# Solar 290LC-V

Shop Manual

2023-7113AE

Serial Number 0001 and Up

Daewoo reserves the right to improve our products in a continuing process to provide the best possible product to the market place. These improvements can be implemented at any time with no obligation to change materials on previously sold products. It is recommended that consumers periodically contact their distributors for recent documentation on purchased equipment.

This documentation may include attachments and optional equipment that is not available in your machine's package. Please call your distributor for additional items that you may require.

Illustrations used throughout this manual are used only as a representation of the actual piece of equipment, and may vary from the actual item.

# TO THE OPERATOR OF A DAEWOO EXCAVATOR

## DANGER!

**Unsafe use of the excavator could lead to serious injury or death. Operating procedures, maintenance and equipment practices or traveling or shipping methods that do not follow the safety guidelines on the following pages could cause serious, potentially fatal injuries or extensive damage to the machine or nearby property.**

Please respect the importance of taking responsibility for your own safety, and that of other people who may be affected by your actions.

The safety information on the following pages is organized into the following sections:

idler end of the track frame. That will keep travel controls in their intended configuration and at the same time, maintain the proper orientation of lights on the machine and posted flags and signs.

**KEEP "PINCH POINT" AREAS CLEAR - USE CAUTION IN REVERSE AND SWING**

Use a signal person in high traffic areas and whenever the operator's view is not clear, such as when traveling in reverse. Make sure that no one comes inside the swing radius of the machine.

Anyone standing near the track frames, or working assemblies of the attachment, is at risk of being caught between moving parts of the machine.

Never allow anyone to ride on any part of the machine or attachment, including any part of the turntable or operator's cab.

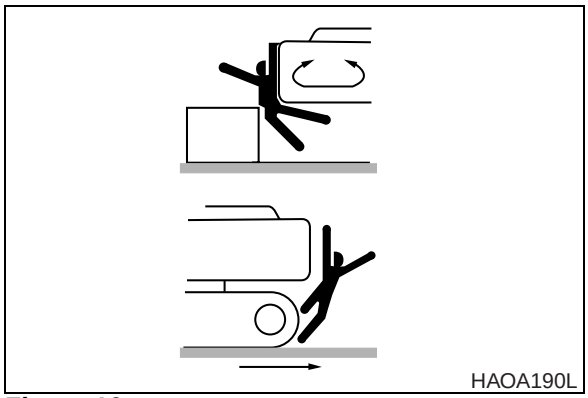



**Figure 10**

**TRAVEL PRECAUTIONS**

Attachment control levers should not be operated while traveling.

Do not change selected travel mode (FAST/SLOW) while traveling.

Fold in work equipment so that the outer end of the boom is as close to the machine as possible, and is 200 mm - 300 mm (8" - 12") above ground.

Never travel over obstacles or slopes that will cause the machine to tilt severely. Travel around any slope or obstacle that causes 10 degrees tilt, or more.

**OPERATE CAREFULLY ON SNOW AND ICE AND IN VERY COLD TEMPERATURES**

In icy cold weather avoid sudden travel movements and stay away from even very slight slopes. The machine could skid off to one side very easily.

Snow accumulation could hide or obscure potential hazards. Use care while operating or while using the machine to clear snow.

Warming up the engine for a short period may be necessary, to avoid operating with sluggish or reduced working capacity. The jolting shocks and impact loads caused by bumping or bottoming the boom or attachment are more likely to cause severe stress in very cold temperatures. Reducing work cycle rate and work load may be necessary.

**PARKING THE MACHINE**

Avoid making sudden stops, or parking the machine wherever it happens to be at the end of the work day. Plan ahead so that the excavator will be on a firm, level surface away from traffic and away from high walls, cliff edges and any area of potential water accumulation or runoff. If parking on inclines is unavoidable, block the crawler tracks to prevent movement. Lower the bucket or other working attachment completely to the ground, or to an overnight support saddle. There should be no possibility of unintended or accidental movement.

# SPECIFICATIONS

| | |
|---|---|
| Optional 850 mm (34.0") shoe - | 0.39 kg/cu. cm (5.5 psi) |
| Optional 910 mm (36.0") shoe - | 0.38 kg/cu. cm (5.4 psi) |
| Transport Dimensions | |
| Overall Shipping Length (standard boom and arm) | 10,650 mm (35’) |
| Overall Shipping Width (standard shoes) | 3,200 mm (10’ 6") |
| Overall Shipping Height (to top of cylinder hose) | 3,370 mm (11’) |
| Track Shipping Length | 4,930 mm (16’ 2") |
| Transport Trailer Capacity | 30 tons (33 short tons), minimum load capacity |
| Transport Loading Ramp Allowable Slope | 15° angle **CAUTION:** Refer to Transport Maximum Procedure for Safe Shipping Instructions. |

**NOTE:** *Grease lip seals prior to assembly.*

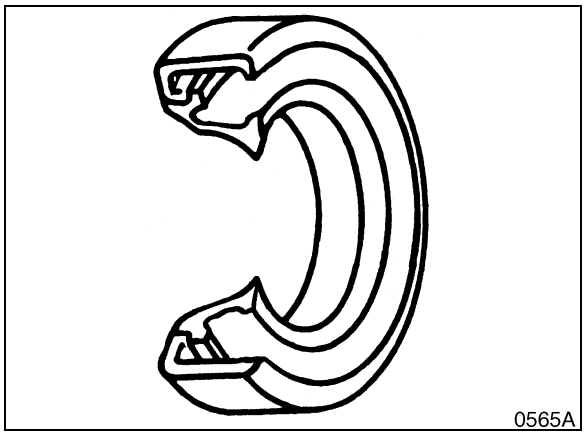



**Figure 1**

# CLEANING AND INSPECTION

### GENERAL GUIDELINES

All parts must be clean to permit an effective inspection. During assembly, it is very important that no dirt or foreign material enters unit being assembled. Even minute particles can cause malfunction of close fitting parts such as thrust bearing, matched parts, etc.

**⚠ WARNING!**

**Care should be exercised to avoid inhalation of vapors, exposure to skin and creating fire hazards when using solvent type cleaners.**

1. Clean all metal parts thoroughly using a suitable cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all oils, lubricants, and/or foreign materials are dissolved and parts are thoroughly clean.
2. For bearings that can be removed, soak them in a suitable cleaning fluid for a minute or two, then remove bearings from cleaning fluid and strike flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. To dry bearings, use moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning bearings that are not lubricated. DO NOT SPIN BEARINGS WHEN DRYING; bearings may be rotated slowly by hand to facilitate drying process.
3. Carefully inspect all bearing rollers, cages and cups for wear, chipping or nicks to determine condition. Do not replace a bearing cone or cup individually without replacing mating cup or cone at the same time. After inspection, dip bearings in light weight oil and wrap in clean lintless cloth or paper to protect them until installation.

   For those bearings that are to be inspected in place; inspect bearings for roughness of rotation, scoring, pitting, cracked or chipped races. If any of these defects are found, replace bearings. Also inspect defective bearing housing and/or shaft for grooved, galled or burred conditions that indicate bearing has been turning in its housing or on its shaft.
4. It is more economical to replace oil seals, O-rings, sealing rings, gaskets and snap rings when unit is disassembled than waiting for premature failures; refer to latest Micro Fiche and/or Parts Book for replacement items. Be extremely careful when installing sealing members, to avoid cutting or

# TORQUE VALUES FOR STANDARD METRIC FASTENERS

**NOTE:** *The units for the torque values are kg•m (ft lbs)*

| Dia. x Pitch (mm) | Grade | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **3.6 (4A)** | **4.6 (4D)** | **4.8 (4S)** | **5.6 (5D)** | **5.8 (5S)** | **6.6 (6D)** | **6.8 (6S)** | **6.9 (6G)** | **8.8 (8G)** | **10.9 (10K)** | **12.9 (12K)** |
| **M5 x Std.** | 0.15 (1.08) | 0.16 (1.15) | 0.25 (1.80) | 0.22 (1.59) | 0.31 (2.24) | 0.28 (2.02) | 0.43 (3.11) | 0.48 (3.47) | 0.50 (3.61) | 0.75 (5.42) | 0.90 (6.50) |
| **M6 x Std.** | 0.28 (2.02) | 0.30 (2.16) | 0.45 (3.25) | 0.40 (2.89) | 0.55 (3.97) | 0.47 (3.39) | 0.77 (5.56) | 0.85 (6.14) | 0.90 (6.50) | 1.25 (9.04) | 1.50 (10.84) |
| **M7 x Std.** | 0.43 (3.11) | 0.46 (3.32) | 0.70 (5.06) | 0.63 (4.55) | 0.83 (6.00) | 0.78 (5.64) | 1.20 (8.67) | 1.30 (9.40) | 1.40 (10.12) | 1.95 (14.10) | 2.35 (16.99) |
| **M8 x Std.** | 0.70 (5.06) | 0.75 (5.42) | 1.10 (7.95) | 1.00 (7.23) | 1.40 (10.12) | 1.25 (9.04) | 1.90 (13.74) | 2.10 (15.18) | 2.20 (15.91) | 3.10 (22.42) | 3.80 (27.48) |
| **M8 x 1** | 0.73 (5.28) | 0.80 (5.78) | 1.20 (8.67) | 1.00 (7.23) | 1.50 (10.84) | 1.35 (9.76) | 2.10 (15.18) | 2.30 (16.63) | 2.40 (17.35) | 3.35 (24.23) | 4.10 (29.65) |
| **M10 x Std.** | 1.35 (9.76) | 1.40 (10.12) | 2.20 (15.91) | 1.90 (13.74) | 2.70 (19.52) | 2.35 (19.99) | 3.70 (26.76) | 4.20 (30.37) | 4.40 (31.18) | 6.20 (44.84) | 7.20 (52.07) |
| **M10 x 1** | 1.50 (10.84) | 1.60 (11.57) | 2.50 (18.08) | 2.10 (15.18) | 3.10 (22.42) | 2.80 (20.25) | 4.30 (31.10) | 4.90 (35.44) | 5.00 (36.16) | 7.00 (50.63) | 8.40 (60.75) |
| **M12 x Std.** | 2.40 (17.35) | 2.50 (18.08) | 3.70 (26.76) | 3.30 (23.86) | 4.70 (33.99) | 4.20 (30.37) | 6.30 (45.56) | 7.20 (52.07) | 7.50 (54.24) | 10.50 (75.94) | 12.50 (90.41) |
| **M12 x 1.5** | 2.55 (18.44) | 2.70 (19.52) | 4.00 (28.93) | 3.50 (25.31) | 5.00 (36.16) | 4.50 (32.54) | 6.80 (49.18) | 7.70 (55.69) | 8.00 (57.86) | 11.20 (81.00) | 13.40 (96.92) |
| **M14 x Std.** | 3.70 (26.76) | 3.90 (28.20) | 6.00 (13.23) | 5.20 (37.61) | 7.50 (54.24) | 7.00 (50.63) | 10.00 (72.33) | 11.50 (83.17) | 12.00 (86.79) | 17.00 (122.96) | 20.00 (144.66) |
| **M14 x 1.5** | 4.10 (29.65) | 4.30 (31.10) | 6.60 (47.73) | 5.70 (41.22) | 8.30 (60.03) | 7.50 (54.24) | 11.10 (80.28) | 12.50 (90.41) | 13.00 (94.02) | 18.50 (11.26) | 22.00 (158.12) |
| **M16 x Std.** | 5.60 (40.50) | 6.00 (43.39) | 9.00 (65.09) | 8.00 (57.86) | 11.50 (83.17) | 10.50 (75.94) | 15.50 (112.11) | 17.90 (129.47) | 18.50 (133.81) | 26.00 (188.05) | 31.00 (224.22) |
| **M16 x 1.5** | 6.20 (44.84) | 6.50 (47.01) | 9.70 (70.16) | 8.60 (62.20) | 12.50 (90.41) | 11.30 (81.73) | 17.00 (122.96) | 19.50 (141.04) | 20.00 (144.66) | 28.00 (202.52) | 35.50 (256.77) |
| **M18 x Std.** | 7.80 (56.41) | 8.30 (60.03) | 12.50 (90.41) | 11.00 (79.56) | 16.00 (115.72) | 14.50 (104.87) | 21.00 (151.89) | 27.50 (198.90) | 28.50 (206.14) | 41.00 (296.55) | 43.00 (311.01) |
| **M18 x 1.5** | 9.10 (65.82) | 9.50 (68.71) | 14.40 (104.15) | 12.50 (90.41) | 18.50 (133.81) | 16.70 (120.79) | 24.50 (177.20) | 27.50 (198.90) | 28.50 (206.14) | 41.00 (296.55) | 49.00 (354.41) |
| **M20 x Std.** | 11.50 (83.17) | 12.00 (86.79) | 18.00 (130.19) | 16.00 (115.72) | 22.00 (159.12) | 19.00 (137.42) | 31.50 (227.83) | 35.00 (253.15) | 36.00 (260.38) | 51.00 (368.88) | 60.00 (433.98) |
| **M20 x 1.5** | 12.80 (92.58) | 13.50 (97.64) | 20.50 (148.27) | 18.00 (130.19) | 25.00 (180.82) | 22.50 (162.74) | 35.00 (253.15) | 39.50 (285.70) | 41.00 (296.55) | 58.00 (419.51) | 68.00 (491.84) |
| **M22 x Std.** | 15.50 (112.11) | 16.00 (115.72) | 24.50 (177.20) | 21.00 (151.89) | 30.00 (216.99) | 26.00 (188.05) | 42.00 (303.78) | 46.00 (332.71) | 49.00 (354.41) | 67.00 (484.61) | 75.00 (542.47) |
| **M22 x 1.5** | 17.00 (122.96) | 18.50 (133.81) | 28.00 (202.52) | 24.00 (173.59) | 34.00 (245.92) | 29.00 (209.75) | 47.00 (339.95) | 52.00 (44.76) | 56.00 (405.04) | 75.00 (542.47) | 85.00 (614.80) |
| **M24 x Std.** | 20.50 (148.27) | 21.50 (155.50) | 33.00 (238.68) | 27.00 (195.29) | 40.00 (289.32) | 34.00 (245.92) | 55.00 (397.81) | 58.00 (419.51) | 63.00 (455.67) | 82.00 (593.10) | 92.00 (655.43) |
| **M24 x 1.5** | 23.00 (166.35) | 35.00 (253.15) | 37.00 (267.62) | 31.00 (224.22) | 45.00 (325.48) | 38.00 (202.52) | 61.00 (441.21) | 67.00 (484.61) | 74.00 (535.24) | 93.00 (672.66) | 103.00 (744.99) |

# UPPER STRUCTURE

# FALLING OBJECT PROTECTIVE STRUCTURES (F.O.P.S.)

## ⚠ DANGER!

**If the excavator is to be used in mines, for demolition, or in other areas where falling rocks, building materials (concrete blocks, steel beams) or other heavy objects pose a danger to the safety of the operator, a certified Falling Object Protective Structure (F.O.P.S.) must be installed over the roof and/or front of the cab.**

**NOTE:** ***A Falling Object Guard (F.O.G.) is another type of protective structure. In all cases check with all regulatory agencies for your situation.***

Falling Object Protective Structures are available from independent manufacturers or fabricators. A certified, approved F.O.P.S. system should normally have a permanent, environmentally-protected label securely attached to the structure (per Society of Automotive Engineers [SAE] standard J1164, "Labeling of ROPS and FOPS and OPS"), indicating the following:

- Name and address of the manufacturer or fabricator and their certification control.
- Model number of the protective structure and/or the equipment make, model(s) or series the structure is designed to fit.
- Maximum machine weight for which the structure is certified.
- Numbered, dated list of SAE performance criteria that have been met or exceeded; for example, SAE J1040 (Apr88), SAE J231 (Jan81), SAE J1356 (Feb88) and/or other performance criteria or recognized standards (ISO).

## ⚠ WARNING!

**Additional protection against projectiles or flying or thrown objects, or supplementary protection for the operator in the event of equipment tip-over could also be required, if operating conditions pose additional hazards.**

Roll Over Protective Structures (R.O.P.S.) are designed to work with seat belt protective restraints and shield the operator in the event of an overturn, in situations where equipment is operated over hazardous slopes or other unstable ground conditions. Additional R.O.P.S. performance criteria specify protective measures for fuel tanks, oil reservoirs, batteries and operator's cab edges, corners and projections.

Operator Protective Structures (O.P.S.) are designed to provide additional barrier protection around the operator's cab area. For example, using a shearing attachment on the excavator for demolition work or certain kinds of mining operation could cause violent break-up of materials, posing the threat of hazardous projectiles or flying objects being thrown through the operator's cab wall or window.

## IMPORTANT

**Observe all recommended equipment installation procedures for O.P.S., F.O.P.S., and/or R.O.P.S. systems. Do not attempt to weld, drill holes in or otherwise modify the structure. The integrity of the system could be compromised. Always use correct fasteners, torqued to specified limits, and follow all manufacturer's instructions for installation, maintenance, and/or transfer or re-installation of the protective system.**

# FUEL TANK

## CAUTION!

**Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.**

**Always use tools and equipment that is in good working order.**

**Use lifting and hoisting equipment capable of safely handling load.**

**Remember, that ultimately safety is your own personal responsibility.**

| MODEL | SERIAL NUMBER RANGE |
|---|---|
| Solar 130LC-V | 0001 and Up |
| Solar 220LC-V | 0001 and Up |
| Solar 290LC-V | 0001 and Up |
| | |



March 1999

# START-UP PROCEDURES

1. Loosen plug on top of fuel filter head.
2. Unscrew and pump the hand operated primer pump located by the fuel injection pump. Pump primer until fuel is present at plug hole in fuel filter head.
3. Tighten plug in fuel filter head.
4. Continue to pump primer pump until a strong resistance is felt. Screw the primer pump knob back into housing.
5. Start engine and look for signs of leaks.
6. Repeat procedure if necessary.

# SWING BEARING MAINTENANCE

### OPERATING RECOMMENDATION

The service life of the swing bearing may be extended if a conscious, daily effort is made to equalize usage over both ends of the excavator. If the excavator is used in the same operating configuration day in and day out (for example, with the travel motors always under the counterweight, or with the attachment over one side of the machine more than the other), the bearing's service life could be reduced. Taking a few minutes in the middle of each work shift to reposition the excavator, to work the opposite end of the bearing, will provide a payoff in terms of more even, gradual rate of wear and extended service life.

### MEASURING SWING BEARING AXIAL PLAY

Periodic, regular checks of bearing displacement should be made at least twice a year. Use a dial indicator. Push the attachment against the ground to lift the excavator off the ground and take measurements at 4 points, 90° apart, around the circumference of the bearing (Figure 1).

Record and keep all measurements. Play in the bearing should increase minimally from one inspection to the next. Eventually, however, as the bearing begins to approach the limit of its service life, clearance increases become much more pronounced and the actual measured play in the bearing could exceed twice the value that was measured when the machine was new.

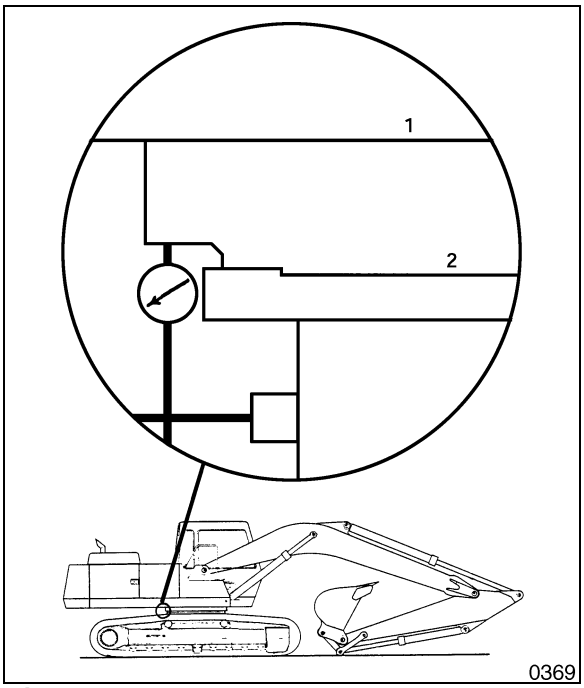


**Figure 1**

### MEASURING BEARING LATERAL PLAY

At the same time that vertical checks are made, the side-to-side play in the bearing can be checked by fully retracting the arm and bucket cylinders and extending the tip of the bucket as far forward as it will go. With the excavator parked on a flat, level surface and the bucket tip just off the ground, push against the bucket sideways to take up all of the lateral clearance in the bearing. (Less than 100 lb of force should be required to move the bucket over all the way.) Check lateral play in both directions and record the values. When the bearing is beginning to approach the end of its service life, measured lateral clearance should start to show larger and larger increases.

