

Solar 130W-V

Shop Manual

2023-7133E

Serial Number 0001 and Up

January 1999

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

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

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

Solar 130W-V
Serial No. 0001 and Up
Pub.No. 2023-7133E



Product Label



Instructions

**Trim Out The Label Along
The Lines And Insert Int
Pocket On The Binder Spine**

TABLE OF CONTENTS

Safety

Wheel Excavator Safety	S0102020
------------------------------	----------

Specifications

Specifications for Solar 130W-V	S0202020
---------------------------------------	----------

General Maintenance

General Maintenance Procedures	S0302000
Standard Torques	S0309000

Upper Structure

Cab	S0402020
Counterweight.....	S0403010
Fuel Tank.....	S0405040
Swing Bearing.....	S0407010
Swing Reduction Gearbox.....	S0408020

Lower Structure and Chassis

Ram Lock Valve Operation.....	S0503000
-------------------------------	----------

Engine and Drive Train

Front Axle	S0602050
Rear Axle with Transmission	S0602060
Service Brake	S0603010
Air-Conditioner	S0605010

Hydraulics

Hydraulic System Troubleshooting, Testing and Adjustment	S0702060
Accumulator.....	S0703000
Center Joint (Swivel).....	S0704020

Cylinders.....	S0705000
Swing Motor.....	S0707220
Travel Motor.....	S0707350
Brake Pump.....	S0708100
Main Pump (Uchida)	S0708345
Steering Pump.....	S0708420
Brake Supply Valve	S0709220
Counterbalance Valve	S0709300
Main Control Valve	S0709420
Remote Control Valve (Work Lever / Joystick).....	S0709450
Steering Valve	S0709710
Steering Pump.....	S0709820
Dozer Control Valve.....	S0709900

Electrical System

Electrical System	S0802065
Electrical Schematic (S130W-V).....	S0892070

Attachments

Boom and Arm.....	S0902060
Bucket.....	S0904000

SAFETY



WHEEL 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 130W-V	0001 and Up

TABLE OF CONTENTS

To the Operator of a Daewoo Excavator	3
General Safety Essentials	5
Location of Safety Labels	6
Summary of Safety Precautions for Lifting in Digging Mode	12
Work-site Precautions	13
Operation.....	15
Equipment	20
Maintenance.....	24
Shipping andTransportation	27

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 6
3. "Summary of Safety Precautions for Lifting in Digging Mode" on page 12
4. "Work-site Precautions" on page 13
5. "Operation" on page 15
6. "Equipment" on page 20
7. "Maintenance" on page 24
8. "Shipping and Transportation" on page 27



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 and Shop Manuals.

LOCATION OF SAFETY LABELS

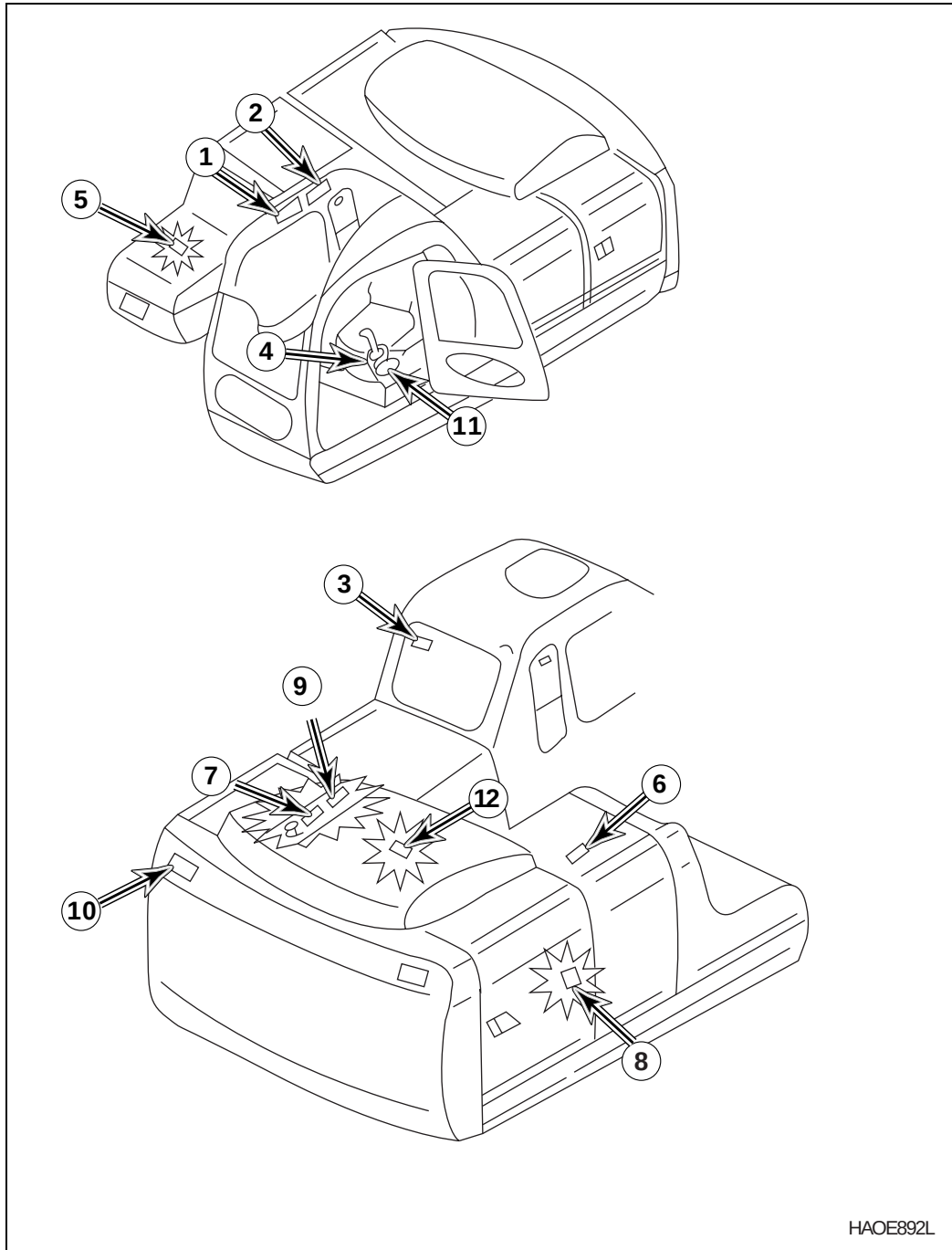


Figure 1

Always keep these labels clean. If they are lost or damaged, replace them with a new label. It is the responsibility of the equipment owner and crew to provide essential safety information in the immediate vicinity of hazards.

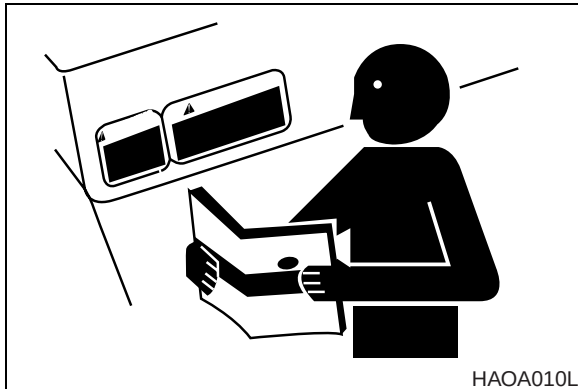
Safety labels may be available in languages other than English, or labels providing a warning for other hazards than those that follow may be available. Contact your Daewoo distributor to find out what labels are available.

1. WARNING FOR OPERATION, INSPECTION MAINTENANCE (2190 - 3312)



CAUTION!

- Read manual and labels before operation and maintenance. Follow instructions and warnings in manual and on labels on the machine.
- Never get in under the machine while it is being jacked up with boom and arm.
- Turn Auto-Idle switch OFF, when loading or unloading the machine.
- Sound the horn to alert the people nearby before operating, and make sure all persons are clear of area.
- Always make sure when leaving operator's seat to:
 - Lower bucket or other working tools to the ground.
 - Pull SAFETY LOCK LEVER to LOCK position.
 - Turn key switch OFF. Remove key from switch.



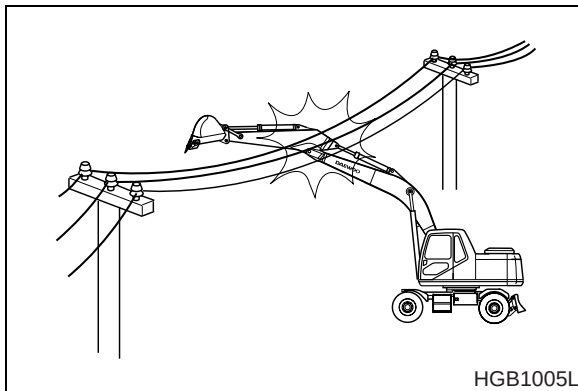
HAOA010L

2. WARNINGS FOR HIGH VOLTAGE (2190 - 2532)



DANGER!

Serious injury or death can occur if machine or attachments contact with electric lines. Never move any part of unit or load closer to electric lines than 3 m (10') plus twice the line insulator length.



HGB1005L

3. WARNING WHEN OPENING FRONT WINDOW (2190 - 3388).



WARNING!

When raising window, lock it in place with lock pins on both sides.
Falling window can cause injury.

4. CAUTION FOR SAFETY LEVER LOCKING (2190 - 3383).



CAUTION!

When putting down the side control stand, use the safety lever surely.

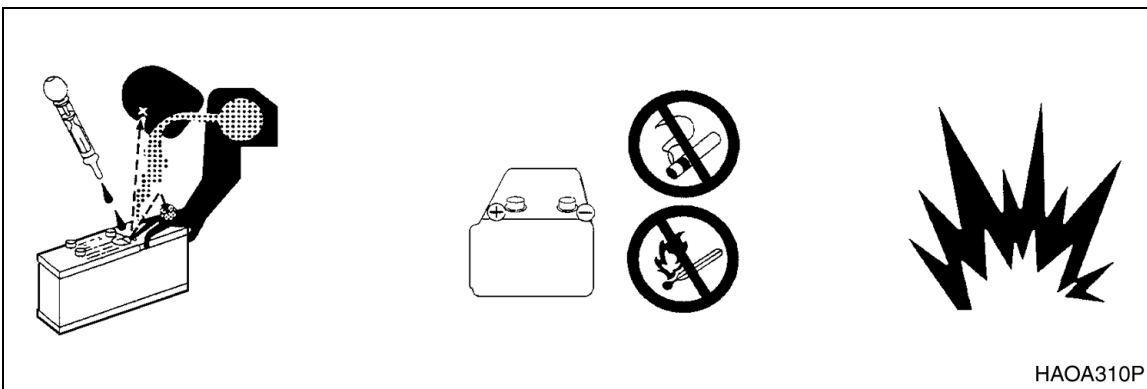
5. WARNING FOR BATTERIES MAINTENANCE (2190 - 2533).



WARNING!

- Battery fumes can explode. Keep sparks and flames away from batteries.
- Always avoid storing metals like tools or inflammable materials around or on the batteries. Explosion or fire can be caused by short circuiting batteries.
- Sulfuric acid in battery is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed in eyes.
- If you spill acid on yourself:
 1. Flush your skin with water.
 2. Apply baking soda or lime to help neutralize the acid.
 3. Flush your eyes with water for 10-15 minutes.

Get medical attention immediately.



6. WARNING FOR HIGH TEMPERATURE HYDRAULIC OIL (2190 - 3318)

 WARNING!
To prevent hot oil from spurting out: • Turn engine off. • After oil to cooled. • Push button on the breather to relieve pressure before removing cover.

7. WARNING FOR HIGH TEMPERATURE COOLANT (2190 - 2531)

 WARNING!
To prevent hot water from spurting out: • Turn engine off. • Allow water to cool. • Slowly loosen cap to relieve pressure before removing.

8. WARNING FOR HANDLING ACCUMULATOR (2190 - 2528)

 WARNING!	
Explosion hazard • Keep away from flame. • Do not weld or drill.	 HAOA311P

ACCUMULATOR

The pilot control system is equipped with an accumulator. The accumulator will store a pressure charge that may enable the hydraulic controls to be activated for a brief period of time after the engine has been shut down. Activation of any of the controls may enable the selected function to operate under the force of gravity.

When shutting the machine down, lower the front attachment to the ground. After the engine has been shut down, move the joystick controls to release the pressure in the accumulator.



WARNING!

Any raised attachment will lower to the ground if the accumulator holds a charge.



WARNING!

Refer to the Shop Manual for service procedures. Do not release any of the pilot lines until the pressure within the accumulator has been released.

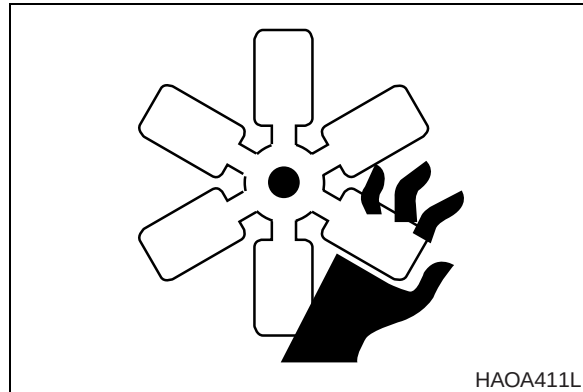
9. WARNING FOR ENGINE FAN (2190 - 3315)



WARNING!

Keep your hands away from the fan during operation.

Entanglement in the fan can cause serious injury.



10. KEEP OUT OF THE SWING AREA (2190 - 3379).



DANGER!

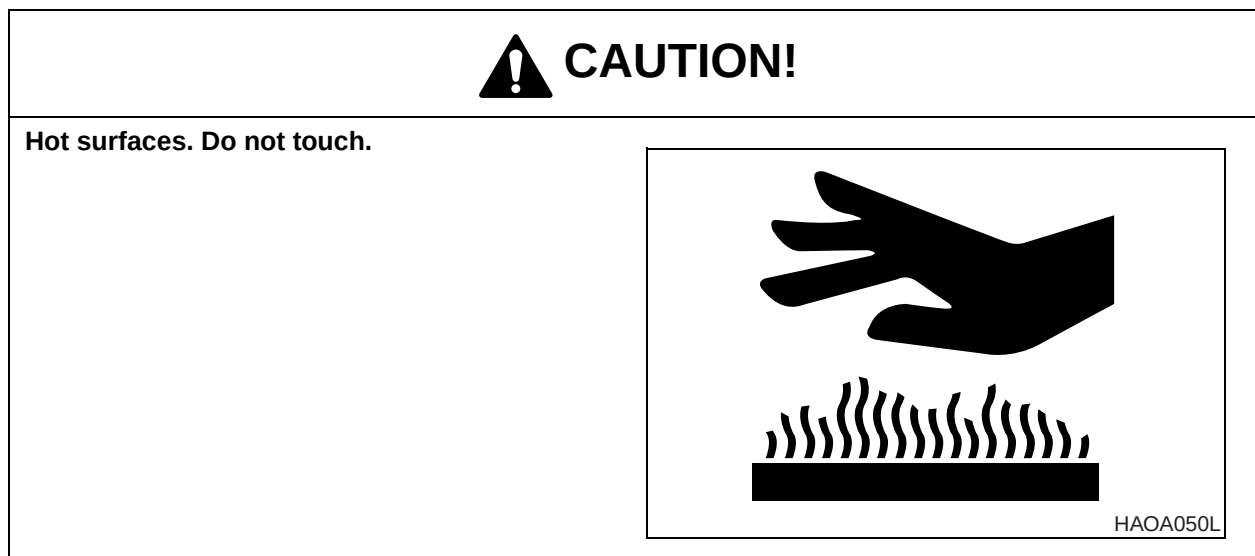
KEEP OUT OF SWING AREA

11. WARNING TAG - USED WHEN INSPECTING HYDRAULIC SYSTEM (2190 - 2549).



Figure 2

12. WARNING FOR HOT ENGINE SURFACE (2190-3314)



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 in excess of 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
6.6kV	3.0 m (9' - 10")
33.0kV	4.0 m (13' - 1")
66.0kV	5.0 m (16' - 5")
154.0kV	8.0 m (26' - 3")
275.0kV	10.0 m (32' - 10")

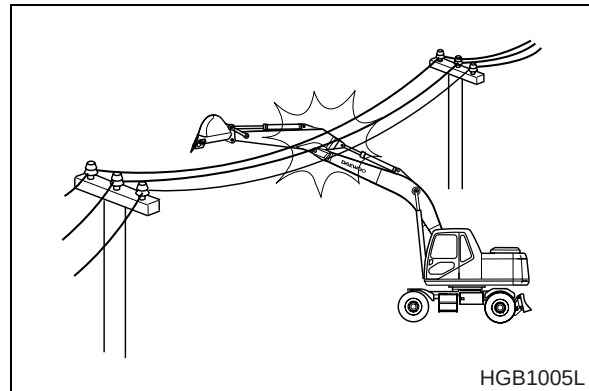


Figure 3

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 tire support.

USE SOLID SUPPORT BLOCKING

Never rely on lift jacks or other inadequate supports when work is being done. Block tires 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 on to 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 shutdown.

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 prior to starting a work cycle. Stay alert for instability situations in order to avoid getting into them. For example, you should always avoid working the bucket over downhill tires 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.

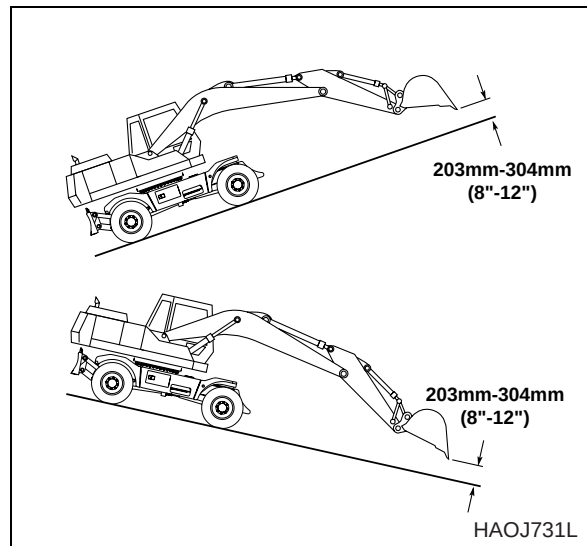


Figure 4

STAY ALERT FOR PEOPLE MOVING THROUGH THE WORK ARE

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.

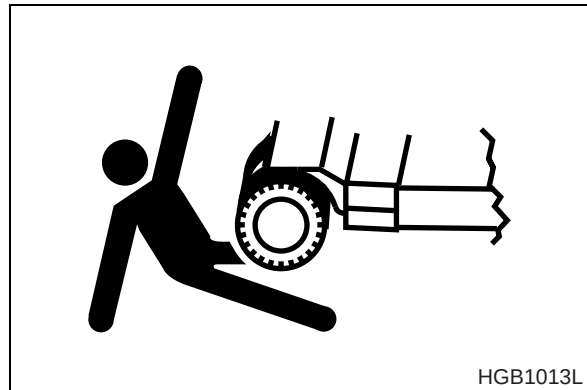


Figure 5

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 can't 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 6

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 prior to start-up.
- Check gauges and monitor displays for normal operation prior to 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.

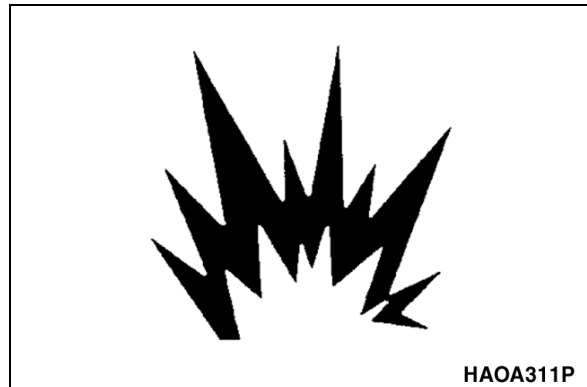


Figure 7

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 and steps, 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.

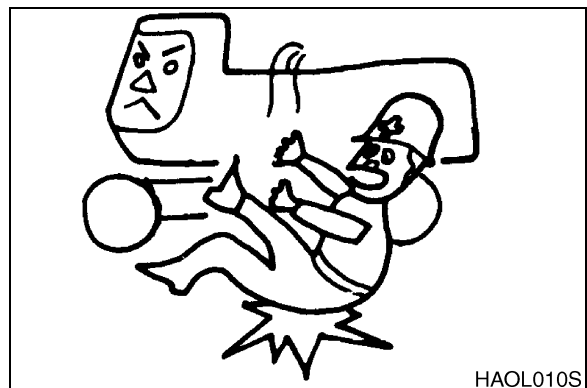


Figure 8

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 job 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, as well as 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.

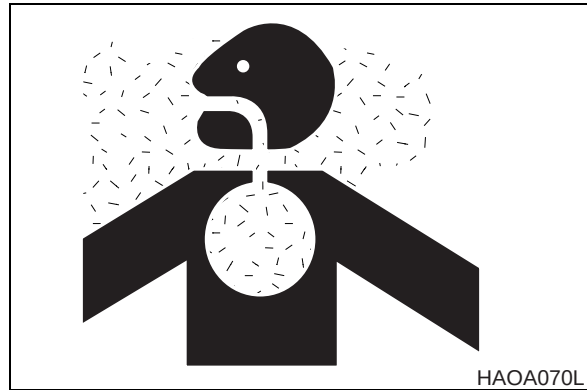


Figure 9

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 cartridges.

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

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.



Figure 10

BOOST STARTING OR CHARGING ENGINE BATTERIES

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 "Starting Engine Using A Booster Battery" on page 3 8 of this 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.

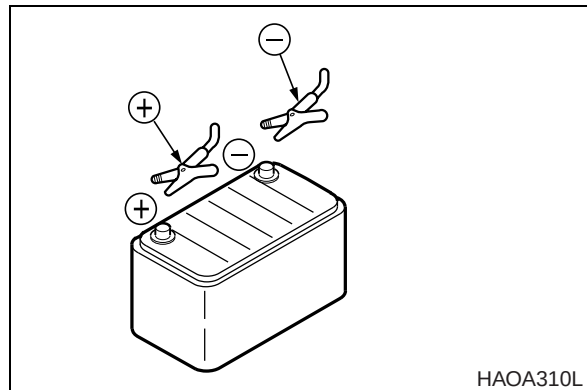


Figure 11

TRAVEL CONTROLS MAY PRODUCE REVERSED OPERATIONS

Before starting the machine you should always check to see which end of the lower structure is under the operator's cab. In the normal travel configuration, the steering axle is at the front of the machine, and the rigid axle is under the engine and counterweight. If the operator swings the cab 180°, the rigid axle will be underneath the operator's cab, and steering 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 front end of lower structure. 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 & 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 lower structure, 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.

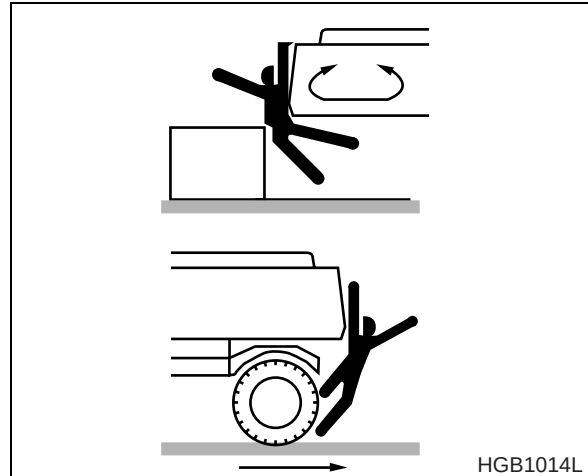


Figure 12

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 203 mm – 304 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 tires 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.

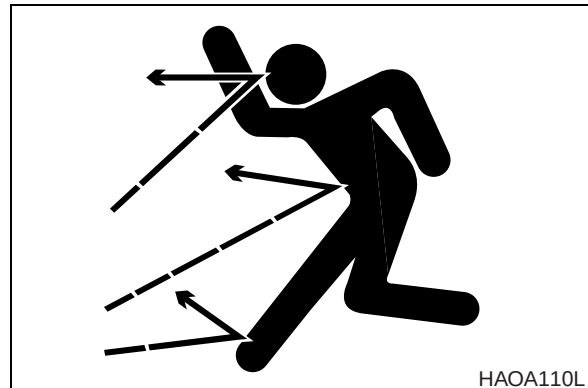


Figure 13

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 14

INSTALL ADDITIONAL SAFETY EQUIPMENT IF CONDITIONS REQUIR

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 15

WINDOW GLASS BREAKING TOOL

This excavator is equipped with a glass breaking tool. It is located 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 16

KEEP A FIRE EXTINGUISHER AT HAND

It is recommended that an appropriately sized (2.27 kg [5 lb.] or larger) multi-purpose "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.

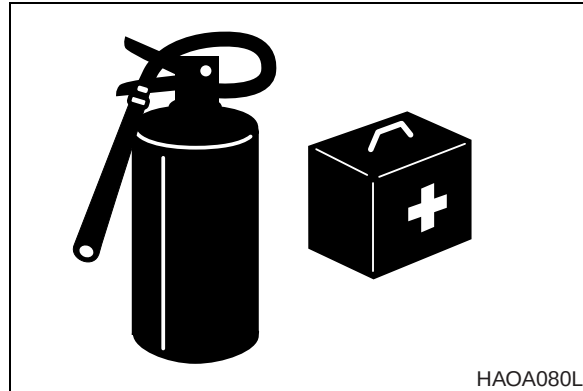


Figure 17

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 "Location of Safety Labels" on page 6 of this section.

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 Specification section in the Excavator Shop 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 jobsite hazard. *Extra safety guards may be required.* NEVER allow hoses to be hit, bent or interfered with during operation. Always replace with same or greater bursting pressure for protection.

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 job 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.

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.

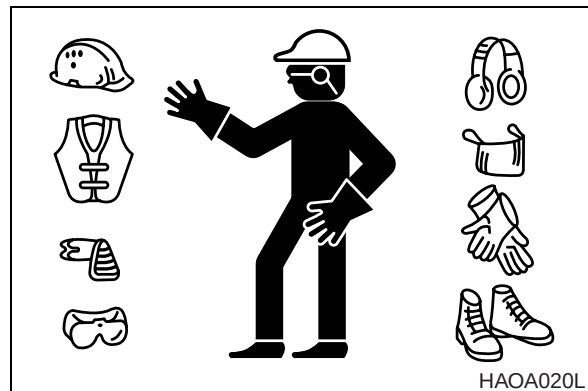


Figure 18

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.



HAOA440L

Figure 19

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 WARNINGTAG 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.



HAOC920L

Figure 20

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, prior to removal.

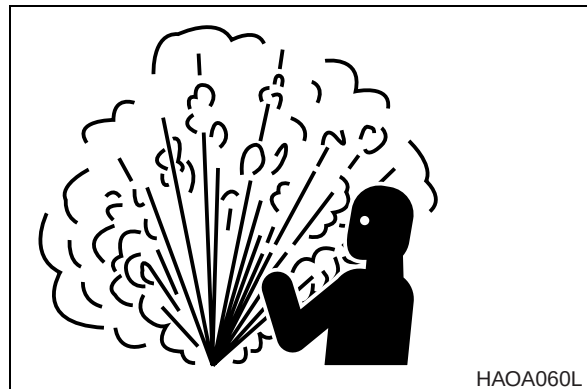


Figure 21

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.

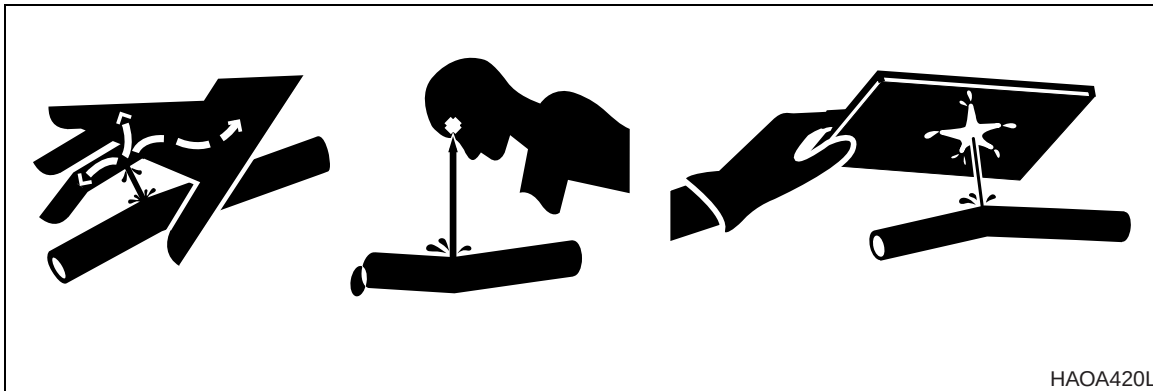


Figure 22

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 PROPERTORQUE

Refer to the "General Maintenance" section of the Shop 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.

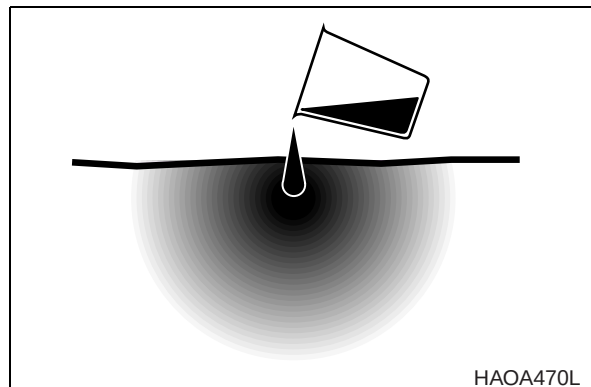


Figure 23

SHIPPING AND TRANSPORTATION

OBEY STATE AND LOCAL OVER-THE-ROAD REGULATIONS

Check state and local restrictions regarding weight, width and length of a load prior to 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 job site. See the Shop Manual for information on partial disassembly.

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

SPECIFICATIONS



SPECIFICATIONS FOR SOLAR 130W-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 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Component Location	4
General Dimensions	6
Dimensions	6
Working Range	7
Front Linkage Pin Size	8
Hydraulic Cylinders	9
Engine Specifications	10
Engine Performance Curves (Per KS-R1004 Standard)	12
Approximate Weight of Workload Materials	13
General Specifications	16
Hydraulic System Component Specifications.....	18
System Component Specifications.....	19
Drive System.....	19
Swing Mechanism	19
Brake System.....	20
Steering System.....	21
Chocking System	21
Performance Tests and Standards	22
Standards.....	22
Tests.....	23
Test Conditions.....	23
Travel Speed Tests	24
Swing SpeedTest	25
Swing SpeedTest	25
Swing Force Test.....	25
Cylinder PerformanceTests	26
Boom Cylinders Test	26
Arm CylinderTest	26
Hydraulic Cylinder Natural Drop Test	26

GENERAL DESCRIPTION

The excavator has three main component sections:

- The Upper Turntable
- The Lower Undercarriage and Power Train
- The Excavator Front-end Attachment

The following illustration identifies main components and their locations. (See Figure 1.)

COMPONENT LOCATION

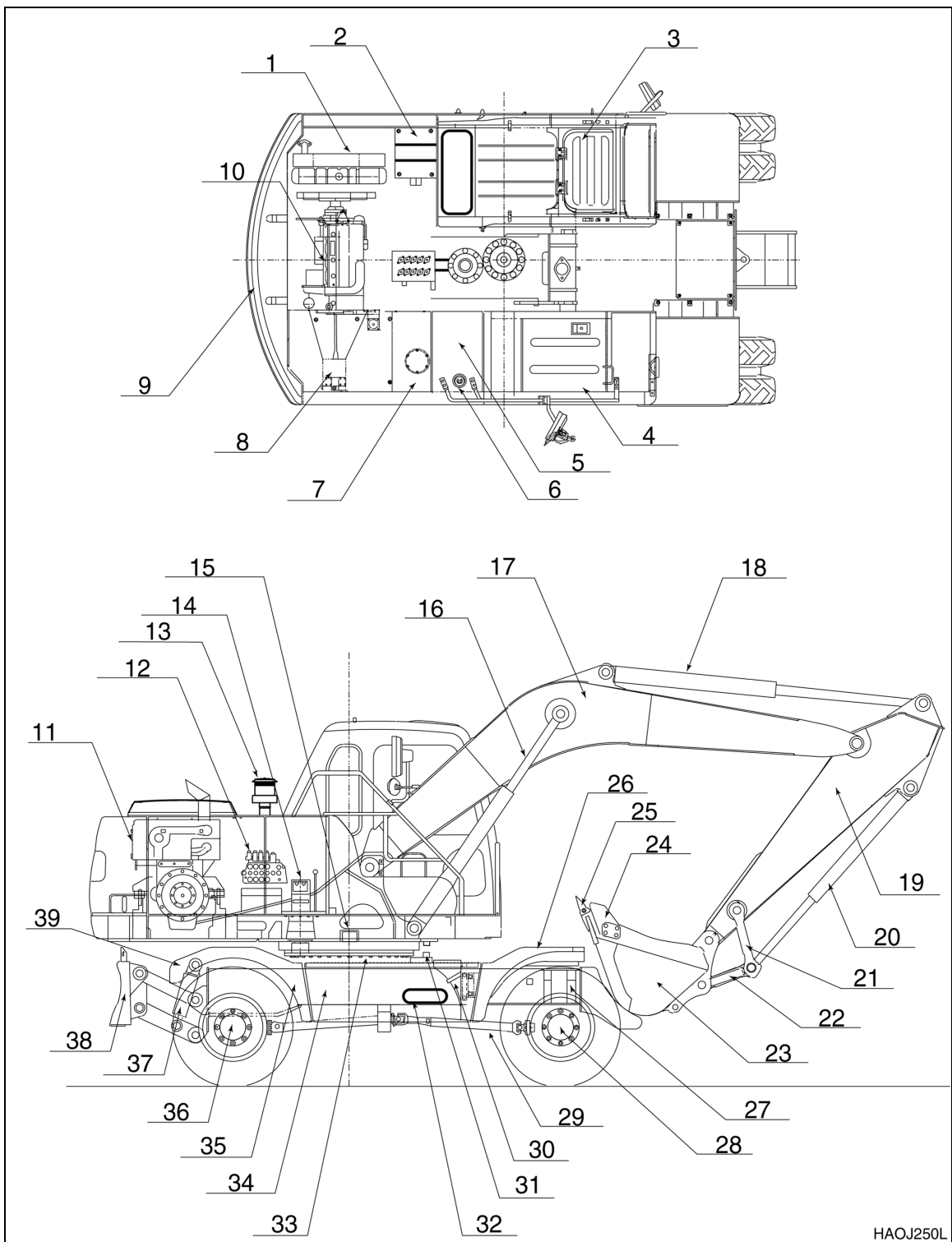


Figure 1

Reference Number	Description
1	Radiator and Oil Cooler
2	Air Cleaner
3	Cab
4	Battery
5	Fuel Tank
6	Fuel Tank Fill Cap
7	Hydraulic Oil Tank
8	Pumps
9	Counterweight
10	Engine
11	Muffler
12	Control Valve
13	Precleaner
14	Swing Motor
15	Center Joint
16	Boom Cylinder
17	Boom
18	Arm Cylinder
19	Arm
20	Bucket Cylinder

Reference Number	Description
21	Guide Link
22	Link
23	Bucket
24	Side Cutter
25	Bucket Tooth
26	Fender
27	Ram Cylinder
28	Front Axle
29	Drive Shaft
30	Wheel Chocks
31	Swing Lock
32	Step
33	Swing Bearing
34	Travel Motor
35	Transmission
36	Rear Axle
37	Blade Cylinder
38	Dozer Blade
39	Fender

GENERAL DIMENSIONS

DIMENSIONS

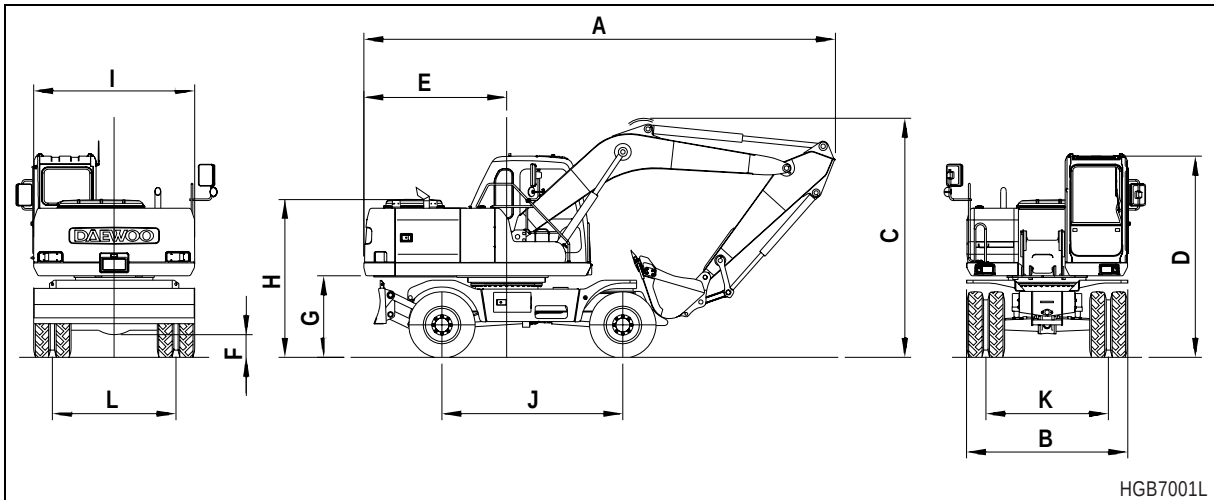


Figure 2

General Dimensions		
Reference	Description	Dimension
A	Shipping Length	7,300 mm (287.4 in)
B	Shipping Width	2,496 mm (98.3 in)
C	Shipping Height (Boom)	3,700 mm (145.7 in)
D	Height Over Cab	3,116 mm (122.7 in)
E	Counter Weight Swing Clearance	2,210 mm (87 in)
F	Ground Clearance	350 mm (13.8 in)
G	Frame Clearance	1,262 mm (49.7 in)
H	Engine Cover Height	2,445 mm (96.3 in)
I	Upper Housing Width	2,494 mm (98.2 in)
J	Wheel Base	2,800 mm (110.2 in)
K, L	Tread Width	1,914 mm (75.4 in)



WARNING!

The actual value for "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.

WORKING RANGE

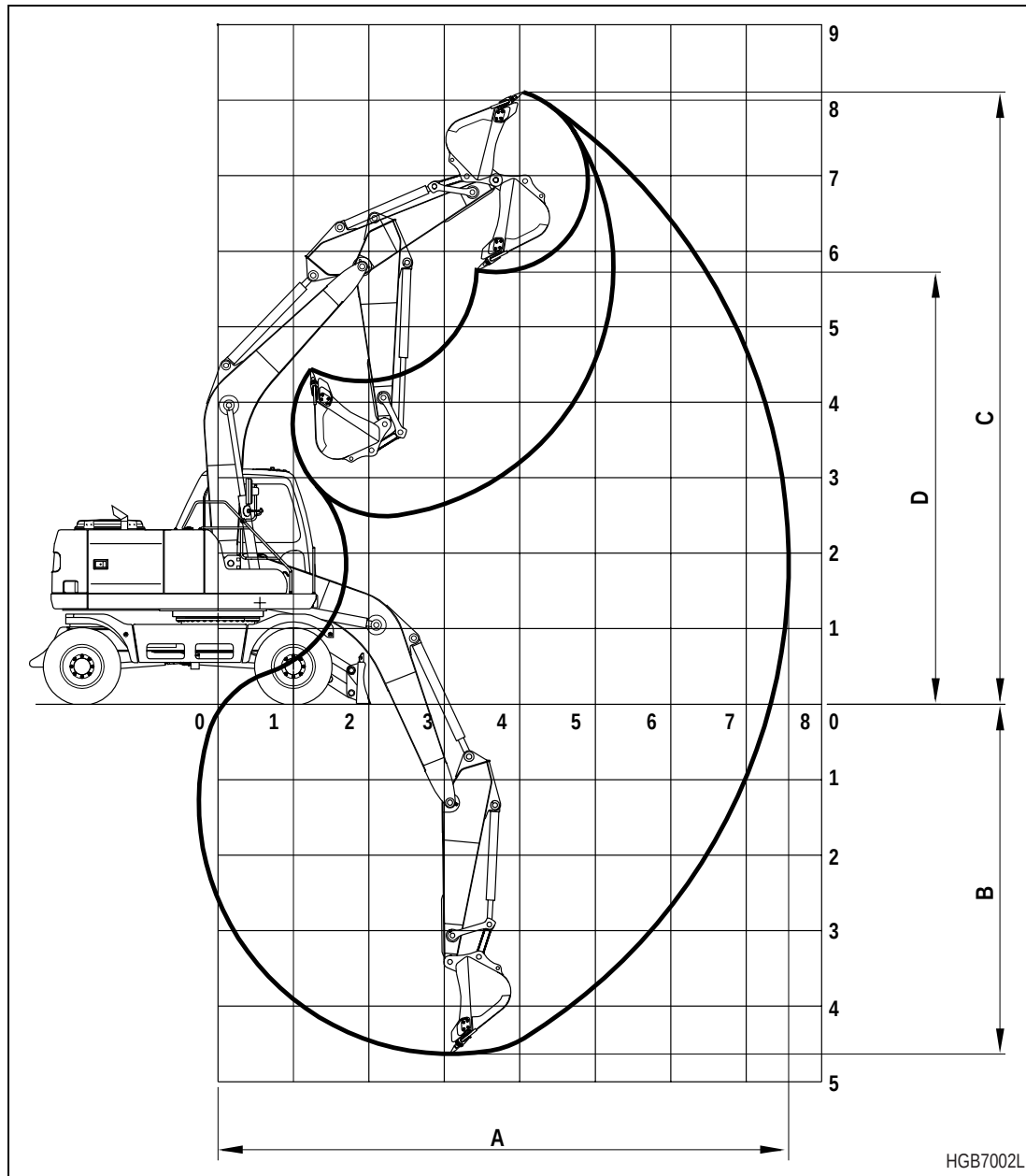


Figure 3

REFERENCE	DESCRIPTION	DIMENSION
A	Maximum Digging Radius	7,560 mm (24' 10")
B	Maximum Digging Depth	4,630 mm (15' 2")
C	Maximum Digging Height	8,100 mm (26' 7")
D	Maximum Dump Height	5,720 mm (18' 9")

FRONT LINKAGE PIN SIZ

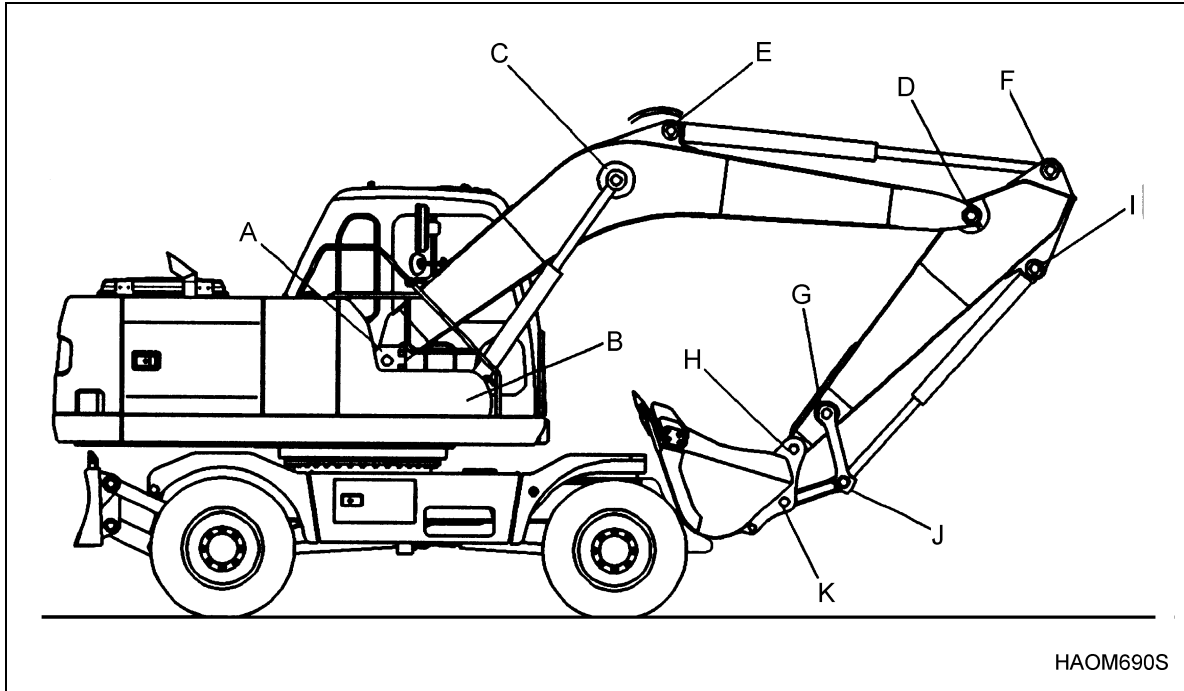


Figure 4

Point	Diameter	Length
A	71.0 mm (2.80 in.)	651.0 mm (25.63 in.)
B	71.0 mm (2.80 in.)	176.0 mm (6.93 in.)
C	71.0 mm (2.80 in.)	670.0 mm (26.38 in.)
D	71.0 mm (2.80 in.)	413.0 mm (16.26 in.)
E	71.0 mm (2.80 in.)	201.0 mm (7.91 in.)
F	71.0 mm (2.80 in.)	201.0 mm (7.91 in.)
G	65.0 mm (2.56 in.)	380.0 mm (14.96 in.)
H	65.0 mm (2.56 in.)	431.0 mm (16.97 in.)
I	71.0 mm (2.80 in.)	187.0 mm (7.36 in.)
J	71.0 mm (2.80 in.)	380.0 mm (14.96 in.)
K	65.0 mm (2.56 in.)	431.0 mm (16.97 in.)

HYDRAULIC CYLINDERS

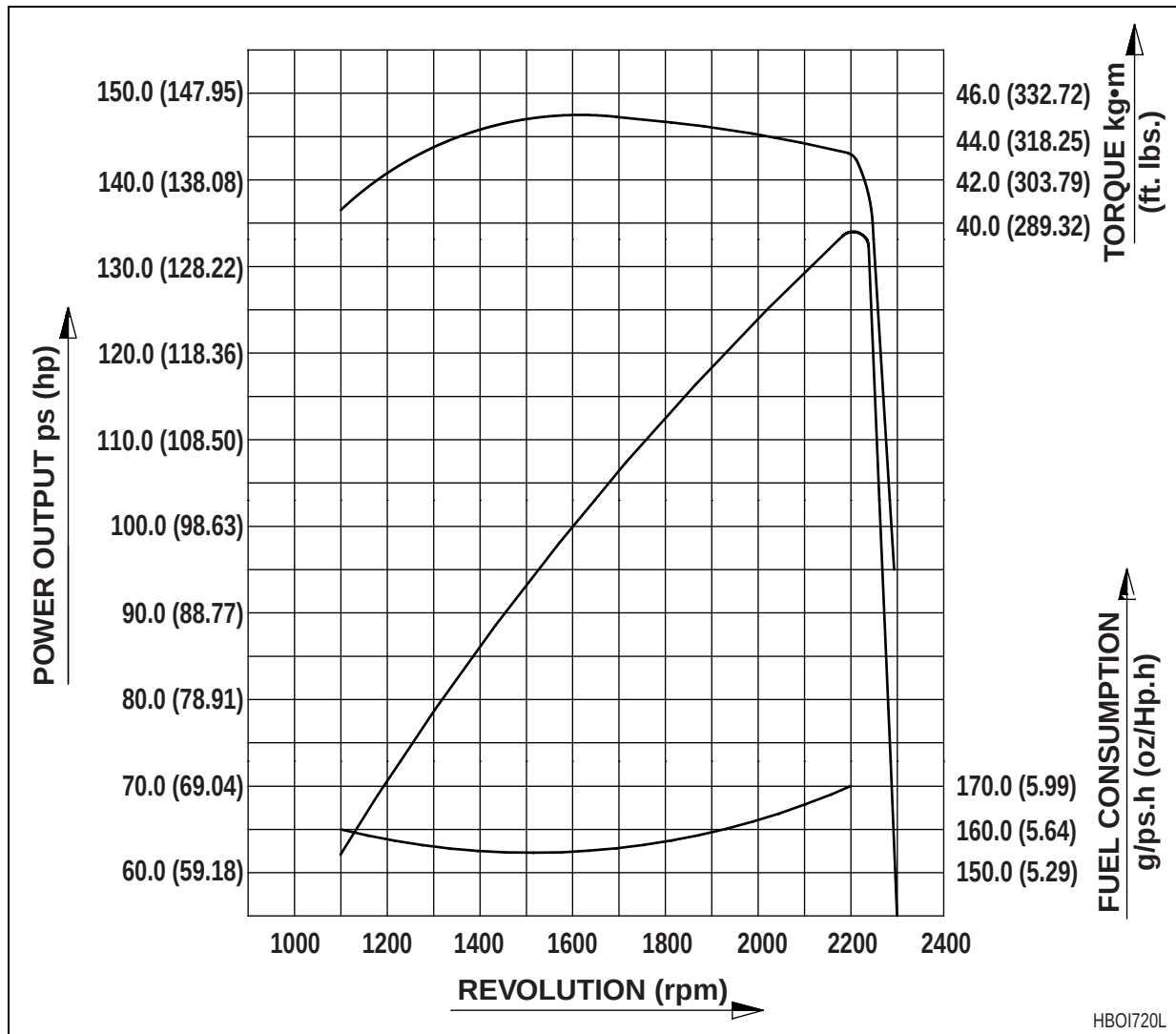
	Boom	Arm	Bucket	Blade	Stabilizer	Chocking
Quantity	2	1	1	2	2	2
Bore	100 mm (3.94 in.)	110 mm (4.33 in.)	95 mm (3.74 in.)	100 mm (3.94 in.)	110 mm (4.33 in.)	80 mm (3.15 in.)
Stroke	1080 mm (42.52 in.)	1110 mm (43.70 in.)	885 mm (34.84 in.)	197 mm (7.75 in.)	310 mm (12.20 in.)	140 mm (5.51 in.)
Rod Dia.	70 mm (2.76 in.)	75 mm (2.95 in.)	65 mm (2.56 in.)	60 mm (2.36 in.)	70 mm (2.76 in.)	80 mm (3.15 in.)
Closed Length	1570 mm (61.81 in.)	1660 mm (65.35 in.)	1365 mm (53.74 in.)	546 mm (21.50 in.)	750 mm (29.53 in.)	331 mm (13.03 in.)
Retract. Cushion	X	O	X	X	X	X
Extend. Cushion	O	O	O	X	X	X
Maker	Dongyang	Dongyang	Dongyang	Dongyang	OI Hyd.	Dongyang

ENGINE SPECIFICATIONS

Model	Daewoo DB58T
Type	4 Cycle In-line 6 Cylinder Diesel, Turbo Charged Water cooled
Engine Block	
Combustion Chamber	Toroidal
Combustion System	Direct Injection
Cylinder Bore and Stroke	102 mm x 118 mm (4.00 in x 4.60 in)
Engine Displacement	5,785 cm ³ (353 in ³)
Direction of Rotation	Counterclockwise (viewed facing flywheel)
Compression Ratio	17.5 : 1
Compression Pressure (Engine Cylinder No-Load Test Pressure)	31 kg/cm ² (440 psi) @ 200 RPM
Cylinder Firing Order	1-5-3-6-2-4
Engine Valve Cold Lash Adjustment	0.4 mm (0.0157 in), intake & exhaust
Valve Timing	Intake Open @ 10° BTDC
	Intake Close @ 42° ABDC
	Exhaust Open @ 50° BTDC
	Exhaust Close @ 10° ABDC
Rated Flywheel Horsepower	134 PS @ 2,200 RPM, per KS R1004;
	99 Kw (132 Hp) @ 2,200 RPM,
	per SAE J1349 net rating and
	99 Kw (134 PS) @ 2,200 RPM,
	per DIN 6271 net rating
Minimum No-Load RPM	1050 (plus or minus 25 rpm)
Torque Output	432 Nm, or 45 kg•m @ 1,600 RPM (318 ft lb @ 1,600 RPM)
Mass (Dry)	450 kg (992 lbs.)
Fuel System	
Fuel Injection Pump	BOSCH A
Fuel Injection Opening Pressure	185 kg/cm ² (2,631 lb/in ²)

Model	Daewoo DB58T
Fuel Injection Timing	18° BTDC
Cooling System	
Injector NozzleType	Multi-hole
Lubrication System	
Fuel Filter	Paper, Element Center Bolt
Governor	Mechanical (RSV)
Fuel Consumption	< 175 g per Hp/hr, @ 2,200 RPM, per DIN 6271
Engine Oil Capacity	19 l (20 qt)
Engine Oil Pressure	4 kg/cm ² (56.9 psi)
Engine Oil	American Petroleum Institute/SAE Class CC/CD or better (Class CD-II, CE, CF-4, CG-4)
Coolant Capacity (Engine only)	12 l (12.7 qt)
Engine Coolant Thermostat	Wax-Pellet Type
Coolant, Thermostat Opening	80°– 84°C (180°– 203°F)
Electrical System	
Batteries	2 x 12V, 100 AH
Charging System Regulator	IC Type (Integrated Circuit)
Alternator	60 amp, 24 V (ICType)
Starter	4.5 Kw, 24V, Magnet Type

ENGINE PERFORMANCE CURVES (PER KS-R1004 STANDARD)



CONDITIO	SPECIFICATION
BAROMETIC PRESSURE	760 mm Hg (20°)
COOLING FAN	590.0 mm (23.23 in.),SUCKER
ALTERNATOR	24V x 50A
AIR CLEANER	INSTALLED
MUFFLE	NOT INSTALLED

PERFORMANCESTANDARD	KS R1004
POWER (MAX , RATED)	134.0 ps (132.17 hp) / 2200 rpm
MAX. TORQUE	45.0 kg·m (325.49 ft lbs) / 1600 rpm
FUEL CONSUMPTION(MIN,RATED	170.0 g/ps·h (5.99 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/M³ (1,850 LB/YD³), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M³ (2,700 LB/YD³), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M³ (3,370 LB/YD³), 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)	-----

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M³ (1,850 LB/YD³), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M³ (2,700 LB/YD³), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M³ (3,370 LB/YD³), OR LESS
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)	-----
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)	-----

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M³ (1,850 LB/YD³), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M³ (2,700 LB/YD³), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M³ (3,370 LB/YD³), OR LESS
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)
Shale, broken	-----	1,362 kg/m ³ (2,295 lb/yd ³)	-----
Sulphur, broken	529 kg/m ³ (1,620 lb/yd ³)	-----	-----

GENERAL SPECIFICATIONS

Shipping Weight	12,500.0 kg (27,558 lbs.), includes 10% fuel, 4,300 mm (14' - 1") mono boom, 2,280 mm (7' - 6") arm, 1,050 mm (3' - 5") backhoe bucket and dozer
Counterweight	1,600 kg (3,527 lbs.)
Upper Turntable	4,100 kg (9,040 lbs.)
Lower Turntable (Incl. Swing Bearing)	4,750 kg (10,472 lbs.)
Operating Weight	12,700 kg (28,000 lbs.) with full fuel tank and operator
Mono Boom	740 kg (1,631 lbs.)
Boom Cylinders	105 kg (232 lbs.) ea
Arm (Std), 2,100 mm (6' 11")	350 kg (772 lbs.)
Long Arm (Opt), 2,250 mm (7' 5")	380 kg (838 lbs.)
Short Arm (Opt), 1,900 mm (6' 3")	320 kg (705 lbs.)
Arm Cylinder	146 kg (322 lbs.)
Bucket (Standard) 0.50 m ³ (0.65 yd ³)	450 kg (992 lbs.)
Bucket Cylinder	88 kg (194 lbs.)
Dozer (Standard)	370 kg (816 lbs.)
Dozer Cylinder	40 kg (88 lbs.) ea
Stabilizer (Option)	560 kg (1,235 lbs.)
Stabilizer Cylinder (Option)	50 kg (110 lbs.) ea
Digging Forces:	
Bucket Cylinder	81.7 kN or 8,336 kg (18,378 ft lbs.) (with 2,100 mm [6' 11"] or 1,900 mm [6' 3"] arm)
Arm Cylinder	65.2 kN or 6,652 kg (14,665 ft lbs.) with 2,100 mm (6' 11") standard arm, 69.3 kN or 7,073 kg (15,593 ft lbs.) with 1,900 mm (6' 3") optional short arm, or 61.3 kN or 6,250 kg (13,779 ft lbs.) with 2,250 mm (7' 5") optional long arm
Fuel Tank Capacity	230.0 liters (60.72 U.S. gal.)
Hydraulic Reservoir Capacity	168.0 liters (44.35 U.S. gal.)
Bucket Heaped Capacity Range	PCSA 0.3 – 0.76 m ³ (2/5 – 1 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.

Undercarriage:	
Ground Clearance	350 mm (13.8")
Wheel Base	2,800 mm (9' 2")
Overall Width	2,494 mm (8' 2")
Dozer Blade Width	2,495 mm (8' 2")
Tire Size	8 x 9.00 – 20 – 14PR (OTR)
Transport Dimensions:	
Overall Shipping Length (standard boom and arm)	7,300 mm (23' 11")
Overall Shipping Width	2,495 mm (8' 2")
Overall Shipping Height (to top of cylinder hose)	3,700 mm (12' 2")
Transport Loading Ramp	15° angle.
Allowable Slope	CAUTION: Refer to Transport Procedure for Safe Shipping Instructions

HYDRAULIC SYSTEM COMPONENT SPECIFICATIONS

Pilot Pump Type: Displacement: Max Flow Rate: Relief Valve:	Gear Pump 10.7 cm ³ /rev (0.65 in ³ /rev) 23.5 l/min (6.2 gal/m) @ 2,200 RPM 40 kg/cm ² (569 lb/in ²)
Control Valve Relief Valves (Main): Left Side Spools: (22 mm [0.87"] diameter) Right Side Spools: (22 mm [0.87"] diameter) Overload Relief Pressure:	350 kg/cm ² (4,978 psi) – travel 330 kg/cm ² (4,692 psi) – all other Dozer/Outtrigger Swing Boom 2 Arm 1 Travel Option Bucket Boom 1 Arm 2 360 kg/cm ² (5,119 psi) Boom, Arm, Bucket, Options, Dozer
Remote Travel Control Valve Type: Pressure/Stroke:	Pilot Control 30 kg/cm ² (427 psi) at 30° pedal angle
Remote Implement Control Valve Type: Pressure/Stroke:	Pilot Control 19 kg/cm ² (270 psi) at 6.5 mm (0.256") stroke
Pilot Accumulator PilotNitrogen Charge: Volume:	15 kg/cm ² (213 psi) 350 cm ³ (19.5 in ³)
Transmission Accumulator Nitrogen Charge: Volume:	8 kg/cm ² (114 psi) 700 cm ³ (42.7 in3)
Brake Accumulator Nitrogen Charge: Volume:	30 kg/cm ² (426 psi) 700 cm ³ (42.7 in ³)

SYSTEM COMPONENT SPECIFICATIONS

DRIVE SYSTEM	
Propeller Shaft (Front & Rear) Max. Allowable Torque Max. Joint Angle Max. Rotating Speed	447.5 kg•m (3,237 ft lbs) 22.5° 5,000 rpm
Tire and Wheel; Standard Type Tire Rim Disc Offset	Double 9.00 – 20 – 14PR, OTR, Tube 7.00T x 20 162 mm (6.38")
Tire and Wheel; Option Type Tire Rim Disc Offset	Wide Single 18 – 19.5 – 14PR, OTR, Tubeless 14.00 x 19.5 67 mm (2.64")
SWING MECHANISM	
Swing Reduction Gear Drive Type Reduction Ratio Max. Output Speed Max. Output Torque Weight	2-Stage Planetary Gear 19.04 105 rpm 495 kg•m (3,580 ft lbs) 88 kg (194 lbs.)
Pinion Gear (Built in Reduction Gear) Type Gear P.C.D No. of Teeth Module	Spur Gear Dia 120 mm (4.72") 10 12

Swing Bearing Type Gear P.C.D No. of Teeth Ball Dia. Race O.D. Race Height Static Thrust Load Weight	Ball Bearing Internal Gear Dia 960 mm (37.79") 80 Dia 28.575 mm (1.125") Dia 1,200 mm (47.24") 100 mm (3.93") 364,500 kg (803,584 lbs.) 230 kg (507 lbs.)
Swing Performance Max Swing Speed Max Swing Torque	12.5 rpm 4,224 kg•m (30,552 ft lbs)
Brake Control Type Brake Torque Brake Release Pressure	Pilot Pressure, Wet Disc 22 kg•m (159 ft lbs) 22 kg/cm ² (313 psi)
Swing Safety Lock Type	Manual Pin Locking
Motor Accessory Brake Time Delayer Make Up Valve Characteristic	5 (+3/20) Sec. 3 kg/cm ² (43 psi) at 120 l/min (31.7 gal/min)
BRAKE SYSTEM	
Accumulator Nitrogen Charge Pressure Volume	30 kg/cm ² (427 psi) 0.7 l (0.73 qt)
Service Brake Valve Max Output Pressure	60 kg/cm ² (853 psi)
Brake Filter Filtration Rating Bypass Valve Pressure	10 micron 1.5 kg/cm ² (21 psi)
System and Pressure System Service Brake Pressure Digging Brake Pressure Brake Distance	Full Hydraulic, Dual Line 60 kg/cm ² (853 psi) 60 kg/cm ² (853 psi) 5.8 m (19') at 24 km/h (15 mi/h)

STEERING SYSTEM	
Steering Cylinder (Built-in Front Axle)	
Bore Size	80 mm (3.15")
Rod Size	40 mm (1.57")
Stroke	92 mm (3.62")
Maximum Pressure	150 kg/cm ² (2,133 psi)
CHOCKING SYSTEM	
Chocking Valve	
Maker & Model	HANIL, HIH1246
Maximum Working Pressure	400 kg/cm ² (5,689 psi)
Check Valve Cracking Pressure	2 kg/cm ² (28 psi)
Make-up Pressure	4.5 kg/cm ² (64 psi)
Oscillating Angle	± 7°

PERFORMANCE TESTS AND STANDARDS

STANDARDS

1. Main Relief Pressure
 - normal operation: 330 bar (4,786 psi)
 - with high travel "Pressure Up": 343 bar (4,974 psi)
2. Actuator Speeds

Operation		Unit	H Mode	S Mode
Boom	Up	seconds	3.1 ± 0.4	3.2 ± 0.4
	Down	seconds	2.8 ± 0.4	2.8 ± 0.4
Arm	Dump	seconds	2.7 ± 0.4	2.6 ± 0.3
	Crowd	seconds	2.1 ± 0.4	3.2 ± 0.4
Bucket	Dump	seconds	2.0 ± 0.4	2.0 ± 0.3
	Crowd	seconds	3.3 ± 0.4	3.3 ± 0.4
Dozer	Up	seconds	3.1 ± 0.4	3.3 ± 0.4
	Down	seconds	2.8 ± 0.4	3.0 ± 0.4
Swing (3 Revolutions)		seconds	13.1 ± 0.4	14.4 ± 0.7
Stabilizer	Up	seconds	2.0 ± 0.4	
	Down	seconds	2.5 ± 0.4	
Propeller Shaft	High	RPM (min)	$2,700 \pm 50$	
	Low	RPM (min)	740 ± 50	
Breaking Distance		m	5.8 @ 24 km/h (14.9 mph)	

TESTS

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, 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.

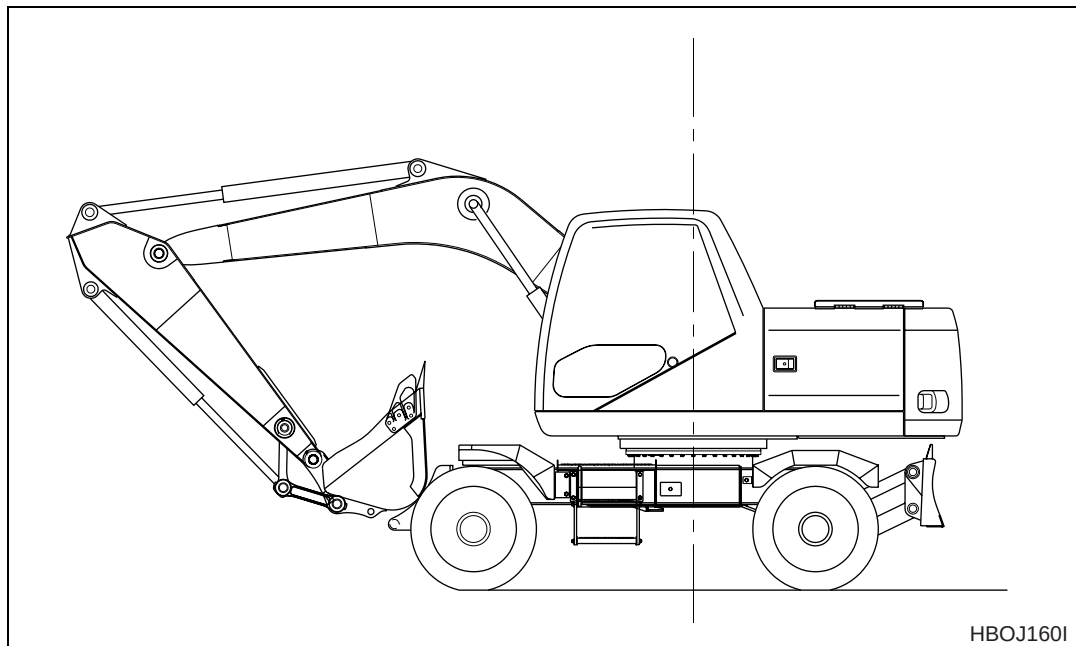


Figure 6

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° to 55°C (112° to 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 S (standard work mode) and Power Mode H (high speed mode). Travel speed tests should also be repeated at both high and low speed.

TRAVEL SPEED TESTS

Travel Mode	Speed
High Speed	37 km/h (23 mph)
Low Speed	10 km/h (6.21 mph)

1. Block up all wheels securely.
2. Check that RPM at drive shaft is above
2,700 RPM at high speed and above
 740 ± 50 RPM at low speed.

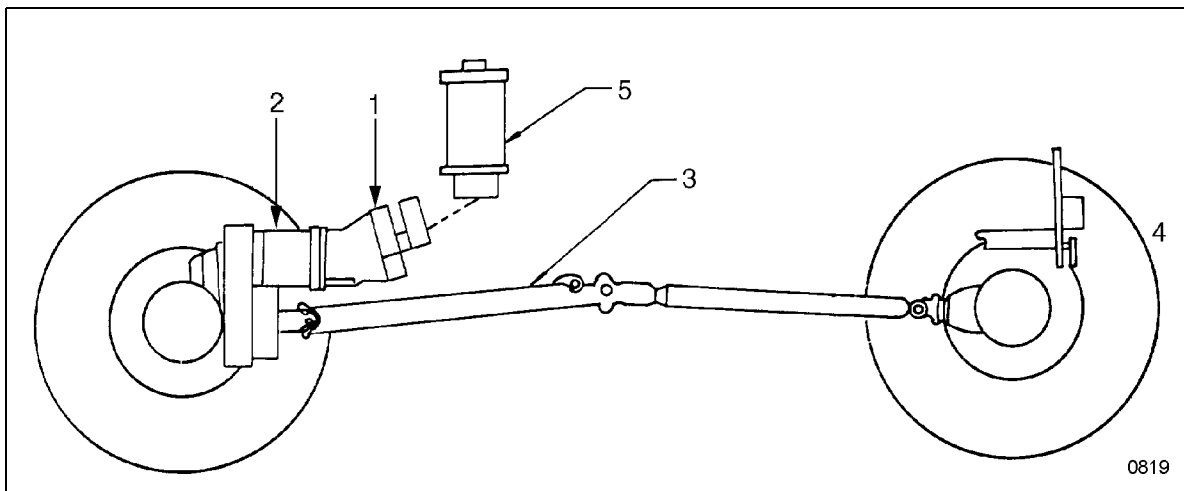


Figure 7

1. Travel Motor
2. Transmission
3. Propeller Shaft
4. Front Axle
5. Center Joint

SWING SPEED TEST

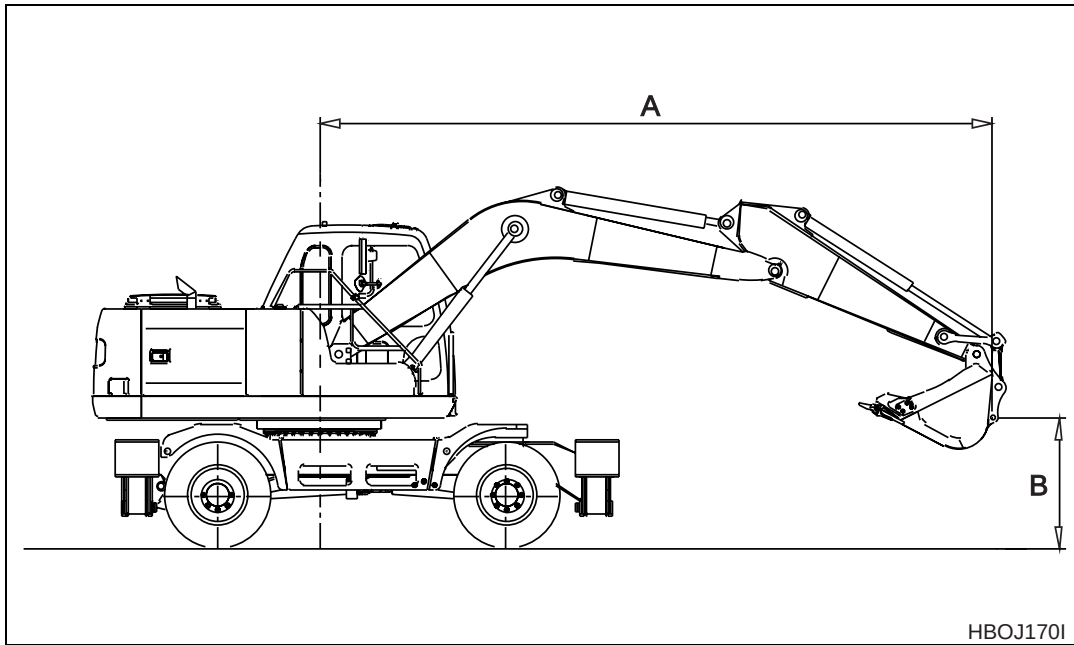


Figure 8

SWING SPEED TEST

Extend the arm cylinder completely and retract the bucket cylinder, as shown, to test swing speed. The lowest point of the bucket will be approximately 1.5 m (just over 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 is 13.7 seconds, in both Power Mode H and Power Mode S.

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, 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, at “swing stop” (4).

Record how far the turntable drifts past the stop point, measuring the distance between paint marks. Maximum distance should be less than 700 mm (27 1/2") or less, in both Power Mode H and Power Mode S.

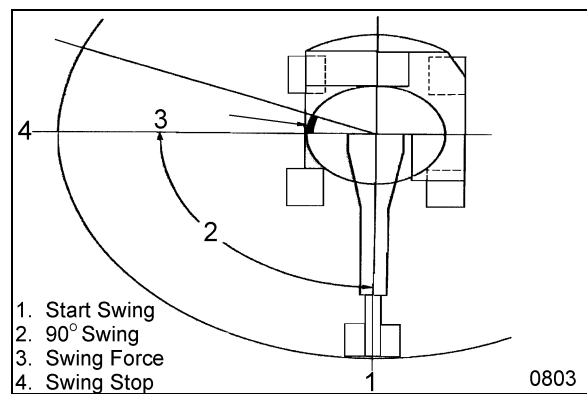


Figure 9

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 S and Power Mode H.

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' to 2') above the ground. Dump and crowd the bucket several times, and average results, for both standard and extra-duty power modes

Measurement in Seconds

Operation	Mode H	Mode S
Boom up	3.1 ± 0.4	3.2 ± 0.4
Boom down	2.8 ± 0.4	2.8 ± 0.4
Arm dump	2.7 ± 0.4	2.6 ± 0.4
Arm crowd	2.1 ± 0.4	3.2 ± 0.4
Bucket dump	2.0 ± 0.4	2.0 ± 0.4
Bucket crowd	3.3 ± 0.4	3.3 ± 0.4

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 mm to 50 mm (1" to 2") and boom cylinders are retracted the same amount, 20 mm to 50 mm (1" to 2"). The top of the bucket should be approximately 2 m (6' to 7') off the ground.

Turn off the engine and measure cylinder drop after 5 minutes. Maximum cylinder drops are as follows: boom and bucket 20 mm (0.787"); arm 40 mm (1.57"); and blade 10 mm (0.39").

GENERAL MAINTENANCE



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

TABLE OF CONTENTS

Welding Precautions and Guidelines	3
Hydraulic System - General Precautions	4
Maintenance Service and Repair Procedure	5
General Precautions	5
Hydraulic System Cleanliness And Oil Leaks	6
Maintenance Precautions for Hydraulic System Service	6
Oil Leakage Precautions	6
Cleaning and Inspection.....	7
General Guidelines	7
Bearing inspection	8

WELDING PRECAUTIONS AND GUIDELINES

IMPORTANT

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

WARNING!

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

CAUTION!

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



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 prior to 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 (as well as 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 multi-display 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 life 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 – as well as 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 prior to 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 prior to assembly

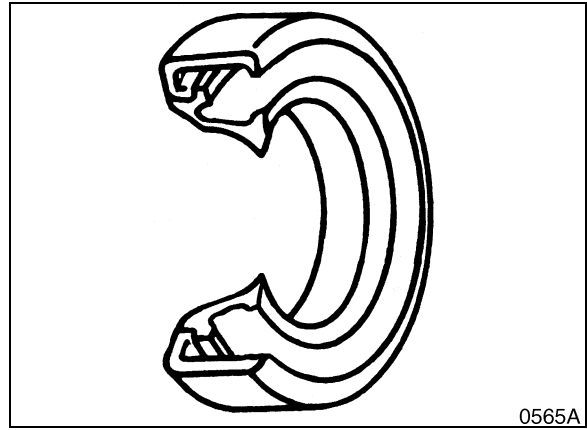


Figure 1

CLEANING AND INSPECTION

GENERAL GUIDELINES

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



WARNING!

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

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

For those bearings that are to be inspected in place; inspect bearings for roughness of rotation, scoring, pitting, cracked or chipped races. If any of these defects are found, replace bearings. Also inspect defective bearing housing and/or shaft for grooved, galled or burred conditions that indicate bearing has been turning in its housing or on its shaft.

4. It is more economical to replace oil seals, O-rings, sealing rings, gaskets and snap rings when unit is disassembled than waiting for premature failures; refer to latest Micro Fiche and/or Parts Book for replacement items. Be extremely careful when installing sealing members, to avoid cutting or

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 can not be removed and is to be inspected in place, check for 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

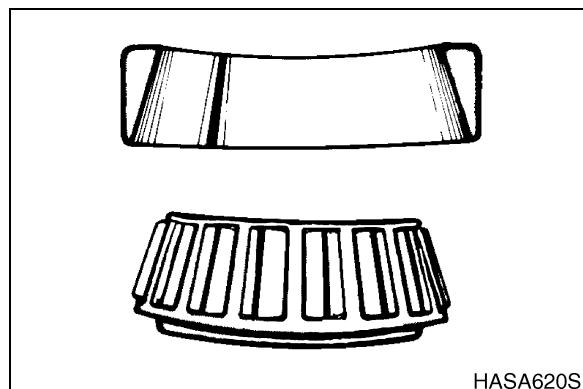


Figure 2

Bent Cage

Cage damage due to improper handling or tool usage.

Replace bearing

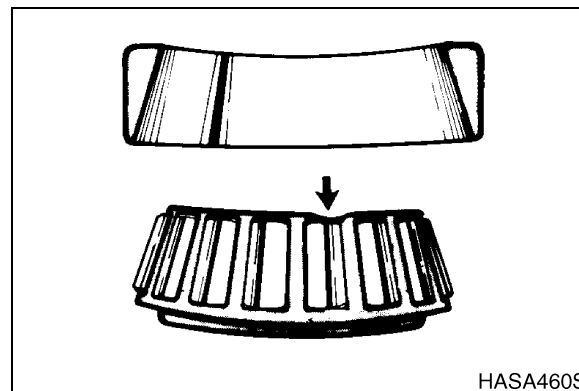


Figure 3

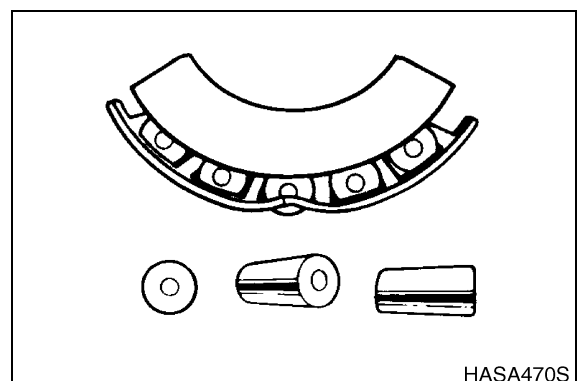


Figure 4

Galling

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

Replace bearing - check seals and check for proper lubrication.

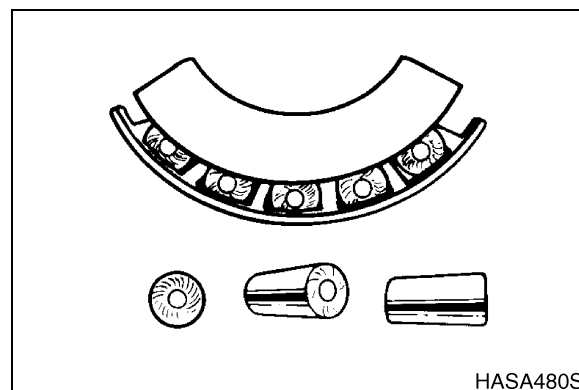


Figure 5

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.

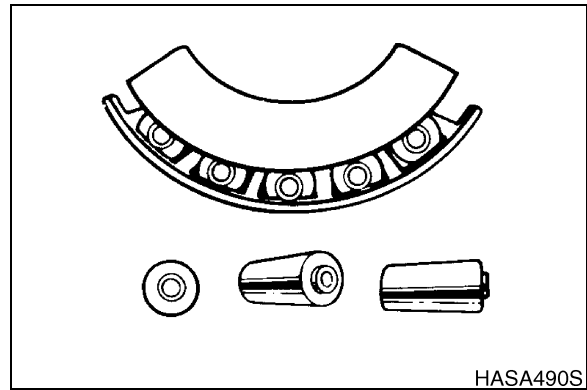


Figure 6

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.

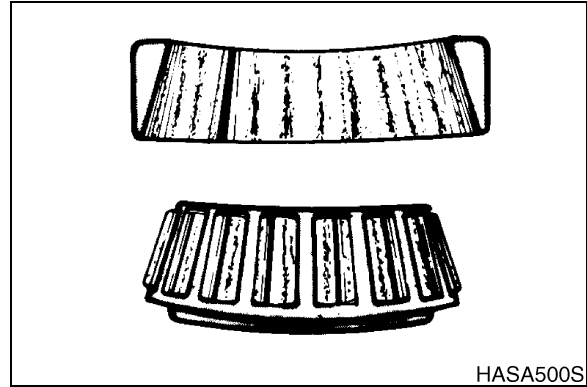


Figure 7

Misalignment

Outer race misalignment due to foreign object.

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

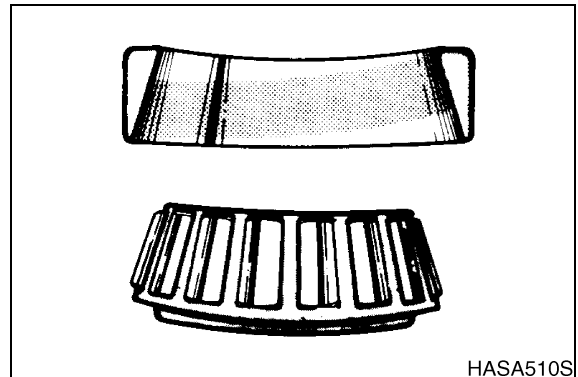


Figure 8

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.

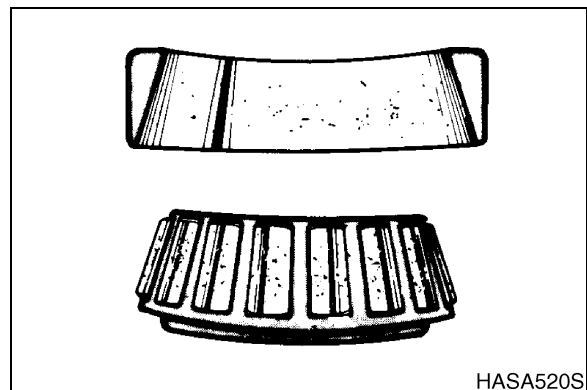


Figure 9

Fatigue Spalling

Flaking of surface metal resulting from fatigue.

Replace bearing - clean all related parts.

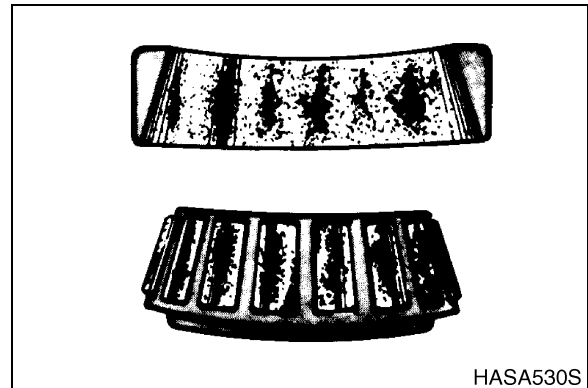


Figure 10

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.

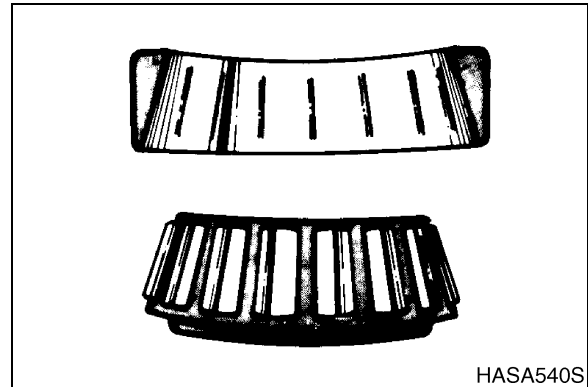


Figure 11

Cage Wear

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

Replace bearings - check seals.

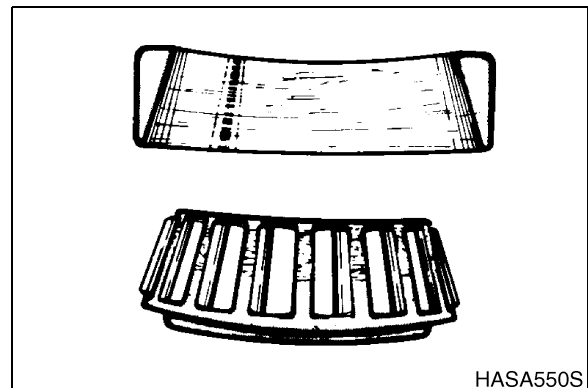


Figure 12

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

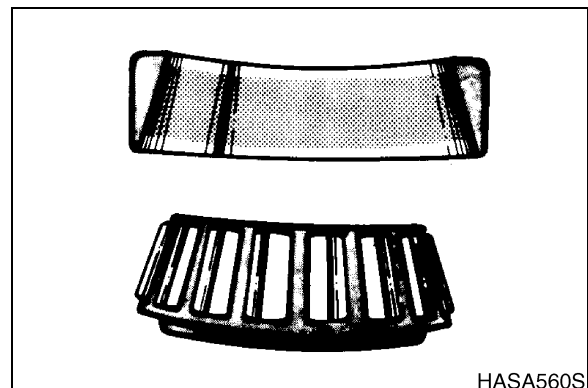


Figure 13

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.

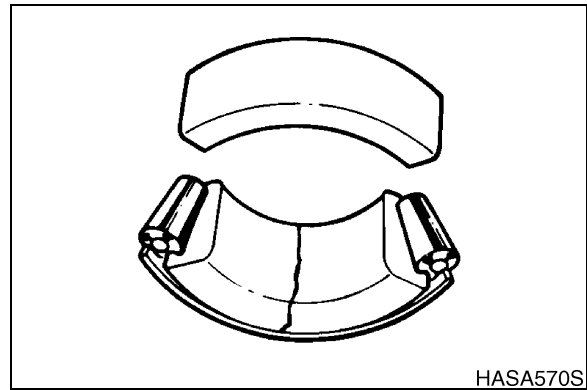


Figure 14

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.

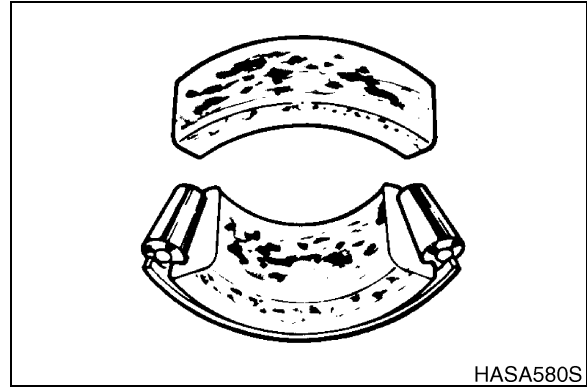


Figure 15

Fretting

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.

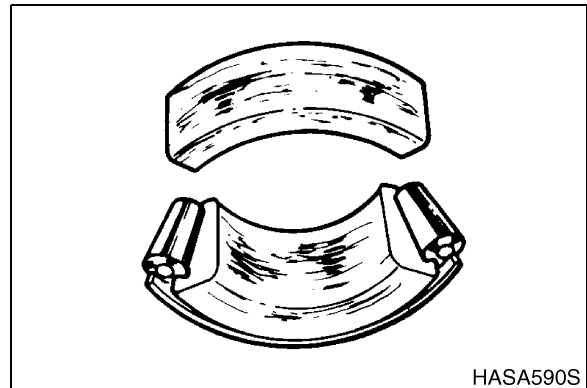


Figure 16

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

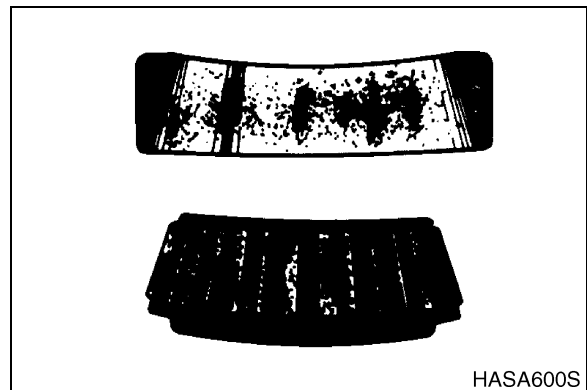


Figure 17

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.

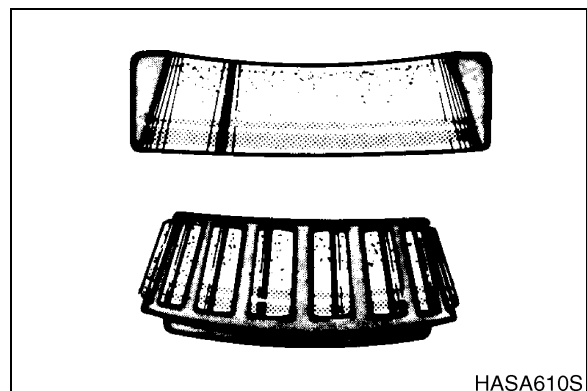


Figure 18



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

TABLE OF CONTENTS

Torque Values for Standard Metric Fasteners	3
Torque Values for Standard U.S. Fasteners	4
Type 8 Phosphate Coated Hardware	6
Torque Values for Hose Clamps	7
Torque Values for Split Flanges	8
Torque Wrench Extension Tools	9
Torque Multiplication	9
Other Uses for Torque Wrench Extension Tools	10
Tightening Torque Specifications (Metric)	10

TORQUE VALUES FOR STANDARD METRIC FASTENERS

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

Grade Dia. x Pitch (mm)	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 (43.23)	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 (132.26)	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 HeatTreated	
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: <i>TORQUE VALUES LISTED THROUGHOUT THIS MANUAL ARE LUBRICATED (WET) THREADS; VALUES SHOULD BE INCREASED 1/3 FOR NON-LUBRICATED (DRY) THREADS</i>				
THREAD SIZE	HEAT TREATED MATERIAL GRADE 5 & GRADE 8			
	GRADE 5 (3 RADIAL DASHES ON HEAD)		GRADE 8 (6 RADIAL DASHES ON HEAD)	
	FOOT POUNDS (Ft. Lbs.)	NEWTON METER (N.m)	FOOT POUNDS (Ft. Lbs.)	NEWTON METER (N.m)
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 $\pm$ 10%	
	KILOGRAM METER (kg m)	FOOT POUNDS (Ft. Lbs.)
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 PLUS OR MINUS 5 lbf in (0.1 kg m)			
	RADIATOR, AIR CLEANER, BOOTS, ETC.		HYDRAULIC SYSTEM	
	KILOGRAM METER (kg m)	INCH POUNDS (In. Lbs.)	KILOGRAM METER (kg m)	INCH POUNDS (In. Lbs.)
``T" Bolt (Any Diameter)	0.6 - 0.7	55 - 65	-----	-----
Worm Drive - 1-3/4 in. Open Diameter & 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: *Overtorquing 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. Lbs.)
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 in order to achieve recommended tightening torque values.

Common problems that could occur as a result are:

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

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

TORQUE MULTIPLICATION

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

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

$I = A \times T / A + B$ 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.

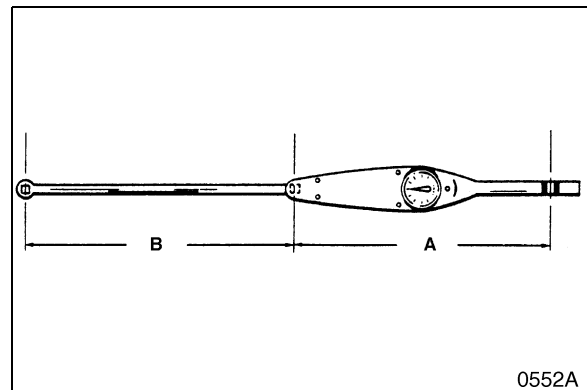


Figure 1

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 excavator, 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 to 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 to 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 to 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



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 130W-V	0001 and Up

TABLE OF CONTENTS

Removal	3
Installation	5
Window and Gasket Replacement	8
Falling Object Protective Structures (F.O.P.S.)	9

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.

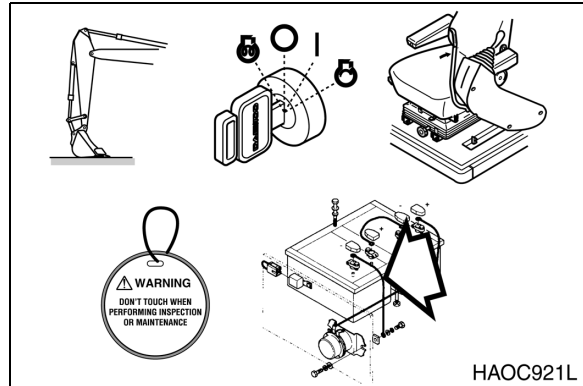


Figure 1

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 (5, 6, 7 and 9, Figure 2). When removing duct cover (7), disconnect hour meter connector.
11. Remove air duct (3, 4 and 8, Figure 2) located at right side of cab. Disconnect duct wiring connector before removing air duct (3).
12. Disconnect wiper motor connector and front window washer hose located at floor plate bottom.

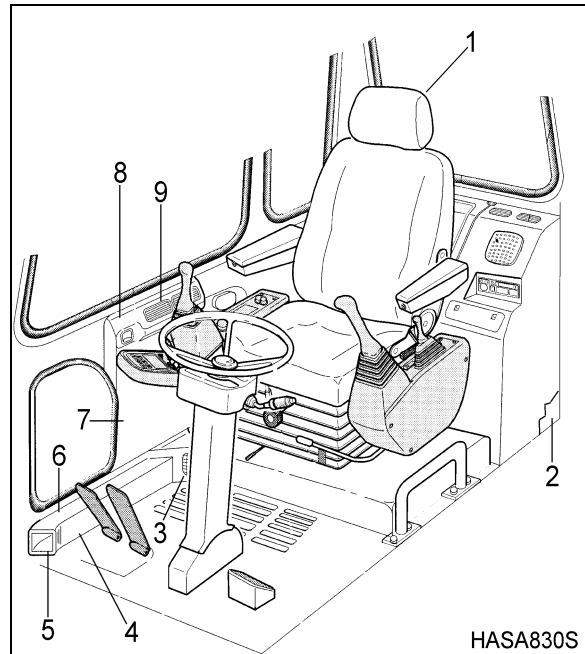


Figure 2

13. Remove two rubber stops (2, Figure 3) used in storing the front lower glass. Remove bolts (1) from the rear left and right dash covers. Lift left side cover (3) slightly and disconnect speaker wire, stereo wire and antenna wire connector. Remove left cover (3).
14. Lift right side cover (4, Figure 3) and disconnect speaker wire. Remove right side cover.
15. Disconnect cab lamp wiring connector.
16. Disconnect cabin ground cable (2, Figure 2).

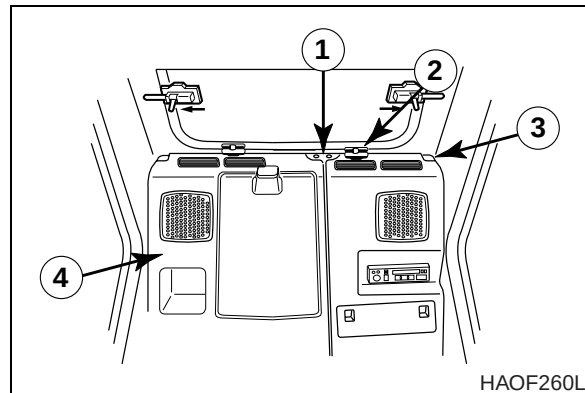


Figure 3

17. Remove four mounting nuts from four corners of cabin floor (2, Figure 4).
18. Remove four hex bolts (3, Figure 4) from door side of cabin floor.
19. Remove two hex bolts (1, Figure 4) 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.

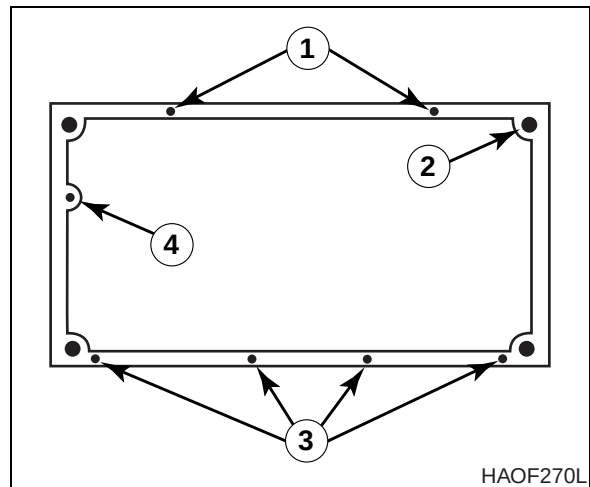


Figure 4

20. Using a suitable lifting device, attach slings to four lift points on top of cab (Figure 5).
- NOTE:** Cab weighs approximately 290 kg (639 lb).
21. Lift cab from 25 - 50 mm (1" - 2") above deck height. Check that all electrical connections have been disconnected and all other items unbolted.
 22. Continue lifting with the assist crane to remove the cab shell. Lower the shell to a pre-prepared safe blocking support.

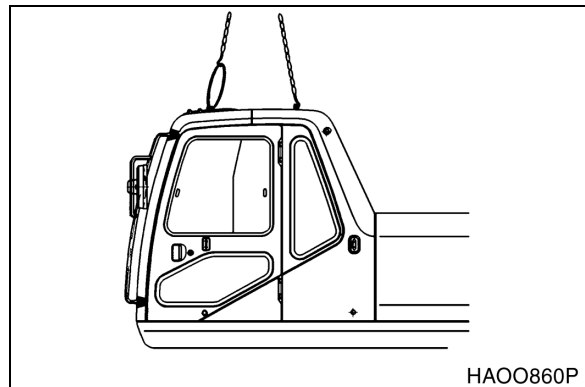


Figure 5

INSTALLATION

1. Using a suitable lifting device, attach slings to four lift points on top of cab (Figure 5).
- NOTE:** Cab weighs approximately 290 kg (639 lb).
2. Lower cab into position on cab floor

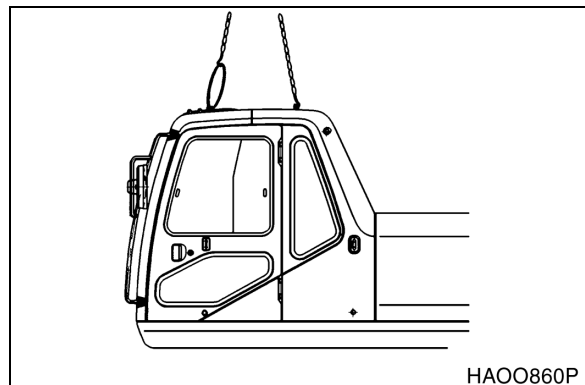


Figure 6

3. Install four mounting nuts on four corners of cabin floor (2, Figure 4).

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

4. Install four hex bolts (3, Figure 4) in door side of cabin floor.
5. Install two hex bolts (1, Figure 4) 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.

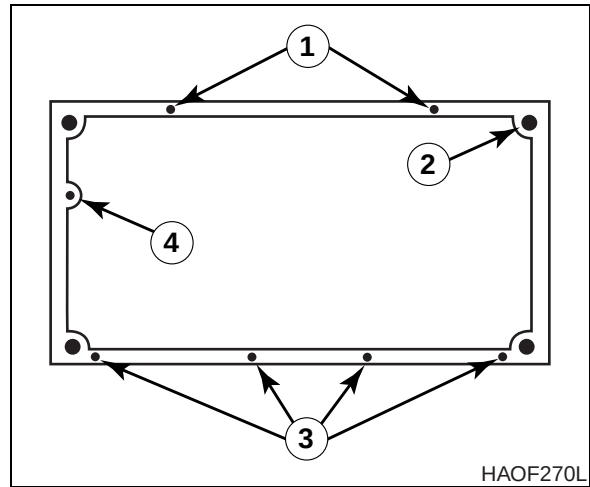


Figure 7

6. Once cab is mounted to floor unhook lifting device
7. Connect cabin ground cable (2, Figure 2).
8. Connect cab lamp wiring connector.
9. Connect speaker wire to right side cover (4, Figure 3).
10. Connect speaker wire, stereo wire and antenna wire connector to left side cover (3).
11. Install bolts (1) to hold rear left and right dash covers (3 and 4) in place.
12. Install two rubber stops (2, Figure 3) used in storing the front lower glass.

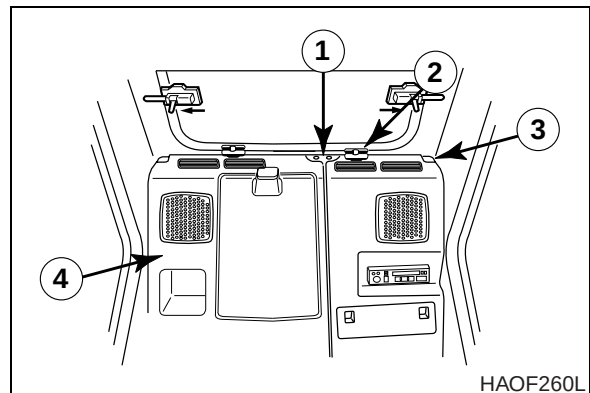


Figure 8

13. Connect wiper motor connector and front window washer hose located at floor plate bottom.

14. Install air duct (3, 4 and 8, Figure 2) located at right side of cab.

NOTE: *Connect duct wiring connector before installing air duct (3).*

15. Connect hour meter connector and install duct covers (5, 6, 7 and 9, Figure 2).

16. Install operator's seat (1, Figure 2).

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

17. Install floor mat.

18. Disconnect negative (-) battery cable leading to frame from battery.

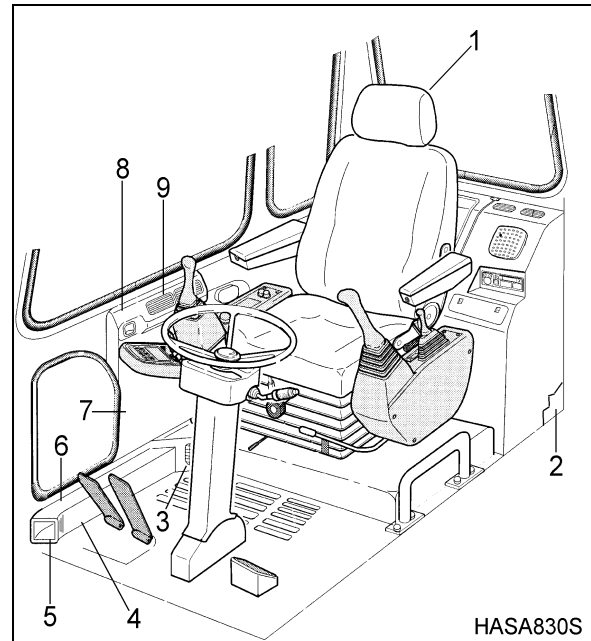


Figure 9

WINDOW AND GASKET REPLACEMENT

The cab removal drawing also shows replacement glass and mating window gaskets and rubber trim pieces.

When replacing glass or weather-strip gaskets, always:

- Make sure the window frame and rubber trim section are both clean.
- Use soap and water to lubricate both the rubber and glass for assembly.
- A sharp, curving metal hook and/or a straight, pointed awl can be helpful in easing window glass into position. Start from the bottom of the frame and work up.

IMPORTANT

When replacing window glass or making any type of structural repair to any part of the operator's cab, consider the cause of the damage and evaluate the potential for other threats or hazards in the operating environment. Refer to "Falling Object Protective Structures (F.O.P.S.)" on page-9 and make an evaluation to determine the need for additional protection for the operator.

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



DANGER!

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

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

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

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



WARNING!

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

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

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

IMPORTANT

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



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 130W-V	0001 and Up

TABLE OF CONTENTS

General.....	3
Removal	4
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 counterweight weighs 1,600 kg (3,527 lbs.). 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 1,600 kg (3,527 lbs.) capacity is required.

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.

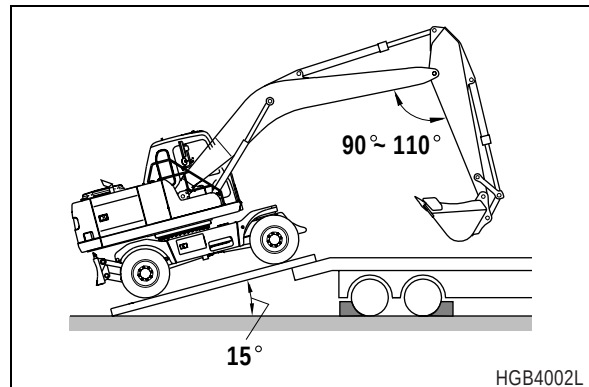


Figure 1

When loading an excavator 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).

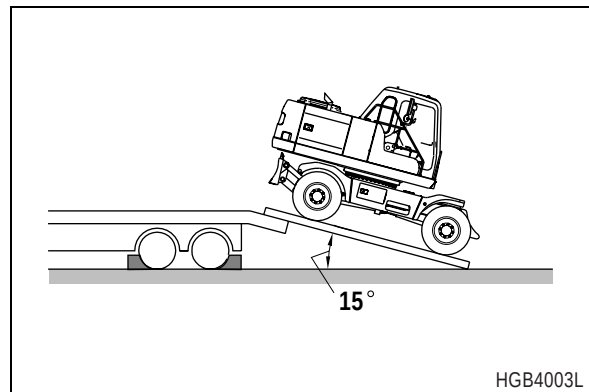


Figure 2

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.

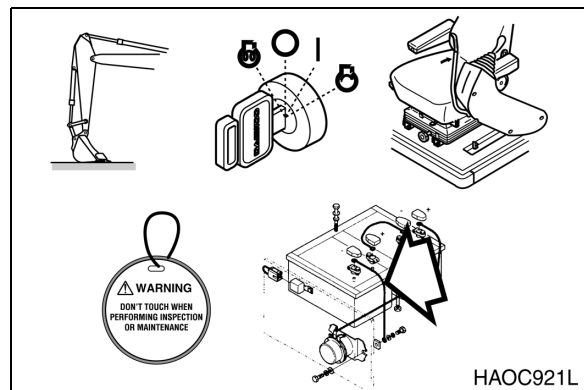


Figure 3

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. Using a suitable lifting device capable of handling 1,600 kg (3,527 lbs.), attach two lifting hooks to points (A and B, Figure 4). Partially support counterweight (1) before beginning to loosen four 27 mm bolts (2). Stop lifting with assist crane as soon as lifting slings are taut.

