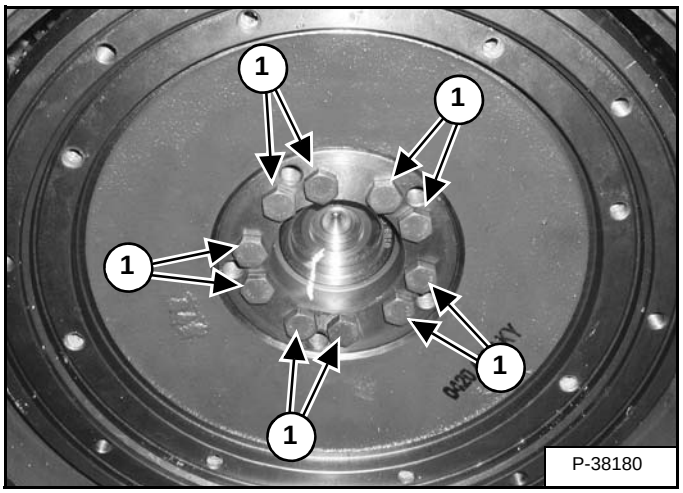
Figure 60-70-3



Remove the plugs (Item 1) **[Figure 60-70-3]**.

Mark the flywheel to crankshaft.

Figure 60-70-4



Remove the bolts (Item 1) **[Figure 60-70-4]**.

Installation: Tighten the bolts as follows:

10. 30-45 mm long 15-22 ft.-lb. (20-30 N•m)
    50-85 mm long 22-30 ft.-lb. (30-40 N•m)

11. 60°

12. 30 mm long 30°
    35-85 mm long 60°

Remove the flywheel.

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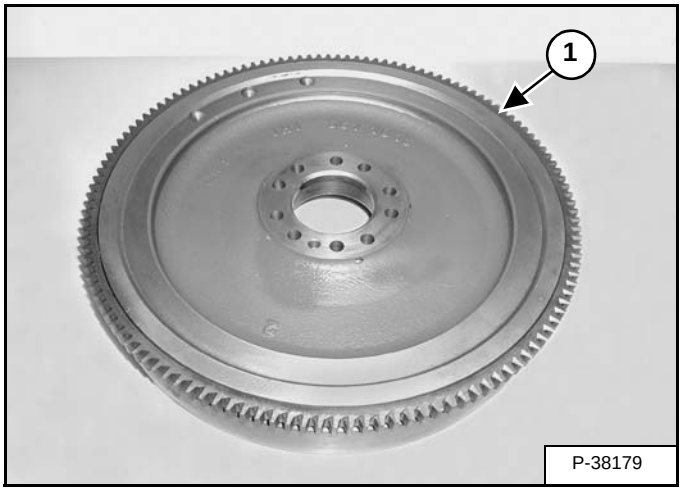
Flywheel Ring Gear

⚠ 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

Figure 60-70-5



The ring gear on the flywheel is an interference fit. Heat the ring gear (Item 1) **[Figure 60-70-5]** enough to expand it and hit it with a hammer evenly to remove it.

Clean the outer 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.

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FLYWHEEL (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

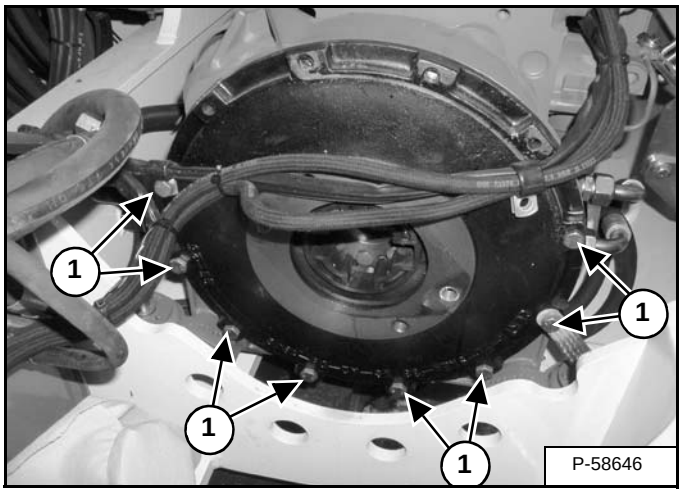
Removal And Installation

Remove the muffler and muffler mount. (See MUFFLER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 60-21-1).

Remove the hydraulic piston pump. (See Removal And Installation on Page 20-52-13.)

Mark the flywheel cover to engine block for ease of assembly.

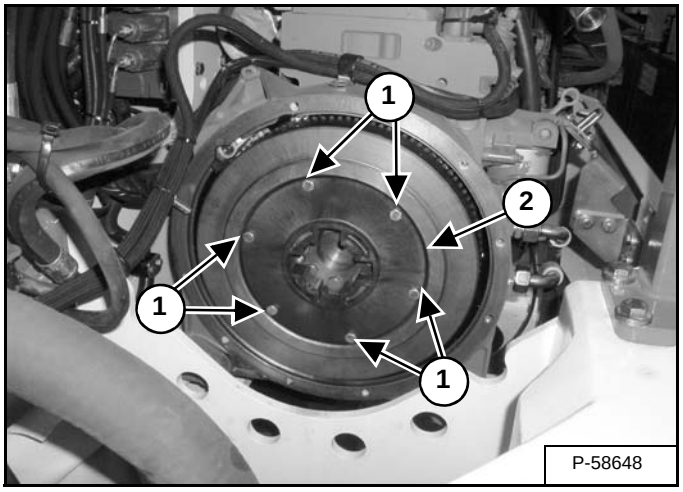
Figure 60-71-1



Remove the eight bolts (Item 1) **[Figure 60-71-1]**.

Installation: Apply thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 30-37 ft.-lb. (40-50 N•m) torque.

Figure 60-71-2

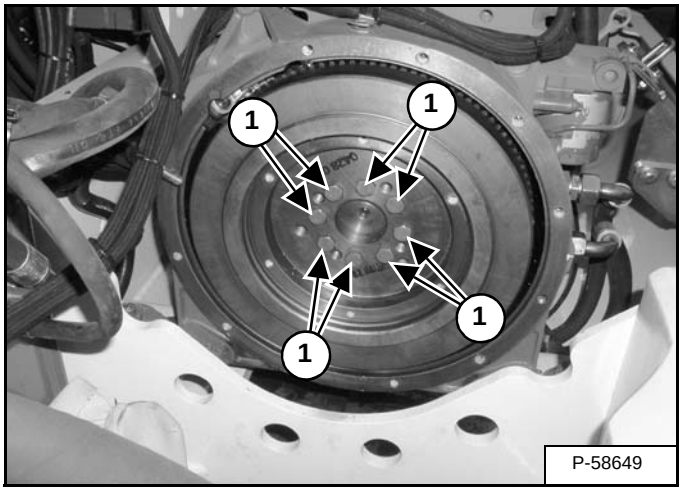


Remove the bolts (Item 1) and pump coupler (Item 2) **[Figure 60-71-2]**.

Installation: Apply thread adhesive (Loctite™ 242) to the bolt threads. Tighten the bolts to 15-18 ft.-lb. (20-25 N•m) torque.

Mark the flywheel to crankshaft.

Figure 60-71-3



Remove the bolts (Item 1) **[Figure 60-71-3]**.

Installation: Do not reuse the bolts. Install new bolts and tighten the bolts to 22 ft.-lb. (30 N•m) torque.

Torque the bolts an additional 60×.

Final torque the bolts an additional 30×.

Remove the flywheel.

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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.

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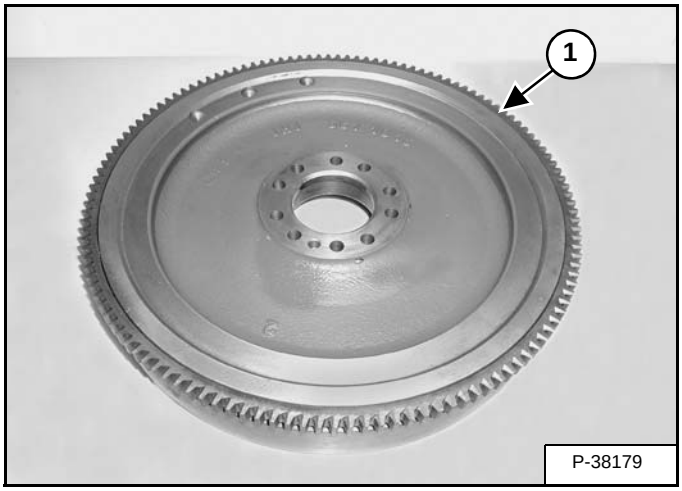
Figure 60-71-4



The ring gear on the flywheel is an interference fit. Heat the ring gear (Item 1) **[Figure 60-71-4]** enough to expand it and hit it with a hammer evenly to remove it.

Clean the outer 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.

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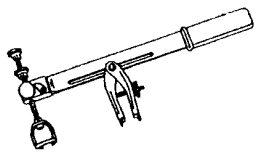
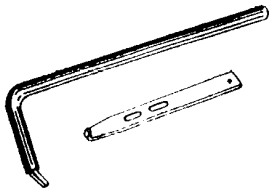
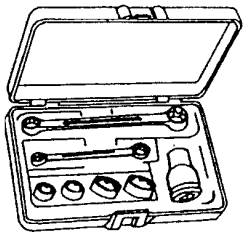
Deutz Engine Tools Identification Chart

Part No.	Description	Illustration	Part No.	Description	Illustration
MEL1456	Valve Spring Assembly Lever		MEL1465	Crankshaft Gasket Removing Tool	
MEL1457	Torx Tool Kit				

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RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

Disassembly

Remove the engine. Mount the engine on a suitable engine stand.

Remove the starter. (See Removal And Installation (S/N 522311001 & Above) on Page 50-40-1.)

Remove the alternator. (See Removal And Installation (S/N 522311001 & Above) on Page 50-30-1.)

Drain the oil from the engine oil pan.

Remove the turbocharger. See "Turbo Charger Removal and Installation" on page 72.

Remove the shut off solenoid.

Remove the fuel injectors. (See Fuel Injection Pump Removal on Page 60-50-7.)

Remove the overflow valve.

Remove the exhaust manifold.

Remove the intake manifold.

Remove the oil filter.

Remove the fuel filter.

Remove the fuel pump.

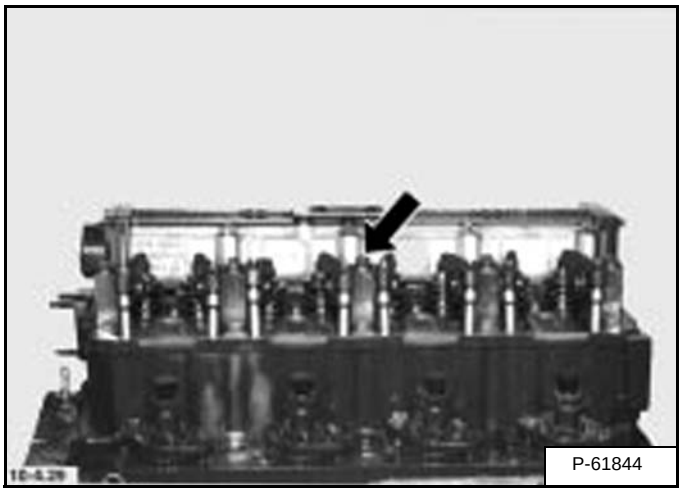
Remove the water pump.

Remove the oil cooler.

Remove the valve cover.

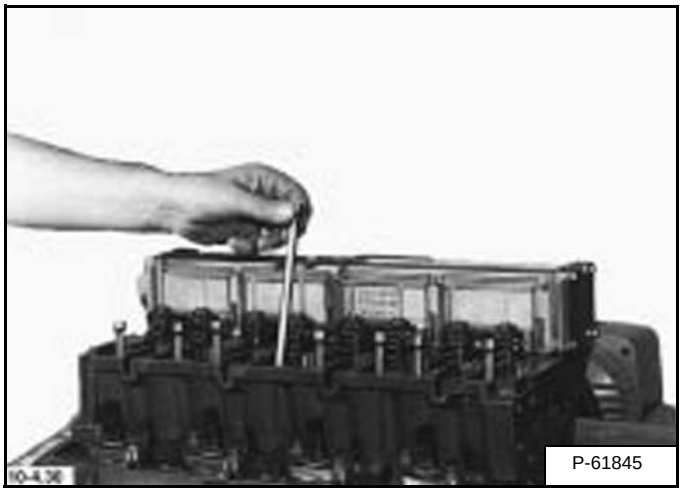
Remove the glow plugs.

Figure 60-80-1



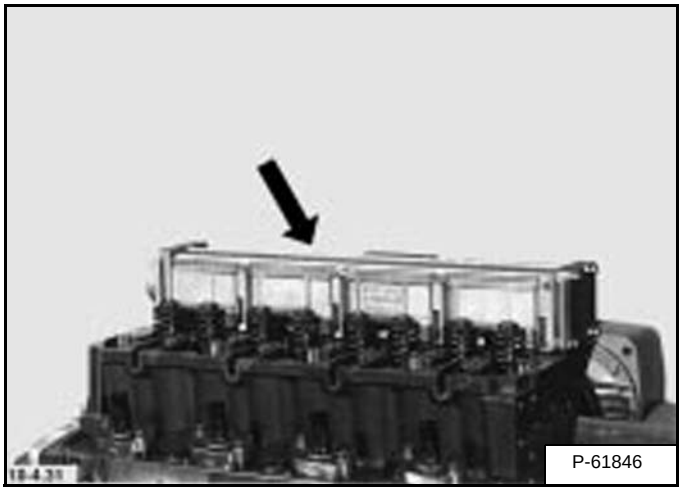
Remove the rocker arms and brackets **[Figure 60-80-1]**.

Figure 60-80-2



Remove the push rods **[Figure 60-80-2]**.

Figure 60-80-3



Remove the air intake manifold **[Figure 60-80-3]**.

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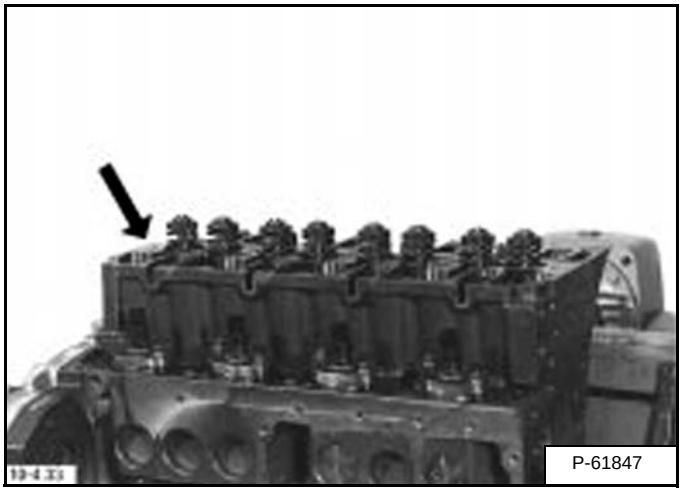
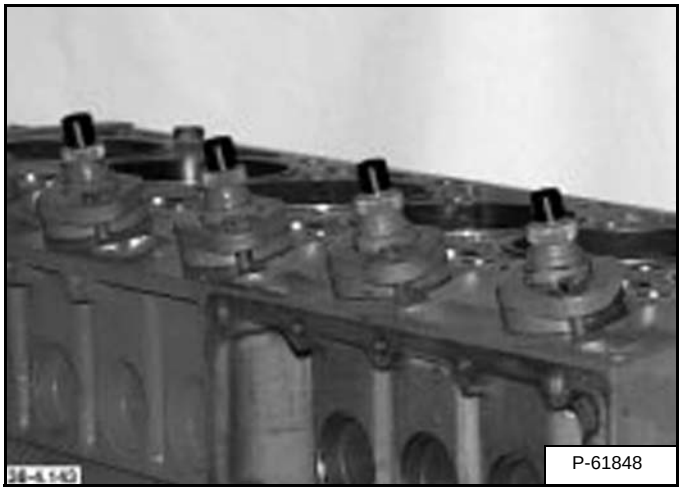
Disassembly (Cont'd)

Figure 60-80-4



Remove the cylinder head bolts. Remove the cylinder head **[Figure 60-80-4]**.

Figure 60-80-5

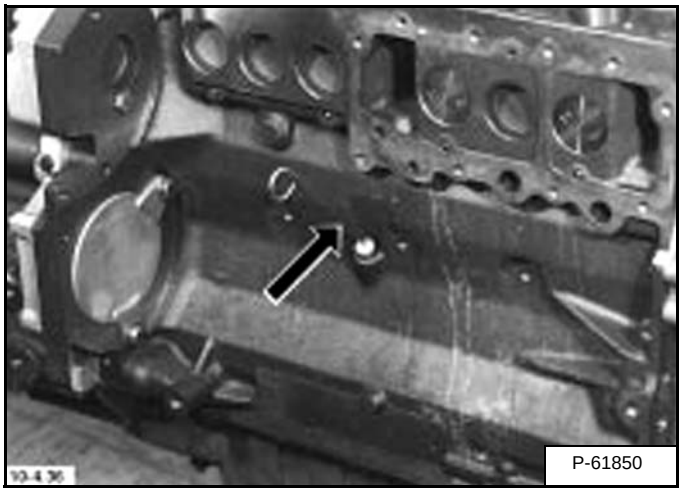


Remove the fuel injection pumps **[Figure 60-80-5]**. Remove the shims. (If installed)

Figure 60-80-6

Remove the injection pump roller tappets **[Figure 60-80-6]** and shims.

Figure 60-80-7



Remove the dipstick **[Figure 60-80-7]**.

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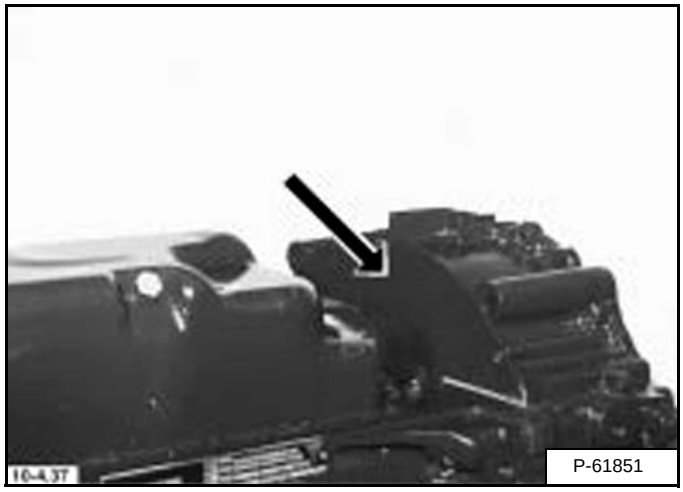
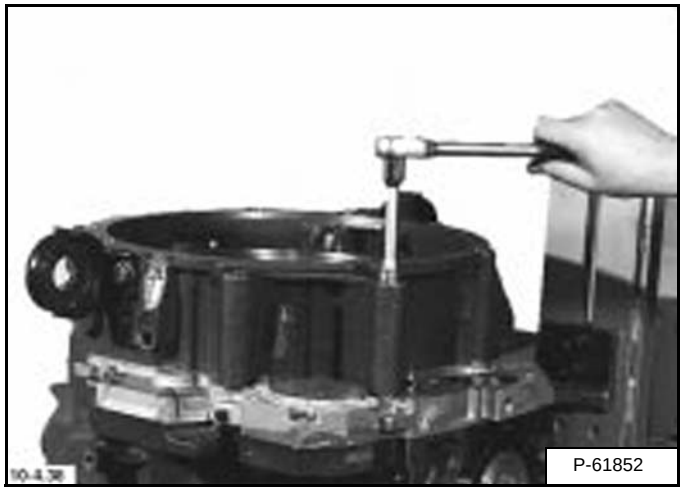
Disassembly (Cont'd)

Figure 60-80-8



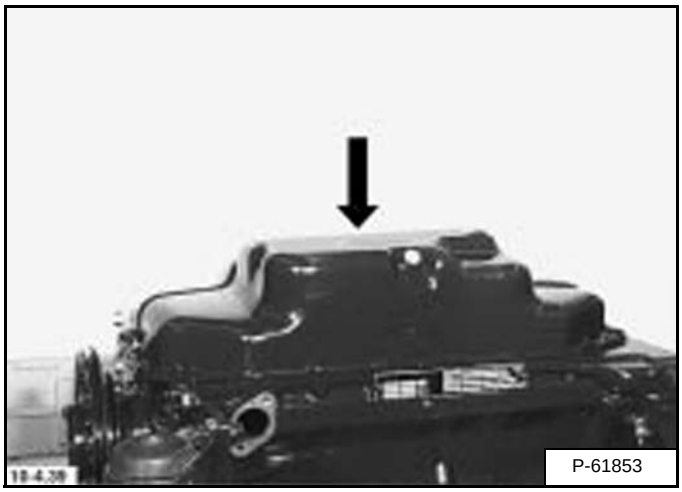
Remove the cover **[Figure 60-80-8]**.

Figure 60-80-9



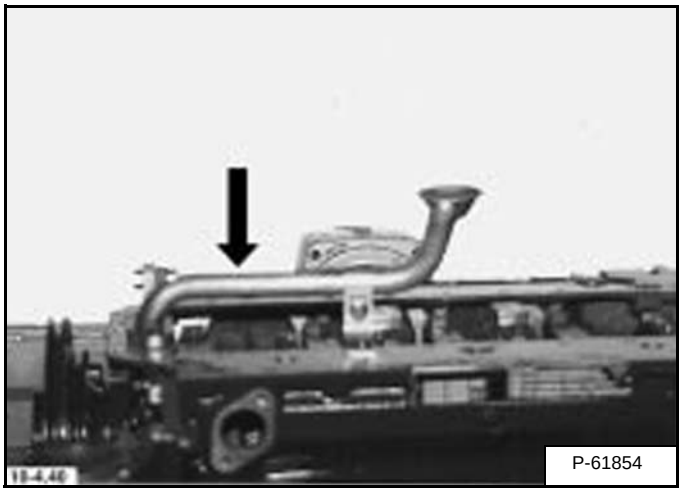
Remove the housing **[Figure 60-80-9]**.

Figure 60-80-10



Remove the oil pan **[Figure 60-80-10]**.

Figure 60-80-11



Remove the oil suction pipe **[Figure 60-80-11]**.

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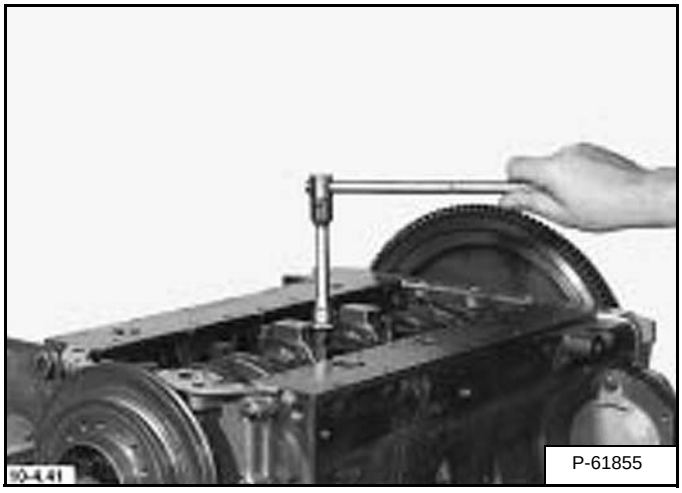
Disassembly (Cont'd)

Figure 60-80-12

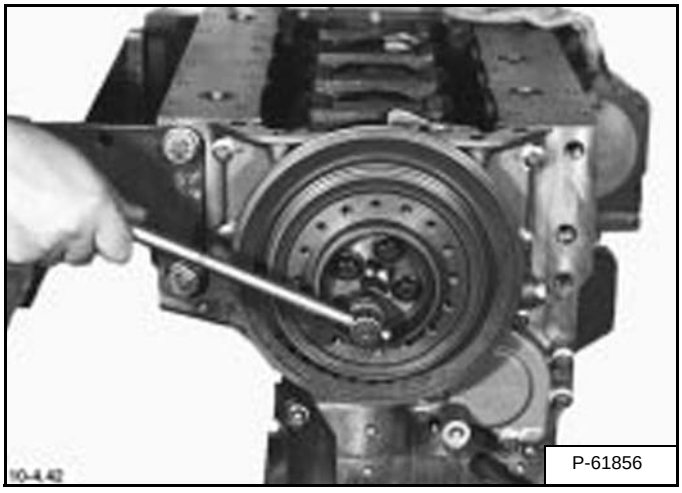


Remove the connecting rod bolts **[Figure 60-80-12]**.

Remove all the piston/connecting rod assemblies from the engine block.

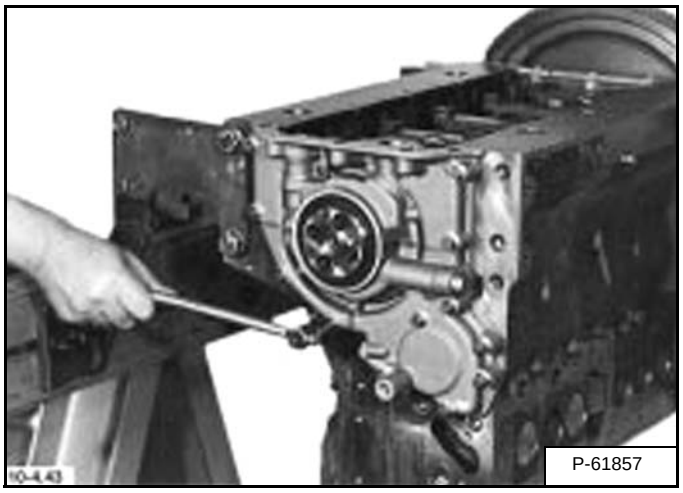
To check the piston/connecting rod assembly. See "Piston Installation On The Connecting Rod" on page 64.

Figure 60-80-13



Remove the pulley **[Figure 60-80-13]**.

Figure 60-80-14

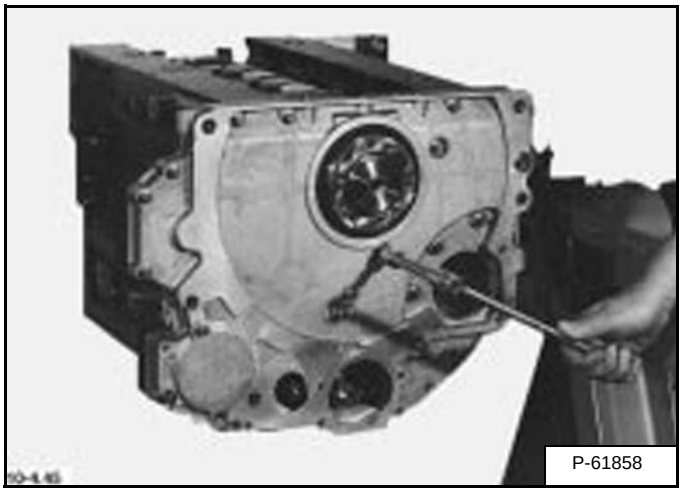


Remove the front cover **[Figure 60-80-14]**.

To disassemble and assemble the front cover. See "Front Cover Disassembly" on page 70.

Remove the flywheel. (See Removal And Installation on Page 60-70-1.)

Figure 60-80-15



Remove the rear cover **[Figure 60-80-15]**.

To install a new rear seal and inspect the cover. See "Rear Cover Seal Removal And Installation" on page 54.

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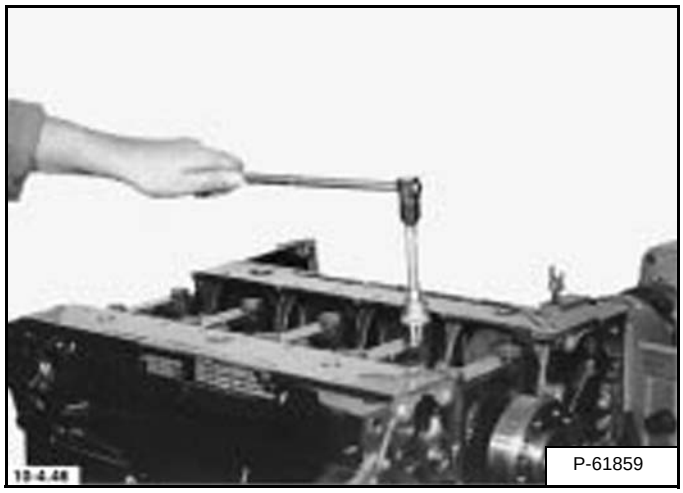
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

Disassembly (Cont'd)

Mark the location of each main bearing cap so it will be installed in the original position.

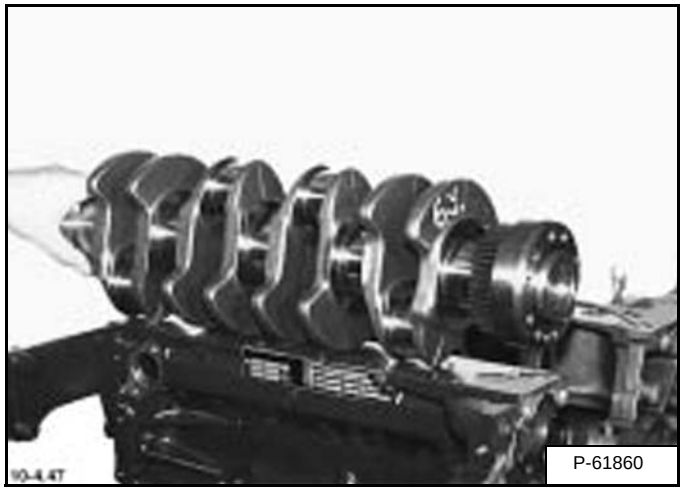
Figure 60-80-16



Remove the main bearing caps bolts **[Figure 60-80-16]**.

Remove the main bearing caps.

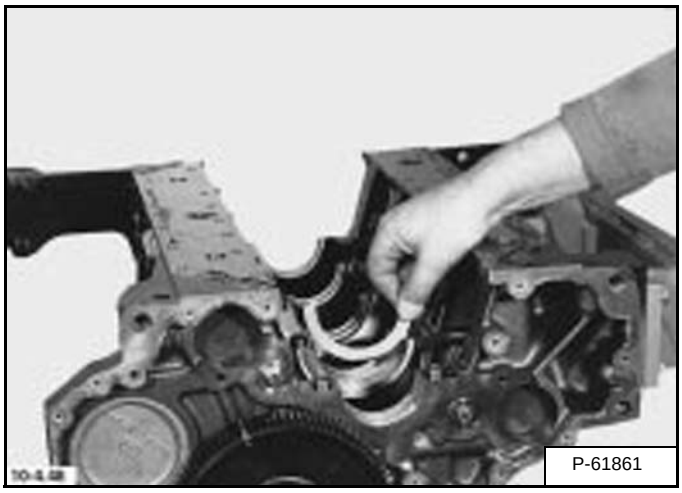
Figure 60-80-17



Remove the crankshaft **[Figure 60-80-17]**.

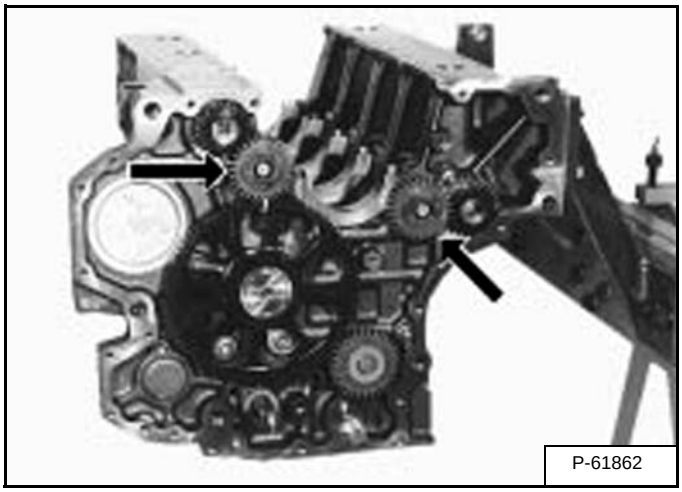
Check the crankshaft specifications. See "Crankshaft, Checking" on page 56.

Figure 60-80-18



Remove the thrust rings and upper half of the main bearings **[Figure 60-80-18]**.

Figure 60-80-19



Install the balancing shaft drive gears **[Figure 60-80-19]**. (If equipped)

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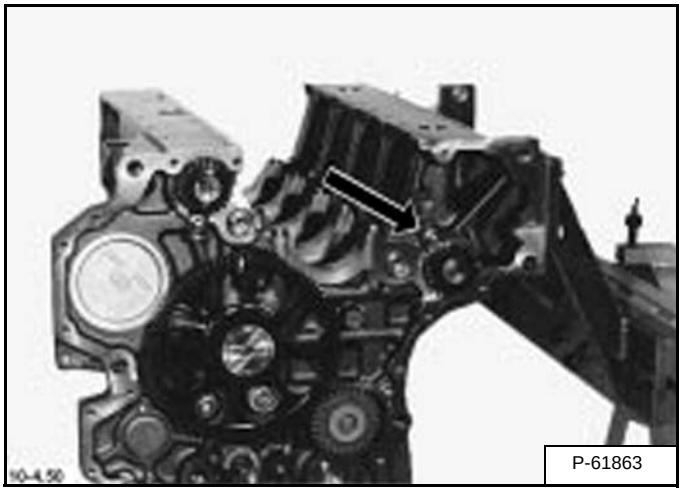
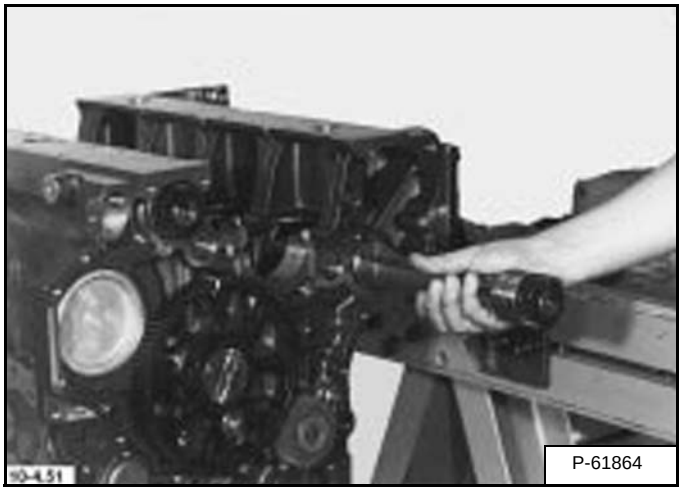
Disassembly (Cont'd)

Figure 60-80-20



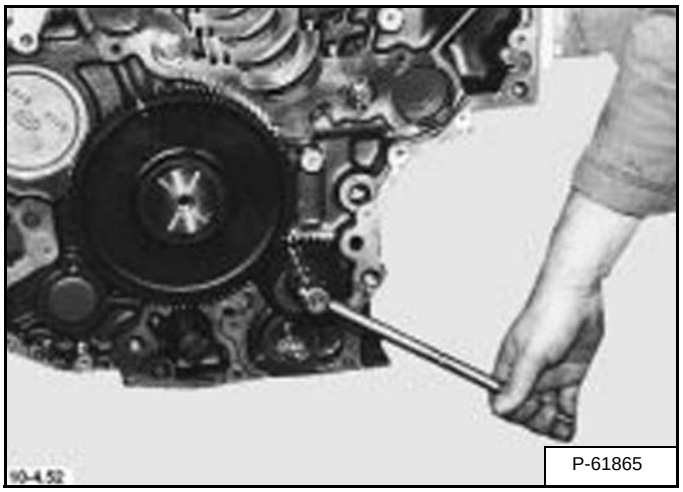
Remove the balancing shaft thrust washers **[Figure 60-80-20]**. (If equipped)

Figure 60-80-21



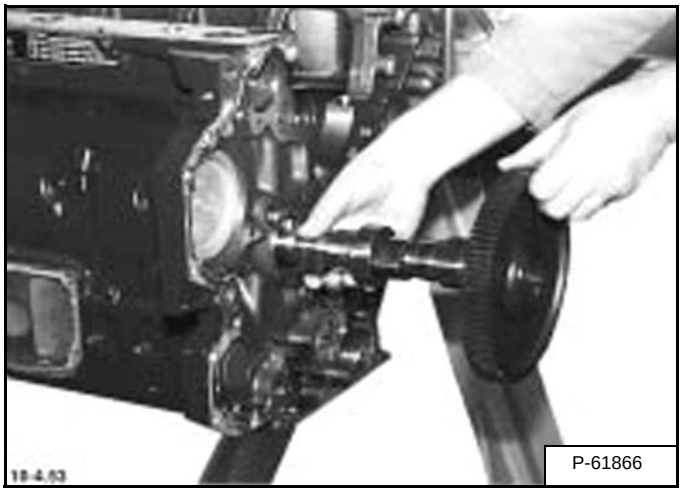
Remove the balancing shafts **[Figure 60-80-21]**. (If equipped).

Figure 60-80-22



Remove the governor drive gear **[Figure 60-80-22]**.

Figure 60-80-23



Remove the camshaft **[Figure 60-80-23]**.

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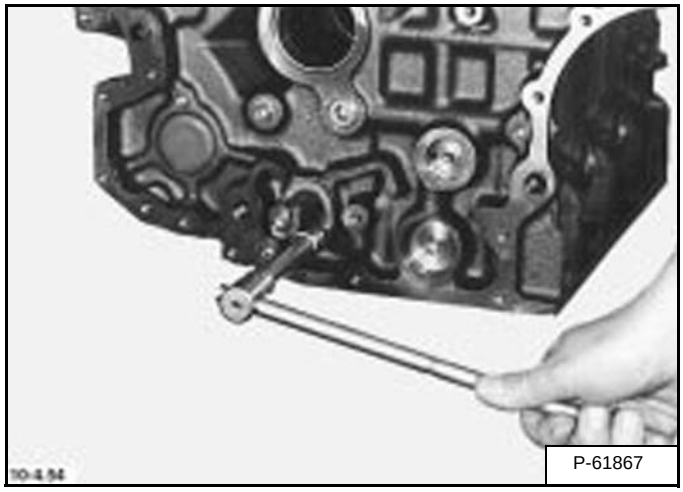
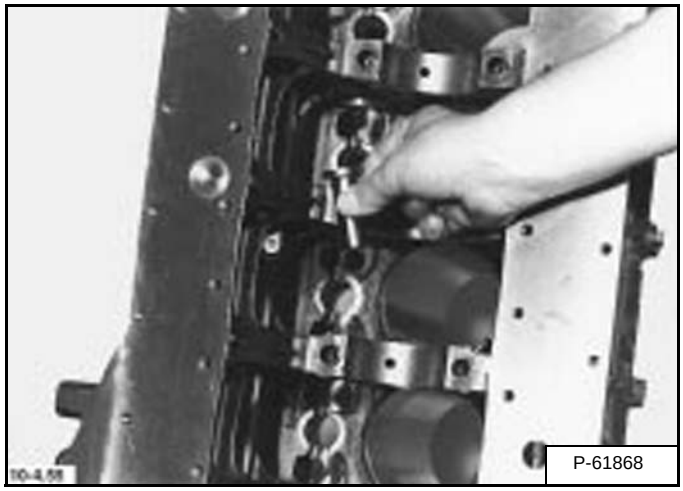
Disassembly (Cont'd)

Figure 60-80-24



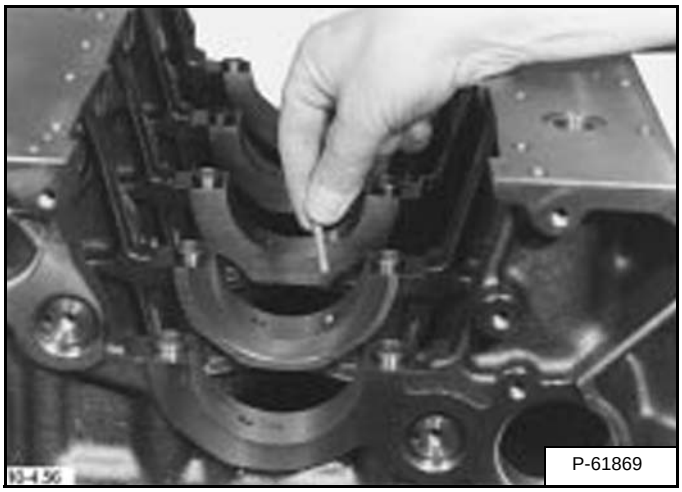
Remove the guide sleeve and control rod **[Figure 60-80-24]**.

Figure 60-80-25



Remove the tappets from the engine block **[Figure 60-80-25]**.

Figure 60-80-26



Remove the oil spray nozzles **[Figure 60-80-26]**.

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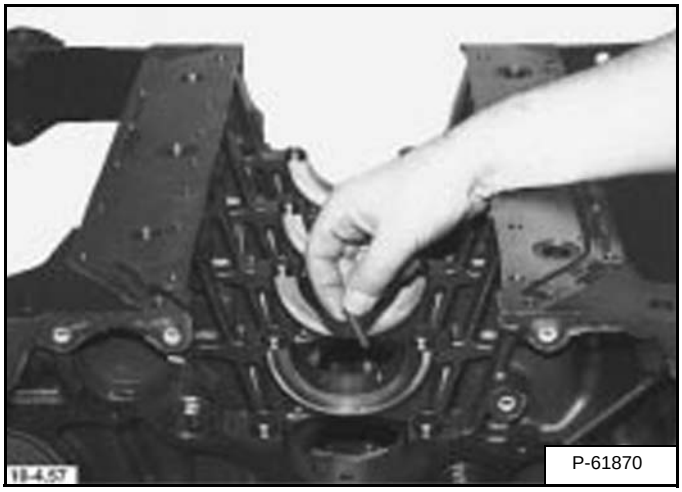
Assembly

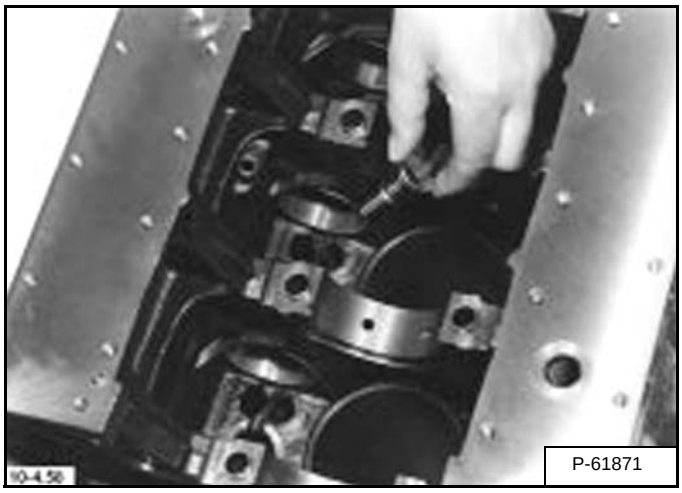
Figure 60-80-27



Install the oil spray nozzles **[Figure 60-80-27]**.

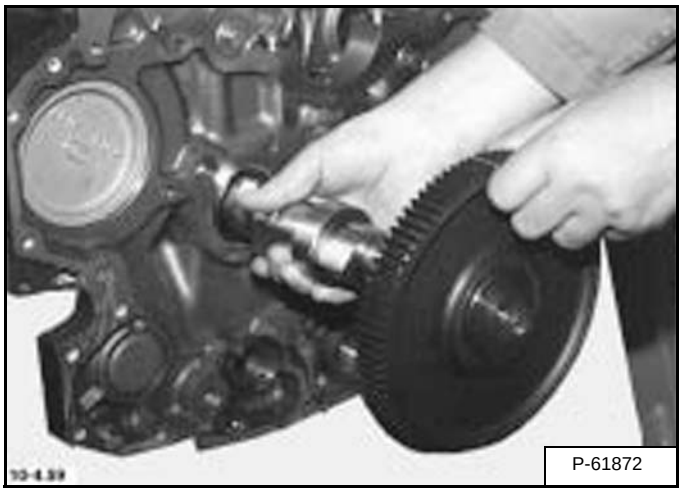
NOTE: Check the oil parts for obstructions.

Figure 60-80-28



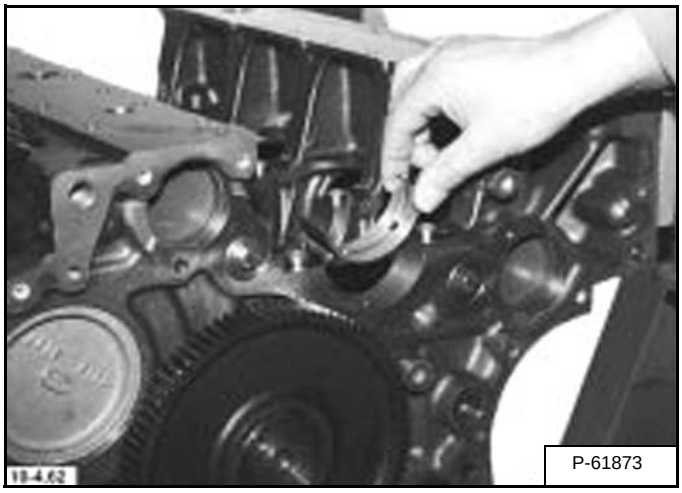
Install the tappets **[Figure 60-80-28]**.

Figure 60-80-29



Install the camshaft **[Figure 60-80-29]**.

Figure 60-80-30



Install the upper main bearing halves **[Figure 60-80-30]**.

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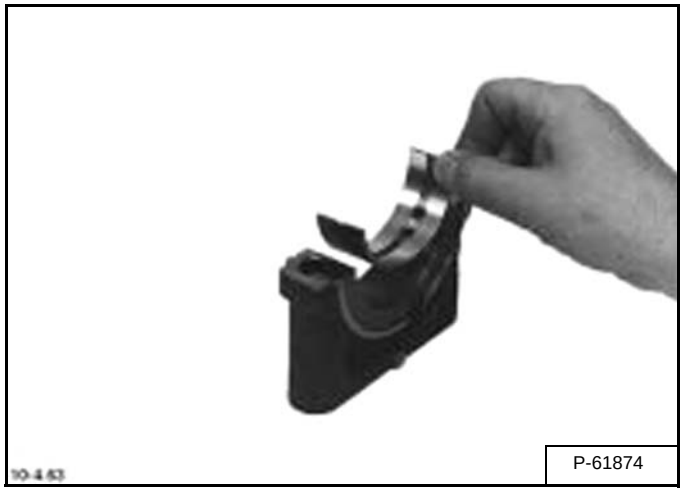
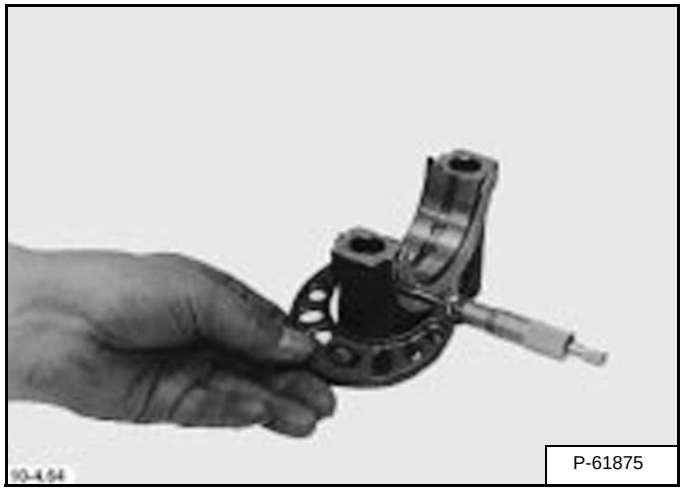
Assembly (Cont'd)

Figure 60-80-31



Install the other main bearing half into the main bearing caps **[Figure 60-80-31]**.

Figure 60-80-32



Install the thrust bearings halves on the main bearing cap **[Figure 60-80-32]**.

Measure the width of the thrust washers/main bearing cap **[Figure 60-80-32]**.

Figure 60-80-33

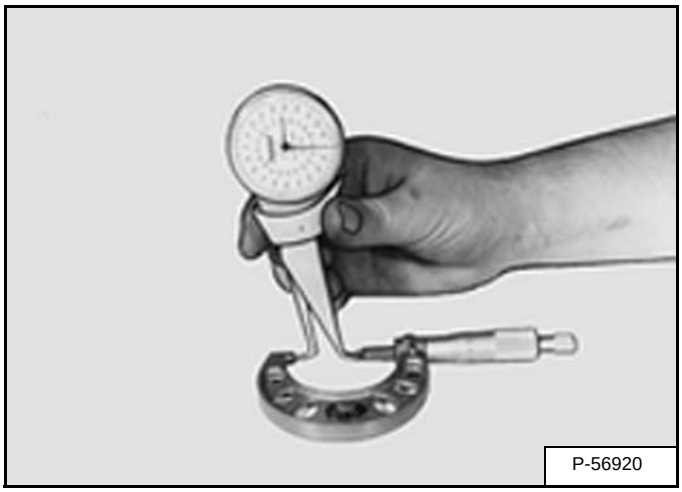
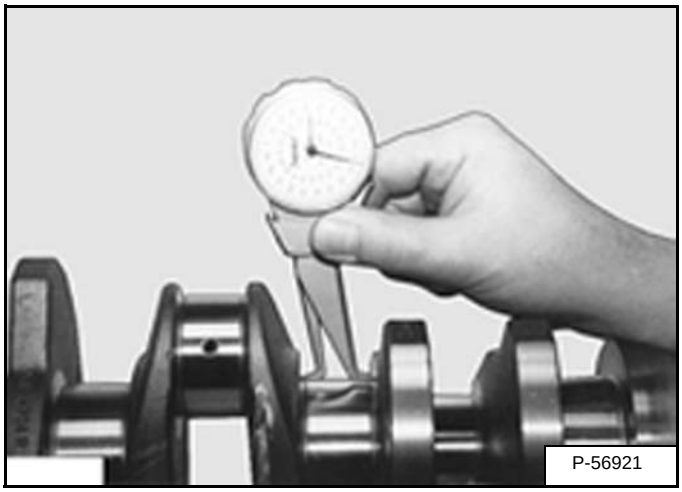


Figure 60-80-34



Measure the bearing journal width at the crankshaft **[Figure 60-80-33]** & **[Figure 60-80-34]**.

Specifications:
Journal Width Std. . . . . .1.417-1.419 inch. (36,0-36,04 mm)
Limit for O/S . . . . . 1.435 inch. (36,44 mm)

Determine the end play for the crankshaft.

Specifications:
Std. End Play. . . . . .0.004-0.012 inch. (0,10-0,30 mm)
Use new thrust washers as needed to get the correct end play.

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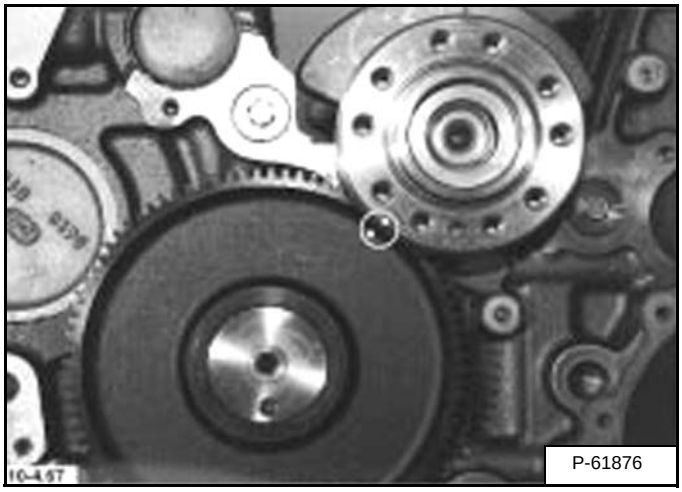
Assembly (Cont'd)

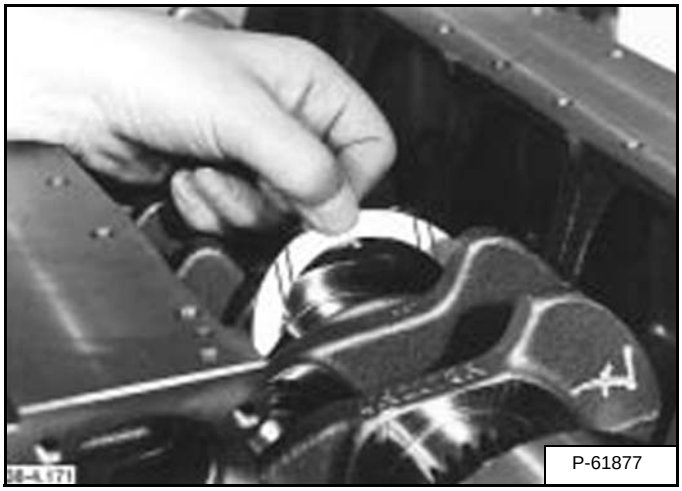
Figure 60-80-35



Install the crankshaft into the engine block **[Figure 60-80-35]**.

NOTE: Align the marks on the crankshaft and camshaft.

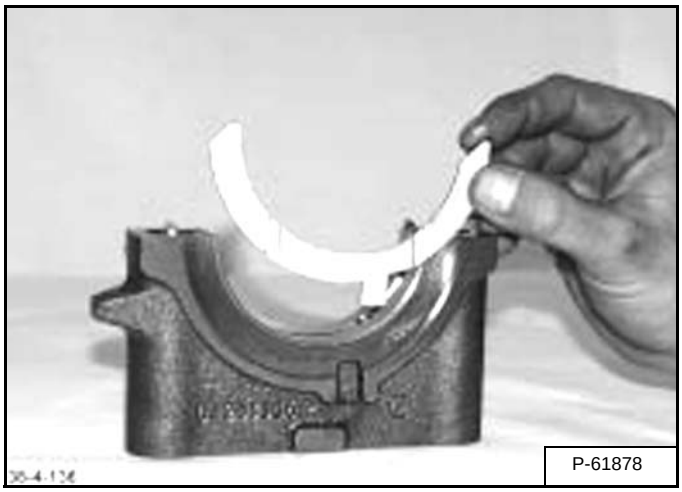
Figure 60-80-36



Lubricate the thrust washer (without tab) with grease and install them on the main bearing cap **[Figure 60-80-36]**.

NOTE: The wear surface of the thrust washer must face the crank web.

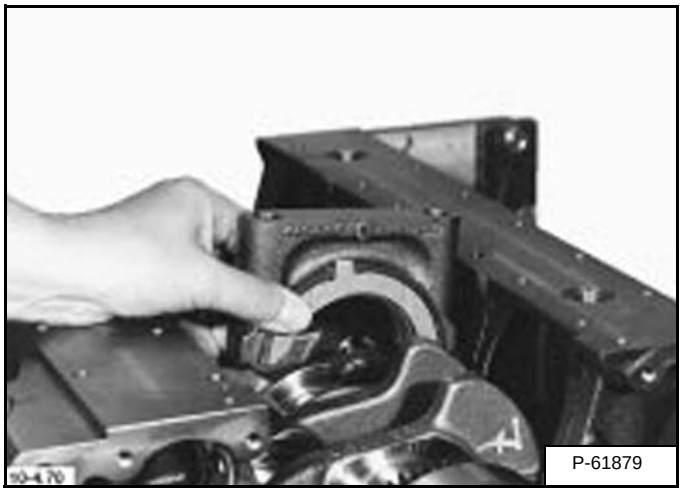
Figure 60-80-37



Lubricate the thrust washer (with tab) with grease and install them on the main bearing cap **[Figure 60-80-37]**.

NOTE: The wear surface of the thrust washer must face the crank web.

Figure 60-80-38



Install the main bearing/thrust washer assembly **[Figure 60-80-38]**.

NOTE: The main bearing cap No. 1, at the flywheel end, the chamfer must be towards the flywheel end.

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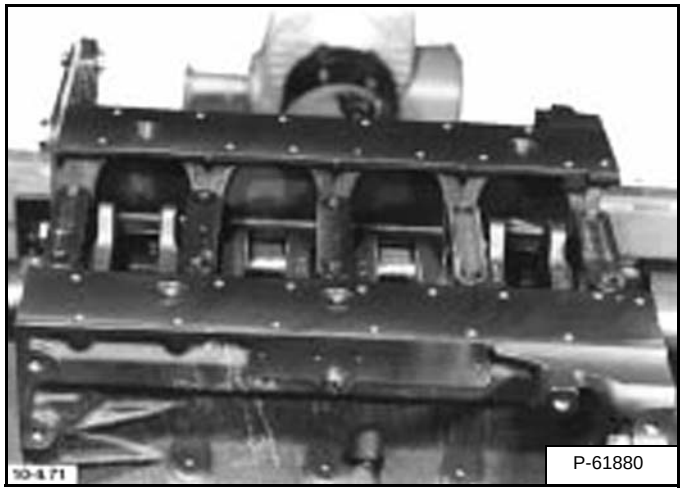
Assembly (Cont'd)

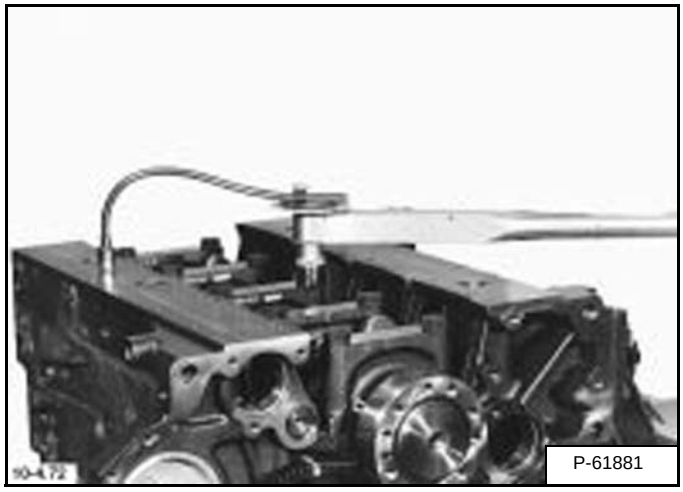
Figure 60-80-39



Install the main bearing caps/main bearing assembly **[Figure 60-80-39]**.

Install the caps in the original locations.

Figure 60-80-40

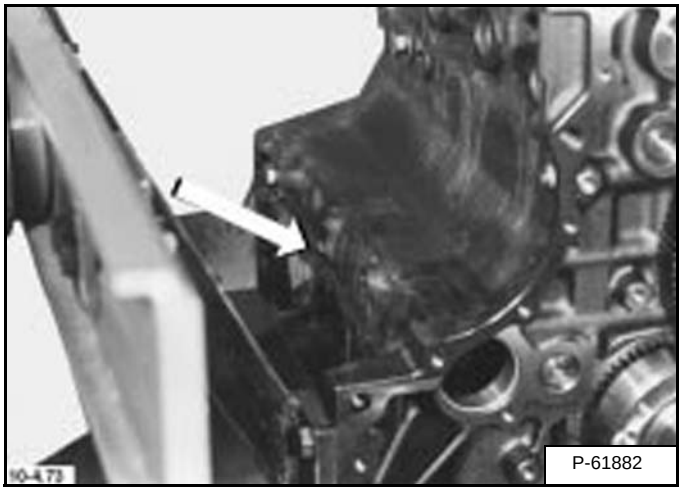


Tighten the main bearing cap bolts as follows **[Figure 60-80-40]**:

Initial Torque . . . . . 22 ft.-lb. (30 N•m)
1st Step Angle . . . . . 60°
2nd Step Angle . . . . . 60°

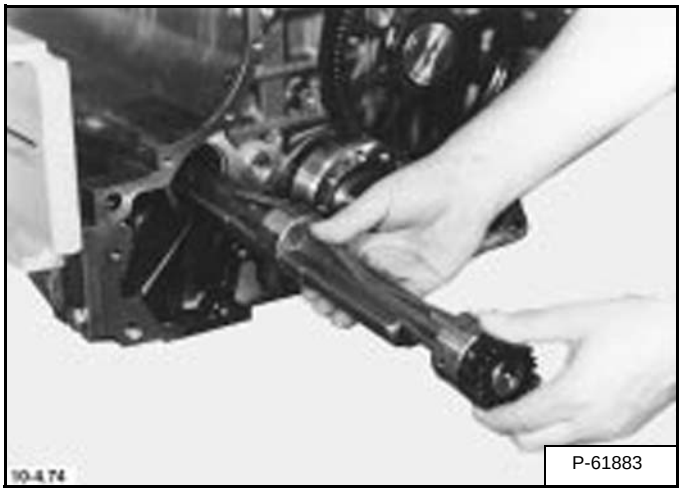
If the engine is equipped with balancing shafts use Figure 60-80-41 through Figure 60-80-63.

Figure 60-80-41



Remove the plugs **[Figure 60-80-41]**.

Figure 60-80-42



Install the balancing shaft **[Figure 60-80-42]**.

NOTE: The weights must be positioned toward the oil pan sealing surface.

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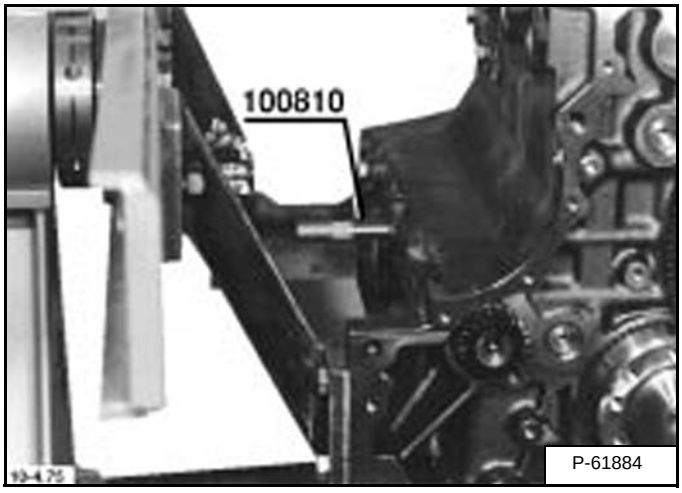
Assembly (Cont'd)

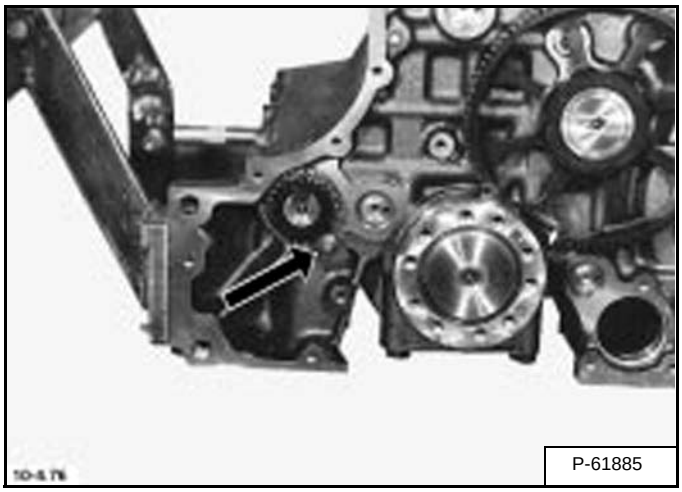
Figure 60-80-43



Turn the adjusting pin in as far as possible **[Figure 60-80-43]**.

NOTE: The bore of the balancing shaft must align with the crankcase bore.

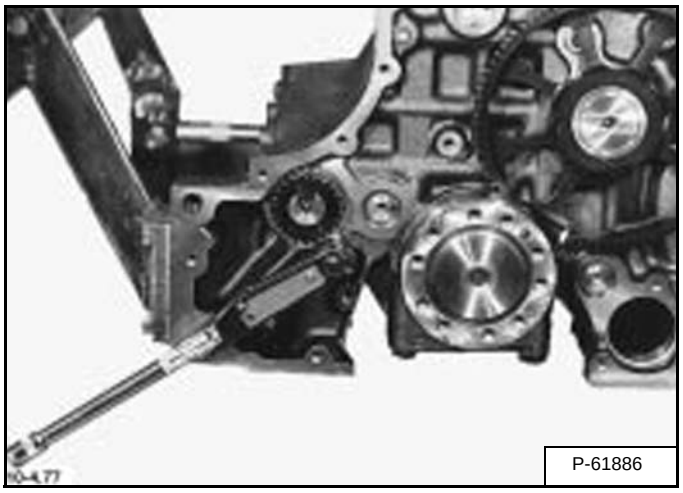
Figure 60-80-44



Install the thrust washer **[Figure 60-80-44]**.

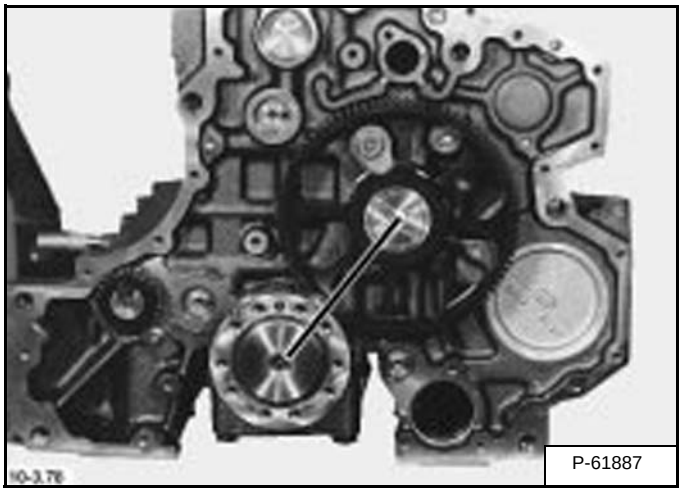
NOTE: Align the thrust washer with the shaft axis.

Figure 60-80-45



Tighten the bolt to 21 ft.-lb. (29 N•m) torque **[Figure 60-80-45]**.

Figure 60-80-46



Turn the crankshaft until the #1 cylinder is at TDC **[Figure 60-80-46]**.

NOTE: TDC is reached when the mark on the crankshaft aligns with the centerline of the crankshaft and camshaft [Figure 60-80-46].

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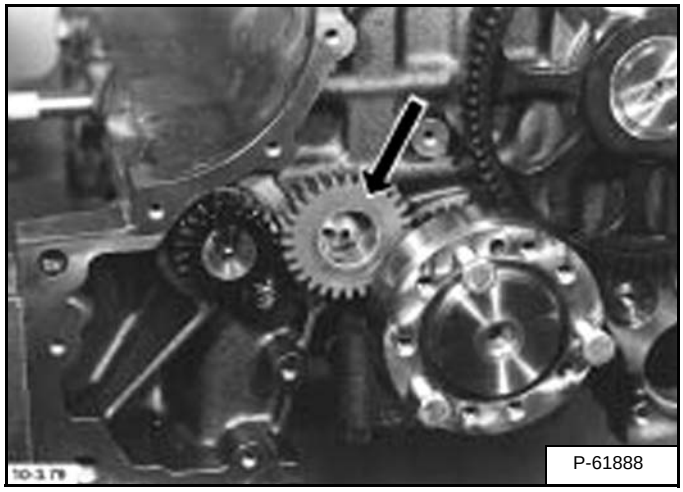
Assembly (Cont'd)

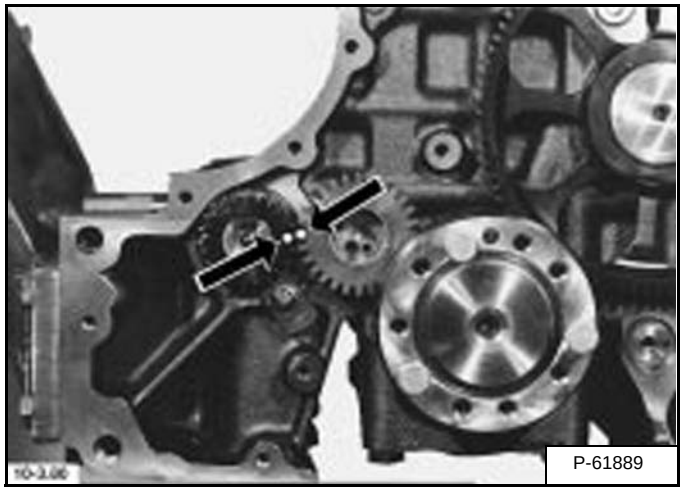
Figure 60-80-47



Install the idler gear **[Figure 60-80-47]**.

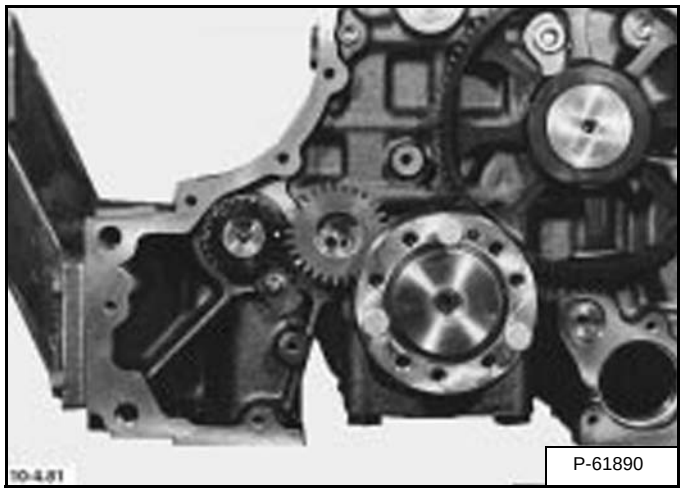
NOTE: The teeth on the idler gear must mesh with the teeth on the crankshaft gear.

Figure 60-80-48



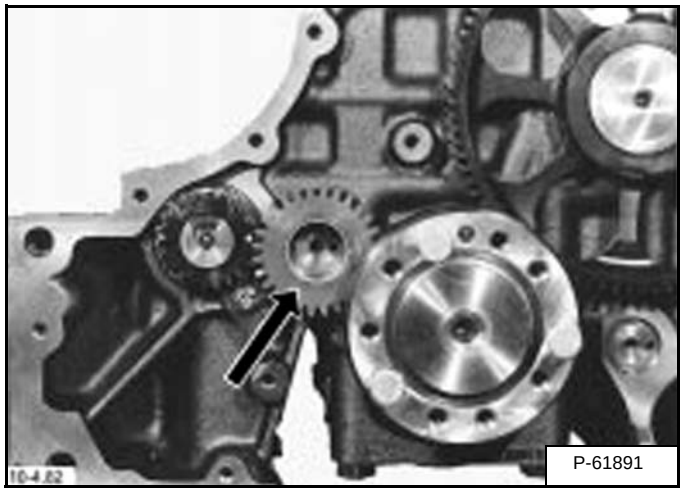
Mark the teeth on the idler gear and crankshaft gear **[Figure 60-80-48]**.

Figure 60-80-49



Turn the crankshaft clockwise until the crankshaft and idler gears have moved three teeth **[Figure 60-80-49]**.

Figure 60-80-50



Turn the crankshaft until the bores are in line **[Figure 60-80-50]**.

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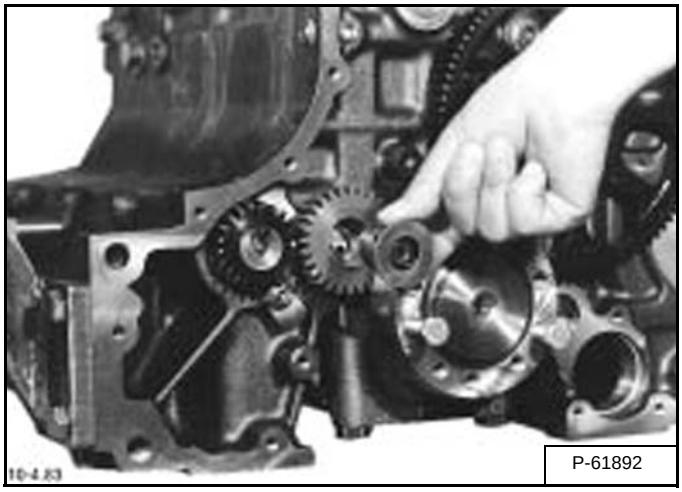
Assembly (Cont'd)

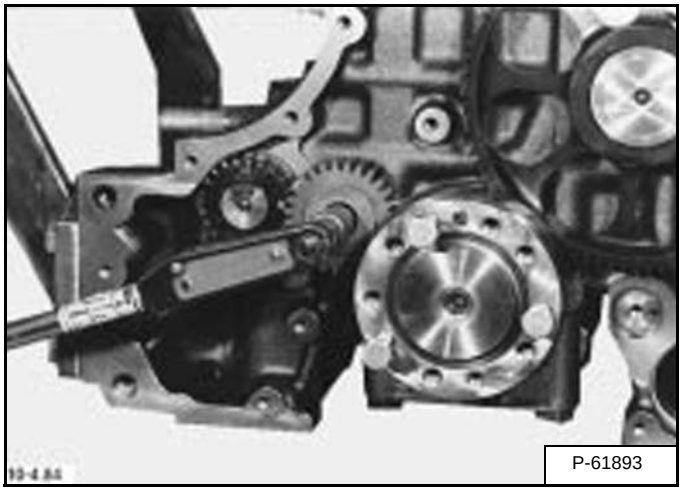
Figure 60-80-51



Install the bearing journal **[Figure 60-80-51]**.

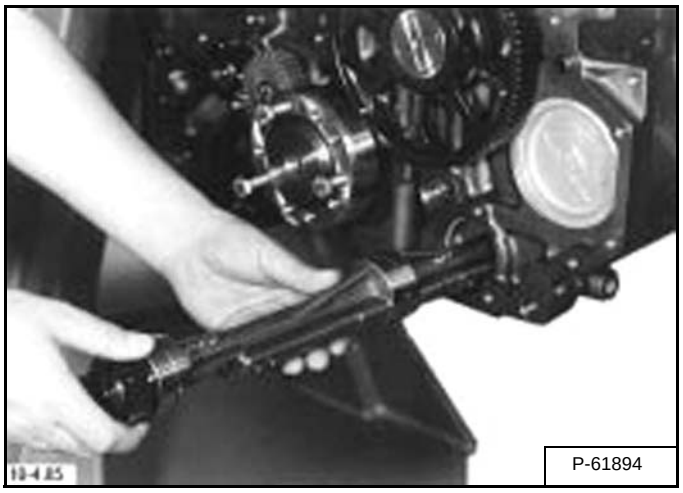
NOTE: Turn the crankshaft in both directions to align the bearing journal in the bore.

Figure 60-80-52



Install and tighten the bolt to 21 ft.-lb. (29 N•m) torque **[Figure 60-80-52]**.

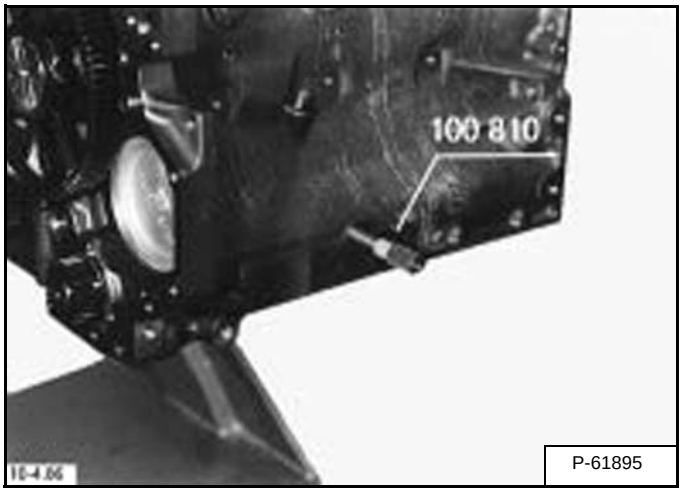
Figure 60-80-53



Install the second balancing shaft **[Figure 60-80-53]**.

NOTE: Install the weights toward the oil pan sealing surface.

Figure 60-80-54



Turn the adjusting pin in as far as possible **[Figure 60-80-54]**.

NOTE: Align the balancing shaft with the crankcase bore.

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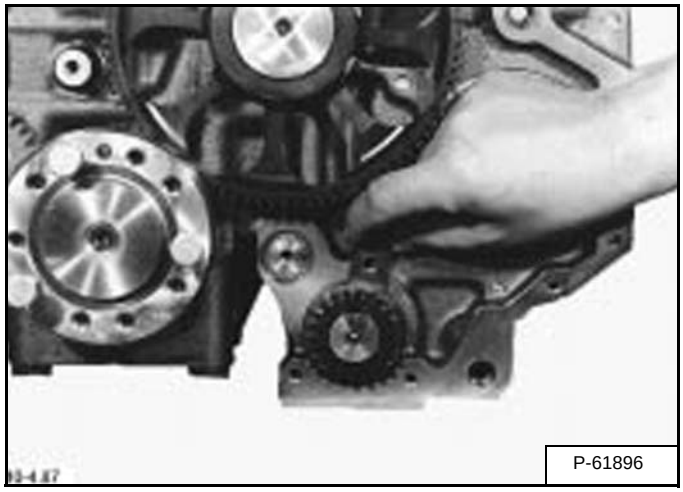
Assembly (Cont'd)

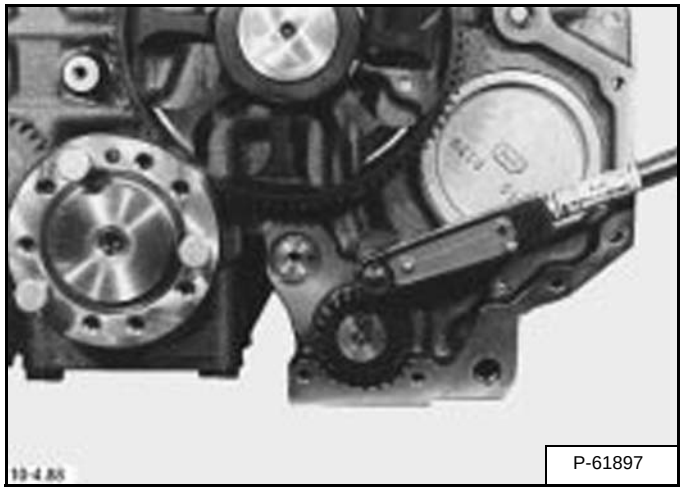
Figure 60-80-55



Install the thrust washer **[Figure 60-80-55]**.

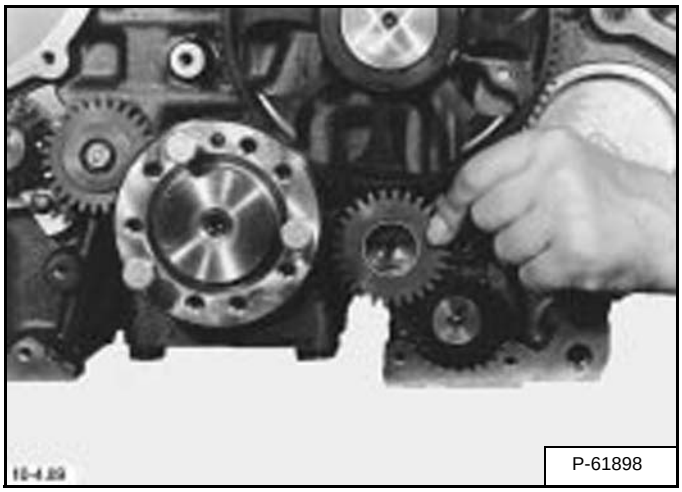
NOTE: Align the thrust washer with the axis of the shaft.

Figure 60-80-56



Tighten the bolt to 21ft.-lb. (29 N•m) torque **[Figure 60-80-56]**.

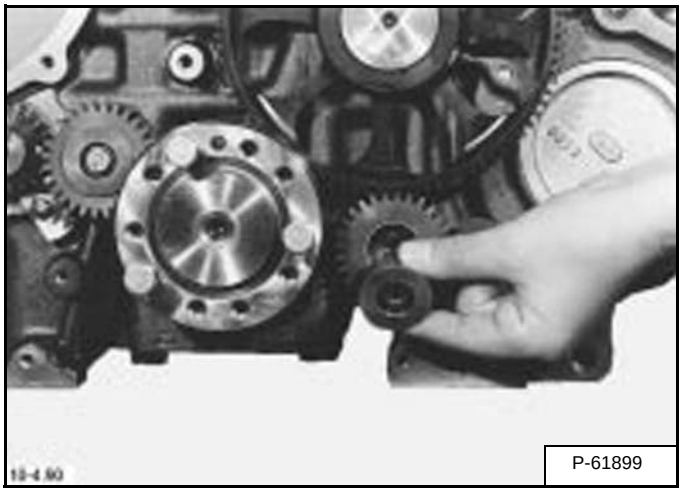
Figure 60-80-57



Install the idler gear **[Figure 60-80-57]**.

NOTE: The bores must align.

Figure 60-80-58



Install the bearing journal **[Figure 60-80-58]**.

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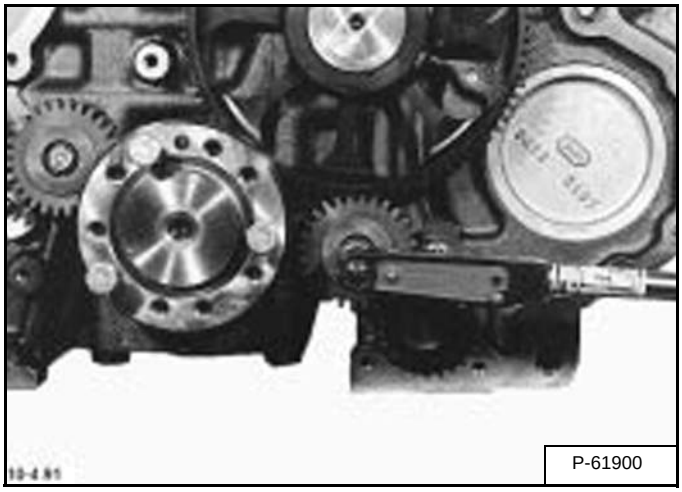
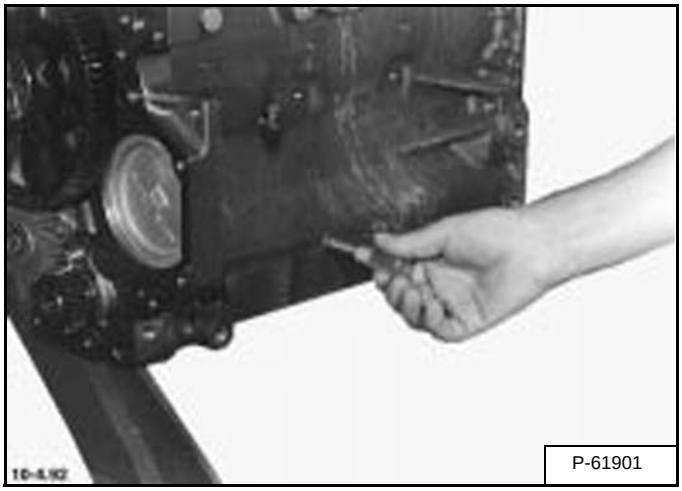
Assembly (Cont'd)

Figure 60-80-59



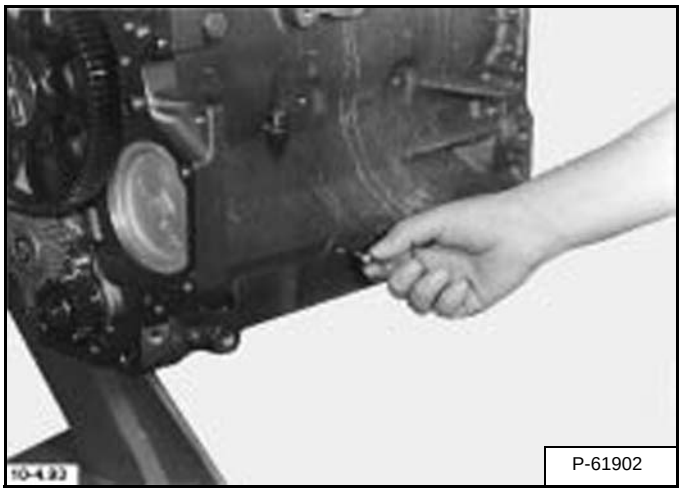
Install and tighten the bolt to 21 ft.-lb. (29 N•m) torque **[Figure 60-80-59]**.

Figure 60-80-60



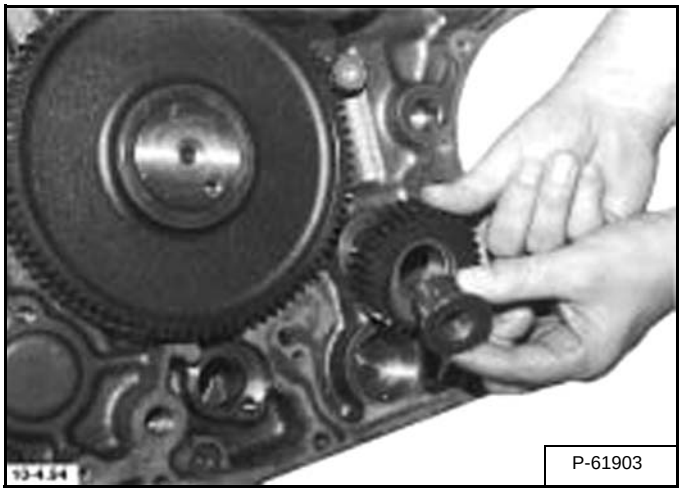
Remove both adjusting pins **[Figure 60-80-60]**.

Figure 60-80-61



Install a seal in the bore (both sides) **[Figure 60-80-61]**.

Figure 60-80-62



Install the governor drive gear in the bearing journal **[Figure 60-80-62]**.

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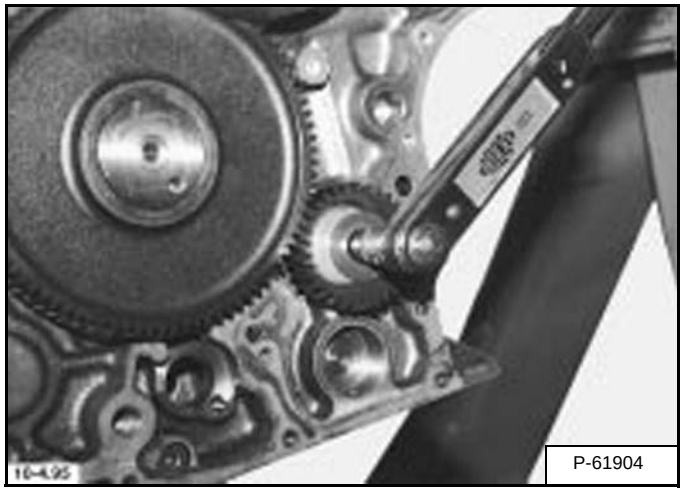
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

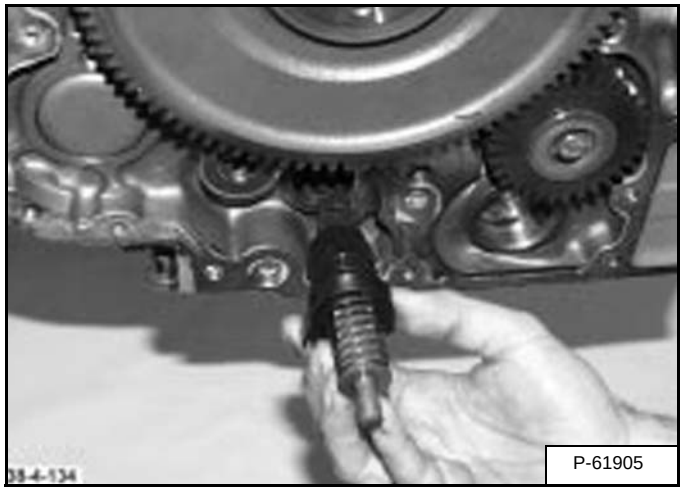
Assembly (Cont'd)

Figure 60-80-63



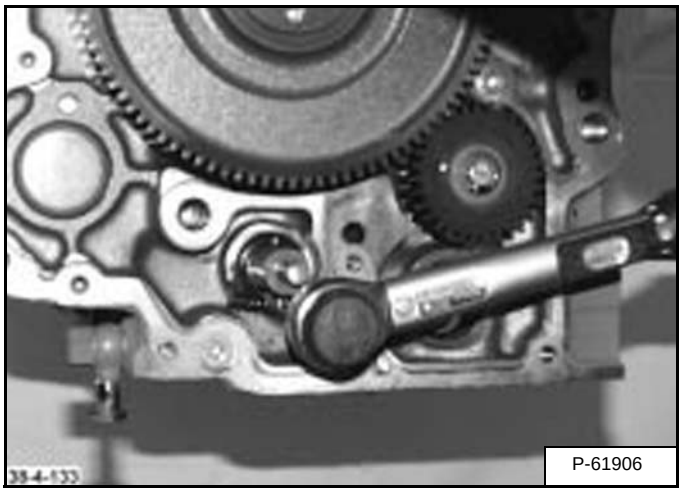
Install and tighten the bolt to 15 ft.-lb. (21 N•m) torque **[Figure 60-80-63]**.

Figure 60-80-64



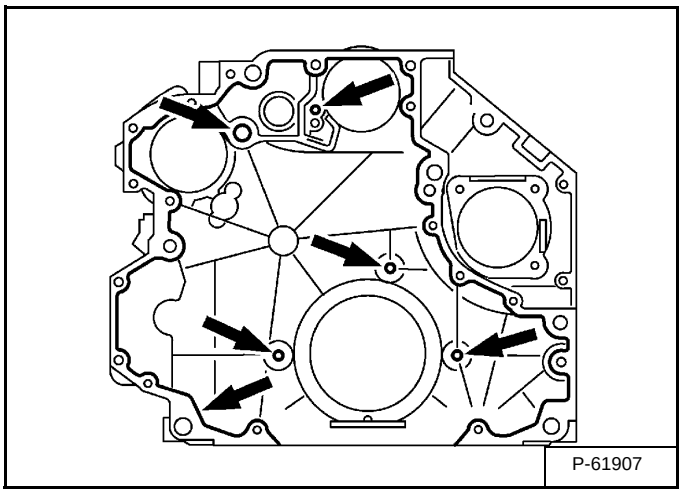
Install the control rod and guide sleeve **[Figure 60-80-64]**.

Figure 60-80-65



Apply thread lock adhesive to the bolt. Install and tighten the bolt to 7-9 ft.-lb. (10-12 N•m) torque **[Figure 60-80-65]**.

Figure 60-80-66



Put high temperature silicone sealing compound on the rear cover **[Figure 60-80-66]**.

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Assembly (Cont'd)

Figure 60-80-67

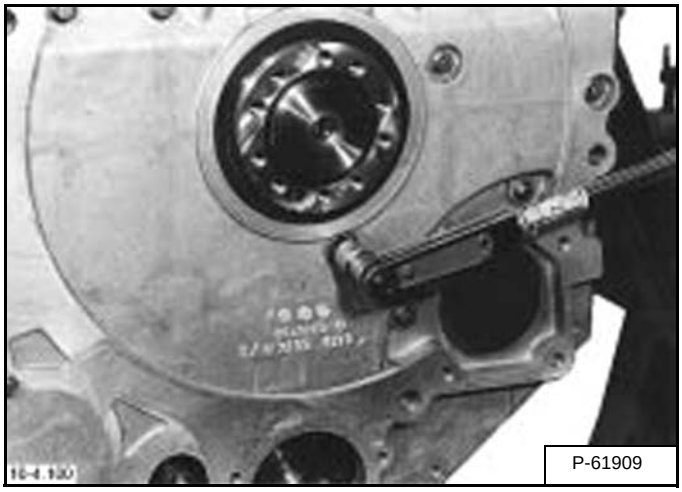
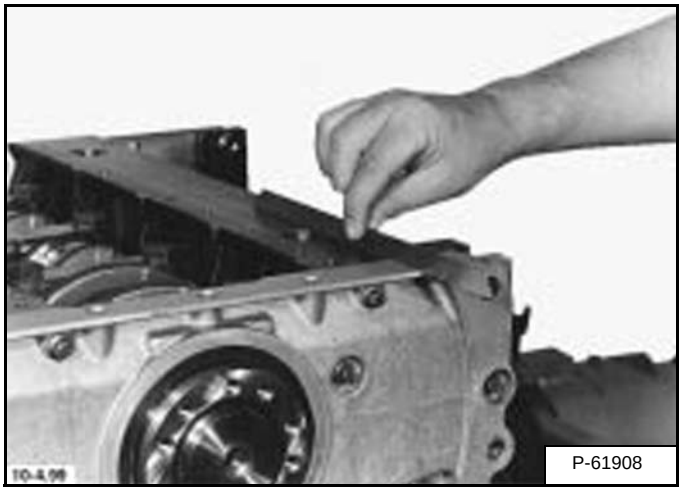


Figure 60-80-68

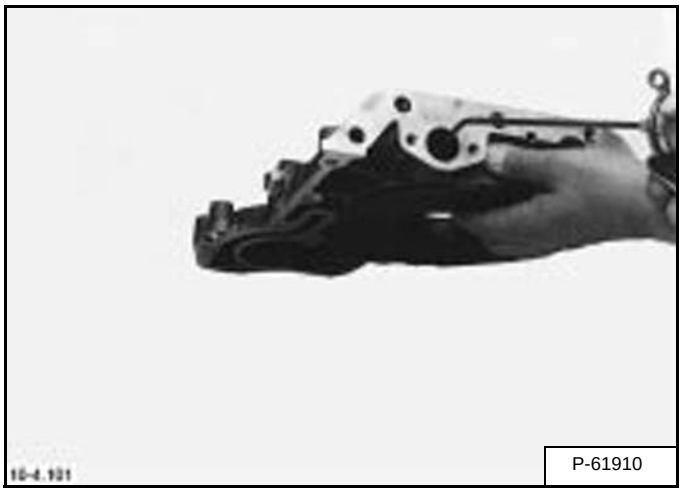


Install the rear cover complete with a new rear seal **[Figure 60-80-67]** and **[Figure 60-80-68]**.

NOTE: Make sure the rear cover oil pan surface aligns with the engine block surface [Figure 60-80-68].

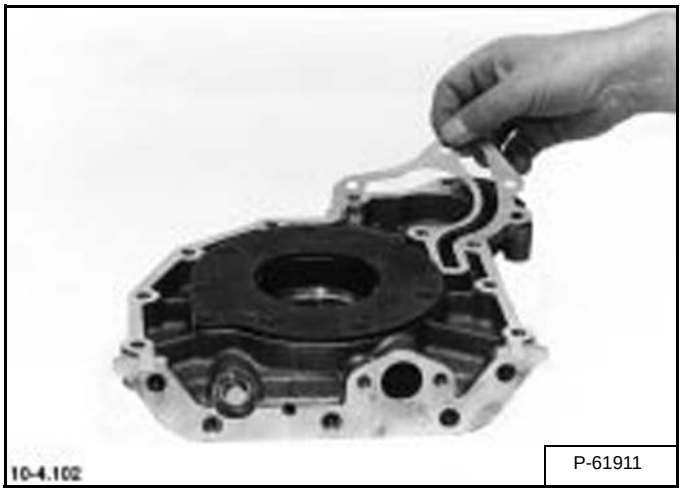
Install and tighten the bolts to 14-17 ft.-lb. (21-23 N•m) torque.

Figure 60-80-69



Lightly oil the rotors on the front cover **[Figure 60-80-69]**.

Figure 60-80-70



Use the grease to install the gasket on the front cover **[Figure 60-80-70]**.

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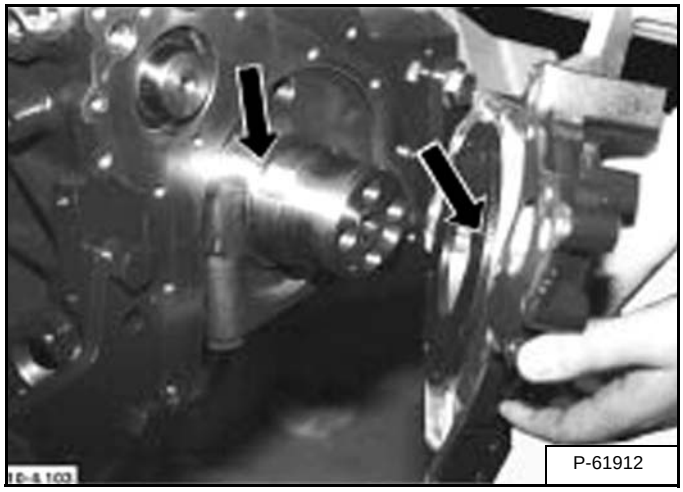
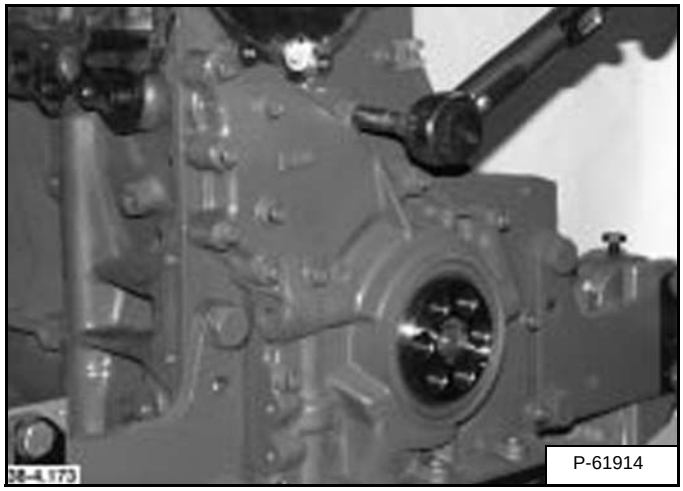
Assembly (Cont'd)

Figure 60-80-71



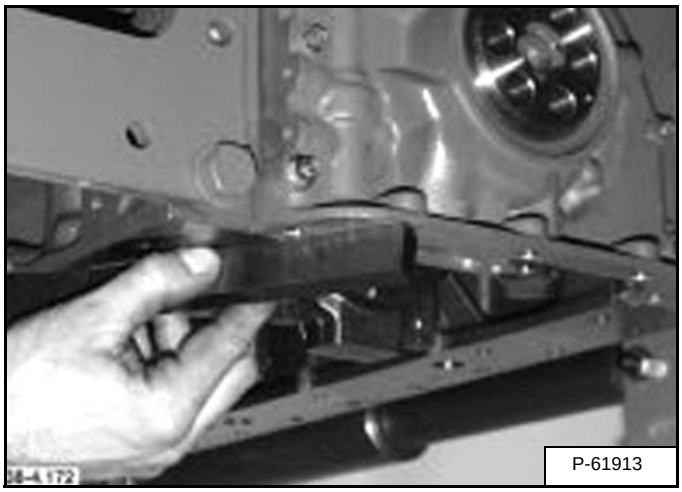
Align the rotor on the crankshaft **[Figure 60-80-71]**.

Figure 60-80-72



Install the front cover **[Figure 60-80-72]**.

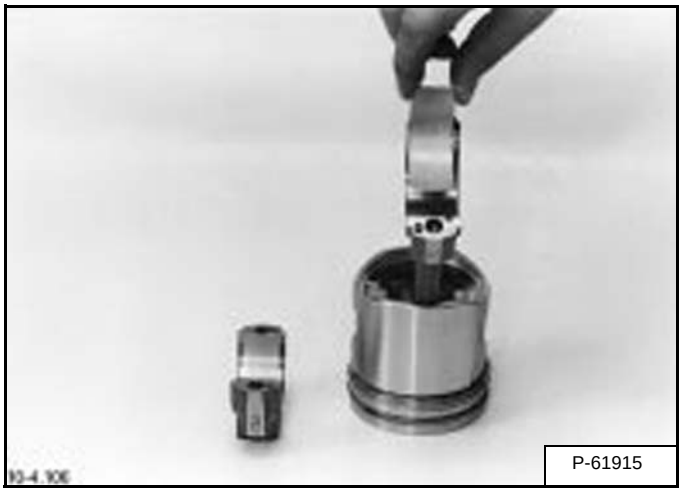
Figure 60-80-73



NOTE: Make sure the front cover oil pan surface aligns with the engine block surface [Figure 60-80-73].

Install and tighten the bolts to 14-17 ft.-lb. (19-23 N•m) torque.

Figure 60-80-74



Install the connecting rod bearing halves into the connecting rod **[Figure 60-80-74]**.

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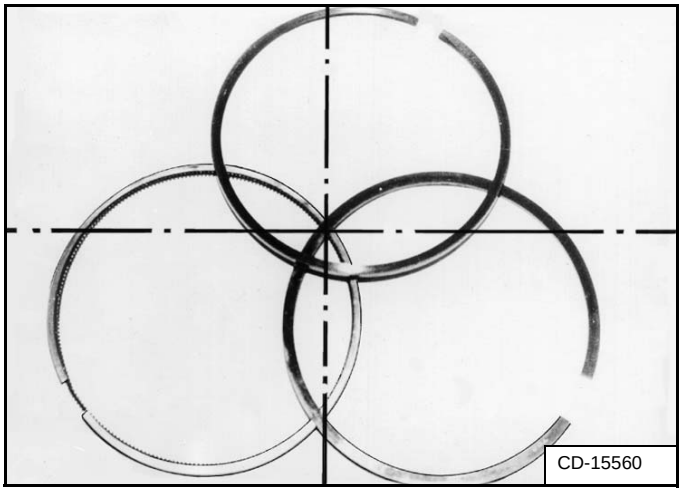
Assembly (Cont'd)

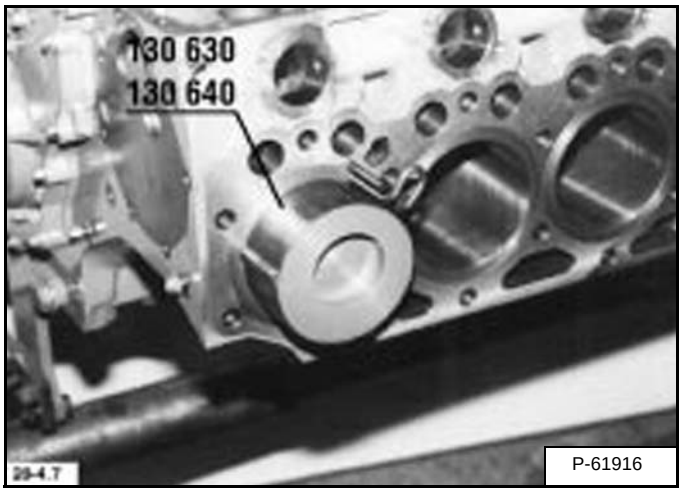
Figure 60-80-75



Before installing piston/connecting rod assembly, make sure the piston ring gaps are staggered as shown in **[Figure 60-80-75]**.

Install a piston ring compressor on the piston rings.

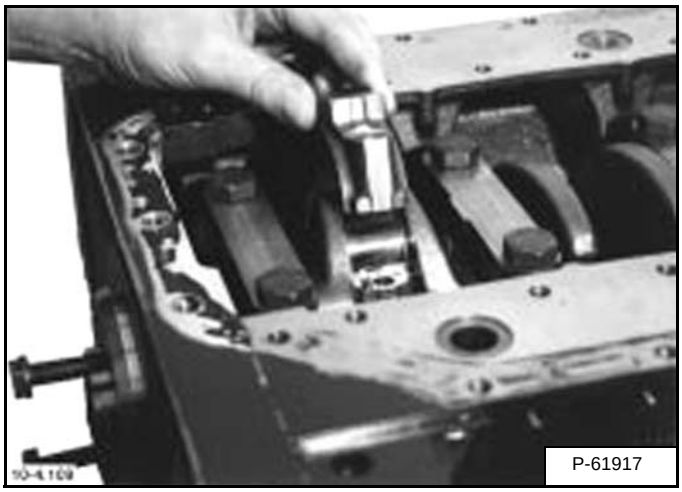
Figure 60-80-76



Install the piston/connecting rod assembly in the engine block **[Figure 60-80-76]**.

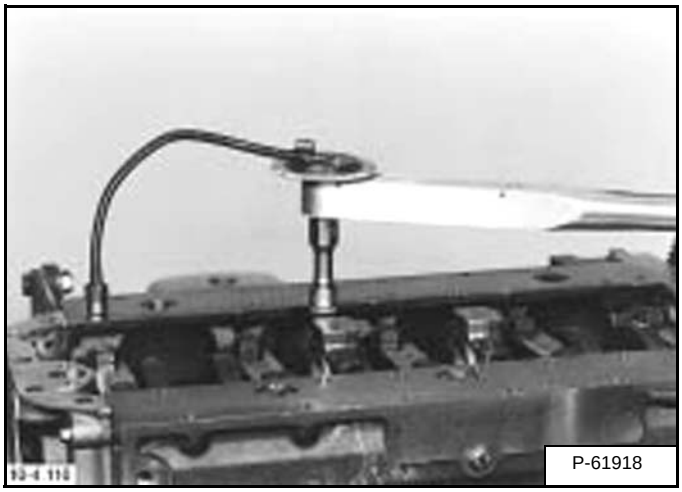
NOTE: The flywheel symbol on the piston must be toward the flywheel.

Figure 60-80-77



Install the connecting rod cap on the connecting rod. The ends of rod caps must be aligned **[Figure 60-80-77]**.

Figure 60-80-78



Tighten the connecting rod bolts as follows **[Figure 60-80-78]**:

Initial Torque . . . . . 22 ft.-lb. (30 N•m)
1st Step Angle . . . . . .60°
2nd Step Angle . . . . . .30°

NOTE: If the connecting rod bolts are still serviceable, do not reuse the bolts more than five times.

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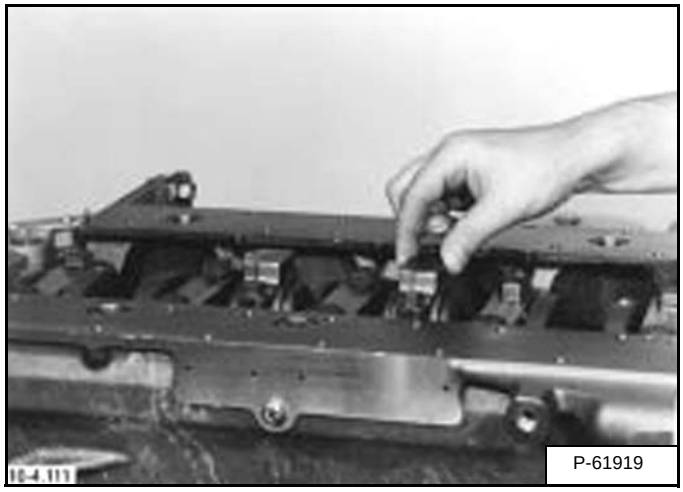
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

Assembly (Cont'd)

Figure 60-80-79

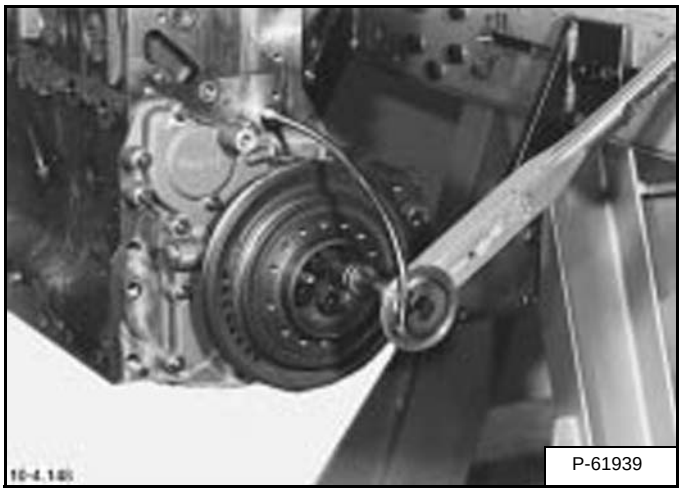


Check that the connecting rods can be easily moved back and forth on the crank pin **[Figure 60-80-79]**.

Install the flywheel. (See Removal And Installation on Page 60-70-1.)

Install the injection pump. (See Fuel Injection Pump Installation on Page 60-50-15.)

Figure 60-80-80



Install the pulley and bolts **[Figure 60-80-80]**. Tighten the bolts as follows:

Initial torque . . . . . 29-37 ft.-lb. (40-50 N•m)

First tightening angle:
60 mm long bolts . . . . . 60°
80 mm long bolts . . . . . 60°

Second tightening angle:
60 mm long bolts . . . . . 30°
80 mm long bolts . . . . . 60°

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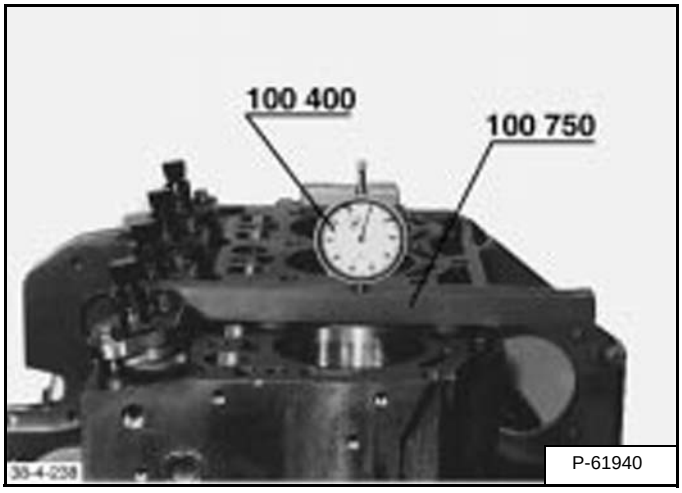
Assembly (Cont'd)

Figure 60-80-81

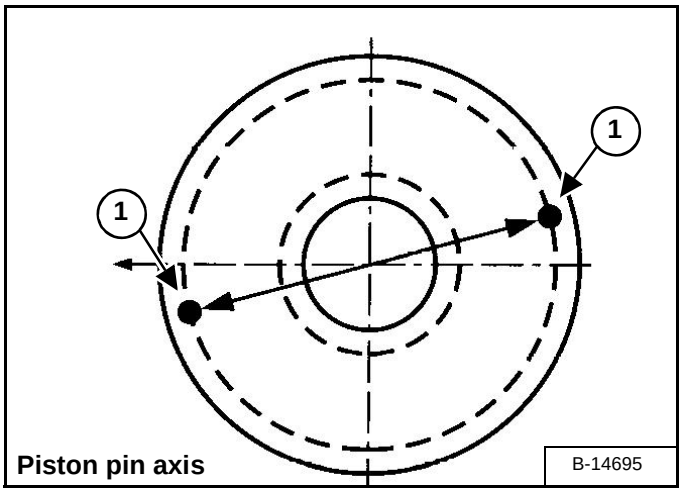


Put spacers on sealing surface of the engine block and set dial indicator gauge to 0 **[Figure 60-80-81]**. See "Deutz Engine Tools Identification Chart" on page 1.

Figure 60-80-82

Position the dial gauge on the piston **[Figure 60-80-82]**.

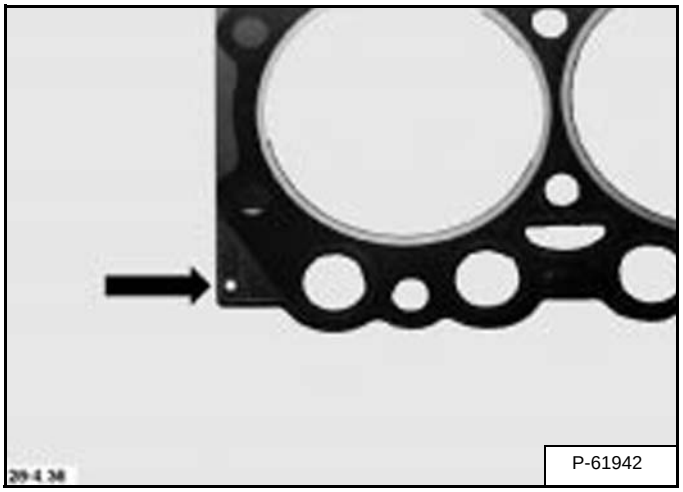
Figure 60-80-83



Measure at the gauge points (Item 1) **[Figure 60-80-83]**.

To determine maximum piston projection measure all the pistons.

Figure 60-80-84



Compare the measurements with the specifications to determine the correct cylinder head gasket **[Figure 60-80-84]**.

Specifications:

Piston Projection	**Marking of Cylinder Head Gasket**
0.017-0.025 inch. (0,43-0,64 mm)	1 hole
0.025-0.029 inch. (0,64-0,74 mm)	2 holes
0.029-0.033 inch. (0,77-0,85 mm)	3 holes

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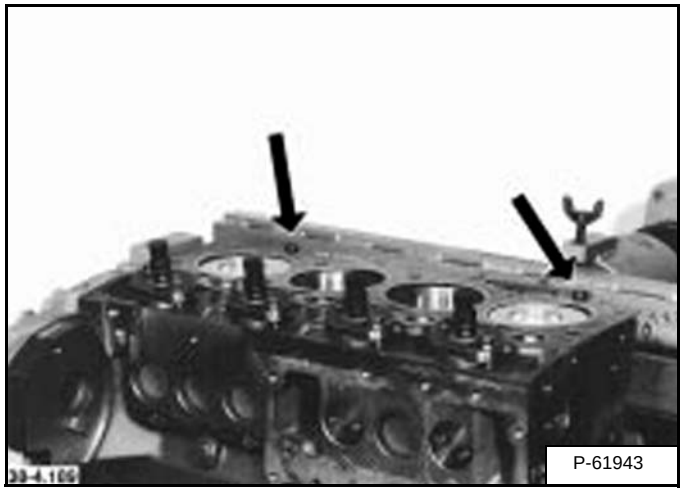
Assembly (Cont'd)

Figure 60-80-85



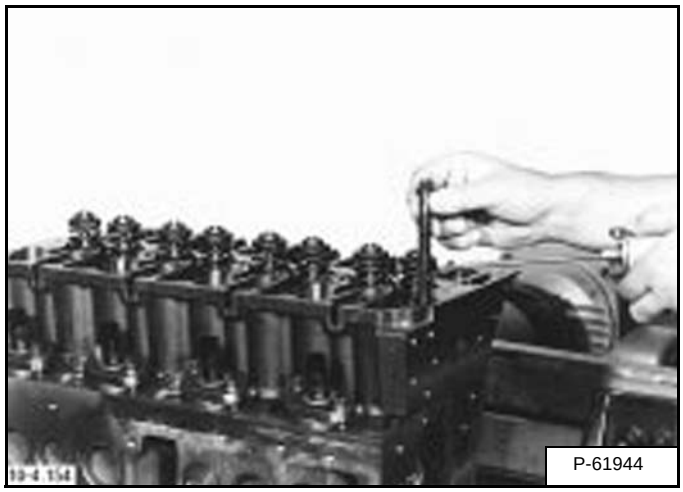
Install the cylinder head gasket over the dowel pins **[Figure 60-80-85]**.

The sealing surfaces of the cylinder head gasket must be free of oil.

Install the cylinder head.

Put a light coat of oil on the short cylinder head bolts.

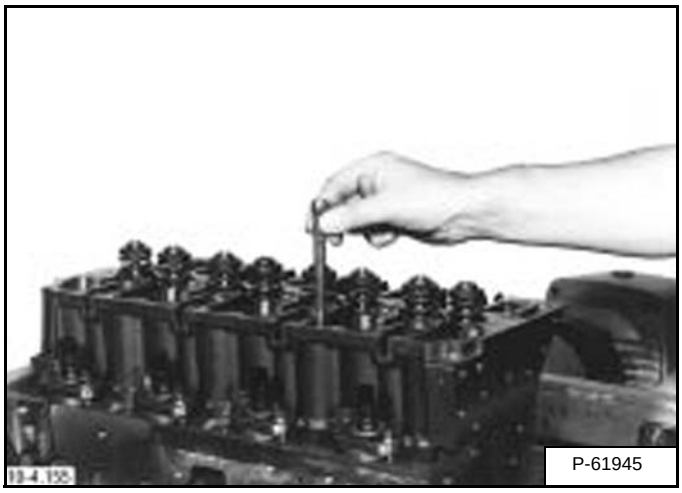
Figure 60-80-86



Install the short cylinder head bolts **[Figure 60-80-86]**.

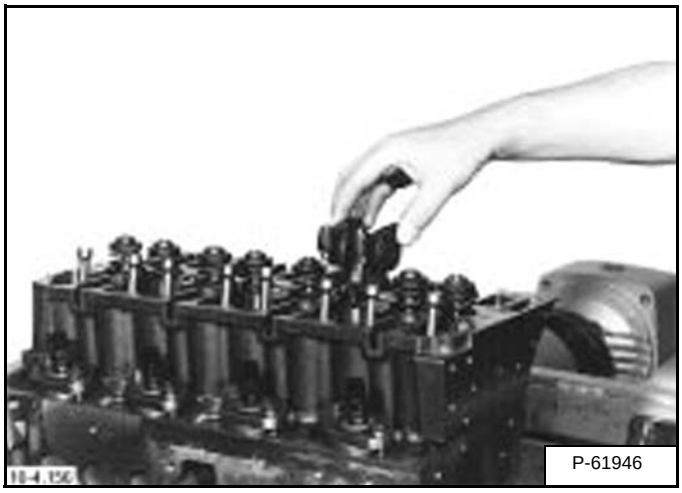
NOTE: Do not tighten the cylinder head bolts at this time.

Figure 60-80-87



Install the pushrods **[Figure 60-80-87]**.

Figure 60-80-88



Install the rocker arm bracket **[Figure 60-80-88]**.

NOTE: Align the rocker arm bracket with the pushrods and valves.

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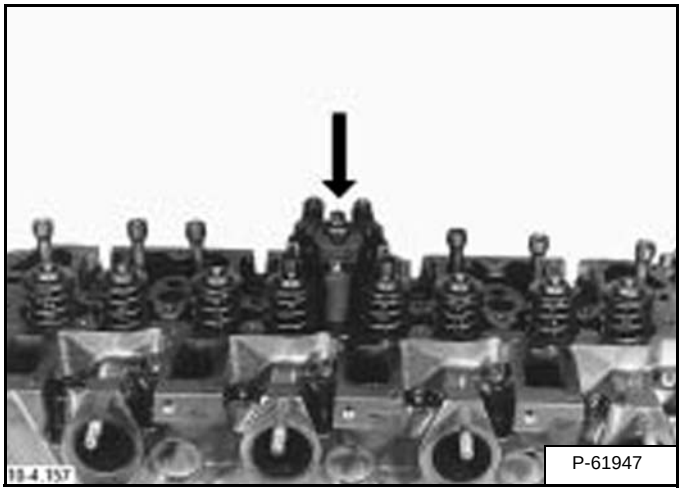
Assembly (Cont'd)

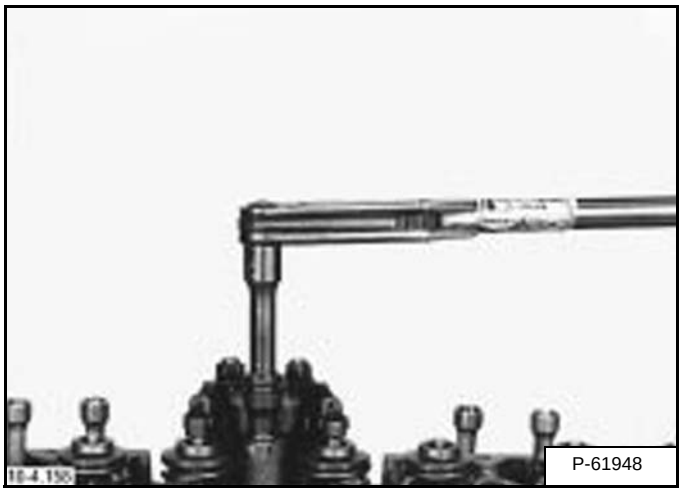
Put a light coat of oil on the long head bolts.

Figure 60-80-89



Install the long head bolts **[Figure 60-80-89]**.

Figure 60-80-90



Tighten the bolt to 15 ft.-lb. (21 N•m) torque **[Figure 60-80-90]**.

Figure 60-80-91

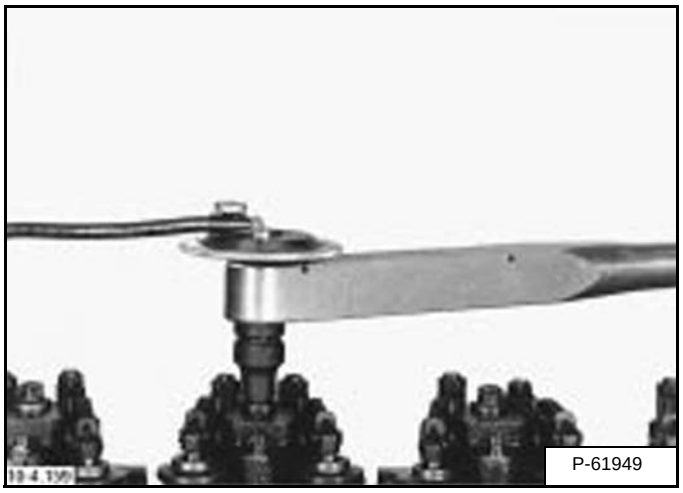
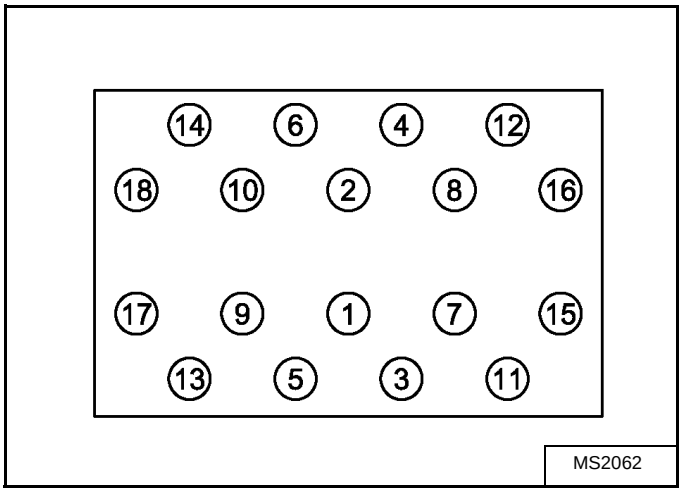


Figure 60-80-92



Tighten the cylinder head bolts in the correct sequence **[Figure 60-80-91]** and **[Figure 60-80-92]**.