# REMOVAL

1. Lower bucket to ground.
2. Shut engine down and remove key from starter switch.

> **WARNING!**
>
> **If engine must be run while performing maintenance, use extreme care. Always have one person in the cab at all times. Never leave the cab with the engine running.**

3. Fully stroke work levers (joysticks) in all directions to relieve pressure from accumulators.
4. Set safety lever on "LOCK" position.
5. Hang maintenance warning tag on controls.
6. Disconnect negative (-) battery cable leading to frame from battery.
7. Tag and disconnect hoses from swing motor (1, Figure 3). Plug and cap hoses and port to prevent contamination from entering hydraulic system or component.
8. Disconnect tube (2) from drain cock (3)
9. Remove fourteen bolts and washers (4, Figure 3) holding swing reduction gearbox (5) to frame.
10. Using a suitable lifting device, sling swing motor (1, Figure 3) and remove swing motor and reduction gearbox (5) as an assembly from unit.

    **NOTE:** *A drain cock (3*, Figure 3*) and tube are located on side of gearbox. Be careful not to damage valve or tube.*

    **NOTE:** *There are two alignment pins (6*, Figure 3*), one located on each side of reduction gearbox flange.*

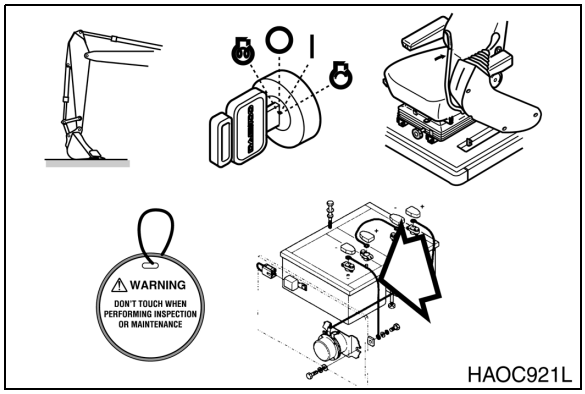



**Figure 2**

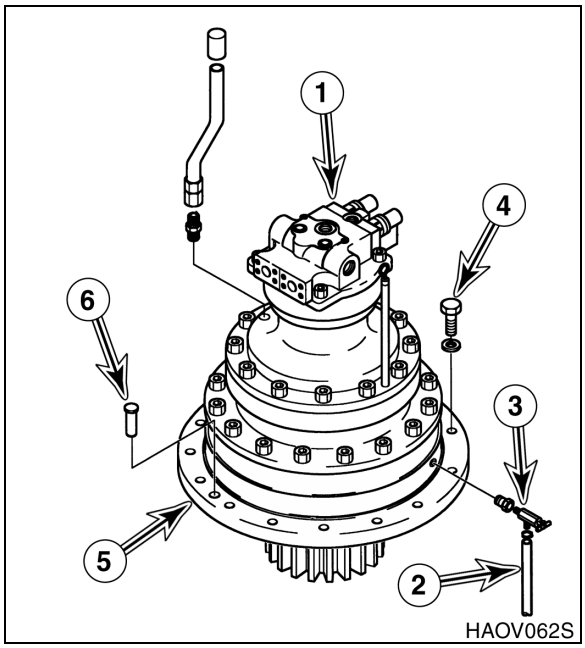



**Figure 3**

# LOWER STRUCTURE AND CHASSIS

# TRACK SHOES AND LINKS

**TRACK REMOVAL**

1. Position machine on a smooth level surface with adequate room for forward and reverse travel.
2. Relieve track tension. Refer to "Track Tension" in this section for procedure.
3. Move machine until master link (1, Figure 15) is positioned at approximately 10 o'clock from top position on travel reduction gearbox.
4. Remove four nuts and bolts (2, Figure 15) holding shoe to link. Remove enough shoes to make access to lock pin easier.

   **NOTE:** *Support track shoes with blocking so that when master pin (4*, Figure 15*) is removed tack will not fall.*

5. Straighten lock pin (3, Figure 15) and remove it from master pin (4). Discard lock pin.
6. Remove master pin from master links.
7. Move unit forward until entire track is laying on ground.

   **NOTE:** *Do not drive unit off track.*

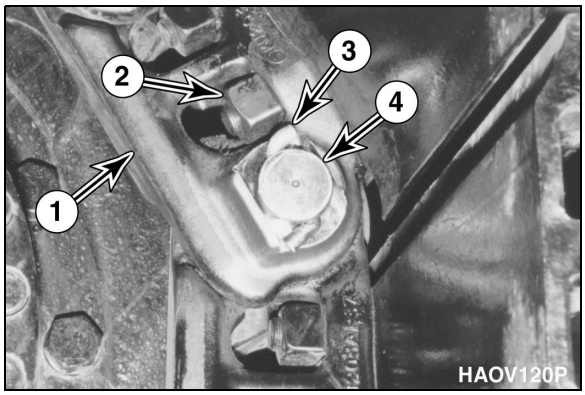



**Figure 15**

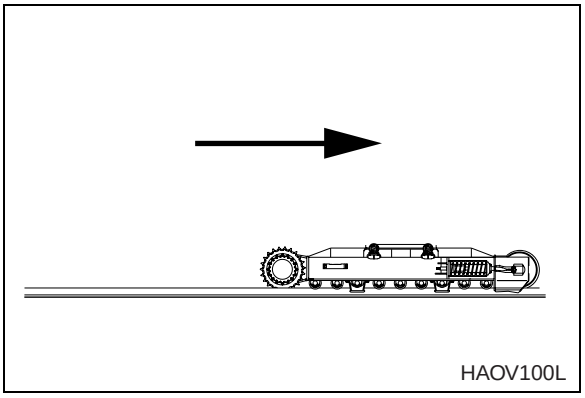



**Figure 16**

# UPPER ROLLER

**PARTS LIST**

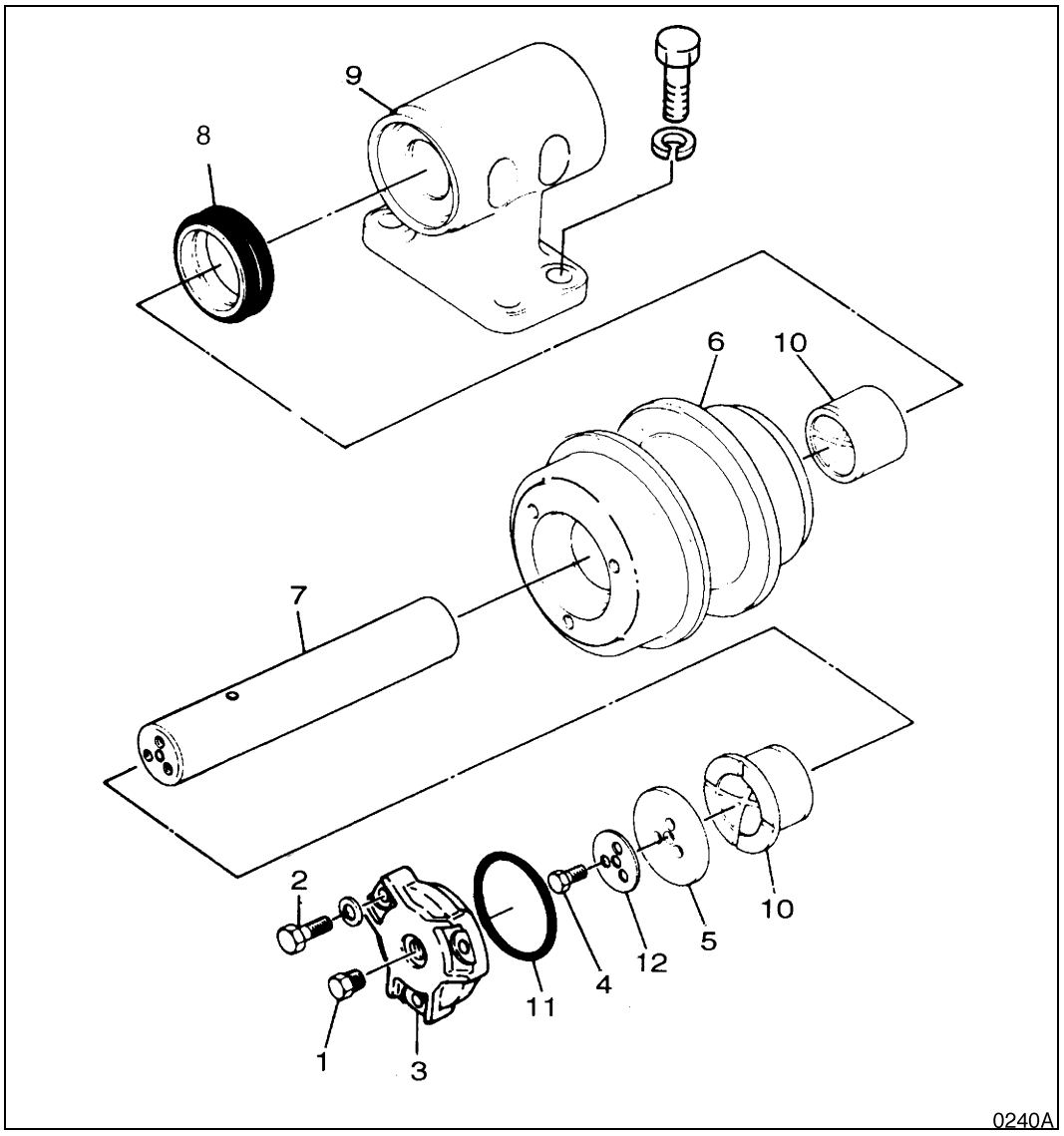



**Figure 40**

| Reference Number | Description |
|---|---|
| 1 | Plug |
| 2 | Bolt |
| 3 | Cover |
| 4 | Bolt |
| 5 | Washer |
| 6 | Roller |

| Reference Number | Description |
|---|---|
| 7 | Axle |
| 8 | Group Seal |
| 9 | Bracket |
| 10 | Bushing |
| 11 | O-ring |
| 12 | Lock Washer |

# AIR-CONDITIONER

## ⚠ CAUTION!

**Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.**

**Always use tools and equipment that is in good working order.**

**Use lifting and hoisting equipment capable of safely handling load.**

**Remember, that ultimately safety is your own personal responsibility.**

| MODEL | SERIAL NUMBER RANGE |
|---|---|
| Solar 130LC-V | 0001 and Up |
| Solar 130W-V | 0001 and Up |
| Solar 170LC-V | 1001 and Up |
| Solar 200W-V | 0001 and Up |
| Solar 220LC-V | 0001 and Up |
| Solar 220LL | 1001 and Up |
| Solar 250LC-V | 1001 and Up |
| Solar 290LC-V | 0001 and Up |
| Solar 290LL | 1001 and Up |
| Solar 330LC-V | 1001 and Up |
| Solar 400LC-V | 1001 and Up |
| Solar 450LC-V | 1001 and Up |



August 2000

**Defroster**

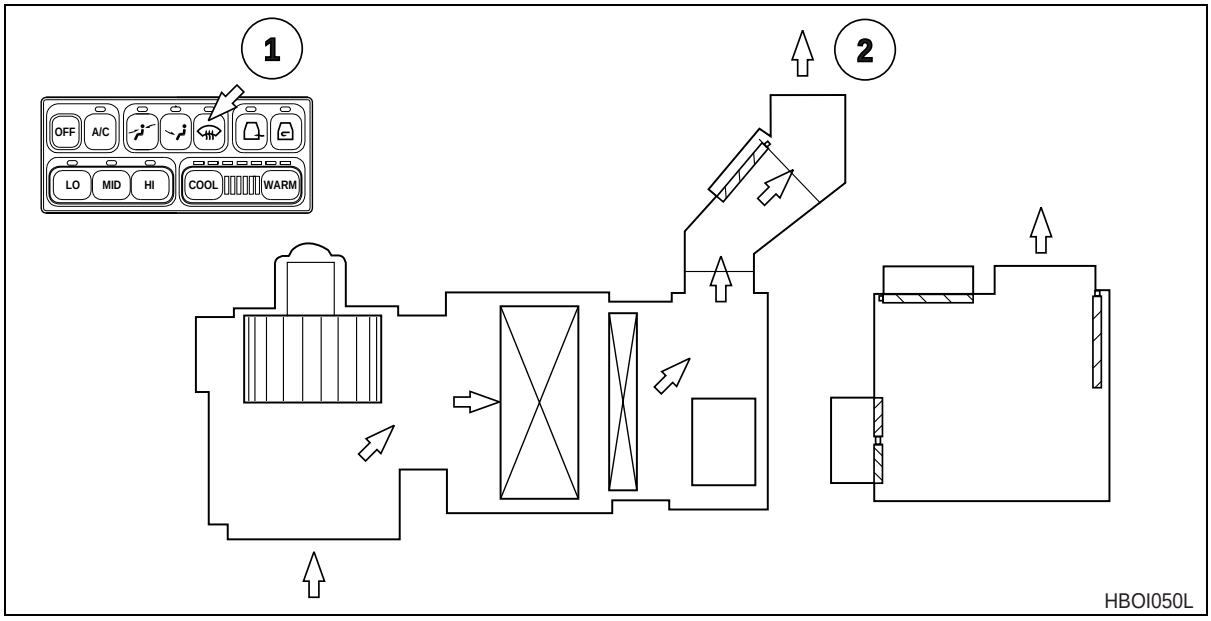



**Figure 9**

| Reference Number | Description |
|---|---|
| 1 | Select Switch |

| Reference Number | Description |
|---|---|
| 2 | Defroster Vent |

**REFRIGERANT RECOVERY**

| Reference Number | Description |
|---|---|
| 1 | To Compressor |
| 2 | Low Pressure Side |
| 3 | High Pressure Side |
| 4 | From Receiver |
| 5 | Refrigerant Recovery Tank |

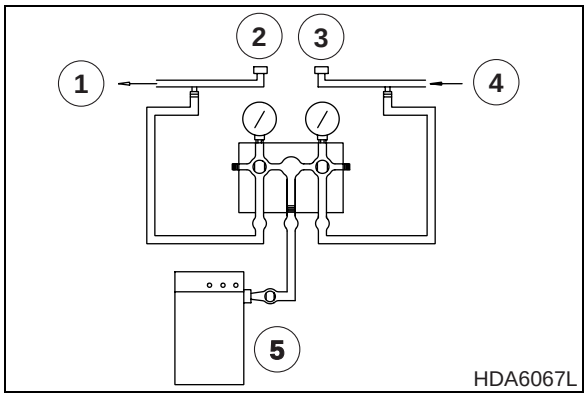



**Figure 14**

1. Attach the manifold gauges and the refrigerant recovery unit to the refrigerant lines as shown.

   **NOTE:** *Be careful not to switch the connections for the low and high pressure valves.*

2. Open the high pressure valve slowly to release the refrigerant to the recovery unit.

   **NOTE:** *Open the valve slowly, while checking to see that refrigerant is not leaking out.*

3. When the manifold gauge dial falls below 3.5 kg/sq cm (50 psi), slowly open the low pressure valve.

4. Open both the high and low pressure valves slowly until the manifold gauge dials indicates 0 kg/sq cm (0 psi).

**VACUUMING REFRIGERANT SYSTEM**

| Reference Number | Description |
|---|---|
| 1 | To Compressor |
| 2 | Low Pressure Side |
| 3 | High Pressure Side |
| 4 | From Receiver |
| 5 | Vacuum Pump |

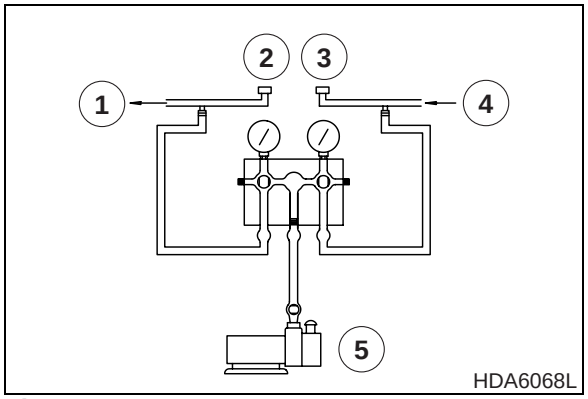



**Figure 15**

1. Vacuuming Procedure

   **NOTE:** *When the A/C system has been exposed to the air, it must be vacuumed out. Perform vacuum process for 30 minutes for complete moisture and air evacuation.*

   A. Attach the manifold gauges and vacuum pump to the refrigerant system as shown.

   B. Turn on the vacuum pump and open both valves.

   C. When the low pressure gauge shows approximately 710 mmHg, close both valves and turn off vacuum pump.

| Dimensional Details for Figure 5 | | |
|---|---|---|
| **Dimension** | **Measurement** | **Models** |
| A | 18 ±0.1 mm (0.7087 ±0.0039 in.) | DD80L |
| B | 5.5 ±0.1 mm (0.2165 ±0.0039 in.) | S330LC-III, S330LC-V, S400LC-III, S400LC-V, S450LC-V |
| C | 20.0 mm (0.787 in.) | |
| D | 7.0 mm (0.275 in.) | |
| E | 11.0 mm (0.433 in.) Radius | |
| F | 18.0 mm (0.708 in.) Radius | |
| G | 30.0 mm (1.181 in.) Radius | |
| H | 1.0 mm (0.039 in.) x 45° Chamfer | |

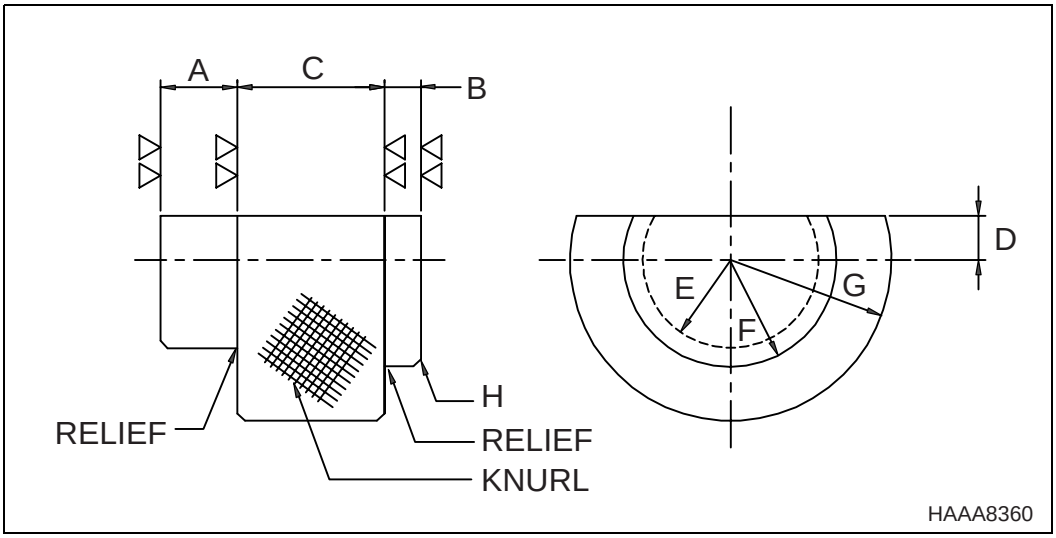



**Figure 6**

| Dimensional Details for Figure 6 | | |
|---|---|---|
| **Dimension** | **Measurement** | **Models** |
| A | 10.5 ±0.1 mm (0.4134 ±0.0039 in.) | S170LC-III, S200W-V, S220LC-III, S220LC-V, S220LL, S220N-V, S250LC-V |
| B | 5 ±0.1 mm (0.1969 ±0.0039 in.) | S280LC-III, S290LC-V, S290LL |
| C | 20.0 mm (0.787 in.) | |
| D | 7.0 mm (0.275 in.) | |
| E | 12.0 mm (0.472 in.) Radius | |
| F | 14.50 mm (0.570 in.) Radius | |
| G | 25.0 mm (0.984 in.) Radius | |
| H | 1.0 mm (0.039 in.) x 45° Chamfer | |

# HYDRAULIC SYSTEM TROUBLESHOOTING, TESTING AND ADJUSTMENT

## CAUTION!

**Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.**

**Always use tools and equipment that is in good working order.**

**Use lifting and hoisting equipment capable of safely handling load.**

**Remember, that ultimately safety is your own personal responsibility.**

| MODEL | SERIAL NUMBER RANGE |
|---|---|
| Solar 290LC-V | 0001 and Up |
| Solar 290LL | 1001 and Up |
| | |
| | |



February 1999

# PILOT PRESSURE

**ADJUSTMENT AND TESTING**

## ⚠ WARNING!

**This procedure should be done with two people. To reduce the chance of accident or unintended start-up, one person should remain at the operator's control stand while checks and adjustments are made.**

Vent hydraulic pressure from the reservoir before breaking the seal on fittings to install two in-line "t-style" adapters and test gauges (60 bar/1,000 psi) at the gear pump outlet port, and at the joystick control valve pilot line.