9. Remove four bolts (2, Figure 4) and washers (3) from counterweight (1).

NOTE: Heat bolts if necessary, to free them.

10. When bolts (2, Figure 4) and washers (3) have been removed, lift counterweight (1) a very short distance above support frame (4) and stop. Check slings and make sure counterweight is being supported evenly. Once checked, continue to remove counterweight.
11. Remove shims (5) and plates (6) from frame (4).

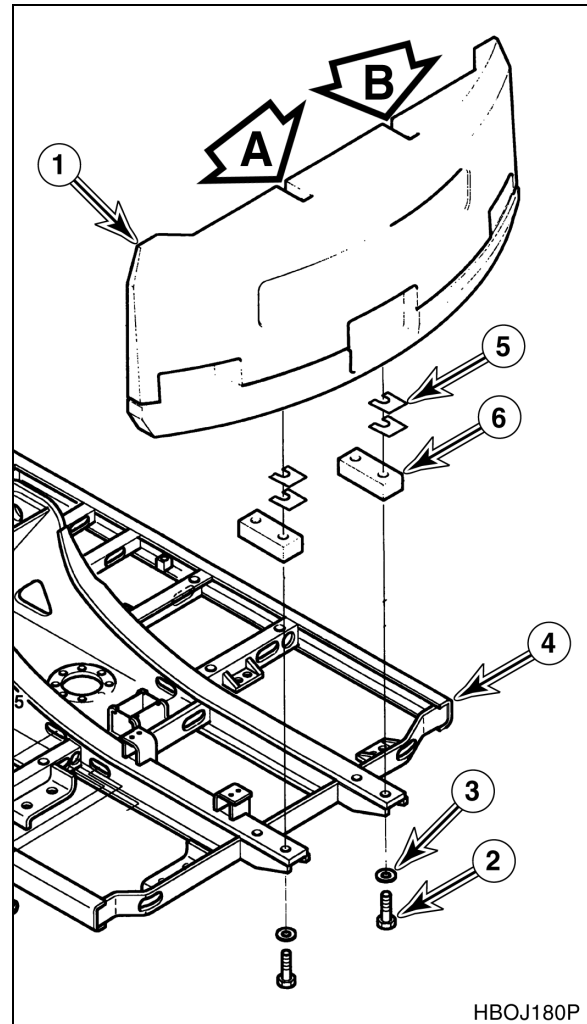


Figure 4

INSTALLATION

1. Raise engine compartment cover.
2. Set plates (6, Figure 5) (without shims) into position on frame (4).
3. Using suitable lifting device capable of handling 1,600 kg (3,527 lbs.), raise counterweight (1, Figure 5) into position just above support frame (4) and plates (6) leaving counterweight suspended. Verify that counterweight is level and even.

NOTE: Leave counterweight (1, Figure 5) suspended 3 mm (0.125") above support frame (4) until all four mounting holes on the counterweight, plates and the frame holes are aligned.

4. Install four bolts (4, Figure 5) with washers (5) into counterweight until washers contact support frame. Fully lower counterweight onto plates and support frame.
5. Using a feeler gauge, check for a gap between counterweight (1, Figure 5) and plates (6). Use an appropriate amount of shims (5) for each bolt location.
6. Remove four bolts (2, Figure 5) and washers (3).
7. Raise counterweight (1, Figure 5) so that shims (5) can be set into position on each plate (6).
8. Lower counterweight (1, Figure 5) until it is 3 mm (0.125") above the shims (5) and install four bolts and washers. Apply Loctite 242 to mounting bolt threads.
9. Fully lower counterweight (1, Figure 5) onto shims (5), plates (6) and support frame (4) and finish tightening bolts (5) to 115 kg•m (832 ft lbs).
10. Remove lifting device and lifting hooks from counterweight (1, Figure 5).
11. Connect negative (-) battery cable to battery.

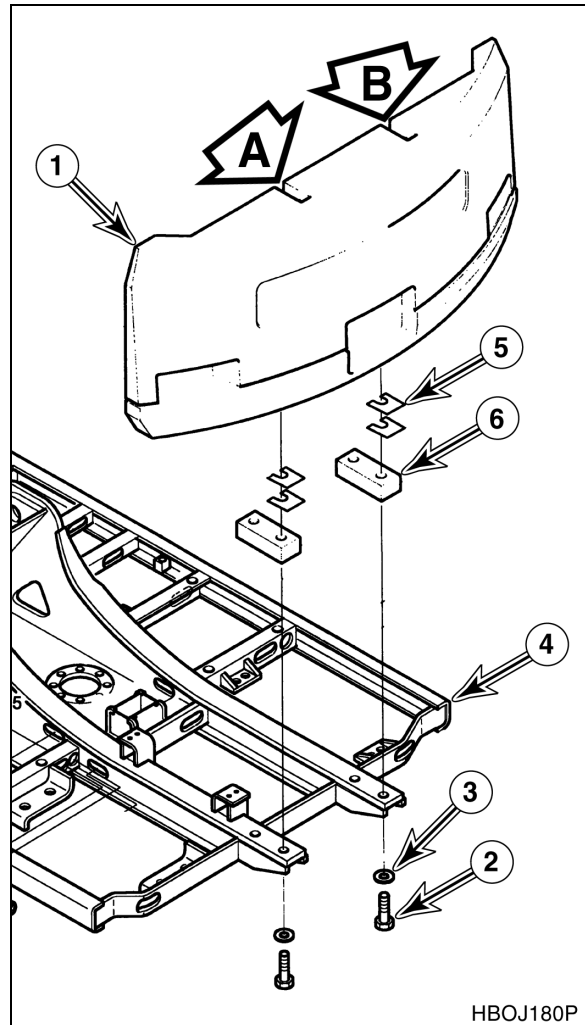


Figure 5



FUEL TANK



CAUTION!

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

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

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Solar 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Parts List	4
Specifications	5
Removal	6
Installation	9
Start-up Procedures	11

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.

Reference Number	Description
1	Fuel Tank
2	Filter
3	O-ring
4	Cover
5	Bolt
6	Spring Washer
7	Cock
8	Bolt
9	Shim
10	Shim
11	Fuel Filter
12	Cap
13	Plug
14	Level Gauge

Reference Number	Description
14a	Plate
14b	O-ring
14c	Bolt
14d	Plug
14e	Tape
18	Cover Flange
19	O-ring
20	Socket Bolt
23	Hard Washer
24	Bolt
25	Vinyl Hose
26	Hose Clamp
28	Hose Clamp

SPECIFICATIONS

Model	Fuel Tank Capacity
130W-V	230 liters (60.8 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.*

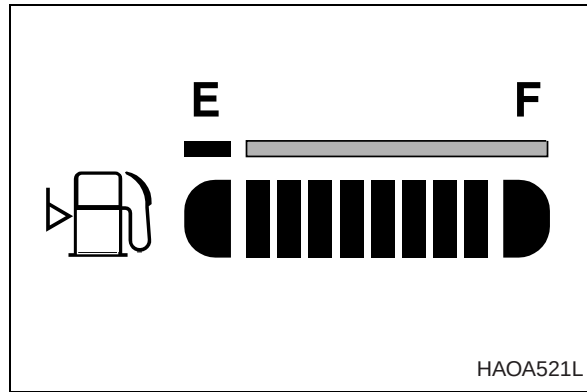


Figure 2

2. Park on firm and level ground and swing turntable to approximately a 180° with respect to wheels. See Figure 3.

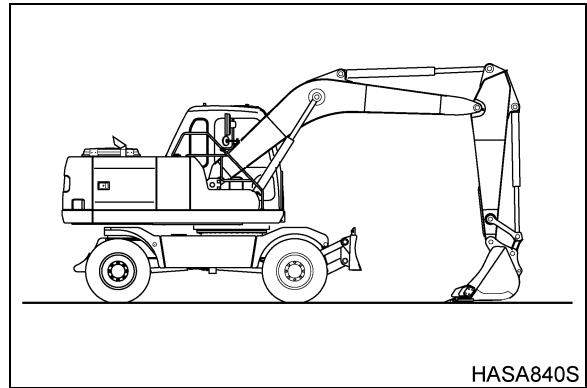


Figure 3

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.

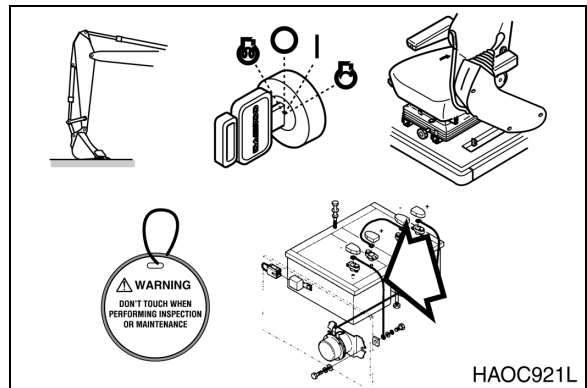


Figure 4

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

8. Clean area around fuel tank fill cap (Figure 5). Open fuel cap
9. Remove access cover located under fuel tank.



Figure 5

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

NOTE: Refer to "Specifications" on page 5, for fuel tank capacity.

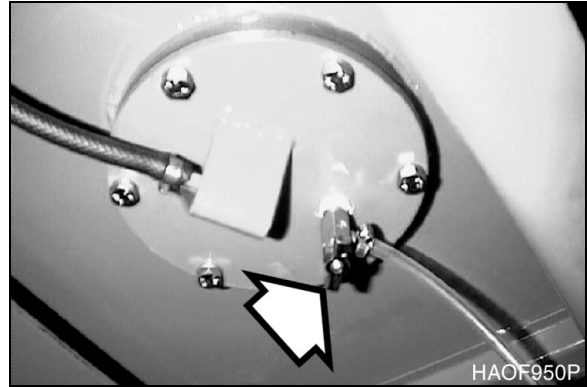


Figure 6

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

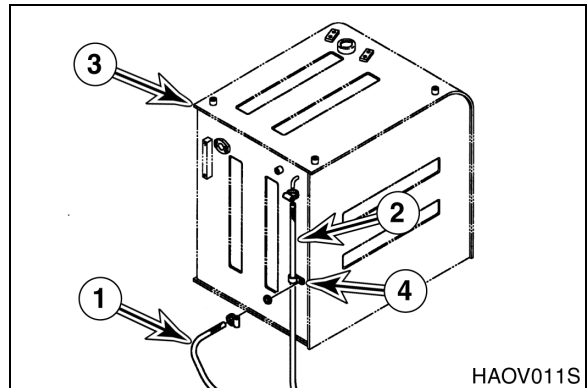


Figure 7

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

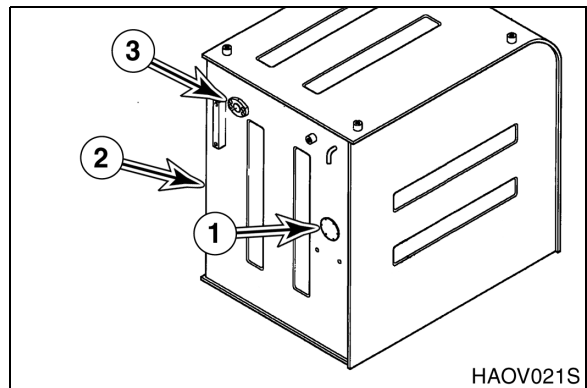


Figure 8

15. Remove six bolts and washers (1, Figure 9), and handrail (2) from fuel tank (3) and cover (4).

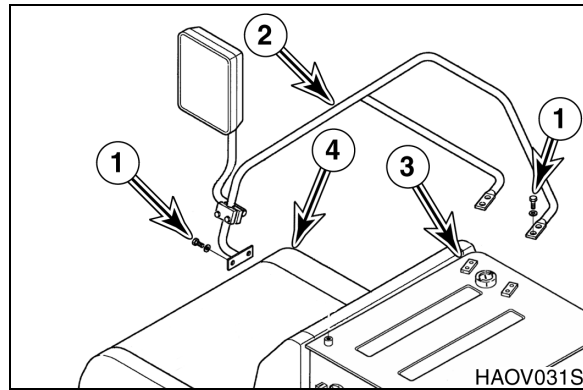


Figure 9

16. Remove four bolts and washers (1, Figure 10) and cover (2) from fuel tank (3) and support (4).

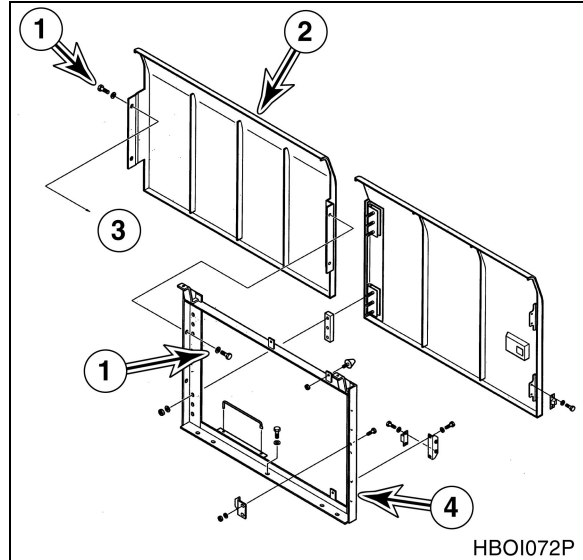


Figure 10

17. Install two 12 mm eye bolts in threaded holes at top surface of tank (1 and 2, Figure 11). Using a suitable lifting device, sling eye bolts.
18. Remove four bolts and washers (4, Figure 11) 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 11).

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

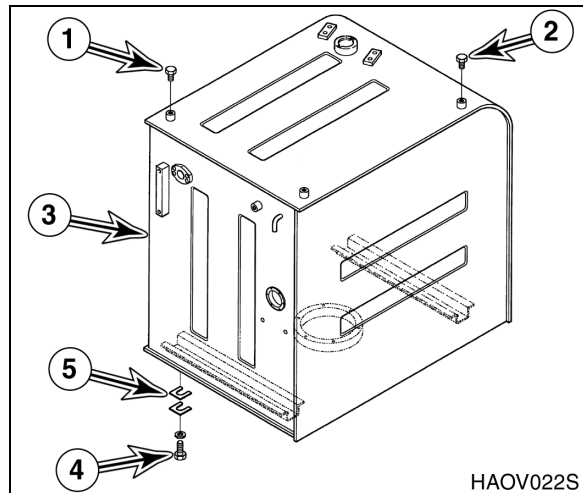


Figure 11

INSTALLATION

NOTE: Be sure to clean or replace fuel strainer/screens prior to installation. These are located in top and bottom of fuel tank and mounted in-line, downstream from fuel filler pump.

1. Install two 12 mm eye bolts in threaded holes at top surface of tank (1 and 2, Figure 12). Using a suitable lifting device, sling eye bolts.
2. Set fuel tank (3, Figure 12) into position. Install four bolts and washers (4) figure tight, to secure tank (3) 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 12) as needed to prevent tank (3) from rocking or stress from mounting bolts (4).
4. Tighten mounting bolts (4, Figure 12) after shims are installed.
5. Install cover (2, Figure 13) on fuel tank (3) and support (4) with four bolts and washers (1).

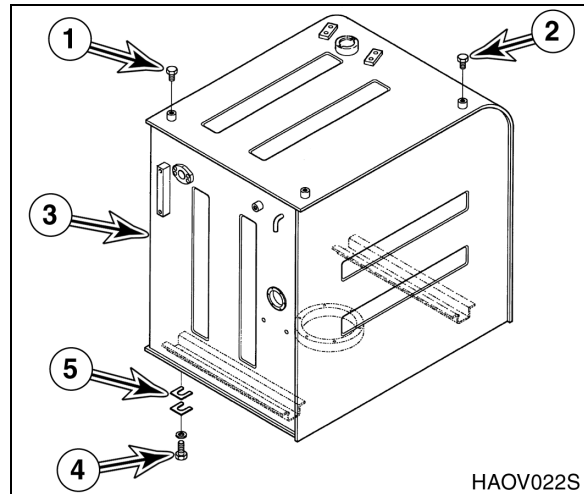


Figure 12

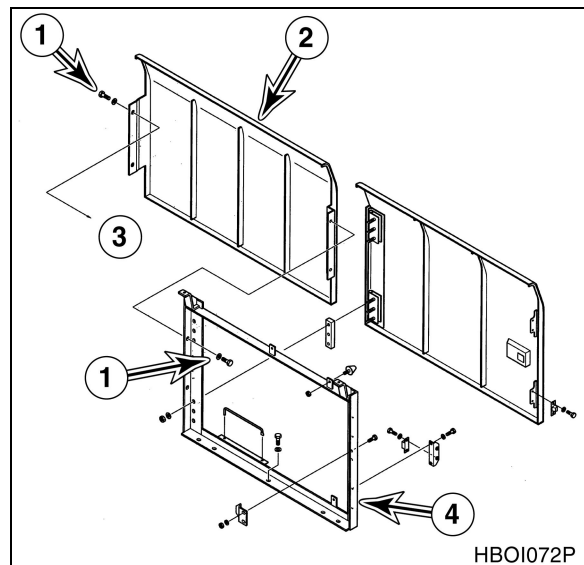


Figure 13

6. Install six bolts and washers (1, Figure 14), and handrail (2) on fuel tank (3) and cover (4).

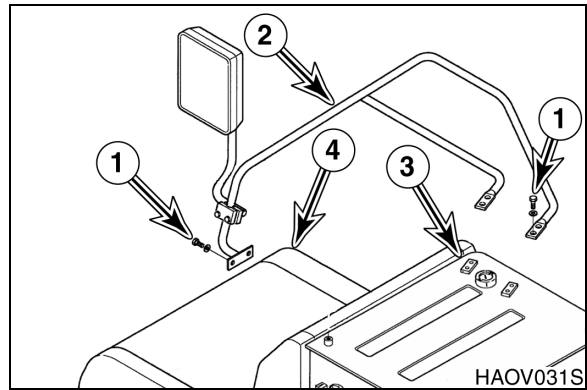


Figure 14

7. Connect wires as tagged to fuel sensor (1, Figure 15) on side of fuel tank (2).
8. If equipped, connect components to the fuel filler pump port (3, Figure 15) on side of fuel tank (2).

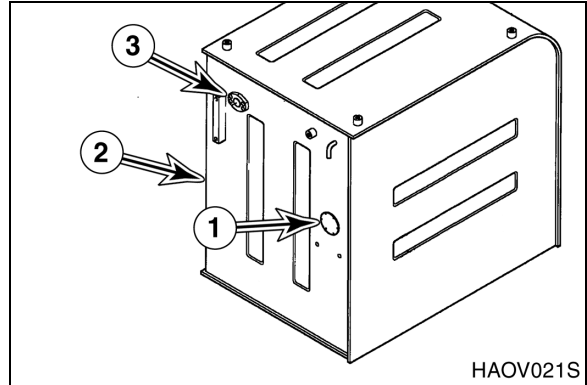


Figure 15

9. Connect as tagged, fuel supply line (1, Figure 16) and fuel return line (2) to fuel tank (3).
10. Install clamp (4, Figure 16) to hold fuel return line (2) to tank (3).

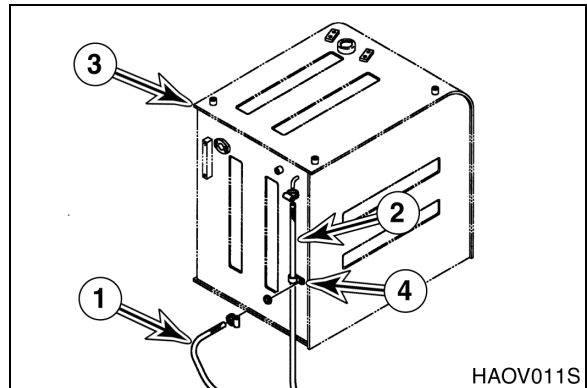


Figure 16

11. Make sure fuel tank drain valve (Figure 17) on bottom of tank is closed.
12. Fill fuel tank and check for signs of leaks. Correct any problems found.
13. Install access cover to protect bottom of tank.
14. Connect negative (-) battery cable to battery.

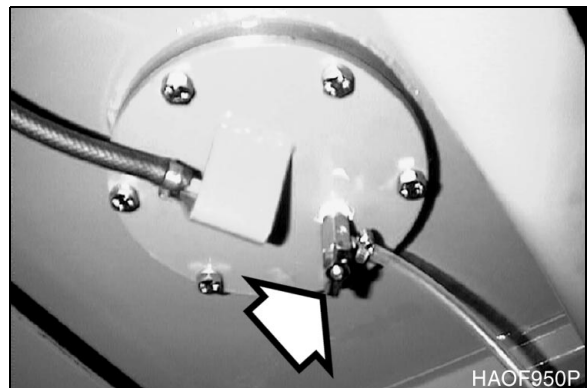


Figure 17

START-UP PROCEDURES

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



SWING BEARING



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 130W-V	0001 and Up

TABLE OF CONTENTS

Swing Bearing Maintenance	3
Operating Recommendation	3
Measuring Swing Bearing Axial Play	3
Measuring Bearing Lateral Pla	3
Swing Bearing Basic Operation	4
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.

MEASURING BEARING LATERAL PLAY

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

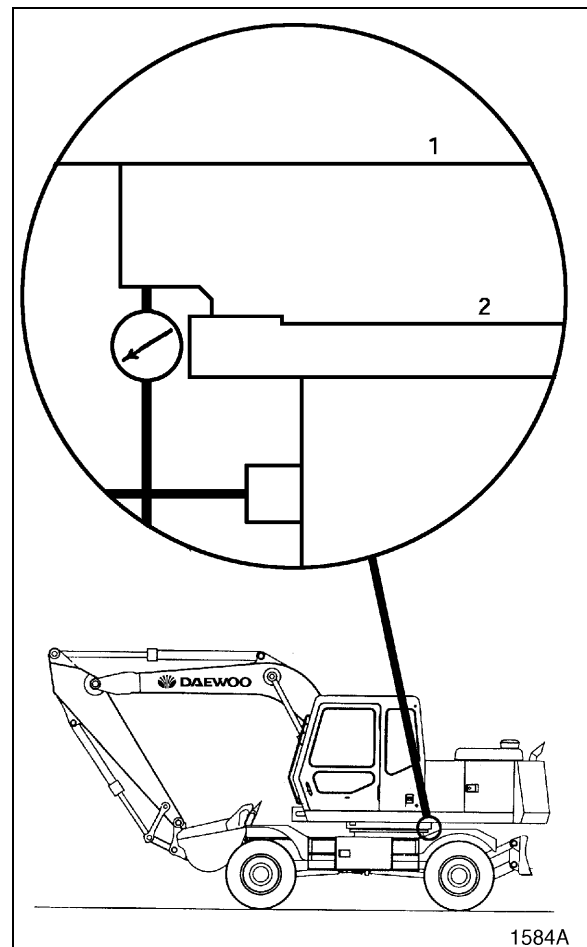


Figure 1

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

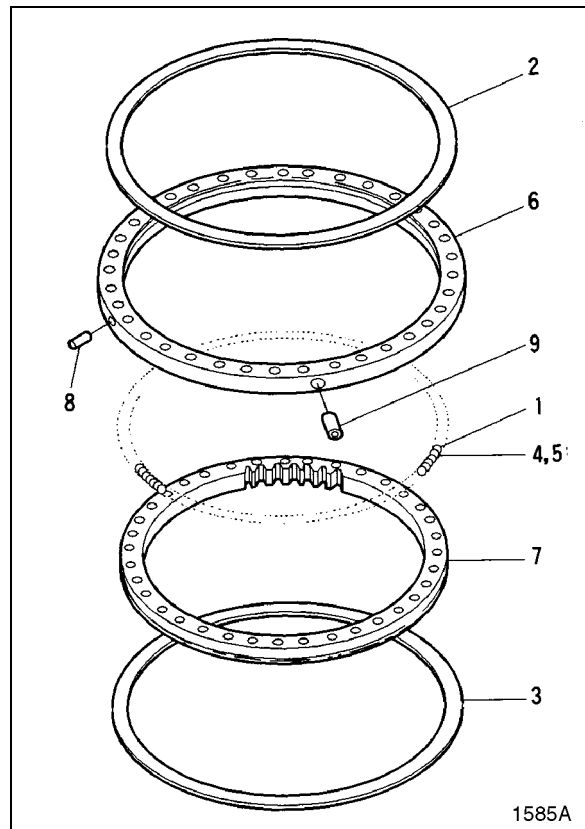


Figure 2

REBUILDING SWING BEARING

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

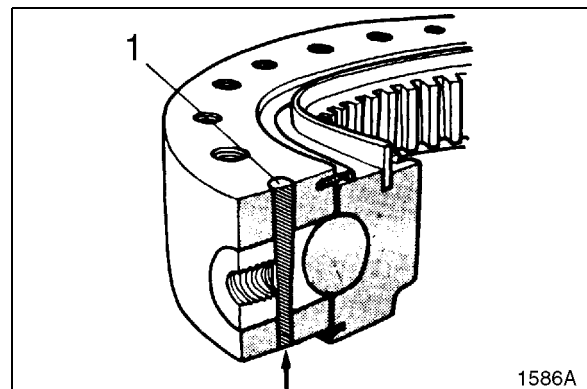


Figure 3

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

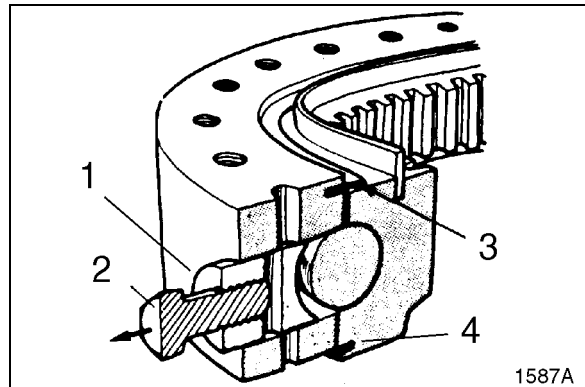


Figure 4

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).

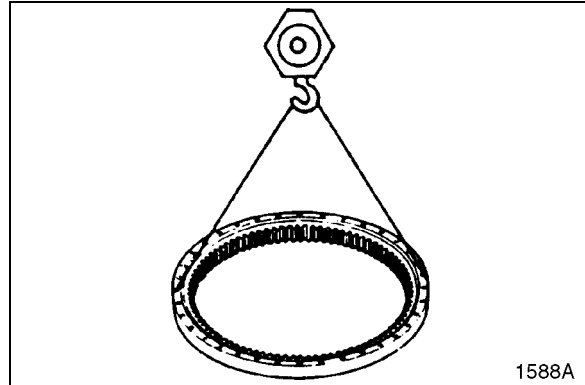


Figure 5

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

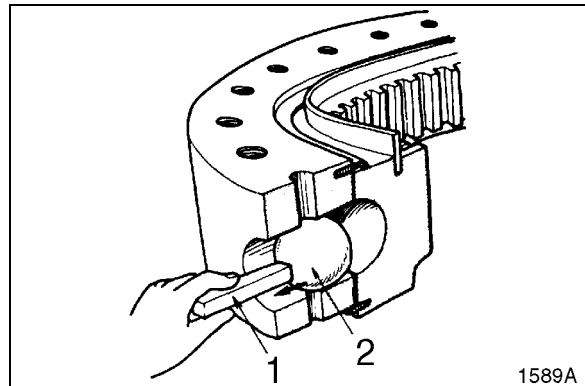


Figure 6

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

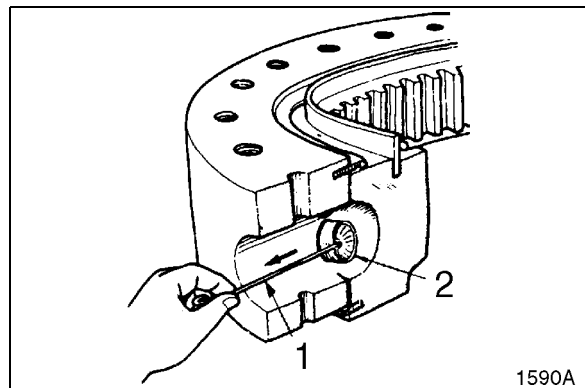


Figure 7

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.

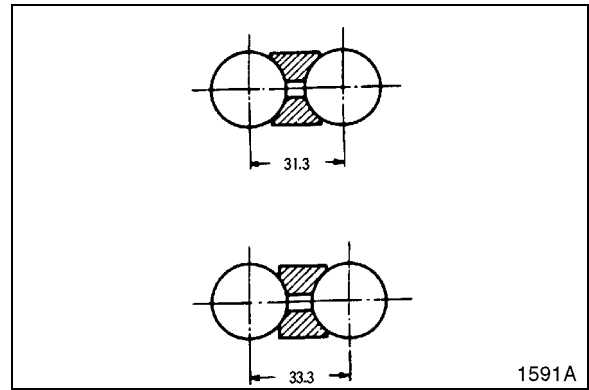


Figure 8



SWING REDUCTION 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 130LC-V	0001 and Up
Solar 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	3
Parts List	4
SpecialTools and Materials	6
SpecialTools	6
Troubleshooting, Testing and Adjustment.....	7
Removal	8
Disassembly	9
Reassembly.....	11
Installation	13

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 (12.0 RPM) provides a fast turning rate for efficient, rapid work cycling with more than adequate power for good acceleration.

	Linear Gear	Planetary Gear	Ring Gear	Reduction Ratio
1 st Stage	15	20	57	$i_1 = 4.8$
2 nd Stage	19	18	57	$i_2 = 4$
Total				$i_1 \times i_2 = 19.2$

PARTS LIST

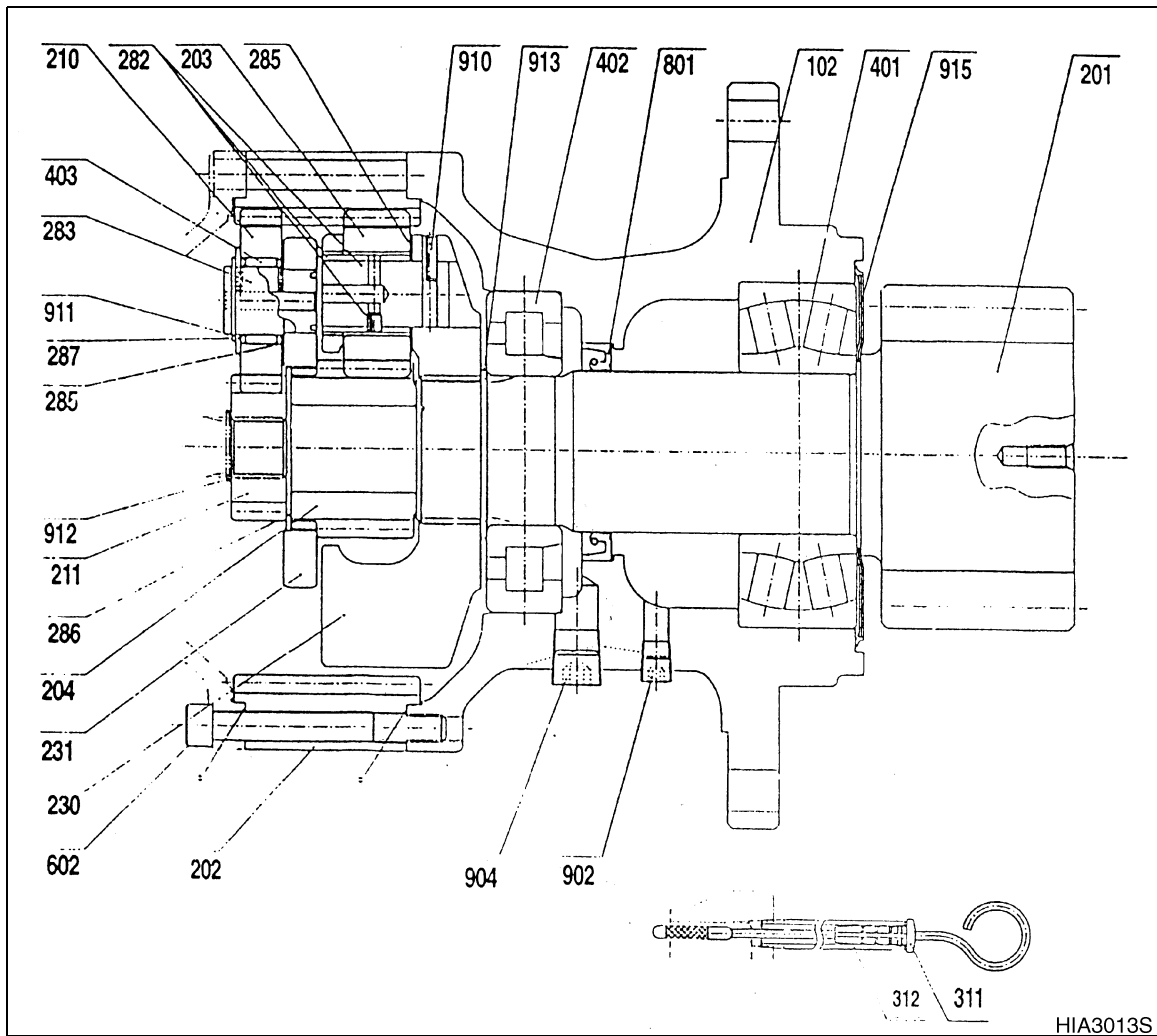


Figure 1

HIA3013S

Reference Number	Description
102	Casing
201	Shaft
202	Gear
203	Gear
204	Gear
210	Gear
211	Gear
230	Carrier
231	Carrier
282	Pin
283	Pin
285	Side Plate
286	Washer
287	Side Plate

Reference Number	Description
311	Level Bar
312	Pipe
401	Bearing
402	Bearing
403	Needle Cage
602	Hex Bolt
601	Oil Seal
901	Plug
902	Plug
910	Pin
911	Snap Ring
912	Snap Ring
913	Snap Ring
915	Seal

NOTE: *The inner and outer cylinder roller bearing must be changed at the same time.*

SPECIAL TOOLS AND MATERIALS

SPECIAL TOOLS

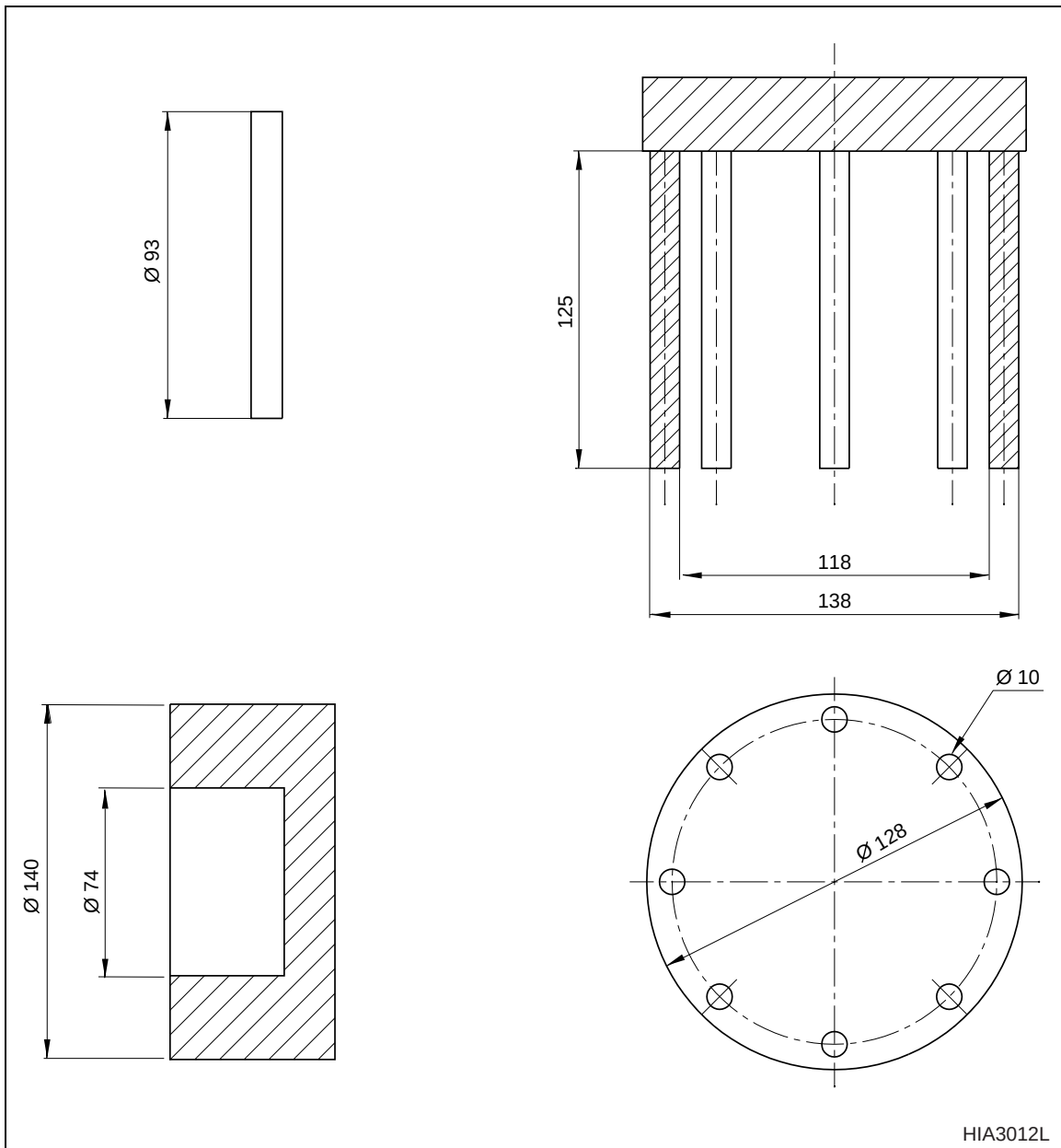


Figure 2

TROUBLESHOOTING, TESTING AND ADJUSTMENT

Symptoms	Possible Causes	Remedies
1. No rotation and – a. Pressure at swing motor inlet <i>increases</i> b. Pressure at swing motor inlet shows <i>no increase</i>, and the swing motor is making irregular noises c. Pressure at swing motor inlet shows <i>no increase</i>, but without irregular noises from the swing motor	Swing brake not releasing Internal damage to gearbox drive train Overload Swing motor drive shaft damage Internal damage to gearbox drive train Hydraulic pump or valve broken	Check brake engagement and disengagement, check release pressure Replace broken gears, drive train assemblies Reduce load weight Replace swing motor Repair/replace broken or faulty assemblies Troubleshoot hydraulic system
2. Oil leakage a. From drive shaft b. 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
3. Excess heat Gearbox casing becomes excessively hot, with or without irregular noise(s) during operation	Low oil level Bearings or gear worn but not completely inoperative	Replace oil, refill to specified level 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 4). Plug and cap hoses and port to prevent contamination from entering hydraulic system or component.
8. Disconnect tube (2) from drain cock (3)
9. Remove eleven bolts and washers (4, Figure 4) holding swing reduction gearbox (5) to frame.
10. Using a suitable lifting device, sling swing motor (1, Figure 4) and remove swing motor and reduction gearbox (5) as an assembly from unit.

NOTE: A drain cock (3, Figure 4) and tube are located on side of gearbox. Be careful not to damage valve or tube.

NOTE: There is one alignment pin (6, Figure 4), located on side of reduction gearbox flange.

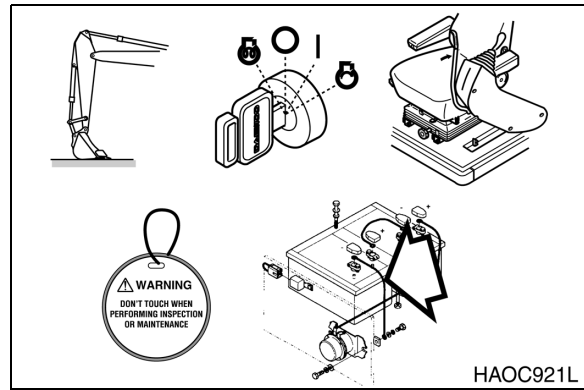


Figure 3

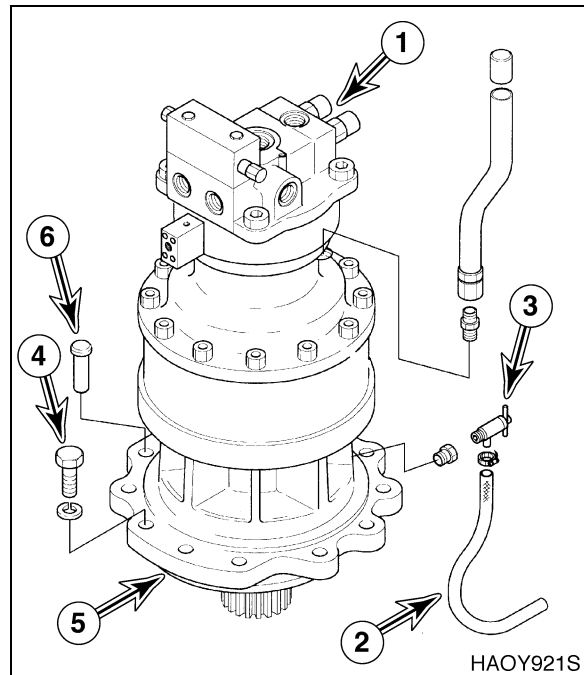


Figure 4

DISASSEMBLY



CAUTION!

1. Place the disassembled parts in a safe location so they do not get damaged.
2. Prior to reassembly, inspect each part for any damages.
3. Clean and dry each part before reassembly.
4. Clean all surface of sealing compound.
5. Torque all bolts according to specifications.

1. Remove swing motor assembly from the equipment and drain gear oil from housing by opening drain plug.



CAUTION!

Please take out gear oil with clean container and check for wearing out part.

2. Remove mounting bolts (602) and separate motor from reduction gear.
3. Remove No. 1 sun gear (211)
4. Remove No. 1 carrier assembly with No. 1 planetary gear (210).
5. Disassembling No. 1 carrier assembly.
 - A. Remove stopper ring (911) and separate side plate located on the upper part.



CAUTION!

Mark on each planetary gear and pin so that they can be replaced to their proper location during reassembly.

- B. Remove planetary gear (210) and needle cage (403).
 - C. Remove side plate from lower section of planetary gear (285).
 - D. Remove three planetary gear A (210) and remove thrust washer located in the center.

If the No. 1 pin (283) is not defective, do not remove it from the No. 1 carrier (231). If it must be replaced, tap on the inner side of the pin to remove.
6. Remove No. 2 sun gear (204).
7. Remove No. 2 carrier assembly.
8. Disassembling No. 2 carrier assemble.

If there are no visible defects after inspection, do not disassemble the No. 2 carrier assembly.

 - A. Place a dowel at the opposite end of No. 2 pin (282) and tap it with a hammer to cut off the spring pin (910) and remove No. 2 pin (282).
 - B. Remove No. 2 planetary gear (203) and thrust washer 1 (285).



CAUTION!

Do not reuse No. 2 pin once it is removed.

9. Remove ring gear (202).

NOTE: *Install two M12 bolts in the threaded holes and lift out.*

10. Remove lock pin (351).
11. Remove stop ring (913) from shaft (201).



CAUTION!

Do not remove lock pin if it is not necessary.

12. Place the reduction gear so that axle is facing the ground. Tap the axle shaft using a hammer to remove from housing.
13. To remove bearing seal (915) and roller bearing (401), secure axle shaft into a vise and press out using appropriate equipment.
14. Remove oil seal (801) from casing (102).



CAUTION!

Do not reuse oil seal and bearing once it is removed.

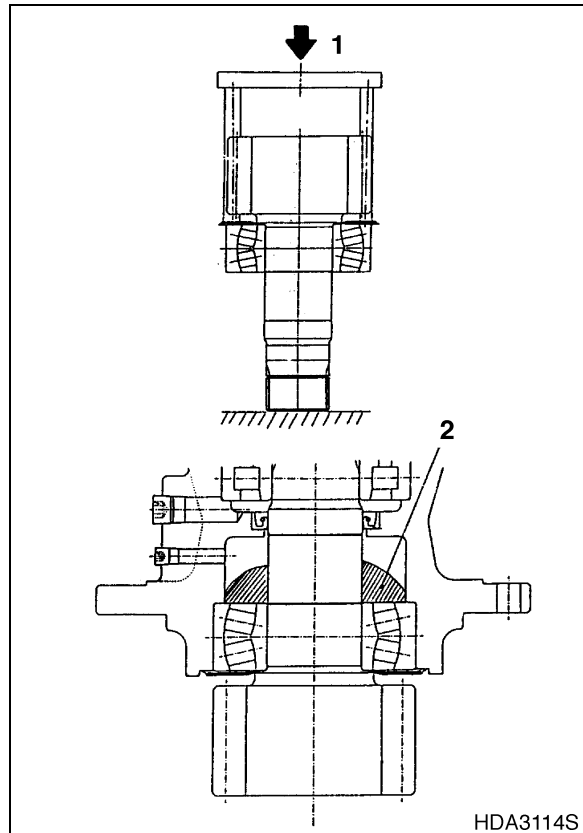


Figure 5

REASSEMBLY

Reassembly of the motor is basically accomplished by reversing disassembly steps.

Use a torque wrench to make sure that all bolts are tightened to specified values. Always begin a bolt tightening sequence from the innermost part of the assembly, working outward toward the ends in careful, even rotations.

1. Assembling shaft.
 - A. Insert bearing seal (915) into shaft.
 - B. Spread grease on inner side of roller bearing (401) then install completely using a press. Apply grease to the bearing (2, Figure 5).



CAUTION!

The bearing must be installed completely perpendicular to the shaft. Do not force bearing on to shaft.

2. Place the housing on a flat working area.
3. Assemble roller bearing into housing by placing it vertically using a screw at the bottom of the axle. Insert it by lightly tapping until it is completely horizontal to the housing.

NOTE: Use roller bearing installing tool listed in the section "Special Tools and Materials" on page e-6.
4. Position the housing so that the axle shaft is facing down.
5. Insert oil seal into housing (102).
6. Use bearing installing tool listed in the section "Special Tools and Materials" on page-6 and a press.
7. Install stop ring (913).
8. Insert grease into bearing and seal area. Wrap sealing tape on plug and tighten into hole.
9. Assembling No. 2 carrier assembly.
 - A. Place thrust and 1 (285) into the location of pin hole.
 - B. Insert the No. 2 planetary carrier (203) into place.
 - C. Check the location of hole and insert No. 2 pin (282) with tapping which from direction which is same as No. 1 carrier hole to spring pin fixed at a hole direction as seen at the top.
 - D. Insert spring pin (901) using jig and use a punch and hammer to secure the spring from moving.
10. Drive in locking pin (351) into two holes of the casing (102).
11. Spread sealing compound on the mating surface between casing (102) and ring gear (202).
12. Locate the marks that were made during disassembly and assemble ring gear (202) into casing (10). Install 4 bolts temporarily to hold it in place. Install all bolts with flat washers and tighten to 8kg.m.
13. Assemble No. 2 carrier assembler into ring gear.
14. Install No. 2 sun gear (204).
15. Assembling No. 1 carrier assembly.
 - A. Place No. 1 carrier (231) on flat working area.

- B. Align the spring pin (910) hole of the No. 1 pin (283) and the No. 1 carrier (231) and insert pin by lightly tapping.
- C. Use the spring pin installing jig to install the spring pin (910) and punch 2 areas with a hammer and punch to secure into place.
- D. Install the low side plate (285).

NOTE: *The upper and lower side plates are different thickness and must not be interchanged.*

- E. Install thrust washer 3 (286) located in the center.
 - F. Install needle cage (403) and planetary gear (210).
 - G. Install two side plates (287) located on the upper section and install stop ring (911).
- 16. Assemble No. 1 carrier assembly. Check that the thrust washer (286) located in the center is properly aligned with No. 2 sun gear.
 - 17. Assemble No. 1 sun gear (211).
 - 18. Remove the temporarily bolts and apply sealant on motor mating surface area on ring gear (211).
 - 19. Lower the motor shaft vertically placing stop ring (912) into it then assemble motor comparing with the location of thrust washer then tighten it with hex. socket bolt (602).
 - 20. Wrap seal tape onto the plug and place it into the casing.
 - 21. Fill with gear oil.

INSTALLATION

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

NOTE: Apply Loctite 262 to bolt threads.

5. Connect tube (2) to drain cock (3)
6. Connect hoses as tagged during removal to swing motor (1, Figure 6).
7. Fill swing reduction gearbox with oil. Refer to operation manual for specifications.

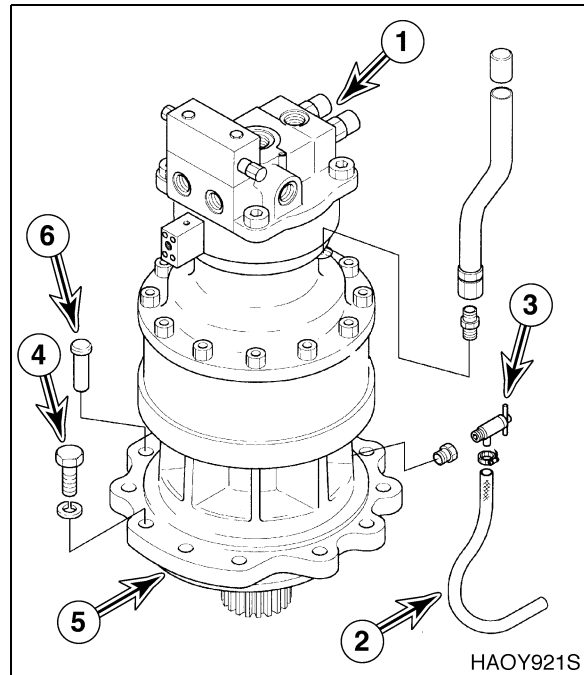


Figure 6

LOWER STRUCTURE AND CHASSIS



RAM LOCK VALVE OPERATION



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 130W-V	0001 and Up

TABLE OF CONTENTS

Theory of Operation	3
---------------------------	---

THEORY OF OPERATION

The ram lock valve absorbs vibration of the front axle and helps adjust the front axle, according to the type of work being done. When the ram lock solenoid valve is off, port P's pressure is the same as the tank pressure and spring pressure moves the check valve to the left and blocks passage between the ram cylinders. When the ram lock solenoid valve is on, pressurized oil flows into port P, pushes the spool, moves the check valve to the right and opens the passage between the ram cylinders. The stroke is adjusted according to the load applied to the ram cylinder.

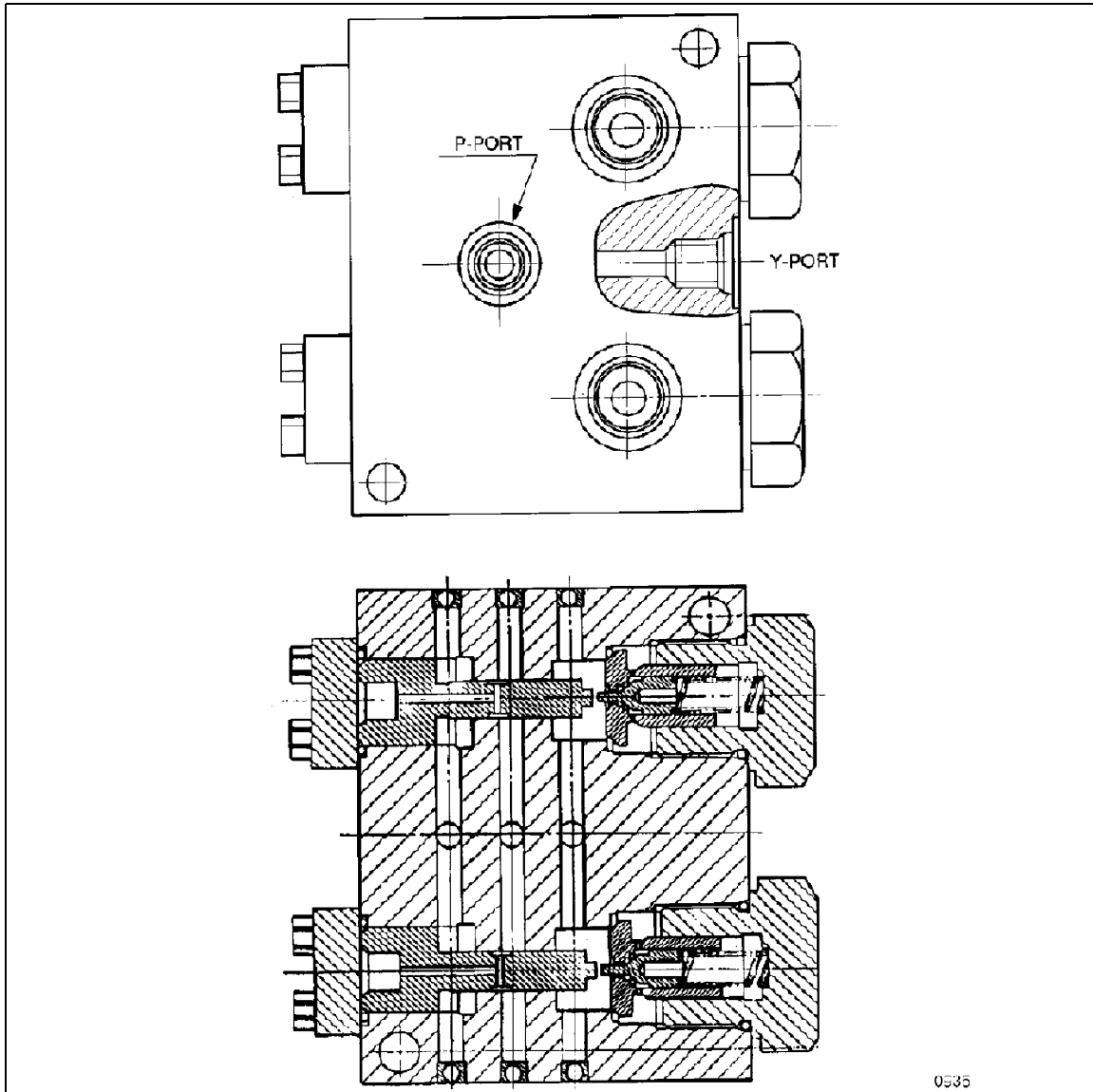


Figure 1

ENGINE AND DRIVE TRAIN



FRONT AXLE



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 130W-V	0001 and Up

TABLE OF CONTENTS

Parts List	4
Specifications	6
Disassembly	7
Reassembly.....	16

PARTS LIST

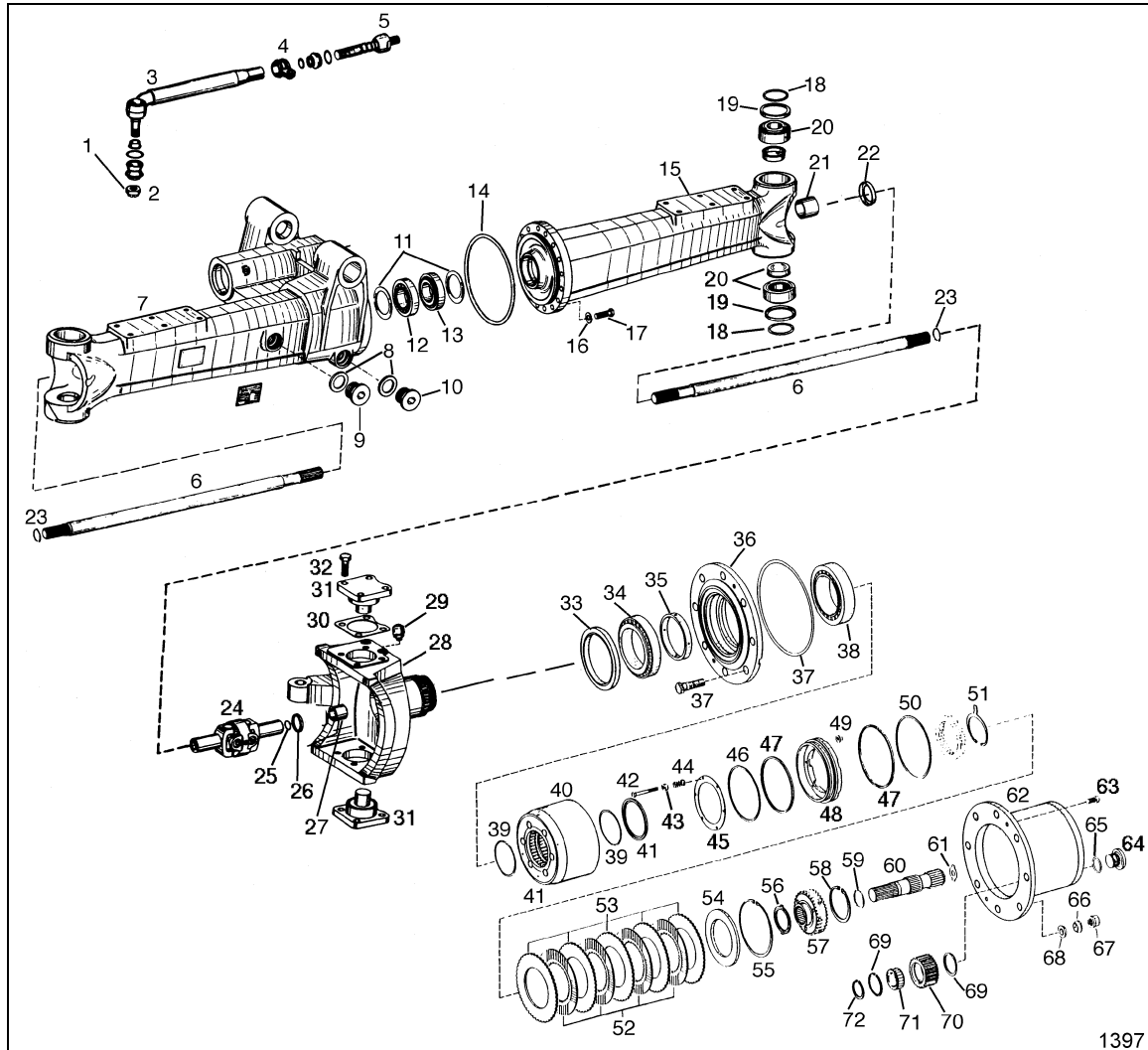


Figure 1

Part	Description	Qty.
1	Pin, Cotter	1
2	Nut, Castle	2
3	Joint, Ball	2
4	Clamp	2
5	Joint, LH	1
6	Shaft, Steel	2
7	Housing, Axle (LH)	7
8	O-ring	2
9	Plug	1
10	Plug	1
11	Shim	A/R
12	Bearing, Roller	1
13	Bearing, Roller	1
14	O-ring	1
15	Housing, Axle (RH)	1
16	Washer	16
17	Screw	15
18	O-ring	4
19	Cap, Sealing	4
20	Bearing, Roller	4
21	Bushing	2
22	Seal, Shaft	2
23	Ring, Retaining	2
24	Knuckle, Steering	2
25	Ring, Retaining	2
26	Seal, Shaft	2
27	Bushing	2
28	Housing and Nut, Joint	1
29	Valve, Vent	2
30	Shim	A/R
31	Bearing	4
32	Screw	16
33	Seal, Shaft	2
34	Bearing, Roller	2
35	Ring	2
36	Hub	2

Part	Description	Qty.
37	O-ring	2
38	Bearing, Ball	2
39	O-ring	4
40	Plug	8
41	Ring	2
42	Screw	12
43	Sleeve	12
44	Spring	12
45	Shim	2
46	Ring	2
47	O-ring	4
48	Piston	2
49	Nut, Lock	12
50	Ring	2
51	Ring, Retaining	2
52	Disc, Clutch	8
53	Disc, Clutch	10
54	Shim	2
55	Ring, Retaining	2
56	Washer, Thrust	2
57	Carrier, Disc	2
58	Ring, Retaining	2
59	Ring, Retaining	2
60	Shaft, Sun Gear	2
61	Washer, Thrust	2
62	Carrier, Planetary	2
63	Screw	4
64	Plug	2
65	O-ring	2
66	Washer, Spring	16
67	Nut, Wheel	16
68	Ring, Centering	16
69	Ring, Angle	12
70	Gear, Planetary	6
71	Bearing, Roller	6
72	Ring, Retaining	6

SPECIFICATIONS

Front Axle	
Type	Fully Floating Planetary Drive
Overall Reduction Ratio	13.26 : 1
Axle Load(Travel Condition)	6,000 kg (13,228 lbs.)
Axle Load (Working Condition)	25,500 kg (56,218 lbs.)
Brake Type	Wet Disc
Brake Torque	670 kg•m (4,846 ft lbs) at 44 kg/cm2 (626 psi)
Steering Angle	35°

DISASSEMBLY

1. Support axle assembly in a suitable fixture.

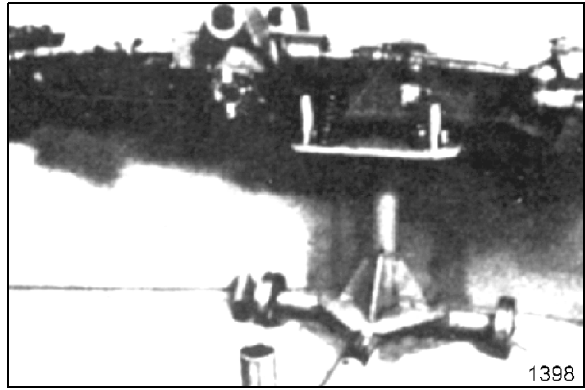


Figure 1

2. Remove oil drain plug and drain oil

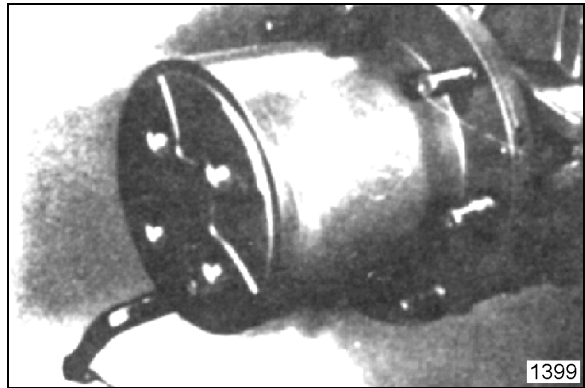


Figure 2

3. Remove socket head screws.

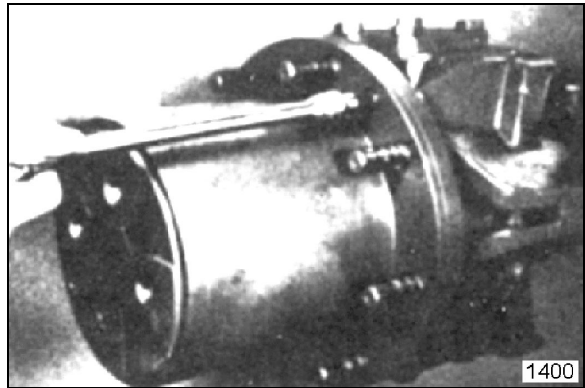


Figure 3

4. Remove planetary carrier, being careful not to lose thrust washer.

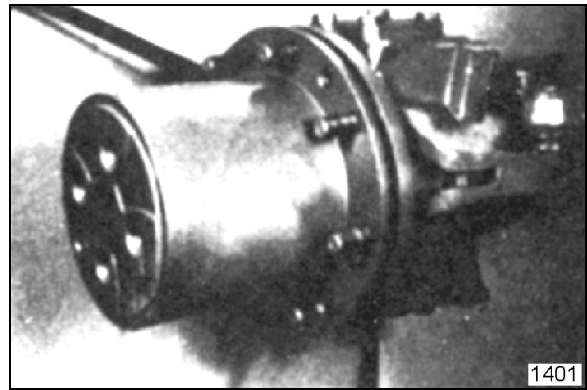


Figure 5

5. Using gear puller, remove planetary gears.

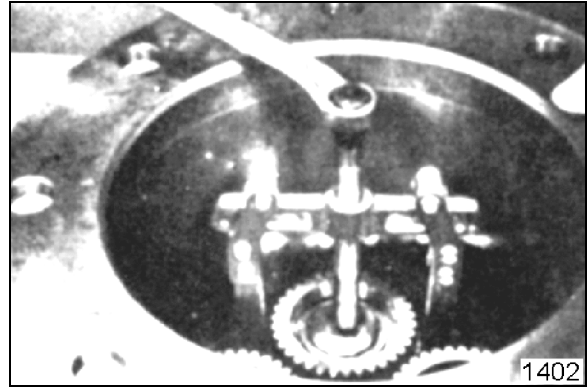


Figure 6

6. Remove angle ring and roller bearing from planetary gear.

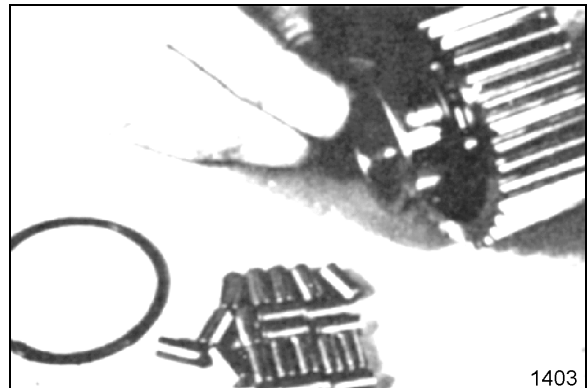


Figure 7

7. Remove clip from sun gear shaft and remove inner disc carrier.

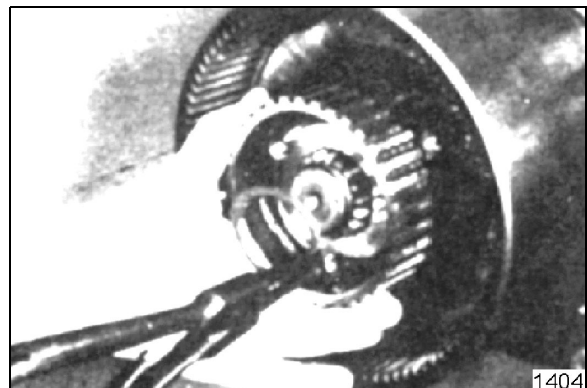


Figure 8

8. Remove clip.

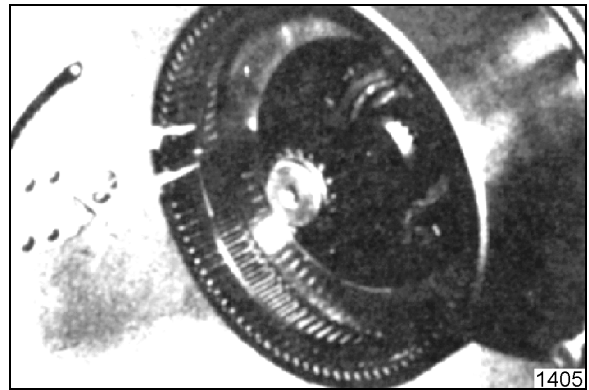


Figure 9

9. Remove backing plate.

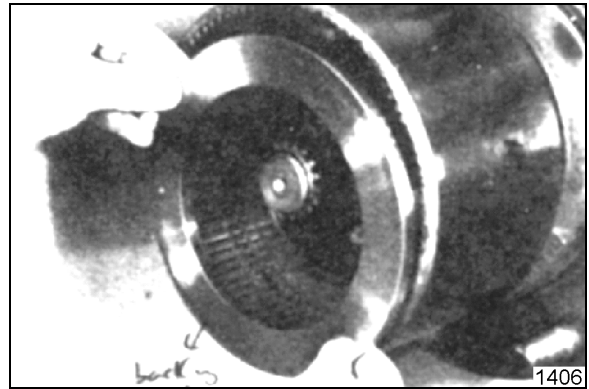


Figure 10

10. Remove ring gear plate pack (Figures 11 and 12).

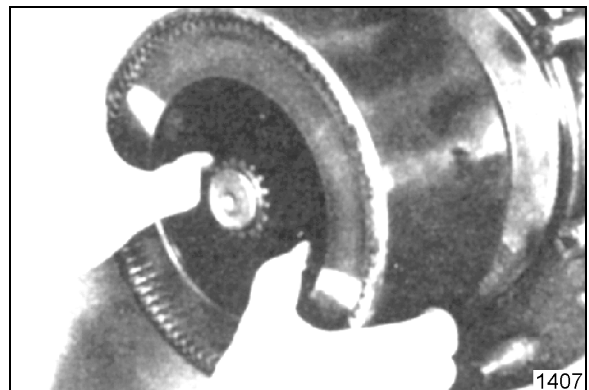


Figure 11

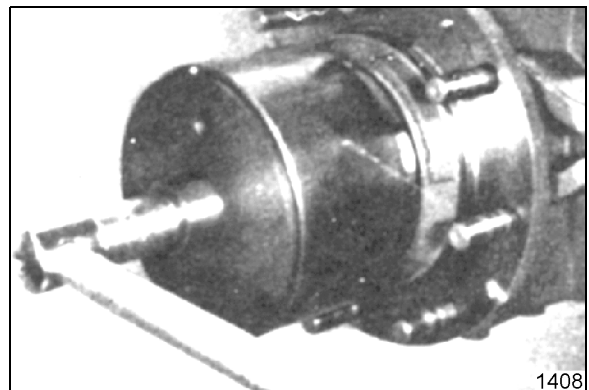


Figure 12

11. Remove clip.

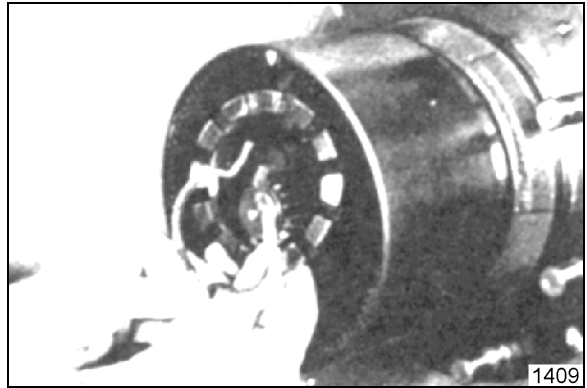


Figure 13

12. Remove ring carrier, being careful not to lose angle ring and O-ring (Figures 14 and 15).

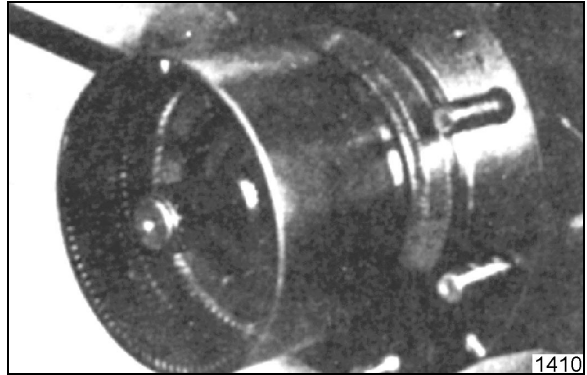


Figure 14

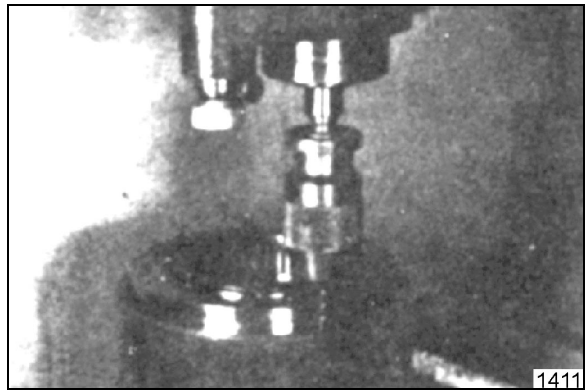


Figure 15

13. After clip is removed from ring carrier, remove gear and carrier.



Figure 16

14. Secure ring gear carrier in vise and loosen return spring.

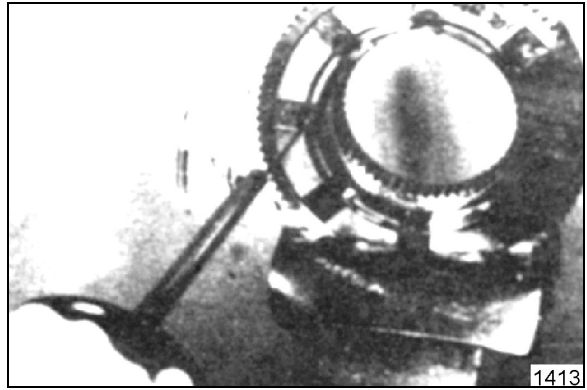


Figure 17

15. Remove ring and return spring.

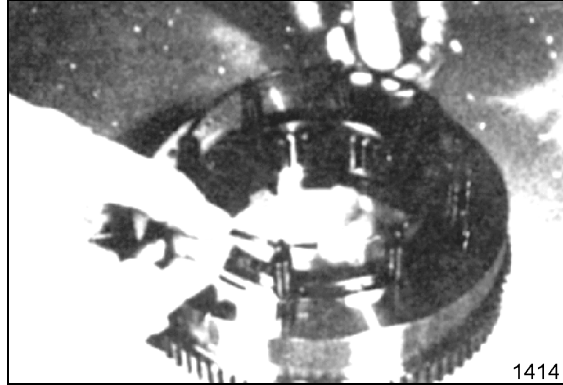


Figure 18

16. Remove piston from ring gear.

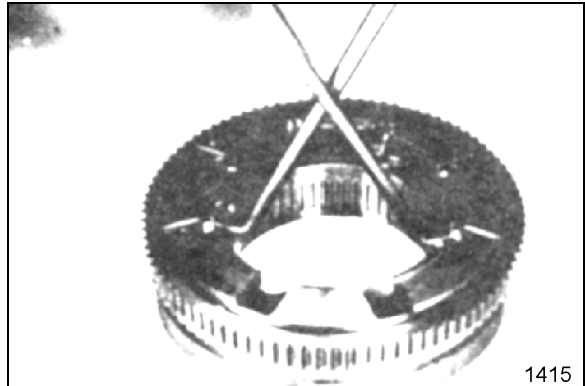


Figure 19

17. Remove O-ring (two parts).

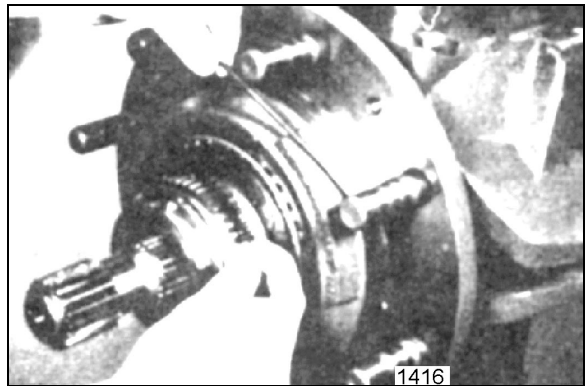


Figure 20

18. Remove thrust washer.

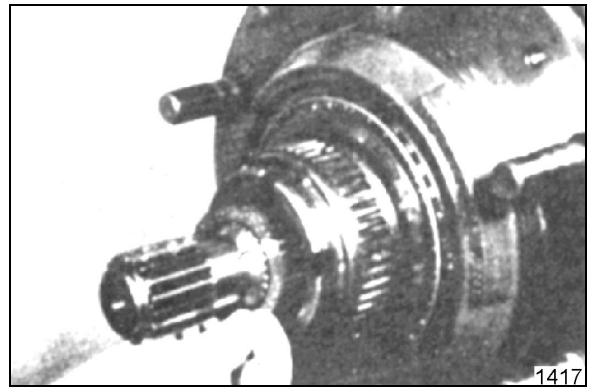


Figure 21

19. Remove hub using pulley type puller. (Do not remove tapered roller bearing.)

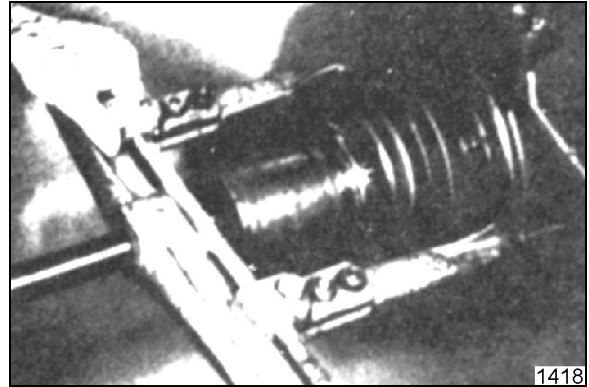


Figure 22

20. Remove shaft seal.

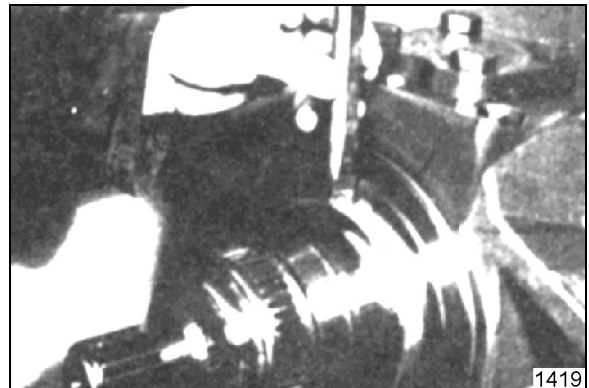


Figure 23

21. Remove tapered roller bearing using a bearing puller.

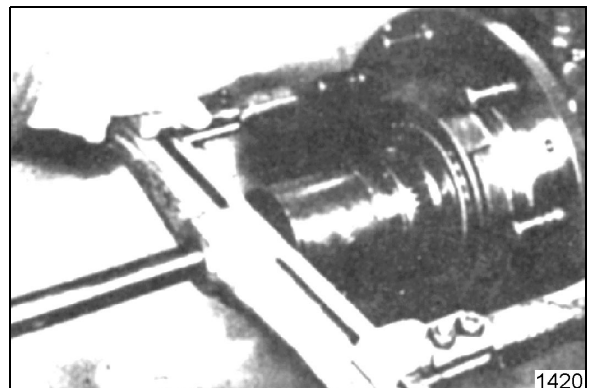


Figure 24

22. Pull liner from shaft.

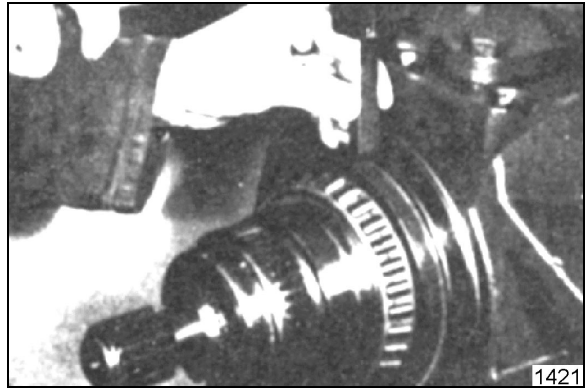


Figure 25

23. Loosen castle nut and loosen tie rod.

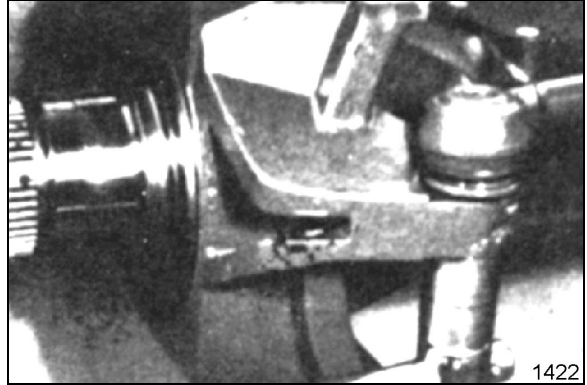


Figure 26

24. Unscrew hex bolts and pull out both king pins.

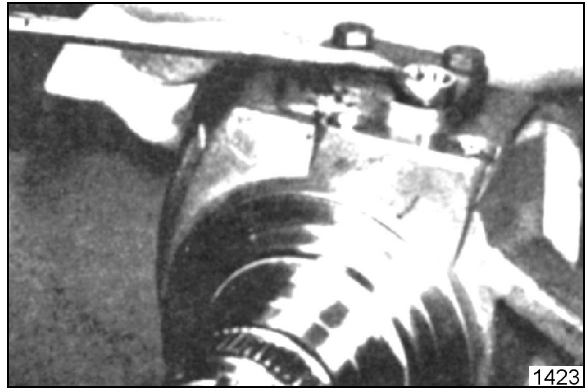


Figure 27

25. Remove steering knuckle housing from axle shaft, being careful not to remove tapered roller bearing.

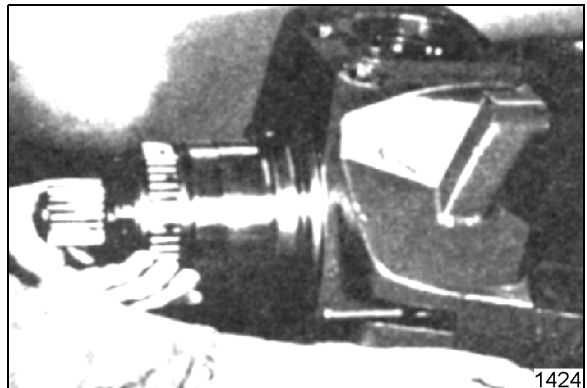


Figure 28

26. Remove liner and shaft seal from housing.

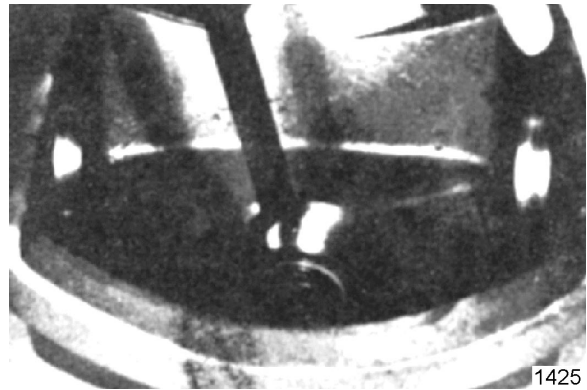


Figure 29

27. Pull universal from axle shaft.

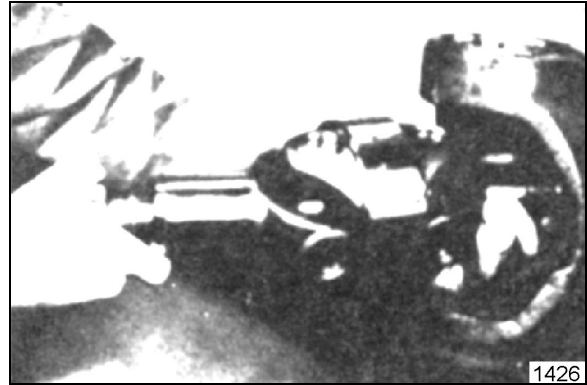


Figure 30

28. Remove clip from universal shaft. Remove sun gear shaft and stub shaft by tapping with rubber hammer.

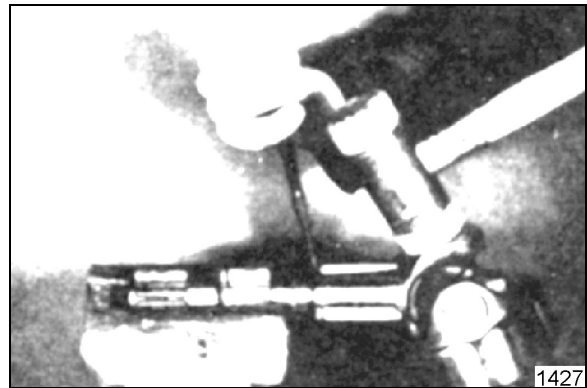


Figure 31

29. Pull brass liner and shaft seal from axle.



Figure 32

30. Remove sealing cover and bearing outer surface, if necessary.

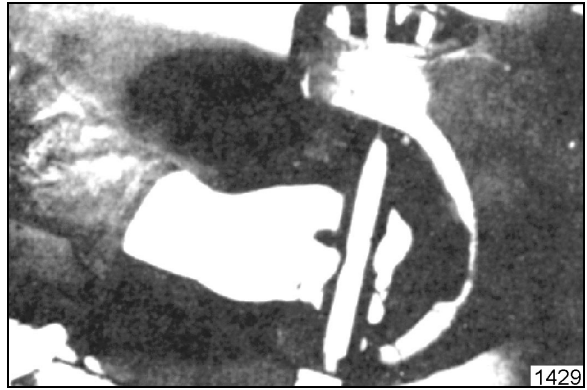


Figure 33

REASSEMBLY

1. Note assembly order.

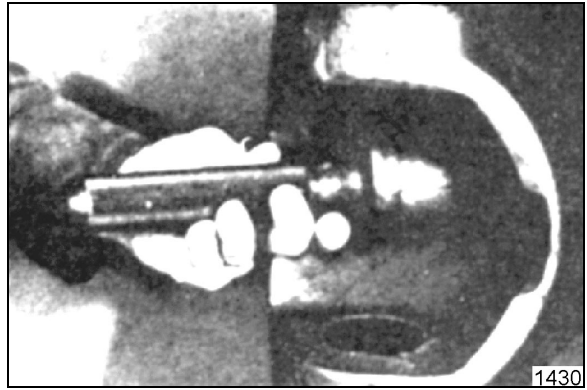


Figure 34

2. Install shaft seal into axle housing, using special driver. Grease sealing cover.

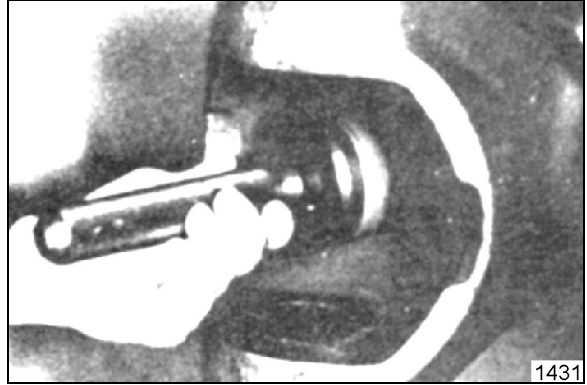


Figure 35

3. Install caps to steering knuckle bearing.

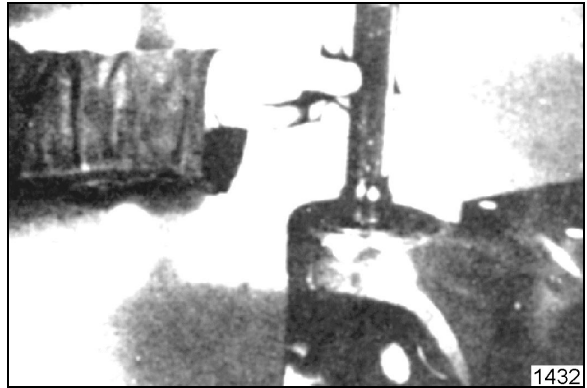


Figure 36

4. Install retaining ring to groove of universal shaft.

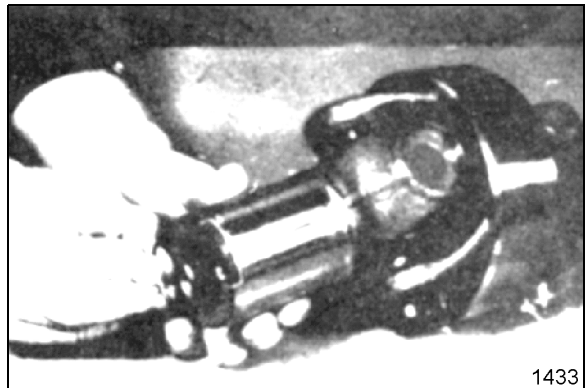


Figure 37

5. Install sun gear shaft and stub shaft to universal shaft.

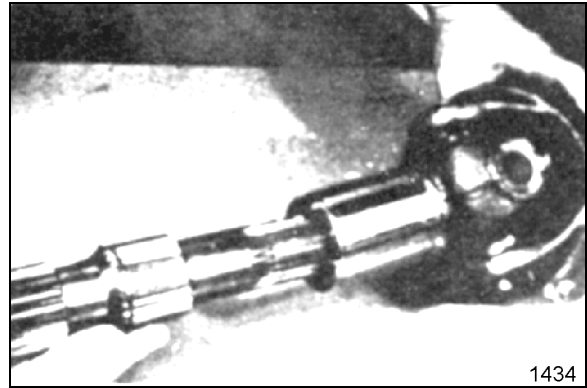


Figure 38

6. Install universal shaft to spline groove of stub shaft and axle groove.

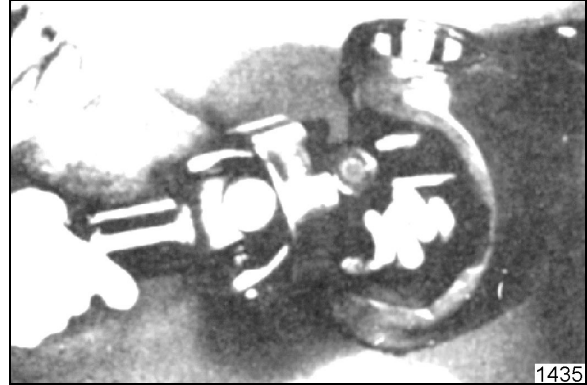


Figure 39

7. Install brass sleeve to steering knuckle housing and install shaft seal. Grease lip of sealing cover.

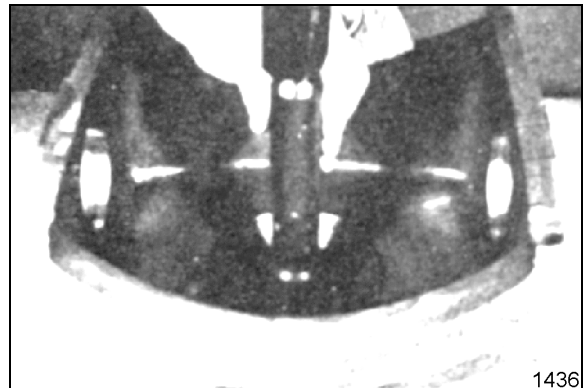


Figure 40

8. Install plug (two parts) to steering knuckle housing.

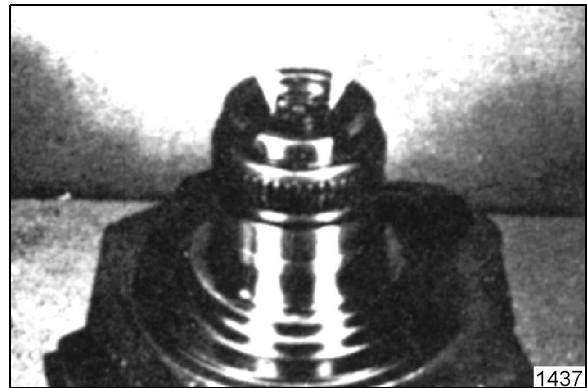


Figure 41

9. Install tapered roller bearing to steering knuckle housing.

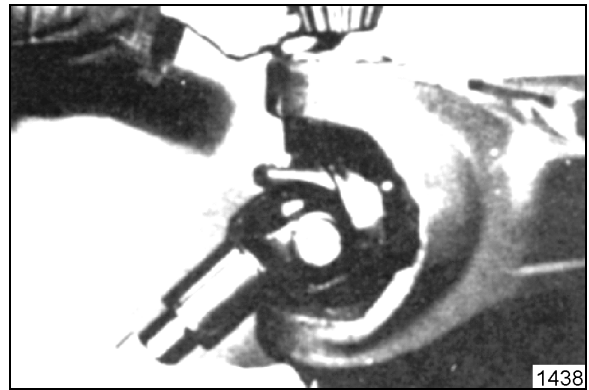


Figure 42

10. Install steering knuckle housing to axle housing.

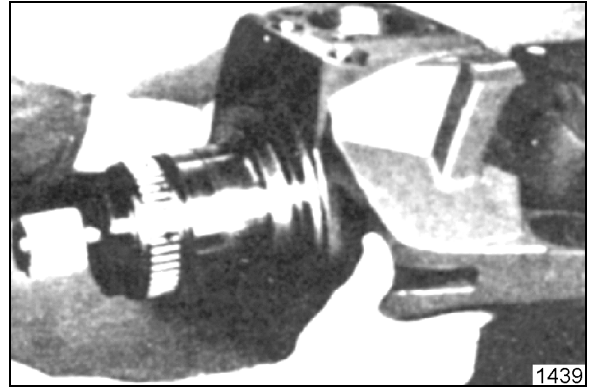


Figure 43

11. Install O-ring to cover and king pins (two parts) to groove.

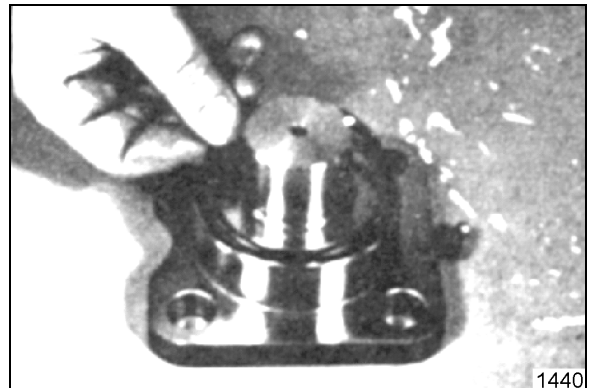


Figure 44

12. Install upper king pin with 0.80 mm (0.03 in.) shim.

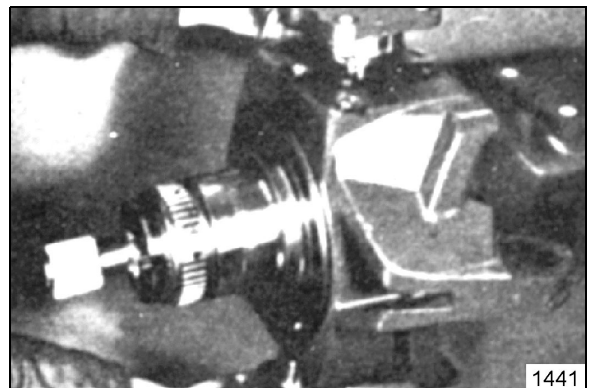


Figure 45

13. Tighten hex bolts at cover to 295 Nm (66.3 ft.lb.)

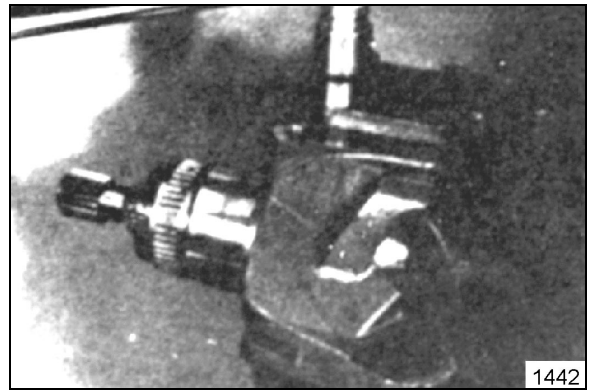


Figure 46

14. Check that rolling resistance is 28 - 35 Nm (6.3 - 7.9 ft.lb.). Correct with shim thinner than 0.80 mm (0.03 in.)

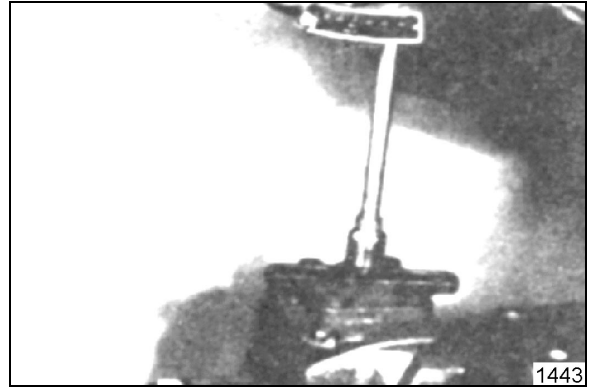


Figure 47

15. Apply Loctite 573 to cover.

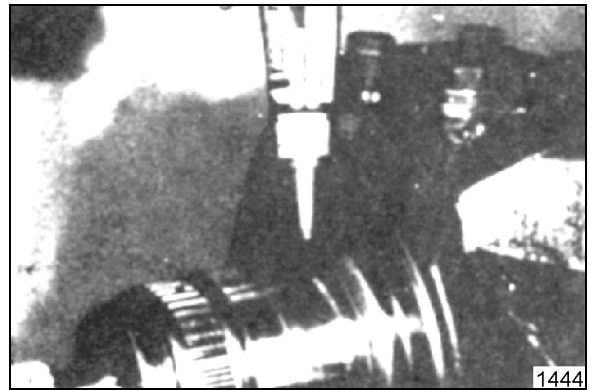


Figure 48

16. Heat liner and install using special driver.

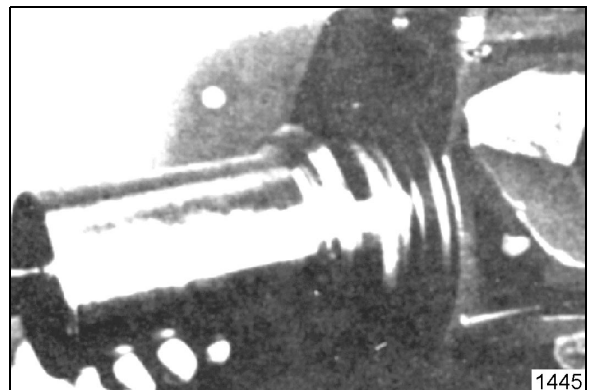


Figure 49

17. Check that rolling resistance of bearing wheel is 8 - 12 Nm (1.8 - 2.7 ft.lb.). Heat inner ring of bearing.

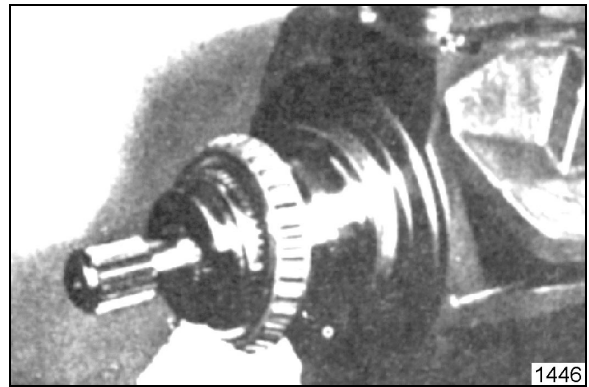


Figure 50

18. Install second bearing using 14.5 mm (0.57 in.) spacer.

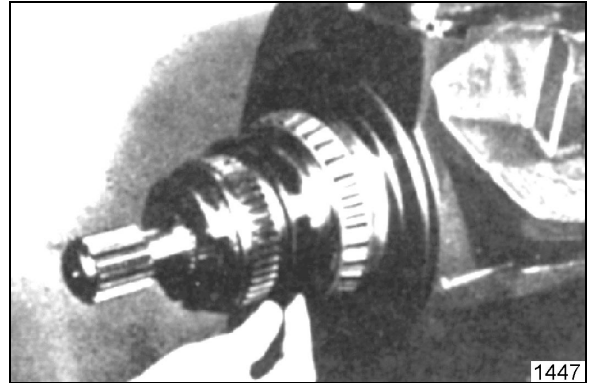


Figure 51

19. Install hub collar to hub carrier, and after heating inner surface of bearing, install bearing.

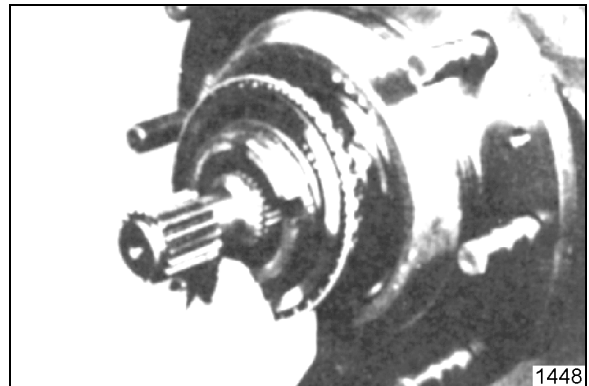


Figure 52

20. Install ring gear carrier.

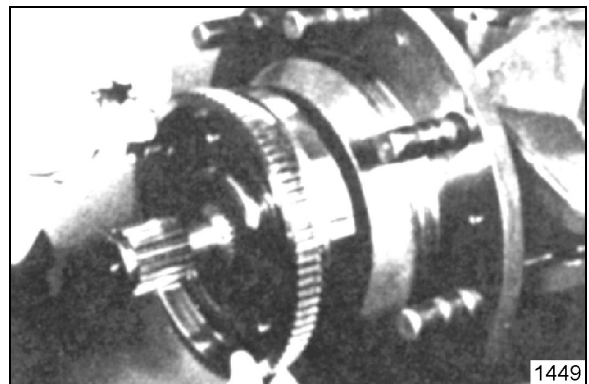


Figure 53

21. Tighten slot nut, while rotating hub, to 1,000 Nm (39.4 ft.lb.).

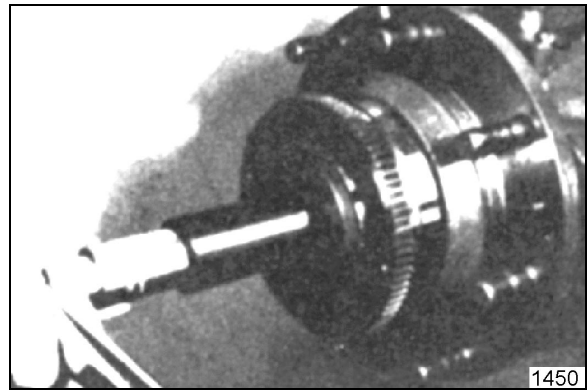


Figure 54

22. Check rolling resistance using the following formula and specifications.

Formula		Specifications
T = F x R	Hub Diameter	320 mm (12.6 in) F: 50 – 75 Nm (11.2 – 16.8 ft lb)
		390 mm (15.4 in) 20 – 30 Nm (5.2 – 7.8 ft lb)
T = Rolling resistance		
F = Tension	Bearing	320 mm (12.6 in)
	Rotation	25 – 40 Nm (5.6 – 10.4 ft lb)
R = Hub radius		390 mm (15.4 in)
		20 – 30 Nm (5.2 – 7.8 ft lb)

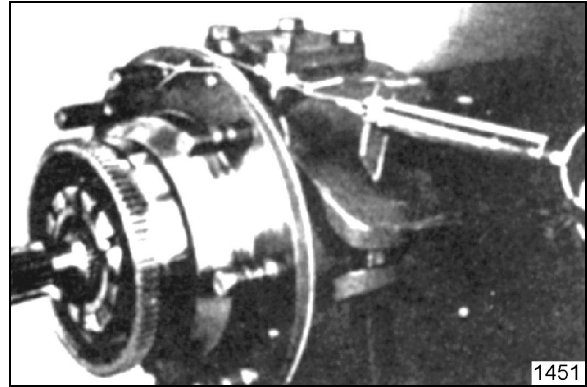


Figure 55

If rolling resistance is out of normal range, install thinner spacer and remeasure. Loosen slot nut, remove hub and ring gear carrier and remove inner race of bearing.