1st Stage Torque . . . . . 22 ft.lbs. (30 N•m)
2nd Stage Torque . . . . . 59 ft.lbs. (80 N•m)
3rd Stage Torque . . . . . .90°

Adjust the valve clearance. (See Valve Clearance Adjustment on Page 60-50-23.)

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Assembly (Cont'd)

Install the glow plugs. (See Glow Plug Removal And Installation on Page 60-50-4.)

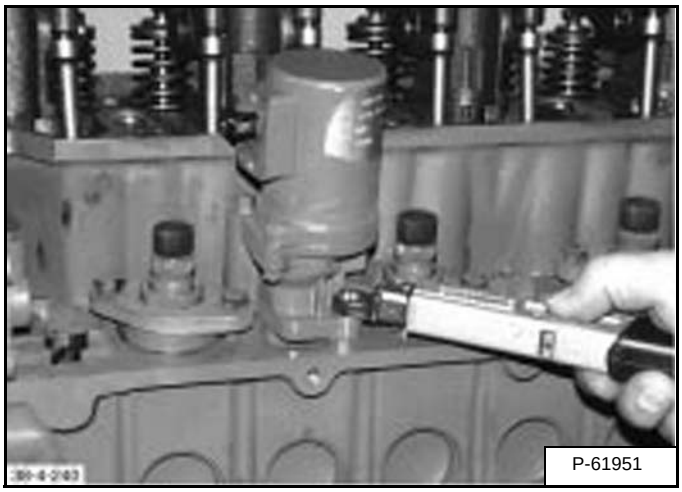
Lightly oil and install a new O-ring on the shutoff solenoid.

Press and hold the control rod in the stop position.

Figure 60-80-93

Install the shutoff solenoid **[Figure 60-80-93]**.

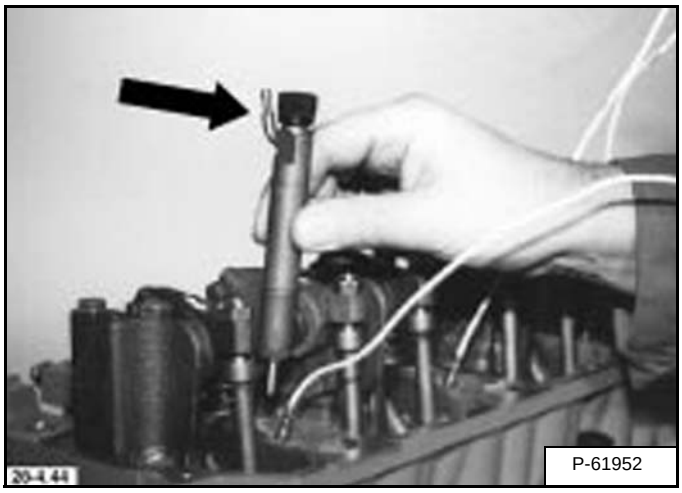
Figure 60-80-94



Install and tighten the bolts to 15 ft.-lb. (21 N•m) torque **[Figure 60-80-94]**.

Lightly grease and install a seal on the injectors.

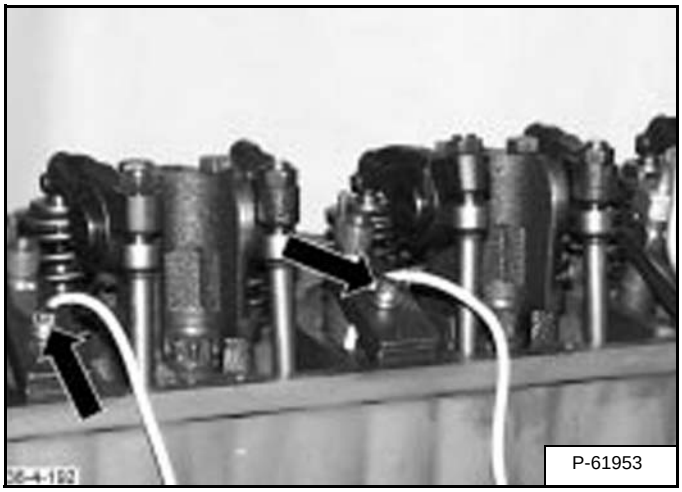
Figure 60-80-95



Install the injectors **[Figure 60-80-95]**.

NOTE: The return line fitting must face the exhaust side.

Figure 60-80-96



Install the clamps and start the bolts. Do not tighten the bolts at this time **[Figure 60-80-96]**.

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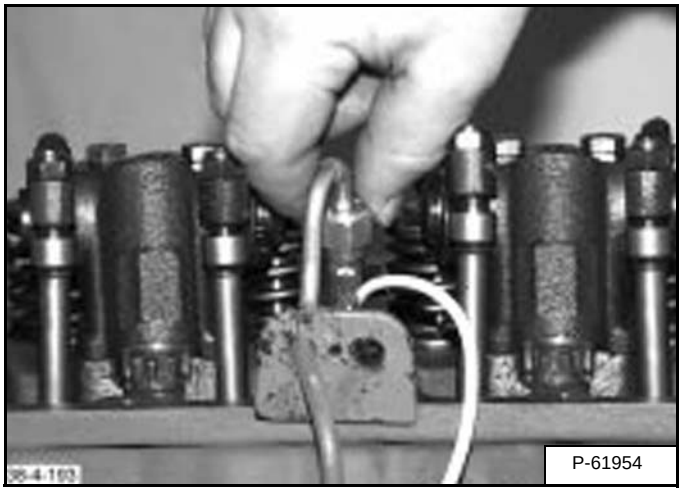
Assembly (Cont'd)

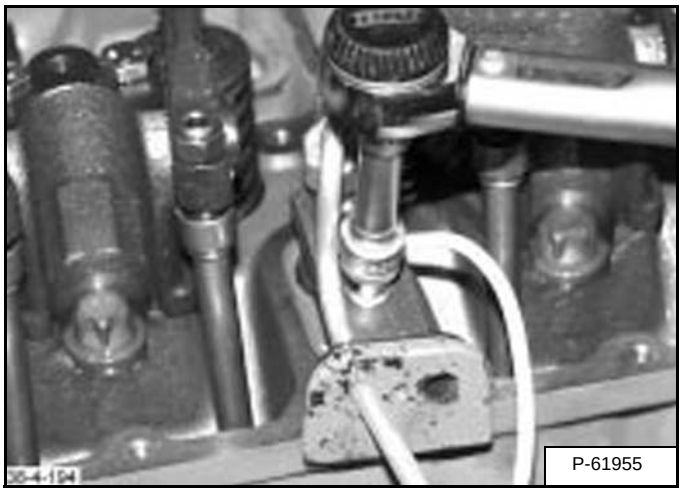
Figure 60-80-97



Install a new seal on the injector lines. Install lines and hand tighten **[Figure 60-80-97]**.

NOTE: Do not rebend the injector lines. Do not reuse the injector lines.

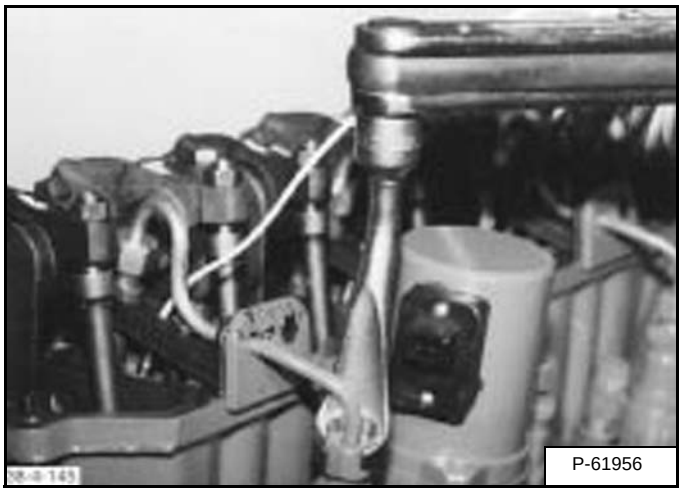
Figure 60-80-98



Tighten the injector clamp bolts to 12-15 ft.-lb. (16-21 N•m) torque **[Figure 60-80-98]**.

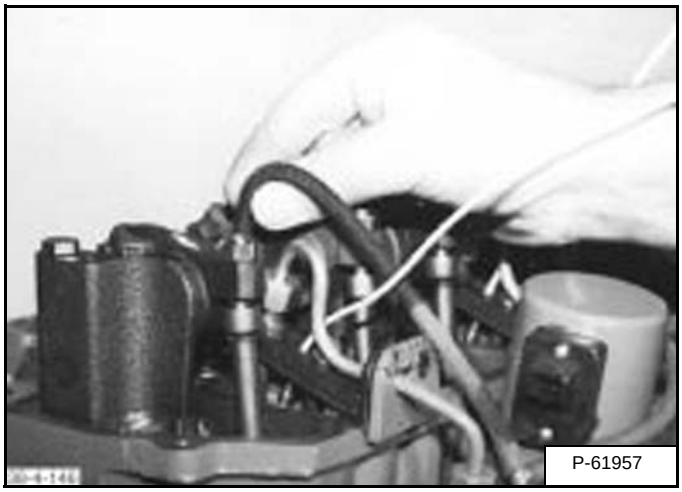
Preload the injector line cap nuts to 4 ft.-lb. (5 N•m) torque.

Figure 60-80-99



Tighten the cap nuts to 18-21 ft.-lb. (25-28,5 N•m) torque **[Figure 60-80-99]**.

Figure 60-80-100



Install the fuel return lines through the seal and on the injector **[Figure 60-80-100]**.

NOTE: Do not reuse the fuel return lines.

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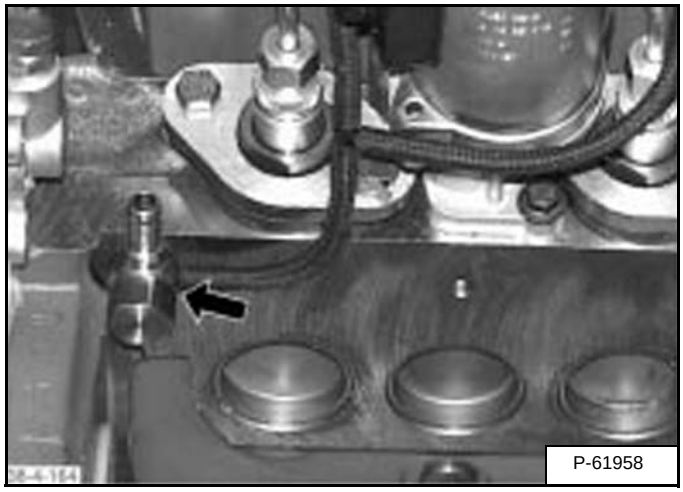
Assembly (Cont'd)

Figure 60-80-101



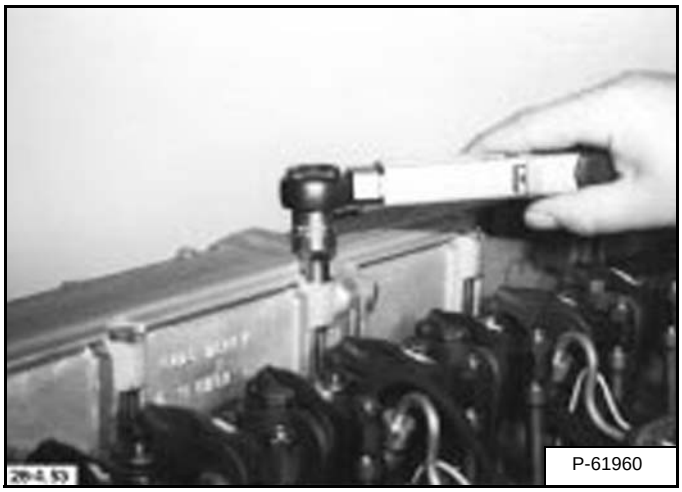
Install seals on the overflow valve. Install the overflow valve and install the fuel return line **[Figure 60-80-101]**.

Install new gaskets on the air intake manifold.

Figure 60-80-102

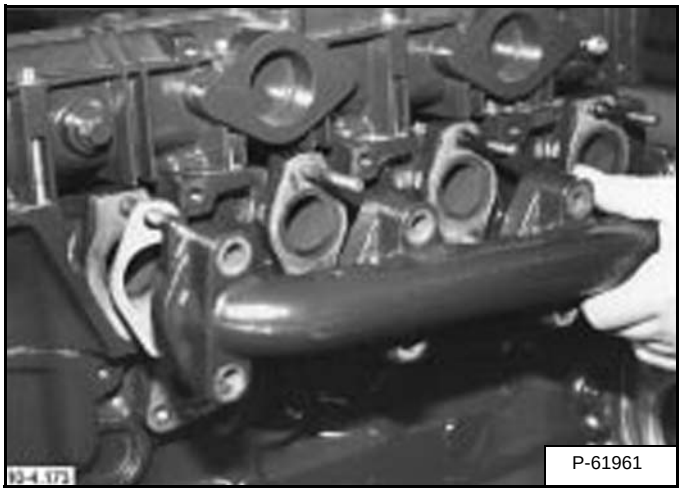
Install the air intake manifold **[Figure 60-80-102]**.

Figure 60-80-103



Install and tighten the bolts on the air intake manifold to 7-9 ft.-lb. (10-12 N•m) torque **[Figure 60-80-103]**.

Figure 60-80-104



Install a new exhaust manifold gasket. Install the exhaust manifold **[Figure 60-80-104]**.

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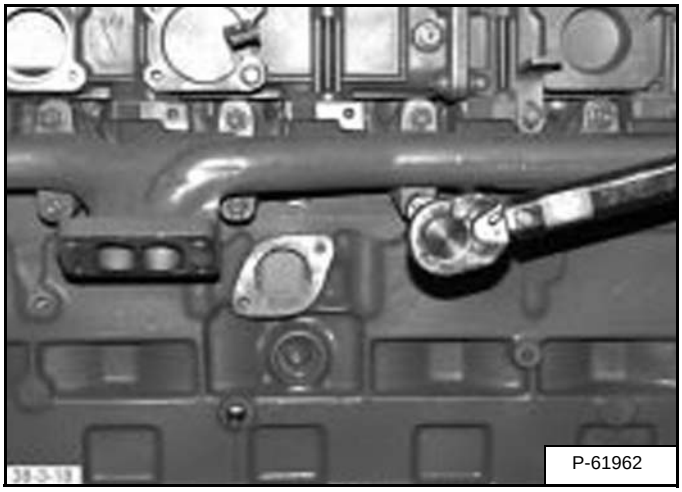
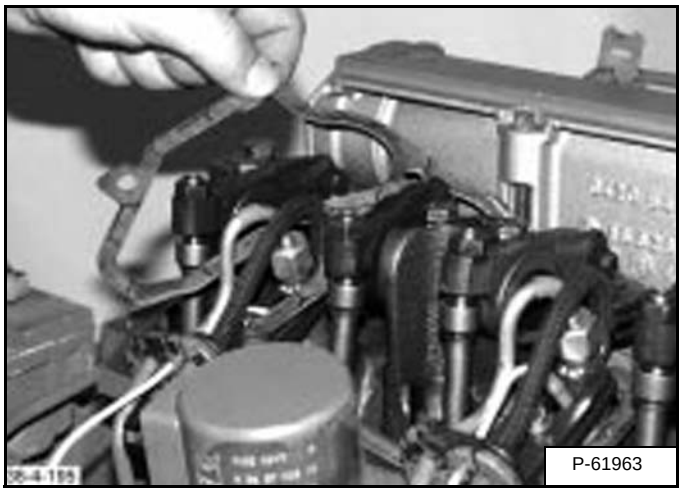
Assembly (Cont'd)

Figure 60-80-105



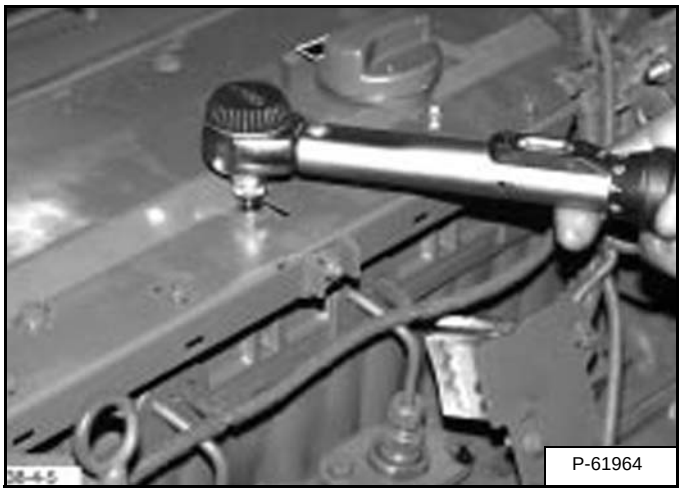
Apply anti-seize to the studs. Install the nuts on the exhaust manifold studs and tighten to 17-20 ft.-lb. (22,5-27,5 N•m) torque **[Figure 60-80-105]**.

Figure 60-80-106



Install the valve cover gasket **[Figure 60-80-106]**.

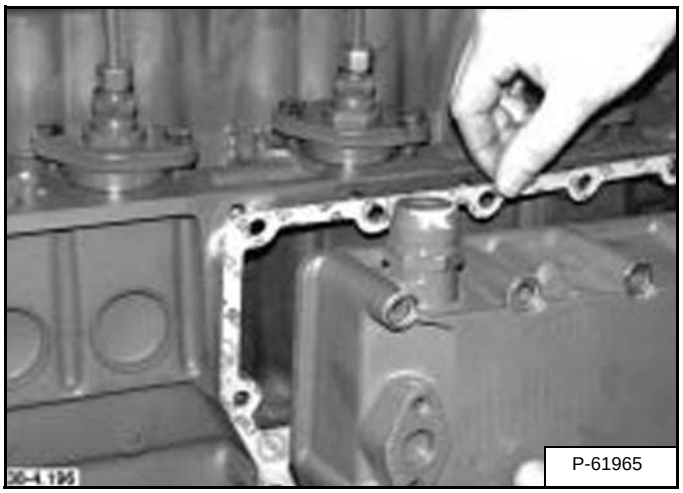
Figure 60-80-107



Install the valve cover **[Figure 60-80-107]**.

Tighten the bolts to 6-7 ft.-lb. (8-10 N•m) torque.

Figure 60-80-108



Install a new gasket on the oil cooler. Install the oil cooler **[Figure 60-80-108]**.

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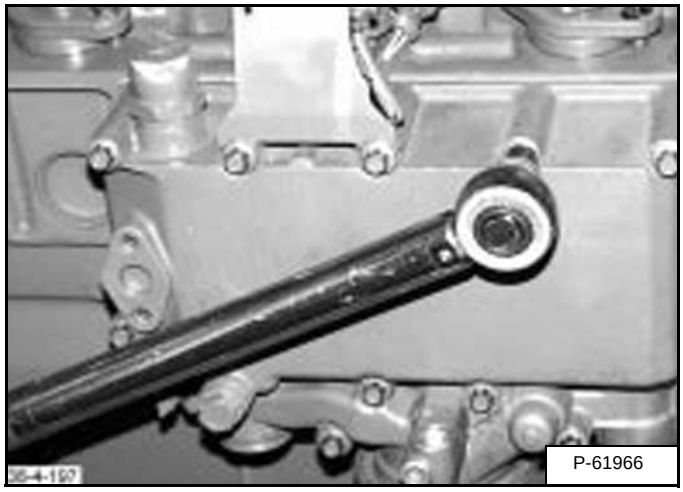
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

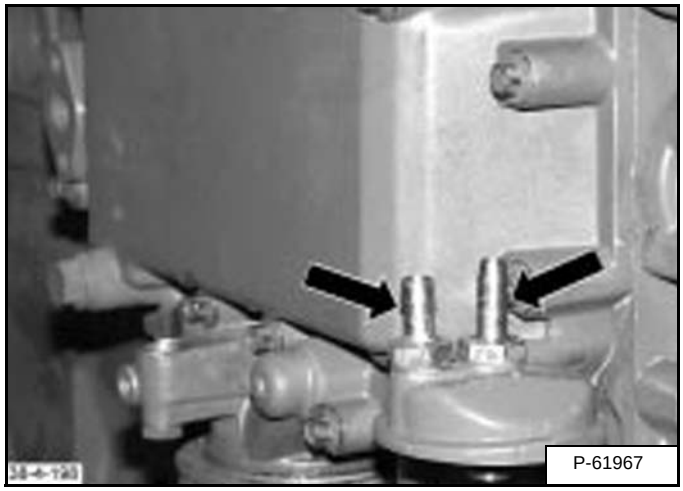
Assembly (Cont'd)

Figure 60-80-109



Tighten the bolts to 14-17 ft.-lbs (19-23 N•m) torque **[Figure 60-80-109]**.

Figure 60-80-110



Install seals on the fittings **[Figure 60-80-110]**. Tighten the fittings to 33-41 ft.-lb. (45-55 N•m) torque.

Lightly oil the fuel filter gasket. Install the fuel filter.

Figure 60-80-111

Hand tighten the fuel filter **[Figure 60-80-111]**.

Figure 60-80-112

Lightly oil the oil filter gasket. Install the oil filter. Hand tighten the oil filter **[Figure 60-80-112]**.

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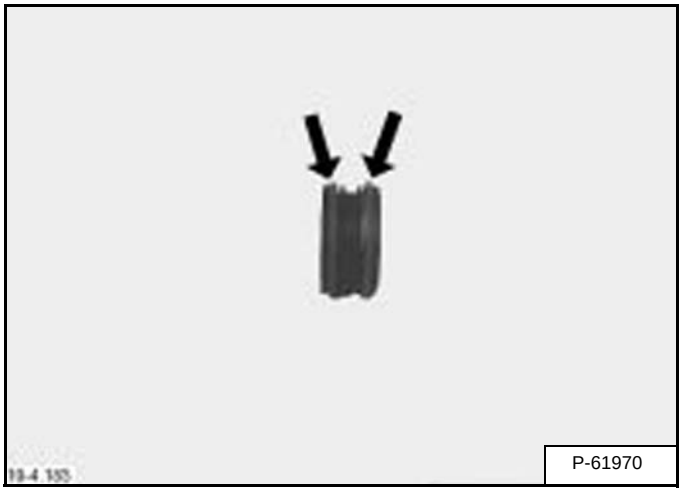
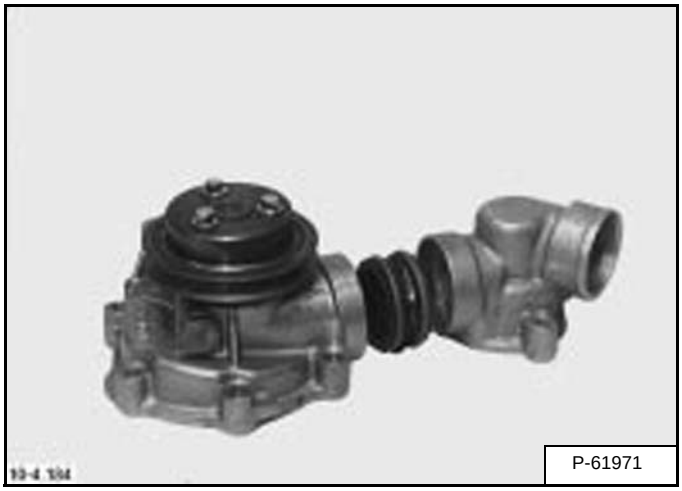
Assembly (Cont'd)

Figure 60-80-113



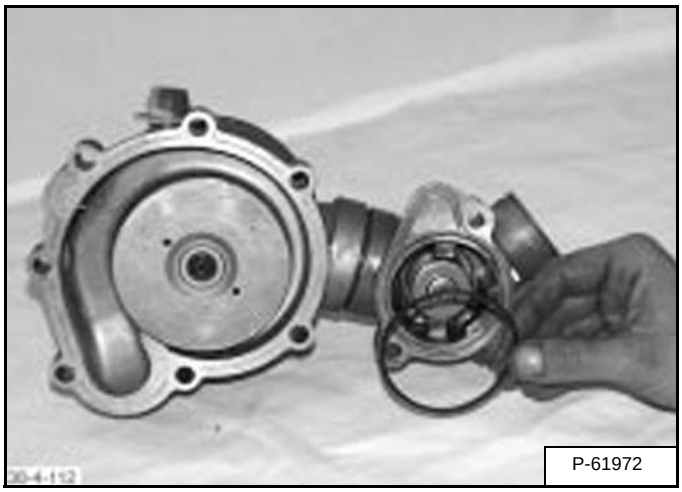
Lightly oil and install the O-rings on the coupler **[Figure 60-80-113]**.

Figure 60-80-114



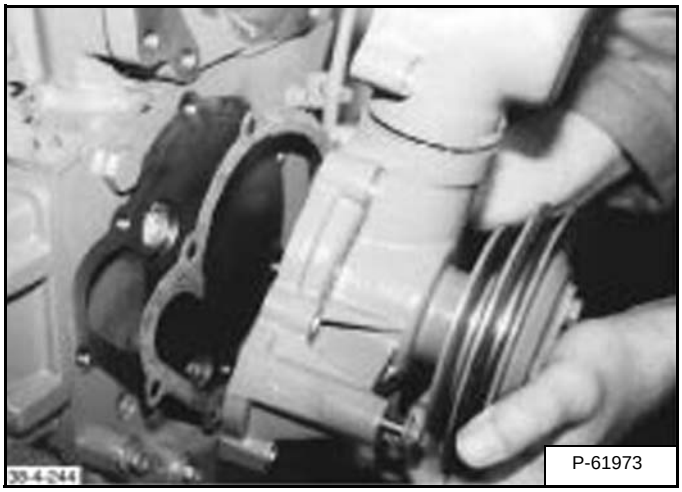
Install the coupler in the thermostat housing and coolant pump **[Figure 60-80-114]**.

Figure 60-80-115



Lubricate and install new O-rings into the thermostat housing **[Figure 60-80-115]**.

Figure 60-80-116



Install a new gasket and coolant pump **[Figure 60-80-116]**.

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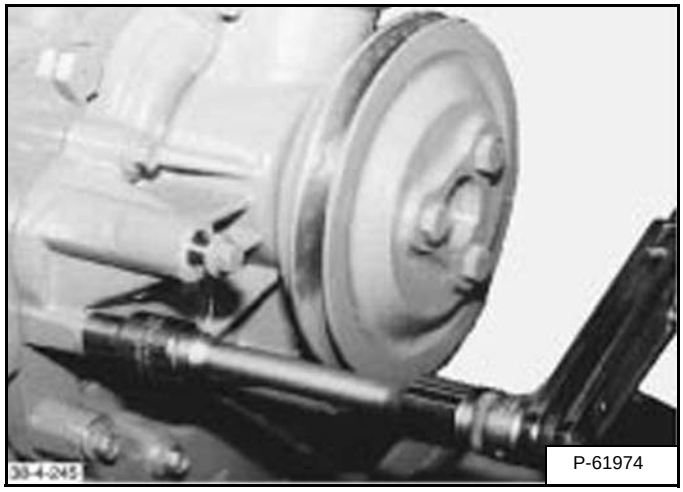
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

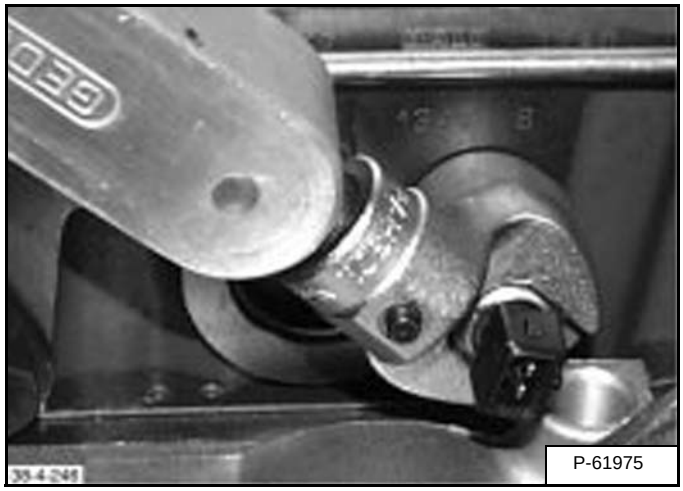
Assembly (Cont'd)

Figure 60-80-117



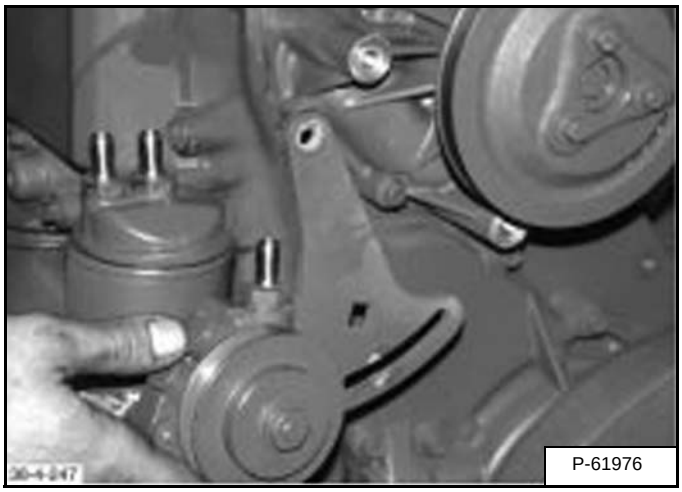
Install and tighten the coolant pump bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-117]**.

Figure 60-80-118



Install a new seal and insulating hose (if equipped) on the temperature sensor. Install the temperature sensor and tighten to 12-15 ft.-lb. (16-20 N•m) torque **[Figure 60-80-118]**.

Figure 60-80-119



Install the fuel pump. Install the bolts **[Figure 60-80-119]**.

NOTE: Do not tighten the bolts at this time.

Figure 60-80-120

Install new seals on the fuel lines. Install the fuel lines **[Figure 60-80-120]**.

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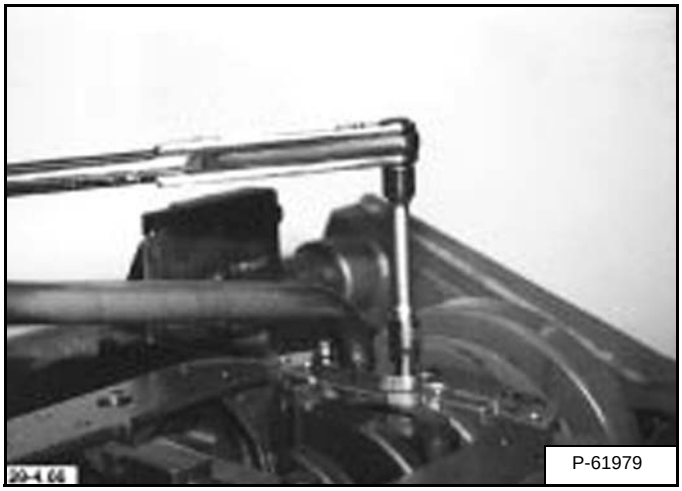
Assembly (Cont'd)

Figure 60-80-121

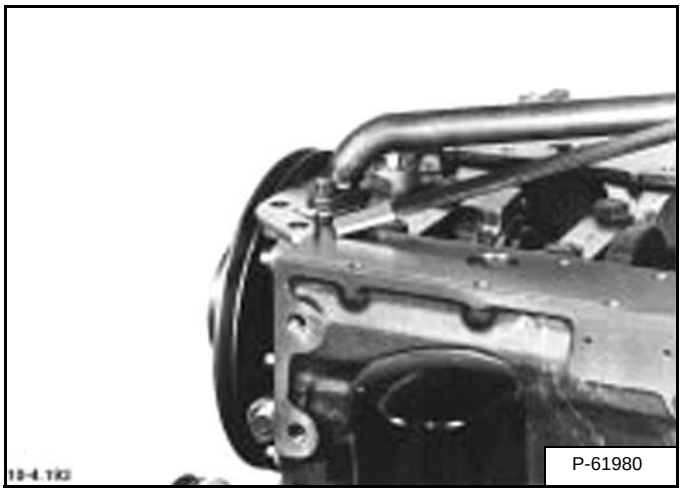
Turn the engine 180°. Install a new gasket. Install the oil suction pipe and retainer **[Figure 60-80-121]**.

Figure 60-80-122



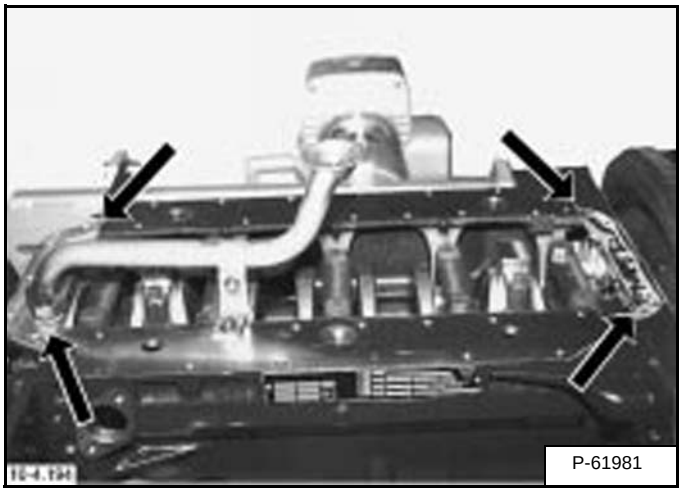
Tighten the flange bolts first then the retainer bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-122]**.

Figure 60-80-123



Trim the gasket **[Figure 60-80-123]**.

Figure 60-80-124



Put sealing compound on the sealing surface of the oil pan **[Figure 60-80-124]**.

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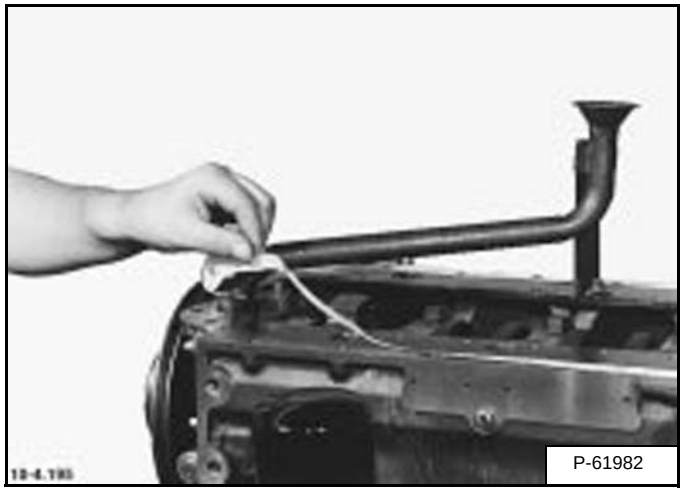
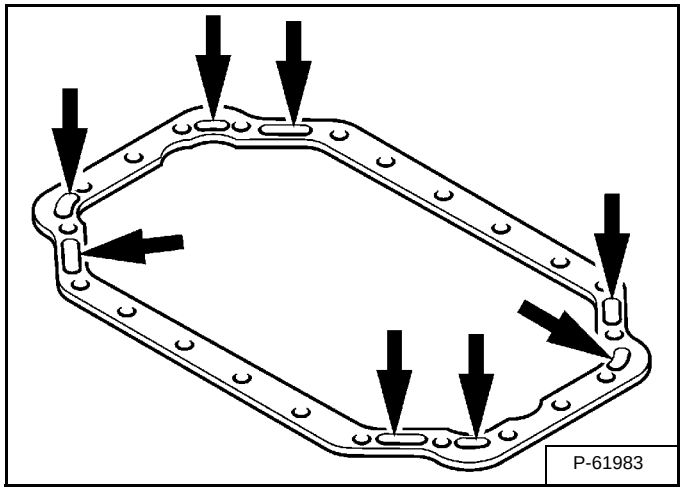
Assembly (Cont'd)

Figure 60-80-125



Install a new gasket **[Figure 60-80-125]**.

Figure 60-80-126



Put sealing compound on the sealing surface of the oil pan gasket **[Figure 60-80-126]**.

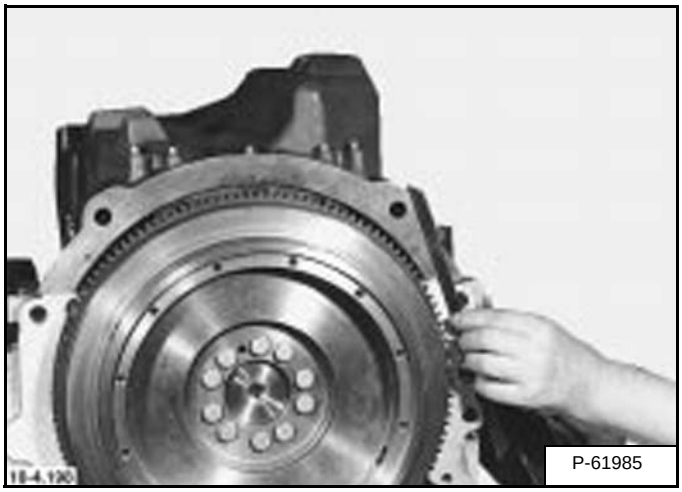
Sheet Meal Oil Pan

Figure 60-80-127

Install the sheet metal oil pan and tighten the bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-127]**.

Cast Iron Oil Pan

Figure 60-80-128



Align the cast iron oil pan with the timing cover tighten the bolts to 20-23 ft.-lbs (27-31 N•m) torque **[Figure 60-80-128]**.

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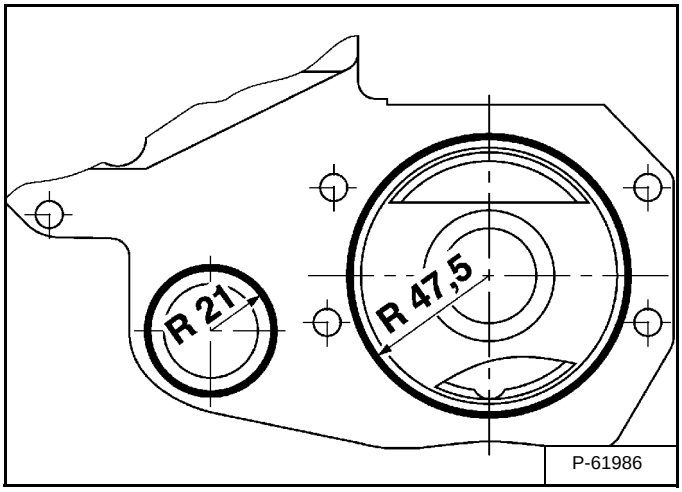
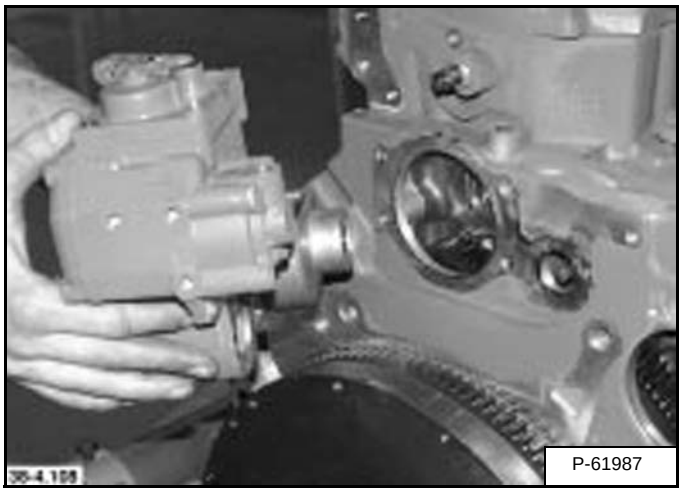
Assembly (Cont'd)

Figure 60-80-129



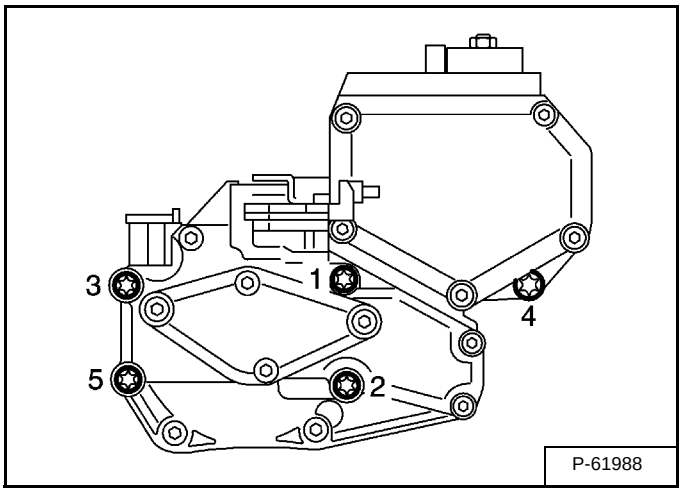
Clean and dry the sealing surface of the governor. Apply a 0.06-0.07 in. (1,5-2,0 mm) bead of sealing compound to the sealing surface of the governor **[Figure 60-80-129]**.

Figure 60-80-130



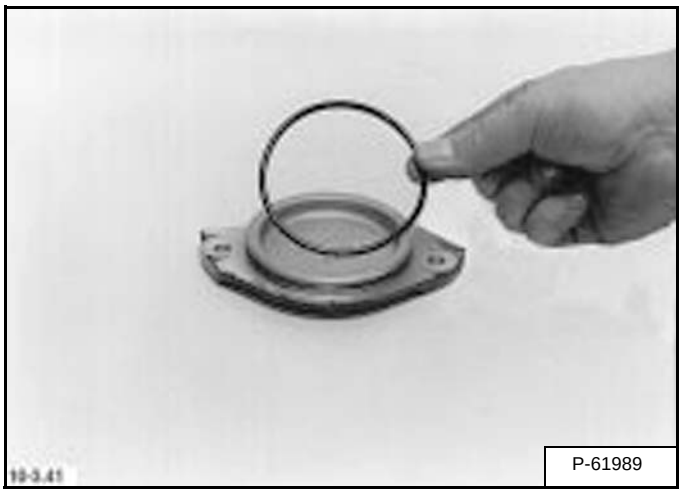
Turn the engine 180°. Install the governor **[Figure 60-80-130]**.

Figure 60-80-131



Install the bolts and tighten in the order shown 1-2-3-4-5 to 11-14 ft.-lb. (15.5-18.5 N•m) torque **[Figure 60-80-131]**.

Figure 60-80-132



Lightly grease and install the O-ring on the cover **[Figure 60-80-132]**.

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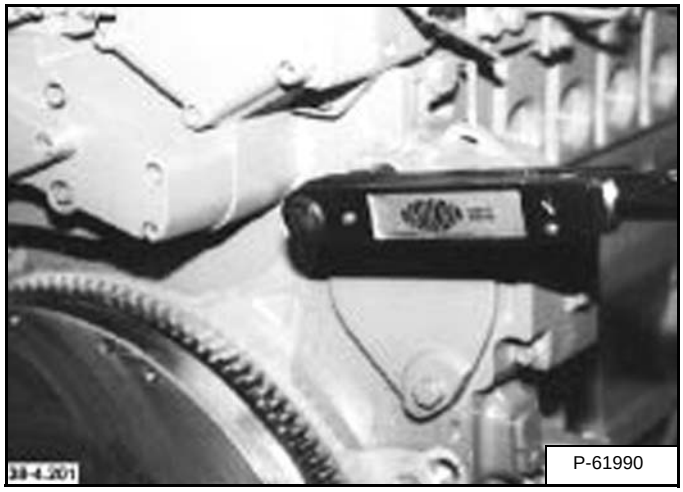
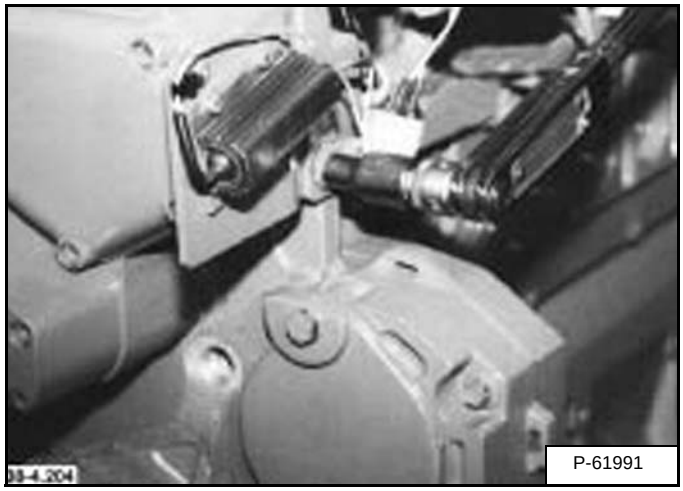
Assembly (Cont'd)

Figure 60-80-133



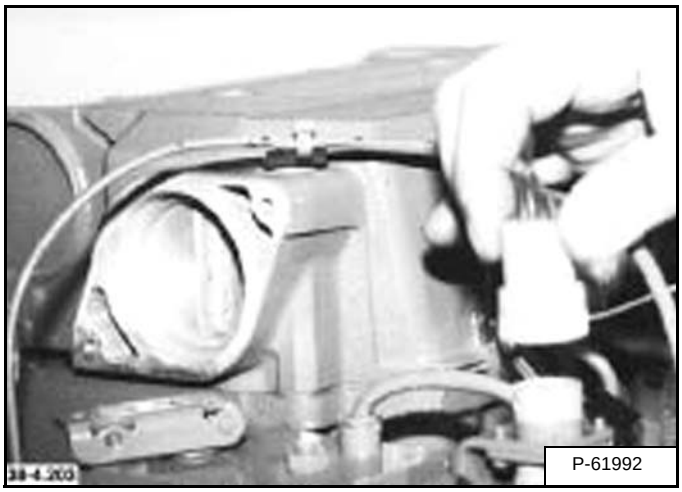
Install the cover and tighten the bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-133]**.

Figure 60-80-134



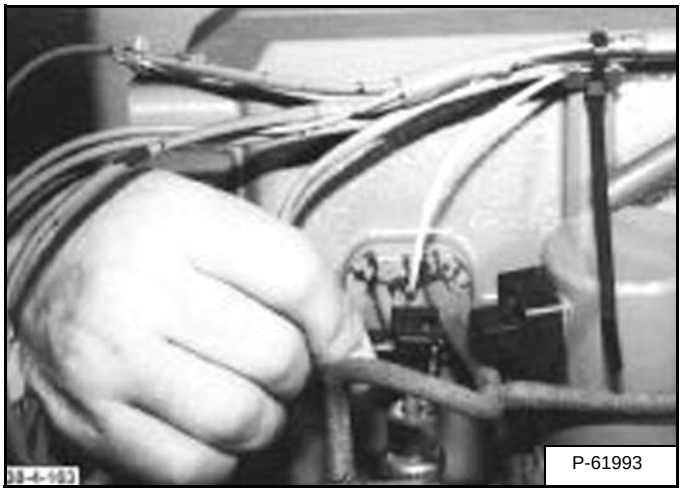
Install the plate on the governor and tighten the bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-134]**.

Figure 60-80-135



Connect the wire harness to the governor **[Figure 60-80-135]**.

Figure 60-80-136



Connect the wire harness to the shutoff solenoid **[Figure 60-80-136]**.

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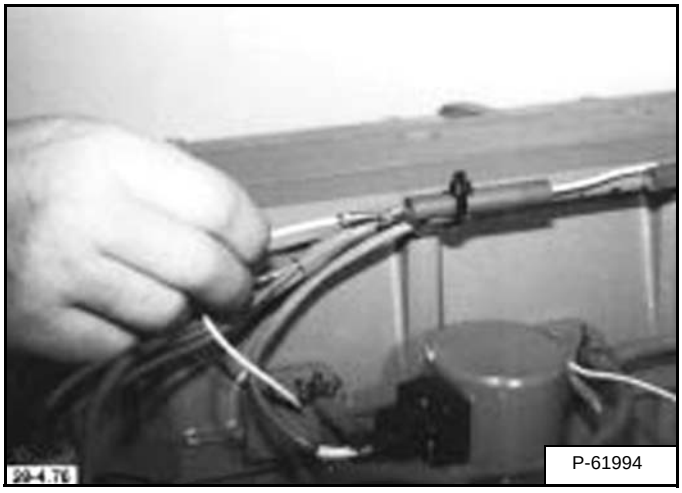
Assembly (Cont'd)

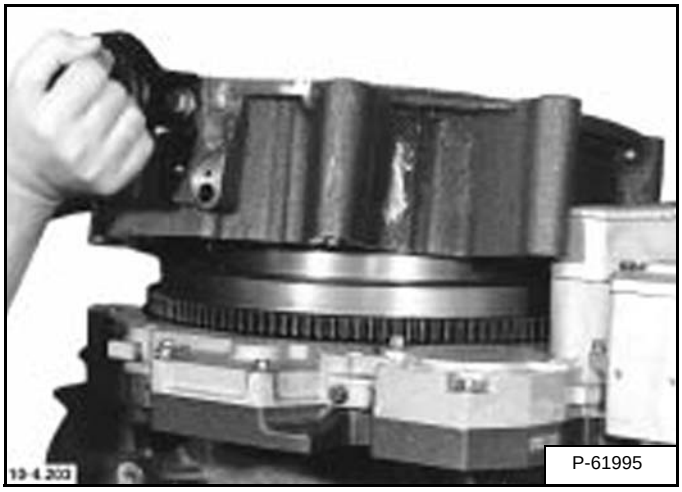
Figure 60-80-137



Connect the glow plug wire connectors **[Figure 60-80-137]**.

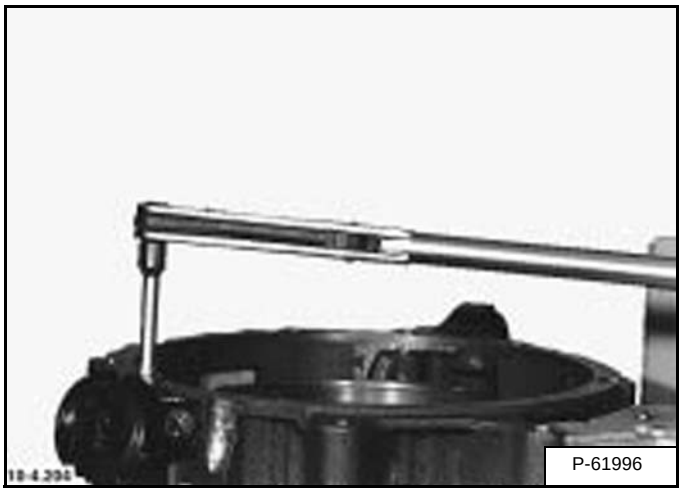
Turn the engine 180°.

Figure 60-80-138



Install the adapter housing **[Figure 60-80-138]**.

Figure 60-80-139



Install the bolts and tighten as follows **[Figure 60-80-139]**:

M-12 bolt torque . . . . . 66-80 ft.-lb. (89-109 N•m)
M-16 bolt torque . . . . . 161-198 ft.-lb. (218-268 N•m)

Figure 60-80-140

Install the plate **[Figure 60-80-140]**.

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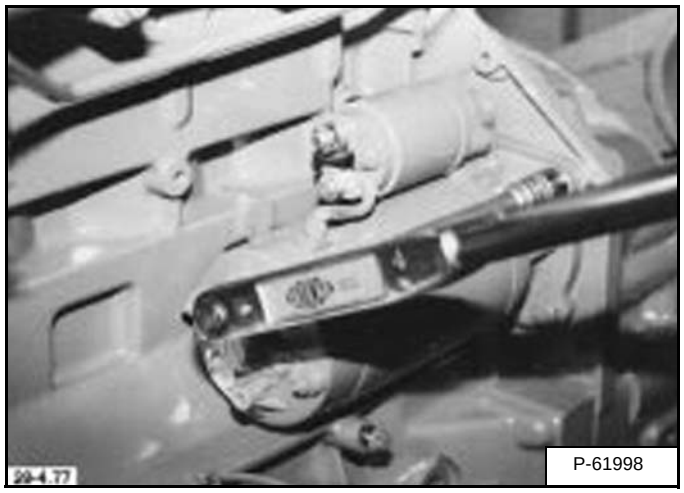
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

Assembly (Cont'd)

Install the starter.

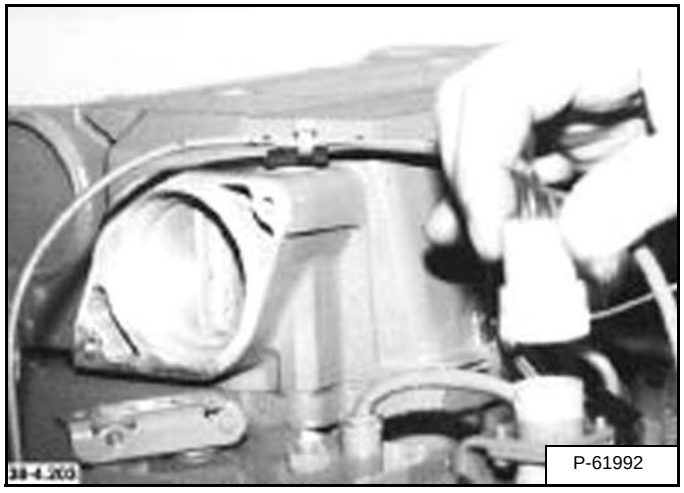
Tighten the bolts to 52 ft.-lb. (70 N•m) torque.

Figure 60-80-141



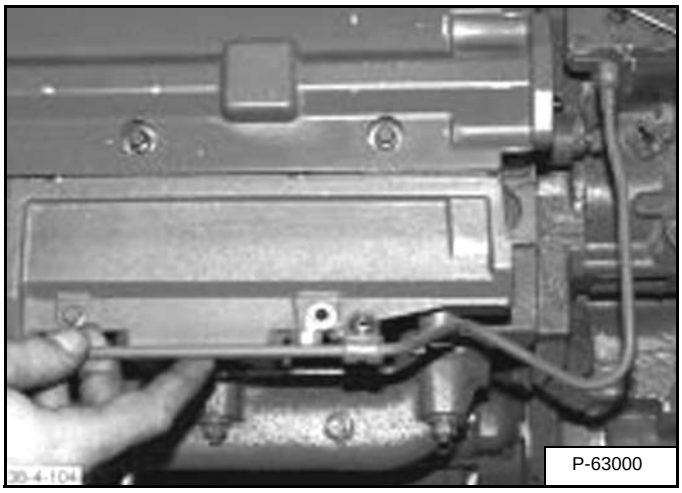
TIghten the collar to 30 ft.-lb. (40 N•m) torque (if equipped **[Figure 60-80-141]**.

Figure 60-80-142



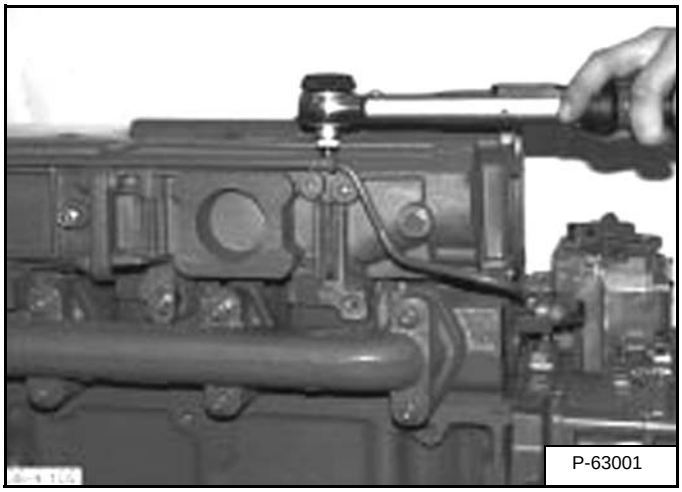
Connect the wire harness and clips **[Figure 60-80-142]**.

Figure 60-80-143



Install new seals on the breather pipe **[Figure 60-80-143]**.

Figure 60-80-144



Install the breather and tighten the bolts to 7-9 ft.-lb. (10-12 N•m) torque **[Figure 60-80-144]**.

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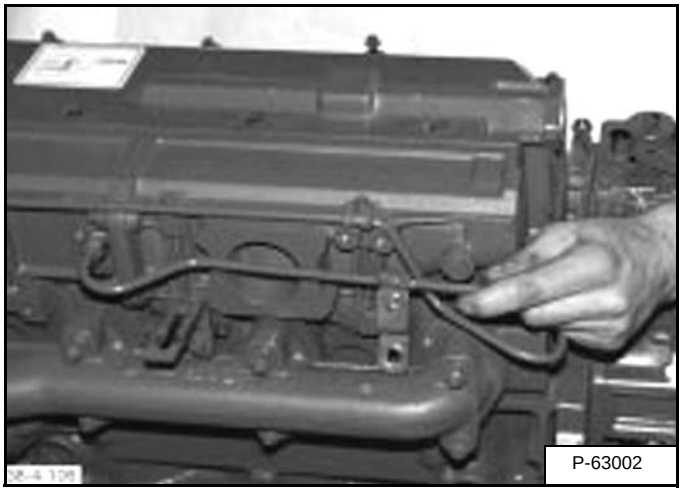
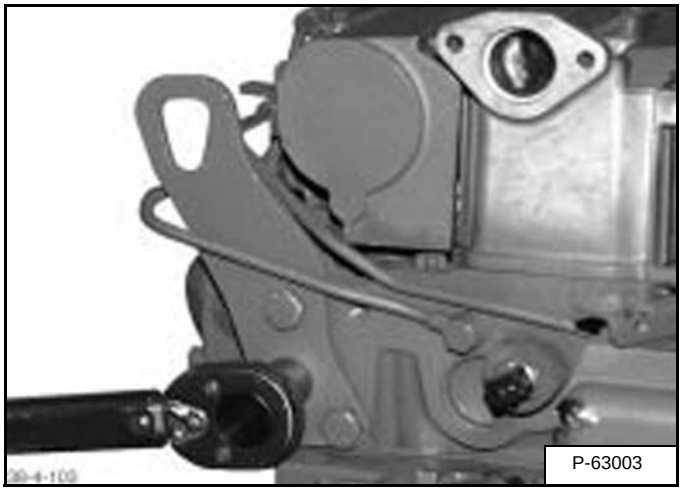
Assembly (Cont'd)

Figure 60-80-145



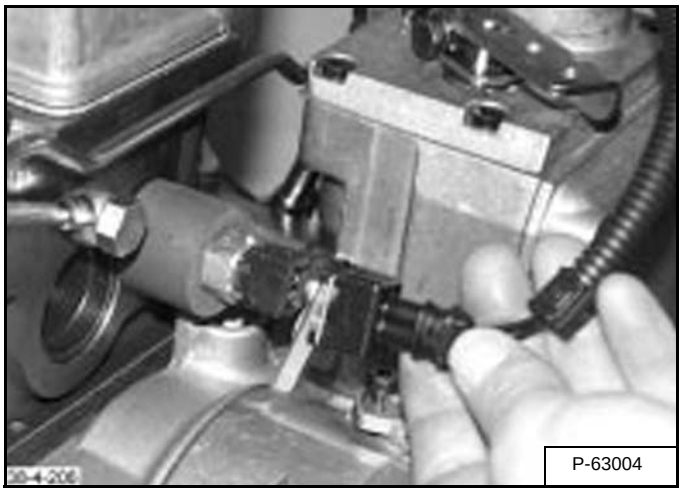
Install the air pipe on the manifold pressure compensator **[Figure 60-80-145]**.

Figure 60-80-146



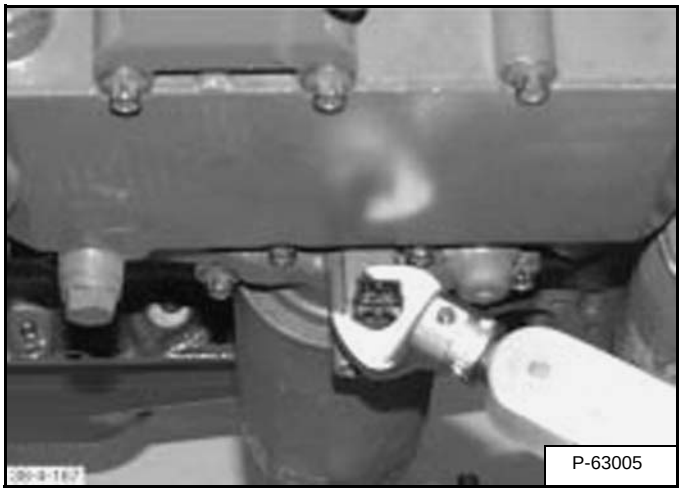
Install the lift brackets and tighten to 32-38 ft.-lb. (43-51 N•m) torque **[Figure 60-80-146]**.

Figure 60-80-147



Connect the wire harness to the temperature sensor **[Figure 60-80-147]**.

Figure 60-80-148



Install a seal on the oil pressure switch. Install and tighten the oil pressure switch to 12-15 ft.-lb. (16-20 N•m) torque **[Figure 60-80-148]**.

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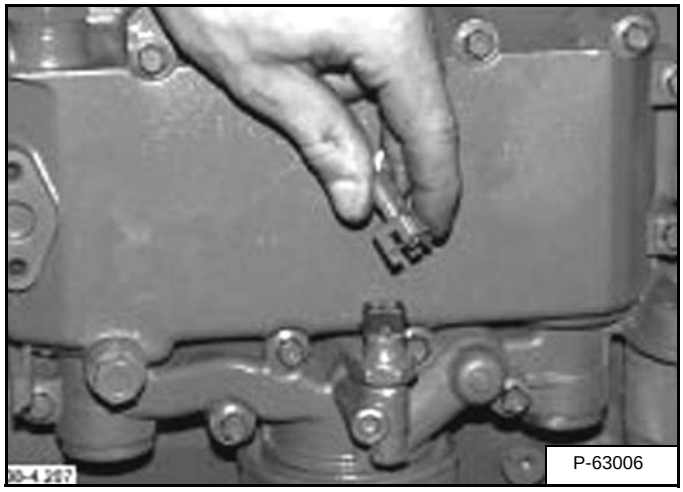
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

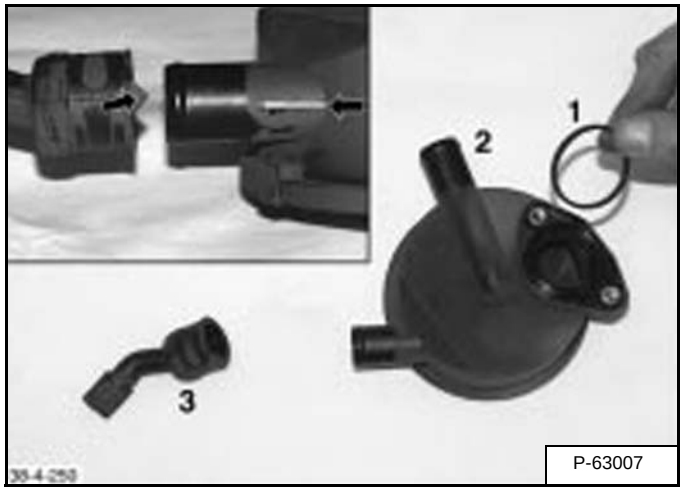
Assembly (Cont'd)

Figure 60-80-149



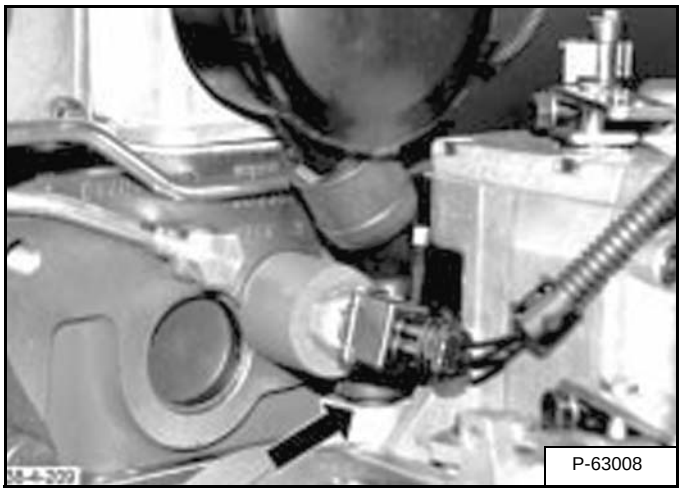
Connect the wire harness to the oil pressure switch **[Figure 60-80-149]**.

Figure 60-80-150



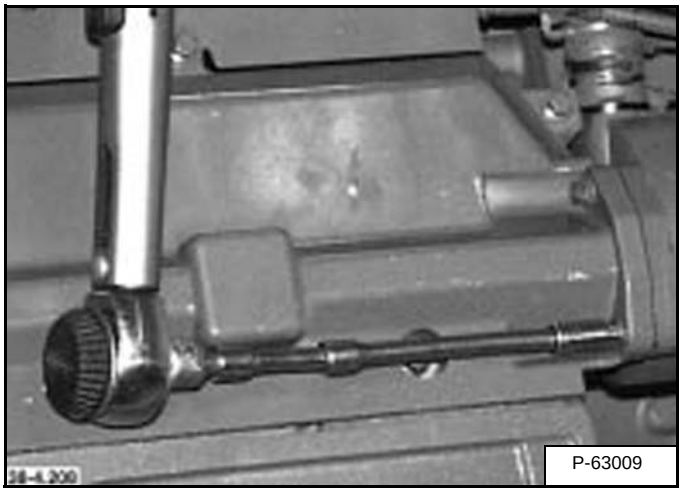
Install the seal, pressure control valve and sleeve on the crankcase breather **[Figure 60-80-150]**.

Figure 60-80-151



Lightly grease the bore in the cylinder head. Install the pressure control valve **[Figure 60-80-151]**.

Figure 60-80-152



Install the bolts in the crankcase breather. Tighten the bolts to 6-7 ft.-lbs (7,5-9,5 N•m) torque **[Figure 60-80-152]**.

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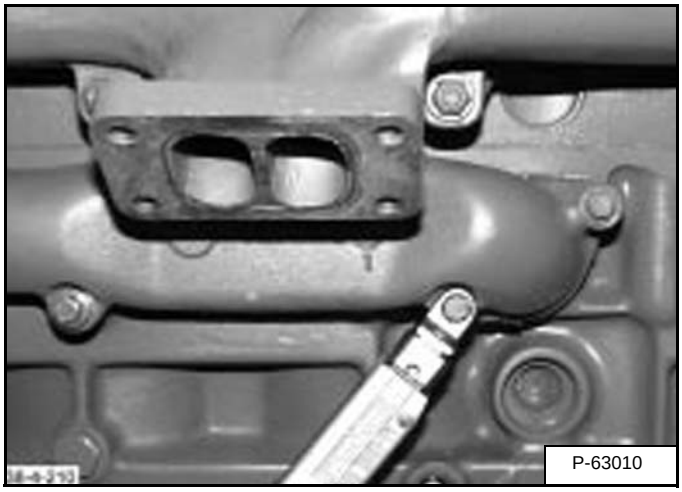
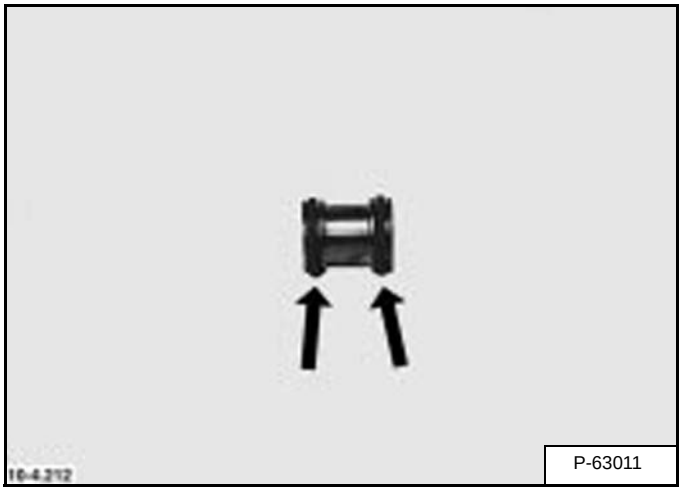
Assembly (Cont'd)

Figure 60-80-153



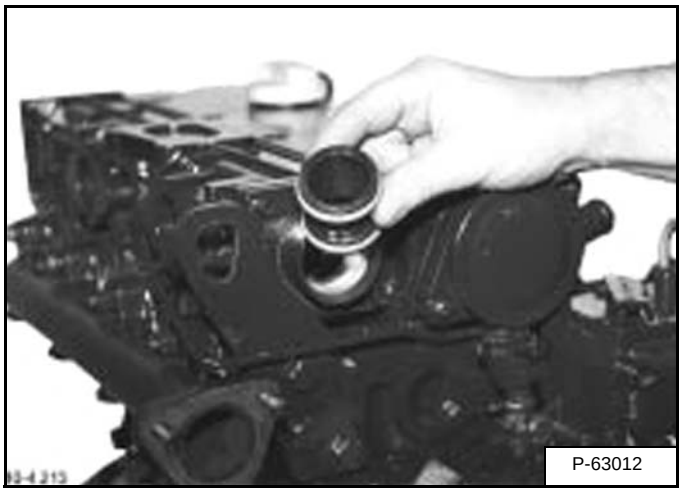
Apply sealing compound to the coolant pipe. Install the coolant pipe and tighten the bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-153]**.

Figure 60-80-154



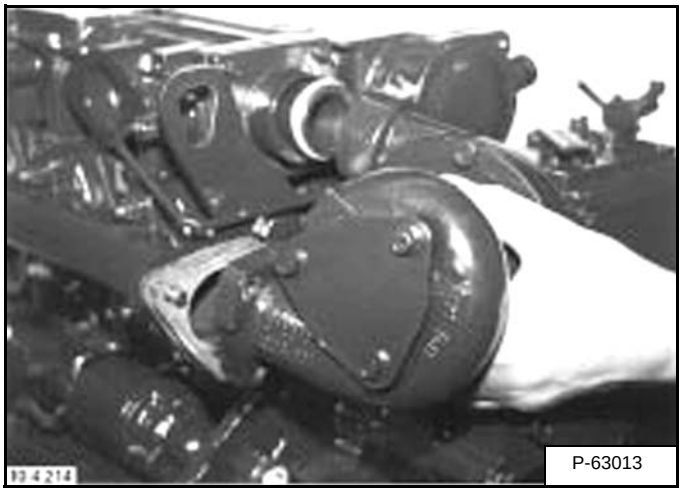
Apply a light coat of grease on the O-rings. Install the O-rings on the adapter **[Figure 60-80-154]**.

Figure 60-80-155



Install the adapter **[Figure 60-80-155]**.

Figure 60-80-156



Install a new gasket. Install the turbo charger **[Figure 60-80-156]**.

NOTE: Prelubricate the turbo charger by spraying a drop of oil into the oil supply line.

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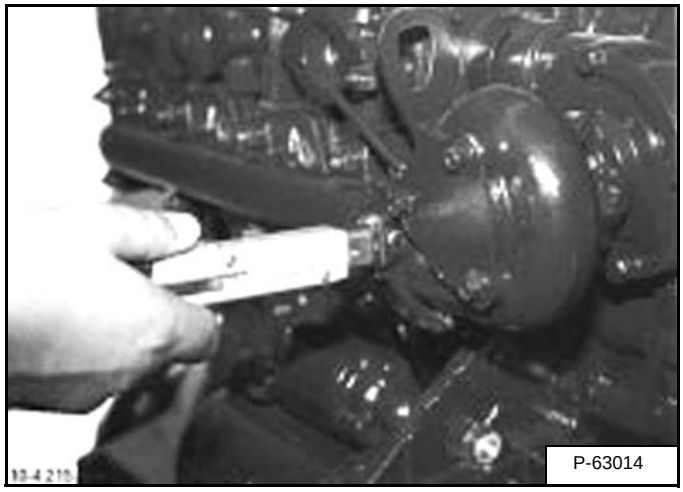
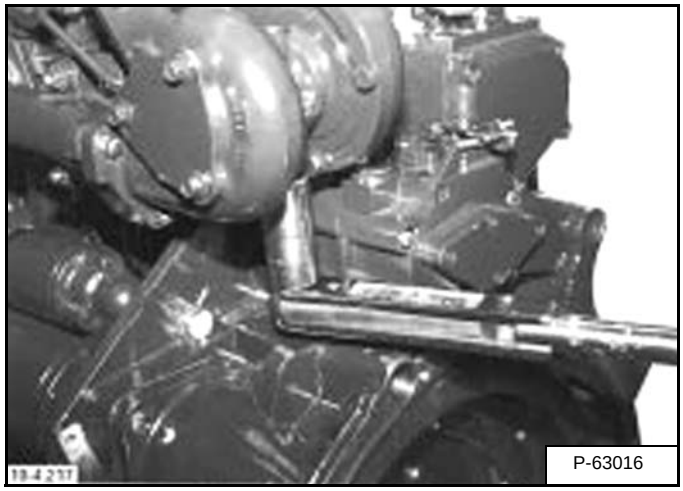
Assembly (Cont'd)

Figure 60-80-157



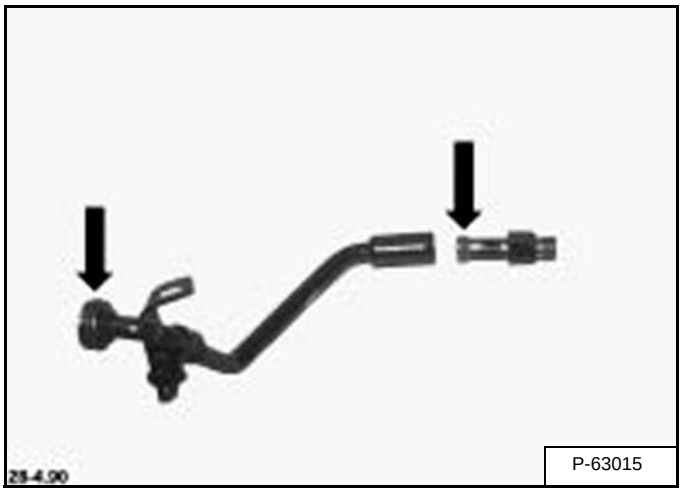
Apply anti-seize to the studs. Install the nuts and tighten to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-157]**.

Figure 60-80-158



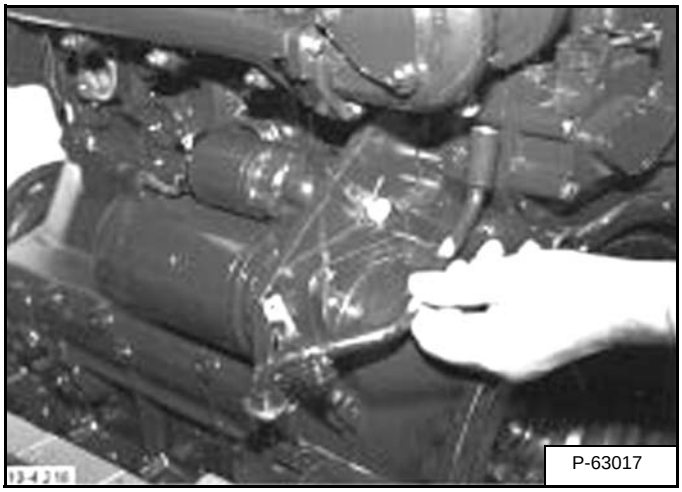
Install a new seal on the plug. Install the plug and tighten to 28-31 ft.-lb. (38-42 N•m) torque **[Figure 60-80-158]**.

Figure 60-80-159



Apply a light coat of grease to the O-rings. Install the O-rings on the oil return pipe **[Figure 60-80-159]**.

Figure 60-80-160



Install the oil return pipe **[Figure 60-80-160]**.

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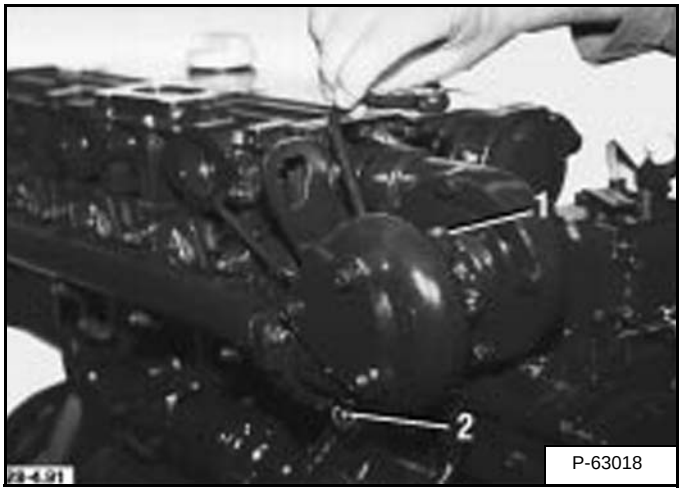
Assembly (Cont'd)

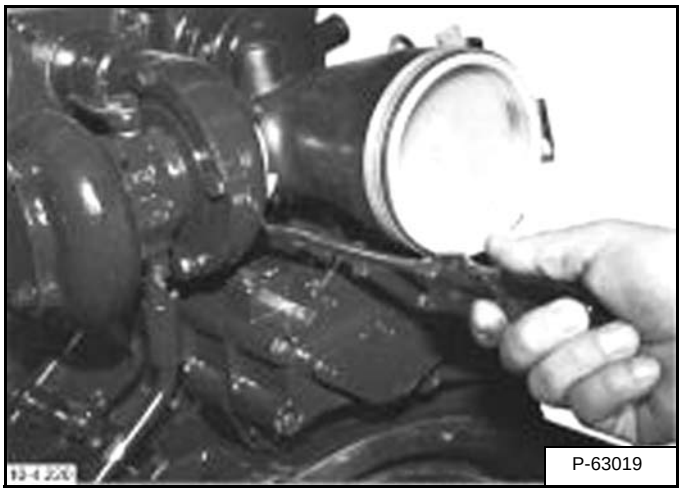
Install the oil pressure pipe. Install seals on the bolts.

Figure 60-80-161



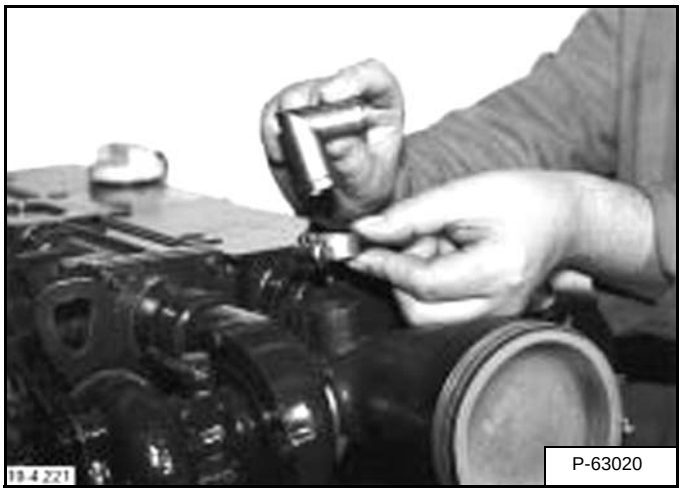
Tighten the bolt (Item 1) to 19-24 ft.-lb. (26-32 N•m) torque. Tighten the bolt (Item 2) **[Figure 60-80-161]** to 26-32 ft.-lb. (35-43 N•m) torque.

Figure 60-80-162



Install the intake hose **[Figure 60-80-162]**.

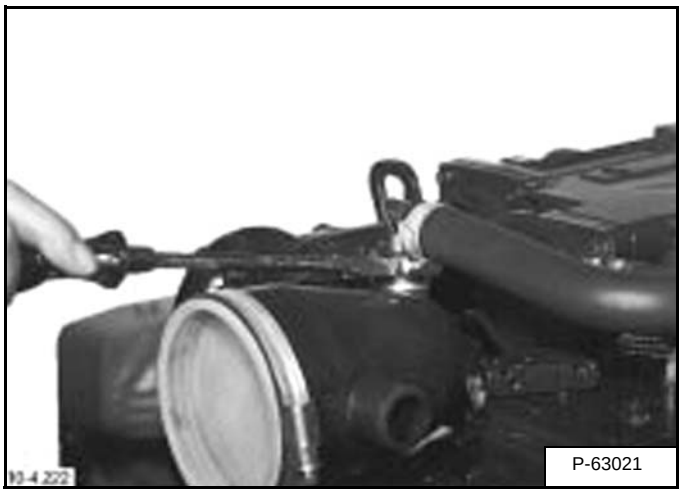
Figure 60-80-163



Install the elbow **[Figure 60-80-163]**.

NOTE: Do not tighten the hose clamp at this time.

Figure 60-80-164



Install the breather hose. Tighten the hose clamps **[Figure 60-80-164]**.

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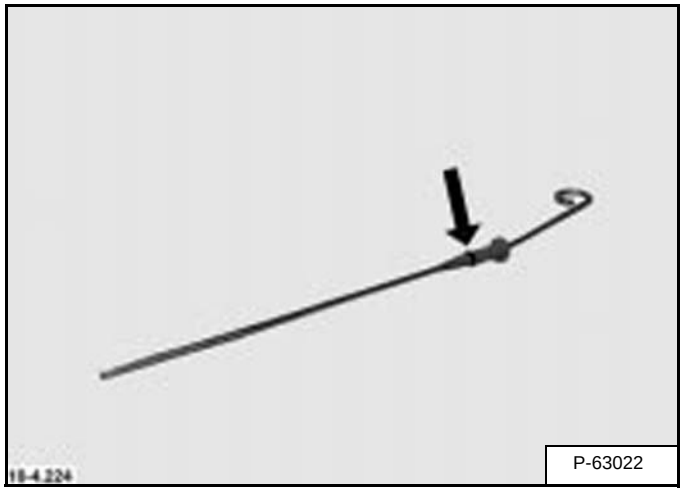
Assembly (Cont'd)

Figure 60-80-165

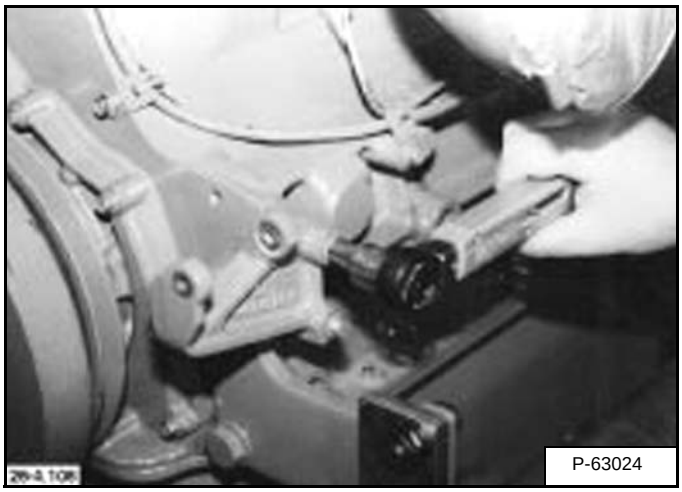


Install a new O-ring on the dipstick **[Figure 60-80-165]**.

Figure 60-80-166

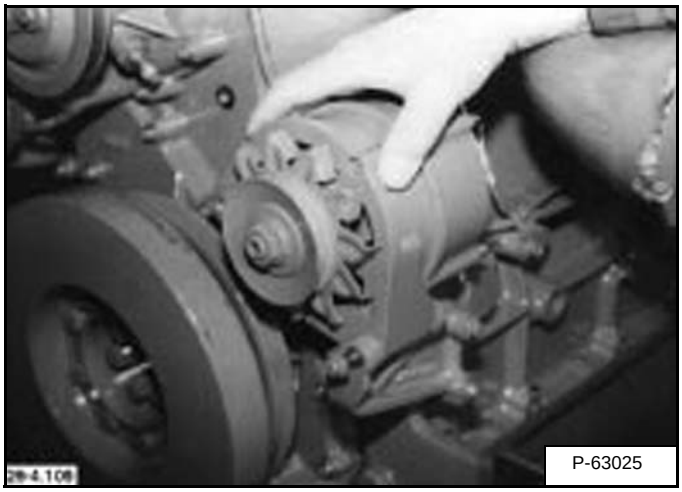
Install the dipstick **[Figure 60-80-166]**.

Figure 60-80-167



Install the alternator bracket. Tighten the bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-167]**.

Figure 60-80-168



Install the alternator **[Figure 60-80-168]**.

NOTE: Do not tighten the bolt at this time.

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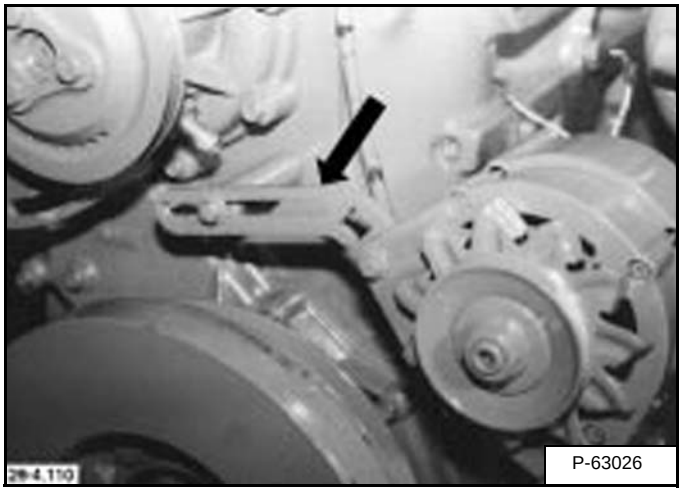
Assembly (Cont'd)

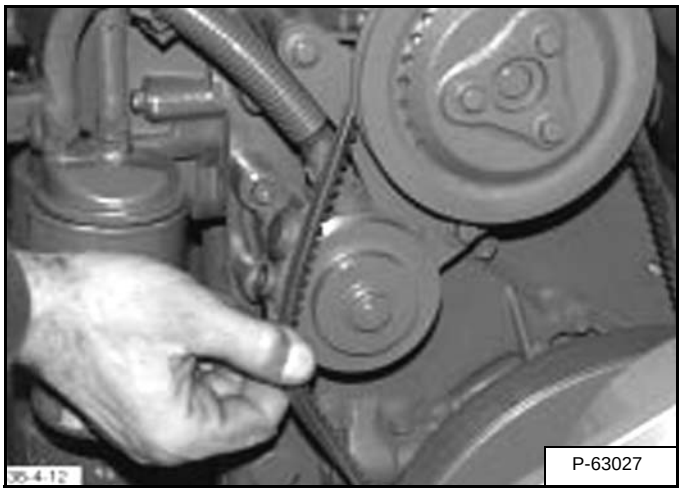
Figure 60-80-169



Install the adjusting bracket with bushings and bolts **[Figure 60-80-169]**.

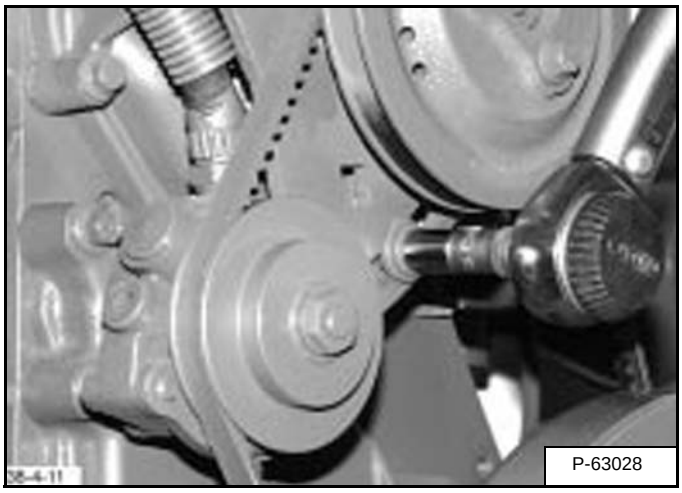
NOTE: Do not tighten the bolts at this time.

Figure 60-80-170



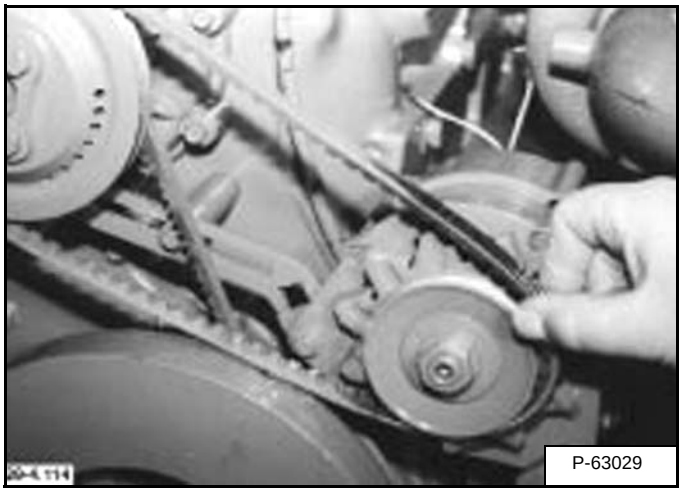
Install the fan/fuel pump belt **[Figure 60-80-170]**.

Figure 60-80-171



Adjust the fan/fuel pump belt tension by applying approximately 33 lbs (15 kg) force on the belt. The belt should deflect 0.40 in. (10 mm). Tighten the bolts to 14-17 ft.-lb. (19-23 N•m) torque **[Figure 60-80-171]**.

Figure 60-80-172



Install the alternator belt **[Figure 60-80-172]**.

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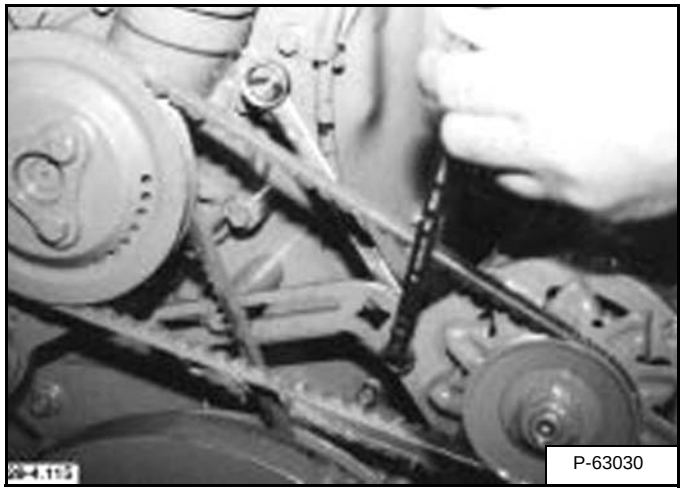
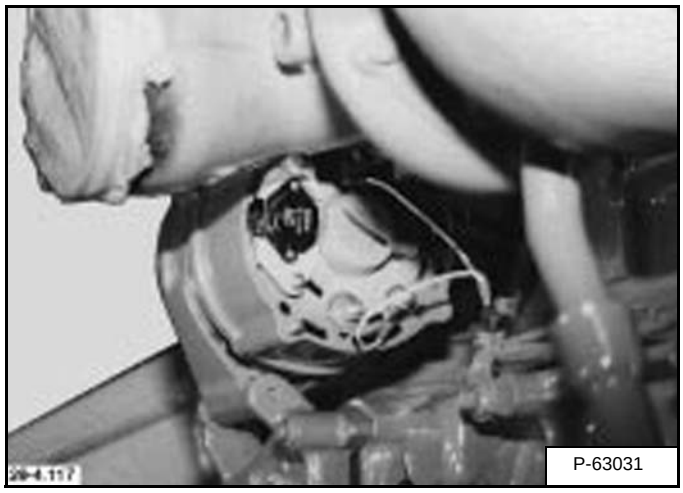
Assembly (Cont'd)

Figure 60-80-173



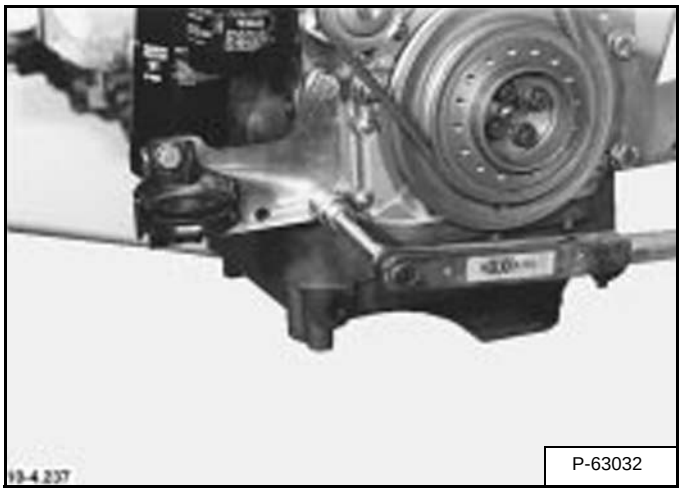
Adjust the alternator belt tension by applying approximately 33 lbs (15 kg) force to the belt at the mid span of the belt. Tighten the bolts to 22 ft.-lb. (30 N•m) torque **[Figure 60-80-173]**.

Figure 60-80-174



Install the wire harness on the alternator **[Figure 60-80-174]**.

Figure 60-80-175



Install the engine mount bracket **[Figure 60-80-175]**. Tighten the bolts to 192 ft.-lb. (260 N•m) torque

Figure 60-80-176

Install the engine mount bracket **[Figure 60-80-176]**.

Tighten the bolts to 70 ft.-lb. (95 N•m) torque.

Remove the engine from the engine stand.

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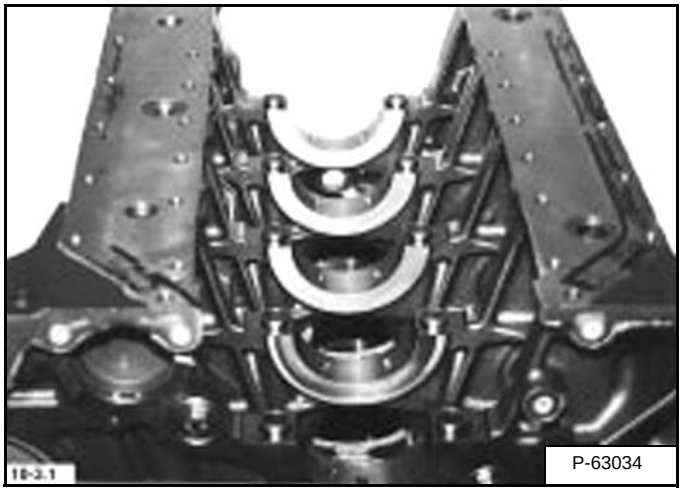
Cylinder, Checking

Clean the engine block and inspect for damage.

Figure 60-80-177

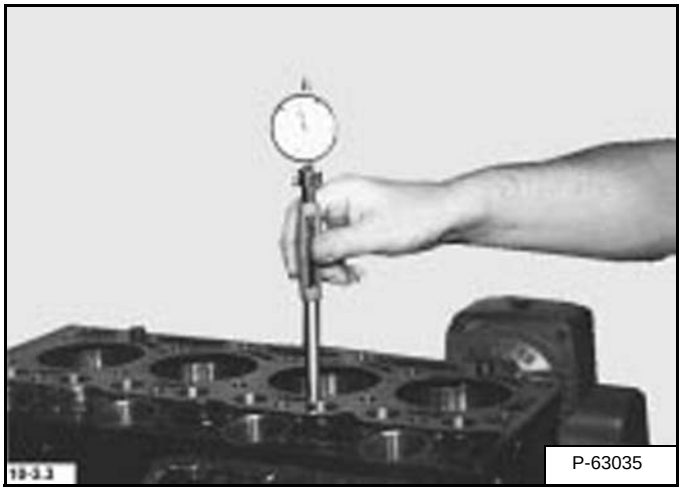


Install the main bearing caps **[Figure 60-80-177]**.

Tighten the main bearing cap bolts as follows:

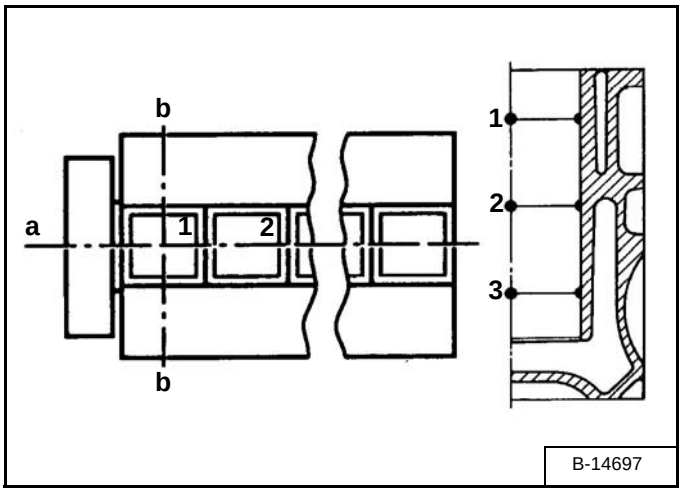
Initial Torque . . . . . 22 ft.-lb. (30 N•m)
1st Stage Angle . . . . . 60°
2nd Stage Angle. . . . . 60°

Figure 60-80-178



Using a dial indicator gauge check the cylinders **[Figure 60-80-178]**.

Figure 60-80-179



Check the cylinders with engine block longitudinal **(a)** and transverse **(b)** axis and in three planes **[Figure 60-80-179]**.

Specifications:
Cylinder Bore. . . . . 3.7008 - 3.7016 inch. (94 - 94.02 mm)
Wear Limit . . . . . 3.59 inch. (94.1 mm)

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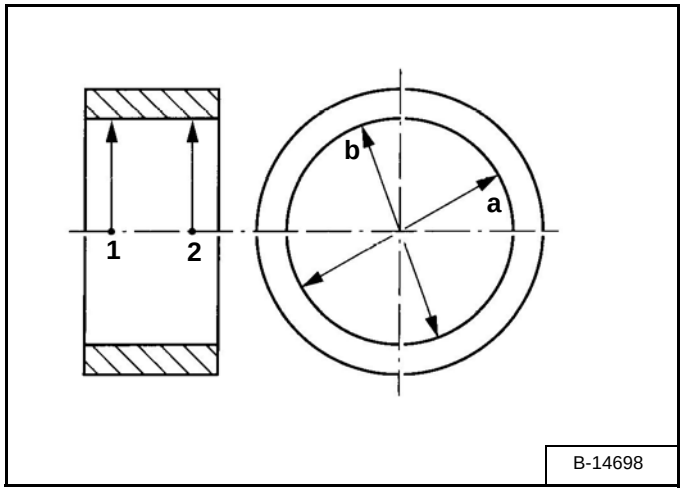
Camshaft Bearing, Checking

Figure 60-80-180



Check the camshaft bearing bushings at points **(1)** and **(2)** in the planes of **(a)** and **(b) [Figure 60-80-180]**.

Figure 60-80-181

Check the camshaft bushings using a gauge **[Figure 60-80-181]**.

Inner Diameter . . . . . 2.362 + 0.002 inch. (60 + 0,054 mm)
Wear Limit . . . . . 2.365 inch. (60,08 mm)

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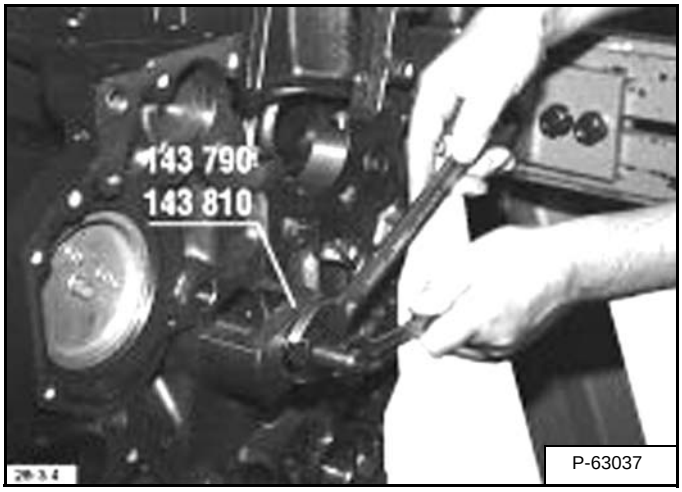
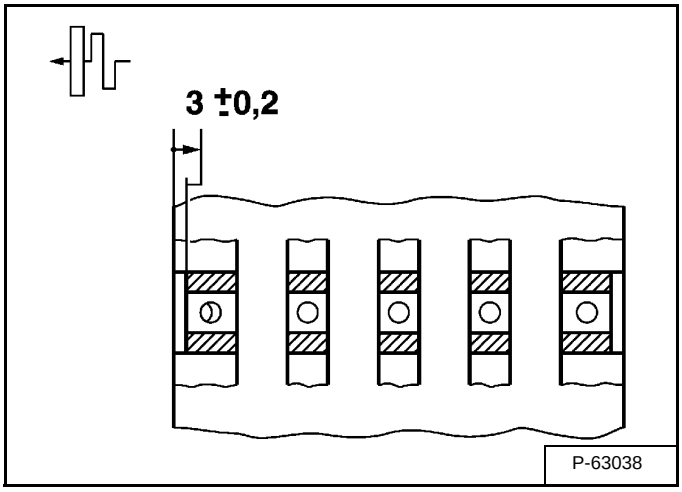
Camshaft Bearing, Removal And Installation

Figure 60-80-182



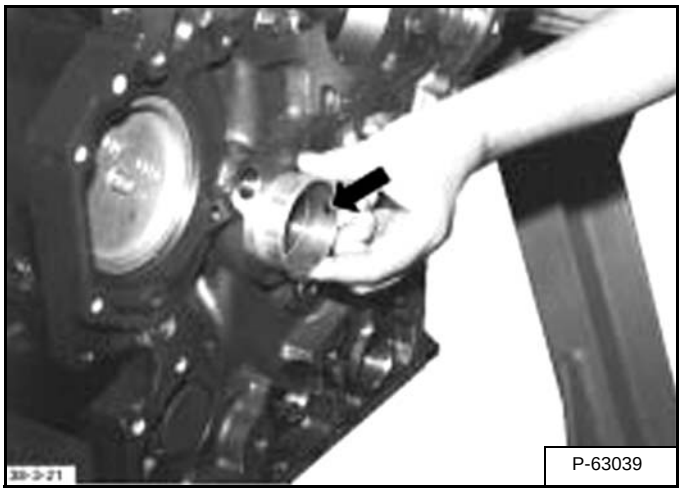
Remove all the camshaft bearing bushings using a camshaft bushing removal tool as needed **[Figure 60-80-182]**.

Figure 60-80-183



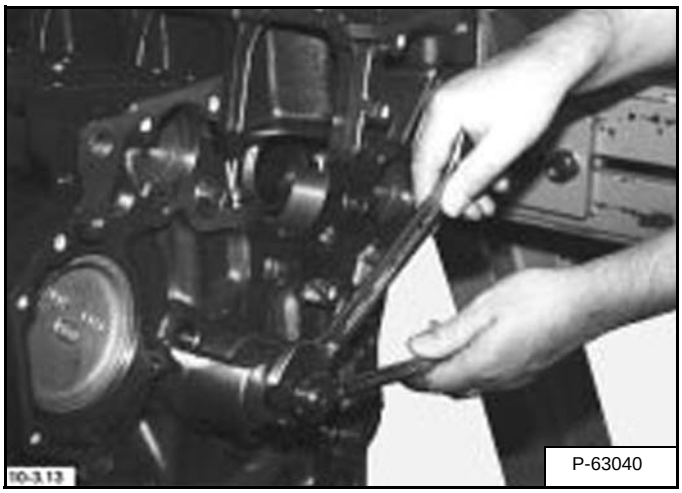
Use the dimensions in **[Figure 60-80-183]** to install the camshaft bushing at the flywheel end.

Figure 60-80-184



When installing the new camshaft bushings, the oil lube hole must align with the oil hole in the engine block **[Figure 60-80-184]**.

Figure 60-80-185



Install the new camshaft bushings using a camshaft bushing installation tool **[Figure 60-80-185]**.

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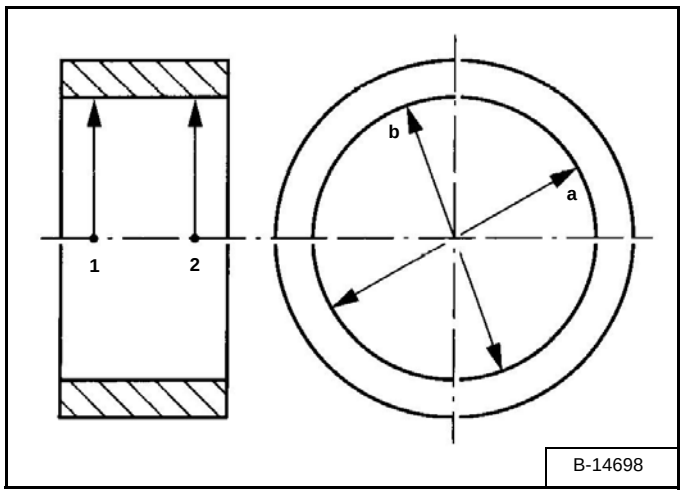
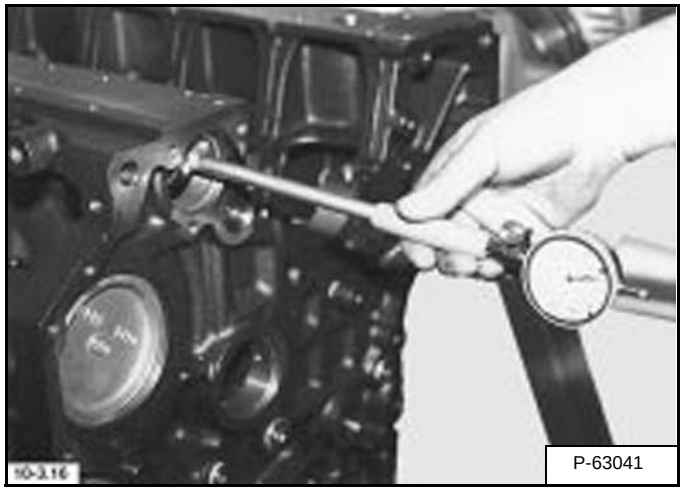
Balancing Shaft Bearing, Checking (If Equipped)

Figure 60-80-186



Check the balancing bearing bushings at points **(1)** and **(2)** in the planes of **(a)** and **(b) [Figure 60-80-186]**.

Figure 60-80-187



Check the balancing shaft bushings using a gauge **[Figure 60-80-187]**.

Inner Diameter . . . . . 2,128 + 0.002 inch. (54,06 + 0,045 mm)
Wear Limit . . . . . 2.131 inch. (54,125 mm)

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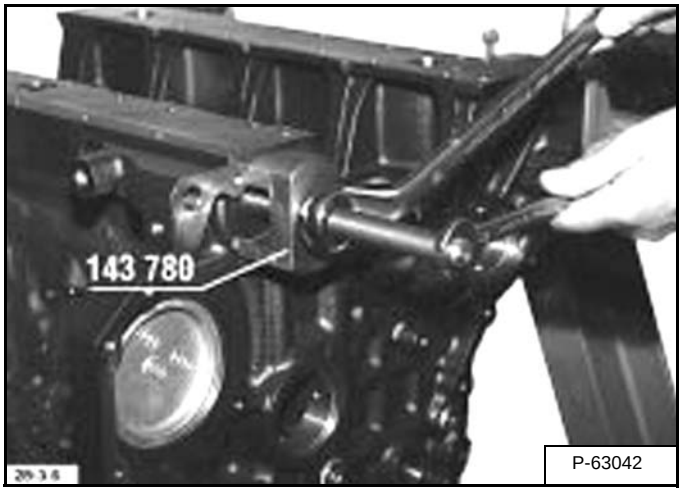
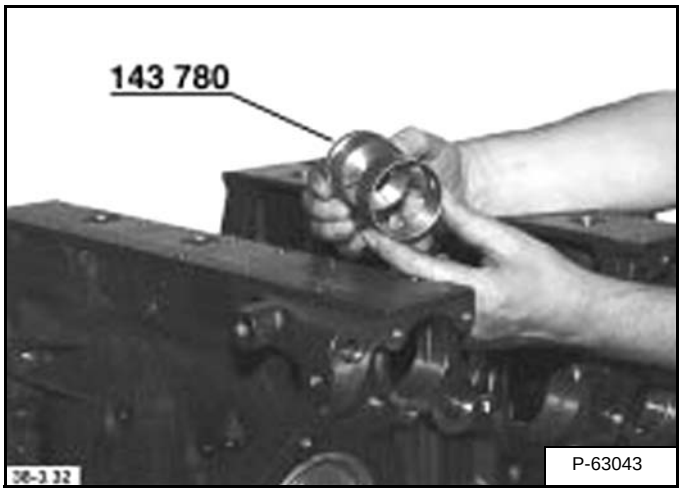
Balancing Shaft Bearing, Removal And Installation

Figure 60-80-188



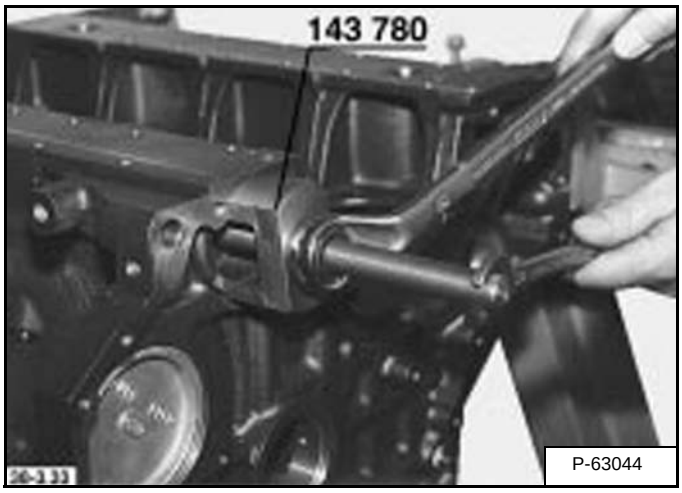
Remove all the balancing shaft bearing bushings using a balancing shaft bushing removal tool as needed **[Figure 60-80-188]**.

Figure 60-80-189



When installing the new balancing shaft bushings, the oil lube hole must align with the oil hole in the engine block **[Figure 60-80-189]**.

Figure 60-80-190



Install the new balancing shaft bushings using a balancing shaft bushing installation tool **[Figure 60-80-190]**.

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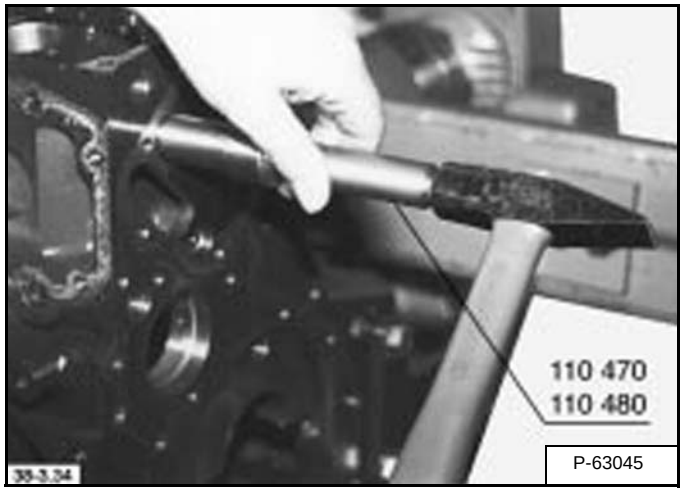
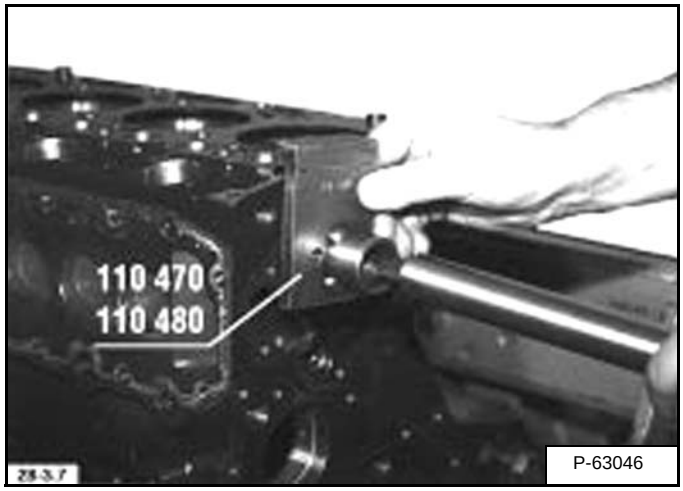
Control Rod Guide Bushing Installation

Figure 60-80-191



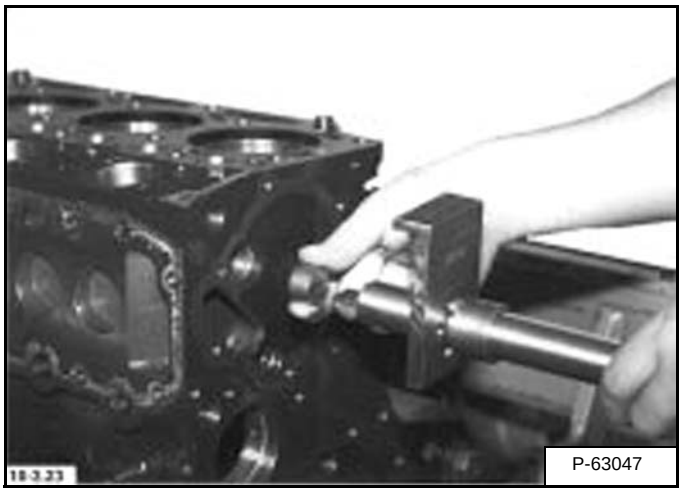
Using the tool, drive the guide bushing out **[Figure 60-80-191]**.

Figure 60-80-192



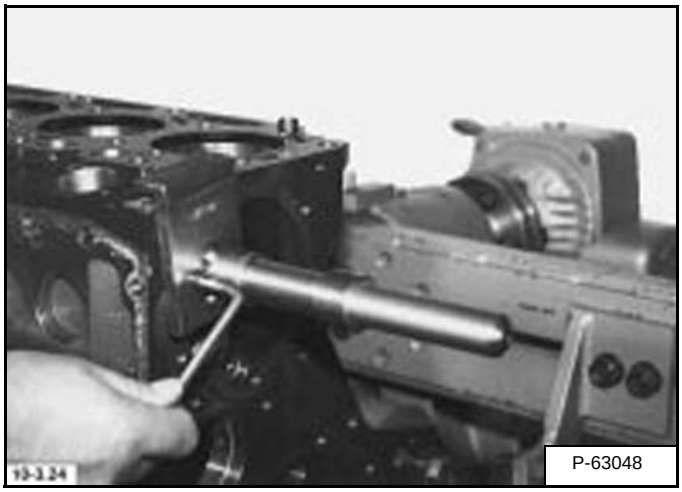
Install the new bushing into the center of the arbor assembly **[Figure 60-80-192]**.

Figure 60-80-193



Install the guide on the arbor assembly with the chamfer pointing toward the crankcase **[Figure 60-80-193]**.

Figure 60-80-194



Fasten the arbor assembly and bushing on the engine block **[Figure 60-80-194]**.

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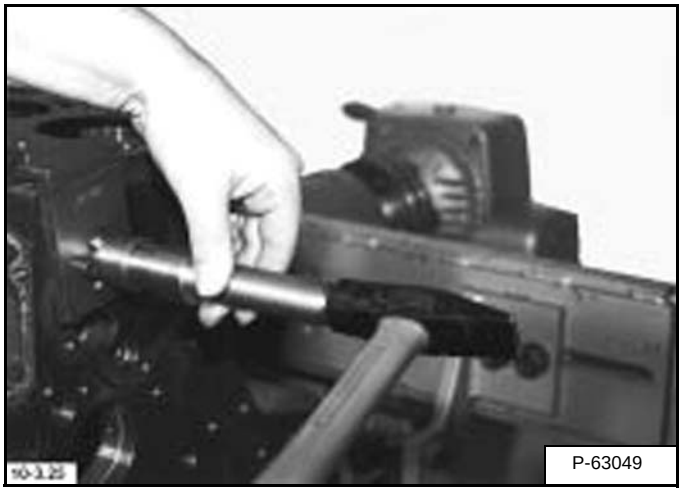
Control Rod Guide Bushing Installation (Cont'd)

Figure 60-80-195



Drive the bushing into the engine block as far as it will go **[Figure 60-80-195]**.

Remove the arbor assembly.

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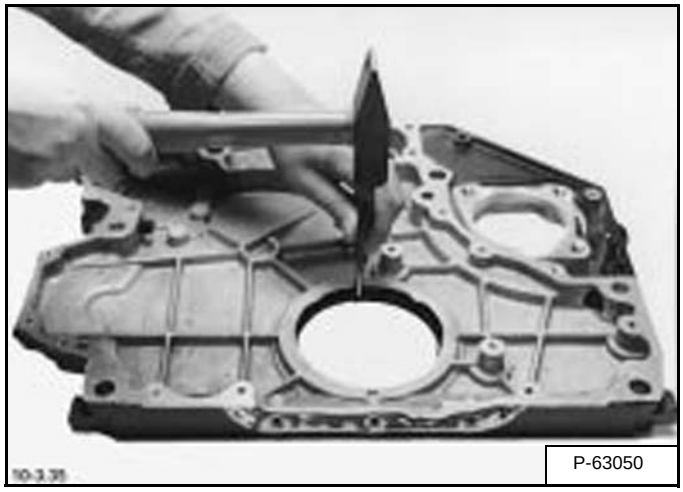
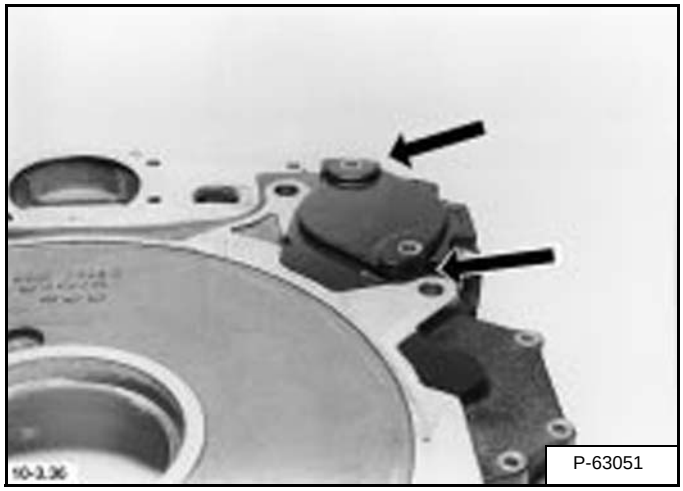
Rear Cover Seal Removal And Installation

Figure 60-80-196



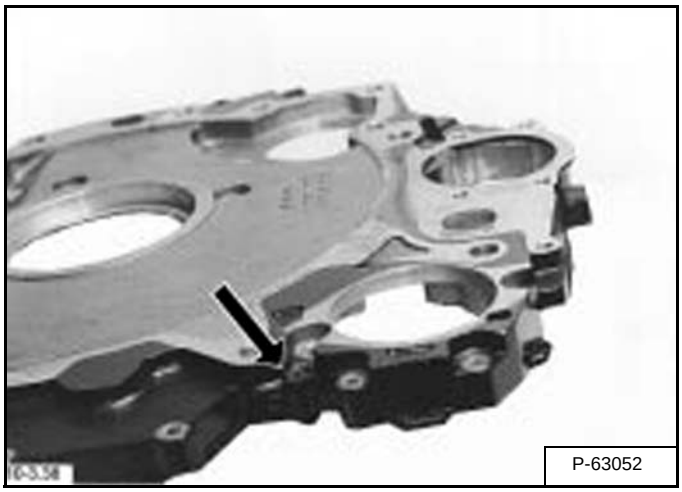
Remove the rear cover shaft seal **[Figure 60-80-196]**.

Figure 60-80-197



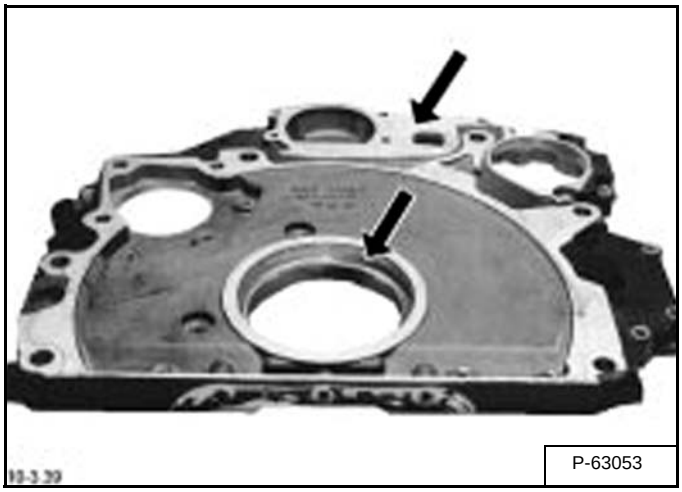
Remove cover and spacers **[Figure 60-80-197]**.

