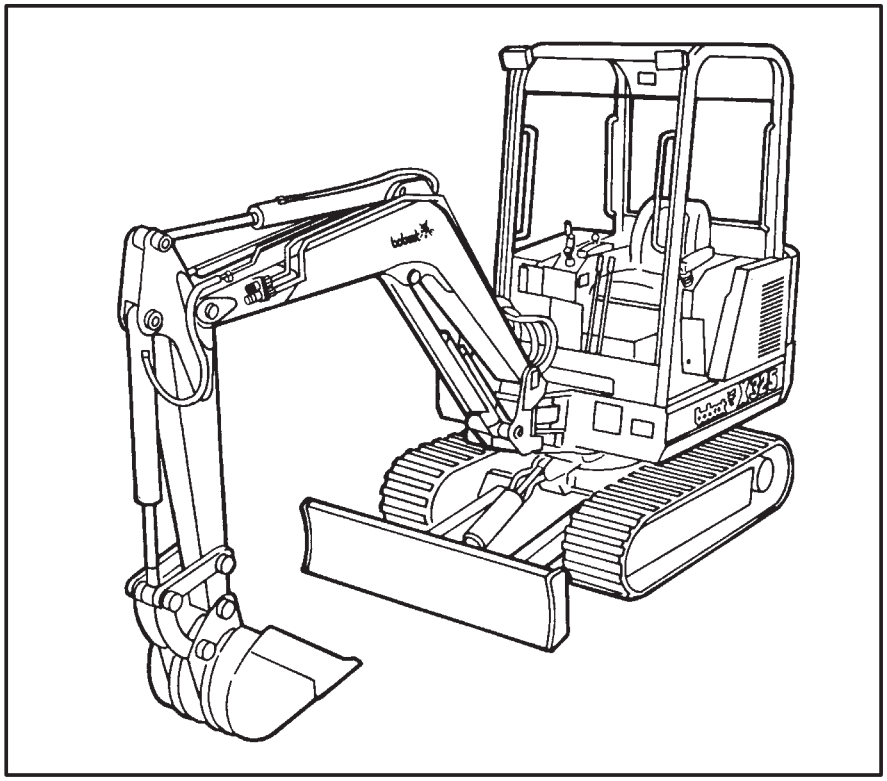
X 325
X 328

Excavator

Service Manual

325 (S/N 514013001 & Above)
328 (S/N 516611001 & Above)



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MELROE
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bobcat

6900462 (6-12)

SAFETY INSTRUCTIONS

⚠ WARNING

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

W–2003–0797

The following publications provide information on the safe use and maintenance of the excavator 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 excavator gives operating information as well as routine maintenance and service procedures. It is a part of the excavator and must stay with the machine when it is sold. Replacement Operation & Maintenance Manuals can be ordered from your Bobcat Excavator dealer.
- The excavator has machine signs (decals) which instruct on the safe operation and care. The signs and their locations are shown in the Operation & Maintenance Manual. Replacement signs are available from your Bobcat Excavator dealer.
- The Bobcat Hydraulic Excavator has a plastic 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 CIMA Safety Manual delivered with the excavator gives information for safe operating and standard signals.
- The Service Manual and Parts Manual are available from your dealer for use by mechanics to do shop–type service and repair work.
- The Bobcat Compact Excavator Operator Training Course is available through your local dealer. This course is intended to provide rules and practices of correct operation of the Hydraulic Excavator.
- The Bobcat Skid–Steer Loader Safety Video is available from your Bobcat Dealer.

⚠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

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

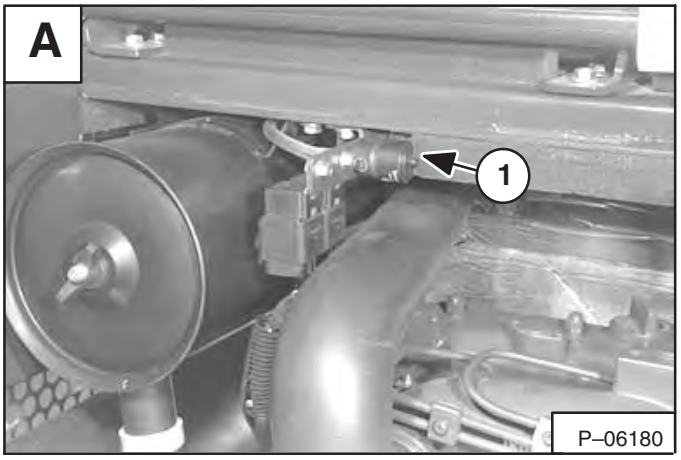
AIR CLEANER SERVICE (Cont'd)

Replacing The Filter Element (325 S/N 514013001–514014899)

See the *SERVICE SCHEDULE*, Page 1–3 for the correct service interval.

Replace the filter element when the red ring shows in the window of the condition indicator (Item 1) **[A]**.

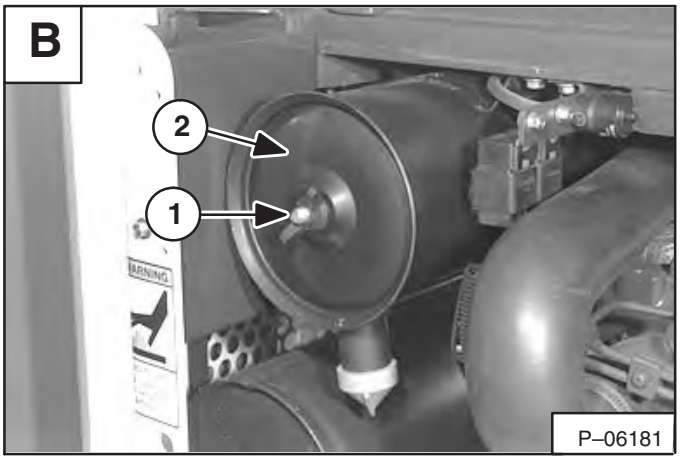
NOTE: Push the button on the condition indicator , start the engine and run the engine at high idle. If the red ring does not show, do not replace the filter element.



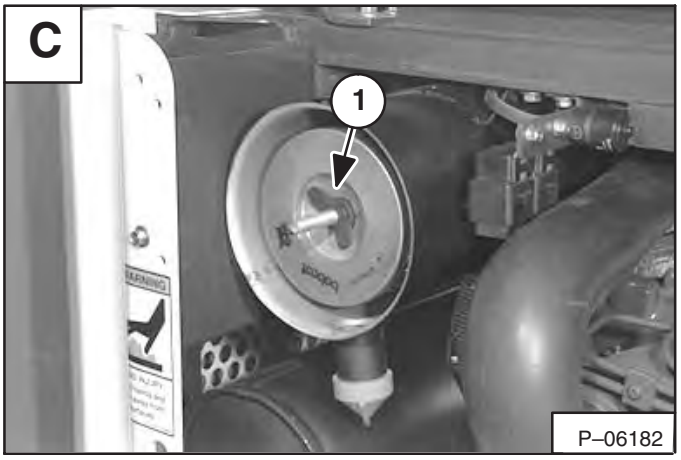
Service the air cleaner as follows:

Remove the cover wing nut (Item 1) **[B]**.

Remove the cover (Item 2) **[B]**.

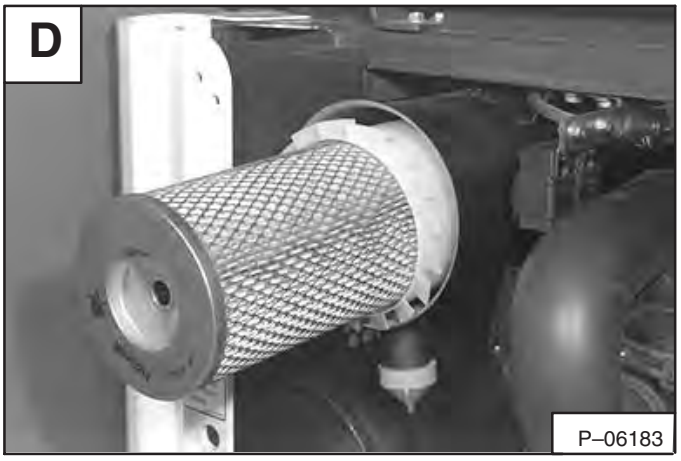


Remove the wing nut (Item 1) **[C]** at the primary filter element.



Remove the primary filter element **[D]**.

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



HYDRAULIC SYSTEM

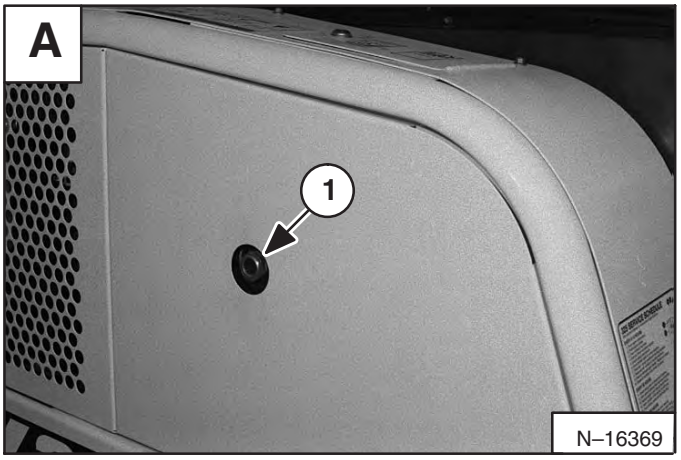
Checking And Adding Fluid

To check and add hydraulic fluid to the reservoir, use the following procedure:

Put the machine on a flat level surface.

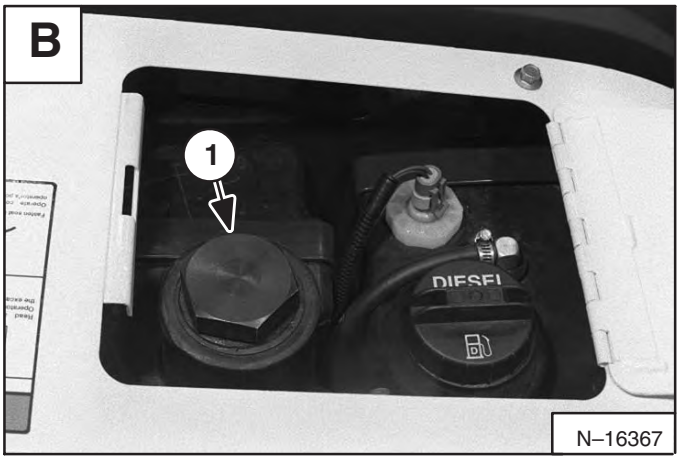
Retract the arm and bucket cylinders, put the bucket on the ground and raise the blade. Stop the engine.

Check the hydraulic fluid level, it must be visible in the sight gauge (Item 1) **[A]** located on the side of the hydraulic reservoir.



If the fluid level is not correct, open the hydraulic tank access door **[B]**.

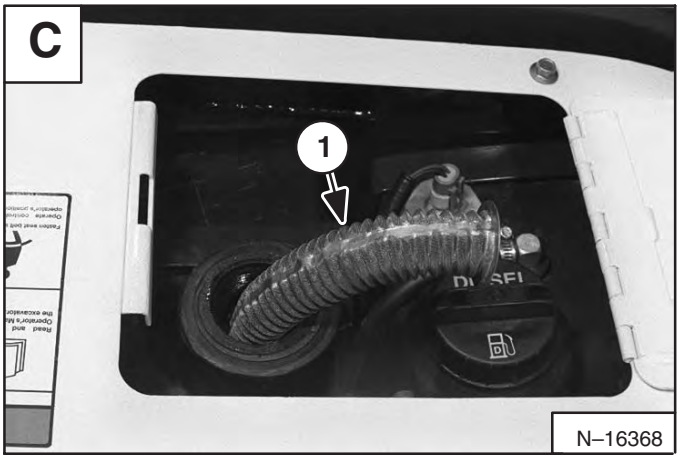
Remove oil fill cap (Item 1) **[B]**.



Check the condition of the fill strainer (Item 1) **[C]**. The screen must be installed in fill neck when adding oil.

Add the correct fluid to the reservoir until it is visible in the sight gauge. (See *FUEL, COOLANT AND LUBRICANTS Chart* Page 8–1.)

Install the reservoir cap, close and lock the access door.



⚠ 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

Page Number

ACCUMULATOR
- Assembly (S/N 514013001 – 17331 & 516611001 – 11918) 2–76
- Assembly (S/N 514017332 & Above & 516611919 & Above) 2–82
- Disassembly (S/N 514013001 – 17331 & 516611001 – 11918) 2–74
- Disassembly (S/N 514017332 & Above & 516611919 & Above) 2–80
- Parts Identification (S/N 514013001 – 17331 & 516611001 – 11918) 2–73
- Parts Identification (S/N 514017332 & Above & 516611919 & Above) 2–79
- Removal and Installation 2–72
- Testing 2–85

ARM CYLINDER
- Parts Identification 2–98
- Removal and Installation 2–97

AUXILIARY SELECTOR VALVE
- Disassembly and Assembly 2–90
- Removal And Installation (325 S/N 514013001–514014899) 2–89
- Removal And Installation (325 S/N 514014900 & Above) & (328 S/N 516611001 & Above) 2–89

BLADE CYLINDER
- Parts Identification 2–101
- Removal and Installation 2–101

BOOM CYLINDER
- Parts Identification 2–96
- Removal and Installation 2–95

BOOM CYLINDER SHIELD
- Removal and Installation 2–95

BOOM SWING CYLINDER
- Parts Identification 2–103
- Removal and Installation 2–102

BUCKET CYLINDER
- Parts Identification 2–100
- Removal and Installation 2–99

BUILD UP VALVE
- Description 2–88
- Disassembly And Assembly 2–88
- Removal And Installation 2–88

CASE DRAIN FILTER
- Removal And Installation 2–94

CROSS PORT RELIEF VALVE
- Description 2–20
- Testing 2–20

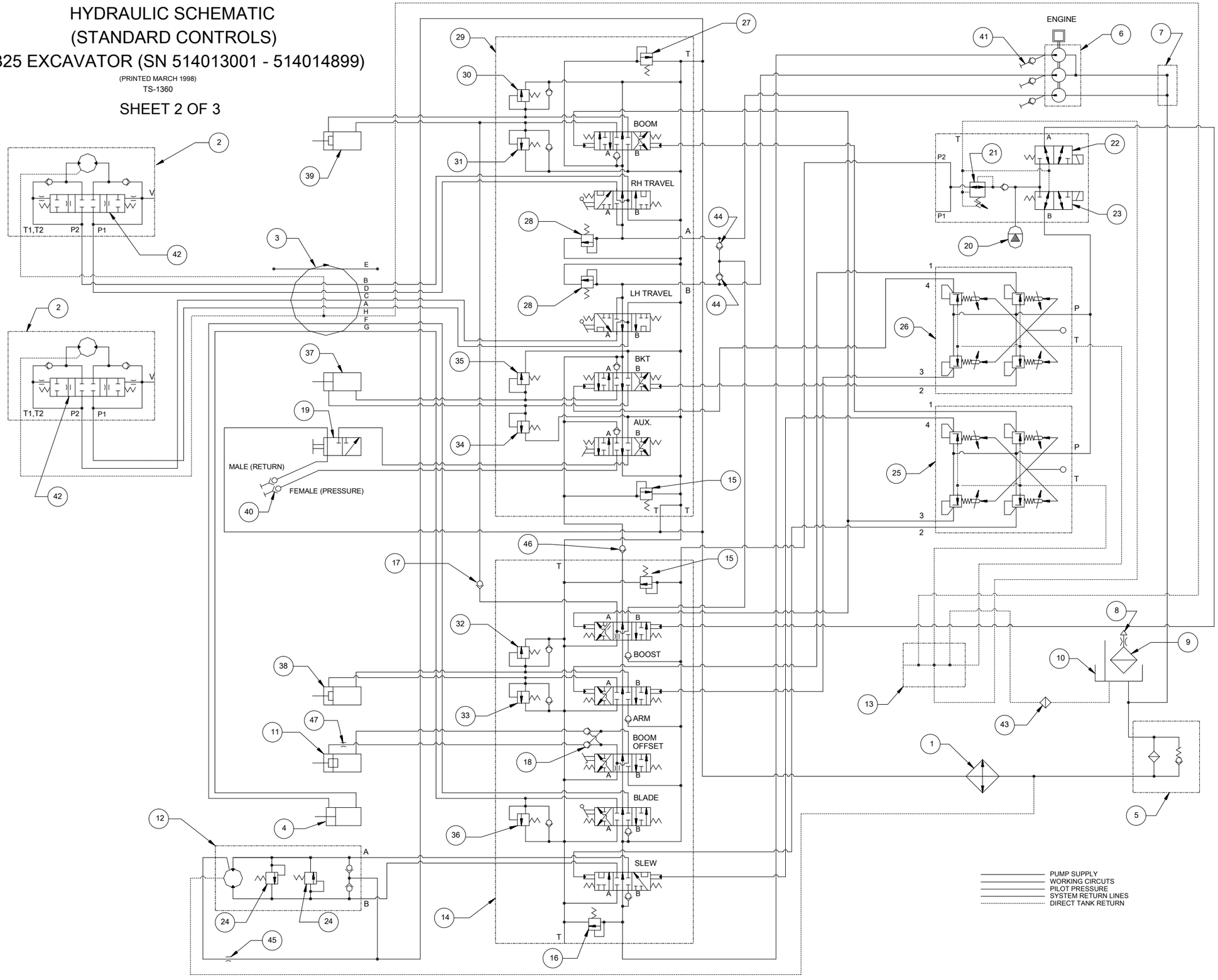
Continued On Next Page

HYDRAULIC SCHEMATIC
(STANDARD CONTROLS)
325 EXCAVATOR (SN 514013001 - 514014899)

(PRINTED MARCH 1998)

TS-1360

SHEET 2 OF 3



HYDRAULIC SYSTEM OPERATION

To Be Used With

HYDRAULIC FLOW CHART

(ISO and STANDARD)

For Model

325 EXCAVATOR (S/N 514016283 & ABOVE)

328 EXCAVATOR (S/N 516611316 & ABOVE)

(Printed December 2000

CHART LEGEND

[1] **OIL COOLER**

[2] **TRAVEL MOTORS**

[3] **CENTER SWIVEL JOINT**

[4] **BLADE CYLINDER**

[5] **#10 MICRON FILTER**
(W/25 PSI By–Pass Valve)

[6] **HYDRAULIC PUMPS**
2 x 6.39 GPM (24,2 L/min.) @ 2200 RPM
1 x 8.14 GPM (30.8 L/min.) @ 2200 RPM

[7] **SUPPLY PORT BLOCK**

[8] **HYDRAULIC RESERVOIR PLUG**
(Non–Vented)

[9] **STRAINER** (254 micron)

[10] **HYDRAULIC RESERVOIR** (10.6 Gals. 40 L)
(Vented)

[11] **BOOM SWING CYLINDER**

[12] **SWING MOTOR**

[13] **RETURN PORT BLOCK**

[14] **5–SPOOL CONTROL VALVE**

[15] **MAIN RELIEF VALVE** 2550 PSI (17582 kPa)

[16] **MAIN RELIEF VALVE** 4200 PSI (28959 kPa)

[17] **CHECK VALVE**

[18] **LOAD CHECK VALVES**
(Boom Swing Cylinder)

[19] **AUXILIARY SELECTOR VALVE**

[20] **ACCUMULATOR** 165 PSI
(1138 kPa) pre charge

[21] **PRESSURE REDUCING VALVE** 365 PSI
(2517 kPa)

[22] **TWO SPEED SOLENOID**

[23] **CONSOLE LOCK–OUT SOLENOID**

[24] **RELIEF VALVE** Swing Motor (2)
1650 PSI (11376 kPa)

[25] **L.H. JOYSTICK**

[26] **R.H. JOYSTICK**

[27] **MAIN RELIEF VALVE** 2700 PSI (18617 kPa)

[28] **MAIN RELIEF VALVE** 3700 PSI (25512 kPa)

[29] **5–SPOOL CONTROL VALVE**

[30] **PORT RELIEF VALVE** (Boom Cyl.)
3400 PSI (23442 kPa)

[31] **PORT RELIEF VALVE** (Boom Cyl.)
2950 PSI (20340 kPa)

[32] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20340 kPa)

[33] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20340 kPa)

[34] **PORT RELIEF VALVE** (Bucket Cyl.)
3400 PSI (23442 kPa)

[35] **PORT RELIEF VALVE** (Bucket Cyl.)
2950 PSI (20340 kPa)

[36] **PORT RELIEF VALVE** (Blade Cyl.)
3400 PSI (23442 kPa)

[37] **BUCKET CYLINDER**

[38] **ARM CYLINDER (Cushion)**

[39] **BOOM CYLINDER (Cushion)**

[40] **AUXILIARY QUICK COUPLERS**

[41] **HYDRAULIC PUMP TEST PORTS**

[42] **TRAVEL MOTOR SPOOL**

[43] **RETURN DRAIN LINE FILTER**
(150 Micron)

[44] **CHECK VALVE** (2)

[45] **ORIFICE** 0.035 inches (0,89 mm)

[46] **BUILD UP VALVE** 150 PSI (1034 kPa)

[47] **ORIFICE** 0.082 inches (2,08 mm)

[48] **SELECT VALVE, ISO/STANDARD**
Standard on S/N 514016283 514017395 And 516611001 –516611962
Optional On S/N 514017396 & Above And 516611963 & Above

TROUBLESHOOTING THE CYLINDER CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
Cylinder inoperable.	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 and or safety valvein pressure reducing valve body.
	Lever linkage incorrectly adjusted.	Readjust.
	Control console lockout switch.	Readjust or replace.
	Cylinder internal leakage excessive.	Repair or replace.
	Joystick manifold pressure reducing valve defective.	Repair or replace.
	Joystick internal leakage excessive.	Repair or replace.
Cylinder force insufficient.	Lever linkage incorrectly adjusted.	Readjust.
	Main relief valve pressure too low.	Readjust or replace.
	Cylinder internal leakage excessive.	Repair or replace.
Cylinder speed too slow.	Joystick manifold solenoid valve defective.	Repair or replace.
	Joystick manifold pressure reducing valve defective.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Low tie rod torque on control valves.	Tighten tie rods to correct torque.
	Joystick internal leakage excessive.	Repair of replace.
	Low or dirty fluid.	Add or replace the hydraulic fluid.
	Main relief valve malfunctioning.	Readjust or replace.

Checking The Main Relief Valves (Cont'd)

Testing The Left Hand Travel Circuit Relief Valve

Lift and block the excavator. (See Page 1–1.)

⚠ 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.