23. Heat inner surface of bearing and install bearing.

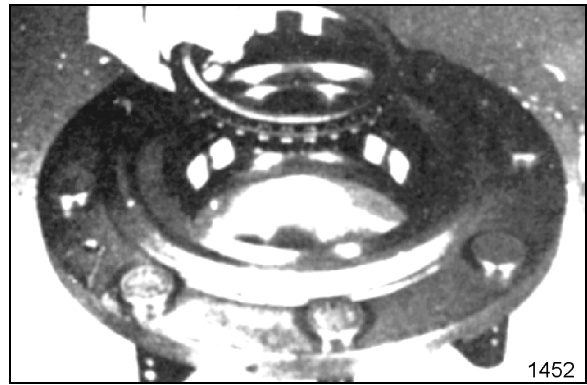


Figure 56

24. Apply alcohol/water mixture to outer surface of shaft seal and grease to lip. Install shaft seal.

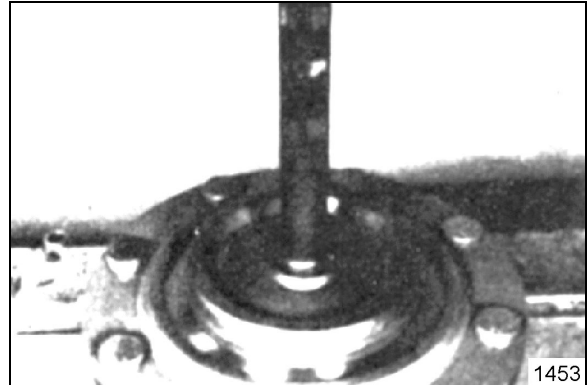


Figure 57

25. Install scraper seal on shaft seal with smaller lip up.

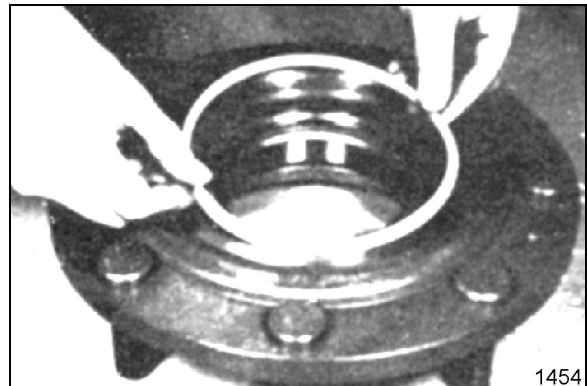


Figure 58

26. Install hub while turning steering knuckle housing.

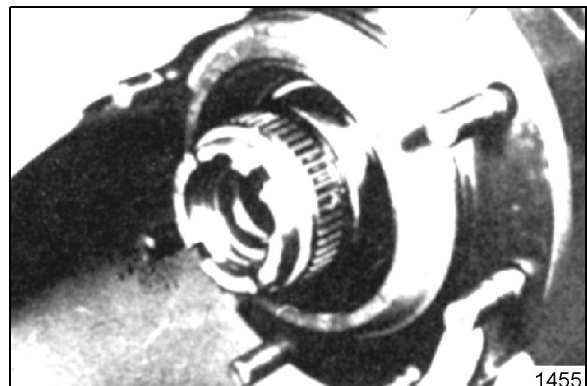


Figure 59

27. Install spacer to hub

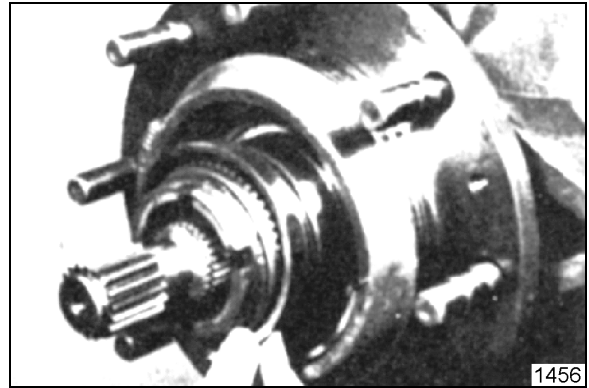


Figure 60

28. Heat inner ring of bearing and install to hub.

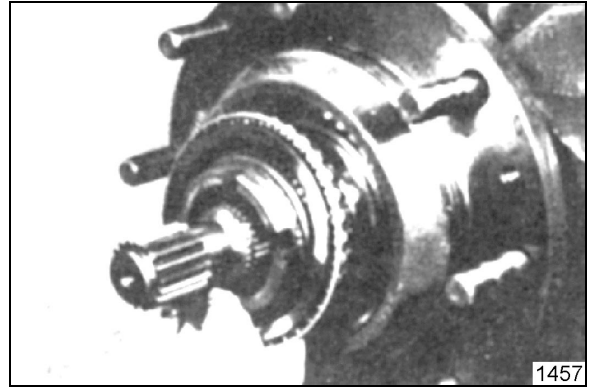


Figure 61

29. Install O-ring to steering knuckle housing and hub.

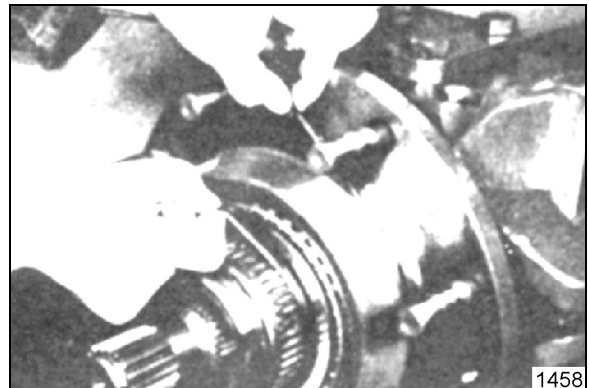


Figure 62

30. Install rings (two parts), apply W-10 oil to ring.

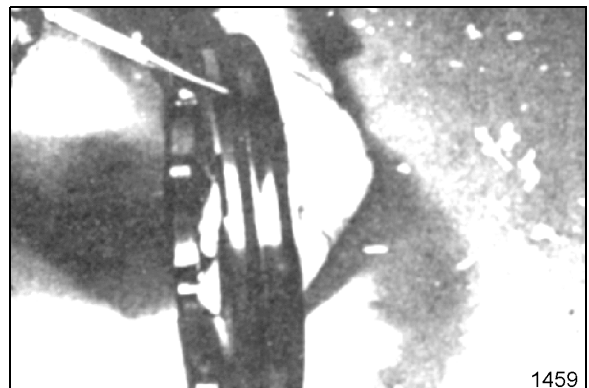


Figure 63

31. Install piston to ring gear carrier, being careful not to block hole for return spring.

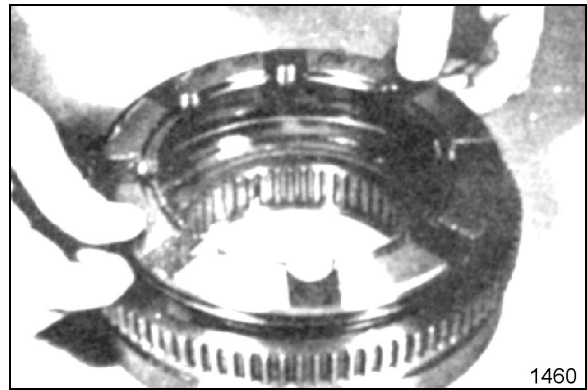


Figure 64

32. Install return spring to ring gear carrier.

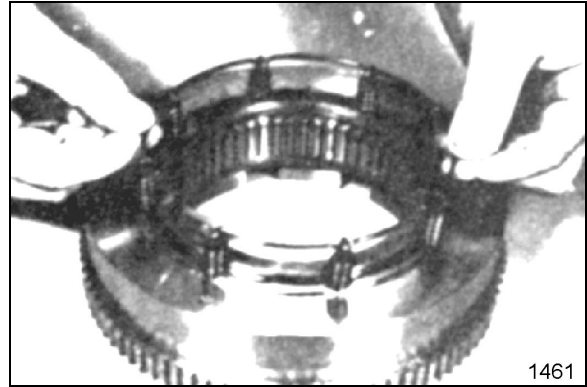


Figure 65

33. Place ring gear carrier in vise and carefully attach return spring without overstressing it.

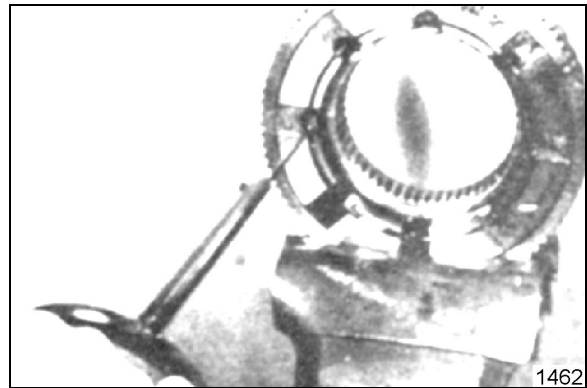


Figure 66

34. Install snap ring to ring gear carrier.

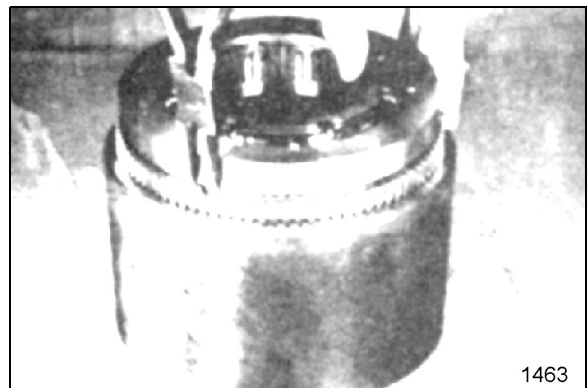


Figure 67

35. Install ring gear to spline groove of steering knuckle housing, making sure that ring gear carrier and oil hole of knuckle housing are aligned properly so that oil hole is not blocked.

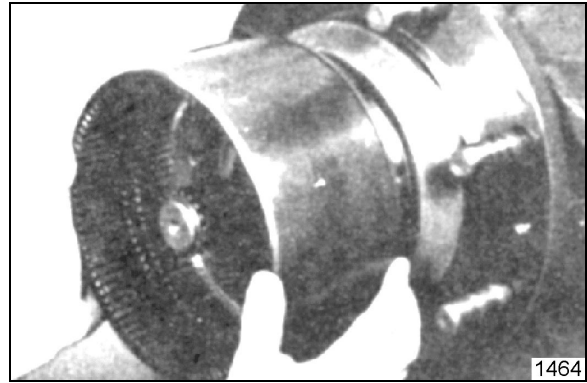


Figure 68

36. Install O-ring and angle ring so that O-ring contacts flat side of ring. Back slot nut off several times to check that O-ring is not damaged.

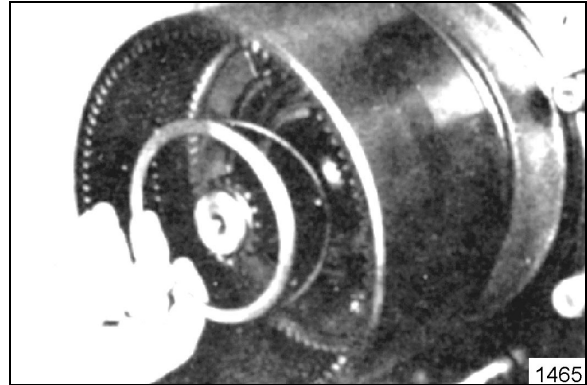


Figure 69

37. Torque slot nut to 1,500 Nm (337 ft.lb.).

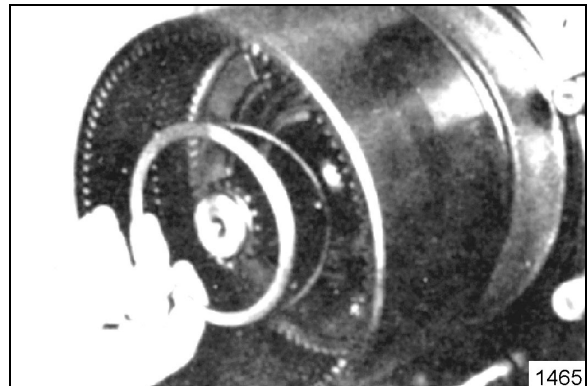


Figure 70

38. Apply grease to thrust washer and install.

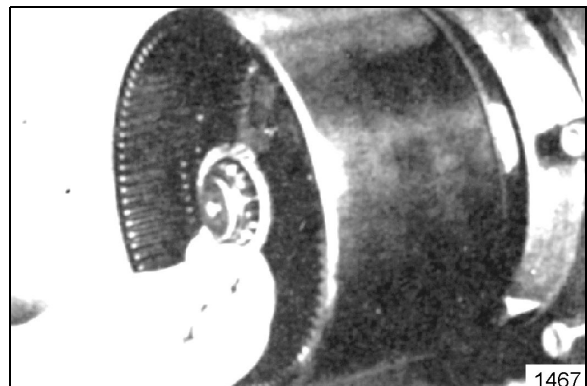


Figure 71

39. Insert clip.

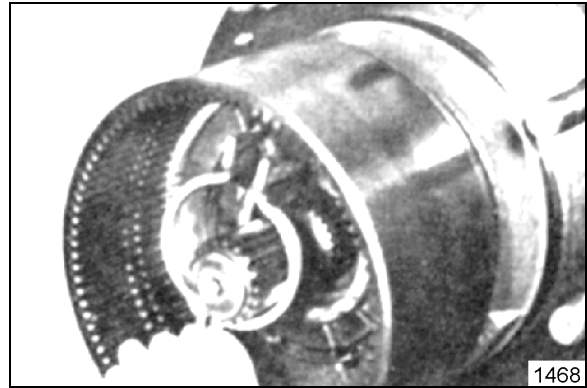


Figure 72

40. Install baffle ring retaining ring.

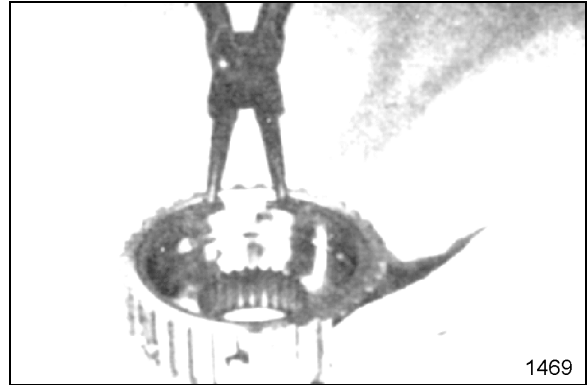


Figure 73

41. Install inner plate carrier to sun gear spline groove and secure with ring.

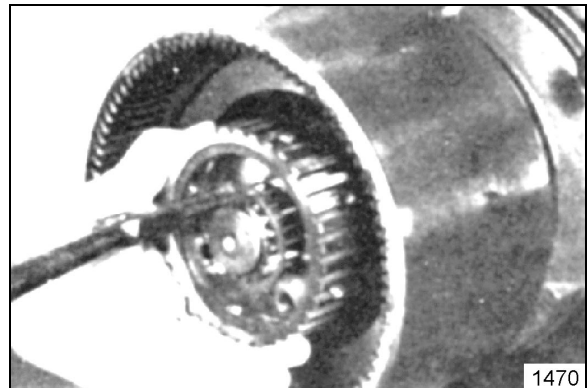


Figure 74

42. Measure distance between ring gear and piston. Example: A = 81.10 mm (3.19 in.).

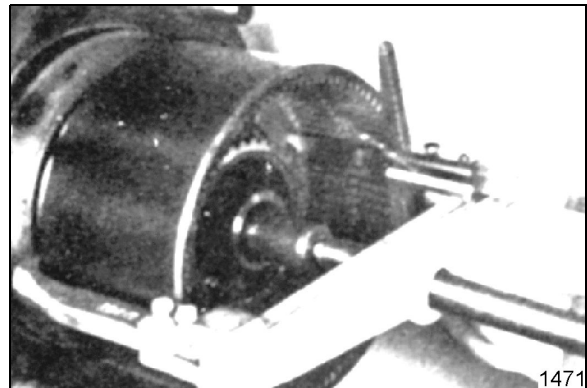


Figure 75

43. Install backing plate, secure with retaining ring and measure distance between ring gear surface and backing plate.

Example: B = 51.90 mm (2.04 in.).

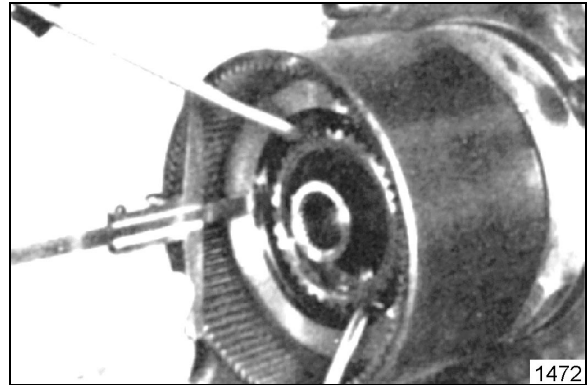


Figure 76

44. Torque plate pack assembly to 200 Nm (45 ft.lb.) and measure its length.

Example: C = 26.50 mm (1.04 in.).

Calculate value of A-B-C (270 mm) (0.106 in.): it should fall within a range of 2.5 mm (0.098 in.) - 0.4 mm (0.015 in.).

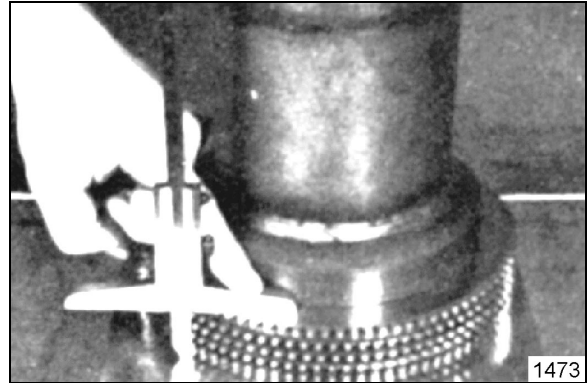


Figure 77

45. Install plate pack.

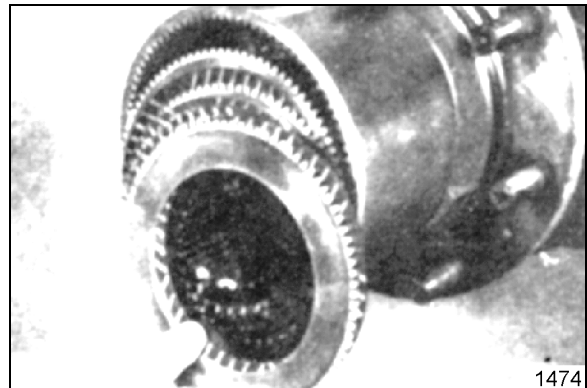


Figure 78

46. Install backing plate and secure with retaining ring.

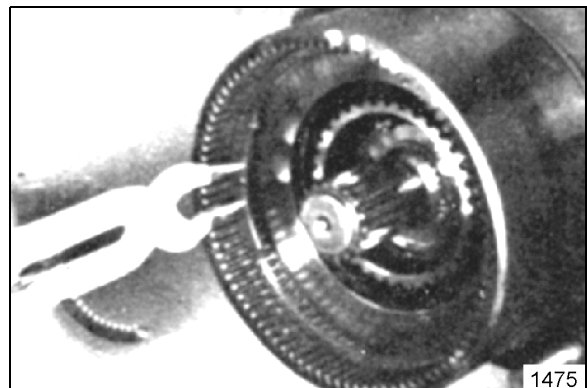


Figure 79

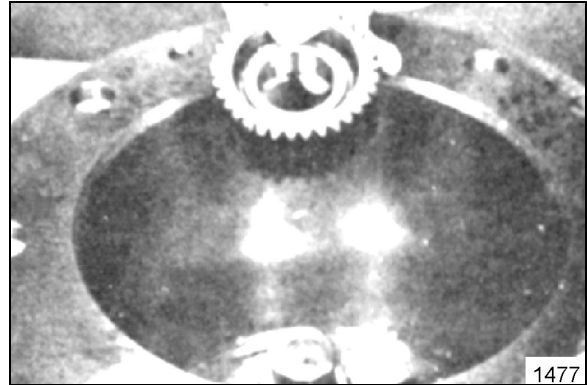
47. Install first angle ring to planet gear, install roller bearing, and install second angle ring with thicker part of ring facing bearing.



1476

Figure 80

48. Install planet gear to planetary carrier.



1477

Figure 81

49. Secure planetary gear with retaining ring.

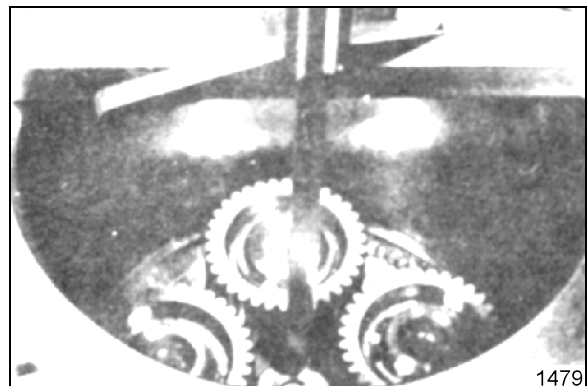


1478

Figure 82

50. Measure distance from flange surface and thrust washer.

Example: $A = 289.50 \text{ mm (11.39 in.)}$.



1479

Figure 83

51. Install sun gear, measure distance between sun gear shaft and flange surface.

Example: $B = 286.40 \text{ mm (11.27 in.)}$.

52. Calculate: $A - C = 3.10 \text{ mm (0.122 in.)}$.

Specification = $0.30 - 0.60 \text{ mm (0.011 - 0.023 in.)}$. In this case, a $2.70 \text{ mm (0.11 in.)}$ thrust washer is needed to meet the specification.

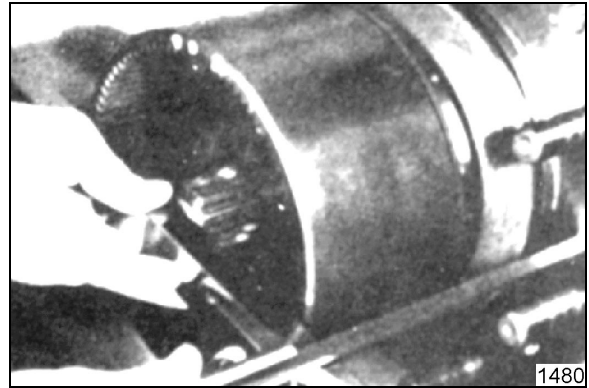


Figure 84

53. Apply Loctite to thrust washer and install into planetary carrier.

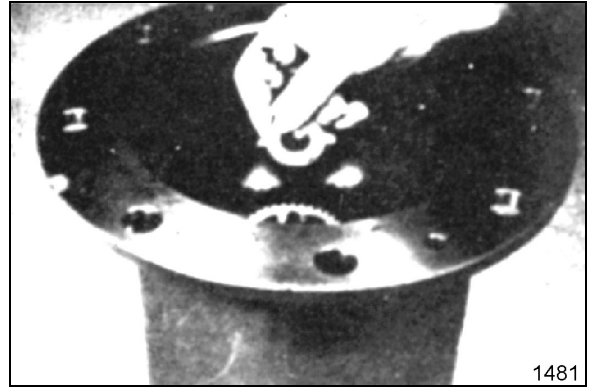


Figure 85

54. Grease O-ring and install planetary carrier to hub.

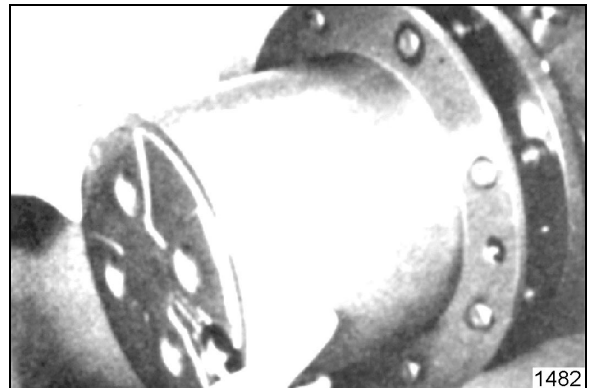


Figure 86

55. Torque socket head bolts to $49 \text{ Nm (11 ft.lb.)}$

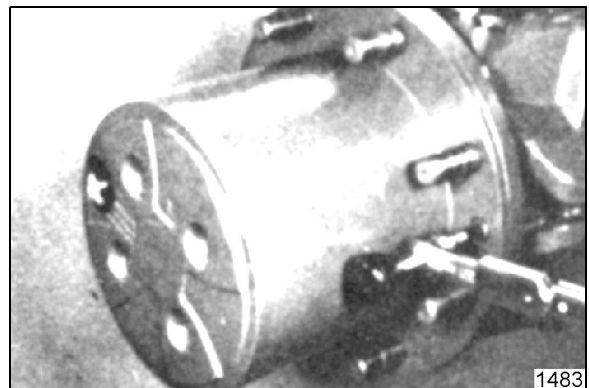


Figure 87

56. Install tie rod and tighten castle nut.

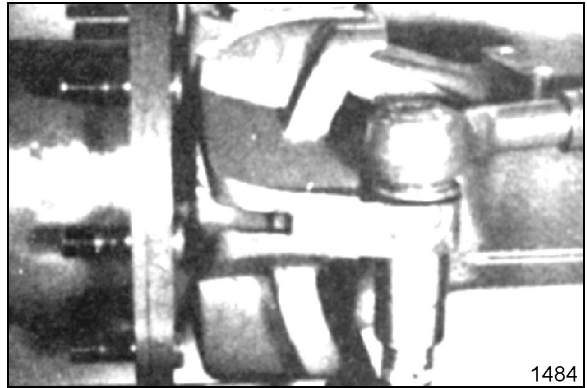


Figure 88

57. Secure castle nut with cotter pin.
58. Test for leaks using SAE 10W oil and applying 120 bar (1,740 psi) for 15 minutes. Pressure should stay within 2%.

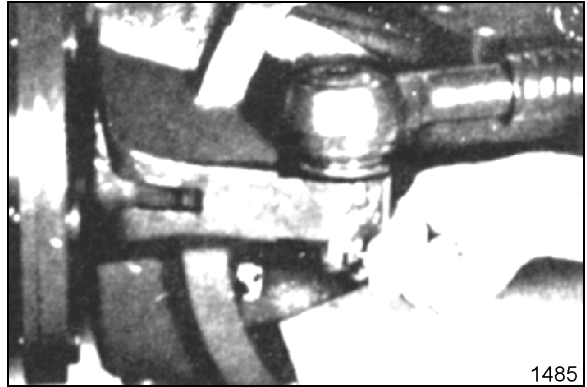


Figure 89



REAR AXLE WITH TRANSMISSION



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 130W-V	0001 and Up

TABLE OF CONTENTS

Specifications	4
Rear Axle Assembly	5
Disassembly of Rear Axle	5
Assembly of Rear Axle	12
Disassembly of Differential Gear	24
Reassembly of Differential Gear	28
Separating Gear Box from Axle	38
Transmission Operation	40
Transmission Disassembly	41
Detaching Drive (Input) Housing	41
Disassembling Input Shaft Assembly	42
Disassembling Planetary Drive	48
Disassembling Clutch and Spur Gear	50
Disassembling Shift Lock	55
Final Drive, Drive Shaft and Differential Disassembly	56
Transmission Reassembly	62
Shimming Drive Pinion	62
Reassembling Drive Pinion	63
Adjusting Rolling Resistance of Drive Pinion Bearing	67
Installing Differential	70
Adjusting Backlash and Bearing Preload	73
Installing Helical Gear and Clutch	75
Installing Planetary Carrier	79
Adjusting Shift Lever	80
Preassembling and Installing Clutch	81
Checking Clutch	88
Installing Brake	90
Installing Drive Casing	94
Mounting Gear Box to Axle	98
Drive Pinion / Crown Wheel Contact Pattern	101

Correct Pattern	101
Increase Pinion Distance	101
Decrease Pinion Distance	102
Transmission Governor	103
Parts List	103
Disassembly of Governor	105
Reassembly of Governor	106
Steering Cylinder	107
Parts List	107
Disassembly and Reassembly of Steering Cylinder	108
Tools Required	108
Disassembly	108
Reassembly	112

SPECIFICATIONS

Rear Axle Type Overall Reduction Ratio Axle Load(Travel Condition) Axle Load (Working Condition) Brake Type Brake Torque	Fully Floating Planetary Drive 13.26:1 6,000 kg (13,228 lbs.) 25,500 kg (56,218 lbs.) Wet Disc 670 kg•m (4,846 ft lbs) at 44 kg/cm2 (626 psi)
Transmission Type Reduction Ratio Power Shift Control Pressure Max. InputTorque Max. Rotating Speed	2 Speed, Power-Shift 5.35 / 1.39 30 – 35 kg/cm2 (427 – 498 psi) 78.0 kg•m (564.17 ft lbs) 4,500 rpm

REAR AXLE ASSEMBLY

DISASSEMBLY OF REAR AXLE

NOTE: *If possible perform repairs in a clean dry shop to avoid damage of rusting of parts.*

1. Before disassembly, carefully clean exterior of all components.
2. Remove oil drain plug and drain oil
3. Loosen socket head screws.
4. Detach carrier, using pry bars and being careful not to lose thrust washer.

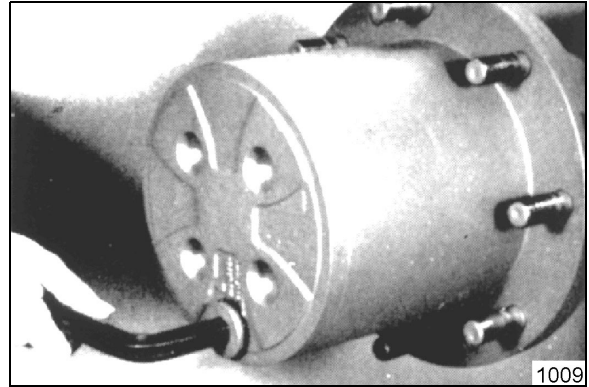


Figure 1

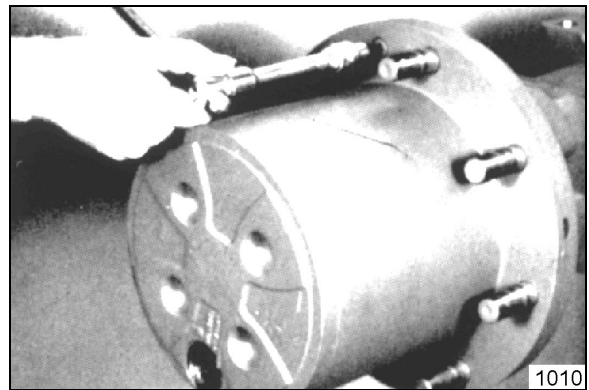


Figure 2

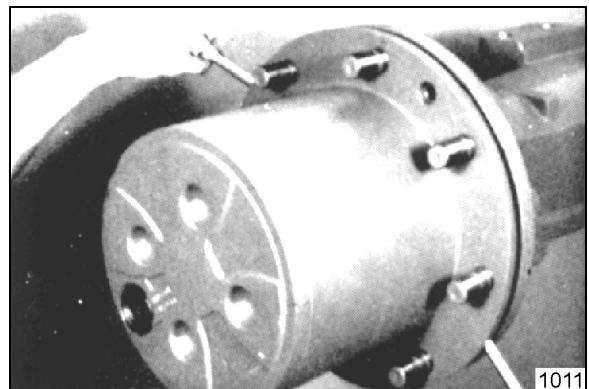


Figure 3

5. Remove clip, then remove planetary gears using a gear puller.

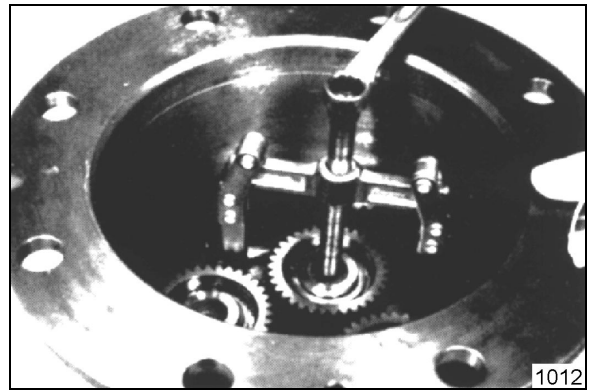


Figure 4

6. Detach beveled washer and roller bearing from gear.

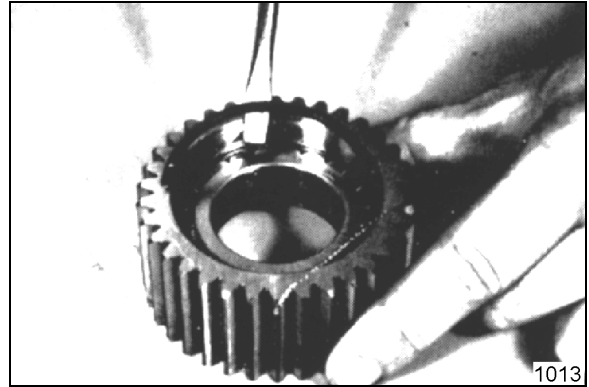


Figure 5

7. Remove sun gear.

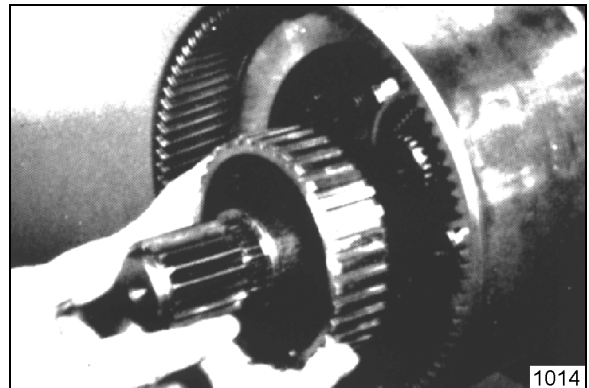


Figure 6

8. Remove clip.

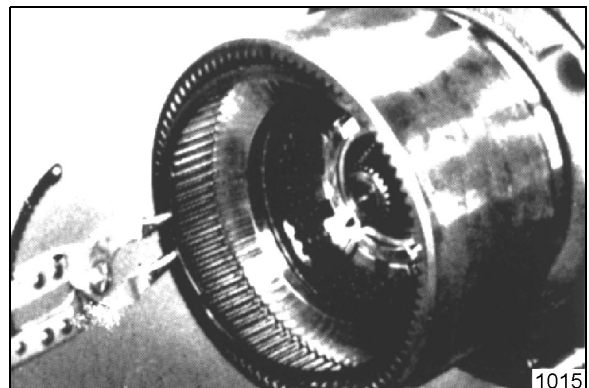


Figure 7

9. Detach backing plate.

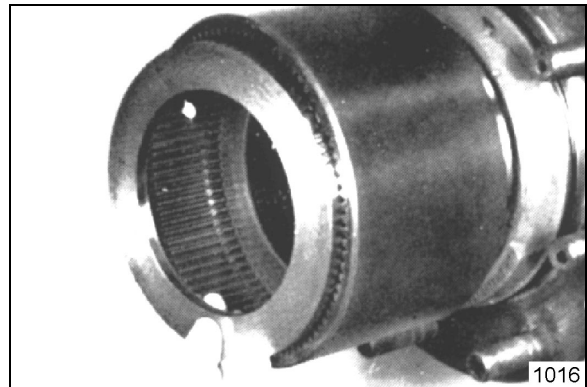


Figure 8

10. Remove clutch plate pack assembly from ring gear.

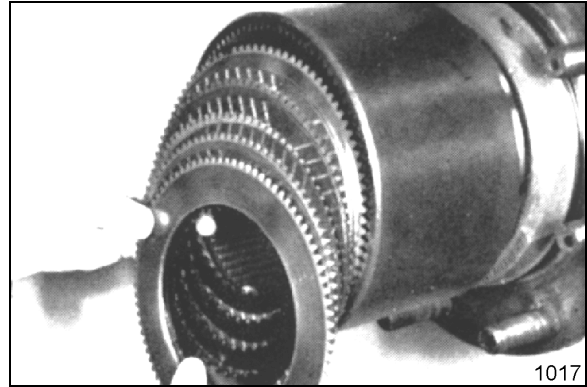


Figure 9

11. Detach clip.

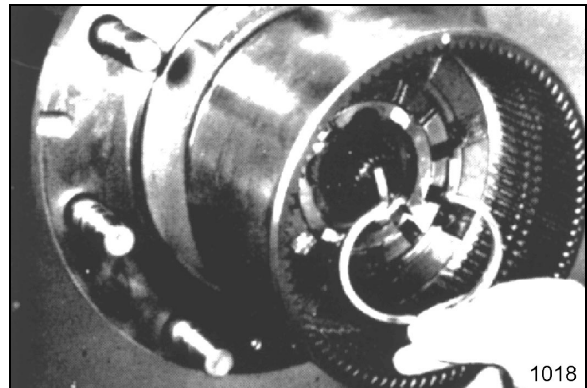


Figure 10

12. Loosen slot nut using a hook spanner.

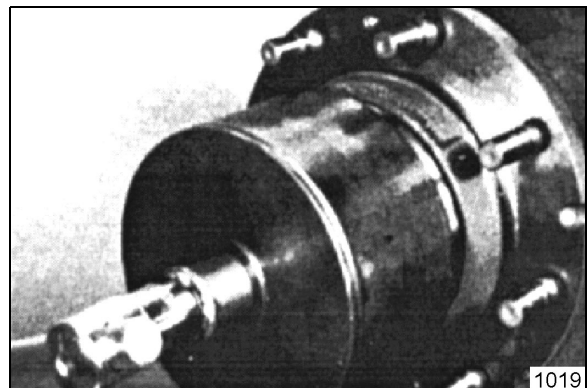


Figure 11

13. Detach ring gear, using pry bars and being careful not to lose beveled washer and O-ring. (Figures 12 and 13)

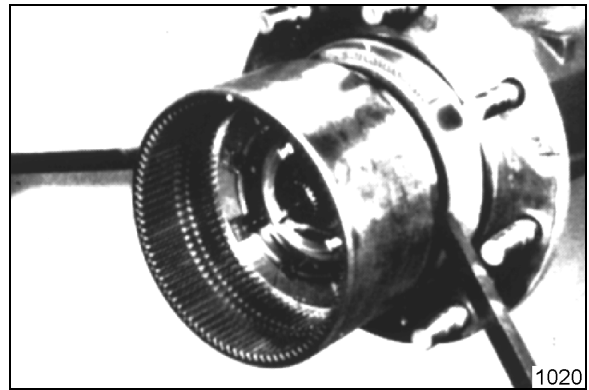


Figure 12

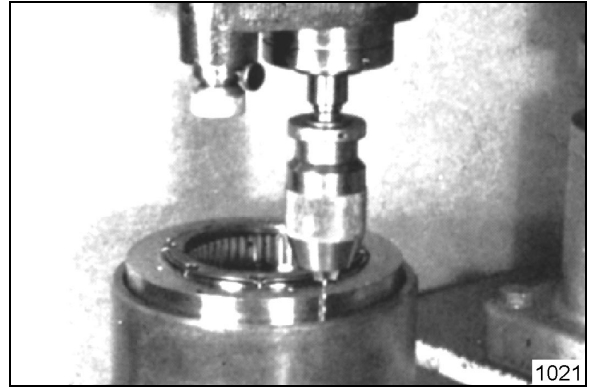


Figure 13

14. Remove clip and detach ring gear and ring gear carrier.



Figure 14

15. Place ring gear carrier in vise and remove return spring.

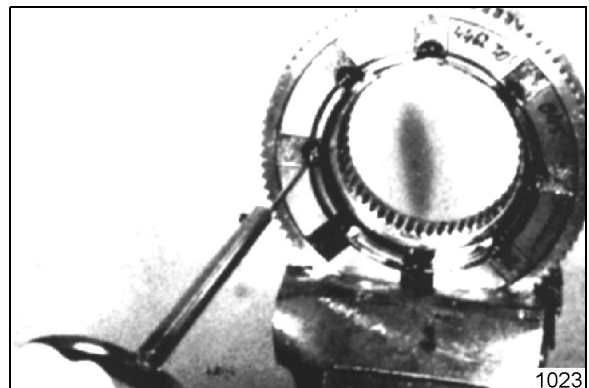


Figure 15

16. Remove piston from ring gear using adjustable spanner.

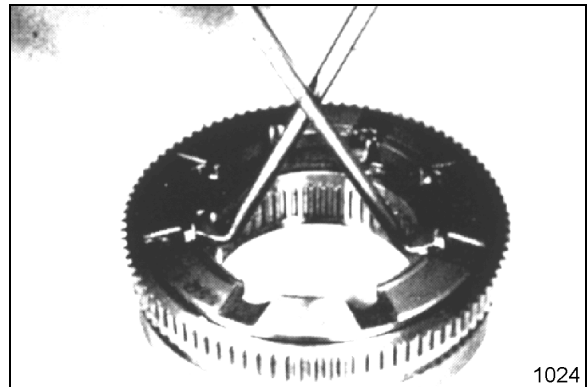


Figure 16

17. Detach thrust washer.

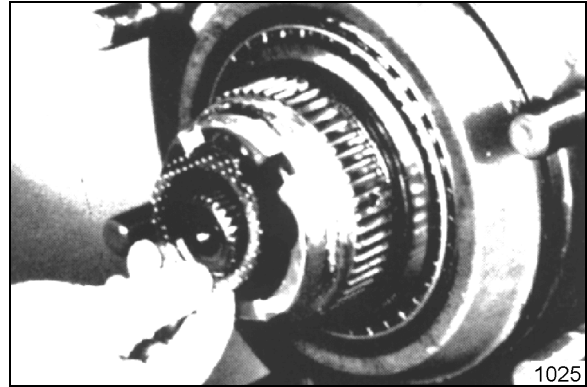


Figure 17

18. Remove O-ring.

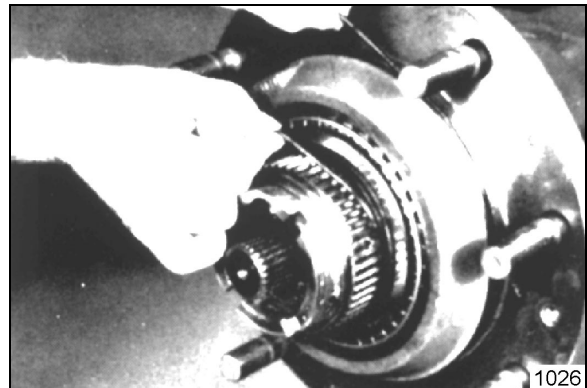


Figure 18

19. Remove stub shaft from axle housing.

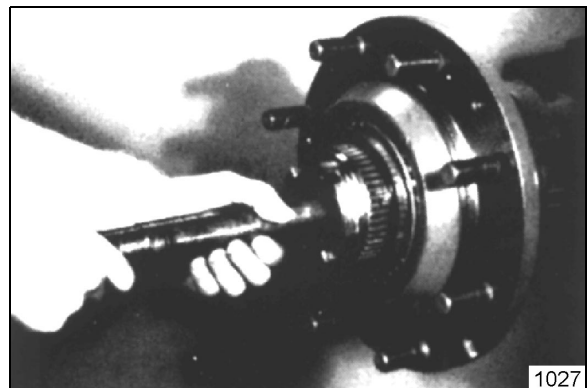


Figure 19

20. Remove hub from hub carrier using pulley.

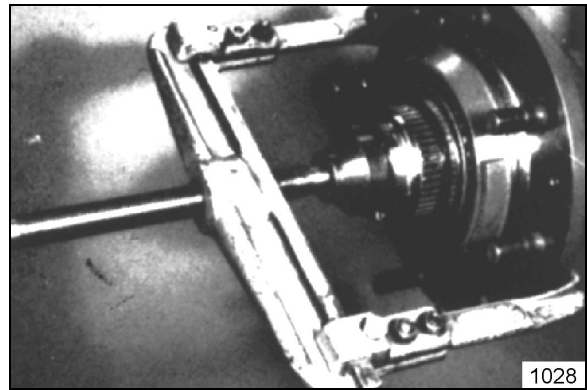


Figure 20

21. Cut shaft seal with chisel and remove drive bearing.

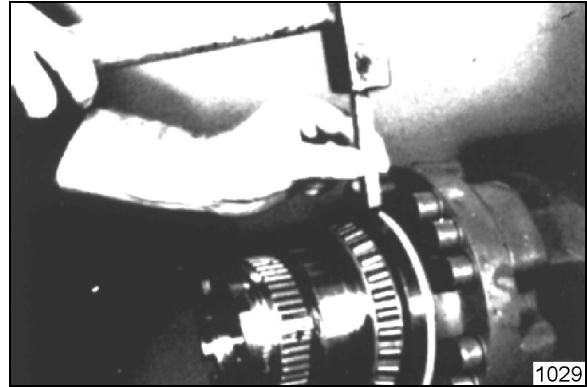


Figure 21

22. Remove tapered roller bearing from hub carrier, using puller

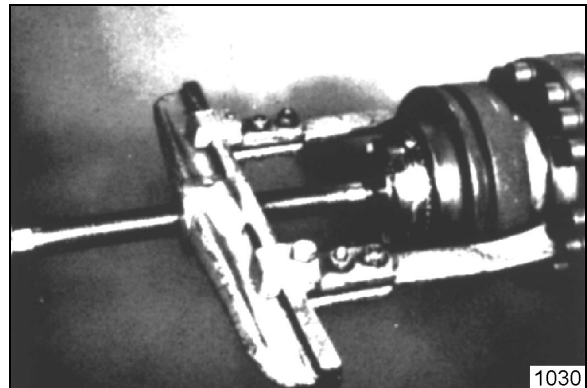


Figure 22

23. Remove ring and liner.

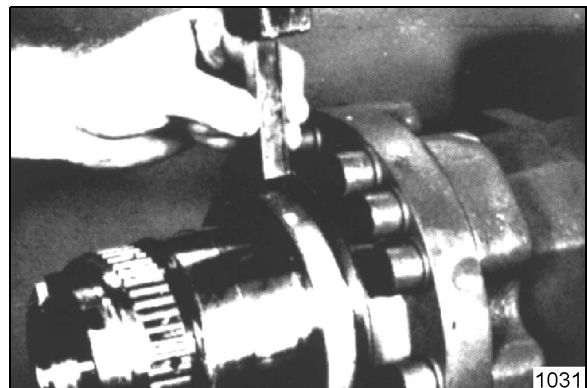


Figure 23

24. Remove and discard baffle plate.

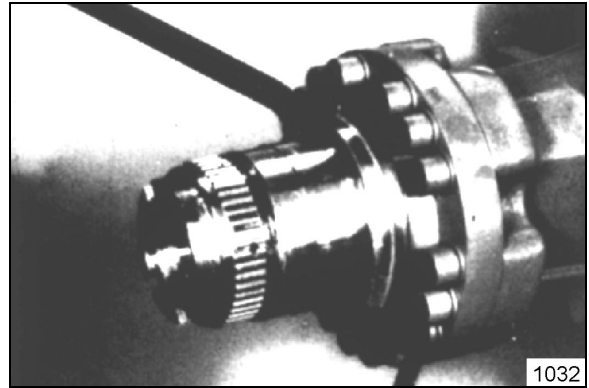


Figure 24

25. Mark axle housing and hub carrier for reassembly and remove socket screw.

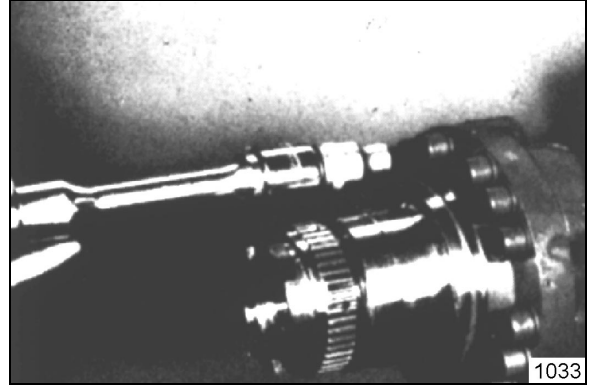


Figure 25

26. Remove hub carrier by tapping with rubber hammer.

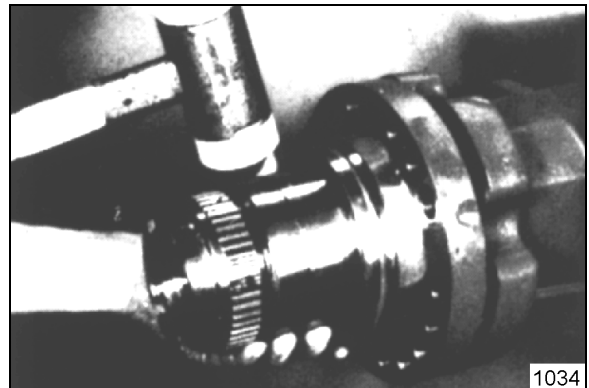


Figure 26

ASSEMBLY OF REAR AXLE

1. Install greased O-ring to hub carrier groove.

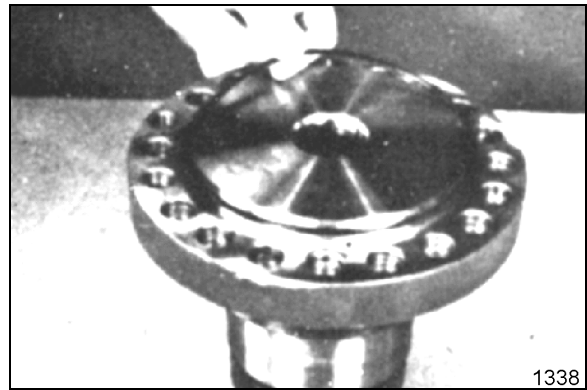


Figure 27

2. Install hub carrier to axle housing, being careful that installation marks are lined up.

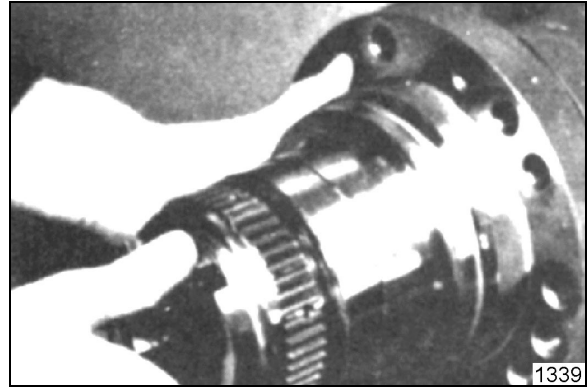


Figure 28

3. Tighten socket bolts to 295 Nm (66 ft.lb.).

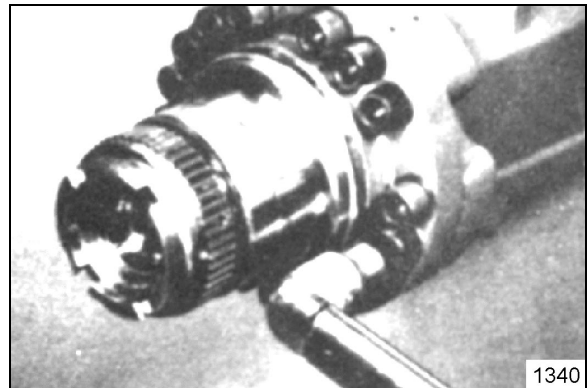


Figure 29

4. Install baffle plate to cover using Loctite 277.

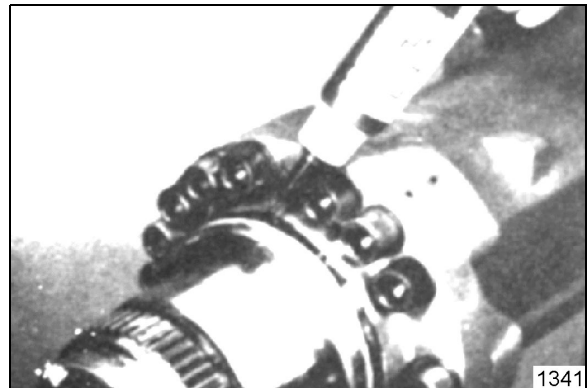


Figure 30

5. Heat baffle plate and install on raised part of hub carrier making sure flat surface is toward differential gear.

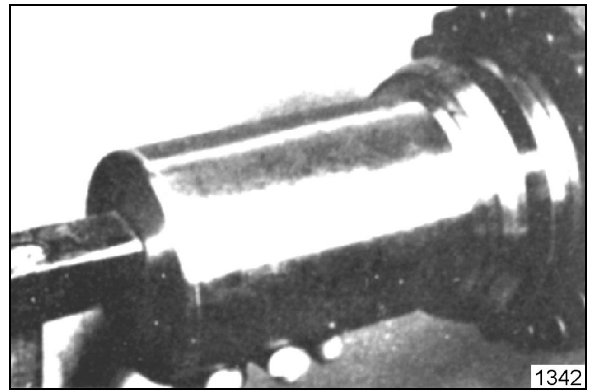


Figure 31

6. Apply Loctite 573 and install liner to cover.

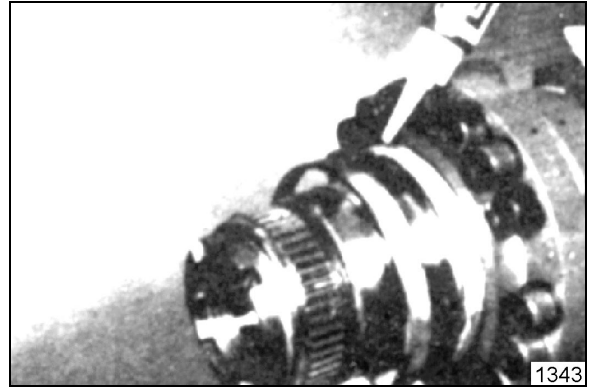


Figure 32

7. Remove wheel stud from hub shaft.

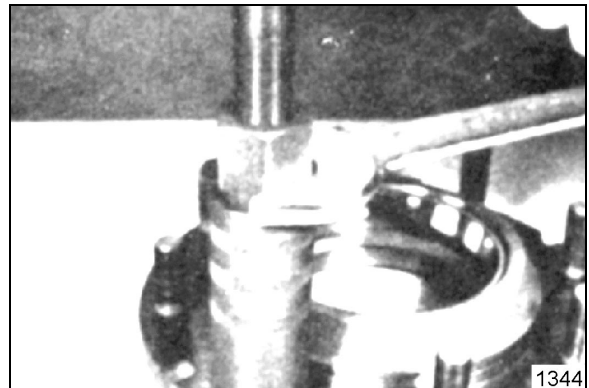


Figure 33

8. Install bearing to both sides of hub.

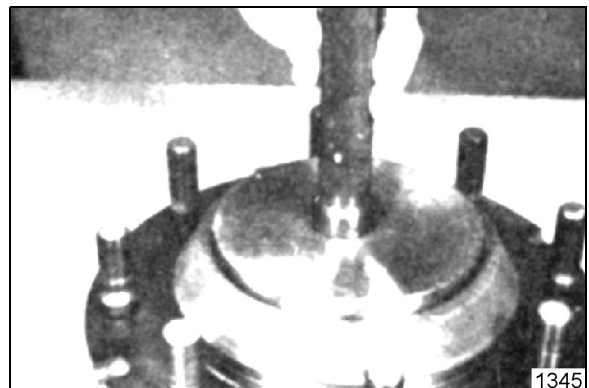


Figure 34

9. Check that rolling resistance is between 8 - 12 Nm (1.8 - 2.7 ft.lb.), and install bearing.

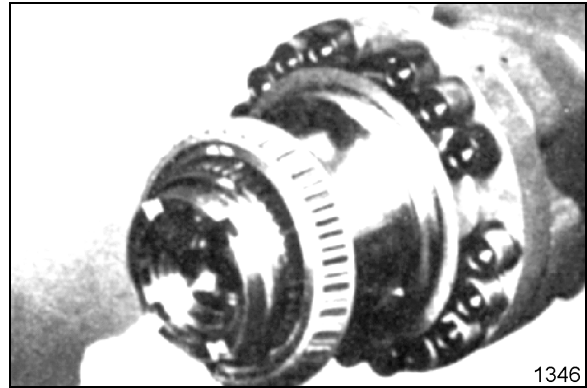


Figure 35

10. Install 14.50 mm (0.57 in.) spacer to end of hub carrier.

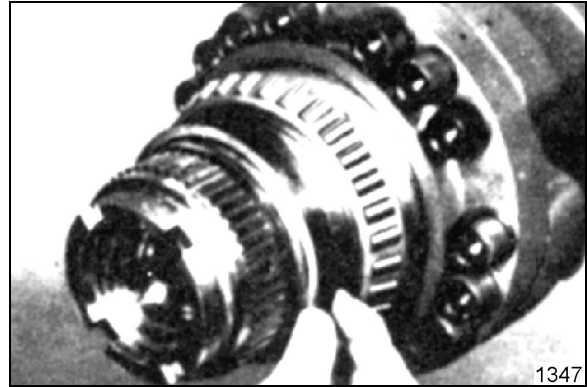


Figure 36

11. Heat inner surface of bearing and install bearing.

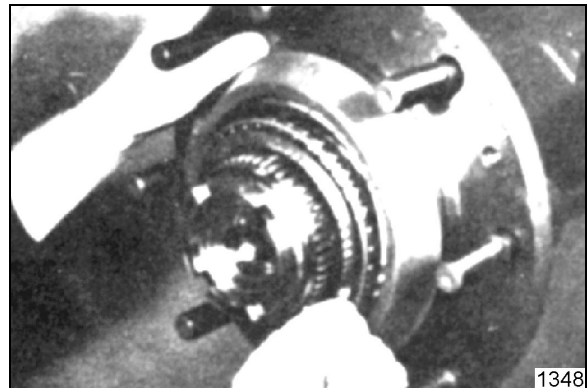


Figure 37

12. Install ring gear carrier.

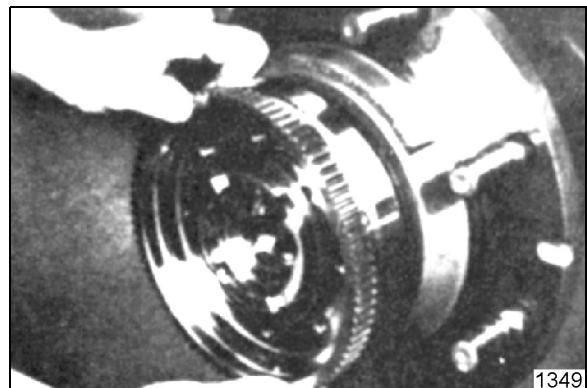


Figure 38

13. Tighten slot nut to 1,000 Nm (224 ft.lb.) [M90 x 1.5] or 1,500 Nm (337 ft.lb.) [M95 x 1.5] by rotating hub.

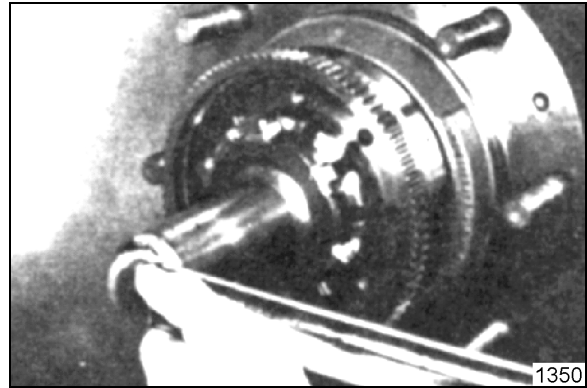


Figure 39

14. Check rolling resistance by winding wire around hub.

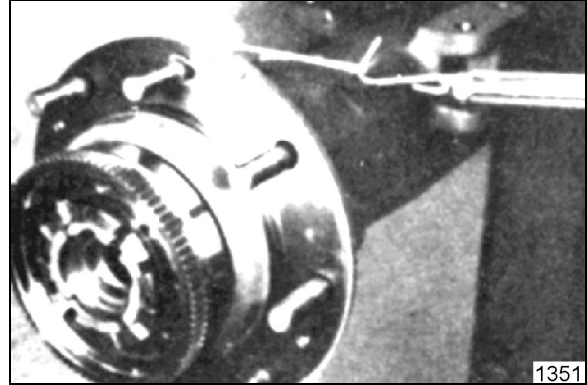


Figure 40

Hub Inner Diameter (320 mm [12.6 in.])	
Before Hub Moves 50 - 75 Nm (11.2 - 16.9 ft.lb.)	After Hub Moves 25 - 40 Nm (5.6 - 9.8 ft.lb.)
Hub Outer Diameter (390 mm [15.3 in.])	
Before Hub Moves 40 - 60 Nm (9.8 - 14.7 ft.lb.)	After Hub Moves 20 - 30 Nm (4.9 - 7.4 ft.lb.)

Reassemble if rolling resistance is not within specifications. Loosen slot nut to remove ring gear carrier from hub carrier and remove bearing.

15. Heat and install bearing.

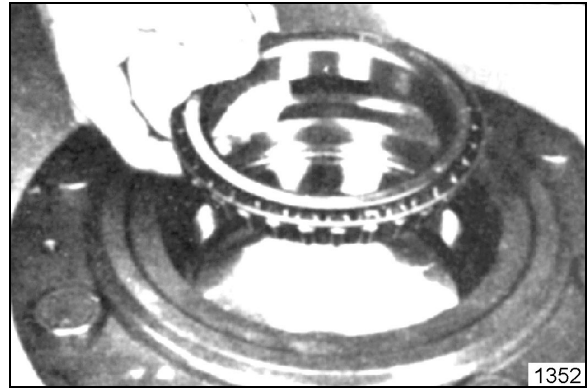


Figure 41

16. Install scraper ring to upper side of shaft seal so that ring faces up.

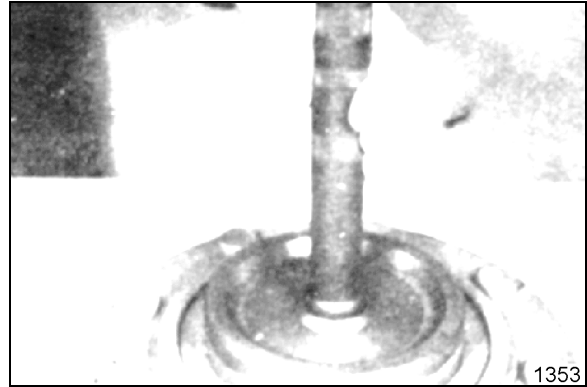


Figure 42

17. Install hub to hub carrier.

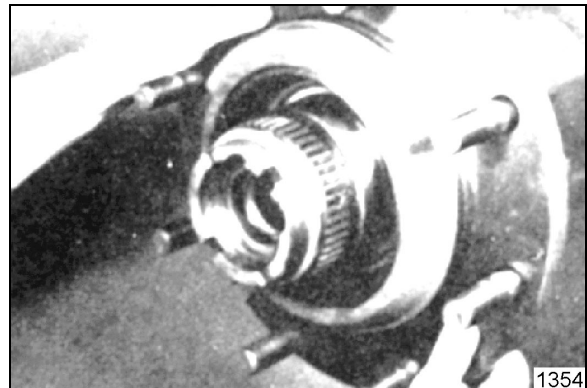


Figure 43

18. Determine spacer size.



Figure 44

19. Heat inner ring of bearing and install bearing.

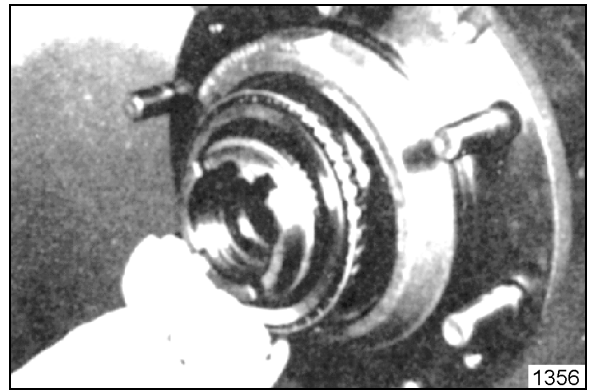


Figure 45

20. Grease O-ring and install to hub and hub carrier.

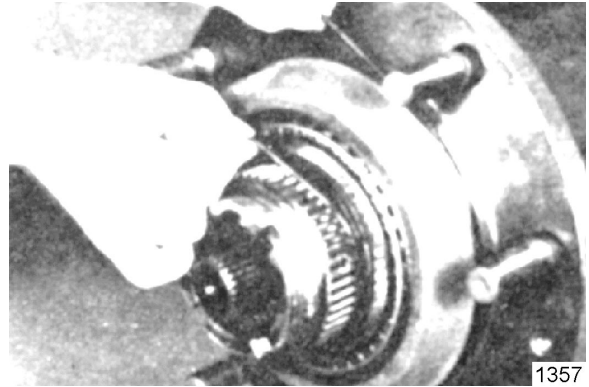


Figure 46

21. Install two piece rings to piston groove.



Figure 47

22. Install piston to ring gear carrier, being careful of position of return spring.



Figure 48

23. Install return springs in sets

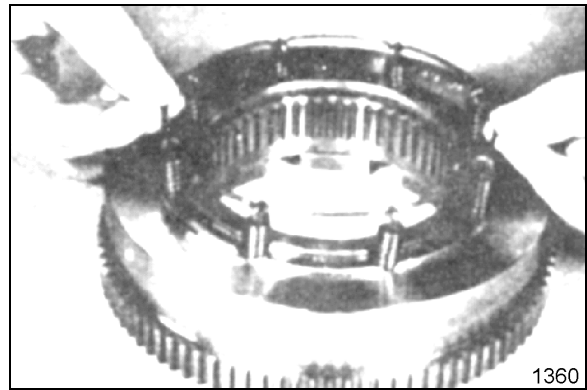


Figure 49

24. Place ring carrier in vise and carefully secure return spring with wire, being careful not to overstress the return spring.



Figure 50

25. Install snap ring in groove of ring gear carrier.



Figure 51

26. Install ring gear to spline groove of hub carrier, being careful not to overlap oil holes of ring gear carrier and hub carrier.

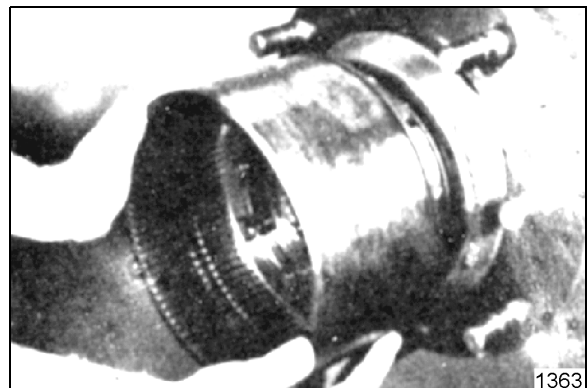


Figure 52

27. Grease and install angle ring and O-ring, being careful of angle ring's position. Tighten slot nut.

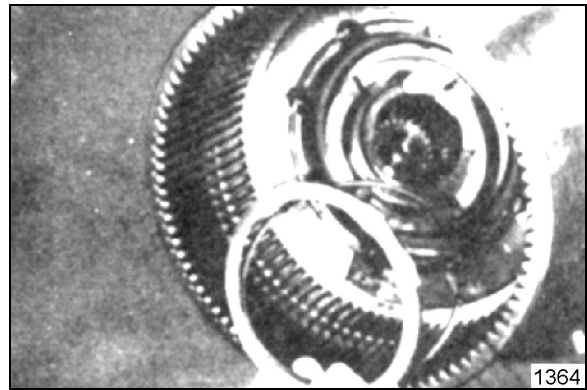


Figure 53

28. Tighten slot nut to 1,000 - 1,500 Nm (224 - 336 ft.lb.) [M90 x 1.5] or 1,500 - 2,000 Nm (336 - 448 ft.lb.) [M95 x 1.5].

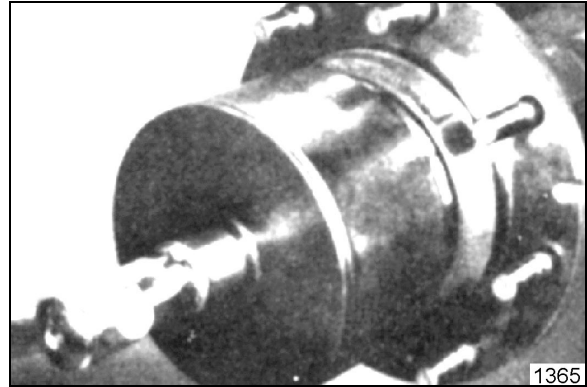


Figure 54

29. Install thrust washer.

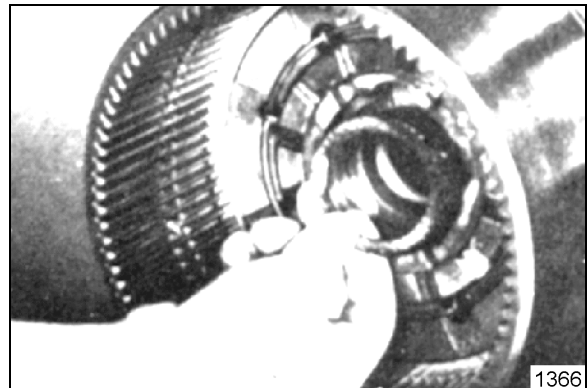


Figure 55

30. Remove clip on B side.

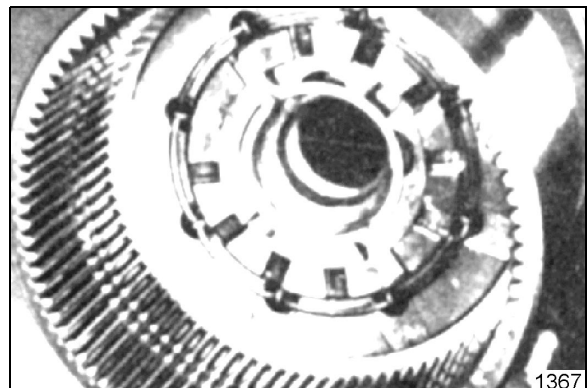


Figure 56

31. Install stub shaft until it bottoms out.

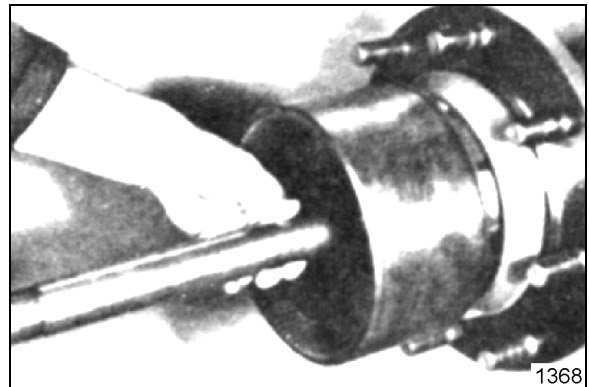


Figure 57

32. Tighten clip on baffle ring.

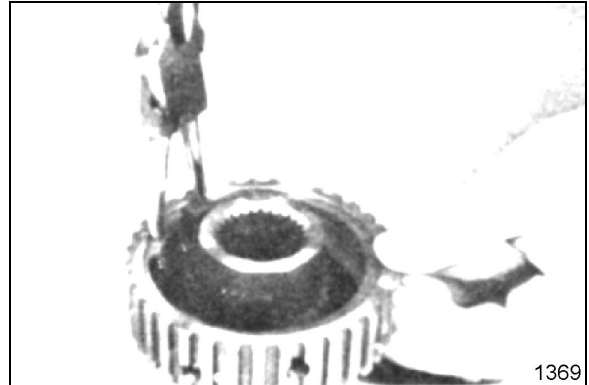


Figure 58

33. Install inner plate of carrier.

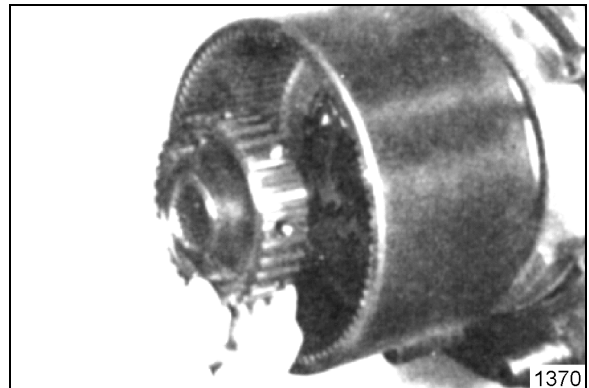


Figure 59

34. Check movement of plate. Install ring gear to ring gear carrier. Measure distance from ring gear to piston.

Example: A = 80.60 mm (3.17 in.)

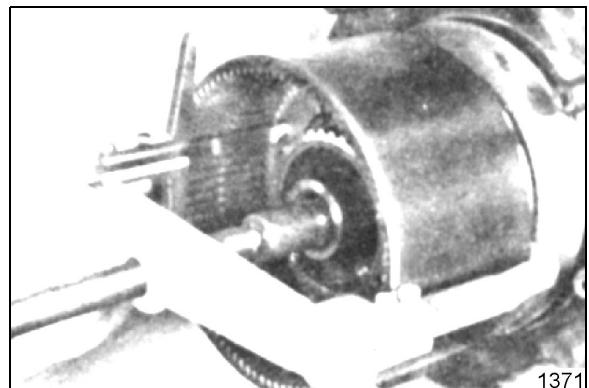


Figure 60

35. Install back plate and tighten with clip. Measure distance from ring gear surface to back plate.

Example: $B = 51.70 \text{ mm (2.034 in.)}$.

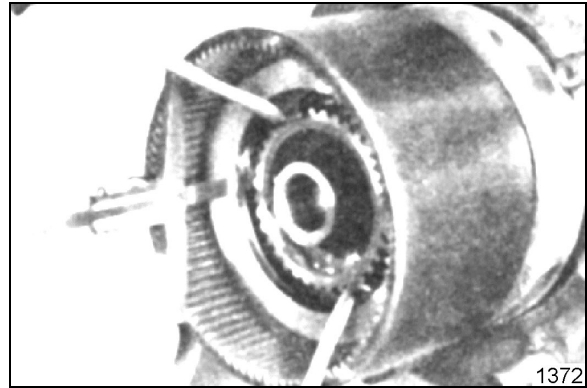


Figure 61

36. Place 200 Nm (44 ft.lb.) of force on pack assembly and check distance.

Example: $C = 26.30 \text{ mm (1.035 in.)}$.

37. Note that, in examples $A - B - C = 2.60 \text{ mm (0.102 in.)}$ falls within the specified range of $2.50 + 0.4 \text{ mm (0.098 + 0.015 in.)}$.

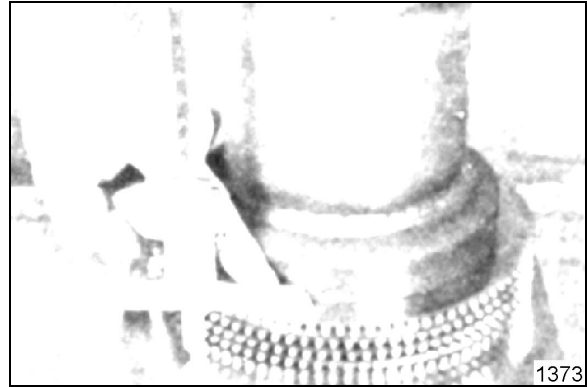


Figure 62

38. Install outer plates (5) and inner plates (4) to plate; secure with clip.

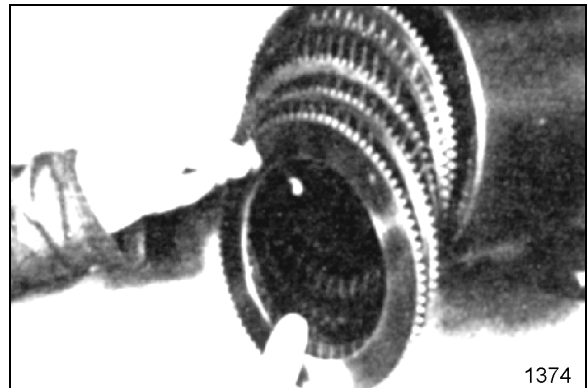


Figure 63

39. Install sun gear shaft.

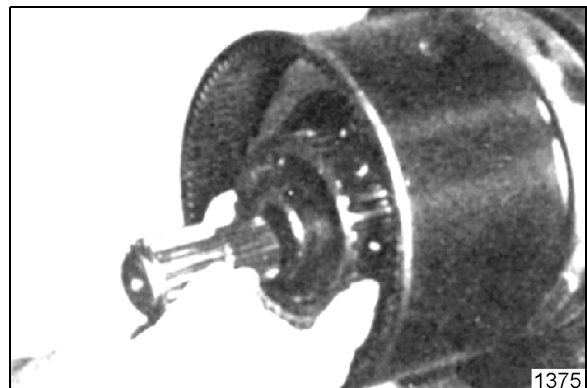
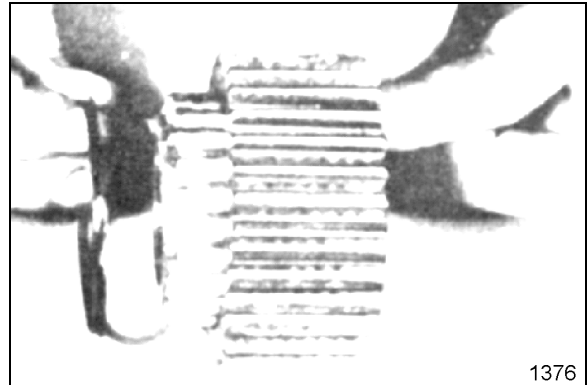


Figure 64

40. Tighten first angle ring, install roller bearing and secure second angle ring.



1376

Figure 65

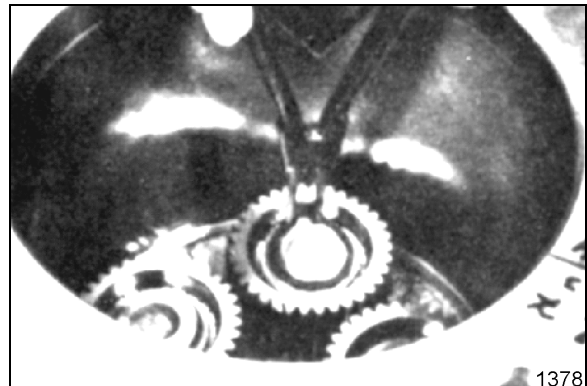
41. Install planetary gear to planetary carrier shaft, making sure larger inner diameter of bearing inner race faces planetary carrier.



1377

Figure 66

42. Secure planetary gear with clip.

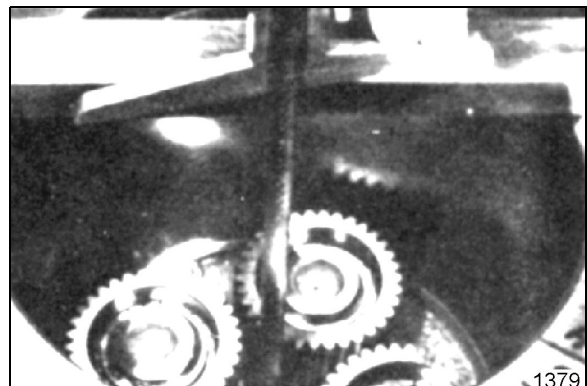


1378

Figure 67

43. Measure distance from stub shaft to end of sun gear.

Example: A = 289.50 mm (11.39 in.)



1379

Figure 68

44. Measure distance from shaft of sun gear to flange surface.

Example: B = 286.50 mm (11.28 in.).

Since $A - B = 3.10$ mm (0.12 in.), use 2.70 mm (0.11 in.) thrust washer to make shaft end play 0.32 - 0.60 mm (0.012 - 0.023 in.).

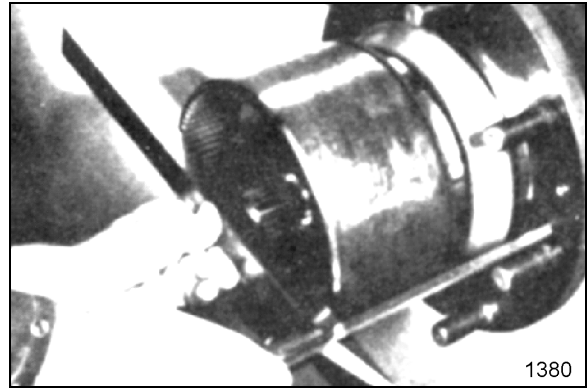


Figure 69

45. Apply Loctite to thrust washer and install to planetary carrier.

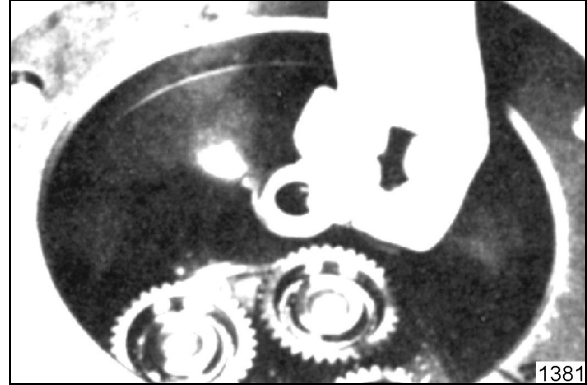


Figure 70

46. Grease and install O-ring, install planetary carrier to hub, and tighten bolts to 40Nm (11 ft.lb.).

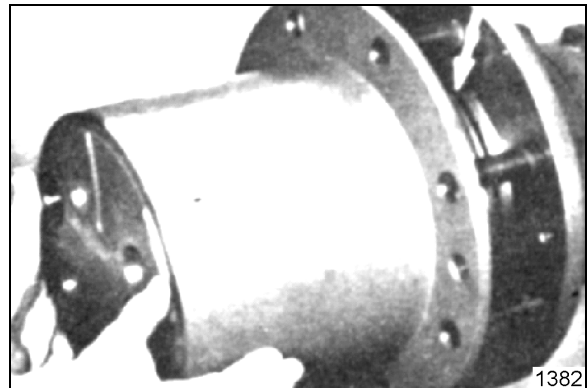


Figure 71

47. Fill assembly with test oil (motor oil, SAE #10W {MIL-1 2104 1}) and pressure check by applying 120 bar (1,740 psi) for 15 minutes, it should not drop more than 2%.

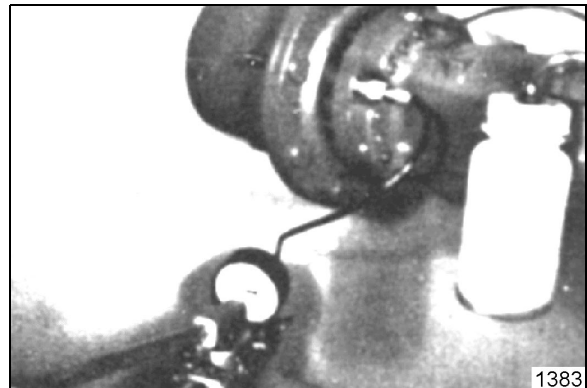


Figure 72

DISASSEMBLY OF DIFFERENTIAL GEAR

1. Loosen hex screw, position adjusting screw of differential gear side, and remove axle housing II.
2. Remove differential gear assembly from axle housing.
3. Remove tapered roller bearing from differential gear case.
4. Mark parts of differential gear assembly and unscrew socket bolts.

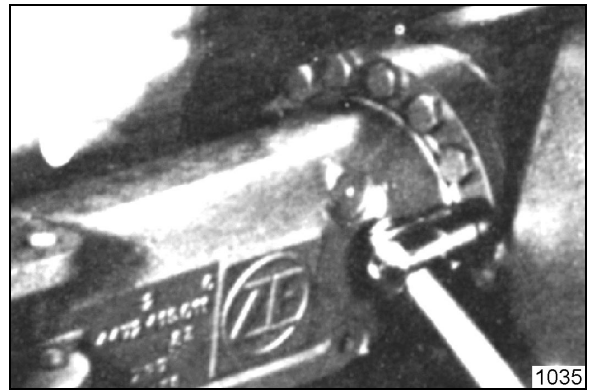


Figure 73

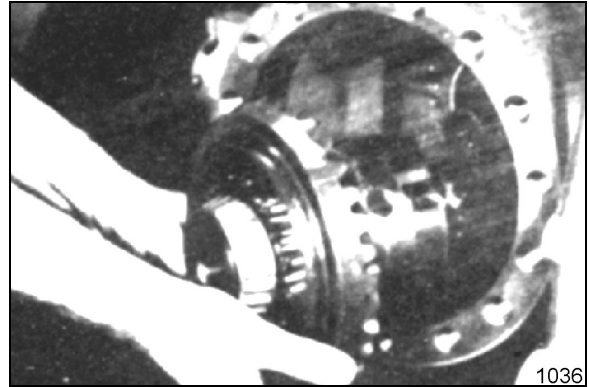


Figure 74



Figure 75

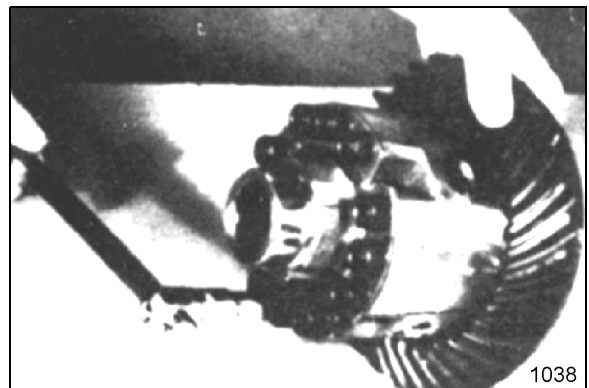


Figure 76

5. Separate differential case and remove components.

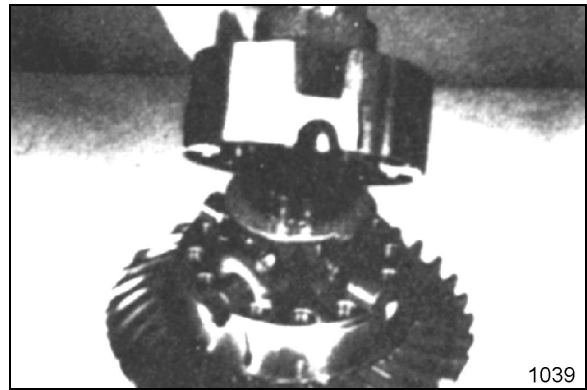


Figure 77

6. Remove tapered roller bearing of crown wheel side from differential gear case.



Figure 78

7. Pull out circular pin.

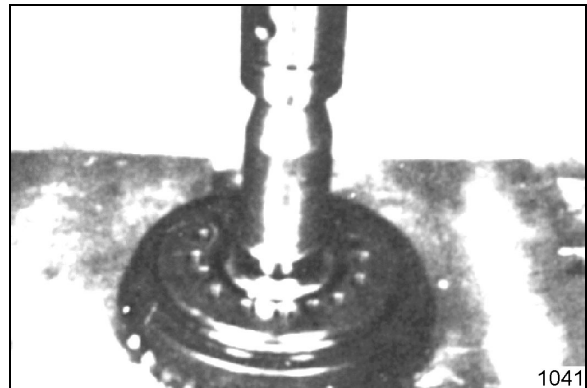


Figure 79

8. Loosen hex bolts.



Figure 80

9. Remove cover.

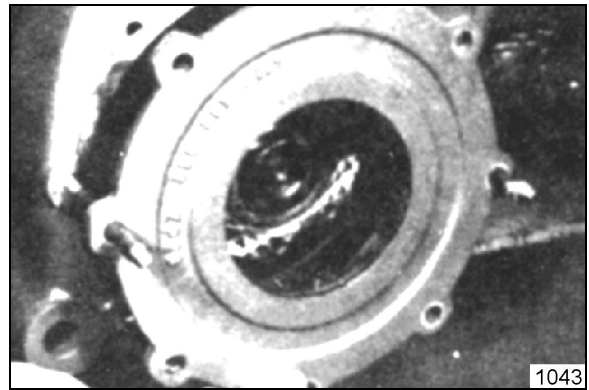


Figure 81

10. Loosen hex nuts on inner surface.

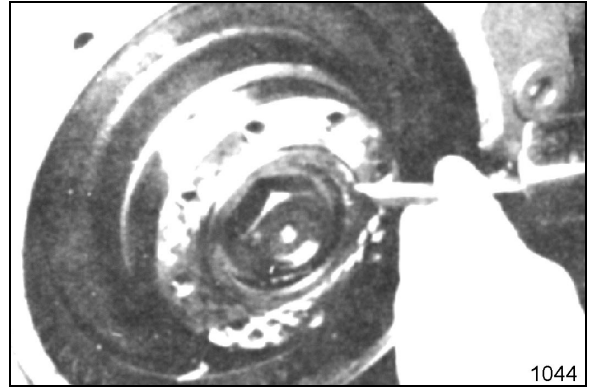


Figure 82

11. Remove lock plate.

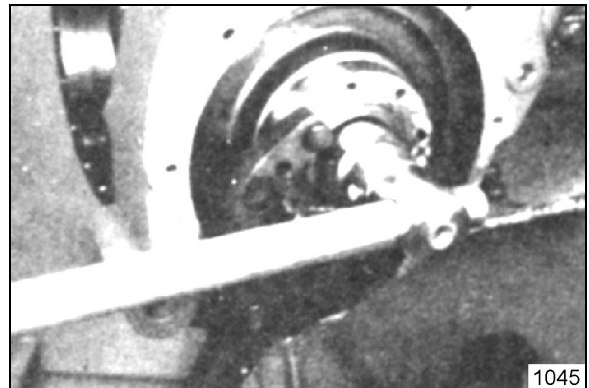


Figure 83

12. After lock plate is disassembled, remove spur gear.

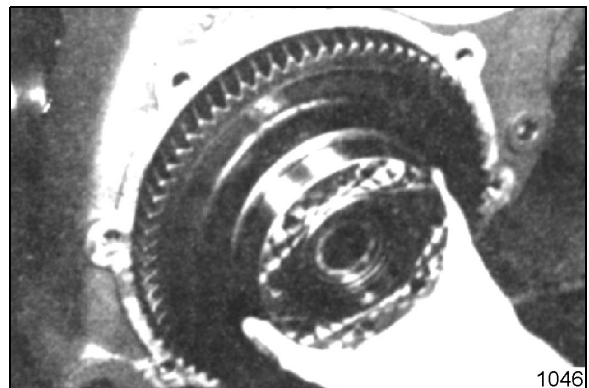


Figure 84

13. Remove drive pinion gear from axle housing, and carefully remove tapered roller bearing.

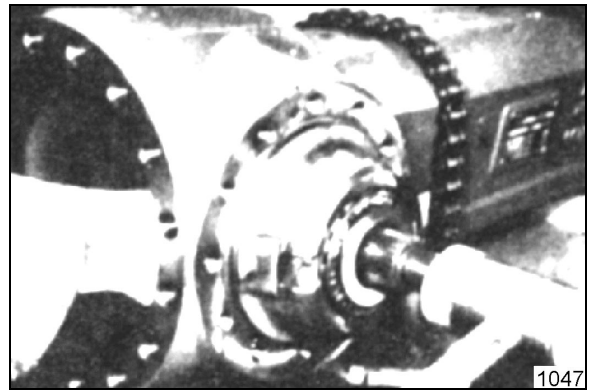


Figure 85

14. Remove spacer and tapered roller bearing from pinion gear.



Figure 86

15. Remove drive pinions and spacer washer from axle housing.

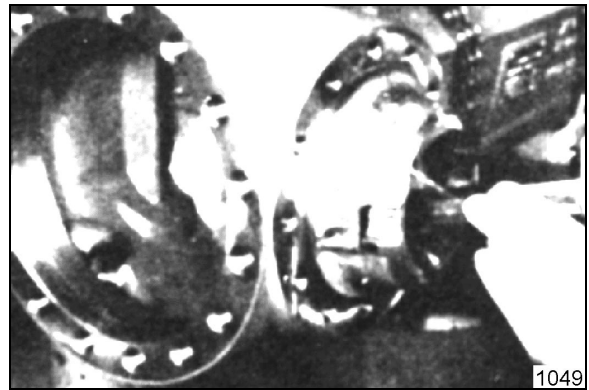


Figure 87

16. Remove differential gear bearing and spacer washer from axle housing using puller.

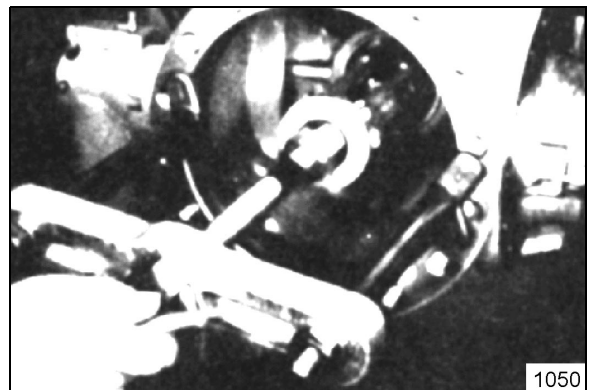


Figure 88

REASSEMBLY OF DIFFERENTIAL GEAR

NOTE: *Shim thickness is determined in the next 4 steps.*

1. Measure distance to center cylinder.

Example: Depth A = 192.4 mm (7.57 in.).

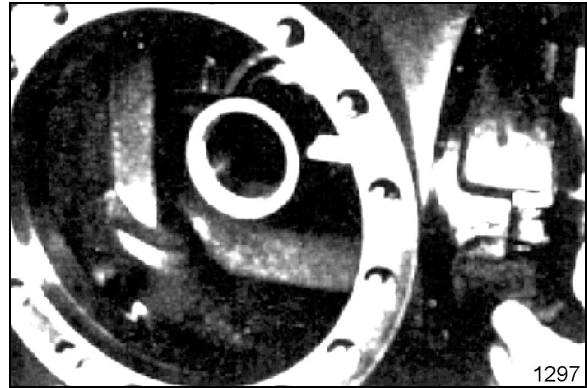


Figure 89

2. Measure distance from housing collar and outer surface of bearing.

Example: Depth B = 47.4 mm (1.86 in.).

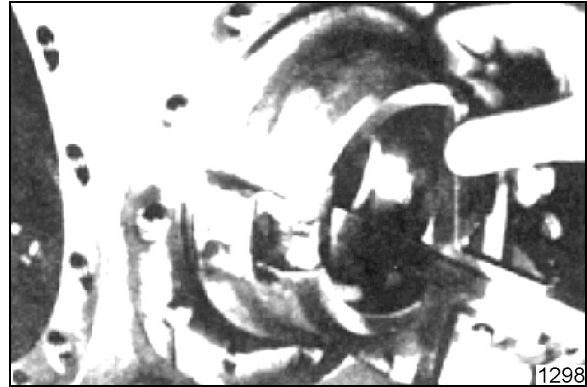


Figure 90

3. Measure width of bearing.

Example: 32 mm (1.26 in.).

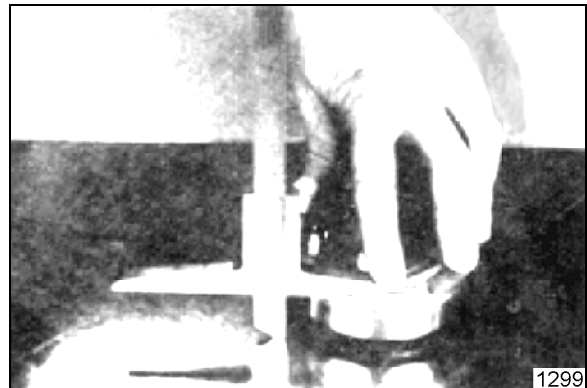


Figure 91

4. Measure size of pinion gear and subtract number marked on gear.

Example:

112 mm - 0.1 mm = 111.90 mm (4.41 in.)

A = 192.40 mm (7.57 in.)

-B+C = 79.40 mm (3.13 in.)

Example:

113.00 mm (4.45 in.)

-C = 111.90 mm (4.41 in.)

Shim Thickness = 1.10 mm (0.04 in.)

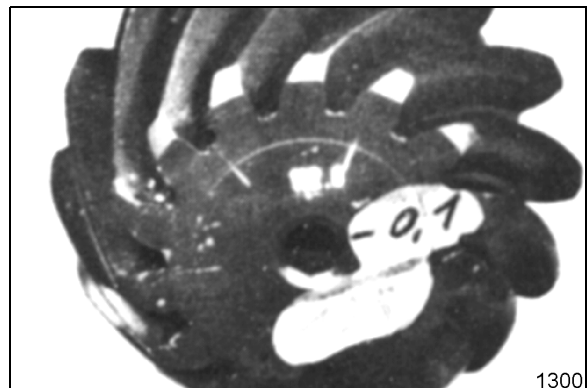


Figure 92

5. Install shim to axle housing.

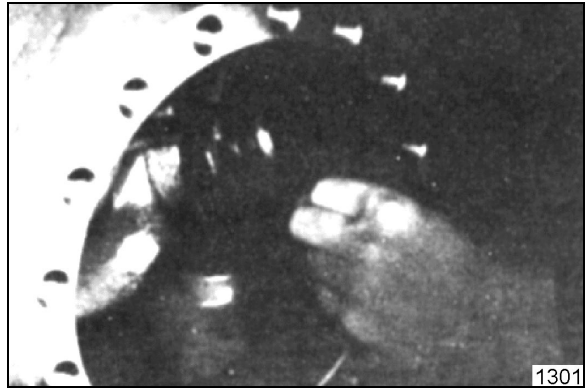


Figure 93

6. Install bearing using special tool.

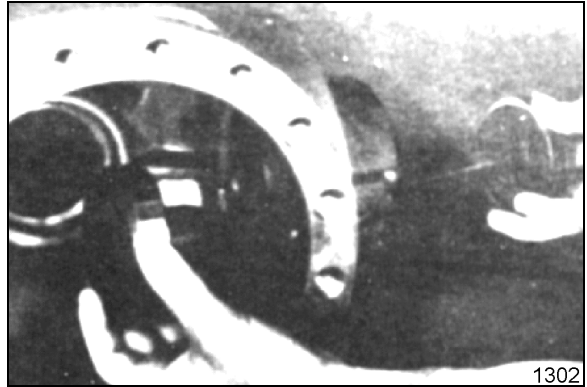


Figure 94

7. Install second bearing.

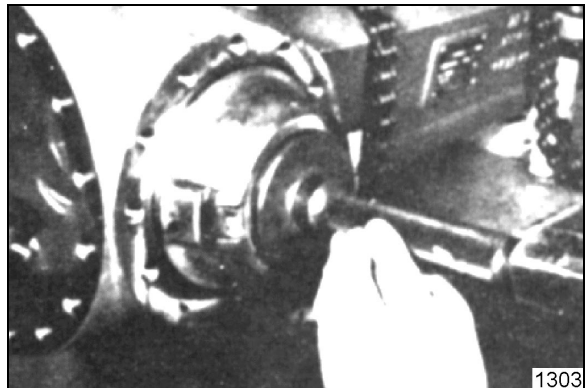


Figure 95

8. Install bearing to end of drive pinion gear.

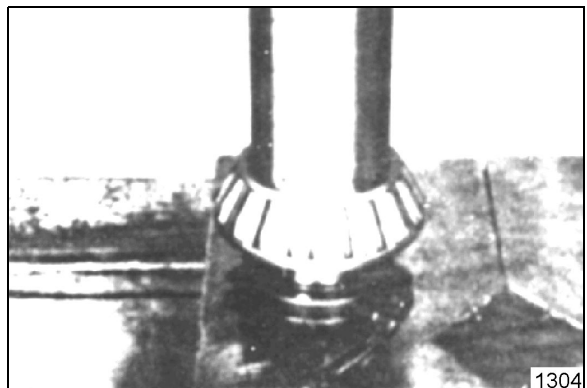


Figure 96

9. Measure rolling value of drive pinion gear.

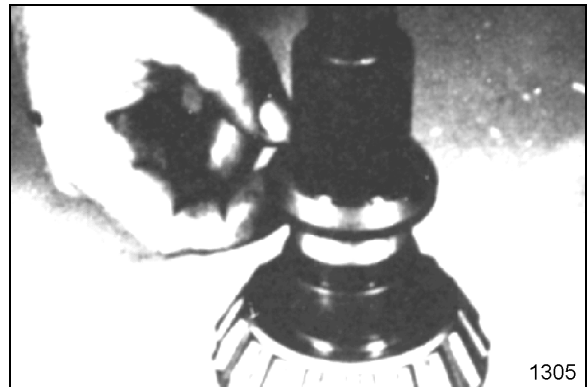


Figure 97

10. Measure rolling resistance of pinion gear by installing a measurement ring to drive pinion collar.



Figure 98

11. Install drive pinion gear by heating bearing's inner ring.

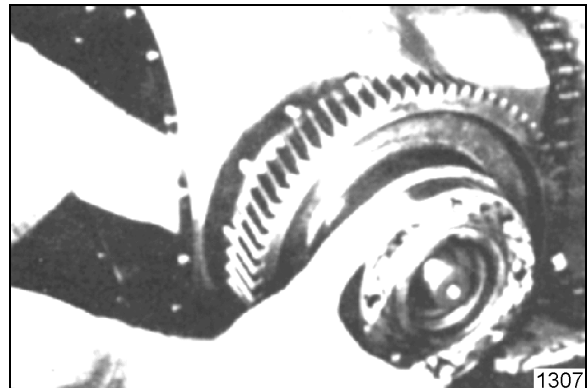


Figure 99

12. Install spur gear to spline of drive pinion gear.
13. Insert washer and tighten nut so that rolling resistance is 1 - 2 Nm (0.225 - 0.449 ft.lb.)

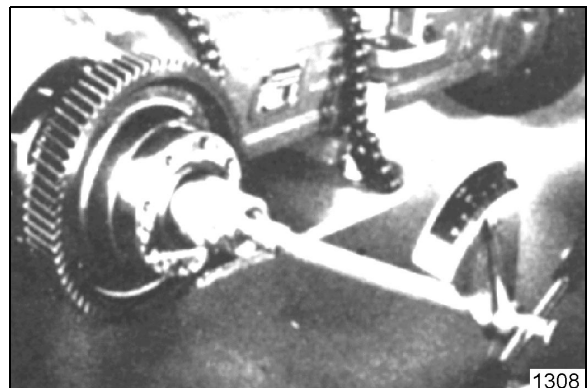


Figure 100

14. Loosen hex nut and remove washer and spur gear.

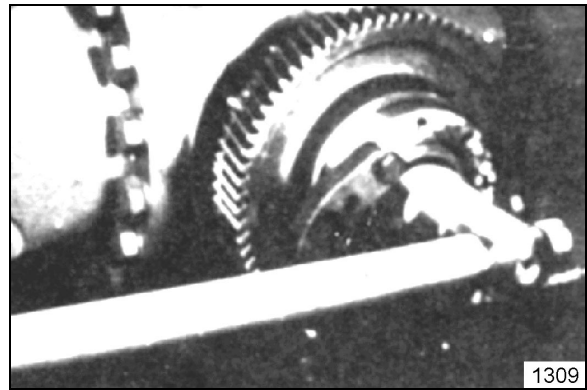


Figure 101

15. Remove measurement ring from drive pinion gear and determine spacer thickness.

Example: 12.15 mm (0.478 in.).