Figure 60-80-198



Remove speed sensor (if equipped) **[Figure 60-80-198]**.

Figure 60-80-199



Clean the seal seating surface **[Figure 60-80-199]**. Inspect the cover for damage, replace as needed.

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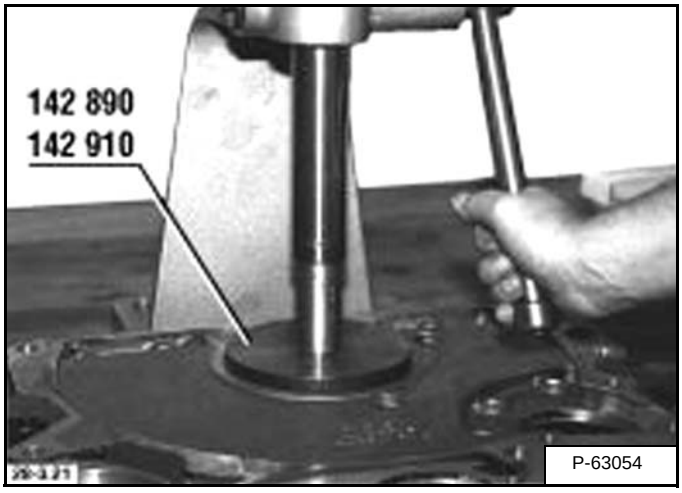
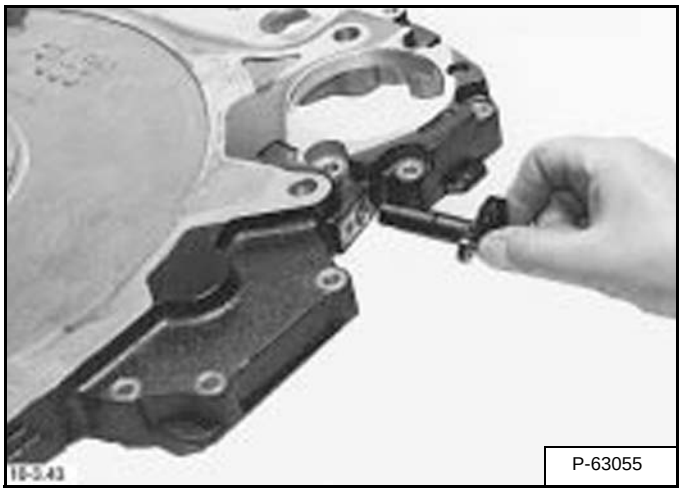
Rear Cover Seal Removal And Installation (Cont'd)

Figure 60-80-200



Use the seal driver tool and install to the correct depth **[Figure 60-80-200]**. See "Deutz Engine Tools Identification Chart" on page 1.

Figure 60-80-201



Install the speed sensor (if equipped). Tighten the bolt to 6-7 ft.-lbs (8-10 N•m) torque **[Figure 60-80-201]**.

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RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

Crankshaft, Checking

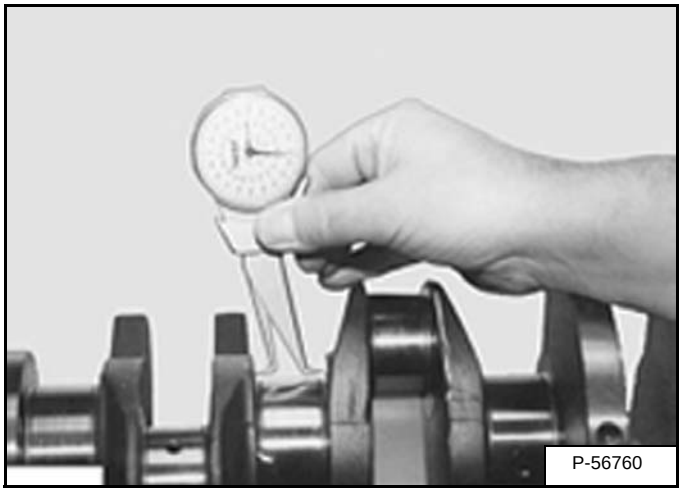
Put the crankshaft on v-blocks.

Check the main bearing journals:

Specifications:

Journal Diameter . . . . . 2.912 - 2.913 inch. (73,98 - 74,0 mm)
Each Undersize . . . . . 0.010 inch. (0,25 mm)
Undersize Limit . . . . . 2.893 inch. (73,48 mm)

Figure 60-80-202

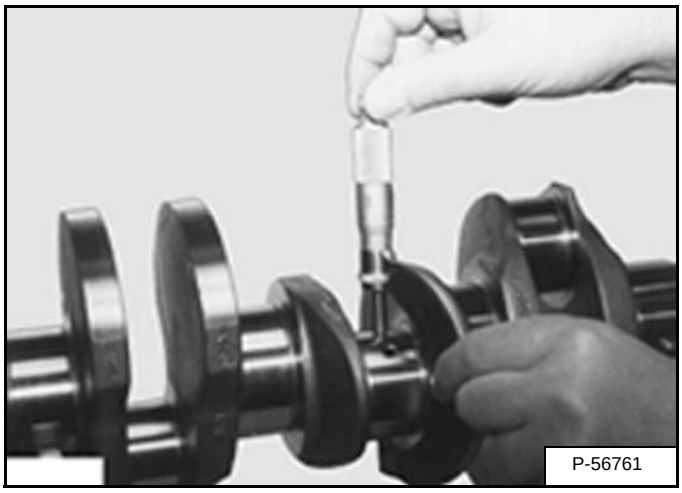


Check the thrust bearing width **[Figure 60-80-202]**.

Specifications:

Journal Width. . . . . 1.417 +0.0016 inch. (36 + 0,04 mm)
Limit Oversize . . . . . 1.395 inch. (36,44 mm)
Each Oversize . . . . . 0.016 inch. (0.4 mm)

Figure 60-80-203

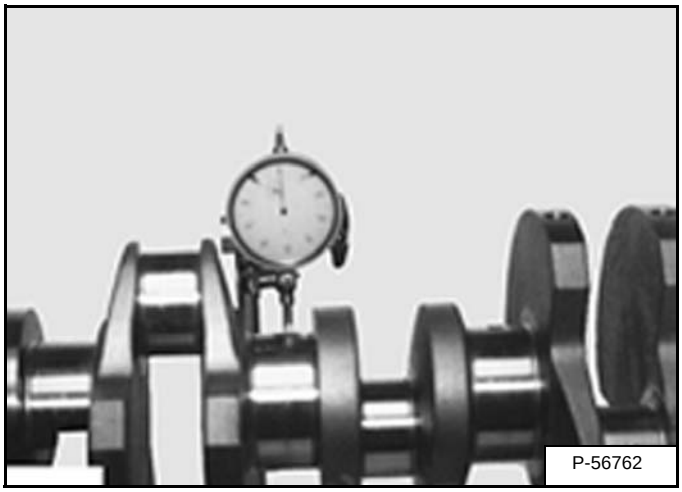


Check the connecting rod journals **[Figure 60-80-203]**.

Specifications:

Pin Diameter . . . . . .2.283 - 2.284 inch. (57,98 - 58,0 mm)
Undersize Limit . . . . . .2.263-2.264 inch. (57,48 - 57,50 mm)
Wear Limit . . . . . .0.0004 inch. (0,1 mm)

Figure 60-80-204



Use a dial indicator and check crankshaft for out of roundness **[Figure 60-80-204]**.

Specifications:

Out of Roundness Max.. . . . . 0.003 inch. (0,07 mm)

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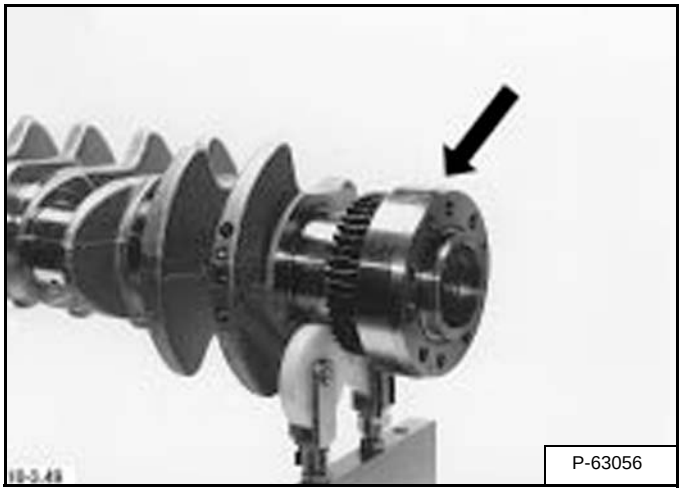
Crankshaft, Checking (Cont'd)

Figure 60-80-205



Check the surface of the crankshaft seal area **[Figure 60-80-205]**.

Recondition the crankshaft as needed.

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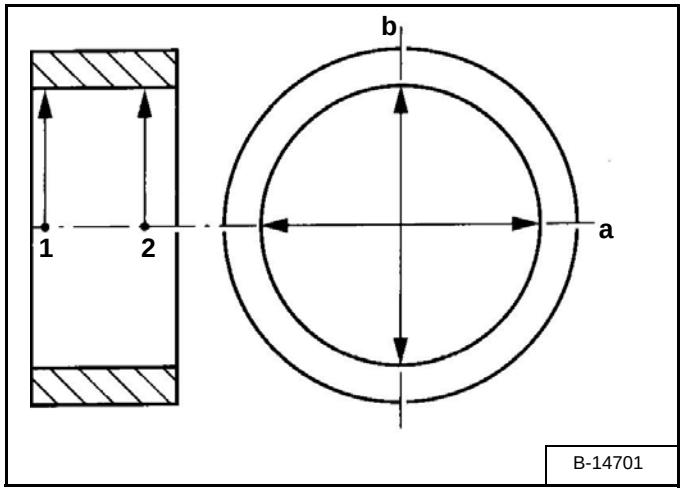
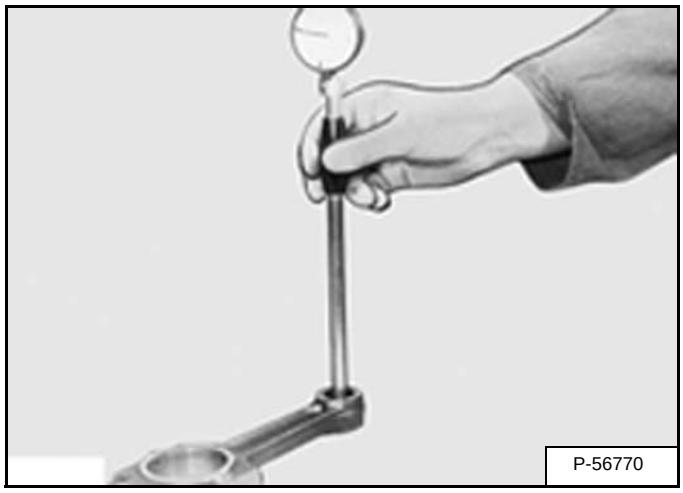
Connecting Rod, Checking

Figure 60-80-206



When checking the connecting rod large and small end, measure at the points (1) and (2) and in planes (a) and (b) **[Figure 60-80-206]**.

Figure 60-80-207

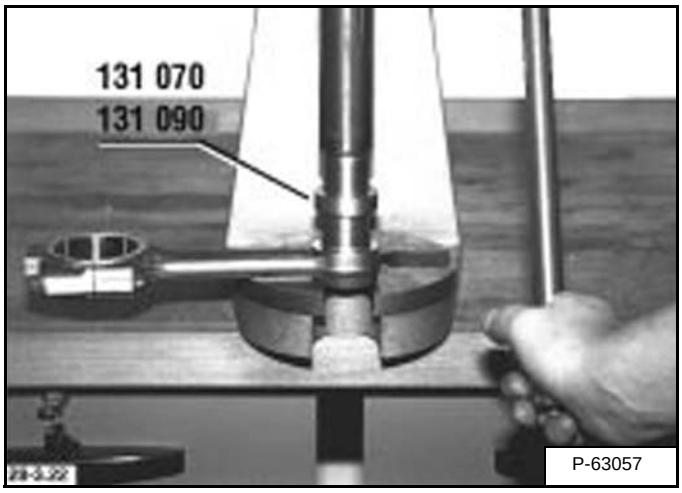


Check the small end bushing **[Figure 60-80-207]**.

Specifications:

I.D. of Small End Bushing . . . . . 1.338 - 1.340 inch.
(33,975 - 34,035 mm)
Wear Limit Bushing Clearance . . . . . 0.003 inch.
(0,08 mm)

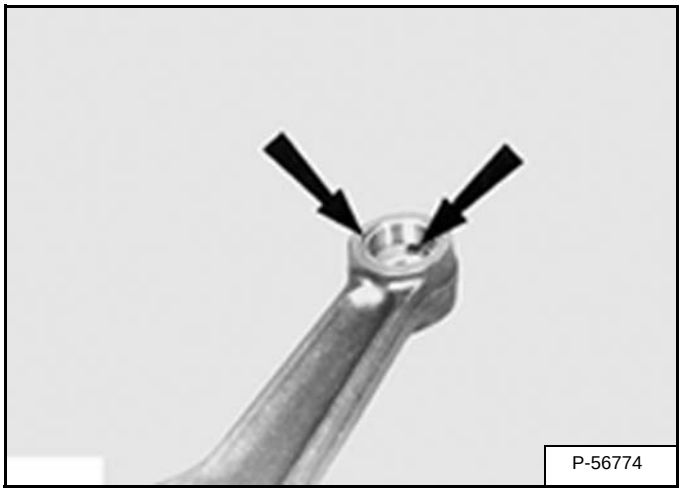
Figure 60-80-208



Replace small end bushing as needed **[Figure 60-80-208]**.

Bore for Small End Bushing . . . . . 1.457 + 0.0008 inch.
(37,0 + 0,02 mm)
O.D. of Small End Bushing . . . . . .1.4539 - 1.461 inch.
(39,93 - 37,11 mm)

Figure 60-80-209



Press in the small end bushing, make sure the lubrication holes are in alignment **[Figure 60-80-209]**.

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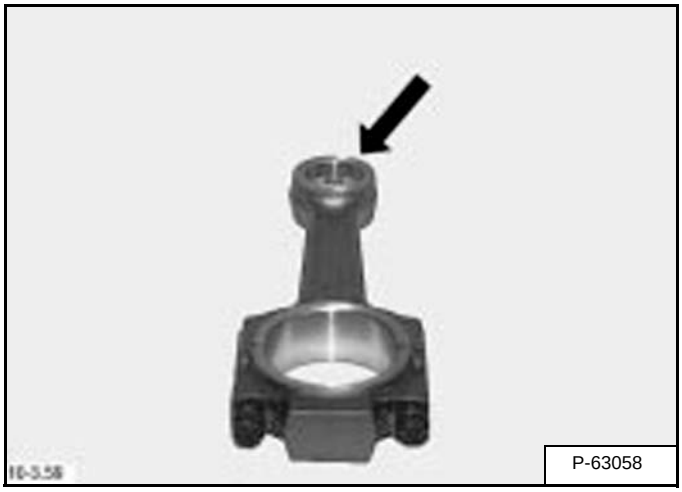
Connecting Rod, Checking (Cont'd)

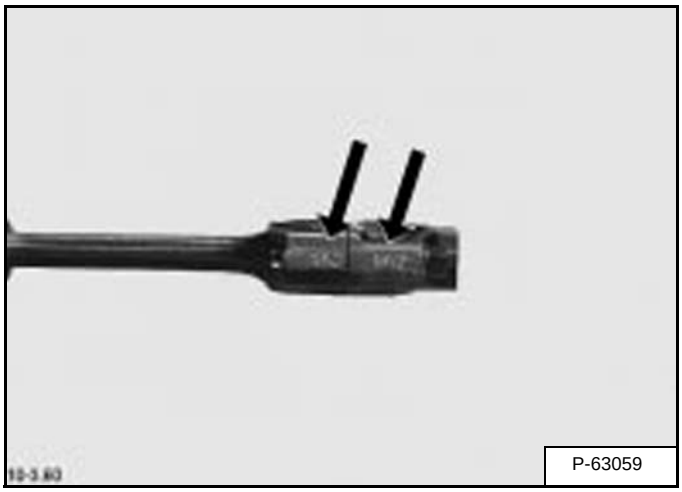
Figure 60-80-210



After pressing in the small end bushing, bore the bushing to the following dimensions **[Figure 60-80-210]**.

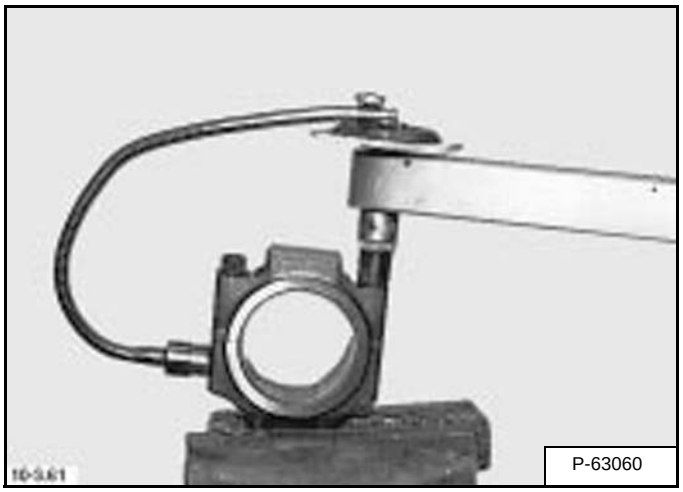
Specifications:
I.D. of Small End Bushing . . . . . 1.338-1.340 inch. (33.975 - 34.035 mm)

Figure 60-80-211



Install the correct cap on the correct rod **[Figure 60-80-211]**.

Figure 60-80-212



Tighten the connecting rod cap nuts as follows **[Figure 60-80-212]**.

Initial Torque . . . . . 22 ft.-lb. (30 N•m)
1st Step Angle . . . . . .60°
2nd Step Angle . . . . . .30°

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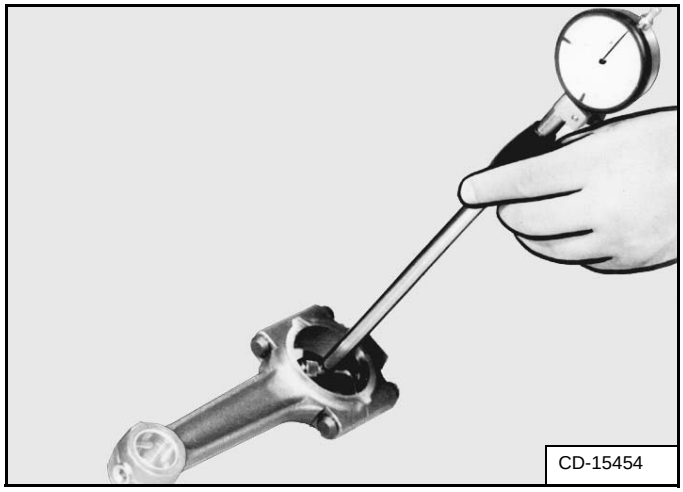
Connecting Rod, Checking (Cont'd)

Figure 60-80-213



Measure the big end bore **[Figure 60-80-213]**. If the measurement is the same as the specific valve, the necessary preload on the bearing halves will be obtained.

Specifications:
Big End I.D. . . . . 2.425 + 0.0008 inch
(61,6 + 0,02 mm)

Remove connecting rod cap. Install new bearing halves. Tighten the connecting rod cap nuts and tighten as listed in **[Figure 60-80-212 on Page 59]**.

Measure the bearing halves:
Big End Bearing I.D. . . . . 2.2846 - 2.2862 inch.
(58,03 - 58,07 mm)
Each Undersize . . . . . 0.010 inch.
(0,25 mm)
Limit For Undersize . . . . . 2.2748 - 2.3157 inch.
(57,78 - 57,82 mm)
Radial Clearance
Wear Limit . . . . . 0.005 inch. (0,12 mm)

Check the connecting rod, without bearing halves, on a connecting rod tester.

Specifications:
Parallel Check-Tolerance . . . . . 0.002 inch. (0,05 mm)
Over a Distance of . . . . . 3.94 inch. (100 mm)
Squareness Check-Tolerance . . . . 0.002 inch. (0,05 mm)

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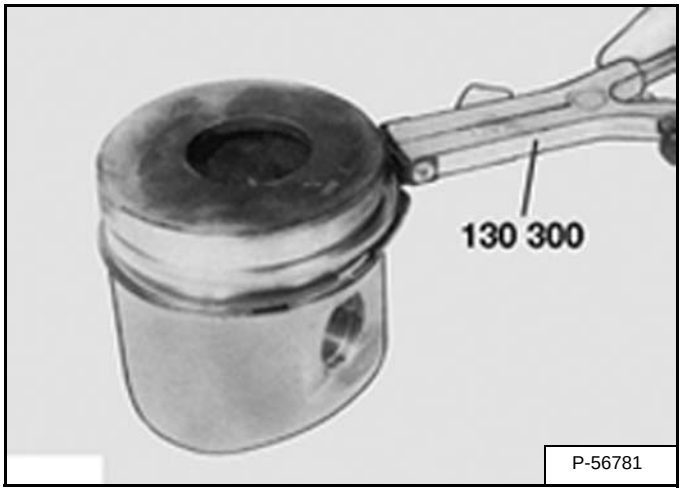
Piston, Checking

Figure 60-80-214

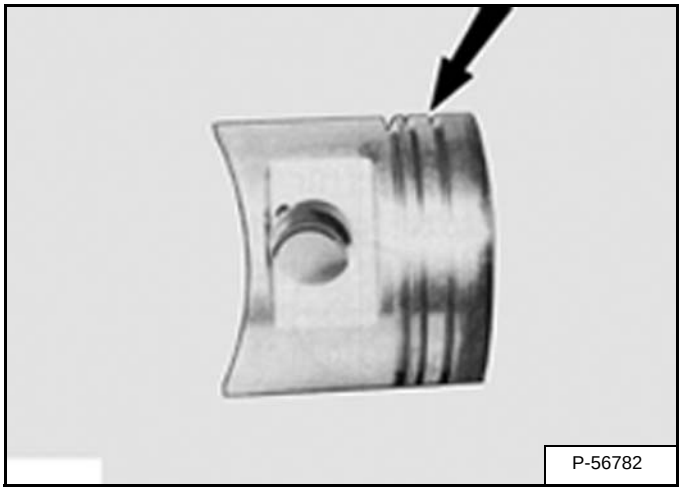


Remove the piston rings from the piston **[Figure 60-80-214]**.

Remove the piston from the connecting rod.

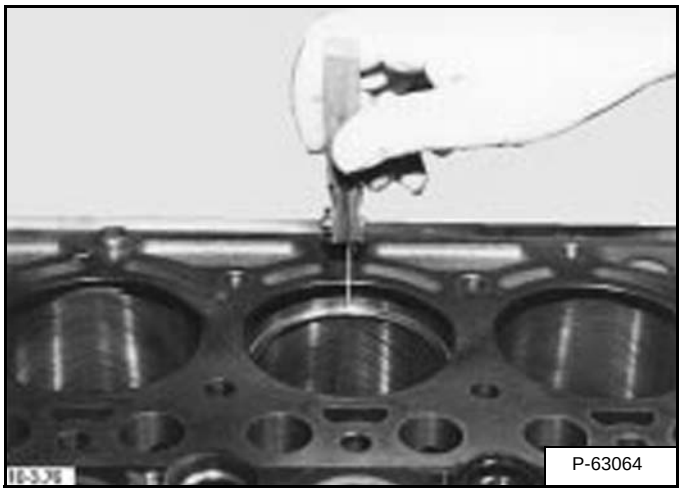
See Connecting Rod, Checking to check connecting rod specifications. (See Connecting Rod, Checking on Page 60-80-58.)

Figure 60-80-215



Clean and inspect piston and piston ring grooves **[Figure 60-80-215]**.

Figure 60-80-216



Measure the ring gap with a feeler gauge in the cylinder **[Figure 60-80-216]**.

Specifications:
Wear Limit
1st Ring Gap . . . . . 0.031 inch. (0,8 mm)
2nd Ring Gap . . . . . 0.098 inch. (2,5 mm)
3rd Ring Gap . . . . . 0.045 inch. (1,15 mm)

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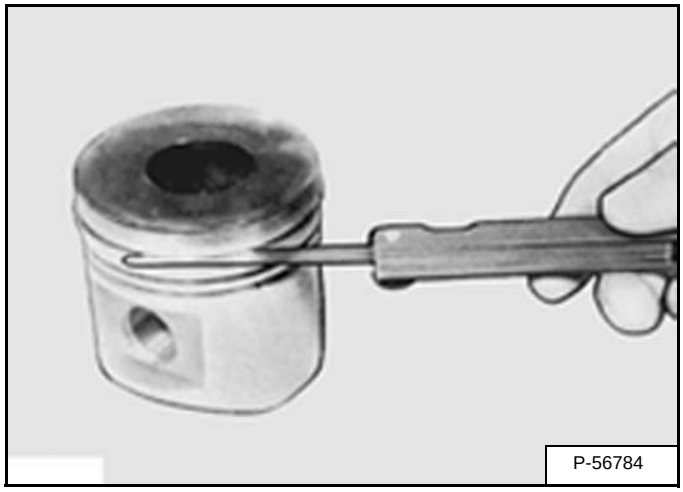
Piston, Checking (Cont'd)

Figure 60-80-217



Using new rings, measure the ring grooves using a feeler gauge **[Figure 60-80-217]**.

Specifications:
Wear Limit
1st Ring. . . . . Keystone Groove
2nd Ring . . . . . 0.007 inch. (0.17 mm)
3rd Ring . . . . . 0.004 inch. (0.10 mm)

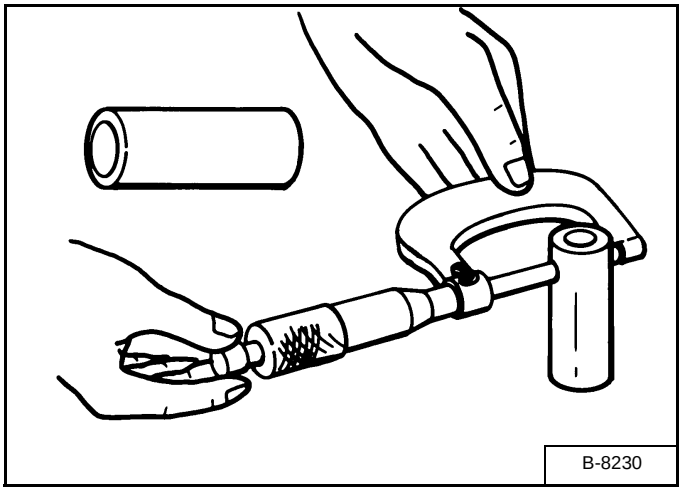
Measure the keystone groove with the keystone groove gauge **[Figure 60-80-217]**.

If a distance is present between the gauge and piston, the piston is serviceable **[Figure 60-80-217]**.

If the gauge rests against the piston, replace the piston **[Figure 60-80-217]**.

Piston Pin, Checking

Figure 60-80-218



Check piston pin for wear **[Figure 60-80-218]**.

Specifications:
Pin O.D. . . . . 1.3383-1.3386 inch. (33,994-34,0 mm)

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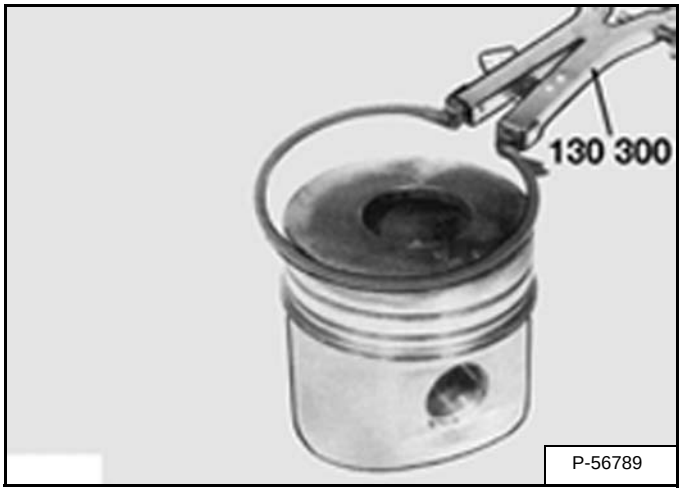
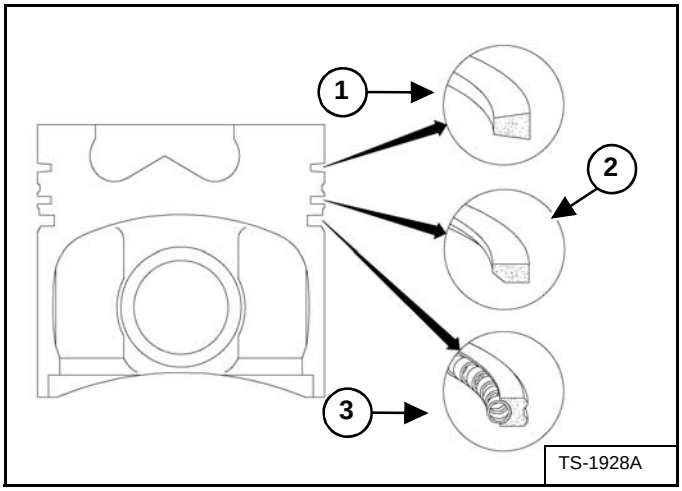
Piston Rings Installation

Figure 60-80-219



When installing the piston rings position them as listed below **[Figure 60-80-219]**.

Figure 60-80-220



lst Ring - Is a trapezoidal ring, (Item 1) **[Figure 60-80-220]**. It is installed on the piston with the facing the combustion chamber.

2nd Ring - Is a tapered compression ring (Item 2) **[Figure 60-80-220]**, which is installed on the piston with the mark TOP facing the combustion chamber.

3rd Ring - Is a bevelled edge slotted oil control ring (Item 3) **[Figure 60-80-220]**.

The gap of each ring must be offset by 180° to the other ring.

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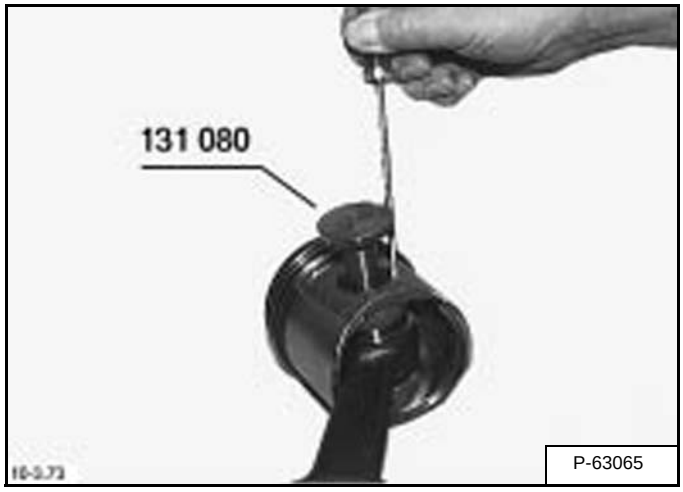
Piston Installation On The Connecting Rod

Figure 60-80-221

Install the snap ring **[Figure 60-80-221]**.

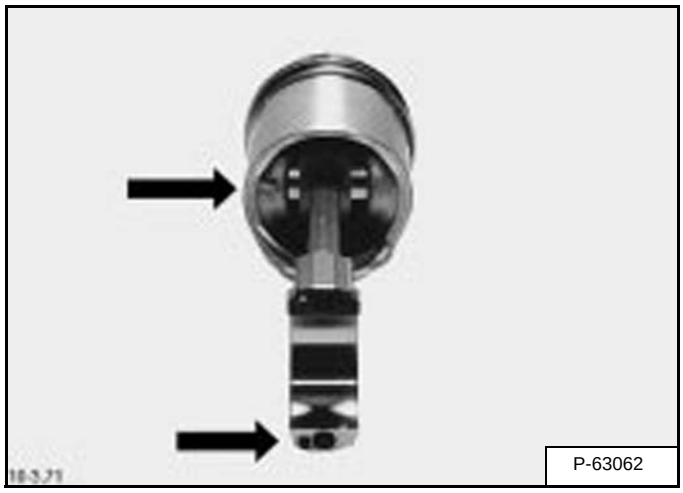
NOTE The ring gap of the snap rings must face toward the piston crown.

Figure 60-80-222



Install the piston on the rod. Install the piston pin **[Figure 60-80-222]**.

Figure 60-80-223



The flywheel symbol on the piston and dowel pins on the connecting rod must be located on the same side **[Figure 60-80-223]**.

Figure 60-80-224

Install the snap ring **[Figure 60-80-224]**.

NOTE: The ring gap of the snap rings must face toward the piston crown.

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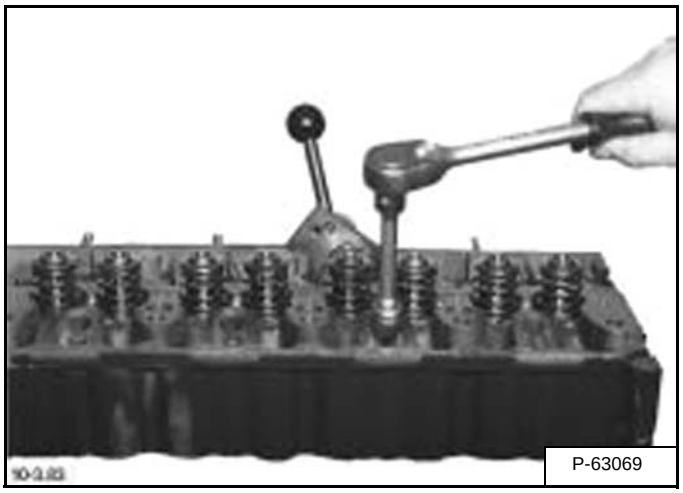
Cylinder Head Disassembly

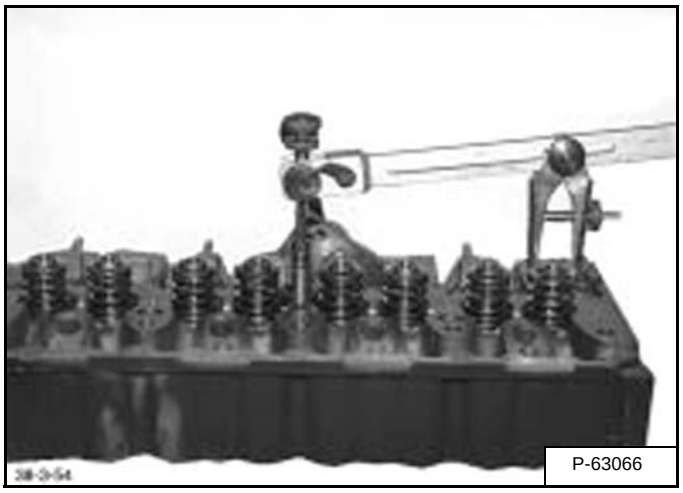
NOTE: Do not grind the cylinder head surface, if its damaged, replace the cylinder head.

Figure 60-80-225



Remove the glowplugs **[Figure 60-80-225]**.

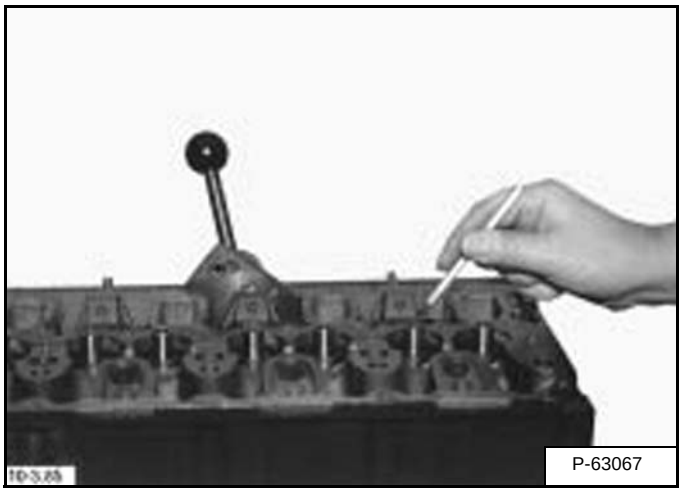
Figure 60-80-226



Using a valve spring tool, remove the spring locks, valve spring cap, valve spring and valve **[Figure 60-80-226]**. See "Deutz Engine Tools Identification Chart" on page 1.

Repeat the procedure for all the valves.

Figure 60-80-227



Remove the valve seals **[Figure 60-80-227]**.

Clean the cylinder head and inspect for damage.

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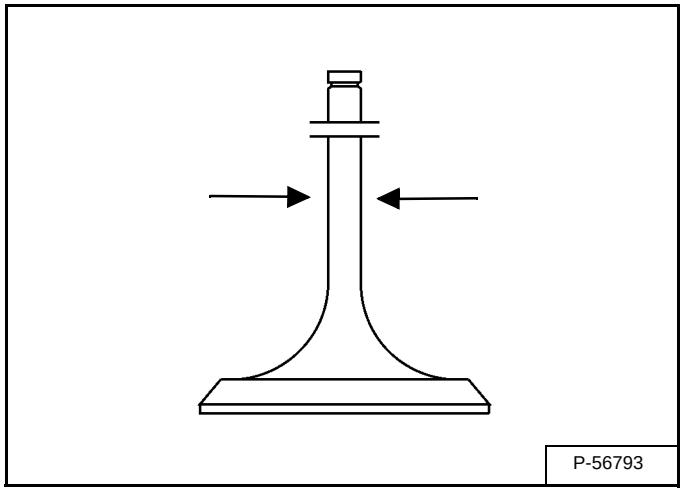
Valves, Checking

Figure 60-80-228

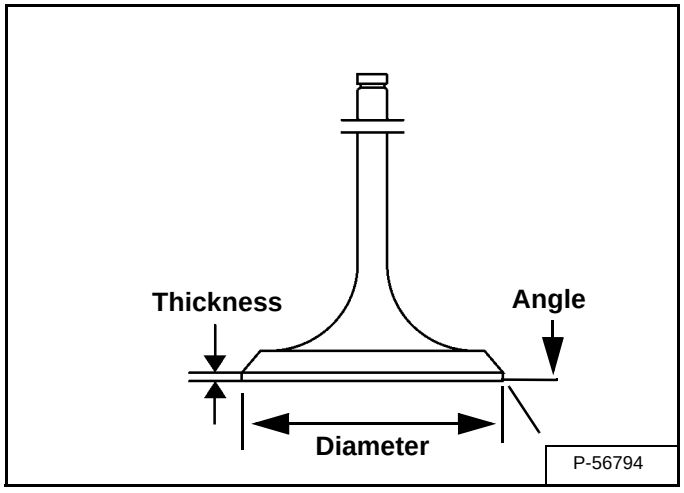


Measure the valve stem diameter **[Figure 60-80-228]**.

Std. Intake Valve . . . . . 0.308-0.0006 inch. (7,98-0,015 mm)

Std. Exhaust Valve . . . . . 0.313-0.0006 inch. (7,96-0,015 mm)

Figure 60-80-229

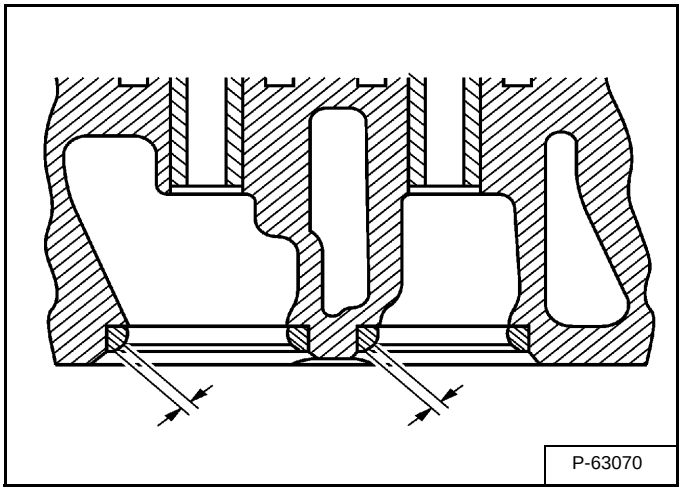


Measure the valve edge thickness **[Figure 60-80-229]**.
Specifications:
Intake Valve . . . . . 0.071 inch. (1,8 mm)
Exhaust Valve . . . . . 0.043 inch. (1,1 mm)

Measure the valve head diameter **[Figure 60-80-229]**.
Specifications:
Intake Valve . . . . . 1.618 ± 0.004 inch (41,5 ± 0,1 mm)
Exhaust Valve . . 1.430 ± 0.004 inch. (35,9 ± 0,01 mm)

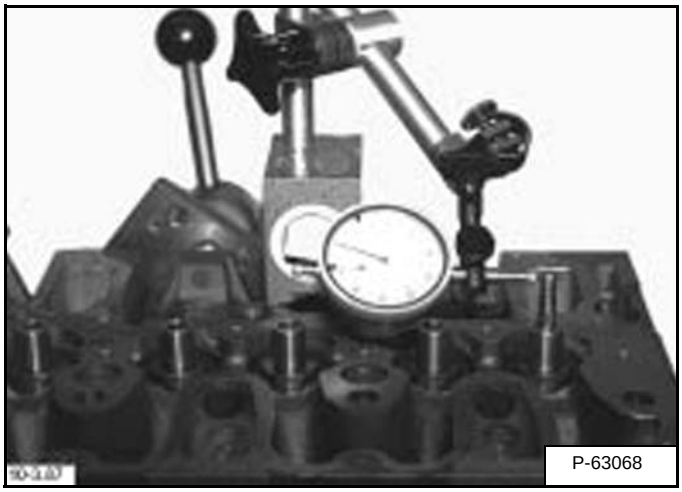
Valve seat angle:
Specifications:
Intake Valve . . . . . 30°
Exhaust Valve . . . . . 45°

Figure 60-80-230



Measure the valve seat width **[Figure 60-80-230]**.
Specifications:
Width (Intake) . . . . . 0.106 ± 0.016 inch. (1,27 ± 0,4 mm)
(Exhaust) . . . . . 0.083 ± 0.016 inch. (2,1 ± 0,4 mm)

Figure 60-80-231



Install the valves and measure the valve stem clearance **[Figure 60-80-231]**.

Wear Limit:
Intake Valve . . . . . 0.004 inch (0,10 mm)
Exhaust Valve . . . . . 0.006 inch (1,13 mm)

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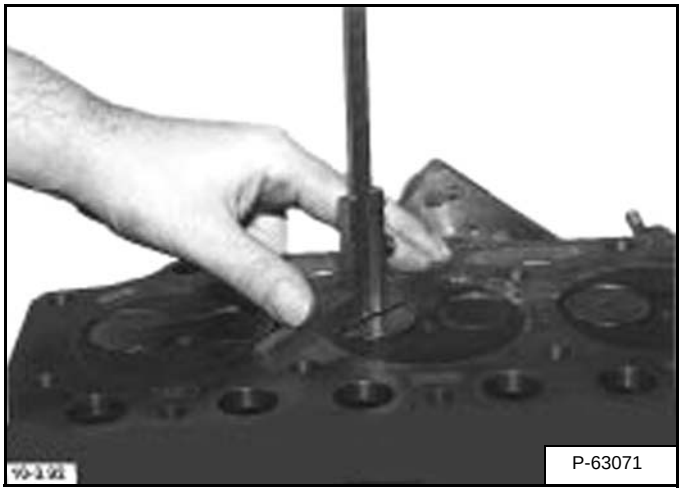
Valve Clearance Adjustment

Figure 60-80-232

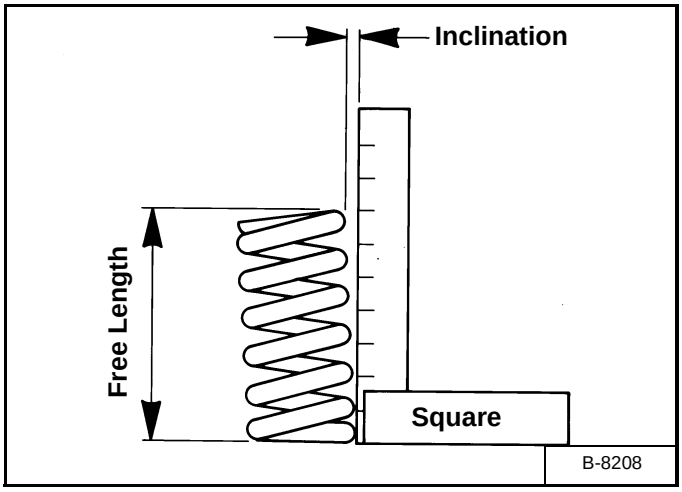


Measure the valve clearance between the valve head and cylinder head sealing surface **[Figure 60-80-232]**.

Valve penetration into cylinder head:
Specifications:
Wear Limit . . . . . .0.0551 inch. (1,4 mm)

Recondition the valve seats and valve guides if worn.

Figure 60-80-233



Measure valve spring free length **[Figure 60-80-233]**.

Specifications:
Valve Spring Free Length . . . . . 2.323±0.08 inch. (59±1,9 mm)

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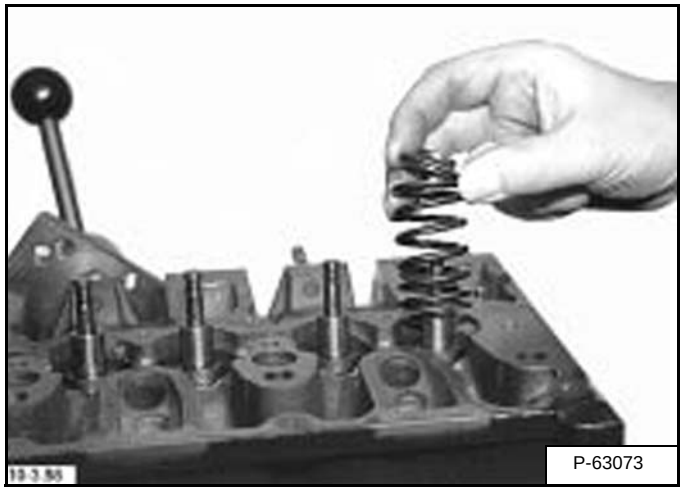
Cylinder Head Assembly

Figure 60-80-234

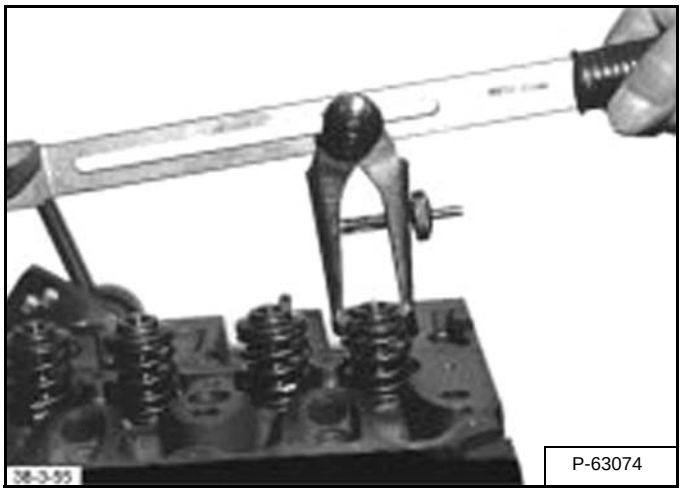
Install the valve into the cylinder head and install the valve stem seal **[Figure 60-80-234]**.

Figure 60-80-235



Install the valve spring and cap **[Figure 60-80-235]**.

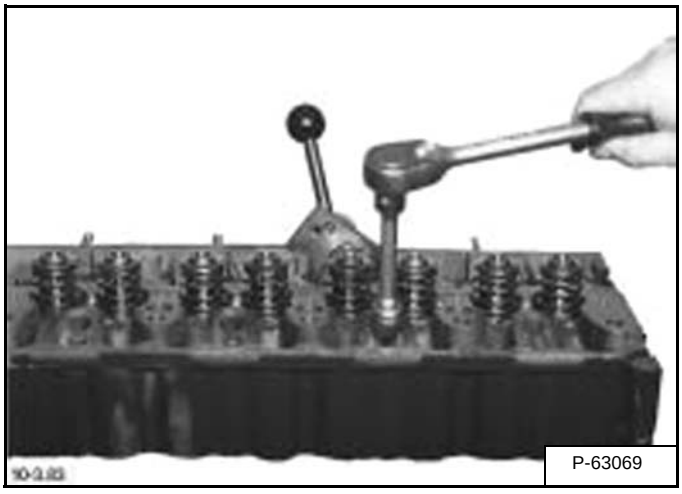
Figure 60-80-236



Use the valve spring tool, install the valve spring locks **[Figure 60-80-236]**.

Repeat the procedure to install all the valves.

Figure 60-80-237



Install the glow plugs **[Figure 60-80-237]**.

Tighten the glow plugs to 7-11 ft.-lb. (10-15 N•m) torque.

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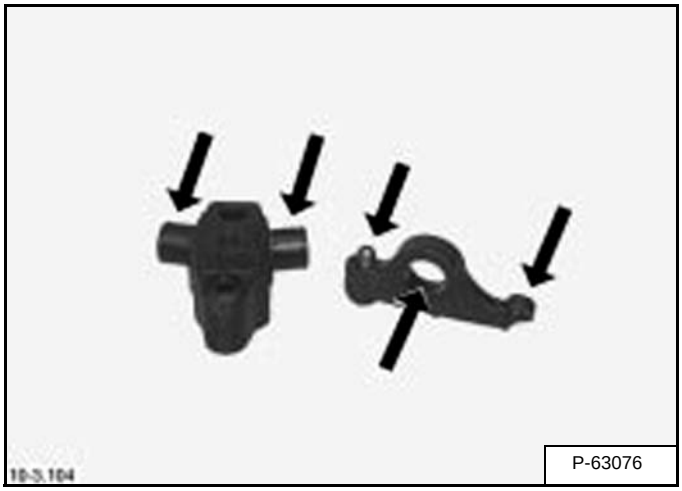
Rocker Arm And Bracket, Checking

Figure 60-80-238

Disassemble the rocker arms from the bracket **[Figure 60-80-238]**.

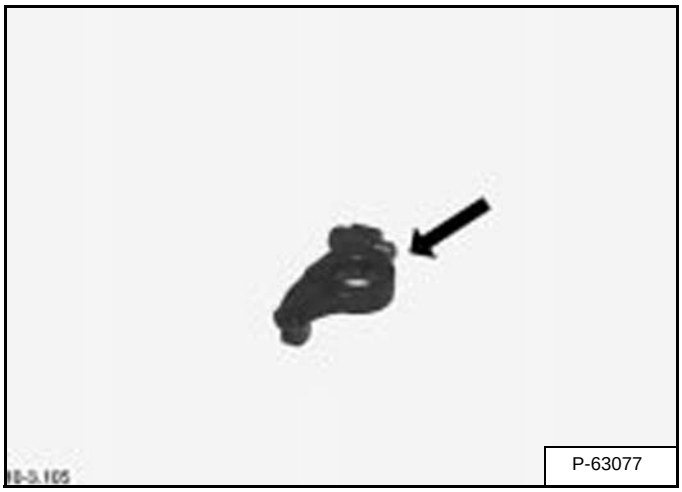
Figure 60-80-239



Check for wear at the following locations and replace as needed **[Figure 60-80-239]**:

Journals
Adjusting Bolt
Rocker Arm Contact Face
Bore

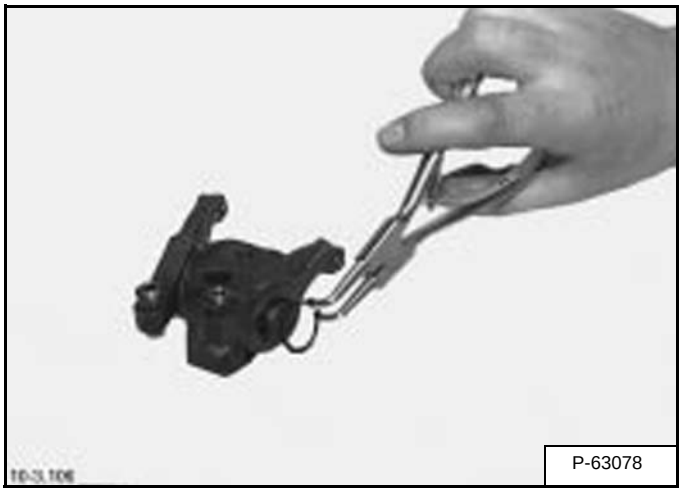
Figure 60-80-240



Check the oil passages that they are open and clean **[Figure 60-80-240]**.

Install the rocker arms on the bracket.

Figure 60-80-241



Install the snap ring **[Figure 60-80-241]**.

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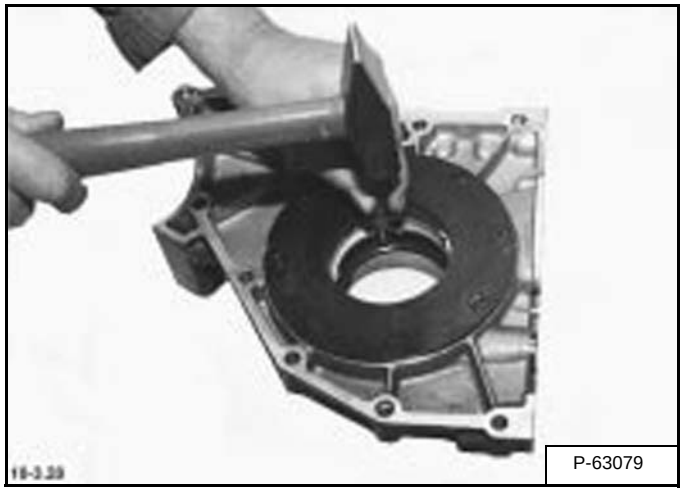
RECONDITIONING THE ENGINE (S/N 522311001 & ABOVE) (CONT'D)

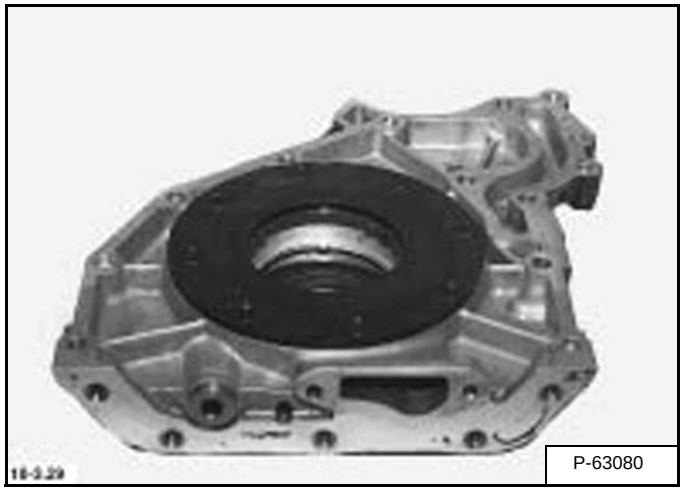
Front Cover Disassembly

Figure 60-80-242



Remove the breather vent **[Figure 60-80-242]**.

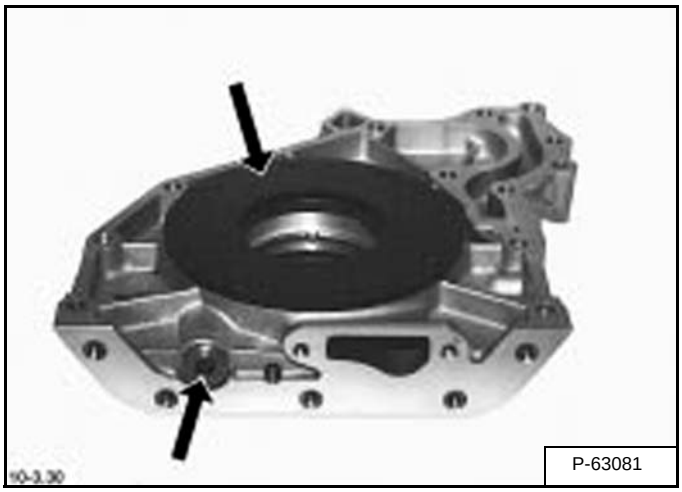
Figure 60-80-243



Inspect the front cover. Replace if necessary **[Figure 60-80-243]**.

NOTE: The rotor must turn freely.

Figure 60-80-244



Remove the oil pump and pressure control valve **[Figure 60-80-244]**.

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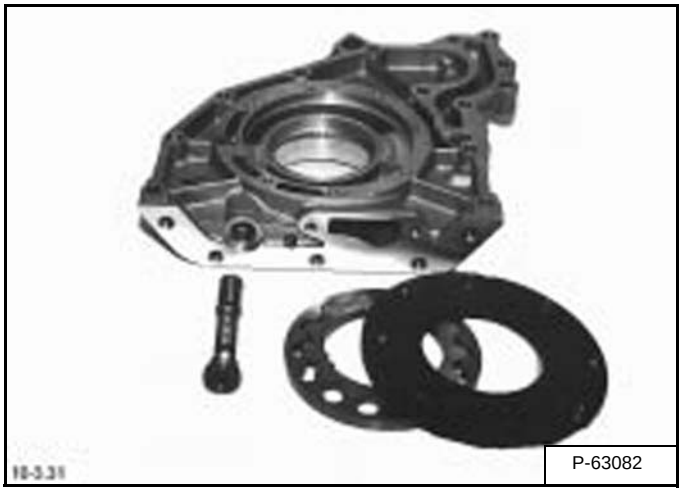
Front Cover Assembly

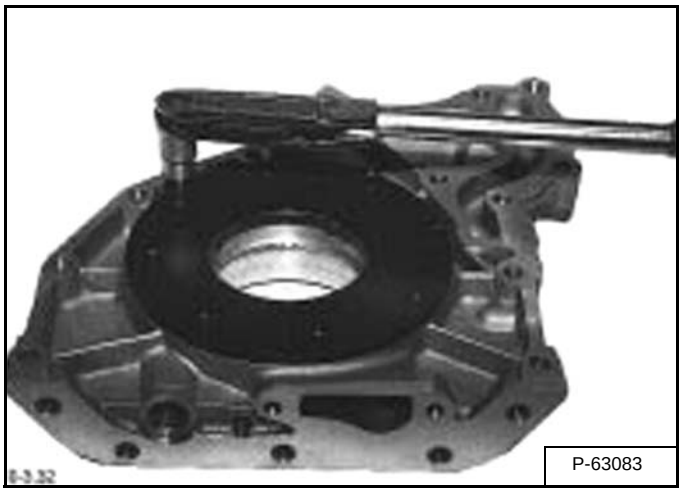
Figure 60-80-245



Inspect the front cover for damage **[Figure 60-80-245]**.

Replace the front cover if any components are damaged.

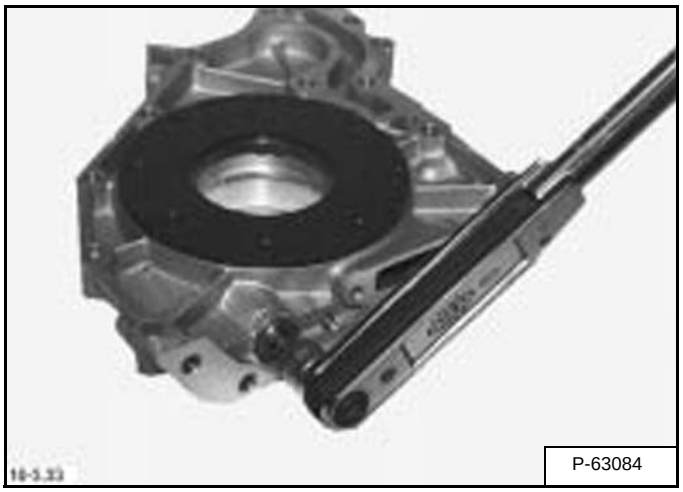
Figure 60-80-246



Install the oil pump **[Figure 60-80-246]**.

Tighten the oil pump to 6-7 ft.-lb. (8-9 N•m) torque.

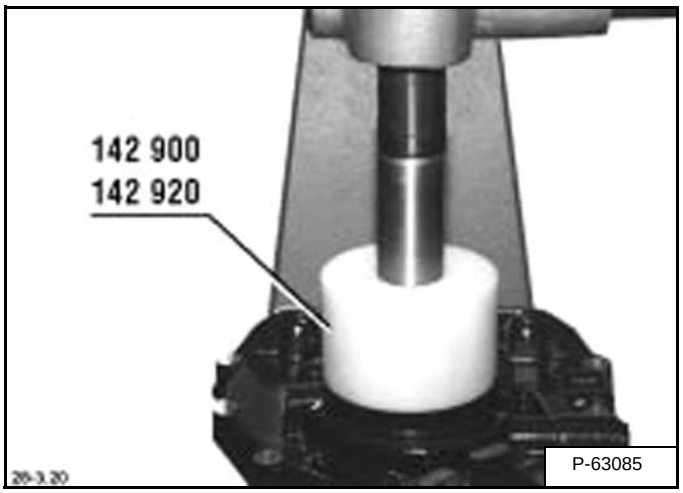
Figure 60-80-247



Install the pressure control valve **[Figure 60-80-247]**.

Tighten 27-32 ft.-lb. (36-44 N•m) torque.

Figure 60-80-248



Install the shaft **[Figure 60-80-248]**.

NOTE: Apply a dry lubricant to the shaft seal.

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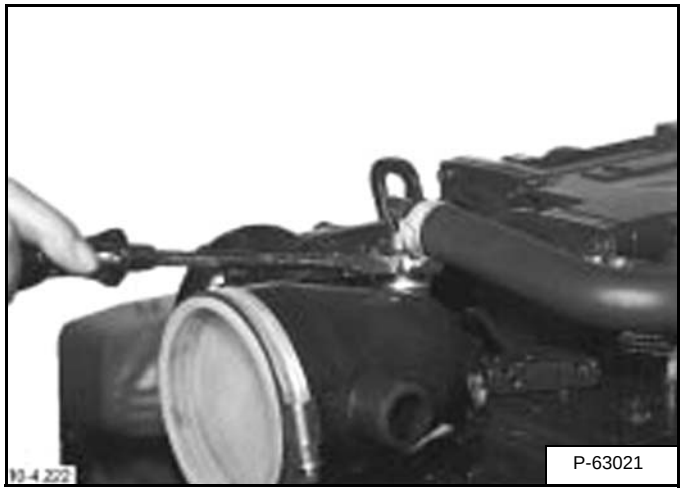
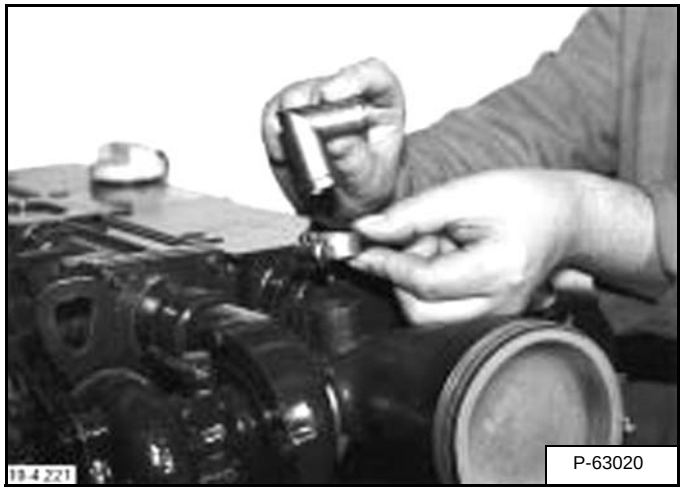
Turbo Charger Removal and Installation

Figure 60-80-249



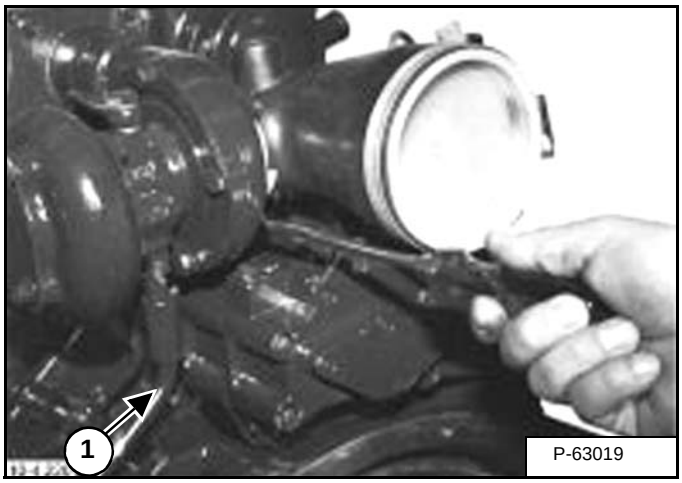
Remove the clamp and breather hose **[Figure 60-80-249]**.

Figure 60-80-250



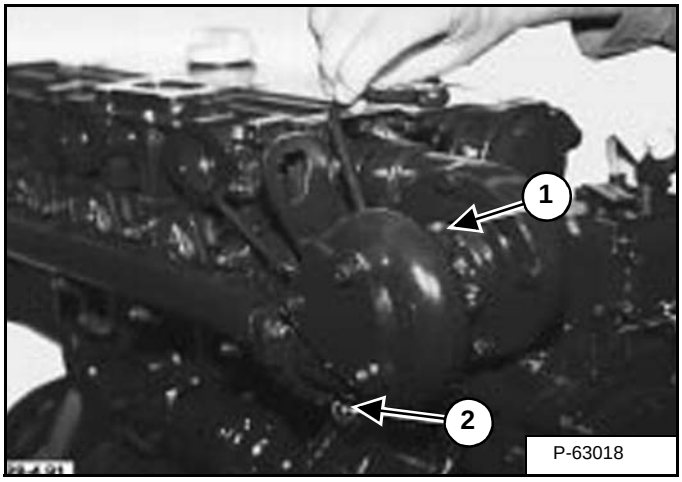
Remove the elbow (Item 1) **[Figure 60-80-250]**.

Figure 60-80-251



Remove the air inlet hose (Item 1) **[Figure 60-80-251]**.

Figure 60-80-252



Remove the oil pressure pipe (Item 1) **[Figure 60-80-252]**.

Installation: Tighten the bolt to 19-24 ft.-lb. (26-32 N•m) torque.

Tighten the bolt (Item 2) to 26-32 ft.-lb. (35-43 N•m) torque.

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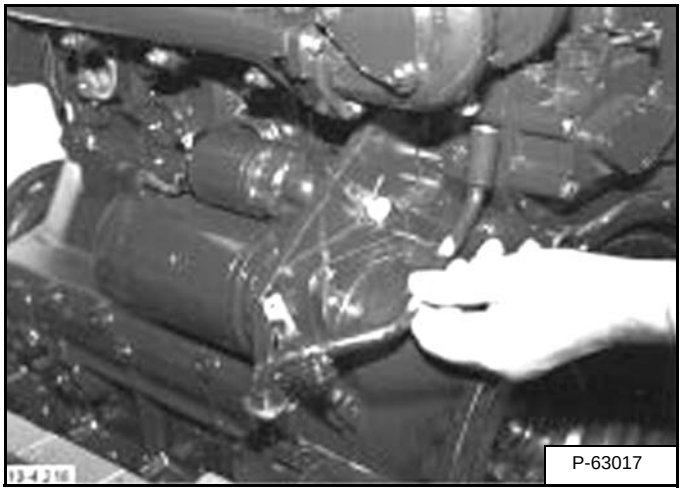
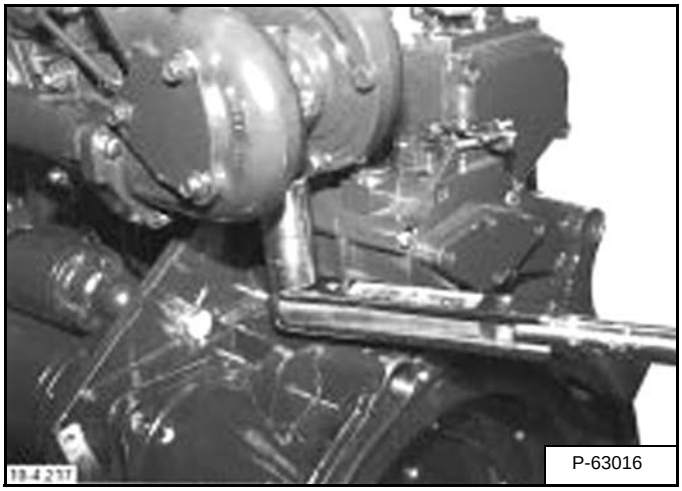
Turbo Charger Removal and Installation (Cont'd)

Figure 60-80-253



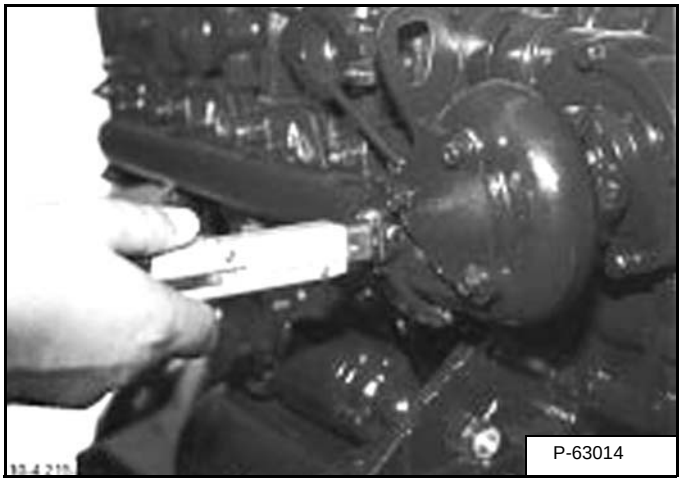
Remove the oil return pipe **[Figure 60-80-253]**.

Figure 60-80-254



Remove the plug **[Figure 60-80-254]**.

Figure 60-80-255



Remove the nuts **[Figure 60-80-255]**.

Installation: Apply anti-seize to the studs. Tighten the nuts to 14-17 ft.-lb. (19-23 N•m) torque.

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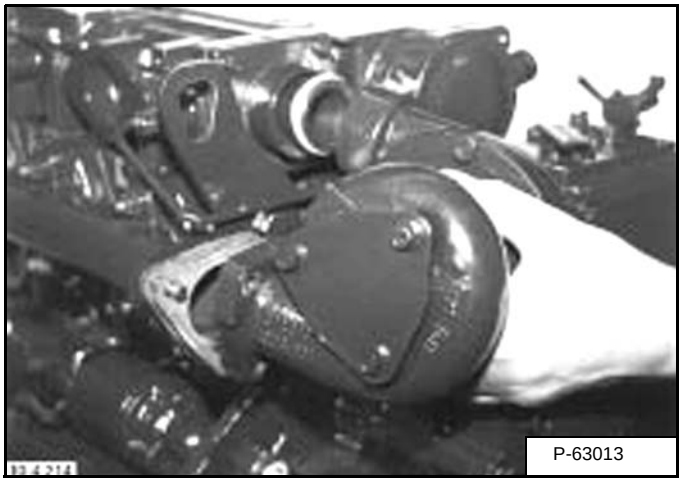
Turbo Charger Removal and Installation (Cont'd)

Figure 60-80-256



Remove the turbo charger **[Figure 60-80-256]**.

Installation: Prelubricate the turbo charger by spraying a drop of oil into the oil supply line.

NOTE: In the event of severe engine oil contamination, drain and flush the engine oil cooler, cab heater and plumbing.

Drain the engine oil from the crankcase and replace the engine oil and filter. (See Replacing Oil And Filter on Page 10-90-2.)

Start the engine and run at idle until oil pressure is assured.

Work the unit until operating temperature of engine is maintained for approximately 15 minutes.

Idle and cool the down engine approximately 3 to 4 minutes, and stop the engine.

Drain the engine oil from the crankcase again, replace the engine oil and filter. (See Replacing Oil And Filter on Page 10-90-2.)

Re-start engine, check for leaks and performance.

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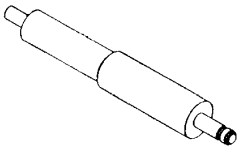
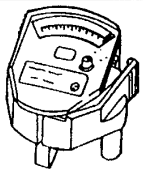
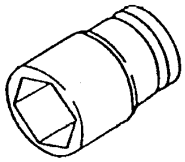
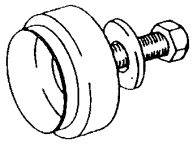
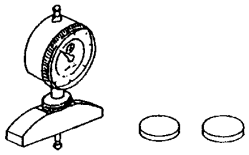
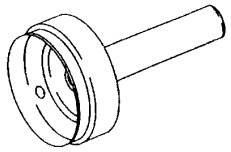
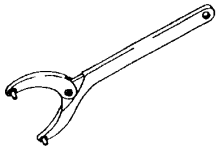
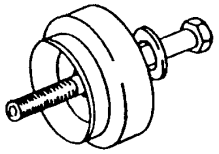
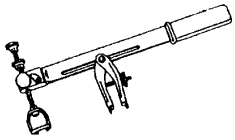
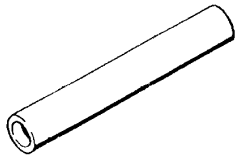
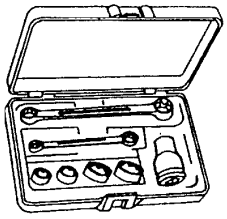
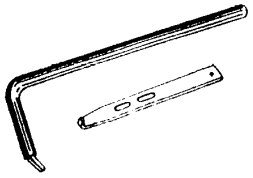
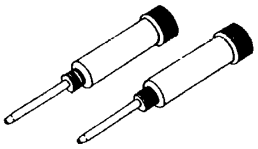
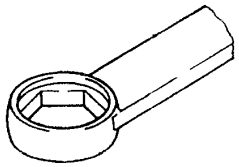
Deutz Engine Tools Identification Chart

Part No.	Description	Illustration	Part No.	Description	Illustration
MEL1433	Compression Test Adapter		MEL1460	Belt Tension Tool for Toothed Belt	
MEL1453	Socket 60 JMP		MEL1461	Crankshaft Seal Tool (Front)	
MEL1454	Depth Gauge w/Spacers		MEL1462	Crankshaft Seal Tool (Rear)	
MEL1455	Spanner		MEL1463	Camshaft Seal Tool	
MEL1456	Valve Spring Assembly Lever		MEL1464	Valve Stem Seal Tool	
MEL1457	Torx Tool Kit		MEL1465	Crankshaft Gasket Removing Tool	
MEL1458	Timing Pin for Crankshaft and Camshaft		MEL1466	Camshaft Gear Wrench	
MEL1459	Adjusting Pin for Injection Pump Control		MEL1467	Centering Pin Injection Pump Control Lever	

B-16718

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Disassembly

Remove the engine. Mount the engine on a suitable engine stand.

Remove the starter. (See Removal And Installation (S/N 528911001 & Above And S/N 528611001 & Above) on Page 50-40-1.)

Remove the alternator. (See Removal And Installation (S/N 528911001 & Above And 528611001 & Above) on Page 50-30-3)

Drain the oil from the engine oil pan.

Remove the turbocharger. See "Turbo Charger Removal and Installation" on page 70.

Remove the fuel injectors. (See Fuel Injector Removal And Installation on Page 60-51-13.)

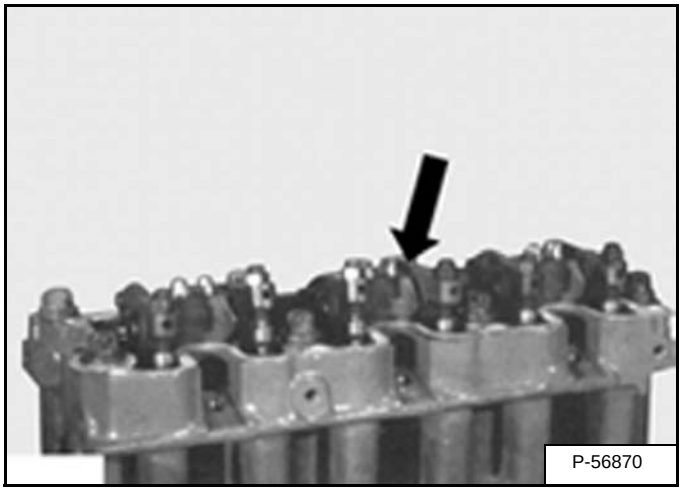
Remove the exhaust manifold.

Remove the intake manifold.

Remove the oil filter.

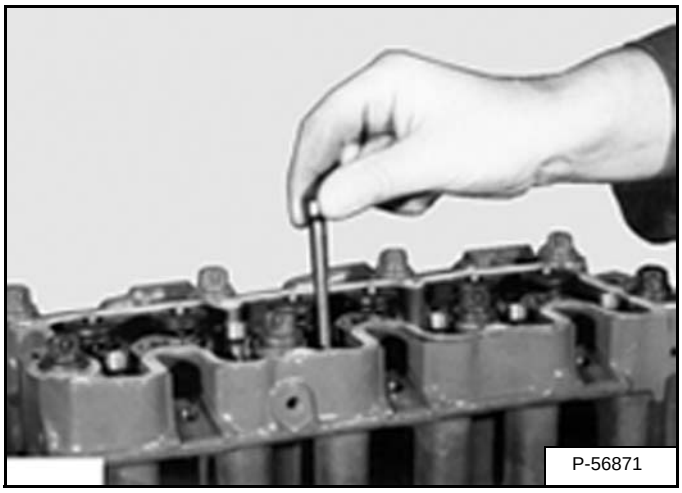
Remove the valve cover.

Figure 60-81-1



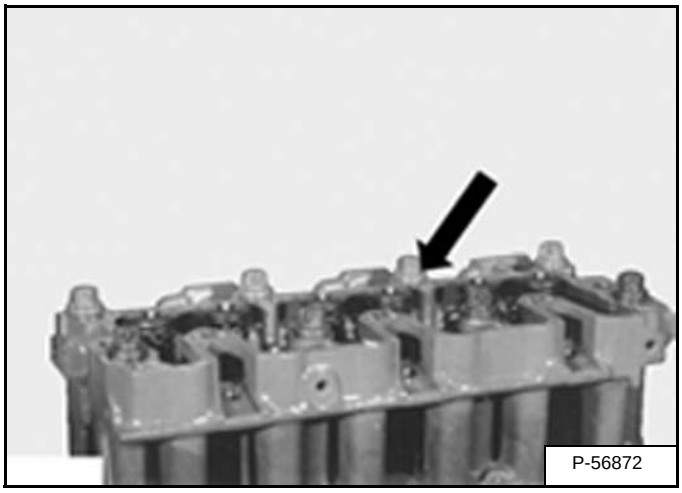
Remove the rocker arms and brackets **[Figure 60-81-1]**.

Figure 60-81-2



Remove the push rods **[Figure 60-81-2]**.

Figure 60-81-3



Remove the cylinder head bolts. Remove the cylinder head **[Figure 60-81-3]**.

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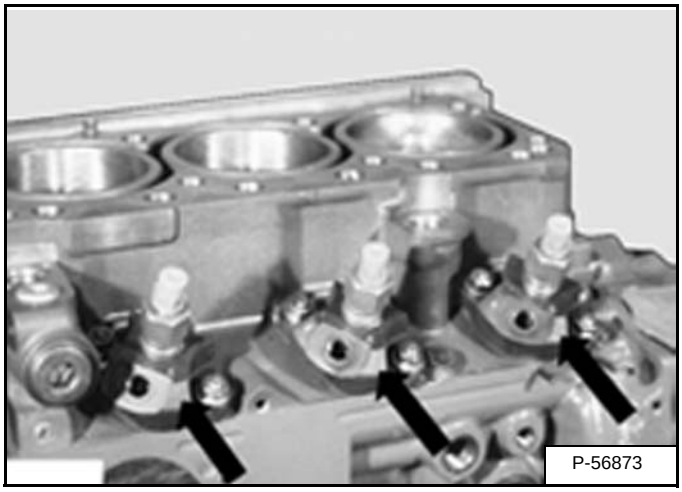
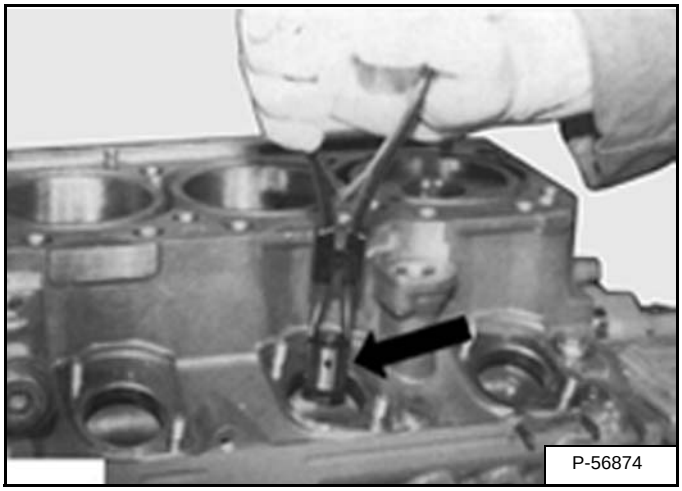
Disassembly (Cont'd)

Figure 60-81-4



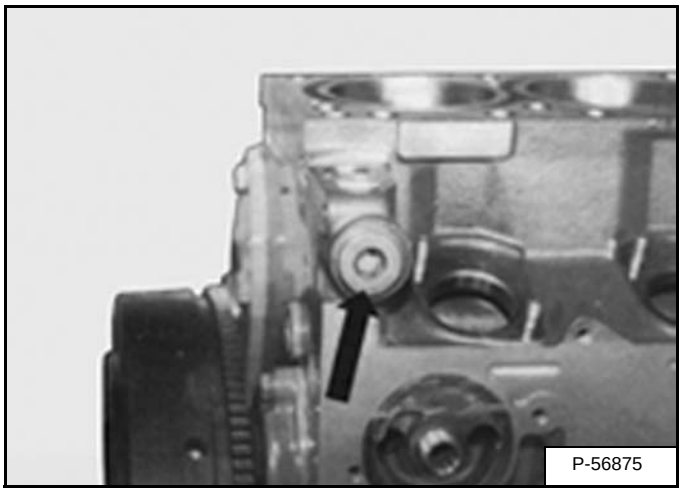
Remove the fuel injection pumps **[Figure 60-81-4]**.

Figure 60-81-5



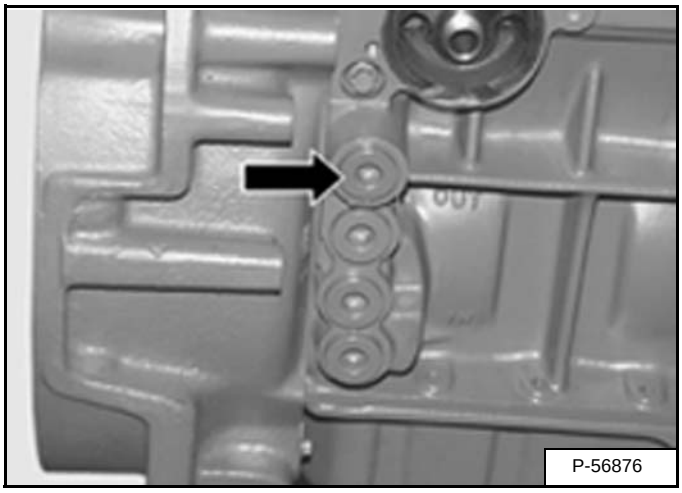
Remove the injection pump roller tappets **[Figure 60-81-5]**.

Figure 60-81-6



Remove the thermostat **[Figure 60-81-6]**.

Figure 60-81-7



Remove the oil pressure control valve **[Figure 60-81-7]**.

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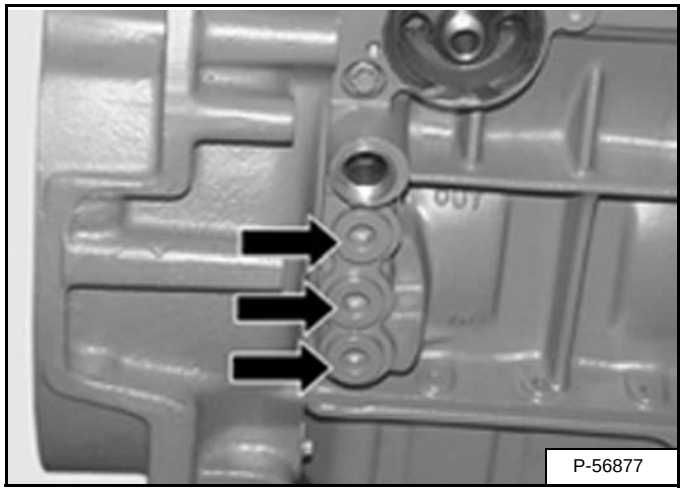
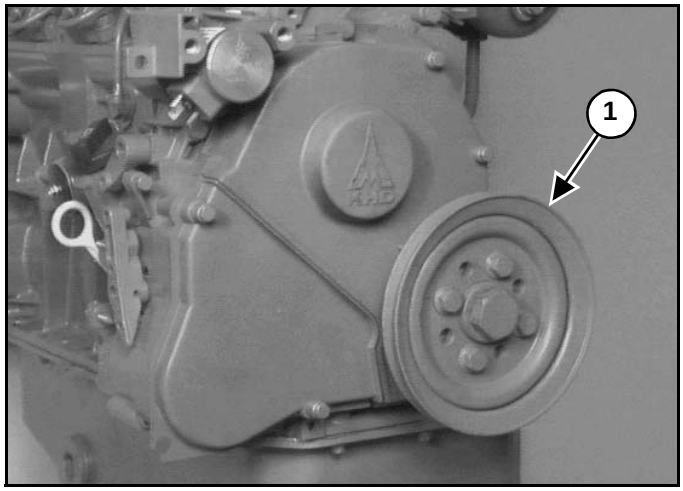
Disassembly (Cont'd)

Figure 60-81-8



Remove the plugs and heater oil pressure control valves **[Figure 60-81-8]**.

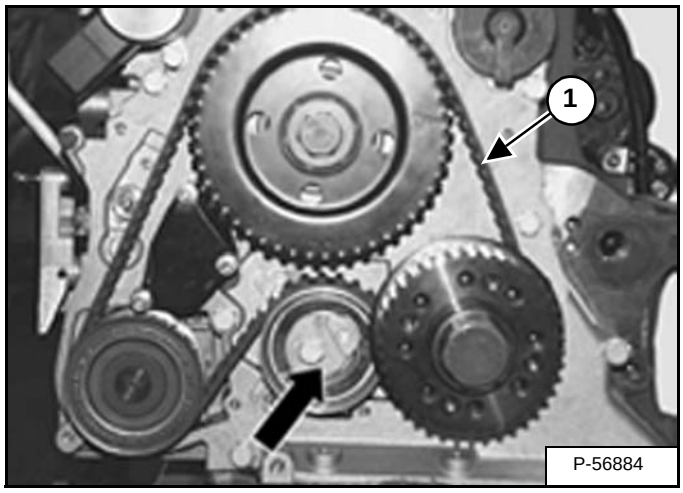
Figure 60-81-9



Remove the belt pulley (Item 1) **[Figure 60-81-9]**.

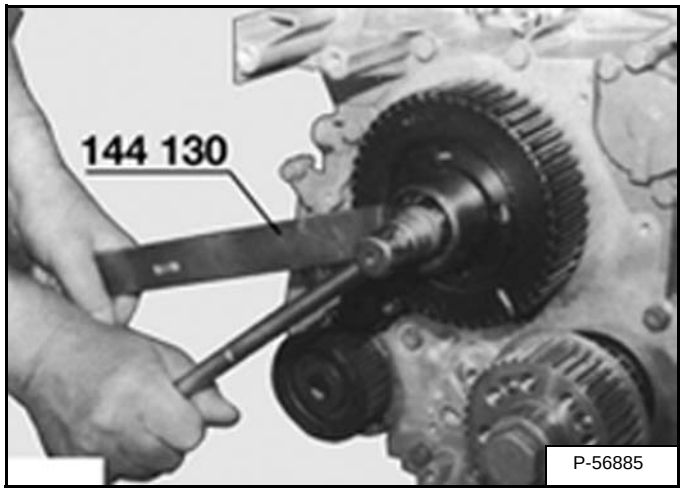
Remove the front cover and timing belt. See "Front Cover Assembly" on page 60.

Figure 60-81-10



Remove the timing belt (Item 1) **[Figure 60-81-10]** and idler.

Figure 60-81-11



Remove the camshaft gear **[Figure 60-81-11]**.

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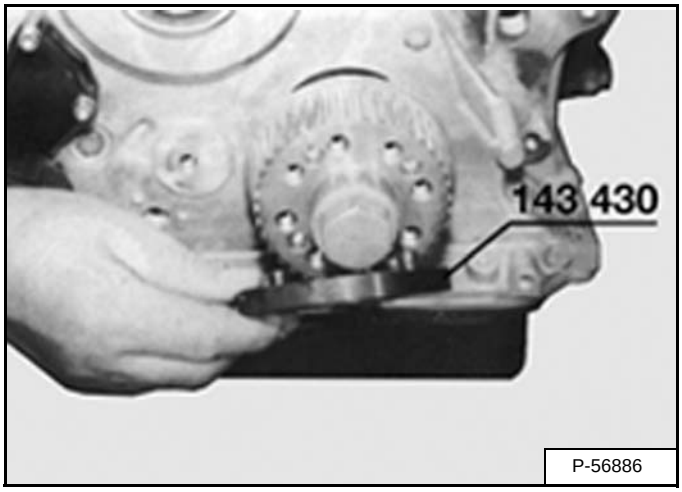
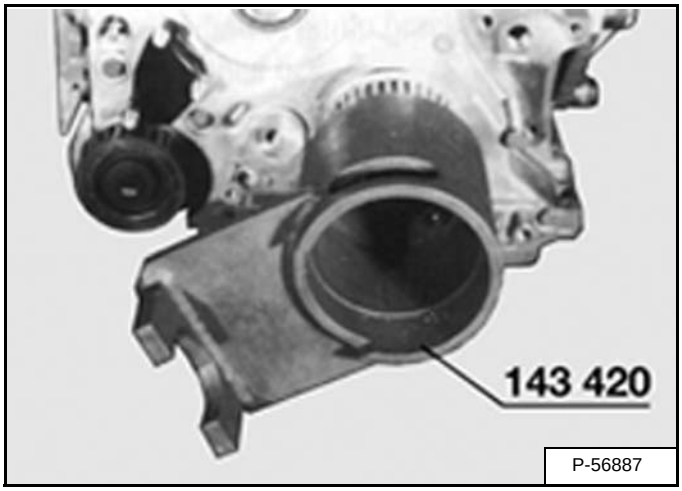
Disassembly (Cont'd)

Figure 60-81-12



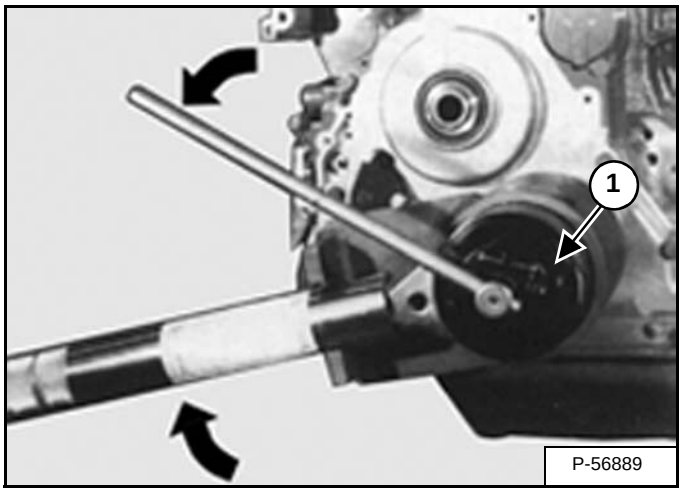
Install intermediate plate on the crankshaft **[Figure 60-81-12]**.

Figure 60-81-13



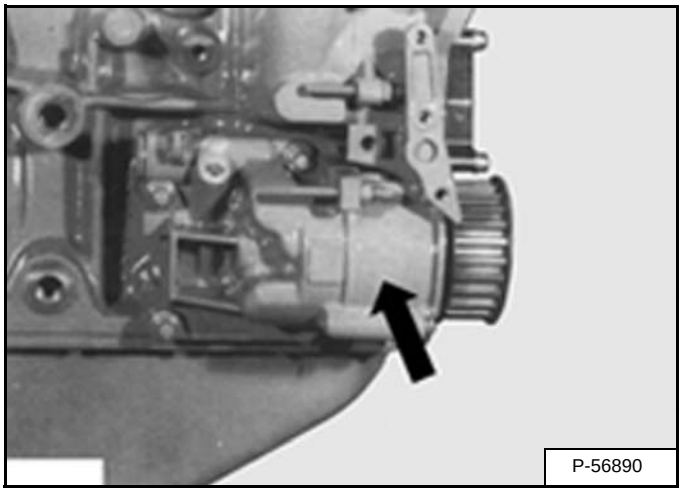
Install the crank shaft dolly on the holding plate **[Figure 60-81-13]**.

Figure 60-81-14



Using a torque multiplier (Item 1) **[Figure 60-81-14]**. Remove the crankshaft nut.

Figure 60-81-15



Remove the oil pump **[Figure 60-81-15]**.

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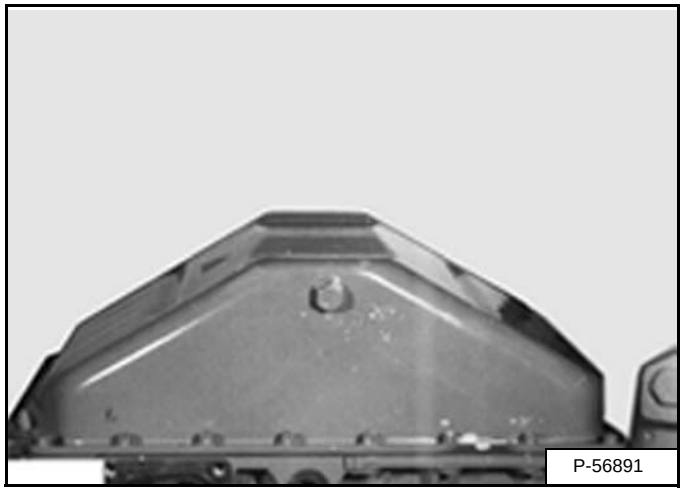
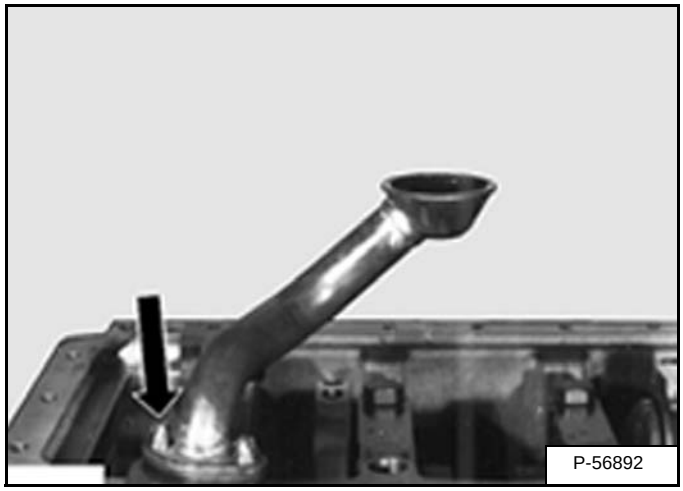
Disassembly (Cont'd)

Figure 60-81-16



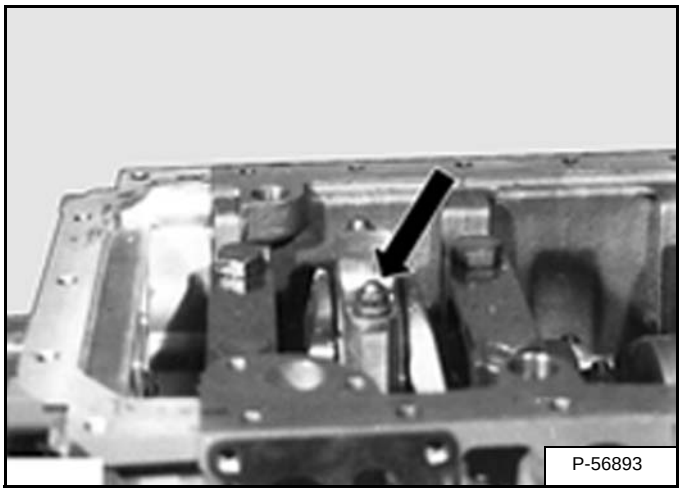
Remove the oil pan **[Figure 60-81-16]**.

Figure 60-81-17



Remove the oil suction pipe **[Figure 60-81-17]**.

Figure 60-81-18

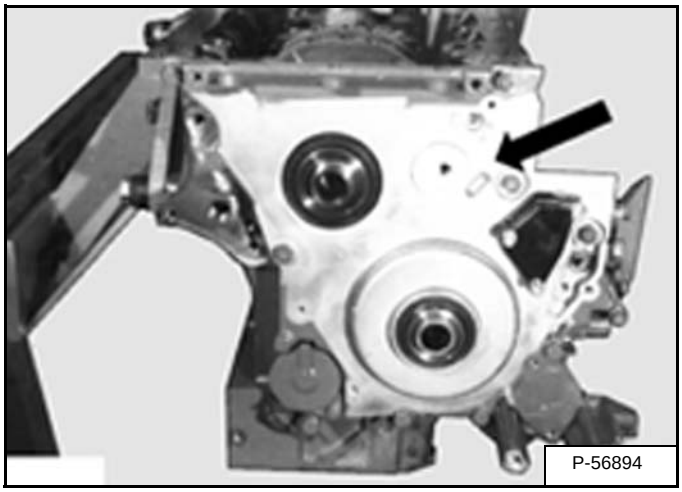


Remove the connecting rod bolts **[Figure 60-81-18]**.

Remove all the piston/connecting rod assemblies from the engine block.

To check the piston/connecting rod assembly. See “Piston Installation On The Connecting Rod” on page 47.

Figure 60-81-19



Remove the front cover **[Figure 60-81-19]**.

To disassemble and assemble the front cover. See “Front Cover Disassembly” on page 54.

Remove the flywheel. (See Removal And Installation on Page 60-71-1.)

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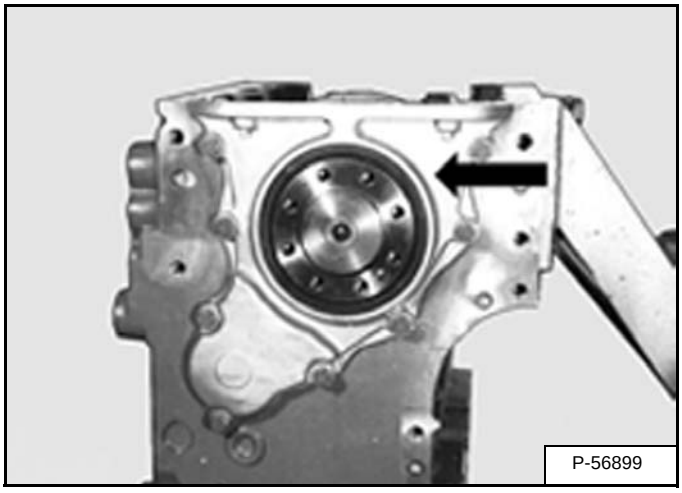
Disassembly (Cont'd)

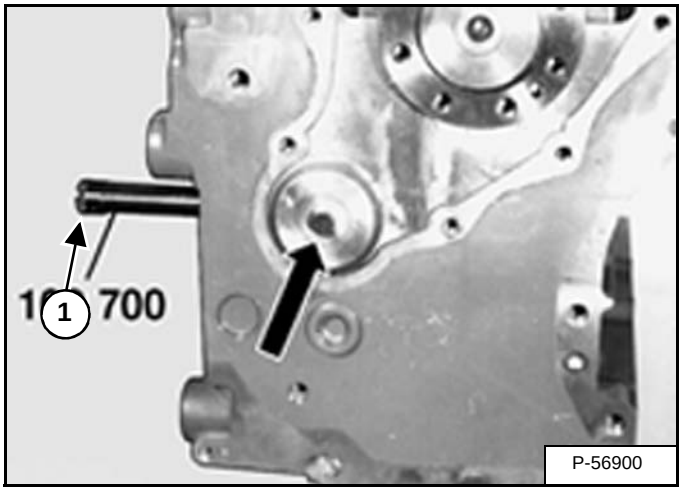
Figure 60-81-20



Remove the rear cover **[Figure 60-81-20]**.

To install a new rear seal and inspect the cover. See "Rear Cover Seal Removal And Installation" on page 38.

Figure 60-81-21

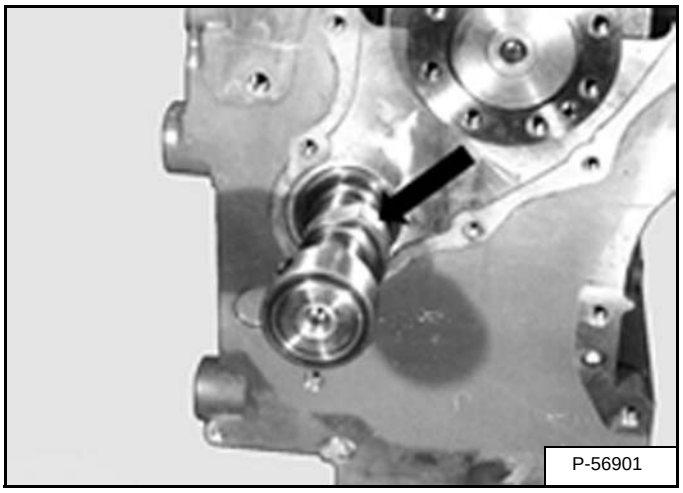


Install the timing tool (Item 1) **[Figure 60-81-21]** for the camshaft.

Remove the thrust washer from the camshaft **[Figure 60-81-21]**.

Remove the timing tool.

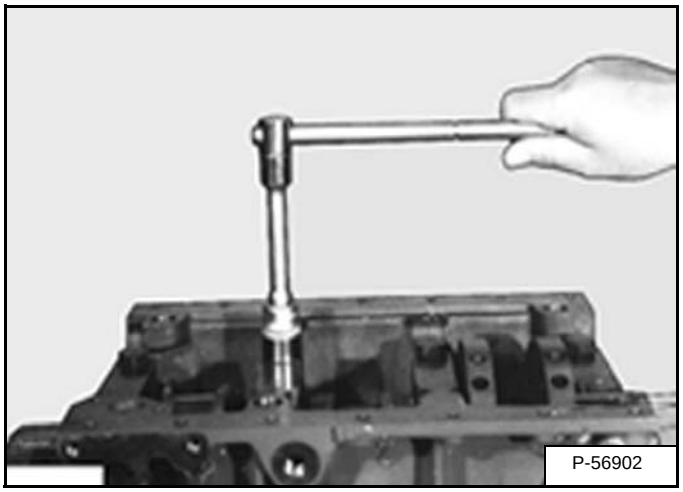
Figure 60-81-22



Remove the camshaft **[Figure 60-81-22]**.

Mark the location of each main bearing cap so it will be installed in the original position.

Figure 60-81-23



Remove the main bearing caps bolts **[Figure 60-81-23]**.

Remove the main bearing caps.

Remove the crankshaft.

Check the crankshaft specifications. See "Crankshaft, Checking" on page 39.

Remove the upper half of the main bearings.

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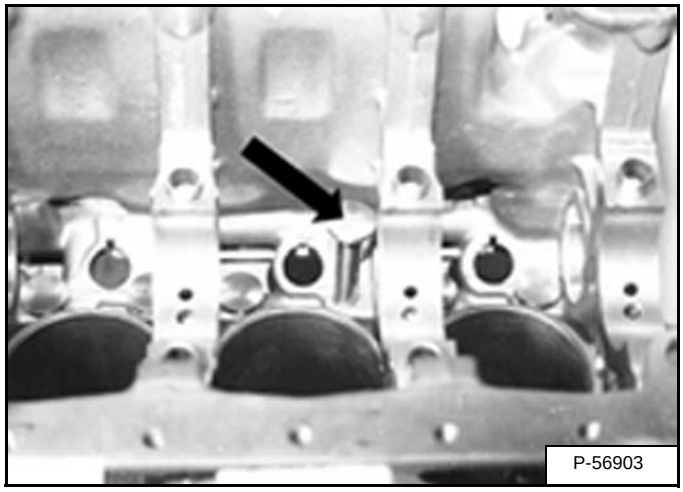
Disassembly (Cont'd)

Figure 60-81-24



Remove the tappets from the engine block **[Figure 60-81-24]**.

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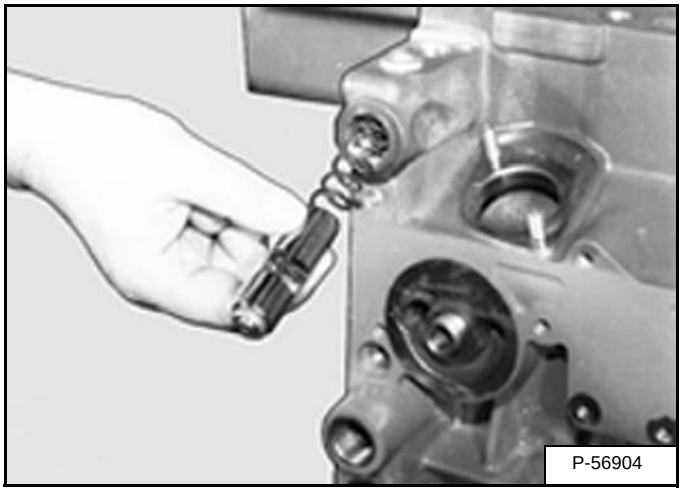
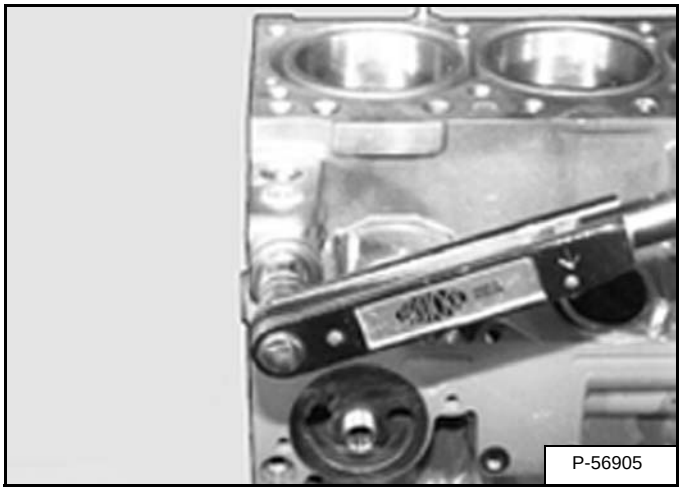
Assembly

Figure 60-81-25



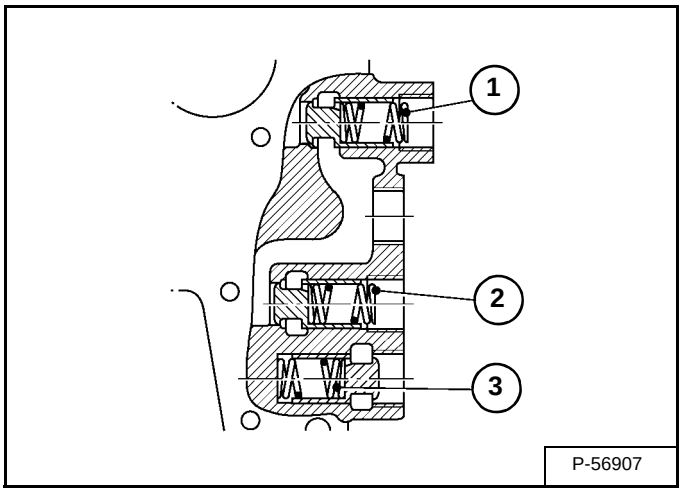
Install the thermostat and spring **[Figure 60-81-25]**.

Figure 60-81-26



Install the plug and tighten to 82 ft.-lb. (111 N•m) torque. **[Figure 60-81-26]**.

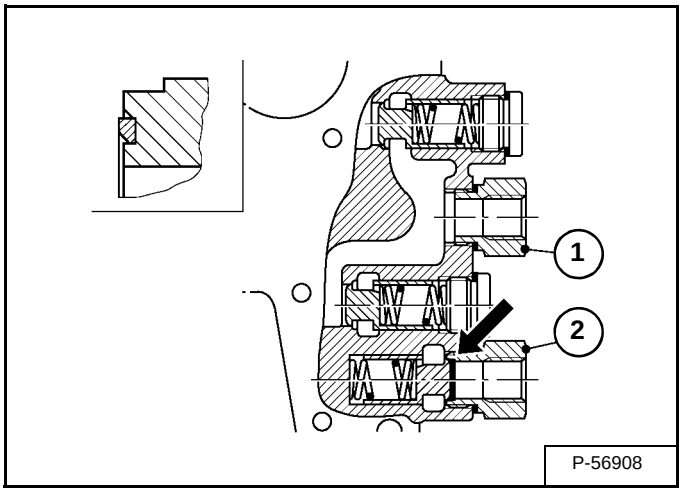
Figure 60-81-27



Install the heater oil pressure control valves and springs as shown **[Figure 60-81-27]**.

- (Item 1) **[Figure 60-81-27]** 14.5 PSI (1 bar) spring, marked yellow
- (Item 2) **[Figure 60-81-27]** 24.7 PSI (bar) spring, marked red
- (Item 3) **[Figure 60-81-27]** 4.4 PSI (bar) spring, marked blue

Figure 60-81-28



Install the fittings (Item 1) and plugs (Item 2) **[Figure 60-81-28]**. Tighten the fittings and plugs to 83 ft.-lb. (111 N•m) torque.

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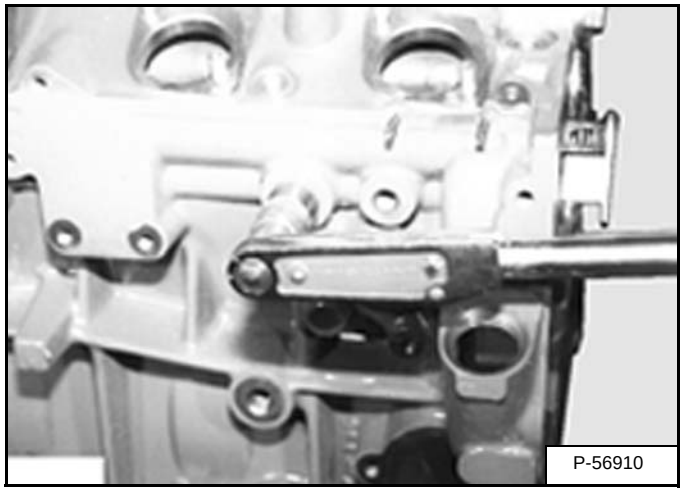
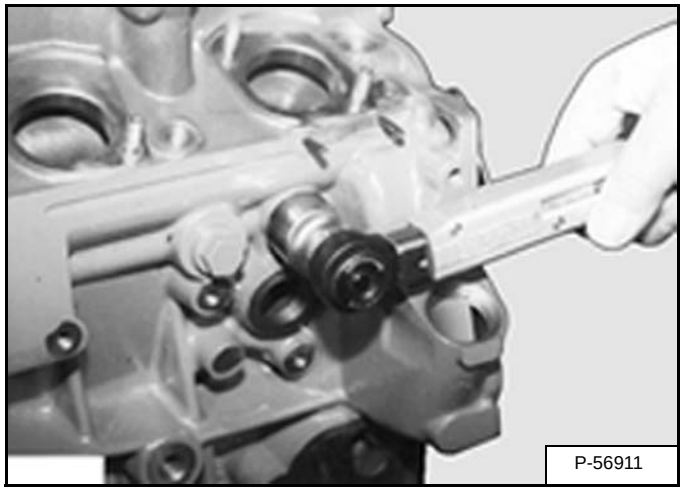
Assembly (Cont'd)

Figure 60-81-29



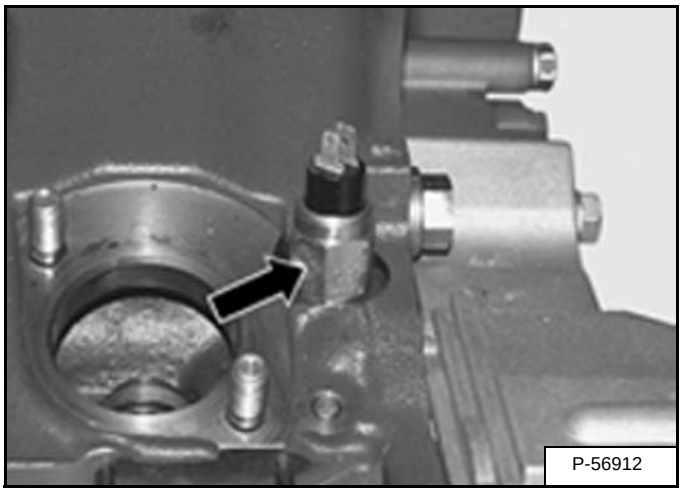
Install and tighten the plug to 37 ft.-lb. (50 N•m) torque **[Figure 60-81-29]**.

Figure 60-81-30



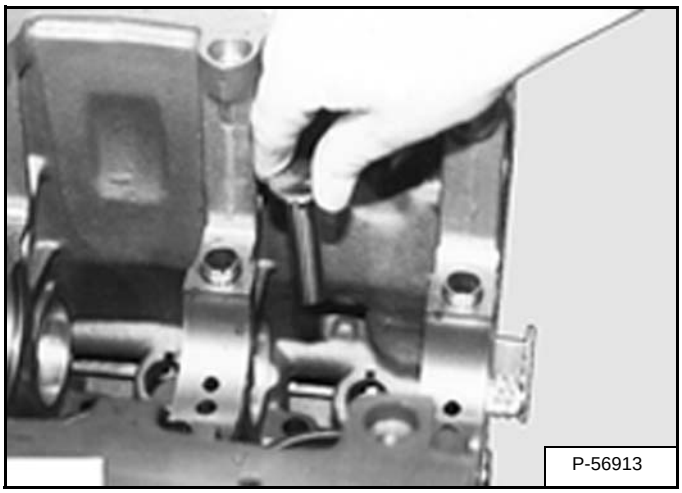
Install the oil pressure switch and tighten to 102-128 in.-lb. (11.5-14.5 N•m) torque **[Figure 60-81-30]**.

Figure 60-81-31



Install the oil temperature sending unit. Tighten the sending unit to 17-20 ft.-lb. (22.5-27.5 N•m) torque **[Figure 60-81-31]**.

Figure 60-81-32



Install the tappets **[Figure 60-81-32]**.

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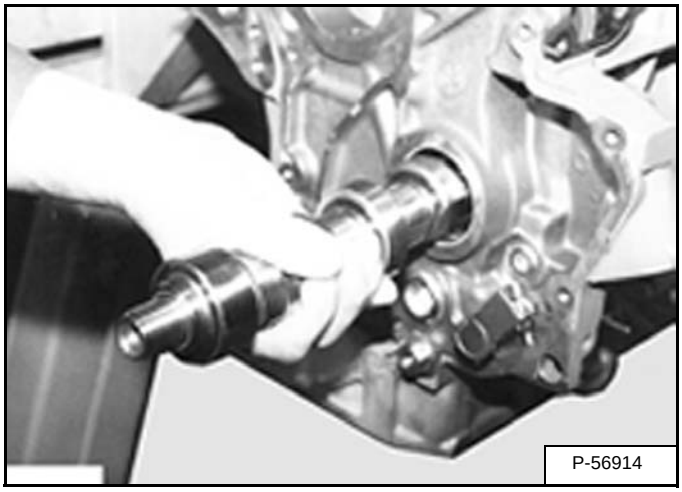
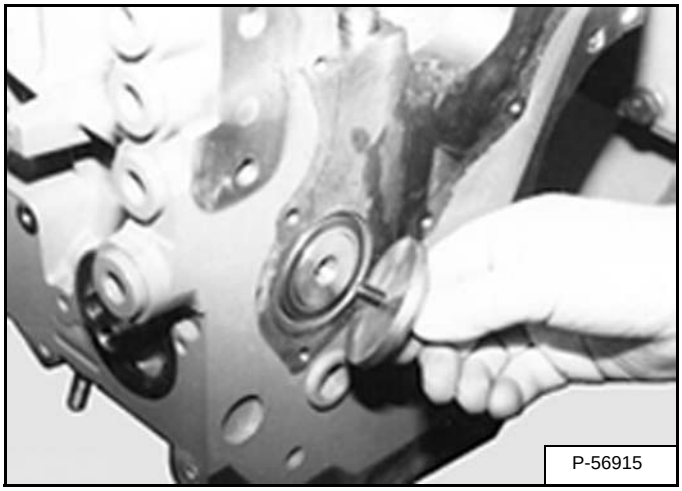
Assembly (Cont'd)

Figure 60-81-33



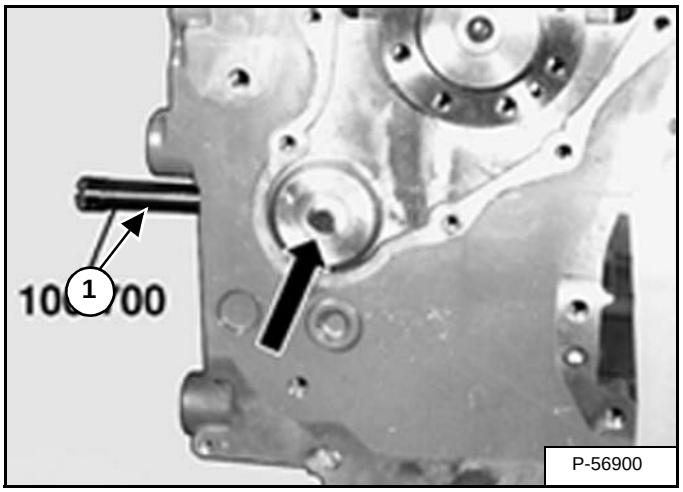
Install the camshaft **[Figure 60-81-33]**.

Figure 60-81-34



Install the thrust washer with the lubricating groove toward the crankcase **[Figure 60-81-34]**.

Figure 60-81-35

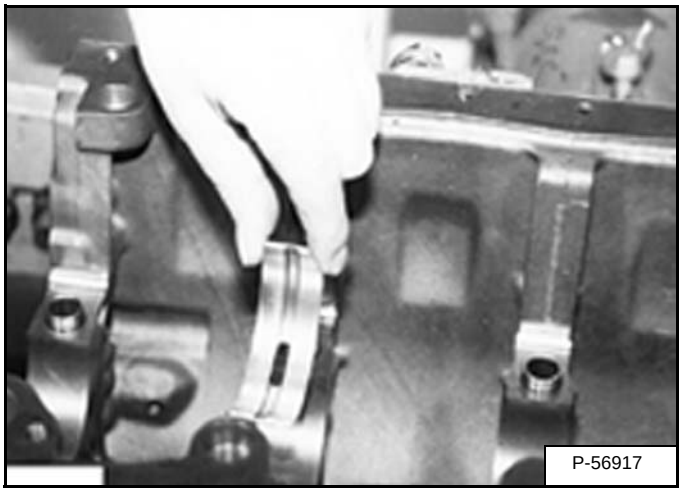


Install the camshaft timing tool (Item 1) **[Figure 60-81-35]**.

Tighten the camshaft thrust washer bolt to 15 ft.-lb. (21 N•m) torque.

Remove the timing tool.

Figure 60-81-36



Install the upper main bearing halves **[Figure 60-81-36]**.

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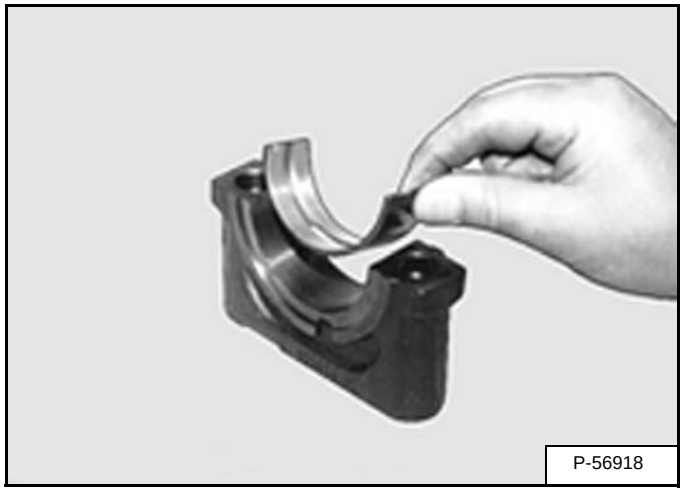
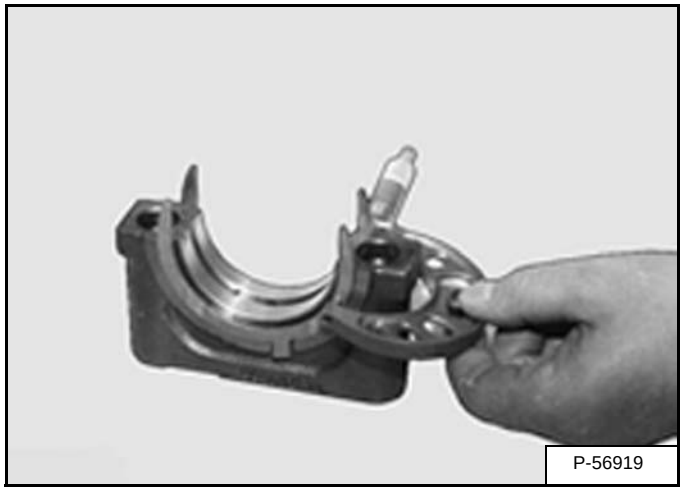
Assembly (Cont'd)

Figure 60-81-37



Install the other main bearing half into the main bearing caps **[Figure 60-81-37]**.