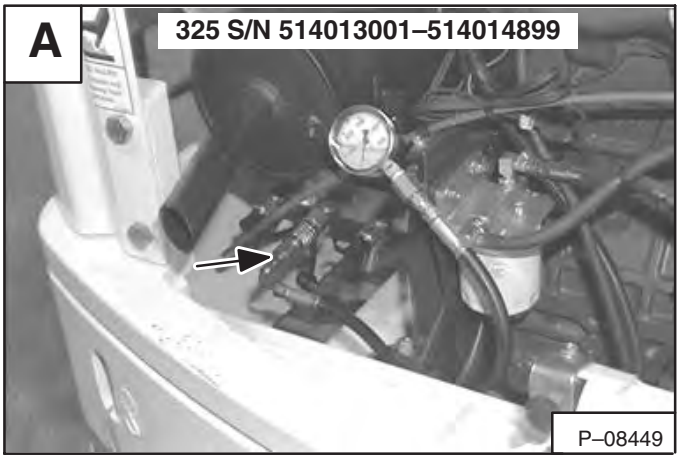
W–2218–1097

Install the test gauge and coupler to pump section 2 **[A]** & **[B]**.

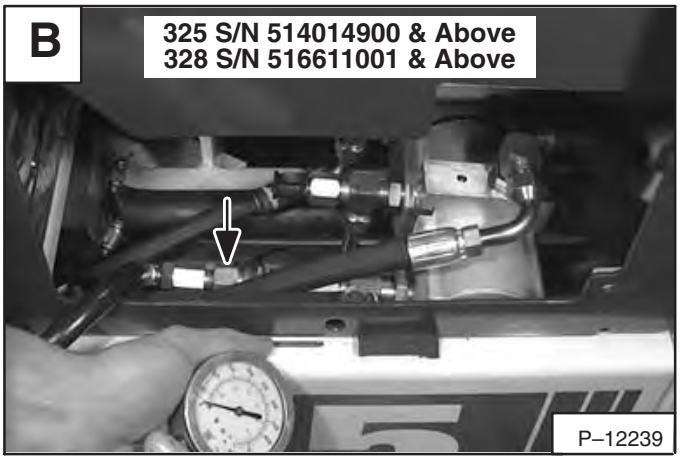
NOTE: Pump Section 2 is the middle pump section.

Position the upperstructure as shown in **[C]** to gain access to the main relief valve from under theexcavator.

A



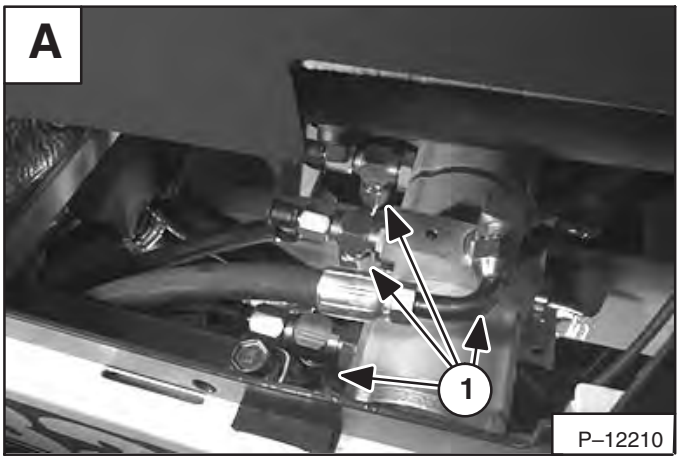
B



C

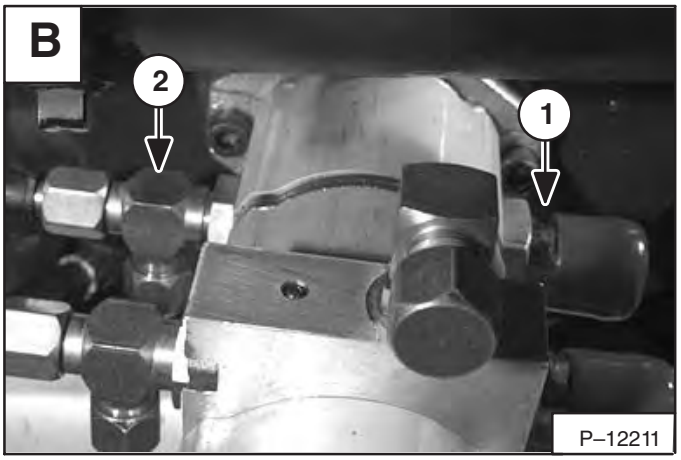
Removal And Installation (Cont'd)

Remove the four hoses (Item 1) **[A]**.



Remove the inlet fitting (Item 1) **[B]** from pump section one.

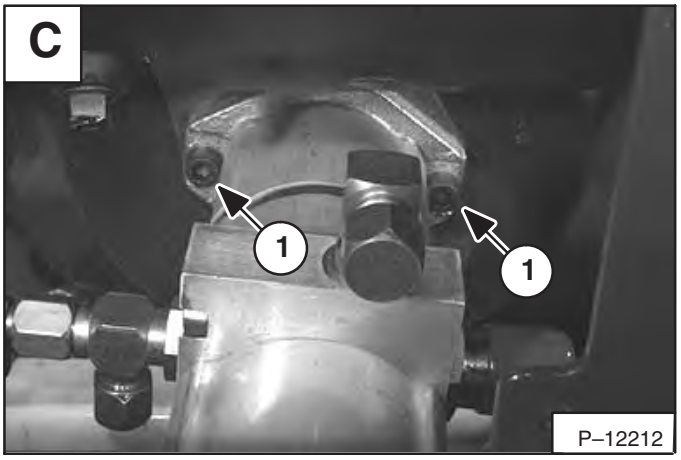
Remove the outlet fitting (Item 2) **[B]** from pump section one.



Remove the two bolts (Item 1) **[C]** holding the pump to the housing.

Installation: Tighten the bolts to 48–55 ft.–lbs. (65–75 Nm) torque.

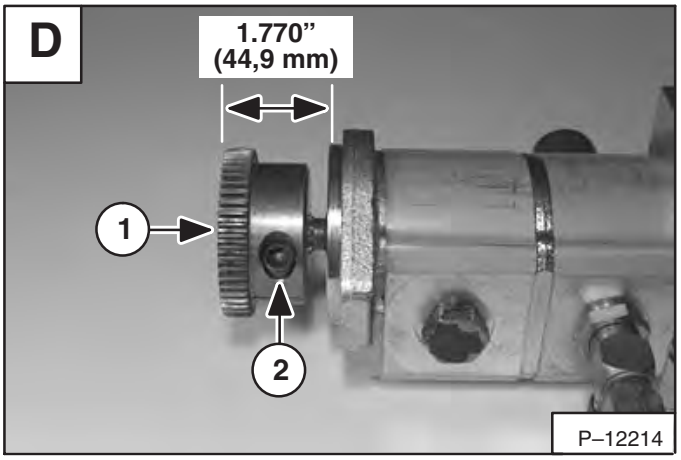
Slide the pump away from the engine and lower the pump out the bottom of the excavator.



Remove the coupler (Item 1) **[D]** from the pump.

Installation: The pump coupler must be 1.770 inches (44,9 mm) from the face of the pump.

Tighten the bolts (Item 2) **[D]** to 36 ft.–lbs. (49 Nm) torque.



HYDRAULIC CONTROL VALVE (5–Spool) (Cont'd)

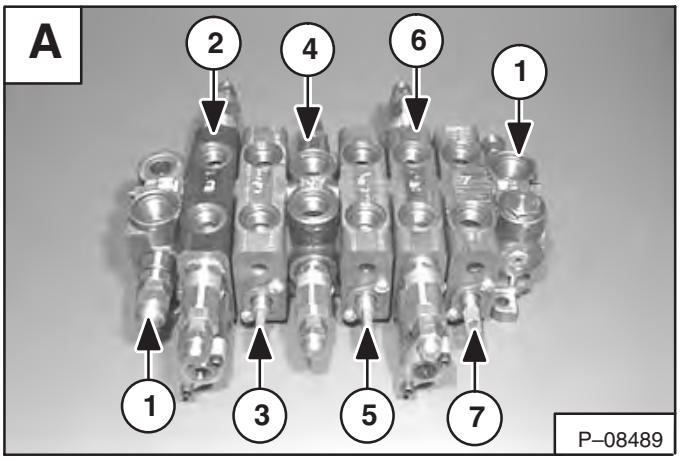
Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

The Husco 5 Spool control valve has eight different sections:

Parts Identification

The Outlet Section (Item 1) **[A]**.
The Boom Section (Item 2) **[A]**.
The Right Hand Travel Section (Item 3) **[A]**.
The Mid Inlet Section (Item 4) **[A]**.
The Left Hand Travel Section (Item 5) **[A]**.
The Bucket Section (Item 6) **[A]**.
The Auxiliary Section (Item 7) **[A]**.

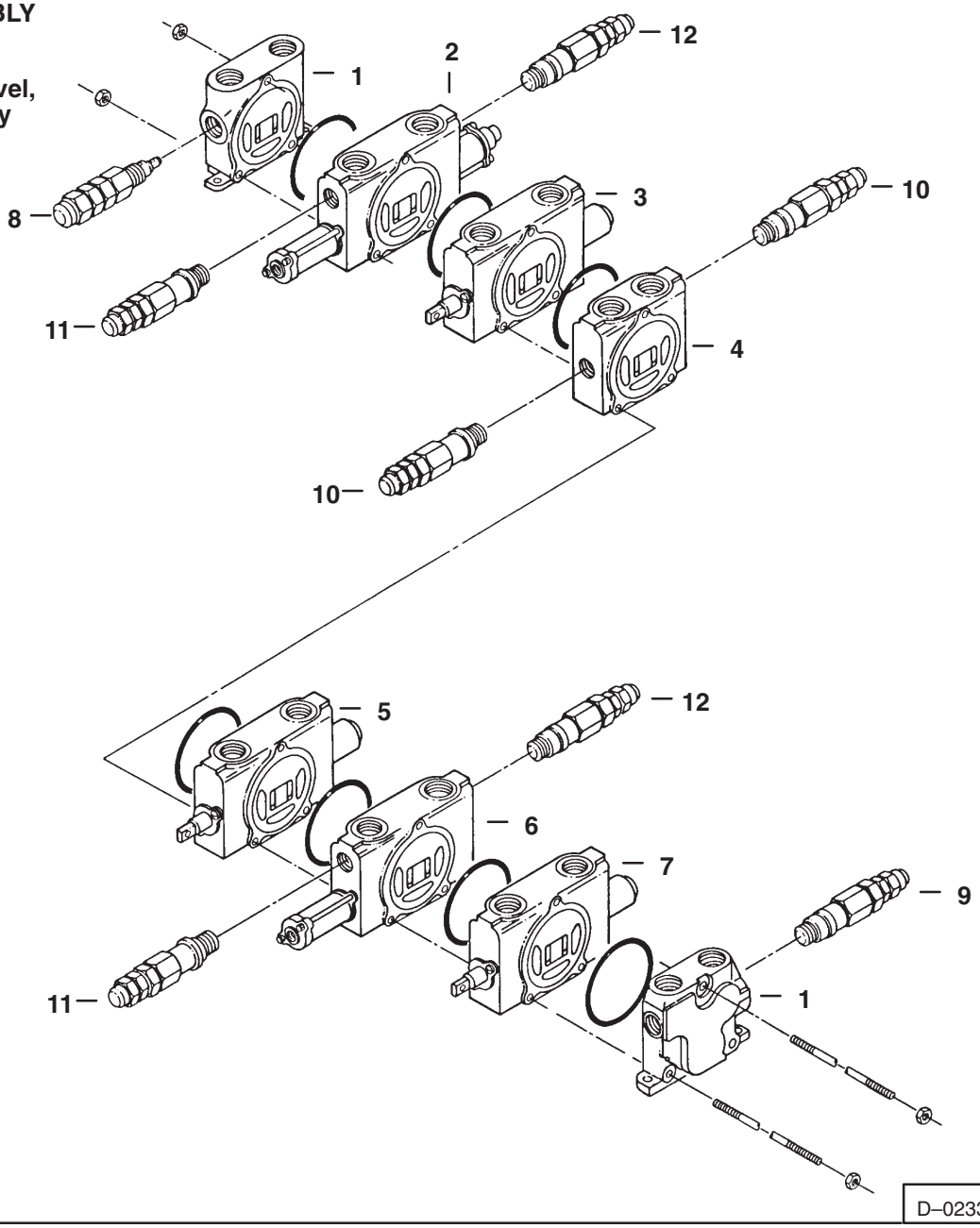
The two outlet sections and mid inlet section have main relief valves. The boom and bucket sections have work port relief valves.



CONTROL VALVE ASSEMBLY (5–Spool)

Left Travel, Right Travel, Boom, Bucket and Auxiliary

1. **Outlet**
2. **Boom**
3. **Right Hand Travel**
4. **Mid Inlet**
5. **Left Hand Travel**
6. **Bucket**
7. **Auxiliary**
8. **Main Relief Valves 2700 PSI (18617 kPa)**
9. **Main Relief Valves 2550 PSI (17582 kPa)**
10. **Main Relief Valves 3700 (25512 kPa)**
11. **Port Relief Valves 2950 PSI (20340 kPa)**
12. **Port Relief Valves 3400 PSI (23443 kPa)**

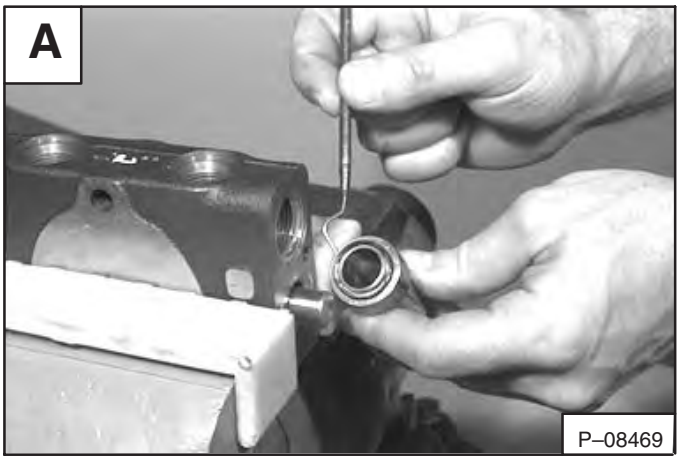


HYDRAULIC CONTROL VALVE (5–Spool) (Cont'd)

Left Travel, Right Travel, Boom, Bucket AndAuxiliary (Cont'd)

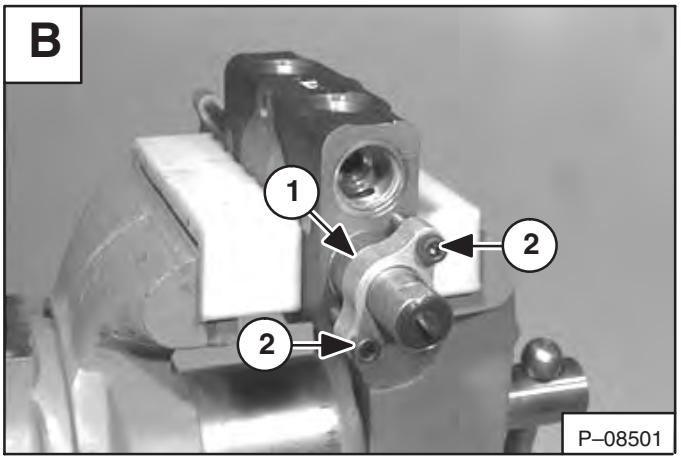
Boom And Bucket Assembly (Cont'd)

Oil and install a new O–ring on the end cover of the valve section **[A]**.

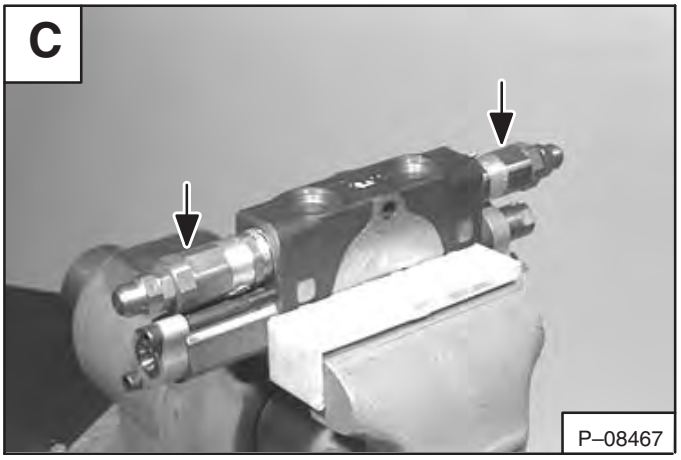


Install the end cover, the end cover retaining plate (Item 1) **[B]** and the screws (Item 2) **[B]**.

Tighten the screws to 6–9 ft.–lbs. (8–10 Nm) of torque.



Install the port relief valves on the valve section. Tighten to 30–36 ft.–lbs. (40–48 Nm) of torque **[C]**.



HYDRAULIC CONTROL VALVE (5–Spool) (Cont'd)

Boost, Arm, Boom Swing, Blade And Swing Section (Cont'd)

Parts Identification

The Husco five spool control valve has seven dif ferent sections:

The inlet section (Item 1) **[A]**.

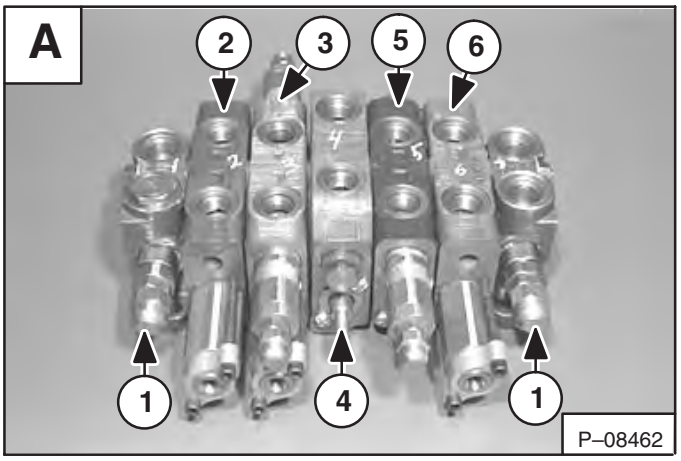
The boost section (Item 2) **[A]**.

The arm section (Item 3) **[A]**.

The boom swing section (Item 4) **[A]**.

The blade section (Item 5) **[A]**.

The swing section (Item 6) **[A]**.

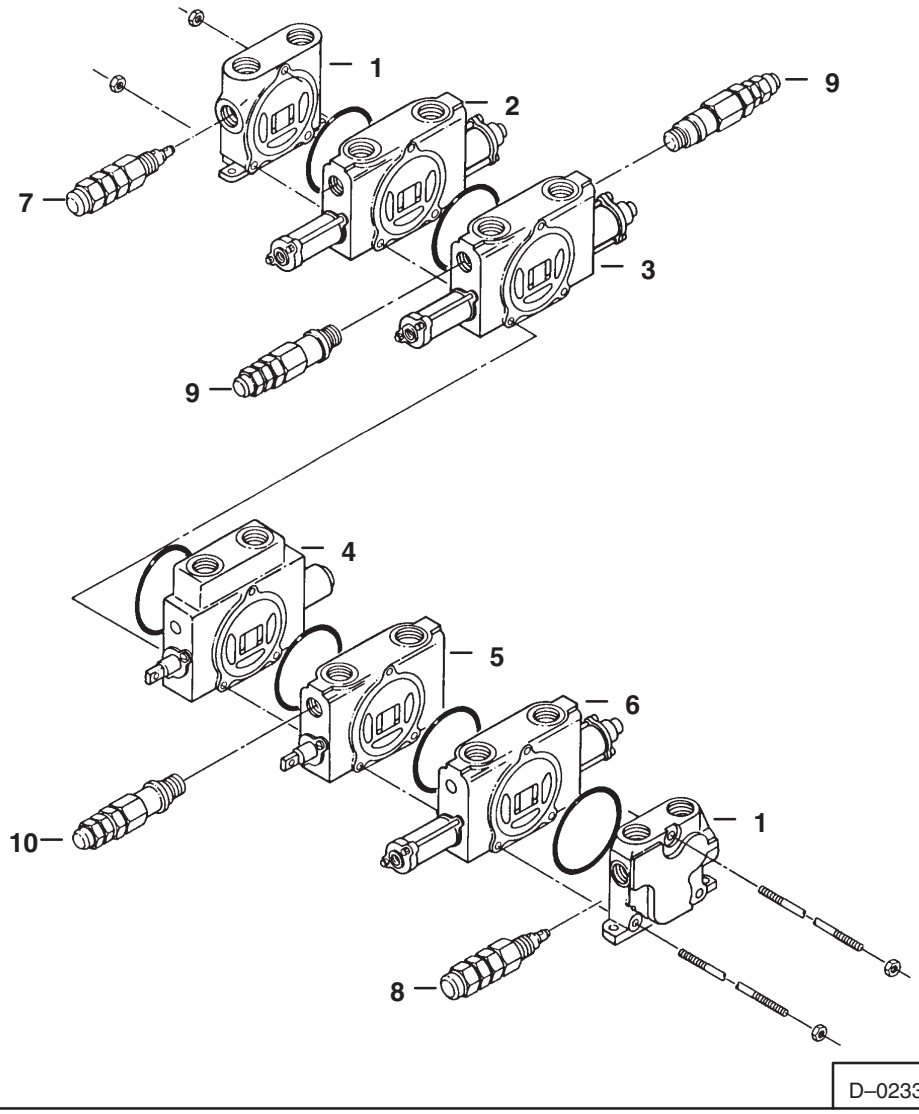


Each of the two inlet sections on the valve have a main relief valve. The arm and blade sections have threework port relief valves.

CONTROL VALVE ASSEMBLY (5–Spool)

Boost, Arm, Boom Swing, Blade and Swing Section

1. **Inlet**
2. **Boost**
3. **Arm**
4. **Boom Swing**
5. **Blade**
6. **Swing**
7. **Main Relief Valve 2650 PSI (18272 kPa)**
8. **Main Relief Valve 4200 PSI (28959 kPa)**
9. **Port Relief Valve 2950 PSI (20340 kPa)**
10. **Port Relief Valve 3400 PSI (23443 kPa)**



HYDRAULIC CONTROL VALVE (5–Spool) (Cont'd)

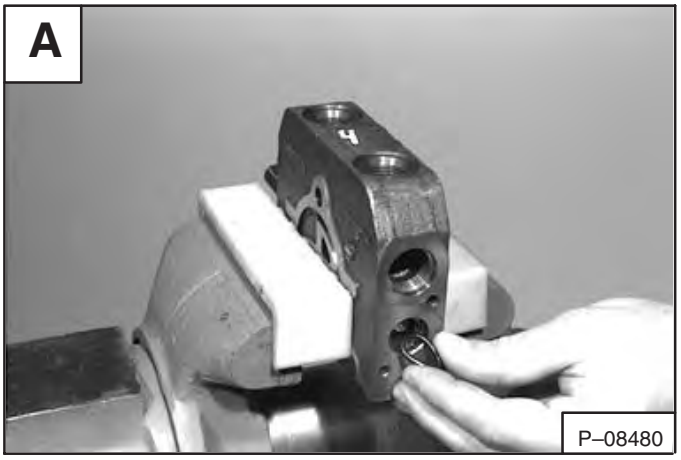
Boost, Arm, Boom Swing, Blade And Swing Section (Cont'd)

Boom Swing Assembly (Cont'd)

Clean all parts with solvent and dry.