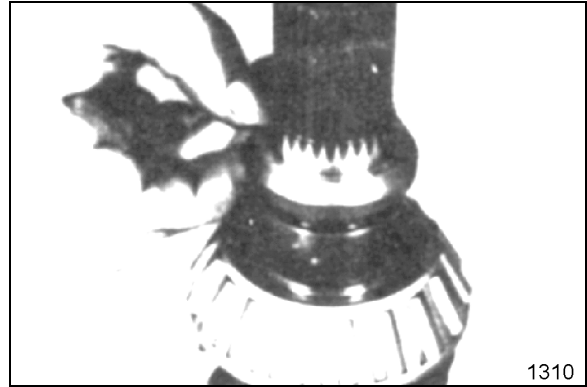


Figure 102

16. Install spacer to drive pinion gear collar.



Figure 103

17. After installing drive pinion gear bearing, install spur gear and washer. Tighten to 550 Nm (123 ft.lb.).

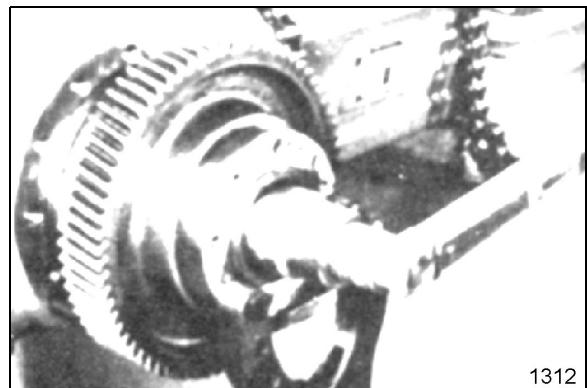


Figure 104

18. Check that rolling resistance is 1 - 2 Nm (7.23 - 14.47 ft.lb.). Adjust by changing spacer.

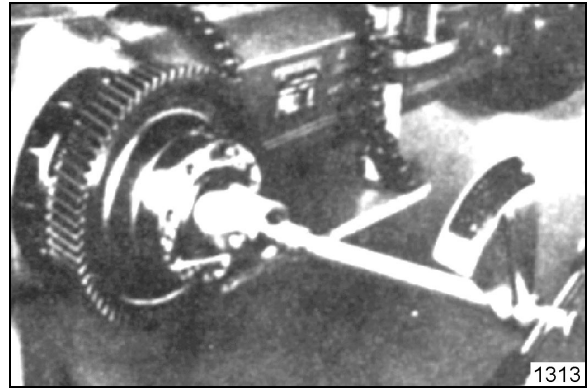


Figure 105

19. Heat differential gear case and crown wheel, being careful of circular pin position.



Figure 106

20. Install two circular pins



Figure 107

21. Install thrust washer to differential gear.

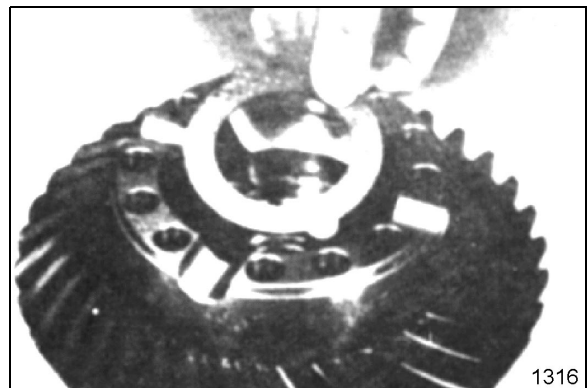


Figure 108

22. Install side gear to differential gear case.

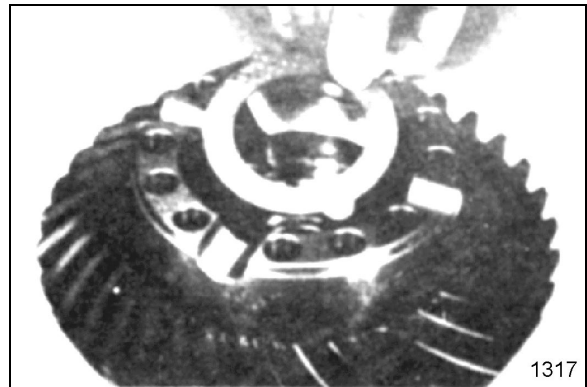


Figure 109

23. Install differential gear spider, placing thrust washer with nose part facing up.

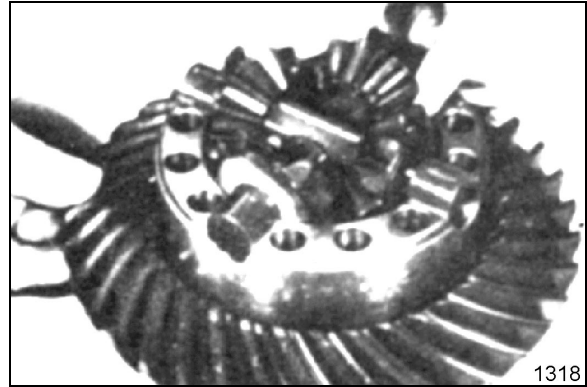


Figure 110

24. Install second side gear above spider.

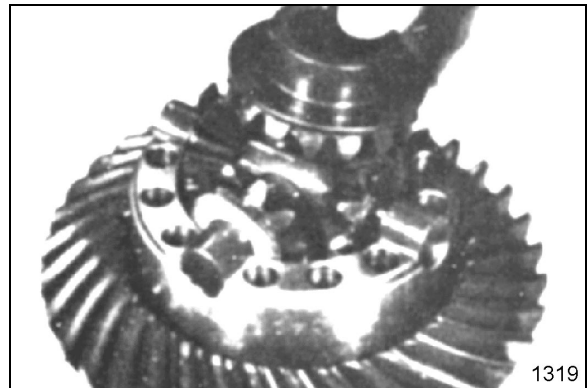


Figure 111

25. Coat thrust washer with grease and install to other differential gear case, being careful of washer position.



Figure 112

26. Install differential gear case.

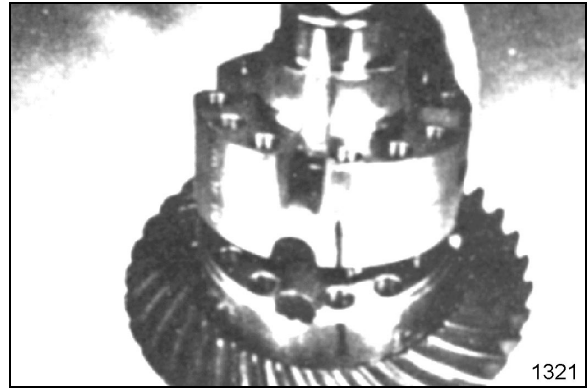


Figure 113

27. Tighten socket bolts on disc.

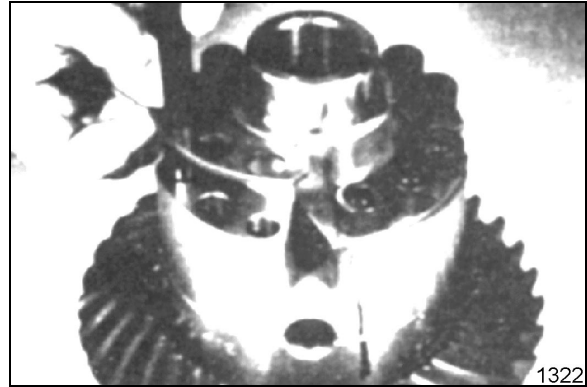


Figure 114

28. Place differential gear assembly in vise and tighten socket bolts to 145 Nm (32 ft.lb.).

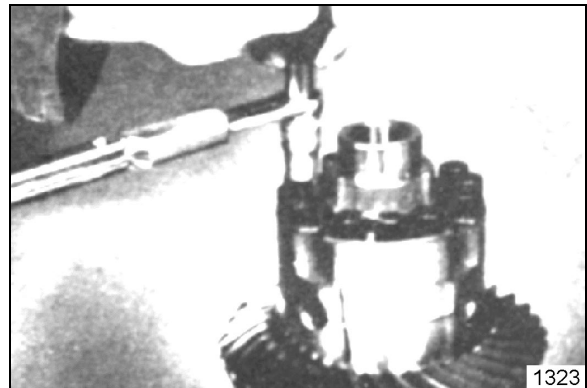


Figure 115

29. Heat and install roller bearing.

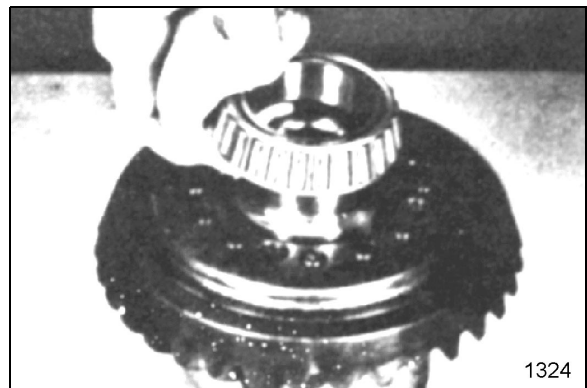


Figure 116

30. Apply load to differential gear to determine backlash. Install 1.76 mm (0.07 in.) shim to axle housing I, and install bearing.

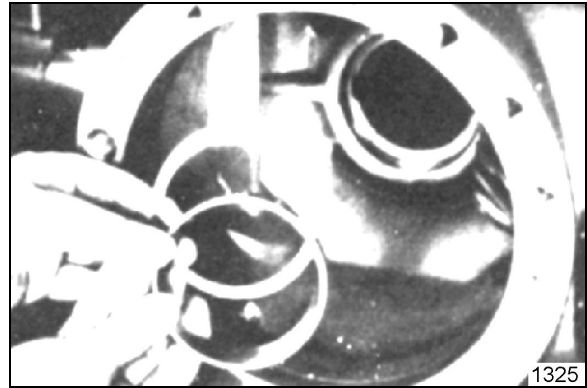


Figure 117

31. Install differential gear bearing using special tool.

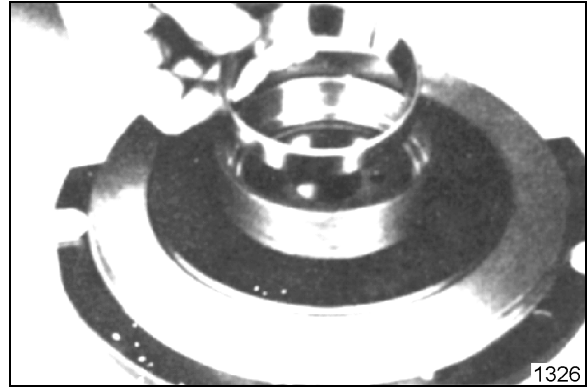


Figure 118

32. Install differential gear assembly to axle housing I, and install cover.

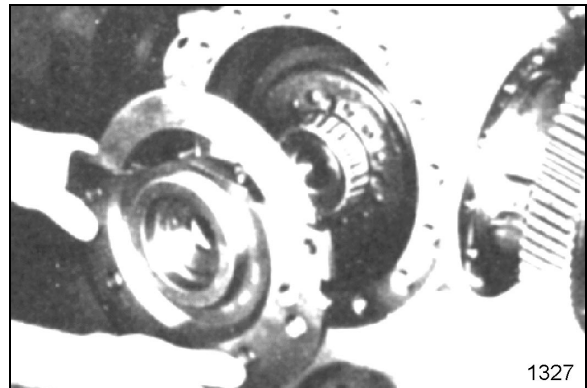


Figure 119

33. Tighten hex bolts.

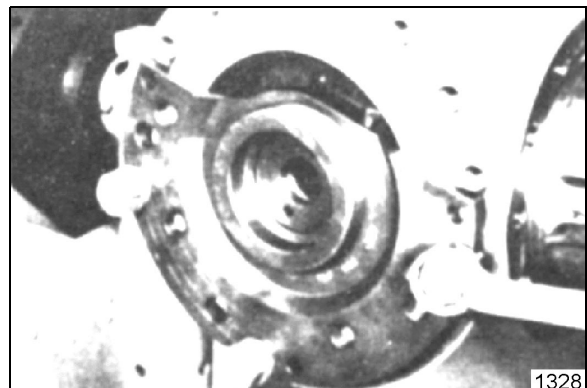


Figure 120

34. Adjust differential gear shaft using spindle bolts, then tighten spindle screw.

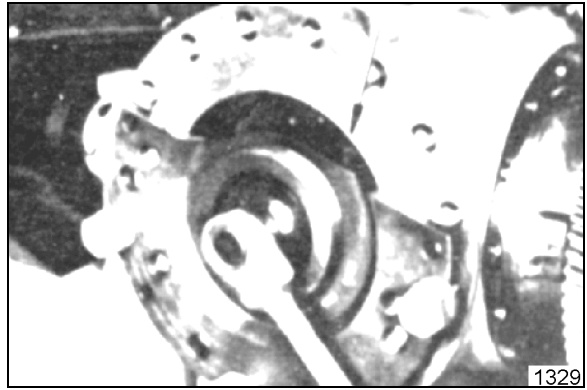


Figure 121

35. Measure backlash of crown wheel using dial gauge. If value is not between 0.13 - 0.28 mm (0.005 - 0.011 in.), adjust by changing shim thickness.

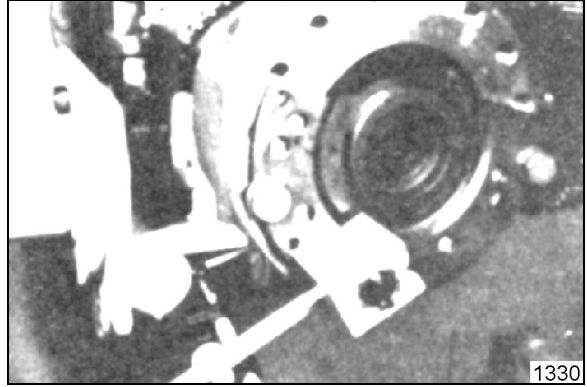


Figure 122

36. Measure distance from bearing to surface of flange.

Example: A = 16.50 mm (0.649 in.).

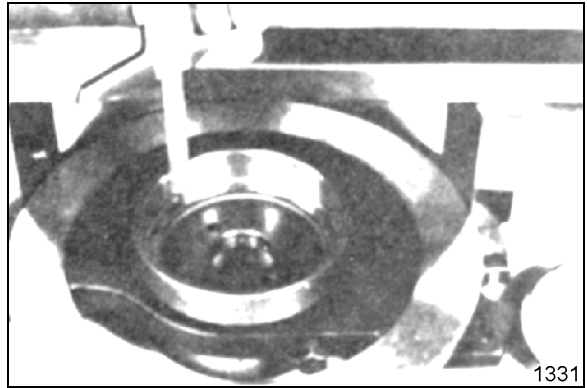


Figure 123

37. Measure distance from flange of axle housing II to outer surface of bearing.

Example: B = 14.00 mm (0.551 in.).

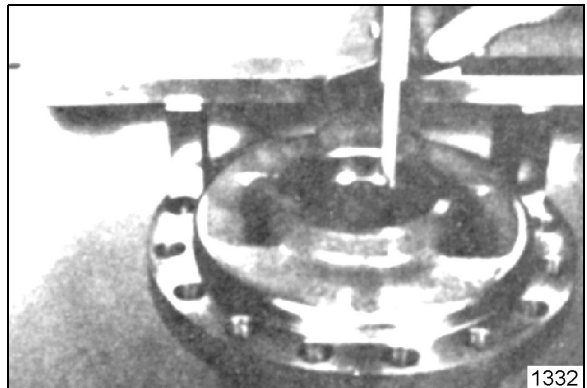


Figure 124

38. Since A-B is 2.50 mm (0.098 in.) and 0.1 mm (0.0039 in.) is needed for rolling resistance, a 2.6 mm (0.10 in.) spacer is needed. Specification is 1 - 4 Nm (0.225 - 0.899 ft.lb.).

39. Install shim to axle housing II and install bearing.

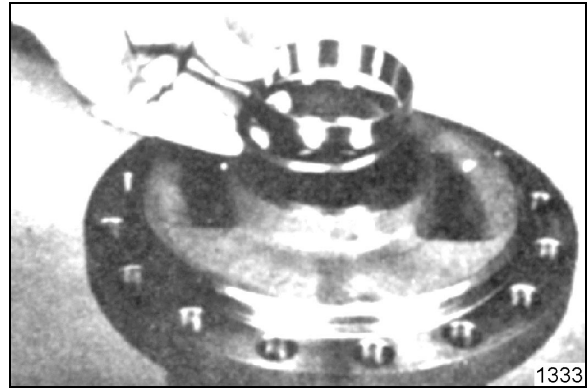


Figure 125

40. Secure axle housings with hex nuts.

41. After rotating and checking both housings, remove axle housing II and check that tolerances and assemblies (such as drive pinion gear) are correct.

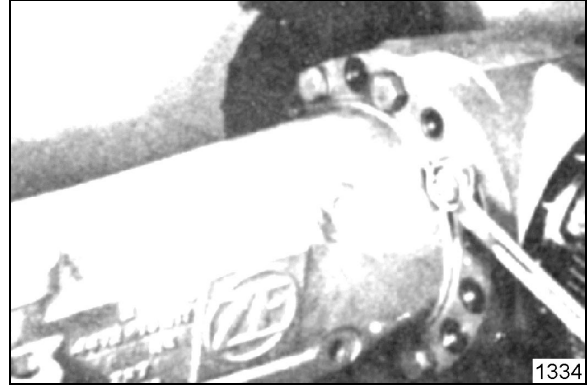


Figure 126

42. Install stub shaft to axle housing I, without moving axle housing II. Install greased O-ring to axle housing II.

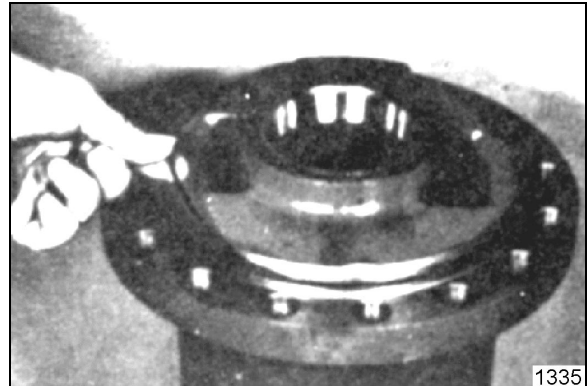


Figure 127

43. Install axle, and cross tighten hex bolts to 400 Nm (90 ft.lb.).



Figure 128

SEPARATING GEAR BOX FROM AXLE

1. Loosen plug and drain oil. Remove hex socket bolts, and detach gear cover.

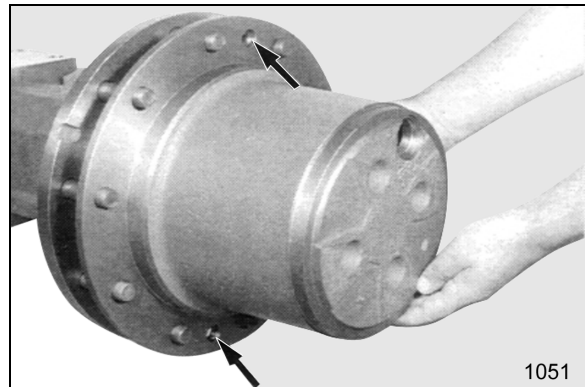


Figure 129

2. Remove disc carrier with sun gear from shaft.

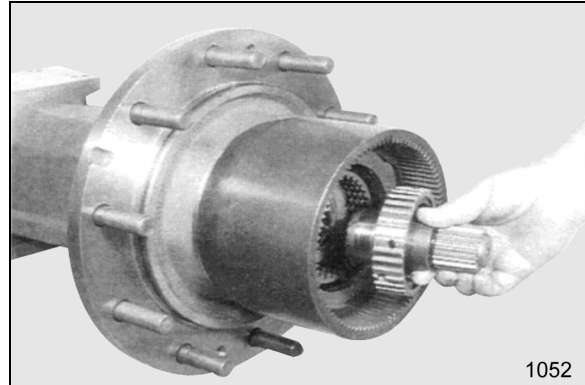


Figure 130

3. Pull stub shaft out of axle housing.

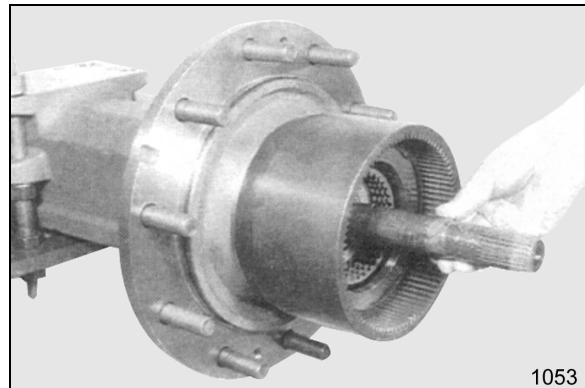


Figure 131

4. Remove snap ring and clutch plate pack.

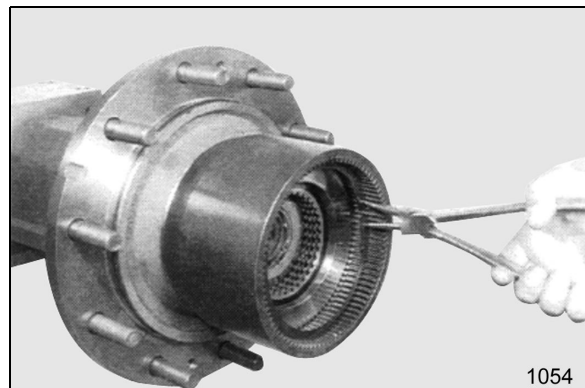


Figure 132

5. Loosen plug and drain oil from axle. Attach hoist to transmission and loosen screws that secure gear box to axle.

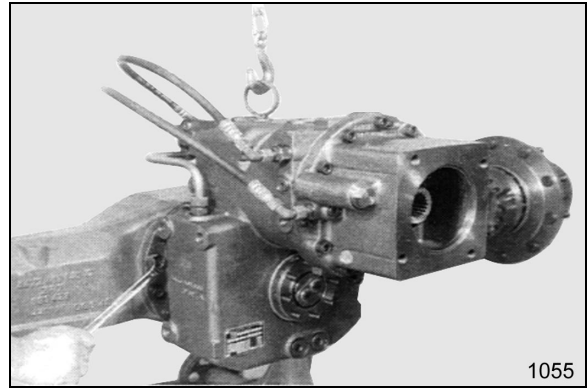


Figure 133

TRANSMISSION OPERATION

The transmission is a two-speed, powershift transmission of planetary design with helically cut spur gear and dual countershaft construction. The powershift stage includes an integrated multi-disc brake and a rotating multi-disc clutch. Both are actuated by plate springs and hydraulically released. A mechanically operated dog clutch, between the planetary and spur gears, allows interruption of power and towing of the unit.

The shift control is hydraulic for open hydraulic circuitry and electro-hydraulic for closed loop circuitry. Both types of control provide overspeed protection by preventing downshifting until speed is reduced to a point where damage to the hydraulic motor will not occur.

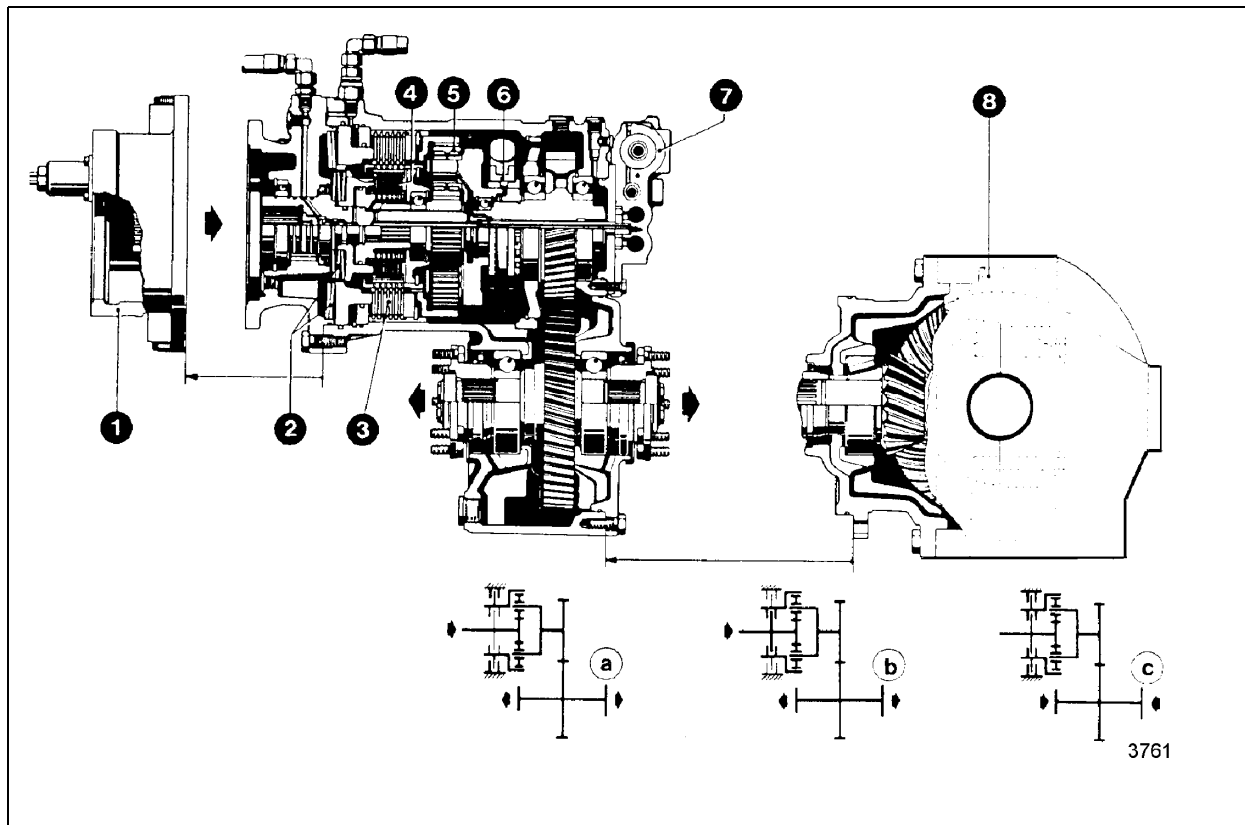


Figure 134

Power Flow	5. Planetary Stage
a = 1st Gear	6. Manual Disconnect Clutch
b = 2nd Gear	7. Inductive Speed Sensor for Electro-hydraulic Overspeed Protection
c = Braking	8. Hydraulic Overspeed Protection
1. Drive Housing with Integrated Shifting Valves	9. Emergency Steering Pump
2. Hydraulically Released Plate Springs	10. Direct Axle Mounting
3. Multi-disc Brak	
4. Multi-disc Clutch	

TRANSMISSION DISASSEMBLY

DETACHING DRIVE (INPUT) HOUSING

1. Secure gear box; then loosen plug and drain oil.

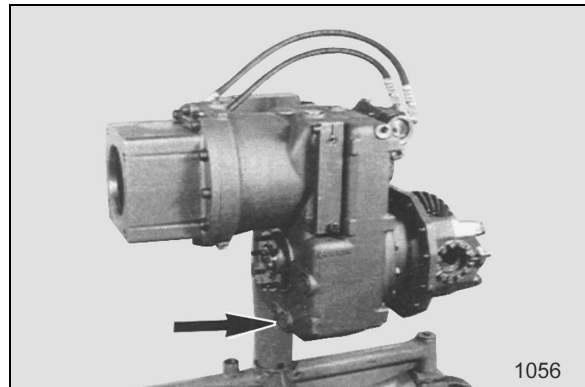


Figure 135

2. Remove two oil lines.

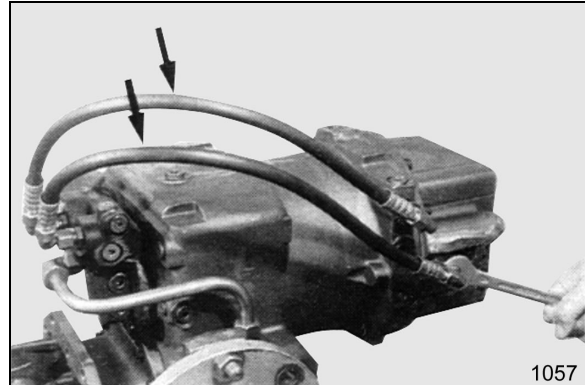


Figure 136

3. Remove screw

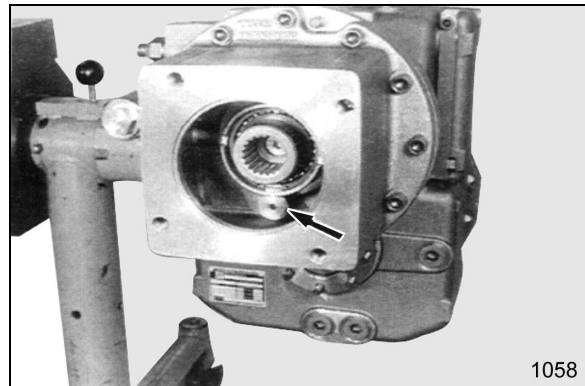


Figure 137

4. Remove snap ring.

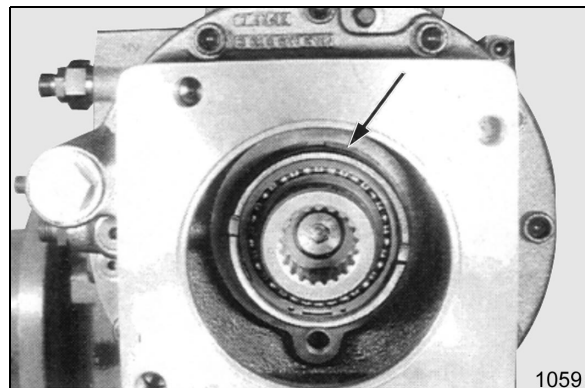


Figure 138



CAUTION!

Drive housing is spring loaded - Work carefully in next step.

5. Loosen hex socket bolts and detach drive housing from gearbox using two adjusting bolts.

DISASSEMBLING INPUT SHAFT ASSEMBLY

1. Remove two cup springs.
2. Block supply line and use compressed air or press piston out of bore in housing.
3. Remove plug and breather.

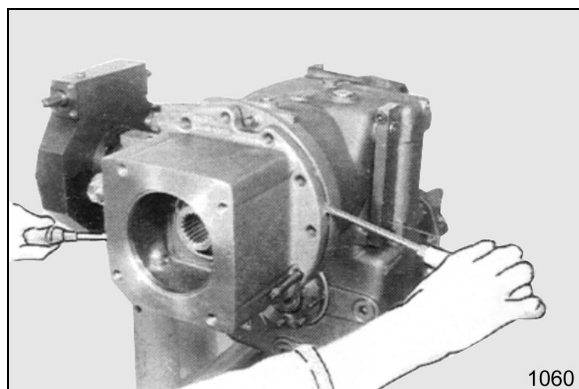


Figure 139

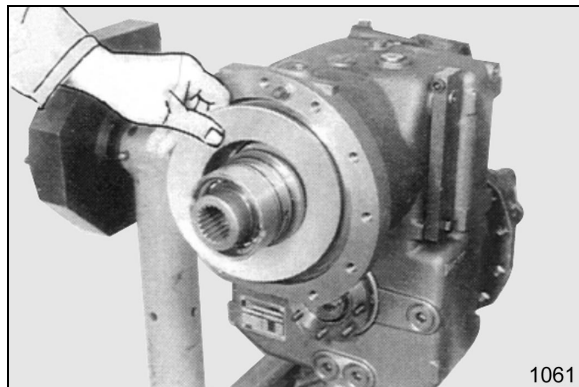


Figure 140

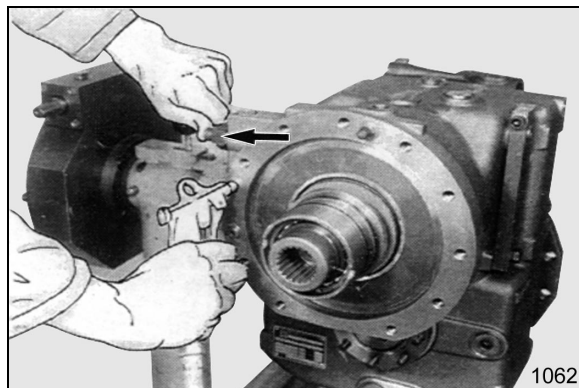


Figure 141

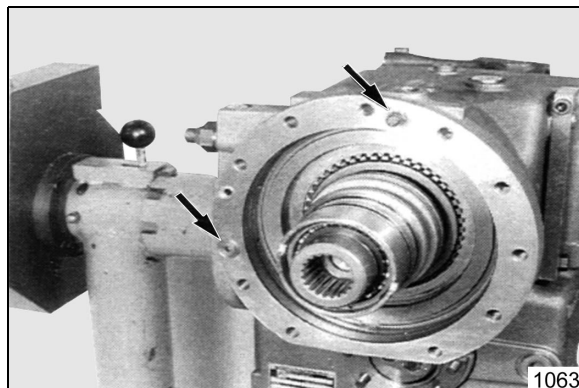


Figure 142

4. Remove seal ring and back-up ring from ring groove in housing.

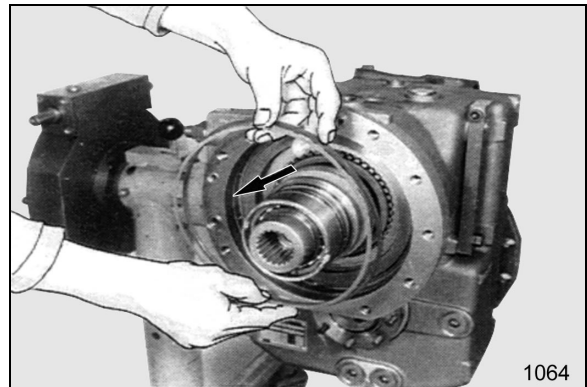


Figure 143

5. Remove snap ring.

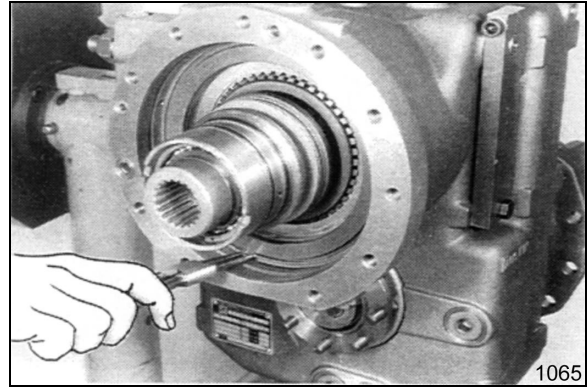


Figure 144

6. Pull gasket from housing, using an L-type driver or offset screwdriver.

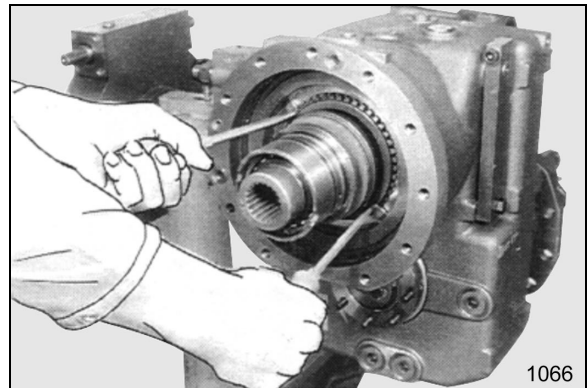


Figure 145

7. Remove O-ring.

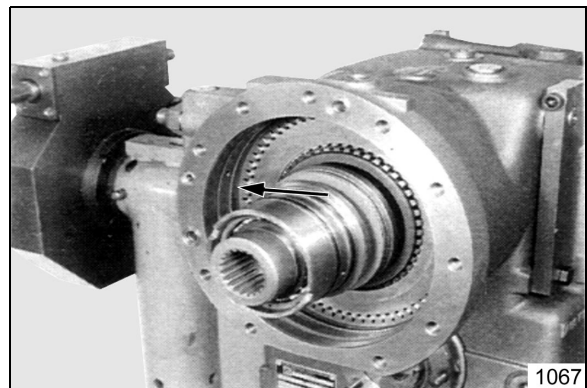


Figure 146

8. Remove clutch plate pack and backing plate.

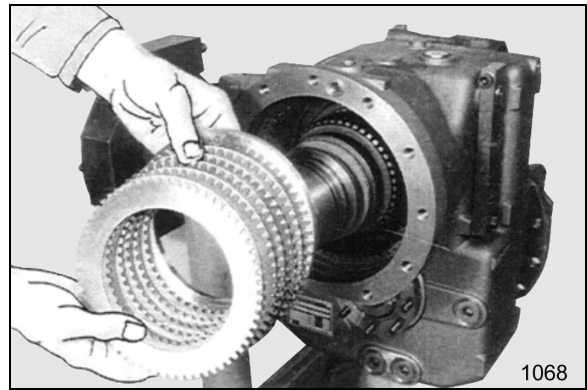


Figure 147

9. Remove snap ring.

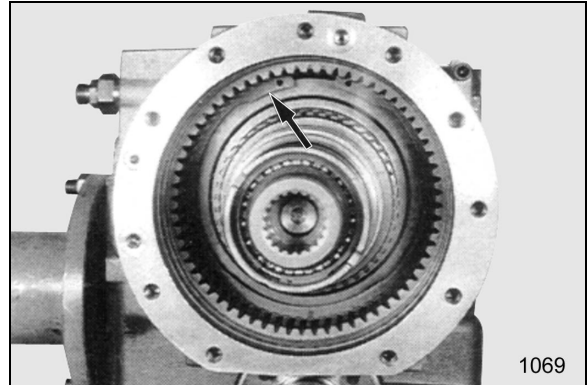


Figure 148

10. Remove clutch.

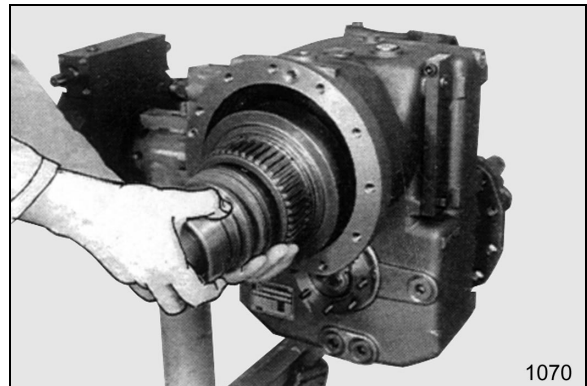


Figure 149

11. Secure sun gear shaft so that it will not turn. Remove snap ring and cup spring pack.

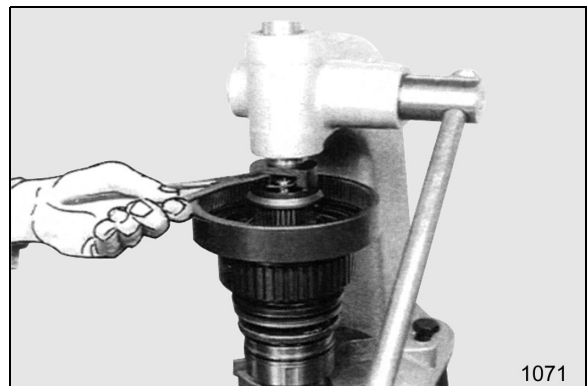


Figure 150

12. Remove disc and sun gear.



Figure 151

13. Remove ring gear from drive shaft.

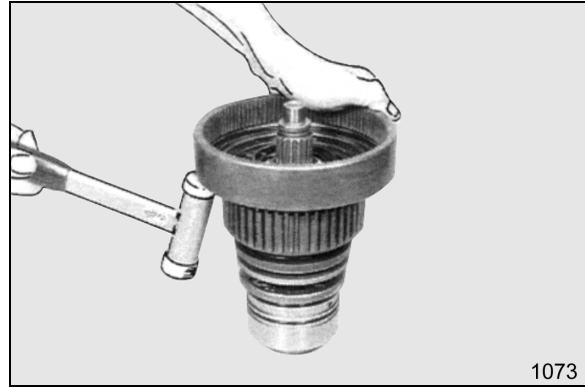


Figure 152

14. Remove snap ring and centering disc.

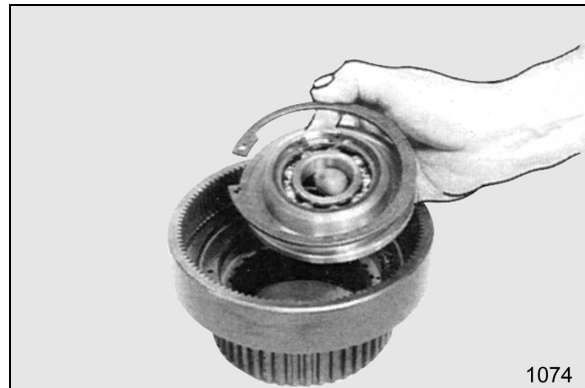


Figure 153

15. Remove plate pack.



Figure 154

16. Remove plate.

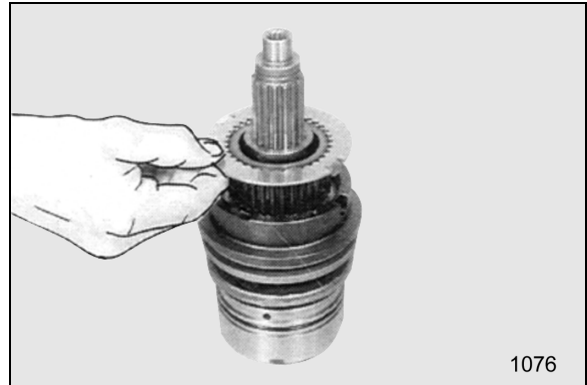


Figure 155

17. Pry inner plate carrier out of piston.

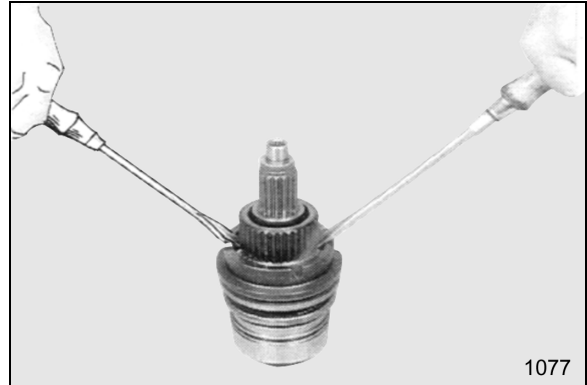


Figure 156

18. Remove piston from drive shaft

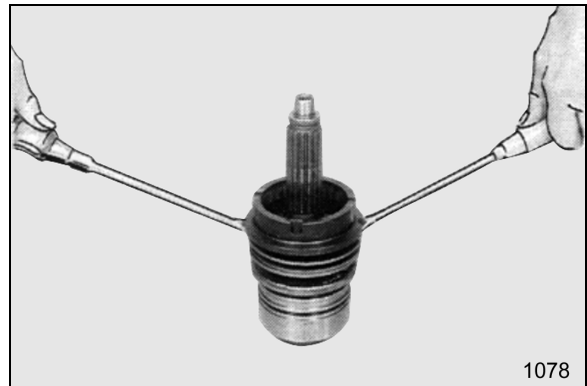


Figure 157

19. Remove cup spring pack.



Figure 158

20. Remove seal ring and O-ring. Remove disc.

NOTE: *Seal rings have to be replaced.*



Figure 159

21. Remove snap ring.



Figure 160

22. Remove snap ring from 85 mm (3.35 in.) ring groove of guide bushing.



Figure 161

23. Separate guide bushing from drive shaft.

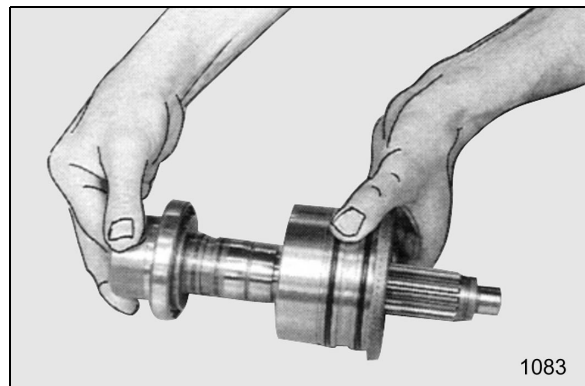


Figure 162

24. Remove snap ring and shaft seal.



Figure 163

25. Remove snap ring and press bearing off shaft.

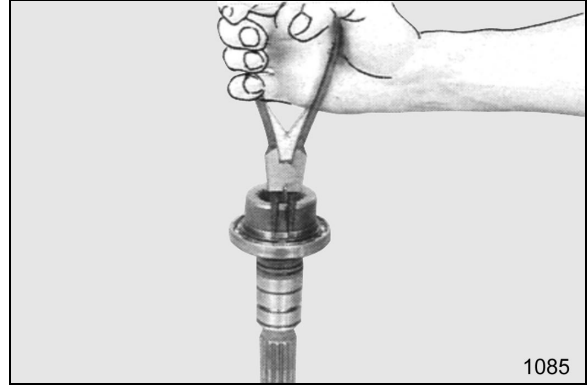


Figure 164

26. Remove throttle valve.



Figure 165

DISASSEMBLING PLANETARY DRIVE

1. Remove snap ring.

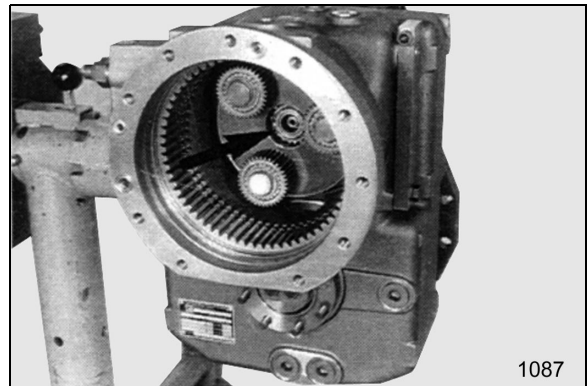


Figure 166

2. Turn housing so that it faces up, and remove the planetary gear carrier from the helical gear using an internal puller.

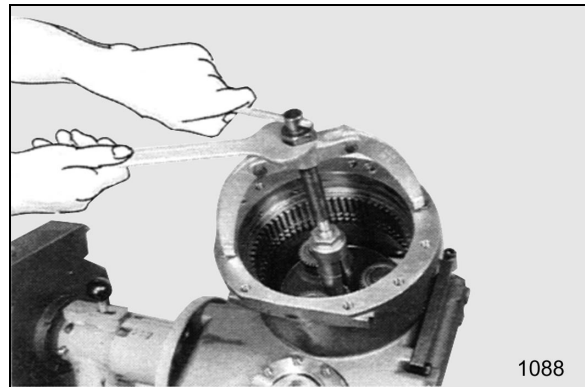


Figure 167

3. Remove snap ring.



Figure 168

4. Remove planetary gear from gear shaft using an L-type driver.

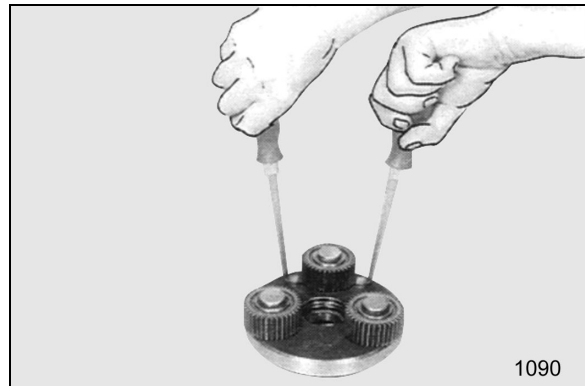


Figure 169

5. Remove inner race of bearing using puller.

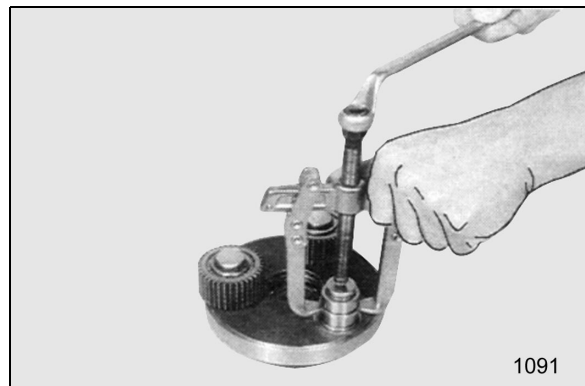


Figure 170

6. Remove snap ring and ball bearing.



Figure 171

DISASSEMBLING CLUTCH AND SPUR GEAR

1. Loosen hex bolts and remove sliding collar and block.

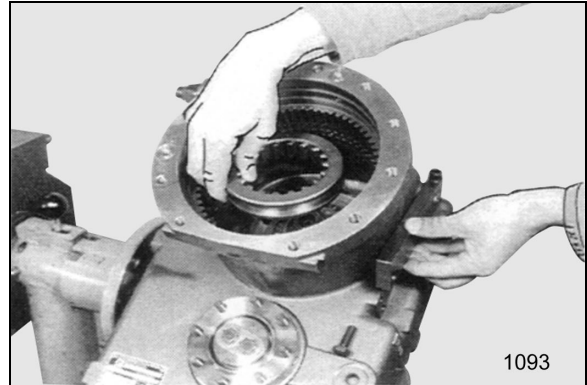


Figure 172

2. Loosen plug.

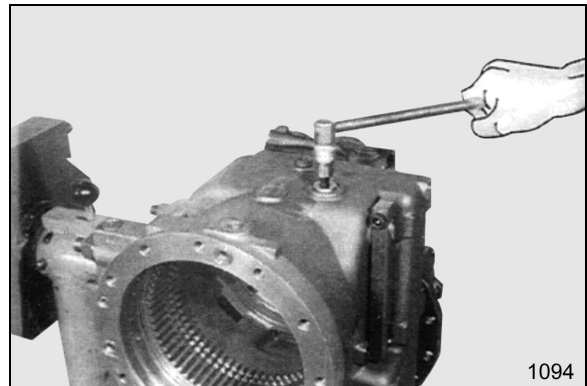


Figure 173

3. Drive out roll pin.

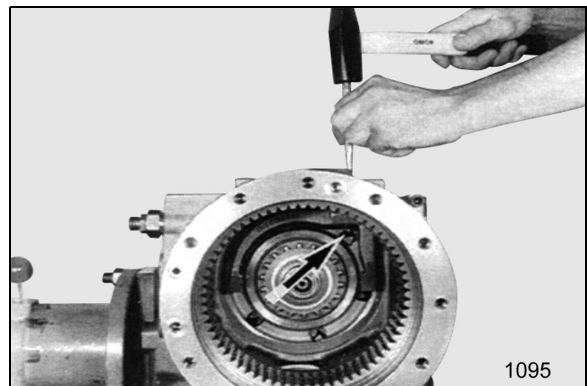


Figure 174

4. Pry shift lever out of bore in housing and detach shift fork.

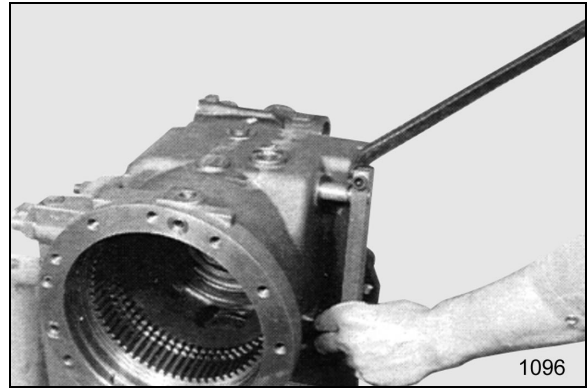


Figure 175

5. Remove suction line.

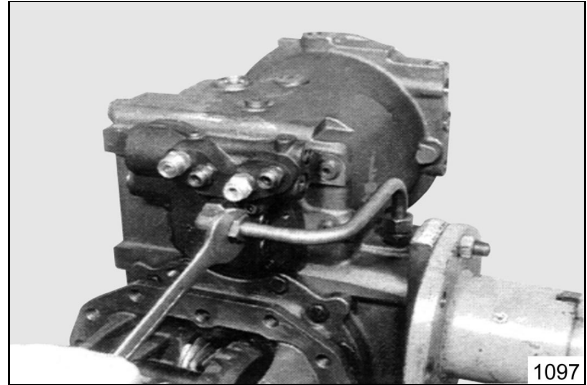


Figure 176

6. Loosen four hex socket bolts and remove shift lock from housing.

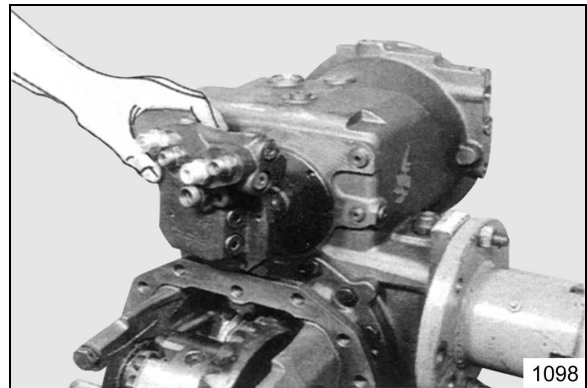


Figure 177

7. Pull rotor set from shaft and remove drive ball.

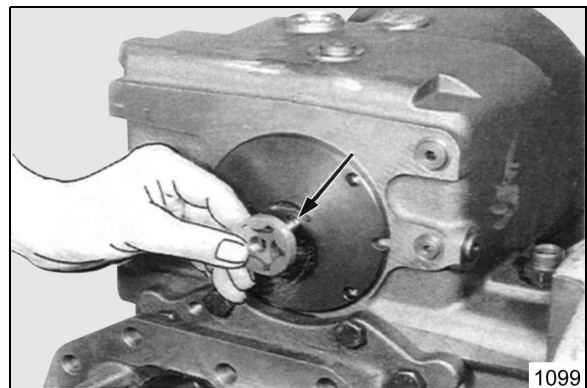


Figure 178

8. Pry pump cover out of housing.

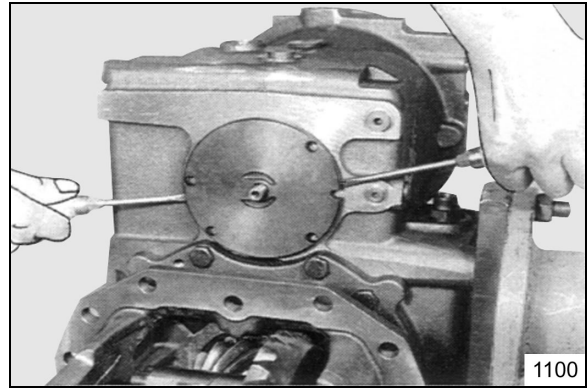


Figure 179

9. Remove snap ring.

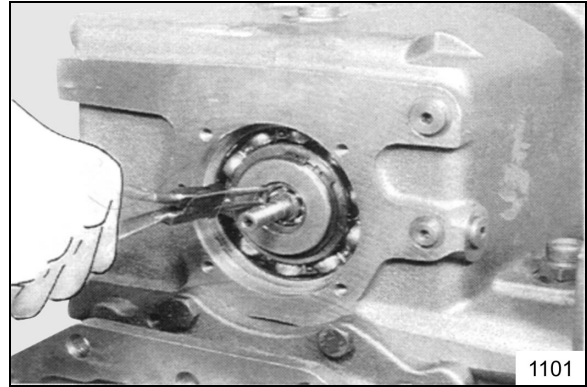


Figure 180

10. Remove pump shaft.

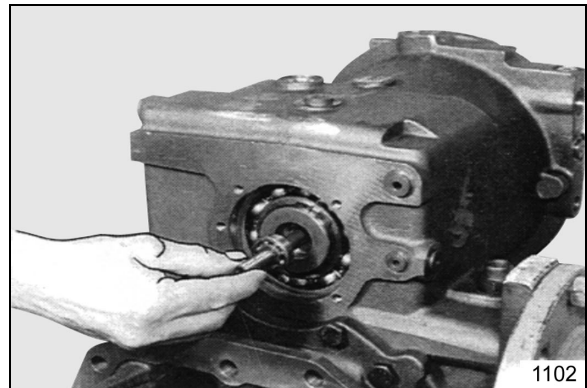


Figure 181

11. Remove snap ring.

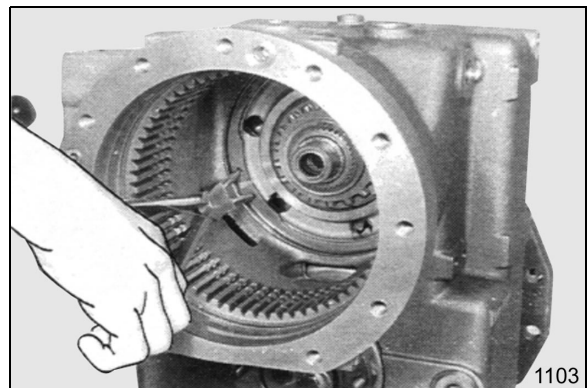


Figure 182

12. Pry off helical gear and lift from housing.

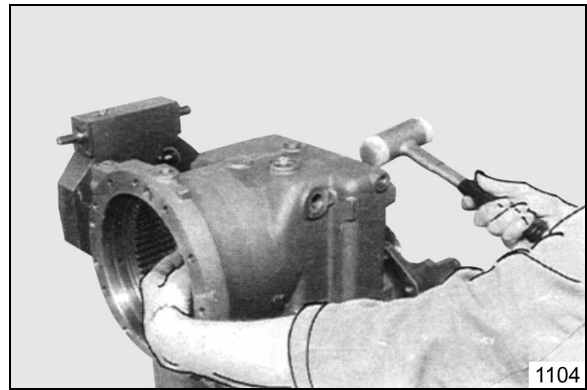


Figure 183

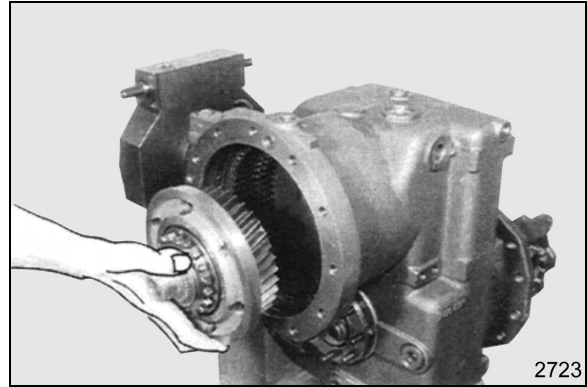


Figure 184

13. Remove snap ring and shim.



Figure 185

14. Remove shift dog and, on some models, remove spacer.

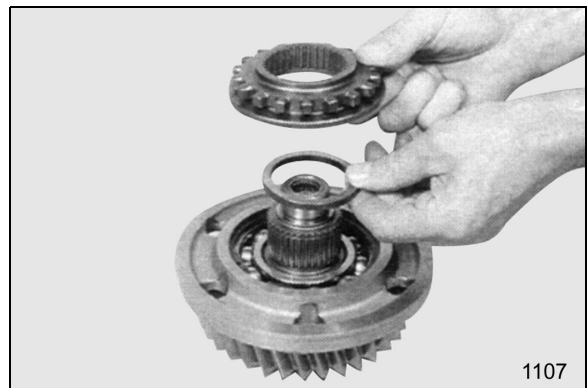


Figure 186

15. Pull needle bearing from bore of housing using an internal puller.



Figure 187

16. Press helical gear from bearing cup.

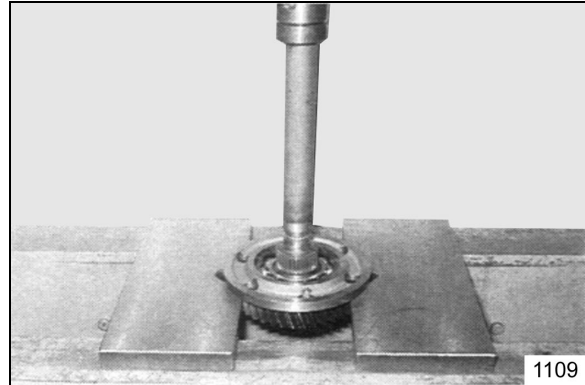


Figure 188

17. Remove snap ring and press ball bearing out of bearing cup.



Figure 189

18. Remove snap ring.

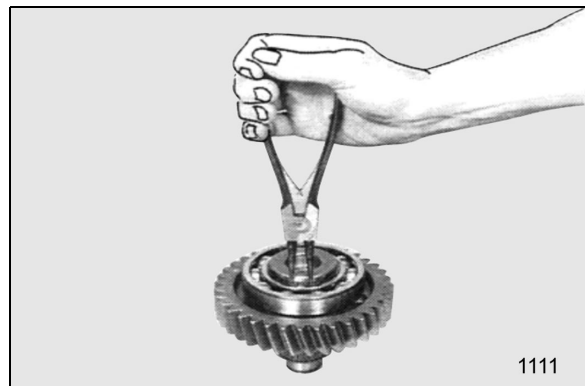


Figure 190

19. Pry ball bearing off collar of helical gear.



Figure 191

DISASSEMBLING SHIFT LOC

NOTE: *If oil pump rotor or valve body is damaged, replace entire shift lock*

1. Remove control spool.



Figure 192

2. Heat and remove set screw; disassemble control spool.

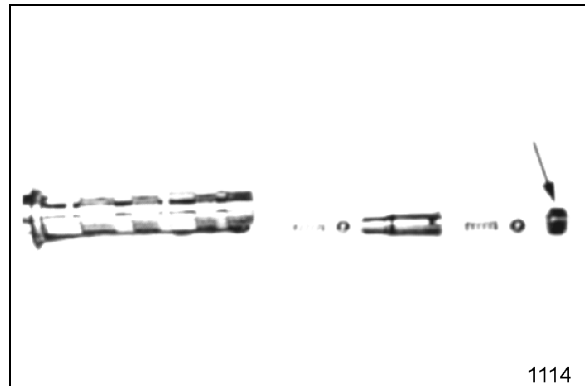


Figure 193

3. Remove pilot spool.



Figure 194

4. Remove shuttle valve.



Figure 195

5. Disassemble shuttle valve using special tool to remove bushing.



Figure 196

6. Remove diaphragm, which is secured in place with Loctite.

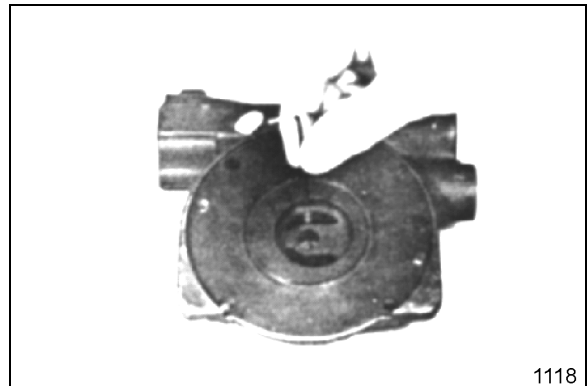


Figure 197

FINAL DRIVE, DRIVE SHAFT AND DIFFERENTIAL DISASSEMBLY

1. Loosen hex bolts and remove flange.



Figure 198

2. Pry out shaft seal.



Figure 199

3. Turn housing so that it faces up, loosen hex bolts and remove drive shaft, (using adjusting screws), and taking care not to damage inner bearing race or shim.

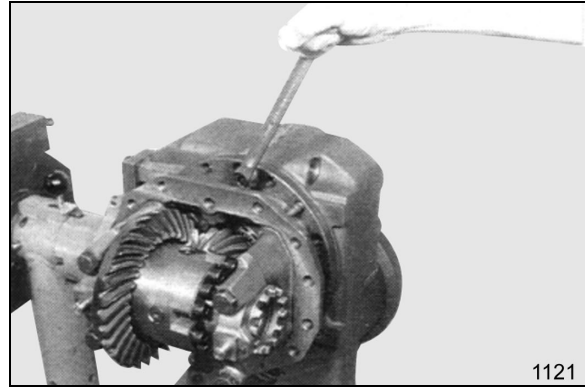


Figure 200

4. Remove output gear from drive pinion.



Figure 201

5. Remove baffle plate.

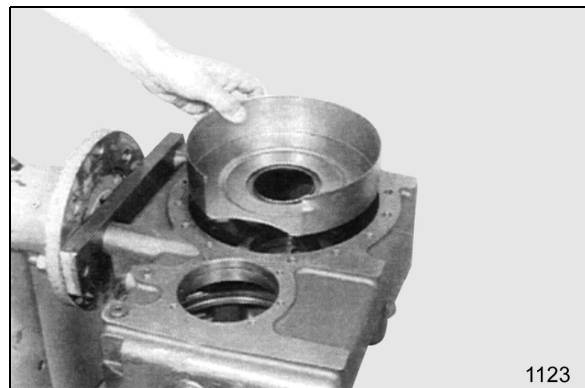


Figure 202

6. Drive bearing outer race out of housing.

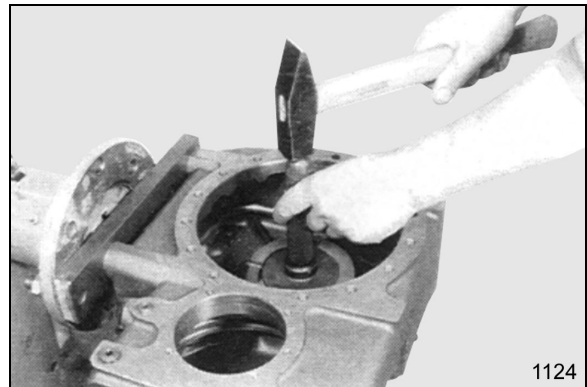


Figure 203

7. Remove shaft seal from housing.

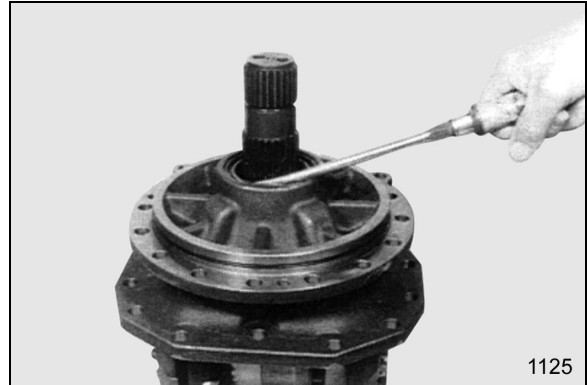


Figure 204

8. Secure axle carrier, by means of an assembly type fixture. Drive out roll pins.

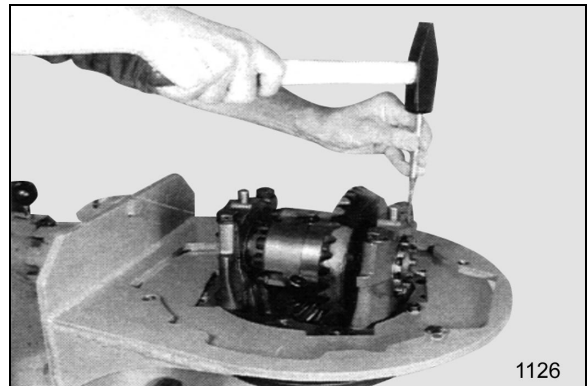


Figure 205

9. Remove differential bearing preload by loosening adjusting nut.

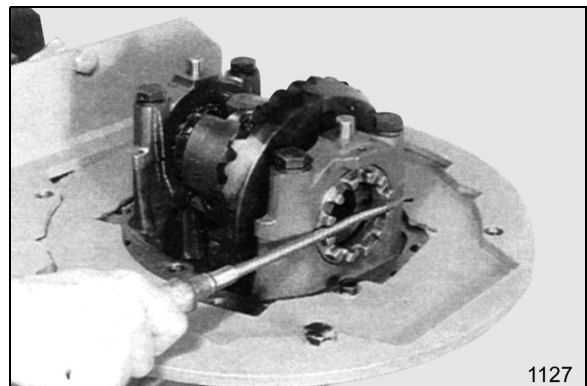


Figure 206

10. Loosen hex head screws and remove bearing caps and adjusting nuts.

NOTE: *Mark position of bearing caps and position of crown wheel.*

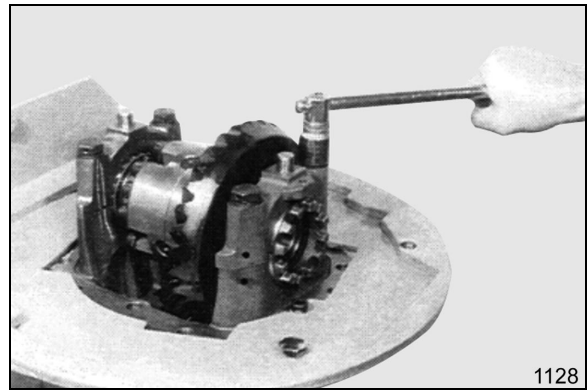


Figure 207

11. Lift differential assembly out of axle carrier.

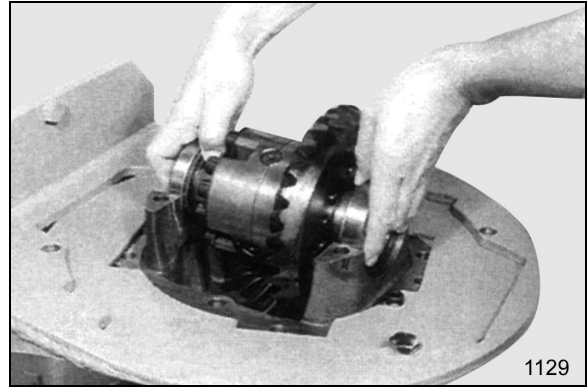


Figure 208

12. Remove inner bearing races, using puller.



Figure 210

13. Loosen socket head screws.



Figure 211

14. Separate halves of differential case and remove loose components.

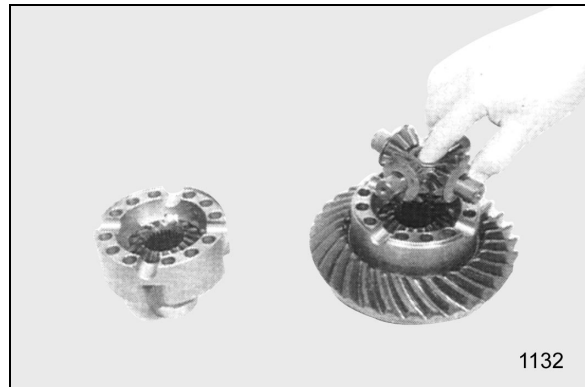


Figure 212

15. Press crown wheel from differential case.

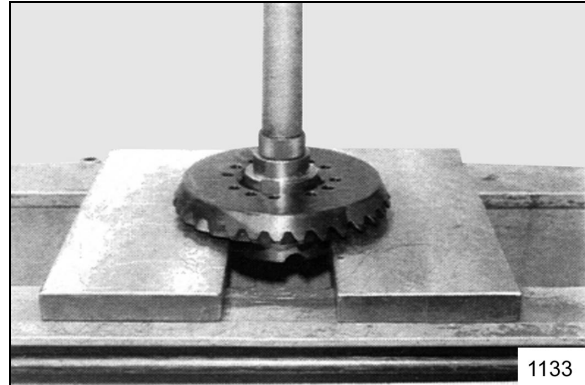


Figure 213

16. Remove drive pinion.

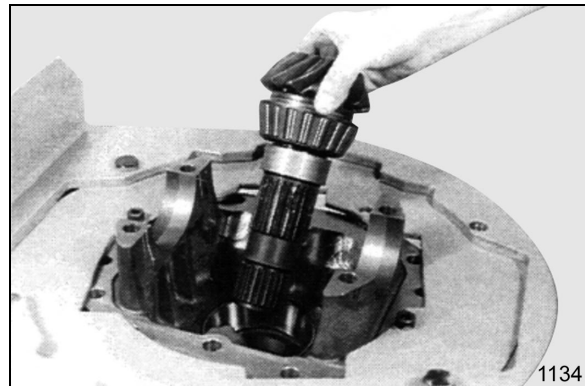


Figure 214

17. Remove O-ring and bushing.



Figure 215

18. Pull tapered roller bearing from drive pinion.

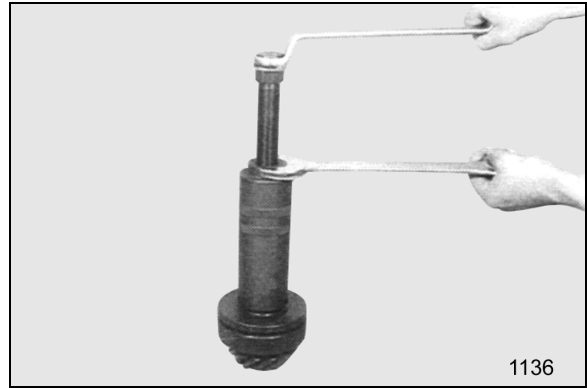


Figure 216

19. Pull bearing outer race from housing bore, using internal puller.

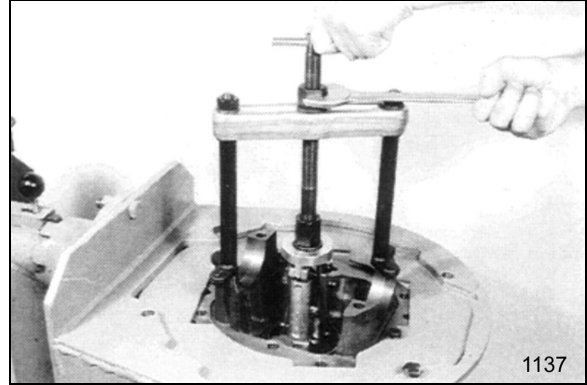


Figure 217

20. Remove shim.

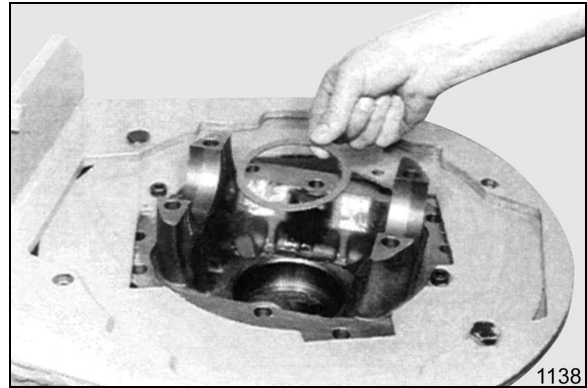


Figure 218

TRANSMISSION REASSEMBLY

NOTE: Replace all seals and damaged components.

NOTE: Crown wheel and drive must be replaced as a matched assembly.

NOTE: Use oil to protect seal lips and other compounds such as Loctite and silicon as directed in reassembly.

SHIMMING DRIVE PINION

1. Install shims, two bearing caps, pin, and measuring shaft.

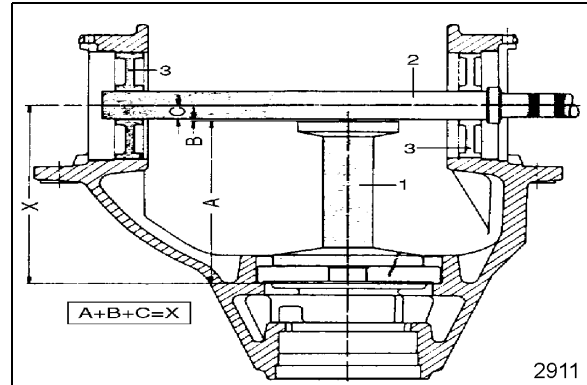


Figure 219

2. Measure gap between pin and shaft using feeler gauge.

Example:

Dimension A (pin) 134 mm (5.275 in.)

Dimension B (gap) +0.85 mm (0.33 in.)

Dimension C +15.00 mm (0.590 in.)

(1/2 dia of shaft) _____

Dimension X = 149.85 mm (5.899 in.)

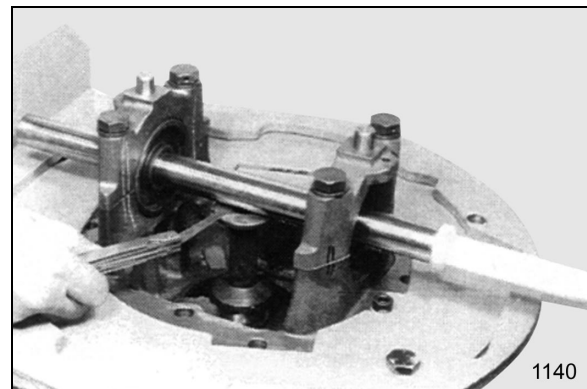


Figure 220

3. Measure bearing width.

Example:

Bearing Width: 36.50 mm (1.437 in.)

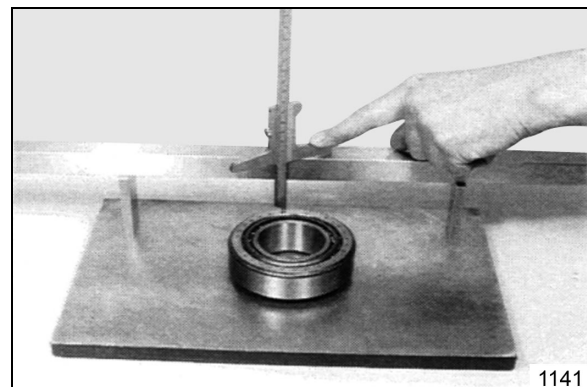


Figure 221

4. Measure pinion.

Example:	
Bearing width	36.50 mm (1.437 in.)
Pinion dimension (112 - 0.15 mm)	+111.85 mm (4.404 in.)
gives Dimension X^1	= 148.35 mm (5.840 in.)

5. Subtract X^1 from X to find shim thickness.

Example:	
Dimension X	149.85 mm (5.899 in.)
Dimension X^1	- 148.35 mm (5.840 in.)
Gives Shim Thickness	= 1.50 mm (0.059 in.)

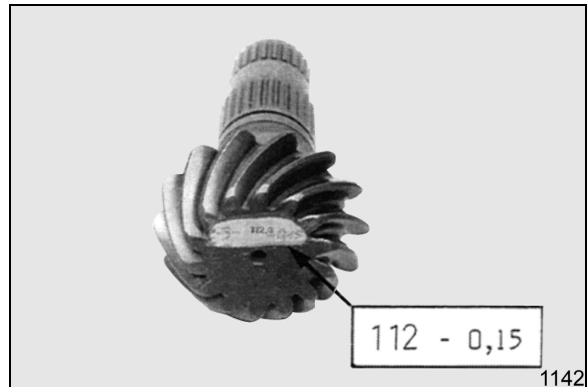


Figure 222

REASSEMBLING DRIVE PINION

1. Remove bearing caps, shims and measuring shaft.
2. Insert shim, determined according to Steps 2 through 4 above, in housing bore.
3. Chill bearing outer race and seat firmly against shoulder.

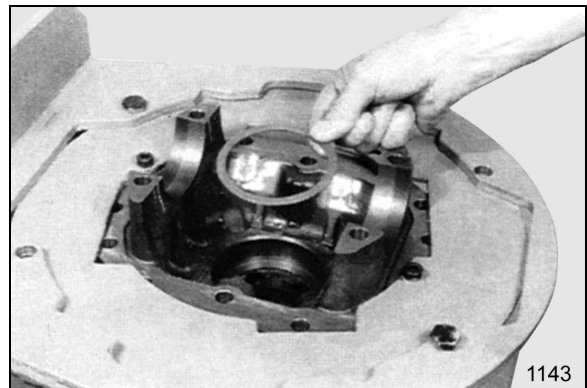


Figure 223

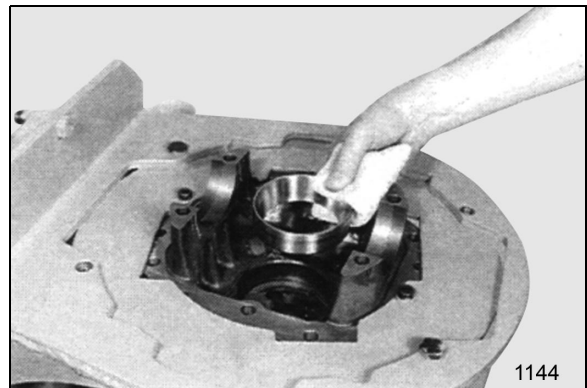


Figure 224

4. Insert second outer race in housing bore.

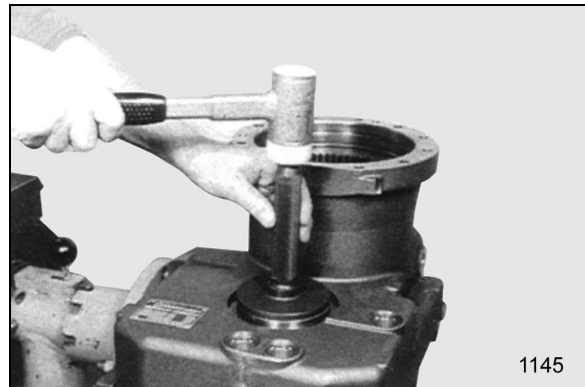


Figure 225

5. Install new seal using Loctite 586 and install adapter.

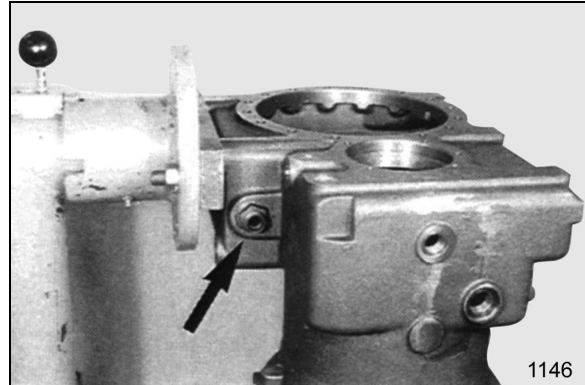


Figure 226

6. Install oil pipe, using hex head screws secured with Loctite 586. Torque to maximum of 23 Nm (5.17 ft lb).

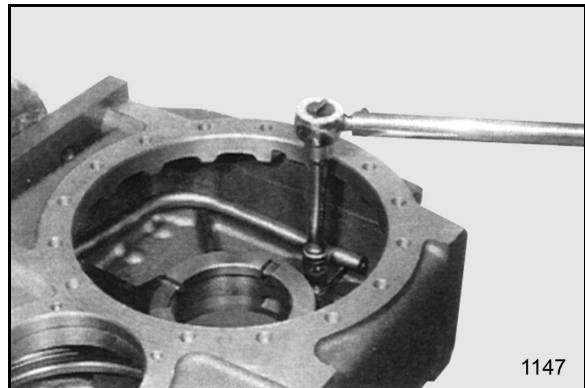


Figure 227

7. Note installation position (Figure 219) and install baffle plate firmly against shoulder.

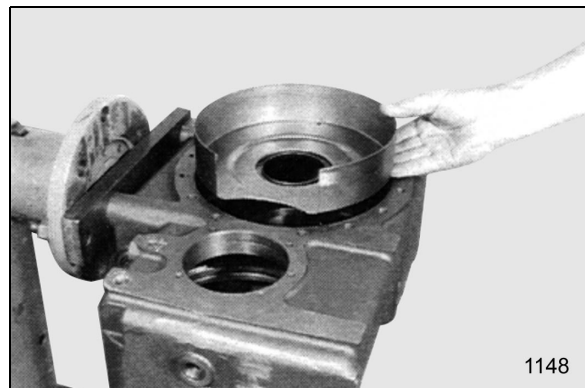


Figure 228

8. Lubricate outer diameter and grease sealing lip of shaft seal. Install shaft seal, open side up, firmly against shoulder. Install O-ring.

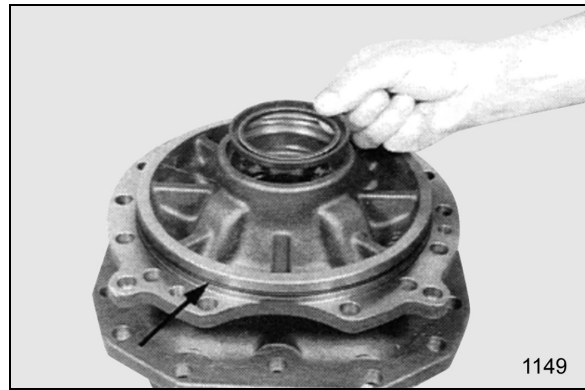


Figure 229

9. Install output gear as shown.

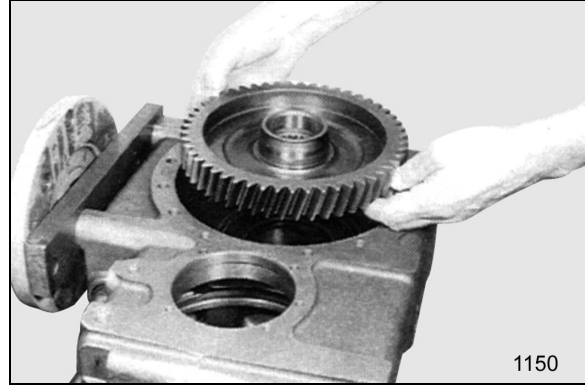


Figure 230

10. Install two adjusting screws, assemble housing as shown. Secure housing with two hex head screws and torque to 79 Nm (17.7 ft lb).

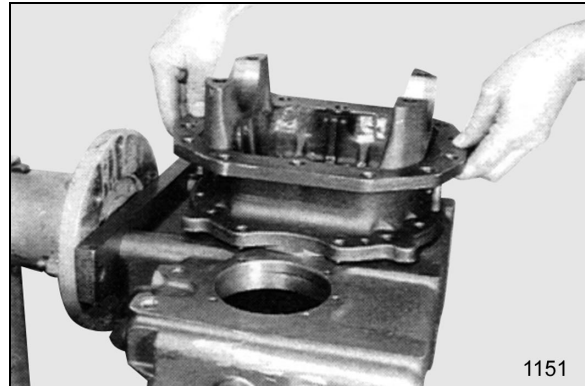


Figure 231

11. Heat and install tapered roller bearing.



Figure 232

12. Install bushing. Grease O-ring and install in ring groove.



Figure 233

13. Install drive pinion.



Figure 234

14. Secure drive pinion so that it will not turn, using puller.

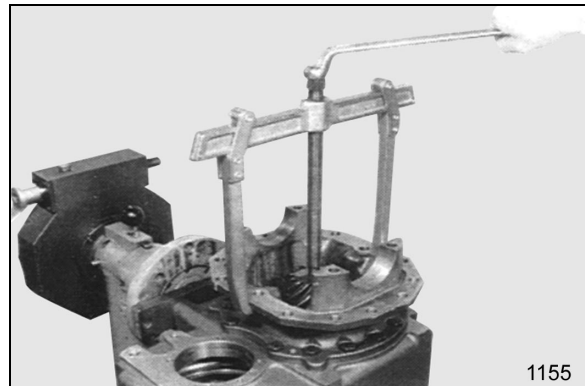


Figure 235

15. Turn housing 180°, place output gear firmly over O-ring, and install shim and bearing inner race.

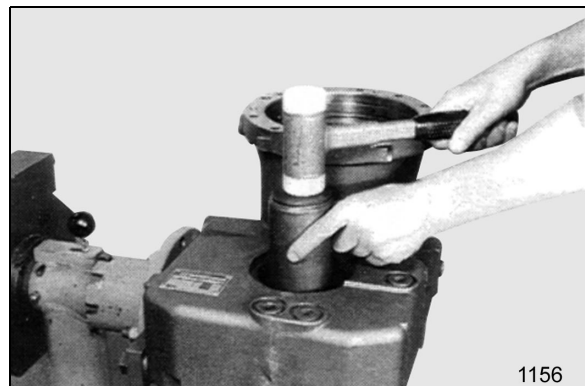


Figure 236

ADJUSTING ROLLING RESISTANCE OF DRIVE PINION BEARING

1. Install 2.60 mm (0.10 in.) shim.

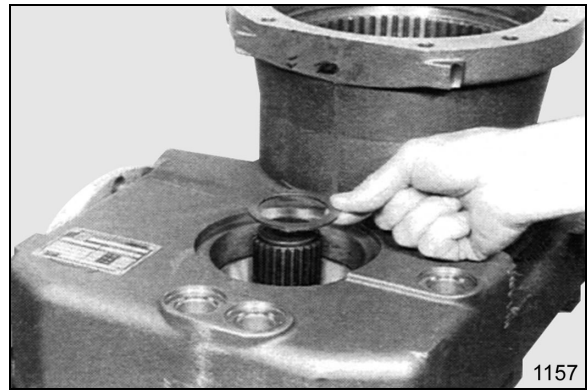


Figure 237

2. Heat and install bearing inner race.



Figure 238

3. Place output flange in position.



Figure 239

4. Secure output flange with disk and hex head screws, turning drive pinion several times while tightening. Torque to 46 Nm (10.34 ft lb).

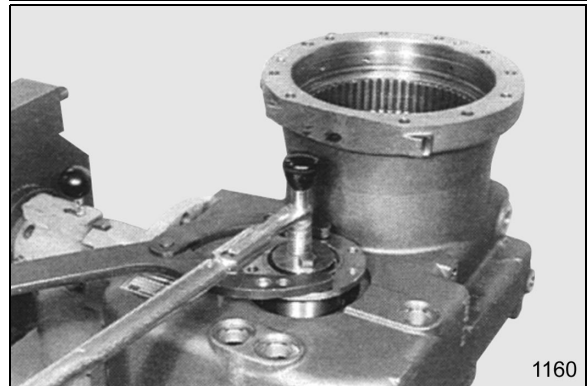


Figure 240

5. Check movement of drive pinion bearing. If rolling resistance does not fall between 2.5 Nm (0.56 ft lb) to 3.5 Nm (0.78 ft lb), adjust thickness of shim(s).

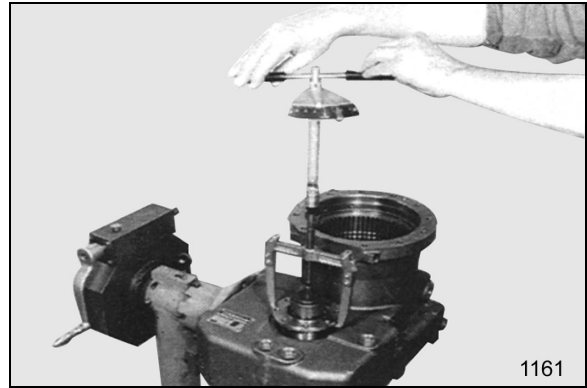


Figure 241

6. Lubricate outer diameter and grease sealing lip of shaft seal. Install shaft seal to a depth of exactly 2.1 mm (0.0827") using driver.



Figure 242

7. Install output flange, tightening hex head screws evenly to allow mounting of dust shield.



Figure 243

8. Press plate against collar of output flange.



Figure 244

9. Install output flange. Grease and install O-ring.

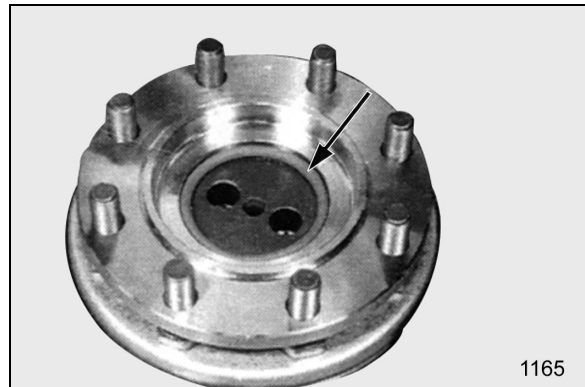


Figure 245

10. Secure output flange using washers and hex head screws. Torque to 46 Nm (10.34 ft lb).

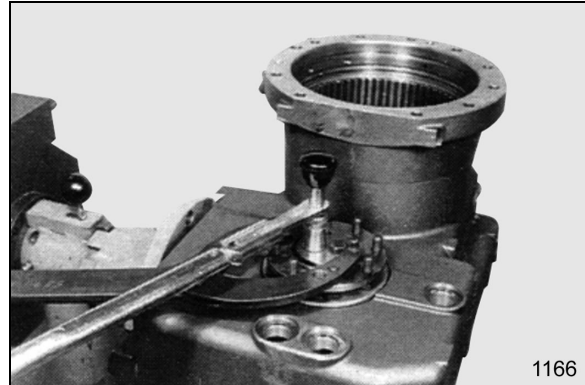


Figure 246

11. Secure output flange screws with lockplate.

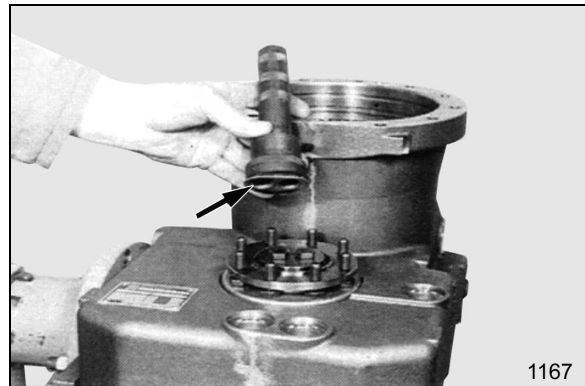


Figure 247

INSTALLING DIFFERENTIAL

NOTE: *Oil all differential components using DA 85W/90 before reassembly.*

1. Drive in two roll pins per bore, spaced 180° apart, in differential case half.

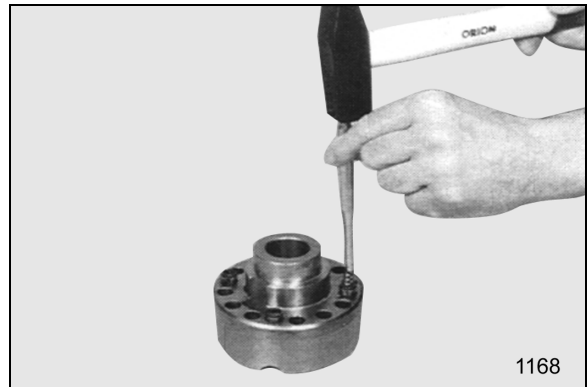


Figure 248

2. Press crown wheel onto roll pins.

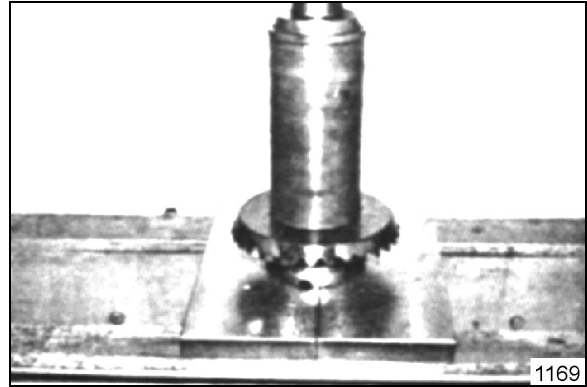


Figure 249

3. Install thrust washer.



Figure 250

4. Install side gear.



Figure 251

5. Install spider assembly and second side gear, making sure thrust washer lobes face up.



Figure 252

6. Use grease so that thrust washers will adhere to differential, and install differential.

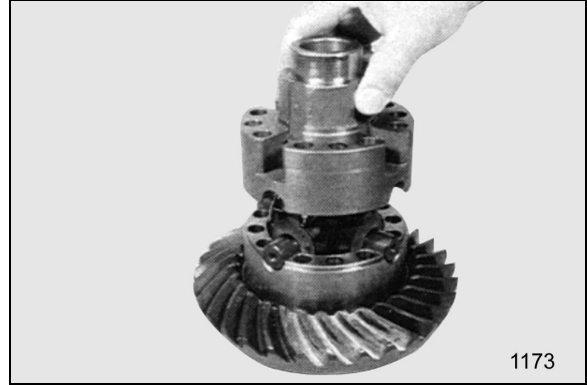


Figure 253

7. Secure differential in a fixture. Install segments and torque socket head screws to 145 Nm (32.6 ft lb).

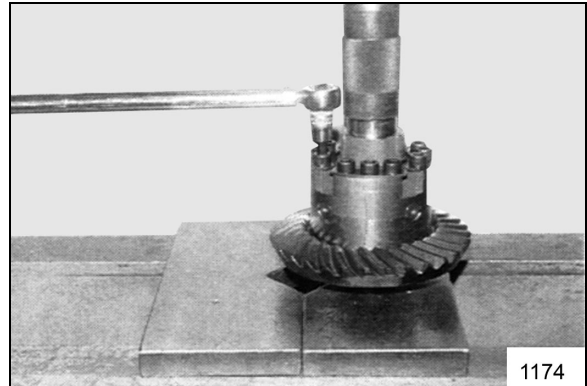


Figure 254

8. Press both inner races of differential bearing firmly against shoulder.

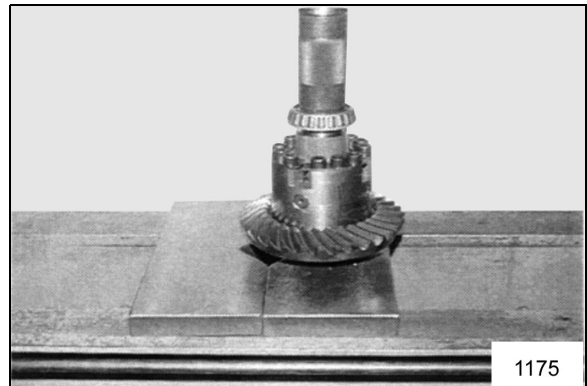


Figure 255

9. Install bearing outer races and insert differential into axle carrier, noting position of crown wheel in next step.

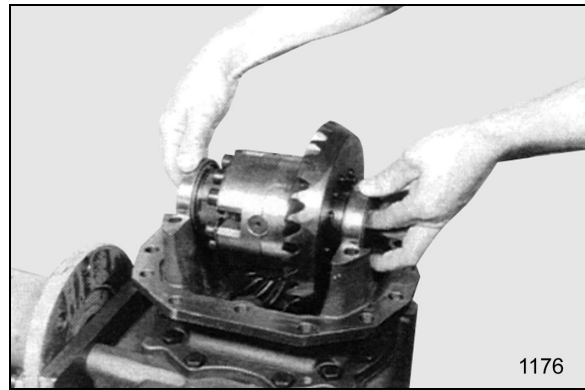


Figure 256

10. Note crown wheel position: arrow shows direction of Forward Drive.

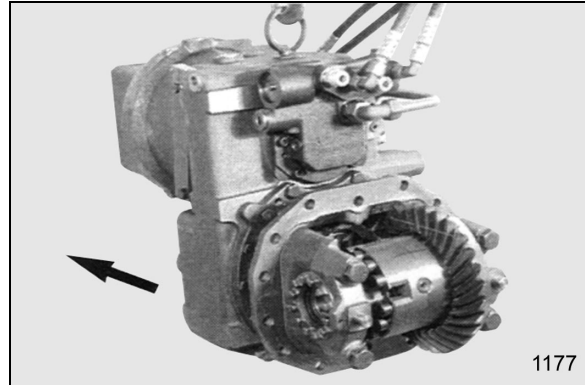


Figure 257

11. Screw two adjusting nuts into bearing bores.

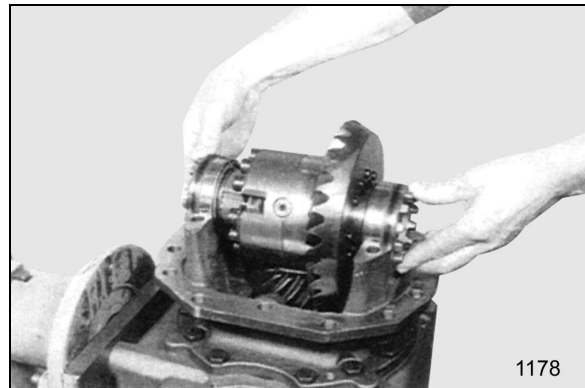


Figure 258

12. Using Loctite 242, drive straight pins fully into bores of bearing caps.

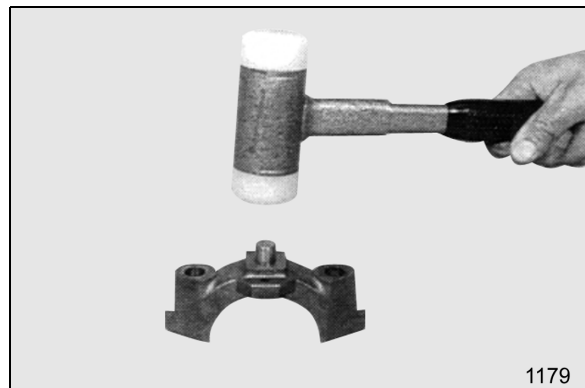


Figure 259

13. Note correct installation position and install two bearing caps with hex head screws. Torque to 195 Nm (43.8 ft lb).

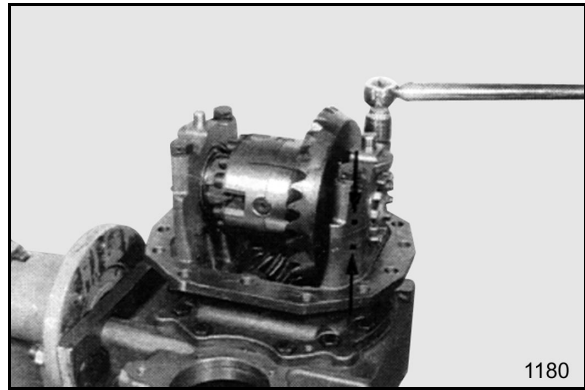


Figure 260

ADJUSTING BACKLASH AND BEARING PRELOAD

NOTE: Note backlash value marked on crown wheel. Bearing pre-load is 1 – 4 Nm (0.22 – 0.89 ft lb).

1. Install dial indicator at right angle to side of tooth.
2. Adjust adjusting nut on crown wheel side until backlash is correct.
3. Screw in second adjusting nut, on side opposite to crown wheel, until there is no play in differential bearing.
4. Tighten adjusting nut two more notches to obtain differential bearing preload.
5. Check backlash again while rotating differential several times, correct if necessary.
6. Check that dimension is 216 ± 0.05 mm (8.5 ± 0.002 "); correct if necessary by repeating last step of differential installation and Steps 1 – 5 in this adjustment procedure.

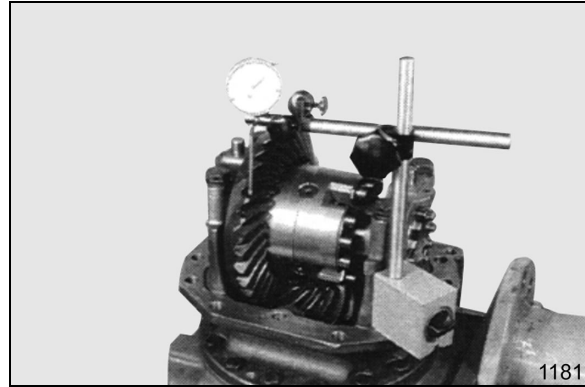


Figure 261

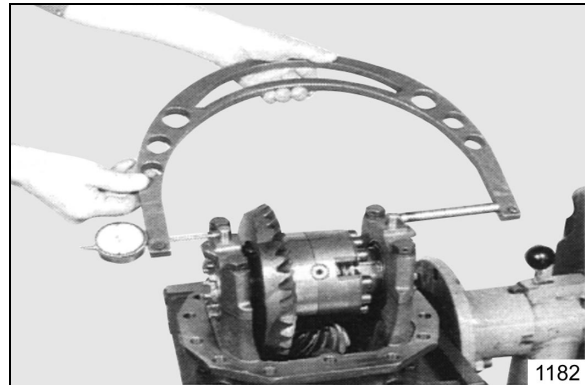


Figure 262

7. Install dial indicator on back side of crown wheel and make one full rotation to determine run out. Maximum run-out is 0.08 mm (0.003 in.).

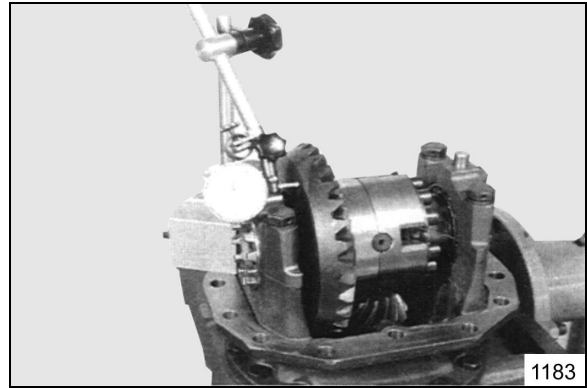


Figure 263

8. Cover several crown wheel teeth with gear marking compound, roll crown wheel back and forth over drive pinion, and compare contact pattern with samples in Figures 357 – 362 at the end of this section.