Figure 60-81-38



Install the thrust bearings halves on the main bearing cap **[Figure 60-81-38]**.

Measure the width of the thrust washers/main bearing cap **[Figure 60-81-38]**.

Figure 60-81-39

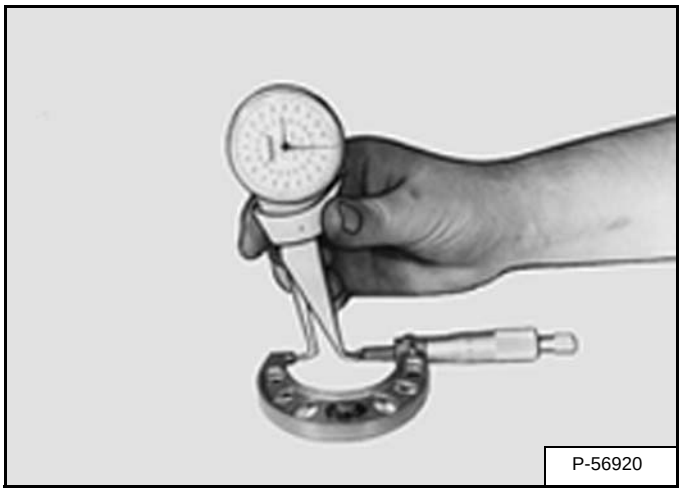
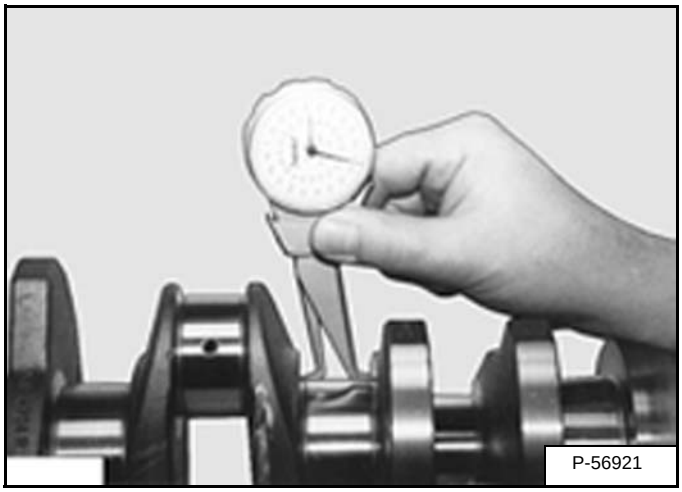


Figure 60-81-40



Measure the bearing journal width at the crankshaft **[Figure 60-81-39]** & **[Figure 60-81-40]**.

Specifications:
Journal Width Std. . . . . .1.378-1.379 inch. (35,0-35,04 mm)
Limit for O/S . . . . . 1.395 inch. (35,44 mm)

Determine the end play for the crankshaft.

Specifications:
Std. End Play. . . . . .0.004-0.010 inch. (0,1-0,273 mm)
Wear Limit . . . . . 0.016 inch. (0,4 mm)

Use new thrust washer as needed to get the correct end play.

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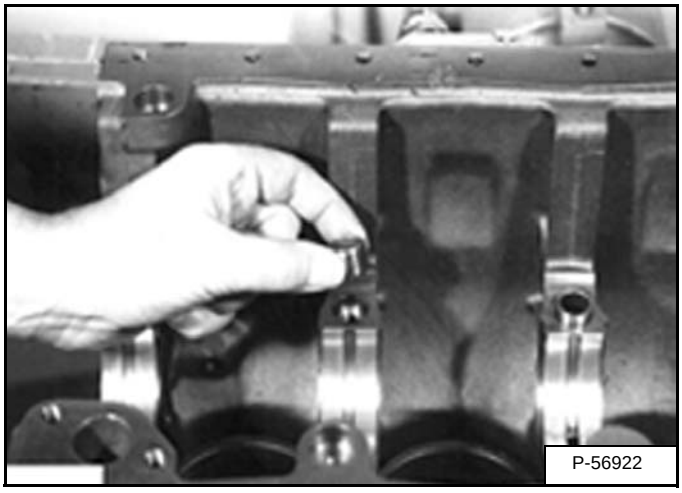
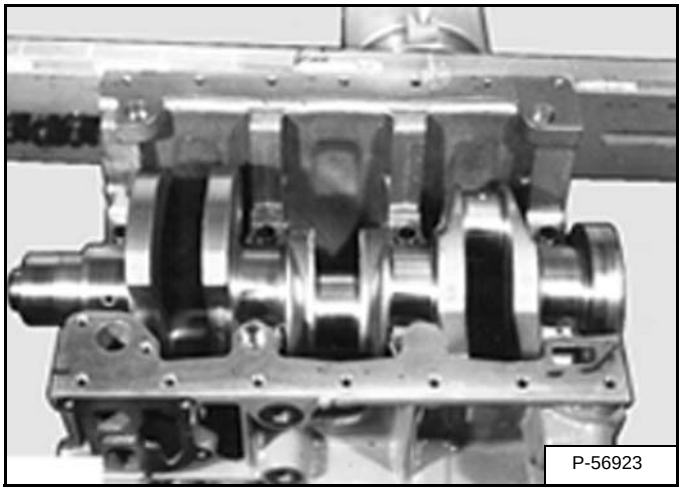
Assembly (Cont'd)

Figure 60-81-41



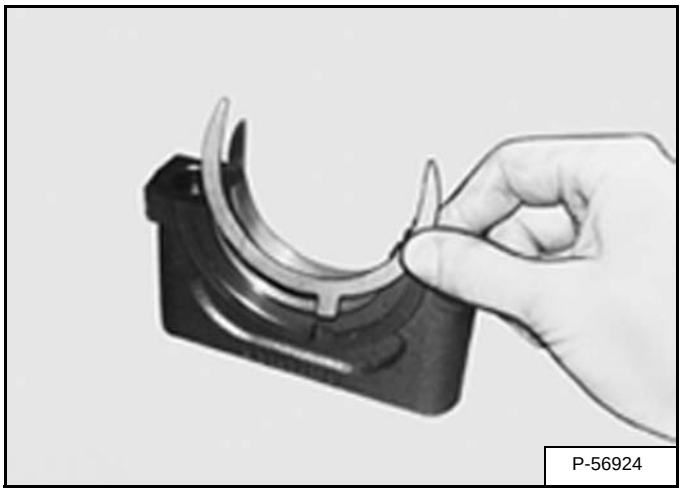
Install the main bearing locating sleeves **[Figure 60-81-41]**.

Figure 60-81-42



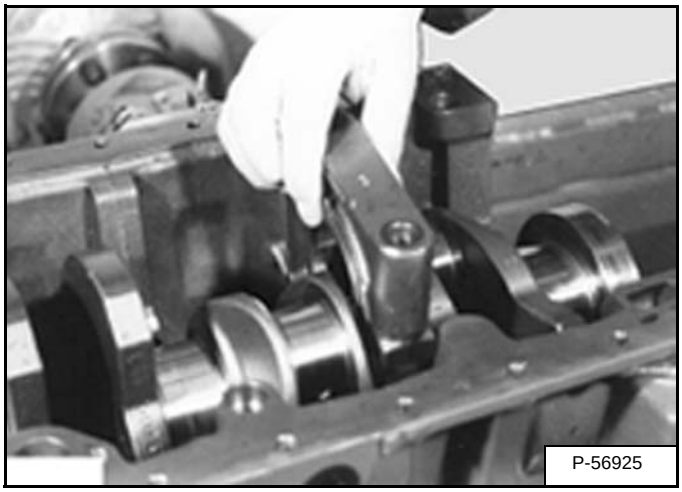
Install the crankshaft into the engine block **[Figure 60-81-42]**.

Figure 60-81-43



Lubricate the thrust washer with grease and install them on the main bearing cap **[Figure 60-81-43]**.

Figure 60-81-44



Install the main bearing/thrust washer assembly **[Figure 60-81-44]**.

NOTE: The main bearing cap No. 1, at the flywheel end, the chamfer must be towards the flywheel end.

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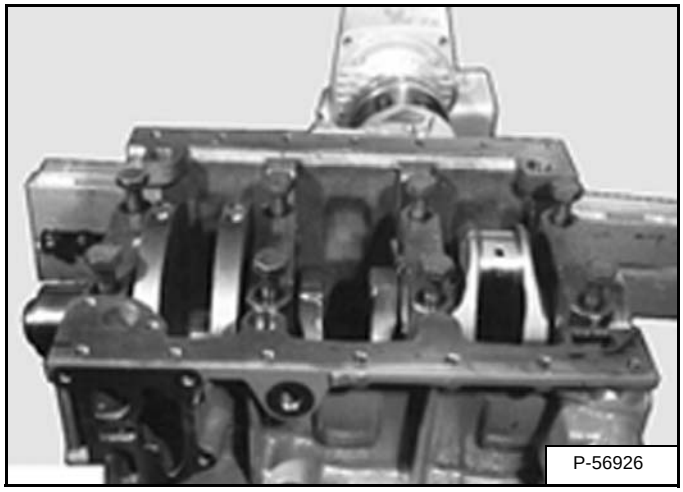
Assembly (Cont'd)

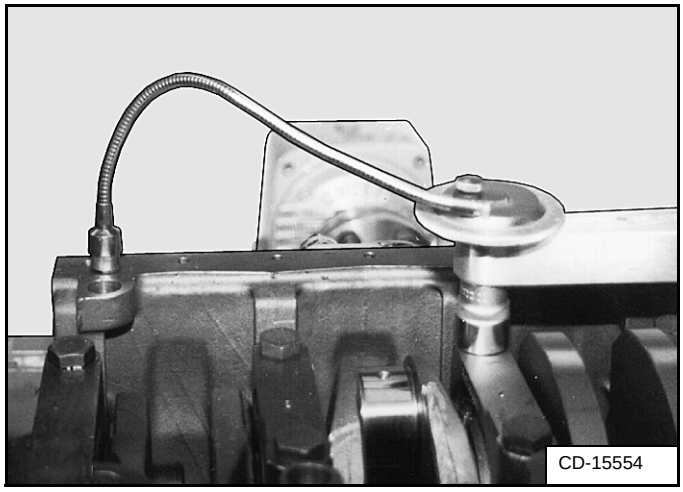
Figure 60-81-45



Install the main bearing caps/main bearing assembly **[Figure 60-81-45]**.

Install the caps in the original locations.

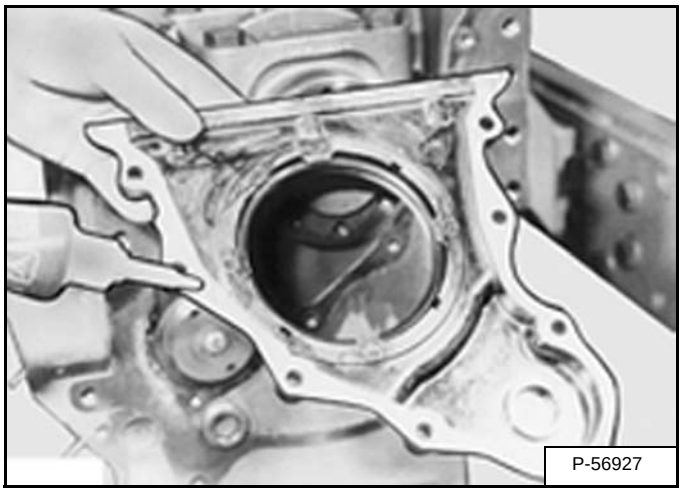
Figure 60-81-46



Tighten the main bearing cap bolts as follows **[Figure 60-81-46]**:

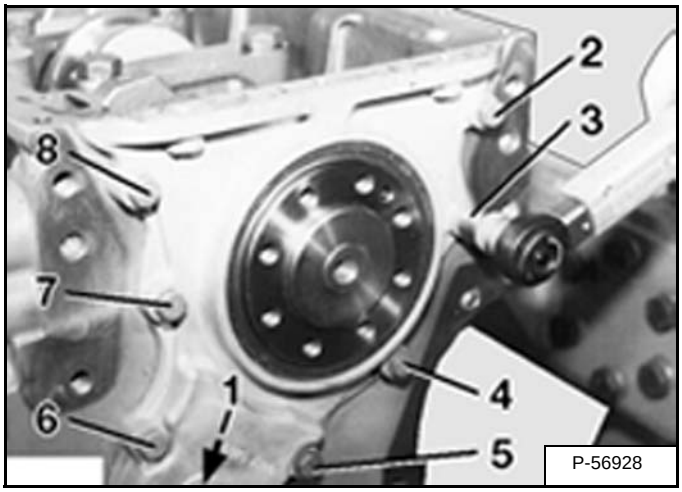
Initial Torque . . . . . 37 ft.-lb. (50 N•m)
1st Step Angle . . . . . 60°
2nd Step Angle . . . . . 45°

Figure 60-81-47



Put sealing compound on the rear cover **[Figure 60-81-47]**.

Figure 60-81-48



Install the rear cover complete with a new rear seal **[Figure 60-81-48]**.

NOTE: Make sure the rear cover oil pan surface aligns with the engine block surface.

Tighten the bolts to 15 ft.-lb. (21 N•m) torque in the order shown.

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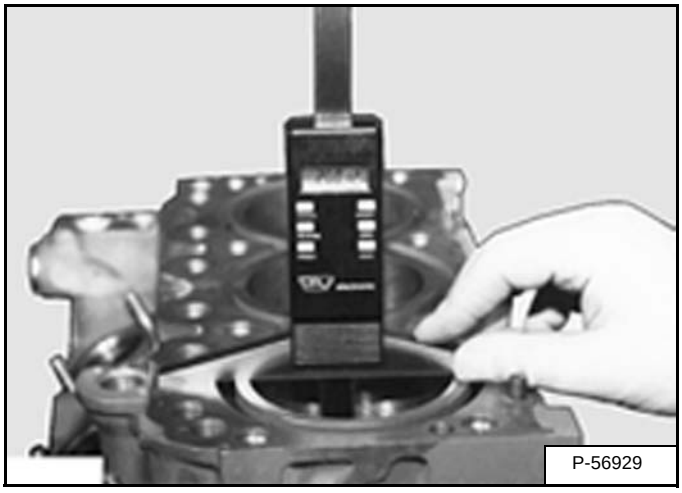
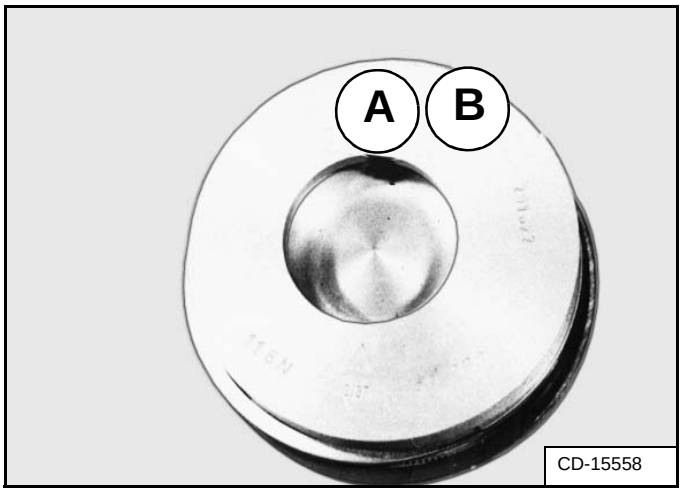
Assembly (Cont'd)

Figure 60-81-49



Measure the distance between the top edge of the crank pin (TDC) and cylinder head sealing surface at all cylinders **[Figure 60-81-49]**.

Figure 60-81-50

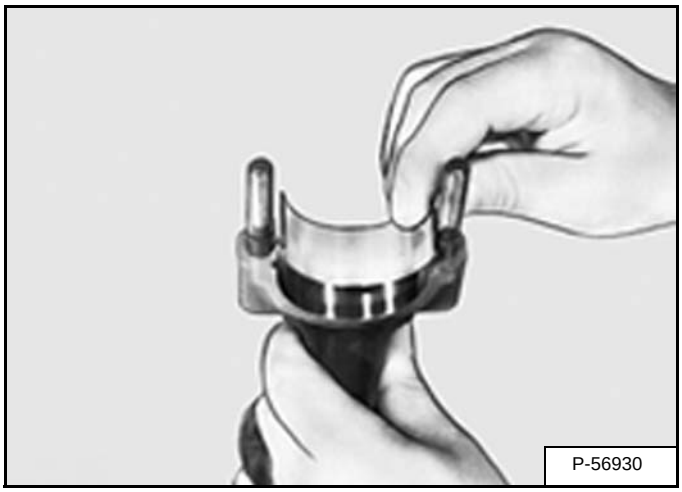


Compare actual dimension with the dimension listed **[Figure 60-81-50]**:

Specifications:
Piston Class A . . . . . 7.732-7.736 inch. (196,39-196,49 mm)
Piston Class B . . . . . 7.736-7.744 inch. (196,491-196,69 mm)

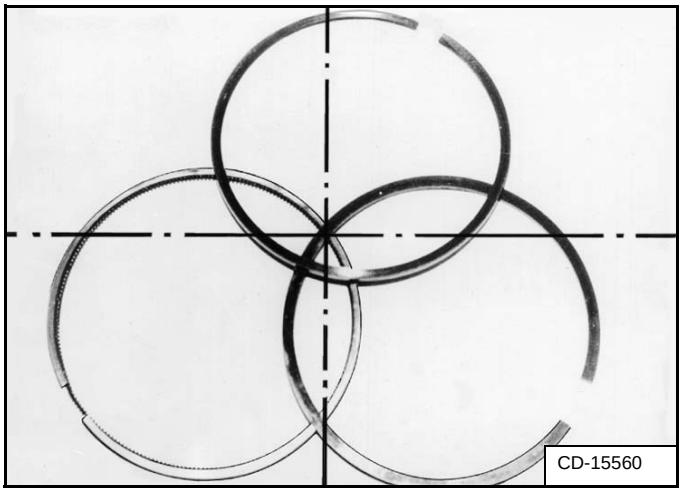
NOTE: If the crankshaft is undersize, 0.005 inch (0,125 mm) must be added to the dimension listed.

Figure 60-81-51



Install the connecting rod bearing halves into the connecting rod **[Figure 60-81-51]**.

Figure 60-81-52



Before installing piston/connecting rod assembly, make sure the piston ring gaps are staggered as shown in **[Figure 60-81-52]**.

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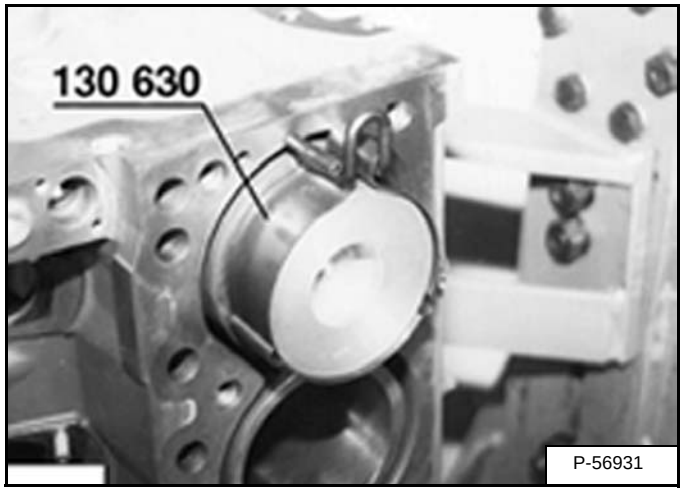
Assembly (Cont'd)

Install a piston ring compressor on the piston rings.

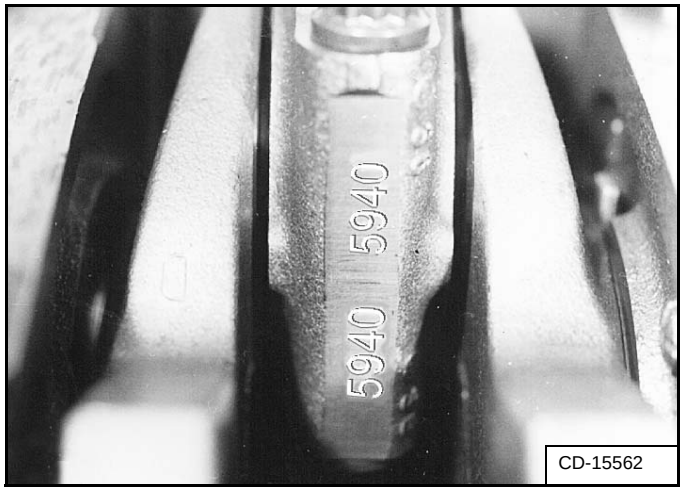
Figure 60-81-53



Install the piston/connecting rod assembly in the engine block **[Figure 60-81-53]**.

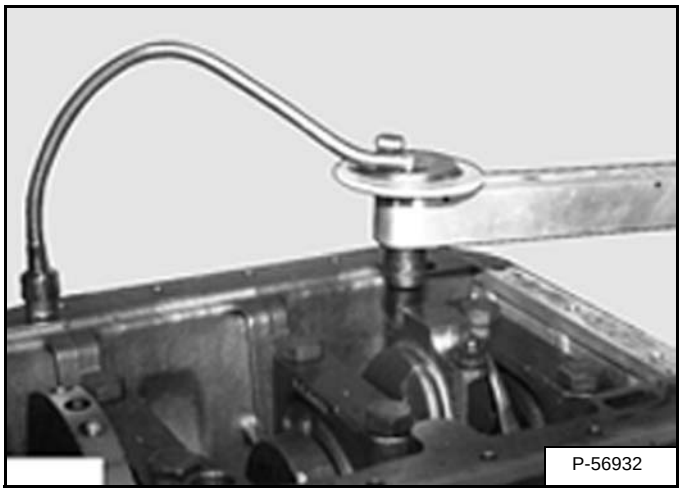
NOTE: The flywheel symbol on the piston must be toward the flywheel.

Figure 60-81-54



Install the connecting rod cap on the connecting rod. The numbers must be aligned **[Figure 60-81-54]**.

Figure 60-81-55

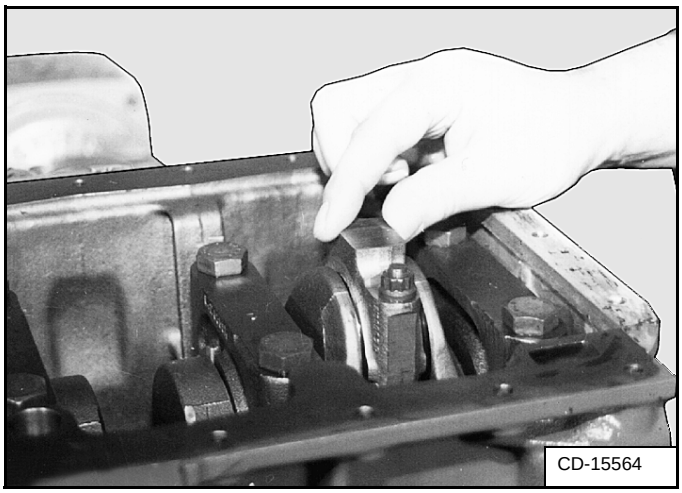


Tighten the connecting rod bolts as follows **[Figure 60-81-55]**:

Initial Torque . . . . . 22 ft.-lb. (30 N•m)
1st Step Angle . . . . . 60°
2nd Step Angle . . . . . 60°

NOTE: If the connecting rod bolts are still serviceable, do not reuse the bolts more than five times.

Figure 60-81-56



Check that the connecting rods can be easily moved back and forth on the crank pin **[Figure 60-81-56]**.

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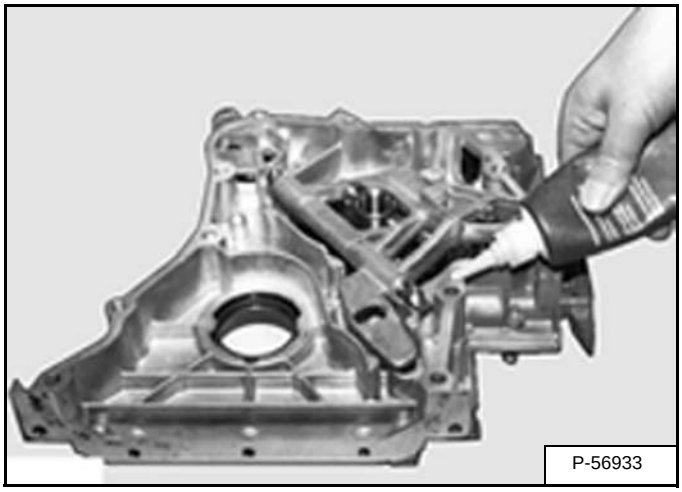
Assembly (Cont'd)

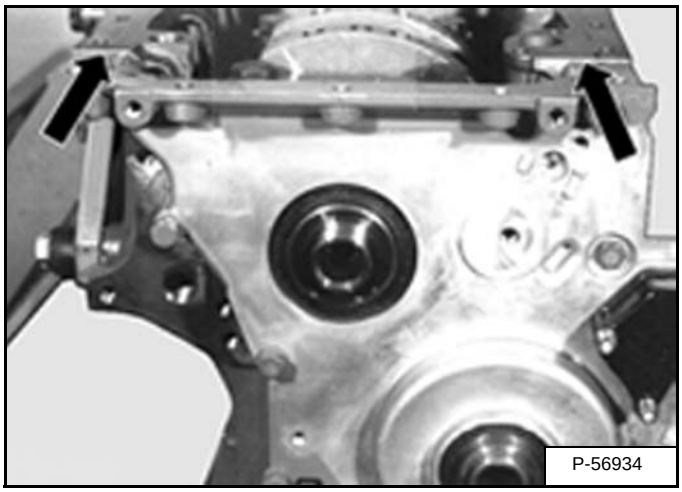
Figure 60-81-57



Put sealing compound on the front cover sealing surface **[Figure 60-81-57]**.

NOTE: Make sure the camshaft/centrifugal governor connecting is clean and free of oil.

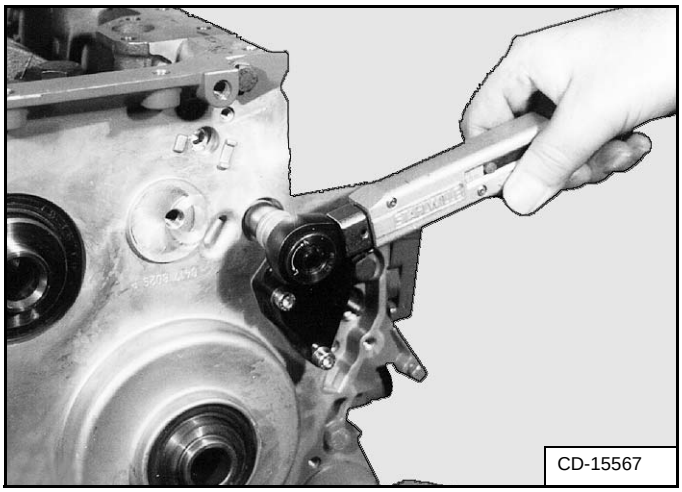
Figure 60-81-58



Install the front cover with the new shaft seals on the engine block **[Figure 60-81-58]**.

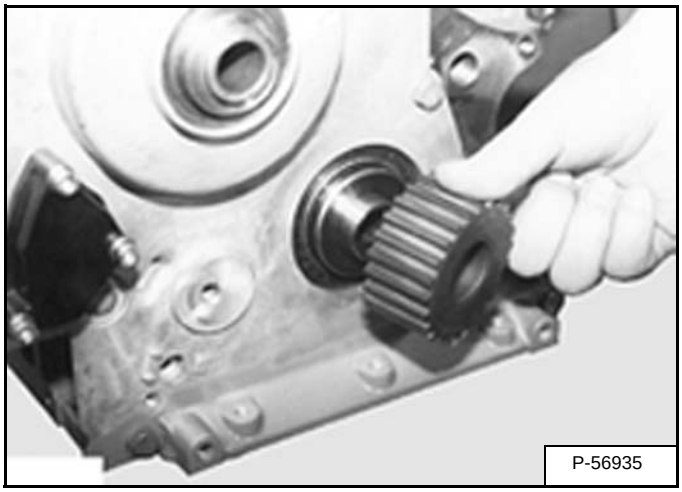
NOTE: Make sure the oil pan sealing surface on the front cover aligns with the sealing surface on the block [Figure 60-81-61 on Page 18].

Figure 60-81-59



Tighten the front cover bolts to 15 ft.-lb. (21 N•m) torque **[Figure 60-81-59]**.

Figure 60-81-60



Make sure the mating surfaces are clean and free of oil and install the crankshaft gear on the crankshaft **[Figure 60-81-60]**.

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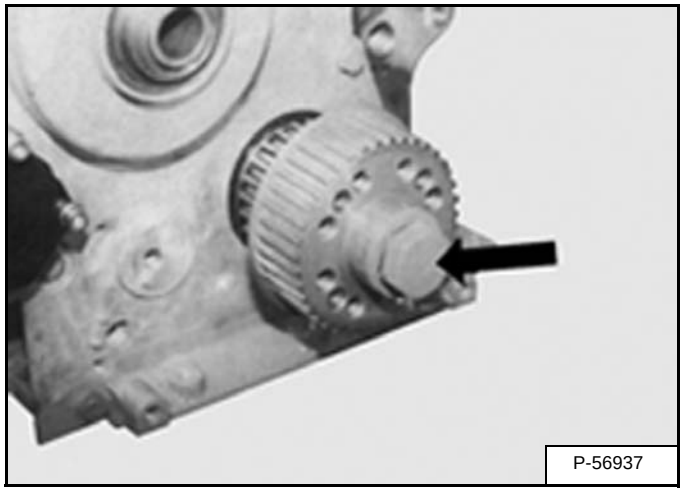
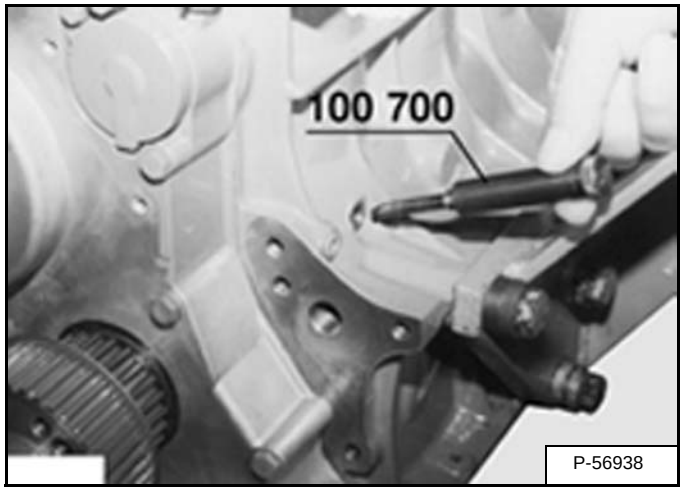
Assembly (Cont'd)

Figure 60-81-61



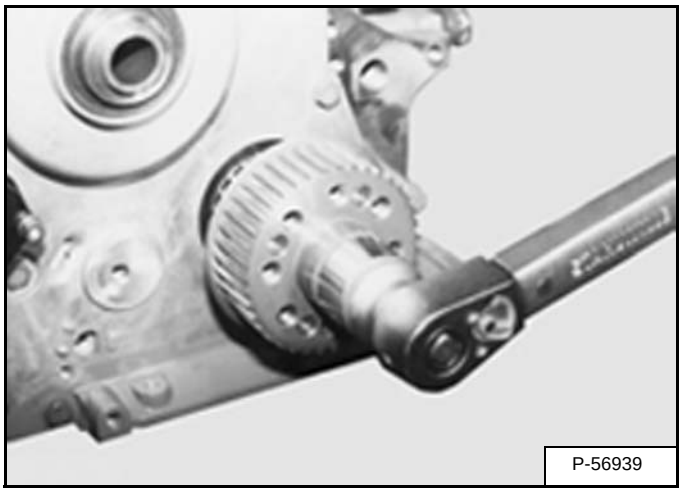
Install the bolt **[Figure 60-81-61]**.

Figure 60-81-62



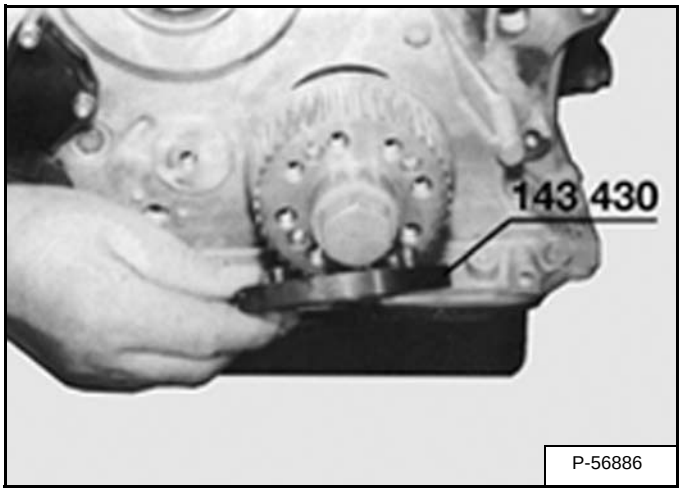
Install the crankshaft timing tool **[Figure 60-81-62]**.

Figure 60-81-63



Tighten the bolt to 96 ft.-lb. (130 N•m) torque **[Figure 60-81-63]**.

Figure 60-81-64



Install the intermediate disc on the crankshaft **[Figure 60-81-64]**.

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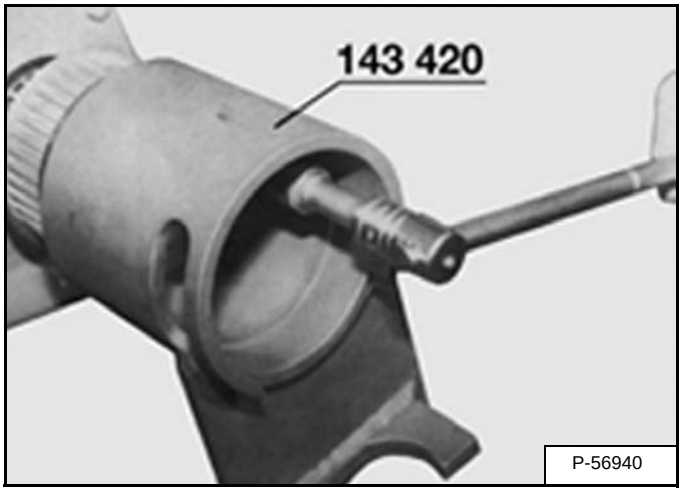
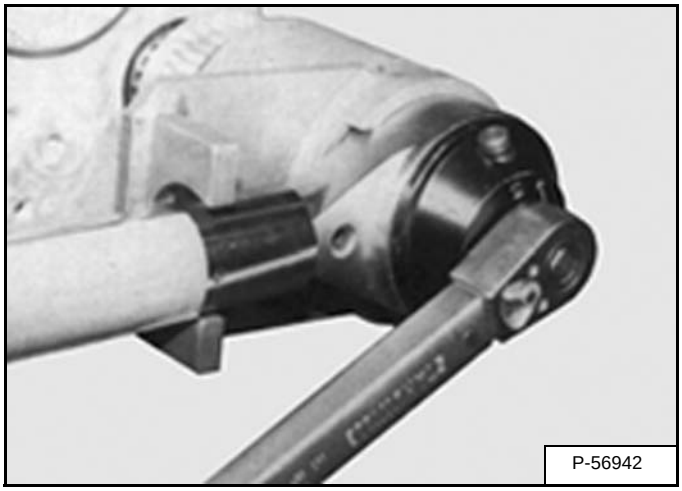
Assembly (Cont'd)

Figure 60-81-65



Install the crankshaft dolly on the holding plate **[Figure 60-81-65]**.

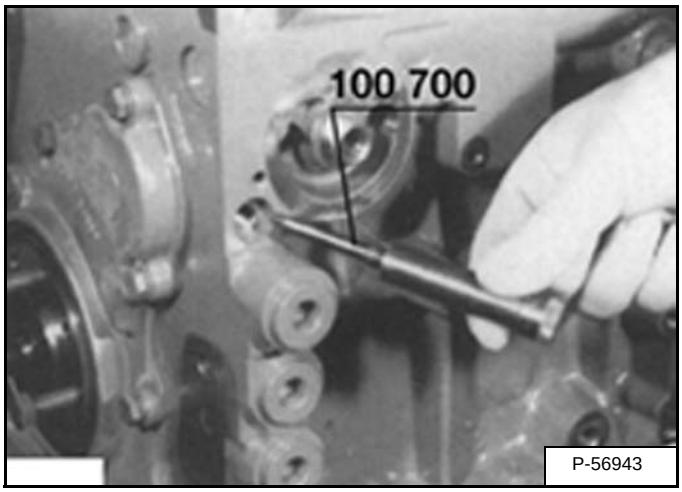
Figure 60-81-66



Using a torque multiplier, tighten the bolt an additional 210° **[Figure 60-81-66]**.

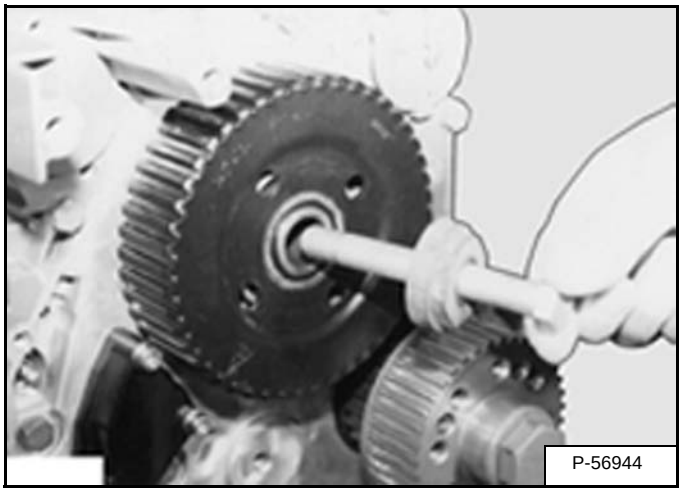
NOTE: Screw the crankshaft timing tool back in as far as it will go. Turn the crankshaft clockwise against the stop. The piston at the front cover is at the TDC position.

Figure 60-81-67



Install the camshaft timing tool **[Figure 60-81-67]**.

Figure 60-81-68



Install the camshaft gear and bolt **[Figure 60-81-68]**.

NOTE: All mounting surfaces must be clean and free of oil.

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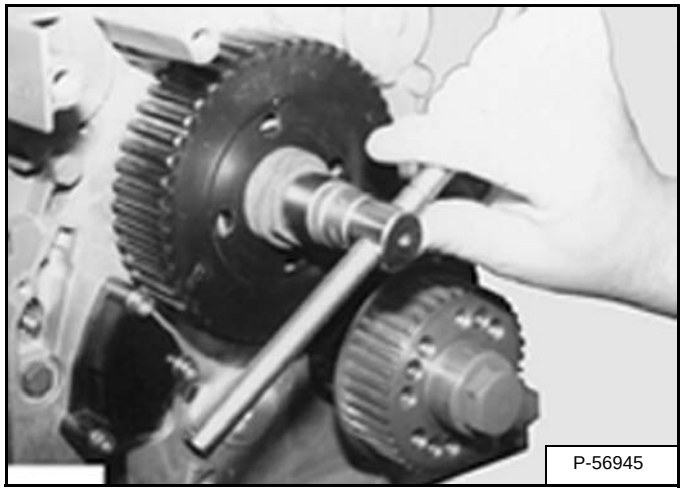
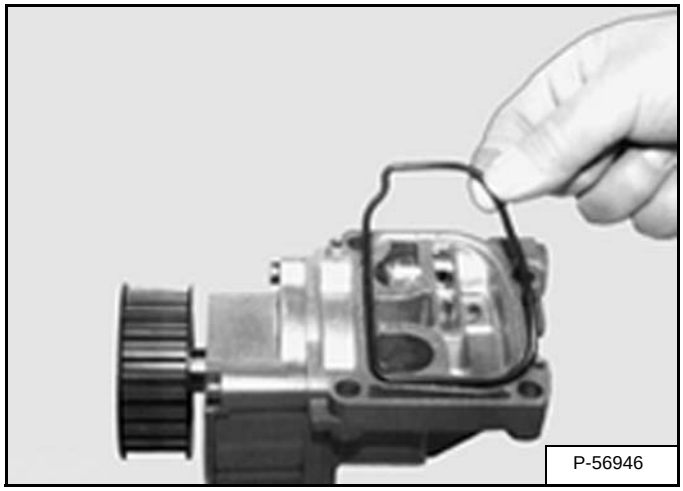
Assembly (Cont'd)

Figure 60-81-69



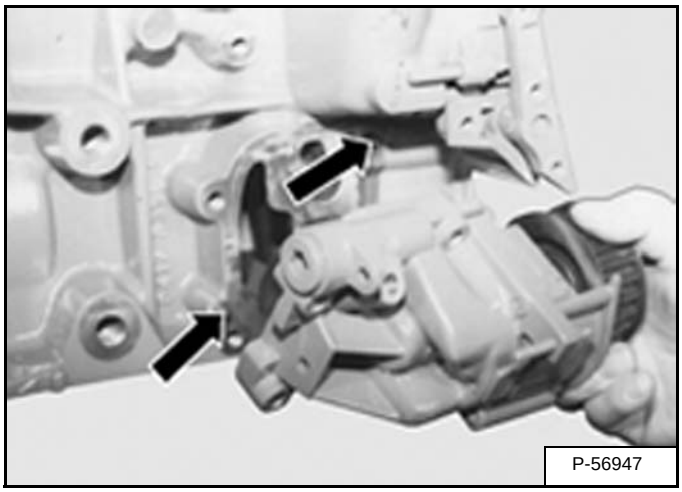
Tighten the bolt finger tight. The gear must turn freely **[Figure 60-81-69]**.

Figure 60-81-70



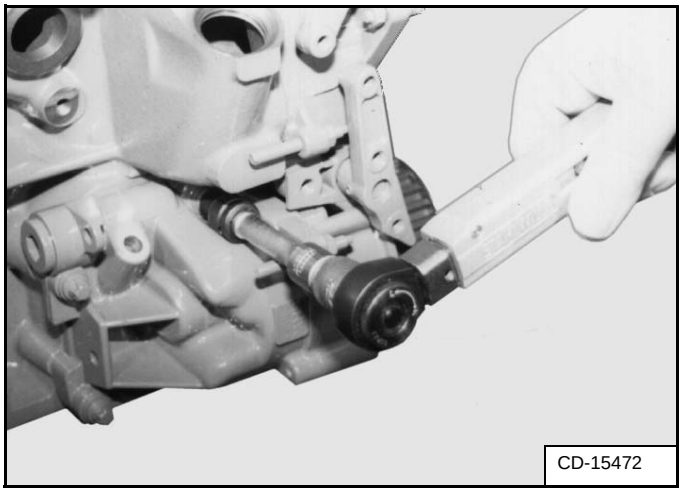
Install the gasket on the oil pump **[Figure 60-81-70]**.

Figure 60-81-71



Install the oil pump on the engine block **[Figure 60-81-71]**.

Figure 60-81-72



Tighten the oil pump bolts to 14-17 ft.-lb. (18,9-23,1 N•m) torque **[Figure 60-81-72]**.

Install the engine timing belt. (See Timing Belt Installation on Page 60-51-22.)

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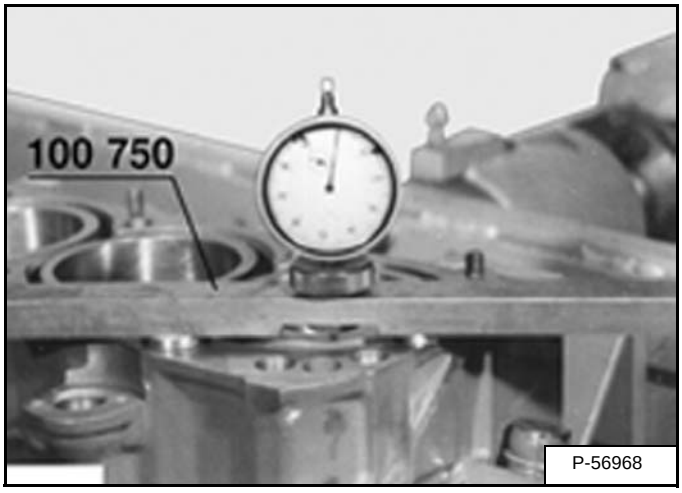
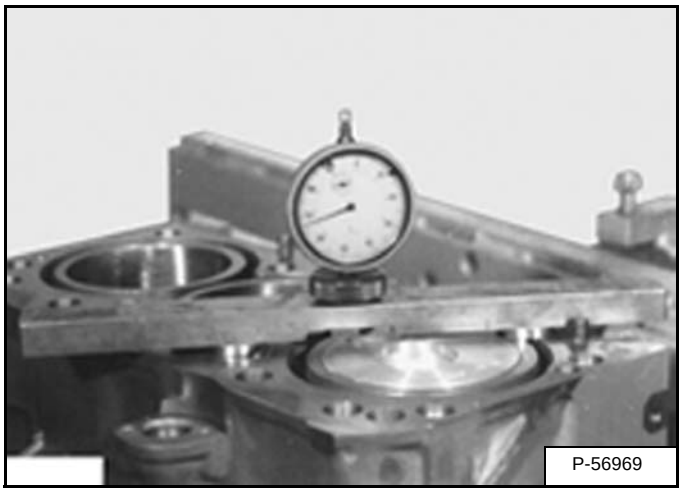
Assembly (Cont'd)

Figure 60-81-73



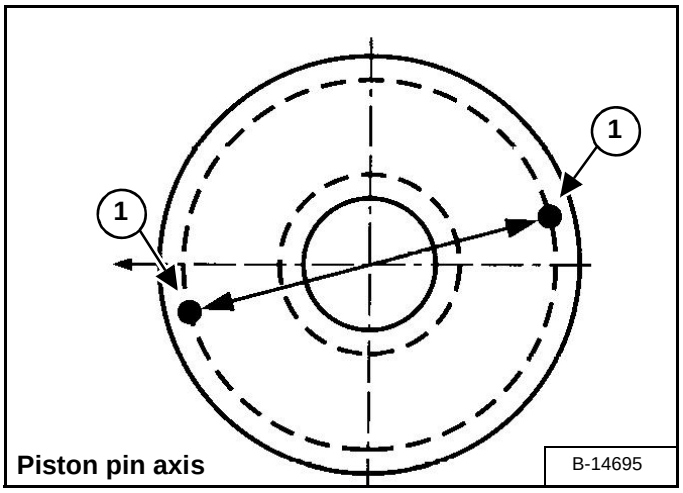
Put spacers on sealing surface of the engine block and set dial indicator gauge to 0 **[Figure 60-81-73]**. See "Deutz Engine Tools Identification Chart" on page 1.

Figure 60-81-74



Position the dial gauge on the piston **[Figure 60-81-74]**.

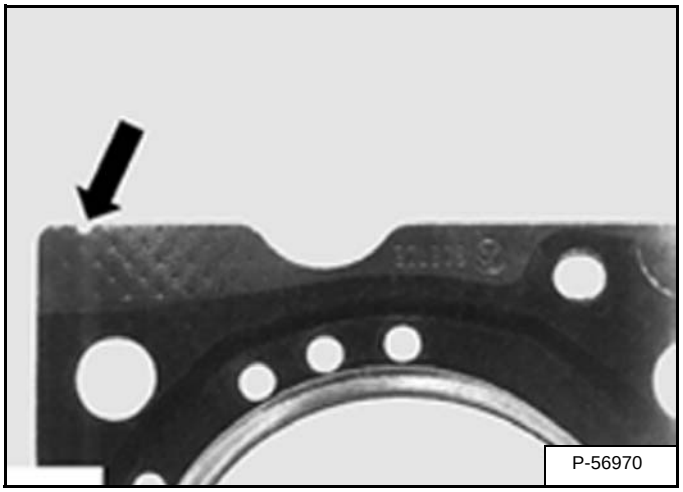
Figure 60-81-75



Measure at the gauge points (Item 1) **[Figure 60-81-75]**.

To determine maximum piston projection measure all the pistons.

Figure 60-81-76



Compare the measurements with the specifications to determine the correct cylinder head gasket **[Figure 60-81-76]**.

Specifications:

Piston Projection	**Marking of Cylinder Head Gasket**
0.023-0.027 inch. (0,59-0,69 mm)	1 Notch
0.027-0.030 inch. (0,69-0,76 mm)	2 Notches
0.030-0.033 inch. (0,76-0,83 mm)	3 Notches

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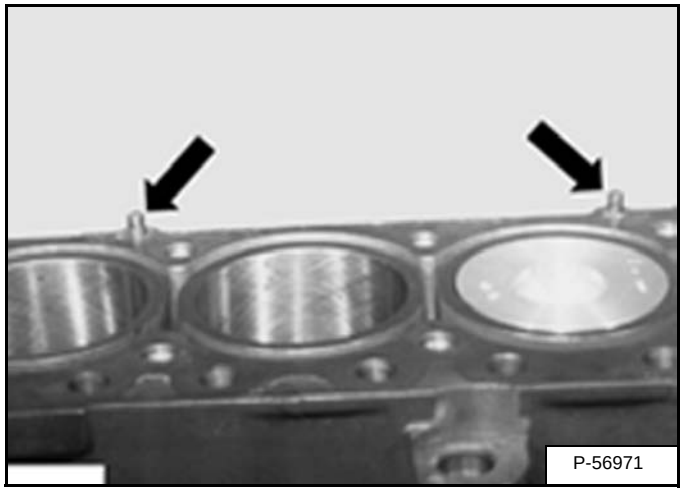
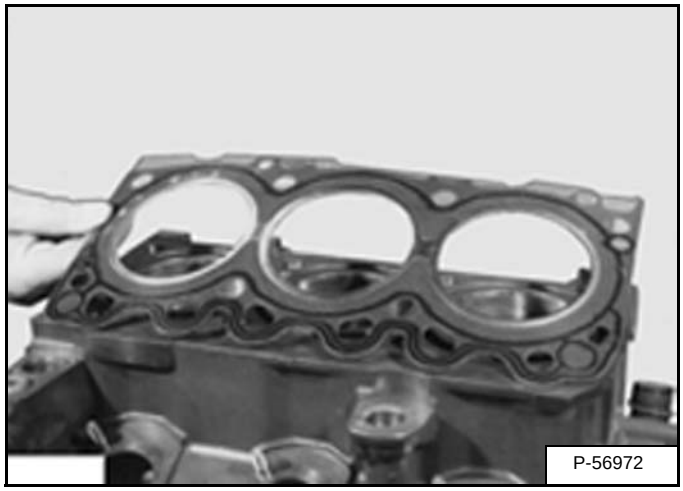
Assembly (Cont'd)

Figure 60-81-77



Make sure the dowel pins are installed in the engine block **[Figure 60-81-77]**.

Figure 60-81-78



Install the cylinder head gasket **[Figure 60-81-78]**.

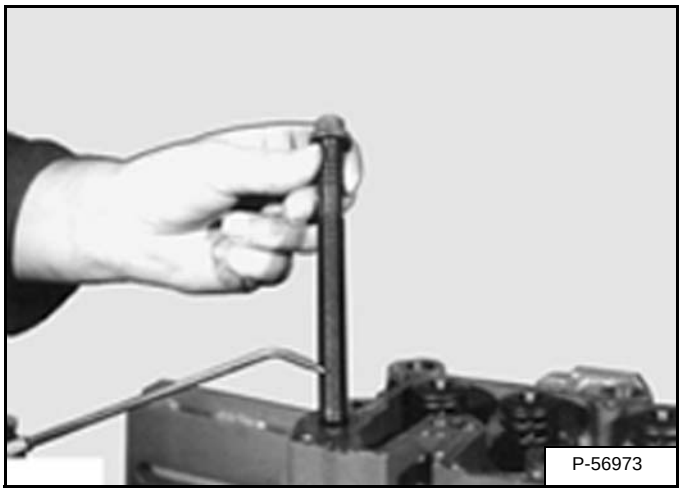
The sealing surfaces of the cylinder head gasket is free of oil.

Install the cylinder head.

Measure the cylinder head bolts.

Std. Length. . . . . .5.90 ± 0.03 inch (150 ± 0,8 mm)

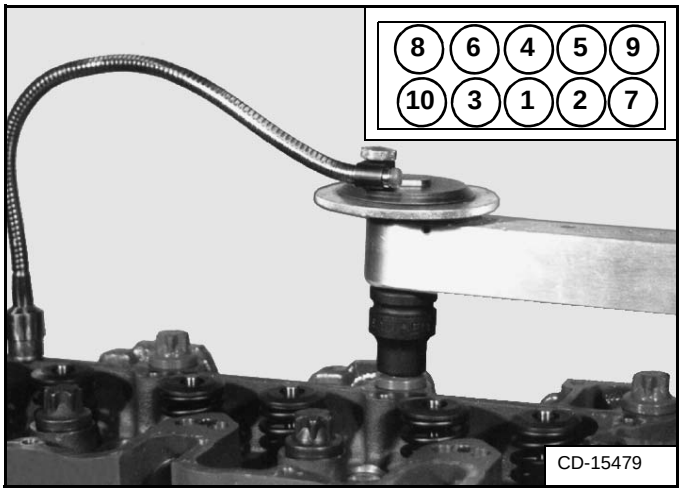
Figure 60-81-79



Put a light coat of oil on the head bolts **[Figure 60-81-79]**.

Install the head bolts.

Figure 60-81-80



Tighten the cylinder head bolts in the correct sequence **[Figure 60-81-80]**.

Initial Torque . . . . . 22 ft.-lb. (30 N•m)
1st Stage Torque. . . . . 59 ft.-lb. (80 N•m)
2nd Stage Torque . . . . . 118 ft.-lb. (160 N•m)
3rd Stage Torque. . . . . .90°

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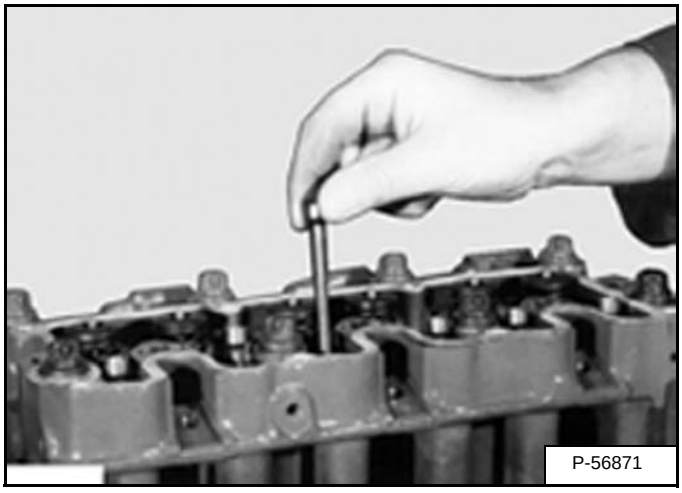
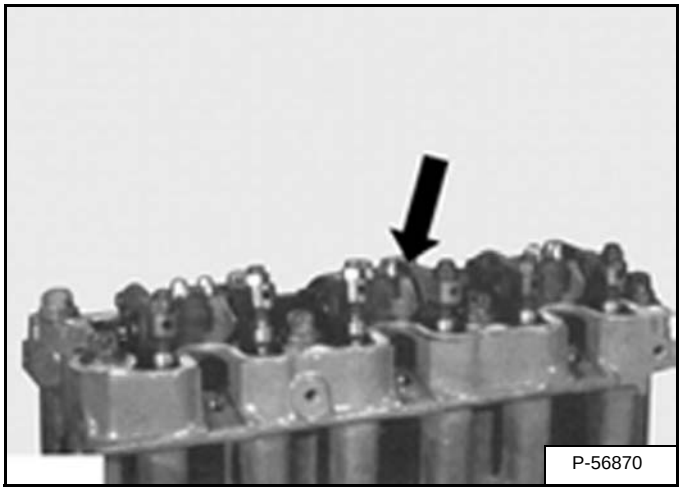
Assembly (Cont'd)

Figure 60-81-81



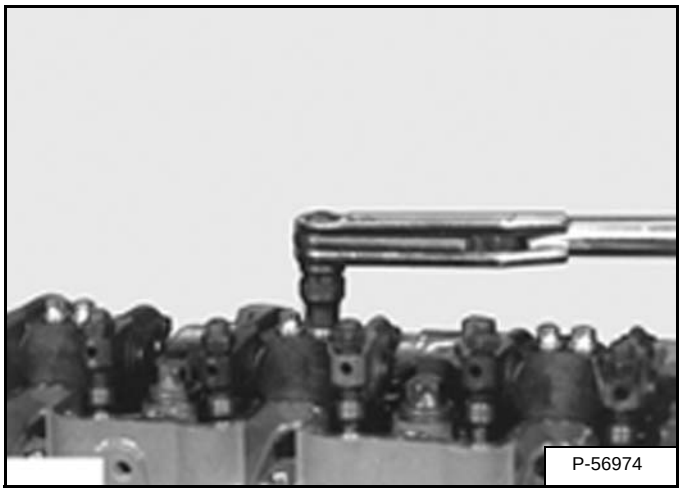
Install the push rods **[Figure 60-81-81]**.

Figure 60-81-82



Install the rocker arms/bracket assembly **[Figure 60-81-82]**.

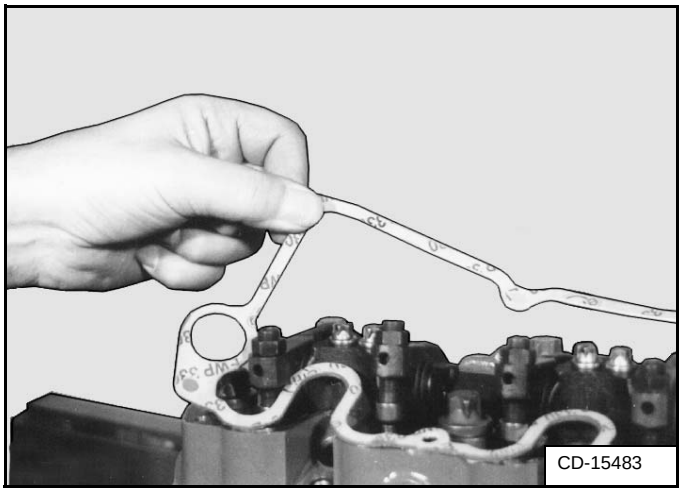
Figure 60-81-83



Tighten the rocker arm bracket bolts to 15 ft.-lb. (21 N•m) torque **[Figure 60-81-83]**.

Set the valve clearance. See "Valve Clearance Adjustment" on page 50.

Figure 60-81-84



Install the valve cover gasket **[Figure 60-81-84]**.

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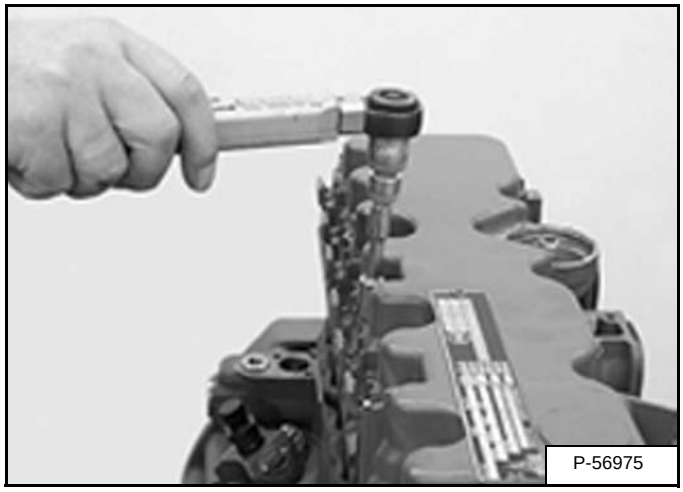
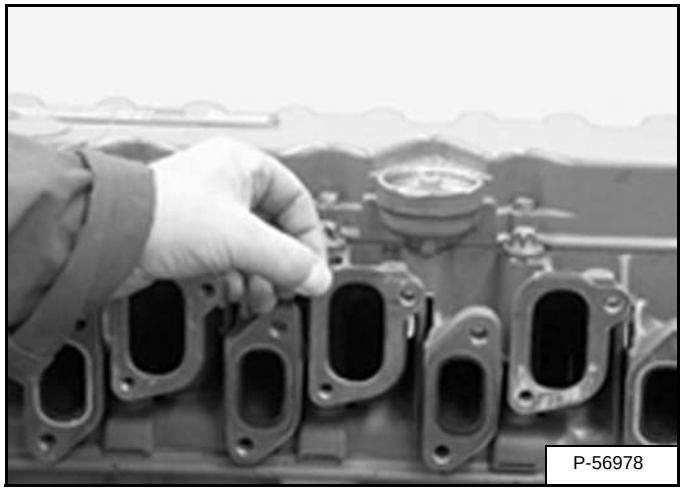
Assembly (Cont'd)

Figure 60-81-85



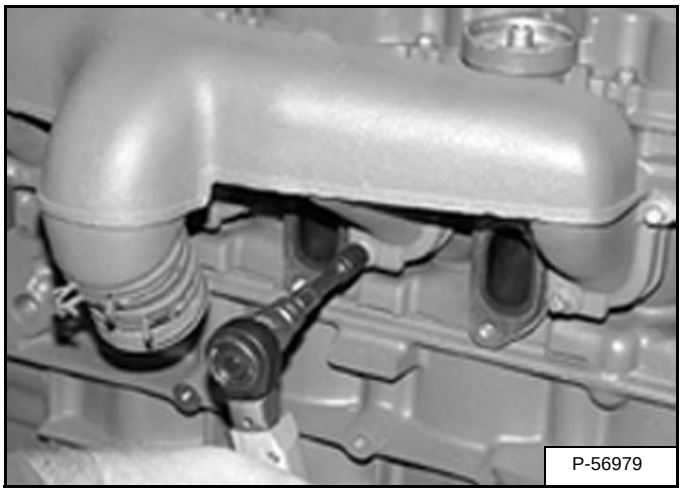
Install the valve cover **[Figure 60-81-85]**. Tighten the bolts to 75 in.-lb. (8,5 N•m) torque.

Figure 60-81-86



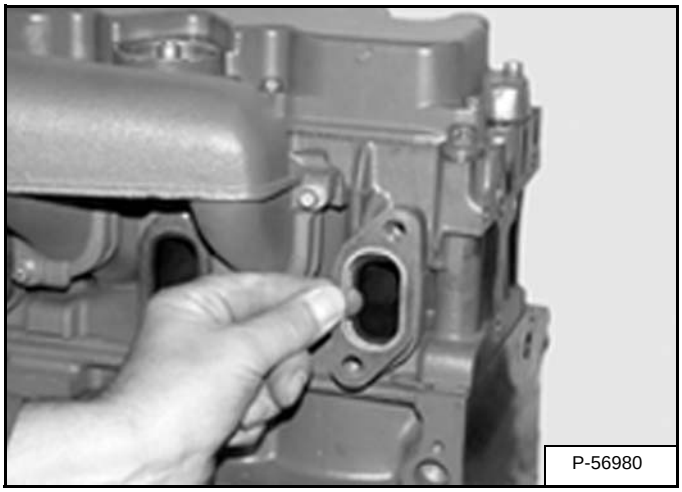
Install new intake manifold gasket **[Figure 60-81-86]**.

Figure 60-81-87



Install the intake manifold and tighten the bolts to 15 ft.-lb. (21 N•m) torque **[Figure 60-81-87]**.

Figure 60-81-88



Install the exhaust manifold **[Figure 60-81-88]**.

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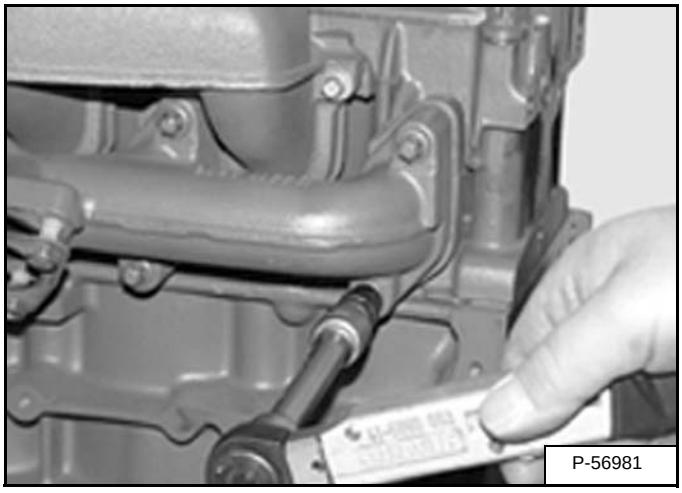
Assembly (Cont'd)

Figure 60-81-89

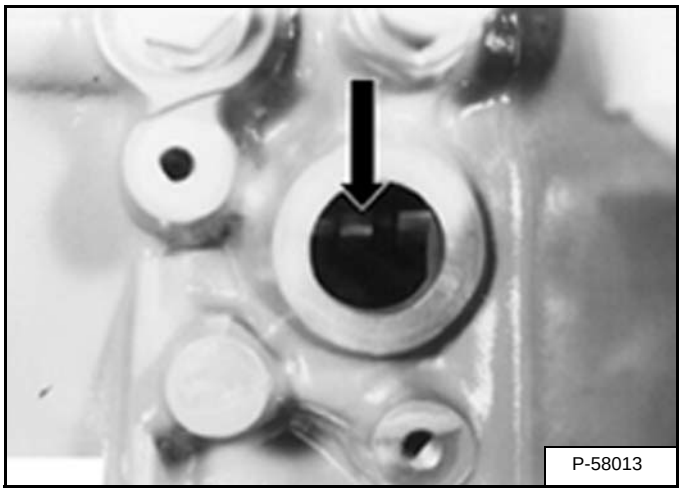


Install the exhaust manifold and tighten the bolts to 41 ft.-lb. (55 N•m) torque **[Figure 60-81-89]**.

Figure 60-81-90

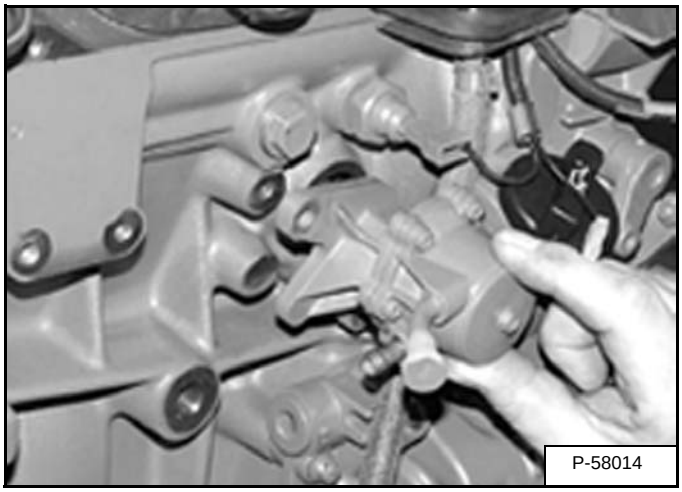
Install a new seal on the fuel lift pump **[Figure 60-81-90]**.

Figure 60-81-91



Turn the camshaft so the fuel lift pump lobe is at B.D.C. (bottom dead center) **[Figure 60-81-91]**.

Figure 60-81-92



Install the fuel lift pump **[Figure 60-81-92]**.

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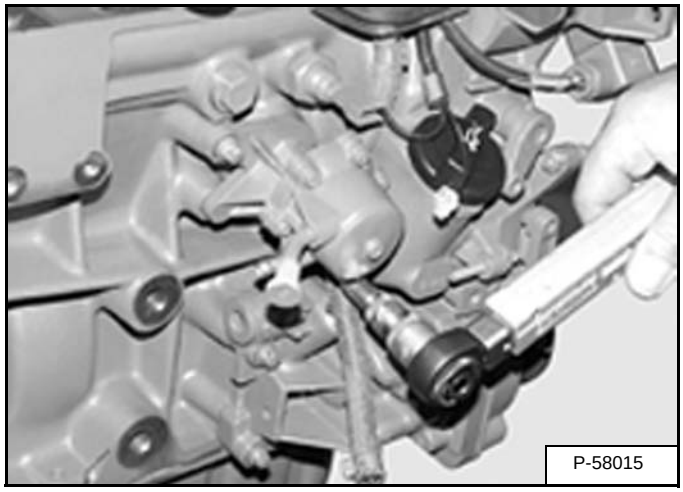
Assembly (Cont'd)

Figure 60-81-93



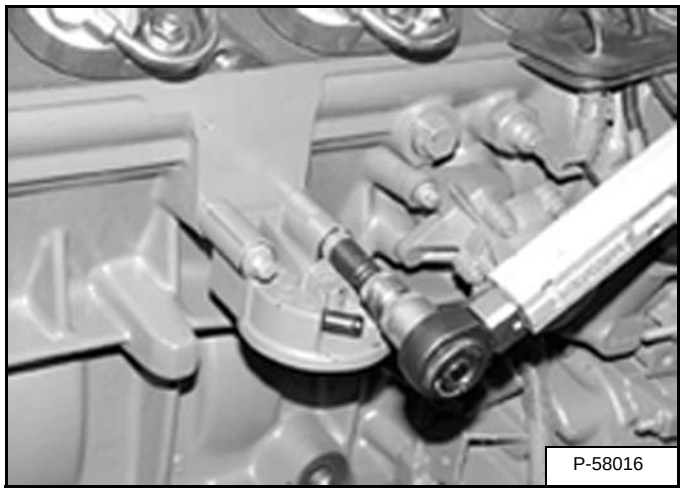
Tighten the lift pump bolts to 15 ft.-lb. (21 N•m) torque **[Figure 60-81-93]**.

Install a new oil filter.

Install the fuel injectors. (See Fuel Injector Removal And Installation on Page 60-51-13.)

Install the fuel injector pumps. (See Fuel Injection Pump Installation on Page 60-51-10.)

Figure 60-81-94



Install the fuel filter mount **[Figure 60-81-94]**.

Tighten the bolts to 15 ft.-lbs (21 N•m) torque.

Install the fuel filter.

Figure 60-81-95

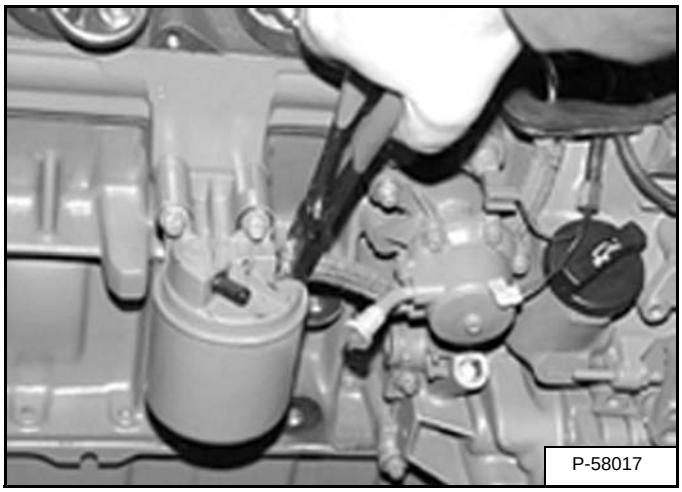
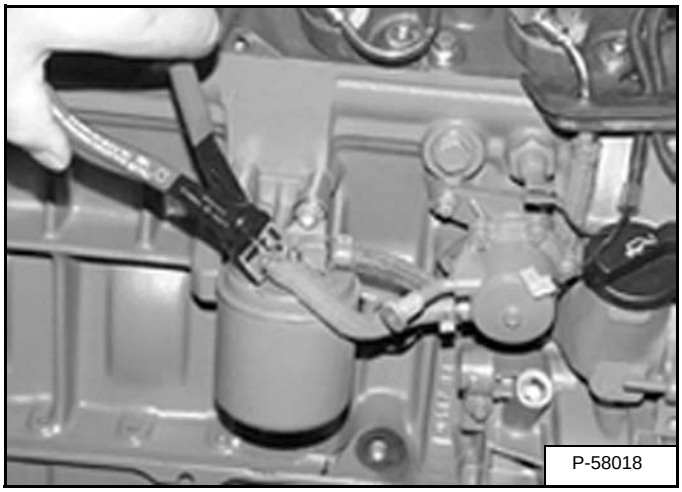


Figure 60-81-96



Install the fuel lines **[Figure 60-81-95]** & **[Figure 60-81-96]**.

Install the oil filter.

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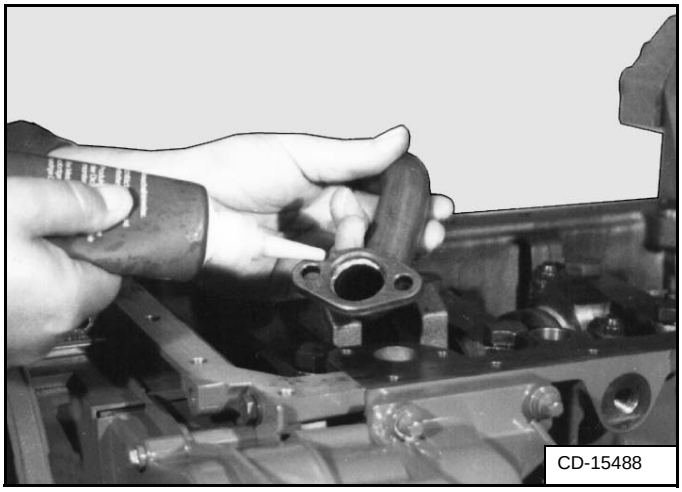
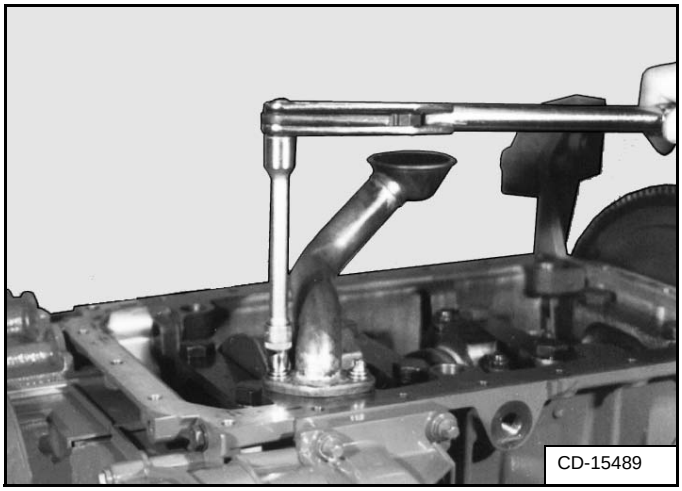
Assembly (Cont'd)

Figure 60-81-97



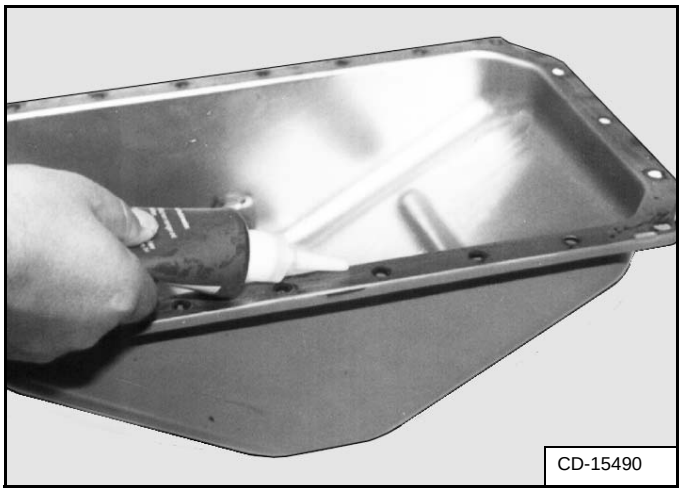
Put sealing compound on the sealing surface of the oil suction pipe **[Figure 60-81-97]**.

Figure 60-81-98



Install the oil suction pipe and tighten the bolts to 15 ft.-lb. (21 N•m) torque **[Figure 60-81-98]**.

Figure 60-81-99

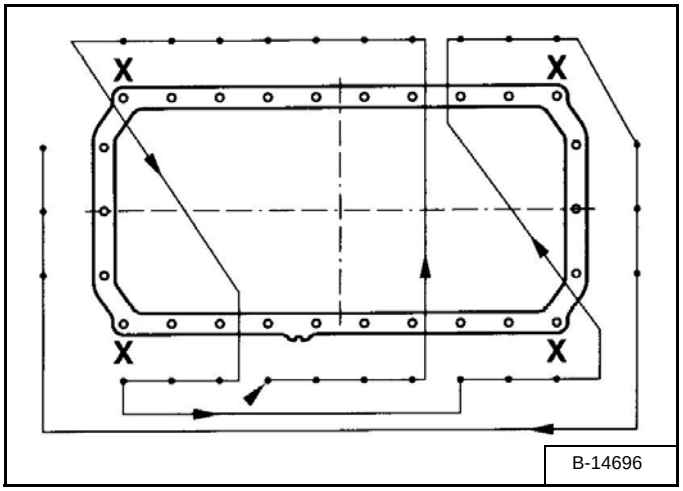


Put sealing compound on the sealing surface of the oil pan **[Figure 60-81-99]**.

Install the oil pan

Initially install the corner bolts first and tighten to 5 in.-lb. (0,5 N•m) torque.

Figure 60-81-100



Install the oil pan bolts and tighten to 15 ft.-lb. (21 N•m) torque as shown in **[Figure 60-81-100]**.

Install the oil pan plug and tighten to 40 ft.-lb. (55 N•m) torque.

Install the flywheel. (See Removal And Installation on Page 60-71-1.)

Install the turbocharger. See "Turbo Charger Removal and Installation" on page 70.

Install the starter. (See Removal And Installation (S/N 528911001 & Above And S/N 528611001 & Above) on Page 50-40-1.)

Install the alternator. (See Removal And Installation (S/N 528911001 & Above And 528611001 & Above) on Page 50-30-3.)

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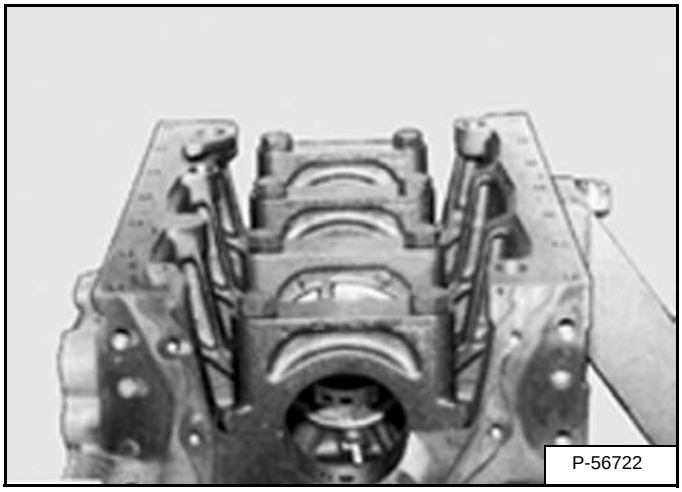
Cylinder, Checking

Clean the engine block and inspect for damage.

Figure 60-81-101



Install the main bearing caps **[Figure 60-81-101]**.

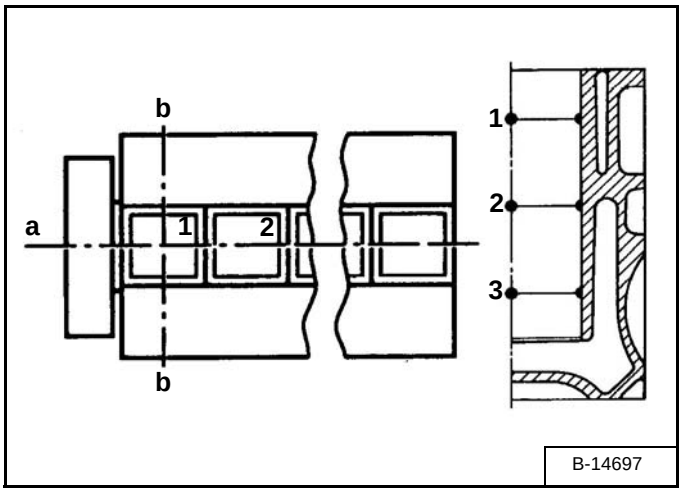
Tighten the main bearing cap bolts as follows:

Initial Torque . . . . . 37 ft.-lb. (50 N•m)
1st Stage Angle . . . . . 60°
2nd Stage Angle . . . . . 45°

Figure 60-81-102

Using a dial indicator gauge check the cylinders **[Figure 60-81-102]**.

Figure 60-81-103



Check the cylinders with engine block longitudinal **(a)** and transverse **(b)** axis and in three planes **[Figure 60-81-103]**.

Specifications:
Cylinder Bore. . . . . .3.7008 - 3.7016 inch. (94 - 94.02 mm)
Wear Limit . . . . . 3.59 inch. (94.1 mm)

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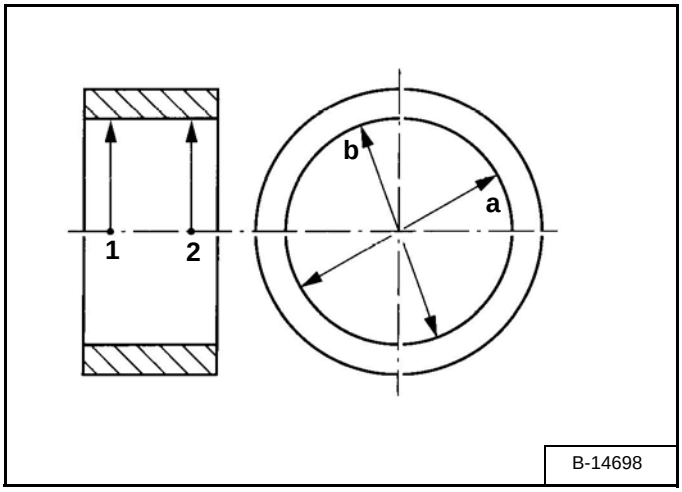
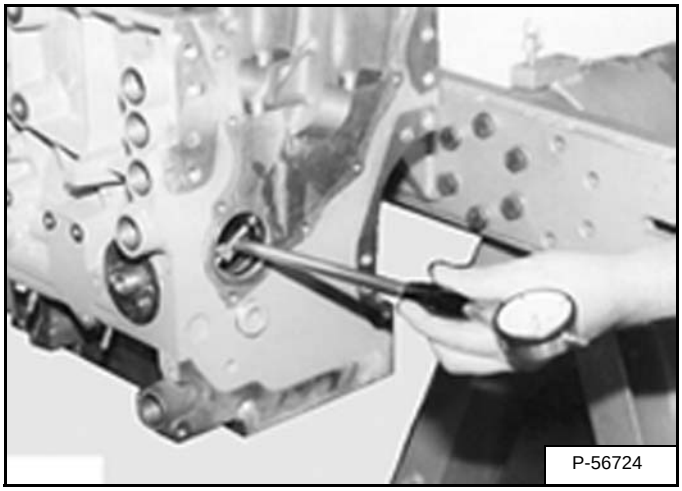
Camshaft Bearing, Checking

Figure 60-81-104



Check the camshaft bearing bushings at points **(1)** and **(2)** in the planes of **(a)** and **(b) [Figure 60-81-104]**.

Figure 60-81-105



Check the camshaft bushings using a gauge **[Figure 60-81-105]**.

Inner Diameter . . . . . .2.126 + 0.002 inch. (54 + 0,054 mm)
Wear Limit . . . . . .2.129 inch. (54,08 mm)

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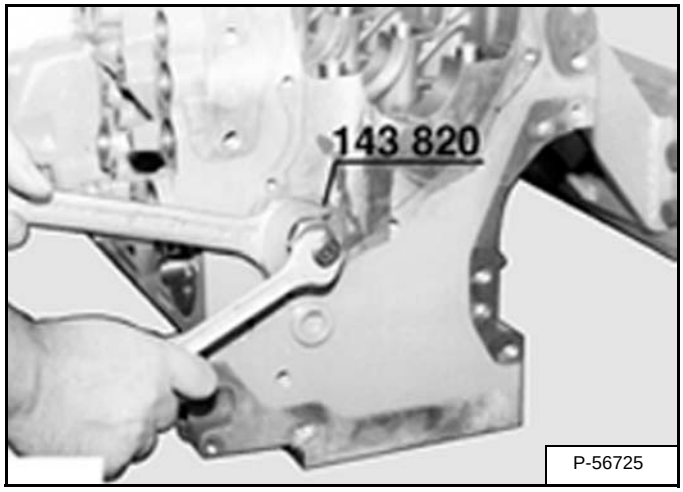
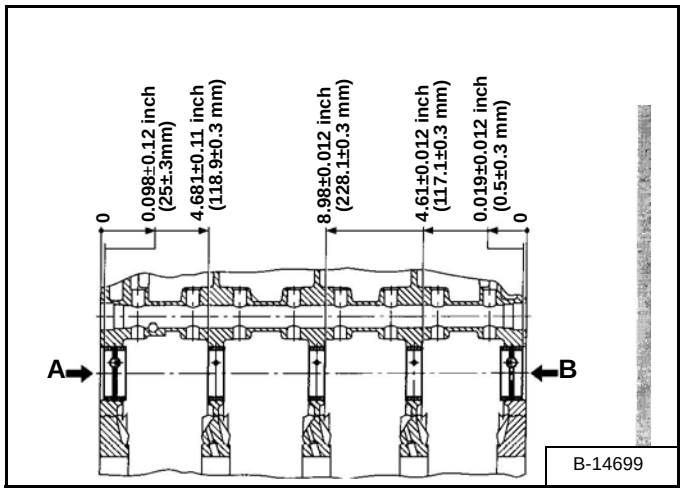
Camshaft Bearing, Removal And Installation

Figure 60-81-106



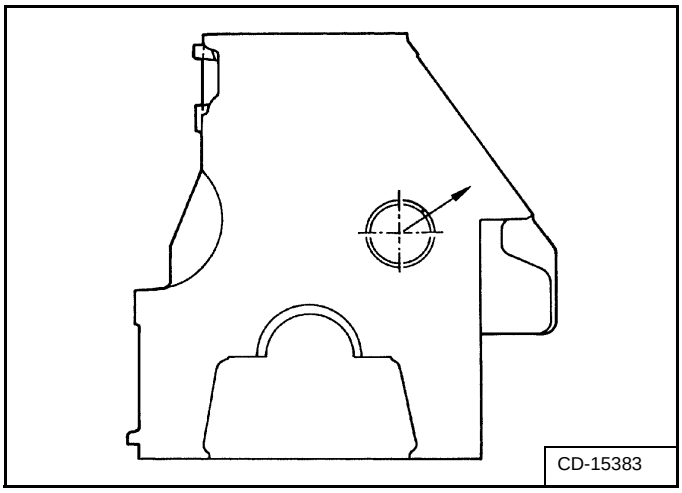
Remove all the camshaft bearing bushings using a camshaft bushing removal tool as needed **[Figure 60-81-106]**.

Figure 60-81-107



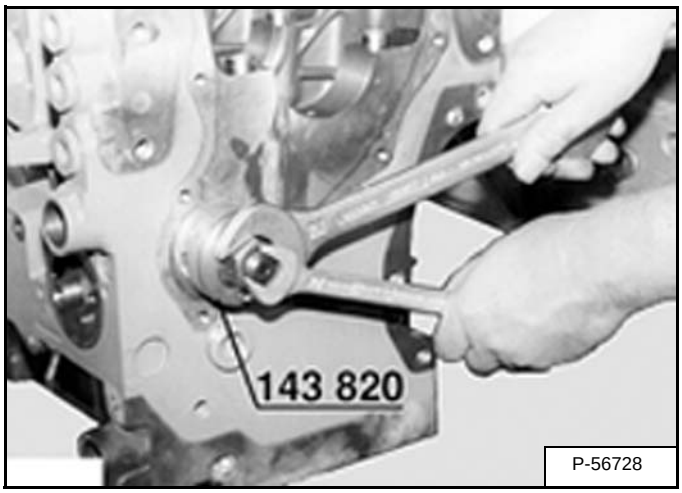
Use the dimensions in **[Figure 60-81-107]** to install the camshaft bushings.

Figure 60-81-108



When installing the new camshaft bushings, the oil lube hole must align with the oil hole in the engine block **[Figure 60-81-108]**.

Figure 60-81-109



Install the new camshaft bushings using a camshaft bushing installation tool **[Figure 60-81-109]**.

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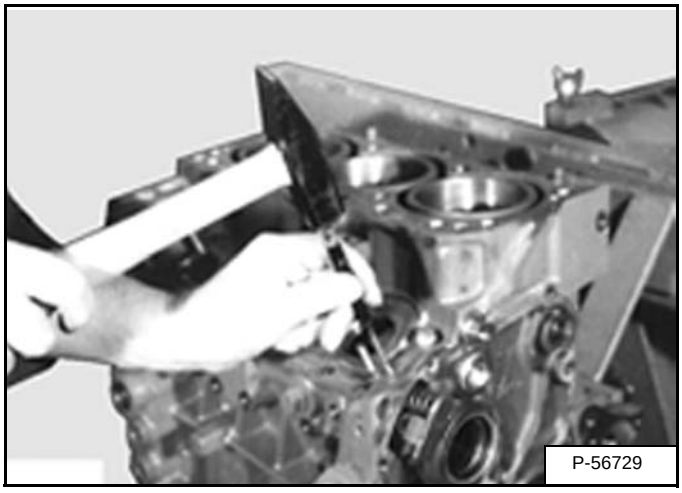
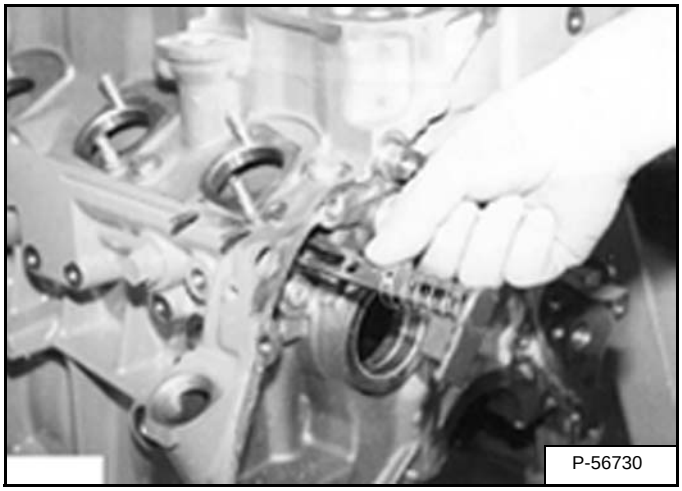
Control Rod Guide Bushing Removal

Figure 60-81-110



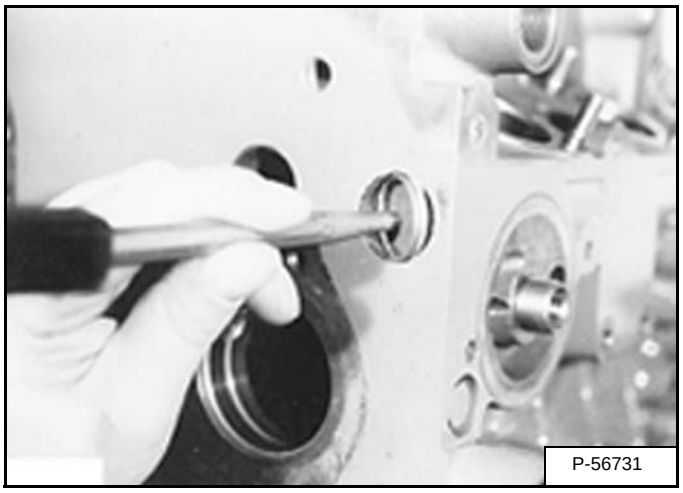
Remove the parallel pin **[Figure 60-81-110]**.

Figure 60-81-111



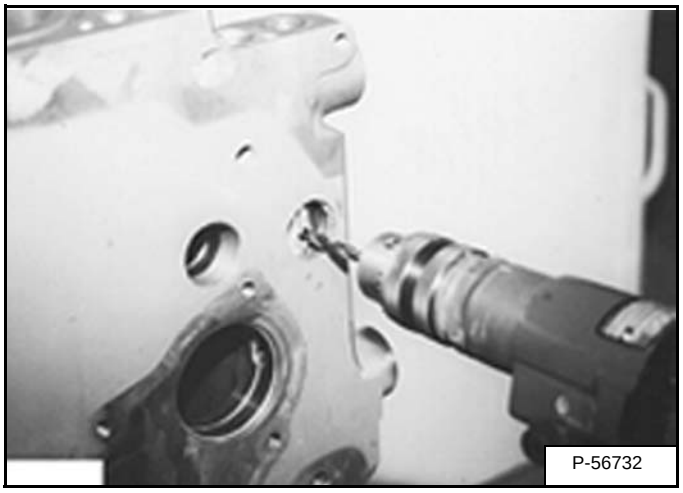
Remove the control rod and spring **[Figure 60-81-111]**.

Figure 60-81-112



Remove the cover **[Figure 60-81-112]**.

Figure 60-81-113



Drill a 7/32 inch (5,5 mm) hole on one side of the pipe **[Figure 60-81-113]**.

NOTE: Carefully clean the engine block after drilling.

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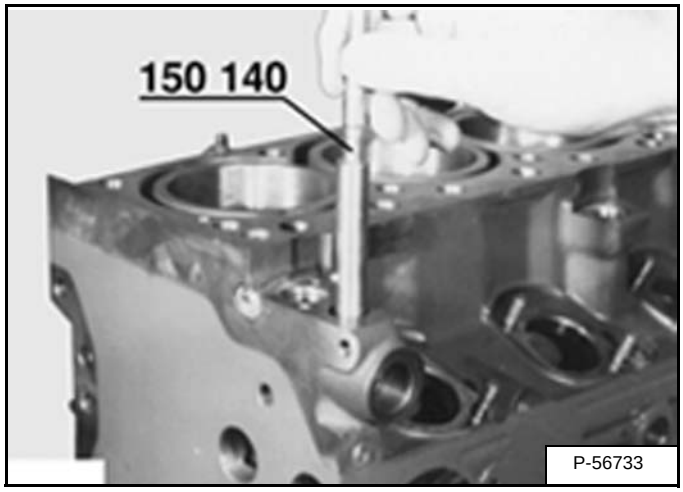
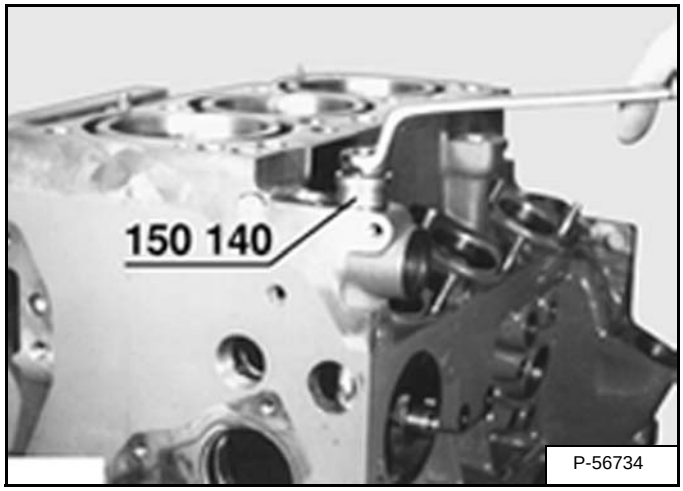
Control Rod Guide Bushing Removal (Cont'd)

Figure 60-81-114



Install the puller into the bore until the pin engages **[Figure 60-81-114]**.

Figure 60-81-115

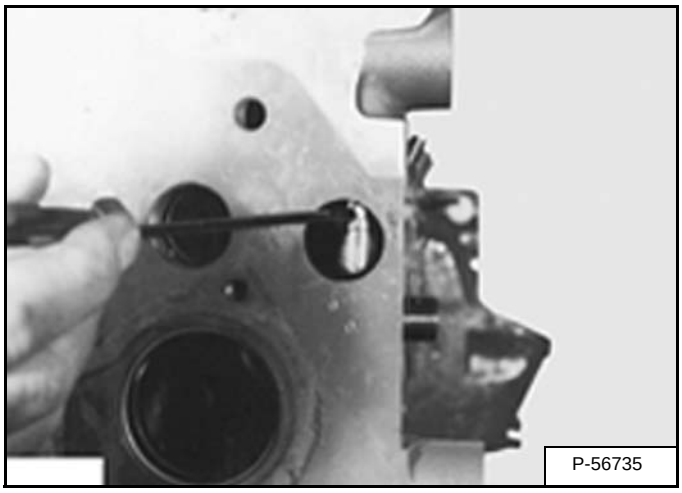


Install the spacer tool in position. Pull the pipe from the lower press fit **[Figure 60-81-115]**.

NOTE: Do Not pull pipe completely out.

Remove the spacer tool.

Figure 60-81-116



Press pin in until it does not project beyond the pipe **[Figure 60-81-116]**. Pull the pipe out completely.

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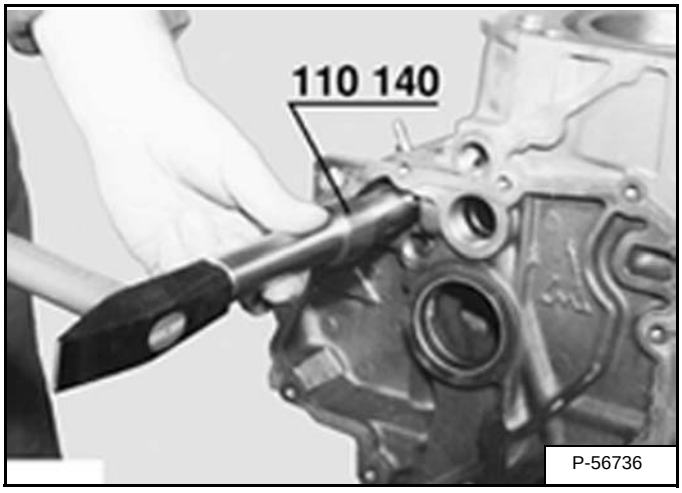
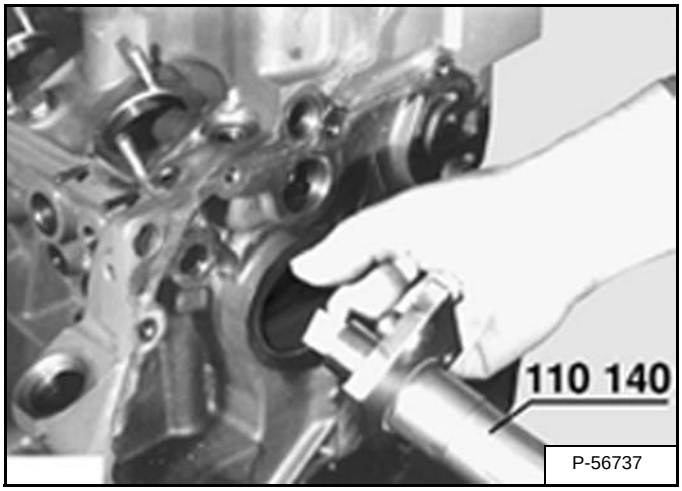
Control Rod Guide Bushing Installation

Figure 60-81-117



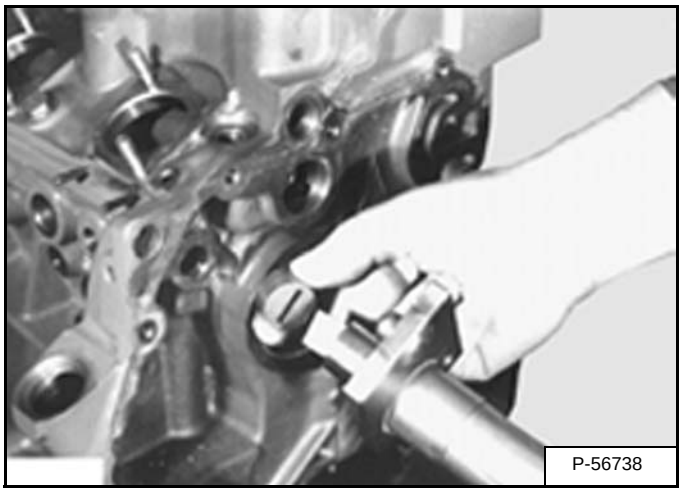
Using the tool, drive the guide bushing out **[Figure 60-81-117]**.

Figure 60-81-118



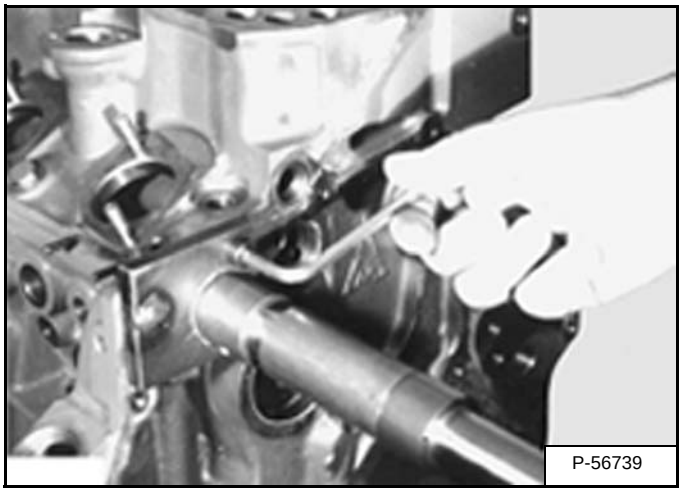
Install the new bushing into the center of the arbor assembly **[Figure 60-81-118]**.

Figure 60-81-119



Install the guide on the arbor assembly with the chamfer pointing toward the crankcase **[Figure 60-81-119]**.

Figure 60-81-120



Fasten the arbor assembly and bushing on the engine block **[Figure 60-81-120]**.

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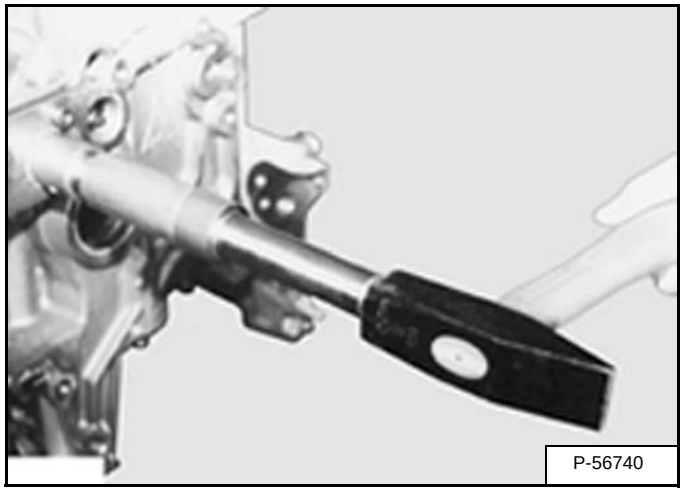
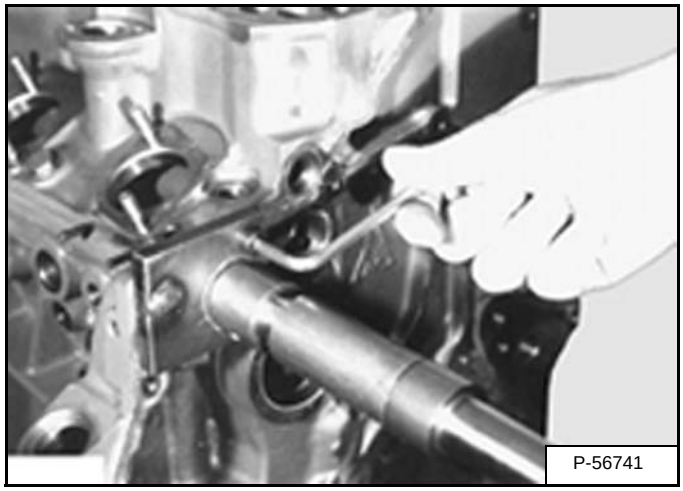
Control Rod Guide Bushing Installation (Cont'd)

Figure 60-81-121



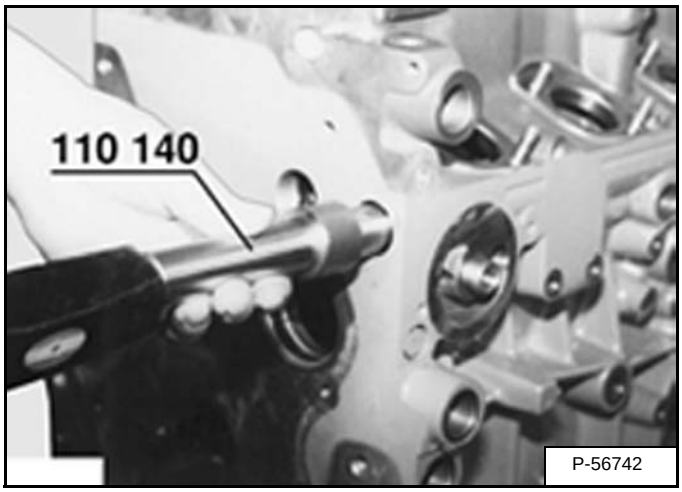
Drive the bushing into the engine block as far as it will go **[Figure 60-81-121]**.

Figure 60-81-122



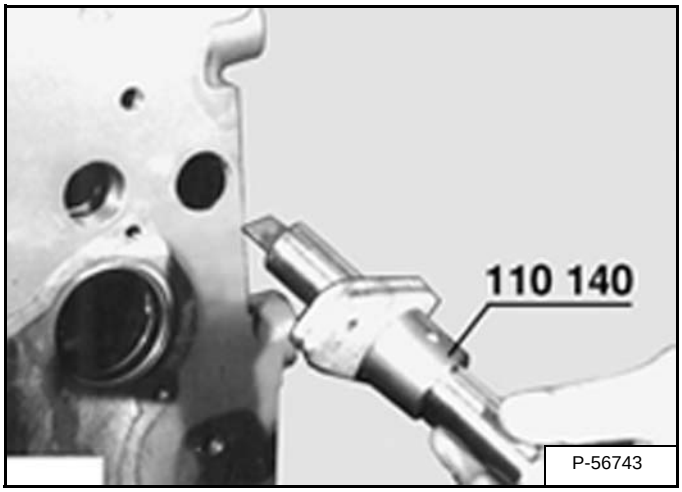
Remove the arbor assembly **[Figure 60-81-122]**.

Figure 60-81-123



Remove the guide bushing at the flywheel end of the engine block **[Figure 60-81-123]**.

Figure 60-81-124



Assemble the arbor without the spacer **[Figure 60-81-124]**.

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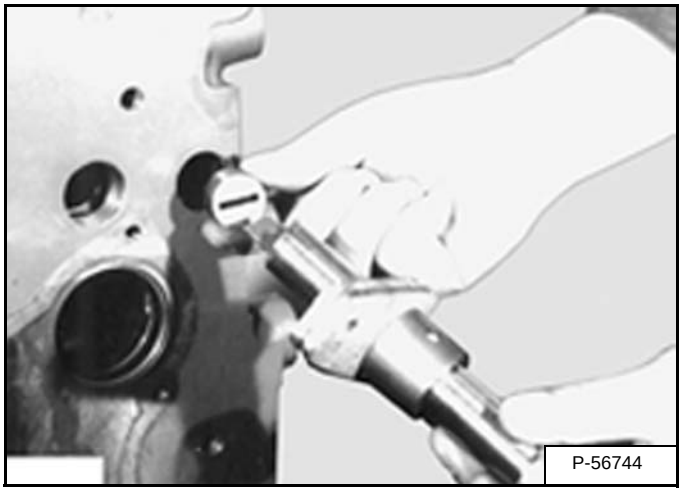
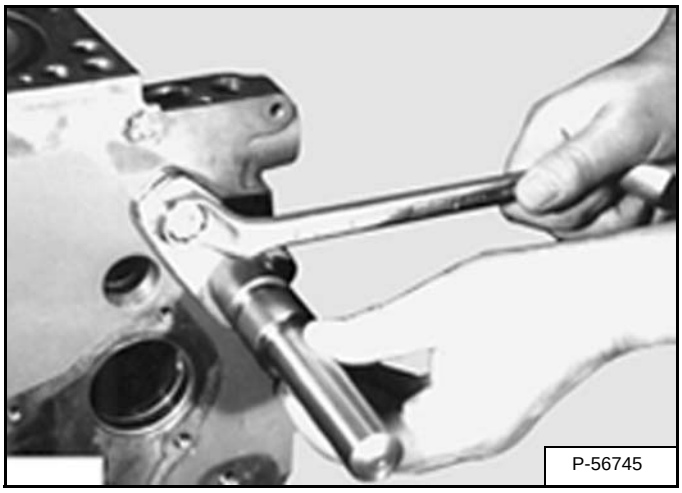
Control Rod Guide Bushing Installation (Cont'd)

Figure 60-81-125



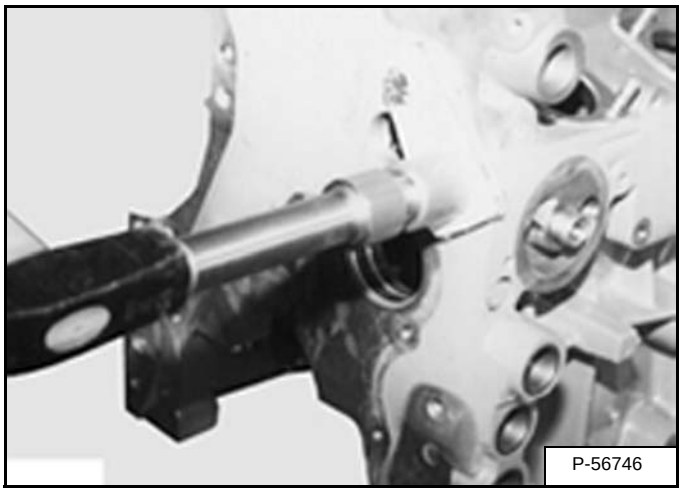
Install the guide bushing on the arbor assembly with the chamfer pointing toward the crankcase **[Figure 60-81-125]**.

Figure 60-81-126



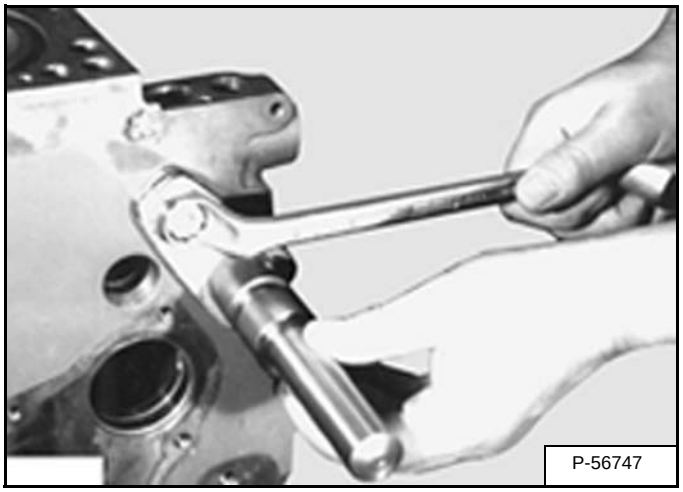
Fasten the arbor assembly and guide bushing to the engine block **[Figure 60-81-126]**.

Figure 60-81-127



Drive in the guide bushing as far as it will go, at the flywheel end **[Figure 60-81-127]**.

Figure 60-81-128



Remove the arbor assembly **[Figure 60-81-128]**.

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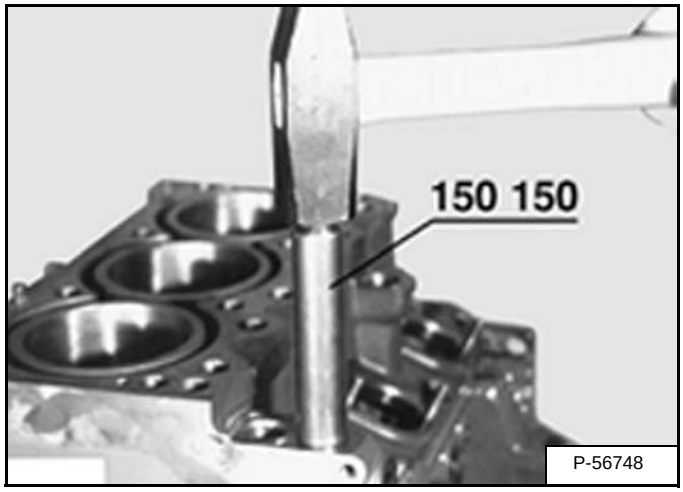
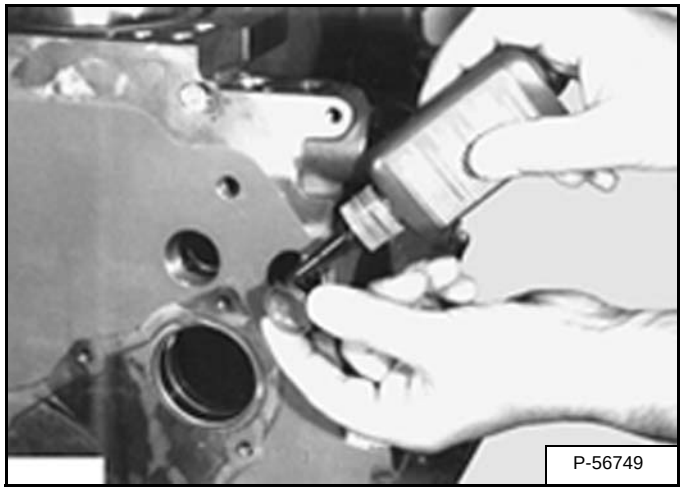
Control Rod Guide Bushing Installation (Cont'd)

Figure 60-81-129



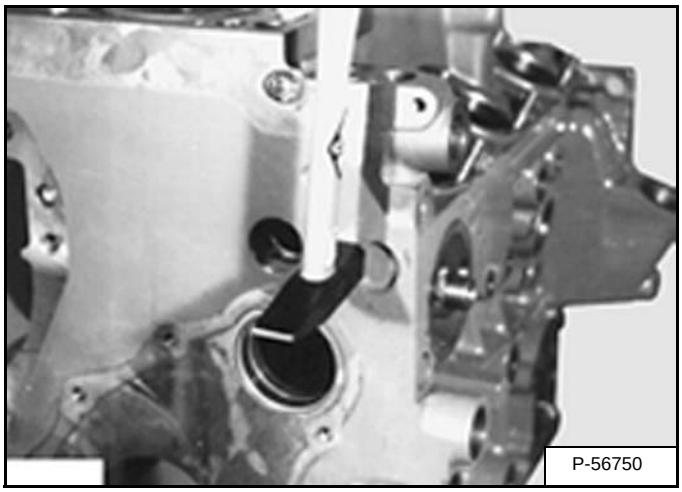
Install the new pipe in the block as far as it will go with the arbor assembly **[Figure 60-81-129]**.

Figure 60-81-130



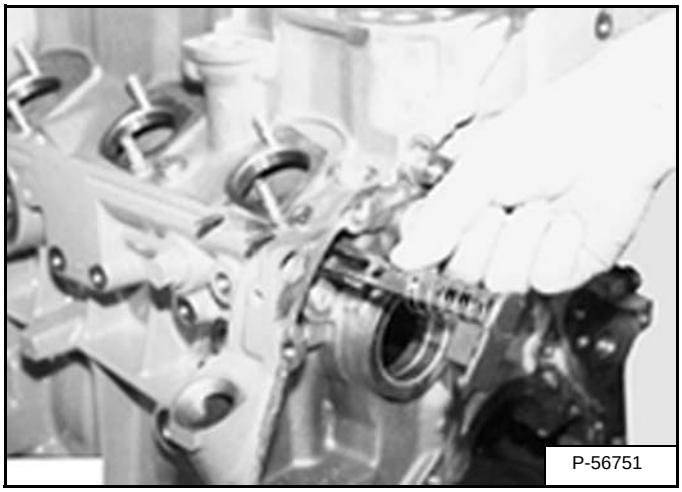
Put sealing compound on the new plug **[Figure 60-81-130]**.

Figure 60-81-131



Install the new cover flush with the engine block **[Figure 60-81-131]**.

Figure 60-81-132



Install the control rod with starter spring into the guide bushings **[Figure 60-81-132]**.

NOTE: The control rod must move freely.

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Control Rod Guide Bushing Installation (Cont'd)

Figure 60-81-133

Compress the starter spring. Install the parallel pin into the recess for the control rod travel limitation **[Figure 60-81-133]**.

Check to make sure it is flush with the surface.

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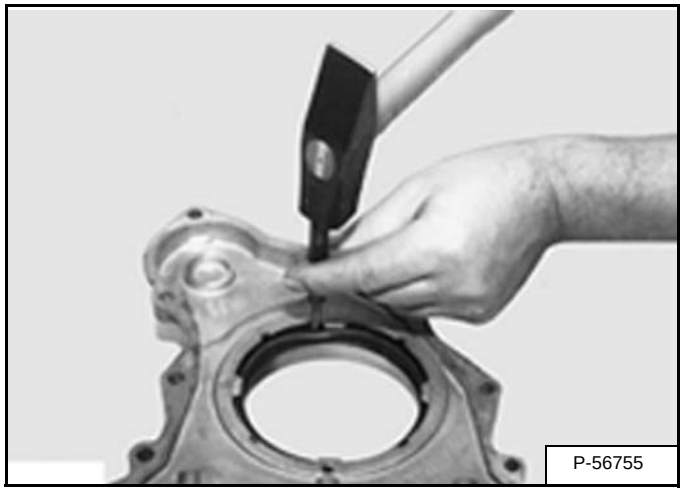
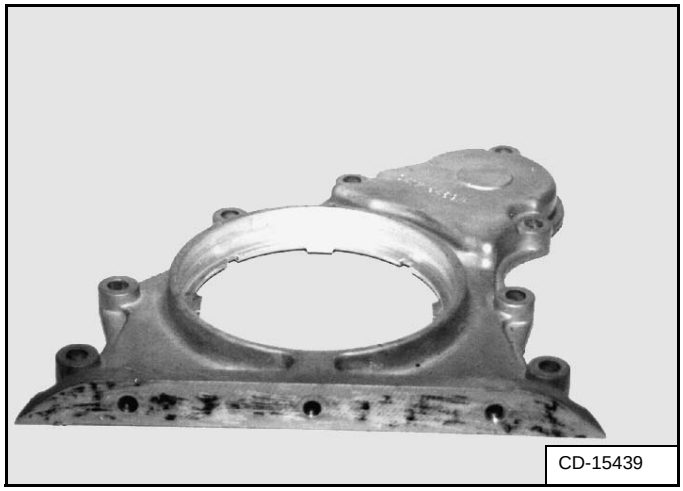
Rear Cover Seal Removal And Installation

Figure 60-81-134



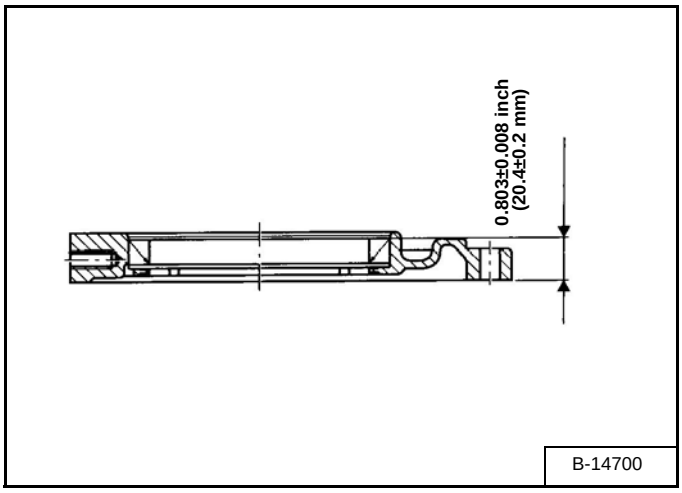
Remove the rear cover shaft seal **[Figure 60-81-134]**.

