SAFETY

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

TRACK EXCAVATOR SAFETY

⚠ 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 170LC-V	1001 and Up
Solar 220LC-V	0001 and Up
Solar 220N-V	1001 and Up
Solar 250LC-V	1001 and Up
Solar 290LC-V	0001 and Up
Solar 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 330LC-V	1001 and Up
Solar 340LC-V	1001 and Up
Solar 400LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 450LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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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:

1. “General Safety Essentials” on page 5
2. “Location of Safety Labels” on page 5
3. “Summary of Safety Precautions for Lifting in Digging Mode” on page 6
4. “Work Site Precautions” on page 7
5. “Operation” on page 9
6. “Equipment” on page 14
7. “Maintenance” on page 18
8. “Shipping and Transportation” on page 21

SAFETY ALERT SYMBOL

Be Prepared - Get To Know All Operating and Safety Instructions.

This is the Safety Alert Symbol. Wherever it appears in this manual or on safety signs on the machine you should be alert to the potential for personal injury or accidents. Always observe safety precautions and follow recommended procedures.

LEARN THE SIGNAL WORDS USED WITH THE SAFETY ALERT SYMBOL

The words **"CAUTION," "WARNING"** and **"DANGER"** used throughout this manual and on decals on the machine indicate degree of risk of hazards or unsafe practices. All three degrees of risk indicate that safety is involved. Observe precautions indicated whenever you see the Safety Alert "Triangle," no matter which signal word appears next to the "Exclamation Point" symbol.

CAUTION!

Indicates potential of a hazardous situation that, if not avoided, could result in minor or moderate injury. It may also be used to alert against a generally unsafe practice.

WARNING!

Indicates potential of a hazardous situation that, if not avoided, could result in serious injury or death. It may also be used to alert against a highly unsafe practice.

DANGER!

Indicates imminent hazard of a situation that, if not avoided, is very likely to cause death or extremely serious injury. It may also be used to alert against equipment that may explode or detonate if handled or treated carelessly.

GENERAL SAFETY ESSENTIALS

ACCESSORY APPLICATIONS

The excavator has been primarily designed for moving earth with a bucket. For use as a grapple or for other object handling, contact Daewoo for proper installation and application. Lifting-work applications (unless restricted or prohibited by local regulations) are permitted in approved lift configuration, to rated capacity only, with no side-loading. DO NOT use the machine for activities for which it was not intended. DO NOT use the bucket for lifting work, unless lift slings are used in the approved configuration.

Use of an accessory hydraulic hammer (breaker), work in rough terrain, demolition applications or other hazardous operation may require installation of additional protective structures to safeguard the operator.

LIFTING CAPACITY RATING CONFIGURATION

Lifting capacity ratings that are printed at the end of this safety section are based on the machine being level, on a firm supporting surface, with hooks and slings attached in approved configuration. Loads must be balanced and supported evenly. Use taglines to keep the load steady if wind conditions and large surface area are a problem. Work crew hand signals, individual tasks and safe procedures should all be universally understood before the lift is made**.**

IMPORTANT

Before using the excavator to make lifts check municipal and regional regulations or statutes that could apply. Governing ordinances may require that all heavy lifting be done with single purpose equipment specifically designed for making lifts, or other local restrictions may apply. Making heavy lifts with a general purpose excavator that can be used for digging, loading, grading or other work may be expressly forbidden by a regional injunction or other legal prohibition. Always follow all of the other instructions, guidelines and restrictions for Safe Lifting in the Operation and Maintenance Manuals.

LOCATION OF SAFETY LABELS

Location of safety labels (decals) can vary from unit to unit. Refer to appropriate Operation and Maintenance Manual, and parts manual for your unit.

Always replace damaged or faded decals.

SUMMARY OF SAFETY PRECAUTIONS FOR LIFTING IN DIGGING MODE

DANGER!

Unsafe use of the excavator while making rated lifts could cause serious, potentially fatal injuries or extensive damage to the machine or nearby property. Do not let anyone operate the machine unless they've been properly trained and understand the information in the Operation and Maintenance Manual.

To lift safely while in Digging Mode, the following items must be evaluated by the operator and the work site crew.

- Condition of ground support.
- Excavator configuration and attachments.
- Weight, lifting height and lifting radius.
- Safe rigging of the load.
- Proper handling of the suspended load.

Taglines on opposite sides of the load can be very helpful in keeping a suspended load secure, if they are anchored safely to control points on the ground.

WARNING!

NEVER wrap a tagline around your hands or body.

NEVER rely on taglines or make rated lifts when wind gusts are more than 48.3 km/hr (30 mi/h). Be prepared for any type of wind gust when working with loads that have a large surface area.

Always engage the **"Digging Mode"** control on the Instrument Panel before using the excavator for lifting work.

WARNING!

If you need more information or have any questions or concerns about safe operating procedures or working the excavator correctly in a particular application or in the specific conditions of your individual operating environment, please consult your local Daewoo representative.

UNAUTHORIZED MODIFICATIONS

Any modification made without authorization or written approval from Daewoo can create a safety hazard, for which the machine owner must be held responsible.

For safety's sake, replace all OEM parts with the correct authorized or genuine Daewoo part. For example, not taking the time to replace fasteners, bolts or nuts with the correct replacement parts could lead to a condition in which the safety of critical assemblies is dangerously compromised.

WORK SITE PRECAUTIONS

ATTACHMENT PRECAUTIONS

Options kits are available through your dealer. Contact Daewoo for information on available one-way (single-acting) and two-way (double-acting) piping/valving/auxiliary control kits. Because Daewoo cannot anticipate, identify or test all of the attachments that owners may wish to install on their machines, please contact Daewoo for authorization and approval of attachments, and their compatibility with options kits.

AVOID HIGH-VOLTAGE CABLES

Serious injury or death can result from contact or proximity to high-voltage electric lines. The bucket does not have to make physical contact with power lines for current to be transmitted.

Use a spotter and hand signals to stay away from power lines not clearly visible to the operator.

VOLTAGE	MINIMUM SAFE DISTANCE
6.6 kV	3.0 m (9’ 10")
33.0 kV	4.0 m (13’ 1")
66.0 kV	5.0 m (16’ 5")
154.0 kV	8.0 m (26’ 3")
275.0 kV	10.0 m (32’ 10")

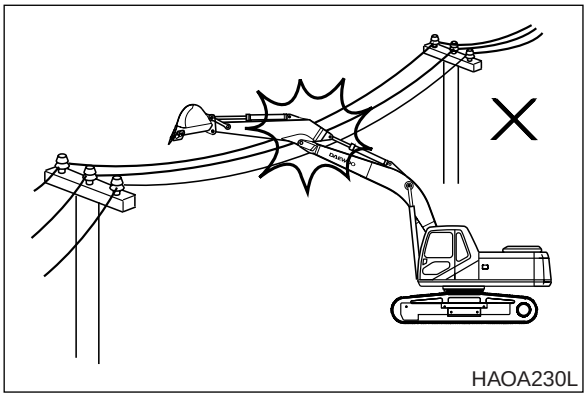


Figure 1

Use these minimum distances as a guideline only. Depending upon the voltage in the line and atmospheric conditions, strong current shocks can occur with the boom or bucket as far away as 4 - 6 m (13 - 20 ft) from the power line. Very high voltage and rainy weather could further decrease that safety margin.

NOTE: *Before starting any type of operation near power lines (either above ground or buried cable-type), you should always contact the power utility directly and work out a safety plan with them.*

BEFORE STARTING TO DIG, CONTACT AUTHORITIES

Below ground hazards also include natural gas lines, water mains, tunnels and buried foundations. Know what’s underneath the work site before starting to dig.

BE AWARE OF HEIGHT OBSTACLES

Any type of object in the vicinity of the boom could represent a potential hazard, or cause the operator to react suddenly and cause an accident. Use a spotter or signal person working near bridges, phone lines, work site scaffolds, or other obstructions.

USE CARE ON LOOSE SUPPORT

Working heavy loads over loose, soft ground or uneven, broken terrain can cause dangerous side load conditions and possible tipover and injury. Travel without a load or balanced load may also be hazardous.

If temperatures are changing, be cautious of dark and wet patches when working or traveling over frozen ground. Stay away from ditches, overhangs and all other weak support surfaces. Halt work and install support mats or blocking if work is required in an area of poor track support.

USE SOLID SUPPORT BLOCKING

Never rely on lift jacks or other inadequate supports when work is being done. Block tracks fore and aft to prevent any movement.

OVERHANGS ARE DANGEROUS

Digging the workface under an overhang - the work area beneath a cliff or under the edge of a ditch - is dangerous. Know the height and reach limits of the excavator and plan ahead while working. Avoid creating dangerous situations by moving around the work site while making excavations. Go onto another digging area before steep overhangs are formed. Working around deep pits or along high walls or trenching may require support blocks, especially after heavy rainfalls or during spring thaws. Park the excavator away from overhangs before work shut down.

SLOPING TERRAIN REQUIRES CAUTION

Dig evenly around the work site whenever possible, trying to gradually level any existing slope. If it's not possible to level the area or avoid working on a slope, reducing the size and cycling rate of the workload is recommended.

On sloping surfaces, use caution when positioning the excavator before starting a work cycle. Stay alert for instability situations to avoid getting into them. For example, you should always avoid working the bucket over downhill crawler tracks when parked perpendicular to the slope. Slow all downhill swing movements and avoid full extensions of the bucket in a downhill direction. Lifting the bucket too high, too close to the machine, while the excavator is turned uphill can also be hazardous.

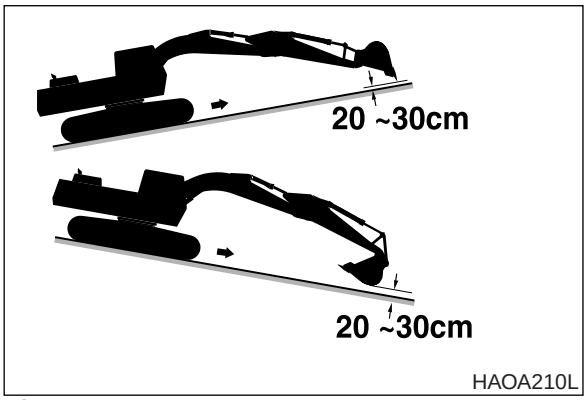


Figure 2

STAY ALERT FOR PEOPLE MOVING THROUGH THE WORK AREA

When loading a truck you should always know where the driver is.

Avoid loading over the cab of a truck even if the driver is in a safe spot. Someone else could have gone inside, for any number of reasons. Avoid working where unseen passersby might be.

Slow down the work cycle and use slower travel speeds in congested or populated areas. Use a commonly understood signal so that other members of the work crew can warn the operator to slow or halt work in an impending hazard situation.

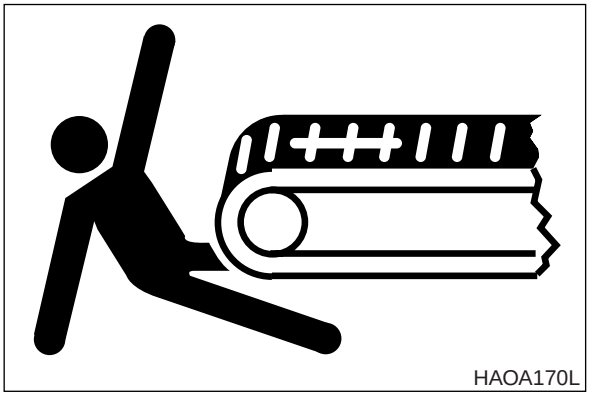


Figure 3

BE AWARE OF AND CONFORM TO LOCAL REGULATIONS

Minimum levels of insurance coverage, work permits or certification, physical barriers around the work site or restricted hours of operation may be mandated by governing authorities. There may also be guidelines, standards or restrictions on equipment that may be used to perform certain kinds of work. Check and follow all local requirements, which may also be related to below ground hazards and power lines.

OPERATION

OPERATE WHILE SEATED AT THE OPERATOR'S STATION ONLY

Never reach in through a window to work a control. Do not operate the excavator unless you're in the command position stay alert and focused on your work at all times but DO NOT twist out of the seat if job activity behind you (or to the side) requires your attention.

Use a spotter or signal person if you cannot see clearly and something is happening behind you.

Replace damaged safety labels and lost or damaged owner's manuals.

Do not let anyone operate the machine unless they've been fully and completely trained, in safety and in the operation of the machine.



Figure 4

BEFORE STARTING THE ENGINE

Do a "pre-start" safety check:

- Walk around your machine before getting in the operator's cab. Look for evidence of leaking fluid, loose fasteners, misaligned assemblies or any other indications of possible equipment hazard.
- All equipment covers and machinery safety guards must be in place, to protect against injury while the machine is being operated.
- Look around the work site area for potential hazards, or people or property that could be at risk while operation is in progress.
- NEVER start the engine if there is any indication that maintenance or service work is in progress, or if a warning tag is attached to controls in the cab.
- A machine that has not been used recently, or is being operated in extremely cold temperatures, could require a warm-up or maintenance service before start-up.
- Check gauges and monitor displays for normal operation before starting the engine. Listen for unusual noises and remain alert for other potentially hazardous conditions at the start of the work cycle.

NEVER USE ETHER STARTING AIDS

An electric-grid type manifold heater is used for cold starting. The glowing heater element can cause ether or other starting fluid to detonate, causing injury.

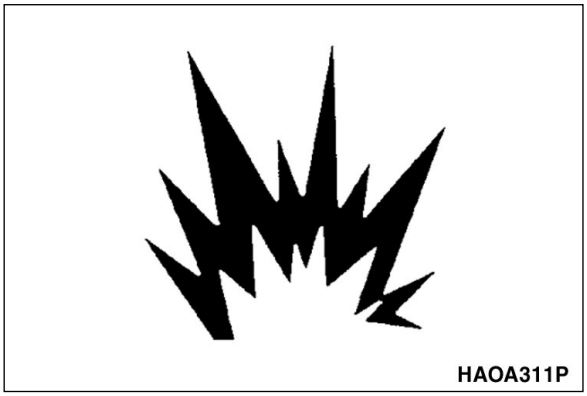


Figure 5

MOUNTING AND DISMOUNTING

NEVER get on or off a moving machine. Do not jump on/off. The entry/egress path should be clear of mud, oil and spills and mounting hardware must be kept tight and secure.

Always use handholds, steps or track shoes and maintain at least 3-point contact of hands and feet. Never use controls as handholds.

NEVER get up from the operator's seat or leave the operator's station and dismount the machine if the engine is running.



Figure 6

OBSERVE GENERAL SAFETY RULES

Only trained and authorized personnel, with a good knowledge and awareness of safe procedures, may be allowed to operate or perform maintenance or service on the excavator.

All personnel at the work site should be aware of assigned individual responsibilities and tasks. Communication and hand signals used should be understood by everyone.

Terrain and soil conditions at the work site, approaching traffic, weather-related hazards and any above or below ground obstacles or hazards should be observed and monitored by all work crew members.

ENGINE VENTILATION

Engine exhaust gases can cause fatal accidents, and unconsciousness, loss of alertness, judgement and motor control and serious injury.

Make sure of adequate ventilation before starting the engine in any enclosed area.

You should also be aware of open windows, doors or ductwork into which exhaust may be carried, or blown by the wind, exposing others to danger.

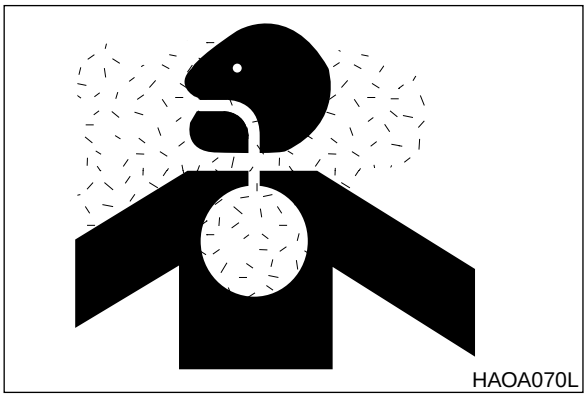


Figure 7

ASBESTOS DUST HAZARD PREVENTION

Asbestos dust can be HAZARDOUS to your health if it is inhaled.

If you handle materials containing asbestos fibers, follow these guidelines as given below:

- Never use compressed air for cleaning.
- Use water for cleaning to keep down the dust.
- Work on the machine or component with the wind at your back whenever possible.
- Use an approved respirator with proper filtration.

TAKE TIME TO PROVIDE GOOD VISIBILITY

Halt work if visibility is poor. Strong rains, snow, fog and extremely dusty conditions can all obscure visibility so badly that it is best to wait for weather to change or dust to settle before continuing operation.

Night work in areas of limited visibility should be halted if installation of extra work lights on the machine (or work area) is necessary.

Keep dirt and dust off of windows and off the lens surfaces of work lights. Stop working if lights, windows or mirrors need cleaning or adjustment.

FUEL, OIL AND HYDRAULIC FLUID FIRE HAZARDS



Figure 8

Add fuel, oil, antifreeze and hydraulic fluid to the machine only in a well-ventilated area. The machine must be parked with controls, lights and switches turned off. The engine must be off and any flames, glowing embers, auxiliary heating units or spark-causing equipment must be doused, turned off and/or kept well clear of the machine.

Static electricity can produce dangerous sparks at the fuel filling nozzle. In very cold, dry weather or other conditions that could produce static discharge, keep the tip of the fuel nozzle in constant contact with the neck of the fuel filling nozzle, to provide a ground.

Keep fuel and other fluid reservoir caps tight and do not start the engine until caps have been secured.

BOOST STARTING OR CHARGING ENGINE BATTERIES

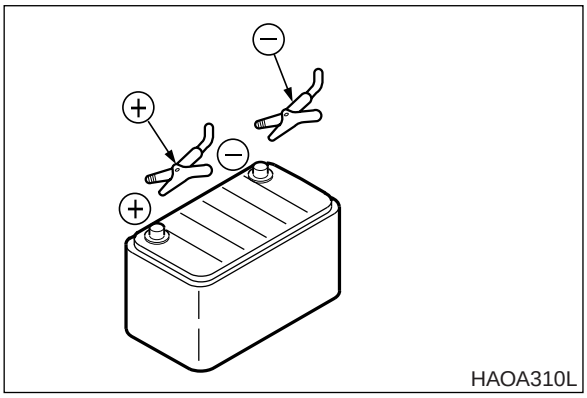


Figure 9

Turn off all electrical equipment before connecting leads to the battery. This includes electrical switches on the battery charger or boost starting equipment.

When boost-starting from another machine or vehicle do not allow the two machines to touch. Wear safety glasses or goggles while required parallel battery connections - positive to positive and negative to negative - are made.

24 volt battery units consisting of two series-connected twelve volt batteries have a cable connecting one positive terminal on one of the 12 volt batteries to a negative terminal on the other battery. Booster or charger cable connections must be made between the non-series-connected positive terminals and between the negative terminal of the booster battery and the metal frame of the machine being boosted or charged. Refer to the procedure and illustration in Operation and Maintenance Manual.

Connect positive cable first when installing cables and disconnect the negative cable first when removing them. The final cable connection, at the metal frame of the machine being charged or boost-started, should be as far away from the batteries as possible.

TRAVEL CONTROLS MAY PRODUCE REVERSED OPERATIONS

Before starting the machine you should always check to see which end of the track frame is under the operator's cab. In the normal travel configuration, track frame travel motors are at the rear of the machine, under the engine and counterweight. If the operator swings the cab 180˚, travel motors will be underneath the operator's cab, toward the front of the track frame and operating travel will be reversed.

When traveling the excavator always keep lights on; make sure that you are in compliance with all state and local regulations concerning warning flags and signs and keep the operator's cab positioned over the

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.

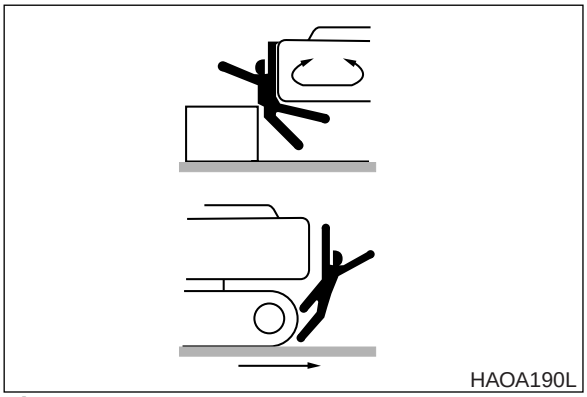


Figure 10

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.

SHUTDOWN CONTROL FUNCTIONS

After the machine has been lowered to the overnight storage position and all switches and operating controls are in the "OFF" position, the control stand lock lever must be engaged. Release the left console to disable all pilot circuit control functions.

Insert the swing lock pin and engage all brakes and lock-down security equipment that may have been installed on the machine.

IMPORTANT
When hydraulic system maintenance or service work must be performed, you should be aware that an accumulator in the system stores fluid under pressure after system lock down, even after the control stand is raised. Release this energy by working controls with the engine off, until pressure in the pilot circuit has been completely bled away.

EQUIPMENT

ROUGH OPERATION MAY REQUIRE USE OF CERTIFIED SAFETY EQUIPMENT

Working in mines, tunnels, deep pits or on loose or wet surfaces could produce danger of falling rock or hazardous flying objects. Additional protection for the operator's cab could be required in the form of a FOG / Falling Object Guard or windows guards.

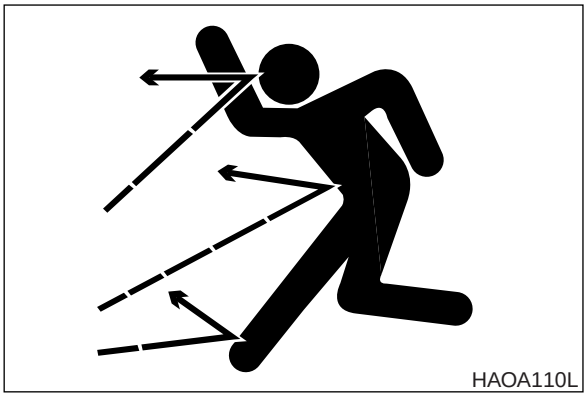


Figure 11

Any reinforcement system that is installed on the machine must pass safety and certification standards and carry appropriate labeling and rating information. For example, the most often added type of reinforcement system, FOG, must meet or exceed International Standard ISO10262, Laboratory Tests and Performance Requirements Earth-Moving Machinery.

Never attempt to alter or modify any type of protective structure reinforcement system, by drilling holes, welding, remounting or relocating fasteners. Any serious impact or damage to the system requires a complete integrity reevaluation. Reinstallation, recertification and/ or replacement of the system may be necessary.



Figure 12

INSTALL ADDITIONAL SAFETY EQUIPMENT IF CONDITIONS REQUIRE

When working with a breaker or in some shear work applications, a front guard over the windshield may be required. The windshield guard may or may not be OPS/certified, depending upon the specific application and working situation.

Laminate glass protection for the front, side or rear windows may also be recommended depending upon particular site conditions.

Contact your Daewoo distributor for available safety guards and/or recommendations if there is any danger of getting hit by objects that could strike the operator's cab. Make sure that all other work site crew members are kept well away from the excavator and safe from potential hazards.

MOVEMENT ALARMS

If the excavator is equipped with an audible travel movement alarm or visible swing movement alarm (strobe light), test the alarm on a daily basis. The audible alarm should sound as soon as the travel system is engaged. The strobe light should begin to flash as soon as the swing system is engaged.

SEAT BELTS SHOULD BE USED AT ALL TIMES

Whenever the engine is running, the operator should be seated at the control station with the seat belt properly engaged.



Figure 13

WINDOW GLASS BREAKING TOOL

This excavator is equipped with a glass breaking tool. It is behind the operator seat in the upper right corner of the cab. This tool can be used in case of an emergency situation which requires the breaking of glass to exit from the operator's cabin. Grip the handle firmly and use the sharp point to break the glass.



Figure 14

WARNING!

Protect your eyes when breaking the glass.

KEEP A FIRE EXTINGUISHER AT HAND

It is recommended that an appropriately sized (2.27 kg [5 lb] or larger) multipurpose "A/B/C" fire extinguisher be mounted in the cab. Check and service the fire extinguisher at regular intervals and make sure that all work site crew members are adequately trained in its use.

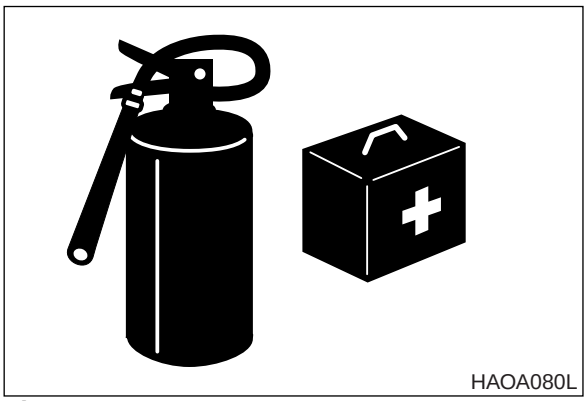


Figure 15

MAINTAIN STANDARD SAFETY EQUIPMENT IN GOOD CONDITION

Machinery guards and body panel covers must be in place at all times. Keep well clear of rotating parts. Pinch point hazards such as cooling fan and alternator drive belts could catch hair, jewelry or oversize or very loose clothing.

Safety labels must be replaced if they are damaged or become unreadable. The information on labels gives work crew members an important safety reminder exactly where it will do the most good. Part numbers for each label and required mounting locations are shown in Operation and Maintenance Manual.

SAFETY-CRITICAL PARTS MUST BE REPLACED PERIODICALLY

Replace the following fire-related components as soon as they begin to show any sign of wear, or at regular periodic intervals, whether or not deterioration is visible:

- Fuel system flexible hoses, the tank overflow drain hose and the fuel fill cap.
- Hydraulic system hoses, especially the pump outlet lines and front and rear pump branch hoses.
- Keep mounting brackets and hose and cable routing straps tight. Hose routing should have gradual bends.

HYDRAULIC CYLINDER SEALS REQUIRE PERIODIC REPLACEMENT

Check cylinder drift rate at regular intervals. Maximum allowable rates are included in the in this manual. Overhaul seal kits are available through Daewoo.

HIGH PRESSURE HYDRAULIC LINES CAN STORE A GREAT DEAL OF ENERGY

Exposed hydraulic hoses on the arm or boom could react with explosive force if struck by a falling rock, overhead obstacle or other work site hazard. *Extra safety guards may be required.* NEVER allow hoses to be hit, bent or interfered with during operation.

THE OPERATOR'S CAB AND TURNTABLE DECK SHOULD BE KEPT CLEAN

Cleaning off accumulations of grease and dirt helps extend equipment service life. Cleaning also provides an opportunity to inspect equipment. Minor damage can be repaired or corrected before major problems result.

Keep the cab floor and consoles free of tools and personal items.

WEAR EYE PROTECTION AND SAFETY CLOTHING

Full eye protection, a hard hat, safety shoes and gloves may be required at the work site.

While working on the machine, never use inadequate tools. They could break or slip, causing injury, or they may not adequately perform intended functions.



Figure 16

BREATHING MASKS, EAR PROTECTION MAY BE REQUIRED

Don't forget that some risks to your health may not be immediately apparent. Exhaust gases and noise pollution may not be visible, but these hazards can cause disabling or permanent injuries.

BATTERY ELECTROLYTE AND EXPLOSIVE GASES CAN BE LETHAL

Flush eyes with water for 10-15 minutes if acid is splashed in the face. Anyone who swallows acid must have **immediate** medical aid. *Call the Poison Control listing in the front cover of the telephone directory.* Water, a popsicle or ice cream are likely better than old remedies that try to induce vomiting (which would expose tissue to damage twice).

Explosive battery gas can be set off by sparks from incidental contact or static discharge. Turn off all switches and the engine when working on batteries. Keep battery terminals tight. Contact between a loose terminal and post can create an explosive spark.



Figure 17

DISCONNECT BATTERIES FOR ELECTRICAL SERVICE BEFORE ELECTRICAL WELDING

Remove cable to negative terminal first, when disconnecting cable. **Connect positive terminal cables first when installing a battery.**

USE LOW HEAT PORTABLE LIGHTING

Hot surfaces on trouble lights or portable work lights can set off fuel or battery explosive gases.

MAINTENANCE

USE WARNING TAG CONTROL LOCKOUT PROCEDURES DURING SERVICE

Alert others that service or maintenance is being performed and tag operator's cab controls - and other machine areas if required - with a warning notice. OSHA-mandated control lever lockout can be made with any OSHA certified lockout device and a length of chain or cable to keep the left-hand control console in the fully raised, non-active position.

Warning tags for controls are available from Daewoo distributors.



Figure 18

DO NOT RUN THE ENGINE IF REPAIRS OR WORK IS BEING PERFORMED ALONE

You should always have at least two people working together if the engine must be run during service. One person needs to remain in the operator's seat, ready to work the controls or stop the machine and shut off the engine.

ALWAYS USE ADEQUATE EQUIPMENT SUPPORTS AND BLOCKING

Do not allow weight or equipment loads to remain suspended. Lower everything to the ground before leaving the operator's seat. Do not use hollow, cracked or unsteady, wobbling weight supports. Do not work under any equipment supported solely by a lift jack.

DO NOT WORK ON HOT ENGINES OR HOT COOLING OR HYDRAULIC SYSTEMS

Wait for the engine to cool off after normal operation. Park the excavator on a firm, level surface and lower all equipment before shutting down and switching off controls. When engine lube oil, gearbox lubricant or other fluids require change, wait for fluid temperatures to decrease to a moderate level before removing drain plugs.

NOTE: *Oil will drain more quickly and completely if it is warm. Do not drain fluids at 95°C (203°F) temperatures but don't allow full cool-down.*

COOL-DOWN IS REQUIRED PRIOR TO RADIATOR OR RESERVOIR CHECKS

Stop the engine and allow heat to dissipate before performing service on the engine radiator or hydraulic fluid reservoir. Both assemblies have air vent levers at or near the fill cap for venting built-up air pressure. Release the levers before trying to take off fill caps and LOOSEN CAPS SLOWLY, before removal.

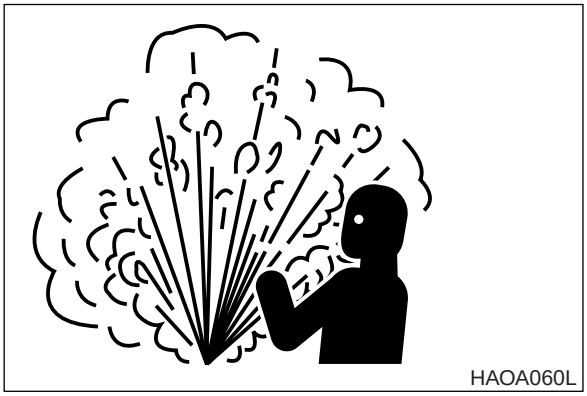


Figure 19

PRESSURIZED HYDRAULIC OIL FLUID LEAKS CAN BE DANGEROUS

Fluid leaks from hydraulic hoses or pressurized components can be difficult to see but pressurized oil has enough force to pierce the skin and cause serious injury.

Always use a piece of wood or cardboard to check for suspected hydraulic leaks. Never use your hands or expose your fingers.

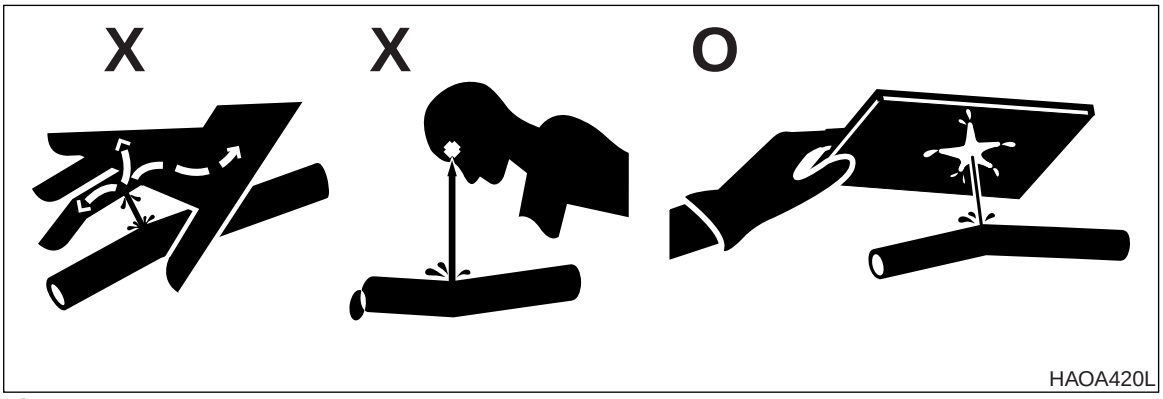


Figure 20

OBTAIN IMMEDIATE MEDICAL ATTENTION IF PRESSURIZED OIL PIERCES THE SKIN

WARNING!

Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.

USE CORRECT REPLACEMENT FASTENERS TIGHTENED TO PROPER TORQUE

Refer to the "General Maintenance" section of this manual for information on tightening torques and recommended assembly compounds and always use the correct part.

Poor or incorrect fastener connections can dangerously weaken assemblies.

DISPOSE OF ALL PETROLEUM-BASED OILS AND FLUIDS PROPERLY

Physical contact with used motor oil may pose a health risk. Wipe oil from your hands promptly and wash off any remaining residue.

Used motor oil is an environmental contaminant and may only be disposed of at approved collection facilities. Never drain any petroleum-based product on the ground or dispose of old oil in municipal waste collection containers, or in metropolitan sewer systems or rural landfills.

Check state and local regulations for other requirements.

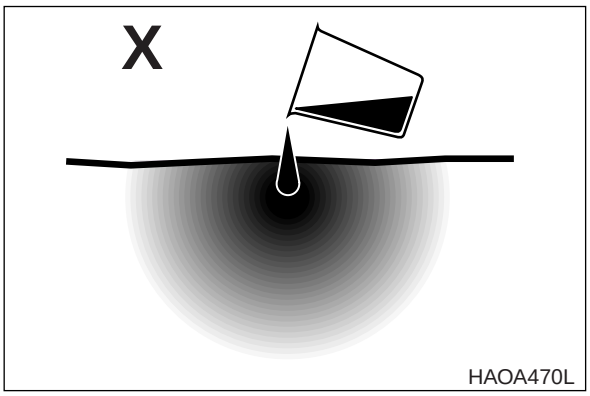


Figure 21

TRACK TENSION ADJUSTMENTS REQUIRE CAUTION

NEVER turn out the track tension grease fitting nut. To release pressure from the crawler frame track tension assembly, you should NEVER attempt to disassemble the track adjuster or attempt to remove the grease fitting or valve assembly.

Keep your face and body away from the valve. Refer to the track adjustment procedure in the Operation and Maintenance Manual or this manual.

SHIPPING AND TRANSPORTATION

OBEY STATE AND LOCAL OVER-THE-ROAD REGULATIONS

Check state and local restrictions regarding weight, width and length of a load before making any other preparation for transport.

The hauling vehicle, trailer and load must all be in compliance with local regulations governing the intended shipping route.

Partial disassembly or tear-down of the excavator may be necessary to meet travel restrictions or particular conditions at the work site. See this manual for information on partial disassembly.

Refer to the Transportation and Shipping section of the Operation and Maintenance Manual for information on loading, unloading and towing.

LIFTING WITH SLING

WARNING!

Improper lifting can allow load to shift and cause injury or damage.

1. Refer to Specification section of Operation and Maintenance Manual for information on weight and dimensions.
2. Use properly rated cables and slings for lifting.
3. Position machine for a level lift.
4. Lifting cables should have a long enough length to prevent contact with the machine. Spreader bars may be required.

   NOTE: *If spreader bars are used, be sure that cables are properly secured to them and that the angle of the cables is factored into the lift strength.*

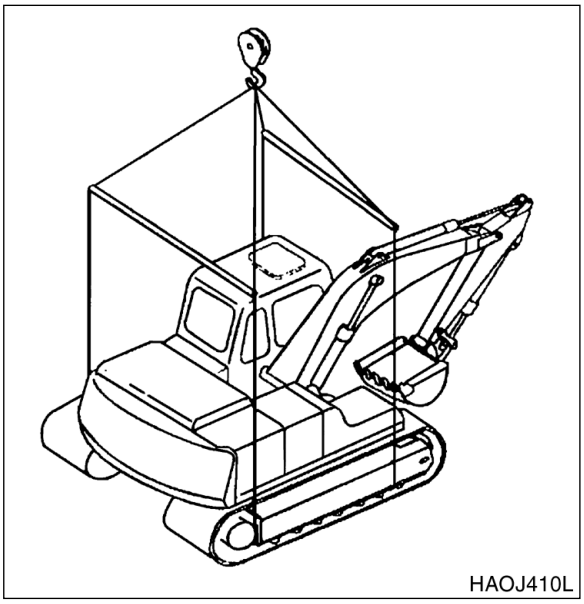


Figure 22

SPECIFICATIONS

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

SPECIFICATIONS FOR SOLAR 300LC-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 300LC-V	1001 and Up

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November 2001

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GENERAL DESCRIPTION

The excavator has three main component sections:

- The Upper Turntable
- The Lower Undercarriage and Track Frames
- The Excavator Front-end Attachment

The following illustration identifies main components and their locations. (See Figure 1 on page -4.)

COMPONENT LOCATIONS

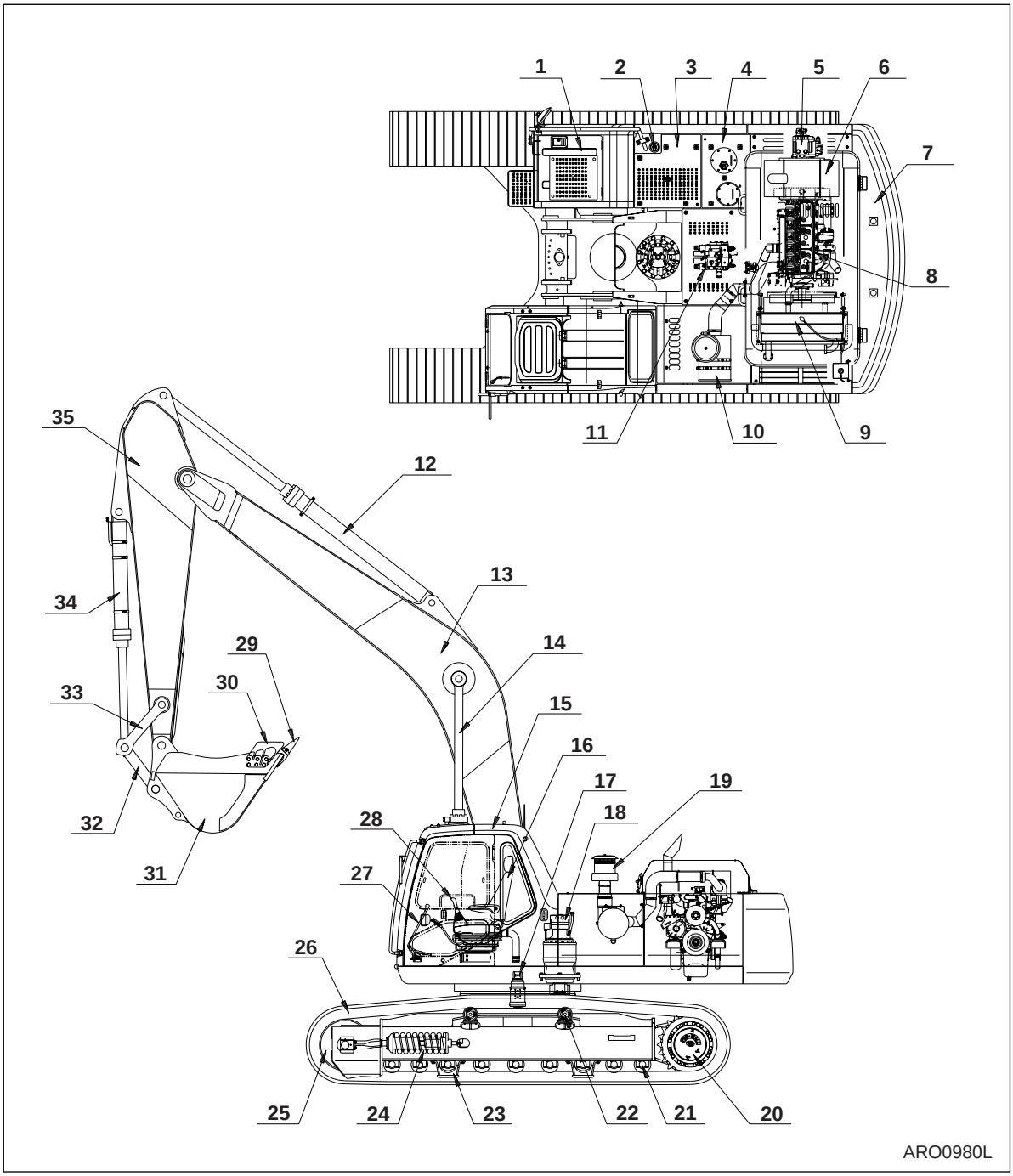


Figure 1

1. BATTERY
2. FUEL TANK FILL CAP
3. FUEL TANK
4. HYDRAULIC OIL TANK
5. PUMPS
6. MUFFLER
7. COUNTERWEIGHT
8. ENGINE
9. RADIATOR AND OIL COOLER
10. AIR CLEANER
11. CONTROL VALVES
12. ARM CYLINDER
13. BOOM
14. BOOM CYLINDER
15. CAB
16. SEAT
17. CENTER JOINT
18. SWING MOTOR
19. PRECLEANER
20. TRAVEL MOTOR
21. LOWER ROLLER
22. UPPER ROLLER
23. TRACK GUIDE
24. TRACK ADJUSTER
25. IDLER
26. TRACK LINK AND SHOE
27. TRAVEL LEVER
28. WORK LEVER (JOYSTICK) CONTROLS
29. TOOTH POINT
30. SIDE CUTTER
31. BUCKET
32. PUSH LINK
33. GUIDE LINK
34. BUCKET CYLINDER
35. ARM

GENERAL DIMENSIONS

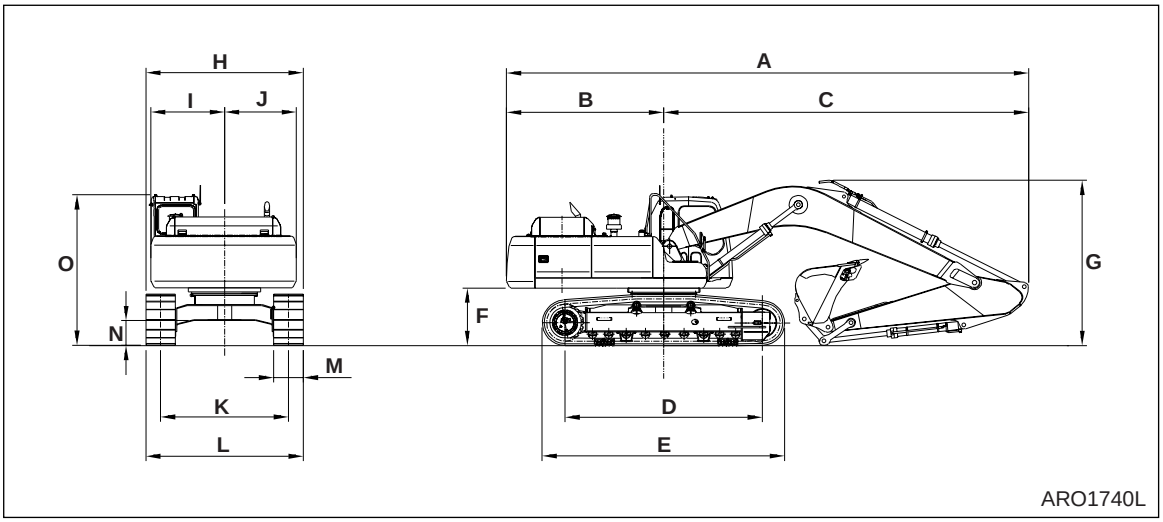


Figure 2

DIMENSION	6.245 M (20.5 FT) BOOM		
	3.1 M (10.17 FT) ARM	**2.5 M (8.2 FT) ARM**	**3.75 M (12.3 FT) ARM**
A	10,620 mm (34’ 10")	10,705 mm (35’ 1")	10,700 mm (35’ 1")
B	3,200 mm (10’ 6")		
C	7,420 mm (24’ 4")	7,505 mm (24’ 7")	7,500 mm (24’ 7")
D	4,010 mm (13’ 2")		
E	4,930 mm (16’ 2")		
F	1,175 mm (3’ 10")		
G	3,365 mm (11’ 0")	3,515 mm (11’ 6")	3,930 mm (12’ 11")
H	2,960 mm (9’ 9")		
I	1,500 mm (4’ 11")		
J	1,460 mm (4’ 9")		
K	2,600 mm (8’ 6")		
L	3,200 mm (10’ 6")		
M	600 mm (23.62 in)		
N	500 mm (19.69 in)		
O	3,065 mm (10’ 1")		

WORKING RANGE

⚠ WARNING!

The actual value for dimension "L" Digging Reach, depends on the stability and support provided by ground conditions. Digging too far underneath the excavator if soil conditions are wet, loose or unstable can collapse ground support, which could cause injury and/or equipment damage.

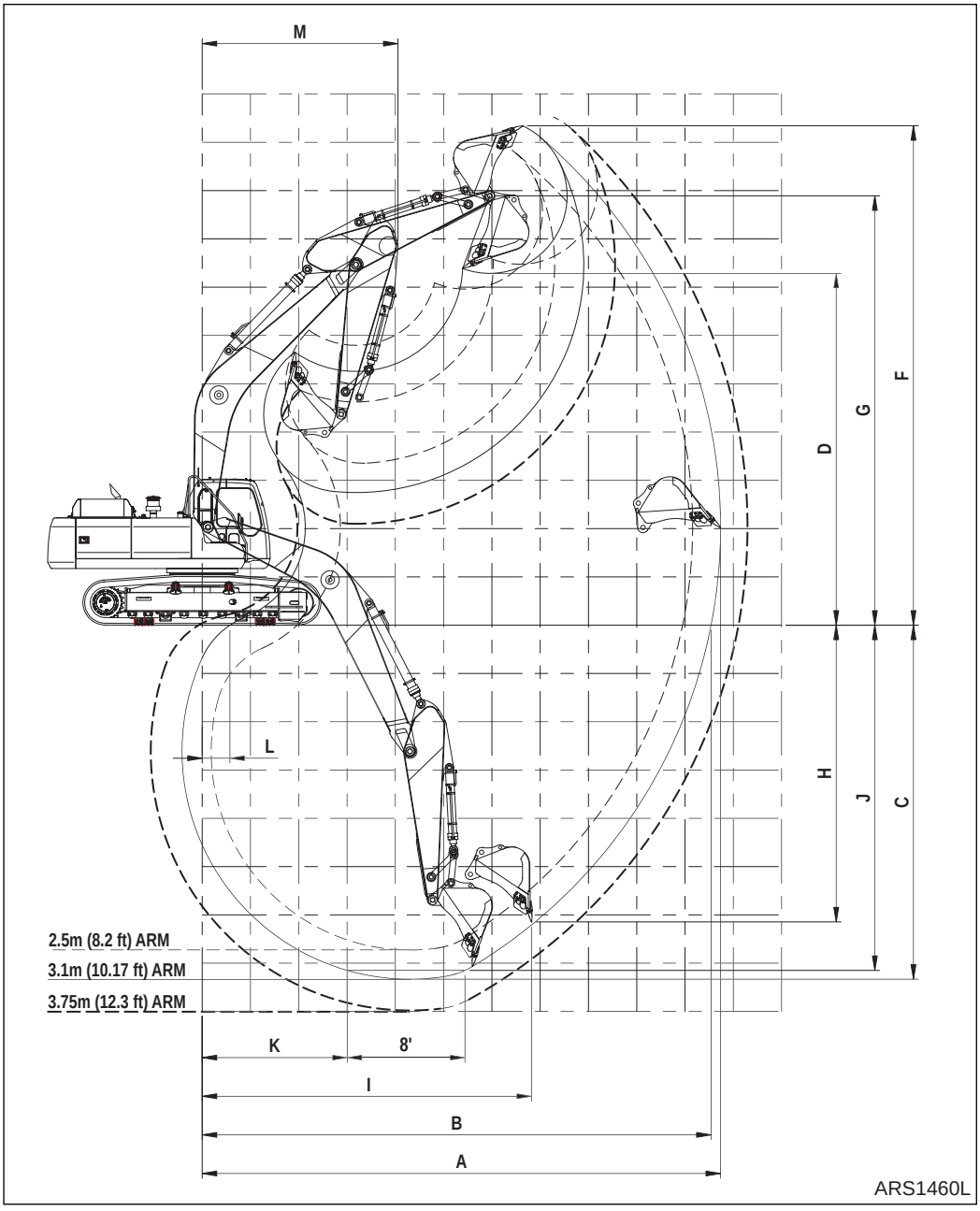


Figure 3

Dim.	Boom Type	One Piece 6.245 m (20.5 ft)		
	Arm Type	**3.1 m (10.17 ft)**	**2.5 m (8.2 ft)**	**3.75 m (12.3 ft)**
	Bucket Type (PCSA)	**1.27 m^3 (1.66 yd^3)**	**1.50 m^3 (1.96 yd^3)**	**1.75 m^3 (2.29 yd^3)**
A	Max. Digging Reach	10,735 mm (35' 3")	10,155 mm (33' 4")	11,290 mm (37' 0")
B	Max. Digging Reach (Ground)	10,540 mm (37' 7")	9,950 mm (32' 8")	11,105 mm (36' 5")
C	Max. Digging Depth	7,330 mm (24' 1")	6,725 mm (22' 1")	7,980 mm (26' 2")
D	Max. Loading Height	7,286 mm (23' 11")	6,960 mm (22' 10")	7,475 mm (24' 6")
F	Max. Digging Height	10,345 mm (33' 11")	9,985 mm (32' 9")	10,520 mm (34' 6")
G	Max. Bucket Pin Height	8,890 mm (29' 2")	8,565 mm (28' 1")	9,080 mm (29' 9")
H	Max. Vertical Wall	6,145 mm (20' 2")	5,370 mm (17' 7")	6,745 mm (22' 2")
I	Max. Radius Vertical	6,820 mm (22' 5")	6,865 mm (22' 6")	6,950 mm (22' 10")
J	Max. Depth to 8 ft Line	7,150 mm (23' 5")	6,505 mm (21' 4")	7,810 mm (25' 7")
K	Min. Radius 8 ft Line	3,005 mm (9' 10")	2,965 mm (9' 9")	2,970 mm (9' 9")
L	Min. Digging Reach	575 mm (1' 11")	1,970 mm (6' 6")	- 80 mm (- 0' 9")
M	Min. Swing Radius	4,055 mm (13' 4")	4,107 mm (13' 6")	4,010 mm (13' 2")

GENERAL SPECIFICATIONS

Shipping Weight	29.3 metric tons (64,600 lb), includes 10% fuel, boom, 3,100 mm (10’ 2") arm, 1,334 mm (4’ 5") backhoe bucket and standard shoes
Operating Weight	Add weight of full fuel tank and operator.
Shipping Weights With Optional Track Shoes	Add 600 kg (1,320 lb) for 700 mm (28") shoes
	Add 1,000 kg (2,204 lb) for 800 mm (32") shoes
	Add 1,200 kg (4,408 lb) for 850 mm (34") shoes
Major Component Weights	Standard Boom 2,330 kg (5,137 lb)
	2,500 mm (8’ 2") Arm 900 kg (1,984 lb)
	3,100 mm (10’ 2") Arm 1,050 kg (2,315 lb)
	3,750 mm (12’ 4") Arm 1,060 kg (2,337 lb)
	Boom Cylinders 260 kg (573 lb) each
	Arm Cylinder 340 kg (750 lb)
	Bucket Cylinder 220 kg (485 lb)
	Counterweight 4,900 kg (10,800 lb)
	Upper Turntable 7,700 kg (16,975 lb)
	Lower - below Swing Bearing 11,050 kg (24,360 lb)
Digging Forces:	
Bucket Cylinder	177 KN or 18,100 kg (39,900 lb) - (with either 3,100 mm [10’ 2"] or 2,500 mm [8’ 2"] arm)
Arm Cylinder	131 KN or 13,400 kg (29,500 lb) with 3,100 mm (10’ 2") standard arm
Fuel Tank Capacity	450 liters (119 U.S. gal)
Hydraulic System Capacity	290 liters (77 U.S. gal)
Hydraulic Reservoir Capacity	160 liters (42 U.S. gal)
Bucket Heaped Capacity Range	PCSA 0.90 - 1.5 m^3 (1.18 - 1.96 yd^3)
	IMPORTANT: Refer to the Load Weight, Bucket and Arm Length Compatibility Table for information on which bucket sizes may be used safely with which arm length, for load material weights.
Shoe Type	Triple Grouser
Shoe Width and Optional Sizes	600 mm (23.5") - standard
	700 mm (28") - optional
	800 mm (32") - optional
	850 mm (34") - optional
	910 mm (36") - special option (triangular)
Ground Pressure Ratings:	
Standard 600 mm (23.6") shoe -	0.57 kg/cm^2 (8.1 psi)
Optional 700 mm (28.0") shoe -	0.50 kg/cm^2 (7.1 psi)
Optional 800 mm (32.0") shoe -	0.44 kg/cm^2 (6.2 psi)

Optional 850 mm (34.0") shoe -	0.42 kg/cm^2 (6.0 psi)
Optional 910 mm (36.0") shoe -	0.39 kg/cm^2 (5.5 psi)
Transport Dimensions	
Overall Shipping Length (standard boom and arm)	10,620 mm (34’ 10")
Overall Shipping Width (standard shoes)	3,200 mm (10’ 6")
Overall Shipping Height (to top of cylinder hose)	3,365 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.

ENGINE PERFORMANCE CURVES (PER KS-R1004 STANDARD)

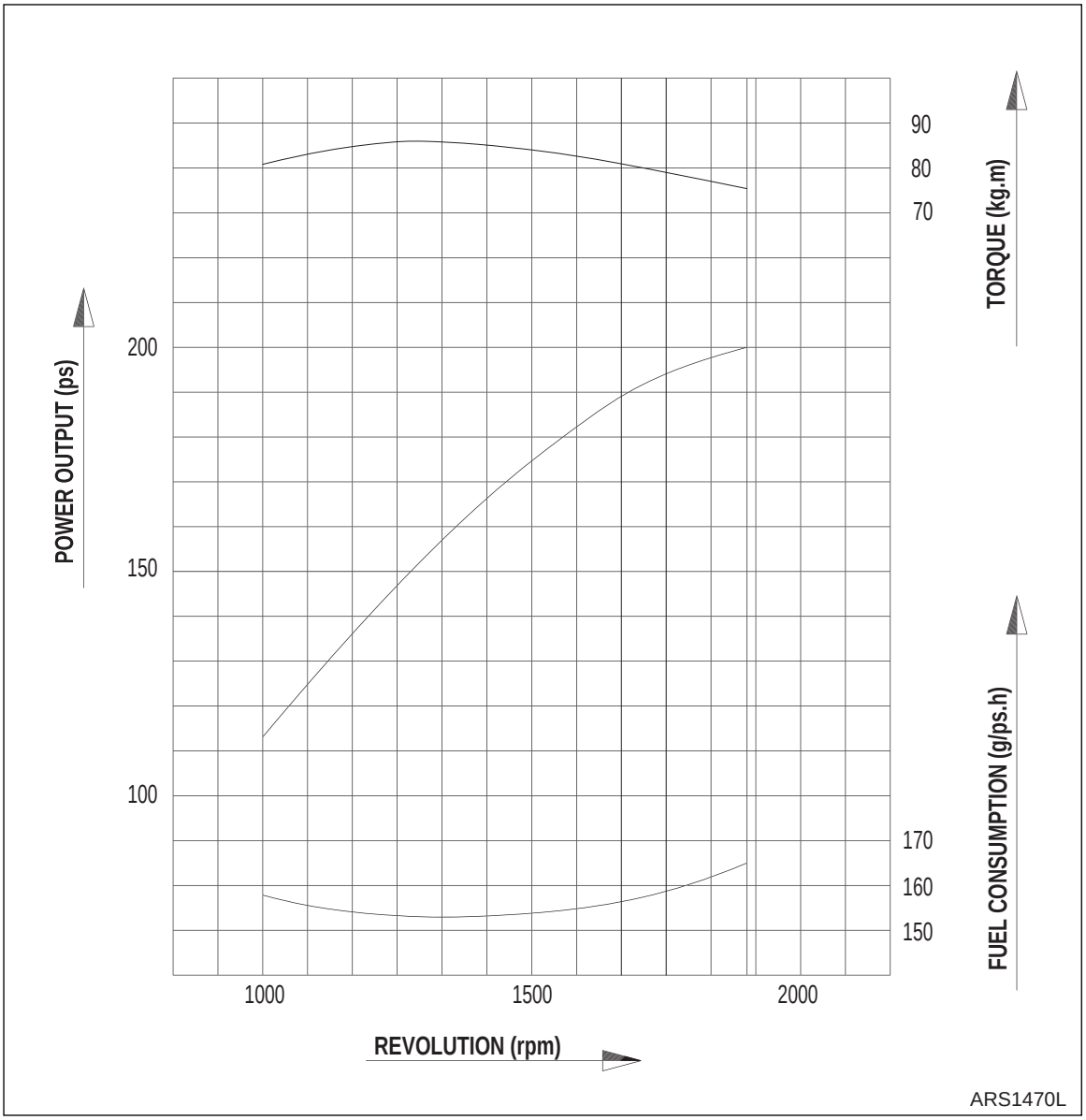


Figure 4

Condition	Specification
Engine Model	DE08TIS
Barometic Pressure	760 mmHg (20°C)
Cooling Fan	711 mm, SUCKER
Alternator	24V x 50A
Air Cleaner	Installed
Muffler	Installed

Performance Standard	KS-R1004
Power	200 ps @ 1,900 rpm
Max. Torque	86 kg•m @ 1,300 rpm (620 ft lb @ 1,300 rpm)
Fuel Consumption (Min. Rated)	165.0 g/ps•h (5.82 oz/hp•h)

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)	----------

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
Earth, DRY, packed	----------	1,522 kg/m^3 (2,565 lb/yd^3)	----------
Earth, WET, muddy	----------	----------	1,762 kg/m^3 (2,970 lb/yd^3)
Gypsum, calcined, (heated, powder)	961 kg/m^3 (1,620 lb/yd^3)	----------	----------
Gypsum, crushed to 3 inch size	----------	1,522 kg/m^3 (2,565 lb/yd^3)	----------
Gravel, DRY, packed fragments	----------	----------	1,810 kg/m^3 (3,051 lb/yd^3)
Gravel, WET, packed fragments	----------	----------	1,922 kg/m^3 (3,240 lb/yd^3)
Limestone, graded above 2	----------	1,282 kg/m^3 (2,160 lb/yd^3)	----------
Limestone, graded 1-1/2 or 2	----------	1,362 kg/m^3 (2,295 lb/yd^3)	----------
Limestone, crushed	----------	1,522 kg/m^3 (2,565 lb/yd^3)	----------
Limestone, fine	----------	----------	1,602 kg/m^3 (2,705 lb/yd^3)
Phosphate, rock	----------	1,282 kg/m^3 (2,160 lb/yd^3)	----------
Salt	929 kg/m^3 (1,566 lb/yd^3)	----------	----------
Snow, light density	529 kg/m^3 (891 lb/yd^3)	----------	----------
Sand, DRY, loose	----------	1,522 kg/m^3 (2,565 lb/yd^3)	----------
Sand, WET, packed	----------	----------	1,922 kg/m^3 (3,240 lb/yd^3)

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
Shale, broken	----------	1,362 kg/m^3 (2,295 lb/yd^3)	----------
Sulphur, broken	529 kg/m^3 (1,620 lb/yd^3)	----------	----------

PERFORMANCE TESTS

1. Main Relief Pressure

   normal operation: 330 kg/cm^3 (4,689 psi)

   with "Pressure Up": 350 kg/cm^3 (4,970 psi)

2. Actuator Speeds

Operation		Unit	Power Mode II	Power Mode III
Boom	Up	sec.	3.8 ±0.4	3.5 ±0.4
	Down	sec.	2.8 ±0.4	2.7 ±0.4
Arm	Dump	sec.	2.9 ±0.4	2.8 ±0.4
	Crowd	sec.	4.1 ±0.4	3.8 ±0.4
Bucket	Dump	sec.	2.7 ±0.4	2.6 ±0.4
	Crowd	sec.	3.6 ±0.4	3.5 ±0.4
Swing (3 Revolutions)		sec.	16.5 ±1.0	16.5 ±1.0
Jack-Up Speed (3 Turns)	High	sec.	22.0 ±1.2	22.0 ±1.2
	Low	sec.	35.0 ±1.9	35.0 ±1.9
Travel Speed 20 m (65.62 ft)	High	sec.	14.4 ±0.9	14.4 ±0.9
	Low	sec.	23.5 ±1.3	22.5 ±1.3
Travel Deviation 20 m (65.62 ft)	High	mm (in)	150 (5.91)	150 (5.91)
	Low	mm (in)	150 (5.91)	150 (5.91)

EXCAVATOR PERFORMANCE STANDARDS

Evaluation of equipment performance and operating condition can be made by running the excavator through a series of different tests, and recording results with a stop watch and tape measure.

Compare results of performance tests against the specifications and standards that follow, which are for equipment in new or renewed condition.

TEST CONDITIONS

1. All tests should be performed on a flat, level, firmly supporting ground surface.
2. All recommended, applicable maintenance and adjustment service should be completed prior to testing.
3. Hydraulic fluid and engine oil should be of appropriate viscosity for ambient weather conditions. Warm up hydraulic oil to standard operating temperature, between 45° - 55°C (112° - 135°F).
4. Run all tests with the engine speed control set to maximum RPM.
5. Repeat tests with Power Mode engine control settings at both Power Mode II (standard work mode) and Power Mode III (high speed mode). Travel speed tests should also be repeated at both high and low speed.

TRAVEL SPEED AND TRAVEL MOTOR BALANCE (STEERING DEVIATION) TESTS

Speed Test

Prepare the excavator for travel speed tests by extending all hydraulic cylinders - boom, arm and bucket - to the fully extended position, shown in Figure 5.

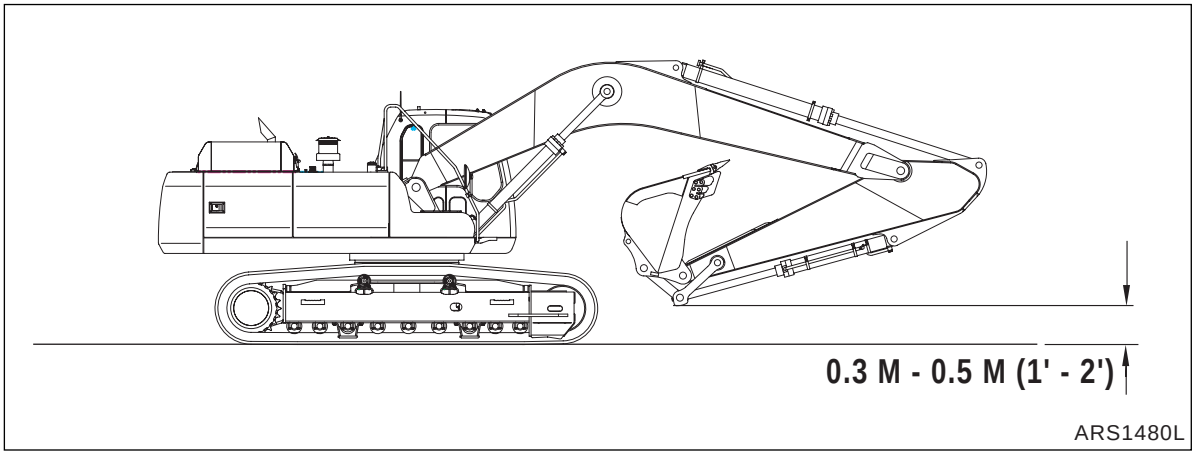


Figure 5

The lowest part of the bucket linkage should be 0.3 - 0.5 m (1' - 2') off the ground.

Mark off a 20 m (65' 7-1/2") test distance, with a 3 - 5 m (10' - 15') run-up area, and a 3 - 5 m (10' - 15', or longer) speed run-off distance.

Travel the excavator back and forth to be sure steering is centered and side frames are perfectly parallel with the test course.

Operate both travel levers at the fully engaged position and measure the time it takes to cross 20 m (65' 7-1/2"). Compare measured results against the standard for new machines:

RATE OF TRAVEL	TIME	
	MODE II	MODE III
High Speed	14.4 ±0.9 seconds	14.4 ±0.9 seconds
Low Speed	23.5 ±1.3 seconds	22.5 ±1.3 seconds

Rotate the turntable 180°. Both tests should be repeated three times. Average all results to obtain a final value.

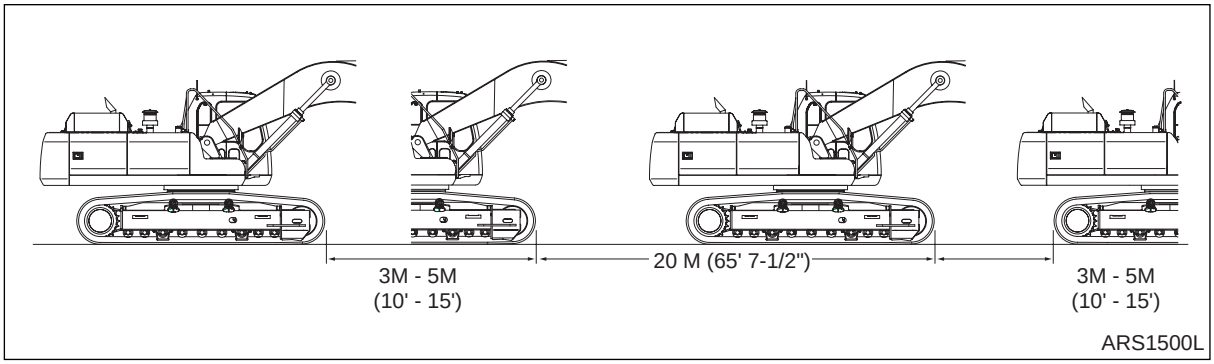


Figure 6

Travel Deviation

To check steering deviation (travel motor balance), use a long tape or rope, or the edge of an undeviating straight road curb or other marker to verify side-to-side travel motor uniformity.

Deviation distance should always be measured at the 20 m (65' 7-1/2") "finish line." Repeat the test in reverse to measure in both directions, with starting point becoming the finish line, and vice versa. (Figure 6)

A greater amount of deviation is allowed with the travel control set for high speed.

RATE OF TRAVEL	MAX. DISTANCE
High Speed	150 mm (6 in)
Low Speed	150 mm (6 in)

Swing Speed Test

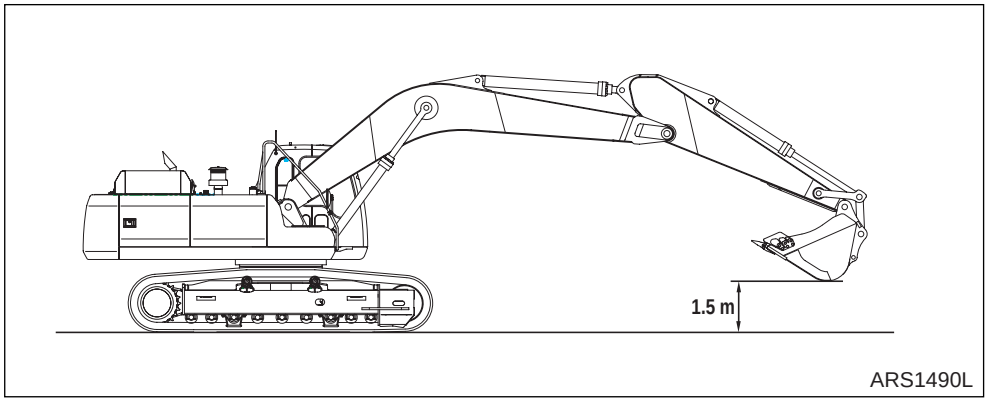


Figure 7

Extend the bucket cylinder completely and retract the arm cylinder, as shown in Figure 7, to test swing speed. The lowest point of the bucket will be approximately 1.5 m (3') off the ground.

Use paint marks at the same point on the turntable and undercarriage, or select alternate measuring locations and use a stopwatch to time 3 full 360° rotations. The time required for 3 revolutions should be between 15.5 and 17.5 seconds in Power Mode II, 15.5 and 17.5 seconds in Power Mode III.

Swing Force Test

With the boom, arm and bucket in the same position as for the swing speed test, rotate the turntable so that the boom is evenly centered between the side frames, pointing straight ahead. Locate the 90° reference point, perpendicular to the boom. Mark the turntable and undercarriage with paint at the 90° point.

Make several attempts to rotate the turntable exactly 90°, starting from the boom straight ahead position. Engage the swing lever and brake at the 90° point, shown as "swing stop" in Figure 8.

Record how far the turntable drifts past the stop point, measuring the distance between paint marks. Maximum distance should be less than 1200 mm (47-1/4"), in both Power Mode III and Power Mode II.

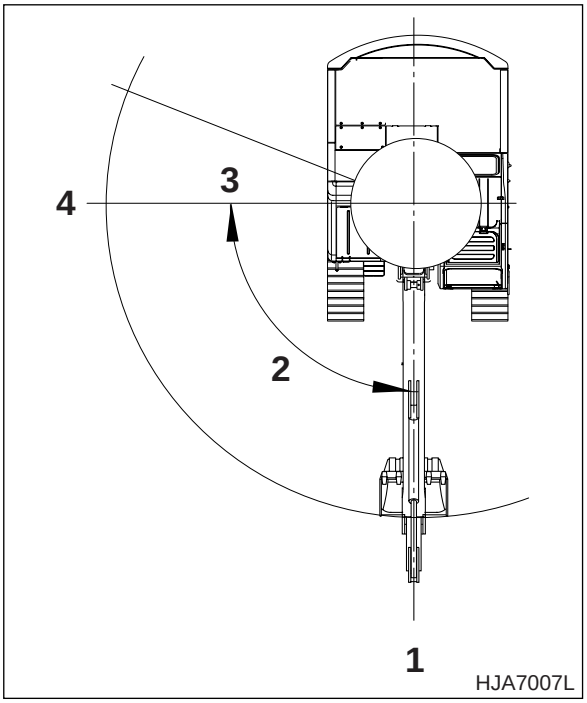


Figure 8

Reference Number	Description
1	Start Swing
2	90˚ Swing
3	Swing Force
4	Swing Stop

CYLINDER PERFORMANCE TESTS

NOTE: *All tests are performed with standard boom, arm and bucket configuration. The bucket should be empty.*

Boom Cylinders Test

The starting points for the test are with the boom and arm extended away from the excavator, and the bucket curled inward. The arm cylinder should be fully retracted; boom and bucket cylinders must be extended. Test movement in both directions, several times, and average results for both Power Mode II and Power Mode III.

Arm Cylinder Test

Start with the boom up and the arm cylinder fully retracted. Test movement in both directions several times, between the "crowd" and "dump" positions, and average the results of both tests, in both standard and extra-duty power modes.

Bucket Cylinder Test

Start with the boom up and the teeth of the bucket hanging vertically, 500 mm (1-1/2’ - 2’) above the ground. Dump and crowd the bucket several times, and average results, for both standard and extra-duty power modes.

OPERATION	MODE II	MODE III
Boom Up	3.4 - 4.2 seconds	3.1 - 3.9 seconds
Boom Down	2.4 - 3.2 seconds	2.3 - 3.1 seconds
Arm Dump	2.5 - 3.3 seconds	2.4 - 3.2 seconds
Arm Crowd	3.7 - 4.5 seconds	3.4 - 4.2 seconds
Bucket Dump	2.3 - 3.1 seconds	2.2 - 3.0 seconds
Bucket Crowd	3.2 - 4.0 seconds	3.1 - 3.9 seconds

Hydraulic Cylinder Natural Drop Test

To check boom and arm cylinder tightness against the specified performance standard for new cylinders, put a full load of dirt in the bucket and move the attachment cylinders so that the arm cylinder is extended 20 - 50 mm (1" - 2") and boom cylinders are retracted the same amount, 20 - 50 mm (1" - 2"). The top of the bucket should be approximately 2 m (6' - 7') off the ground.

Turn off the engine and measure cylinder drop after 5 minutes. Bucket cylinder should not show more than 40 mm (1.57") change, while the arm and boom cylinders should not fall more than 10 mm (0.39").

Travel Motor Jack-up Test

Test travel motor operation on each side by painting or chalking a mark on one crawler shoe, with a corresponding mark on the travel frame. Use the attachment to jack up one side of the machine and operate the raised travel motor. Record the number of seconds it takes the crawler shoe to make 3 full rotations, during both high speed and low speed operation.

OPERATION	MODE II	MODE III
High Speed	20.8 - 23.2 seconds	20.8 - 23.2 seconds
Low Speed	33.1 - 36.9 seconds	33.1 - 36.9 seconds

GENERAL MAINTENANCE

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GENERAL MAINTENANCE PROCEDURES

⚠ 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
ALL MODELS	ALL RANGES

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December 2000

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WELDING PRECAUTIONS AND GUIDELINES

IMPORTANT

To avoid accidents, personal injury and the possibility of causing damage to the machine 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 machine 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 machine (that is not always readily visible) could be caused. Always consult Daewoo After Sales Service before welding on integral components (loader arm, frames, car body, track frames, turntable, attachment, etc.) of the machine. 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 machine 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.

⚠ CAUTION!

Observe the following safety precautions:

1. **Use extra caution and adequate safety shielding when welding near fuel and oil tanks, batteries, hydraulic piping lines or other fire hazards.**
2. **Never weld when the engine is running. Battery cables must be disconnected before the welding procedure is started.**
3. **Never weld on a wet or damp surface. The presence of moisture causes hydrogen embrittlement and structural weakening of the weld.**
4. **If welding procedures are being performed near cylinder rods, operator's cab window areas or any other assemblies that could be damaged by weld spatters, use adequate shielding protection in front of the assembly.**
5. **During equipment setup, always attach ground cables directly to the area or component being welded to prevent arcing through bearings, bushings, or spacers.**
6. **Always use correct welding rods for the type of weld being performed and observe recommended precautions and time constraints. AWS Class E7018 welding rods for low alloy to medium carbon steel must be used within two hours after removal from a freshly opened container. Class E11018G welding rods for T-1 and other higher strength steel must be used within 1/2 hour.**

HYDRAULIC SYSTEM - GENERAL PRECAUTIONS

Always maintain oil level in the system at recommended levels. Assemblies that operate under heavy loads, at high speed, with extremely precise dimensional tolerances between moving parts - pistons and cylinders, or shoes and swash plates, for example - can be severely damaged if oil supply runs dry.

Assemblies can be run dry and damaged severely in a very short time when piping or hoses are disconnected to repair leaks and/or replace damaged components. Hoses that are inadvertently switched during disassembly (inlet for outlet and vice versa), air introduced into the system or assemblies that are low on oil due to neglect or careless maintenance, could all produce sufficient fluid loss to cause damage.

When starting the engine (particularly after long layoff or storage intervals), make sure that all hydraulic controls and operating circuits are in neutral, or "OFF." That will prevent pumps or other components that may be temporarily oil-starved from being run under a load.

Replacement of any hydraulic system component could require thorough cleaning, flushing, and some amount of pre-filling with fresh, clean oil if the protective seal on replacement parts has obviously been broken or if seal integrity may have been compromised. When protective seals are removed before installation and reassembly, inspect all replacement parts carefully, before they are installed. If the replacement part is bone dry (with no trace of factory pre-lube) or has been contaminated by dirt or by questionable oils, flushing and pre-filling with clean hydraulic fluid is recommended.

Vibration, irregular or difficult movement or unusual noise from any part of the hydraulic system could be an indication of air in the system (and many other types of problems). As a general precaution (and to help minimize the risk of potential long-term damage), allow the engine to run at no-load idle speed immediately after initial start-up. Hydraulic fluid will circulate, releasing any air that may have been trapped in the system before load demands are imposed.

A daily walk-around pre-start equipment safety inspection, including a quick visual scan for any exterior evidence of leaking hydraulic fluid, can help extend the service life of system components.

IMPORTANT

Hydraulic system operating conditions (repetitive cycling, heavy work loads, fluid circulating under high pressure) make it extremely critical that dust, grit or any other type of contamination be kept out of the system. Observe fluid and filter change maintenance interval recommendations and always pre-clean any exterior surface of the system before it is exposed to air. For example, the reservoir filler cap and neck area, hoses that have to be disassembled, and the covers and external surfaces of filter canisters should all be cleaned before disassembly.

MAINTENANCE SERVICE AND REPAIR PROCEDURE

GENERAL PRECAUTIONS

Fluid level and condition should always be checked whenever any other type of maintenance service or repair is being performed.

NOTE: *If the unit is being used in an extreme temperature environment (in sub-freezing climates or in high temperature, high humidity tropical conditions), frequent purging of moisture condensation from the hydraulic reservoir drain tap should be a regular and frequent part of the operating routine. In more moderate, temperate climates, draining reservoir sediment and moisture may not be required more than once or twice every few months.*

Inspect drained oil and used filters for signs of abnormal coloring or visible fluid contamination at every oil change. Abrasive grit or dust particles will cause discoloration and darkening of the fluid. Visible accumulations of dirt or grit could be an indication that filter elements are overloaded (and will require more frequent replacement) or that disintegrating bearings or other component failures in the hydraulic circuit may be imminent or have already occurred. Open the drain plugs on the main pump casings and check and compare drain oil in the pumps. Look for evidence of grit or metallic particles.

Vibration or unusual noise during operation could be an indication of air leaking into the circuit (Refer to the appropriate Troubleshooting section for component or unit for procedures.), or it may be evidence of a defective pump. The gear-type pilot pump could be defective, causing low pilot pressure, or a main pump broken shoe or piston could be responsible.

NOTE: *If equipped, indicated operating pressure, as shown on the multidisplay digital gauge on the Instrument Panel ("F-Pump" and "R-Pump") will be reduced as a result of a mechanical problem inside the pump. However, pressure loss could also be due to cavitation or air leakage, or other faults in the hydraulic system.*

Check the exterior case drain oil in the main pumps. If no metallic particles are found, make sure there is no air in the system. Unbolt and remove the tank return drain line from the top part of the swing motor, both travel motors and each main pump. If there is air in any one of the drain lines, carefully pre-fill the assembly before bolting together the drain line piping connections. Run the system at low rpm.

HYDRAULIC SYSTEM CLEANLINESS AND OIL LEAKS

MAINTENANCE PRECAUTIONS FOR HYDRAULIC SYSTEM SERVICE

Whenever maintenance, repairs or any other type of troubleshooting or service is being performed, it's important to remember that the hydraulic system - including both the interior and exterior surfaces of assemblies, and every drop of operating fluid - must be protected from contamination.

Dust and other foreign contaminants are major contributors to premature wear in hydraulic circuits. The narrow tolerances, rapidly moving parts and high operating pressures of the system require that fluid be kept as clean as possible. The performance and dependability of the machine (and the service lift of individual components) can be noticeably reduced if proper precautions are not observed:

- Use a safe, non-combustible, evaporative-type, low-residue solvent and thoroughly clean exterior surfaces of assemblies before any part of the circuit is opened up or disassembled.

NOTE: *It's just as important to clean the cap and reservoir top before routine fluid changes or quick checks as it is before major repairs. (Accumulated dirt attracts moisture, oil and other fluids - and more dirt.)*

- Keep dismantled parts covered during disassembly. Use clean caps, plugs or tape to protect the disconnected openings of flanges, manifolds and piping.
- Do not allow cleaning solvents or other fluids to mix with the oil in the system. Use clean oil to flush any traces of solvent or other residue before reassembly.
- If metal or rubber fragments are found in the system, flush and replace all fluid in the system and troubleshoot the circuit to identify the source of contamination.

IMPORTANT
Make sure that cleaning solvents will be compatible with rubber materials used in the hydraulic system. Many petroleum based compounds can cause swelling, softening, or other deterioration of system sealing elements, such as O-rings, caps and other seals.

OIL LEAKAGE PRECAUTIONS

Oil that is visibly seeping from joints or seals should always serve as a "red flag" alarm.

Leaks must alert the machine operator and maintenance crew that air, water and dirt have an open, free passageway through which to enter the circuit. Harsh, corrosive salt air, freezing and thawing condensation cycles and working environments that are full of fine dust are especially hazardous. Clogging of valve spools or external piping (especially pilot circuit piping) can gradually diminish or very suddenly put a complete stop to normal hydraulic function. You can prevent having to make these types of repairs by following recommended assembly procedures:

1. Use new O-rings and oil seals whenever hydraulic assemblies are rebuilt.
2. Prepare joint surfaces before assembly by checking alignment and flatness. Clean and repair corrosion or any other damage.
3. Follow bolt torque recommendations and all other assembly requirements.

NOTE: *Grease lip seals before assembly.*

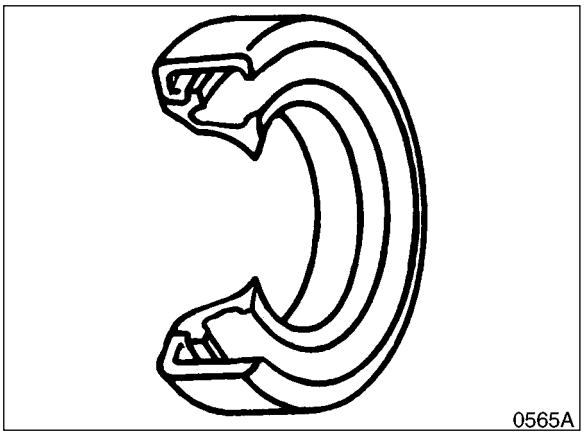


Figure 1

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

scratching. Curling under of any seal lip will seriously impair its efficiency. Apply a thin coat of Loctite #120 to outer diameter, of metal casing, on oil seals to assure an oil tight fit into retainer. Use extreme care not to get Loctite on lips of oil seals. If this happens, that portion of the seal will become brittle and allow leakage.

When replacing lip type seals, make sure spring loaded side is towards oil to be sealed.

5. If available, use magna-flux or similar process for checking for cracks that are not visible to the eye. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. Replace all gears showing cracks or spots where case hardening has worn through. Small nicks may be removed with suitable hone. Inspect shafts and quills to make certain they have not been sprung, bent, or splines twisted, and that shafts are true.

   NOTE: *Spline wear is not considered detrimental except where it affects tightness of splined parts.*

   Inspect thrust washers for distortion, scores, burs, and wear. Replace thrust washer if defective or worn.

6. Inspect bores and bearing surfaces of cast parts and machined surfaces for scratches, wear, grooves and dirt. Remove any scratches and burrs with crocus cloth. Remove foreign matter. Replace any parts that are deeply grooved or scratched which would affect their operation.

BEARING INSPECTION

The conditions of the bearing are vital to the smooth and efficient operation of the machinery. When any component containing bearings is disassembled, always carefully examine the condition of the bearings and all of its components for wear and damage.

Once the bearing is removed, clean all parts thoroughly using a suitable cleaning solution. If the bearing is excessively dirty soak the bearing assembly in a light solution and move the bearing around until all lubricants and or foreign materials are dissolved and the parts are thoroughly clean.

When drying bearings, moisture free compressed air can be used. Be careful not to direct the air in a direction which will force the bearing to dry spin while not being properly lubricated.

After the bearings have been cleaned and dried, carefully inspect all bearing rollers, cages and cups for wear, chipping or nicks. If the bearing cannot be removed and is to be inspected in place, check foe roughness of rotation, scoring, pitting, cracked or chipped races. If any of these defects are found replace the whole bearing assembly. NEVER replace the bearing alone without replacing the mating cup or the cone at the same time.

After inspection lightly coat the bearing and related parts with oil and wrap in a clean lintless cloth or paper and protect them from moisture and other foreign materials until installation.

It is also important to inspect the bearing housing and/or shaft for grooved, galled or burred conditions that indicate that the bearing has been turning in its housing or on its shaft.

If available, use magna-flux or similar process for checking for cracks that are not visible to the naked eye.

The following illustrations will aid in identifying and diagnosing some of the bearing related problems.

NOTE: *The illustrations will only show tapered roller bearings, but the principles of identifying, diagnosing and remedying the defects are common to all styles and types of bearings.*

Normal Bearing

Smooth even surfaces with no discoloration or marks.

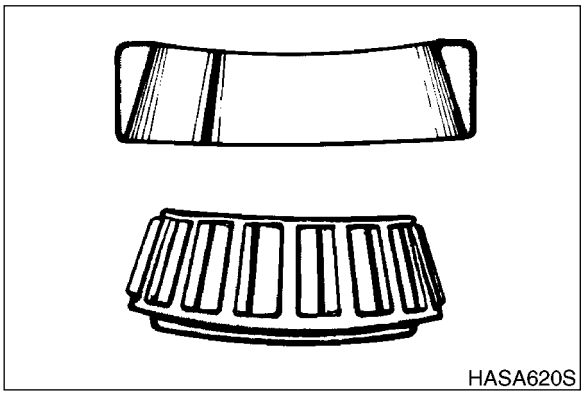


Figure 2

Bent Cage

Cage damage due to improper handling or tool usage.

Replace bearing.

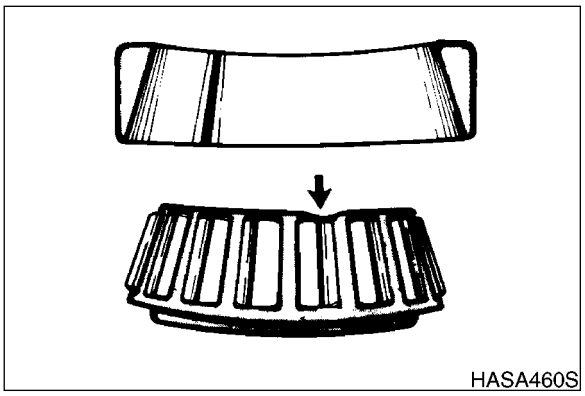


Figure 3

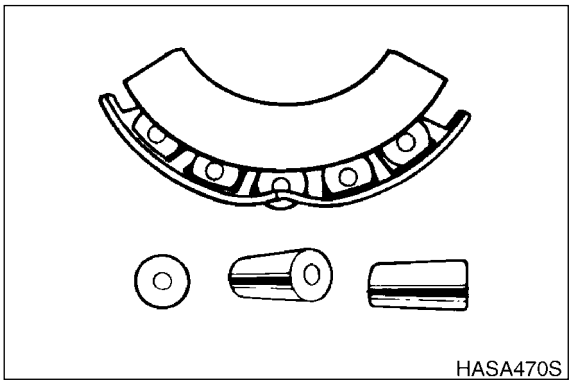


Figure 4

Galling

Metal smears on roller ends due to overheat, lubricant failure or overload.

Replace bearing - check seals and check for proper lubrication.

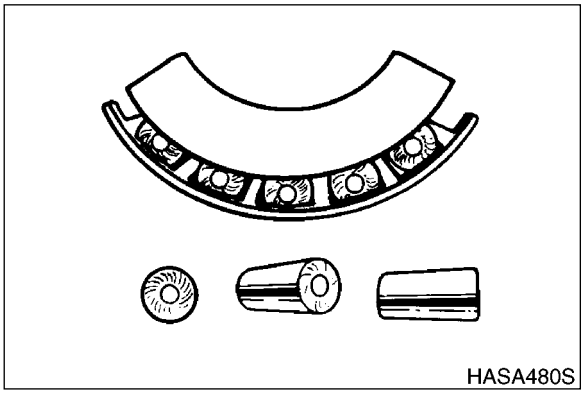


Figure 5

Abrasive Step Wear

Pattern on roller ends caused by fine abrasives.

Clean all parts and housings, check all parts and housings, check seals and bearings and replace if leaking, rough or noisy.

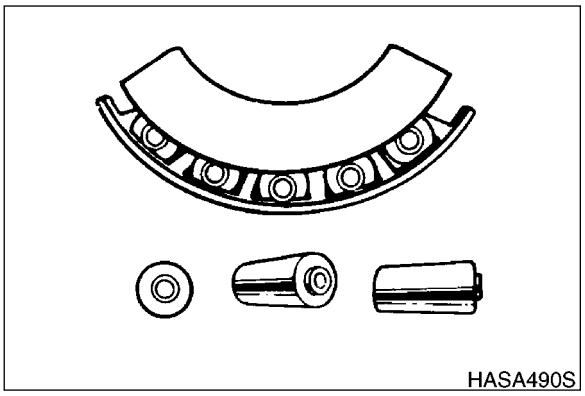


Figure 6

Etching

Bearing surfaces appear gray or grayish black in color with related etching away of material usually at roller spacing.

Replace bearings - check seals and check for proper lubrication.

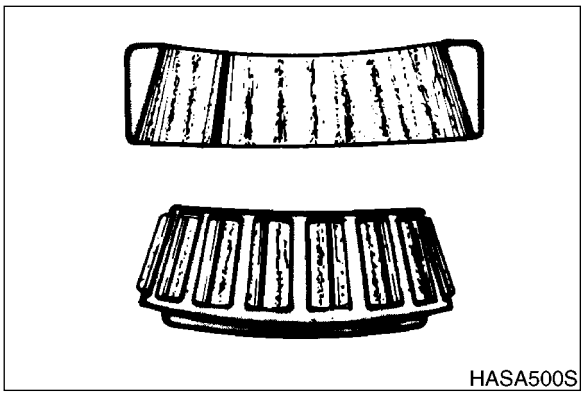


Figure 7

Misalignment

Outer race misalignment due to foreign object.

Clean related parts and replace bearing. Make sure races are properly seated.

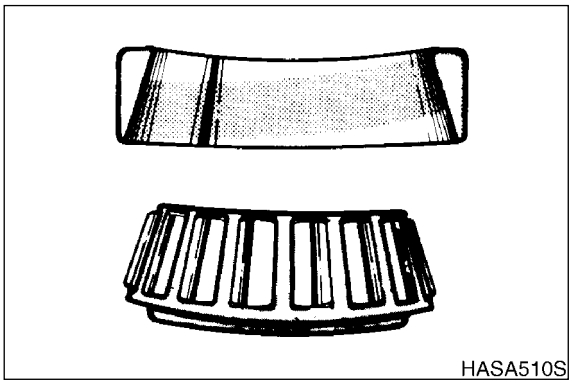


Figure 8

Indentations

Surface depressions on race and rollers caused by hard particles of foreign materials.

Clean all parts and housings, check seals and replace bearings if rough or noisy.

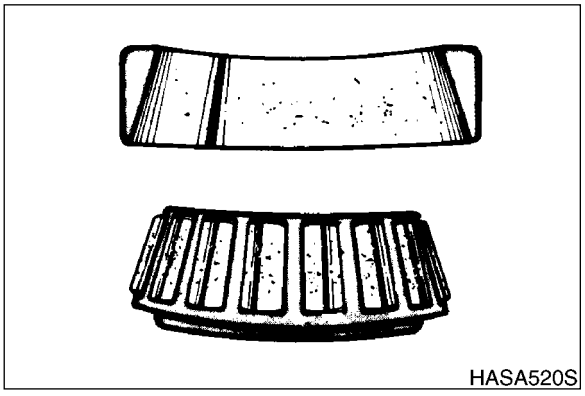


Figure 9

Fatigue Spalling

Flaking of surface metal resulting from fatigue.

Replace bearing - clean all related parts.

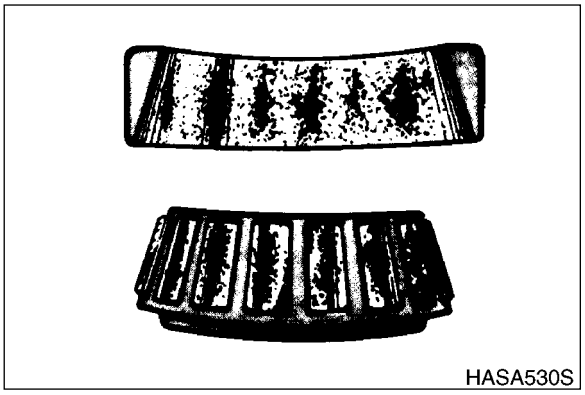


Figure 10

Brinelling

Surface indentations in raceway caused by rollers either under impact loading or vibration while the bearing is not rotating.

Replace bearing if rough or noisy.

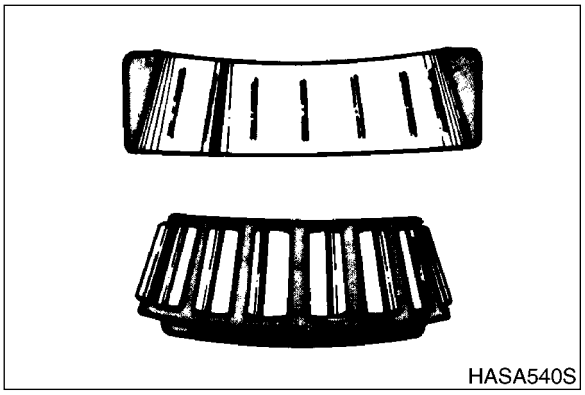


Figure 11

Cage Wear

Wear around outside diameter of cage and roller pockets caused by abrasive material and inefficient lubrication.

Replace bearings - check seals.

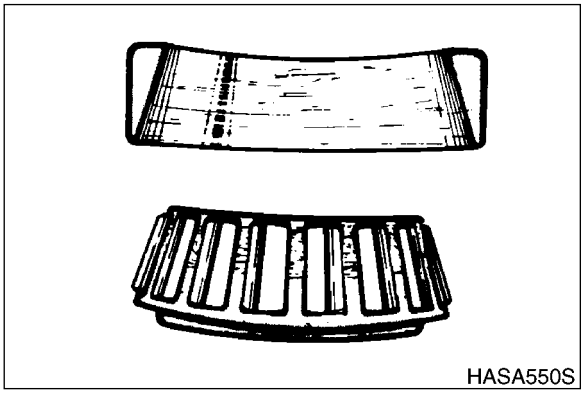


Figure 12

Abrasive Roller Wear

Pattern on races and rollers caused by fine abrasives.

Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.

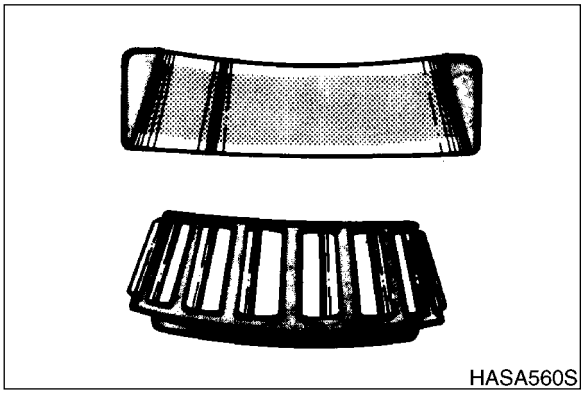


Figure 13

Cracked Inner Race

Race cracked due to improper fit, cocking or poor bearing seat.

Replace all parts and housings, check seals and bearings and replace if leaking.

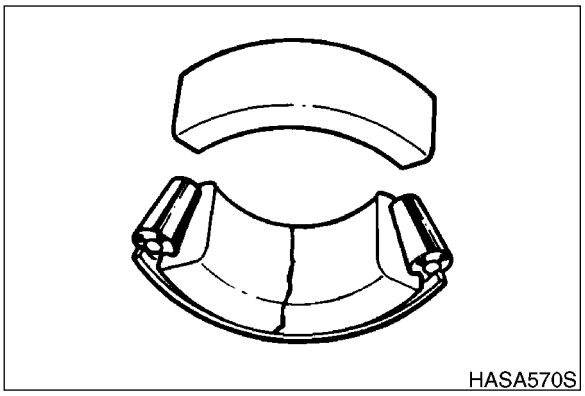


Figure 14

Smears

Smearing of metal due to slippage caused by poor fitting, lubrication, overheating, overloads or handling damage.

Replace bearings, clean related parts and check for proper fit and lubrication.

Replace shaft if damaged.

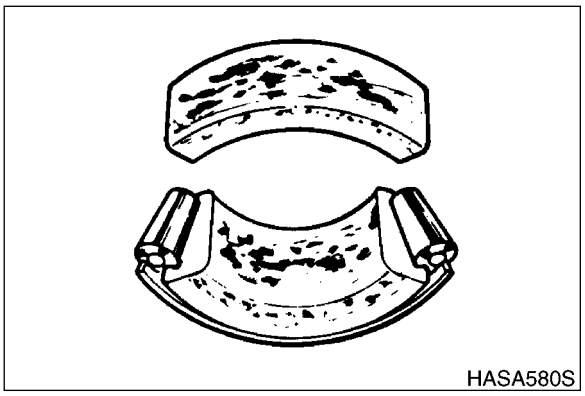


Figure 15

Frettage

Corrosion set up by small relative movement of parts with no lubrication.

Replace bearing. Clean all related parts. Check seals and check for proper lubrication.

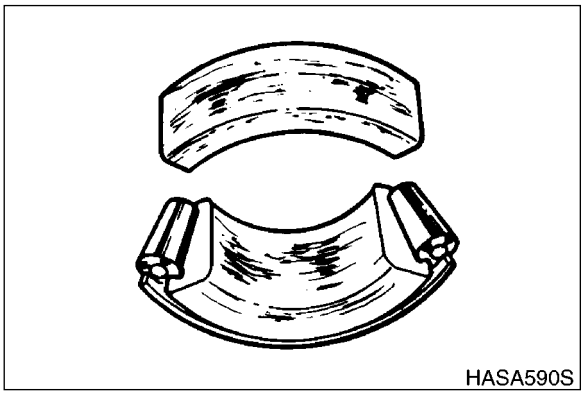


Figure 16

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.

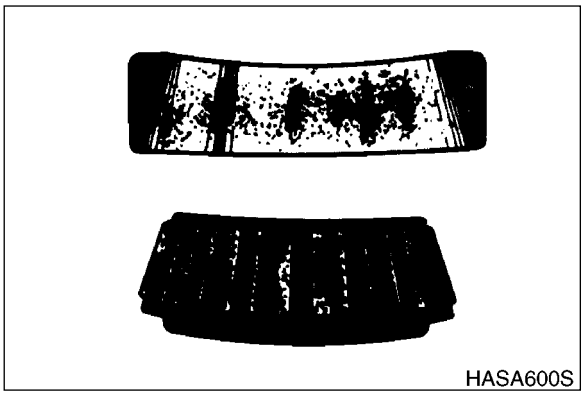


Figure 17

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.

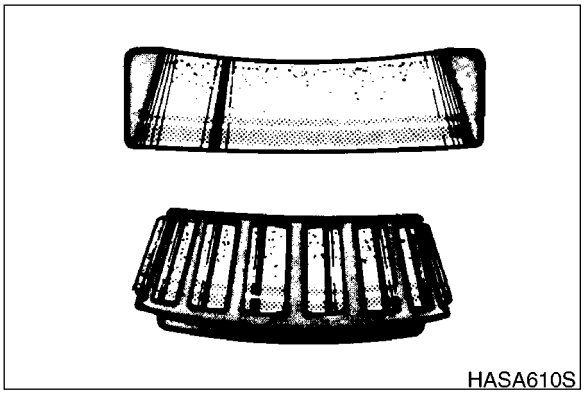


Figure 18

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STANDARD TORQUES

⚠ 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
ALL MODELS	ALL RANGES

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TORQUE VALUES FOR STANDARD METRIC FASTENERS

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

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)

TORQUE VALUES FOR STANDARD U.S. FASTENERS

TYPE	S.A.E. GRADE	DESCRIPTION	BOLT HEAD MARKING
1	1 OR 2	WILL HAVE NO MARKINGS IN THE CENTER OF THE HEAD. Low or Medium Carbon Steel Not Heat Treated.	
5	5	WILL HAVE THREE RADIAL LINES. Quenched and Tempered Medium Carbon Steel.	
8	8	WILL HAVE 6 RADIAL LINES. Quenched and Tempered Special Carbon or Alloy Steel.	

Recommended torque, in foot pounds, for all Standard Application Nuts and Bolts, provided:

1. All thread surfaces are clean and lubricated with SAE-30 engine oil. (See Note.)
2. Joints are rigid, that is, no gaskets or compressible materials are used.
3. When reusing nuts or bolts, use minimum torque values.

NOTE: *Multiply the standard torque by:*

0.65 when finished jam nuts are used.

0.70 when Molykote, white lead or similar mixtures are used as lubricants.

0.75 when parkerized bolts or nuts are used.

0.85 when cadmium plated bolts or nuts and zinc bolts w/waxed zinc nuts are used.

0.90 when hardened surfaces are used under the nut or bolt head.

NOTE: *When reusing bolts and nuts in service, use minimum torque values.*

The following General Torque Values must be used in all cases where **SPECIAL TORQUE VALUES** are not given

NOTE: *TORQUE VALUES LISTED THROUGHOUT THIS MANUAL ARE LUBRICATED (WET) THREADS; VALUES SHOULD BE INCREASED 1/3 FOR NON-LUBRICATED (DRY) THREADS.*

THREAD SIZE	HEAT TREATED MATERIAL GRADE 5 AND GRADE 8			
	GRADE 5 (3 RADIAL DASHES ON HEAD)		GRADE 8 (6 RADIAL DASHES ON HEAD)	
	FOOT POUNDS (ft lb)	NEWTON METER (Nm)	FOOT POUNDS (ft lb)	NEWTON METER (Nm)
1/4" - 20	6	8	9	12
1/4" - 28	7	9	11	15
5/16" - 18	13	18	18	24
5/16" - 24	15	20	21	28
3/8" - 16	24	33	34	46
3/8" - 24	27	37	38	52
7/16" - 14	38	52	54	73
7/16" - 20	42	57	60	81
1/2" - 13	58	79	82	111
1/2" - 20	65	88	90	122
9/16" - 12	84	114	120	163
9/16" - 18	93	126	132	179
5/8" - 11	115	156	165	224
5/8" - 18	130	176	185	251
3/4" - 10	205	278	290	393
3/4" - 16	240	312	320	434
7/8" - 9	305	414	455	617
7/8" - 14	334	454	515	698
1" - 8	455	617	695	942
1" - 14	510	691	785	1064
1 1/8" - 7	610	827	990	1342
1 1/8" - 12	685	929	1110	1505
1 1/4" - 7	860	1166	1400	1898
1 1/4" - 12	955	1295	1550	2102
1 3/8" - 6	1130	1532	1830	2481
1 3/8" - 12	1290	1749	2085	2827
1 1/2" - 6	1400	2034	2430	3295
1 1/2" - 12	1690	2291	2730	3701
1 3/4" - 5	2370	3213	3810	5166
2" - 4 1/2	3550	4813	5760	7810

NOTE: *If any bolts and nuts are found loose or at values less than what the chart states, it is recommended that the loose bolt and/or nut be replaced with a new one.*

TYPE 8 PHOSPHATE COATED HARDWARE

This chart provides tightening torque for general purpose applications using original equipment standard hardware as listed in the Parts Manual for the machine involved. **DO NOT SUBSTITUTE**. In most cases, original equipment standard hardware is defined as Type 8, coarse thread bolts and nuts and thru hardened flat washers (Rockwell "C" 38 - 45), all phosphate coated and assembled without supplemental lubrication (as received) condition.

The torques shown below also apply to the following:

1. Phosphate coated bolts used in tapped holes in steel or gray iron.
2. Phosphate coated bolts used with phosphate coated prevailing torque nuts (nuts with distorted threads or plastic inserts).
3. Phosphate coated bolts used with copper plated weld nuts.

Markings on bolt heads or nuts indicate material grade ONLY and are NOT to be used to determine required torque.

NOMINAL THREAD DIAMETER	STANDARD TORQUE ±10%	
	KILOGRAM METER (kg•m)	FOOT POUNDS (ft lb)
1/4"	1.1	8
5/16"	2.2	16
3/8"	3.9	28
7/16"	6.2	45
1/2"	9.7	70
9/16"	13.8	100
5/8"	19.4	140
3/4"	33.2	240
7/8"	53.9	390
1"	80.2	580
1 - 1/8"	113.4	820
1 - 1/4"	160.4	1160
1 - 3/8"	210.2	1520
1 - 1/2"	279.4	2020
1 - 3/4"	347.1	2510
2	522.8	3780

TORQUE VALUES FOR HOSE CLAMPS

The following chart provides the tightening torques for hose clamps used in all rubber applications (radiator, air cleaner, operating lever boots, hydraulic system, etc.).

CLAMP TYPE AND SIZE	TORQUE ±5 in lb (0.1 kg•m)			
	RADIATOR, AIR CLEANER, BOOTS, ETC.		HYDRAULIC SYSTEM	
	KILOGRAM METER (kg•m)	INCH POUNDS (in lb)	KILOGRAM METER (kg•m)	INCH POUNDS (in lb)
"T" Bolt (Any Diameter)	0.6 - 0.7	55 - 65	-------	------
Worm Drive - 1-3/4 in Open Diameter and Under	0.2 - 0.3	20 - 30	0.5 - 0.6	40 - 50
Worm Drive - Over 1-3/4 in Open Diameter	0.5 - 0.6	40 - 50	-------	------
Worm Drive - All "Ultra-Tite"	1.1 - 1.2	95 - 105	0.5 - 0.6	40 - 50

TORQUE VALUES FOR SPLIT FLANGES

The following chart provides the tightening torques for split flange connections used in hydraulic systems. Split flanges and fitting shoulders should fit squarely. Install all bolts, finger tight and then torque evenly.

NOTE: *Over torquing bolts will damage the flanges and/or bolts, which may cause leakage.*

FLANGE SIZE (*)	BOLT SIZE	BOLT TORQUE	
		KILOGRAM METER (kg•m)	FOOT POUNDS (ft lb)
1/2"	5/16"	2.1 - 2.5	15 - 18
3/4"	3/8"	3.0 - 3.7	22 - 27
1"	3/8"	3.7 - 4.8	27 - 35
1 - 1/4"	7/16"	4.8 - 6.2	35 - 45
1 - 1/2"	1/2"	6.4 - 8.0	46 - 58
2"	1/2"	7.6 - 9.0	55 - 65
2 - 1/2"	1/2"	10.9 - 12.6	79 - 91
3"	5/8"	19.1 - 20.7	138 - 150
3 - 1/2"	5/8"	16.2 - 18.4	117 - 133

(*) - Inside diameter of flange on end of hydraulic tube or hose fitting.

NOTE: *Values stated in chart are for Standard Pressure Series (Code 61) Split Flanges.*

TORQUE WRENCH EXTENSION TOOLS

Very large diameter, high grade fasteners (nuts, bolts, cap screws, etc.) require a great deal of turning force 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:

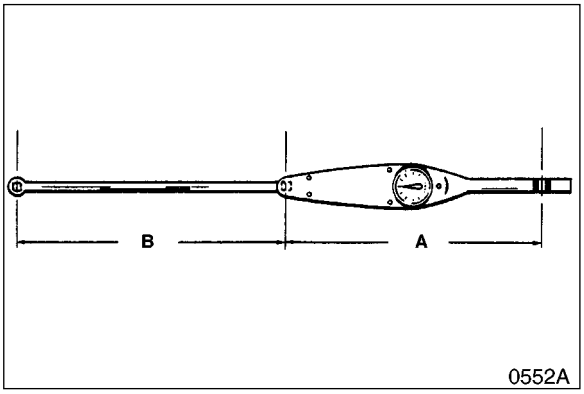


Figure 1

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 lb," the real force applied to the bolt is 300 ft lb:

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

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.

OTHER USES FOR TORQUE WRENCH EXTENSION TOOLS

Torque wrench extensions are sometimes made up for reasons other than increasing leverage on a fastener.

For example, a torque wrench and extension can be used to measure adjustment "tightness" of a linkage or assembly. Specially fabricated extensions can be used to make very precise checks of the force required to engage or disengage a clutch mechanism, release a spring-applied brake assembly, or "take up" free play in most any movable linkage.

Once the value of the adjustment force is established, repeated checks at regular intervals can help to monitor and maintain peak operating efficiency. These types of adjustment checks are especially useful if physical measurements of linkage travel are difficult to make or will not provide the needed degree of precision and accuracy.

To allow the assembly or mechanism to accept a torque wrench, welding a nut or other adapter on the end of a linkage shaft or other leverage point will allow turning the shaft or assembly manually.

TIGHTENING TORQUE SPECIFICATIONS (METRIC)

(For coated threads, prelubricated assemblies.)

⚠ CAUTION!

Disassembly, overhaul and replacement of components on the machine, installation of new or replacement parts and/or other service-related maintenance may require the use of thread or flange sealing assembly compound.

Use the information on this page as a general guide in selecting specific formulas that will meet the particular requirements of individual assembly installations. Daewoo does not specifically endorse a specific manufacturer or brand name but the following table of "Loctite" applications is included for which cross-references to other makers' products should also be widely available.

IMPORTANT

Use primer "T" or "N" for all cold weather assembly of fastener adhesives, with Thread locker sealers 222, 242/243, 262, 271, 272, or 277.

I. "Loctite" Fastener Adhesives

Product	Application	Color	Removal	Break-away Cure Strength (in lb) Of Sealer Alone
222	Low strength for 6 mm (1/4") or smaller fasteners.	Purple	Hand tools	45
242 or 243	Medium strength for 6 mm (1/4") and larger fasteners.	Blue	Hand tools	80
262	High strength for high grade fasteners subject to shock, stress and vibration.	Red	Heat/260°C (500°F) Remove HOT (NO solvent)	160
271	Extra high strength for fine thread fasteners up to 25 mm (1") diameter.	Red	Heat/260°C (500°F) Remove HOT	160
272	High temperature/high strength for hostile environments to 232°C (450°F).	Red	Heat/316°C (600°F) Remove HOT	180
277	Extra high strength for coarse thread fasteners 25 mm (1") diameter and larger.	Red	Heat/260°C (500°F) Remove HOT	210

II. "Loctite" Pipe Thread Sealant

Product	Application	Color	Removal	Required Setup
545	"No-filler/non-clog" formula for high-pressure hydraulic systems. Over-application will not restrict or foul system components.	Purple	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)
656	Solvent-resistant, higher viscosity tapered thread sealer.	White	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)

III. "Loctite" gasket/flange sealer

Product	Application	Color	Notes
518	Gasket eliminator specifically made for aluminum flanges/surfaces. For hydraulic systems to 34,475 kPa (5,000 psi).	Red	Use Locquic "N" primer for fast (1/2 - 4 hours) setup. Unprimed setup 4 - 24 hours.
504	Low pressure/wide-gap gasket eliminator compound. Fills gaps to 0.0012 mm (0.030"), cures to rigid seal.	Orange	Use Locquic "N" primer for faster (1/2 - 4 hours) setup. Unprimed setup 4 - 24 hours.
515	General purpose, fast setup, flexible-cure gasket eliminator. For non-rigid assemblies subject to shock, vibration or deflection.	Purple	Use Locquic "N" primer for faster (1/4 - 2 hours) setup. Unprimed setup 1 - 12 hours.

IV. "Loctite" retaining compounds

Product	Application	Color	Notes
609	For bushings, sleeves, press-fit bearings, splines and collars. For gaps to 0.0002 mm (0.005"), temperatures to 121°C (250°F).	Green	Use Locquic "N" primer for increased bond strength and all cold temperature applications.
620	For high temperatures to 232°C (450°F).	Green	Same as 609, above.
680	For high strength bonds and tight clearance gaps, to 0.00008 mm (0.002").	Green	Same as 609, above.

V. "Loctite" Adhesives

Product	Application	Color	Notes
380	Black Max instant adhesive for shock and vibration-resistant bonds.	Black	May take 120 hours to reach full cure strength.
454	Adhesive for porous surfaces.	Clear	Full strength in 24 hours.
480	Increased strength (+50%), shock and vibration-resistant.	Black	Full strength in 24 hours.

UPPER STRUCTURE

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

S0402040K

CAB

⚠ 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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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REMOVAL

⚠ CAUTION!

Avoid disassembling cab if there are strong wind gusts, which could catch large surface area of cab shell and push it sideways during lift.

1. Park on firm and level ground.
2. Lower bucket to ground.
3. 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.

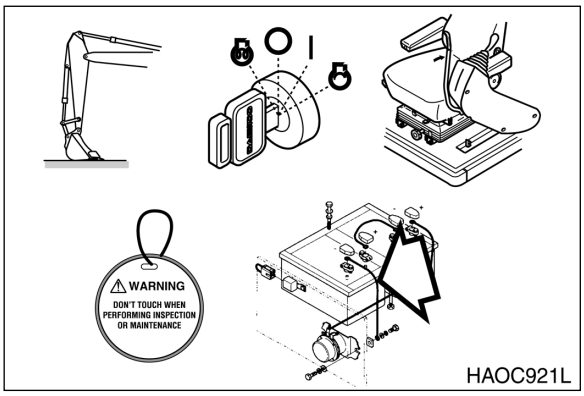


Figure 1

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. Prepare cab shell for removal by disconnecting wiring connectors for:
   - A. Cab interior lighting.
   - B. External light wiring.
   - C. Radio antenna and connections.
   - D. Wiper/washer connections.

NOTE: *Control console wiring harnesses and hydraulic piping lines that pass through the floor of the cab do not need to be disassembled.*

NOTE: *If unit is equipped with a cab protective structure (for forestry, or hazardous working conditions), it must be removed.*

8. Remove floor mat.
9. Remove operator's seat (1, Figure 2).

   NOTE: *Be careful not to damage seat covering.*

10. Remove duct covers (2, 3 and 4, Figure 2). When removing cover (2) disconnect hour meter connector and cigar lighter connector. Disconnect main harness connector before removing cover (4).
11. Removing pocket (5, Figure 2) before removing side panel (6, Figure 2).

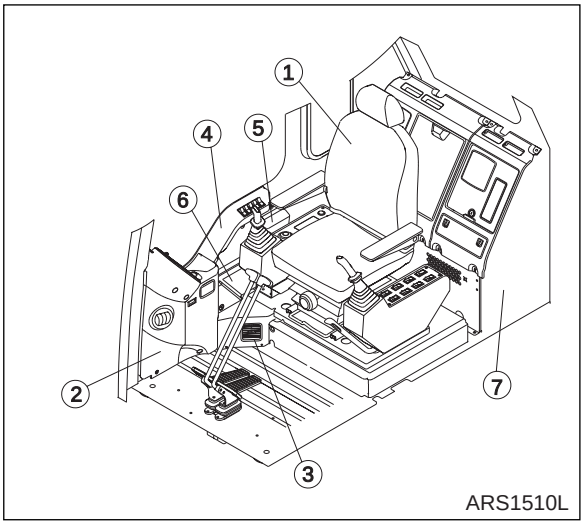


Figure 2

12. Remove air duct (1, 2 and 3, Figure 2) located at right side of cab. Disconnect duct wiring connector before removing duct (2).
13. Disconnect washer hose located at floor plate bottom.

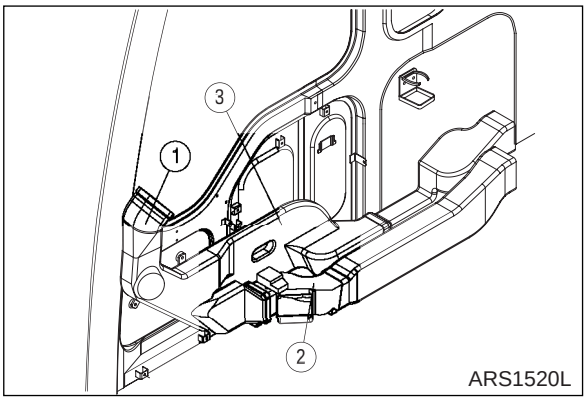


Figure 3

14. Remove cover (5, Figure 4) on left side dash cover (3) and bolts (1, Figure 5).

    NOTE: *When removing cover disconnect speaker wire.*

15. Remove two rubber stops (2, Figure 4) used in storing the front lower glass. Remove bolts (1) from the rear left and right dash covers. Remove left side cover (3).
16. Lift right side dash cover (4, Figure 4) and disconnect speaker wire. Remove cover.

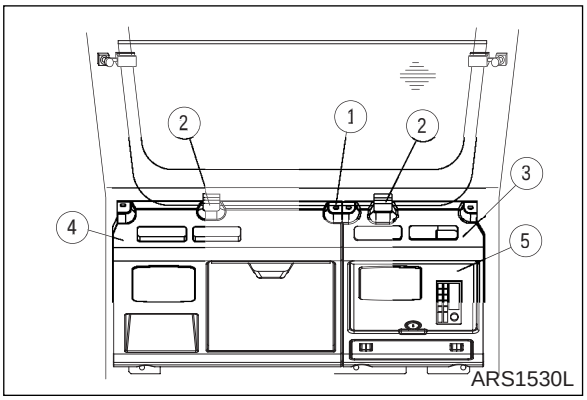


Figure 4

17. Remove three bolts (2, Figure 5) after disconnect speaker wire and antenna wire. Remove stereo assembly.
18. Disconnect cab lamp wiring connector.
19. Disconnect cabin ground cable (7, Figure 2).

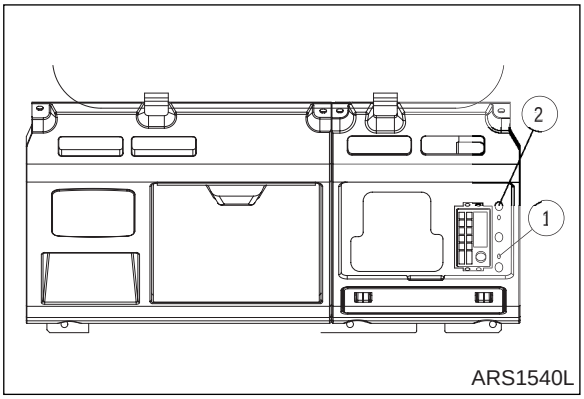


Figure 5

20. Remove four mounting nuts from four corners of cabin floor (2, Figure 6).
21. Remove four hex bolts (3, Figure 6) from door side of cabin floor.
22. Remove two hex bolts (1, Figure 6) from right side of cabin floor and one bolt (4) under front window of cab floor.

Quantity	Description
4	16 mm hex nuts at each corner of the cab
4	10 mm x 1.5 hex bolts at the door side of the cab
3	10 mm x 1.5 mm hex head bolts, 2 on the right side of the cab and 1 under the front window.

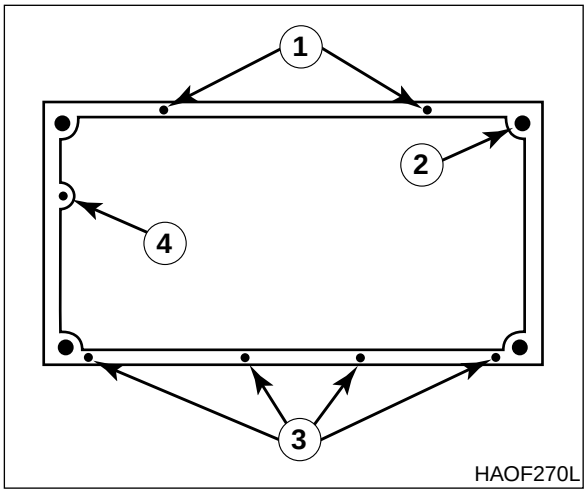


Figure 6

23. Using a suitable lifting device, attach slings to four lift points on top of cab (Figure 7).

    NOTE: *Cab weighs approximately 290 kg (639 lb).*

24. Lift cab from 25 - 50 mm (1" - 2") above deck height. Check that all electrical connections have been disconnected and all other items unbolted.
25. Continue lifting with the assist crane to remove the cab shell. Lower the shell to a pre-prepared safe blocking support.

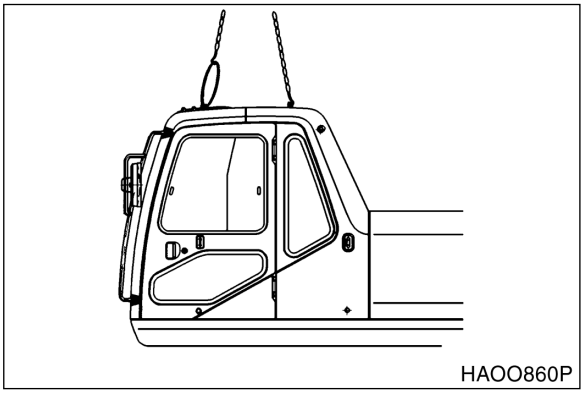


Figure 7

INSTALLATION

1. Using a suitable lifting device, attach slings to four lift points on top of cab (Figure 7).

   NOTE: *Cab weighs approximately 290 kg (639 lb).*

2. Lower cab into position on cab floor

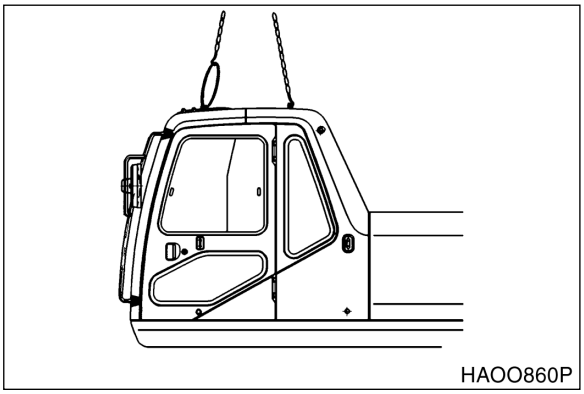


Figure 8

3. Install four mounting nuts on four corners of cabin floor (2, Figure 9).

   NOTE: *Mounting nut torque 20.2 kg•m* (146 ft lb)

4. Install four hex bolts (3, Figure 9) in door side of cabin floor.

5. Install two hex bolts (1, Figure 9) in right side of cabin floor and one bolt (4) under front window of cab floor.

Quantity	Description
4	16 mm hex nuts at each corner of the cab
4	10 mm x 1.5 hex bolts at the door side of the cab
3	10 mm x 1.5 mm hex head bolts, 2 on the right side of the cab and 1 under the front window.

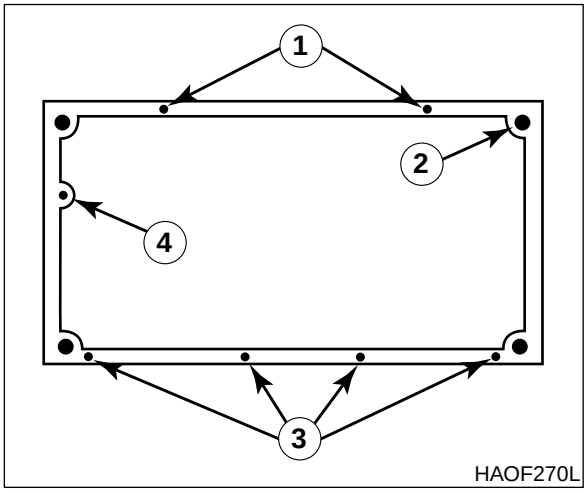


Figure 9

6. Once cab is mounted to floor, unhook lifting device

7. Connect cabin ground cable (7, Figure 2).

8. Connect cab light wiring connector.

9. Install stereo assembly with bolts (2, Figure 10) after connect speaker wire and antenna wire.

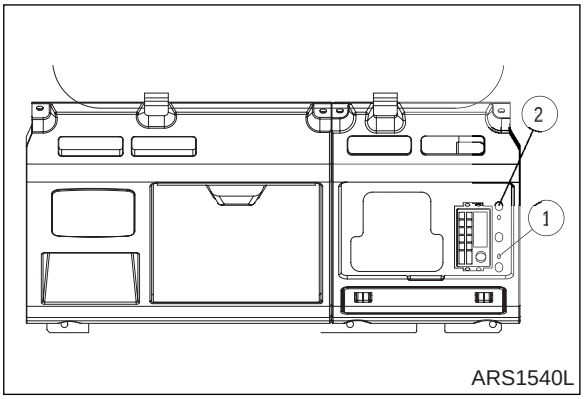


Figure 10

10. Lift right side dash cover (4, Figure 11) with bolts (1, Figure 10). Install two rubbers (2, Figure 11).
11. Install left side dash cover (3, Figure 11) with bolts (1, Figure 10). Install two rubbers (2, Figure 11).
12. Install cover (5, Figure 11) on left side dash cover (3).

    NOTE: *Connect speaker wire before installing cover.*

13. Connect washer hose located at floor plate bottom.
14. Install air duct (3, 2 and 1, Figure 12) located at right side of cab.

    NOTE: *Connect wire connector of duct (2).*

15. Install side panel (6, Figure 12) and pocket (5).

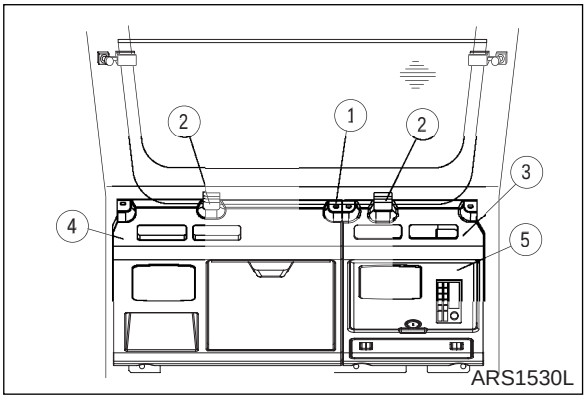


Figure 11

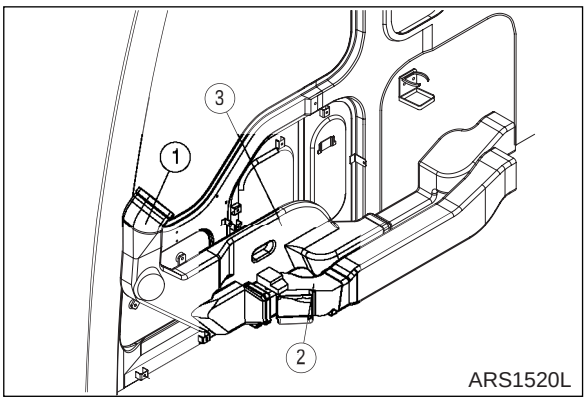


Figure 12

16. Install cover (4, Figure 13) and connect main harness. Install cover (3, Figure 13). Connect hour meter connector and cigar lighter connect of cover (2, Figure 13).
17. Install cover (2).
18. Install operator's seat (1, Figure 13).

    NOTE: *Be careful not to damage seat covering.*

19. Install floor mat.
20. Disconnect negative (-) battery cable leading to frame from battery.

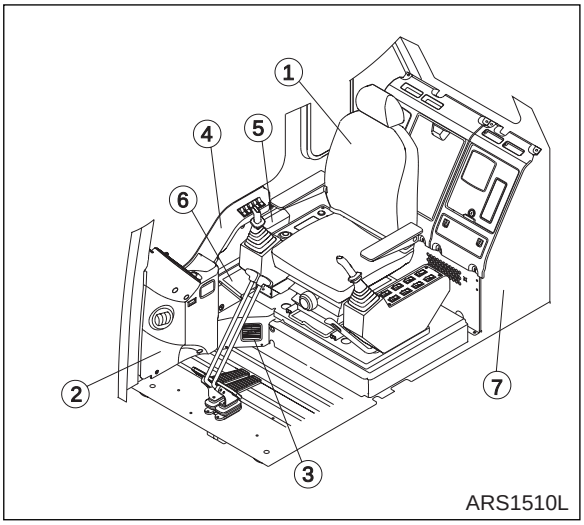


Figure 13

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COUNTERWEIGHT

⚠ 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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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Installation 6

GENERAL

Before any attempt is made to begin removal or installation of the counterweight, the excavator must be parked on a firm and level supporting surface, with no sloping surfaces or soft or muddy ground in the area where the assist lift crane will be working. Position all accessories in the overnight storage position.

⚠ WARNING!

The weight of counterweight is given in the following table. Use only rated and approved slings and hardware when removal or installation lifts are being made. Lifting slings, shackles and all other hardware must be rigged safely. An assist crane that is rated above weight capacity is required.

MODEL	WEIGHT OF COUNTERWEIGHT
Solar 300LC-V	4,900 kg (10,803 lb)
Solar 300LL	6,300 kg (13,890 lb)
Solar 340LC-V	6,500 kg (14,330 lb)
Solar 420LC-V	8,200 kg (18,078 lb)
Solar 470LC-V	8,500 kg (18,740 lb)

Responsibility should be assigned to one person to be in charge of the lifting crew, and to verify that required safe lifting precautions have been taken before each part of the procedure has been started.

All members of the working crew should know and understand the signals that will be used between the lifting leader, the assist crane operator and the remainder of the work crew.

⚠ WARNING!

If the turntable deck has been unbalanced by removal of weight from one end only, traveling the excavator, swinging the turntable, movement over bumps or sloping and uneven surfaces could cause loss of control and possible accidents or injuries.

To maintain stability the counterweight should be removed whenever the front attachment is taken off the machine.

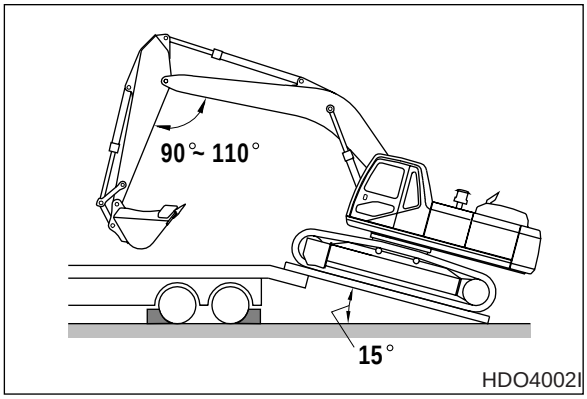


Figure 1

When loading an excavator (either track or wheeled type) on a trailer for transport after the front attachment has been removed, secure the swing lock (if equipped) to hold the deck in place and always go backwards up the loading ramp. The counterweight end of the deck has to get on the trailer first, while the cab is still going up the ramp (Figure 1).

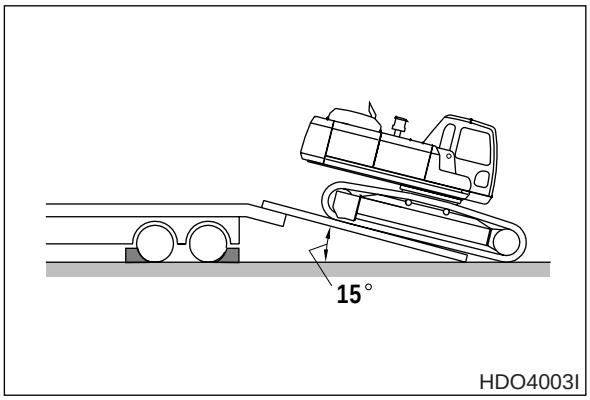


Figure 2

REMOVAL

1. Park on firm and level ground.
2. Lower bucket to ground.
3. 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.**

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. Raise engine compartment cover.
8. Remove two caps (1, Figure 4) from counterweight (2).
9. Install two lifting eyes in lifting holes (3, Figure 4).

Model	Lifting Eye Size
Solar 300LC-V Solar 300LL Solar 340LC-V Solar 420LC-V Solar 470LC-V	M48x5.0

10. Using a suitable lifting device capable of handling load, partially support counterweight (2, Figure 4) before beginning to loosen four bolts (4). Stop lifting with assist crane as soon as lifting slings are taut.
11. Remove four bolts (4, Figure 4) and washers (5) from counterweight (2).

    NOTE: *Heat bolts if necessary, to free them.*

12. When bolts (4, Figure 4) and washers (5) have been removed, lift counterweight (2)

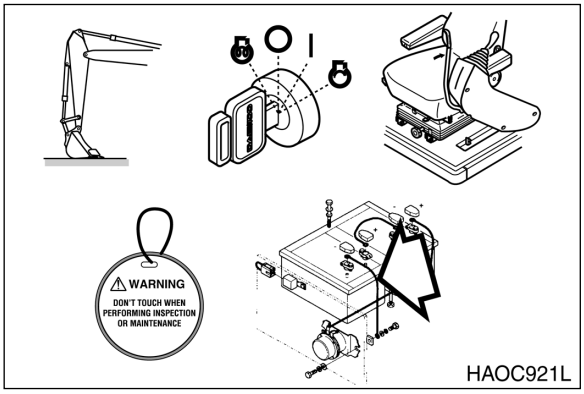


Figure 3

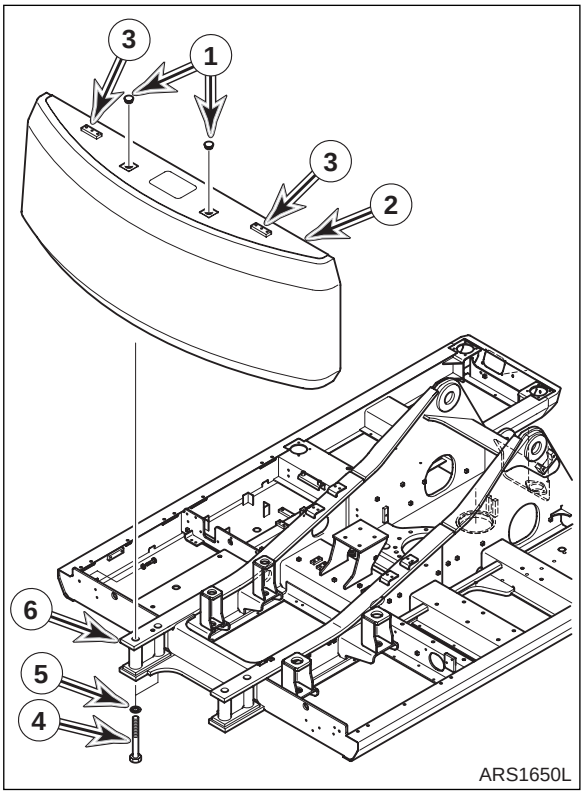


Figure 4

a very short distance above support frame (6) and stop. Check slings and make sure counterweight is being supported evenly.

INSTALLATION

1. Raise engine compartment cover.
2. Using suitable lifting device capable of handling load, raise counterweight (2, Figure 5) into position just above support frame (6) leaving counterweight suspended. Verify that counterweight is level and even.

   NOTE: *Leave counterweight (2, Figure 5) suspended 3 mm (0.125") above support frame (6) until all four mounting bolts (4) are started in counterweight mounting holes.*
3. Slide washers (5, Figure 5) onto bolts (4). Apply Loctite #242 to mounting bolt threads.
4. Install four bolts (4, Figure 5) with washers (5) into counterweight until washers contact support frame. Fully lower counterweight onto support frame and finish tightening bolts.

   NOTE: *Tighten bolts (4, Figure 5) to values shown in following table.*

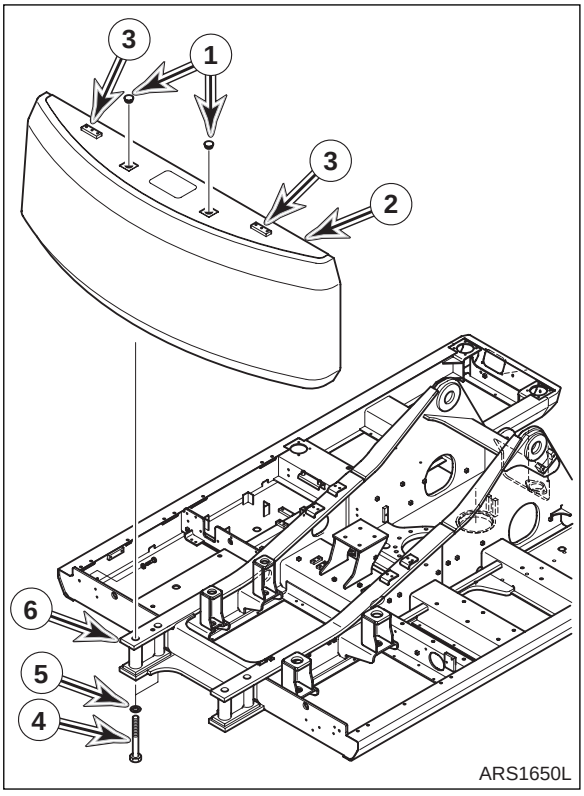


Figure 5

Model	Bolt Torque
Solar 300LC-V Solar 300LL Solar 340LC-V Solar 420LC-V Solar 470LC-V	250 kg•m (1,807 ft lb)

5. Remove lifting device and lifting eyes from counterweight lifting holes (3, Figure 5).
6. Install two caps (1, Figure 5) in lifting holes (3).
7. Connect negative (-) battery cable to battery.

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FUEL TANK

⚠ CAUTION!

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Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Solar 300LC-V	1001 and Up
Solar 300LL	1001 and Up

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GENERAL DESCRIPTION

⚠ WARNING!

Engine fuel is highly flammable and potentially explosive. To prevent possible injury and/or damage to equipment, extinguish or move to a safe distance all potential fire hazards.

PARTS LIST

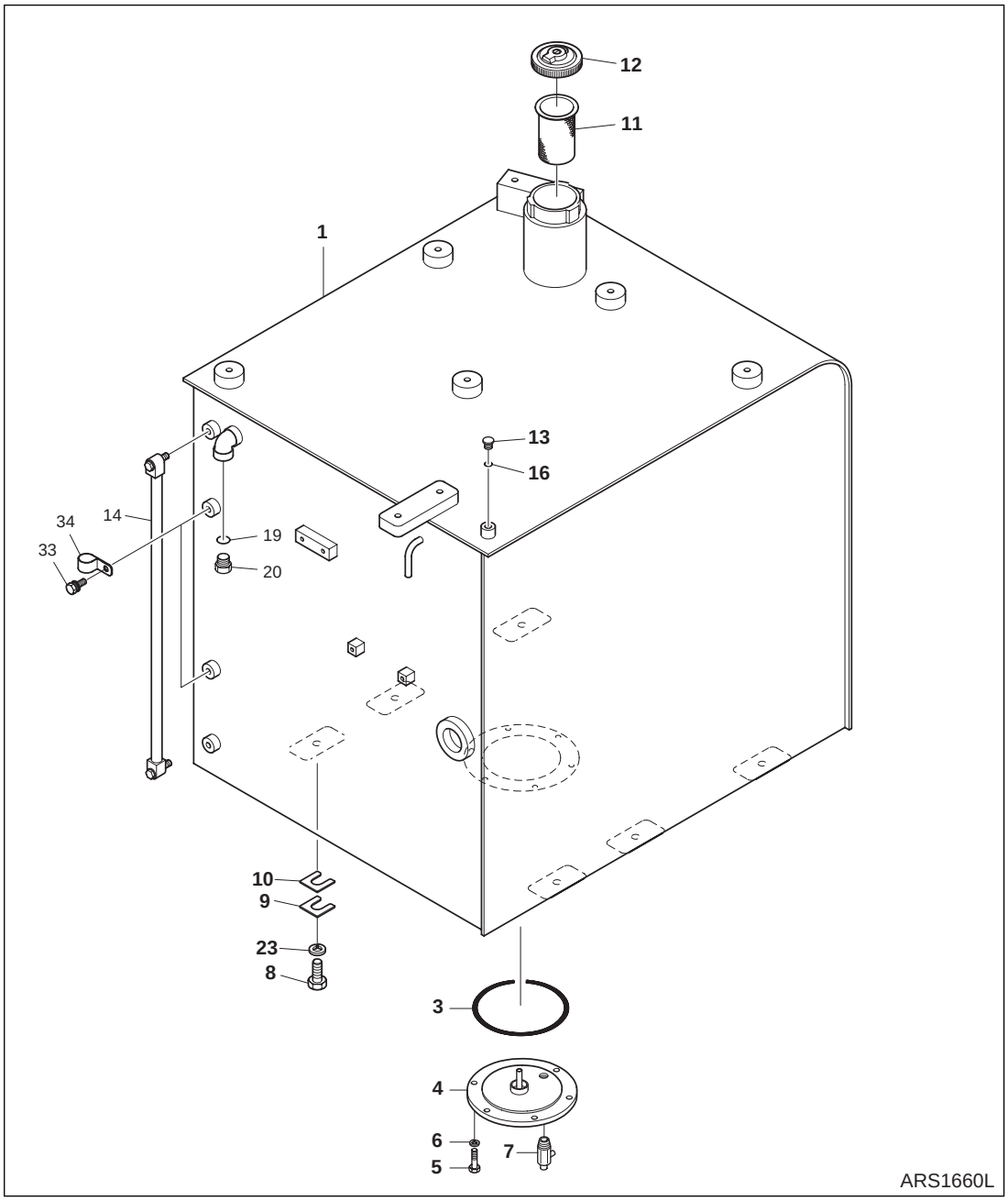


Figure 1

Reference Number	Description
1	Fuel Tank
3	O-ring
4	Cover
5	Bolt (M10x1.5x25)
6	Spring Washer (M10)
7	Drain Valve
8	Bolt
9	Shim
10	Shim
11	Fuel Filter

Reference Number	Description
12	Cap (=2188-9004)
13	Plug; SP
14	Level Gauge
16	O-ring
19	O-ring
20	Plug
23	Spacer
33	Bolt
34	Clip

SPECIFICATIONS

Fuel tank capacity is 450 liters (119 U.S. gal).

REMOVAL

1. Look at fuel level display (Figure 2) on instrument panel in operator's cab to see when it shows. The display is divided into ten separated segments, each representing 10 percent of total fuel supply. Also look at level gauge on side of tank to estimate volume of fuel left in tank.

   NOTE: *If possible, work excavator until available fuel supply in tank has been run down as far as possible.*

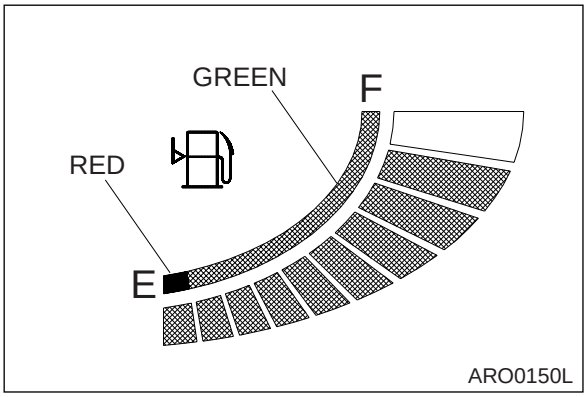


Figure 2

2. Park on firm and level ground and swing turntable to approximately a 90˚ with respect to tracks. See Figure 3.

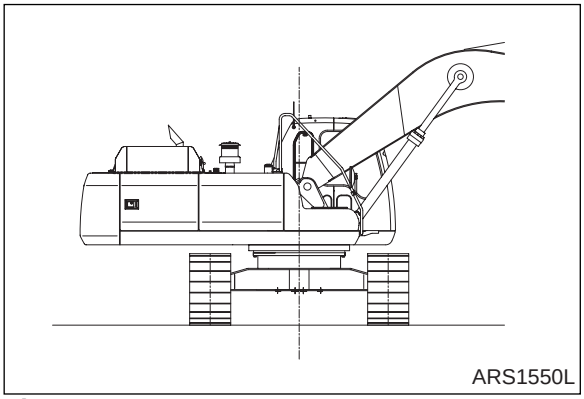


Figure 3

3. Lower bucket to ground.
4. 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.**

5. Set safety lever on "LOCK" position.
6. Hang maintenance warning tag on controls.
7. Disconnect negative (-) battery cable leading to frame from battery.

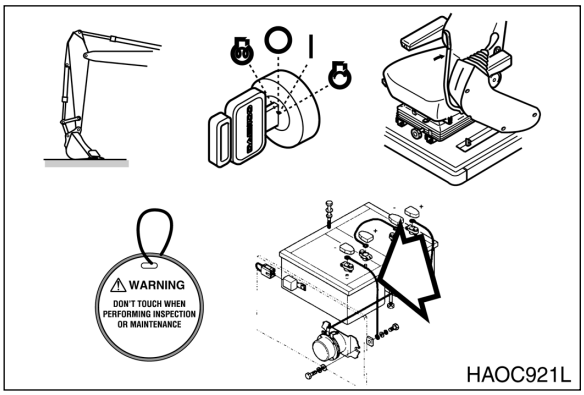


Figure 4

8. Clean area around fuel tank fill cap (1, Figure 5). Open fuel cap.

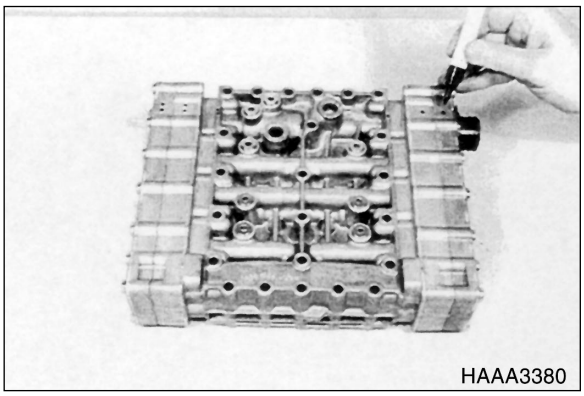


Figure 5

9. Place a large enough container under the tank to collect remaining fuel. Open drain valve (Figure 6) at bottom of tank and empty tank.

   NOTE: *Fuel tank capacity is 450 liters (119 U.S. gal).*

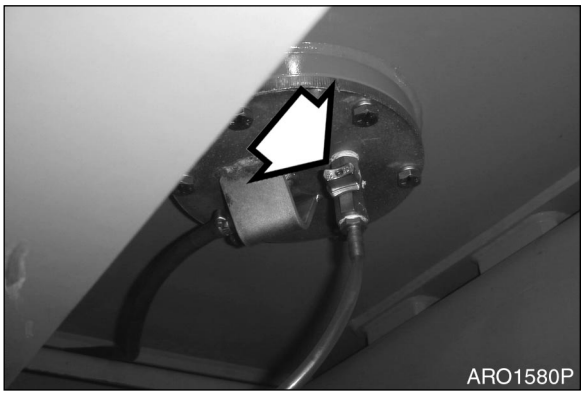


Figure 6

10. Tag and disconnect fuel supply line (1, Figure 7) and fuel return line (2) from tank (3) and carefully drain remaining fuel from lines.
11. Remove clamp (4, Figure 7) holding fuel return line (2) to tank (3).

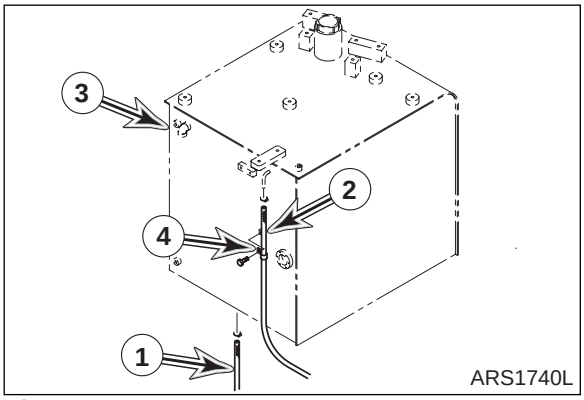


Figure 7

12. Tag and disconnect wires leading to fuel sensor (1, Figure 8) on side of fuel tank (2).
13. If equipped, remove components from fuel filler pump port (3, Figure 8) on side of fuel tank (2).

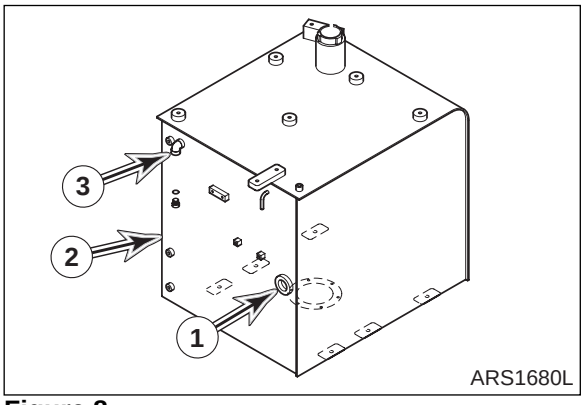


Figure 8

14. Remove six bolts (1, Figure 9) and cover (2) from fuel tank.

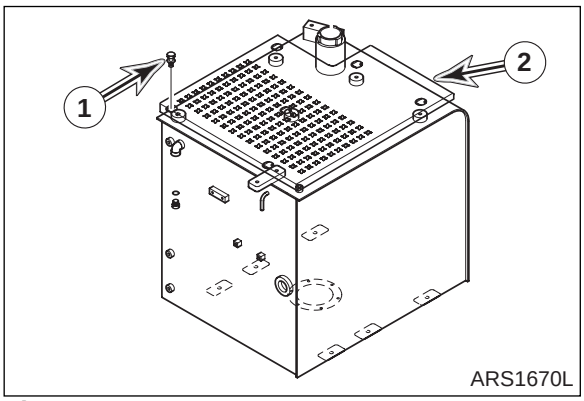


Figure 9

15. Remove four bolts (1 and 2, Figure 10), clamp (6) and stay (3) from fuel tank and frame.

    Remove four bolts (4) and battery cover (5) from frame.

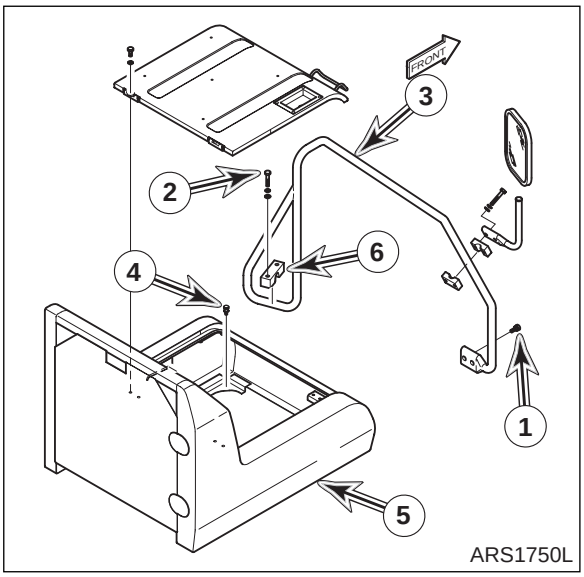


Figure 10

16. Remove four bolts (1 and 2, Figure 11) and cover (3) from fuel tank and support.

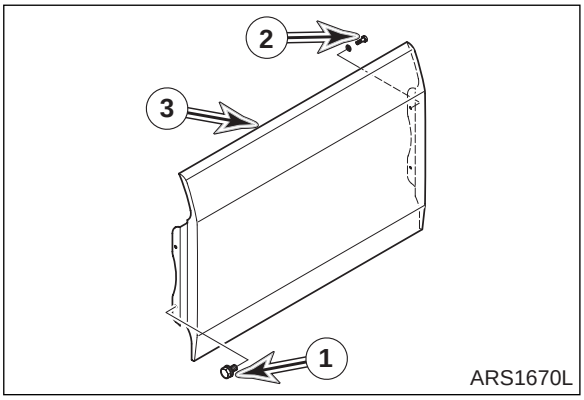


Figure 11

17. Install two 12 mm eye bolts in threaded holes (1 and 2, Figure 12). Using a suitable lifting device, sling eye bolts.

18. Remove six bolts and washers (4, Figure 12) holding tank (3) to frame. Lift tank 25 mm (1") and make sure it is balanced. Make sure that there are no other electrical wires or hoses connected to tank. Completely remove tank after inspection.

    NOTE: *The clear level gauge on the side of the tank is easily damaged. Be careful of obstacles and wind gusts.*

19. Remove shims (5, Figure 12).

    NOTE: *If tank is to be reused note position and amount of shims used for each mounting bolt location.*

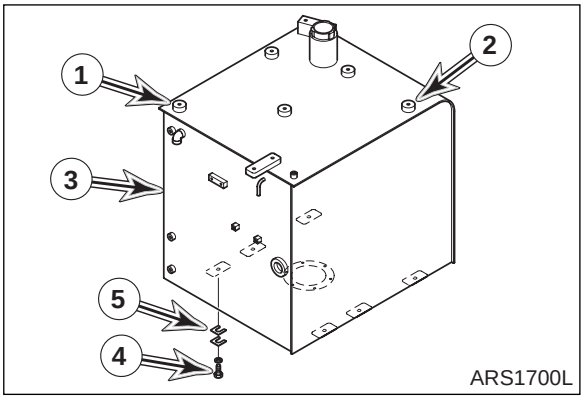


Figure 12

INSTALLATION

1. Install two 12 mm eye bolts in threaded holes (1 and 2, Figure 13). Using a suitable lifting device, sling eye bolts.
2. Set fuel tank (3, Figure 13) into position. Install six bolts and washers (4) finger tight, to secure tank to frame.

   NOTE: *The clear level gauge on the side of the tank is easily damaged. Be careful of obstacles and wind gusts.*
3. Install shims (5, Figure 13) as needed to prevent tank (3) from rocking or stress from mounting bolts (4).
4. Tighten mounting bolts (4, Figure 13) after shims are installed.

   NOTE: *Bolt torque is 27 kg.m*
5. Install four bolts (1and 2, Figure 14) and cover (3) on fuel tank and support.

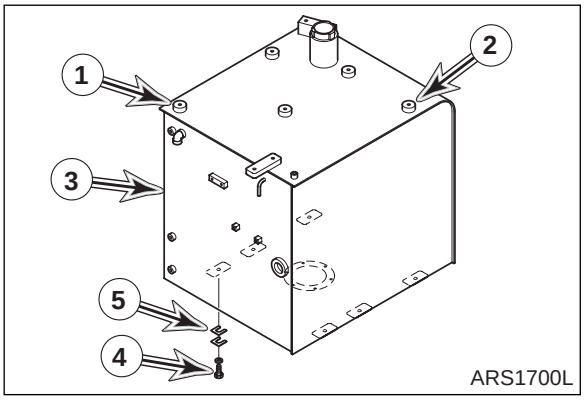


Figure 13

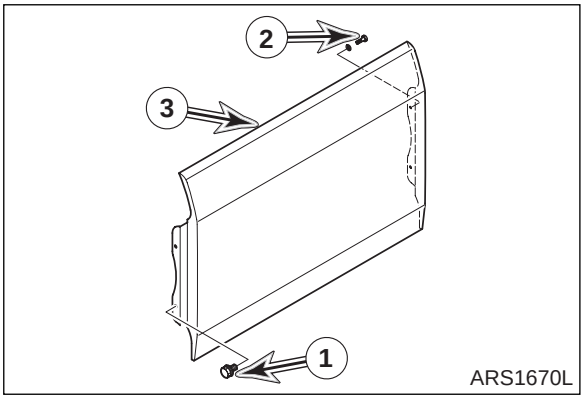


Figure 14

6. Install four bolts (4, Figure 15) and battery cover (5) on frame.

   Install four bolts (1 and 2), clamp (6) and stay (3) on fuel tank and frame.

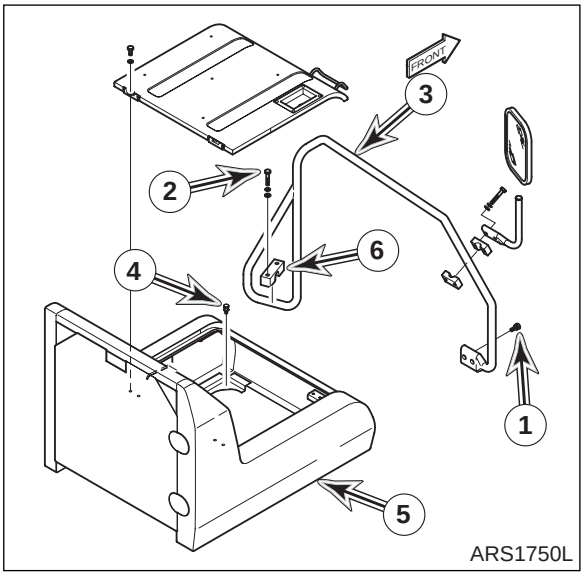


Figure 15

7. Install six bolts (1, Figure 16) and cover (2) on fuel tank.

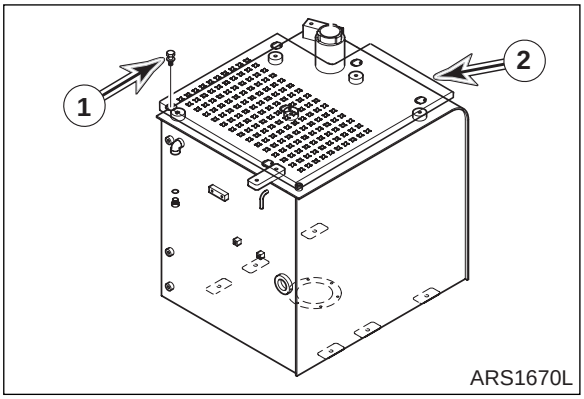


Figure 16

8. Connect wires as tagged to fuel sensor (1, Figure 17) on side of fuel tank (2).
9. If equipped, connect components to fuel filter pump port (3, Figure 17) on side of fuel tank (2).

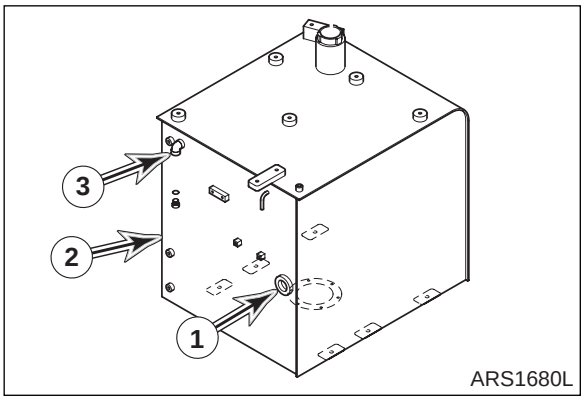


Figure 17

10. Connect as tagged, fuel supply line (1, Figure 18) and fuel return line (2) to fuel tank (3).
11. Install clamp (4, Figure 18) to hold fuel return line (2) to tank (3).

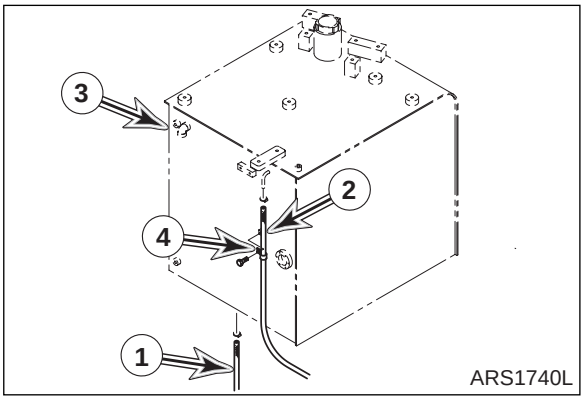


Figure 18

12. Make sure fuel tank drain valve (Figure 19) on bottom of tank is closed.
13. Fill fuel tank and check for signs of leaks. Correct any problems found.
14. Connect negative (-) battery cable to battery.