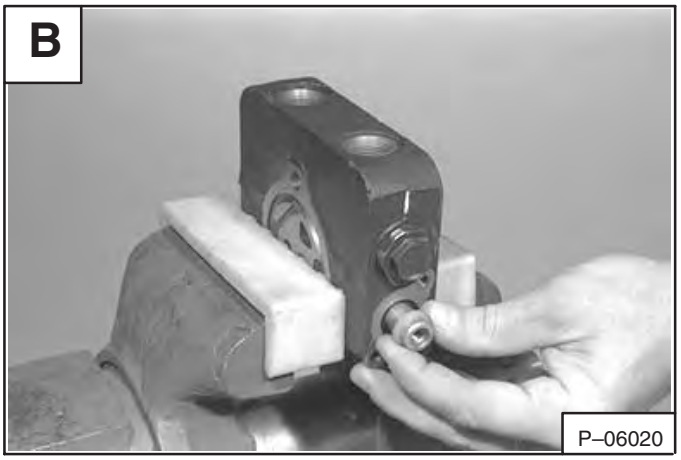
Install new O–rings by pinching the O–ring and inserting it into the O–ring gland. Use a brass tool to position the O–ring firmly in the O–ring gland **[A]**.

Put oil on the O–ring and slowly rotate the spool while pushing it through the valve section. Pull the spool far enough into the housing to install a new O–ring on the opposite end of the spool. Repeat the above steps for installing the spool O–ring.



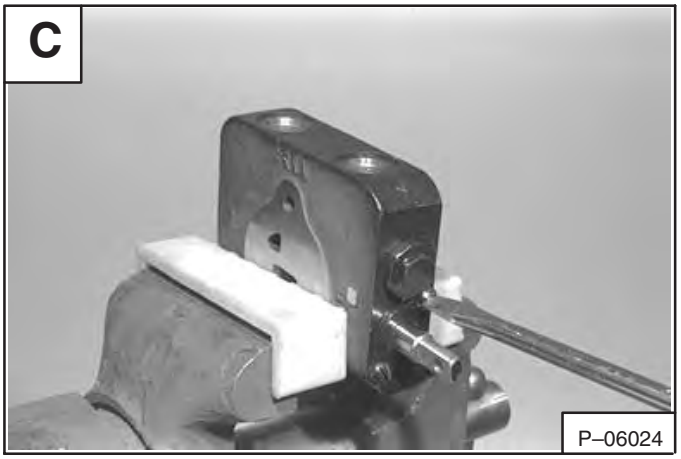
Install the wiper on both ends of the spool **[B]**.

Use finger pressure to seat the wiper into the bore of the valve.



Install the plate and the two screws on the actuating end of the spool **[C]**.

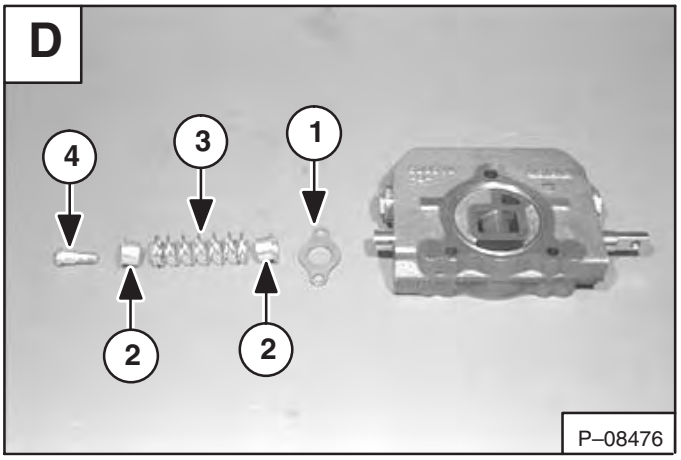
Tighten the screws to 3–5 ft.–lbs. (4–6 Nm) torque.



Apply thread adhesive (LOCTITE 271) to the spring retaining screw (Item 4) **[D]**.

Slide the plate (Item 1)**[D]** over the spool, install the inner spring seat (Item 2) **[D]** on the end of the spool.

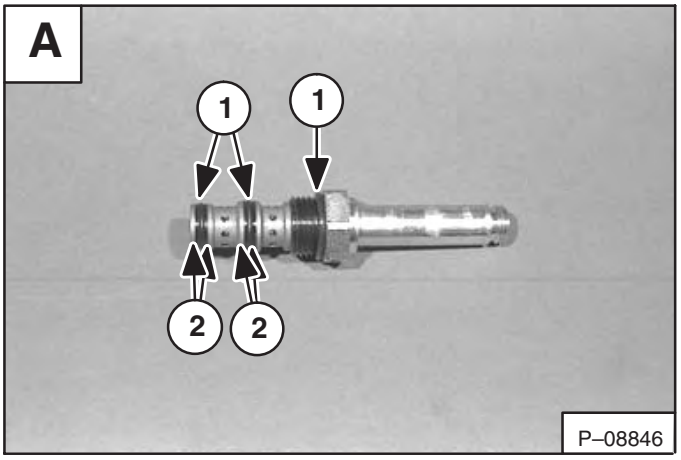
Install the spring (Item 3) **[D]** on the spool. Install the outer spring seat (Item 2) **[D]** and the retaining screw (Item 4) **[D]**.



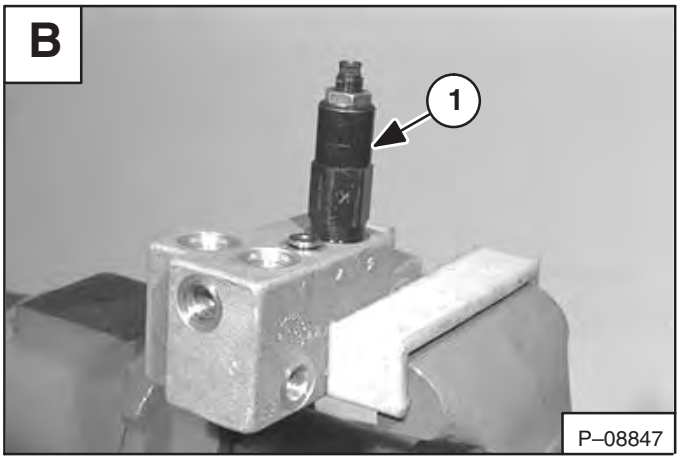
ACCUMULATOR (Cont'd)

Disassembly (S/N 514013001 – 514017331 & 516611001 – 516611918) (Cont'd)

Remove the O–rings (Item 1) **[A]** and back–up rings (Item 2) **[A]** from both spools.

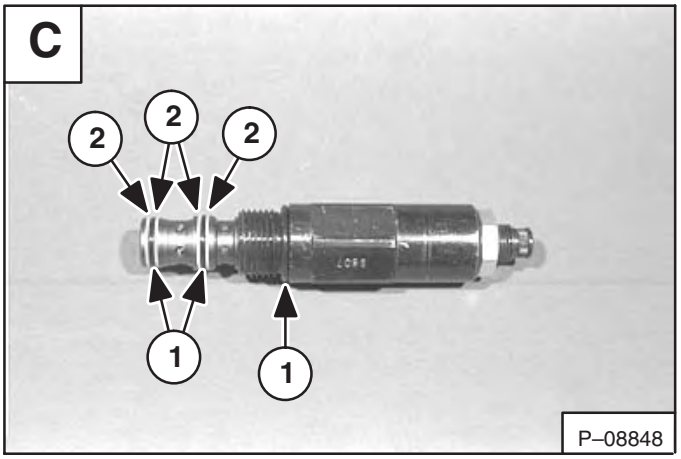


Remove the relief valve (Item 1) **[B]** from the valve body.



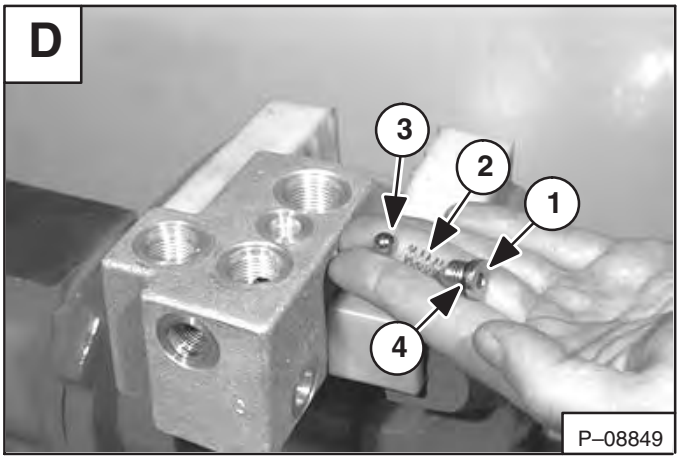
Remove the O–rings (Item 1) **[C]** and back–up rings (Item 2) **[C]** from the relief valve.

NOTE: The relief valve is not serviceable with the exception of new O–rings and back–up rings.



Remove the plug (Item 1) **[D]**, spring (Item 2) **[D]** and check ball (Item 3) **[D]** from the valve body.

Remove the O–ring (Item 4) **[D]** from the plug (Item 1 **[D]**.



ACCUMULATOR) (Cont)

Testing (All Models)

To test the accumulator for proper operation, start the engine and raise the boom one foot (305 mm) off the ground. Stop the engine.

While the engine is not running, turn the start key to the run position.

Activate the boom down circuit. The boom must lower when the boom circuit is activated.

The T port on the accumulator block (drain to reservoir port) is normally blocked when the excavator is running. If a high pressure spike occurs, hydraulic fluid will flow out the T port and to the reservoir.

Remove the line from the T port (on the accumulator block) and plug the line.

Install a temporary drain line on the T port. Route the drain line in an empty drain pan.

Run the excavator for one minute.

Measure the amount of oil in the drain pan.

The service limit is 1/2 gal. (1,9 liters) per minute.

If the amount of oil from the T port is at or over service limits. it is an indication of worn O–rings and back–up rings on the spools and pressure reducing valve, or a stuck pressure reducing valve.

Remove the pressure reducing valve.

Remove the O–rings (Item 1) **[A]** and back–up rings (Item 2) **[A]** from the valve.

Loosen the locknut (Item 3) **[A]** and turn the adjustment screw (Item 4) **[A]** counterclockwise until the adjustment screw reaches it's top limit.

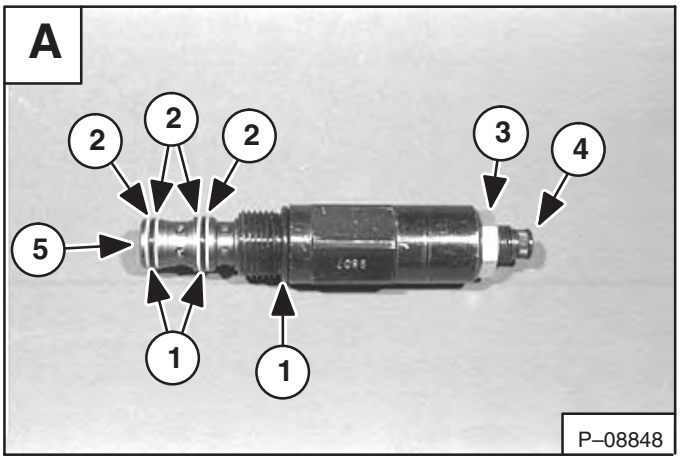
Using a brass or plastic drift, activate thepoppet (Item 5) **[A]** while the valve is in clean solvent.

Dry the valve with compressed air.

Install the new O–rings (Item 1) **[A]** and back–up rings (Item 2) **[A]**.

Install the valve and set to 365 PSI (2517 kPa). (See the following page for setting relief valve pressure.)

Repeat the test for excessive oil from the T port.

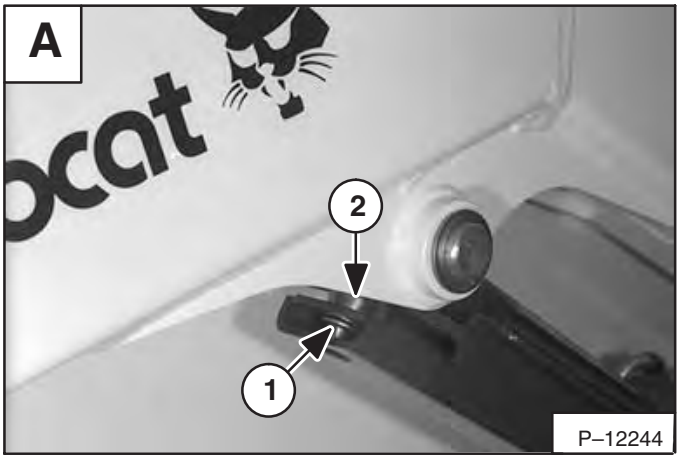


BOOM CYLINDER SHIELD

Removal And Installation

Remove the bolt (Item 1)**[A]** and spacer (Item 2)**[A]** from the end of the boom cylinder.

Slide the shield off of the boom cylinder retaining tab.



BOOM CYLINDER

Removal And Installation

See Page 2–98 for disassembly and assembly procedure of cylinders.

Put the bucket on the floor. Stop the engine.

Move the hydraulic controls to release the hydraulic pressure.

IMPORTANT

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

I–2003–0888

Install a chain hoist at the boom lift area.

Disconnect the two hoses from the boom cylinder **[B]**.

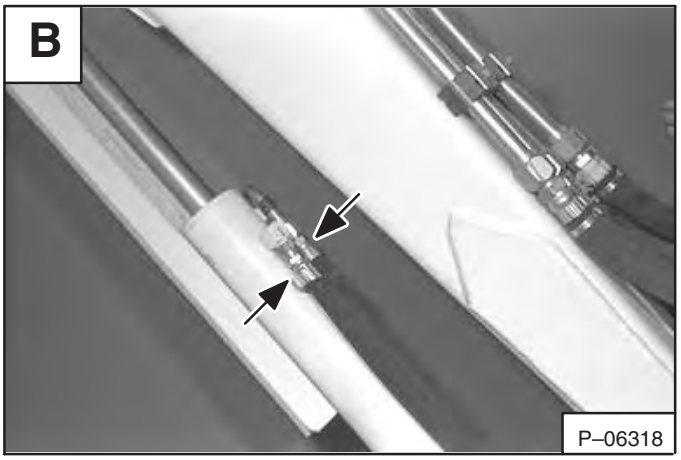
Remove the snap ring (Item 1) **[C]** and washer (Item 2) **[C]** from the boom cylinder base end pin.

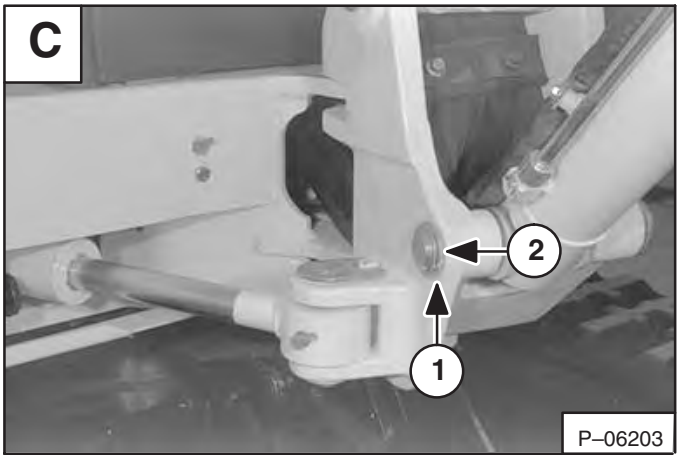
Remove the cylinder base end pin.

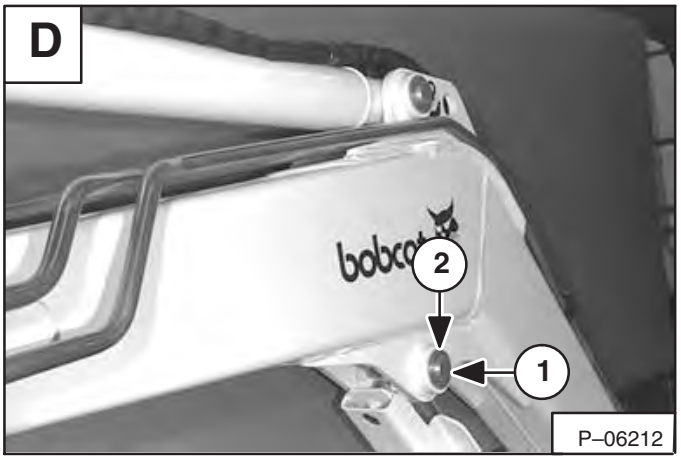
Lower the base end of the boom cylinder to the floor.

Remove the snap ring (Item 1) **[D]** and washer (Item 2) **[D]** from the cylinder rod end pin.

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



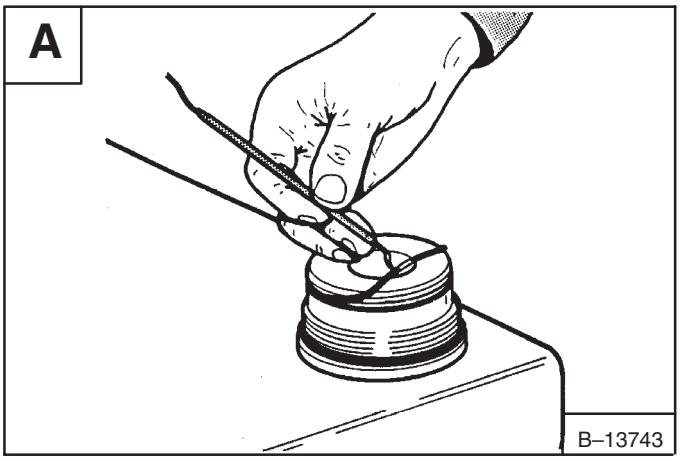




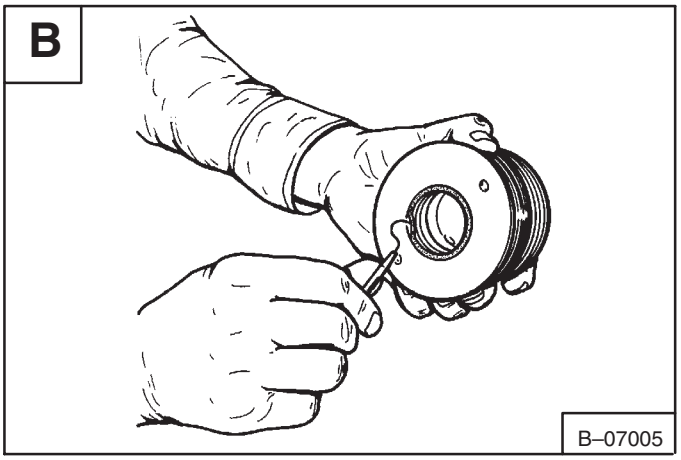
HYDRAULIC CYLINDER (Cont'd)

Disassembly (Cont'd)

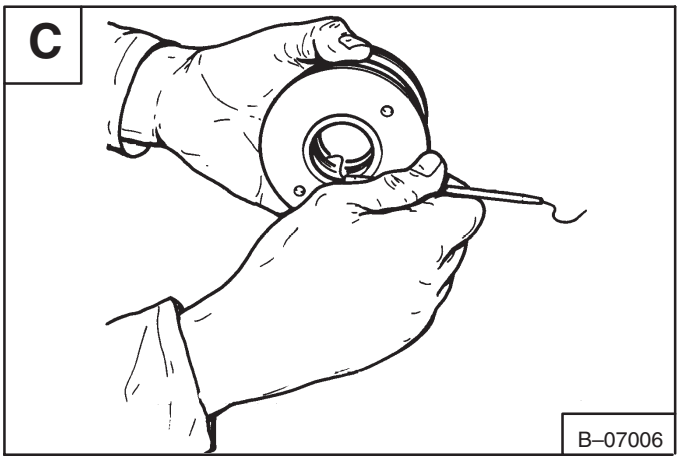
Remove the O–ring and back–up washer from the head with seal hook **[A]**.



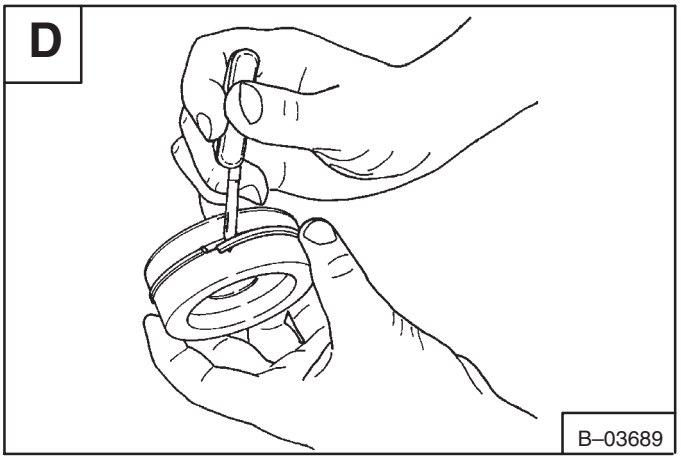
Remove the wiper seal **[B]**.



Remove the oil seal from the head **[C]**.



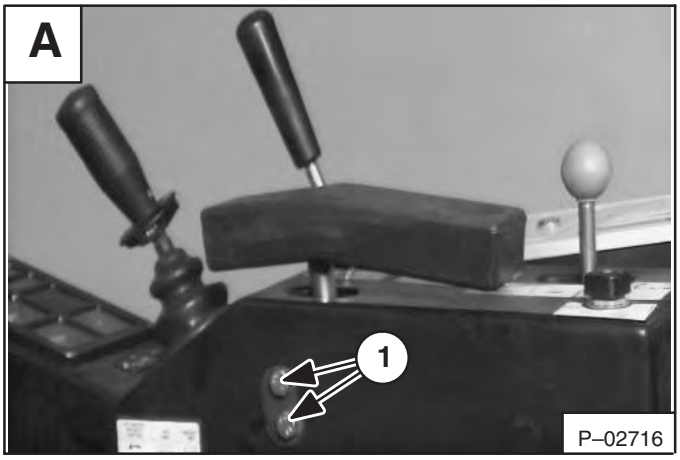
Cut the old teflon seal and remove the seal from the piston **[D]**.



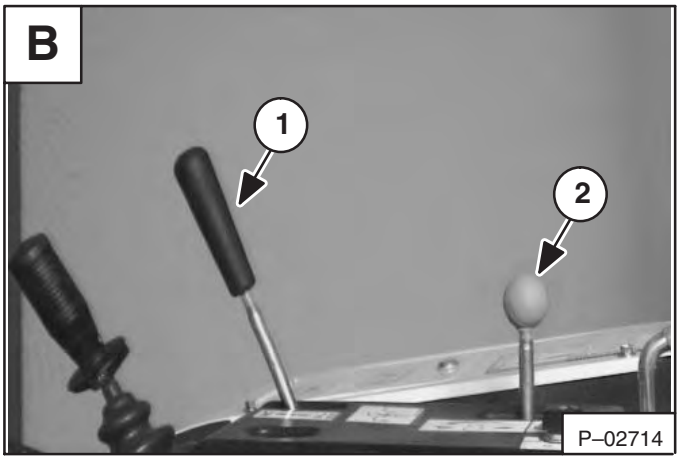
RIGHT CONSOLE COVER (325 S/N 514013001– 514014899)

Removal And Installation

Loosen the two bolts (Item 1)**[A]** to remove the arm rest.