Figure 60-81-135



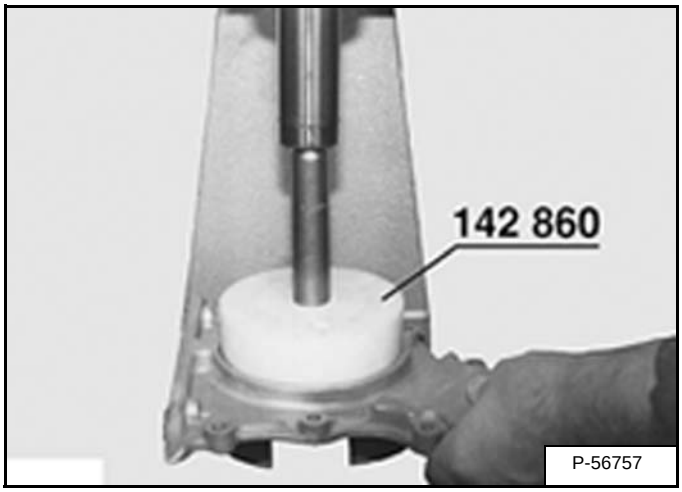
Clean the seal seating surface **[Figure 60-81-135]**. Inspect the cover for damage, replace as needed.

Figure 60-81-136



When installing the new shaft seal, use the dimension shown in **[Figure 60-81-136]**.

Figure 60-81-137



Use the seal driver tool and install to the correct depth **[Figure 60-81-137]**. See "Deutz Engine Tools Identification Chart" on page 1.

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Crankshaft, Checking

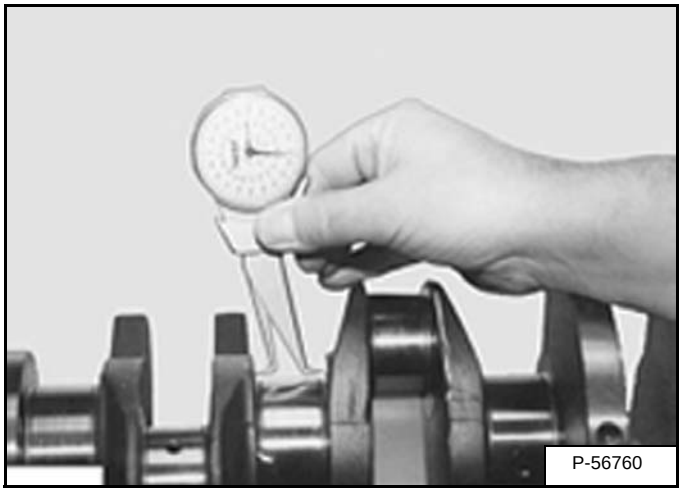
Put the crankshaft on v-blocks.

Check the main bearing journals:

Specifications:

Journal Diameter . . . . . 2.7538 - 2.7546 inch. (69,97 - 69,99 mm)
Each Undersize . . . . . 0.010 inch. (0,25 mm)
Undersize Limit . . . . . 2.7348 inch. (69.47 mm)

Figure 60-81-138

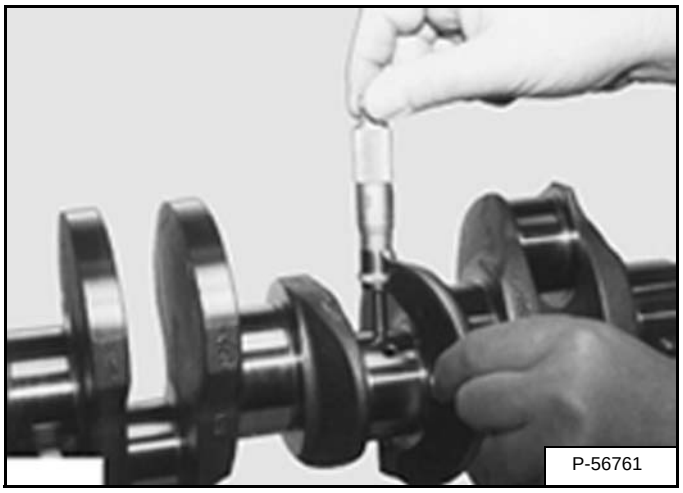


Check the thrust bearing width **[Figure 60-81-138]**.

Specifications:

Journal Width . . . . . 1.378 +0.0016 inch. (35 + 0,04 mm)
Limit Oversize . . . . . 1.395 inch. (35,44 mm)
Each Oversize . . . . . 0.016 inch. (0.4 mm)

Figure 60-81-139

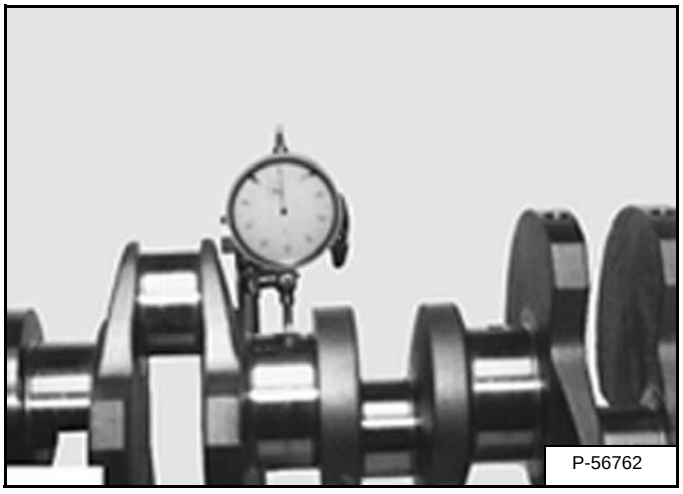


Check the connecting rod journals **[Figure 60-81-139]**.

Specifications:

Pin Diameter . . . . . 2.1588 - 2.1596 inch. (54,97 - 54,99 mm)
Undersize Limit . . . . . 2.1448 inch. (54,47 - 54,49 mm)
Wear Limit . . . . . 0.0004 inch. (0,1 mm)

Figure 60-81-140



Use a dial indicator and check crankshaft for out of roundness **[Figure 60-81-140]**.

Specifications:

Out of Roundness Max. . . . . 0.002 inch. (0,05 mm)

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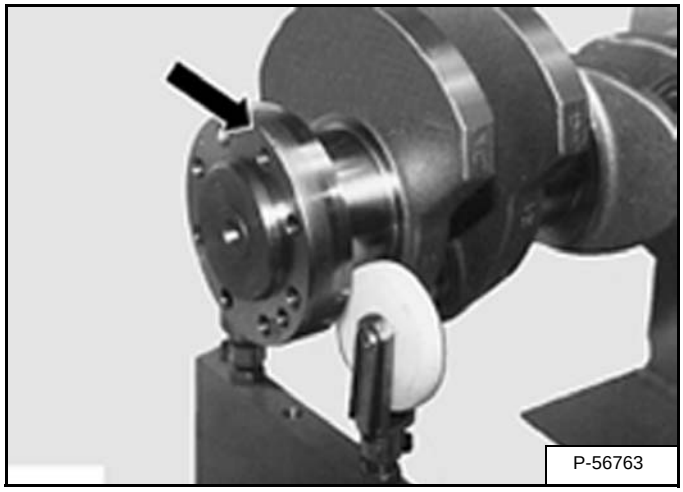
Crankshaft, Checking (Cont'd)

Figure 60-81-141



Check the surface of the crankshaft seal area **[Figure 60-81-141]**.

Recondition the crankshaft as needed.

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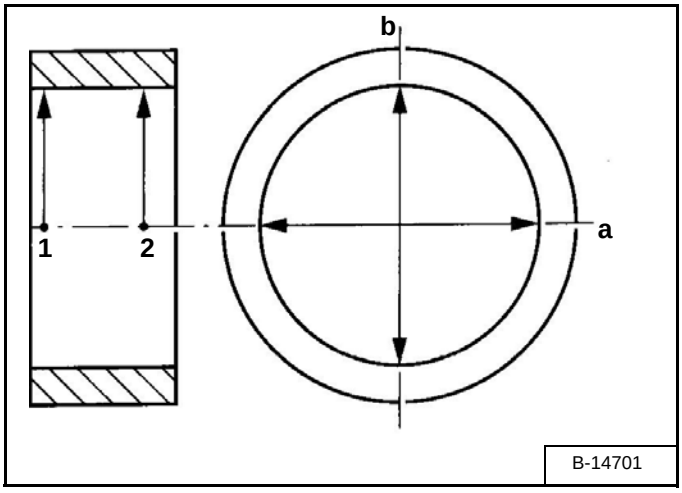
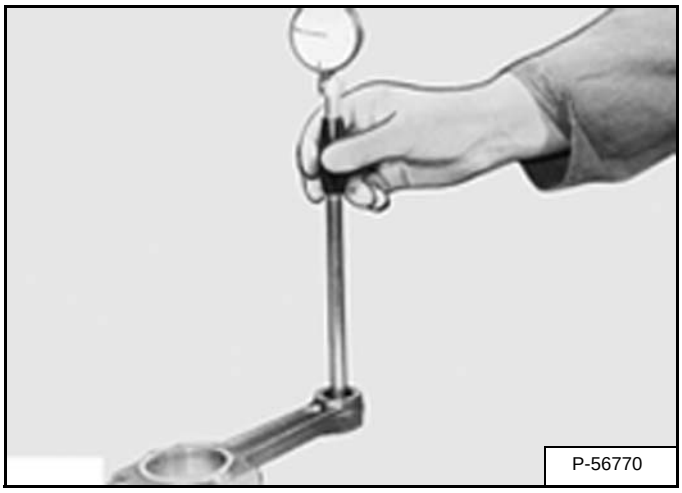
Connecting Rod, Checking

Figure 60-81-142



When checking the connecting rod large and small end, measure at the points (1) and (2) and in planes (a) and (b) **[Figure 60-81-142]**.

Figure 60-81-143

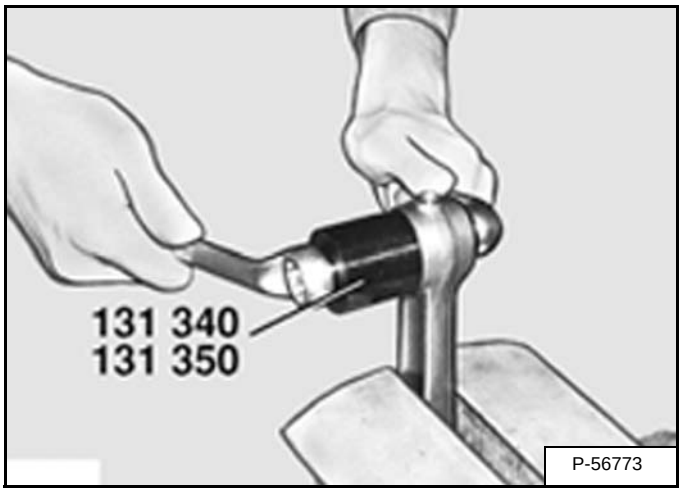


Check the small end bushing **[Figure 60-81-143]**.

Specifications:

I.D. of Small End Bushing . . . . . 1.18 - 1.182 inch. (30.025 - 30.035 mm)
Wear Limit Bushing Clearance . . . . . 0.003 inch. (0,08 mm)

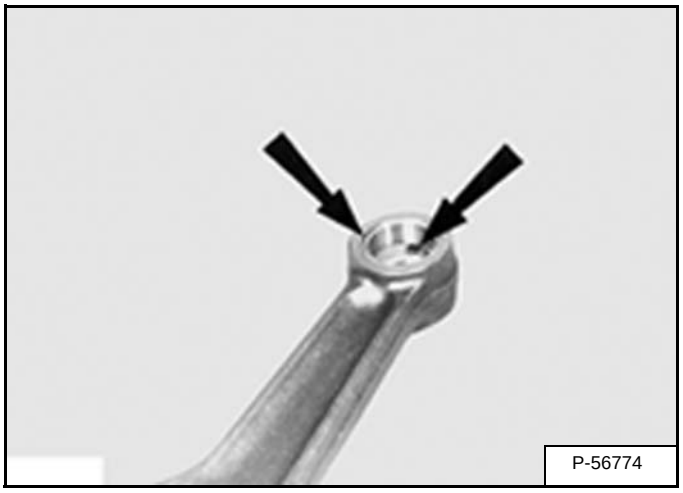
Figure 60-81-144



Replace small end busing as needed **[Figure 60-81-144]**.

Bore for Small End Bushing . . . . . 1.299 + 0.0008 inch. (33 + 0,02 mm)
O.D. of Small End Bushing . . . . . 1.3017 - 1.303 inch. (33,07 - 33,11 mm)

Figure 60-81-145



Press in the small end bushing, make sure the lubrication holes are in alignment **[Figure 60-81-145]**.

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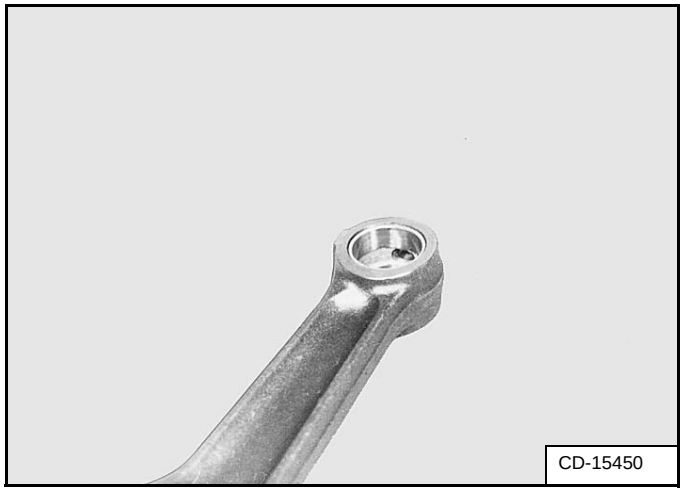
Connecting Rod, Checking (Cont'd)

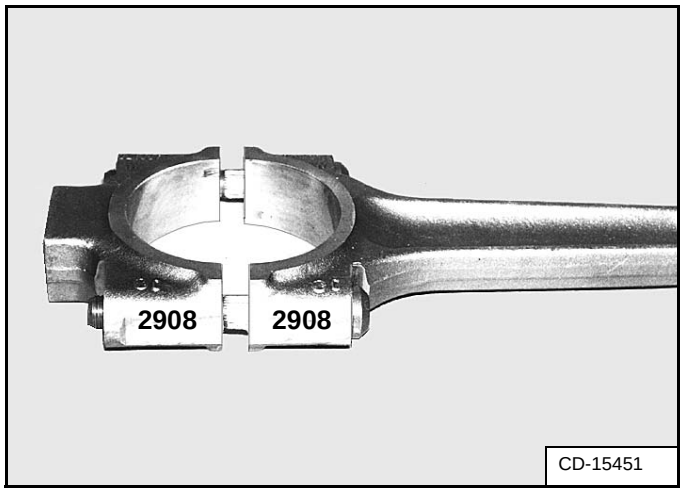
Figure 60-81-146



After pressing in the small end bushing, bore the bushing to the following dimensions **[Figure 60-81-146]**.

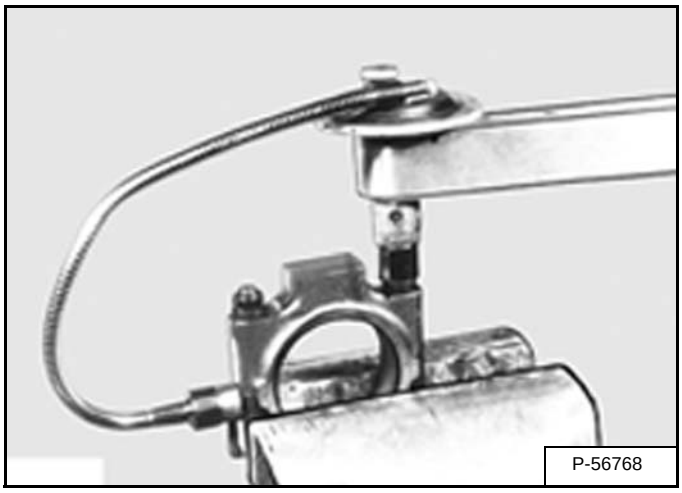
Specifications:
I.D. of Small End Bushing . . . . . 1.181-1.182 inch. (30.025 - 30.035 mm)

Figure 60-81-147



Install the correct cap on the correct rod **[Figure 60-81-147]**.

Figure 60-81-148



Tighten the connecting rod cap nuts as follows **[Figure 60-81-148]**.

Initial Torque . . . . . 22 ft.-lb. (30 N•m)
1st Step Angle . . . . . 60°
2nd Step Angle . . . . . 60°

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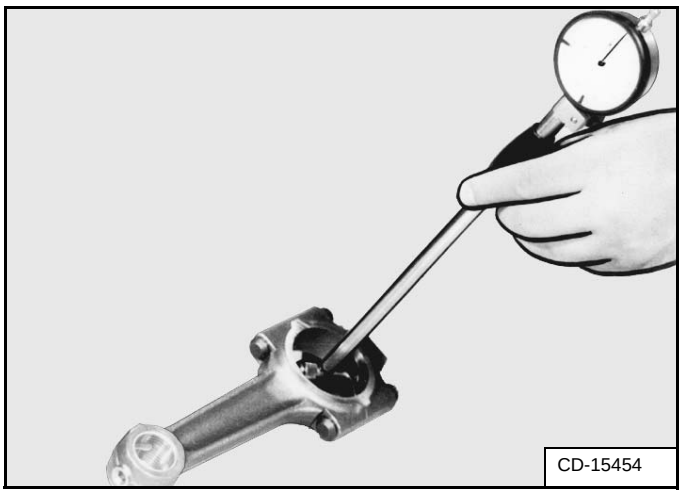
Connecting Rod, Checking (Cont'd)

Figure 60-81-149



Measure the big end bore **[Figure 60-81-149]**. If the measurement is the same as the specific valve, the necessary preload on the bearing halves will be obtained.

Specifications:
Big End I.D. . . . . 2.303 + 0.0008 inch
(58,5 + 0,02 mm)

Remove connecting rod cap. Install new bearing halves. Tighten the connecting rod cap nuts and tighten as listed above.

Measure the bearing halves:
Big End Bearing I.D. . . . . 2.1662 - 2.1675 inch.
(55.024 - 55.055 mm)
Each Undersize . . . . . 0.010 inch.
(0,25 mm)
Limit For Undersize . . . . . 2.1466 - 2.1478 inch.
(54.524 - 54.555 mm)
Radial Clearance
Wear Limit . . . . . .0.005 inch. (0,12 mm)

Check the connecting rod, without bearing halves, on a connecting rod tester.

Specifications:
Parallel Check-Tolerance. . . . . .0.118 inch. (0.03 mm)
Over a Distance of . . . . . 3.94 inch. (100 mm)
Squareness Check-Tolerance . . . .0.002 inch. (0,05 mm)

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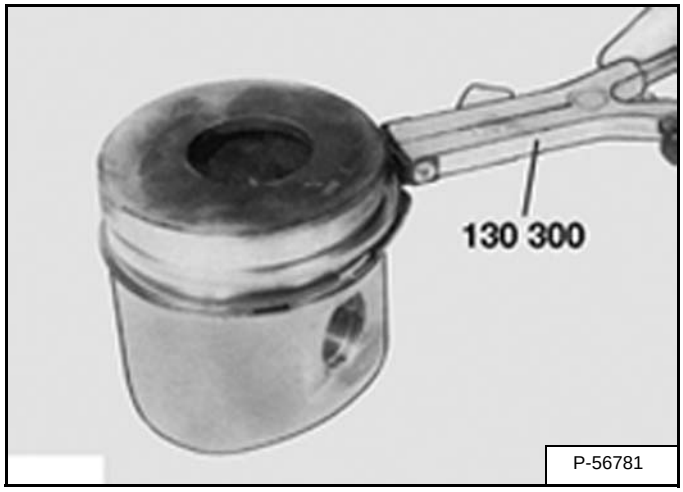
Piston, Checking

Figure 60-81-150

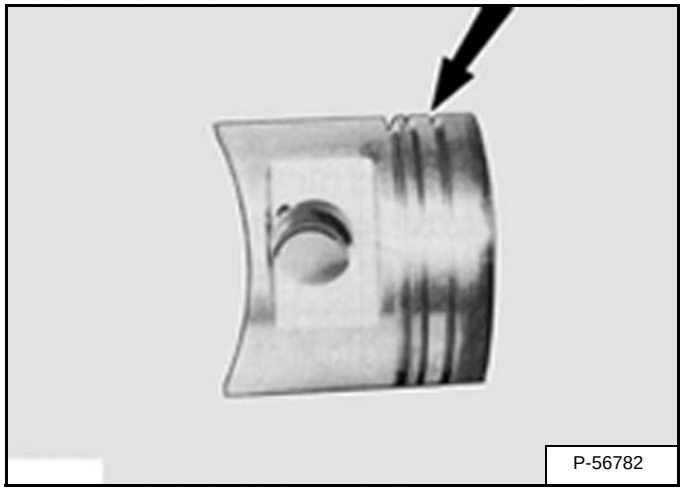


Remove the piston rings from the piston **[Figure 60-81-150]**.

Remove the piston from the connecting rod.

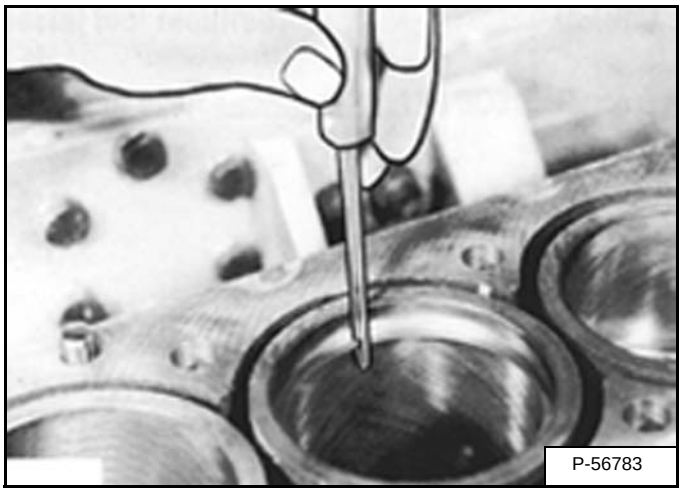
See Connecting Rod, Checking to check connecting rod specifications. (See Connecting Rod, Checking on Page 60-81-41.)

Figure 60-81-151



Clean and inspect piston and piston ring grooves **[Figure 60-81-151]**.

Figure 60-81-152



Measure the ring gap with a feeler gauge in the cylinder **[Figure 60-81-152]**.

Specifications:
Wear Limit
1st Ring Gap . . . . . 0.031 in. (0.8 mm)
2nd Ring Gap . . . . . 0.098 in (2.5 mm)
3rd Ring Gap . . . . . 0.043 in (1,1 mm)

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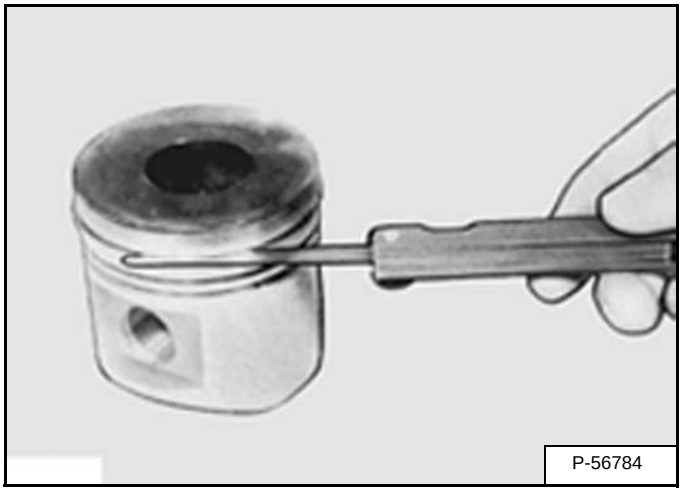
Piston, Checking (Cont'd)

Figure 60-81-153



Using new rings, measure the ring grooves using a feeler gauge **[Figure 60-81-153]**.

Specifications:
Wear Limit
1st Ring. . . . . Trapezoidal Slot
2nd Ring . . . . . 0.0078 in (0.20 mm)
3rd Ring . . . . . 0.0059 in (0.15 mm)

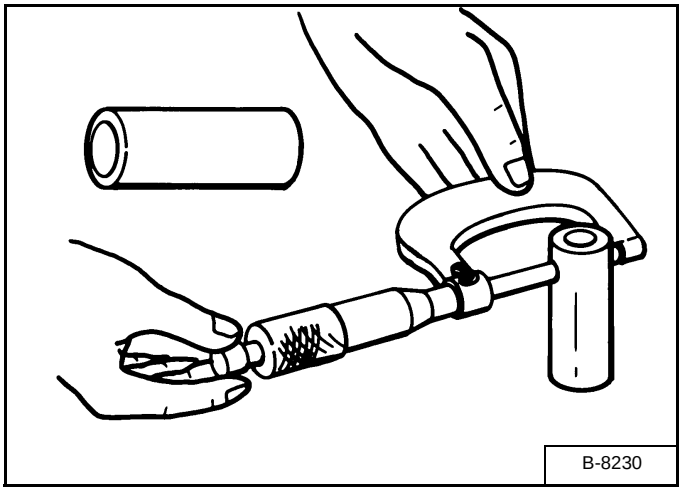
Measure the trapezoidal slot with the trapezoidal slot gauge **[Figure 60-81-153]**.

If a distance is present between the gauge and piston, the piston is serviceable **[Figure 60-81-153]**.

If the gauge rests against the piston, replace the piston **[Figure 60-81-153]**.

Piston Pin, Checking

Figure 60-81-154



Check piston pin for wear **[Figure 60-81-154]**.

Specifications:
Pin O.D. . . . . .1.180-1.181 inch. (29.995-30.0 mm)

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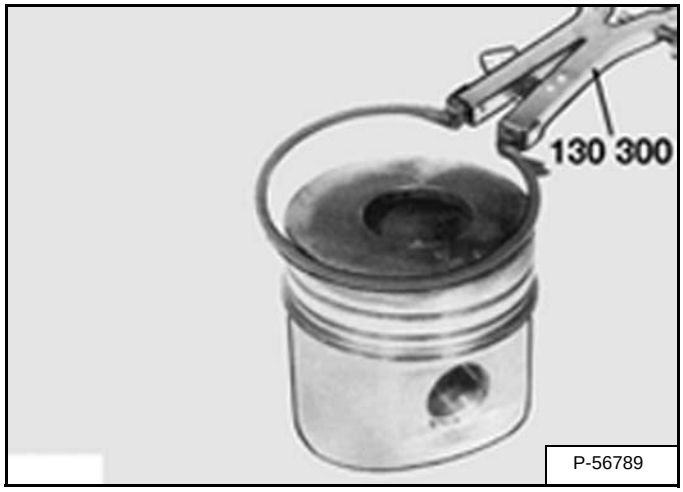
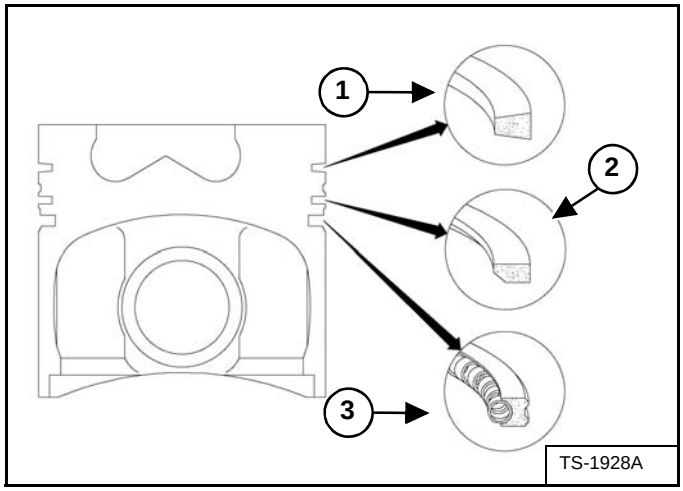
Piston Rings Installation

Figure 60-81-155



When installing the piston rings position them as listed below **[Figure 60-81-155]**.

Figure 60-81-156



lst Ring - Is a trapezoidal ring, (Item 1) **[Figure 60-81-156]**. It is installed on the piston with the mark BLF/M 2011 facing the combustion chamber.

2nd Ring - Is a tapered compression ring (Item 2) **[Figure 60-81-156]**, which is installed on the piston with the mark TOP facing the combustion chamber.

3rd Ring - Is a bevelled edge slotted oil control ring (Item 3) **[Figure 60-81-156]**.

The gap of each ring must be offset by 180° to the other ring.

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Piston Installation On The Connecting Rod

Figure 60-81-157

Install the piston **[Figure 60-81-157]**.

Install the snap ring **[Figure 60-81-157]**.

Figure 60-81-158

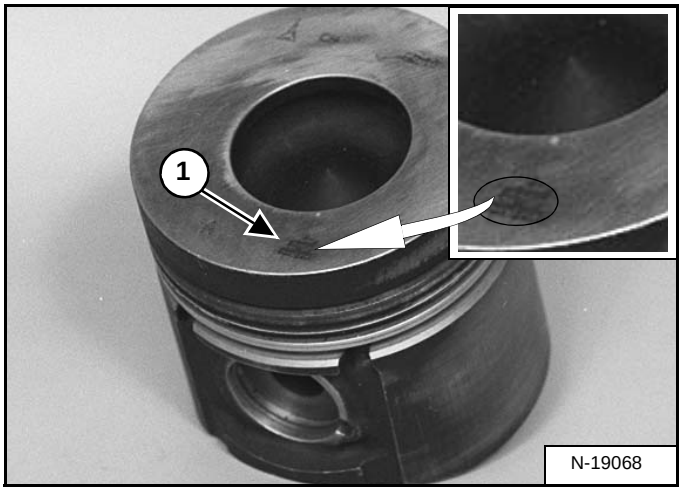


Figure 60-81-159

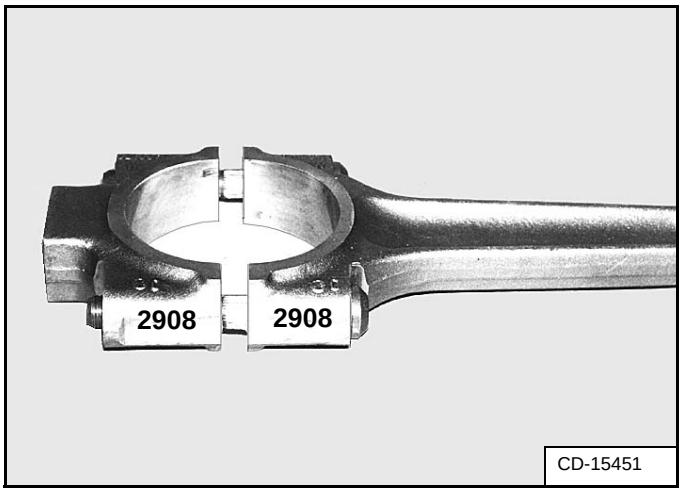
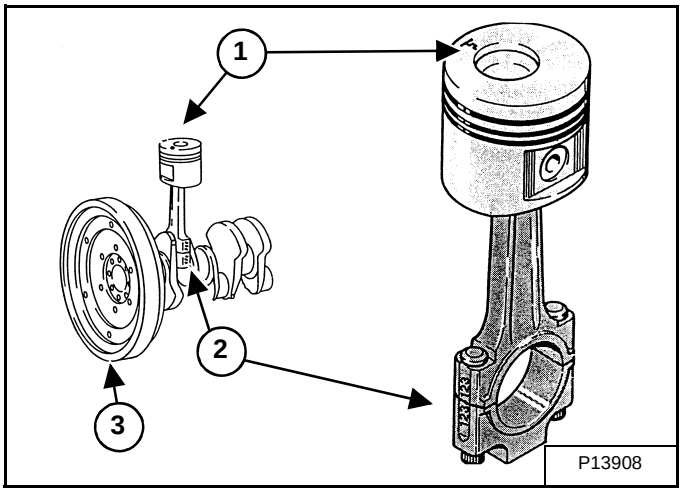


Figure 60-81-160



The flywheel symbol (Item 1) **[Figure 60-81-158]** & **[Figure 60-81-160]** on the piston must point toward the flywheel (Item 3) **[Figure 60-81-160]**, when properly installed on the connecting rod.

The numbers on the connecting rod and cap (Item 1) **[Figure 60-81-159]** & (Item 2) **[Figure 60-81-160]** point toward the camshaft side of the engine when being install in the engine block.

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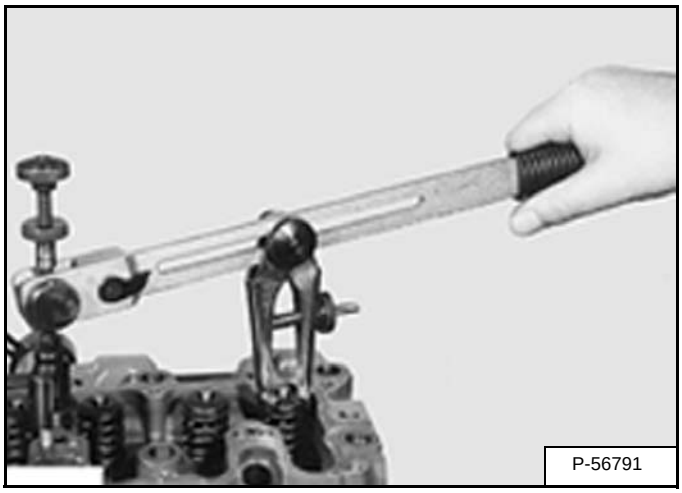
Cylinder Head Disassembly

NOTE: Do not grind the cylinder head surface, if its damaged, replace the cylinder head.

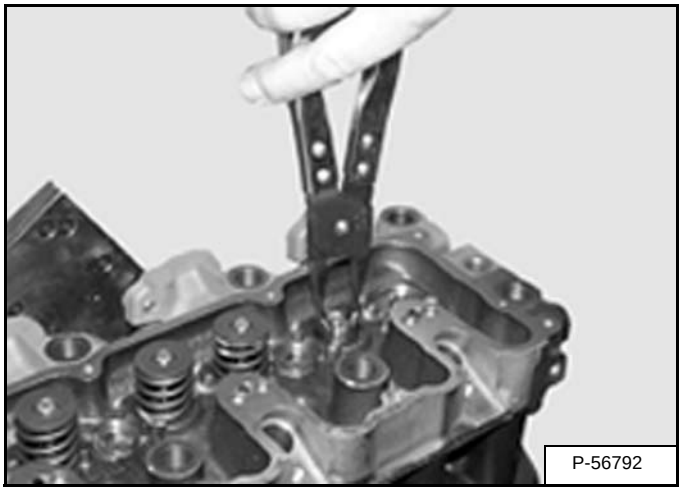
Figure 60-81-161



Using a valve spring tool, remove the spring locks, valve spring cap, valve spring and valve **[Figure 60-81-161]**. See "Deutz Engine Tools Identification Chart" on page 1.

Repeat the procedure for all the valves.

Figure 60-81-162



Remove the valve seals **[Figure 60-81-162]**.

Clean the cylinder head and inspect for damage.

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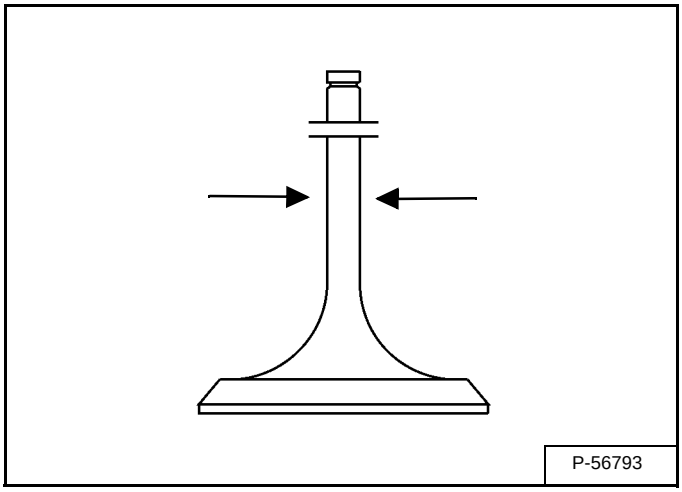
Valves, Checking

Figure 60-81-163

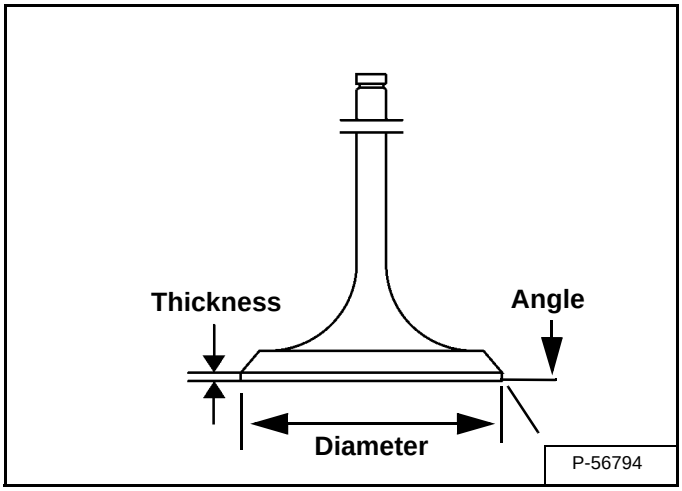


Measure the valve stem diameter **[Figure 60-81-163]**.

Std. Intake Valve . . . . . .0.3134-0.314 in (7,97-7,98 mm)

Std. Exhaust Valve. . . . . .0.3124-0.313 in (7,95-7.96 mm)

Figure 60-81-164

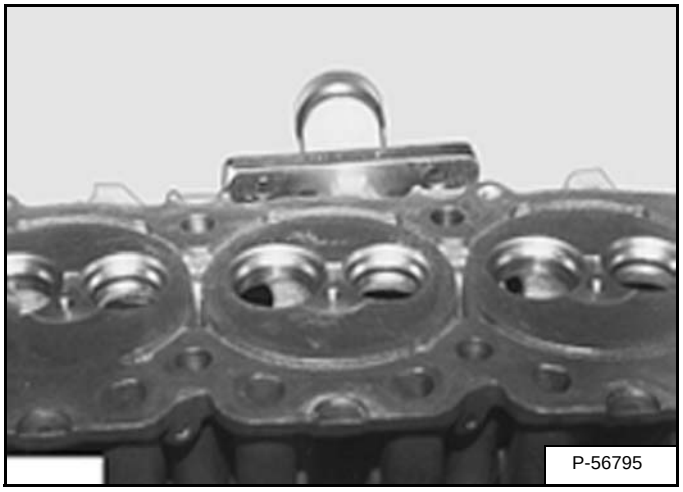


Measure the valve edge thickness **[Figure 60-81-164]**.
Specifications:
Intake Valve . . . . . .0.055 inch. (1,4 mm)
Exhaust Valve. . . . . .0.05 inch. (1,2 mm)

Measure the valve head diameter **[Figure 60-81-164]**.
Specifications:
Intake Valve . . . . . 1.594 ± 0.004 inch (40,5 ± 0,1 mm)
Exhaust Valve . .1.374 ± 0.004 inch. (34,9 ± 0,01 mm)

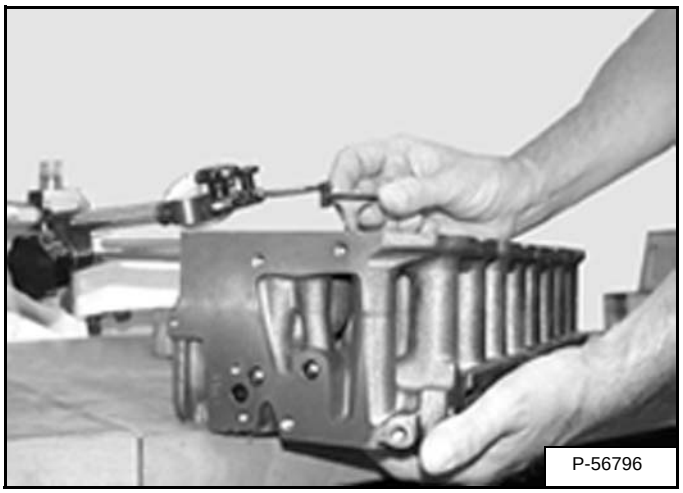
Valve seat angle:
Specifications:
Intake Valve . . . . . .30°
Exhaust Valve . . . . . .45°

Figure 60-81-165



Measure the valve seat width **[Figure 60-81-165]**.
Specifications:
Width (Intake) . . . . . 0.062 ± 0.016 inch. (1,58 ± 0,4 mm)
(Exhaust) . . . . . 0.067 ± 0.016 inch. (1,7 ± 0,4 mm)

Figure 60-81-166



Install the valves and measure the valve stem clearance **[Figure 60-81-166]**.

Wear Limit:
Intake Valve . . . . . 0.0197 inch (0.5 mm)
Exhaust Valve. . . . . 0.0511 inch (1.3 mm)

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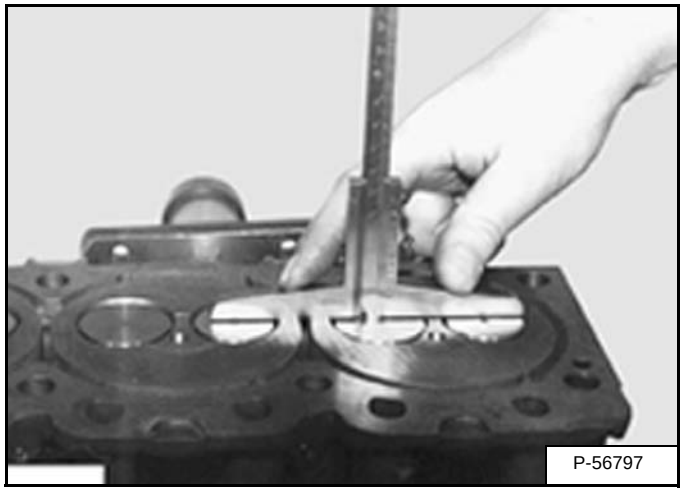
Valve Clearance Adjustment

Figure 60-81-167

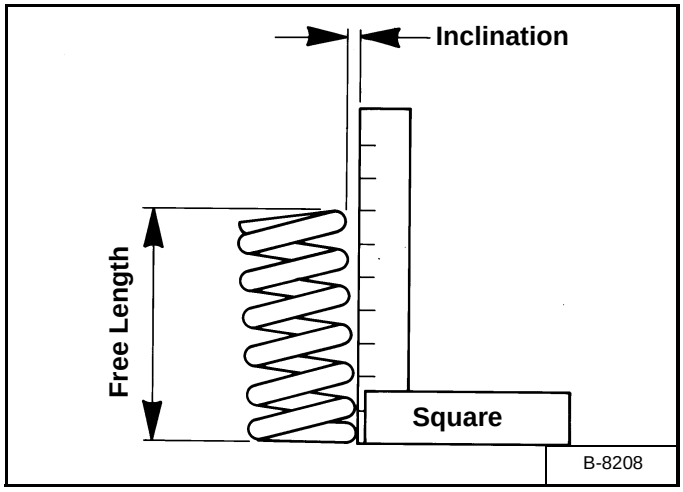


Measure the valve clearance between the valve head and cylinder head sealing surface **[Figure 60-81-167]**.

Valve penetration into cylinder head:
Specifications:
Wear Limit . . . . . .0.0512 inch. (1,3 mm)

Recondition the valve seats and valve guides if worn.

Figure 60-81-168



Measure valve spring free length **[Figure 60-81-168]**.

Specifications:
Valve Spring Diameter . . . . . .0.132 inch. (3,35 mm)
Free Length . . . . . .1.53 inch. (38.9 mm)
Valve Spring Diameter . . . . . .0.134 inch. (3,40 mm)
Free Length . . . . . .1.547 inch. (39,3 mm)
Inclination . . . . . .0.126 inch. (3,2 mm)

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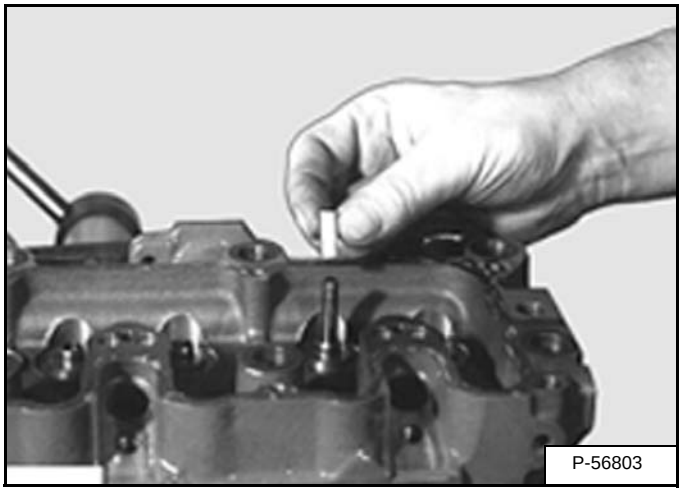
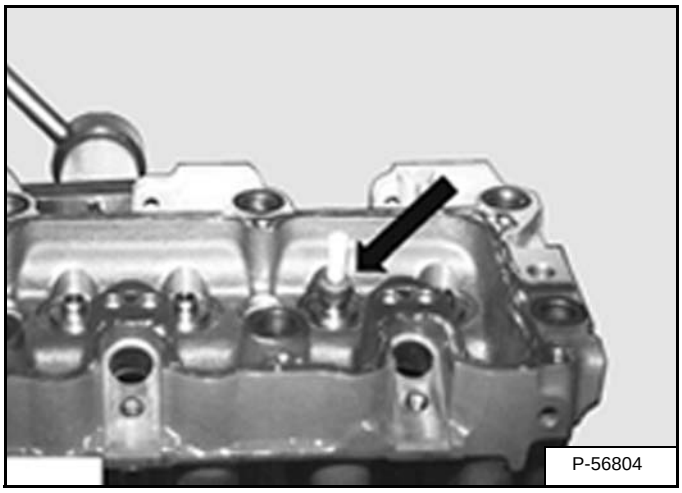
Cylinder Head Assembly

Figure 60-81-169



Install the valve into the cylinder head and install the protective sleeve or masking tape on the valve stem grooves **[Figure 60-81-169]**.

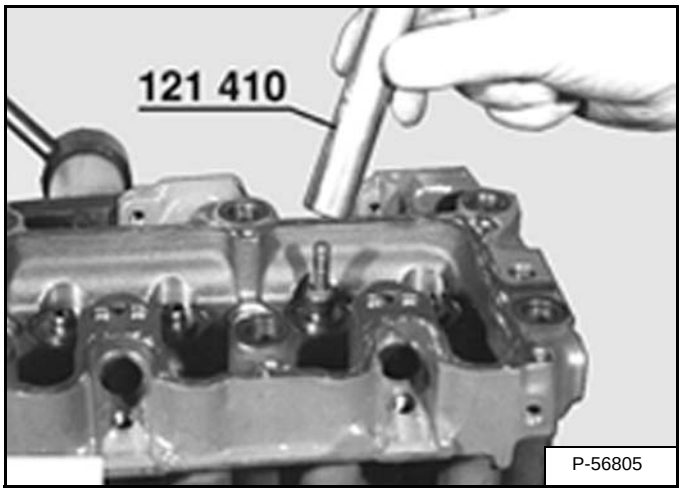
Figure 60-81-170



Install the valve seal on the protective sleeve and push the seal down **[Figure 60-81-170]**.

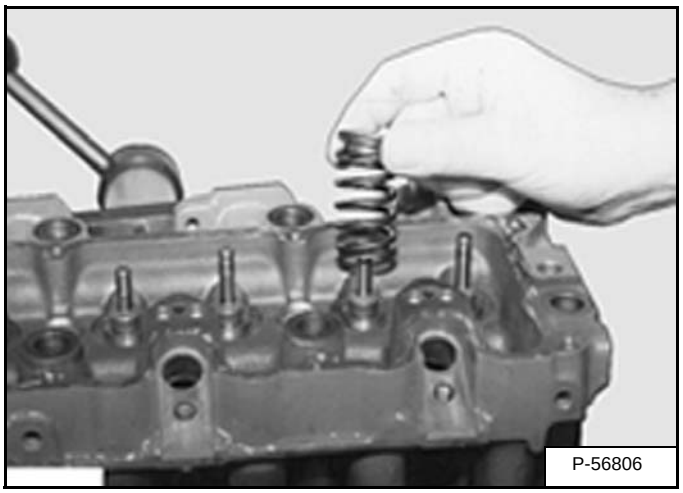
Remove the protective sleeve.

Figure 60-81-171



Use the tool and press the valve stem as far as it will go **[Figure 60-81-171]**. See "Deutz Engine Tools Identification Chart" on page 1.

Figure 60-81-172



Install the valve spring and cap **[Figure 60-81-172]**.

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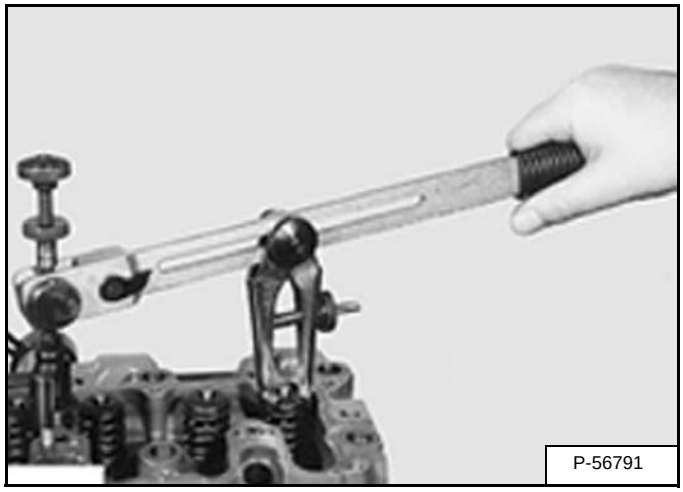
Cylinder Head Assembly (Cont'd)

Figure 60-81-173



Use the valve spring tool, install the valve spring tool **[Figure 60-81-173]**.

Repeat the procedure to install all the valves.

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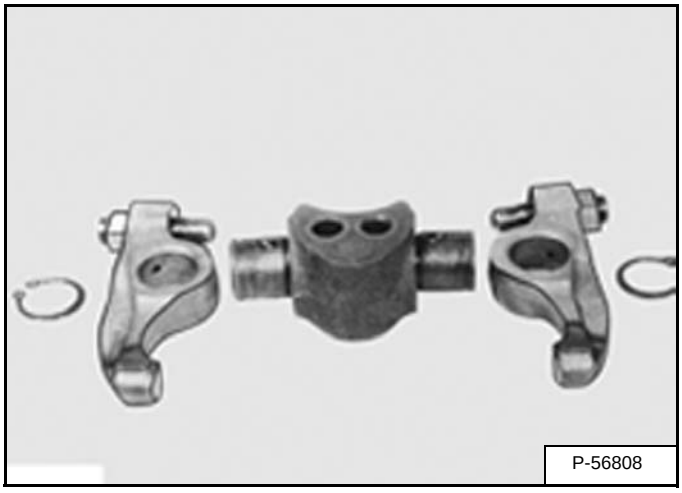
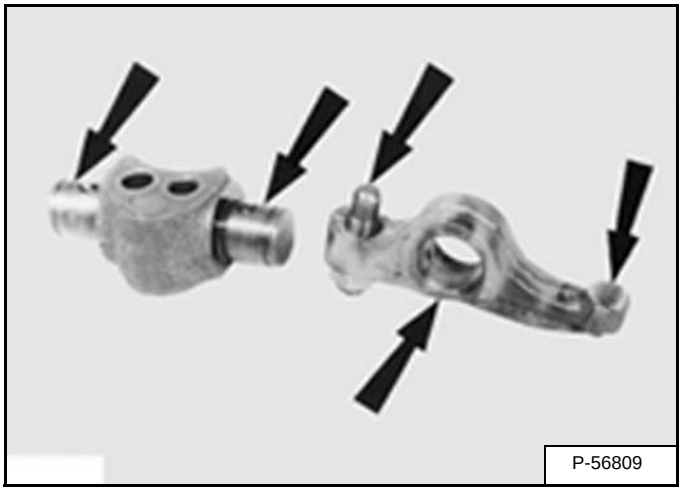
Rocker Arm And Bracket, Checking

Figure 60-81-174



Disassembly the rocker arms from the bracket **[Figure 60-81-174]**.

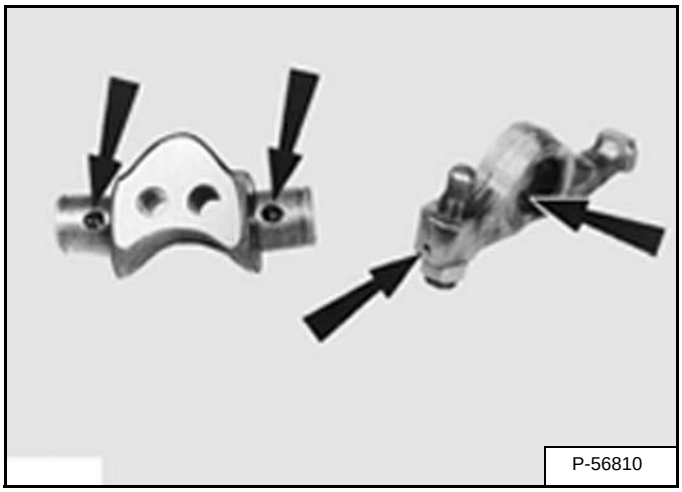
Figure 60-81-175



Check for wear at the following locations and replace as needed **[Figure 60-81-175]**:

Journals
Adjusting Bolt
Rocker Arm Contact Face
Bore

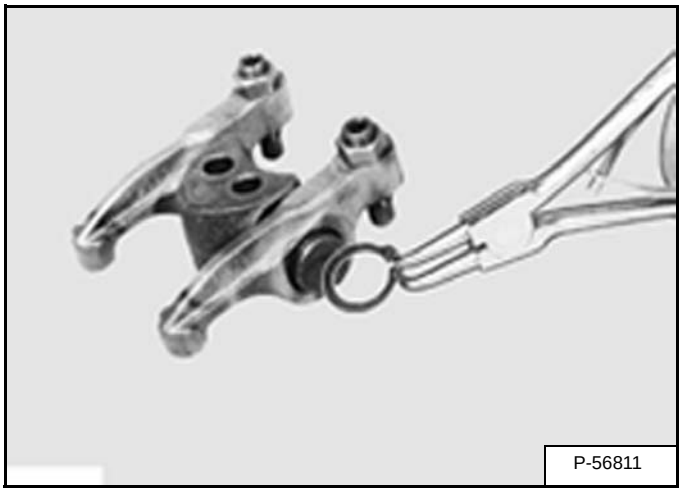
Figure 60-81-176



Check the oil passages that they are open and clean **[Figure 60-81-176]**.

Install the rocker arms on the bracket.

Figure 60-81-177



Install the snap ring **[Figure 60-81-177]**.

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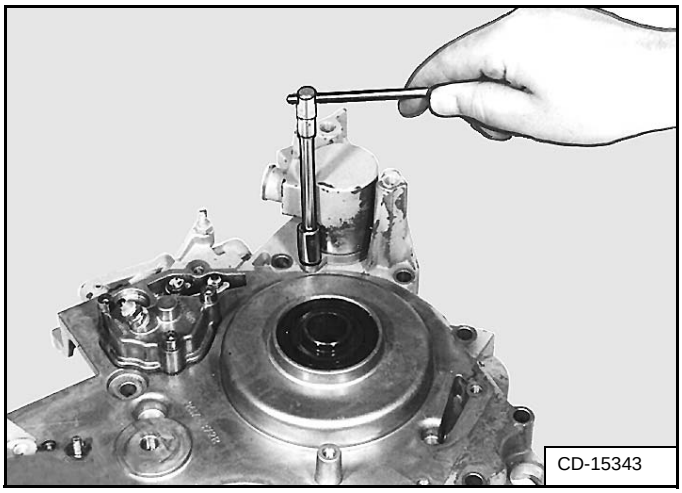
Front Cover Disassembly

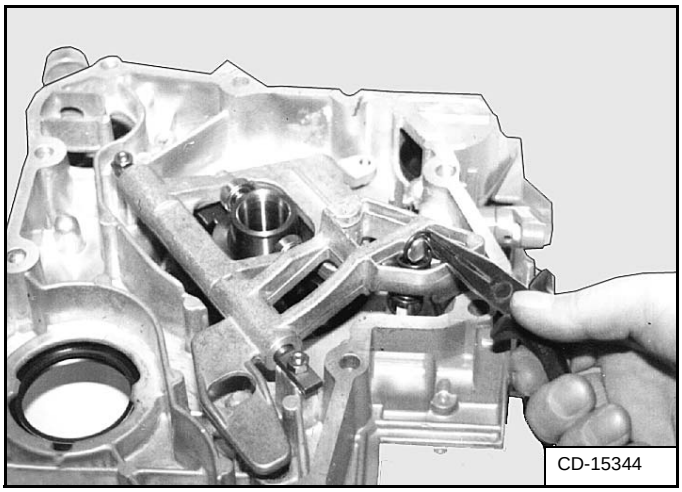
NOTE: Dynamometer testing is recommended if the governor assembly is re-built.

Figure 60-81-178



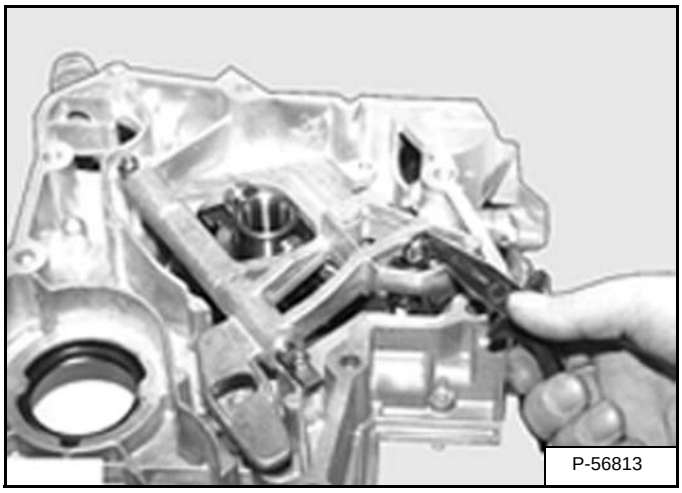
Remove the engine shut-down solenoid **[Figure 60-81-178]**.

Figure 60-81-179



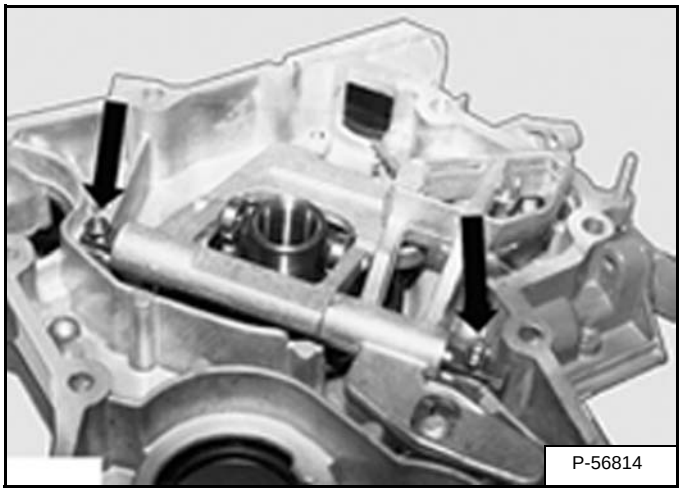
Disconnect the governor spring **[Figure 60-81-179]**.

Figure 60-81-180



Remove the governor spring (Item 1) **[Figure 60-81-180]**.

Figure 60-81-181



Mark the governor lever shaft (Item 1) **[Figure 60-81-181]** for proper installation.

Remove the governor lever shaft.

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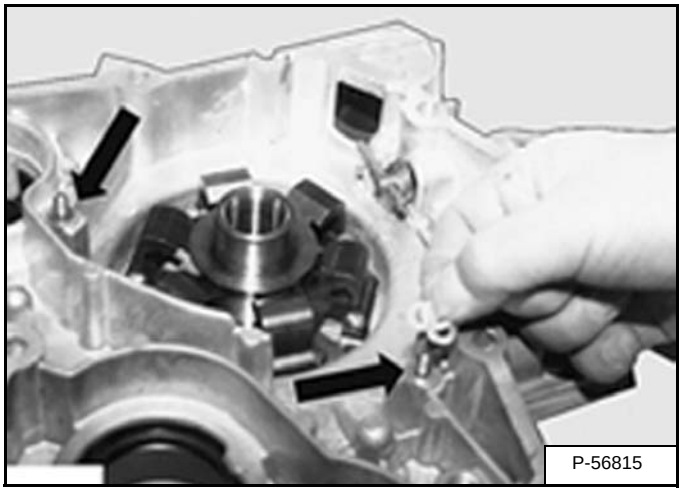
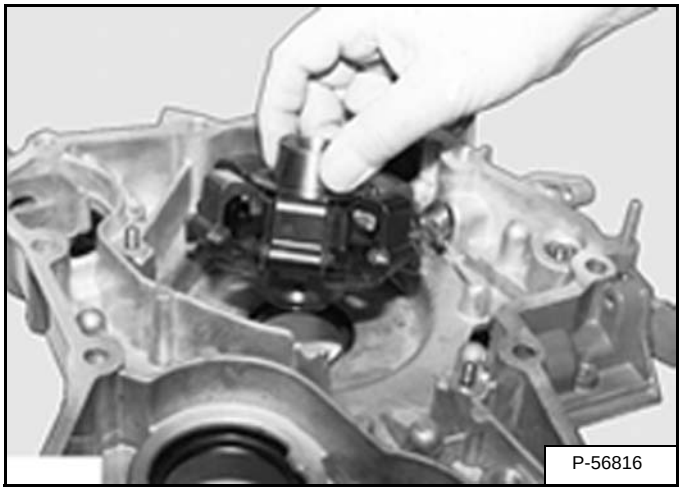
Front Cover Disassembly (Cont'd)

Figure 60-81-182



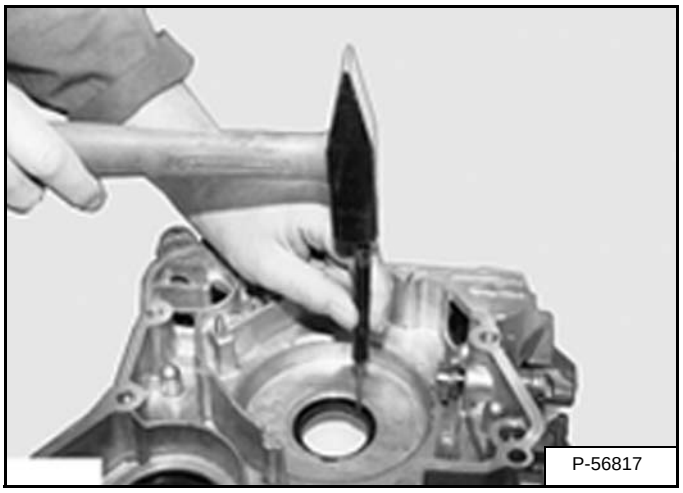
Remove the shims below the governor lever shaft **[Figure 60-81-182]**.

Figure 60-81-183



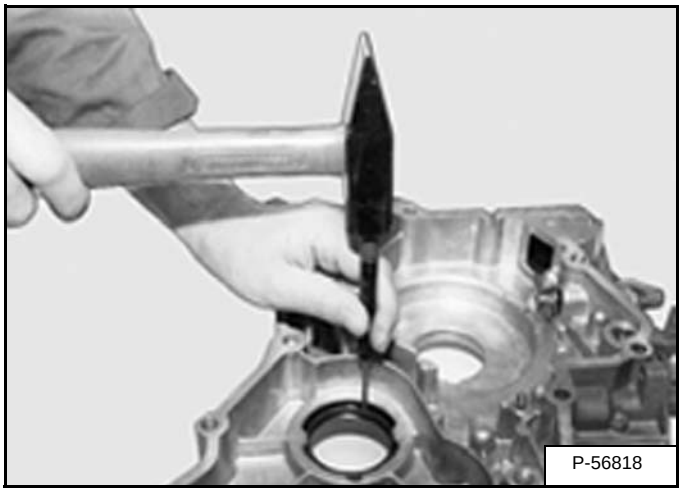
Remove the centrifugal governor **[Figure 60-81-183]**.

Figure 60-81-184



Remove the camshaft seal **[Figure 60-81-184]**.

Figure 60-81-185



Remove the crankshaft seal **[Figure 60-81-185]**.

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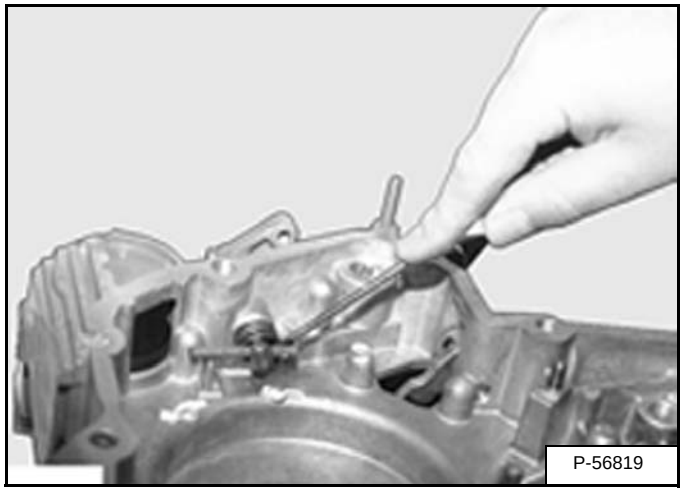
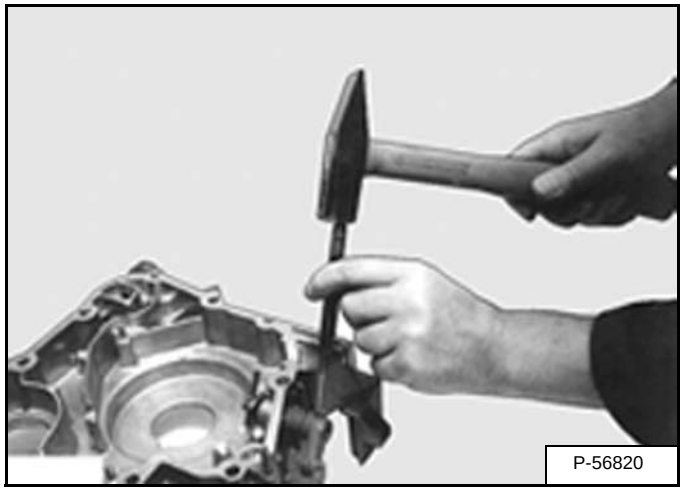
Front Cover Disassembly (Cont'd)

Figure 60-81-186



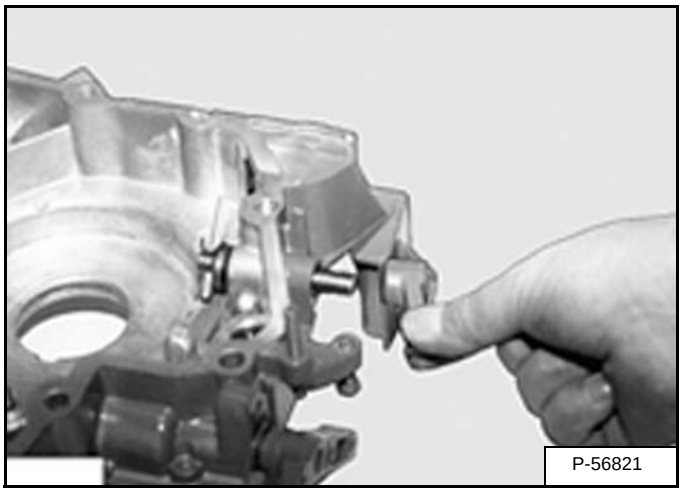
Disconnect the spring **[Figure 60-81-186]**.

Figure 60-81-187



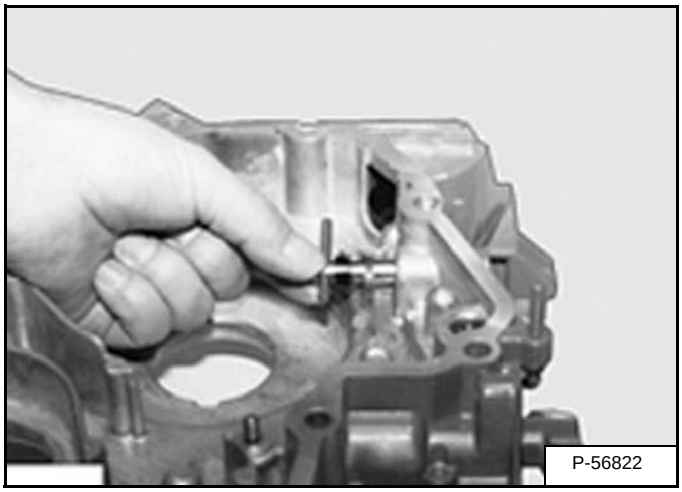
Remove the dowel pin **[Figure 60-81-187]**.

Figure 60-81-188



Remove the shut-down lever with spacer bushings **[Figure 60-81-188]**.

Figure 60-81-189



Remove the shaft, spacer bushing and spring **[Figure 60-81-189]**.

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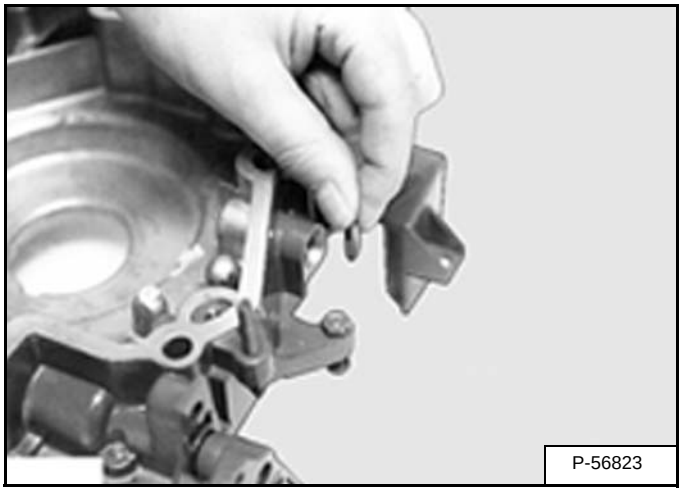
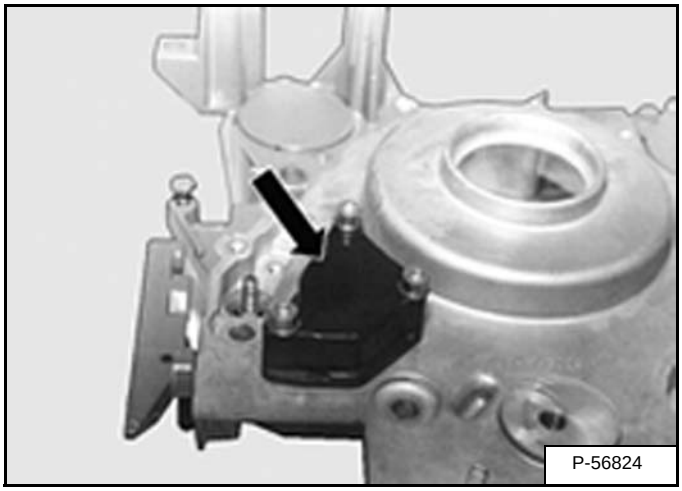
Front Cover Disassembly (Cont'd)

Figure 60-81-190



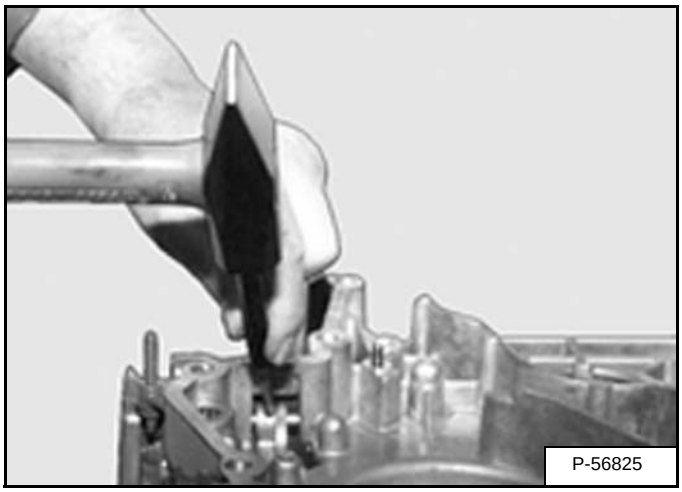
Remove the O-ring **[Figure 60-81-190]**.

Figure 60-81-191



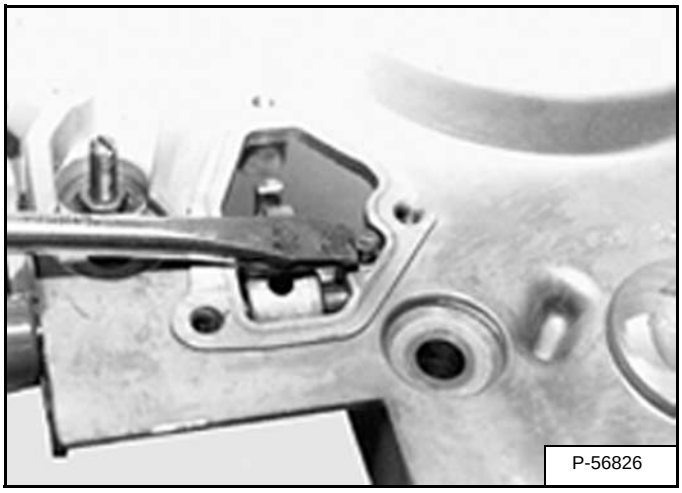
Remove the cover **[Figure 60-81-191]**.

Figure 60-81-192



Remove the dowel pin **[Figure 60-81-192]**.

Figure 60-81-193



Remove the pin from the lever **[Figure 60-81-193]**.

Do not damage the cover sealing surface.

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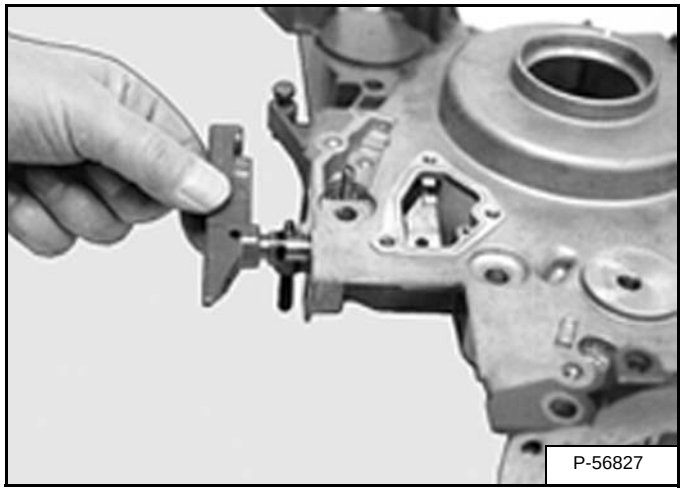
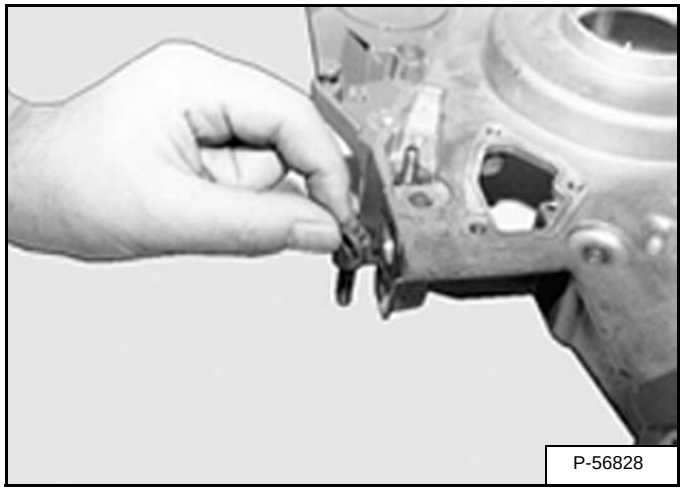
Front Cover Disassembly (Cont'd)

Figure 60-81-194



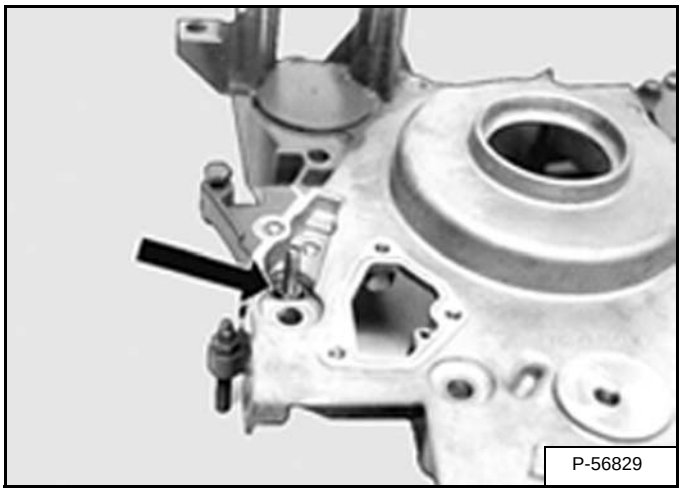
Remove the speed control lever and spacer bushing **[Figure 60-81-194]**.

Figure 60-81-195



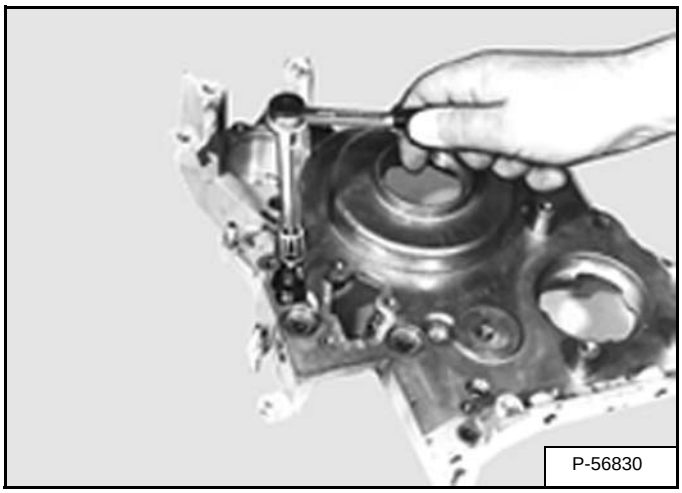
Remove the O-ring **[Figure 60-81-195]**.

Figure 60-81-196



Before removing the torque control assembly, measure the height from the cover **[Figure 60-81-196]** and make a record of this for assembly.

Figure 60-81-197



Remove the nut and clamp **[Figure 60-81-197]**.

Remove the torque control assembly.

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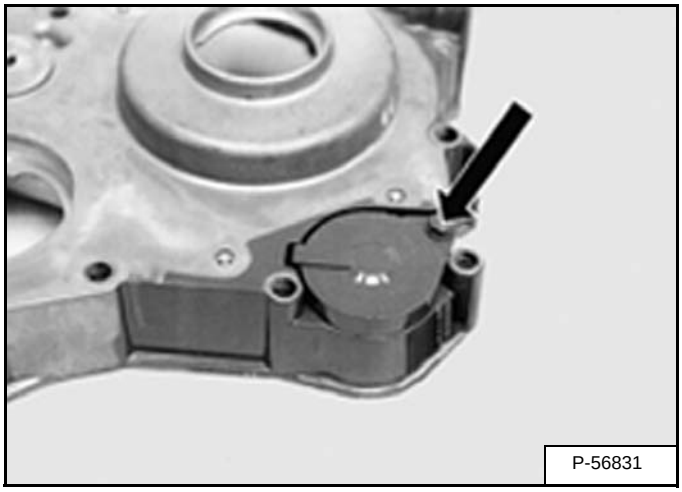
Front Cover Disassembly (Cont'd)

Figure 60-81-198



Remove the breather vent **[Figure 60-81-198]**.

NOTE: On later model Deutz engines the breather is located in the valve cover. The breather vent shown in photo [Figure 60-81-198] is used in both engines.

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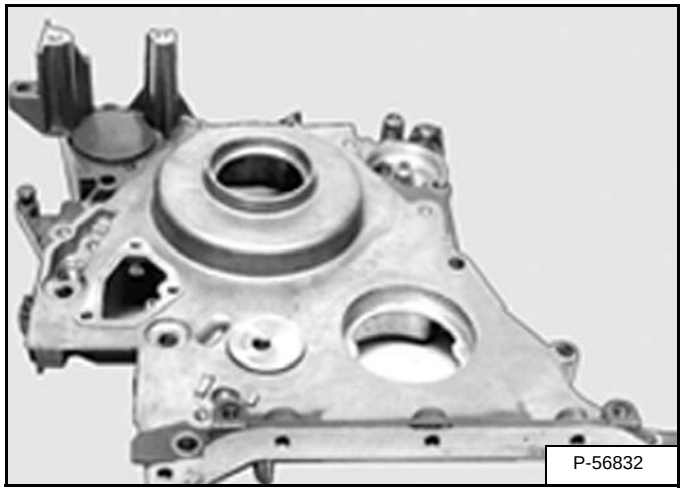
Front Cover Assembly

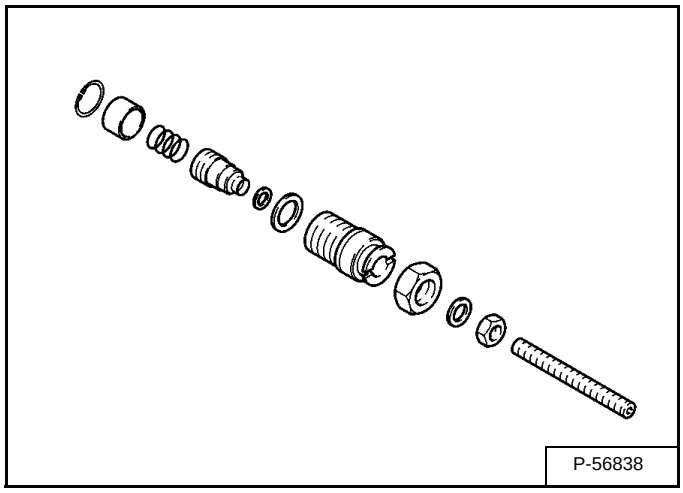
Figure 60-81-199



Inspect the front cover for damage **[Figure 60-81-199]**.

Replace the front cover as needed.

Figure 60-81-200

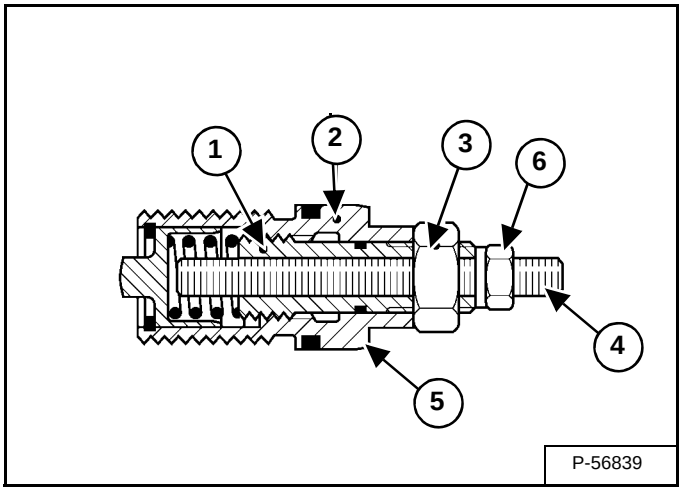


Inspect the individual parts of the torque control assembly **[Figure 60-81-200]**.

Replace the parts as needed.

If the torque control was disassembled, do the following procedure to assemble:

Figure 60-81-201



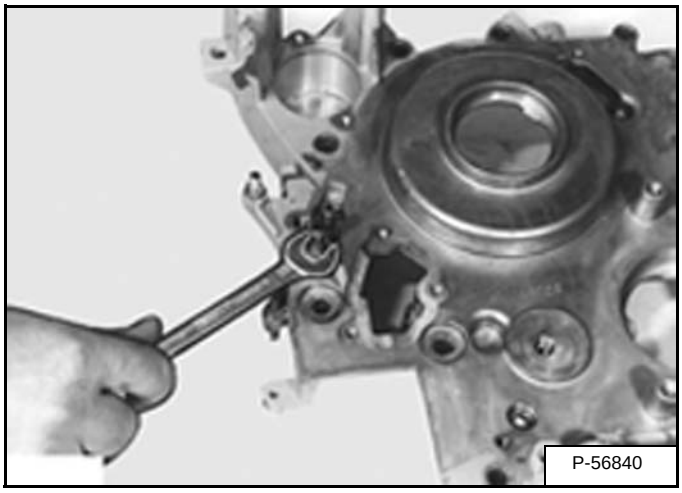
Turn (Item 1) into (Item 2) until lightly bottomed, back (Item 1) **[Figure 60-81-201]** out 1-1/2 turns.

Tighten the lock nut (Item 3) **[Figure 60-81-201]** to 12 ft.-lb. (16 N•m) torque.

Turn (Item 4) as far as it will go into (Item 5) **[Figure 60-81-201]**. Turn back one full turn.

Tighten the lock nut (Item 6) **[Figure 60-81-201]** to 53 in.-lb. (6 N•m) torque.

Figure 60-81-202



Install the torque control into the front cover **[Figure 60-81-202]**.

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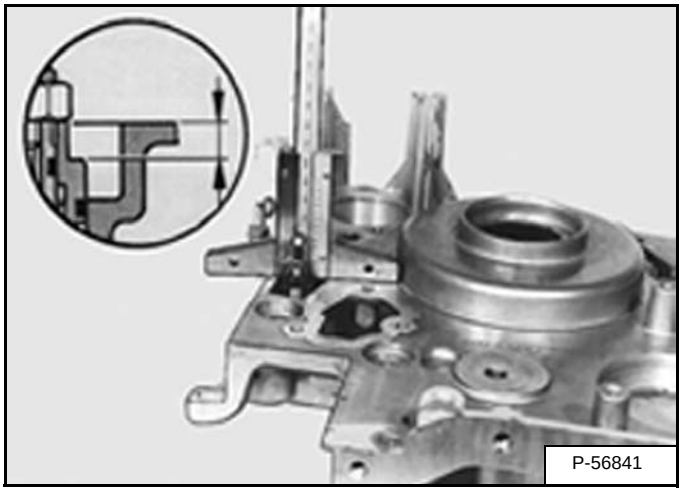
Front Cover Assembly (Cont'd)

Figure 60-81-203



Install the torque control assembly to the dimensions taken **[Figure 60-81-203]** or use the procedure below: See "Front Cover Disassembly" on page 54.

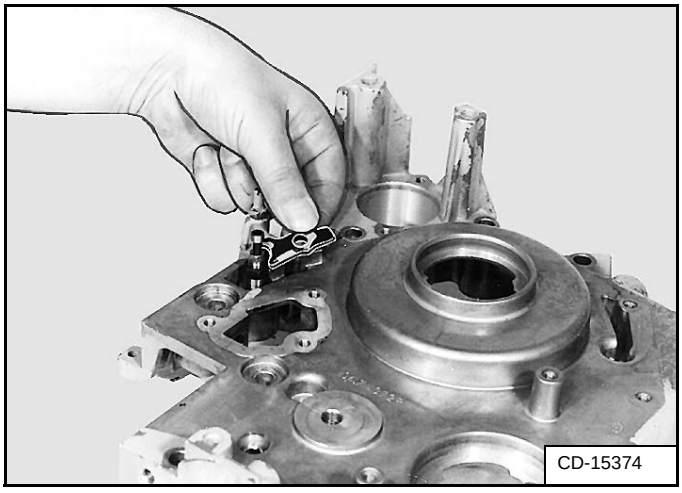
Measure the thread reach **[Figure 60-81-203]**.

Specifications:

Thread Reach . . . . . .0.252 ± 0.019 inch. (6,4 ± 0,5 mm)

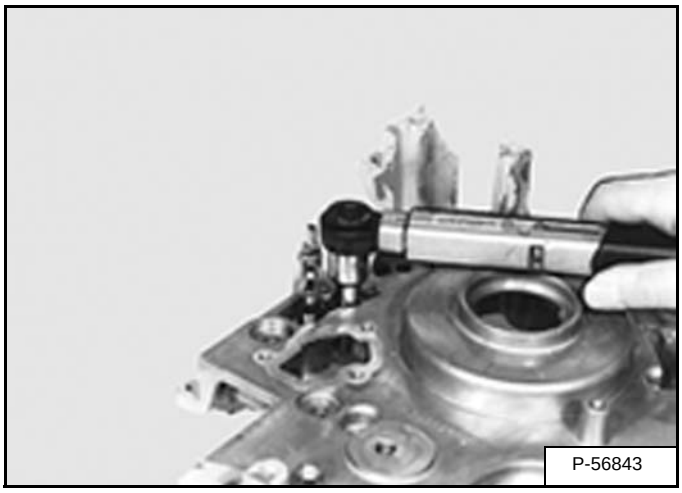
NOTE: Dynamometer testing may be necessary depending on engine performance.

Figure 60-81-204



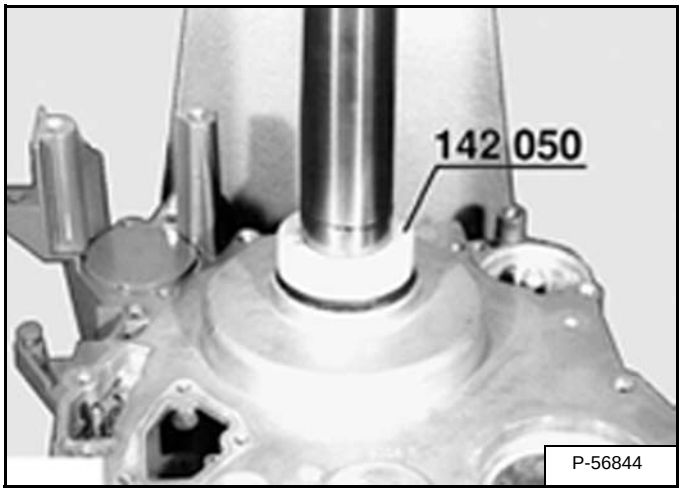
Install the clamp and nut **[Figure 60-81-204]**.

Figure 60-81-205



Tighten the clamp nut to 88 in.-lb. (10 N•m) torque **[Figure 60-81-205]**.

Figure 60-81-206



Press the camshaft seal into the front cover **[Figure 60-81-206]**. See "Deutz Engine Tools Identification Chart" on page 1.

NOTE: Do not put oil on the camshaft seal before installation.

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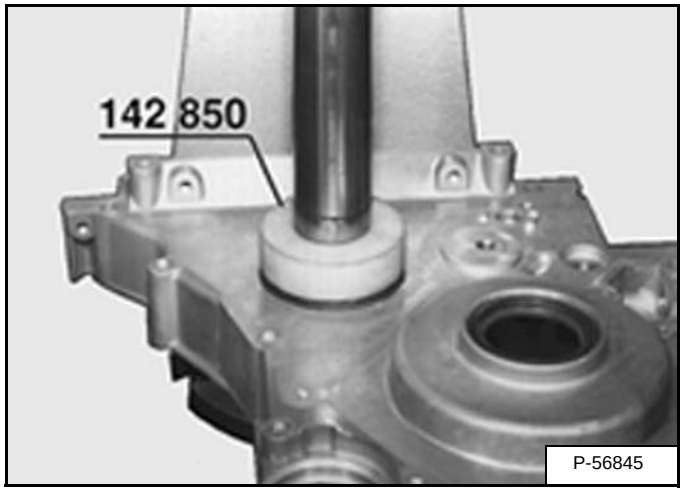
Front Cover Assembly (Cont'd)

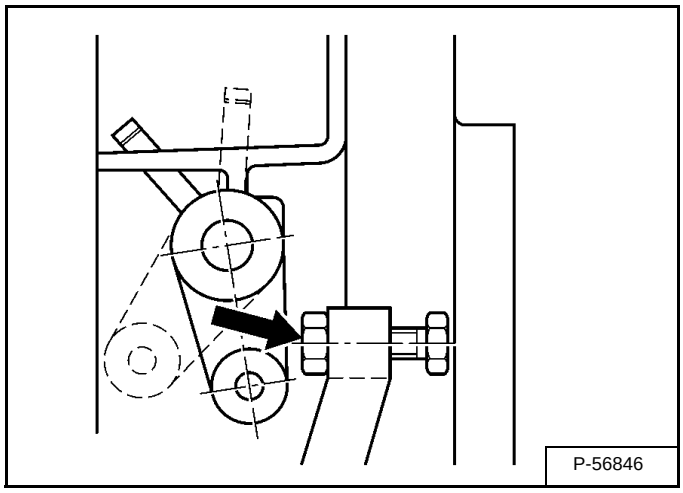
Do Not put oil on the crankshaft seal.

Figure 60-81-207



Press the crankshaft seal into the front cover **[Figure 60-81-207]**.

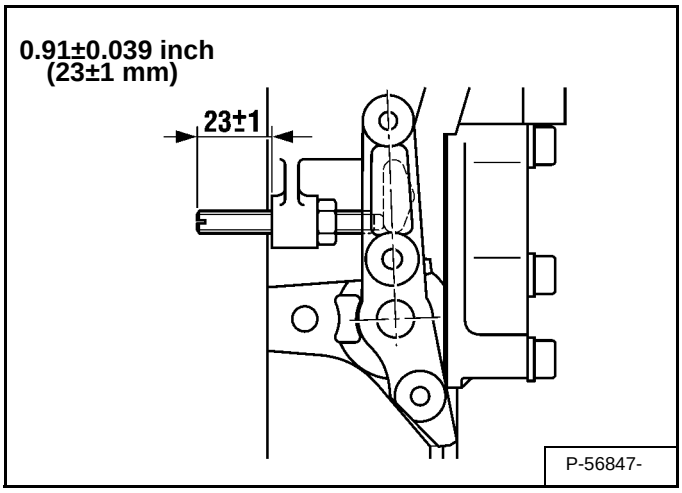
Figure 60-81-208



Install the stop bolt and nut. The nut must be flush with the end of the bolt **[Figure 60-81-208]**.

Tighten the nut to 40 in.-lb. (4,5 N•m) torque.

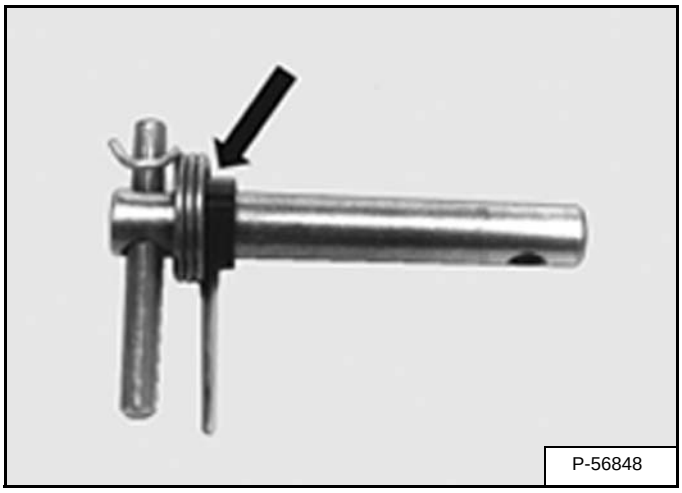
Figure 60-81-209



Adjust the minimum speed screw to 0.91 + 0.039 inch (23 ± 1.0 mm) **[Figure 60-81-209]**.

Tighten the lock nut to 40 in.-lb. (4.5 N•m) torque.

Figure 60-81-210



Install the spacer bushing and spring on the shut down shaft **[Figure 60-81-210]**.

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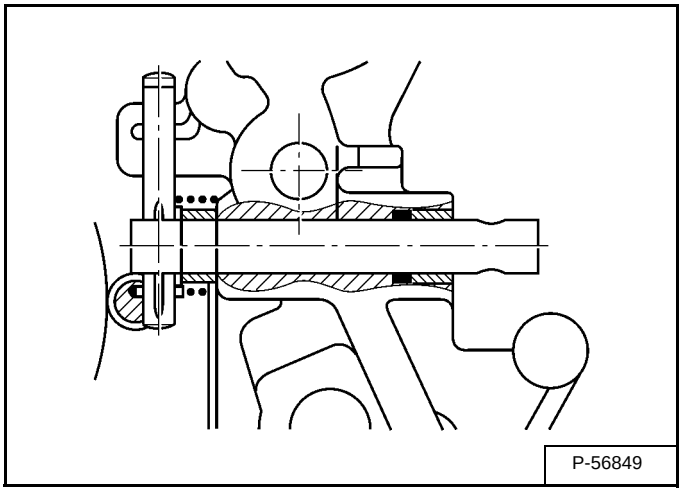
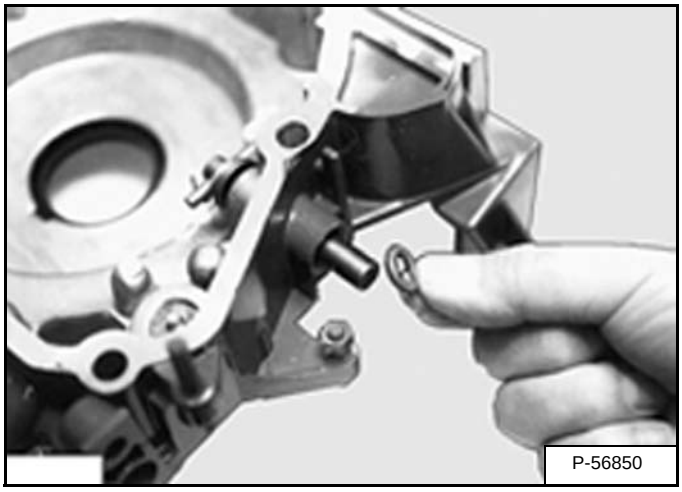
Front Cover Assembly (Cont'd)

Figure 60-81-211



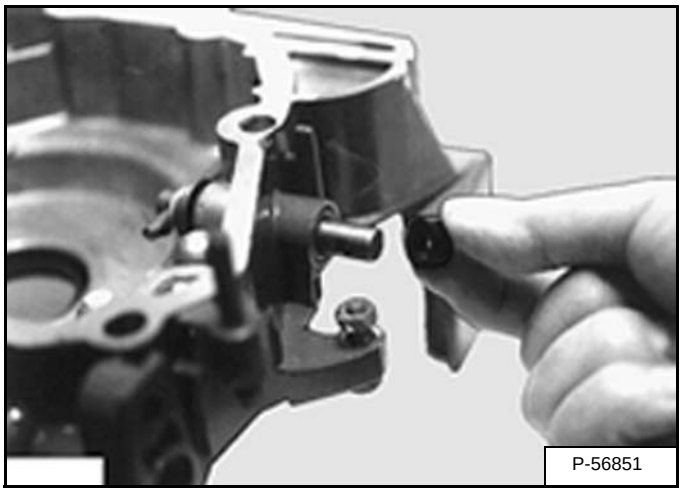
Install the shut down shaft **[Figure 60-81-211]**.

Figure 60-81-212



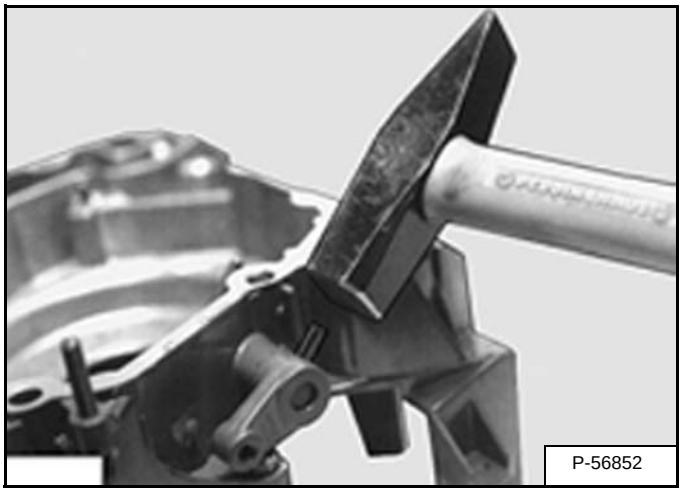
Put grease on the O-ring and install on the shaft **[Figure 60-81-212]**.

Figure 60-81-213



Install the spacer bushing **[Figure 60-81-213]**.

Figure 60-81-214



Install the shut down lever and dowel pin **[Figure 60-81-214]**.

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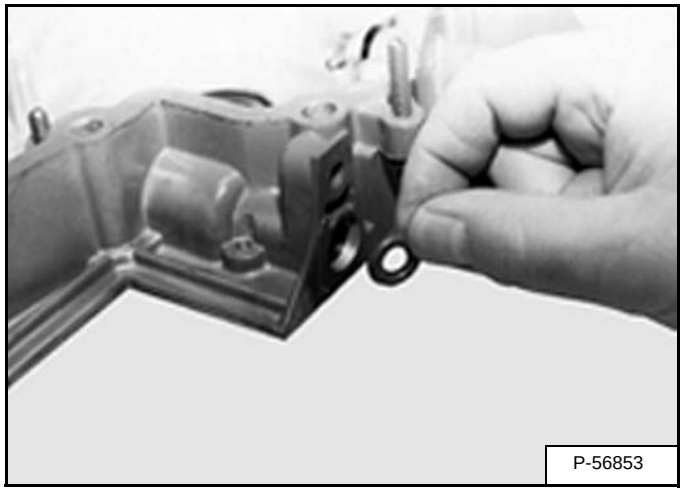
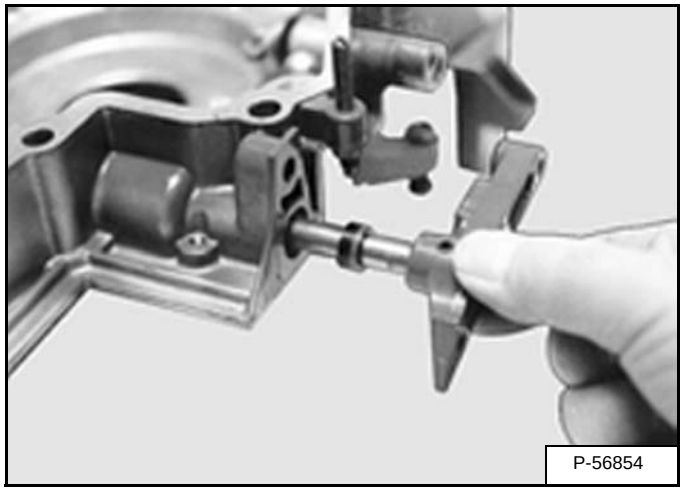
Front Cover Assembly (Cont'd)

Figure 60-81-215



Put grease on the O-ring and install in the front cover **[Figure 60-81-215]**.

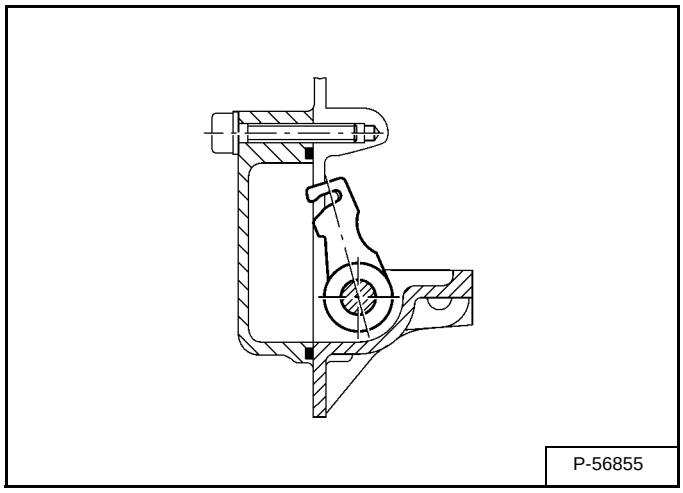
Figure 60-81-216



Install the spacer bushing on the speed control lever **[Figure 60-81-216]**.

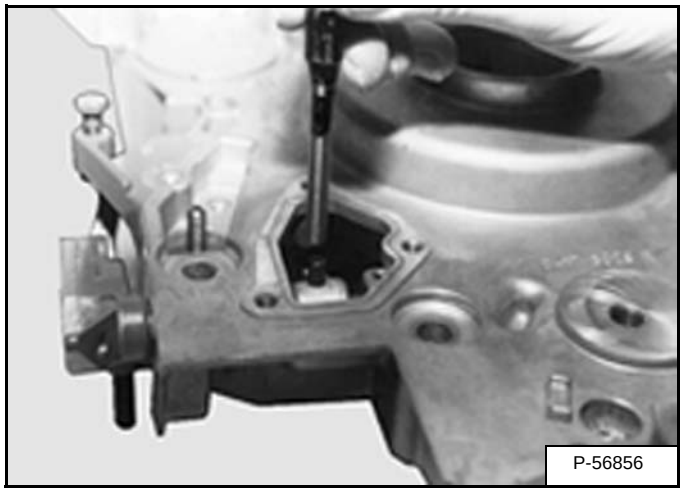
Install the speed control lever into the front cover **[Figure 60-81-216]**.

Figure 60-81-217



When installing the speed control lever, make sure it is installed in the correct direction **[Figure 60-81-217]**.

Figure 60-81-218



Install the dowel pin into the speed control lever **[Figure 60-81-218]**.

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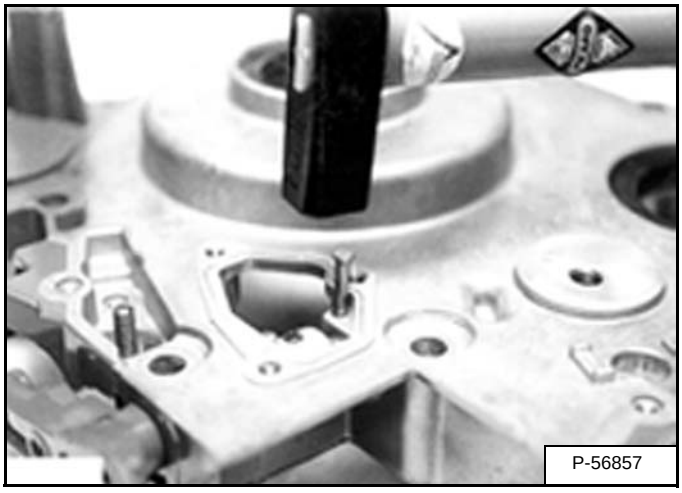
Front Cover Assembly (Cont'd)

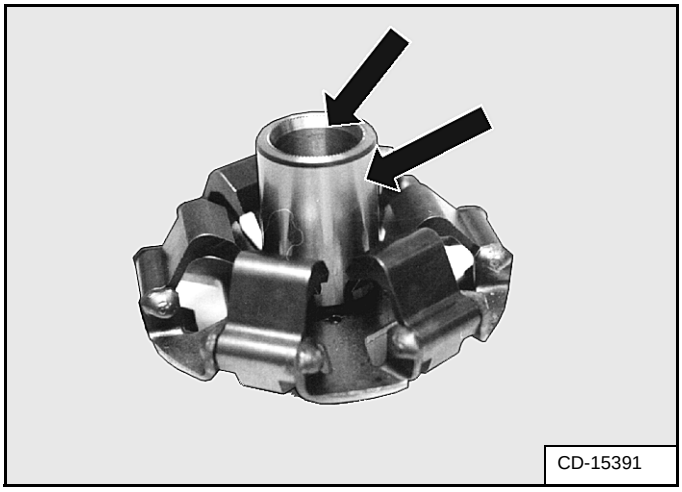
Figure 60-81-219



Drive the pin into the lever **[Figure 60-81-219]**.

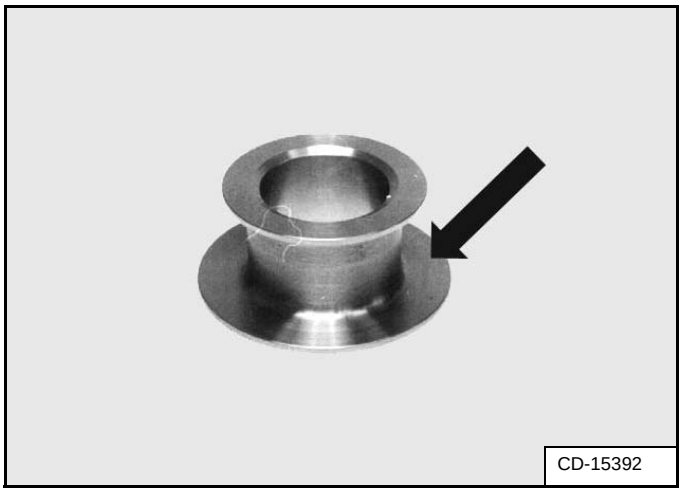
The groove in the speed control shaft must be in line with the dowel pin bore.

Figure 60-81-220



Inspect the centrifugal governor for wear **[Figure 60-81-220]**. Replace as needed.

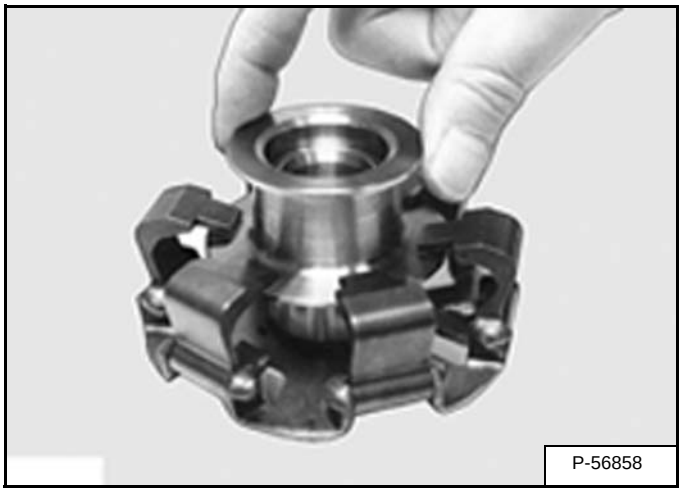
Figure 60-81-221



Inspect the governor plate for wear **[Figure 60-81-221]**.

Replace as needed.

Figure 60-81-222



Assemble the governor plate with the centrifugal governor **[Figure 60-81-222]**.

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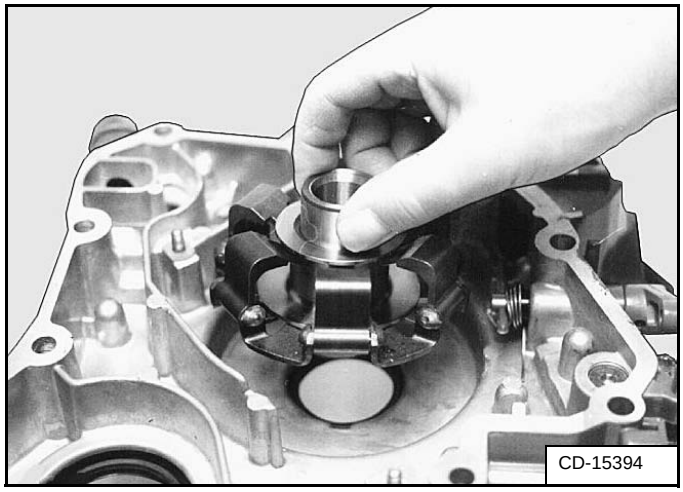
Front Cover Assembly (Cont'd)

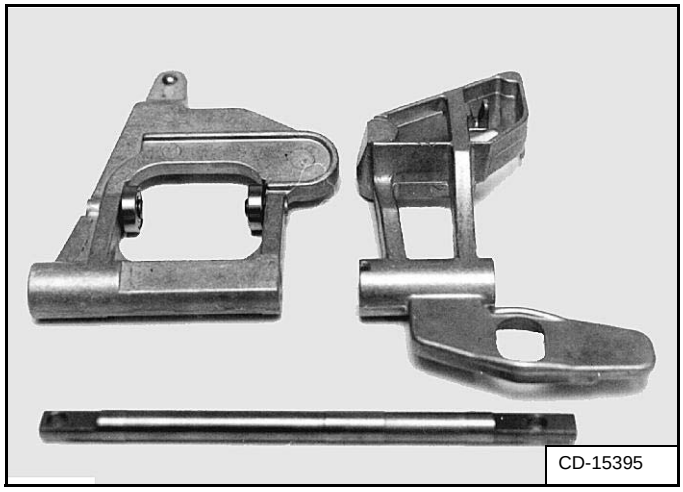
Figure 60-81-223



Install centrifugal governor assembly into the front cover **[Figure 60-81-223]**.

Be careful not to damage the shaft seal.

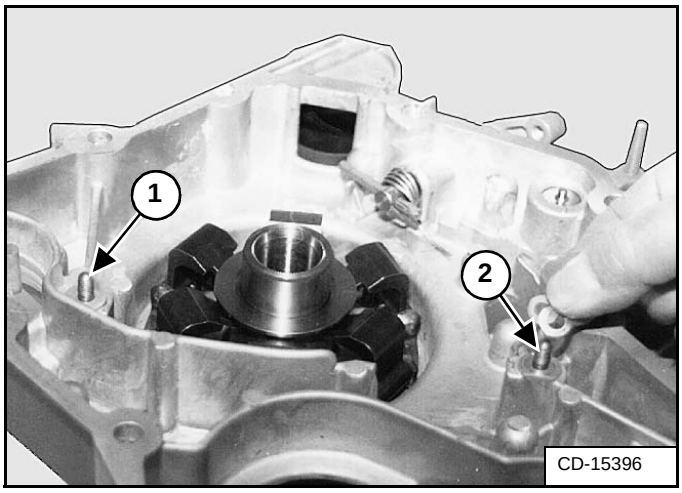
Figure 60-81-224



Inspect roller lever, shaft and idling lever wear **[Figure 60-81-224]**.

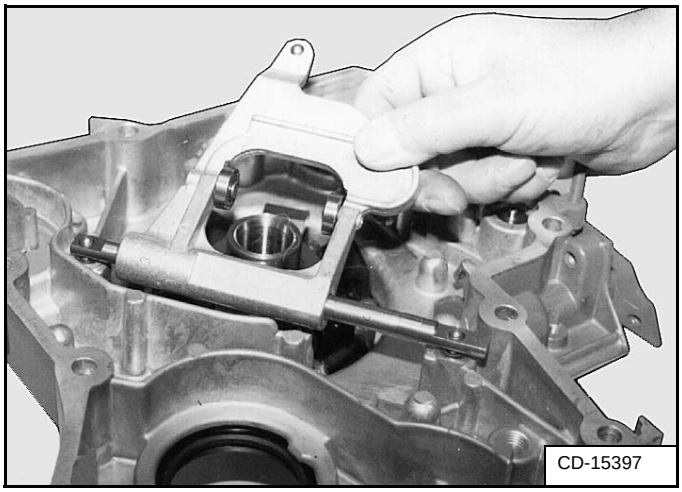
Replace the parts as needed.

Figure 60-81-225



Install shims of at least 0.011 inch (0,3 mm) thickness at points (Items 1 & 2) **[Figure 60-81-225]**.

Figure 60-81-226



Install the governor lever shaft without the idling lever **[Figure 60-81-226]**. Tighten the bolts to 81 in.-lb. (9,2 N•m) torque.

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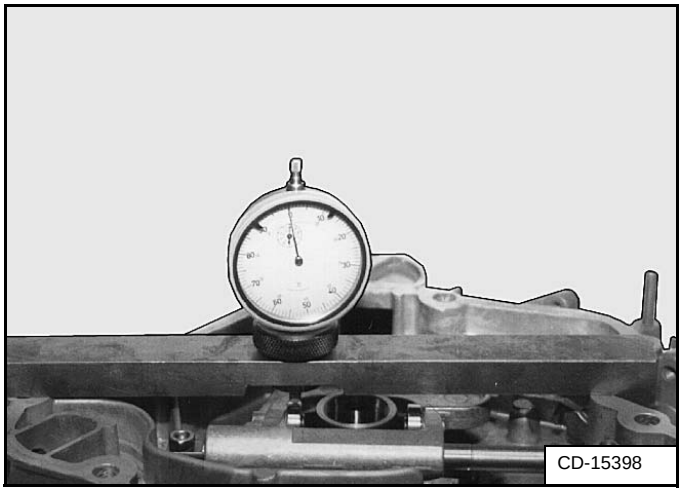
Front Cover Assembly (Cont'd)

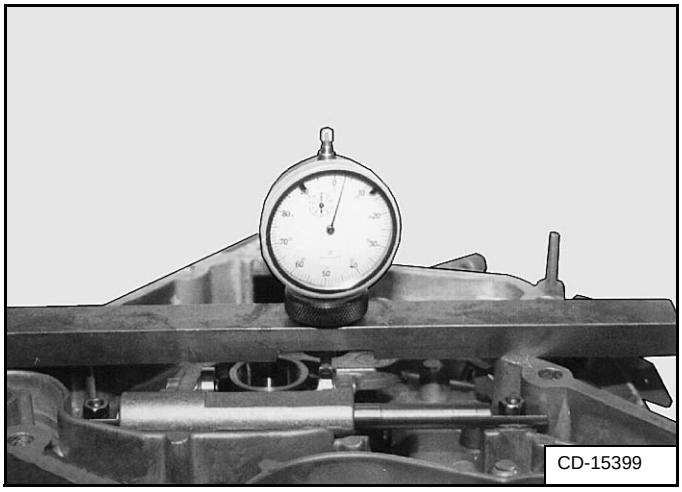
Figure 60-81-227



Measure the ball bearing by lightly pressing the roller lever **[Figure 60-81-227]**.

Set the dial gauge to zero.

Figure 60-81-228



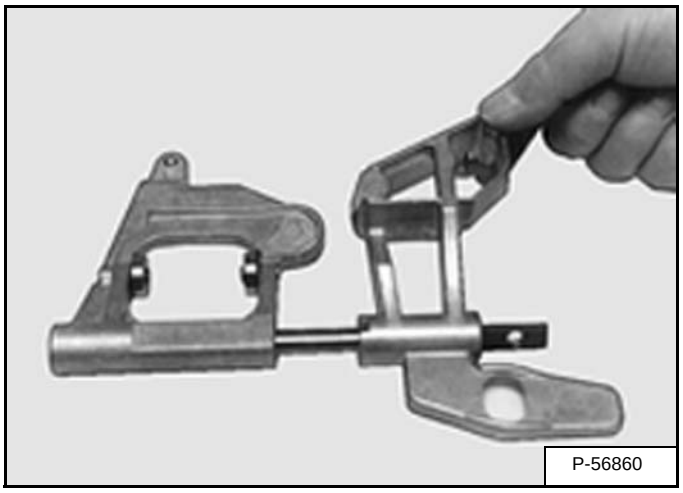
Place dial indicator on ball bearing **[Figure 60-81-228]**.

Make record of the two readings.

The required tolerance is 0.0019 inch (0,05 mm).

It is possible to install extra shims (max 0.0019 inch [0.05mm]) at (Items 1 & 2) **[Figure 60-81-225 on Page 66]** to get the required measurement.

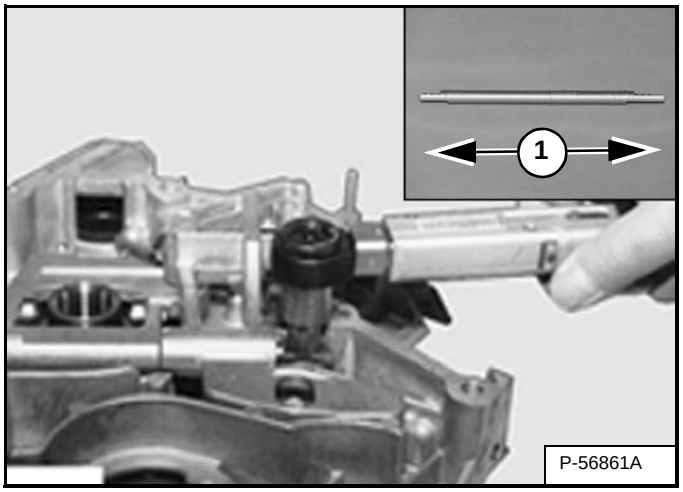
Figure 60-81-229



Assemble the roller lever with the idling lever and shaft **[Figure 60-81-229]**.

Install the complete governor lever shaft assembly into the front cover.

Figure 60-81-230



Tighten the bolts to 81 in.-lb. (9,2 N•m) torque **[Figure 60-81-230]**.

NOTE: The longer space (Item 1) [Figure 60-81-230] on the governor lever shaft goes down toward the cover when installed.