NOTE: *If contact pattern is incorrect, unit must be reshimmed.*

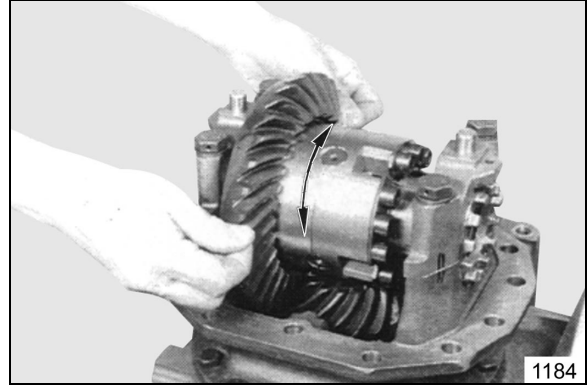


Figure 264

9. When adjustment is correct, secure position of adjusting nuts using straight pins.

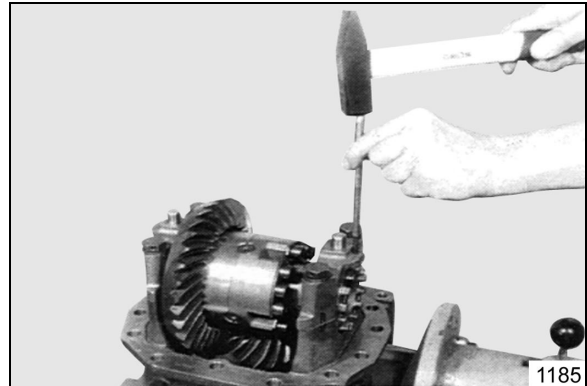


Figure 265

INSTALLING HELICAL GEAR AND CLUTCH

1. Install ball bearing in bearing cover and secure with retaining ring.



Figure 266

2. Press ball bearing over collar of helical gear and secure with retaining ring.

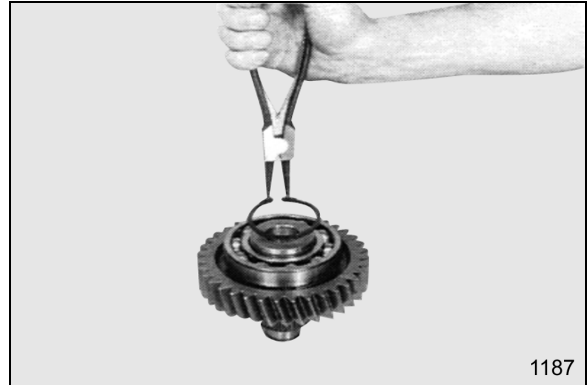


Figure 267

3. Press bearing cover, retaining ring up, firmly onto shoulder.

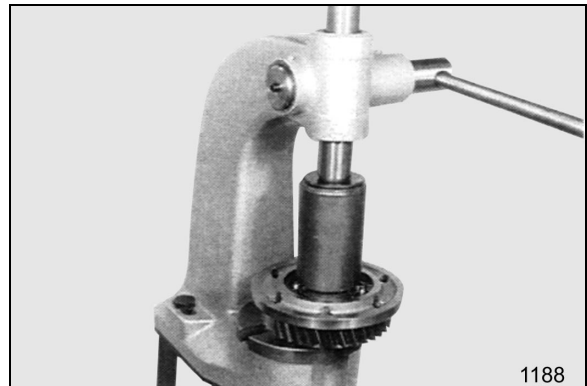


Figure 268

4. Install spacer, on some models, and shift dog.

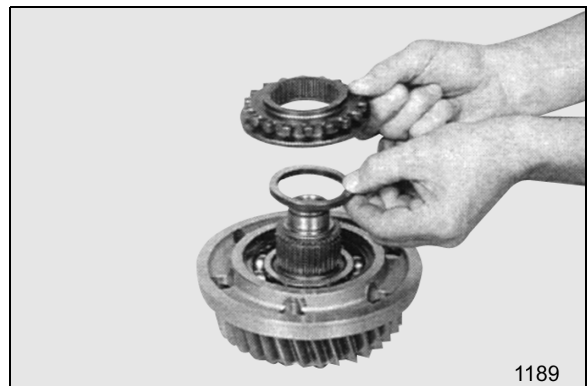


Figure 269

5. Secure shift dog with shim and retaining ring; maximum end play is 0.1 mm (0.0039 in.).



Figure 270

6. Check installation position in illustration and press needle bearing firmly against shoulder.



Figure 271

7. Insert preassembled helical gear into housing bore.

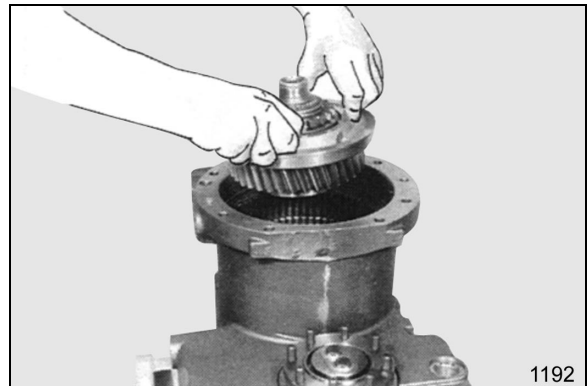


Figure 272

8. Secure bearing cover with retaining ring.

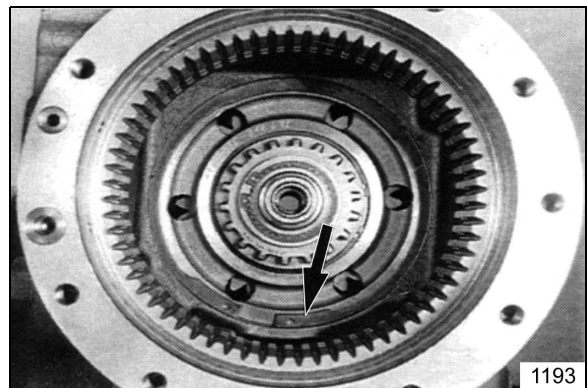


Figure 273

NOTE: *Shift Dog Assembly is shown.*

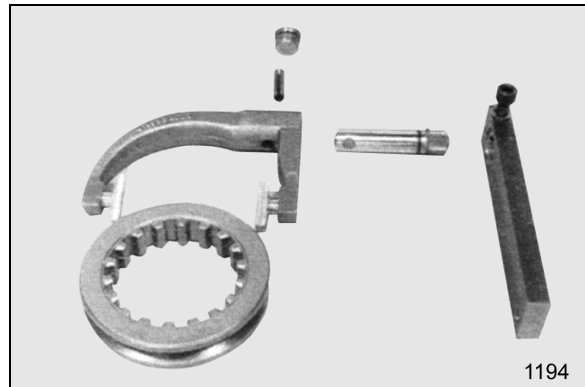


Figure 274

9. Install retaining ring (1) and O-ring (2).



Figure 275

10. Insert shift fork and sliding collar.

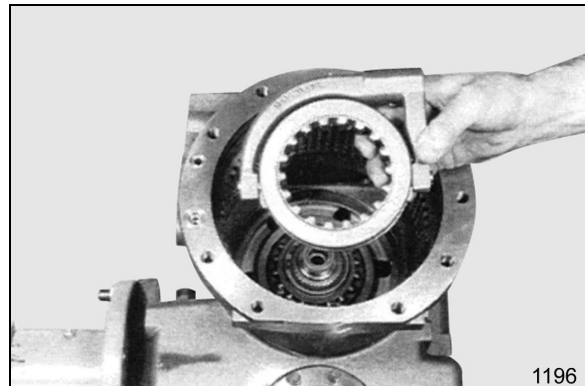


Figure 276

11. Install shift shaft so that it is tight.

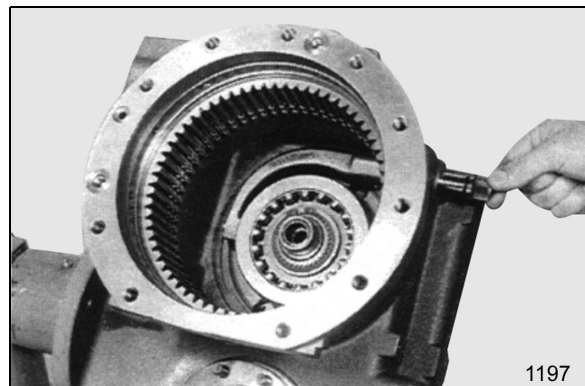


Figure 277

12. Align shift shaft radially and secure by driving in roll pin until it is flush.

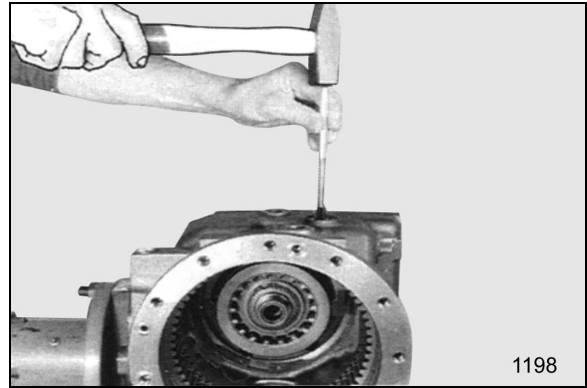


Figure 278

13. Install new O-ring and install screw plug, torque to 60 Nm (13.5 ft lb).

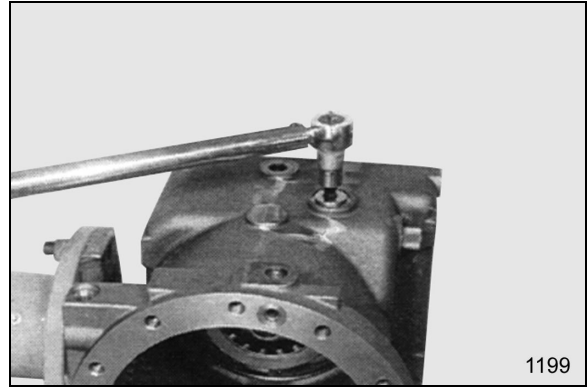


Figure 279

INSTALLING PLANETARY CARRIER

1. Grease cylindrical rollers and preassemble planetary gear.

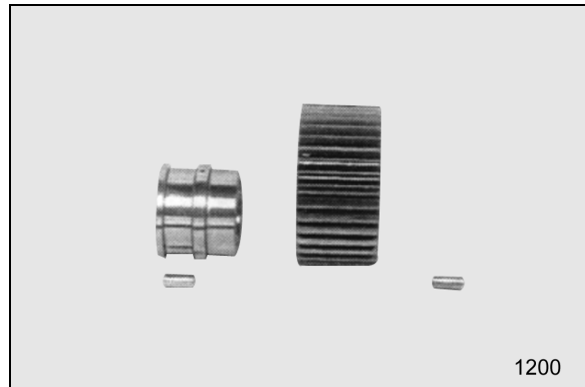


Figure 280

2. Press planetary gear firmly against shoulder.

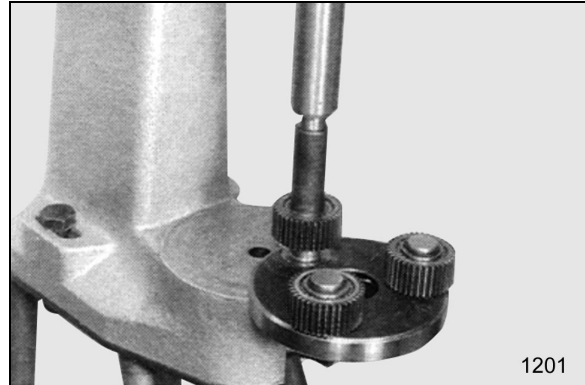


Figure 281

3. Install collar shim and retaining ring.

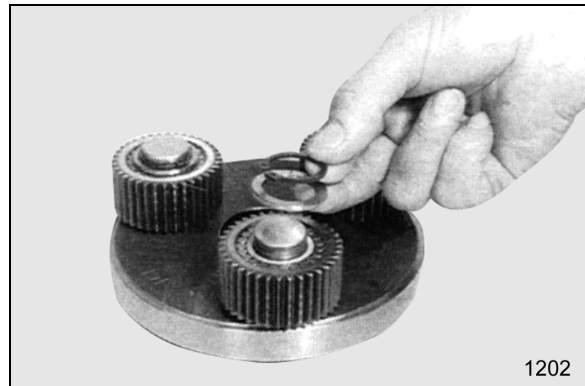


Figure 282

4. Install ball bearing firmly on shoulder and secure with retaining ring.



Figure 283

5. Heat ball bearing and install planetary carrier.

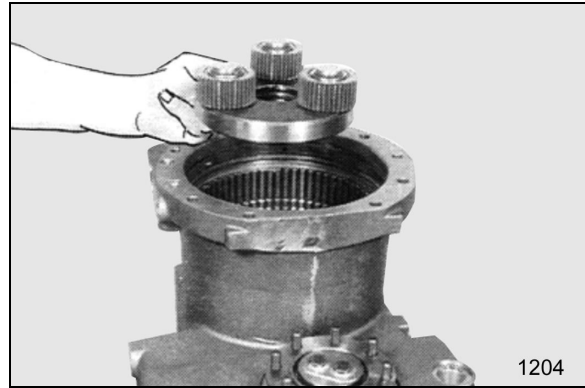


Figure 284

6. Secure planetary carrier with retaining ring.

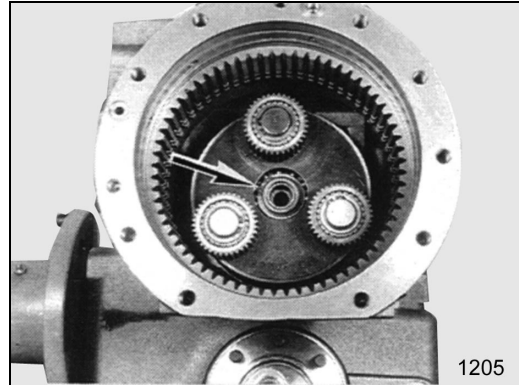


Figure 285

ADJUSTING SHIFT LEVER

1. Install shift lever and secure temporarily in "OFF" Position with hex screw.
2. Turn shift shaft clockwise to stop, using (temporary) screw, and secure shift lever using socket head screw and flat washer. Torque to 46 Nm (10.3 ft lb).

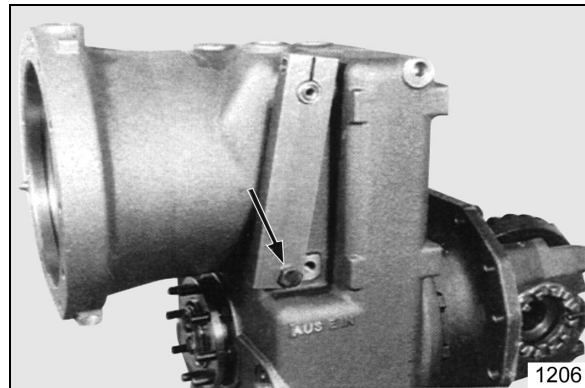


Figure 286

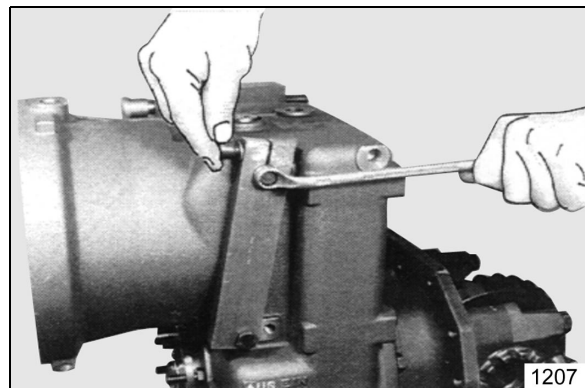


Figure 287

3. Turn shift lever to ON Position and fasten with hex head screw. Torque to 46 Nm (10.3 ft lb).

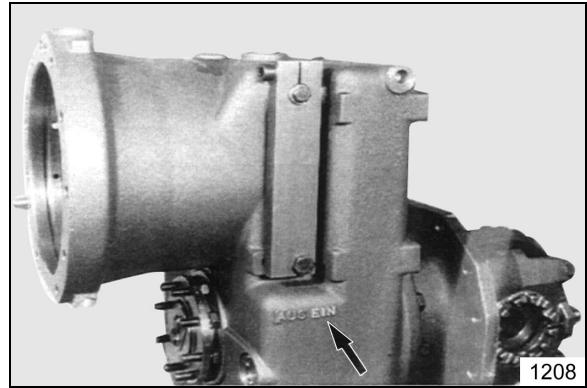


Figure 288

PREASSEMBLING AND INSTALLING CLUTCH

1. Press ball bearing firmly against shoulder and secure with retaining ring.
2. Install two rings (rectangular cross section).
3. Wet outer diameter of shaft seal and grease sealing lip. Install to correct depth by using special driver.

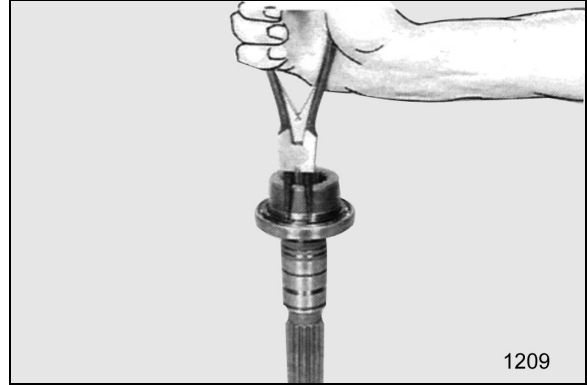


Figure 289



Figure 290

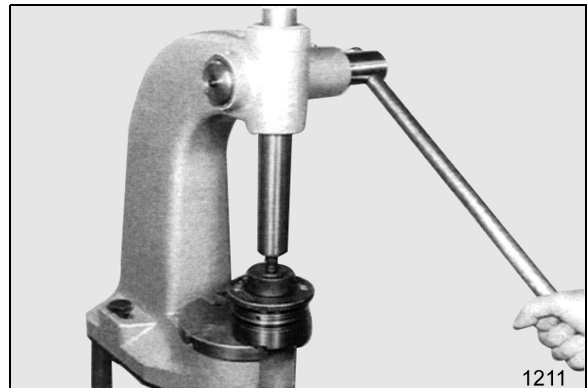


Figure 291

4. Secure shaft seal with retaining ring.



Figure 292

5. Grease two rings (with rectangular cross section), align vertically and press drive shaft into guide sleeve until seated.

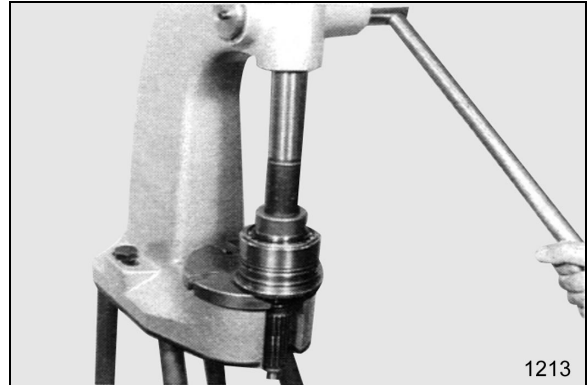


Figure 293

6. Secure drive sleeve with retaining ring.



Figure 294

7. Install retaining ring (one only). Install back plate with bevel facing up.



Figure 295

8. Determine value B from table and adjust if necessary, following Steps 9-13.

Number of Plate Pairs	Value B
10	10.6 + 0.2 mm (0.417 ± 0.0079")
11	7.8 + 0.2 mm (0.307 ± 0.0079")

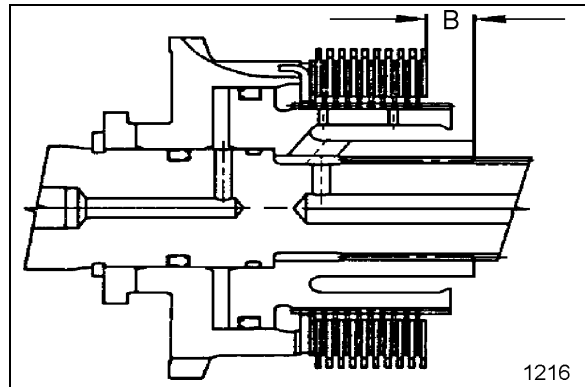


Figure 296

9. Install piston.



Figure 297

10. Install plate carrier and tap against shoulder until seated. See Figures 298 and 299.



Figure 298



Figure 299

11. Install plate.



Figure 300

12. Determine number of plate pairs, using Parts List, and assemble the plate pack starting with an inner plate and using no oil.



Figure 301

13. Determine dimension B, the distance from face of inner plate carrier to outer plate and correct distance to 10.6 ± 0.2 mm (0.417 ± 0.0079 in.) or 7.8 ± 0.2 mm (0.3071 ± 0.0079 in.) using shims of 1.0, 1.2, 1.4 or 1.8 mm.



Figure 302

14. Determine end play of plate carrier, ball bearing and sun gear. Adjust to maximum end play of 0.1 mm (0.0039 in.), using shim(s) in next Step. Install ball bearing and sun gear.



Figure 303

15. Assemble shim(s) of 3.0 mm to 3.9 mm, secure with retaining ring and check end play again. Remove all components including the piston assembled in Steps 9-15.



Figure 304

16. Grease lip of sealing ring and install, lip up, using driver (S).

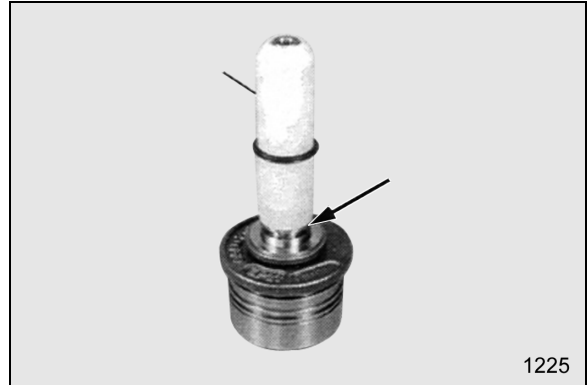


Figure 305

17. Grease and install O-ring.



Figure 306

18. Install cup springs according to illustration.



Figure 307

19. Install piston.



Figure 308

20. Grease seal ring and install lip down.
Install inner plate carrier against shoulder.



Figure 309

21. Install plate.



Figure 310

22. Oil and assemble plate pack.



Figure 311

23. Install ball bearing into centering disc and secure with snap ring.



Figure 312

24. Install centering disc in internal gear bore and secure with retaining ring.



Figure 313

25. Align outer plates radially and install internal gear.



Figure 314

26. Install sun gear



Figure 315

27. Install end play shims determined in Steps 14 and 15.



Figure 316

28. Preload plate pack using an assembly type fixture and secure with retaining ring (one only).

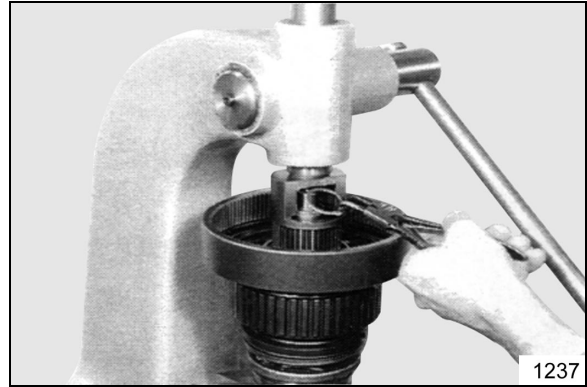


Figure 317

CHECKING CLUTCH

1. Install hydraulic connection.



Figure 318

NOTE: *Test medium in following test should be TE-M107 or TEMPL2*

2. Clean piston by blowing compressed air into it several times. Set test pressure to 35 bar (507 psi); use shut off valve to shut off pump, and check that pressure holds for 3 minutes.

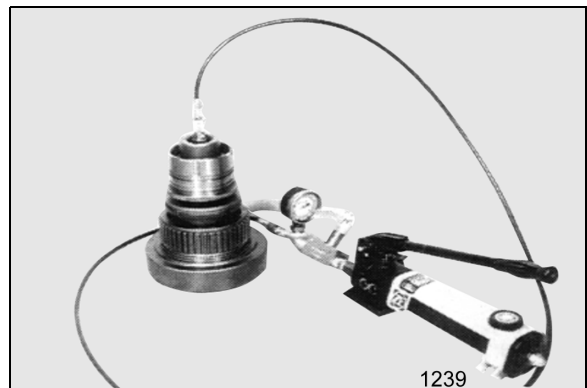


Figure 319

3. Remove pressure connection, install throttle valve and new O-rings.



Figure 320

4. Install preassembled clutch.

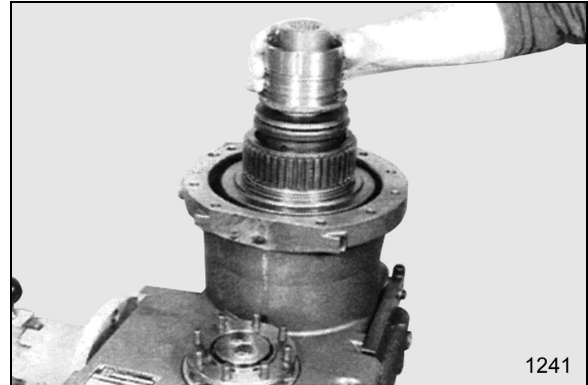


Figure 321

5. Install 190 x 4 retaining ring.

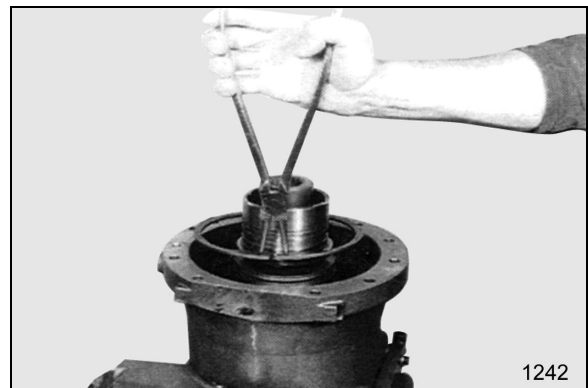


Figure 322

INSTALLING BRAKE

1. Install backing plate.

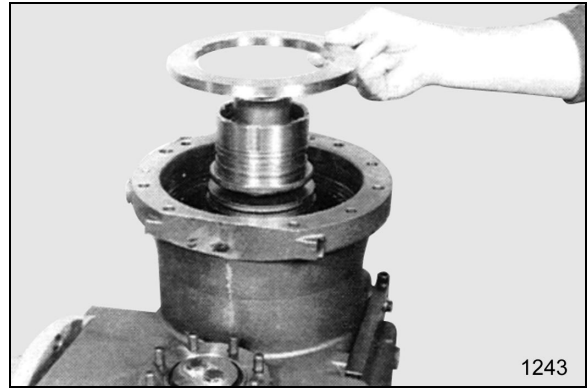


Figure 323

2. Determine number of plate pairs, using Parts List; oil and assemble the plate pack starting with an inner plate.

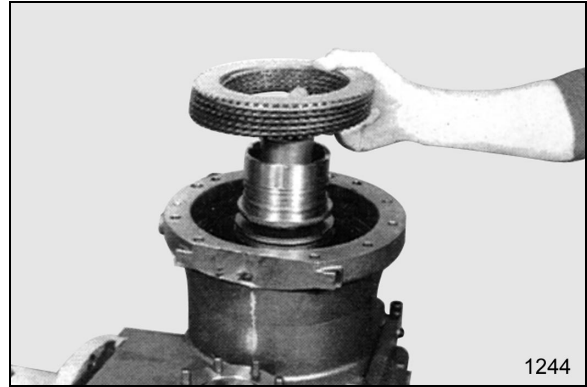


Figure 324

3. Seat piston firmly on shoulder.

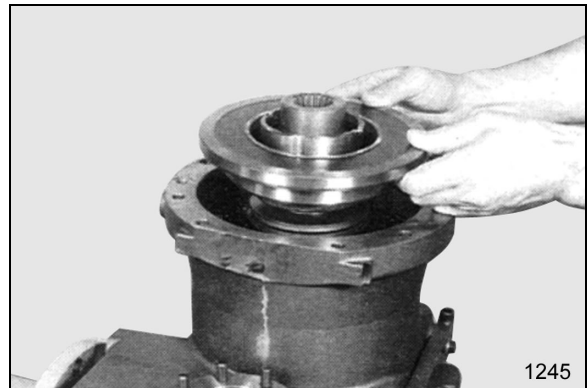


Figure 325

4. Install two cup springs, centering them carefully.



Figure 326

5. Install measuring cover and draw it down evenly against shoulder using socket head screws. Torque to 79 Nm (17.8 ft lb).

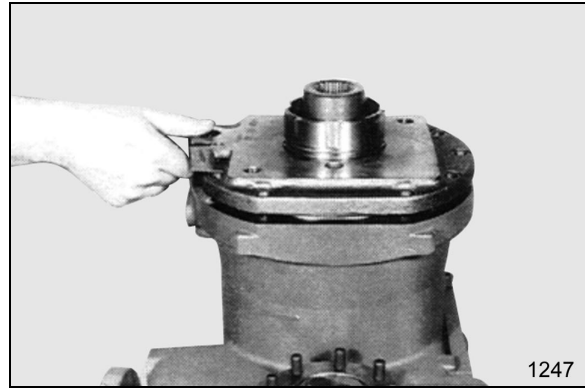


Figure 327

6. Measure distance from cover to piston (Dimension 1). Subtract manufacturing dimension engraved on cover (20 mm) from Dimension 1 to get Dimension X.

Dimension 1	32.60 mm (1.28 in.)
Manufacturing Dimension	- 20.00 mm (.787 in.)
Dimension X	= 12.60 mm (0.499 in.)

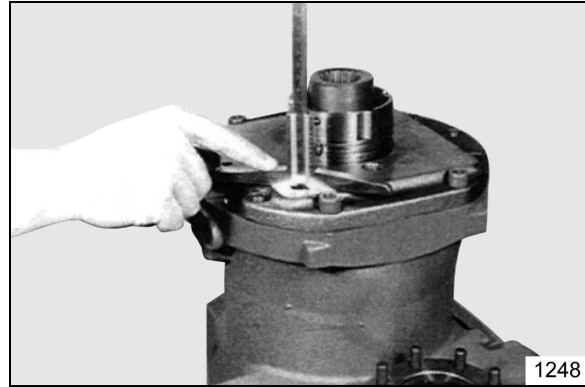


Figure 328

7. Measure distance from drive casing to flange (Dimension "Y"). Subtract Y from X to get Adjustment Value (A).

Dimension X	12.60 mm (0.496 in.)
Dimension Y	-11.10 mm (0.437 in.)
Adjustment Value (A)	= 1.50 mm (0.059 in.)

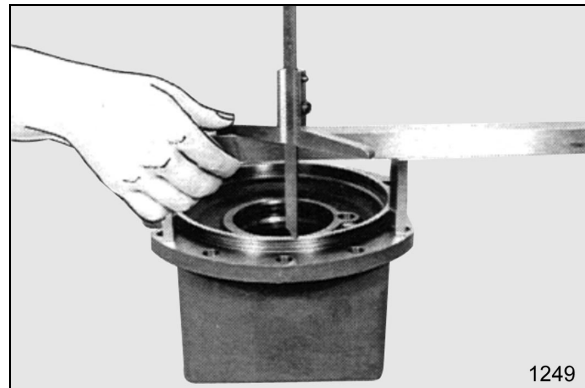


Figure 329

8. Correct adjustment, using 3.0, 3.2 and 3.5 mm shims. Remove measuring cover and piston.
9. Install O-ring in ring groove, making sure O-ring makes good contact.

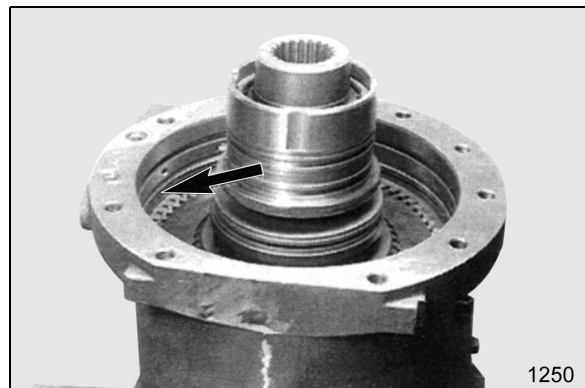


Figure 330

10. Note position of disc, piston, and seals.

1) Drive Casing	7) Disc
2) Clutch Disc Housing	8) Gasket, Back-up
3) Gasket, Back-up	9) Gasket, U-section
4) Gasket, U-section	10) Piston
5) Retaining Ring	11) Cup Springs
6) O-ring	12) O-ring

11. Install Back-up and U-section rings in ring groove. Oil rings. Check installation position and install disc.

12. Secure disc with snap ring.

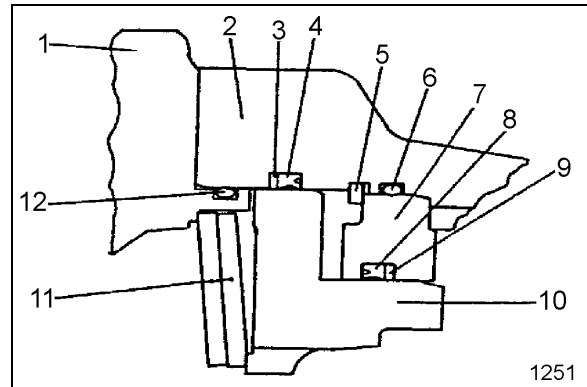


Figure 331

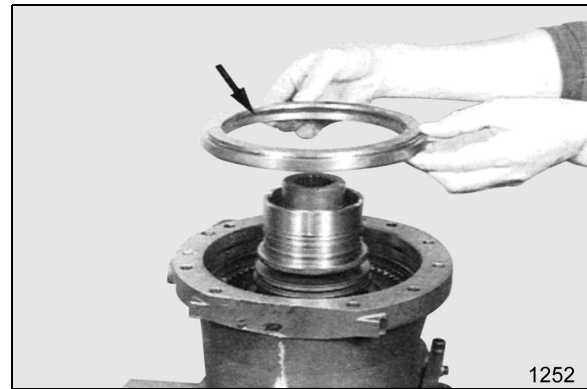


Figure 332

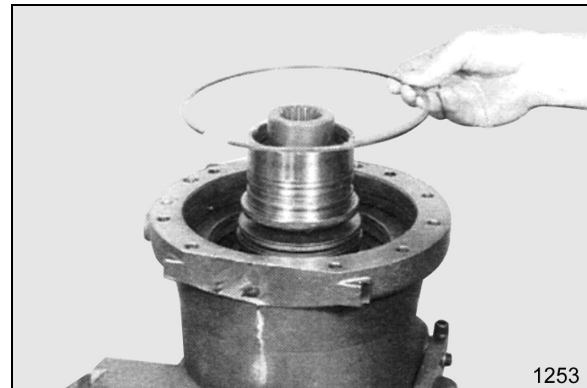


Figure 333

13. Install back-up ring and seal ring in ring groove of housing; oil the rings. Install piston evenly against shoulder using measuring cover and socket head screws, then remove measuring cover. See Figures 334 and 335.

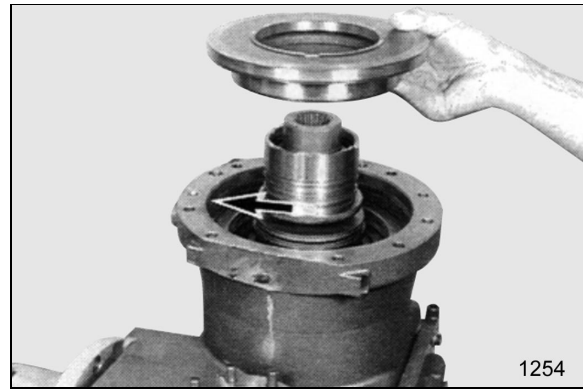


Figure 334

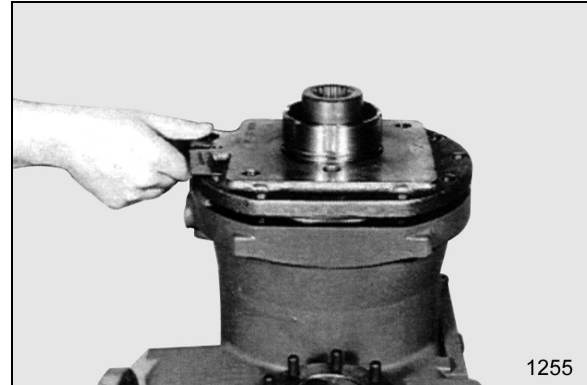


Figure 335

14. Install two cup springs and center them (noting installation position in Figure 331).

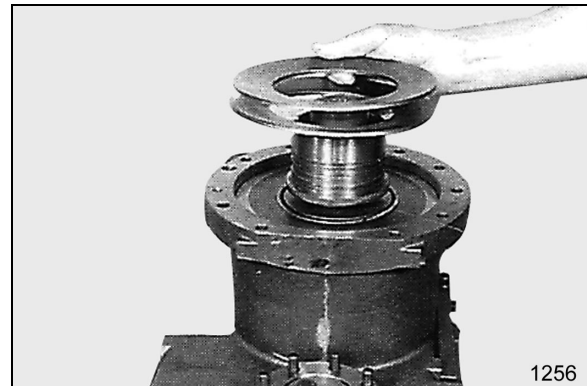


Figure 336

INSTALLING DRIVE CASING

1. Insert O-ring (1) in bore and insert O-rings in ring grooves of guide sleeve. Grease O-rings.

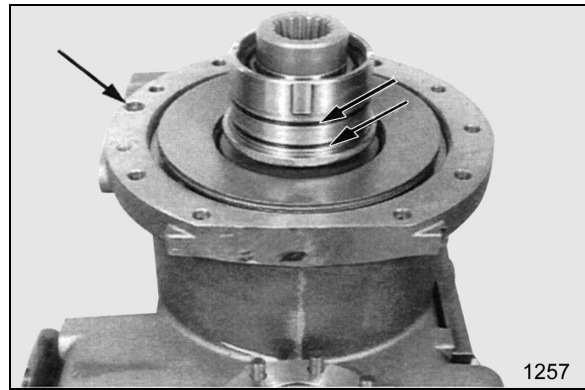


Figure 337

2. Insert O-ring into groove of drive casing. Grease O-ring.

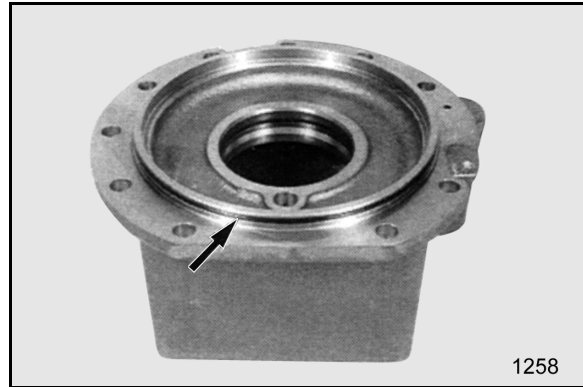


Figure 338

3. Align guide bushing radially.

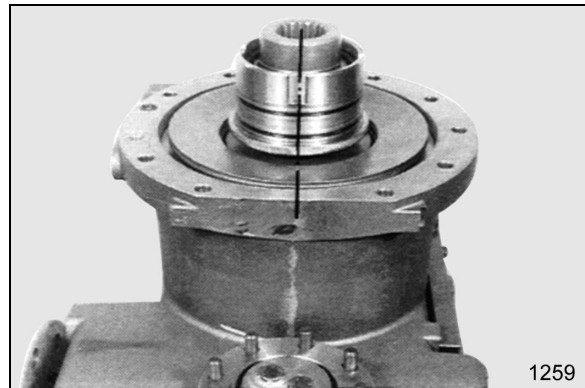


Figure 339

4. Install drive casing, being careful to align it radially.

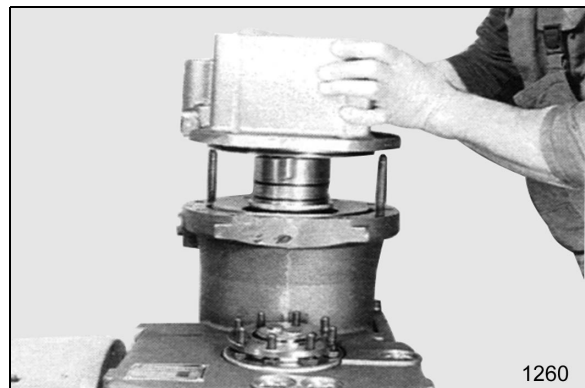


Figure 340

5. Pull drive casing evenly against shoulder using socket head screws. Torque to 79 Nm (17.8 ft lb).

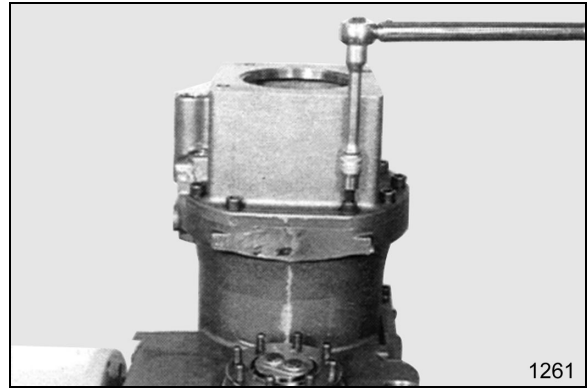


Figure 341

6. Pull guide bushing out of housing using internal puller until snap ring (95 mm) can be installed.

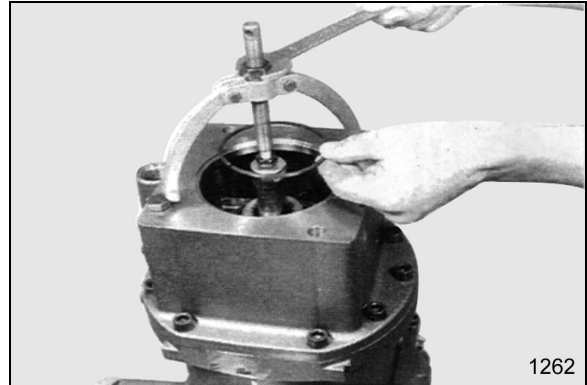


Figure 342

7. Secure guide bushing radially, using screw plug. Install new U-ring.

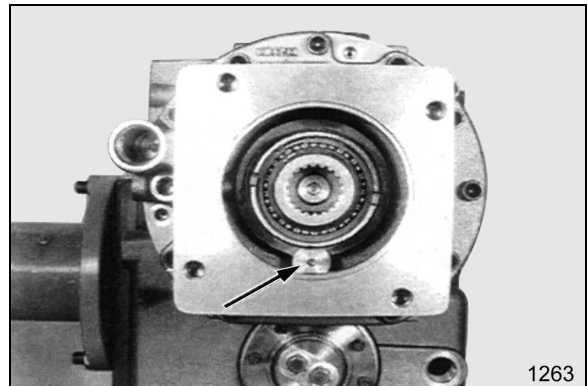


Figure 343

8. Heat turcon ring in oil bath. Insert gasket (O-ring and turcon ring) into ring groove of piston, using installer. Grease gasket.

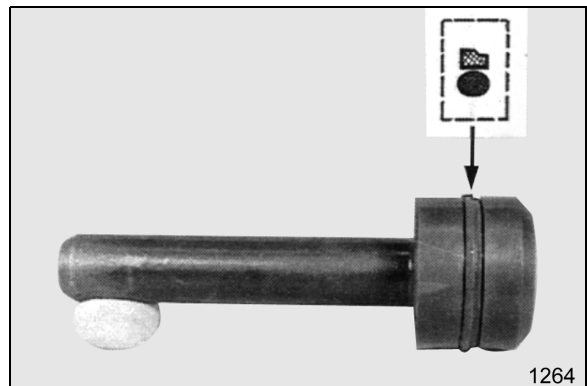


Figure 344

9. Install new O-ring on screw plug. Insert pre-assembled piston and spring into housing bore and secure with screw plug.

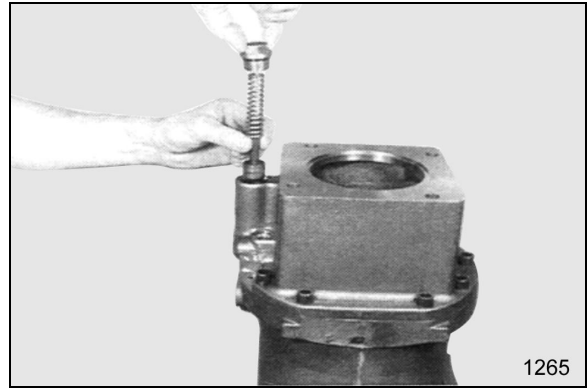


Figure 345

10. Install new O-ring on screw plug. Install breather (1) and screw plug (2).

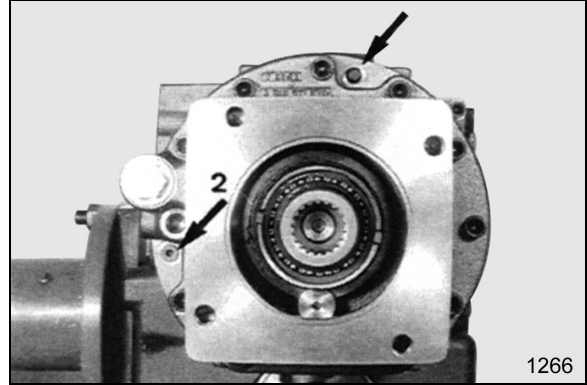


Figure 346

11. Install two screw plugs (1) and shear plug (S). Install hydraulic connection (2).

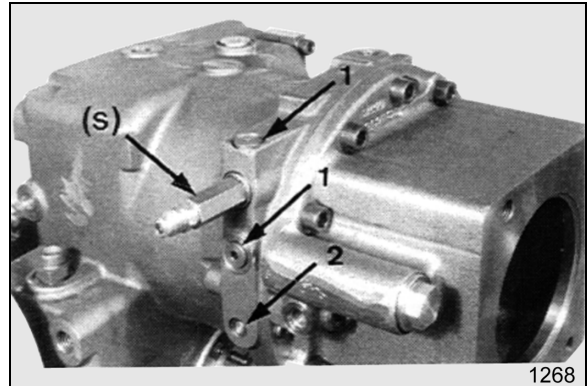


Figure 347

12. Ventilate piston chamber by filling it several times with air. Build up test pressure of 35 bar (507 psi), close off HP-pump using shut-off valve and check that there is no pressure drop during a period of three minutes.

NOTE: Use ZF lubricants TE ML 07 or TE ML 12 for testing.

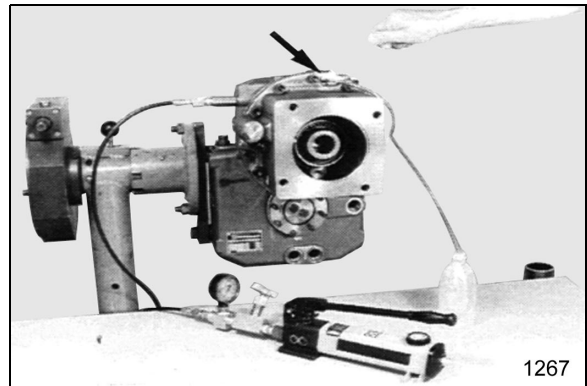


Figure 348

13. Remove hydraulic connection. Install throttle valve and install new O-ring.

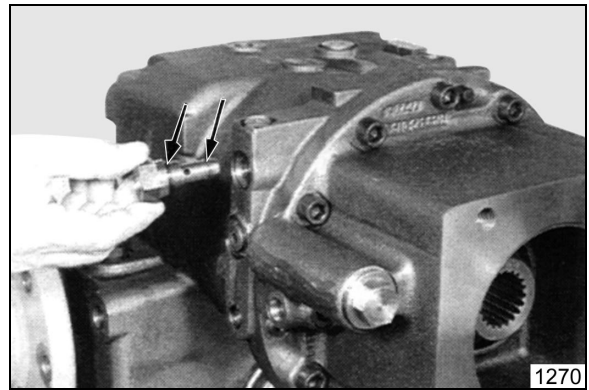


Figure 349

MOUNTING GEAR BOX TO AXLE

1. Cover flange mounting surface with loctite 573. Install two adjusting screws, place gear box against axle and secure with locking screws, torquing to 230 Nm (51 ft.lb.).

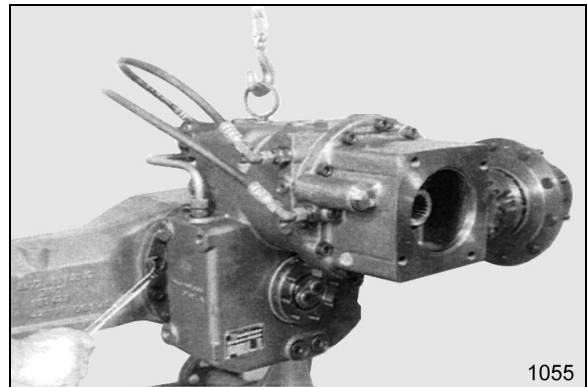


Figure 350

2. Install stub shaft.

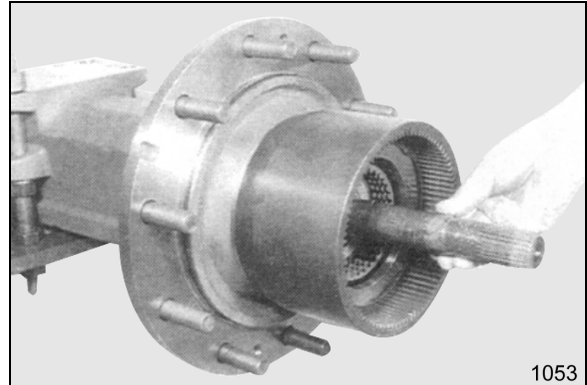


Figure 351

3. Install thrust washer.

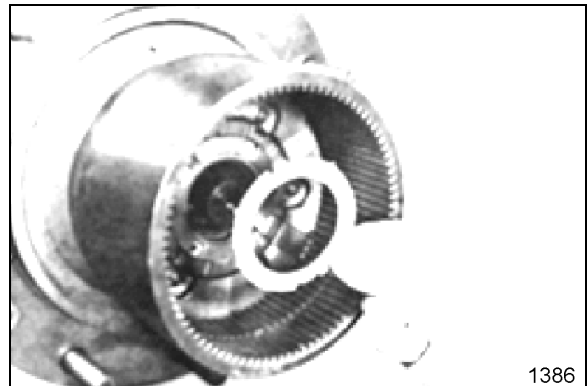


Figure 352

4. Install inner plate carrier and sun gear.

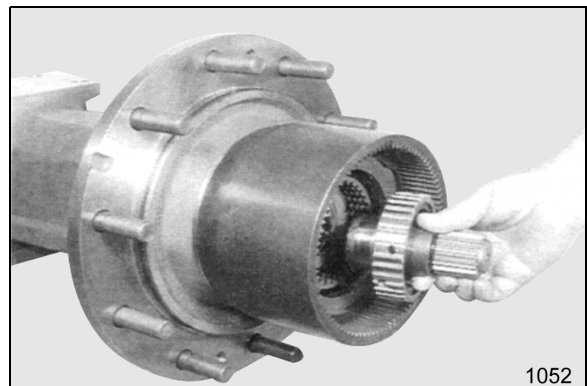


Figure 353

5. Assemble inner and outer plates into plate package as shown.

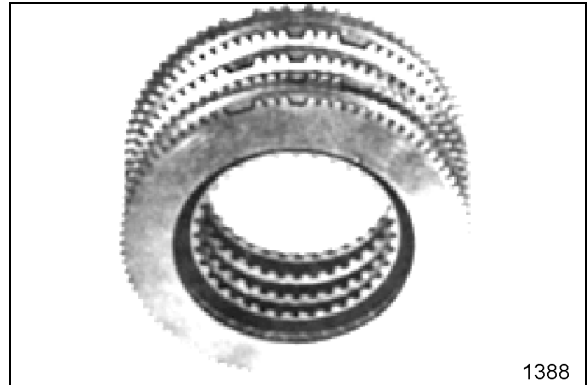


Figure 354

6. Install plate pack and secure with backing plate and retaining ring. Install new O-ring.

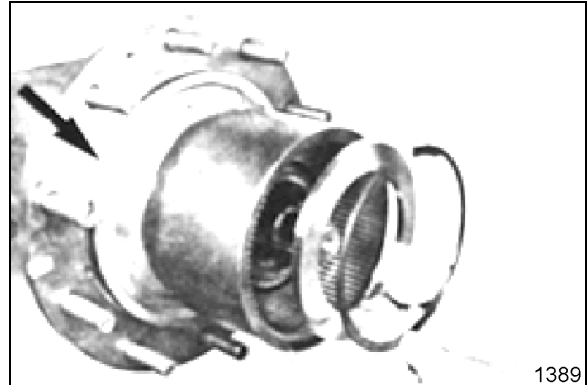


Figure 355

7. Install planetary carrier and secure with socket head screws. Torque to 56 Nm (12.6 ft.lb.). Tighten drain plugs.

NOTE: Fill rear axle using TE-ML 05 lubricant, list and mark on planetary carrier as guide.

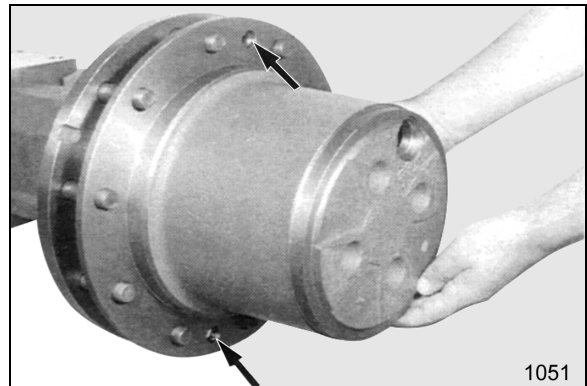


Figure 356

DRIVE PINION / CROWN WHEEL CONTACT PATTERN

CORRECT PATTERN

Drive Side.

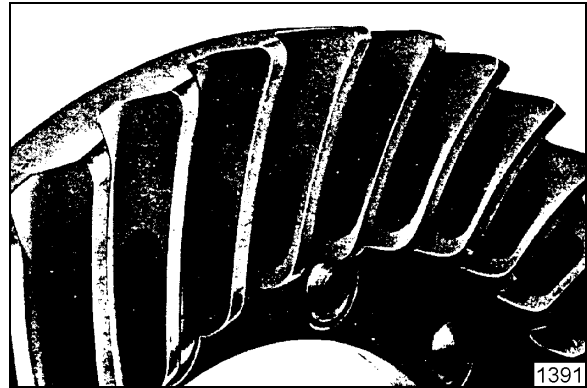


Figure 357

Neutral Side.

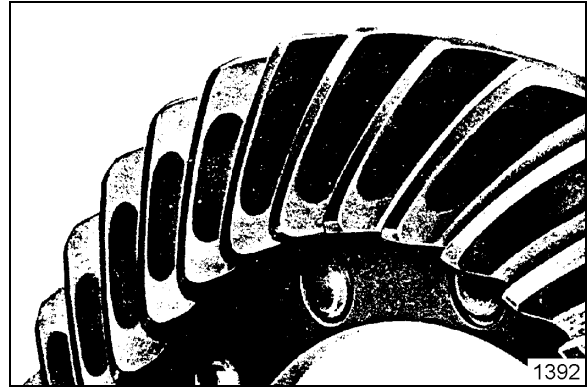


Figure 358

INCREASE PINION DISTANCE

Drive Side

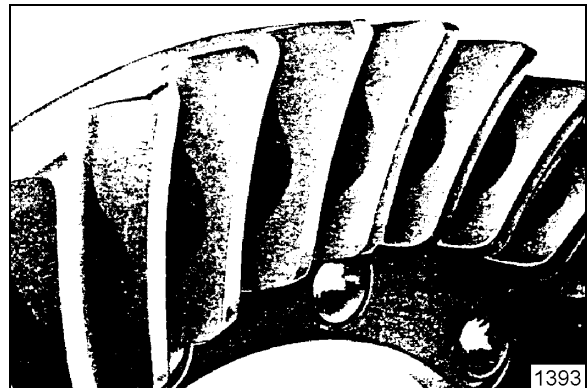


Figure 359

Neutral Side



Figure 360

DECREASE PINION DISTANCE

Drive Side

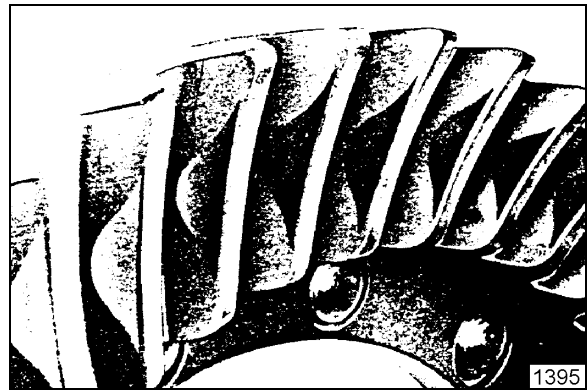


Figure 361

Neutral Side



Figure 362

TRANSMISSION GOVERNOR

PARTS LIST

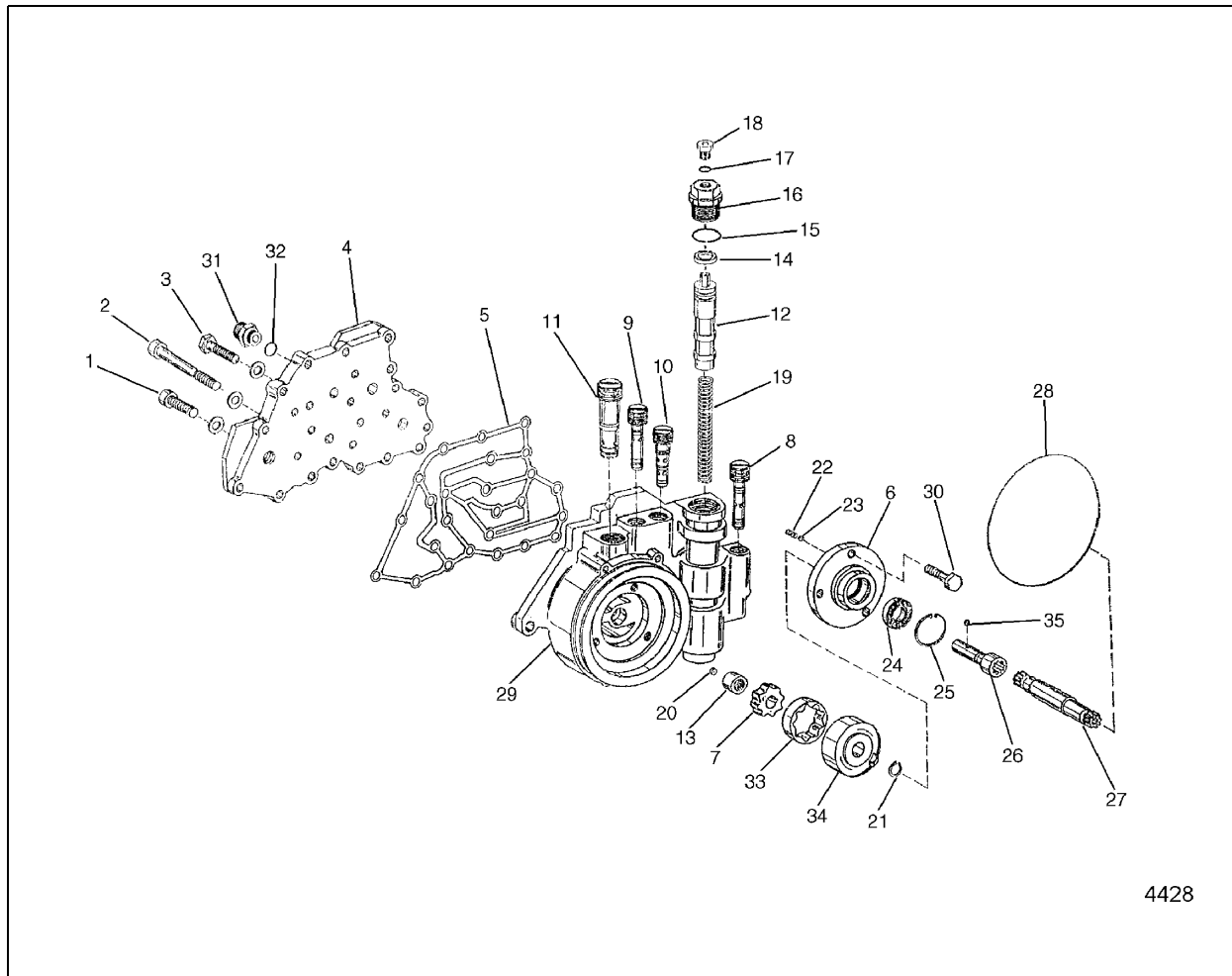


Figure 363

Reference Number	Description
1	Screw, Socket Head
2	Screw, Socket Head
3	Screw, Hex Head
4	Cover, Valve
5	Gasket, Cover
6	Cover, Pump
7	Rotor Assembly
8	Valve, Check
9	Valve, Check
10	Valve, Check
11	Valve, Pressure Limiting
12	Spool, Control
13	Bearing, Needle
14	Ring, Plastic
15	O-ring
16	Reducer
17	Ring, Sealing
18	Plug, Threaded

Reference Number	Description
19	Spring, Compression
20	Orifice
21	Ring, Retaining
22	Spring
23	Ball
24	Bearing, Ball
25	Ring, Retaining
26	Shaft, Drive
27	Shaft, Extension
28	O-ring, Cover
29	Housing, Valve
30	Screw, Hex Head
31	Adapter, Hose
32	O-ring
33	Ring, Rotor
34	Housing, Rotor
35	Ball, Drive Shaft

DISASSEMBLY OF GOVERNOR

(Refer to Figure 363)

1. Remove any oil lines and hoses connected to governor housing (29).
2. Remove four socket head bolts (1) and (2), and remove governor assembly from transmission.
3. Remove hex bolts (3) that hold cover (4) to housing (29). Remove cover (4) and gasket (5).

NOTE: *In the following steps, be prepared to catch four balls and three springs that will be released when cover (4) is removed.*

4. Remove three hex bolts (30) that hold pump cover (6) to housing (29). Remove cover (6) using caution to catch three springs (22) and four balls (23).
5. Remove rotor gear (7), rotor ring (33), and ball (35) from end of drive shaft (26).
6. Remove retaining ring (21) from groove in drive shaft (26).
7. Remove rotor housing (34) from drive shaft (26).
8. Slide drive shaft (26) and shaft extension (27) out of pump cover (6).
9. Use an internal puller to remove needle bearing (13) from housing (29).
10. Remove retaining ring (25) and bearing (24) from pump cover (6).
11. Match mark the position and remove check valves (8), (9), and (10) from housing (29).
12. Match mark position and remove pressure limiting valve (11) from housing (29).
13. Unthread reducer (16) and remove control spool (12) and spring (19) from housing (29).

REASSEMBLY OF GOVERNOR

(Refer to Figure 363)

NOTE: *It is recommended that new O-rings and sealing rings are used when reassembling the governor.*

1. Coat a new orifice (20) with Loctite 242. Install orifice with a flat tipped punch until the orifice bottoms in its bore. Use compressed air to clean orifice passage and remove any excess Loctite.
2. Use a press to install needle bearing (13) into its bore. Install the bearing to a depth of 0.2 - 0.5 mm (0.0078 - 0.0196 in.).
3. Slide new O-ring (15) into its groove on control spool (12). Use a installing sleeve to slide plastic ring (14) into position on O-ring (15).

NOTE: *To properly size plastic ring (14), slide a calibrating ring over plastic ring.*

4. Lubricate check valves (8), (9), (10), and pressure limiting valve (11) with transmission fluid, and install. Torque these valves to 10 Nm (7.4 ft lb). Use a center punch to stake each valve in 2 places.
5. Lubricate the control spool components (12) and (19) with transmission fluid and install them into housing (29). Torque reducer (16) to 50 Nm (36.8 ft lb). Torque threaded plug (18) to 20 Nm (14.7 ft lb).
6. Install bearing (24) into cover (6). Install retaining (25) to hold bearing in place.
7. Slide drive shaft (26) through bearing (24). Install retaining ring (21) onto drive shaft (26) to hold shaft in place.
8. Install springs (22) into bores in pump cover (6). Coat balls (23) with grease and place them into bores, on top of springs.
9. Slide rotor housing (34) over drive shaft (26). Install ball (35) into drive shaft (26). Slide rotor gear (7) onto drive shaft (26). Be certain that ball (35) properly engages inside of rotor gear (7). Slide rotor ring (33) over rotor gear (7). Lubricate rotor components before installing cover (6) onto housing (29).
10. Insert assembled pump cover (6) into bore of housing (29). Install bolts (30) and torque to 9.5 Nm (7 ft lb).
11. Place gasket (5) on cover (4). Place cover (4) on housing (29). Install bolts (3) through cover (4) and torque to 20 Nm (14.7 ft lb).
12. Grease O-ring (28) and place around bore on housing (29).
13. Slide shaft extension (27) into transmission. Engage splines on shaft extension (27) with splines in transmission.
14. Thread two aligning studs into transmission, slide governor assembly over studs until flush against transmission. Be certain that splines on drive shaft (26) are fully engaged with splines on shaft extension (27).
15. Install bolts (1) and (2) and torque to 23 Nm (17 ft lb).
16. Attach all oil lines and hoses that were originally attached to the governor. Before operating check and fill transmission with the recommended fluid.

STEERING CYLINDER

PARTS LIST

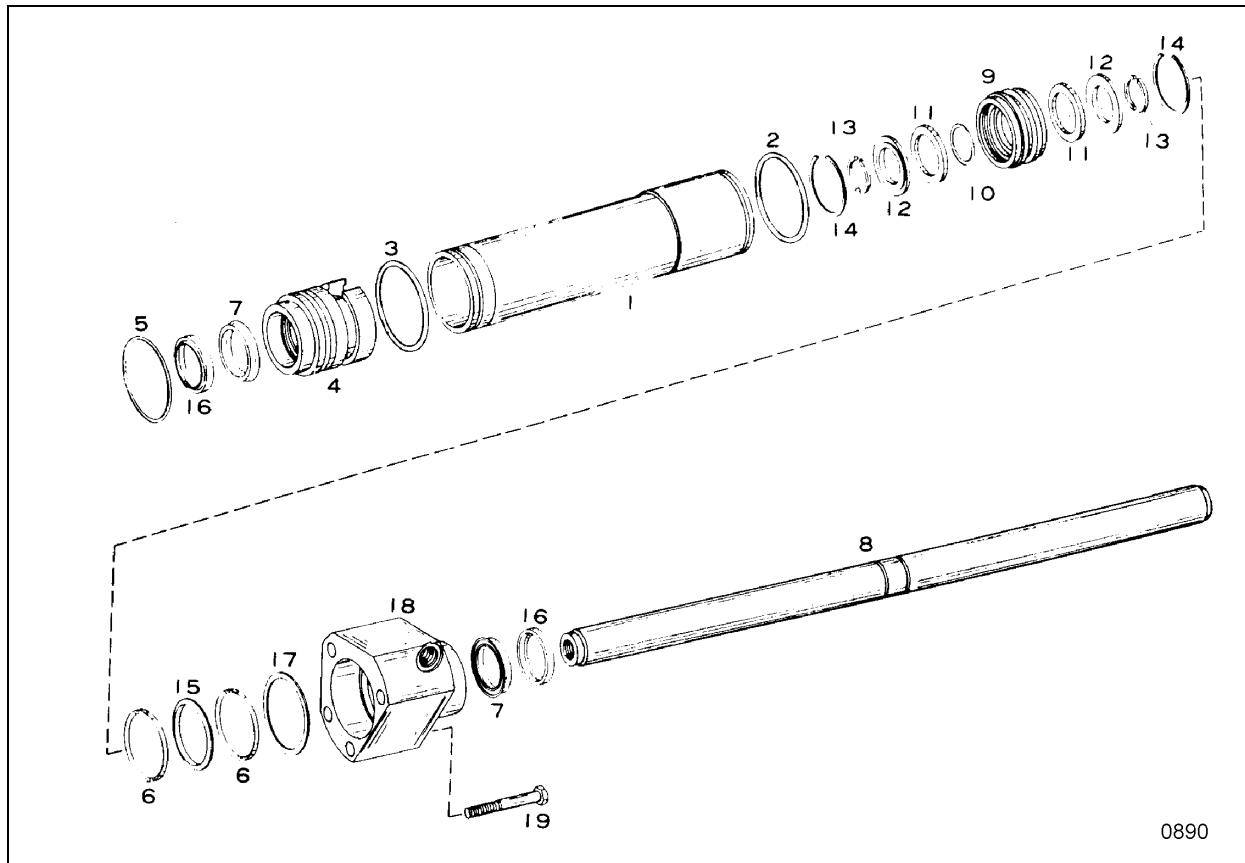


Figure 364

Reference Number	Description
1	Steering Cylinder
2	O-ring
3	O-ring
4	Guide
5	O-ring
6	Scraper Ring
7	O-ring
8	Piston Rod

Reference Number	Description
9	Piston
10	O-ring
11	Washer
12	Retaining Ring
13	Split, Ring
14	Snap Ring
15	Sealing Ring
16	Rod Wiper
17	Washer (Varies)

DISASSEMBLY AND REASSEMBLY OF STEERING CYLINDER

Tools Required

- Heat Source (Torch, Etc.)
- Drift
- Vise Protective Plate
- Rule
- Lubricant (Seals)
- Loctite 242
- Torque Wrench

Disassembly

1. Loosen castle nut, remove tie rod and drive from tapered bore.
2. Heat piston rod and remove tie rod from piston rod.

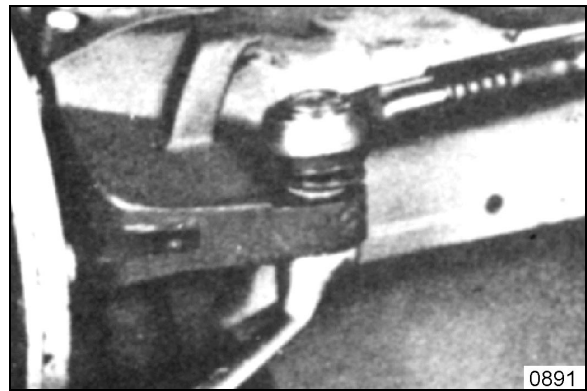


Figure 365

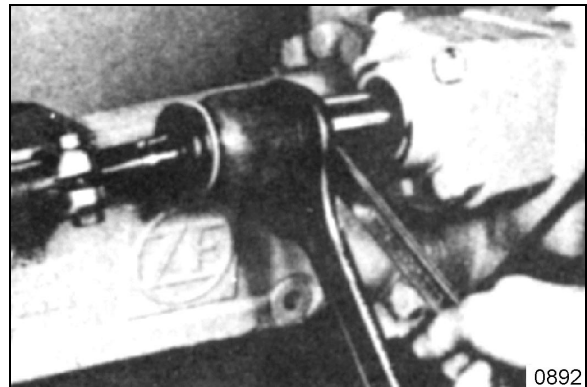


Figure 366

3. Loosen hex bolt.

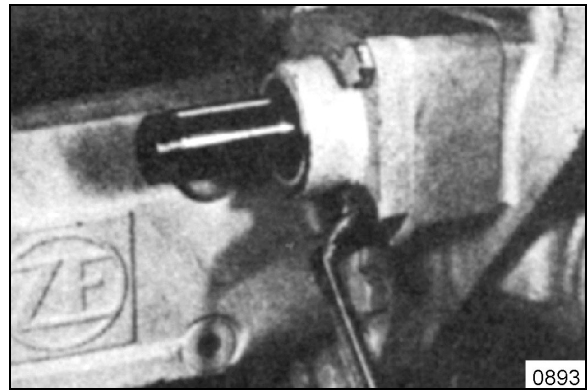


Figure 367

4. Remove piston guide and spacer washer.

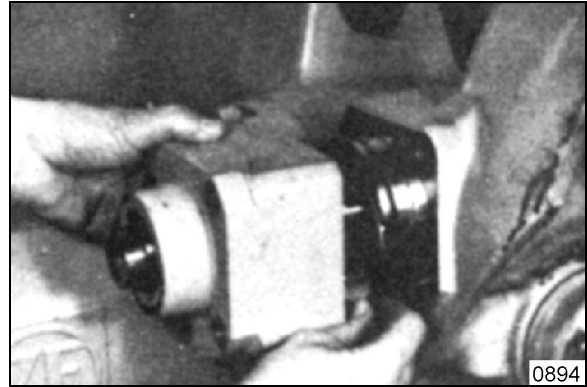


Figure 368

5. Pull piston from cylinder

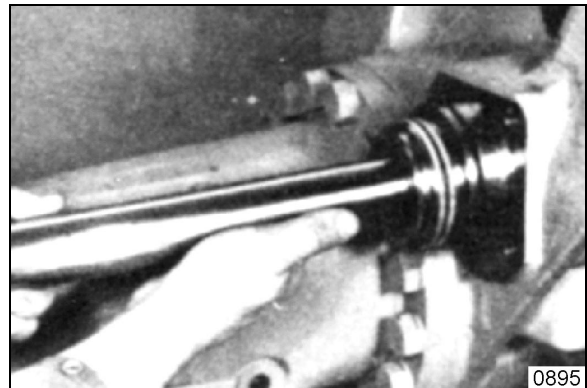


Figure 369

6. Pull guide out using drift.

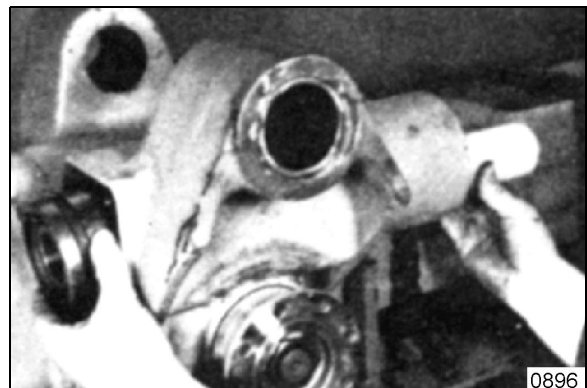


Figure 370

7. Remove scraper ring and groove ring from guide.



Figure 371

8. Remove scraper ring and groove ring from second piston guide.

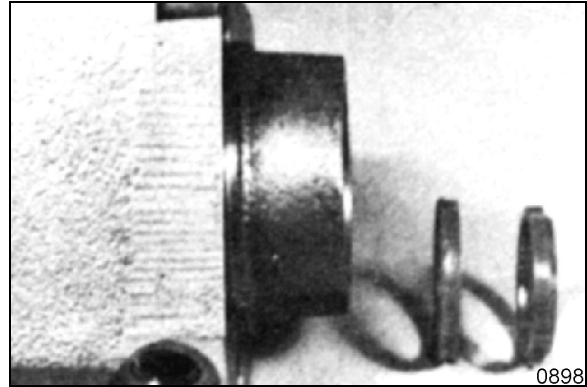


Figure 372

9. Remove scraper rings from piston rod.

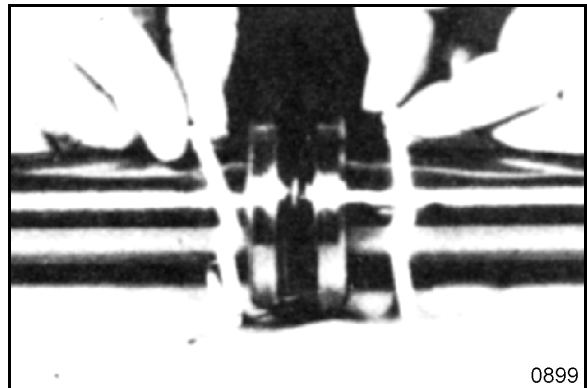


Figure 373

10. Remove piston rod seal.

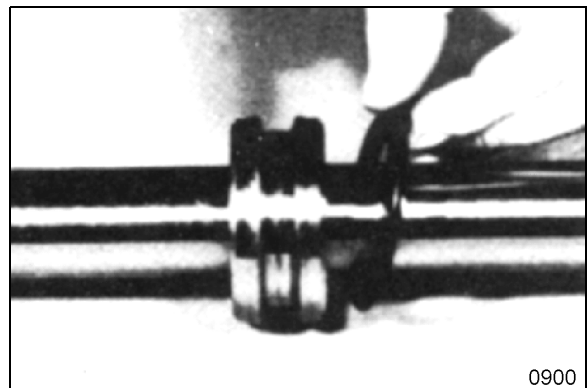


Figure 374

11. Place piston rod in vise with a protective plate and remove snap ring.

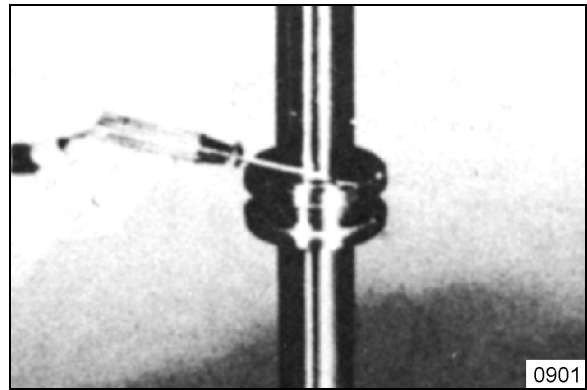


Figure 375

12. Remove disc.

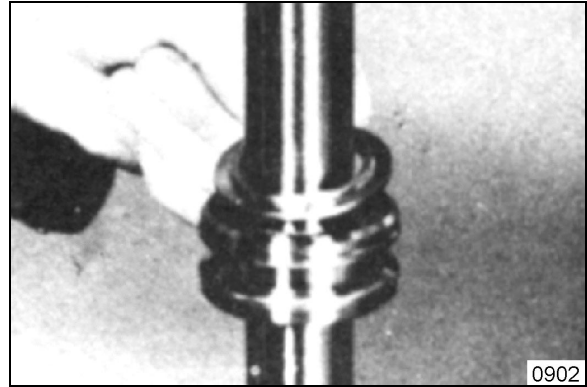


Figure 376

13. Remove split ring.

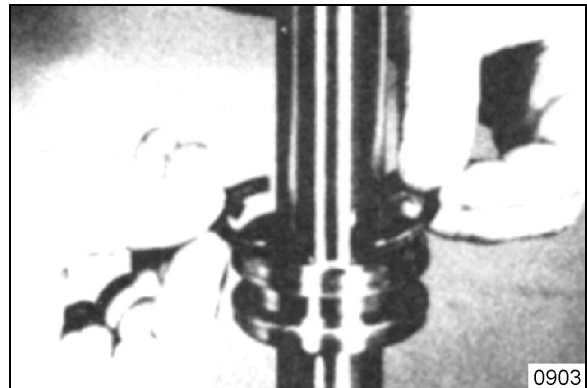


Figure 377

14. Remove disc and O-ring from piston.

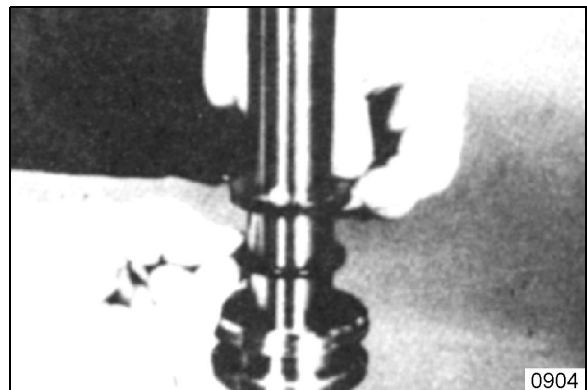


Figure 378

15. Remove split ring and piston.

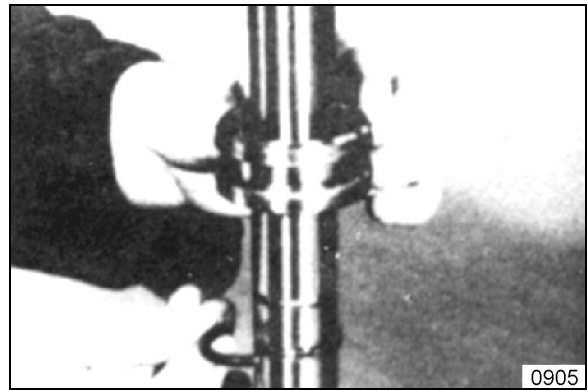


Figure 379

Reassembly

1. Install groove ring and scraper ring to piston rod guide groove so that lip of groove ring faces pressure chamber

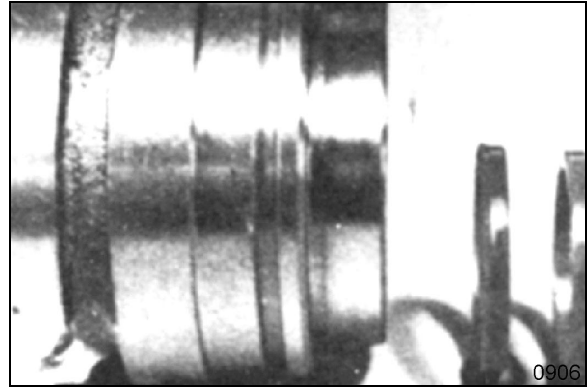


Figure 380

2. Install O-ring to groove.

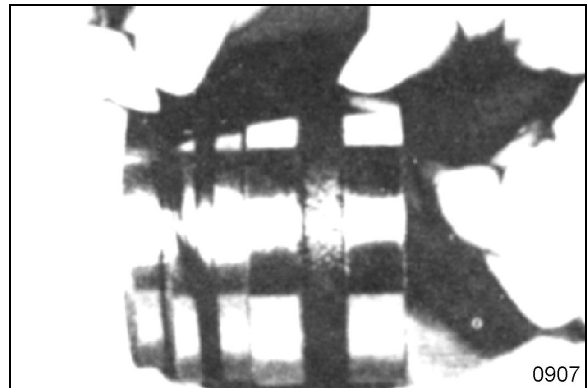


Figure 381

3. Install groove and scraper ring to second guide of piston rod.

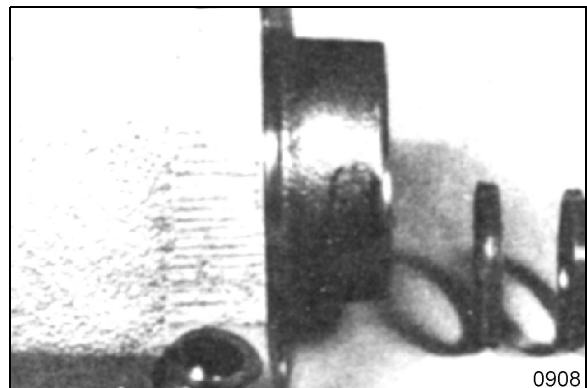


Figure 382

4. Install O-ring (different sizes) on both ends of cylinder.

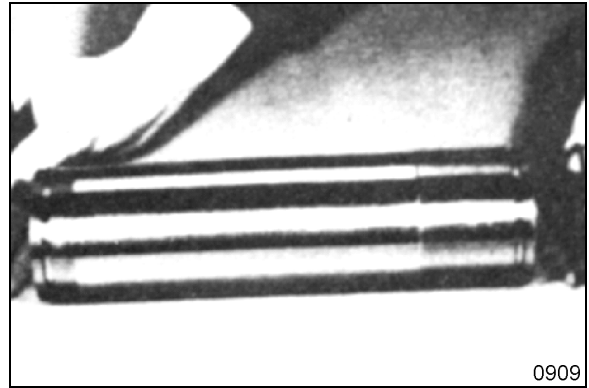


Figure 383

5. Piston and piston rod parts are shown.

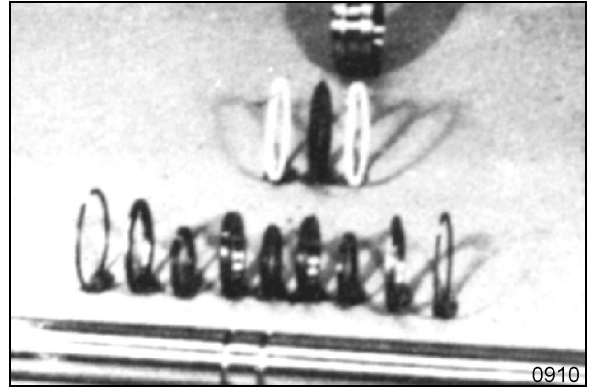


Figure 384

6. Install washer to piston.

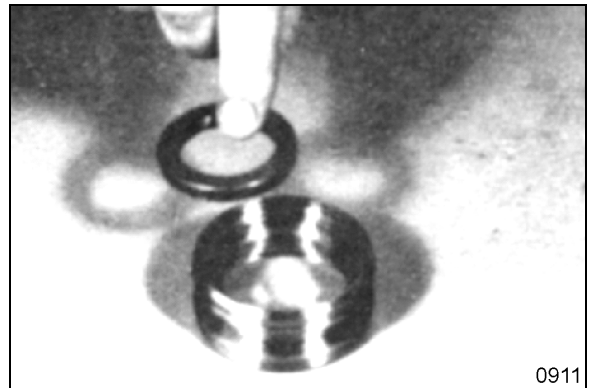


Figure 385

7. Install clip with collar up



Figure 386

8. Install snap ring.

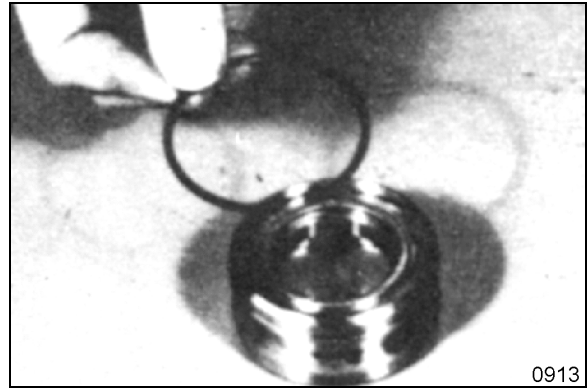


Figure 387

9. Secure piston rod in padded vise, install split ring to piston rod, install piston and install split ring.

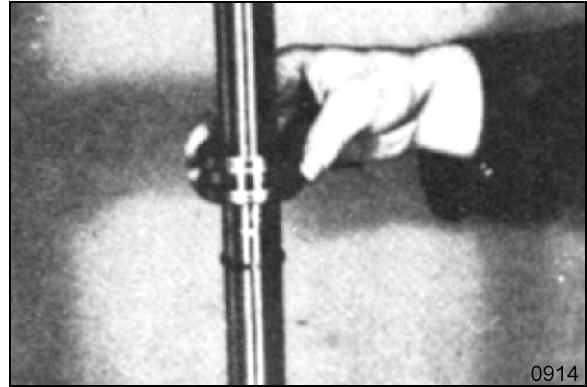


Figure 388

10. Install O-ring to piston rod.

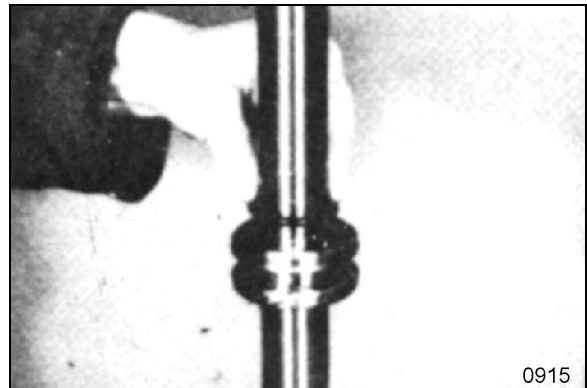


Figure 389

11. Install washer.

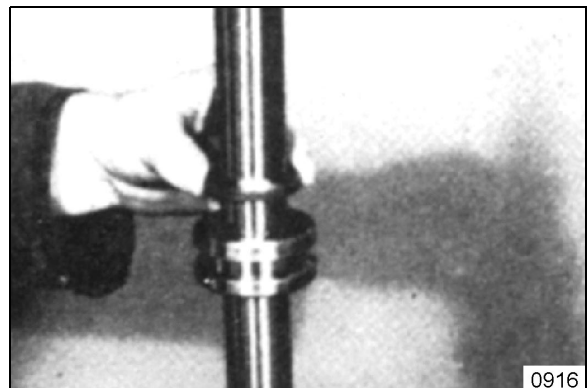


Figure 390

12. Install split ring to groove

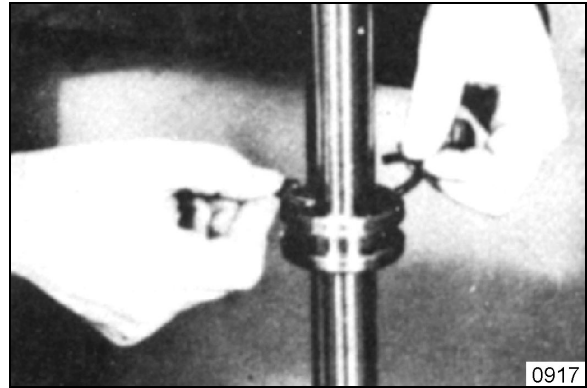


Figure 391

13. Install clip with collar facing up and secure with snap ring.

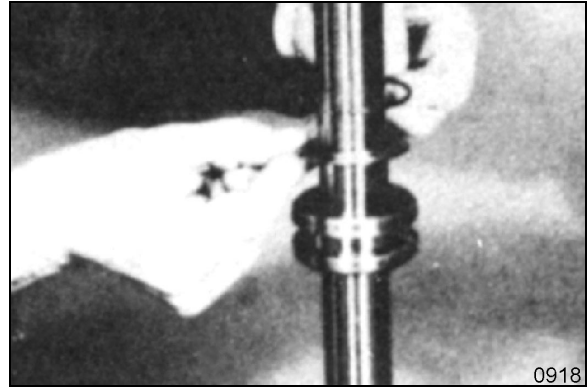


Figure 392

14. Install first scraper ring to piston groove, and install seal.

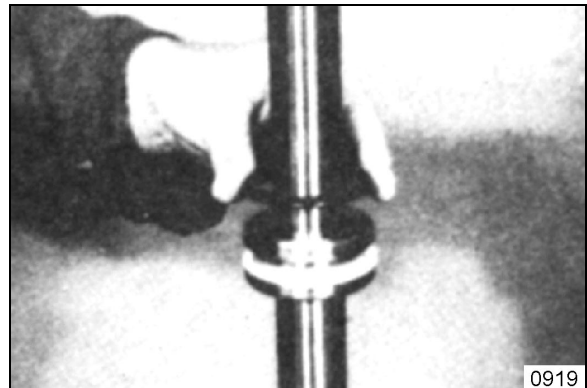


Figure 393

15. Install second scraper ring to piston.

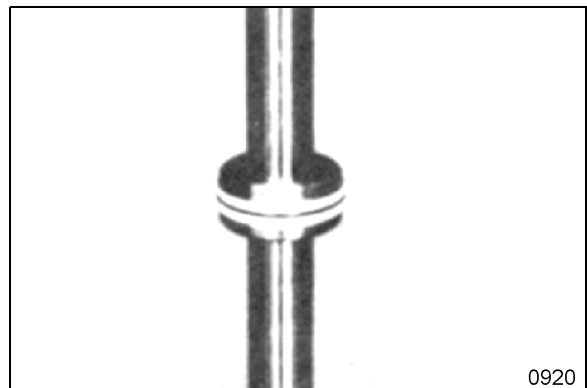


Figure 394

16. Install cylinder guide using a drift.

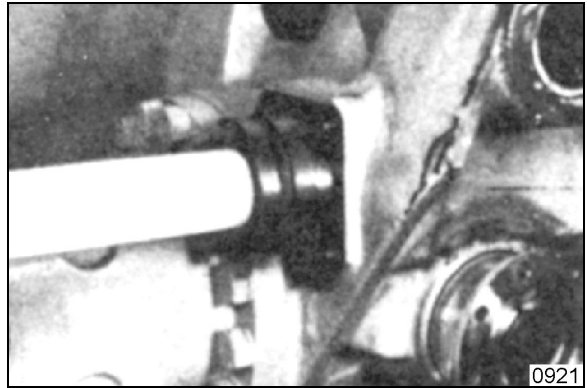


Figure 395

17. Install cylinder with smaller outer diameter facing guide side.

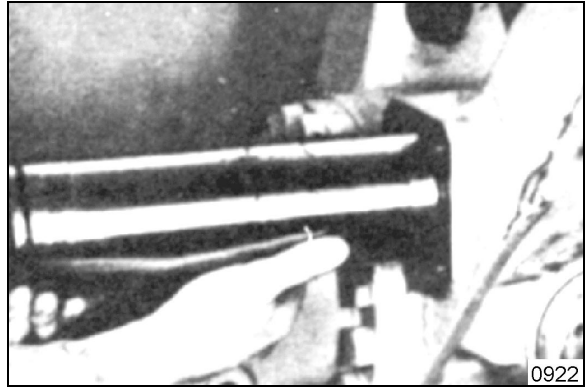


Figure 396

18. Install piston rod to cylinder.

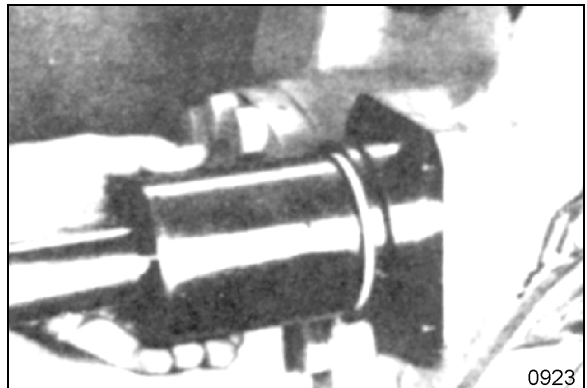


Figure 397

19. Measure length from piston guide and flange to cylinder and guide.

Example: A = 32.15 mm (1.266 in.)

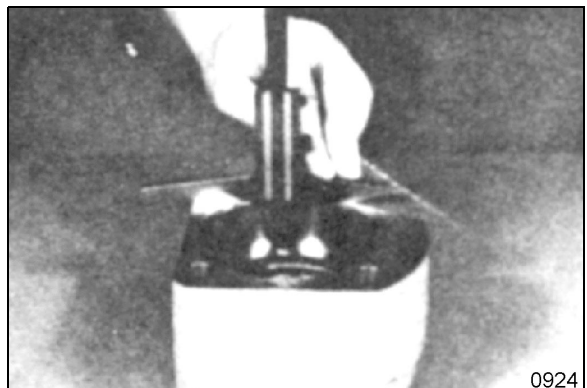


Figure 398

20. With cylinder all the way in housing, measure length between flange and cylinder

Example: B = 30.85 mm (1.215 in.)

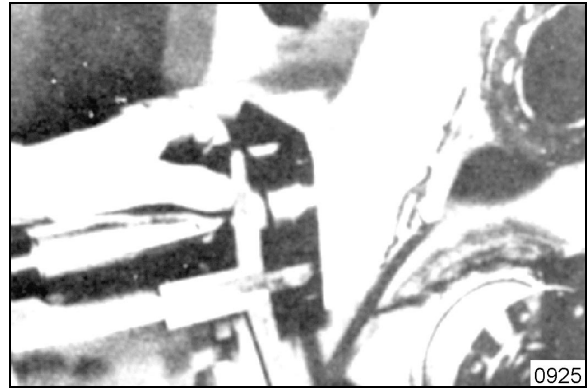


Figure 399

21. Determine washer by subtracting B from A. Apply grease to washer, and install to guide.



Figure 400

22. Install guide, cylinder and piston rod.

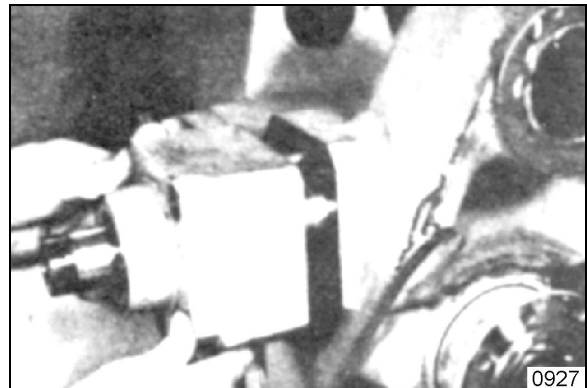


Figure 401

23. Tighten guide hex screw to 190 Nm (42.7 ft lb).

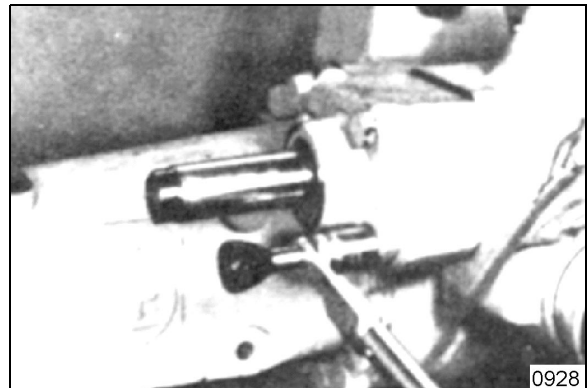


Figure 402

24. Tighten both tie rods and piston rod.

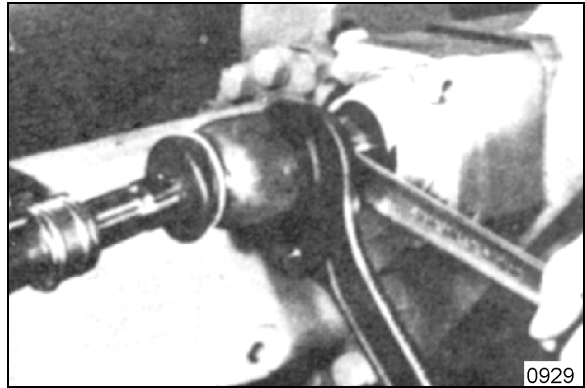


Figure 403

25. Apply Loctite 242 to two or three threads of each tie rod, being careful not to switch left and right tie rods.

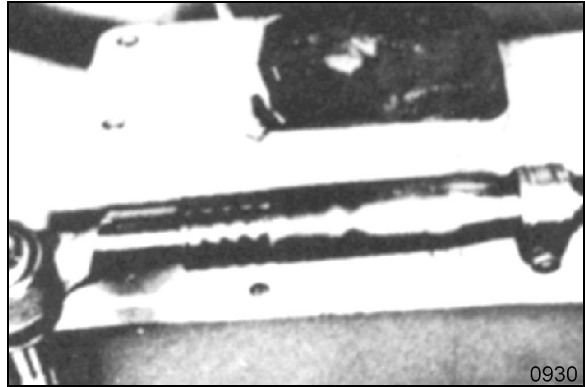


Figure 404

26. Tighten tie rods.

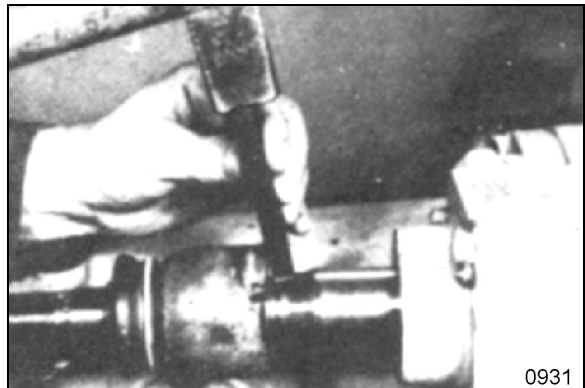


Figure 405

27. Tighten tie rod castle nuts.

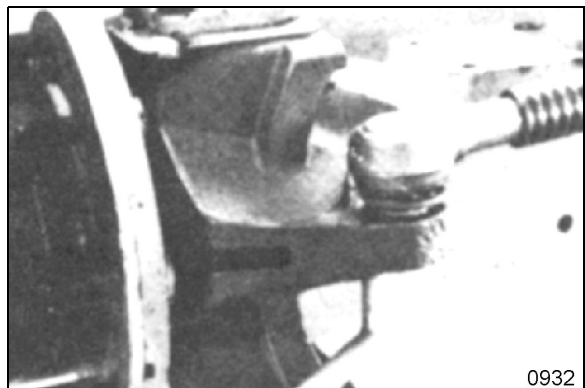


Figure 406

28. Center piston rod to adjust steering.

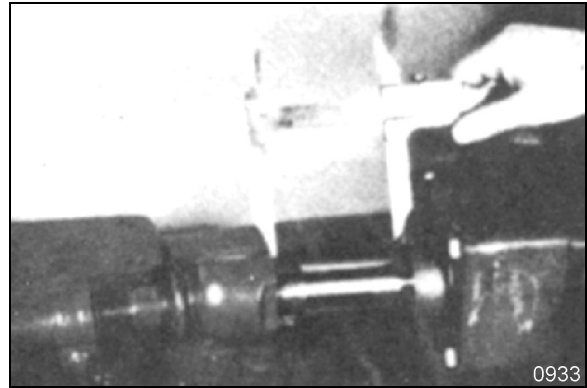


Figure 407

29. Adjust both sides.

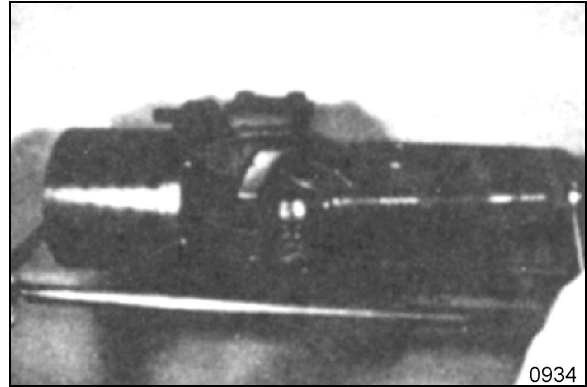


Figure 408



SERVICE BRAKE



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 130W-V	0001 and up

TABLE OF CONTENTS

Measuring Wear of Brake Disc.....	3
SpecialTool	3
When to Measure Brake Disc Wear	3
How to Measure Brake Disc Wear.	4
Maximum Allowable Value of "X" - "Y"	6

MEASURING WEAR OF BRAKE DISC

Measure brake disc wear in the following manner. If disc wear exceeds designated thickness, performance of brakes is reduced, defective parts, replace with new discs right away.

SPECIAL TOOL

1. Bolt for measuring brake disc wear is ZF part number 5870 204 051.

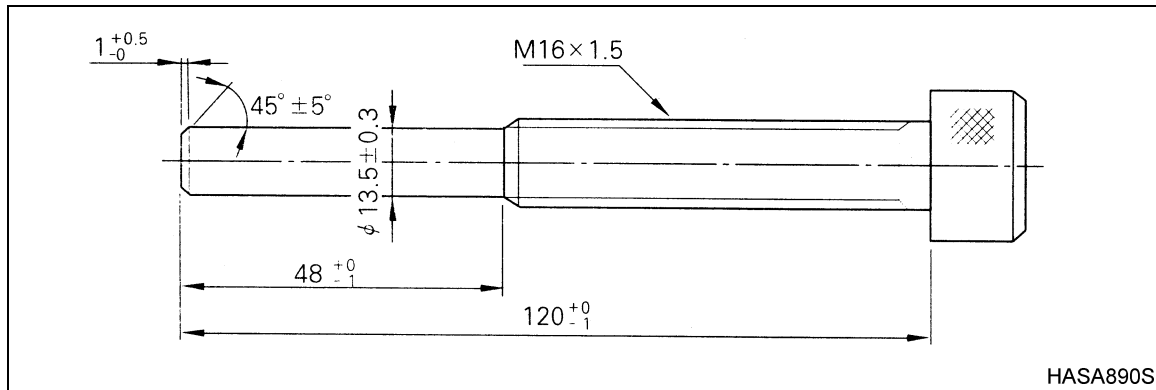


Figure 1

WHEN TO MEASURE BRAKE DISC WEAR

- Measure wear more than once a year.
- When abnormal sounds come out of brake.
- When brake performance is poor.
- When brake pressure falls below 60 kg/cm^2 (853.40 psi).

HOW TO MEASURE BRAKE DISC WEAR.

1. For measuring brake disc wear, first have plug "A" face upward, then remove. Plug "A" is (M16 x 1.5).

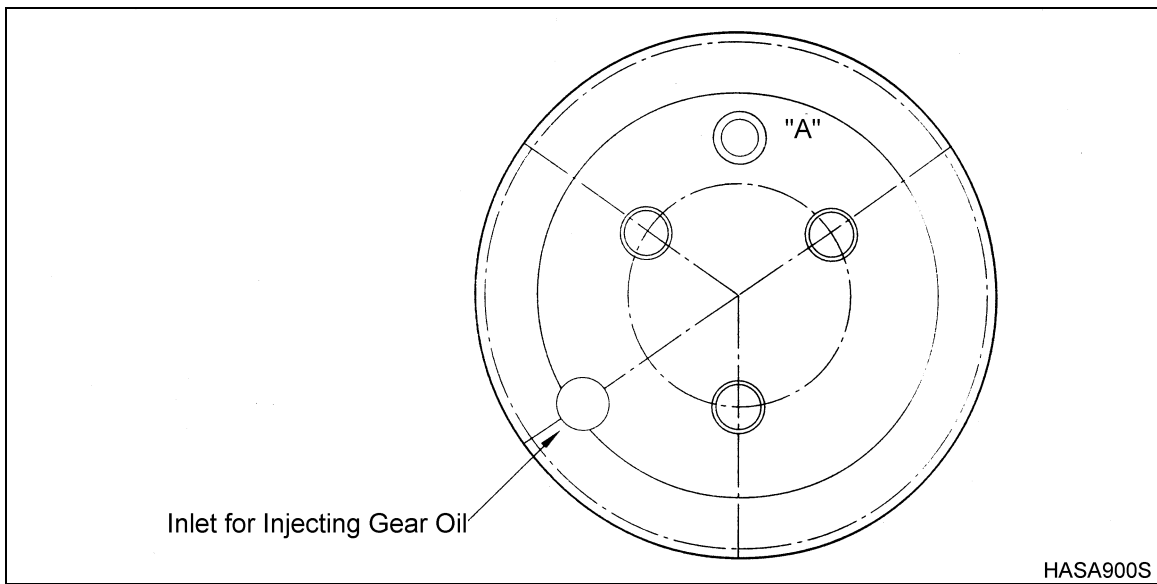


Figure 2

2. Depress brake pedal to actuate.
3. Insert bolt to measure amount of brake disc wear. Bolt should be inserted into hole that plug "A" was removed from, and tighten until bolt contacts plate "C". Torque to 10 N·m (1 kg·m) (7.23 ft.lb.).