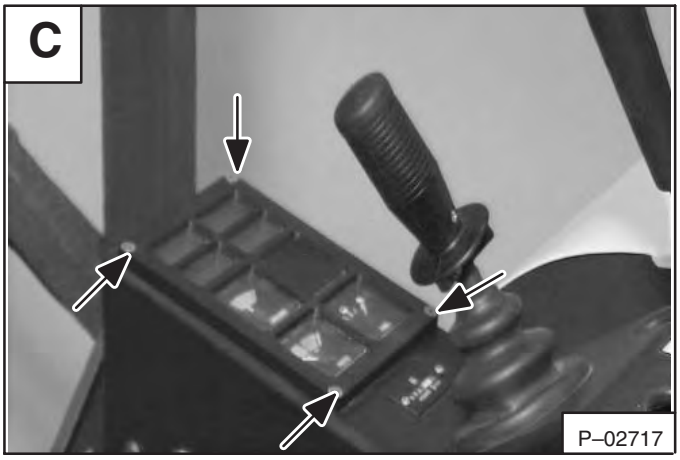


Remove the blade knob (Item 1) **[B]** and speed control knob (Item 2) **[B]**.



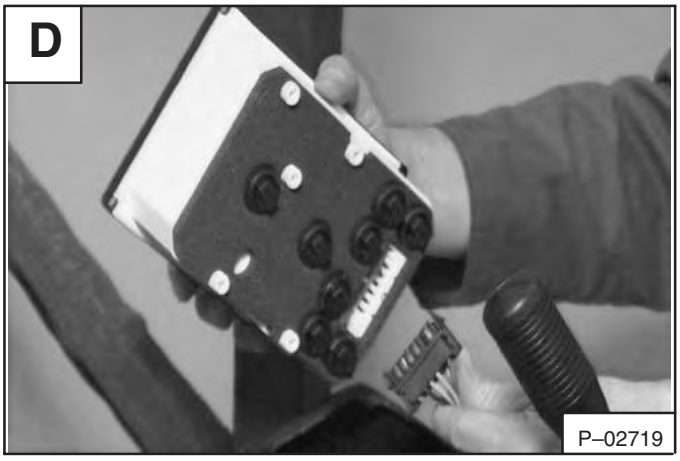
Remove the four instrument panel mounting screws **[C]**.

Remove the instrument panel.



Remove the wire harness from the instrument panel socket **[D]**.

See Page 6–1 for *GAUGE Removal And Installation*.

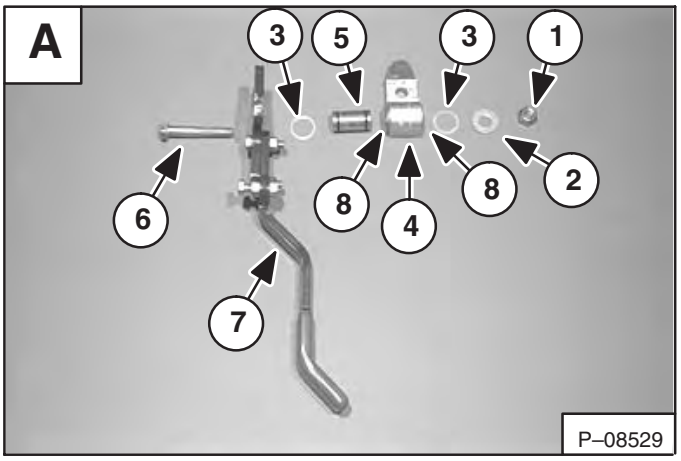


LEFT CONSOLE (Cont'd)

Lock Lever Disassembly And Assembly

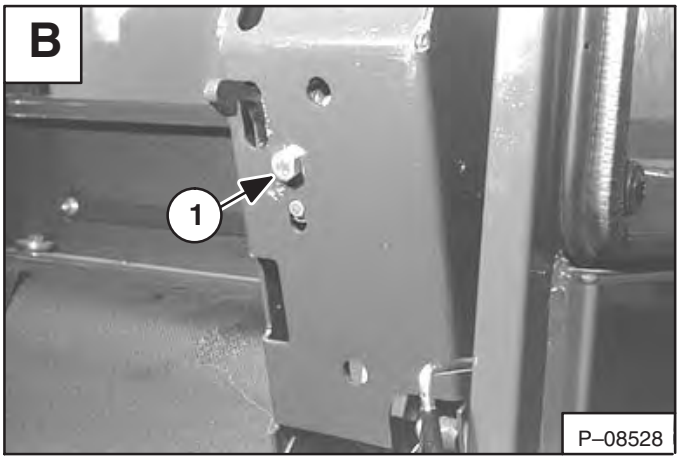
Remove the nut (Item 1) **[A]**, washer (Item 2) **[A]**, thrust washer (Item 3) **[A]**, mount (Item 4) **[A]**, sleeve (Item 5) **[A]** and the bolt (Item 6) **[A]** from the lever (Item 7) **[A]**.

NOTE: Remove the two bushing (Item 8) [A] from the mount (Item 4) [A].



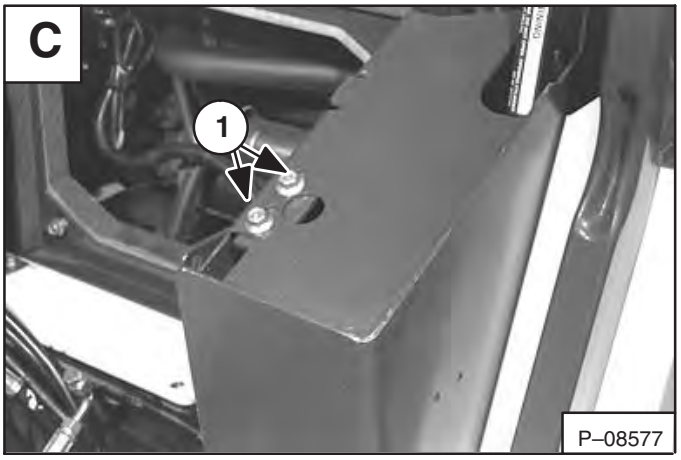
Lock Lever Adjustment

Loosen the bolt (Item 1) **[B]** and slide the lever to adjust.



Latch Plate Adjustment

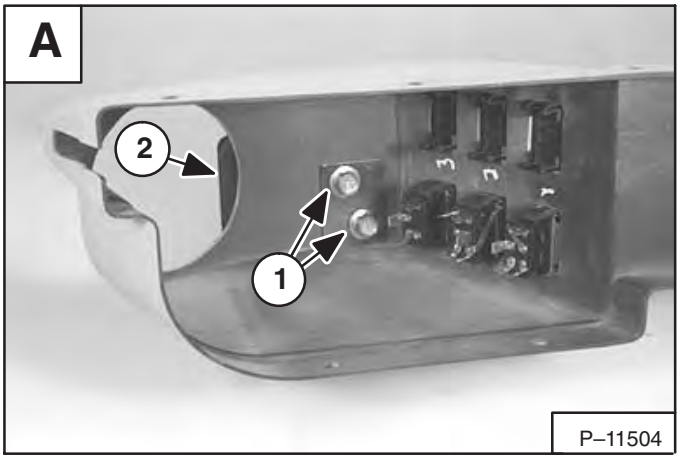
Loosen the two bolts (Item 1) **[C]** and slide the plate to adjust.



LEFT CONSOLE COVER (Cont'd)

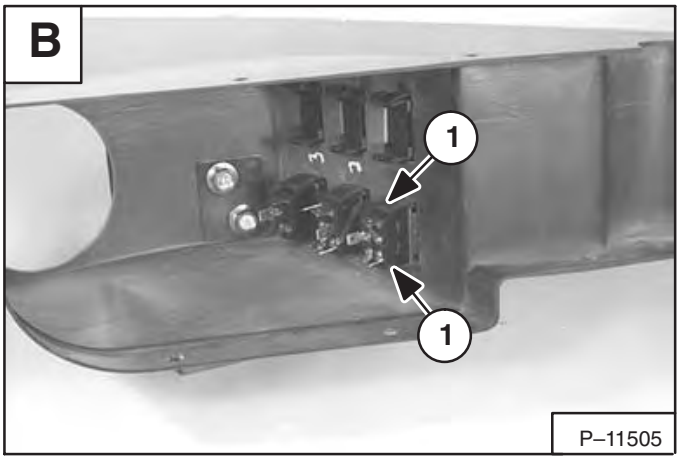
Arm Rest Removal And Installation

Remove the two bolts (Item 1) **[A]** and remove the arm rest (Item 2) **[A]**.



Switch Removal And Installation

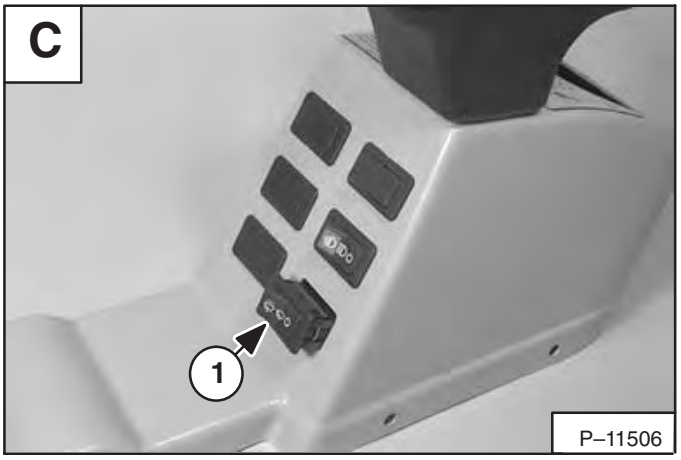
Squeeze the sides of the switch (Item 1) **[B]**.



Push the switch (Item 1) **[C]** out of the console cover.

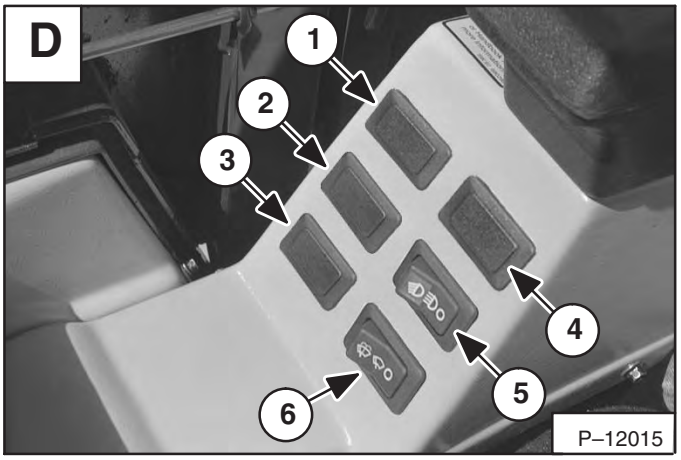
Repeat the procedure for all switch removal.

Installation: Push the switch (Item 1) **[C]** in the console cover until it is firmly seated against the cover.



Switch Description

1. Switch (if equipped) – Load moment **[D]**.
2. Switch (if equipped) – Overhead beacon **[D]**.
3. Switch (if equipped) – Hydraulic X–Change™ release **[D]**.
4. Switch position – Future functions or attachments **[D]**.
5. Switch (Standard) – Headlights and boom work light **[D]**.
6. Switch (Cab Option) – Wiper washer **[D]**.



JOYSTICK (Cont'd)

Removal And Installation Of Right Hand Joystick (325 S/N 514014900 & Above)& (328 S/N 516611001 & Above)

Remove the console cover. (See Page 3–14.)

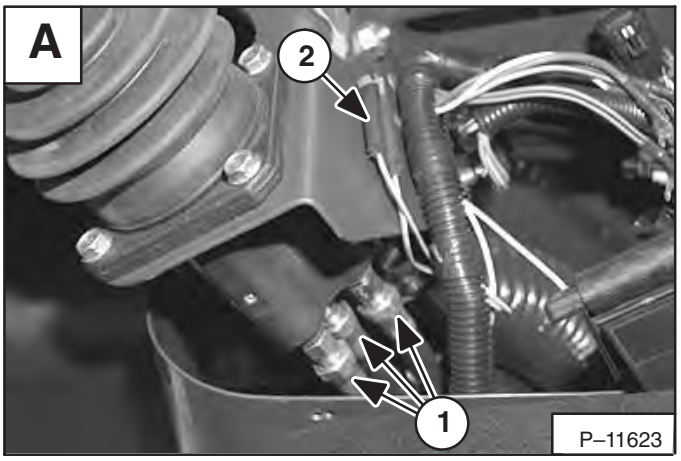
Remove the hoses (Item 1) **[A]** from the joystick.

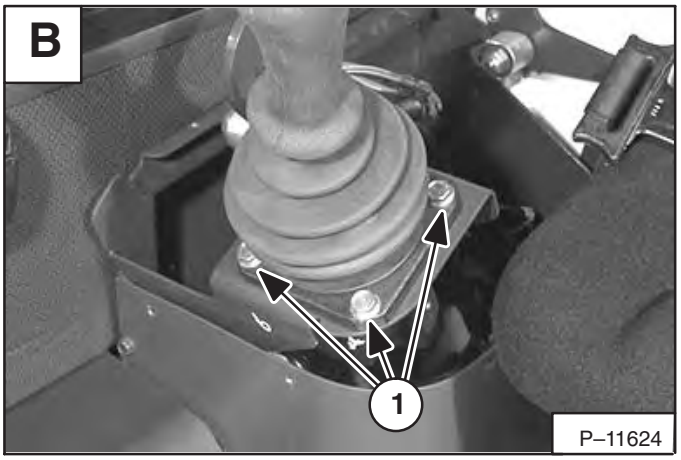
NOTE: Mark the hoses locations for correct installation.

Disconnect the horn wires (Item 2) **[A]** from the wire harness.

NOTE: The horn wires are non–specific.

Remove the four bolts (Item 1) **[B]** from the joystick flange. Remove the joystick.



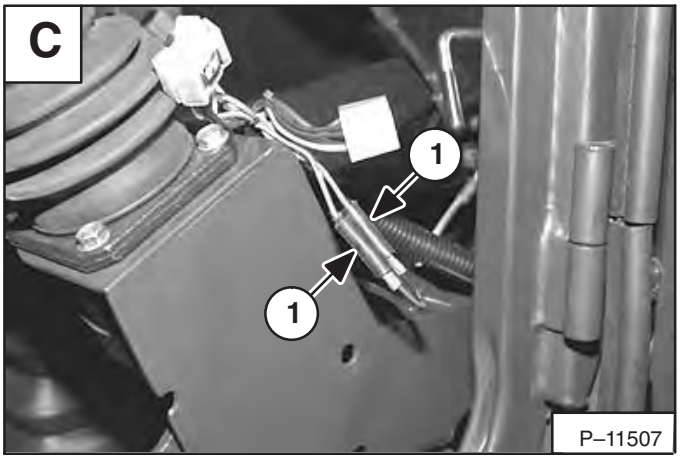


Removal And Installation Of Left Hand Joystick (325 S/N 514014900 & Above) & (328 S/N 51661 1001 & Above)

Remove the console cover. (See Page 3–22.)

Disconnect the secondary auxiliary hydraulic wires (Item 1) **[C]** from the wire harness.

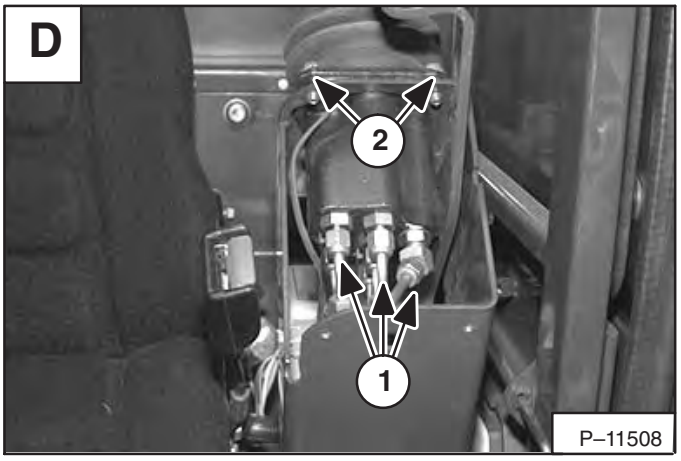
NOTE: The wires are non–specific.



Remove the hoses (Item 1) **[D]** from the joystick.

NOTE: Mark the hose locations for correct installation.

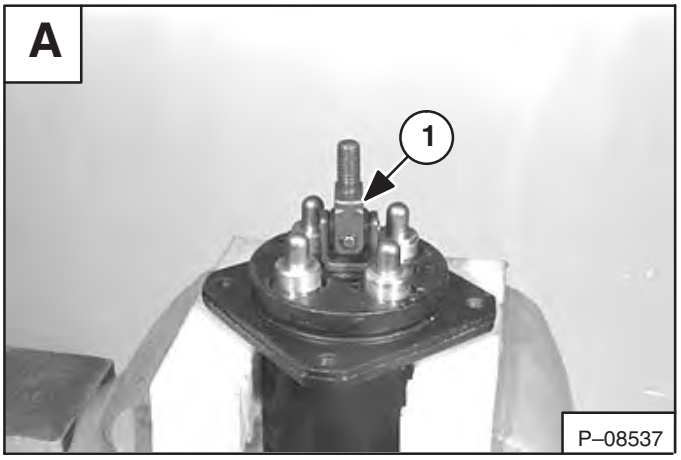
Remove the four bolts (Item 2) **[D]** from the joystick flange. Remove the joystick.



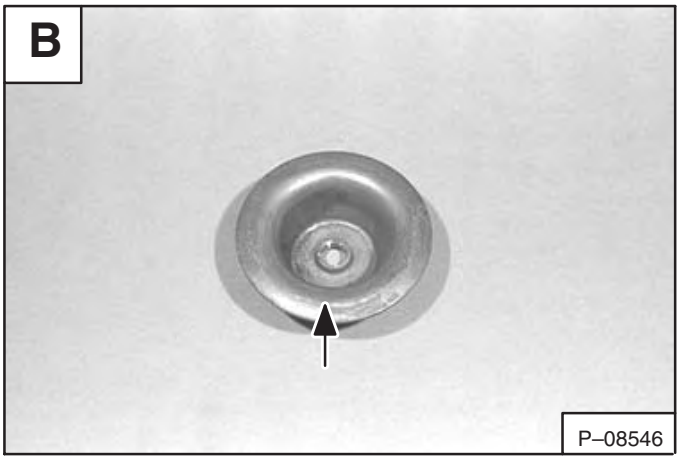
JOYSTICK (Cont'd)

Assembly (Cont'd)

Apply thread lock (LOCTITE 242) to the swivel joint threads. Install the swivel joint (Item 1) **[A]** in the joystick valve body. Tighten to 5 ft.–lbs. (7 Nm) of torque. Lubricate the swivel joint after installation.

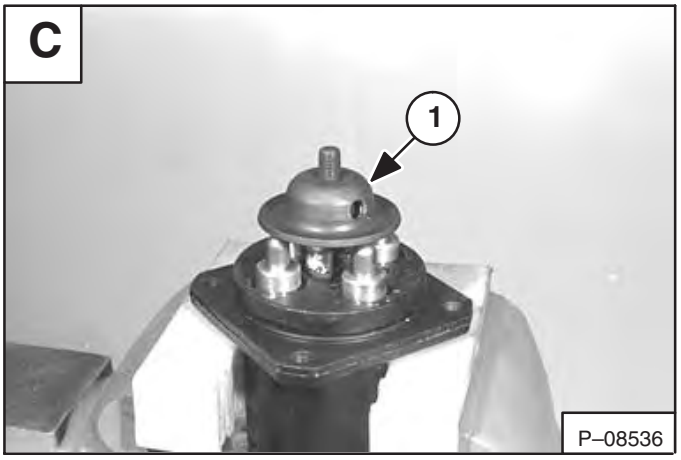


Grease the bottom plate of the selector ring **[B]**.

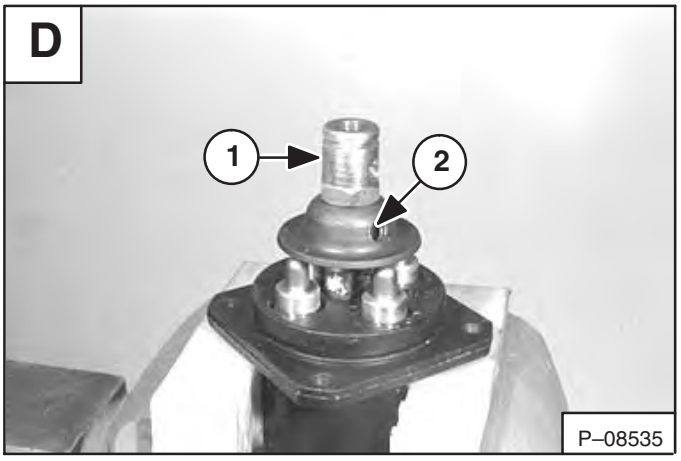


Install the selector ring (Item 1) **[C]**.

Tighten the selector ring until it makes slight contact with all four push rods.



Install the coupler (Item 1) **[D]** on the end of the swivel joint. Insert a drift pin in the hole in the selector ring (Item 2) **[D]** and tighten the coupler to 5 ft.–lbs. (Nm) of torque.



SEAT AND SEAT MOUNT (Cont'd)

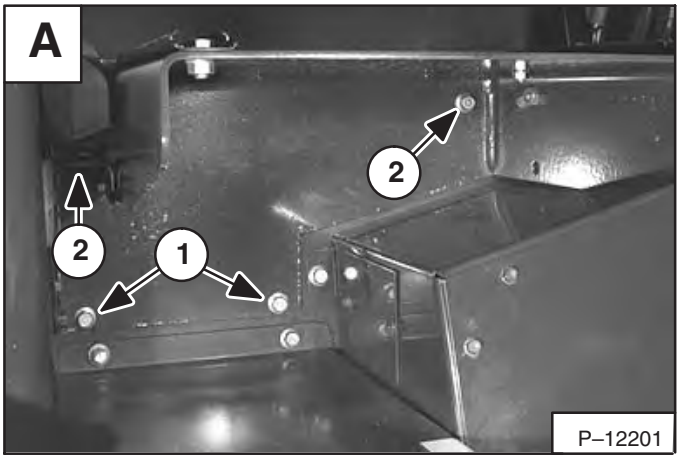
Removal And Installation (Cont'd)

Loosen the two bottom bolts (Item 1) **[A]**.

Remove the two top bolts (Item 2) **[A]**.

Installation: Tighten the bolts to 30–36 ft.–lbs. (40–50 Nm) torque.