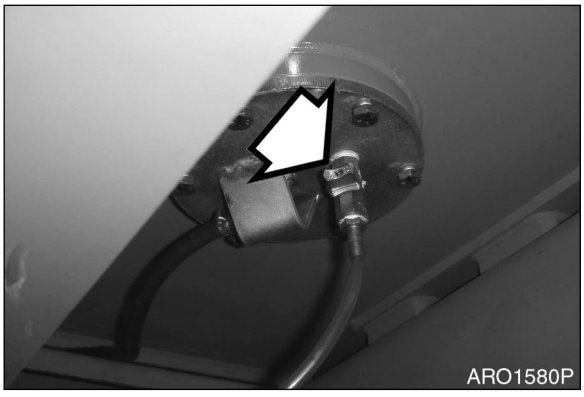


Figure 19

START-UP PROCEDURES

If engine does not start, the fuel system may need priming. Prime the fuel system using the following procedure;

1. Loosen plug (Figure 20) on top of fuel filter head.

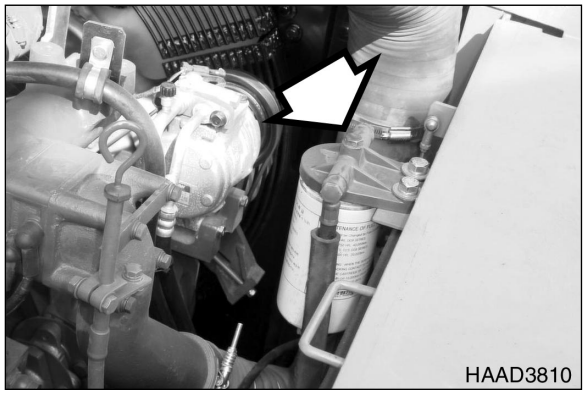


Figure 20

2. Unscrew and pump the hand operated primer pump (Figure 21) 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.

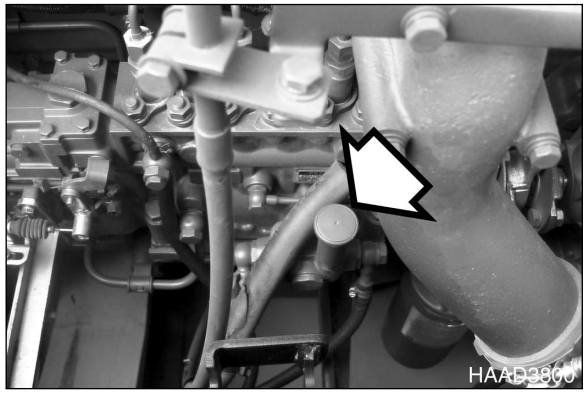


Figure 21

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FUEL TRANSFER PUMP

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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 200-V	1001 and Up
Mega 250-III	1001 and Up
Mega 250-V	1001 and Up
Mega 300-V	1001 and Up
Mega 400-III PLUS	1001 and Up
Mega 400-V	1001 and Up
Mega 500-V	1001 thru 2000
Solar 130LC-V	0001 and Up
Solar 130W-V	0001 and Up
Solar 170LC-V	1001 and Up
Solar 170W-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

Models continued on back of cover.

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MODEL	SERIAL NUMBER RANGE
Solar 290LC-V	0001 and Up
Solar 290LL	1001 and Up
Solar 300LC-V	1001 and Up
Solar 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 400LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 450LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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GENERAL DESCRIPTION

THEORY OF OPERATION

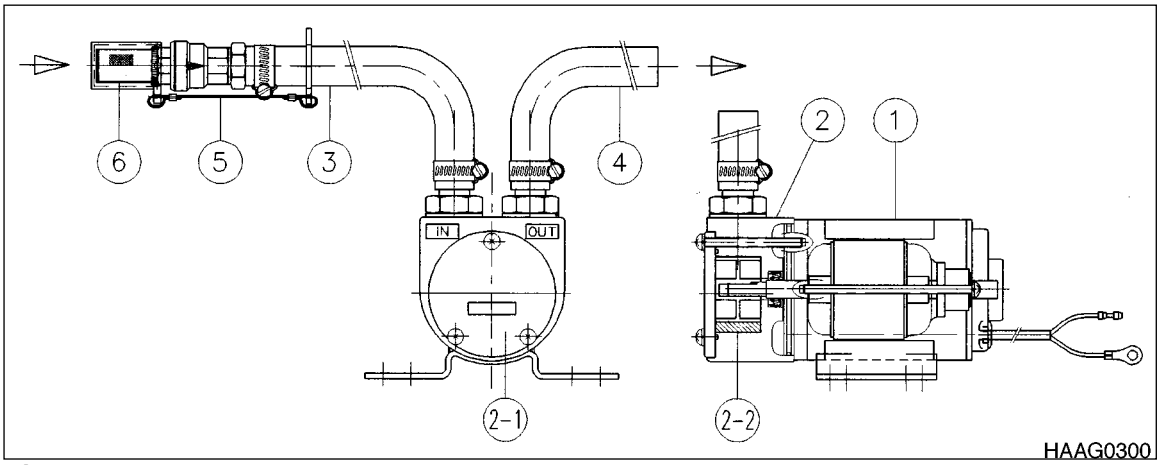


Figure 1

Reference Number	Description
1	Motor
2	Pump
2-1	Pump Cover
2-2	Rotor and Vane

Reference Number	Description
3	Inlet Hose
4	Outlet Hose
5	Check Valve
6	Strainer Cap

Fuel pump consists of motor, pump, switch and hose assembly.



Figure 2

TROUBLESHOOTING

On some pumps the ON-OFF switch is installed separately at a remote location.

A thermal limiter, built into the motor, will automatically shut off power if motor is overheating to protect it from damage.

NOTE: *OPEN TEMP: 150 ±5°C (302 ±41°F). After circuit is automatically shut off due to overheating the pump will stop running. When temperature drops below 143˚C (289˚F) the circuit will reactivate allowing the pump to restart.*

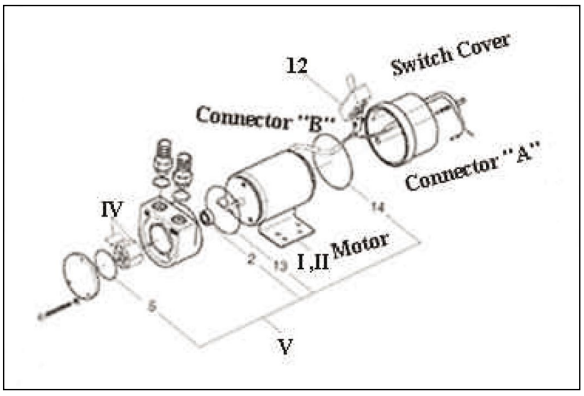


Figure 3 WITH TOGGLE SWITCH

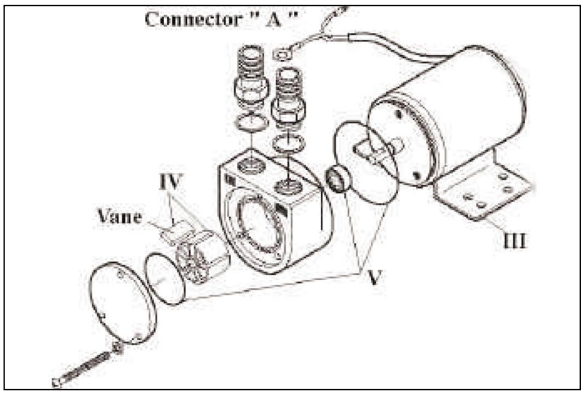


Figure 4 WITHOUT TOGGLE SWITCH

Check resistance at connectors "A." If reading is zero, or very close to zero, the motor is bad and must be replaced.

On units equipped with a toggle switch, check the resistance through the toggle switch, while the switch is in the "ON" position. If continuity is not present, the switch is bad. Be sure to check resistance through the motor.

REPLACEMENT OF ROTOR AND VANE

If dirt or other foreign materials enter pump during operation, it can become lodged between the rotor and/or vanes and generate heat which can cause pump damage.

Remove the pump cover and check the rotor and vane. If any pump parts or components become lost, damaged or inoperable, immediately replace them with a new ones.

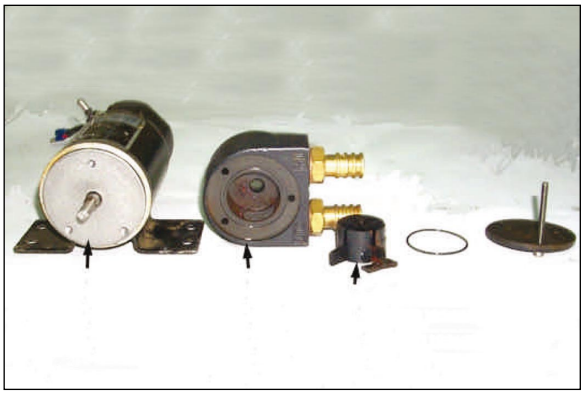


Figure 5 WITHOUT TOGGLE SWITCH

Insert vane, with the circled edge of vane facing in the counterclockwise direction. (Detail A)

Insert O-ring again at reassembly of pump cover.

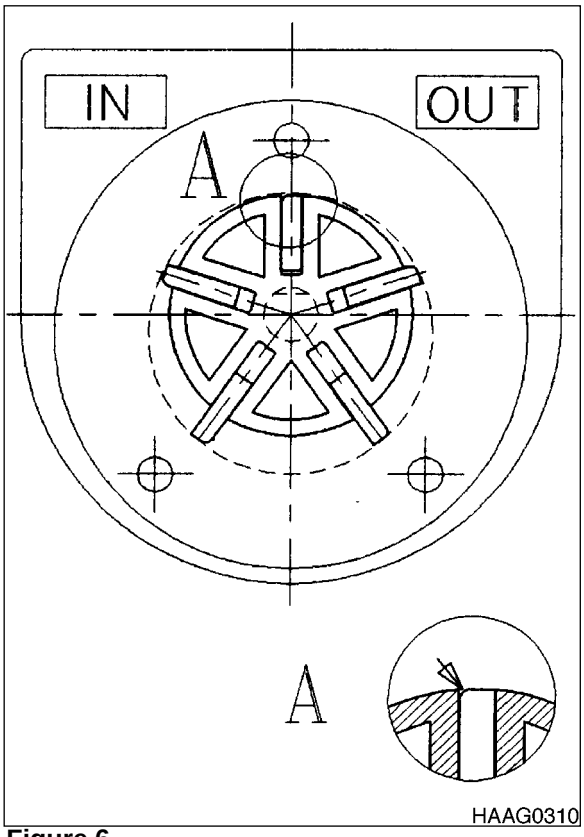


Figure 6

REPLACEMENT OF REAR COVER

Brush assembly and a thermal limiter are installed in the rear cover. If you find any damage, replace them with new ones.

Loosen the switch cover and screw (M5 x L95) from the rear cover.

Remove cover.

At reassembly of rear cover, widen the space of brush and insert it to the armature. Then fit the hole of screw in the housing.

Be careful when installing screw. The cover screw may be attracted by the motor magnet.

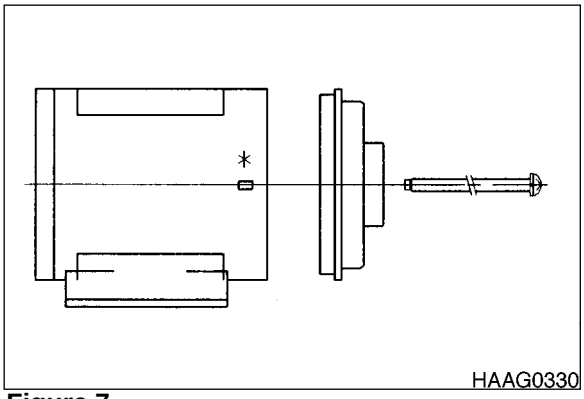


Figure 7

REPLACEMENT OF ARMATURE

You can replace only the armature in case motor was damaged by a short circuit.

Remove the switch cover and rear cover, than remove the armature from the housing.

Loosen the pump cover and remove the rotor and vane.

Insert a new armature into the housing.

Refer to “Replacement of Rear Cover” on page 5, for installation of rear cover.

Fit the rotor in the shaft flute of armature. Insert vane to the rotor being careful for the direction. Refer to “Replacement of Rotor and Vane” on page 4.

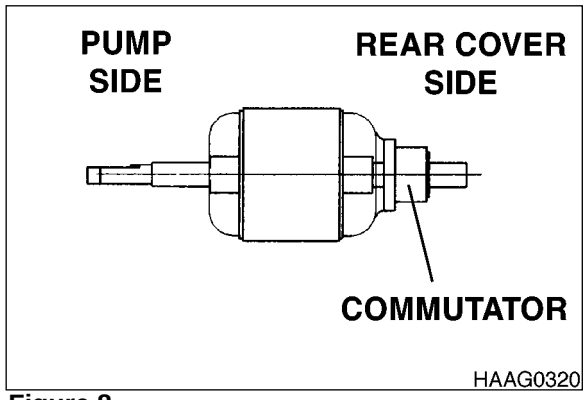


Figure 8

SWING BEARING

⚠ 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 170LC-V	1001 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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 330LC-V	1001 and Up
Solar 340LC-V	1001 and Up
Solar 400LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 450LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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- Rebuilding Swing Bearing 4

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.

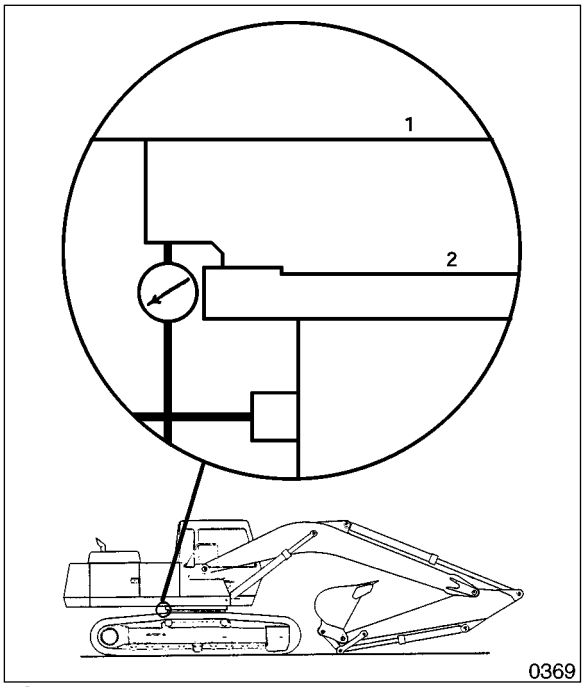


Figure 1

MEASURING BEARING LATERAL PLAY

When 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.

SWING BEARING BASIC OPERATION

The swing bearing, which connects the upper structure with the lower structure, consists of a inner ring, outer ring and ball bearings. During swing movement, power from the swing motor is transferred to the pinion by planetary gears connected to gears on the inner ring, which is fixed in the undercarriage. Ball bearings turn the outer ring.

Reference Number	Description
1	Ball
2	Seal A
3	Seal B
4	Retainer
5	Retainer
6	Outer Ring
7	Inner Ring
8	Tapered Pin
9	Plug

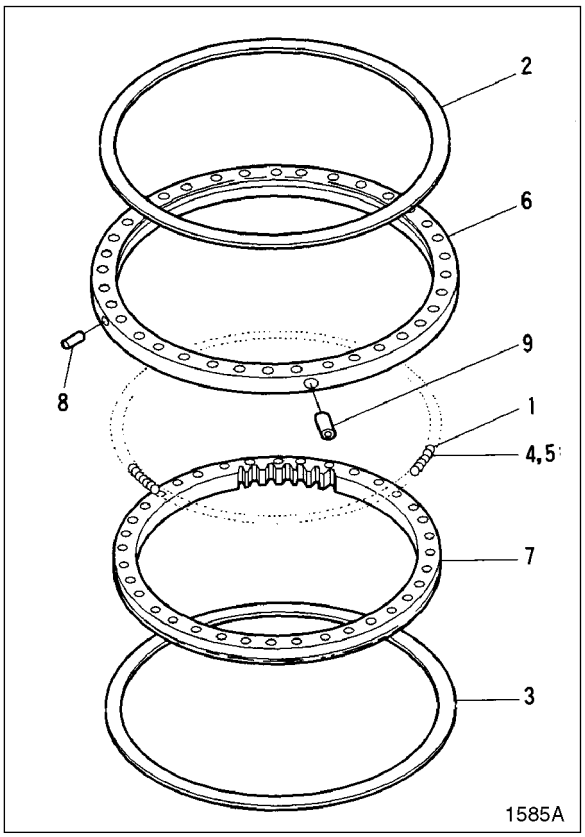


Figure 2

REBUILDING SWING BEARING

1. Remove tip of tapered pin (1, Figure 3) using grinder and tap lightly to remove debris.

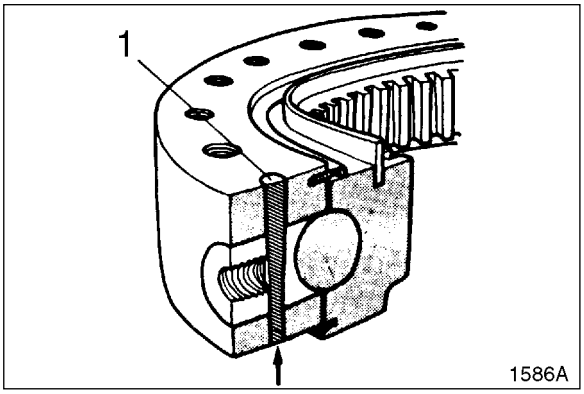


Figure 3

2. Remove plug (1, Figure 4) using a M10 x 1.25 bolt (2).

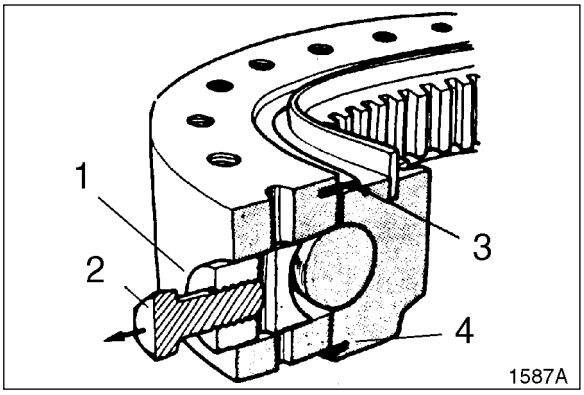


Figure 4

3. Lift outer ring and check that inner ring can move freely. See Figure 5, if not, replace seal (3, Figure 4) and/or seal (4, Figure 4).

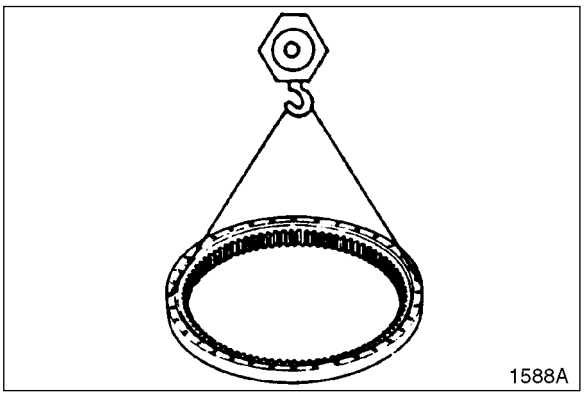


Figure 5

4. Turn inner ring and use magnet bar (1, Figure 6) to remove steel balls (2).

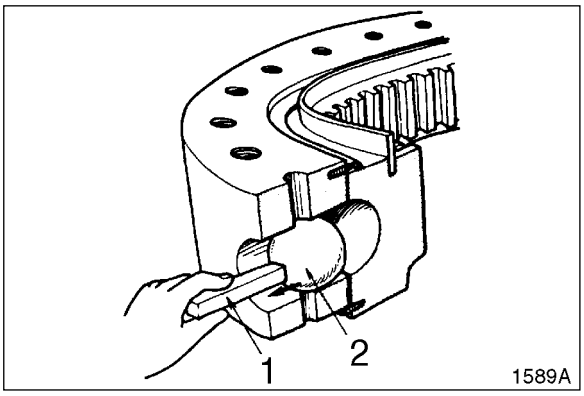


Figure 6

5. Turn inner ring and use wire (1, Figure 7) to remove retainers (2).

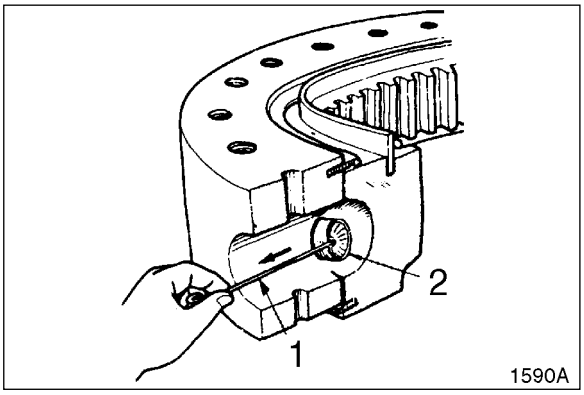


Figure 7

6. Assemble in reverse order of disassembly and then adjust the gap between the steel balls and retainers using the following guidelines: Assemble steel ball, retainer (A) and retainer (B) to bearing; if gap is too wide, adjust by moving steel balls or by replacing one of the retainers.

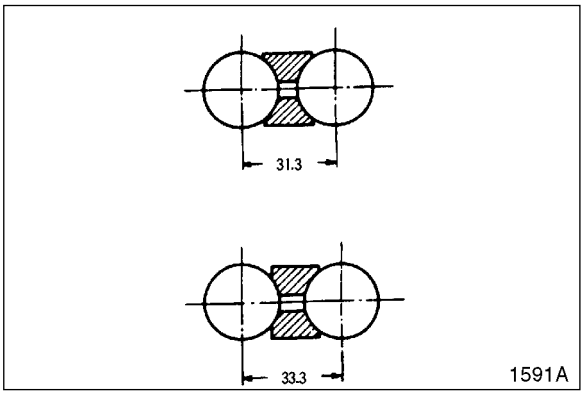


Figure 8

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DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

SWING REDUCTION GEAR (M105)

⚠ 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 300LC-V	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up

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GENERAL DESCRIPTION

THEORY OF OPERATION

The swing motor final drive is a two-step planetary gearbox with two planet gears, two sun gears and two-step output reduction. The planetary gear engages with the ring gear. The pinion gear is connected with the output shaft and spline.

The final drive reduces swing motor RPM in order to increase swing motor output torque. The available maximum swing speed provides a fast turning rate for efficient, rapid work cycling with more than adequate power for good acceleration.

PARTS LIST

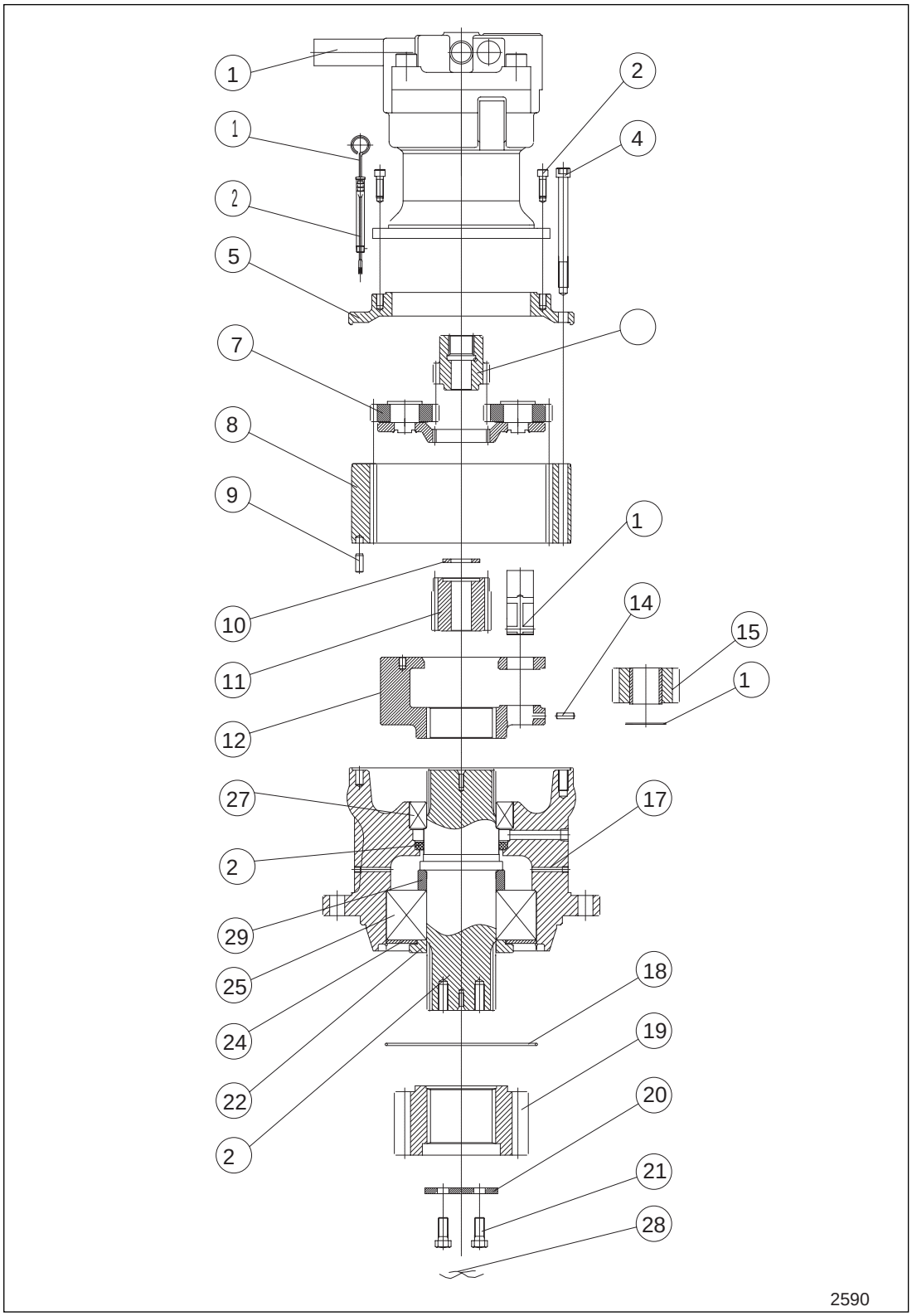


Figure 1

Reference Number	Description
1	Motor
2	Socket Bolt (M12x35)
3-1	Level Gauge
3-2	Pipe
4	Socket Bolt(M16x180)
5	Cover Plate
6	No.1 Sun Gear
7	No. 1 Carrier Assembly
8	Ring Gear
9	Lock Pin
10	Thrust Plate
11	No. 2 Sun Gear
12	No. 2 Carrier
13	No. 2 Shaft For Pin
14	Spring Pin

Reference Number	Description
15	No. 2 Planetary Gear
16	No. 2 Side Plate
17	Gear Case
18	Lock Ring
19	Pinion Gear
20	Cover
21	Hex Bolt (M16x40)
22	Collar
23	Seal
24	Plate
25	Bearing
26	Shaft
27	Bearing
28	Lock Wire
29	Spacer

SPECIFICATIONS

Swing Reduction Gearbox	Specification
Drive Type	2-Stage Planetary Gear
Reduction Ratio	21.968
Maximum Output Speed	63 rpm
Maximum Output Torque	1,860 kg•m (1,345 ft lb)
Weight	320 kg (706 lb)

Pinion Gear	Specification
Type	Spur Gear
Gear P.C.D	190 mm (7.48 in.)
No. of Teeth	14
Module	14

SPECIAL TOOLS AND MATERIALS

SPECIAL TOOLS

Tool "A"

Dimension	Measurement
A	∅190 mm (7.4803 in)
B	∅220 mm (8.6614 in)
C	350 mm (13.7795 in)

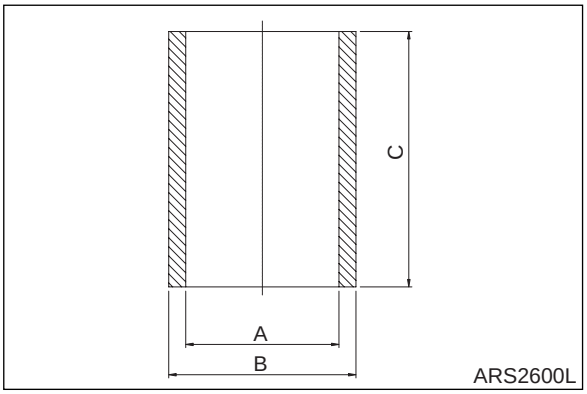


Figure 2

Tool "B"

Dimension	Measurement
A	∅156 mm (6.1417 in)
B	∅130 mm (5.1181 in)
C	$3^{+0.5}_{+0.3}$ mm (0.1299 - 0.1378 in)
D	128 mm (5.0394 in)
E	20 mm (0.7874 in)
F	120 mm (4.7244 in)
G	268 mm (10.5512 in)
H	∅60 mm (2.3622 in)
I	∅168 mm (6.6142 in)

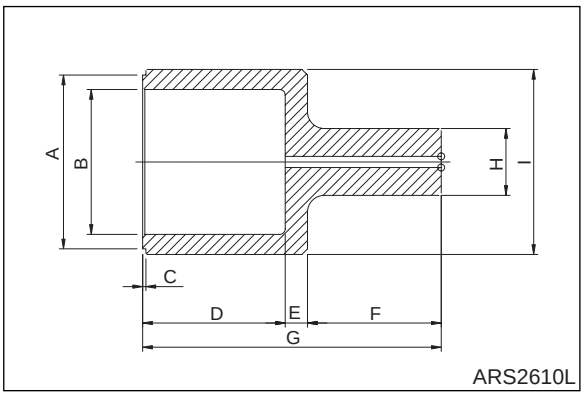


Figure 3

Tool "C"

Dimension	Measurement
A	70 mm (2.7559 in)
B	6 mm (0.2362 in)
C	6 mm (0.2362 in)
D	18 mm (0.7087 in)

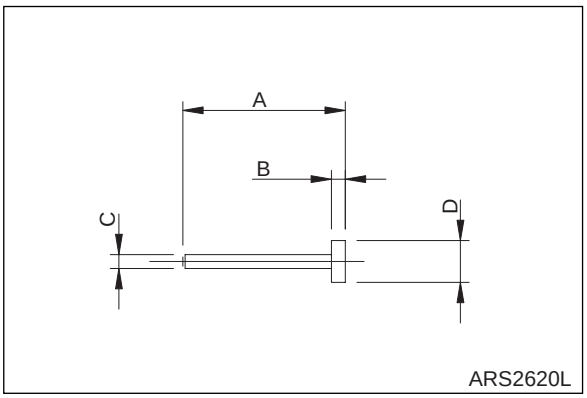


Figure 4

Tool "D"

Dimension	Measurement
A	∅60 mm (2.3622 in)
B	∅80 mm (3.1496 in)
C	150 mm (5.9055 in)

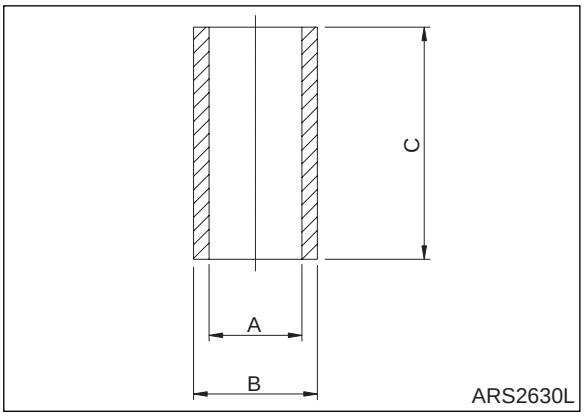


Figure 5

Tool "E"

Dimension	Measurement
A	∅108 mm (4.2520 in)
B	∅138 mm (5.4331 in)
C	150 mm (5.9055 in)

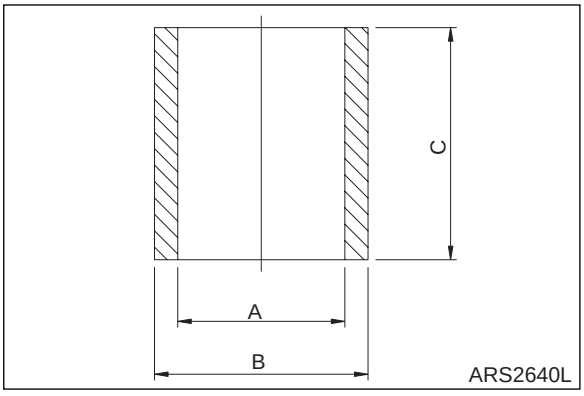


Figure 6

Tool "F"

Dimension	Measurement
A	∅128 mm (5.0394 in)
B	∅158 mm (6.2205 in)
C	150 mm (5.9055 in)

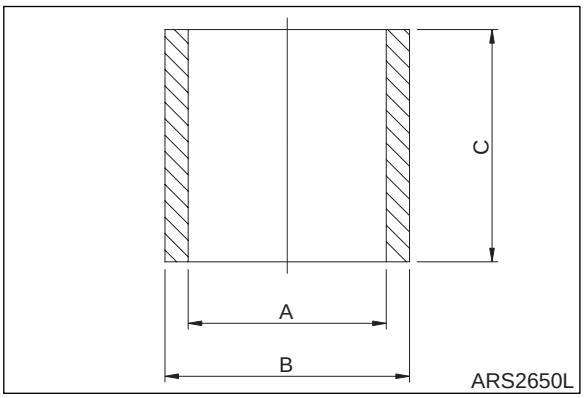


Figure 7

TROUBLESHOOTING, TESTING AND ADJUSTMENT

Symptoms	Possible Causes	Remedies
1. No rotation and –		
a. 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, drive train assemblies
	Overload	Reduce load weight
b. 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
c. Pressure at swing motor inlet shows *no increase,* but **without** irregular *noises* from the swing motor	Hydraulic pump or valve broken	Troubleshoot hydraulic system
2. Oil leakage		
a. From drive shaft	Oil seal damaged	Replace oil seal
b. From bolted connections or other assembled surfaces	Assembly compound (joint sealer) old and not sealing, bolt not tight or flange warped	Disassemble and check mating surfaces. Reapply Loctite, torque bolts to specifications
3. Excess heat		
Gearbox casing becomes excessively hot, with or without irregular noise(s) during operation	Low oil level	Replace oil, refill to specified level
	Bearings or gear worn but not completely inoperative	Repair or replace gearbox

HAOE960L

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 9). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.
8. Remove drain plug (3, Figure 9) from frame and drain oil from reduction gearbox (5, Figure 9).
9. Disconnect and grease lubrication line (7, Figure 9) from reduction gearbox (5).
10. Remove twelve bolts and washers (4, Figure 9) holding swing reduction gearbox (5) to frame.
11. Using a suitable lifting device, sling swing motor (1, Figure 9) and remove swing motor and reduction gearbox (5) as an assembly from unit.

    NOTE: *There are two alignment pins (6*, Figure 9*), located on reduction gearbox flange.*

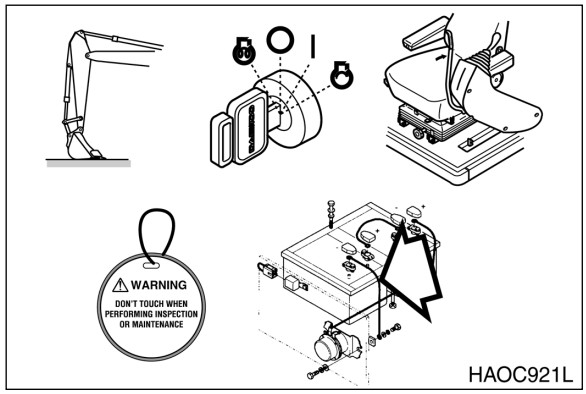


Figure 8

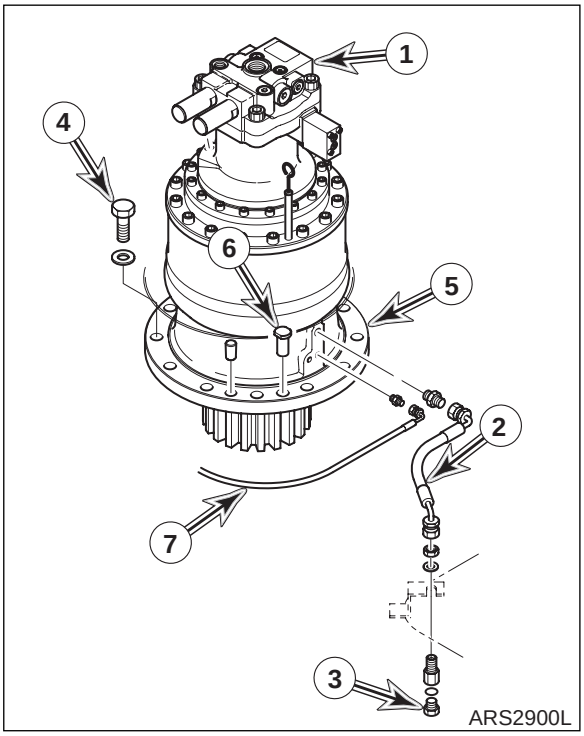


Figure 9

DISASSEMBLY

1. Drain oil from port A.
2. Using a pipe wrench, remove oil level gauge (3-1) and pipe (3-2) (PT1/4).

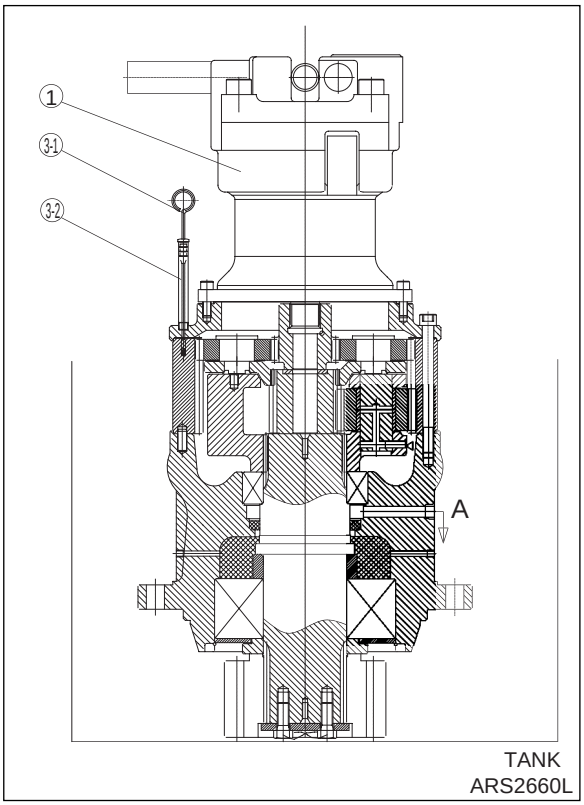


Figure 10

3. Using L-wrench, remove socket bolts (2) and motor (1).

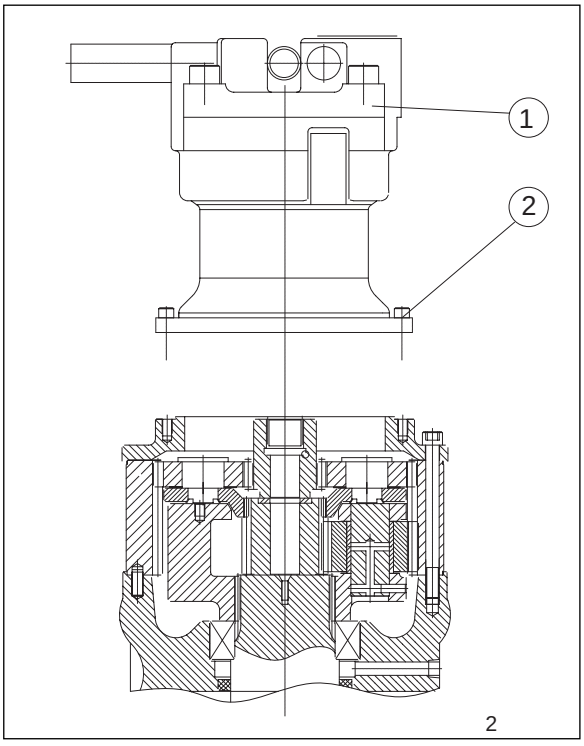


Figure 11

4. Using L-wrench, remove socket bolts (4) and cover (5).

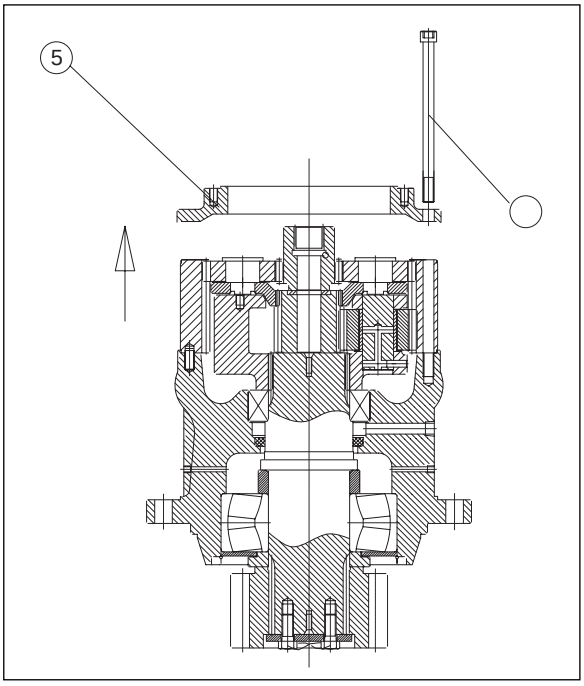


Figure 12

5. Remove sun gear No. 1 (6) and carrier assembly No. 1 (7). Remove thrust plate (10).

IMPORTANT
Do not remove carrier assembly No. 1 (7) in field because pin No. 1 and carrier No. 1 are caulked.

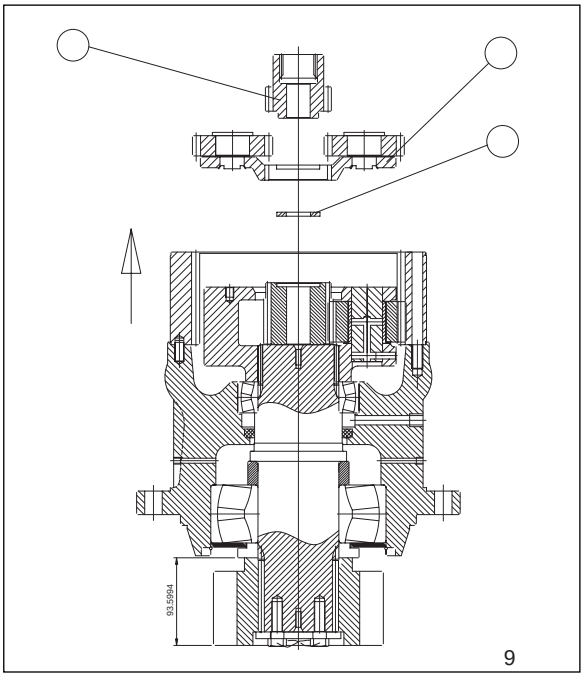


Figure 13

6. Remove sun gear No. 2 (11). Remove carrier assembly No. 2 and disassemble it.

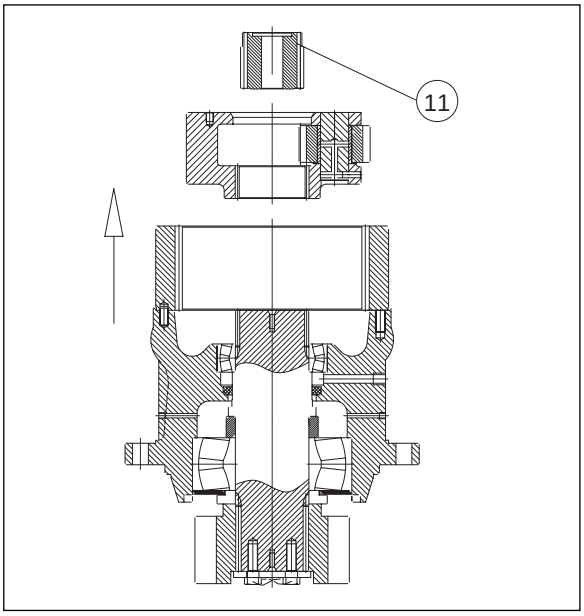


Figure 14

7. Using special tool (C), drive spring pin (14) into shaft No. 2 (13). This will allow shaft to be pressed out of carrier No. 2.

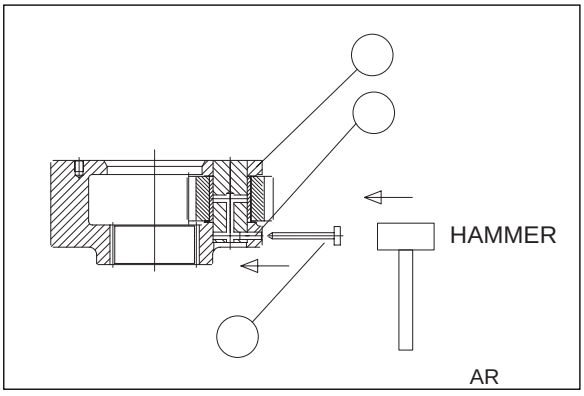


Figure 15

8. Remove shaft No. 2 (13) from carrier No. 2 (12). Remove spring pin (14) from shaft No. 2 (13). Remove planetary gear No. 2 (15) and side plate (16) from carrier No. 2 (12).

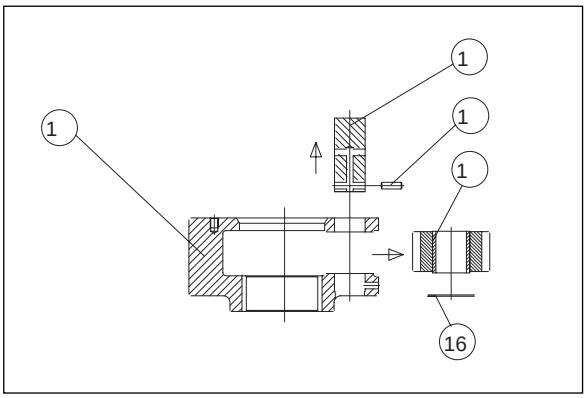


Figure 16

9. Remove ring gear (8). Remove lock pin (9) and turn body over.

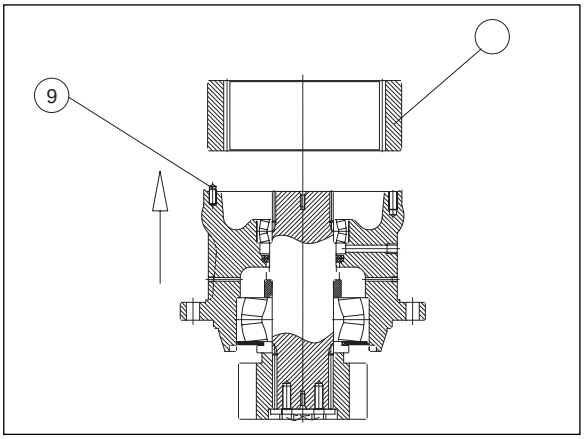


Figure 17

10. Remove wire (28) and hex bolt (21) by using socket wrench. Remove cover (20) and pinion (19).

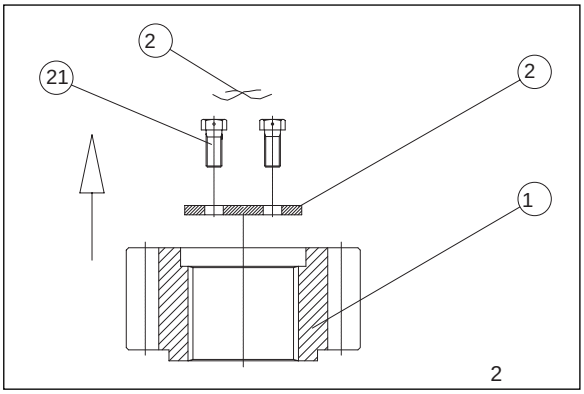


Figure 18

11. Remove lock ring (18). Put jig (D) on shaft (26) and press shaft assembly (22, 24, 25 and 26) out.

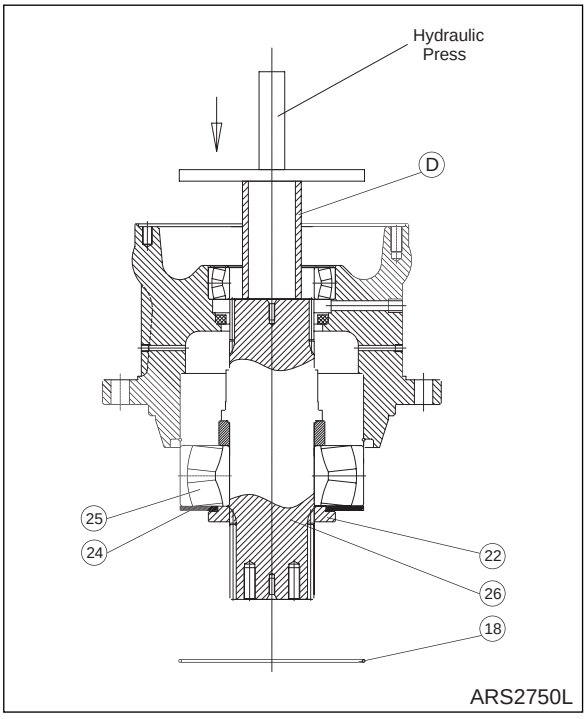


Figure 19 HYDRAULIC PRESS

12. Put jig (A) on bearing (25) and press bearing (25), plate (24) and collar (22) from shaft (26). Pull spacer (29) out.

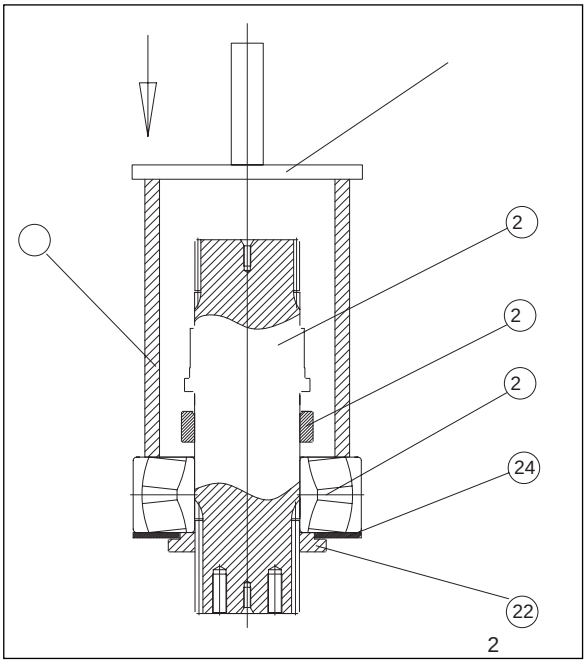


Figure 20 HYDRAULIC PRESS

13. Remove bearing (27). Put jig (F) on seal (23) and using a rubber hammer, tap seal (23) out of gear case (17).

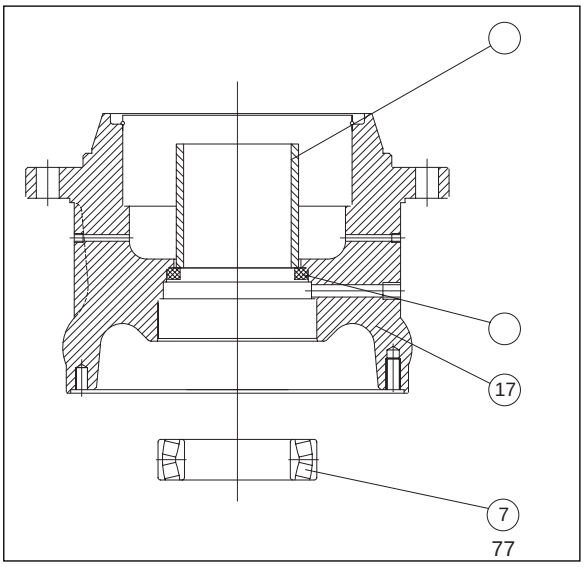


Figure 21

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

Inspect all components in the assembly. Pay particular attention to oil seals, lock and spring pins and fastener bolts. Using new replacement parts for these components is recommended whenever there is any doubt at all about the condition or serviceability of original parts.

REASSEMBLY

1. Install spacer (29) on shaft (26). Poisition jig (A) on bearing (25) and press bearing (25) on shaft (26) until contact is obtained.

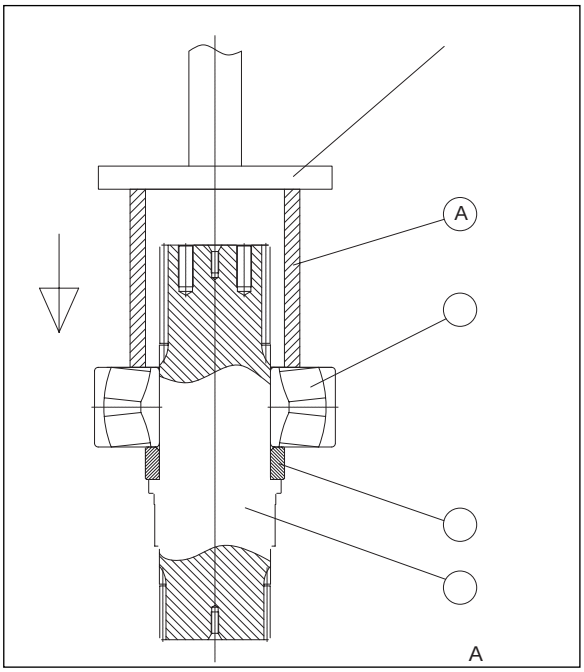


Figure 22 HYDRAULIC PRESS

2. Install plate (24) on shaft (26). Position Jig (A) on collar (22) and press collar (22) on shaft (26) until contact is obtained.

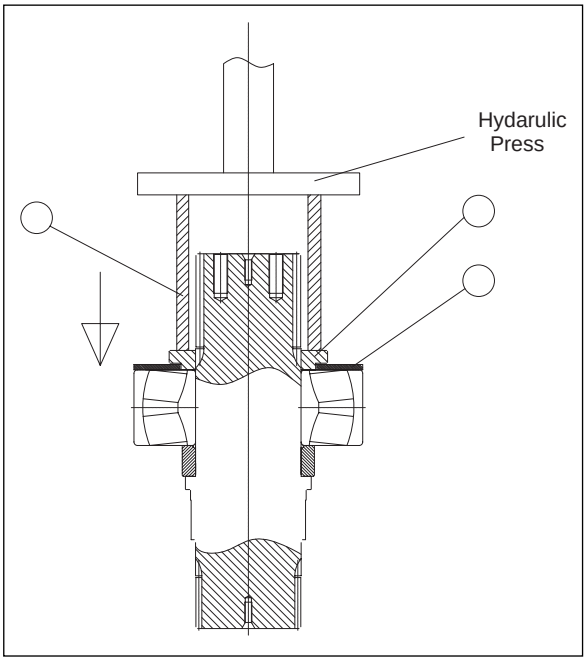


Figure 23 HYDRAULIC PRESS

3. Install pinion gear (19) on shaft assembly. Fasten cover (20) with hex bolts (21) and secure with lock wire (28) diagonally.

   NOTE: *Apply Loctite #262 to bolt threads.*

   NOTE: *Tighten bolt to 2,700 kg•cm (195 ft lb).*

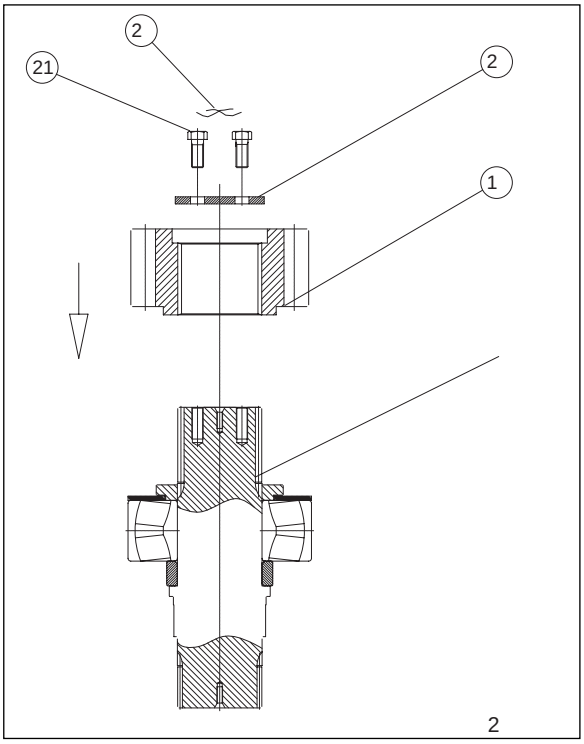


Figure 24

4. Put jig (A) on pinion gear and press shaft assembly with pinion into case (17) until contact is obtained. Install lock ring (18) and turn case over.

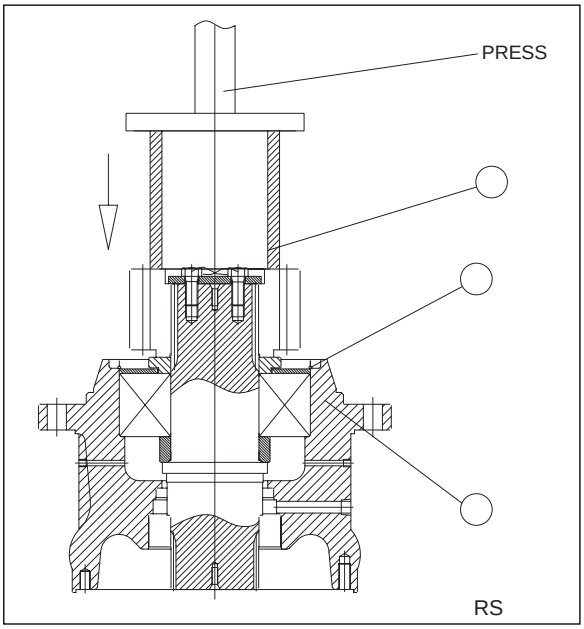


Figure 25

5. Using jig (B), insert seal (23) into case (17).

IMPORTANT
When installing, tap with rubber hammer lightly not to damage seal.

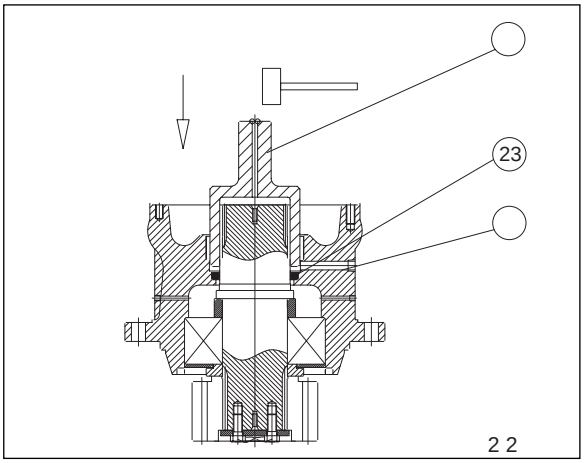


Figure 26

6. Place jig (F) on bearing (27) and press bearing (27) onto shaft assembly until contact is obtained.

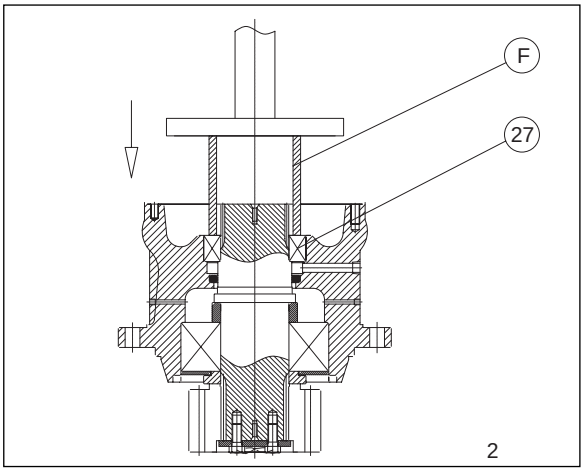


Figure 27

7. Insert lock pin (9) in case (17) and install ring gear (8) on case (17).

   NOTE: *Coat mating faces of case (17) and ring gear (8) with Loctite #609.*

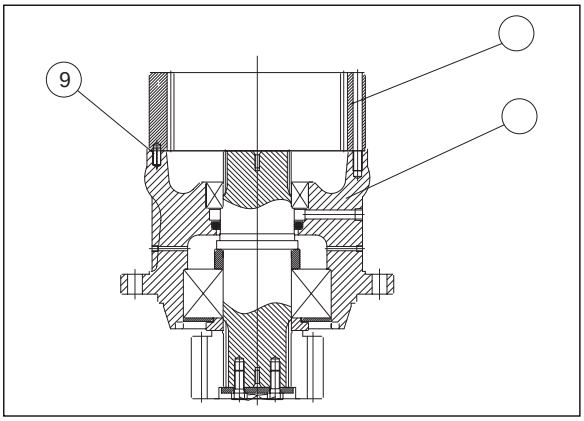


Figure 28

8. Install side plate No. 2 (16) on planetary gear No. 2 (15) and insert it into carrier No. 2 (12). Install shaft No. 2 (13) into carrier No. 2 (12) and planetary gear No. 2 (15). Using a hammer, tap pin (14) into carrier No. 2 (12) and shaft No. 2 (13).

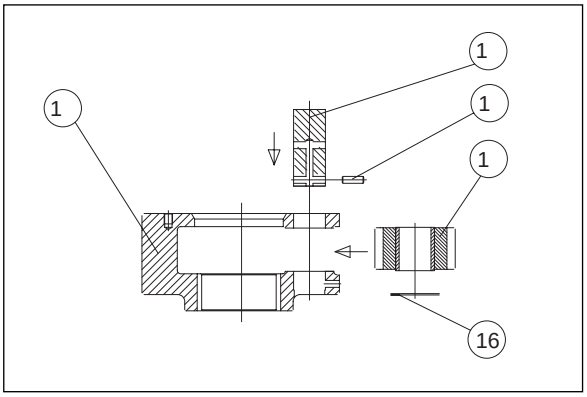


Figure 29

9. Install carrier assembly No. 2 onto ring gear (8) and shaft assembly and install sun gear No. 2 (11) in carrier assembly No. 2.

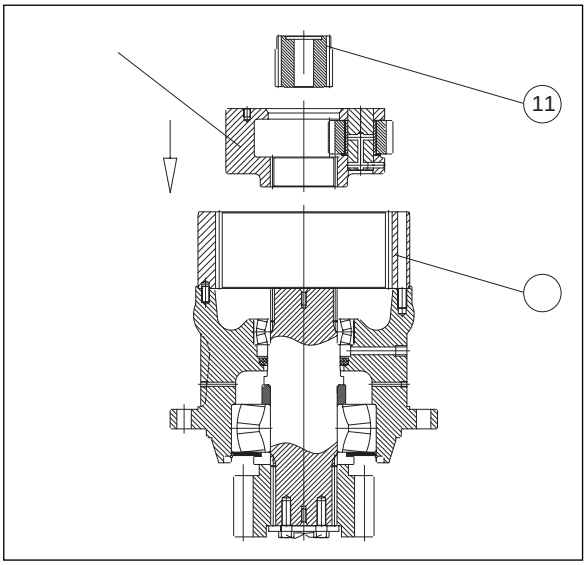


Figure 30

10. Insert thrust plate (10) in sun gear No. 2 (11). Install carrier assembly No. 1 (7) onto ring gear (8) and sun gear No. 2 (11). Install sun gear No. 1 (6) onto carrier assembly No. 1 (7).

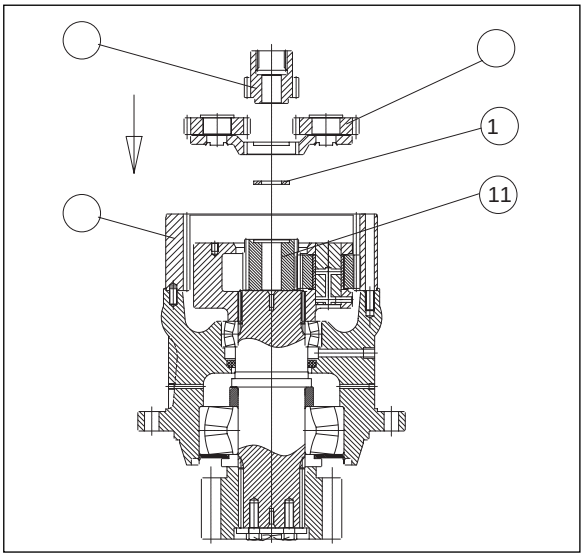


Figure 31

11. Secure cover plate (5) and ring gear (8) onto gear case (17) with socket bolt (4).

    NOTE: *Coat mating faces of ring gear (8) and cover plate (5) with Loctite #609.*

    NOTE: *Apply Loctite #262 to bolt threads.*

    NOTE: *Tighten bolt to 2,700 kg•cm (195 ft lb).*

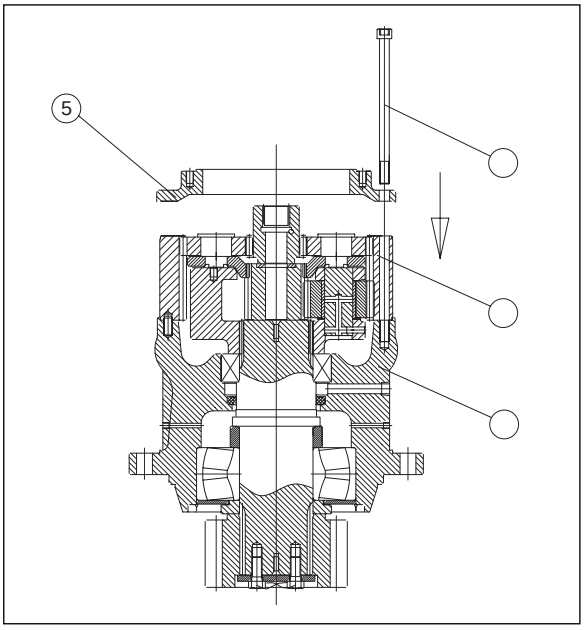


Figure 32

12. Secure motor (1) onto cover plate (5) with socket bolt (2). Install pipe (3-2) onto cover plate (5). Insert oil level gauge (3-1) into pipe.

    NOTE: *Coat mating faces of cover plate (5) and motor (1) with Loctite #609.*

    NOTE: *Apply Loctite #262 to bolt threads.*

    NOTE: *Tighten bolt to 1,100 kg•cm (875 ft lb).*

IMPORTANT
After reassembling, turn gear pinion by hand and check if it is turned smoothly.

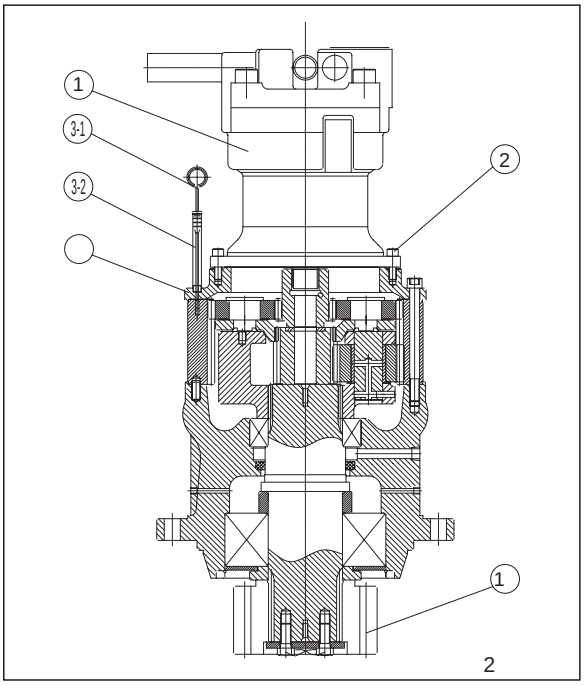


Figure 33

INSTALLATION

1. Coat pinion gear with grease. Refer to operation manual for specifications.
2. Make sure two alignment pins (6, Figure 34) are installed in flange of swing reduction gearbox (5).
3. Using a suitable lifting device, sling swing motor (1, Figure 34) and position swing motor and reduction gearbox (5) as an assembly on unit.
4. Install twelve bolts and washers (4, Figure 34) to secure swing reduction gearbox (5) to frame.

   NOTE: *Apply Loctite #262 to bolt threads.*

   NOTE: *Tighten bolt to 95 kg•m (6.87 ft lb).*
5. Install drain plug (3) to frame.
6. Connect and grease lubrication line (7, Figure 34) to reduction gearbox (5).
7. Connect hoses as tagged during removal to swing motor (1, Figure 34).
8. Fill swing reduction gearbox with oil. Refer to operation manual for specifications.

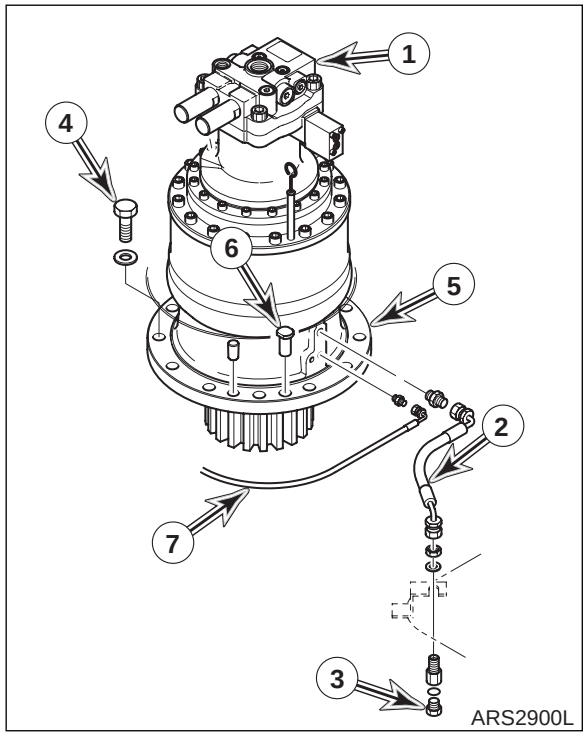


Figure 34

START-UP PROCEDURES

IMPORTANT

If the air is not vented from the system, it will cause damage to the swing motor and bearings.

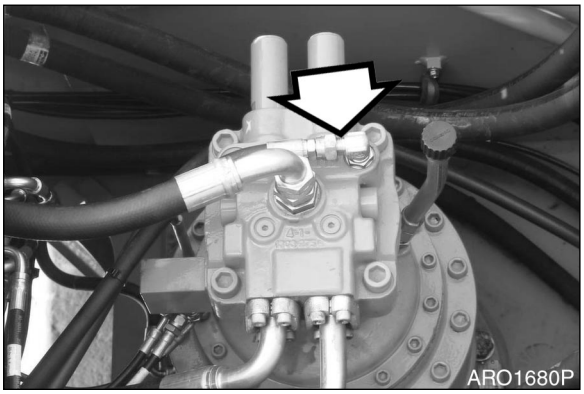


Figure 35

1. Disconnect drain hose and fill swing motor case with hydraulic oil.
2. Connect the drain hose.
3. Start engine and set throttle at "LOW IDLE" and swing upper structure slowly two full revolutions to the left and right.
4. Shut the engine down and check the hydraulic oil level. Fill hydraulic oil tank to "H" mark on sight gauge.
5. Check for oil leaks and clean all fill and venting locations.

LOWER STRUCTURE AND CHASSIS

TRACK ASSEMBLY

⚠ 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 300LC-V	1001 and Up

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December 2001

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GENERAL DESCRIPTION

The track assembly is composed of the following major components:

1. Track
2. Front Idler Roller
3. Upper Roller
4. Lower Roller
5. Track Spring and Track Adjustment Cylinder

TRACK TENSION

⚠ WARNING!

Safely measuring track tension requires two people. One person must be in the operator's seat, running the controls to keep one side frame in the air, while the other person makes dimensional checks. Take all necessary precautions to make sure the machine won't move or shift position during service. Warm up the engine to prevent stalls, travel the excavator to an area that provides level, uniform ground support and/or use support blocks when necessary.

The track adjusting mechanism is under very high pressure. NEVER release pressure too suddenly. The grease cylinder valve should never be backed off more than 1 complete turn from the fully snugged down position. Bleed off pressure slowly and keep your body away from the valve at all times.

Track shoe link pins and bushings wear with normal usage, reducing track tension. Periodic adjustment is necessary to compensate for wear and it may also be required by working conditions.

1. Track tension is checked by jacking up one side of the excavator. See Figure 1. Place blocking under frame while taking measurement.

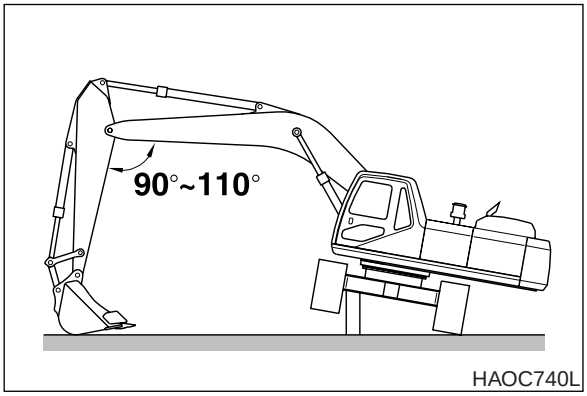


Figure 1

2. Measuring the distance (A, Figure 2) between the bottom of the side frame and the top of the lowest crawler shoe. Recommended tension for operation over most types of terrain is 340 - 370 mm (13.39 - 14.57 in)

   NOTE: *This measurement can be thrown off if there is too much mud or dirt or other material in the track assembly. Clean off the tracks before checking clearance.*

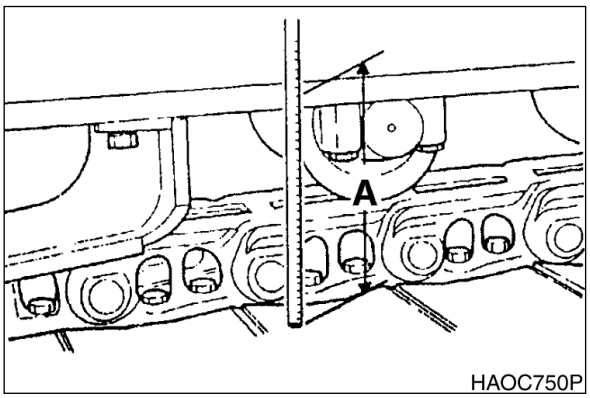


Figure 2

3. Too little sag in the crawler track (less than 340 mm (13.39 in) clearance) can cause excessive component wear. The recommended adjustment can also be too tight causing accelerated stress and wear if ground conditions are wet, marshy or muddy, or if the ground is hard and full of rocks or gravel.

4. The increased clearance recommended for muddy ground conditions is between 370 - 410 mm (14.57 - 16.14 in). The clearance should be approximately 410 mm (16.14 in) for operation over gravel, rocky terrain, or over sand or snow.

Terrain Type	Distance "A"
Normal	340 - 370 mm (13.39 - 14.57 in)
Muddy	370 - 410 mm (14.57 - 16.14 in)
Gravel, Rocky, Sand or Snow	410 mm (16.14 in)

WARNING!

The track adjusting mechanism is under very high pressure. NEVER release pressure too suddenly. The grease cylinder valve should never be backed off more than 1 complete turn from the fully snugged down position. Bleed off pressure slowly and keep your body away from the valve at all times.

5. Track tension adjustments are made through the grease fitting (1, Figure 3) in the middle of each side-frame. Adding grease increases the length of an adjustment cylinder (2). The longer the adjustment cylinder, the greater the pressure on the tension spring pushing the track idler wheel outward.

6. If there is not enough slack or clearance in the tracks and the adjustment is too tight, the idler wheel and adjusting cylinder can be retracted by bleeding off grease thru hole in adjustment cylinder (2, Figure 3).

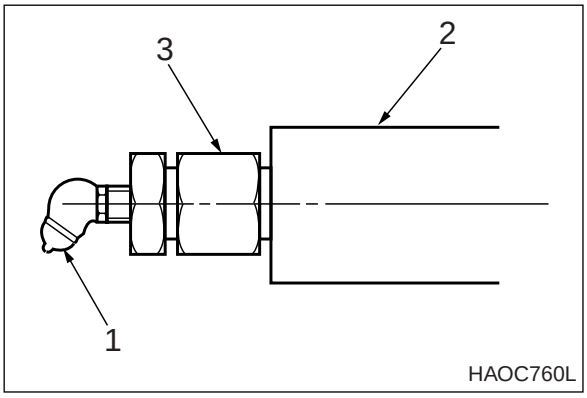


Figure 3

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

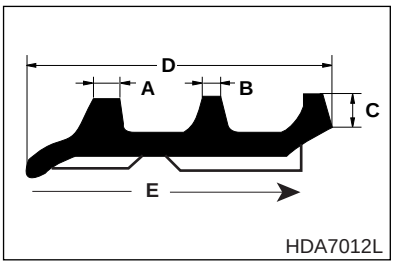
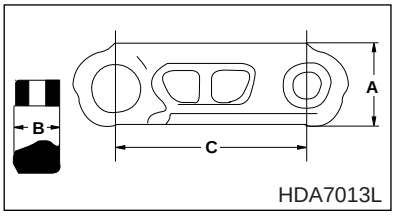
⚠ CAUTION!

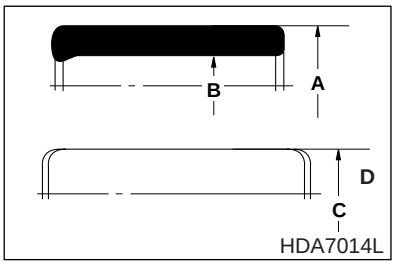
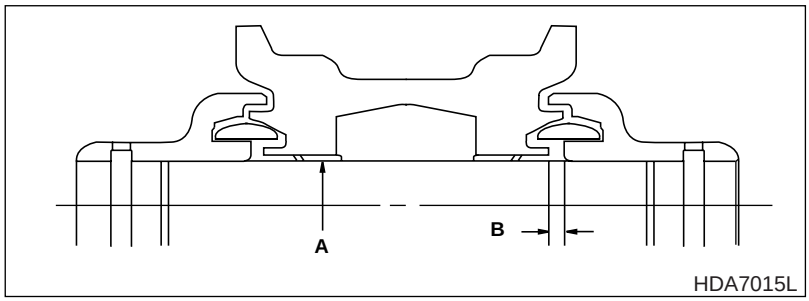
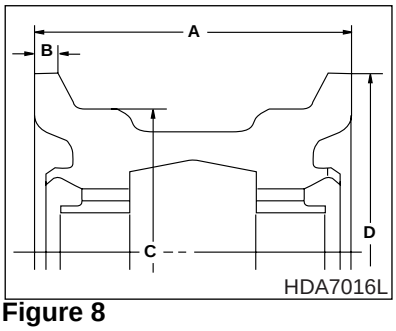
Refer to the "Welding Precautions and Guidelines" information in "General Maintenance Procedures" section for general recommendations and specific safety precautions, before starting any lower travel frame component rebuilding procedure.

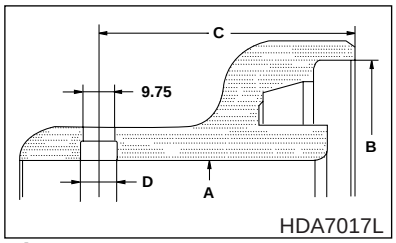
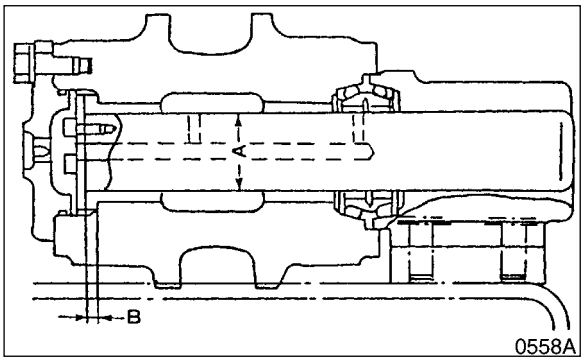
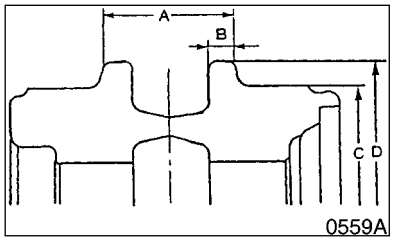
The tables that follow provide factory-specified dimensional limits (as-new condition, recommended service and replacement limit) for lower travel frame components.

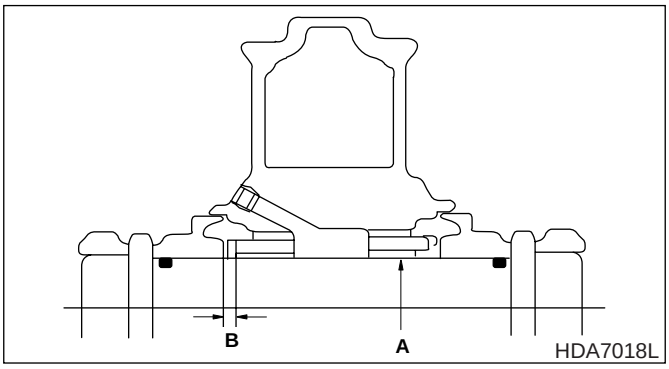
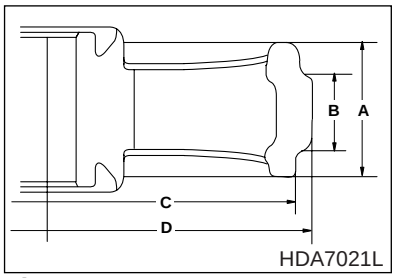
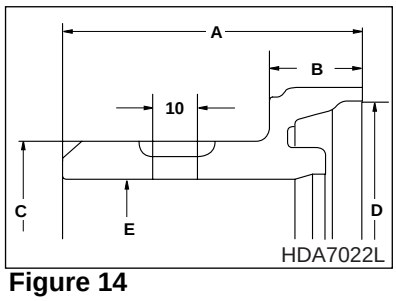
Recommended maintenance to renew most listed components requires welding on additional material and grinding off excess. Some components must be replaced before the service limit is exceeded. No maintenance or renewal is possible.

Compare the values in the tables with dimensions and profiles shown in the adjacent figures.

Component / Reference Dimensions	Reference	Normal (New) Dimension	Recommended Limit for Maintenance	Limit for Use (Repair - P or Replace - R)
Standard 600 mm Shoe  **Figure 4**	A	26 mm (1.024")	20 mm (0.787")	13 mm [P] (0.512")
	B	26 mm (1.024")	20 mm (0.787")	13 mm [P] (0.512")
	C	37 mm (1.457")	30 mm (1.181")	23 mm [P] (0.906")
	D	232.5 mm (9.154")		
	E	110 mm (4.331")		
Track link, master link  **Figure 5**	A	116.4 mm (4.583")	108 mm (4.252")	103 mm [P] (4.055")
	B	50 mm (1.969")	45 mm (1.772")	40 mm [P] (1.575")
	C*	203.2 mm (8.0")	206 mm (8.110")	208 mm [R] (8.189")
	*Check and record the pitch of at least 5 links. Use average of all measurements to assess required service or action. Master links must be replaced, they cannot be renewed or rebuilt.			

Component / Reference Dimensions	Reference	Normal (New) Dimension	Recommended Limit for Maintenance	Limit for Use (Repair - P or Replace - R)
Track link, master pin bushing, master bushing  **Figure 6**	A	66.45 mm (2.616")	62.5 mm (2.461")	59.0 mm [R] (2.323")
	B	45.0 mm (1.772")	47.0 mm (1.850")	49.0 mm [R] (1.929")
	C	44.5 mm (1.752")	42.5 mm (1.673")	41.5 mm [R] (1.634")
	D*	42.9 mm (1.689")	40.5 mm (1.594")	39.0 mm [R] (1.535")
	* Master pin			
 **Figure 7**				
Lower roller, axle	A	70 mm (2.756")	69.5 mm (2.736")	69.2 mm [R] (2.724")
Lower roller, bushing	A		70.5 mm (2.776")	71 mm [R] (2.796")
Axle-bushing, clearance			1.0 mm (0.039")	1.8 mm (0.071")
Lower roller, axle	B	10 mm (0.394")		
Lower roller, bushing	B		9.0 mm (0.354")	8.5 mm (0.335")
Lower roller dimensions  **Figure 8**	A	246 mm (9.685")	252 mm (9.921")	257 mm [R] (10.118")
	B	12.35 mm (0.486")	9.0 mm (0.354")	6.0 mm [P] (0.236")
	C	190 mm (7.480")	280 mm (11.024")	175 mm [P] (6.890")
	D	226 mm (8.898")	210 mm (8.268")	205 mm [P] (8.071")

Component / Reference Dimensions	Reference	Normal (New) Dimension	Recommended Limit for Maintenance	Limit for Use (Repair - P or Replace - R)
Lower roller, side collar  **Figure 9**	A	70 mm (2.756")	70.5 mm (2.776")	70.7 mm [R] (2.783")
	B	145 mm (5.709")	138 mm (5.433")	135 mm [R] (5.315")
	C	64.75 mm (2.550")	63.5 mm (2.50")	62.5 mm [R] (2.461")
 **Figure 10**				
Upper roller, axle	A	55 mm (2.165")	54.5 mm (2.146")	54.22 mm [R] (2.134")
Upper roller, bushing	A		55.5 mm (2.185")	56 mm [R] (2.205")
Axle-bushing, clearance			1.0 mm (0.039")	1.8 mm (0.071")
Upper roller, axle	B	6.5 mm (0.256")		
Upper roller, bushing	B		5.5 mm (0.217")	5.0 mm (0.197")
Upper idler  **Figure 11**	A	78 mm (3.071")	73 mm (2.874")	70 mm [P] (2.756")
	B	14 mm (0.551")	11 mm (0.433")	8 mm [P] (0.315")
	C	142 mm (5.591")	135 mm (5.315")	130 mm [P] (5.118")
	D	169 mm (6.654")	160 mm (6.299")	155 mm [P] (6.102")

Component / Reference Dimensions	Reference	Normal (New) Dimension	Recommended Limit for Maintenance	Limit for Use (Repair - P or Replace - R)
Front idler, axle	A	90 mm (3.543")	89.5 mm (3.524")	89.2 mm [R] (3.512")
 **Figure 12**				
Front idler, bushing	A		90.5 mm (3.563")	91 mm [R] (3.583")
Axle-bushing, clearance			1.0 mm (0.039")	1.8 mm (0.071")
Front idler, axle	B	8 mm (0.315")		
Front idler, bushing	B		7.0 mm (0.276")	6.5 mm (0.256")
Front idler  **Figure 13**	A	200 mm (7.874")	192 mm (7.559")	188 mm [P] (7.401")
	B	99 mm (3.898")	95 mm (3.740")	93 mm [P] (3.661")
	C	600 mm (23.622")	590 mm (23.228")	585 mm [P] (23.031")
	D	25 mm (0.984")	30 mm (1.181")	32.5 mm [P] (1.280")
Front idler, bearing  **Figure 14**	A	74 mm (2.913")	70 mm (2.756")	66 mm [P] (2.598")
	B	32.5 mm (1.280")	30 mm (1.181")	28 mm [P] (1.102")
	C	120 mm (4.724")	117 mm (4.606")	114 mm [P] (4.488")
	D	90 mm (3.543")	90.5 mm (3.563")	90.7 mm [P] (3.571")

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.*

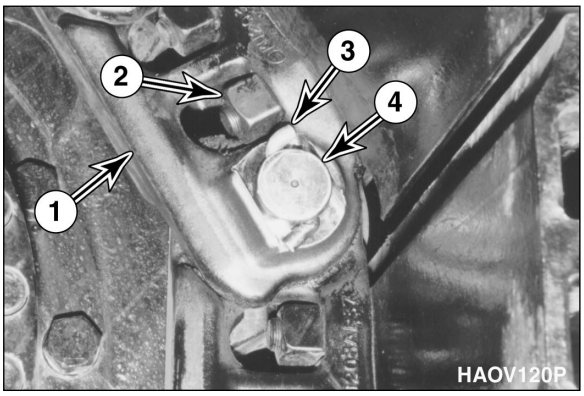


Figure 15

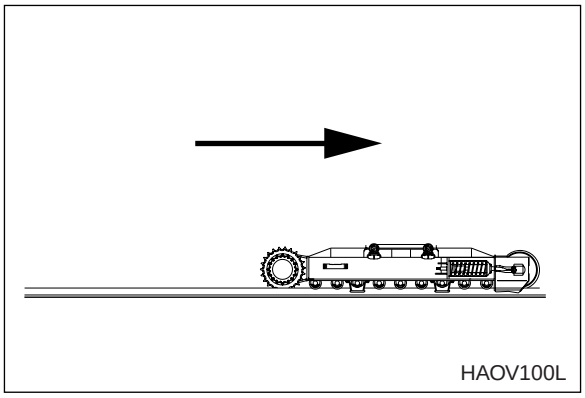


Figure 16

8. Rotate upper structure to 90˚ from track. Use bucket and boom to raise track frame off track.
9. Position blocking under frame.

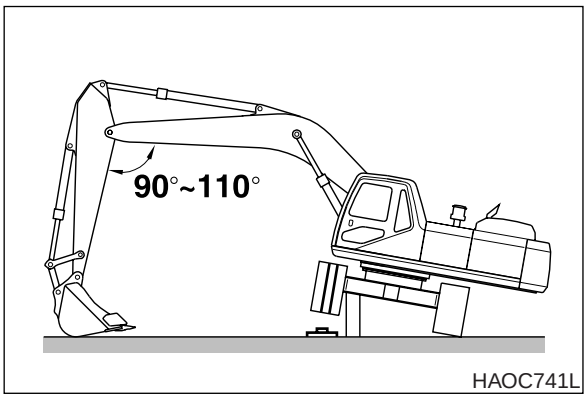


Figure 17

TRACK INSTALLATION

1. Lay rebuilt or new track into position under track frame. End of track should be positioned under front idler roller.
2. With upper structure at 90˚ to track frame. Use bucket and boom to raise track frame off blocking.
3. With blocking removed, lower track frame onto track. Make sure all rollers are properly positioned on track.

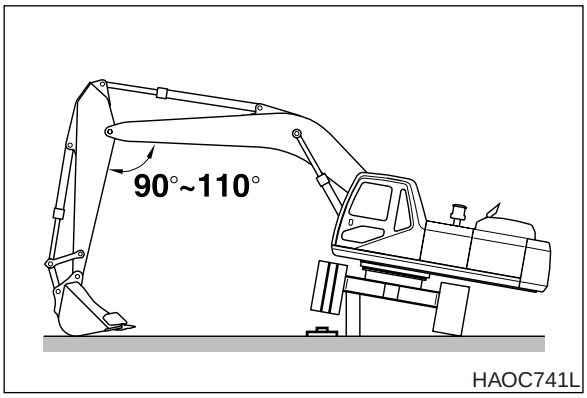


Figure 18

4. Move unit backwards while feeding track up over front idler roller. Continue to pull track back until it engages drive sprocket.
5. Align master links and install master pin.
6. Insert new lock pin in master pin. Bend end of pin over so it is pointing in opposite direction of other end as shown.
7. Apply track tension. Refer to "Track Tension" in this section for procedure.

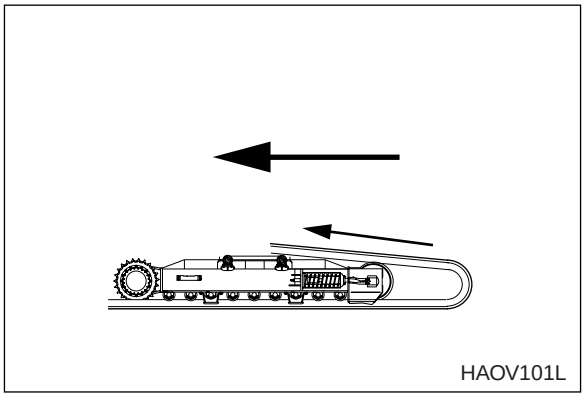


Figure 19

FRONT IDLER ROLLER

PARTS LIST

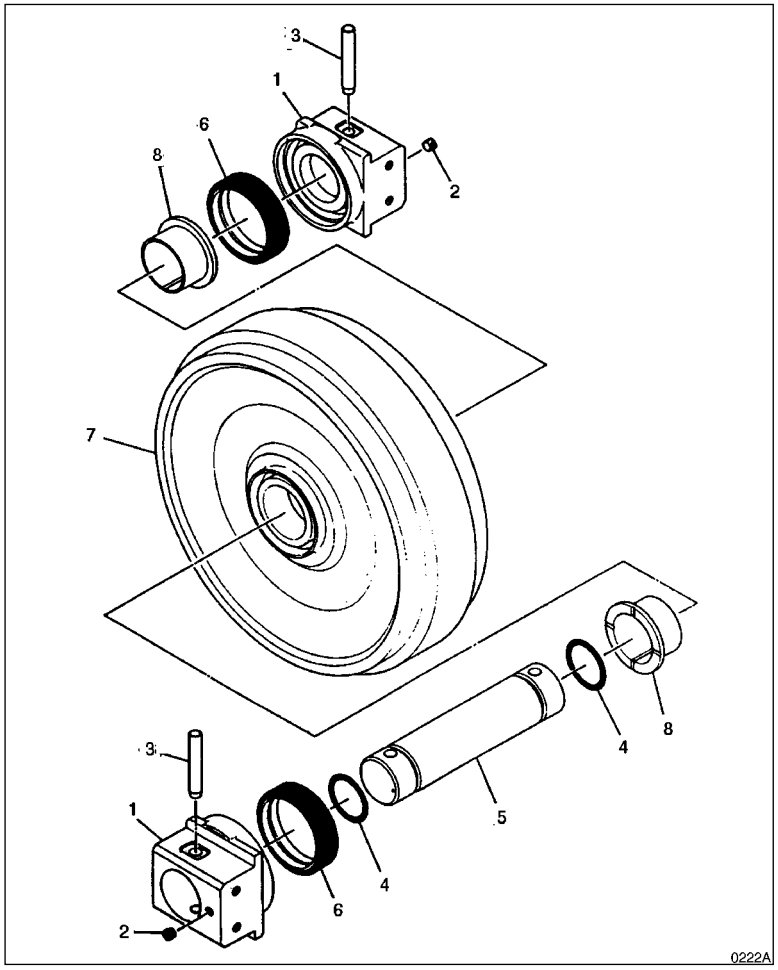


Figure 20

Reference Number	Description
1	Bearing
2	Plug
3	Pin
4	O-ring

Reference Number	Description
5	Axle
6	Group Seal
7	Idler
8	Bushing

FRONT IDLER ROLLER DISASSEMBLY

1. Remove plug (2, Figure 21) and drain oil from roller assembly (1).

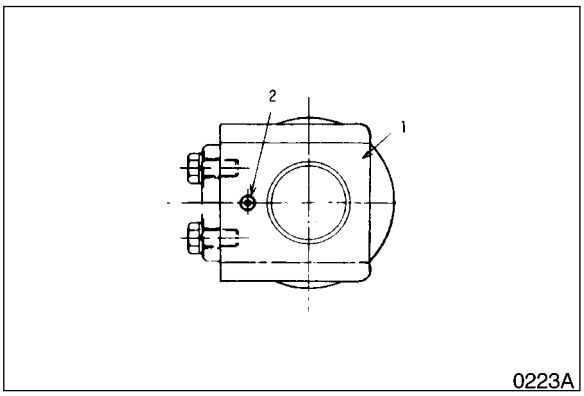


Figure 21

2. Separate the pin (3, Figure 22) from the bearing (1).

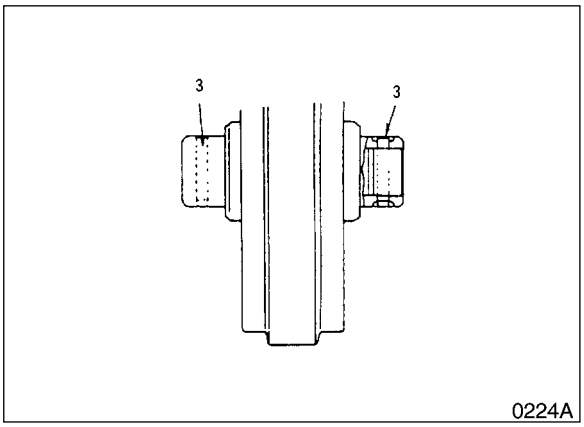


Figure 22

3. Use a press to remove the bearing from the axle. Separate the O-ring (4, Figure 23) from the axle and insert it into the bearing.

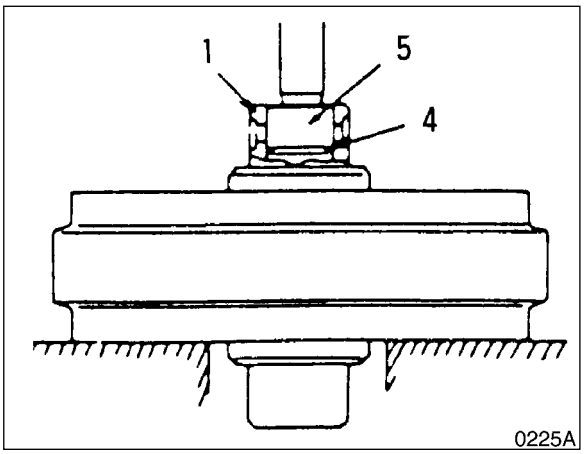


Figure 23

4. Detach the group seal (6, Figure 24) from the idler (7) and bearing (1).

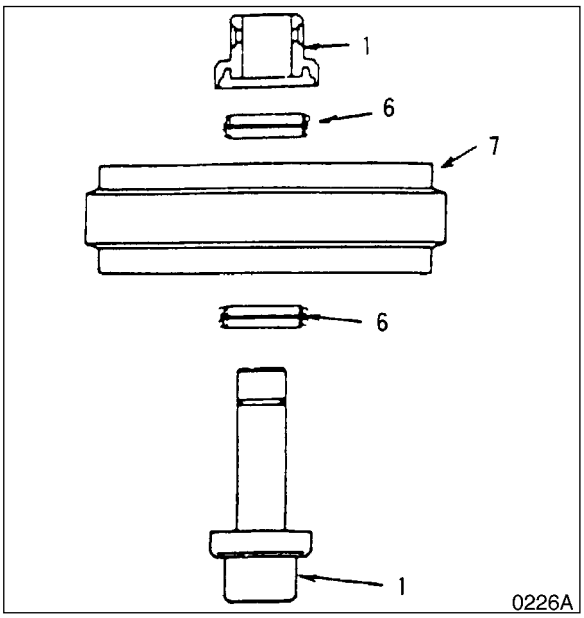


Figure 24

5. Use a press to separate the axle (5, Figure 25), O-ring (4) and bearing (1).

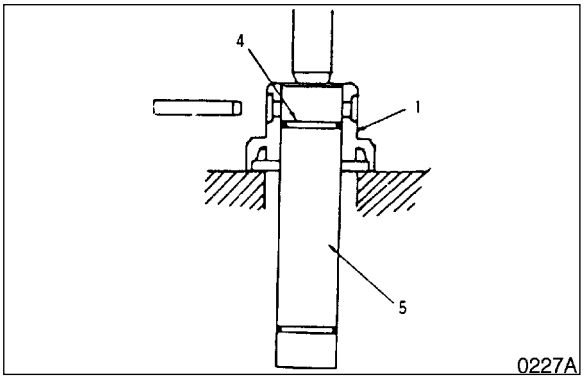


Figure 25

6. Remove bushing (8, Figure 26) with the press and special tool (ST-1909).

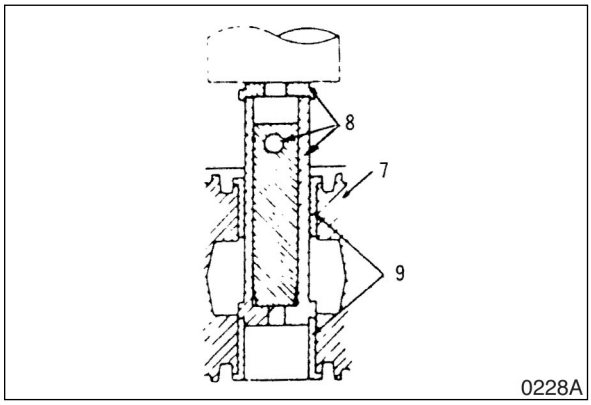


Figure 26

FRONT IDLER ROLLER REASSEMBLY

1. Degrease, clean and dry all parts before reassembly. Insert bushing (8, Figure 27) into the idler (7).
2. Grease O-ring (4, Figure 27) and insert it into the axle.
3. Align the bearing (1, Figure 27) and axle (5) holes and pin (3) them together.

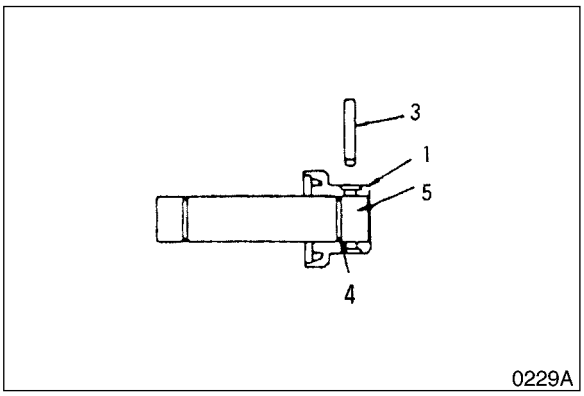


Figure 27

4. Install group seal (6, Figure 28) inside the idler (7) and bearing (1).

   NOTE: *Apply clean engine oil to the joint side of the group seal. Apply grease to the group seal O-ring.*

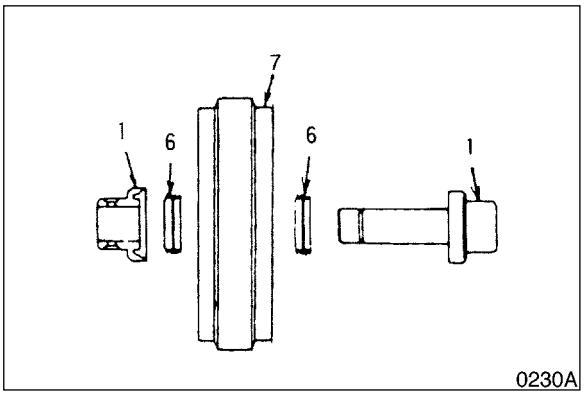


Figure 28

5. Install idler (7, Figure 29) on the axle.
6. Install bearing (1, Figure 29) and pin (3) to the axle.

   NOTE: *Fill the idler assembly with new engine oil with approximately 260 cc (1/2 pint).*

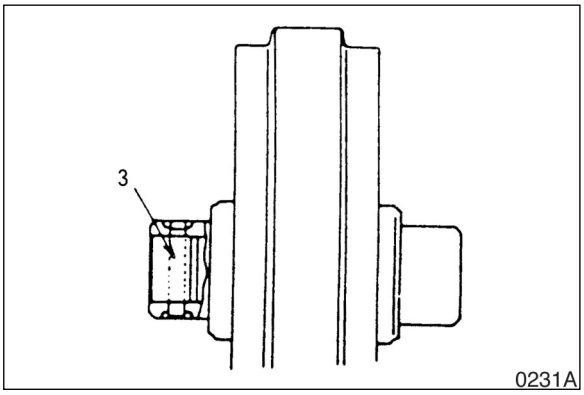


Figure 29

LOWER ROLLER

PARTS LIST

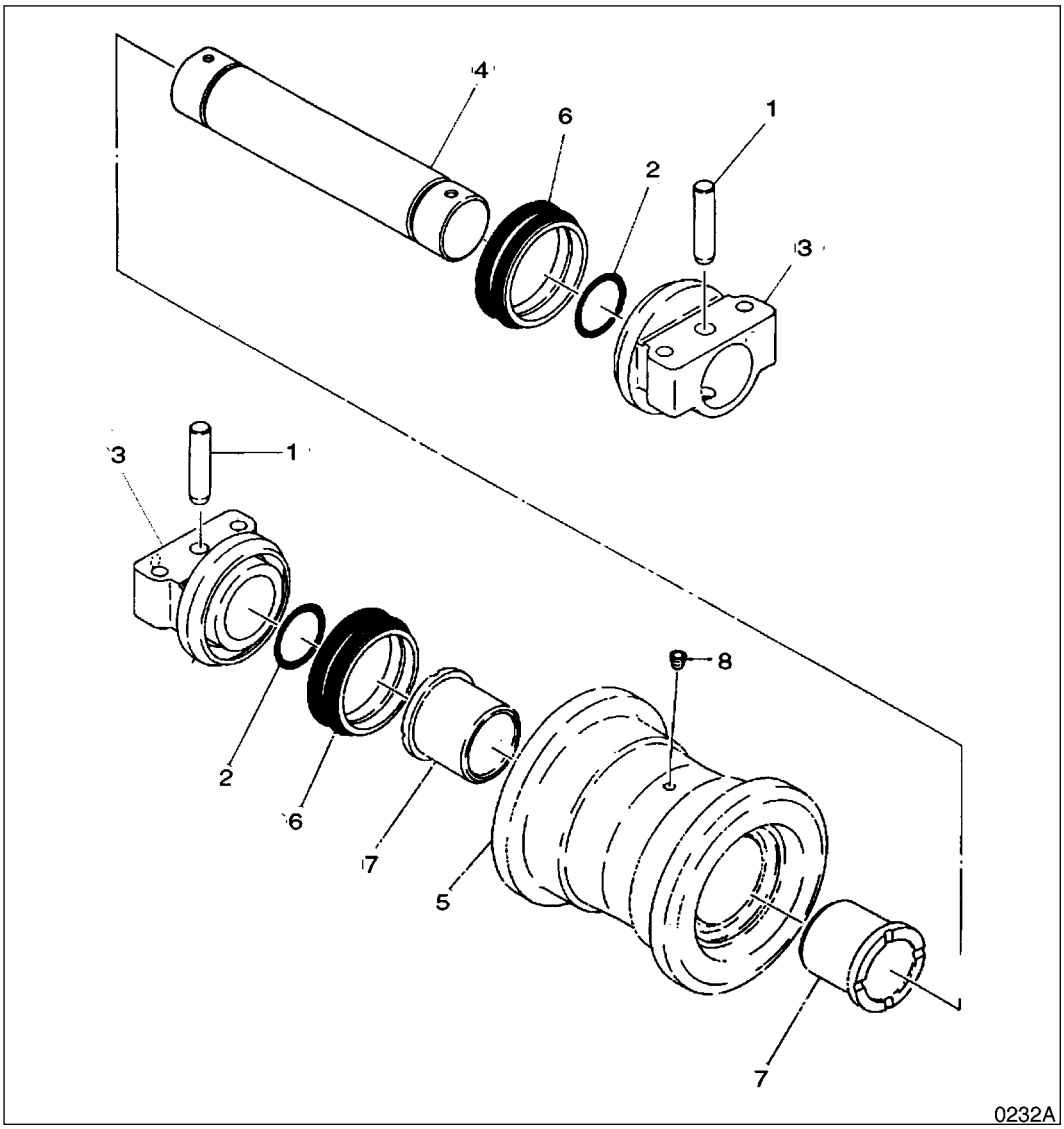


Figure 30

Reference Number	Description
1	Pin
2	O-ring
3	Collar
4	Axle

Reference Number	Description
5	Roller
6	Group Seal
7	Bushing
8	Plug

LOWER ROLLER REMOVAL

1. Relieve track tension. Refer to "Track Tension" in this section for procedure.
2. Swing upper structure at 90˚ to frame.
3. Using bucket raise track off ground and place blocking under frame.
4. Remove four bolts and lower roller assembly from track frame. There is an alignment pin on each end of lower roller assembly.

   NOTE: *To gain access to some rollers the link guard may have to be removed. Remove four spring washers and bolts to remove guard.*

   NOTE: *If additional track clearance is required, remove upper rollers before raising track.*

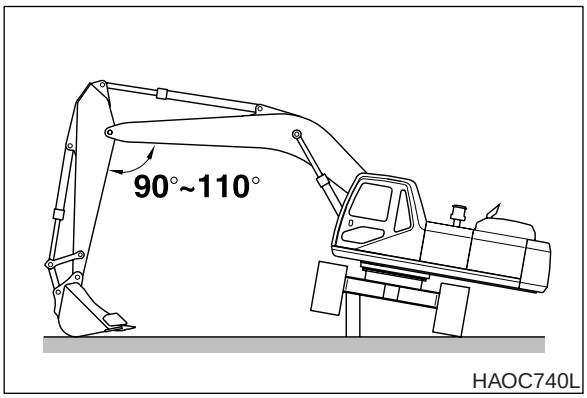


Figure 31

LOWER ROLLER DISASSEMBLY

1. Remove plug from the collar and drain oil.
2. Pull the pin (1, Figure 32) from the collar.

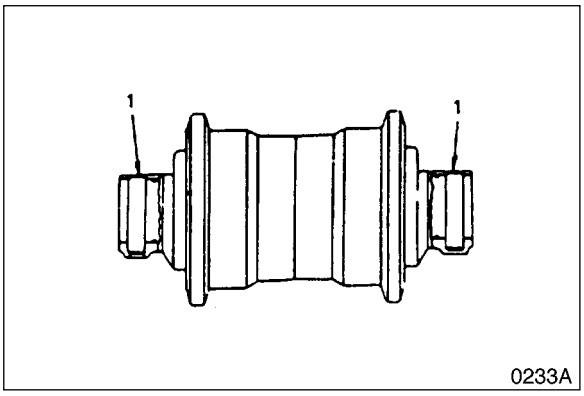


Figure 32

3. Separate the collar (3, Figure 33) from the axle, using a press.

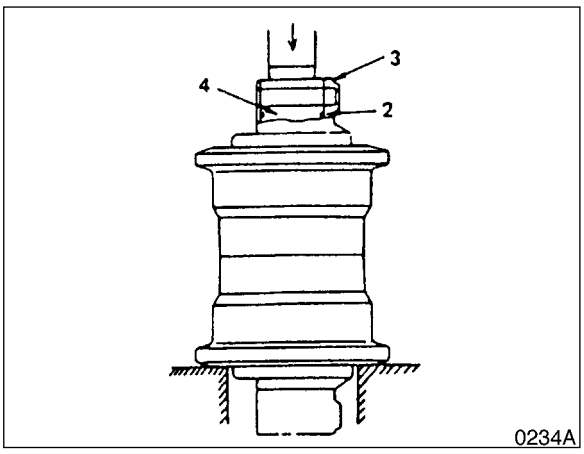


Figure 33

4. Detach O-rings (2, Figure 34) from the axle.
5. Separate group seals (6, Figure 34) from the collar and roller (5).
6. Detach collar (3, Figure 34) and O-rings (2) from the axle, using a press.

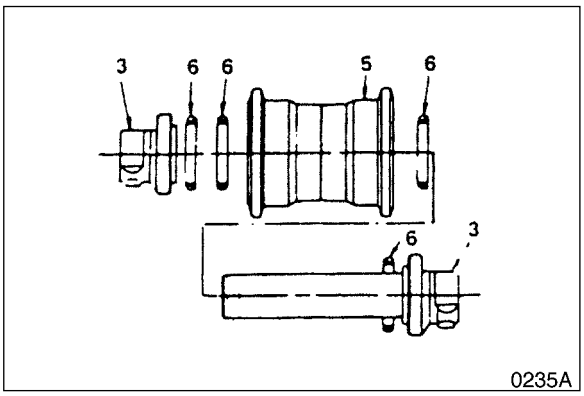


Figure 34

LOWER ROLLER REASSEMBLY

1. Degrease, clean and dry all parts before reassembly. Insert bushing (7, Figure 35) into roller.
2. Apply grease to the O-rings (2, Figure 35) and insert into axle.

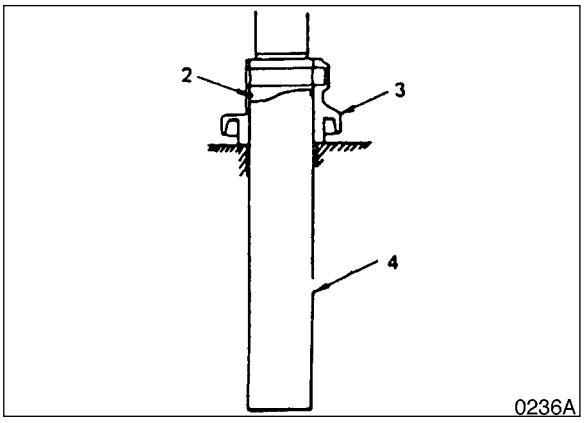


Figure 35

3. Align collar (3, Figure 36) and axle (4) pin holes and pin (1) the collar.

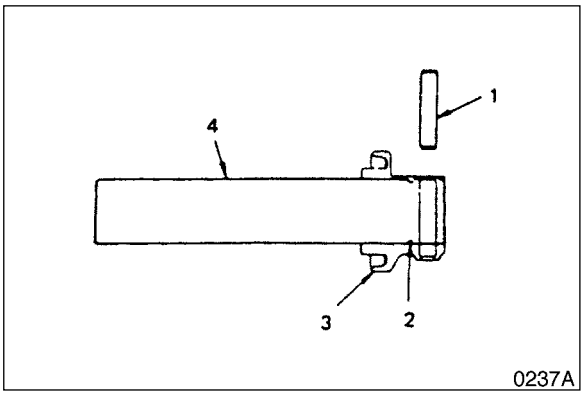


Figure 36

4. Insert group seals (6, Figure 37) into the roller (5) and collar (3).

   NOTE: *Apply clean engine oil to the joint side of the group seal. Apply grease to the group seal O-ring.*

5. Slide the axle inside the roller.

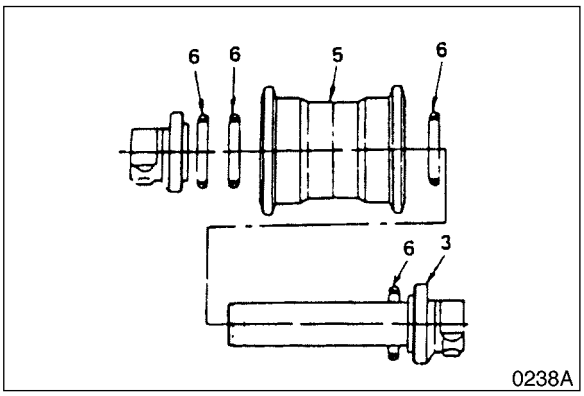


Figure 37

6. Install the collar (3, Figure 38), O-ring (2), and pin (1) on the remaining side.
7. Fill with clean engine oil with approximately 350 cc (3/4 pint).

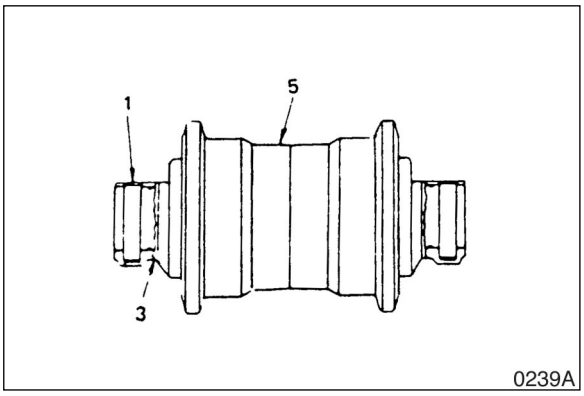


Figure 38

LOWER ROLLER INSTALLATION

1. Install four bolts to hold lower roller assembly to track frame.

   NOTE: *To gain access to some rollers a link guard may have to be removed. Remove four spring washers and bolts to remove guard.*

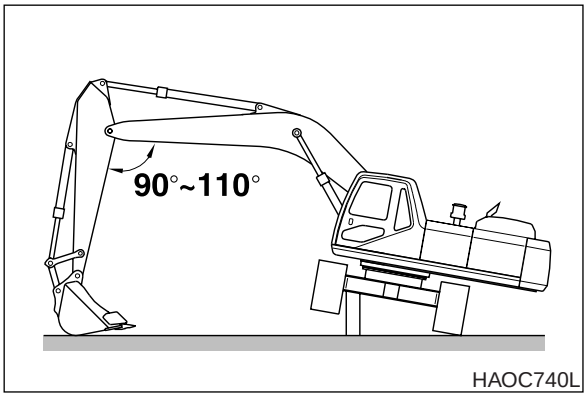


Figure 39

UPPER ROLLER

PARTS LIST

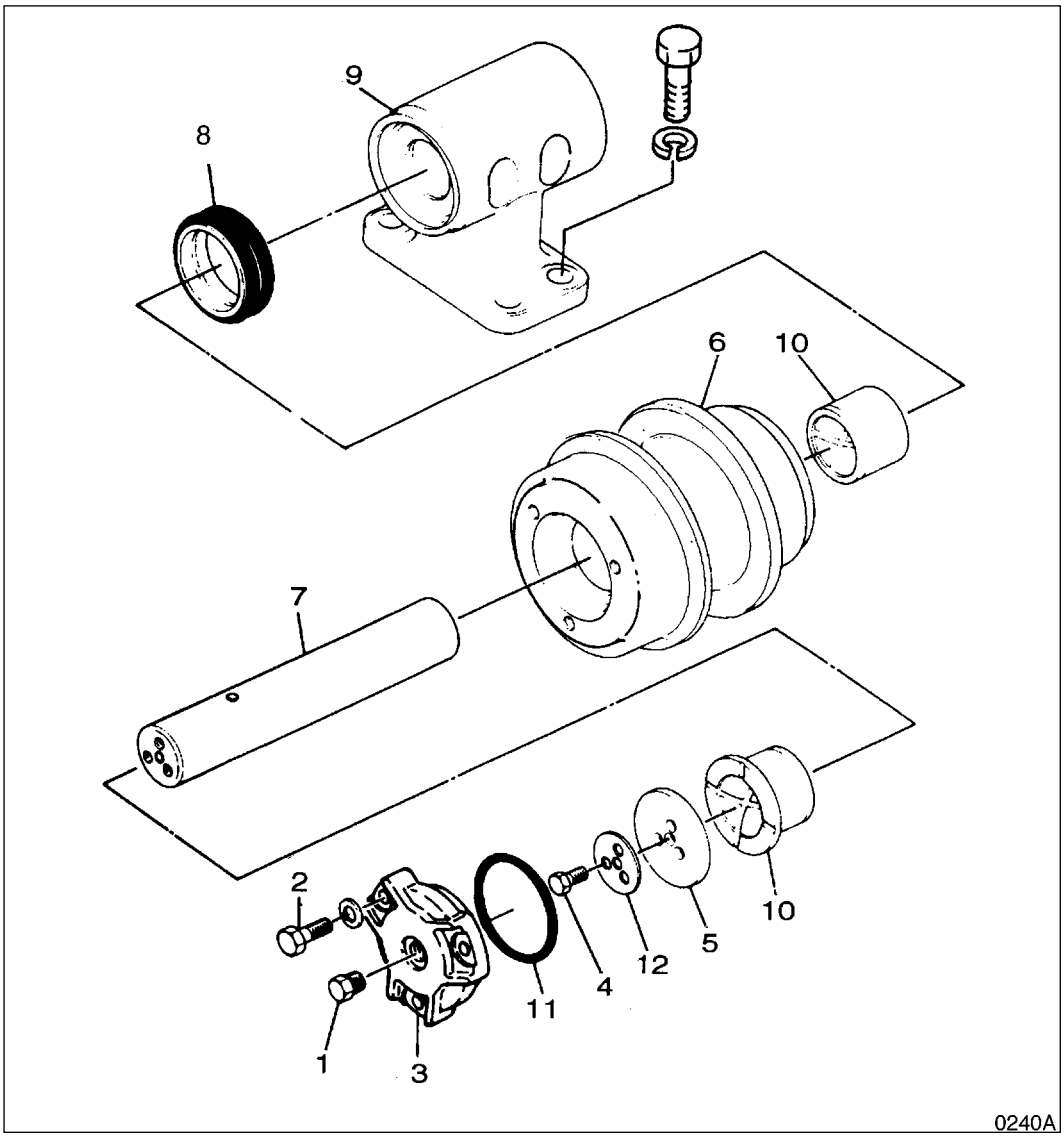


Figure 40

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

UPPER ROLLER REMOVAL

1. Relieve track tension. See This will allow track to be raised so that links clear top of roller.
2. Position a bottle jack on top of track frame and apply pressure to track shoe.
3. Remove mounting hardware holding upper roller assembly to track frame.



Figure 41

UPPER ROLLER DISASSEMBLY

1. Remove the plug (1, Figure 42) from the cover and drain oil.

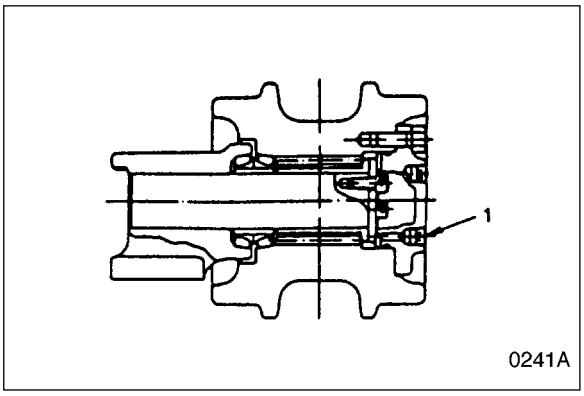


Figure 42

2. Remove the bolts and cover (3, Figure 43). Detach bolts (4) and washer (5).

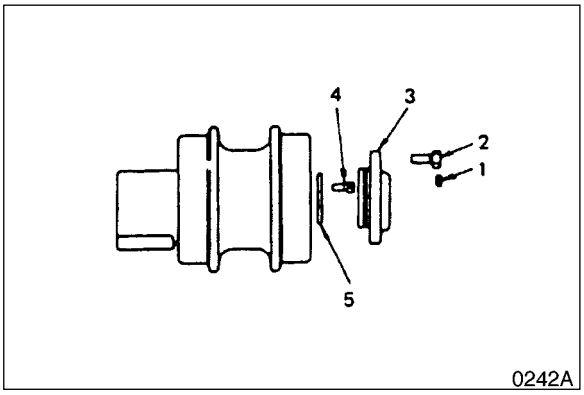


Figure 43

3. Separate the roller (6, Figure 44) from the axle (7).

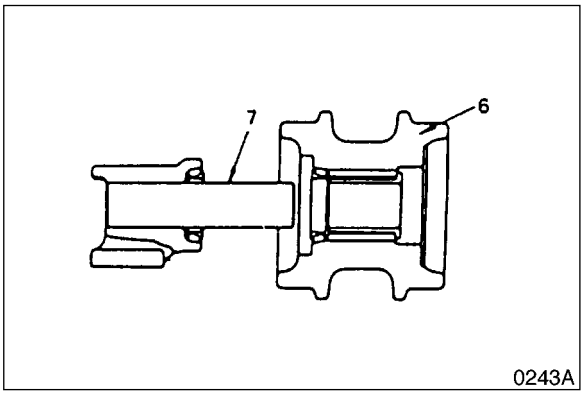


Figure 44

4. Separate the group seal (8, Figure 45) from the roller and bracket (9).

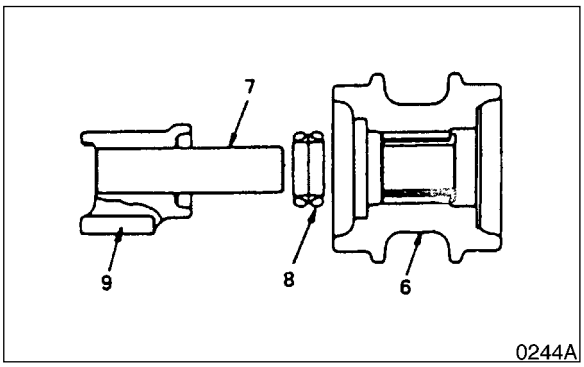


Figure 45

5. Separate the bushing (10, Figure 46) from the roller with a press and special tool (ST-1919).

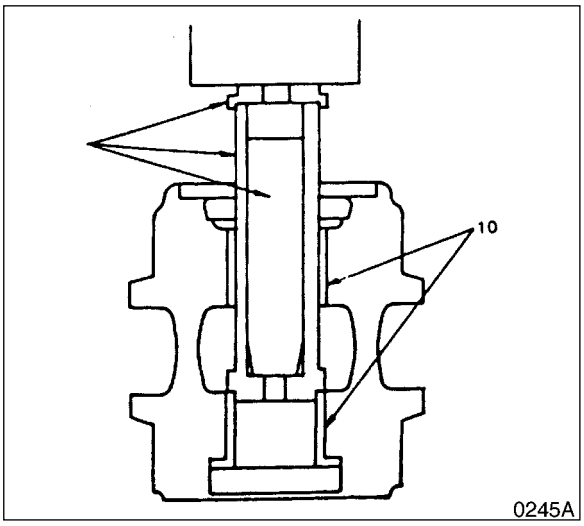


Figure 46

UPPER ROLLER REASSEMBLY

1. Degrease, clean and dry all parts before reassembly. Insert bushing (10, Figure 47) into the roller (6).

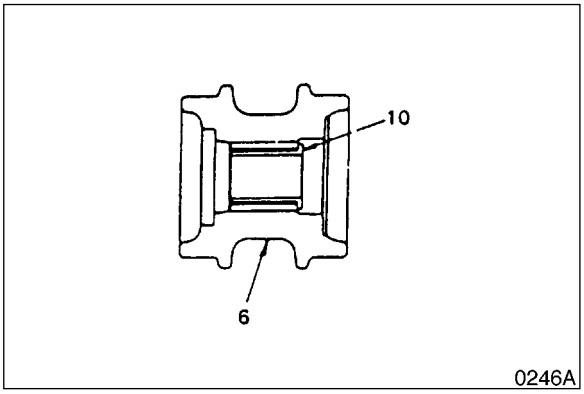


Figure 47

2. Insert group seal (8, Figure 48) into the roller (6) and bushing.

   NOTE: *Apply clean engine oil to the joint side of the group seal. Apply grease to the group seal O-ring.*

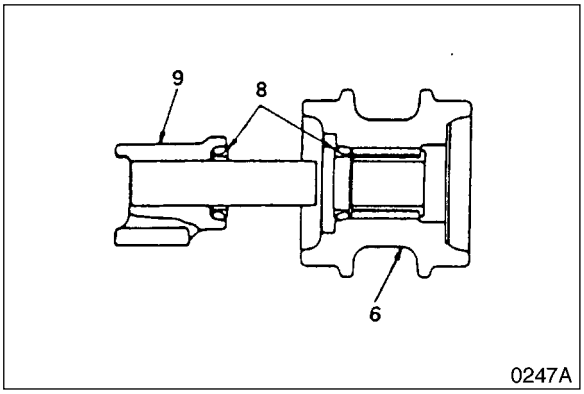


Figure 48

3. Install the axle, washer (5, Figure 49) and bolt (4).
4. Attach group seal (8, Figure 40) to the roller (6, Figure 49) and cover (3).
5. Insert the O-ring (11, Figure 49) to the cover. Attach cover (3) and bolt (2) to the roller.
6. Fill with engine oil.

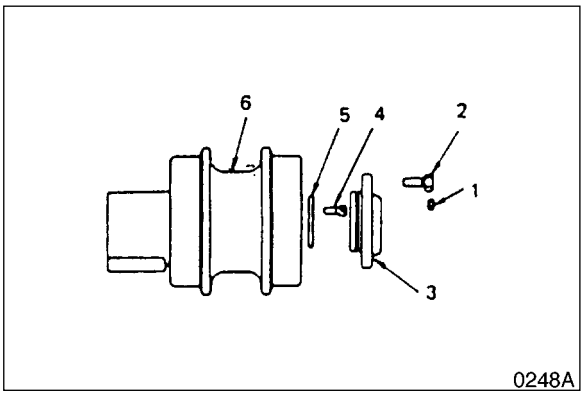


Figure 49

7. Tighten plug (1, Figure 50).

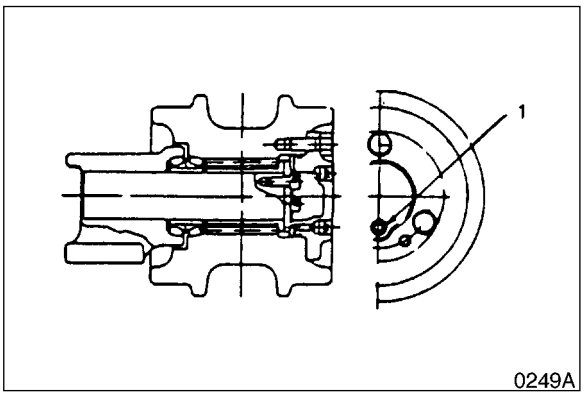


Figure 50

TRACK SPRING AND TRACK ADJUSTING CYLINDER

PARTS LIST

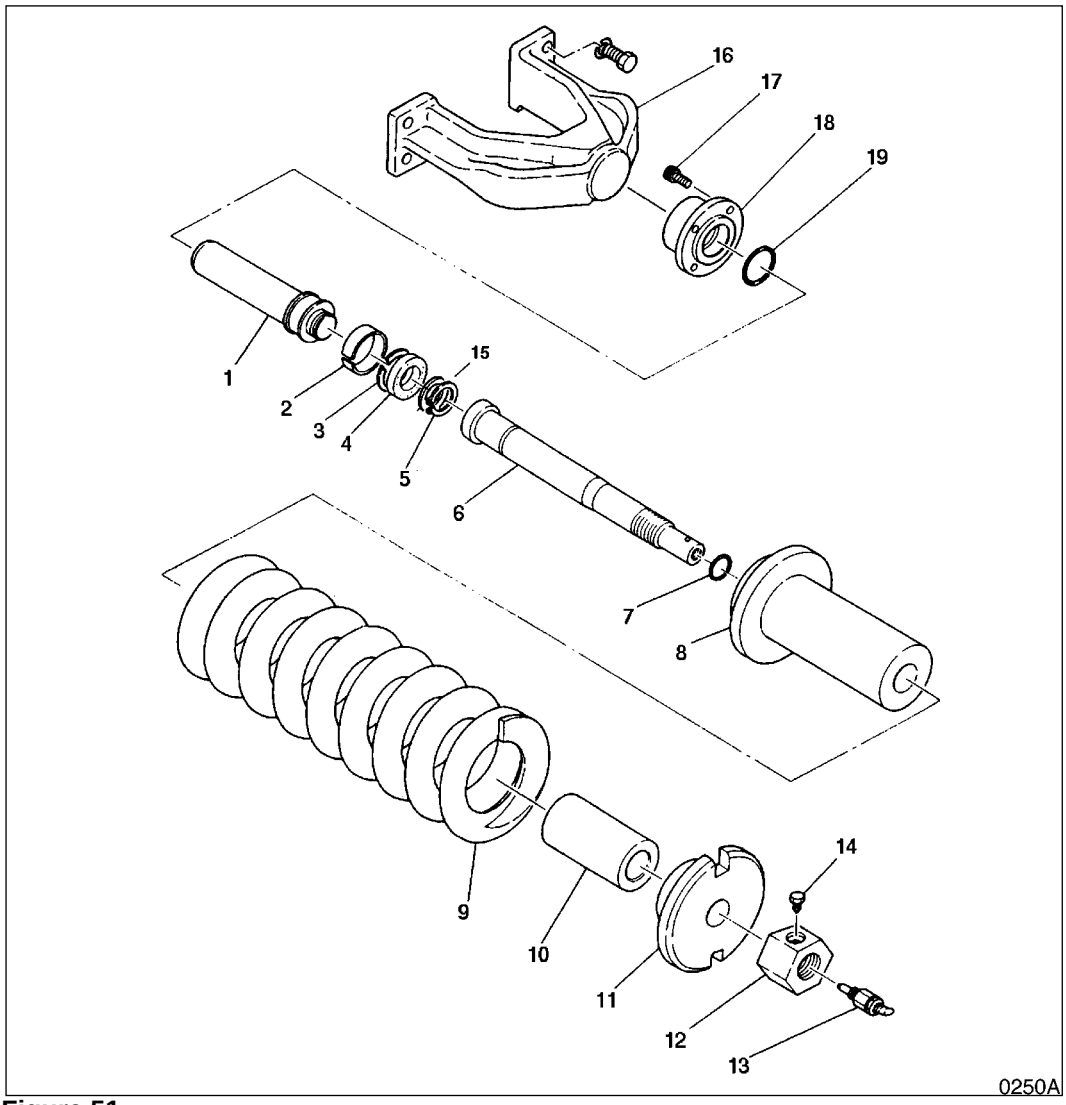


Figure 51

Reference Number	Description
1	Piston Rod
2	Piston Ring
3	Backup Ring
4	Packing
5	Retaining Ring
6	Rod
7	O-ring
8	Cylinder
9	Spring
10	Spacer

Reference Number	Description
11	Flange
12	Nut
13	Valve
14	Bolt
15	Plate
16	Yoke
17	Socket Bolt
18	Flange
19	O-ring

ENGINE AND DRIVE TRAIN

S0605060K

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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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October 2001

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REFRIGERANT CIRCULATION

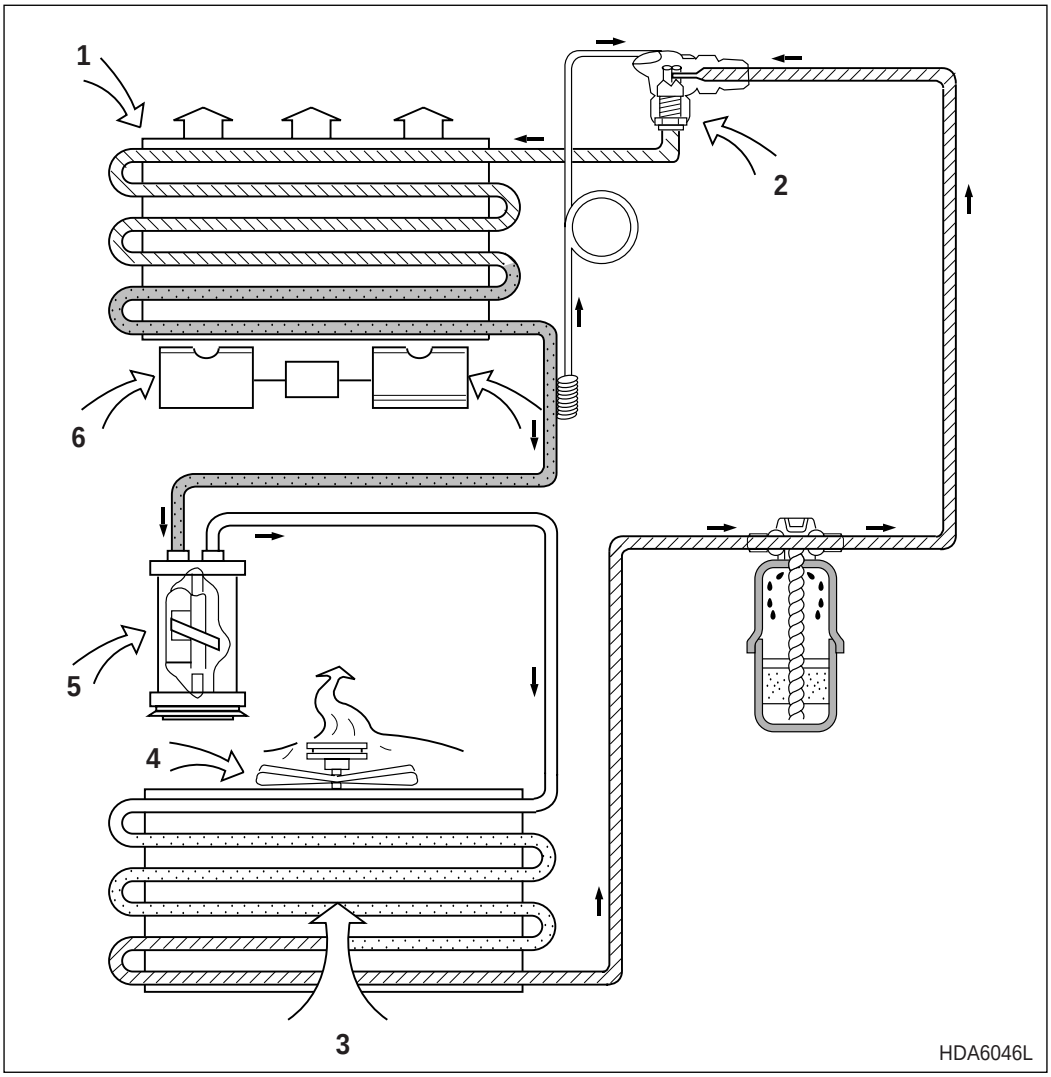


Figure 1

Reference Number	Description
1	Evaporator
2	Expansion Valve
3	Condenser
4	Condenser Fan

Reference Number	Description
5	Compressor
6	Blower Fan
7	Receiver Dryer

Shading	Temperature	Refrigerant State
	High	High Pressure Gas
	High	High Pressure Liquid
	Low	Low Pressure Liquid
	High	High Pressure Gas/Liquid
	Low	Low Pressure Gas

- Refrigerant (R134a) is compressed to approximately 15.0 kg/sq cm (213 psi) within the compressor.
- The compressed refrigerant flows into the condenser at high temperature (approximately 80°C (176˚F)).
- The refrigerant in the condenser is cooled to approximately 60° by the condenser fan. At this time the refrigerant changes from the gas to the liquid state, even though the temperature has only been reduced 20°C (68˚F). (From 80° - 60°C (176˚ - 140˚F)).
- The refrigerant in its liquid form is injected into the evaporator through the expansion valve. At this time the pressure is reduced by approximately 2.0 kg/sq cm (28 psi) and the temperature is also reduced. As a result, the refrigerant absorbs the heat from the air surrounding the evaporator creating a cooling effect and changes from the gas to the liquid state.
- The refrigerant once again flows into the compressor in the gaseous state and the process is repeated.

WARNING!

Refrigerant gas is pressurized and sealed in the air conditioning system. Special precautions are required for the proper recharging or release of refrigerant. Release of refrigerant into the atmosphere is strictly regulated by law. Make sure that you are in compliance with all mandated federal, state and municipality requirements, before starting any service or repair of the air conditioner. Refrigerant gas used in the system must meet or exceed specifications for R134a refrigerant, or any subsequently issued environmentally-mandated standard.

CONTROL PANEL

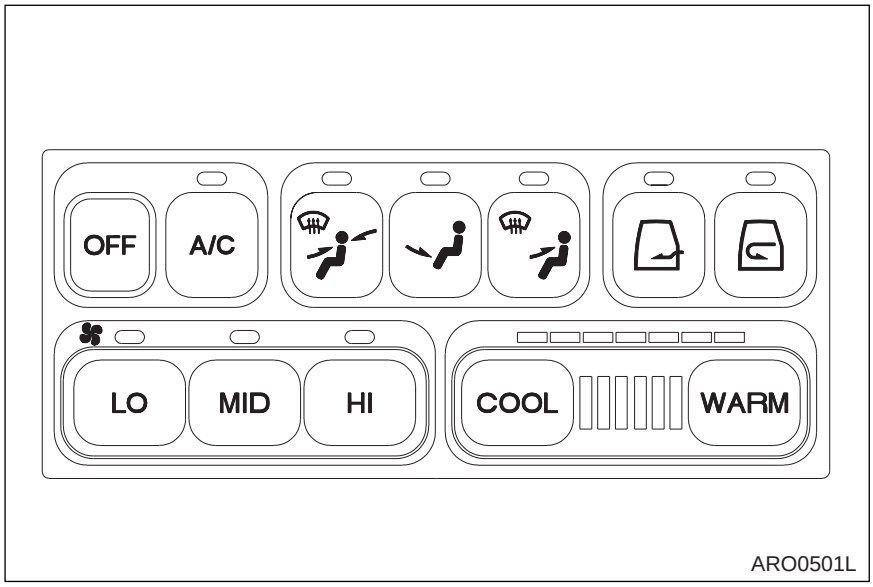


Figure 2

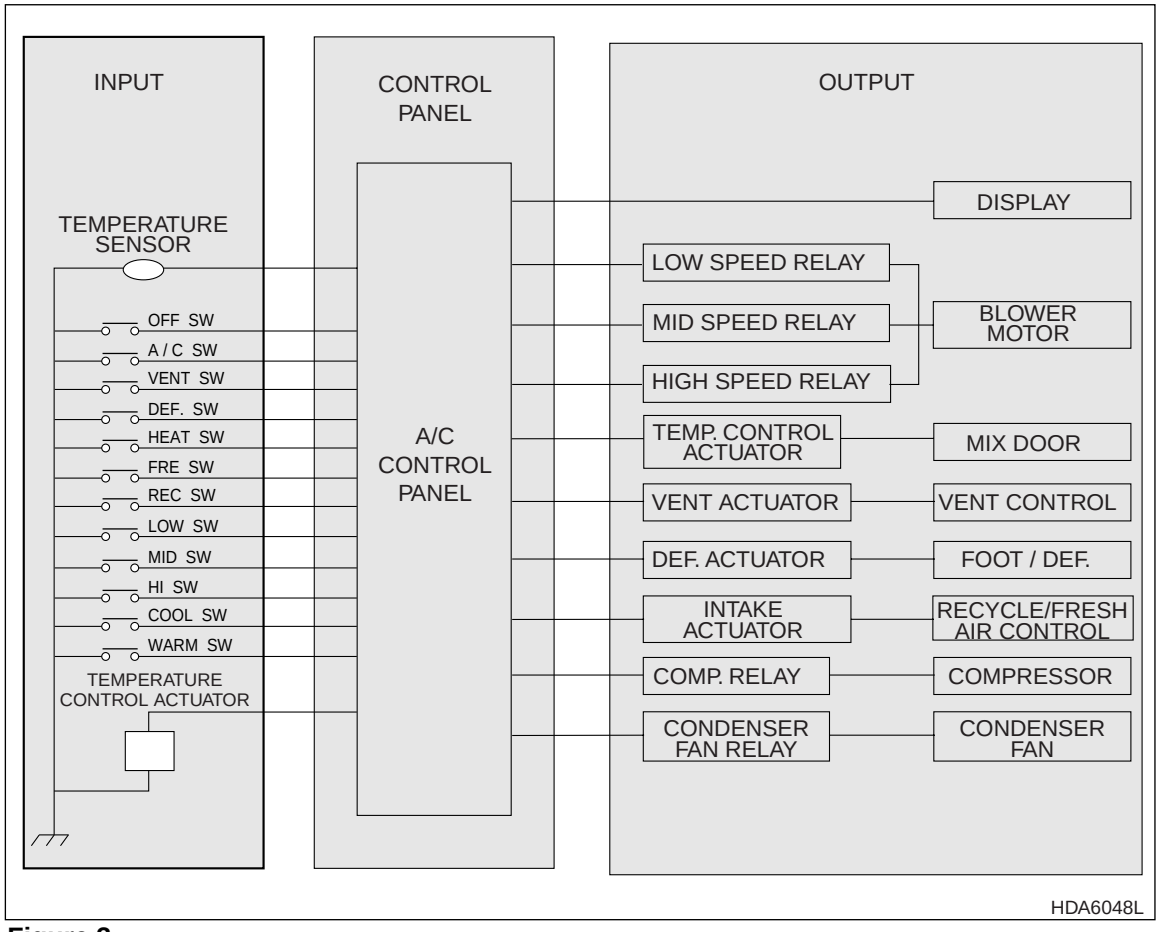
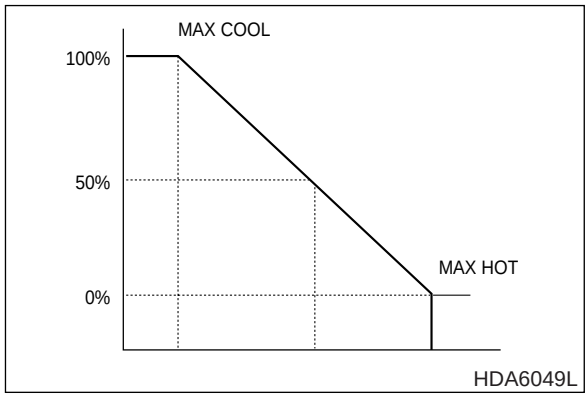
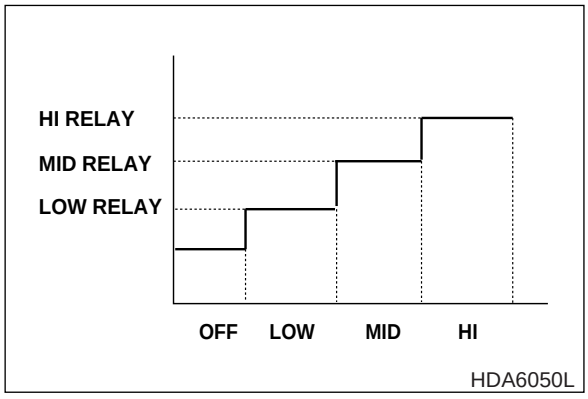
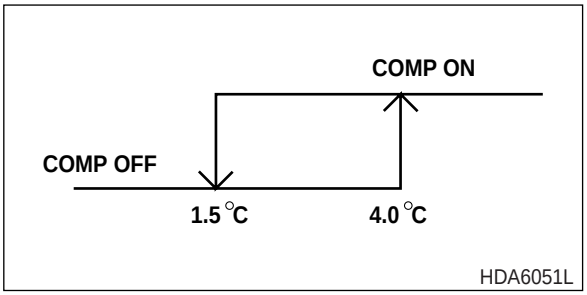


Figure 3

CONTROL SPECIFICATIONS

Control Item	Control Switch	Control Specifications
Temperature Control	'COOL' Switch 'WARM' Switch	 **Figure 4** Temperature control switch consists of a 24 step variable selector. The display uses 7, Green / Red two-color LEDs to display the selected temperature.
Blower Fan Speed Control	'OFF' Switch 'LOW' Switch 'MID' Switch 'HI' Switch	 **Figure 5**
Compressor Control	Temperature Sensor	 **Figure 6**

TEMPERATURE LEVEL CONTROL AND DISPLAY

Step	LED 1	LED 2	LED 3	LED 4	LED 5	LED 6	LED 7	Position Sensor Voltage	Remark
0	Green	Green	Green	Green	Green	Green	Green	4.50 V ± 0.2	MAX. COOL
1	Green	Green	Green	Green	Green	Green	Green	4.33 V ± 0.2	
2	Green	Green	Green	Green	Green	Green	Green	4.15 V ± 0.2	
3	Red	Green	Green	Green	Green	Green	Green	3.98 V ± 0.2	
4	Red	Green	Green	Green	Green	Green	Green	3.80 V ± 0.2	
5	Red	Green	Green	Green	Green	Green	Green	3.63 V ± 0.2	
6	Red	Red	Green	Green	Green	Green	Green	3.46 V ± 0.2	
7	Red	Red	Green	Green	Green	Green	Green	3.28 V ± 0.2	
8	Red	Red	Green	Green	Green	Green	Green	3.11 V ± 0.2	
9	Red	Red	Red	Green	Green	Green	Green	2.93 V ± 0.2	
10	Red	Red	Red	Green	Green	Green	Green	2.76 V ± 0.2	
11	Red	Red	Red	Green	Green	Green	Green	2.59 V ± 0.2	
12	Red	Red	Red	Red	Green	Green	Green	2.41 V ± 0.2	
13	Red	Red	Red	Red	Green	Green	Green	2.24 V ± 0.2	
14	Red	Red	Red	Red	Green	Green	Green	2.07 V ± 0.2	
15	Red	Red	Red	Red	Red	Green	Green	1.89 V ± 0.2	
16	Red	Red	Red	Red	Red	Green	Green	1.72 V ± 0.2	
17	Red	Red	Red	Red	Red	Green	Green	1.54 V ± 0.2	
18	Red	Red	Red	Red	Red	Red	Green	1.37 V ± 0.2	
19	Red	Red	Red	Red	Red	Red	Green	1.20 V ± 0.2	
20	Red	Red	Red	Red	Red	Red	Green	1.02 V ± 0.2	
21	Red	Red	Red	Red	Red	Red	Red	0.85 V ± 0.2	
22	Red	Red	Red	Red	Red	Red	Red	0.67 V ± 0.2	
23	Red	Red	Red	Red	Red	Red	Red	0.50 V ± 0.2	MAX. HOT

AIR DISCHARGE ACCORDING TO PATH SELECTION

Face, Rear, and Defroster

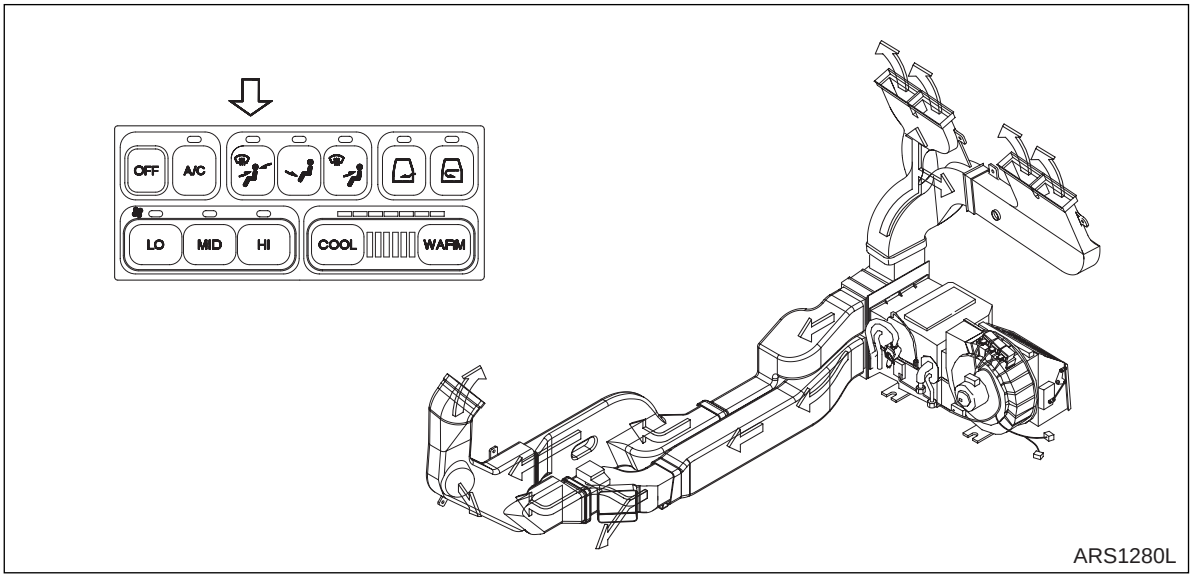


Figure 7

Foot

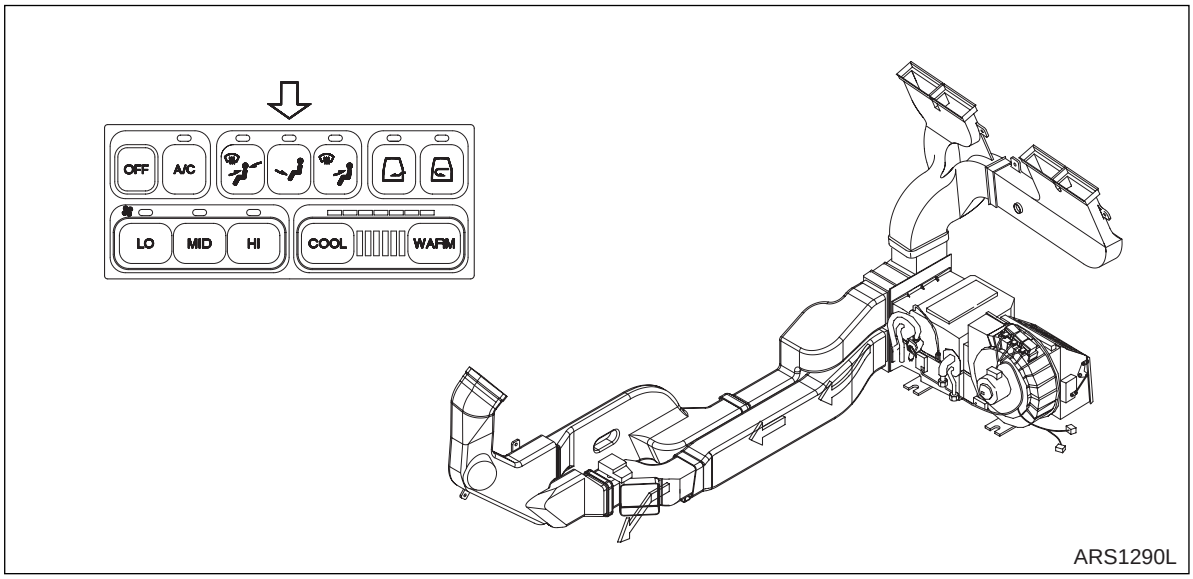


Figure 8

Face and Defroster

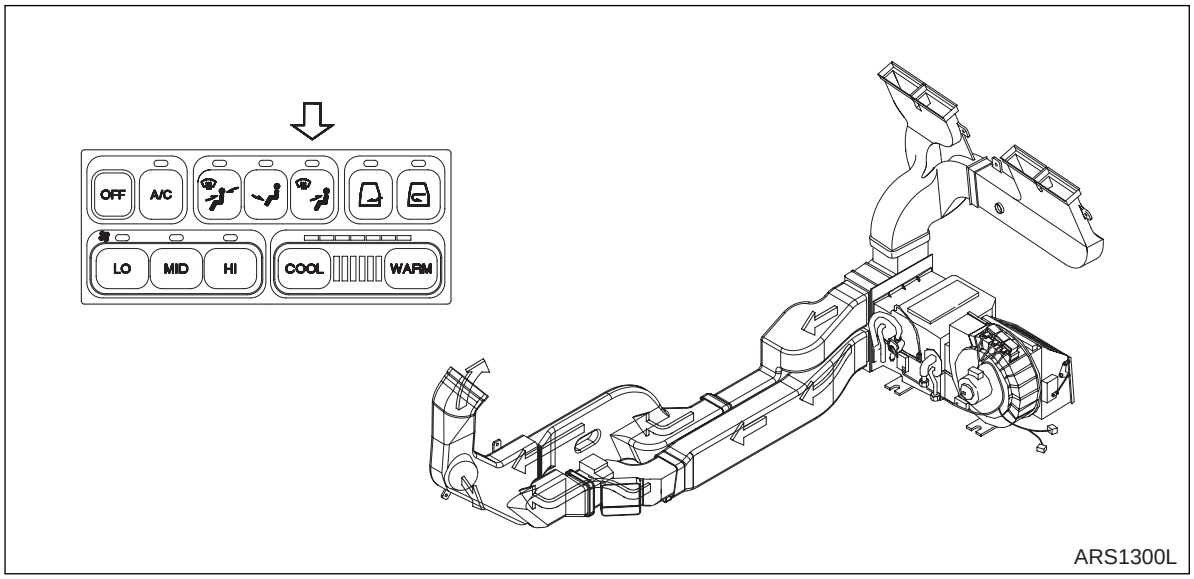


Figure 9

AIR-CONDITIONING SYSTEM CIRCUIT DIAGRAM

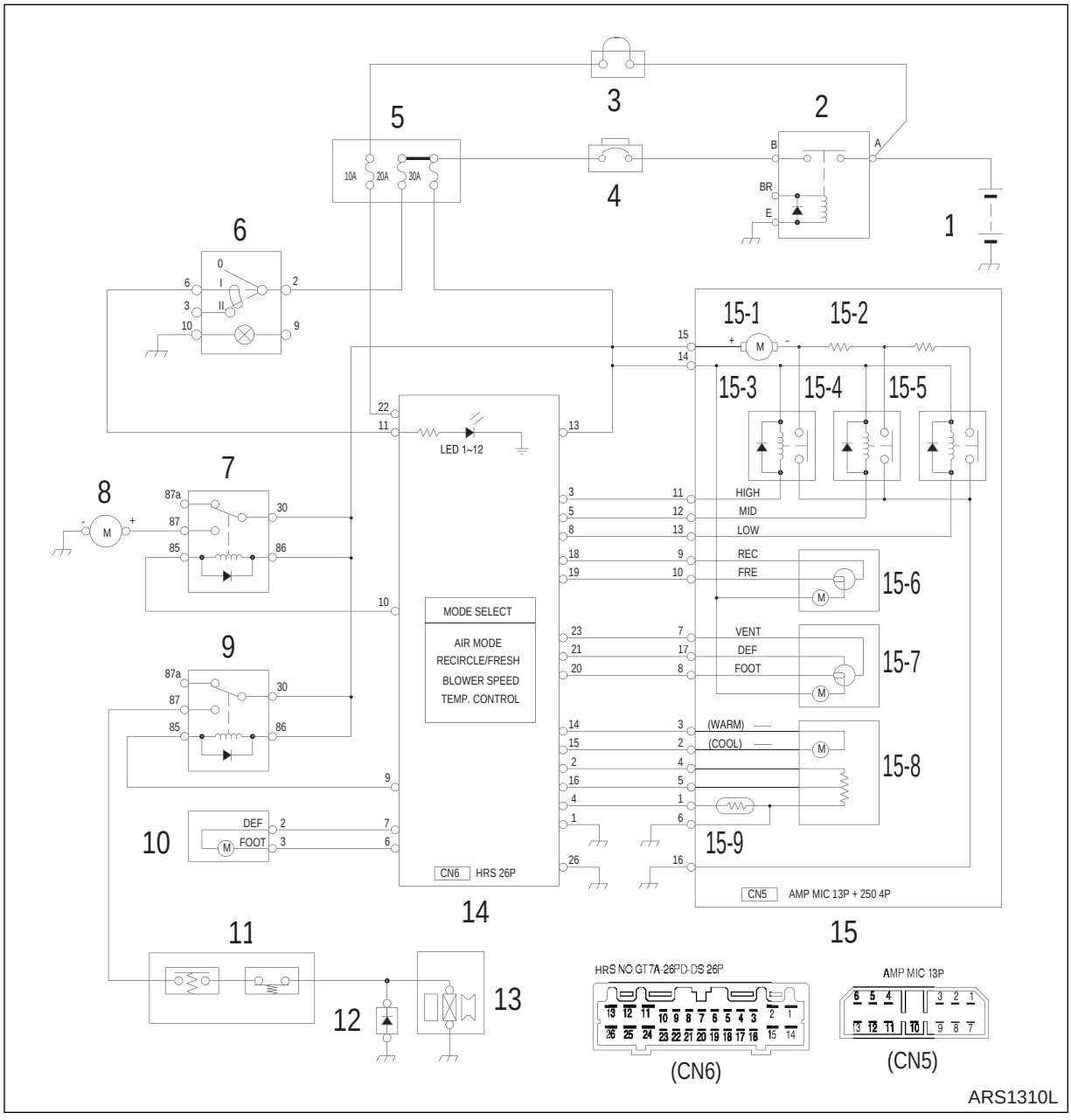


Figure 10

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Fuse
6	Lamp Switch
7	Condenser Fan Relay
8	Condenser Fan Motor
9	Compressor Relay
10	Foot / Defrost Control Actuator
11	Receiver Dryer (Low / High Pressure Cut Off Switch)
12	Diode

Reference Number	Description
13	Compressor
14	A/C Control Panel
15	A/C Unit
15-1	Blower Motor
15-2	Resister
15-3	High Speed Relay
15-4	Mid Speed Relay
15-5	Low Speed Relay
15-6	Recirculate / Fresh Air Control Actuator
15-7	Vent Actuator
15-8	Temperature Control Actuator
15-9	Temperature Sensor (Evaporator)

TROUBLESHOOTING

Refrigerant Pressure Check

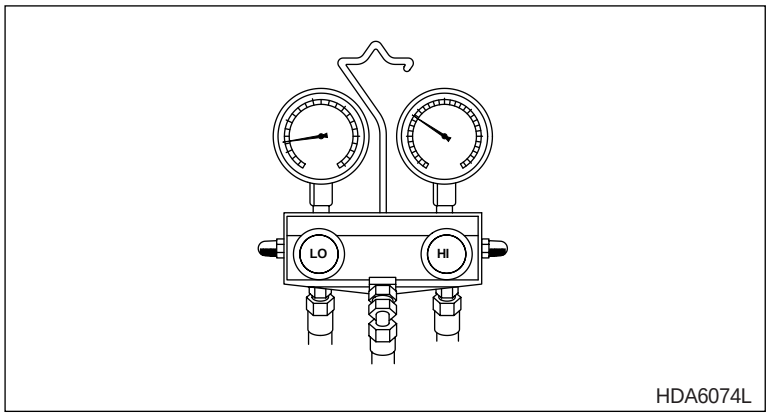


Figure 11

1. Open all doors and windows.
2. Install manifold gauge set.
3. Start engine and maintain engine speed at 1,800 - 2,000 RPM.
4. Check high / low pressure of refrigerant.