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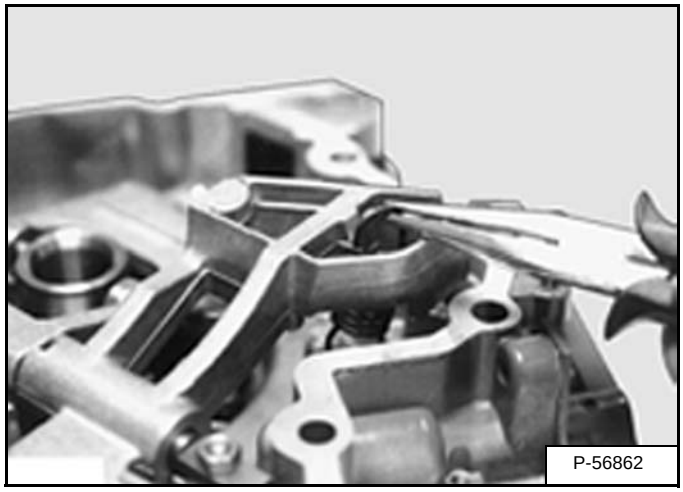
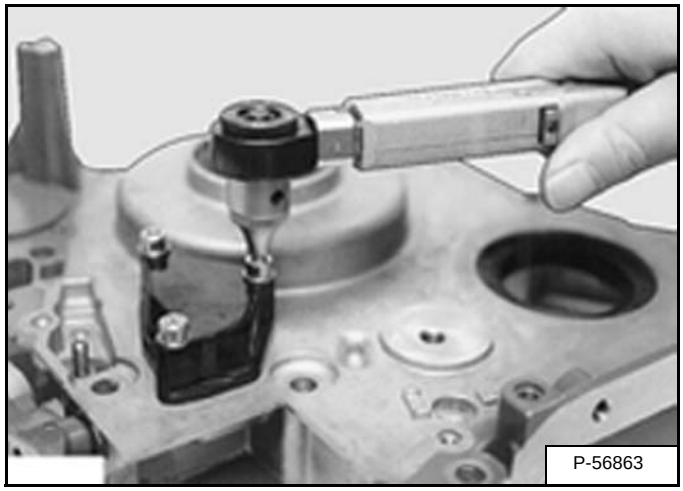
Front Cover Assembly (Cont'd)

Figure 60-81-231



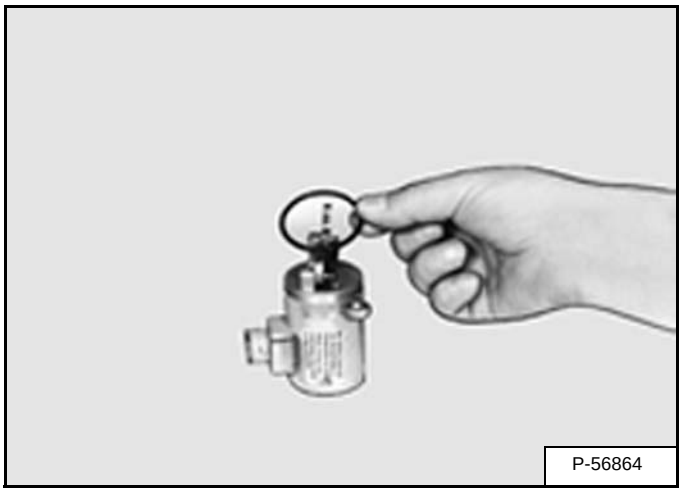
Connect the governor spring **[Figure 60-81-231]**.

Figure 60-81-232



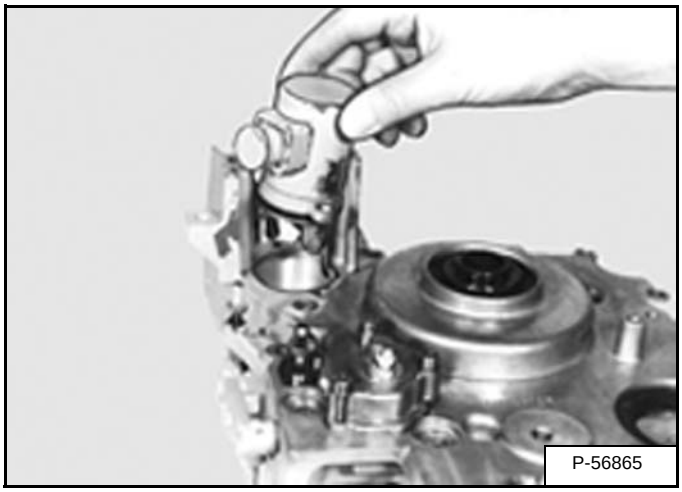
Install the cover with new gasket. Tighten the bolts to 40 in.-lb. (4,5 N•m) torque **[Figure 60-81-232]**.

Figure 60-81-233



Install a greased O-ring on the shut down solenoid **[Figure 60-81-233]**.

Figure 60-81-234



Install the shut down solenoid into the front cover **[Figure 60-81-234]**.

Tighten the bolts to 10-12 ft.-lb. (13,5-16,3 N•m) torque.

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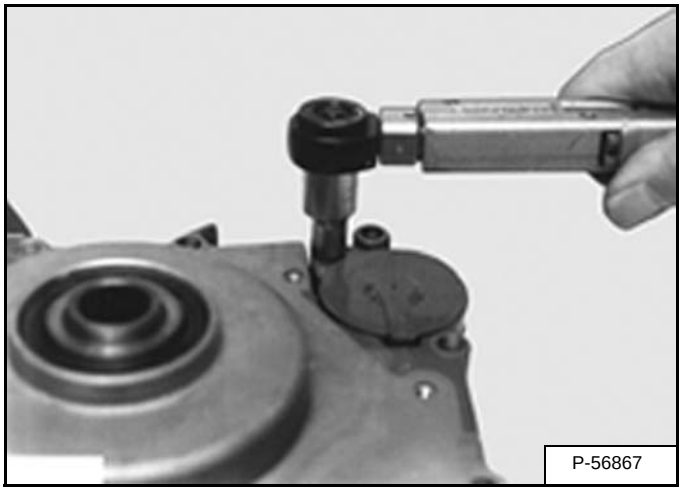
Front Cover Assembly (Cont'd)

Figure 60-81-235

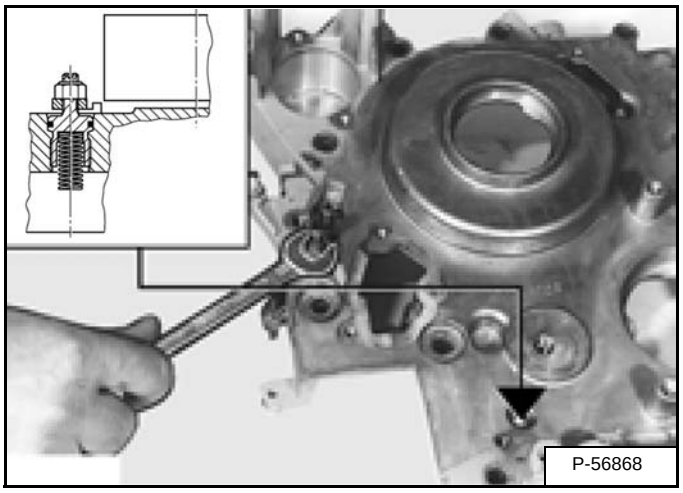
Install new O-ring on the breather vent **[Figure 60-81-235]**.

Figure 60-81-236



Install the breather vent into the front cover. Tighten the bolts to 75 in.-lb. (8,5 N•m) torque **[Figure 60-81-236]**.

Figure 60-81-237



Install the idle speed casting (If equipped) **[Figure 60-81-237]**.

Tighten the bolt to 41 ± 4 in.-lb. (4.6 ± 0.4 N•m) torque.

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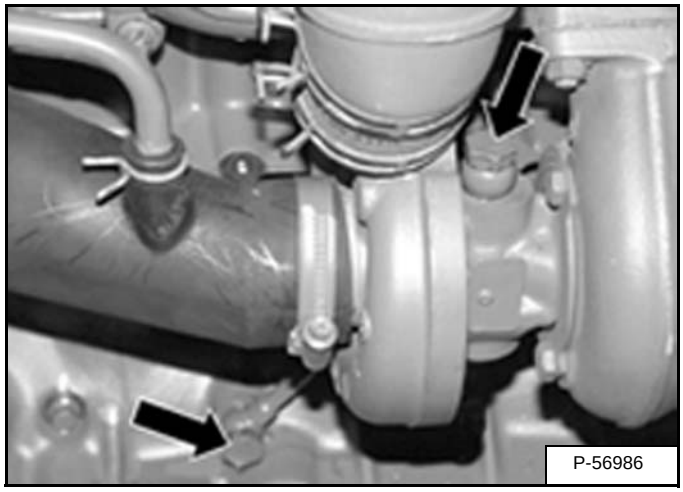
Turbo Charger Removal and Installation

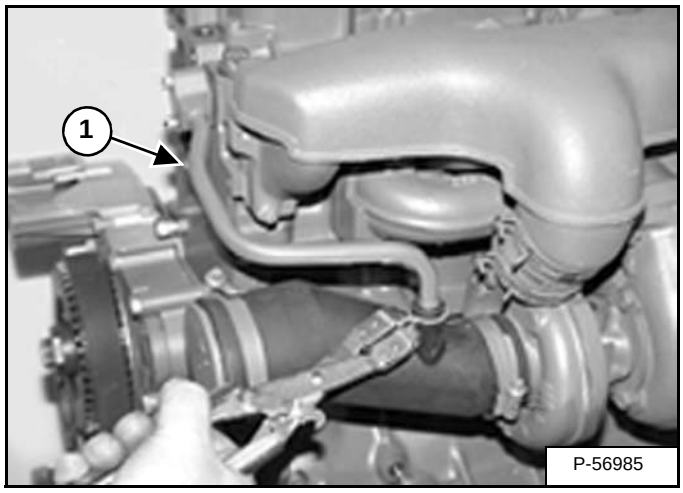
Figure 60-81-238



Remove the lube oil line **[Figure 60-81-238]**.

Installation: Tighten the bolt to 21 ft.-lb. (29 N•m) torque.

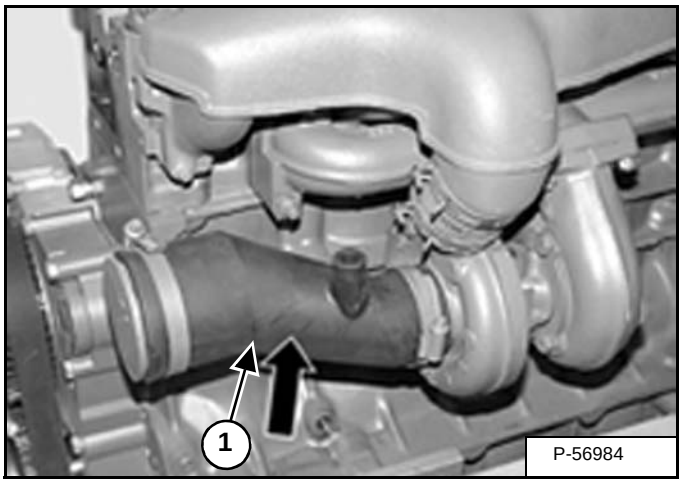
Figure 60-81-239



Remove the vent pipe (Item 1) **[Figure 60-81-239]**.

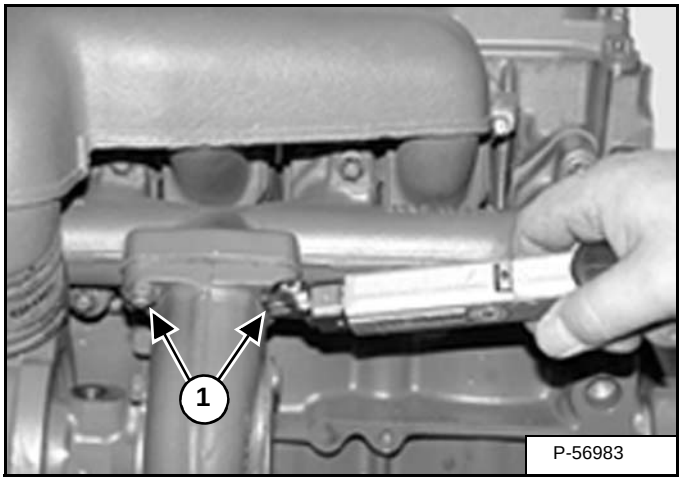
Installation: Initially tighten the bolt to 6 ft.-lb. (8.5 N•m) torque. Final tighten the bolts to 9 ft.-lb. (12.5 N•m) torque.

Figure 60-81-240



Remove the air inlet hose (Item 1) **[Figure 60-81-240]**.

Figure 60-81-241



Remove the bolts (Item 2) **[Figure 60-81-241]**.

Installation: Tighten the bolts to 15 ft.-lb. (21 N•m) torque.

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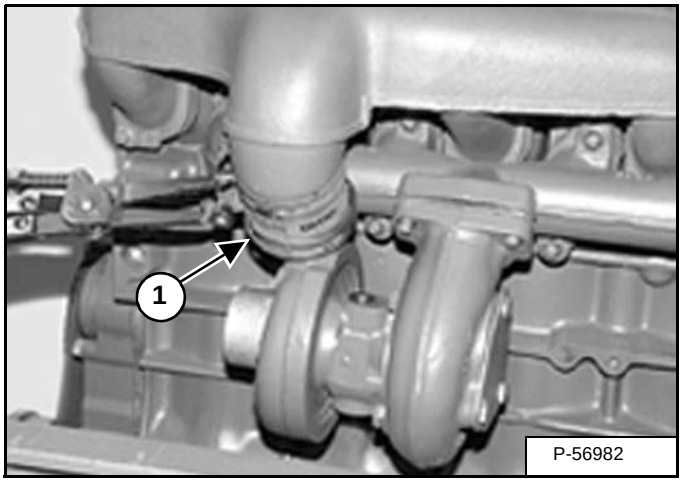
Turbo Charger Removal and Installation (Cont'd)

Figure 60-81-242



Remove the hose (Item 1) **[Figure 60-81-242]** and turbo charger.

NOTE: In the event of severe engine oil contamination, drain and flush the engine oil cooler, cab heater and plumbing.

Drain the engine oil from the crankcase and replace the engine oil and filter. (See Replacing Oil And Filter on Page 10-90-2)

Start the engine and run at idle until oil pressure is assured.

Work the unit until operating temperature of engine is maintained for approximately 15 minutes.

Idle and cool the down engine approximately 3 to 4 minutes, and stop the engine.

Drain the engine oil from the crankcase again, replace the engine oil and filter. (See Replacing Oil And Filter on Page 10-90-2.)

Re-start engine, check for leaks and performance.

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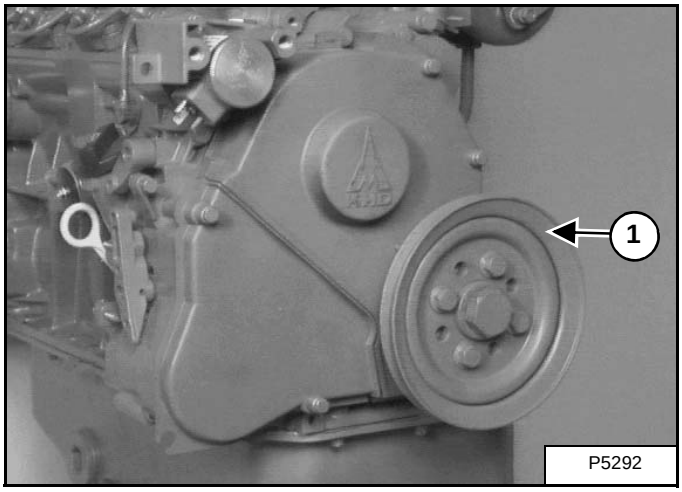
Crankshaft Gear Mounting Bolt Torque Procedure

The tool listed will be needed to do the following procedure:

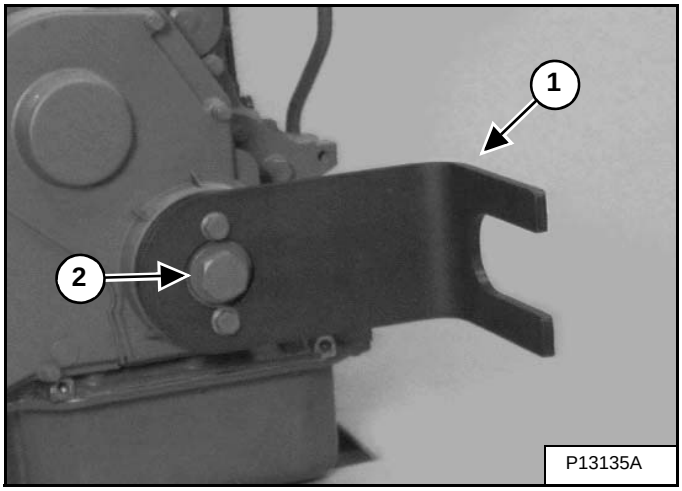
MEL1522 - Torque Multiplier Support Device
MEL1526 - Torque Multiplier

Figure 60-81-243



If the V-belt pulley is installed, remove the four bolts and remove the pulley (Item 1) **[Figure 60-81-243]**.

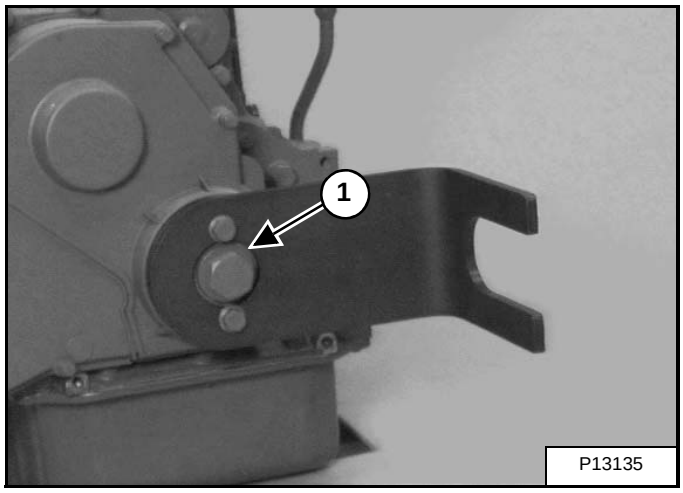
Figure 60-81-244



Install the tool (Item 1) **[Figure 60-81-244]** on the crankshaft hub using the V-belt pulley bolts.

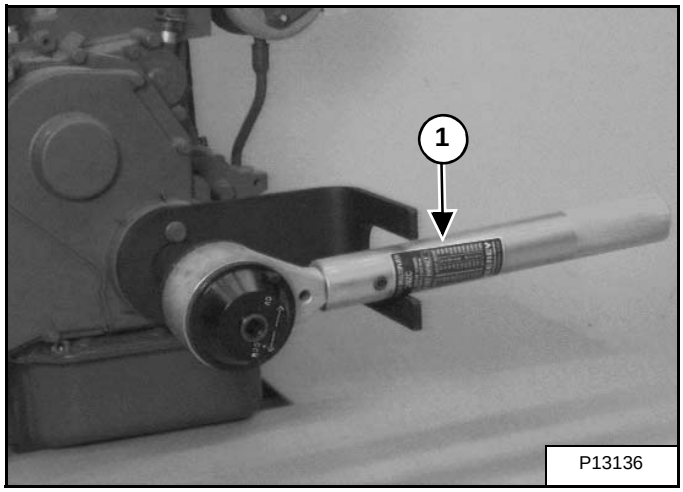
Install the crankshaft gear mounting bolt (Item 2) **[Figure 60-81-244]** and tighten to 96 ft.-lb. (130 N•m) torque.

Figure 60-81-245



Mark the crankshaft gear mounting bolt (Item 1) **[Figure 60-81-245]**.

Figure 60-81-246



NOTE: If the torque multiplier tool (Item 1) [Figure 60-81-246] has a degree wheel, the crankshaft bolt does not have to be marked.

Install the torque multiplier tool (Item 1) **[Figure 60-81-246]**, with the socket, into the tool.

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Crankshaft Gear Mounting Bolt Torque Procedure (Cont'd)

Figure 60-81-247

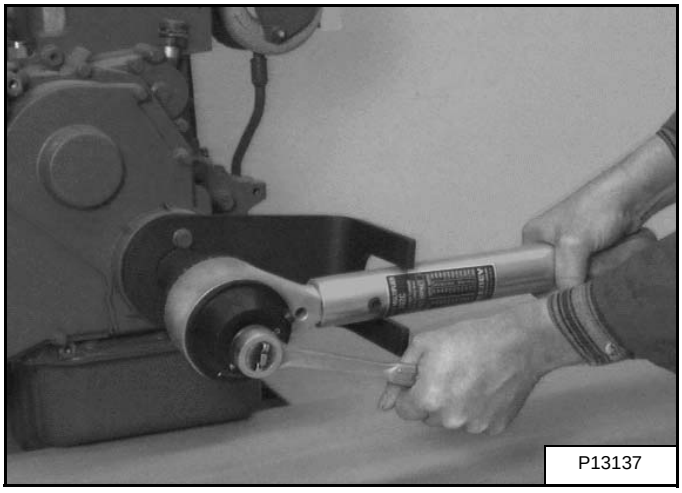
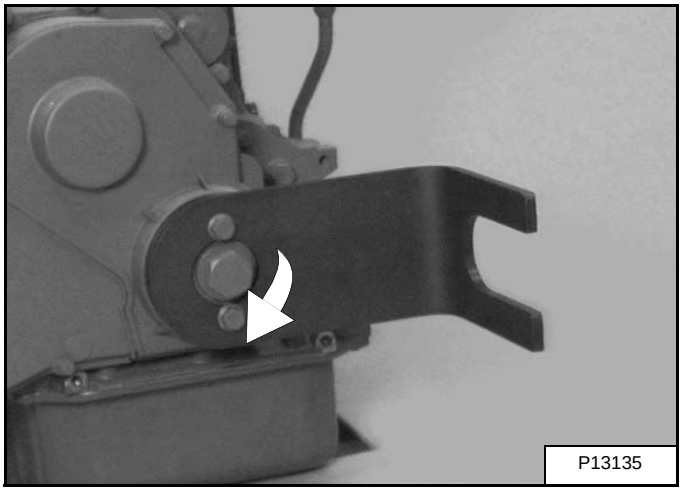


Figure 60-81-248



Tighten the gear bolt 210° (+ or - 10°) **[Figure 60-81-247]** & **[Figure 60-81-248]**.

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AIR CONDITIONING SERVICE 70-120-1
Chart 70-120-1

AIR CONDITIONING SYSTEM FLOW 70-40-2
Chart 70-40-3
Principles 70-40-2

BASIC TROUBLESHOOTING 70-80-1
Checking The Electrical System 70-80-5
Cleaning The A/C Evaporator Coil & Heater Coil (S/N 522311001 & Above) 70-80-2
Cleaning The A/C Evaporator Coil And Heater Coil (S/N 528911001 & Above And 528611001 & Above). 70-80-3
Compressor Drive Belt Inspection 70-80-2
Engine Coolant By-Passing The Heater Valve 70-80-15
Poor A/C Performance. 70-80-1

COMPONENTS (S/N 522311001 & ABOVE) 70-50-1
Identification. 70-50-1

COMPONENTS (S/N 528911001 & ABOVE AND 52864001 & ABOVE). 70-51-1
Identification. 70-51-1

COMPRESSOR (S/N 522311001 & ABOVE) 70-140-1
Removal And Installation 70-140-1

COMPRESSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE). 70-141-1
Compressor Clutch Disassembly And Assembly. 70-141-3
Parts Identification 70-141-2
Removal And Installation 70-141-1

CONDENSER (S/N 522311001 & ABOVE) 70-150-1
Removal And Installation 70-150-1

CONDENSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE). 70-151-1
Removal And Installation 70-151-1

EVAPORATOR/HEATER UNIT (S/N 522311001 & ABOVE) . 70-10-1
Removal And Installation 70-10-1

Continued On Next Page

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EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE). 70-11-1
Disassembly And Assembly. 70-11-5
Removal And Installation 70-11-1

EXPANSION VALVE 70-200-1
Removal And Installation 70-200-1

GENERAL AIR CONDITIONING SERVICE GUIDELINES . . . 70-90-1
Component Replacement And Refrigeration Leaks. 70-90-3
Compressor Oil 70-90-1
Compressor Oil Check. 70-90-1

HEATER/AC FAN 70-20-1
Removal And Installation 70-20-1
Resistor Removal And Installation 70-20-3

HEATER COIL/EVAPORATOR 70-180-1
Removal And Installation 70-180-1

HEATER VALVE 70-30-1
Removal And Installation 70-30-1

PRESSURE SWITCH (S/N 522311001 & ABOVE). 70-170-1
Removal And Installation 70-170-1

PRESSURE SWITCH (S/N 528911001 & ABOVE AND 528611001 & ABOVE). 70-171-1
Removal And Installation 70-171-1

RECEIVER/DRYER (S/N 522311001 & ABOVE) 70-160-1
Removal And Installation 70-160-1

RECEIVER/DRYER (S/N 528911001 & ABOVE AND 528611001 & ABOVE)) 70-161-1
Removal And Installation 70-161-1

REGULAR MAINTENANCE 70-70-1
Air Conditioning Compressor Belt 70-70-1
Cleaning The Condenser 70-70-2
Heater Air Filter 70-70-1

SAFETY 70-60-1
Safety Equipment. 70-60-1

Continued On Next Page

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SYSTEM CHARGING AND RECLAMATION 70-130-1
Reclamation Procedure 70-130-1

SYSTEM TROUBLESHOOTING CHART 70-100-1
Blower Motor Does Not Operate 70-100-1
Gauge Pressure Related Troubleshooting. 70-100-2

TEMPERATURE/PRESSURE. 70-110-1
Chart 70-110-1

THERMOSTAT 70-190-1
Removal And Installation 70-190-1

UPGRADED AIR CONDITIONING SYSTEM 70-210-1
Disassembly And Assembly. 70-210-4
Evaporator Removal And Installation. 70-210-7
Evaporator Unit Removal And Installation 70-210-1
Fan Removal And Installation 70-210-8
Switch Removal And Installation 70-210-8
Thermostat Removal And Installation 70-210-7

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EVAPORATOR/HEATER UNIT (S/N 522311001 & ABOVE)

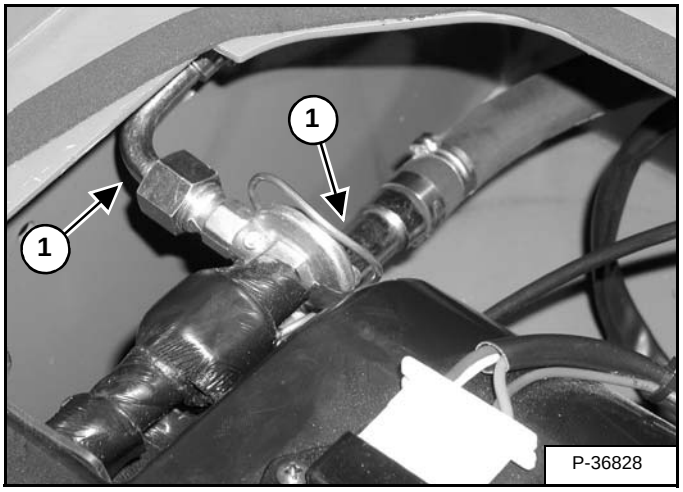
Removal And Installation

Drain the radiator. (See COOLING SYSTEM on Page 10-70-1.)

Discharge the air conditioning system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1).

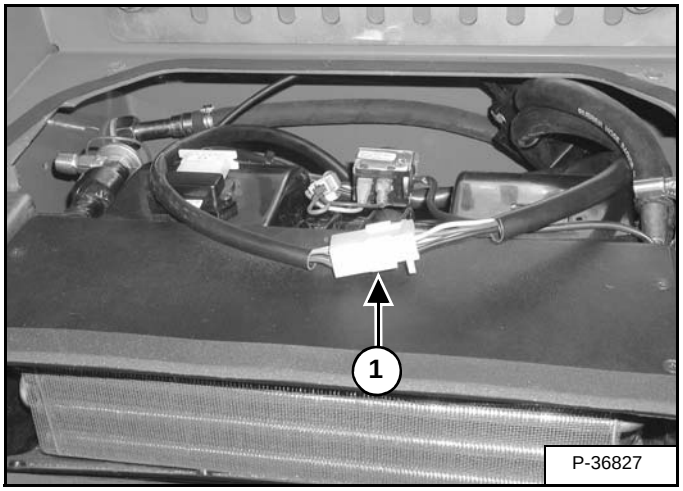
Remove the seat and seat mount. (See SEAT AND SEAT MOUNT on Page 40-30-1.)

Figure 70-10-1



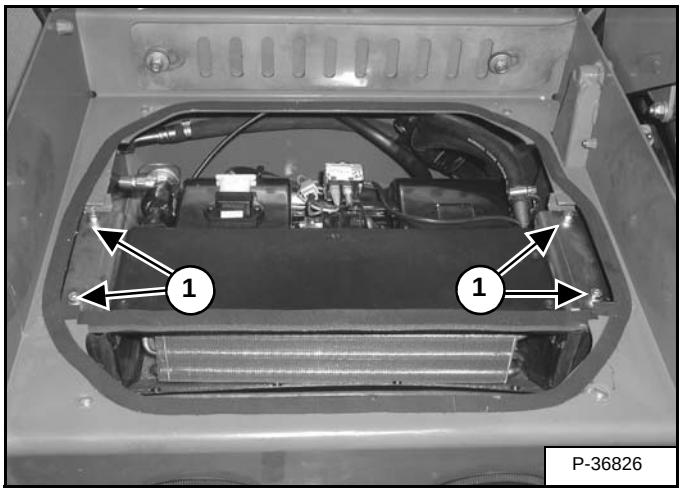
Remove the air conditioner hoses (Item 1) **[Figure 70-10-1]**.

Figure 70-10-2



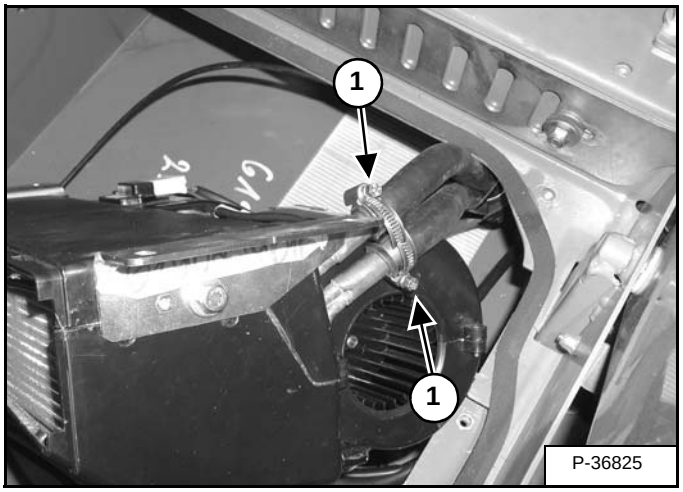
Disconnect the wire harness (Item 1) **[Figure 70-10-2]**.

Figure 70-10-3



Remove the four bolts (Item 1) **[Figure 70-10-3]** and washers.

Figure 70-10-4



Raise the air conditioning/heating unit to gain access to the heater hoses (Item 1) **[Figure 70-10-4]**

Remove the heater hoses.

Remove the evaporator/heater unit from the excavator.

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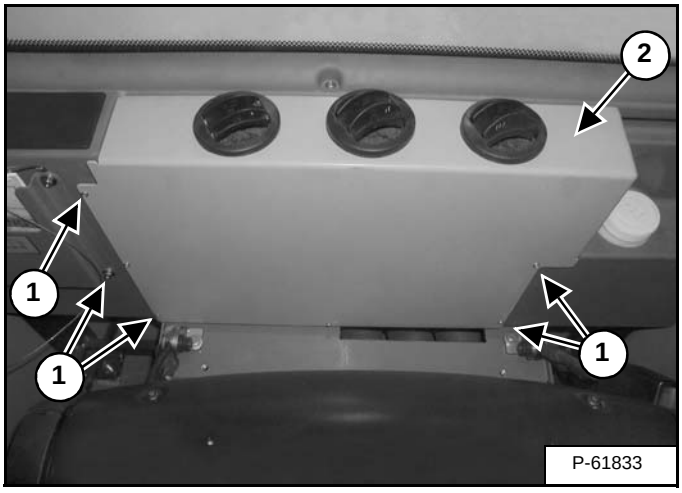
EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE)

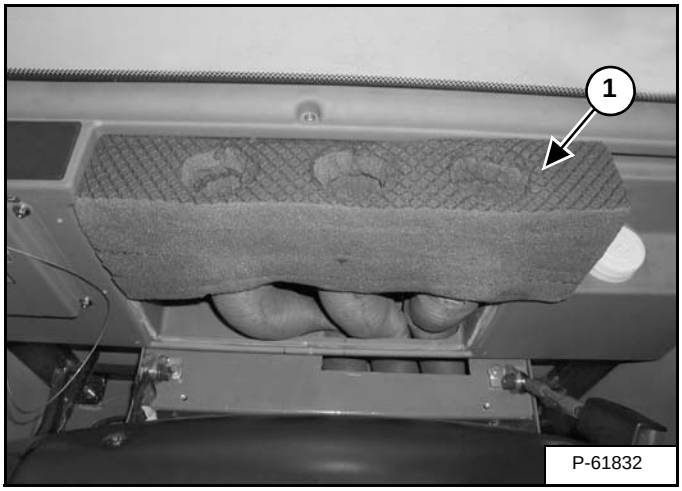
Removal And Installation

Figure 70-11-1



Remove the six screws (Item 1) and cover (Item 2) **[Figure 70-11-1]**.

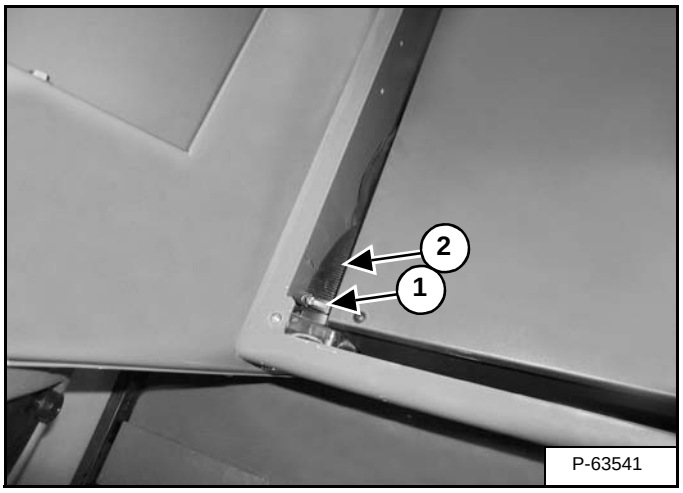
Figure 70-11-2



Remove the foam (Item 1) **[Figure 70-11-2]**.

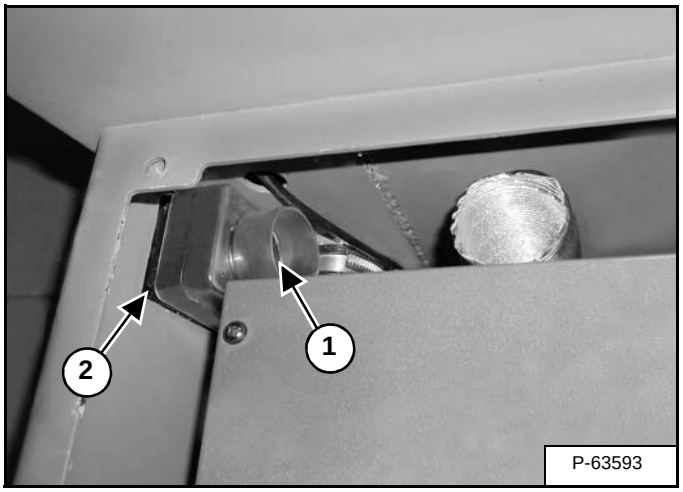
Remove the seat and seat mount. (See SEAT AND SEAT MOUNT on Page 40-30-1)

Figure 70-11-3



Loosen the clamp (Item 1). Remove the hose (Item 2) **[Figure 70-11-3]**.

Figure 70-11-4



Remove the adapter (Item 1) from the louver (Item 2) **[Figure 70-11-4]**.

Remove the louver.

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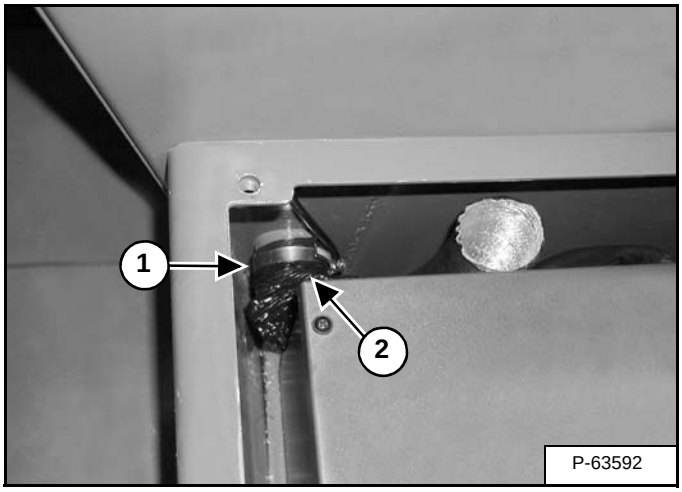
Removal And Installation (Cont'd)

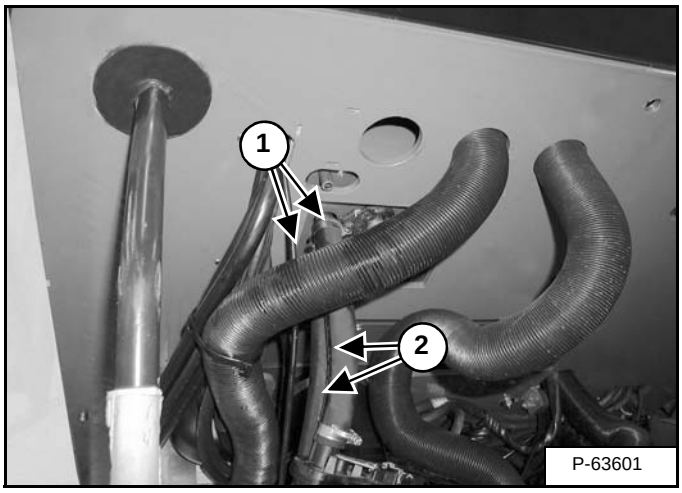
Figure 70-11-5



Loosen the clamp (Item 1). Remove the hose (Item 2) **[Figure 70-11-5]**.

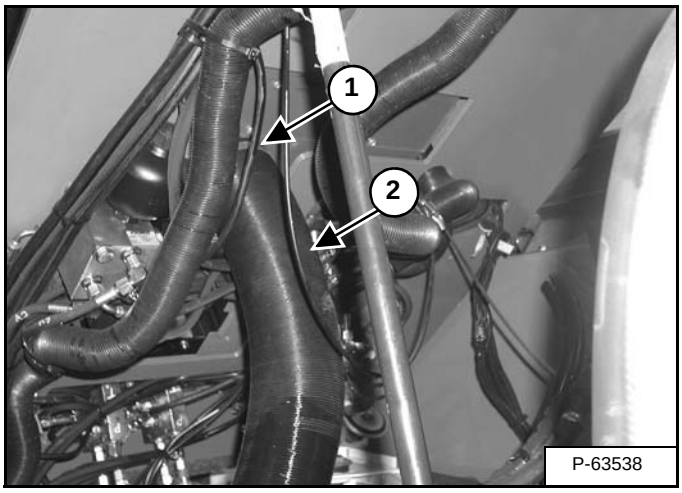
Tilt the cab. (See Tilting The Cab on Page 10-160-2)

Figure 70-11-6



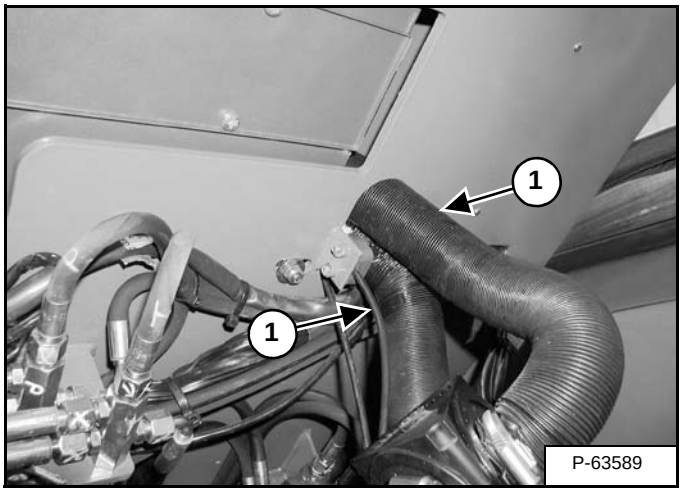
Loosen the clamps (Item 1). Remove the 2 heater hoses (Item 2) **[Figure 70-11-6]**.

Figure 70-11-7



Loosen the clamp (Item 1). Remove the hose (Item 2) **[Figure 70-11-7]**.

Figure 70-11-8



Remove the 2 hoses (Item 1) **[Figure 70-11-8]**.

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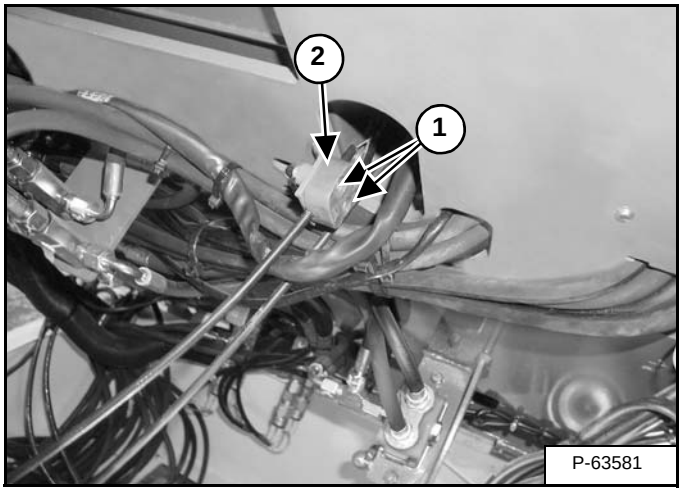
Removal And Installation (Cont'd)

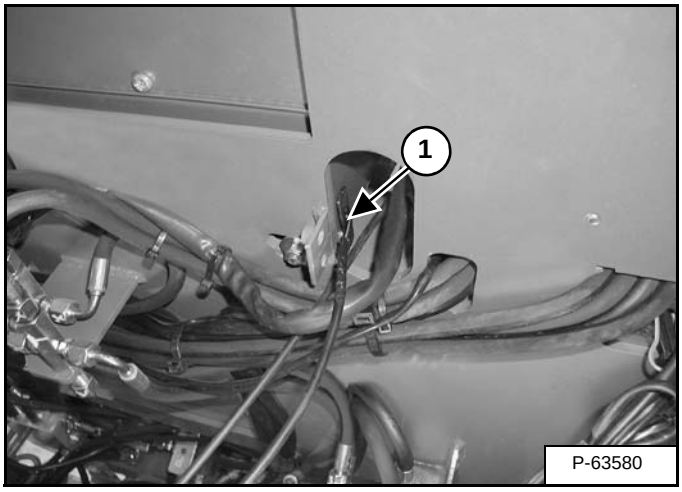
Figure 70-11-9



Remove the 2 bolts (Item 1) from the retainer (Item 2) **[Figure 70-11-9]**.

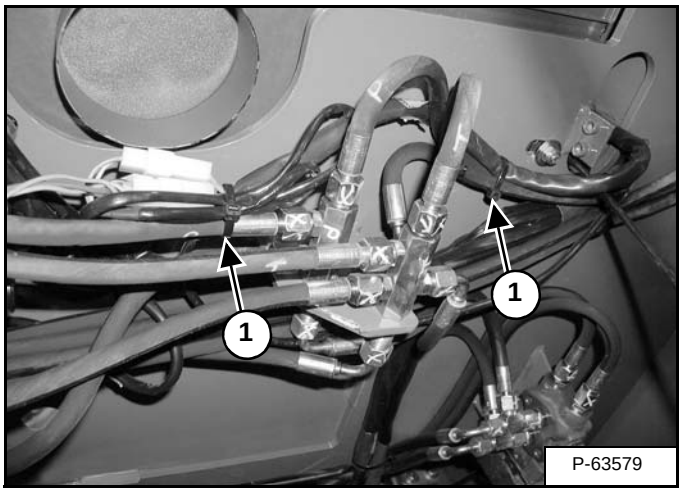
Remove the retainer.

Figure 70-11-10



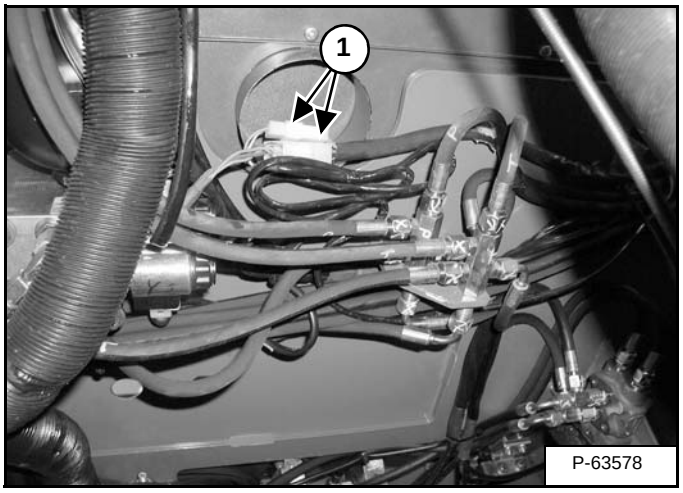
Remove the control cable (Item 1) **[Figure 70-11-10]**.

Figure 70-11-11



Remove the tiestraps (Item 1) **[Figure 70-11-11]**.

Figure 70-11-12



Disconnect the 2 wire connectors (Item 1) **[Figure 70-11-12]**.

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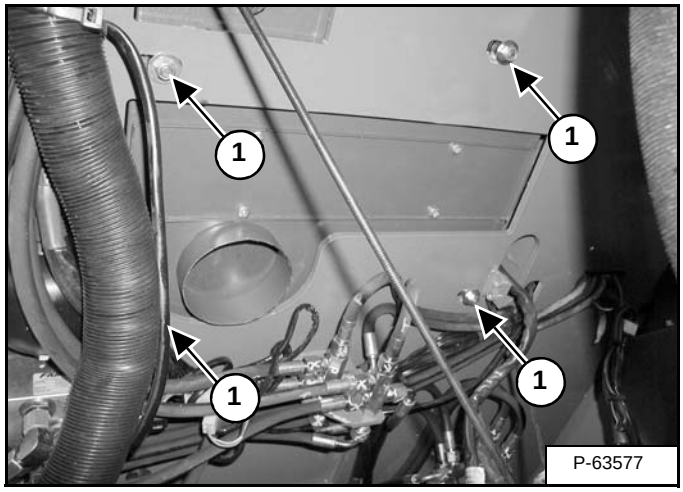
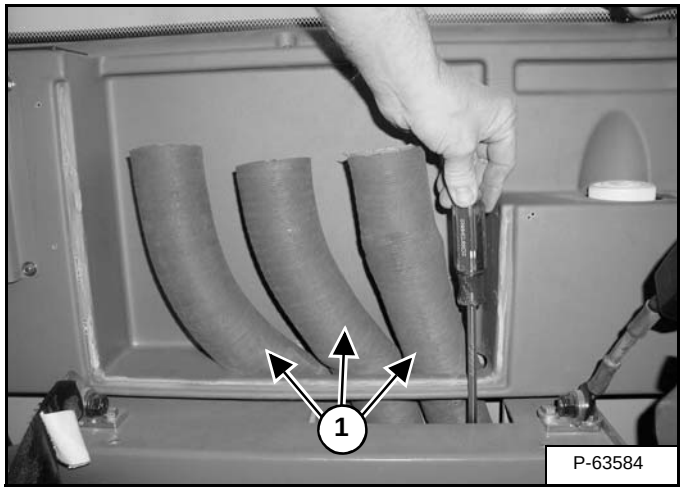
Figure 70-11-13



Remove the 4 bolts (Item 1) **[Figure 70-11-13]** and washers.

Lower the cab.

Figure 70-11-14

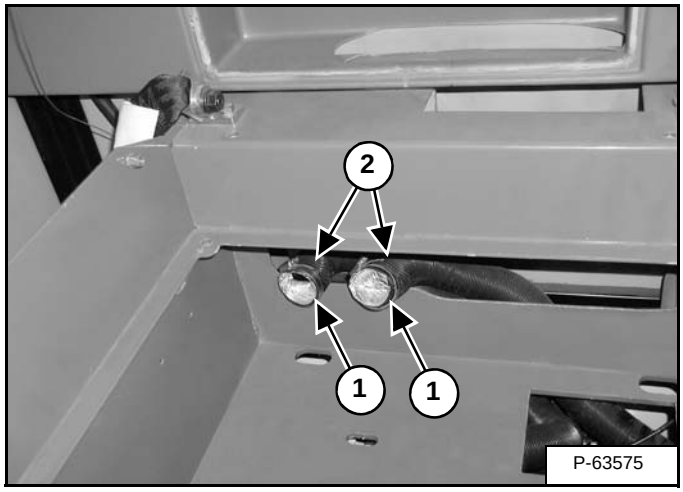


Loosen the clamps. Remove the 3 hoses (Item 1) **[Figure 70-11-14]**.

EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) (CONT'D)

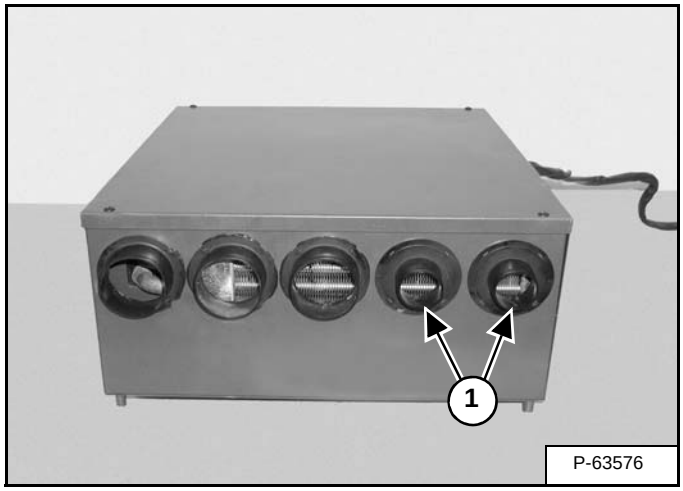
Removal And Installation (Cont'd)

Figure 70-11-15



The heater unit is shown removed in **[Figure 70-11-15]** and **[Figure 70-11-16]** for photo clarity.

Figure 70-11-16



Loosen the clamps (Item 1). Remove the hoses (Item 2) **[Figure 70-11-15]** from the 2 vents (Item 1) **[Figure 70-11-16]**.

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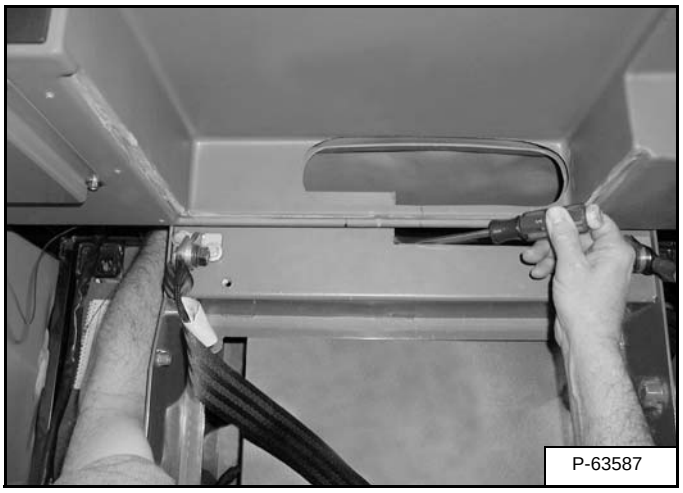
Figure 70-11-17



NOTE: The clamps and hoses can be accessed from the top and right of the housing [Figure 70-11-17].

Figure 70-11-18

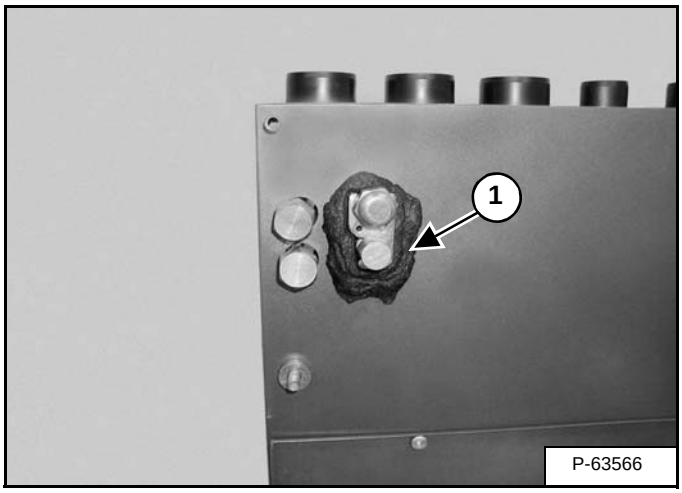
Remove the evaporator/heater unit **[Figure 70-11-18]**.

EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) (CONT'D)

Disassembly And Assembly

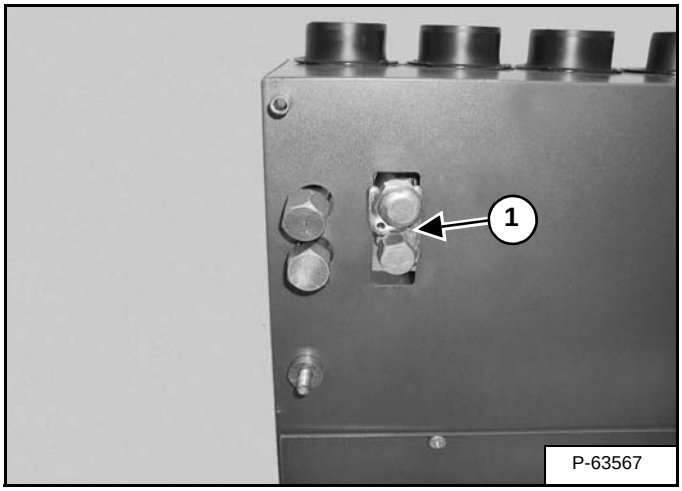
NOTE: The evaporator and thermostat are not used in this application. (See UPGRADED AIR CONDITIONING SYSTEM on Page 70-210-1)

Figure 70-11-19



Remove the seal (Item 1) **[Figure 70-11-19]** from the bottom of the evaporator/heater box.

Figure 70-11-20



Remove the retainer (Item 1) **[Figure 70-11-20]**.

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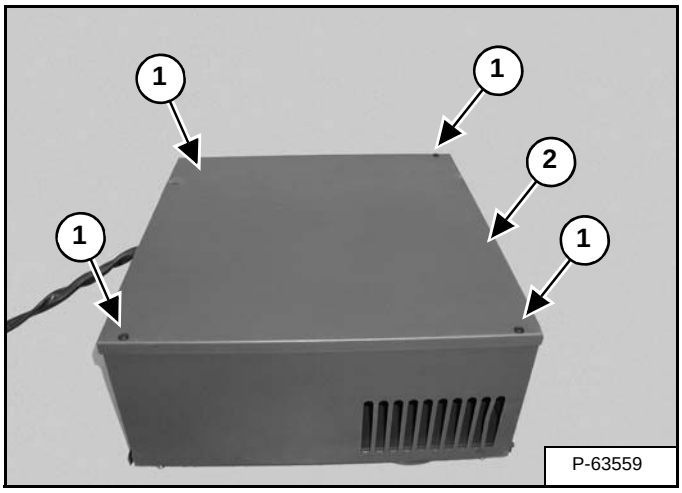
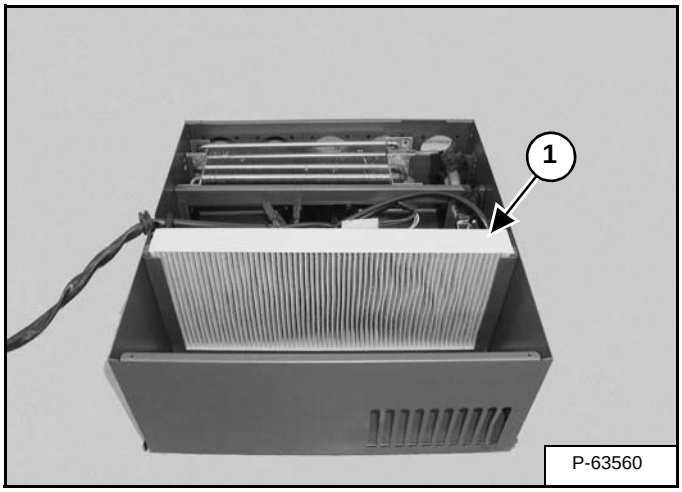
Figure 70-11-21



Remove the 4 screws (Item 1) from the cover (Item 2) **[Figure 70-11-21]**.

Figure 70-11-22

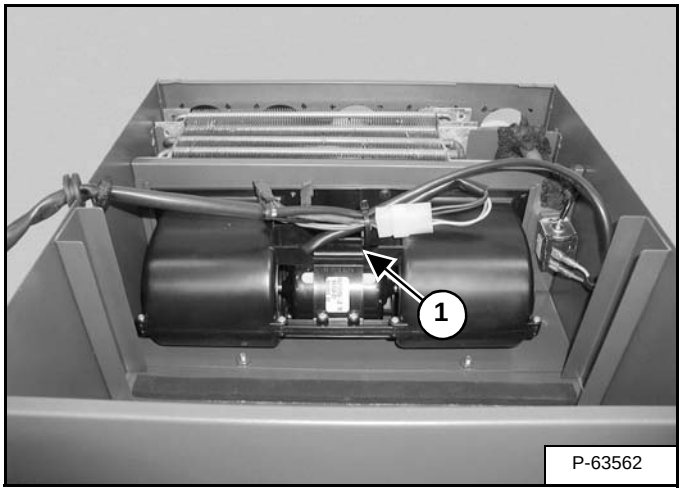


Remove the filter (Item 1) **[Figure 70-11-22]**.

EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) (CONT'D)

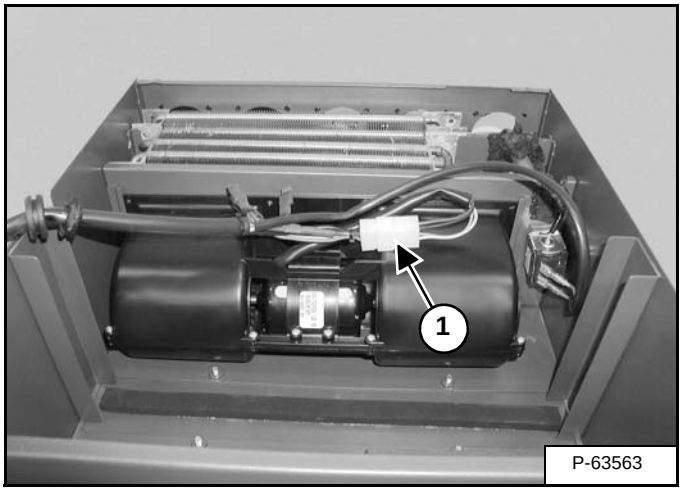
Disassembly And Assembly (Cont'd)

Figure 70-11-23



Remove the tiestrap (Item 1) **[Figure 70-11-23]**.

Figure 70-11-24



Disconnect the electrical connectors (Item 1) **[Figure 70-11-24]**.

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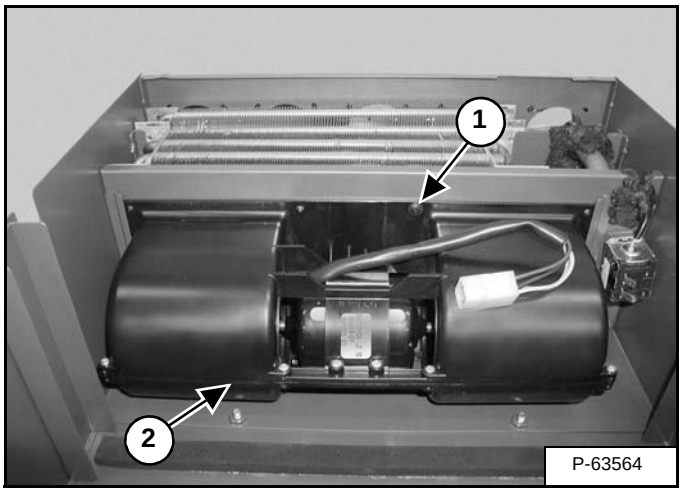
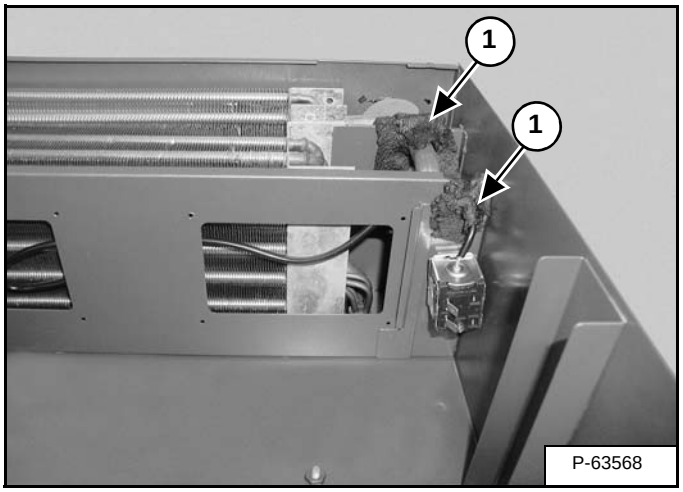
Figure 70-11-25



Remove the screw (Item 1) from the blower (Item 2) **[Figure 70-11-25]**.

Remove the blower.

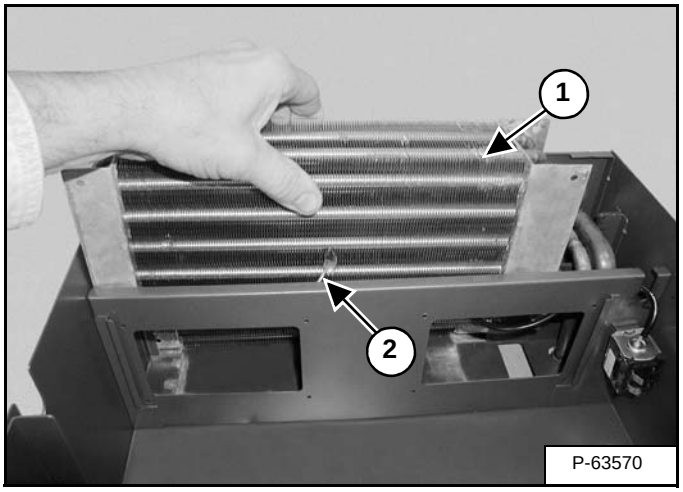
Figure 70-11-26



Remove the seals (Item 1) **[Figure 70-11-26]**.

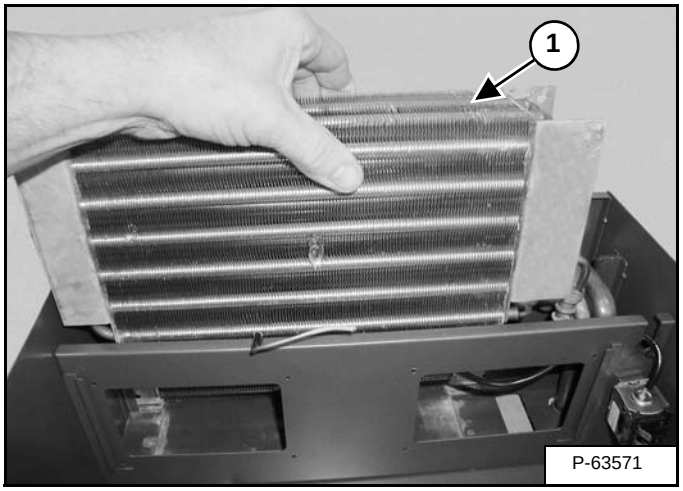
Disassembly And Assembly (Cont'd)

Figure 70-11-27



Raise the evaporator (Item 1). Remove the thermostat wire (Item 2) **[Figure 70-11-27]**.

Figure 70-11-28



Remove the evaporator (Item 1) **[Figure 70-11-28]**.

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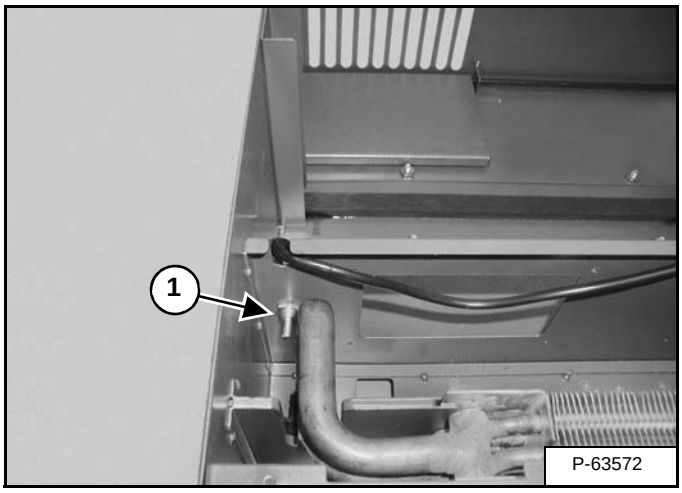
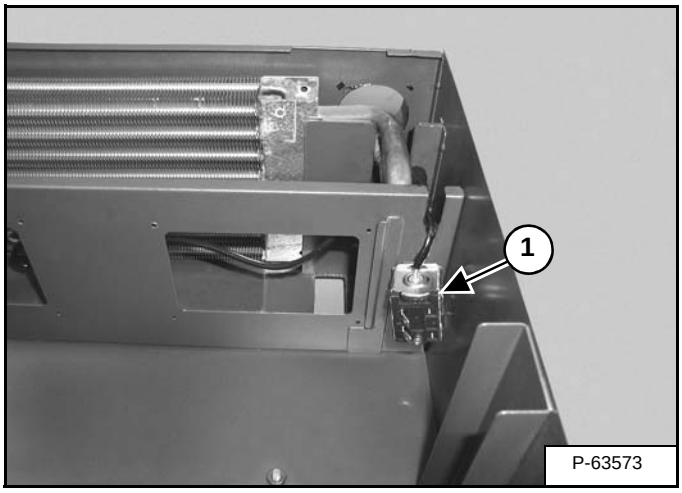
Figure 70-11-29



Remove the nut (Item 1) **[Figure 70-11-29]**.

Figure 70-11-30

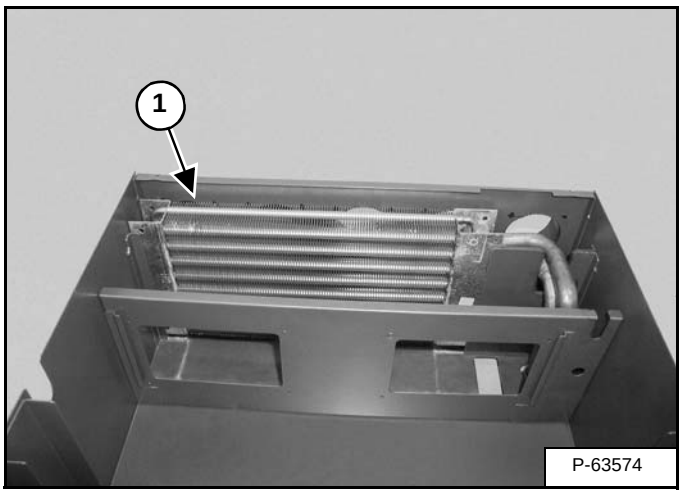


Remove the thermostat (Item 1) **[Figure 70-11-30]**.

EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) (CONT'D)

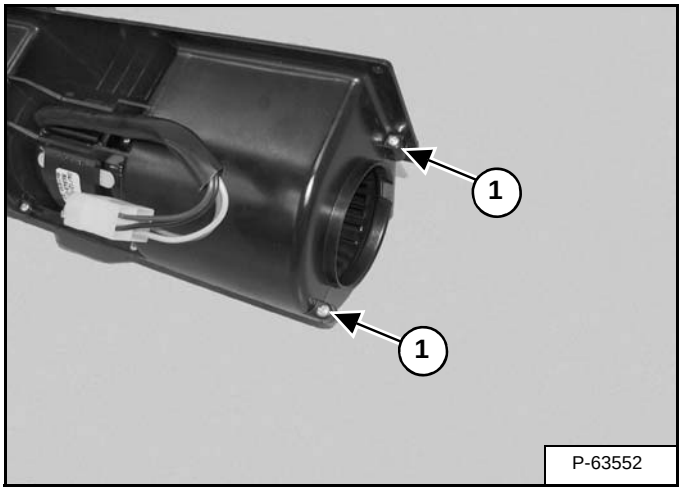
Disassembly And Assembly (Cont'd)

Figure 70-11-31



Remove the heater coil (Item 1) **[Figure 70-11-31]**.

Figure 70-11-32



Remove the 2 screws (Item 1) **[Figure 70-11-32]** from the housing. (Both ends)

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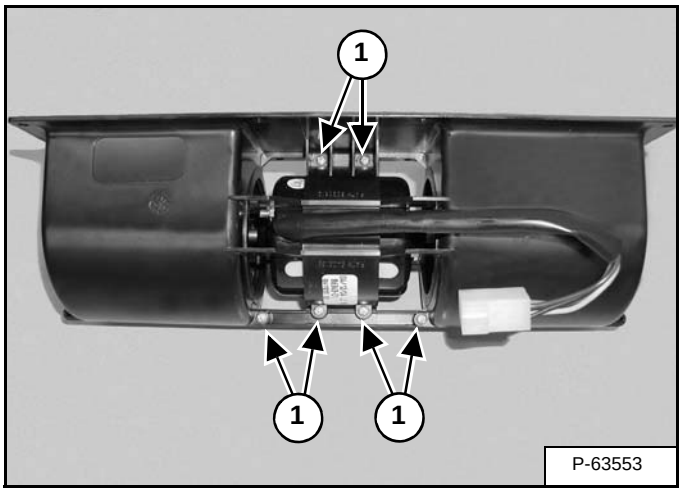
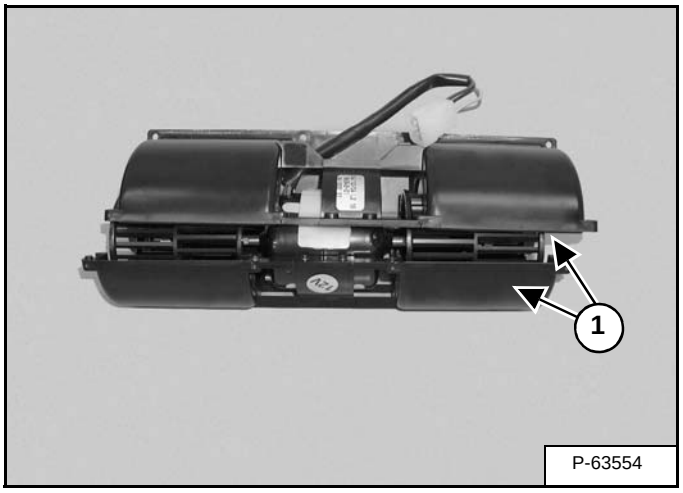
Figure 70-11-33



Remove the 6 screws (Item 1) **[Figure 70-11-33]**.

Figure 70-11-34

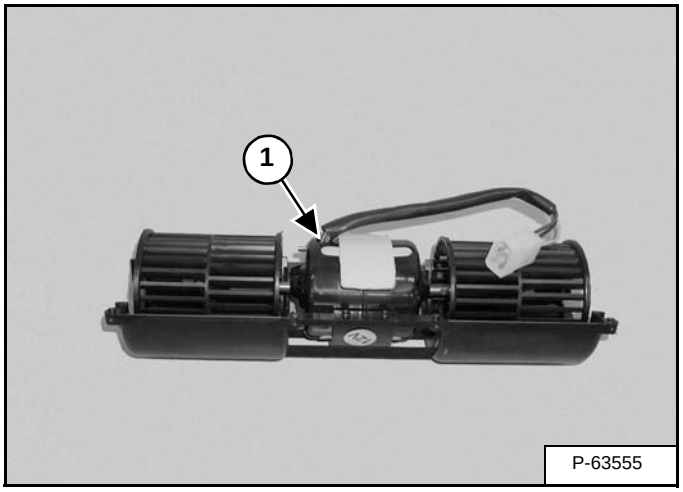


Separate the 2 housing sections (Item 1) **[Figure 70-11-34]**.

EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) (CONT'D)

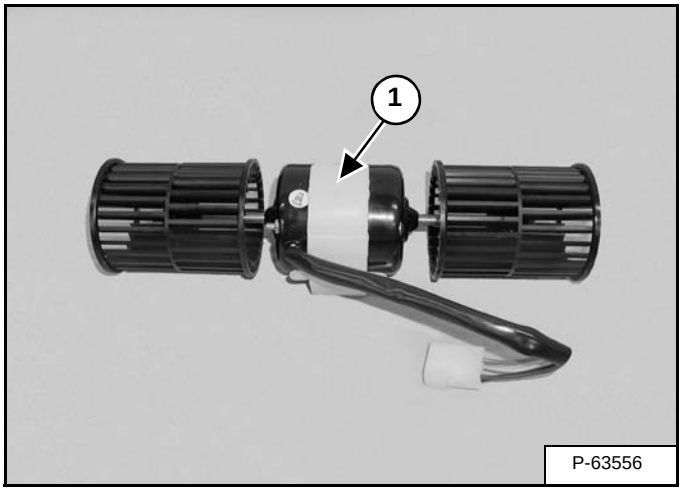
Disassembly And Assembly (Cont'd)

Figure 70-11-35



Remove the fan/motor assembly (Item 1) **[Figure 70-11-35]**.

Figure 70-11-36



Remove the cushion (Item 1) **[Figure 70-11-36]**.

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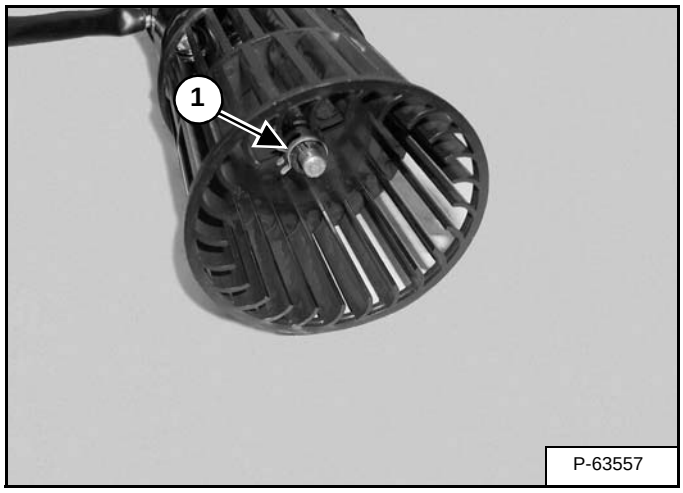
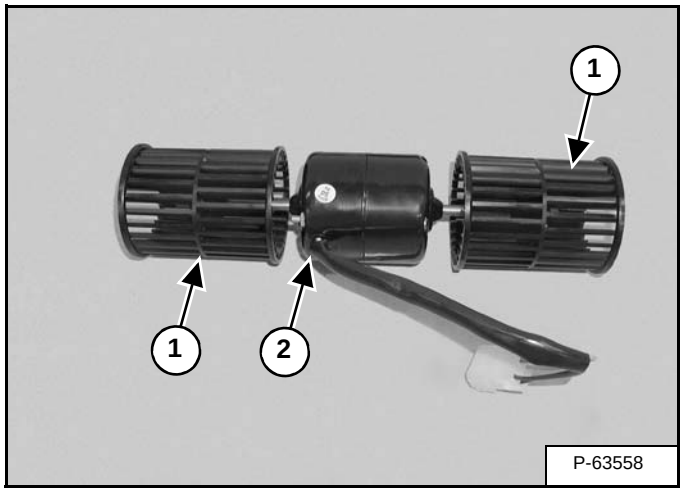
Figure 70-11-37



Remove the clamp (Item 1) **[Figure 70-11-37]**. (Both sides)

Figure 70-11-38



Remove the fans (Item 1) from the motor (Item 2) **[Figure 70-11-38]**.

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HEATER/AC FAN

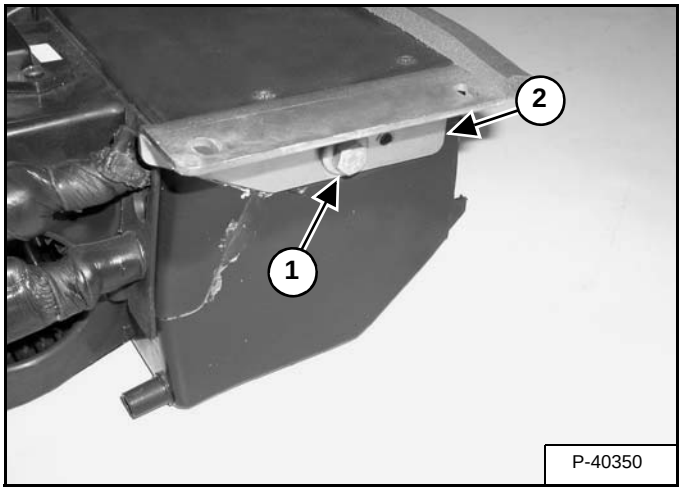
Removal And Installation

Remove the evaporator/heater unit. (See EVAPORATOR/HEATER UNIT (S/N 522311001 & ABOVE) on Page 70-10-1 or See EVAPORATOR/ HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) on Page 70-11-1.)

Remove the thermostat. (See THERMOSTAT on Page 70-190-1.)

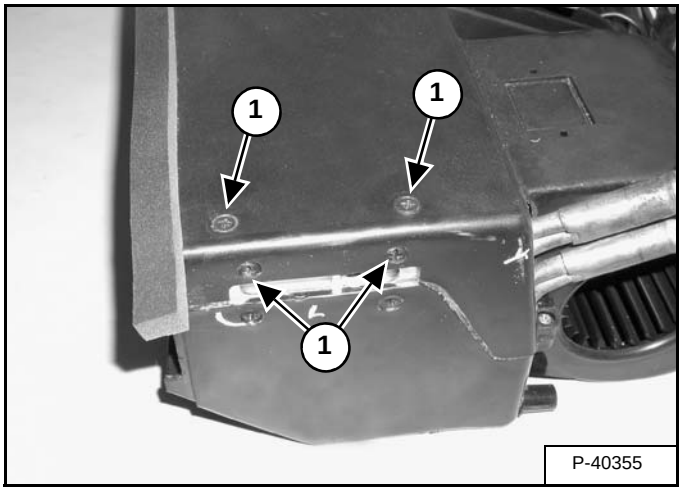
Mark around the edges of both mount brackets.

Figure 70-20-1



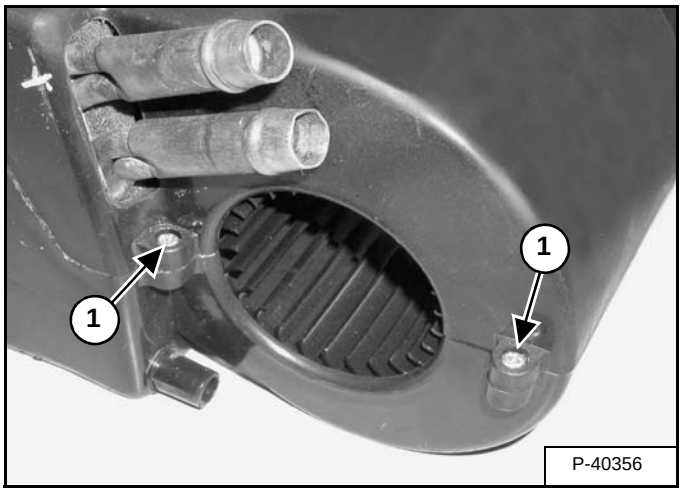
Remove the bolt (Item 1) **[Figure 70-20-1]**, washer and mount (Item 2) **[Figure 70-20-1]** from both sides.

Figure 70-20-2



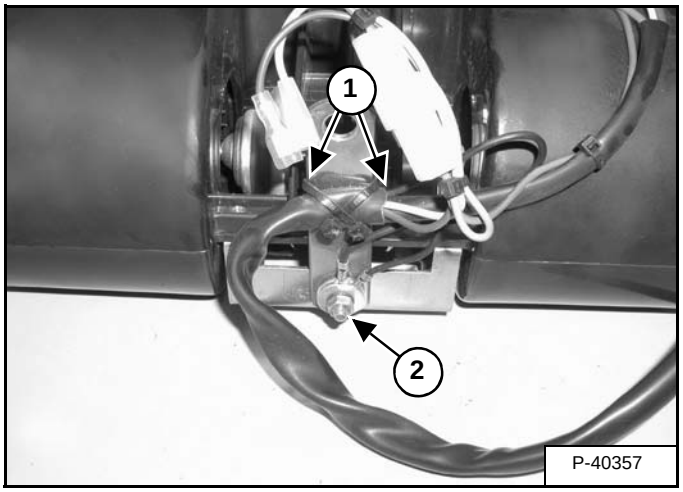
Remove the four screws (Item 1) **[Figure 70-20-2]** from both sides.

Figure 70-20-3



Remove the two screws (Item 1) **[Figure 70-20-3]** from both ends.

Figure 70-20-4



Cut and remove the cable ties (Item 1) **[Figure 70-20-4]**

Remove the nut (Item 2) **[Figure 70-20-4]** washers, ground wires and thermostat mount.

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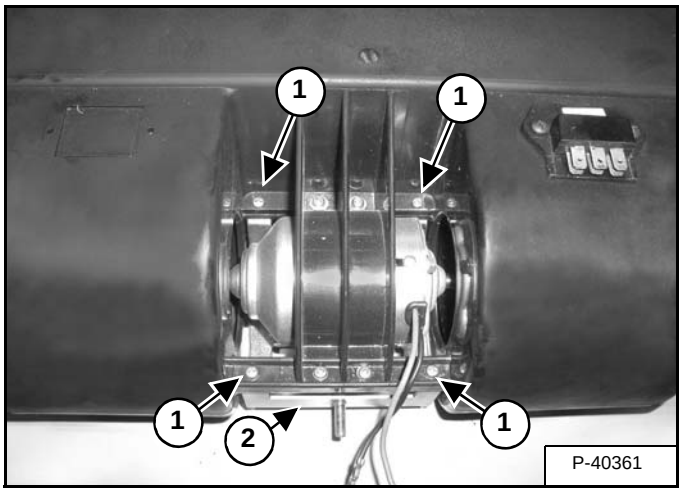
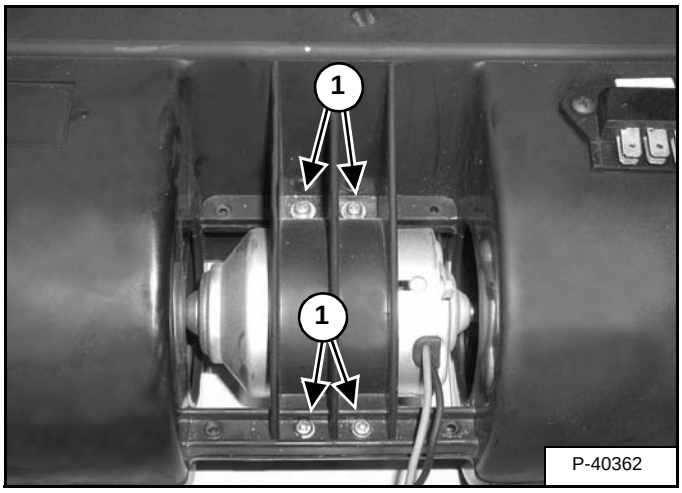
Removal And Installation (Cont'd)

Figure 70-20-5



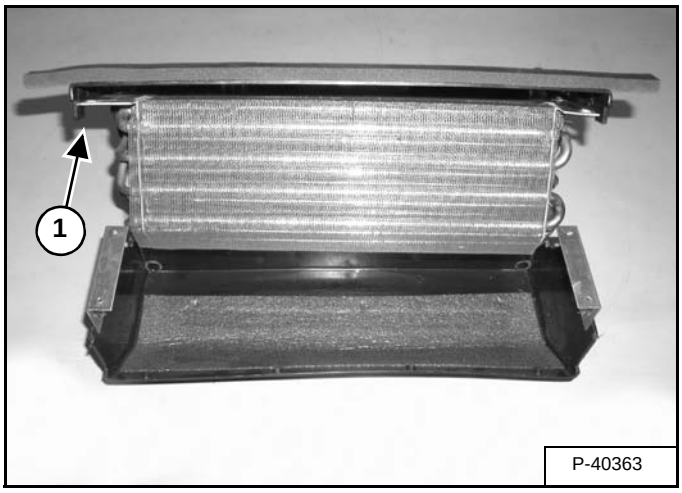
Remove the four screws (Item 1) and bracket (Item 2) **[Figure 70-20-5]**.

Figure 70-20-6



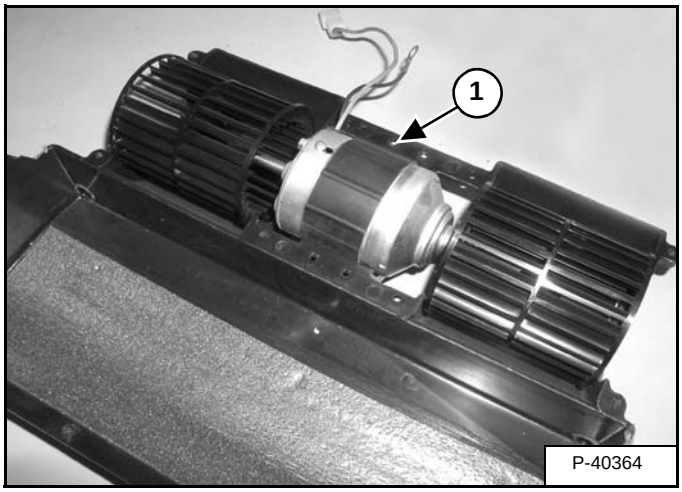
Remove the four screws (Item 1) **[Figure 70-20-6]**, washers and nuts.

Figure 70-20-7



Remove the top cover (Item 1) **[Figure 70-20-7]** and heater coil/evaporator.

Figure 70-20-8



Remove the fan (Item 1) **[Figure 70-20-8]**.

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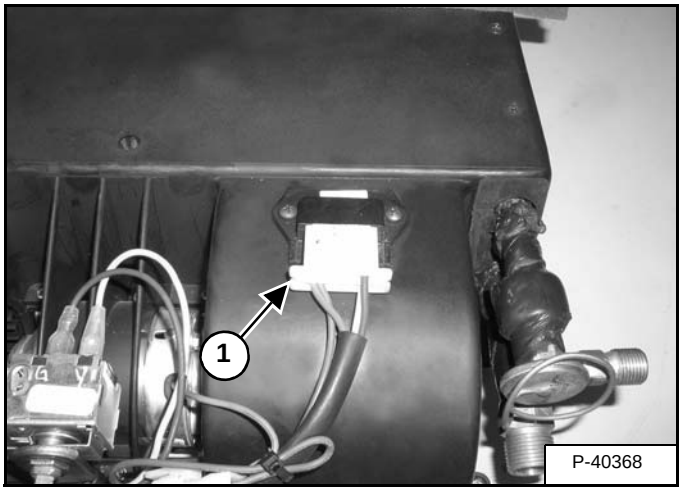
Resistor Removal And Installation

NOTE: The resistor removal and installation is shown out of the excavator. The procedure can be done with the evaporator/heater unit installed in the excavator.

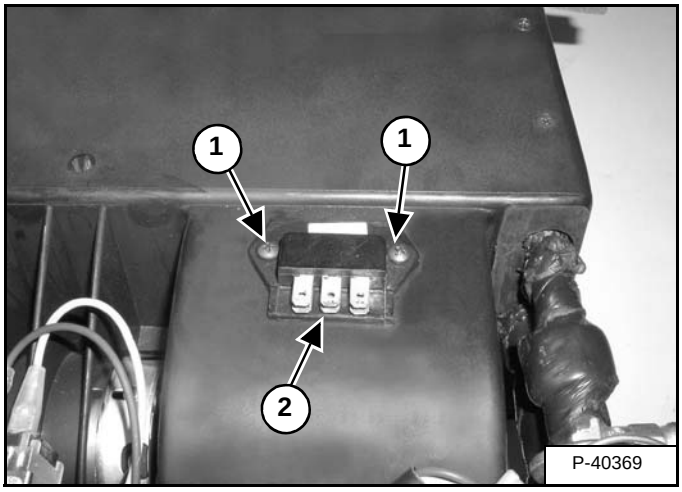
Remove the seat and seat mount. (See SEAT AND SEAT MOUNT on Page 40-30-1.)

Figure 70-20-9



Disconnect the wire harness (Item 1) **[Figure 70-20-9]**

Figure 70-20-10



Remove the screws (Item 1) **[Figure 70-20-10]**.

Remove the resistor (Item 2) **[Figure 70-20-10]**.

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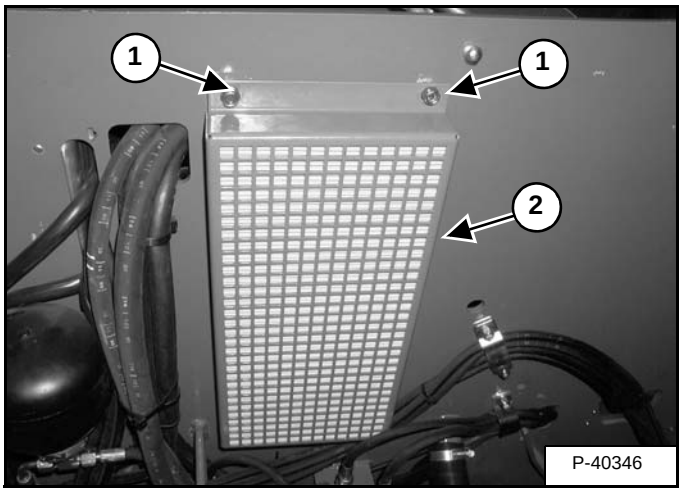
HEATER VALVE

Removal And Installation

Drain the radiator. (See COOLING SYSTEM on Page 10-70-1.)

Tilt the cab. (See Tilting The Cab on Page 10-160-2.)

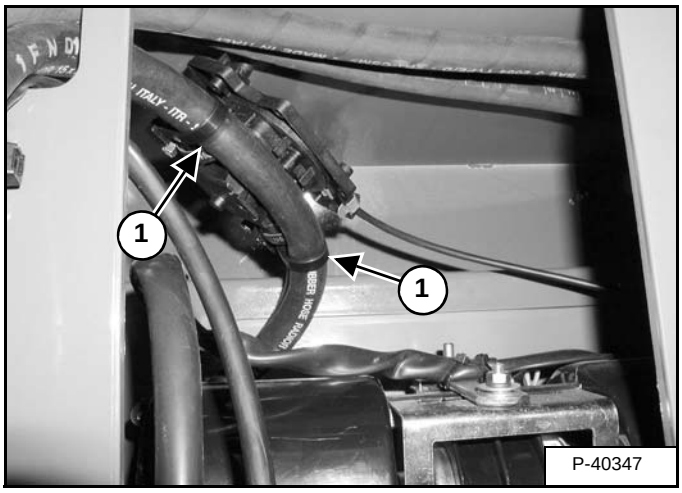
Figure 70-30-1



Remove the four nuts (Item 1) **[Figure 70-30-1]** and washers.

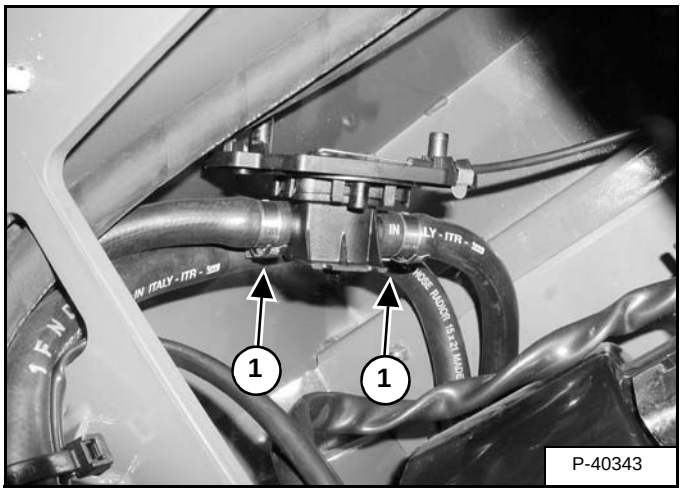
Remove the filter (Item 2) **[Figure 70-30-1]**.

Figure 70-30-2



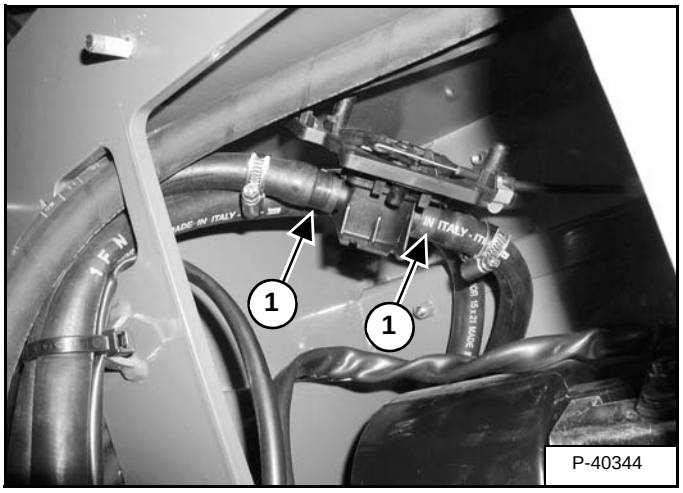
Cut and remove the cable ties (Item 1) **[Figure 70-30-2]**.

Figure 70-30-3



Loosen the hose clamps (Item 1) **[Figure 70-30-3]**.

Figure 70-30-4



Mark and remove the hoses (Item 1) **[Figure 70-30-4]**

Lower the valve out of the cab.

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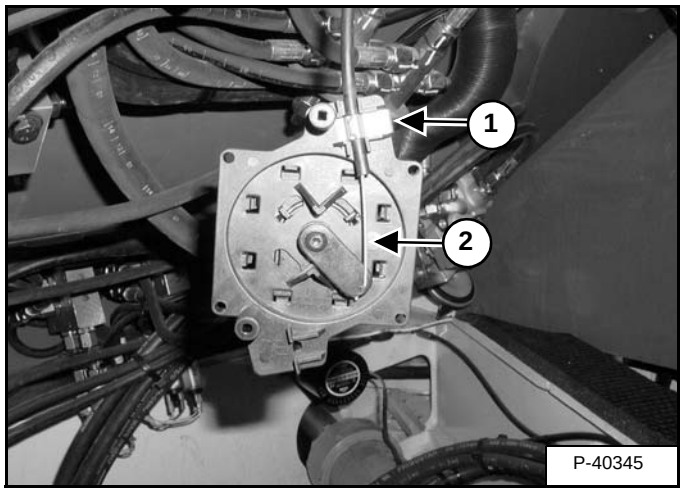
Removal and Installation (Cont'd)

Figure 70-30-5



Mark the cable length and remove the clamp (Item 1) **[Figure 70-30-5]**.

Remove the cable (Item 2) **[Figure 70-30-5]** from the valve.

Remove the heater valve.

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AIR CONDITIONING SYSTEM FLOW

Principles

In an air conditioning system the refrigerant is circulated under pressure through five major components in a closed circuit. At these five points in the system the refrigerant goes through pressure and temperature changes.

The compressor (Item 1) takes in heated, low pressure refrigerant gas through the suction valve (low pressure side) and as the name indicates, pressurizes the heated refrigerant and forces it through the discharge valve (high pressure side) on the condenser (Item 2) **[Figure 70-40-1 on Page 3]**.

Ambient air passing through the condenser removes the heat from refrigerant resulting in physical state change in the refrigerant from a gas to a liquid.

The liquid refrigerant moves on to the receiver/dryer (Item 3) where impurities such as moisture and dirt are filtered out. The receiver/dryer also serves as the storage tank for the liquid refrigerant. The liquid refrigerant (still under high pressure) flows to the expansion valve (Item 4) **[Figure 70-40-1 on Page 3]**.

The expansion valve meters the amount of refrigerant into the evaporator coil (Item 5). As the refrigerant passes through the expansion valve, it again changes its physical state. It becomes a low temperature, low-pressure liquid and saturated vapor. The low pressure liquid immediately starts to boil and vaporize as it enters the evaporator. The hot humid air of the machine's cab is drawn through or blown into the evaporator by the evaporator fan (Item 6) **[Figure 70-40-1 on Page 3]**. Since the refrigerant is colder than the air, it absorbs the heat from the air and produces cooled air, which is pushed into the cab by the fan. The moisture in the air condenses on the evaporator coil and drips into the drain pan, which directs the water out of the cab.

The refrigerant cycle is completed when the heated low pressure gas is again drawn into the compressor

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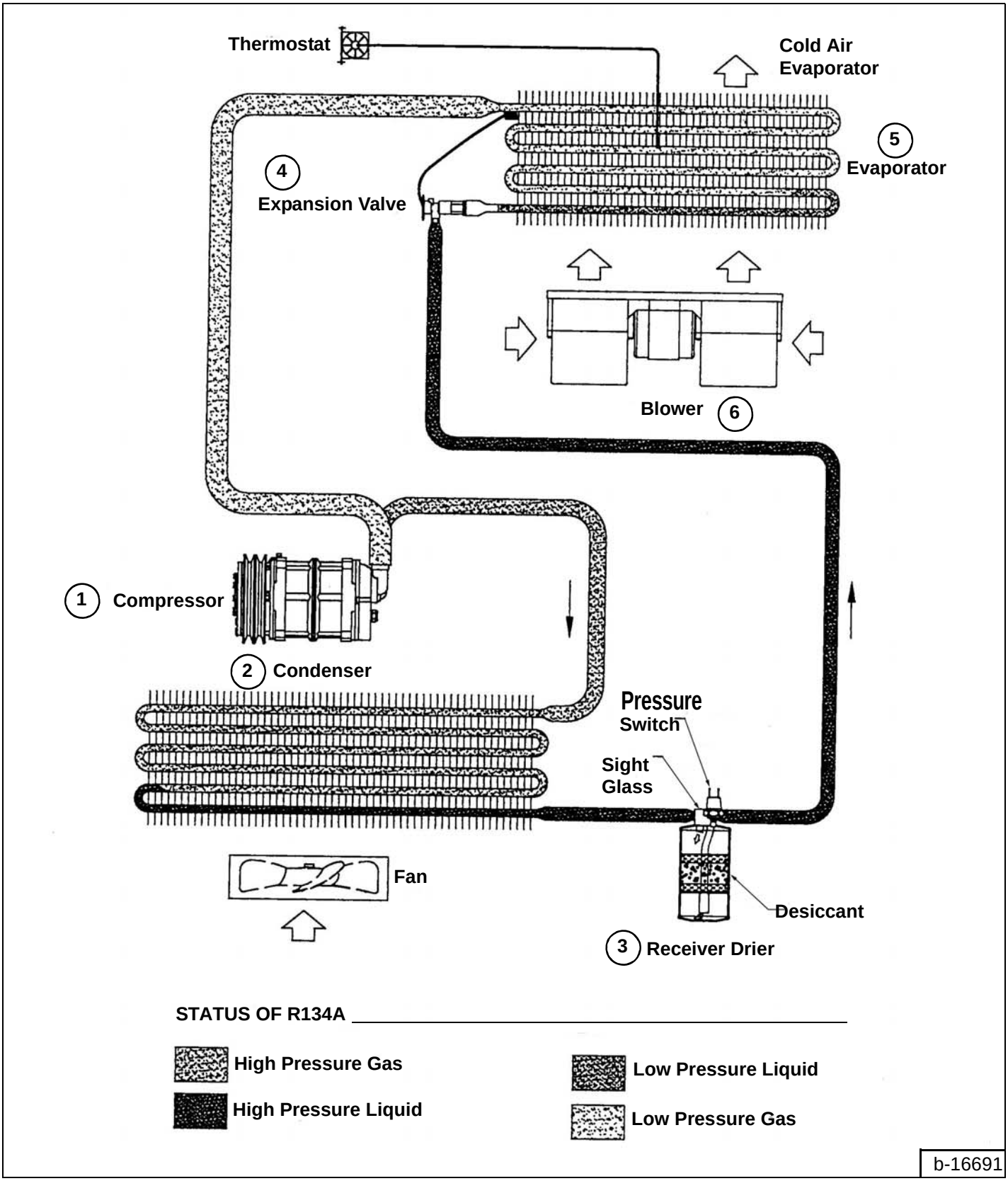
AIR CONDITIONING SYSTEM FLOW (CONT'D)

Chart

Figure 70-40-1



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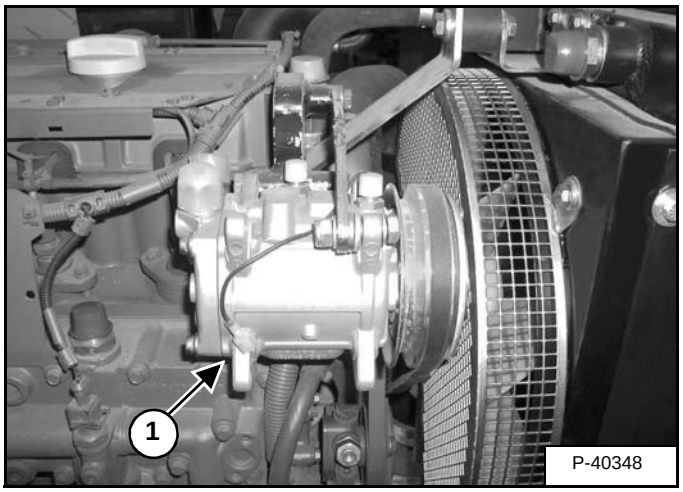
COMPONENTS (S/N 522311001 & ABOVE)

Identification

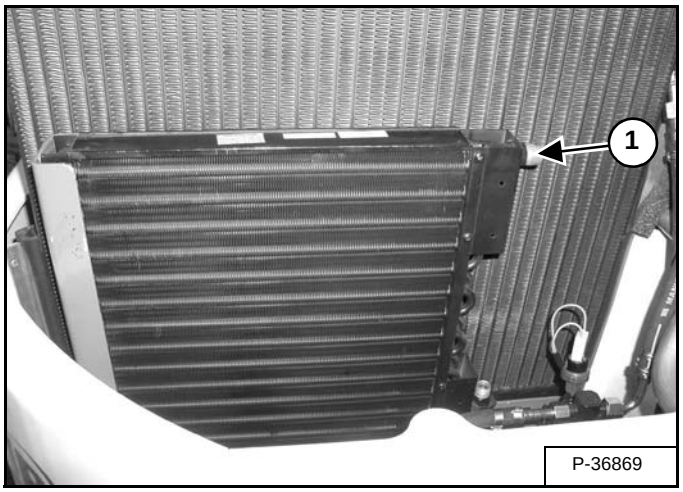
Figure 70-50-1



Compressor: The compressor (Item 1) **[Figure 70-50-1]** is the pump that circulates the refrigerant throughout the system. It raises the pressure of the refrigerant for heat transfer through the condenser and evaporator.

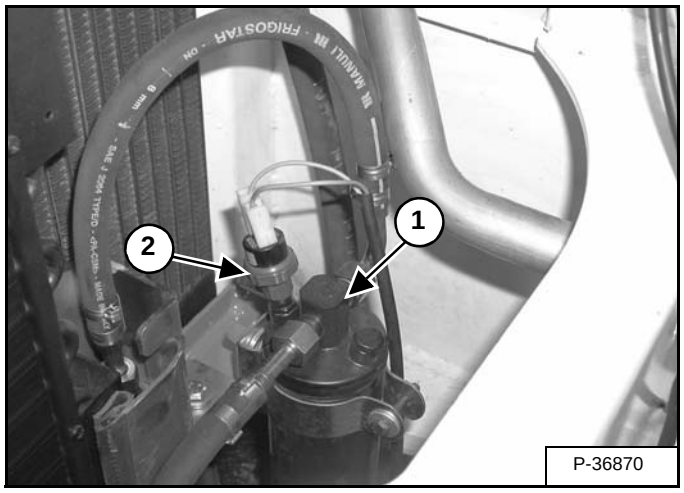
NOTE: The A/C system (compressor) is recommended to be turned on for at least five minutes weekly throughout the year to lubricate the internal components.

Figure 70-50-2



Condenser: The condenser (Item 1) **[Figure 70-50-2]** is the unit that receives the high pressure, high temperature refrigerant vapor from the compressor and condenses it into a high temperature liquid.

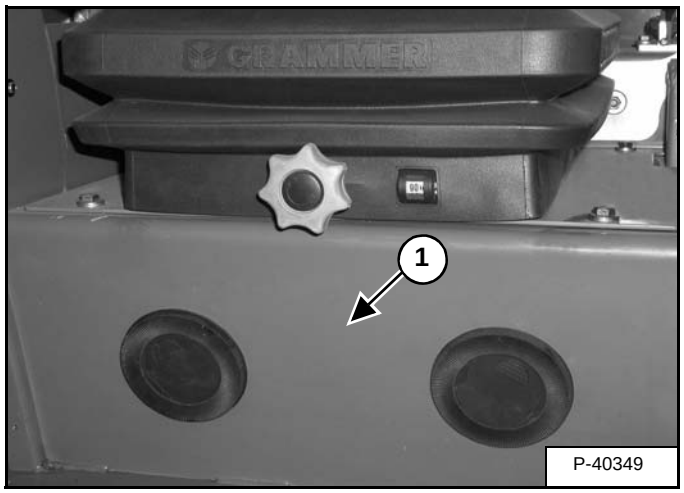
Figure 70-50-3



Receiver/Drier: The receiver/drier (Item 1) **[Figure 70-50-3]** is the unit that receives the liquid refrigerant from the condenser and removes moisture and foreign matter from the system. It also serves as a storage tank for the extra liquid refrigerant until it is needed by the evaporator.

Pressure Switch: The pressure switch (Item 2) **[Figure 70-50-3]** will disengage the compressor clutch at high pressure readings on the high side, or at low pressure on the high side, which indicates loss of refrigerant.

Figure 70-50-4



Heater/Evaporator Unit: The heater/evaporator unit (Item 1) **[Figure 70-50-4]** is located under the operator seat in the excavator cab. The unit delivers the cold air for the A/C and warm air for heat into the cab. The unit contains the blower, heat & A/C coils, thermostat and expansion valve.

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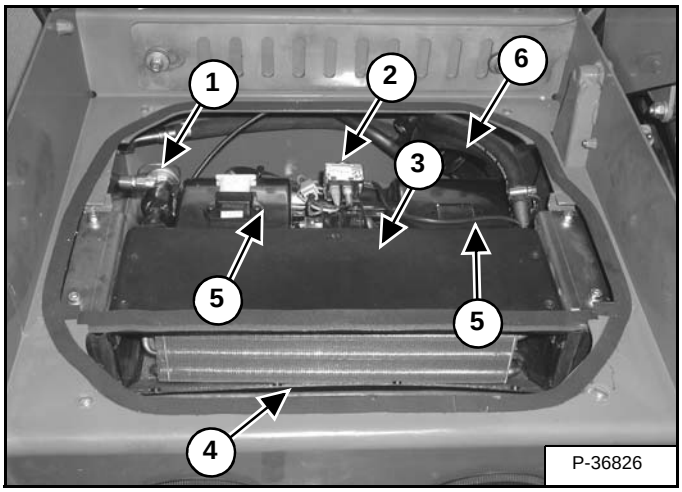
Identification (Cont'd)

Figure 70-50-5



Expansion Valve: The expansion valve (Item 1) **[Figure 70-50-5]** controls the amount of refrigerant entering the evaporator coil.

Thermostat: The thermostat (Item 2) **[Figure 70-50-5]** controls the temperature of the evaporator coil.

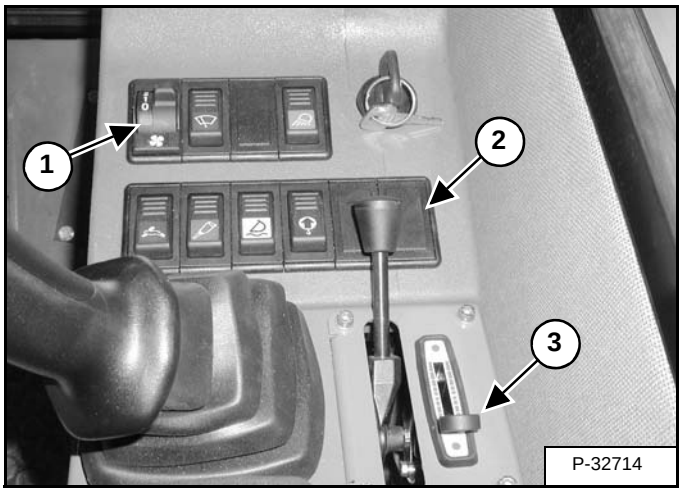
Heater Coil: The heater coil (Item 3) **[Figure 70-50-5]** supplies the warm air into the cab by passing air through the coil.

Evaporator Coil: The evaporator coil (Item 4) **[Figure 70-50-5]** cools and dehumidifies the air before it enters the cab.

Heater/Evaporator Blower: The blower (Item 5) **[Figure 70-50-5]** is used to push air through the heater and evaporator coils and into the cab.

Heater Valve: The heater valve (Item 6) **[Figure 70-50-5]** is used to control the amount of engine coolant that flows to the heater coil.

Figure 70-50-6



Fan Switch: This is a four position rotary switch (Item 1) **[Figure 70-50-6]**. When the fan switch is in the off position the A/C will not engage.

A/C Switch: The rocker switch (Item 2) **[Figure 70-50-6]** will be illuminated when the A/C is engaged.

Temperature Control Lever: Push the lever (Item 3) **[Figure 70-50-6]** forward to increase the cab temperature; backward to decrease temperature

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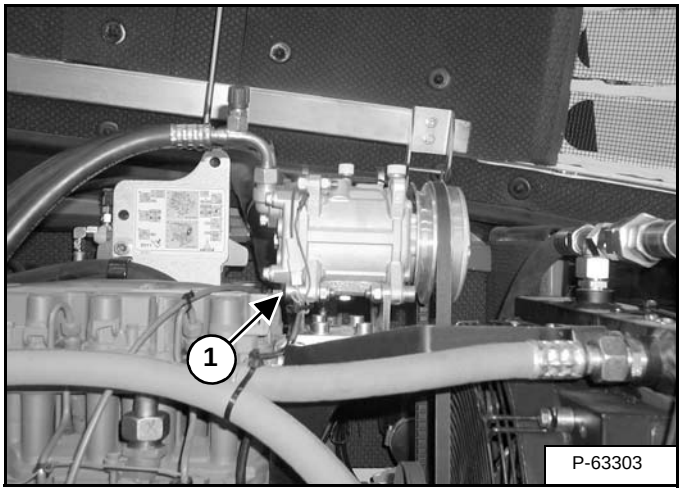
COMPONENTS (S/N 528911001 & ABOVE AND 52864001 & ABOVE)

Identification

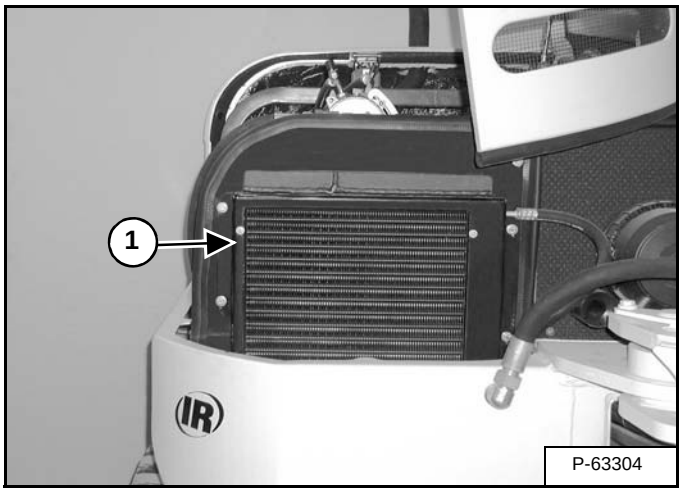
Figure 70-51-1



Compressor: The compressor (Item 1) **[Figure 70-51-1]** is the pump that circulates the refrigerant throughout the system. It raises the pressure of the refrigerant for heat transfer through the condenser and evaporator.

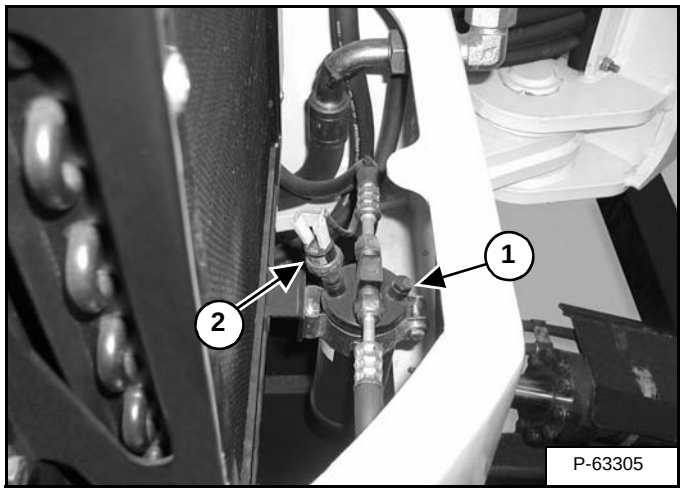
NOTE: The A/C system (compressor) is recommended to be turned on for at least five minutes weekly throughout the year to lubricate the internal components.

Figure 70-51-2



Condenser: The condenser (Item 1) **[Figure 70-51-2]** is the unit that receives the high pressure, high temperature refrigerant vapor from the compressor and condenses it into a high temperature liquid.

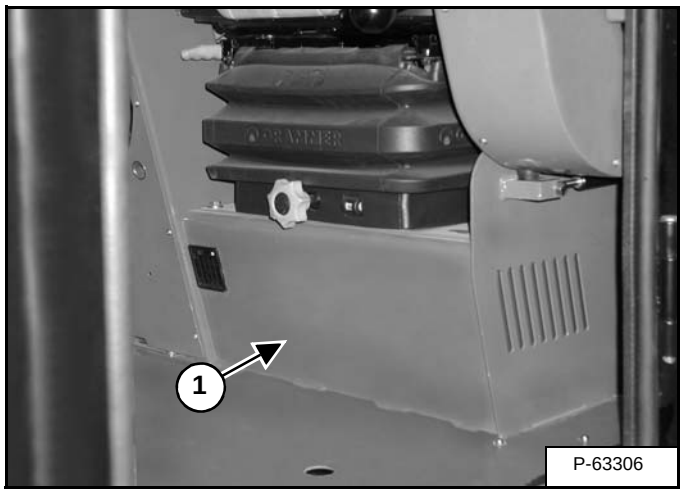
Figure 70-51-3



Receiver/Drier: The receiver/drier (Item 1) **[Figure 70-51-3]** is the unit that receives the liquid refrigerant from the condenser and removes moisture and foreign matter from the system. It also serves as a storage tank for the extra liquid refrigerant until it is needed by the evaporator.

Pressure Switch: The pressure switch (Item 2) **[Figure 70-51-3]** will disengage the compressor clutch at high pressure readings on the high side, or at low pressure on the high side, which indicates loss of refrigerant.

Figure 70-51-4



Heater Unit: The heater unit (Item 1) **[Figure 70-51-4]** is located under the operator seat in the excavator cab. The unit delivers warm air for heat into the cab. The unit contains the blower, heater coil and thermostat.

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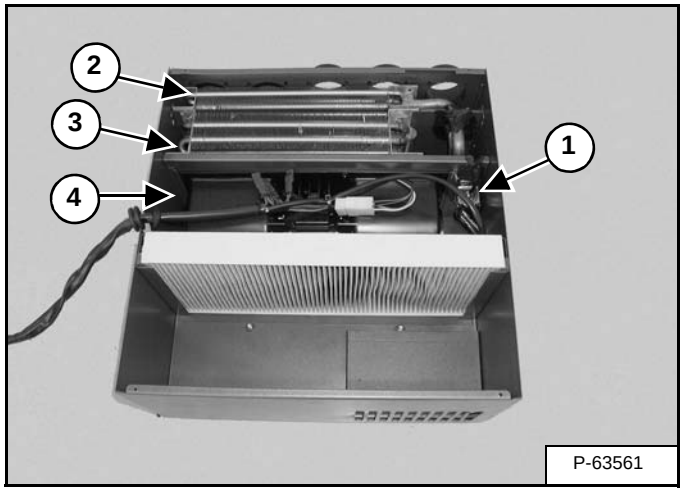
COMPONENTS (S/N 528911001 & ABOVE AND 52864001 & ABOVE)

Identification (Cont'd)

Figure 70-51-5



NOTE: The evaporator coil and thermostat are not used in this application. See Upgraded A/C system [Figure 70-51-8].

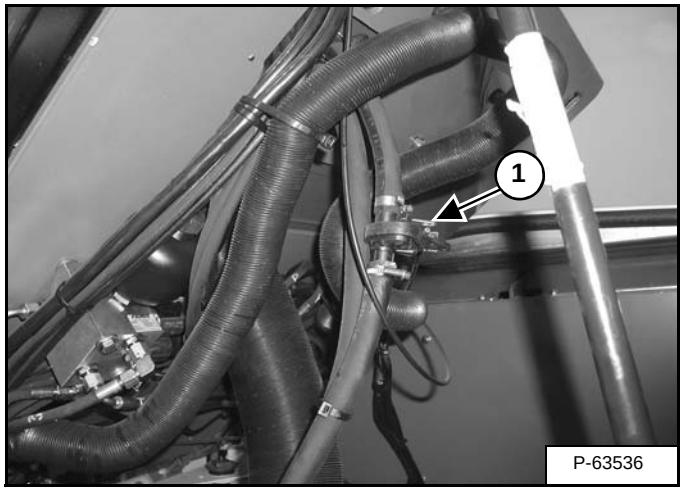
Thermostat: The thermostat (Item 1) **[Figure 70-51-5]** is not used in this application.

Heater Coil: The heater coil (Item 2) **[Figure 70-51-5]** supplies the warm air into the cab by passing air through the coil.

Evaporator Coil: The evaporator coil (Item 3) **[Figure 70-51-5]** is not used in this application.

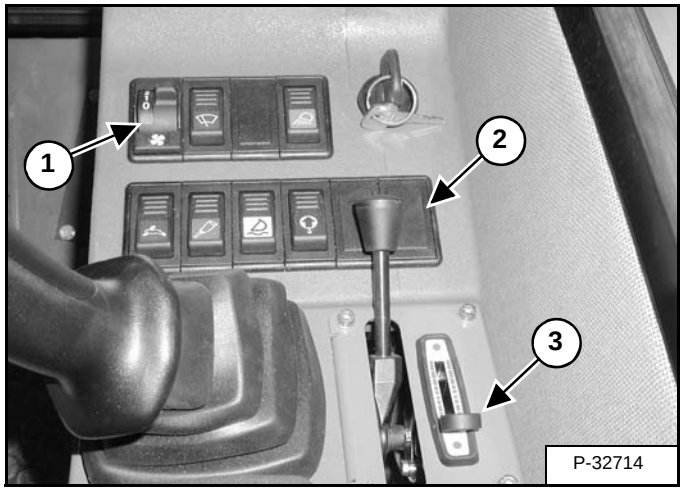
Heater/Evaporator Blower: The blower (Item 4) **[Figure 70-51-5]** is used to push air through the heater and evaporator coils and into the cab.

Figure 70-51-6



Heater Valve: The heater valve (Item 1) **[Figure 70-51-6]** is used to control the amount of engine coolant that flows to the heater coil.

Figure 70-51-7



Fan Switch: This is a four position rotary switch (Item 1) **[Figure 70-51-7]**. When the fan switch is in the off position the A/C will not engage.

A/C Switch: The rocker switch (Item 2) **[Figure 70-51-7]** will be illuminated when the A/C is engaged.

Temperature Control Lever: Push the lever (Item 3) **[Figure 70-51-7]** forward to increase the cab temperature; backward to decrease temperature

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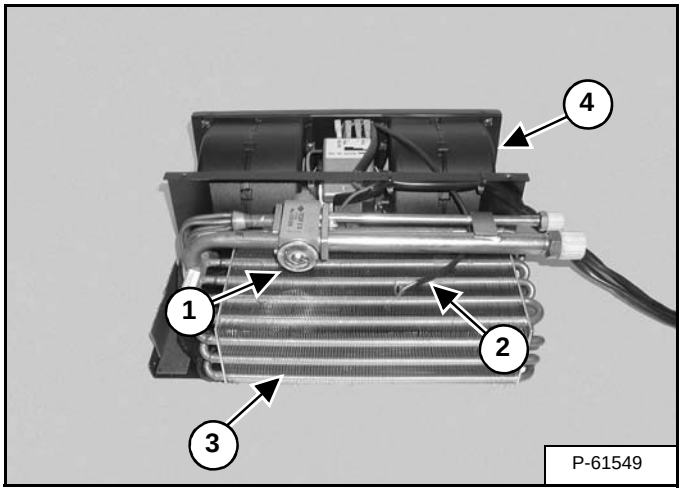
Identification (Cont'd)

Upgraded A/C System

Figure 70-51-8



Expansion Valve: The expansion valve (Item 1) **[Figure 70-51-8]** controls the amount of refrigerant entering the evaporator coil.

Thermostat: The thermostat (Item 2) **[Figure 70-51-8]** controls the temperature of the evaporator coil.

Evaporator Coil: The evaporator coil (Item 3) **[Figure 70-51-8]** cools and dehumidifies the air before it enters the cab.

Evaporator Blower: The blower (Item 4) **[Figure 70-51-8]** is used to push air through the evaporator coil and into the cab.