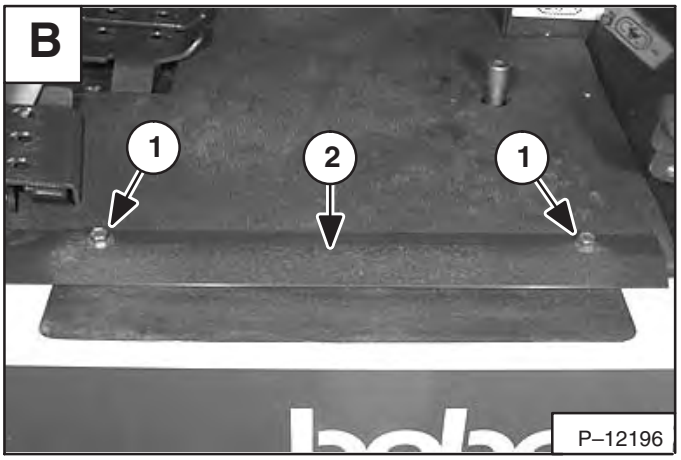
Remove the seat mount.



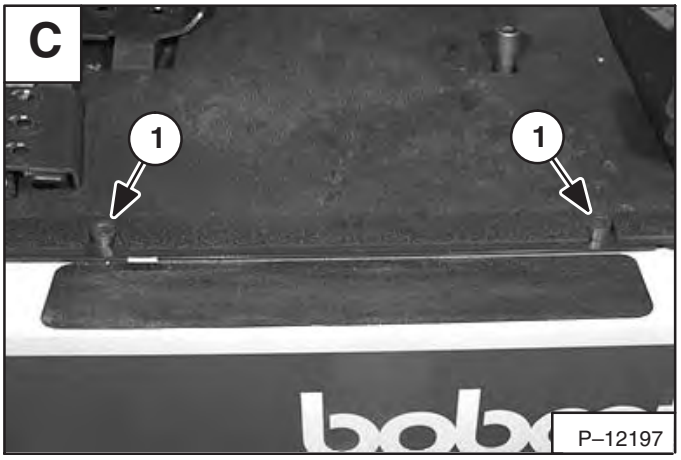
FLOOR MAT AND FLOOR PLATE

Removal And Installation

Remove the two bolts (Item 1) **[B]** and the retainer plate (Item 2) **[B]**.



Remove the two spacers (Item 1) **[C]**.



Remove the floor mat **[D]**.

ARM

Removal And Installation

Support the boom **[A]**.

Remove the arm cylinder. (See Page 2–1.)

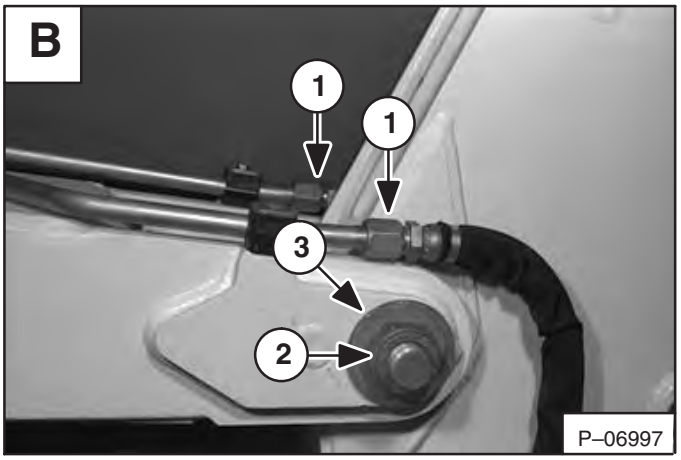
Support the arm with a chain hoist.

Disconnect the bucket cylinder hoses (Item 1) **[B]**.

Remove the nut (Item 2) **[B]** and the washer (Item 3) **[B]** from the boom mounting pin.

Installation: Tighten the lock nut until it is seated firmly against the boom but do not over tighten and deflect the boom mounting plates. The arm must pivot freely.

Remove the arm.



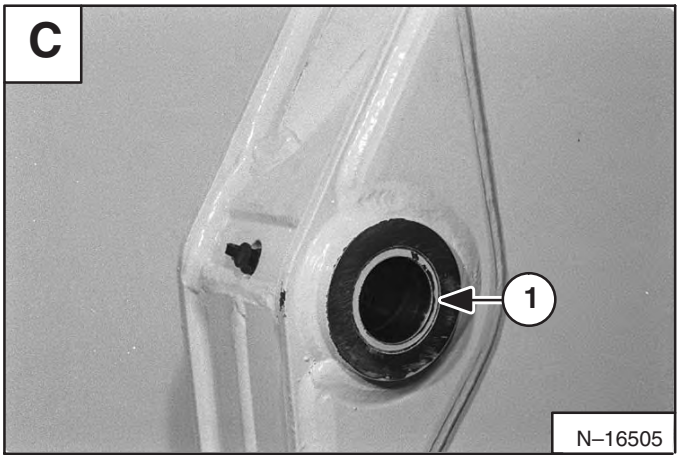
ARM BUSHINGS

Arm To Boom Bushing Removal And Installation

Remove the dust seal (if equipped) from both sides of the arm.

NOTE: If the bushing has a dust seal it has a through bore. If it is not equipped with the dust seal it has a stepped bore.

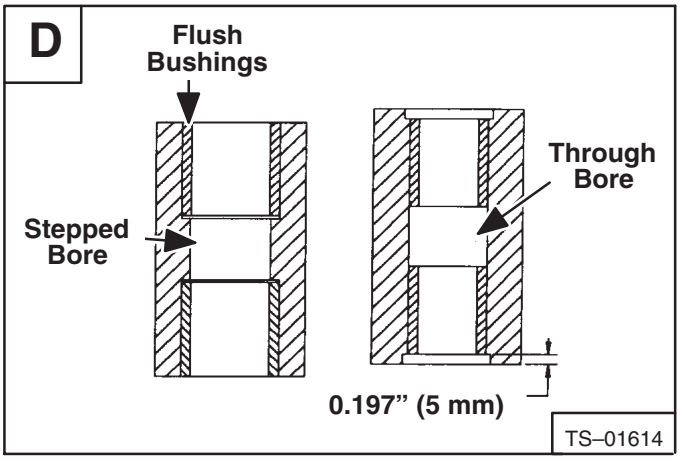
Remove the bushings (Item 1) **[C]** from both sides of the arm.



Install the new bushings in the arm. If the arm is not equipped with the dust seal, install the bushings until they are flush with the pin boss **[D]**.

If the arm is equipped with the dust seal, install the bushings until they are seated 0.197inches (5 mm) in the pin boss **[D]** (both sides).

Install new dust seals (if equipped).

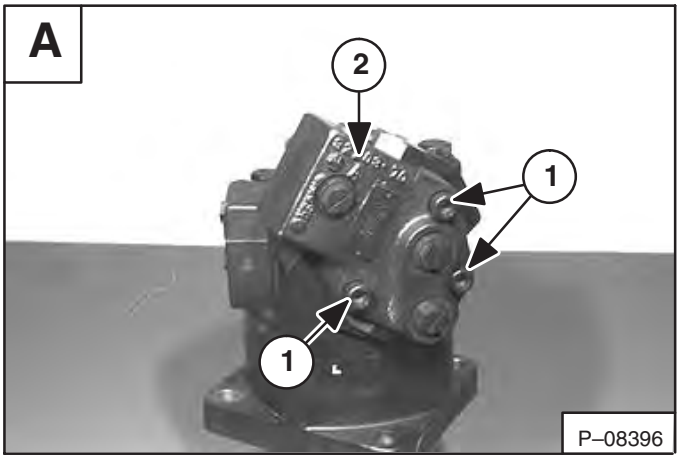


SWING MOTOR (Cont'd)

Disassembly

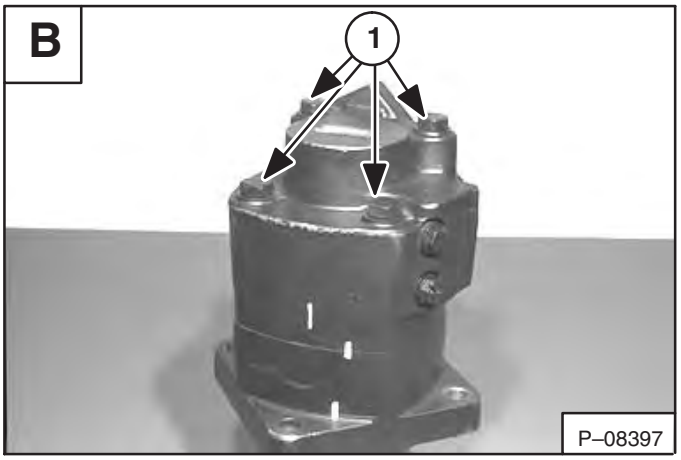
Remove the three bolts (Item 1)**[A]** and remove the cross port relief valve (Item 2) **[A]** from the swing motor.

NOTE: See Page 4–32 for *CROSS PORT RELIEF VALVE Disassembly*.

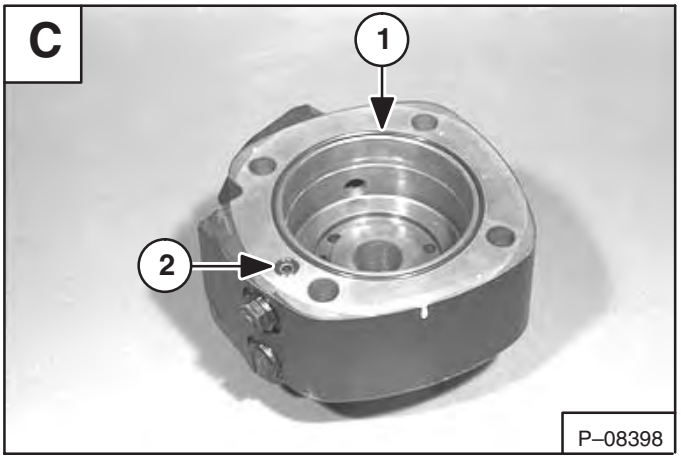


Remove the four bolts (Item 1) **[B]** from the motor.

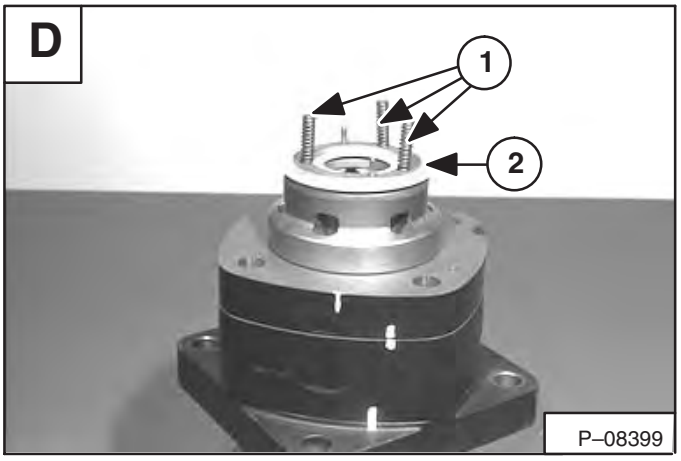
Mark the housing for ease of assembly **[B]**.



Remove the large O–ring (Item 1) **[C]** and small O–ring (Item 2) **[C]** from the housing.



Lift the valve housing straight up. If done carefully the springs (Item 1) **[C]** and balance ring sub–assembly (Item 2) **[C]** will remain on the valve for easy removal. Remove the springs (Item 1) **[D]** and balance ring (Item 2) **[D]**.



SWING MOTOR DRIVE CARRIER

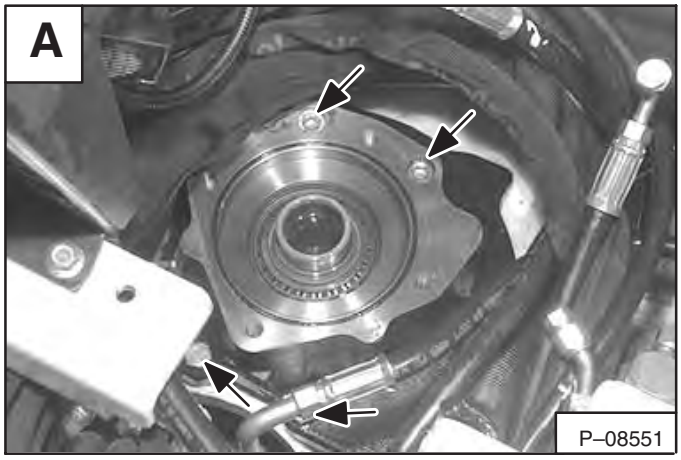
Removal And Installation

NOTE: 325 S/N 514013001–514014899 excavator is shown. The procedure is the same for 325 S/N 514014900 & Above and 328 S/N 516611001 & Above excavators.

Remove the swing motor. (See Page 4–23.)

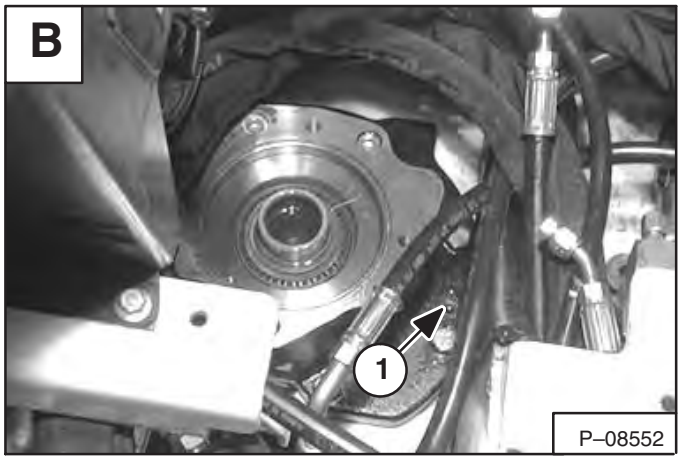
Mark and remove the eight drive carrier mounting bolts **[A]**.

NOTE: It is necessary to mark the mounting bolts as the bolts are not all the same length. The bolts must be installed in the original positions.



Install two 11mm bolts in the threaded holes (Item 1) **[B]** in the drive carrier. Tighten the bolts down to push the drive carrier off of the two alignment pins.

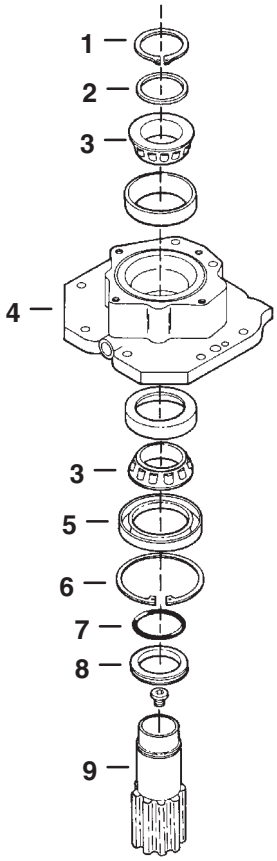
Remove the drive carrier from the excavator.



Parts Identification

SWING MOTOR DRIVE CARRIER

1. Snap Ring
2. Spacer
3. Bearing
4. Housing
5. Seal
6. Snap Ring
7. O–ring
8. Spacer
9. Shaft



Swing Bearing Installation (Cont'd)

Install the three tapered head alignment bolts (P/N 6535902) thru the swing bearing and into the upperstructure **[A]**. These bolts should be spaced at approximately 120°. This procedure will correctly align the upperstructure for correct swing motor gear to swing bearing ring gear clearance.

Tighten these three tapered bolts to 60 ft.–lbs. (81 Nm) torque.

Remove the three, 3.500 inches (90 mm) alignment pins from the upperstructure.

These headless pins can be removed from the bottom.

Apply thread adhesive (LOCTITE 242) to the swivel joint stop bolt.

Install the swivel joint stop bolt and nut into the swivel joint.
Install the nut completely onto the bolt threads then tighten the bolt to 110–125 ft.–lbs. (150–170 Nm) torque.

Install the hoses and fittings that were removed earlier . Start the engine and run at idle to rotate the upperstructure to install and tighten the bolts.

Apply liquid adhesive (LOCTITE 242) to the threads of the bolts. Install the bolts into all holes (except the three with the alignment bolts installed). Tighten these bolts to 73–81 ft.–lbs. (100–110 Nm) torque.

Remove the three alignment bolts (P/N 6535902). Install the three remaining bolts. Tighten these bolts to 73–81 ft.–lbs. (100–110 Nm) torque.

Check the backlash between the gears by moving the frame back and forth at several points throughout 360 of frame rotation. There must be some backlash present.

Install the floor plate and floormat.

Check the hydraulic fluid level and add as necessary.

Alignment Pins (Not Threaded)

If the upperstructure is being replaced, use the special alignment pins (P/N 6586495) in the holes provided in the upperstructure **[B]** & **[C]**.

Remove any paint from the three alignment pin holes.

Use a chain hoist to lower the upperstructure onto the swing bearing.

Align the bolt holes in the upperstructure with the holes in the bearing.

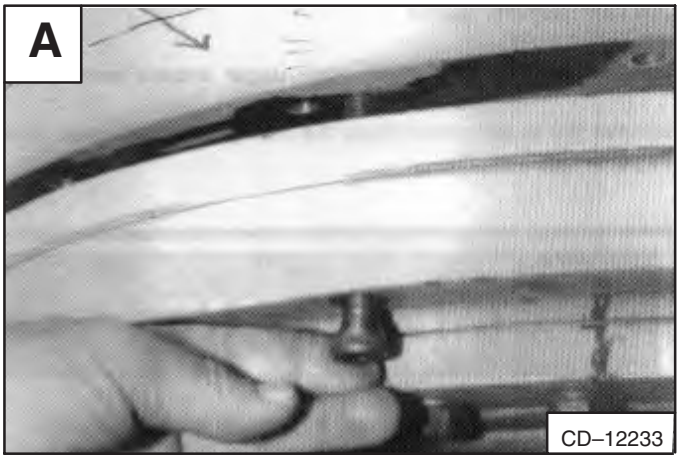
Install an alignment pin into the upperstructure and put the upperstructure on the bearing to allow the pin to be put into the swing bearing gear teeth. Pull the upperstructure to set the pin firmly into the bearing teeth.

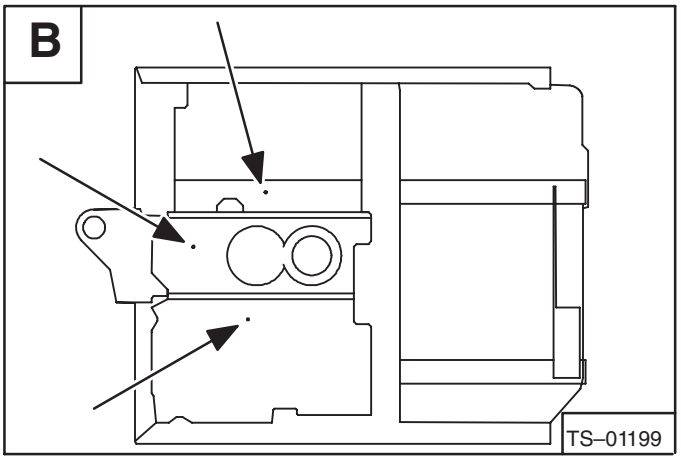
Install the next alignment pin into the upperstructure and into the bearing gear teeth. Pull the upperstructure to set the second pin into the bearing teeth.

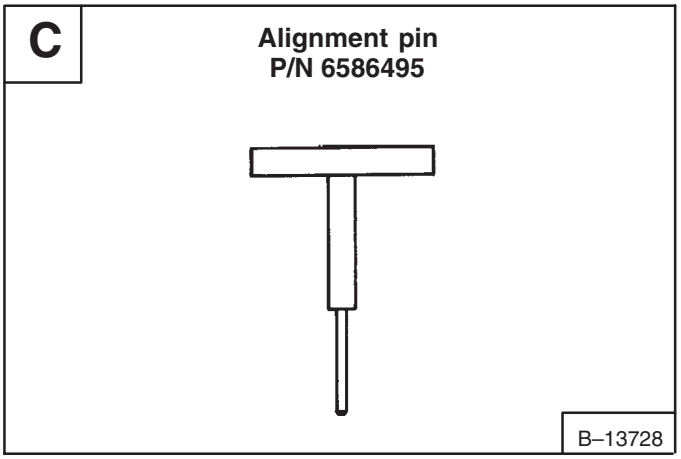
Install the third alignment pin, this will align the bearing to the upperstructure for correct swing motor to bearing teeth engagement.

Apply liquid adhesive (LOCTITE 242) to the bolt threads. Rotate the upperstructure to install the bolts.

Tighten the bolts to 73–81 ft.–lbs. (100–110 Nm) torque.







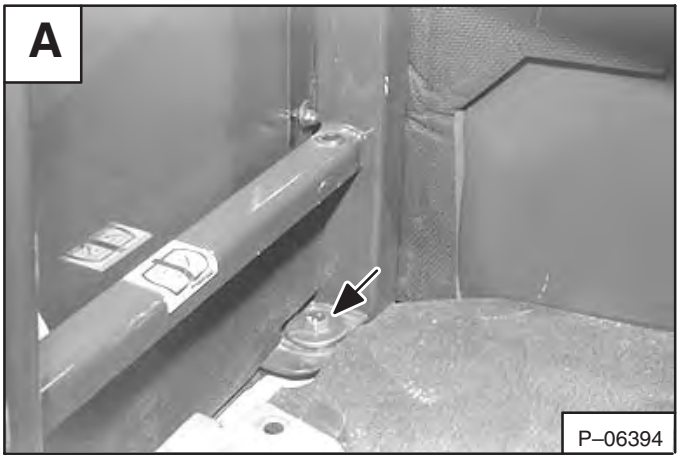
CAB

Removal And Installation

NOTE: For 325 S/N 514013001–514014899 Remove the cab heater. (See Page 4–57.)

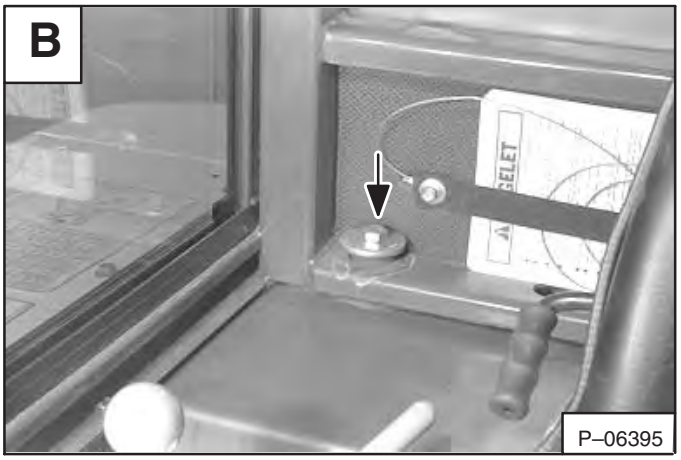
Remove the bolt, washer, plate and nut from both front cab mounts **[A]**.

Installation: Tighten the bolts to 48–55 ft.–lbs. (65–75 Nm) torque.



Remove the bolt and the washer from left rear cab mount **[B]**.