Start the engine and turn the engine speed control dial to the maximum setting. After the excavator has been operated long enough to reach normal operating temperature, back off the engine control dial to minimum rated RPM speed. With all controls in neutral, make sure the left console control stand is locked in the down (operating) position and check pressure at the gear pump outlet port and at the joystick.

If gear pump pressure is outside the tolerance specified in the table, adjust gear pump relief pressure by loosening the lock nut and turning the set screw in (clockwise) to increase pressure, or turning it out to decrease it.

**NOTE:** *Be aware that serial number changes and variation in the joystick assemblies used on different excavators could produce slight change in actual performance characteristics. Comparison of part numbers to serial numbers stamped on your assembly may be required, if questions or doubt exists.*

## IMPORTANT

**Top off the hydraulic fluid reservoir if there is any measurable loss of hydraulic oil during test gauge and adapter fitting installation.**

| Engine RPM | Pilot Pressure @ Pump | Pilot Pressure - Joystick |
|---|---|---|
| Minimum Speed Setting (full left) on Speed Control Dial | 40 bar ±5 bar<br>(580 psi ±73 psi) | 23.5 bar ±1.5 bar<br>(341 psi ±22 psi) |

Compare recorded values with output shown in the P-Q curve in the specifications section of this book.

If test results do not measure up to specified values, pump output tests can be repeated using different control levers. Recheck front pump operation while stroking the bucket cylinder out lever, and the rear pump by actuating the swing control lever.

**NOTE:** *When testing bucket and swing functions, read maximum flow tests at 330 kg/sq cm (4,785 psi), not 350 kg/sq cm (5075 psi).*

# ACCUMULATOR

## CAUTION!

**Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.**

**Always use tools and equipment that is in good working order.**

**Use lifting and hoisting equipment capable of safely handling load.**

**Remember, that ultimately safety is your own personal responsibility.**

| MODEL | SERIAL NUMBER RANGE |
|---|---|
| Mega 130 | 0001 and Up |
| Mega 160 | 0001 and Up |
| Mega 200-III | 1001 and Up |
| Mega 250-III | 1001 and Up |
| Mega 400-III PLUS | 1001 and Up |
| Solar 130LC-V | 0001 and Up |
| Solar 130W-V | 0001 and Up |
| Solar 170LC-V | 1001 and Up |
| Solar 200W-V | 0001 and Up |
| Solar 220LC-V | 0001 and Up |
| Solar 220LL | 1001 and Up |
| Solar 220N-V | 1001 and Up |
| Solar 250LC-V | 1001 and Up |
| Solar 290LC-V | 0001 and Up |
| Solar 290LL | 1001 and Up |
| Solar 330LC-V | 1001 and Up |
| Solar 400LC-V | 1001 and Up |
| Solar 450LC-V | 1001 and Up |



August 2000

# GENERAL DESCRIPTION

The center joint (swivel) is designed to allow hydraulic oil from the upper structure to flow to components in the lower structure.

It is capable of allowing continuous 360° rotation of the upper structure in relationship to the lower structure.

| Reference Number | Description |
|---|---|
| 1 | Bushing |
| 2 | Dust Wiper |
| 3 | Retaining Ring |
| 4 | U-Packing |
| 5 | Buffer Seal |
| 6 | Rod Bushing |
| 7 | Bolt |
| 8 | Retaining Ring |
| 9 | Rod Cover |
| 10 | O-ring |
| 11 | O-ring |
| 12 | Backup Ring |
| 13 | Piston Rod |
| 14 | Cylinder Tube |
| 15 | Cushion Ring |

| Reference Number | Description |
|---|---|
| 16 | Piston |
| 17 | Slide Ring |
| 18 | Wear Ring |
| 19 | Slipper Seal |
| 20 | O-ring |
| 21 | Backup Ring |
| 22 | Piston Nut |
| 23 | Set Screw |
| 24 | Cushion Plunger |
| 25 | Bushing |
| 26 | Check Valve |
| 27 | Spring Support |
| 28 | Spring |
| 29 | Plug |
| 30 | Stop Ring |

16. Disassemble retaining ring (3) and dust wiper (2). Separate retaining ring (8) and rod bushing (6).

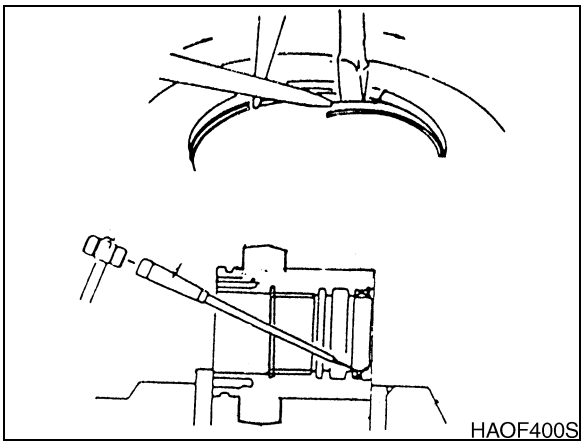



**Figure 23**

17. Force out pin bushing (1) from body of cylinder.

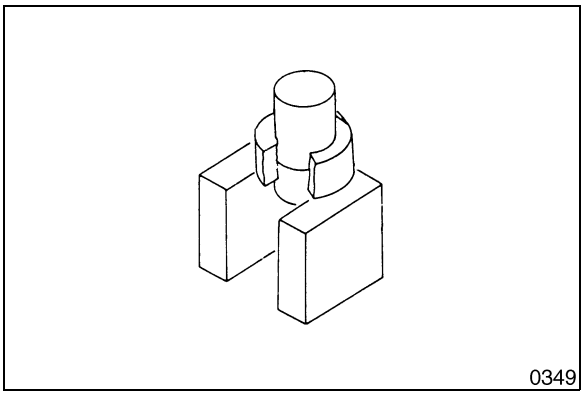



**Figure 24**

**RELIEF VALVE**

The relief valve is one in a set of two, and is Item "51" of the swing motor assembly.

Return line pressure (the normal pressurization of the hydraulic reservoir, also referred to as "tank pressure") pushes the valve piston to open ports "R" and "P" at the end of the valve whenever the hydraulic system is operating.

This valve initially reacts to the engagement of hydraulic function (and pressurization of the tank) by opening momentarily, so that there is no pressure developed through the valve at all.

Tank pressure at "pressurized area A2" is set against spring pressure inside the valve, opening the relief valve until pressure at the spring chamber ("g") momentarily reduces "g" chamber pressure "Pg." "Pg" subsequently increases until the piston reaches the end of travel inside the valve bore at "h."

After the piston reaches "h" and its normally closed, pressurized operating position, pressure through the valve can be continually increased up to the relief valve maximum pressure ("Ps").

$$Ps = \frac{Fsp}{A_1 - A_2}$$

Where Fsp: Spring Force

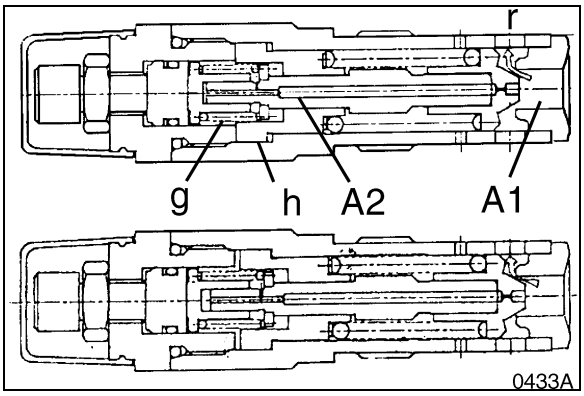



**Figure 2**

**SWING BRAKE OPERATION**

The swing brake is normally held in the applied position - preventing the upper deck revolving superstructure from rotating - whenever the hydraulic system is not operated (pressurized). The brake system is automatically released whenever the swing controls are engaged to swing in one direction or the other.

14. Separate casing and drive shaft (101). Tap upper end of drive shaft with a soft-faced, plastic hammer. To avoid damaging drive shaft, do not use excessive force.

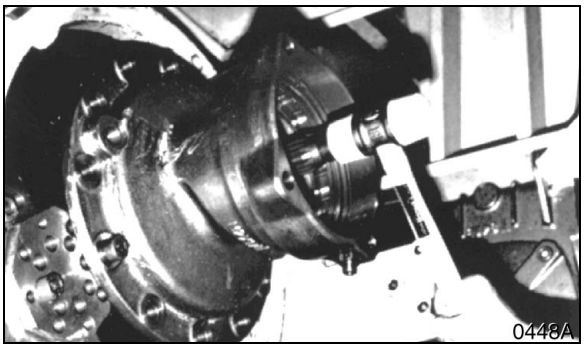



**Figure 18**

15. Tap bearing race out of casing.

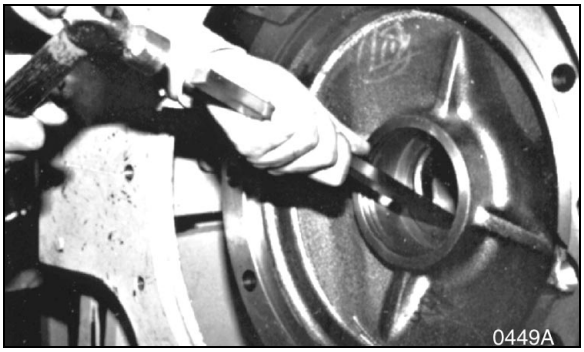



**Figure 19**

16. Disassembly of motor has now been completed, unless there is any reason to suppose that drive shaft bearing has become excessively worn.

    If it is necessary, replace bearing by pulling away stop ring (432) and spacer (106). Put drive shaft in a press to separate bearing cage from drive shaft

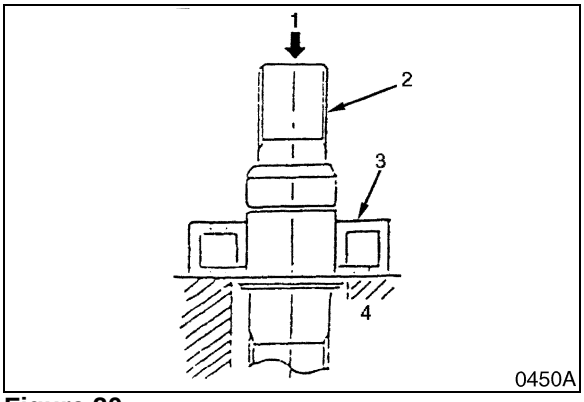



**Figure 20**

| Reference Number | Description |
|---|---|
| 1 | Press |
| 2 | Drive Shaft |
| 3 | Roller Bearing |
| 4 | Base of Press |

19. Put plungers (351), springs (355), O-rings (488), and RO plugs (469) back in casing. Make sure that both plungers are free to move back and forth.

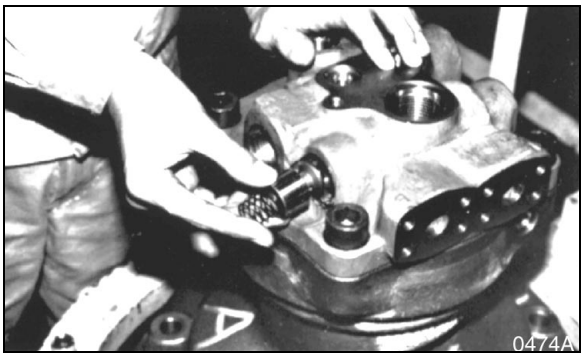



**Figure 45**

20. Reassemble relief valves (51) by putting rod, spring, stop and piston back together, then turning plunger side of valve up to reassemble valve body and all components of piston: spring seat, spring, bushing, retainer, O-ring and plug.


**Figure 46**

| **IMPORTANT** |
| --- |
| **Be careful not to damage the plunger and spring seat.** |


**Figure 47**

21. Before replacing relief valves (51) in upper valve casing (303), install backup rings and O-rings.

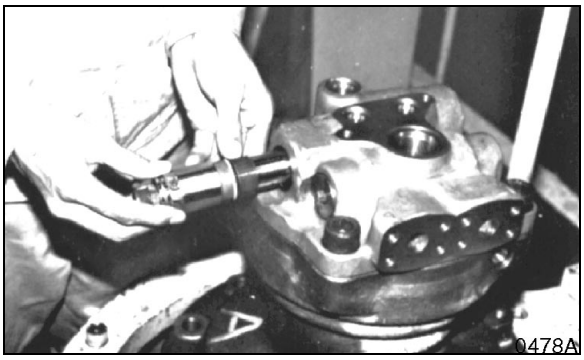



**Figure 48**

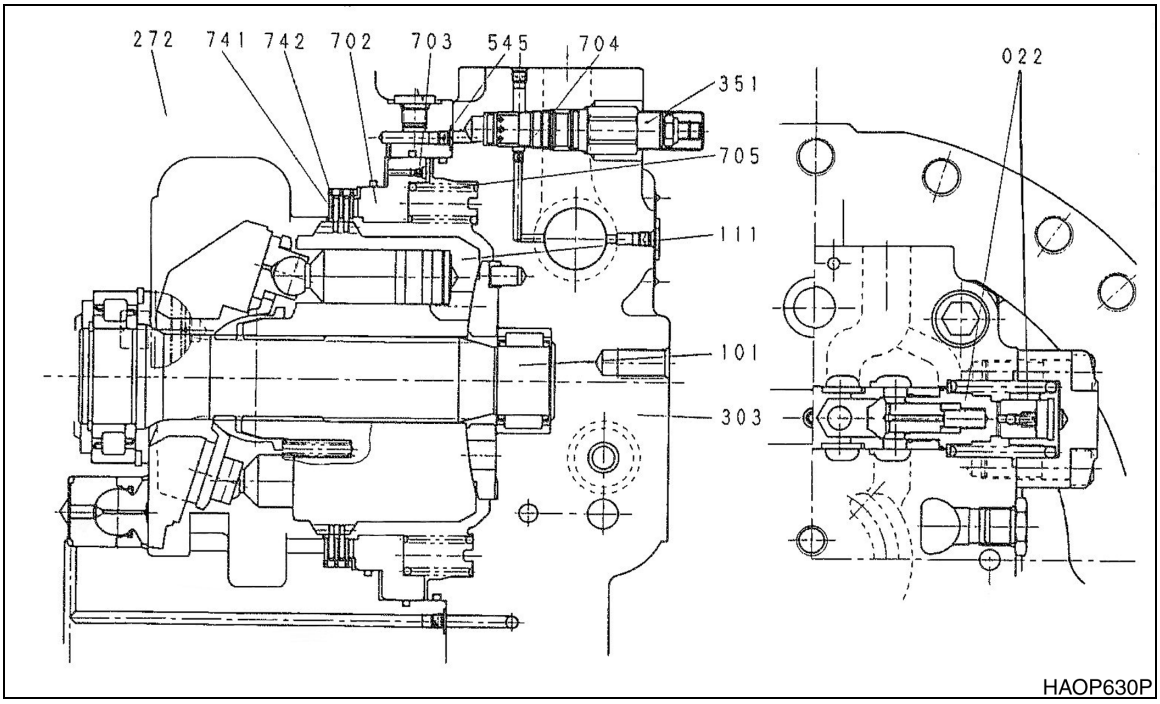



**Figure 7**

High pressure oil works on the motor by a high pressure selection valve installed in the valve casing (303). The valve casing works on the port P of the tilting valve. This pressure becomes SERVO- pressure.

Because the spool (531) installed in the tilting valve is pushed to the plug (571) by the spring (533), the high pressure of port P becomes blocked.

B. When the external pilot pressure is applied to the valve, at 20 kg/sq cm or higher (Pi> 20 kg/sq cm), the tilting angle becomes low.

| Tools | B Dimension | Applicable Parts Remarks |
|---|---|---|
| Minus Driver | | For removing a floating seal |
| Press (1 ton) | | Angular Bearing (33) |
| Depth Gauge (depth 100mm) | | For adjusting shim (35) |
| Punch | | Not to be taken off spring pin |
| Torque Wrench | | It should be possible to be tightened with tightening torque. |
| Tap M16 | | For releasing locking of tapped hole |
| Grindstone | | |
| Seal Tape | | Plug (32) |
| Screw Lock Adhesive (Three bond 1303B) | | Hex Screw (29) |