1	**High Pressure: 8.0 - 10.0 kg/cm^2 (114 - 142 psi)** **Low Pressure: Approximately 1.0 kg/cm^2 (14 psi)**		
Possible Cause: Low Refrigerant Level			
Step	**Inspection Item**		**Remedy**
1	Check for traces of refrigerant oil.	Yes	Reassemble using correct tightening torque.
		No	Go to next step.
2	Using a leak detection device or soapy water check for refrigerant leakage at all major components and joints.	Yes	Repair leaking component.
		No	Recharge system to correct pressure.

2	**High Pressure: Over 23 kg/cm^2 (327 psi)** **Low Pressure: Approximately 2.5 - 3.0 kg/cm^2 (36 - 43 psi)**		
Possible Cause: Overcharge, Frost on condenser			
Step	**Inspection Item**		**Remedy**
1	Check for condenser pin damage or contamination.	Yes	Clean, repair or replace condenser.
		No	Refrigerant overcharge.

3	**High Pressure: Approximately 20 - 25 kg/cm^2 (285 - 356 psi)** **Low Pressure: Approximately 2.5 - 3.5 kg/cm^2 (36 - 50 psi)**
Possible Cause: Air in system.	
1. Recover any remaining refrigerant. 2. Vacuum out system. 3. Recharge system. **NOTE:** *If the system has been exposed to the air for a long period of time, replace the receiver dryer.*	

4	**High Pressure: Over 6 kg/cm^2 (85 psi)** **Low Pressure: Approximately 760 mmHg (Negative Pressure)**		
Possible Cause: Refrigerant does not circulate			
Step	**Inspection Item**		**Remedy**
1	1. Connect manifold gauge and start engine. 2. Turn on air-conditioner. 3. Set blower switch to HIGH position. 4. Turn air-conditioner OFF and wait 10 minutes. 5. Recheck high / low pressure readings. High Pressure: 13.0 - 19.0 kg/cm^2 (185 - 270 psi) Low Pressure: 1.5 - 3.3 kg/cm^2 (21.3 - 46.9 psi)	Yes	Moisture in system, replace receiver dryer.
		No	Contaminated system, replace expansion valve. (Replace evaporator core assembly.)

5	**High Pressure: Over 6 - 18 kg/cm^2 (85 - 256 psi)** **Low Pressure: 500 mmHg (Negative Pressure) - Dial indicator needle unstable.**
Possible Cause: Moisture in system has iced up the expansion valve. **NOTE:** *When the absorbed moisture freezes the pressure readings may look normal. Careful readings should be made to determine whether pressure is in normal range.*	
1. Recover any remaining refrigerant. 2. Vacuum out system. 3. Recharge system. **NOTE:** *If the system has been exposed to the air for a long period of time, replace the receiver dryer.*	

6	**High Pressure: Over 22.0 - 23 kg/cm^2 (313 - 327 psi)** **Low Pressure: 2.5 kg/cm^2 (36 psi)**		
Possible Cause: Refrigerant pressure problem due to defective expansion valve or temperature sensor.			
Step	**Inspection Item**		**Remedy**
1	Inspect whether the temperature sensor is installed properly.	Yes	Replace expansion valve.
		No	Exchange duct sensor.

7	**High Pressure: Over 7.0 - 11.0 kg/cm^2 (100 - 156 psi)** **Low Pressure: 4.0 - 6.0 kg/cm^2 (57 - 85 psi)**
Possible Cause: Low refrigerant pressure due to poor compressor compression	
Inspect and replace compressor if necessary.	

REFRIGERANT SYSTEM REPAIRS

⚠ WARNING!

Always wear protective glasses and gloves when handling refrigerant. If refrigerant comes in contact with the skin or eyes, immediately flush with clean, running water and consult a physician.

Select a clean and well ventilated area to work.

The refrigerant container is under high pressure and should be stored below 40˚C (104˚F). Be careful not to drop the container from a high location

The contents are under high pressure and should not be used with compressed air or near an open flame.

REFRIGERANT SAFE HANDLING PROCEDURES

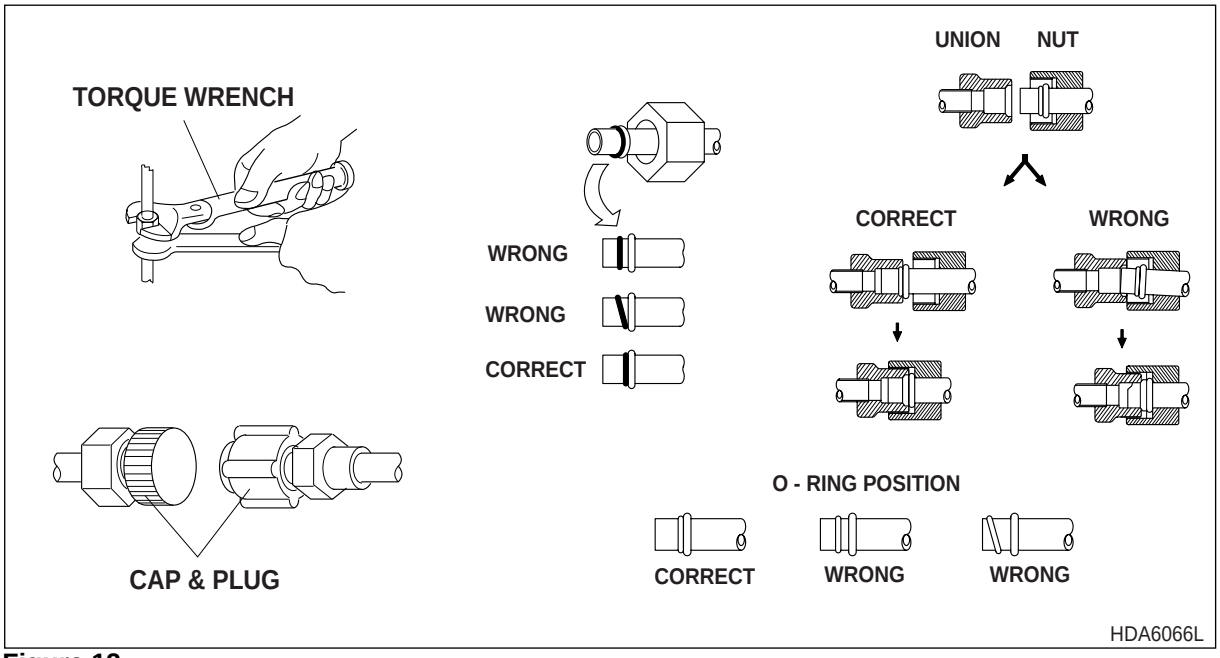


Figure 12

The following procedures should be observed for safe handling of refrigerant during vacuum and charging process.

1. Use an approved recovery / charging device which can safely perform vacuum and charge work simultaneously.
2. The new refrigerant has improved cooling characteristics than the old type and care should be used not to overcharge the system.
3. Do not over tighten connections when working on refrigerant system.
4. The new refrigerant system standards require new tools, equipment and parts. DO NOT attempt to use equipment use in servicing the old refrigerant system.

5. The new refrigerant oil (PAG type) has a high moisture absorption characteristic. When the refrigerant system vacuum seal has been broken, immediately plug up all openings to prevent moisture from entering into the system.
6. When joining unions which use O-ring seals, lightly coat O-rings with refrigerant oil. Be careful not to drip oil on the threads of the nut.
7. Be certain the O-rings are seated properly on the refrigerant line lip. Always use new O-rings when reassembling parts. Do not reuse old O-rings.
8. Use a vacuum pump to evacuate refrigerant system of air.
9. When charging the refrigerant system with the engine running, do not open the high pressure valve on the manifold gauge as the reverse flow of high pressure refrigerant will rupture the hose.
10. When releasing the high pressure hose after completing the charging process, quickly disconnect the hose to minimize refrigerant released to the air.

REPAIR AND REPLACEMENT PROCEDURE

1. Work Procedure
   A. Before repairing or replacing any refrigerant components first, return all refrigerant oil to the compressor and perform recovery procedures.
2. Operating Condition
   A. Run engine at maximum engine speed.
   B. Select ‘HI’ blower fan speed and select A/C switch to ‘ON’.
   C. Set the temperature control switch for maximum cooling and leave running for approximately 20 minutes.

   NOTE: *The manifold gauge dial pointer can vary depending on the outdoor temperatures.*

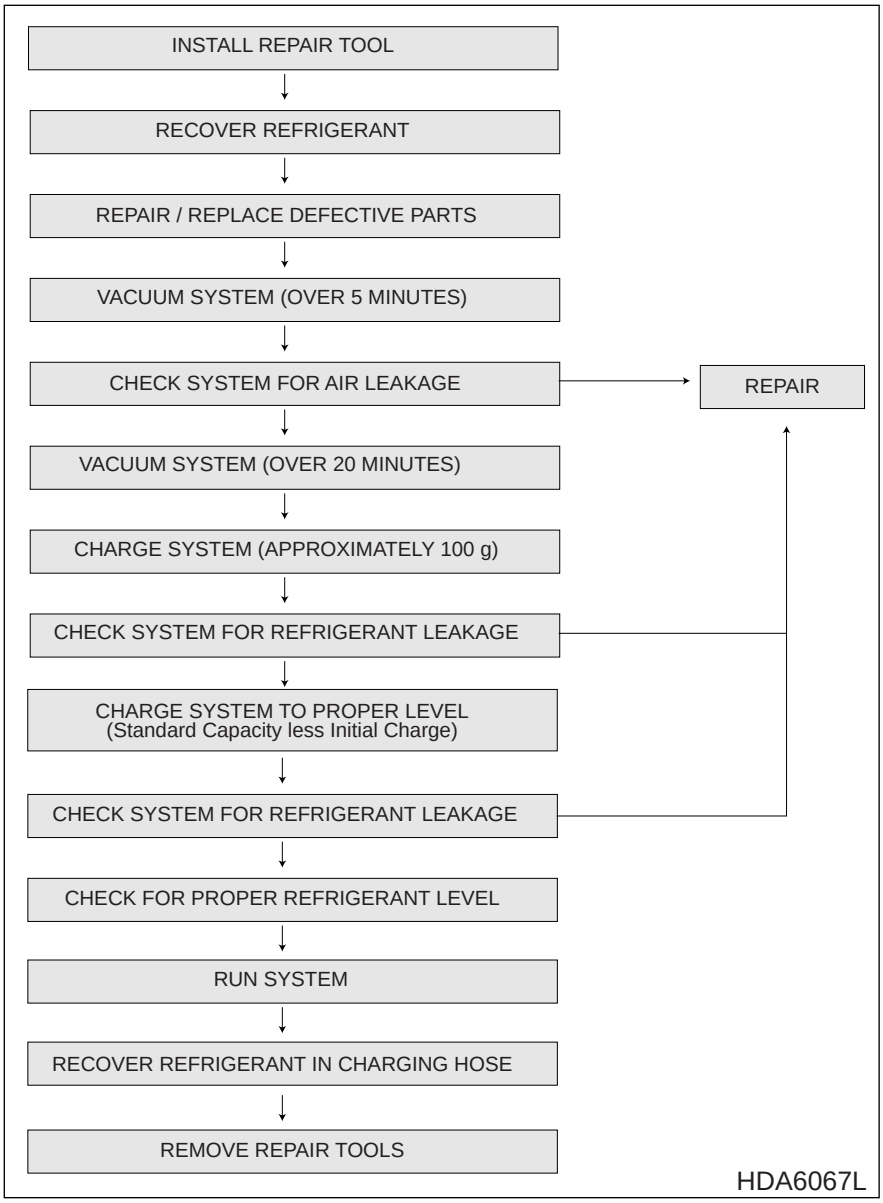

INSTALL REPAIR TOOL
RECOVER REFRIGERANT
REPAIR / REPLACE DEFECTIVE PARTS
VACUUM SYSTEM (OVER 5 MINUTES)
CHECK SYSTEM FOR AIR LEAKAGE
REPAIR
VACUUM SYSTEM (OVER 20 MINUTES)
CHARGE SYSTEM (APPROXIMATELY 100 g)
CHECK SYSTEM FOR REFRIGERANT LEAKAGE
CHARGE SYSTEM TO PROPER LEVEL
(Standard Capacity less Initial Charge)
CHECK SYSTEM FOR REFRIGERANT LEAKAGE
CHECK FOR PROPER REFRIGERANT LEVEL
RUN SYSTEM
RECOVER REFRIGERANT IN CHARGING HOSE
REMOVE REPAIR TOOLS
HDA6067L

Figure 13

REFRIGERANT RECOVERY

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

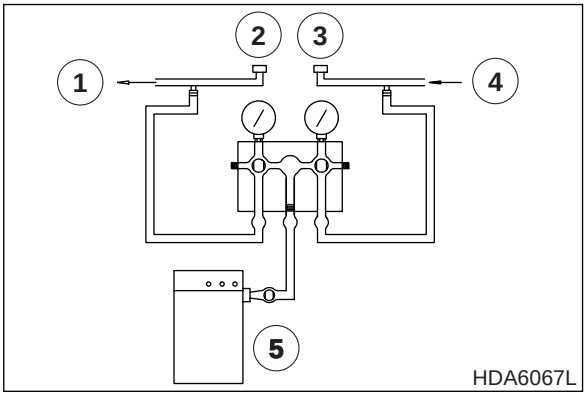


Figure 14

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/cm^2 (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/cm^2 (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

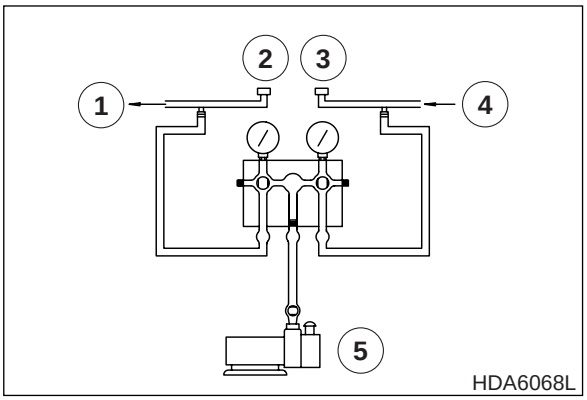


Figure 15

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.

2. Check system for vacuum leak.

   Allow system to sit for 10 minutes and check whether the system is holding the pressure. If the pressure has dropped, it must be repaired before proceeding to the next step.

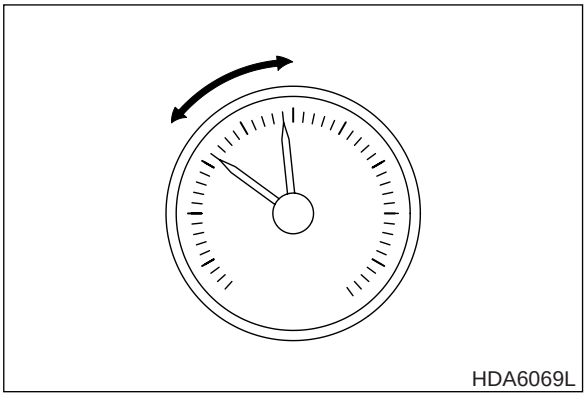


Figure 16

3. Vacuuming Procedure

   If the system is holding the pressure and it has not changed for 10 minutes, vacuum out the system for an additional 20 minutes.

   A. Turn on the vacuum pump and slowly open both valves.

   B. Allow vacuum pump to run for additional 20 minutes until the low pressure gauge dial reads approximately 750 mmHg.

   C. Close both valves and stop the vacuum pump.

4. Installation Of Refrigerant Container

Reference Number	Description
1	Handle
2	Hose Connection
3	Mounting Disk

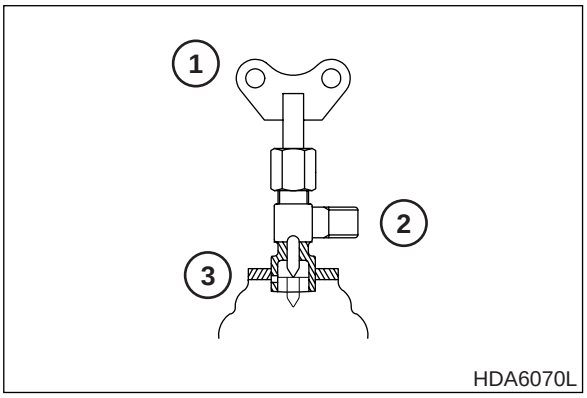


Figure 17

   A. Before mounting valve on the container, make sure the handle is in the counter clockwise most position, with the puncture pin retracted and the mounting disk is in the raised position.

   B. Attach the manifold gauge center hose to the valve assembly.

   C. Turn the disc in the clockwise direction and securely mount valve onto refrigerant container.

   D. Turn the valve handle in the clockwise direction and puncture the container seal with the pin.

   E. Once the can has been punctured, turn the handle in the counter clockwise direction so the refrigerant can flow into the manifold gauge center hose. At this time, do not open the low and high pressure valves of the manifold gauge.

   F. Press the manifold gauge low side valve to eliminate the trapped air in the hose.

LEAKAGE CHECK

NOTE: *Perform the leakage check after completing vacuuming process.*

1. After attaching the manifold gauge, open the high side valve.

2. Charge system until the low side gauge dial indicates a pressure of 1 kg/cm^2 (14 psi) and close the high side valve.

3. Using a refrigerant leak detector or soapy water check each joint for leakage.

Reference Number	Description
1	Refrigerant Leak Detection Device

4. If a leak is detected, check for O-ring damage or correct tightening torque and replace or repair as necessary.
5. If no leaks are detected, proceed with the charging process.

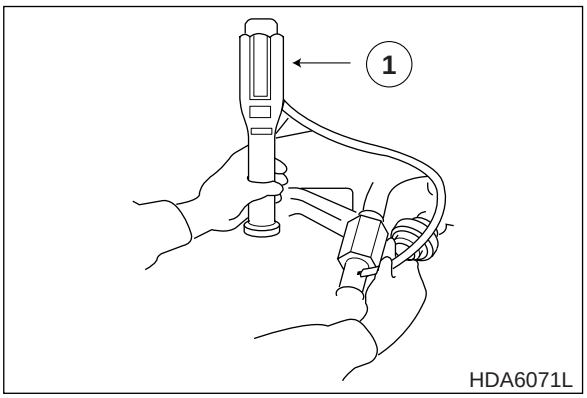


Figure 18

WARNING!

For accurate refrigerant leak detection, perform leak detection procedure in a well ventilated area.

REFRIGERANT CHARGING

1. Perform the vacuuming procedure, vacuum holding and leaking tests as described in the proceeding headings.

   NOTE: *First charge the refrigerant system with 100g (3.5 ounces) of refrigerant with the engine off. Then using the manifold gauges as a guide fully charge the system with the engine running.*

   When exchanging refrigerant containers, press the manifold gauge low side valve to eliminate air from the charging hose.

Reference Number	Description
1	To Compressor
2	Low Pressure Side
3	High Pressure Side
4	From Receiver
5	Refrigerant Supply Container

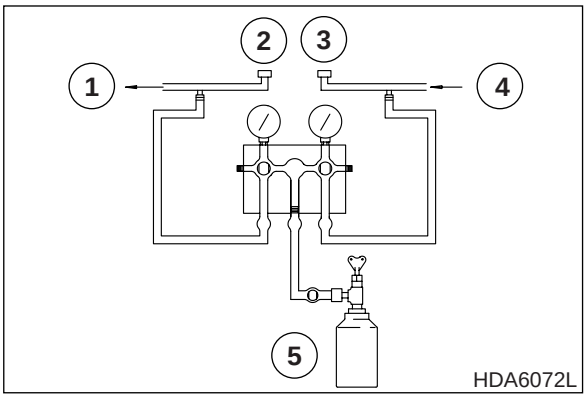


Figure 19

2. Charge the system by opening the manifold gauge low side valve.

   Initial charge amount: 100 g (3.5 ounces).

3. If refrigerant does not flow freely into system, try starting engine first before operating air-conditioner.

   - Temperature control switch setting: Maximum Cooling

     Blower Speed Setting: Hi (3 step)

Engine Speed: 1,300 - 1,500 RPM

⚠ WARNING!

When charging refrigerant system with the engine running;

- **Always keep refrigerant supply container in the upright position.**
- **Never open the high side pressure valve.**

4. Open the manifold gauge low side valve and charge system to standard capacity.

Gauge Dial	Standard Reading
High Side Gauge	13 - 20 kg/cm^2 (185 - 285 psi)
Low Side Gauge	1.5 - 3.5 kg/cm^2 (22 - 50 psi)

NOTE: *These standards are for outside temperatures between 30˚ - 35˚C (86˚ - 95˚F). The gauge readings may vary for extreme temperature conditions.*

⚠ WARNING!

- **When outside temperature is low, warm the refrigerant supply container with warm water not exceeding 40˚C (104˚F). Do not allow water to come in contact with the charging adapter valve handle.**
- **When outside temperature is high, cool off refrigerant supply container and condenser to aid the refrigerant charging process.**

5. Close low pressure side valve.
6. Shut off engine and close refrigerant supply container adapter valve. Disconnect manifold gauge hoses from vehicle.

INSPECTING SYSTEM FOR LEAKAGE

After completing charging procedures, clean all joints and connections with a clean dry cloth. Using a refrigerant leak detecting device or soapy water, inspect system for leaks starting from the high pressure side.

NOTE: *When the refrigerant circulation has been stopped the high pressure will start to decrease and the low pressure will start to increase until they are equalized. Starting the inspection from the high side will result in a accurate test.*

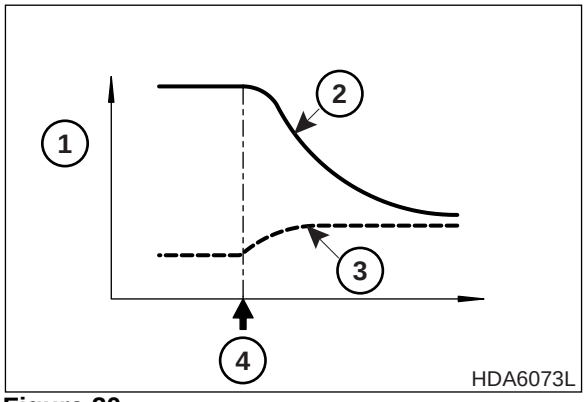


Figure 20

Reference Number	Description
1	Pressure
2	High Pressure
3	Low Pressure
4	Compressor Stop

Inspection Procedure

1. High Pressure Side

   Compressor outlet → condenser inlet → receiver dryer inlet → air-conditioner unit inlet

2. Low pressure side

   Compressor inlet → air-conditioner unit outlet

3. Compressor

   Compressor shaft area, bolt hole area and magnetic clutch area.

4. Receiver dryer

   Pressure switch and plug area.

5. Connection valve area

   Inspect all valve areas.

   Verify all valves are capped to prevent leaking.

   Check for foreign matter inside of valve cap.

6. Interior of air-conditioning unit.

   After stopping engine, insert detector probe into drain hose. (Leave inserted for 10 seconds minimum.)

   NOTE: *When inspecting leakage from the air-conditioning unit, perform the inspection in a well ventilated area.*

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

DRIVE COUPLING (MAIN PUMP)

⚠ 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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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December 2001

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DRIVE COUPLING

When installing the main pump on the engine, it is very important to properly adjust clearance between the face of the coupling hub and end of pump drive shaft ("Measurement H" shown in the following procedure) to a specific value.

Figure 1 thru Figure 2, show typical drive coupling installations.

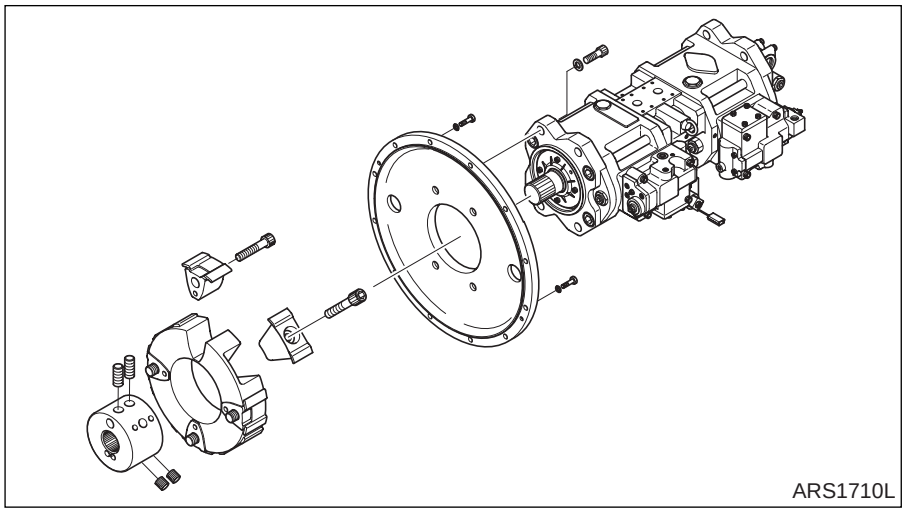


Figure 1 KAWASAKI

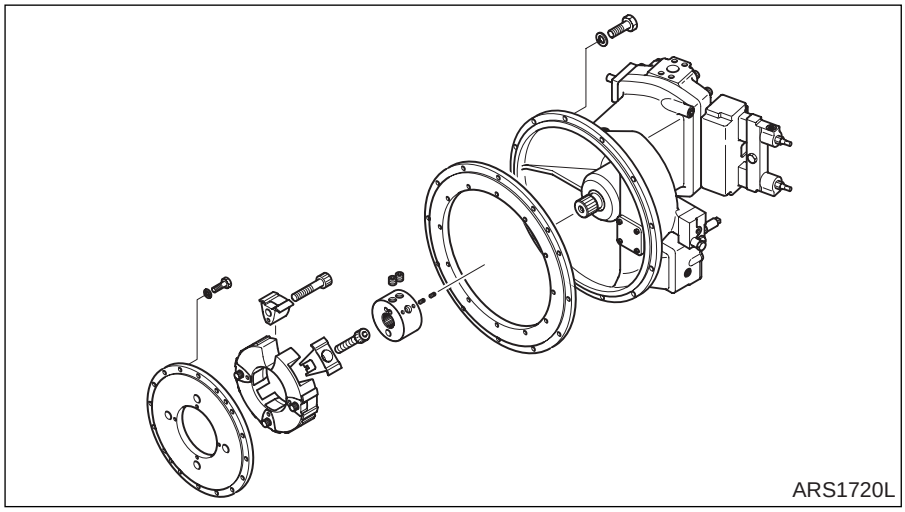


Figure 2 REXROTH

SPECIAL TOOLS

This tool is used to control the distance between the end of the pump drive shaft and the front face of the drive coupling hub (Figure 3 and Figure 5). This distance will be referred to as "Measurement H" in the installation instructions that follow.

NOTE: *In manufacturing drawings (Figure 4), dimension "A" and "B" equal the "Measurement H." The two tools shown are designed to be used on various models of equipment. Only one end of the tool is used for a specific model of equipment.*



Figure 3

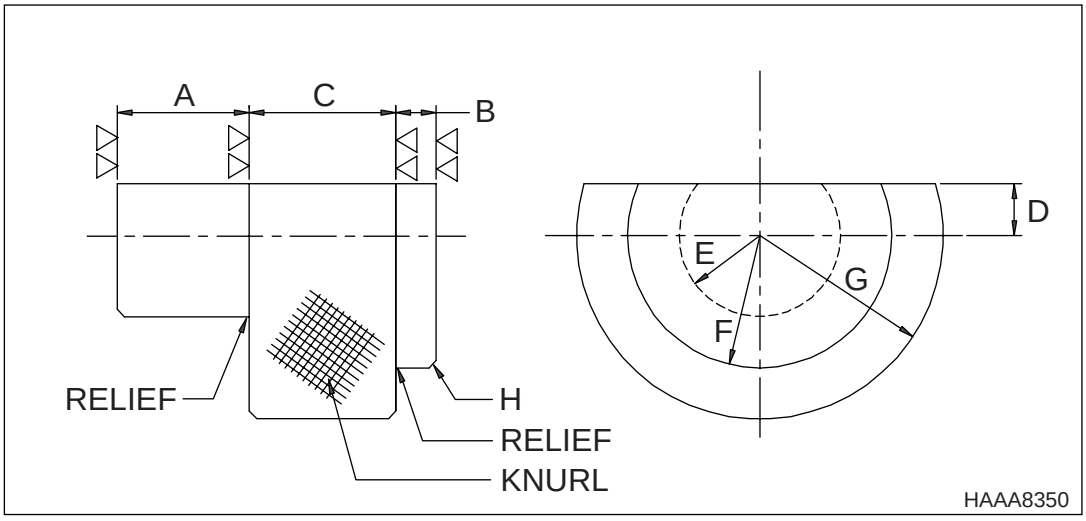


Figure 4

Dimensional Details for Figure 4		
Dimension	**Measurement**	**Models**
A	6 ±0.1 mm (0.2362 ±0.0039 in.)	S300LC-V, S300LL
B	7 ±0.1 mm (0.2756 ±0.0039 in.)	S340LC-V, S420LC-V, S470LC-V
C	20.0 mm (0.787 in.)	
D	7.0 mm (0.275 in.)	
E	18.0 mm (0.708 in.) Radius	
F	22.0 mm (0.866 in.) Radius	
G	30.0 mm (1.181 in.) Radius	
H	1.0 mm (0.039 in.) x 45˚ Chamfer	

DRIVE COUPLING INSTALLATION

Whenever the drive coupling for main pump is installed, the following mounting dimensions and installation procedures must be observed.

NOTE: *If these procedures are not followed, noise will occur and/or the service life of drive coupling or main pump will be reduced.*

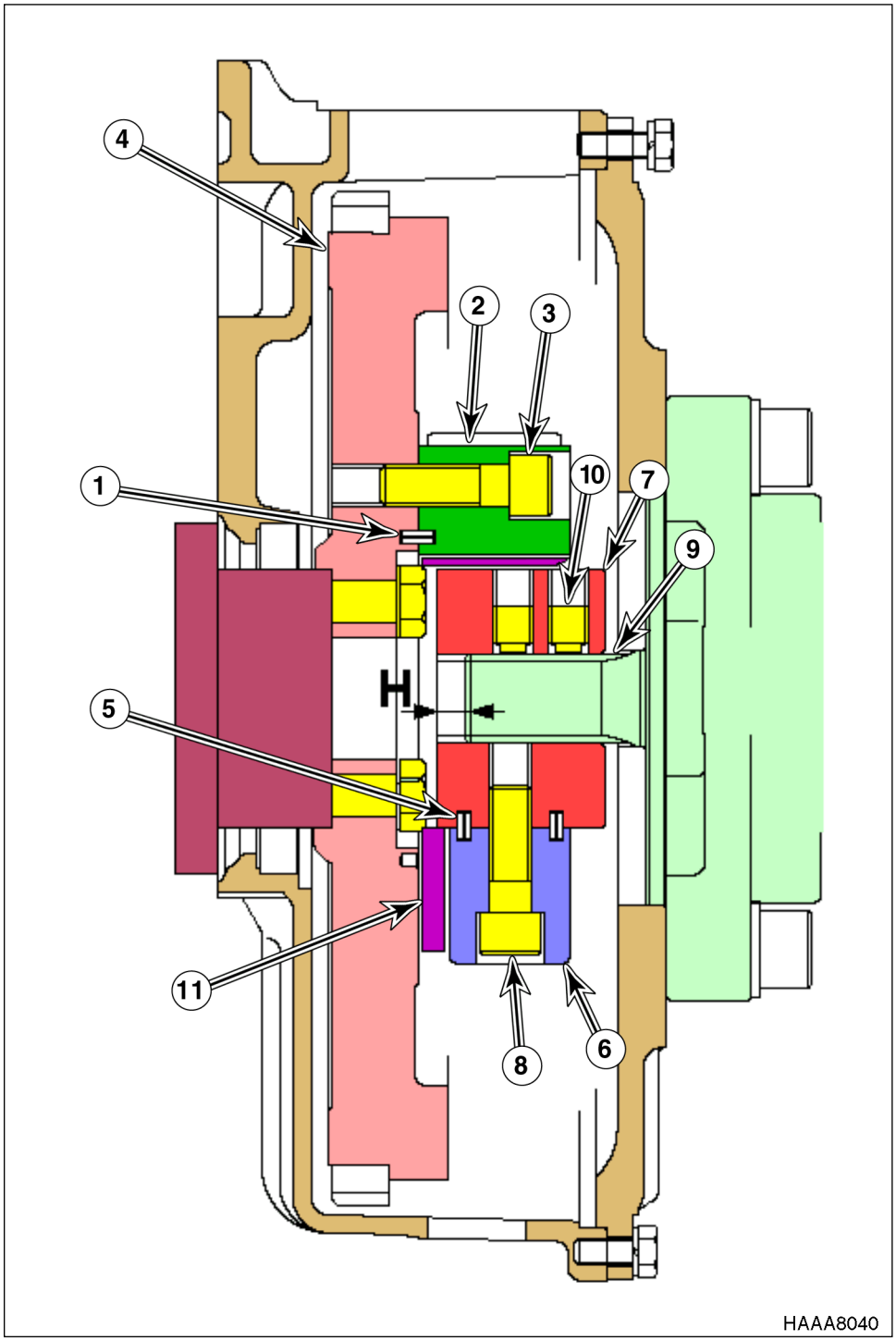


Figure 5 DRIVE COUPLING INSTALLATION

Table 1 Parts Information and Torque for Figure 5			
Reference Number	**Description**	**Qty.**	**Torque (See Table 2)**
1	Spring Pin	4	
2	Insert	4	
3	Bolt	4	Ta
4	Flywheel	1	
5	Spring Pin	8	
6	Insert	4	
7	Hub	1	
8	Bolt	4	Ta
9	Pump shaft	1	
10	Clamping screw	2	Tb
11	Element	1	

Specification for "Measurement H," from front hub face to pump shaft end, and TIGHTENING TORQUE of bolts and screws written in the "Table 2" must be observed.

Table 2 Specification for "Measurement H" and Torque (Refer to Figure 5)

Model	Coupling Part Number	"Measurement H"	Torque Value for "Ta"	Torque Value for "Tb"
S300LC-V	414-00040	5.5 - 6.5 mm (0.216 - 0.256 in.)	44 - 49 kg•m (318 - 354 ft lb)	20 - 22 kg•m (145 - 159 ft lb)
S300LL				
S340LC-V	414-00041	6.5 - 7.5 mm (0.256 - 0.295 in.)	44 - 49 kg•m (318 - 354 ft lb)	20 - 22 kg•m (145 - 159 ft lb)
S420LC-V				
S470LC-V				

INSTALLATION PROCEDURE

NOTE: *Refer to Figure 5 while using following procedure.*

1. Install spring pin (1) and attach insert (2) with bolt (3) to engine flywheel (4).

   NOTE: *Tighten bolts to value "Ta" in the tables.*

2. Install two spring pins (5) and attach insert (6) to hub (7) bolts (8).

   NOTE: *Tighten bolts to value "Ta" in the tables.*

3. Attach flywheel cover to the main pump with bolts. (S300LC-V, S340LC-V only.)

4. Slide hub (7) into place on pump shaft (9) as specified in the "Table 2" for "Measurement H" and secure it in position with clamping screws (10).

   NOTE: *Tighten clamping screws to value "Tb" in the tables.*

   NOTE: *Coat clamping screws (10) with Loctite #262.*

5. Install element (11) between inserts (2) on engine flywheel (4)

6. Install main pump and hub (7) by pushing it softly into element (11).

7. Attach flywheel cover / pump housing to flywheel housing with bolts

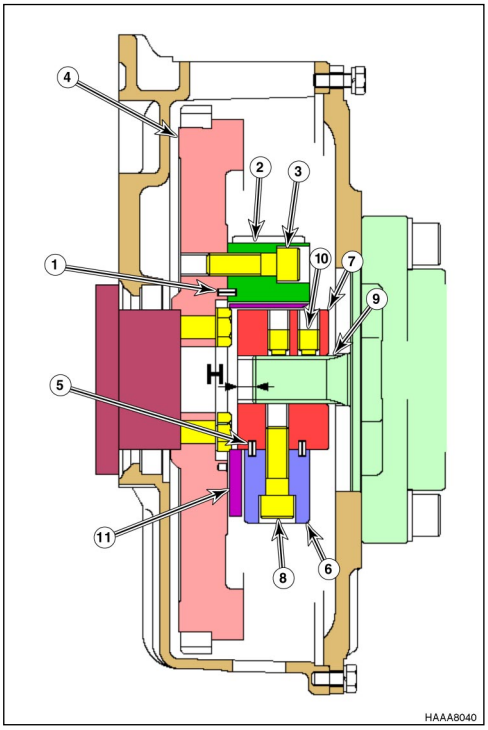


Figure 6 DRIVE COUPLING INSTALLATION

CAUTION!

1. **Bolts (3 and 8) are coated against loosening with a bonding compound. Do not use any additional bonding compounds, oils or cleaning solvents on them.**
2. **Element (11) is non-resistant to bonding compounds, oil or grease. Be careful not to expose it to them.**
3. **Remove oil or dirt from flywheel cover and pump shaft before assembly.**
4. **Misalignment between pump and engine should be controlled to less than 0.6 mm (0.023 in.).**

HYDRAULICS

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

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 300LC-V	1001 and Up
Solar 300LL	1001 and Up

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HYDRAULIC SYSTEM - GENERAL NOTES

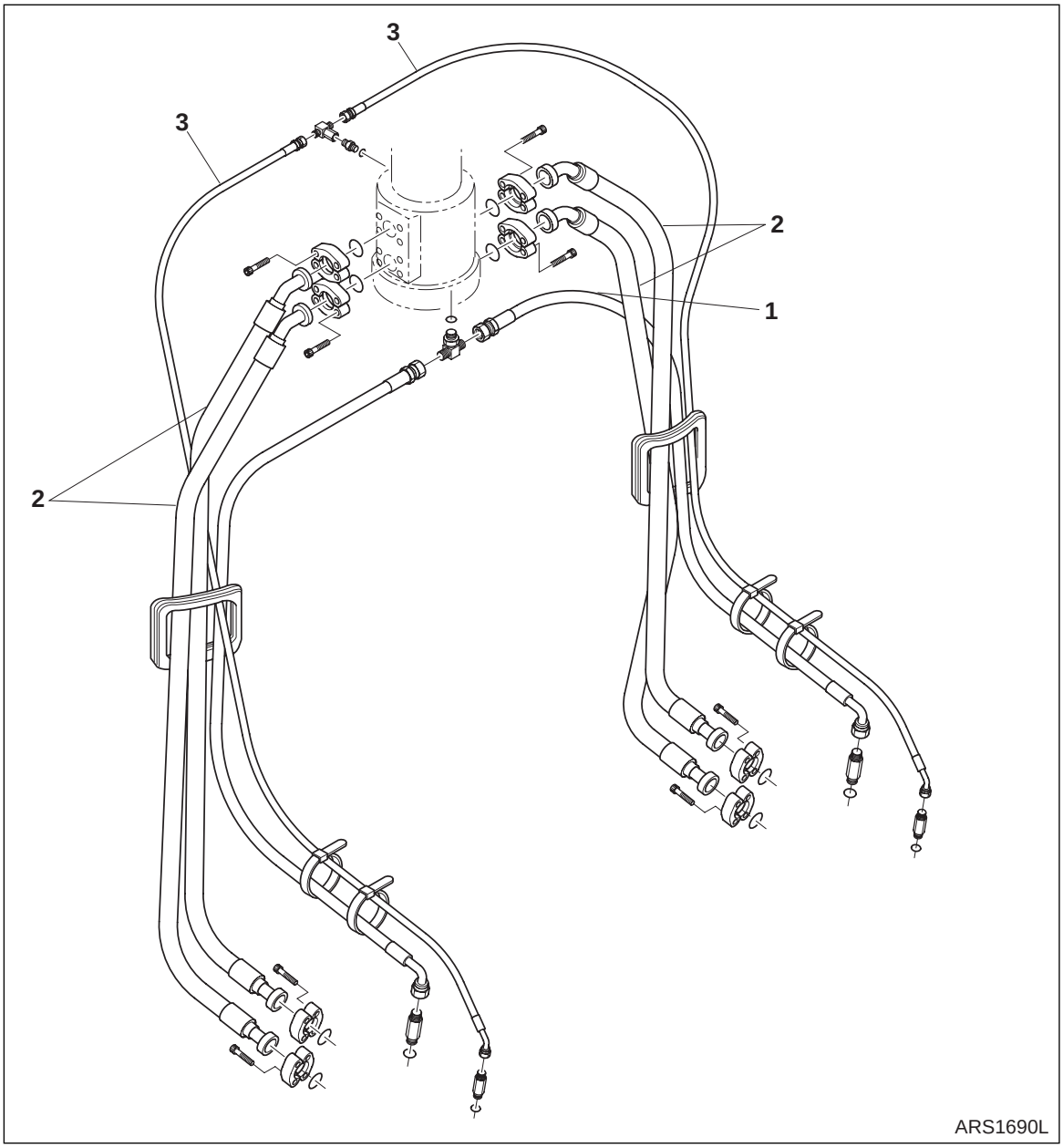


Figure 1

The hydraulic system has several improvements over conventional hydraulic systems - including cross-sensing total horsepower control - to maximize output efficiency.

The system features an electronically controlled output optimization system, which allows the operator to choose between three, distinctly different power modes: high-output/rapid cycling maximum-speed power mode, low fuel consumption/low-noise light duty power mode, and a standard power mode for most types of general operation offering some of the advantages of each of the other two power modes.

Electronic management of hydraulic control valves assists in optimizing the application speed and overall operator control of hydraulic actuators and functions.

HYDRAULIC SCHEMATIC

The hydraulic schematic(s) is available in the "Hydraulic and Electrcial Schematic Shop Manual." This manual is a collection of diagrams and schematics for a number of models.

GENERAL NOTES

When refering to the schematic, refer to the following items:

- As shown in the schematic, the main pump assembly is driven by the engine. Mechanical energy is converted to hydraulic power, generating the required hydraulic flow which drives the system. Two main pumps (a right side pump and a left side pump) make up the main pump assembly.
- Hydraulic output from the right side pump is transmitted to the right side of the control valve. Output from the left side pump is transmitted to the valve spools on the left side of the control valve. Hydraulic output from the pilot pump is used to control the pump and to operate pilot and solenoid valves.
- The right half of the hydraulic control valve, supplied by the right pump in the pump assembly, operates valve spools for right travel, swing, boom up and arm functions. The amount of oil flow to the actuators at the output end of each of those circuits is regulated through the movement of each individual valve spool.
- The left half of the hydraulic control valve, fed by the left pump in the pump assembly, has control spools for left travel, bucket, boom and arm operation.
- Two-stage operation is a feature of boom and arm function. All of these circuits can be operated using the output of only one half of the hydraulic pump assembly (one pump or the other), or – since both halves of the control valve have a spool and available circuit for these functions – the output of both pumps can be combined, allowing higher speed operation. Boom up, arm crowd and dumping functions can operate in any one of the two available power modes – the standard or general duty mode, the high speed/rapid cycling mode.
- Whenever the right travel or left travel control spools are shifted, output from the main pump assembly passes through the center joint to one or both of the axial piston motors driving the side frame crawler tracks. A pilot valve connected to the swash plate of each travel motor changes motor capacity (and output) in direct proportion to the position of the travel switch selected by the operator.
- The hydraulic reservoir return line and the pilot circuit both have 10 micron full flow filters. The disposable elements in these two canister-type filters trap and remove impurities from the oil in the system. An 80 mesh, 177 micron reservoir intake strainer also helps maintain system cleanliness and should be cleaned each time hydraulic fluid is drained and replaced. An oil cooler in the hydraulic system helps maintain the operating temperature of the system at approximately 50°C (122°F).
- The arm cylinder operating circuit includes anti-vacuum valves which protect the hydraulic system from vacuum that could result from external shocks or other unusual conditions. Boom, Arm, and Bucket cylinder circuit are also protected by overload relief valves. Whenever high pressure is generated as a result of a shock or overload, excess pressure is dumped to the reservoir return circuit through the relief valve.

A selection valve in the travel circuit can be used to provide constant high torque/low speed travel, or variable speed/variable torque output for travel. To prevent sliding during simultaneous travel and boom/arm/bucket operation, select the high torque/low speed travel position.

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.

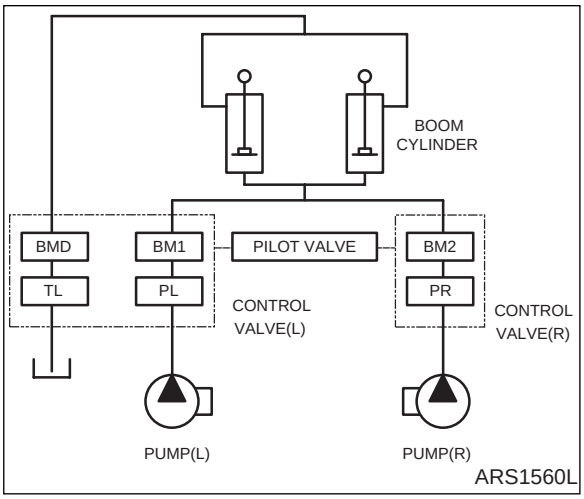


Figure 2

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 left side of the control valve. When secondary pilot pressure reaches 4 - 6 kg/cm sq. (57 - 85 psi), the valve spool on the left 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.

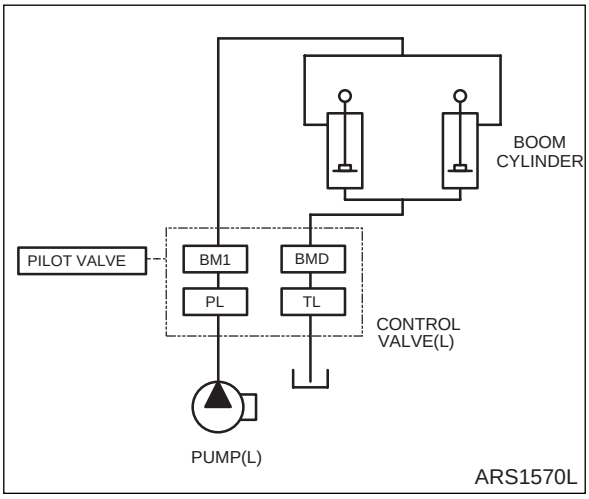


Figure 3

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.

Overload relief valves set at 360 kg/cm sq.(5,112 psi) have been installed at the **AM 1** and **AMD 1** ports on the right side of the control valve to protect the circuit and system components from possible damage caused by shocks and/or overload pressure. Additional protection - to prevent cavitation of the cylinder - is provided by a make-up valve and reservoir return circuit, which ensures that the volume of oil going to the cylinder will not exceed the volume of oil coming out.

ARM CROWD CIRCUIT

When the arm control lever is put in the crowd mode, the left side pilot valve generates secondary 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), the arm control valve spool on the right and left sides of the control valve opens. Output flow from both halves of the pump assembly is directed to the arm cylinder.

When working in the arm crowd mode, under certain conditions, oil in the cylinder could suddenly be forced out by the weight of the arm and bucket itself. Insufficient oil flow to the cylinder could lead to cavitation in the cylinder and/or surging or irregular movement. This is prevented by a regeneration valve attached to the control valve which maintains the balance between oil flowing into the cylinder and oil flowing out.

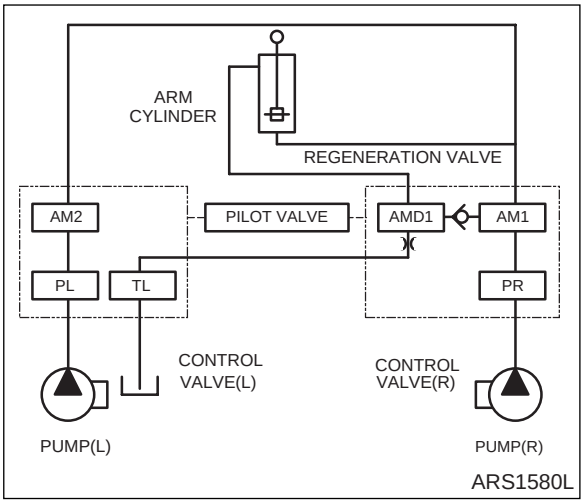


Figure 4

ARM DUMP CIRCUIT

When the arm control lever is put in "dump" mode, the left side pilot valve generates secondary pilot pressure that goes to both halves of the control valve simultaneously.

When pilot pressure reaches 4 - 6 kg/cm sq. (57 - 85 psi), the control spools open on both sides allowing oil from the right and left pumps to flow to the arm cylinder.

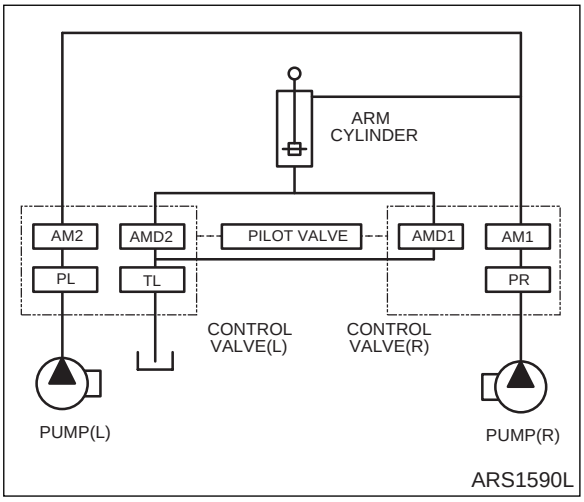


Figure 5

BUCKET OPERATING CIRCUIT

The bucket operating circuit includes the left main pump, the left half of the control valve and the bucket cylinder. 360 kg/cm sq. (5,112 psi) overload relief valves located at **BKT** and **BKTD 1** ports of the control valve protect the circuit and its components from damage.

BUCKET CROWD CIRCUIT

When the bucket control lever is placed in the crowd position, the bucket control valve spool on the left side of the control valve opens and oil from left main pumps flows to the bucket cylinder.

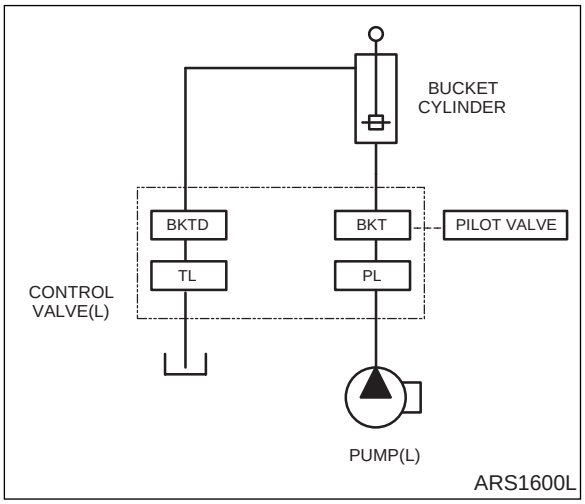


Figure 6

BUCKET DUMP CIRCUIT

When the bucket control lever is put in the dump mode, the bucket control valve spool in the left half of the control valve opens to supply oil from the left main pump to the cylinder.

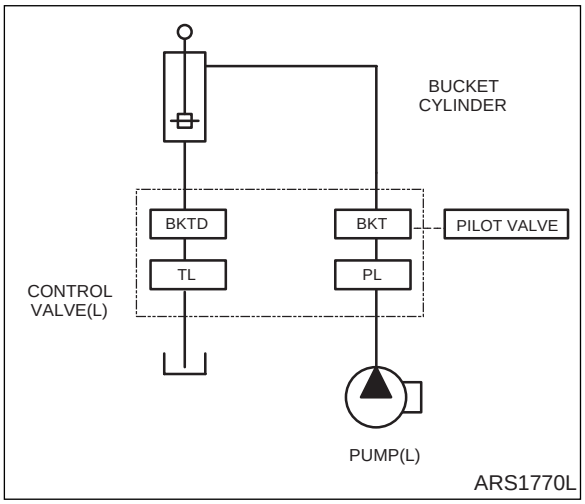


Figure 7

SWING OPERATING CIRCUIT

The swing operating circuit consists of the right main pump in the pump assembly, the right half of the control valve and the swing motor. To keep the upper works from coasting when the swing control is in neutral, an electrical sensor in the control circuit activates a valve to automatically engage a mechanical brake.

RIGHT SWING OPERATING CIRCUIT

When the swing control lever is pushed to the right swing position, pilot pressure from the left side pilot valve is directed to the right side pump regulator and right half of the control valve. Output flow from the right pump is then directed through the PR and SWR ports of the control valve to the swing motor.

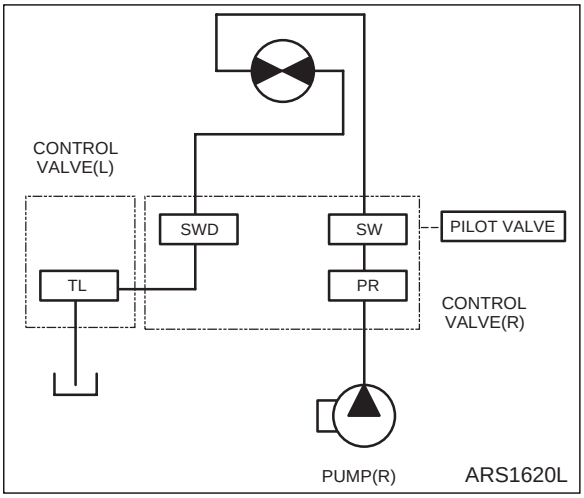


Figure 8

LEFT SWING OPERATING CIRCUIT

When the swing control lever is pushed to the left swing position, the control valve spool at the right side of the control valve moves in the opposite direction and output flow from the right pump is directed through the PR and SWL ports of the control valve to the swing motor.

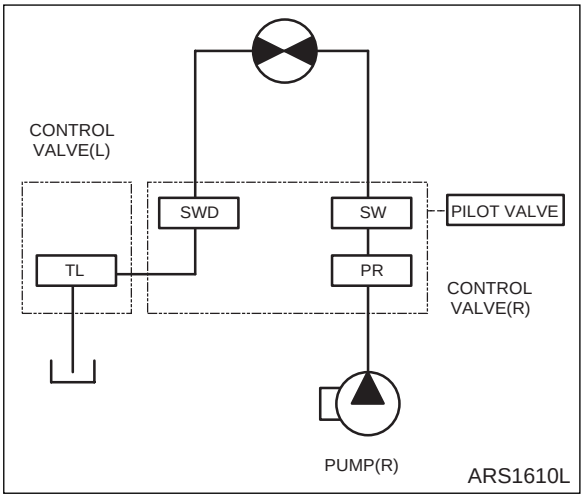


Figure 9

SWING RELIEF VALVE AND MAKE-UP VALVE

Whenever the spool is shifted to the neutral mode during swing operation, the possibility exists that surge pressure in the circuit - caused by inertial momentum of the upper works and correspondingly reduced pressure at the opposite motor port - could produce cavitation in the circuit. To keep that from happening, a 285 kg/cm sq. (4,052 psi) relief valve is installed in the swing motor and a large-capacity make-up valve is connected to the entrance port of the hydraulic reservoir, helping maintain acceptable pressures on both sides of the circuit.

TRAVEL OPERATING CIRCUIT

Output flow from both halves of the pump assembly is directed to the right and left travel motors through the right and left sides of the control valve, and the upper works center joint.

FORWARD TRAVEL CIRCUIT

When the right and left travel control levers are pushed forward, output from both of the main pumps is directed through the **PR**, **PL**, **TRRF** and **TRLF** ports on the control valve, through the upper works center joint, to the travel motors on each side of the machine.

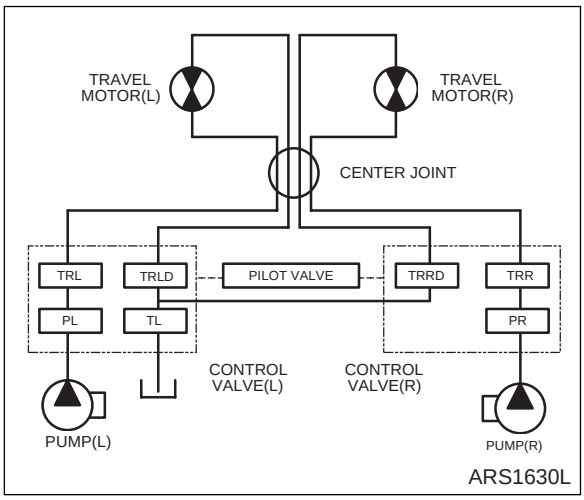


Figure 10

REVERSE TRAVEL CIRCUIT

When the right and left travel control levers are pushed backward, output from both main pumps is directed through the PR, PL, TRRR and TRLR ports on the control valve, through the upper works center joint, to the travel motors.

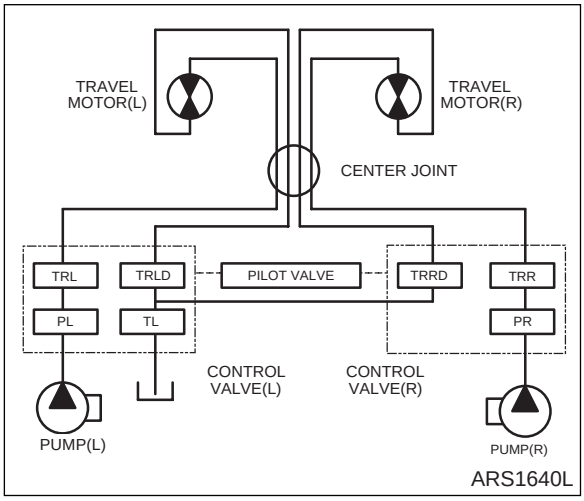


Figure 11

PROCEDURAL TROUBLESHOOTING BASELINE RECOMMENDATIONS

INITIAL CHECKS AND TESTS TO ESTABLISH OPERATING CONDITION OF THE EXCAVATOR

Triage Summary

An excavator that fails to deliver designed performance should be checked for the following:

- Hydraulic flow, first, and
- Hydraulic pressure, afterwards, in a specified order of priority through different points of the system.

To verify adequate available hydraulic flow, before any other tests are performed through the circuit:

Check engine operation -

- at 1,950 RPM with no load

- at 1,950 RPM stall load

If engine RPM drops excessively with a load or fails to surpass rated speed (1,900 RPM), performance problems may be due to inadequate hydraulic flow caused by lagging rotational speed.

NOTE: *Verify actual flow on the excavator against rated performance, with a flow meter.*

If engine tests meet specifications and adequate torque and horsepower are available at the pump drive flex coupling, pull out the electrical tray under the operator's seat to inspect the self-diagnostic display.

If the EPOS trouble code display is clear, check hydraulic functions in the following sequence:

- Pilot pressure
- Negacon, negative control pressure
- Main relief pressure (front and rear pump)
- Swing pressure
- Port relief pressure (individual control functions; crowd, bucket, boom, travel)
- Power boost circuit
- Standard performance tests; cylinder speed, hydraulic motor (travel and swing) speed, cylinder oil-tightness "permissible drift" test

NOTE: *System specification performance tests of individual activator function are determined by flow rate through the component or circuit, not the control pressure or system pressure available to the actuator. Poor flow through the individual circuit may indicate that the component is worn beyond tolerance limits, while all other hydraulic functions are adequate.*

IMPORTANT
It is suggested that the troubleshooter maintain the testing sequence of the preceding list. Checks and adjustments nearer the middle or the end of the list may depend on adequate functioning of systems tested nearer the top of the list.

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 (580 psi ±73 psi)	23.5 bar ±1.5 bar (341 psi ±22 psi)

POWER MODE VALVE

CURRENT SIGNAL AND HYDRAULIC PRESSURE 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.

The electromagnetic pressure proportioning control (EPPR) "power mode" valve is located on the underside of the pumps (not visible in the harness connections drawing, because it is underneath the assembly), near the engine/pump flexible coupling, adjacent to the pump return line. To test and adjust power shift current and pressure through the power mode valve a multi-lead jumper harness is required. The jumper harness (which is available through Daewoo After Sales Service, or could be spliced together from commonly available, purchased parts) has extra leads so that a VOM meter can be connected to the circuit.

To set up the testing equipment, turn off the engine and disconnect the single electrical lead from the power mode valve. Attach the jumper harness to the terminal on the valve, connect the test leads of the multimeter to the extra leads on the harness and reconnect the valve electrical lead.

Vent the lever on top of the hydraulic tank to relieve pressure and connect an in-line "t-style" adapter to the valve pressure port. Install a 60 bar/870 psi (1,000 psi) test gauge in the adapter.

Restart the engine and increase engine RPM by turning the speed control to the maximum speed setting. Warm up the engine and hydraulic system until hydraulic oil temperature is at least 45°C (113°F). Select Power Mode III on the Instrument Panel. Check current readings (in milliamps) on the VOM meter and hydraulic pressure gauge readings and make sure both conform to the values in the table below.

NOTE: *If recorded values do not conform to the specified current or pressure in the table, back off the lock nut on the end of the valve, turn the adjusting screw 1/4 turn and re-check current and pressure. Repeat adjustment as required to obtain specified performance and retighten the valve lock nut.*

Mode	Engine RPM	Current	Pressure
Power Mode III	High Idle: 2,050 RPM Operating Range: 1,200 - 1,600 RPM	600 ±20 mA Mid-range value corresponding to engine RPM for both current and hydraulic pressure readings.	26 ±1 bar (377 ±15 psi)
Power Mode II	2,050 RPM	0 mA	36 ±6 bar (524 ±58 psi)

SWING PRIORITY VALVE

CONTROL VALVE PRESSURE AND CURRENT 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.

The swing priority control valve is located inside the compartment behind the cabin.

The same jumper harness used for testing the power mode (EPOS) control valve is used to test this valve. Turn off the engine, disconnect either of the electrical leads and connect the test equipment to that side of the valve. An in-line "t-style" gauge adapter can be used to connect a 60 bar/870 psi (1,000 psi) test gauge to the outlet (pressure) side of the valve. Set the engine control speed dial to maximum and warm up the engine to at least 45°C (113°F) before making any tests.

NOTE: *Vent air from the hydraulic system before installing test equipment. Use the lever on the reservoir, while the engine is running. Pour clean replacement fluid back into the system if excessive fluid was lost.*

To verify operation of the swing priority solenoid valve, connect test equipment and begin testing with the work mode switch set to "digging" (the state turning off the "trenching" lamp) and the engine speed control dial at the maximum RPM position.

Operate the swing motor in both directions. Measure signal current and hydraulic pressure through the valve and record the highest and lowest values as the swing motor rotate clockwise and counter clockwise several times. Reset the work mode control to "trenching" mode and repeat the same tests.

Valve Function / Work Mode	Signal Voltage	Hydraulic Pressure
Swing Priority / Digging	0 V	0 bar (0 psi)
Swing Priority / Trenching	20 - 30 V	20 - 40 bar (568 psi)

NOTE: *If recorded values do not conform to the specified current or pressure in the table, readjust as required.*

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 (290 - 580 psi)	30 bar + 10 bar (435 psi + 145 psi)
Mode III	Cylinder Stall	330 bar + 5 bar (4,785 psi + 75 psi)	30 bar + 10 bar (435 psi + 145 psi)
Mode III W/ pressure Up	Cylinder Stall	350 bar + 10 bar 5,075 psi + 145 psi	30 bar + 10 bar (435 psi + 145 psi)

NOTE: *The electrical pressure up (power boost) solenoid valve located alongside the swing priority solenoid and arm speed control solenoid, in compartment rear of the operator's cab, must be operating correctly, or pressure tests and further adjustments cannot be made.*

PUMP INPUT POWER CONTROL

PUMP REGULATOR ADJUSTMENT

⚠ 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.

To perform these adjustments accurately the use of a flow meter is strongly recommended, as is consulting the factory (before starting work) to validate the need for making regulator adjustments. Vent hydraulic pressure from the reservoir before breaking the seal on fittings to install the flow meter kit. (Refer to the "Flow meter Installation and Testing" procedure.)

IMPORTANT
Before starting this procedure or going on to make any changes of adjustment settings, • **Verify engine output to the rated speed – 2,050 RPM (± 50 RPM).** • **Permanently mark setscrew positions at the current regulator control setting.**

Use a scribe or other permanent marker to identify a reference point on adjusting screws with a corresponding reference on the body of the valve. The adjustment process affects a complex balance and could require some time to complete. If adjustment has to be interrupted or postponed, reference marks at the adjustment point allow immediate restoration of original performance.

This adjustment procedure is normally performed:

- If the engine is being consistently overloaded (and engine troubleshooting shows engine performance to be at or above rated output);
- If reduced cylinder speed and diminished work performance provide an indication that rated, maximum pump flow may not be available (and all other troubleshooting gives no indication of other flaws or hydraulic system defects);
- If pump output is out of balance and one pump is failing to keep up with the output flow of the other.

To check pump imbalance without a flow meter, travel the excavator forward on flat, level terrain. If the machine veers off despite neutral control input and even, balanced track adjustment, the pump which supplies output to the track frame toward which the excavator is veering is weak.

Refer to the illustration of the pump regulator control valve (Figure 3-102) for the location of adjustment screws (925, 628, 642). There are three different adjustments, along with the Negacon, negative control, adjustment screw (924, directly below 925 and 628). Each one of the adjustment procedures could affect the setting of the others.

Check and record the arm dump speed performance test before and after input power adjustment, whether or not a flow meter is used.

NOTE: *Regulator adjustments affect total cumulative horsepower, since each regulator compensates for the output of the other. It is not necessary to adjust both regulators at the same time, but after checking or adjusting one of them, the remaining unit should also be checked.*

Start the engine and turn the engine speed dial to maximum. When normal operating temperature is reached, loosen the largest diameter lock nut around the adjustment screw (628) for the outer regulator spring. Tightening the screw shifts the P/Q (Pressure/Flow) control curve to the right, and increases compensating control pressure.

On the other hand, if the persistent cause of performance problems is engine overloading, decreasing the adjustment by turning the larger diameter adjusting screw (628) out will decrease pump input horsepower. 1/4 turn on the adjusting screw is equal to approximately 17 horsepower.

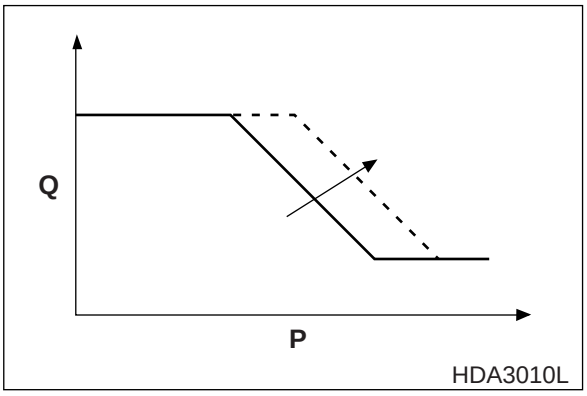


Figure 12

IMPORTANT

Because changing the position of adjusting screw (628) also affects the setting of the adjustment for the inner spring, the smaller diameter adjusting screw (925), turn in the inner screw 198° (slightly more than 1/2 turn, 180°) before screw (628) is backed out 1/4 turn (90°).

NOTE: *For each full turn of adjustment on the larger diameter screw (628), the square-tipped adjusting screw should be turned in the opposite direction 2.2 turns to avoid changing inner spring adjustment.*

Pump input power adjustments are normally made in small increments, 1/4 turn (90°) or less, each time.

Turning the square-tipped, smaller diameter screw (925) clockwise moves the flow curve up, increasing flow and then input horsepower.

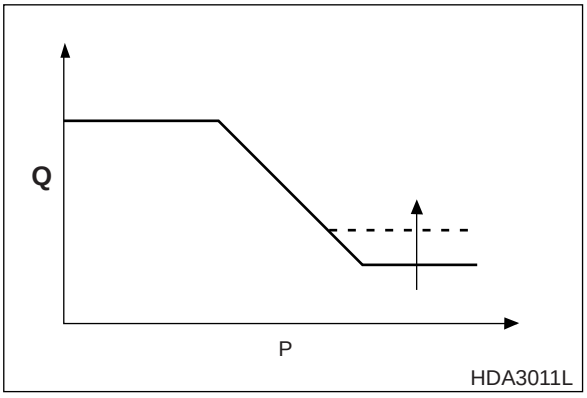


Figure 13

The adjusting screw on the opposite side of the regulator (642) affects the delivery rate (Q) of the pump. Tightening the adjusting screw decreases the maximum cut flow (as shown in Figure 8-3) while backing out the screw increases cut flow delivery rate.

Balance both pumps for equal output.

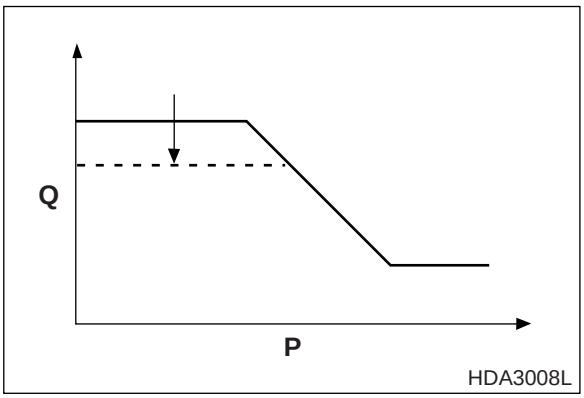


Figure 14

FLOW METER AND FLOW METER KIT INSTALLATION AND TESTING

Checking regulator and pump output, to assess the output balance between the front and rear pumps and to verify operating adjustment of each regulator, will require installation of a flow meter.

The After Sales Service department of the nearest local Daewoo dealer can assist you with these tests or, if you prefer carrying out your own testing, they should be able to help in putting together a hose and fitting kit (or the required dimensions and specifications for hoses and fittings) to allow you to install a flow meter downstream from the main pump assembly.

Installation and Testing Procedure

- Turn off the engine and operate controls to release hydraulic pressure from the accumulator.
- Vent the reservoir to release all pressure from the hydraulic system.
- Remove guard panels from around the main pump assembly.
- Disconnect the main pump discharge output line. Install the input flange of the flow meter on the pump end of the output line.
- Cap off the unused (input) end of the pump discharge line with a blocking flange.
- Bolt up a pre-measured length of hydraulic hose, between the output end of the flow meter assembly and the top of the reservoir. Use appropriate fittings and adapter flanges to guarantee a pressure tight seal.

NOTE: *Be sure to maintain even tightening torque on all flange fittings. Use Loctite brand "PST 545" (or an alternate manufacturer's hydraulic system joint seal) if required, to give an airtight seal.*

- An assistant – who must remain at the operator's control station at all times – should restart the engine and run it long enough (at minimum RPM) to de-aerate the system and warm up the engine and hydraulic system to operating temperature.

Record the values of all test results in three columns, comparing 1) pump pressure (from the instrument panel display) with 2) measured flow, in gallons or liters per minute, from the installed flow

meter. The third column of test results should provide a record of engine RPM measured during each of the following tests – with the engine speed control dial set at maximum, the power mode selector at Power Mode III and the work mode selector at digging mode:

- Unloaded maximum engine speed baseline test (all controls in neutral).
- Front pump test – operate “travel right” lever. Record values at all specified pressures.
- Rear pump test – operate “travel left” lever. Record values at all specified pressures.

Record the values for each of the three tests (neutral, travel right and travel left) at the following pump pressure levels, with travel speed control set at “high speed.”

Engine RPM	Pressure	Flow
	100 kg/cm2 (1,422 psi)	
	135 kg/cm2 (1,930 psi)	
	180 kg/cm2 (2,560 psi)	
	240 kg/cm2 (3,413 psi)	
	320 kg/cm2 (4,550 psi)*	
	*See Note, below	

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/cm^2 (4,785 psi), not 350 kg/cm^2 (5075 psi).*

SWING SYSTEM TROUBLESHOOTING

PRECAUTIONS/INITIAL CHECKS

1. Stop work. Release all weight or any type of load safely before proceeding. Avoid risking injury or adding to damage.
2. Turn off engine and disengage control functions until initial tests are ready to be made.

⚠ WARNING

Prevent possible injury and/or loss of operating control. Stop work and park the excavator at the first indication of:

1. **Equipment breakdown**
2. **Inadequate control response**
3. **Erratic performance**

Stop the machine, put the boom and arm in the inoperative (overnight park) position and begin by making the fastest, simplest checks first:

- Check oil level.
- Check for overheating, oil leaks, external oil cooler clogging or broken fan belt. Consult service record for prior repair/service work.

- Drain some tank oil to a clean, clear container. Look for metal shavings/grit, cloudiness/water or foam/air bubbles in the oil.
- Check for wobble through the engine/pump flex coupling. Run engine with the pump input hydraulic power control nut turned to the lowest power to check the engine.
- Investigate unusual operating noises or vibration. Check for loose bolts, connections.

SWING RELIEF VALVE CHECKING AND ADJUSTMENT

Make a check of operating pressures through the swing relief valve if:

- The swing motor fails to turn.
- Swings in one direction only.
- Swings but continues to coast.
- There is drifting on a slope.

1. Check operation by connecting:
   A. Two 600 bar (8,700 psi) pressure gauges to the inlet and outlet measuring ports on top of the swing motor.

      Pressure should be between 280 and 290 bar (4,060 psi and 4,205 psi), with both swing locks engaged. With swing locks released, during full acceleration and deceleration, pressure should approach 250 bar (3,625 psi) in each direction.

   B. Connect a 60 bar (870 psi) pressure gauge at the “SH” port of the hydraulic brake.

      Pressure should always stay at or above 4 bar (58 psi) when operating swing, boom or arm.

   C. Connect a 10 bar (145 psi) gauge at the motor makeup valve.

      Pressure should stay consistently above 2.5 bar (36 psi). If pressure falls below the recommended minimum level, forceful acceleration of the swing motor could lead to cavitation of the circuit and stalling, slowed rotation, noise and possible damage.
2. If main inlet and outlet pressures were off in the preceding tests in Step 1, adjust swing relief valve pressure.

   Following adjustment, repeat the operating pressure tests (with gauges connected to the inlet and outlet test ports on top of the swing motor) and check pressures with the swing locks engaged and released.

   If pressure adjustment fails to restore adequate performance, proceed to the Troubleshooting – Swing table.
3. If pressure tests were at recommended levels through the main inlet and outlet ports, and through the “SH” port of the swing brake, the causes of poor swing performance could include a faulty swing motor, drive train overloading or gearbox defect, or a problem in the brake assembly or swing control valve. Proceed to the troubleshooting information in the next procedure.

   If pressure through the “SH” port was tested below the minimum 4 bar (58 psi) level, check the shuttle valve in the rear compartment behind cabin. When pressure through the port is at the recommended level, the brake release valve should disengage the swing brake, allowing the swing motor to rotate the excavator. If pressure adjustment to the valve has been restored but the brake still fails to release, the brake piston or friction plate may be frozen, requiring disassembly of the motor and parts repair/ replacement.
4. If pressure tested at the motor makeup valve falls below recommended minimum level, and consequent problems with cavitation, stalling and surging are observed, check the restriction valve. If

pressure adjustment to the valve has been restored but if problems with cavitation continues, disassemble the upper swing motor housing and clean or replace assembly components as required.

NOTE: *If all tested pressures are at or above recommended levels, and there are no mechanical problems in the drive train or in the motor/brake assembly, the problem will require further hydraulic troubleshooting. It's also possible that a defective joystick, an intermittent short in an electrical control circuit or a problem in the EPOS-V circuit is causing diminished swing performance. Pull out the EPOS-V indicator panel from underneath the operator's seat and perform the self-diagnosis test. If the display panel reads code "0.2," it is reporting that the swing priority proportional valve is not functioning, except in the minimum "fail-safe" mode. Refer to the Electrical section of this book for more information.*

TROUBLESHOOTING – SWING GEARBOX

Problem	Possible Causes	Remedies
Swing motor fails to operate and:		
Three pressure tests at motor, brake or makeup valve show low reading (s).	Swing relief valve defective Brake release valve defective Motor makeup valve defective.	Adjust pressure to recommended range in affected valve. OR Disassemble and clean valve assembly. Replace all valve components that show damage.
All three pressure checks are OK but left travel also fails to run.	Exchange front and rear pump inlet and outlet hoses to test pump function.	If swing and left travel are restored but right travel stops working, replace or repair P1 pump.
All three pressure tests are OK, but machine fails to swing at all.	Brake assembly or motor friction plate failing to release.	Check for binding. Disassemble and repair.
	Pilot (control) pressure low or swing control valve stuck.	Disassemble / Repair pilot pressure swing spool (305) and / or swing control valve.
	Swing motor defective.	Test motor drain rate. Replace / Repair motor.
	Gear train defective.	Refer to "Swing Gear Troubleshooting" procedure.
Swing functions but only at reduced RPM.	Causes listed above could also produce dragging swing, OR hot or wrong oil OR worn-out parts.	Check above list; then replace oil, test motor drain rate and check for "02" reading (EPOS-V self-test).
Left travel speed is also reduced.	Low output at P1 pump or external pilot piping leaks/is clogged.	Clean and repair piping or repair or replace pump P1.
Swing control movement is reversed.	Inlet / outlet piping reversed.	Reset controls or reverse piping.

Problem	Possible Causes	Remedies
Machine swings but continues coasting on past stopping point.	Swing control valve spool not centered.	Replace return spring; clean/ repair valve piston and spool.
	Pilot pressure may be outside range.	Disassemble, clean or replace pilot relief valve or pilot valve.
	Swing relief valve may be faulty.	Repair/Replace swing relief valve.
Swing movement is in one direction only.	Check to see that pilot pressure is the same right and left.	If pilot pressure is unequal, clean or repair piping or repair/ replace valve.
	Swing control valve spool may be stuck.	Repair/Replace the swing control valve.
	Swing relief valve may be faulty.	Repair/Replace the swing relief valve.
No rotation and:		
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 noise (s), 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
Oil temperature abnormally high.	Oil cooler clogged or air circulation to cooler blocked	Clean
	Cooling fan belt tension too loose	Readjust belt tension
	Relief valve set too low	Readjust valve
	Relief valve in constant use	Reduce or slow work load or cycling rate
	Hydraulic oil severely neglected or incorrect for application	Replace oil
One circuit in hydraulic system inoperable.	Overload relief valve malfunction	Readjust or replace
	Oil leak at make-up valve	Clean, repair
	Control valve spool damaged	Repair or replace
	Dirt in control valve spool	Clean or replace
	Actuator (joystick, foot pedal) damaged or worn	Repair or replace
	Internal seal leak in cylinder	Repair or replace
	Cylinder rod damaged	Repair or replace
	Pilot valve or piping malfunction	Repair or replace
	Mechanical linkage frozen, loose or damaged	Repair or replace
Travel motors inoperable.	Center joint damaged.	Repair or replace.
	Parking brake not releasing.	Repair or replace.
	Travel motor worn or damaged.	Repair or replace.
	Travel motor pilot piping damaged.	Repair or replace.

Problem	Possible Causes	Remedies
Travel motors operate very slowly.	Track tension poorly adjusted Low oil in idlers or rollers.	Readjust tension Refill.
	Travel brake dragging.	Repair
	Track frame out of alignment, deformed or twisted.	Repair
Swing motor inoperable.	Swing brake not releasing.	Repair or replace
	Relief valve malfunction.	Repair or replace
	Pilot piping damaged.	Repair or replace
Swing motor operates unevenly.	Swing gear, bearing or mounting loose or worn.	Repair or replace
	Lubricant worn away, inadequate.	Grease
	Swing relief valve may be faulty.	Repair/Replace the swing relief valve.

TROUBLESHOOTING – CONTROL VALVE

Check control valve problems only after other hydraulic circuit operational tests have been made. Refer to the “Troubleshooting Baseline Recommendations” procedure. Pump flow, pilot pressure, Negacon pressure, main relief pressure, and port relief pressure should all be checked before starting to work on the control valve. Make sure the hydraulic system is topped up to the required level and free of oil leaks or air in the system that could cause cavitation problems.

Problem	Possible Causes	Remedies
Main Relief Valve	Particulate contamination.	Disassemble, clean main poppet.
	Broken or damaged spring.	Replace
	Adjusting screw loose.	Readjust
	Main poppet sticking.	Repair/replace
	Clogged orifice in pilot passage to control valve.	Clean/replace
Cylinder goes down in spool neutral.	Excessive clearance between casing and spool.	Replace spool or casing.
	Spool does not return to neutral/ sticking spool.	Check secondary pilot pressure.
	Spool does not return to neutral because of dirt or other contaminants.	Clean
	Broken or damaged spring.	Replace
	Main relief or port relief not operating properly.	See above
	Impurities in pilot circuit.	Clean

Problem	Possible Causes	Remedies
Cylinder drops before start at boom up operation	Rod check valve damaged or clogged.	Clean/replace
	Poppet sticking.	Clean/replace
	Broken or damaged spring	Replace
Slow operation or response	Excessive clearance between spool or casing.	Check pilot pressure and/or replace spool or casing.
	Sticking spool.	Clean/replace
	Broken or damaged spring.	Replace
	Main or port relief valve damaged.	Check pressure/replace
Swing priority not operating correctly	Sticking spool.	Clean/replace
	Solenoid valve faulty.	Replace
Boom and arm cylinders do not perform normally in combined operation	Priority valve faulty or spool sticking.	Check pilot pressure.
	Broken or deformed spring.	Replace
	Excess clearance between right and left casing and valve spool.	Clean/replace
	Clogged spool passage.	Clean/replace, replace filter.
Relief valve malfunctions:		
Pressure does not increase at all.	Main poppet or pilot poppet stuck open.	Clean/replace
Irregular or uneven pressure.	Poppet seat damaged or pilot piston sticking to main poppet.	Clean/replace
	Loose lock nut and adjusting screw.	Readjust
	Components worn out, past wear limits.	Replace

TROUBLESHOOTING – TRAVEL CONTROL VALVE

Problem	Possible Causes	Remedies
Secondary pressure does not increase.	Low primary pressure.	Check primary pressure.
	Broken spring.	Replace spring.
	Spool sticking.	Clean, repair or replace.
	Excess spool to casing clearance.	Replace spool casing.
	Worn or loose universal joint (handle) subassembly.	Repair or replace U-joint subassembly.
Secondary pressure too high.	Dirt, other interference between valve parts.	Clean, repair or replace.
	Return line pressure too high.	Redirect return line.

Problem	Possible Causes	Remedies
Secondary pressure does not hold steady.	Dirt, other interference between valve parts, or worn spool sticking intermittently.	Clean, repair or replace.
	Interference or binding on spool return spring.	Clean, repair or replace.
	Interference, restriction or unsteady pressure in tank return line.	Repair or re-route tank return line.
	Air bubbles in piping (temporary) or air leak.	Vent air, or repair leak.
NOTE: *Look for evidence of leaking oil.*		

TROUBLESHOOTING – JOYSTICK CONTROL VALVE

Problem	Possible Causes	Remedies
Secondary pressure does not increase	Low primary pressure	Check primary pressure
	Broken spring	Replace spring
	Spool sticking	Clean, repair or replace
	Excess spool to casing clearance	Replace spool casing
	Worn or loose handle subassembly	Repair or replace handle subassembly
Secondary pressure too high	Dirt, other interference between valve parts	Clean, repair or replace
	Return line pressure too high	Redirect return line
Secondary pressure does not hold steady	Dirt, other interference between valve parts, or worn spool sticking intermittently	Clean, repair or replace
	Interference or binding on spool return spring	Clean, repair or replace
	Unsteady pressure in tank return line	Redirect return line
	Air bubbles in piping (temporary) or air leak	Vent air, or repair leak
NOTE: *Look for evidence of leaking oil to help locate damaged seals or gaskets that could be the cause of air leaks.*		

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

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
Solar 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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GENERAL DESCRIPTION

The accumulator is a gas-charged storage device designed to hold a reserve quantity of hydraulic fluid under pressure. Accumulators are used in hydraulic circuits in much the same way that condensers (or capacitors) are used to collect, store and maintain electrical charge in a circuit.

In a hydraulic circuit, minor variations or lags in pump output that might otherwise cause unsteady or irregular operation are made up from the supply of pressurized oil in the accumulator.

Reference Number	Description
1	Screw Plug
2	Steel Pressure Vessel
3	Diaphragm
4	Fluid Valve

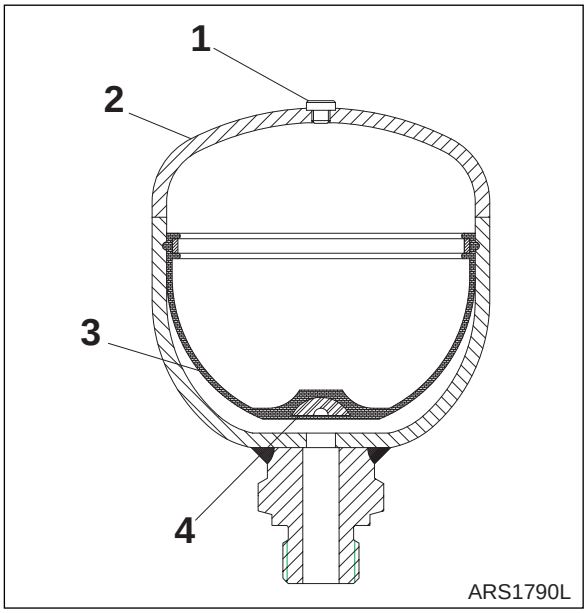


Figure 1

Accumulators are solidly constructed to resist the high operating pressures of the fluids they contain. There are only three main moving parts: a plug at the top allows pre-charging or expelling gas from the compressible, pre-charged upper chamber; a valve assembly at the bottom of the accumulator for passing hydraulic fluid in and out, and an elastic diaphragm to separate the two chambers. The flexible diaphragm changes shape to conform to the changing pressures and volumes of the two fluids in the upper and lower chambers.

There are six possible positions the diaphragm can be in and they are as follows:

1. With no gas charge in the upper chamber 0 bar (0 psi, empty) and no oil in the bottom 0 bar (0 psi, dry) the elastic diaphragm hangs loosely.
2. When the pre-pressure charge of gas (usually nitrogen) is introduced through the port at the top of the accumulator, the diaphragm expands to maximum size. The valve button in the center of the diaphragm pushes into the fluid opening in the bottom chamber, sealing off the lower valve. If the pressure of the gas charge exceeds system oil pressure, no fluid enters the accumulator. The button also keeps the diaphragm from protruding into the lower valve opening.

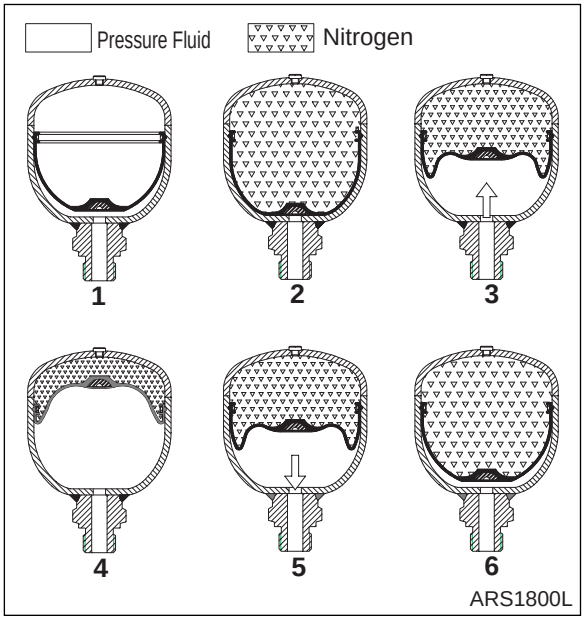


Figure 2

NOTE: *Pre-charge pressure is referred to as the "P1" pressure. The accumulator manufacturer's "P1" rated pressure should be stamped or marked on the accumulator's rating plate. Annual checks of actual pre-charge pressure should be made by tapping a hydraulic pressure gauge (and 3-way adapter coupling) into the valve on the bottom of the accumulator. When hydraulic fluid is pushed out the lower valve opening by the pressure of the gas charge on the other side of the diaphragm - and there is no counter-pressure from system oil - the valve button on the bottom of the diaphragm eventually seals off the lower oil passage. Just after the needle on the gauge reaches its highest point (when there is 0 bar (0 psi) resistance from hydraulic system pressure) pressure on the gauge will drop sharply to zero, as the accumulator is completely emptied of oil and the diaphragm button closes.*

Record the highest gauge reading and compare to the "P1" rated pre-charge pressure on the accumulator manufacturer's data label. Repeat this test at least once a year to verify proper functioning of the accumulator.

3. As hydraulic system pressure overcomes accumulator pre-charge pressure, the flexible diaphragm begins to retract upward.

4. When system oil is at highest working pressure and the accumulator fills to maximum reserve capacity, the flexible diaphragm is pushed up into the top of the upper chamber.

   The highest working pressure is sometimes referred to as the "P3" pressure and can also be referenced on the manufacturer's data label on the exterior of the accumulator.

5. If system oil pressure begins to fall off or is momentarily checked or interrupted, the energy stored on the other side of the diaphragm, in the form of compressed gas, pushes oil back out of the lower chamber, maintaining oil pressure of the circuit.

6. With minimal system pressure, an equilibrium point may be reached in which accumulator pre-charge pressure and hydraulic system oil pressure achieve a rough balance. In this condition a minimal amount of oil is stored in the accumulator.

SPECIFICATIONS

Accumulator		
Model	**Nitrogen Charge**	**Volume**
Solar 300LC-V Solar 300LL Solar 340LC-V Solar 420LC-V Solar 470LC-V	10 kg/cm^2 (142 psi)	320 cc (19.5 in^3)

DAEWOO
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CENTER JOINT (SWIVEL)

⚠ 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 300LC-V	1001 and Up
Solar 300LL	1001 and Up

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November 2001

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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.

PARTS LIST

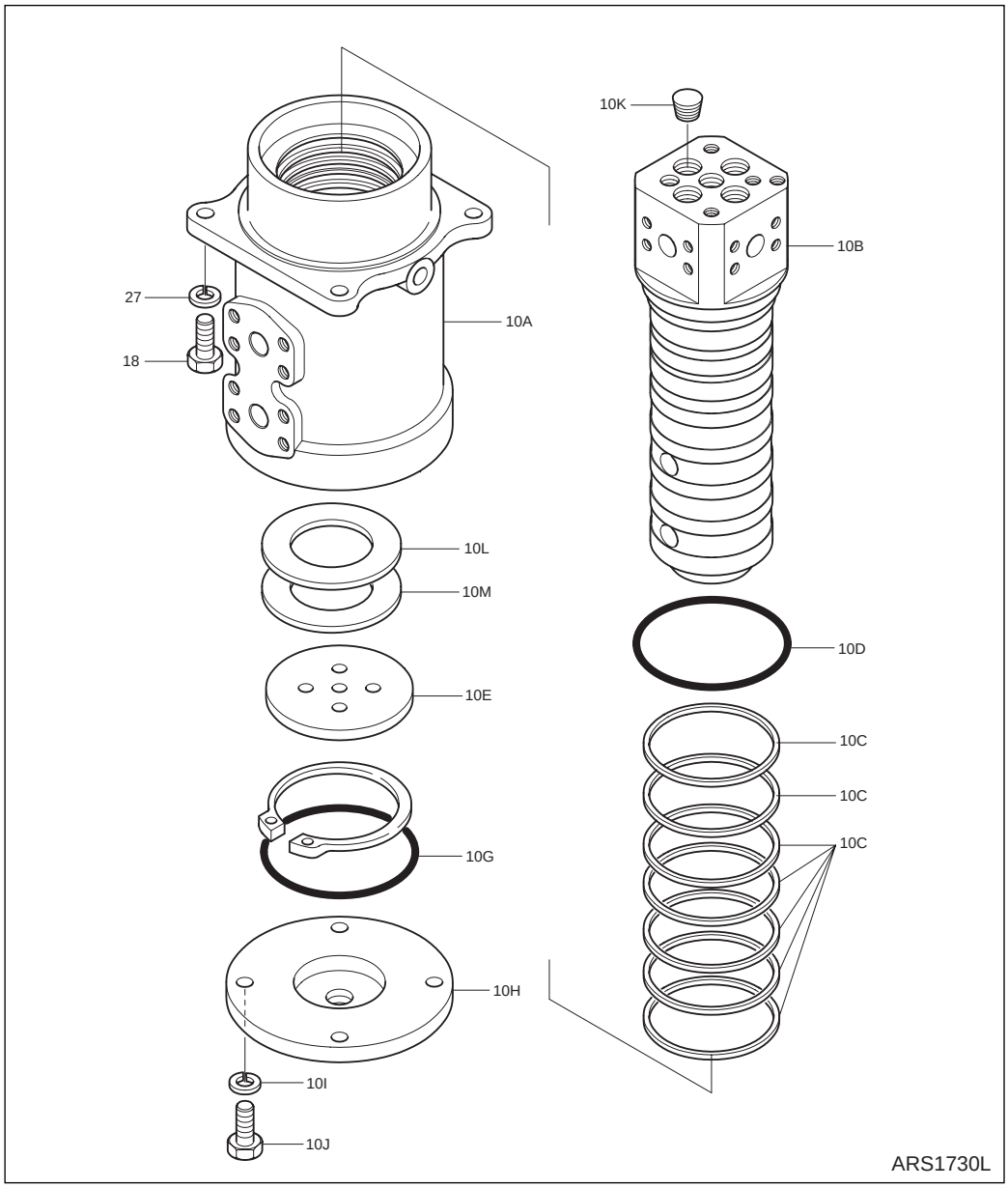


Figure 1

Reference Number	Description
10A	Body
10B	Spindle
10C	Seal
10D	O-ring
10E	Thrust Plate
10F	Retaining Ring
10G	O-ring

Reference Number	Description
10H	Cover
10I	Spring Washer
10J	Bolt
10K	Plug
10L	Shim
10M	Shim

TROUBLESHOOTING, TESTING AND ADJUSTMENT

INSPECTION

The center joint should be checked for evidence of external oil leakage every 2,000 operating hours. Leaking or defective O-rings are an indication that dirt and other contaminants could be getting inside the assembly, which will promote accelerated, abnormal wear and may cause early failure of the assembly.

If internal seals or other sliding surface components are worn and there is internal fluid leakage, complete overhaul and repair or replacement of the center joint may be required.

TESTING

To check pressure through the center joint, make up a test kit from the following equipment list:

- 700 bar (10,000 psi) pressure gauge
- Adapters, connectors, piping and flange block-off plates conforming to those used in high pressure piping connections of the excavator.
- A high pressure relief valve with a setting pressure 1.5 times maximum system pressure.
- A stop valve
- A manually operated, in-line change-over valve.

Install the change over valve upstream from one of the stem high-pressure ports. Connect the pressure gauge downstream from one of the body ports. Install the stop valve between the change-over valve and the stem of the center joint. Other components should be installed according to the layout in the block diagram. The test kit is used to pressurize the center swivel above normal working pressure and lock in the higher pressure (as the stop valve is closed manually) for a leak down test.

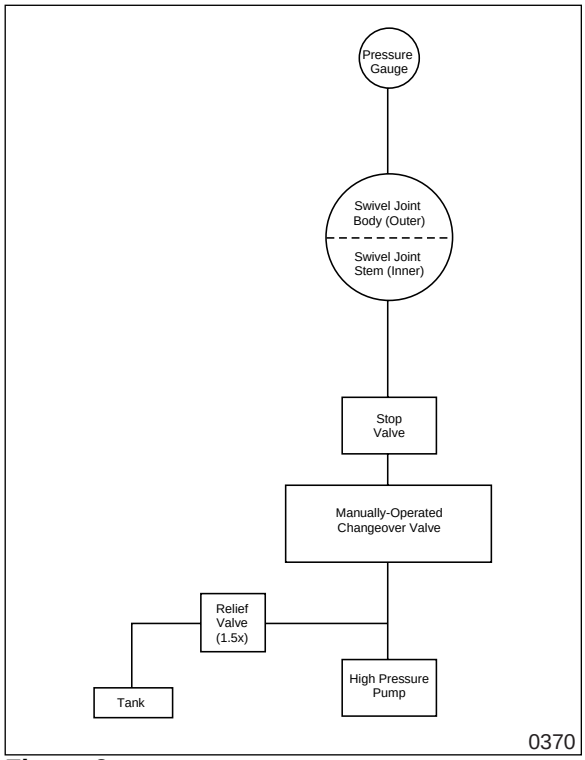


Figure 2

NOTE: *The same type of kit can also be made up for the drain port (return line) side of the center joint. Use appropriate piping, connectors, test gauges, etc., and follow the same block diagram general layout (Figure 2).*

DISASSEMBLY

Refer to the assembly drawing of the swivel joint for component references (Figure 1).

IMPORTANT

Do not unbolt the center joint from the lower car body until an adequate number of piping block-off plates are available, for disconnected piping lines. Be sure that system pressure has been vented - including the hydraulic accumulator and tank reserve pressure - before disassembly is started.

1. Clean off the exterior of the swivel joint after it has been removed.
2. Scribe or otherwise mark a line across the cover and the body of the center joint, to allow reassembly in the same configuration.
3. Unbolt the four 12 mm fasteners holding the cover. Use a vise or V-block to hold the assembly in place.
4. Remove the cover, withdraw the O-ring and remove the retaining ring holding the thrust plate, taking care to support the spindle assembly, so that it will not separate and fall out when retaining ring is removed.
5. If the spindle assembly doesn't separate easily when the thrust plate and retaining ring are removed, use a wooden block and hammer to drive it out of the housing.
6. O-rings and seals should be replaced whenever the assembly is being overhauled or rebuilt. For repair procedures or emergency tear down, use a thin but rounded-tip, smooth-edge scraper or spatula to remove O-rings or seals, to avoid causing damage to those that must be reused.

   NOTE: *The "backup ring" shown in the assembly drawing (above the swivel joint spindle lower seals) should not be overlooked. It is tucked behind the top slip ring, doubled up inside the same groove in the body of the spindle.*
7. Before reassembling the center swivel, visually inspect ball bearing surfaces for visible signs of wear, damage or discoloration and replace any worn component.

   Check clearance between the spindle and thrust plate. Replace any component that shows more than 0.5 mm (0.020") of visible wear.

   Clearance between the spindle and body of the center swivel must be tight. Replace or repair either component if there is more than 0.1 mm (0.0039") of measurable wear.

REASSEMBLY

1. Pre-lubricate O-rings with hydraulic oil, white grease or petroleum jelly.

⚠ CAUTION!

Apply a very light film of white grease or petroleum jelly to the lower rim of the stem and inner surface of the center swivel body. Apply slow, even-handed pressure, using both hands, to slowly push the stem into the body. Seals may be damaged if the stem is pushed in too quickly.

2. Thoroughly clean all other component surfaces of dirt or grease prior to reassembly.

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.

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CYLINDERS

⚠ 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 170W-V	1001 and Up
Solar 200W-V	0001 and Up
Solar 220LC-V	0001 and Up
Solar 250LC-V	1001 and Up
Solar 290LC-V	0001 and Up
Solar 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 330LC-V	1001 and Up
Solar 340LC-V	1001 and Up
Solar 400LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 450LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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GENERAL DESCRIPTION

Two essentially similar types of hydraulic cylinders are used on the excavator. The cylinder that is used to operate the excavator boom or bucket is equipped with a rod stopper, which acts as a cushion only when the cylinder rod is fully retracted (and the bucket is pulled close to the arm). This type of cylinder is shown in the lower drawing.

Arm cylinders have a cushion or stopper for operation in both directions. This type of cylinder is shown in the upper drawing.

THEORY OF OPERATION

1.	**Piston**
2.	**Oil Path A**
3.	**Oil Path B**

Cylinder piston rods are extended or retracted by oil flow to the back side of the cylinder (shown as ("oil path A") or to the front of the cylinder ("oil path B").

The cylinder rod is extended as oil flow is pumped through the circuit to the back side of the piston. The force (F1) of the piston stroke can be expressed by the formula below, where P = circuit oil pressure and the inside diameter of the cylinder is expressed by B (Figure 1).

$$F_1 = P \times \frac{\pi B^2}{4}$$

(P: Pressure, π = 3.14, B: Cylinder Inside Diameter)

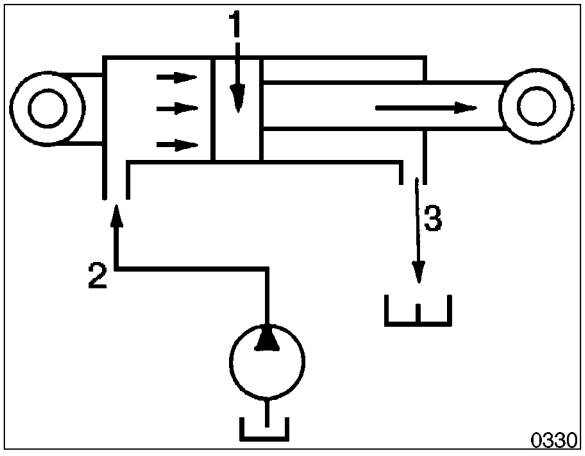


Figure 1

1.	**Cylinder Inside Diameter - B**
2.	**Oil Path A**
3.	**Oil Path B**
4.	**Rod Diameter**

When the cylinder rod is retracted, oil flow through the circuit from the pump to the front side of the cylinder generates a force (F2) that can be expressed by the formula in which the diameter of the piston rod is expressed by R, and the other two terms are the same as in the preceding expression.

$$F_2 = P \times \frac{\pi(B^2-R^2)}{4}$$

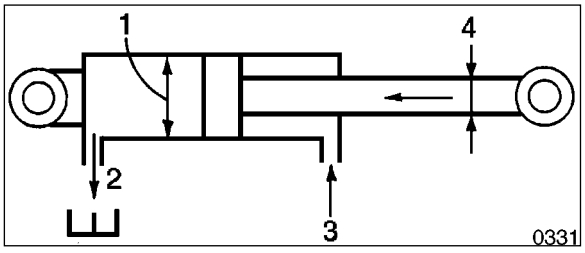


Figure 2

Because the volume of oil needed to lengthen the cylinder rod (Q1) is greater than the volume of oil required to retract the cylinder rod, it takes more time to decrease cylinder stroke length than it does to lengthen it.

$$Q_1 = S \times \frac{\pi(B^2)}{4}$$

$$Q_2 = S \times \frac{\pi(B^2-R^2)}{4}$$

$Q_1 > Q_2$

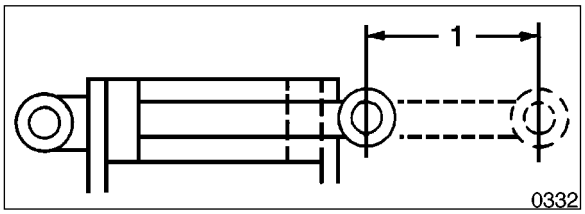


Figure 3

PARTS LIST

The following parts list is a partial listing only; for full and complete parts list information, refer to the Hydraulic Equipment Component Parts List

Cross section in Figure 4 shows an arm cylinder.

Cross section in Figure 5 shows a boom cylinder.

The bucket and boom cylinders are identical and differ only in the attached pipes.

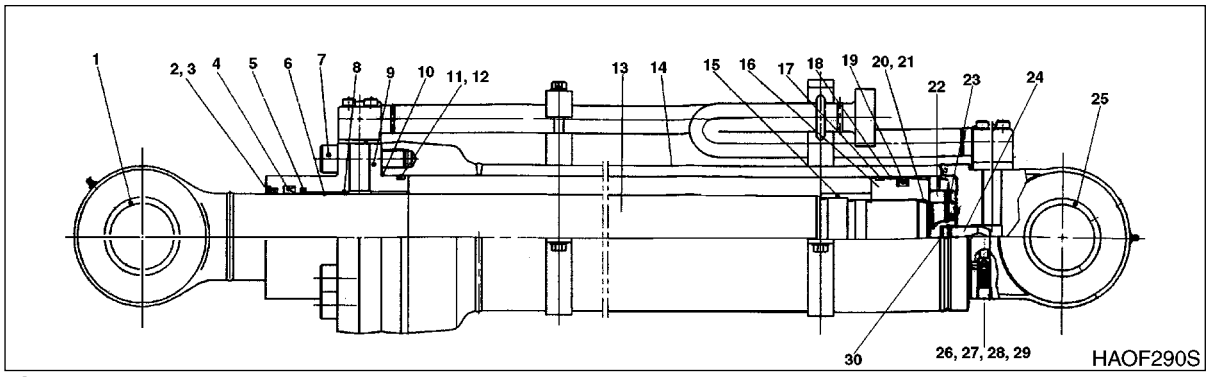


Figure 4

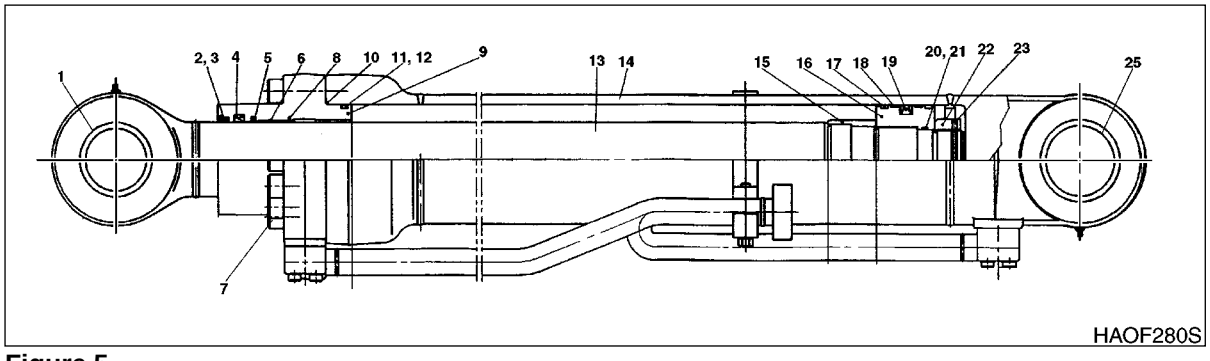


Figure 5

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

SPECIAL TOOLS AND MATERIALS

PISTON NUT

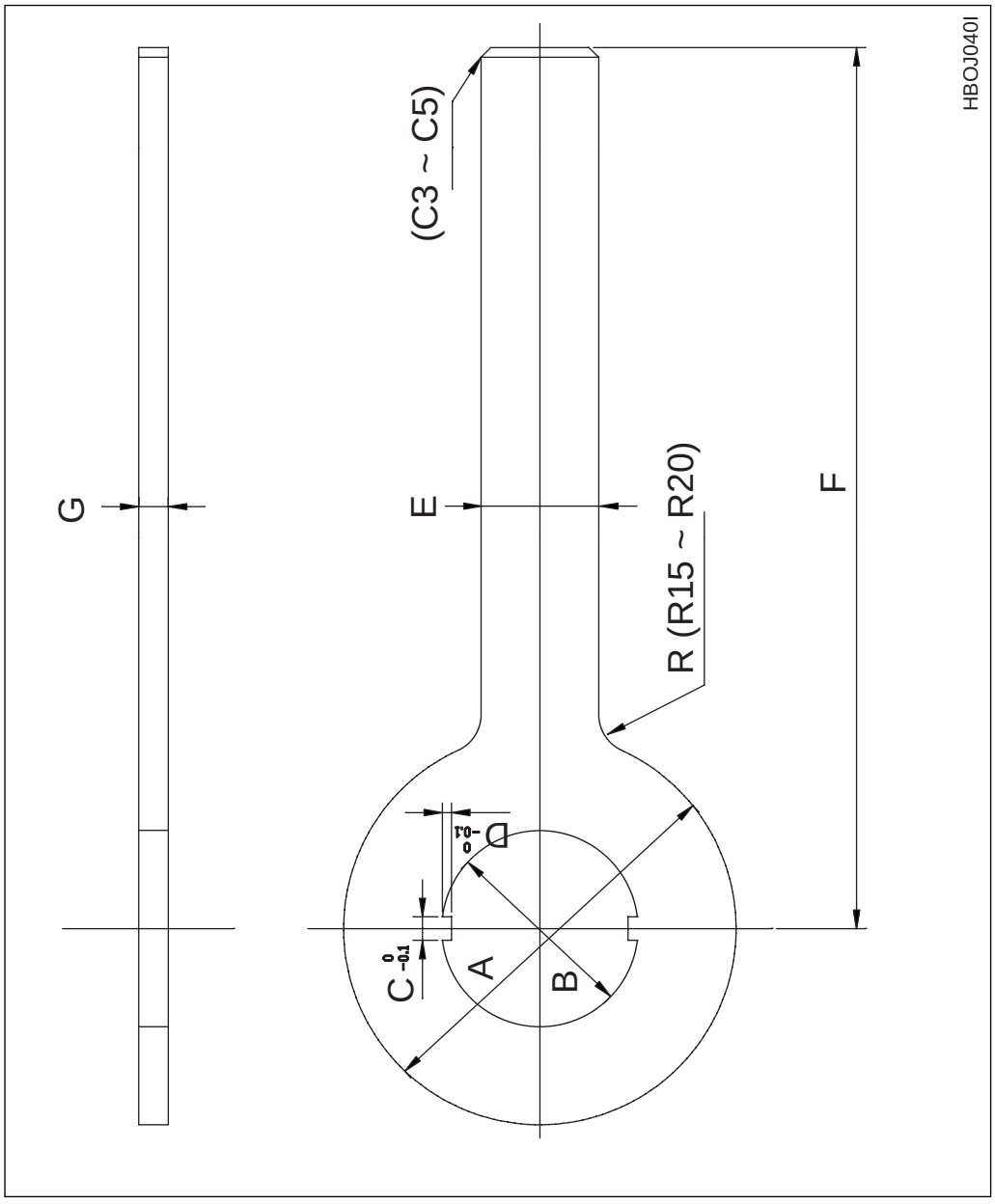


Figure 6

Material SM45C (AISI 1045)

Rockwell Harden from 22 - 27

Oil Quence

MODEL	CYLINDER	A	B	C	D	E	F	G	MODEL (CYLINDER)
S55-V	ARM	110.0 mm (4.33 in)	69.0 mm (2.72 in)	9.0 mm (0.35 in)	4.5 mm (0.18 in)	30.0 mm (1.18 in)	300.0 mm (11.81 in)	15.0 mm (0.59 in)	S55-V (BOOM, BUCKET)
S130-V	ARM	130.0 mm (5.12 in)	90.0 mm (3.54 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	S130W-V (ARM) S170LC-V (BUCKET) S170W-V (BOOM) S200W-V (BOOM) S200LC-V (BOOM)
	BOOM	120.0 mm (4.72 in)	85.0 mm (3.35 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	30.0 mm (1.18 in)	300.0 mm (11.81 in)	15.0 mm (0.59 in)	S130W-V (BOOM) S170W-V (BUCKET)
	BUCKET	115.0 mm (4.53 in)	75.0 mm (2.95 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	30.0 mm (1.18 in)	300.0 mm (11.81 in)	15.0 mm (0.59 in)	S130W-V (BUCKET)
S220LC-V	ARM	140.0 mm (5.51 in)	102.0 mm (4.02 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	S170LC-V (ARM) S200W-V (ARM) S250LC-V (BOOM, ARM, BUCKET) S290LC-V (BOOM)
	BUCKET	125.0 mm (4.92 in)	102.0 mm (4.02 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	S170LC-V (BOOM) S200W-V (BUCKET)
S330-V	ARM	140.0 mm (5.51 in)	107.0 mm (4.21 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	S290LC-V (ARM) S360-V (ARM) S400LC-V (BOOM, BUCKET) S450LC-V (BOOM, BUCKET)
	BOOM	140.0 mm (5.51 in)	105.0 mm (4.13 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	S360-V (BUCKET) S400LC-V (BUCKET)
S400LC-V	ARM	140.0 mm (5.51 in)	115.0 mm (4.53 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	
S200W-V	DOZER	130.0 mm (5.12 in)	92.0 mm (3.62 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	S170W-V (DOZER, OUTRIGGER) S200W-V (OUTRIGGER)
S170W-V	ARM	130.0 mm (5.12 in)	98.0 mm (3.86 in)	11.0 mm (0.43 in)	4.5 mm (0.18 in)	35.0 mm (1.38 in)	350.0 mm (13.78 in)	15.0 mm (0.59 in)	

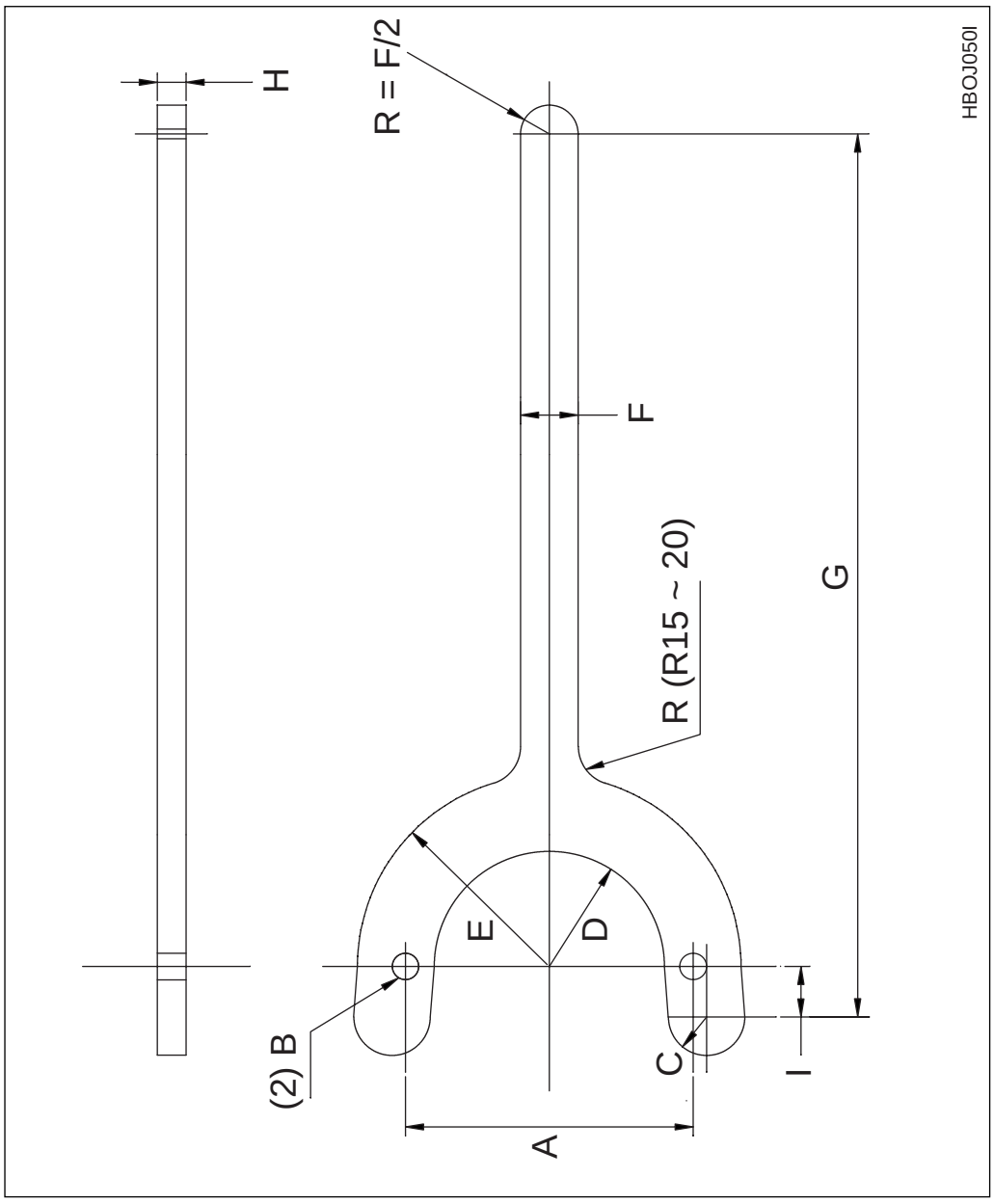


Figure 7

Material SM45C (AISI 1045)

Rockwell Harden from 22 - 27

Oil Quence

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) 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) S200W-V (ARM) S250LC-V (BOOM, ARM, BUCKET) 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) S200W-V (BUCKET) 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)	S170W-V (DOZER, OUTRIGGER) 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) 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) S400LC-V (ARM) S400LC-V (BOOM) S400LC-V (BUCKET) S450LC-V (BOOM, BUCKET)

DISASSEMBLY

⚠ CAUTION!

Vent air from the hydraulic system before disconnecting cylinder piping connections. Use the lever on the reservoir, while the engine is running. Discharge the hydraulic accumulator and vent residual tank pressure after the engine is shut off. Pour clean replacement fluid back into the system if excessive fluid is lost.

1. Following removal of cylinder from excavator attachment, support cylinder on some type of sturdy work platform and drain all oil. Rotate cylinder so that piping ports are on top, to allow trapped air to vent.

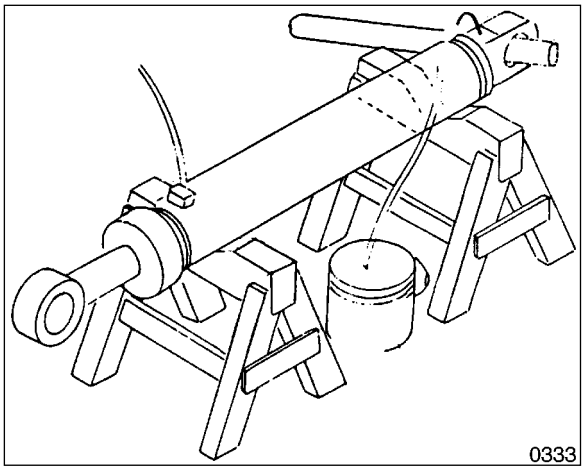


Figure 8

2. Position piston rod so that it is extended approximately one half meter (20").

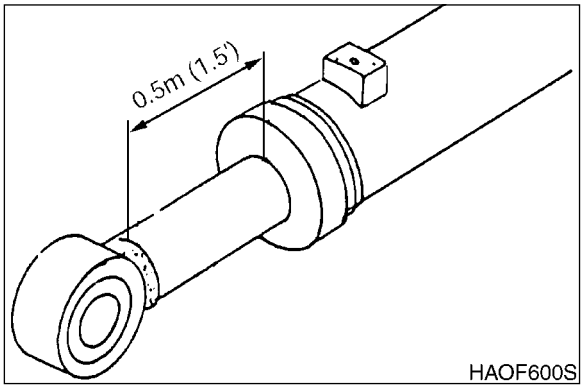


Figure 9

3. Loosen bolts (7) on the end of cylinder.

   NOTE: *Wrap a cloth or other protective material around piston rod, to avoid possibility of accidentally scratching or scoring rod surface while fasteners are being loosened and removed. Component parts (numbered in parentheses) are keyed to Figure 4.*

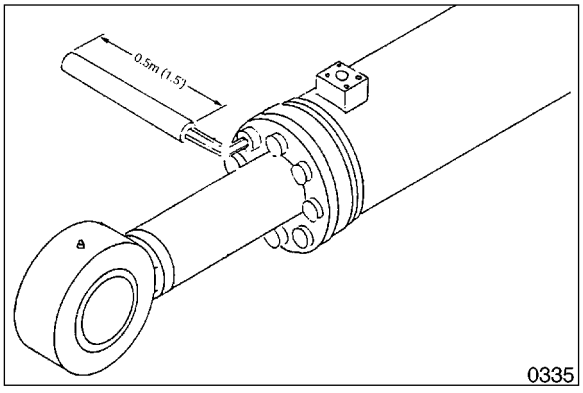


Figure 10

4. Tap two bolts into cover of cylinder head, 180° apart. Tighten them in a staggered, even sequence, to back off piston rod end cover from edge of cylinder wall. Look for adequate clearance between cover and end of cylinder wall before using a plastic or other soft-faced hammer for final disassembly.

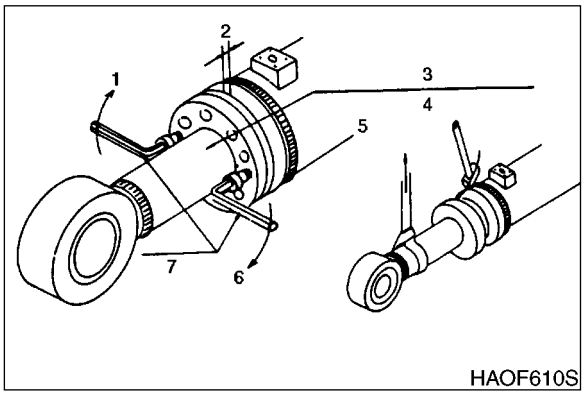


Figure 11

5. Begin withdrawing piston rod assembly, away from cylinder. Attach a lifting support when final 1/3 of rod is still inside barrel of cylinder. Prepare support blocks for piston rod before it has been completely withdrawn.

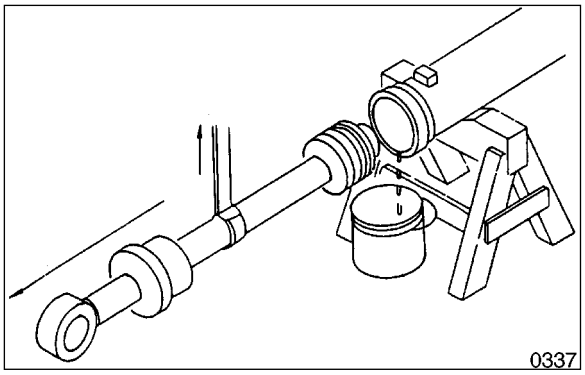


Figure 12

6. Lower piston rod to support blocks and detach wear ring (outer surface) (18) from end of rod.

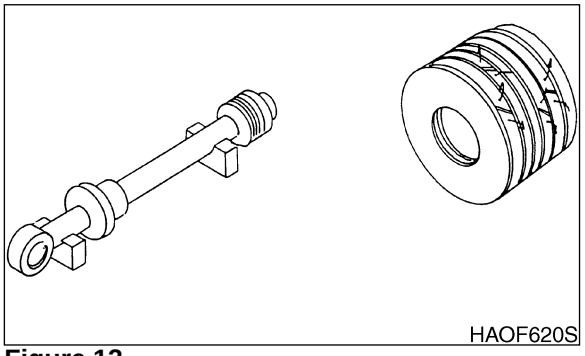


Figure 13

7. Immobilize piston rod by inserting a wooden or other non-scoring, non-metallic support through end of rod.

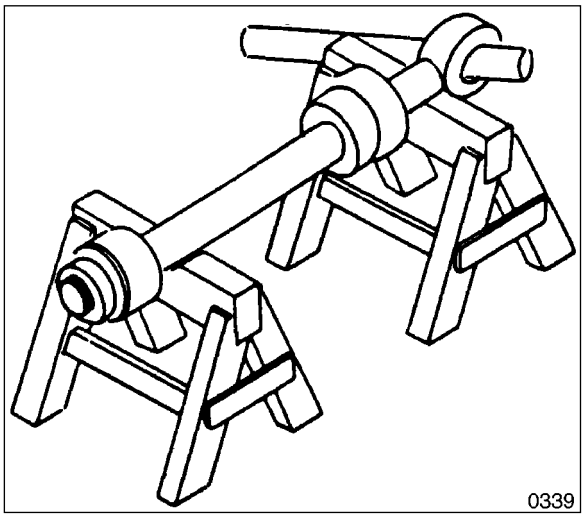


Figure 14

8. Loosen set screw by using a socket wrench.

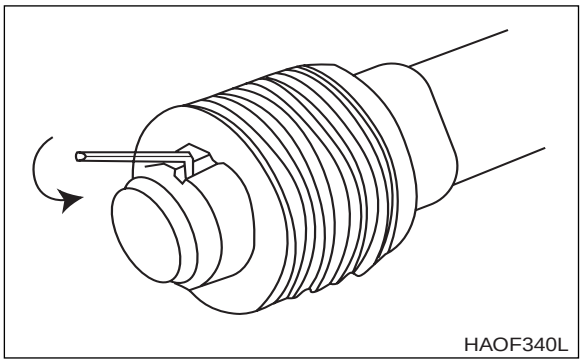


Figure 15

9. Fabricate or purchase a piston nut removal wrench. (Dimensions are called off at beginning of this procedure. This tool may also be ordered through your local Daewoo Parts distributor). Remove nut from end of piston.

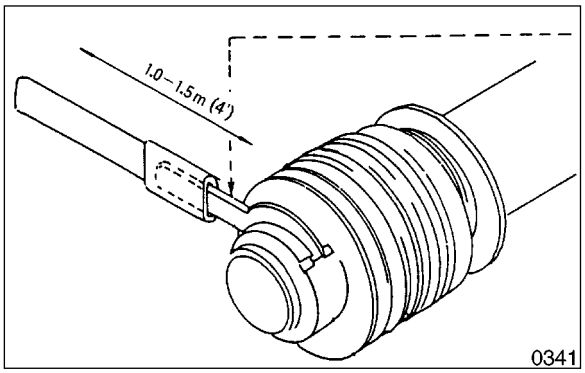


Figure 16

10. Use second piston tool described at beginning of this procedure to separate piston. Detach cushion ring (15), taking care not to damage cushion ring.

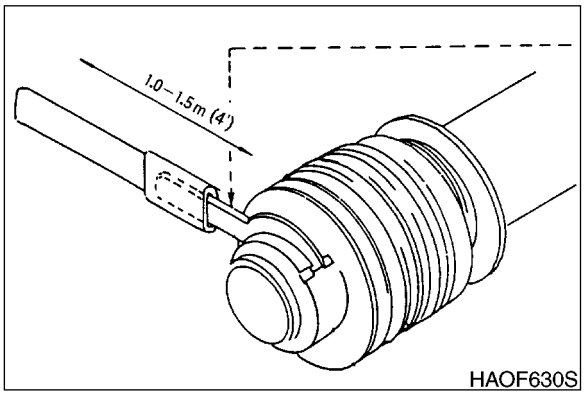


Figure 17

11. Use a plastic hammer to evenly pull off rod cover (9) from end of piston rod. Be careful not to damage rod bushing (6) and dust wiper, U-packing and other seals.

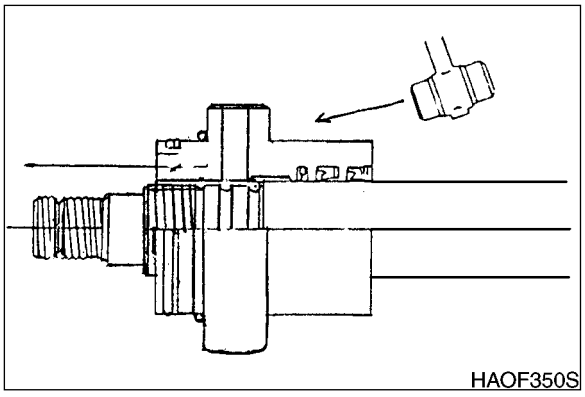


Figure 18

12. Use a dull, rounded-tip tool to pry off O-ring (11) and backup ring (12).

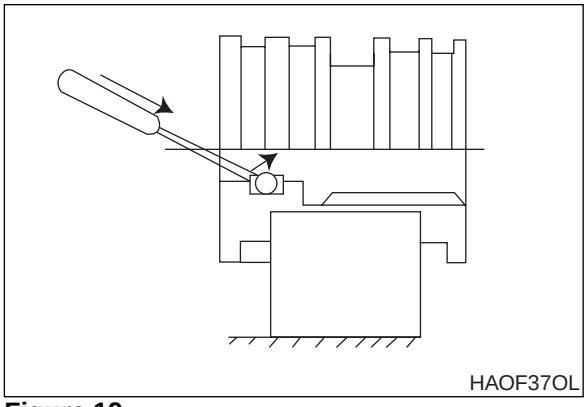


Figure 19

13. Find a screwdriver with an appropriate width tip to facilitate removal of slipper seal (19), wear ring (18) and slide ring (17) from piston (16).

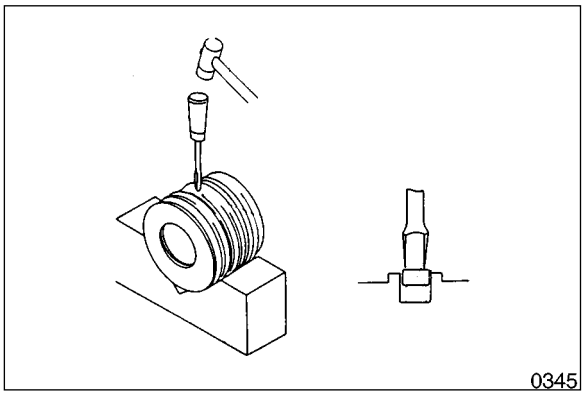


Figure 20

14. Pull off O-ring (20) and backup ring (21) from cylinder head.

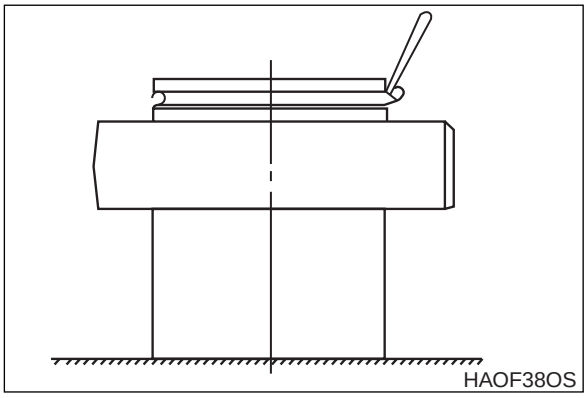


Figure 21

15. During disassembly of cylinder head, be careful not to damage buffer seal (5) and U-packing (4).

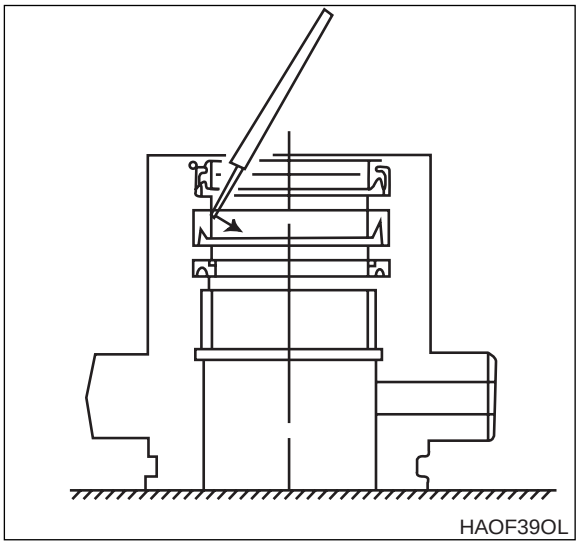


Figure 22

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

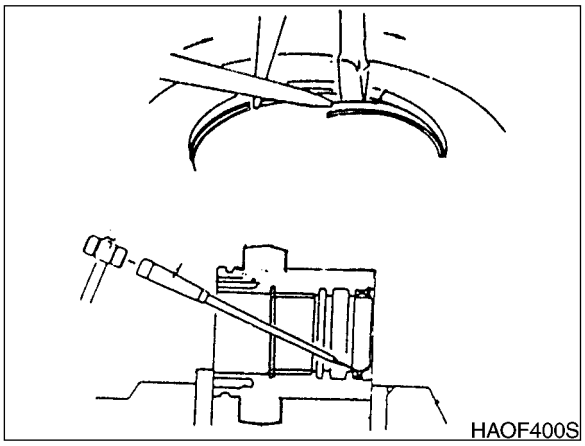


Figure 23

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

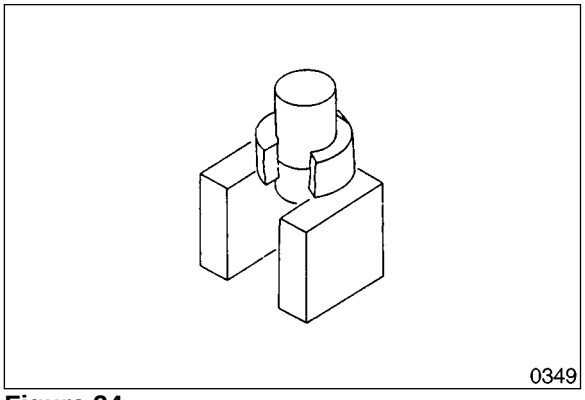


Figure 24

REASSEMBLY

IMPORTANT

Replace any part that shows evidence of damage or excessive wear. Replacement of all O-rings and flexible seals is strongly recommended. Before starting the cylinder reassembly procedure, all parts should be thoroughly cleaned and dried, and/or prelubricated with clean hydraulic fluid. Prepare the work area beforehand to maintain cleanliness during the reassembly procedure.

NOTE: *Reassemble the subassemblies of the cylinder in the following order:*

1. *Body of the cylinder*
2. *Piston rod*
3. *Piston assembly*
4. *Cylinder head assembly*

1. Reassemble pin bushing (1) to piston rod (13) and body of cylinder (14).

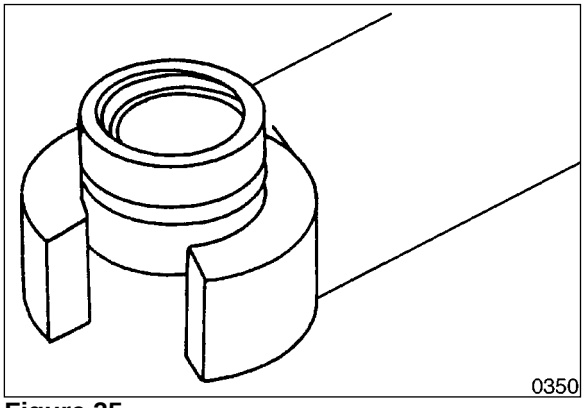


Figure 25

2. Following reassembly of rod cover components, install the dust wiper (2) and rod bushing (6) to the rod cover (9). Insert retaining rings (3 and 8).

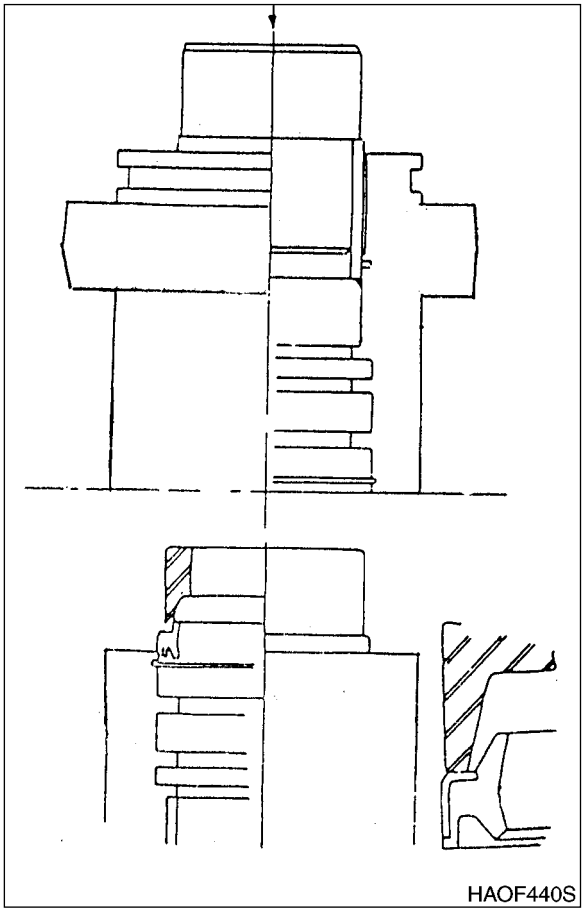


Figure 26

3. Pre-lubricate O-rings and seals before reassembly (Figure 27).

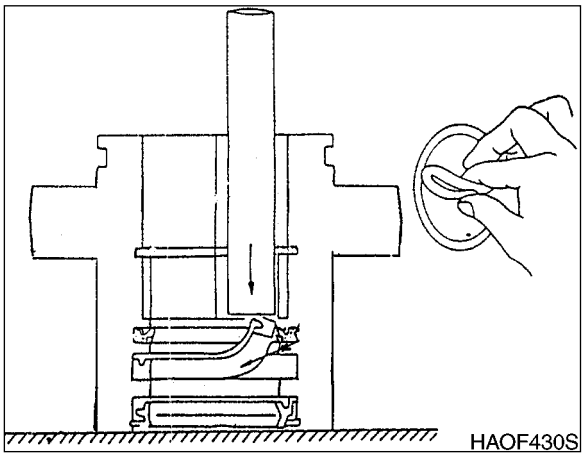


Figure 27

4. Before starting to rebuild piston assembly, heat slipper seal for 5 minutes in an oil bath warmed to 150° - 180°C (302° - 356°F). Use special slipper seal jig (third item in list of specialized tools at the beginning of this procedure) to attach seal. Cool seal by pushing a retracting jig against seal for several minutes. Apply a strip of clean, see-through sealing tape around slipper seal to keep it free of dust.

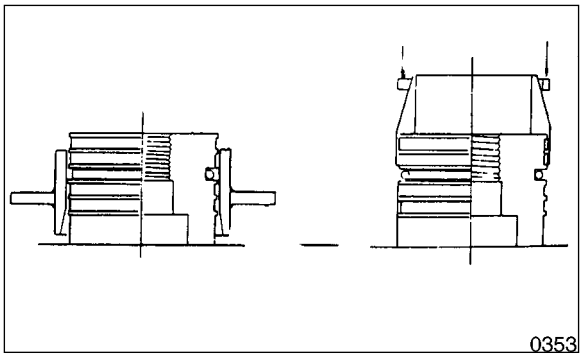


Figure 28

5. Immobilize piston rod on solid support blocks. Assemble O-ring (20) and backup ring (21). Prepare to attach rod cover assembly to piston rod. Push rod cover by tightening piston nut (22).

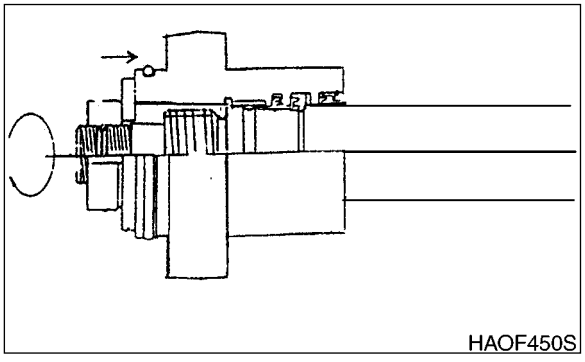


Figure 29

6. Assemble cushion ring (15) and attach piston assembly to piston rod.

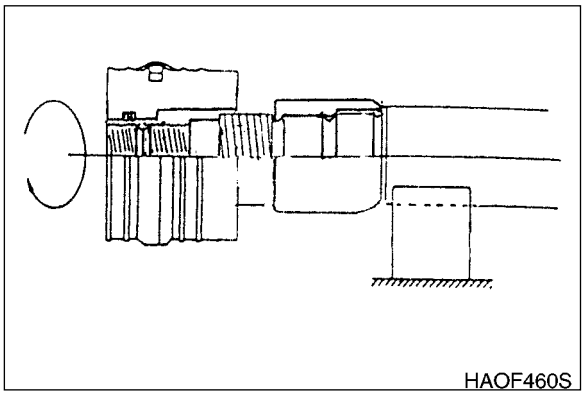


Figure 30

7. Use specially fabricate or factory-sourced tool to tighten piston nut (22).

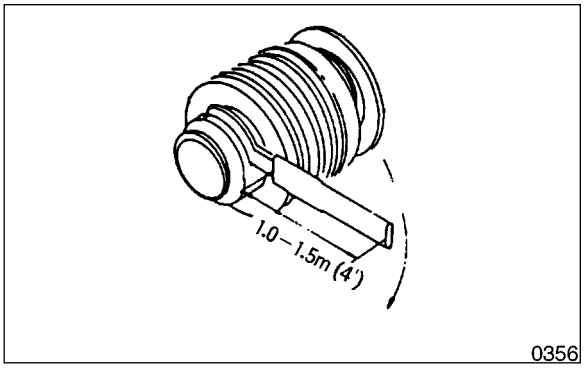


Figure 31

8. Assemble wear ring (18), slide ring (17) and set screw (23) to piston assembly.

Reference Number	Description
1	Set Screw

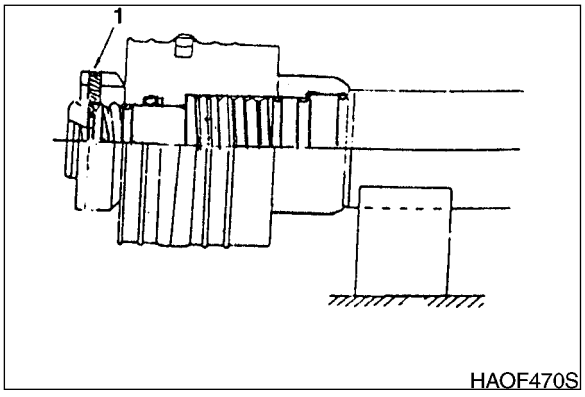


Figure 32

9. Immobilize body of cylinder before reassembly.

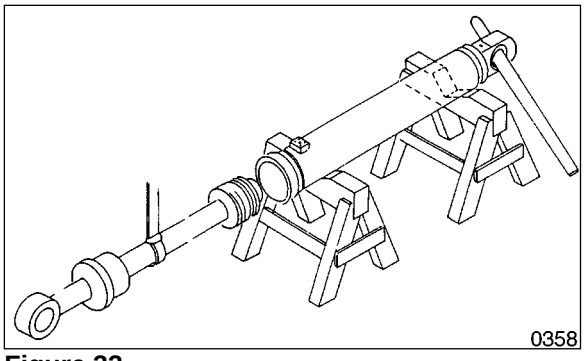


Figure 33

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.

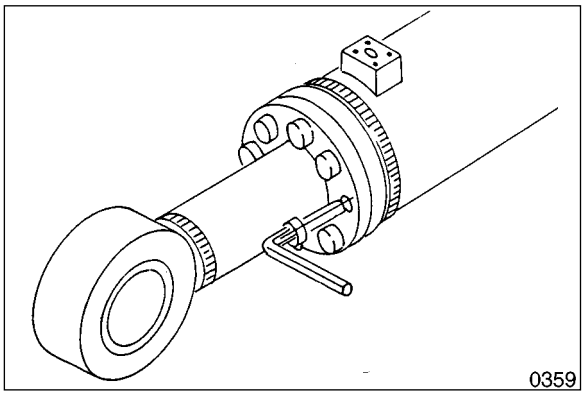


Figure 34

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

SWING MOTOR (TOSHIBA MFC200)

⚠ 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 300LC-V	1001 and Up

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December 2001

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GENERAL DESCRIPTION

THEORY OF OPERATION

The swing drive motor is an axial piston motor (MFC200). The motor also contains the following components;

1. Mechanical brake
2. Make-up valve
3. Ultra shockless valve
4. Time relay valve
5. Bypass valve

Hydraulic Motor

The rotary group consist of a cylinder block (27) which is a single body design with an intergal drive shaft. Nine piston assemblies (9) are housed in the cylinder block (27). Both ends of the cylinder block (27) are supported by bearings (4 and 25).

Piston assembly (9) is guided by return plate (8) and backing spring (6) to slide on cam/swash plate (7). The strength of scrowave (18) and the hydraulic power which actuates bush (16), cause the mating surfaces of balance plate (24) and cylinder block (27) pressed together.

Mechanical brake plates (10 and 11) used for braking are installed between the outer surface of cylinder block (27) and housing (28). Lining plates (10) are splined to the cylinder block. Plates (11) are splined to the housing. The brake plates are forced together by piston (13) and eighteen springs (15). This configuration results in the brake being "spring applied" and "hydraulically released."

Installed in the motor cover (19) are the following items;

- Relief valve (45) for cushioning function.
- Make-up valves (36, 37 and 38) for cavitation elimination.
- Bypass valve (30) for the elimination of vibration when stopping.

1. Hydraulic Motor Operation

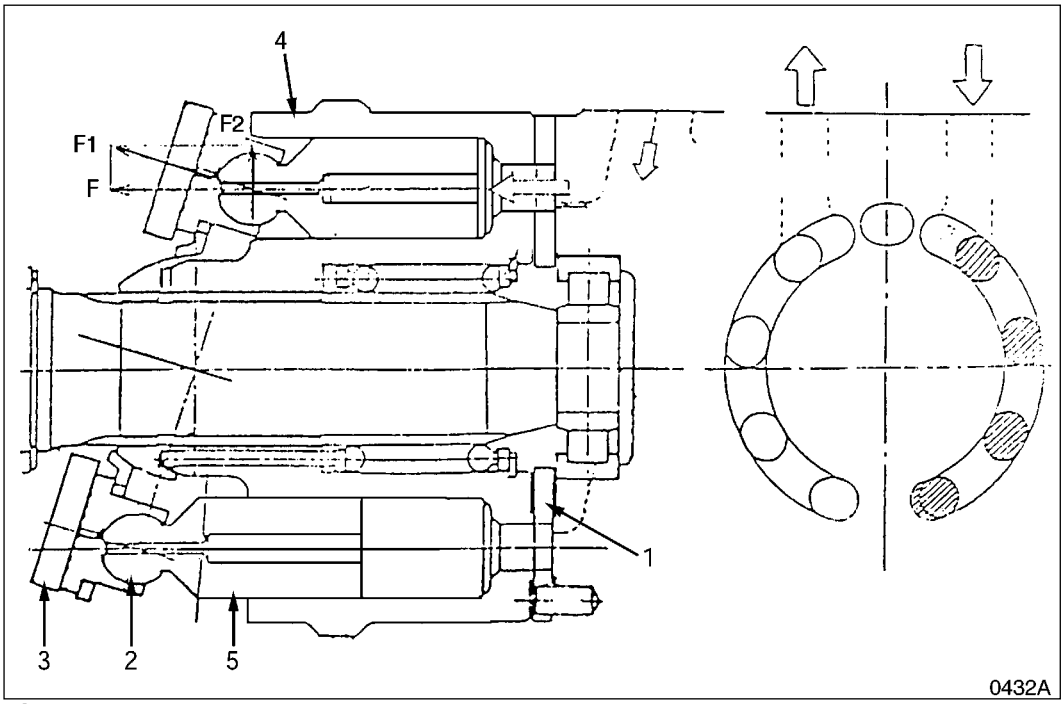


Figure 1

Reference Number	Description
1	Valve Plate
2	Shoe
3	Swash Plate

Reference Number	Description
4	Cylinder Block
5	Piston

The cross sectional view of the swing motor, Figure 1, show most of the main components of an axial-piston type hydraulic motor. Arrows indicating direction of flow and other graphic symbols provide a general guide for understanding basic operation.

When high-pressure oil enters the cylinder through the inlet port of the valve plate the sliding piston inside the cylinder is driven back, generating force "F" against the shoe behind the piston.

Force "F" acts in two different directions. Force F1 exerts pressure directly on the swash plate (3) to generate oil flow through the motor, while force F2 pushes laterally - at a right angle - against the drive shaft, providing the rotational energy to turn the cylinder block around the drive shaft.

All nine pistons in the cylinder block have equal width bore, length and volume. They are configured in a concentric layout around the drive shaft, as shown in the cross section end-view in Figure 1. As oil is forced through the inlet port, pistons rotating past the pressurized (supply) side of the motor (indicated as the shaded cylinders) transmit drive torque - one after the next, each in turn - to the swash plate (through F1, direct output force) and to the cylinder block (F2, lateral force to keep the block rotating).

If oil flow to the motor is directed to the opposite port (so that the supply side becomes the exhaust side and vice versa), the rotation of the motor is reversed.

If oil flow to the motor is directed to the opposite port (so that the supply side becomes the exhaust side and vice versa), the rotation of the motor is reversed.

Trench mode allows the operator to "prioritize" hydraulic oil flow between swing function and boom and arm function. Turning "ON" the trench mode boosts oil flow to swing circuit components, increasing swing speed, as boom up/arm dump speed is reduced. If trench mode is turned "OFF" - diminishing the size of the opening through the swing priority valve - boom/arm speed increases as slew rate falls off.

Connected through the e-EPOS controller, the switch of the trench mode changes the voltage of the electronic signal sent to the solenoid valve.

IMPORTANT
The trench mode setting only has a noticeable effect if both functions are used at the same time, when the right and the left joysticks are each engaged simultaneously, to control swing and boom/arm functions.

When the trench mode is engaged, an engaged voltage signal to the solenoid valve shifts the "swing priority" spool valve to increase oil flow through the swing motor. With trench mode "OFF," voltage is disengaged while current flow is reduced, shifting the spool in the priority valve for increased oil flow to the boom/arm side of the circuit.

Make-up Valve Operation

1. Half brake condition (Condition that relief valve (45) does not operate)

   When reducing swing speed by half after rapidly accelerating upper structure, supply oil from pump to port (A) is suddenly reduced, but a supply oil demand is still present due to inerta of the upper structure. This causes pressure (c) to turn into negative pressure, since the the motor starts to act like a pump. Since the motor is now acting as a pump, make-up oil is needed to supply oil in (c).

   However, if pressure at port (B) is lower than the operating pressure of relief valve (45), the supply oil from port (A) to (c) passes through port (B) and flows out to the control valve. so that absolutely needed oil quantity of (c) is insufficient with the only oil quantity from control valve (control valve is half lever position so that oil quantity from pump is controlled.).

   To prevent it, insufficient oil quantity from make-up port is supplied by installing make-up check (36).

2. When brake operates (Condition that relief valve (45) operates)

   If lever is set to neutral by rapid operation at condition of (1), supplying oil from pump to port (A) is zero, but swing structure turns by inertia force. In this case, relief valve (45) of port (B) operates and oil sent from relief valve passes through oil passages (g) and (h), push make-up check (36) of port (A), and is supplied to oil passages (b) and (c), but oil quantity is insufficient as much as oil quantity which is leaked from motor case drain, and so to protect it, open make-up check (36) from make-up port, and cavitation is prevented by supplying oil to passage (b) and (c).

Super Shockless Relief Valve Operation (Relief Valve Section Drawing)

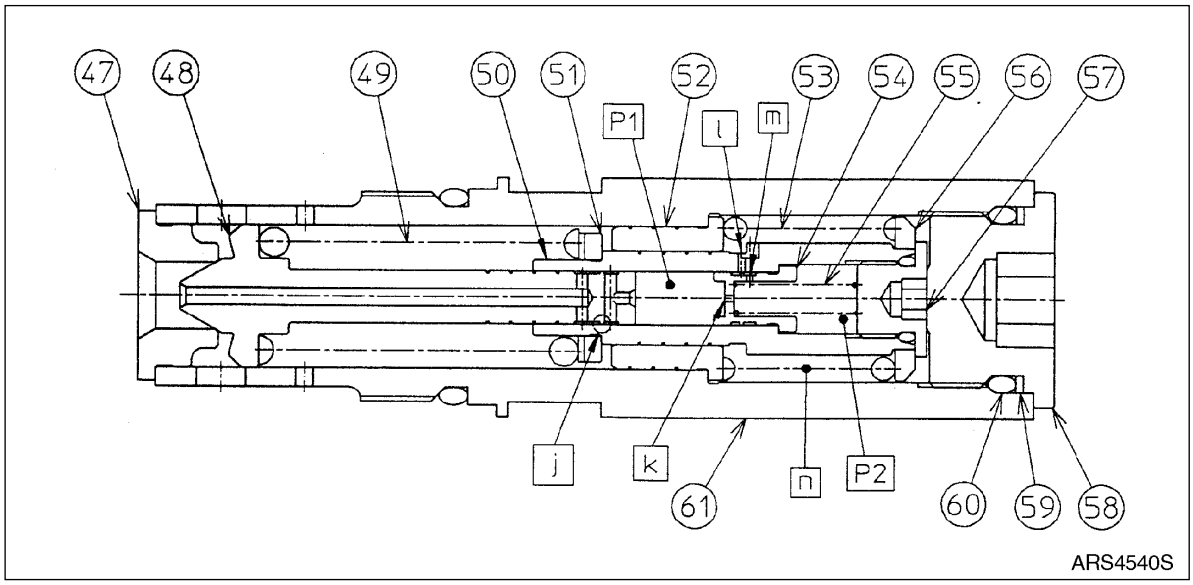


Figure 2

1. When starting

   Pressure oil supplied to port (A) by operation of control valve can not reach normal swing because of large inertia of swing structure, some oil flows through relief valve (45) and oil passages (i) and (h), pushes and opens check of port (B), and flows out to port (B).

   Oil of port (A) makes resistance against spring (49) force, pushes and opens poppet (48), passes through passage (i) between seat (47) and poppet (48), and flows out to passage (h).

2. When braking (When cushioning)

   When setting control valve to neutral, return oil passage of motor is closed. Just after operating it, motor which turns with big inertia force and works pumping tries to charge oil from port (A) to discharge oil to port (B), but return oil passage of control valve is closed, so that pressure of port (B) increases. Increased pressure of port (B) makes resistance against spring (49) force, pushes and opens poppet (48), so that oil passes through oil passages (g) and (h) from port (B), pushes and opens make-up check (36), and flows into (c).

   In this process, it is stopped by continuously absorbing inertia energy of turning structure. Also in pressure increasing process of above mentioned, high pressure oil charged to front chamber of poppet (48) flows through circumferential orifice (j) of poppet (48) into front chamber of poppet (54). As orifice (k) is installed in poppet (54), the shoulder part of it is contacted on the stepped surface of piston (50) by spring load (54).

   Pressure oil flowed into the front chamber of poppet (54) passes through orifice (k)(m) and (l), flows into piston chamber (n), and pushes piston (54) to the left. At this time, if the difference pressure (P1-P2) between the front chamber pressure (P1) of orifice (k) and the spring chamber pressure (P2) is bigger than spring installing load (F)/poppet area (A), poppet (54) moves to the right, the stopper of the groove part shut the orifice (l), and the oil flowed to piston chamber is stopped.

   Then the pressure (P2) of spring chamber is equal to (P1), poppet (54) is moved to the left by the spring (55) load, so that again oil is flowed from orifice (m) to (l).

   Thus oil regulating valve controls intake oil quantity flowing to piston chamber (n), and controls the moving hour till the piston is contacted to the shoulder of liner (52).

As piston (50) is moving like above mentioned, spring (49) load is increased from low load to high load, cushion relief operation is actuated at low pressure first, then it is increased to the rated pressure after a few hours have passed. By this slowly increased pressure, shock of motor decreases when starting or stopping.

Bypass Valve Operation (Bypass Valve Section Drawing)

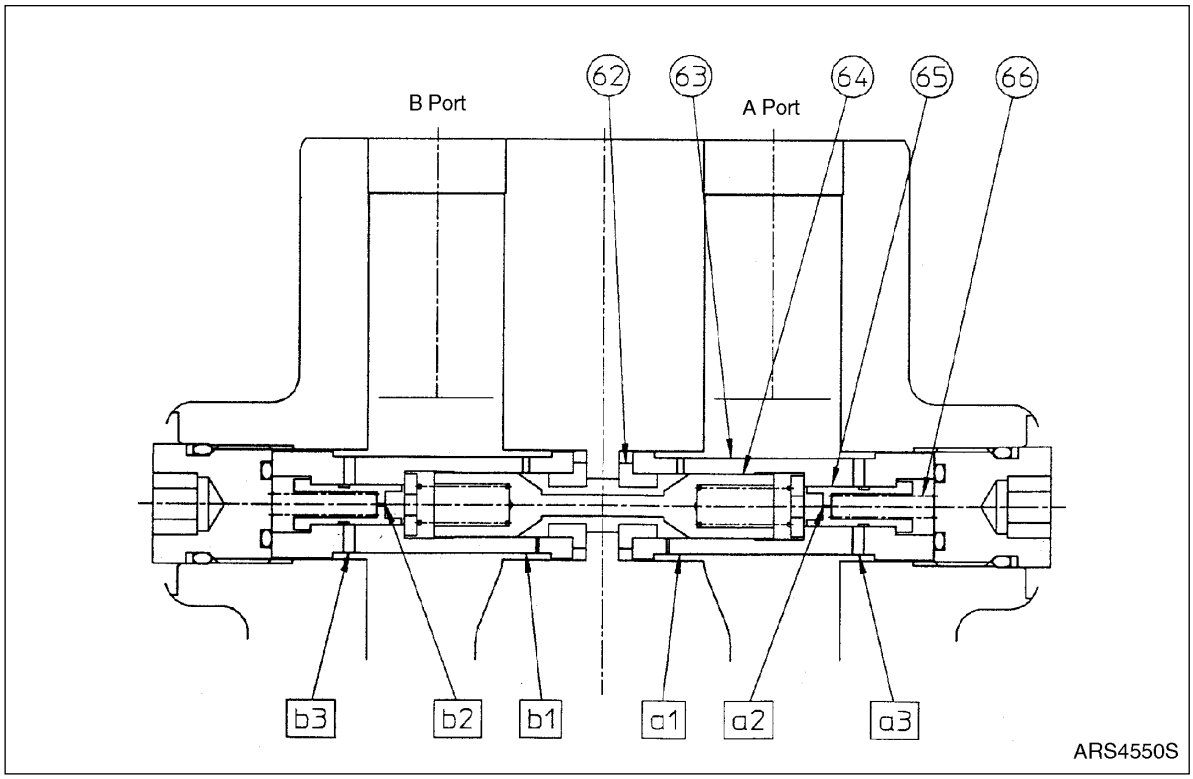


Figure 3

When stopping swing structure after moving it by operating control valve, as it tries to continuously turn by inertia force, hydraulic motor operates pumping, and brake pressure is generated at one port. If it is port (A), as this brake pressure oil flows through orifice (a3) and (a2) into rear chamber of check (64) of side (A), side (A) check (64) pushes side (B) check (64), which is installed symmetrically, to the left side till it is contacted to side (A) seat (62), closes bypass passage in the process of reducing speed of swing structure.