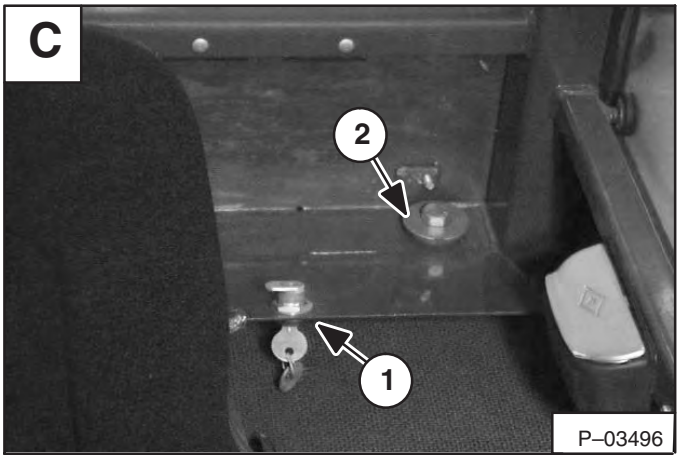
Installation: Tighten the bolt to 48–55 ft.–lbs. (65–75 Nm) torque.



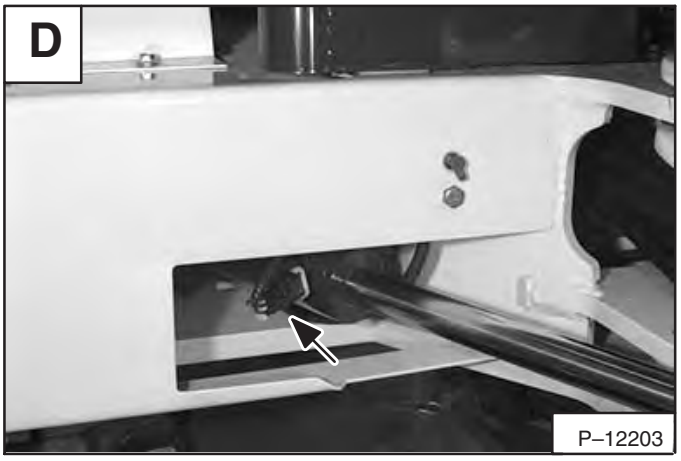
Unlock and open the operators manual storage compartment (Item 1) **[C]**.

Remove the bolt and washer (Item 2) **[C]** from the right rear cab mount.

Installation: Tighten the bolt to 48–55 ft.–lbs. (65–75 Nm) torque.



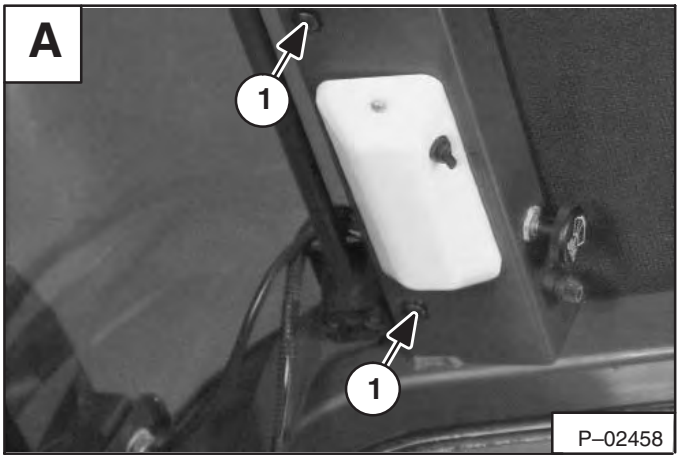
Disconnect the cab harness from the main harness **[D]**. The harness connectors are under the right hand upperstructure, near the boom swing cylinder.



CAB (Cont'd)

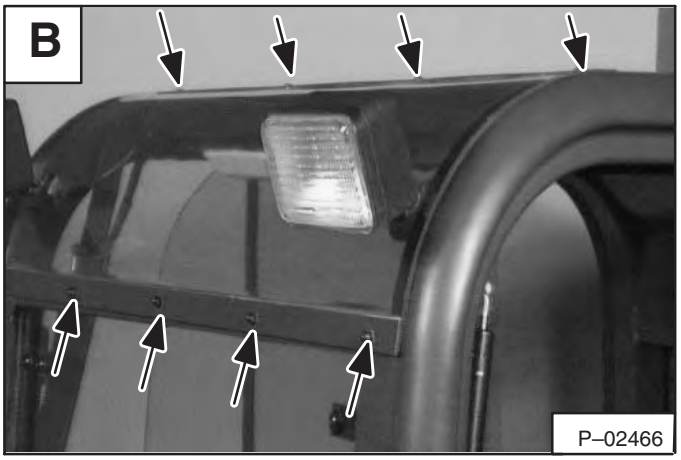
Front Upper Window Removal And Installation (325 S/N 514013001–514014899)

Remove the mounting screws (Item 1)**[A]** from the upper cab console to access the window mounting nuts.



Remove the mounting screws, retainer straps and nuts **[B]**.

Installation: Tighten the mounting screws to 30 in.–lbs. (3,4 Nm) torque.



Remove the window.

Remove the gasket from the cab frame.

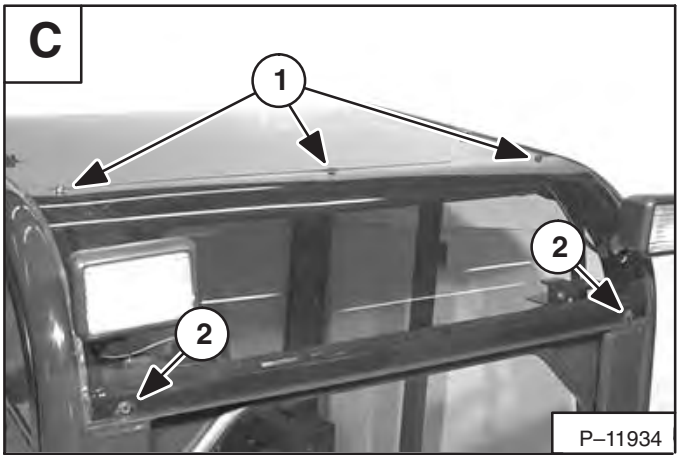
When installing the window, use a new window gasket seal.

Front Upper Window Removal And Installation (325 S/N 514014900 & Above) & (328 S/N 51661 1001 & Above)

Remove the three bolts (Item 1) **[C]** from the top of the upper window.

Remove the two bolts (Item 2) **[C]** from the front of the upper window.

Installation: Tighten the mounting screws to 30 in.–lbs. (3,4 Nm) torque.



Cut the adhesive seal around the edge of the upper window.

Cut the seal around the edge of the upper window.

Remove the window.

Remove any sealant from the cab frame.

After the window is installed, apply sealant to the top and sides of the window.

Door Removal And Installation

The door can be removed from the cab by slowly swinging the door back and forth while lifting up on the door **[D]**.

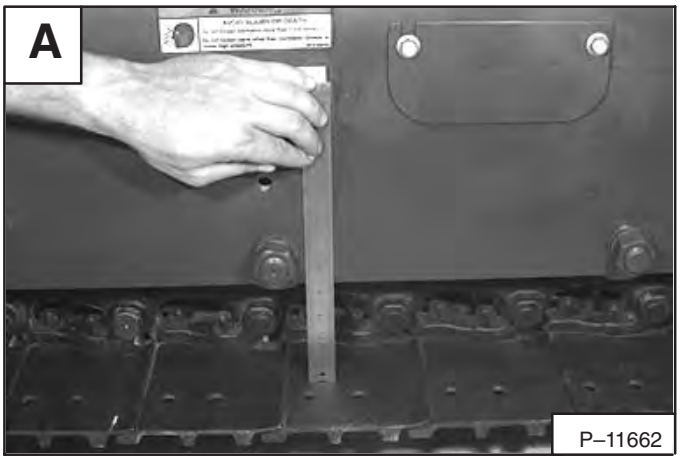
NOTE: When installing the door; the top hinge is bolted to the door. Align the top hinge first and then position the bottom hinge. Hold up on the door and slowly rock the door back and forth until the hinges are engaged about 0.750 inch (19 mm). Then rock the door back and forth until the door weight moves the door hinges to full engagement.

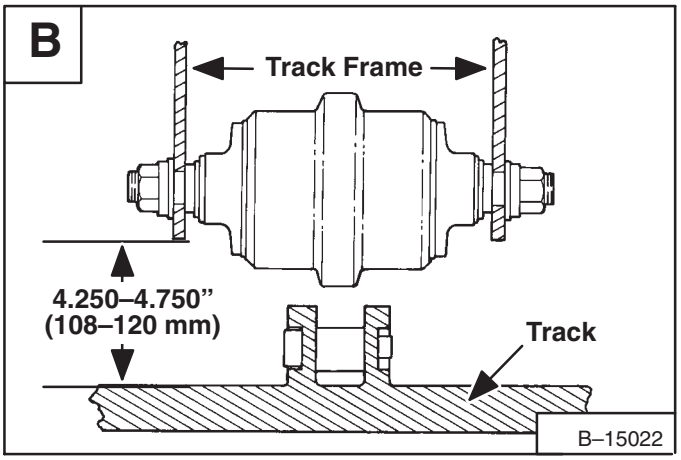
TRACK (Cont'd)

Steel Track Clearance

Measure the steel track sag at the center of the track, between the lower edge of the track frame and the top surface of the track **[A]** & **[B]**.

Steel Track Sag . . . 4.250–4.750 inches (108–120 mm)



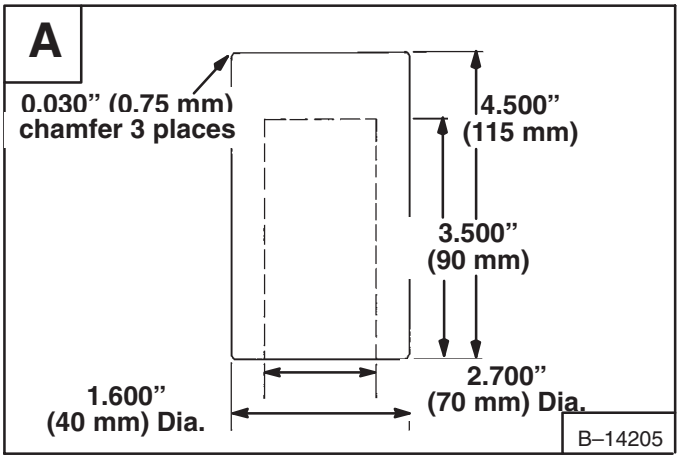


TRACK IDLER (Cont'd)

Disassembly

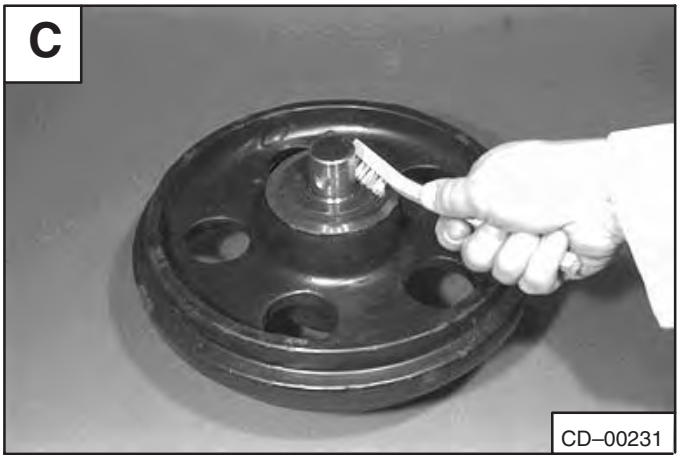
The following tools must be fabricated for this procedure:

1. Driver Tool – See **[A]**.
2. Support Fixture – Tube, 3.0 inches ID x 0.250 inch wall x 6.0 inches long.



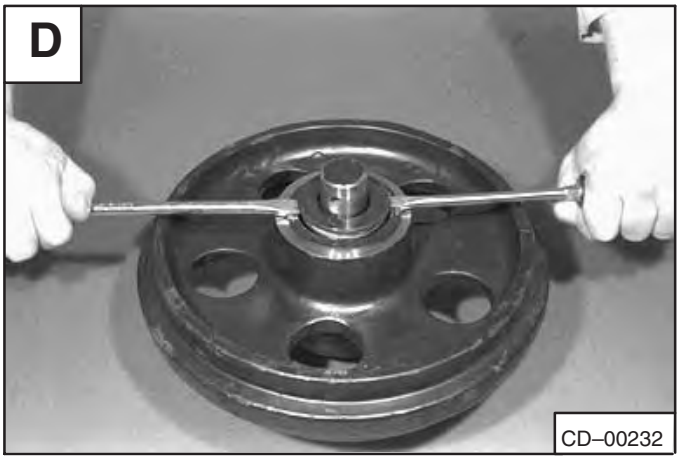
Remove the roll pin and block from each end of the shaft **[B]**.

Use a wire brush to remove any corrosion or paint from both ends of the exposed shaft that could affect seal removal or damage the new seal during installation **[C]**.



Apply penetrating oil to both ends of the exposed shaft to ease removal of the inner part of the seal.

Remove the inner part of the seal using two screwdrivers **[D]**.



TRACK ROLLER (Cont'd)

Assembly (Cont'd)

Turn the roller assembly over.

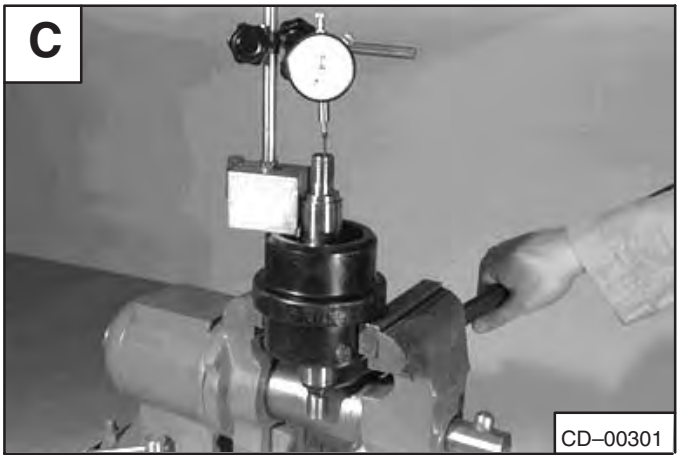
Using the driver tool, install the other bearing, with the numbered side upward, in the roller **[A]**.

Install the snap ring **[B]**.

Using a dial indicator, check the endplay of the shaft **[C]**.

If the endplay is greater than 0.030 inch (0,76 mm) then the bearing must be shimmed.

Cut a shim from the necessary thickness shim stock and install the shim between the bearing and the shoulder on the shaft.



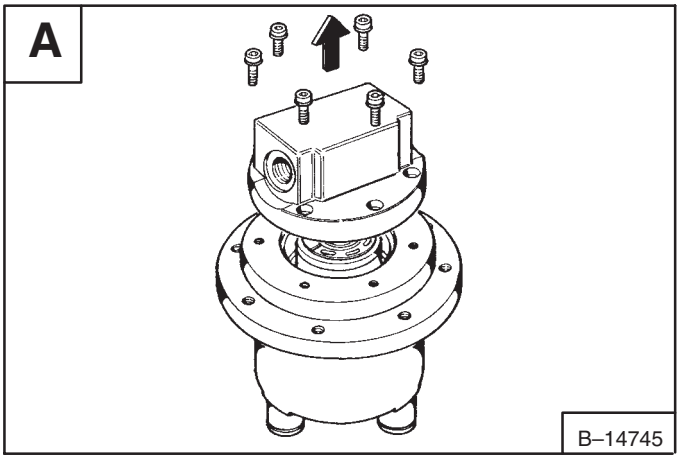
Separate the inner and outer halves of the seal.

Apply grease to the grooves on the outer part of a new seal **[D]**.

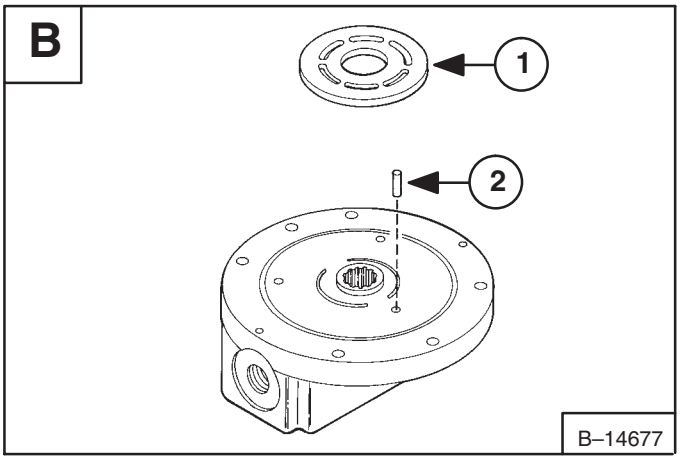
TRAVEL MOTOR (Cont'd)

Disassembly (Cont'd)

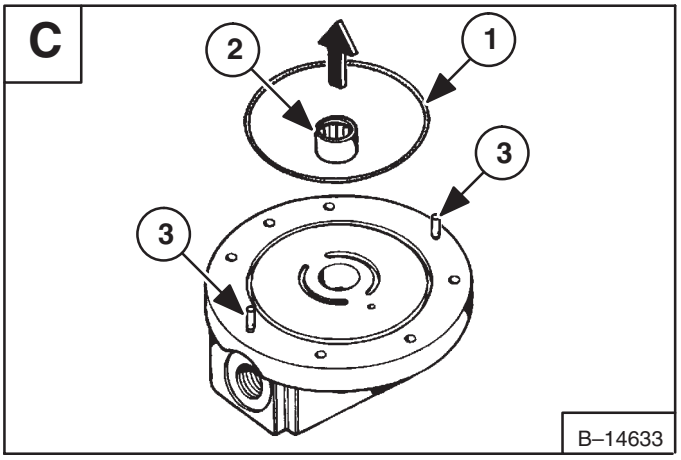
Remove the six screws and remove the motor cover**[A]**.



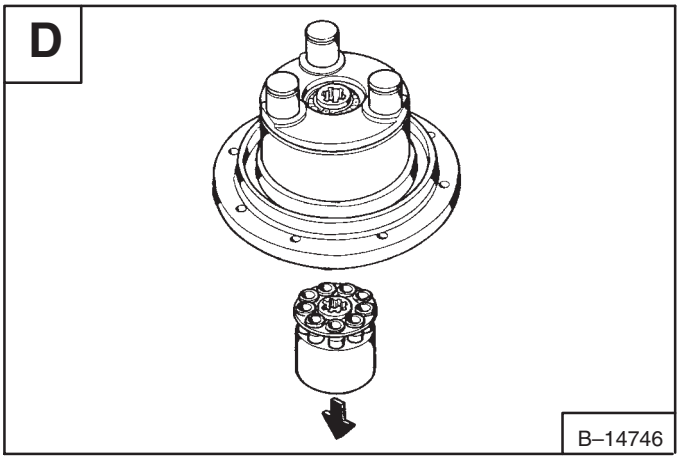
Remove the bronze motor plate (Item 1**[B]** and dowel pin (Item 2) **[B]**.



Remove the O–ring (Item 1)**[C]**, bearing (Item 2)**[C]** and the two alignment pins (Item 3)**[C]**. Remove the bearing (Item 2) **[C]** with a bearing puller.



Invert the hub, and the rotating block will slide out **[D].**

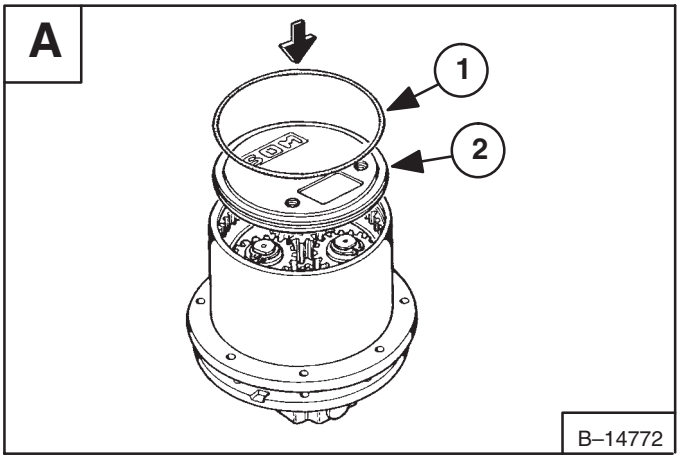


TRAVEL MOTOR (Cont'd)

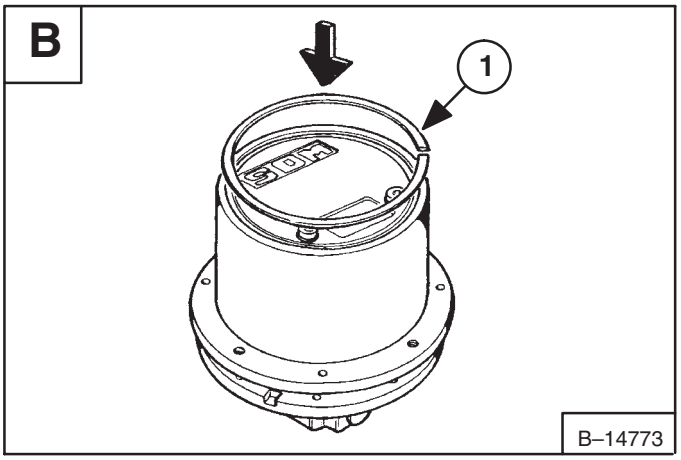
Assembly (Cont'd)

Apply oil to and install the O–ring (Item 1) **[A]** on the cover.

Install the cover (Item 2) **[A]** on the hub.

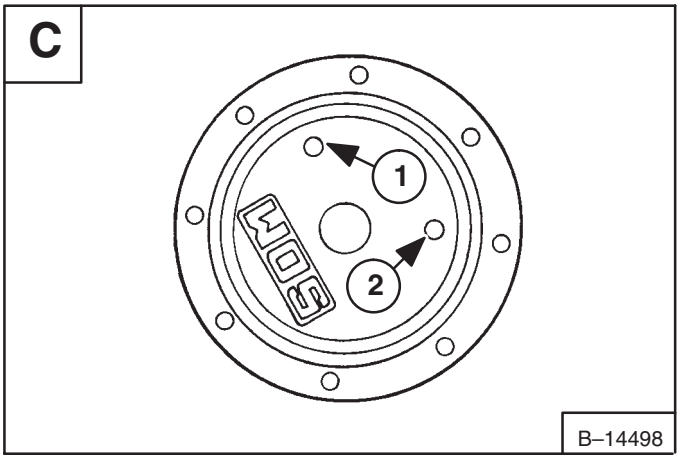


Install the snap ring (Item 1) **[B]** securing the cover to the drive motor.



Add 1.06 quarts (1,0 L) of gear lube 90W to the top plug hole (Item 1) **[C]** until the gear lube is at the bottom of the plug hole (Item 2) **[C]**.

Install and tighten the two plugs.