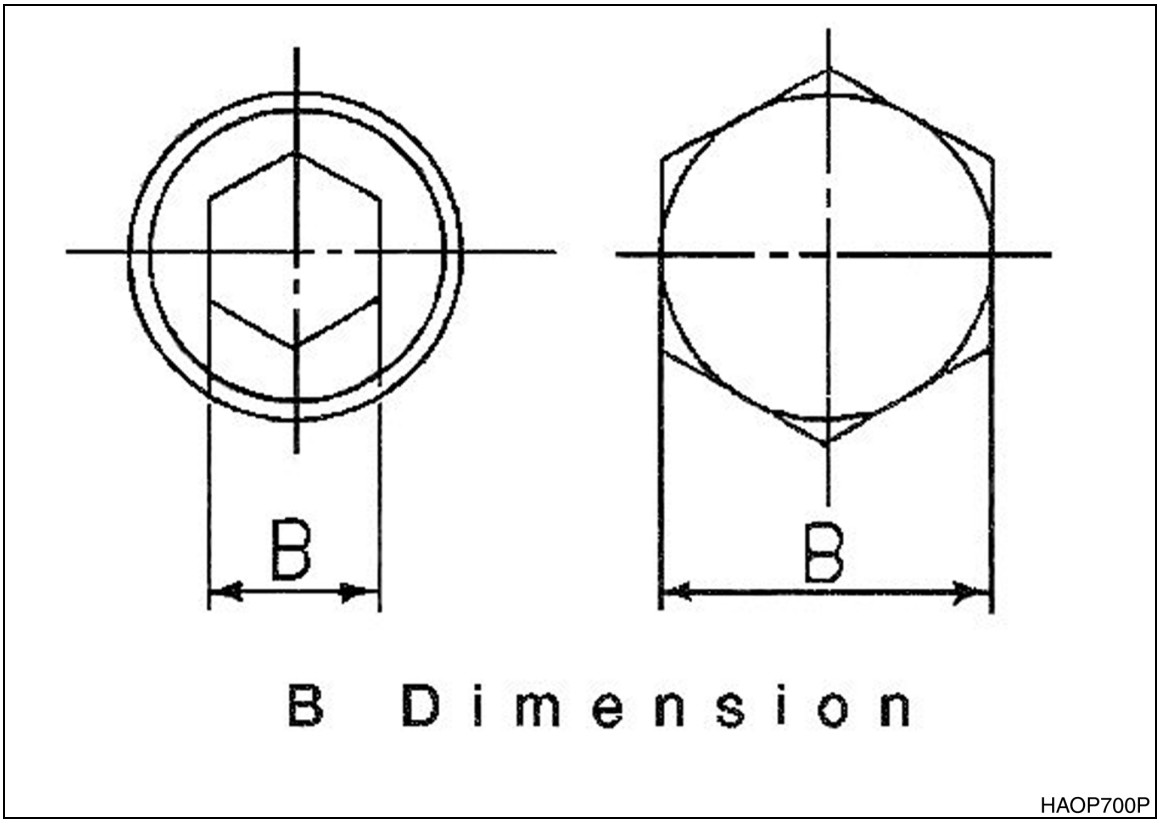



**Figure 13**

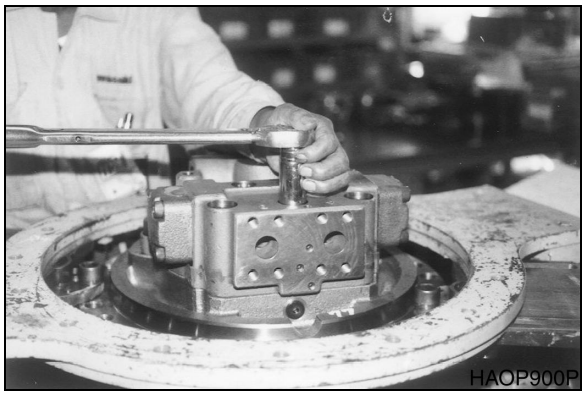



**Figure 31**

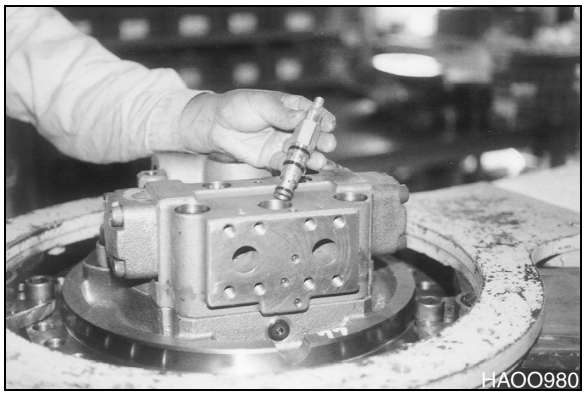



**Figure 32**

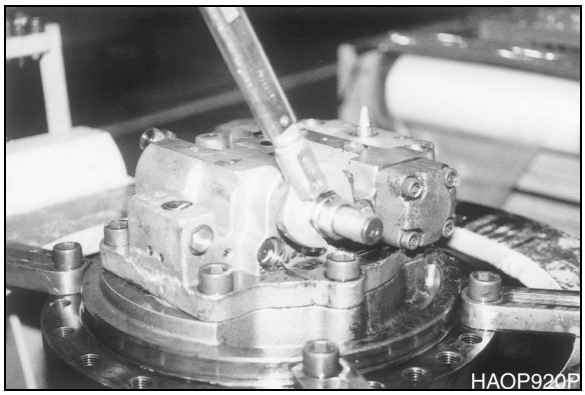



**Figure 33**

3. Remove M10X135 bolt from valve casing (303) for manual brake release and subassembly valve casing and brake piston.

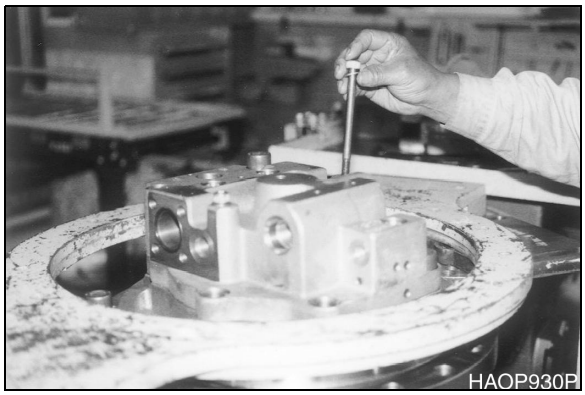



**Figure 34**

| Parts name and Inspection item | Standard Value | Standard value of replacement | Remedies |
|---|---|---|---|
| No.3 planetary gear | Tooth thickness 54.930 mm (2.1626 in.) (4 teeth) | 54.630 mm (2.1508 in.) | Replacement (z=22) |
| Ring gear (for the third step) | Over pin 348.740 mm (13.7299 in.) (ϕ 8.50 mm (0.3346 in.)) | 349.340 mm (13.7535 in.) | Replacement (z=71) |
| Crack and flaking of bearing inner or outer race | | | If there are any signs of crack and flaking,<br>replace it |
| Crack and flaking of 1,2,3 speed planetary gear and pin | | | If there is any signs of crack and flaking, replace it. |
| Radial clearance of needle cage | 0.010 - 0.040 mm (0.0004 - 0.0016 in.) | 0.070 mm (0.0028 in.) | Replace the whole set |
| Crack of spline | | | If there is any signs of damage,<br>replace it. |
| Back lash of spline | 0.10 - 0.30 mm (0.0039 - 0.0118 in.) | 0.50 mm (0.0197 in.) | After checking dimension, replace parts according to the next standard. |
| Thrust ring (26) | Thickness 7.0 mm (0.2756 in.) | 6.60 mm (0.2598 in.) | Replace each part, if part is worn and stuck. |
| Thrust ring (27) | Thickness 8.0 mm (0.3150 in.) | 7.60 mm (0.2992 in.) | |
| Floating seal | | | Replace it, if the sliding surface is scratched, or rusted, and if the O-ring is deformed or damaged |
| Gear oil | 90EP or SAE#90 | | The 1st replacement: 500 operation hours<br>After the 2nd replacement: about every 2000 hours |

17. Reassemble No. 2 carrier subassembly.

A. After assembling No. 2 carrier (6) to No. 3 sun gear (1), insert clip (46).

B. Place No. 2 carrier so that front side of No. 3 sun gear is facing down.

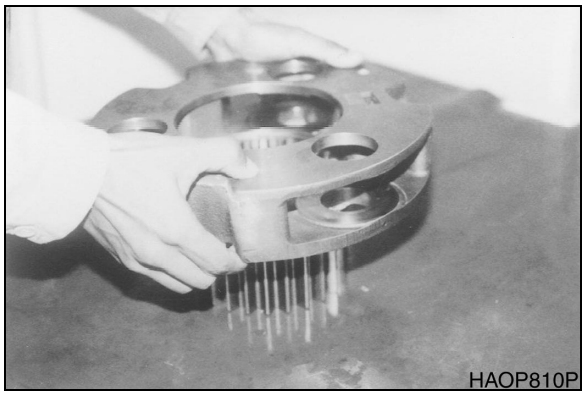



**Figure 82**

C. After inserting needle cage (22) inside No. 2 planetary gear (13), assemble to No. 2 carrier so that it is between side plate (19).

D. Insert No. 2 pin (16) into No. 2 carrier.

E. Insert spring pin (37) into holes of No. 2 carrier and No. 2 pin. Tighten using a punch at both locations as shown in Figure 84.

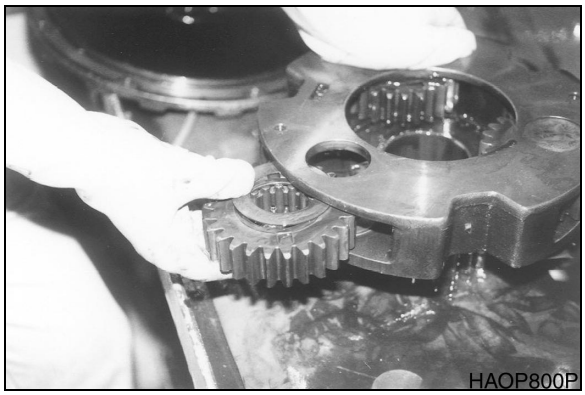



**Figure 83**

**NOTE:** *Configure center of planetary gear and pin hole of carrier.*

*Match up bolt holes of spring.*

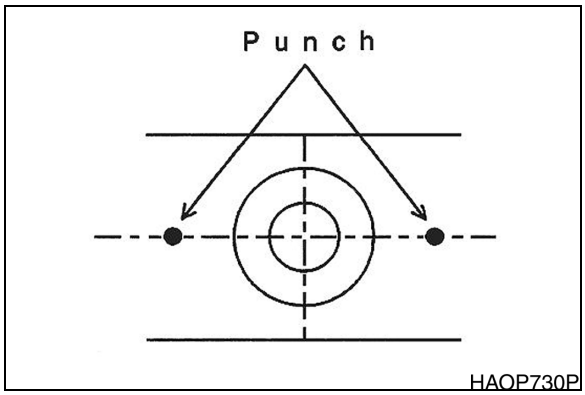



**Figure 84**

18. Screw two M10 lifting eye bolts in No. 2 carrier subassembly, and assemble with a crane making sure that No. 2 planetary gear and ring meshed correctly.

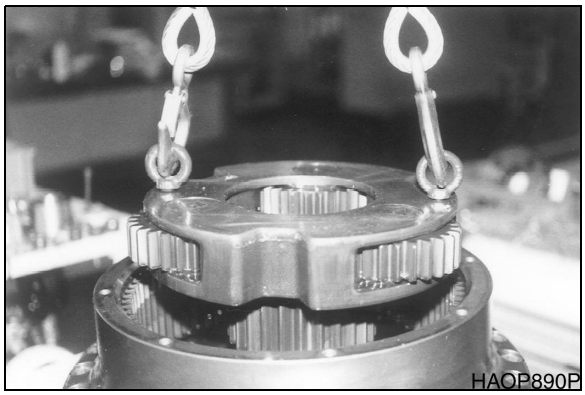



**Figure 85**

**PUMP REGULATOR OPERATION**

The relationship between Pump Displacement Flow (Q on the vertical axis) and Pilot Pressure (Pi on the horizontal axis). Pump output discharge is controlled by increasing or decreasing pilot pump pressure (Figure 7).

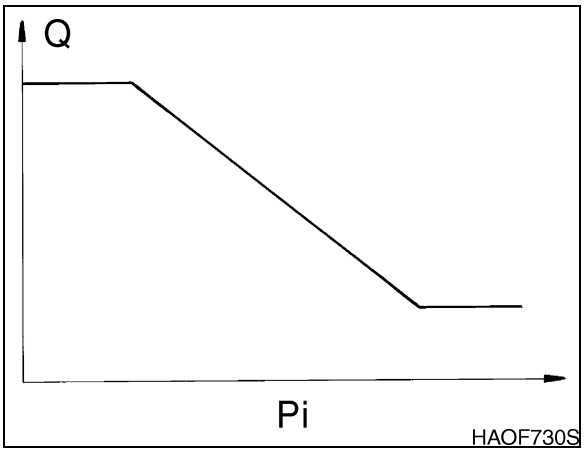



**Figure 7**

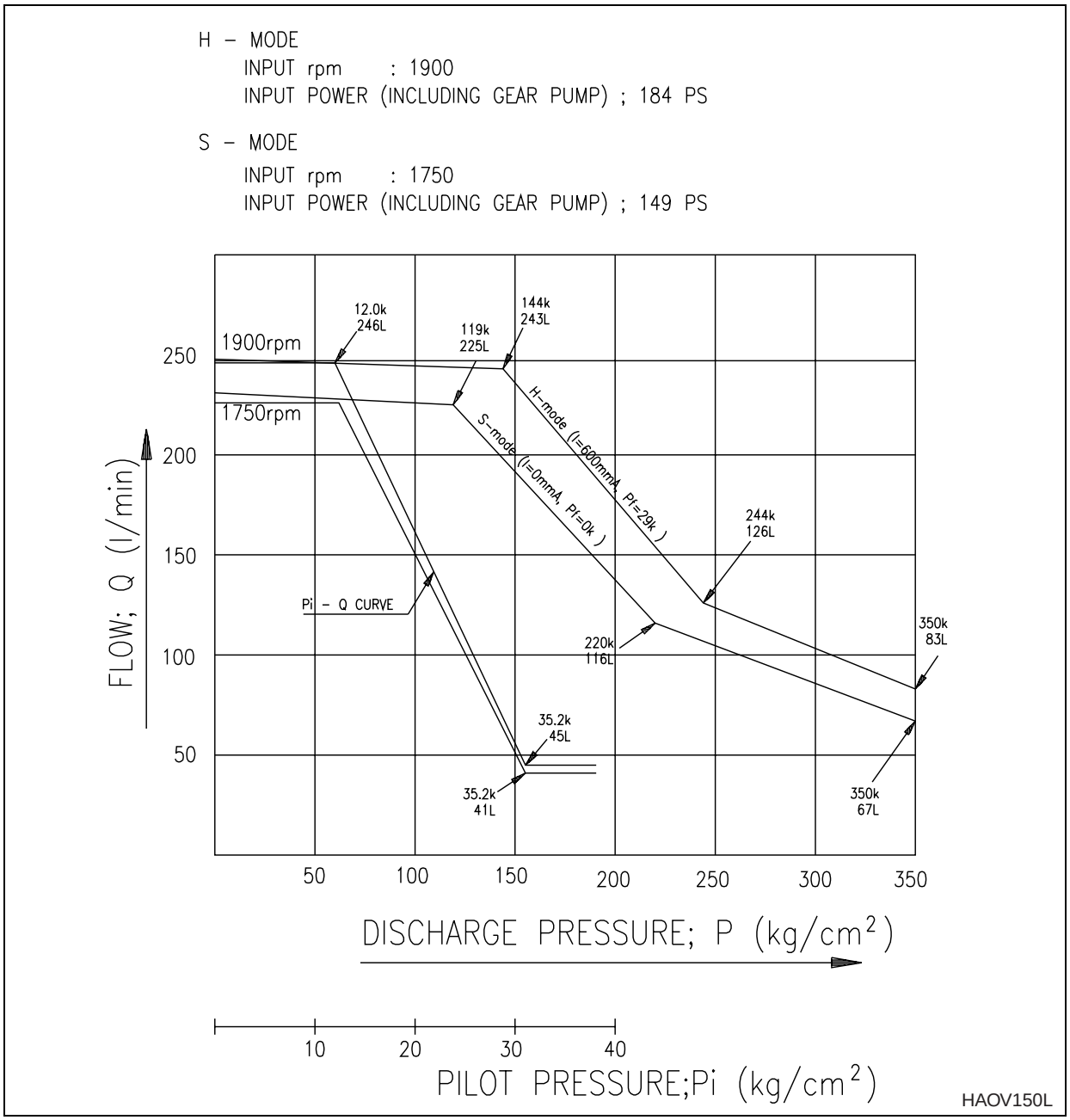

H – MODE
INPUT rpm : 1900
INPUT POWER (INCLUDING GEAR PUMP) ; 184 PS
S – MODE
INPUT rpm : 1750
INPUT POWER (INCLUDING GEAR PUMP) ; 149 PS
1900rpm
1750rpm
12.0k
246L
119k
225L
144k
243L
H-mode (I=600mmA, Pi=29k )
S-mode (I=0mmA, Pi=0k )
244k
126L
Pi – Q CURVE
220k
116L
350k
83L
35.2k
45L
35.2k
41L
350k
67L
FLOW; Q (l/min)
250
200
150
100
50
50
100
150
200
250
300
350
DISCHARGE PRESSURE; P (kg/cm²)
10
20
30
40
PILOT PRESSURE;Pi (kg/cm²)
HAOV150L

**Figure 16**

**Service Standards for Replacing Worn Parts**

**NOTE:** *When parts exceed the standard, replace them. When there is conspicuous surface damage, it is always safer to replace parts, whether standards are exceeded or not.*

| Item | Standard Value mm (In) | Replacement Recommended mm (In) | Remedy |
|---|---|---|---|
| Clearance between the cylinder bore and the piston (D-d). | 0.403 mm (0.00169") | 0.070 mm (0.00276") | Replace piston or cylinder. |
| Piston ball - shoe socket clearance (d). | 0 - 0.1 mm (0.00394") | 0.3 mm (0.0118") | Replace piston or shoe assembly. |
| Thickness of shoe (t). | 5.4 mm (0.2126") | 5.0 mm (0.1969") | Replace piston, shoe assembly parts. |
| Free-length of cylinder spring (L). | 47.9 mm (1.8858") | 47.1 mm (1.8543") | Replace spring. |
| Height of push plate, round bushing assembly (H-h). | 13.5 mm (0.5315") | 12.5 mm (0.4921") | Replace. |

Inspect O-rings and oil seals very carefully for cuts, nicks, brittleness, softness or any other type of damage or distortion, prior to final reassembly if any must be reused.

**ARM LOAD HOLDING VALVE**

1. When plunger is in neutral position (Pal pilot signal: "OFF")

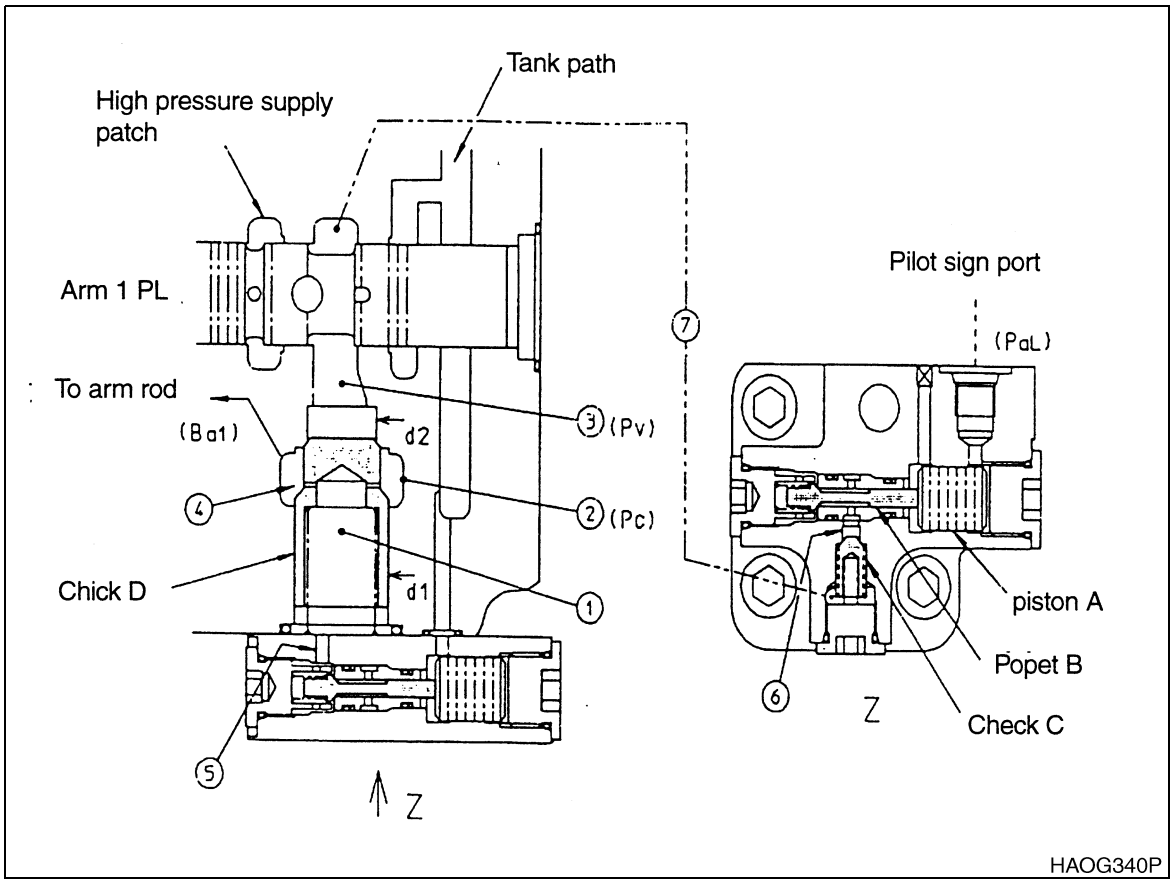



**Figure 16**

A. Piston A and poppet B are in position blocking path 5 and 6. As oil flows from chamber (1) to chamber (2), the pressure at orifice (4) is Pe. Since d1 > d2, check valve D is seated completely blocking out chambers (2 and 3).