After this, swing structure is stopped, but it reverses by brake pressure, pressure of side (B) increases, side (B) check (64) tries to push side (A) check (64), which is installed symmetrically, but oil of rear chamber of check (64) discharges slowly by operating of oil regulating valve consisted of side (A) poppet (65) and spring (66), side (B) check (64) moves slowly, at this interval, pressure oil flows through orifice (b1) into center chamber, and bypasses through orifice (a1) to side (A) port.

After this, side (B) check (64) moves to the position where bypass passage is closed by being compressed to side (B) seat (62). Like this, by generating process of reverse pressure of side (B) port, pressure oil flow is not stopped and reversing is prevented by bypassing this pressure to side (A) port.

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.

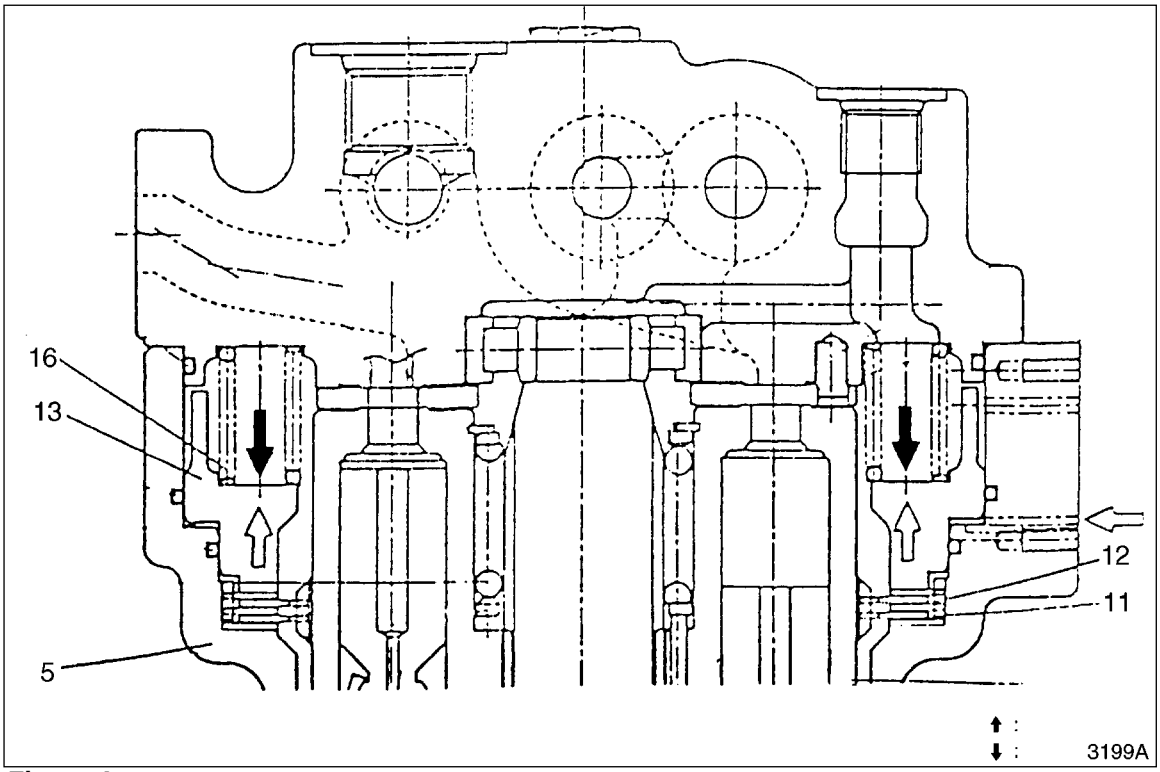


Figure 4

IMPORTANT

Along with the swing brake, a 2-position positive swing lock has also been provided. It should be secured whenever the upper deck revolving superstructure must be locked down and positively kept from rotating - including maintenance and/or repair intervals. (Do not rely on the swing brake alone to hold the superstructure in position for repairs, transport, maintenance or normal storage.)

The swing brake is applied when the brake spring (16, Figure 4) locks up the friction plate (11), split plate (12) and swing motor casing (5), preventing the motor drive shaft from turning. When hydraulic pressure is forced to the back side of the brake piston, the friction plate and swing motor casing are separated, releasing the brake.

Time Delay Valve (Time Delay Valve Section Drawing)

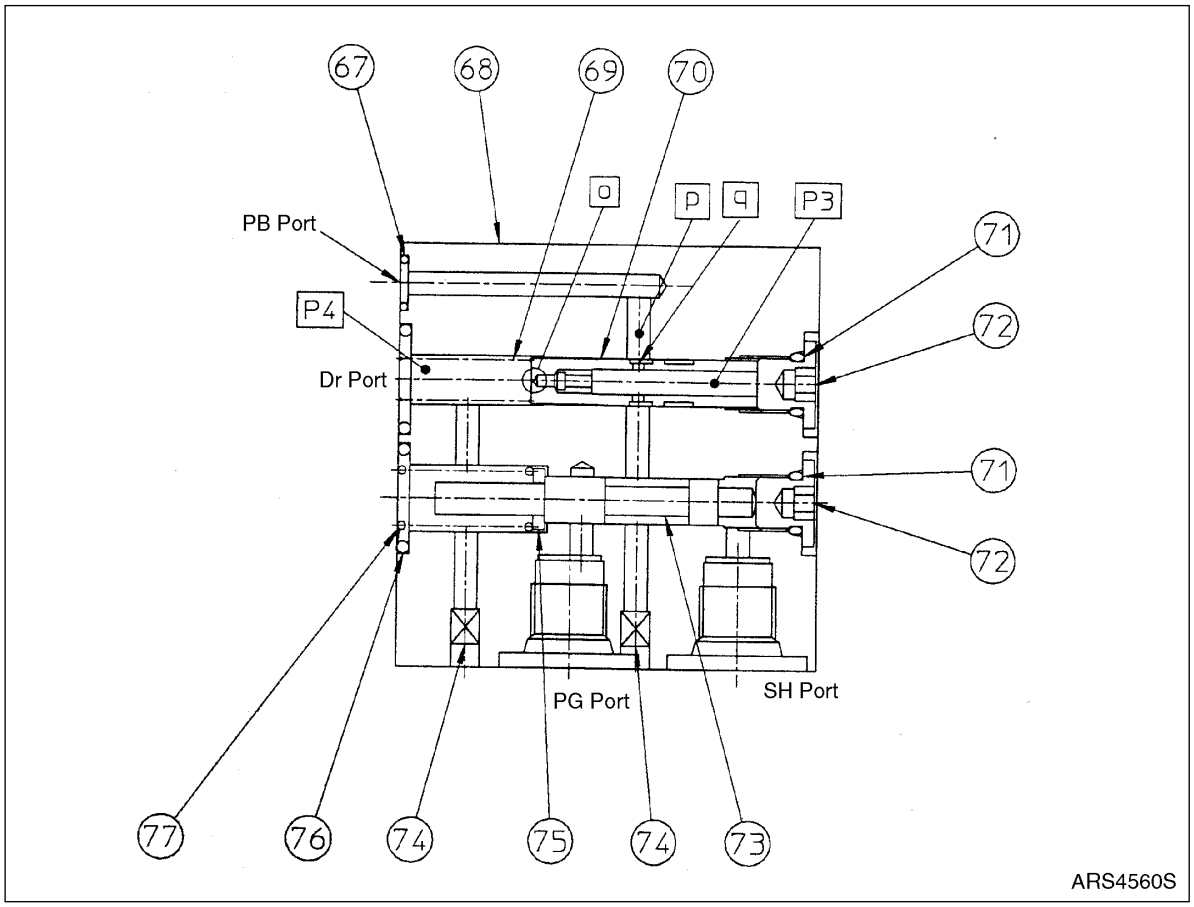


Figure 5

Pressure over mechanical brake releasing pressure always exists in (PG) port.

1. Condition that driving shaft is locked by operation of mechanical brake

   In case that pressure in (SH) port does not exist, spool (73) is pushed to the end of right side by spring (77) load and stops the oil flow flowing from port (PG) to port (PB).

2. Condition that mechanical brake is released

   In case that signal pressure flows into port (SH), spool (73) moves to left side and oil flows through port (PG) and (PB) into brake releasing chamber.

3. When delay function is operated

   When pressure oil flowing into port (SH) is stopped at the condition of (2), spool (73) is pushed to the end of right side by spring load (77), and closes port (PG) and (PB). Pressure oil of port (PB) flows out to port (Dr). At this time, when the difference pressure (P3-P4) between the front chamber pressure (P3) of orifice (o) and spring chamber pressure (P4) is bigger than spring (69) installation load (F)/poppet (70) area (A), poppet (70) is moved to left side, then stopper part of slot part of it closes passage (p), and stops the oil flow flowing into front chamber of orifice (o). Then spring chamber pressure (P4) equals (P3), then poppet (70) is moved to right side by spring (68) force, and oil flows from passage (p) to orifice (q) again. This oil quantity flowing to port (Dr) is controlled by the oil regulating valve and time is regulated till piston (13) is in the condition (1).

PARTS LIST

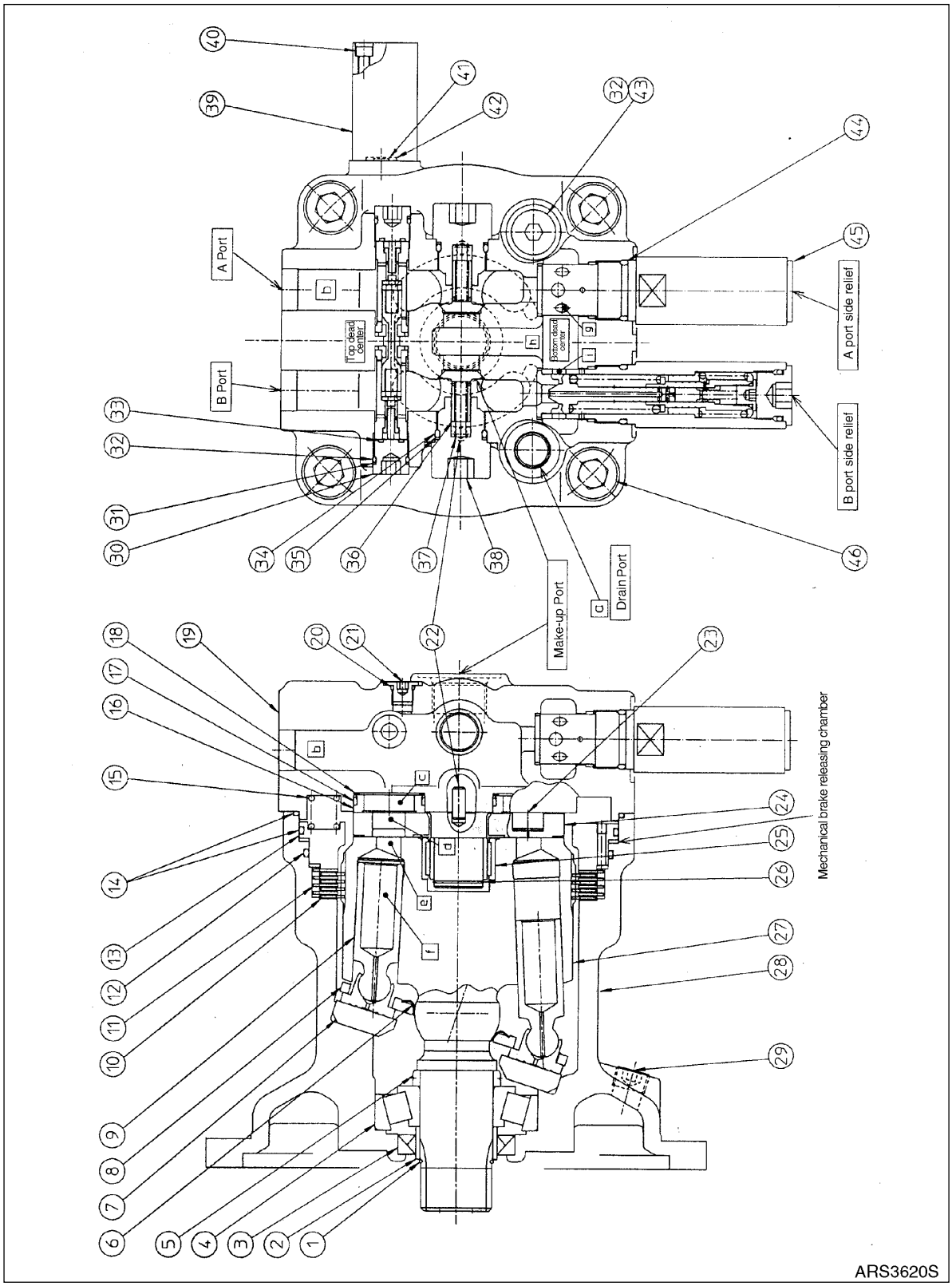


Figure 6

Reference Number	Description
1	Snap ring
2	Inner Ring
3	Oil Seal
4	Tapered Roller Bearing
5	Collar
6	Backing Spring
7	Cam Plate
8	Return Plate
9	Piston Assembly
10	Lining Plate
11	Plate
12	O-ring
13	Piston
14	O-ring
15	Spring
16	Bush
17	Teflon Ring
18	Scrowave
19	Cover
20	O-ring
21	Cap
22	Parallel Pin
23	Piston

Reference Number	Description
24	Balance Plate
25	Needle Bearing
26	Snap Ring
27	Cylinder
28	Housing
29	Plug
30	Bypass Valve Assembly
31	Back-up Ring
32	O-ring
33	O-ring
34	O-ring
35	Back-up Ring
36	Check
37	Spring
38	Cap
39	Time Delay Valve
40	Hex. Socket Bolt
41	O-ring
42	O-ring
43	Cap
44	O-ring
45	Relief Assembly
46	Hex. Socket Bolt

SPECIFICATIONS

Swing Motor	Specification
Theoritical Motor Displacement	186.7 cm^3/rev
Working Pressure	27.9 MPA
Brake Torque	834 (at Backpressure 0 MPa)
PG Port Supplying Pressure	3.9 MPa (100% Release Pressure) Allowable Pressure 4.9 MPa
Ratating Direction	B Port Inflow : Clockwise A Port Inflow : Counterclockwise
Allowable Viscosity Range	10 ~ 1000 mm^2/s
Allowable Temperature Range	-30 ~ +80°C
Mass	About 60 kg
Allowable Drain Pressure	Max 0.3 MPa
SH Port Selector Switching Pressure	Cranking 1.27 MPa Allowable Pressure 4.9 MPa
Hydraulic Timer Setting Hour	6.5 ± 1.5 S (VG# 46.50°C)

SPECIAL TOOLS AND MATERIALS

SPECIAL TOOLS

Pressing Tool of Inner Ring (2) and Taper Roller Bearing (4) Inner Race

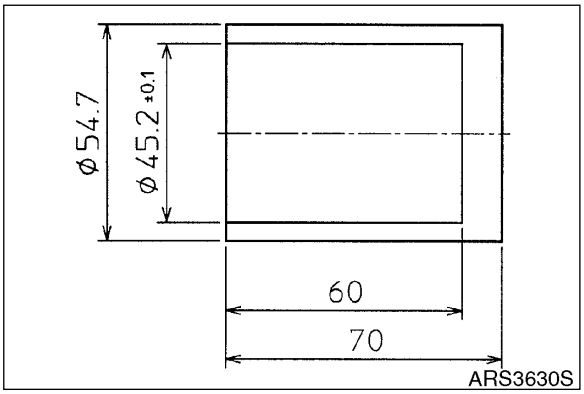


Figure 7

Assembly Tool for Oil Seal (3)

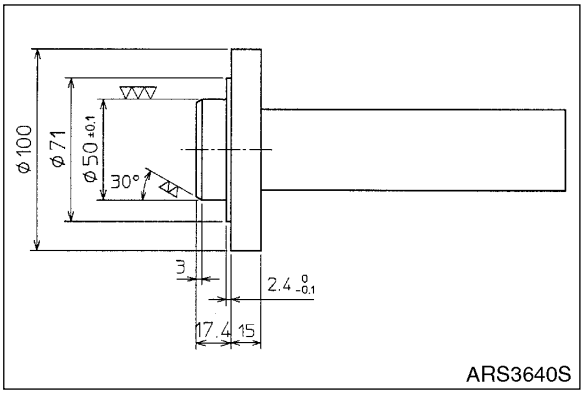


Figure 8

Assembly Tool for Brake Piston (13)

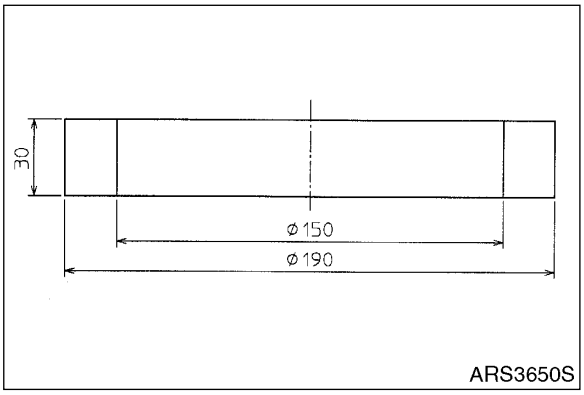


Figure 9

TROUBLESHOOTING, TESTING AND ADJUSTMENT

If abnormality is finded when using motor, a way of handling to work is described when function is poor. As disassembling, inspection and reassembling is described in detain later also, use extreme care for handling absolutely not to damage the sliding surface of motor when working.

Problem	Possible Cause	Remedy
Motor does not rotate	Motor internal damaged	Check fluid drain quantity. If the fluid quantity supplied to motor is almost all of fluid drain quantity, it is necessary to disassemble and check it because the possibilty of damage is large. Refer to “Inspection Parts List” on page -16.
	Motor internal damaged	Open inlet and outlet port of motor, apply pilot pressure of 3.9 - 4.9 Mpa to brake release port, and then check the turning of output shaft with torque of about 30 - 40 Nm over one revolution smoothly. If it does not turn smoothly with the torque described above, it is necessary to disassemble and check it because the possibilty of damage is large. Replace damaged parts or motor assembly.
	Setting pressure of relief valve in circuit poor	Check load pressure by pressure guage. Reset it to setting pressure.
Slip is very big	Sliding surface parts of motor and high pressure seal parts worn or damaged	Check fluid drain quantity. If fluid drain quantity is over 2.5 l/min, it is necessary to disassemble and check it. Refer to “Inspection Parts List” on page -16.
	fluid temperature too high and motor internal leakage too big	Check fluid temperature. Lower fluid temperature.

Problem	Possible Cause	Remedy
Torque is poor & Abnormal noise	Sliding surface parts worn or damaged	Open inlet and outlet port of motor, apply pilot pressure of 3.9 - 4.9 Mpa to brake release port, and then check the turning of output shaft with torque of about 30 - 40 Nm over one revolution smoothly. If it does not turn smoothly with the torque described above, it is necessary to disassemble and check it because the possibilty of damage is large. Check the parts of the articles from (a) to (e) of “Inspection Parts List” on page -16 and bearings and replace if they are abnormal.
	Setting pressure of relief valve in circuit poor	Check load pressure by pressure guage. Reset it to setting pressure.
	Motor internal damaged	Check whether metalic foreign material is in fluid drain of motor and drain filter. If metalic material is found, disassemble and check motor internal because the possibility of its damage is large. Repair or replace damaged parts. Replace motor.
	Air in fluid mixed	Check fluid in tank and motor case. Bleed air fully.
	Fasening parts loose	Check pipe laying parts, fastening part bolts, motor fastening bolts, and each motor fastening part bolts. Fasten suitable tightening torque.
Abnomal heat	Motor sliding and rotating parts stuck	Check whether metalic foreign material is in motor fluid drain and drain filter, and check the turning of output shaft with torque of about 30 - 40 Nm over one revolution smoothly. If metalic material is found or it does not turn smoothly with the torque described at left, it is necessary to disassemble and check it because the possibilty of damage is large. Repair or replace damaged parts. Replace motor.
Assembling parts leaking	O-ring damaged	Replace O-ring.
	Seal surface damaged	Repair seal surface or replace seal.
	Bolt loose	Check bolts Fasten suitable tightening torque. Repair or Replace motor.

Problem	Possible Cause	Remedy
Oil seal leaking	Oil seal lip part damaged or worn	
	Shaft seal part damaged or worn	
	Pressure of case abnormal	Check pressure in case and drain quantity Pressure in case is made lower than 0.3Mpa. If drain is high, disassemble and check it. Replace oil seal. Repair or replace damaged parts. Replace motor assembly.

Inspection Parts List

No.	INSPECTION PARTS	CORRECTION
a	Wear of sliding part of balance plate(24)	Repair or replace parts
b	Damage of sliding part of cam plate(7)	Repair parts or replace motor
c	Damage of sliding part of piston assembly(9)	Repair parts or replace motor
d	Wear of piston circumferencial surface of piston assembly(9)	Repair parts or replace motor
e	Wear of piston hole of cylinder(27)	Replace motor
f	Damage of teflon ring(17)	Replace parts

REMOVAL

HANDLING METHOD

When transporting and storing, set motor down vertically by pointing drive shaft downwards. When lifting motor, always attach a lifting-eye to make-up port in center of motor cover.

Do not attach sling or other lifting device to relief valve or timer. This could result in them begin deformed and/or malfunctioning.

DISASSEMBLY

⚠ CAUTION!

Read this manual before working on or performing disassembly, reassembly, inspection, repair etc. of this component.

Disassembly of this component should be done after stopping machine and allowing surface temperature of this component to cool to 40'C or below. Working on this component when it is at higher temperatures can result in burns.

When disconnecting hoses from component, always work after allowing pressurized air and oil to vent. Disconnecting hoses from component that are under pressure can cause seriuos injury from oil squirting out.

Special tool or measuring apparatus are used to disassembly, reassembly, inspection, repair etc. of component. Using an inappropriate tool can cause wound or damage of component.

When performing disassembly, reassembly, inspection, repair, etc. of this component, be careful not to drop components. It can cause personal injury or damage to component parts.

When performing disassembly, reassembly, inspection, repair etc. of this component, do not touch threads with bare hands. It can cause injury.

After reassembling, verify operational performance and do not use it, if it does not operate properly. Improper operation can cause damage to other components.

1. Remove the following valve assemblies from motor cover (19).
   - Relief valve assembly (45) (hex hole size 14 mm).
   - Cap (38) (hex hole size 14 mm), spring (37), check (36) and
   - Bypass valve assembly (30) (hex hole size 10) installed in motor cover.
   - Loosen socket bolt (40) (hex hole size 5 mm) and disassemble oil pressure timer (39).

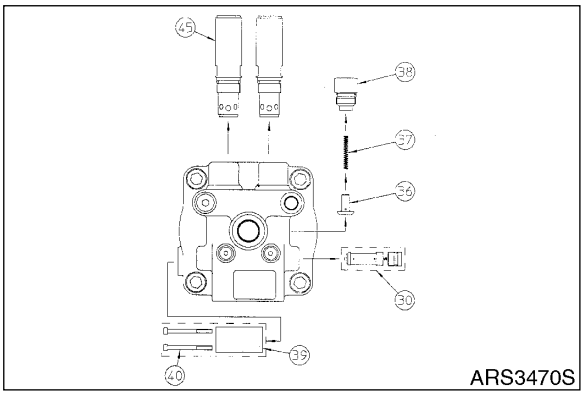


Figure 10

NOTE: *Relief assembly (45), cap (38), spring (37), check (36), bypass valve assembly (30), oil pressure timer (39) which are disassembled should be reassembled in the same position.*

2. Match mark cover (19) and housing (28) so that they can be properly oriented during reassembly.

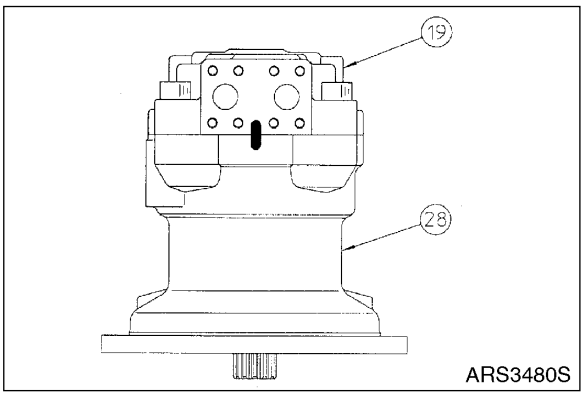


Figure 11

3. With motor output shaft pointing down, remove four socket head bolts (46) (hex hole size 17 mm) and cover (19) from housing.

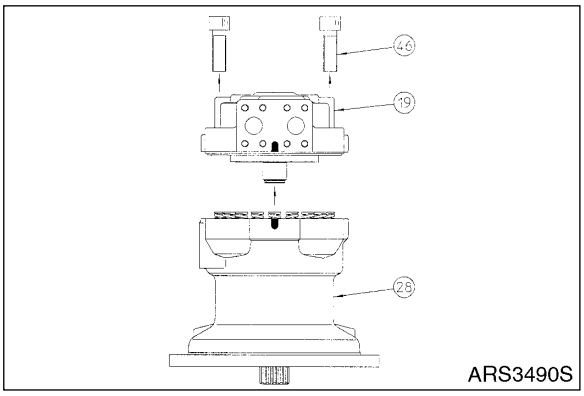


Figure 12

4. Remove snap ring (26), inner race of needle bearing (25) and balance plate (24).
5. Remove piston (23) from balance plate (24).

   NOTE: *Be careful not to scratch the sliding surface of balance plate (24) or not to deform it by excessive force.*

   NOTE: *Match mark balance plate (24) with cover (19). Note assembly direction of the balance plate (24) against cover (19).*

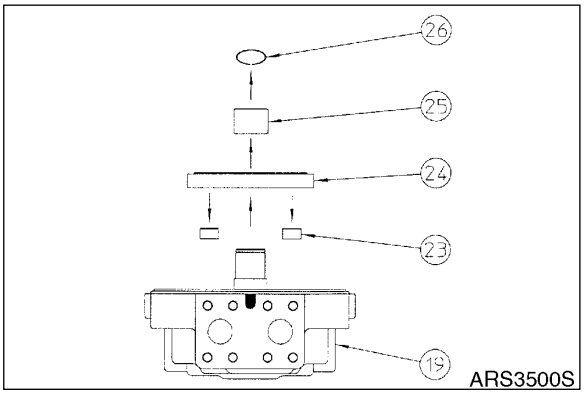


Figure 13

6. Remove O-ring (14) from cover (19).

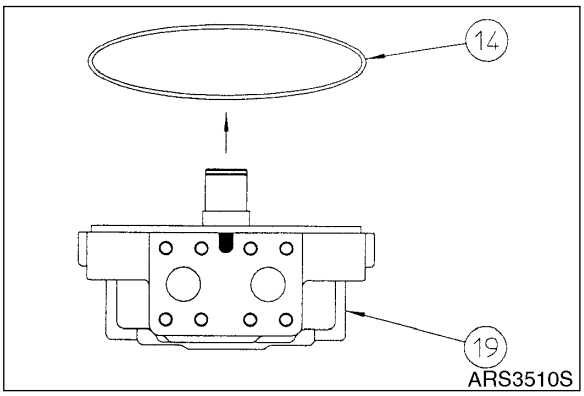


Figure 14

7. Remove bush (16) attached in Teflon ring (17) and scrowave (18) from cover (19).

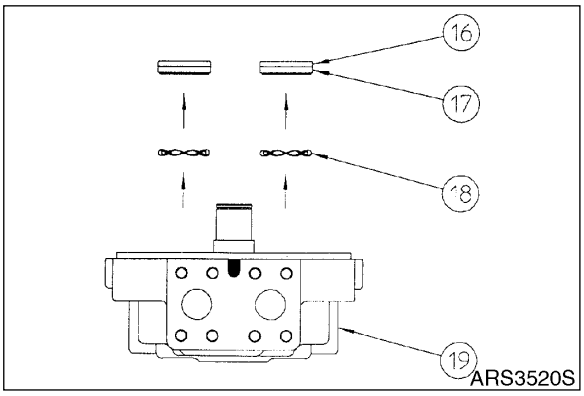


Figure 15

8. Remove springs (15) from piston (13).

   NOTE: *Match mark springs (15) with piston (13).*

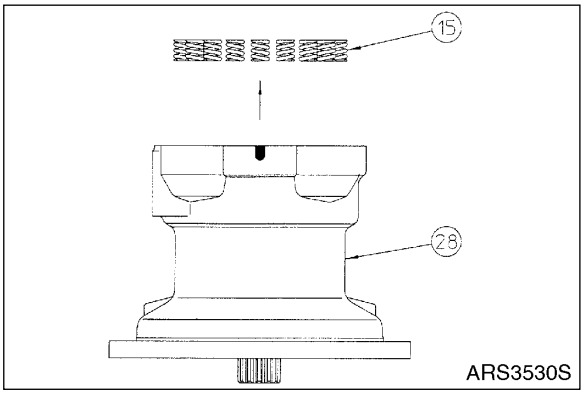


Figure 16

9. Piston (13) will not come out of housing (28) due to sliding resistance of O-rings (12 and 14). Remove it using tap holes (M6) in piston. remove piston (13) as in the right figure.

   NOTE: *Position the fulcrum outside of the inner diameter of housing (28).*

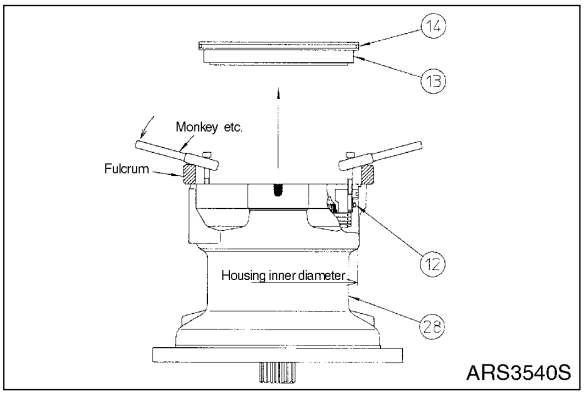


Figure 17

10. Disassembly of lining plates and plates

    - Remove lining plate (10) and plates (11).

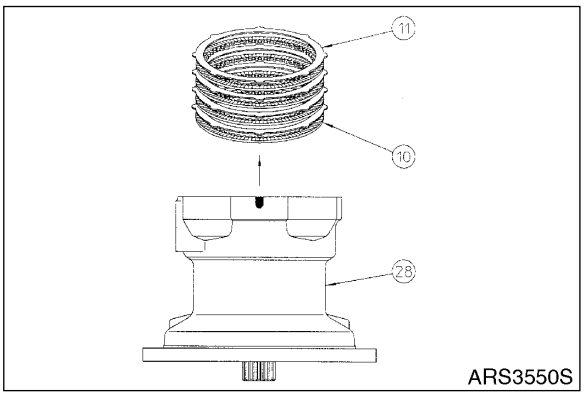


Figure 18

11. Disassembly of cylinder assembly

    - Holding cylinder (27) by the end part, remove cylinder assembly from housing (28).

    NOTE: *Be careful not to drop cylinder (27) as it is slippery.*

    NOTE: *The remains in housing (28) are outer race of taper roller bearing (4) and oil seal (3).*

    NOTE: *Keep the sliding surface (A) of cylinder (27) covered until installation to protect it from damages.*

    NOTE: *Mark or number piston holes of cylinder (27) and piston assemblies (9) for identification of original position at reassembly, and install them in the original position when reassembling them.*

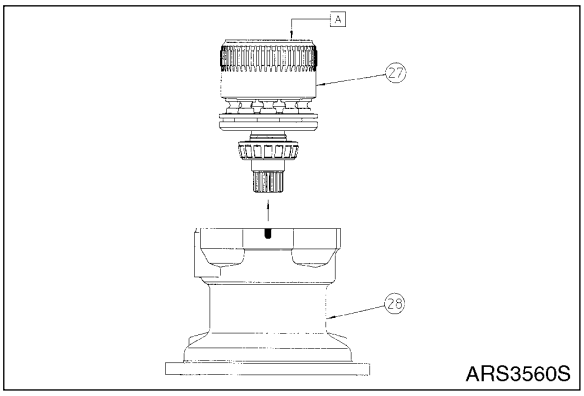


Figure 19

12. Disassembly of taper roller bearing outer race

    - Remove taper roller bearing outer race (4) from housing (28). Push out oil seal (3) using driver and hammer.

    NOTE: *Do not reuse oil seal (3).*

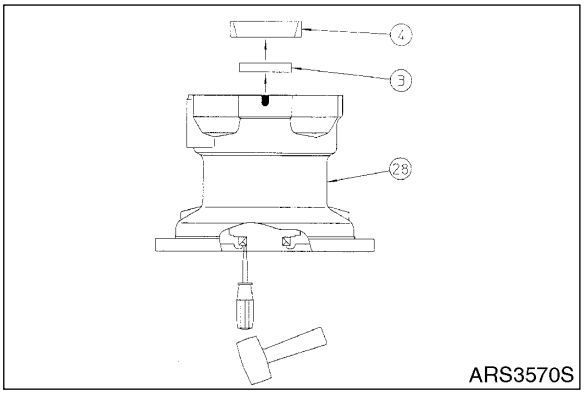


Figure 20

13. Disassembly of cylinder assembly

A. Disassembly of inner ring and taper roller bearing

- Squeeze out snap ring (1) using marking off pin, and pull out taper roller bearing inner race (4) and inner ring (2) at a time using bearing puller.

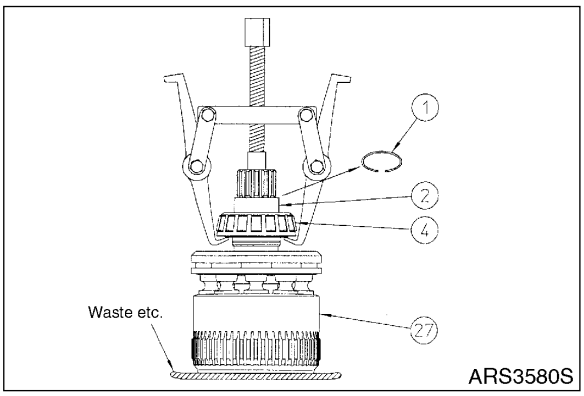


Figure 21

B. Remove collar (5) from cylinder (27). Remove cam plate (7), return plate (8) and piston assembly (9) from cylinder (27) at a time.

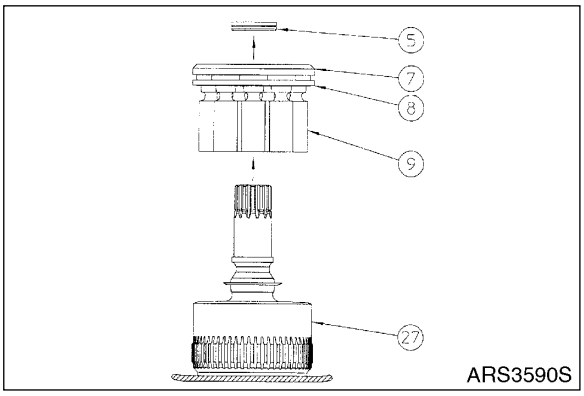


Figure 22

C. Remove cam plate (7) from sliding surface of piston assembly (9) like sliding.

NOTE: *Be careful not to damage cam plate (7) and sliding surface of piston assembly (9).*

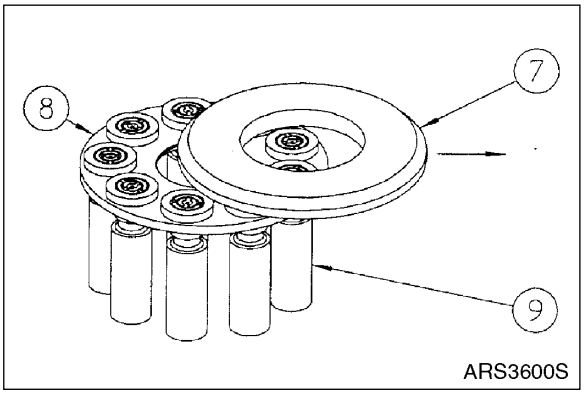


Figure 23

D. Remove spring plate (6) from cylinder (27).

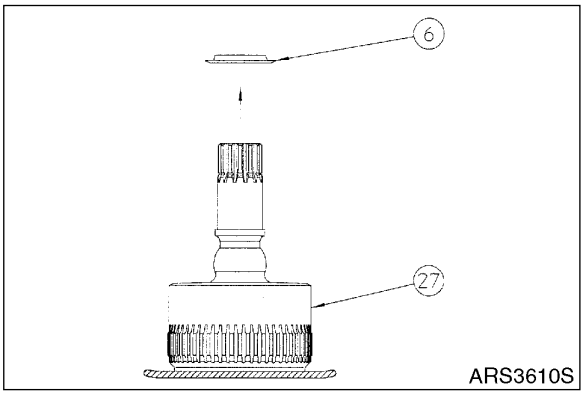


Figure 24

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

REASSEMBLY

Preparation details

When reassembling, first carry out the following details.

1. Check if each part is damaged when using or disassembling. if it is damaged, remove any damages with fine grading oil stone or sand paper according to necessity. Then thoroughly clean it with a suitable cleaning oil and dry it with moisture free compressed air.

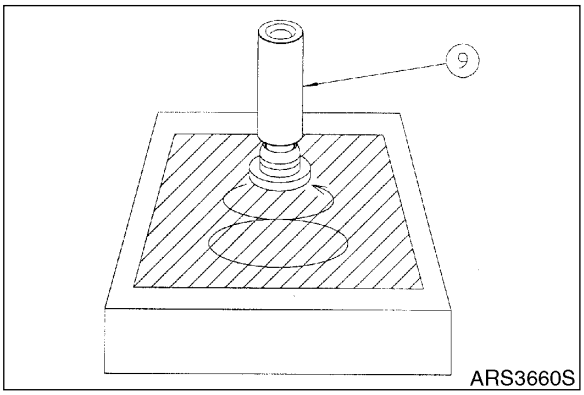


Figure 25

2. Replace seal kit with new one.
3. Lap sliding surfaces of piston assemblies (9), cam plate (7) and balance plate (24) with #2, 000 sand paper on the surface plate.

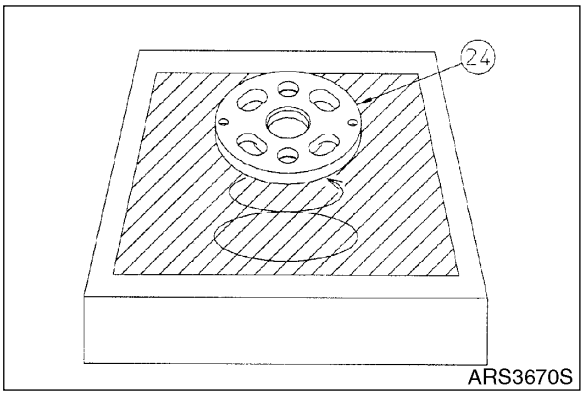


Figure 26

4. When reassembling sliding parts, apply clean hydraulic oil to them.

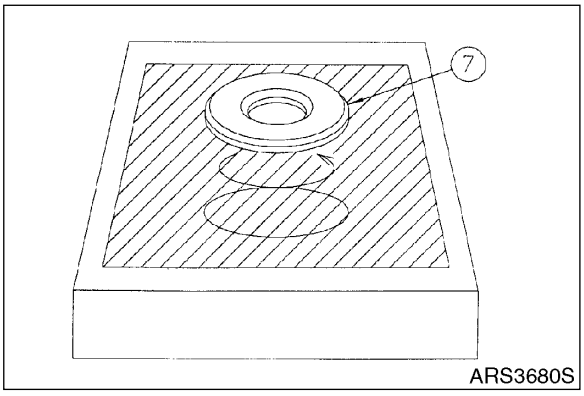


Figure 27

Reassembly of Cylinder Assembly

1. Apply hydraulic oil to round part (contact part of backing spring (6)) of cylinder (27) and insert backing spring (6).

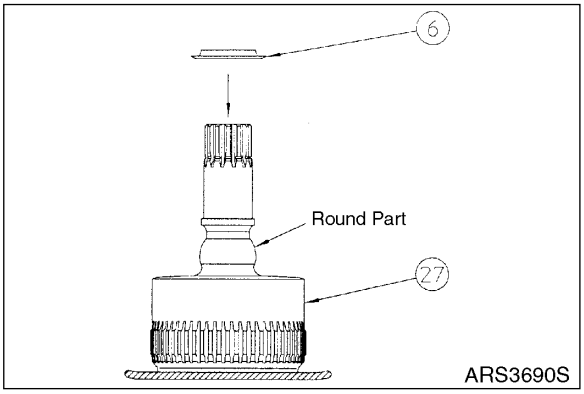


Figure 28

2. Insert piston assembly (9) in the hole of return plate (8).

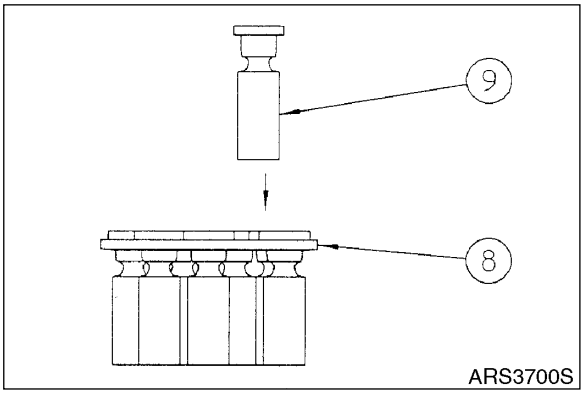


Figure 29

3. Install piston assembly (9) and return plate (8) together into cylinder (27).

   NOTE: *Install piston assembly (9) into the holes of cylinder (27) in the original position.*

   NOTE: *When reassembling, apply hydraulic oil to the piston holes of cylinder (27).*

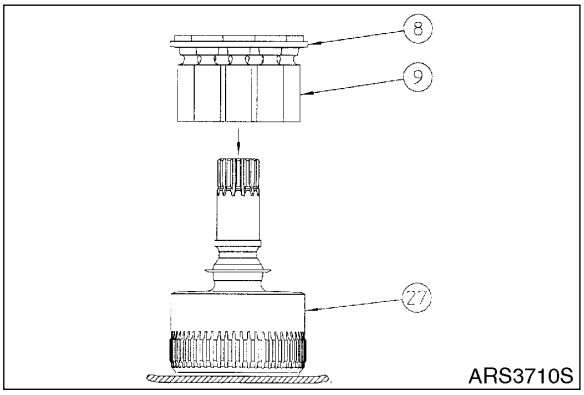


Figure 30

4. Apply hydraulic oil to the sliding surface of shoe of piston assembly (9) and install cam plate (7) to cylinder (27).

   Insert collar (5) to cylinder (27).

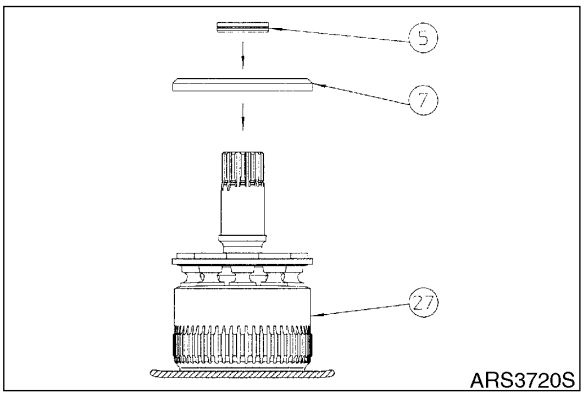


Figure 31

5. Press fit inner race of taper roller bearing (4) to cylinder by using special tool and press.

   NOTE: *When pressing, wrap the surface of cylinder (27) with a lint free cloth or paper to protect it from damaging.*

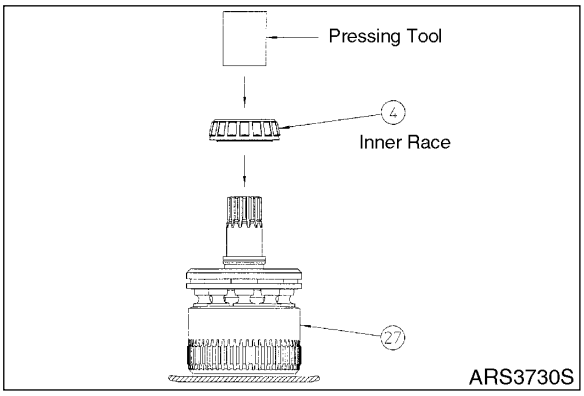


Figure 32

6. After cleaning and drying the reassembling part of cylinder (27), apply a thin coat of Loctite (515, 518 or equivalent) to it and press fit inner ring (2) dried cleanly to it by using special tool. Install snap ring (1).

   NOTE: *Use extreme care not to get Loctite on the roller part of taper roller bearing (4).*

   NOTE: *Clean the remained Loctite between inner ring (2) and taper roller bearing (4).*

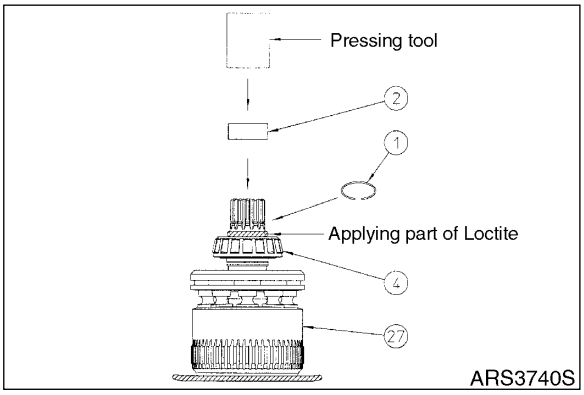


Figure 33

Reassembly of Oil Seal

Clean and dry the reassembling part of seal of housing (28). Dry the outer surface of oil seal (3), apply a thin coat of sealing compound (Three bond kk "1211" white or equivalent) to it and press fit it to housing (28) by using special tool.

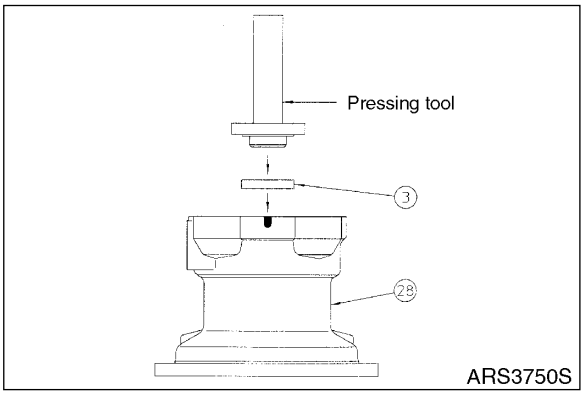


Figure 34

NOTE: *Be careful of the reassembling direction of oil seal (3).*

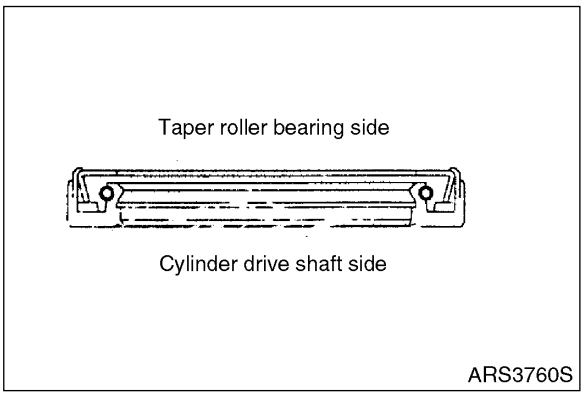


Figure 35

Reassembly of Taper Roller Bearing Outer Race

Install taper roller bearing outer race (4) to housing (28).

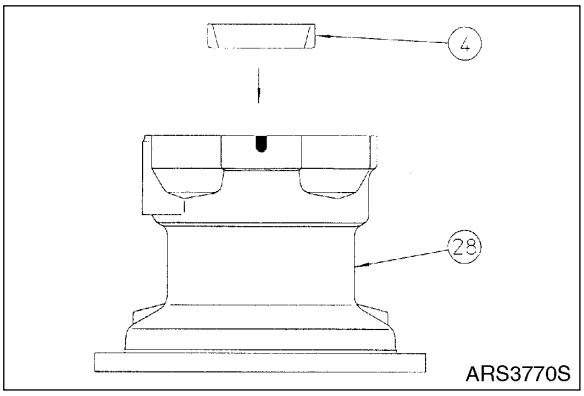


Figure 36

Reassembly of Cylinder Assembly

Apply a thin coat of grease on lip of oil seal (3), hold end part of cylinder (27) with hand, and slowly install cylinder assembly to housing (28).

NOTE: *When installing cylinder assembly, check if backing spring (6) is inserted in the spot facing part of return plate (8).*

NOTE: *When installing cylinder assembly, as the spline of cylinder (27) is out from the under part of housing (28), put a support of 30-50mm under the under part of housing (28).*

NOTE: *Check if the end part of cylinder (27) is lower of about 15.3mm then the end part of housing (28). If it is less lower, as cam plate (7) is not installed to the spot facing of housing (28) in the original place, slowly lean cylinder (28) to lower the high part of cylinder, slightly wave cylinder up and down, and install cam plate (7).*

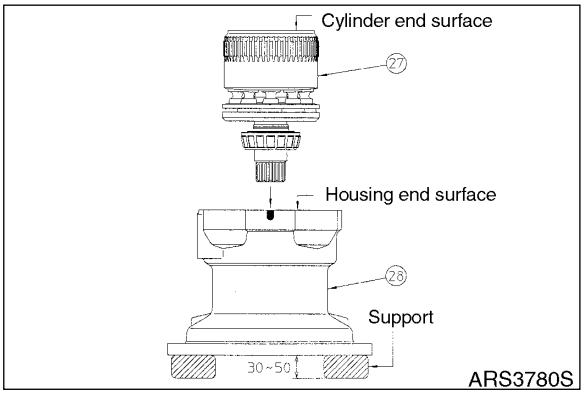


Figure 37

Reassembly of Lining Plate and Plate

Install lining plates (10) and plates (11).

NOTE: *Apply hydraulic oil to both faces of each plate.*

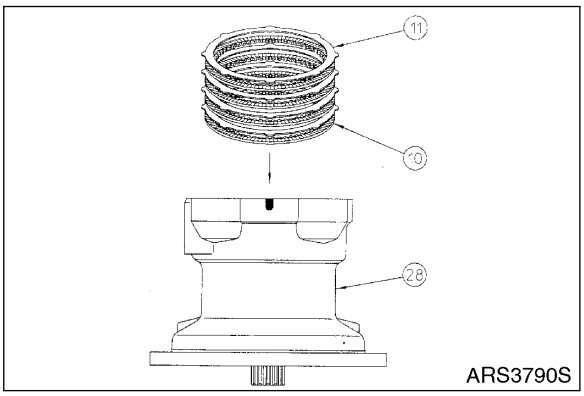


Figure 38

Reassembly of O-ring

Install O-ring (12) to housing (28) and O-ring (14) to piston (13).

NOTE: *Apply grease to O-ring (12) and (14).*

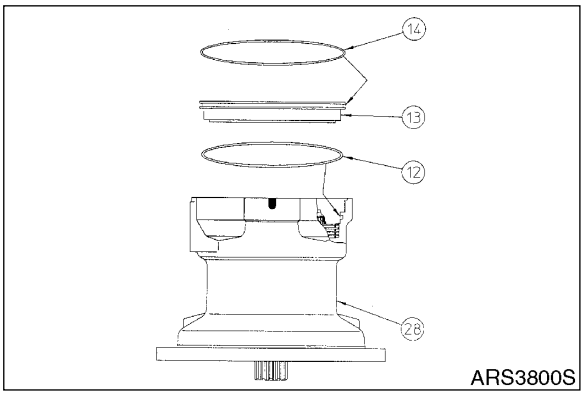


Figure 39

Reassembly of Brake Piston

Apply hydraulic oil to the circumferential sliding surface of piton (13) and install it to housing (28).

NOTE: *As there is an interference between piston (13) and O-ring (12) and (14), when installing piston (13), mount the whole piston (13) horizontally and push it in housing (28) with hand at a time.*

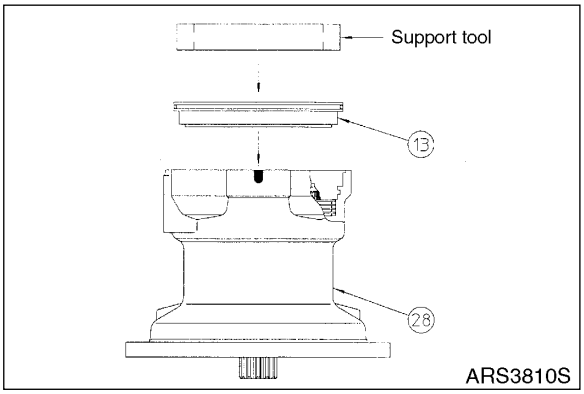


Figure 40

Reassembly of Spring

Install spring (15) to piston (13) of brake part.

NOTE: *Install spring (15) at the original position where it was disassembled before.*

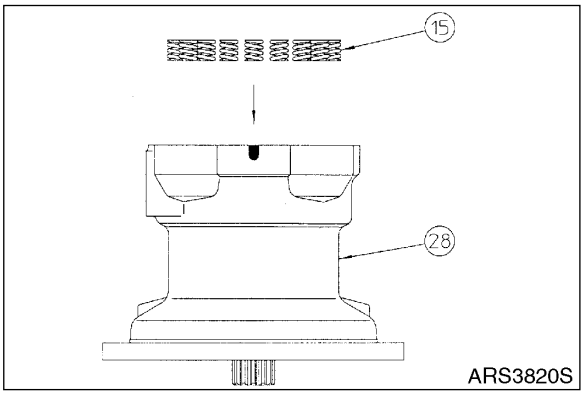


Figure 41

Reassembly of Balance Plate

Install scrowave (18) and bush (16) with Teflon ring (17) to bush hole of cover (19). Install balance plate (24) in which piston (23) is inserted to cover (19).

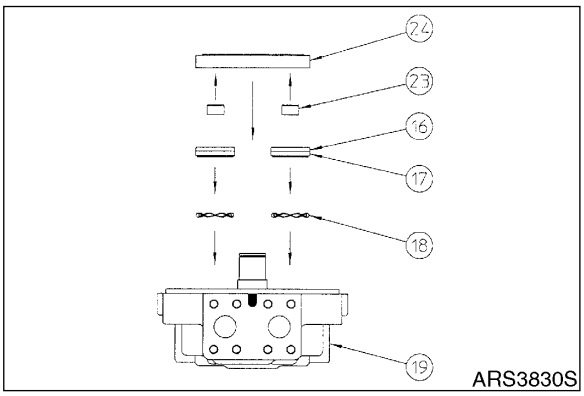


Figure 42

NOTE: *Be careful of the reassembling direction, which was marked before disassembling, of balance plate (24) and cover (19).*

NOTE: *Fully apply grease to piston (23) and pin (22) (for stopping turning of balance plate) of cover (19) and install balance plate to cover part.*

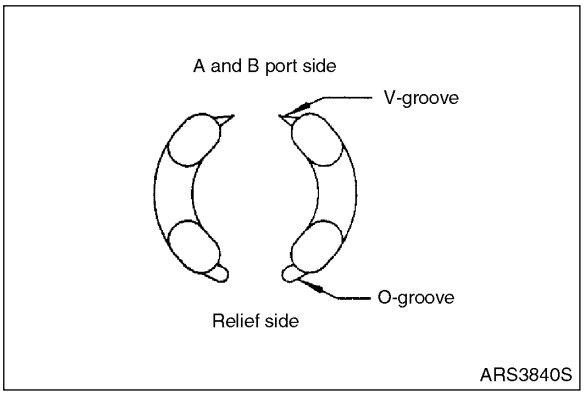


Figure 43

Reassembly of Inner Race

Press fit needle bearing (25) inner race to cover (19) and install snap ring (26).

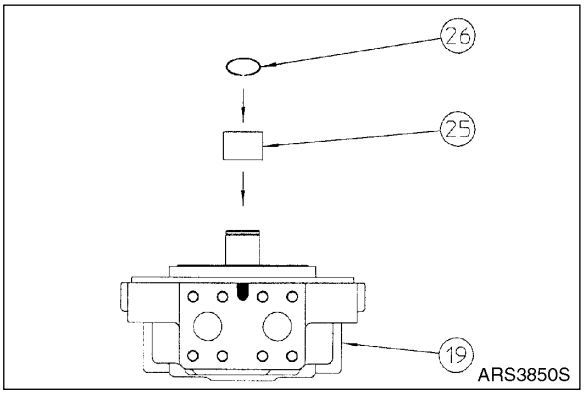


Figure 44

Reassembly of O-ring

Install O-ring (14) to cover (19).

NOTE: *Apply grease to O-ring (14).*

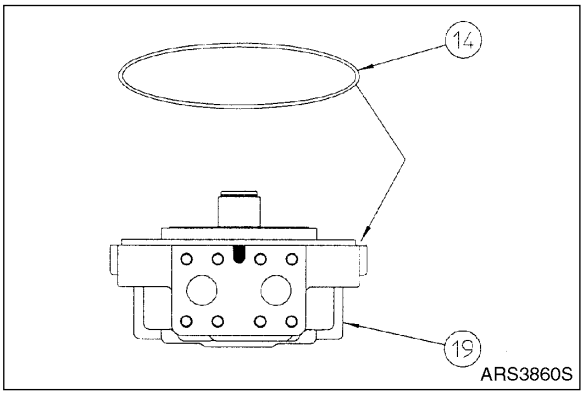


Figure 45

Applying of Liquid Packing

Clean and dry the mating surface of housing (28) against cover (19), and apply liquid packing (Three bond kk "1211" white or equivalent) to it like right figure.

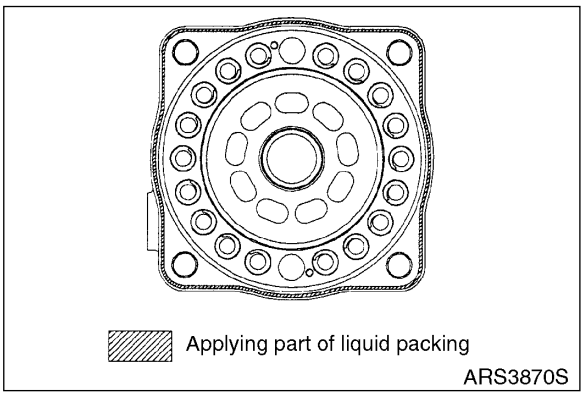


Figure 46

Reassembly of Cover

Clean and dry the mating surface of cover (19) against housing (28), lift cover (19) by hand, and install it to housing (28) slowly.

NOTE: *Align and install cover (19) to housing (28) according to the installation position marked before disassembling.*

NOTE: *At this time the clearance between housing (28) and cover (19) is about 4mm.*

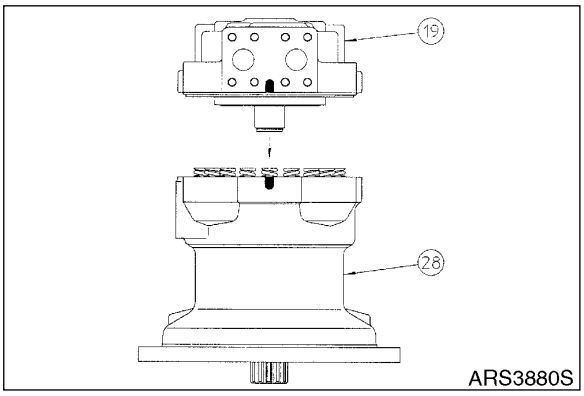


Figure 47

Tightening of Bolt (Tightening Of Cover (19) And Housing (28))

Tighten bolt (46) (hex hole size17) with torque of 392 Nm.

NOTE: *At this time four bolts should be equally and slightly tightened to align housing (28) and cover (19) straight.*

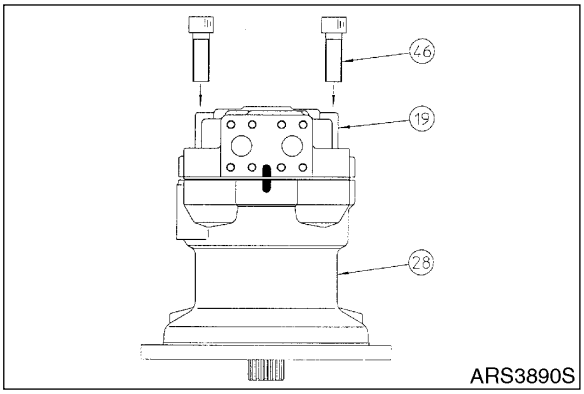


Figure 48

Reassembly of Relief Valve Assembly, etc.

Install relief valve assembly (45) (hex hole size 14) to cover (19) with torque of 137Nm. Install check (36) and spring (37) to cover (19) and tighten cap (38) (hex hole size) to cover (19) with torque of 137 Nm. Tighten bypass valve assembly (30) (hex hole size 10) to cover (19) with torque of 78 Nm. Tighten time relay valve (39) to housing with torque of 12 Nm by means of hex socket bolt (40) (hex hole size 5).

NOTE: *Install relief valve assembly (45), cap (38), spring (37), check (36), bypass valve assembly (30), and time relay valve (39) to the original position which was disassembled before.*

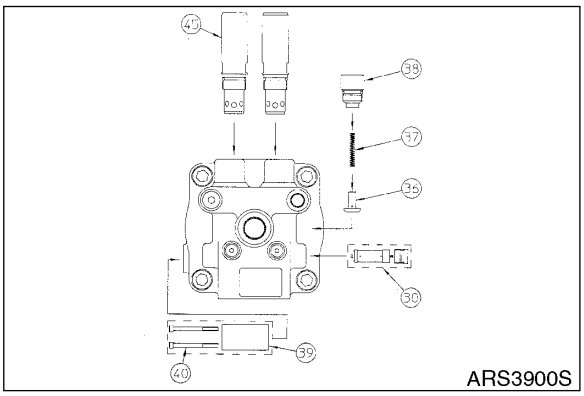


Figure 49

Confirming of Reassembly

Open inlet and outlet port of motor, apply pilot pressure of 3.9 - 4.9 Mpa to brake release port, and then check the turning of output shaft with torque of about 30 - 40 Nm over one revolution smoothly. If it does not turn, readjust it by disassembling because it is improperly reassembled. At this time open drain port also.

NOTE: *After reassembling hydraulic motor, check the setting pressure of relief valve (45).*

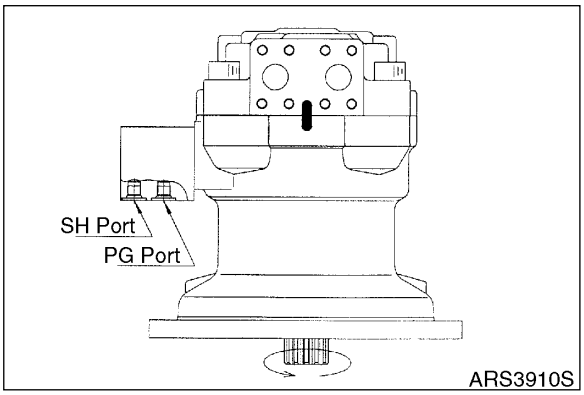


Figure 50

INSTALLATION

Piping

Dimensions for piping is already decided in outside drawing. Piping is to be hose or steel part. Also when piping, detach cap seal of rubber of port part. Because drain pipe is decreased pressure in motor case, uses large diameter pipe. Also when connecting return pipe other components, return oil is squirted out suddenly, abnormal back pressure of pressure in motor case should be below 0.3 MPa.

START-UP PROCEDURES

Hydraulic Oil

Use recommended hydraulic oil listed in the Operation and Maintenance Manual.

Preliminary Operation

Make sure that all hoses and pipes are flushed and free of contamination. Check all fittings and connections in the circuit to be sure that they are properly tighten and connected.

Bleed air from motor case, when filling case with hydraulic oil. If motor is operated without hydraulic oil, it can result in internal parts being damage. After fully filling motor with oil, operate it at a no load condition, and low speed, for 10 - 15 minutes. Check for abnormal noises or vibration when operating. Slowly operate motor at a higher speed and load.

Relief Valve

The relationship between adjusting oil pressure of relief valve and turning the adjustment screw is as follows, and it is very difficult to confirm. Do not adjust pressure unless absolutely necessary.

Pressure variation for 0.1 mm of screw advancement, is about 0.4 MPa.

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

TRAVEL MOTOR (WITH GEARBOX)

⚠ 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 300LC-V	1001 and Up

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December 2001

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GENERAL DESCRIPTION

1. Travelling device consists of hydraulic motor part and reduction gear part.
2. Hydraulic motor part consists of the following five items.
   - Rotary part generating rotating force
   - Cross over relief valve part
   - Negative brake part
   - Counter balance valve part
   - Swash tilting part
3. Reduction gear part consists of two speed differential gear and graphic symbols are as follows.

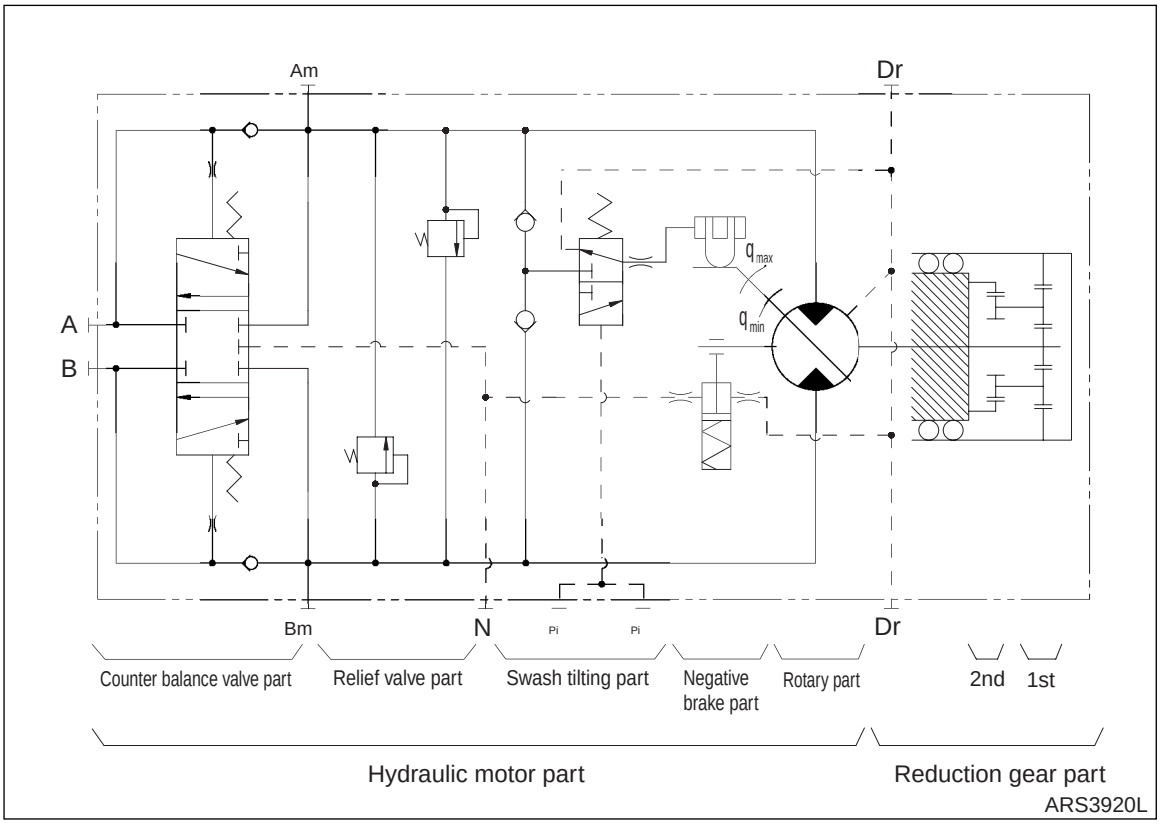


Figure 1

THEORY OF OPERATION

Hydraulic Motor

1. Operation of rotating force generation

High pressure oil supplied from hydraulic pump flows through valve casing (14) and valve plate (11) into cylinder block (06).(Refer to Figure 11 for indicating number).
Structure makes this high pressure oil flow to one side against the connected line Y-Y of top and bottom dead center of piston (10).

This high pressure oil acts on piston like above figure and generates force F1(F1=P x A (P:Supply pressure, A:Pressure area)). This force F1 generates perpendicular force N1 and radial force W1 against swash plate (12) which has tilting angle β. W1 generates torque T (T = W1 x R1) against the line Y-Y of bottom and top dead center of piston like above figure.

The resultant(∑ W1 x R1) of torques which are generated from pistons (4 - 5ea) of high pressure side by high pressure oil generates rotating force. This torque is transmitted to cylinder (06) through piston, and then rotating force is transmitted to drive shaft because cylinder block is combined with drive shaft by spline.

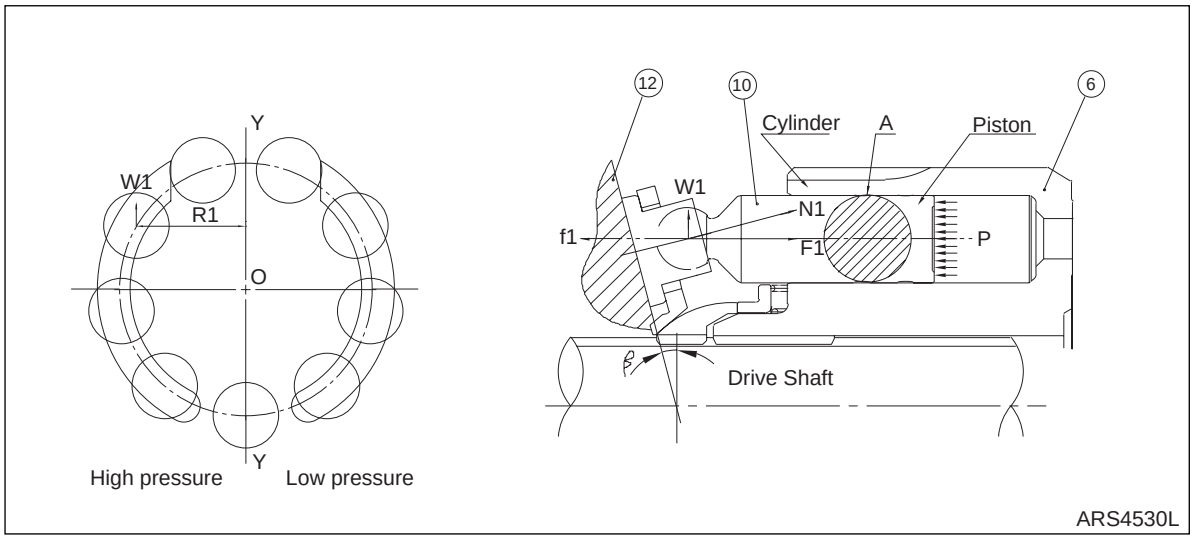


Figure 2

2. Operation of relief valve

Relief valve performs the following two functions.

A. When the hydraulic motor is operated, the relief valve keeps pressure and passes the surplus oil of motor inlet part to outlet part in relation to acceleration of inertial matter.

B. When inertial matter is stopped, brake pressure can be generated to outlet part, so that equipment can be stopped forcedly.

Always chamber A is connected with port A of motor, when pressure of port A rises and exceeds setting pressure of spring pressing poppet A, poppet A is opened and hydraulic oil flows from chamber A to port B.

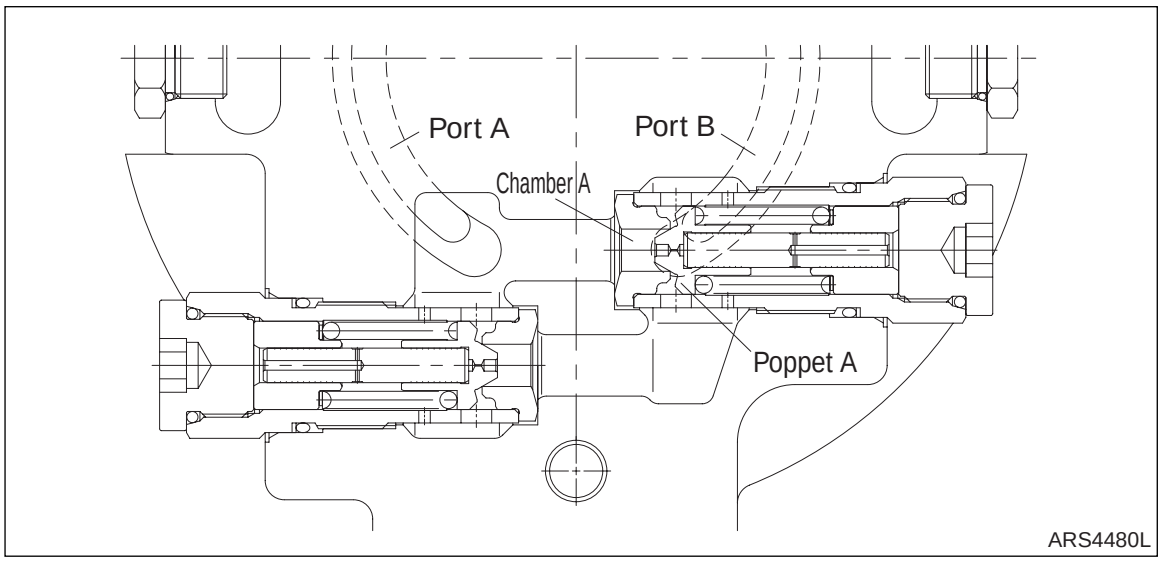


Figure 3

3. Operation of negative brake

Pressure entered through counter balance spool (15) in valve casing acts to brake piston (44) and negative brake releases brake. When pressure does not act, brake is always activated.
Brake force is generated by friction force of separate plate (48) which is fixed by pin (32) pressed in shaft casing and friction plate (49) which is connected with shaft casing, brake piston (44) and spline of cylinder block (06).
When pressure does not act to brake piston part, brake springs press brake piston and oil in brake chamber flows through orifice to drain of motor. At this time, brake piston presses separate plate and friction plate against shaft casing by pressing force of ten brake springs (45) and generates friction force. By this friction force, cylinder block and drive shaft connected by spline are fixed and act as brake.

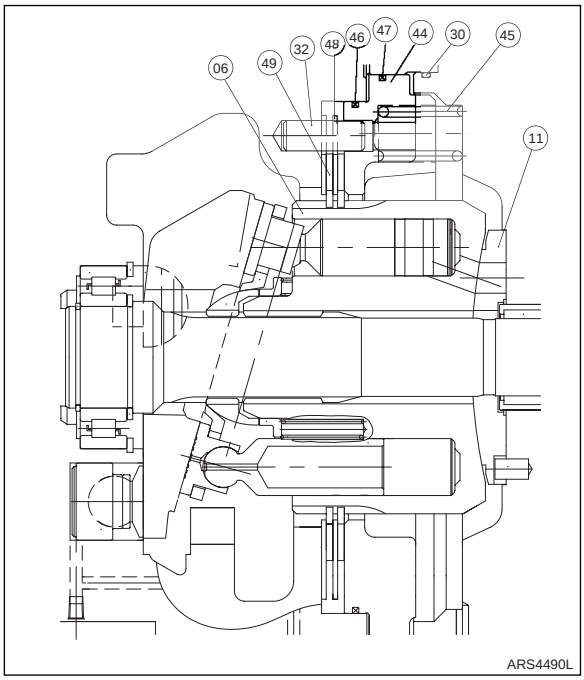


Figure 4

4. Counter balance valve

Av port is connected with hydraulic pump and Bv port is connected with tank. Oil supplied from pump flows to Av, to Cv and to C', presses and opens poppet of check valve, flows to L and to Am, and is supplied to hydraulic motor. Even though oil tries to turn the motor, it is locked with negative brake. Pressure of oil discharged from pump rises, and it is transmitted through passage G to spring chamber M, and pressure of chamber M exceeds spring force keeping spool to neutral, then spool moves to right.

Oil in chamber N flows through orifice I to chamber Dv, drains from port Bv to tank, and spool moves to left, then oil flows to K, to Dv, and to Bv. Passages of Cv, H and P are constructed, so that Pressure of oil discharged from pump Av is transmitted to port P.

Hydraulic oil in chamber N drains through orifice and clearance, so that changing operation of spool becomes slowly.

When discharging pressure of pump lowers, spool moves to left by spring of chamber N side, so that hydraulic oil, as spool moves to the left, flows through orifice I' to chamber Cv and drains to port Av.

If pressure of port Av lowers to pressure of tank, as pressure of chamber M is pressure of tank and so it is the same as pressure of chamber N, spool returns to neutral.

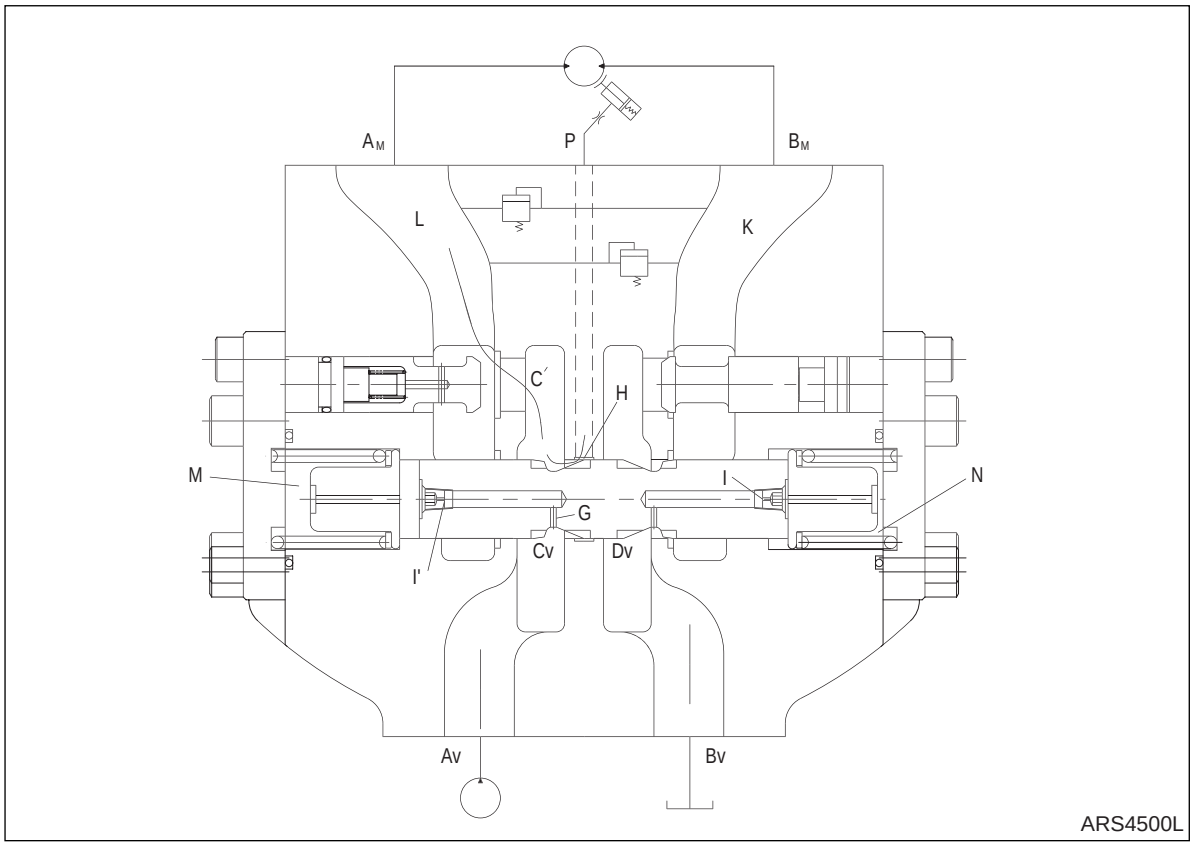


Figure 5

5. Operation of tilting part

Capacity of travelling motor varies with the change of swash plate (12) tilting angle and the change of tilting angle is achieved by tilting valve.

A. External pilot pressure: Pi = 0 (Large tilting)

If pilot pressure does not act to tilting valve, the position of swash plate (12) is in large tilting. Ball-swash (61) supports swash plate (12) at the apposite side of piston-swash (58) from base of shaft center line, and acting point of hydraulic force coming into piston (10) is always in swash piston side against center of ball-swash (61), and so swash plate (12) is close to the bottom surface of housing, and then oil in piston-swash (58) drains through passage like figure.

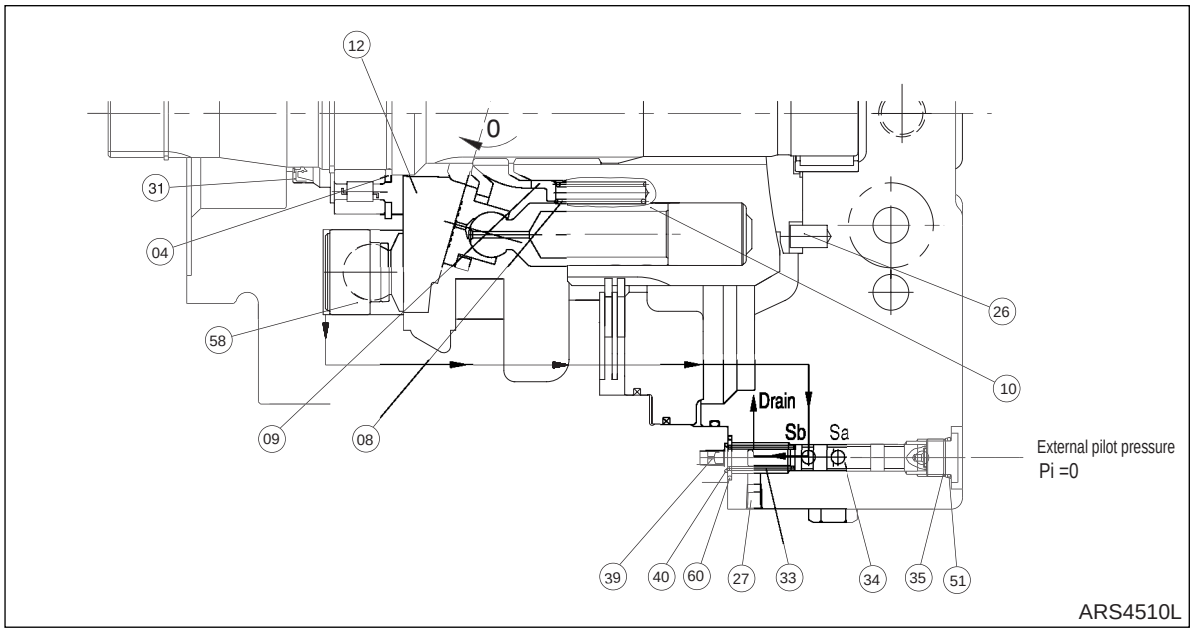


Figure 6

B. External pilot pressure: Pi ≥ 20kgf/cm^2 (Small tilting)

If pilot pressure acts to tilting valve, force acting to spool (34) is stronger than spring (33), and so spool (34) moves to left. High pressure oil flows through port Sa and Sb of tilting valve and passages, and acts to piston-swash (58), and the position of swash plate (12) is in small tilting. Hydraulic force acting to piston-swash (58) is larger than the hydraulic force acting to swash plate (12) by piston (10) at piston-swash (58) side by basing on ballswash (61), and so swash plate (12) moves to the end of shoulder by basing on ballswash (61) and fixes.

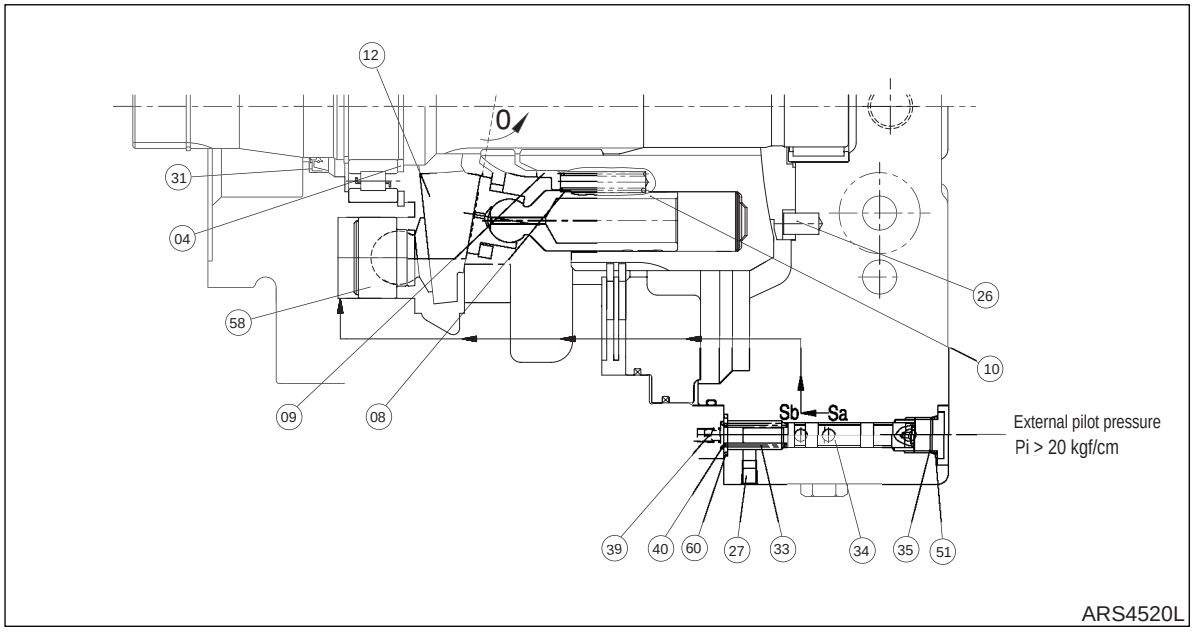


Figure 7

Reduction Gear

1. Operation

Reduction gear consists of planetary differential combined device combining planetary device and differential device. It is to obtain the turning of housing by changing high speed low torque turning movement of hydraulic motor to low speed high torque.

2. Theory of operation

A. If turning sun gear (S) from input shaft, planetary gear (P) rotates and revolves by connecting to fixed ring gear (R). This revolution movement is transmitted to carrier (C) and so torque is transmitted.

- Reduction ratio

$$I1 = 1 = \frac{R \times P2}{S \times P1}$$

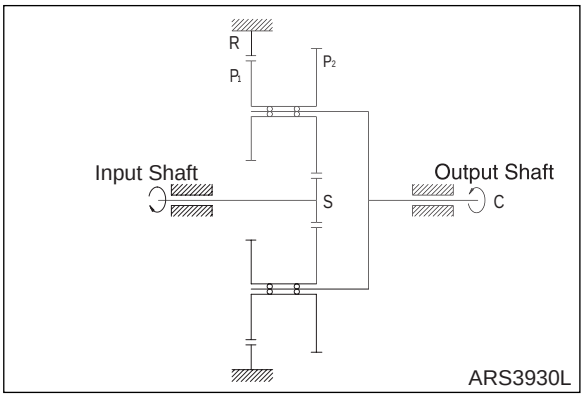


Figure 8 Planetary Device

- Planetary gear(P1, P2) revolves by turning of carrier (C). Torque is transmitted by turning gear R1 because gear P1 and P2 are coaxial and the gear ratios between P1 and R2, P1 and P2 are properly different.
- Reduction ratio

$$I2 = \frac{1}{1 - \frac{R2 \times P2}{R1 \times P1}}$$

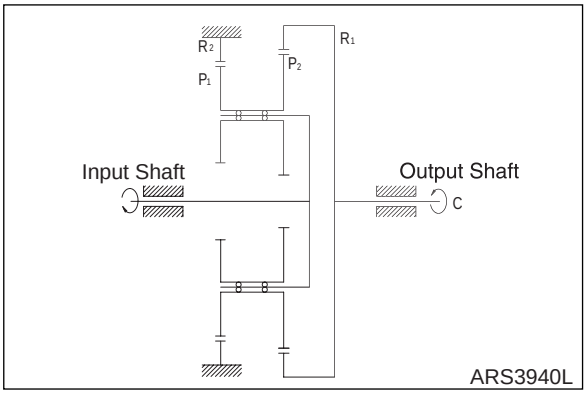


Figure 9 Differential Device

B. If turning sun gear (S) from input shaft, each gear among S, P1 and R1 starts planetary motion and revolution of gear P1 rotates carrier C1. Rotation of carrier C raises differential motion among gears R1, R2, P1, and P2, and rotates ring gear (R1). This ring gear (R1) rotates housing because it is combined with housing.

- Reduction ratio:

$$I = I1 \times I2 = \frac{1 + \frac{R2 \times P2}{S \times P1}}{-\frac{R2 \times P2}{R1 \times P1}}$$

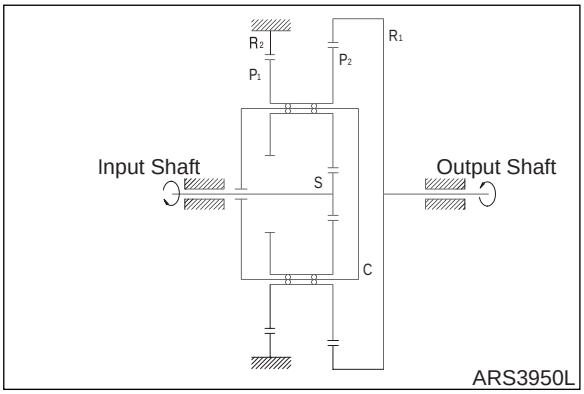


Figure 10 Differential Combined Device

NOTE: *Rotating direction: Input shaft is opposite direction to output shaft.*

PARTS LIST

Hydraulic Motor

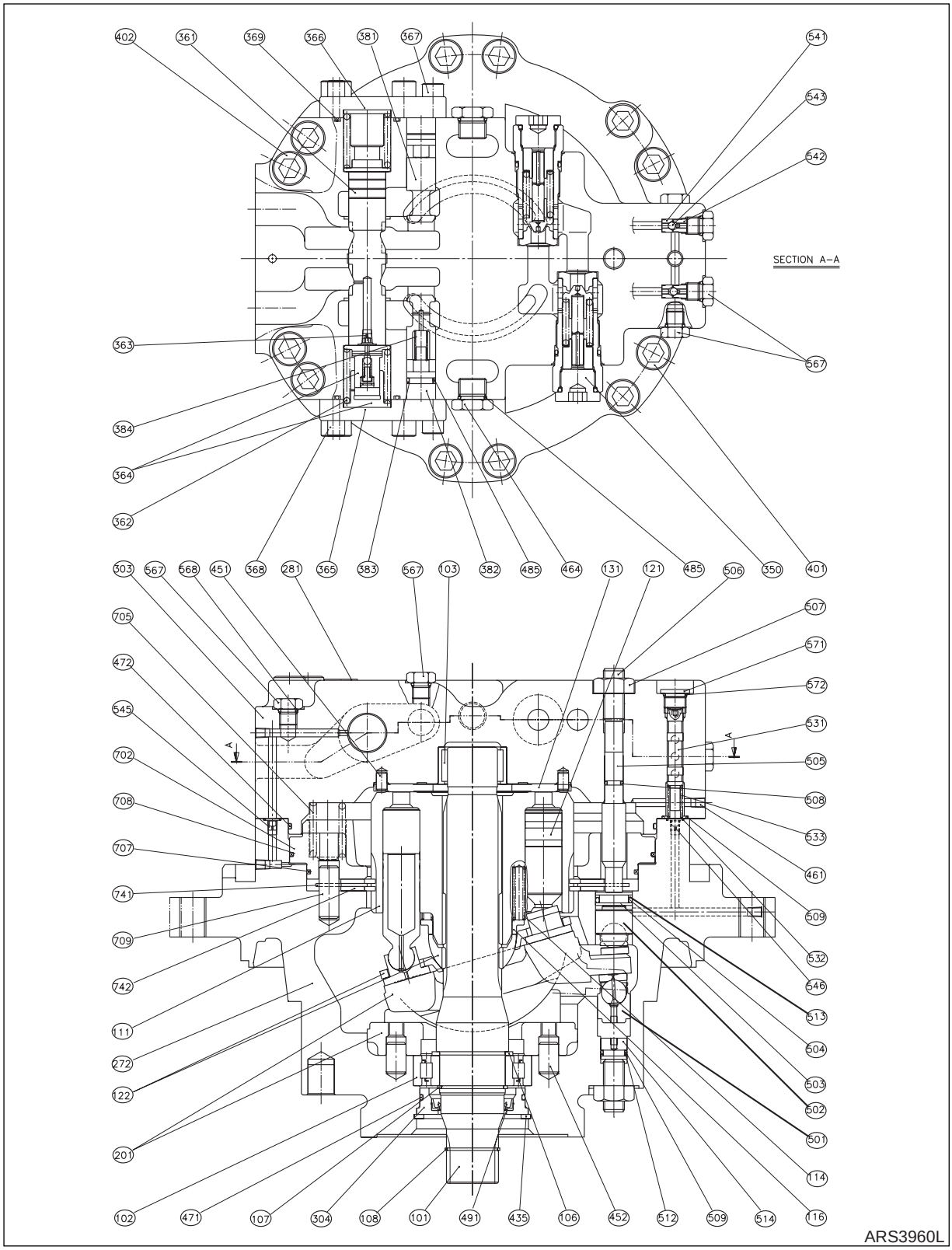


Figure 11

Reference Number	Description
101	Shaft
102	Roller Bearing
103	Needle Bearing
106	Spacer - Bearing
107	Stop Ring
108	Stop Ring
111	Cylinder Block
114	Spring Cylinder
116	Spacer
121	Piston and Shoe Assembly
122	Bush and Push Plate Assembly
131	Valve Plate
201	Swash Assembly
272	Shaft Casing
281	Name Plate
303	Valve Casing
304	Seal Cover
350	Relief Valve Assembly
361	Spool - C.B. Valve
362	Spring - C.B. Valve
363	Orifice Screw
364	Damping Check Assembly
365	Cap - C.B. Valve (Left)
367	Hex. Socket Bolt
368	Hex. Socket Bolt
369	O-ring
381	Plunger- C.B. Valve
382	Stopper - Check
383	Back Up Ring
384	Spring - Check
401	Hex. Socket Bolt
402	Hex. Socket Bolt
435	Lock Ring
451	Valve Plate Pin
452	Support Pin
461	Plug

Reference Number	Description
464	HP Plug
471	O-ring
472	O-ring
485	O-ring
491	Oil Seal
501	Swash Piston
502	Swash Piston
503	Stopper (Left)
504	O-ring
505	Swash Rod
506	Lock Screw
507	Hex. Nut
508	O-ring
509	O-ring
512	Back Up Ring
513	Back Up Ring
514	Stopper (S)
531	Swash Spool
533	Swash Spring
534	O-ring
541	Seat
542	Stopper
543	Ball
545	Orifice Screw
546	Orifice Screw
567	HP Plug
568	O-ring
571	Plug
572	O-ring
702	Brake Piston
705	Brake Spring
707	Piston Ring 252
708	Piston Ring 278
709	Brake Pin
741	Separator Plate
742	Friction Plate

Reduction Gear

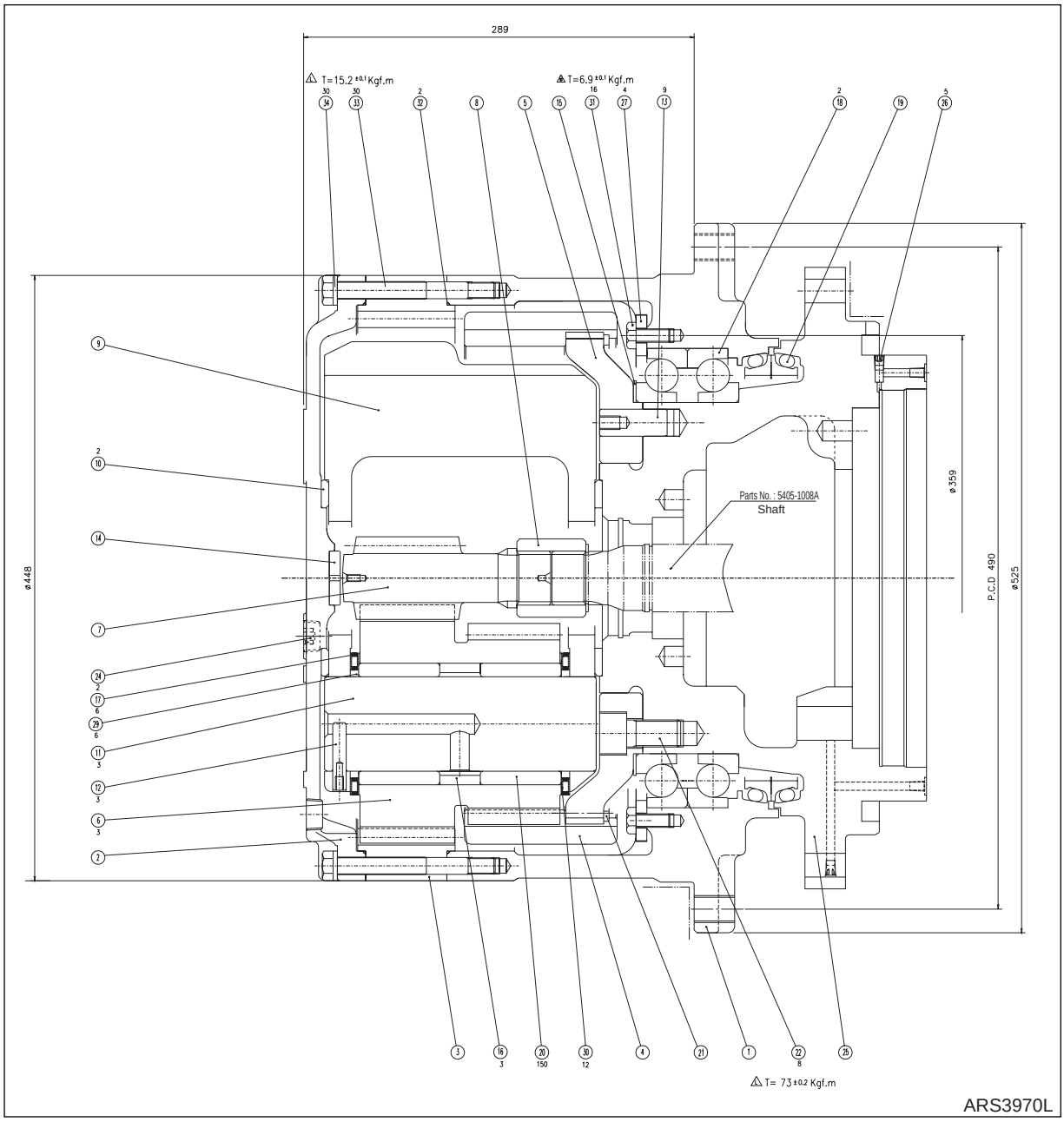


Figure 12

Reference Number	Description
1	Housing
2	Cover
3	Ring Gear No. 1
4	Ring Gear No. 2
5	Coupling Gear
6	Cluster Gear
7	Sun Gear
8	Coupling
9	Carrier
10	Thrust Bearing
11	Shaft
12	Pin
13	Pin
14	Thrust Plate
15	Shim
16	Spacer

Reference Number	Description
17	Thrust Needle Bearing
18	Angular Bearing
19	Floating Seal
20	Needle Roller
21	Snap Ring
22	Hex. Socket Head Bolt
23	Hex. Bolt
24	Plug
25	Shaft Casing
26	Plug
27	Stopper
28	Spacer
29	Collar
30	Thrust Washer
31	Hex. Head Bolt
32	O-ring

SPECIFICATIONS

Travel Motor	Specification
Motor displacement	174/105 cc/rev
Reduction ratio	66.67
Total displacement	11600/7033 cc/rev
Working pressure	330 kg/cm^2
Working flow	248 l/min
Output torque	6092/3694 kg•m
Speed	21.3/35.2 rpm
Gear oil	4.3 l/min
Weight	415 kg

Tightening Torque Chart

Section	No.	Name	Standard	B	Tightening torque (kg•cm)
Hydraulic motor part	14	Relief valve	M33	36 mm	1, 700 - 1, 900
	27	Plug	NPTF 1/16	4 mm	70 - 110
	28	HP Plug	PF 1/2	27 mm	1, 100
	35	Plug	PF 3/8	8 mm	750
	41	HP Plug	PF 1/4	19 mm	370
	39, 43	Orifice screw	NPTF 1/16	4 mm	70
	53	Hex socket bolt	M12x30L	10 mm	1, 000
	54	Hex socket bolt	M10x30L	8 mm	670
	55	Hex socket bolt	M16x50L	14 mm	2, 400
	56	Hex socket bolt	M16x120L	14 mm	2, 400
Reduction gear part	22	Hex socket bolt	M20x40L	17 mm	7, 300 ± 20
	24	Plug	PT1/2	10 mm	580
	26	Plug	NPTF 1/16	4 mm	70 - 110
	31	Hex head bolt	M10x25L	14 mm	690 ± 10
	33	Hex head bolt: Reamer	M12x120L	17 mm	1, 520 ± 10

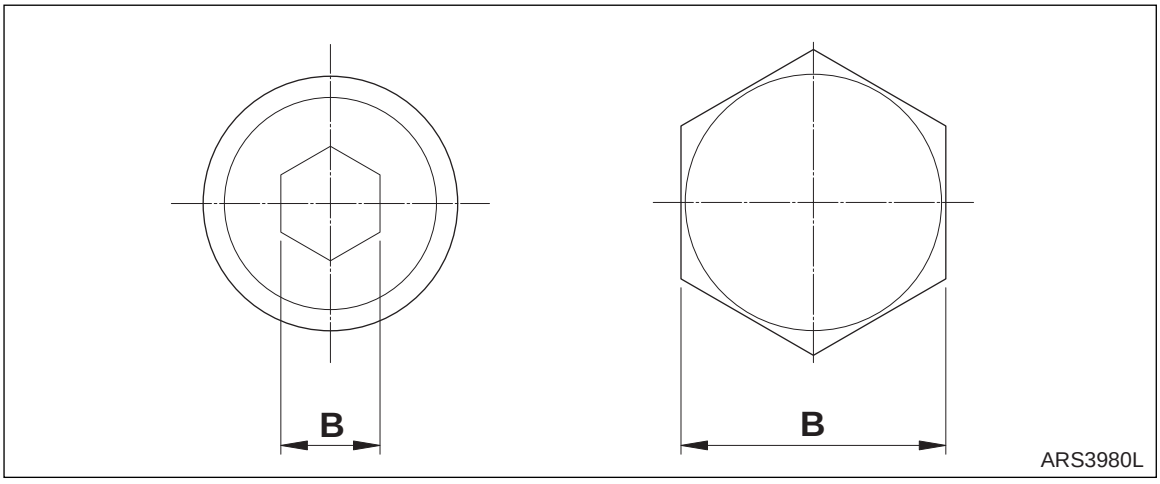


Figure 13

SPECIAL TOOLS

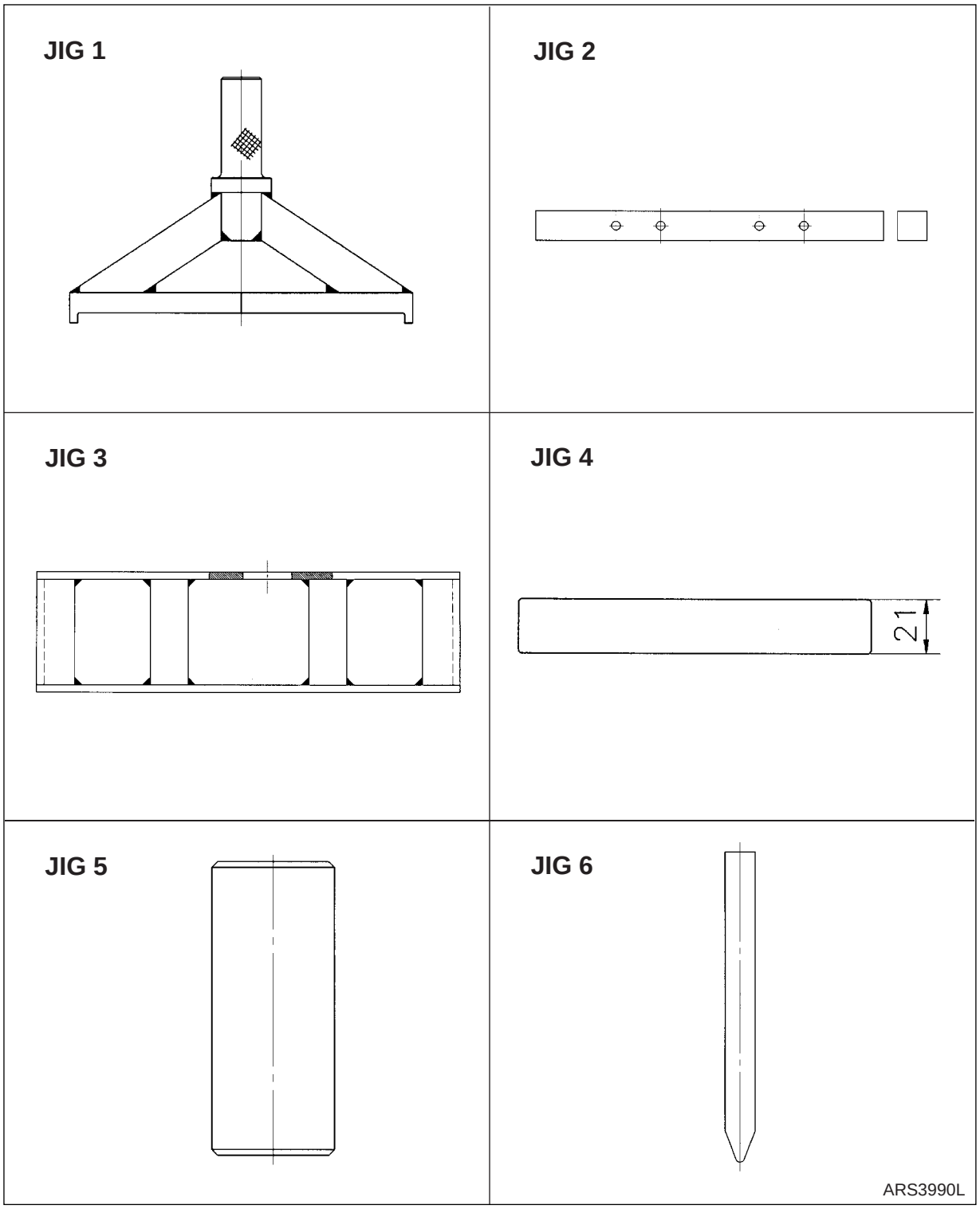


Figure 14

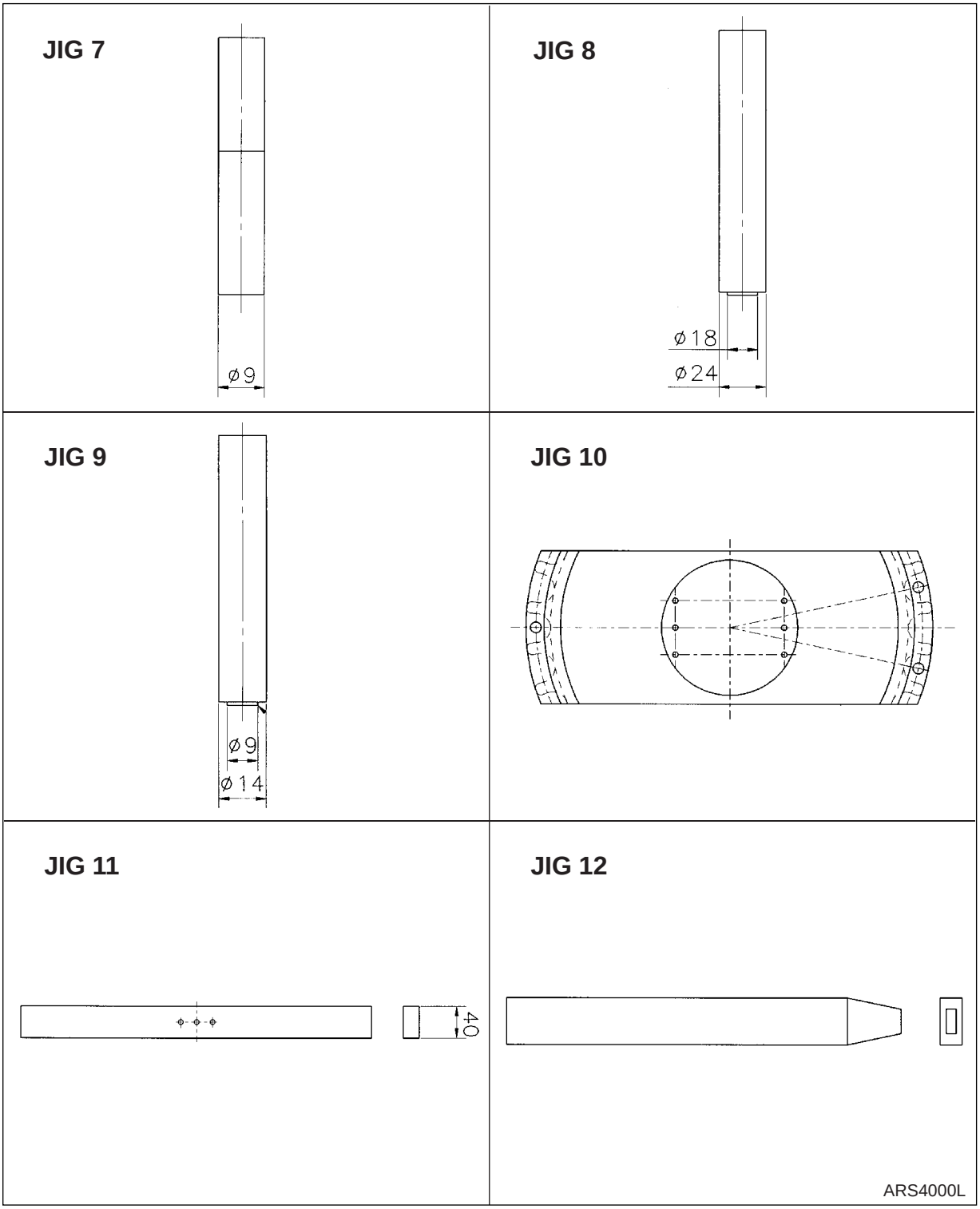
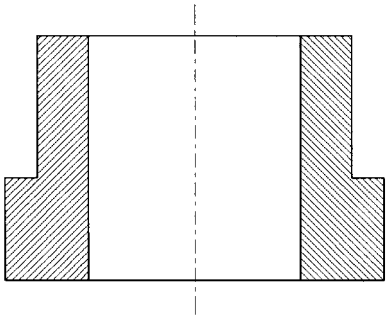

JIG 7
ø9
JIG 8
ø18
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JIG 9
ø9
ø14
JIG 10
JIG 11
40
JIG 12
ARS4000L

Figure 15

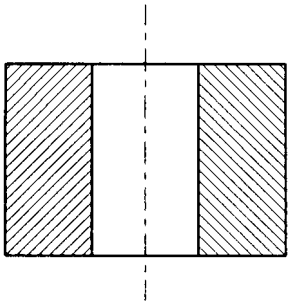
JIG 13



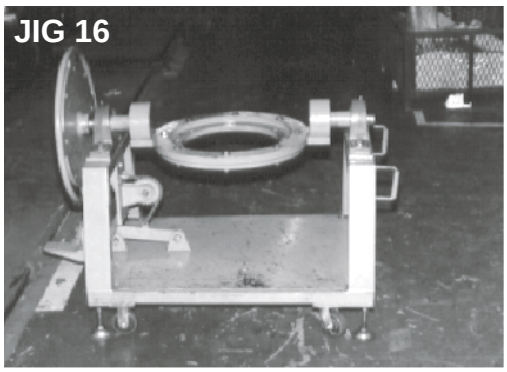
JIG 14



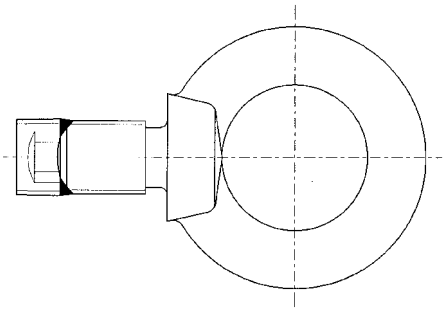
JIG 15



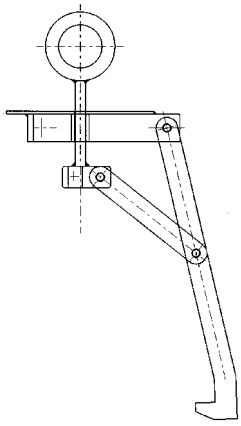
JIG 16



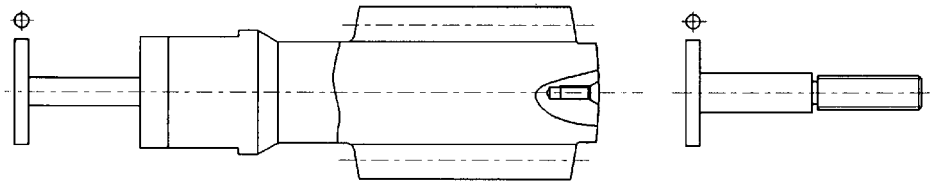
JIG 17



JIG 18



JIG 19 & 20



ARS4010L

Figure 16

Tools	Applicable Parts
JIG 1	Angular ball bearing (18)
JIG 2	Coupling gear (5), Housing (1), Shaft casing (25)
JIG 3	Carrier (9), Shaft (11)
JIG 4	Thrust washer (17)
JIG 5	Cluster gear (6)
JIG 6	Pin (12)
JIG 7	
JIG 8	Pin (13)
JIG 9	
JIG 10	

Tools	Applicable Parts
JIG 11	Coupling gear (5), Shaft casing (25), Thrust bearing (10)
JIG 12	Cover (2), Ring gear No.1 (3)
JIG 13	Housing (1)
JIG 14	Floating seal (19)
JIG 15	Bolt (33), Travel device
JIG 16	Shaft casing (25)
JIG 17	Cover (2)
JIG 18	Coupling (8), Ring gear No.2 (4), Carrier (9)
JIG 19	Cluster gear (6)
JIG 20	Carrier (9)

Reduction Gear Part

Section	Name	Standard	Remark
Tool	Hex L-wrench	Nominal dimension; 4mm, 10mm	Plug (24) and (26)
	Hex wrench	Nominal dimension; 17mm	
	Socket wrench	Nominal dimension; 14mm, 17mm	
	Torque wrench	Nominal dimension; 2, 000mm, 7, 500mm	
	Impact gun		
	Plastic hammer		
	Copper hammer		
	Eye bolt	M20 M10 x 1.5	2ea 3ea
	Depth micrometer	Measurement range: 0 - 50 mm Minimum scale: 0.01 mm	
	Punch, vise, pliers		
	Driver		

Sub material	Loctite	Loctite 262 Loctite depend Loctite 567	
	Grease		Disulfuric molybdenum group
	Cleaning oil		
	Gear oil	Shell Spirax	SAE #90 - #140
	Seal tape		
Etc.	Air pressure	6 kg/cm^2	
	Oil bath	Heating temperature: over 120°C	
	Vacuum cleaner		

Hydraulic Motor Part

Tool name	B Dimension	Applying part name
Hex L- wrench	4 mm	Plug (27), Orifice, Screw (39, 43)
	8 mm	Hex socket bolt (54), Plug (35)
	10 mm	Hex socket bolt (53)
	14 mm	Hex socket bolt (55, 56)
Socket wrench spanner	19 mm	HP Plug (41)
	27 mm	HP Plug (28)
	36 mm	Relief valve (14)
Snap ring pliers (For hole or shaft)		Stop ring (05, 50)
Plastic hammer (Also wood hammer is possible)		
Steel bar (7x7x200)		Needle bearing (03), pin (26, 32)
Monkey spanner		
Torque wrench		Nominal dimension: 500 mm, 3000 mm
Driver		
Jig for assembling of oil seal		Oil seal (31)
Induction heating device for bearing		Roller bearing (02)
Bearing puller		Roller bearing (02)
Jig for disassembling of motor		
Seal tape		

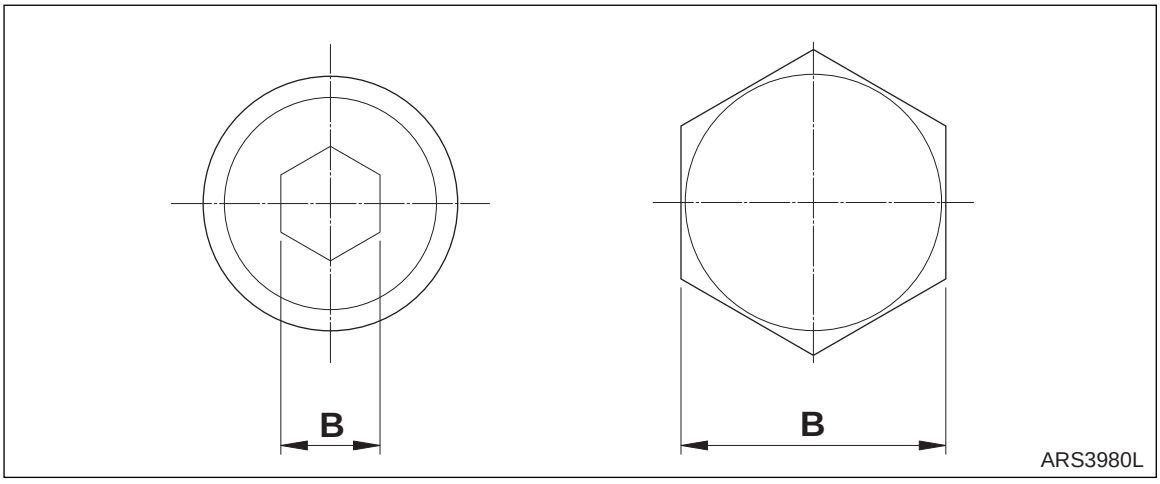


Figure 17

TROUBLESHOOTING, TESTING AND ADJUSTMENT

HYDRAULIC MOTOR

General caution matters

1. Before working, judge the abnormal phenomena well and be careful whether there are other causes or not except motor.
2. As the causes of wear have lots of cases with mixing of foreign materials, when disassembling, be careful not to mix foreign materials.
3. As internal parts machine accurately, be careful in handling and not to damage.

Inspection method of abnormality of hydraulic motor

1. Loosen drain plug and check hydraulic oil in case.
2. Check of existence of abnormal noise. Check whether abnormal noises occur in motor itself.
3. Measurement of each part pressure

Before disassembling, measure the circuit pressures to hydraulic motor and check existence of abnormality.

Cause and remedy of trouble

Problem	Possible Cause	Remedy
Travelling device fails to operate.		
Motor pressure does not increase.	Oil is bypassed at relief valve(14).	Replace or repair relief valve.
	Check spring damaged	Replace check spring.
	Counter balance valve spring damaged	Replace counter balance valve spring.
	Passage in valve casing cracked	Replace valve casing.
	Contact surface of check worn abnormally	Replace check.
	Clearance between valve casing and counter balance spool is big.	Replace valve casing or counter balance spool.
	Coupling of reduction gear damaged	Replace coupling after disassembling reduction gear.
Pressure increases but hydraulic motor does not rotate.	Orifice screw(43) plugged	Clean or replace orifice screw.
	Piston ring (46) and (47) damaged	Replace piston ring.
	Friction and separation plate stuck	Replace friction and separation plate.
	Sliding surfaces stuck	Replace sliding surfaces.
	Orifice screw in counter balance spool plugged	Clean or replace orifice screw.
	Gear of reduction gear damaged	Replace gear after disassembling reduction gear.

Problem	Possible Cause	Remedy
Rated swing speed is not reached.		
Swing speed low	Quantity of inflow oil low	Check hydraulic circuit to motor.
	Oil temperature too high	Lower oil temperature.
	Excessively large abnormal oil leaks	Replace or repair abnormal parts.
	Each sliding surface worn or damaged Tilting angle (from large to small) is not switched. - Orifice of small tilting side plugged - Abnormal leak of small tilting chamber (shaft casing, swash piston, too large clearance of stopper 'L')	Replace or repair abnormal parts. - Clean or replace orifice. - Replace abnormal parts.
Rated operating power is not reached.		
Pressure low	Setting pressure of relief valve low	Adjust pressure.
Brake is released but operating power is low.	Each sliding surface worn or damaged abnormally	Replace or repair sliding parts
Brake operation is difficult.		
Brake torque low	Friction and separation plate worn	Replace worn parts.
	Brake spring damaged	Replace brake spring.
Brake does not operate.	Parts in brake stuck	Replace parts.
Tilting angle does not switched.		
Tilting angle does not switched.	Orifice of tilting passage of shaft casing plugged	Clean or replace orifice.
	Tilting angle adjusting spool(34) and case stuck	Replace or repair abnormal parts.
	Abnormal oil leaks from excessive clearance between shaft casing and swash piston(58) stopper	
	Swash piston outer diameter or spherical part stuck	
	High pressure selection valve in valve casing does not operate.	
Oil leaks		
Oil seal(34) leaks	Oil seal or sliding parts of shaft damaged	Remove foreign materials after replacing damaged parts.
	Internal pressure of case high	Check drain line of equipment.
Leaks from assembling surface	O-ring damaged	Replace O-ring.
	Bolt or plug loose	Tighten rated torque.
Major sliding surfaces are stuck.		

Problem	Possible Cause	Remedy
Piston and shoe	Excessive load swing of motor	Check relief valve operation.
Shoe and swash plate	Temperature increasing	Check circuit.
Piston and cylinder	Roughness of sliding surfaces poor	Replace or repair abnormal parts.
Cylinder and valve plate	Hydraulic oil and lubricating poor	Replace hydraulic oil.
Pressure and spherical bush		

TRAVEL REDUCTION GEAR

General caution matters

1. Check whether damages occur in transportation.
2. Check whether bolts are loose or rated oil quantities fill.
3. When working, close piping port.
4. Before fitting pipe, fill oil in case of motor part adequately.

Problem	Possible Cause	Remedy
Temperature of reduction gear housing is high.(Over 60°C of ambient temperature)		
Gear oil is insufficient.	Lubricating poor due to insufficient gear oil	Fill gear oil in rated quantity.
Bearing is damaged.	Heat due to bearing damaged	Replace bearing.
Gear is damaged	Heat due to pitting or damaging of gear tooth	Replace gear.
Leakage phenomena occur.		
Assembling surfaces leak	Bolt loose	Tighten rated torque.
	Liquid gasket is not applied.	Tighten rated torque after applying liquid gasket.
Leaks from plug	Plug loose	Tighten rated torque.
	Seal tape is not wound	Apply seal tape.
Leaks from floating seal	Sliding surface damaged or stuck	Replace
	O-ring damaged	Replace
surface of housing	Casting surface cracked	Replace
Abnormal noises occur.; Disassemble reduction gear and replace abnormal parts after inspecting parts.		

DISASSEMBLY

GENERAL CAUTION MATTERS

1. Select clean disassembling place.
   Put rubber plate on the work bench and prevent parts from damaging.
2. Clean dirt and foreign materials from reduction gear and motor part.
3. Be careful not to damage the contact surface of O-ring, oil seal, and seal class and the contact or sliding surface of gear, pin, and bearing class.
4. Numbers of () of part names indicate part numbers of reduction gear and motor drawing.
5. Piping side of motor indicates rear side and output side indicates front side.
6. Before applying Loctite, surely remove oil from two surfaces completely by using Loctite 587 and uniting them.
7. When tightening bolt, apply Loctite 262 to bolt tap part and tighten rated torque by using torque wrench. (Apply when assembling reduction gear only)
8. When using hammer, use plastic hammer surely.
9. After cleaning each part, blow dry with moisture free air. But do not clean friction plate by cleaning oil.

REDUCTION GEAR PART

1. Put hydraulic motor side of traveling device on assembling jig (15, Figure 14), fasten 4 bolts (M20x50L), and fix hydraulic motor to assembling jig.
2. Hex bolt of cover (2); Loosen reamer bolt (33) and plug (24).

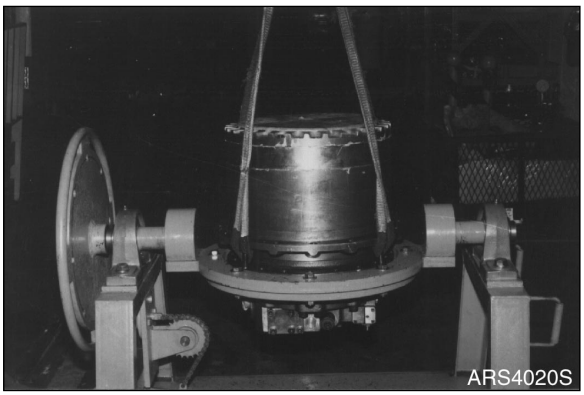


Figure 18

3. Remove cover (2) from ring gear No. 1 (3) by using jig (12).



Figure 19

4. Remove carrier subassembly from housing (1) by using (jig8) or eye bolt (M10x1.5) and rope and put and align hole of jig (3) and shaft (11).

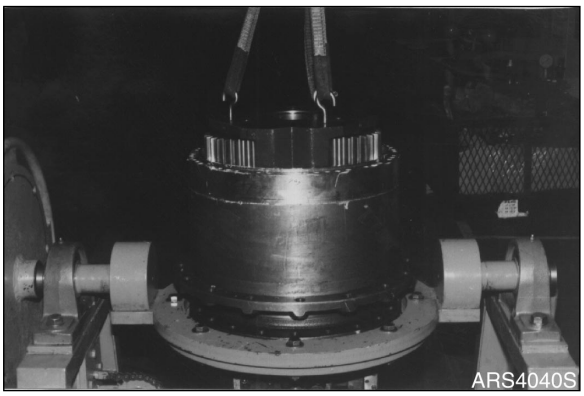


Figure 20

5. Remove calking mark of carrier (9) and pull pin by using pulling tap (M6x1) of pin (12).
6. Tap and drop shaft under jig (3) by using copper hammer.

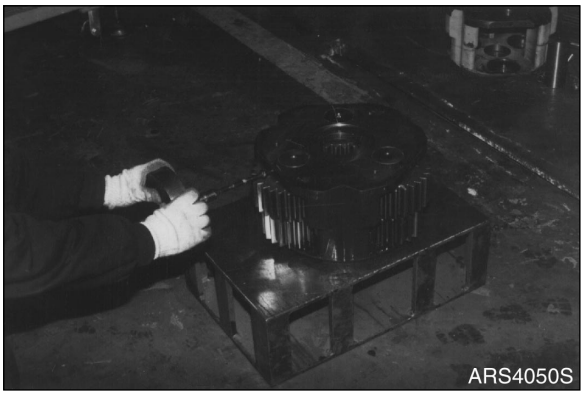


Figure 21

7. Pull cluster gear (6) and remove thrust washer (17), needle roller (20) and spacer (16).



Figure 22

8. Remove gear oil in housing (1) by using vacuum cleaner.

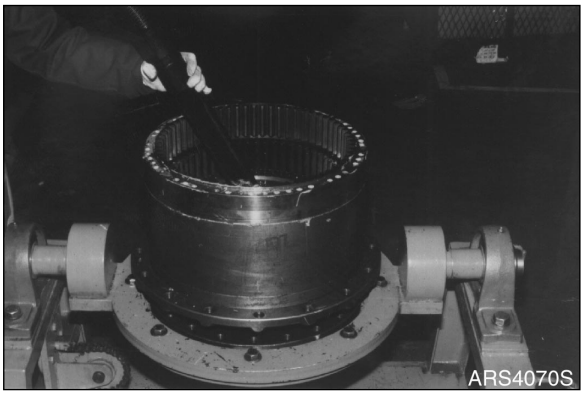


Figure 23

9. Remove ring gear No. 1 (3) from housing (1) by using jig (12).
10. Loosen Hex hole head bolt (22) by using wrench (size B17).
11. Remove coupling gear subassembly from shaft casing by using bolts (3ea, M10x1.5x70) and coupling gear pulling tap.

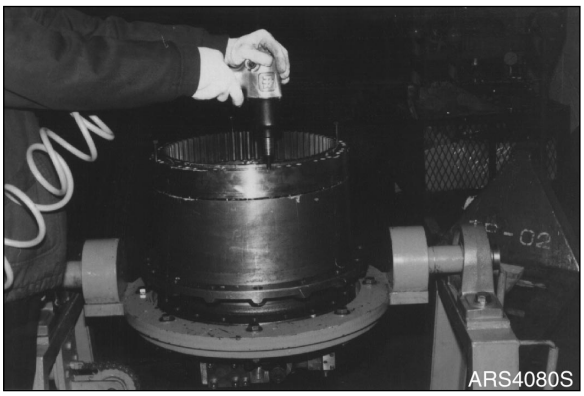


Figure 24

12. Put it with coupling gear subassembly facing ground by using eye bolts (2ea, M10).



Figure 25

13. Remove snap ring (21) by using driver.

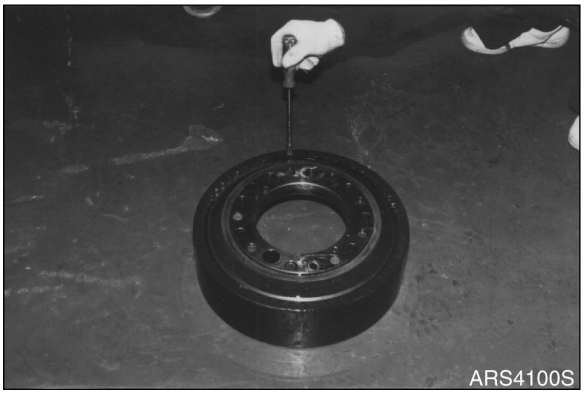


Figure 26

14. Remove coupling gear (5) from ring gear No. 2 (4).



Figure 27

15. Remove housing (1) from shaft casing by using eye bolts (3ea, M10x1.5), rope and crane and put it with the mating surface to ring gear No. 1 (3) facing ground.



Figure 28

16. Pull out floating seal (19) from housing by using drive and separate O-ring and seal.
17. Pull out floating seal (19) from shaft casing by using drive and separate O-ring and seal.



Figure 29

HYDRAULIC MOTOR PART

Disassembly of Motor

1. Remove stop ring (50) from shaft by using pliers.



Figure 30

2. Remove relief valve (14).

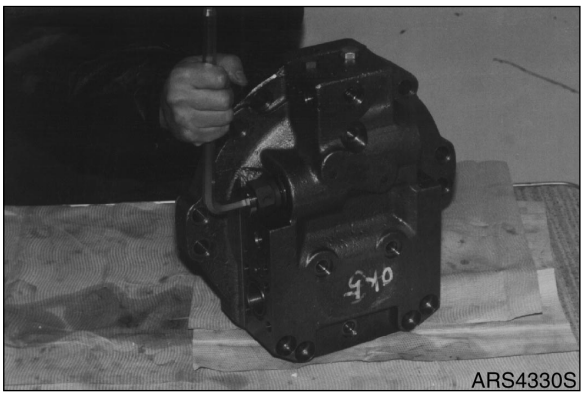


Figure 31

3. Remove hex socket bolt (56) from shaft casing and remove valve plate (11) from valve casing.
4. Remove O-ring and remove orifice screw (39) and (43).

   NOTE: *(39, 1ea ∅1.5)(43, 1ea ∅1.5)*

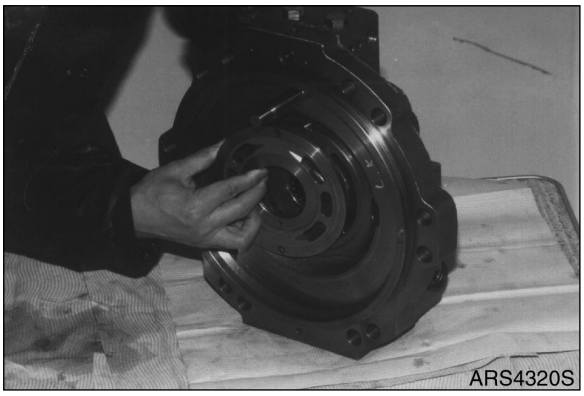


Figure 32

5. Remove brake spring (45).

   NOTE: *(Spring, 10ea)(Hole, 11ea)*

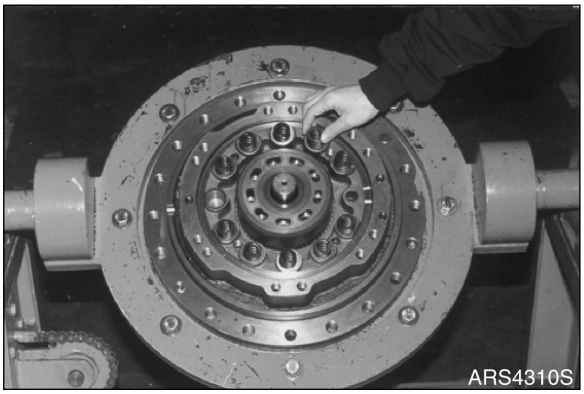


Figure 33

6. Remove brake piston (44) from shaft casing.
7. Remove piston ring 47 (∅278) and 46 (∅252) from brake piston (44).
8. Turn disassembling and reassembling jig 90' and set it with shaft direction from horizontal to vertical.

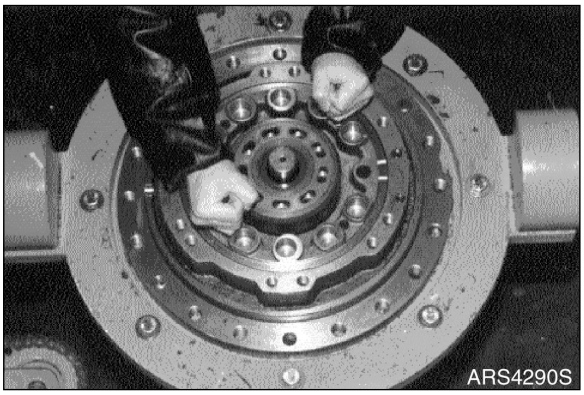


Figure 34

9. Remove cylinder subassembly.
10. Turn disassembling and reassembling jig 90° and set it with shaft direction from vertical to horizontal.

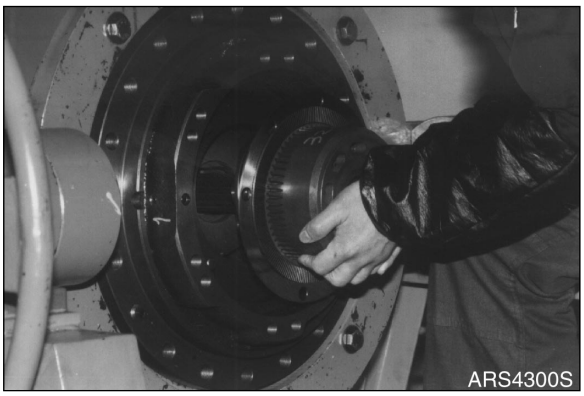


Figure 35

11. Remove swash plate (12).

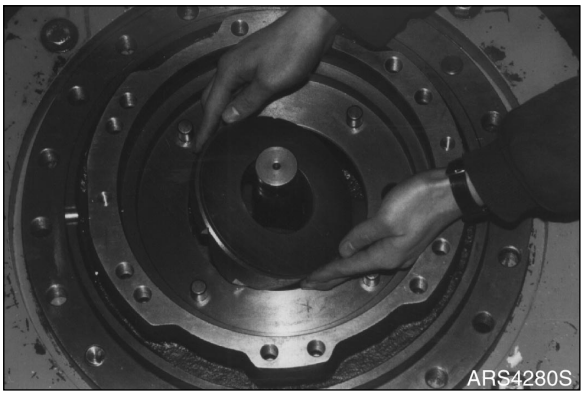


Figure 36

12. Remove tilting piston (58).
13. Remove two swash balls (61).
14. Remove snap ring (62) by using snap ring pliers.

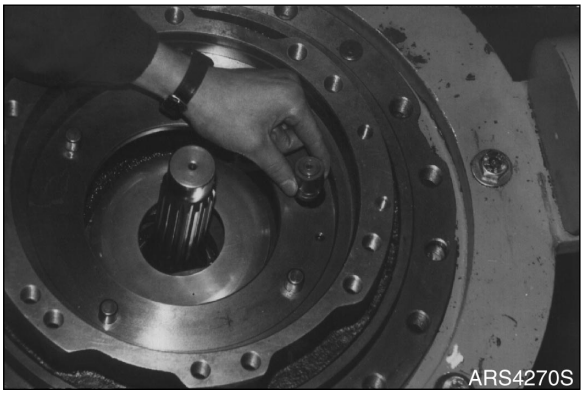


Figure 37

15. Remove drive shaft subassembly.

    NOTE: *Lightly tap and remove cylindrical roller and outer race of bearing (02) by using copper bar and plastic hammer.*

16. Remove oil seal (31).
17. Remove fixing pin (32) of separate plate.
18. Remove four plugs (27) from shaft casing.

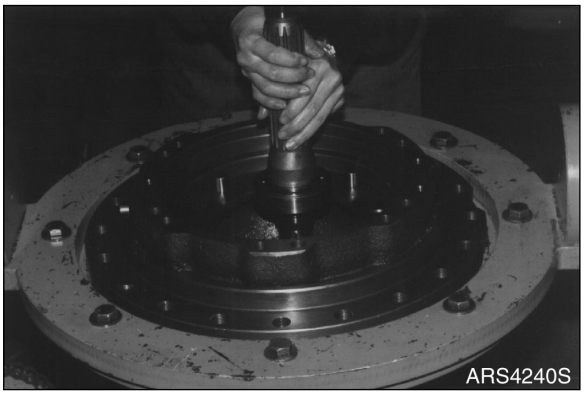


Figure 38

Disassembly of Cylinder Subassembly

1. Remove pressure plate (07) and piston shoe (10) from cylinder.

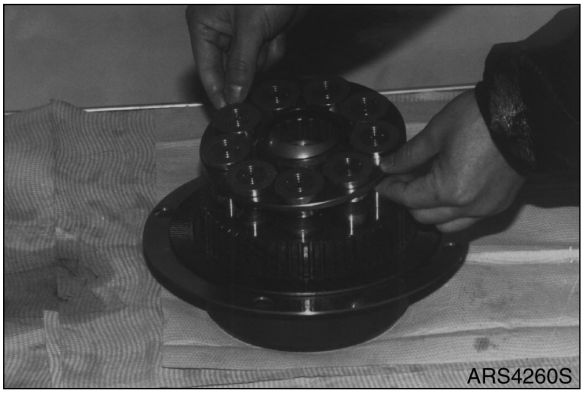


Figure 39

2. Remove friction plate (49) and separate plate (48) from cylinder.



Figure 40

3. Remove cylinder spring (08), spacer (09) and spherical bush (07) from cylinder block (06).

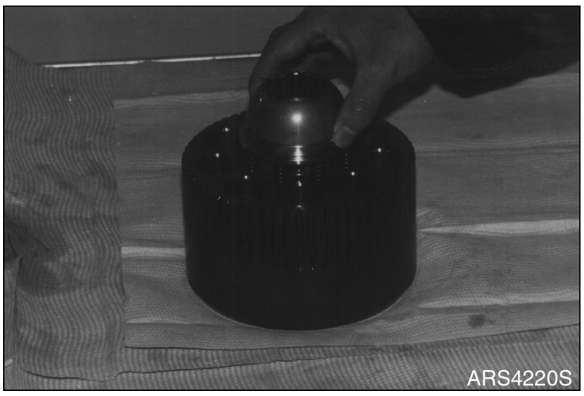


Figure 41

Disassembly of Valve Casing

1. Remove drain HP plug (28)with O-ring.
2. Remove O-ring (30) from valve casing.
3. Remove tilting spool (34), tilting spring (33) and O-ring (60) and remove plug with O-ring (51).



Figure 42

4. Remove hex socket bolt (53, 54) with which cap R (24) and cap L (25) are tightened.

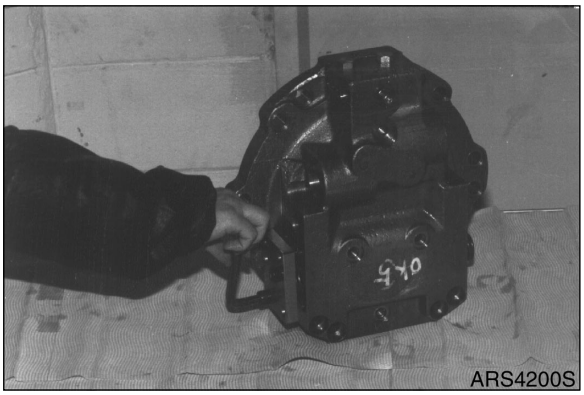


Figure 43

5. Remove spring (17), O-ring (29) and backup ring (57) from stopper (23) and remove plunger (18) from valve casing.

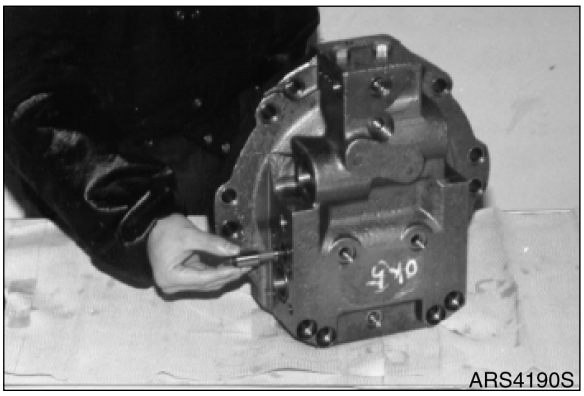


Figure 44

6. Remove CB valve spool (15), stopper (20), shim (19) and spring (22).
7. Remove left and right orifice screws (16) of CB valve spool (15).
8. Remove HP plug (41) with O-ring (42).

   NOTE: *5 places*

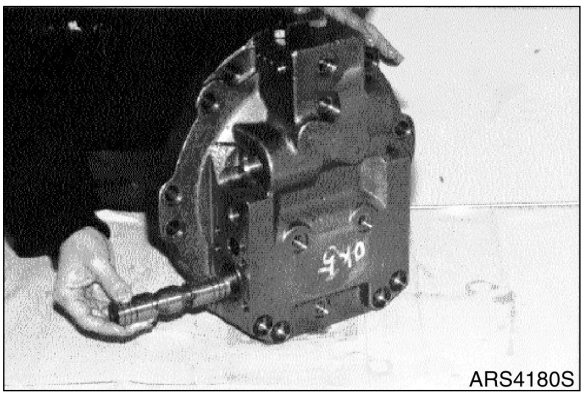


Figure 45

9. Remove seat (36), ball (37), stopper (38) and HP plug (41) with O-ring (42).
10. Remove needle bearing (03).

    NOTE: *Use plastic hammer and copper bar.*
11. Remove pin (26).
12. Remove plug (27) from valve casing (13).

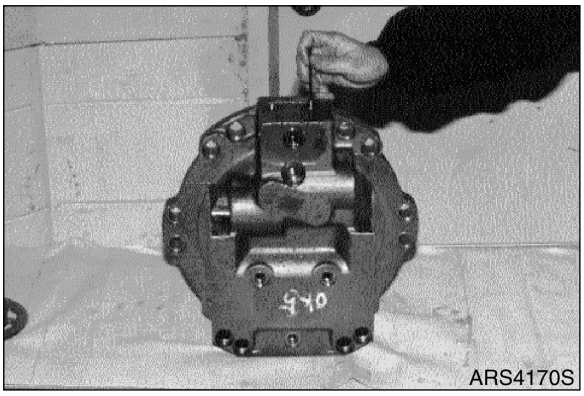


Figure 46

Disassembling Of Drive Shaft Subassembly

1. Remove stopper ring (05) by using pliers.
2. Remove cylindrical roller bearing (02) by using bearing puller and remove bearing spacer from drive shaft (01).

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

MAINTENANCE STANDARD

Change parts with standard of the following table. If parts have damages of external appearance, change without the following table.

Changing Standard of Hydraulic Motor Part

Parts name and inspection item		Standard dimension	Recommended value of replacement	Remedy
Clearance between piston and cylinder bore		0.035	0.06	Replace
Vertical direction vibration of piston and shoe		0.05	0.3	
Shoe thickness		5.5	5.3	
Height difference between spherical bush and pressure plate		13.5	13	Replace with set
Free length of cylinder spring		47.9	47.3	Replace
Over pin diameter (4.5) of drive shaft	Drive spline	43.91	43.31	Even if one each of recommended value of replacement is not reached, replace.
	Cylinder spline	49.06	48.46	
Over pin diameter (4.5) of spline inside of cylinder and spherical bush		35.25	35.75	Replace
Thickness of separate plate		3.3	3	
Thickness of friction plate		2.3	2.1	
Free length of brake spring		46.6	45.97	
Base tangent length of cylinder outside (7 each)		49.97	49.37	
Over pin diameter (4.5) of inside gear of friction plate		145.77	146.37	
Roughness of sliding surface	Swash plate/ shoe	0.8S	3.2S	Lap each
	Cylinder	1.6S	3.2S	Lap
	valve plate	0.8S	3.2S	
	Swash plate/ swash plate support	6.3sS	12.5S	Joint lapping
	Pressure plate/ spherical bush	1.6S	6.3S	
Roller bearing/needle bearing				If there are flaking on sliding surface, replace.
O-ring/Oil seal				When disassembling, replace as a rule.
Kinds of bolt				If there are crushing parts, replace.
Piston ring				If there are signs of sticking or deforming, replace.

1. Clearance between piston and cylinder bore: D-d

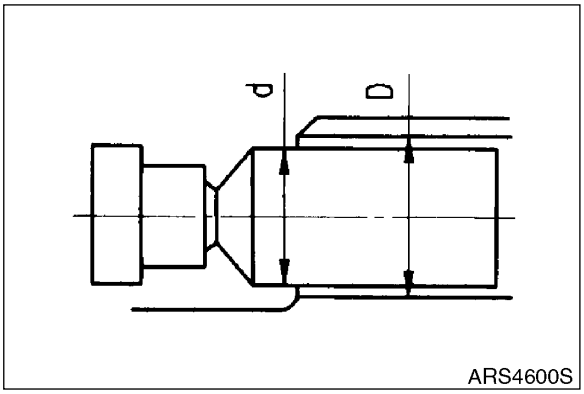


Figure 47

2. Thickness of shoe: t

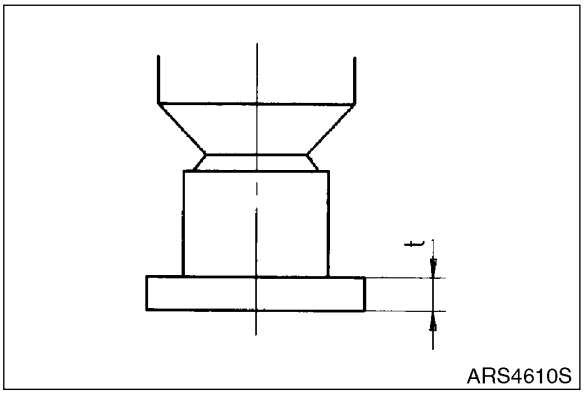


Figure 48

3. Vibration of vertical direction of piston and shoe : δ

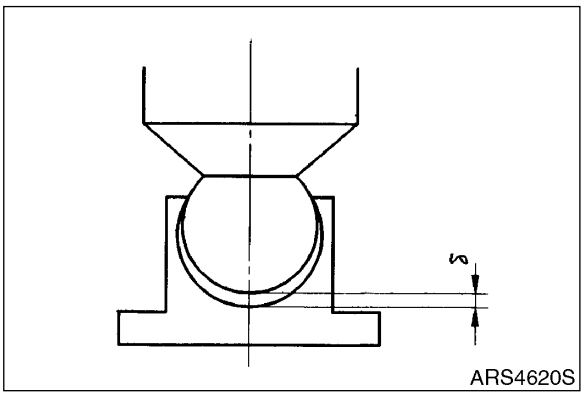


Figure 49

4. Height difference of spherical bush and pressure plate : H-h

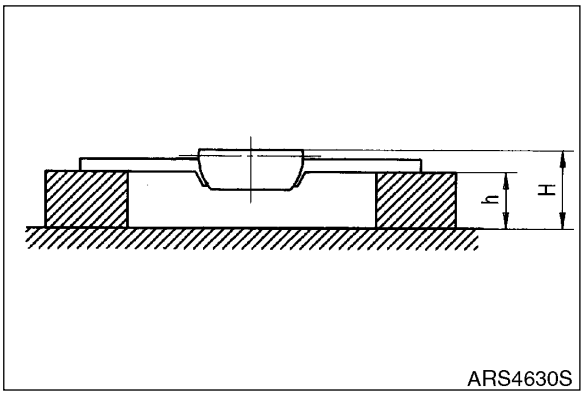


Figure 50

Parts Inspection and Inspection Standard of Reduction Gear

1. This reduction gear has few parts and designing life of each part is about the same. And so a state of single part can be supplied, but when changing there are many parts to change simultaneously for structure and function.

2. Inspection and inspection standard: It is a rule to change damaged parts unconditionally.

Inspection item		Standard	Standard of replacement	Remark
Backlash	Sun gear + Cluster gear	0.160 - 0.320	1	
	Cluster gear + Ring gear No.1	0.200 - 0.395	1	
	Cluster gear + Ring gear No.2	0.200 - 0.395	1	
	Ring gear No.2 + Coupling gear	0.200 - 0.608	1.3	
	Coupling + Sun gear spline	0.1-0.2	0.5	
OPD	Ring gear No.1	386.106 - 368.514		
	Ring gear No.2	337.482 - 337.678		
Base tangent length	Cluster gear No.1	63.259 - 63.344		4 Teeth
	Cluster gear No.2	65.845 - 65.930		4 Teeth
	Sun	27.791 - 27.858		4 Teeth
Each kind of gear	Pitting		Pitting size of one each is over 1 mm. Area rate:10%	
	Crack			
Angular ball bearing		Flaking, pressing marks, and other damages		
Carrier assembly	Clearance between cluster gear and thrust washer	0.3 - 0.7	1.2	
	Smoothing turn and noise of cluster gear			
Floating seal	Seal		Damage of sliding surface	
	O-ring		Damage	
Thrust bearing		5	Below 4.7	
		5.5	Below 5.2	
		6	Below 5.7	
Gear oil		Shell spirax 90EP or SAE#90 API Service class GL-4	First service: 500 Hour Second service: Every 2, 000 Hour - Hour is standard of engine hour meter - But, change unconditionally when disassembling.	

REASSEMBLY

GENERAL CAUTION MATTERS

1. After cleaning each part cleanly, blow dry with moisture free air. But friction plate is not cleaned with cleaning oil.
2. When fastening each part, tighten tightening torque.
3. When using hammer, surely use plastic hammer.

MOTOR PART

Reassembling of Drive Shaft Subassembly

1. After installing bearing spacer (04) to drive shaft, install cylindrical roller bearing (02) by means of heat fit.

   NOTE: *Use induction heater to heat fit of cylindrical roller bearing and adjust temperature to about 100°C.*

   NOTE: *Be careful not to damage oil seal contacting part of drive shaft.*

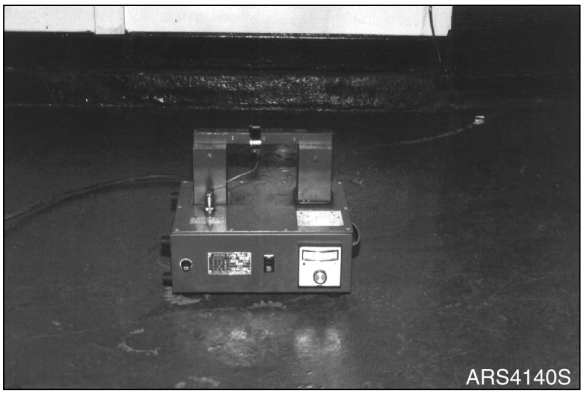


Figure 51

2. Install stopper ring (05) by using pliers.

   NOTE: *Be careful of direction of stopper. (Round direction is bearing side.)*



Figure 52

Reassembling of Valve Casing Subassembly

1. Tighten five plugs (27) to valve casing (13) by rated tightening torque.

   NOTE: *After winding seal tape and applying Loctite to plug, install it.*

   NOTE: *Tightening torque: 70 - 110 kg•cm*

2. Press pin (26).

   NOTE: *Height of pin should be 5 mm from contacting surface of valve plate by using hammer.*

3. Install needle bearing (03).

   NOTE: *Use plastic hammer and copper bar.*

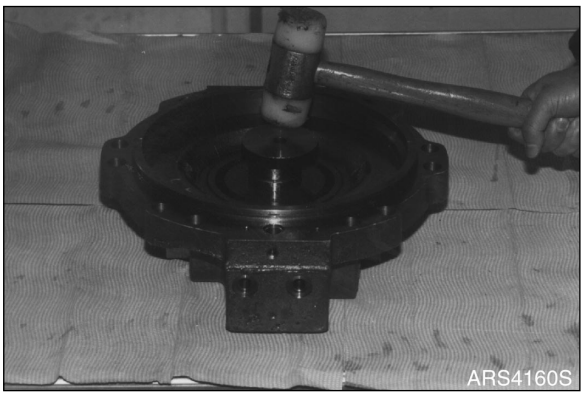


Figure 53

4. Install seat (36), ball (37), stopper (38) and HP plug (41) with O-ring (42) according to the order.

   NOTE: *Be careful of installing order and direction of seat and stopper.*

   NOTE: *Tightening torque: 370 kg•cm*

5. Install HP plug (41) with O-ring (42).

   NOTE: *Five places*

   NOTE: *Tightening torque: 370 kg•cm*

6. Tighten orifice screws (16)of right and left of CB valve spool (15) by rated tightening torque.

   NOTE: *Tightening torque: 70 kg•cm*

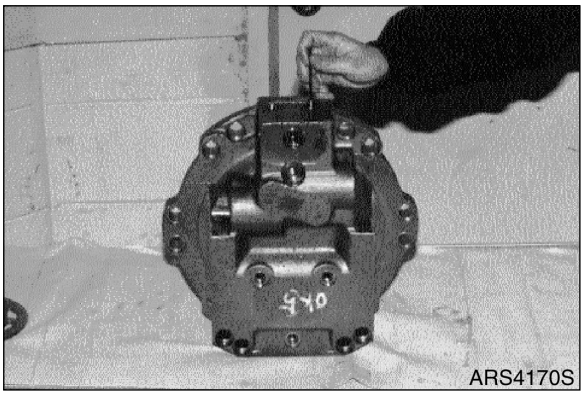


Figure 54

7. Install CB valve spool (15), stopper (20), shim (19), and spring (22) to valve casing according to order.

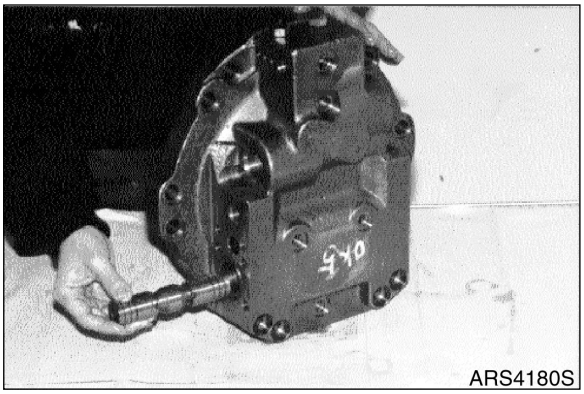


Figure 55

8. Insert plunger (18) to valve casing and install spring (17), O-ring (29), stopper (23) with backup ring (57).

   NOTE: *Be careful of order of O-ring and backup ring.*

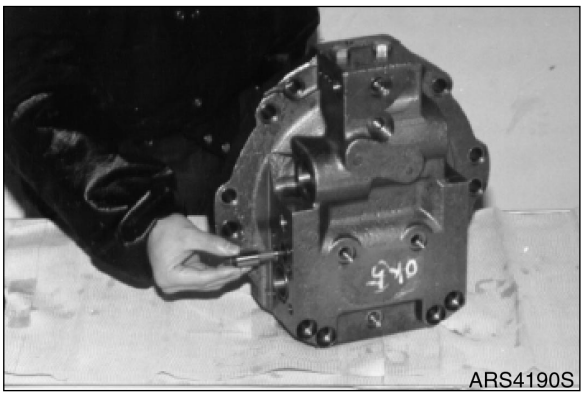


Figure 56

9. Tighten cap R (24) and cap L (25) by means of hex socket bolts (53, 54).

   NOTE: *When installing, cap R and L should not be changed.*

   NOTE: *Tightening torque:*
   M12: 1, 000 kg•cm - (67)
   M10: 670 kg•cm - (68)

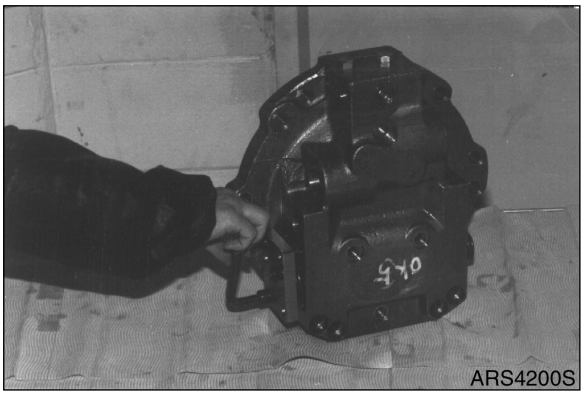


Figure 57

10. After tighten plug (35) with O-ring (51) by rated tightening torque, insert tilting spool (34), tilting spring (33), and O-ring (60).