ELECTRICAL SYSTEM

Page Number

ALTERNATOR
- Alternator Regulator Test 6–10
- Alternator Output Test 6–9
- Assembly 6–13
- Belt Adjustment . . . . . 6–8.
- Disassembly And Inspection 6–11
- Parts Identification 6–11
- Rectifier (Diode) Test 6–9
- Rectifier Continuity (Diode) Test 6–12
- Removal And Installation 6–8
- Rotor Continuity Test 6–12
- Rotor Ground Test 6–12
- Stator Continuity Test 6–11
- Stator Ground Test 6–11

BATTERY
- Removal And Installation 6–6
- Servicing The Battery 6–7

BUZZER
- Removal And Installation 6–38

CAB ELECTRICAL
- Cab Option (325 S/N 514013001–514014899) 6–37
- Cab Option (325 S/N 514014900 & Above) & (328 S/N 516611001 & Above) 6–37

DIODES (325 S/N 514014900 & Above) & (328 S/N 516611001 & Above)
- Diode Location 6–36
- Diode Replacement 6–36
- Diode Testing 6–36

ELECTRICAL SYSTEM
- Description . . . . . 6–3 .
- Electrical Relays And Diodes (325 S/N 514014900 & Above) & (328 S/N 516611001 & Above) 6–4
- Fuses (325 S/N 514013001–514014899) 6–4
- Fuse Arrangement (325 S/N 514013001–514014899) 6–4
- Fuse Arrangement (325 S/N 514014900 & Above) & (328 S/N 516611001 & Above) 6–5

FUEL LEVEL SENDER
- Testing 6–32
- Removal And Installation 6–32

GAUGES
- Bulb Replacement (325 S/N 514013001–514014899) 6–34
- Bulb Replacement (325 S/N 514014900 & Above) & (328 S/N 516611001 & Above) 6–35
- Removal And Installation (325 S/N 514013001–514014899) 6–33
- Removal And Installation (325 S/N 514014900 & Above) & (328 S/N 516611001 & Above) 6–35

HORN
- Removal And Installation 6–38

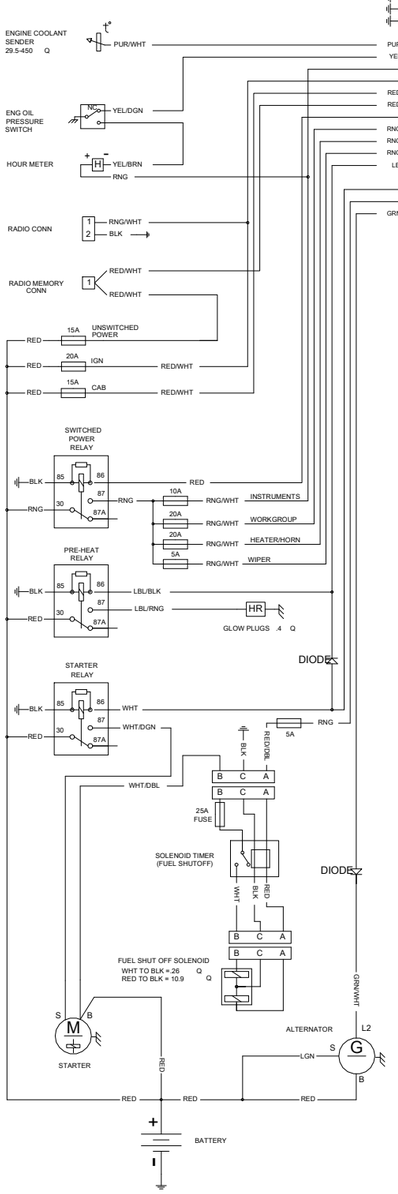
INSTRUMENT PANEL (325 S/N 514013001–514014899)
- Removal And Installation 6–33

Continued On Next Page

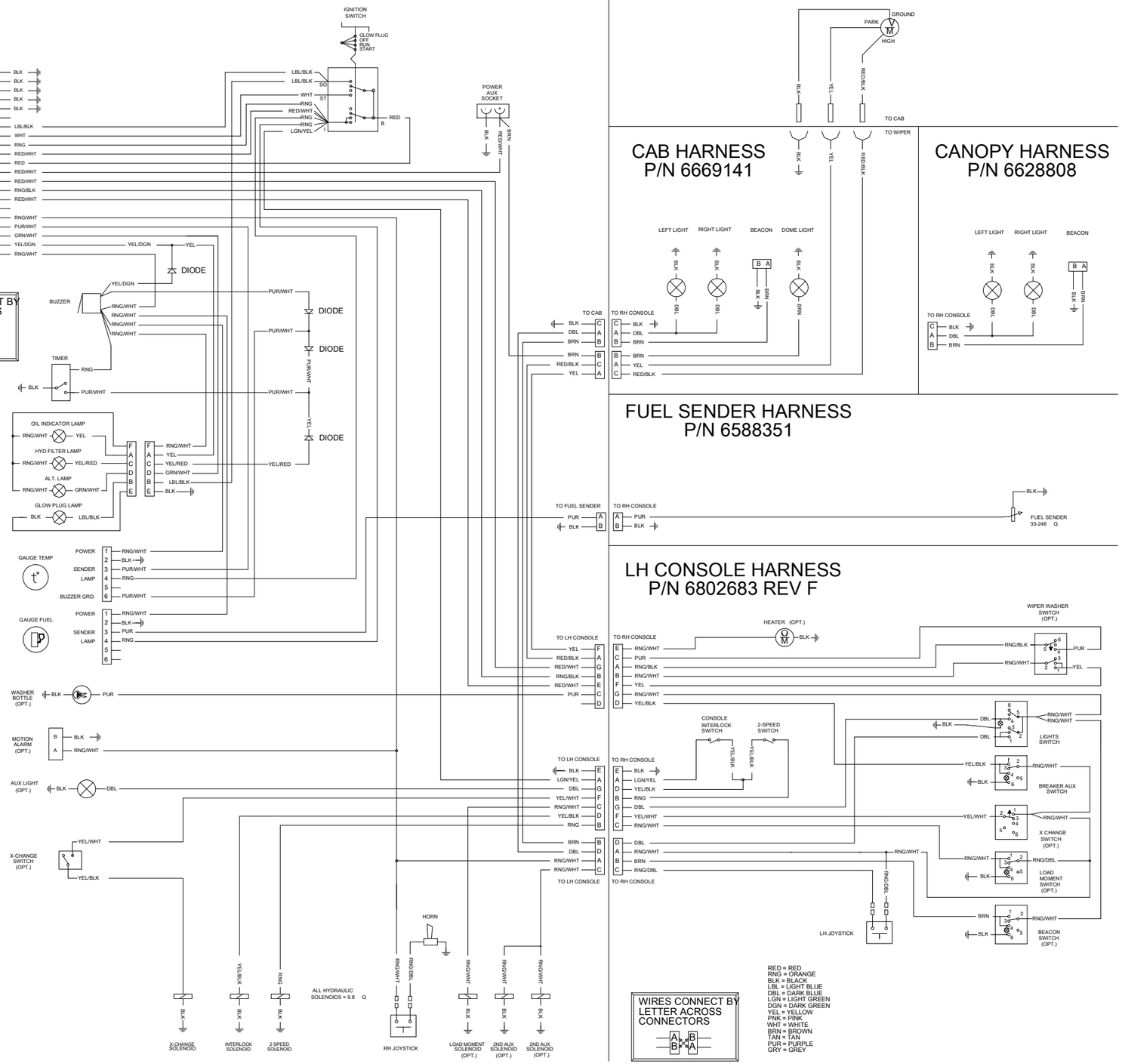
WIRING SCHEMATIC
325 EXCAVATOR (SN 514014900 AND ABOVE)
328 EXCAVATOR (SN 516611001 AND ABOVE)

(PRINTED DECEMBER 2000)
TS-1630A

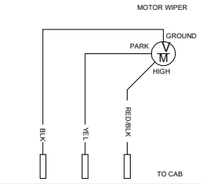
ENGINE HARNESS
P/N 6802730 REV E



RH CONSOLE HARNESS
P/N 6715161 REV C



WIPER HARNESS
P/N 6715162



CAB HARNESS
P/N 6669141

CANOPY HARNESS
P/N 6628808

FUEL SENDER HARNESS
P/N 6588351

LH CONSOLE HARNESS
P/N 6802683 REV F

WIRES CONNECT BY LETTER ACROSS CONNECTORS

RED = RED
RNG = ORANGE
BLK = BLACK
LBL = LIGHT BLUE
DBL = DARK BLUE
LGN = LIGHT GREEN
DGN = DARK GREEN
YEL = YELLOW
PNK = PINK
WHT = WHITE
BRN = BROWN
TAN = TAN
PUR = PURPLE
GRY = GREY

ALTERNATOR (Cont'd)

Parts Identification

Disassemble the alternator (See Parts Identification) **[A]**.

Disassembly And Inspection

Remove the regulator cover and regulator.

Remove the four bolts holding halves together.

Pry the halves apart (use a press if needed).

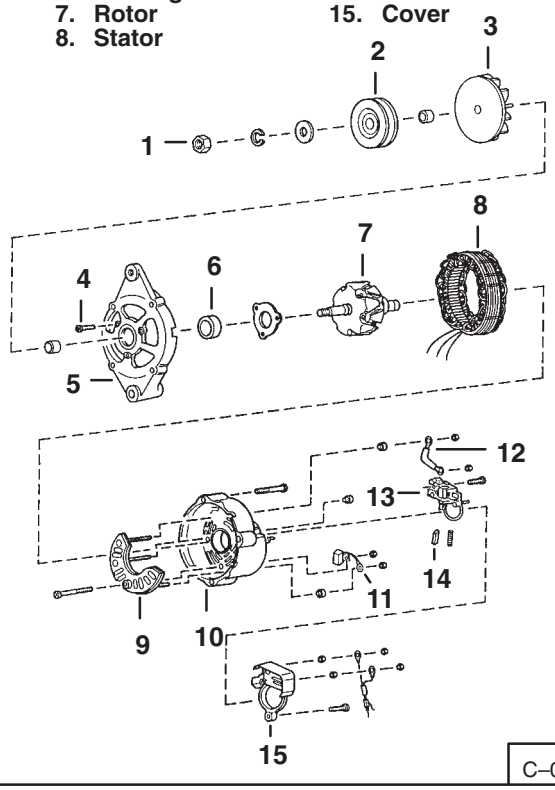
Use a soft jaw vise to hold rotor while removing pulley nut.

Remove front case half from the rotor while removing pulley nut.

Unsolder the stator leads from the rectifier. Remove the stator.

A

1. Nut
2. Pulley
3. Fan
4. Bolt
5. Case Half (Front)
6. Bearing
7. Rotor
8. Stator
9. Rectifier (Diode)
10. Case Half (Rear)
11. Condenser Assy.
12. Bolt
13. Regulator
14. Brush
15. Cover



C–03312

Stator Continuity Test

Use an ohmmeter to test the stator.

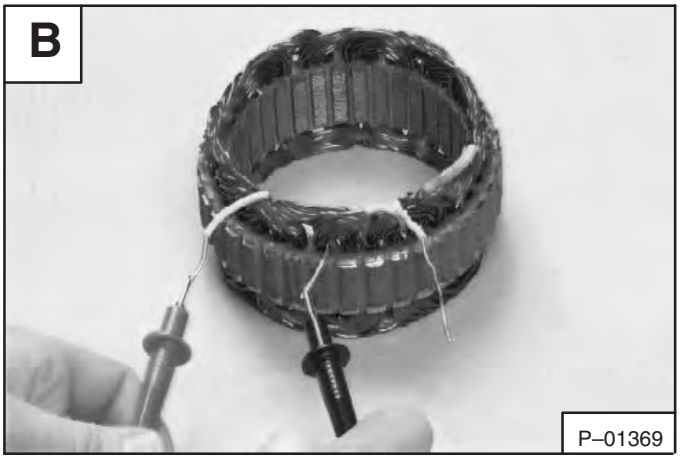
Touch the probes to two of the bare stator wires **[B]**.

Move one of the probes to the third wire.

The readings should be the same.

If there is no continuity, replace the stator.

B



P–01369

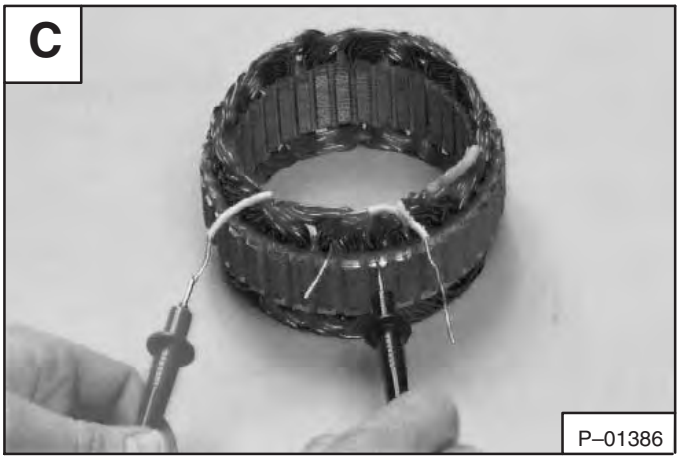
Stator Ground Test

Touch one probe to a bare stator lead and the other probe to the bare metal surface of the stator **[C]**.

There should be no continuity.

Replace the stator if there is continuity.

C

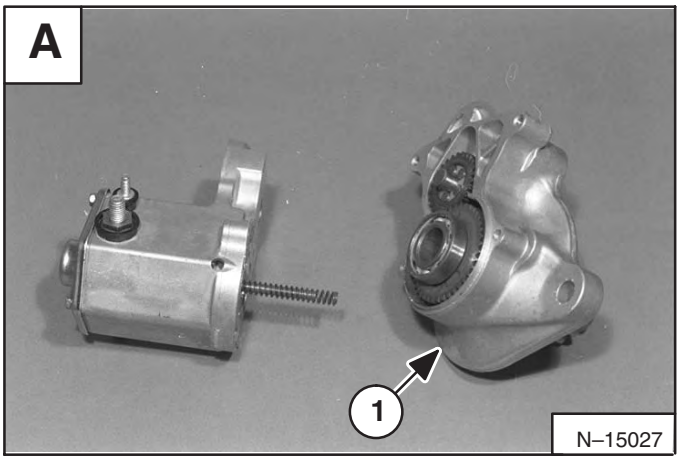


P–01386

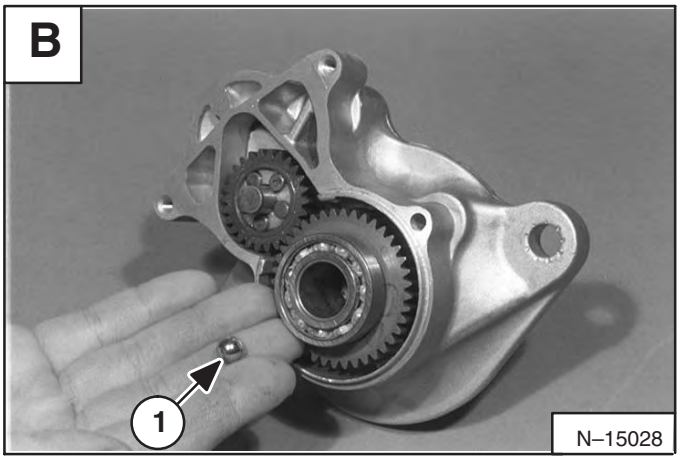
STARTER (Cont'd)

Disassembly (Cont'd)

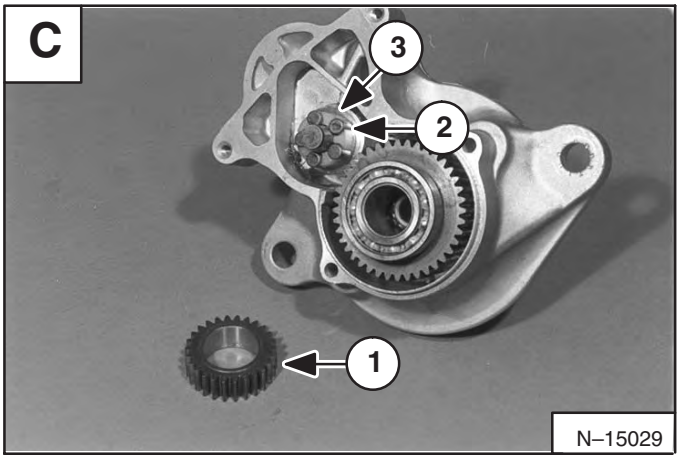
Remove the starter housing (Item 1) **[A]** from the magnetic switch housing.



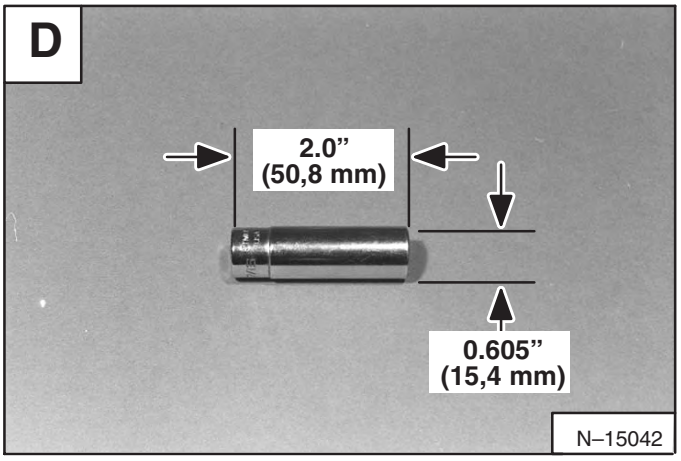
Remove the ball (Item 1) **[B]** from the pinion shaft.



Remove the idler gear (Item 1**[C]**, rollers (Item 2)**[C]** and retainer (Item 3) **[C]**.



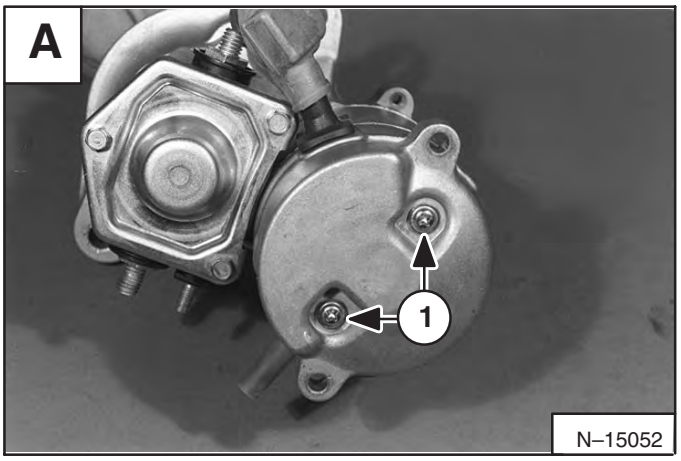
In order to remove the snap ring from the pinion shaft, a tube 0.605 inches (15,4 mm) in diameter by 2.0 inches (50,8 mm) in length is needed **[D]**.



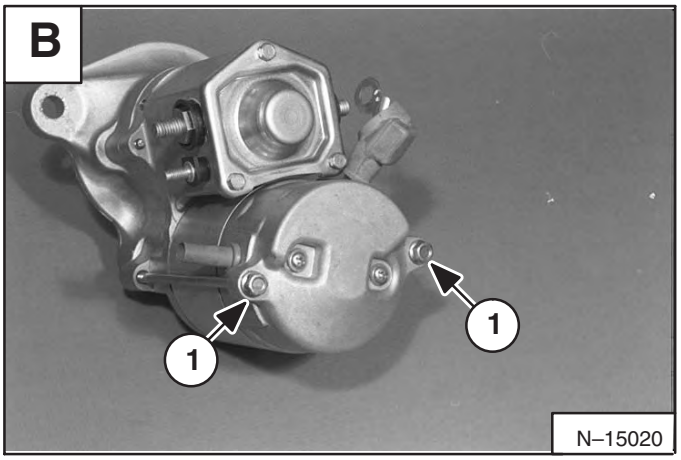
STARTER (Cont'd)

Assembly (Cont'd)

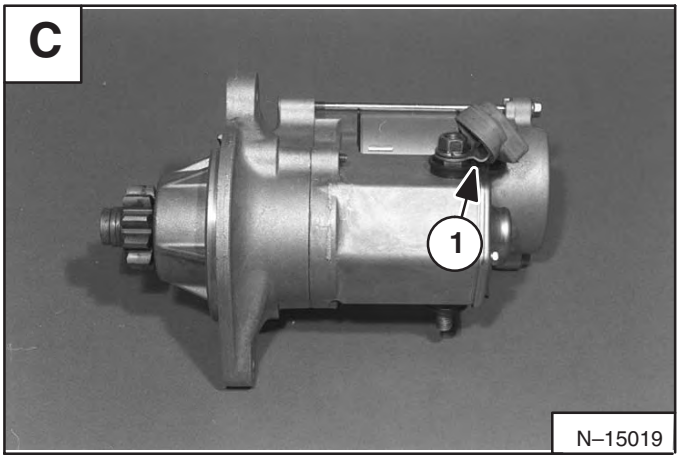
Install the brush cover and screws (Item 1) **[A]**.



Install the thru bolts (Item 1) **[B]**. Tighten the bolts to 60–104 in.–lbs. (7–12 Nm) torque.



Install the cable (Item 1) **[C]** on the terminal. Tighten the terminal nut to 4–7 ft.–lbs. (5–9 Nm) torque.



TROUBLESHOOTING

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, 50
Low oil pressure.	4, 31, 32, 33, 34, 35, 37, 38, 39, 52
Engine knocking.	13, 15, 16, 19, 22, 24, 25, 27, 29, 31, 40, 41, 53
Engine running rough.	7, 8, 9, 10, 11, 12, 13, 17, 18, 22, 24, 25, 26, 29, 40, 53
Vibration.	12, 13, 17, 21, 22, 25, 26, 29, 40, 42, 43
High oil pressure.	4, 33, 36
Overheating.	10, 12, 13, 15, 16, 20, 21, 40, 44, 45, 46, 47, 48, 51
Too much crankcase pressure.	22, 27, 29, 30, 40, 49
Poor compression.	10, 16, 21, 24, 25, 27, 28, 29, 30, 41, 53
Start and stop	9, 10, 11

KEY TO CORRECT THE CAUSE

1. Battery capacity low.
2. Bad electrical connections.
3. Faulty starter motor.
4. Incorrect grade of oil.
5. Low cranking speed.
6. Fuel tank empty.
7. Faulty stop control operation.
8. Plugged fuel line.
9. Plugged fuel filter.
10. Restriction in the air cleaner.
11. Air in the fuel system.
12. Faulty fuel injection pump.
13. Faulty fuel injectors.
14. Broken injection pump drive.
15. Incorrect injection pump timing.
16. Incorrect valve timing.
17. Poor compression.
18. Plugged fuel tank vent.
19. Incorrect grade of fuel.
20. Exhaust pipe restriction.
21. Cylinder head gasket leaking.
22. Overheating.
23. Cold running.
24. Incorrect tappet adjustment.
25. Sticking valves.
26. Incorrect high pressure fuel lines.
27. Worn cylinder bores.
28. Worn valves and seat.
29. Broken or worn piston rings.
30. Worn valve stems or guides.
31. Worn or damaged bearings.
32. Not enough oil in the oil pan.
33. Switch is defective.
34. Oil pump worn.
35. Relief valve is stuck open.
36. Relief valve is stuck closed.
37. Broken relief valve spring.
38. Faulty suction pipe.
39. Plugged oil filter.
40. Piston seizure.
41. Incorrect piston height.
42. Faulty engine mounting.
43. Incorrect alignment of flywheel.
44. Faulty thermostat.
45. Restriction in water jacket.
46. Loose alternator belt.
47. Plugged radiator.
48. Faulty water pump.
49. Plugged breather pipe.
50. Damaged valve stem oil deflectors.
51. Coolant level too low.
52. Plugged oil pump pipe strainer.
53. Broken valve spring.