**Main Relief Valve**

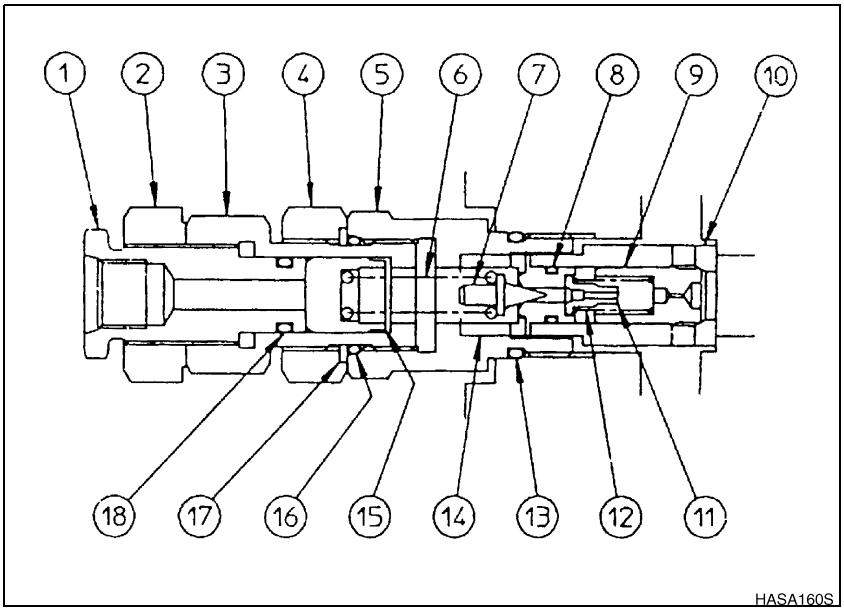



**Figure 29**

| Reference Number | Description |
|---|---|
| 1 | Adjusting Screw |
| 2 | Hexagonal Nut |
| 3 | Sleeve |
| 4 | Hexagonal Nut |
| 5 | Cap |
| 6 | Spring |
| 7 | Pilot Poppet |
| 8 | O-ring |
| 9 | Main Poppet |

| Reference Number | Description |
|---|---|
| 10 | Sleeve |
| 11 | Orifice |
| 12 | Spring |
| 13 | O-ring |
| 14 | Pilot Sheet |
| 15 | Piston |
| 16 | O-ring |
| 17 | Backup Spring |
| 18 | O-ring |

# CONTROL VALVE DRAWING AND HYDRAULIC CIRCUIT

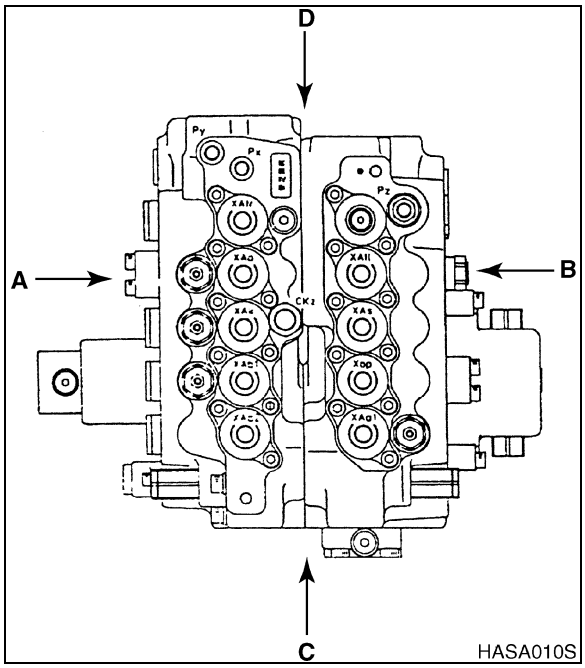



**Figure 50** CONTROL VALVE TOP VIEW

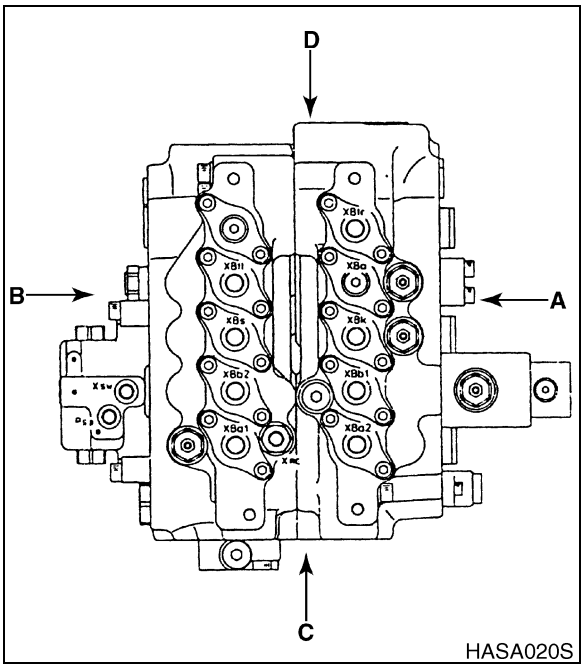



**Figure 51** CONTROL VALVE BOTTOM VIEW

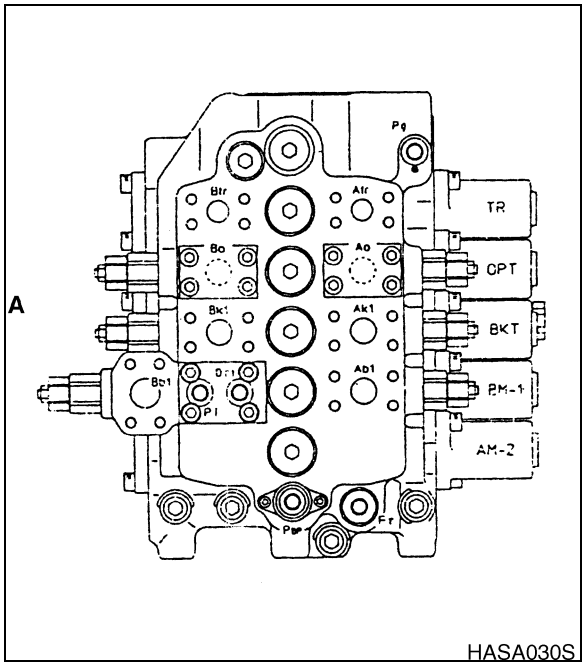



**Figure 52** CONTROL VALVE LEFT VIEW

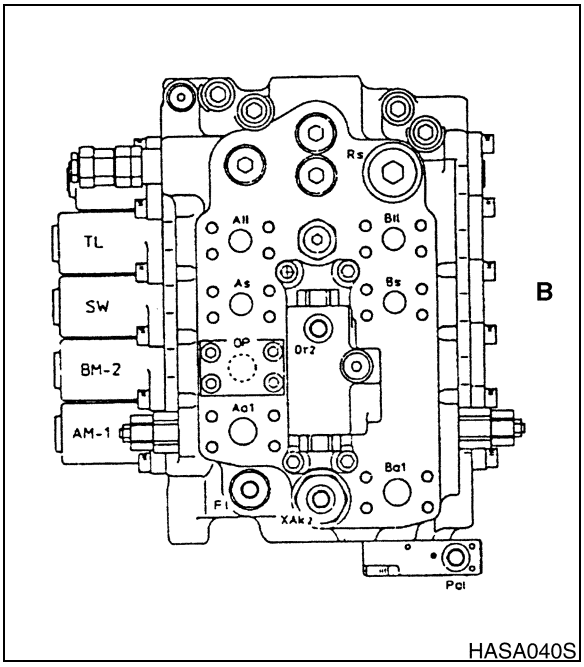



**Figure 53** CONTROL VALVE RIGHT VIEW

# IMPORTANT

**Improper relief valve pressure settings may cause severe damage to the hydraulic system. Extreme caution should be taken when making pressure adjustments.**

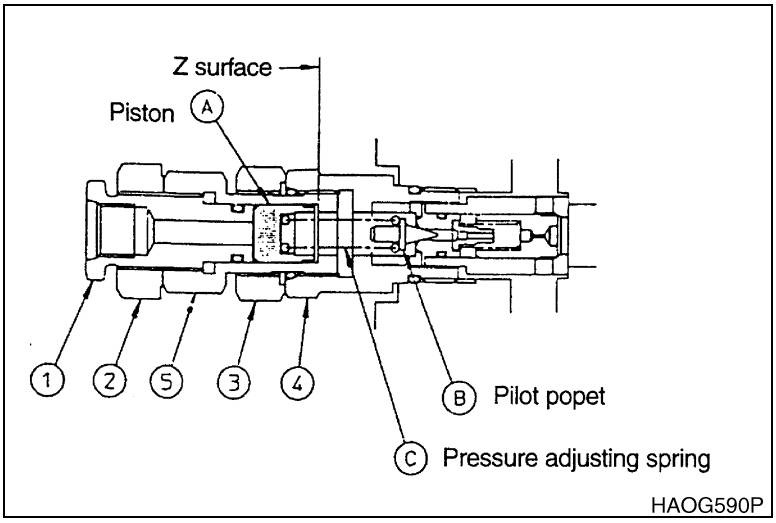



**Figure 75**

# IMPORTANT

**Inspect all O-ring gaskets for damage and replace as necessary. Never reuse damaged or questionable O-rings.**

**Main Relief Valve - Reassembly**

1. Insert piston (A) into sleeve (7). Assemble hex nut (2) onto adjust screw (1). Assemble adjust screw (1) to sleeve (7), until piston (A) is seated.
2. Insert pilot poppet (B) into pressure adjust spring (C) and insert into sleeve (7). Assemble cap (4) onto sleeve (7), making sure pilot poppet (B) is properly seated.
3. Insert orifice (10), spring (9) and piston (8) into lower sleeve (6).
4. Assemble lower sleeve (6) onto cap (4).
5. Insert assembled relief valve into control valve body and tighten cap (4).

| | |
|---|---|
| **Tightening torque** | 10 kg•m<br>(72 ft lbs) |

# IMPORTANT

**When disassembling Arm Regeneration Valve, tag and label each component so that all parts can be reassembled in the proper order.**

| Reference Number | Description |
|---|---|
| 1 | Cap |
| 2 | Check |
| 3 | Spring |

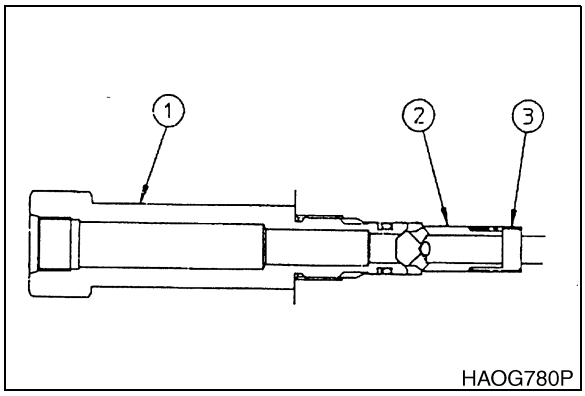



**Figure 92**

1. Loosen cap (1) and remove check (2) and spring (3).

| | |
|---|---|
| **Cap wrench size** | 32 mm |
| **Tightening torque** | 10 kg•m (72 ft lbs) |

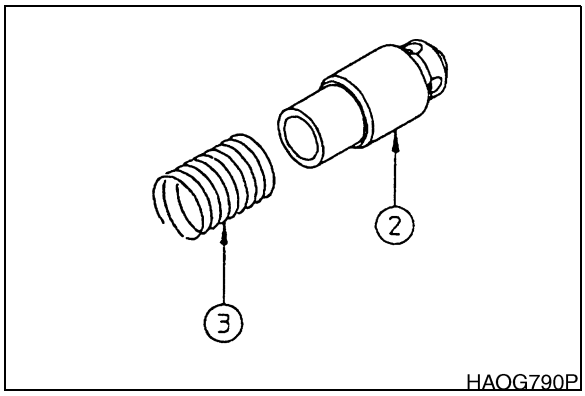



**Figure 93**

# IMPORTANT

**When disassembling Check Valves, tag and label each component so that all parts can be reassembled in the proper order.**

**A: Check Valve (Main Relief Valve, TS)**

| Reference Number | Description |
|---|---|
| 1 | Cap |
| 2 | Spring |
| 3 | Check |

| | |
|---|---|
| **Cap hole size** | 12 mm |
| **Tightening torque** | 10 kg•m (72 ft lbs) |

1. Loosen cap (1), remove spring (2) and check (3).

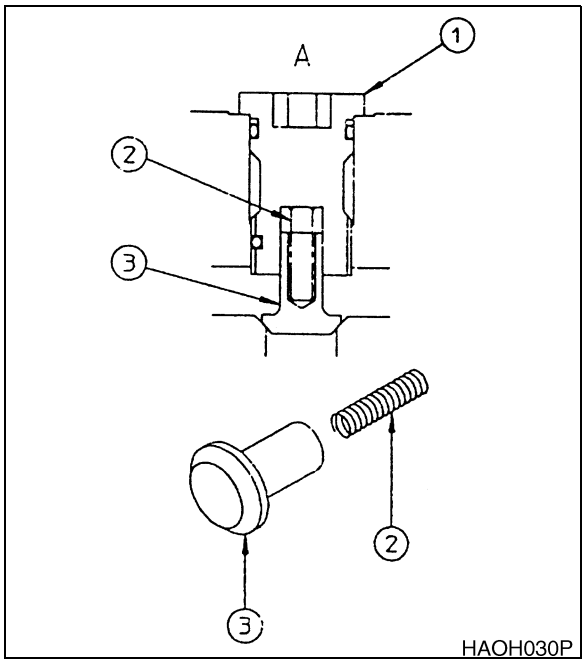



**Figure 113**

**B: Check Valve (P2)**

| Reference Number | Description |
|---|---|
| 1 | Cap |
| 2 | Spring |
| 3 | Check |

| | |
|---|---|
| **Cap hole size** | 12 mm |
| **Tightening torque** | 20 kg•m (145 ft lbs) |

1. Loosen cap (1), remove spring (2) and check (3).

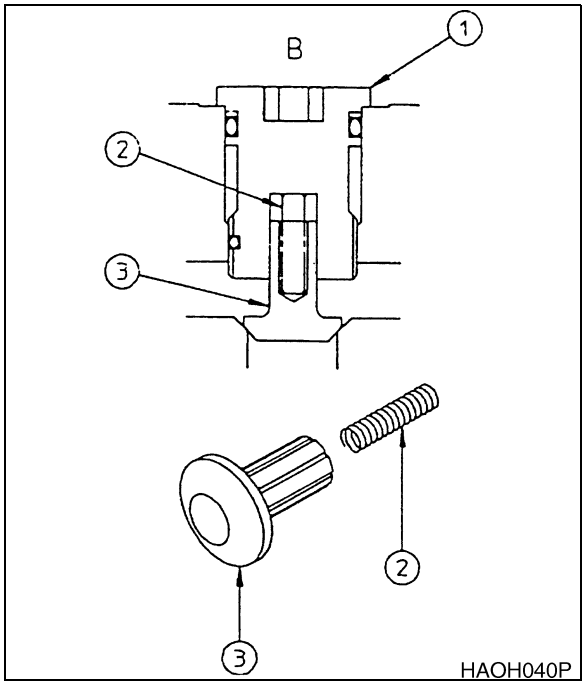



**Figure 114**

| Reference Number | Description |
|---|---|
| 1 | Switch Assembly |
| 2 | Nut |
| 3 | Boot |
| 4 | Nut |
| 5 | Nut |
| 6 | Push Rod |
| 7 | Plate |
| 8 | Plug |
| 9 | Stopper |
| 10 | Shim |
| 11 | Spring |
| 12 | Spool |
| 13 | Plug |
| 14 | O-ring |

| Reference Number | Description |
|---|---|
| 15 | Plug |
| 16 | Case |
| 17 | O-ring |
| 18 | Spring |
| 19 | Spring Seat |
| 20 | O-ring |
| 21 | Bushing |
| 22 | Rod Seal |
| 23 | Swash Plate |
| 24 | Joint Assembly |
| 25 | Connector, Handle |
| 26 | Insert |
| 27 | Screw |
| 28* | Handle Assembly |

**NOTE:** ** On some models the handle assembly (28) may contain other switches for operation of specialized components (grapples, scrap handlers, etc.). Basic construction of valve is the same.*

**SPECIFICATIONS**

**Torques**

| Reference Number | Description | Size | Torque |
|---|---|---|---|
| 15 | Plug | PT 1/8 | |
| 5 | Nut | M14 | |
| 4 | Nut | M14 | |
| 23 | Swash Plate | M14 | |
| 24 | Joint | M14 | |

9. Install plug (8) to housing. Apply hydraulic oil (13).


**Figure 26**

| Reference Number | Description |
|---|---|
| 1 | Seal |
| 2 | Plug |
| 3 | Hydraulic Oil |

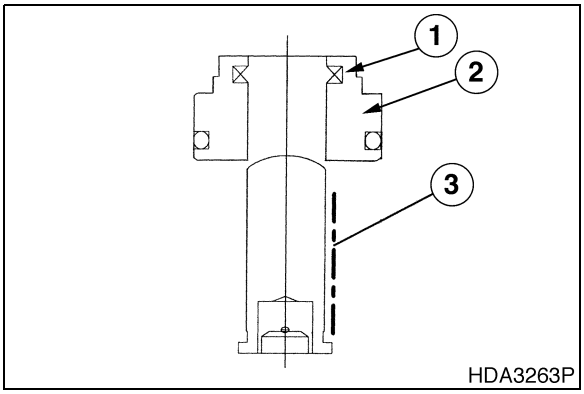



**Figure 27**

10. Assemble plate. Tighten joint (24) to housing using special tool.

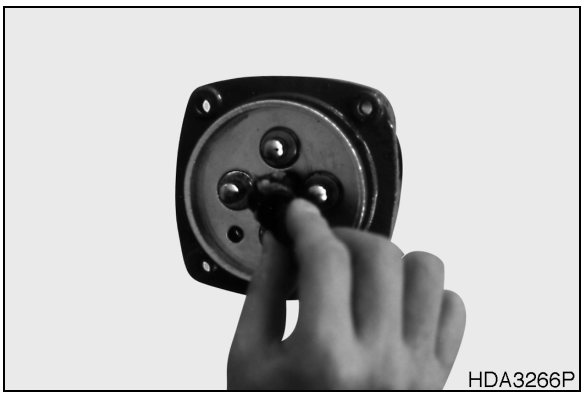



**Figure 28**

11. Attach swatch plate (23) to joint.


**Figure 29**

| Reference Number | Description |
|---|---|
| 101 | Casing |
| 151 | Plug |
| 201 | Cover |
| 202 | Plug |
| 203 | Grease Cup |
| 210 | NHU Packing |
| 212 | O-ring |
| 214 | Push Rod |
| 215 | Washer 1 |
| 217 | Washer 2 |
| 218 | Spring Seat |
| 221 | Retaining Ring |
| 223 | Bushing |
| 224 | Piston |
| 225 | Steel Ball |

| Reference Number | Description |
|---|---|
| 271 | Hex Bolt |
| 301 | Spool |
| 311 | Spring Seat |
| 313 | Washer 3 |
| 324 | Spring |
| 335 | Spring |
| 336 | Spring |
| 337 | Spring |
| 412 | Bushing |
| 413 | Cam Shaft |
| 420 | Cam |
| 423 | Set Screw |
| 471 | Set Screw |
| 472 | Lock Nut |
| 501 | Bellows |

**SPECIFICATIONS**

| | | |
|---|---|---|
| Travel Control Valve | Type: | Pilot Control |
| | Pressure/Stroke: | 27 kg/sq cm (383 psi) @ 4.8 mm (0.19") stroke |
| | Weight: | 7.8 kg (26.5 lb) |

**TORQUE TABLE**

| Part Reference Number | Bolt Size | Tightening Torque |
|---|---|---|
| 151 | NPTF 1/16 | 6.9 ±1 N•m (70 ±10 kgf cm) |
| 271 | M12 | 78.5 ±9.8 N•m (800 ±100 kgf cm) |
| 423 | M6 | 6.9 ±1.0 N•m (70 ±10 kgf cm)<br>Apply Loctite #241 |
| 472 | M10 | 33.3 ±3.4 N•m (340 ±35 kgf cm) |

21. Remove grease cup (203) from plug (202).

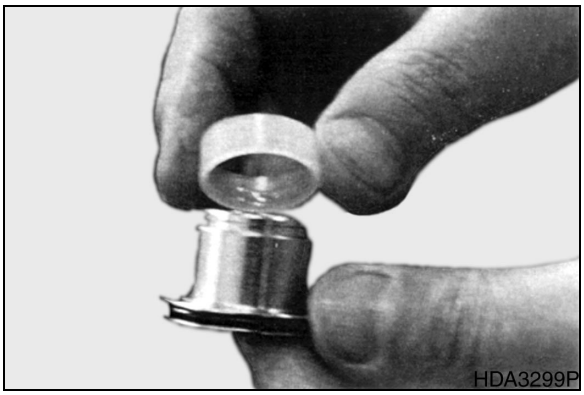



**Figure 30**

22. Remove NHU packing (210) from plug (202) using a small screwdriver.

| **IMPORTANT** |
| --- |
| **Be careful not to scratch the inside surface of the plug.** |

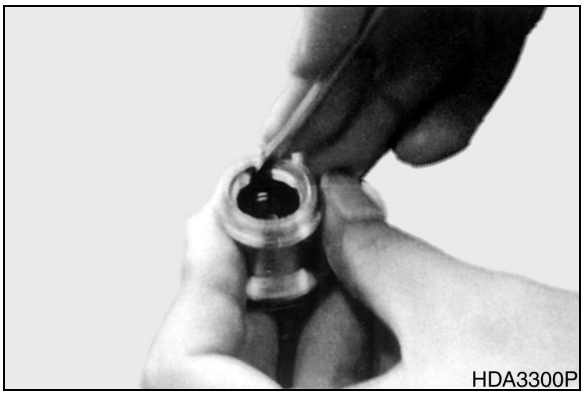



**Figure 31**

23. Remove O-ring (212) from plug.


**Figure 32**

24. Apply Loctite #241 on the threads of the set screw (423).

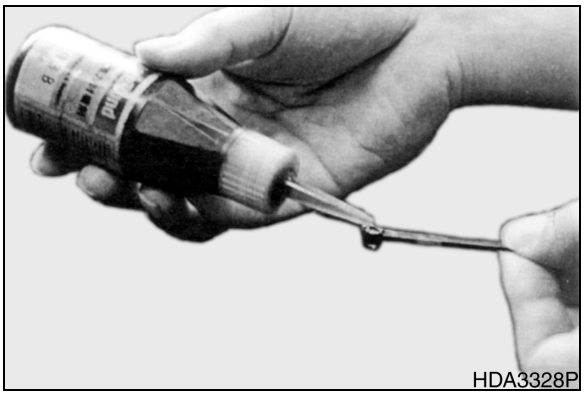



**Figure 59**

25. Assemble allen head set screw (423) and tighten to torque specified in torque table.

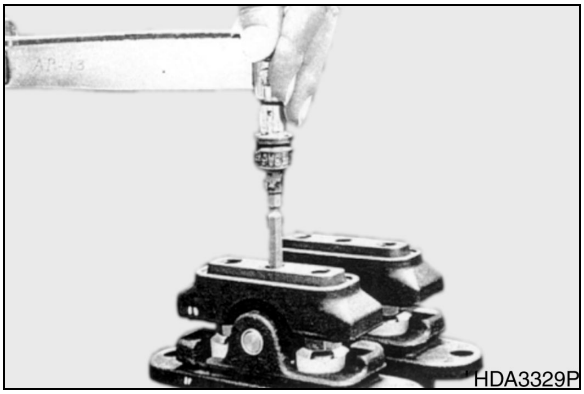



**Figure 60**

26. Move the cam to the left and right and adjust the height of the set screw (471) so that the cam base is parallel to the cover and tighten lock nut (472).