    NOTE: *Tightening torque: 750 kg•cm*

11. Install name plate (52).

12. Insert O-ring (30) to valve casing

13. Tighten drain plug (28) with O-ring (29) by rated tightening torque.

    NOTE: *Tightening torque: 1, 100 kg•cm*

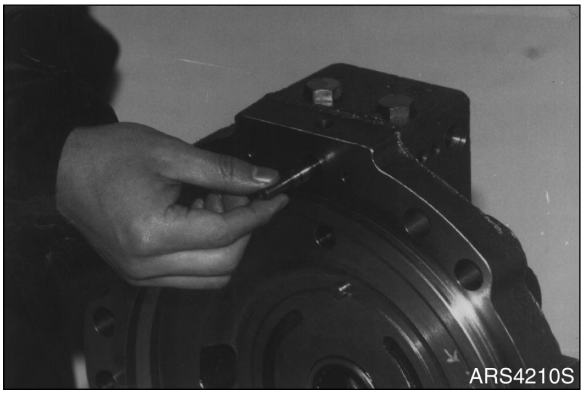


Figure 58

Reassembling of Cylinder Subassembly

1. Install cylinder spring (08), spacer (09), and spherical bush (07) to cylinder (06).

   NOTE: *Align cylinder and spline of spherical bush.*

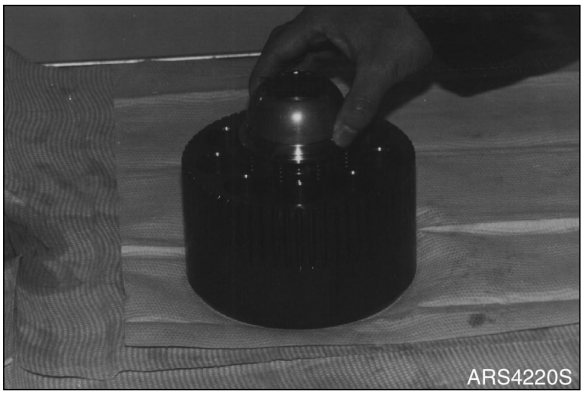


Figure 59

2. Install friction plate (49) and separate plate (48) to cylinder.



Figure 60

3. After inserting piston shoe (10) to pressure plate (07), install it to cylinder.

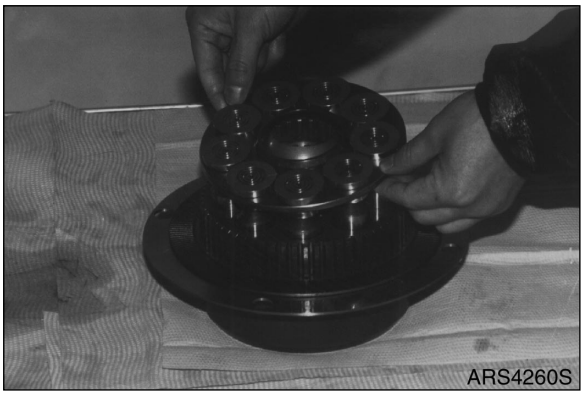


Figure 61

Reassembling of Motor

1. Tighten four plugs (27) to shaft casing by rated tightening torque.

   NOTE: *After winding seal tape and applying Loctite to plug, install it.*

   NOTE: *Tightening torque: 70 - 110 kg•cm*

2. Press pin (32) for fixing of separate plate by using hammer and round bar.

   NOTE: *Pin (26, 4ea): Set height to 19 mm from machining surface of shaft casing.*

3. Install oil seal (31).

   NOTE: *Install carefully not to damage lip by using assembling jig.*

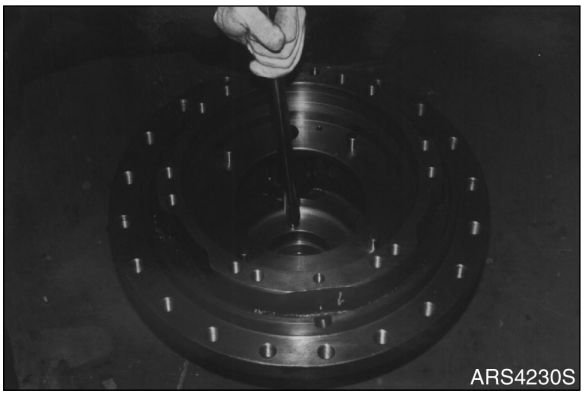


Figure 62

4. Install drive shaft subassembly

   NOTE: *Slightly tap and install outer race of cylindrical roller bearing (02) by using copper bar and plastic hammer.*

5. Install snap ring (62).

   NOTE: *Install snap ring (62) of which rounded surface faces bearing side.*

6. Install two swash balls (61).

7. Install tilting piston (58).

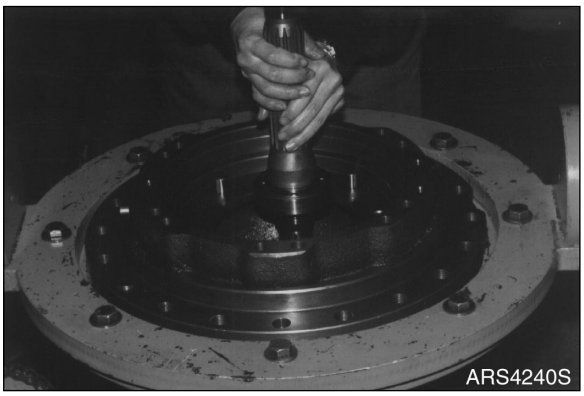


Figure 63

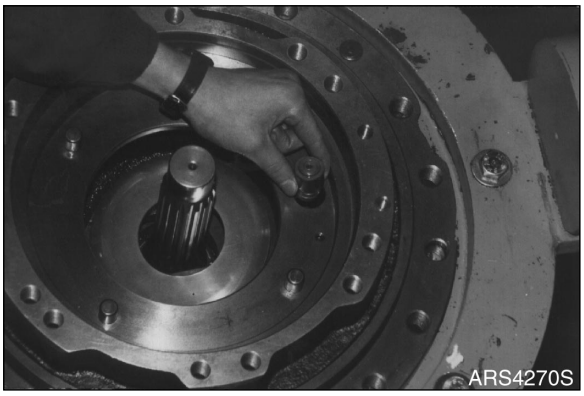


Figure 64

8. Install swash plate (12).

   NOTE: *Apply grease to sliding surface of swash plate.*

   NOTE: *Check if swash plate moves smoothly.*

9. Turn disassembling and reassembling jig to 90° and direction of shaft should be from horizontal to vertical.

   NOTE: *Be careful not to drop swash plate from swash plate support.*

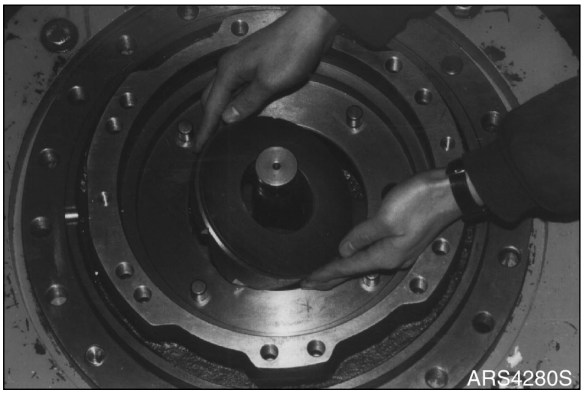


Figure 65

10. Install cylinder subassembly.

    NOTE: *Align hole of separate plate to pin and install.*

11. Turn disassembling and reassembling jig to 90° and direction of shaft should be from vertical to horizontal.

12. Install piston ring 46 (∅252) and 47 (∅278) to brake piston (4).

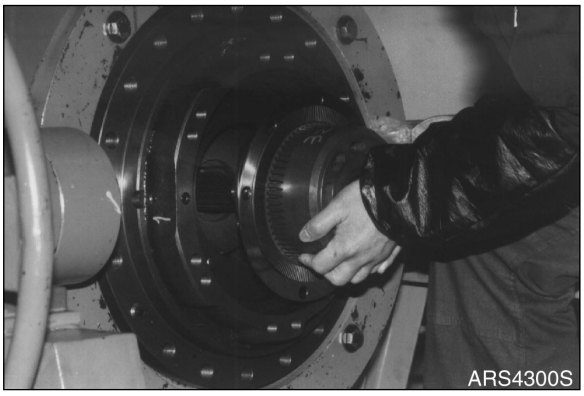


Figure 66

13. Install brake piston to shaft casing.

    NOTE: *Be careful of installing direction of brake piston.*

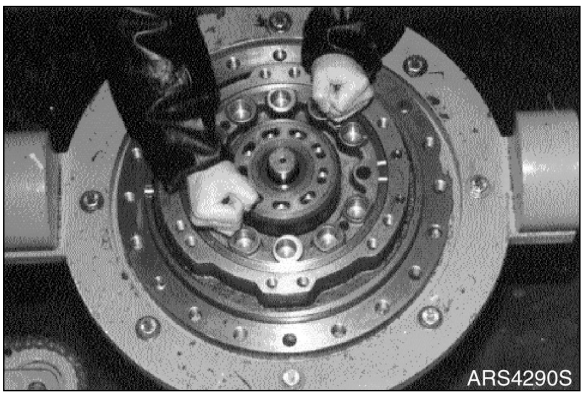


Figure 67

14. Install brake spring (45).

    NOTE: *Quantity: Spring (10ea), Hole (11ea).*

    NOTE: *Do not install at highest top portion of brake piston.*

15. After tightening orifice screw (39) and (43) by rated tightening torque, insert O-ring (40).

    NOTE: *Quantity and size: (39):1ea, ∅1.5 (43):1ea, ∅1.5*

    NOTE: *Tightening torque: 70kg•cm*

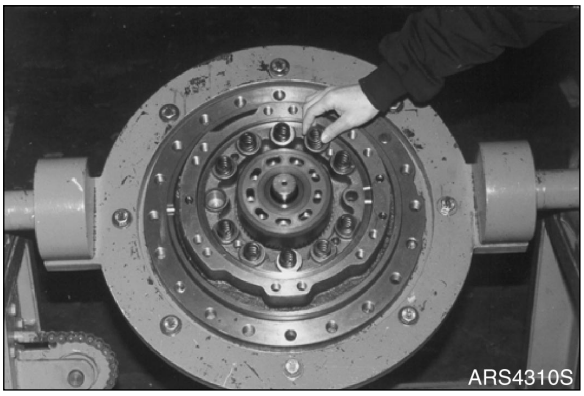


Figure 68

16. After inserting valve plate (11) to valve casing, tighten it to shaft casing by means of hex socket bolt (56).

    NOTE: *(1) Apply grease to back surface of valve plate not to drop valve plate.*
    (2) When installing valve plate to shaft casing, use crane.
    (3) Install valve plate of which F5 hole faces inlet and outlet ports side of valve casing.
    (4) Apply grease to tilting spool side of tilting spring not to drop tilting spring.
    (5) Tightening torque: 2, 400 kg•cm

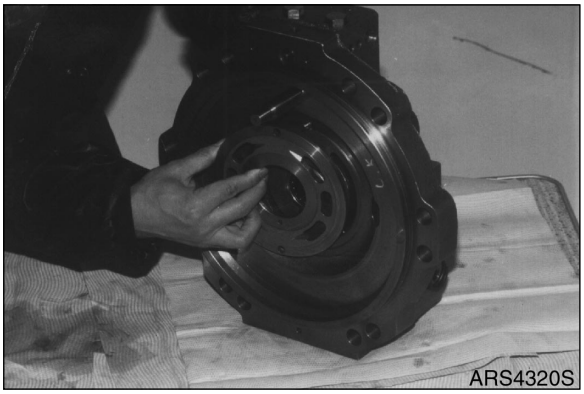


Figure 69

17. Tighten relief valve (14) by rated tightening torque.

    NOTE: *Tightening torque: 1, 800±100 kg•cm*

18. Install stop ring (50) to shaft by using pliers.

    NOTE: *Be careful of direction of stop ring. (Round direction is bearing side.)*

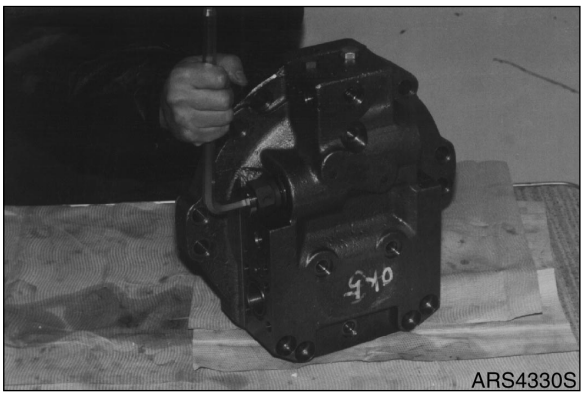


Figure 70

REDUCTION GEAR

Reassembling of Angular Ball Bearing (18) of Housing (1) Part

1. Adjust oil bath temperature to 100±5°C.
2. Fully submerge housing (1) into oil bath by using two eye bolts of M10 and crane.
   At this time, be careful not to contact bottom of housing (1) to bottom of oil bath.

   NOTE: *Prevent uneven heat.*

3. Take out housing (1) and position on assembling stand.
   Wipe off oil by using clean rag and insert angular ball bearing (18) in order.

   NOTE: *Be careful not to change top and bottom direction of bearing.*

4. Tap and completely contact end surface of angular ball bearing (18) and housing (1) seat by using jig (1) and hammer like figure (1).

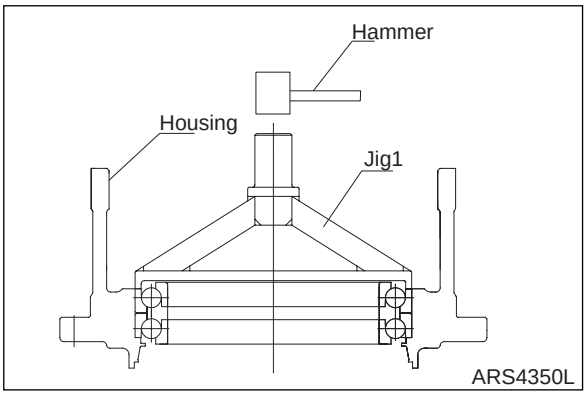


Figure 71

Selection Method of Shim (15) Thickness

1. Position coupling gear (5) on working stand like figure (2) and measure dimension "A" by using jig (2) or jig (11).
2. Calculate "T1".
   - T1= A - B

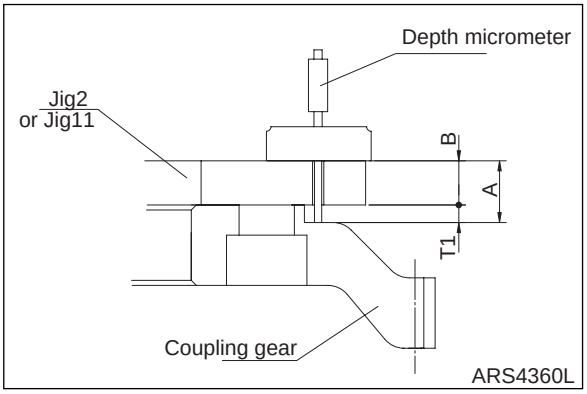


Figure 72

3. Position housing on jig (13) like figure (3) and measure "C" by using jig (2).
4. Calculate "T2".
   - T2= E + C - D

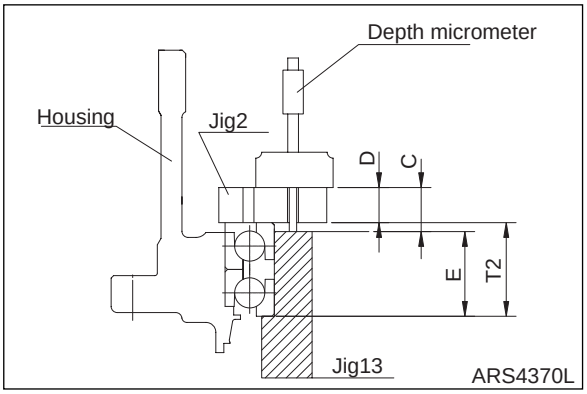


Figure 73

5. Position shaft casing (25) like figure (4) and measure "F" by using jig (2) or jig (11).
6. Calculate "T3".
   - T3= F - D
7. Calculate "T".
   - T= (T1 + T3 + 0.1) - T2
8. Select shim (15) thickness "Ts" with value "T" from below table. Method is to decide most approximate value.

Part No.	Ts
2114-1647-1	1.2
2114-1647-2	1.4
2114-1647-3	1.6
2114-1647-4	1.8
2114-1647-5	2.0
2114-1647-6	2.3
2114-1647-7	2.5
2114-1647-8	2.8

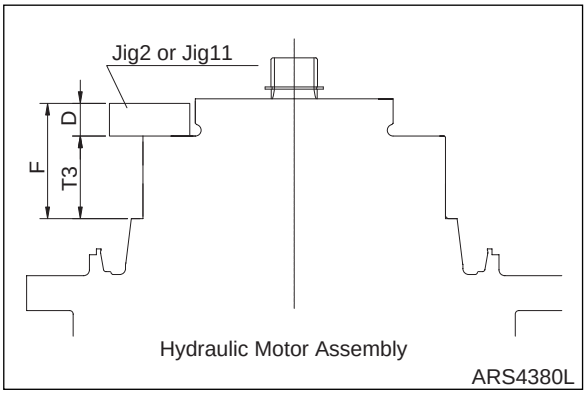


Figure 74

Reassembling of Floating Seal (19)

1. Position shaft casing (25), of which mating part against housing (1) faces upward, on jig (16) by using two eye bolts and crane and fasten with two M20 bolts.
   Apply grease lightly to O-ring of floating seal (19).
   Insert floating seal (19) to groove of shaft casing O-ring not to damage seal surface with care by using jig (14).

   NOTE: *Pay attention to intruding of foreign materials.*
   Pay attention to damaging of O-ring.

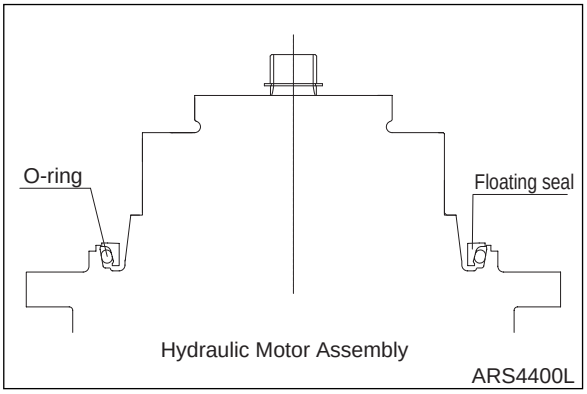


Figure 75

2. Position housing (1), of which mating surface against ring gear No.1 (3) faces upward, on working stand like figure (6) by using crane.
   Apply grease lightly to O-ring of floating seal (19).
   Insert floating seal (19) to groove of shaft casing O-ring not to damage seal surface with care like means of clause 13.

   NOTE: *Pay attention to intruding of foreign materials.*
   Pay attention to damaging of O-ring.

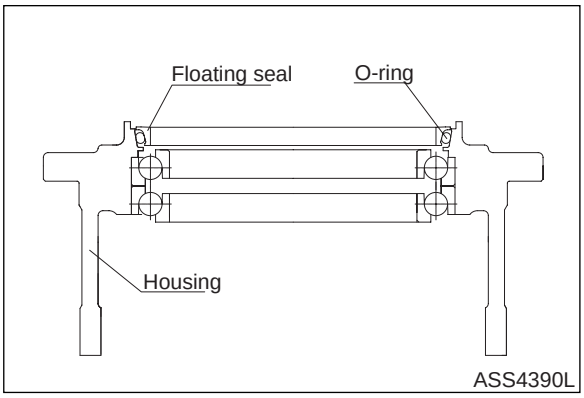


Figure 76

Reassembling of Housing (1) and Shaft Casing (25)

1. After tightening two eye bolts to housing (1), lift by using crane, make sure whether fitting part of inner race of angular ball bearing (18) and shaft casing (25) is aligned, and then insert housing (1) slowly. At this time, when angular ball bearing (18) can not be inserted well, tap contacting surface of housing (1) against ring gear No.1 by using copper hammer and insert

   NOTE: *Do not tap by force.*

Reassembling of Stopper (27)

1. Position stopper (27) on outer race surface of angular ball bearing (18), after slightly applying Loctite 262 to screw of bolt (31), tighten with rated tightening torque by using socket wrench and torque wrench. Install remained three stoppers by the same means.

   NOTE: *Tightening torque: 690±10kg•cm*

Reassembling of Coupling Gear (5) and Ring Gear No.2 (4)

1. Position ring gear No.2 (4) on working stand like figure 7 and install coupling gear (5) from upside. After squeezing snap ring (21) in ring groove of ring gear No.2 (4) by hand and adjust completely.

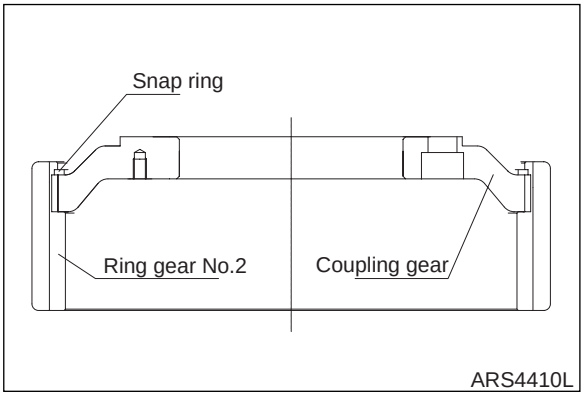


Figure 77

Reassembling of Coupling Gear Subassembly and Housing Subassembly

1. Lift coupling gear subassembly by using two eye bolts (M10) and crane. After slightly applying grease to one side of shim (15) of thickness Ts selected clause 12, insert to contact this side to coupling gear (5).

   NOTE: *Be careful not to drop shim from coupling gear (5)*

2. After checking lap reaming hole of coupling gear (5) and shaft casing (25), slowly position on shaft casing (25). Temporarily fasten coupling gear subassembly with four bolts (M20). Measure pre-pressure of angular ball bearing by using spring balance and tap of M20 bolt of shaft casing. If pre-pressure is appropriate, drive pin (13) by using jig (8).

   Close two points of end surface of pin (13) hole of coupling gear (5) with 180' space by using punch and prevent pin (13) from dropping.

   NOTE: *Refer to Figure 78.*

3. After slightly applying Loctite 262 to tap part of hex socket bolt (22), tighten with rated torque by using torque wrench.

   NOTE: *Tightening torque: 7, 300kg•cm*

Reassembling of Carrier Subassembly

1. Position carrier (9), of which pin (12) hole side faces downward, on jig (3) to crisscross hole of jig (3) and gear assembling hole of carrier (9) about 10 mm.
   Place jig (4) near by carrier (9).
   Position on jig (4) to make oil groove of washer (17) face downward (carrier).
   Position cluster gear (6) on thrust washer (17) to make No.1 spur gear face downward, insert jig (5) to cluster gear (6).
   Insert twenty five needle rollers (20) between cluster gear (6) and jig (5).
   Insert spacer (16) on them and insert twenty five needle rollers (20).

   NOTE: *Three cluster gears in carrier subassembly should be same phase. That is, The same English characters among the carved marks of English characters A, B, C, and D should be assembled among themselves.*

   NOTE: *Pay attention to the 25ea of needle roller bearing.*

2. After moving horizontally the whole except jig (4) in cluster subassembly to carrier (9), make jig (5) be inserted to hole of carrier (9).

3. Place on cluster gear (6) to make oil groove of thrust washer (27) face upward (carrier).
4. Check pin (12) hole of shaft (11) and pin (12) hole of carrier (9) by the naked eye, after aligning them in a straight line, lightly tap shaft (11) by using copper hammer, align jig (5) to hole of jig (3), and pull out under jig (3).

   NOTE: *At this time, prop jig (5) with rag from bottom not to fall first.*

5. Check pin (12) hole of shaft (11) and pin (12) hole of carrier (9) by the naked eye. At this time, if holes are crisscrossed, align them by using jig (6). Drive pin (12) to 1 mm below the surface of carrier (9) by using hammer and jig (9).
   Close end surface of pin (12) hole of carrier (9) with two points of 180° space like Figure 78 by using punch and prevent pin (12) from coming out.
6. Install the remaining two cluster gears (6) by repeating the upper clauses from one to four.
7. Turn over carrier subassembly of which cluster No.1 spur gear faces downward.
8. When finishing installation completely, draw lines on the upper surface of carrier (9) like below figure to mate cluster gear phase easily.
   At this time, three lines should all be parallel.

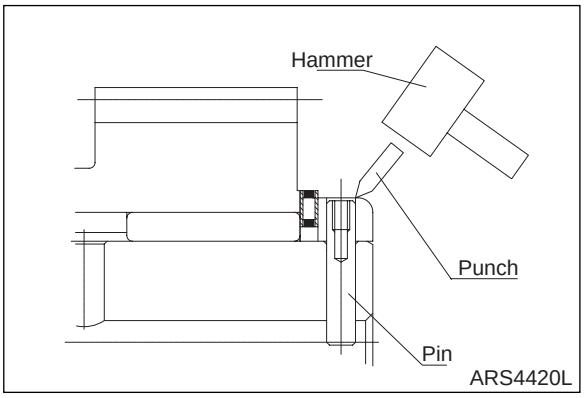


Figure 78

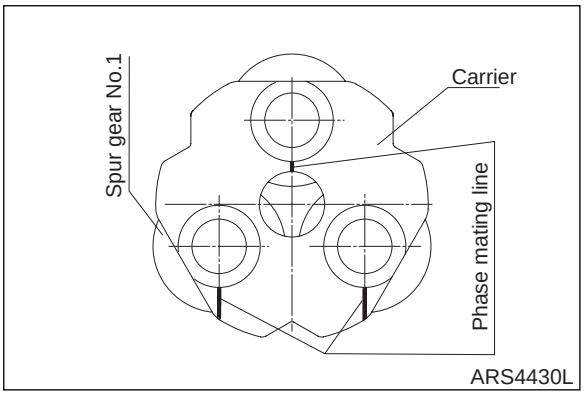


Figure 79

Decision of Cluster Gear (6) Phase

1. Make mark "C" of cluster gear (6) of carrier subassembly face like figure (9).

   NOTE: *It is when phase indicated mark is "C".*

2. Insert jig (19) to make spline side face upward like on the state of figure (9).

   NOTE: *At this time, cluster gear (6) phase should not be changed at clause (28).*

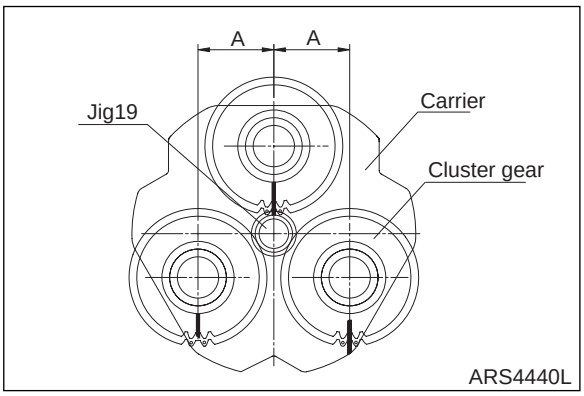


Figure 80

Reassembly of Housing (1) and Ring Gear No.1 (3)

1. Insert thrust bearing (10) Ttb = 5.5 (parts no: 2114-1647-2) to shaft casing (25).
2. Slightly apply grease to spline part of coupling (8). Insert coupling (8) to hydraulic motor shaft. Insert sun gear (7) being adjusted to spline part of coupling (8).

   NOTE: *Jig (18) can be used.*

3. Take carrier subassembly down slowly by using M10 eye bolts and crane and make ring gear No.2 (4) align tooth

   NOTE: *Jig (18) can be used.*

4. Completely clean oil from mating surfaces between ring gear No.2 (4) and housing (1) by using cleaning oil and evenly apply Loctite 587.
5. Lift ring gear No.1 (3) by using M10 two eye bolts and crane, check simultaneous machining lot No. of housing (1) and side surface of ring gear No.1 (3) and put down to make tooth of cluster No.1 spur gear and ring gear No.1 align.
   Insert jig (5) to M10x1.5 four bolts (33) and temporarily fasten.
6. Turn the whole reduction gear by hand by using jig (20) for inspection. At this time, if kinds of gear do not turn, take out carrier subassembly, check phase, and then recheck turning of kinds of gear after reassembling.
   Even though kinds of gear turn, if there are noises or turning is irregular, as there are interference between bottom surface of carrier (9) and top surface of coupling gear (5), take out carrier subassembly and reassemble after inspection.

Selection of Thrust Bearing (10) Thickness

1. Measure (G) (H), and (I) of figure (10) by using depth gauge and jig (11). At this time, measure four points and (I) is calculated with the biggest value.

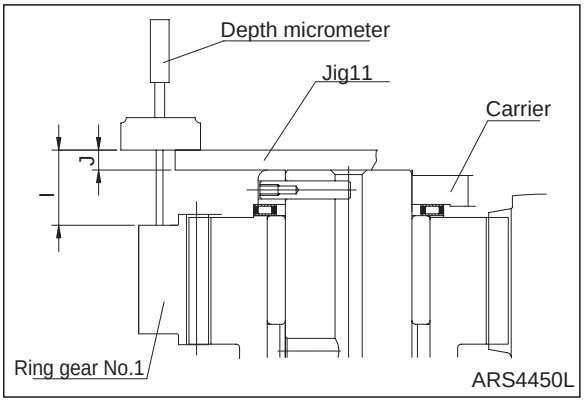


Figure 81

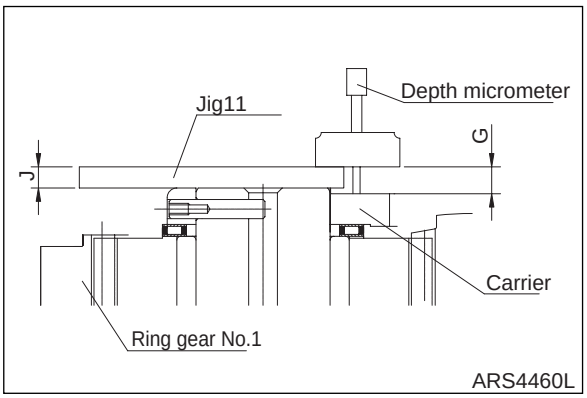


Figure 82

NOTE: *If the difference of (I) among four points is over 0.3, reassembly of carrier subassembly is wrong or there is interference of bottom surface of carrier, so that take out carrier subassembly and check whether there is interference.*

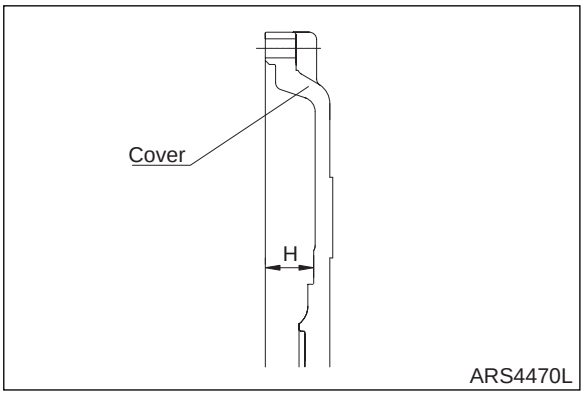


Figure 83

2. Calculate (T4).
   - T4 = I - G
3. Calculate (T5).
   - T5 = H - T4 - (0.3 ~ 0.7)
4. Select thickness (T_{TB}), which belong to T5, of thrust bearing from below table.

Part No.	T_{TB}
2114-1647-1	1.2
2114-1647-2	1.4
2114-1647-3	1.6
2114-1647-4	1.8

5. In case that T5 is over 6 and below 4.5, change T_{TB} = 5.5 (part no: 2114-1647-2) of clause (31) to another and select with method of clause (34)- (37) (But, do not use T_{TB}=4.5).
6. After slightly applying grease to surface of bearing (10) selected from clause (39) and oil groove faces carrier subassembly, press fit to cover (2) by using copper hammer.
   Press fit thrust plate (14) to be stuck to cover (2) by using hammer.
7. Fill gear oil with specific quantity.

   NOTE: *Specific quantity: 4.3 liters*
8. Loosen M10x1.5 bolts temporarily fastened at clause (35).
   After completely clean oil from mating surface of ring gear No.1 (3) and cover (2) by using cleaning oil, evenly apply Loctite 587. After Tightening jig (17) to level tap hole of cover (2) and lifting it, position it to ring gear No.1 (3). Tighten thirty hex head bolts (33, M10) with specific torque by using torque wrench.

   NOTE: *Specific torque: 1, 520±10 kg•cm*

9. Wind seal tape to tap part of plug (24) and tighten it to cover (2) with specific torque by using torque wrench.

   NOTE: *Specific torque: 660 kg•cm*

10. Coat with specific paint except guide surface of hydraulic motor, tap part of bolt and contact part of sprocket.

INSTALLATION

CHECK

Check the following items before fitting and manage it if it is abnormal.

Checking Items	Managing Matters
Are there any damages when transporting?	Report to Q/C Department.
Are there any loose bolts?	Tighten rated torque. (Refer to “Tightening Torque Chart” on page -14)
Is gear oil filled with rated quantity? After leveling motor indicated in outside dimension drawing (2401-6198) (Set level mark horizontally.), it is normal if oil flows out.	Refer to “Oil Filling” on page -50

FITTING

1. Fitting part of motor machines as $\varnothing 380 m6^{+0.057}_{+0.021}$, and so fitting part of equipment machines as $\varnothing 380 F7^{+0.119}_{+0.062}$.
2. Do not impact on motor and install it by means of bolts.

PIPING

1. Turning direction is indicated in outside dimension drawing. Be careful of piping direction.

   • Turning direction

Inlet	Outlet	Direction seeing from drive shaft
A	B	Right turning
B	A	Left turning

2. Cover piping port with plug when transporting, and be careful not to insert welding and cutting scales, etc. in it.

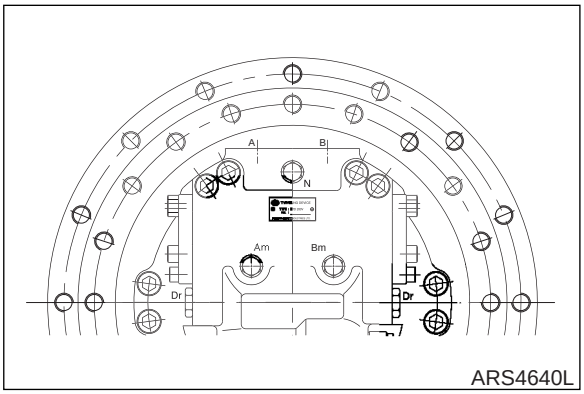


Figure 84

3. Two drain pipes are covered with plug. Use an upper pipe between two pipes. Fill fully hydraulic oil in motor casing before piping. Pipe to lower drain pressure under 2 kg/cm^2.

4. If sand particle or metal powder are mixed in hydraulic oil, wear of sliding surfaces are excessively and it causes sticking, so that use filter of 10μm in circuit.

GEAR OIL

Kinds of Oil

Use GL-4 GRADE of service grouping API of SAE #90 equivalent. Do not use with mixing of oil of other kinds.

Oil Drain

Turn motor to position oil drain port to low side, then drain oil. (If level plug is loosened, oil drains rapidly.)

Oil Filling

Set LEVEL mark on cover horizontally, then fill 4.3 liters of oil.

GENERAL CAUTION MATTERS

1. Be careful whether there are loosened bolts or oil leaks.
2. Be careful of casing temperature in operation. There is no problem if atmospheric temperatures are about below +60°C (90°F).

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

MAIN PUMP (KAWASAKI)

⚠ 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 300LC-V	1001 and Up

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October 2001

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SWASH PLATE TYPE K5V SERIES AXIAL PISTON PUMP

TYPE DESIGNATION

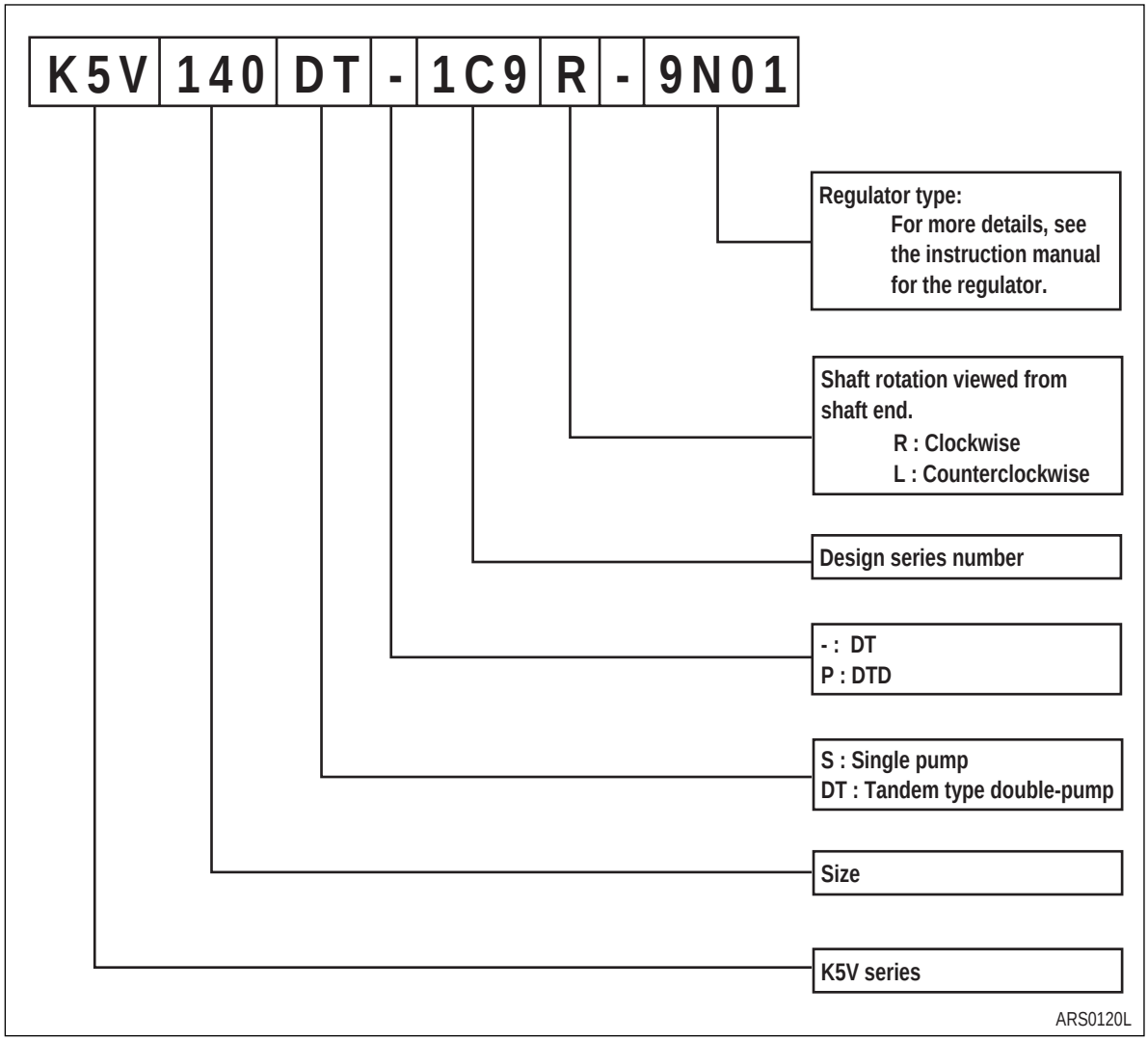


Figure 1

SPECIFICATIONS

Item		Specification
Size		140
Displacement		140 cm^3/ rev
Pressure	Rated	34.3 MPa (350 kgf/cm^2)
	Max.	37.7 MPa (385 kgf/cm^2)
Speed	Max. *1	2,500 min^{-1}
	Max. for self-priming *2	2,150 min^{-1}
Weight	Single	
	Double	130 kg
Working Oil	Type	Mineral working oil
	Oil temp range	-20 ~ +95 °C
	Oil viscosity range	10~1,000 cSt (mm^2/s)
	Recommended filter	10μm

*1 These are the maximum speeds for the closed-circuit specifications.
For the closed-circuit specifications, consult us in advance.

*2 These are the speeds when the suction pressure is 0 kgf/cm^2.

CONSTRUCTION AND FUNCTION

Construction

This pump assy consists of two pumps connected by spline coupling (114). The two pumps can be driven simultaneously as the rotation of the prime mover is transferred by the drive shaft (F) (111) on the front side. The suction and discharge ports are integrated at the connecting part of the two pumps, i.e. in valve block (312) : The suction port serves for both the front pump and the rear pump.

Function

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

1. Rotary Group

   The rotary group consists of drive shaft (F, Figure 24) (111), cylinder block (141), piston shoes (151,152), set plate (153), spherical bush (156) and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends. The shoe is caulked to the piston to form a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and to take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush.
   Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.

2. Swash Plate Group

   The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

   The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

   If the servo piston moves to the right and left as hydraulic force controlled by the regulator is admitted to hydraulic chamber located on both sides of the servo piston, the swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle (α).

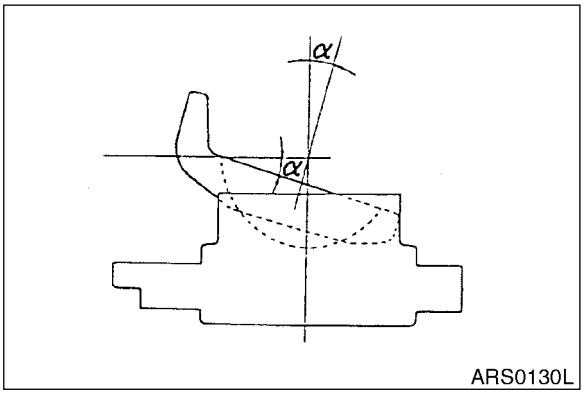


Figure 2 Swash Plate Group

3. Valve Block Group

The valve block group consists of valve block (312), valve plate (313) and valve plate pin (885). The valve plate having two melon-shaped ports is fixed to the valve block and feeds and collects oil to and from the cylinder block.

The oil changed over by the valve plate is connected to an external pipeline by way of valve block.

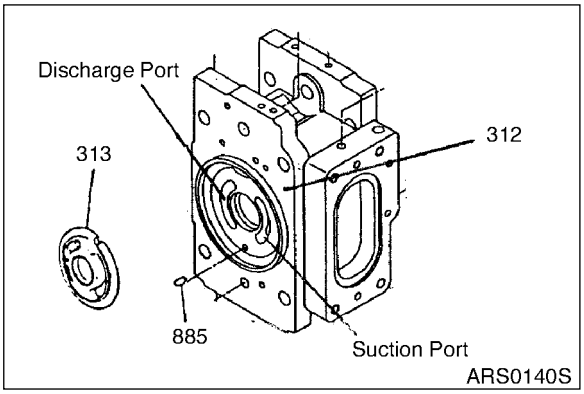


Figure 3 Swash Plate Group

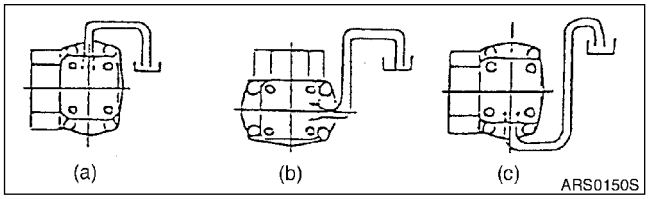
Now, if the drive shaft is driven by a prime mover (electric motor, engine, etc.), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig1. the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block. If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (or oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.

CAUTIONS FOR OPERATION

Installation

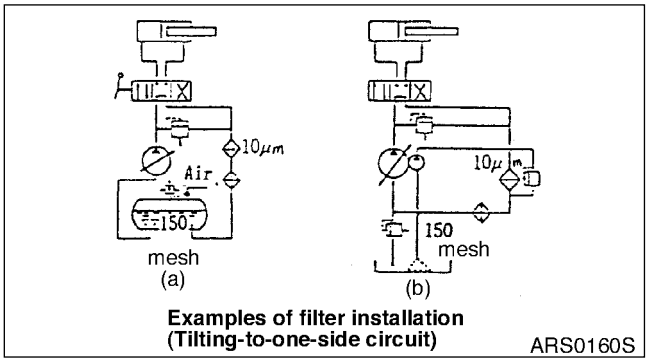
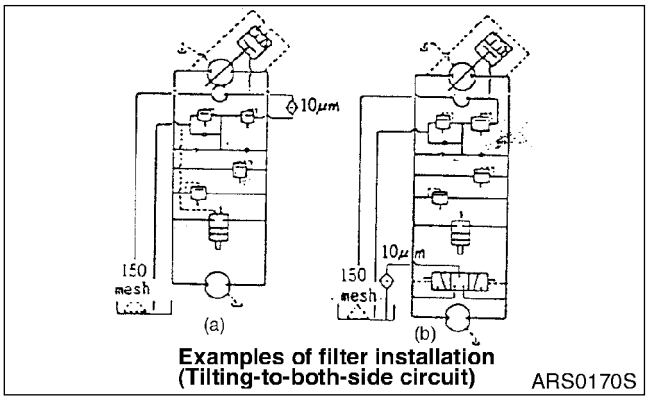
Item	Caution	Applied Type
Installed Direction	Install the pump with the drive shaft horizontal in general.	All types
External load to shaft end	Apply neither radial nor thrust load externally to the pump shaft end in general. When a belt of gear drive is to be adopted or any equivalent load applied, consult us, explaining the specifications.	All types
Removal of rust preventing paint	Since the shaft end splined section has been applied with rust preventing paint, remove it with cleaning liquid before using the pump, and apply lubricant, such as molybdenum disulfide, before fitting this section to the coupling. When cleaning liquid is used, pay attention not to sprinkle liquid on oil seal sections.	All types
Coupling & centering of pump	Couple the pump drive shaft with the prime mover shaft with a flexible coupling in general. For centering between the coupling and drive shaft, keep the alignment within ±0.03mm.	All types
Tightening of pump fitting bolts	For the tightening torques of the pump fitting bolts, refer to the values of their respective sizes shown in attached list1.	All types

Cautions for Pipings

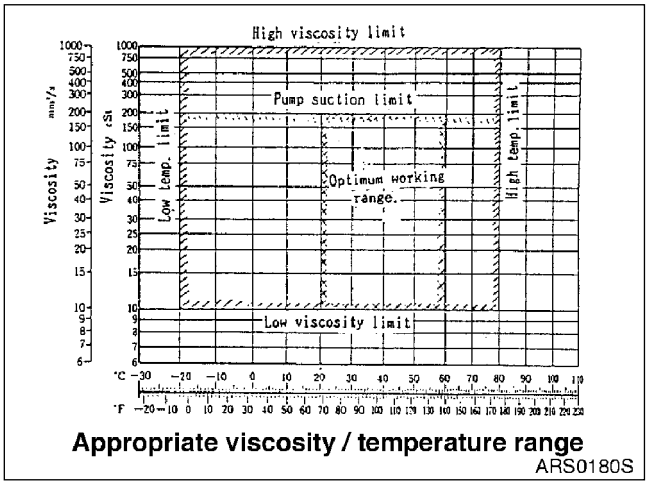
Item	Caution	Applied Type
Rotating direction & delivery direction	For the variable pump, these indications depend on the command method of the regulator. For each application of the pump, refer to the indications shown without fail in the outside dimension drawing.	All types
Sanitation of pipings	Carry out acid pickling and flushing of the suction / delivery pipings and tank fully. Especially, clean the suction piping thoroughly.	All types
Fitting of suction / delivery pipings	In fitting the pipings, prevent the suction and delivery ports of the pump from being forcedly-stressed. Also avoid sudden bending as much as possible. Refer to attached list 1 tightening torque list in tightening the fitting bolts.	All types
Drain piping	Raise the drain piping of the pump higher than the pump and then lead it to the tank, as shown in the following figures.  For the tandem type double-pump, fit the drain piping to the front pump first as far as possible. It is desirable to provide a filter in the drain line.	All types Tandem type pumps
Drain pressure	Remember that the allowable internal casing pressure of this pump is normally less than 1 kgf/	All types

Cautions for Filters

The most conclusive factor to prevent the pumps and other components from damaging and to lengthen their life-spans is whether pollution control of their working oil is carried out fully or not. A filter of 10μm should be provided in the circuit without fail.

Item	Caution	Applied Type
Tilting-to-one side circuit	In this circuit, do not fail to provide a filter of 10μm in the actuator return pipe. The following figure shows examples. In addition, provide a filter of 80 to150 mesh at the suction side.  **Examples of filter installation (Tilting-to-one-side circuit)** ARS0160S	All types of tilting-to-one side pumps
Tilting-to-both side circuit	It is ideal to provide a filter of 10ß≠ in the booster line as shown in (a) of the following figure, but there are also a number of experiences to provide filters of 10μm in the flushing circuits. Anyway, provide a filer of 80-150 mesh at the suction side of the booster pump.  **Examples of filter installation (Tilting-to-both-side circuit)** ARS0170S	All types of tilting-to-both side pumps
Contamination	The relation between contamination and the pump's life-span is very ununderstandable and the latter depends largely on the kind and nature of dust. Especially, mixing of sand causes any pump to lessen its life-span remarkably. On the premises that sand is not mixed the recommended range is class 9 or better in NAS class, and 2 to 4 mmg/100cc or lessin millipoise pollution grade.	All types

Working Oil and Temperature Range

Item	Caution	Applied Type
Kind of oil	Use generally-used working oil that is added with bubbling preventive agent, antioxidant, anti corrosives, sec. and has a high viscosity index.	All types
Optimum viscosity & temperature of working oil	For the open circuit, the recommended working viscosity range is 10 to 200 cSt. For the close circuit or when used as a motor, the range of 10 to 1000 cSt can be available, but the range of 10 to 200 cSt is desirable, considering the optimum efficiency. The temperature range is limited approximately to -20°C to 80°C by oil seals, O-rings, etc. It is desirable to use oil at a temperature lower than 65°C as low as possible, considering deterioration of working oil, seals and so on.  **Appropriate viscosity / temperature range** ARS0180S	All types
Working oil other than mineral oil	When any working oil of phosphate, water-glycol, fatty acid ester or so on is to be used, do not fail to consult us in advance.	All types

Operational Cautions

Item	Caution	Applied Type
Laid-up for a long period	It is not recommendable that the pump/motor is laid-up for a long period (one year or more) without being operated. During such period, rotate it sometimes even for a short time. When it is laid-up independently, it is effective even to turn its shaft manually. If the laid-up period is longer it is necessary to overhaul it.	All types
Change of rotating direction	The rotating direction is as indicated by the arrow plate. If it must be changed during its life-span, consult us.	All types

Oil filling and Air Venting

Item	Caution	Applied Type
Oil filling	Fill the pump casing with oil without fail. Inside the pump there are the high-speed sliding parts, such as bearings, pistons/ shoes, retainer, etc. If not filled with oil, these parts may suffer from serious troubles, such as seizures damage	All types
Air venting	When air is left in the circuit or pump, it may cause any malfunction or damage. Vent air completely without fail.	All types

Cautions in Starting Operation

1. Check pipings for being fitted completely.
2. Check that the rotating and suction / delivery directions are correct.
3. Before starting the prime mover, make the pump free of any load.
4. After starting, continue the idle running for a while to vent air from the circuit completely.
5. Check the pump and pipings for oil leaks and abnormal vibrations.
6. When the pump is attached to the gear box, check the box for full oil level with its oil level gage.

TROUBLESHOOTING

General Cautions

This section describes the countermeasures to be taken if any abnormality is detected during the operation of the Kawasaki swash plate type axial piston pump.

The general cautions are as follows:

1. Consider the condition before starting work.
2. Judge the nature of the abnormality, before starting work. Especially, judge if it is a problem in the circuit or caused by the regulator or attached valves and determine that something is wrong truly with the pump or not.
3. Read the maintenance manual well before disassembling and then follow the right disassembling procedures.
4. Even when any section is to be disassembled, pay attention not to make dust enter into the pump.
5. Since the parts are finished finely, handle them carefully not to damage it.

Check of Pump Proper for Abnormalities

The pump is often fitted with regulator, accessory valves and associated pump, and so it is very difficult to find the cause of the failure. Investigate the following principal check item, and the abnormal point will be revealed.

1. Check of filter and drain oil

   Check filter elements for a great deal of abnormal impurities. Since the shoes and cylinder may give worn metal particles, a small quantity may be detected there. However if a great deal of metal particles are found in filters, it is considered that shoes may be damaged. Similarly, check drain oil in the pump casing.

2. Existence of abnormal noises or vibrations

   Check the pump proper for abnormal noises and vibrations. If any, investigate if it is a noise of a regular frequency, such as hunting of the regulator or the relief valve of the accessory valve, or not. If it is an abnormal vibration or noise, it may result from cavitation or a damage inside the pump.

3. Case where two pumps are used

   For the circuit with two simples pumps or motors or for the duplex pump, exchange the piping of one pump with that of the other one. With the results of this exchange, it will be determined if the trouble is the problem of the circuit downstream the pump or not.

4. Pressure Measurement at Various Points

   If the failure is problem in control, do not overhaul the pump recklessly, but measure pressures at various part to investigate the abnormal position.

Overload of Prime Mover

Cause	Countermeasure	Remark
Is not the speed-pressure higher than their specified values?	Set them as specified.	
Is not the torque setting of the regulator higher?	Reinvestigate the regulator.	See the instruction manual of the regulator.
Seizure or damage of a part inside the pump.	Replace the damaged part.	Check the filter and drain oil for abnormal worn metal particles.
Wrong fitting of the regulator piping.	Correct the regulator piping.	

Extreme Decrease of Pump Delivery Flow and Non-increase of Delivery Pressure

Cause	Countermeasure	Remark
Failure of the regulator.	Repair the regulator.	See the instruction manual of the regulator.
Seizure or damage of a part inside the pump.	Replace the damaged part.	Check the filters and drain oil.
Failure of the associated pump.	Replace the damaged part.	Remove the associated pump and check the shaft coupling.
Failure of the accessory valve.	Check the accessory valves. (Especially check the poppets, seats and springs).	See the instruction manual of the accessory valves.
Wrong fitting of the regulator piping.	Correct the regulator piping.	

Abnormal Noises and Abnormal Vibrations

Cause	Countermeasure	Remark
Cavitation	Prevention from cavitation. Check working oil for emulsion.	Low boost press. Failure of the associated pump. Air leakage at the suction pipe. Increased suction resistance.
Damage in the caulking suction of the shoe.	Replace the piston shoe, plate, etc.	
Cranking of the cylinder.	Replace the cylinder.	
Wrong installation of the pump.	Correct installation.	
Hunting of the regulator.	Repair the regulator.	See the instruction manual of the regulator.
Hunting of the relief valve of the accessory valve.	Repair the accessory valve.	See the instruction manual of the accessory valve.

CONSTRUCTION OF TANDEM TYPE DUPLEX PUMP

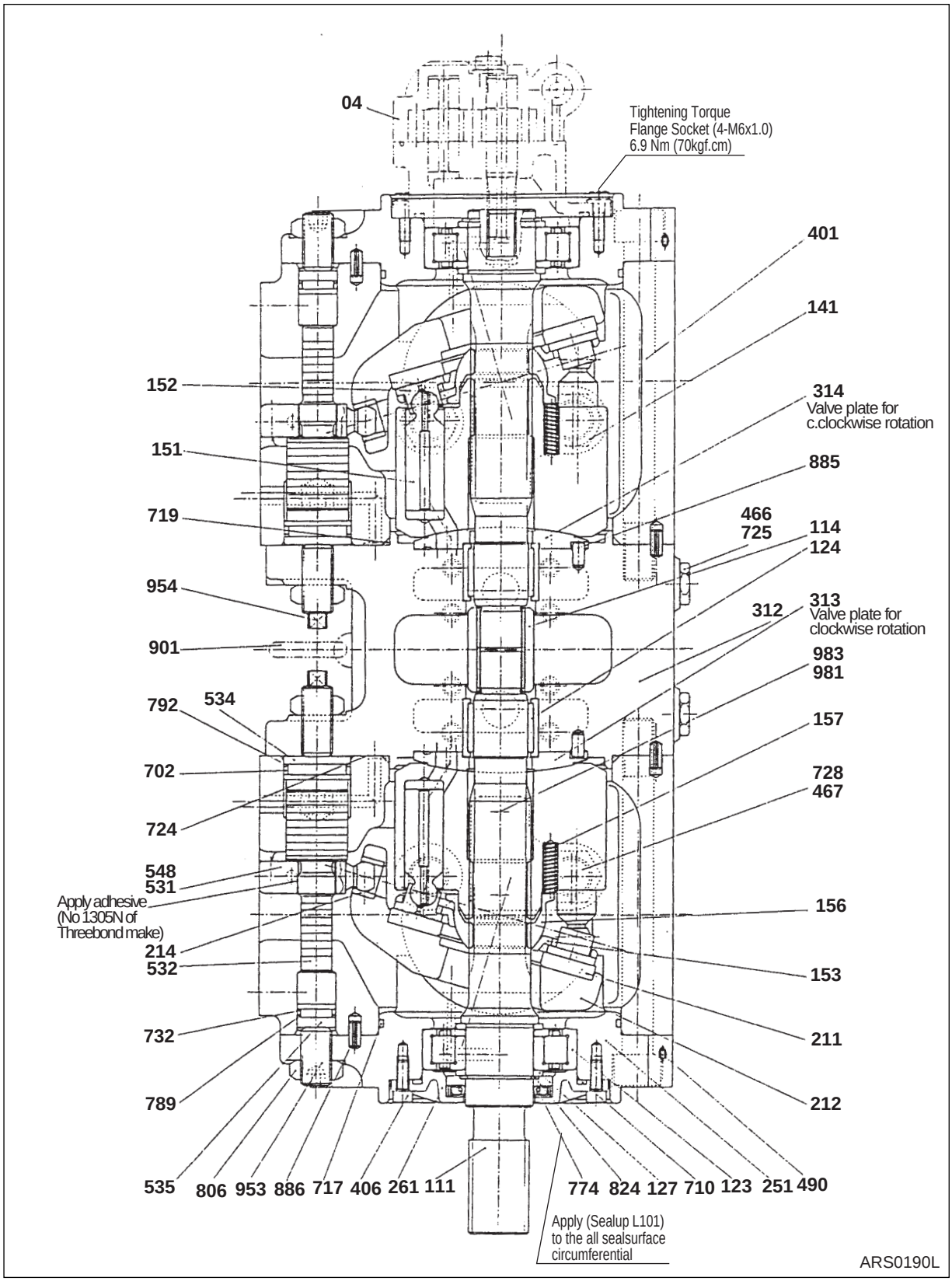


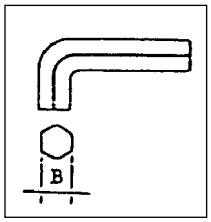
Figure 4

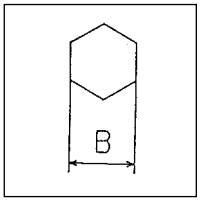
Reference Number	Description
04	Gear Pump
111	Drive Shaft (F)
113	Drive Shaft (R)
114	Spline Coupling
116	1st Gear (for DTP)
123	Roller Bearing
124	Needle Bearing
127	Bearing Spacer
141	Cylinder Block
151	Piston
152	Shoe
153	Set Plate
156	Spherical Bush
157	Cylinder Spring
211	Shoe Plate
212	Swash Plate
214	Tilting Bush
251	Swash Plate Support
261	Seal Cover (F)
262	Seal Cover (R)
271	Pump Casing
312	Valve Block
313	Valve Plate (R)
314	Valve Plate (L)
325	Valve Casing
401	Hexagon Socket Head Bolt
406	Hexagon Socket Head Bolt

Reference Number	Description
466	VP Plug
468	VP Plug
531	Tilting Pin
532	Servo Piston
534	Stopper (L)
535	Stopper (S)
548	Feed Back Pin
702	O-ring
710	O-ring
717	O-ring
719	O-ring
724	O-ring
725	O-ring
728	O-ring
732	O-ring
774	Oil Seal
789	Back Up Ring
792	Back Up Ring
808	Nut
824	Snap Ring
885	Valve Plate Pin
886	Spring Pin
901	Eye Bolt
953	Set Screw
954	Set Screw
981	Name Plate
983	Pin

TOOLS

The tools necessary to disassemble / reassemble the K3V pump are shown in the following list. The size of the bolts and plugs depend on the pump type.

Tool name & size		**Necessary tool (Marked with O)**		**Part name**			
		Pump type					
Name	B	K5V80	K5V140	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	2						M4
	2.5						M5
	3						M6
	4	O	O	M5	BP-1/16		M8
	5	O	O	M6	BP-1/8		M10
	6	O	O	M8	BP-1/4	PO-1/4	M12,M14
	8	O		M10	BP-3/8	PO-3/8	M16,M18
	10			M12	BP-1/2	PO-1/2	M20
	12			M14			
	14	O		M16, M18	BP-3/4	PO-3/4	
	17		O	M20, M22	BP-1	PO-1, $1^1/_4$, $1^1/_2$	
	19			M24, M27			
	21						
	22			M30		PO-2	

Tool name & size		Necessary tool (Marked with O)		Part name		
Name	B	K5V80	K5V140	Hexagon headed bolt	Hexagon nut	VP plug (PF thread)
Double ring spanner, Socket wrench, Double (single) open end spanner. 	19	O	O	M12	M12	VP-1/4
	22					VP-3/8
	24		O	M16	M16	
	27	O		M18	M18	VP-1/2
	30		O	M20	M20	
	36		O			VP-3/4
	41					VP-1
	50					VP-$1^1/_4$
	55					VP-$1^1/_2$
Adjustable angle wrench		O	O	Medium size, 1 set		
Screwdriver		O	O	Minus type screwdriver, medium size, 2 sets		
Hammer		O	O	Plastic hammer, 1 set		
Pliers		O	O	For snap ring, TSR-160		
Steel bar		O	O	Steel bar of key material approx. 10x8x200		
Torque wrench		O	O	Capable of tightening with the specified torques		

AXIAL PISTON PUMP DISASSEMBLING

For disassembling the pump, read this section thoroughly and then disassemble it in the following sequence. The figures in parentheses after part names show the items in “Construction of Tandem Type Duplex Pump” on page 14.

This maintenance manual describes the disassembling procedures for both the single pump and tandem type double-pump. Disassemble the pump, referring to the contents for its appropriate type.

In addition, for the double-pump, take care not to mix up parts of one pump with the same ones of the other pump.

1. Select place suitable to disassembling.

IMPORTANT
Select clean place. **Spread rubber sheet, cloth or so on overhaul workbench top to prevent parts from being damaged.**

2. Remove dust, rust, etc., from pump surfaces with cleaning oil or so on.
3. Remove drain port plug (468) and let oil out of pump casing.

IMPORTANT
For tandem type pump, remove plugs from both front and rear pumps.

4. Remove hexagon socket head bolts (412, 413) and remove regulator.

IMPORTANT
Refer to instruction manual of regulator for its disassembling.

5. Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve block (312).

IMPORTANT
If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

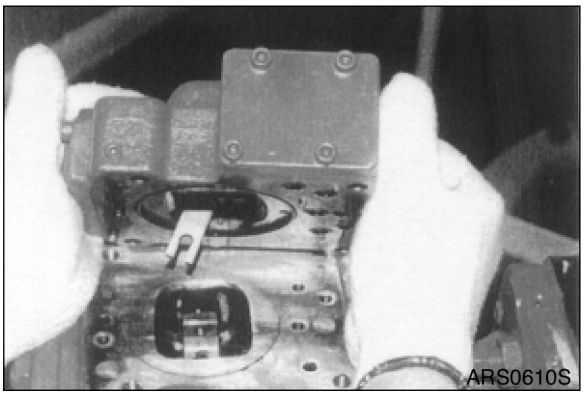


Figure 5

6. Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve block (312).

IMPORTANT
Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.

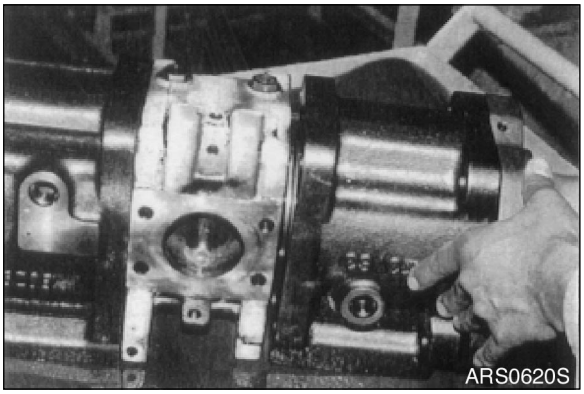


Figure 6

7. Pull cylinder (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simutaneously.

IMPORTANT
Take care not to damage sliding surfaces of cylinder, spherical bush, shoes, swash plate, etc.

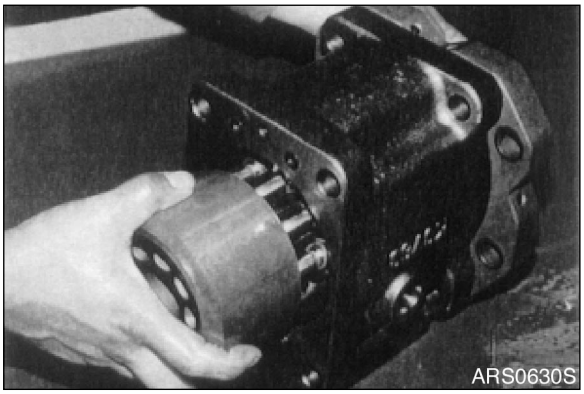


Figure 7

8. Remove hexagon socket head bolts (406) and then seal cover (F) (261).

IMPORTANT
Fit bolt into pulling-out tapped hole of seal cover (F), and cover can be removed easily. **Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.**

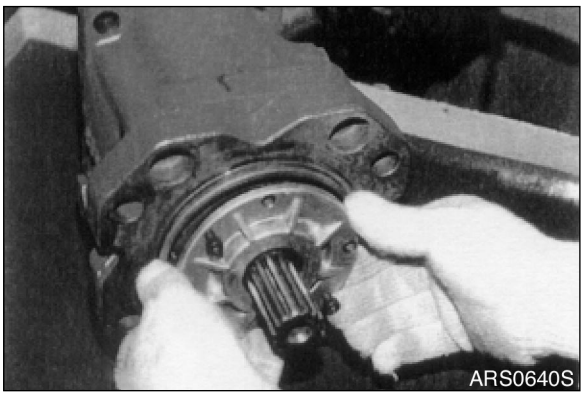


Figure 8

9. Remove hexagon socket head bolts (408) and then seal cover (R) (262).

NOTE: *In case fitting a gear pump, first, remove gear pump.*

10. Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.

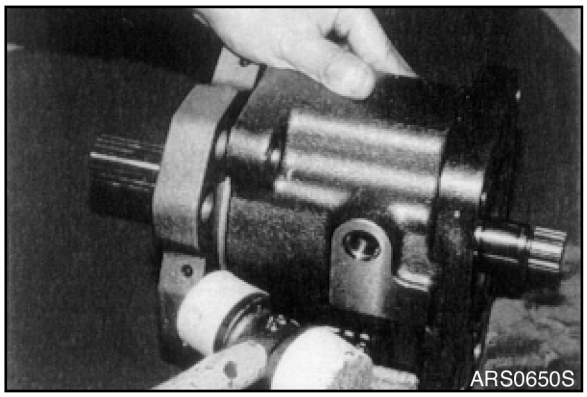


Figure 9

11. Remove shoe plate (211) and swash plate (212) from pump casing (271).

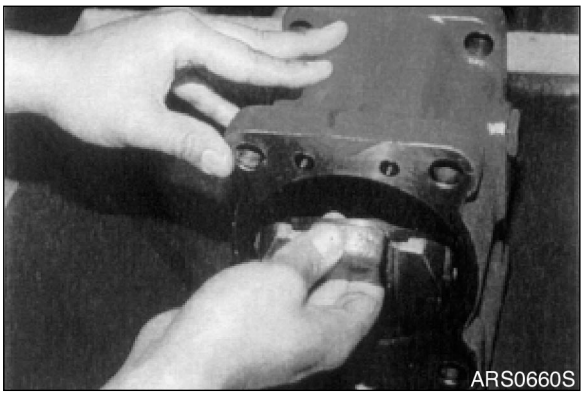


Figure 10

12. Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.

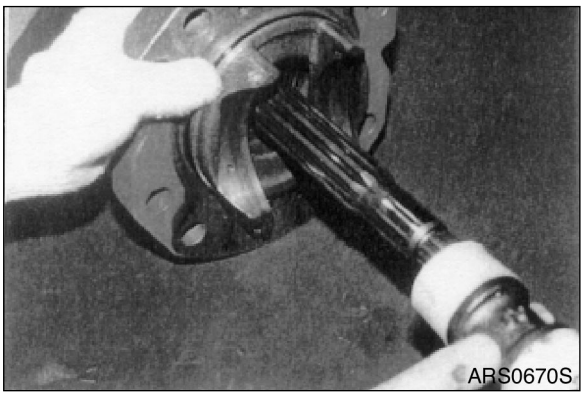


Figure 11

13. Remove valve plates (314, 314) from valve block (312).

IMPORTANT
These may be removed in work 6.

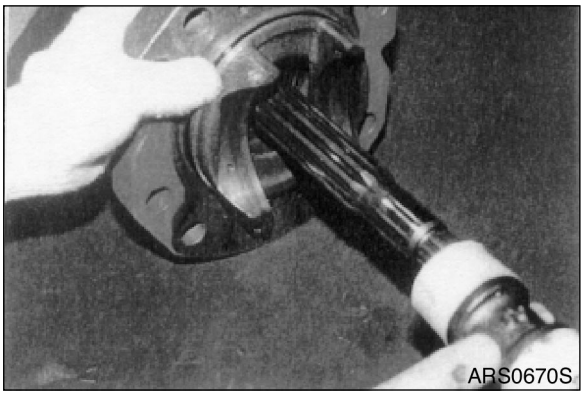


Figure 12

14. If necessary, remove stopper (L) (534), stopper (S) (535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) and splined coupling (114) from valve block (312).

IMPORTANT
In removing tilting pin, use a protector to prevent pin head from being damaged. **Since locktight is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.** **Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.** **Do not loosen hexagon nuts of valve block and swash plate support. If loosened, flow setting will be changed.**

AXIAL PISTON PUMP REASSEMBLING

For reassembling reverse the disassembling procedures, paying attention to the following items.

- Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.
- Clean each part fully with cleaning oil and dry it with compressed air.
- Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.
- In principle, replace seal parts, such as O-rings, oil seals, etc.
- For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in “Tightening Torques” on page 26.
- For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

1. Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

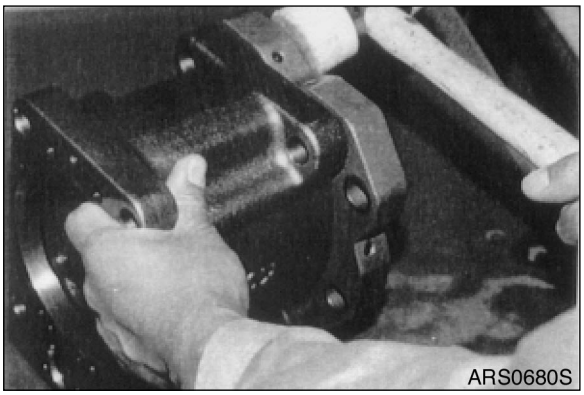


Figure 13

IMPORTANT

After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply Lock-tight (medium strength) to their threaded sections.

2. Place pump casing with its regulator-fitting surface down, fit tilting bush of swash plate to tilting pin (531), and fit swash plate (212) to swash plate support (251) correctly.



Figure 14

IMPORTANT

Confirm with fingers of both hands that swash plate can be removed smoothly.

Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.

3. To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (!27) and snap ring (824).

IMPORTANT
Do not tap drives shaft with hammer or so on. **Assemble them into support, tapping outer race of bearing lightly with plastic hammer. Fit them fully, using steel bar or so on.**

4. Assemble seal cover (F) (261) to pump casing (271) and fix it with hexagon socket head bolts (406).

IMPORTANT
Apply grease lightly to oil seal in seal cover (F). **Assemble oil seal, taking full care not to damage it.** **For tandem type pump, fit rear cover (263) and seal cover (262) similarly.**

5. Assemble piston cylinder subassembly (cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156) and cylinder spring (157).

   Fit spline phases of retainer and cylinder.

   Then insert piston cylinder subassembly into pump casing.

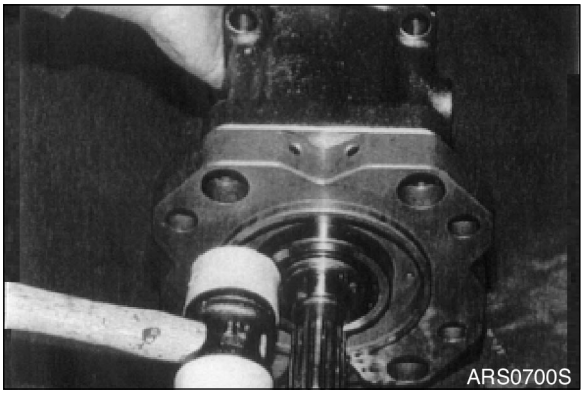


Figure 15

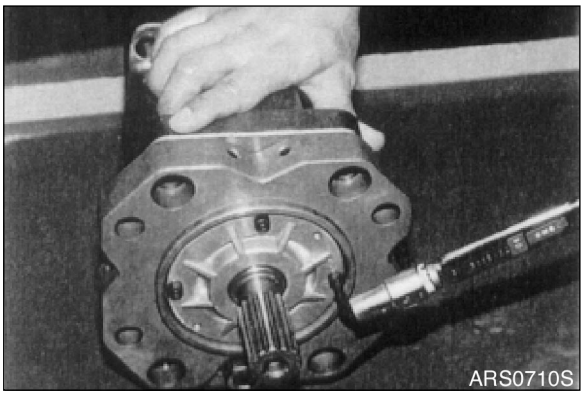


Figure 16

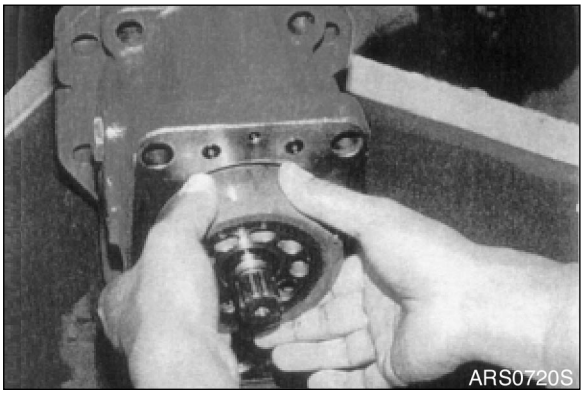


Figure 17

6. Fit valve plate (313) to valve block (312), entering pin in to pin hole.

IMPORTANT
Take care not to mistake suction / delivery directions of valve plate.

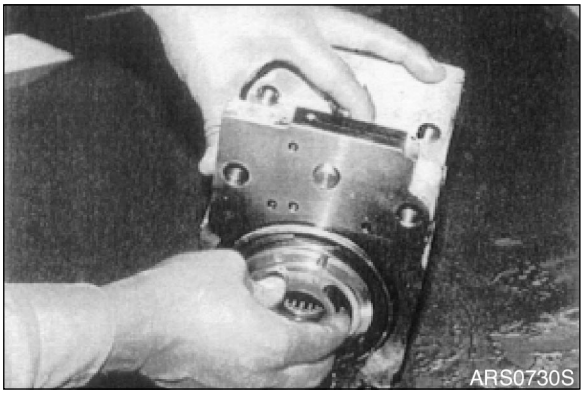


Figure 18

7. Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).

IMPORTANT
At first assemble this at rear pump side, and this work will be easy. **Take care not to mistake direction of valve block.** **Clockwise rotation (viewed from input shaft side) - Fit block with regulator up and with delivery flange left, viewed from front side.** **Counterclockwise rotation (viewed from input shaft side) - Fit block with regulator up and with delivery flange right, viewed from front side.**

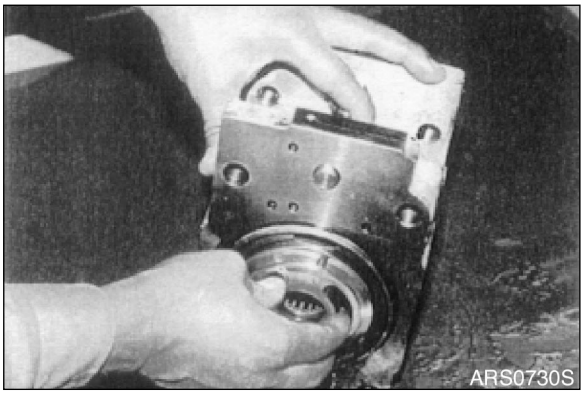


Figure 19

8. Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).

IMPORTANT
Take care not to mistake regulator of front pump for that of rear pump.

9. Fit drain port plug (468). This is the end of reassembling procedures.

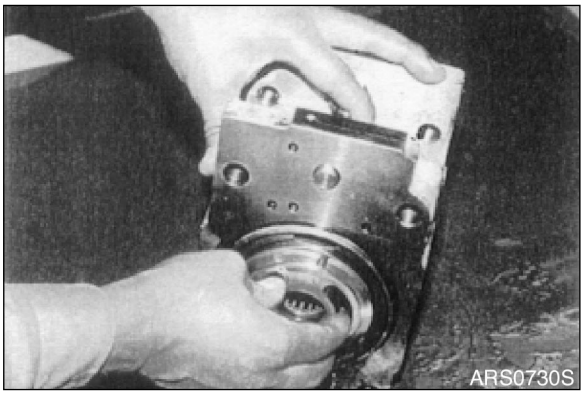
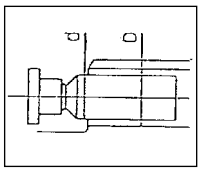
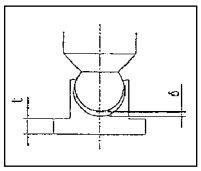
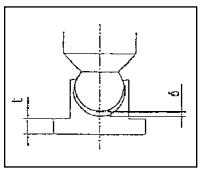
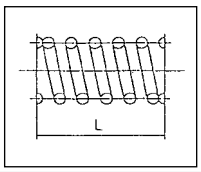
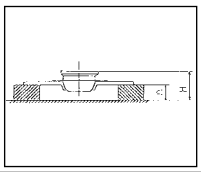


Figure 20

AXIAL PUMP MAINTENANCE CRITERIA

Worn Part Replacement Criteria

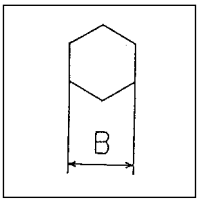
When a part exceeds any of the following criteria, replace or readjust it. However, when a part is damaged seriously in appearance, replace it without fail.

Part name & inspection item	Pump Type		Countermeasures
	K3V63/K5V80	K5V140	
	Standard dimension / Recommended replacement value		
Clearance between piston & cylinder bore (D-d) 	0.028 / 0.056	0.043 / 0.070	Replace piston or cylinder
Play between piston & shoe-caulking section (δ) 	0-0.1 / 0.3	0-0.1 / 0.3	Replace assembly of piston & shoe
Thickness of shoe (t) 	3.9 / 3.7	4.9 / 4.7	Replace assembly of piston & shoe
Free height of cylinder spring (L) 	31.3 / 30.5	41.1 / 40.3	Replace cylinder spring
Combined height of set plate & spherical bush (H-h) 	19.0 / 18.3	23.0 / 22.0	Replace retainer or set plate

Correction Criteria for Cylinder, Valve Plate and Swash Plate (Shoe Plate)

Surface roughness for valve plate (sliding face), swash plate (shoe plate area) & cylinder (sliding face)	Surface roughness necessary to be corrected	3-Z
	Standard surface roughness (Corrected value)	0.4-Z or lower (Lapping)

Tightening Torques

Part name	Size	Tightening torque	Tool name	
Hexagon socket head bolt (Material:SCM 435)	M 5	70 kgf cm	B=4	 Allen wrench
	M 6	120 kgf cm	B=5	
	M 8	300 kgf cm	B=6	
	M 10	580 kgf cm	B=8	
	M 12	1,000 kgf cm	B=10	
	M 14	1,600 kgf cm	B=12	
	M 16	2,400 kgf cm	B=14	
	M 18	3,400 kgf cm	B=14	
	M 20	4,400 kgf cm	B=17	
PT plug (Material :S45C) Wind a seal tape $1^1/_2$ to 2 turns round the plug.	PT 1/16	70 kgf cm	B=4	Do.
	PT 1/8	105 kgf cm	B=5	
	PT 1/4	175 kgf cm	B=6	
	PT 3/8	350 kgf cm	B=8	
	PT 1/2	500 kgf cm	B=10	
	PF 1/4	300 kgf cm	B=6	Do.
	PF 1/2	1,000 kgf cm	B=10	
	PF 3/4	1,500 kgf cm	B=14	
	PF 1	1,900 kgf cm	B=17	
	PF $1^1/_4$	2,700 kgf cm	B=17	
	PF $1^1/_2$	2,800 kgf cm	B=17	

REGULATOR FOR K5V, K3V SERIES OF KAWASAKI SWASH PLATE TYPE AXIAL PISTON PUMP

TYPE DESCRIPTION

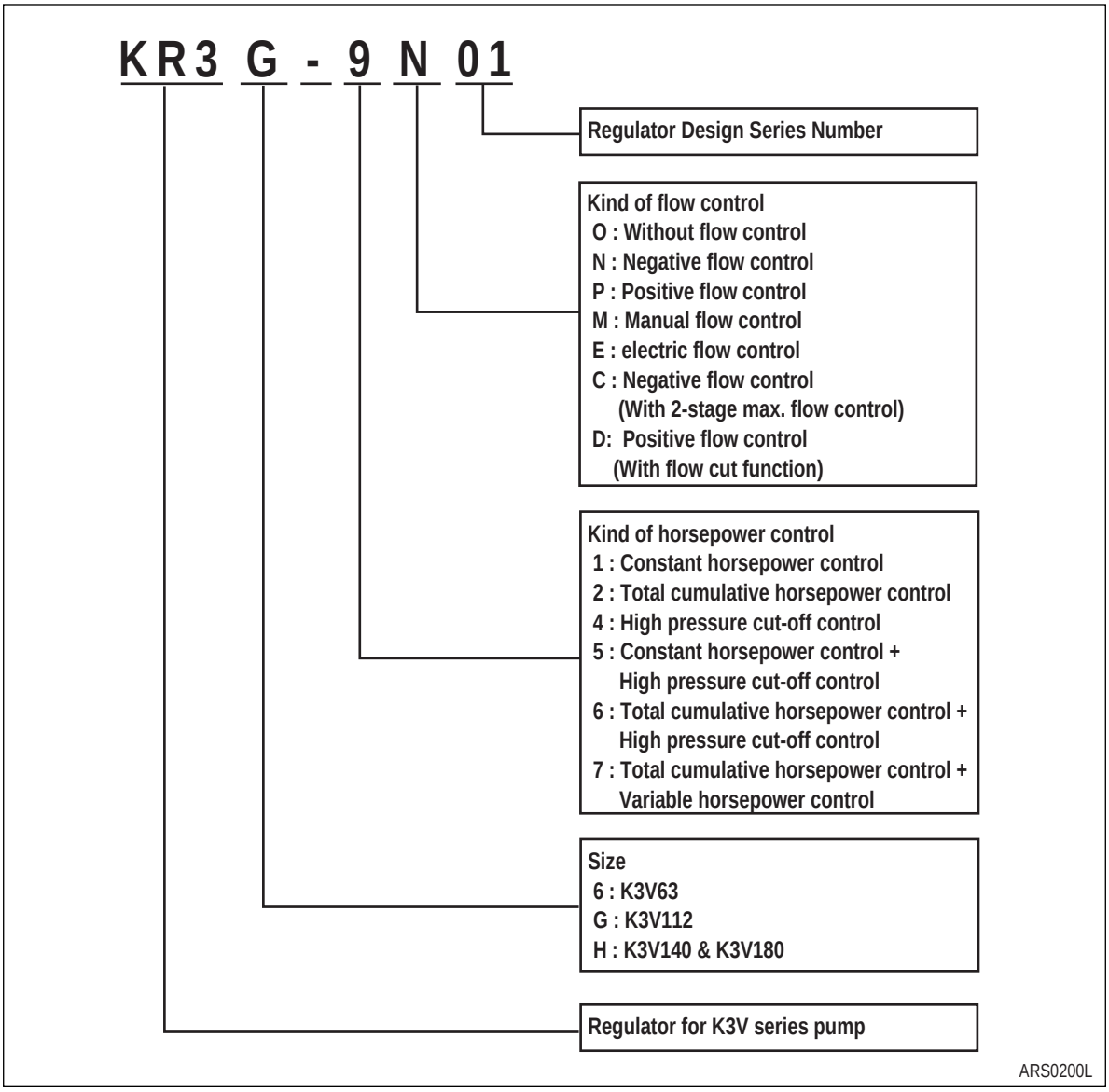


Figure 21

REGULATOR EXPLODED VIEW

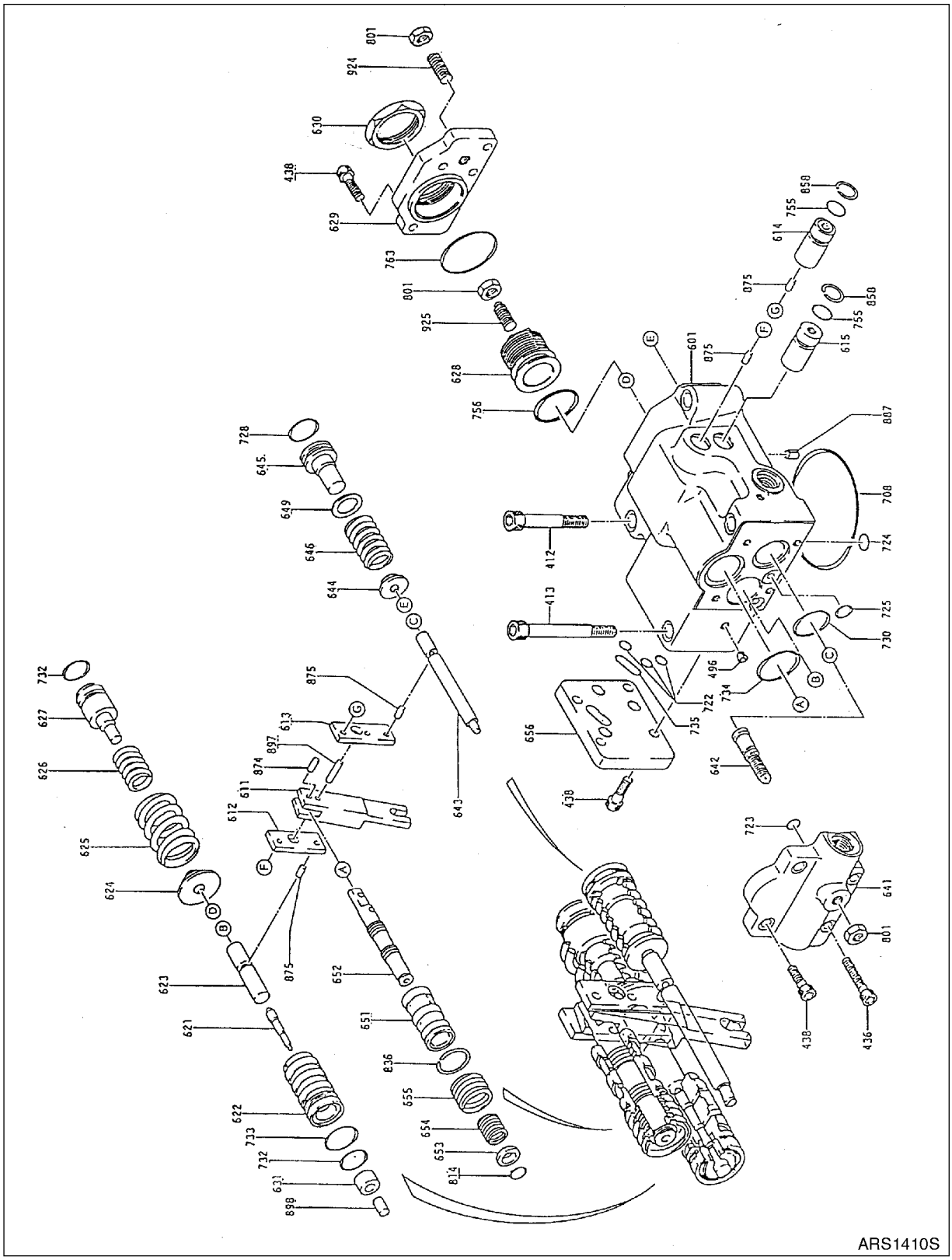


Figure 22

CONSTRUCTION OF REGULATOR

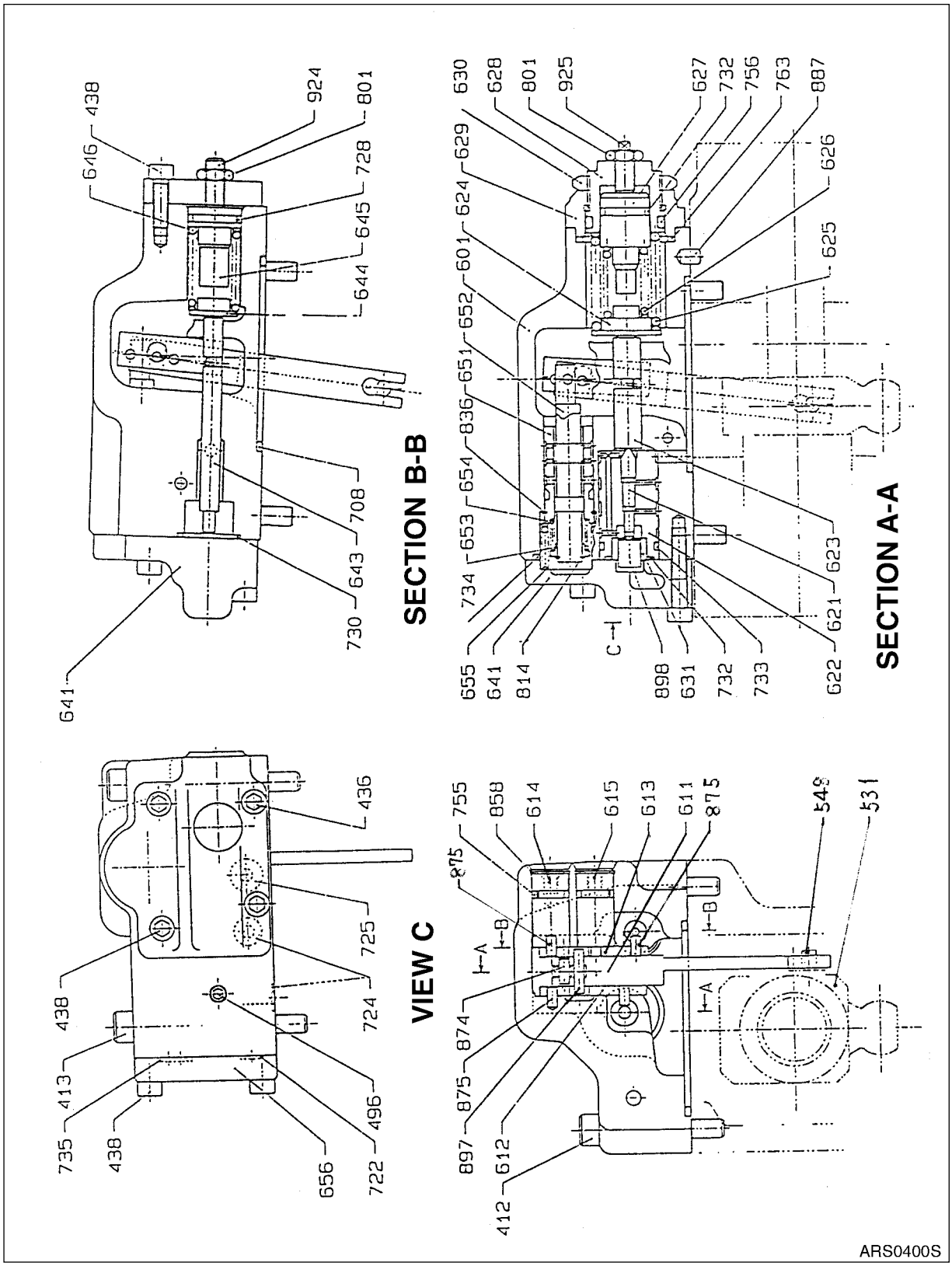


Figure 23

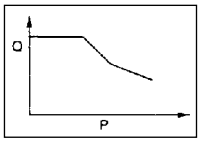
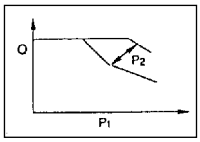
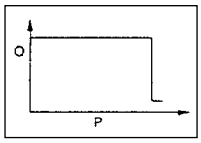
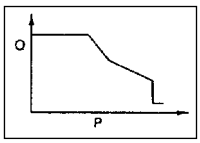
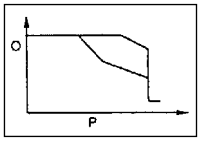
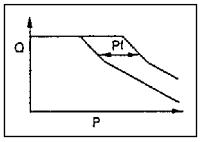
Reference Number	Description
412	Hexagon Socket Head Screw
413	Hexagon Socket Head Screw
436	Hexagon Socket Head Screw
438	Hexagon Socket Head Screw
496	Plug
531	Tilting Pin
548	Feedback Pin
601	Casing
611	Feedback Lever
612	Lever (1)
613	Lever (2)
614	Fulcrum Plug
615	Adjusting Plug
621	Compensating Piston
622	Piston Case
623	Compensating Rod
624	Spring Seat (C)
625	Outer Spring (
626	Inner Spring
627	Adjusting Ring (C)
628	Adjusting Screw (C)
629	Cover (C)
630	Lock Nut
631	PF Sleeve
641	Pilot Cover
643	Pilot Piston
644	Spring Seat
645	Adjusting Ring (Q)
646	Pilot Spring
651	Sleeve

Reference Number	Description
652	Spool
653	Spring Seat
654	Return Spring
655	Set Spring
656	Block Cover
708	O-ring
722	O-ring
724	O-ring
725	O-ring
728	O-ring
730	O-ring
732	O-ring
733	O-ring
734	O-ring
735	O-ring
755	O-ring
756	O-ring
763	O-ring
801	Nut
814	Snap Ring
836	Snap Ring
858	Locking Ring
874	Pin
875	Pin
887	Pin
897	Pin
898	Pin
924	Adjusting Screw
925	Adjusting Screw (QI)

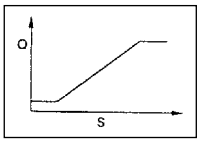
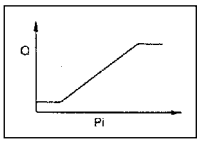
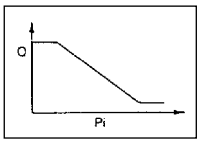
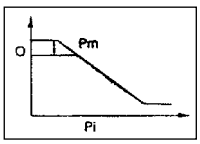
OUTLINE

The regulator for the K3V Series Kawasaki in-line type axial piston pump has various models to satisfy various kinds of specifications required. Therefore, the customer can select the appropriate model to its intended application.

Horsepower Control

Code	Control Type	Control Curve	Function & Features
1	Constant horsepower control		According to the rise of delivery pressure of a pump, the tilting angle of the pump is automatically torque control is achieved.
2	Total horsepower control	 P2 Companion pump pressure	According to the rise of delivery pressure of a pump, the tilting angle of the pump is automatically torque control is achieved. (compensation control) The total horsepower control can be achieved by decreasing the horsepower of a pump depending upon the pressure of its companion pump.
4	High pressure cut-off	 Pressure cut-off	If the pressure rises above the set value, the pump outlet flow is automatically decreased by the pressure cut-off control.
5		 Horsepower control pressure cut-off	
6		 Total horsepower control pressure cut-off	
9	Variable horsepower control		Variable horsepower control can be obtained by supplying pilot pressure or electric current.

Flow Control

Code	Control Type	Control Curve	Function & Features
M	Manual flow control	 Lever stroke	With the manual control, the outlet flow can be freely controlled.
P	Positive flow control	 Pilot pressure	Positive flow control can be carried out by using the pilot pressure.
N	Negative flow control		Negative flow control can be carried out by using the pilot pressure.
C	2-stage max. flow control		Two-stage max. flow control can be obtained by supplying external pilot pressure. (only in negative flow control)

One flow control and one horsepower control can be combined for use. When these controls function simultaneously, the lower tilting angle (lower flow) will prevail through the mechanical calculation mentioned below.

SPECIFICATIONS

- Working oil: Wear-resistant hydraulic working oil, ISO VG 32, 46 & 68
- Temperature range: -20 °C ~ +95°C
- Viscosity range: 10~1000 cSt (During normal operation: 10 ~ 200 cSt)
- Miscellaneous: With proportional pressure reducing valve (In case of type KR3*-9***)

FUNCTIONAL EXPLANATIONS

The regulator for Kawasaki inline axial piston pump K3V Series consists of the following control functions.

1. Negative flow control
2. Total cumulative horsepower control
3. Variable horsepower control

Regulator Function Diagram

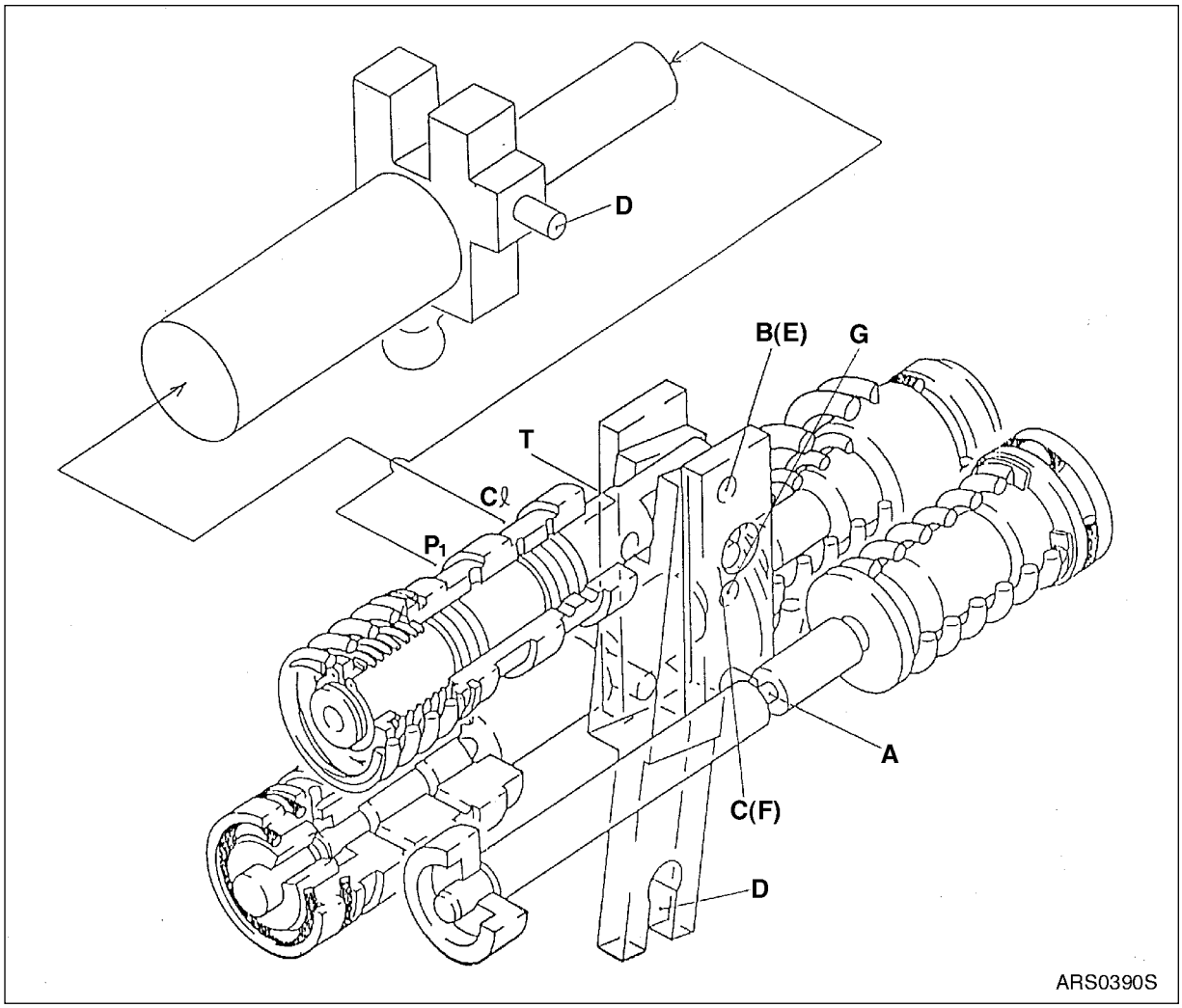


Figure 24

Negative Flow Control

By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown on the Figure 25.

This regulator is of the negative flow control in which the delivery flow Q decreases as the pilot pressure Pi rises. With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.

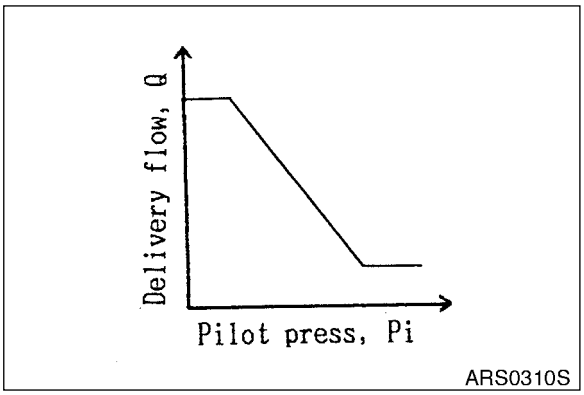


Figure 25

1. Functional Explanation

   A. Flow reducing Function

   As the pilot pressure Pi rises, the pilot piston (643) moves to the right to a position where the force of the pilot spring (646) balances with the hydraulic force.

   The groove (A) in the pilot piston is fitted with the pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever2 rotates around the fulcrum of point B (fixed by the fulcrum plug (614) and pin (875). Since the large-hole section (C, Figure 24) of lever 2 contains a protruding pin (897) fixed to the feedback lever(611), the pin (897) moves to the right as lever 2 rotates. Since the opposing-flat section (D) of the feedback lever is fitted with the pin (548) fixed by the tilting pin (531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin (897) moves.
   Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

   The movement of the spool causes the delivery pressure P1 to connect to port C liter through the spool and to be admitted to the large-diameter section of the servo position. The delivery pressure P1 that is constantly admitted to the small-diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.

   When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring (654) and is tensioned to the left at all times, and so the pin (897) is pressed against the large-hole section (C) of lever2.
   Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve (651) and spool (652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

   B. Flow Increasing Function

   As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point B. Since the pin (897) is pressed against the large-hole section (C) of lever 2 by the action of the return spring (654) via the spool (652), pin (874), and feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the left. Port C liter opens a way to the tank port as the spool moves. This deprives the large-diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P1 in the small-diameter section, resulting in an increase in the flow rate.

   As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

2. Adjustment of flow control characteristic

The flow control characteristic can be adjusted with the adjusting screw.

Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

Tightening the screw shifts the control chart to the right as shown in the Figure 26.

NOTE: *Adjusting values are shown in the attached Table. See "Summary of Regulator Adjustment Values" on page -39.*

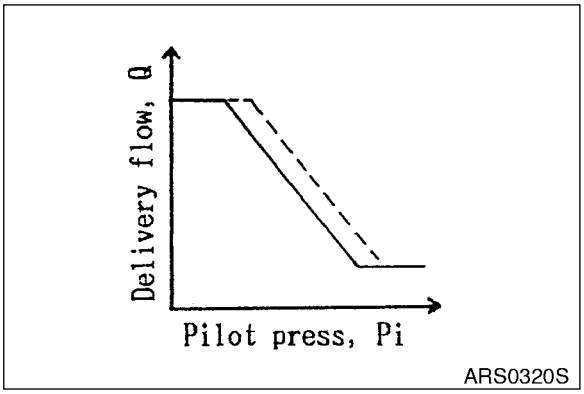


Figure 26

Total Horsepower Control

The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump. (The input horsepower is constant when the speed is constant.)

Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.

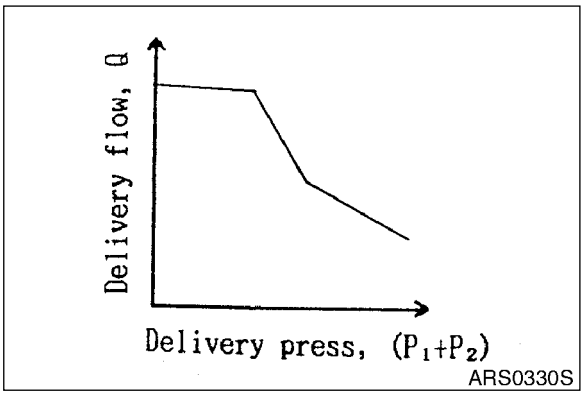


Figure 27

1. Functional explanation

Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same values as represented by the following equation:

- $T\ in = P1 \times q/2\pi + P2 \times q/2\pi = (P1 + P2) \times q/2\pi$

The horsepower control function is the same as the flow control function and is summarized in the following. (For detailed behaviors of respective parts, refer to the section of flow control).

A. Overload Preventive Function

When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force. The movement of the compensating rod is transmitted to Lever 1 via pin (875). Lever 1 rotates around the pin (875) (E) fixed to the casing (601).

Since the large-hole section (F) of Lever 1 contains a protruding pin (897) fixed to the feedback lever (611), the feedback lever rotates around the fulcrum of Point D as Lever 1 rotates, and then the spool (652) is shifted to the right. As the spool moves, the delivery pressure P1 is

admitted to the large-diameter section of the servo piston via Port C liter, causes the servo piston move to the right, reduces the pump delivery flow rate, and prevents the prime mover from being overloaded.

The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool and sleeve (651) is closed.

B. Flow Reset Function

As the self pump delivery pressure P1 or the companion pump delivery pressure P2 decreases, the compensating rod (623) is pushed back by the action of the springs (625 & 626) to rotate Lever 1 around point E. Rotating of Lever 1 causes the feedback lever to rotate around the fulcrum of point D and then the spool to move to the left. As a result, Port C liter opens a way to the tank port. This causes the servo piston to move to the left and the pump's delivery rate to increase.

The movement of the servo piston is transmitted to the spool by the action of the feedback mechanism to move it till the opening between the spool and sleeve is closed.

2. Low tilting angle (low flow) command preferential function

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (∅4) protruding from the large hole (∅8), only the lever lessening the tilting angle contacts the pin (897); the hole (∅8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

3. Adjustment of Input horsepower

Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one pump is loaded.

A. Adjustment of outer springs

Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the Figure 28. Since turning the adjusting screw C by N turns changes the setting of the inner spring, return the adjusting screw CI (925) by NxA turns at first.

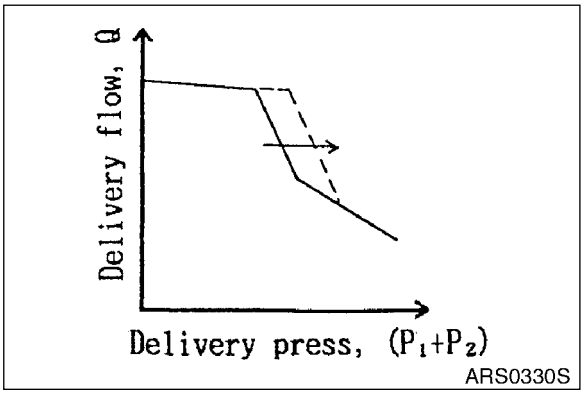


Figure 28

B. Adjustment of inner spring

Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the adjusting screw Cl (925). Tightening the screw increases the flow and then the input horsepower as shown in the Figure 29.

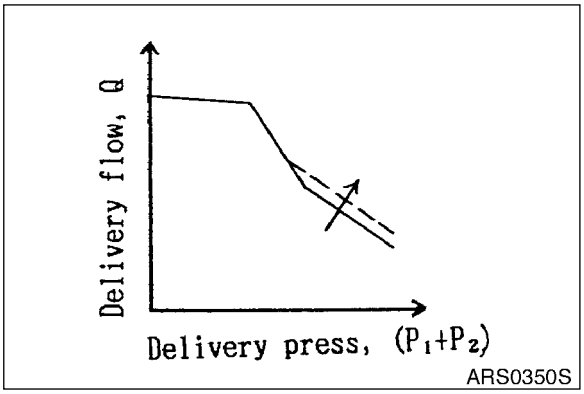


Figure 29

Variable Horsepower Control

The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided. However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level. This function permits arbitrary setting of the Pump output power, thereby providing the optimum power level according to the operating condition.

1. Functional explanation

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the Figure 30.

As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

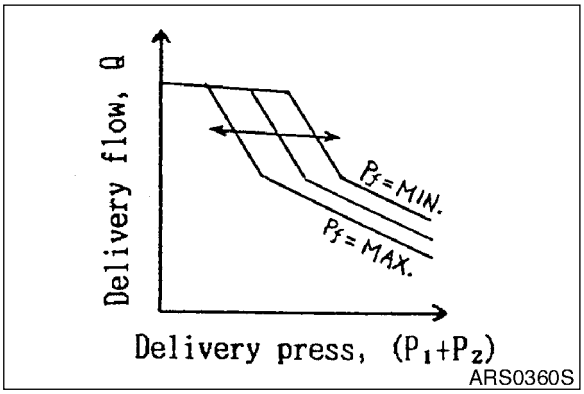


Figure 30

ADJUSTMENT OF MAXIMUM AND MINIMUM FLOWS

The regulator can adjust the maximum and minimum flows with the adjusting screws.

NOTE: *Their respective adjustment values are shown in the attached Table. See "Summary of Regulator Adjustment Values" on page -39.*

Adjustment of Maximum Flow

Adjust it by loosening the hexagon nut (809) and by tightening (or loosening) the set screw (954). The maximum flow only is adjusted without changing other control characteristics.

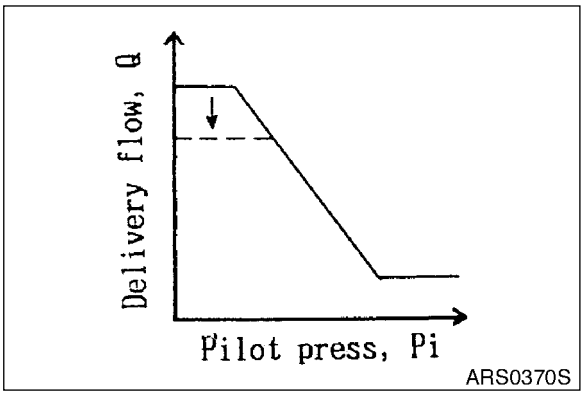


Figure 31

Adjustment of Minimum Flow

Adjust it by loosening the hexagon nut (909) and by tightening (or loosening) the hexagonal socket head set screw (953).
Similarly to the adjustment of the maximum flow, other characteristics are not chanced.
However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure (or during relieving) may increase.

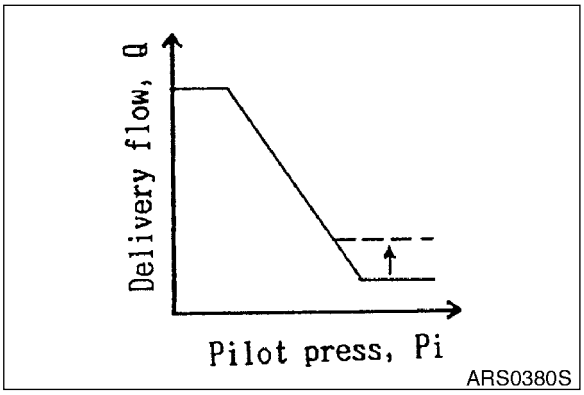


Figure 32

Summary of Regulator Adjustment Values

Item			Specification
Speed			2200 min^{-1}
Adjustment of Maximum Flow		Tightening amount of adjusting screw (954)	+1/4 Turn
		Flow change amount	-3.5 L/min
Adjustment of Minimum Flow		Tightening amount of adjusting screw (953)	+1/4 Turn
		Flow change amount	+3.5 L/min
Adjustment of Input Horsepower	Adjustment of outer spring	Tightening amount of adjusting screw (C) (628)	+1/4 Turn
		Compensating control starting pressure change amount	+19 kgf/cm^2
		Input torque change amount	+3 kgf m
		A	1.9
	Adjustment of inner spring	Tightening amount of adjusting screw (QI) (925)	+1/4 Turn
		Compensating control starting pressure change amount	+27 kgf/cm^2
		Input torque change amount	+2.5 kgf m
Adjustment of flow control characteristic		Tightening amount of adjusting screw (924)	+1/4 Turn
		Flow control starting pressure change amount	+1.5 kgf/cm^2
		Flow change amount	+8 L/min

FAULT FINDING AND REMEDIES ON REGULATOR

In case a functional fault probably resulting from the regulator occurs, disassemble and inspect it, referring to the maintenance manual.

Prime Mover is Overloaded

Determine which is faulty, the front pump or rear pump, by loading each pump independently. When both pumps are found faulty, investigate the following (1) and (2). Begin investigation with (3), when only one pump is found faulty. (1) and (2) are only for cases of the variable horsepower control.

1. Check that the power shift command current I is normal.
2. The power shift pressure is low:
   - Check the amplifier dither.
   - Replace the proportional pressure reducing valve.
3. The compensating piston (621) and compensating rod (623) are stuck with each other:
   - Disassemble and clean the regulator.
4. The Pin (898) is stuck:
   - Disassemble and clean the regulator.

Maximum Flow Is Not Available

1. Check that the pilot pressure Pi is normal.

2. The pilot piston (643) is stuck:
   - Disassemble and clean the regulator.
3. The spool (652) is stuck:
   - Disassemble and clean the regulator.
4. The piston QMC stopper (647) and piston (648) are stuck with each other:
   - Disassemble and clean the regulator.
5. The spool (COV) (637) is stuck:
   - Disassemble and clean the regulator.

NOTE: *Replace faulty parts that are deeply scord.*

(1) and (2) are only for cases of the pilot control.

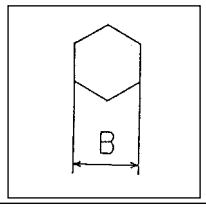
(4) is only for cases of the 2-stage max. flow control.

(5) is only for cases of the cut-off control.

PREPARATION FOR DISASSEMBLY

1. Since the regulator consists of small precision-finished parts, disassembly and assembly are rather complicated. For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.
2. The numbers in parentheses after part names represent those in the construction drawings on Figure 22 and Figure 23.

TOOLS

Name	Description
Allen wrench	4,5,6 (Dimension B mm) 
Socket wrench, double-ended (single-ended) wrench	
Adjustable wrench	Small size (max. 36 mm)
Screw driver	
Plastic hammer	
Torque wrench	
Pliers	2 sets for stop ring
Steel bar	4 mm or less in dia., L=100mm
Pincers	
Bolt	M4, L=about 50 mm

REGULATOR DISASSEMBLY

1. Choose a plate for disassembly.

⚠ CAUTION!
1. Choose a clean place.
2. Spread rubber sheet, cloth, or so on top of work-bench to prevent parts from being damaged.

2. Remove dust, rust, etc. from surfaces of regulator with clean oil.

3. Remove hexagon socket head screws (412,413) and remove regulator main body from pump main body.

IMPORTANT
Take care not to lose O-ring.

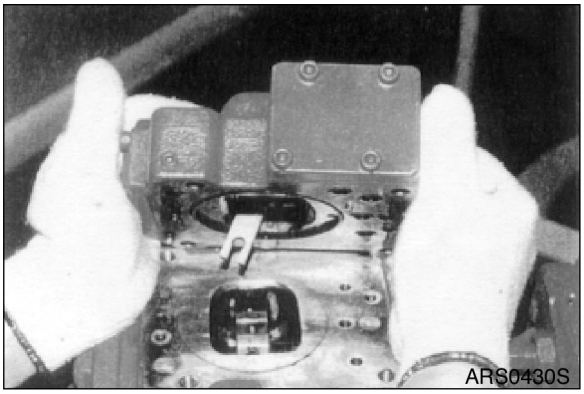


Figure 33

4. Remove hexagon socket head screws (488) and remove cover (C) (629).

IMPORTANT
Cover (C) is fitted with adjusting screw (C), (QI) (628, 925), adjusting ring (C) (627), lock nut (630), hexagon nut (801) and adjusting screw (924). Do not loosen these screws and nuts. If they are loosened, adjusted pressure-flow setting will vary.

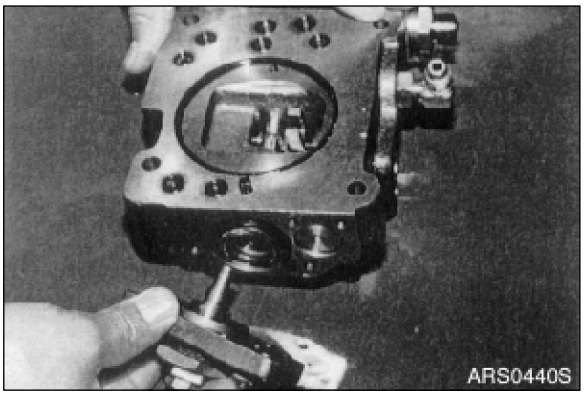


Figure 34

5. After removing cover (C) (629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C) (624) from compensating section. Then draw out adjusting ring (Q) (645), pilot spring (646) and spring seat (644) from pilot section.

IMPORTANT
Adjusting ring (Q) (645) can easily be drawn out with M4 bolt.



Figure 35

6. Remove hexagon socket head screws (436, 438) and remove pilot cover (641). After removing pilot cover, take out set spring (655) from pilot section.

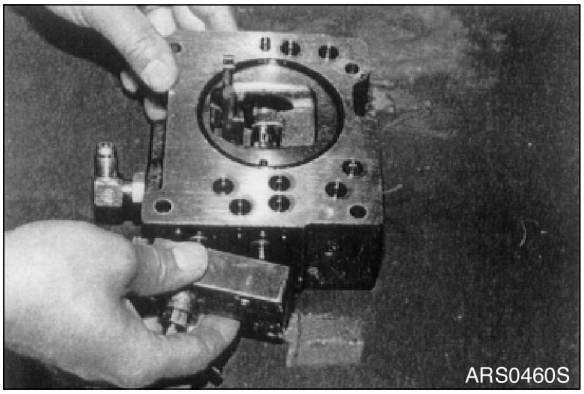


Figure 36

7. Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).

IMPORTANT
Sleeve (651) is fitted with snap ring (836). **When removing snap ring (814), return spring (654) may pop out. Take cae not to lose it.**

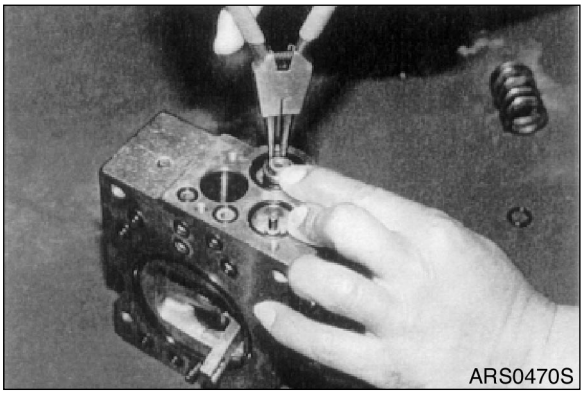


Figure 37

8. Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).



Figure 38

IMPORTANT
Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.



Figure 39

9. Remove lever (2) (613). Do not draw out pin (875).

IMPORTANT
Work will be promoted by using pincers or so on.



Figure 40

10. Draw out pin (874) and remove feedback lever (611).

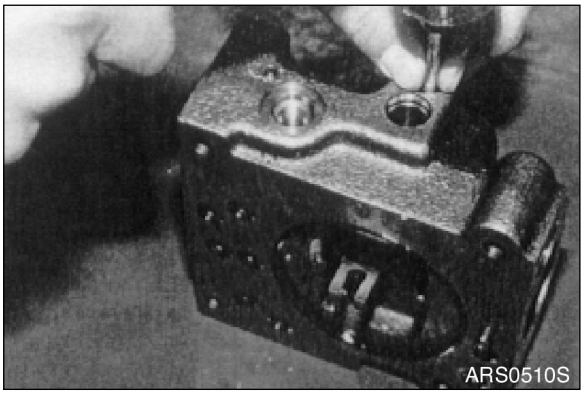


Figure 41

IMPORTANT
Push out pin (874) (4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1) (612).

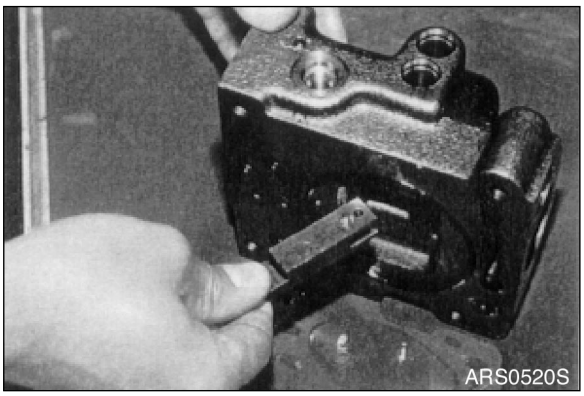


Figure 42

11. Remove lever (1) (612). Do not draw out pin (875).
12. Draw out pilot piston (643) and spool (652).
13. Draw out piston case (622), compensating piston (621) and compensating rod (623). This completes operation.

    NOTE: *Since component parts are small, take care not to lose them.*

REGULATOR REASSEMBLY

For assembly, reverse disassembly procedures, but pay attention to the following.

- Always repair parts that were scored at disassembly. Get replacement parts ready beforehand.
- Mixing of foreign matter will cause malfunction. Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.
- Always tighten bolts, plugs, etc. to their specified torques.
- Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.
- Replace seals such as O-rings with new ones as a rule.

1. Put compensating rod (623) into compensating hole of casing (601).
2. Put pin force-fitted in lever (1) (612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.
3. Fit spool (652) and sleeve (651) into hole in spool of casing.

IMPORTANT
Confirm that spool and sleeve slide smoothly in casing without binding. **Pay attention to orientation of spool.**

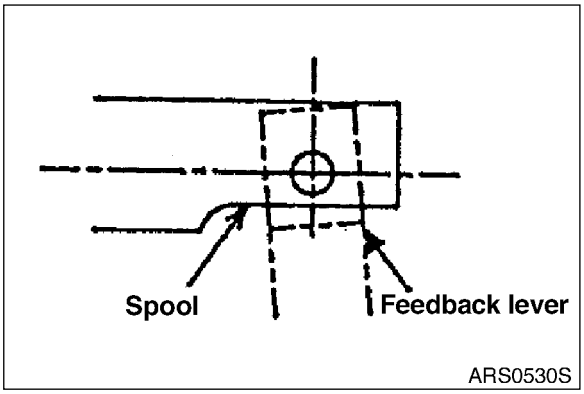


Figure 43

4. Fit feedback lever (611), matching its pin hole with pin hole in spool. Then insert pin (874).

IMPORTANT
Insert pin in feedback lever a little to ease operation. **Take care not to mistake direction of feedback lever.**

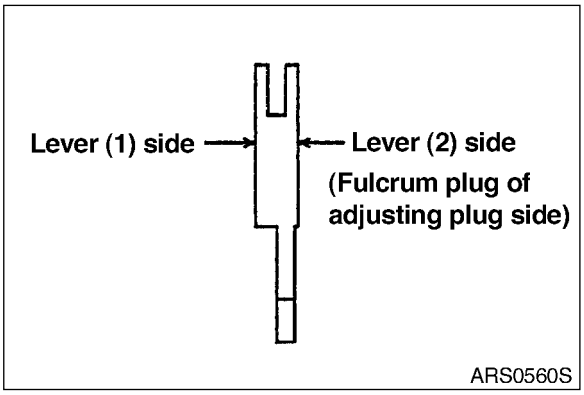


Figure 44

5. Put pilot piston (643) into pilot hole of casing.

IMPORTANT
Confirm that pilot piston slides smoothly without binding.

6. Put pin force-fitted in lever (2) (613) into groove of pilot piston. Then fix lever (2).

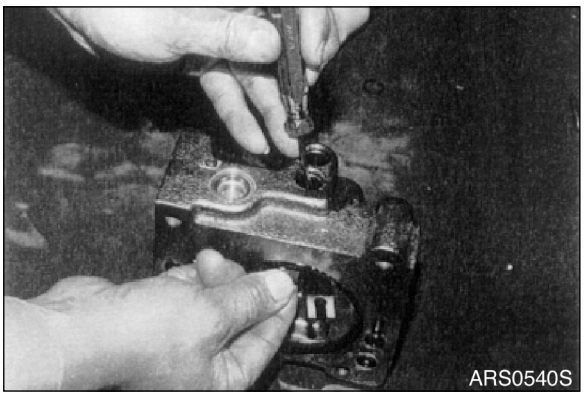


Figure 45

7. Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever (2). Then fix locking ring (858).
8. Insert adjusting plug (615) and fit locking ring.

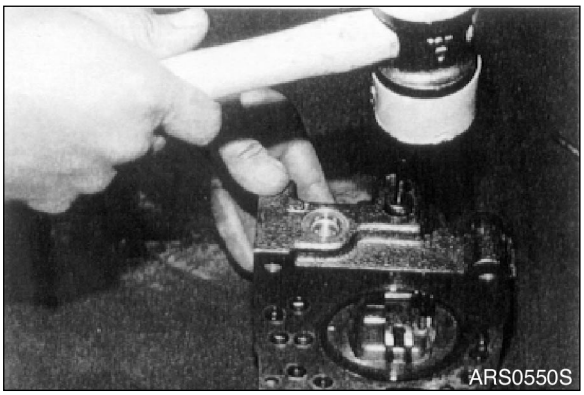


Figure 46

IMPORTANT
Take care not to mistake inserting holes for fulcrum plug and adjusting plug. **At this point in time move feedback lever to confirm that it has no large play and is free from binding.**

9. Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).

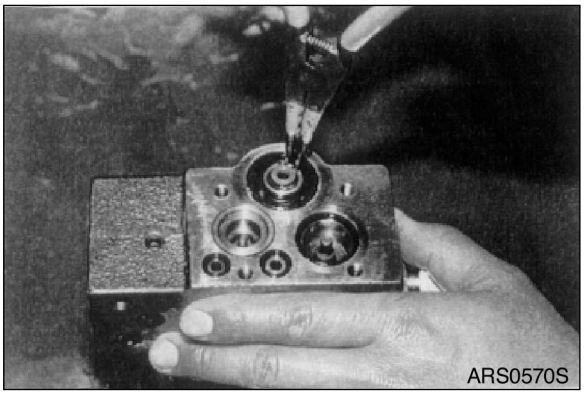


Figure 47

10. Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.

    Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).

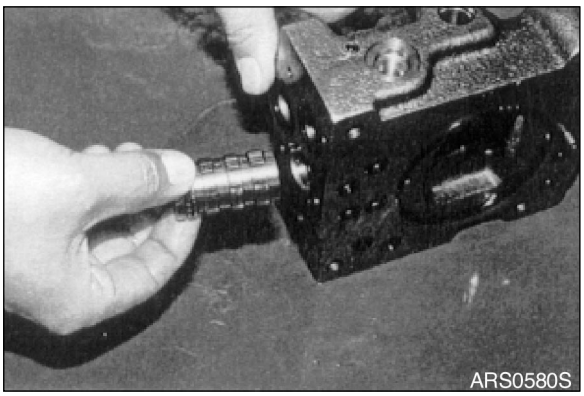


Figure 48

11. Put spring seat (644), pilot spring (646) and adjusting ring (Q) (645) into pilot hole.

    Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

IMPORTANT
When fitting spring seat, take care not to mistake direction of spring seat.

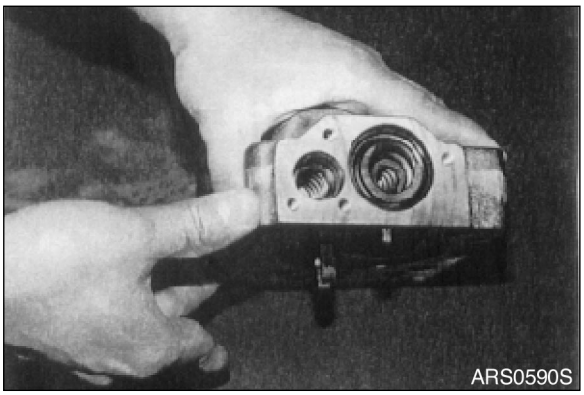


Figure 49

12. Install cover (C) (629) fitted with adjusting screws (628) (925), adjusting ring (C) (627), lock nut (630), hexagon nut (801) and adjusting screw (924).

    Then tighten them with hexagonal socket head screws (438).
    This completes assembly.

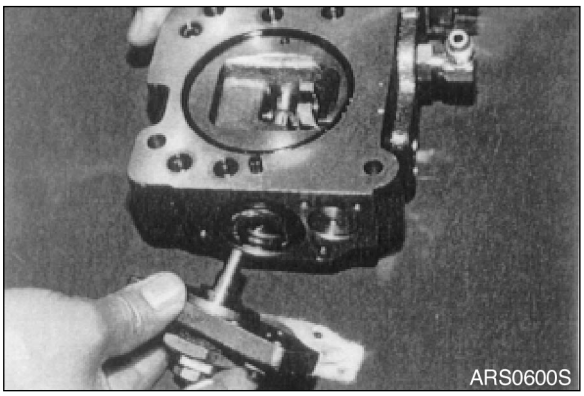
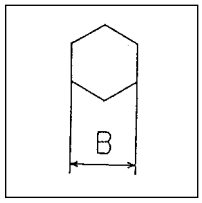


Figure 50

TIGHTENING TORQUE

Part Name	Size	Tightening Torque	Tool Name	
Hexagon socket head bolt (Material: SCM 435)	M 5	70 kgf•cm	B = 4	 Allen wrench
	M 6	120 kgf•cm	5	
	M 8	300 kgf•cm	6	
	M 10	580 kgf•cm	7	
	M 12	1,000 kgf•cm	8	
	M 14	1,600 kgf•cm	10	
	M 16	2,400 kgf•cm	12	
	M 18	3,400 kgf•cm	14	
	M 20	4,400 kgf•cm	17	
PT filling plug (Material: S45C) Wind a seal tape 1 1/2 to 2 turns round the plug.	PT 1/16	70 kgf•cm	4	Do.
	PT 1/8	105 kgf•cm	5	
	PT 1/4	175 kgf•cm	6	
	PT 3/8	350 kgf•cm	8	
	PT 1/2	500 kgf•cm	10	
PO plug (Material: S35C)	PF 1/4	300 kgf•cm	6	Do.
	PF 1/2	1,000 kgf•cm	10	
	PF 3/4	1,500 kgf•cm	14	
	PF 1	1,900 kgf•cm	17	
	PF 1 1/4	2,700 kgf•cm	17	
	PF 1 1/2	2,800 kgf•cm	17	

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

MAIN CONTROL VALVE (KAYABA)

⚠ 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 300LC-V	1001 and Up
Solar 340LC-V	1001 and Up

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January 2002

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GENERAL DESCRIPTION

THEORY OF OPERATION

When All Spools are in Neutral

1. Neutral Passage

The oil supplied from the port (P1, Figure 1 and Figure 2) flows from the neutral passage (L1) through the low pressure relief valve orifice (Lc1) to tank passage (Ta) and flows into the ports (T1, T2, and T3).
The oil supplied from the port (P1) flows from the neutral passage (R1) through the low pressure relief valve orifice (Rc1) to tank passage (Ta) and flows into the ports (T1, T2, and T3).
The pressures of the low pressure relief valve upper chambers (L2 and R2) reach through the ports (ps1 and ps2) to the pump and control the displacements of the pumps (P1 and P2).
If too much oil flows into the neutral passages, the low pressure relief valves act and prevent the ports (P1 and P2) from raising the pressures.

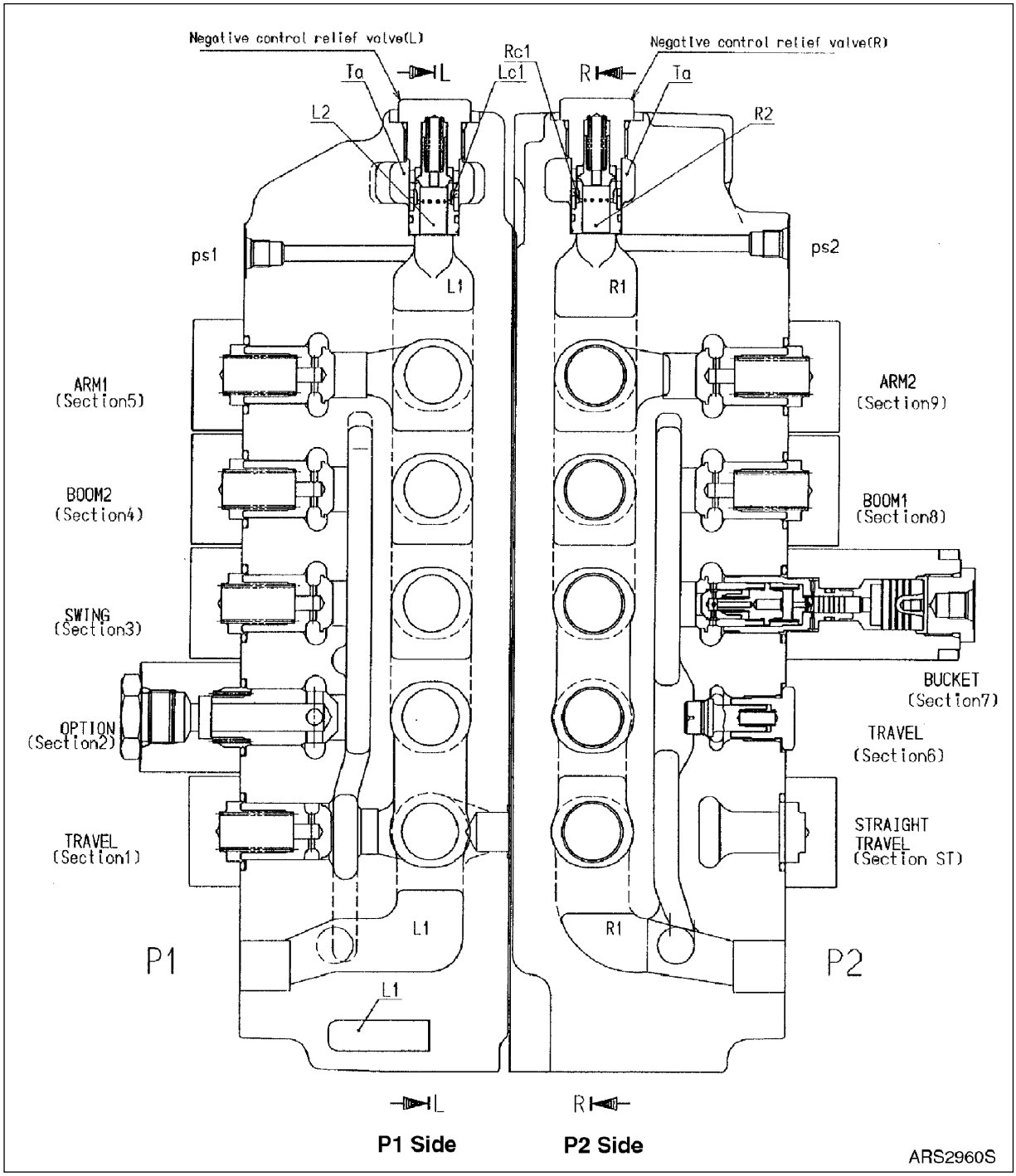

Negative control relief valve(L)
Negative control relief valve(R)
Ta
L
Rc1
Lc1
R
Ta
L2
R2
ps1
ps2
L1
R1
ARM1
(Section5)
ARM2
(Section9)
BOOM2
(Section4)
BOOM1
(Section8)
SWING
(Section3)
BUCKET
(Section7)
OPTION
(Section2)
TRAVEL
(Section6)
TRAVEL
(Section1)
STRAIGHT
TRAVEL
(Section ST)
L1
R1
P1
P2
L1
L
R
P1 Side
P2 Side
ARS2960S

Figure 1

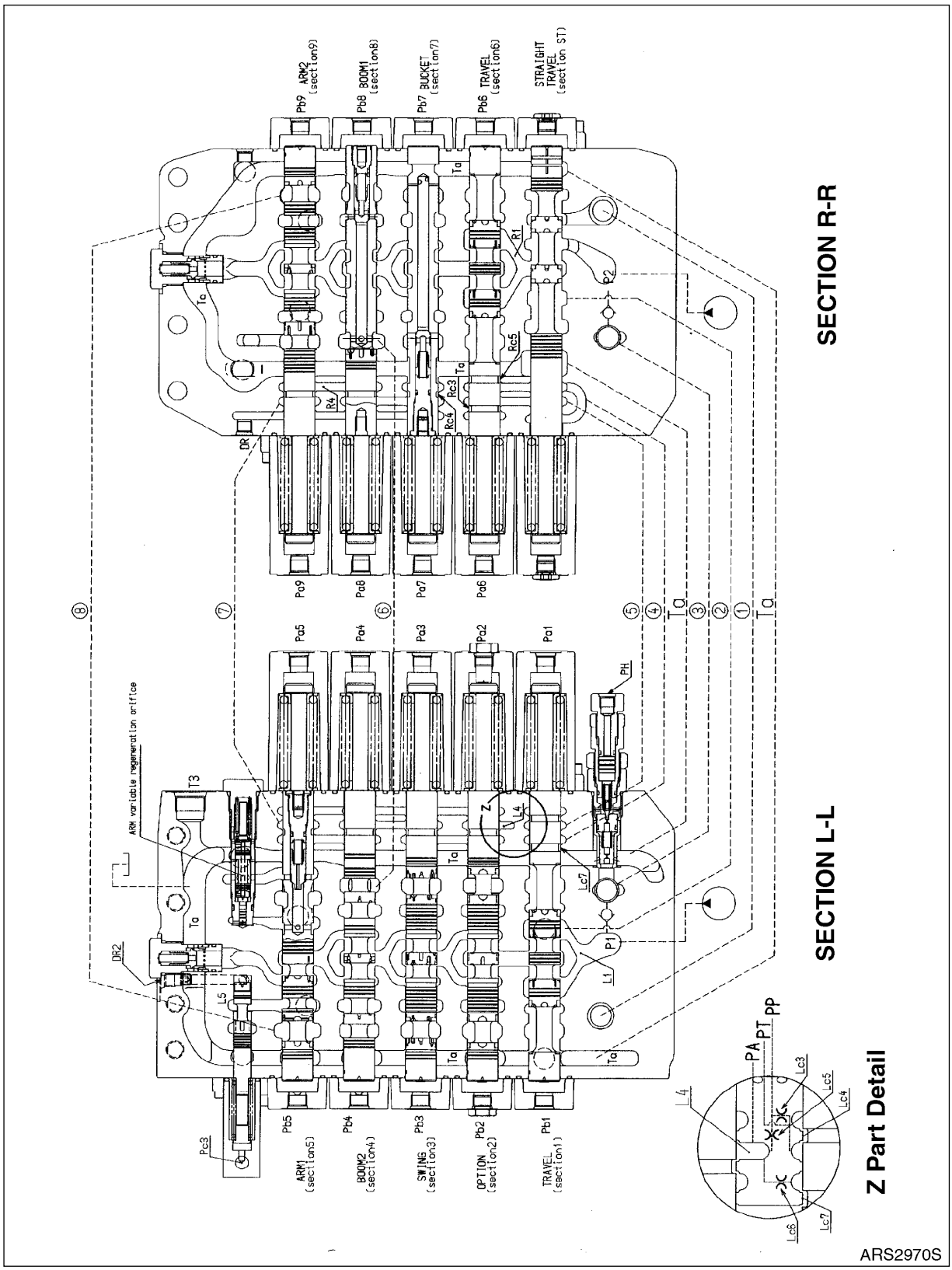

SECTION R-R
SECTION L-L
Z Part Detail
ARS2970S
ARM variable regeneration orifice
Pb9 ARM2 (section9)
Pb8 BOOM1 (section8)
Pb7 BUCKET (section7)
Pb6 TRAVEL (section6)
STRAIGHT TRAVEL (section ST)
Pb5 ARM1 (section5)
Pb4 BOOM2 (section4)
Pb3 SWING (section3)
Pb2 OPTION (section2)
Pb1 TRAVEL (section1)
Pa9
Pa8
Pa7
Pa6
Pa5
Pa4
Pa3
Pa2
Pa1
Pc3
PA
PT
PP
PH
PI
DR
DR2
T3
Ta
R1
R2
R4
Rc3
Rc4
Rc5
L1
L4
L5
Lc3
Lc4
Lc5
Lc6
Lc7

Figure 2

2. Signal Passage

The oil supplied from the port (PP, Figure 2 and Figure 3) flows through the orifice (Lc3) to port (PT) and simultaneously flows through the land (Lc4), the passage (5), and land (Rc3) into the tank passage (Ta).
The some oil supplied from the port (PP) flows through the orifice (Lc5) into port (PA), and also flows through passages (L4)(7) and (R4) to the bucket spool land (Rc4) and flows into drain passage (DR).
The oil passed through the orifice (Lc6) flows from the land (Lc7) to the tank passage (Ta) or passes through the passage (4) to the travel spool land (Rc5) and flows into the tank passage (Ta).

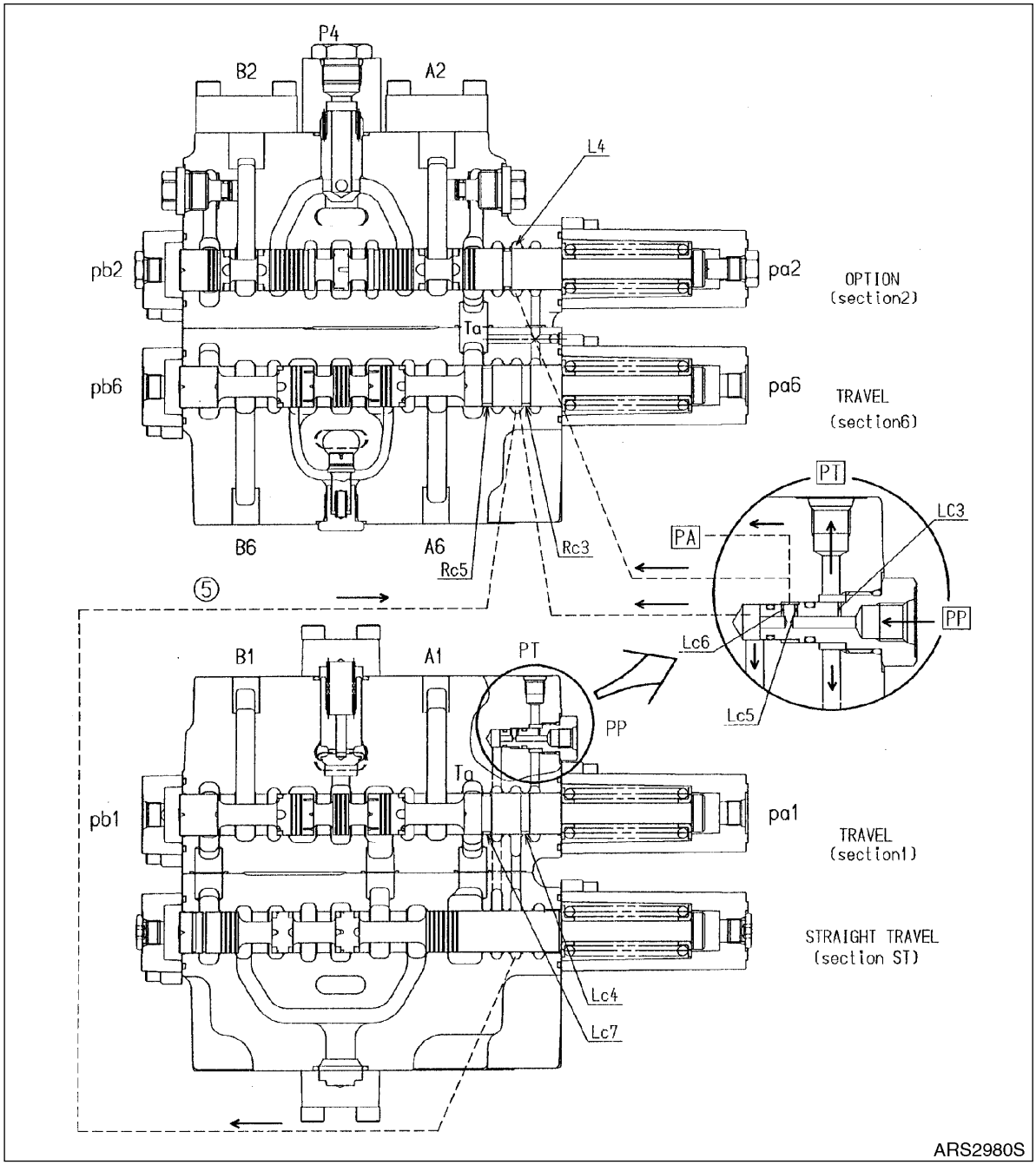


Figure 3

Single Operation

1. Travel Spool Switching

When switching the travel spool by increasing the pressure of the travel (section 1, Figure 4) pilot port (Pb1 (Pa1)), the oil supplied from the port (P1) passes through the neutral passage (L1) to the spool head and flows to the port (B1 (A1)). The return oil passes through the port (A1 (B1)) to the spool head and return to the tank passage (Ta).
When switching the travel spool by increasing the pressure of the travel (section 6) pilot port (Pb6 (Pa6)), the oil supplied from the port (P2) passes through the neutral passage (R1) to the spool head or passage (S6-1) and flows to the port (B6 (A6)). At this time, the pressure of parallel passage (R3) and passage (S6-1) is same, and so poppet (S6-2) is not opened. The return oil passes through the port (A6 (B6)) to the spool head and return to the tank passage (Ta).
If either one of travel spool (section 1) or (section 6) is switched, land (Lc4) or (Rc3) is closed. Oil supplied from port (PP) does not flow into tank passage, so that the pressure of port (PT) rises.

2. Spare Spool Switching

When switching the spare spool by increasing the pressure of the spare (section 2, Figure 4) pilot port (Pb2 (Pa2)), neutral passage (L1) is closed. The oil supplied from the port (P1) passes through the parallel passage (L3), road check valve (S2-2), passage (S2-1), and spool head and flows to port (B2 (A2)). The return oil passes through the port (A2 (B2)) to the spool head and return to the tank passage (Ta). In case that oil is supplied from port (P4), it passes through load check valve (S2-2) and is combined at passage (S-1).

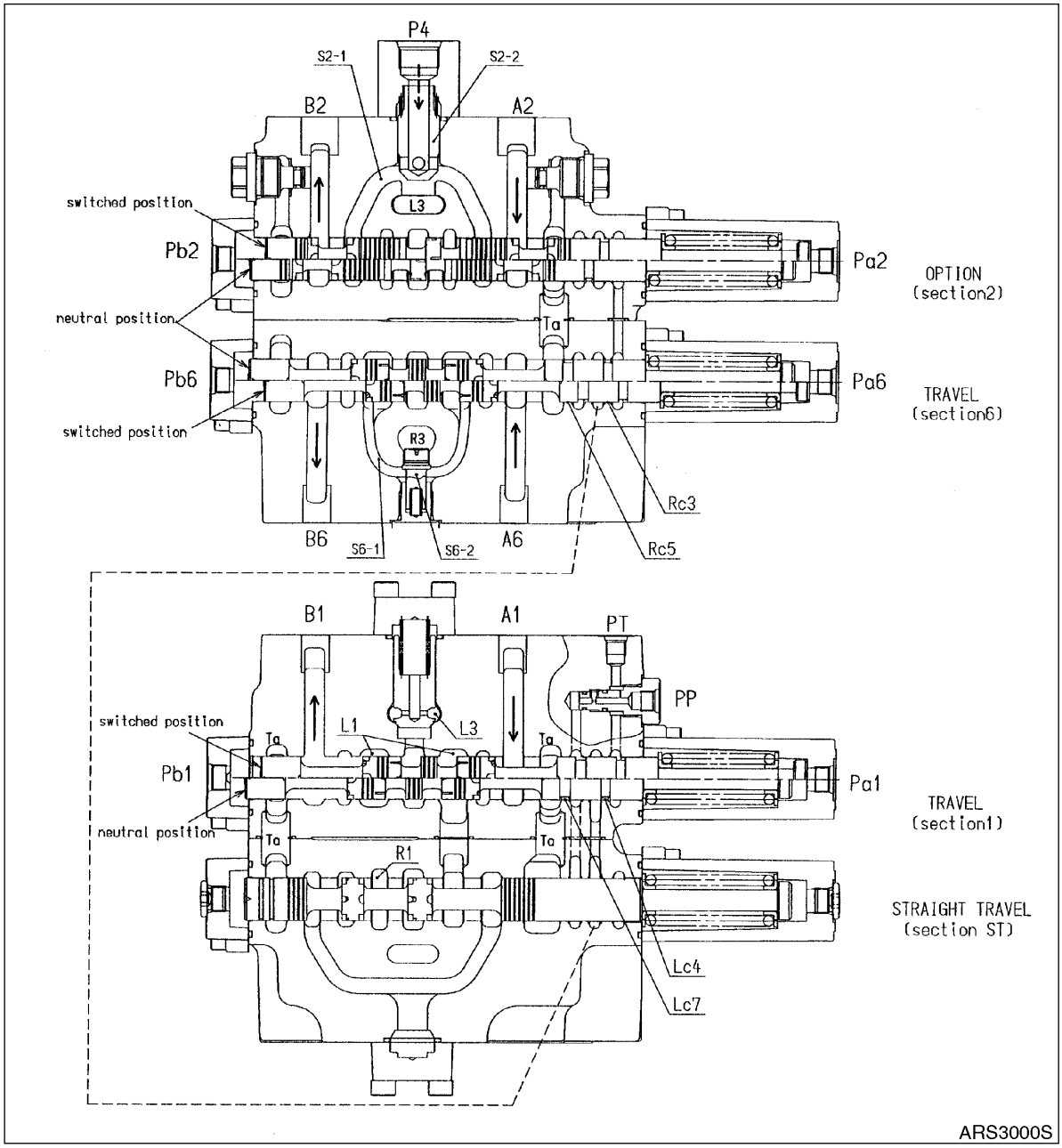

P4
S2-1
S2-2
B2
A2
switched position
L3
Pb2
Pa2
OPTION
(section2)
neutral position
Ta
Pb6
Pa6
TRAVEL
(section6)
switched position
R3
Rc3
B6
S6-1
S6-2
A6
Rc5
B1
A1
PT
PP
switched position
Ta
L1
L3
Ta
Pb1
Pa1
TRAVEL
(section1)
neutral position
Ta
R1
Ta
STRAIGHT TRAVEL
(section ST)
Lc4
Lc7
ARS3000S

Figure 4

3. Swing Spool Switching

When switching the swing spool by increasing the pressure of the swing (section 3, Figure 5) pilot port (Pb3 (Pa3)), the neutral port (L1) is closed. The oil supplied from the port (P1) flows through the parallel passage (L3), the load check valve (S3-1), passage (S3-1) and the spool head to the port (B3 (A3)). The return oil passes through the port (A3 (B3)) to the spool head and returned to the tank passage (Ta).

4. Bucket Spool Switching

Oil flow direction of bucket section of this valve against pilot port is different from other section because it has a regeneration function.

A. Dump

When the bucket spool is switched by increasing the pressure of the bucket (section 7, Figure 5) pilot port (Pa7), the neutral passage (R1) is closed. The oil supplied from the port (P2) flows through the parallel passage (R3), the load check valve (S7-2), the passage (S7-1), the spool head and into the port (B7). The oil returns through the port (A7) and the spool head to the tank passage (Ta).

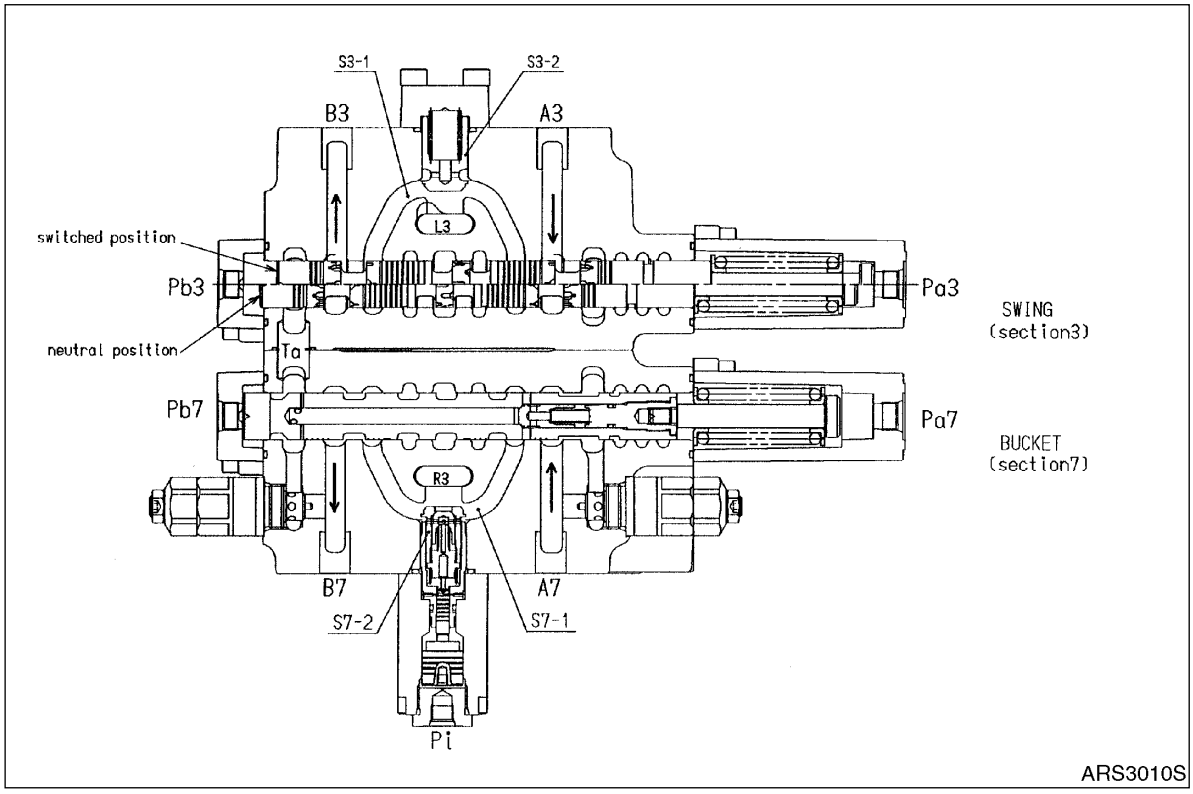


Figure 5

B. Crowd

When the bucket spool is switched by increasing the pressure of the bucket (section 7, Figure 6) pilot port (Pb7), the neutral passage (R1) is closed. The oil supplied from the port (P2) flows through the parallel passage (R3), the load check valve (S7-2), the passage (S7-1), the spool head and into the port (A7). The oil flows through the port (B 7) and the one oil returns through the spool head to the tank passage (Ta) and the other oil passes through spool inside, push up load check, and then is combined at port (A7).

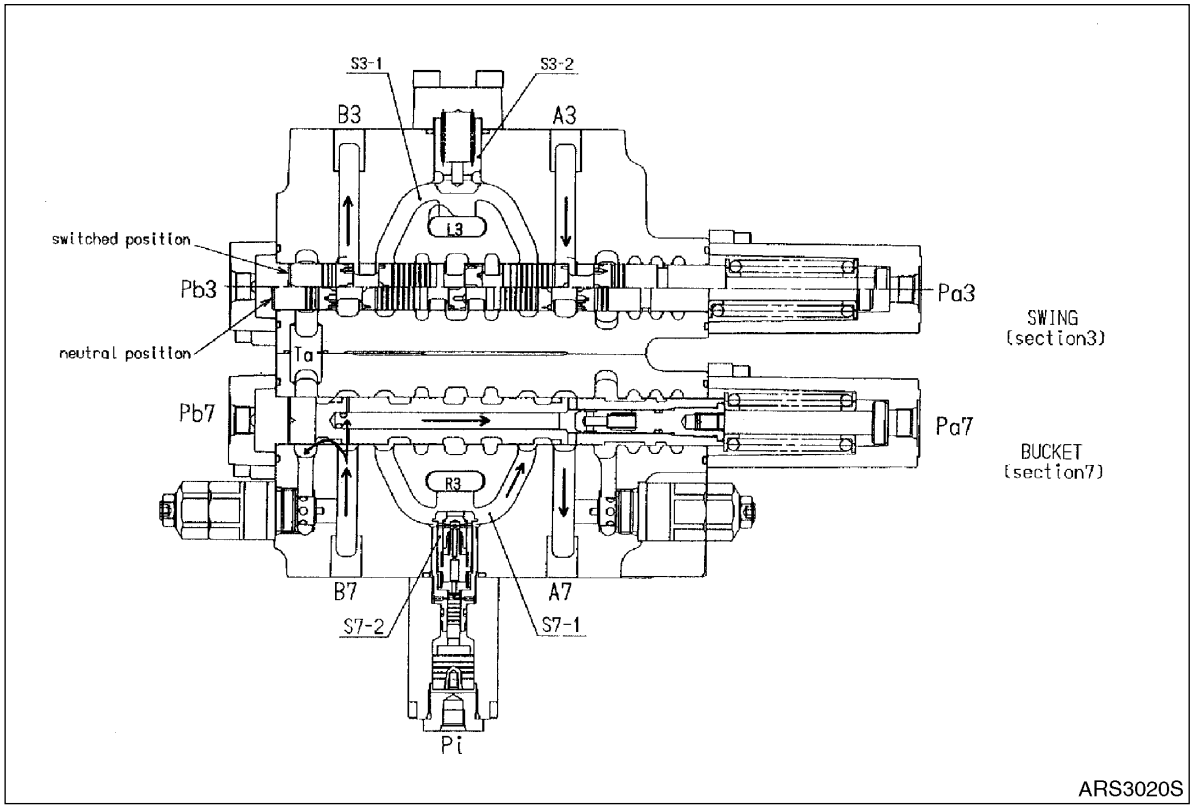


Figure 6

5. Boom Spool Switching

A. Neutral

This valve has the antidrift valve which is installed on the bottom side of the boom 1 cylinder.

When neutral, the poppet (AD1, Figure 7) is surely closed by the port (A8) pressure which is sent through the passage (AD2) and the spool (AD3) and to the spring chamber (AD4).