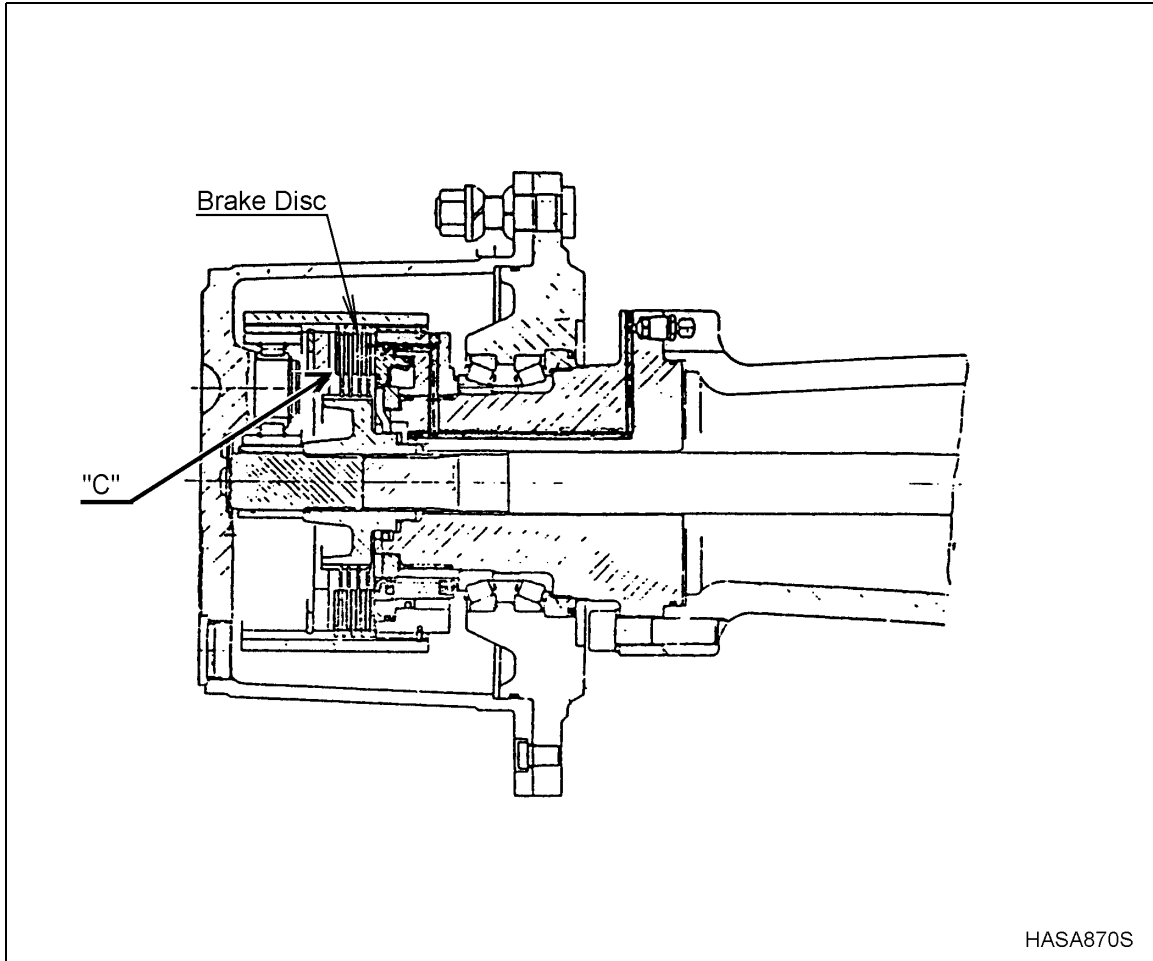


Figure 3

4. With brake engaged, measure distance "X", between outer side of planetary gear housing and edge of bolt.
5. Release brake and measure distance "Y", between outer side of planetary gear housing and edge of bolt.

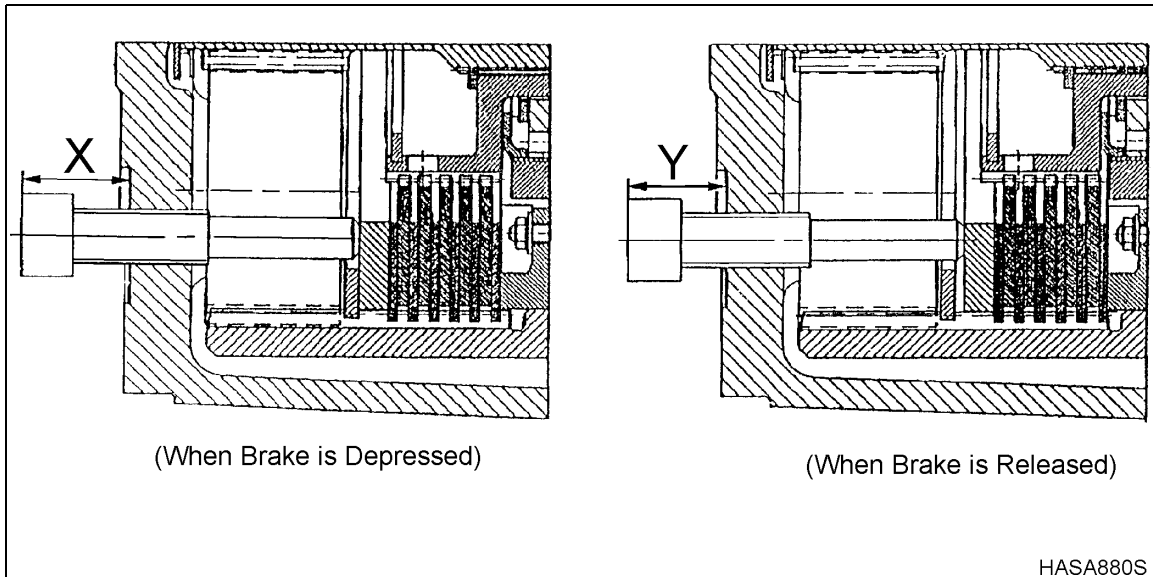


Figure 4

MAXIMUM ALLOWABLE VALUE OF "X" - "Y"

1. With "X" and "Y" values obtained in previous measurements, obtain the value of "X" - "Y". If this value exceeds 5.0 mm, replace brake discs with new.



CAUTION!

If the value of "X" - "Y" exceeds 5 mm, this means that brake is beyond its usable condition due to wear. Continued use may cause brake piston to breakaway, and brake oil to leak into hub, resulting in defective brakes.



S0605010
R1

AIR-CONDITIONER



CAUTION!

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

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

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

MODEL	SERIAL NUMBER RANGE
Solar 130LC-V	0001 and Up
Solar 130W-V	0001 and Up
Solar 220LC-V	0001 and Up
Solar 220LL	1001 and Up
Solar 290LC-V	0001 and Up
Solar 290LL	1001 and Up
Solar 330LC-V	1001 and Up
Solar 400LC-V	1001 and Up

TABLE OF CONTENTS

General Description.....	3
Refrigerant Circulation.....	4
Control Panel.....	6
Control Specifications.....	7
Temperature Level Control and Display.....	8
Air Discharge According to Path Selection.....	9
Air-conditioning System Circuit Diagram.....	12
Troubleshooting	14
Refrigerant System Repairs	17
Refrigerant Safe Handling Procedures	17
Repair and Replacement Procedure.....	18
Refrigerant Recovery	20
Vacuuming Refrigerant System.....	20
Leakage Check	21
Refrigerant Charging.....	22
Inspecting System For Leakage.....	24

GENERAL DESCRIPTION

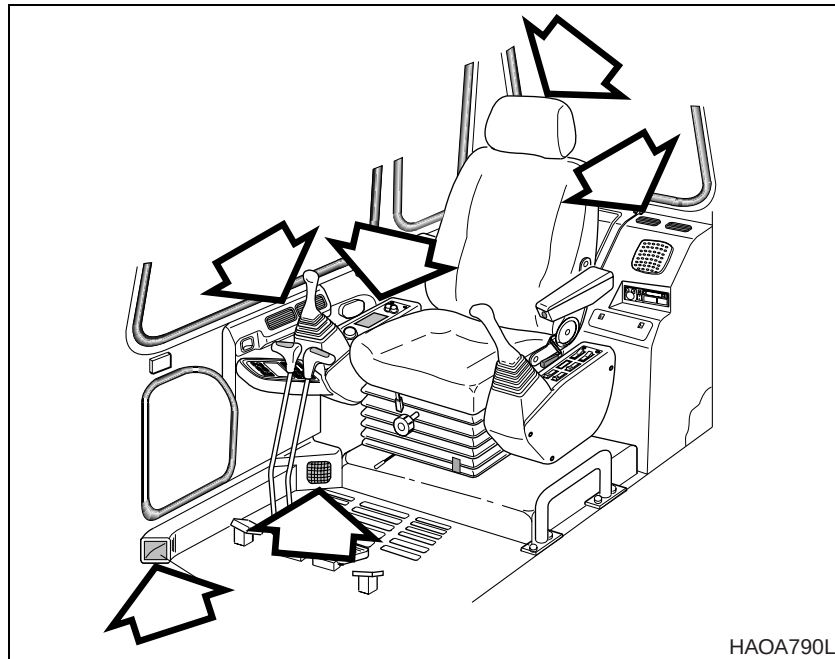


Figure 1

The heater and air-conditioner are combined into one blower unit located in the rear cover of operator's seat. If necessary, the operator can control inner temperature using the operation panel installed in the right control stand.

The unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cab. This filter (1, Figure 2) should be cleaned out at approximately every 500 hours and replaced with a new one every 1000 hours.

NOTE: *In the event that the unit is being operated in a dusty environment, cleaning and replacement should be performed more frequently.*



WARNING!

All service and inspection of the air conditioning system should be performed with the ignition switch in the "O" (OFF) position.

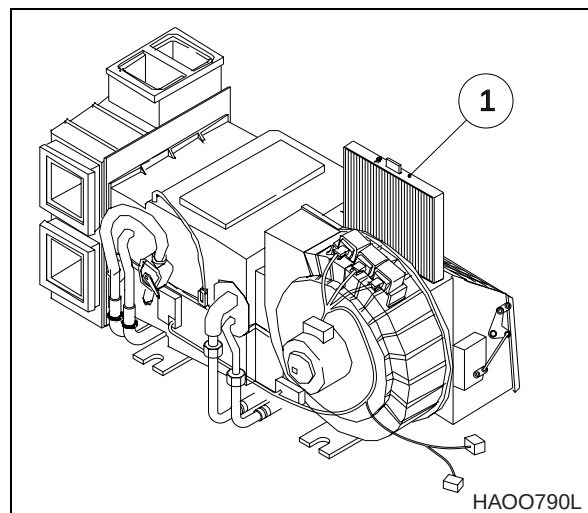


Figure 2

NOTE: *Refer to appropriate operation and maintenance manual for latest service intervals.*

REFRIGERANT CIRCULATION

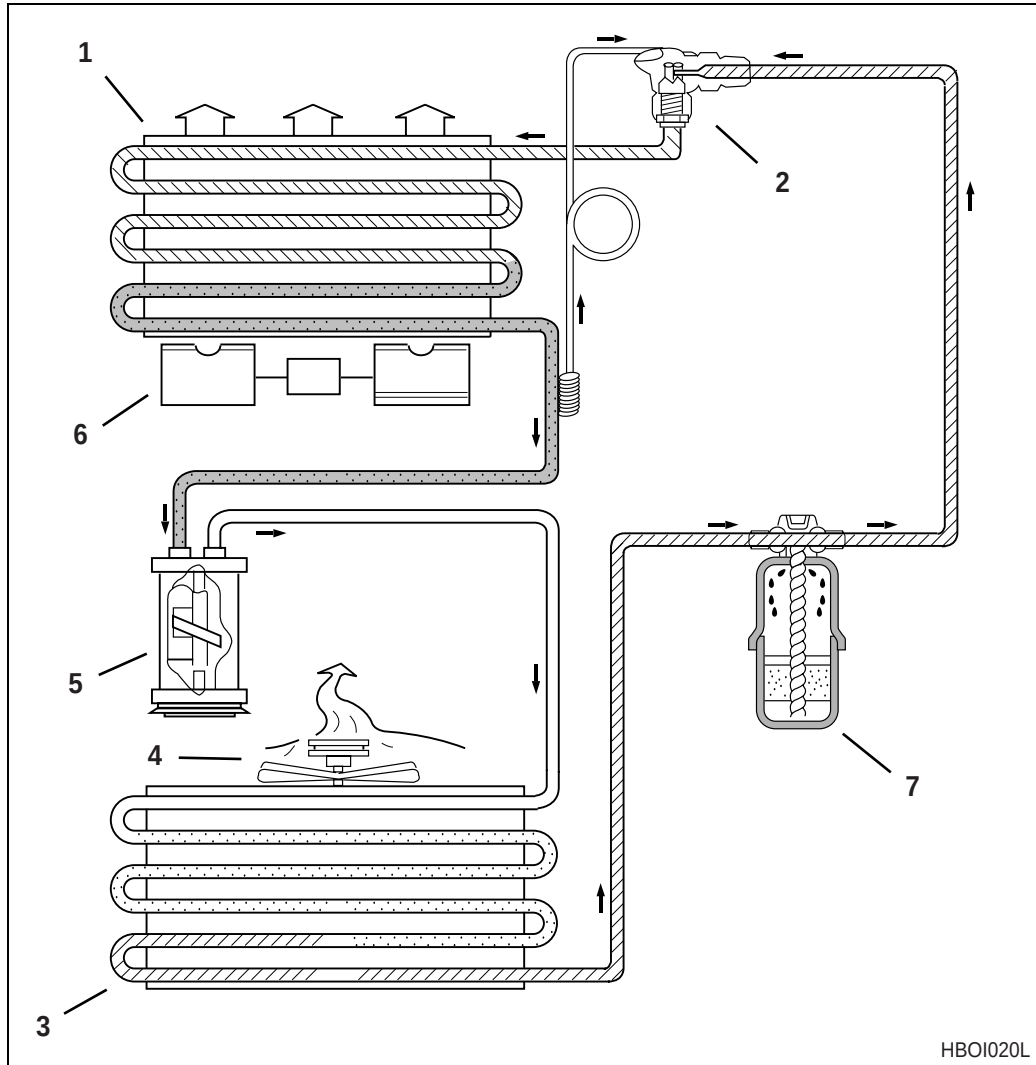
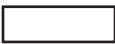


Figure 1

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 (213.35 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 (28.45 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

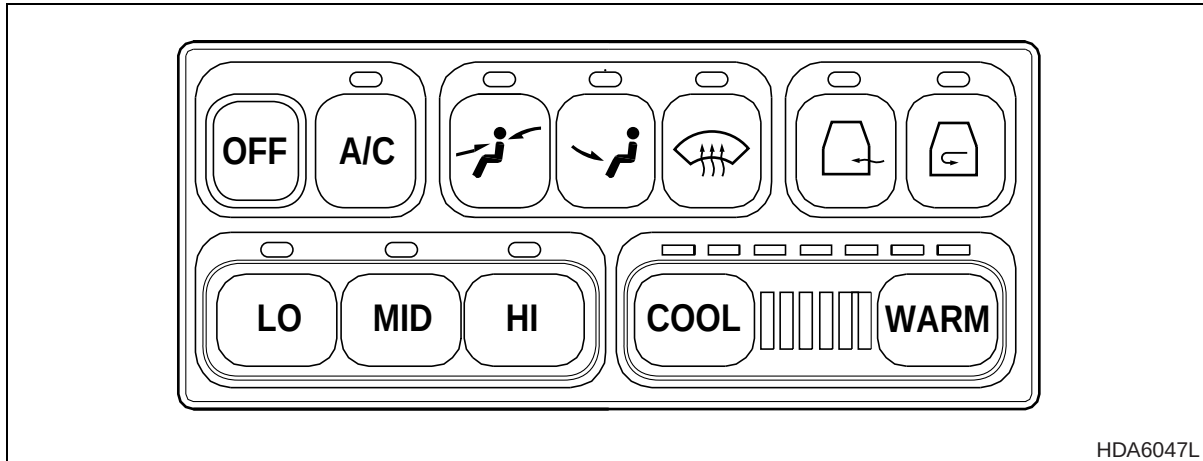


Figure 2

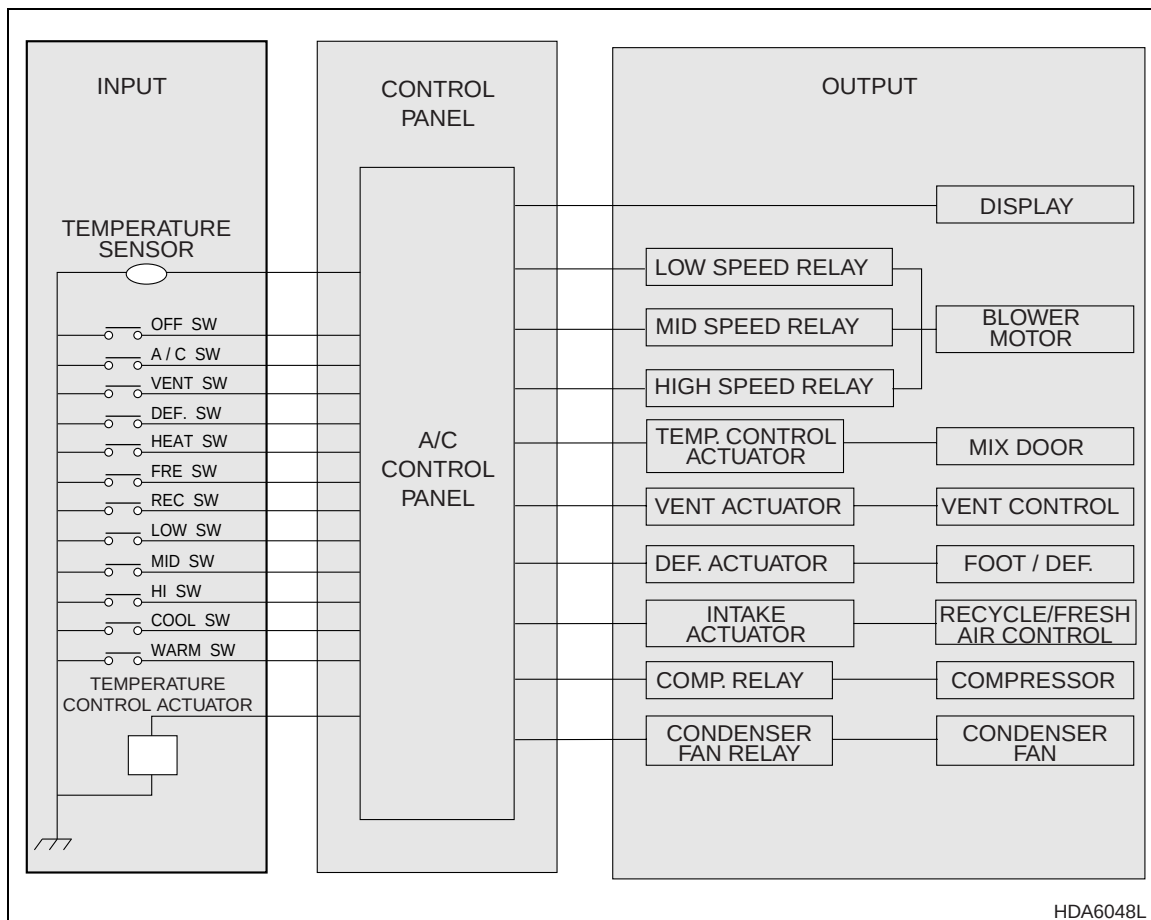
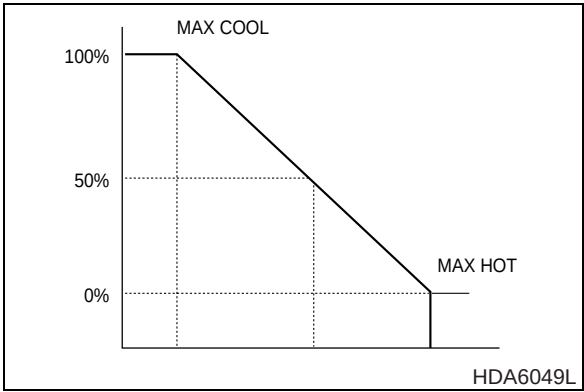
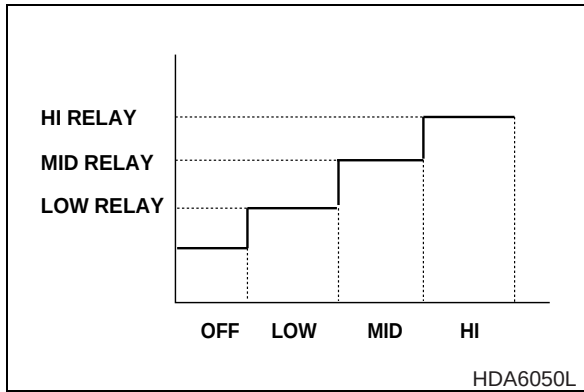
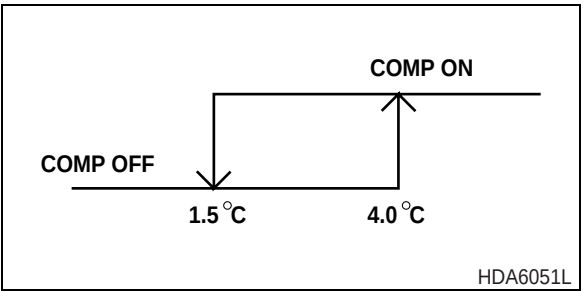


Figure 3

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

AIR DISCHARGE ACCORDING TO PATH SELECTION

Vent

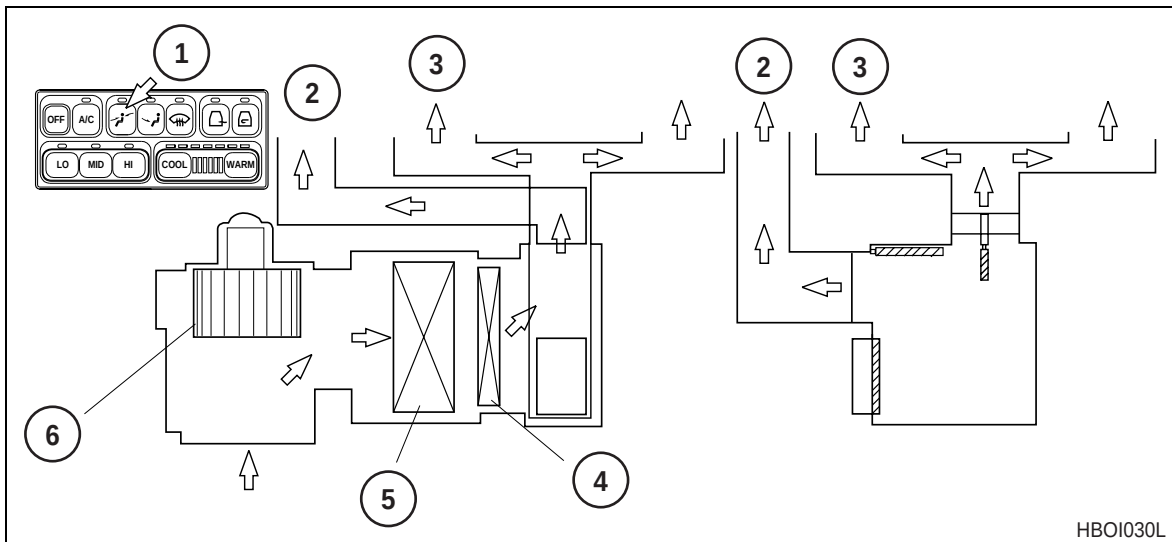


Figure 7

Reference Number	Description
1	Select Switch
2	Side Vent
3	Rear Vent

Reference Number	Description
4	Heater Core
5	Evaporator Core
6	Blower Motor

Foot

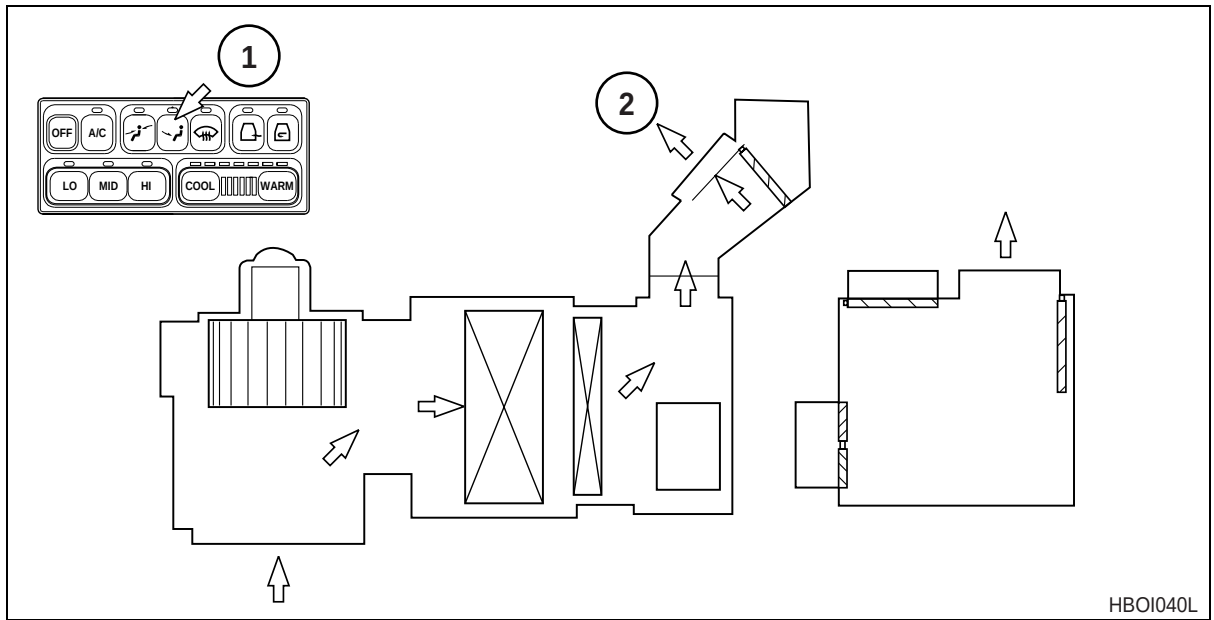


Figure 8

Reference Number	Description
1	Select Switch

Reference Number	Description
2	FootVent

Defroster

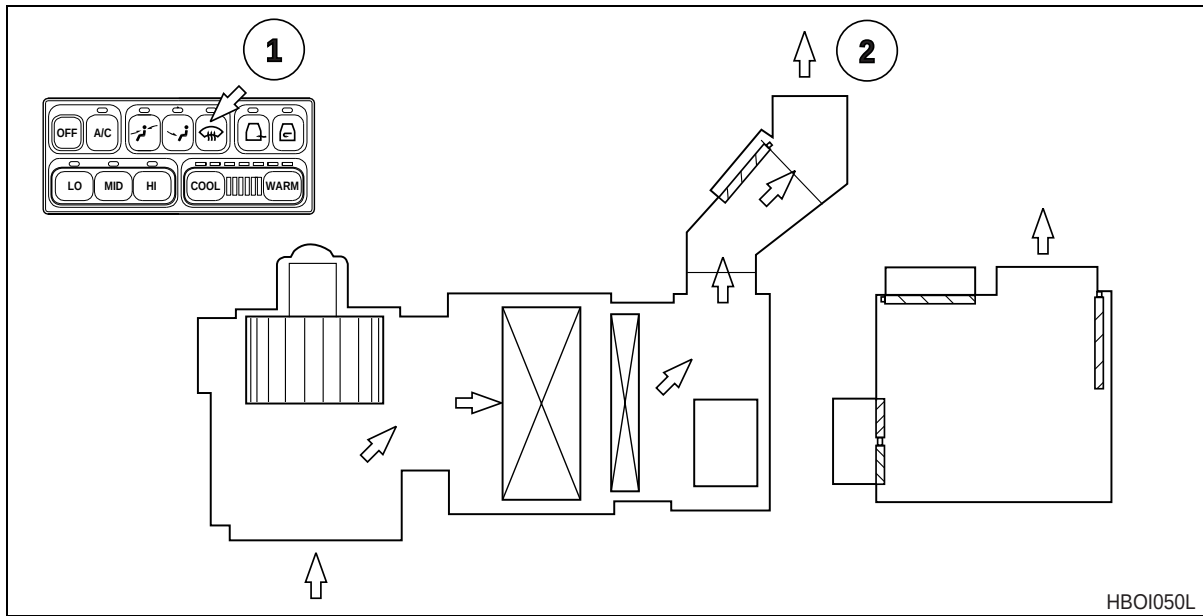


Figure 9

Reference Number	Description
1	Select Switch

Reference Number	Description
2	Defroster Vent

AIR-CONDITIONING SYSTEM CIRCUIT DIAGRAM

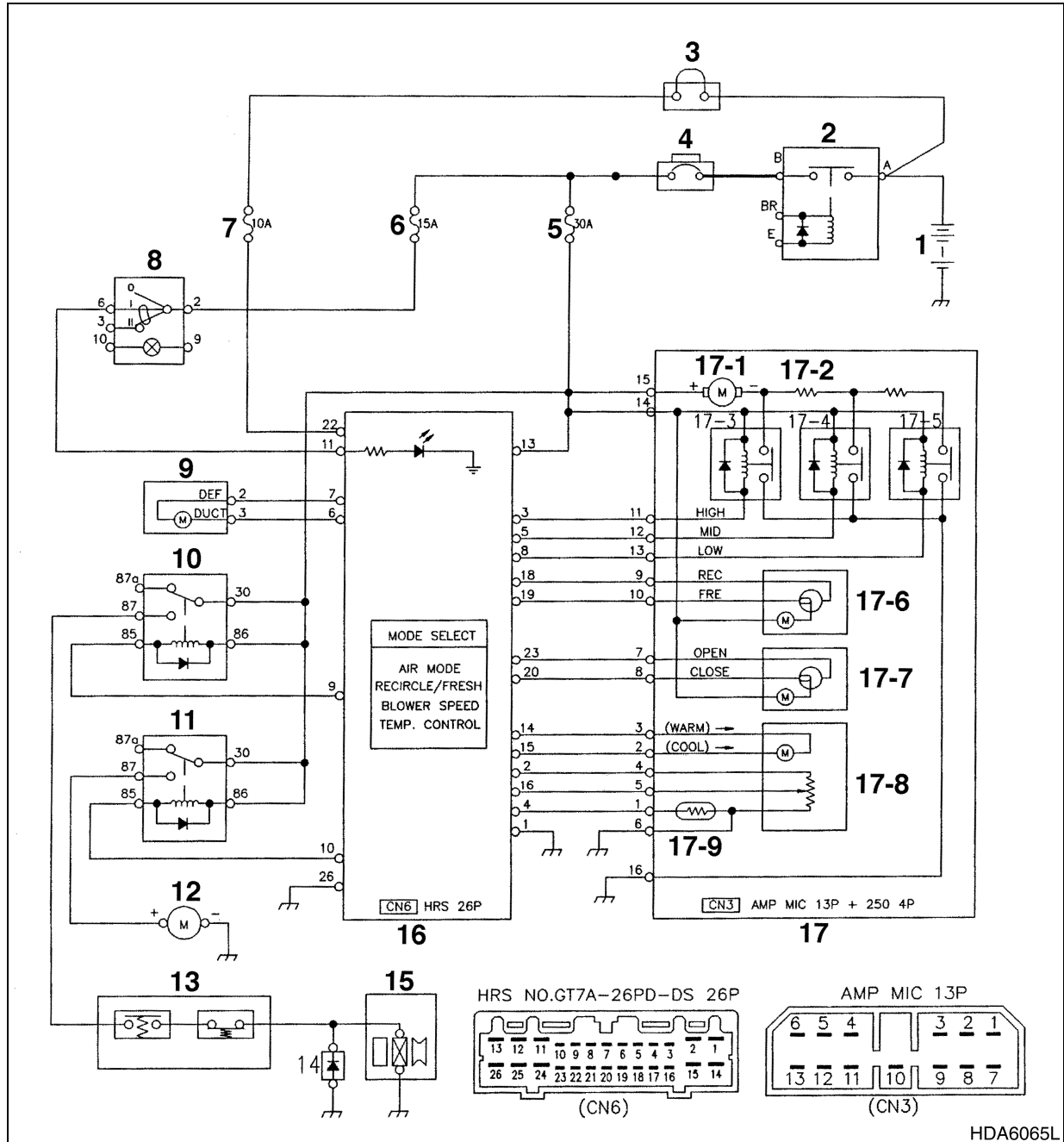


Figure 10

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

Reference Number	Description
15	Compressor
16	A/C Control Panel
17	A/C Unit
17-1	Blower Motor
17-2	Resister
17-3	High Speed Relay
17-4	Mid Speed Relay
17-5	Low Speed Relay
17-6	Recirculate / Fresh Air Control Actuator
17-7	Vent Actuator
17-8	Temperature Control Actuator
17-9	Temperature Sensor (Evaporator)

TROUBLESHOOTING

Refrigerant Pressure Chec

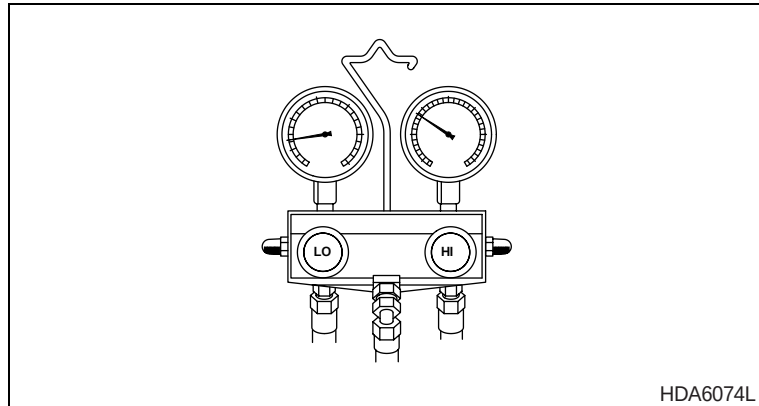


Figure 11

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/c 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 (35.56 - 42.67 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/cm² (284.47 - 355.58 psi) Low Pressure: Approximately 2.5 - 3.5 kg/cm² (35.56 - 49.78 psi)
Possible Cause: Air in system.	
1. Recover any remaining refrigerant. 2. Vacuum out system. 3. Recharge system. NOTE: <i>If the system has been exposed to the air for a long period of time, replace the receiver dryer.</i>	

4	High Pressure: Over 6 kg/cm² (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.	Yes	Moisture in system, replace receiver dryer.
	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)	No	Contaminated system, replace expansion valve. (Replace evaporator core assembly.)

5	High Pressure: Over 6 - 18 kg/cm² (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: <i>When the absorbed moisture freezes the pressure readings may look normal. Careful readings should be made to determine whether pressure is in normal range.</i>	
1. Recover any remaining refrigerant. 2. Vacuum out system. 3. Recharge system. NOTE: <i>If the system has been exposed to the air for a long period of time, replace the receiver dryer.</i>	

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/cm² (100 - 156 psi) Low Pressure: 4.0 - 6.0 kg/cm² (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

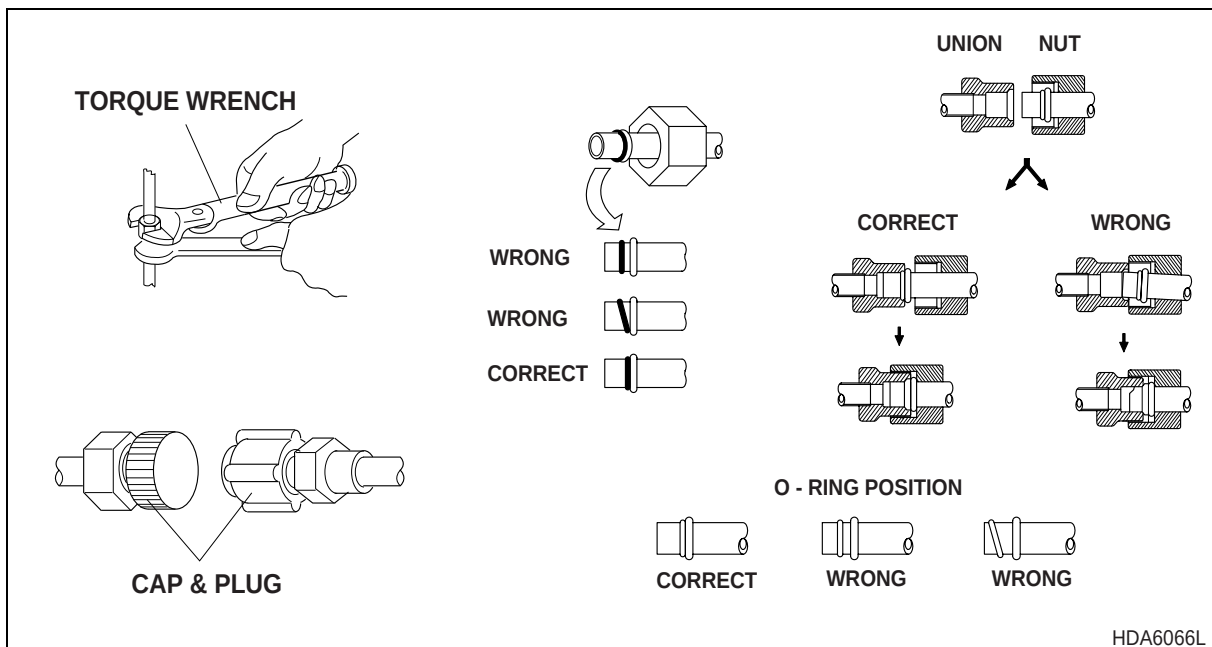


Figure 12

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.*

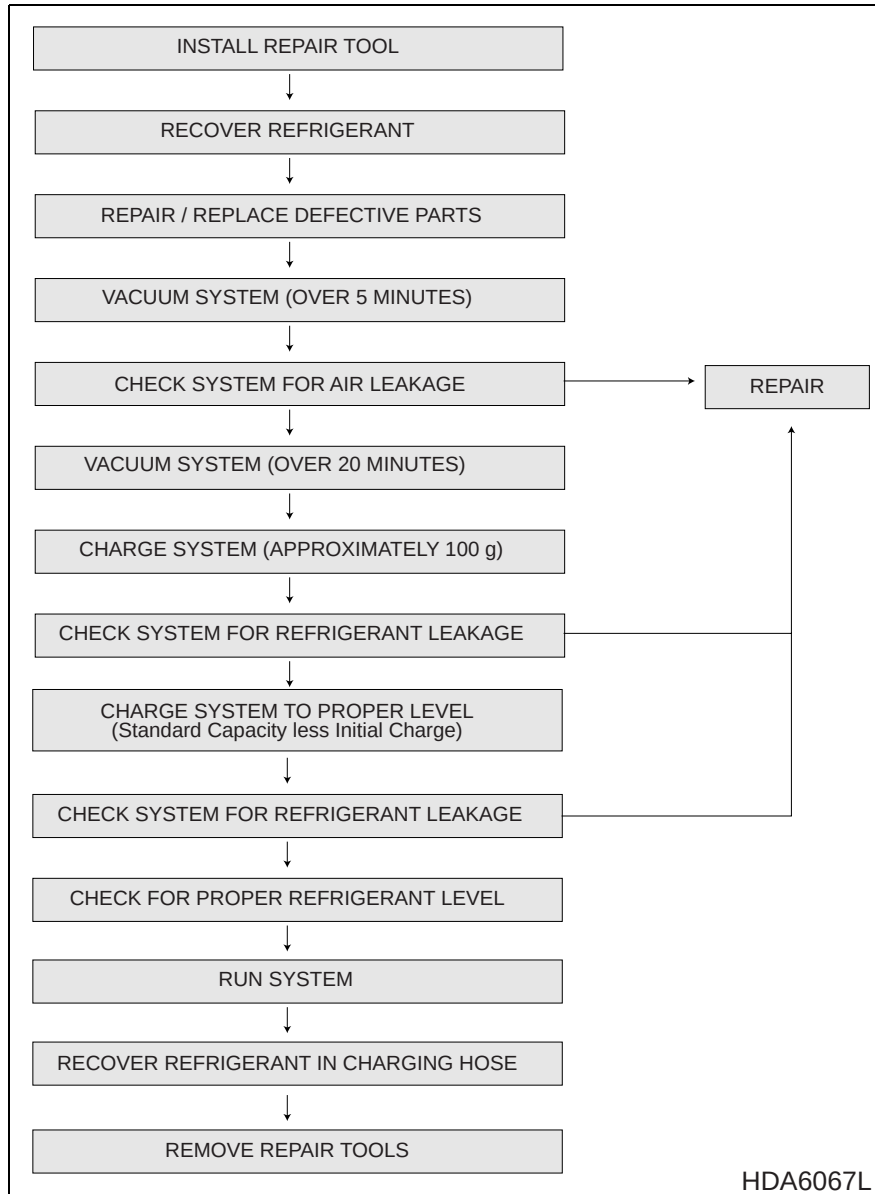


Figure 13

REFRIGERANT RECOVERY

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

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/cm² (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/cm² (0 psi).

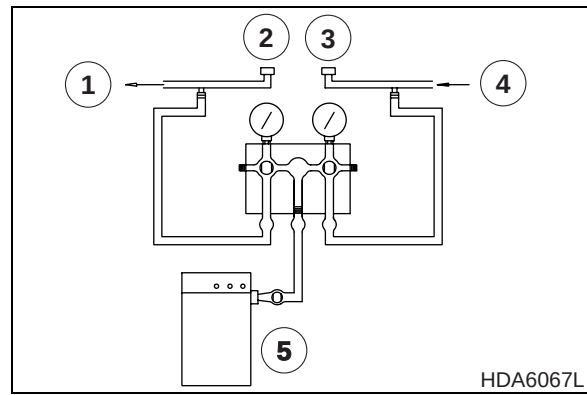


Figure 14

VACUUMING REFRIGERANT SYSTEM

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

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.

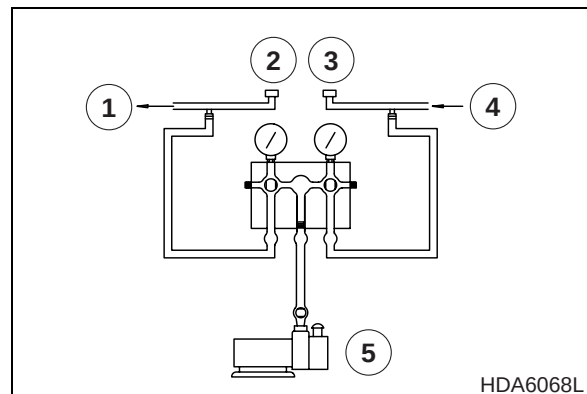


Figure 15

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.

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

- 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.

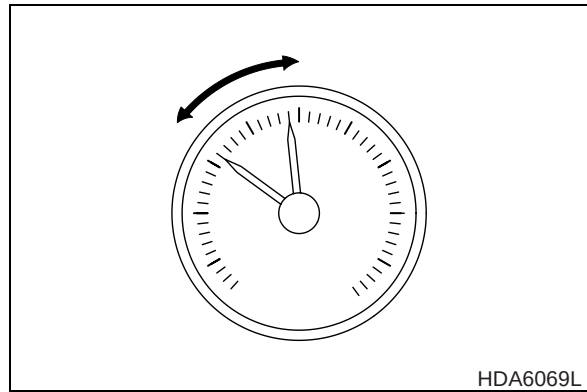


Figure 16

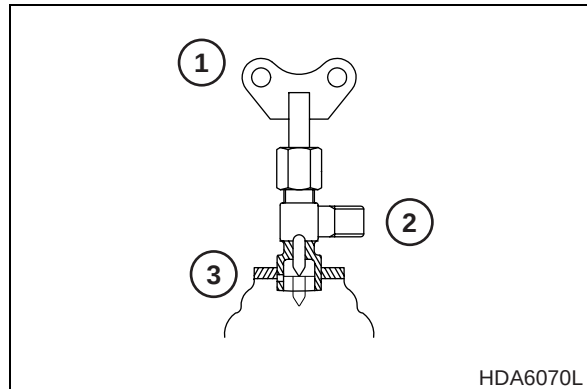


Figure 17

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/cm² (14.22 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.

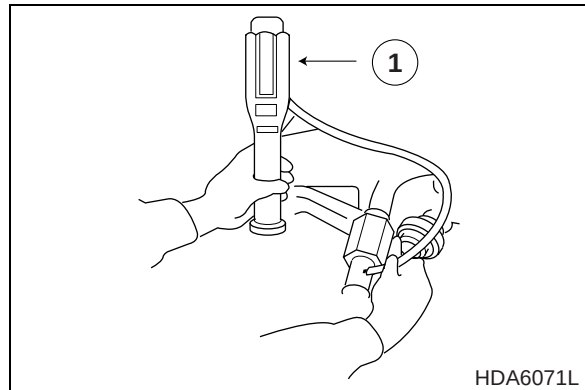


Figure 18



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

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)

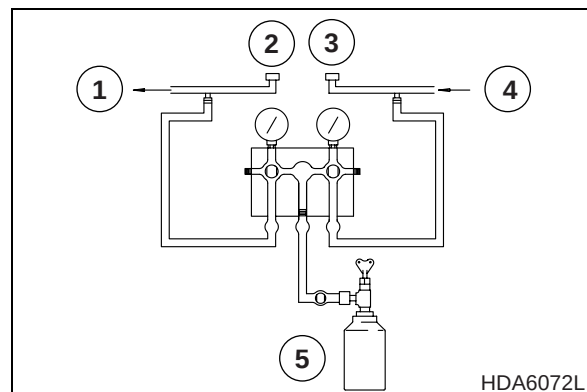


Figure 19

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 (184.90 - 284.47 psi)
Low Side Gauge	1.5 - 3.5 kg/cm ² (21.34 - 49.78 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 LEAKAG

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.*

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

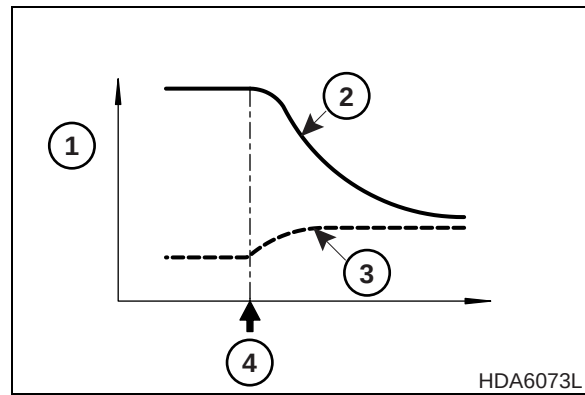


Figure 20

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.*

HYDRAULICS



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 130W-V	0001 and Up

TABLE OF CONTENTS

Hydraulic System - General Notes	4
Hydraulic Schematic.....	5
General Notes	5
Operation of Working Components	6
Boom Operating Circuit	6
Boom Up Circuit	6
Boom Down Circuit	6
Arm Operating Circuit	7
Arm Crowd Circuit.....	7
Arm Dump Circuit.....	7
Bucket Operating Circuit	8
Bucket Crowd Circuit.....	8
Bucket Dump Circuit	8
Swing Operating Circuit	9
Right Swing Operating Circuit.....	9
Left Swing Operating Circuit	9
Swing Relief Valve and Make-up Valv	9
Procedural Troubleshooting Baseline Recommendations	10
Initial Checks and Tests to Establish Operating Condition of the Excavator	10
Pilot Pressure	11
Adjustment and Testing	11
Power Mode Valve	12
Current Signal and Hydraulic Pressure Adjustments	12
Boom/Swing Priority Valv	13
Control Valve Pressure and Current Adjustments.....	13
Pressure Up Valv	15
Checks and Adjustments	15
Pump Input Power Control	16
Pump Regulator Adjustment	16

Flow Meter and Flow Meter Kit Installation and Testing	18
Swing System Troubleshooting	19
Precautions/Initial Chec	19
Swing Relief Valve Checking and Adjustment.....	20
Troubleshooting – Swing Gearbox.....	21
Troubleshooting – Hydraulic Problems	22
Troubleshooting – Control Valv	24
Troubleshooting – Joystick Control Valve	25

HYDRAULIC SYSTEM - GENERAL NOTES

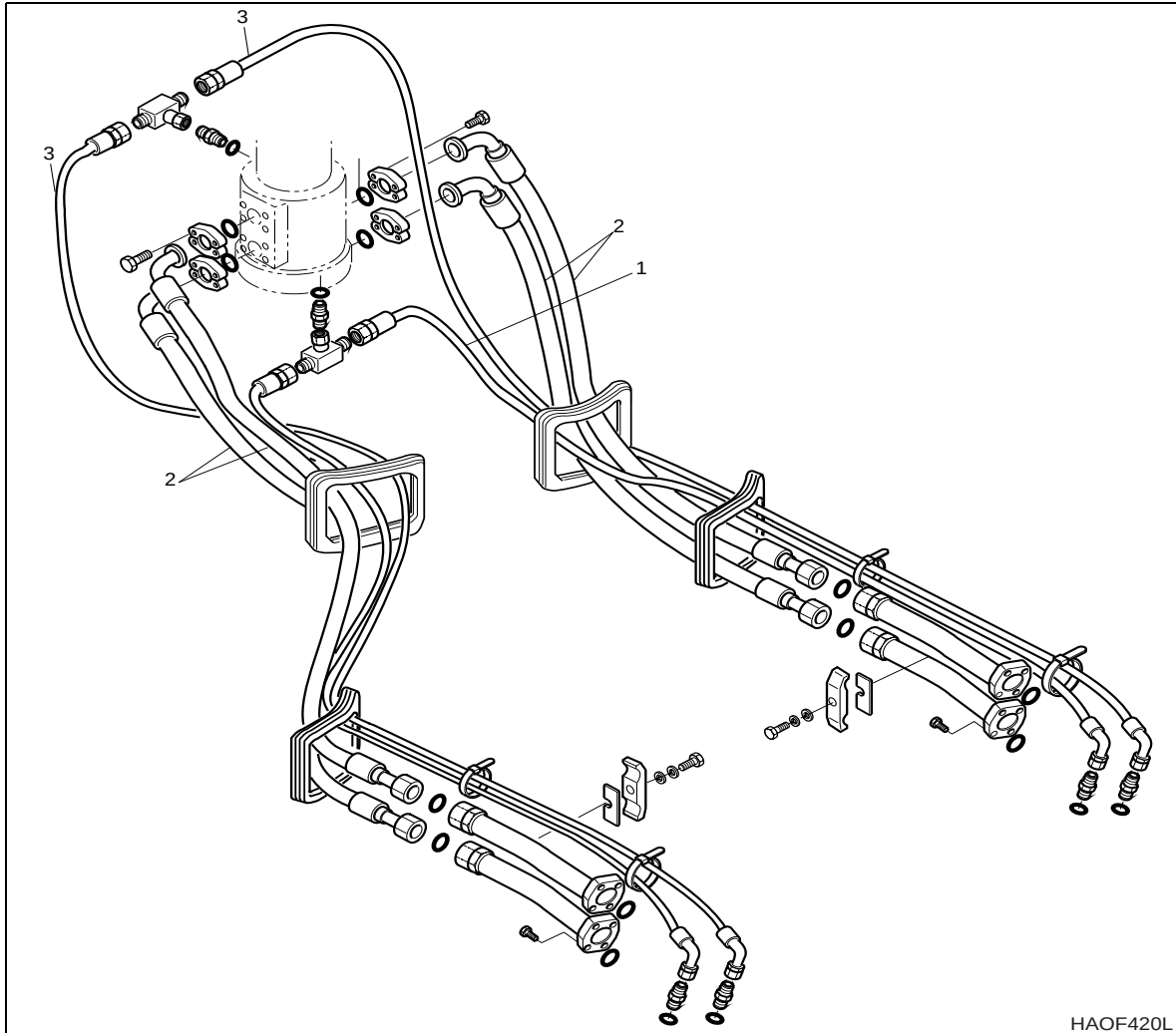


Figure 1

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 Electrical Schematic Shop Manual." This manual is a collection of diagrams and schematics for a number of models.

GENERAL NOTES

When referring 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, boom, bucket 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, swing, boom up and arm operation.
- Two-stage operation is a feature of boom, arm and bucket function. All three 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 three available power modes – the standard or general duty mode, the high speed/rapid cycling mode, or the low noise/high fuel efficiency 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. The arm cylinder circuit is 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 to 6 kg/cm sq. (57 to 85 psi), boom control valve spools open and oil from both pumps goes to the boom cylinder.

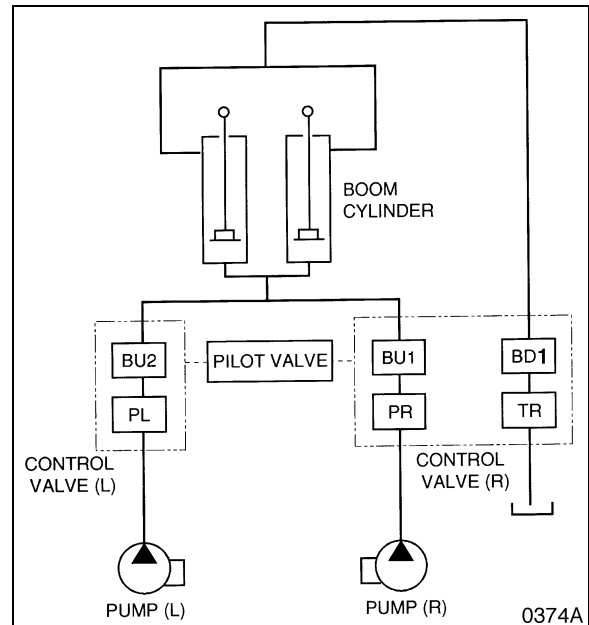


Figure 2

BOOM DOWN CIRCUIT

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

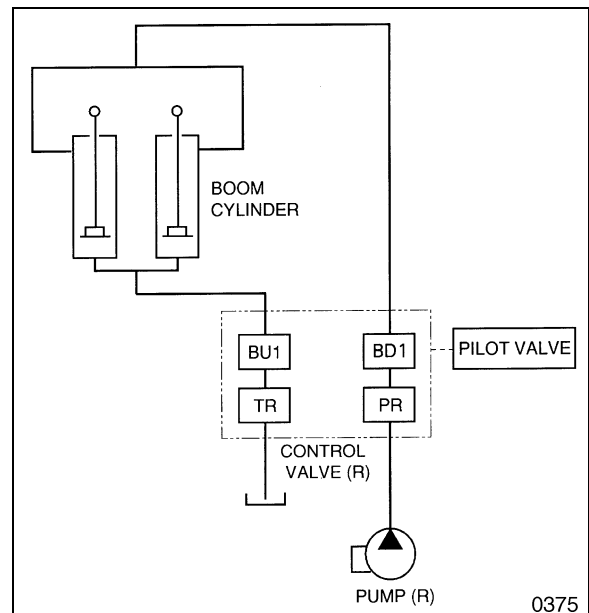


Figure 3

ARM OPERATING CIRCUIT

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

Overload relief valves set at 360 kg/cm sq.(5,112 psi) have been installed at the **AC 1** and **AD 1** ports on the left 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 to 6 kg/cm sq. (57 to 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.

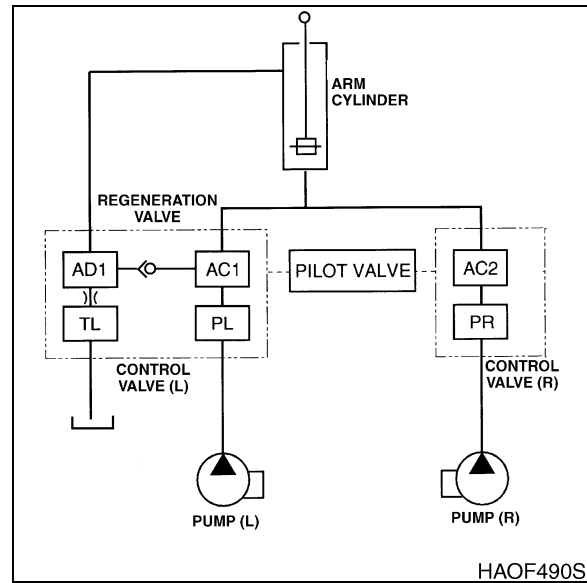


Figure 4

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

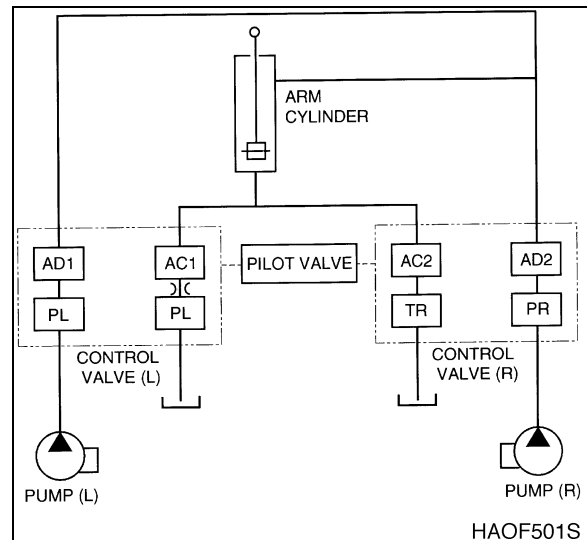


Figure 5

BUCKET OPERATING CIRCUIT

The bucket operating circuit includes the right and left main pumps, the right and left halves of the control valve and the bucket cylinder. 360 kg/cm² (5,112 psi) overload relief valves located at **BKC** and **BKD 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 right side of the control valve opens and oil from both main pumps flows to the bucket cylinder

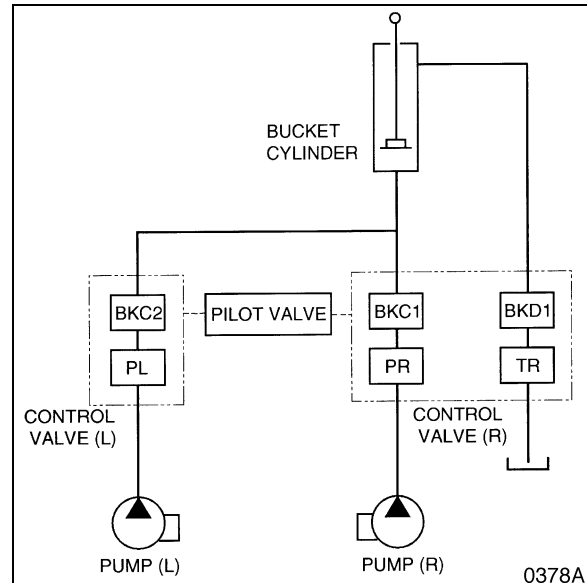


Figure 6

BUCKET DUMP CIRCUIT

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

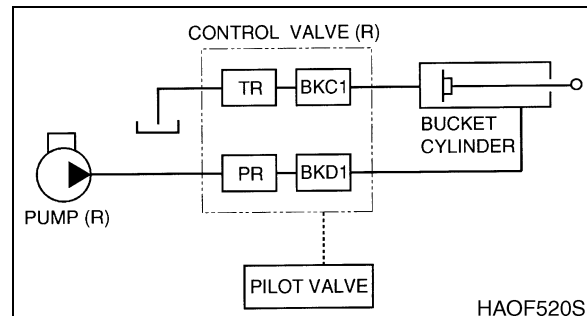


Figure 7

SWING OPERATING CIRCUIT

The swing operating circuit consists of the left main pump in the pump assembly, the left 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 pump regulator and left half of the control valve. Output flow from the left pump is then directed through the PSR and SR ports of the control valve to the SR port of the swing motor.

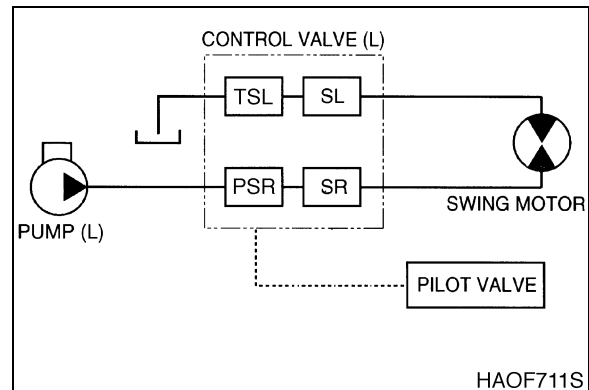


Figure 8

LEFT SWING OPERATING CIRCUIT

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

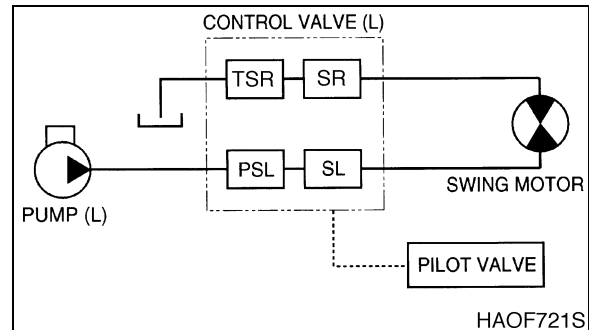


Figure 9

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 270 kg/cm sq. (3,840 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.

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 2,000 RPM with no load
- at 2,000 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



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 $\pm$ 5 bar (580 $\pm$ 73 psi)	23.5 $\pm$ 1.5 bar (341 $\pm$ 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: 1,900 RPM	600 ±20 mA Mid-range value corresponding to engine RPM for both current and hydraulic pressure readings.	29 ±4 bar (421 ±58 psi)
Power Mode II	1,750 RPM	0 mA	0 bar (0 psi)
Power Mode I	1,600 RPM	0 mA	0 bar (0 psi)

BOOM/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.

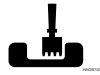
The arm speed down and swing priority control valves are located inside the compartment behind the cabin.

The same jumper harness used for testing the power mode (EPOS) control valve is used to test these two valves. 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 arm speed down solenoid valve, connect test equipment and begin testing with the work mode switch set to "Leveling" and the engine speed control dial at the maximum RPM position.

Operate the arm cylinder in both directions. Measure signal current and hydraulic pressure through the valve and record the highest and lowest values as the cylinder is extended and retracted several times. Reset the work mode control to "digging" mode, and then to "trenching" mode and repeat the same tests, extending and retracting the arm cylinder several times and recording highest and lowest values.

VALVE FUNCTION	LEVELING MODE 		DIGGING MODE 		TRENCHING MODE 	
	VOLTAGE	PRESSURE	VOLTAGE	PRESSURE	VOLTAGE	PRESSURE
Arm Speed Down (AM)	20 - 30 V	20 - 40 bar (290 - 580 psi)	0 V	0 bar (0 psi)	0 V	0 bar (0 psi)
Swing Priority (SP)	0 V	0 bar (0 psi)	0 V	0 bar (0 psi)	20 - 30 V	20 - 40 bar (290 - 580 psi)
Arm Priority (AP)	0 V	0 bar (0 psi)	0 V*	0 bar* (0 psi*)	0 V	0 bar (0 psi)
* A dip switch located in the instrument panel, can be set for either export or domestic markets. If a 20 - 30 V / 20 - 40 bar (290 - 580 psi) reading is obtained, the switch is set for a domestic market and must be reset to export. See Figure 10.						

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

Dip Switch Setting (Export / Domestic)

A set of dip switches is located inside the instrument panel. These switches are used to configure the instrument panel for the model of machine and market place it is being used in.

Switch 4, in the set is used to control the arm priority (AP) setting for either export or domestic markets.

A decal located on the back of the panel explains the various setting combinations.

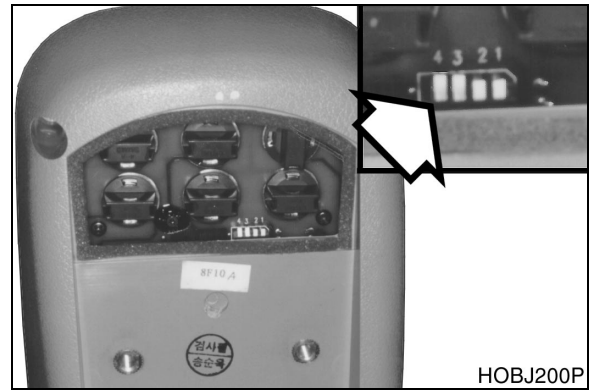


Figure 10

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 & Tolerance	Pilot Pressure & Tolerance
Mode III	Neutral, No Operation	20 To 40 Bar (290 To 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 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.

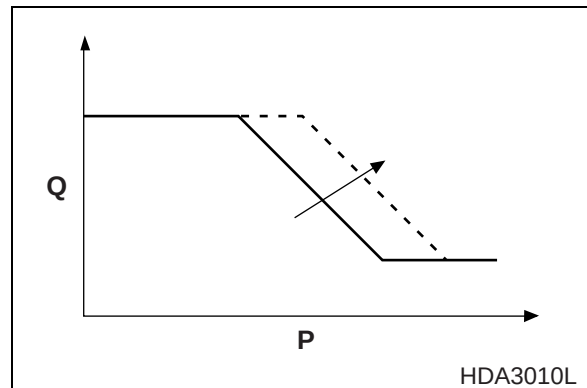


Figure 11

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.

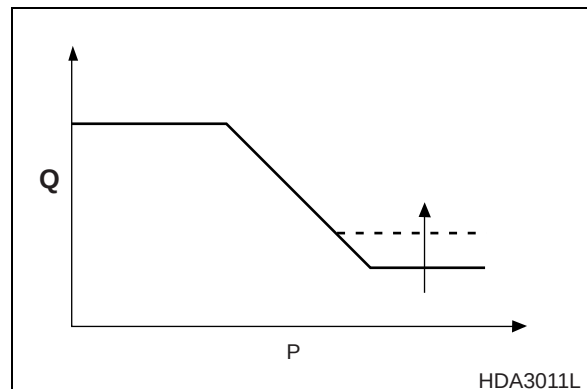


Figure 12

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 while backing out the screw increases cut flow delivery rate.

Balance both pumps for equal output.

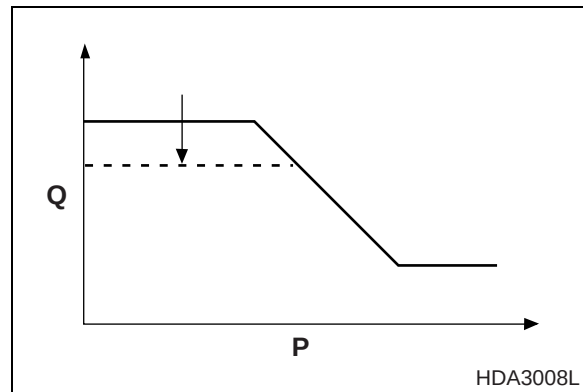


Figure 13

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/cm ² (1,422 psi)	
	135 kg/cm ² (1,930 psi)	
	180 kg/cm ² (2,560 psi)	
	240 kg/cm ² (3,413 psi)	
	330 kg/cm ² (4,785 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/cm² (4,785 psi), not 350 kg/cm² (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 265 and 285 bar (3,843.56 psi and 4,133.64 psi), with both swing locks engaged. With swing locks released, during full acceleration and deceleration, pressure should approach 275 bar (3,988.60 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 GEARBO

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.
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.

Problem	Possible Causes	Remedies
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

Problem	Possible Causes	Remedies
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.
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

Problem	Possible Causes	Remedies
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
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

Problem	Possible Causes	Remedies
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 – 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.		



ACCUMULATOR



CAUTION!

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

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

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

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

TABLE OF CONTENTS

General Description.....	3
Specifications	4
Accumulator Charging.....	5
Charging the Accumulator with Nitrogen.....	5

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	Sealing Ring
3	Diaphragm
4	Fluid Valve
5	Steel Pressure Vessel

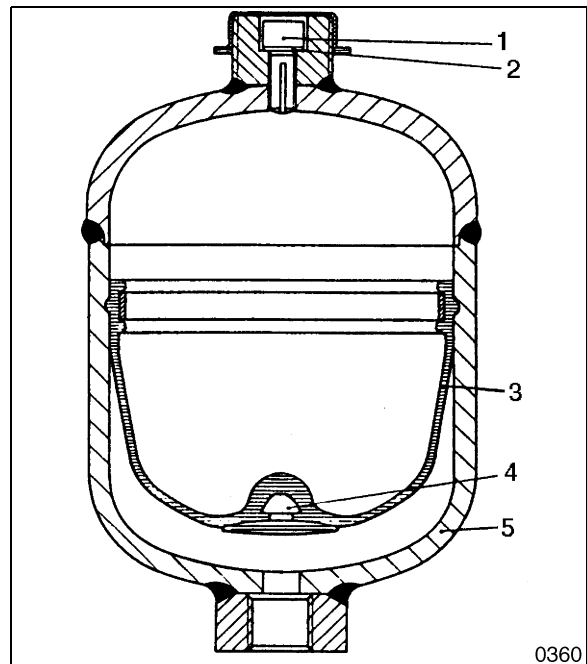


Figure 1

Accumulators are solidly constructed to resist the high operating pressures of the fluids they contain. There are only three main moving parts: a valve assembly at the top allows adding 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 valve 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.

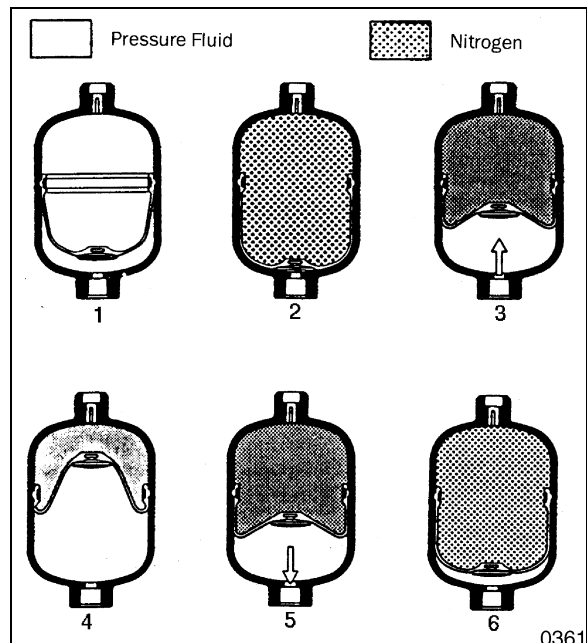


Figure 2

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		
Specifications	Models	
	Solar 130LC-V Solar 130W-V Solar 220LC-V Solar 220LL Solar 220N-V Solar 290LC-V Solar 290LL Solar 330LC-V Solar 400LC-V	Mega 250-III Mega 200-III Mega 400-III PLUS
Nitrogen Charge:	15 kg/cm ² (213 psi)	30 kg/cm ² (427 psi)
Volume:	320.0 cc (19.53 cu. in.)	

ACCUMULATOR CHARGING



WARNING!

In the event of a diaphragm or upper valve failure, or any type of accident or handling fault, the upper chamber of the accumulator could at some point require re-pressurization. Depending upon the specific procedures and safety precautions recommended for the type and model accumulator that has been installed on your excavator, a specialized adapter and/or filling tool may be required to perform the procedure. Consult your dealer or Daewoo After Sales Service for more information and follow recommended procedures carefully. All accumulators may contain gas held under high pressure. Careless handling or improper disassembly could release explosive stored energy, resulting in an accident or injury.

NOTE: Some excavators use 320 cc (19.53 cu. in.) Bosch Accumulators with a nitrogen precharge (P1) pressure of 15 kg/cm². (213 psi). Always verify pre-charge pressure by checking the manufacturer's data label on the exterior of the accumulator.

CHARGING THE ACCUMULATOR WITH NITROGEN

1. Remove the protective cap (10, Figure 3) and the protective plug (11) from the accumulator (6).

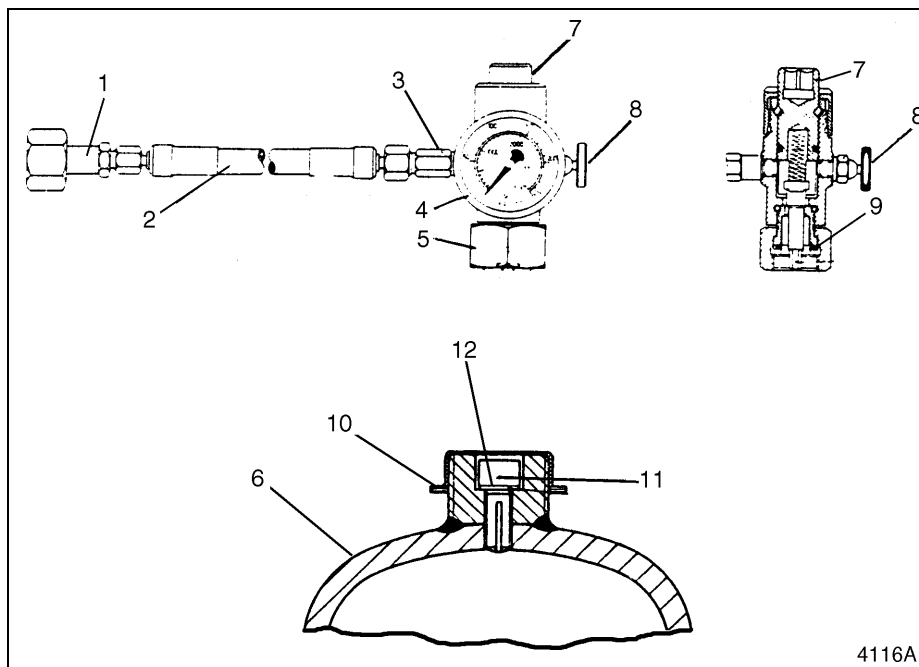


Figure 3

Reference Number	Description
1	Nitrogen Cylinder Fitting
2	Hose, 3 Meters (10 ft.) Long
3	Check Valve
4	Pressure Gauge
5	Sealing Nut
6	Accumulator

Reference Number	Description
7	Cylinder to Accumulator Adapter
8	Nitrogen Bleeder Valve
9	Nut O-ring
10	Protective Cap
11	Protective Plug
12	Sealing Ring

2. Clean area around seal ring (12).
3. Thread the sealing nut (5, Figure 3) of adapter (7) onto accumulator. Tighten adapter securely. Close nitrogen bleeder valve (8).
4. Thread nitrogen cylinder fittings (1, Figure 3) onto nitrogen cylinder.
5. Open valve on nitrogen cylinder and charge accumulator to a appropriate pressure (P1). Close valve on nitrogen cylinder.
NOTE: Wait 2 or 3 minutes for nitrogen to warm to ambient temperature. This will stabilize pressure
6. Slowly open nitrogen bleeder valve (8). Open valve (8) until gauge (4) reading is equal to primary pressure. Close bleeder valve.
7. Unscrew adapter (7, Figure 3) from accumulator (6).
8. Thread protective plug (11, Figure 3) into accumulator. Tighten to 3.0 kg•m (22 ft. lbs.).
9. Check for nitrogen leaks around protective plug (11, Figure 3). Coat area around protective plug (11) with soapy water. If soap bubbles form, retighten protective plug (11).
10. Install protective cap (10, Figure 3) on accumulator.



WARNING!

Accumulator store nitrogen under high pressure. Before replacing an accumulator, install an adapter (7) with a bleeder valve (8) on the accumulator. Slowly and carefully bleed off all nitrogen before removing the accumulator from the hydraulic system.

NOTE: After an accumulator has been installed, or after an accumulator has been recharged with (P1) after the first week of operation. Check for a pressure drop due to leaks. If no pressure drop is found after the first week, check again after 3 more weeks. If no pressure drop is found after 3 weeks, check after one year.



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 130LC-V	0001 and Up
Solar 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Parts List	4
Troubleshooting, Testing and Adjustment.....	5
Inspection.....	5
Testing	5
Disassembly	6
Reassembly.....	7

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

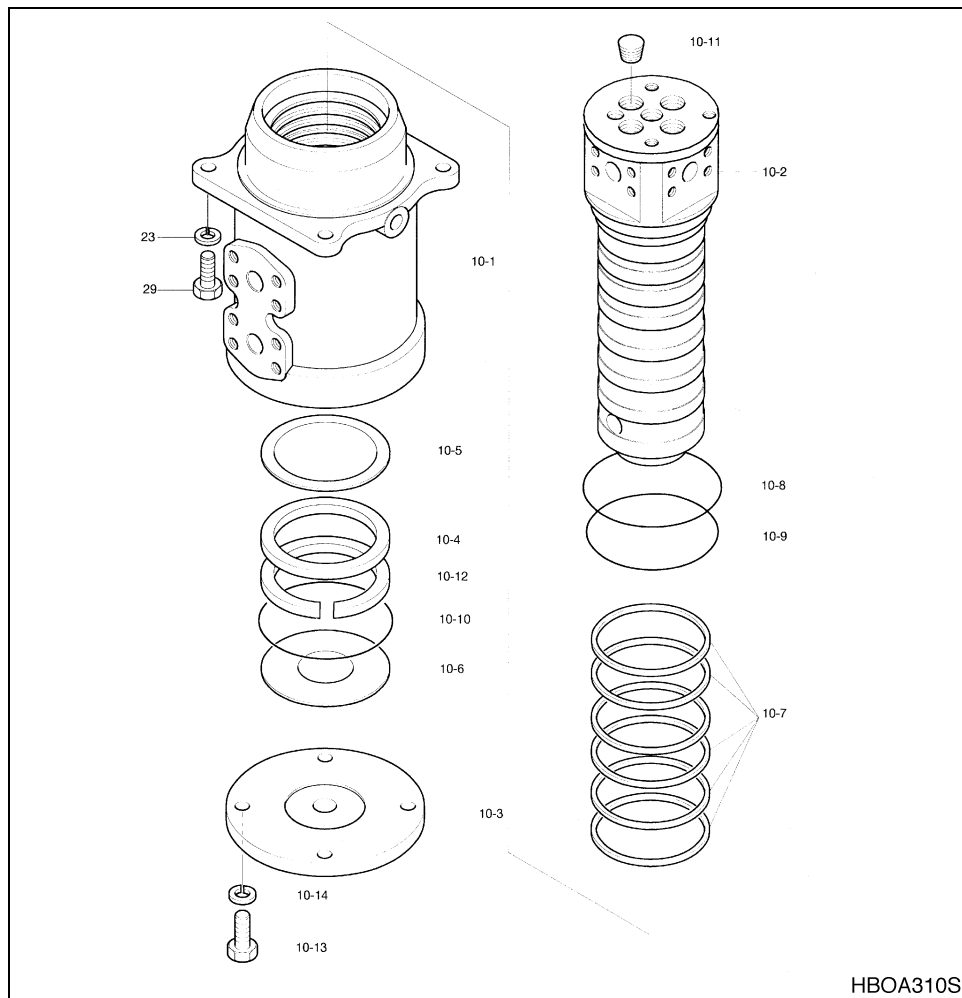


Figure 1

Reference Number	Description
10-1	Center Joint Body
10-2	Spindle
10-3	Cover
10-4	Spacer
10-5	Shim
10-6	Shim
10-7	Seal; Slipper
10-8	O-ring 1AP-120

Reference Number	Description
10-9	O-ring 1BP-100
10-10	O-ring 1BG-120
10-11	Plug PT3/4
10-12	Ring; Retaining
10-13	Bolt M12x1.75x30
10-14	Washer; Spring M12
23	Washer; Spring
29	Bolt

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.

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).

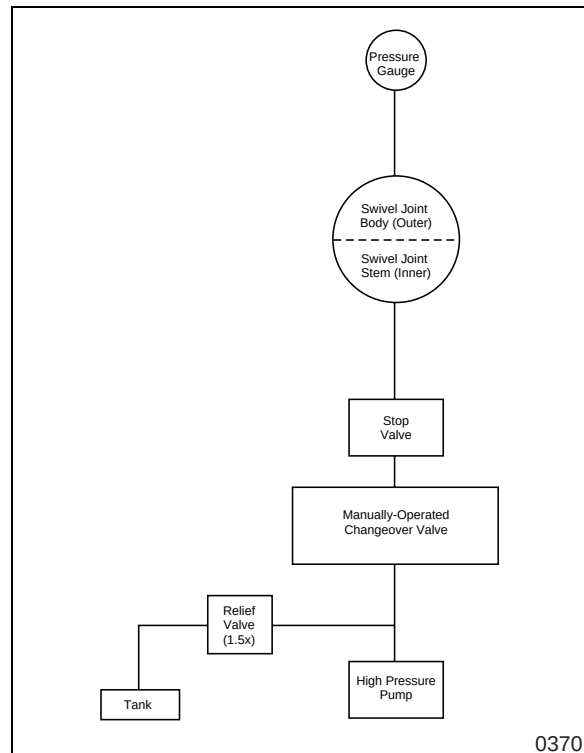


Figure 2

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 unbolt the fasteners holding the thrust plate, taking care to support the stem (inner) assembly, so that it will not separate and fall out when bolts are disconnected.
5. If the stem assembly doesn't separate easily when the thrust plate and fastener bolts 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 stem 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 stem.*

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 cover and thrust plate, and between the stem and thrust plate. Replace any component that shows more than 0.5 mm (0.020") of visible wear.

Clearance between the stem 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.



S0705000
R1

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 220LC-V	0001 and Up
Solar 290LC-V	0001 and Up
Solar 330LC-V	1001 and Up
Solar 400LC-V	1001 and Up

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	3
Parts List	4
SpecialTools and Materials	6
Piston Nut.....	6
Piston Jig.....	8
Disassembly	10
Reassembly.....	16

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, $\pi = 3.14$, B: Cylinder Inside Diameter)

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.

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

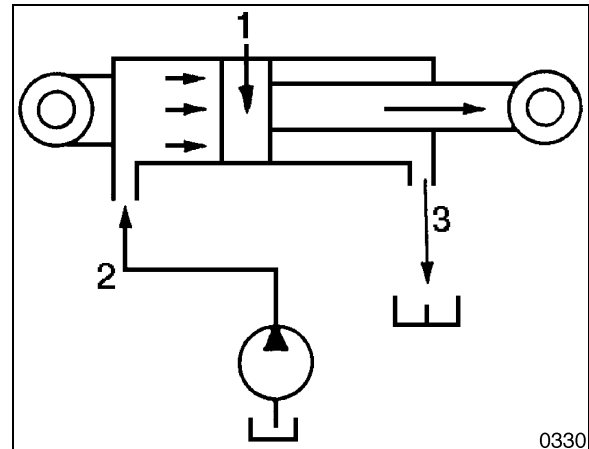


Figure 1

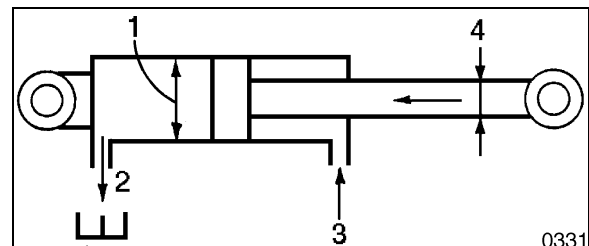


Figure 2

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.

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

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

$$Q_1 > Q_2$$

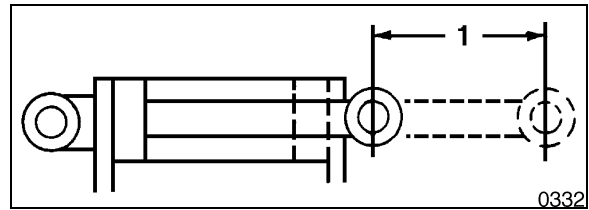


Figure 3

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.

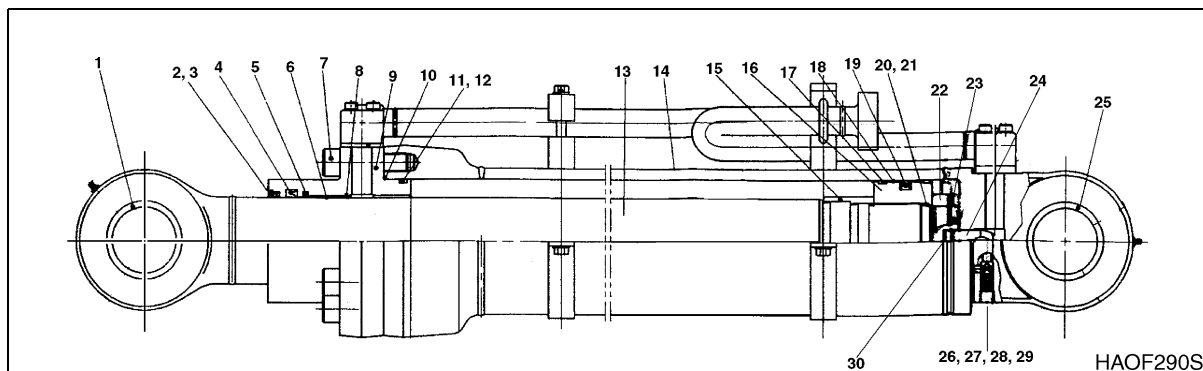


Figure 4

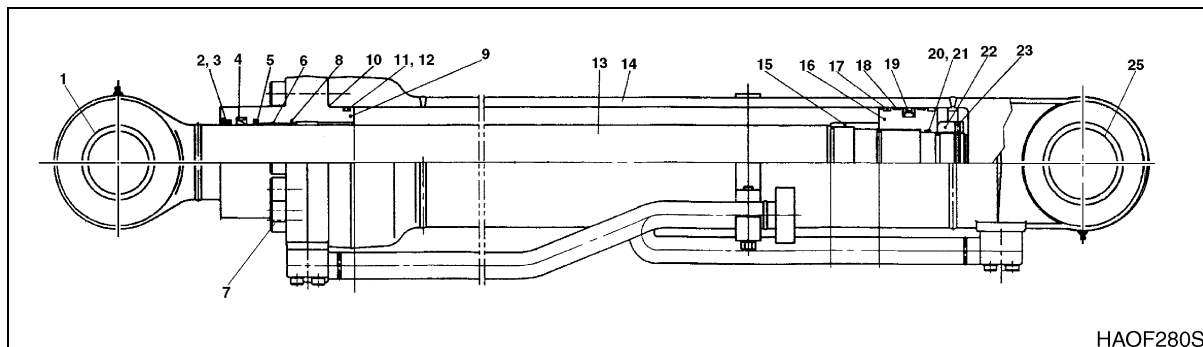


Figure 5

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

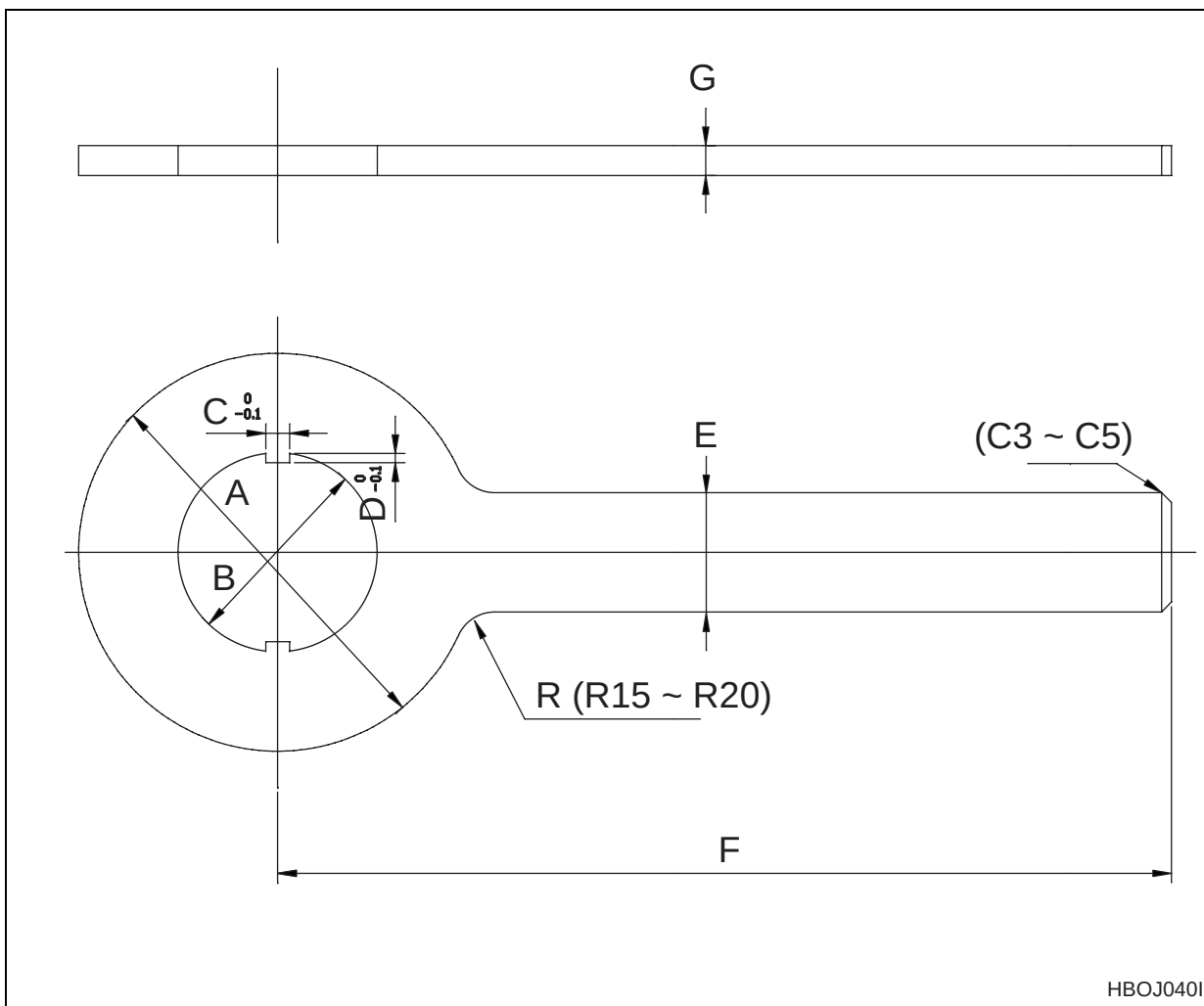


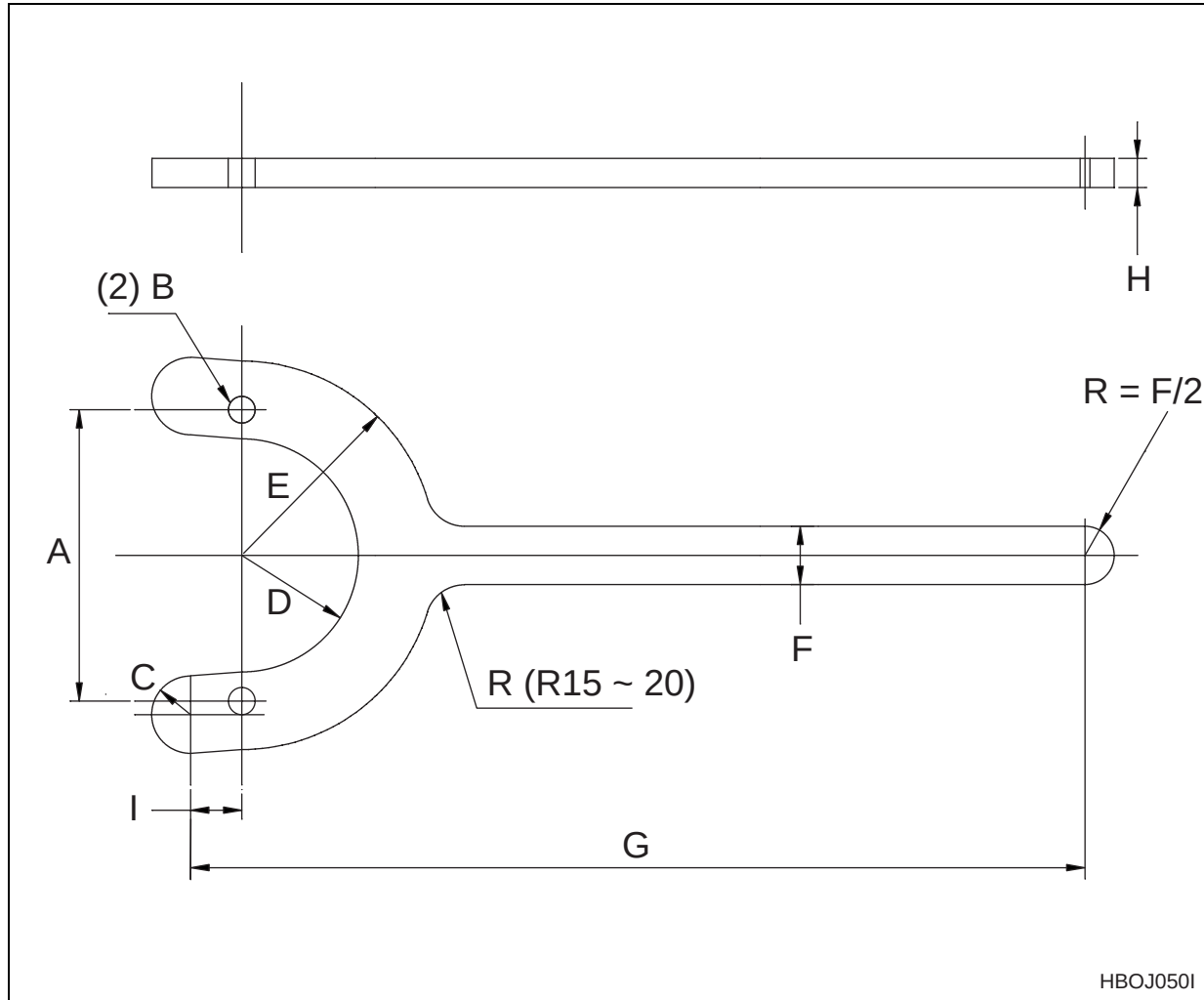
Figure 6

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.)	4.0 mm (0.16 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.)	4.0 mm (0.16 in.)	35.0 mm (1.38 in.)	350.0 mm (13.78 in.)	15.0 mm (0.59 in.)	S130W-V (ARM) 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.)	4.0 mm (0.16 in.)	30.0 mm (1.18 in.)	300.0 mm (11.81 in.)	15.0 mm (0.59 in.)	S130W-V (BOOM)
	BUCKET	115.0 mm (4.53 in.)	75.0 mm (2.95 in.)	11.0 mm (0.43 in.)	4.0 mm (0.16 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.)	4.0 mm (0.16 in.)	35.0 mm (1.38 in.)	350.0 mm (13.78 in.)	15.0 mm (0.59 in.)	S200W-V (ARM) S290LC-V (BOOM)
	BUCKET	125.0 mm (4.92 in.)	102.0 mm (4.02 in.)	11.0 mm (0.43 in.)	4.0 mm (0.16 in.)	35.0 mm (1.38 in.)	350.0 mm (13.78 in.)	15.0 mm (0.59 in.)	S200W-V (BUCKET)
S330-V	ARM	140.0 mm (5.51 in.)	107.0 mm (4.21 in.)	11.0 mm (0.43 in.)	4.0 mm (0.16 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) S400LC-V (BUCKET)
	BOOM	140.0 mm (5.51 in.)	105.0 mm (4.13 in.)	11.0 mm (0.43 in.)	4.0 mm (0.16 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.)	4.0 mm (0.16 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.)	4.0 mm (0.16 in.)	35.0 mm (1.38 in.)	350.0 mm (13.78 in.)	15.0 mm (0.59 in.)	S200W-V (OUTRIGGER)



HBOJ050I

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)
	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.)	S200W-V (ARM) 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.)	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.)	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)

DISASSEMBLY



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.

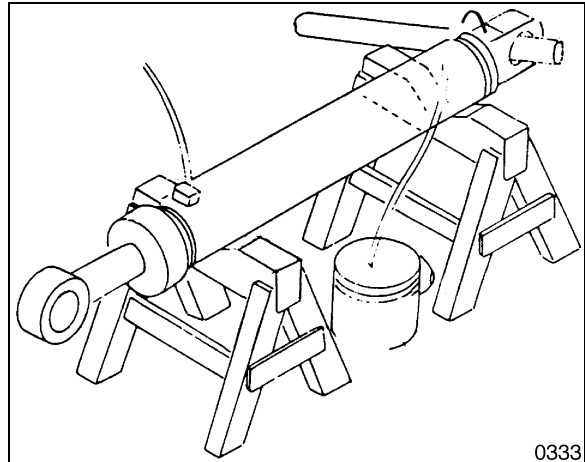


Figure 8

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

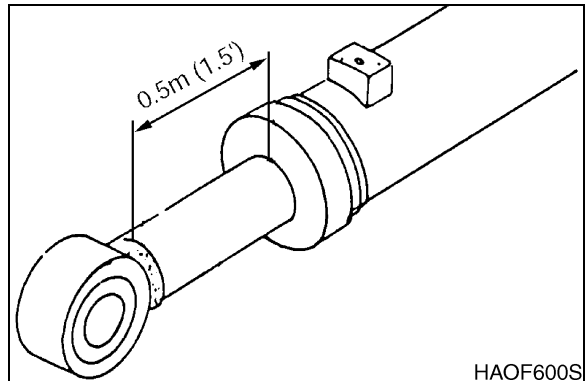


Figure 9

3. Loosen bolts (34) 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.

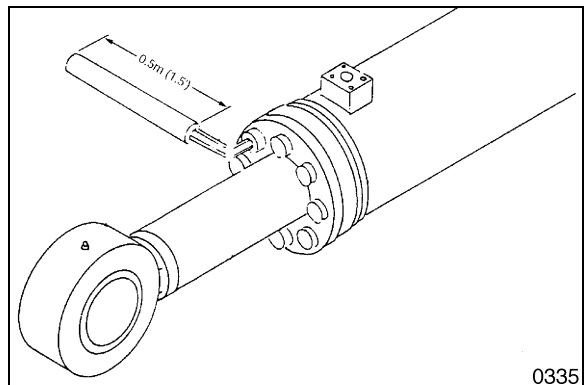


Figure 10

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

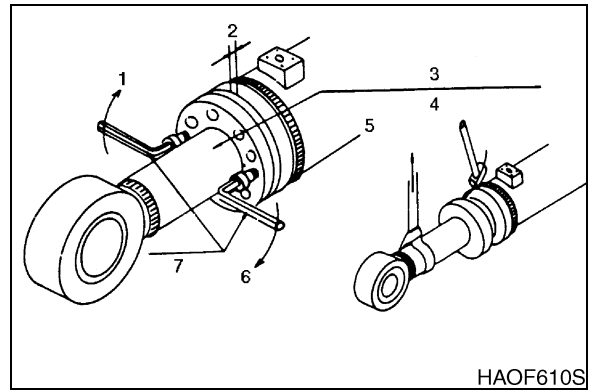


Figure 11

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.

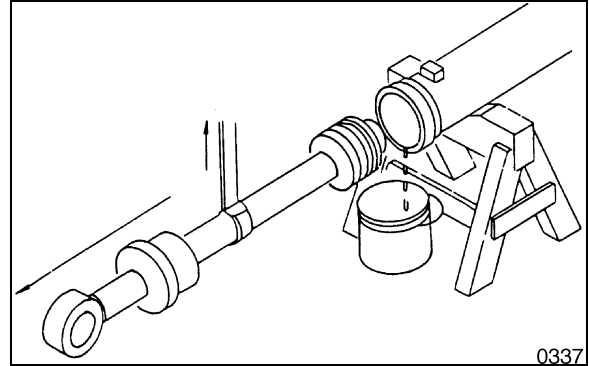


Figure 12

6. Lower piston rod to support blocks and detach wear ring (outer surface) (7) from end of rod.

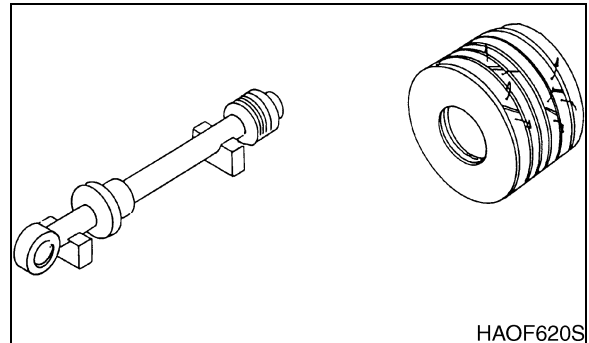


Figure 13

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

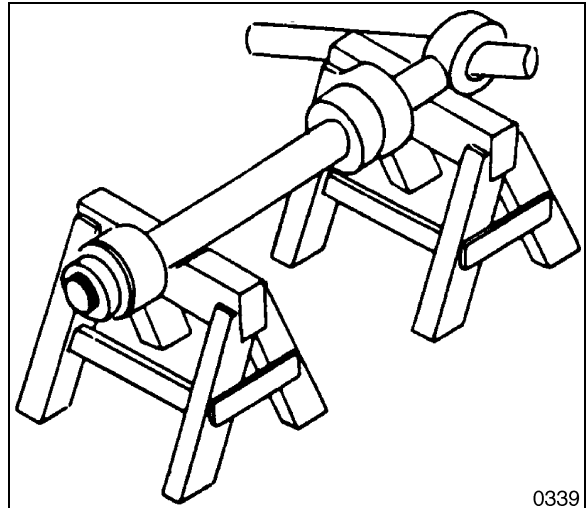


Figure 14

8. Loosen set screw by using a socket wrench.

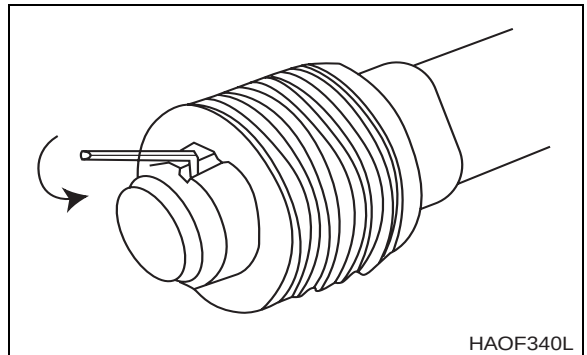


Figure 15

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.

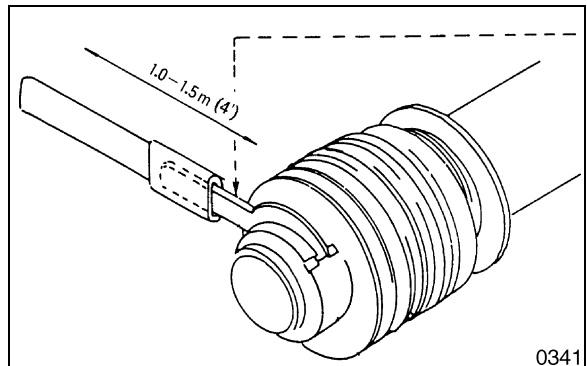


Figure 16

10. Use second piston tool described at beginning of this procedure to separate piston. Detach cushion ring (11), taking care not to damage cushion ring.

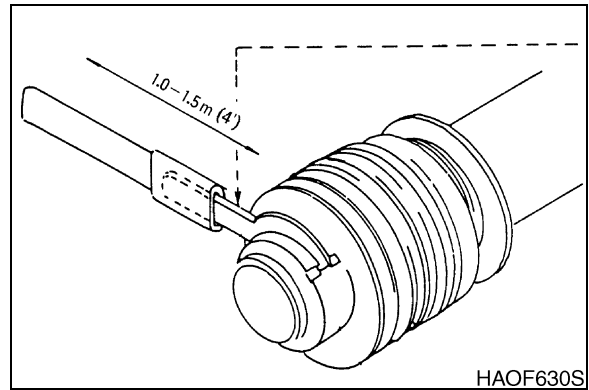


Figure 17

11. Use a plastic hammer to evenly pull off rod cover (14) from end of piston rod. Be careful not to damage rod bushing (15) and dust wiper, U-packing and other seals.

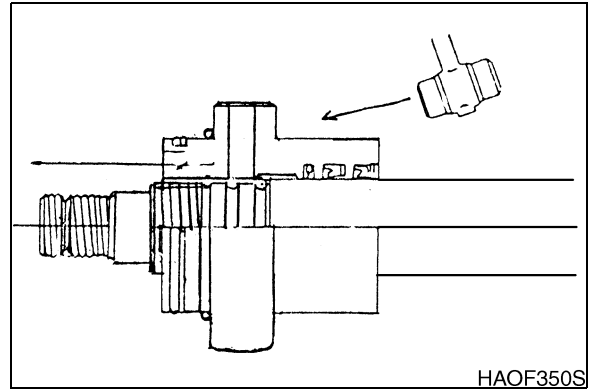


Figure 18

12. Use a dull, rounded-tip tool to pry off O-ring (9) and backup ring (10).

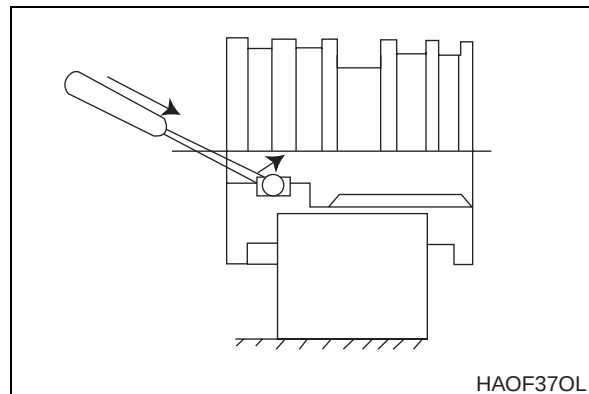


Figure 19

13. Find a screwdriver with an appropriate width tip to facilitate removal of slipper seal (6), wear ring (7) and slide ring (8) from piston (5).

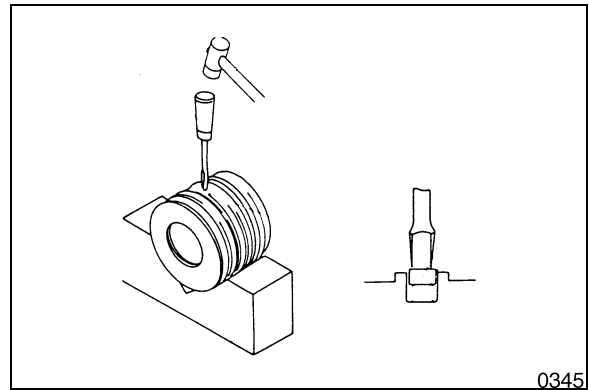


Figure 20

14. Pull off O-ring (21) and backup ring (22) from cylinder head.

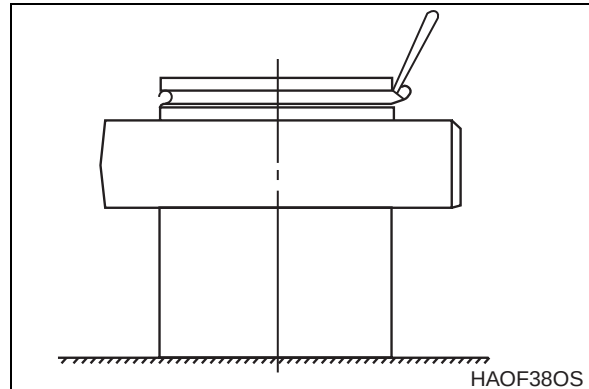


Figure 21

15. 15. During disassembly of cylinder head, be careful not to damage buffer seal (17) and U-packing (18).