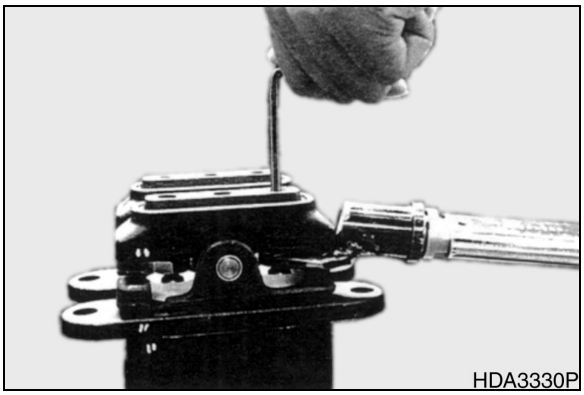



**Figure 61**

## IMPORTANT

**Do not overtighten set screw (471) to the point where the push rod is being pressed down in the neutral position. This may cause the excavator to make sudden unwanted movement without the operating the control levers.**

9. Remove seal (16,17) from plug (19).
   (16) DUST SEAL
   (17) ROD SEAL

**Figure 11**

10. Remove plug (19) from O-ring.

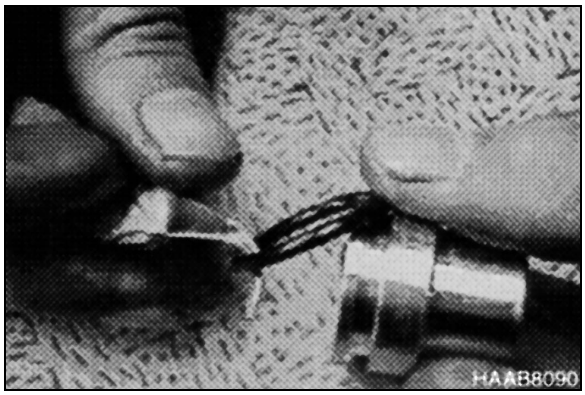


**Figure 12**

11. Remove spool assembly from casing (1).

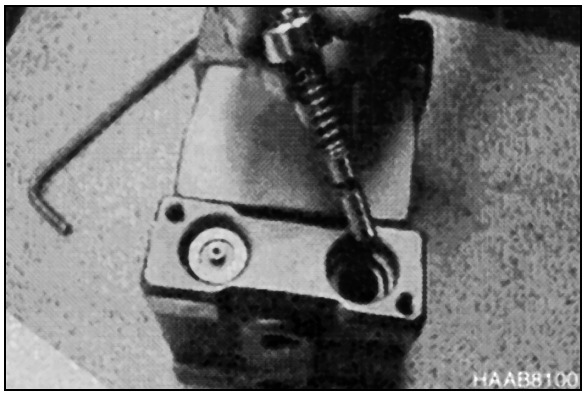


**Figure 13**

12. Remove stopper (13) from spool assembly.

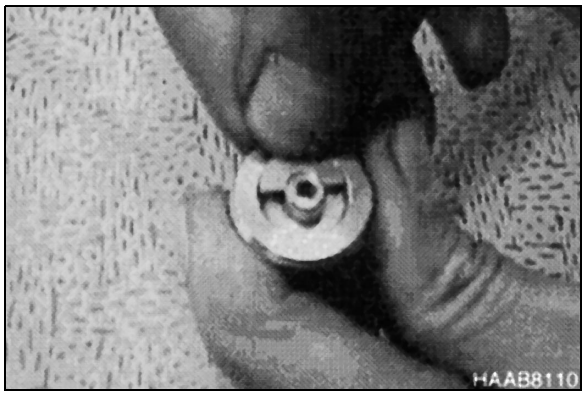


**Figure 14**

# GENERAL DESCRIPTION

Schematic(s) presented in this section are laid out on facing pages.

An overlapping edge has been taken into consideration so that a photocopy can be made and pasted together to make a complete schematic.

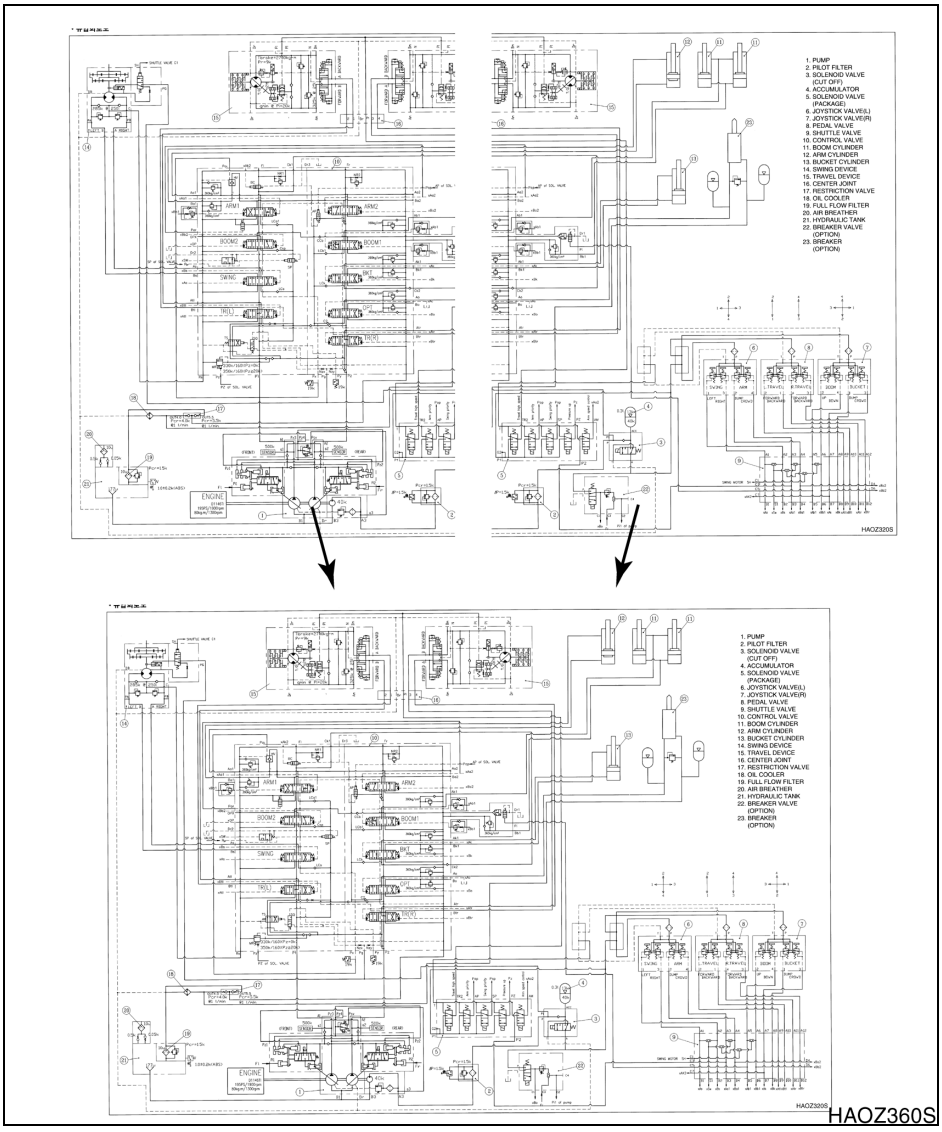



**Figure 1**

# WIRING HARNESS ILLUSTRATIONS

The electrical system diagram(s) is available in the "Hydraulic and Electrical Schematic Shop Manual." This manual is a collection of diagrams and schematics for a number of models.

# OVERVIEW

The electrical system for this equipment is DC 24 volts. The rated voltage for all electric components is 24 volts with the exception of the car stereo and the air-conditioning control actuator. The system contains two 12 volt batteries connected in series and a three phase AC generator with a rectifier. The electric wiring used in the system is easily identifiable by the insulator color. The color symbols used in the electric system is listed in the following chart.

**Electric Wire Color**

| Symbol | Color |
|---|---|
| W | White |
| G | Green |
| Or | Orange |
| B | Black |
| L | Blue |
| Lg | Light Green |

| Symbol | Color |
|---|---|
| R | Red |
| Gr | Gray |
| P | Pink |
| Y | Yellow |
| Br | Brown |
| V | Violet |

**NOTE:** *RW: Red wire with White stripe*

*R - Base Color, W - Stripe Color*

**NOTE:** *0.85G: Nominal sectional area of wire core less insulator = 0.85 $mm^2$*

When the starter switch is in the ‘OFF’ position, the internal components of the engine stop motor‘s cam switch is in the position shown.

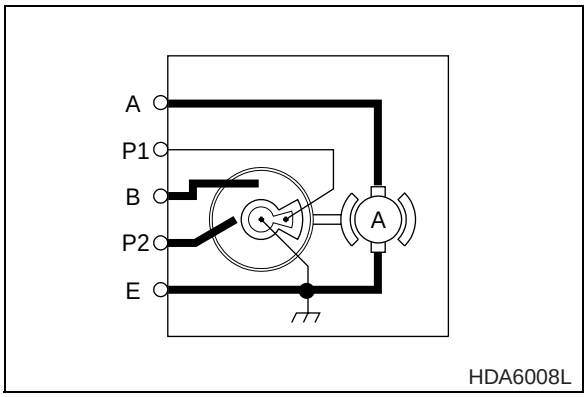
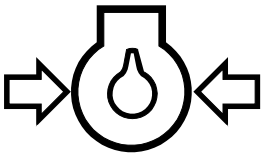
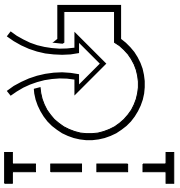
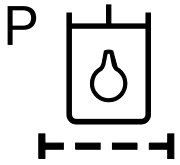
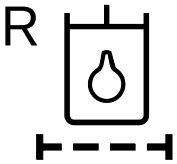
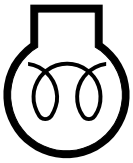



**Figure 8**

# PILOT LIGHT

| Symbol | Description | Input Terminal | Operation | Remarks |
|---|---|---|---|---|
|  HAOH240L | Engine Oil Pressure | CN4 - 6 | Lights up when oil pressure drops below 0.3 kg/sq cm. | After starting engine, if engine oil pressure is insufficient after 8 seconds, a warning buzzer will sound. |
|  HAOH250L | Air Cleaner | CN4 - 7 | Lights up when air cleaner is clogged | |
|  HAOH260L | Pilot Filter | CN4 - 10 | Lights up when pressure increases over 1kg/sq cm. | |
|  HAOH270L | Return Filter | CN4 - 9 | Lights up when pressure increases over 1kg/sq cm. | |
|  HAOH280L | Preheat | CN4 - 11 | Lights up when preheat process is completed. (Approximately 19 seconds from start) | |

# ENGINE CONTROL CIRCUIT DIAGRAM

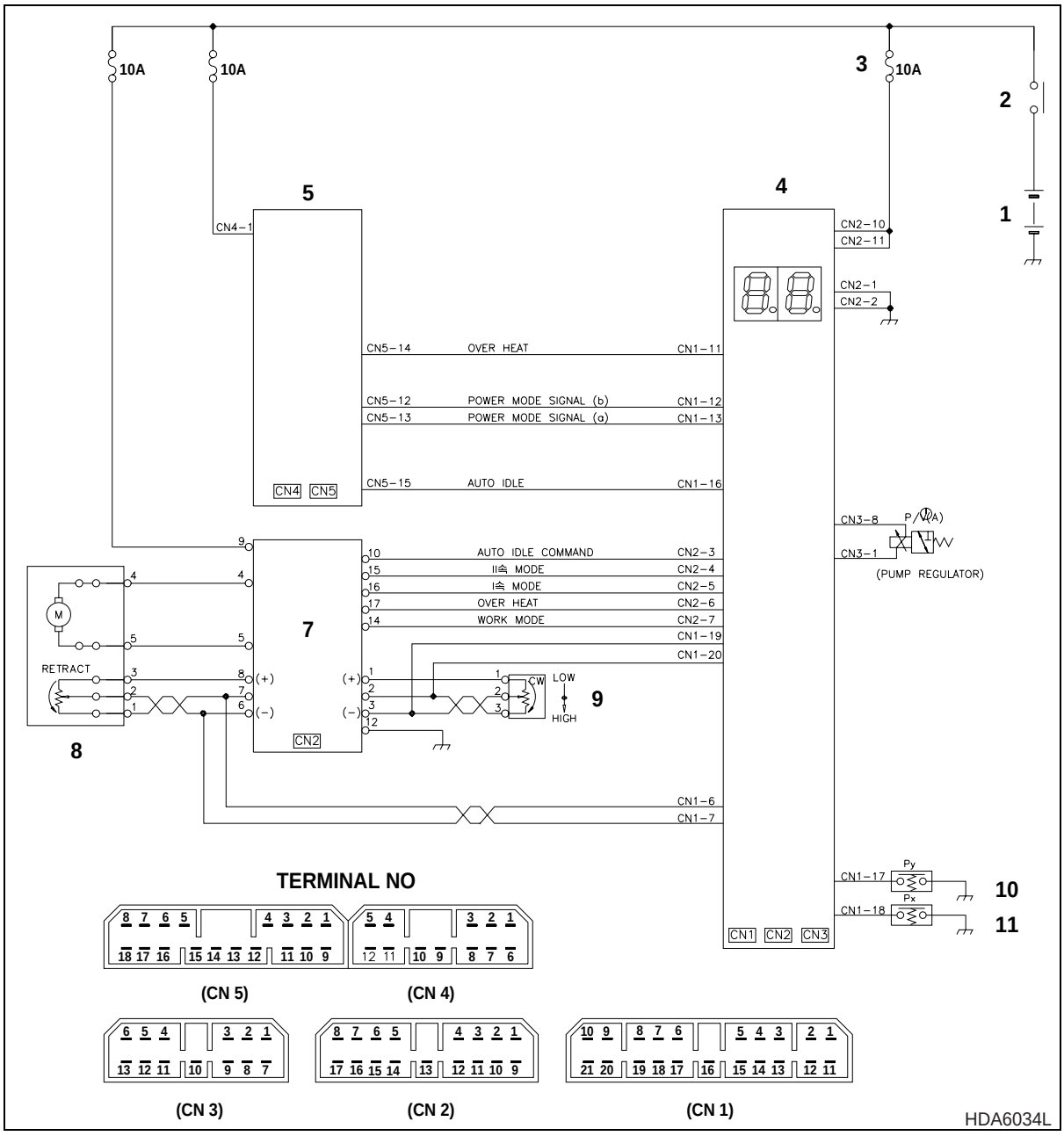



**Figure 31**

| Reference Number | Description |
|---|---|
| 1 | Battery |
| 2 | Battery Relay |
| 3 | Fuse |
| 4 | EPOS-V Controller |
| 5 | Instrument Panel |
| 6 | Engine Speed Sensor |

| Reference Number | Description |
|---|---|
| 7 | Engine Throttle Controller |
| 8 | Engine Control Motor |
| 9 | Engine Control Dial |
| 10 | Pressure Switch (Py Port) |
| 11 | Pressure Switch (Px Port) |

# SELF-DIAGNOSTIC FUNCTION

**EPOS-V CONTROLLER**

The system operation status and malfunction codes can be checked through the display on top of the EPOS-V control box located in the drawer under the operator's seat.

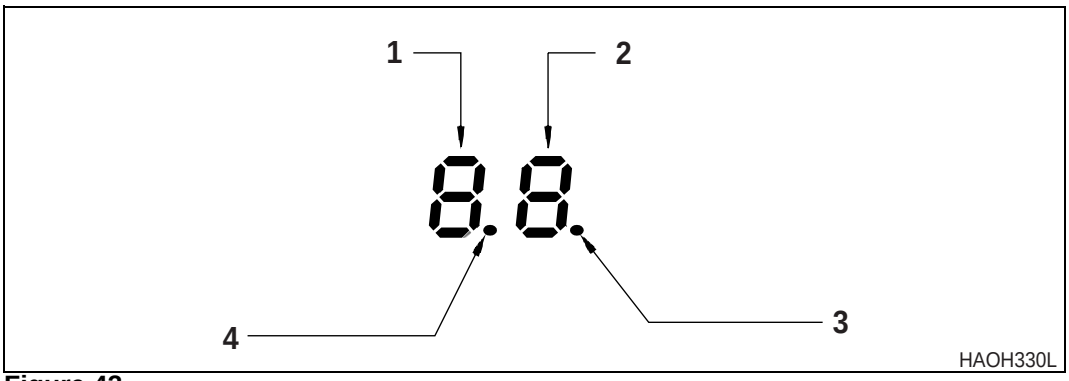



**Figure 43**

| Reference Number | Description |
|---|---|
| 1 | Upper Digit |
| 2 | Lower Digit |
| 3 | Engine Speed Monitor LED (Flash Interval Increases With Engine Speed.) |

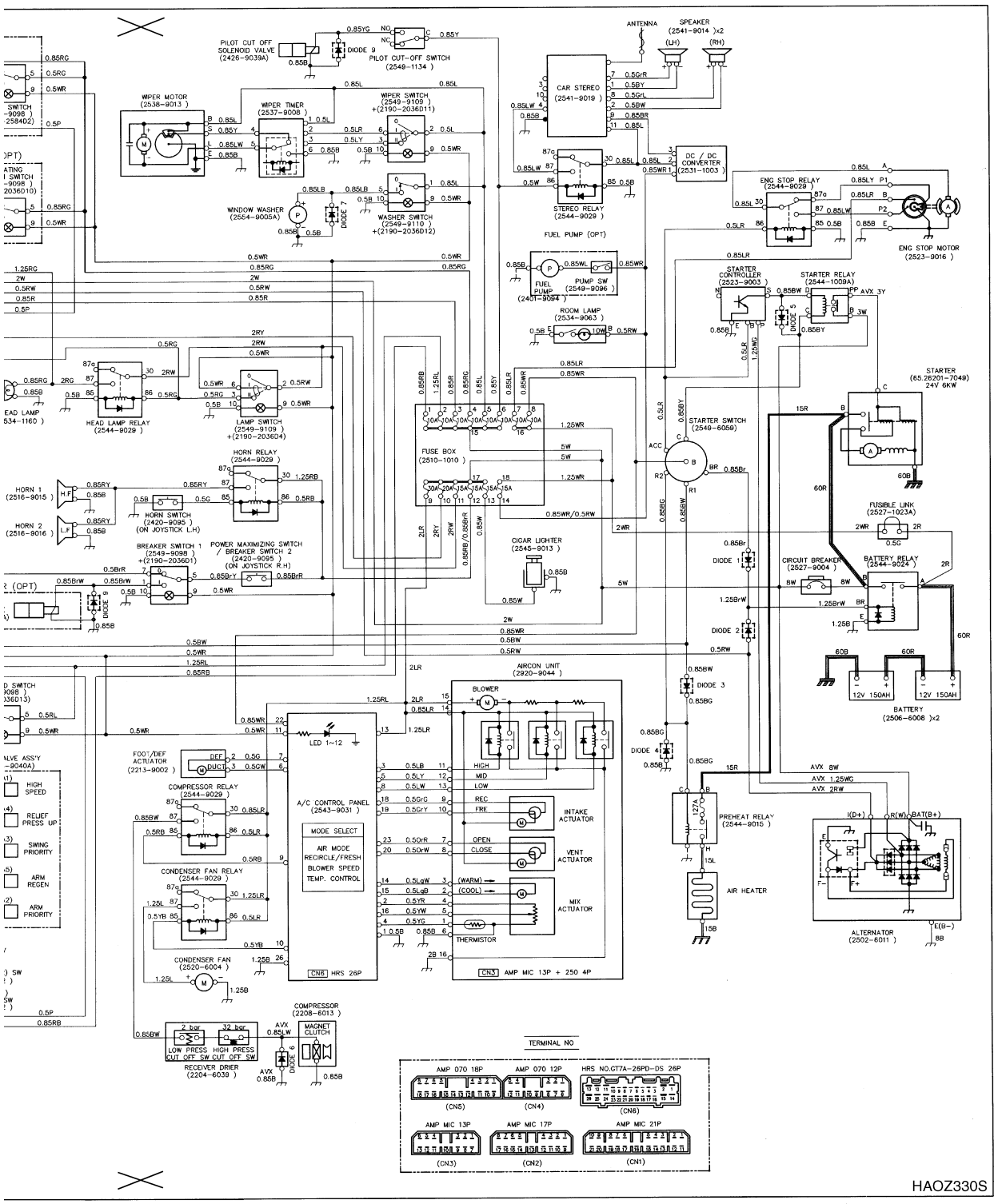
| Reference Number | Description |
|---|---|
| 4 | Power Monitor (Stays On While Power Is In Normal Range,) |

**1. Power Monitor**

This LED is turned off when the input voltage to the EPOS-V controller is below 18.5 ±1 V or above 32.5 ±1 V. Stays on while in normal range.