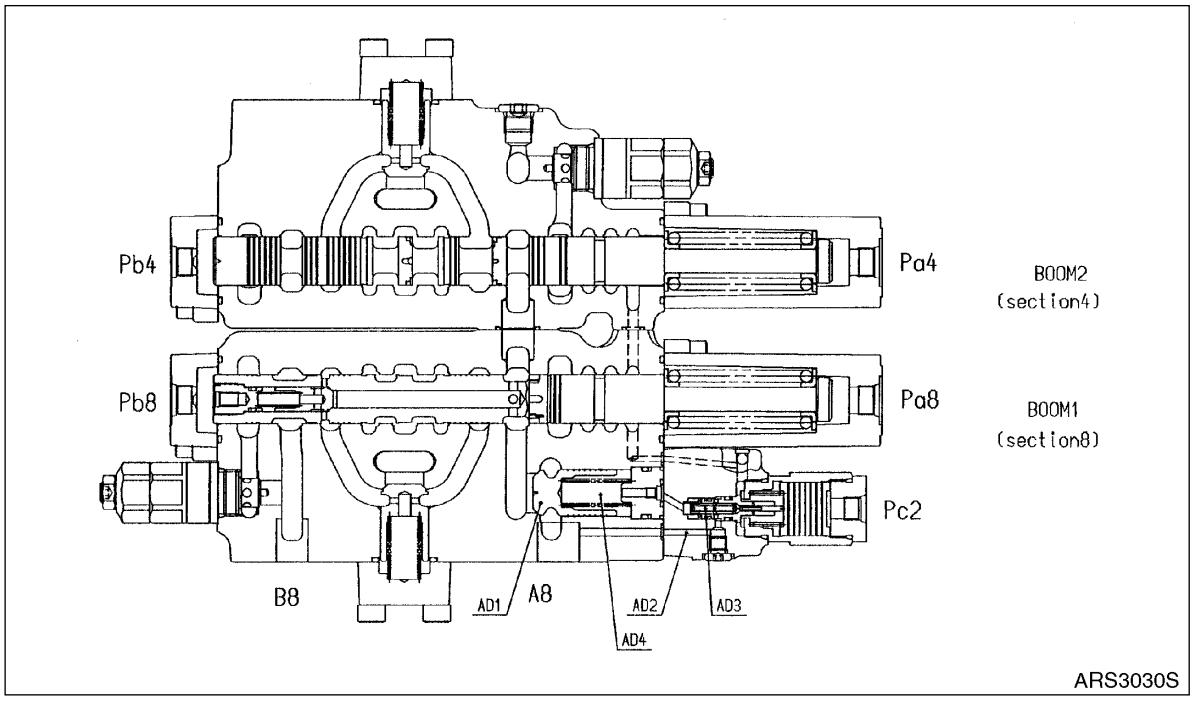


Figure 7

B. Boom Up (2 Speed Junction)

When the boom 1 spool is switched by increasing the pressure of the boom 1 (section 8, Figure 8) pilot port (Pa8), the neutral passage (R1) is closed. The oil supplied from the port (P2) passes through the parallel passage (R3) and the load check valve (S8-2) to the spool head and flows into the port (A8).

When the boom 2 spool is switched by increasing the pressure of the boom 2 (section 4) pilot port (Pb4) also, the neutral passage (L1) is closed. The oil supplied from the port (P1) passes through the parallel passage (L3), the load check valve (S4-2), the spool head, and to the passage (6) and joins at the port (A8). The return oil flows from the port (B8) to the spool head and returns to the tank passage (Ta).

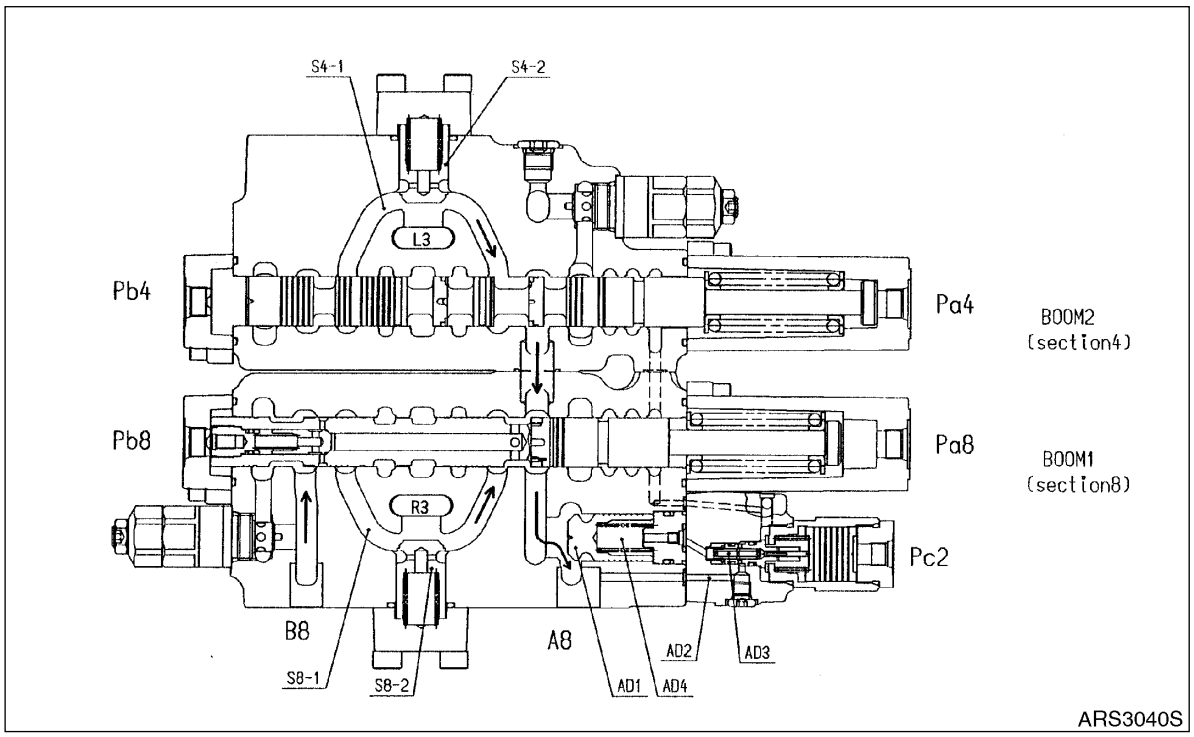


Figure 8

C. Boom Down (Regeneration)

When the boom 1 (section 8, Figure 9) spool is switched by increasing the pressure of the boom 1 pilot port (Pb8), the neutral passage (R1) is closed. The oil supplied from the port (P2) passes through the parallel passage (R3) and the load check valve (S8-2) to the spool head and flows into the port (B8).

When the spool (AD3) of the antidrift valve is switched by increasing the pressure of the port (P2) also, the poppet (AD1) is opened by the decreasing of the pressure of the spring chamber (AD4), and the return oil from the port (A8) returns to the tank passage. Some of the return oil opens the poppet (S8-3) in the boom 1 spool, passes through the passage (S8-2), joins at the port (B7), and then prevents the cavitation of the cylinder rod side.

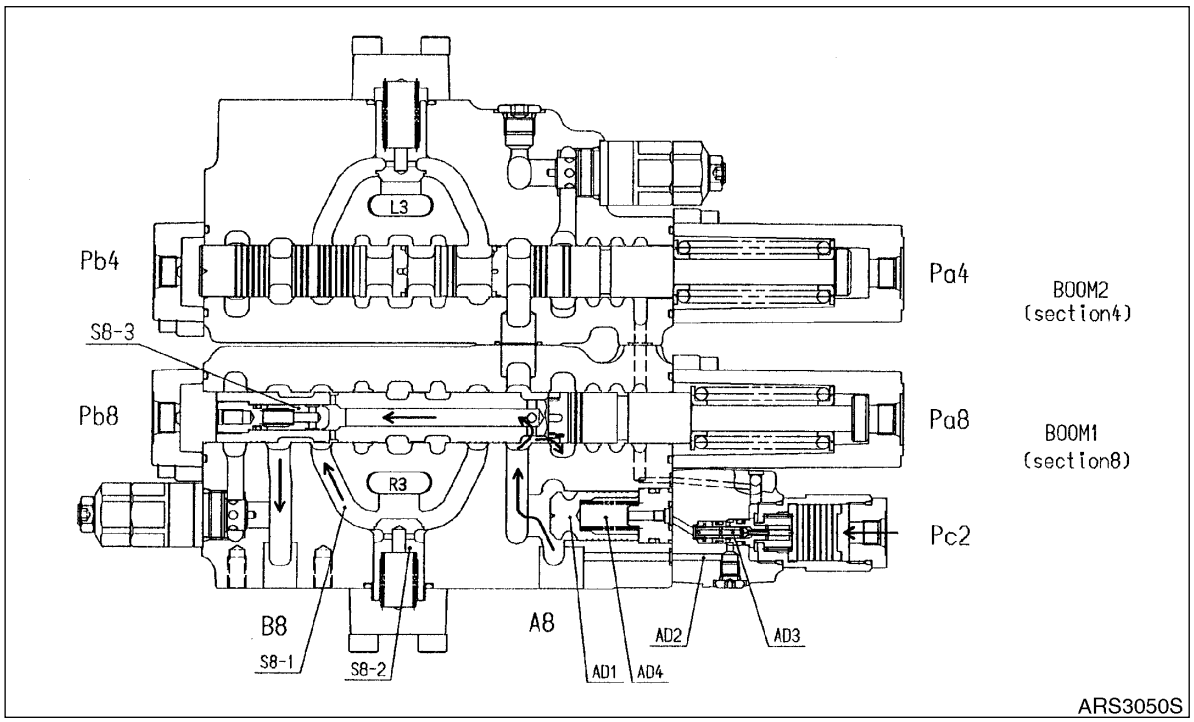


Figure 9

6. Arm Spool Switching

A. Neutral

This valve has the antidrift valve which is installed on the rod side of the arm 1 cylinder.

When neutral, the poppet (AD1, Figure 10) is surely closed by the port (A5) pressure which is sent through the passage (AD2) and the spool (AD3) and to the spring chamber (AD4).

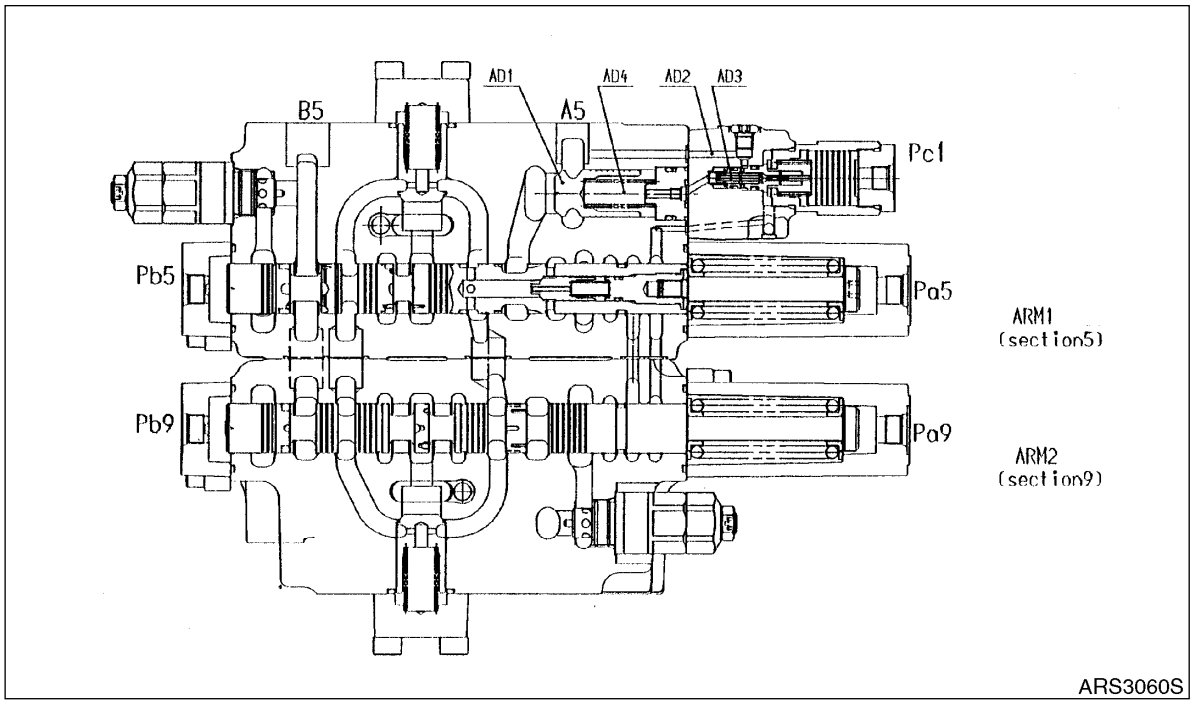


Figure 10

B. Arm Crowd (2 Speed Junction)

When the arm 1 spool is switched by increasing the pressure of the arm 1 (section 5, Figure 11) pilot port (Pb5), the oil supplied from the port (P1) flows through the neutral passage (L1), the load check valve (S5-2), the passage (S5-1) and the spool head and into the port (B5). When the arm 2 spool is switched by increasing the pressure of the arm 2 (section 9) pilot port (pb9) also, the oil supplied from the port (P2) passes through the neutral passage (R1), the load check valve (S9-1), the passage (S9-2), and the spool head and to the passage (8) and joins at the port (B5).

The return oil from the port (B5) passes through regeneration check in spool and flows to port B to regenerate, and some oil returns through variable regeneration release valve to tank (Ta). (Refer to section 2-2)

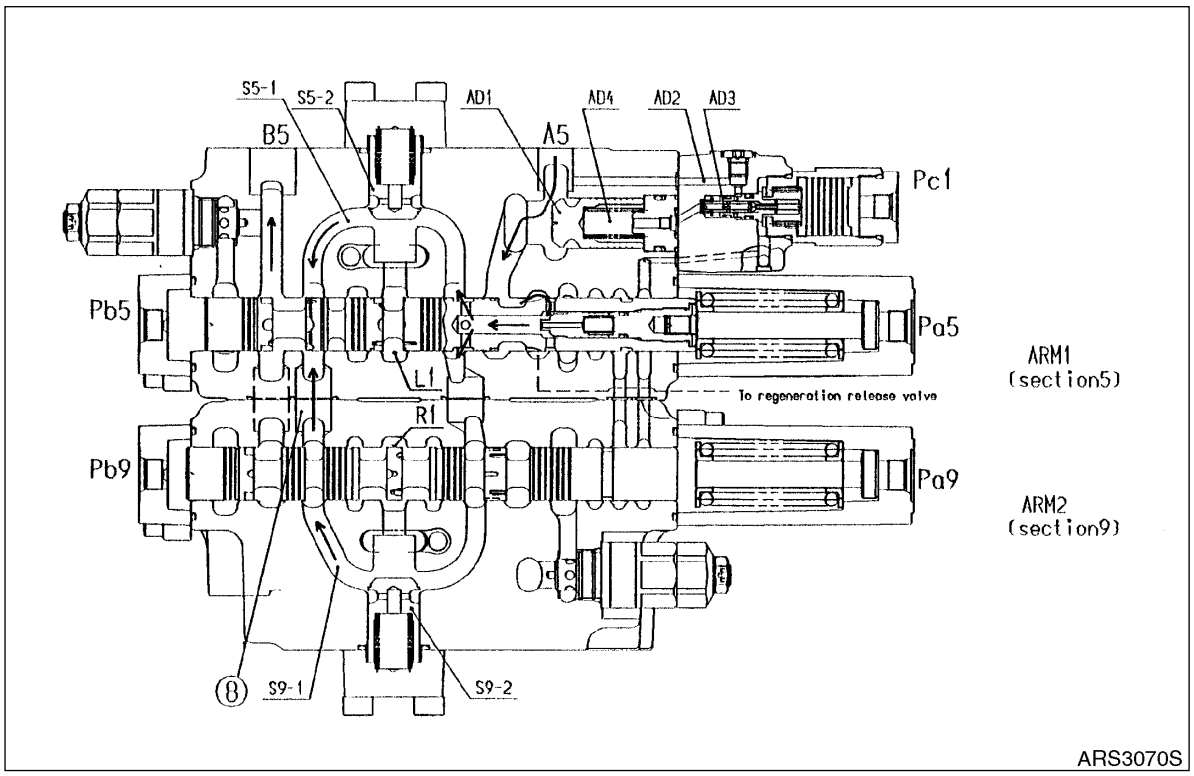


Figure 11

C. Arm Crowd (Variable Regeneration)

When crowding arm, after the return oil from port (A5, Figure 12) passes through notch (a), the one oil returns through fixed orifice (d), passage (e) and variable orifice (f) and to tank passage (Ta), and the other oil flows through fixed orifice (b), regeneration check (c), and fixed orifice (i) in arm 1 spool, and joins to bridge passage (S5-1).

From here, if load pressure of port (B) is increased, it passes through regeneration release valve piston (g) and pushes regeneration release spool (h), as a result the area of variable orifice (f) is increased, and the oil returning to tank (Ta) is increased, and partly the oil to regenerate in port (B5) is decreased.

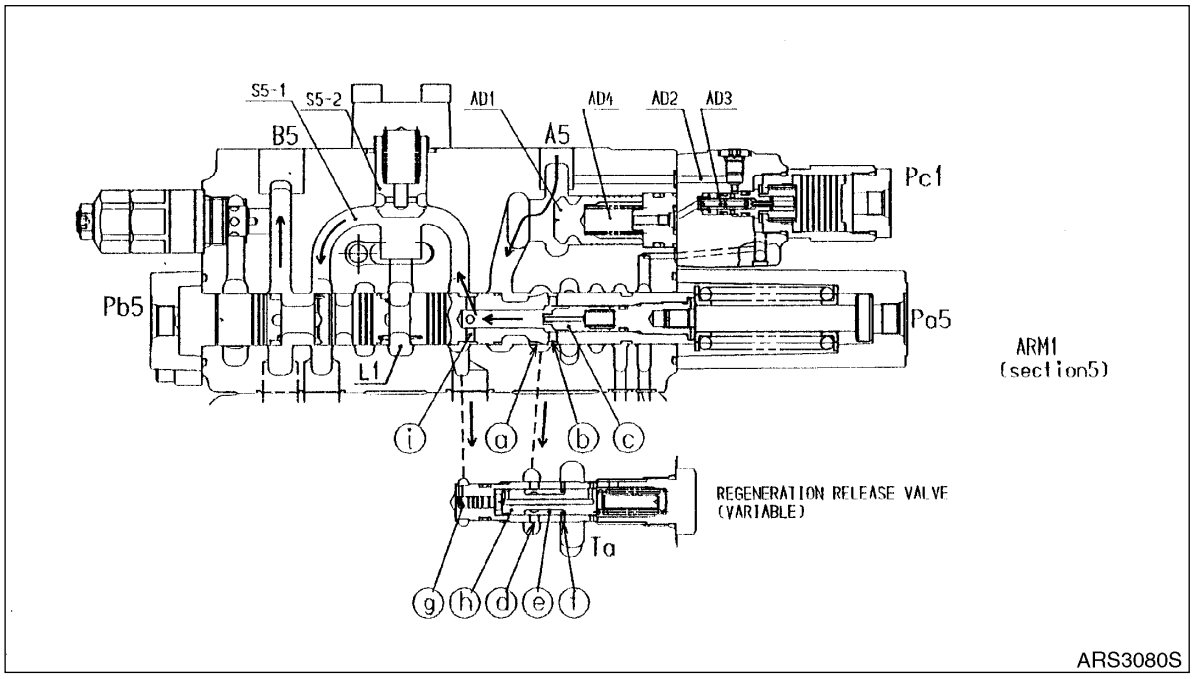


Figure 12

D. Arm Dump (2 Speed Junction)

When the arm 1 spool is switched by increasing the pressure of the arm 1 (section 5, Figure 13) pilot port (Pa5), the oil supplied from the port (P1) flows through the neutral passage (L1), the load check valve (S5-2), the passage (S5-1) and the spool head and into the port (A5).

The oil supplied from the port (P2) passes through the neutral passage (R1), the load check valve (S9-2), the passage (S9-1), the spool head and the passage (8) and joins at the port (A5). The return oil from port (B5) returns through the spool head to the tank passage (Ta).

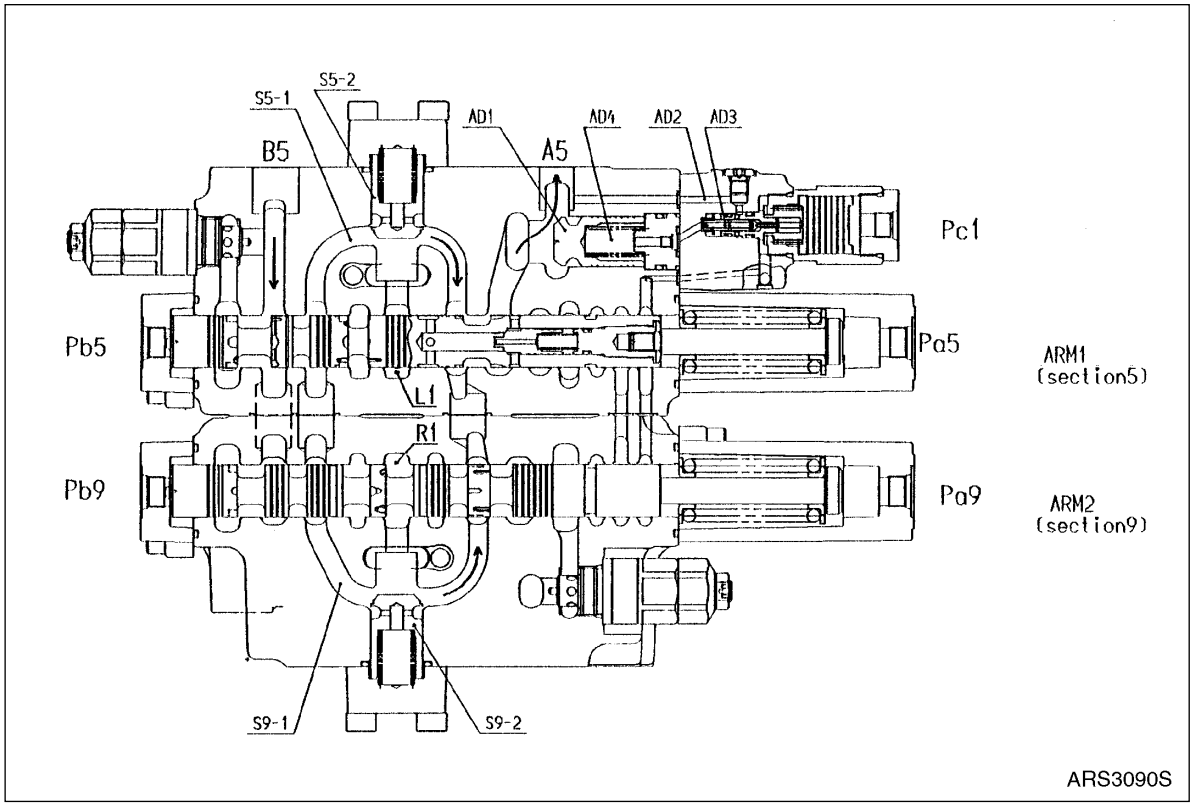


Figure 13

7. Parallel Orifice for Arm

The orifice, which is installed in the parallel passage for the arm 1 of this valve, controls arm speed when operating the combined operation. The oil supplied from parallel passage (L3, Figure 14) of arm 1 (section 5) pushes and opens poppet (S-3), after passes through orifice (Lc8) of variable orifice A54 spool, and then is connected to passage (L5, Figure 3). From here, the flow of orifice (Lc8) can be varied by increasing the pressure against pilot poppet (Pc3).

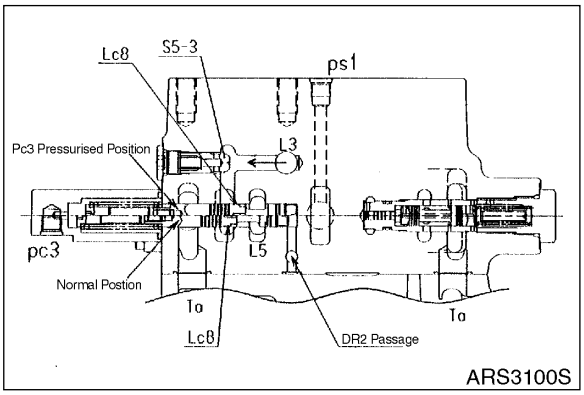


Figure 14

8. Relief Valve

A. Main Relief Valve

The oil supplied from the port (P1, Figure 15) passes through the poppet (LP), the oil supplied from the port (P2) passes through the poppet (RP) and the passage (3) also, and join at the main relief valve. The highest pressure of the pump (P1) and (P2) is controlled by acting of main relief valve.

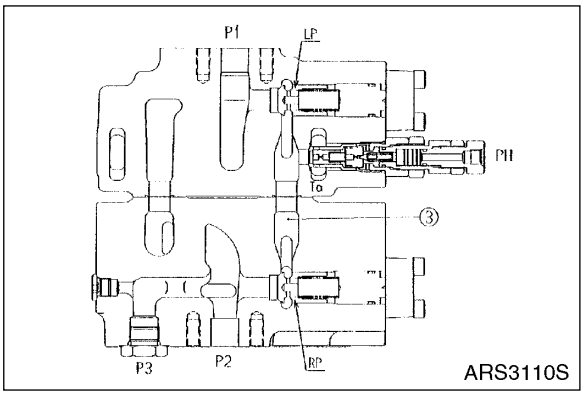


Figure 15

B. Over Load Relief Valve

The over load relief valve, which is installed in each cylinder port of the boom 1, arm 1 and bucket, prevent the pressure of the actuator from increasing extremely high by the foreign strength. This relief valve, when the pressure of the cylinder port is a negative pressure, has the function to prevent the cavitation by sucking the oil from the tank also.

Combined Operation

1. Travel Combined Operation

When applying the operation except travel simultaneously while applying travel left and right operating simultaneously (while forward traveling, backward traveling, or pivot turning) or when applying travel left and right operating simultaneously while applying the operation except travel, the oil supplied from the port (PP, Figure 16) is disconnected with the tank passage (Ta) at the signal land part of the section of the exception of travel switched with the land (Lc4) (Lc7) (Rc3) (Rc), and the pressure of the signal passage increases up to the relief setting pressure of the pressure source for signal.

By increasing of the signal pressure, the travel straight spool is switched and the pressures of the ports (PT) (PA) increase.

When the travel straight spool is switched, the oil supplied from the port (P1) flows from the neutral passage (L1) to the travel (section 1), and simultaneously flows through the passage (2), the travel straight spool head and the neutral passage (R1) and into the travel (section 6).
The oil supplied from the port (P2) flows through the travel straight spool and the passage (1) into the parallel passage (L3).
If the section load pressure except the travel is higher than the travel (section 6) load pressure, some of the oil supplied from the port (P2) pushes and opens the poppet (S6-2), passes through the orifice of the head of the poppet, and joins with the passage (S6-1).

Because the travel (section 1 and 6) is activated by the oil supplied from the port (P1) and the implement except the travel is activated by the oil supplied from the port (P2), when applying the combined operation with the travel left and right simultaneous operation and the implement operation except the travel, the travel is prevented from veering.

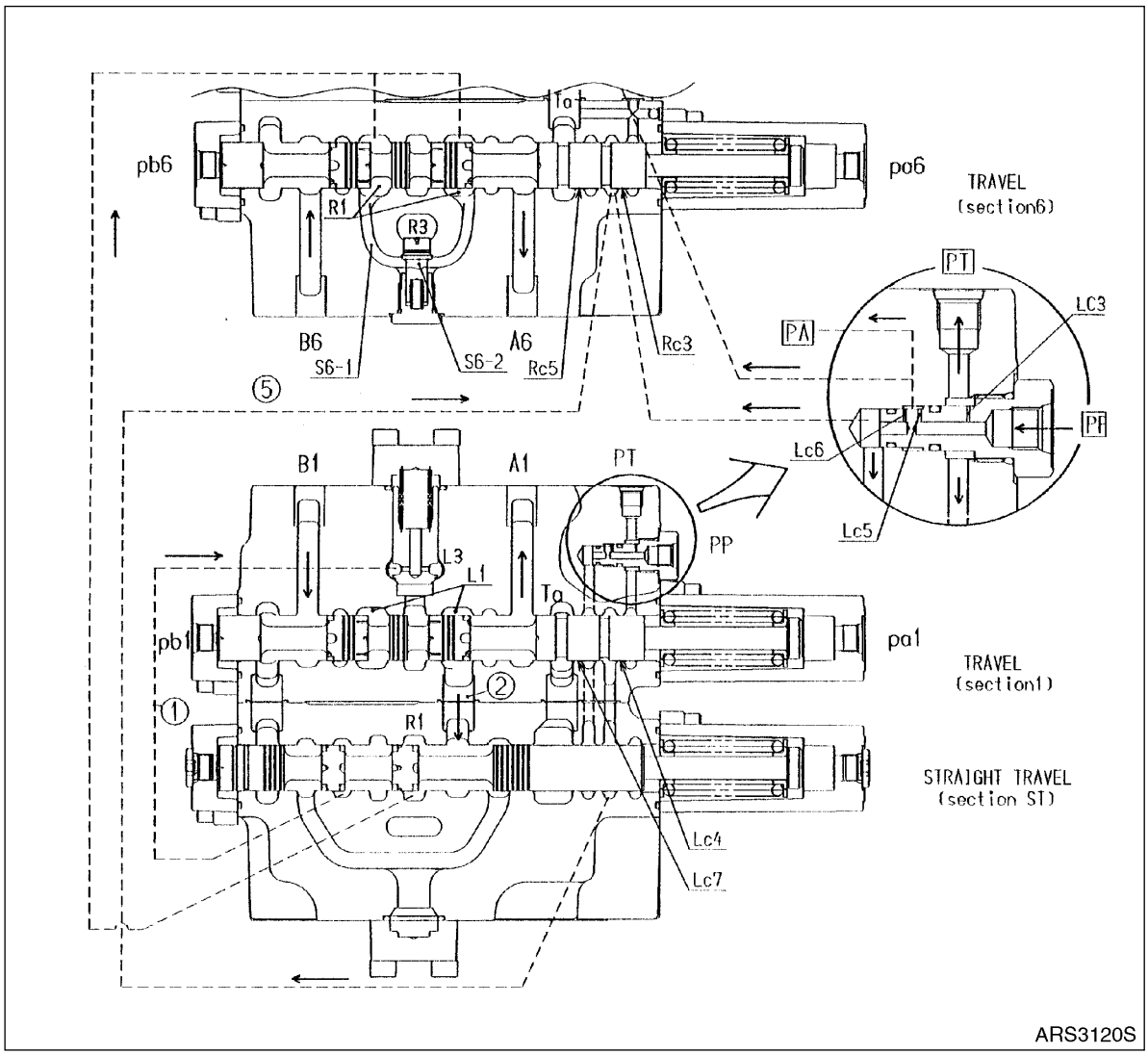

pb6
Ta
pa6
TRAVEL
(section6)
R1
R3
B6
S6-1
S6-2
A6
Rc5
Rc3
PT
PA
LC3
PF
Lc6
Lc5
B1
A1
PT
PP
L3
L1
Ta
pb1
pa1
TRAVEL
(section1)
R1
STRAIGHT TRAVEL
(section ST)
Lc4
Lc7
ARS3120S

Figure 16

2. Bucket Combined Operation

Priority control valve is installed in bucket section (section 7, Figure 17) of this valve to control the flow entering into bucket when operating combined operation with section (travel, boom 1, arm 2) of P2 side.

If the pressure of port (Pi) is increased when operating bucket, piston (S7-6) is pressed, piston (S7-5) and plug (S7-4) are pressed, and then poppet assembly (S7-2) is seated closely on the seat of valve housing. Therefore the oil flowed from parallel passage (R3) presses the poppet (S7-3) in the poppet assembly and flows into passage (S7-1).

As a result, passage diameter of operating combined operation is smaller than passage diameter of operating single operation and then the oil flowing to port (A7, B7) is reduced, and the remaining oil passes through parallel passage (R3) and primarily flows to section being operated at P2 side simultaneously.

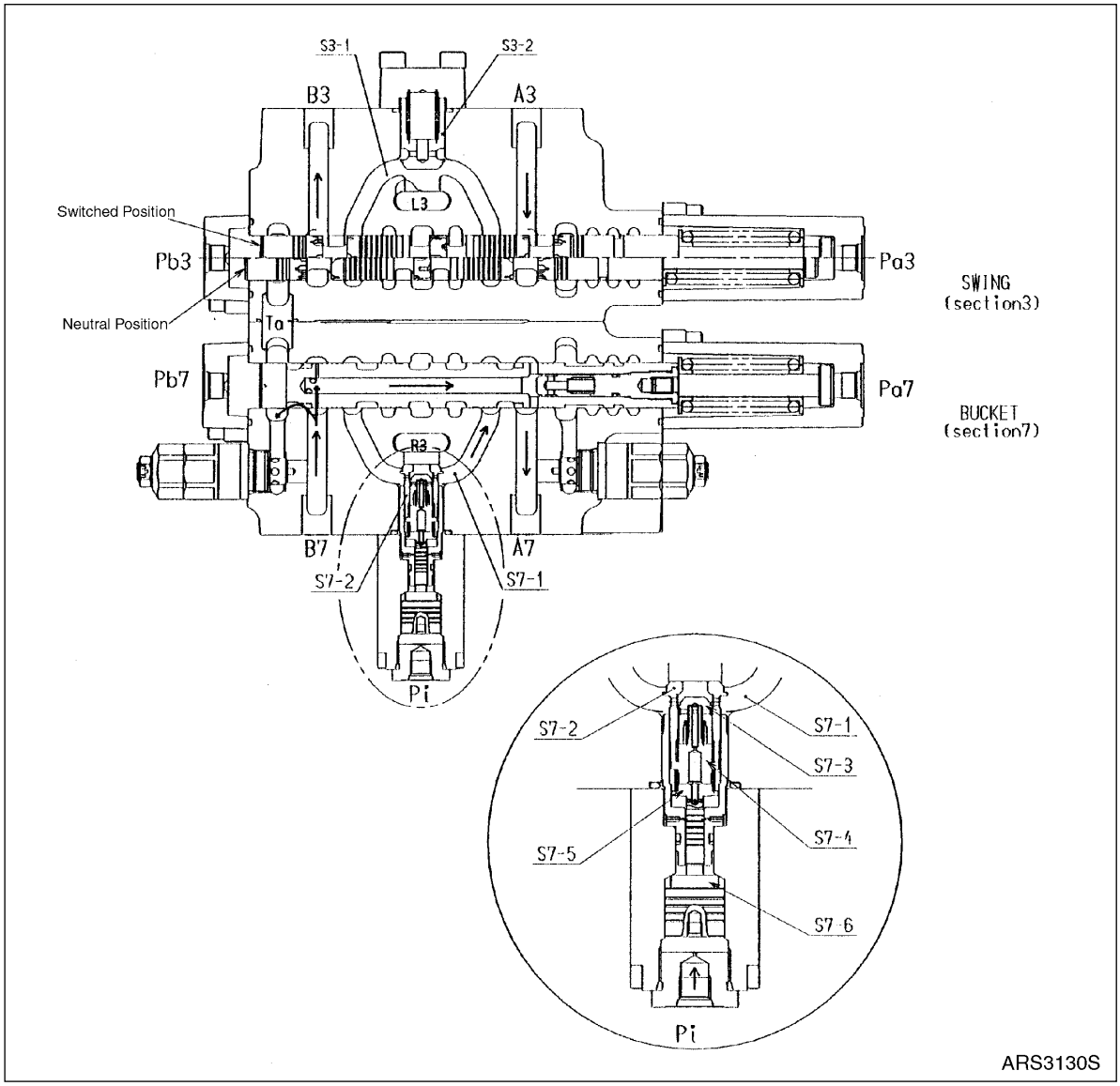


Figure 17

Antidrift Valve

The antidrift valve is installed in the cylinder port of the arm rod (boom bottom) side to prevent the arm (boom) cylinder from natural lowering. (As a representative arm side (A5) is shown.)

1. Neutral condition (A5, Figure 18 port keeping condition)

   The keeping pressure of A5 port is sent through the passage (a), the passage (b), the passage (c), and into the spring chamber (d) of poppet (1). At this time the pressure oil of A5 port is surely cut off by seat part S1 and seat part S2.

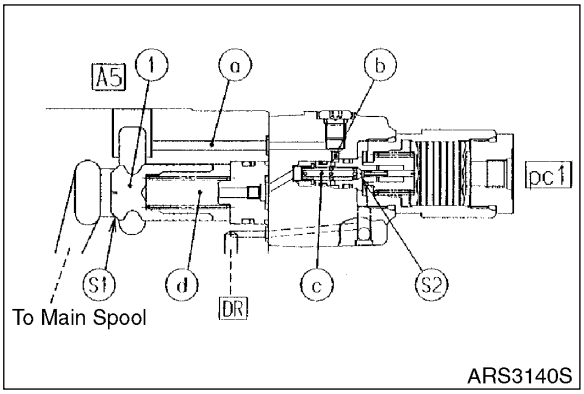


Figure 18

2. Cut off condition of passage of (A5, Figure 19) port and spring chamber

   A. If pc1 port is pressed, piston 2 is moved and spring 3 acts.

   B. Spring 3 activates poppet 4.

   C. And then by acting of poppet 4, A5 port and spring chamber (d) is cut off by T1 part.

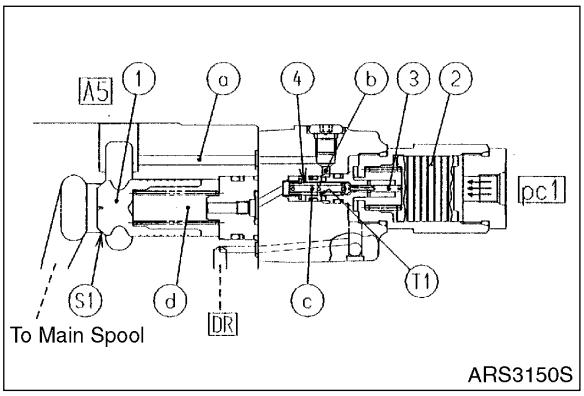


Figure 19

3. Operating condition of main poppet

   A. If again piston (2, Figure 20) acts, spring chamber (d) is led through passage (c) and passage (e) and to drain chamber (DR) by T2 part.

   B. Spring chamber becomes drain pressure and main poppet 1 acts.

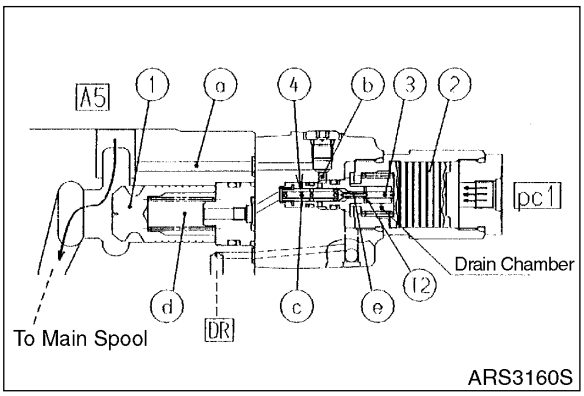


Figure 20

Main Relief Valve

1. This relief valve is inserted between the neutral passage "HP" and the low pressure passage "LP" and oil flows through orifice of main poppet "C" and fills inside space "D".

   Main poppet "C" is completely seated to sleeve "E" because area "B" is larger than area "A".

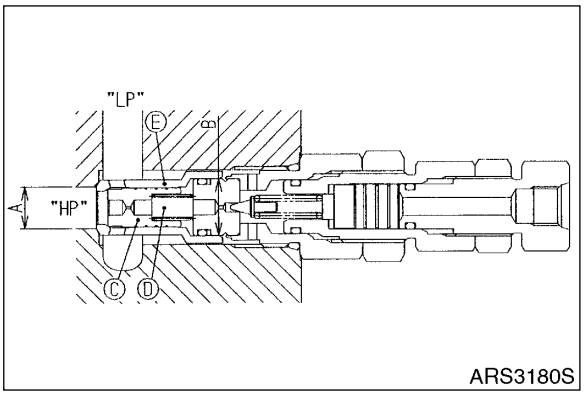


Figure 21

2. When pressure of neutral passage "HP" reaches spring pressure setting of pilot poppet, pilot poppet "F" opens. Oil flows around poppet and through drill hole "G" and reaches low pressure passage "LP".

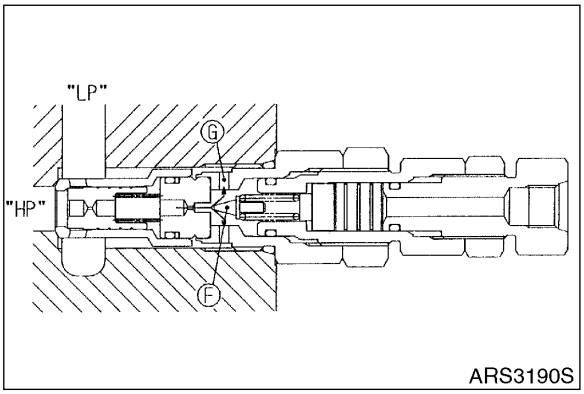


Figure 22

3. When pilot poppet opens, pressure of "D" decreases, main poppet "C" opens, and oil flows to direct passage "LP".

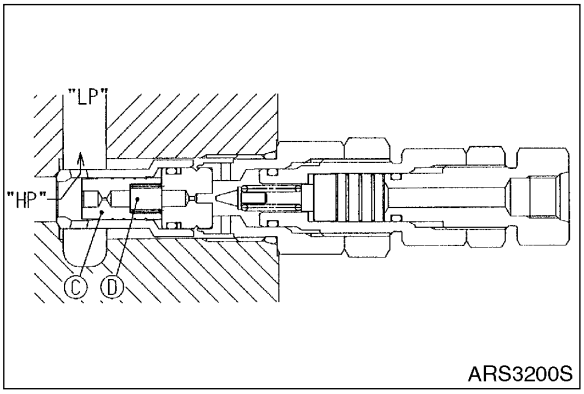


Figure 23

4. Pressure up operation

   If pressure is given to pilot port "PH", piston "H" moves to the position set by plug "I". With this, pressure of pilot spring increases, and so pressure of "HP" increases.

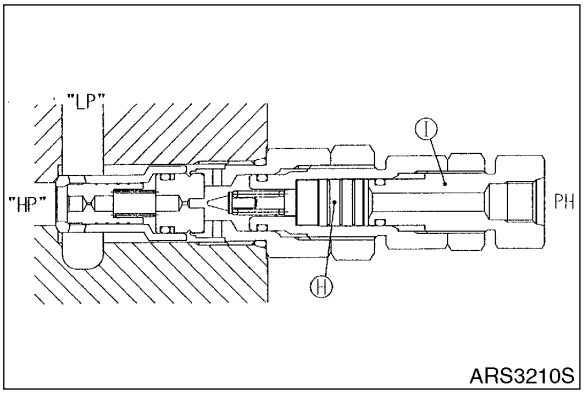


Figure 24

Overload Relief Valve (69, Total: Six Places)

1. This relief valve is inserted between cylinder port "HP" and low pressure passage "LP" and oil flows through orifice of piston "C" and fills inside space "G". Owing to the difference between "A" and "B" in area on which the hydraulic pressure acts sleeve "K" and main poppet "D" are seated closely.

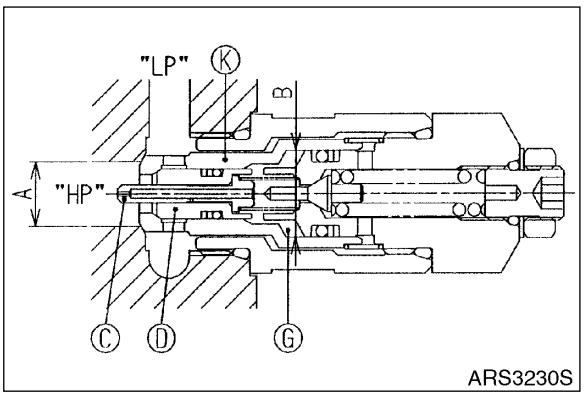


Figure 25

2. When pressure of cylinder port "HP" reaches spring pressure setting of pilot poppet, pilot poppet "E" opens. Oil flows around poppet, through drill hole "H", and into low pressure passage "LP".

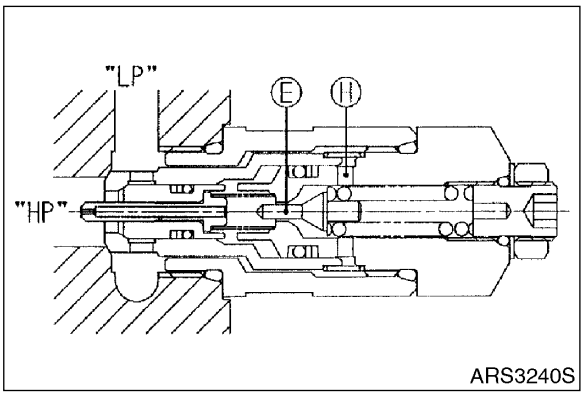


Figure 26

3. As the pilot poppet (E) opens, the oil flows through the orifice (I) of piston "C", so that differential pressure is generated between passage "HP" and back of piston "C", and piston "C" is moved and seated with poppet "E".

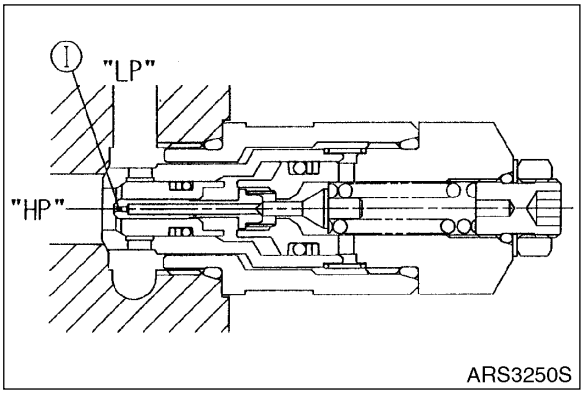


Figure 27

4. Oil which flow from passage "HP" to the back of poppet "D" fills the ring shape clearance of poppet "D" and piston "C" and orifice "F", so that differential pressure increases. As a result, poppet "D" opens and oil flows to direct passage "LP".

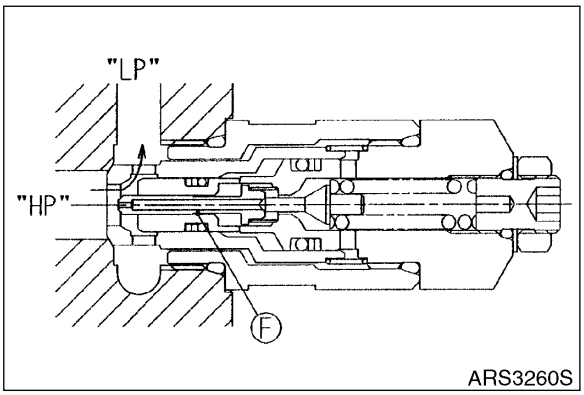


Figure 28

5. Sucking operation

   This relief valve has the antivoid unit which is installed in the cylinder port (HP) and supplies oil when cavitation is generated. If pressure of cylinder port "HP" is lower than low pressure side "LP", sleeve "K" opens by differential area of "A" and "B". Oil flowed from lower pressure side "LP" enters cylinder port "HP" and prevents cavitation.

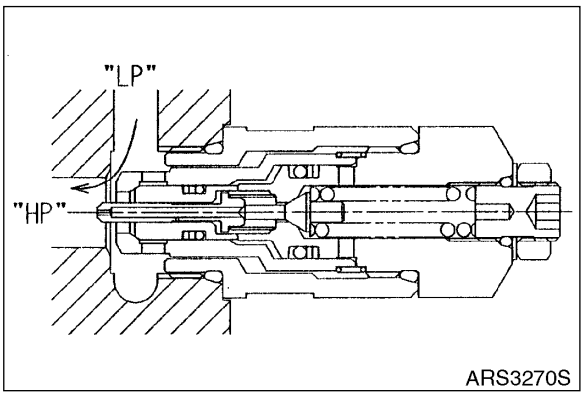


Figure 29

Low Pressure Relief Valve (70, Total: Two Places)

1. Generation of signal pressure

Oil supplied from pump port (P1 (P2)) flows through neutral passage (L1 (R1)), low pressure relief passage (L2 (R2)), orifice (Lc1 (Rc1)) to tank passage (At).
At this time, pressure generated at passage (L2 (R2)) by orifice (Lc1 (Rc1)) moves to low pressure relief signal port (Ps1 (Ps2)).

If main spool of the upper reaches of L2 (R2)) operates, signal pressure of Ps1 (Ps2) decreases because oil flowing to L2 (R2) decreases.

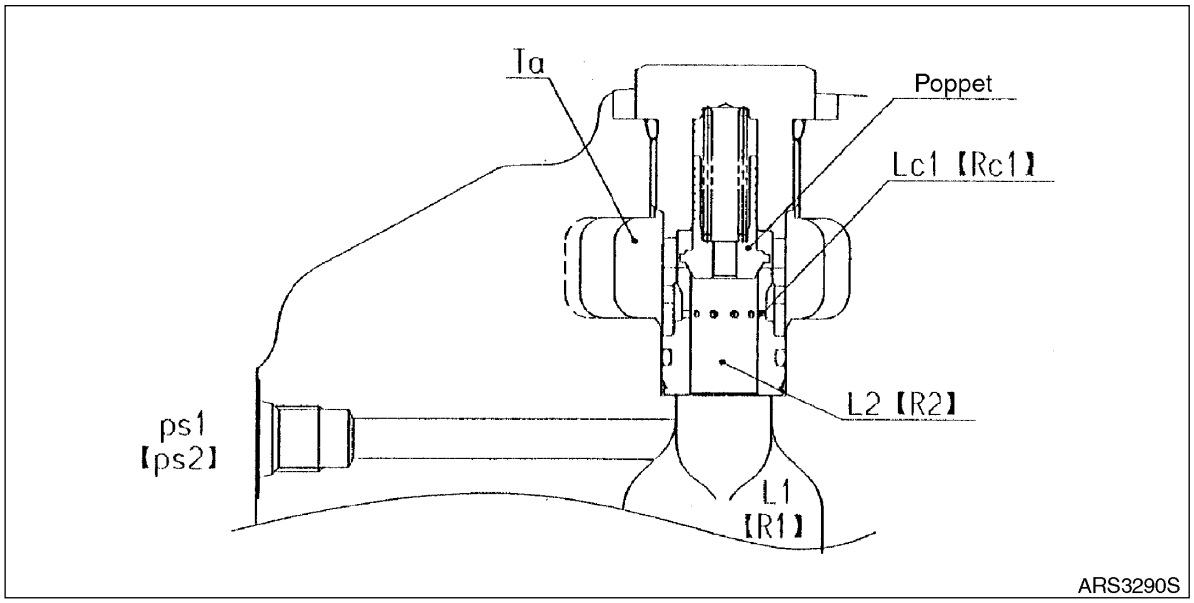


Figure 30

2. Relief operation

If excessive oil flows into passage (L2 (R2)), pressure generated at passage (L2 (R2)) by orifice (Lc1 (Rc1)) goes to back chamber of poppet and poppet operates by the difference of pressurized area between passage and back chamber.
By the operation of this poppet, oil flows from passage through plug and drill hole to tank passage (At). By it, the generation of excessive pressure of low pressure relief signal port is prevented.

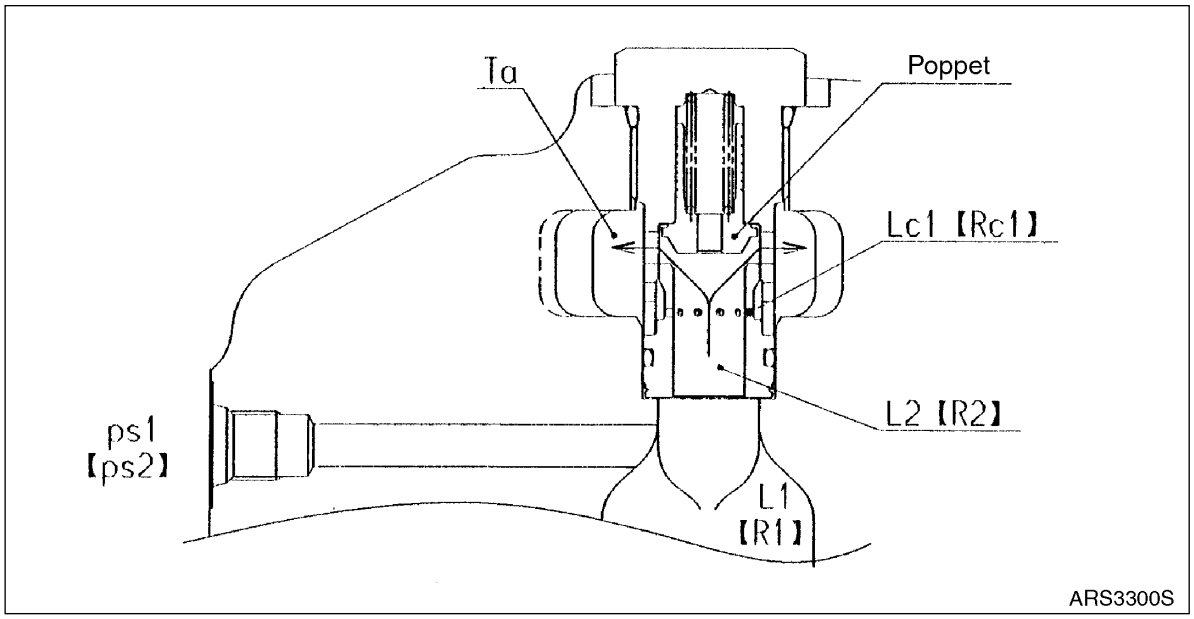


Figure 31

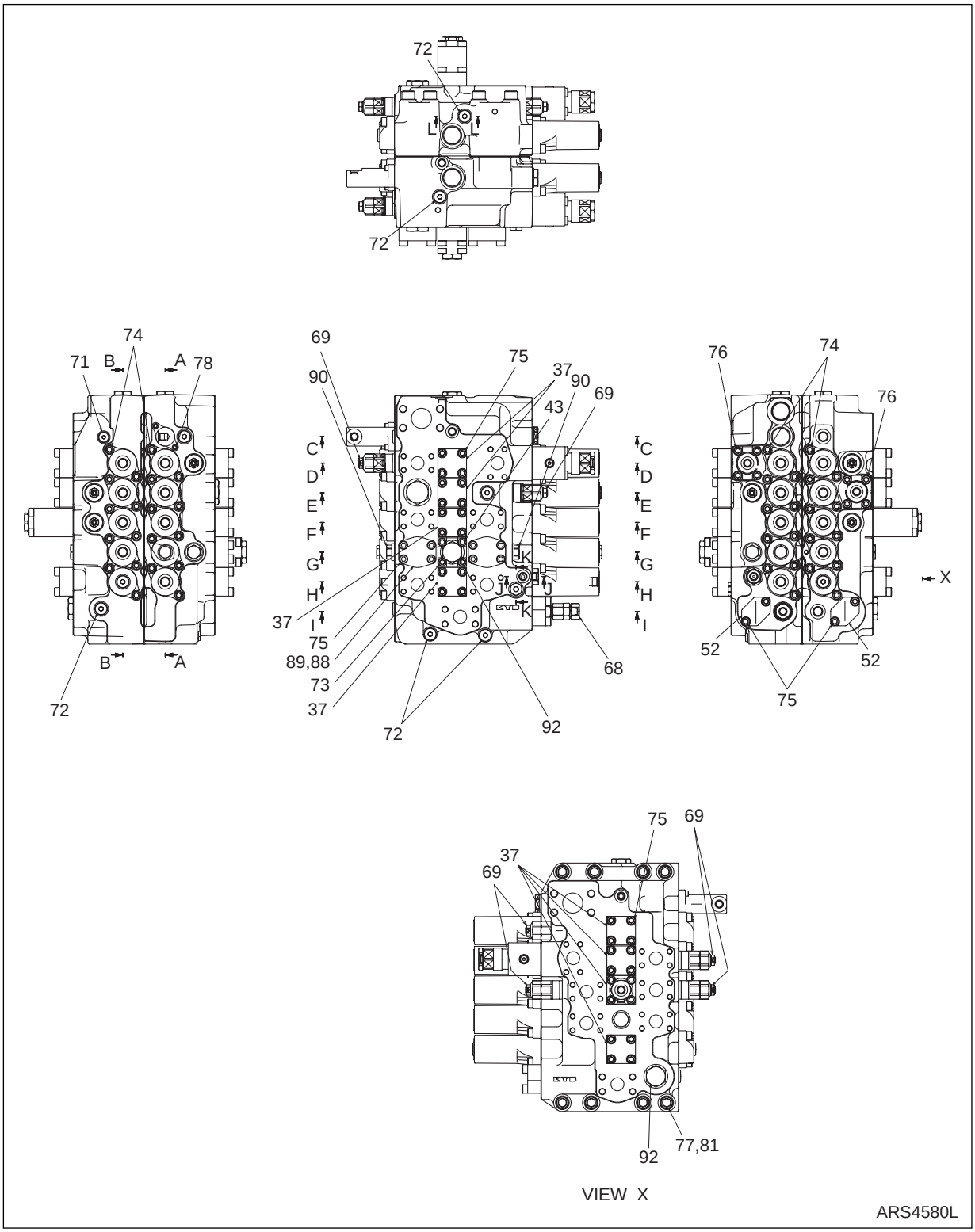

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Figure 32

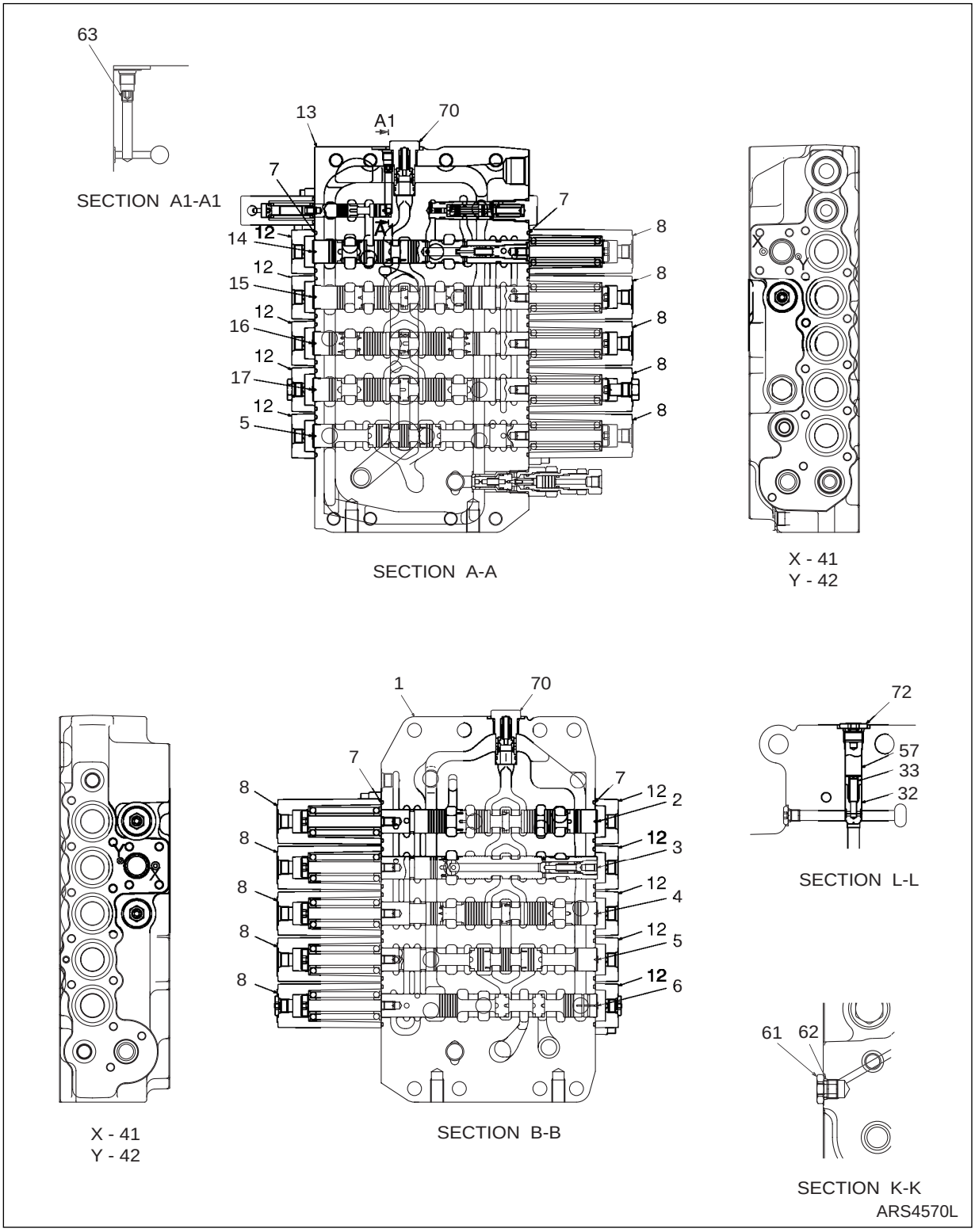

63
SECTION A1-A1
13
A1
70
7
7
14
12
15
16
17
5
8
SECTION A-A
X
X - 41
Y - 42
1
70
7
7
8
12
2
3
4
5
6
SECTION B-B
72
57
33
32
SECTION L-L
61
62
SECTION K-K
ARS4570L

Figure 33

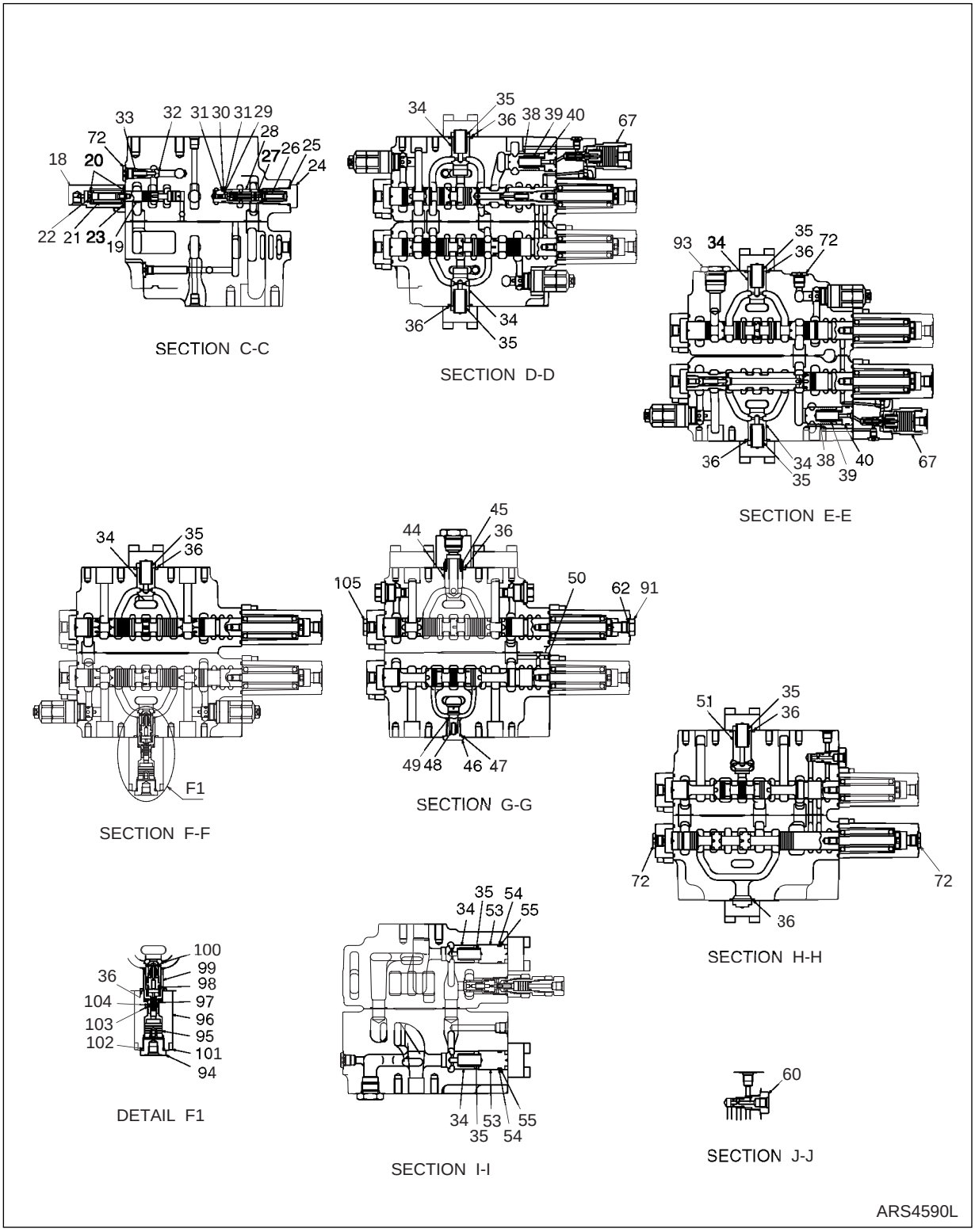

SECTION C-C
SECTION D-D
SECTION E-E
SECTION F-F
SECTION G-G
SECTION H-H
DETAIL F1
SECTION I-I
SECTION J-J
ARS4590L

Figure 34

Reference Number	Description
1	Valve Housing
2	Spool Assembly (Arm2)
3	Spool Assembly (Boom1)
4	Spool Assembly (Bucket)
5	Spool Assembly (Travel)
6	Spool Assembly (Straight Travel)
7	O-ring
8	Cap
12	Cap
13	Valve Housing
14	Spool Assembly (Arm1)
15	Spool Assembly (Boom2)
16	Spool Assembly (Swing)
17	Spool Assembly (Option)
18	Cap
19	Spool
20	Spring Seat
21	Spring
22	Spool End
23	O-ring
24	Plug
25	O-ring
26	Spring
27	Spool Assembly
30	O-ring
31	Back-up Ring
32	Poppet
33	Spring
34	Poppet
35	Spring
36	O-ring
37	Flange
38	Poppet
39	Spring
40	Spacer Assembly
41	O-ring
42	O-ring
43	Flange
44	Poppet
45	Spring
46	Plug

Reference Number	Description
47	O-ring
48	Spring
49	Poppet
50	Steel Ball
51	Poppet
52	Flange
53	Spacer
54	O-ring
55	Back-up Ring
57	Spacer
60	Plug Assembly
61	Plug
62	O-ring
63	Orifice Plug
65	O-ring
66	O-ring
67	Anti-draft Valve Assembly
68-70	Relief Valve Assembly
71	Plug Assembly
72	Plug Assembly
73-78	Socket Head Bolt
79	Name Plate
80	Drive Screw
81	Washer
88	Cap
89	O-ring
90	Plug Assembly
91	Plug
92	Plug Assembly
93	Plug Assembly
94	Plug
95	Piston
96	Body
97	Piston
98	Spring
99	Sleeve
100	Poppet Assembly
101	Socket Head Bolt
102	O-ring
103	Back-up Ring
104	O-ring
105	Plug Assembly

Spool Assembly (2, Arm 2)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End

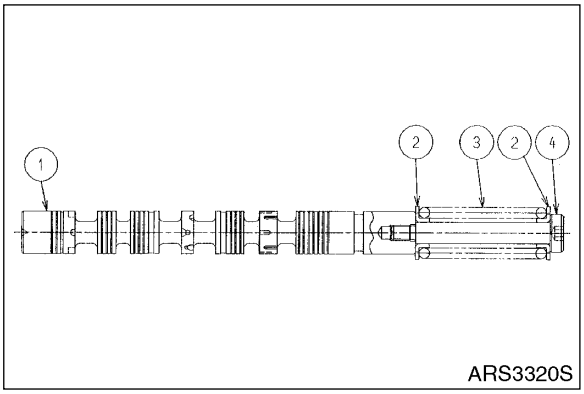


Figure 35

Spool Assembly (3, Boom1)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End
5	Plug
6	Poppet
7	Spring
8	O-ring
9	Back-up Ring

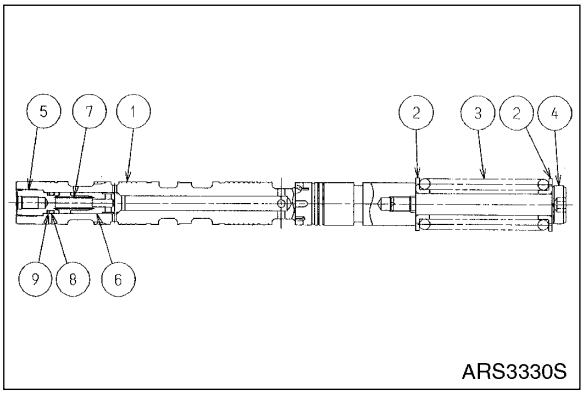


Figure 36

Spool Assembly (4, Bucket)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End
5	Plug
6	Poppet
7	Spring
8	O-ring
9	Back-up Ring

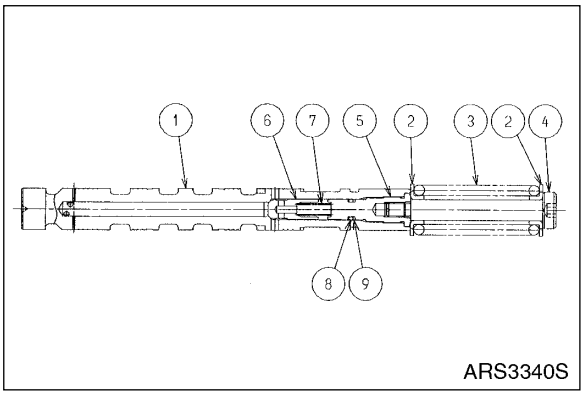


Figure 37

Spool Assembly (5, Travel)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End

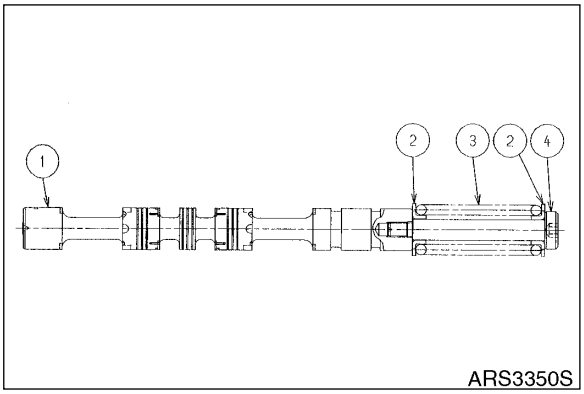


Figure 38

Spool Assembly (6, Straight Travel)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End

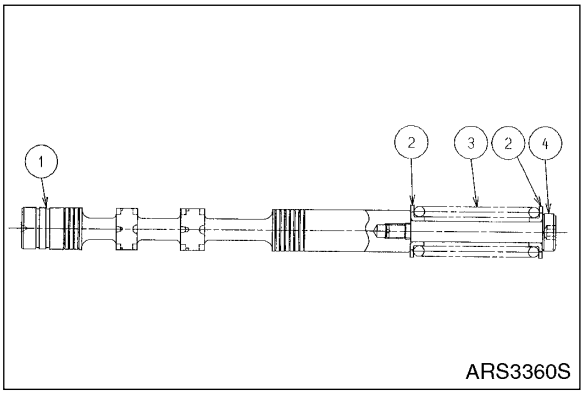


Figure 39

Spool Assembly (14, Arm1)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End
5	Plug
6	Poppet
7	Spring
8	O-ring
9	Back-up Ring

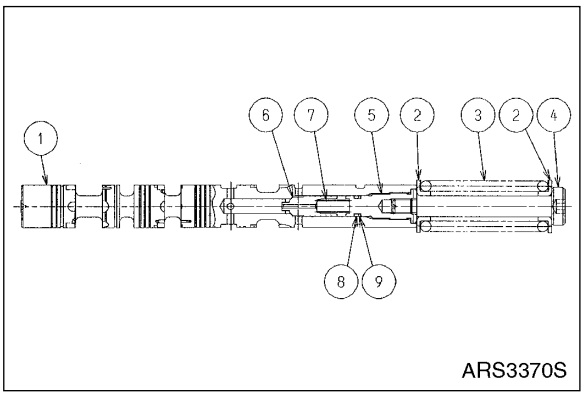


Figure 40

Spool Assembly (15, Boom 2)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End

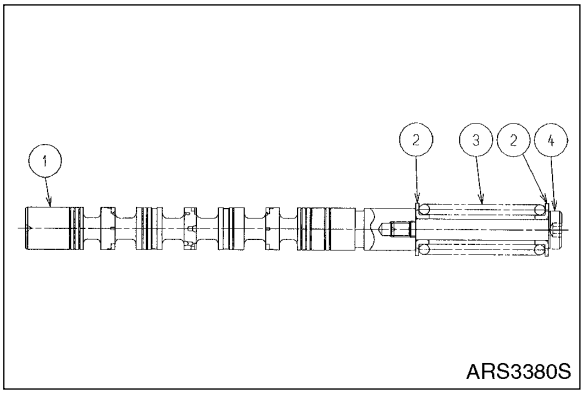


Figure 41

Spool Assembly (16, Swing)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End

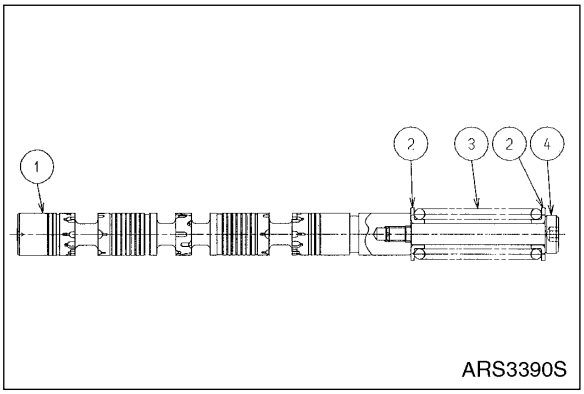


Figure 42

Spool Assembly (17, Option)

Reference Number	Description
1	Spool
2	Spring Seat
3	Spring
4	Spool End

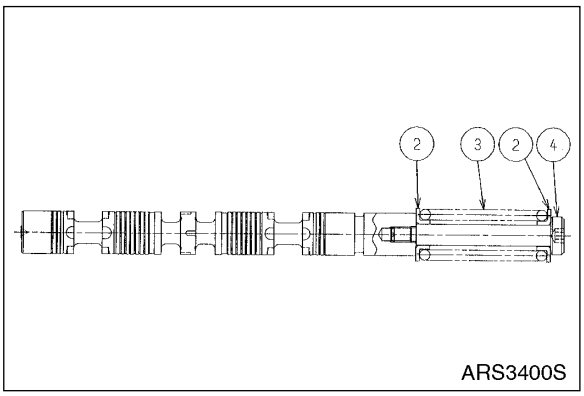


Figure 43

Spool Assembly (20, Arm Regeneration Release Valvle)

Reference Number	Description
1	Spool
2	Sleeve
3	Piston

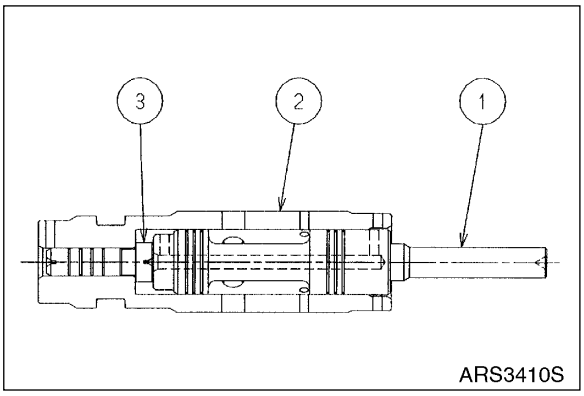


Figure 44

Spacer Assembly (40)

Reference Number	Description
1	Spacer
2	O-ring
3	Back-up Ring
4	O-ring

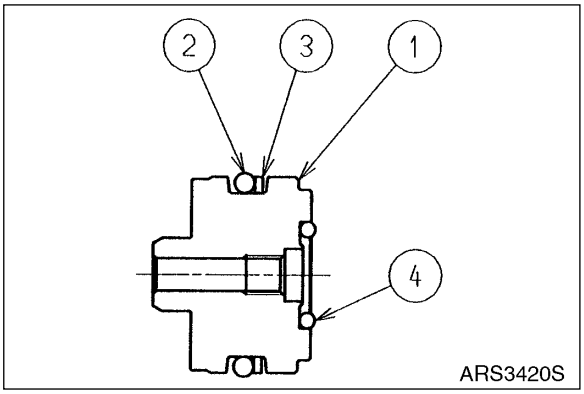


Figure 45

Plug Assembly (60)

Reference Number	Description
1	Plug
2	O-ring
3	O-ring
4	O-ring

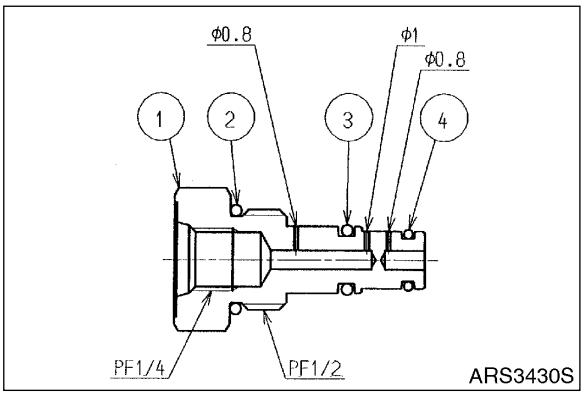


Figure 46

Anti-draft Valve Assembly (67)

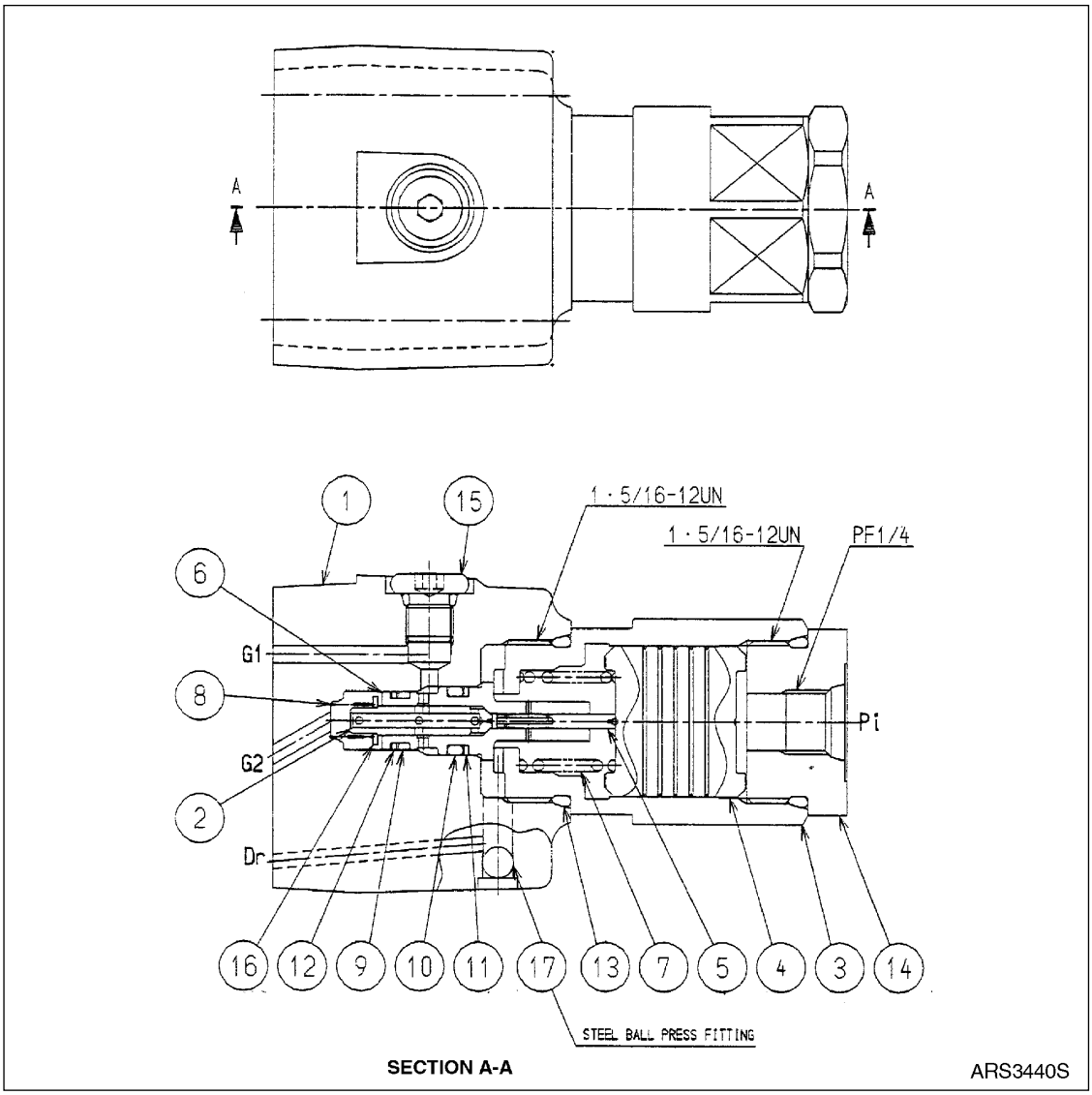


Figure 47

Reference Number	Description
1	Body
2	Poppet
3	Plug
4	Piston
5	Spool
6	Sleeve
7	Spring
8	Spirng
9	O-ring

Reference Number	Description
10	O-ring
11	Back-up Ring
12	Back-up Ring
13	O-ring
14	Plug Assembly
15	Plug Assembly
16	Spring Seat
17	Steel Ball

Relief Valve Assembly (70)

Reference Number	Description
1	Plug
2	Spring
3	Poppet
4	Sleeve
5	O-ring
6	O-ring

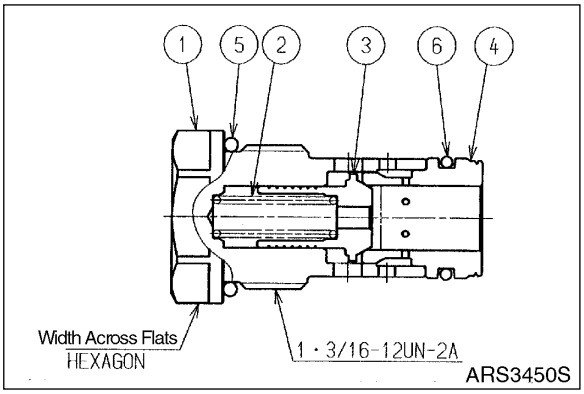


Figure 48

Plug Assembly (90)

Reference Number	Description
1	Plug
2	O-ring
3	O-ring
4	Back-up Ring

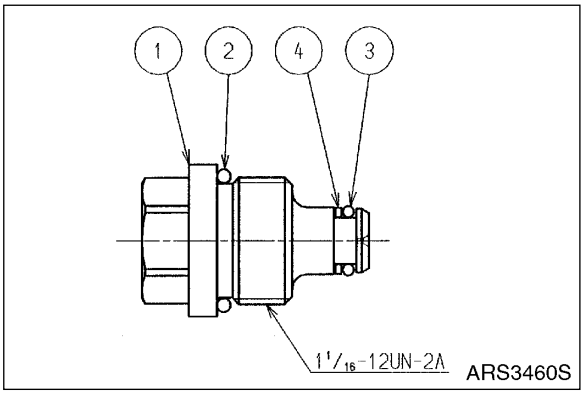


Figure 49

SPECIFICATIONS

Control Valve	Specification
Rated Flow	270 liter/min. 50 liter.min at Neutral
Max. Pressure	34.3 MPa
Allowable Back Pressure	Peak Pressure: Below 1.5 MPa Normal Pressure: Below 0.5 MPa
Allowable Working Temperature Range	-20 ~ 90°C Peak Max: 100°C (Seal is used nitrile rubber.)

TROUBLESHOOTING, TESTING AND ADJUSTMENT

GENERAL

Problem	Possible Cause	Remedy
Spool does not stroke.	Hydraulic oil excessively hot.	Remove blockage in oil piping.
	Hydraulic oil contaminated.	Change oil and clean oil passages.
	Over tightened piping port fittings.	Check torque.
	Valve housing deformed when assembling.	Loosen assembling bolts and check.
	Pressure too high.	Check pump port pressure and cylinder port pressure with pressure gauge.
	Spool bent.	Replace valve assembly.
	Return spring damaged.	Replace damaged parts.
	Spring or cap crisscrossed.	Loosen, center, and retighten cap.
	Valve temperature uneven.	Warm up entire system.
	Dirt in valve.	Clean valve (flushing).
	Lack of pilot pressure.	Check pilot valve and pilot relief pressure.
Fail to keep load	Cylinder leaks.	Check seal parts of cylinder.
	Spool leaks.	Check spool.
	Overload relief valve leaks.	Clean valve housing and relief valve seat parts.
	Antidrift valve leaks.	Remove antidrift valve and clean every seat parts.
		If seat parts are damaged, replace poppet or lap poppet and seat parts.
		If draft valve is malfunction, replace spool and sleeve at the same time.
Load drops when changing the spool from neutral to up.	Dirt in load check valve.	Remove and clean check valve.
	Poppet or seat parts in check valve scratched.	Remove poppet or lap poppet and seat parts.

RELIEF VALVE

Problem	Possible Cause	Remedy
Pressure does not rise.	Stuck main poppet, sleeve or pilot poppet opened or dirt in seat part.	Replace relief valve.
Relief pressure unstable	Seat parts of pilot poppet damaged.	
	Piston or main poppet stuck.	
Relief pressure is incorrect.	Seat parts worn due to dust.	
	Lock nut and adjuster loose.	Reset pressure and tighten lock nut in rated torque.
Oil leaks	Relief valve seat parts damaged	Replace relief valve.
	Every parts stuck due to dust	
	O-ring worn.	Replace adjuster or O-ring.

HYDRAULIC SYSTEM

Problem	Possible Cause	Remedy
Hydraulic system is malfunction or does not operate.	Hydraulic pump failed.	Check pressure or replace pump.
	Relief valve failed.	Replace pump.
	Some kinds of cylinders failed.	Repair or replace.
	Pump load pressure too high.	Check circuit pressure.
	Valve cracked.	Replace valve assembly.
	Spool does not fully stroke.	Check spool operation.
	Hydraulic oil level in tank too low.	Add hydraulic oil.
	Filter in circuit plugged.	Clean or replace filter.
	Circuit piping twisted.	Check piping.

ADJUSTMENT OF RELIEF VALVE

Main Relief Valve

1. Connect a accurate pressure gauge to inlet port.
2. Start the engine and maintain the rated pump speed.
3. Switch the control valve spool and read the pressure gauge from the stroke end of the cylinder.

   NOTE: *Replace the spool of the actuator if the setting pressure of the over load relief valve is higher than the setting pressure of the main relief valve.*

4. High pressure adjustment (1st stage) (refer to figure of page 32/63)

   A. Loosen lock nut (7) and tighten plug (8) until piston contacts the step (* mark) of plug (6). Plug (8) should be torqued below 19.6 N*M. While plug (8) is tightened, plug (6) should not be turned. The distance A (Page 32/63) should be above 4 mm. Tighten lock nut (7).

B. Loosen lock nut (4) and turn adjusting plug (6) clockwise to raise relief pressure at the state of 4-1. Turn adjusting plug (6) counterclockwise to lower relief pressure. One turn varies 28.4 MPa. Tighten lock nut (4) after pressure has been adjusted.

5. Low pressure adjustment (second stage)

   Loosen lock nut (7) and turn adjusting plug (8) counterclockwise to lower relief pressure at the state of 4. One turn varies 21.3 MPa. Tighten lock nut (7) after pressure has been adjusted.

6. Recheck the setting pressure by raising pressure once more.

Over Load Relief Valve

IMPORTANT
If the pressure of the main relief valve is higher than the setting pressure of it, change it to the main relief valve assembly setting without adjusting the over load relief valve.

1. Switch the control valve spool and read the pressure gauge from the stroke end of the cylinder.
2. Loosen lock nut (3) and turn adjusting plug clockwise to raise pressure. Item number 69: six places One turn varies 21.2 MPa.
3. Tighten lock nut (3) after pressure has been adjusted. Lock nut (3) should be torqued to 27.5-31.4 N*m.
4. Recheck the setting pressure by raising pressure once more.

DISASSEMBLY

GENERAL INSTRUCTIONS FOR DISASSEMBLY

1. Stop engine when pressure of actuator is not indicated.
   It is dangerous to disassemble control valve while it has a pressure because high pressure oil can squirt out or components can spring. When partially disassemble control valve which is on machine, be careful the following caution.

⚠ CAUTION!
When disassemble short cap assembly while pressure is not released fully or bucket is not lowered to ground, it is very dangerous because poppet of antidrift valve spring out and bucket is dropped simultaneously, so that lower bucket to ground and release pressure fully before disassembling.

2. Release air pressure in tank.
3. Clean all of the exterior surfaces of the valve prior to disassembly and protect it from dirt and foreign materials.
4. Attach labels to the disassembled parts to know reassembling position.
5. Replace all sealing parts such as O-ring and back-up ring with a new ones.
6. Do not replace spool as it is engaged with valve housing selectively.

DISASSEMBLING PROCEDURE

Parts number is based on the parts list.

Disassembly of Main Spool Part

1. Loosen socket head bolt (74, two places per each section, width across flat: 8) and remove cap (8, ten places).
2. Loosen plug assembly (72, width across flat: 8) and plug (91, width across flat: 22) according to necessity.
3. Remove O-ring (7, one place per each section) from valve housing (1, 13).
4. Remove each spool under subassembly conditions from valve housing.

IMPORTANT
1. When remove spool, be careful not to damage. **2. Attach label to each spool in order to set it to correct position when reassembling.**

5. Loosen socket head bolt (74, two places per each section, width across flat: 8) and remove cap (12, ten places).
6. Remove O-ring (7, one place per each section) from valve housing (1, 13).

7. Disassembly of spool

IMPORTANT
1. Work with spool gripped in vise with wood (see Figure 50) not to scratch in outside diameter of spool.
2. Because Loctite is applied to screw part of spool end, heat screw part of outside surface of spool with industrial drier and melt Loctite.
3. Heat spool until spool end is loosened easily immediately after heating it to 200 - 250°C.
4. If it is over heated, change spring to new one.

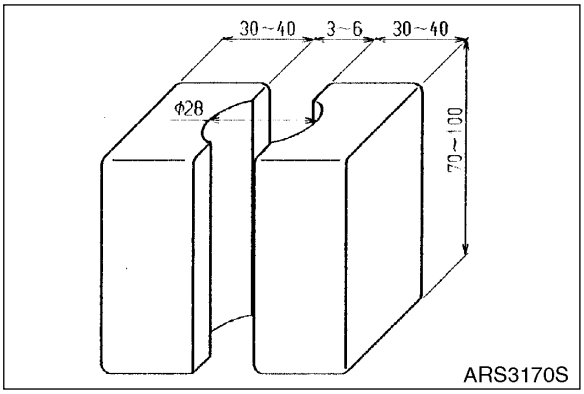


Figure 50

A. Loosen spool end (width across flat: 8) of spool assembly (2-6, 14-17) and remove spring seat and spring.

B. There are poppet, spring and plug in spool of spool assembly, but if disassembly is unnecessary, do not remove them. If disassembly is necessary, heat spool outside surface, melt Loctite in screw part and remove plug. When reassembling, change O-ring and backup ring to new ones.

Disassembly of Arm 1 Para Spool Turn

1. Loosen socket head bolt (78, width across flat: 5) and remove cap (18).
2. Remove O-ring (23) from cap (18).
3. Remove spool (19) from valve housing under subassembly conditions.
4. Disassembly of spool

IMPORTANT
1. Work with spool gripped in vise with wood (see Figure 50) not to scratch in outside diameter of spool.
2. Because Loctite is applied to screw part of spool end, heat screw part of outside surface of spool with industrial drier and melt Loctite.
3. Heat spool until spool end is loosened easily immediately after heating it to 200 - 250'C.
4. If it is over heated, change spring to new one.

A. Loosen spool end (22, width across flat: 5) of spool (19) and remove spring seat (20) and spring (21).

Disassembly of Arm Regeneration Release Valve Part

Small parts in assembly are indicated to (parental number - son number).

CAUTION!

1. When loosening plug, it is dangerous because parts can be spring out by internal remaining pressure.

2. Loosen plug slowly, check if there is a resistance by remaining pressure and remove.

1. Loosen plug (24, width across flat: 32) and remove O-ring (25).
2. Remove spring (26) and spool (27-1) from sleeve (27-2).
3. Remove sleeve (27-2) from valve housing.
4. Remove piston (27-3), O-ring (30) and back-up ring (31) from sleeve (27-2).

Disassembly of Rod Check Valve Part

CAUTION!

1. When loosening plug, it is dangerous because parts can be spring out by internal remaining pressure.

2. Loosen plug slowly, check if there is a resistance by remaining pressure and remove.

1. Loosen socket head bolt (75, four places per each section, width across flat: 8) and remove flange (37, seven places).
2. Remove spring (35), poppet (34) (poppet (51)), O-ring (36) from valve housing.

IMPORTANT

Be careful there are not poppet and spring in travel straight valve section (section H-H).

3. Loosen socket head bolt (75, width across flat: 8) and remove flange (52, two places).
4. Remove spacer (53) from valve housing and remove O-ring (54) and back up ring (55) from spacer (53).
5. Remove spring (35) and poppet (34) from valve housing.
6. Remove plug (72, width across flat: 8) (section C-C).
7. Remove spring (33) and poppet (32) from valve housing.
8. Remove plug (72, width across flat: 8) (section L-L).
9. Remove spacer (57), spring (33) and poppet (32) from valve housing.
10. Remove plug (92, width across flat: 36) (section G-G).
11. Loosen socket head bolt (73, four places, width across flat: 8) and remove flange (43).
12. Remove spring (45), poppet (44) and O-ring (36) from valve housing.

13. Loosen plug (46, width across flat: 27) and remove O-ring (47).
14. Remove spring (48) and poppet (49) from valve housing.
15. Loosen socket head bolt (101, four places, width across flat: 8) from body (96, one places).
16. Remove body (96) from valve housing. Remove sleeve (99) and remove piston (97), spring (98), poppet assembly (100), back up ring (103), and O-ring (104).
17. Remove O-ring (36).
18. Grip body (96) in vise, loosen plug (94), and remove piston (95) and O-ring (102).

Disassembly of Antidrift Valve

Small parts in assembly is indicated to (parental number - son number).

CAUTION!

1. When removing antidrift valve seat, it is dangerous that parts like seal can spring out by internal remaining pressure.

2. Loosen socket head bolt slowly, check if there is a resistance by remaining pressure and remove.

1. Loosen socket head bolt assembly (76, four places per section, width across flat: 8) and remove antidrift valve assembly (67, two places).
2. Remove O-ring (41, 42) from valve housing and remove O-ring (40-4) from spacer assembly.
3. Screw socket head bolt (78, M6*1) to spacer and remove spacer assembly (40) from valve housing.
4. Remove O-ring (40-2) and back up ring (40-3).
5. Remove spring (39) and poppet (38) from valve housing.
6. Disassembly of antidrift valve assembly

CAUTION!

1. If inner parts of antidrift valve are removed while it is on the valve housing, it is dangerous that parts can spring out by inner remaining pressure.

2. Loosen plug assembly (67-14) and plug (67-3) slowly, check if there is a resistance by remaining pressure and remove.

A. Loosen plug assembly (67-14, width across flat: 38) and remove O-ring.

B. Remove piston (67-4), spool (67-5), and spring (67-7).

C. Loosen plug (67-3, width across flat: 38) and remove O-ring.

D. Remove sleeve (67-6) and poppet (67-2) from body and remove O-ring (67-9, 10) and back up ring (67-11, 12) from outside diameter of sleeve.

E. Pull spring seat (67-16) and spring (67-8) from hole inside.

F. Loosen plug assembly (67-15) according to the necessity.

But do not remove steel ball (67-14) because it is pressed in body.

Disassembly of Relief Valve

⚠ CAUTION!

1. When removing relief valve, loosen plug attached in body and remove it.

2. Do not loosen adjusting plug for set pressure and lock nut.

3. If adjusting plug for set pressure is turned, it is dangerous because set pressure is varied.

1. Loosen over load relief valve (69, six places, width across flat: 32).
2. Loosen main relief valve (68, width across flat: 32).
3. Loosen relief valve assembly (70, two places, width across flat: 32) and remove O-ring (70- 5, 6).

Disassembly of Spare Section Part

1. Loosen socket head bolt (75, width across flat: 8) and remove cap (88, two places) and remove O-ring (89).
2. Loosen plug assembly (87, two places, width across flat: 24) and remove O-ring and back up ring.

Disassembly of Miscellaneous Plug Kind

1. Loosen plug assembly (60, width across flat: 27) and remove O-ring (section J-J).
2. Loosen plug (61, width across flat: 22) and remove O-ring (62) (section K-K).
3. Loosen orifice plug (63, width across flat: 5) (section A1-A1).
4. Loosen plug assembly (92, width across flat: 36) and remove O-ring.
5. Loosen plug assembly (71, width across flat: 6) and remove O-ring.
6. Loosen plug assembly (72, width across flat: 8) and remove O-ring.

Disassembly of Valve Housing Combined Bolt

IMPORTANT

1. Do not disassemble combined bolt (77) if it is unnecessary.

2. If it is necessary to disassemble it, work with putting it on the horizontal work bench.

3. Prepare spare O-ring (65, 66).

1. Loosen socket head bolt (77, eight places, width across flat: 14) and remove washer (81, eight places).
2. Remove O-ring (65, 66) of valve housing mating surface.

Disassembly of Main Relief Valve

This unit should be replaced by assembly. When replacing it, loosen plug (1, Width Across Flat: 32) by using spanner, etc., and remove O-ring (2). If oil is leaked in nut (4), loosen nut (4) and plug (1), and replace O-ring (3). And if oil is leaked in nut (7)loosen nut (7) and plug (8), and replace O-ring (3).

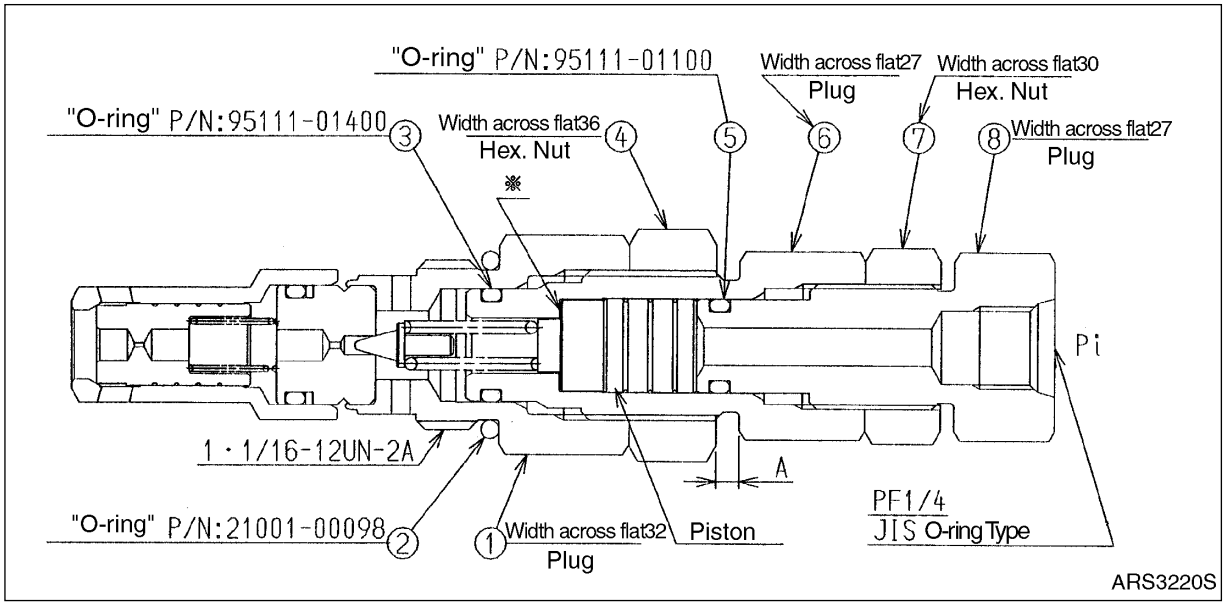


Figure 51

Disassembly of Overload Relief Valve

This unit should be replaced by assembly. When replacing it, loosen plug (1, Width across flat: 32) by using spanner, etc., and remove O-ring (2). If oil is leaked in nut (4), loosen nut (4) and plug (1), and replace O-ring (3). And if oil is leaked in nut (7)loosen nut (7) and plug (8), and replace O-ring (3).

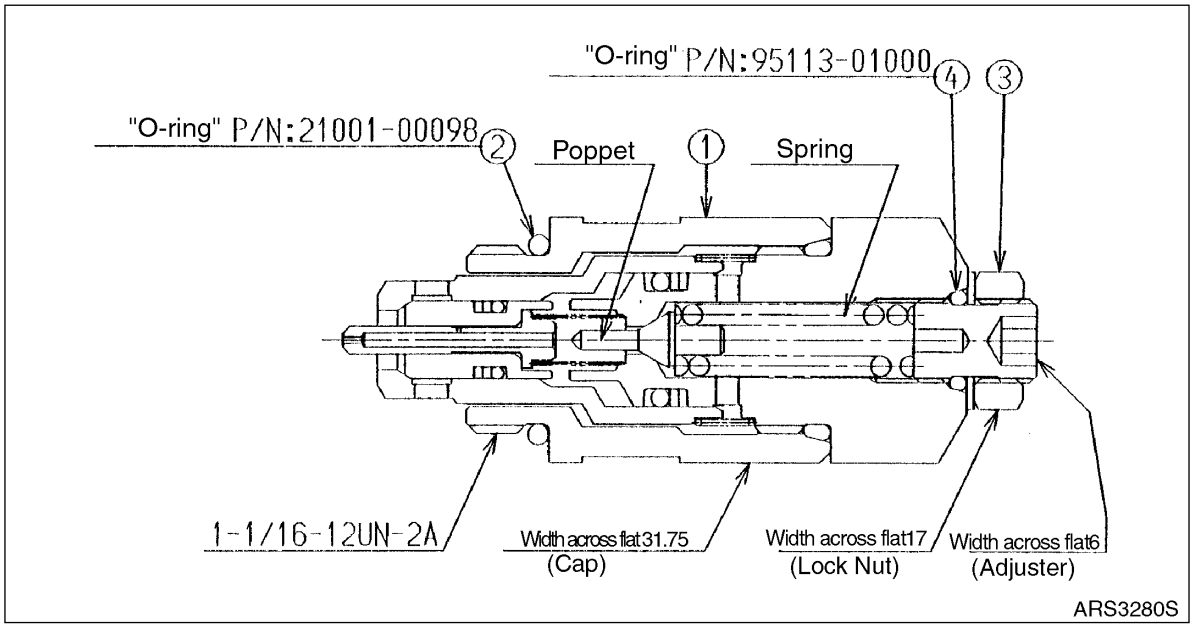


Figure 52

This unit should be replaced by assembly. When replacing it, loosen cap (1, width across flat: 31.75) by using spanner, etc., and remove O-ring (2). If oil is leaked in adjusting kit (3), loosen adjusting kit (3), and replace O-ring (4).

IMPORTANT
When disassembling adjuster kit, be careful not to spring out parts or lose poppet because of spring.

Disassembly of Low Pressure Relief Valve

This unit has the press fit portion (D) so that it should be replaced by assembly.

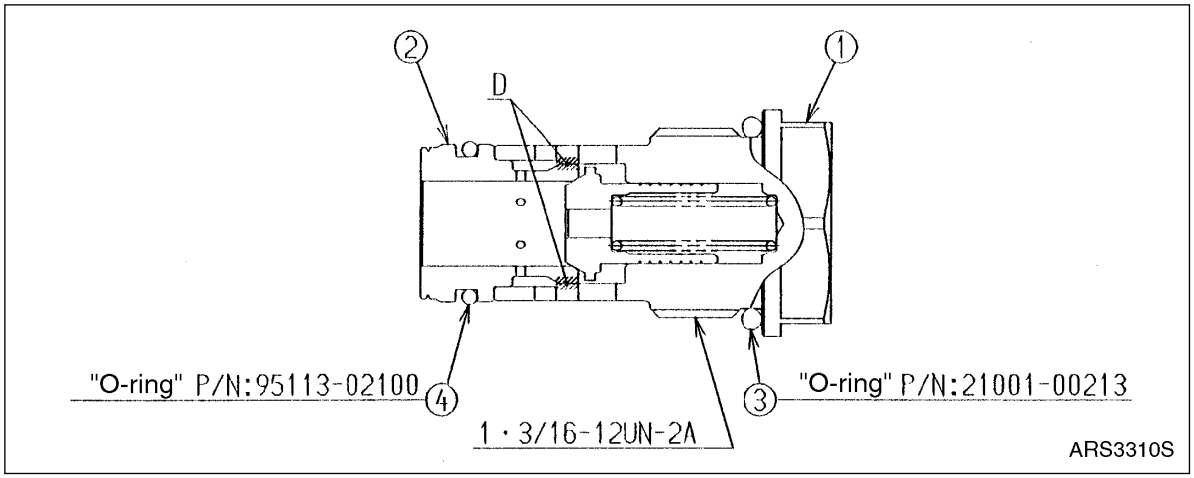


Figure 53

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

CLEANING

Clean all parts thoroughly using a suitable cleaning fluid and dry them with moisture free compressed air. Put them on a clean paper or a vinyl for inspection.

INSPECTION

Inspect all parts for scratches, notches and the other defects.

1. Inspect load check seat surface of valve housing for scratches, scores, dirt, notches and corrosion. Remove small scratches with oilstone.
2. Inspect exterior surface of spool for scratches and notches. Remove small scratches with oilstone.
3. Sliding parts should be moved lightly and foreign materials should be removed in all grooves and passages.

4. Replace any springs that are damaged, heavy deformed or worn.
5. If relief valve malfunction, inspect it by relief valve maintenance procedure (see page).
6. Replace all O-rings and backup rings with new ones.
7. After disassembling cap or plug, check whether there are paint chips around body hole or plug. If paint chips penetrate into valve, they can cause malfunction or leak of valve.

REASSEMBLY

INSTRUCTIONS FOR REASSEMBLY

Handling Instructions of O-ring

1. Do not use O-ring which has plastic defect or scratch when handling.
2. Apply grease or hydraulic oil to the installing position of O-ring and O-ring to install smoothly.
3. Do not stretch O-ring beyond permanent set.
4. When installing O-ring, be careful not to twist it. (Twisted O-ring, which is difficult to return to its original form naturally after installing it, cause leak.)

Handling Instructions for Spool

1. Rated torque should be kept because over torque of screw part cause malfunction of spool.
2. Be careful that each spool, spring and spool end should be reassembled like before disassembling.

Applying method of Adhesive

Male and female screw parts of parts which need to adhere.

⚠ CAUTION!

When working with adhesive, work at the place which is well ventilated.

1. Cleaning (removal of fat)

   Remove the fat with steam of acetate or ether, etc. or clean with alkali cleanser.

2. Dry

   Dry the adhesive surface with cleaned air or naturally. If it is not dried completely adhesive effect is dropped.

3. Primer painting

   Slightly spray Loctite primer T effect promoter to adhesive surface and leave it for three or five minutes to dry.

4. Adhesive applying

   Slightly apply adhesive (Loctite #274 or equivalent) to two or three threads of spool female inlet. At this time, be careful not to touch applying part to spring seat.

PROCEDURE OF SUBASSEMBLY

IMPORTANT
Check number of each part, installing position and tools needed before reassembling.

Reassembly of Spool Assembly (Main Spool)

1. Apply adhesive to thread part of spool (2-6, 14-17) and install spring seat, spring and spool end.
2. After gripping spool in vise with wood (which is used when disassembling it) and tighten spool end with rated torque. Tightening torque: 20-22 Nm

IMPORTANT
1. Be careful not to penetrate adhesive into spool inside by applying it over.
2. Be careful that spool operation become deteriorated If torque is so big when tightening spool end.
3. When reassembling it+A56 be careful because spring is two kinds.

Reassembly of Arm 1 Para Turn Spool Assembly

1. Apply adhesive to thread part of spool (19) and install spring seat (20), spring (21) and spool end (22).
2. After gripping spool in vise with wood (which is used when disassembling it) and tighten spool end with rated torque. Tightening torque: 19-22 Nm

IMPORTANT
1. Be careful not to penetrate adhesive into spool inside by applying it over.
2. Be careful that spool operation become deteriorated If torque is so big when tightening spool end.

Reassembly of Antidrift Valve Assembly

1. Install O-ring (67-9, 10) and back up ring (67-11, 12) on the circumferential groove of sleeve (67-6).

IMPORTANT
1. Be careful of installing position of O-ring and back up ring.
2. If they are reversed O-ring is damaged and natural lowering of actuator can be increased.

2. Insert poppet (67-2) and spool (67-5) in the sleeve hole.

3. Install spring seat (67-16) on small diameter of poppet end part, insert spring (67-8) and insert them with sleeve to body (67-1).

IMPORTANT
It Is better to apply grease to the seat surface to install spring and spring seat to seat of poppet surely.

4. Install spring (67-7) and piston (67-4) to plug (67-3).
5. Tighten plug assembly (67-14) which O-ring is installed to plug (67-3). Tightening torque: 147 - 157 Nm
6. Install O-ring (67-13) to plug (67-3) and tighten it to body (67-1). Tightening torque: 147 - 157 Nm
7. Tighten plug assembly (67-15) with O-ring to body (67-1). Tightening torque: 14 - 18 Nm

REASSEMBLING PROCEDURE OF CONTROL VALVE BODY

Reassembling of Relief Valve

CAUTION!
When reassembling safety valve, tighten plug which is installed to body surely. **Do not tighten plug for set pressure or lock nut.** **If plug for set pressure is turned, it is dangerous because set pressure is varied.**

1. Screw main relief valve (68) and tighten it. Tightening torque: Tightening torque: 78 - 88 Nm
2. Screw over load relief valve (69, six places) to each section and tighten them. Tightening torque: 78 - 88 Nm
3. Install spring seat (67-16) on small diameter of poppet end part, insert spring (67-8) and insert them with sleeve to body (67-1). Tightening torque: 103 - 113 Nm

Reassembling of Road Check Valve

1. Install O-ring (36) to arm (1, 2, section D-D), boom (1, 2, section E-E) and swing section (section F-F) and install poppet (34) and spring (35). Mount flange (37) and tighten socket head bolt (75). Tightening torque: 58 - 64 Nm
2. Install O-ring (36) to travel section (section H-H) and install poppet (51) and spring (35). Mount flange (37) and tighten socket head bolt (75). Tightening torque: 58 - 64 Nm
3. Install O-ring (36) to travel straight section (section H-H). Mount flange (37) and tighten socket head bolt (75). Tightening torque: 58 - 64 Nm

4. Install poppet (51) and spring (35) to common (section I-I) and insert spacer (53) which O-ring (54) and back up ring (55) are installed to. Tightening torque: 39-44 Nm

IMPORTANT
1. Be careful of installing position of O-ring and back up ring. **2. If they are reversed O-ring is damaged and oil leak can be caused.**

5. Install O-ring (36) to spare section (section G-G) and install poppet (44) and spring (45). Mount flange (43) and tighten socket head bolt (96). Tightening torque: 58 - 64 Nm. Tighten flange assembly (92) with O-ring. Tightening torque: 205-227 Nm
6. Insert poppet (49) and spring (48) to travel section (section G-G). Tighten plug (46) with O-ring (47). Tightening torque: 107-117 Nm
7. Bucket section (section F-F)

   Insert piston (95) and O-ring (102) to plug (94) and tighten it to body (96). Tightening torque: 103-113 Nm. Insert back up ring (103), O-ring (104), spring (98) and poppet assembly (100) to sleeve (99) and install it to body (96). Install O-ring (36) to valve housing and tighten body by means of socket head bolt (101). Tightening torque: 58-64 Nm
8. Insert poppet (32) and spring (33) to arm 1 para turn part (section C-C). Tighten plug assembly (72) with O-ring. Tightening torque: 73-79 Nm
9. Insert poppet (32), spring (33), and spacer (57) to arm 2 para turn part (section L-L). Tighten plug assembly (72) with O-ring. Tightening torque: 73-79 Nm

Reassembling of Antidrift Valve

1. Install O-ring (41, 42) to the surfaces of antidrift valve assembly of arm 1 section (section D-D) and boom 1 section (section E-E).
2. Insert poppet (32) and spring (39). Install spacer assembly (40) which O-ring and back up ring are installed to.

IMPORTANT
1. Be careful of installing position of O-ring and back up ring. **2. If they are reversed O-ring is damaged and oil leak can be caused.** **3. Check installing of O-ring (40-4) of spacer assembly and be careful of installing direction.**

3. Install antidrift valve assembly (67, two places) and tighten it by means of socket head bolt. Tightening torque: 39-44 Nm

Reassembling of Spare Section Part

1. Install O-ring (89) to cap (88, two places) and tighten it by means of socket head bolt (76). Tightening torque: 58-64 Nm
2. Install O-ring and back up ring to plug assembly (87, two places) and tighten it. Tightening torque: 78-88 Nm

Reassembling of Arm Regeneration Release Valve

1. Install O-ring (30) and back up ring (31, two places) to sleeve (28).
2. Install piston (29) and spool (27) to sleeve and Insert it to valve housing.
3. Install O-ring (25) to plug (27), insert spring (26) to it and tighten it to valve housing. Tightening torque: 103-113 Nm

Reassembling of Arm 1 Paraturn Spool

1. Install spool of subassembly condition (19) to valve housing.

IMPORTANT
After inserting spool, slide it and check if it is good sliding condition.

2. Install O-ring (23) to cap (18) and tighten it by means of socket head bolt (78). Tightening torque: 8.8-10.8 Nm

Reassembling of Main Spool

1. Install O-ring to the mating surface of cap of valve housing.
2. Install spool of subassembly condition (2-6, 14-17) to the same position before.

IMPORTANT
1. Align spool to hole and insert it slowly. **2. After inserting spool, slide it and check if it is good sliding condition without a crash.** **3. If insert spool when it is bad sliding condition with a crash, it causes malfunction of spool.**

3. Install cap (12, ten places) and tighten it by means of socket head bolt (74). A129
4. Install cap (8, ten places) and tighten it by means of socket head bolt (74). Tightening torque: 39-44 Nm
5. Install O-ring to plug assembly (72) and tighten it to two sides of cap of travel straight section (section H-H).
6. Install O-ring (62) to plug assembly (91) and tighten it to the long cap of spare section (section G-G). Install O-ring (62) to plug assembly (105) and tighten it to the short cap of spare section (section G-G).

IMPORTANT
1. When tightening plug to cap, be careful not to over tighten. **2. If it is over tighten, threads of cap can be damaged.**

Reassembling of Miscellaneous Plug Kinds

1. Install O-ring to plug assembly (60) and tighten it. Tightening torque: 103-113 Nm
2. Install O-ring (62) to plug assembly (61) and tighten it. Tightening torque: 39-44 Nm
3. Tighten orifice plug (63). Tightening torque: 14-18 Nm
4. Install O-ring to plug assembly (92) and tighten it. Tightening torque: 205-227 Nm
5. Install O-ring to plug assembly (71) and tighten it. Tightening torque: 14-18 Nm
6. Install O-ring to plug assembly (72) and tighten it. Tightening torque: 73-79 Nm

Reassembly of Main Relief Valve

Check if there are dirt and paint chips around threads of plug (1, 6, 8) and nut (4, 7), replace O-ring with new one. Clean the installing part of relief valve of valve housing, install it, and then tighten plug (1, width across flat:32). Tightening torque: 78-88 Nm Also, when disassembling plug, adjust pressure by referring “Main Relief Valve” on page -38.

NOTE: *The torque values are based on the use of lubricated threads.*

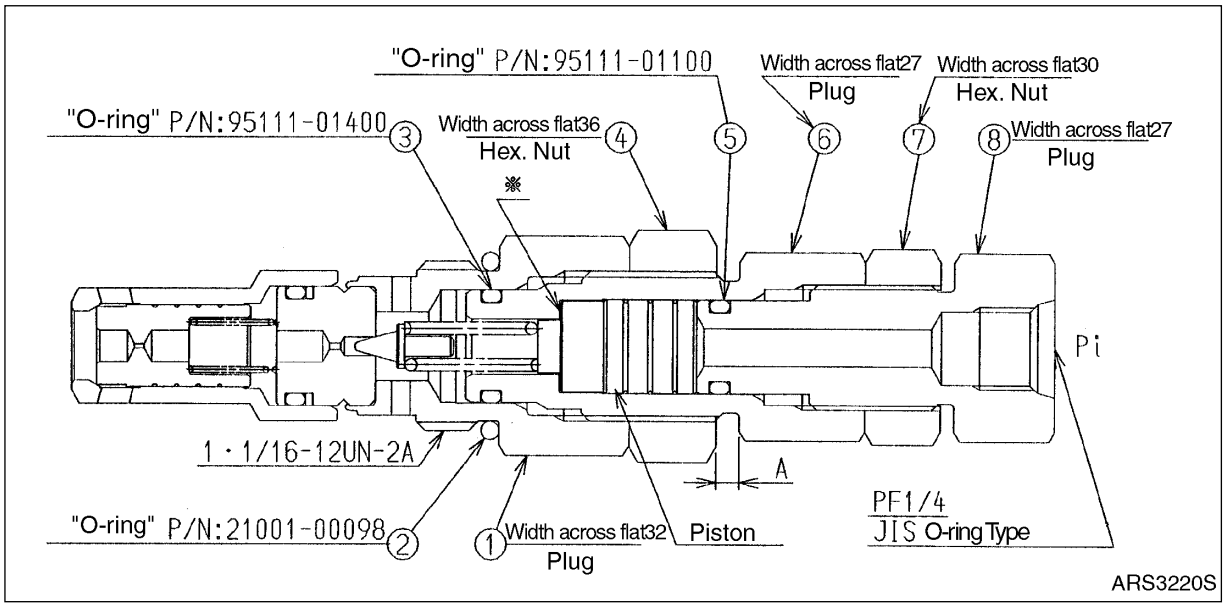


Figure 54

Reassembling of Overload Relief Valve

Check whether there are dirt and paint chips around cap (1) and install O-ring with a new one. Clean the installing part of relief valve of valve housing, install relief valve, and tighten cap (1). Torque: 78-88N*M

If adjusting kit is disassembled, Clean around threads and adjust pressure by section 6-5-2).

NOTE: *The torque values are based on the use of lubricated threads.*

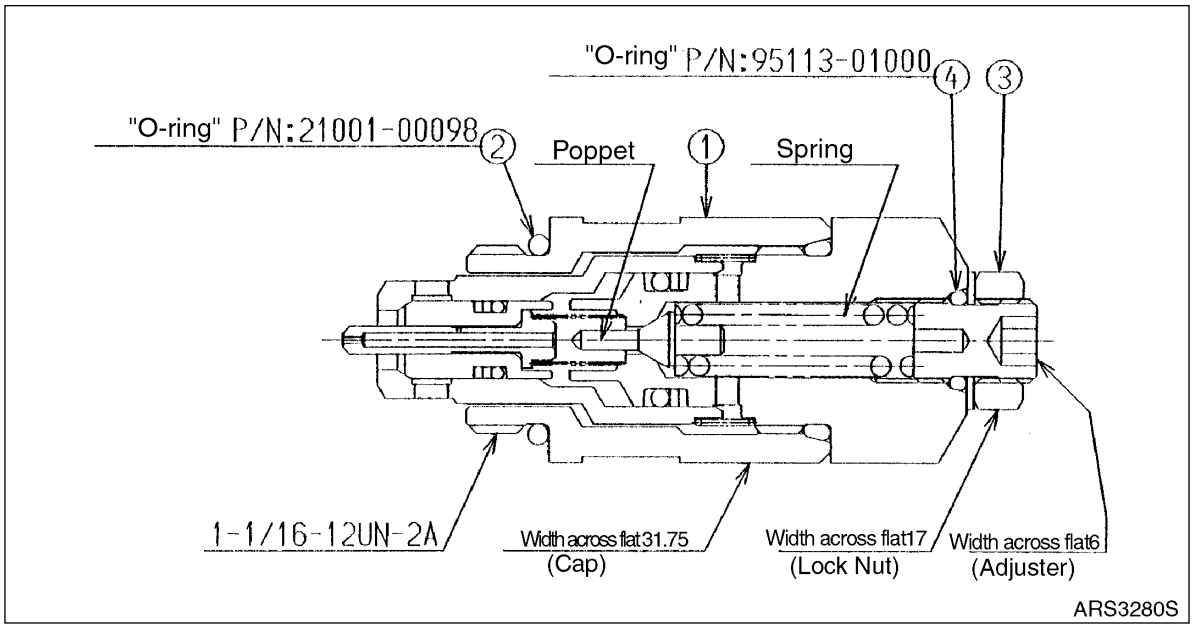


Figure 55

Reassembling of Low Pressure Relief Valve

Check whether there are dirt and paint chips around plug (1) and replace O-ring (3) with new one. Install new O-ring (4) to sleeve (2). Clean the installing part of relief valve of valve housing and tighten plug (1, width across flat: 32) of relief valve. Torque: 103-113 Nm

NOTE: *The torque values are based on the use of lubricated threads.*

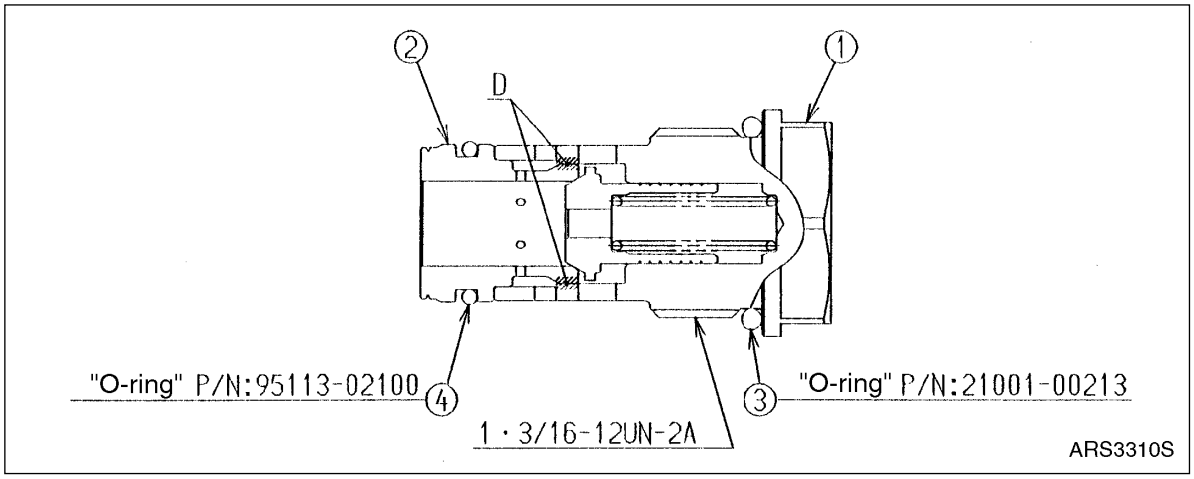


Figure 56

INSTALLATION

1. Be careful not to give other foreign strength to control valve by pipe laying.
2. Tighten the assembling bolts alternately and evenly to the specified torque.
3. If welding procedures are being performed near control valve that could be damaged by weld spatters and heat, be careful and use adequate shielding protection in front of valve.
4. Valve ports should be covered with caps, plugs or tape to protect the disconnected openings from dust and other foreign materials until pipe laying work is started.

START-UP PROCEDURES

1. Before operating machine, make sure that oil passages and hydraulic oil are clean.
2. Hydraulic oil of which aniline point is 82-113°C should be used for hydraulic system.
3. Relief valve pressure should not be raised above setting pressure.
4. The difference between main relief valve setting pressure and over load relief valve setting pressure should be set over 2.0 MPa.
5. Before operating machine, hydraulic system should be fully warmed up. If machine is operated with cold hydraulic oil and valve, be careful of the followings for preventing from sticking by heat shock of spool.

   NOTE: *Do not operate main relief valve or over load relief valve suddenly and continuously. Cycle oil through all actuators and warms up cold hydraulic oil in the lines and components uniformly.*

   NOTE: *Slight or compound work should not be suddenly operated at cold weather because heat is developed partly at all the throttles.*

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

PILOT CONTROL VALVE (WORK LEVER / JOYSTICK)

⚠ 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 300LC-V	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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GENERAL DESCRIPTION

THEORY OF OPERATION

Structure

The remote control valve contains four push rods, spring holders, spools and return springs, which are located in the valve casing. The valve works as a pressure reduction valve.

The housing has six ports, which include input port P, tank port T, and four secondary pressure ports.

The electric horn switch is installed in the valve handle. Gear pump pressure is used for operating control spools.

Function

1. Neutral Mode

   When the lever is in neutral mode, the spool is thrust upward by return spring, and the force of balancing spring, which determines the secondary discharge pressure, is not transmitted to the spool. The input port is closed and the pressure of the output port is the same as the pressure of the tank port T.

2. Control Mode

   When push rod is pushed, the balance spring begins to compress, and spring force is conveyed to the spool. Ports P and T are then connected together and the pilot pressure is conveyed to the area. Output pressure works on the bottom of the spool, thrusting the spool upward until it is balanced with the power of the balance spring. The secondary pressure (output pressure), therefore, changes in proportion to the compression force of the balance spring.

PARTS LIST

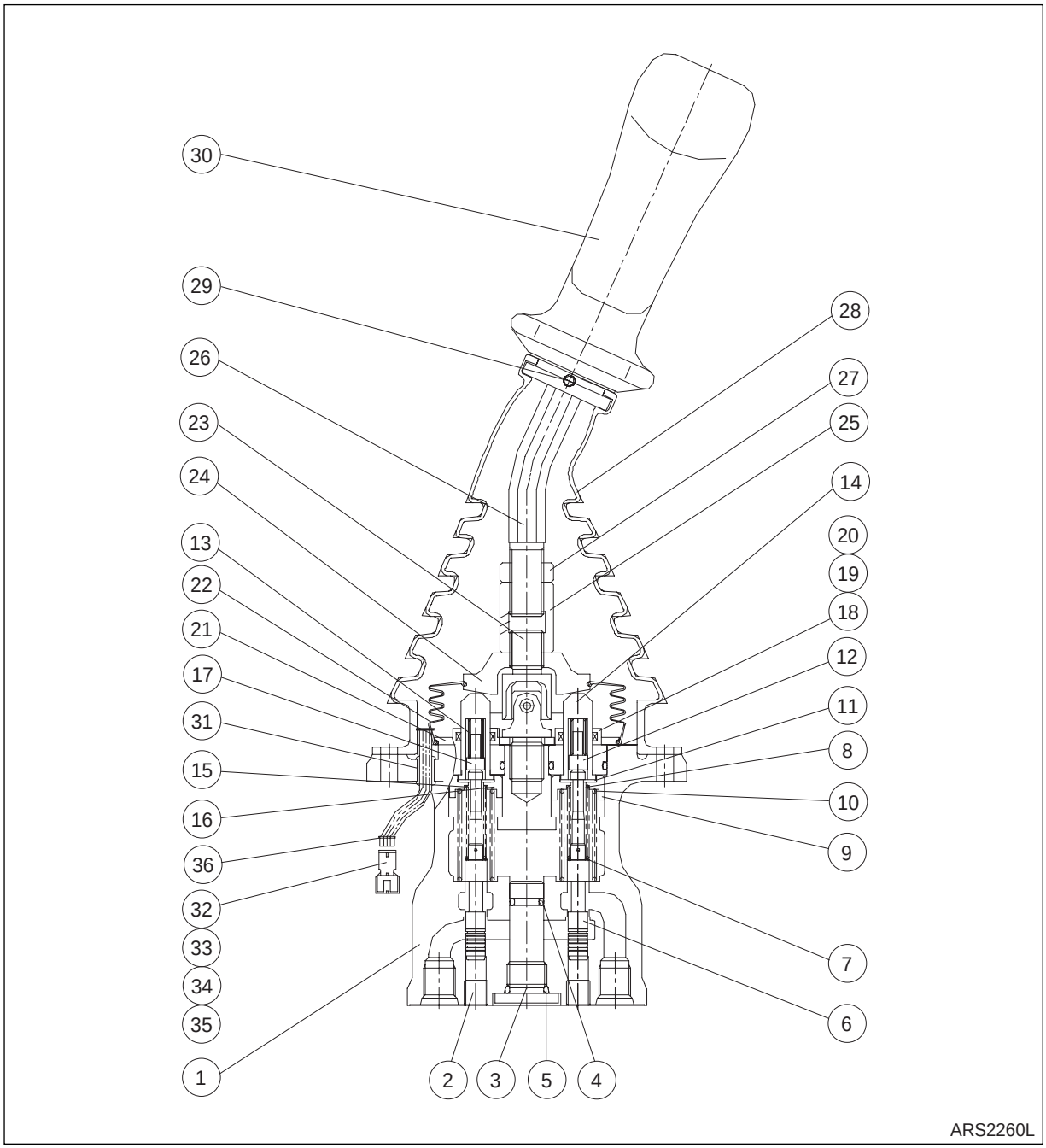


Figure 1

Reference Number	Description
1	Case
2	Plug
3	Plug
4	O-ring
5	O-ring
6	Spool
7	Shim
8	Spring
9	Spring Seat
10	Spring
11	Stopper
12	Stopper
13	Spring
14	Push Rod
15	Spring
16	Spring Seat
17	Stopper
18	Plug

Reference Number	Description
19	O-ring
20	Rod Seal
21	Plate
22	Boot
23	Joint Assembly
24	Swash Plate
25	Hex Nut
26	Handle Bar
27	Nut
28	Boot
29	Spring Pin
30	Handle Assembly
31	Bushing
32	Terminal
33	Seal Wire
34	Housing
35	Holder Rear
36	Clip Band

SPECIFICATIONS

Pilot Control Valve	Specification
Type	Pilot Control (2-Stage Joystick)
Pressure / Stroke	(1,3) 28 kg/cm^2 @ 6.5 mm Stroke (398 psi @ 0.256 in. Stroke) (2,4) 28 kg/cm^2 @ 7.5 mm Stroke (398 psi @ 0.295 in. Stroke)
Weight	4.8 kg (10.58 lb)

Torques

Reference Number	Bolt Size	Tool	Torque
2	PT 1/8		
3	PF 3/8	8 mm L-Wrench	500 kg•cm (36.2 ft lb)
24	M14	24 mm Spanner	1,240 kg•cm (89.7 ft lb)
25	M14	22 mm Spanner	1,240 kg•cm (89.7 ft lb)
27	M14	22 mm Spanner	1,240 kg•cm (89.7 ft lb)

Performance

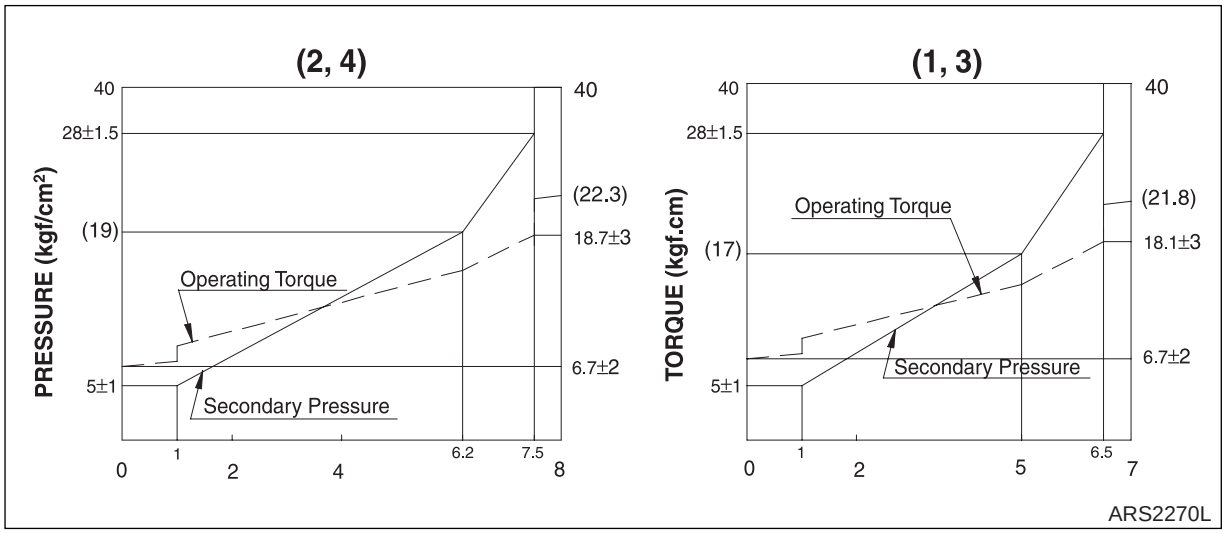


Figure 2

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.

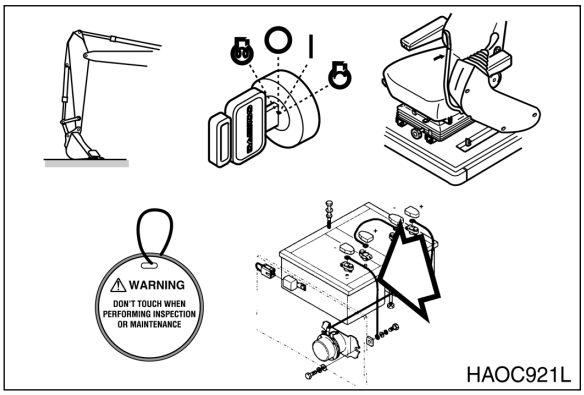


Figure 3

7. Remove four bolts and washers (2, Figure 4) and cover (1).
8. Pull cap (5, Figure 4) out and remove two screws, two bolts and washers (6) and cover (3).
9. Remove three screws, one bolt and washers (7, Figure 4) and cover (4).

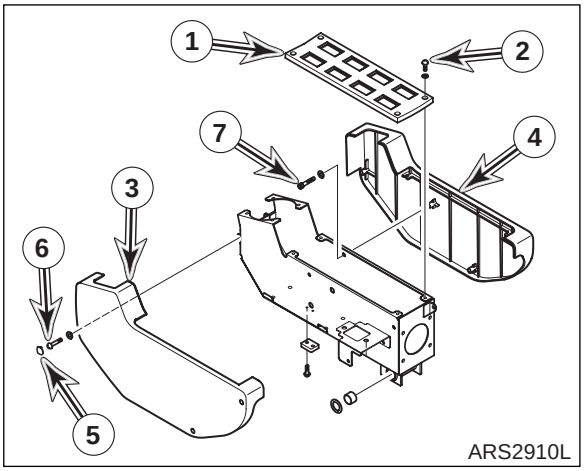


Figure 4

10. Remove four bolts (3, Figure 5) and cover (2), and pull remote control valve LH (1) out.
11. Tag and disconnect hoses from remote control valve LH (1, Figure 5). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.

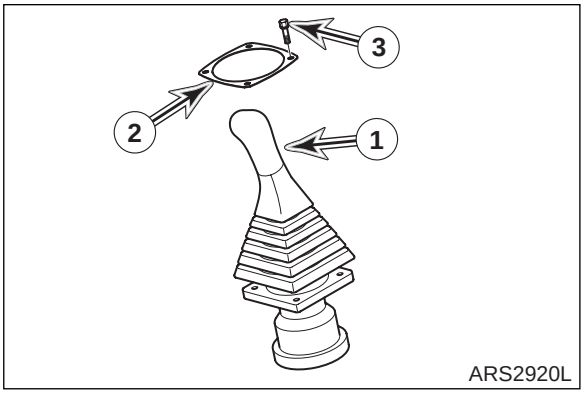


Figure 5

12. Remove four bolts and washer (2, Figure 6), and cover (2).
13. Pull cap (5, Figure 6) out and remove screw, three bolts and washers (6) and cover (3).
14. Remove two screws, two bolts and washers (7 and 8, Figure 6) and cover (4).

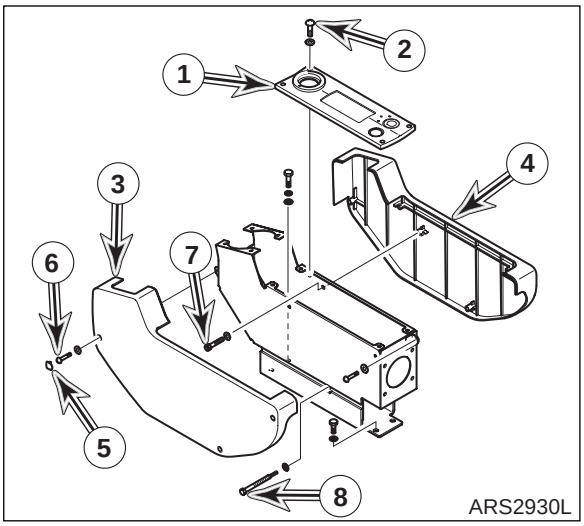


Figure 6

15. Remove four bolts (3, Figure 7) and cover (2), and pull remote control valve RH (1) out.

16. Tag and disconnect hoses from remote control valve RH (1, Figure 7). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.

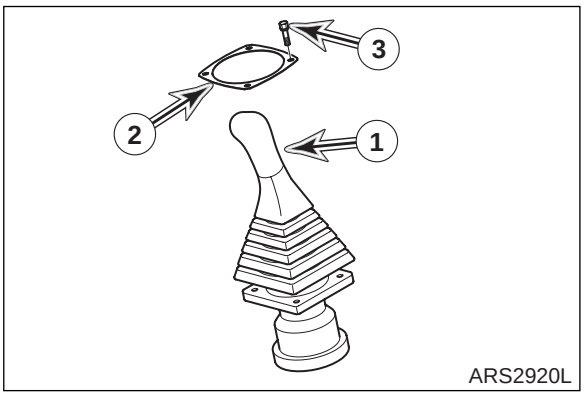


Figure 7

DISASSEMBLY

1. Lift up the boot (28) and pull the switch cord through the hole in the case (1).



Figure 8



Figure 9

2. Loosen nut (27) from hex nut (25) and remove handle assembly (30).



Figure 10

3. Remove hex nut (25) and swash plate (24).

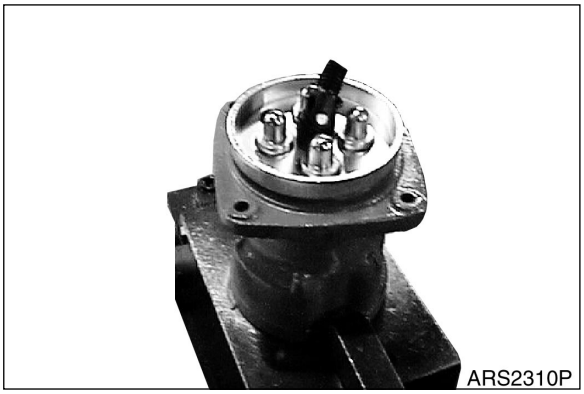


Figure 11

4. Remove joint (23) from case (1).

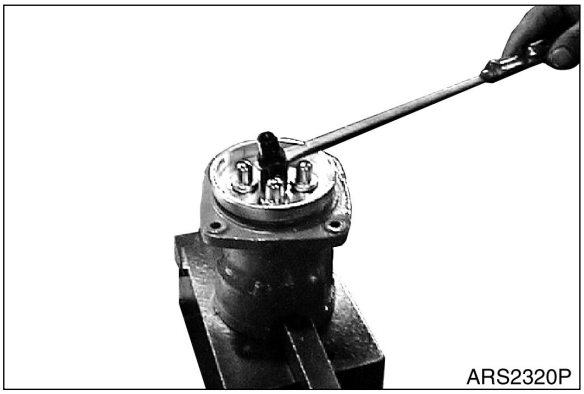


Figure 12

5. Remove plate (21).

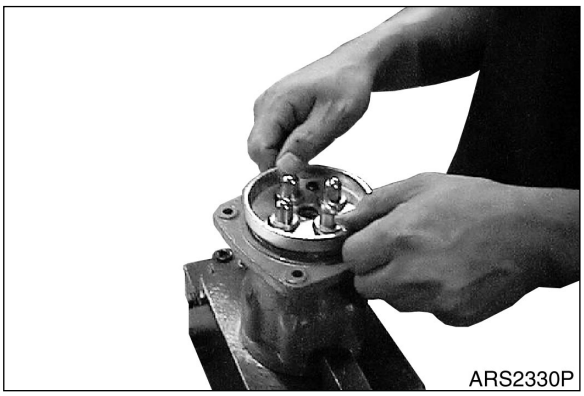


Figure 13

6. Press spring (10) and remove plug (18).

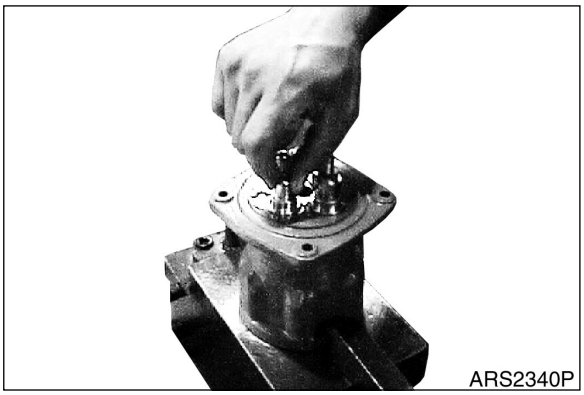


Figure 14

7. Remove pressure reduction valve (6, 7, 8, 9, 11) and spring (10).

IMPORTANT
Mark valve disassembling position (port).

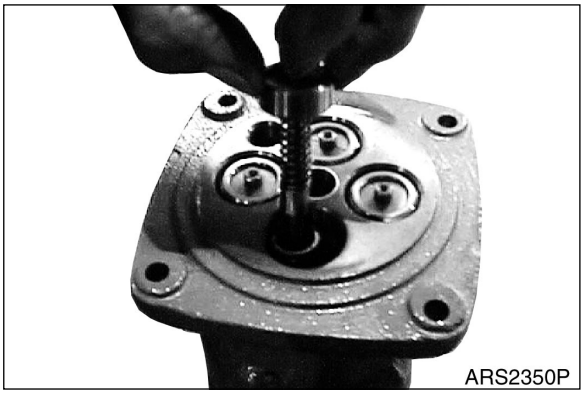


Figure 15

8. Remove plug (3) and four plugs (2).

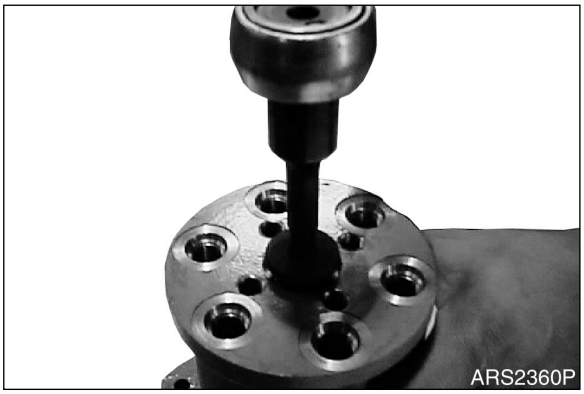


Figure 16

9. Remove stopper (11) from pressure reduction valve (6, 7, 8, 9, 11).

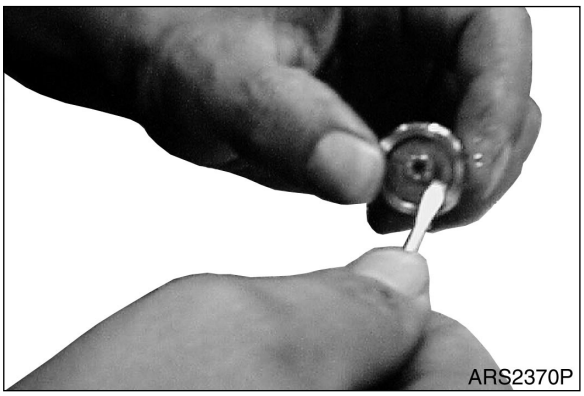


Figure 17

10. Remove spool (6), spring seat (9), spring (8) and shim (7).

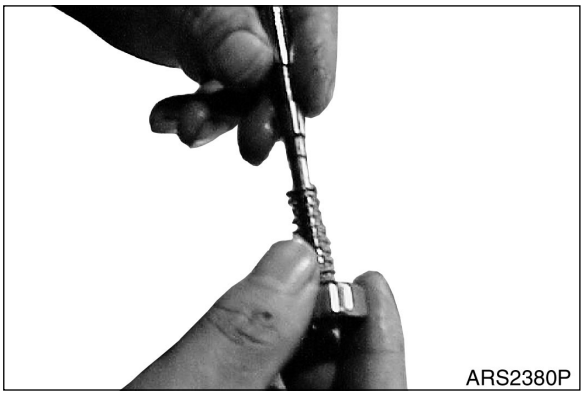


Figure 18

11. Remove push rod (14) and plug (18).

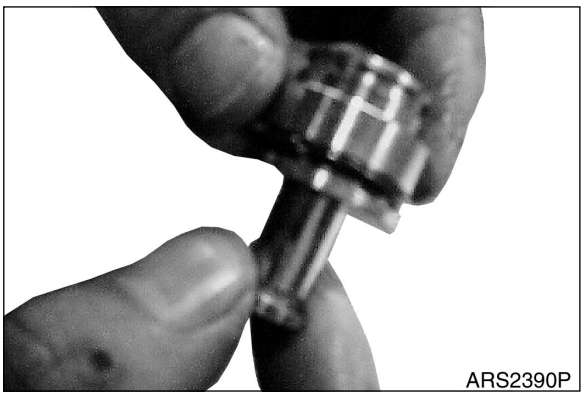


Figure 19

12. Remove O-ring (19) from plug (18).

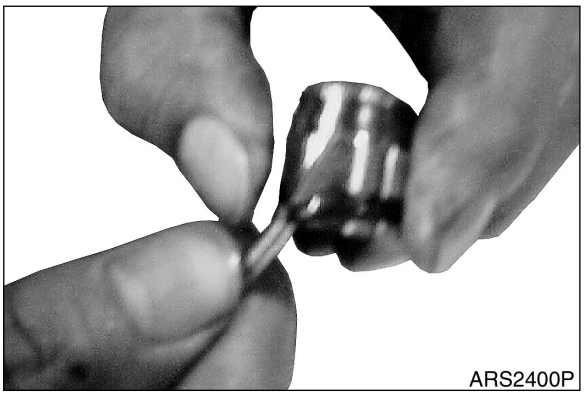


Figure 20

13. Remove seal (20) from plug (18).

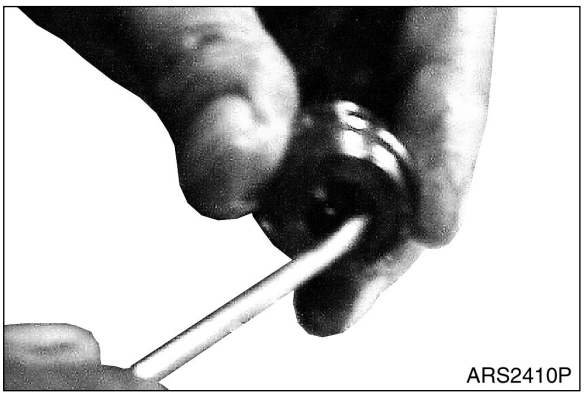


Figure 21

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

Clean all parts and dry them with compressed air. Keep all parts free from dust. Lubricate all moving parts.

REASSEMBLY

1. Tighten plug (3) slowly.

   NOTE: *Tightening torque: 350 kg•cm (25.3 ft lb).*

   Tighten four plugs (2).

   NOTE: *Use Loctite #592 pipe sealant on plugs.*

   NOTE: *Tightening torque 150 kg•cm (10.9 ft lb).*

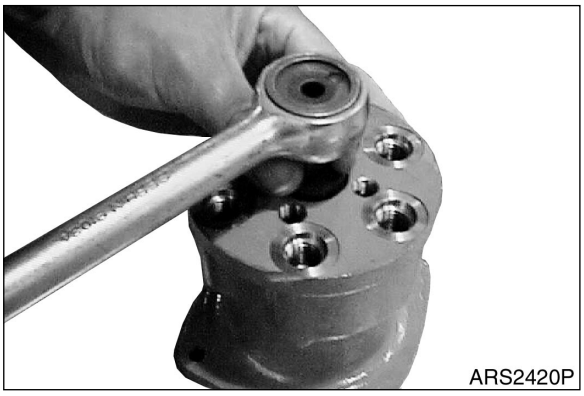


Figure 22

2. Install shim (7), spring (8), spring seat (9), and spool (6).

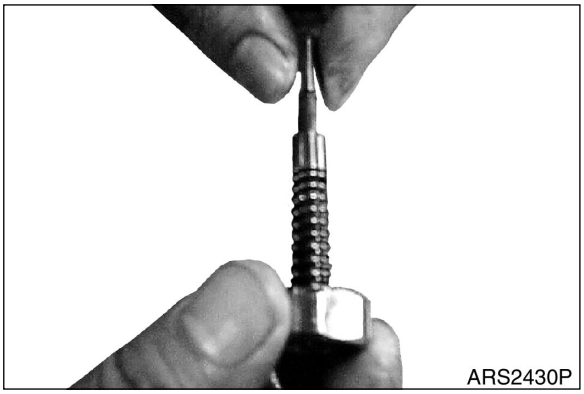


Figure 23

3. Press spring (9) and install stopper (11).



Figure 24

4. Install spring (10) in case (1) and pressure reducing valve assembly (6, 7, 8, 9, 11).

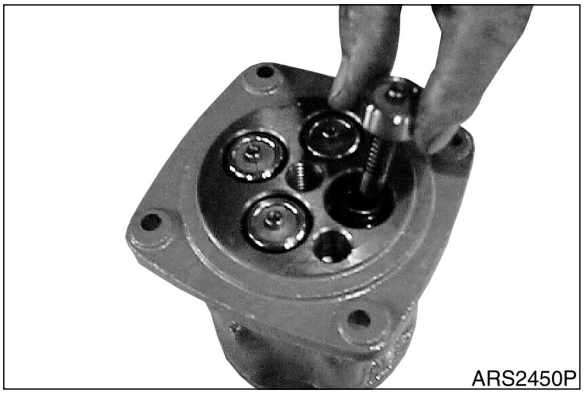


Figure 25

5. Install seal (20) on plug (18).



Figure 26

6. Install O-ring (19) on plug (18).



Figure 27

7. Install push rod (14) on plug (18).

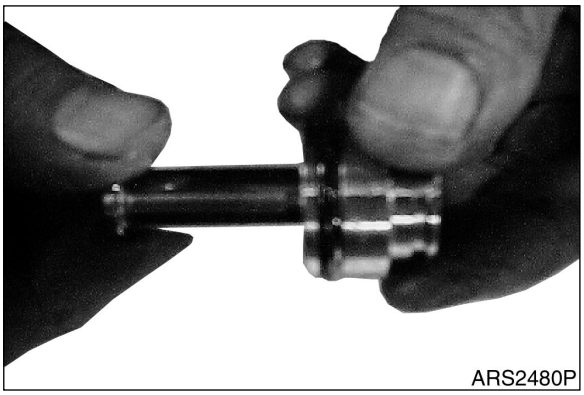


Figure 28

8. Install spring (13) on stopper (12).

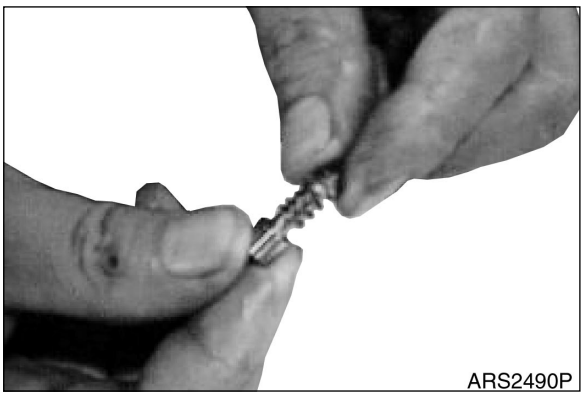


Figure 29

9. Position stopper (12) and spring (13) on pressure reducing valve.

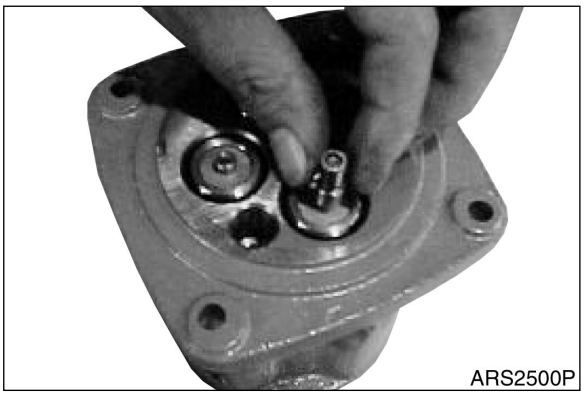


Figure 30

10. Install plug (18) in case (1).

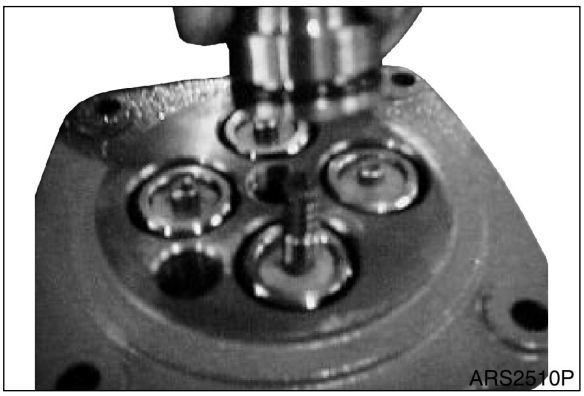


Figure 31

11. Install plate (21) and tighten joint (23).

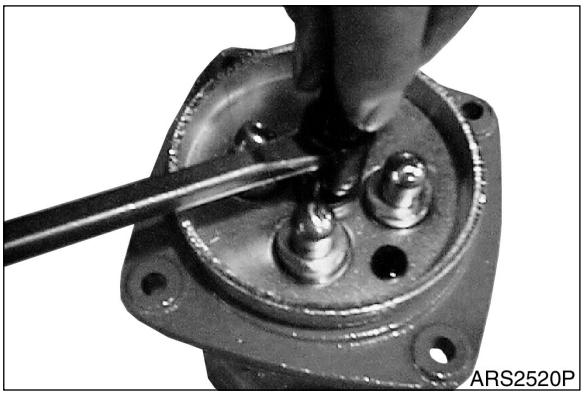


Figure 32

12. Install swash plate (24) on joint (23).

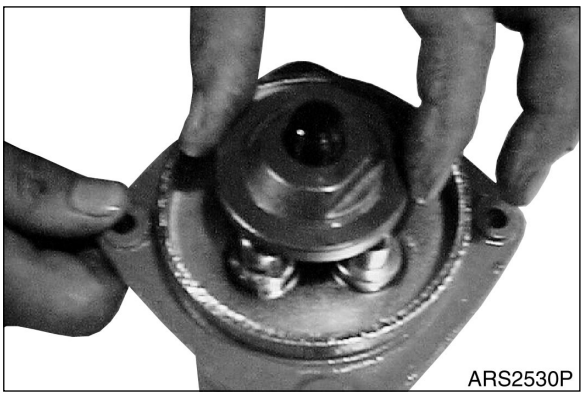


Figure 33

13. Install hex nut (25) and tighten swash plate (24).

    NOTE: *Tightening torque 1,240 kg•cm (89.7 ft lb).*

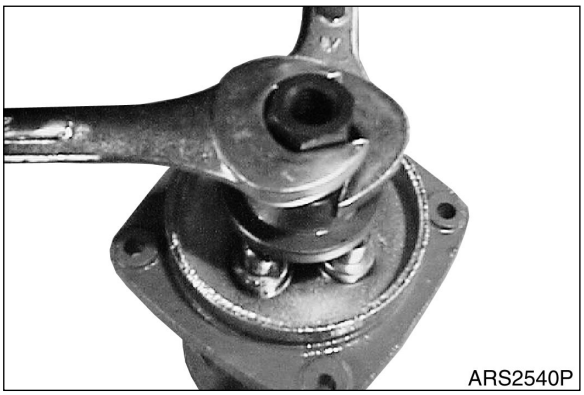


Figure 34

14. Pull cord and tube out through hole of hex nut (25).

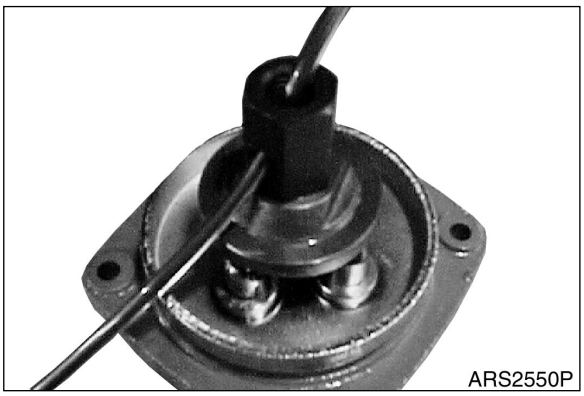


Figure 35

15. Align the direction of handle (30) and tighten hex nut (25) and nut (27).

    NOTE: *Tightening torque 1,240 kg•cm (89.7 ft lb).*

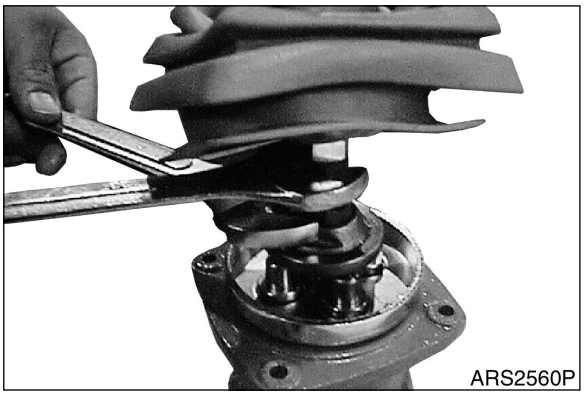


Figure 36

16. Grease joint (23), swash plate (24) and push rod (14).

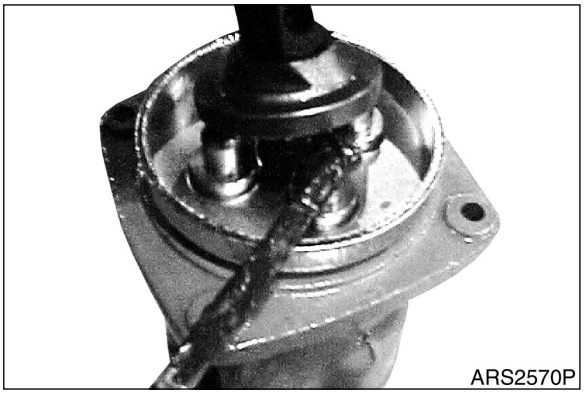


Figure 37

17. Install boot (28).

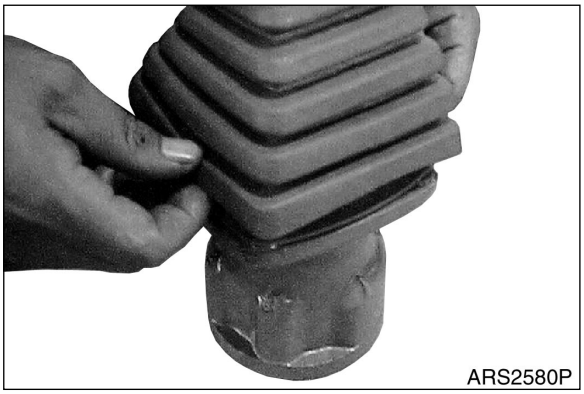


Figure 38

INSTALLATION

1. Connect hoses as tagged during removal to remote control valve RH (1, Figure 39).
2. Position remote control valve RH (1, Figure 39) on control stand and install four bolts and washers (3) and cover (2).