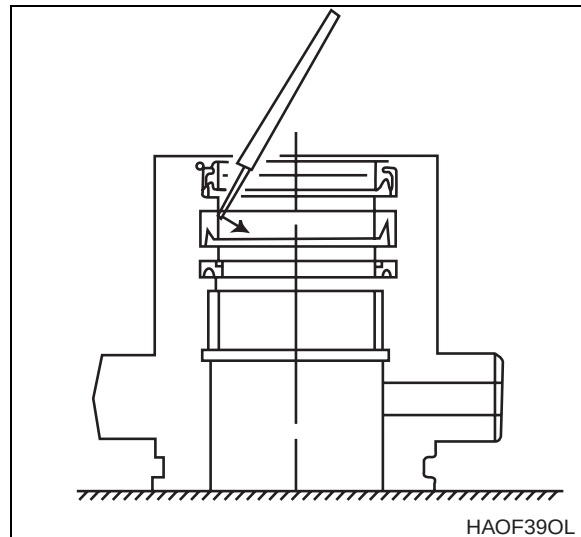


Figure 22

16. Disassemble retaining ring (20) and dust wiper (19). Separate retaining ring (16) and rod bushing (15).

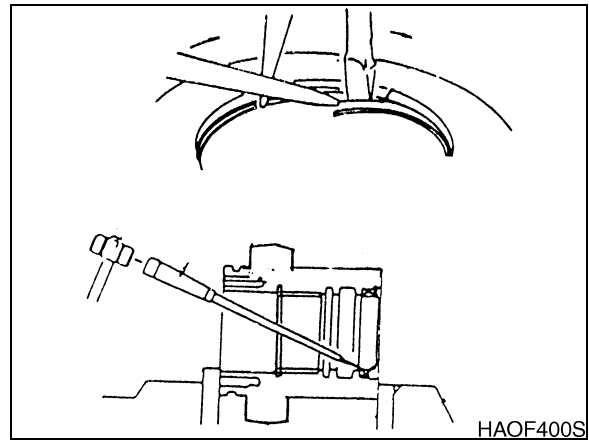


Figure 23

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

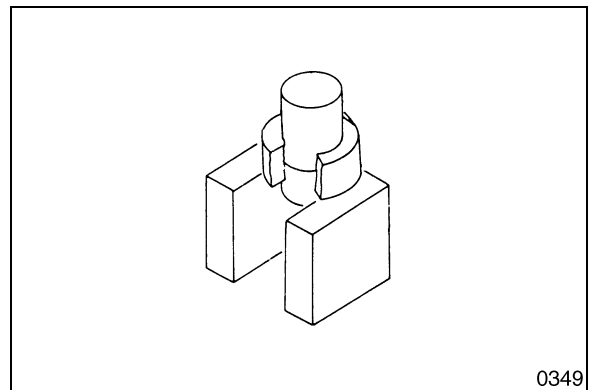


Figure 24

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 (4) to piston rod(3) and body of cylinder (1).
2. Following reassembly of rod cover components, install the dust wiper (19) and rod bushing (15) to the rod cover (14). Insert retaining rings (16 and 20).

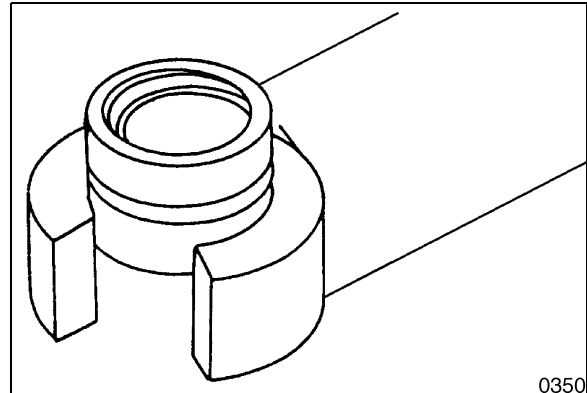


Figure 25

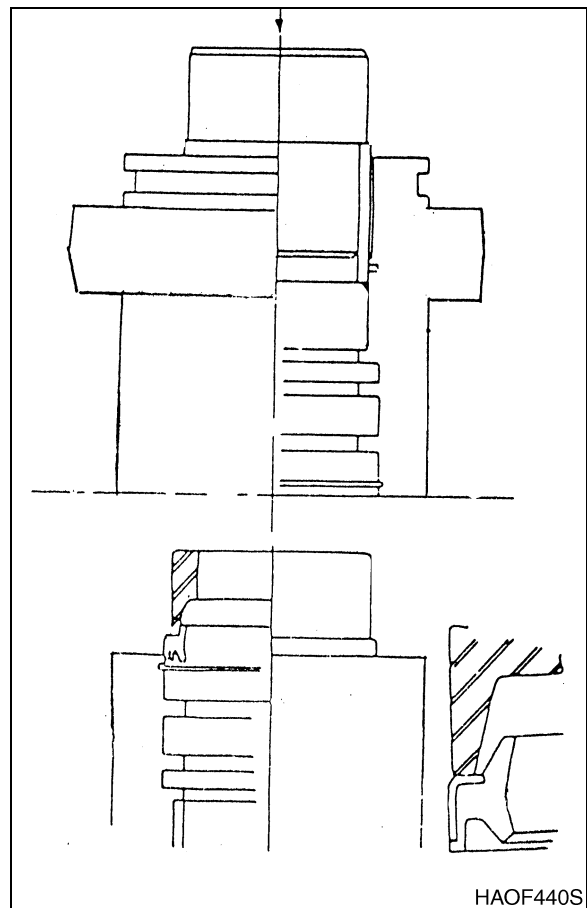


Figure 26

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

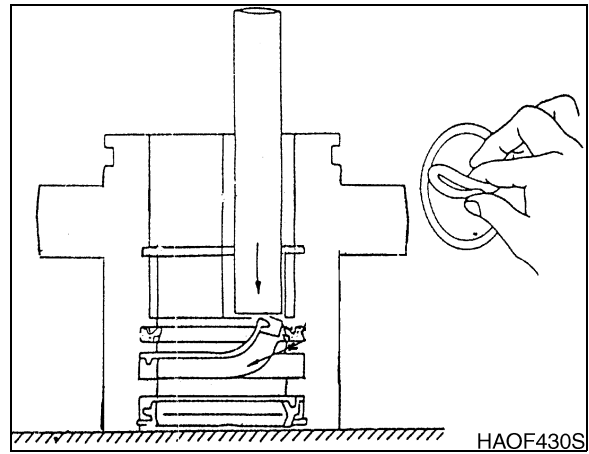


Figure 27

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.

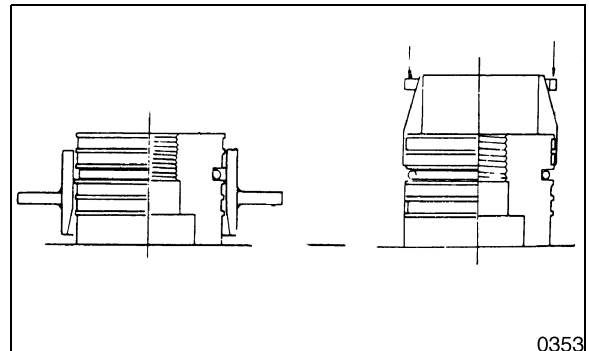


Figure 28

5. Immobilize piston rod on solid support blocks. Assemble O-ring and backup ring (21 and 22). Prepare to attach rod cover assembly to piston rod. Push rod cover by tightening piston nut (12).

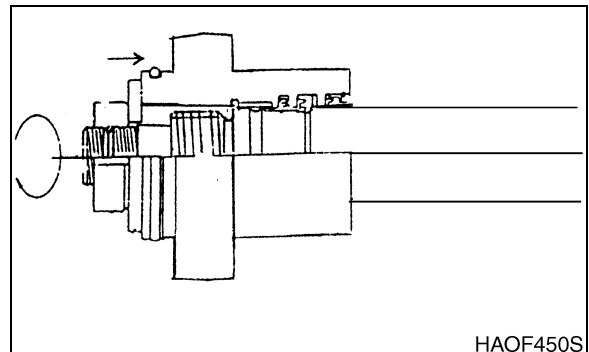


Figure 29

6. Assemble cushion ring (11) and attach piston assembly to piston rod.

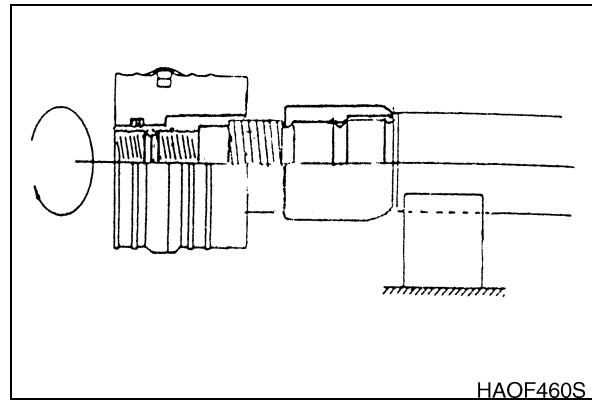


Figure 30

7. Use specially fabricate or factory-sourced tool to tighten piston nut (12).

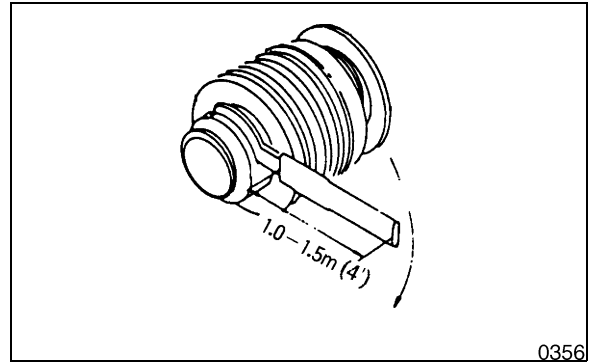


Figure 31

8. Assemble wear ring (7), slide ring (8) and set screw(13) to piston assembly.

1. Set Screw

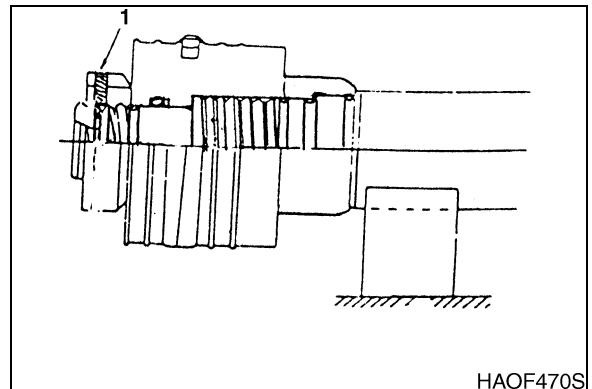


Figure 32

9. Immobilize body of cylinder prior to reassembly.

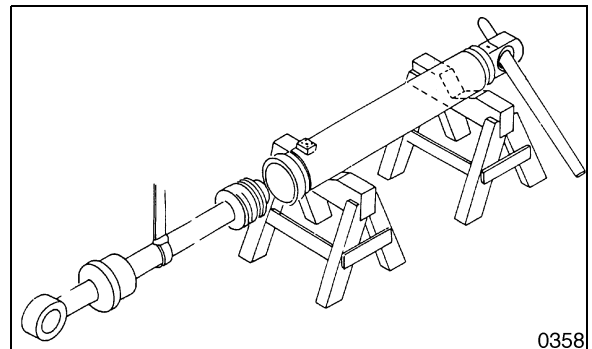


Figure 33

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.

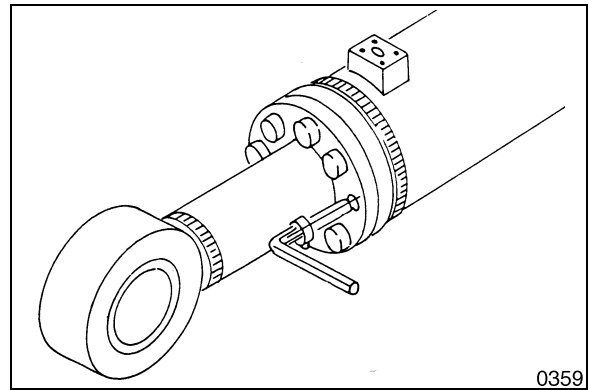


Figure 34



SWING MOTOR



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

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	3
Swing Motor Anti-cavitation Make-up Valve	4
Relief Valve	5
Swing Brake Operation	6
Parts List	8
Specifications	10
SpecialTools	11
Disassembly	12
Cleaning and Inspection (Wear Limits and Tolerances)	18
Reassembly.....	20

GENERAL DESCRIPTION

THEORY OF OPERATION

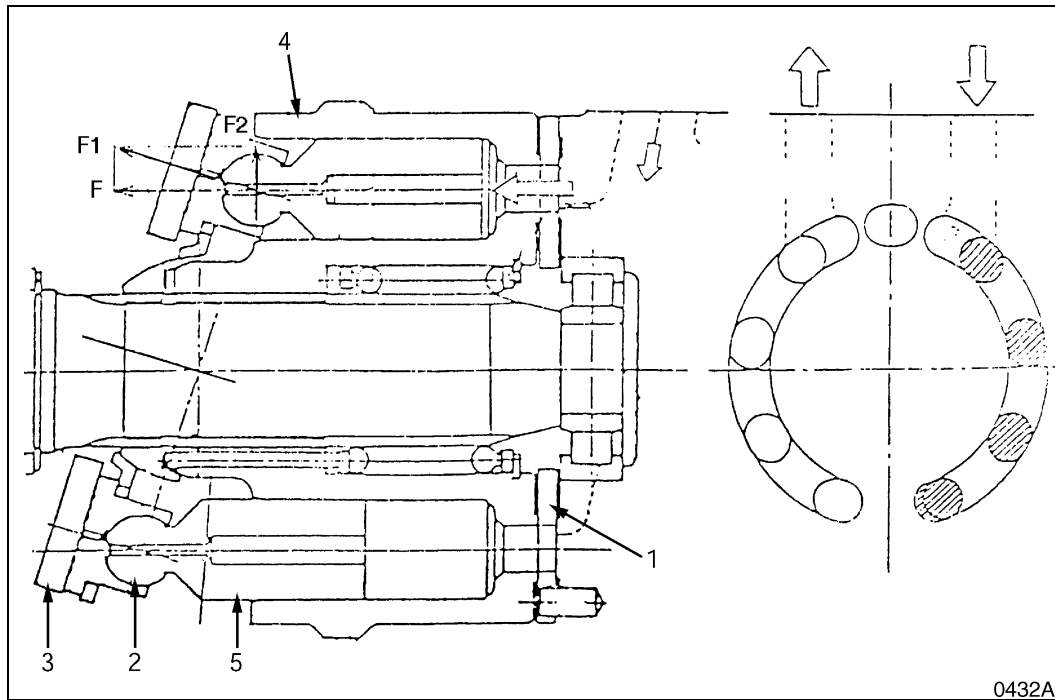


Figure 1

Reference Number	Description
1.	Valve Plate
2.	Shoe
3.	Swash Plate

Reference Number	Description
4.	Cylinder Block
5.	Piston

The cross sectional views of the swing motor, 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 (Figure 1).

When high-pressure oil enters the cylinder through the inlet port of the valve plate (1, Figure 1), the sliding piston inside the cylinder is driven back, generating force “F” against the shoe behind the piston (2).

Force “F” acts in two different directions, as indicated by the arrows. Force F1 exerts pressure directly on the swash plate (3, Figure 1) 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. 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.

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 EPOS-V 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.

SWING MOTOR ANTI-CAVITATION MAKE-UP VALVE

Unlike those designs for hydraulic swing motor application which incorporate a separate, external counterbalance valve, the problem of motor rotational speed overtaking or surpassing oil flow rate at the motor’s supply-side inlet is answered with pressure-control valving that is incorporated in the motor casing.

An anti-cavitation “make-up” valve is incorporated into each relief valve (Figure 2) to prevent oil starvation on whichever side of the motor is serving as the supply side by allowing greater oil flow through one side of the circuit. There is one valve for each side of the motor. When swing motor case drain pressure increases past the set value of the make-up valves, oil flow is increased through that side of the motor circuit.

RELIEF VALVE

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

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

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

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

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

$$P_s = \frac{F_{sp}}{A_1 - A_2}$$

Where Fsp: Spring Force

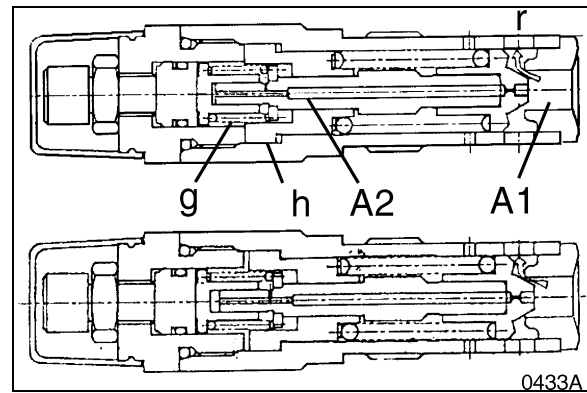


Figure 2

SWING BRAKE OPERATION

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

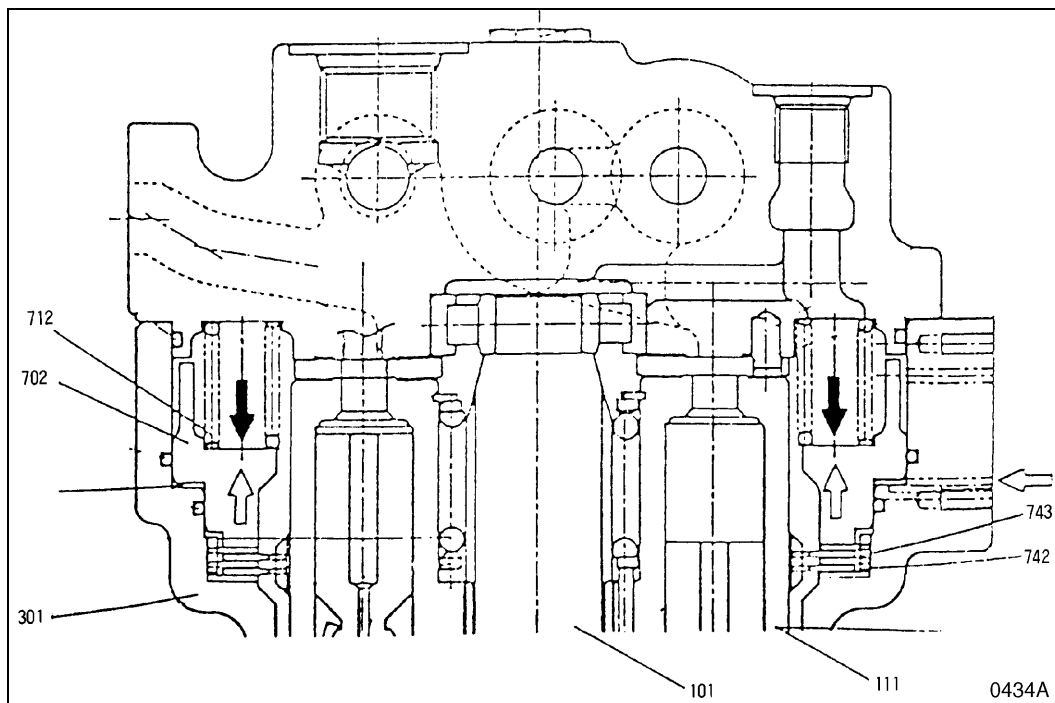


Figure 3

The swing brake is applied when the brake spring (Item 712, Figure 3) locks up the friction plate (742), split plate (743) and swing motor casing (301), 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.

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)

PARTS LIST

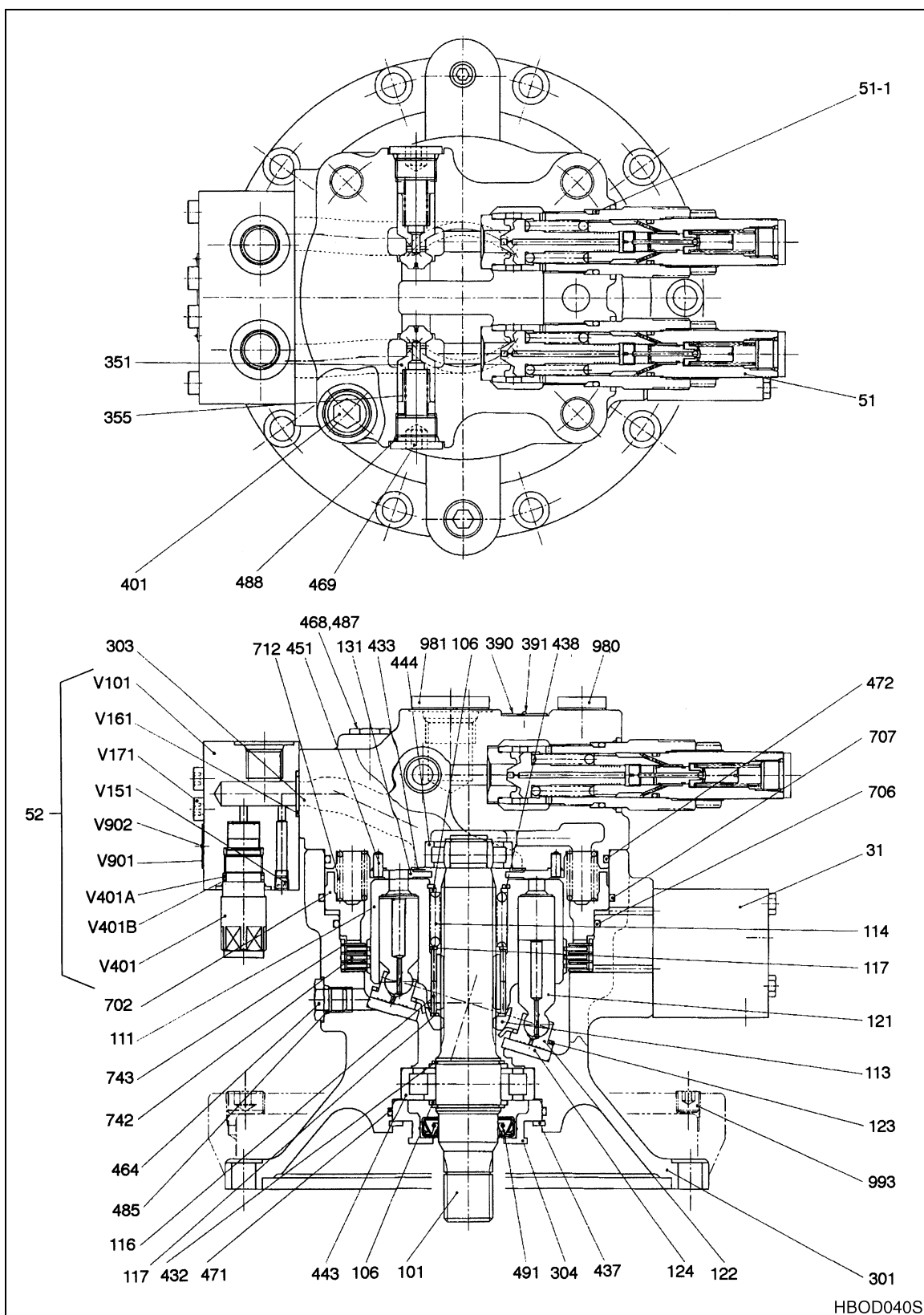


Figure 4

Reference Number	Description
	Swing Motor
11	Piston Ass'y (121,122)
20	Valve Casing Ass'y (303,451)
31	Valve; Time Delay
51	Valve; Relief
51-1	O-ring
52	Relief Valve
80	Seal
100	Casing
101	Shaft; Drive
106	Spacer
111	Cylinder
113	Retainer
114	Spring; Cylinder
116	Rod; Push
117	Spacer
118	Spacer
121	Piston
122	Shoe
123	Plate; Set
124	Plate; Shoe
131	Plate; Valve
151	Plug PF1/4
161	O-ring
162	O-ring
163	O-ring
171	Screw M8
301	Casing C1
303	Casing Valve

Reference Number	Description
305	Cover; Seal
351	Plunger
355	Spring
400	Valve; Swing Reactionless
400-1	O-ring
400-2	Ring; Back Up
401	Screw M20
437	Ring; Snap
438	Ring; Snap
443	Bearing; Roller
444	Bearing; Roller
451	Pin
464	Plug
469	Plug M30x1.5
472	O-ring
485	O-ring
488	O-ring
491	Seal; Oil
702	Piston; Brak
706	O-ring
707	O-ring
712	Spring; Brake
742	Plate; Friction
743	Plate; Separator
981	Plug; Masking PF3/4
984	Plug; Masking PF3/8
993	Plug PT1/4
994	Plug PT3/4

SPECIFICATIONS

Swing Motor	Specification	
	Solar 130W-V	Solar 130LC-V
Type	Axial Piston	Axial Piston
Displacement	64 cc/rev. (3.91 cu. in./rev)	64 cc/rev. (3.91 cu. in./rev)
Crossover Relief Valve Setting	270 kg/sq cm (3,840 psi)	270 kg/sq cm (3,840 psi)
Max. Supply Flow Rate	140 liters/min. (36.96 gpm)	118 liters/min (31.15 gpm)
Motor Output Speed	2,185 rpm	1,850 rpm
Motor Output Torque	27.5 kg•m (199 ft lbs)	27.5 kg•m (199 ft lbs)
Weight	29 kg (64 lbs.)	29 kg (64 lbs.)

SPECIAL TOOLS

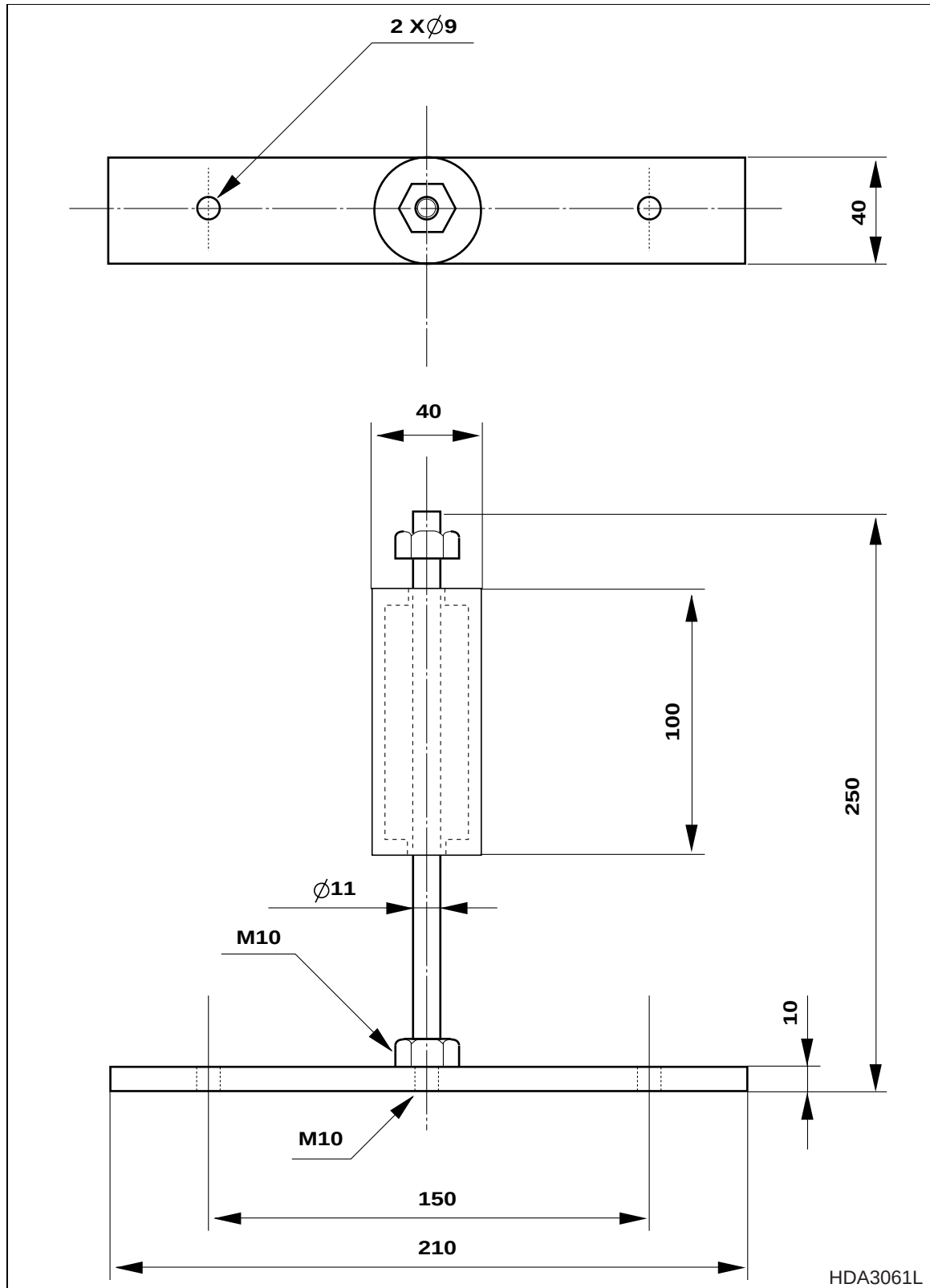


Figure 5

DISASSEMBLY

1. The area where the motor is going to be rebuilt should be well lighted, clean and protected from dust and/or wind gusts that could carry grit or dust. Use a rubber mat or other protective overlay on workbench area to prevent damaging or scratching any precision machined components.

IMPORTANT

Clean all of the exterior surfaces of the motor prior to disassembly. There should not be any visible dirt, grease, or other type of accumulation on the outside of the casing. Clean off or blow dry all traces of cleaner or solvent before starting work and cap off or use other types of protective seals, plugs or wrapping on temporarily disconnected hoses, piping or ports.

2. Open drain plug and drain all oil from motor casing.

NOTE: *Swing Motor component parts (numbered in parentheses) are keyed to Figure 4.*

IMPORTANT

Use a clean, dry container to catch gear oil. A clean container allows an evaluation to be made of the used oil. The presence or lack of metal wear shavings in the used oil or obvious deterioration or contamination of the oil can provide a useful indicator of the motor's general condition.

NOTE: *Used oil is an environmental contaminant and should be disposed of promptly at approved recycling facilities. Prolonged physical contact with used oil has been thought by some to pose a health risk. Clean oil residue from hands and clothing promptly, and don't allow used oil containers to accumulate*

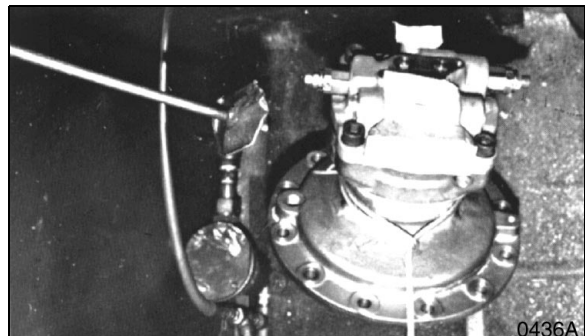


Figure 6

3. After oil has been drained completely, motor should be positioned so that exposed end of drive shaft faces downwards.

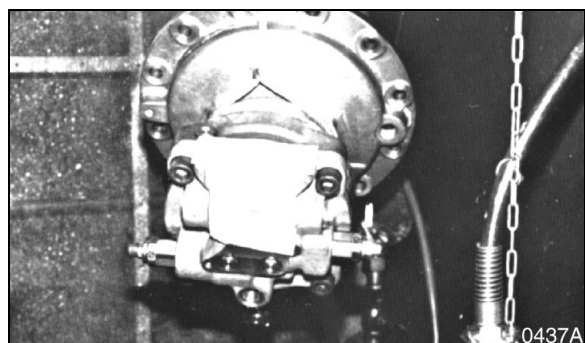


Figure 7

4. Make two permanent marks on exterior of motor to indicate assembly position of motor casing (301) and upper valve casing (303).
5. Disassemble brake valve (31) from side of casing.

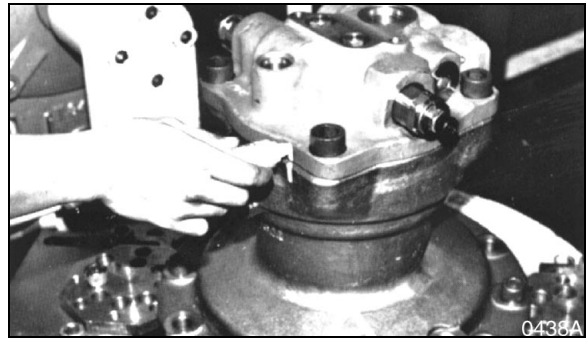


Figure 8

6. Loosen and remove relief valve assemblies (51) from upper valve casing (303).

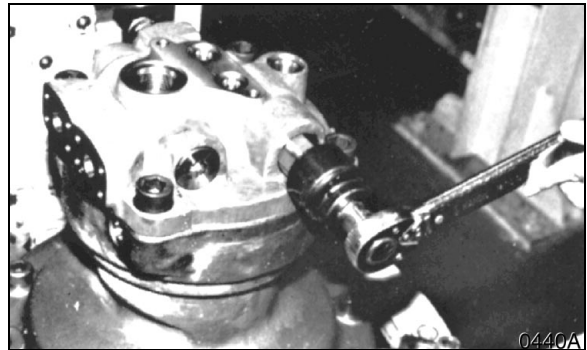


Figure 9

7. Remove RO plug (469) from upper valve casing (303). That will allow subsequent separation of spring (355) and plunger (351).

IMPORTANT

Use extra care to avoid damaging the plunger seat.



Figure 10

8. Loosen and remove all four socket head bolts (401) and separate upper valve casing (303) from lower casing (301).

NOTE: Valve plate (131) inside upper valve casing (303) must be separated from assembly but take extra care to make sure that it is not scratched or damaged by an accidental fall, after cover is removed.

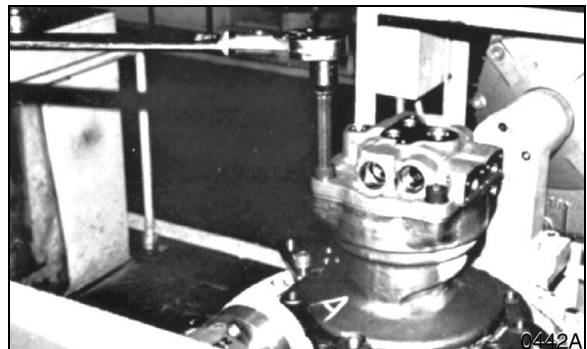


Figure 11

9. Remove all sixteen brake springs.

NOTE: *If brake springs are to be reused and not replaced, check and record spring free height. If a test stand is available, check height of all twenty springs under consistent loading. Replace all springs that show excessive variation or weakness.*

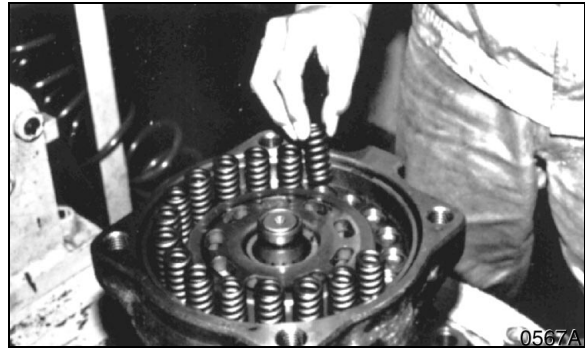


Figure 12

10. Disassemble brake piston assembly using special tool and corresponding piston bolt hole.

NOTE: *See "Special Tools" portion of this section for manufacturing details of special tool.*



Figure 13

11. Reposition motor so that end of drive shaft faces out to one side. Pull out cylinder block (111) and disassemble pistons (121), retainer plate (123), spherical bushing (113), front spacer (117) and shoe plate (124). Be careful not to make any scratches or leave nicks on reciprocating parts.

NOTE: *Record or mark piston position or store them in order in which they were removed so that they can be returned to same cylinder bores they were taken out of. Service life could be extended incrementally by maintaining previous wear-pattern relationships by avoiding new ones.*

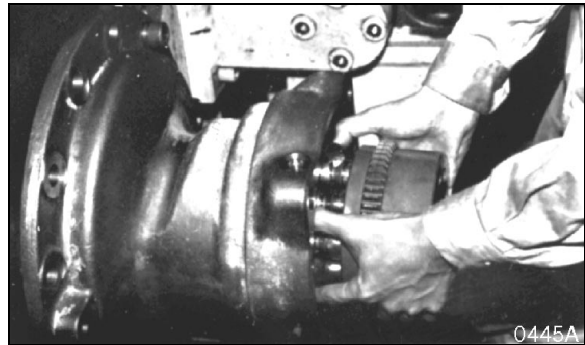


Figure 14

12. Pull out friction plates (742) and separator plates (743) from area behind cylinder block.

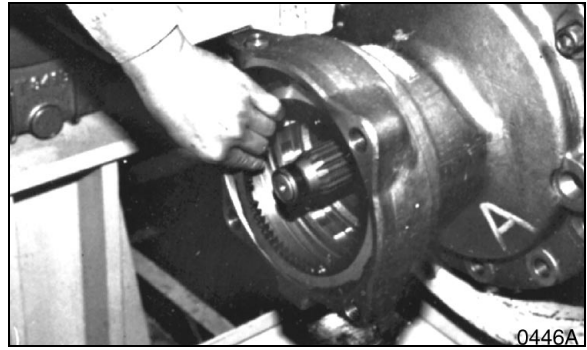


Figure 15

13. Remove lock ring (437) from around drive shaft. Use a large enough pair of snap-ring pliers to properly tension ring and pull it away from locking groove.

Use extra caution in pulling off front cover (304) behind snap ring. Drive shaft oil seal (491) underneath cover must be replaced if it is damaged during disassembly. Use a little bit of extra caution (and a very large set of channel locks, a puller or extra wide adjustable wrench) to carefully withdraw cover straight back off drive shaft.

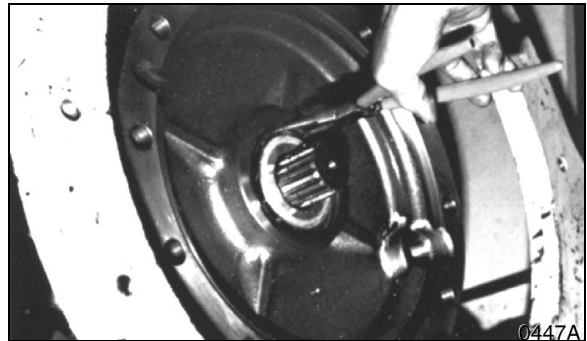


Figure 16

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

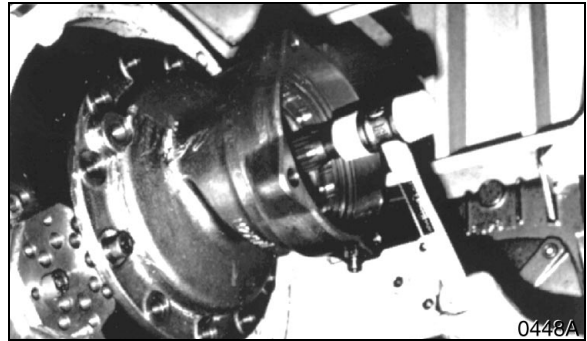


Figure 17

15. Tap bearing race out of casing.

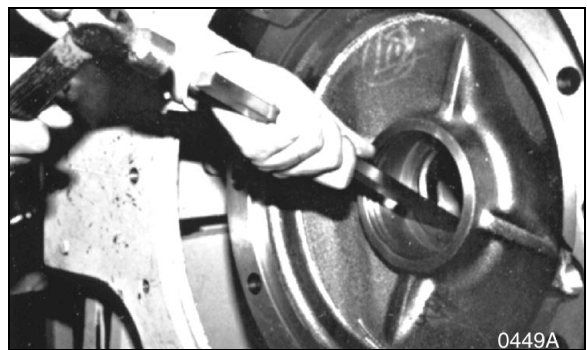


Figure 18

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

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

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

NOTE: *Final disassembly of individual components may also require:*

- A. Disassemble oil seal from the front cover if they were not separated during removal. Apply force (2, Figure 20) and use a plug (1) to hammer through drive shaft opening in cover.

Reference Number	Description
1	Plug
2	Apply Force

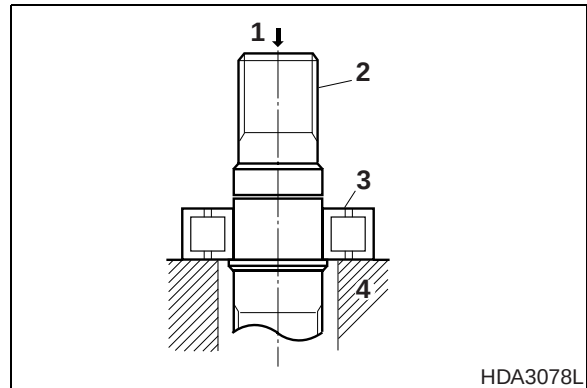


Figure 19

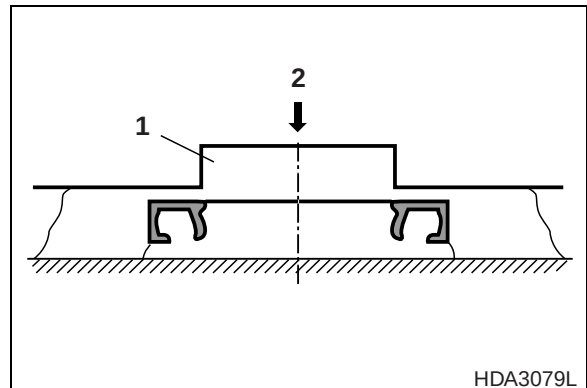


Figure 20



Figure 21

- B. If upper bearing is going to be replaced, whether as a general precaution as part of normal rebuilding or because of unmistakable wear, separate bearing from cover.



Figure 22

- C. Relief valves can be replaced in sets by ordering one part number through your authorized Daewoo dealer/parts distributor. To disassemble relief valves, pull out plug (201, Figure 4), disassemble bushing (343), spring (322) and spring seat (331) from rod (303). Position valve housing facing down and separate piston (302), rod (303), spring (321), spring seat (331) and plunger (301).

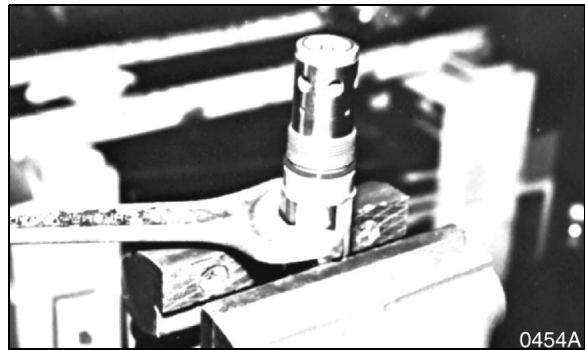


Figure 23

IMPORTANT

Do not touch the adjusting screw and lock nut. Replace the valve as a complete unit if any parts have been damaged.

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

Inspect all components and precision surfaces, to confirm that they haven't been worn beyond service limits. Refer to table below for dimensional specifications.

All parts should be cleaned, air-dried and re-lubricated with clean, approved-type hydraulic fluid, prior to final reassembly or as the final step after the unit has been put back together.

Replacement of all O-rings and oil seals with new parts is generally recommended, unless motor has had minimal use. Inspect O-rings and oil seals very carefully for cuts, nicks, brittleness or softness, or any other type of damage or distortion, prior to final reassembly.

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

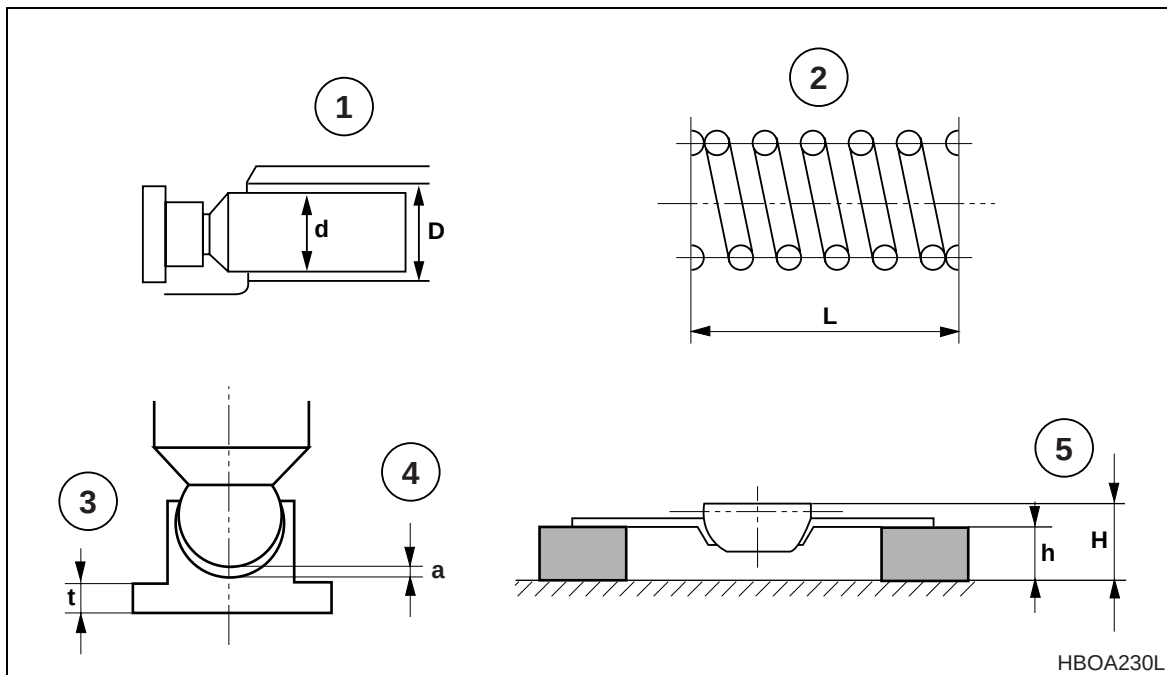


Figure 24

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

1. Clearance Between Piston and Cylinder Bore ($D-d$)
2. Spring Free Length (L)
3. Thickness of Shoe (t)
4. Piston Ball - Shoe Socket Clearance (a)
5. Height Between Round Bushing and Push Plate ($H-h$)

Service Standards for Replacing Worn Parts

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

Item	Standard Value mm (In)	Replacement Limit mm (In)	Remedy
Clearance between cylinder bore and piston (D-d)	0.016 mm (0.006 in.)	0.046 mm (0.018 in.)	Replace piston or cylinder
Clearance between piston and shoe socket	0 mm (0 in.)	0.30 mm (0.0118 in.)	Replace piston, shoe assembly parts
Thickness of shoe (t)	4.0 mm (0.16 in.)	3.80 mm (0.15 in.)	Replace piston, shoe assembly parts
Height of push plate, round bushing assembly (H-h)	5.50 mm (0.22 in.)	5.0 mm (0.20 in.)	Replace set; spherical bushing and retainer
Thickness of friction plate	3.50 mm (0.14 in.)	3.10 mm (0.12 in.)	Replace

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

REASSEMBLY

Reassembly of the motor is basically accomplished by reversing disassembly steps.

Use a torque wrench to make sure that assembly fasteners are tightened to specified values. Always begin a bolt tightening sequence from the innermost part of the assembly, working outward toward the ends in careful, even rotation.

1. Position motor casing face down (Figure 25).

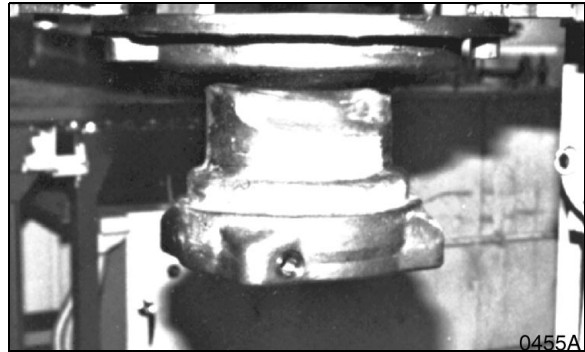


Figure 25

2. If drive shaft roller bearings were not disassembled, go on to next phase of assembly. Bearing reassembly begins with replacement of stop ring (432) (Figure 4 and its accompanying Parts List) and spacer (106) on drive shaft (101).

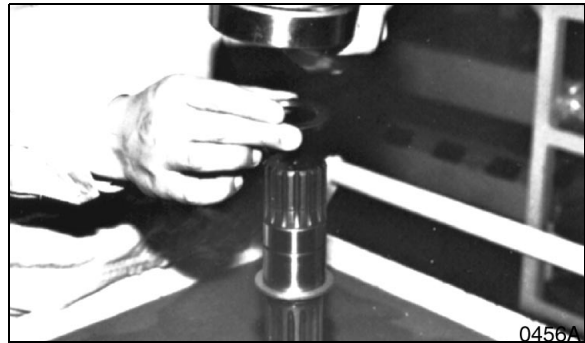


Figure 26

Make sure that bearing raceways (collars) are facing right direction. The drawing shows one side of the bearing collar (1, Figure 27), marked "R," which should be assembled next to spacer (2) on lower end of drive shaft.

- A. Both bearing cages (inner roller assemblies) will probably require heating in oil prior to reassembly. Heat bearings to cause sufficient expansion of their inner diameters to allow reassembly on drive shaft.

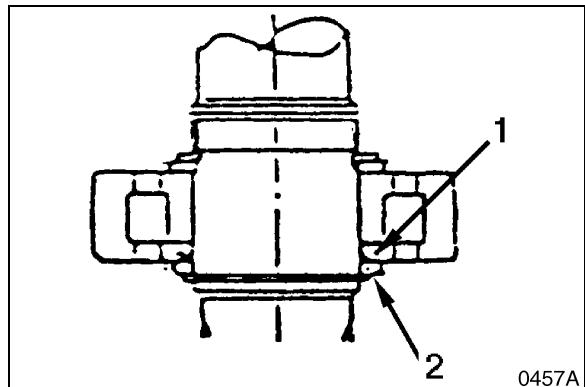


Figure 27

3. Reassemble drive shaft (101, Figure 4), roller bearing (443) and lower casing (301). Pay attention to bearing alignment inside bore of case. Make sure it is fully seated.



Figure 28

4. There is a "right side" and "wrong side" on oil seal. Be careful that you install seal inside cover with correct side facing in.

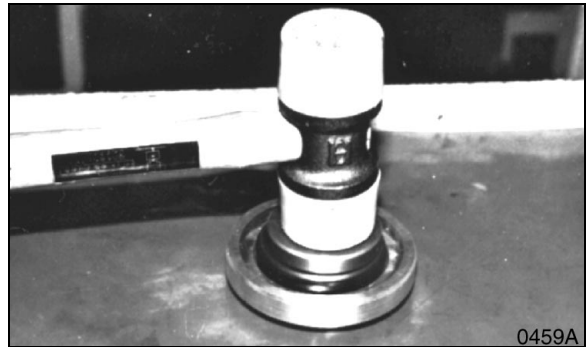


Figure 29

5. Before replacing O-ring (471) in lower casing (301), grease O-ring (and/or inside of groove) very lightly, to facilitate assembly and to help protect O-ring from accidental damage.

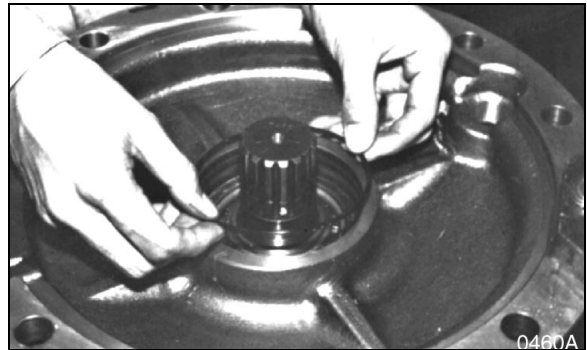


Figure 30

6. Put a little grease on lip of front cover oil seal before replacing front cover and tapping it lightly into place with plastic hammer.

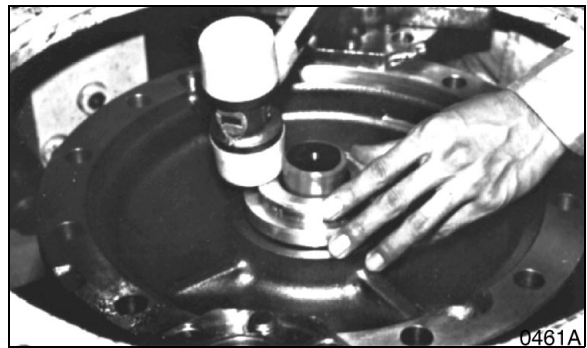


Figure 31

7. Use snap-ring pliers to replace lock ring (437) into lower casing (301).

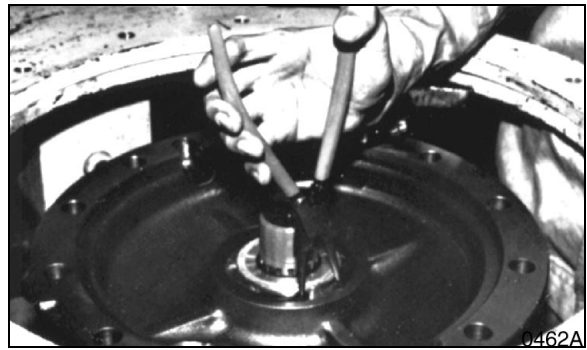


Figure 32

8. Turn motor sideways and assemble shoe plate (124), placing it in motor housing in same position it was in before removal. Using grease on assembled side can help keep individual components in place.

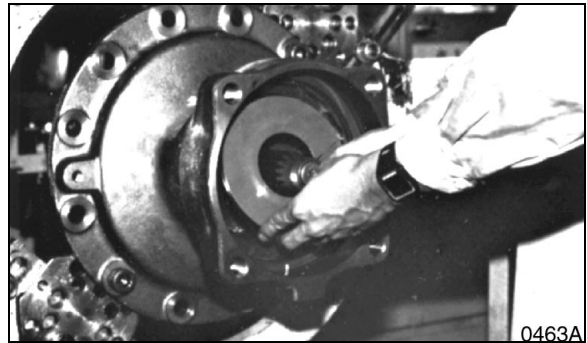


Figure 33

9. Carefully examine cylinder block for any evidence of damage around rotating parts. Put push rods (116) and front spacer (117) back into cylinder block and replace spherical bushing (113).

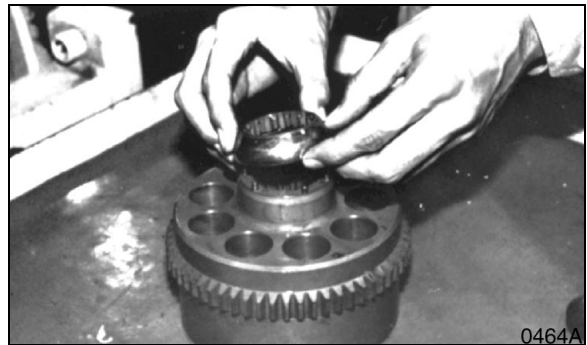


Figure 34

10. Using reference notes or marks made earlier, replace all of the pistons and shoes (121, 122) back in their original cylinder bores.



Figure 35

11. Put cylinder block (111) and retainer plate (123) back in motor. Spherical bushing and grooves of cylinder block splines should fit together without undue difficulty. (Do not try to force or pound parts together.)

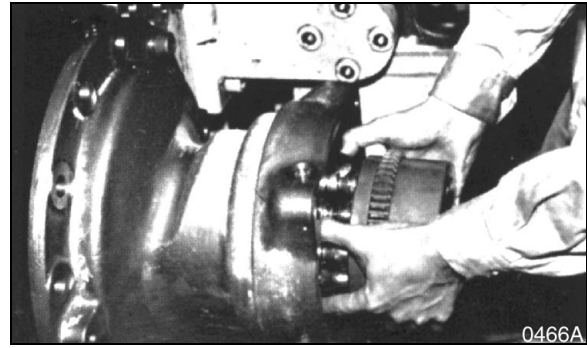


Figure 36

12. Turn motor so that front cover side (304) is down. Put separator plates (743) and friction plates (742) back in same order in which they were removed. There are three separator plates (743) and two friction plates (742), which should be positioned as shown in drawing below, with clearance towards side of casing with brake valve (1, Figure 37).

Reference Number	Description
1	Brake Valve

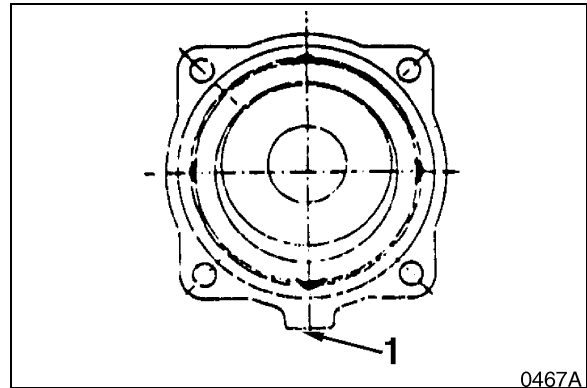


Figure 37 \

13. Very lightly grease larger O-rings (706 and 707, Figure 4) before replacing them in casing (301).



Figure 38

14. Position brake piston (1, Figure 39) in casing. The diagram shows position of four piston grooves (2) in relation to valve-connected side (3), and two 8 mm bolts which should be tightened in an even, progressive rotation.

Reference Number	Description
1	Brake Piston
2	Groove
3	Valve-connected Side

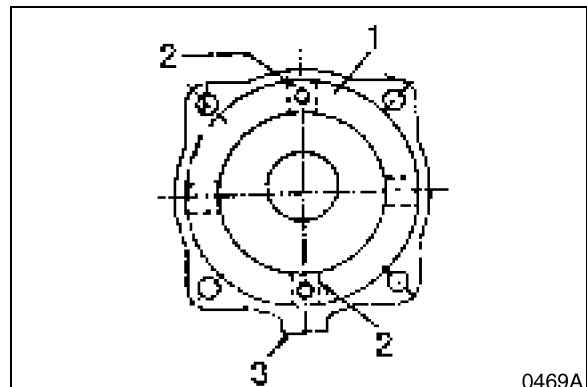


Figure 39

15. Reinstall brake springs, making sure that each gets fully seated on piston.

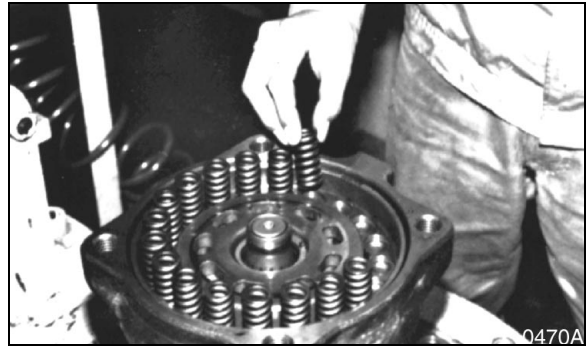


Figure 40

16. Tap roller bearing (444) race back into upper valve casing (303), using hammer and copper rod specified in tool list.

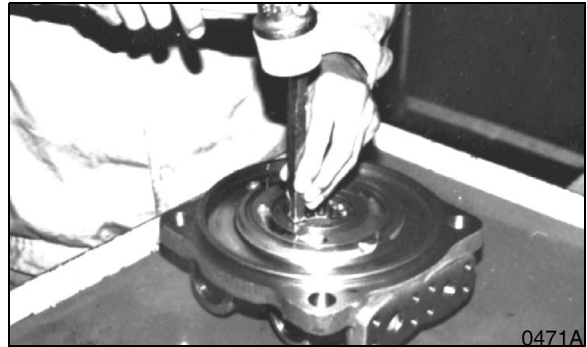


Figure 41

17. Assemble valve plate (131), O-ring and upper valve casing (303). Refer to assembly that shows "R" part (2, Figure 42) of the valve plate turned away from mounting flanges (1) on side of valve plate. Lightly grease O-ring to help keep it in place during assembly.

Reference Number	Description
1	Flange Side
2	R Port

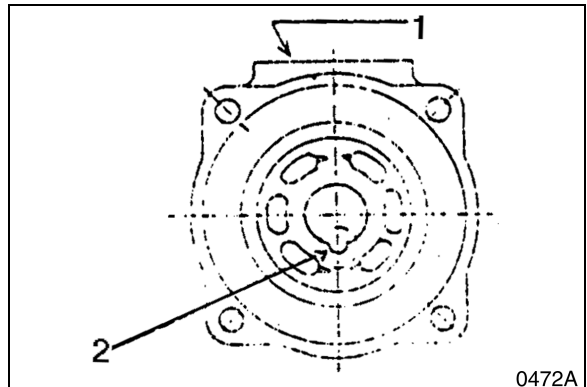


Figure 42

18. Bolt up two halves of motor casing (301 and 303, Figure 4). Be careful not to lose or damage O-ring. Tighten four 20 mm socket head bolts using a progressive, even rotation. Make sure that all brake springs are fully seated and that valve casing inlet and output ports are correctly matched.

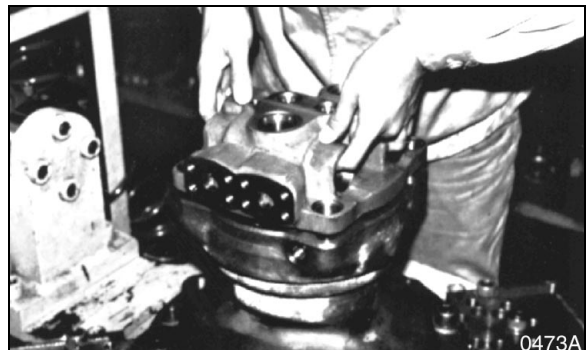


Figure 43

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

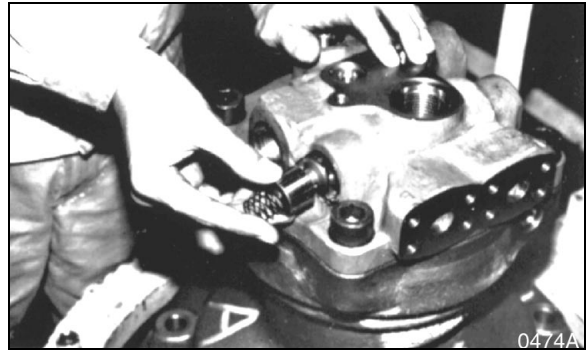


Figure 44

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



Figure 45

IMPORTANT

Be careful not to damage the plunger and spring seat.

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



Figure 46

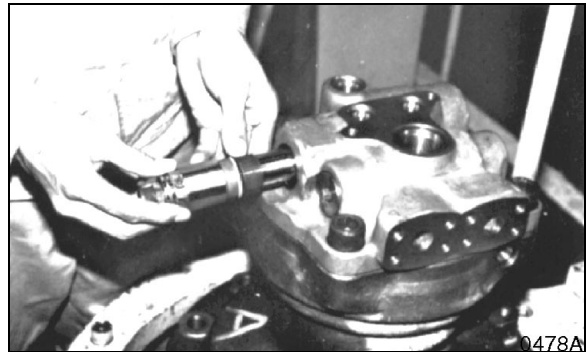


Figure 47

22. Replace the VP plugs (464, 468) and O-rings (485, 487) on each of the three plugs. Reinstall the brake cutoff valve (31).

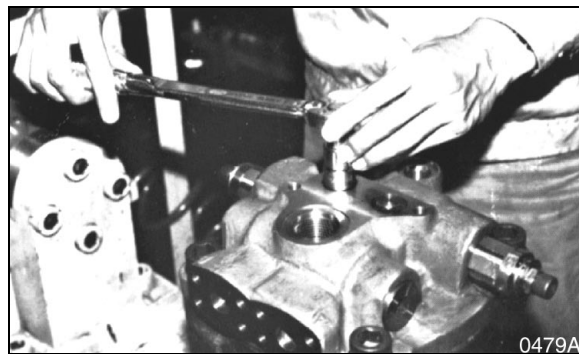


Figure 48



S0707350

TRAVEL MOTOR



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 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	3
Parts List	4
Specifications	4
Travel Motor General Disassembly and Reassembly Instructions.....	5
Recommended Tools	5
Precautions for Disassembly and Assembly	5
Disassembly of Travel Motor	6
Appearance of Motor.....	6
Removal of counterbalance Valve	6
Removal of Outer Piping	7
Removal of Stroke Limiter	8
Removal of Oil Seal	9
Removal of Control Unit	9
Removal of Control Valve.....	11
Disassemble Control Valve	13
Disassemble Stroke Limiter.....	14
Reassemble Stroke Limiter	15
Reassemble Control Valve	15
Installation of Control Valve.....	16
Reassembly of Travel Motor	19
Assembly of Control Unit.....	19
Installation of Oil Seal	21
Installation of Stroke Limiter.....	22
Installation of Outer Piping.....	22
Installation of Counterbalance Valve	23

GENERAL DESCRIPTION

THEORY OF OPERATION

The drive train consists of a travel motor, rear axle/transmission, propeller shaft, and front axle. Drive force from the travel motor is transmitted through the transmission to the rear axle and through a propeller shaft to the front axle. Speed is reduced through differential and hub reduction gears.

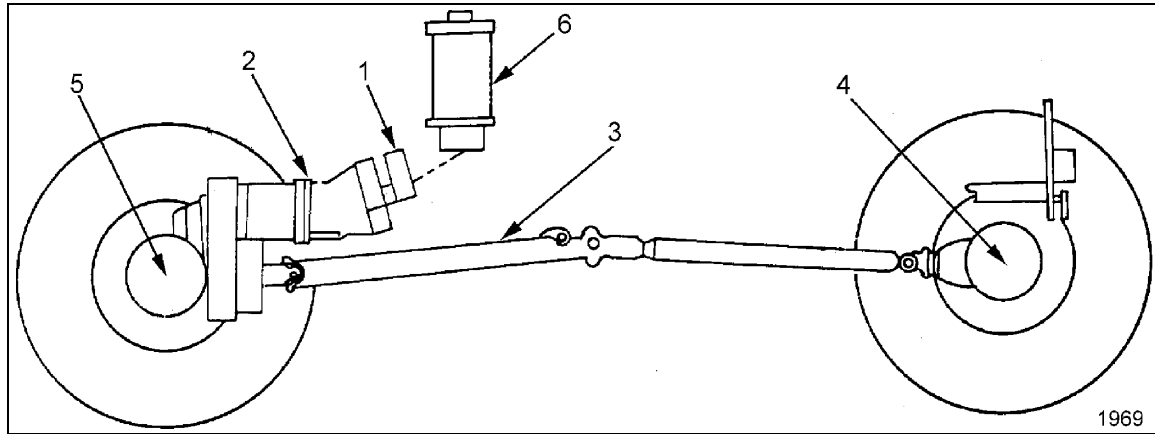


Figure 1

Reference Number	Description
1	Travel Motor
2	Transmission
3	Propeller Shaft

Reference Number	Description
4	Front Axle
5	Rear Axle
6	Center Joint

PARTS LIST

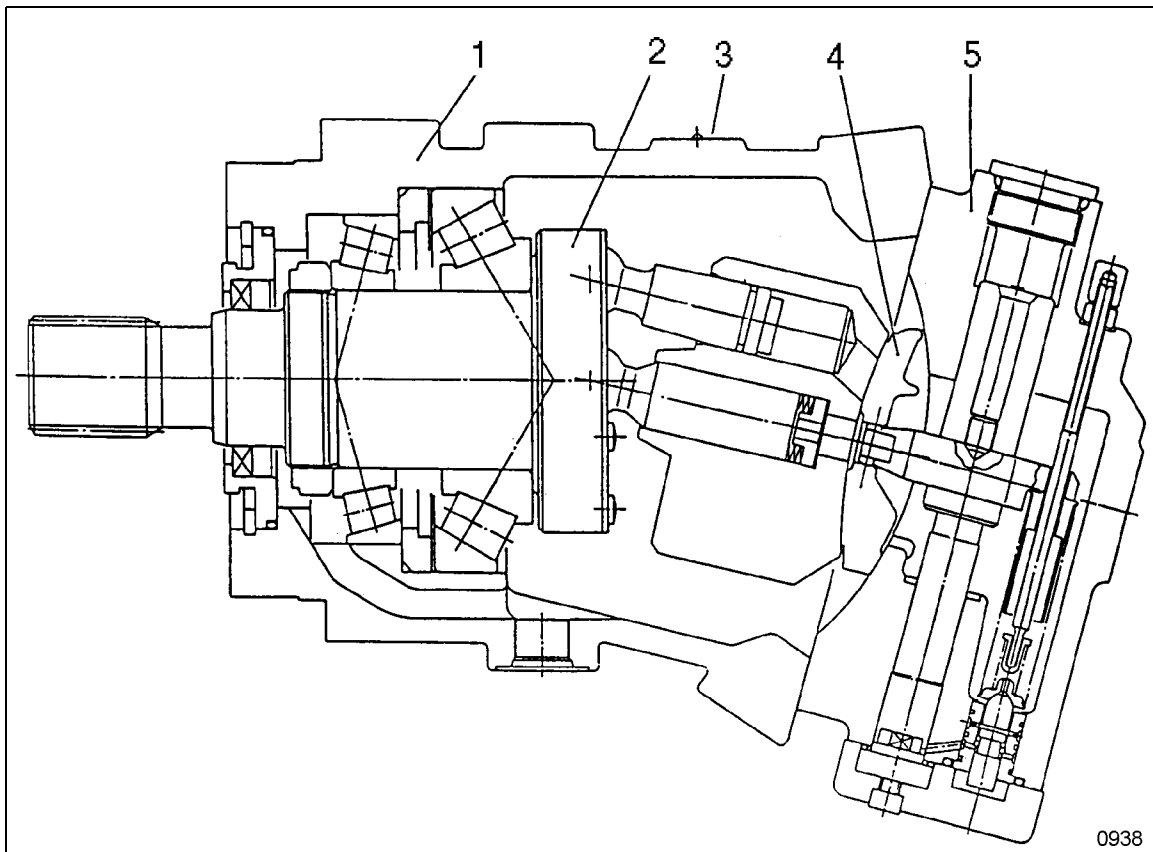


Figure 2

Reference Number	Description
1	Housing
2	Rotary Group
3	Main Valve

Reference Number	Description
4	Control Plate
5	Regulator

SPECIFICATIONS

Travel Motor	
Type	Bent Axis Piston
Displacement	45 – 114.7 cm ³ /r (2.75 – 7 in ³ /r)
Crossover Relief Valve Setting	360 kg/cm ² (5,120 psi)
Max. Supply Flow Rate	160 l/min (42 gal/min)
Max. Operating Speed	3,555 rpm
Max. Output Torque	60.7 kg•m (439 ft lbs)

TRAVEL MOTOR GENERAL DISASSEMBLY AND REASSEMBLY INSTRUCTIONS

RECOMMENDED TOOLS

Hexagon Wrench	4, 6, 8, 10, 17 mm
Spanner Wrench	17, 19, 26, 41, 51 mm
Long Nose Pliers	Nominal Size About 125
Plastic hammer	Medium Size
Snap Ring Pliers	50 - 130 for outer side
Driver	Medium Size
Grease	Spray Type Preferred
Cleaning Oil	Spray Type Preferred
Rubber Disk Assembly (See Figure 3)	To Prevent Cylinder Block from Releasing
Liquid Packing	Three Bond 1215

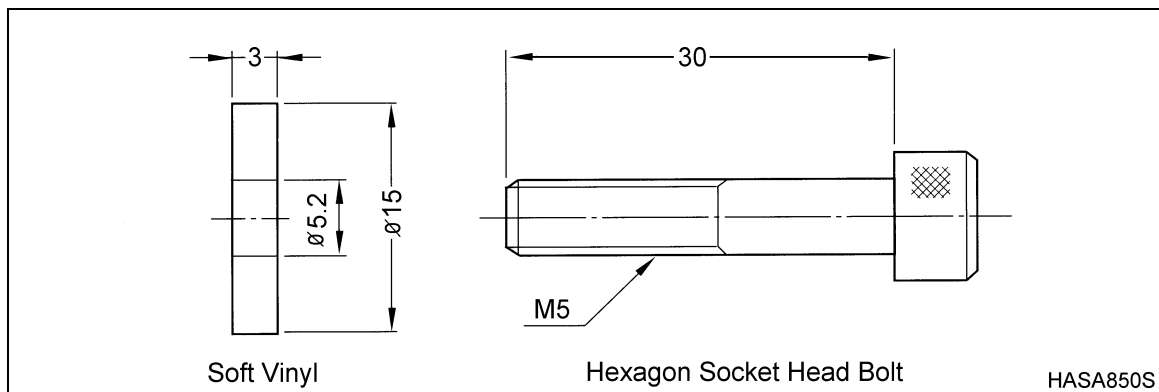


Figure 3

PRECAUTIONS FOR DISASSEMBLY AND ASSEMBLY

1. Replace rotary group with a new one as a complete assembly.
2. Make sure not to damage any adjustment screws, replace any damaged adjustment screw with new. Variance of set value may result with damaged equipment.
3. Drain oil from inside motor, clean outside and place clean paper, cloth, or gum mat on workbench prior to disassembly and assembly. Be careful not to damage any components, and prevent foreign objects from entering motor assembly.
4. Clean, lubricate (with operating oil), and inspect disassembled parts. Replace damaged parts before reassembling.

DISASSEMBLY OF TRAVEL MOTOR

APPEARANCE OF MOTOR

1. Appearance of motor side view.

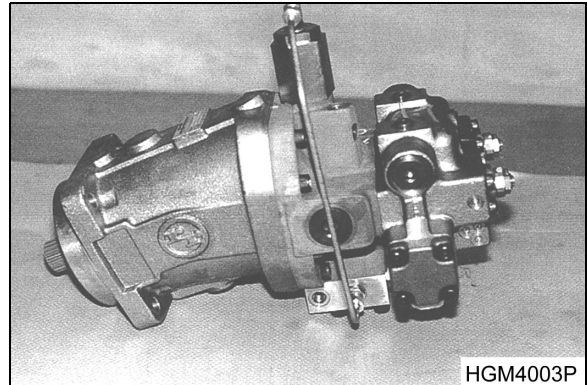


Figure 4

2. Appearance of motor rear view

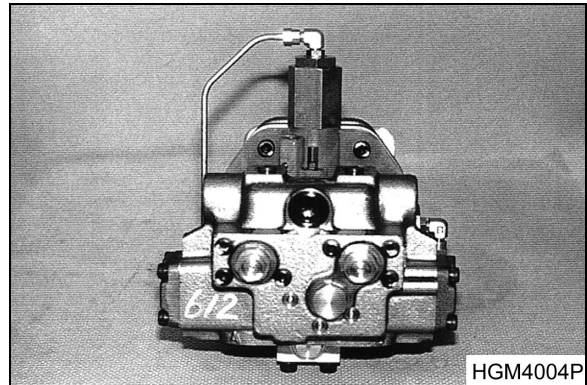


Figure 5

REMOVAL OF COUNTERBALANCE VALVE

1. Remove counterbalance valve by removing six, hex socket bolts.

NOTE: *The counterbalance valve is covered in this section after the travel motor.*

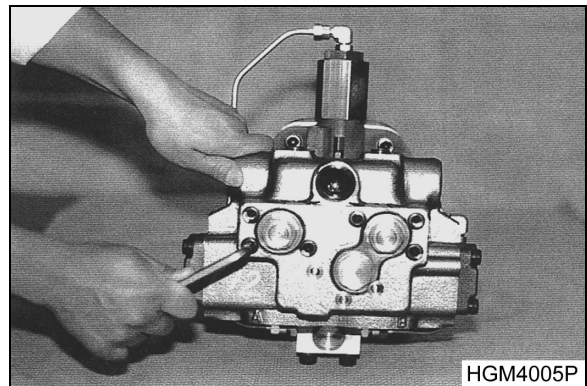


Figure 6

2. Do not adjust pressure adjusting screw at this time.

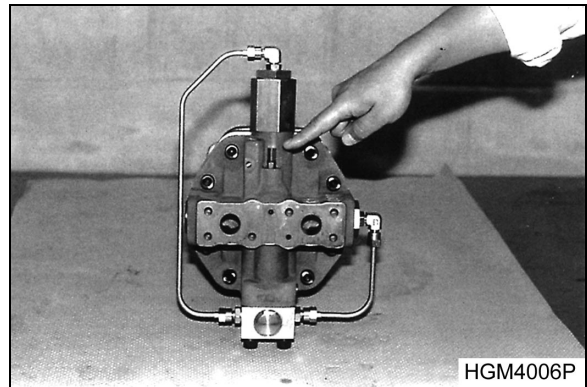


Figure 7

REMOVAL OF OUTER PIPING

1. Remove control valve to stroke limiter lubrication tube.

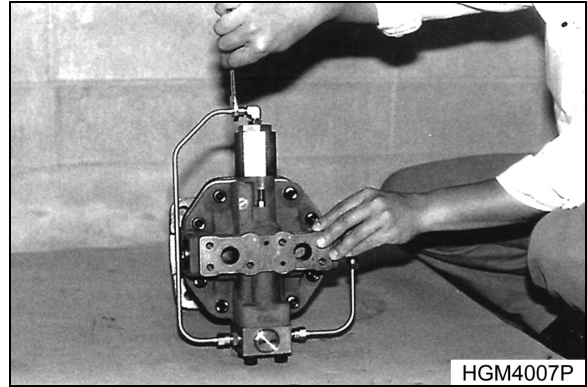


Figure 8

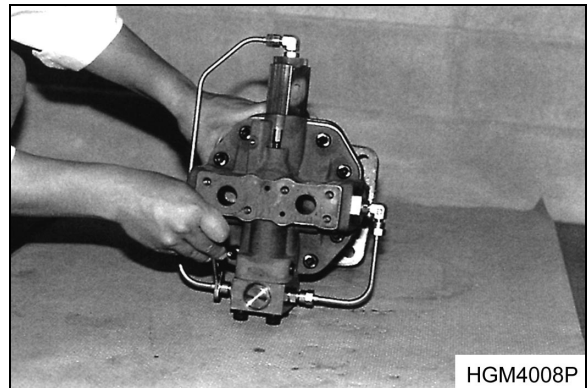


Figure 9

2. Remove control valve to regulator body lubrication tube.

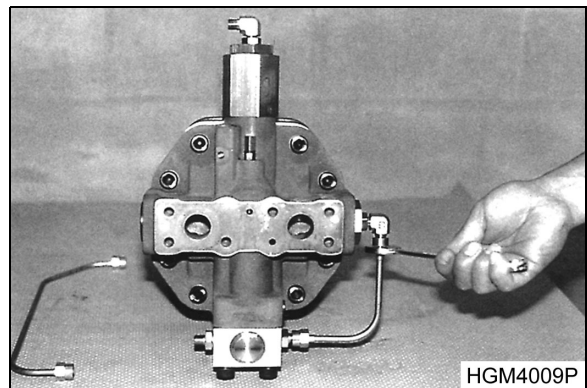


Figure 10

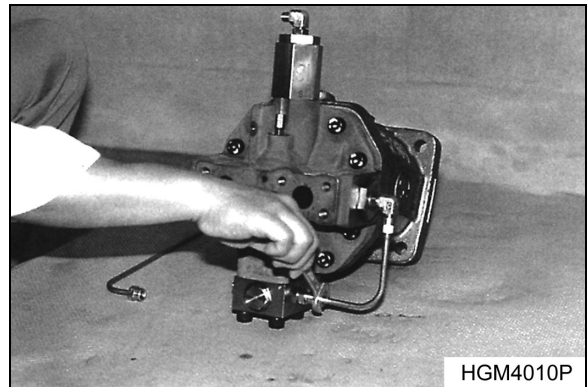


Figure 11

3. Remove 90° elbows from stroke limiter and regulator body.

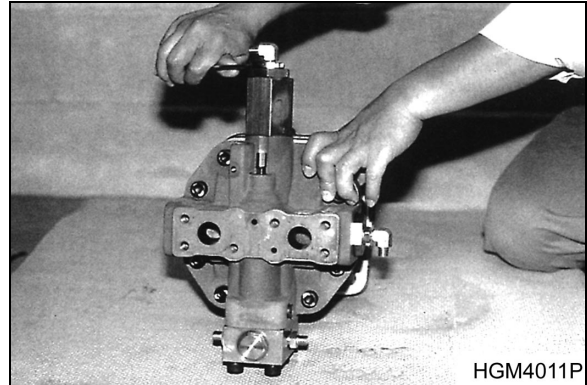


Figure 12

4. Remove nipples from control valve.

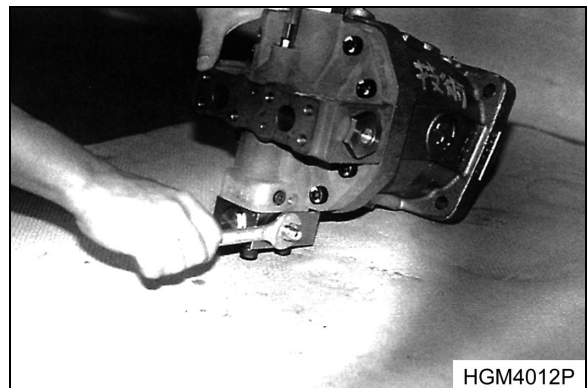


Figure 13

REMOVAL OF STROKE LIMITER

1. Remove stroke limiter assembly

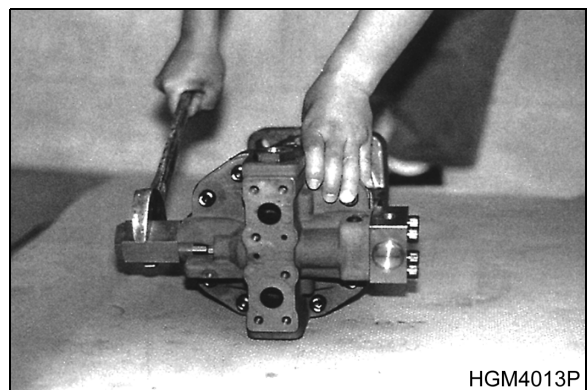


Figure 14

REMOVAL OF OIL SEAL

1. Remove C-type stop ring using snap ring pliers (51 mm).

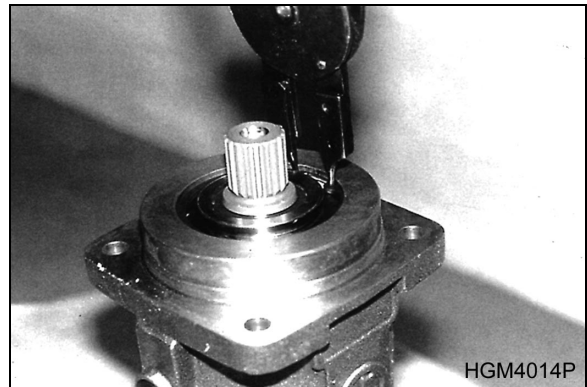


Figure 15

2. Remove seal case using 2 screw drivers inserted into groove.

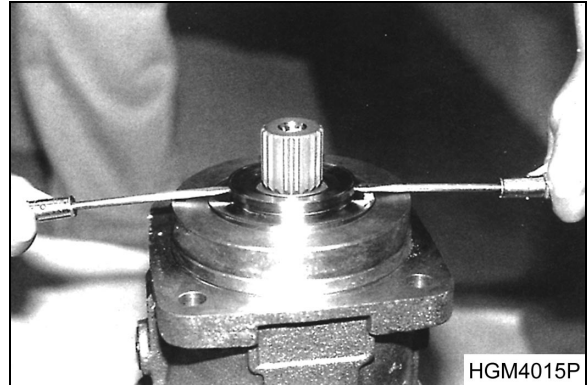


Figure 16

3. Remove case and pull out O-ring.

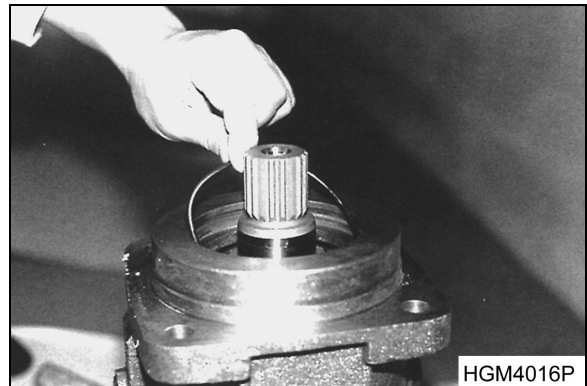


Figure 17

REMOVAL OF CONTROL UNIT

1. Remove eight hex socket bolts.

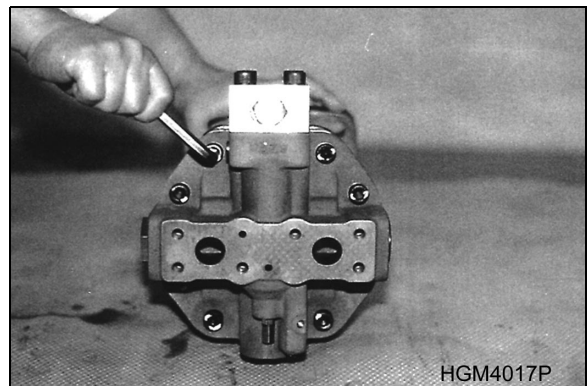


Figure 18

2. Turn motor so that shaft faces down and lift main control body up and out.

NOTE: *During this step, control plate may come out with main control body, be careful not to drop the control plate and damage cylinder block.*

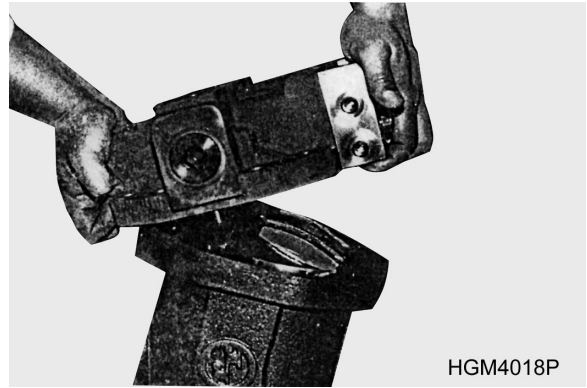


Figure 19

3. Remove control plate.



Figure 20

4. Install rubber disc assembly, which is used to fix cylinder block to prevent separation.

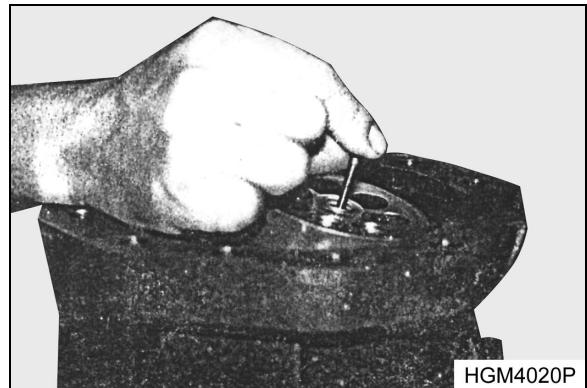


Figure 21

5. Remove parallel pins with pliers.

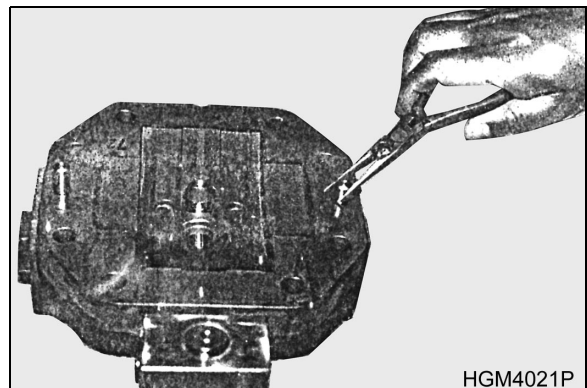


Figure 22

6. Remove plug.

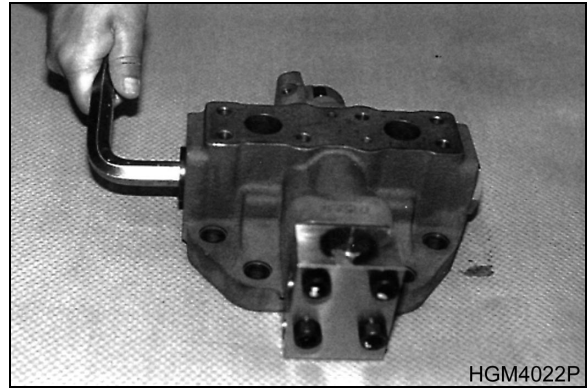


Figure 23

7. Remove bushing.

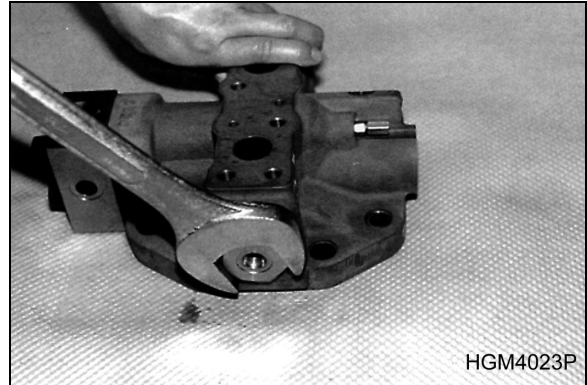


Figure 24

REMOVAL OF CONTROL VALVE

1. Loosen four hex socket bolts and remove cover.

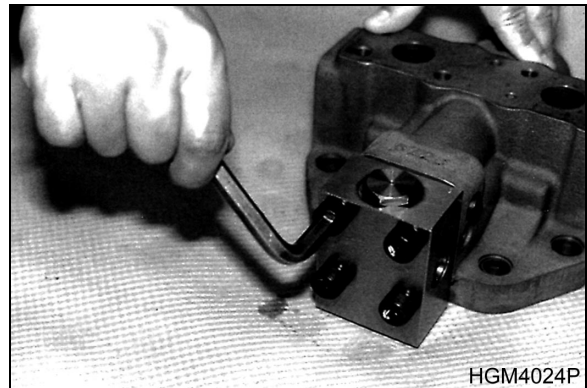


Figure 25

2. Remove O-ring.

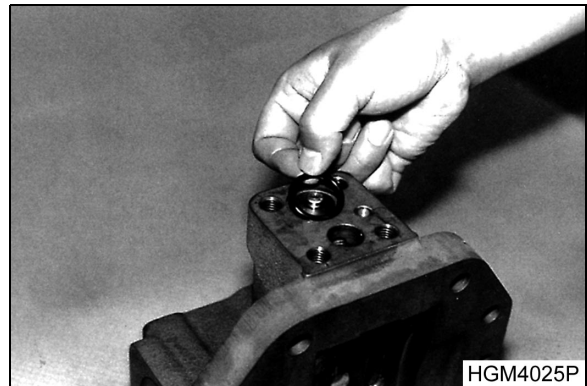


Figure 26

3. Remove spool and barrel, being careful not to cut piston ring on outside of barrel.

NOTE: *If spool and barrel are not pulled out smoothly, hold the groove part of spool slightly, using a long nose pliers. Remove spool being careful not to scratch it.*

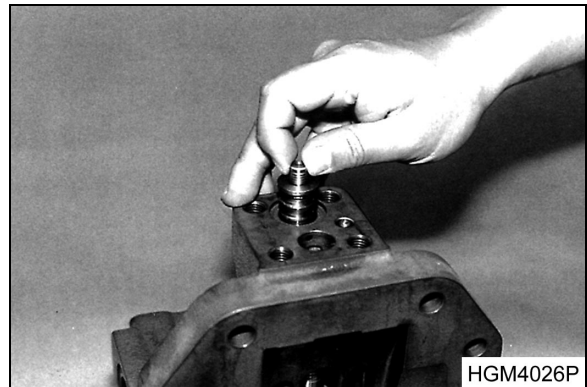


Figure 27

4. Remove spring seats.

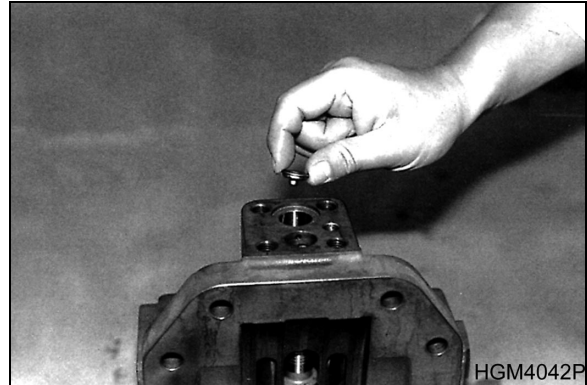


Figure 28

5. Remove large spring.

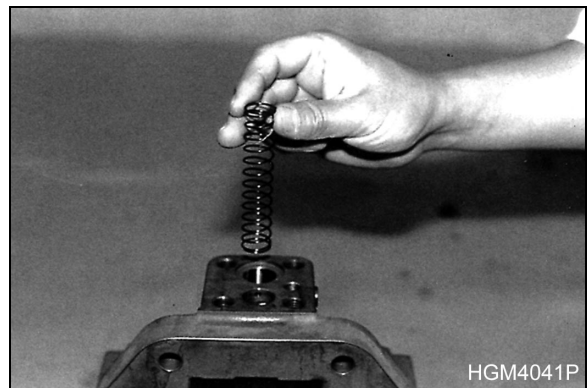


Figure 29

6. Remove small spring.

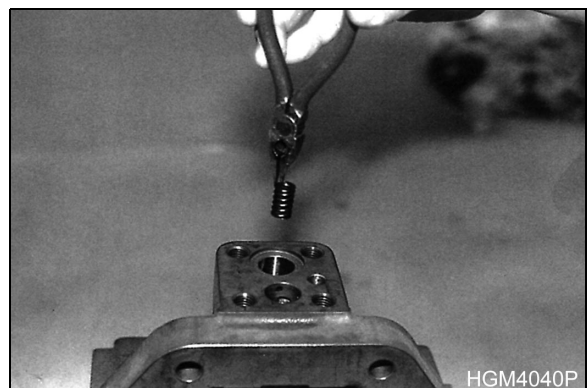


Figure 30

7. Remove spring seats.

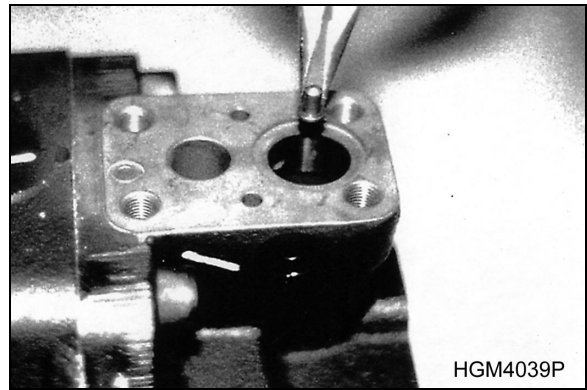


Figure 31

8. Arrange removed components, as shown.

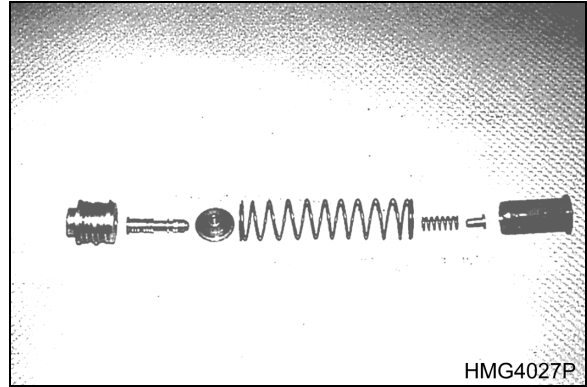


Figure 32

DISASSEMBLE CONTROL VALVE

1. Remove hex head plug.

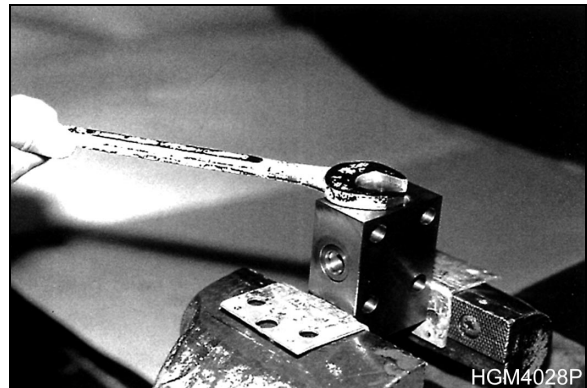


Figure 33

2. Remove spring.

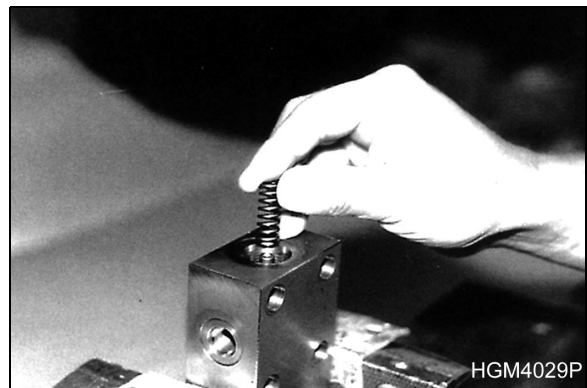


Figure 34

3. Remove spool.

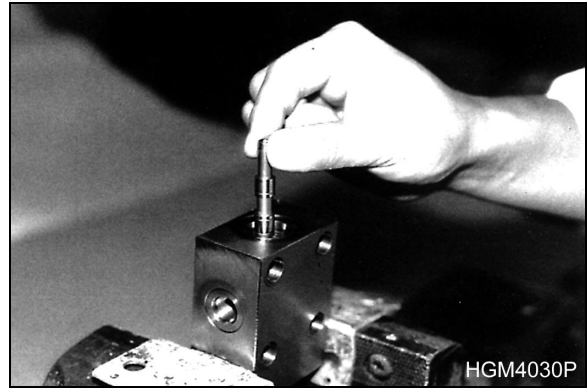


Figure 35

4. Remove socket head plug.

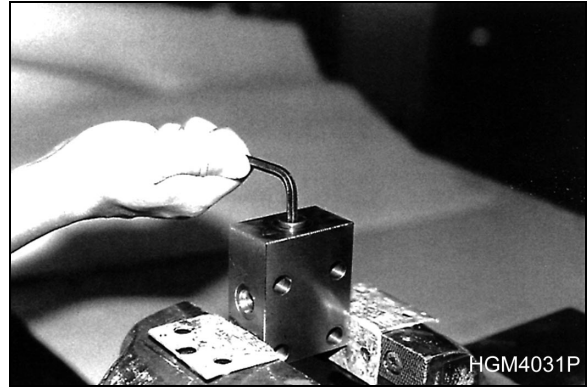


Figure 36

5. Arrange removed components as shown.

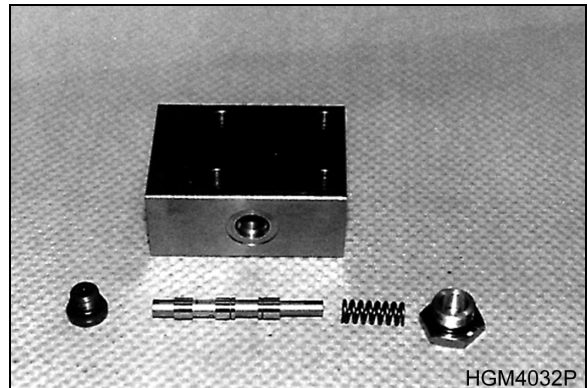


Figure 37

DISASSEMBLE STROKE LIMITER

1. Remove bushing.

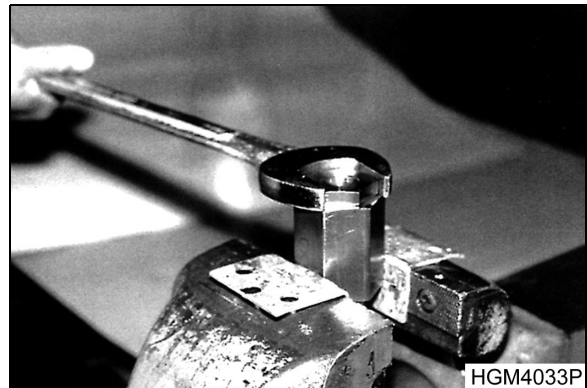


Figure 38

2. Remove piston.

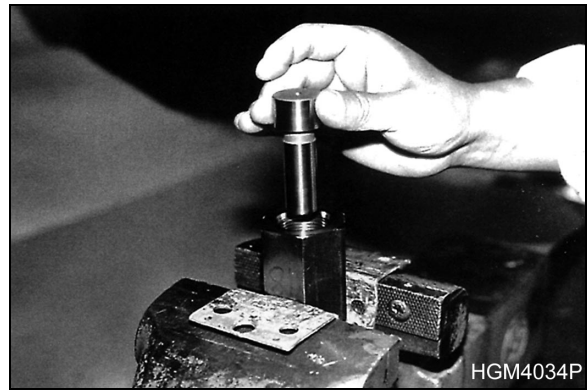


Figure 39

REASSEMBLE STROKE LIMITER

1. Install piston.

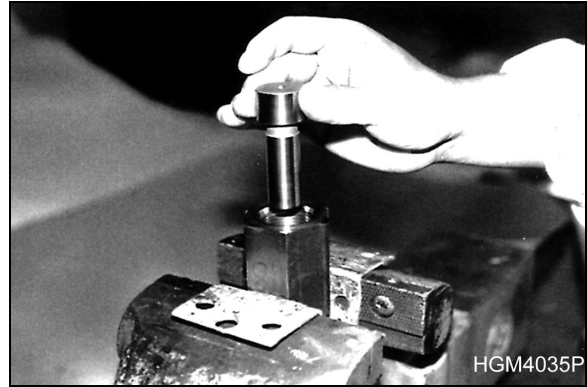


Figure 40

2. Install bushing.



Figure 41

REASSEMBLE CONTROL VALVE

1. Install socket head plug.

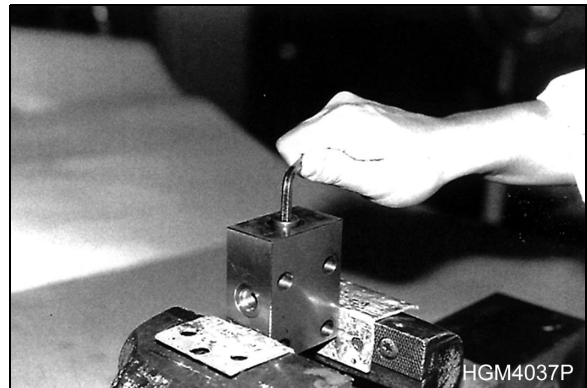


Figure 42

2. Install spool.

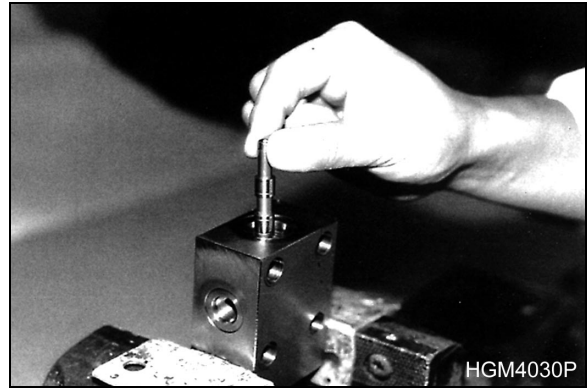


Figure 43

3. Install spring.

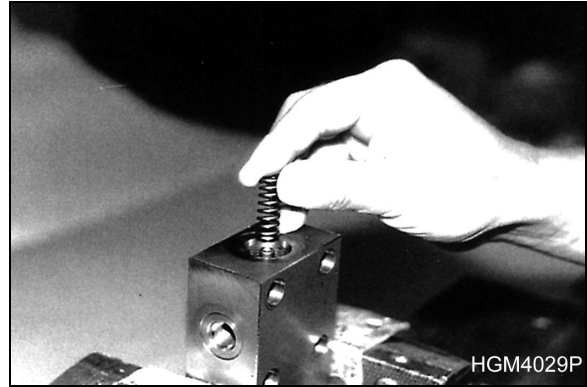


Figure 44

4. Install hex head plug.

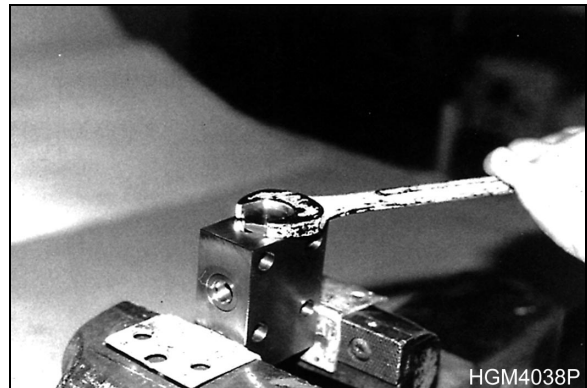


Figure 45

INSTALLATION OF CONTROL VALVE

1. Attach spring seats.

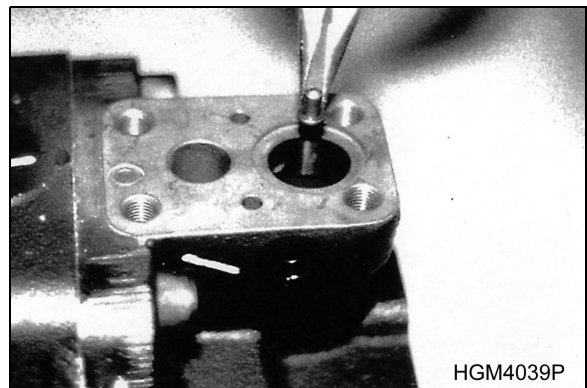


Figure 46

2. Attach small spring.

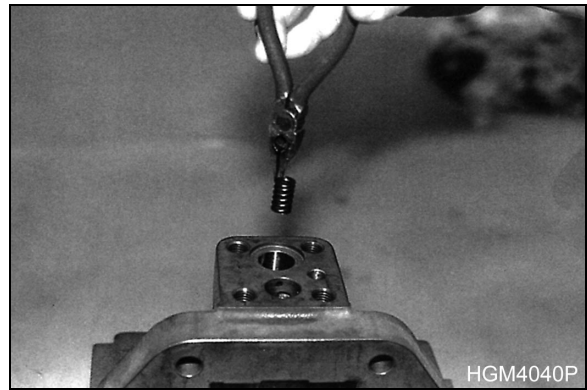


Figure 47

3. Attach large spring.

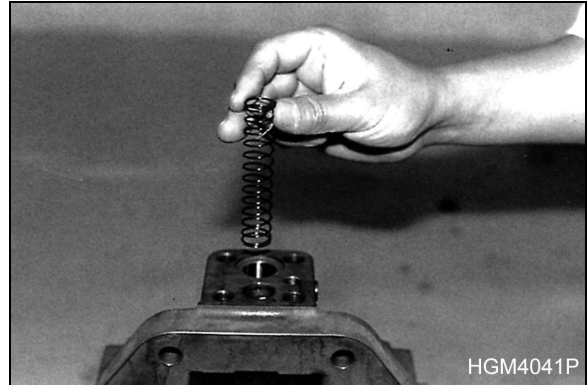


Figure 48

4. Attach spring seat.

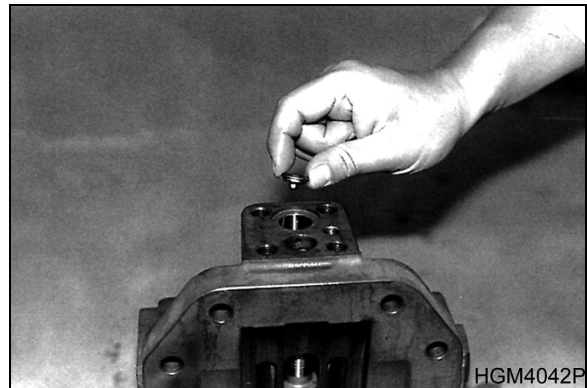


Figure 49

5. Insert spool in middle of barrel.



Figure 50

6. Install barrel into main control body, while pushing piston ring into groove with flat screw driver, being careful not to cut piston ring.