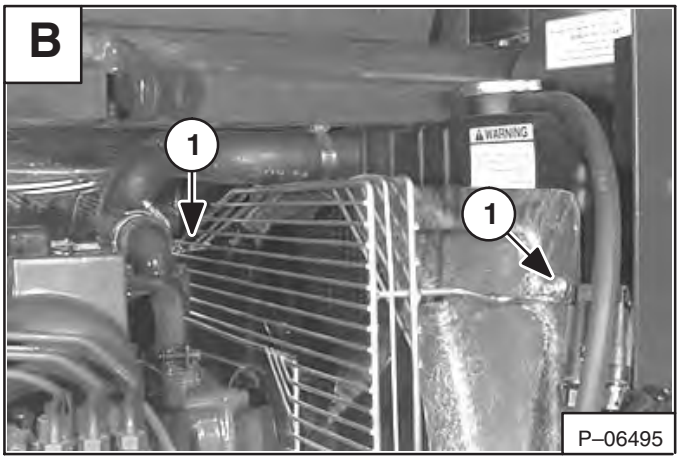
FAN GUARD

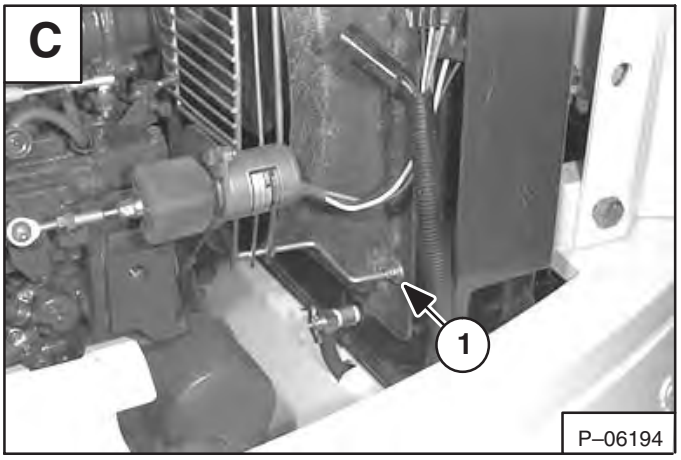
Removal And Installation

Open the engine cover **[A]**.

Remove the three bolts (Item 1) **[B]** & **[C]**.

Remove the fan guard.



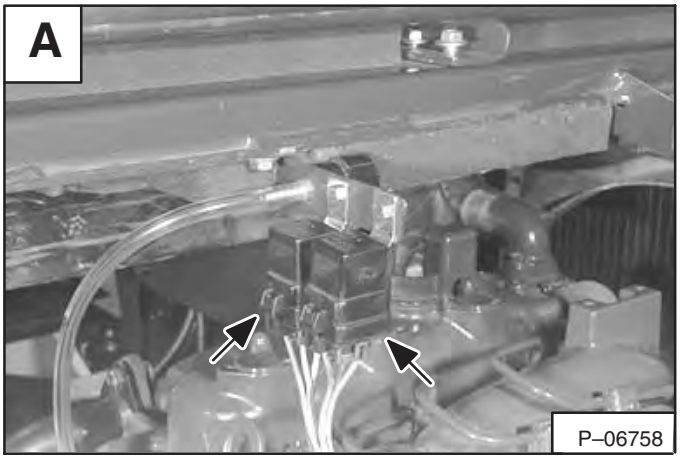


ENGINE (Cont'd)

Removal And Installation (Cont'd)

For 325 S/N 514013001–514014899

Disconnect the wiring harness from the two relays **[A]**.

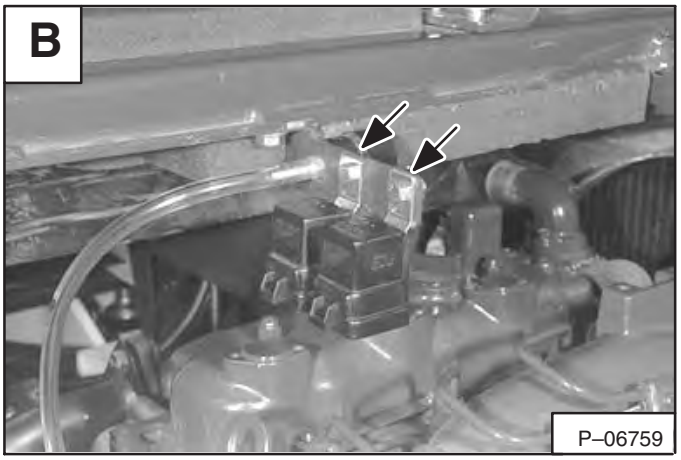


Remove the two bolts from the relay/air indicator mount **[B]**.

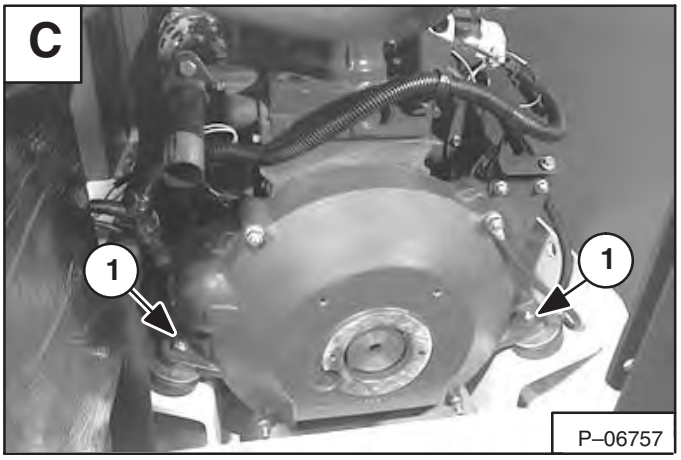
Remove the relay/air indicator mount.

For All S/N Excavators:

Remove the remaining bolt from the shroud and position the shroud over the fan.

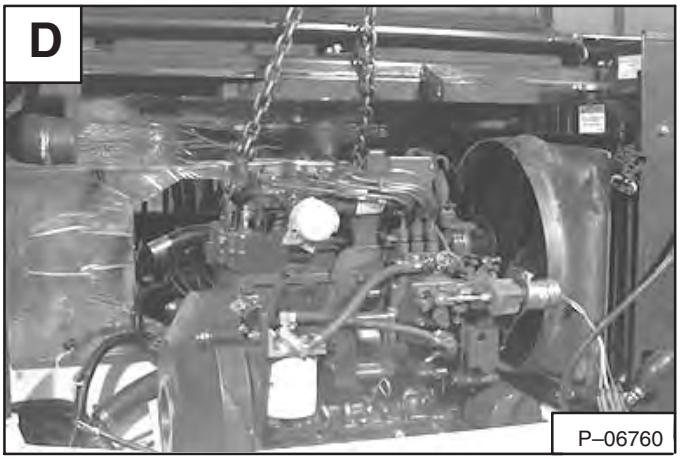


Remove the four nuts and bolts (Item 1) **[C]** from the engine mounts.



Connect a chain to the two engine lift eyes **[D]**.

Attach a hoist to the lifting chain.



VALVE, VALVE SEAT AND GUIDE (Cont'd)

Valve Spring

Measure the length of the valve spring. If the measurement is less that the allowable limit, replace the spring **[A]**.

Free Length1.642–1.661 inch (41,7–42,2 mm) Allowable Limit . . . . . 1.622 inch (41,2 mm)

Put the spring on a flat surface, place a square on the side of the spring **[A]**.

Rotate the spring and measure the maximum tilt. If the measurement excess the allowable limit, replace the spring.

Tilt . . . . . 0.040 inch (1,0 mm)

Put the spring on a tester and compress to specified length **[B]**.

Read the compressed load on the gauge. If the measurement exceeds allowable limit, replace the spring.

Setting Length . . . . . 1.378 inch (35,0 mm)
Setting Load . . . . . 26.4 lbs (117,6 N)
Allowable Limit . . . . . 22.5 lbs. (100,0 N)

ROCKER ARM AND SHAFT

Checking

Measure the rocker arm I.D. (Item 1) **[C]** with an inside micrometer.

Measure the rocker shaft O.D. (Item 2**[C]** with anoutside micrometer.

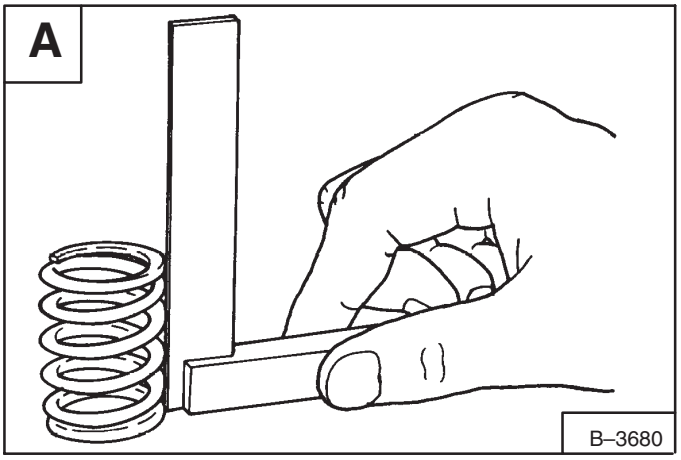
If the clearance exceeds the allowable limit, replace the bushing.

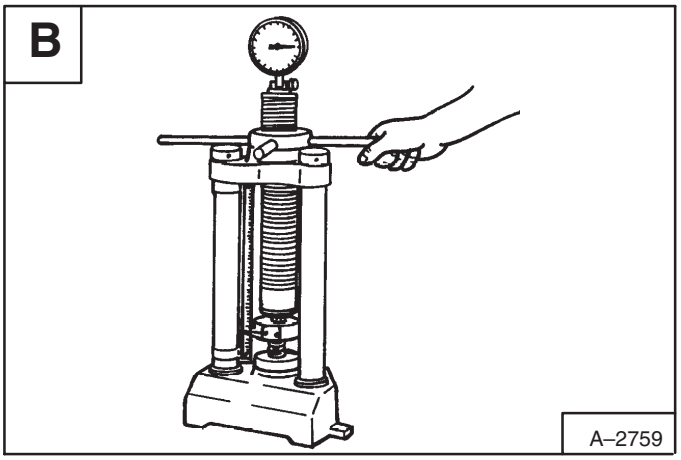
If the clearance still exceeds the the allowable limit after the bushing is replaced, replace the rocker arm shaft.

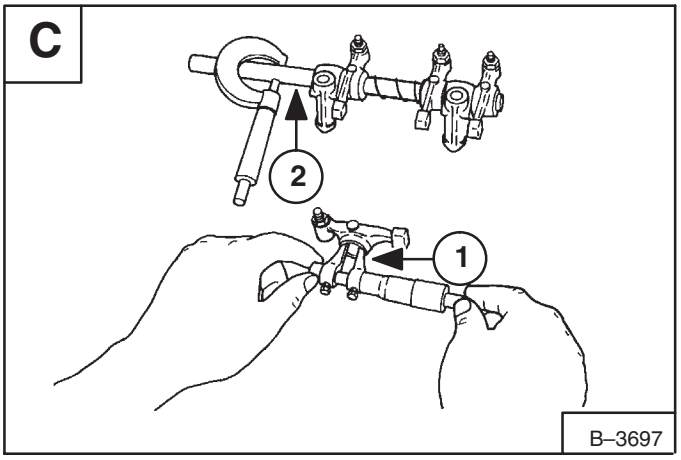
Oil Clearance Between Rocker Arm & Shaft . . . . . 0.0006–0.0018 inch (0,016–0,045 mm)
Allowable Limit . . . . . 0.0059 inch (0,15 mm)

Rocker Arm Shaft O.D. . . 0.5501–0.5506 inch (13,97–13,98 mm)

Rocker Arm I.D. 0.5512–0.5519 inch (14,0–14,02 mm)



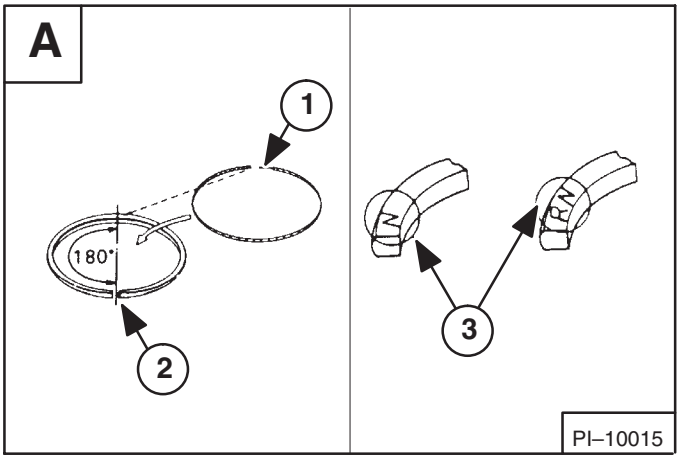




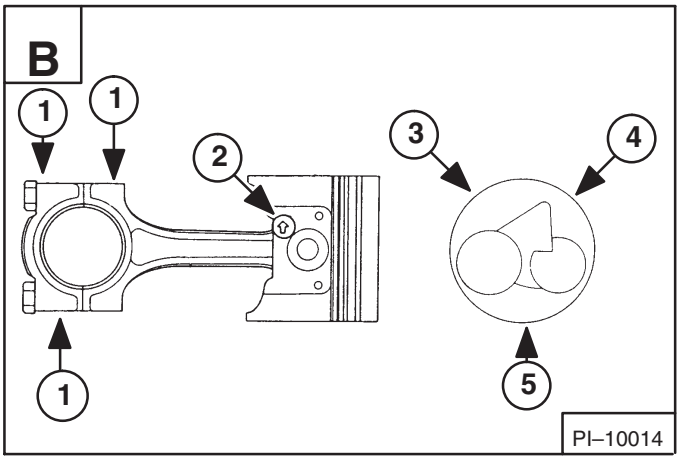
PISTON AND CONNECTING ROD (Cont'd)

Removal And Installation (Cont'd)

***Installation*:** When installing new rings, assemble the ring so the mark (Item 1) **[A]** near the gap faces the top of the piston. When installing the oil ring, place the expander joint (Item 2) **[A]** on the opposite side of the oil ring gap (Item 3) **[A]**.



***Installation*:** When reassembling, align the marks (Item 1) **[B]** on the connecting rod and piston (Item 2) **[B]**. Heat the piston to 176–212°F. (80–100°C.) and tap the piston pin into position. Place the piston rings so that there are gaps every 120° (Item 3, 4 & 5) **[B]** with no gap facing the piston pin in the cylinder.

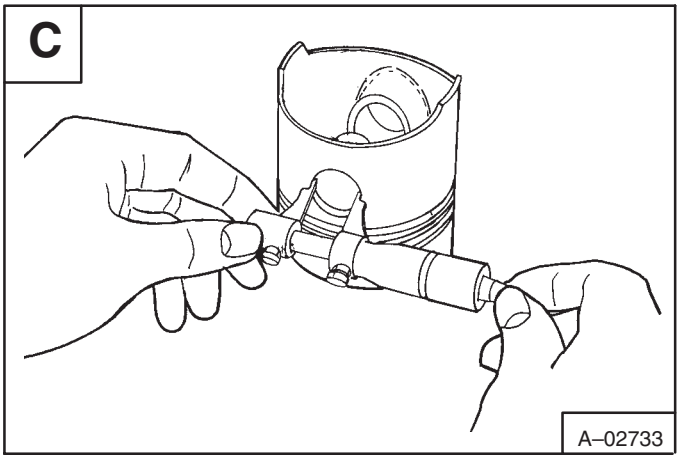


Servicing The Piston And Connecting Rod

Measure the I.D. of the piston pin bore in both horizontal and vertical direction **[C]**.

If the measurement exceeds the allowable limit, replace the piston.

Piston Pin Bore I.D. . . . . .0.984–0.985 inch (25,0–25,013 mm)
Allowable Limit . . . . . .0.986 inch (25,05 mm)

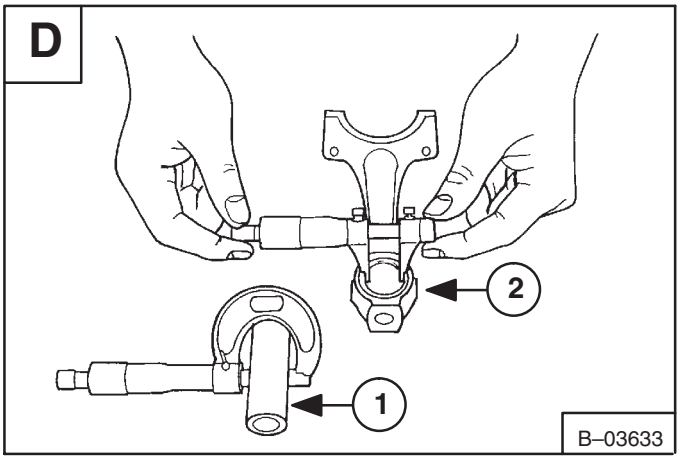


Measure the O.D. of the piston pin (Item 1) **[D]**.

Measure the I.D. of the connecting rod small end (Item 2) **[D]**.

Calculate the oil clearance. If the clearance exceeds the allowable limit, replace the bushing. If it still exceeds the specifications, replace the piston pin.

Piston Pin O.D. . . 0.984–0.985 inch (25,0–25,011 mm)
Bushing I.D. . . . . 0.985–0.986 inch (25,03–25,04 mm)
Oil Clearance between Piston Pin & Bushing . . . 0.0006–0.0015 inch (0,014–0,038 mm)
Allowable Limit . . . . . .0.006 inch (0,15 mm)
Service Replacement Part . . . . . .0.0006–0.003 inch (0,015–0,07 mm)



SPECIFICATIONS

Page Number

BUCKET SPECIFICATIONS 8–14

DECIMAL AND MILLIMETER EQUIVALENTS
Chart 8–15

ENGINE OIL AND COOLING SPECIFICATIONS
Anti–Freeze Solution 8–13
Description 8–13

ENGINE SPECIFICATIONS
Camshaft 8–10
Connecting Rods 8–10
Crankshaft 8–10
Cylinders 8–10
Cylinder Head 8–9
Engine Bolt Torque 8–11
Fuel Injection Nozzles 8–9
Fuel Injection Pump 8–9
Oil Pump 8–10
Pistons 8–10
Piston Rings 8–10
Re–Grinding the Crankshaft 8–12
Rocker Arms 8–9
Tappet 8–10
Thermostat 8–11
Timing Gear 8–11
Valves 8–9
Valve Springs 8–9
Valve Timing 8–9

FUEL, COOLANT AND LUBRICANTS
Chart 8–13

HYDRAULIC EXCAVATOR SPECIFICATIONS
(325 S/N 514013001– 514014899)
Brakes 8–5
Capacities 8–5
Controls 8–4
Digging Force 8–5
Drive System 8–5
Electrical 8–4
Engine 8–4
Hydraulic Cylinders 8–5
Hydraulic System 8–5
Lifting Capacity 8–4
Machine Dimensions 8–3
Std. Track 8–5
Swing System 8–5
Undercarriage 8–5
Weights 8–4

Continued On Next Page

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

Crankshaft (Cont'd)

Clearance Between Connecting Rod Journal and Bearing	0.0014–0.0037 in. (0,035–0,093 mm)
Limit Permitted	0.0079 in. (0,2 mm)
End Play of Crankshaft	0.0059–0.0122 in. (0,15–0,21 mm)
Crankshaft Alignment Limit Permitted	0.0008 in. (0,02 mm)
Oil Clearance Between Journal & Bearing #1	0.0016–0.0046 in. (0,04–0,118 mm)
Limit Permitted	0.008 in. (0,2 mm)
Journal O.D. #1	2.0441–2.0449 in. (51,921–51,94 mm)
Bearing I.D. #1	2.0465–2.0488 in. (51,98–52,04 mm)
Oil Clearance Between Journal & Bearing #2	0.0016–0.0041 in. (0,04–0,104 mm)
Limit Permitted	0.008 in. (0,2 mm)
Journal O.D. #2	2.0441–2.0449 in. (51,921–51,94 mm)
Bearing I.D. #2	2.0465–2.0482 in. (51,98–52,02 mm)
Oil Clearance Between Crank Pin & Bearing	0.0009–0.0034 in. (0,025–0,087 mm)
Limit Permitted	0.008 in. (0,2 mm)
Crank Pin O.D.	1.8488–1.8494 in. (46,96–46,98 mm)
Crank Pin Bearing I.D.	1.8504–1.8522 in. (47,0–47,05 mm)
Crankshaft Side Clearance	0.0059–0.0122 in. (0,15–0,31 mm)
Limit Permitted	0.020 in. (0,5 mm)

Timing Gear

Timing Gear Backlash	
Crank Gear – Idle Gear	0.0016–0.0044 in. (0,042–0,112 mm)
Idler Gear – Cam Gear	0.0016–0.0045 in. (0,042–0,115 mm)
Idler Gear – Injection Pump Gear	0.0016–0.0045 in. (0,042–0,115 mm)
Idler Gear – Oil Pump Gear	0.0016–0.0043 in. (0,042–0,109 mm)
LImit Permitted	0.006 in. (0,15 mm)
Clearance Between Idle Gear Shaft & Idle Gear Bushing	0.001–0.0026 in. (0,025–0,066 mm)
Limit Permitted	0.004 in. (0,10 mm)
Idler Gear Side Clearance Idler Gear	0.008–0.020 in. (0,2–0,51 mm)

Thermostat

Valve Opening Temperature	157–163°F (70–73°C)
Valve Fully Open	185°F (85°C)

Engine Bolt Torque	Ft.–lbs.	Nm
Camshaft Retainer Plate Bolts	17–20	23–27
* Connecting Rod Bolts W/O Flange	27–30	37–41
W/Flange	33–36	45–49
Crankshaft Nut	101–116	137–157
* Cylinder Head Bolts	67–72	91–98
Drain Plug	30–36	39–49
* Flywheel Bolts	83–90	113–122
Fuel Camshaft Retainer Bolts	5–6	6,8–8,1
Fuel Injection Tubeline Fittings	11–19	13–26
Glow Plugs	15–18	20–25
* Idler Gear Shaft Bolts	17–20	23–27
Injection Nozzles	36–51	49–69
Injection Pump Mounting Bolts	17–20	23–27
Injector Nozzle Body	43–58	59–79
* Main Bearing Bolts	51–54	69–73
* Main Bearing Case Bolts	34–38	46–52
Oil Switch	11–15	15–20
Rear Bearing Case Cover Bolts	13–15	18–20
Timing Gearcase Cover Bolts	13–15	18–20
Valve Cover Nut	5–6	7–9

Lightly Oiled Threads