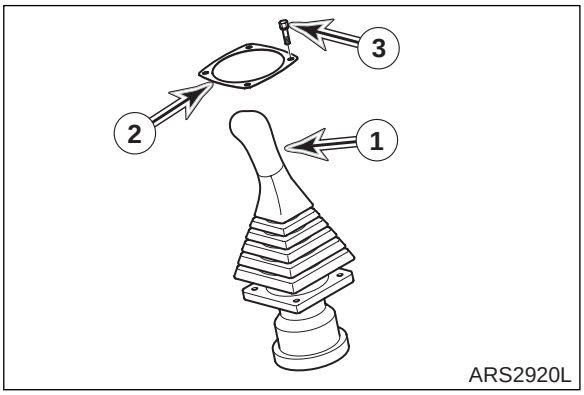


Figure 39

3. Install two screws, two bolts and washers (7 and 8, Figure 40) and cover (4).
4. Install a screw, three bolts and washers (6, Figure 40) and cover (3). Push cap (5) into cover (3).
5. Install four bolts and washers (2, Figure 40) and cover (1).

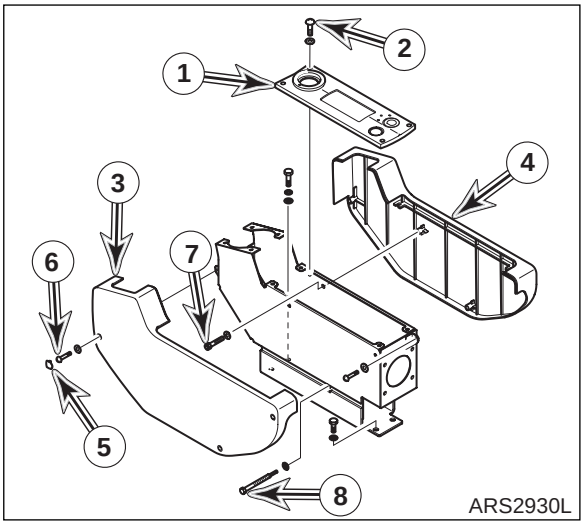


Figure 40

6. Connect hoses as tagged during removal to remote control valve LH (1, Figure 41).
7. Position remote control valve LH (1, Figure 41) on control stand and install four bolts and washers (3), and cover (2).

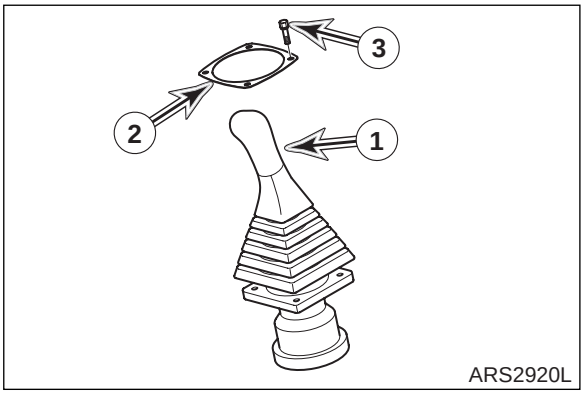


Figure 41

8. Install three screws, one bolts and washers (7, Figure 42), and cover (4).
9. Install two screws, two bolts and washers (6, Figure 42), and cover (3). Push cap (5) into cover (3).
10. Install four bolts and washers (2, Figure 42), and cover (1).

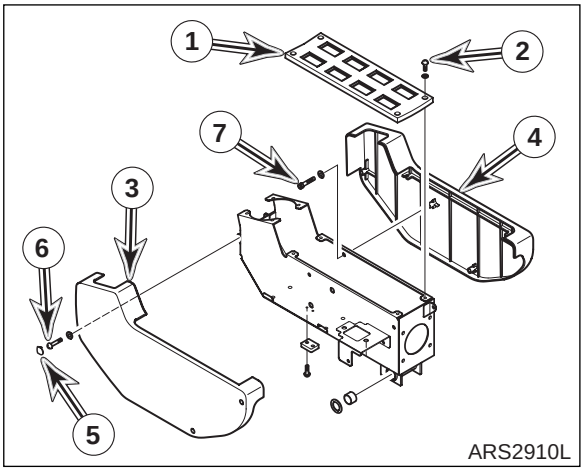


Figure 42

START-UP PROCEDURES

1. Start engine and set throttle at "LOW IDLE".
2. Set safety lever on "UNLOCK" position.

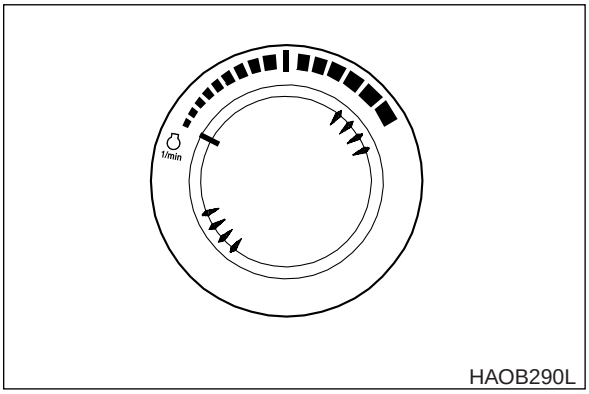


Figure 43

3. Slowly cycle boom, arm, bucket cylinders and swing motor about five times without a load to vent air from pilot lines. Do this for 5 minutes.

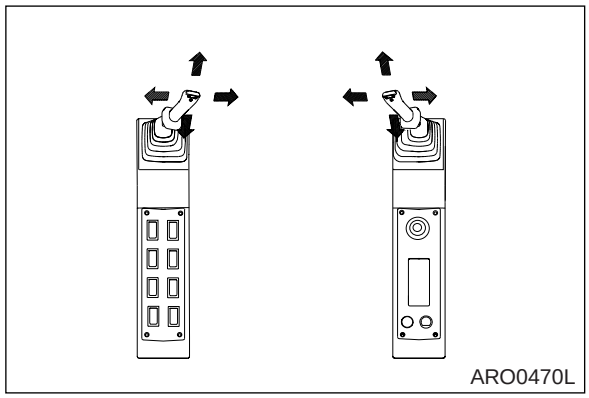


Figure 44

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

TRAVEL CONTROL VALVE (WITH DAMPER)

⚠ 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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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Start-up Procedures 24

GENERAL DESCRIPTION

THEORY OF OPERATION

The damper valve is divided into two areas of operation. There is the pressure reducing valve (a) and the damper mechanism (b). The following hydraulic circuit is an example of a remotely located control valve.

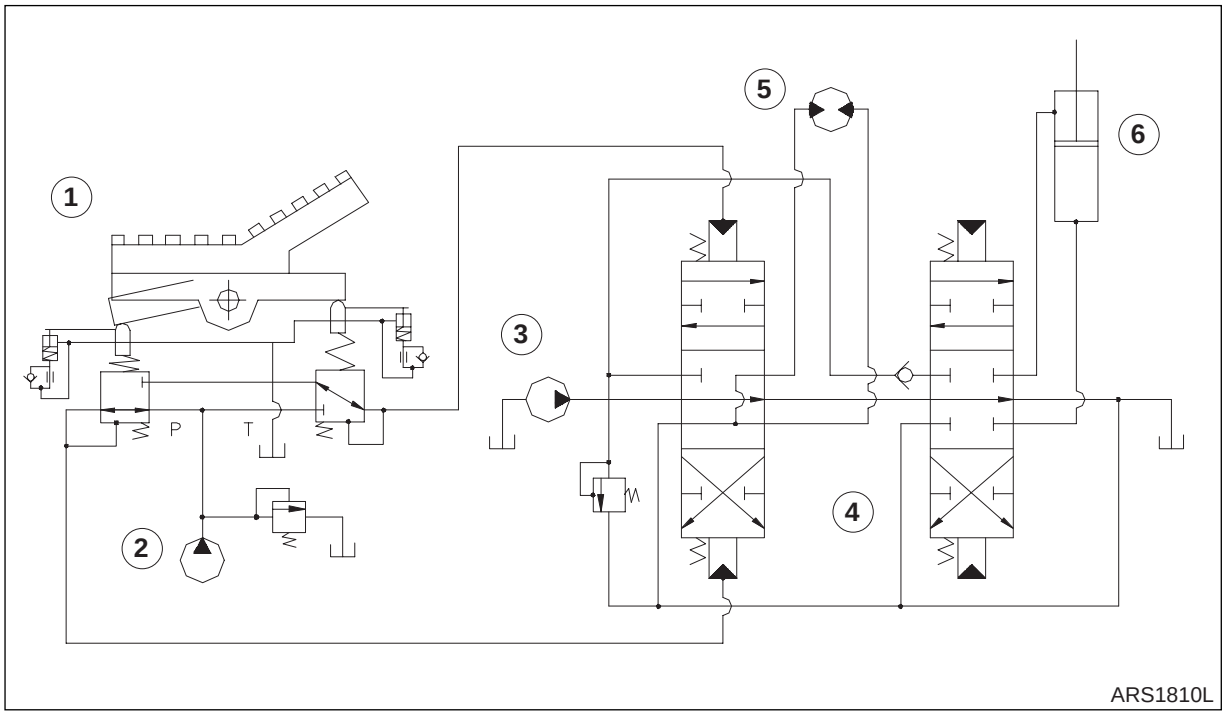


Figure 1

Reference Number	Description
1	Remote Control Valve
2	Pilot Pump
3	Main Pump

Reference Number	Description
4	Control Valve
5	Hydraulic Motor
6	Hydraulic Cylinder

Pressure Reducing Valve

1. Neutral Condition

   If pedal is in neutral, spool is pushed up by return spring and spring seat. Port (P) is blocked by bottom part of spool and four operating ports (left forward and backward, right forward and backward) are connected to port (T) through inner hole of spool.

2. Half Operation Condition

   If pedal is moved, push rod moves down, and they transmit this force through spring seat and control spring to spool. If spool is moved, primary pressure is transmitted through an inner hole of spool to operating port. If lever is stopped in middle position, compressed control spring force and secondary pressure transmitted through hole acts at bottom part of spool, balance is maintained by hydraulic force acted upward, and then this pressure is transmitted to traveling spool of control valve. That is,

primary pressure is transmitted to operating port as secondary pressure equivalent to control spring force compressed by spool.

3. Full Operating Condition

   If pedal is moved to a maximum, bottom part of push rod presses spool seat to a maximum, and compresses control spring to a maximum. Primary pressure is transmitted through inner hole of spool to operating port, secondary pressure transmitted through spool overcomes control spring force and pushes spool up, but spool is restricted by push rod and does not move any more. That is, when pedal lever is moved to a maximum, control spring does not function, spool is restricted by push rod, and then primary pressure equalizes to secondary pressure.

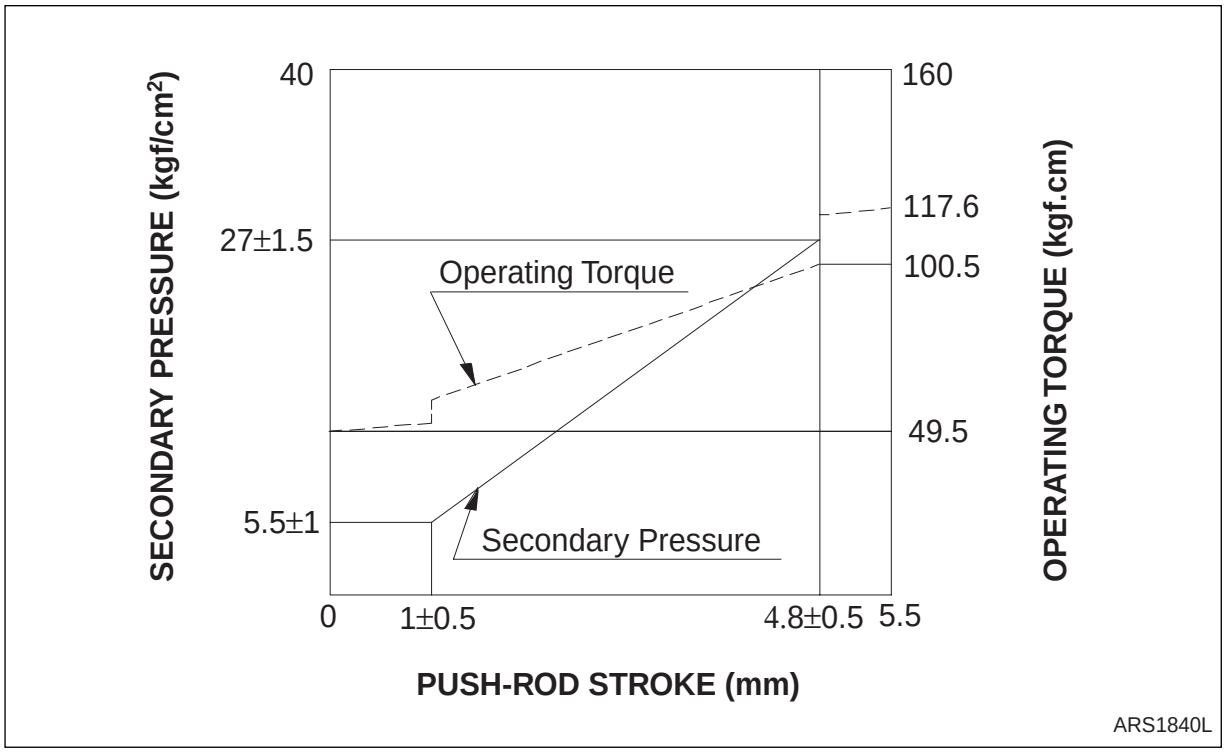


Figure 2

Operating Theory of Damper Mechanism

1. Operation When Operating Lever

   When pushing pedal, pushing force pushing push rod and spool presses cylinder, return spring and hydraulic oil in cylinder is compressed, piston coming down with push rod compresses vibration prevention chamber of lower part, oil of vibration prevention chamber of lower part is flowed through orifice to oil pressure vibration prevention chamber of upper part of low pressure, at this time, ball check valve becomes closing condition because high pressure operates to vibration prevention chamber of lower part.

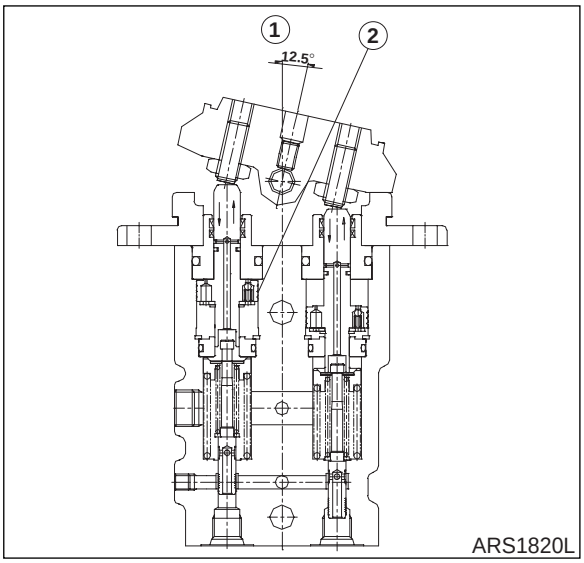


Figure 3

2. Operation When Operating Lever In Neutral Condition

   Climbing restoring force acting on push rod, raises piston in oil pressure prevention chamber and compresses upper oil pressure prevention chamber. This compression operation of upper oil pressure prevention chamber prevents the push rod from quickly rising by restoring spring, and the damping force is generated.

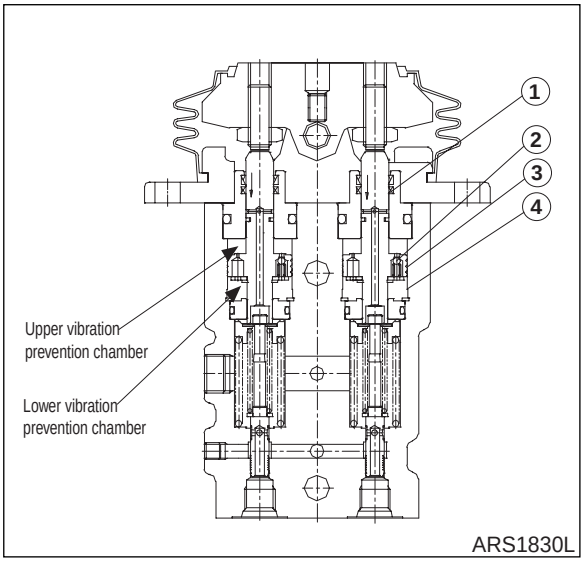


Figure 4

PARTS LIST

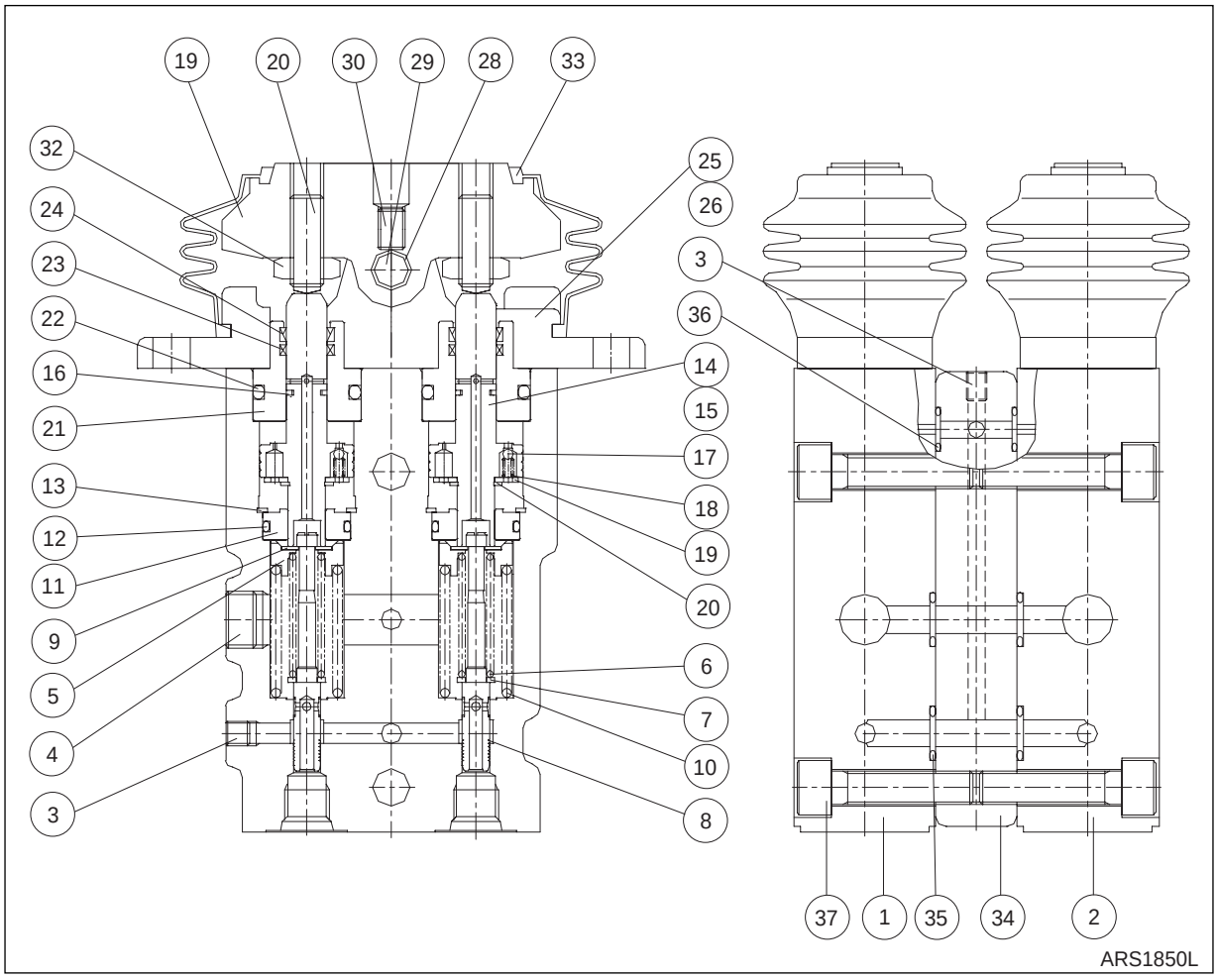


Figure 5

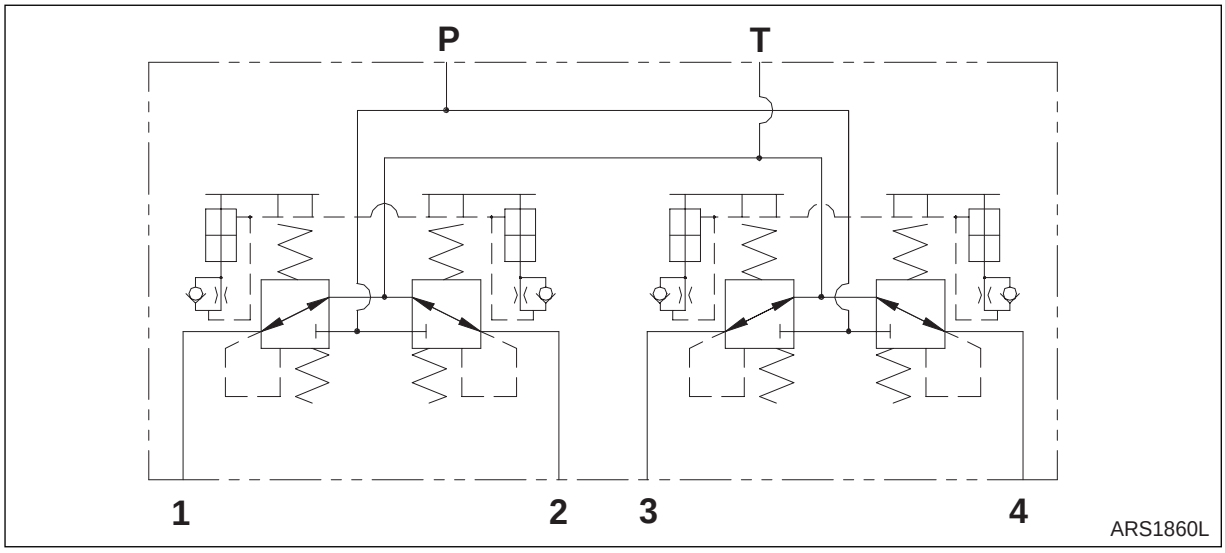


Figure 6

Reference Number	Description
1	Body (1)
2	Body (2)
3	Plug
4	Plug
5	Spring Seat
6	Spring
7	Spring Seat
8	Spool
9	Stopper
10	Spring
11	Rod Guide
12	O-ring
13	Snap Ring
14	Push Rod
15	Spring Pin
16	Seal
17	Steel Ball
18	Spring
19	Plate

Reference Number	Description
20	Snap Ring
21	Plug
22	O-ring
23	Rod Seal
24	Dust Deal
25	Cover
26	Wrench Bolt
27	Cam
28	Bushing
29	Camshaft
30	Set Screw
31	Set Screw
32	Hex Nut
33	Bellows
34	Space
35	O-ring
36	O-ring
37	Wrench Bolt

SPECIFICATION

Travel Control Valve	Specification
Type	Pilot Control (With Damper)
Pressure / Stroke	27 kg/cm^2 @ 4.8 mm Stroke (384 psi @ 1.890 in. Stroke)
Weight	7.8 kg (17.2 lb)

TORQUE

Part Reference Number	Bolt Size	Tool	Tightening Torque
26	M6	5 mm L-Wrench	88 kg•cm (6.37 ft lb)
30	M8	4 mm L-Wrench	100 kg•cm (7.23 ft lb)
32	M10	17 mm Spanner	440 kg•cm (31.8 ft lb)
37	M10	8 mm L-Wrench	440 kg•cm (31.8 ft lb)

TROUBLESHOOTING, TESTING AND ADJUSTMENT

At times pinpointing the source of the problem may be difficult. The following table lists some possible problems, causes and remedies. Refer to this table for possible causes and remedies to help in correcting problems.

The table only lists general problems, causes and remedies. Often the problem is not caused by the failure of a single part but, may be the result of a combination of problems from related parts and their components. Possible problems other than the ones listed are not being specified but that is not to say that these are the only possible problems that can occur. The technician must diagnose the problem, considering all possible causes and repair the source of the malfunction.

Problem	Possible Cause	Remedy
Secondary pressure will not increase.	Low primary pressure.	Adjust primary pressure.
	Defective secondary pressure select spring.	Replace with new spring.
	Gap between spool and casing is abnormally large.	Replace spool casing assembly.
	Defective operating parts and components.	Disassemble/reassemble and replace defective parts.
Unstable secondary pressure.	Jamming of interconnected parts.	Repair/replace cause of jamming.
	Unstable tank line pressure.	Install direct line to hydraulic tank.
	Air in hydraulic lines.	Vent air from system.
Abnormally high secondary pressure.	High tank line pressure.	Install direct line to hydraulic tank.
	Jamming of unconnected parts.	Repair/replace cause of jamming.
No damping.	Jamming of interconnected parts.	Repair/replace cause of jamming.
	Worn damping piston and housing.	Replace damping piston and housing assembly.
	Defective/damaged check valve.	Disassemble and examine check valve.
	Worn damping piston orifice.	Replace damping piston.
Damping piston feels heavy.	Defective interconnected components.	Repair/replace defective parts.
	Restricted movement of damping piston.	Repair/replace damaged piston.
	Plugged orifice.	Replace related parts.

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. Remove cabin under cover by loosening bolts.
8. Tag and disconnect hoses from pedal valve (1, Figure 8). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.
9. Remove rubber boots (1, Figure 9).
10. Remove four bolts and washers (2, Figure 9), pedal brackets (3), and levers (4).

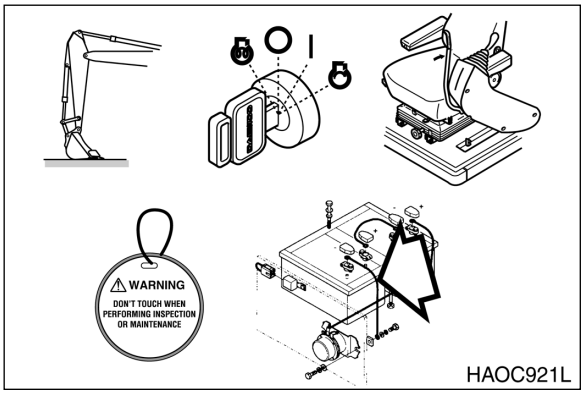


Figure 7

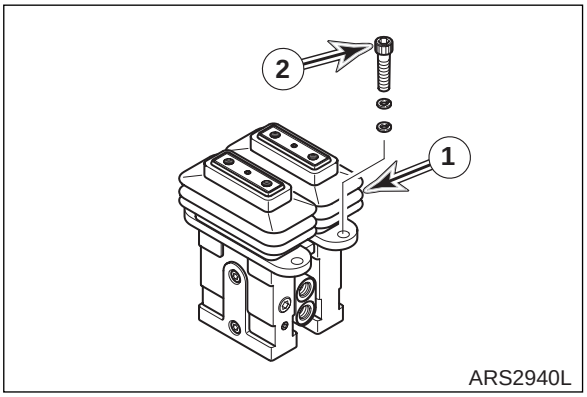


Figure 8

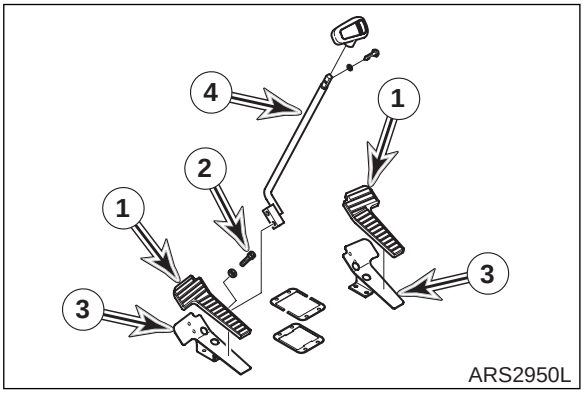


Figure 9

11. Remove four bolts and washers (2, Figure 10), and pedal valve (1).

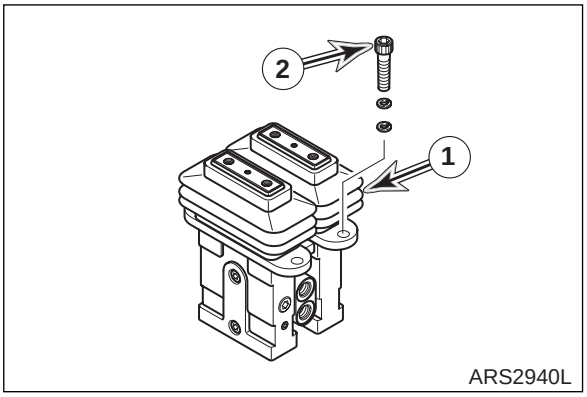


Figure 10

DISASSEMBLY

IMPORTANT
1. Prepare a clean, well lit, stable work bench where disassembly can be performed.
2. Prepare the necessary tools, materials and a container in which disassembled parts can be stored.
3. All precision parts must be handled with great care and all parts must be reassembled to their original position.
4. All parts must be carefully reassembled and not be forced. Damaged parts will cause oil leaks and poor performance of the equipment.
5. Do not leave parts exposed to air during or after disassembly. Exposed parts will come in contact with contaminants and will cause rust and damage.

1. Remove bellows (33).

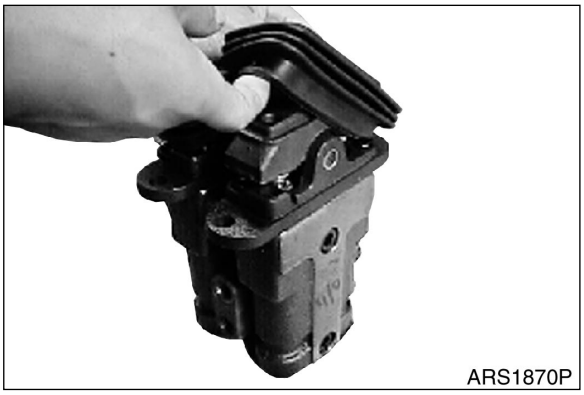


Figure 11

2. Remove set screw (30) by using L wrench.

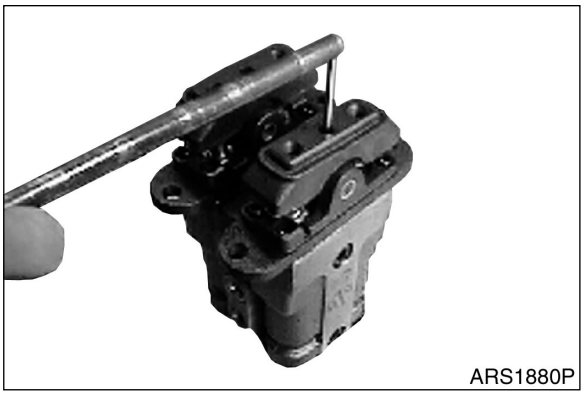


Figure 12

3. Remove cam shaft (29) and bushing (28) from cam (27).

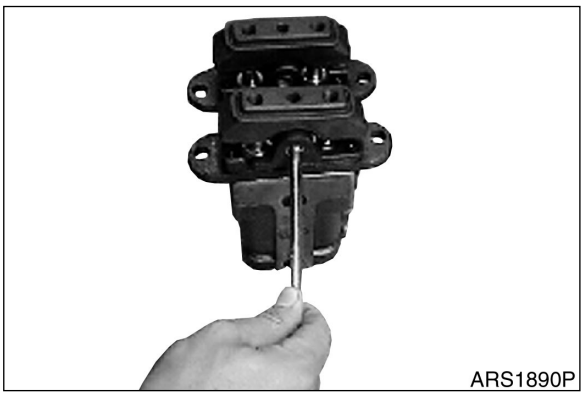


Figure 13

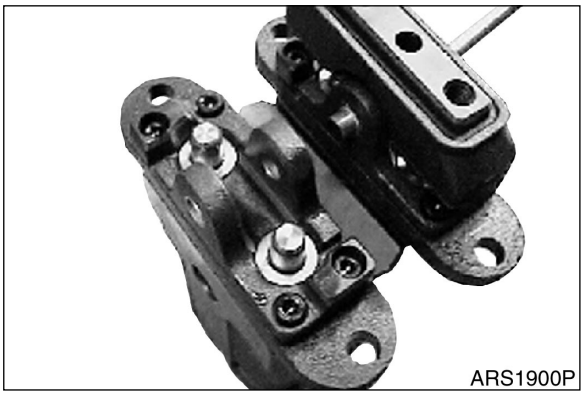


Figure 14

4. Remove cam (27) from cover (25).

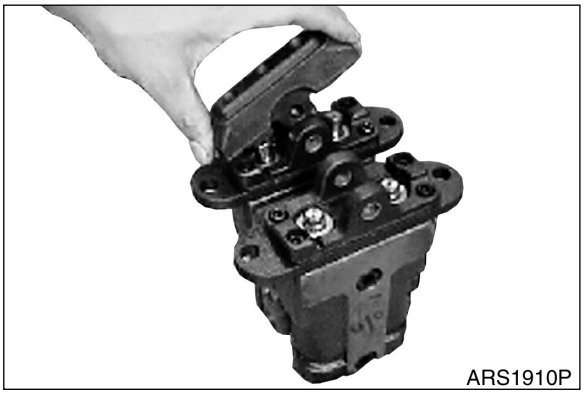


Figure 15

5. Loosen wrench bolt (26) by using tool.

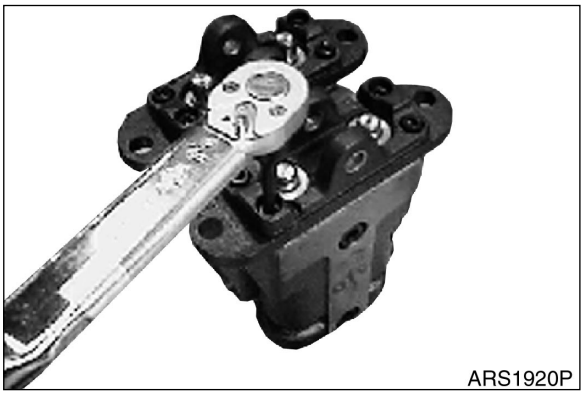


Figure 16

6. Remove cover (25) from body (1 and 2).

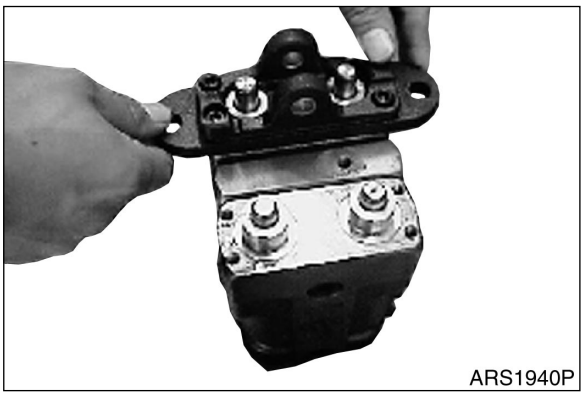


Figure 17

7. Remove plug assembly (21 - 24) with push rod assembly (14 - 20).

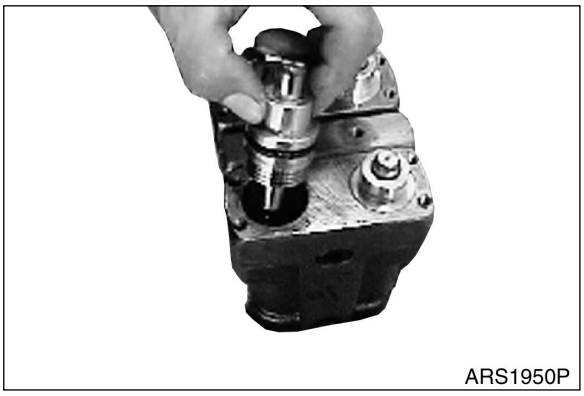


Figure 18

8. Remove snap ring (13).

IMPORTANT
Be careful not to spring rod guide (11).

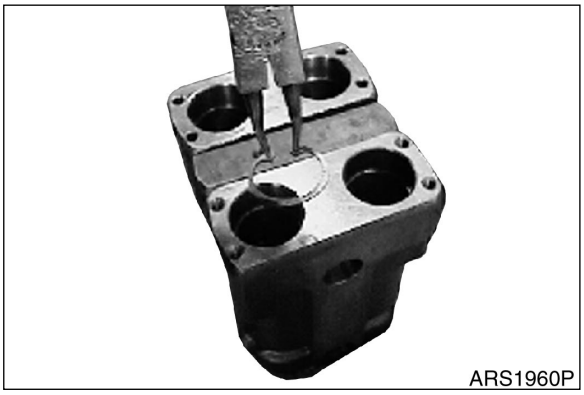


Figure 19

9. Remove rod guide (11).

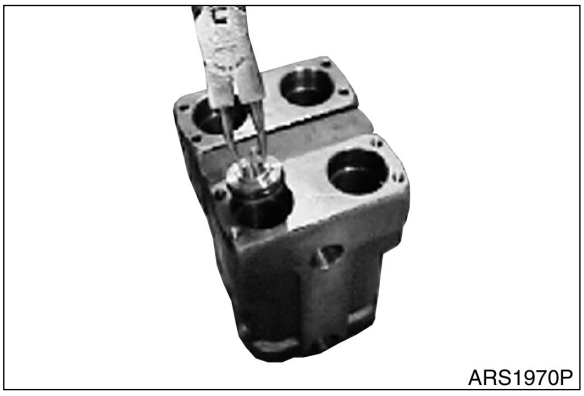


Figure 20

10. Remove spool assembly (5 - 9).

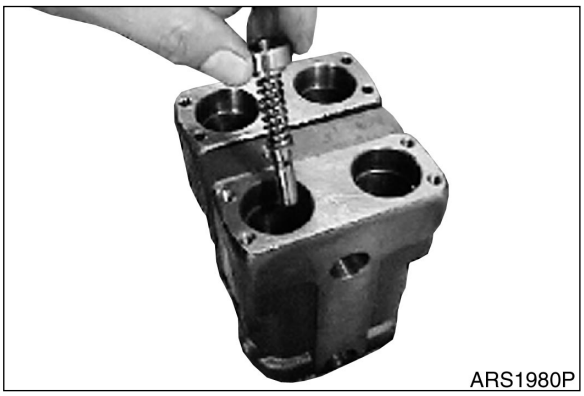


Figure 21

11. Remove spring (10).

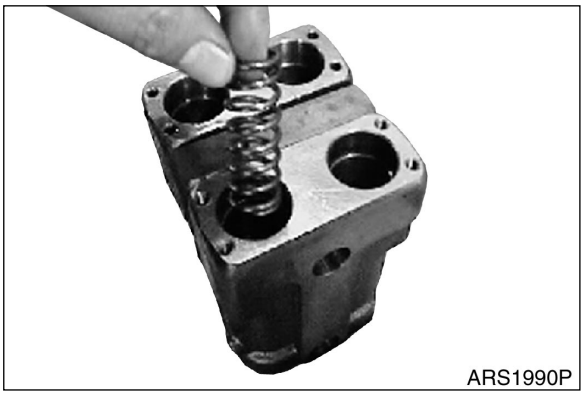


Figure 22

12. Remove stopper (9), spring (6) and spring seat (7) from spool assembly (5 - 9).

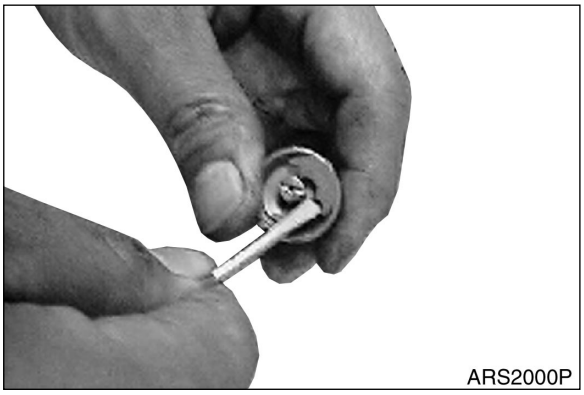


Figure 23

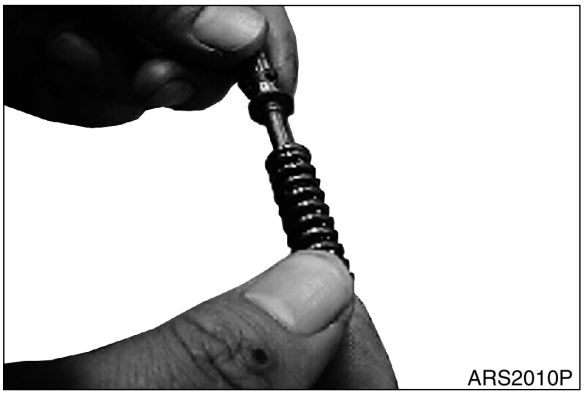


Figure 24

13. Remove plug assembly (21 - 24) from push rod assembly (14 - 20).

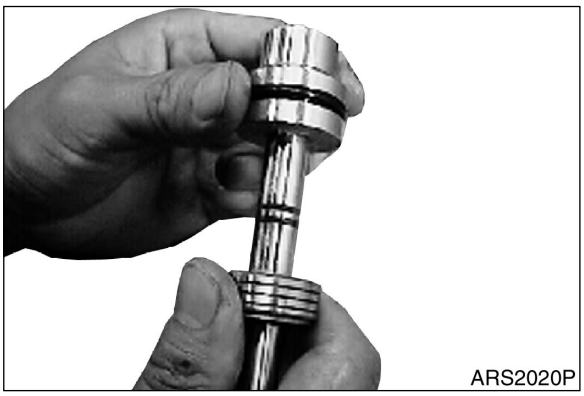


Figure 25

14. Remove seal (23 and 24) from plug (21).



Figure 26

15. Remove O-ring (22) from plug (21).

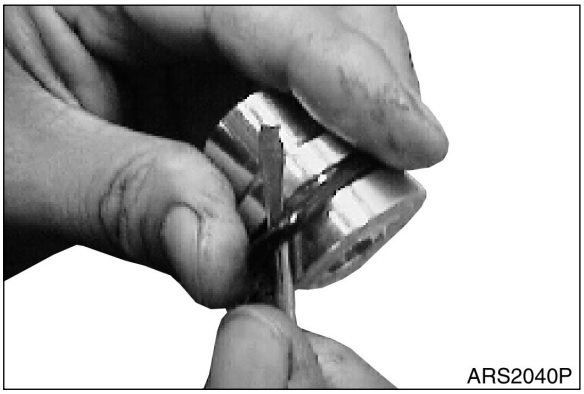


Figure 27

16. Remove seal (16) from push rod (14).

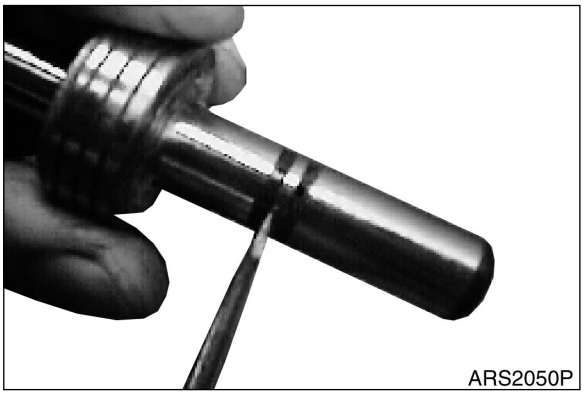


Figure 28

17. Remove snap ring (20) from push rod (14).

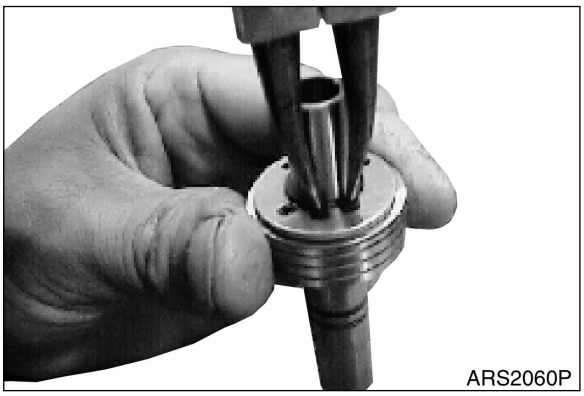


Figure 29

18. Remove plate (19) from push rod (14).

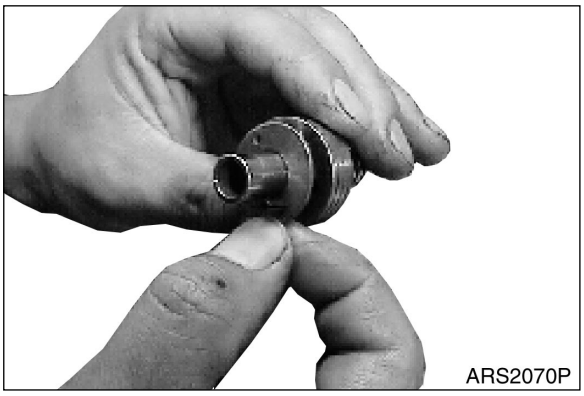


Figure 30

19. Remove spring (18) from push rod (14).



Figure 31

20. Remove steel ball (17) from push rod (14).

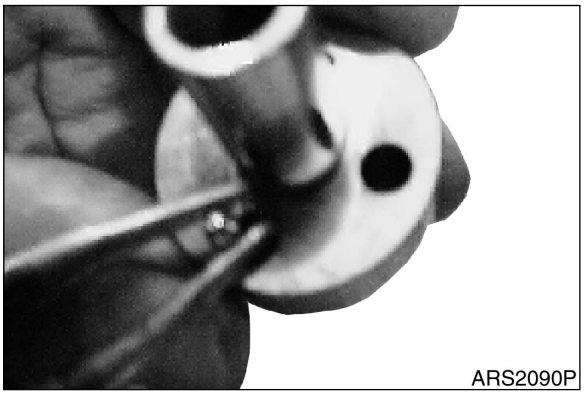


Figure 32

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

1. Cleaning disassembled parts.

    1. Place parts in a container with cleaning solvent.

    • Allow all parts to soak in solvent until grease and other foreign substances have dissolved and become loose, before cleaning.

    • Contaminated cleaning solvent may cause damage to parts and may cause poor equipment performance. Be sure to use clean, uncontaminated solvent when cleaning precision parts.

    2. Clean parts thoroughly by gently turning the solvent. Dry and clean each part with a clean cloth.

    • Do not use compressed air to dry parts. Foreign material and moisture present in compressed air may cause damage or rust.

2. Anti-corrosive treatment of disassembled parts.

    Apply an anti-corrosive lubricant to all disassembled parts.

    • Leaving cleaned parts exposed to contaminants and moisture in the air will cause rust and may cause poor equipment performance.

REASSEMBLY

IMPORTANT

1. **Prepare a clean, well lit, stable work bench where assembly can be performed.**
2. **Prepare the tools and materials necessary for reassembly process.**
3. **Inspect all parts, making sure that all parts are free from dirt and damage. If minor surface scratches are visible, use a very fine sandpaper to clean it off.**
4. **Replace all O-rings and NHU packings with new ones. Use care when assembling O-rings and NHU packings.**
5. **Apply a light coat of approved lubricant to aid in smooth assembly.**
6. **Tighten all bolts to the specified torque rating as outlined in the torque table.**
7. **Seal all opens ports to prevent foreign material from entering the valve assembly.**
8. **All precision parts must be handled with great care and all parts must be reassembled to their original position.**
9. **All parts must be carefully reassembled and not be forced. Damaged parts will cause oil leaks and poor performance of the equipment.**
10. **Do not leave parts exposed to air during or after disassembly. Exposed parts will come in contact with contaminants and will cause rust and damage.**
11. **Grease must be applied to the top portion of each push rod.**
12. **Grease must be filled into each grease cup.**
13. **Spray Anti-rust lubricant into each bellows.**

1. Clean body (1 and 2) and all parts.
2. Install spring (10) on body (1 and 2).

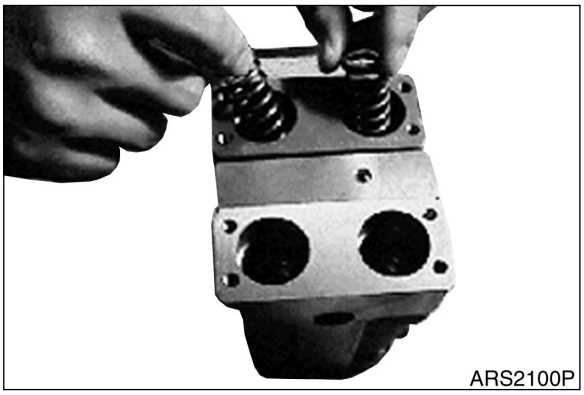


Figure 33

3. Clean plug (21) with thinner, inspect burrs and install rod seal (23) and dust seal (24) on both sides of plug by using tool.

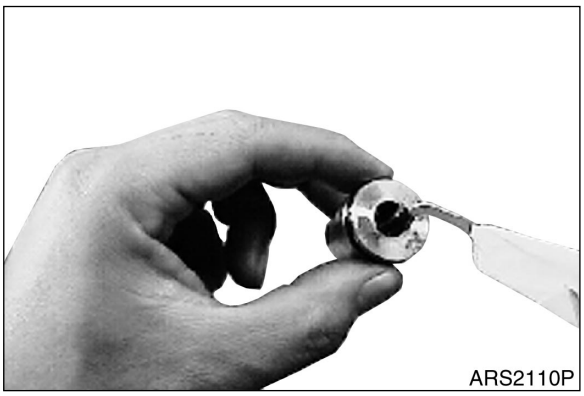


Figure 34

4. Install O-ring (22) on outside diameter of plug (21) and check plug whether it is abnormal.



Figure 35

5. Install spring seat (7), spring (6) and spring seat (5) on spool (8).

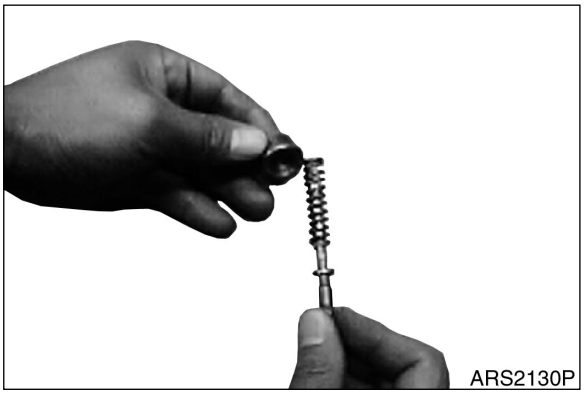


Figure 36

6. Install O-ring (12) on rod guide (11).



Figure 37

7. Install steel ball (17), spring (18), plate (19) and spring pin (15) on push rod (14).

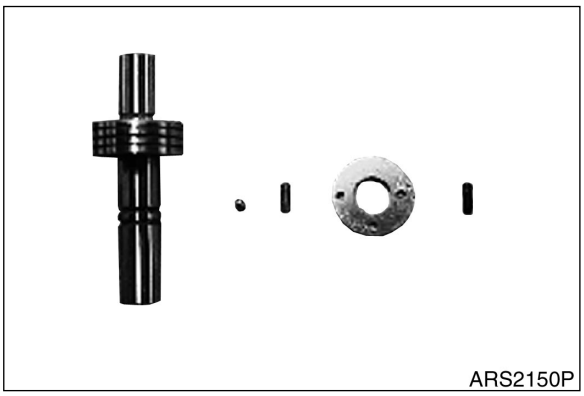


Figure 38

8. Install snap ring (20) on push rod assembly (14 - 19).



Figure 39

9. Install seal (16) on push rod (14).

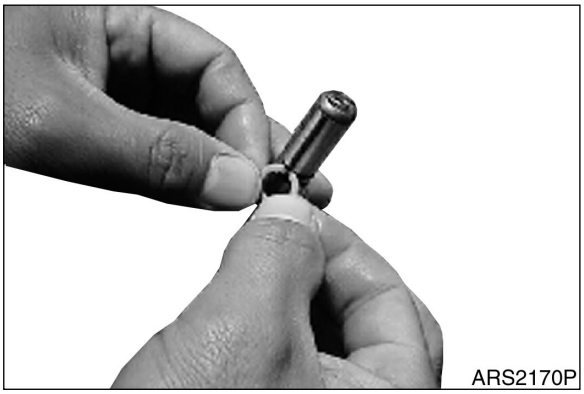


Figure 40

10. After installing spool assembly (5 - 9) on body (1 and 2), insert rod guide (11) and install snap ring (13).



Figure 41

11. Install plug assembly (21 - 24) with push rod assembly (14 - 20) on body (1 and 2).

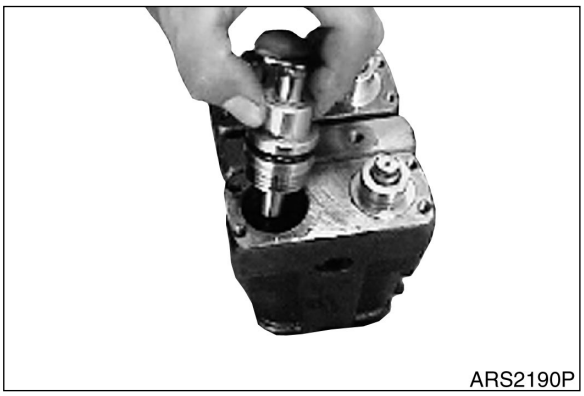


Figure 42

12. Install cover (25) on the upside of body (1 and 2).

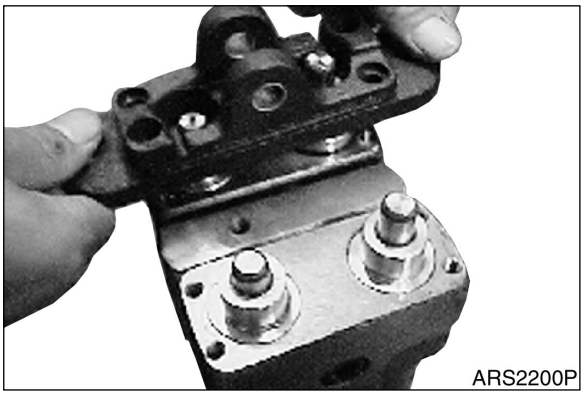


Figure 43

13. Tighten wrench bolt (26).

    NOTE: *Tightening torque: 88 kg•cm (6.37 ft lb).*

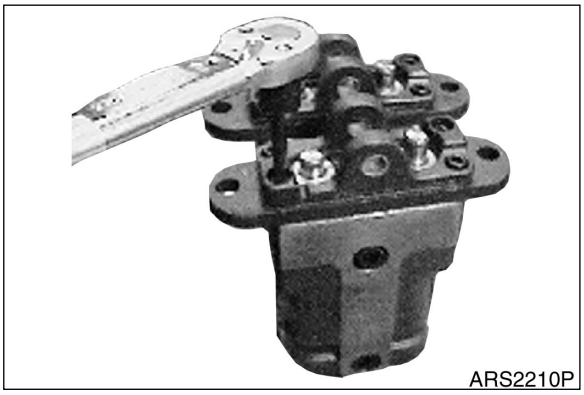


Figure 44

14. Put cam (27) on cover (25) and install cam shaft (29).

IMPORTANT
Check whether there is a play of cam.

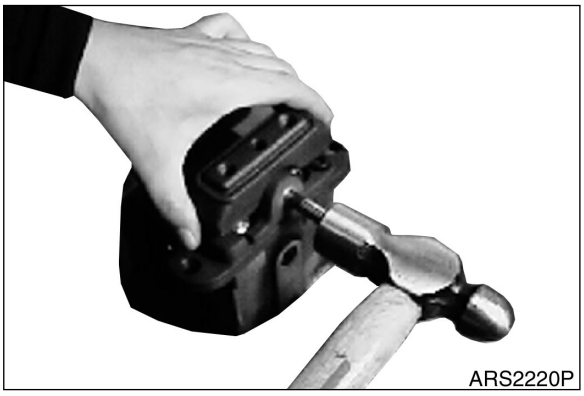


Figure 45

15. Tighten set screw (30) on center of cam (27) not to loose cam (27) and cam shaft (29) by using wrench.

    NOTE: *Tightening torque: 88 kg•cm (6.37 ft lb).*

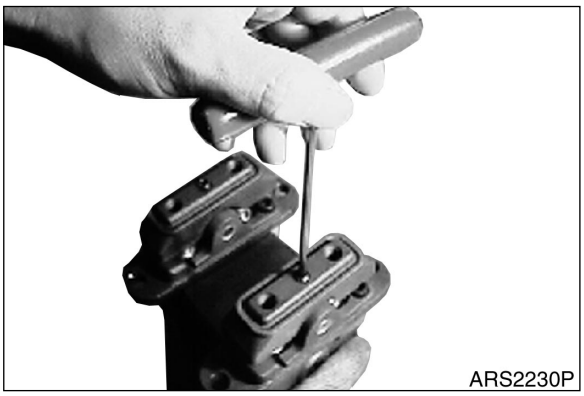


Figure 46

16. One side holds L wrench and the other side holds spanner and tighten set screw (31) and hex nut (32) attached to cam (27) not to loose.

IMPORTANT
Check whether there is a play of cam.

    NOTE: *Tightening torque: 440 kg•cm (31.8 ft lb).*

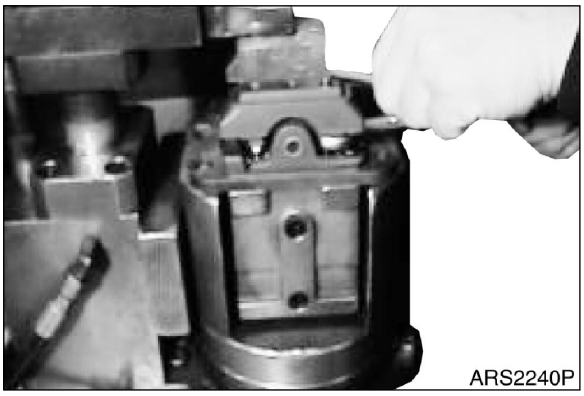


Figure 47

17. Install bellows.

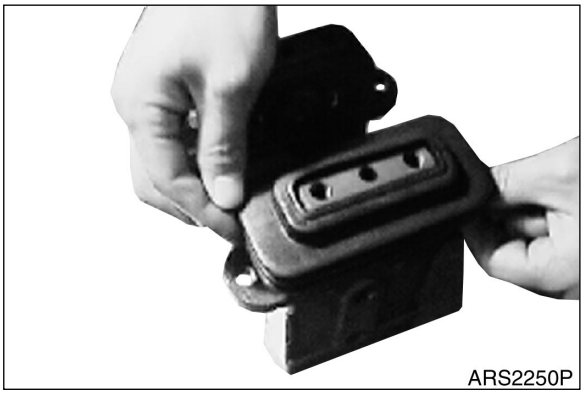


Figure 48

INSTALLATION

1. Position pedal valve (1, Figure 49) on cabin floor plate and install four bolts and washers (2).

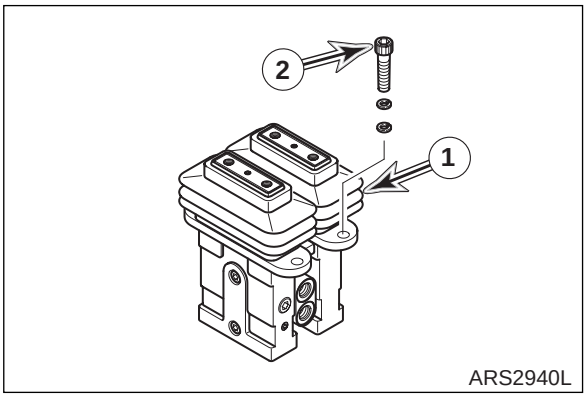


Figure 49

2. Install pedal brackets (3) and levers (4, Figure 50) on pedal valve and install four bolts and washers (2).
3. Install rubber boots (1, Figure 50).

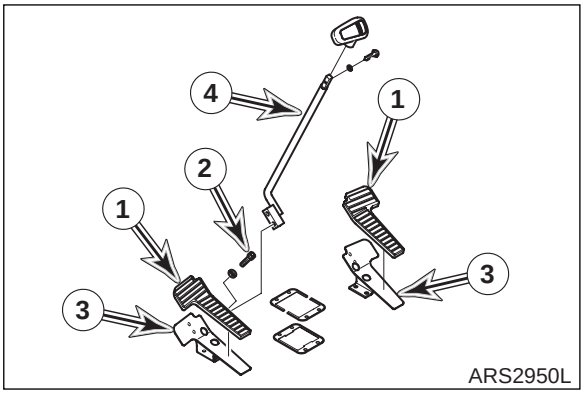


Figure 50

4. Connect hoses as tagged during removal to pedal valve (1, Figure 51).
5. Install cabin under cover by tightening bolts.

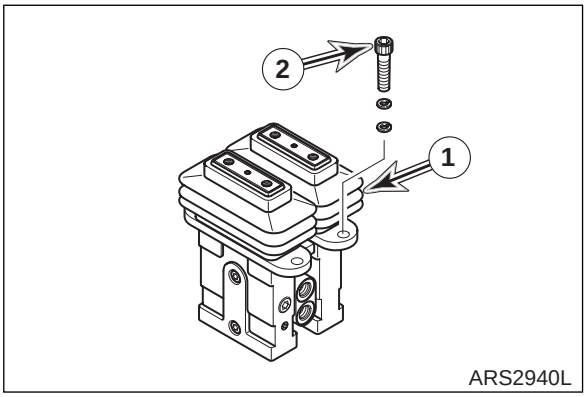


Figure 51

START-UP PROCEDURES

1. Start engine and set throttle at "LOW IDLE".
2. Set safety lever on "UNLOCK" position.

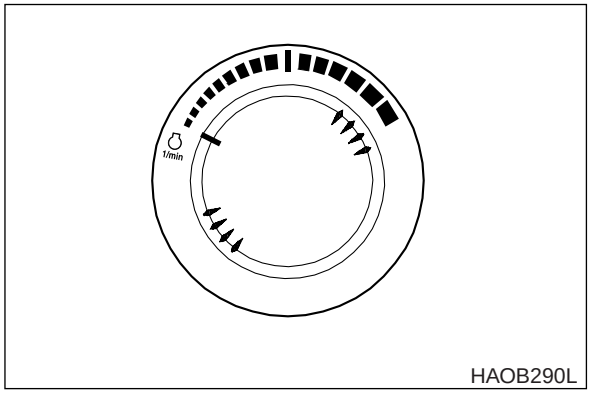


Figure 52

3. Slowly push and pull both travel lever about five times without a load to vent air from pilot lines.

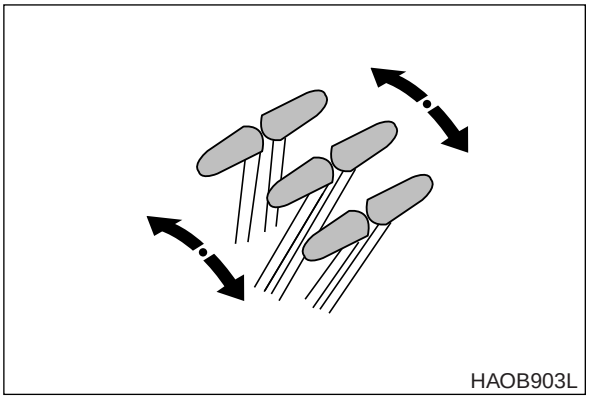


Figure 53

S0792160K

HYDRAULIC SCHEMATIC (S300LC-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 300-V	1001 and Up

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December 2001

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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.

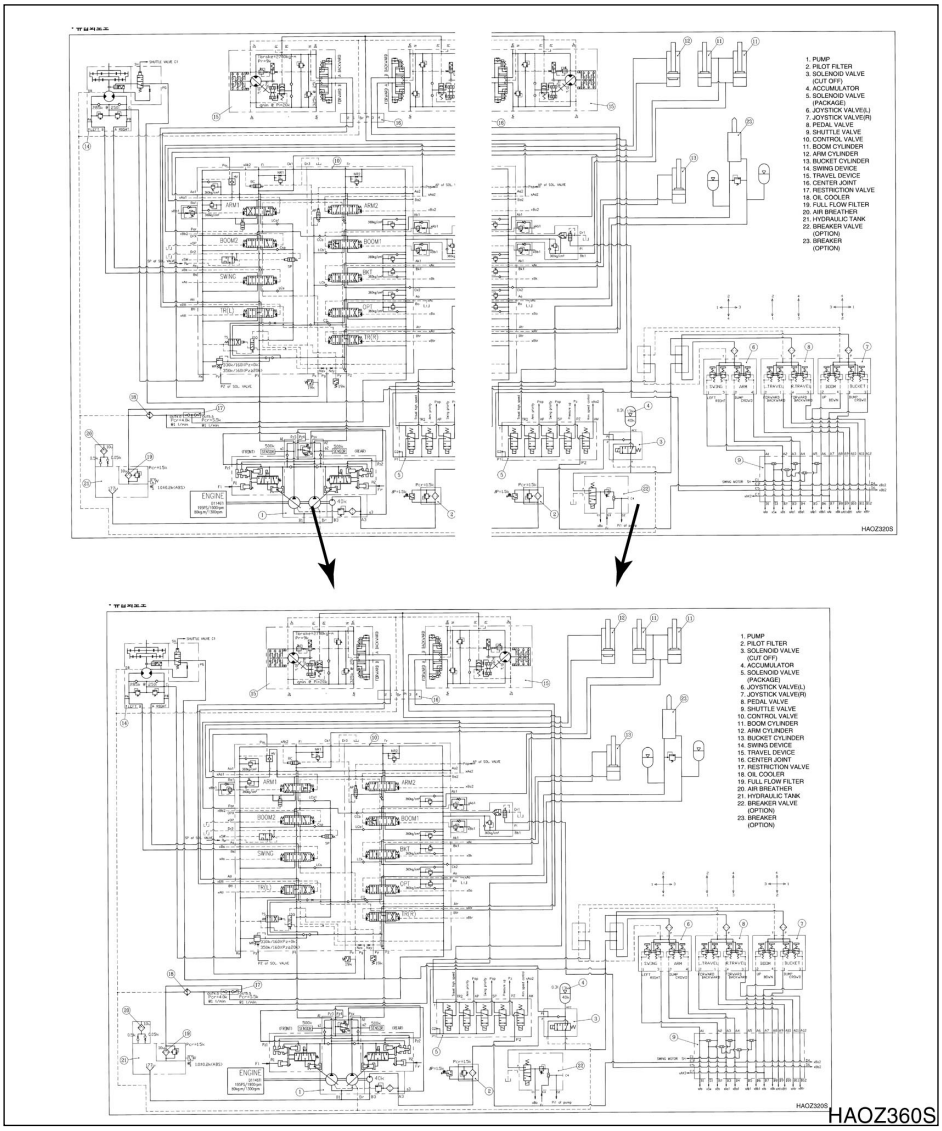


Figure 1

SOLAR 300LC-V

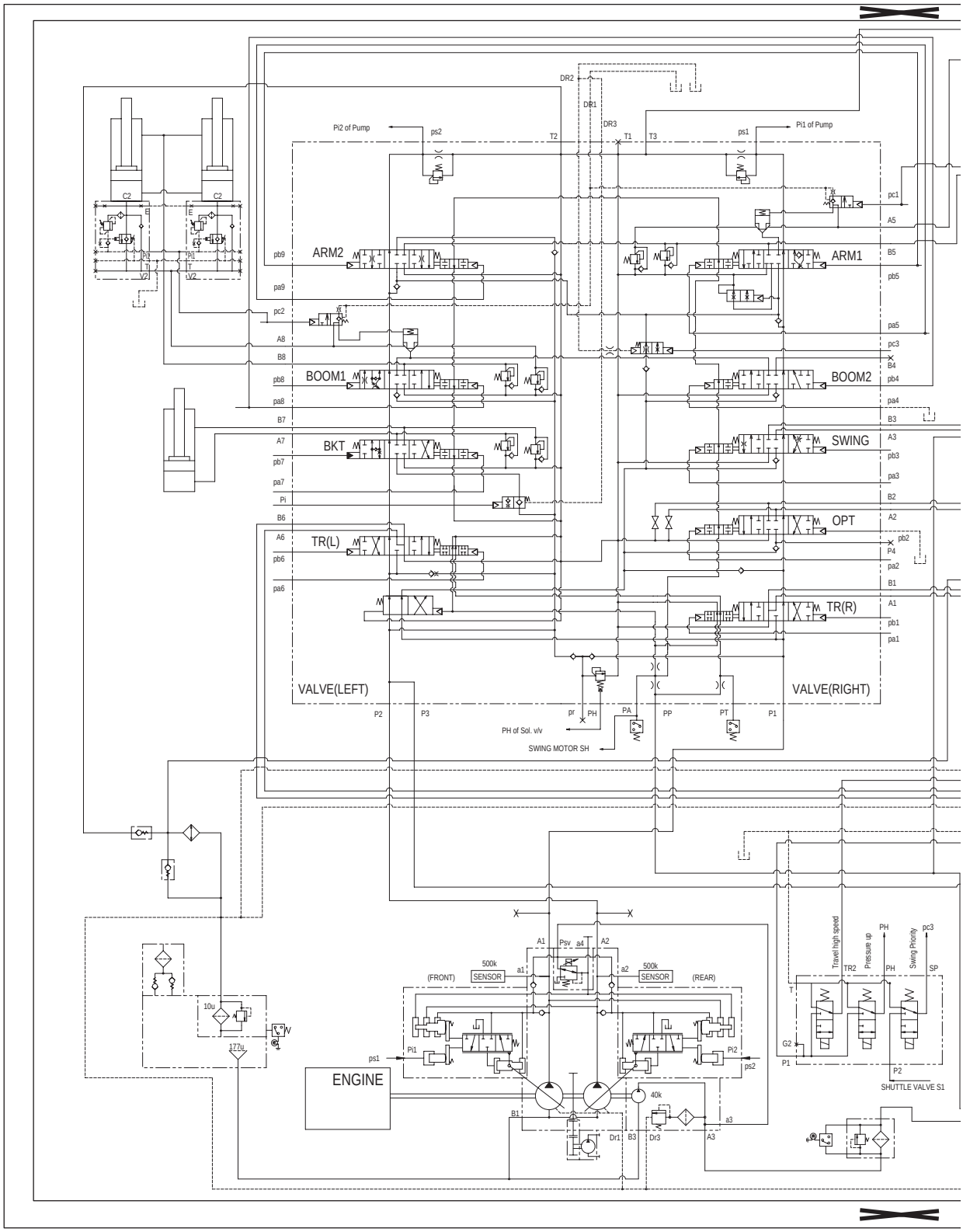
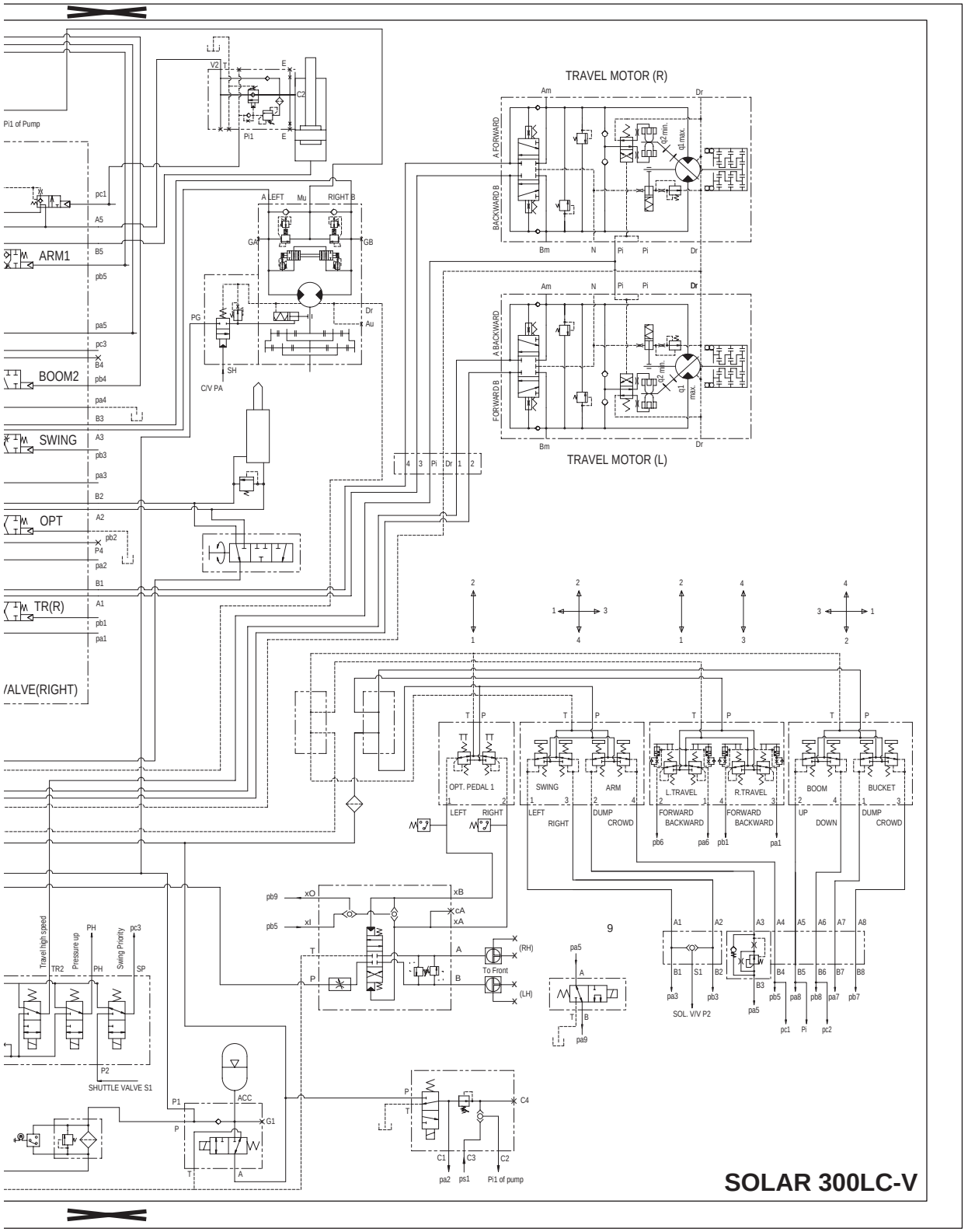


Figure 2


TRAVEL MOTOR (R)
TRAVEL MOTOR (L)
ARM1
BOOM2
SWING
OPT
TR(R)
/ALVE(RIGHT)
OPT. PEDAL 1
SWING
ARM
L.TRAVEL
R.TRAVEL
BOOM
BUCKET
LEFT
RIGHT
DUMP
CROWD
FORWARD
BACKWARD
UP
DOWN
To Front
SHUTTLE VALVE S1
SOL. V/V P2
ACC
C/V PA
Travel high speed
Pressure up
Swing Priority
SOLAR 300LC-V

ARS1450L

ELECTRICAL SYSTEM

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

ELECTRICAL SYSTEM

⚠ CAUTION!

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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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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October 2001

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TROUBLESHOOTING - ELECTRICAL SYSTEM

Problem	Possible Causes	Remedies
Battery will not stay charged.	Internal battery short.	Replace battery.
	Short in other part of circuit.	Repair wiring or replace component.
Battery does not charge.	Battery worn out or defective.	Replace battery.
	Defective alternator or belt.	Repair or replace.
	Cable connection loose or severely corroded. Circuit ground corroded or weak.	Repair or replace.
Engine rpm not controllable.	Engine speed potentiometer or dial defective.	Repair or replace.
	Engine control cable broken or loose.	Repair or replace.
	Engine control motor defective or not connected.	Repair connection or replace component.
	Engine throttle controller defective or not connected.	Repair connection or replace component.
	Blown fuse.	Replace fuse. Check connections and circuit components for shorts or other damage.
	Wiring harness or connector defective or damaged.	Repair or replace.
Power mode selection does not change.	Blown fuse.	Replace fuse. Check connections and circuit components for shorts or other damage.
	Instrument Panel switch broken.	Repair or replace.
	Wiring harness or connector defective or damaged.	Repair or replace.
	e-EPOS controller defective.	Replace.
	Speed sensor defective.	Replace.
Work mode selection does not change.	Blown fuse.	Replace fuse. Check connections and circuit components for shorts or other damage.
	Instrument Panel switch broken.	Repair or replace.
	Wiring harness or connector defective or damaged.	Repair or replace.
	e-EPOS controller defective.	Replace.
	Solenoid valve defective.	Replace.

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 electrical system are 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*

ELECTRIC SUPPLY SYSTEM

The electric power circuit supplies electric current to each electric component. It consists of a battery, battery relay, starter switch, circuit breaker, fusible link and fuse box.

The negative terminal of the battery is grounded to the vehicle body.

Even when the starter switch (5) is in the "OFF" position, electric current is supplied to the following components through battery (1) → fusible link (3) → fuse (6).

1. Cabin light, fuel pump switch, No. 1 terminal of DC-DC converter (backup for car stereo memory)
2. "B" terminal of starter switch and No. 22 terminal of air conditioner control panel.
3. No. 17 terminal of instrument panel (back up for instrument panel).
4. Power terminal "B" of engine stop motor.

When the starter switch (5) is in the preheat, on and start positions, the current flows from the battery (1) → fusible link (3) → fuse (6) → starter switch (5) "B" terminal/starter switch (5) "BR" terminal → battery relay (2) "BR" terminal which activates the coil of the battery relay and the electric supply system is energized.

When the battery relay's contacts are connected, all electric devices can be operated.

While the engine is not running, the electric power for all electric devices are supplied by the battery. Once the engine is started the power is supplied from the alternator (7).

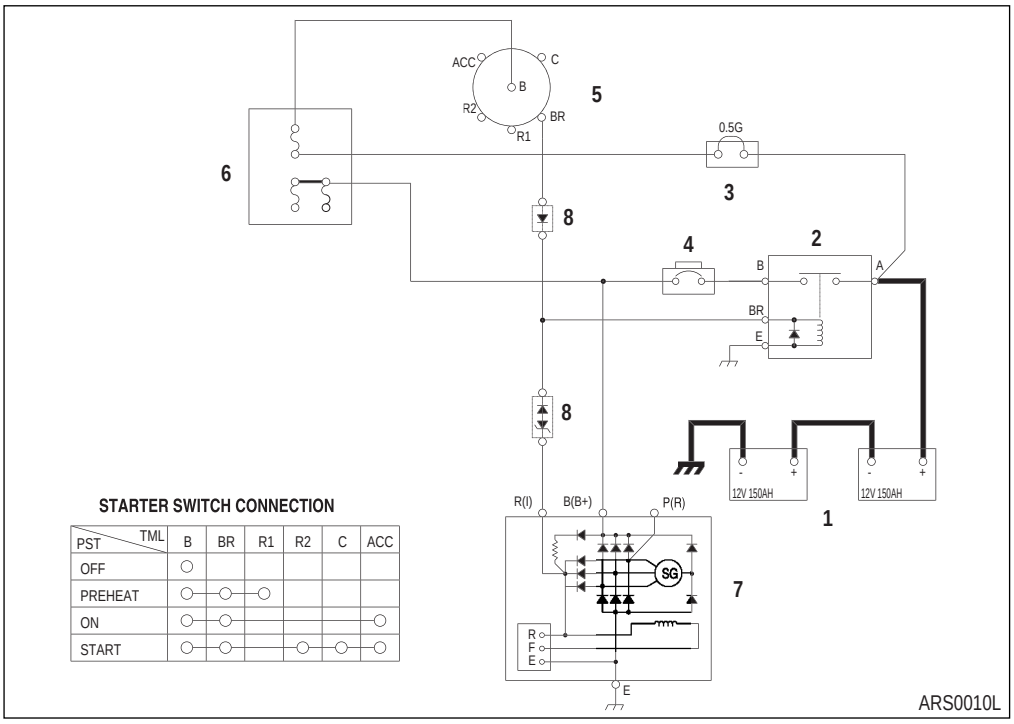


Figure 1 ELECTRIC POWER CIRCUIT DIAGRAM

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Alternator
8	Diode

ENGINE STARTING CIRCUIT

OPERATION DURING START PROCESS

When the starter switch is turned to the start position, the "S" and "E" terminals of the starter controller (7) are connected. At this time the contacts in the starter relay (8) are closed by the current flow from the battery (1, Figure 2) → fusible link (3) → "B" terminal of the starter switch (5) → "C" terminal of the starter switch (5) → "C" terminal of the starter relay (8) → "D" terminal of starter relay (8) → "S" terminal of starter controller (7) → "E" terminal of the starter controller (7) → ground.

The contact point "B" and "PP" of starter relay (8) are connected, the pinion gear of the starter (9) is pushed forward and makes contact with the ring gear of the flywheel and the internal contacts of the starter are connected.

The current flows from the battery (1) → "A" terminal of the battery relay (2) → "B" terminal of the battery relay (2, Figure 2) → "B" terminal of the starter (9). The starter motor is rotated and the engine is started.

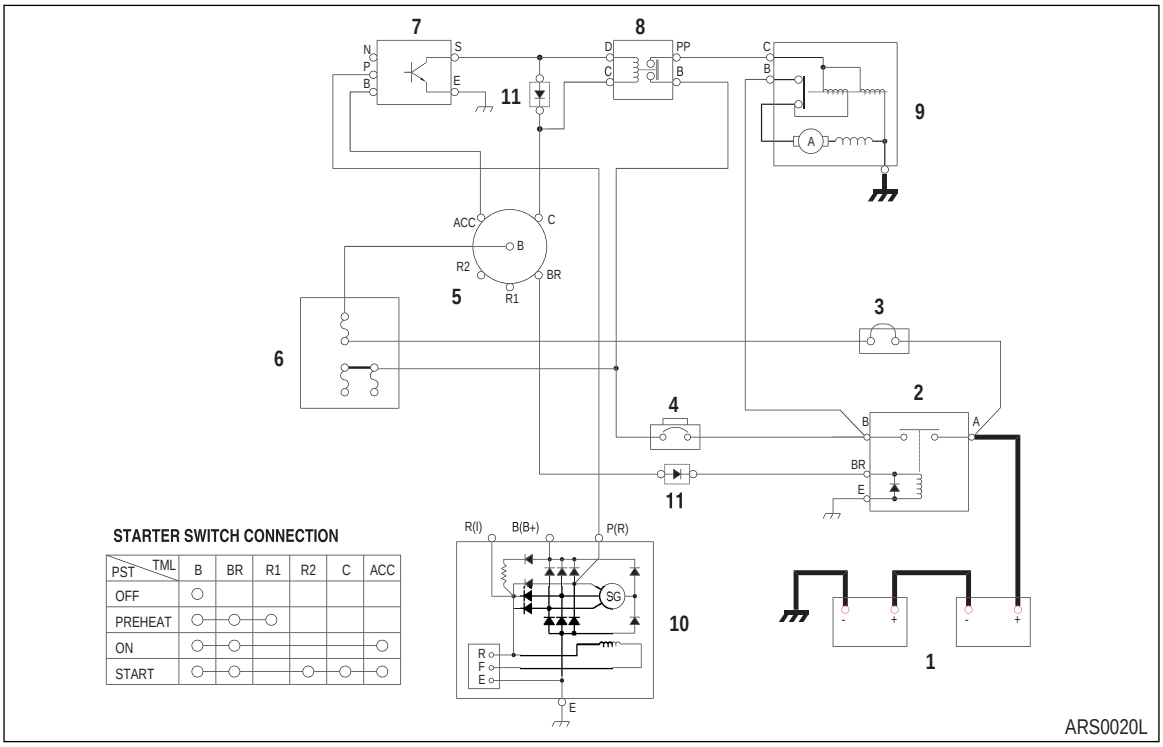


Figure 2 STARTER CIRCUIT (1) - WHILE STARTING

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box

Reference Number	Description
7	Starter Controller
8	Starter Relay
9	Starter
10	Alternator
11	Diode

OPERATION AFTER START PROCESS

Once the engine has been started, the belt driven alternator (10) generates a current.

The output generated by the alternator (10) is a square wave pulse voltage through the "P" terminal and the frequency of the pulse voltage is proportional to the rotation of the alternator.

The starter controller (7) monitors the frequency of the output current. Once the frequency equivalent to 500 rpm is sensed the connection between "S" and "E" terminals and the connection between "B" and "PP" terminals are opened. As a result the rotation of the starter (9) is stopped. Once the engine is running, the starter (9) will not operate even if the starter switch (5) is moved to the start position, preventing possible damage to the starter.

Operation of the Start Circuit (2) - Immediately After Start

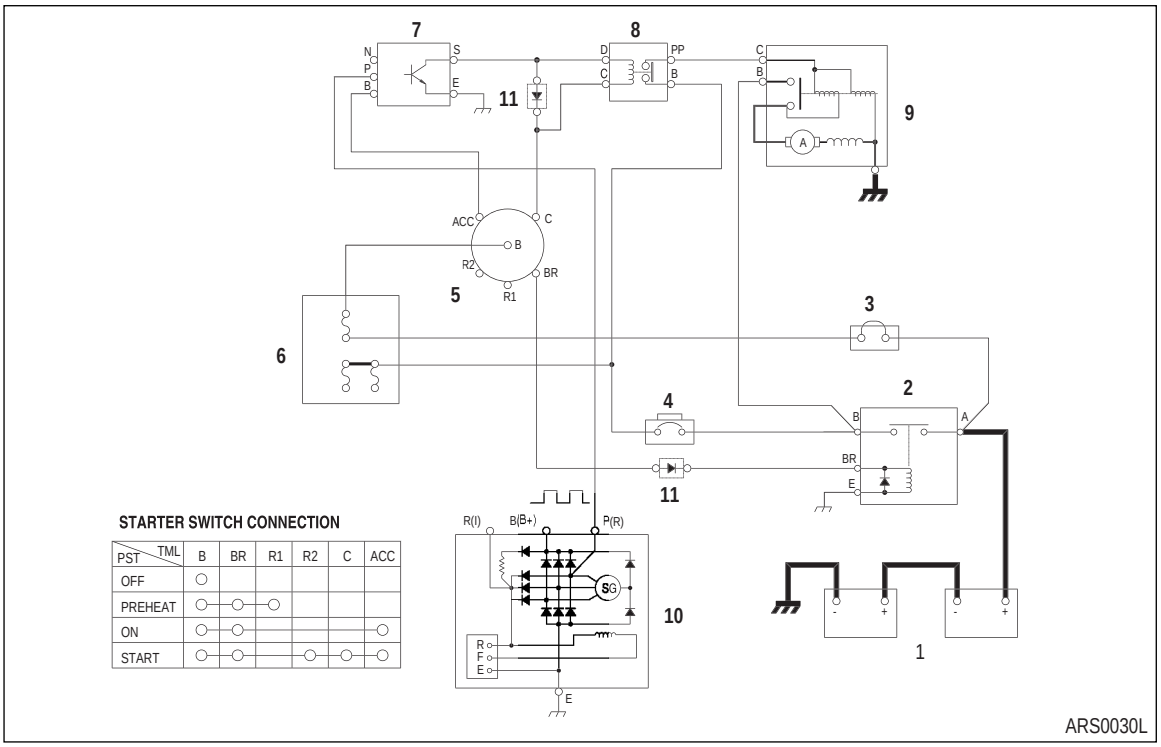


Figure 3 OPERATION OF START CIRCUIT (2) - IMMEDIATELY AFTER START

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box

Reference Number	Description
7	Starter Controller
8	Starter Relay
9	Starter
10	Alternator
11	Diode

ENGINE PREHEATING SYSTEM

An air heater (8) device is installed in the intake manifold of the engine.

When the starter switch (5) is turned to the "Preheat" position, the current flows from the battery (1) → fusible link (3) → "B" terminal of starter switch (5) → "R1" terminal of starter switch (5) → "C" terminal of preheat relay (7) → ground and the contact points of the preheat relay are closed.

When the contact points of the preheat relay (7) are closed, the heating coils of the air heating device are heated by current flowing from the battery (1) → battery relay (2) → preheat relay (7) → air heater (8) → ground.

The preheat time is approximately 19 seconds. A built-in timer in the instrument panel will activate an indicator light approximately 19 seconds after the preheat process has been selected.

Even after the starter switch (5) has been moved to the start position the current will continue to flow through the "R2" terminal of the starter switch (5) to the coil of the preheat relay (7) without disruption of the preheat process.

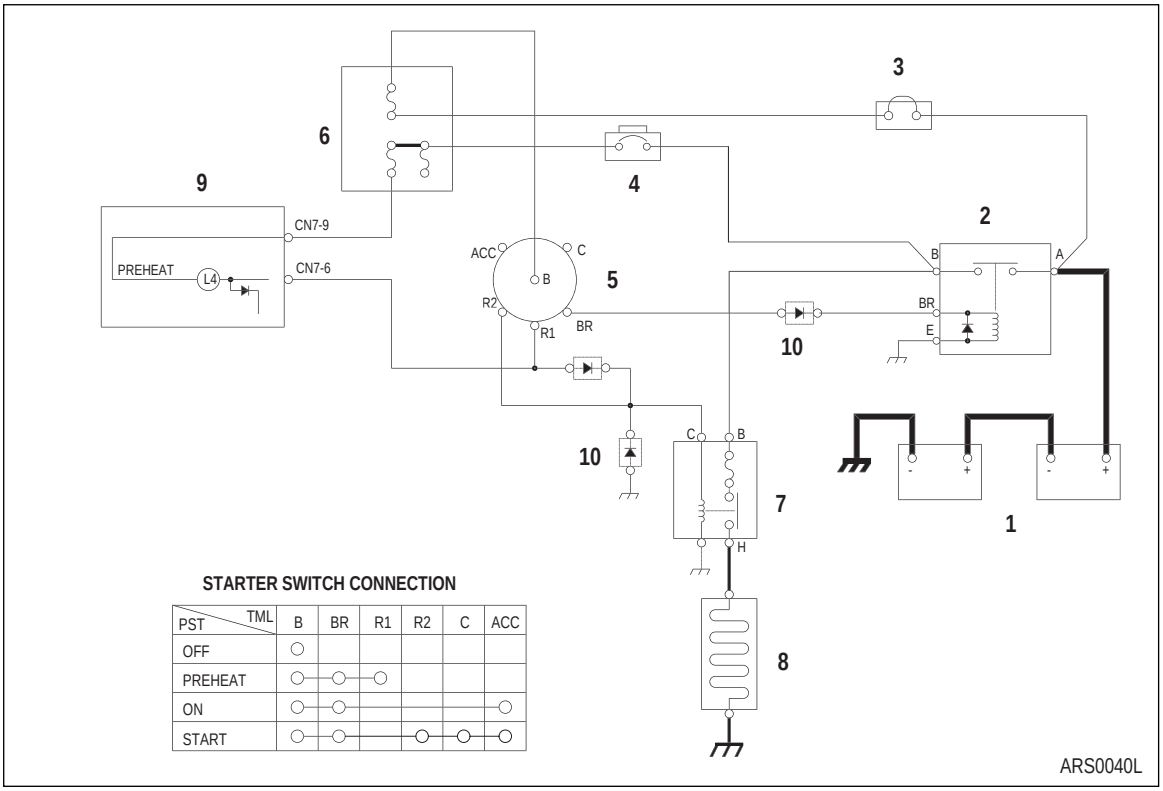


Figure 4 ENGINE PREHEAT CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch

Reference Number	Description
6	Fuse Box
7	Preheat Relay
8	Air Heater
9	Indicator Lamp
10	Diode

ENGINE STOP SYSTEM

The engine stop circuit consists of a starter switch (5), engine stop motor (9) and engine stop relay (8). There are two modes of operation - engine running and engine stop.

The worm gear built into the motor reduces the engine stop motor's speed and changes motor's revolution to reciprocation. The fuel shut off lever is pushed or pulled by this change.

When the start switch is in the "ON" position, the engine stop motor rotates 180° and comes to a stop due to the cam switch. When the start switch is in the "OFF" position, the engine stop motor moves 180° from the running mode position and is stopped by the cam switch.

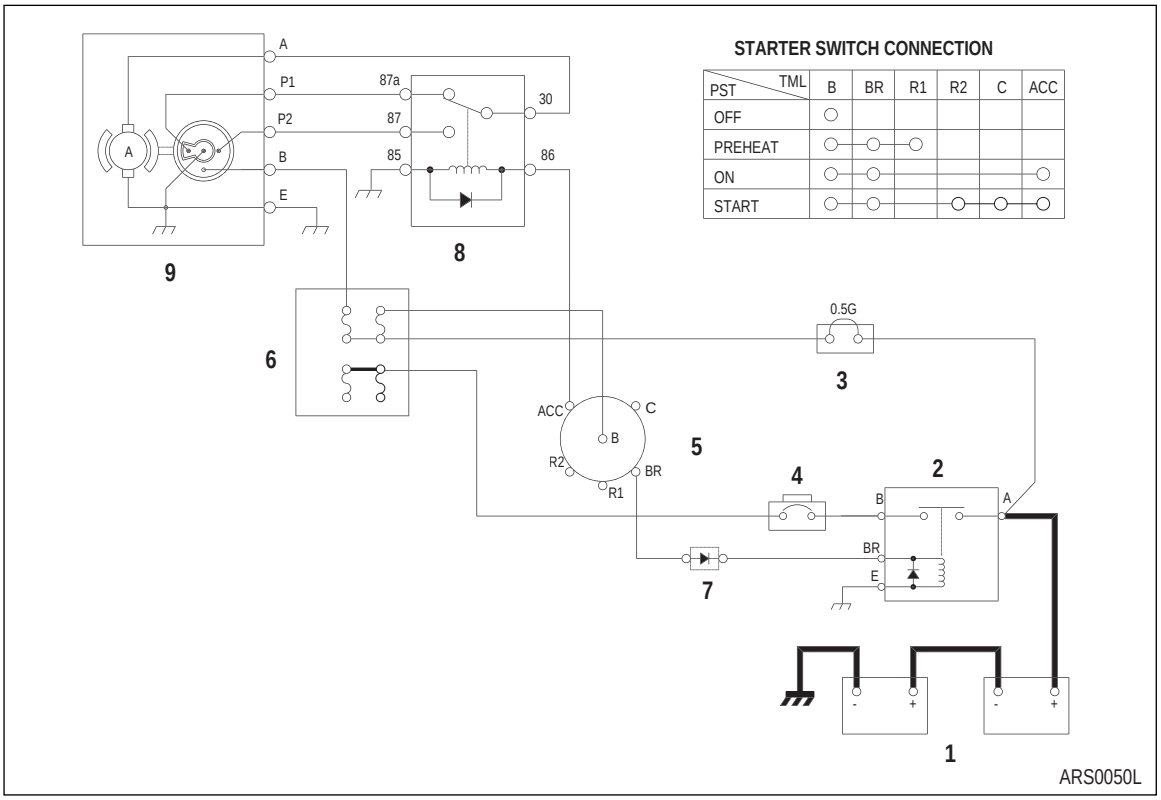


Figure 5 ENGINE STOP CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch

Reference Number	Description
6	Fuse Box
7	Diode
8	Engine Stop Relay
9	Engine Stop Motor

Operation In Engine Running Mode

When the starter switch (3) is turned to the "ON" position, the contact points "30" and "87" of the engine stop relay (5) are closed due to current flowing from the battery (1) → fusible link (2) → "B" terminal of starter switch (3) → "ACC" terminal of starter switch (3) → "86" terminal of engine stop relay (5) → "85" terminal of engine stop relay (5) → ground.

As a result, the engine stop motor (6) is rotated by the current flow from the battery (1) → fusible link (2) → "B" terminal of the engine stop motor (6) → "P2" terminal of engine stop motor (6) → "87" terminal of engine stop relay (5) → "30" terminal of the engine stop relay (5) → "A" terminal of engine stop motor (6) → "E" terminal of engine stop motor (6) → ground. The engine stop motor opens (pushes) the fuel shut off lever of the fuel injection pump and the system is in the running mode. The engine stop motor rotates 180° and comes to a stop due to the cam switch which shuts off the current to the motor.

When the starter switch is in the "ON" position, the internal components of the engine stop motor‘s cam switch is in running mode position.

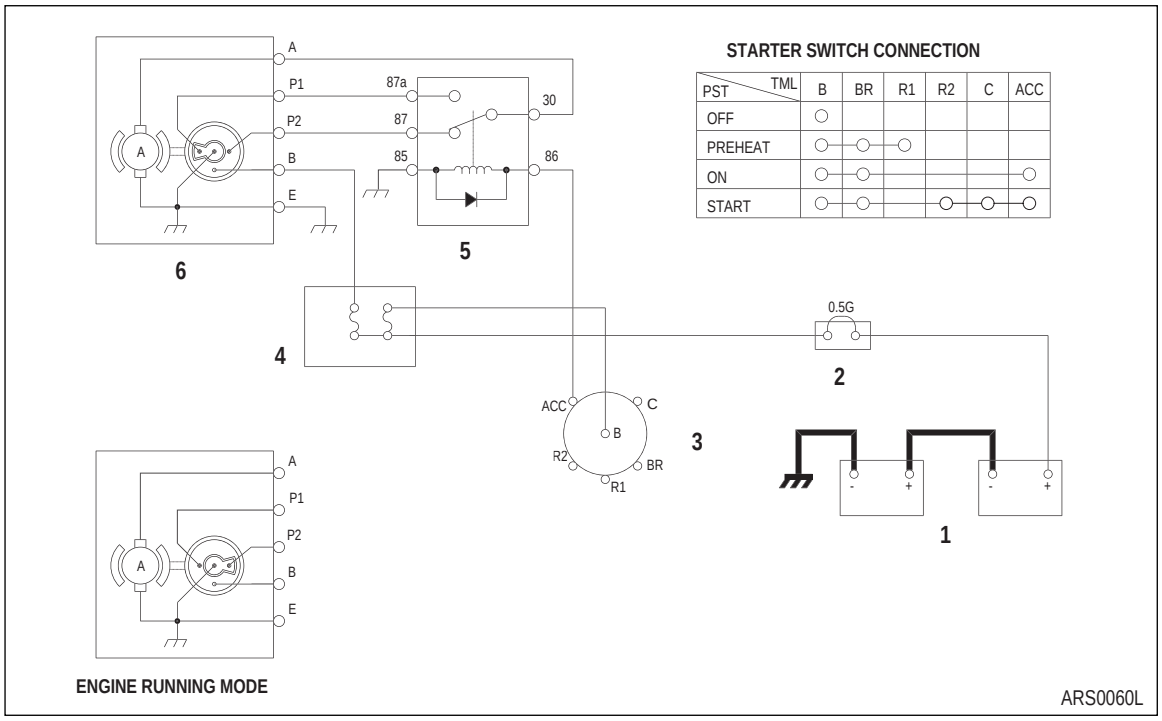


Figure 6 ENGINE STOP CIRCUIT - RUNNING MODE

Reference Number	Description
1	Battery
2	Fusible Link
3	Starter Switch

Reference Number	Description
4	Fuse Box
5	Engine Stop Relay
6	Engine Stop Motor

Operation In Engine Stop Mode

When the starter switch (3) is in the "OFF" position, the electric current flow to the coil of the engine stop relay (5) is shut off.

As a result, the "30" and "87a" contact point of the engine stop relay are connected and current is supplied to the engine stop motor from the battery (1) → fusible link (2) → "B" terminal of engine stop motor (6) → "P1" terminal of engine stop motor (6) → "87a" terminal of engine stop relay (5) → "30" terminal of engine stop relay (5) → "A" terminal of engine stop motor (6) → "E" terminal of engine stop motor (6) → ground and the motor is rotated.

The shut off lever of the fuel injection pump, linked to the engine stop motor by a cable, is moved to the close (pull) position and the engine is stopped. The engine stop motor moves 180° from the running mode position and is stopped by the internal cam switch which cuts off the current to the motor.

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

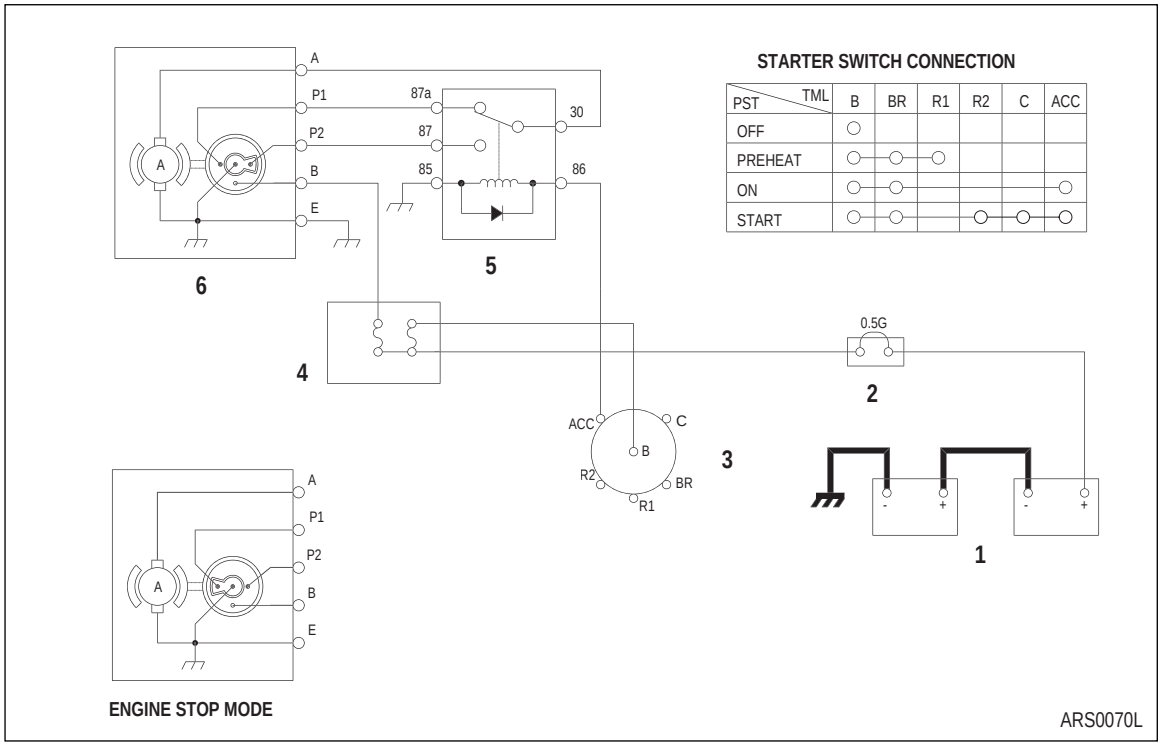


Figure 7 ENGINE STOP CIRCUIT - STOP MODE

Reference Number	Description
1	Battery
2	Fusible Link
3	Starter Switch

Reference Number	Description
4	Fuse Box
5	Engine Stop Relay
6	Engine Stop Motor

CHARGING SYSTEM

When the starter switch (5) is turned to the "ON" position, an initial excited current flows to the field coil of the alternator (7) through the battery relay (2) and circuit breaker (4). When the engine is started from this condition the alternator (7) starts charging. The current flows from the "B" terminal of alternator (7) → circuit breaker (4) → battery relay (2) → battery (1).

The alternator also supplies electric current to other electrical components. When the alternator (7) starts to operate, a current flows from the "R(I)" terminal of alternator → diode (8) → battery relay (2) coil securing a path for the charging current to the battery (1). Thus preventing the possibility of a high voltage build up and possible damage to the electric system.

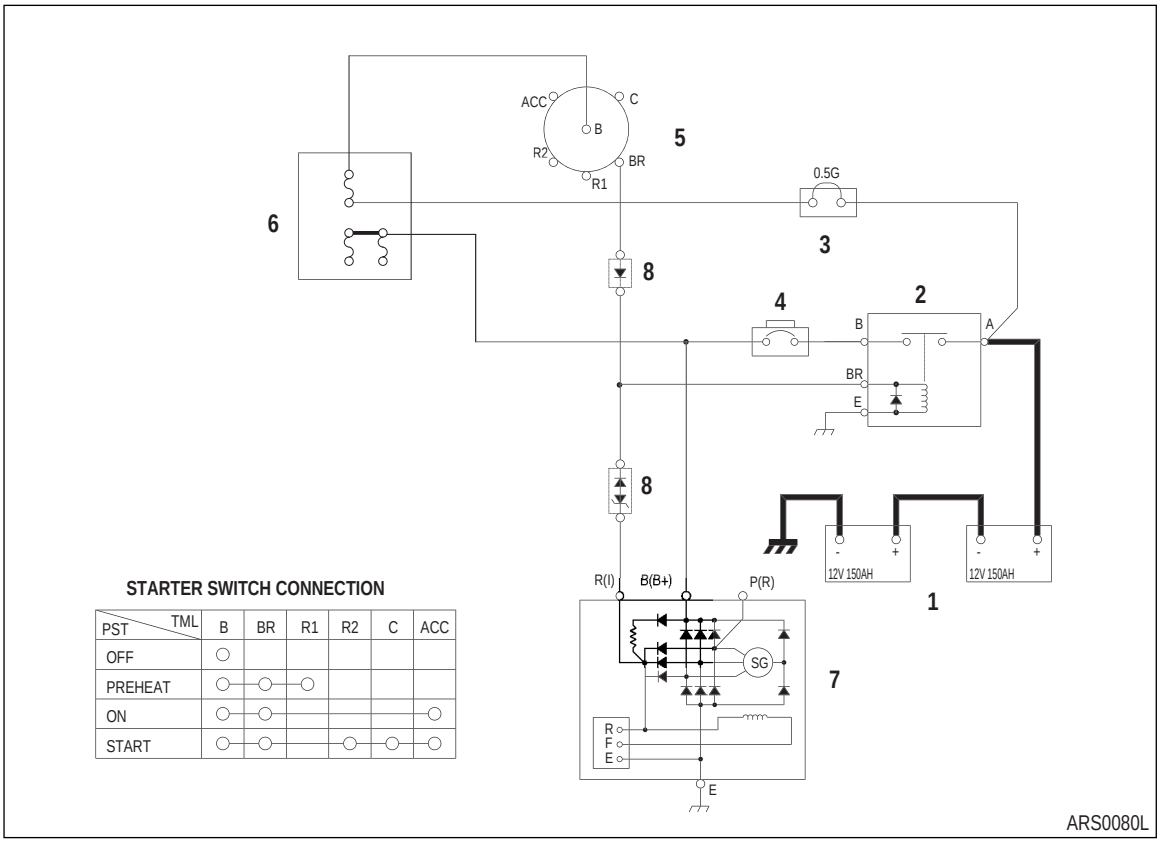


Figure 8 CHARGING CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Alternator
8	Diode

MONITORING SYSTEM

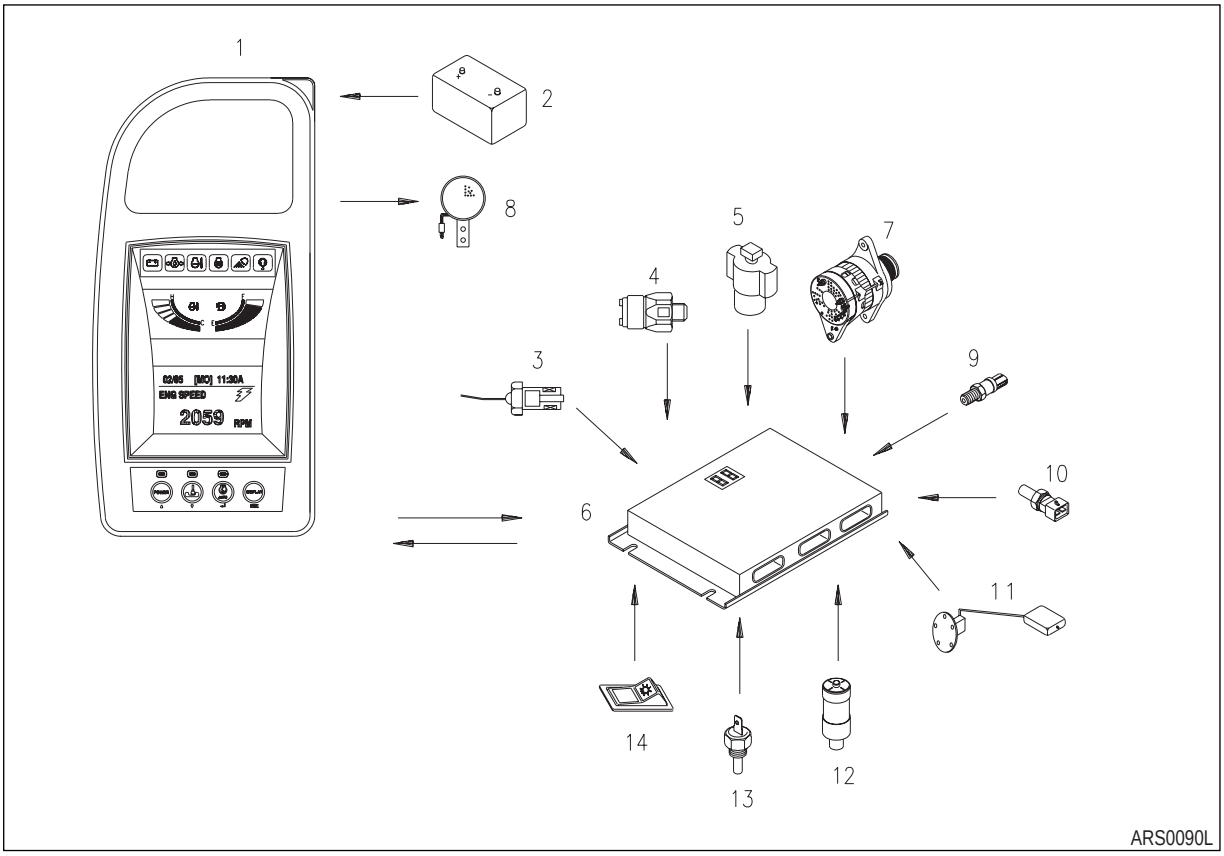


Figure 9

Reference Number	Description
1	Instrument Panel
2	Battery
3	Engine Speed Sensor
4	Return Filter Switch
5	Pilot Filter Switch
6	e-EPOS Controller
7	Alternator
8	Warning Buzzer

Reference Number	Description
9	Pump Discharge Pressure Sensor
10	Engine Coolant Temperature Sensor
11	Fuel Sensor
12	Air Cleaner Indicator
13	Engine Oil Pressure Switch
14	Light Switch

The monitoring system displays the various data and warning signals onto the instrument panel by processing the information gathered from the e-EPOS controller. It displays information selected by the operator.

INSTRUMENT PANEL

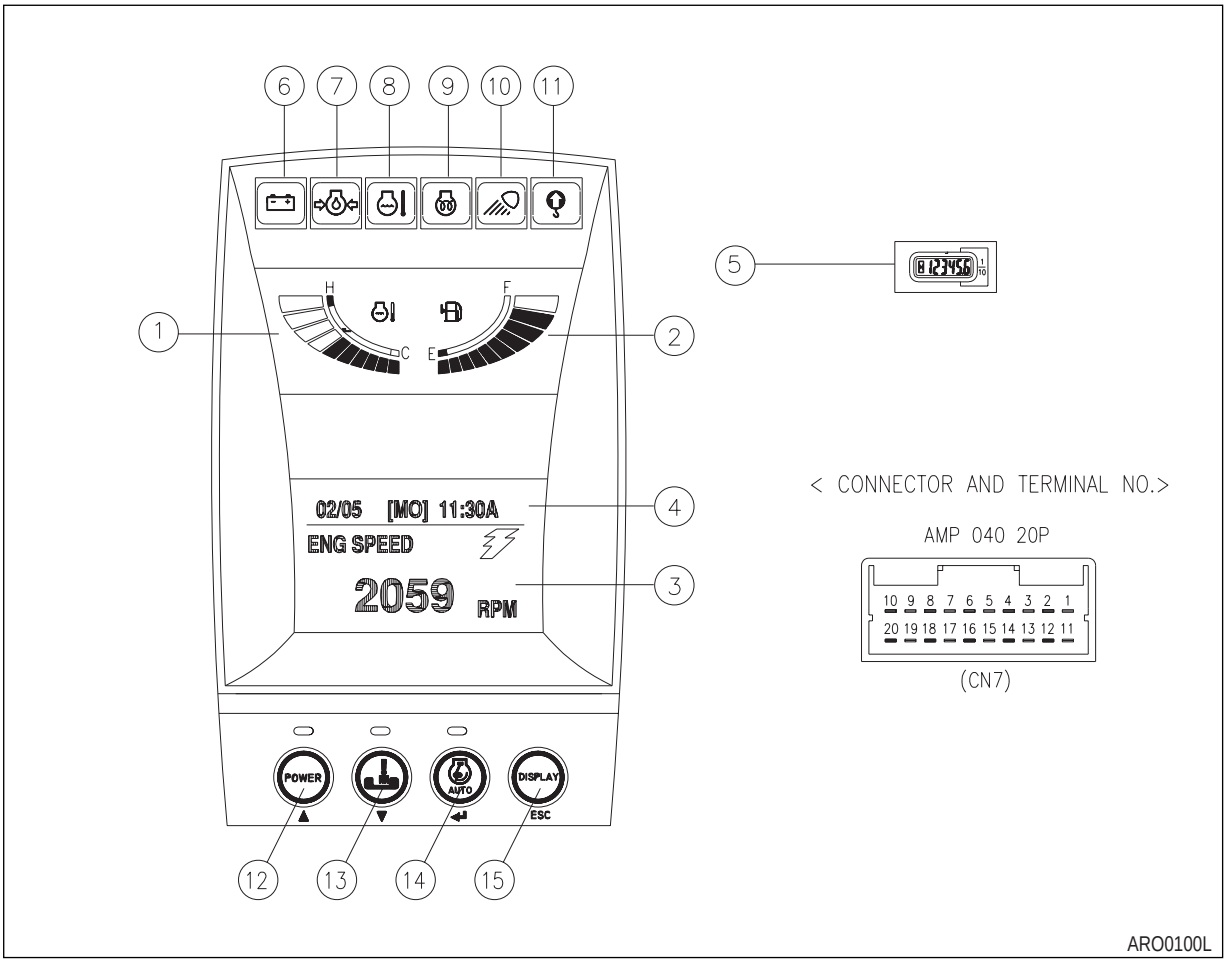


Figure 10

Gauges	Warning Lights	Mode Select Switches
1. Engine Coolant Temp. Gauge	6. Charge Warning Light	12. Power Mode Select Switch (Up Arrow Button)
2. Fuel Gauge	7. Engine Oil Pressure Warning Light	13. Trenching Mode Select Switch (Down Arrow Button)
3. Multi-function Gauge & Graphic Information Area	8. Coolant Temp. Warning Light	14. Auto Idle Switch (Enter Button)
4. Digital Clock	9. Preheat Completion Light	15. Display Select Switch (Escape Button)
5. Service Hour Meter	10. Work Light Indicator Light	
	11. Overload Warning Light	

When the engine starter switch is turned to the "I" (ON) position, all bands of gauges, indicator lights of switches/buttons and indicator/warning lights will turn "ON" and the alarm buzzer will sound for about 2 seconds.

During this time, a moving excavator will appear on the digital clock and graphic information area (3 and 4, Figure 10).

MONITORING SYSTEM SCHEMATIC

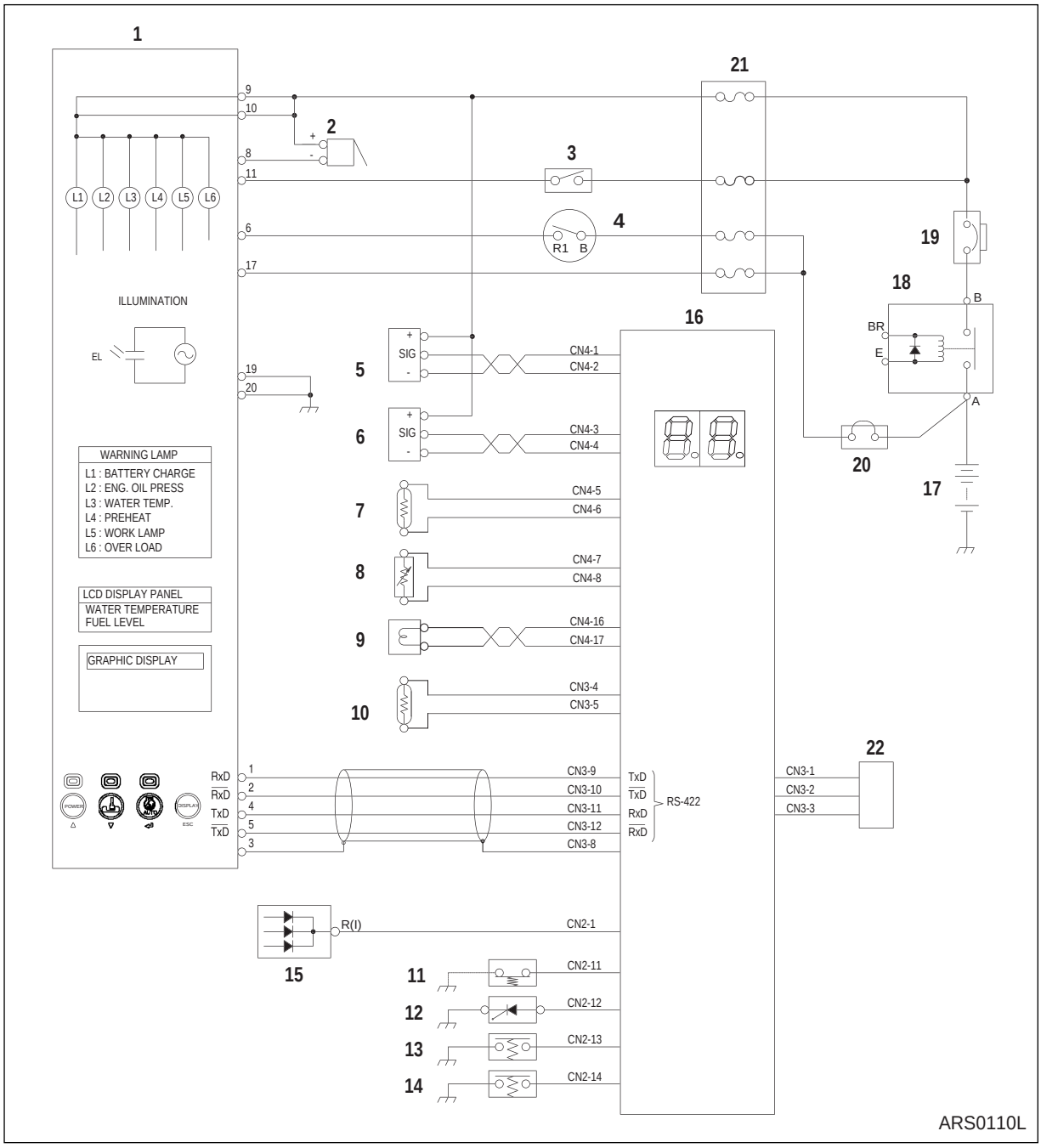


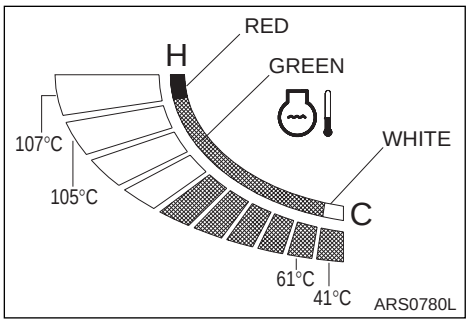
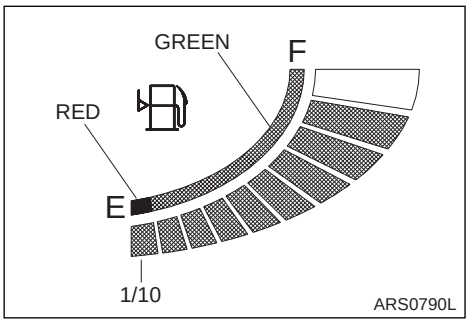
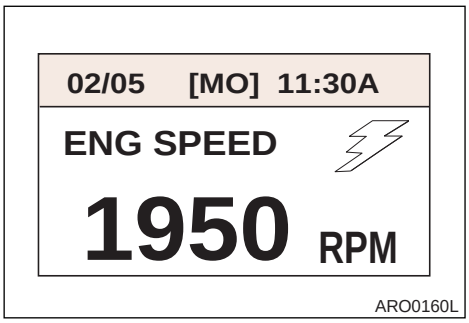
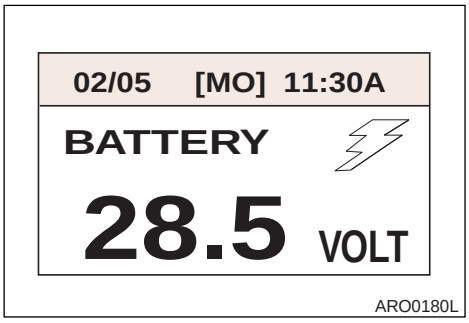
Figure 11

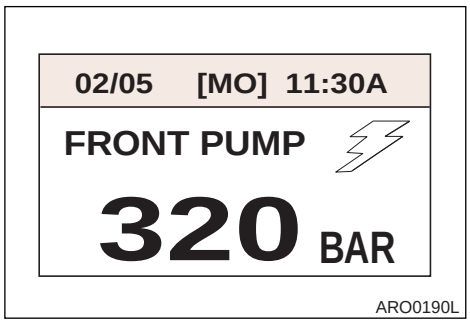
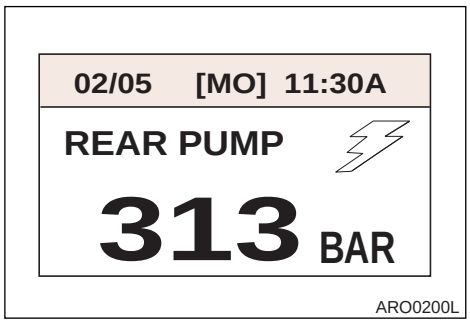
Reference Number	Description
1	Instrument Panel
2	Pilot Buzzer
3	Light Switch
4	Start Switch
5	Front Pump Pressure Sensor
6	Rear Pump Pressure Sensor
7	Engine Coolant Temperature Sensor
8	Fuel Gauge
9	Engine Speed Sensor
10	Hydraulic Oil Temp. Sensor

Reference Number	Description
11	Engine Oil Pressure Switch
12	Air Cleaner Indicator
13	Return Filter Switch
14	Pilot Filter Switch
15	Alternator
16	e-EPOS Controller
17	Battery
18	Battery Relay
19	Circuit Breaker
20	Fusible Link
21	Fuse Box
22	Check Connector

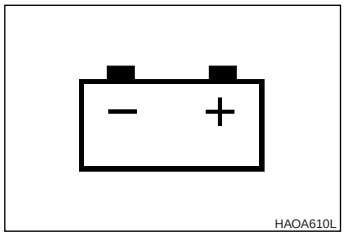
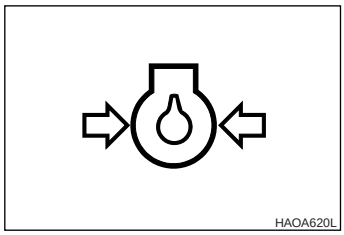
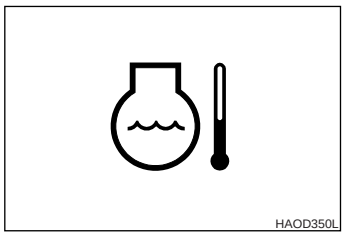
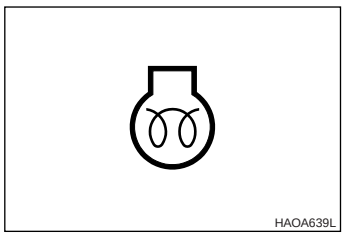
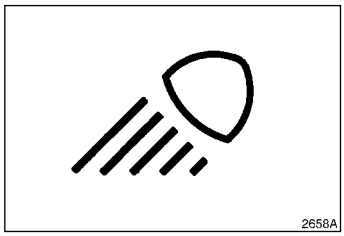
OPERATION

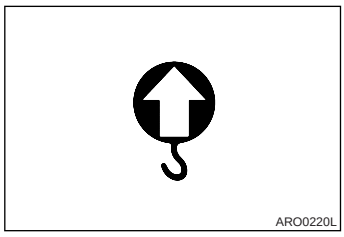
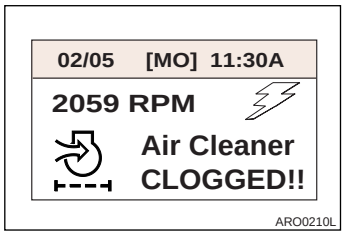
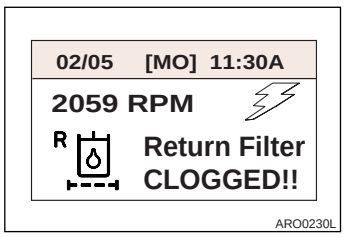
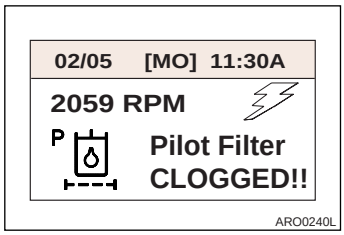
INSTRUMENTS

Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Engine Coolant Temperature		CN4-5 CN4-6	41°C (106°F) → 1,372 ohms 61°C (142°F) → 855 ohms 102°C (216°F)→ 160 ohms 105˚C (221˚F) → 147 ohms 107˚C (225˚F) → 128 ohms
Fuel Level		CN4-7 CN4-8	1/10 LCD Blinking → over 5K ohms FULL → under 525 ohms
Tachometer		CN4-16 CN4-17	N = 146 f / 60 (S300LC-V) N = 146 f / 60 (S300LL) N = 152 f / 60 (S340LC-V) N = 152 f / 60 (S420LC-V) N = 152 f / 60 (S470LC-V) N = Engine speed (rpm) F = Frequency of engine speed sensor (Hz)
Voltmeter		CN7-9 CN7-19	0 - 32 VDC

Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Main pump discharge pressure (front pump)		CN4-1 CN4-2	V = 0.00816 x P + 1.0 V: Sensor output voltage (V) P: Displayed pressure (Bar)
Main pump discharge pressure (rear pump)		CN4-3 CN4-4	

WARNING AND INDICATOR LIGHTS

Description	Symbol	Input Terminal	Operation	Remarks
Charge	 HAOA610L	CN2 - 1	Lights up when not charging [R(I) terminal output drops below 12±1V] and over charging [R(I) terminal output increase over 33 V].	Lights up before engine start up and shut off once engine is running.
Engine Oil Pressure	 HAOA620L	CN2 - 11	Lights up when engine oil pressure switch is turned "ON" (Oil pressure drops below 0.7 kg/ cm^2 (10 psi).	After starting engine, if engine oil pressure is insufficient after 8 seconds, a warning buzzer will sound.
Engine Coolant Temperature	 HAOD350L	CN4 - 5 CN 4 - 6	Lights up when the resistance of engine coolant temperature sensor drops below 128 ohms.	
Preheat	 HAOA639L	CN7 - 6	Lights up when preheat process is completed. (Approximately 19 seconds from start)	
Work Light	 2658A	CN2 - 7	Lights up when work light switch is turned "ON."	

Description	Symbol	Input Terminal	Operation	Remarks
Overload (Optional)	 ARO0220L	CN1 - 3 CN1 - 4	Lights up when lifting load exceeds limit. (When the over load warning switch is turned "ON," output voltage increases over reading in remarks.)	Warning buzzer will sound. 2.80 V (S300LC-V) 2.80 V (S300LL) 2.80 V (S340LC-V) 2.88 V (S420LC-V) 2.80 V (S470LC-V)
Graphic Information Area				
Air Cleaner	 ARO0210L	CN2 - 12	Lights up when air cleaner is clogged	Symbol is blinking.
Return Filter	 ARO0230L	CN2 - 13	Lights up when return filter pressure increases over 1.5 kg/cm^2 (21 psi).	Symbol is blinking.
Pilot Filter	 ARO0240L	CN2 - 14	Lights up when pilot filter pressure increases over 1.0 kg/cm^2 (14 psi).	Symbol is blinking.

INITIAL OPERATION

Item	Input (Terminal)	Output (Operation and initial setting mode)
Initial Operation	When battery voltage is input to CN7 - 9 (starter switch is turned from "OFF" to "ON" position).	• All LCD, LED and warning lights are turned on and turned off after about 2 seconds. • Warning buzzer is activated and turned off after about 2 seconds. • Power mode: Previous setting mode. • Work Mode: Previous setting mode. • Auto Idle: High Output (Activation). • Numerical display: Engine speed. • Clock: Current time display.

NOTE: *Refer to the clock setting method of operation manual for time setting.*

MODE SELECT SWITCH

Power Mode / Trenching Mode Switch

Operation Mode		Output Check (Operation mode display LED)	e-EPOS Output		
			Pump Discharge Volume Control Valve Current (mA)	Swing Priority Solenoid Valve	7-Segment Display
Power Mode	Power Mode	ON	Variable Output	-	9 x
	Standard Mode	OFF	0	-	7 x
Work Mode	Trenching Mode	ON	-	ON	x 2
	Digging Mode	OFF	-	OFF	x 0

Auto Idle Switch

Operation Mode		Output Check (Operation mode display LED)	e-EPOS Output (CN1 - 7 Terminal)
Auto Idle	Activation	ON	H (11 ±1.5V)
	Cancellation	OFF	L (0 - 1V)

GRAPHIC INFORMATION AREA DISPLAY

OVERVIEW

Many kinds of condition of machine are displayed on the letter information display department. The information display department is divided into two menus. One is main menu for user and the other is special menu for specialist. These menus can be moved from normal display mode by the combination of select buttons.

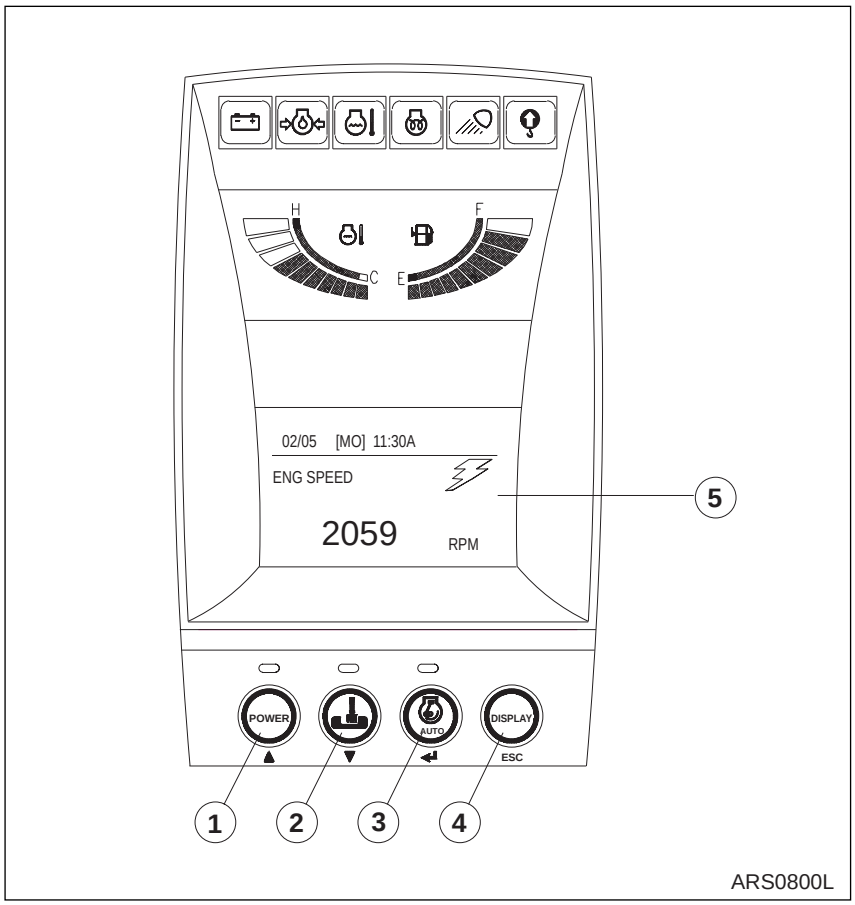


Figure 12

Selection Buttons	Graphic Display Area
1. Up Arrow Button	5. Letter Information Display Department
2. Down Arrow Button	
3. Enter Button	
4. Escape Button	

MAIN MENUS FOR THE GRAPHIC DISPLAY AREA

1. Main menu: Language setting, Time setting, Filter/Oil information
2. Special menu: Information of machine status, failure information, Information of machine operation.

MENU SELECTION BUTTONS

1. Up Arrow Button (▲, 1 on Figure 12): Move the cursor to up, left and previous screen.
2. Down Arrow Button (▼, 2 on Figure 12): Move the cursor to down, right and next screen.
3. Enter Button (↵, 3 on Figure 12): Move the menu to selected mode. When setting the menu, this button is used to function as the select button.
4. Escape Button (ESC, 4 on Figure 12): Move a screen to previous menu or main menu.

MAIN MENU

When the "ESC" button is pressed for more than 3 seconds, the main menu screen is displayed.

Main menu offers three sub-menus (language setting, time setting, or filter/oil information) to the operator.

Refer to the "Operation and Maintenance Manual" for details.

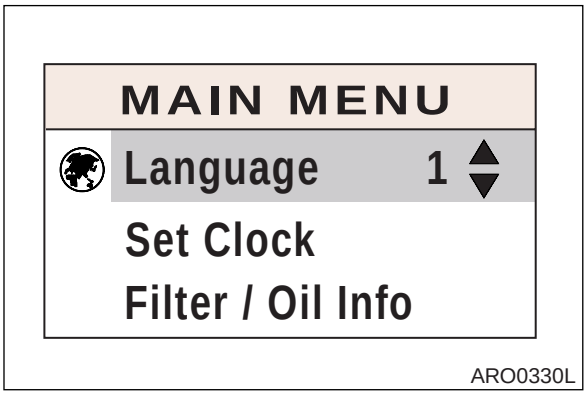


Figure 13

LANGUAGE SETTING

This mode is used for setting desired language.

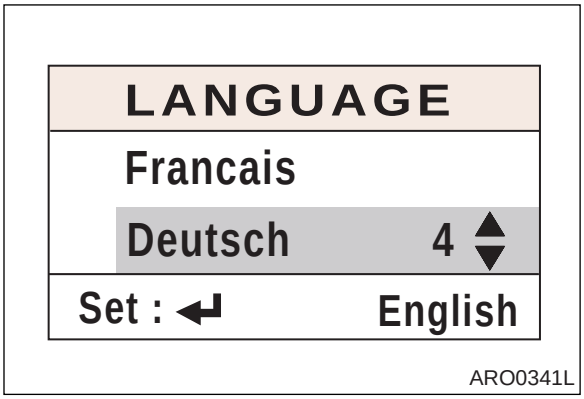


Figure 14

TIME SETTING

This mode is used for setting time on the digital clock.

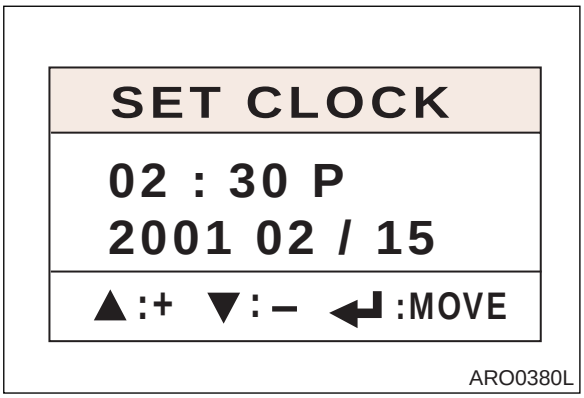


Figure 15

FILTER/OIL INFORMATION

This mode displays total operating hours of filters and oils.

After changing the filter and oil, reset the operating hour and then the operating hours until the next service interval can be easily checked.

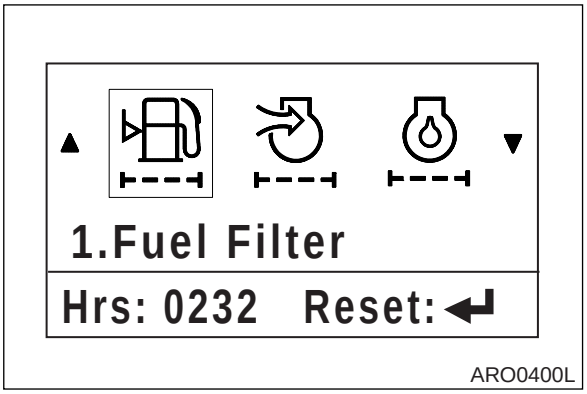


Figure 16

Menu Display Order and Icon Explanation

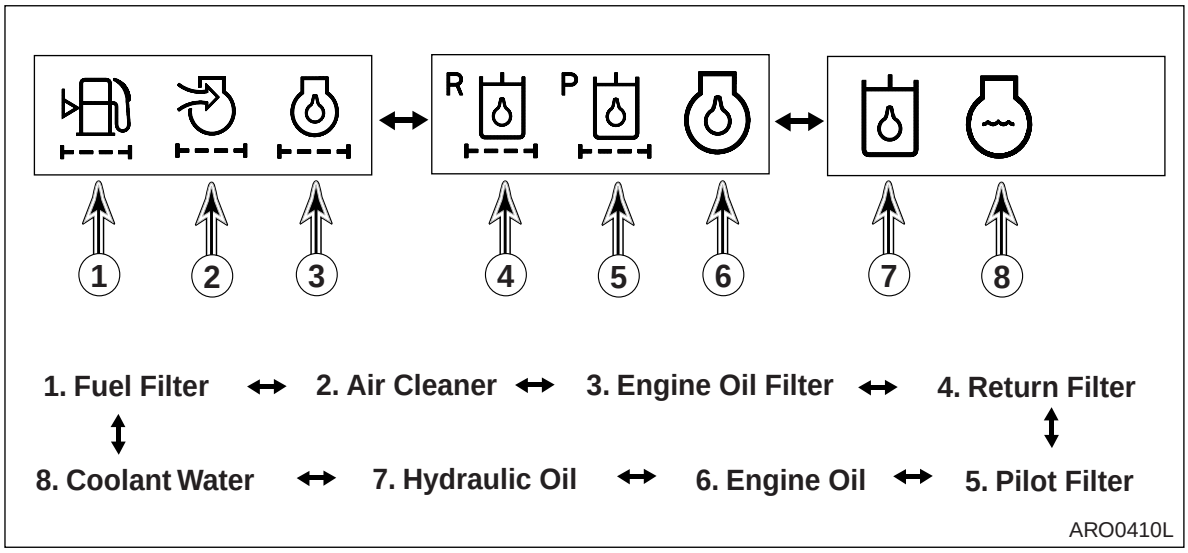


Figure 17

SPECIAL MENU

In this menu, many types of operating conditions and functions can be accessed and disp[layed, including the e-EPOS controller. This menu is mainly used for machine testing and failure diagnostics.

The special menu offers three sub-menus;

1. Machine status.
2. Failure information.
3. Information on machine operation

ENTERING/ACCESSING AND EXITING/ESCAPING MENUS

Entering/Accessing Menus

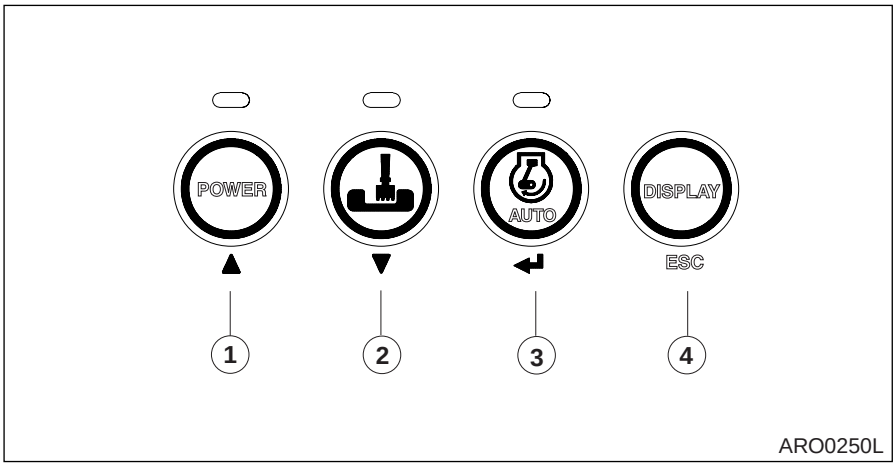


Figure 18

When normal mode screen is displayed, if the enter button (↵, 3) and escape button (ESC, 4) are pressed simultaneously for more than 3 seconds, normal mode screen (Figure 19) will be changed to special menu screen (Figure 20).

Normal Mode Screen

NOTE: *Normal mode screen can display many kinds of display mode by selecting, for example, engine revolution (RPM), battery voltage (V), front pump pressure (BAR), rear pump pressure (BAR) and so on by selecting.*

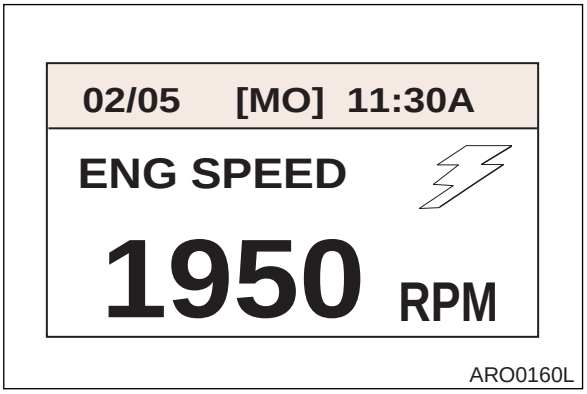


Figure 19

Special Menu Screen

NOTE: *Displayed language on the special menu screen consists of Korean and English.*

If any language except for Korean is selected during language selection mode of main menu, only English will be displayed on special menu screen.

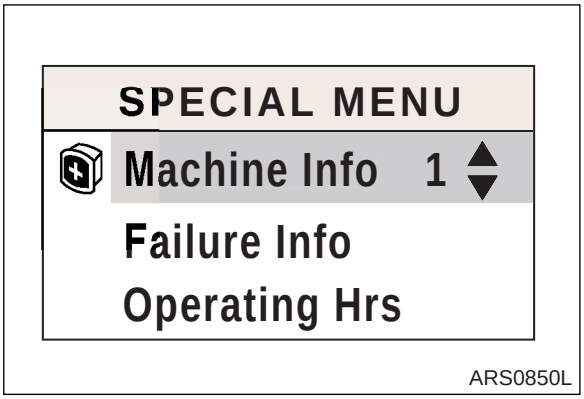


Figure 20

Exiting/Escaping Menus

1. If escape button (ESC, 4 on Figure 18) is pressed for more than 1 second, the special menu screen will be returned to the normal mode screen.
2. If this special menu is "ON" without any activity, for more than 20 seconds, it will turn to the normal mode screen.
3. After the turning starter switch to the "OFF" position, turn it back to the "ON" position, and the normal mode screen displayed once again.

SPECIAL MENU SELECTIONS

Sub-menu Selection Method

Various sub-menus can be selected by pressing "Up (▲, 1 on Figure 18)" and "Down (▼, 2 on Figure 18)" button.

Move the cursor to desired menu and a selected menu will be inverse displayed.

When the selected menu is inverse displayed, press the "Enter (↵, 3 on Figure 18)" button for menu selection.

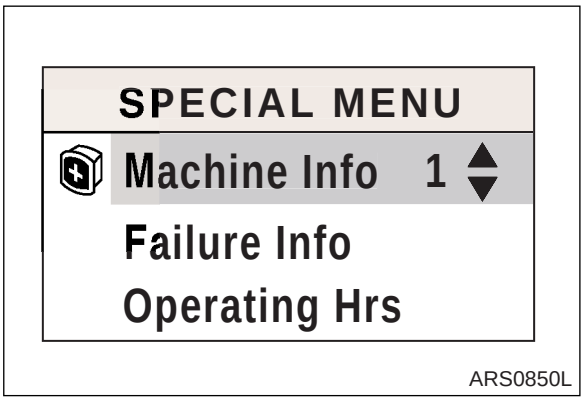


Figure 21

Information of Machine Status

1. Entering Sub-menus: When cursor is located on "Machine Info" of special menu screen, press "Enter (↵, 3 on Figure 18)" button and the "Machine Info Sub-menu" will be displayed.
2. Exiting Sub-menus: If escape button (ESC, 4 on Figure 18) is pressed for more than 1 second, display will be turned to previous sub-menu.

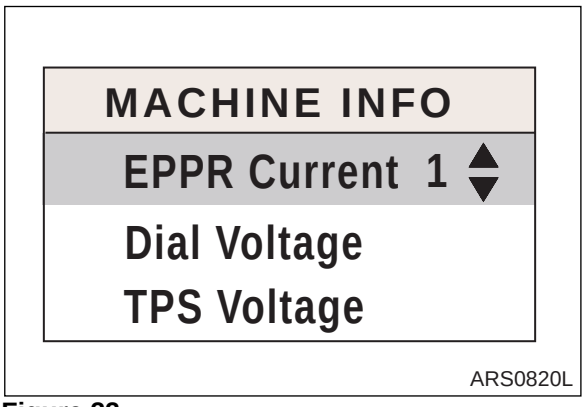


Figure 22

Contents of Machine Status

Display Item of Machine State Information			Display	Remarks
1. EPPR Current			"mA"	EPPR valve current
2. Dial Voltage			"mV"	Dial voltage
3. TPS Voltage			"mV"	TPS voltage
4. Input State	1. Alternator	8. Pressure (Px)	On or Off	Input status delivered from switches and sensors to e-EPOS controller is displayed as on or off. * Number 3 (Work/Travel sel.) is used only wheel type machine. * Number 13 (OWD Select) is optional part.
	2. Power Max	9. E/G Oil Press.		
	3. Work/Travel Sel.	10. Air Cleaner		
	4. Hi Speed Sel.	11. Return Filter		
	5. Auto Travel	12. Pilot Filter		
	6. Work Lamp	13. OWD Select		
	7. Pressure (Py)			
5. Output State	1. Relief Press Up	4. Spare Out 1	On or Off	Output status delivered from e-EPOS controller to solenoid valves is displayed as on or off.
	2. High Speed	5. Spare Out 2		
	3. Swing Priority			
6. Hydraulic Oil Temp			˚C (˚F)	Hydraulic oil temperature.
7. Boom Pressure (Opt)			BAR	On machine with overload warning device, it displays cylinder pressure.
8. T/M Pressure (Wheel Type)			BAR	At this machine, it is always displayed as "O."

Sub-menu Selections

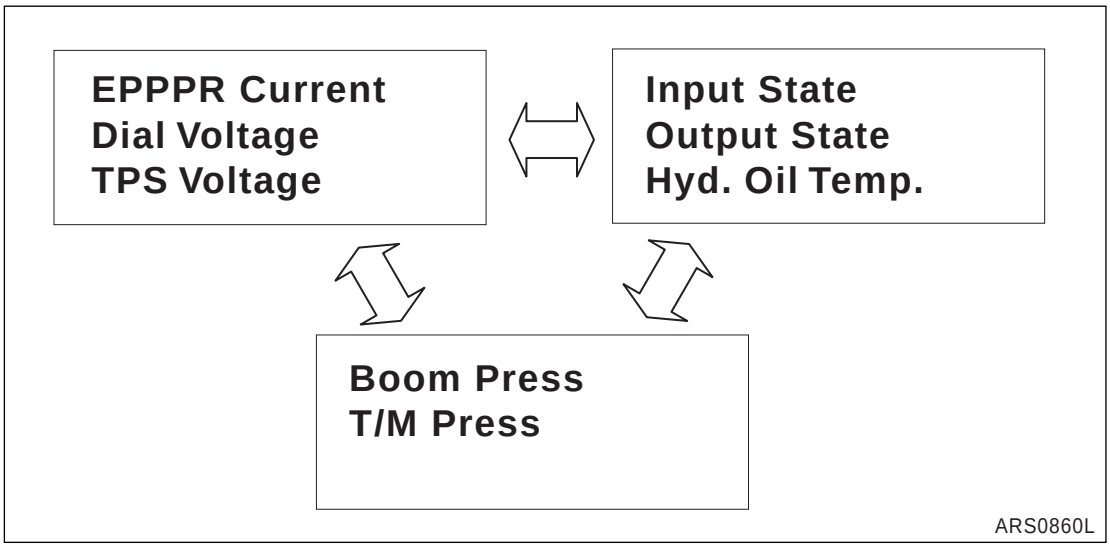


Figure 23

Display Example: Machine Status Information

1. EPPR Valve Current

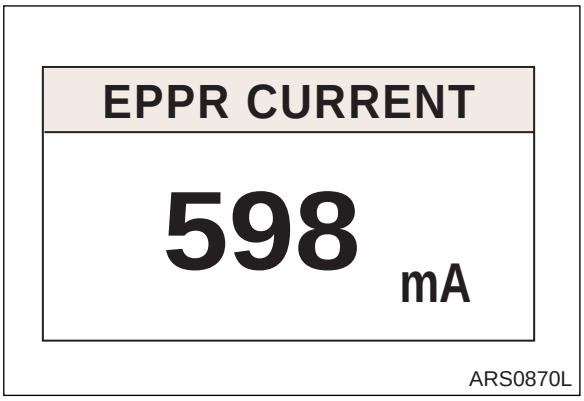


Figure 24

2. Dial Voltage

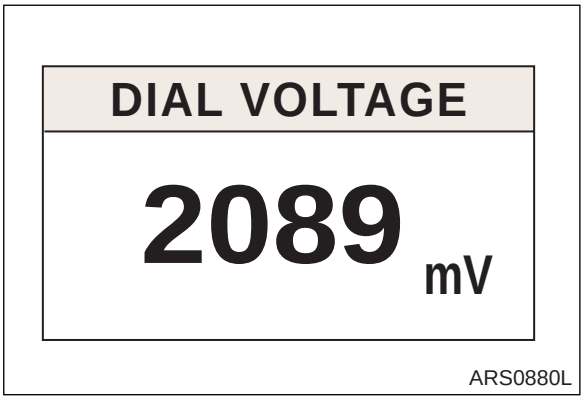


Figure 25

3. TPS Voltage

   Output voltage of potentiometer built into engine control motor.

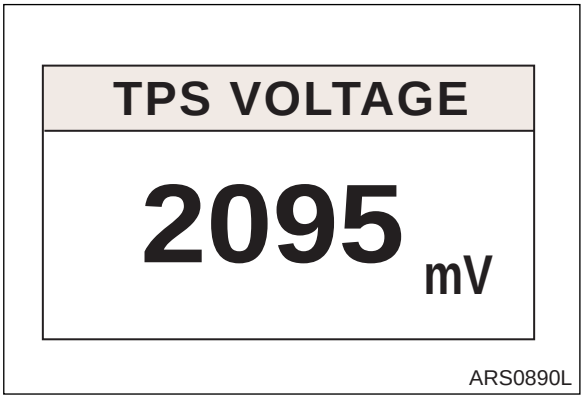


Figure 26

4. Input Status

"YES" or "NO" for alternator's generation (Generation: "ON"/ Non-generation: "OFF"), selection status of select switch (Selection: "ON"/ Non-selection: "OFF") and the other statuses of on/off type sensors.

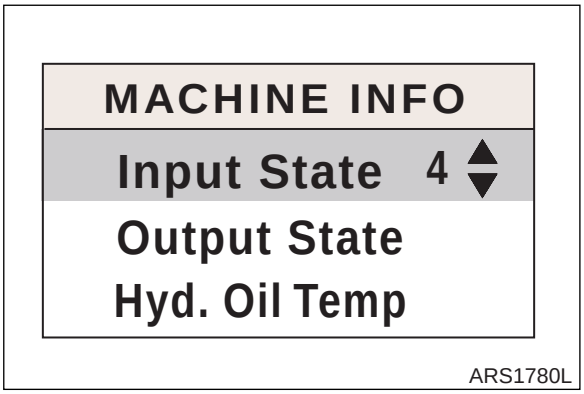


Figure 27

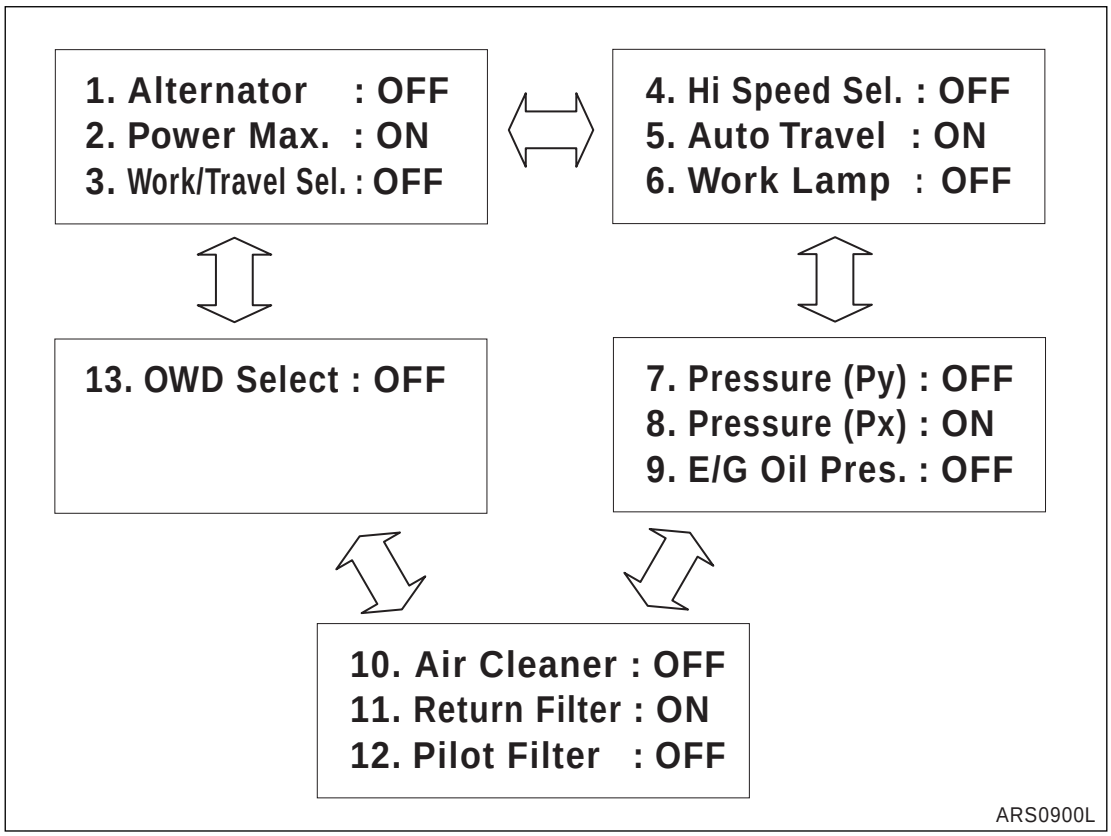


Figure 28

5. Output Status: Output status of solenoid valves and spare valves are displayed. (Output: "ON"/ Non-output: "OFF")

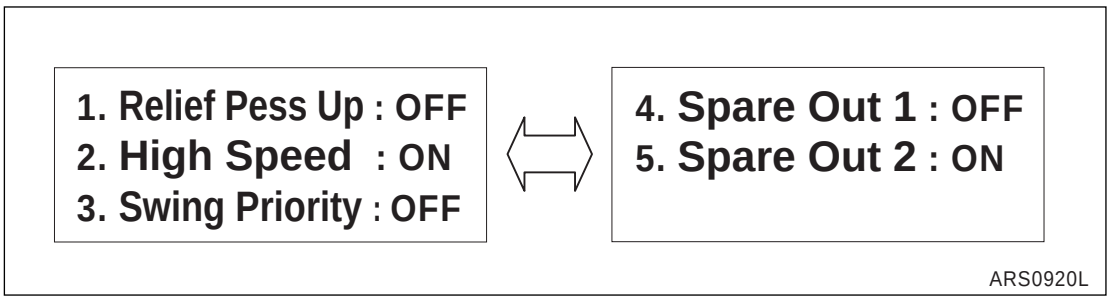


Figure 29

6. Hydraulic Oil Temperature

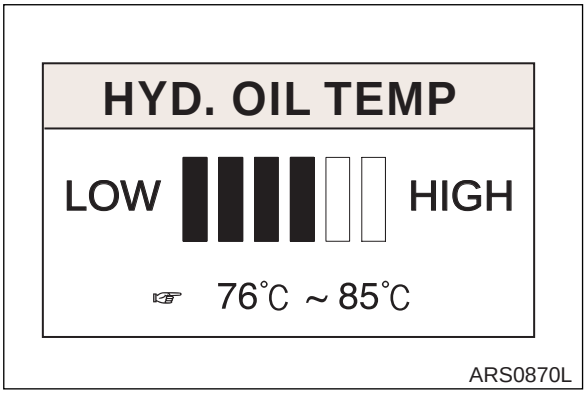


Figure 30

- Display Specification

BAR Graph Display	Input Terminal	Sensor Input Specification	Remarks
1/6 BAR Lit	CN 3 - 4 CN 3 - 5	Over 1,510 Ω	Below 30˚C (Below 86˚F)
1/6 ~ 2/6 BAR Lit		745 ~ 1,510 Ω	31 ~ 50˚C (87 - 122˚F)
1/6 ~ 3/6 BAR Lit		332 ~ 745 Ω	51 ~ 75˚C (123 - 167˚F)
1/6 ~ 4/6 BAR Lit		244 ~ 332 Ω	76 ~ 85˚C (168 - 185˚F)
1/6 ~ 5/6 BAR Lit		181 ~ 244 Ω	86 ~ 95˚C (186 - 203˚F)
1/6 ~ 6/6 BAR Lit		Under 181 Ω	Over 96˚C (Over 204˚F)

7. Boom Pressure (Optional)

   On machine with OWD (Overload Warning Device), detected pressure from boom cylinder is displayed with numeric values (Unit: Bar).