**2. Engine Speed Monitor**

This LED light flashes according to the engine speed. The flashing interval is proportional to the engine speed.


PILOT CUT OFF SOLENOID VALVE (2426-9039A)
DIODE 9
PILOT CUT-OFF SWITCH (2549-1134 )
WIPER MOTOR (2538-9013 )
WIPER TIMER (2537-9008 )
WIPER SWITCH (2549-9109 ) +(2190-2036D11)
WINDOW WASHER (2554-9005A)
DIODE 7
WASHER SWITCH (2549-9110 ) +(2190-2036D12)
ANTENNA
SPEAKER (2541-9014 )×2
(LH)
(RH)
CAR STEREO (2541-9019 )
STEREO RELAY (2544-9029 )
DC / DC CONVERTER (2531-1003 )
ENG STOP RELAY (2544-9029 )
ENG STOP MOTOR (2523-9016 )
FUEL PUMP (OPT)
FUEL PUMP (2401-9084 )
PUMP SW (2549-9096 )
ROOM LAMP (2534-9063 )
STARTER CONTROLLER (2523-9003 )
STARTER RELAY (2544-1008A)
DIODE 5
STARTER (65.26201-7049) 24V 6KW
STARTER SWITCH (2549-6058)
FUSE BOX (2510-1010 )
HEAD LAMP (2534-1160 )
HEAD LAMP RELAY (2544-9029 )
LAMP SWITCH (2549-9109 ) +(2190-2036D4)
HORN RELAY (2544-9029 )
HORN 1 (2516-9015 )
HORN 2 (2516-9016 )
HORN SWITCH (2420-9095 ) (ON JOYSTICK L.H)
BREAKER SWITCH 1 (2549-9098 ) +(2190-2036D1)
POWER MAXIMIZING SWITCH / BREAKER SWITCH 2 (2420-9095 ) (ON JOYSTICK R.H)
DIODE 9
CIGAR LIGHTER (2545-9013 )
FUSIBLE LINK (2527-1023A)
DIODE 1
CIRCUIT BREAKER (2527-9004 )
BATTERY RELAY (2544-9024 )
DIODE 2
DIODE 3
DIODE 4
12V 150AH
BATTERY (2506-6008 )×2
AIRCON UNIT (2920-9044 )
BLOWER
HIGH
MID
LOW
REC
FRE
OPEN
CLOSE
(WARM)
(COOL)
THERMISTOR
INTAKE ACTUATOR
VENT ACTUATOR
MIX ACTUATOR
CN3 AMP MIC 13P + 250 4P
LED 1~12
A/C CONTROL PANEL (2543-9031 )
MODE SELECT
AIR MODE
RECIRCLE/FRESH
BLOWER SPEED
TEMP. CONTROL
CN6 HRS 26P
FOOT/DEF ACTUATOR (2213-9002 )
DEF
DUCT
COMPRESSOR RELAY (2544-9029 )
CONDENSER FAN RELAY (2544-9029 )
CONDENSER FAN (2520-6004 )
COMPRESSOR (2208-6013 )
MAGNET CLUTCH
RECEIVER DRIER (2204-6039 )
LOW PRESS CUT OFF SW
HIGH PRESS CUT OFF SW
2 bar
32 bar
PREHEAT RELAY (2544-9015 )
AIR HEATER
ALTERNATOR (2502-6011 )
I(D+)
R(W)
BAT(B+)
E(B-)
HIGH SPEED
RELIEF PRESS UP
SWING PRIORITY
ARM REGEN
ARM PRIORITY
TERMINAL NO
AMP 070 18P
AMP 070 12P
HRS NO.GT7A-26PD-DS 26P
(CN5)
(CN4)
(CN6)
AMP MIC 13P
AMP MIC 17P
AMP MIC 21P
(CN3)
(CN2)
(CN1)
HAOZ330S

# INSTALLATION

### ARM INSTALLATION PROCEDURE

Re-attach the base of the arm cylinder to the mounting point on top of the boom.

**⚠ WARNING!**

**Before assembling the front attachment, make sure that the individual boom, arm and bucket sections are all compatible and can be used safely for work intended. Refer to the General Safety Pages, Lift Ratings, Working Range Diagrams and Weights of Materials sections in the Operation and Maintenance Manual. Consult your dealer or Daewoo After Sales Service for more information if you have any questions or require more information.**

Begin with the arm securely supported on blocking in front of the excavator. Pre-grease the mounting pin for the rod end of the arm cylinder and push it through the ears on the end of the arm. Attach a sling around that mounting pin and lift the arm with an assist crane until it is in position for the boom-arm pin connection to be made.

Relieve hydraulic pressure from all points of the system before any hydraulic lines are opened, then carefully assemble hydraulic connections to the arm cylinder.

Remove the sling from around the rod end arm cylinder pin, withdraw the pin and lift the body of the arm cylinder to re-pin the mounting connection.

### BOOM INSTALLATION PROCEDURE

Before reassembling the attachment, make sure to inspect all bushings and pivot points of each section. To avoid damaging the seats, bushings should never be hammered or chiseled out of their seats.

Installation is otherwise a reversal of the removal procedures.

3. Remove the old O-ring and temporarily install the new O-ring (1, Figure 11) onto the bucket bushing (2). Make sure that the O-ring groove on both the bucket link (3) and bushing have been cleaned.

4. Realign the arm or link with the bucket pin hole and insert the bucket pin (3, Figure 10).

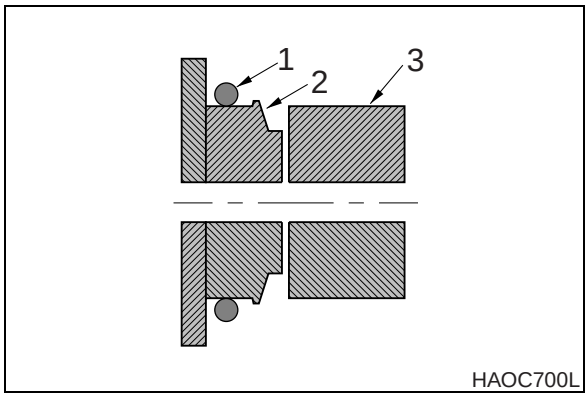



**Figure 15**

5. Roll the new O-ring (1, Figure 12) into the O-ring groove.

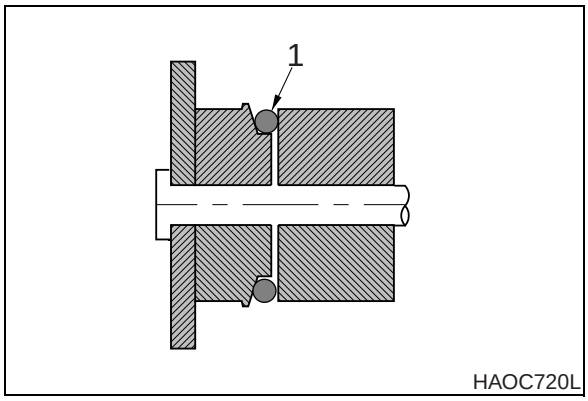



**Figure 16**

# WELDING PRECAUTIONS AND GUIDELINES

## IMPORTANT

**To avoid accidents, personal injury and the possibility of causing damage to the excavator or to components, welding must only be performed by properly trained and qualified personnel, who possess the correct certification (when required) for the specific welding fabrication or specialized repair being performed.**

## WARNING!

**Structural elements of the excavator may be built from a variety of steels. These could contain unique alloys or may have been heat treated to obtain particular strength characteristics. It is extremely important that welding repairs on these types of steel are performed with the proper procedures and equipment. If repairs are performed incorrectly, structural weakening or other damage to the excavator (that is not always readily visible) could be caused. Always consult Daewoo After Sales Service before welding on integral components (car body, track frames, turntable, attachment) of the excavator. It is possible that some types of structurally critical repairs may require Magnetic Particle or Liquid Penetrant testing, to make sure there are no hidden cracks or damage, before the excavator can be returned to service.**

## CAUTION!

**Always perform welding procedures with the proper safety equipment on hand. Adequate ventilation and a dry work area are absolutely essential. Keep a fire extinguisher nearby and always wear protective clothing and the recommended type of eye protection.**

**Heat Discoloration**

Heat discoloration can range from faint yellow to dark blue resulting from overload or incorrect lubrication.

Excessive heat can cause softening of races or rollers.

To check for loss of temper on races or rollers, a simple file test may be made. A file drawn over a tempered part will grab and cut metal, whereas a file drawn over a hard part will glide readily with no metal cutting.

Replace bearing if over heating damage is indicated. Check seals and other related parts for damage.

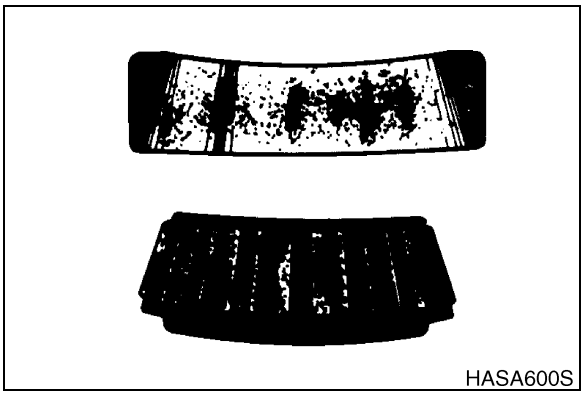



**Figure 17**

**Stain Discoloration**

Discoloration can range from light brown to black caused by incorrect lubrication or moisture.

if the stain can be removed by light polishing or if no evidence of overheating is visible, the bearing can be reused.

Check seals and other related parts for damage.

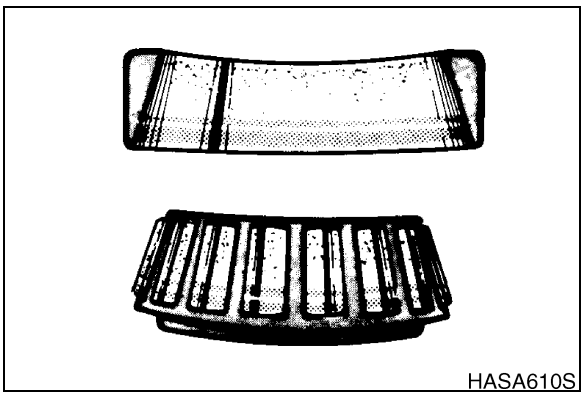



**Figure 18**

# TORQUE WRENCH EXTENSION TOOLS

Very large diameter, high grade fasteners (nuts, bolts, cap screws, etc.) require a great deal of turning force in order to achieve recommended tightening torque values.

Common problems that could occur as a result are:

- Recommended torque exceeds the measuring capacity of the torque wrench.
- Specialized sockets do not fit the adapter on the front end (nose) of the torque wrench.
- Generating adequate force on the back end (handle) of the wrench is difficult or impossible.
- Restricted access or an obstruction may make use of the torque wrench impossible.
- A unique application requires fabrication of an adapter or other special extension.

Most standard torque wrenches can be adapted to suit any one of the proceeding needs or situations, if the right extension tool is used or fabricated.

**TORQUE MULTIPLICATION**

A wrench extension tool can be used to increase the tightening force on a high capacity nut or bolt.

For example, doubling the distance between the bolt and the back (handle) end of the torque wrench doubles the tightening force on the bolt. It also halves the indicated reading on the scale or dial of the torque wrench. To accurately adjust or convert indicated scale or dial readings, use the following formula:

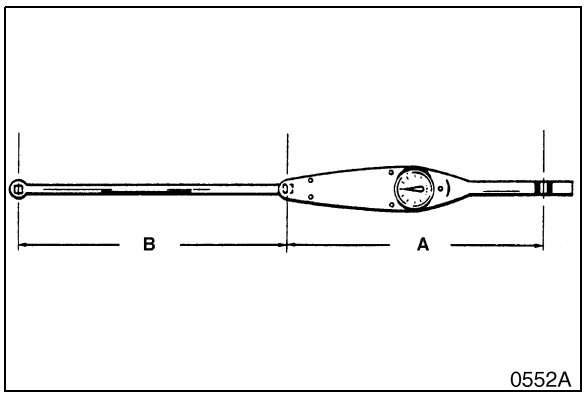



**Figure 1**

I = A x T / A + B where:

I = Indicated force shown on the torque wrench scale or dial.

T = Tightening force applied to the nut or bolt (actual Torque).

A = Length of the torque wrench (between the center of the nut or bolt and the center of the handle).

B = Length of the extension.

As an example, if a 12" extension is added to a 12" torque wrench, and the indicated torque on the dial reads "150 ft lbs," the real force applied to the bolt is 300 ft lbs:

$$I = \frac{A \times T}{A + B} = \frac{12 \times 300}{12 + 12} = \frac{3600}{24} = 150$$

**NOTE:** *The formula assumes that there is no added deflection or "give" in the joint between the extension and torque wrench. Readings may also be inaccurate:*

- If the extension itself absorbs some of the tightening force and starts to bend or bow out.
- If an extension has to be fabricated that is not perfectly straight (for example, an extension made to go around an obstruction, to allow access to a difficult to tighten fastener), the materials and methods used must be solid enough to transmit full tightening torque.

# OPERATION OF WORKING COMPONENTS

### BOOM OPERATING CIRCUIT

The boom operating circuit includes the right and left main hydraulic pumps (both halves of the main pump assembly), both sides of the control valve and the boom cylinder. The circuit operates in boom down mode through the first shift position and through the second shift position in boom up mode. Overload relief valves set at 360 kg/cm sq. (5,112 psi) protect the hydraulic system from damage as a result of overloads or shocks to the boom.

### BOOM UP CIRCUIT

When you pull the boom control lever backward, the right side pilot valve generates secondary boom up pilot pressure that is transmitted to the right and left sides of the control valve simultaneously. When secondary pilot pressure reaches 4 - 6 kg/cm sq. (57 - 85 psi), boom control valve spools open and oil from both pumps goes to the boom cylinder.

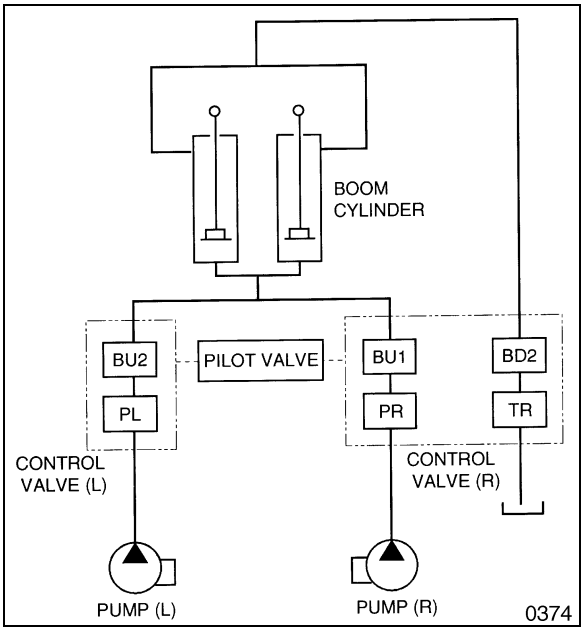



**Figure 2**

### BOOM DOWN CIRCUIT

When the boom control lever is pushed forward, the right side pilot valve generates secondary boom down pilot pressure that is transmitted only to the right side of the control valve. When secondary pilot pressure reaches 4 - 6 kg/cm sq. (57 - 85 psi), the valve spool on the right side of the control valve opens so that oil from only one half of the pump assembly goes to the boom cylinder for boom lowering.

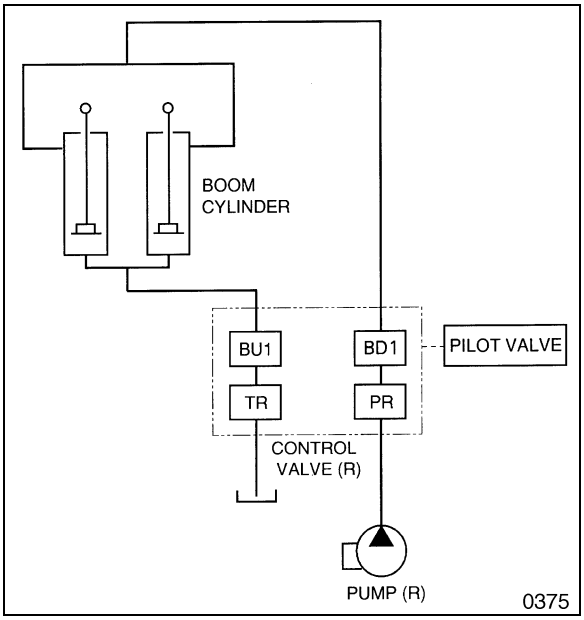



**Figure 3**

### ARM OPERATING CIRCUIT

The arm operating circuit includes both the right and left hydraulic main pumps, the right and left halves of the control valve, a slow return orifice, and the arm cylinder. The circuit can be operated in the two-stage speed control mode which works through both halves of the control valve and doubles the volume of oil flowing to the cylinder.

# PRESSURE UP VALVE

**CHECKS AND ADJUSTMENTS**

## ⚠ WARNING!

**This procedure should be done with two people. To reduce the chance of accident or unintended start-up, one person should remain at the operator's control stand while checks and adjustments are made.**

Vent hydraulic pressure from the reservoir to install an in-line "t-style" adapter and test gauge (60 bar/1,000 psi) at the pilot pump signal port relief valve outlet.

Start the engine and turn the engine speed dial to maximum. When normal operating temperature is reached,

- Check pilot pressure and readjust it, if required;
- Select the Instrument Panel rear pump "pressure display";
- Select Power Mode III;
- Stall the boom cylinder (towards the extend side);
- Read rear pump pressure on the Instrument Panel display.

Repeat all tests with and without "pressure up" selected through the console rocker switch and joystick button.

If the 2-stage main relief valve was not set correctly and main relief high-stage pressure ("pressure up") is outside the tolerance range, begin valve adjustment by loosening the outside (widest diameter) lock nut on the relief valve. Turn the adjusting screw clockwise to increase pressure, or counterclockwise to decrease it. Pressure must be 350 bars (5075 psi), or up to 10 bars (145 psi) higher.

Because one adjustment can affect the other, check low-stage main relief pressure by repeating the cylinder stall test without "pressure up." Readjust standard relief pressure by turning the inner-most (smallest diameter) screw clockwise to increase the setting, or counterclockwise to decrease it. Pressure should be at least 330 bars (4,785 psi), but less than 335 bars (4,858 psi).