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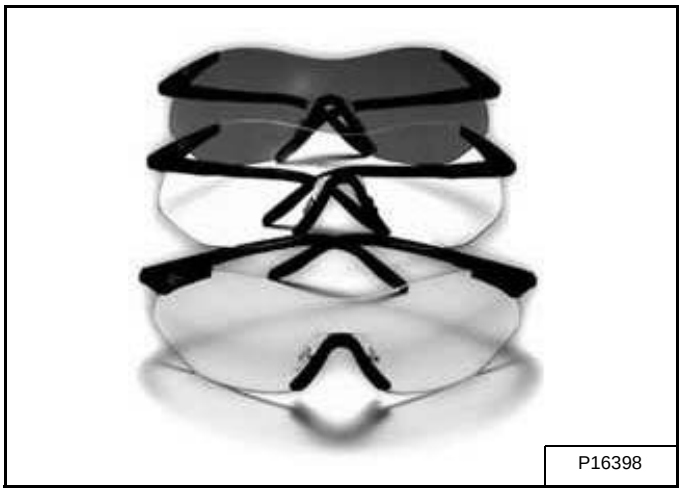
Safety Equipment

In servicing A/C and heater systems you will be exposed to high pressures, temperatures and several chemical hazards. Moving belts and pulleys are normal shop hazards.

Figure 70-60-1



In addition to exercising caution in your work, **DO WEAR SAFETY GLASSES OR A FACE SHIELD [Figure 70-60-1]** when you are using R-134a or a leak detector, adjusting service valves or the manifold gauge set connectors. Safety glasses or a transparent face shield are practical safety items and one or the other is absolutely required.

⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

Figure 70-60-2

R-134a inside a canister or in an A/C system is a liquid under pressure. When it escapes or releases into the air, **ITS TEMPERATURE DROPS TO 21.6 f DEGREES "INSTANTLY"**. If it spills on your skin or in your eyes you should flood the area with cool water and **SEEK MEDICAL ATTENTION FAST**! It is a good idea to wear gloves **[Figure 70-60-2]** to prevent frost bite if you should get refrigerant on your hands.

⚠ WARNING

HFC 134A refrigerant can be dangerous if not properly handled. Liquid 134A may cause blindness if it contacts the eyes and may cause serious frostbite if it contacts the skin.

- **Gaseous 134A becomes lethal (phosgene) gas when it contacts open flame or very hot substances.**
- **NEVER SMOKE when there is the possibility of even small amounts of 134A in the air.**

Any servicing work that involves release or addition of 134A to the system must be done by a competent refrigeration dealer who has the proper equipment, knowledge, and experience to service refrigeration equipment.

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Heater Air Filter

Remove the Heat/AC filter. (See FRESH AIR FILTER (S/N 522311001 & ABOVE) on Page 10-61-1 or See FRESH AIR FILTER (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 10-62-1.)

Clean the filter by shaking or using low air pressure.

Replace the filter two to four times per year under normal operating conditions, up to weekly under extremely dusty operating conditions.

Air Conditioning Compressor Belt

Open the tailgate.

Figure 70-70-3

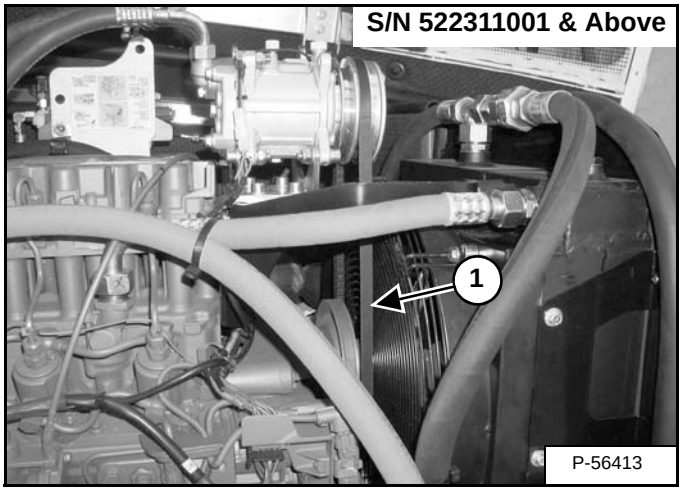
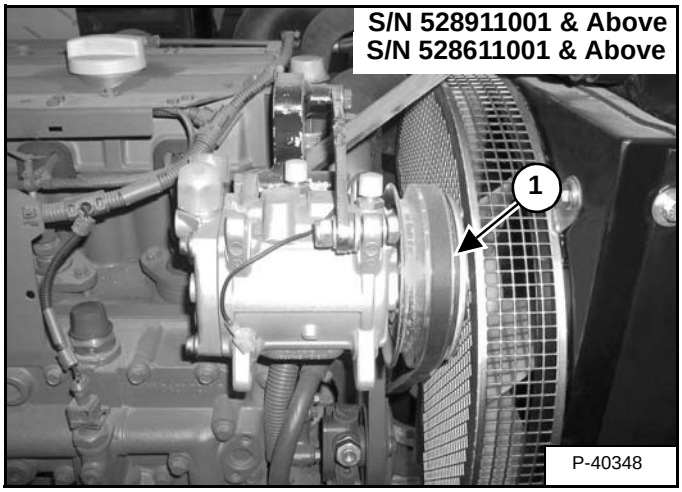


Figure 70-70-4



Check the condition of the belt (Item 1) **[Figure 70-70-3] [Figure 70-70-4]** and adjust as needed every 100 hours of operation. (See AIR CONDITIONING COMPRESSOR BELT (S/N 522311001 & ABOVE) on Page 10-150-1 or See AIR CONDITIONING COMPRESSOR BELT (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 10-151-1.)

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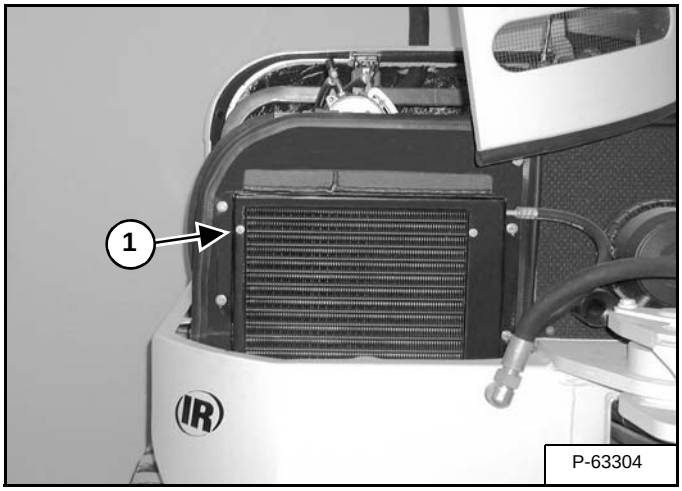
Cleaning The Condenser

Open the right side cover.

Figure 70-70-5



Check the condenser (Item 1) **[Figure 70-70-5]** for mud or dirt.

If the condensor needs to be cleaned, use low air pressure or water pressure to clean the condensor.

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BASIC TROUBLESHOOTING

Poor A/C Performance

Start the excavator. Engage the A/C system with the blower fan on high. Run the excavator at full RPM for approximately 15 minutes, with the cab door closed.

Figure 70-80-6

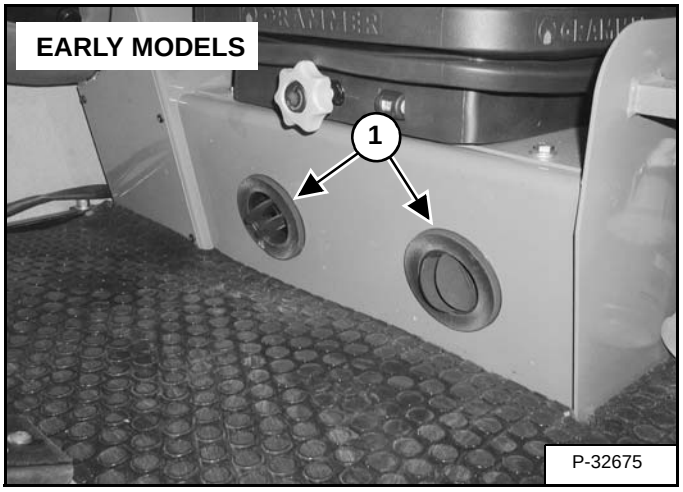


Figure 70-80-7

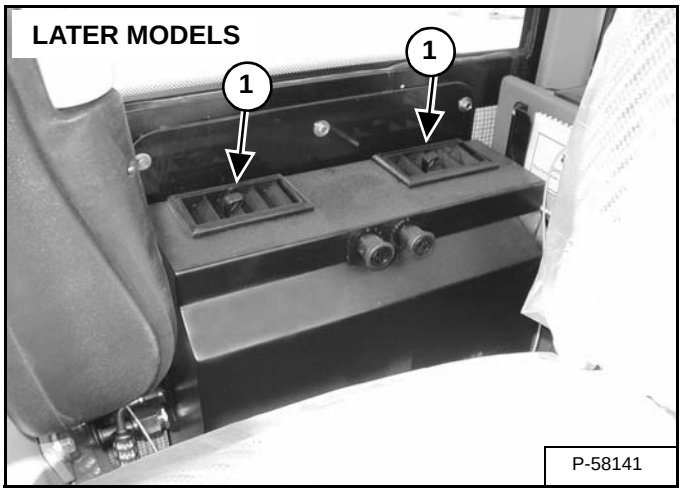
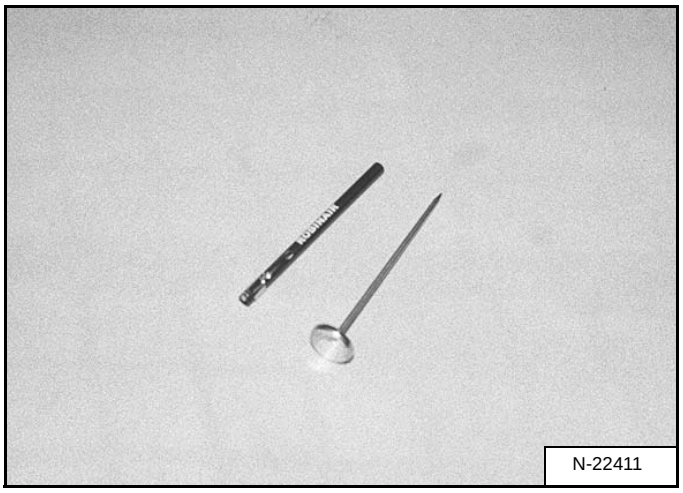


Figure 70-80-8



Check the temperature at the louvers (Item 1) **[Figure 70-80-6]** and **[Figure 70-80-7]** with a thermometer **[Figure 70-80-8]**.

The louver temperature should be between 36-53° F. (2,2 -11,6° C) depending on the amount of humidity in the air.

If louver temperature is too high see the System Troubleshooting Chart. ((See SYSTEM TROUBLESHOOTING CHART on Page 70-100-1.).)

Check the fan for proper operation or noise, and replace if necessary. ((See HEATER/AC FAN on Page 70-20-1.).)

Check the air conditioning compressor belt tension. ((See AIR CONDITIONING COMPRESSOR BELT (S/N 522311001 & ABOVE) on Page 10-150-1.) or (See AIR CONDITIONING COMPRESSOR BELT (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 10-151-1.).)

Check the A/C evaporator coil for dirt or mud, and clean if necessary. ((See Cleaning The A/C Evaporator Coil & Heater Coil (S/N 522311001 & Above) on Page 70-80-2.) or (See Cleaning The A/C Evaporator Coil And Heater Coil (S/N 528911001 & Above And 528611001 & Above) on Page 70-80-3.).)

Inspect the sight glass located on the receiver/drier for air bubbles. ((See COMPONENTS (S/N 522311001 & ABOVE) on Page 70-50-1.) or (See COMPONENTS (S/N 528911001 & ABOVE AND 52864001 & ABOVE) on Page 70-51-1.).)

Check the engine coolant to see if it is bypassing the heater valve. ((See Engine Coolant By-Passing The Heater Valve on Page 70-80-15.).)

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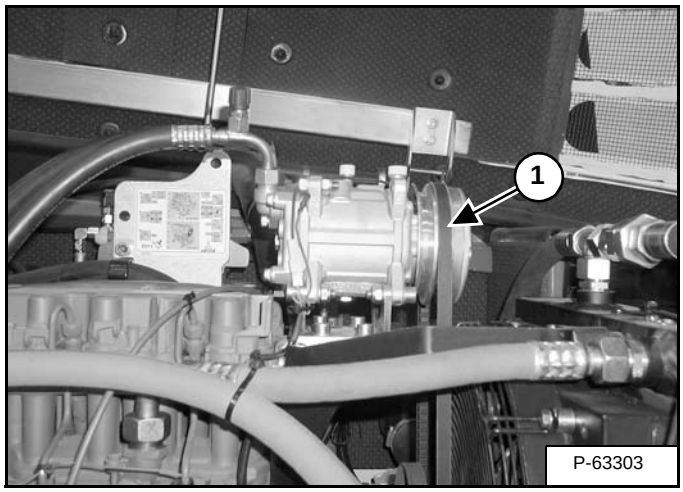
Compressor Drive Belt Inspection

Figure 70-80-9

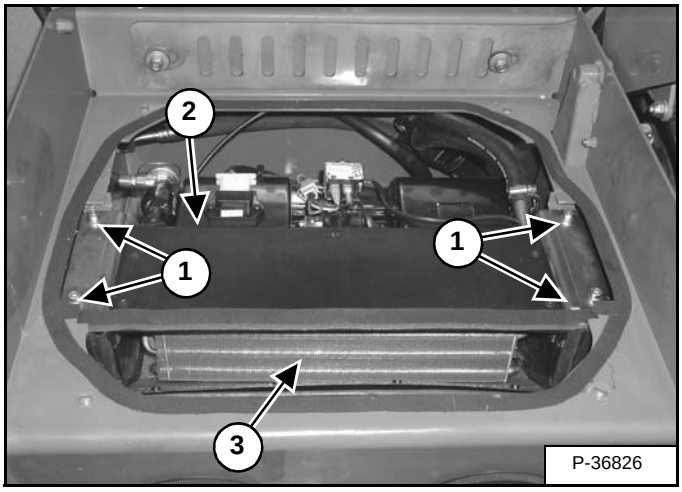


Inspect and adjust the compressor drive belt (Item 1) **[Figure 70-80-9]** every 100 hours of operation. ((See AIR CONDITIONING COMPRESSOR BELT (S/N 522311001 & ABOVE) on Page 10-150-1.) or (See AIR CONDITIONING COMPRESSOR BELT (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 10-151-1.).)

Cleaning The A/C Evaporator Coil & Heater Coil (S/N 522311001 & Above)

Remove the seat and seat mount. ((See SEAT AND SEAT MOUNT on Page 40-30-1.).)

Figure 70-80-10



Remove the bolts (Item 1) **[Figure 70-80-10]**.

Remove the cover (Item 2) **[Figure 70-80-10]**.

Clean the evaporator coil and heater coil (Item 3) **[Figure 70-80-10]** with low pressure air or water.

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Cleaning The A/C Evaporator Coil And Heater Coil (S/N 528911001 & Above And 528611001 & Above)

Early Models

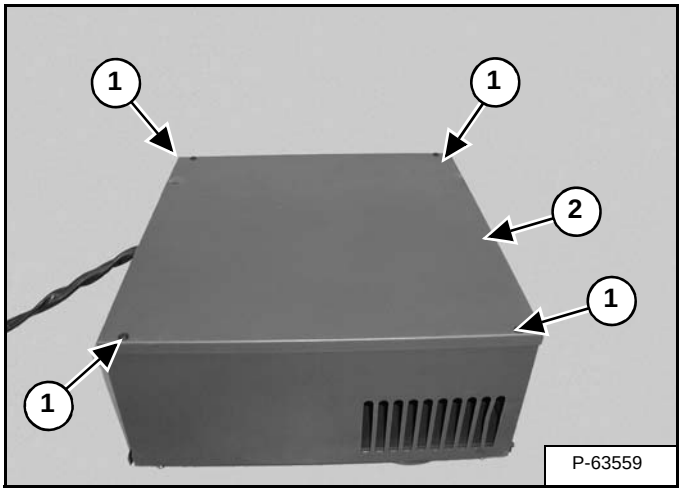
Remove the Evaporator/Heater Unit (S/N 528911001 & Above and 528611001 & Above). ((See EVAPORATOR/ HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) on Page 70-11-1.).)

Later Models

Remove the Upgraded Air Conditioning System. ((See UPGRADED AIR CONDITIONING SYSTEM on Page 70-210-1.).)

Evaporator/Heater Unit

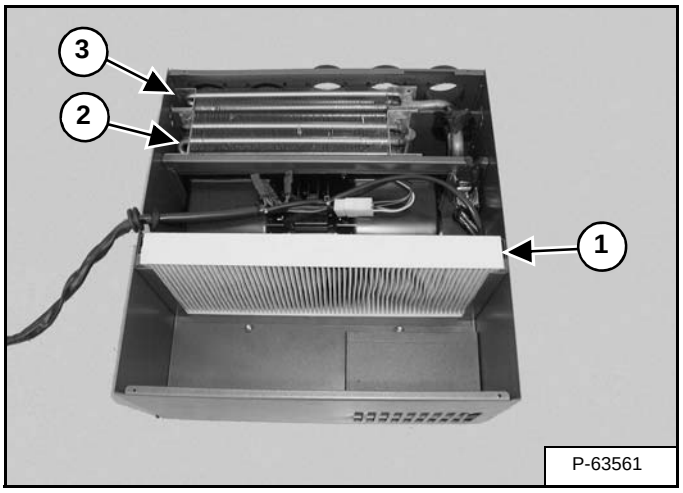
Figure 70-80-11



Remove the 4 screws (Item 1) from the cover (Item 2) **[Figure 70-80-11]**.

Remove the cover.

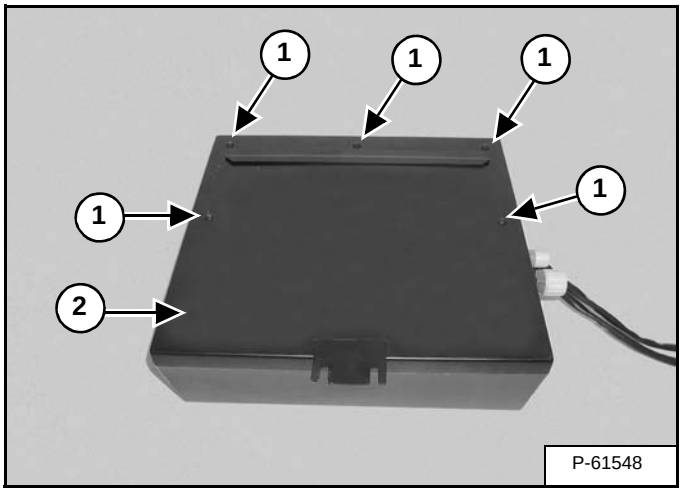
Figure 70-80-12



Remove the filter (Item 1) clean the evaporator coil (Item 2) and heater coil (Item 3) **[Figure 70-80-12]** with low pressure air or water.

Upgraded Air Conditioning System

Figure 70-80-13



Remove the 5 screws (Item 1) from the bottom plate (Item 2) **[Figure 70-80-13]**.

Remove the bottom plate.

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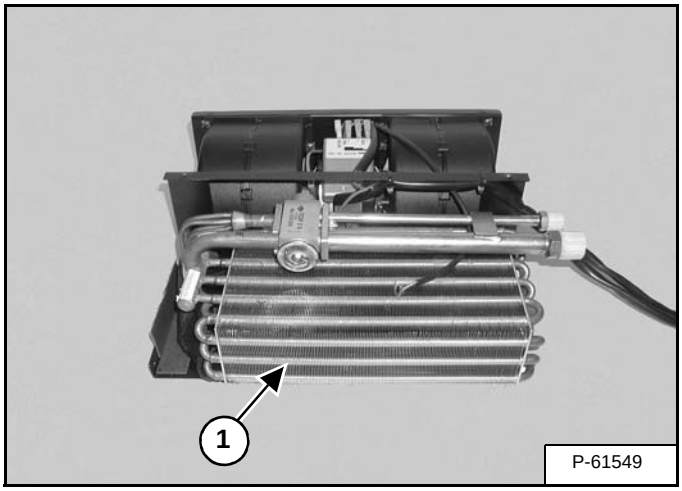
Cleaning The A/C Evaporator Coil And Heater Coil (S/N 528911001 & Above And 528611001 & Above) (Cont'd)

Figure 70-80-14



Clean the evaporator coil (Item 1) **[Figure 70-80-14]** with low pressure air or water.

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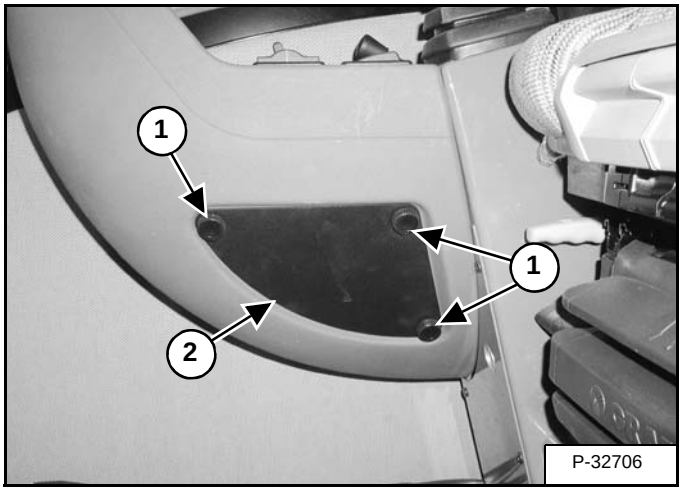
Checking The Electrical System

If the excavator A/C system, shows no blower motor function, no A/C switch light and no A/C compressor function. Do the following checks at the A/C relay.

Figure 70-80-15



The A/C relay is located in the right console. Remove the 3 screws (Item 1) and cover (Item 2) **[Figure 70-80-15]**.

Figure 70-80-16

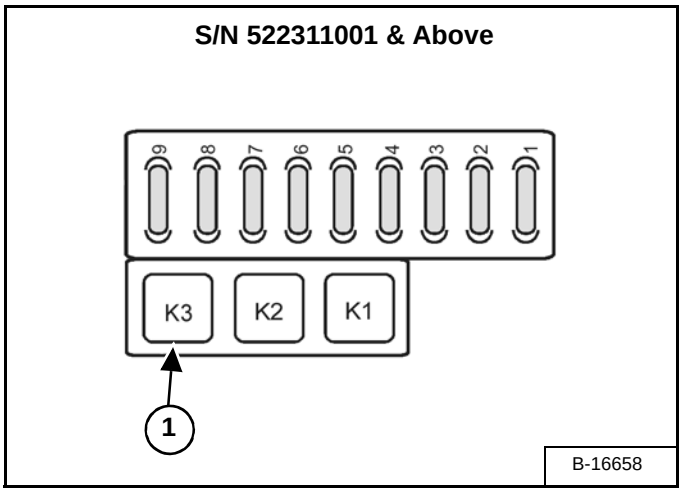
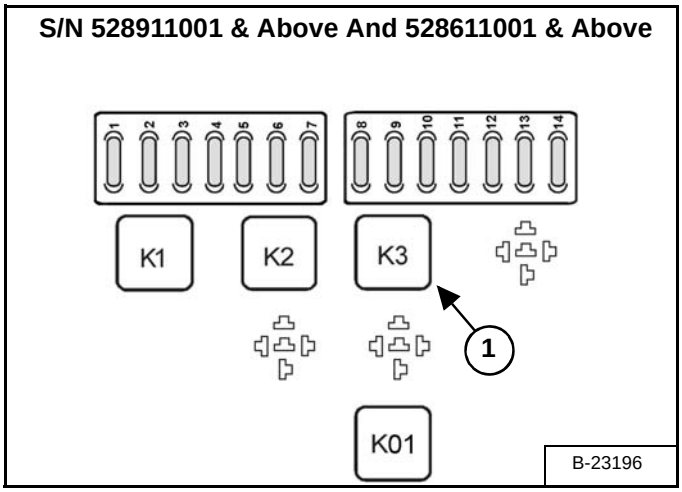


Figure 70-80-17



Remove the K3 relay (Item 1) **[Figure 70-80-16]** or **[Figure 70-80-17]**.

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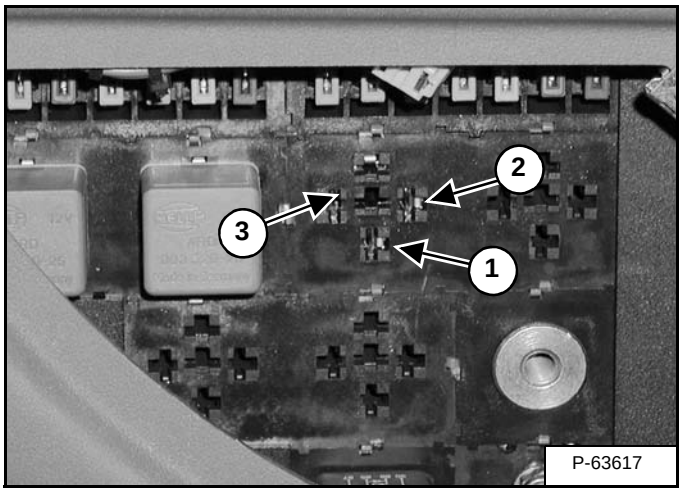
Checking The Electrical System (Cont'd)

Figure 70-80-18



With a multimeter, check the voltage at the excavator A/C relay connector terminals **[Figure 70-80-18]**.

The voltage at Pin 30 (Item 1) **[Figure 70-80-18]** (Yellow Wire) should be 12 volts at all times.

If there is no voltage check the fuse #F8, at the fuse box. (See **[Figure 70-80-16 on Page 5]** or **[Figure 70-80-17 on Page 5]**.

If the fuse is OK, refer to the electrical diagram to trace the yellow wire to its source.

The voltage at pin 85 (Item 2) **[Figure 70-80-18]** (Brown Wire) should be 12 volts when the ignition key is in the ON position.

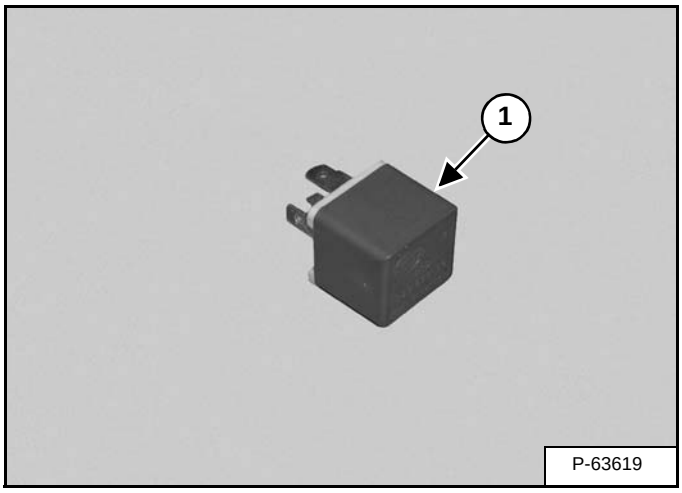
If there is no voltage check the fuse #FA at the fuse box. (See **[Figure 70-80-24 on Page 8]**)

If the fuse is OK, refer to the electrical diagram to trace the brown wire to its source.

Pin 86 (Item 3) **[Figure 70-80-18]** (Green Wire) is the ground wire. Check for continuity at Pin 86 to ground.

If there is no continuity trace the green wire to its source using the electrical diagram.

Figure 70-80-19



If the above voltages and continuity checks are OK, but the problem still persists, replace the A/C relay (Item 1) **[Figure 70-80-19]**.

Check to see if the compressor clutch is engaging.

With a person in the operator seat and the cab door open, turn the key switch to RUN, without starting the excavator.

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Checking The Electrical System (Cont'd)

Figure 70-80-20

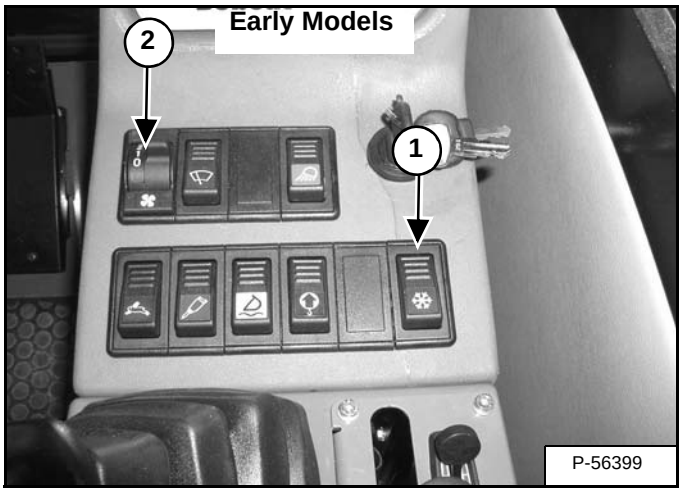
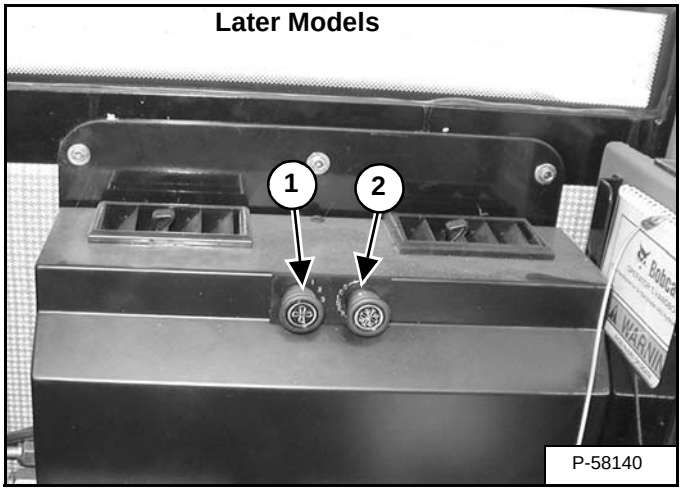


Figure 70-80-21



Push the A/C switch (Item 1) **[Figure 70-80-20]** or **[Figure 70-80-21]** to the ON position.

Turn the blower fan switch (Item 2) **[Figure 70-80-20]** or **[Figure 70-80-21]** to the first ON position.

The compressor clutch should make a *click* sound, which indicates the clutch is engaging.

Figure 70-80-22

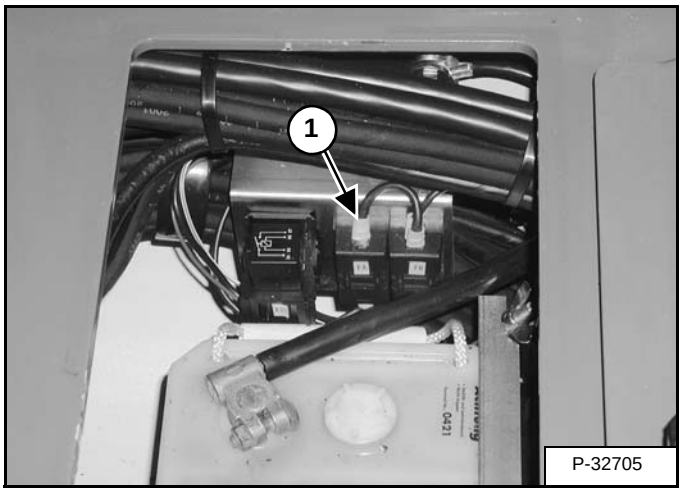
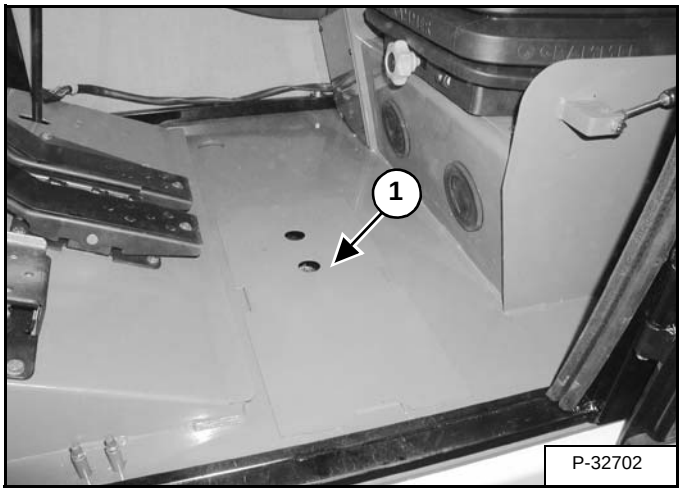


Figure 70-80-23



If the compressor clutch does not engage, check the main fuse (Item 1) **[Figure 70-80-22]** located under the battery compartment cover (Item 1) **[Figure 70-80-23]**.

Replace the fuse if burned out.

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Checking The Electrical System (Cont'd)

Figure 70-80-24

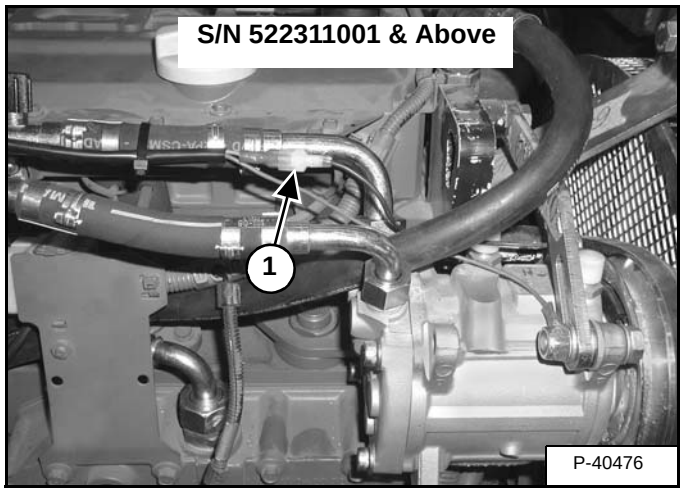
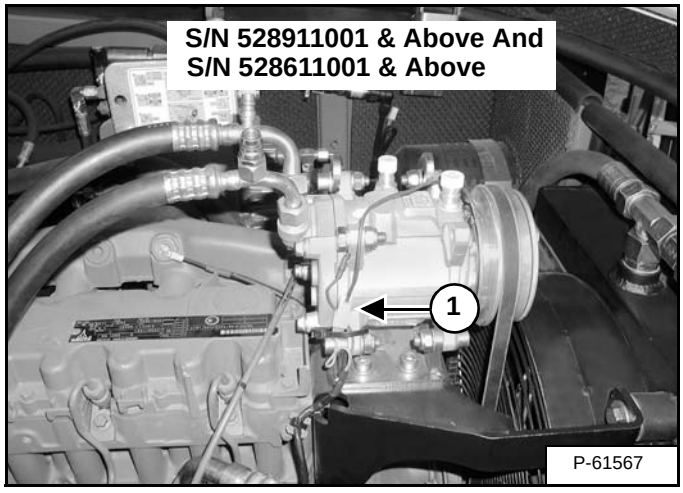
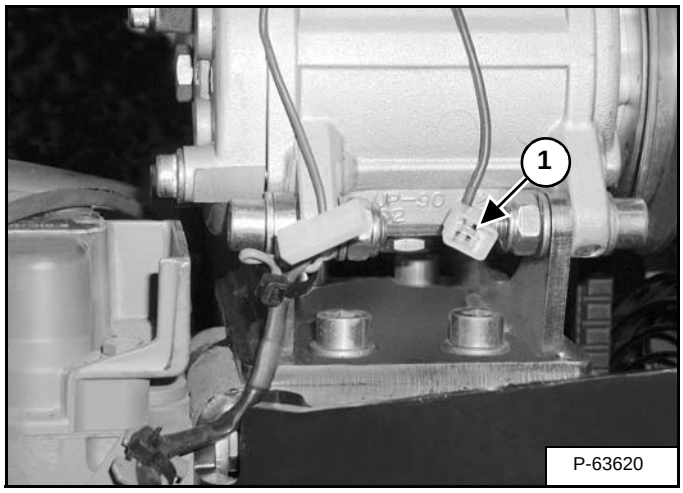


Figure 70-80-25



If the fuses are good, disconnect the wire harness (Item 1) **[Figure 70-80-24]** or **[Figure 70-80-25]** from the compressor clutch wire.

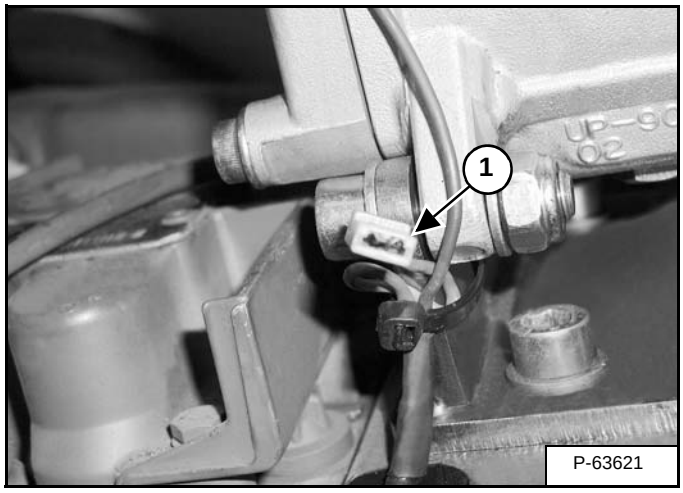
Figure 70-80-26



With a multimeter, check the resistance to the compressor clutch (Item 1) **[Figure 70-80-26]**.

If there is no resistance value, replace the compressor clutch. ((See COMPRESSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 70-141-1.).)

Figure 70-80-27



With a multimeter, check the voltage to the compressor clutch at the wire harness (Item 1) **[Figure 70-80-27]**.

If the voltage reading is approximately 12 volts, the system is operating correctly.

If there is no power at the clutch, reconnect the wiring harness to the compressor clutch.

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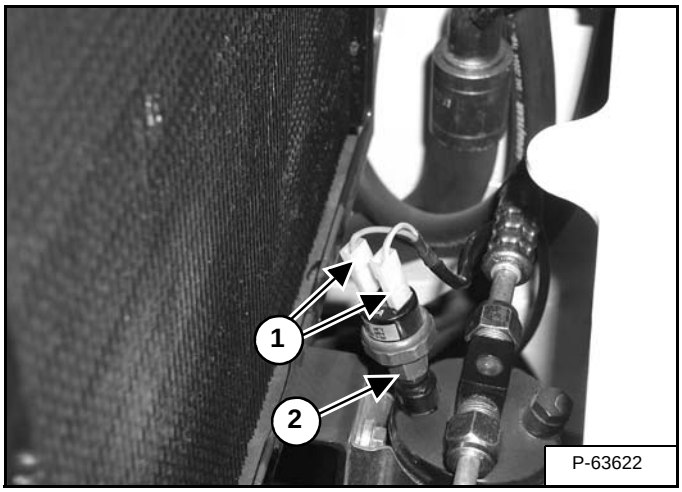
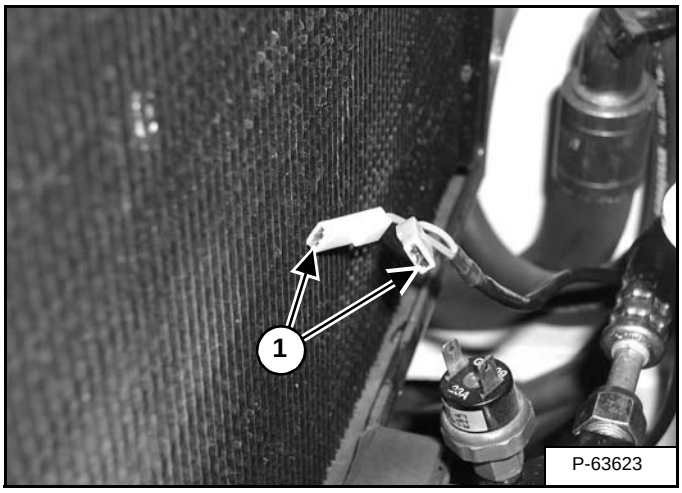
Checking The Electrical System (Cont'd)

Figure 70-80-28



Disconnect the wire harness (Item 1) from the pressure switch (Item 2) **[Figure 70-80-28]**.

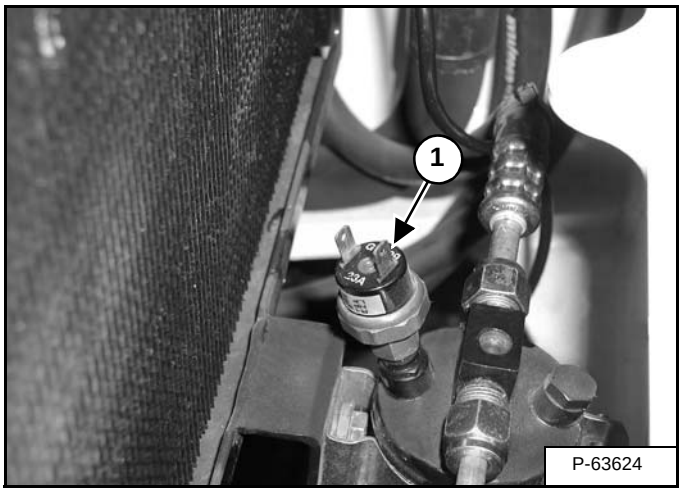
Figure 70-80-29



Using a multimeter check the wiring harness (Item 1) **[Figure 70-80-29]** for voltage.

The voltage should be approximately 12 volts.

Figure 70-80-30



If there is voltage at the harness, check the resistance at the pressure switch (Item 1) **[Figure 70-80-30]**.

If there is no resistance value, check for low or high refrigerant levels in the system. (See Gauge Pressure Related Troubleshooting on Page 70-100-2.)

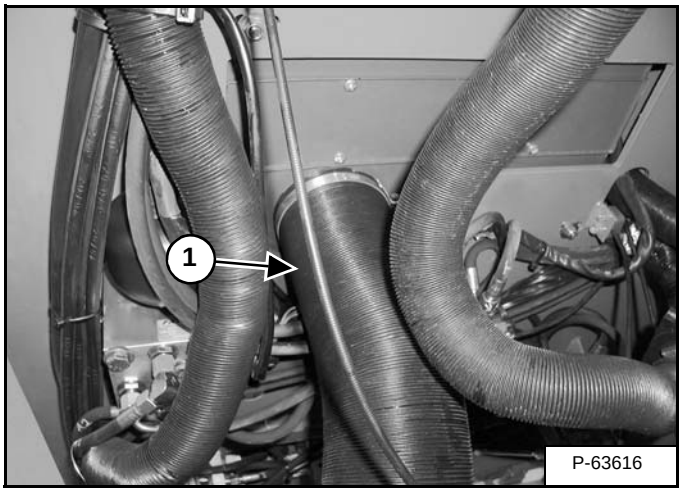
If a resistance value is observed, the pressure switch is good.

If there is no voltage at the wiring harness check the harness for broken wires. If there are no broken wires, reconnect the wire harness to the pressure switch.

Early Models

Tilt the cab. ((See Tilting The Cab on Page 10-160-2.).)

Figure 70-80-31



Remove the hose (Item 1) **[Figure 70-80-31]**.

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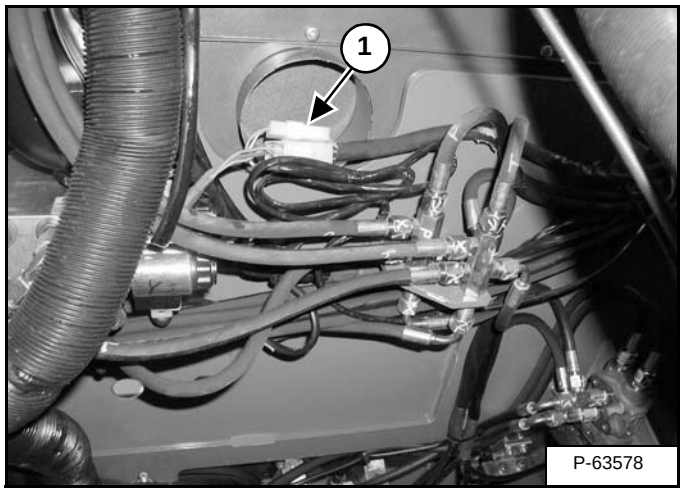
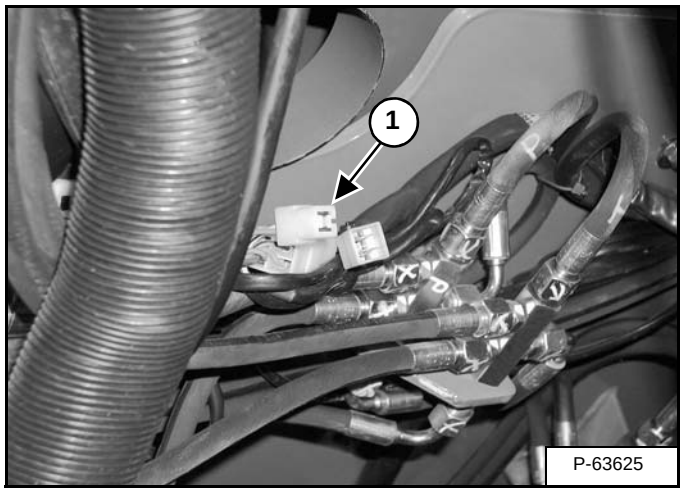
Checking The Electrical System (Cont'd)

Figure 70-80-32



Disconnect the thermostat/blower fan wire harness (Item 1) **[Figure 70-80-32]**.

Figure 70-80-33

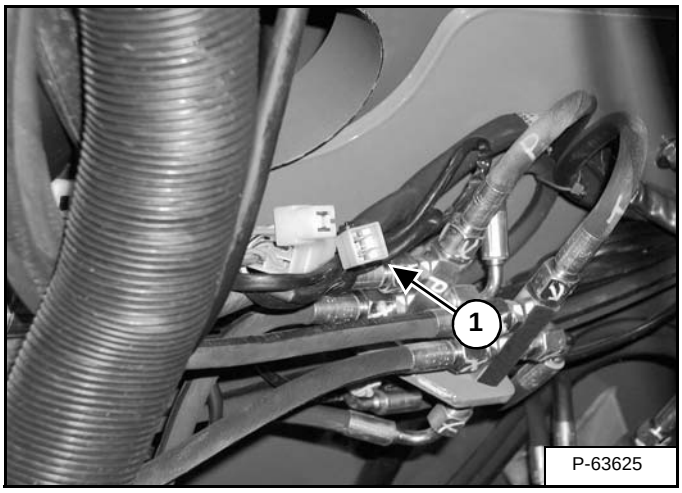


Check the wire harness (Item 1) **[Figure 70-80-33]** for voltage. The voltage should be approximately 12 volts, from Pin A4 (yellow wire) to ground.

If there is no voltage at the wiring harness, check the harness for broken wires.

If there is voltage at the wiring harness, check the thermostat for resistance.

Figure 70-80-34



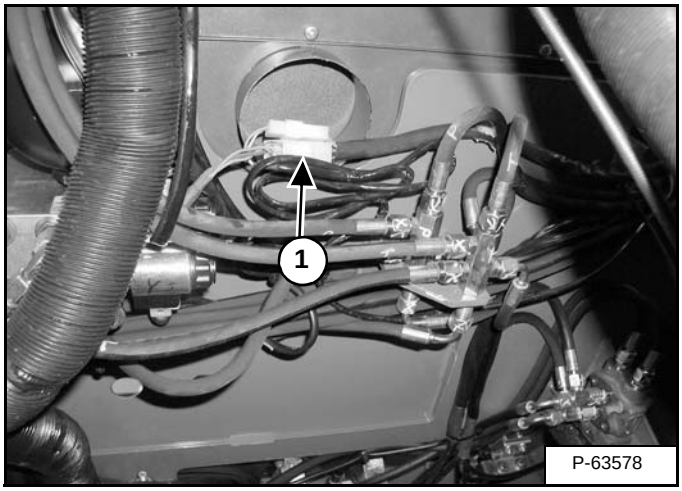
The resistance value of the thermostat should be 10 Ohms at 68° F (20° C), between Pin 8 & Pin 9 on the electrical connector (Item 1) **[Figure 70-80-34]**. (Between the yellow wire and green wire)

If there is no resistance value, replace the thermostat. ((See THERMOSTAT on Page 70-190-1.).)

If there is no voltage at the wiring harness check the harness for broken wires.

If there are no broken wires use the following procedure to check the blower fan and switch.

Figure 70-80-35



Disconnect the wire harness (Item 1) **[Figure 70-80-35]**.

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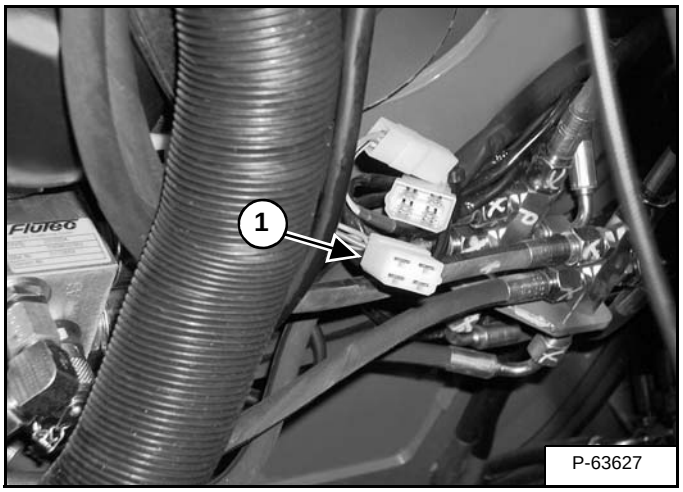
Checking The Electrical System (Cont'd)

Figure 70-80-36



Check the wire harness (Item 1) **[Figure 70-80-36]** for voltage to the blower fan.

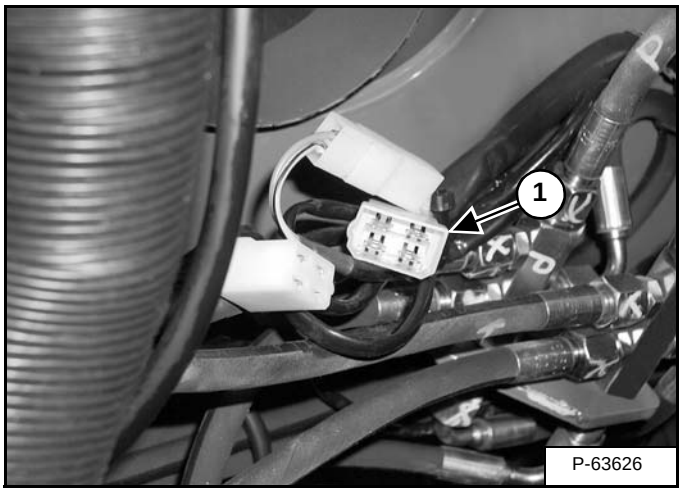
In the cab, place the blower switch in position 1. Check for voltage at the harness connector (Item 1) **[Figure 70-80-36]**, Pin 10. (Green/blue wire). The voltage should be 12 volts.

In the cab, place the blower switch in position 2. Check for voltage at the harness connector (Item 1) **[Figure 70-80-36]**, Pin 9. (green/gray wire). The voltage should be 12 volts.

In the cab, place the blower switch in position 3. Check for voltage at the harness connector (Item 1) **[Figure 70-80-36]**, Pin 8. (Green/black wire). The voltage should be 12 volts.

If there is no voltage at the wiring harness, check the harness for broken wires.

Figure 70-80-37



If there is voltage at the wiring harness, check the resistance to the blower fan at the thermostat/blower fan wiring connector (Item 1) **[Figure 70-80-37]**.

Check the resistance between Pin 2 (brown wire) and Pin 10 (blue wire).

Check the resistance between Pin 2 (brown wire) and Pin 9 (black wire).

Check the resistance between Pin 2 (brown wire) and Pin 8 (red wire).

If there is no resistance value at any of these pins, replace the blower fan. ((See HEATER/AC FAN on Page 70-20-1.).)

If there is resistance value at any of the pins, check the climate controls at the control panel inside the excavator cab.

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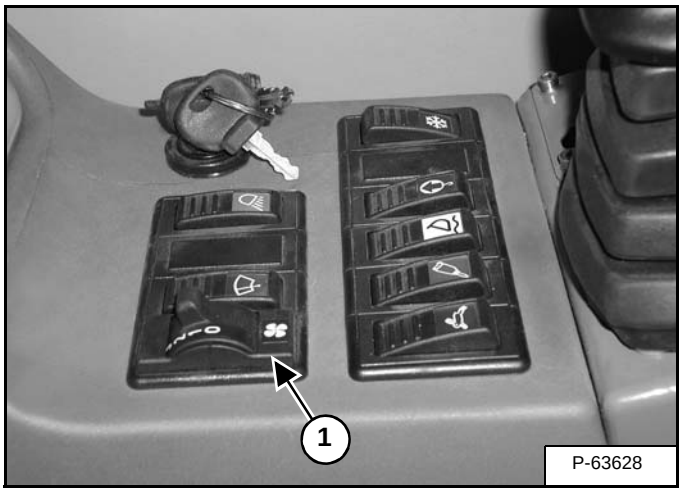
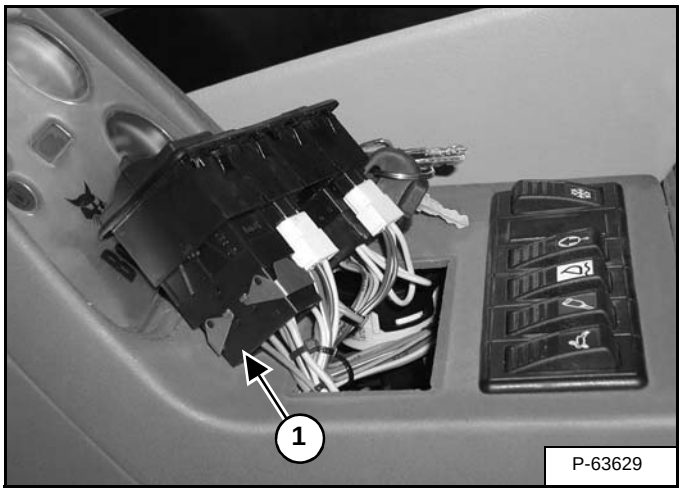
Checking The Electrical System (Cont'd)

Figure 70-80-38



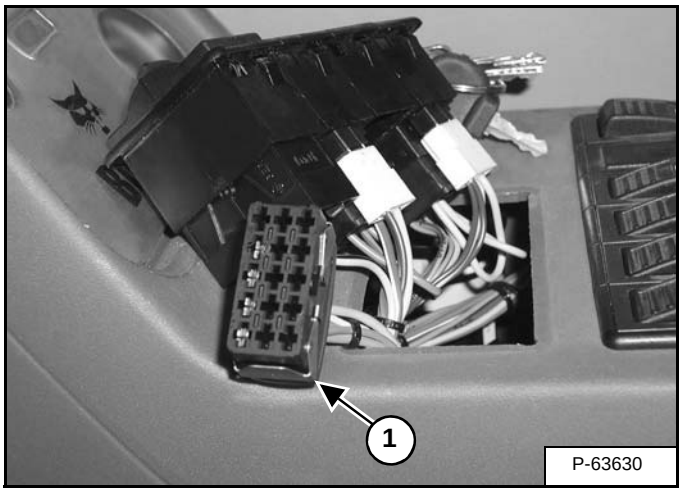
Remove the switch panel (Item 1) **[Figure 70-80-38]**.

Figure 70-80-39



Remove the wiring harness (Item 1) **[Figure 70-80-39]**.

Figure 70-80-40



Check the harness (Item 1) **[Figure 70-80-40]** for voltage. The voltage should be approximately 12 volts.

If there is no voltage at the wiring harness, check the harness for broken wires.

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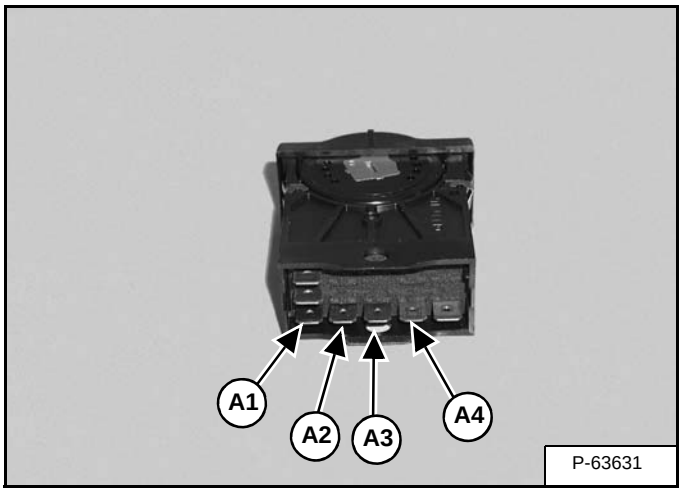
Checking The Electrical System (Cont'd)

Figure 70-80-41



If there is voltage at the wiring harness, check the blower switch **[Figure 70-80-41]** for resistance.

With the switch in the OFF position, there should be zero resistance between all terminals.

With the switch in the **1** position, there should be resistance between **A4** terminal and the **A3** terminal **[Figure 70-80-41]**.

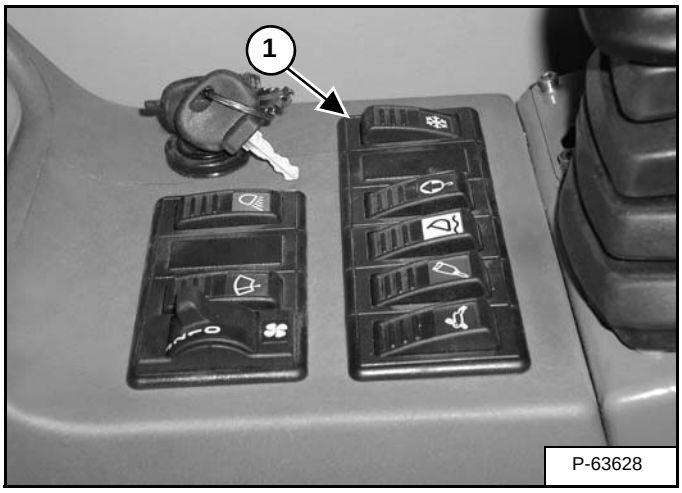
With the switch in the **2** position, there should be resistance between **A4** terminal and the **A2** terminal **[Figure 70-80-41]**.

With the switch in the **3** position, there should be resistance between **A4** terminal and the **A1** terminal **[Figure 70-80-41]**.

If any of the above resistance tests fail, replace the blower switch.

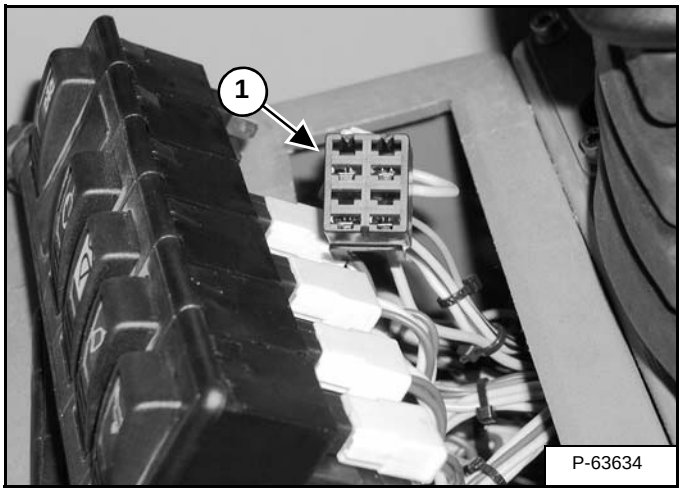
If the above resistance tests are good, check the A/C switch.

Figure 70-80-42



Remove the switch panel (Item 1) **[Figure 70-80-42]**.

Figure 70-80-43



At the excavator cab, disconnect the wire harness (Item 1) **[Figure 70-80-43]** from the A/C switch.

Check the harness for voltage. The voltage should be approximately 12 volts.

If there is no voltage at the wiring harness, check the harness for broken wires.

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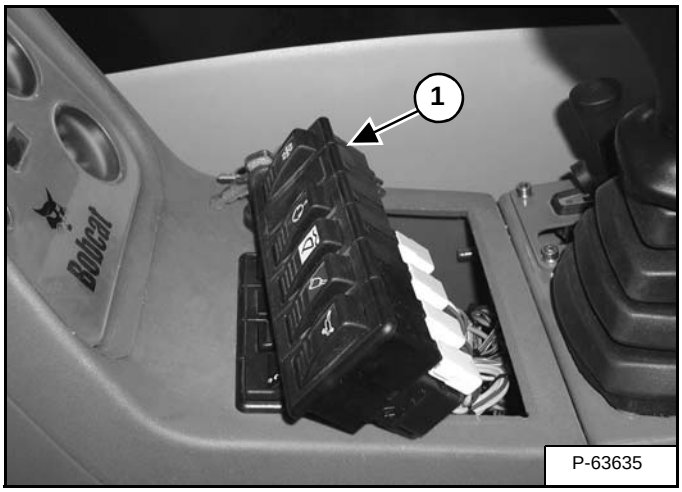
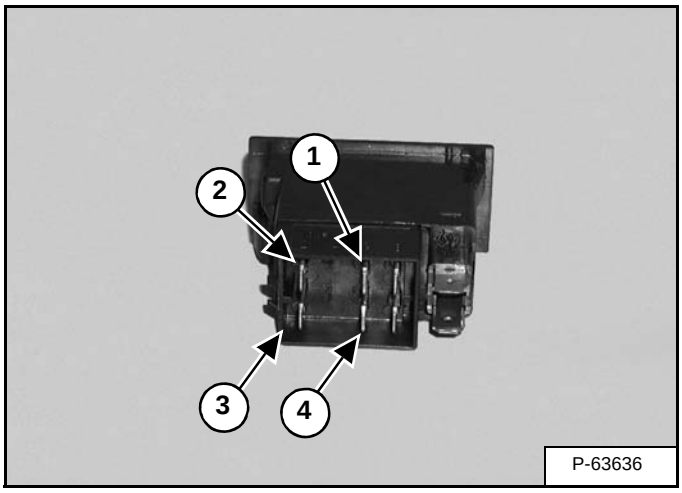
Checking The Electrical System (Cont'd)

Figure 70-80-44



Remove the switch (Item 1) **[Figure 70-80-44]**.

Figure 70-80-45



If there is voltage at the wiring harness, check the A/C switch **[Figure 70-80-45]** for resistance.

With the switch in the OFF position there should be no resistance between any of the 4 terminals (Item 1, 2, 3, 4) **[Figure 70-80-45]** on the A/C switch.

With the switch in the ON position there should be resistance between terminal (Item 1) and terminal (Item 2) **[Figure 70-80-45]**.

If no resistance value is found, replace the A/C switch.

Check the resistance between the wire terminal **C** and wire terminal **B** frame **[Figure 70-80-45]** should be approximately 39K Ohm's.

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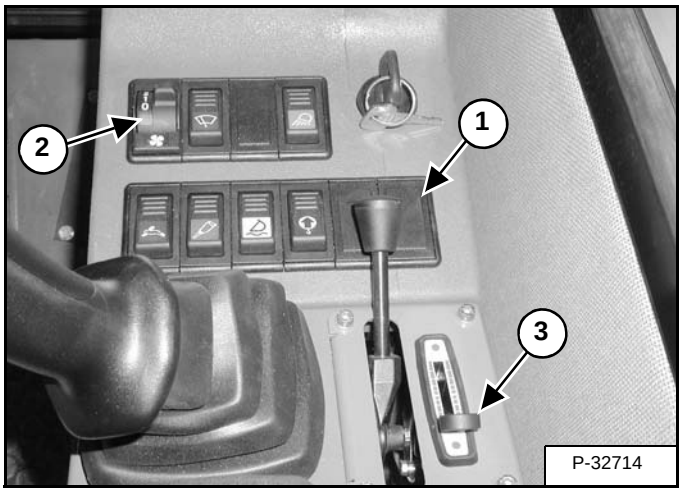
Engine Coolant By-Passing The Heater Valve

Figure 70-80-46



Push the A/C switch (Item 1) to the OFF position. Turn the fan switch (Item 2) to the High Speed position., Turn the temperature control (Item 3) **[Figure 70-80-46]** to the High A/C position, with the key switch OFF.

Start the excavator and run at high idle, for ten minutes.

Figure 70-80-47

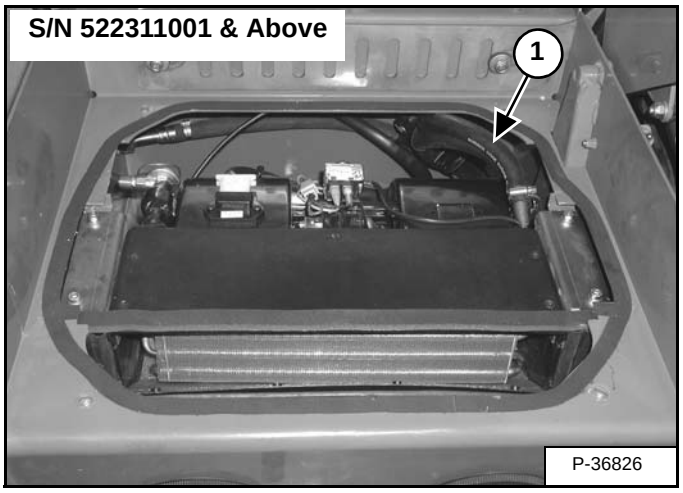
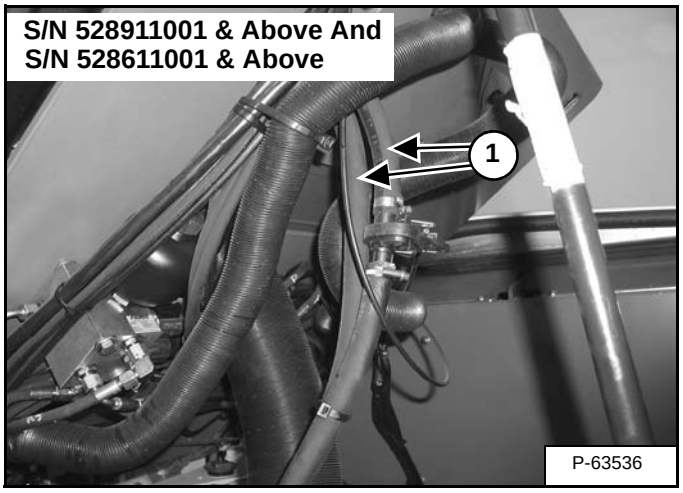


Figure 70-80-48



Check the temperature of the heater hoses (Item 1) **[Figure 70-80-47]** or **[Figure 70-80-48]**.

If the hoses are hot, the heater valve is leaking internally, and needs to be replaced.

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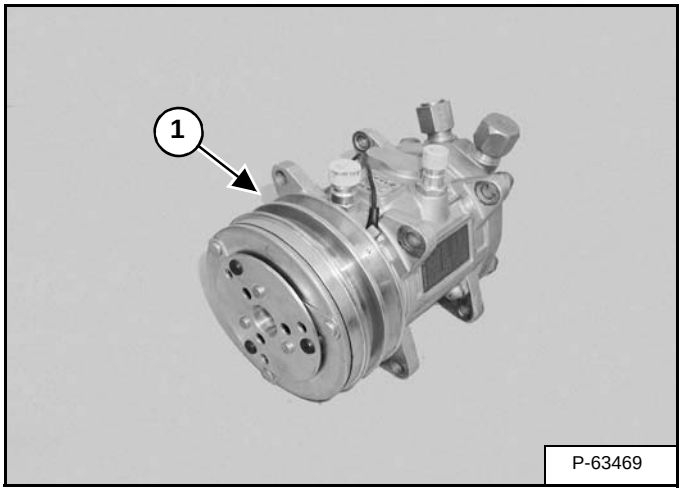
GENERAL AIR CONDITIONING SERVICE GUIDELINES

Compressor Oil

Figure 70-90-49



The compressor (Item 1) **[Figure 70-90-49]** is factory filled with **150-170 cc's** of PAG oil (Poly Alkelene Glycol).

Unlike engine oil, it is not necessary to frequently check or change the compressor oil.

It is necessary to check, replenish or replace the compressor oil in the following cases:

1. When the evaporator, condenser or receiver-drier is replaced.

2. When refrigerant has leaked from the system.

3. When refrigerant is suddenly released from the cooling cycle.

4. When any oil related problems occur in the cooling cycle.

When one of the components (the evaporator, condenser or receiver-drier) is replaced, **one ounce** (30 cc) of PAG oil should be added for each component replaced.

If the A/C compressor is changed, no oil should be added to the system, because the compressor comes factory filled with oil.

NOTE: Only PAG oil should be used. Never mix R-12 and R-134a Oils.

Compressor Oil Check

The compressor oil should be checked as follows when oil is being added to an in service excavator.

There is a close affinity between oil and refrigerant. During normal operation, part of the oil circulates with the refrigerant in the system. Therefore, when checking the amount of oil in the system or replacing any system component, the compressor must be run in advance to insure return of oil to the compressor.

If the amount of refrigerant in the system has decreased, charge the system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

Open the cab door and windows.

Run the blower at maximum speed.

Run the compressor for at least 20 minutes at 800-1200 RPM.

Remove the compressor. (See COMPRESSOR (S/N 522311001 & ABOVE) on Page 70-140-1 or See COMPRESSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE) on Page 70-141-1.)

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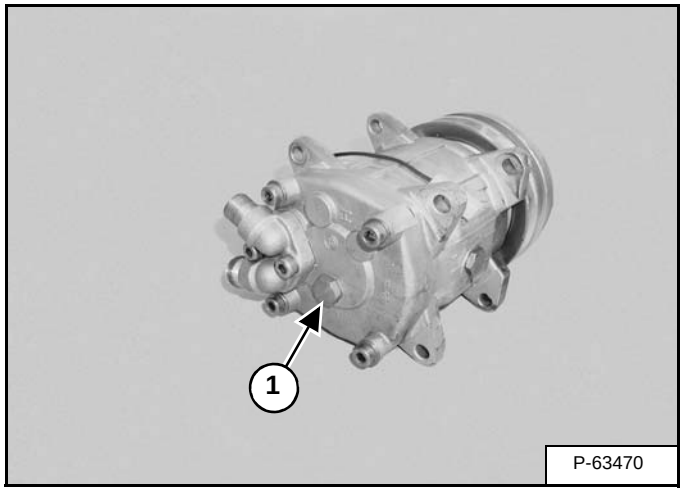
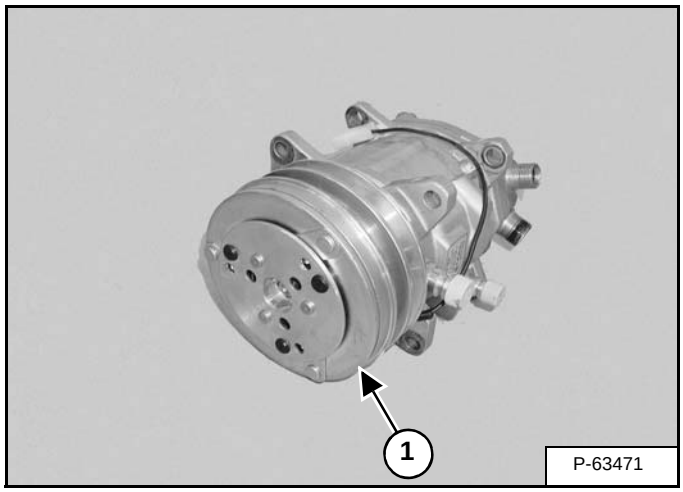
Compressor Oil Check (Cont'd)

Figure 70-90-50



Remove the oil drain plug (Item 1) **[Figure 70-90-50]** and drain the oil through the connectors and the oil drain hole.

Figure 70-90-51



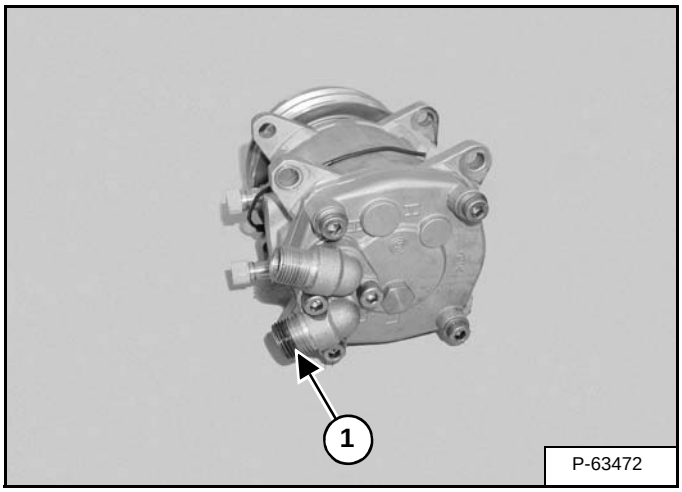
NOTE: After draining the oil through the drain hole and the connectors, extract the remaining oil through the discharge-side connector by rotating the drive pulley (Item 1) [Figure 70-90-51] several times by hand.

Measure the drained oil in a measuring cylinder.

Check the oil for contamination, dirt, metal shavings, or varnish color, discard the oil if contaminated.

NOTE: If metal shavings are found in the compressor oil, replace the complete compressor assembly.

Figure 70-90-52



Add new compressor oil through the suction side connector (Item 1) **[Figure 70-90-52]**.

Installation: **Add 150 -170 cc's of PAG oil**.

NOTE: The suction port on the compressor is marked with an L and is the larger port on the compressor.

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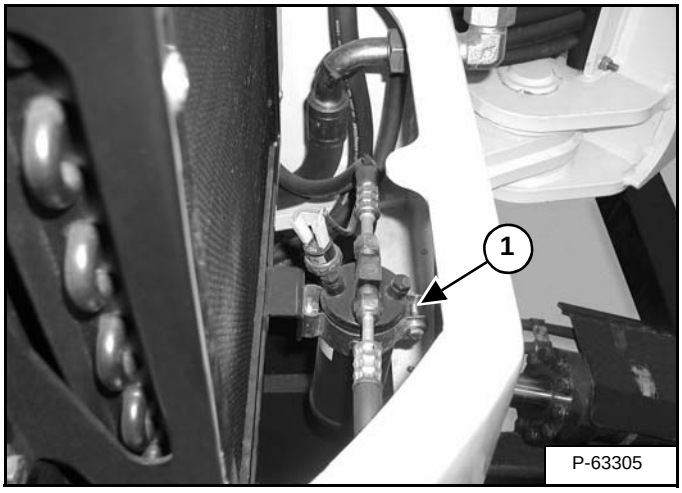
Component Replacement And Refrigeration Leaks

Figure 70-90-53



Whenever the A/C system is opened to the atmosphere or there has been a leak in the system, the receiver/drier (Item 1) **[Figure 70-90-53]** must be changed.

Never leave hose fittings, compressor fittings or components uncapped while working on the A/C system.

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SYSTEM TROUBLESHOOTING CHART

Blower Motor Does Not Operate

POSSIBLE CAUSE	INSPECTION	SOLUTION
1. Blown Fuse.	Inspect	Replace fuse/repair wiring.
2. Broken wiring or bad connection.	Check the fan motor ground and connectors.	Repair the wiring or connector.
3. Fan motor malfunction.	Check the lead wires from the motor with a circuit tester.	Replace Motor.
4. Resistor malfunction.	Check resistor using a circuit tester.	Replace Resistor.
5. Fan motor switch malfunction.	Check power into and out of the fan switch.	Replace Fan Switch.

Blower motor operators normally, but air flow is insufficient

POSSIBLE CAUSE	INSPECTION	SOLUTION
1. Evaporator inlet obstruction	Check evaporator for plugging.	Remove obstruction and clean evaporator fins with air or water.
2. Air leak.	Check to make sure air hoses are properly hooked to louvers and air ducts.	Repair or adjust.
3. Defective thermo. switch (frozen evaporator).	Check thermostat using a circuit tester.	Replace thermostat.

Insufficient cooling although air flow and compressor operation are normal

POSSIBLE CAUSE	INSPECTION	SOLUTION
1. System low on refrigerant.	The high side pressure will be low and bubbles may be present in sight glass on receiver drier.	Repair any leaks and recharge the refrigerant to the correct level.
2. Excessive refrigerant.	The high pressure side pressure will be high.	Use refrigerant recovery equipment to capture excess refrigerant charge to the correct refrigerant level.

The compressor does not operate at all, or operates improperly

POSSIBLE CAUSE	INSPECTION	SOLUTION
1. Loose drive belt.	The belt is vibrating or oscillating.	Adjust tension.
2. Internal compressor malfunction.	The compressor is locked up and the belt slips.	Replace compressor.
Magnetic clutch related		
3. Low battery voltage.	Clutch slips.	Recharge the battery.
4. Faulty coil.	Clutch slips.	Replace the magnetic clutch.
5. Oil on the clutch surface.	Clutch slips.	Replace or clean the clutch surface.
6. Open oil.	Clutch does not engage and there is not reading when a circuit tester is connected between the coil and terminals.	Replace clutch.
7. Broken wiring or poor ground.	Clutch will not engage. Inspect the ground and connections.	Repair.
8. Wiring harness components.	Test the conductance of the pressure switch, thermostat, relay, etc.	Check operation.

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SYSTEM TROUBLESHOOTING CHART (CONT'D)

Gauge Pressure Related Troubleshooting

Normal compressor suction (low side) and discharge (high side) pressure at ambient temperatures of 86-96 degrees F (30-38 degrees C) and compressor speed of approximately 2000 RPM are:

High pressure side pressure: 210-265 PSI

Low pressure side pressure: 15-33 PSI

As a rule of thumb the high side pressure will be around eight times greater than the low side pressure.

POSSIBLE CAUSE		INSPECTION	SOLUTION
Low pressure side too high.		The low pressure side pressure normally becomes too high when the high pressure side pressure is too high. As this is explained below, the following inspection is only used when the low pressure side is too high.	
1.	Expansion valve opens too far.	Frost is present on the suction hose.	Replace expansion valve.
2.	Defective compressor	The high and low pressure side gauge pressures equalize when the magnetic clutch is disengaged.	Replace compressor.
Low pressure side too low.			
1.	Low refrigerant charge	The high side pressure will be low and bubbles may be present in sight glass on receiver drier.	Repair any leaks and recharge the refrigerant to the correct level.
2.	Clogged or closed expansion valve.	The expansion valve's inlet side is frosted. Moisture or other contaminants can be the cause.	Clean or replace the expansion valve.
3.	Restriction between drier and expansion valve.	Frost on the line between drier and expansion valve. A negative low pressure reading may be shown.	Flush system or replace hose.
4.	Thermostat malfunction	The evaporator is frozen.	Replace thermostat.
High pressure side too high.			
1.	Poor condenser performance	Dirty of clogged condenser fins. Condenser fans not operating.	Clean fins, and/or repair the fan.
2.	Excessive refrigerant.	The high pressure side pressure will be high.	Use refrigerant recovery equipment to capture excess refrigerant. Charge to the correct refrigerant level.
3.	Excessive oil charge.	The high pressure side will be high.	Evacuate system. Remove oil from condenser and compressor. Measure oil from compressor and add correct oil charge back into compressor. Flush system with nitrogen. Replace drier.
4.	Air in system.	Pressure side will be high.	Evacuate and recharge with refrigerant.
5.	Restriction in drier condenser or high pressure line.	High pressure side will be high, and low pressure side will be low.	Evacuate and flush system replacing defective parts.

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Gauge Pressure Related Troubleshooting (Cont'd)

POSSIBLE CAUSE		INSPECTION	SOLUTION
High pressure side too low.			
1.	Low refrigerant charge.	The high side pressure will be low and bubbles may be present in sight glass on receiver drier.	Repair any leaks and recharge the refrigerant to the correct level.
System pressures equal			
1.	Clutch not operating.	See magnetic clutch related topics above.	
2.	Compressor not pumping.	Equal high and low pressures.	Replace compressor.

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TEMPERATURE/PRESSURE

Chart

NORMAL EVAPORATOR RANGE		NORMAL CONDENSER RANGE	
TEMP F.	**PSIG**	TEMP F.	**PSIG**
16	15.69	93	110.20
18	17.04	94	112.10
20	18.43	95	114.10
22	19.87	100	124.30
24	21.35	102	128.50
26	22.88	104	132.90
28	24.47	106	137.30
30	26.10	108	141.90
32	27.79	110	146.50
34	29.52	112	151.30
26	31.32	114	156.10
38	33.17	116	161.10
40	35.07	118	166.10
42	37.03	120	171.30
44	39.05	122	176.60
46	40.09	124	182.00
48	45.48	126	187.50
50	51.27	128	193.10
55	57.47	130	198.90
60	64.10	135	213.70
70	71.19	140	229.40
75	78.75	145	245.80
80	86.80	150	263.00
85	95.40	155	281.10
90	104.40	160	300.10
91	106-30	165	320.20
92	108.20	170	340.80

Evaporator

Pressures represent gas temperatures inside the coil. Not the coil surface. For an estimate of the temperature air coming off the coil add 8-10 degrees F. to the temperature on the chart.

Condenser

Temperatures are not ambient temperatures but condensing temperatures. add 40 degrees F. to the ambient temperature to get the condensing temperature and then refer to the pressure chart to see appropriate pressure for ambient temperature.

Example: Ambient Temperature = 90 degrees F.

90 degrees F.
+ 40 degrees F.
130 degrees F. condenser temperature = 200 psig

Conditions and pressures will vary from system to system.

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Chart

Service Company/Phone Number: Date: Machine Model: Machine Dealer: Machine Serial Number: Customer: Machine Hours:			
Pre Service Conditions	15 Minutes	30 Minutes	Notes
Ambient Temperature:			
Louver Temperature			
Cab Temperature at Head Position:			
Temperature into Condenser:			
High Side Pressure			
Low Side Pressure			
Ambient Humidity			
Observations:			
Explain services required:			
Post Service Conditions	15 Minutes	30 Minutes	Notes
Ambient Temperature:			
Louver Temperature:			
Cab Temperature at Head Position:			
Temperature into Condenser:			
High Side Pressure			
Low Side Pressure			
Ambient Humidity			
Observations:			

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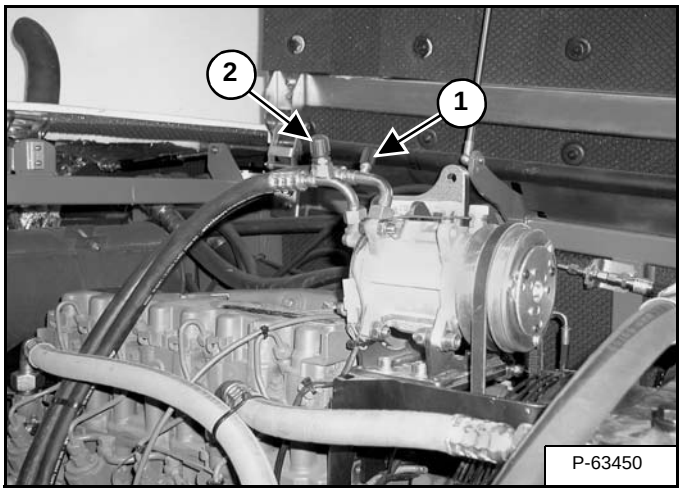
Reclamation Procedure

Figure 70-130-54



Open the right side cover and locate the low pressure port (Item 1) and high pressure port (Item 2) **[Figure 70-130-54]**.

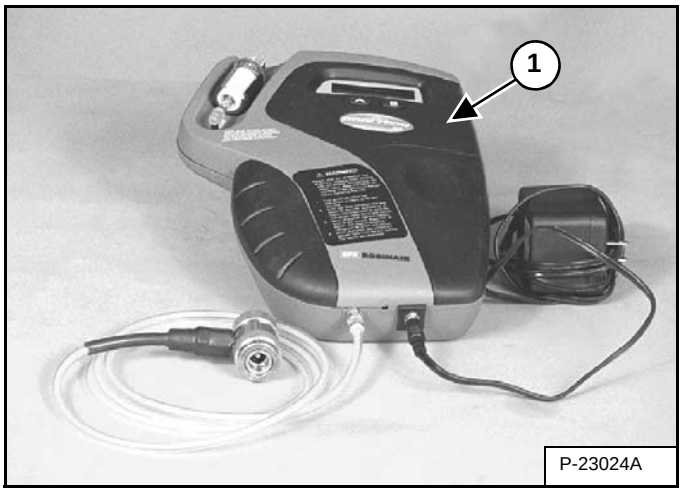
WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

NOTE: This test is run with the excavator engine OFF, and the A/C switch in the OFF position.

Figure 70-130-55



NOTE: Before reclaiming a refrigeration system, it is recommended to identify the type of refrigerant that is in the A/C system and if it is pure enough to use. The tool MEL 1592, Refrigerant Identifier (Item 1) [Figure 70-130-55] will determine, the kind of refrigerant and any possible harmful or dangerous substances that may be present in the system. Thus preventing mixing of dangerous material with your reclaimed R-134a in your reclaimer, and further contamination to other A/C systems that are reclaimed and charged from your MEL 1581 Recovery/Recycling/ Recharging Machine.

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Reclamation Procedure (Cont'd)

Remove the protective cap and connect the Refrigerant Identifier to the low pressure hose.

Connect the Refrigerant Identifier to its power source.

Follow the steps displayed on the refrigerant identifier screen.

Allow two minutes for the refrigerant identifier to display the type of refrigerant and air content. An alarm will sound if potentially flammable hydrocarbons are present and will also indicate on the visual display.

Disconnect the refrigerant identifier from the excavator A/C.

If the refrigerant is dangerous or flammable, it must be evacuated from the A/C system into a separate container and properly and safely disposed of.

If R134a is found, evacuate the system.

IMPORTANT: Only A/C trained technicians should perform the reclaiming and recharging procedure.

WARNING

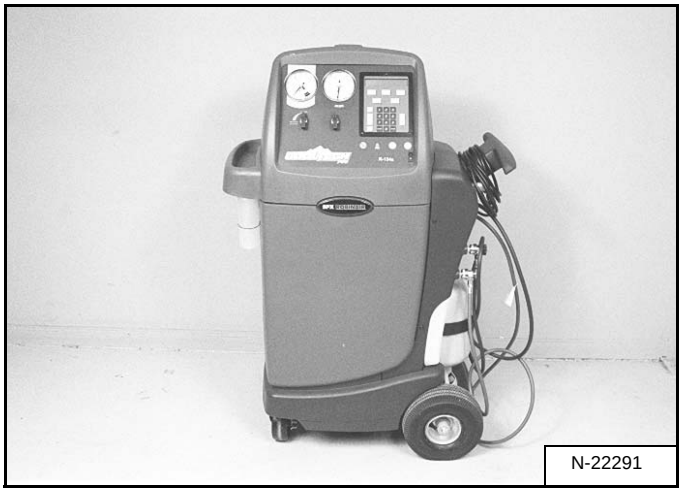
HFC 134A refrigerant can be dangerous if not properly handled. Liquid 134A may cause blindness if it contacts the eyes and may cause serious frostbite if it contacts the skin.

- **Gaseous 134A becomes lethal (phosgene) gas when it contacts open flame or very hot substances.**
- **NEVER SMOKE when there is the possibility of even small amounts of 134A in the air.**

Any servicing work that involves release or addition of 134A to the system must be done by a competent refrigeration dealer who has the proper equipment, knowledge, and experience to service refrigeration equipment.

W-2373-0500

Figure 70-130-56



Use an approved recovery/charging unit **[Figure 70-130-56]** to evacuate the system.

Connect the reclaimer to the excavator A/C charge ports.

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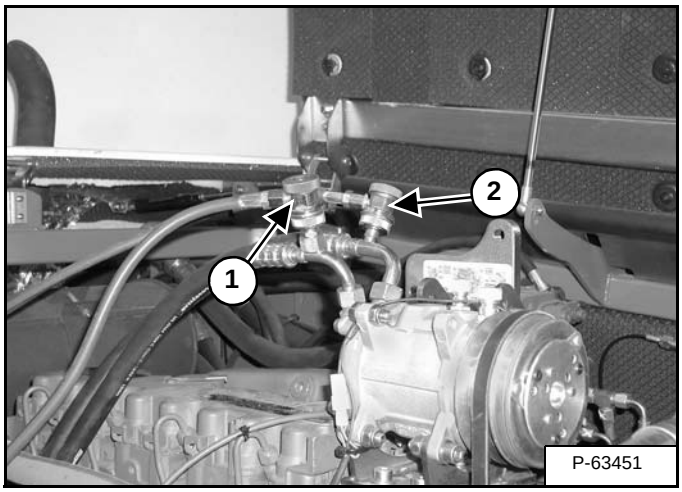
Reclamation Procedure (Cont'd)

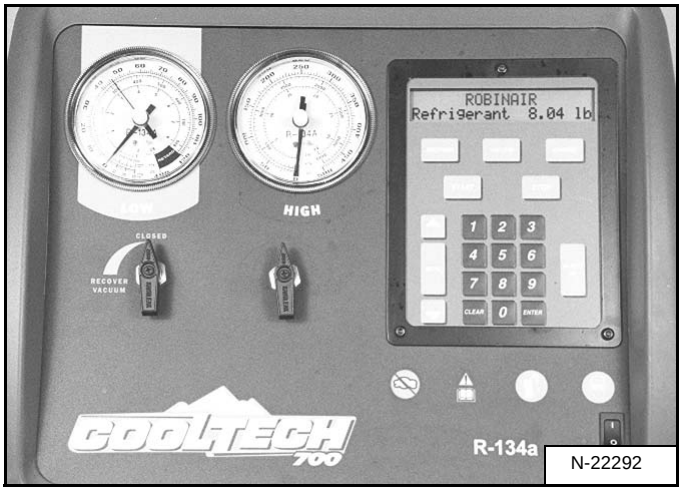
Figure 70-130-57



Connect the Red hose (Item 1) **[Figure 70-130-57]** to the high pressure port and open the valve.

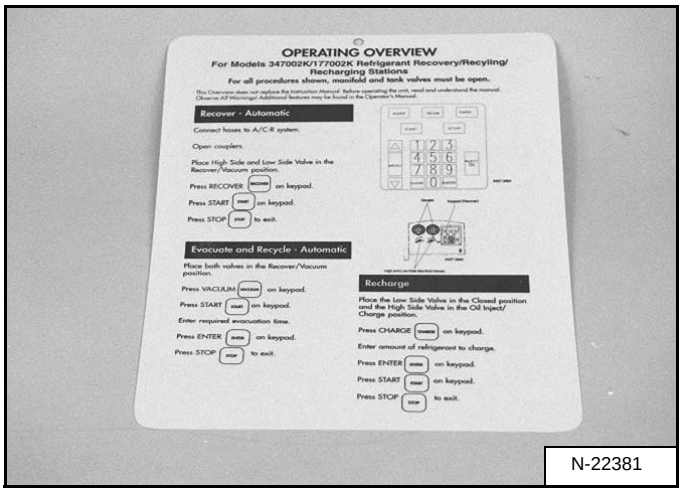
Connect the Blue hose (Item 2) **[Figure 70-130-57]** to the low pressure port and open the valve.

Figure 70-130-58



Turn the reclaimer unit **[Figure 70-130-58]** to the ON position and follow the on screen instructions.

Figure 70-130-59



NOTE: The reclaimer unit, has a complete step by step set of instructions [Figure 70-130-59] to follow for reclamation and recharging of the A/C system. A trained technician should follow these instructions as they may very slightly depending on the model and brand of reclaimer used.

The AC system holds 2.64 lbs (1.20 Kg) of refrigerant.

Add 1 oz of Pag oil to the system when a A/C component has been replaced. The compressor comes from the factory pre-filled with oil.

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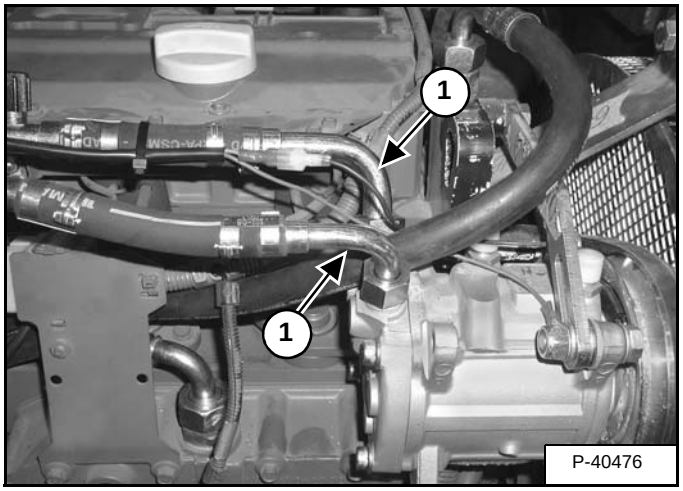
COMPRESSOR (S/N 522311001 & ABOVE)

Removal And Installation

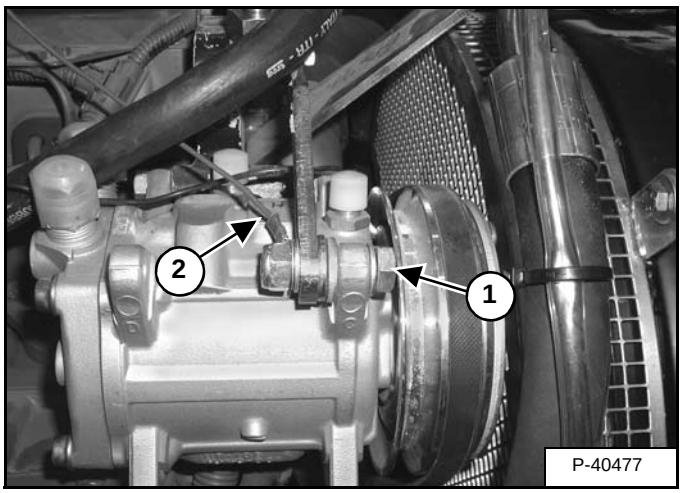
Discharge the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

Figure 70-140-1



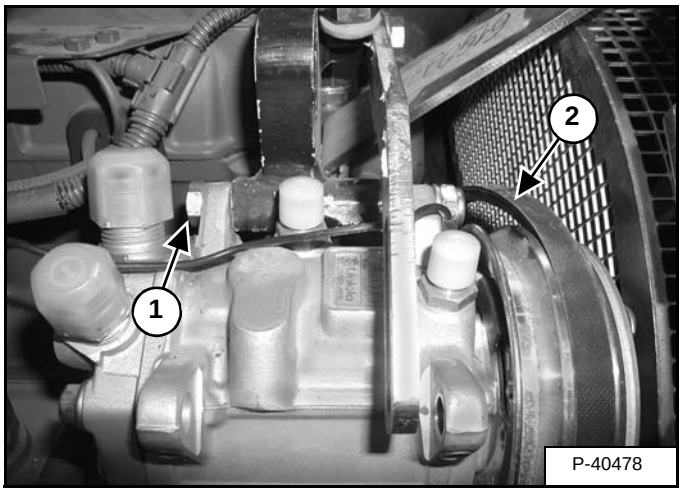
Remove the A/C hoses (Item 1) **[Figure 70-140-1]**.

Figure 70-140-2



Remove the bolt (Item 1), washer, spacers and nut. Remove the ground wire (Item 2) **[Figure 70-140-2]**.

Figure 70-140-3



Remove the bolt (Item 1) and nut. Remove the belt (Item 2) **[Figure 70-140-3]** from the pulley and remove the compressor.

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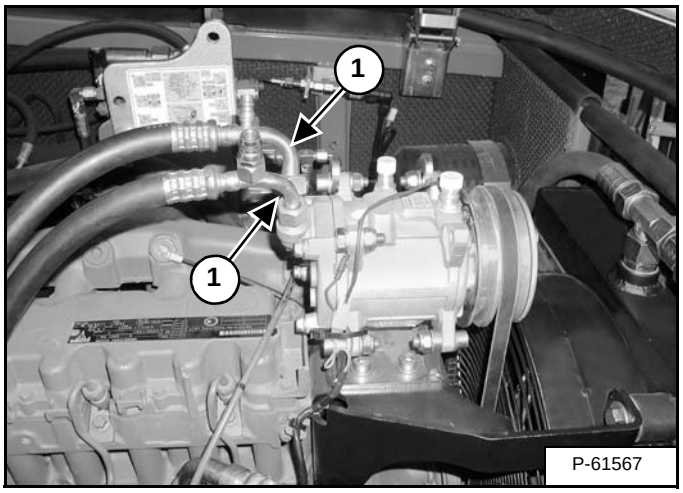
COMPRESSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Removal And Installation

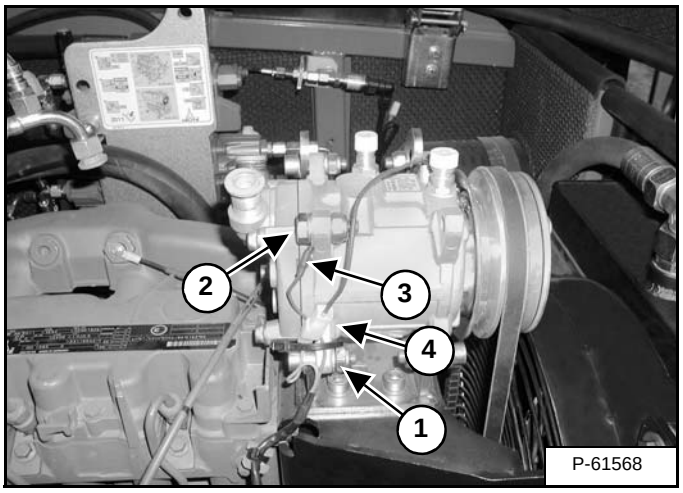
Discharge the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1)

Figure 70-141-1



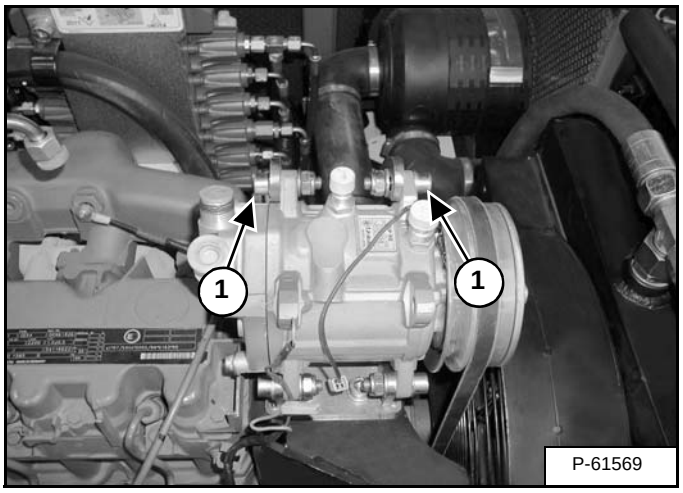
Remove the A/C hoses (Item 1) **[Figure 70-141-1]**.

Figure 70-141-2



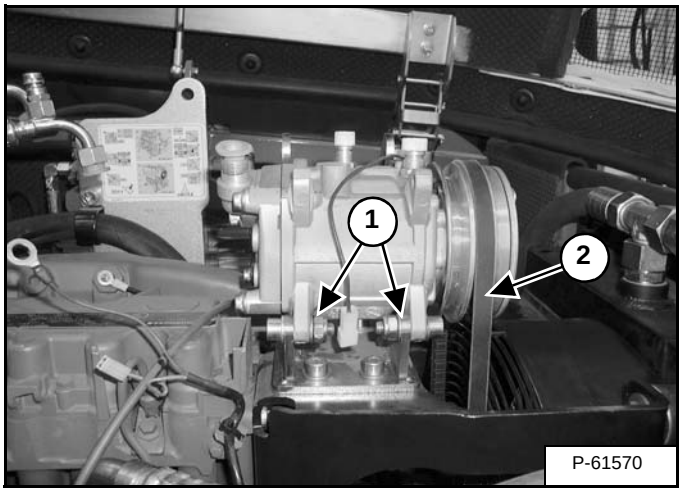
Remove the tiestrap (Item 1), bolt (Item 2), washer, and nut. Remove the ground wire (Item 3) and disconnect the wire harness (Item 4) **[Figure 70-141-2]**.

Figure 70-141-3



Remove the two bolts (Item 1) **[Figure 70-141-3]**, washers and nuts

Figure 70-141-4



Remove the two bolts (Item 1), washers and nuts. Remove the belt (Item 2) **[Figure 70-141-4]**.

Remove the compressor.

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Parts Identification

Not Available At Time Of Print

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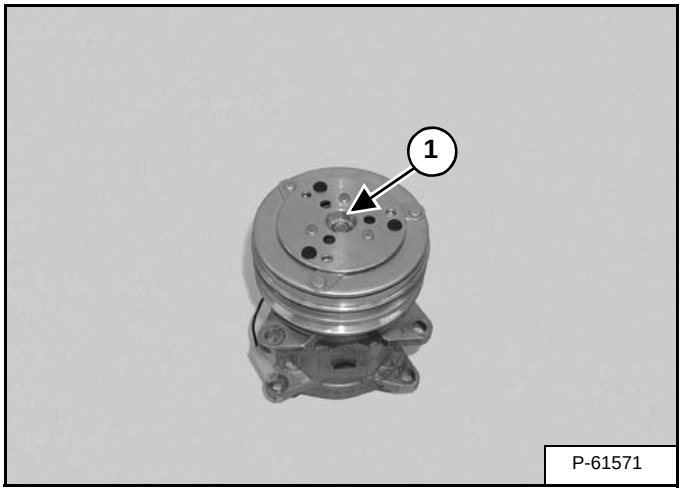
Compressor Clutch Disassembly And Assembly

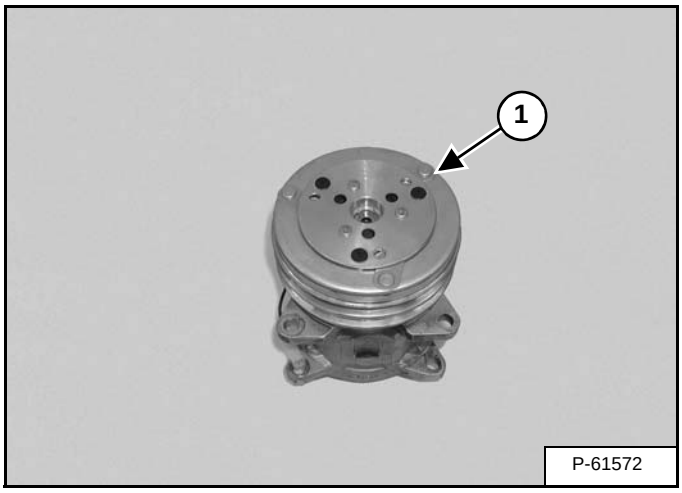
Figure 70-141-5



Remove the bolt (Item 1) **[Figure 70-141-5]**.

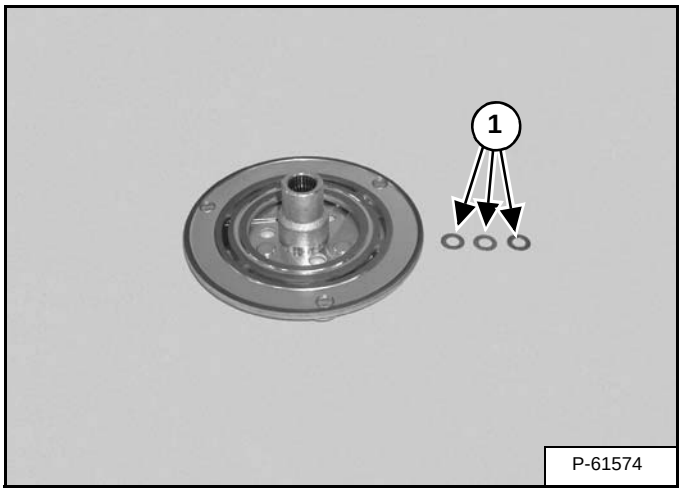
Installation: Tighten the bolt to 8-10 ft.-lbs. (12-14 Nm) torque.

Figure 70-141-6



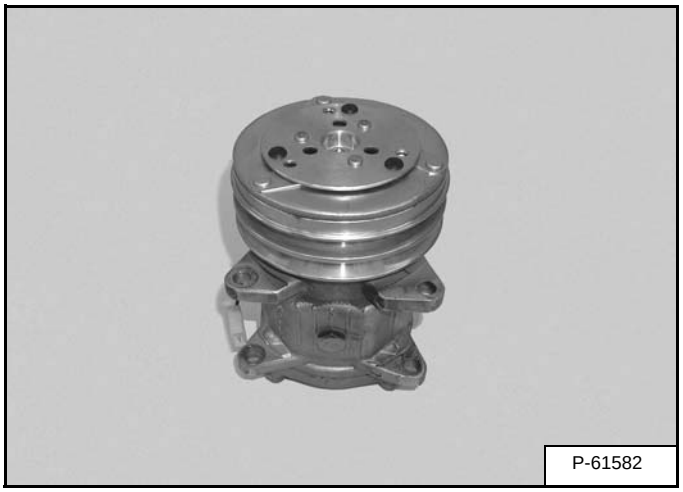
Pull straight up on the armature plate (Item 1) **[Figure 70-141-6]** and remove the armature plate from the compressor clutch.

Figure 70-141-7



Remove the shims (Item 1) **[Figure 70-141-7]** from either the armature shaft or armature plate.

Figure 70-141-8



Installation: Install the needed shims until the correct clearance between the armature plate and compressor clutch is obtained **[Figure 70-141-8]**.

The specified clearance for the clutch is 0.01-0.02 in. (0.3-0.6 mm). Adjusting shims are available in the following thicknesses:

0.0118 in (0.3 mm)
0.0197 in (0.5 mm)

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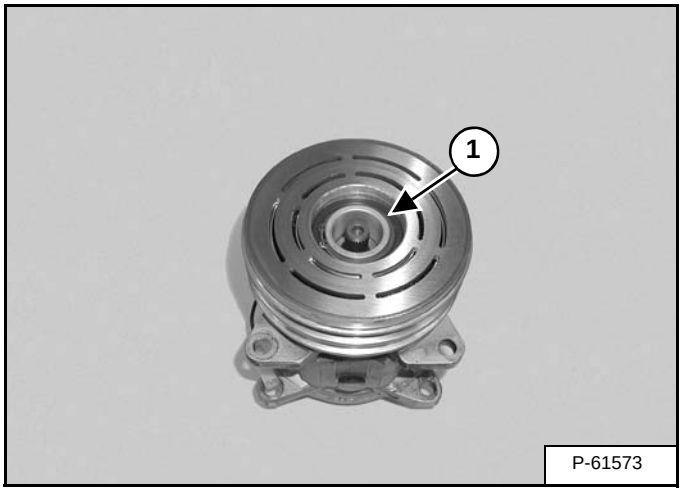
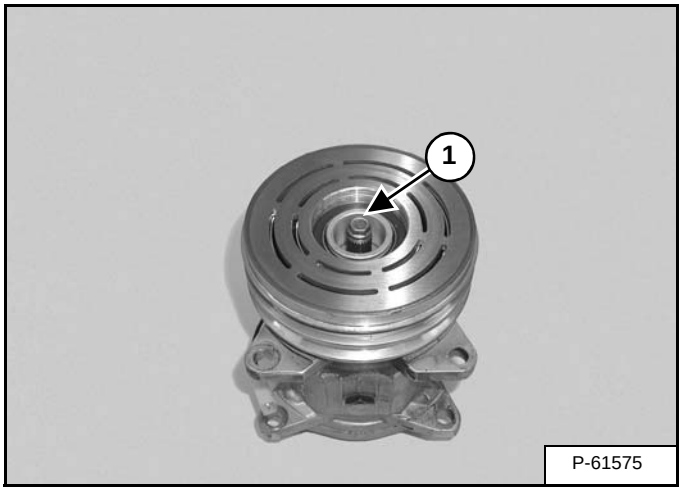
Compressor Clutch Disassembly And Assembly (Cont'd)

Figure 70-141-9



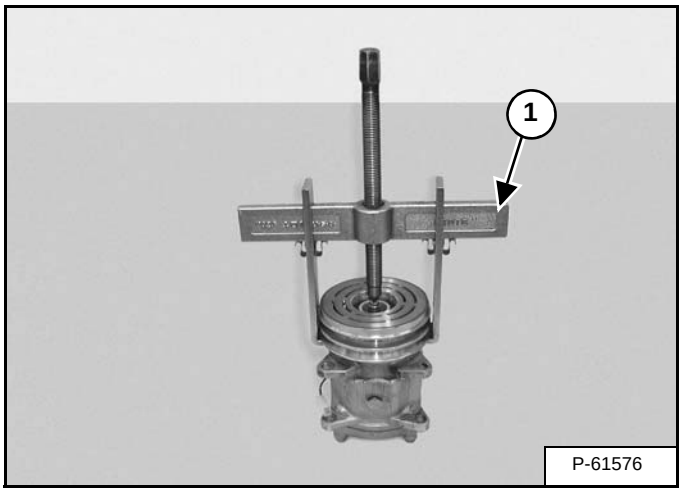
Remove the snap ring (Item 1) **[Figure 70-141-9]**.

Figure 70-141-10



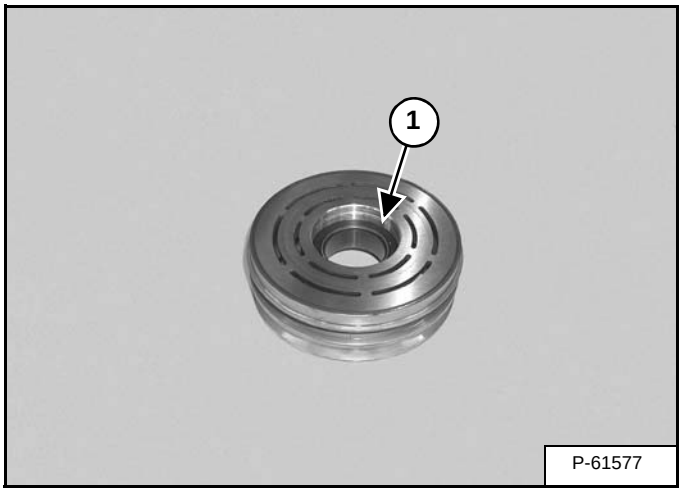
Temporarily install the bolt (Item 1) **[Figure 70-141-10]**.

Figure 70-141-11



Install a puller (Item 1) **[Figure 70-141-11]** on the pulley and remove the pulley/bearing assembly.

Figure 70-141-12



The bearing (Item 1) **[Figure 70-141-12]** is staked in to the pulley and is not serviceable separately.

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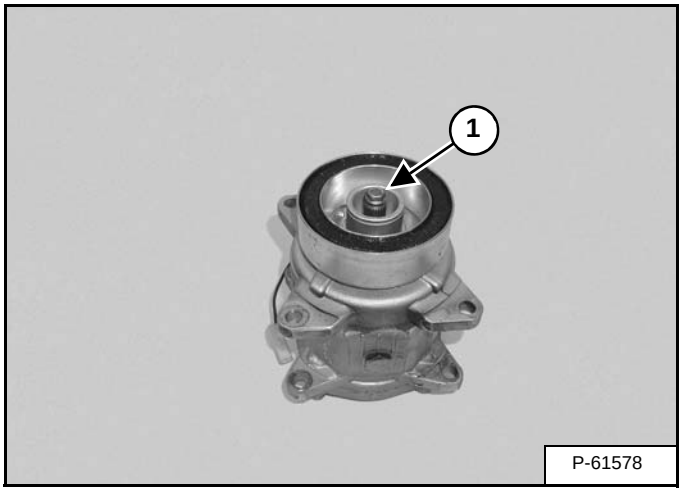
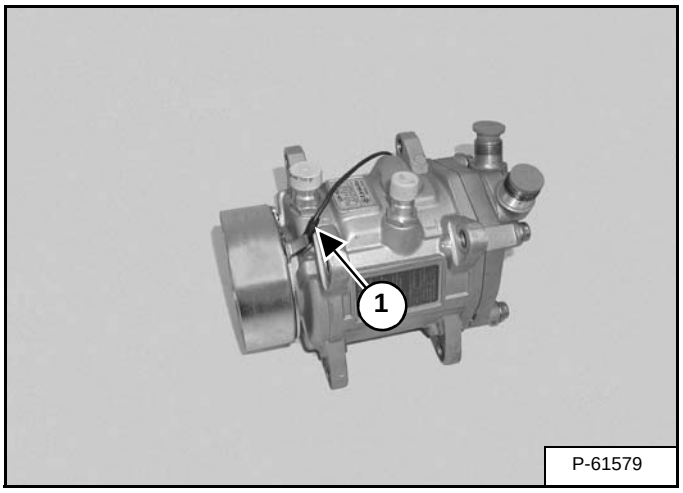
Compressor Clutch Disassembly And Assembly (Cont'd)

Figure 70-141-13



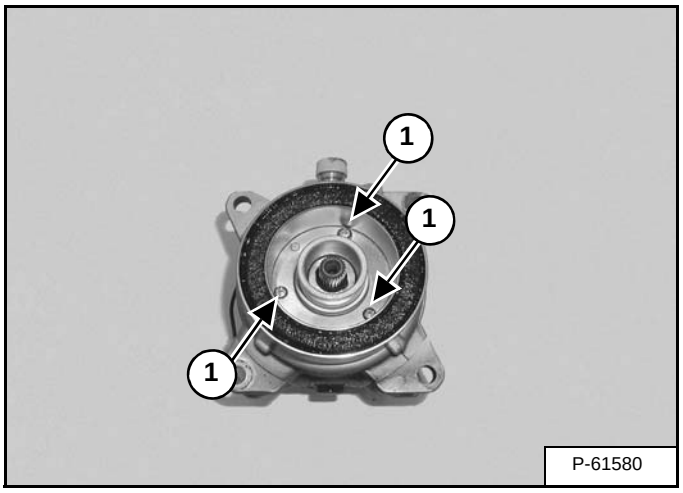
Remove the bolt (Item 1) **[Figure 70-141-13]** from the shaft.

Figure 70-141-14



Slide the grommet and wire harness (Item 1) **[Figure 70-141-14]** from the wire holder.

Figure 70-141-15



Remove the three screws (Item 1) **[Figure 70-141-15]** from the compressor.

Installation: Tighten the screws to 2.9-4.3 ft.-lbs. (4-6 Nm) torque.

Remove the coil from the compressor.

The compressor is not serviceable and must be replaced as a complete unit.

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CONDENSER (S/N 522311001 & ABOVE)

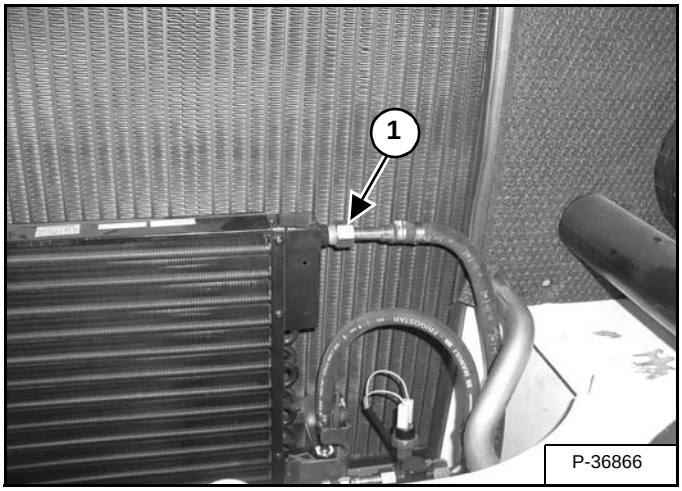
Removal And Installation

Open the right side cover.

Remove the refrigerant from the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

Mark the A/C hoses for correct installation.

Figure 70-150-1



Remove the top hose (Item 1) **[Figure 70-150-1]**.

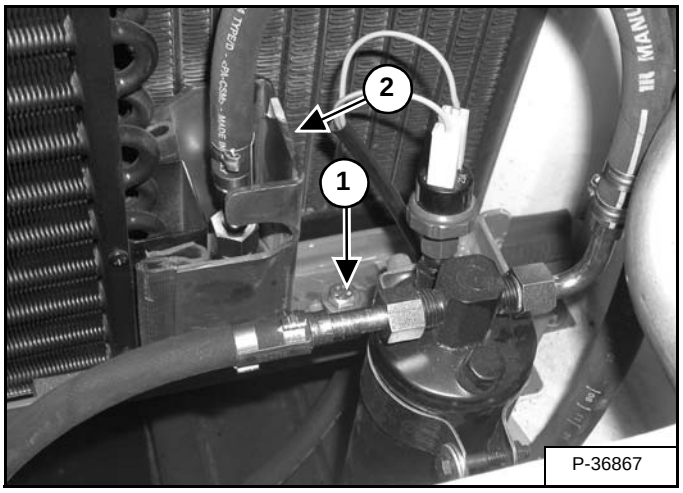
Plug the hose with a proper A/C plug.

⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

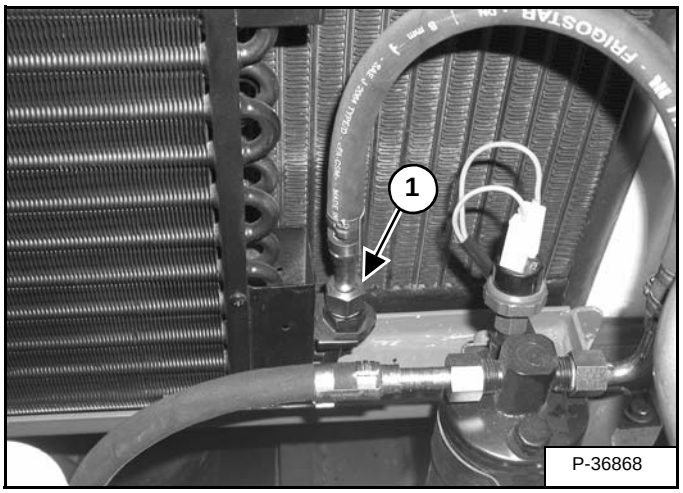
Figure 70-150-2



Remove the bolt (Item 1) **[Figure 70-150-2]** and washer.

Remove the mount (Item 2) **[Figure 70-150-2]**.

Figure 70-150-3



Remove the bottom hose (Item 1) **[Figure 70-150-3]**.

Plug the hose with a proper A/C plug.

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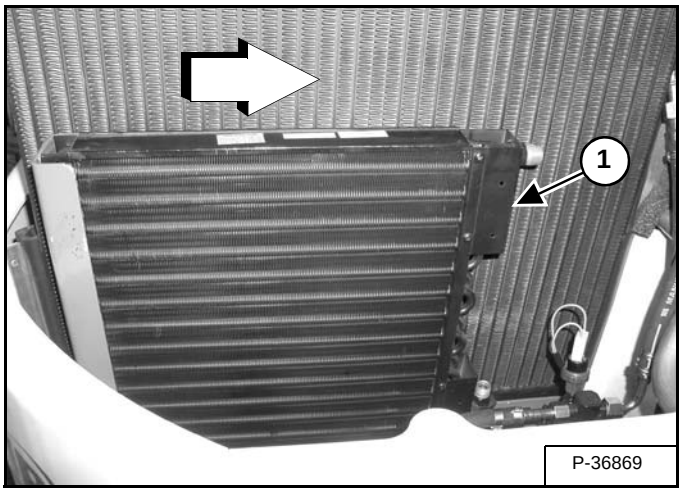
Removal And Installation (Cont'd)

Figure 70-150-4



Slide the condenser (Item 1) **[Figure 70-150-4]** towards the operator cab.

Remove the condenser.

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CONDENSOR (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

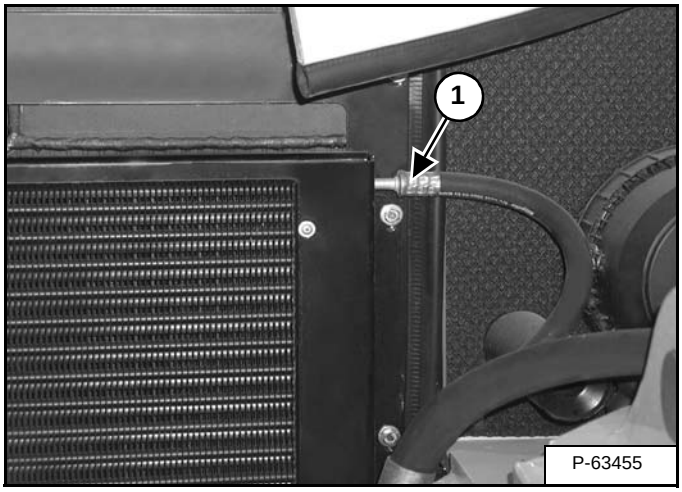
Removal And Installation

Open the right side cover.

Remove the refrigerant from the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1)

Mark the A/C hoses for correct installation.

Figure 70-151-1



Remove the top hose (Item 1) **[Figure 70-151-1]**.