   The relative equation between the, output voltage of pressure sensor, and the pressure of boom cylinder, is as follows.

   - V = 0.00816P + 1

   V: Output voltage of pressure sensor (V).
   P: Displayed pressure (Bar).

   NOTE: *At standard machine, "0 BAR" is always displayed.*

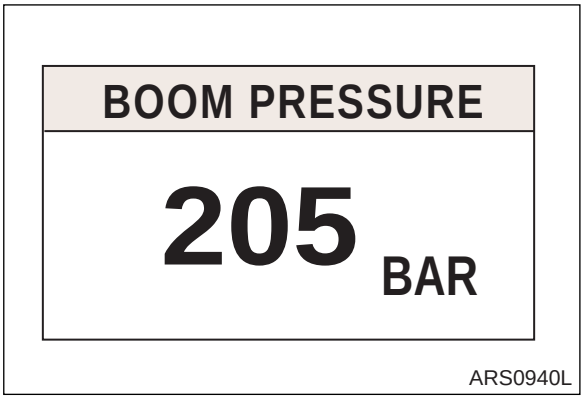


Figure 31

Failure Information

1. Entering Sub-menus: When a cursor is located in "Failure Info" of special menu screen press enter button (↵, 3 on Figure 18) and "Failure Info" screen is displayed.
2. Exiting Sub-menus: If escape button (ESC, 4 on Figure 18) is pressed for more than 1 second, this information screen will be returned to previous screen.

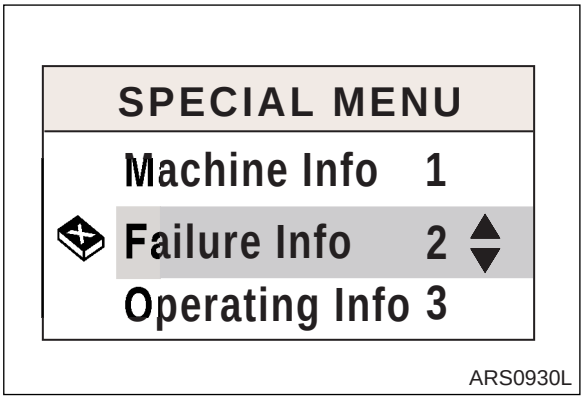


Figure 32

* Real-time Failure:
  Current status of failure is displayed.
* Failure Log:
  Memorized record of past failure is displayed.
* Delete Fail Log:
  This mode is used to delete all of the memorized record of past failure.

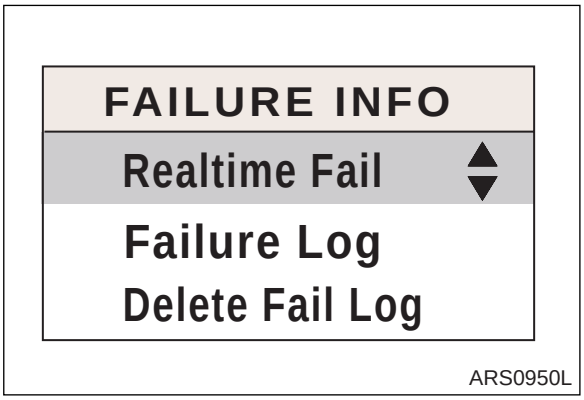


Figure 33

A. Current failure information

Current status of failure is displayed (Failure code, failure contents).

When a number of failures are produced, failure information can be checked by using "PRV" (▲, 1 on Figure 18) or "NXT" (▼, 2 on Figure 18) button.

* CODE: 12: Unique code of failure information.

* 01/02: A serial number of current failure/ total quantity of failure.

This example shows one of two failures.

B. Past failure information

Memorized record of past failure is displayed (Failure code, failure contents).

When a number of failures are produced, failure information can be checked by using "PRV" (▲, 1 on Figure 18) or "NXT" (▼, 2 on Figure 18) button.

NOTE: *" N: xxx " : "xxx" means that the totally counted number of the same failure.*

" xxxx Hr " : It will display the operation hour until the failure is generated. (Above example screen shows that breaking of a wire of pressure solenoid valve is generated at 75Hr.)

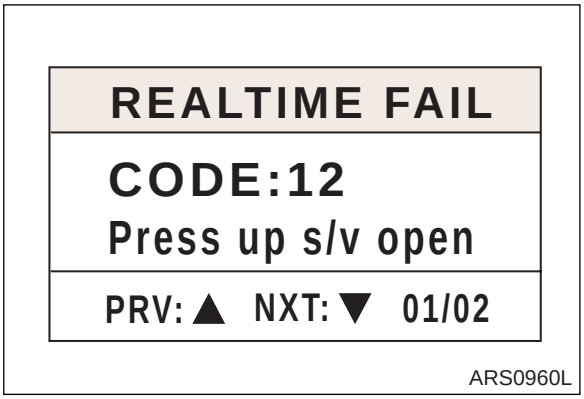


Figure 34

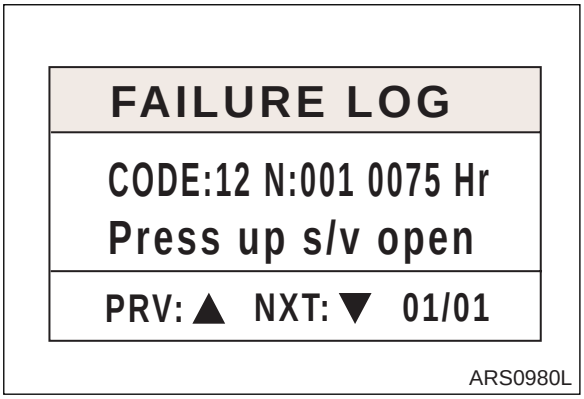


Figure 35

C. Failure record deletion

This mode is used to delete the memorized record of past failure. If this mode is selected, all records will be deleted.

When "YES" (↵, 3 on Figure 18) button is pressed, the memorized record will be deleted.
At this time, deletion signal will be displayed and the screen will move to previous menu after deletion.

This screen will be displayed during 3 seconds.

When "NO" (ESC, 4 on Figure 18) button is pressed, the screen will recover to previous menu without deletion.



Figure 36

Code Description of Failure Information

Code	State
0 x	Short Circuit
1 x	Open circuit
2 x	Output error
3 x	Output error
8 x	Communication

Display Contents of Failure Information Code

Code	Contents	Cause	Operation	Reset Procedure
82	Communication Err!!	Communication error between e-EPOS controller and instrument panel	* Note	Automatic reset when problem is corrected
01	EPPR v/v short	Short Circuit	Cut off output current (0 mA)	After correcting problem, turn start switch from "OFF" to "ON."
02	Press Up s/v short	Short Circuit		
03	Swing pri. s/v short	Short Circuit		

Code	Contents	Cause	Operation	Reset Procedure
11	EPPR v/v open	Open Circuit	-	Automatic reset when problem is corrected
12	Press Up s/v open	Open Circuit	-	
13	Swing pri. s/v open	Open Circuit	-	
21	Dial Voltage Err (H)	Output voltage Over 4.6±0.2 V	-	
22	Dial Voltage Err (L)	Output voltage Over 0.4±0.2 V	-	
23	TPS Voltage Err (H)	Output voltage Over 4.6±0.2 V	Cut off EPPR v/v current (0 mA)	
24	TPS Voltage Err (L)	Output voltage Over 0.4±0.2 V	Cut off EPPR v/v current (0 mA)	
25	Fpump Sensor Err (H)	Output voltage Over 4.6±0.2 V	-	
26	Fpump Sensor Err (L)	Output voltage Over 0.4±0.2 V	-	
27	Rpump Sensor Err (H)	Output voltage Over 4.6±0.2 V	-	
28	Rpump Sensor Err (L)	Output voltage Over 0.4±0.2 V	-	
29	Speed Sensor Err	Under 1067±20Hz (On condition that alternator output exceeds over 12±1V)	-	
31	Fuel shot to GND	Sensor's resistance between two terminals is under 150±100Ω	-	
32	Fuel Sensor open	Sensor's resistance between two terminals is under 6.5±0.5 kΩ	-	
33	Alternator too high	Output voltage of alternator exceeds 33 V for more than 3 seconds	-	
34	Alternator too low	When the output voltage is maintained under 18±1 for more than 3 seconds (On condition that speed sensor output exceeds over 1,067Hz)	-	

NOTE:

1. *If a communication error is generated during operation, the power mode, work mode and auto idle mode will be maintained at the last mode setting before the failure took place until the unit is shutdown.*
2. *When start switch is turned to the "ON" position during a period of a communication error, the e-EPOS controller will operate in the following modes.*
   - *Power mode: Standard mode*

- *Work mode: Digging mode*
- *Auto idle: "ON"(Selection state)*

3. *The above mentioned two statuses are applicable to normal condition of an e-EPOS controller.*
4. *Under the abnormal condition of an e-EPOS controller, communication cable or instrument panel failure, "Failure code: 82" can be generated.*

Information of Machine Operation

Accumulated operation hour of each mode and status is displayed.

1. Operating Hour Information

   A. Entering Sub-menus: When a cursor is located in "Operating Info" of special menu screen (Figure 37) press enter button(↵, 3 on Figure 18) and "Operating Info" screen will be displayed (Figure 38).

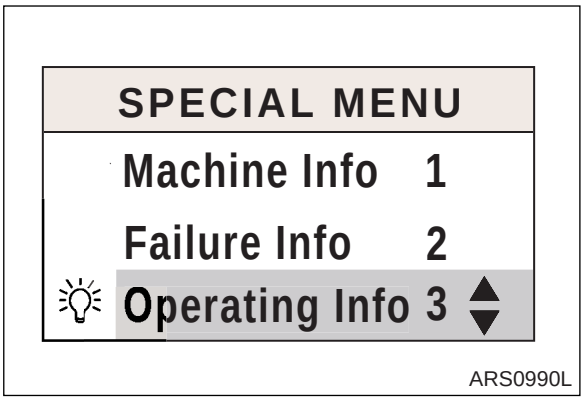


Figure 37

   B. Information screen of machine operation (Figure 38).

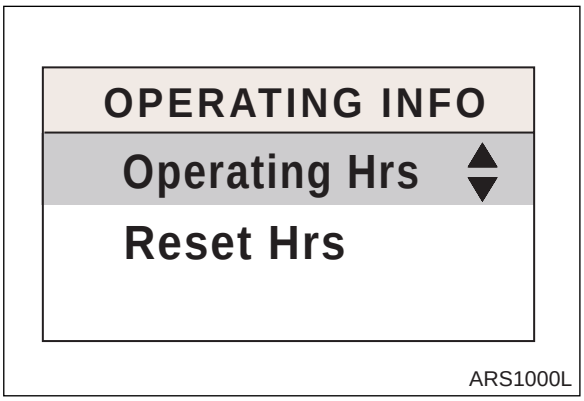


Figure 38

   C. Operation Hour Screen

   D. Exiting Sub-menus: If escape button (ESC, 4 on Figure 18) is pressed for more than 1 second, this information screen will be returned to previous screen.

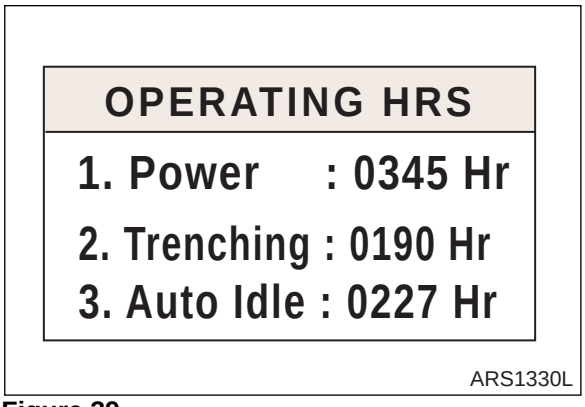


Figure 39

Information contents of operation hour

Item	Information Contents	Detection Method
Power Mode	Operation hours used power mode are displayed.	Power mode switch (Instrument panel) - "ON" status & Alternator signal (CN2-1)
Trenching Mode	Operation hours used trenching mode are displayed.	Trenching mode switch (Instrument panel) - "ON" status & Alternator signal (CN2-1)
Auto Idle	Operation hours used auto idle status are displayed.	Auto idle switch (Instrument panel) - "ON" status & Alternator signal (CN2-1)
Travel Speed: - Low speed - High speed	Operation hours used low speed and high speed are displayed	Low speed: High speed s/v "OFF" status & travel pressure switch "Py" (control valve) - "ON" status High speed: High speed s/v & travel pressure switch "Py" (control valve) - "ON" status
Hydraulic Oil Temperature Distribution (˚C (˚F))	Temperature of hydraulic oil is classified 6 steps. And operation hours of each step are displayed Under 30˚C (87˚F) 31 ~ 50˚C (88 - 123˚F) 51 ~ 75˚C (124 - 168˚F) 76 ~ 85˚C (169 - 186˚F) 86 ~ 95˚C (187 - 203˚F) Over 96˚C (204˚F)	The resistance delivered from temperature sensor of hydraulic oil is classified 6 steps. And operation hours of each step are displayed. (Alternator output)
Coolant Temperature Distribution (˚C (˚F))	Temperature of coolant is classified 6 steps. And operation hours of each step are displayed Under 40˚C (105˚F) 41 ~ 60˚C (106 - 141˚F) 61 ~ 85˚C (142 - 186˚F) 86 ~ 95˚C (187 - 204˚F) 96 ~ 105˚C (205 - 222˚F) Over 106˚C (223˚F)	The resistance delivered from coolant sensor is classified 6 steps. And operation hours of each step are displayed. (Alternator output)

Menu Selection of Operation Hour Information

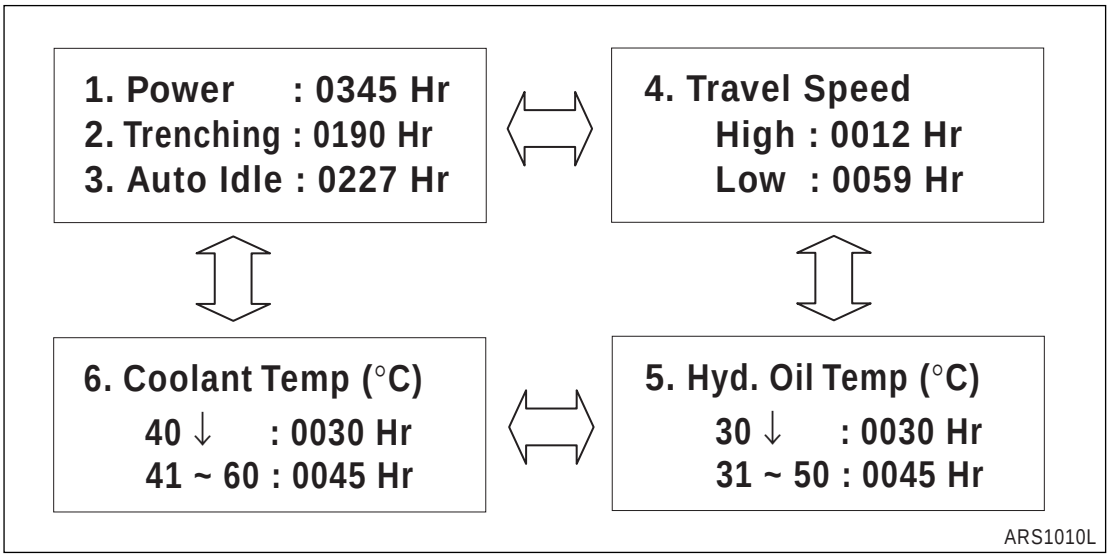


Figure 40

2. Operation hour reset

   A. Entering Sub-menus: When cursor is located in "Reset Hrs" of information screen of operation hour press enter button (↵, 3 on Figure 18) and "Reset Hrs" screen will be displayed.

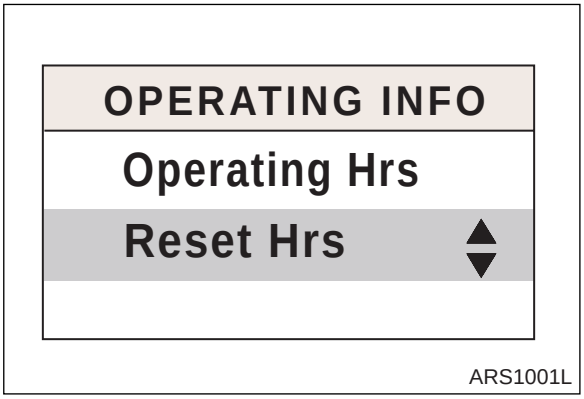


Figure 41

   B. Reset screen of operation hour

   C. Exiting Sub-menus: If escape button (ESC, 4 on Figure 18) is pressed for more than 1 second, this information screen will be returned to previous screen.



Figure 42

NOTE: *When "YES" (↵, 3 on Figure 18) button is pressed, operation hours will reset.*
At this time, resetting signal will be displayed and the screen will move to previous menu after resetting.

NOTE: *When "NO" (ESC, 4) button is pressed, the screen will recover to previous menu without resetting.*

ELECTRONIC HYDRAULIC CONTROL SYSTEM (E-EPOS)

CONTROL SYSTEM SCHEMATIC

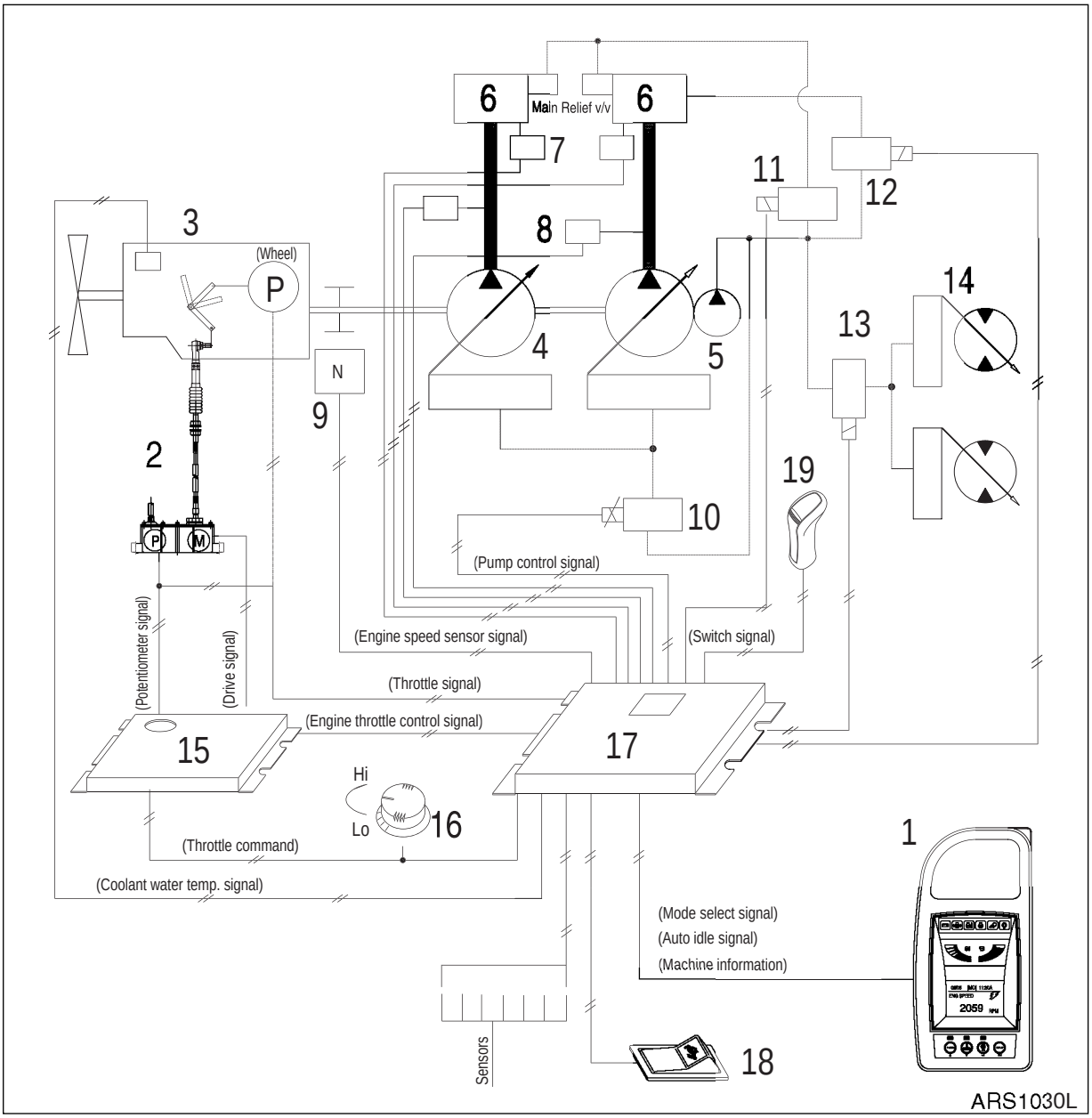


Figure 43

Reference Number	Description
1	Instrument Panel
2	Engine Control Motor
3	Engine
4	Main Hydraulic Pump
5	Control Pump
6	Control Valve
7	Pressure Switch
8	Pump Pressure Sensor
9	Engine Speed Sensor
10	Electro-magnetic Proportional Pressure Reducing Valve (E.P.P.R. Valve)

Reference Number	Description
11	Solenoid Valve (Pressure Up)
12	Solenoid Valve (Swing Priority)
13	Solenoid Valve (High Speed)
14	Travel Motor
15	Engine Throttle Control
16	Engine Control Dial
17	e-EPOS Controller
18	Auto Travel Select Switch
19	Boost Switch (Right Work Lever)

POWER MODE CONTROL

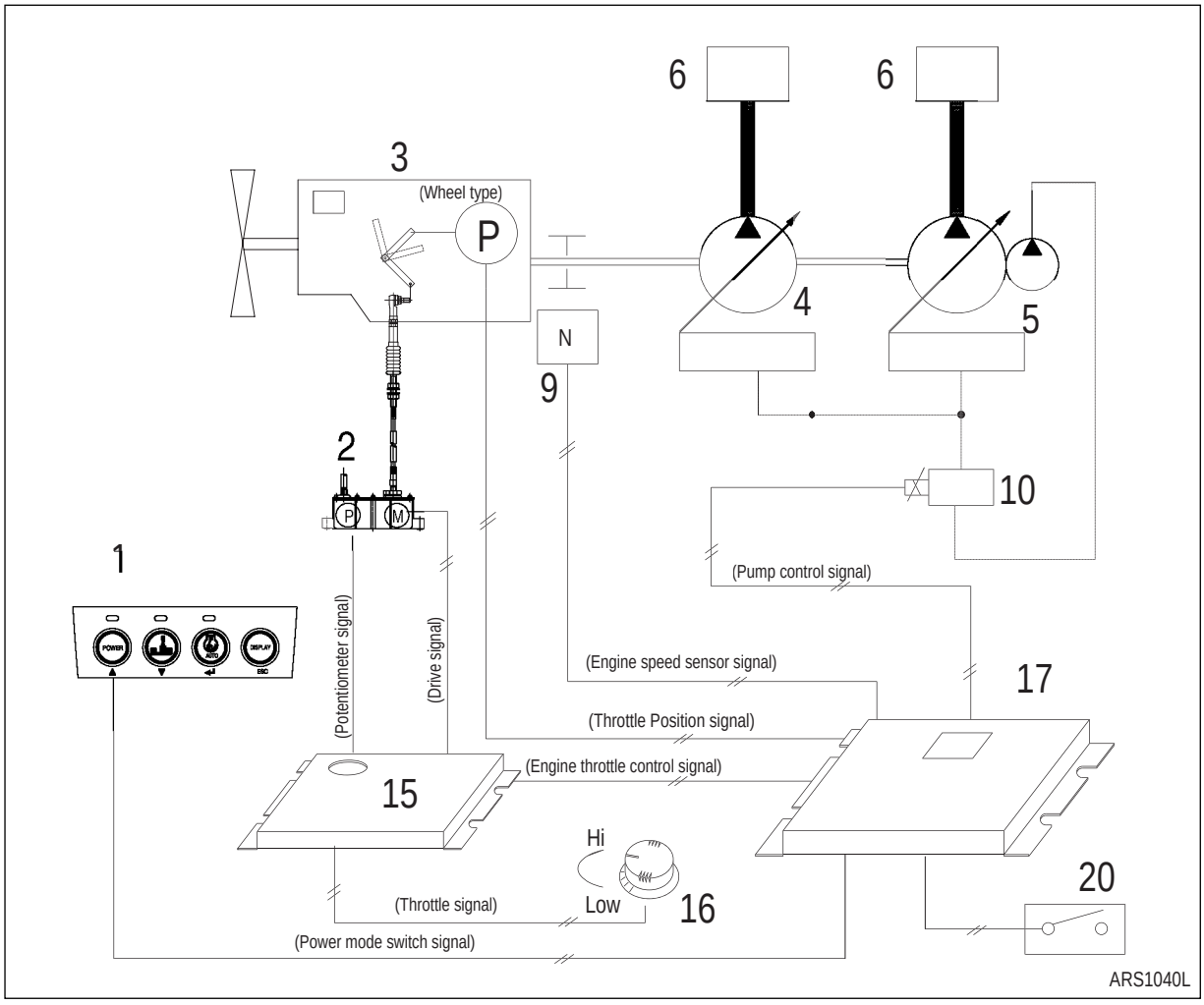


Figure 44

Reference Number	Description
1	Instrument Panel (Power Mode Selection Switch)
2	Engine Control Motor
3	Engine
4	Main Hydraulic Pump
5	Control Pump
6	Control Valve

Reference Number	Description
9	Engine Speed Sensor
10	E.P.P.R. Valve
15	Engine Throttle Controller
16	Engine Control Dial
17	e-EPOS Controller
20	Work / Travel Selection Switch (Wheel Type)

The power mode switch permits the selection of the appropriate engine power depending on the working condition. One of the two, Power Mode or Standard Mode, setting can be selected. When the engine start switch is turned "ON," the last setting before "OFF" will be maintained. The desired mode can be selected by pressing the select button on the instrument panel. When the power mode is selected, the indicator lamp will turn "ON" to display the selected mode.

The quantity of oil discharged by the pump and the engine speed are determined by the mode selected by the operator. The pump output in each mode is determined by the mode selection and is listed in the following table

Mode	Standard Mode	Power Mode
Output (%)	Approximately 85%	100%

OPERATION

1. Power Mode

This mode should be selected for high speed work. In this mode the engine output is most efficiently utilized due to the discharged oil volume being controlled based on the equivalent horsepower curve at various loaded pressures. The e-EPOS controller compares the target engine speed with the actual engine speed and controls the signal to the E.P.P.R. (Electric Proportional Pressure Reducing) valve which in turn varies the pump output quantity.

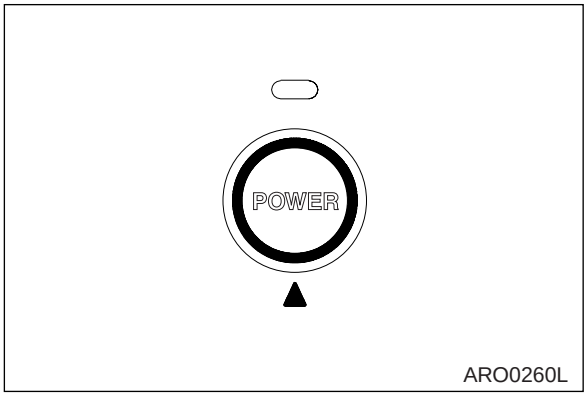


Figure 45

If the load increases, the engine speed will fall below the rated speed. When this occurs, the controller senses this decrease and immediately reduces the pump discharge volume to maintain the engine speed at the rated level.

On the other hand, if the load is decreased the controller increases the discharge volume of the pump to maintain the engine speed at the rated level.

By repeating these control operations, the engine speed is maintained at the rated speed so that maximum power can be generated.

In Power Mode, the controller receives engine speed signals from the engine speed sensor and the throttle position sensor (sensor is built into engine control motor) and converts it to an operating signal current and is then transferred to the pump's E.P.P.R valve. At this time the E.P.P.R. valve converts the electric signal to the corresponding control pressure and sends it to the two pumps, adjusting the pump discharge volume to the desired level.

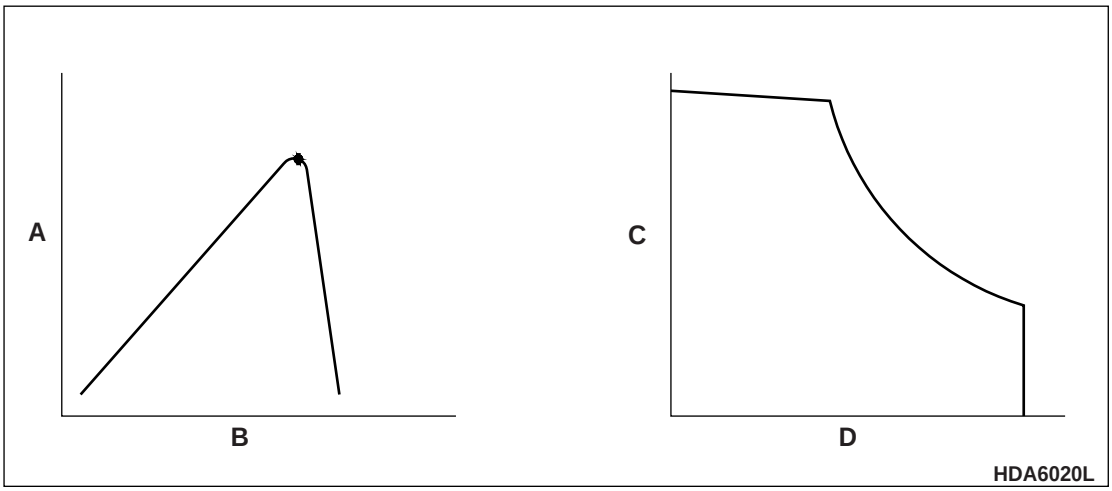


Figure 46

Reference Number	Description
A	Engine Horsepower (hp)
B	Engine Speed (rpm)
C	Pump Discharge Volume (lpm)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm^2)

2. Standard Mode

Standard Mode is used for general work. When this mode is selected it will reduce noise and fuel consumption in comparison with Power Mode. The current to the E.P.P.R. valve is shut off and pump discharge volume is controlled by pump regulator.

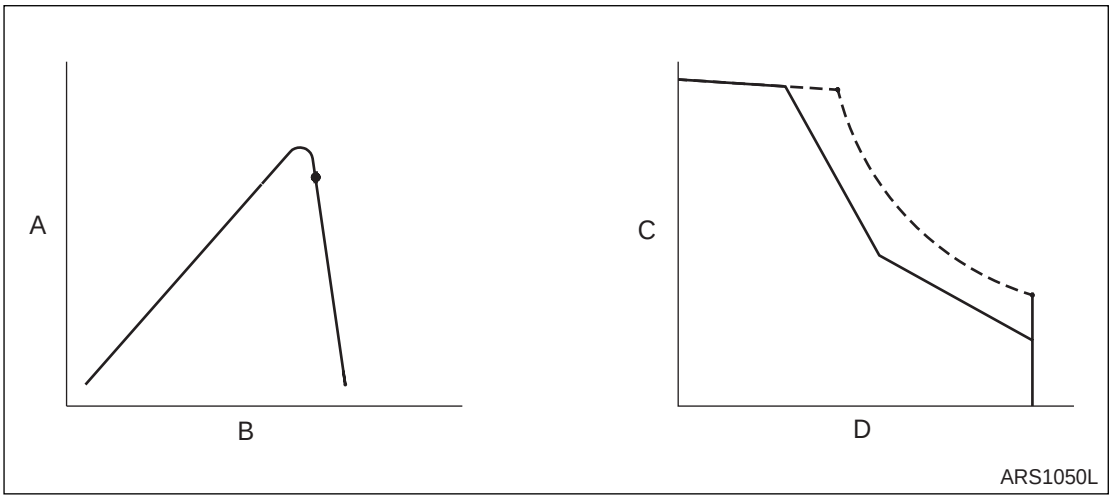


Figure 47

Reference Number	Description
A	Engine Horsepower (hp)
B	Engine Speed (rpm)
C	Pump Discharge Volume (lpm)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm^2)

POWER MODE CONTROL - CIRCUIT DIAGRAM

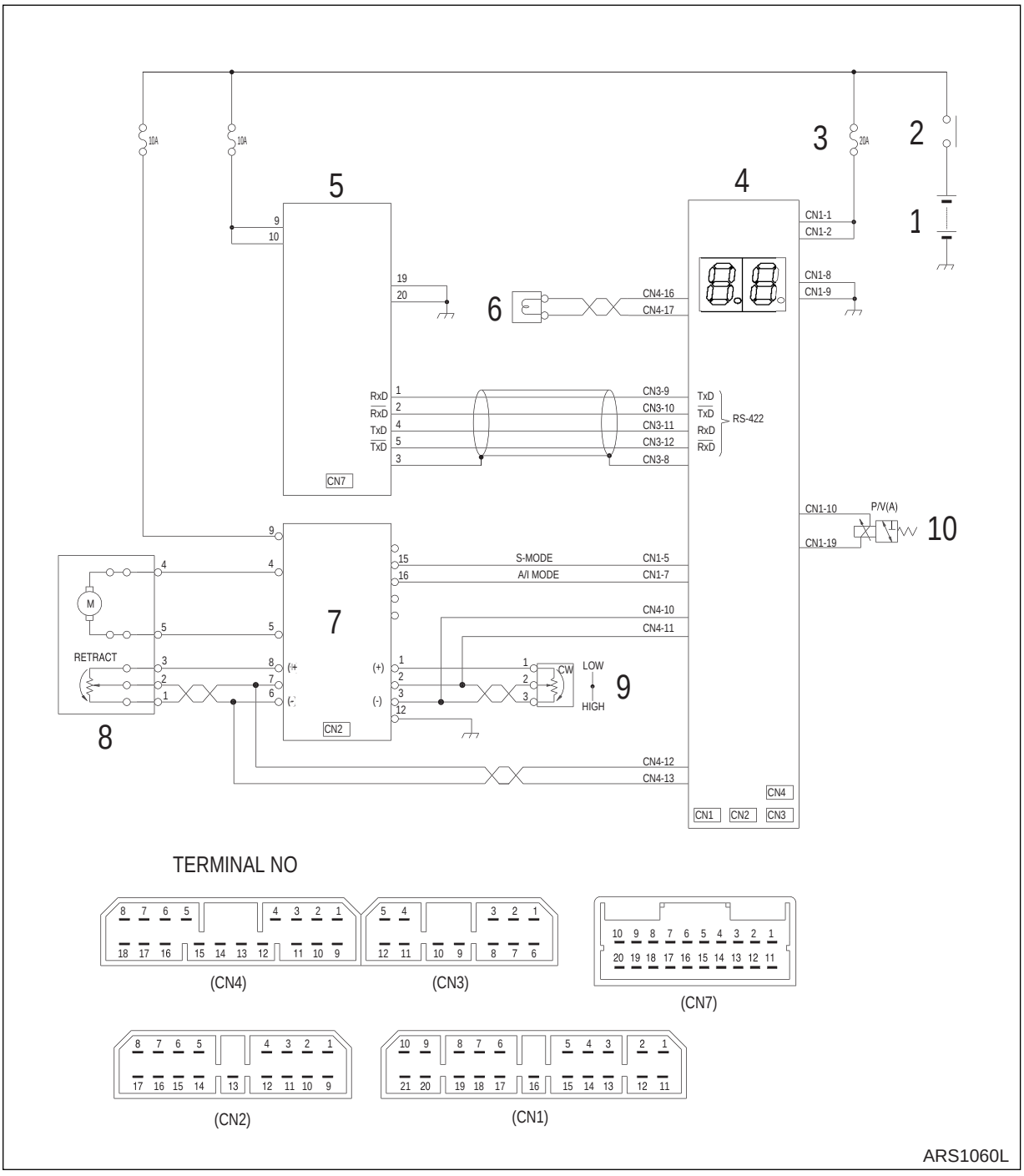


Figure 48

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	e-EPOS Controller
5	Instrument Panel

Reference Number	Description
6	Engine Speed Sensor
7	Engine Throttle Controller
8	Engine Control Motor
9	Engine Control Dial

TRENCHING MODE CONTROL

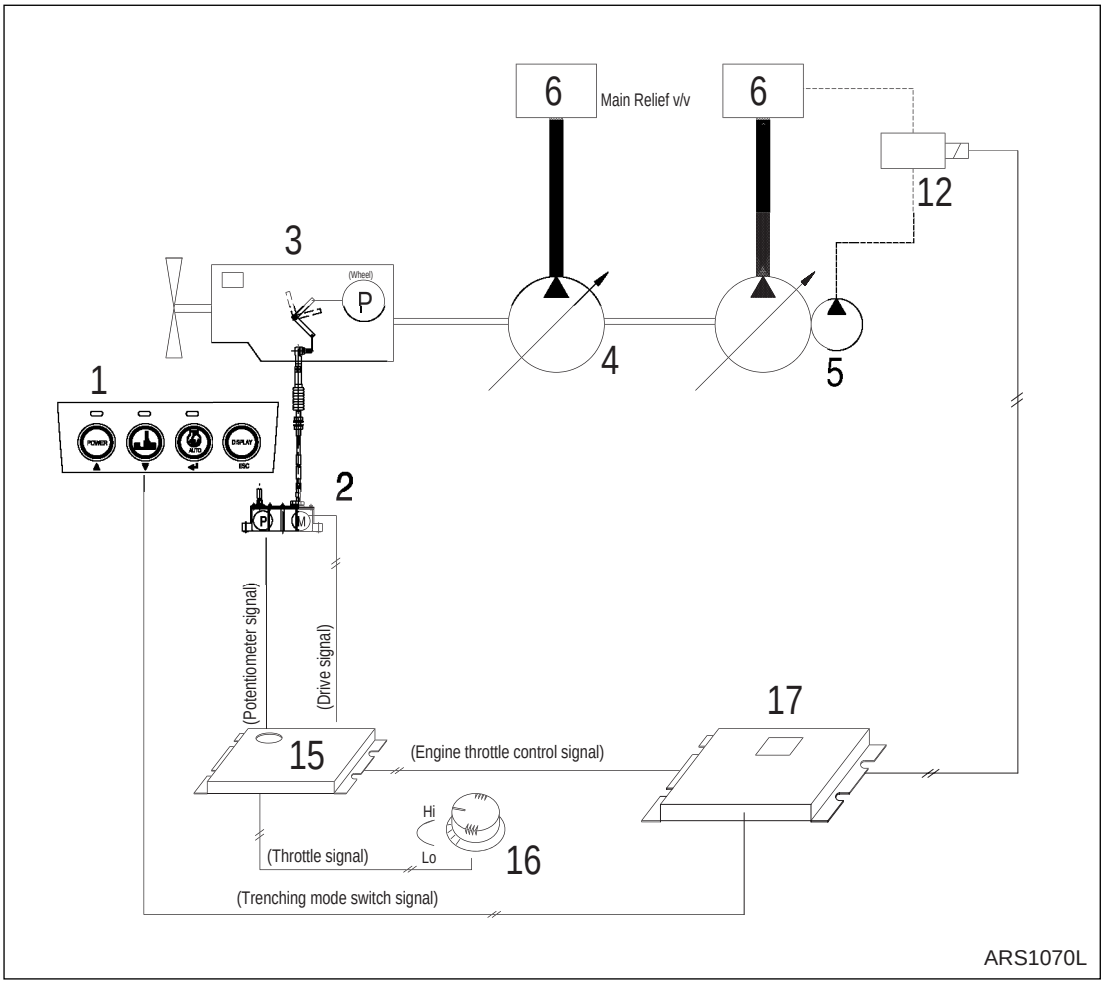


Figure 49

Reference Number	Description
1	Instrument Panel (Trenching Mode Select Switch)
2	Engine Control Motor
3	Engine
4	Main Hydraulic Pump
5	Control Pump

Reference Number	Description
6	Control Valve
12	Solenoid Valve
15	Engine Throttle Control
16	Engine Control Dial
17	e-EPOS Controller

Depending on the working condition, one of two work modes, "DIGGING" or "TRENCHING" can be selected from the instrument panel.

When the engine start switch is turned "ON," the last setting before "OFF" will be maintained.

Depending on the trenching mode selected, the control valve solenoid adjusts the assignment of hydraulic oil flow to each device on the equipment.

OPERATION

1. Digging Mode

This mode is used for general digging work, loading work and ground leveling work requiring quick stops. The current to the solenoid valve for swing priority is shut off.

2. Trenching Mode

This mode is used for heavy duty ditch digging work or for loading work requiring big swing angles. The voltage is assigned to the swing priority control valve activating the swing control valve restricting the flow of oil to the boom and the arm.

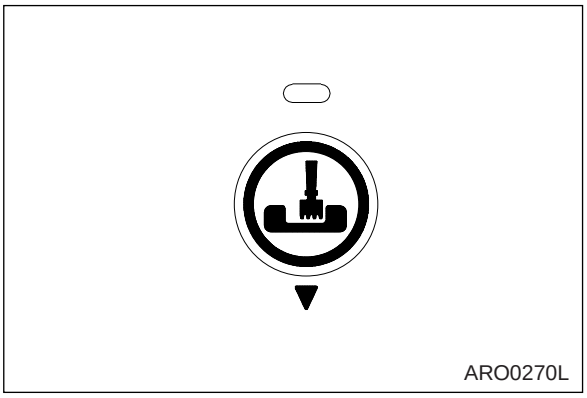


Figure 50

TRENCHING MODE CONTROL - CIRCUIT DIAGRAM

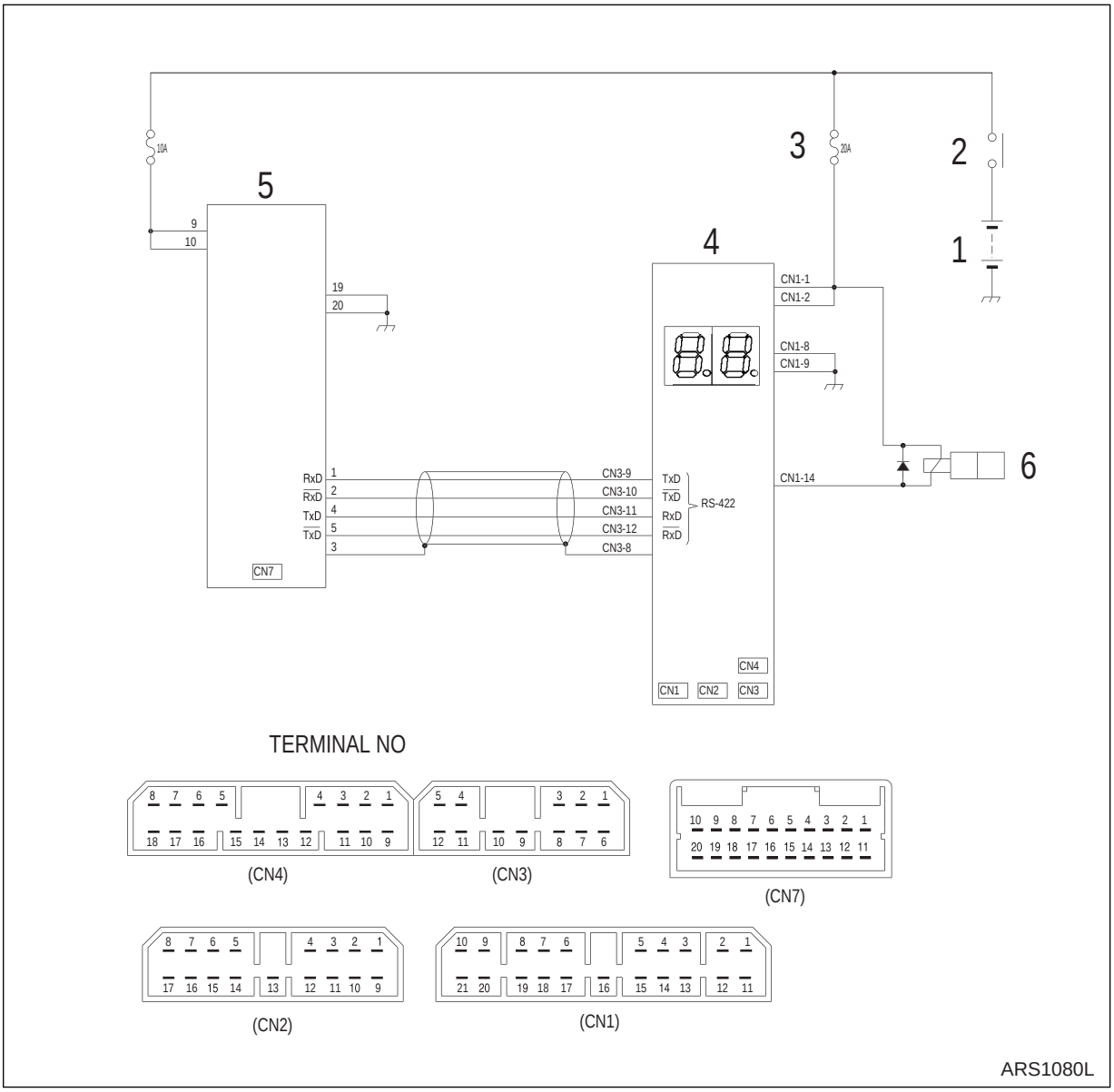


Figure 51

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse

Reference Number	Description
4	e-EPOS Controller
5	Instrument Panel
6	Solenoid Valve (Swing Priority)

ENGINE CONTROL SYSTEM

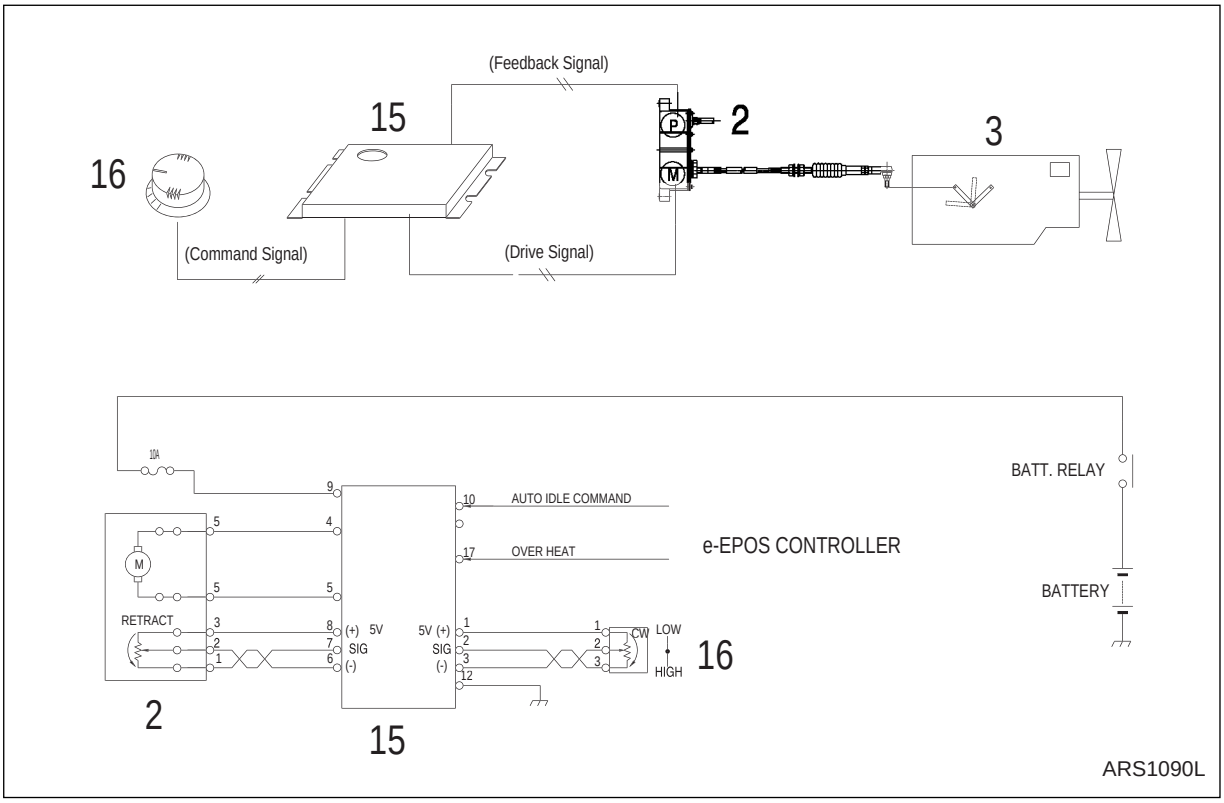


Figure 52

Reference Number	Description
2	Engine Control Motor
3	Engine

Reference Number	Description
15	Engine Throttle Controller
16	Engine Control Dial

When the engine control dial is moved the output voltage changes according to the dial position. This signal is input to the engine throttle controller. The engine throttle controller then compares the input voltage from the engine speed dial with the feedback signal from the throttle position sensor built into the engine control motor and drives the motor to the position set by the control dial. When the command signal and the potentiometer feed back signals are the same the engine controller shuts off the current to the control motor. The engine control motor cable is a solid type and is connected to the engine fuel injection control lever. The engine speed is controlled by the movement of the fuel injection lever which is directly linked with the rotation of the control motor.

ENGINE CONTROL MOTOR

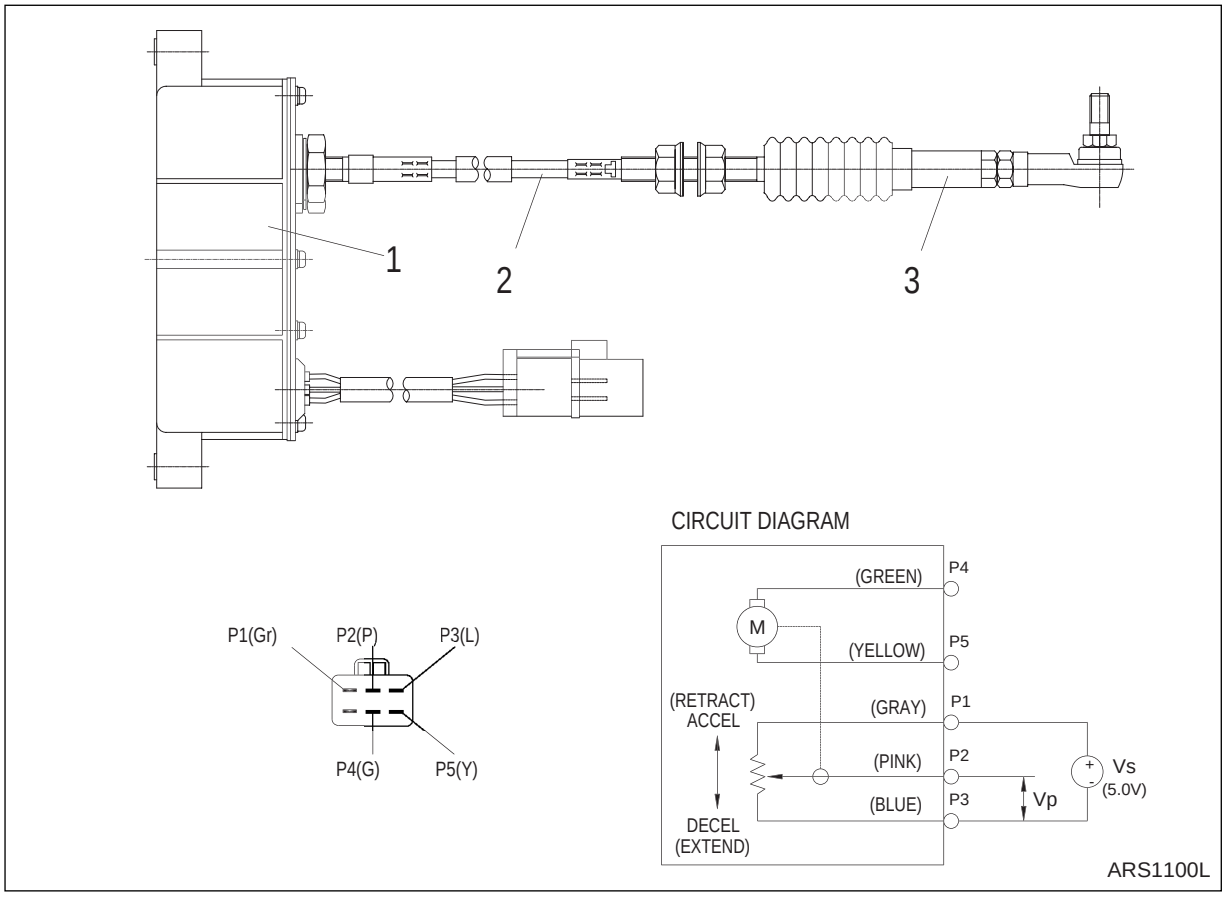


Figure 53

Reference Number	Description
1	Motor Assembly
2	Cable
3	Spring Assembly

The engine control motor uses a D.C. motor with a built in potentiometer to sense the position of the control cable. If an abnormal load (worn or kinked control cable) is sensed in the control motor, the engine controller cuts off the electric current flowing to the engine control motor to protect the system. In such a case, the engine control motor will not operate even though the engine control dial is moved.

The starter switch should be turned off and the cause of abnormal load should be repaired and the starter switch can be turned on again. The engine control dial can once again be used to control the engine speed.

IMPORTANT

When the engine control motor has been replaced or repaired refer to Adjusting the Engine Control Device for correct adjustment of the engine control system. The engine will not perform to its maximum efficiency if it is not adjusted properly.

ENGINE CONTROL DIAL

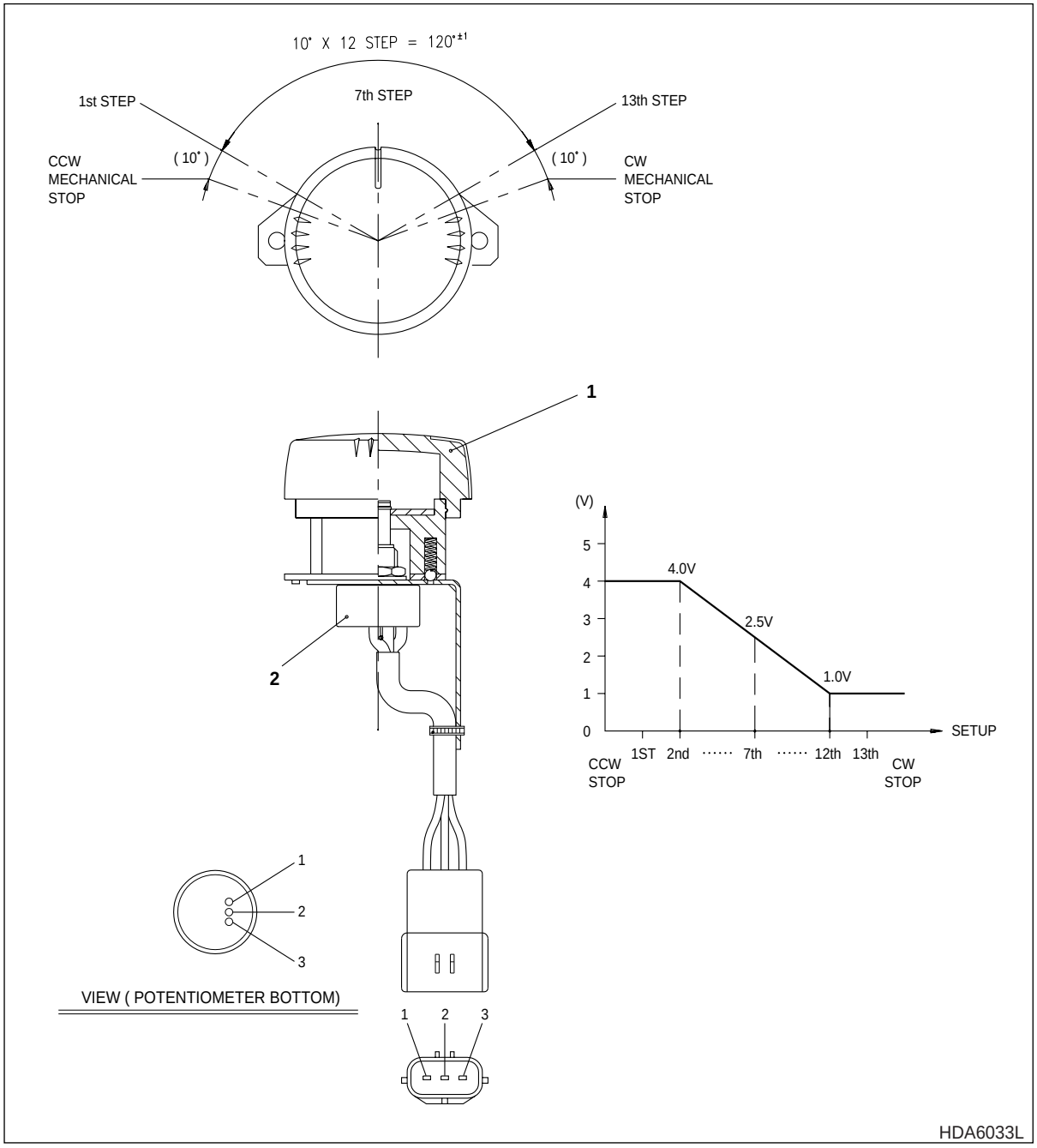


Figure 54

Reference Number	Description
1	Knob
2	Potentiometer (Variable Resistor)

The engine control dial has a built in potentiometer. When the control knob is moved the output voltage (through terminals 2 and 3) will vary from the 5 V supplied from the throttle controller as shown in the graph.

ENGINE CONTROL CIRCUIT DIAGRAM

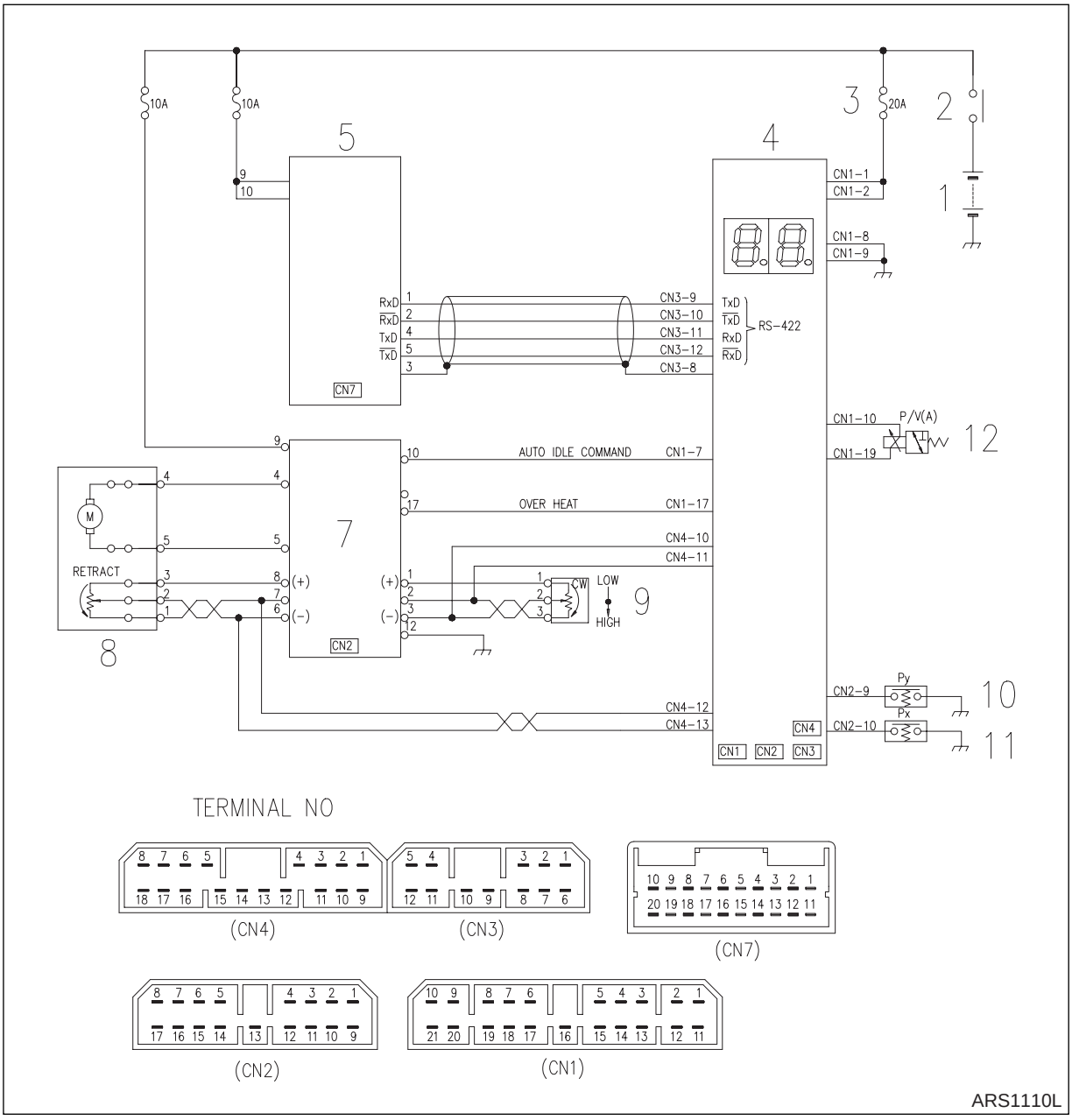


Figure 55

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	e-EPOS 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)

AUTOMATIC DECELERATION CONTROL (AUTO IDLE CONTROL)

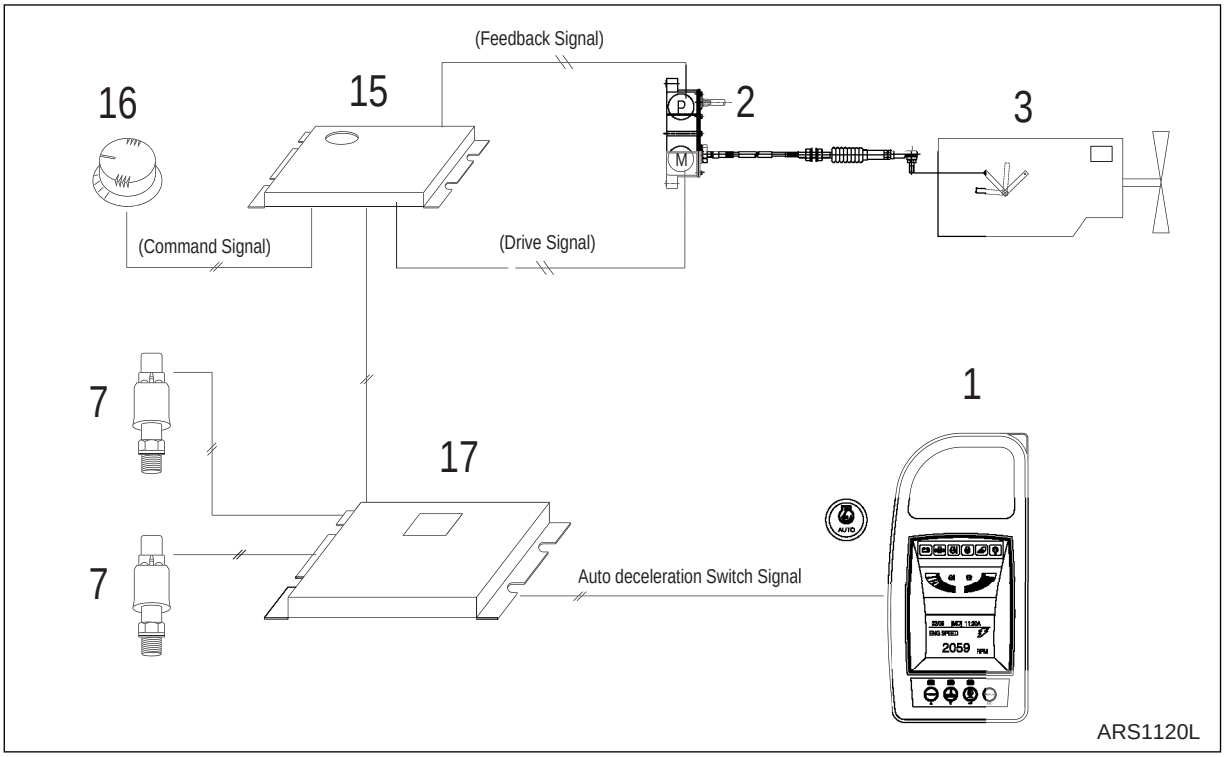


Figure 56

Reference Number	Description
1	Instrument Panel
2	Engine Control Motor
3	Engine
7	Pressure Switch

Reference Number	Description
15	Engine Throttle Controller
16	Engine Control Dial
17	e-EPOS Controller

If the machine is idling without the controls being operated or is waiting for a dump truck the engine speed is automatically lowered. Once the controls are operated and work is being started the machine will be restored to the previous settings. As a result, noise and fuel consumption will be reduced. This function can be selected or cancelled through the Auto Idle Select Switch on the instrument panel.

The initial setting at start-up is with this switch in the select position. Approximately 4 seconds after this function is selected, if all work levers are in the neutral position, the e-EPOS controller sends an automatic reduction signal to the throttle controller. When the engine throttle controller receives this signal, it is compared with the signal set by the engine control dial. The lower of the two signals is selected and the engine control motor is adjusted to this engine speed.

The neutral status of the machine is detected by the two pressure switches in the control valve. When the work levers are in the neutral position, the switch is in the off position.

ENGINE OVERHEAT PROTECTION SYSTEM

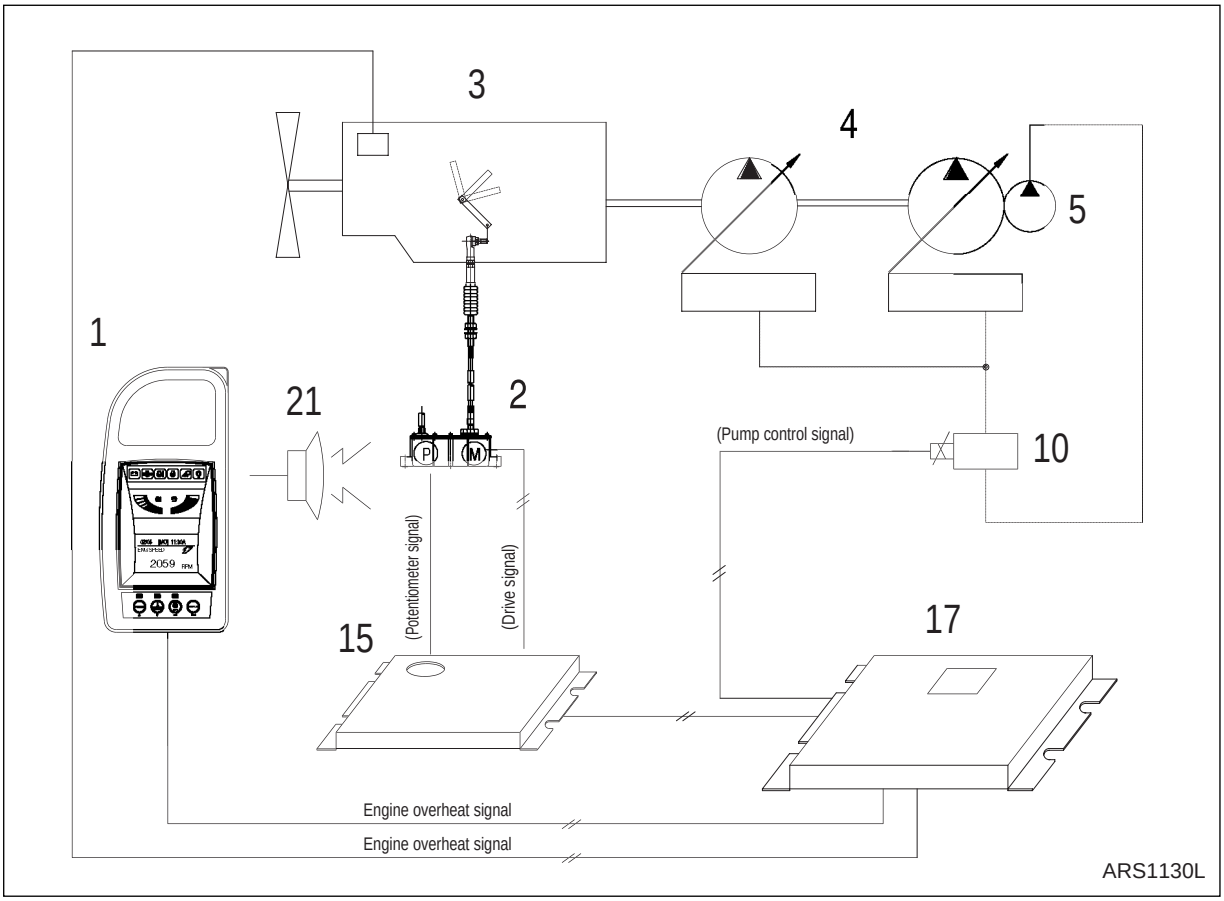


Figure 57

Reference Number	Description
1	Instrument Panel
2	Engine Control Motor
3	Engine
4	Main Pump
5	Control Pump

Reference Number	Description
10	E.P.P.R. Valve
15	Engine Throttle Controller
17	e-EPOS Controller
21	Warning Buzzer

When the engine coolant temperature increases to over 107°C (225˚F), the sensor mounted in the coolant line will send a signal to the instrument panel. A overheat signal is also sent to the e-EPOS controller and the overheat warning buzzer will sound. The e-EPOS controller will send a signal to the engine throttle controller and the engine speed is adjusted to standard mode. The engine throttle controller will signal the engine control motor to decrease the engine speed.

When the coolant is overheated, the warning buzzer will sound, standard mode is selected and low engine speed will be selected.

When the coolant temperature falls below 95°C (203˚F), normal operation will resume.

POWER BOOST MODE

OPERATION

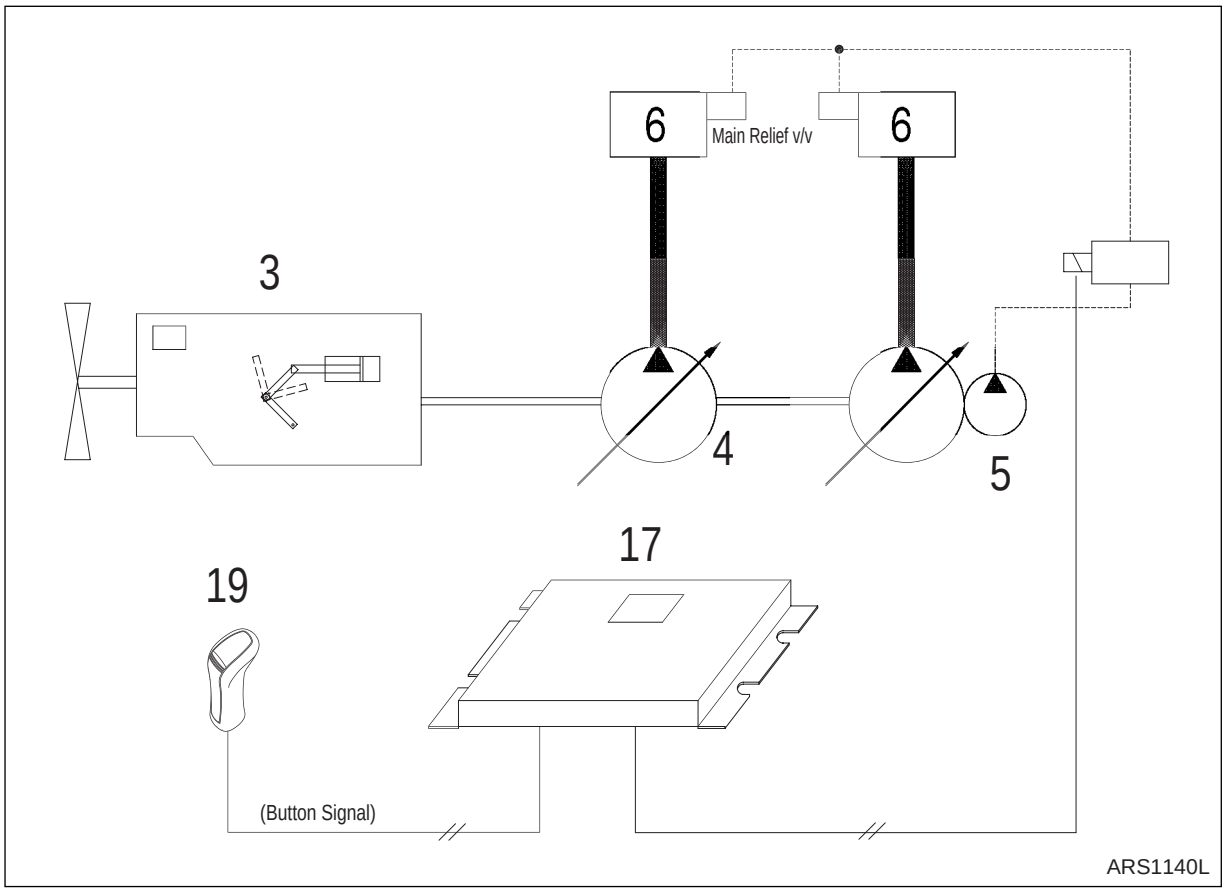


Figure 58

Reference Number	Description
3	Engine
4	Main Pump
5	Control Pump
6	Control Valve

Reference Number	Description
11	Solenoid Valve
17	e-EPOS Controller
19	Power Boost Switch (Top of Right Work Lever)

The Power Boost function is used to temporarily increase the main relief pressure to enhance excavation ability. When the switch button on top of the right work lever is pressed during work, the e-EPOS controller will activate the power boost solenoid valve and increase the relief valve pressure from 330 - 350 kg/cm^2 (4,700 - 5,000 psi). The excavation ability is increased by approximately 6%.

NOTE: *Do not use this switch for more than 10 seconds.*

POWER BOOST CONTROL - CIRCUIT DIAGRAM

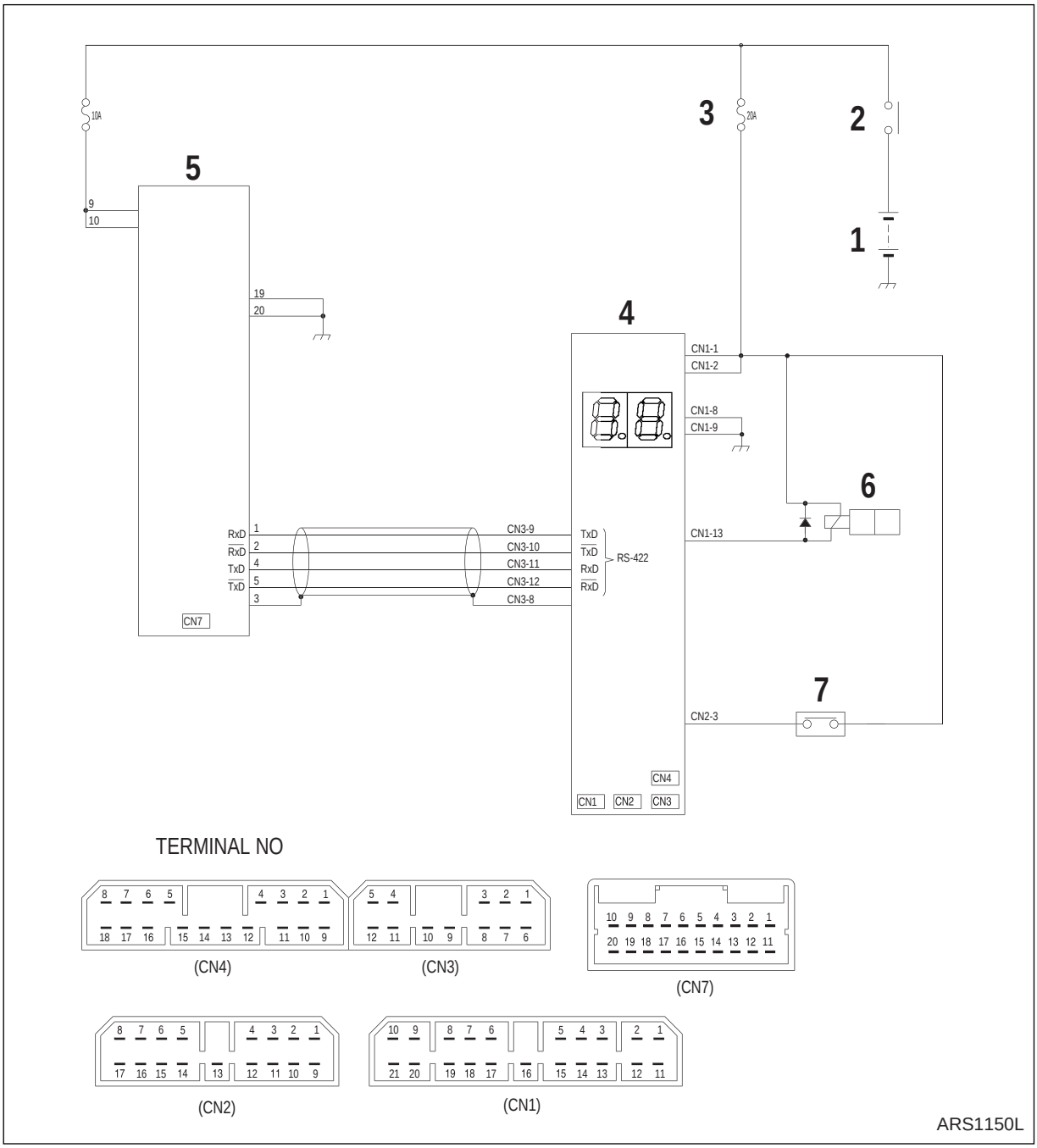


Figure 59

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	e-EPOS Controller

Reference Number	Description
5	Instrument Panel
6	Solenoid Valve (Pressure Up)
7	Power Boost Switch (Top of Right Work Lever)

AUTOMATIC TRAVEL SPEED CONTROL

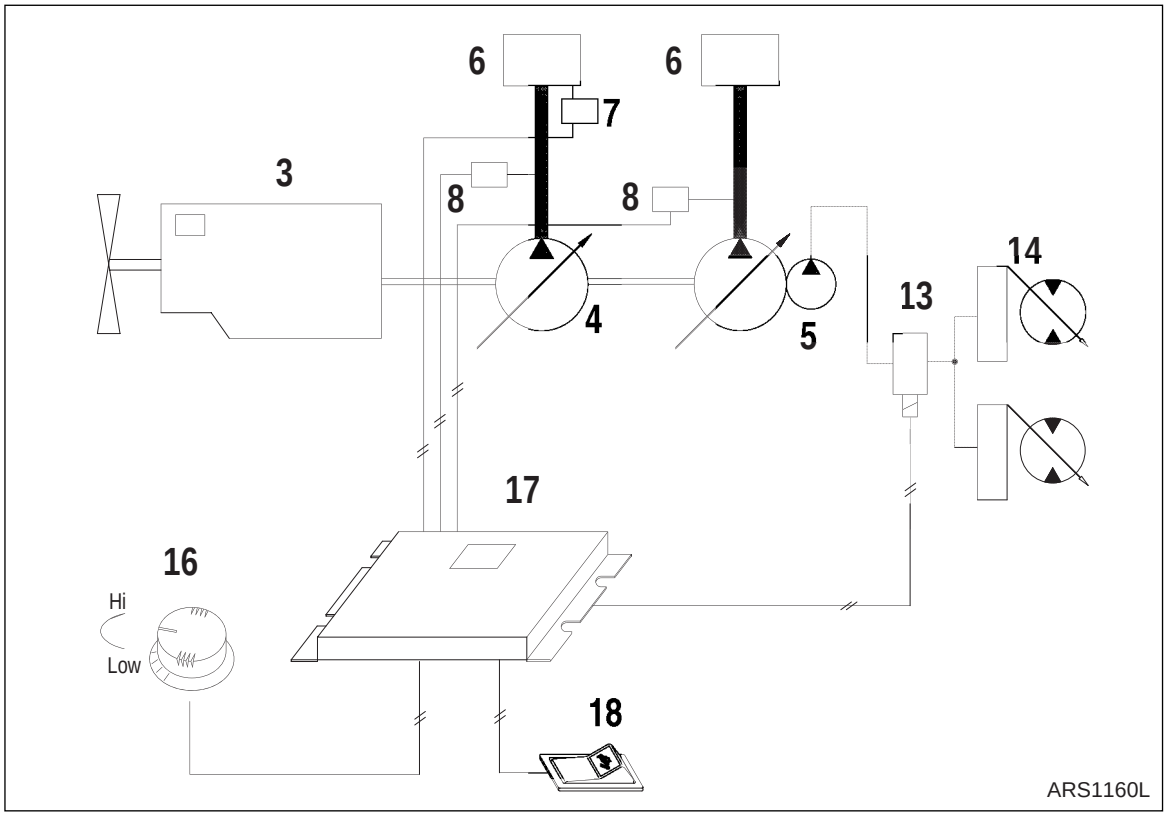


Figure 60

Reference Number	Description
3	Engine
4	Main Pump
6	Control Valve
7	Pressure Switch (Py)
8	Pump Pressure Sensor

Reference Number	Description
13	Solenoid Valve (High speed)
14	Travel Motor
16	Engine Control Dial
17	e-EPOS Controller
20	Selection Switch For Automatic Travel

If the automatic travel speed control switch is set to the "OFF" position, the travel motor will run in the I-speed (low speed) range. If the selection switch is set to the "I" position, the travel motor will run in the II-speed (high speed) range. If the selection switch is set to the "II" position, the e-EPOS controller will monitor the main pump discharge pressure and automatically select the "ON" - "OFF" status of the II - speed travel solenoid valve based on the travel load. The travel speed is changed between the I-speed and the II-speed mode.

The travel load is monitored by the two pressure sensors in the discharge lines of the front (upper) and rear (lower) pumps. When the travel load is high (pressure over 300 kg/cm^2 (4,300 psi) the solenoid valve is turned "OFF" and I-speed (low) is selected. In the case when the travel load is low (pressure under 160 kg/cm^2 (2,280 psi), the solenoid valve will be turned "ON" and the II-speed will be selected. But, if the engine speed control switch dial is set below approximately 1400 rpm, the travel speed will be set to I-speed mode.

AUTOMATIC TRAVEL SPEED CONTROL - CIRCUIT DIAGRAM

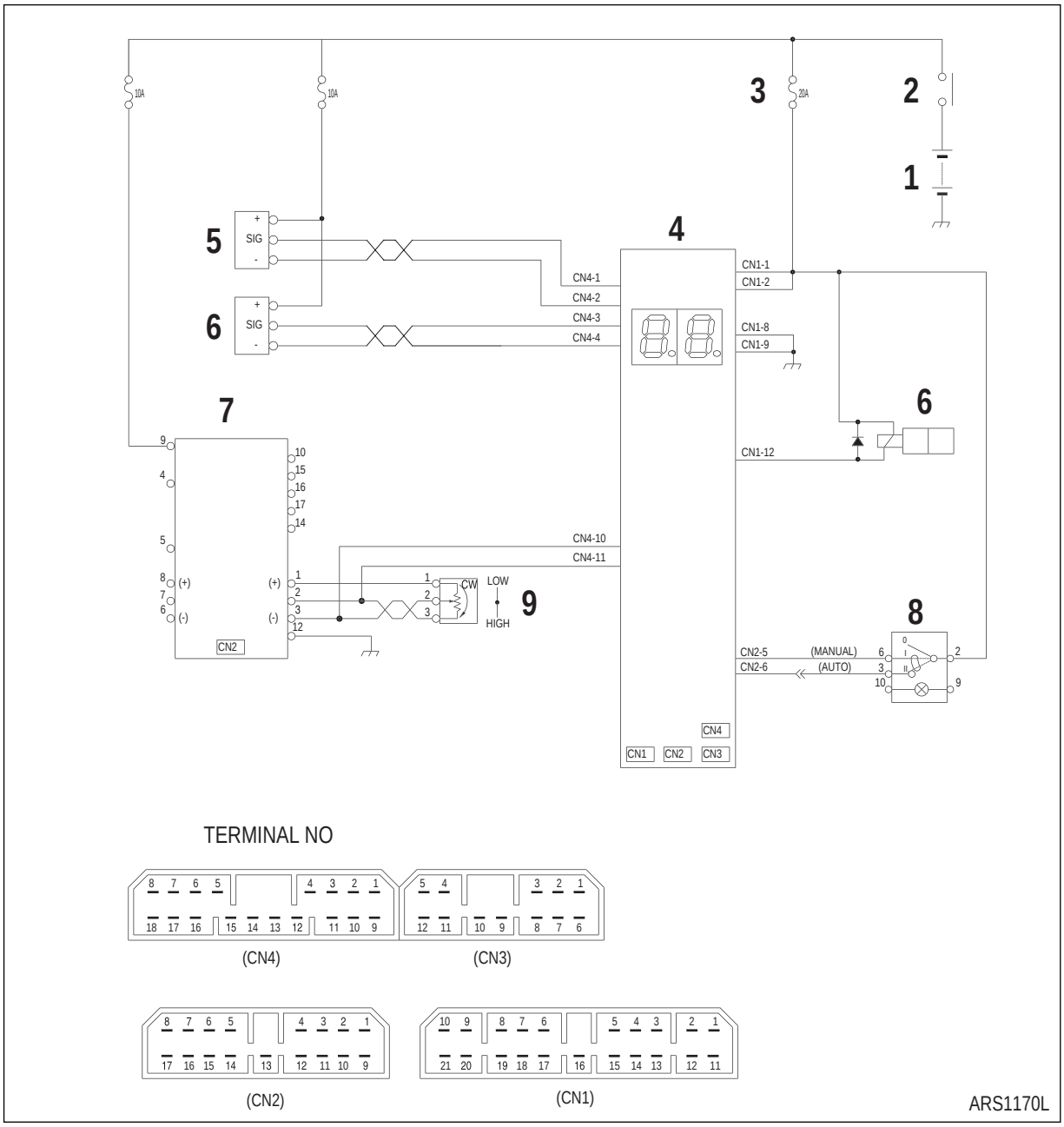


Figure 61

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	e-EPOS Controller
5	Pressure Sensor (Front Pump)

Reference Number	Description
6	Pressure Sensor (Rear Pump)
7	Engine Throttle Controller
8	Automatic Travel Select Switch
9	Engine Control Dial
10	Solenoid Valve (High Speed)

ENGINE CONTROL DEVICE - ADJUSTMENT

Engine speed adjustment should be made by following the procedures listed below. (Under no load conditions)

1. Adjusting The High Idle Speed

1. Turn the starter switch to the "ON" position. Select Power Mode from the instrument panel. Turn the Engine Speed Control dial to the "MAX" position to reduce the (3) motor cable to the shortest length.
2. Adjust the (3) motor cable linked with the (2) bracket so that the engine governor lever touches the maximum position of the stopper.

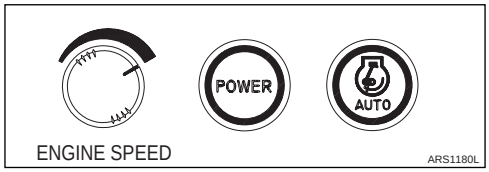
2. Adjusting The Low Idle Speed

1. Turn the engine speed control dial to the "MIN" position so that the (3) motor cable is extended to the maximum length. (The maximum stroke range for the lever and cable is 37.0 mm (1.46 in).)
2. Check that the engine governor is at the minimum stopper position and the cable slack is acceptable.
3. A. If the lever is not in the minimum position and touching the stopper, move the (3) cable to one hole lower on the lever. If the cable slack is excessive, move the (3) cable to one hole above the original hole on the lever. Repeat above steps 1 and 2.

   B. Shorten the (3) motor cable 1 - 1.25 mm (0.0394 - 0.0591 in) by turning the cable adjustment nut for motor cable (3), 2/3 - 1 turn in the high idle position.

3. Adjusting The Automatic Deceleration System and Power Mode (First perform Adjustments 1 and 2 before performing this adjustment.)

1. Set the following switches to the "ON" position as shown in the following table. Adjust the engine speed by slowly turning the variable resister screw. (VR1)

Mode	Variable Resistor	Dial Position and Mode Setting	Engine Speed Setting
Automatic Deceleration (Auto Idle)	VR1		S300LC-V - 1400 ±50 rpm S300LL - 1400 ±50 rpm S340LC-V - 1200 ±50 rpm S420LC-V - 1200 ±50 rpm S470LC-V - 1200 ±50 rpm

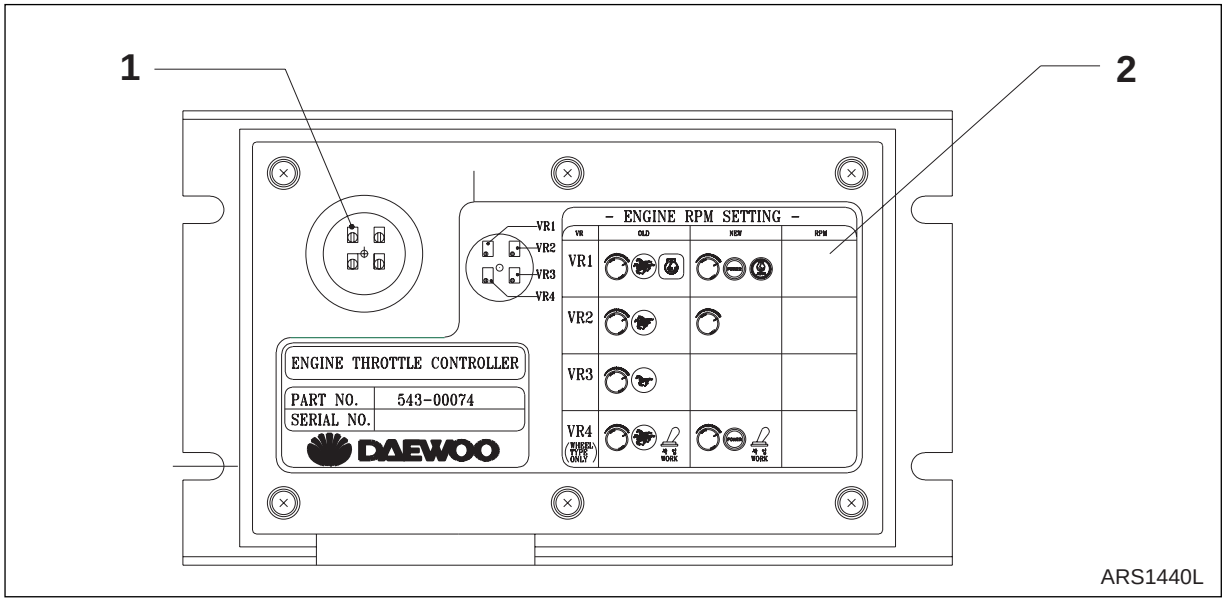


Figure 63

Reference Number	Description
1	VR1 (Automatic Deceleration Adjusting Variable Resister)
2	Name Plate

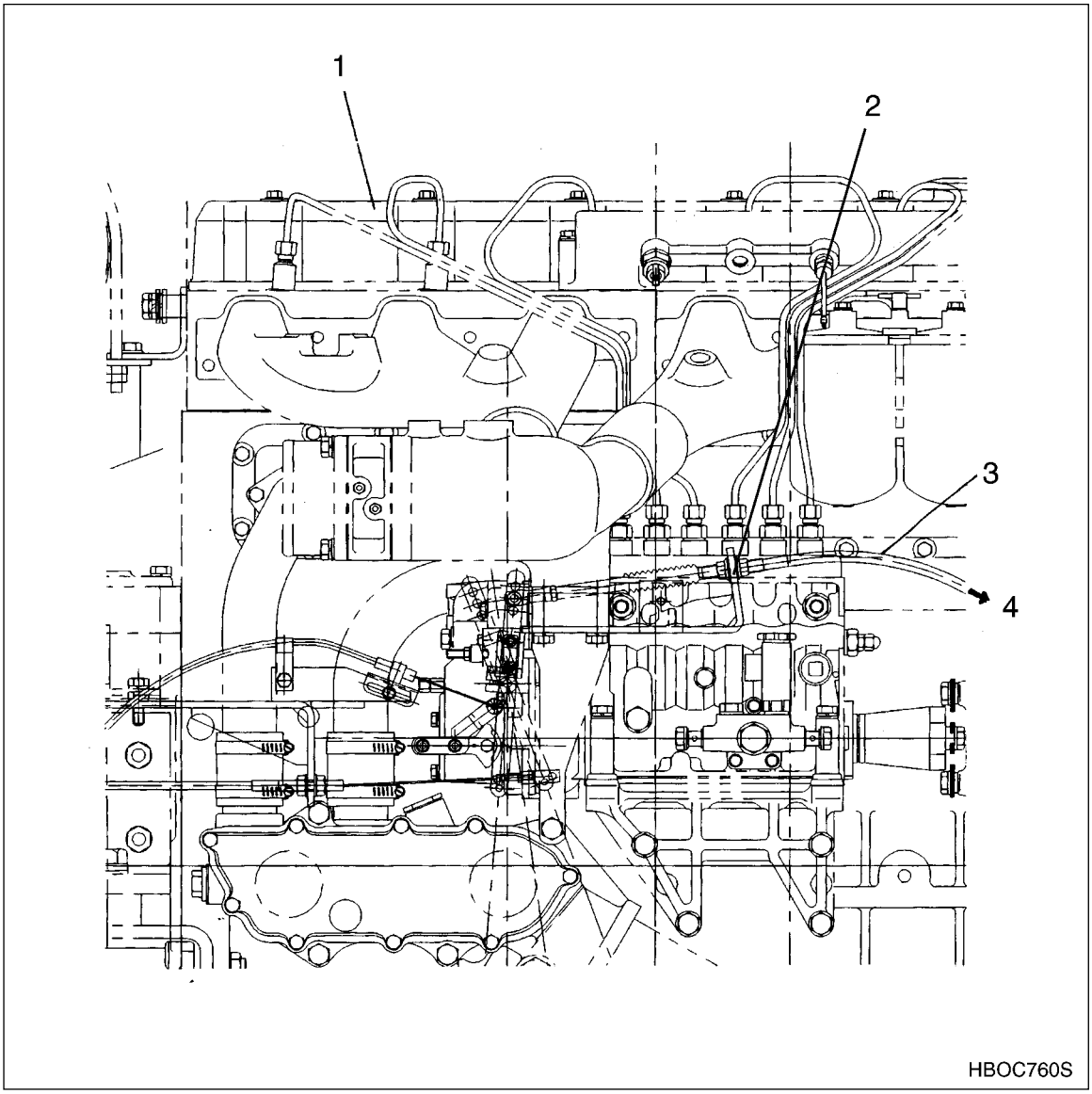


Figure 64

Reference Number	Description
1	Engine - Fuel Control Lever Area
2	Control Motor Cable Bracket

Reference Number	Description
3	Engine Speed Control Cable
4	To Engine Control Motor

SELF-DIAGNOSTIC FUNCTION

E-EPOS CONTROLLER

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

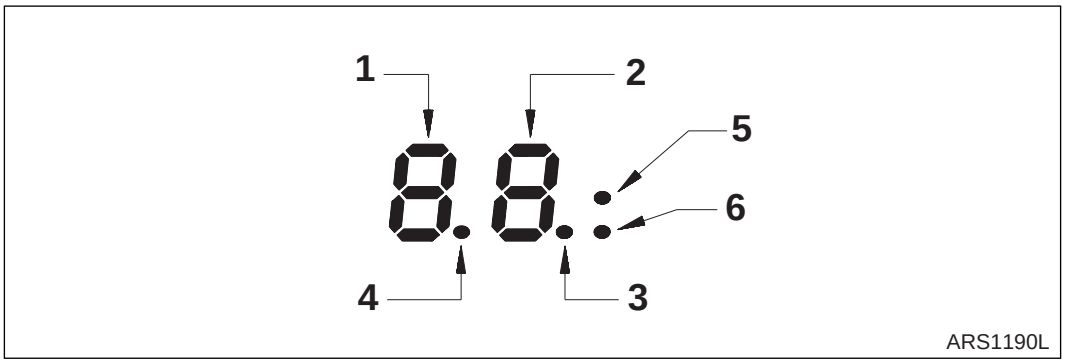


Figure 65

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,)
5	Communication Monitor LED (Flash when normal condition)
6	

1. Power Monitor

This LED is turned off when the input voltage to the e-EPOS 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.

3. Communication Monitor

These LED lamps flash when normal state of communication between main controller and instrument panel.

4. Normal Operation Display Readout

Mode Selection		Display Readout		Operation Status
		Upper Digit	Lower Digit	
Power Mode	Power Mode	 HAOH340L		Normal Operation Power Mode
	Standard Mode	 HAOH350L		Normal Operation Standard Mode
Work Mode	Digging		 HAOH370L	Normal Operation Digging Mode
	Trenching		 HAOH380L	Normal Operation Trenching Mode

5. Malfunction Display and Reset Procedure

The malfunction codes displayed on the top of the e-EPOS controller and reset procedure are the same with failure information codes a part of failure information.

Refer to the failure information part of letter information display for details.

ENGINE THROTTLE CONTROLLER

Under the rubber cap on the surface of the engine controller, there are three LEDs. Based on the equipment status the following LEDs will turn "ON."

Throttle Controller Input Signal	Status	LED Status			Voltage At Control Motor Terminal
		Red	Green	Yellow	
Dial Voltage < Motor Potentiometer Voltage	While Control Motor Is Operating (Increasing rpm)	**X**	Δ	**O**	Approximately +24 V
Dial Voltage > Motor Potentiometer Voltage	While Control Motor Is Operating (Decreasing rpm)	Δ	**X**	**O**	Approximately -24 V
Dial Voltage = Motor Potentiometer Voltage	Control Motor Stopped	**O**	**O**	**O**	0 V
	Motor Overload (Cut Off Motor Current)	**X**	**X**	**O**	0 V
	Abnormal Controller Power Voltage (Low Or No Input)	**X**	**X**	**X**	0 V

Δ	O	X
Brightly Lit	**ON**	**OFF**

NOTE:

1. *Control Motor Voltage is Measured at throttle controller 4 (+) and 5 (-) terminals.*
2. *Yellow LED indicates power status (ON, OFF).*
3. *To protect the control motor from overloads, the control motor automatically cuts off supply voltage to the motor when there is a heavy load on the motor and the possibility of motor damage or burn out exists.*
4. *After the malfunction is corrected, turn the starter switch from "OFF" to the "ON" position and normal operation will resume.*

WIPER SYSTEM

WIPER CIRCUIT

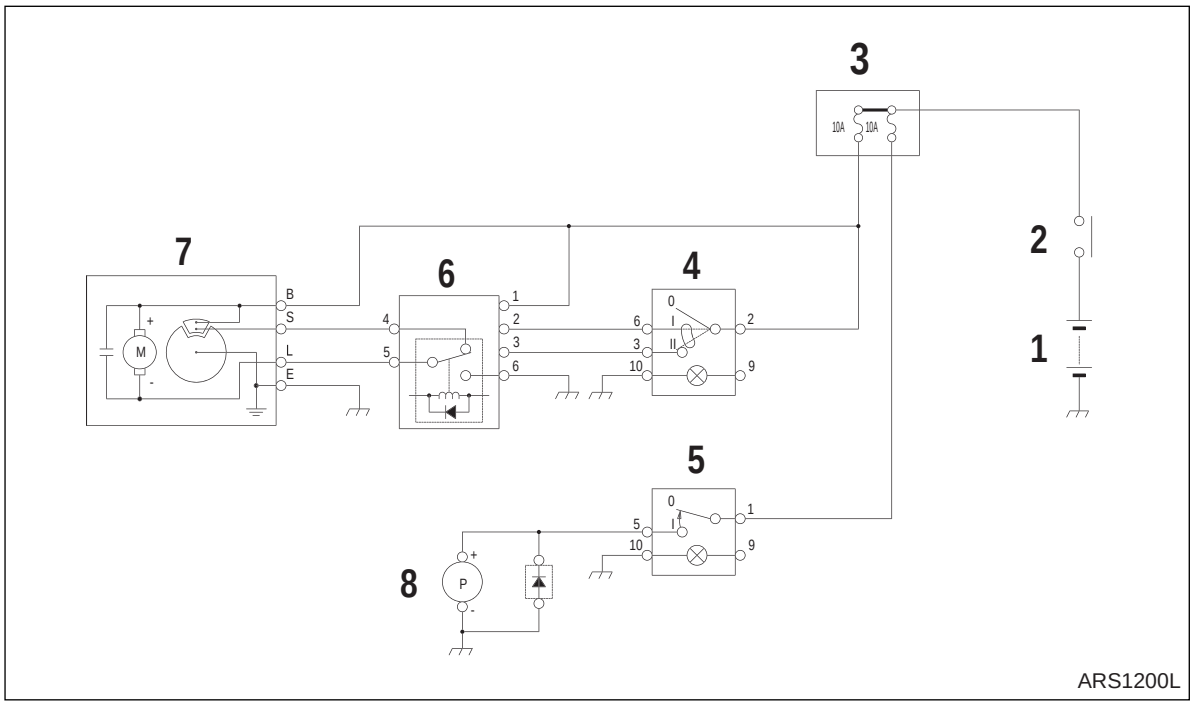


Figure 66

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	Wiper Switch

Reference Number	Description
5	Washer Switch
6	Wiper Timer
7	Wiper Motor
8	Window Washer

WIPER OPERATION

Intermittent Operation (I - position)

When the wiper switch (4) is turned "I" position, the current flows from the fuse (3) → "B" terminal of wiper motor (7) → "L" terminal of wiper motor (7) → "5" terminal of wiper timer (6) → "6" terminal of wiper timer (6) → ground and the wiper motor operates intermittently by the timer built in wiper timer. (On: approximately 1 second, Off: approximately 5 seconds)

Continuous Operation (II - Position)

When the wiper switch (4) is turned "I" position, the current flows from the fuse (3) → "B" terminal of wiper motor (7) → "L" terminal of wiper motor (7) → No. 5 terminal of wiper timer (6) → No. 6 terminal of wiper timer (6) → ground and the contact points No. 5 and No. 6 of wiper timer (6) are connected continuously, the wiper motor operates continuously.

When the wiper switch (4) is turned "OFF," the current flows from the fuse (3) → "B" terminal of wiper motor (7) → "L" terminal of wiper motor (7) → No. 5 terminal of wiper timer (6) → No. 4 terminal of wiper timer (6) → "S" terminal of wiper motor (7) → "B" terminal of wiper motor (7) and the wiper motor is stopped at the auto stop position.

WINDOW WASHER OPERATION

When the window washer switch is turned "ON," the current flows from the fuse (3) → No. 1 terminal of washer switch (5) → No. 5 terminal of washer switch (5) → "+" terminal of window washer (8) → ground and windshield washer fluid is sprayed.

LIGHTING SYSTEM

LIGHTING SYSTEM CIRCUIT DIAGRAM

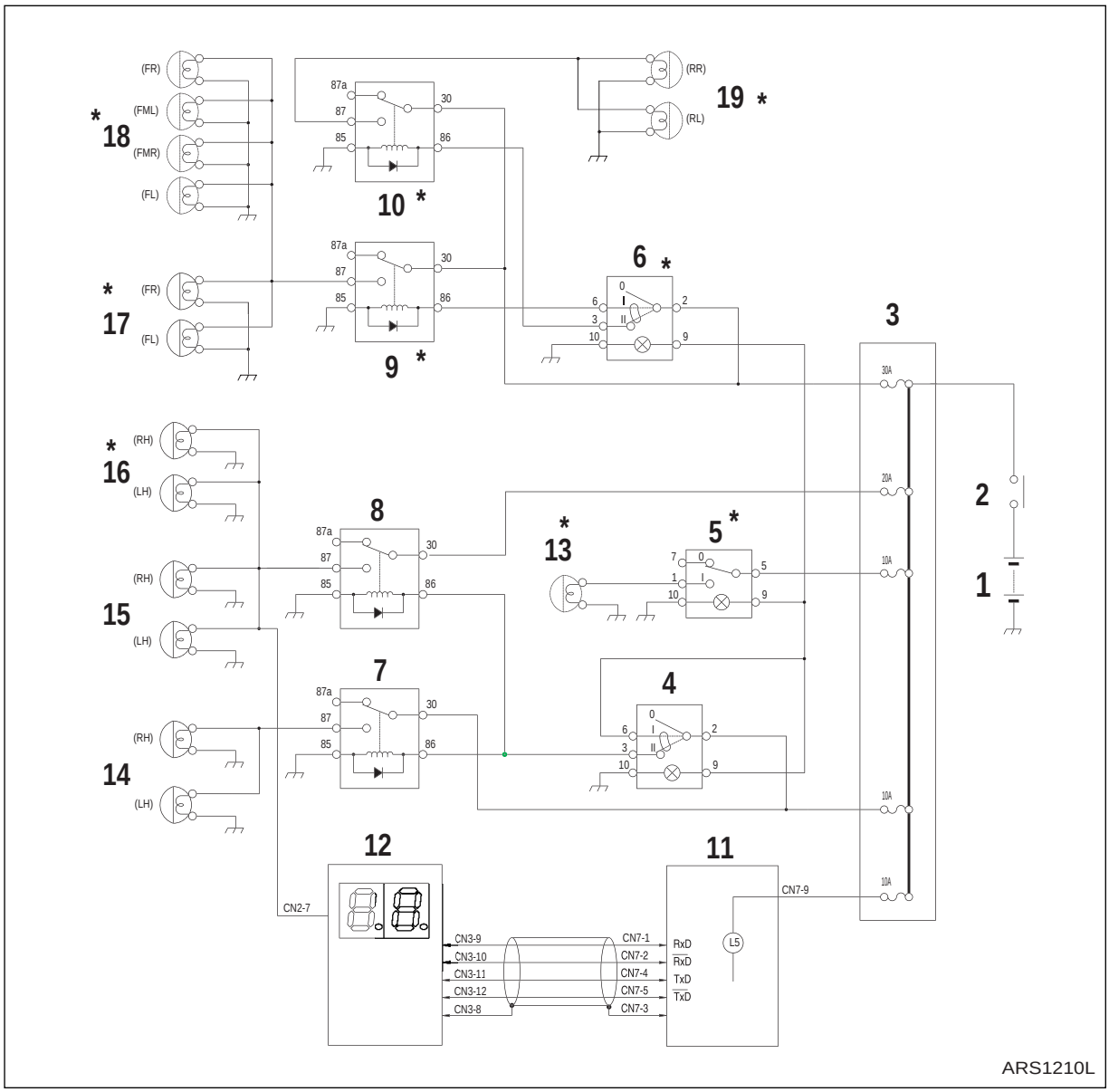


Figure 67

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse Box
4	Light Switch
*5	Warning Light Switch
6	Cabin Light Switch
7	Headlight Relay (Work Light Indicate Light)
8	Work Light Relay
*9	Front Cabin Light Relay

Reference Number	Description
*10	Rear Cabin Light Relay
11	Instrument Panel
12	e-EPOS Controller
*13	Rotating Warning Light
14	Headlight (2 ea.)
15	Work Light (2 ea.)
*16	Additional Work Light (2 ea.)
*17	Front Cabin Light (2 ea.)
*18	Front Cabin Light (4 ea.)
*19	Rear Cabin Light (2 ea.)

NOTE: *The "*" mark (5, 9, 10, 13, 16, 17, 18, 19) are optional parts.*

KIND OF LIGHT

The lighting system is consists of headlights, work lights, cabin lights (optional), rotating warning light (optional), relays and switches.

OPERATION

Switch	Position	Connected Terminal of switch	Activated Relay	Lit Light
Light Switch	1	2-6 Terminal	-	Illumination Light of Switch
	2	2-6 Terminal	-	Illumination Light of Switch
		2-3 Terminal	Headlight Relay	Headlight (2 Ea.)
			Work Relay	Work Light (2 Ea.), Additional Work Light (2 Ea.) Indicator Light of Work Light (L5)
Cabin Light Switch	1	2-6 Terminal	Front Cabin Light Relay	Front Cabin Light (2 Ea.) or Front Cabin Light (4 Ea.)
	2	2-6 Terminal	Front Cabin Light Relay	Front Cabin Light (2 Ea.) or Front Cabin Light (4 Ea.)
		2-3 Terminal	Rear Cabin Light Relay	Rear Cabin Light (2 Ea.)
Warning Light Switch	-	5-1 Terminal	-	Rotating Warning Light

OVERLOAD WARNING DEVICE

OVERLOAD WARNING DEVICE CIRCUIT DIAGRAM

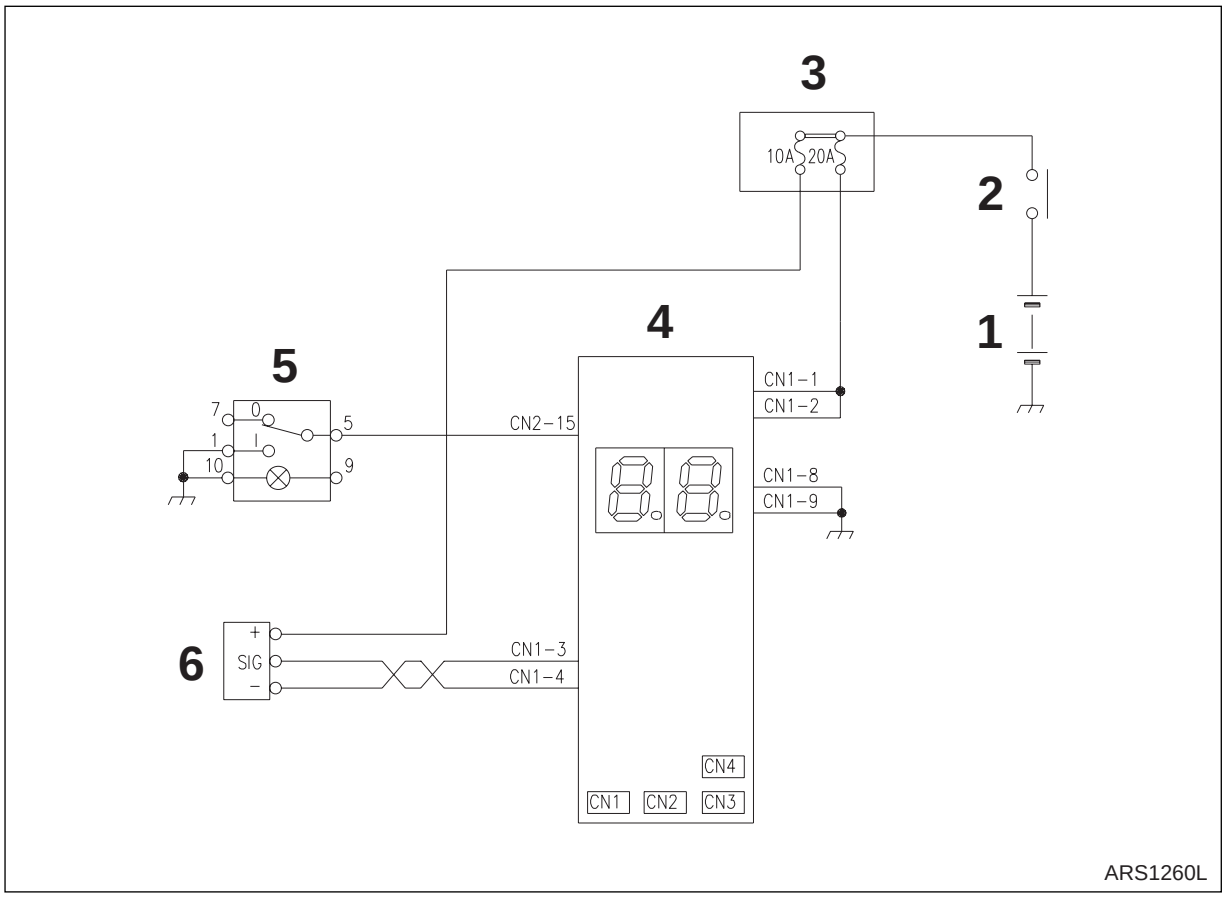


Figure 68

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse Box

Reference Number	Description
4	e-EPOS Controller
5	OWD Select Switch
6	Pressure Sensor

S0892160K

ELECTRICAL SCHEMATIC (S300LC-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 300LC-V	1001 and Up

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December 2001

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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.

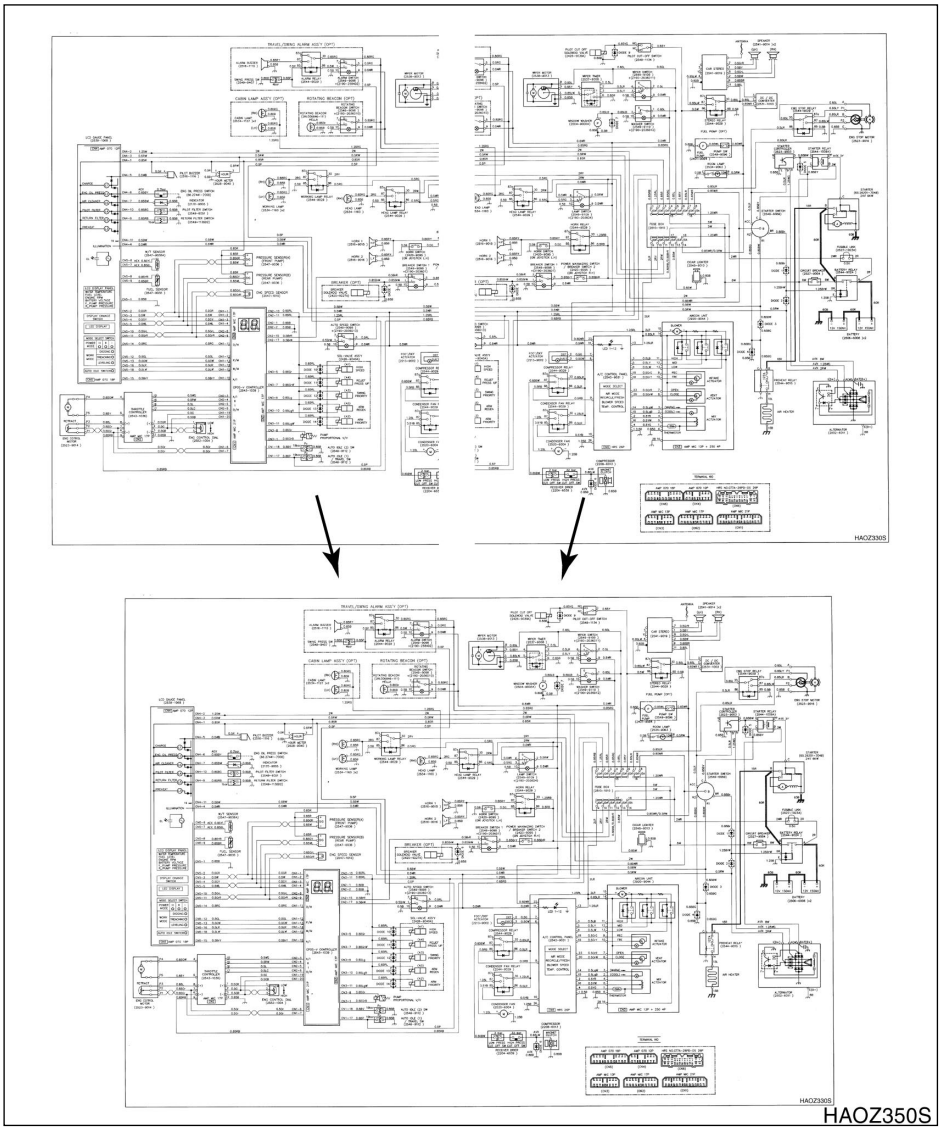


Figure 1

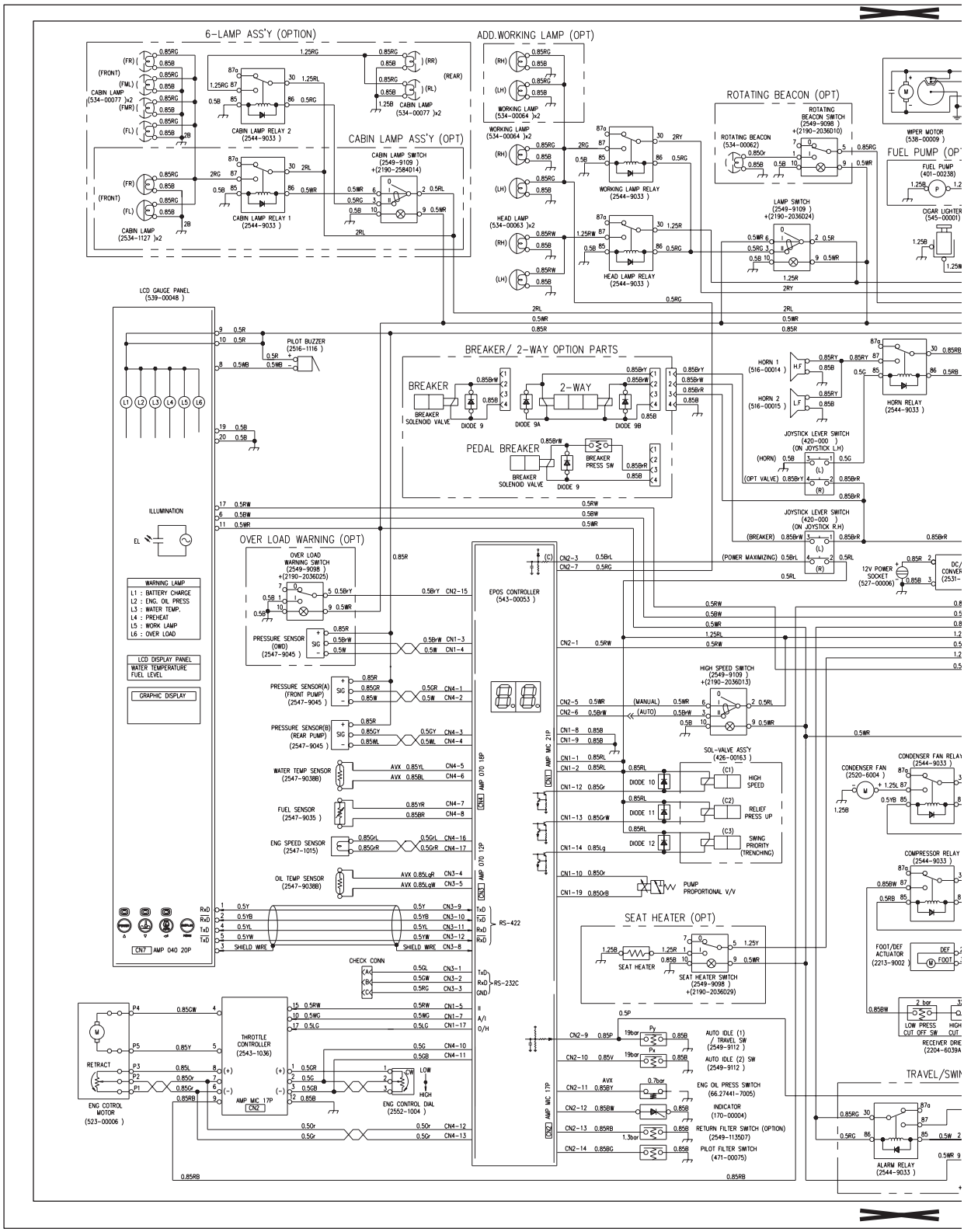
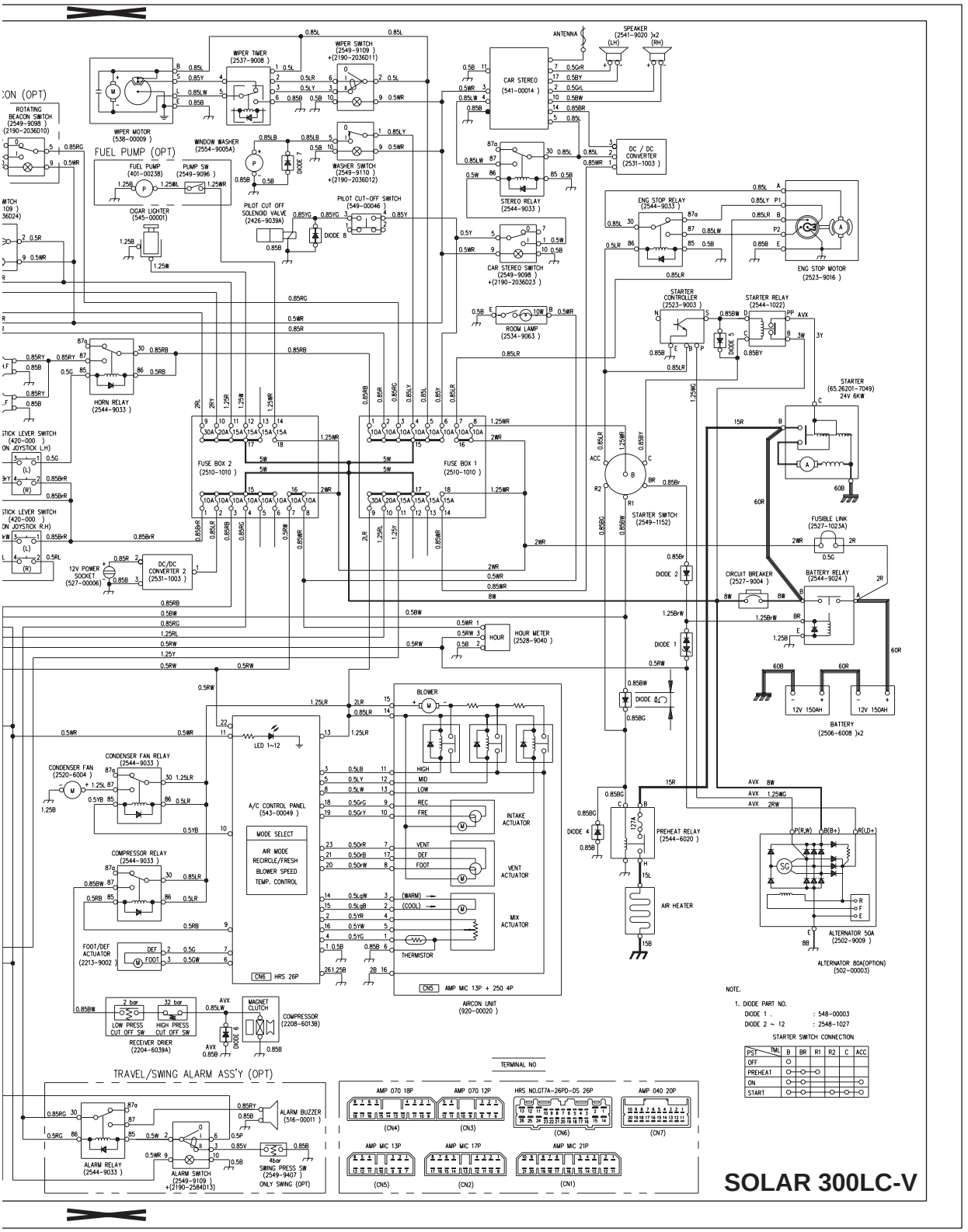

6-LAMP ASS'Y (OPTION)
ADD.WORKING LAMP (OPT)
ROTATING BEACON (OPT)
CABIN LAMP ASS'Y (OPT)
BREAKER/ 2-WAY OPTION PARTS
OVER LOAD WARNING (OPT)
SEAT HEATER (OPT)
LCD GAUGE PANEL (539-00048)
EPOS CONTROLLER (543-00053)
THROTTLE CONTROLLER (2543-1036)
ENG CONTROL MOTOR (523-00006)
ENG CONTROL DIAL (2552-1004)
WIPER MOTOR (538-00009)
FUEL PUMP (OPT
HORN RELAY (2544-9033)
WORKING LAMP RELAY (2544-9033)
HEAD LAMP RELAY (2544-9033)
CABIN LAMP RELAY 1 (2544-9033)
CABIN LAMP RELAY 2 (2544-9033)
ALARM RELAY (2544-9033)
CONDENSER FAN RELAY (2544-9033)
COMPRESSOR RELAY (2544-9033)
SOL-VALVE ASSY (426-00163)
SEAT HEATER SWITCH (2549-9098) +(2190-2036029)
HIGH SPEED SWITCH (2549-9109) +(2190-2036013)
ROTATING BEACON SWITCH (2549-9098) +(2190-2036010)
LAMP SWITCH (2549-9109) +(2190-2036024)
CABIN LAMP SWITCH (2549-9109) +(2190-2584014)
OVER LOAD WARNING SWITCH (2549-9098) +(2190-2036025)
PRESSURE SENSOR (OWD) (2547-9045)
PRESSURE SENSOR(A) (FRONT PUMP) (2547-9045)
PRESSURE SENSOR(B) (REAR PUMP) (2547-9045)
WATER TEMP SENSOR (2547-9038B)
FUEL SENSOR (2547-9035)
ENG SPEED SENSOR (2547-1015)
OIL TEMP SENSOR (2547-9038B)
PILOT BUZZER (2516-1116)
ILLUMINATION
WARNING LAMP
L1 : BATTERY CHARGE
L2 : ENG. OIL PRESS
L3 : WATER TEMP.
L4 : PREHEAT
L5 : WORK LAMP
L6 : OVER LOAD
LCD DISPLAY PANEL
WATER TEMPERATURE
FUEL LEVEL
GRAPHIC DISPLAY
CN7 AMP 040 20P
CHECK CONN
RS-422
RS-232C
AMP MIC 17P
AMP DTO 18P
AMP DTO 12P
AMP MIC 21P
BREAKER
BREAKER SOLENOID VALVE
DIODE 9
DIODE 9A
DIODE 9B
2-WAY
PEDAL BREAKER
BREAKER PRESS SW
HORN 1 (516-00014)
HORN 2 (516-00015)
JOYSTICK LEVER SWITCH (420-000) (ON JOYSTICK L.H)
JOYSTICK LEVER SWITCH (420-000) (ON JOYSTICK R.H)
12V POWER SOCKET (527-00006)
CIGAR LIGHTER (545-00001)
FUEL PUMP (401-00238)
ROTATING BEACON (534-00062)
WORKING LAMP (534-00064)x2
HEAD LAMP (534-00063)x2
CABIN LAMP (534-00077)x2
CABIN LAMP (534-1127)x2
HIGH SPEED
RELIEF PRESS UP
SWING PRIORITY (TRENCHING)
PUMP PROPORTIONAL V/V
AUTO IDLE (1) / TRAVEL SW (2549-9112)
AUTO IDLE (2) SW (2549-9112)
ENG OIL PRESS SWITCH (66.27441-7005)
INDICATOR (170-00004)
RETURN FILTER SWITCH (OPTION) (2549-113507)
PILOT FILTER SWITCH (471-00075)
SEAT HEATER
FOOT/DEF ACTUATOR (2213-9002)
CONDENSER FAN (2520-6004)
RECEIVER DRIE (2204-6039A
LOW PRESS CUT OFF SW
TRAVEL/SWIN

Figure 2


SOLAR 300LC-V
CAR STEREO (541-00014)
ANTENNA
SPEAKER (2541-9020)x2 (LH) (RH)
WIPER TIMER (2537-9008)
WIPER SWITCH (2549-9109) +(2190-2036D11)
WIPER MOTOR (538-00009)
WINDOW WASHER (2554-9005A)
WASHER SWITCH (2549-9110) +(2190-2036D12)
FUEL PUMP (OPT)
FUEL PUMP (401-00238)
PUMP SW (2549-9096)
CIGAR LIGHTER (545-00001)
PILOT CUT OFF SOLENOID VALVE (2426-9039A)
PILOT CUT-OFF SWITCH (549-00046)
DIODE B
DIODE 7
DC / DC CONVERTER (2531-1003)
STEREO RELAY (2544-9033)
CAR STEREO SWITCH (2549-9098) +(2190-2036D23)
ROOM LAMP (2534-9063)
ENG STOP RELAY (2544-9033)
ENG STOP MOTOR (2523-9016)
STARTER CONTROLLER (2523-9003)
STARTER RELAY (2544-1022)
STARTER (65.26201-7049) 24V 6KW
STARTER SWITCH (2549-1152)
FUSIBLE LINK (2527-1023A)
CIRCUIT BREAKER (2527-9004)
BATTERY RELAY (2544-9024)
BATTERY (2506-6008)x2
12V 150AH
DIODE 2
DIODE 1
DIODE 3
DIODE 4
DIODE 5
HORN RELAY (2544-9033)
FUSE BOX 2 (2510-1010)
FUSE BOX 1 (2510-1010)
HOUR METER (2528-9040)
12V POWER SOCKET (527-00006)
DC/DC CONVERTER 2 (2531-1003)
BLOWER
LED 1~12
A/C CONTROL PANEL (543-00049)
MODE SELECT
AIR MODE
RECIRCLE/FRESH
BLOWER SPEED
TEMP. CONTROL
CN6 HRS 26P
CN5 AMP MIC 13P + 250 4P
AIRCON UNIT (920-00020)
INTAKE ACTUATOR
VENT ACTUATOR
MIX ACTUATOR
THERMISTOR
CONDENSER FAN (2520-6004)
CONDENSER FAN RELAY (2544-9033)
COMPRESSOR RELAY (2544-9033)
FOOT/DEF ACTUATOR (2213-9002)
COMPRESSOR (2208-6013B)
MAGNET CLUTCH
LOW PRESS CUT OFF SW
HIGH PRESS CUT OFF SW
RECEIVER DRIER (2204-6039A)
PREHEAT RELAY (2544-6020)
AIR HEATER
ALTERNATOR 50A (2502-9009)
ALTERNATOR 80A(OPTION) (502-00003)
TRAVEL/SWING ALARM ASS'Y (OPT)
ALARM RELAY (2544-9033)
ALARM SWITCH (2549-9109) +(2190-2584D13)
ALARM BUZZER (516-00011)
4bar SWING PRESS SW (2549-9407) ONLY SWING (OPT)
TERMINAL NO
AMP 070 18P
AMP 070 12P
HRS NO.G7A-26PD-DS 26P
AMP 040 20P
AMP MIC 13P
AMP MIC 17P
AMP MIC 21P
(CN1)
(CN2)
(CN3)
(CN4)
(CN5)
(CN6)
(CN7)
NOTE.
1. DIODE PART NO.
DIODE 1 . : 548-00003
DIODE 2 ~ 12 : 2548-1027
STARTER SWITCH CONNECTION
PST
IML
B
BR
R1
R2
C
ACC
OFF
PREHEAT
ON
START

ARS1270L

ATTACHMENTS

DAEWOO
DAEWOO HEAVY INDUSTRIES & MACHINERY LTD.

BOOM AND ARM

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MODEL	SERIAL NUMBER RANGE
Solar 290LC-V	0001 and Up
Solar 300LC-V	1001 and Up

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Installation 7
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Start-up Procedures 8

FRONT ATTACHMENT PIN SPECIFICATIONS

The table below has a complete listing of dimensional specifications for all mounting pins used on the front attachment.

NOTE: *Some mounting pins must be drilled and tapped for lubrication fittings and piping, or may have other required specifications. Consult Daewoo After Sales Service for information on wear tolerances and replacement limits for mounting pins.*

Mounting Pin	Diameter, mm (Inches)	Length, mm (Inches)
A	105 mm (4.134")	1001 mm (39.409")
B	90 mm (3.543")	890 mm (35.039")
C	90 mm (3.543")	266 mm (10.472")
D	100 mm (3.937")	636 mm (25.039")
E	90 mm (3.543")	266 mm (10.472")
F	90 mm (3.543")	244 mm (9.606")
G	80 mm (3.150")	512 mm (20.157")
H	90 mm (3.543")	512 mm (20.157")
I	90 mm (3.543")	593 mm (23.346")
J	90 mm (3.543")	593 mm (23.346")
K	90 mm (3.543")	244 mm (9.606")

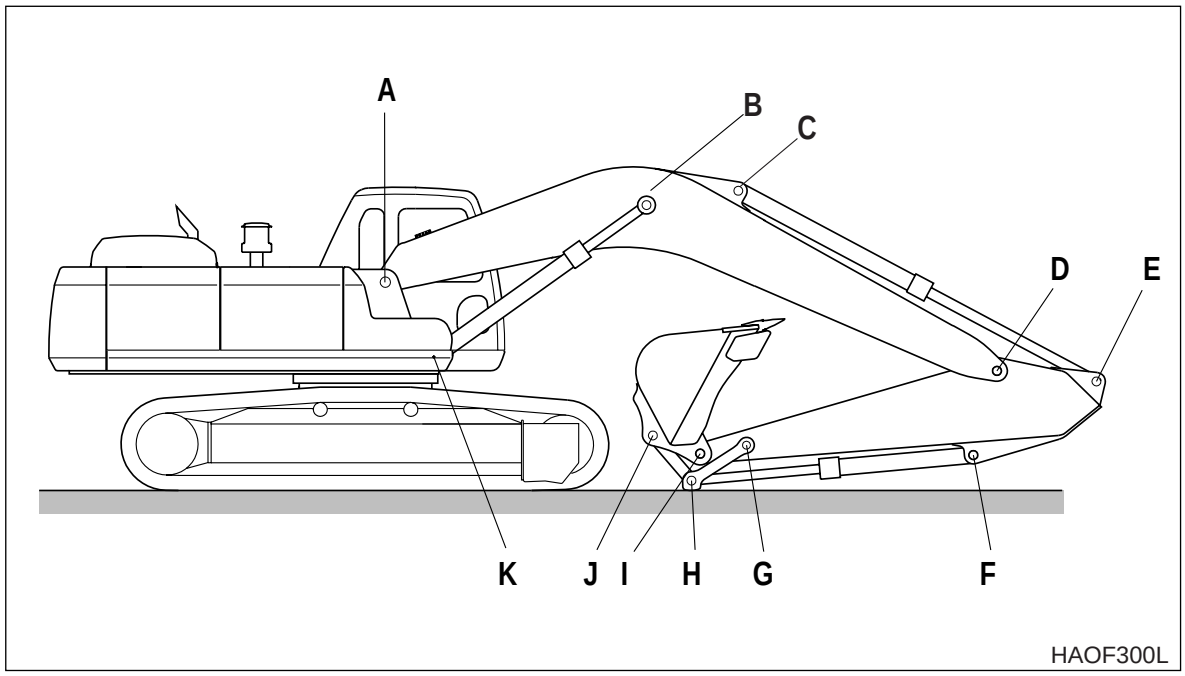


Figure 1

FRONT ATTACHMENT - REMOVAL AND INSTALLATION

IMPORTANT

Always break down the front attachment by removing outermost sections first - the bucket before the arm, the arm before the boom. Reinstallation of the attachment should begin with the boom and end with the bucket.

Refer to the appropriate Bucket section for its removal and installation procedure before going onto the initial step of the front attachment removal or installation procedure.

ARM REMOVAL PROCEDURE

⚠ WARNING!

This procedure is only intended for routine removal or replacement of the attachment, while working under normal, safe operating conditions. In the event of a major structural collapse of some part of the attachment, an accident or complete loss of attachment hydraulic function, DO NOT proceed with attachment disassembly unless you are completely sure of what you are doing. Please call your local Daewoo distributor or Daewoo After Sales Service for assistance. DO NOT allow personnel to stand underneath a weakened or only partially supported attachment section. Keep clear of hydraulic lines that may have fluid escaping at high pressure - it can cause severe or even fatal injuries.

Complete the bucket end removal procedure by pulling out the two bucket linkage pins and the bucket cylinder mounting pin, on the arm. Use an assist crane or hoist to lift the cylinder and relieve weight on mounting pins.

Park the excavator away from obstructions and all traffic on clear, flat, level ground. Extend the arm cylinder and crowd the arm into the boom. Partially retract the boom cylinder so that the boom is stretched out in front of the excavator, as low to the ground as possible, with the arm crowded under the boom.

The tip of the arm point should be lowered to secure blocking that will safely support the weight of the arm. Place the blocking directly in front of the excavator and make sure that it will not be unbalanced with an initial weight load that is all to one end, under the arm point.

Shut off the engine and release hydraulic system pressure - move any of the control levers with the engine off to release pressure built up in the accumulator. Manually vent residual hydraulic pressure in the tank by moving the lever near the cap, on top of the reservoir.

⚠ WARNING!

Secure the swing lock and tag and lock out controls in the operator's cab to keep anyone from moving or inadvertently starting the engine. Restrict access to the work site while sections of the attachment are in the air, or while they are being supported by the assist crane. The safe lifting capacity of the assist crane or hoist that is used must exceed the weight of the heaviest section of the attachment, the boom (approximately 2,000 kg [4,400 lb], not including the weight of accessories or fixtures).

Before beginning the disassembly of attachment mounting pins, disconnect the arm cylinder hydraulic hose couplings and put a clean plug in the end of each one. Use any and all reasonable precautions necessary to avoid introducing dirt or other contaminants into the hydraulic system. Wipe down coupling points before disconnecting hydraulic lines and use evaporative-type solvent spray cleaner. Tag and mark hoses for reassembly, if necessary.

Place a sling under the arm cylinder (the cylinder used to extend and retract the attachment arm, pinned to the top of the boom). Lift the sling so that the weight load on the rod end of the arm cylinder (pinned to the ears on the inner end of the arm) is released. Prepare blocking under the arm that will securely support the weight of the arm and arm cylinder.

CAUTION!

To make sure that the polished surfaces of cylinder rod ends will not suffer accidental damage during disassembly or removal procedures, wrap exposed rod surfaces (especially those of boom cylinders) with a protective covering material. Immediately following disassembly and removal, cylinder rods should always be fully retracted. This eases handling problems and also avoids possible damage.

Remove retainers on the end of the mounting pin for the arm cylinder rod end. Use the assist crane to relieve the weight load and withdraw the pin. Lower the arm down to the blocking support for any continued disassembly procedures.

BOOM REMOVAL PROCEDURE

NOTE: *Boom removal may be simplified if the shell of the operator's cab is taken off the turntable deck first. Refer to the Operator's Cab Removal procedure before continuing, if both components are to be removed from the excavator.*

After the bucket, arm and arm cylinder have been removed, lower the end of the boom to a stable, secure blocking support.

Attach the assist crane sling to the body of either boom cylinder, break the mounting pin connection to the boom by tapping through the pin from the same side of the boom and repeat for the opposite cylinder.

Release hydraulic pressure and disconnect line couplings as previously outlined in the Arm Removal Procedure, observing the same precautions.

Disconnect wiring for work light assemblies and any other accessory lines or connections. Locate the sling of the assist crane near the center of gravity, optimum lift point for the boom, and use the crane to take pressure off the boom foot pin. Drive out the pin after disassembling retainers and carefully lift away the boom.

⚠ WARNING!

Traveling the excavator, swinging the turntable or movement over bumps or sloping, uneven surfaces could all produce loss of control and possible accidents or injuries, if the turntable deck has been unbalanced by removal of weight from one end only.

To maintain stability, the counterweight should be removed whenever the front attachment is taken off the machine.

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.

START-UP PROCEDURES

Once the boom has been serviced, it should be lubricated as outlined in the initial start-up procedures of the operation manual. Refer to the appropriate operation and maintenance manual for unit.

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BUCKET

⚠ 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 300LC-V	1001 and Up
Solar 300LL	1001 and Up
Solar 340LC-V	1001 and Up
Solar 420LC-V	1001 and Up
Solar 470LC-V	1001 and Up

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BUCKET TOOTH INSPECTION AND REPLACEMENT

There are several different types of attachment methods for replaceable bucket teeth. Some of the most common types are shown in the following drawings.

Bucket teeth are usually replaced in sets but it may sometimes be necessary to replace individual teeth.

TYPE 1

Look for the following indications of wear or damage:

- Lock pins protrude unevenly on one side.
- Lock pins have been worn down so far that they no longer make full contact through the length of the pin hole.
- Lock washers or pins show obvious damage or weakness.
- Wear points on the working surfaces of tooth points - pits, cracks, chips or craters - are larger than 8 mm to 10 mm (1/3" to 1/2") across.

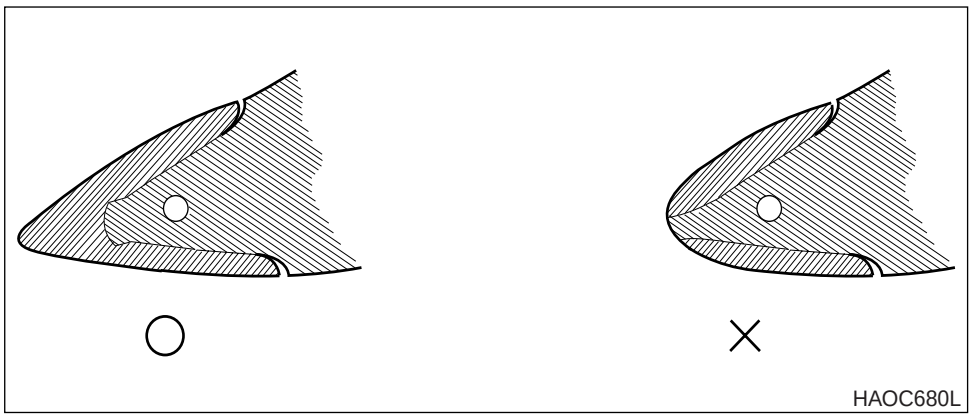


Figure 1

1. On a routine basis, inspect the bucket teeth to make sure that tooth wear or breakage has not developed. Do not allow the replaceable bucket teeth to wear down to the point that the bucket adapter is exposed. See Figure 4.
2. To replace a tooth (1, Figure 2), use a hammer and punch to drive the locking pin (2) and lock washer (3) out of the tooth adapter (4).
3. Once the worn tooth has been removed, use a putty knife to scrape the adapter as clean as possible.
4. Slide the new tooth into position and insert the lock washer.
5. Insert the locking pin into the tooth and with a hammer, drive the pin in until the lock washer seats in the locking groove.

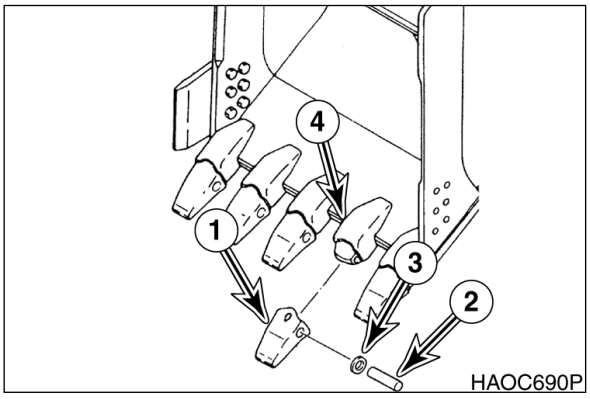


Figure 2

TYPE 2

⚠ WARNING!

Due to the possibility of flying metal objects, always wear safety helmet, protective gloves and eye protection when changing bucket teeth.

Curl the bucket upwards and place the round rear surface of the bucket firmly on the ground. Place wooden blocks under front of bucket. Shut the engine off and lock out the hydraulic controls before working on the bucket.

Inspect locking pin assembly and replace it if the following conditions exist;

1. The locking pin is too short when both surfaces are aligned.
2. The rubber has been torn and bosses of the steel balls are liable to slip off.
3. Pressing steel ball causes the boss to go inside.

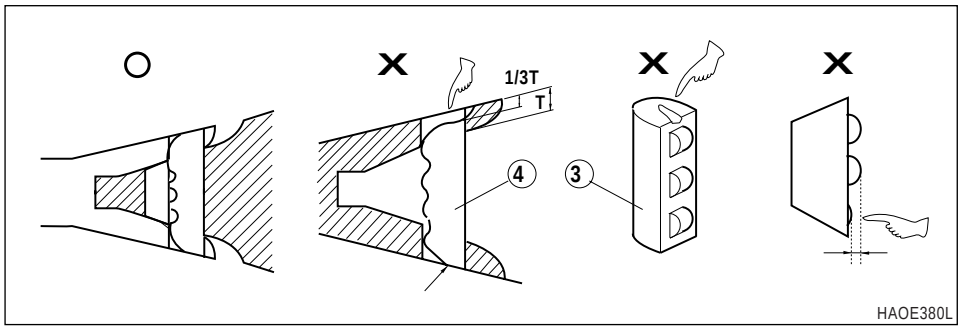


Figure 3

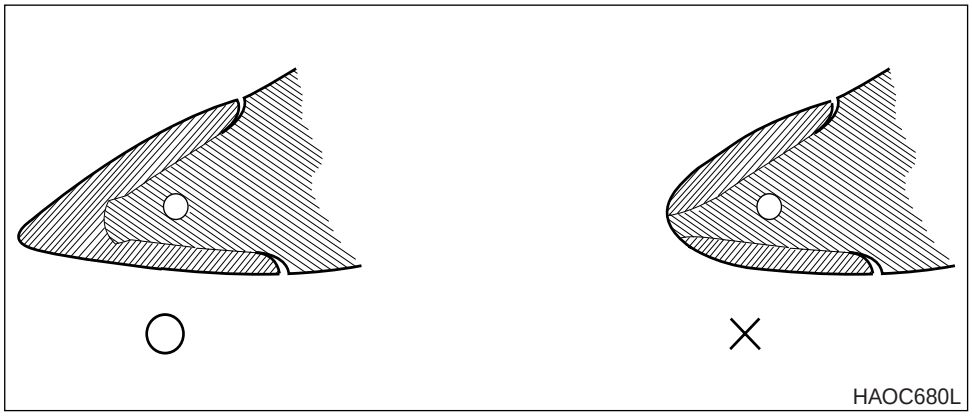


Figure 4

1. On a routine basis, inspect bucket teeth to make sure that tooth wear or breakage has not developed. Do not allow replaceable bucket teeth to wear down to a point that bucket adapter is exposed. See Figure 4.
2. To replace a tooth, use a hammer (1, Figure 5) and punch (2) to drive locking pin assembly out of tooth and tooth adapter.
3. Once the worn tooth has been removed, use a putty knife to scrape adapter as clean as possible.
4. Slide new tooth into position and insert locking pin assembly.

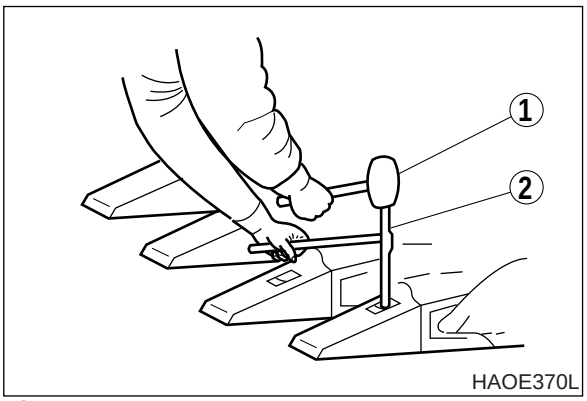


Figure 5

BUCKET O-RING REPLACEMENT

⚠ WARNING!

Due to possibility of flying metal objects, always wear safety helmet, protective gloves and eye protection when changing pins.

1. Inspect the bucket O-rings on a routine basis. If worn or damaged, replacement is necessary.

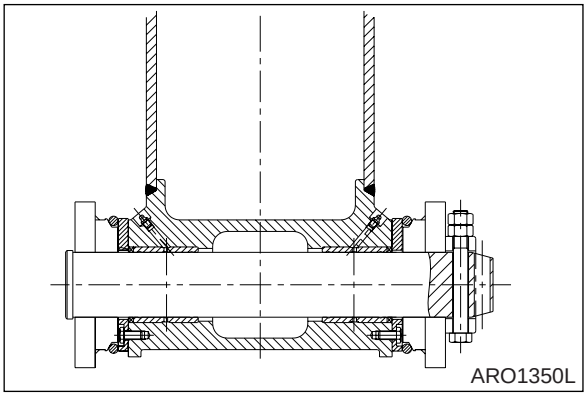


Figure 6

2. Roll the old O-ring (1, Figure 7) onto the boss (2) around the bucket pin (3). Remove the bucket pin and move the arm or bucket link (4) out of the way.

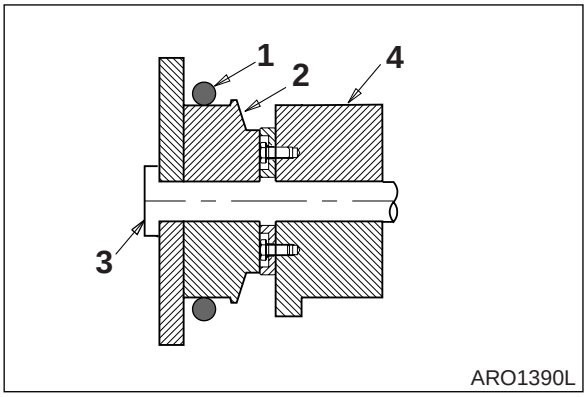


Figure 7

3. Remove the old O-ring and temporarily install the new O-ring (1, Figure 8) onto the bucket boss (2). Make sure that the O-ring groove on both the bucket link (4) and boss have been cleaned.
4. Realign the arm or link with the bucket pin hole and insert the bucket pin (3, Figure 7).

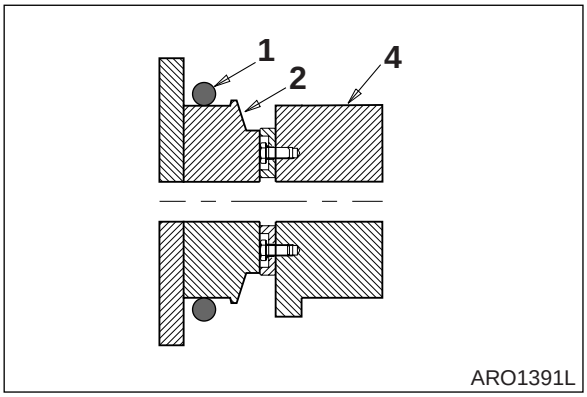


Figure 8

5. Roll the new O-ring (1, Figure 9) into the O-ring groove.

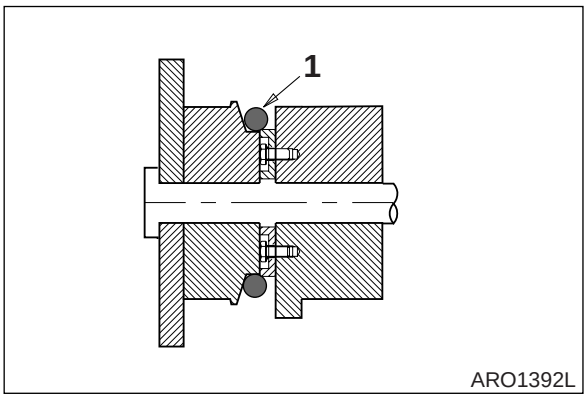


Figure 9

BUCKET SHIMMING PROCEDURES

NEW BUCKET INSTALLATION

1. If a new bucket is being installed on the excavator, measure the inside dimension between the bucket ears and the outside dimension across the arm mounting boss.
2. Subtract the clearance on both sides from the difference of the two and shim accordingly, prior to assembly.

⚠ WARNING!

To check end play (side-to-side) clearance at bucket attachment point, the bucket must be free to move but at all other times lower it to the ground or use support blocks to immobilize this assembly. Shut off engine and tag and lock out controls to prevent movement during this procedure.

Shimming Procedures for Installed Bucket

1. With bucket attached, curl bucket and arm outward and lower boom so that bucket teeth are pointing away from excavator, just a few inches off ground. This position provides easy accessibility for dimensional measurements.
2. Force bucket to one side and check for end play (side-to-side) clearance under O-rings at attachment point. Total clearance should be 1 mm (0.04 in.) between side face of boss and inside edge of ear bushing (Y, Figure 10). Too tight a fit (less than 1 mm (0.04 in.)) can cause excessive wear while too much clearance may produce excessive noise and potentially hazardous slack control.
3. Recheck end play by forcing bucket towards opposite side and repeating clearance measurements.
4. If an adjustment is required, remove two jam nuts (1, Figure 10) and bolt (2) from pin (3). Add or remove shims (4) as required. Use equal amount of shims on each side. Install bolt (2) and two jam nuts (1). Jam nuts must clear boss by 1 - 2 mm (0.04 - 0.08 in.) at point (X).

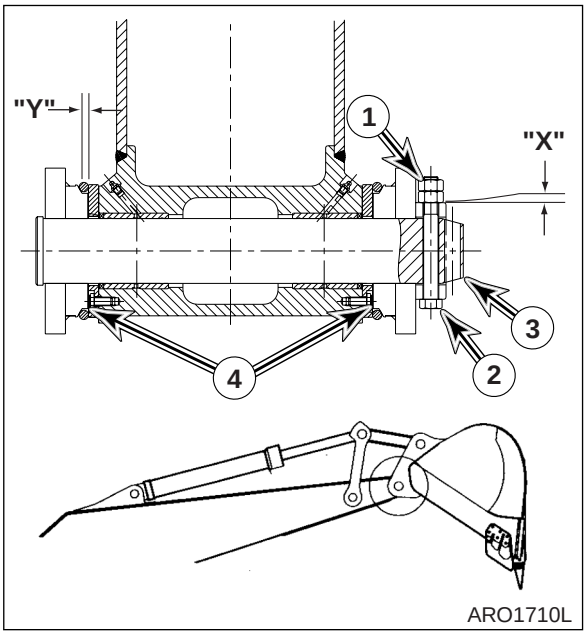


Figure 10

BUCKET ATTACHMENT, REMOVAL AND REVERSAL

DETACHING THE BUCKET

Park the excavator away from obstructions on clear, flat, level ground. Lower the bucket carefully to pre-assembled blocking on the ground. Brace the bucket so that there is no load weight on the pin connecting the bucket and arm. Disassemble the fasteners on the end of the bucket pin and pull out the pin.

If the pin sticks and resists normal withdrawal, there may be a load on it. Raise and lower the arm slightly until an unstressed pin position is located.

⚠ CAUTION!
Use care pulling out the pin to avoid damaging the dust seals on either end of the arm.

When the pin has been withdrawn, move the operating joystick slightly to take weight off the remaining link pin. Disassemble the link pin end retainers and pull out the pin.

Lift the arm away from the bucket so that the bucket can be carried away or another end attachment can be put on the excavator.

ATTACHING THE BUCKET

Carefully inspect all parts before reassembling the bucket linkage. Look for cracks or any other evidence of physical damage and replace any seal or O-ring that is not in like-new condition. Pre-lube linkage pins before reassembly.

Use an old cylinder rod, a long breaker bar or a similar, relatively thin diameter support bar for making the first (temporary) pin connection, between the bucket and arm. If the support bar is straight, the arm can be raised and the bucket will hang level, allowing direct insertion of the bucket ear-attachment linkage pin.

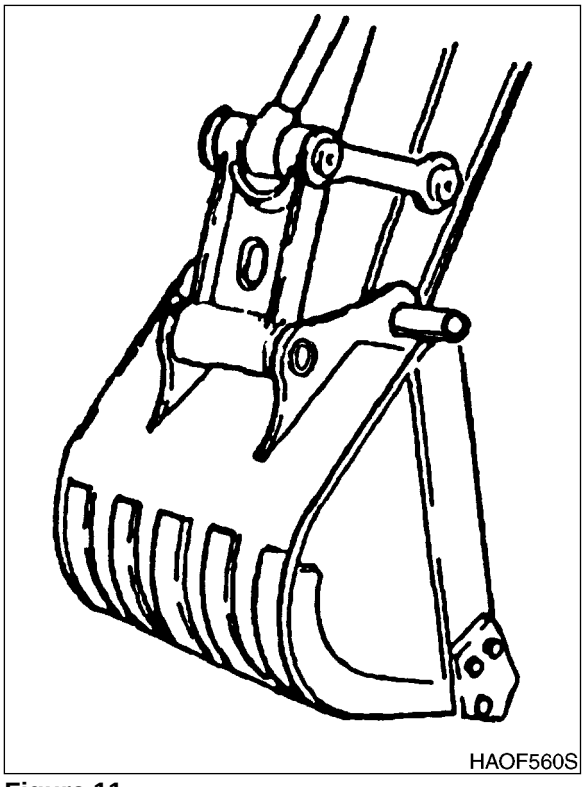


Figure 11

When the link pin has been installed, withdraw the temporary support rod from the bucket pin holes, lower and raise the arm and boom and install the bucket pin.

⚠ WARNING!

When making linkage alignments, never insert fingers into pin holes. The attachment or bucket could shift position and cause a severe injury. Match holes by visually lining them up. Use the sharp-tipped, soft point of a pencil or a similar tool to check for high spots or irregularities.

REVERSING THE BUCKET

Follow instructions for "Detaching the Bucket" and remove both the bucket and link pins. Rotate the bucket 180° to change bucket configuration. This procedure is greatly simplified if some type of rotating or swiveling support can be used, on the ground underneath the bucket. Follow instructions for "Bucket Attachment" to replace pins.

⚠ WARNING!

Bucket curl and dump levers must be used in opposite directions, after the bucket has been reversed.

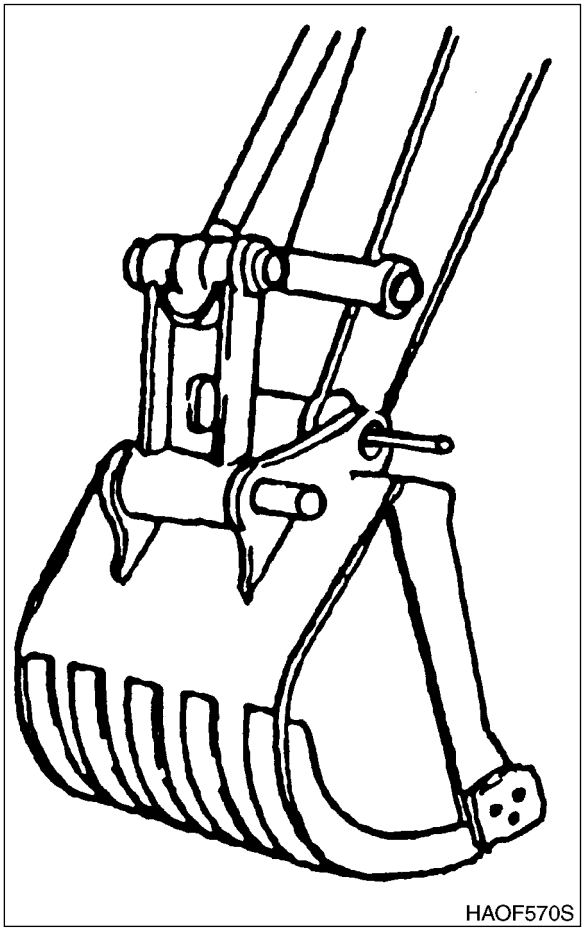


Figure 12