## IMPORTANT

**Pressure adjustments and checks cannot be made if pilot pressure is outside the specified range. Refer to the pilot pump adjustment procedure if required, then proceed with any necessary adjustments to main relief pressure settings.**

| Power Mode | Operation | Main Pressure and Tolerance | Pilot Pressure and Tolerance |
|---|---|---|---|
| Mode III | Neutral, No Operation | 20 - 40 bar<br>(290 - 580 psi) | 30 bar + 10 bar<br>(435 psi + 145 psi) |
| Mode III | Cylinder Stall | 330 bar + 5 bar<br>(4,785 psi + 75 psi) | 30 bar + 10 bar<br>(435 psi + 145 psi) |
| Mode III W/ pressure Up | Cylinder Stall | 350 bar + 10 bar<br>5,075 psi + 145 psi | 30 bar + 10 bar<br>(435 psi + 145 psi) |

| Problem | Possible Causes | Remedies |
|---|---|---|
| Pressure at swing motor inlet increases. | Swing brake not releasing. | Check brake engagement and disengagement; check release pressure. |
| | Internal damage to gearbox drive train. | Replace broken gears and drive train assemblies. |
| | Overload. | Reduce load weight. |
| Pressure at swing motor inlet shows no increase, and the swing motor is making irregular noises. | Swing motor drive shaft damage. | Replace swing motor. |
| | Internal damage to gearbox drive train. | Repair/Replace broken or faulty assemblies. |
| Pressure at swing motor inlet shown no increase, but without irregular noises from the swing motor. | Hydraulic pump or valve problem. | Troubleshoot hydraulic system. |
| Oil Leakage: | | |
| From drive shaft From bolted connections or other assembled surfaces. | Oil seal damaged Assembly compound (joint sealer) old and not sealing, bolt not tight or flange warped. | Replace oil seal Disassemble and check mating surfaces. Reapply Loctite; torque bolts to specifications. |
| Excess heat: | | |
| Gearbox casing becomes excessively hot, with or without irregular noises, during operation. | Low oil level. | Replace oil; refill to specified level. |
| | Bearings or gears worn but not completely inoperative. | Repair or replace gearbox. |

# TROUBLESHOOTING - HYDRAULIC PROBLEMS

| Problem | Possible Causes | Remedies |
|---|---|---|
| Attachment cylinders, swing and travel motors are all inoperable. Loud noises are heard from main pump assembly. | Main pump(s) malfunction | Repair or replace |
| | Low oil level in hydraulic system | Refill |
| | Main pump inlet (oil supply) piping or hose damaged | Repair or replace |
| Attachment cylinders, swing and travel motors are all inoperable. No usual or loud noises can be heard. | Pilot pump malfunction | Repair or replace |
| | Pilot cutoff solenoid stuck | Repair or replace |
| | Pilot cutoff switch faulty | Repair or replace |
| | Engine/pump flex coupling damaged | Replace flex coupling |
| Sluggish performance of all hydraulic functions - attachment, swing and travel. | Main pump(s) damaged or worn | Repair or replace |
| | Main relief valve pressure off | Readjust pressure |
| | Low oil level in hydraulic system | Refill |
| | Hydraulic reservoir intake strainer clogged | Clean |
| | Pump inlet (supply side) piping or hose allowing air into hydraulic system | Tighten connection |

3. Reverse disassembly steps for reassembly.
4. Clean threads of fasteners before pre-applying Loctite #243 to the threads, and before torquing the thrust plate and cover bolts.
5. Pre-fill the center swivel with clean hydraulic fluid prior to reassembly of high-pressure and drain line piping. Clean and pre-fill piping line ends to reduce the amount of air in the system. Bleed air from the hydraulic system and verify hydraulic tank fluid level before returning the excavator to service.

| MODEL | CYLINDER | A | B | C | D | E | F | G | H | I | MODEL (CYLINDER) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S55-V | ARM | 63.0 mm (2.48 in.) | 12.0 mm (0.47 in.) | 15.0 mm (0.59 in.) | 22.0 mm (0.87 in.) | 50.0 mm (1.97 in.) | 30.0 mm (1.18 in.) | 320.0 mm (12.60 in.) | 15.0 mm (0.59 in.) | 12.0 mm (0.47 in.) | S55-V (BUCKET) |
| | BOOM | 80.0 mm (3.15 in.) | 12.0 mm (0.47 in.) | 16.0 mm (0.63 in.) | 25.0 mm (0.98 in.) | 55.0 mm (2.17 in.) | 30.0 mm (1.18 in.) | 320.0 mm (12.60 in.) | 15.0 mm (0.59 in.) | 15.0 mm (0.59 in.) | |
| S130-V | ARM | 80.0 mm (3.15 in.) | 12.0 mm (0.47 in.) | 15.0 mm (0.59 in.) | 29.0 mm (1.14 in.) | 55.0 mm (2.17 in.) | 30.0 mm (1.18 in.) | 320.0 mm (12.60 in.) | 15.0 mm (0.59 in.) | 15.0 mm (0.59 in.) | S130W-V (ARM)<br>S170LC-V (BUCKET) |
| | BOOM | 75.0 mm (2.95 in.) | 12.0 mm (0.47 in.) | 15.0 mm (0.59 in.) | 27.0 mm (1.06 in.) | 55.0 mm (2.17 in.) | 30.0 mm (1.18 in.) | 320.0 mm (12.60 in.) | 15.0 mm (0.59 in.) | 14.0 mm (0.55 in.) | S130W-V (BOOM) |
| | BUCKET | 70.0 mm (2.76 in.) | 12.0 mm (0.47 in.) | 16.0 mm (0.63 in.) | 25.0 mm (0.98 in.) | 65.0 mm (2.56 in.) | 30.0 mm (1.18 in.) | 300.0 mm (11.81 in.) | 15.0 mm (0.59 in.) | 12.0 mm (0.47 in.) | S130W-V (BUCKET) |
| S220LC-V | ARM | 110.0 mm (4.33 in.) | 14.0 mm (0.55 in.) | 17.0 mm (0.67 in.) | 40.0 mm (1.57 in.) | 75.0 mm (2.95 in.) | 32.0 mm (1.26 in.) | 350.0 mm (13.78 in.) | 15.0 mm (0.59 in.) | 15.0 mm (0.59 in.) | S170LC-V (ARM)<br>S200W-V (ARM)<br>S250LC-V (BOOM, ARM, BUCKET)<br>S290LC-V (BOOM, BUCKET) |
| | BUCKET | 50.0 mm (1.97 in.) | 14.0 mm (0.55 in.) | 16.0 mm (0.63 in.) | 33.0 mm (1.30 in.) | 65.0 mm (2.56 in.) | 32.0 mm (1.26 in.) | 350.0 mm (13.78 in.) | 15.0 mm (0.59 in.) | 15.0 mm (0.59 in.) | S170LC-V (BOOM)<br>S200W-V (BUCKET)<br>S200LC-V (BUCKET) |
| S200W-V | OUTRIGGER | 96.0 mm (3.78 in.) | 14.0 mm (0.55 in.) | 17.0 mm (0.67 in.) | 35.0 mm (1.38 in.) | 65.0 mm (2.56 in.) | 30.0 mm (1.18 in.) | 350.0 mm (13.78 in.) | 15.0 mm (0.59 in.) | 15.0 mm (0.59 in.) | S200W-V (DOZER) |
| S290LC-V | ARM | 120.0 mm (4.72 in.) | 14.0 mm (0.55 in.) | 18.0 mm (0.71 in.) | 46.0 mm (1.81 in.) | 80.0 mm (3.15 in.) | 35.0 mm (1.38 in.) | 350.0 mm (13.78 in.) | 15.0 mm (0.59 in.) | 15.0 mm (0.59 in.) | S330-V (BOOM, BUCKET)<br>S360-V (BOOM, BUCKET) |
| S330LC-V | ARM | 130.0 mm (5.12 in.) | 14.0 mm (0.55 in.) | 20.0 mm (0.79 in.) | 50.0 mm (1.97 in.) | 90.0 mm (3.54 in.) | 35.0 mm (1.38 in.) | 350.0 mm (13.78 in.) | 15.0 mm (0.59 in.) | 20.0 mm (0.79 in.) | S360-V (ARM)<br>S400LC-V (ARM)<br>S400LC-V (BOOM)<br>S400LC-V (BUCKET)<br>S450LC-V (BOOM, BUCKET) |

10. Pre-apply fastener locking compound (Loctite #242 or #243 or an alternate manufacturer's equivalent product) to all end cover retaining bolts. Wrap a protective cushion around end of rod while tightening fasteners, to prevent possible damage to polished surface of rod, should a wrench slip during retightening.

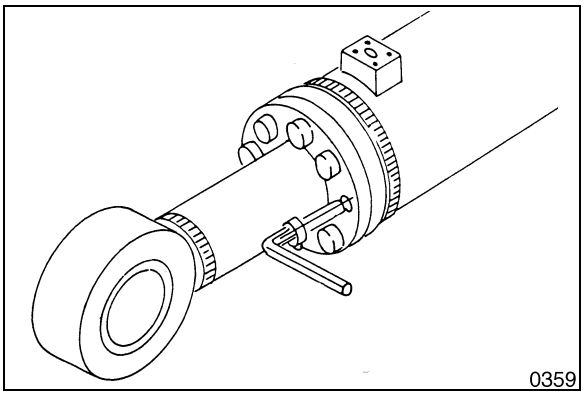



**Figure 34**

| Reference Number | Description |
|---|---|
| 31 | Brake Valve |
| 51 | Relief Valve |
| 101 | Drive Shaft |
| 106 | Spacer |
| 111 | Cylinder Block |
| 113 | Spherical Bushing |
| 114 | Cylinder Spring |
| 116 | Push Rod |
| 117 | Spacer (F) |
| 118 | Spacer (R) |
| 121 | Piston |
| 122 | Shoe |
| 123 | Retainer Plate |
| 124 | Shoe Plate |
| 131 | Valve Plate |
| 301 | Lower Casing |
| 303 | Upper Valve Casing |
| 304 | Front Cover |
| 351 | Plunger |
| 355 | Spring |
| 401 | Socket Head Cover Bolt |
| 432 | Stop Ring |
| 433 | Stop Ring |

| Reference Number | Description |
|---|---|
| 437 | Lock Ring |
| 438 | Lock Ring |
| 443 | Roller Bearing |
| 444 | Roller Bearing |
| 451 | Pin Spring |
| 464 | VP Plug |
| 468 | VP Plug |
| 469 | RO Plug |
| 471 | O-ring |
| 472 | O-ring |
| 485 | O-ring |
| 487 | O-ring |
| 488 | O-ring |
| 491 | Oil Seal |
| 702 | Brake Piston |
| 706 | O-ring |
| 707 | O-ring |
| 712 | Brake Spring |
| 742 | Friction Plate |
| 743 | Separator Plate |
| 993 | PT Plug |
| 994 | PT Plug |

**SPECIFICATIONS**

| Swing Motor | Specification |
|---|---|
| Type | Axial Piston |
| Displacement | 169.40 cc (26.26 cu. in.) |
| Crossover Relief Valve Setting | .285.00 - 290.00 kg/sq cm @ 250 liter/min. (4,054 - 4,125 psi @66.0 gpm) |
| Maximum Supply Flow Rate @ 2000 RPM | 265.0 liter/min. (69.96 gpm) |
| Motor Shaft Speed | 1558 rpm |
| Motor Shaft Torque | 76.8 kg•m (556 ft lbs) |
| Weight | 59 kg (130 lbs) |

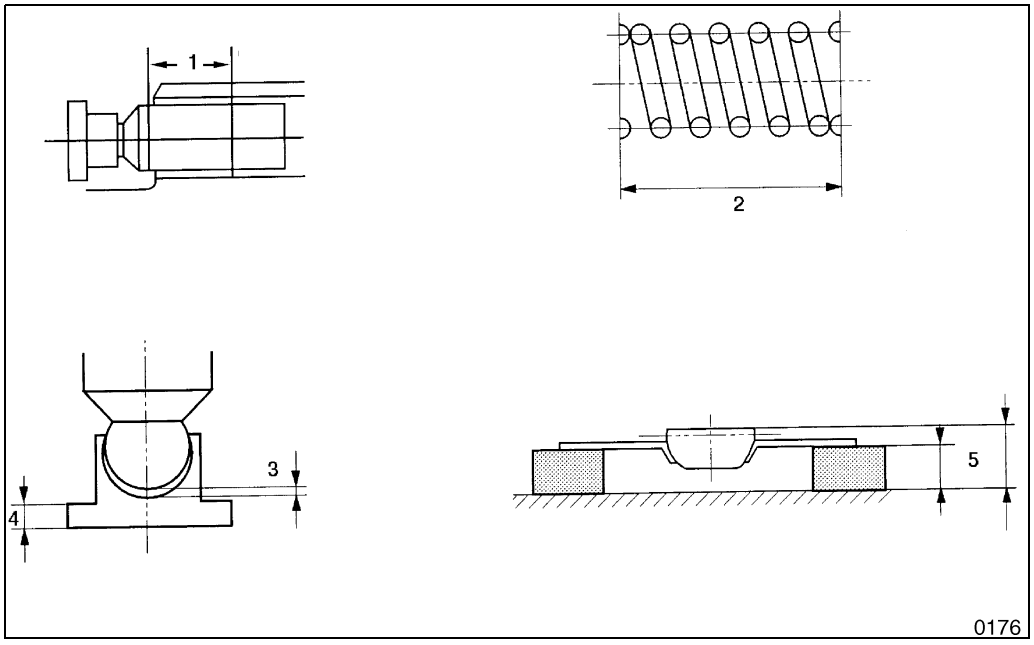



**Figure 25**

| Reference Number | Description |
|---|---|
| 1 | Clearance Between Piston and Cylinder Bore |
| 2 | Spring Free Length |
| 3 | Piston Ball - Shoe Socket Clearance |
| 4 | Thickness of Shoe |
| 5 | Height Between Round Bushing and Push Plate |

**NOTE:** *Spherical bushing and push plate must always be replaced as a set. If either one requires replacement, replace the other*

# SPECIFICATIONS FOR SOLAR 290LC-V

## ⚠ CAUTION!

**Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.**

**Always use tools and equipment that is in good working order.**

**Use lifting and hoisting equipment capable of safely handling load.**

**Remember, that ultimately safety is your own personal responsibility.**

| MODEL | SERIAL NUMBER RANGE |
|---|---|
| Solar 290LC-V | 0001 and UP |
| | |
| | |
| | |



September 1998

# APPROXIMATE WEIGHT OF WORKLOAD MATERIALS

## IMPORTANT

**Weights are approximations of estimated average volume and mass. Exposure to rain, snow or ground water; settling or compaction due to overhead weight, chemical or industrial processing or changes due to thermal or chemical transformations could all increase the value of weights listed in the table.**

| MATERIAL | LOW WEIGHT OR DENSITY, 1,100 KG/M$^3$ (1,850 LB/YD$^3$), OR LESS | MEDIUM WEIGHT OR DENSITY, 1,600 KG/M$^3$ (2,700 LB/YD$^3$), OR LESS | HIGH WEIGHT OR DENSITY, 2,000 KG/M$^3$ (3,370 LB/YD$^3$), OR LESS |
|---|---|---|---|
| Charcoal | 401 kg/m$^3$ (695 lb/yd$^3$) | | |
| Coke, blast furnace size | 433 kg/m$^3$ (729 lb/yd$^3$) | | |
| Coke, foundry size | 449 kg/m$^3$ (756 lb/yd$^3$) | | |
| Coal, bituminous slack, piled | 801 kg/m$^3$ (1,350 lb/yd$^3$) | | |
| Coal, bituminous r. of m., piled | 881 kg/m$^3$ (1,485 lb/yd$^3$) | | |
| Coal, anthracite | 897 kg/m$^3$ (1,512 lb/yd$^3$) | | |
| Clay, DRY, in broken lumps | 1,009 kg/m$^3$ (1,701 lb/yd$^3$) | | |
| Clay, DAMP, natural bed | | 1,746 kg/m$^3$ (2,943 lb/yd$^3$) | |
| Cement, Portland, DRY granular | | 1,506 kg/m$^3$ (2,583 lb/yd$^3$) | |
| Cement, Portland, DRY clinkers | | 1,362 kg/m$^3$ (2,295 lb/yd$^3$) | |
| Dolomite, crushed | | 1,522 kg/m$^3$ (2,565 lb/yd$^3$) | |
| Earth, loamy, DRY, loose | | 1,202 kg/m$^3$ (2,025 lb/yd$^3$) | |

# MAIN PUMP (WITH REGULATOR)

## ⚠ CAUTION!

**Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.**

**Always use tools and equipment that is in good working order.**

**Use lifting and hoisting equipment capable of safely handling load.**

**Remember, that ultimately safety is your own personal responsibility.**

| MODEL | SERIAL NUMBER RANGE |
|---|---|
| Solar 290LC-V | 0001 and Up |
| Solar 290LL | 1001 and Up |
| | |
| | |



February 1999

# IMPORTANT

**Input horsepower adjustments that are made to one pump should also be carried out on the remaining pump, so that both are adjusted to the same input range.**

Horsepower control characteristics can be changed by loosening the large, thin nut (630) on the end of the regulator. The larger (outer) adjusting screw (628) affects adjustment of the outer return spring in the regulator outer spool. Tightening the outer screw approximately 1/4 turn increases compensator control pressure approximately 18 kg/cm sq. (256 psi), for a torque increase of 4 kg•m (29 ft lbs). Changing the adjustment position of the outer screw (628) affects the adjustment position of the inner screw (924), which is the adjustment device for the inner spring of the regulator outer spool. Loosen the inner screw and back it out enough to compensate for the tightening adjustment made to the outer screw, to maintain the original setting. Changing the adjustment position of the inner screw 1/4 turn affects the working resistance of the inner spring. Increases in oil flow of approximately 10 lpm (0.04 gpm) and about 4.8 kg•m (35 ft lbs) of input torque are the result.

The third adjustment screw on the side of the regulator (924) can be repositioned after the smaller lock nut (801) is loosened. Changing the position of the third adjustment screw (924) affects pilot pressure. Turning the screw in 1/4 turn increases pilot pressure by 1.5 kg/cm sq. (21 psi), and consequently, as a result of the increase in pilot pressure, the discharge flow from the main pump assembly will increase by about 16 lpm (0.07 gpm)

**.Electric Proportional Reducing Valve**

- Current/Pressure Operating Characteristics

  Condition: Primary Pressure 50 kg/ $cm^3$

  Load Discharge Flow 0 lpm

  70 Hz, 400-600 mA

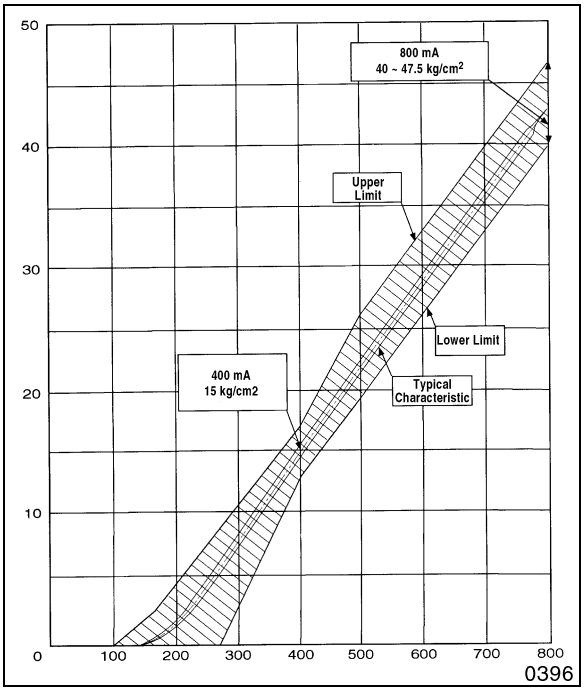



**Figure 12**

2. Unscrew two allen-head hex head bolts from front seal cover plate (261). To separate cover plate from rest of assembly, screw 6 mm cap screws into threaded holes tapped into cover. Tighten all four cap screws in a slow, staggered tightening sequence, taking wrench off of each cap screw after just a fraction of a turn and proceeding to next - in regular rotation - until cover drops out.

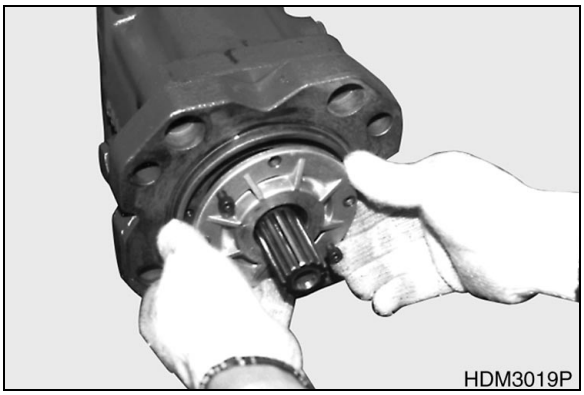



**Figure 20**

3. Separate pump casing (271) from support plate (251) by tapping lightly with a plastic hammer. Be careful not to damage either mating surface or O-ring (717).

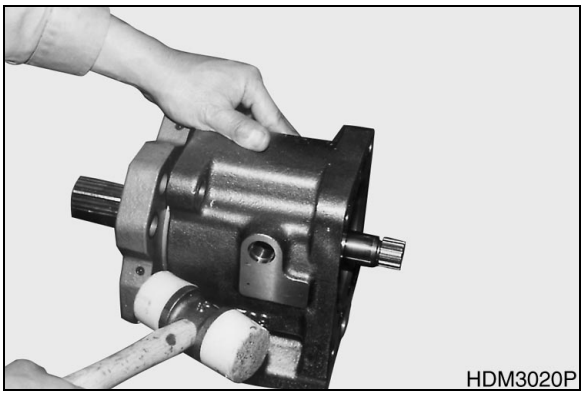



**Figure 21**

4. Withdraw drive shaft (111 and 113) on opposite sides of center valve block) from swashplate support and pull away valve plates (313 or 314).

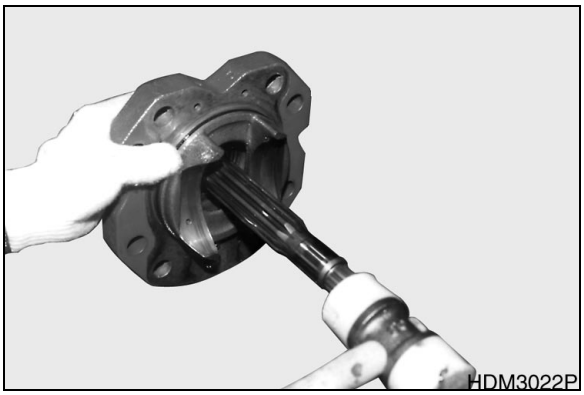



**Figure 22**