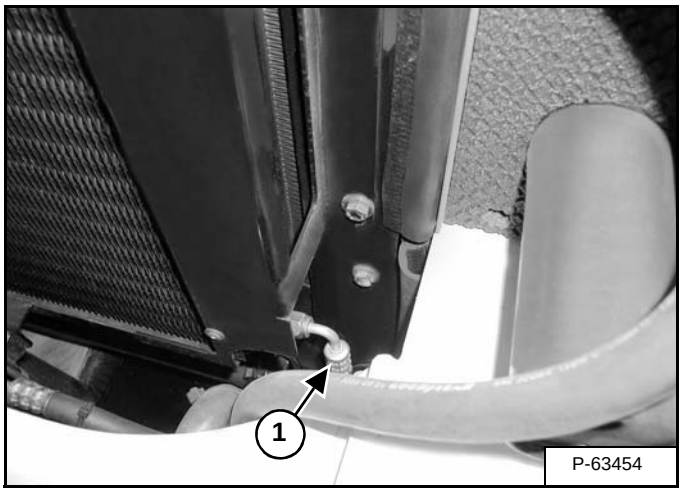
Plug the hose with a proper A/C plug.

WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

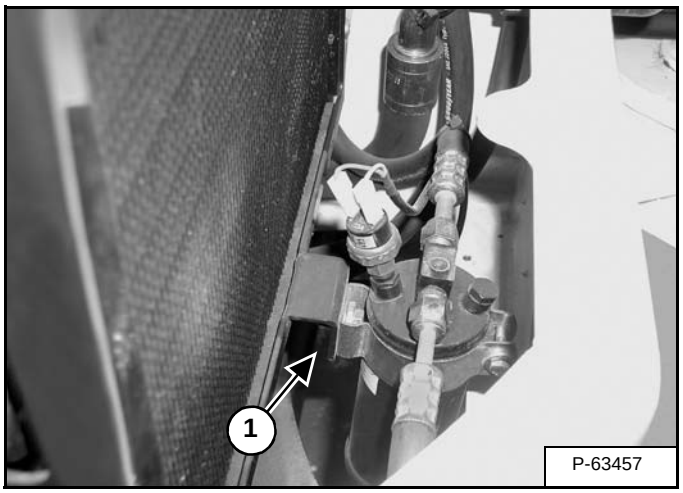
Figure 70-151-2



Remove the bottom hose (Item 1) **[Figure 70-151-2]**.

Plug the hose with a proper A/C plug.

Figure 70-151-3



Remove the bolt (Item 1) **[Figure 70-151-3]** and nut.

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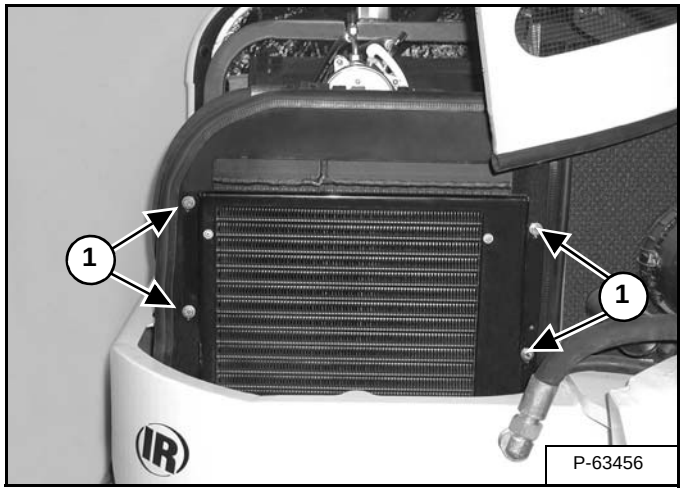
Removal And Installation (Cont'd)

Figure 70-151-4



Remove the bolts (Item 1) **[Figure 70-151-4]**.

Remove the condenser.

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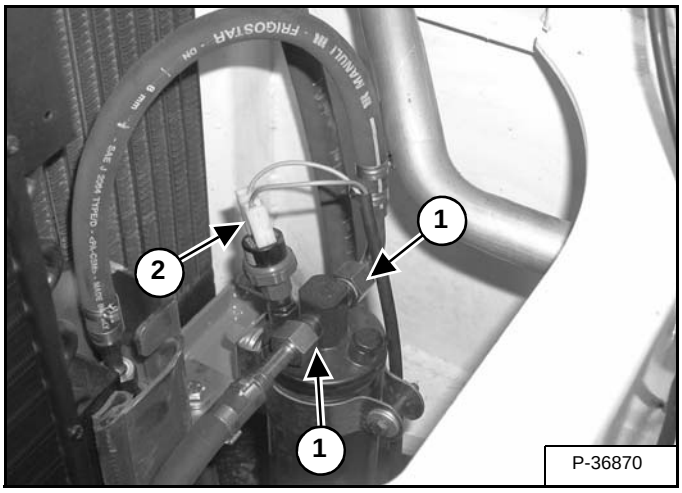
RECEIVER/DRYER (S/N 522311001 & ABOVE)

Removal And Installation

Open the right side cover.

Remove the refrigerant from the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

Figure 70-160-1



Mark the A/C hoses (Item 1) **[Figure 70-160-1]** for correct installation.

Remove the hoses.

Plug the hoses with proper A/C plugs.

NOTE: Both fittings on the drier are the same size. The hoses can be installed incorrectly.

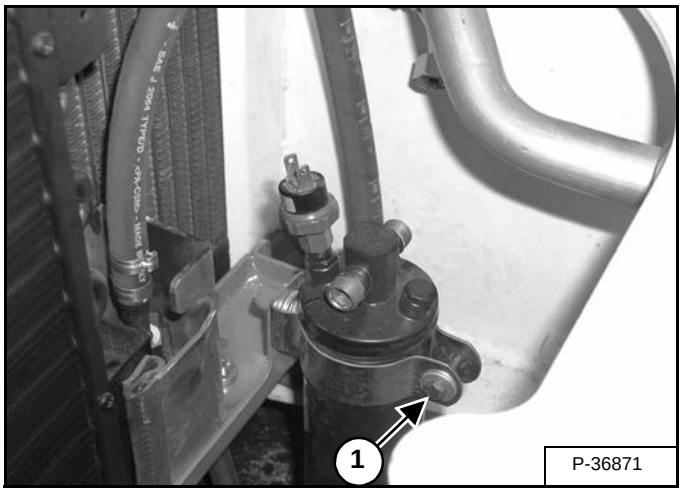
⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

Remove the wire harness (Item 2) **[Figure 70-160-1]**.

Figure 70-160-2



Loosen the clamp (Item 1) **[Figure 70-160-2]**.

Remove the drier.

NOTE: When replacing a receiver/dryer, one fluid ounce (30 cc) of PAG oil must be added to the system when recharging.

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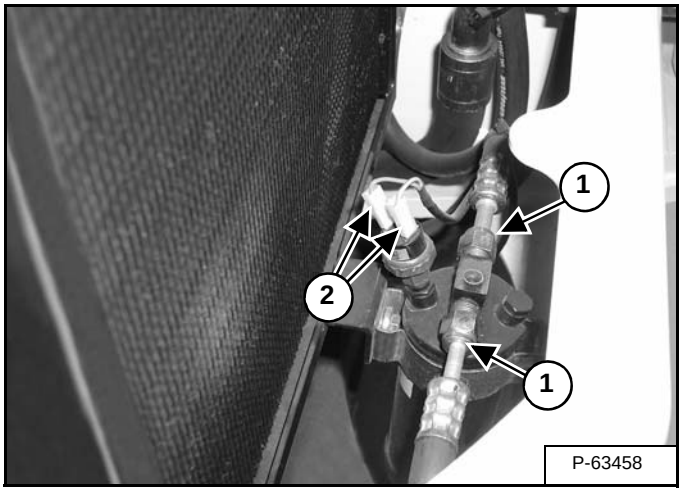
RECEIVER/DRYER (S/N 528911001 & ABOVE AND 528611001 & ABOVE))

Removal And Installation

Open the right side cover.

Remove the refrigerant from the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1)

Figure 70-161-1



Mark the A/C hoses (Item 1) **[Figure 70-161-1]** for correct installation.

Remove the hoses.

Plug the hoses with proper A/C plugs.

NOTE: Both fittings on the drier are the same size. The hoses can be installed incorrectly.

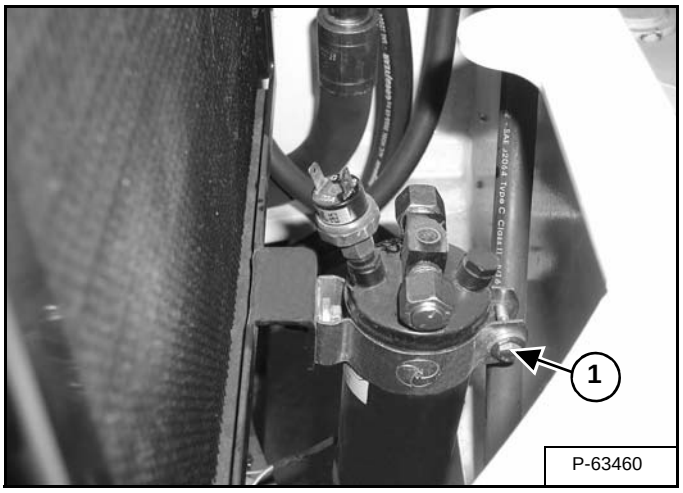
⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

Remove the wire harness (Item 2) **[Figure 70-161-1]**.

Figure 70-161-2



Loosen the clamp (Item 1) **[Figure 70-161-2]**.

Remove the drier.

NOTE: When replacing a receiver/dryer, one fluid ounce (30 cc) of PAG oil must be added to the system when recharging.

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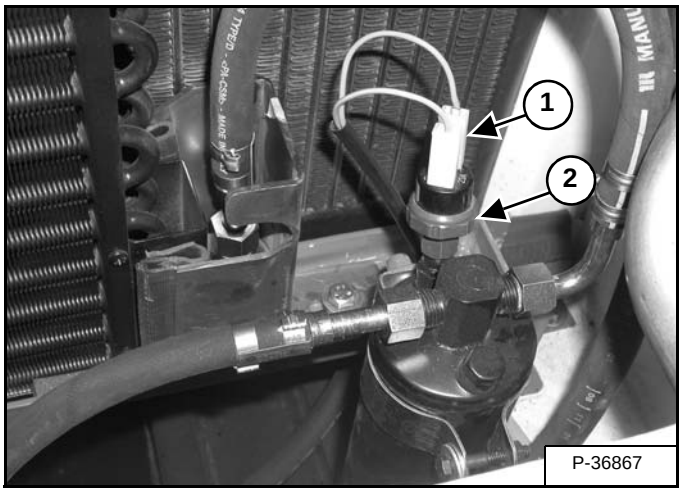
PRESSURE SWITCH (S/N 522311001 & ABOVE)

Removal And Installation

Open the right side cover.

NOTE: The pressure switch can be removed without discharging the A/C system.

Figure 70-170-1



Disconnect the wire harness (Item 1) **[Figure 70-170-1]**

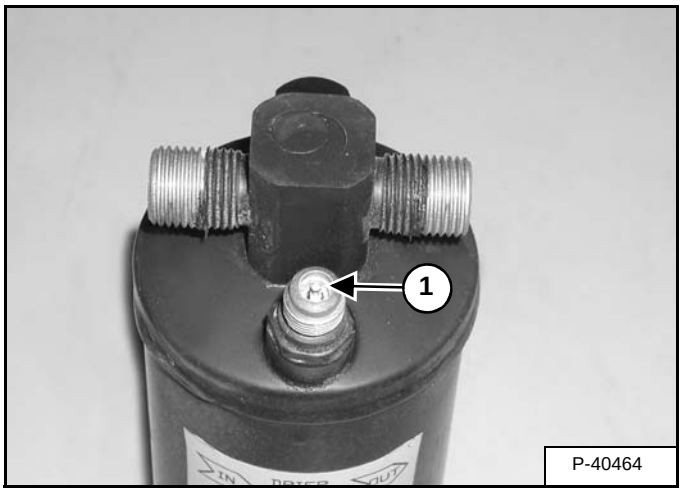
Remove the switch (Item 2) **[Figure 70-170-1]** from the receiver/drier.

⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

Figure 70-170-2



The valve (Item 1) **[Figure 70-170-2]** is located in the receiver/drier and is located under the pressure switch.

Remove the refrigerant from the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

Remove the pressure switch.

With a tire valve core removal tool, remove the valve core.

Replace with a new core.

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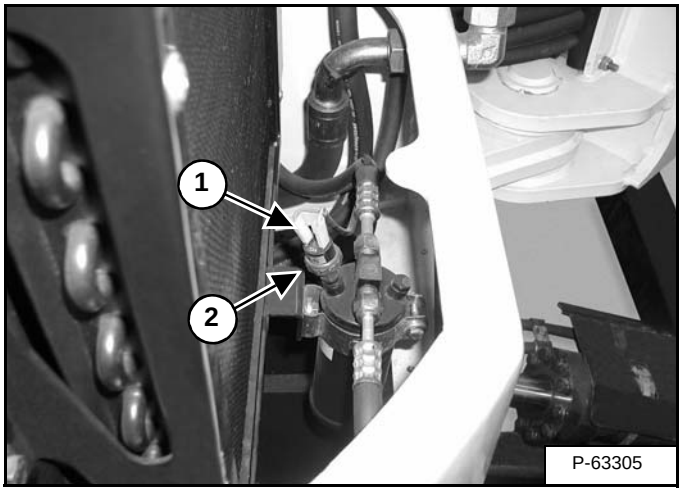
PRESSURE SWITCH (S/N 528911001 & ABOVE AND 528611001 & ABOVE)

Removal And Installation

Open the right side cover.

NOTE: The pressure switch can be removed without discharging the A/C system.

Figure 70-171-1



Disconnect the wire harness (Item 1) **[Figure 70-171-1]**.

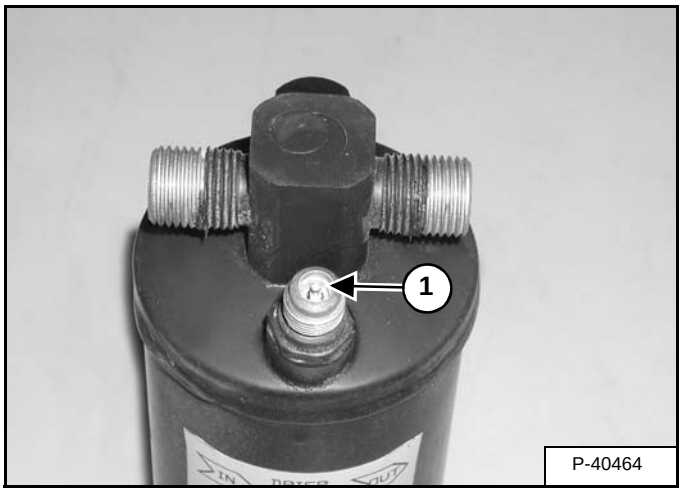
Remove the switch (Item 2) **[Figure 70-171-1]** from the receiver/drier.

⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

Figure 70-171-2



The valve (Item 1) **[Figure 70-171-2]** is located in the receiver/drier and is located under the pressure switch.

Remove the refrigerant from the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

Remove the pressure switch.

With a tire valve core removal tool, remove the valve core.

Replace with a new core.

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HEATER COIL/EVAPORATOR

Removal And Installation

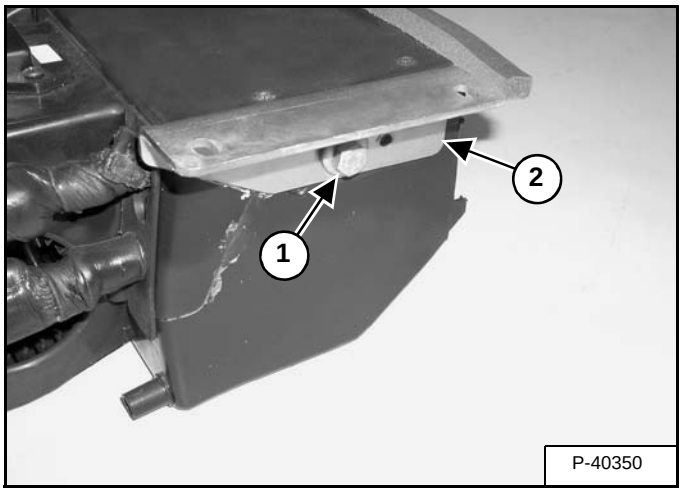
Remove the evaporator/heater unit. (See EVAPORATOR/HEATER UNIT (S/N 522311001 & ABOVE) on Page 70-10-1 or See EVAPORATOR/ HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) on Page 70-11-1.)

Remove the thermostat. (See THERMOSTAT on Page 70-190-1.)

NOTE: The heater coil and evaporator are a combined unit and are not serviceable separately.

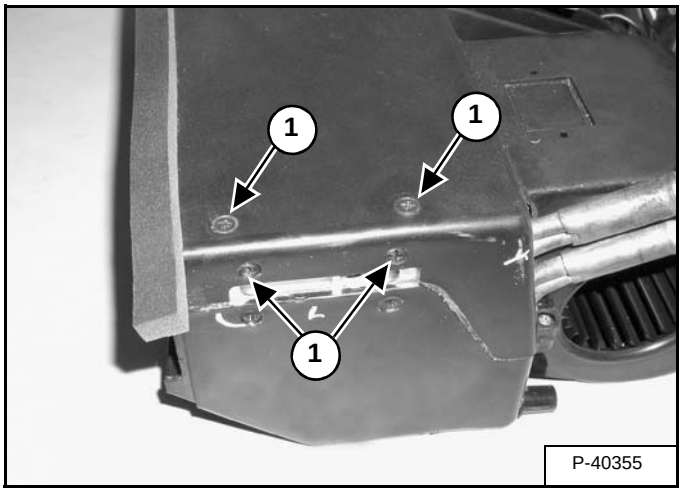
Mark around the edges of both mount brackets.

Figure 70-180-1



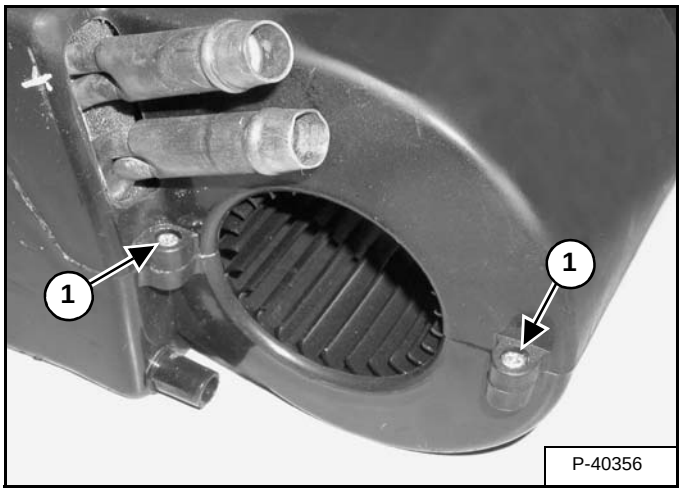
Remove the bolt (Item 1), washer and mount (Item 2) **[Figure 70-180-1]** from both sides.

Figure 70-180-2



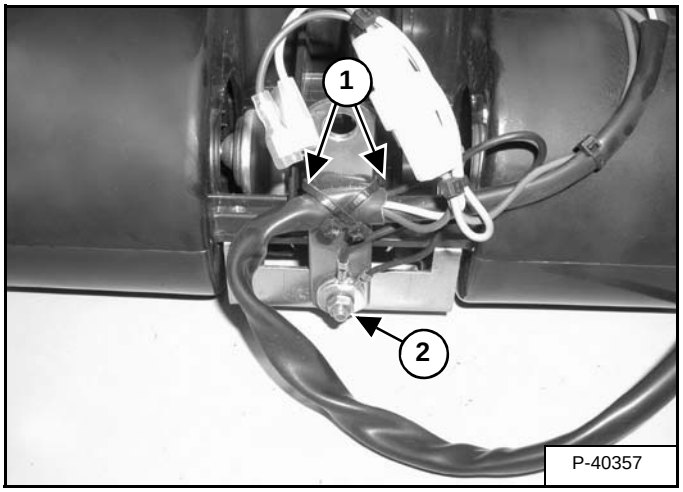
Remove the four screws (Item 1) **[Figure 70-180-2]** from both sides.

Figure 70-180-3



Remove the two screws (Item 1) **[Figure 70-180-3]** from both ends.

Figure 70-180-4



Cut and remove the cable ties (Item 1) **[Figure 70-180-4]**

Remove the nut (Item 2) **[Figure 70-180-4]**, washers, ground wires and thermostat mount.

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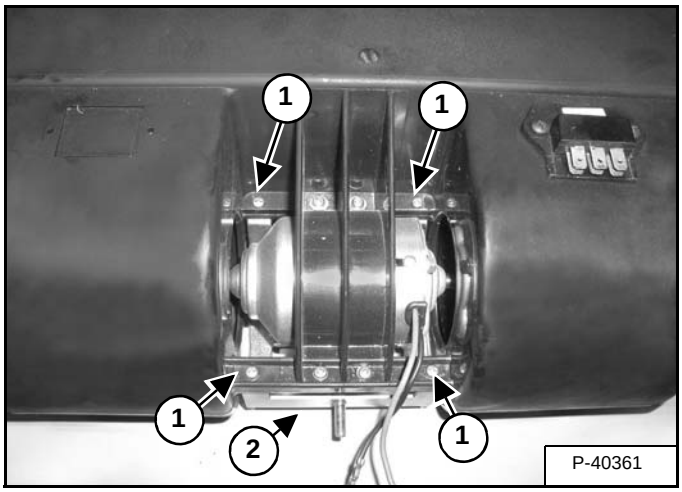
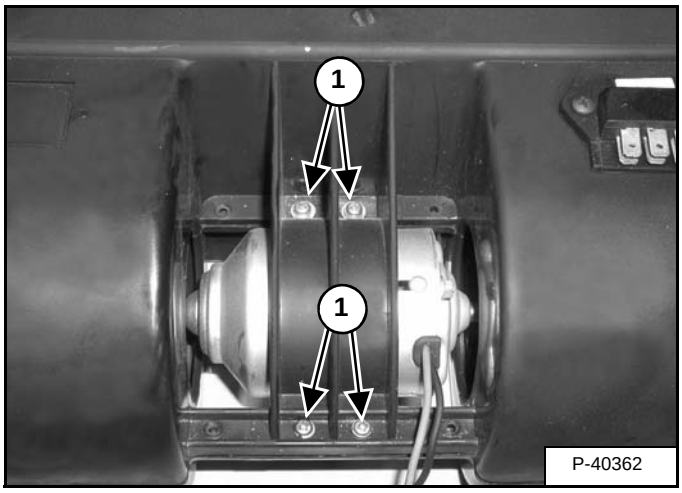
Removal And Installation (Cont'd)

Figure 70-180-5



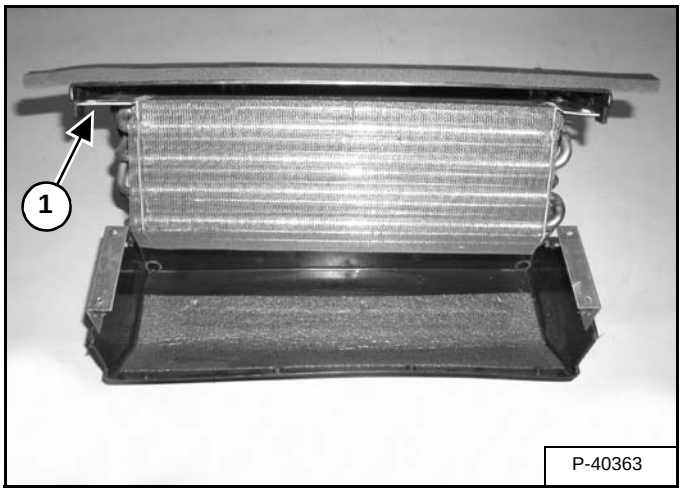
Remove the four screws (Item 1) and bracket (Item 2) **[Figure 70-180-5]**.

Figure 70-180-6



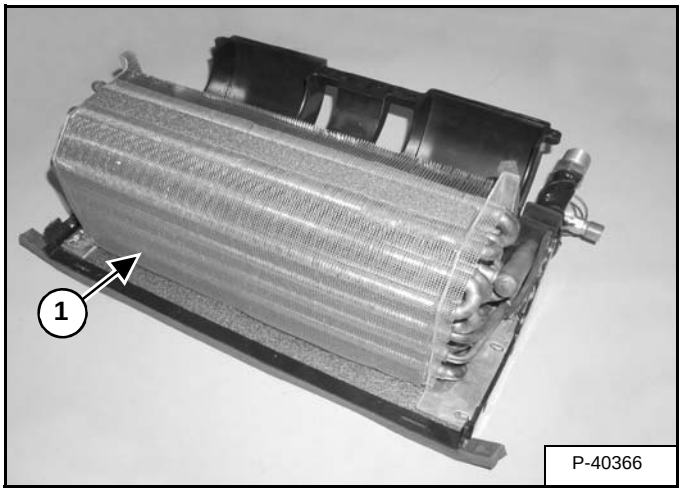
Remove the four screws (Item 1) **[Figure 70-180-6]**, washers and nuts.

Figure 70-180-7



Remove the top cover (Item 1) **[Figure 70-180-7]** and heater coil/evaporator.

Figure 70-180-8



Remove the heater coil/evaporator (Item 1) **[Figure 70-180-8]** from the top cover

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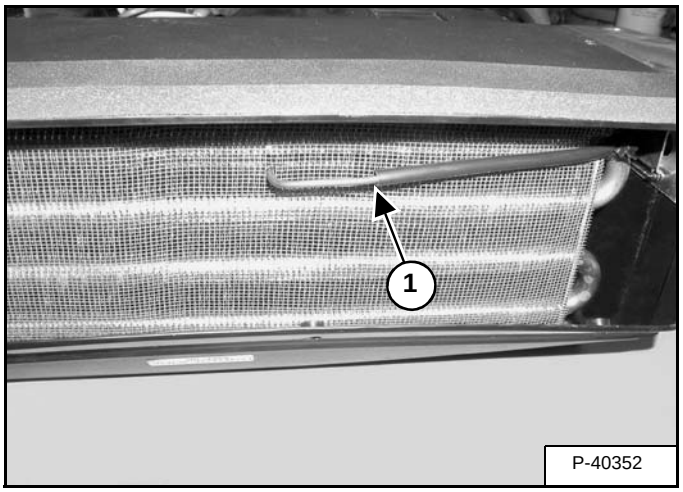
THERMOSTAT

Removal And Installation

NOTE: The thermostat can be changed without evacuating the A/C system, or removing the evaporator/heater unit from the excavator.

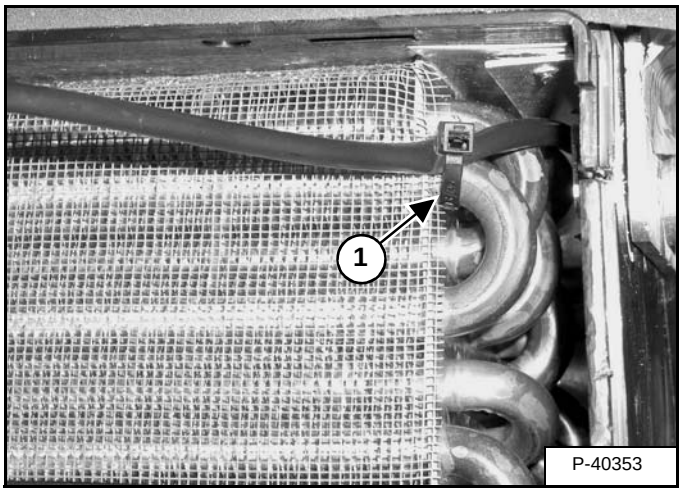
Remove the seat and seat mount. (See SEAT AND SEAT MOUNT on Page 40-30-1.)

Figure 70-190-1



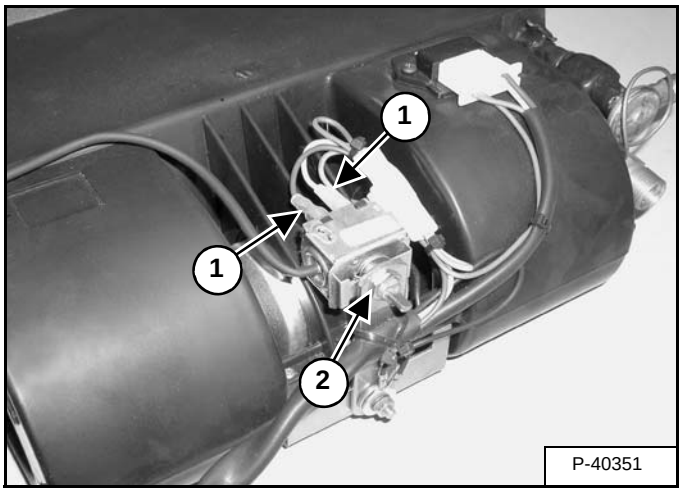
Remove the thermostat probe (Item 1) **[Figure 70-190-1]** from the evaporator.

Figure 70-190-2



Cut and remove the cable tie (Item 1) **[Figure 70-190-2]**.

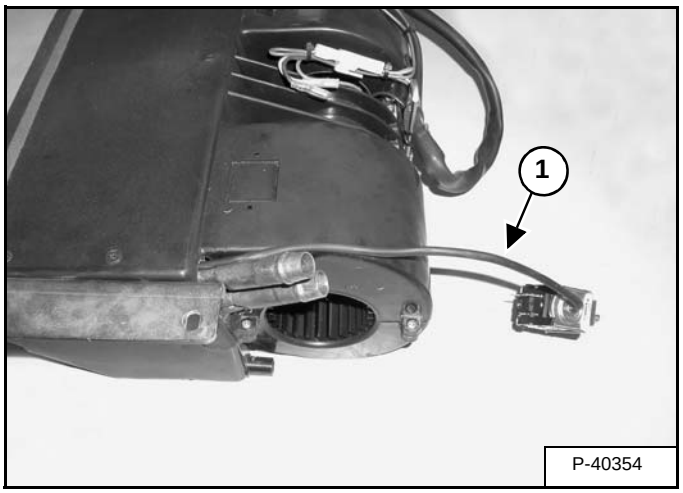
Figure 70-190-3



Mark and remove the wires (Item 1) **[Figure 70-190-3]**.

Remove the nut (Item 2) **[Figure 70-190-3]**.

Figure 70-190-4



Straighten the thermostat probe and pull the thermostat (Item 1) **[Figure 70-190-4]** out of the housing.

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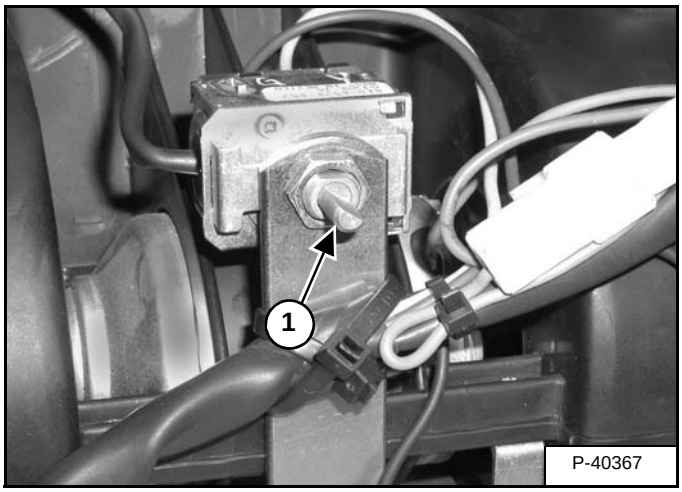
Removal And Installation (Cont'd)

Figure 70-190-5



Installation: The control shaft (Item 1) **[Figure 70-190-5]** must be rotated to the ON position, as shown

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EXPANSION VALVE

Removal And Installation

Evacuate the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

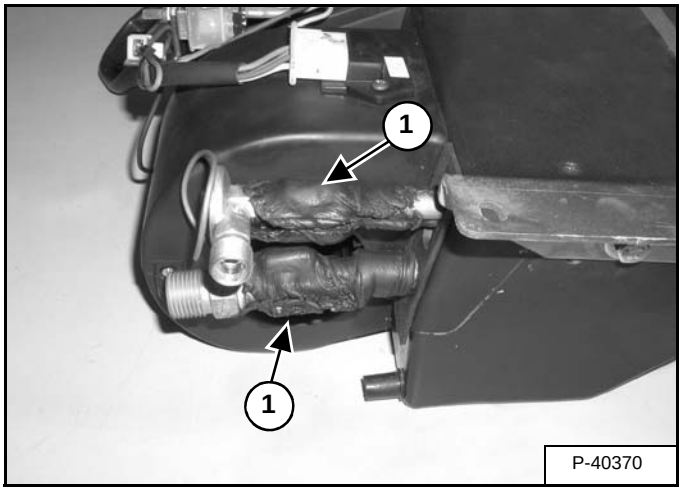
Remove the evaporator/heater unit. (See EVAPORATOR/HEATER UNIT (S/N 522311001 & ABOVE) on Page 70-10-1 or See EVAPORATOR/HEATER UNIT (S/N 528911001 & ABOVE AND 528611001 & ABOVE) on Page 70-11-1.)

⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

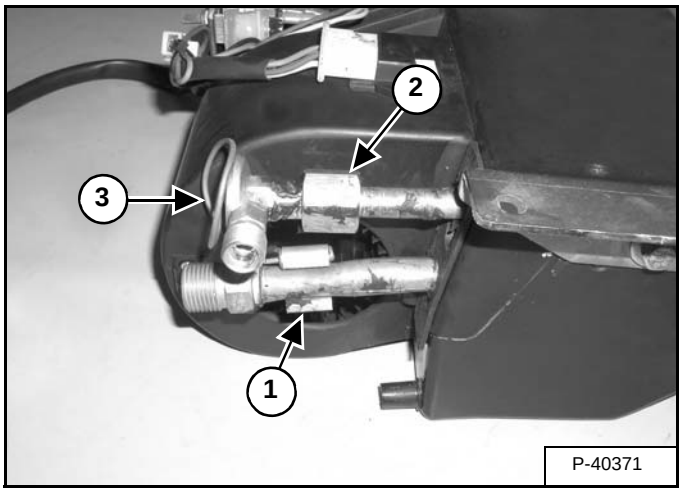
W-2371-0500

Figure 70-200-1



Remove the A/C tape (Item 1) **[Figure 70-200-1]**

Figure 70-200-2



Remove the clamp (Item 1) **[Figure 70-200-2]**.

Loosen the nut (Item 2) and remove the expansion valve (Item 3) **[Figure 70-200-2]**.

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UPGRADED AIR CONDITIONING SYSTEM

Evaporator Unit Removal And Installation

Discharge the A/C system. (See SYSTEM CHARGING AND RECLAMATION on Page 70-130-1.)

⚠ WARNING

In the event of a leakage, wear safety goggles. Escaping refrigerant can cause severe injuries to eyes. In contact with a flame, R134a refrigerant gives a toxic gas.

W-2371-0500

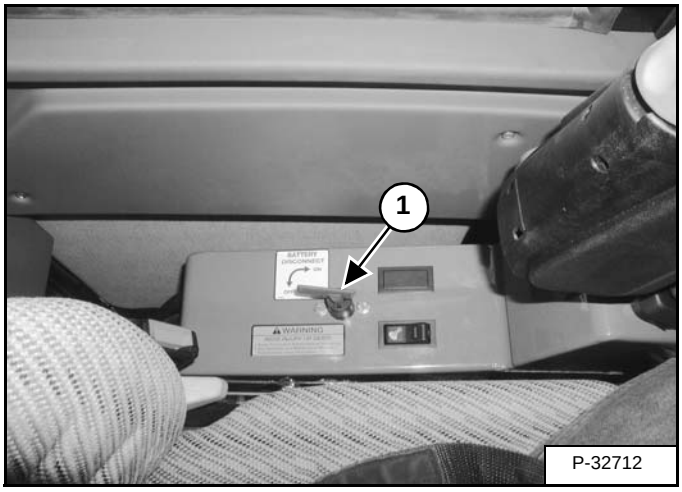
HFC 134A refrigerant can be dangerous if not properly handled. Liquid 134A may cause blindness if it contacts the eyes and may cause serious frostbite if it contacts the skin.

- **Gaseous 134A becomes lethal (phosgene) gas when it contacts open flame or very hot substances.**
- **NEVER SMOKE when there is the possibility of even small amounts of 134A in the air.**

Any servicing work that involves release or addition of 134A to the system must be done by a competent refrigeration dealer who has the proper equipment, knowledge, and experience to service refrigeration equipment.

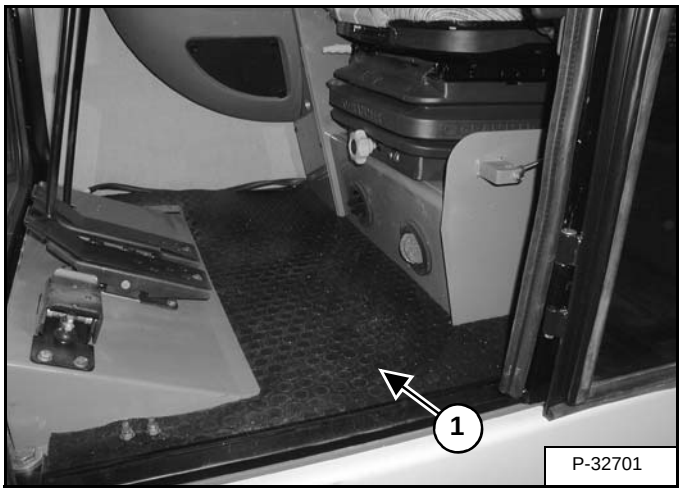
W-2373-0500

Figure 70-210-3



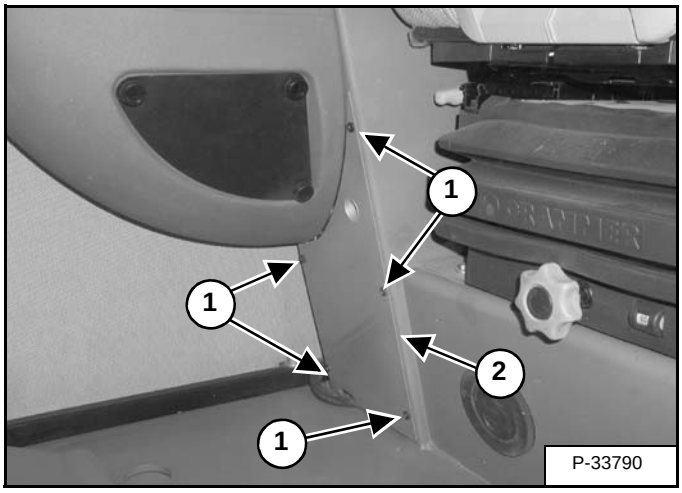
Turn the battery switch (Item 1) **[Figure 70-210-3]** to the off position.

Figure 70-210-4



Remove the floormat (Item 1) **[Figure 70-210-4]**.

Figure 70-210-5



Remove the five screws (Item 1) and right console front cover (Item 2) **[Figure 70-210-5]**.

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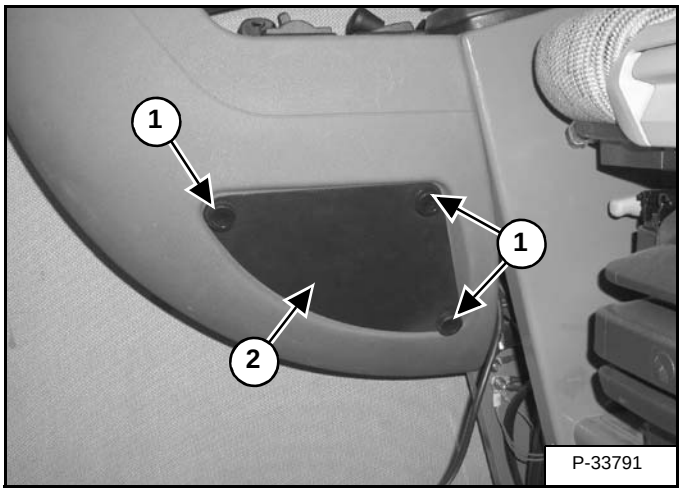
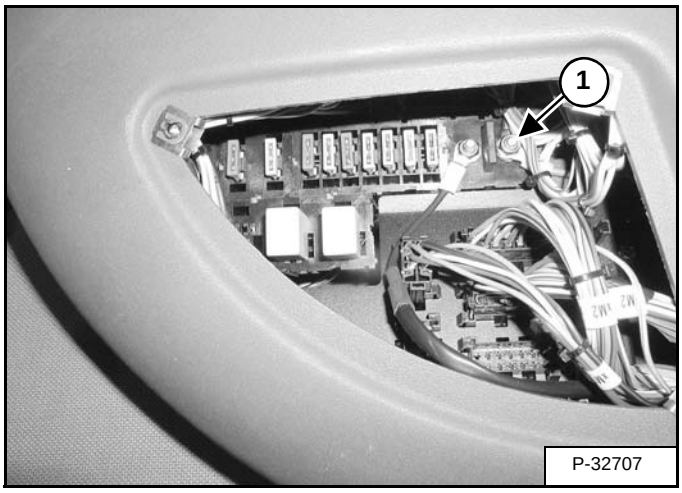
Evaporator Unit Removal And Installation (Cont'd)

Figure 70-210-6



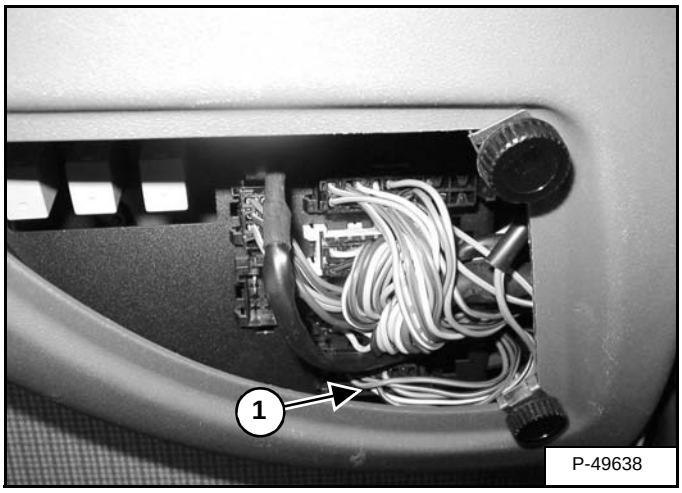
Remove the screws (Item 1) and the cover (Item 2) **[Figure 70-210-6]**.

Figure 70-210-7



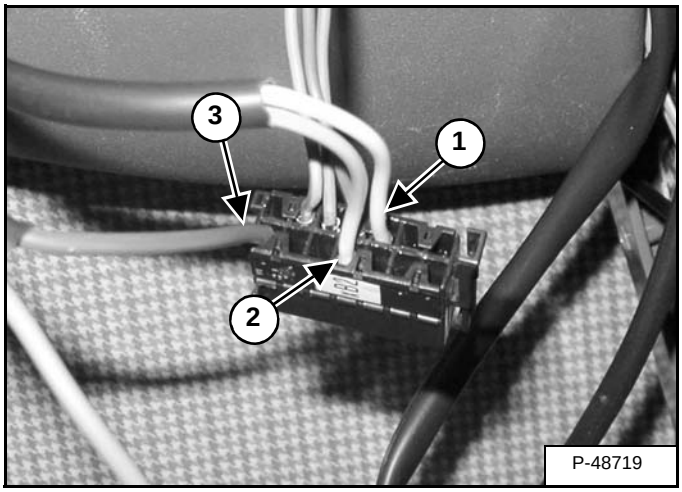
Remove the nut and wires (Item 1) **[Figure 70-210-7]**.

Figure 70-210-8



Disconnect the wire harness connector (Item 1) **[Figure 70-210-8]**.

Figure 70-210-9



Remove the yellow wire (Item 1), green wire (Item 2) and red wire (Item 3) **[Figure 70-210-9]** from the wire harness connector.

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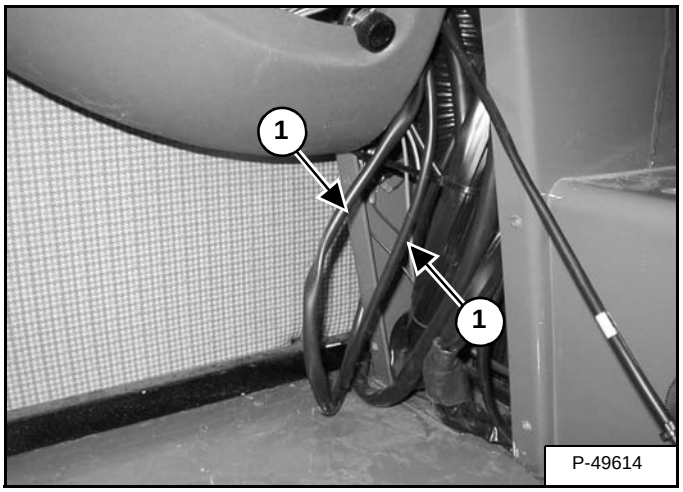
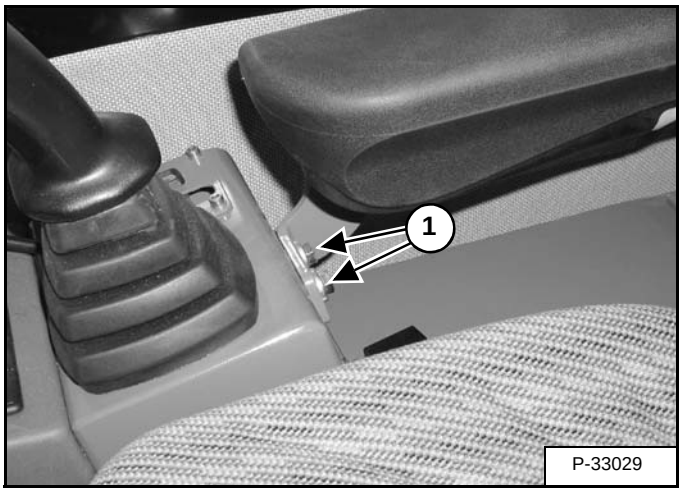
Evaporator Unit Removal And Installation (Cont'd)

Figure 70-210-10



Remove the wire harnesses (Item 1) **[Figure 70-210-10]** from the right console.

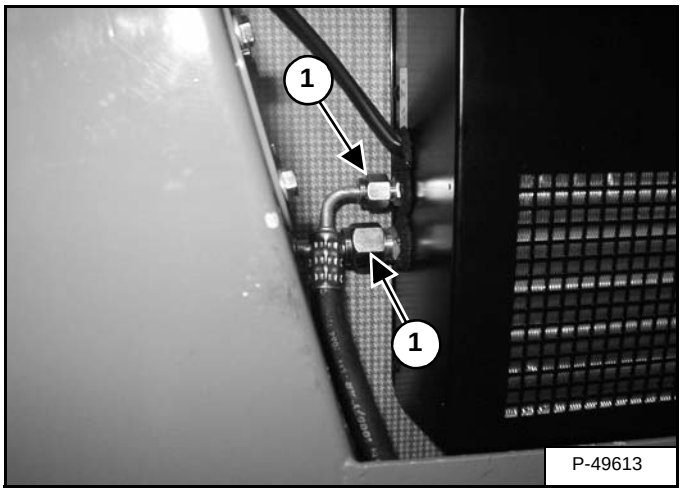
Figure 70-210-11



Remove the two bolts (Item 1) **[Figure 70-210-11]** and washers from the right arm rest. Remove the arm rest.

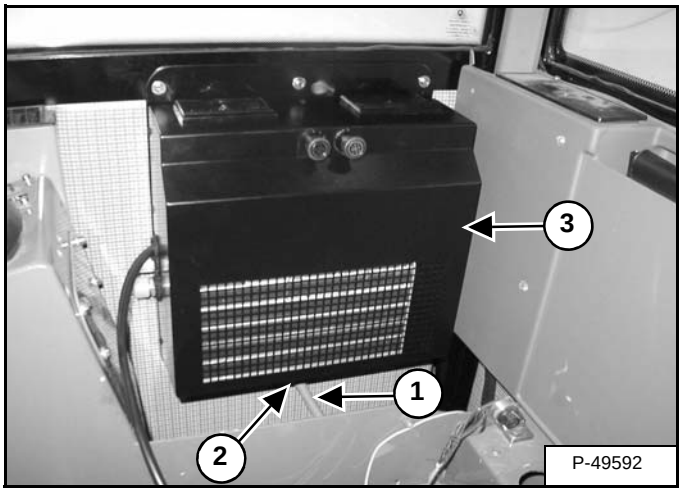
Remove the seat and seat mount. (See SEAT AND SEAT MOUNT on Page 40-30-1.)

Figure 70-210-12



Remove the two hoses (Item 1) **[Figure 70-210-12]** from the evaporator unit.

Figure 70-210-13



Remove the drain hose (Item 1) **[Figure 70-210-13]**.

Loosen the nut (Item 2) **[Figure 70-210-13]**.

Lift and remove the evaporator unit (Item 3) **[Figure 70-210-13]**.

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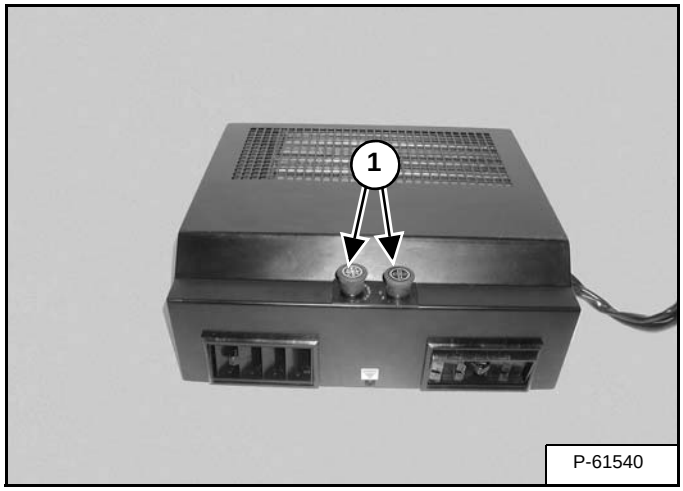
Disassembly And Assembly

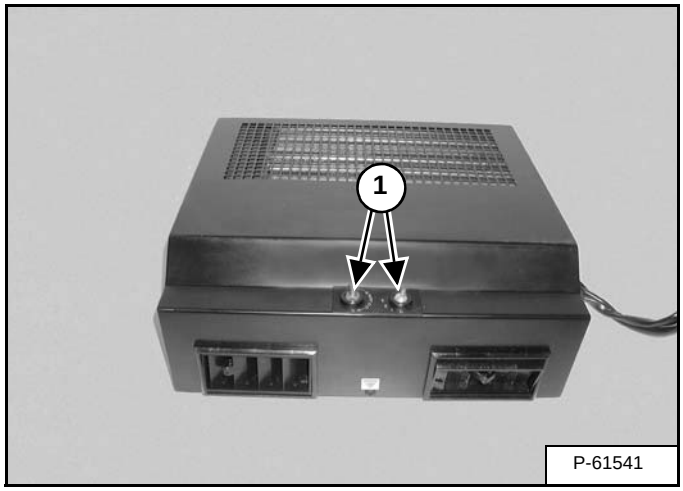
Remove the evaporator unit. (See Evaporator Unit Removal And Installation on Page 70-210-1.)

Figure 70-210-14



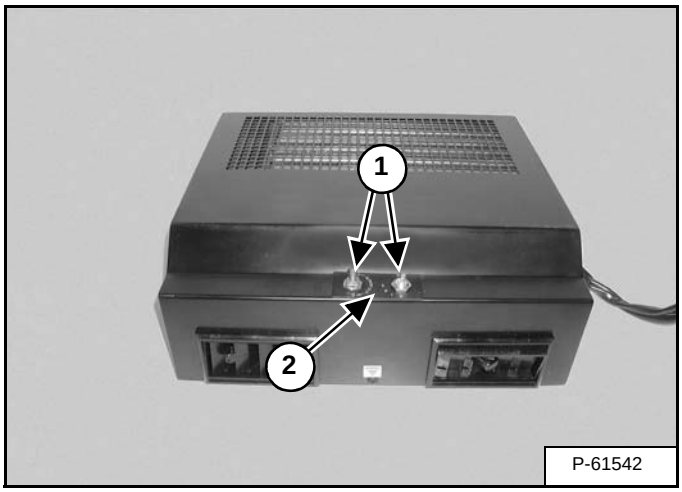
Remove the two control knobs (Item 1) **[Figure 70-210-14]**.

Figure 70-210-15



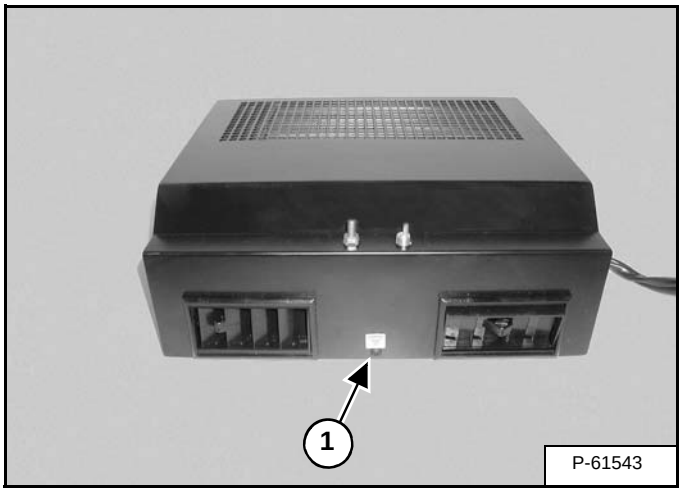
Remove the two washers (Item 1) **[Figure 70-210-15]**.

Figure 70-210-16



Remove the two nuts (Item 1) and plate (Item 2) **[Figure 70-210-16]**.

Figure 70-210-17



Remove the screw (Item 1) **[Figure 70-210-17]**.

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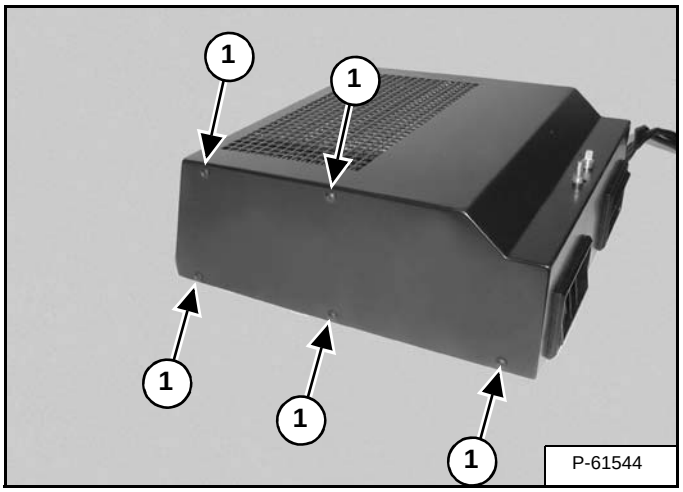
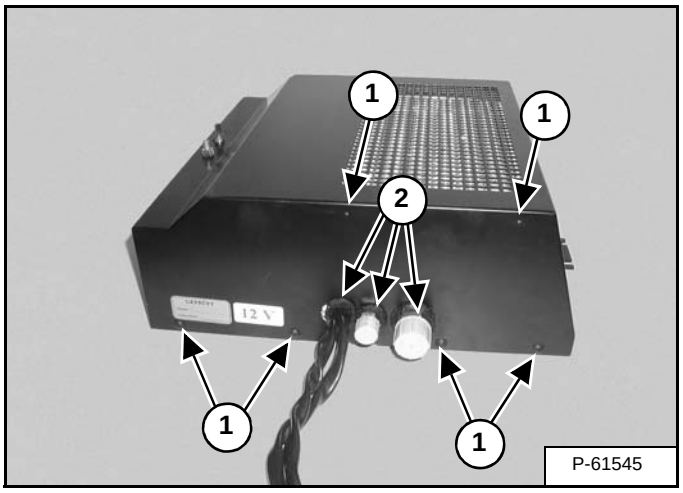
Disassembly And Assembly (Cont'd)

Figure 70-210-18



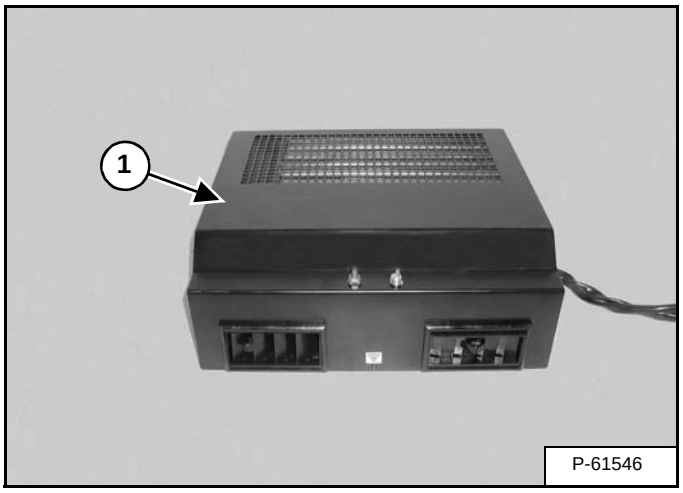
Remove the five screws (Item 1) **[Figure 70-210-18]**.

Figure 70-210-19



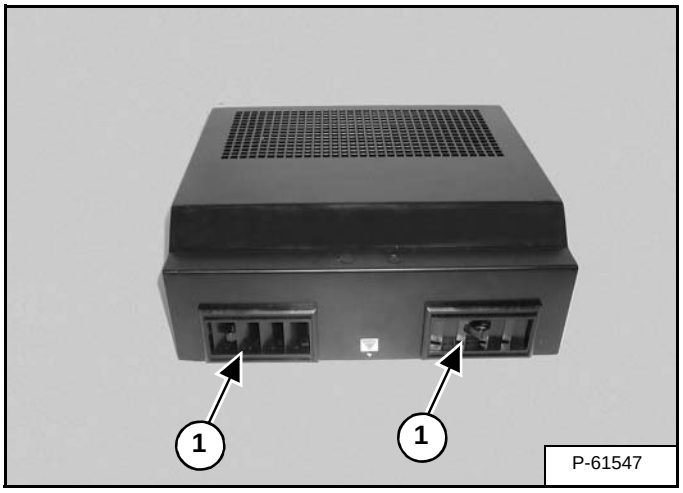
Remove the six screws (Item 1) and seals (Item 2) **[Figure 70-210-19]**.

Figure 70-210-20



Remove the cover (Item 1) **[Figure 70-210-20]**.

Figure 70-210-21



Remove the vents (Item 1) **[Figure 70-210-21]** from the cover.

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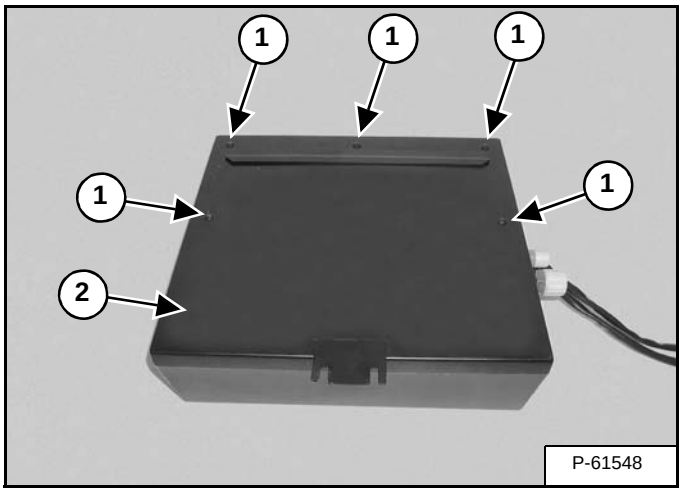
Disassembly And Assembly (Cont'd)

Figure 70-210-22



Remove the five screws (Item 1) and bottom plate (Item 2) **[Figure 70-210-22]**.

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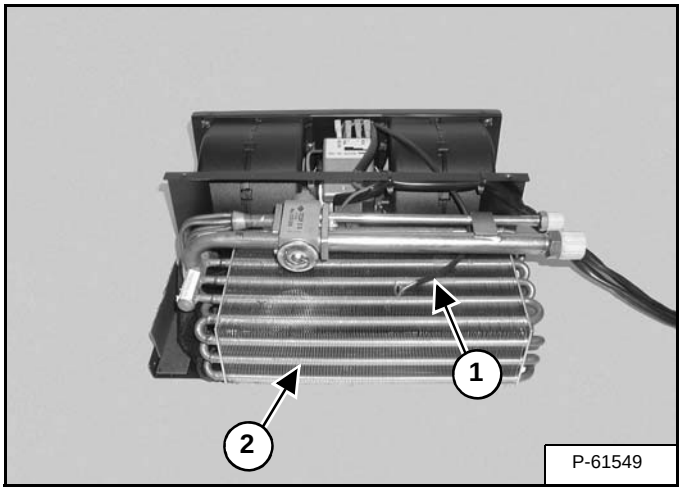
Thermostat Removal And Installation

Disassemble the evaporator unit. (See Disassembly And Assembly on Page 70-210-4.)

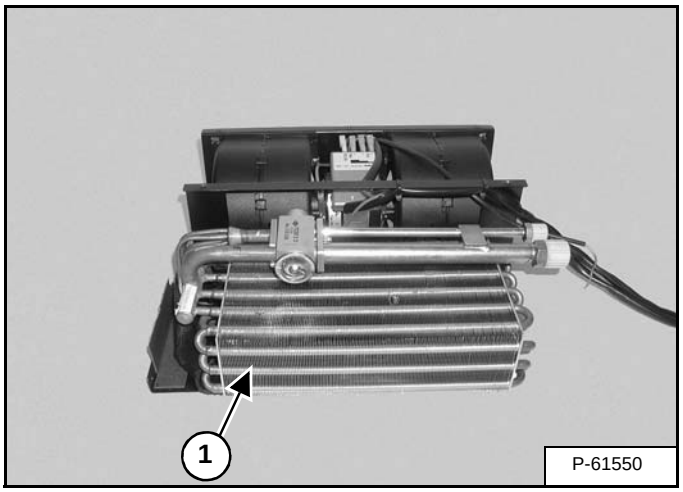
Figure 70-210-23



Remove the thermostat (Item 1) from the evaporator (Item 2) **[Figure 70-210-23]**.

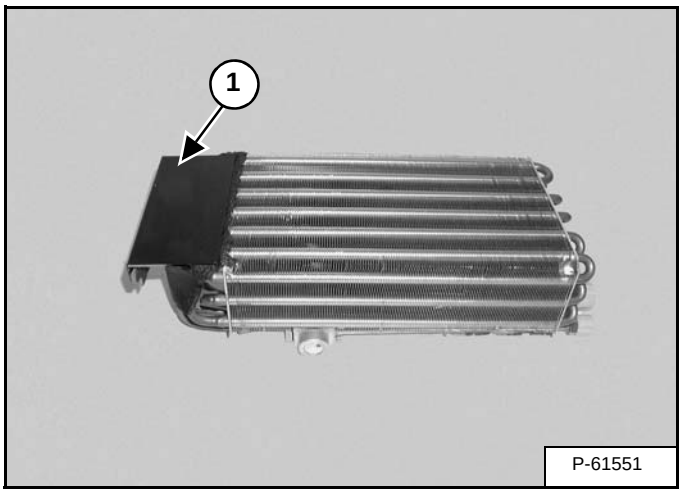
Evaporator Removal And Installation

Figure 70-210-24



Remove the evaporator (Item 1) **[Figure 70-210-24]**.

Figure 70-210-25



Remove the plate (Item 1) **[Figure 70-210-25]** from the evaporator.

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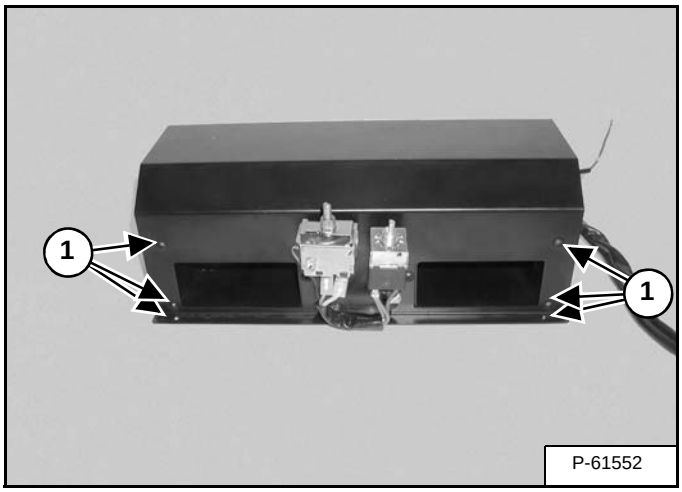
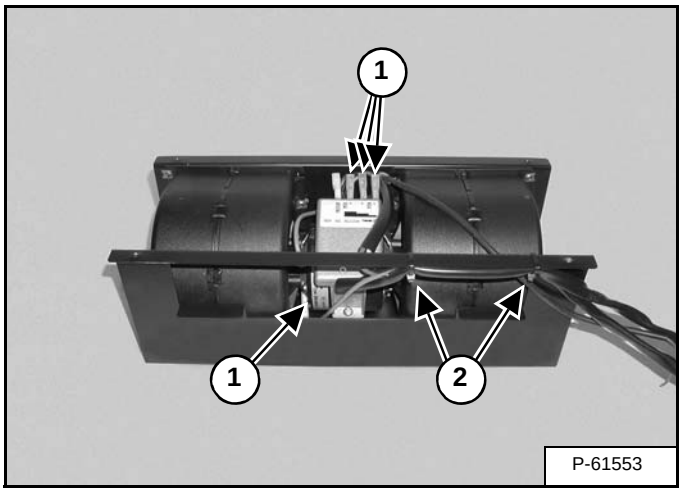
Fan Removal And Installation

Figure 70-210-26



Remove the six screws (Item 1) **[Figure 70-210-26]**.

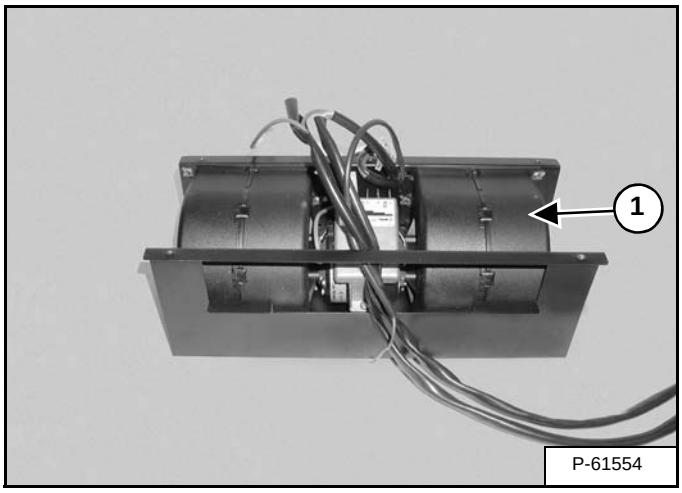
Figure 70-210-27



Mark and remove the wires (Item 1) **[Figure 70-210-27]**.

Remove the tiestraps (Item 2) **[Figure 70-210-27]**.

Figure 70-210-28

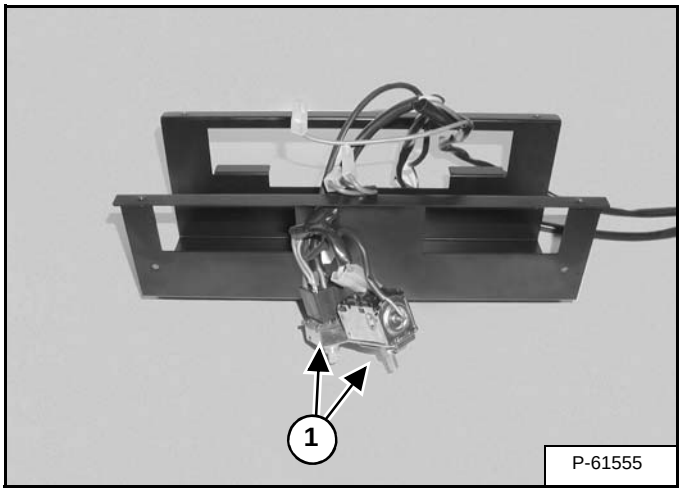


Remove the fan assembly (Item 1) **[Figure 70-210-28]** from the bracket.

NOTE: The fan/motor assembly must be replaced as a complete unit.

Switch Removal And Installation

Figure 70-210-29



Remove the switches (Item 1) **[Figure 70-210-29]**.

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SPECIFICATIONS

CONVERSIONS SPEC-80-1
Decimal And Millimeter Equivalents. SPEC-80-1
U.S. To Metric Conversion SPEC-80-2

ENGINE BOLT TORQUE (S/N 522311001 & ABOVE) SPEC-30-1
Specifications. SPEC-30-1

ENGINE BOLT TORQUE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE). SPEC-31-1
Specifications. SPEC-31-1

ENGINE SPECIFICATIONS (S/N 522311001 & ABOVE). SPEC-20-1
Camshaft And Bearings. SPEC-20-6
Connecting Rod SPEC-20-4
Crankshaft And Main Bearings SPEC-20-5
Cylinder Head and Block SPEC-20-4
Engine Balancing Shaft And Bearings. SPEC-20-6
Fuel System. SPEC-20-1
General SPEC-20-1
Governor SPEC-20-6
Oil Pump SPEC-20-6
Piston And Rings SPEC-20-3
Valve, Valve Guide and Seat Insert SPEC-20-2

ENGINE SPECIFICATIONS (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE). SPEC-21-1
Camshaft And Bearings. SPEC-21-6
Connecting Rod SPEC-21-4
Crankshaft And Main Bearings SPEC-21-5
Cylinder Head and Block SPEC-21-4
Fuel System. SPEC-21-1
General SPEC-21-1
Oil Pump SPEC-21-6
Piston And Rings SPEC-21-3
Valve, Valve Guide and Seat Insert SPEC-21-2

EXCAVATOR BOLT TORQUE. SPEC-40-1
Specifications. SPEC-40-1

FUEL, COOLANT AND LUBRICANTS SPEC-70-1
Chart (S/N 522311001 & Above) SPEC-70-1
Chart (S/N 528911001 & Above And S/N 528611001 & Above) . . . SPEC-70-3

Continued On Next Page

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SPECIFICATIONS (CONT'D)

HYDRAULIC EXCAVATOR SPECIFICATIONS. SPEC-10-1
Brakes SPEC-10-5
Capacities (S/N 522311001 & Above) SPEC-10-6
Capacities (S/N 528911001 & Above And S/N 528611001 & Above) SPEC-10-6
Controls SPEC-10-2
Digging Force. SPEC-10-6
Drive System SPEC-10-5
Electrical SPEC-10-3
Engine (S/N 522311001 & Above). SPEC-10-2
Engine (S/N 528911001 & Above And S/N 528611001 & Above) SPEC-10-3
Hydraulic Cylinders SPEC-10-4
Hydraulic Cycle Times SPEC-10-4
Hydraulic System (S/N 522311001 & Above) SPEC-10-3
Hydraulic System (S/N 528911001 & Above And S/N 528611001 & Above) SPEC-10-4
Machine Dimensions SPEC-10-1
Performance SPEC-10-2
Track SPEC-10-5
Swing System SPEC-10-4
Undercarriage SPEC-10-5

HYDRAULIC FLUID SPECIFICATIONS SPEC-60-1
Specifications. SPEC-60-1

TORQUE SPECIFICATIONS FOR BOLTS SPEC-50-1
Torque For General Metric Bolts SPEC-50-1
Torque For General SAE Bolts. SPEC-50-1

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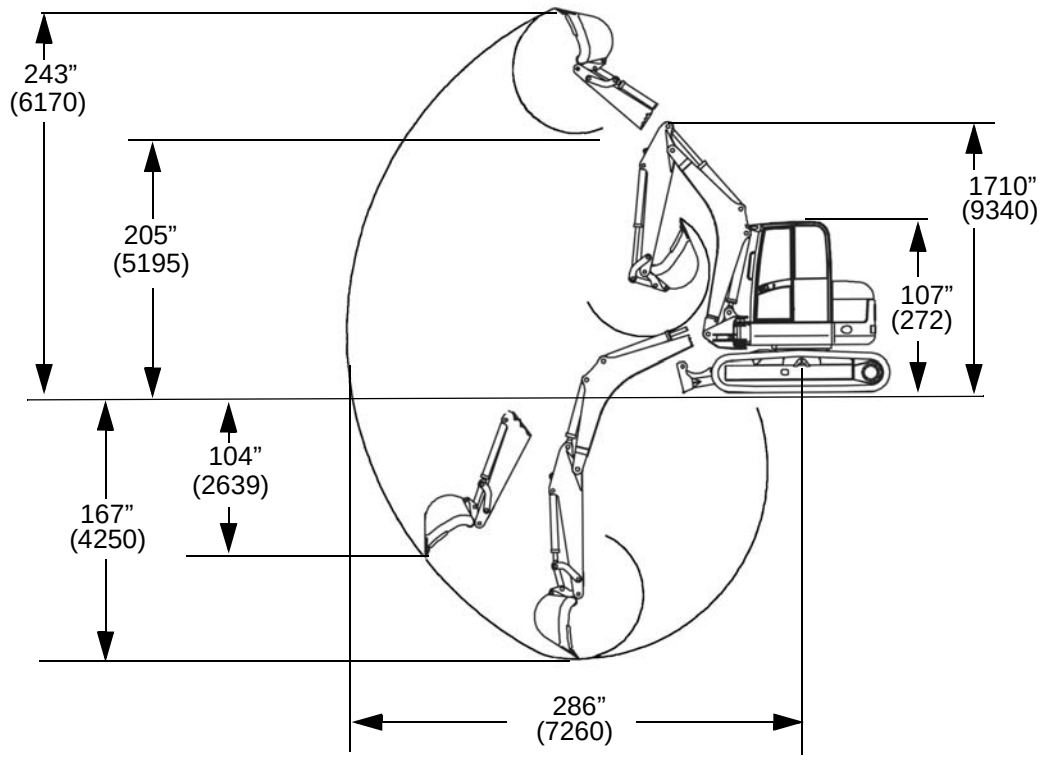
HYDRAULIC EXCAVATOR SPECIFICATIONS

Machine Dimensions

- All dimensions are shown in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.
- Where applicable, specifications conform to SAE or ISO standards. Specifications are subject to change without notice.



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Performance

Operating Weight w/Cab 24" Bucket, rubber tracks)	16534 lbs (7500 Kg)
Travel Speed	
Low	1.7 MPH (2,7 km/hr.)
High	3.2 MPH (5,2 km/hr.)

Controls

Vehicle	Two Hand or Foot Levers control speed & direction. RH console switch controls 2 speed travel.
Excavator Functions	Right and left joysticks control boom, arm, bucket, arm and swing. RH thumb switch controls auxiliary hyd. LH foot pedal controls boom swing Separate hand lever controls blade.

Engine (S/N 522311001 & Above)

Make	Deutz
Model	BF4M 1012E
Fuel	Diesel/Liquid (Antifreeze mixture)
Horsepower (SAE NET)	71 HP (53 kW) @ 2000 RPM
Maximum Governed RPM (Full Load)	NA
Maximum Torque	NA
High Idle RPM	2300 RPM
Low Idle RPM	650 RPM
No. of Cylinders	Four
Displacement	210 cu.in. (3450 cm)
Bore x Stroke	3.7 inch (94 mm) x 4.5 inch (115 mm)
Lubrication	Forced
Filter	Cartridge Type - Full Flow
Air Cleaner	Dry replaceable paper cartridge, dual element

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Engine (S/N 528911001 & Above And S/N 528611001 & Above)

Make	Deutz
Model	BF4M 2011
Fuel	Diesel/Liquid (Oil cooled)
Horsepower	73 HP (54 kW) @ 2200 RPM
Maximum Governed RPM (Full Load)	NA
Maximum Torque	NA
High Idle RPM	2200
Low Idle RPM	900
No. of Cylinders	Four
Displacement	190 cu.in. (3108 cm)
Bore x Stroke	3.7 (94 mm) X 4.4 (112 mm)
Lubrication	Pressure System W/Filter
Filter	Cartridge type - Full Flow
Air Cleaner	Dry replaceable paper cartridge, dual element

Electrical

Starter	12 Volt (2,0 kW) Reduction Drive
Alternator	14 Volt, 55 Amps, open, negative ground
Battery	12 Volt, 450 Cold Crank Amps. @ 0°F (-18°C)

Hydraulic System (S/N 522311001 & Above)

Variable Displacement Piston Pump	37.5 GPM (142 L/min)
Gear Pumps (2 combined)	17.4 GPM (66 L/min)
System Relief Settings -Gear Pump	3335 PSI (230 bar)
-Piston Pump	4060 PSI (280 bar)
Swing Blade And Boom Swing Circuits	3335 PSI (230 bar)
Bucket, Arm, Boom and Travel Circuits	4060 PSI (280 bar)
Auxiliary Flow	26.42 GPM (100 LPM)
Control Valves	Three Spool Open Center Valve, Six Spool Closed Center
Drive Motors	2 Axial Piston
Swing Motor	Piston Motor

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Hydraulic System (S/N 528911001 & Above And S/N 528611001 & Above)

Variable Displacement Piston Pump	41.2 GPM (156 L/min)
Gear Pumps (2 combined)	17.9 GPM (68 L/min)
System Relief Settings -Gear Pump	3335 PSI (230 bar)
-Piston Pump	4060 PSI (280 bar)
Swing Blade And Boom Swing Circuits	3335 PSI (230 bar)
Bucket, Arm, Boom and Travel Circuits	4060 PSI (280 bar)
Auxiliary Flow	26.4 GPM (100 LPM)
Control Valves	Three Spool Open Center Valve, Six Spool Closed Center
Drive Motors	2 Axial Piston
Swing Motor	Piston Motor

Hydraulic Cycle Times

Bucket	Curl 2.2 sec.	Dump 2.7 sec.
Arm	Retract 3.5 sec.	Extend 4.2 sec.
Boom	Raise 6.5 sec.	Lower 5.9 sec.
Boom Offset	Left 9.7 sec.	Right 9.7 sec.
Blade	Raise 2.2 sec.	Lower 2.2 sec.

Swing System

Swing Drive	Radial Piston Motor W/Brake
Swing Circle	Single Row Shear Type Ball Bearings With Internal Gear
Swing Speed	10 RPM

Hydraulic Cylinders

Cylinder	**Bore Dia. in. (mm)**	**Rod Dia. in. (mm)**	**Stroke in. (mm)**
Boom	4.7" (120 mm)	2.4" (60 mm)	33.5" (850 mm)
Arm	4.5" (115 mm)	2.8" (70 mm)	26.4" (670 mm)
Bucket	3.5" (90 mm)	2.4" (60 mm)	28.3" (720 mm)
Boom Swing	4.1" (105 mm)	2.4" (60 mm)	24.6" (625 mm)
Blade	3.9" (100 mm)	2.0" (50 mm)	7.9" (200 mm)

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Drive System

Final Drive	Each Track is Driven by an Axial Piston Motor
Type of Reduction	Two Stage Planetary Gear Reduction
Max. Drawbar Pull	13613 lbs. (60.5 KN))
Gradability	60%

Brakes

Travel	NA
Service & Parking	NA
Swing	NA
Service	Spring loaded multi disc brake applied when control lever is in neutral
Parking	NA

Undercarriage

Type	Crawler-Tractor Design, Sealed Track Rollers W/Box-Section Track Roller Frame. Grease Type Track Adjusters W/Shock Absorbing Recoil Springs.

Track

Type	Rubber (Standard)	Steel (Optional)
Width	18 inch (457 mm)	NA
No. of Shoes	NA	42
No. of Track Rollers	7	7
Ground Pressure	4.1 PSI (0.28 bar)	4.23 PSI (0.29 bar)

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Capacities (S/N 522311001 & Above)

Fuel Tank	34 Gals. (130 L)
Cooling System	3 Gals. (12 L)
Engine & Oil Filter	10.5 Qts. (10 L)
Hydraulic Reservoir	29 Gals. (110 L)
Travel Motor (Each)	1.9 Qts. (1,8 L)

Capacities (S/N 528911001 & Above And S/N 528611001 & Above)

Fuel Tank	34 Gals. (130 L)
Cooling System	10 Qts. (9.4 L)
Engine & Oil Filter	14.8 Qts. (14 L)
Hydraulic Reservoir	29 Gals. (110 L)
Travel Motor (Each)	1.9 Qts. (1,8 L)

Digging Force

Arm	NA
Bucket	NA

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ENGINE SPECIFICATIONS (S/N 522311001 & ABOVE)

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

General

Displacement	195 cu. in. (3192 cu.cm.)
Bore	3.70 (94)
Stroke	4.53 (115)
Crankshaft Rotation (Facing Flywheel)	Counterclockwise
Ignition	4 Stroke Diesel-Compression
Combustion System	Direct Injection
Compression Ratio	17.5-1
Compression	406-479 PSI (28-33 Bar)
Firing Order	1-3-4-2
Weight	728 lbs. (330 Kg)

Fuel System

Fuel Injection Pump Pressure (5 Revolutions)	NA
Injection Pump Testing Tightness (10 Seconds)	3335-3451 PSI (230-238 bar)
Injection Nozzle Opening Pressure	3625-3741 PSI (250-258 bar)

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Valve, Valve Guide and Seat Insert

Valve Clearance (Intake) Oil temp. Below 176°F (80°C)	0.012 (0,3)
Valve Clearance (Exhaust) Oil temp. Below 176°F (80°C)	0.020 (0,5)
Valve Guide I.D.	NA
Valve Rim Thickness (Intake)	0.071 (1,8)
Valve Rim Thickness (Exhaust)	0.043 (1,1)
Valve Seat Insert O.D. (Intake)	0.106 (2,7)
Valve Seat Insert O.D. (Exhaust)	0.083 (2,1)
Valve Seat Insert Bore (Intake)	NA
Valve Seat Insert Bore (Exhaust)	NA
Valve Stem Diameter (Intake)	0.308-0.314 (7,83-7,98)
Valve Stem Diameter (Exhaust)	0.307-0.313 (7,81-7,96)
Valve Stem Clearance (Intake)	0.0118 (0,3)
Wear Limit	0.004 (0,10)
Valve Stem Clearance (Exhaust)	0.020 (0,5)
Wear Limit	0.005 (0,13)
Valve Head O.D. (Intake)	1.637-1.646 (41,6-41,8)
Valve Head O.D. (Exhaust)	1.409-1.417 (35,8-36,0)
Valve Seat Width (Intake)	0.106 (2,7)
Valve Seat Width (Exhaust)	0.083 (2,1)
Seat Angle (Intake)	30°
Seat Angle (Exhaust)	45°
Valve Recess	0.055 (1,4)
Valve Spring Free Length	2.248-2.398 (57,1-60,9)
Valve Spring Inclination	NA

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

Piston And Rings

Piston Diameter	NA
I.D. for Piston Pin	NA
Piston Pin Diameter	1.338-1.339 (33,994-34,0)
Piston Ring Groove-1st	NA
Piston Ring Groove-2nd	NA
Piston Ring Groove-3rd	NA
Piston Ring Clearance-1st	NA
Wear Limit	Keystone Groove
Piston Ring Clearance-2nd	NA
Wear Limit	0.007 (0,17)
Piston Ring Clearance-3rd	NA
Wear Limit	0.004 (0,10)
Piston Ring Gap-1st	0.031 (0,8) Maximum
Wear Limit-1st	NA
Piston Ring Gap-2nd	0.098 (2,5) Maximum
Wear Limit-2nd	NA
Piston Ring Gap-3rd	0.045 (1,15) Maximum
Wear Limit-3rd	NA
Bore for Piston Pin Bushing	NA
Piston Pin Bushing O.D.	NA
Piston Pin Bushing I.D. (pressed in)	NA
Wear Limit	NA

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Connecting Rod

Small End Bushing I.D. (Pressed In)	1.338-1.340 (33,975-34,035)
Wear Limit	0.003 (0,08)
Bore for Small End Bushing	1.457-1.458 (37,0-37,02)
O.D. for Small End Bushing	1.454-1.461 (36,93-37,11)
Parallel Check	Permissible 0.0019 over a distance of 3.937 (0,05 Over 100,0)
Alignment	0.002 (0.05)
Connecting Rod Width	NA
Connecting Rod End Play	NA
Wear Limit	NA
Center Distance From Small to Large Bore	NA
Bore for Large End Bearing	2.425-2.426 (61,6-61,62)
Large End Bearing Shells I.D.	2.285-2.286 (58,03-58,07)
Limit for Undersize	2.275-2.276 (57,78-57,82)
Large End Bearing Radial Clearance	NA
Wear Limit	0.005 (0.12)
Large End Bearing Width	NA

Cylinder Head and Block

Cylinder Head Studs-Length	N/A
Cylinder Bore	3.700-3.702 (94,0-94,02)
Wear Limit	3.705 (94,1)
Cylinder Sleeves I.D. (Seated in Block)	0.351-.366 (8,92-8,95)

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Crankshaft And Main Bearings

Crankshaft Pin Width	NA
Crankshaft Pin Diameter	2.283-2.284 (57,98-58,0)
Crankshaft Pin Undersize Limit	2.263-2.264 (57,48-57,50)
Oval Wear Limit	0.003 (0.07)
Crankshaft Journal Width	1.417-1.419 (36,0-36,04)
Crankshaft Journal Diameter	2.912-2,913 (73,98-74,0)
Oval Wear Limit	0.0004 (0,01)
Eccentricity Max. Permitted	0.0028 (0,07)
Thrust Bearing Journal Width	1.417-1.419 (36,00-36,04)
Wear Limit	1.435 (36,44)
Main Bearing Shell I.D.	2.9126-2.9134 (73,98-74,0)
Radial Clearance	NA
Wear Limit	NA
Bearing Bore in Crankcase	NA
Thrust Bearing Stop Rings O.D.	NA
Oversize	NA
Limit for Oversize	NA
Crankshaft End Play	0.0039-0.0118 (0,10-0,30)
Wear Limit	NA

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Camshaft And Bearings

Camshaft End Play	NA
Wear Limit	NA
Camshaft Bearing I.D.	2.362-2.364 (60-60,054)
Wear Limit	2.365 (60,080)
Radial Clearance	NA
Cam Lift (Intake)	NA
Cam Lift (Exhaust)	NA
Camshaft Bushing Seated in Block (Flywheel End)	2.362+0.002 (60+0.054)

Oil Pump

Oil Pump Pressure Setting	NA
Min. Eng. Oil Pressure, Oil Temp.	NA
250°F (120°C) at 650 RPM	11.6 PSI (.8 bar)
1800 RPM	NA
2800 RPM	NA
Thermostat Rating	NA

Governor

Control Rod Travel (Minimum)	0.661 (16,8)

Engine Balancing Shaft And Bearings

Bearing Bushing I.D.	2.128-2.130 (54,06-54,105)
Wear Limit	2.131 (54,125)

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ENGINE SPECIFICATIONS (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

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

General

Make/Model	BF4 M 2011
Displacement	190 cu. in. (3108 cu.cm.)
Bore	3.70 (94)
Stroke	4.41 (112)
Crankshaft Rotation (Facing Flywheel)	Counterclockwise
Ignition	4 Stroke Diesel-Compression
Combustion System	Direct Injection
Compression Ratio	17.5-1
Compression	319-392 (22-27 bar)
Firing Order	1-3-4-2
Weight	551 lbs. (250 Kg)

Fuel System

Fuel Injection Pump Pressure (5 Revolutions)	NA
Injection Pump Testing Tightness	2755-2871 PSI (190-198 bar) for 10 sec.
Injection Nozzle Opening Pressure	3045-3161 PSI (210-218 bar)

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Valve, Valve Guide and Seat Insert

Valve Clearance (Intake) Oil temp. Below 176°F (80°C)	0.012 (0,3)
Valve Clearance (Exhaust) Oil temp. Below 176°F (80°C)	0.020 (0,5)
Valve Guide I.D.	N/A
Valve Rim Thickness (Intake)	0.055 (1,4)
Valve Rim Thickness (Exhaust)	0.005 (1,2)
Valve Seat Insert O.D. (Intake)	N/A
Valve Seat Insert O.D. (Exhaust)	0.083 (2,1)
Valve Seat Insert Bore (Intake)	N/A
Valve Seat Insert Bore (Exhaust)	N/A
Valve Stem Diameter (Intake)	0.3134-0.314 (7,97-7,98)
Valve Stem Diameter (Exhaust)	0.3124-0.313 (7,95-7,96)
Valve Stem Clearance (Intake)	0.0118 (0,3)
Wear Limit	0.0197 (0,5)
Valve Stem Clearance (Exhaust)	0.0197 (0,5)
Wear Limit	0.0511 (1,3)
Valve Head O.D. (Intake)	1.590-1.598 (40,4-40,6)
Valve Head O.D. (Exhaust)	1.370-1.378 (34,89-34,91)
Valve Seat Width (Intake)	0.0464-0.0827 (1,18-1,98)
Valve Seat Width (Exhaust)	0.0511-0.0827 (1,3-2,1)
Seat Angle (Intake)	30°
Seat Angle (Exhaust)	45°
Valve Recess	0.0512 (1,3)
Valve Spring Free Length 0.132" (3.35) Dia. Springs	1.53 (38,9)
Valve Spring Free Length 0.034" (3,4) Dia. Springs	1.547 (39,3)
Valve Spring Inclination	0.126 (3,2)

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

Piston And Rings

Piston Diameter	N/A
I.D. for Piston Pin	N/A
Piston Pin Diameter	1.1809-1.1811 (29,995-30,0)
Piston Ring Groove-1st	N/A
Piston Ring Groove-2nd	N/A
Piston Ring Groove-3rd	N/A
Piston Ring Clearance-1st	Keystone Groove
Wear Limit	N/A
Piston Ring Clearance-2nd	0.0078 (0,20)
Wear Limit	N/A
Piston Ring Clearance-3rd	0.0059 (0,15)
Wear Limit	N/A
Piston Ring Gap-1st	0.031 (0,8) Maximum
Wear Limit-1st	N/A
Piston Ring Gap-2nd	0.098 (2,5) Maximum
Wear Limit-2nd	N/A
Piston Ring Gap-3rd	0.043 (1,1) Maximum
Wear Limit-3rd	0.004 (0,10)
Bore for Piston Pin Bushing	N/A
Piston Pin Bushing O.D.	N/A
Piston Pin Bushing I.D. (pressed in)	N/A
Wear Limit	N/A

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Connecting Rod

Small End Bushing I.D. (Pressed In)	1.181-1.182 (30,025-30,035)
Wear Limit	0.003 (0,08)
Bore for Small End Bushing	1.299-1.2998 (33-33,02)
O.D. for Small End Bushing	1.3017-1.303 (33,07-33,11)
Parallel Check	Permissible 0.118 over a distance of 3.94 (0,03 Over 100,0)
Alignment	N/A
Connecting Rod Width	N/A
Connecting Rod End Play	N/A
Wear LImit	N/A
Center Distance From Small to Large Bore	N/A
Bore for Large End Bearing	2.303-2.3038 (58,5-58,52)
Large End Bearing Shells I.D.	2.1662-2.1675 (55,024-55,055)
Limit for Undersize	2.1466-2.1478 (54,524-54,555)
Large End Bearing Radial Clearance	0.005 (0,12)
Wear Limit	N/A
Large End Bearing Width	N/A

Cylinder Head and Block

Cylinder Head Bolts Length	5.6-6.2 (142-158)
Cylinder Bore	3.7008-3.7016 (94,0-94,02)
Wear Limit	3.59 (94,1)
Cylinder Sleeves I.D. (Seated in Block)	N/A

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Crankshaft And Main Bearings

Crankshaft Pin Width	N/A
Crankshaft Pin Diameter	2.1588-2.1596 (54,97-54,99)
Crankshaft Pin Undersize Limit	2.1445 (54,47)
Oval Wear Limit	0.0004 (0,01)
Eccentricity Max Permitted	0.0019 (0,05)
Crankshaft Journal Width	1.378-1.379 (35,0-35,04)
Oversize	1.395 (35,44)
Crankshaft Main Bearing Journal Diameter	2.7538-2.7546 (69,97-69,99)
Wear Limit	2.7348 (69,47)
Oval Wear Limit	0.0003 (0,008)
Eccentricity Max. Permitted	0.002 (0,05)
Thrust Bearing Journal Width	1.378-1.379 (35,0-35,04)
Wear Limit	1.395 (35,44)
Main Bearing Shell I.D.	2.797-2.798 (70,02-70,055)
Radial Clearance	.001-.003 (0,03-0,085)
Wear Limit	N/A
Bearing Bore in Crankcase	2.952-2,953 (75-75,019)
Thrust Bearing Journal Width	1.378-1.3796 (35-35,04)
Limit for Oversize	1.395 (35,44)
Crankshaft End Play	0.004-0.010 (0,1-0,273)
Wear Limit	0.016 (0,4)

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Camshaft And Bearings

Camshaft End Play	N/A
Wear Limit	N/A
Camshaft Bearing I.D.	N/A
Wear Limit	N/A
Radial Clearance	N/A
Cam Lift (Intake)	N/A
Cam Lift (Exhaust)	N/A
Camshaft Bushing Seated in Block	2.126-2.128 54-54,054)
Wear Limit	2.129 (54,08)

Oil Pump

Oil Pump Pressure Setting	N/A
Min. Eng. Oil Pressure, Oil Temp.	N/A
250°F (120°C) at 650 RPM	N/A
1800 RPM	N/A
2800 RPM	N/A
Thermostat Rating	N/A

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ENGINE BOLT TORQUE (S/N 522311001 & ABOVE)

Specifications

	Ft.-lb. (Nm)
Adaptor Housing Mount Bolts (M-12)	66-80 (89-109)
(M-16)	161-198 (218-268)
Air Intake Manifold Bolts	7-9 (10-12)
Alternator Bracket Mount Bolts	14-17 (19-23)
Alternator Mount Bolts	22 (30)
Breather Bolts	7-9 (10-12)
Camshaft Bolt	NA
Camshaft Thrust Washer Bolts	NA
Compressor Drive Gear Mount Nut	147-184 (200-250)
Connecting Rod Cap Bolts	22 (30)
	Plus 60 degrees, 30 degrees = 90 degrees
Coolant Pipe Mount Bolts	14-17 (19-23)
Coolant Pump Mount Bolts	14-17 (19-23)
Crankcase Breather Mount Bolts	6-7 (7,5-9,5)
Crankcase Screw Plugs	NA
Crankshaft Gear Mount Bolt	NA
Crankshaft Bearing Cap Bolt	22 (30)
	Plus 60 degrees, 30 degrees = 90 degrees
Cylinder Head Bolts Step 1	22 (30)
Step 2	59 (80)
Step 3	Plus 90 degrees
Engine Lift Bracket Mount Bolts	32-38 (43-51)
Engine Mount Bolt	48-55 (65-75)
Exhaust Manifold Nuts	17-20 (22,5-27,5)
Exhaust Turbocharger Nuts	NA
Flywheel Bolts - Step 1 30-45 mm Long	15-22 (20-30)
50-85 mm long	22-30 (30-40)
Step 2	60 degrees
Step 3 30 mm long	30 degrees
35-85 mm long	60 degrees
Flywheel Pulley Mount Bolts	
Step 1	29-37 (40-50)
Step 2 - 60 mm long	60 degrees
- 80 mm long	60 degrees
Step 3 - 60 mm long	30 degrees
- 80 mm long	60 degrees
Front Cover Bolts	14-17 (19-23)
Fuel Filter Bracket Bolts	NA
Fuel Filter Line Fittings	33-41 (45-55)

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ENGINE BOLT TORQUE (S/N 522311001 & ABOVE) (CONT'D)

Specifications (Cont'd)

	Ft.-lb. (Nm)
Fuel Clamping Plate Pump Bolts	15-18 (20-24)
Fuel Shut Off Solenoid Bolts	15 (21)
Glow Plugs	13-16 (18-22)
Governor Control Rod Bolts	7-9 (10-12)
Governor Drive Gear Mount Bolt	16 (21)
Governor Mount Bolts	11-14 (15,5-18,5)
Governor Mount Bolt Retaining Plate Bolts	14-17 (19-23)
Idler Pulley Mount Nut	14-17 (19-23)
Injector Clamping Pad Bolts	12-15 (16-21)
Injector Line Cap Nut	18-21 (25-28,5)
Injector Pump Mount Bolts	
Step 1	5 (7)
Step 2	7 (10)
Step 3	22 (30)
Main Bearing Cap Bolts	22 (30)
	Plus 60 degrees, 60 degrees = 120 degrees
Oil Cooler Collar Screws (Initial)	59 (80)
(Final)	118 (160)
Oil Cooler Mount Bolts	14-17 (19-23)
Oil Cooler Plugs	59 (80)
Oil Pan Mount Bolts (Steel)	14-17 (19-23)
(Cast)	20-23 (27-31)
Oil Pan Drain Plug	6-7 (8-9)
Oil Pump Mount Bolts	6-7 (8-9)
Oil Pressure Control Valve	27-32 (36-44)
Oil Pressure Pipe (Top)	19-24 (26-32)
(Bottom)	26-32 (35-43)
Oil Pressure Switch	12-15 (16-20)
Oil Return Line Cap Nut	NA
Oil Return Pipe	28-31 (38-42)
Oil Suction Pipe	14-17 (19-23)
Oil Temperature Switch	N.A
Overflow Valve	22 (30)
Rocker Arm Cylinder Head Bolts	15 (21)
Rocker Arm Bolts	NA
Rocker Arm Set Screw Locknut	13-16 (18-22)
Starter Collar Nut	30 (40)
Starter Mount Bolts	52 (70)

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Specifications (Cont'd)

	Ft.-lb. (Nm)
Speed Sensor	6-7 (8-10)
Timing Belt Tensioner Pulley Nut	NA
Timing Cover Mount Bolts	14-17 (19-23)
Turbocharger Mount Bolts	14-17 (19-23)
Turbocharger Cover Mount Bolts	7 (9)
Turbocharger Rotor And Pulley Mount Nut	89 (120)
Valve Adjustment Locknut	13-16 (18-22)
Valve Cover Bolts	6-7 (8-10)
V-Belt Pulley Bolts	16 (21)
Vibration Damper Pulley Mount Bolts	NA
Step 1	30-37 (40-50)
Step 2 - 60 mm long	60 degrees
80 mm long	60 degrees
Step 3 - 60 mm long	30 degrees
80 mm long	60 degrees
Water Pump Mount Bolts	14-17 (19-23)
Water Temperature Sensor	12-15 (16-20)

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ENGINE BOLT TORQUE (S/N 528911001 & ABOVE AND S/N 528611001 & ABOVE)

Specifications

	Ft.-lb. (Nm)
Air Intake Manifold Bolts	15 (21)
Alternator Bracket Mount Bolts	N/A
Alternator Mount Bolts	N/A
Breather Pipe Bolts	6 (8,5)
Camshaft Bolt	
Step 1	22 (30)
Step 2	Plus 210 Degrees
Camshaft Gear Mount Bolt	22 (30) Plus 210 Degrees
Camshaft Thrust Washer Bolts	15 (21)
Connecting Rod Cap Bolts	22 (30)
	Plus 60 degrees, 60 degrees = 120 degrees
Crankshaft Gear Mount Bolt	96 (130) plus 210 degrees
Crankshaft Bearing Cap Bolt	37 (50)
	Plus 60 degrees, 45 degrees = 105 degrees
Cylinder Head Bolts	
Step 1	22 (30)
Step 2	59 (80)
Step 3	118 (160)
Step 4	Plus 90 degrees
Engine Mount Bolts	48-55 (65-75)
Exhaust Manifold Bolts	41 (55)
Exhaust Turbocharger Nuts	N/A
Flywheel Bolts	
Step 1	22 (30)
Step 2	60 degrees
Step 3	30 degrees
Flywheel Pulley Mount Bolts	
Step 1	22 (30)
Step 2	60 degrees
Step 3	30 degrees
Front Cover Bolts	15 (21)
Front Cover Stop Nut	3 (4,5)
Fuel Filter Bracket Bolts	15 (21)
Fuel Line Bolts	20-23 (27-31)

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Specifications (Cont'd)

	Ft.-lb. (Nm)
Fuel Lift Pump Bolts	15 (21)
Fuel Shut Off Solenoid Bolts	10-12 (13,5-16,3)
Governor Lever Shaft Bolts	7 (9,2)
Governor Cover Bolts	3 (4,5)
Governor Mount Bolts	7 (9,2)
Idle Speed Bolts	3-4 (4,2-5)
Idler Pulley Mount Bolts	33 (45)
Injector Clamping Pad Bolts	16 (21)
Injector Line Cap Nut	10-12 (13,5-16,5)
Injector Line Clamping Pad Bolts	16 (21)
Injector Nozzle Cap Nut	29-37 (40-50)
Injector Pump Mount Bolts	15 (21)
Main Bearing Cap Bolts	37 (50)
	Plus 60 degrees, 45 degrees = 105 degrees
Minimum Speed Screw Lock Nut	3 (4,5)
Oil Pan Mount Bolts (Steel)	15 (21)
(Cast) 30 mm long)	16 (21)
(Cast 55 mm long)	16 (21)
Oil Pan Drain Plug	40 (55)
Oil Pump Mount Bolts	14-17 (18,9-23,1)
Oil Pressure Pipe	82 (111)
Oil Pressure Switch	8-11 (11,5-14,5)
Oil Return Clamping Pad	6 (8,5)
Oil Return Pipe	30 (40)
Oil Suction Pipe	15 (21)
Oil Temperature Sensor	17-20 (22,5-27,5)
Oil Temperature Switch	17-21 (22,5-27,5)
Rear Cover Bolts	15 (21)
Rocker Arm Bracket Bolts	15 (21)
Starter Mount Bolts	32 (43,5)

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Specifications (Cont'd)

	Ft.-lb. (Nm)
Thermostat	55 (75)
Timing Belt Tensioner Pulley Nut	14-17 (19-23)
Torque Control Clamp Nut	7 (10)
Torque Control Locknut	12 (16)
Turbocharger Carrier Mount Bolts	15 (21))
Turbocharger Vent Pipe Bolts	
Step 1	6 (8,5)
Step 2	9 (12,5)
Turbocharger Oil Line Bolt	21 (29)
V-Belt Pulley Bolts	28-34 (38-46)
Valve Adjustment Lock Nut	13-16 (18-22)
Valve Cover Bolts	6 (8,5)

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EXCAVATOR BOLT TORQUE

Specifications

	S/N 522311001 & Above	S/N 528911001 & Above S/N 528611001 & Above
	Ft.-lb. (Nm)	**Ft.-lb. (Nm)**
Air Cleaner Mount Bolts	18-19 (24-26)	18-19 (24-26)
Backup Relief Valve	52 (70)	52 (70)
Control Valve Mount Bolts (6 spool)	48-55 (65-75)	48-55 (65-75)
(3 spool)	32-35 (43-47)	32-35 (43-47)
Drive Sprockets	177-203 (240-275)	177-203 (240-275)
Engine Mount Bolts	48-55 (65-75)	48-55 (65-75)
Exhaust Pipe To Exhaust Manifold Mount Bolts	NA	NA
Filter Housing Mount Bolts	NA	NA
Front Panel Bolts	NA	NA
Hydraulic Pump Drive Coupler Mount Bolts	36 (49)	15-18 (20-25)
Hydraulic Pump Mount Bolts (Piston Pump)	125-140 (170-190)	125-140 (170-190)
(Gear Pump)	22-26 (30-35)	48-55 (65-75)
Hydraulic Reservoir Mount Bolts	NA	NA
Main Relief Valve	46-57 (63-77)	46-57 (63-77)
Load Sense Relief Valve	18 (25)	18 (25)
Operator Cab Mount Bolts/ Nuts (Front And Rear)	81-92 (110-125)	81-92 (110-125)
(Side Bolts)	48-55 (65-75)	48-55 (65-75)
Pivot Pin	NA	NA
Seat Belt Mount Bolts	NA	NA
Seat Mount Bolts	NA	NA

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TORQUE SPECIFICATIONS FOR BOLTS

Torque For General SAE Bolts

The following table shows standard torque specifications for bolts with zinc phosphate coating. Bolts purchased from Melroe 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 (5830-6500)
	2.000	3800-4200 (5150-5700)	6500-7200 (8800-9800)

Torque For General Metric Bolts

Nominal Diameter	Grade	Standard Screw and Bolt 4			Special Screw and Bolt 7		
	Unit	Nm	kfg m	ft lbs	Nm	kgf 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

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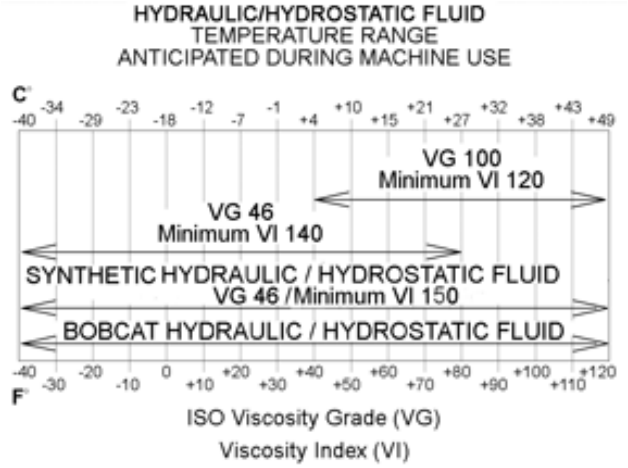
HYDRAULIC FLUID SPECIFICATIONS

Specifications

Use Bobcat hydraulic fluid (P/N 6903117 - 2, 2 1/2 Gal.), (P/N 6903118 - 5 Gal.), (P/N 6903119 - 55 Gal.).



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.

W-2027-1285

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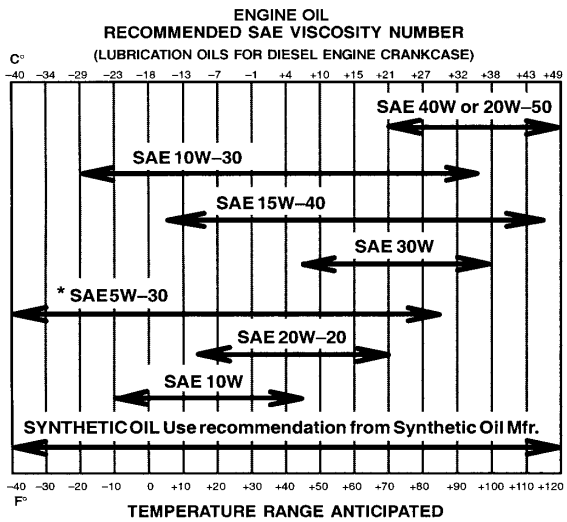
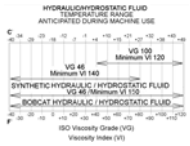
FUEL, COOLANT AND LUBRICANTS

Chart (S/N 522311001 & Above)

Use this chart for correct selection of Fuel, Coolant and Lubricants.

RESERVOIR	KIND OF FLUID	RECOMMENDED SAE VISCOSITY NUMBER (LUBRICATION OILS FOR DIESEL ENGINE CRANKCASE)	CAPACITY REFILL
Engine oil	*Use SAE Viscosity Number as Listed With API Classification CD or Better		10.5 qts. (10 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%	34 gal. (130 L)
Cooling System	***Coolant Mixture		3 gal. (12,0 L)
Hydraulic Tank	Bobcat Fluid		Tank Cap. 29 gal. (110 L)
Drive Motors (each side)	Gear Lube	SAE - 80 W-90 LS	1.9 qts. (1,8 L)

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***ENGINE OIL SPECIFICATIONS*

When fuel sulphur content is less than 0.5% change the engine oil and filter as shown in the Service Schedule (See SERVICE SCHEDULE on Page 10-50-1.)

Change engine oil and filter according to the following chart if fuel sulphur content is above 0.5%.

FUEL SULPHUR CONTENT	CHANGE INTERVAL OF ENGINE & OIL FILTER
0.5 - 1.0%	1/2 of Regular Interval
Above 1.0%	1/4 of Regular Interval

*** *COOLANT MIXTURE*

Ethylene Glycol (Factory Installed)

Add premixed coolant; 50% water and 50% ethylene glycol to the surge tank if the coolant level is low.

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

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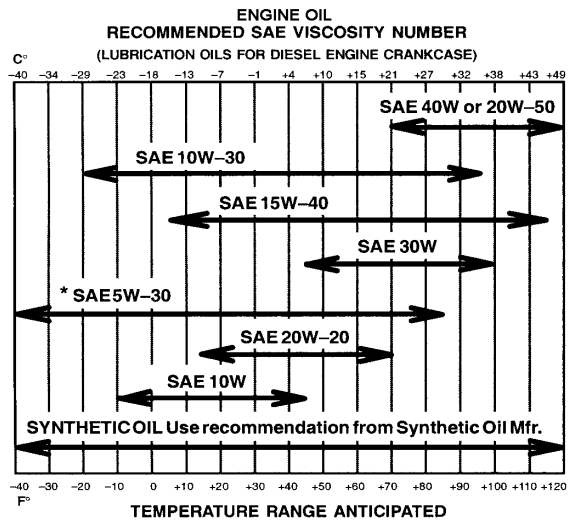
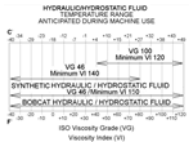
FUEL, COOLANT AND LUBRICANTS (CONT'D)

Chart (S/N 528911001 & Above And S/N 528611001 & Above)

Use this chart for correct selection of Fuel, Coolant and Lubricants.

RESERVOIR	KIND OF FLUID	RECOMMENDED SAE VISCOSITY NUMBER (LUBRICATION OILS FOR DIESEL ENGINE CRANKCASE)	CAPACITY REFILL
Engine oil/ Engine coolant	*Use SAE Viscosity Number as Listed With API Classification CD or Better		14.8 qts. (14 L) System Capacity 10 qts (9.4 L) w/ filter oil change
Fuel	**Diesel Fuel	**Temp. F°** — **No. 2** — **No.1** +15° (9°) — 100% — 0% Down to -20° (-29°) — 50% — 50% Below -20° (-29°) — 0% — 100%	34 gal. (130 L)
Hydraulic Tank	Bobcat Fluid		Tank Cap. 29 gal. (110 L)
Drive Motors (each side)	Gear Lube	SAE - 80 W-90 LS	1.9 qts. (1,8 L)

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***ENGINE OIL SPECIFICATIONS*

When fuel sulphur content is less than 0.5% change the engine oil and filter as shown in the Service Schedule (See SERVICE SCHEDULE on Page 10-50-1.)

Change engine oil and filter according to the following chart if fuel sulphur content is above 0.5%.

FUEL SULPHUR CONTENT	CHANGE INTERVAL OF ENGINE & OIL FILTER
0.5 - 1.0%	1/2 of Regular Interval
Above 1.0%	1/4 of Regular Interval

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CONVERSIONS

Decimal And Millimeter Equivalents

FRACTIONS	DECIMALS	MM	FRACTIONS	DECIMALS	MM
1/64	0.015625	0.397	33/64	0.515625	13.097
1/32	0.03125	0.794	17/32	0.53125	13.494
3/64	0.046875	1.191	35/64	0.546875	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.078125	1.984	37/64	0.578125	14.684
3/32	0.09375	2.381	19/32	0.59375	15.081
7/64	0.109375	2.778	39/64	0.609375	15.478
1/8	0.1250	3.175	**5/8**	0.6250	15.875
9/64	0.140625	3.572	41/64	0.640625	16.272
5/32	0.15625	3.969	21/32	0.65625	16.669
11/64	0.171875	4.366	43/64	0.671875	17.066
3/16	0.1876	4.762	11/16	0.6875	17.462
13/64	0.203125	5.159	45/64	0.703125	17.859
7/32	0.21875	5.556	23/32	0.71875	18.256
15/64	0.234375	5.953	47/64	0.734375	18.653
1/4	0.2500	6.350	**3/4**	0.7500	19.050
17/64	0.265625	6.747	49/64	0.765625	19.447
9/32	0.28125	7.144	25/32	0.78125	19.844
19/64	0.296875	7.541	51/64	0.796875	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.328125	8.334	53/64	0.828125	21.034
11/32	0.34375	8.731	27/32	0.84375	21.431
23/64	0.359375	9.128	55/64	0.859375	21.828
3/8	0.3750	9.525	**7/8**	0.8750	22.225
25/64	0.390625	9.922	57/64	0.890625	22.622
13/32	0.40625	10.319	29/32	0.90625	23.019
27/64	0.421875	10.716	59/64	0.921875	23.416
7/16	0.4375	11.112	15/16	0.9375	23.812
29/64	0.453125	11.509	61/64	0.953125	24.209
15/32	0.46875	11.906	31/32	0.96875	24.606
31/64	0.484375	12.303	63/64	0.984375	25.003
1/2	0.5000	12.700	**1**	1.000	25.400

1 mm = 0.03937” **0.001 = 0.0254 mm**

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CONVERSIONS (CONT'D)

U.S. To Metric Conversion

	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	
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SERVICE MANAGER	☒
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NOTICE **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: **442-1**
Date: **November 7, 2002**
Product: **Bobcat Excavator**
Model: **442**
Manual No: **6901801 (9-02)**

The following pages are a revision to the above Service Manual.

Take out existing pages and put in the new pages as listed below:

TAKE OUT	PUT IN	CHANGE DECRIPTION
	Alphabetical Index	Added
10-01, 10-02	10-01, 10-02	Text change
10-130-1, 10-130-2	10-130-1, 10-130-2	Text change
10-140-1, 10-140-2	10-140-1, 10-140-2	Text change
10-150-1 through 10-150-6	10-150-1, 10-150-2	Text change
	10-160-1 through 10-160-6	Added section
20-01 through 20-06	20-01 through 20-06	Text change
20-34-1 through 20-34-8	20-34-1 through 20-34-6	Text change
20-80-1, 20-80-2	20-80-1 through 20-80-6	Text change
20-100-1, 20-100-2	20-100-1through 20-100-4	Text change
30-01, 30-02	30-01, 30-02	Text change
30-30-1, 30-30-2		Procedure moved to Section 40
40-01, 40-02	40-01, 40-02	Text change
40-10-1, 40-10-2	40-10-1 through 40-10-8	Text change
40-20-1 through 40-20-8	40-20-1 through 40-20-8	Text change
40-30-1, 40-30-2	40-30-1, 40-30-2	Text change
40-80-1, 40-80-2	40-80-1 through 40-80-4	Text change
	40-110-1, 40-110-2	Section added
40-170-1 through 40-170-4	40-170-1 through 40-170-4	Text change
40-180-1, 40-180-2		Remove duplicated section
40-190-1, 40-190-2		Remove duplicated section
40-200-1, 40-200-2		Remove duplicated section
50-01, 50-02	50-01, 50-02	Text change
50-50-1, 50-50-2	50-50-1through 50-50-4	Text change

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TAKE OUT	PUT IN	CHANGE DECRIPTION
60-01, 60-02	60-01, 60-02	Text change
60-20-1, 60-20-2	60-20-1 through 60-20-4	Text change
70-01, 70-02	70-01, 70-02	Text change
70-20-1, 70-20-2	70-20-1 through 70-20-4	Text change
70-30-1, 70-30-2	70-30-1, 70-30-2	Text change
70-40-1 through 70-40-4	70-40-1 through 70-40-4	Text change
70-50-1, 70-50-2	70-50-1, 70-50-2	Text change
70-170-1, 70-170-2	70-170-1, 70-170-2	Text change
70-180-1, 70-180-2	70-180-1, 70-180-2	Text change
70-190-1, 70-190-2	70-190-1, 70-190-2	Text change
70-200-1, 70-200-2	70-200-1, 70-200-2	Text change
70-210-1, 70-210-2		Procedure moved to 70-200-1
70-220-1, 70-220-2		Procedure combined with 70-180-1

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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: **442-2**
Date: **January 15, 2003**
Product: **Bobcat Excavator**
Model: **442**
Manual No: **6901801 (9-02)**

The following pages are a revision to the above Service Manual.

Take out existing pages and put in the new pages as listed below:

TAKE OUT	PUT IN	CHANGE DESCRIPTION
Alphabetical Index	Alphabetical Index	Text change
Hyd/Hyd Schematic	Hyd/Hyd Schematic	Minor corrections to legend
442 Excavator	442 Excavator	and schematic
(S/N 522311001 & Above)	(S/N 522311001 & Above)	
(Printed September 2002)	(Printed January 2003)	
20-120-1, 20-120-2	20-120-1, 20-120-2	Text change
20-130-1, 20-130-2	20-130-1 through 20-130-6	Text change
30-01, 30-02	30-01, 30-02	Text change
30-20-1 through 30-20-6	30-20-1 through 30-20-8	Text change
	30-30-1 through 30-30-4	Section added
	30-40-1 through 30-40-10	Section added
	30-50-1 through 30-50-8	Section added
	30-60-1 through 30-60-10	Section added
	30-70-1 through 30-70-4	Section added
	30-80-1 through 30-80-10	Section added
40-01, 40-02	40-01, 40-02	Text change
40-20-1 through 40-20-8	40-20-1 through 40-20-20	Text change
40-50-1, 40-50-2	40-50-1, 40-50-2	Text change
40-90-1, 40-90-2	40-90-1, 40-90-2	Text change
40-160-1, 40-160-2	40-160-1 through 40-160-4	Text change
50-01, 50-02	50-01, 50-02	Text change
50-40-1, 50-40-2	50-40-1, 50-40-2	Text change
	50-90-1, 50-90-2	Section added
	50-100-1, 50-100-2	Section added

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TAKE OUT	PUT IN	CHANGE DESCRIPTION
70-01, 70-02	70-01, 70-02	Text change
70-130-1, 70-130-2	70-130-1 through 70-130-4	Text change
70-200-1, 70-200-2	70-200-1, 70-200-2	Text change

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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: **442-3**
Date: **15 November 2004**
Product: **Bobcat Excavator**
Model: **442**
Manual No: **6901801 (9-02)**

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
Cover	Cover	S/N Added
10-01	10-01	Text Change
10-20	10-20	Text Change
10-40	10-40	Text Change
	10-41	Added Section
10-50	10-50	Text Change
10-60	10-60	Text Change
	10-61	Added Section
	10-62	Added Section
10-70	10-70	Text Change
10-80	10-80	Text Change
10-90	10-90	Text Change
10-100	10-100	Text Change
10-140	10-140	Text Change
10-150	10-150	Text Change
	10-151	Added Section
Hyd/Hyd Schematic Printed January 2003 MS1433	Hyd/Hyd Schematic Printed November 2004 MS1433	Revised Schematic
	Hyd/Hyd Schematic Printed November 2004 V-0621	Added Schematic

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TAKE OUT	PUT IN	CHANGE DESCRIPTION
20-01	20-01	Text Change
20-40	20-40	Text Change
20-50	20-50	Text Change
20-51	20-51	Text Change
	20-52	Added Section
	20-53	Added Section
20-60	20-60	Text Change
	20-61	Added Section
20-101	20-101	Text Change
	20-102	Added Section
20-160	20-160	Text Change
20-170	20-170	Text Change
	20-171	Added Section
30-01	30-01	Text Change
30-20	30-20	Text Change
50-01	50-01	50-01
50-10	50-10	50-10
	Electrical Schematic Printed November 2004 V-0616, V-0617, V-0618, V-0619, V-0620	Added Schematics
60-01	60-01	Text Change
60-10	60-10	Text Change
60-20	60-20	Text Change
	60-21	Added Text
60-40	60-40	Text Change
	60-41	Added Section
60-60	60-60	Text Change
	60-61	Added Section
60-70	60-70	Text Change
	60-71	Added Section
	60-81	Added Section

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ROUTE TO ATTENTION	
PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

NOTICE **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: 442-4
Date: 15 April 2005
Product: Bobcat Excavator
Model: 442
Manual No: 6901801 (4-05)

Please discard your old 442 Bobcat Excavator Service Manual (P/N 6901801) Dated 9-02 and replace it with the revised 442 Bobcat Excavator Service Manual (P/N 6901801) Dated 4-05.

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SERVICE MANUAL REVISION

NOTICE — **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: 442-5
Date: 24 March 2006
Product: Bobcat Excavator
Model: 442
Manual No: 6901801 (4-05)

442 Service Manual (P/N 6901801) Dated (2-06) contains updated service information which replaces the previous 442 Service Manual (P/N 6901801) Dated (4-05)

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SERVICE MANUAL REVISION

NOTICE **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: **442-6**
Date: **12 July 2006**
Product: **Bobcat Excavator**
Model: **442**
Manual No: **6901801 (2-06)**

The following Sections are a revision to the above Service Manual.

Cover	
20-50 20-52 20-70 20-80	
Spec-10	

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SERVICE MANUAL REVISION

NOTICE **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: **442-7**
Date: **15 November 2007**
Product: **Bobcat Excavator**
Model: **442**
Manual No: **6901801 (11-07)**

The following Sections are a revision to the above Service Manual

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COVER
ALPHABETICAL INDEX
FOREWORD

HYDRAULIC / HYDROSTATIC SCHEMATICS

ELECTRICAL SCHEMATICS
Section 60-01
Section 60-51

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