Figure 51

7. Install O-ring.

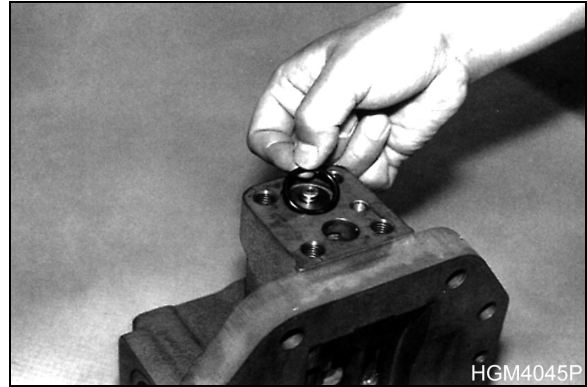


Figure 52

8. Secure control valve with four socket bolts.
NOTE: Torque to 12.5 kg•m (90 ft.lb).

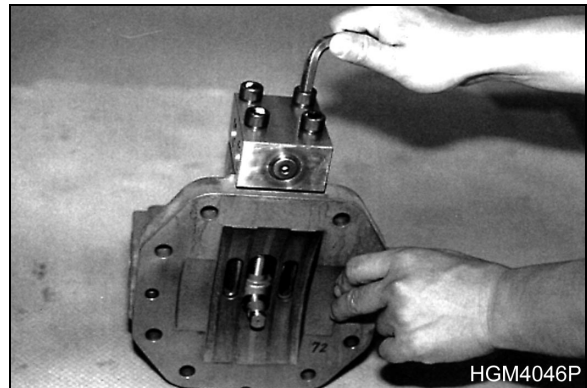


Figure 53

REASSEMBLY OF TRAVEL MOTOR

ASSEMBLY OF CONTROL UNIT

1. Install plug.

NOTE: Torque to 12.5 kg•m (90 ft.lb).

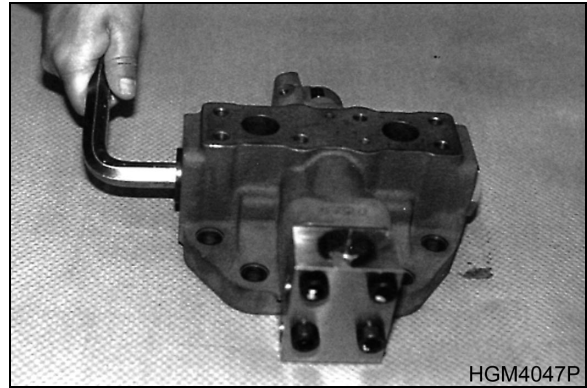


Figure 54

2. Install bushing.

NOTE: Torque from 22 - 27 kg•m (159 - 195 ft.lb).

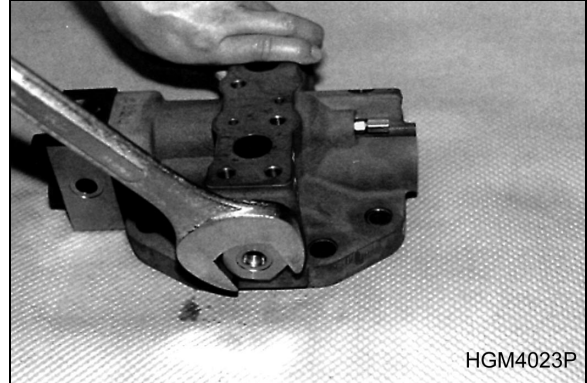


Figure 55

3. Remove rubber disc assembly, which is used to fix cylinder block.

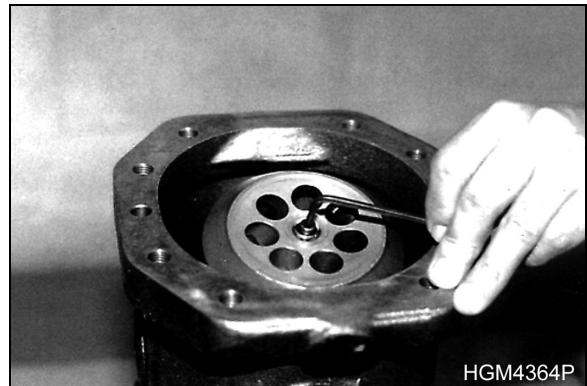


Figure 56

4. Check that control plate is installed in the correct position. Grease control plate and install in main control body.

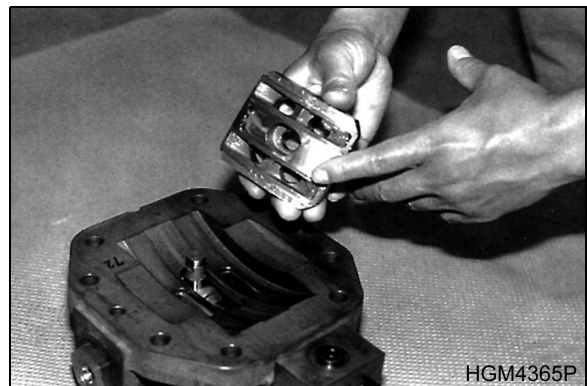


Figure 57

5. Grease top surface of control plate and recheck that it is installed in the right position.

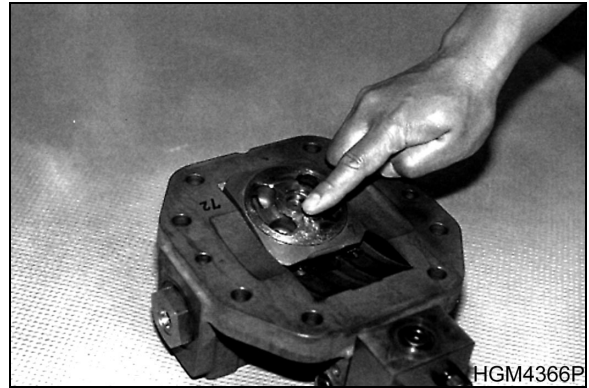


Figure 58

6. Install main control body and parallel pins. Clean surface that contacts housing.

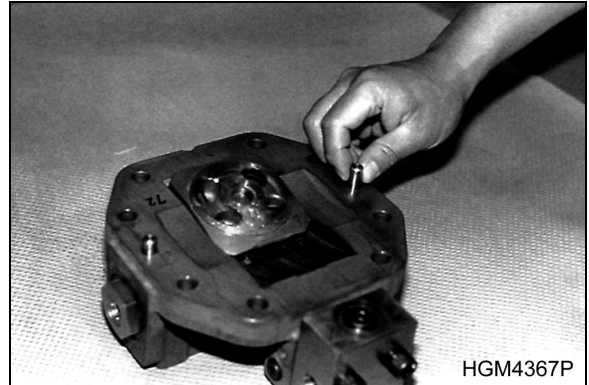


Figure 59

7. Clean surface that contacts main control body and apply Three bond 1215 (allow sufficient time to dry).

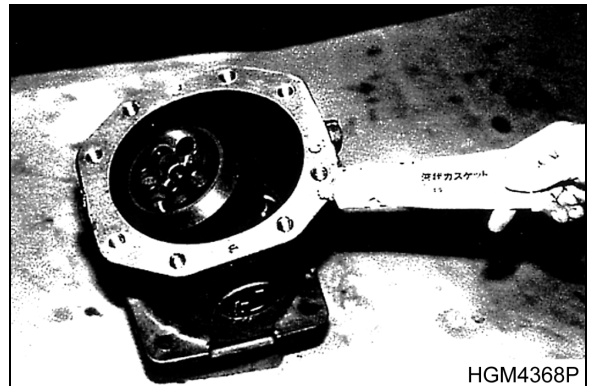


Figure 60

8. Attach main control body to housing, being careful not to drop control plate.

NOTE: *Though this figure does not show parallel pin on connecting side, assemble after engaging it.*

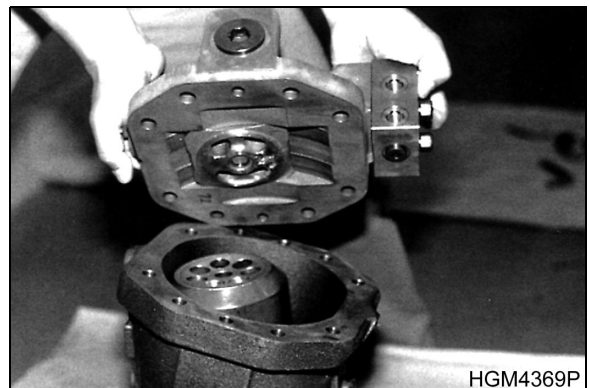


Figure 61

9. Tighten eight, hex socket bolts.

NOTE: Torque to 12.5 kg•m (90 ft.lb).



Figure 62

INSTALLATION OF OIL SEAL

1. Install O-ring.

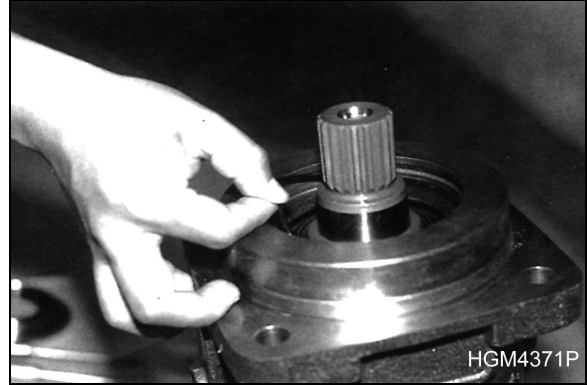


Figure 63

2. Install seal case.

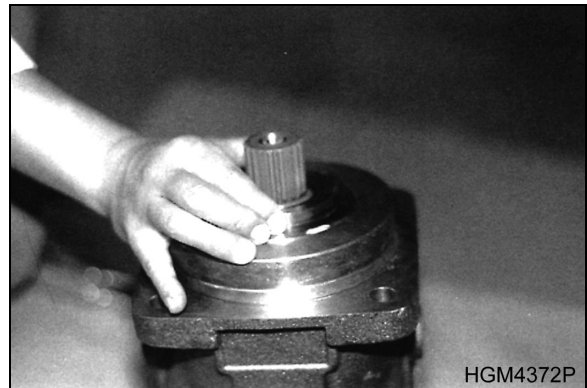


Figure 64

3. Secure seal case with snap ring.

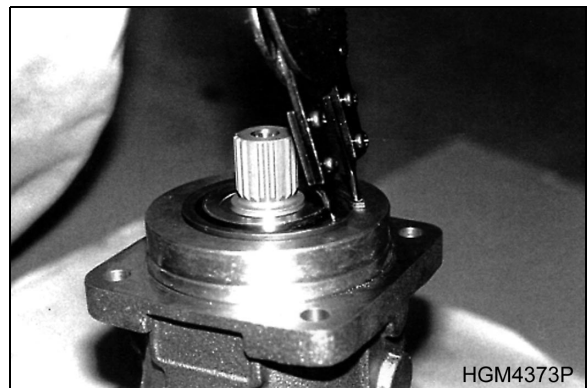


Figure 65

4. Secure C-type snap ring by tapping with plastic hammer and driver.

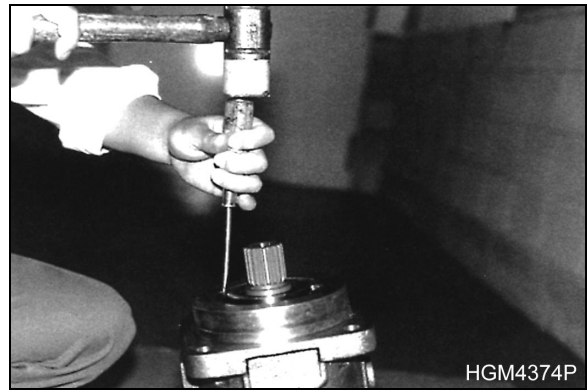


Figure 66

INSTALLATION OF STROKE LIMITER

1. Install stroke limiter assembly.

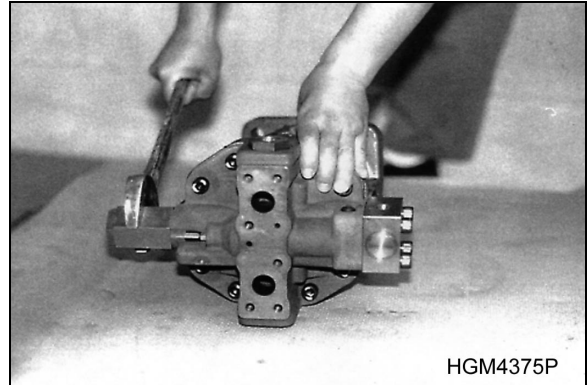


Figure 67

INSTALLATION OF OUTER PIPING

Install connectors to control valve.

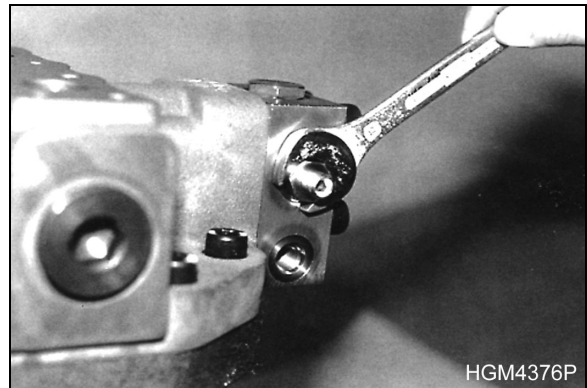


Figure 68

2. Install 90° elbows to stroke limiter and control unit body.

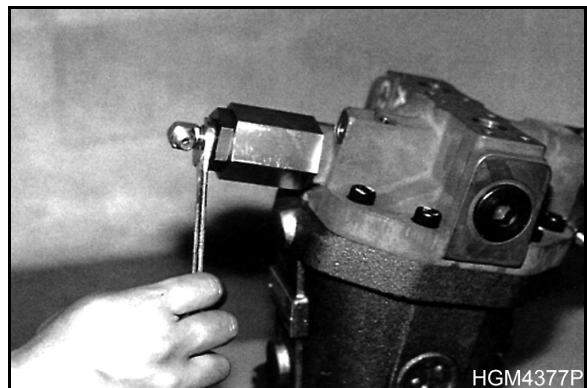


Figure 69

3. Install lubrication lines from control valve to control unit and stroke limiter.

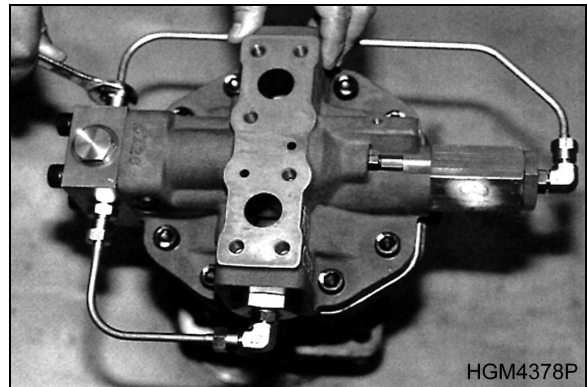


Figure 70

INSTALLATION OF COUNTERBALANCE VALVE

1. Install counterbalance valve with six hex socket bolts.

NOTE: Torque to 7 kg•m (51 ft lb).

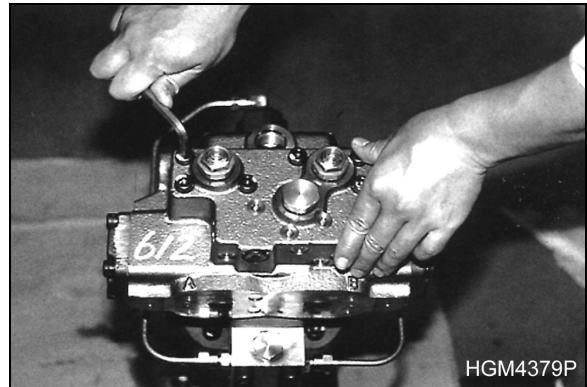


Figure 71



BRAKE 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 130W-V	0001 and Up

TABLE OF CONTENTS

Parts List	3
Specifications	4

PARTS LIST

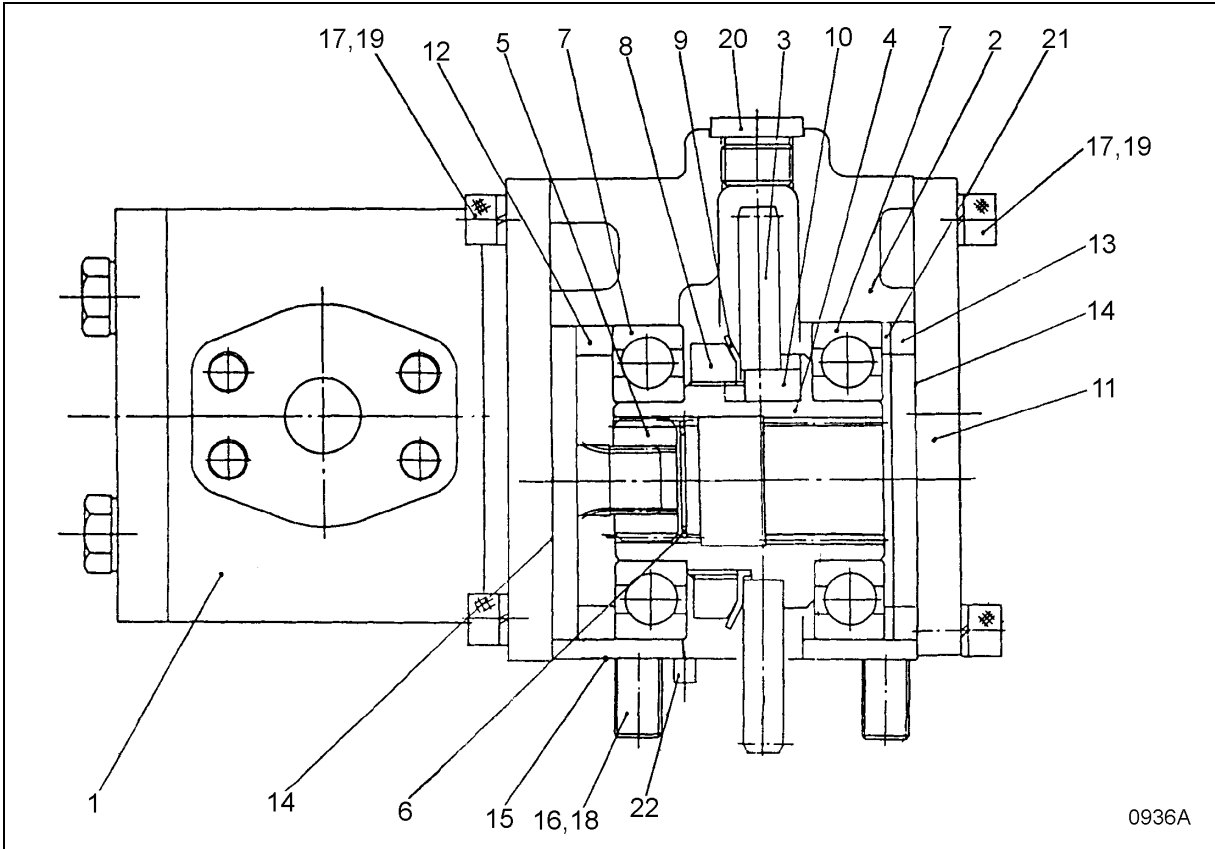


Figure 1

Reference Number	Description
1	Gear Pump
2	Case
3	Gear
4	Shaft
5	Coupling
6	O-ring
7	Bearing
8	Nut
9	Lock Washer
10	Key
11	Cover
12	Distance Piece
13	Distance Piece

Reference Number	Description
14	Packing
15	Packing
16	Bolt
17	Bolt
18	Spring Washer
19	Spring Washer
20	Plug
21	Shim Shim, 0.5 mm Shim, 0.3 mm Shim, 0.1 mm
22	Pin

SPECIFICATIONS

Brake Pump	
Type	Gear
Displacement	6.5 cm ³ /r (0.4 in ³ /r)
Max Flow Rate	12.9 l/min @ 1,995 rpm (3.41 gal/min)
Gear Ratio	1:1026



MAIN PUMP (UCHIDA)



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 130W-V	0001 and Up

TABLE OF CONTENTS

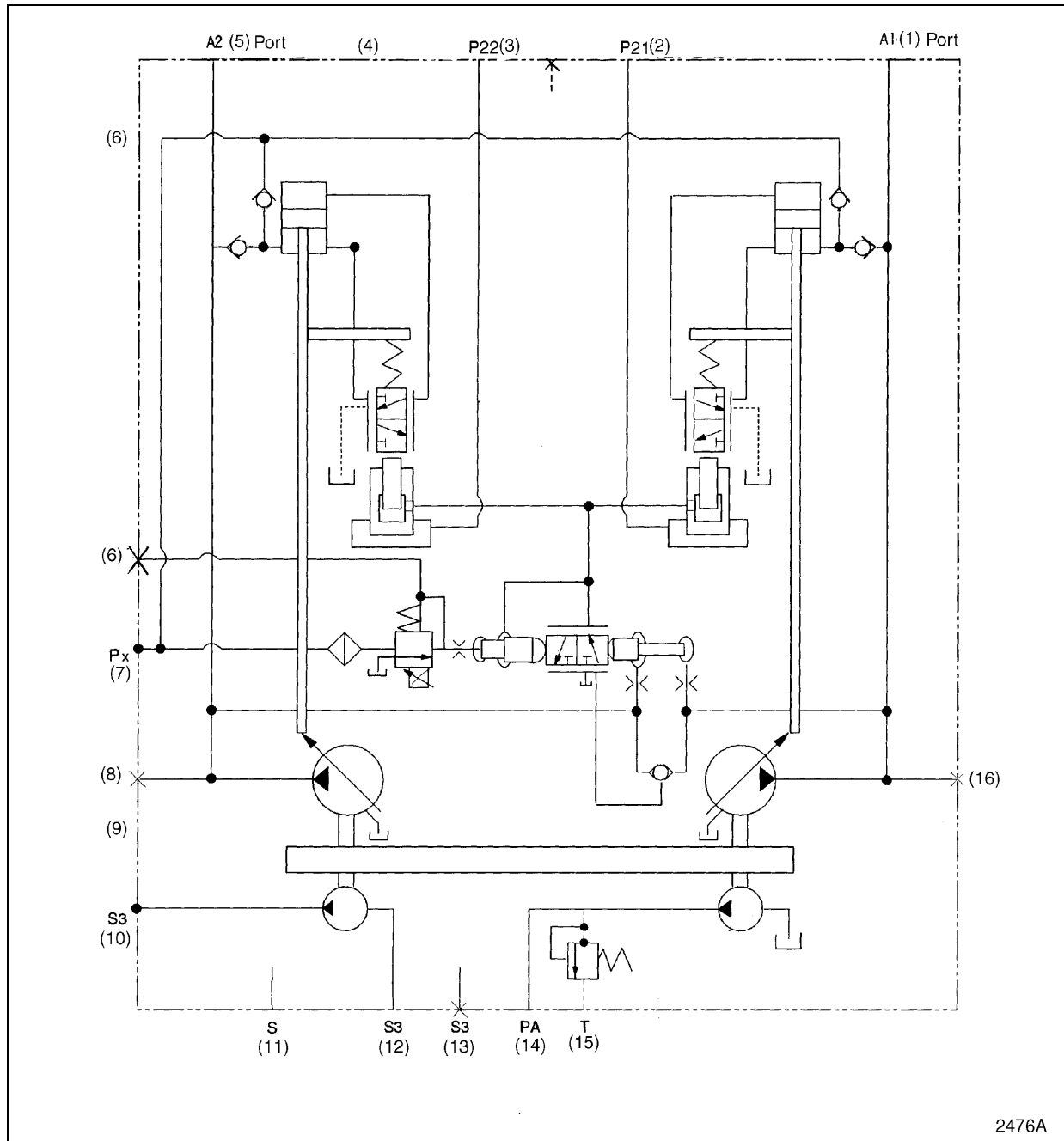
General Description.....	3
Theory of Operation	3
Regulator.....	7
Maximum Discharge Control.....	11
Adjustment and Control of Horsepower with External Command Current	11
Parts List	13
Specifications	14
SpecialTools and Materials	15
SpecialTools	15
Lubricants and Sealants	15
Disassembly	16
Removing Control Unit.....	16
Disassembling Regulator	19
Disassembling Regulator Cover	24
Removing DRE2K (Electronic Proportional Reducing Valve)	27
Removing Relief Valve	28
Removing Rotary Group	28
Cleaning and Inspection (Wear Limits and Tolerances)	32
Reassembly.....	33
General Instructions	33
Installing Rotary Group	33
Relief Valve	36
Installing Regulator Cover Assembly	36
Assembling Regulator	40
Installing Regulator	46

GENERAL DESCRIPTION

THEORY OF OPERATION

The main pump consists of an input shaft and two, inclined shaft, variable capacity piston pumps, connected to each other with a 1:1 gear ratio. The pump includes a gear type pilot pump. The control circuitry is shown in Figure 1.

A rotary drive group on the drive shaft turns in the same direction as the motor, while a rotary drive group on the idle shaft turns in the opposite direction.



2476A

Figure 1

Reference Number	Description
1	Intake Port
2	Pilot Pressure Intake Por
3	Air Release Plug
4	Pilot Pressure Output Port
5	Output Port
6	Gauge Port
7	Pilot Port
8	Gauge Port

Reference Number	Description
9	Brake Pump
10	Output Port
11	Main Pump
12	Brake Pump
13	Oil Exit
14	Pilot Pump
15	Tank Port
16	Gauge Port

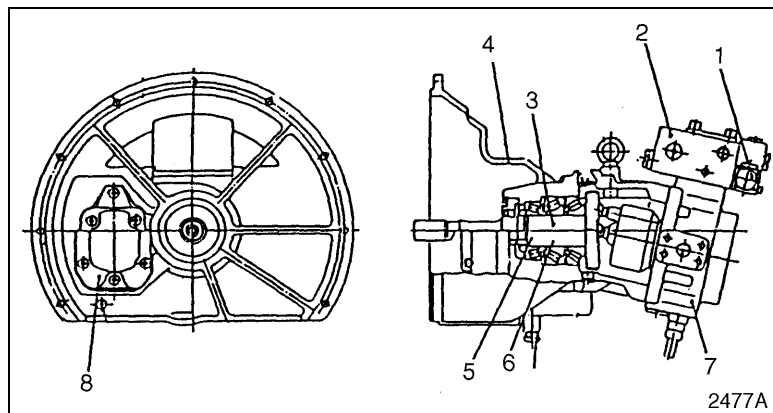


Figure 2

Reference Number	Description
1	Electrical Input Valve
2	Regulator Cover
3	Rotary Group (Drive Shaft)
4	Housing

Reference Number	Description
5	Rotary Group (Idle Shaft)
6	Relief
7	Regulator
8	Pilot Gear Pump

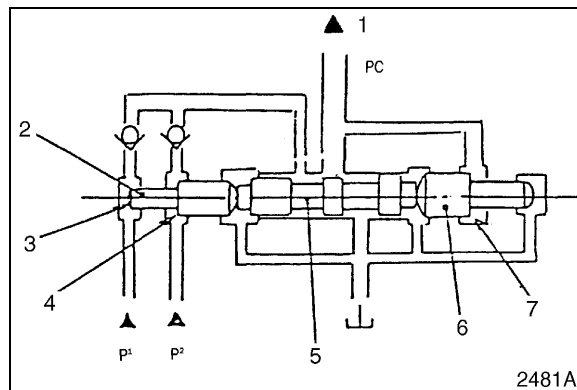


Figure 3

Reference Number	Description
1	Piston (a)
2	Retainer
3	Piston (b)
4	Rod

Reference Number	Description
5	Plug
6	Control Plate
7	Cylinder Block

Reference Number	Description
1	Regulator Body

Both rotary groups take in hydraulic oil from the same inlet port (S). Oil is separated in the regulator and is output through ports A1 and A2. See Figure 2 and Figure 3.

Rotary groups are made up of 7 pistons and a cylinder block. Each cylinder block moves on a round control plate, supplying oil to crescent shaped ports.

A control rod is connected to a piston which is mounted in a hole in the center of the control plate. The piston moves up and down inside the cylinder block and the length of its stroke determines the angle of the plate. Maximum plate angle is limited by a plug, while minimum angle is restricted by a retainer.

The pilot pump is connected to the rotary group on the idle shaft and splined to the drive shaft.

A relief valve, mounted in the pilot line, maintains constant pressure. See Figure 3 and Figure 4.

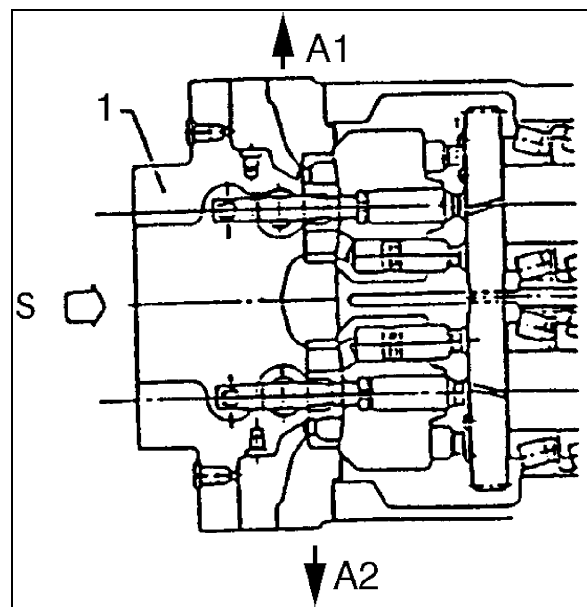


Figure 4

REGULATOR

The regulator controls the pressure of both pumps so that output is constant and simultaneous.

See Figure 5.

Maximum discharge is controlled by external "negative control" and horsepower is controlled by external electrical control.

Reference Number	Description
1	Secondary Spring
2	Secondary Spring
3	Primary Spring
4	Output Curve

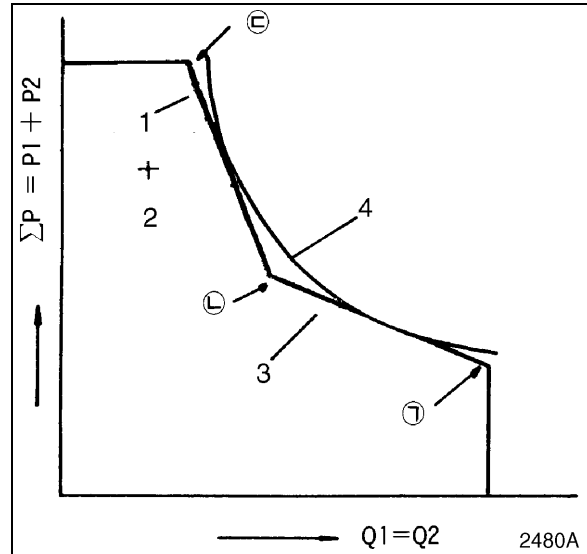


Figure 5

Outlet pressures of the drive and idle pumps (P1 and P2) operate piston A and pressurized areas have the same pressure. Outlet pressures (P1 or P2) are regulated by a check valve, reduced by a spool and sent to the pilot piston which controls the output of oil. This reduced pressure is sent to Piston B. See Figure 6 and Figure 7.

Reference Number	Description
1	Pilot
2	Piston
3	Piston A
4	Surface A
5	Surface A
6	Spool
7	Piston B
8	Piston B

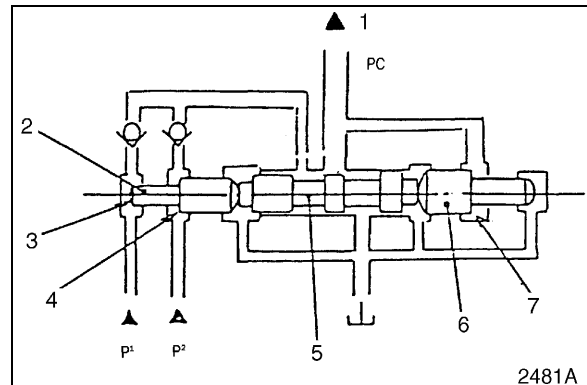


Figure 6

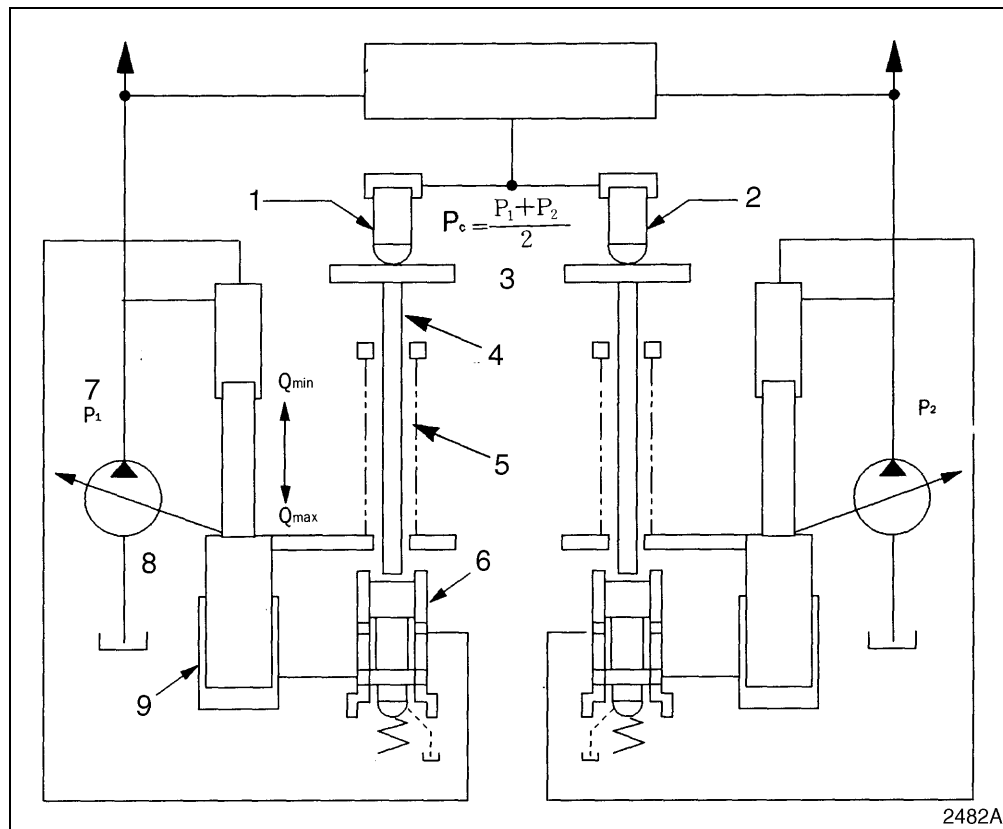


Figure 7

Reference Number	Description
1	Pilot Piston
2	Pilot Piston
3	Control Spring
4	Primary Spring
5	Secondary Spring

Reference Number	Description
6	Spool
7	Small Stroke
8	Large Stroke
9	Piston

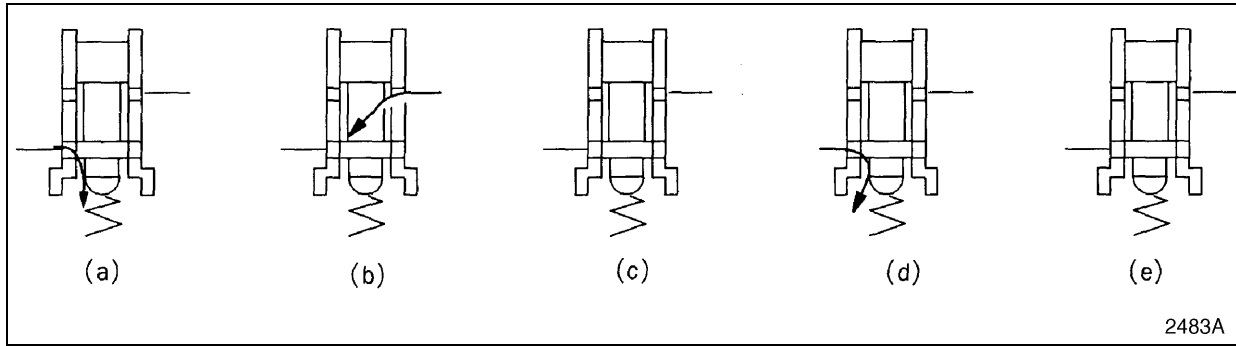


Figure 8

Equation 1

If control pressure = PC, then

$$PC \times B = P1 \times A + P2 \times A$$

$$PC = A/B(P1 + P2)$$

If $B = 2A$, then

$$PC = 1/2(P1 + P2)$$

Since control pressure is equal to the output pressure of P1 and P2, the pilot piston always receives a pressure of $P1 + P2/2$ which results in constant and simultaneous output.

Outlet pressure is applied to the smaller end of each piston(b) and controlled pressure is applied to the pilot pistons of both pumps.

When the primary, secondary and adjustment springs are set the same, output maintains the relationship $P = P1 + P2$ and $Q1 + Q2$.

When the outlet pressure is below the point where the plate starts to turn, see Figure 5 and Figure 8 (a), outlet pressure on the larger end of the piston is the same as the tank pressure. When the pressure increases, it overcomes the force of the primary spring and the adjusting spring and pushes on the spool. Pressure is transferred to the larger end of the piston through the corner of the spool. See Figure 8 (b).

Piston (b) is moved to a minimally turned position by the force produced by the area ratio between the larger and smaller ends of the piston. The piston moves into a position where the force applied to the pilot piston is balanced by the force of the control spring and adjustment spring, which opens the spool passage and maintains the angle of the plate. See Figure 8 (c).

In the power range A to B, the primary spring expands, while in the power range B to C, the primary and secondary spring expand. See

Figure 5. When the output pressure falls, the power of the control spring and the adjustment spring overcomes the power of the pilot piston, the spool is pushed up and oil flows to the tank from the larger end of the piston. See Figure 8 (d).

Force applied to the smaller end of the piston and the force of the control spring move the piston until the plate is turned into its maximum position. See Figure 8 (e). This position and the pressures are balanced.

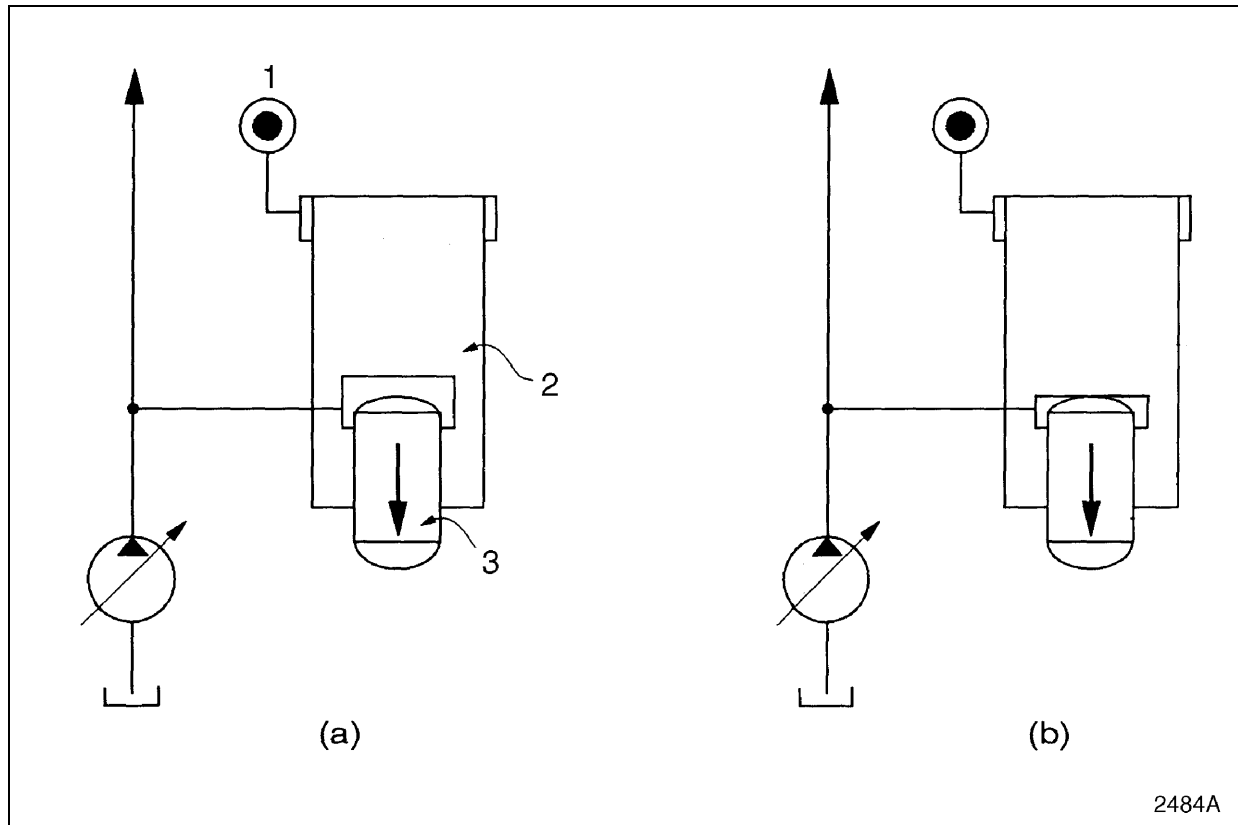


Figure 9

Reference Number	Description
1	External Control Pressure
2	External Control Pressure Piston

Reference Number	Description
3	Pilot Piston

Maximum Discharge is controlled by a valve on the main pump which conserves power and prevents heat build up. When output pressure exceeds the external control pressure established, it moves an external control piston, which controls the pilot piston. See Figure 9.

Output quantity (Q) is determined by external pressure (P2). See Figure 10. Since the external control piston is larger than the pilot piston, when output pressure rises, the quantity of oil remains constant and the external control takes over. See Figure 9.

Adjusting the current that flows to the electronic proportional reducing valve changes the horsepower setting of the pump between S, H or H Max. See Figure 11.

The electronic proportional reducing valve reduces the pressure of oil coming from the pilot gear pump, proportionately based on the electrical setting, and influences the balance of the pressure balance control valves. See Figure 11.

Pressure (Pp) from the electronic proportional reducing valve is applied to area C of piston B. See Figure 11 and Figure 12.

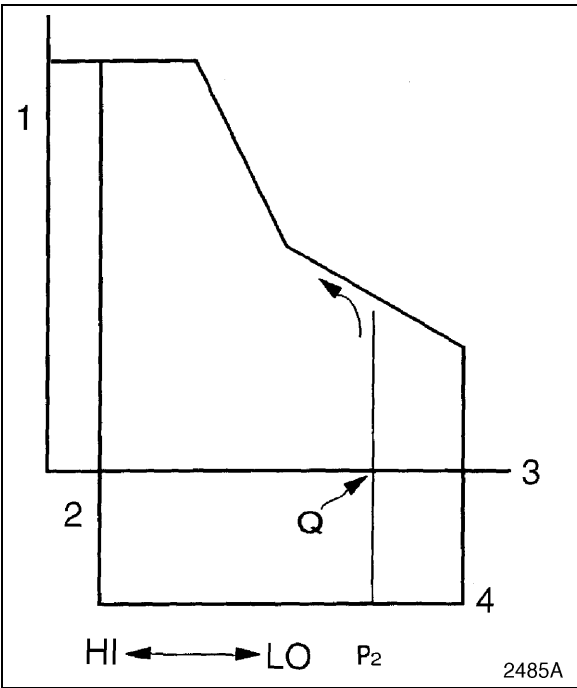


Figure 10

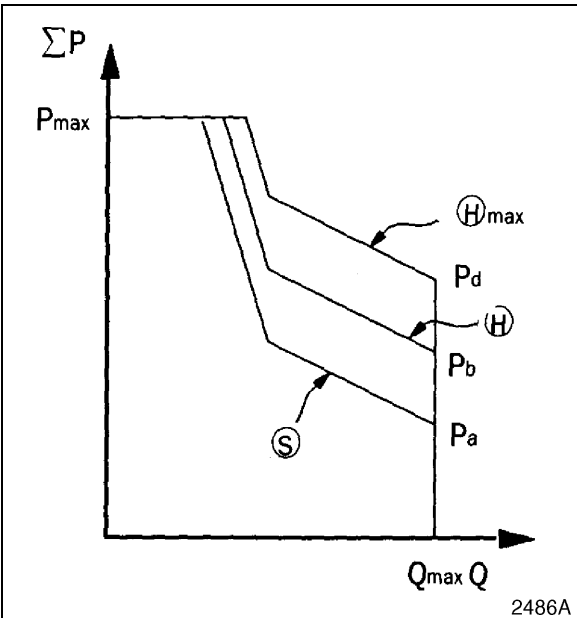


Figure 11

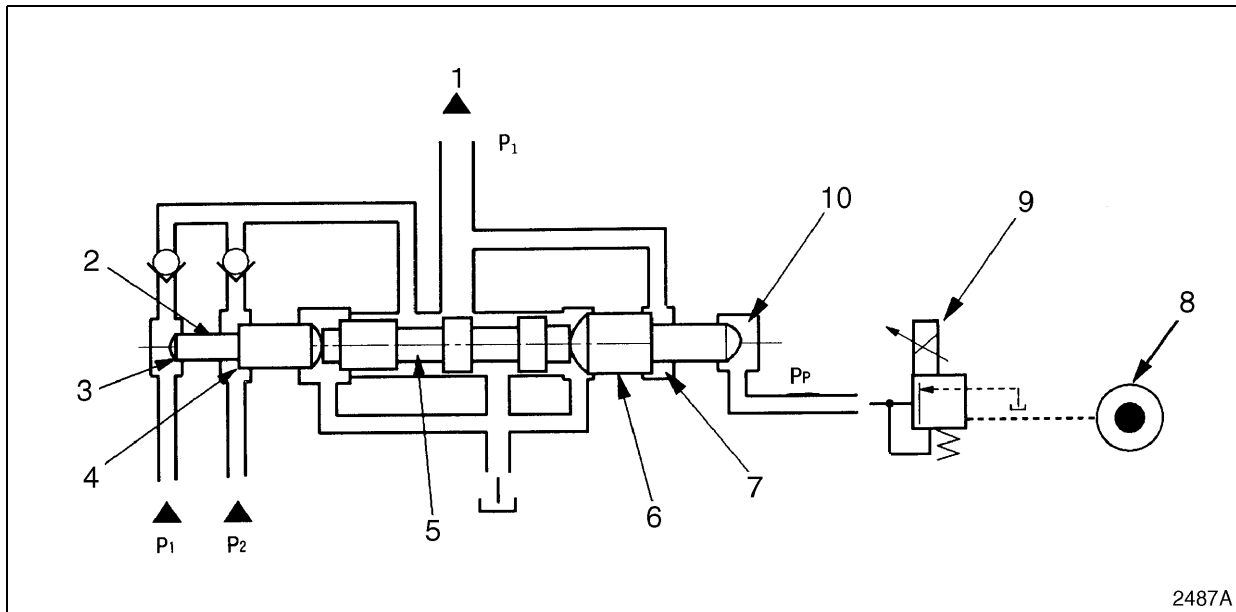


Figure 12

Equation 2

If pilot piston control pressure is PC, then,

$$PC \times B + Pp \times C = (P1 + P2) \times A$$

And where, $B = 2A$

$$PC = 1/2(P1 + P2)C/B \cdot Pp$$

When there is no current flowing through the electronic proportional reducing valve ($I = \text{mA}$ and $Pp = 0 \text{ kg/cm}^2$), Equation 1 becomes equal to Equation 2 and setting L controls constant simultaneous control. At this time, if initial pressure is Pa, then $P1 - P2 = Pa$ and in Equation 2, $PC = 1/2 Pa$ and oil flow is reduced.

When electric current flows through the electronic proportional reducing valve, pressure Pp is generated, pump output increases and Pa =

$P1 + P2$. In Equation 2, $PC = Pa/2$, $-C/B \cdot Pp < Pa/2$. The quantity of oil does not decrease, but output pressure does increase

When $PC = P1 + P2$, outlet pressure rises and

$PC = (1/2 Pp - C/B Pp) = Pa/2$. When current flows through the electronic proportional reducing valve, if the pressure is not higher, oil flow will not decrease. In other words, when electricity flows, horsepower goes up H Max. See Figure 11.

If engine RPM is converted into a current value, which is fed back to the pump, current value is reduced which lowers the pumps horsepower when engine RPM is reduced during overload. The current value is increased to increase horsepower when engine RPM increases due to a surplus of horsepower.

PARTS LIST

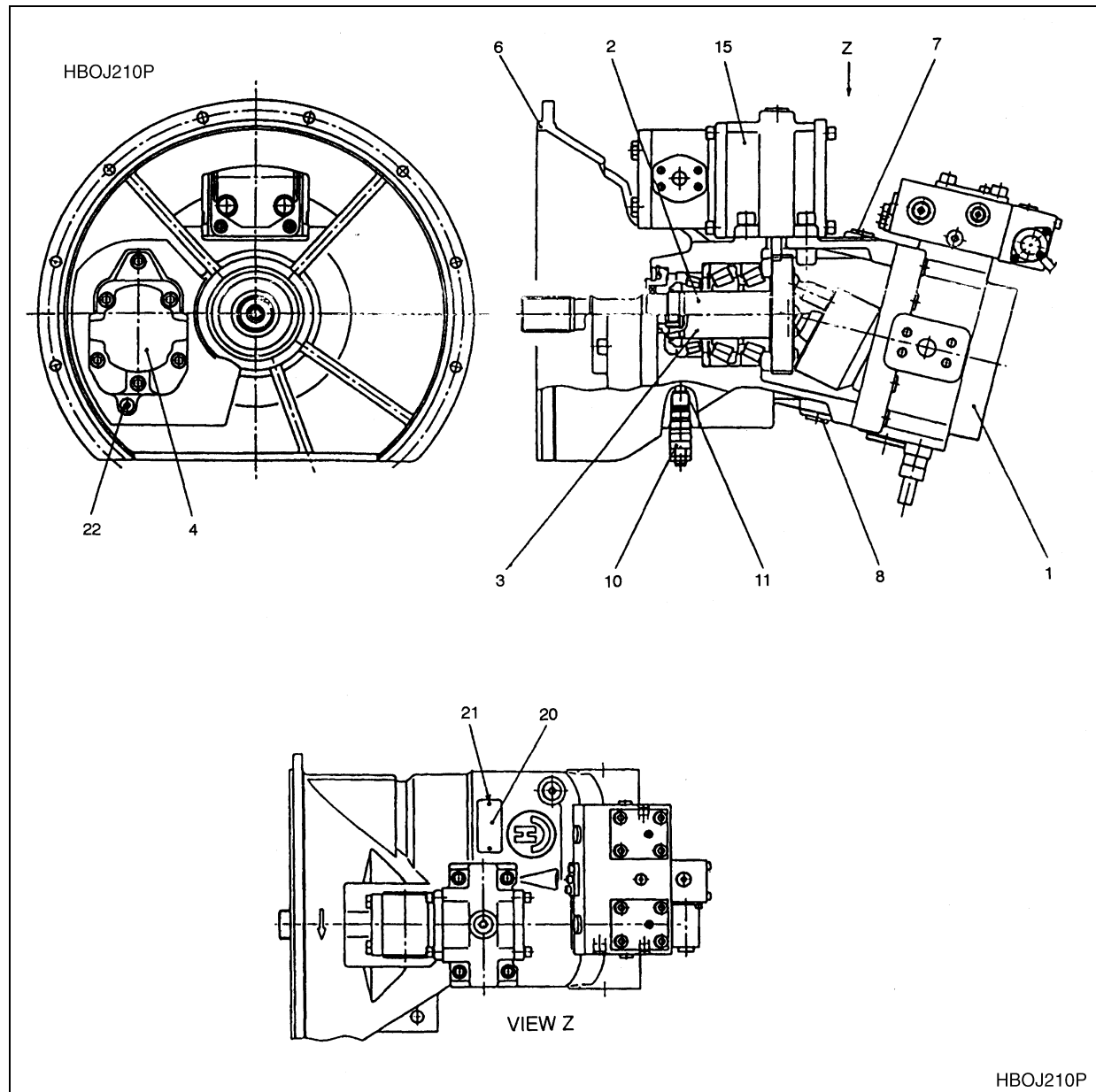


Figure 13

Reference Number	Description
1	Regulator
2	Rotary Group
3	Rotary Group
4	Gear Pump
6	Housing
7	Plug
8	Plug

Reference Number	Description
10	Relief Valve
11	Filter Element
15	Pump
20	Name Plate
21	Screw
22	Plug

SPECIFICATIONS

Hydraulic Pump Performance Characteristics

Main Pump Pressure/Flow Output	
Engine Speed	2,200 RPM
Engine Horsepower	166 PS ("H-Mode," High Output Power Mode III) 107.4 PS ("S-Mode," Standard Output Power Mode II)
Main Pump Total Displacement	73.6 c ³ /rev (4.49 in ³ /rev) x 2 pumps
Main Pump Pressure	350 kg/cm ² (4,978 psi) (for travel and boost)
Pilot Pump Displacement	10.7 c ³ /rev (0.65 in ³ /rev)
Pilot Pump Pressure (Relief Valve)	40 kg/cm ² (569 psi)
NOTE: Values in the graph marked "K" are pressure, in kg/cm ² Values in the graph marked "L" are flow, in Liters/minute	

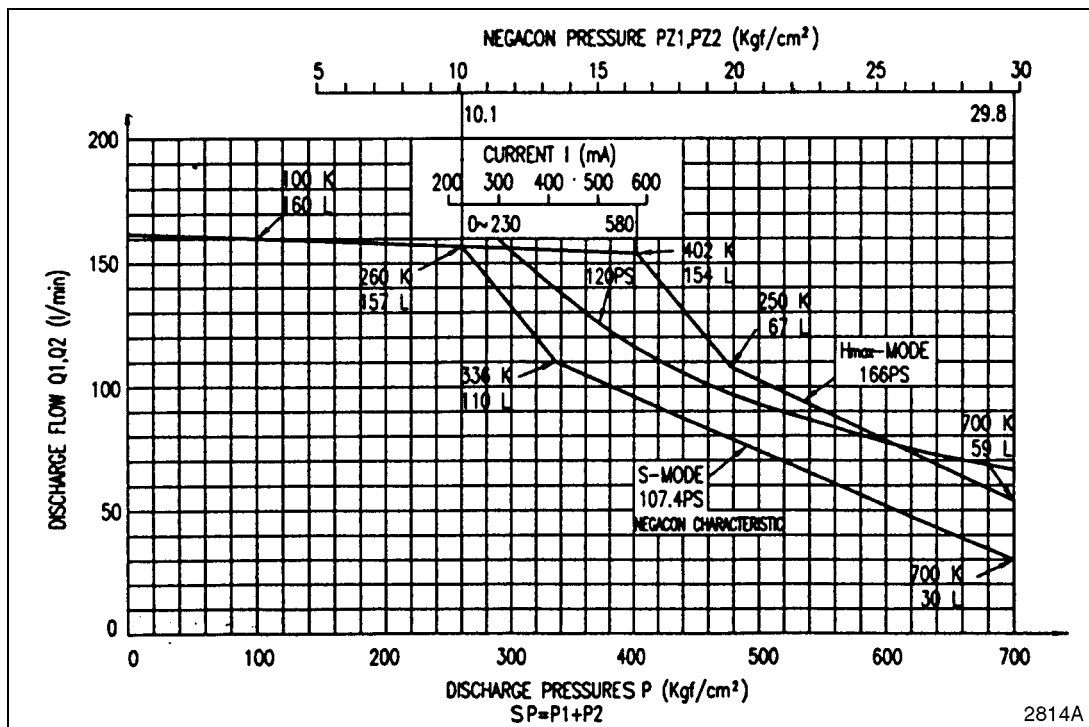


Figure 14

Main Pump	
Quantity:	2
Displacement:	73.6 cm ³ /rev (4.49 in ³ /rev)
Max Flow Rate:	162 l/min
(Each Pump)	(42.79 gal/s) @ 2,200 RPM
Flow RegulatorType:	Negative Control
Pressurization:	Air Breather
Weight:	124 kg (273 lbs.) - (including pilot and brake pump)

SPECIAL TOOLS AND MATERIALS

SPECIAL TOOLS

1. Hex-head metric allen wrenches: 2.5, 3, 4, 5, 6, 8, 14, 26 mm
2. Open-end/Box-end and/or metric sockets: 14, 26 mm
3. Monkey wrench
4. Soft-face (plastic) hammer
5. Snap-ring pliers
6. Long nose pliers
7. Torque wrench
8. Caliper: 200 mm (8")

LUBRICANTS AND SEALANTS

1. Three-Bond 1305
2. Three-Bond 1215

DISASSEMBLY

This procedure assumes that the main pump assembly will be removed from the upper deckplate. Use the eye bolts in the center valve block assembly to move the valve block and the assembled pumps (still bolted together) to the prepared work area.

The area where the pumps are to be rebuilt should be well-lit, clean and protected from dust and/or wind gusts that could carry in dust or grit. Use a rubber mat or other protective overlay on the workbench area to prevent damaging or scratching any precision machined components.

IMPORTANT

Clean all of the exterior surfaces of the pump prior to disassembly. There should not be any visible dirt, grease or other type of accumulation on the outside of the pump case. Clean off or blow dry all traces of cleaner and solvent before starting work.

Open the drain plugs to drain oil from the pump cases prior to disassembly.

IMPORTANT

If at all possible, use a clean, dry container to catch gear oil. A clean container allows an evaluation to be made of the used oil. The presence or relative lack of metal wear shavings in the used oil or obvious deterioration or contamination of the oil can provide a useful indicator of the pumps' general condition.

NOTE: *Used oil is an environmental contaminant and should be disposed of promptly at approved recycling facilities. Prolonged physical contact with used oil has been thought by some to pose a health risk. Clean oil residue from hands and clothing promptly, and do not allow used oil containers to accumulate.*

NOTE: *Replace rotary groups (shaft, bearing, cylinder block, piston, etc.) as assemblies and mark rotary groups and components that are similar but not identical; do not change setting of adjustment screws unless necessary. Mark adjustment screw position and note shim thickness during disassembly.*

REMOVING CONTROL UNIT

1. The pump assembly is shown in Figure 15.

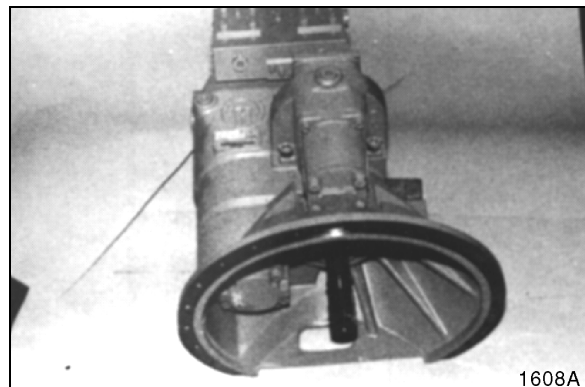


Figure 15

2. Remove auxiliary pump using 10 mm hex wrench. See Figure 16.

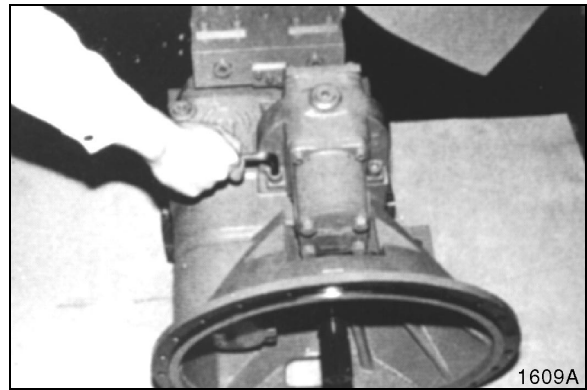


Figure 16

3. Remove regulator cover hex bolts. See Figure 17.

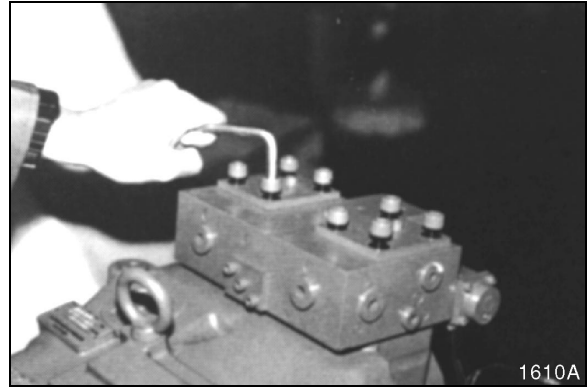


Figure 17

4. Remove control section hex bolts. See Figure 18.

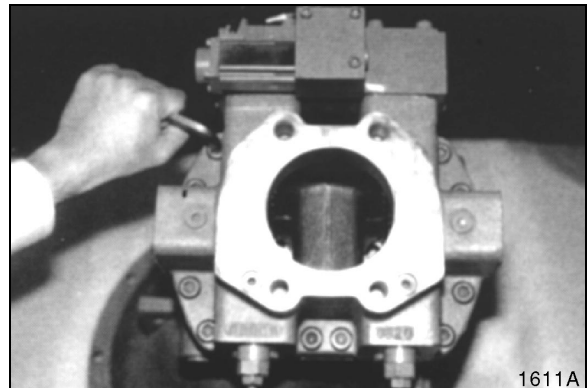


Figure 18

5. Tap regulator cover with soft mallet to separate from control section. See Figure 19.

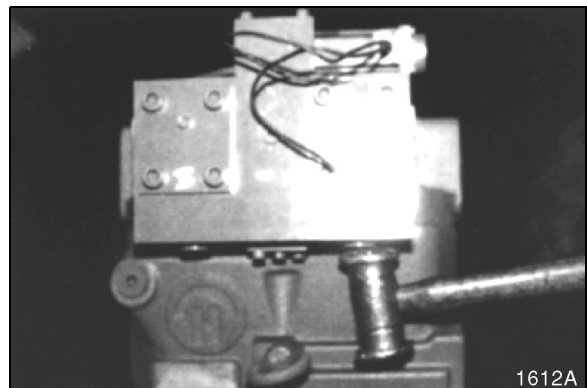


Figure 19

6. Lift control section and regulator cover off pump assembly, being careful not to drop or lose parts. See Figure 20 and Figure 21.

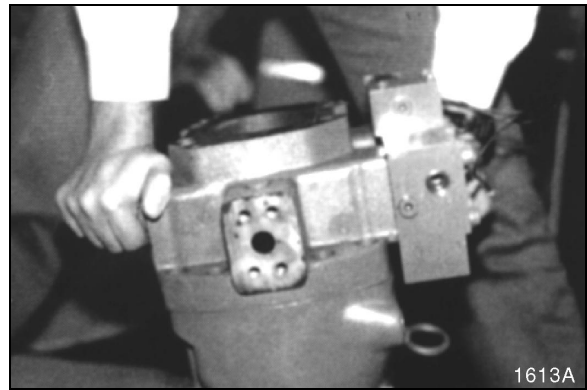


Figure 20



Figure 21

NOTE: Control section is shown removed in Figure 22.

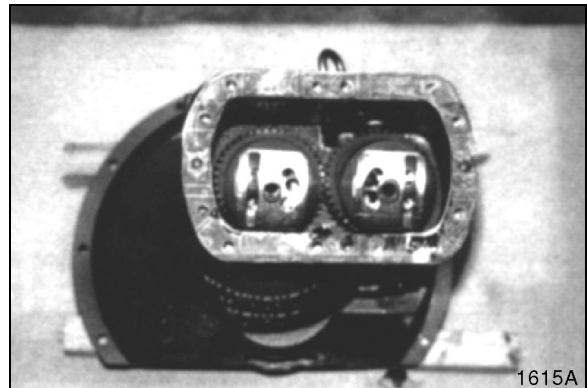


Figure 22

7. Remove control plate. See Figure 23.

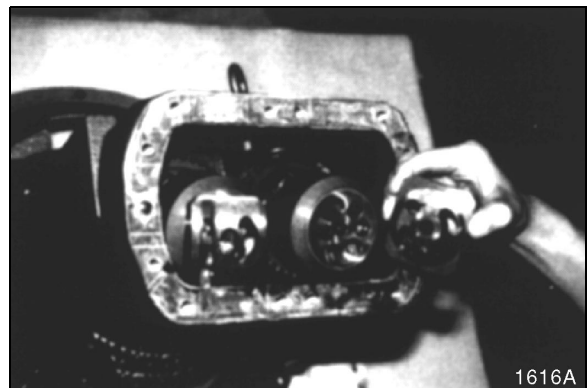


Figure 23

8. Install rubber disks to prevent blocks from falling out. See Figure 24.

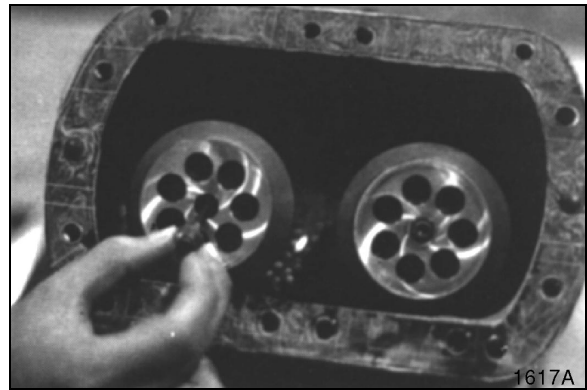


Figure 24

9. Remove guide from housing using a wire of about 1 mm (0.039") or pliers. See Figure 25.

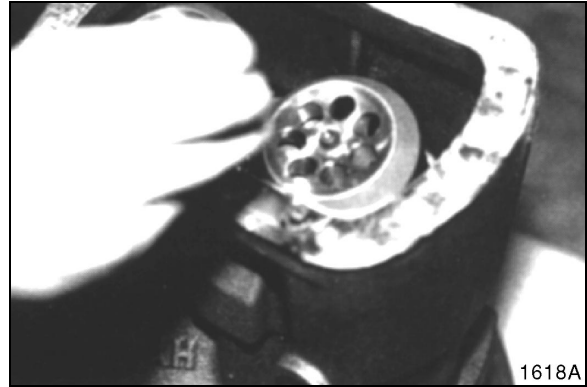


Figure 25

10. Remove steel balls, using magnetized rod or driver. See Figure 26.

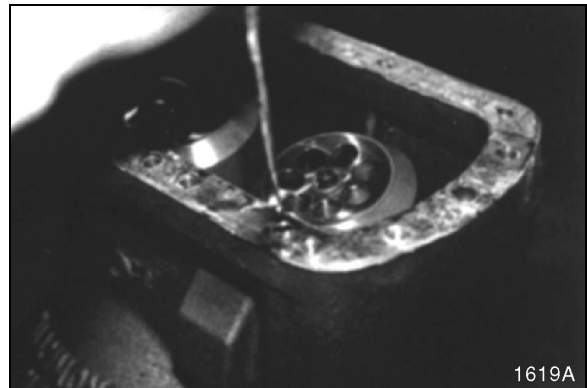


Figure 26

DISASSEMBLING REGULATOR

1. Remove regulator cover and retainer. See Figure 27.

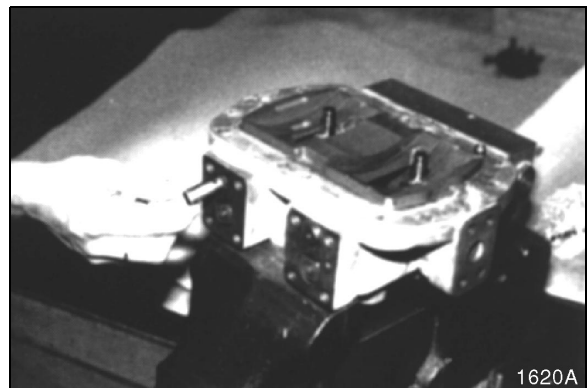


Figure 27

2. Remove ring that retains spring seat, using long nose pliers or a rod with a pointed tip. See Figure 28.

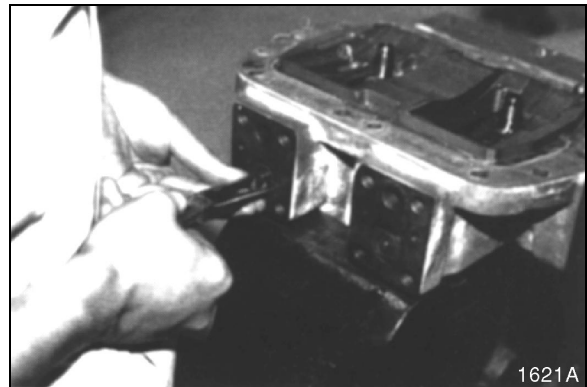


Figure 28

NOTE: *Ring is shown removed in Figure 29.*

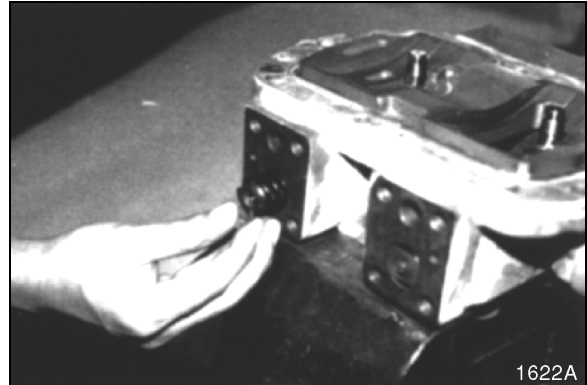


Figure 29

3. Remove spring seat. See Figure 30.

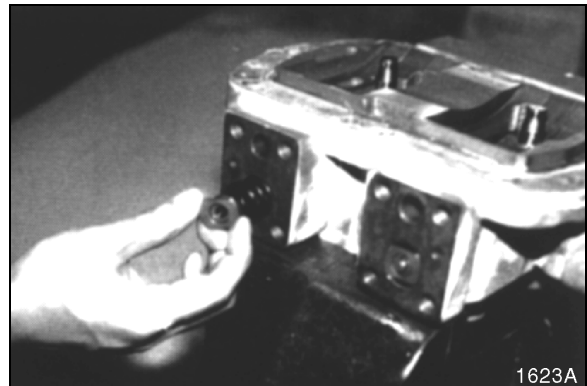


Figure 30

4. Remove spring, being careful not to remove shim at same time. See Figure 31.

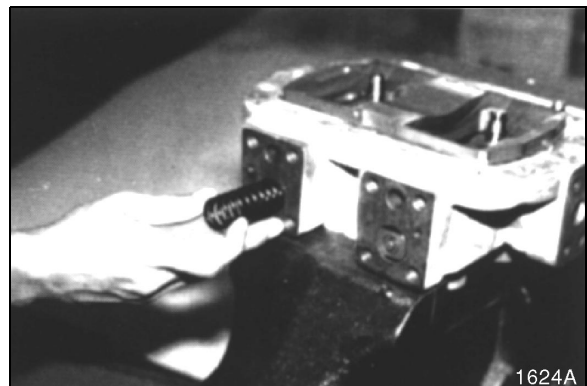


Figure 31

5. Remove shim and measure thickness with caliper. See Figure 32.

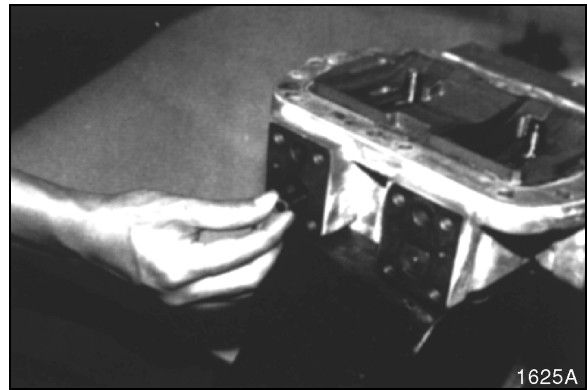


Figure 32

6. Remove spring. See Figure 33.

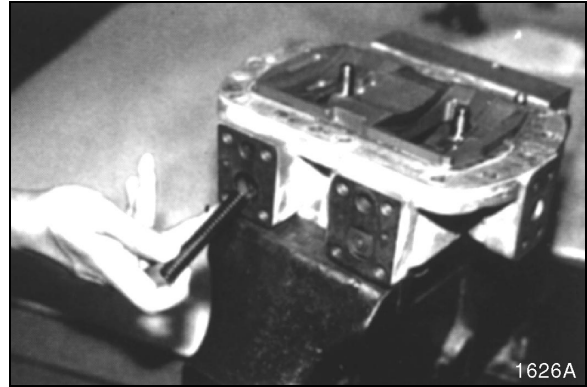


Figure 33

7. Remove spring seat. See Figure 34.

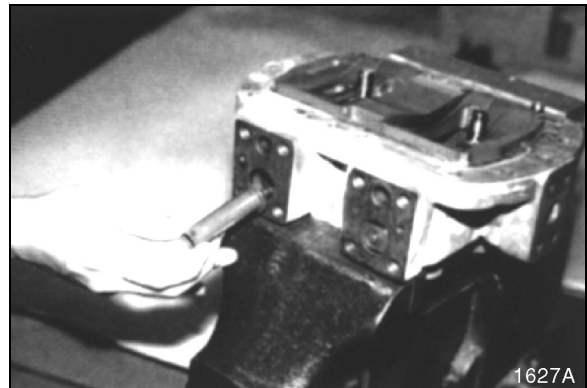


Figure 34

NOTE: *DO NOT turn nut (1, Figure 35).*

8. Turn control section upside down and remove adjusting screw (2), plug (3) and spring. See Figure 35 and Figure 36.

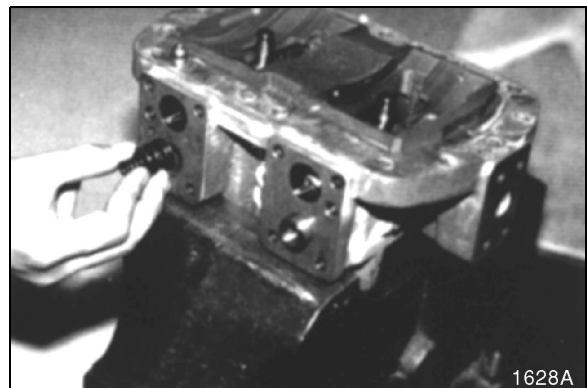


Figure 35

Reference Number	Description
1	Nut
2	Screw
3	Plug

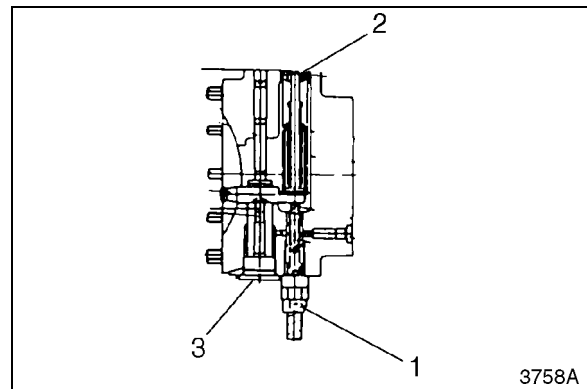


Figure 36

9. Remove spring seat. See Figure 37.

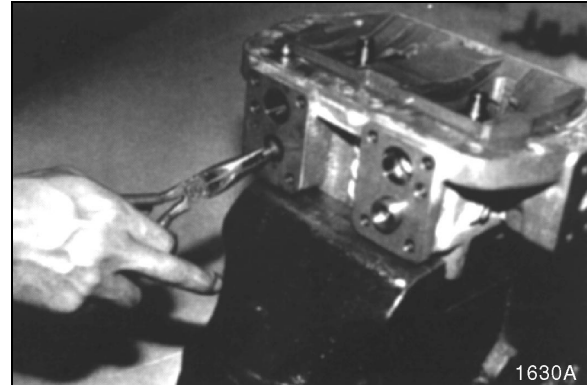


Figure 37

10. Remove rod. See Figure 38.

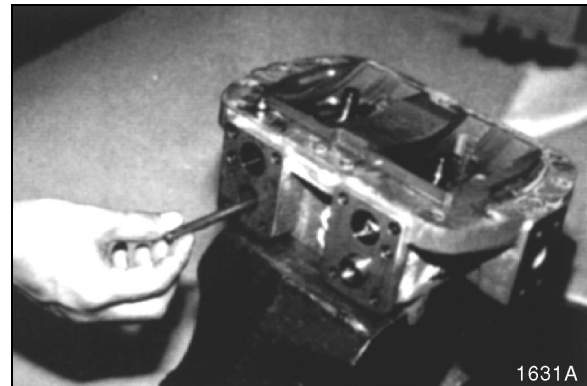


Figure 38

NOTE: *Connecting rod and piston are secured together with Loctite. Do not remove unless necessary.*

11. Heat piston rod slightly with burner. See Figure 39.

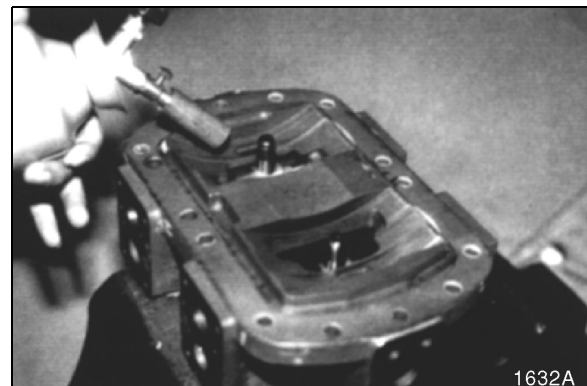


Figure 39

12. Remove stop screws. See Figure 40.

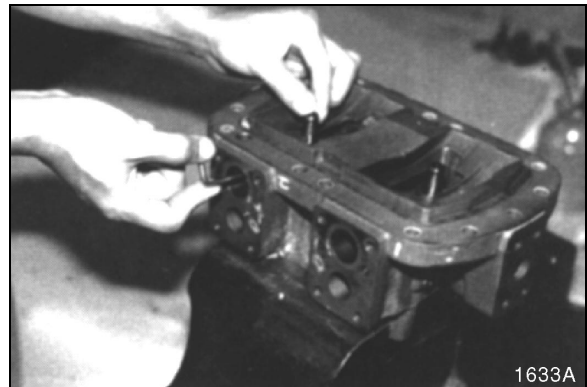


Figure 40

13. Remove first stop screw. See Figure 41.

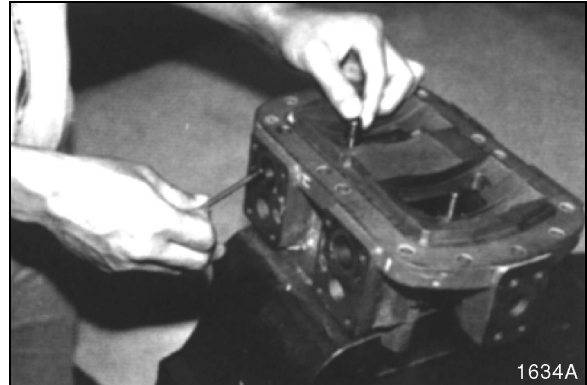


Figure 41

14. Remove second stop screw. See Figure 42.



Figure 42

15. Remove rod by pressing down with one hand and turning back and forth with the other hand. See Figure 43.

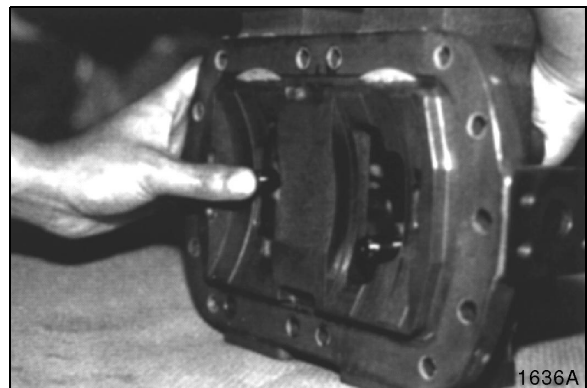


Figure 43

16. Remove rod through inlet side. See Figure 44.

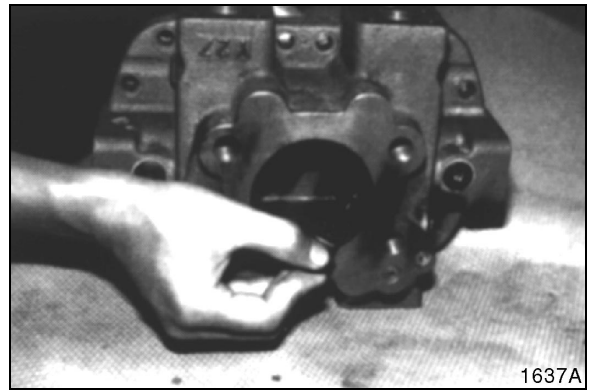


Figure 44

17. Remove piston. See Figure 45.



Figure 45

DISASSEMBLING REGULATOR COVER

1. Remove O-rings. See Figure 46.

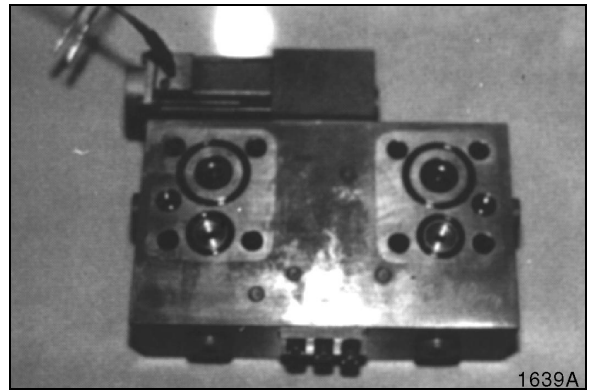


Figure 46

2. Remove plate. See Figure 47.

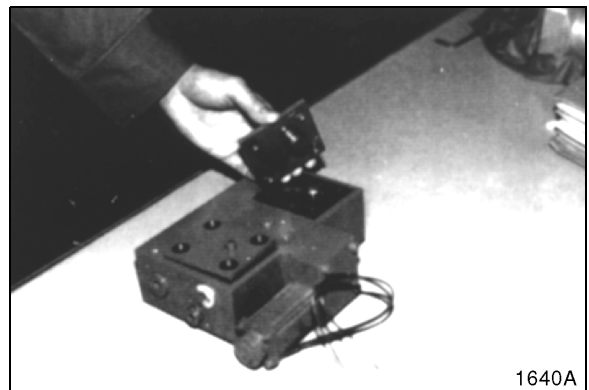


Figure 47

3. Remove piston. See Figure 48.

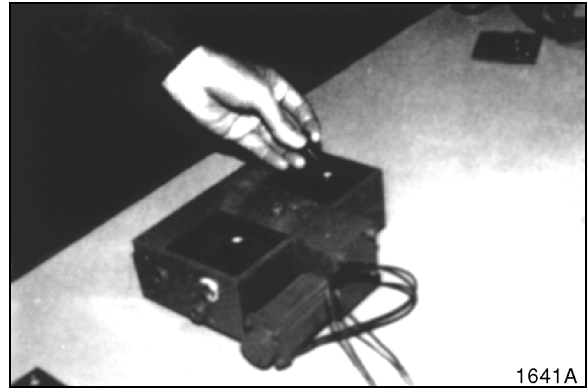


Figure 48

4. Remove hex bolts and detach cover. See Figure 49.

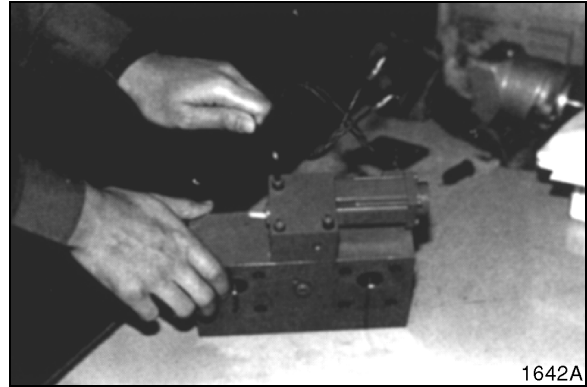


Figure 49

5. Remove piston and bushing. See Figure 50.

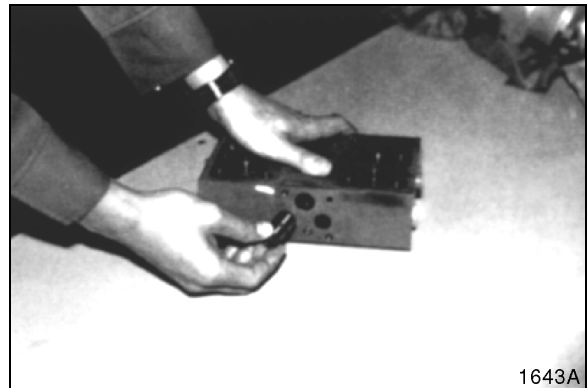


Figure 50

6. Remove two hex bolts and remove plate. See Figure 51.

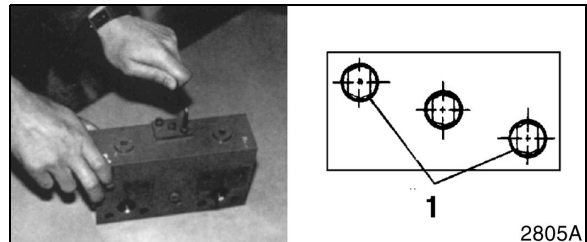


Figure 51

7. Remove bushing. See Figure 52.

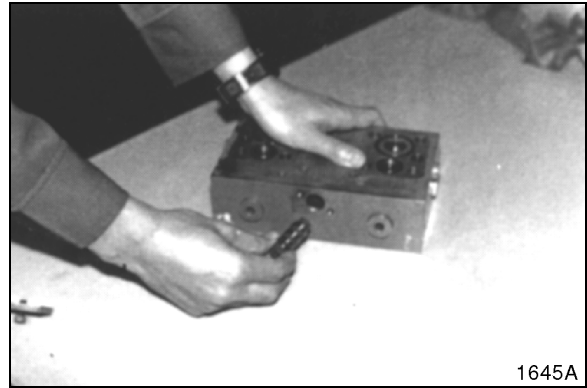


Figure 52

8. Remove plug. See Figure 53.

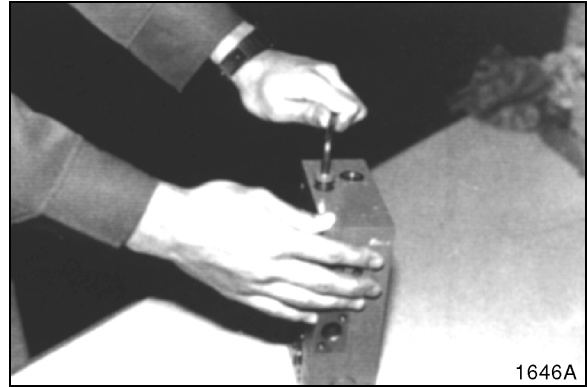


Figure 53

9. Remove valve seat. See Figure 54.

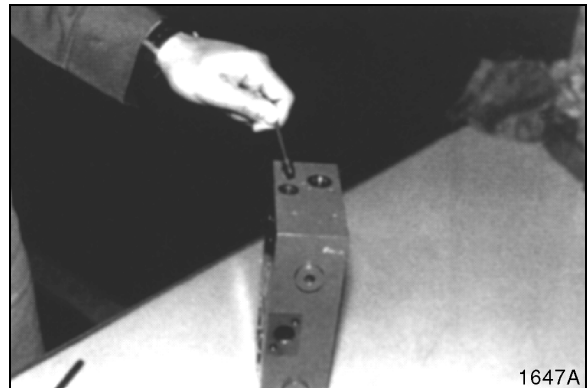


Figure 54

10. Remove steel ball using magnetized driver or rod. See Figure 55.

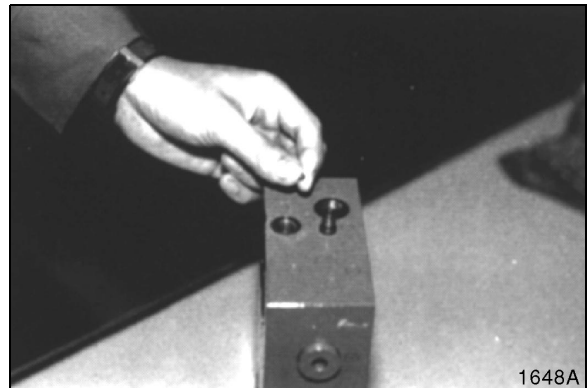


Figure 55

11. Detach guide using pliers or a wire (about 1 mm [0.039"]). See Figure 56.

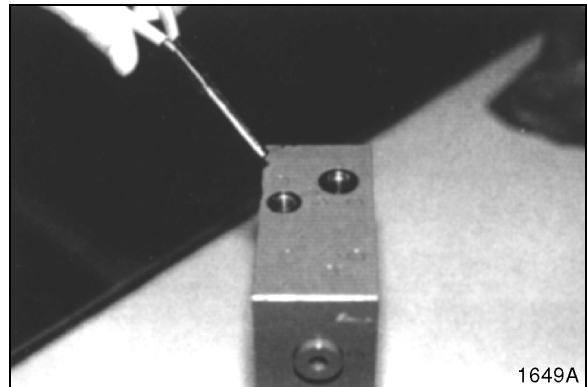


Figure 56

REMOVING DRE2K (ELECTRONIC PROPORTIONAL REDUCING VALVE)

NOTE: *DRE2K cover is shown in Figure 57.*



Figure 57

1. Remove hex bolts and detach cover. See Figure 58.

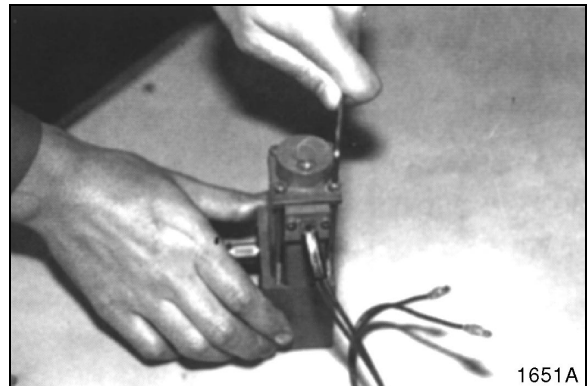


Figure 58

2. Remove filter. See Figure 59.

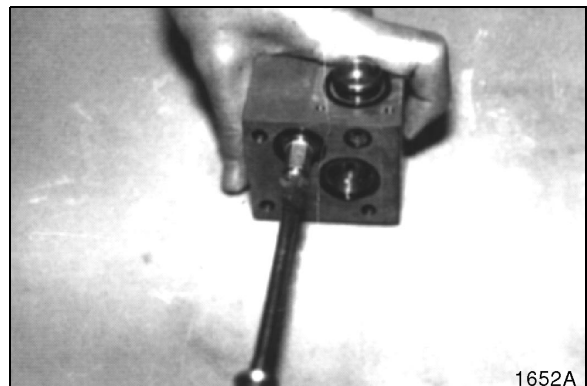


Figure 59

3. Remove orifice. See Figure 60.

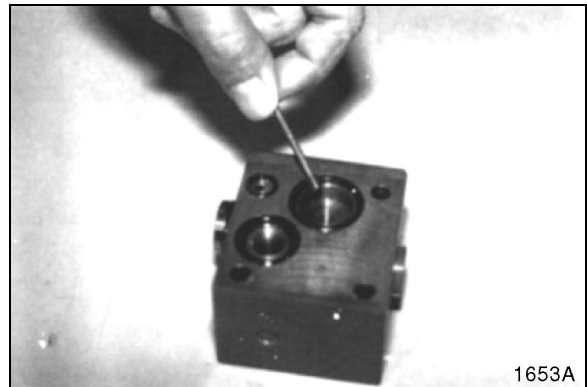


Figure 60

REMOVING RELIEF VALVE

1. Remove relief valve. See Figure 61.



Figure 61

2. Remove filter. Figure 62.



Figure 62

REMOVING ROTARY GROUP

1. Remove packing. Figure 63.

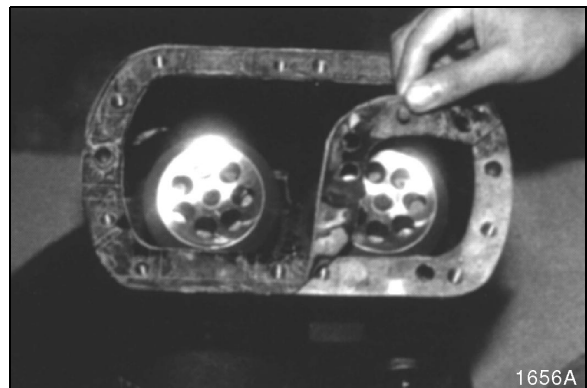


Figure 63

2. Remove parallel pin. See Figure 64.

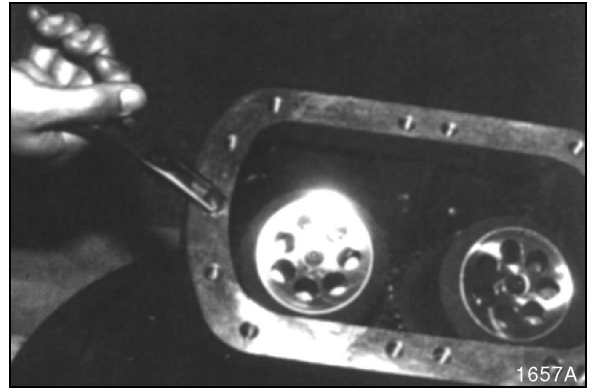


Figure 64

3. Place pump down as shown. See Figure 65.



Figure 65

4. Remove pilot pump from housing by removing two hex bolts. See Figure 66 and Figure 67.



Figure 66

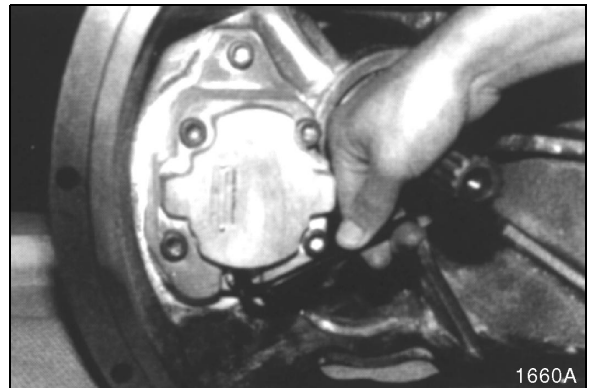


Figure 67

5. Remove pilot pump. See Figure 68.

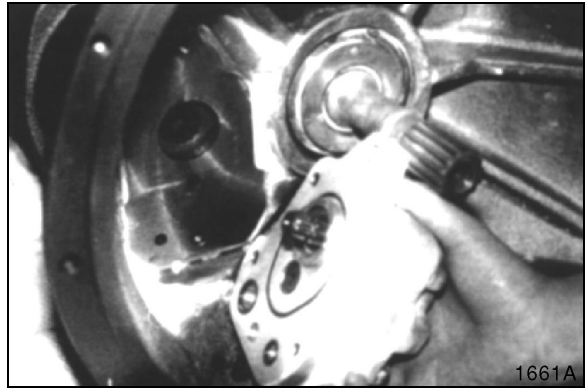


Figure 68

6. Remove coupling. See Figure 69.

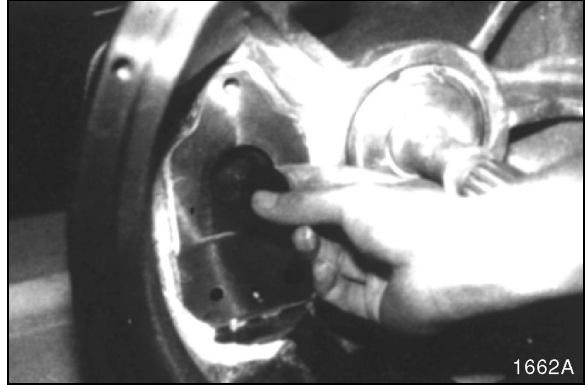


Figure 69

7. Remove C-type stop ring using ring pliers. See Figure 70.



Figure 70

8. Remove oil seal case using two drivers. See Figure 71.



Figure 71

9. Remove oil seal case from driver shaft. See Figure 72.

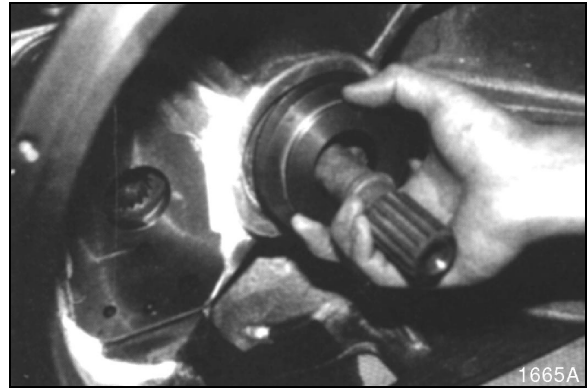


Figure 72

10. Remove O-ring from oil seal case. See Figure 73.

NOTE: *O-ring may have remained in housing.*

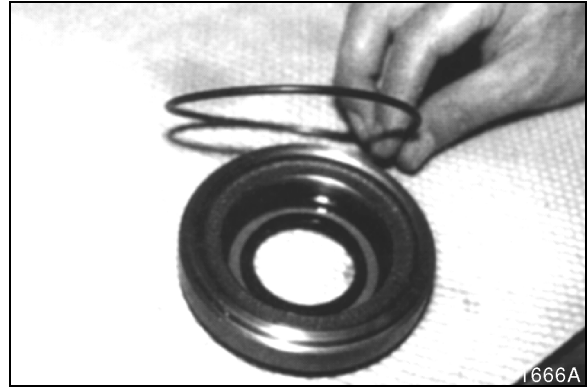


Figure 73

11. Place pipe on edge of idle shaft and strike with plastic hammer to remove rotary group. See Figure 74.

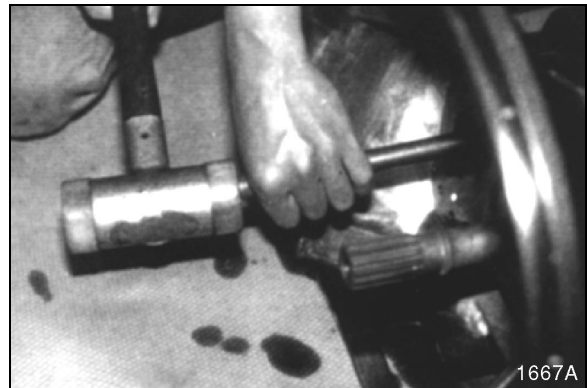


Figure 74

12. Remove rotary group from rear side of housing. See Figure 75.

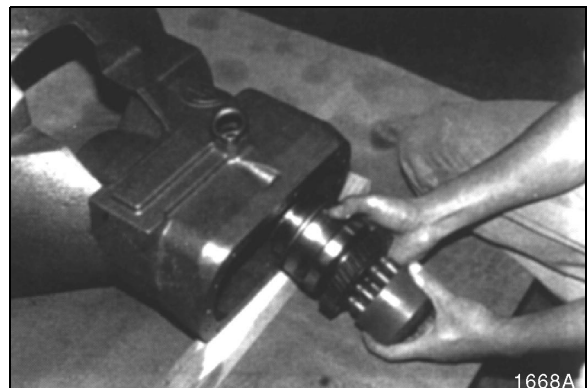


Figure 75

13. Strike end of drive shaft with plastic hammer and remove rotary group. See Figure 76 and Figure 77.

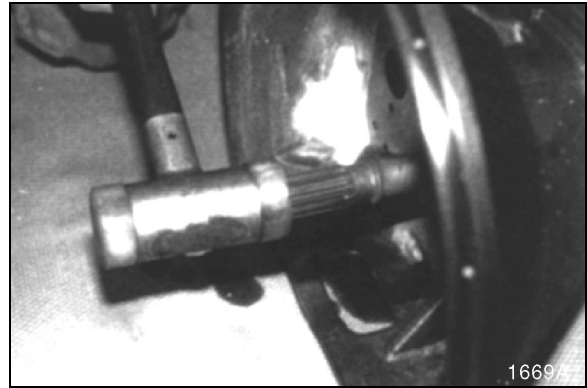


Figure 76

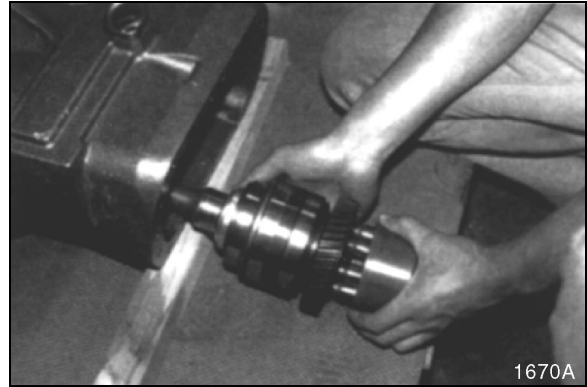


Figure 77

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

REASSEMBLY

GENERAL INSTRUCTIONS

1. Replace all seals (O-rings, plugs, packing, oil seals, etc.).
2. Clean and lubricate all components.
3. Clean all surfaces that require adhesive.
4. Allow adhesive to dry for 12 hours.
5. Set adjusting screw and select shim, based on dimensions recorded at time of disassembly.

INSTALLING ROTARY GROUP

1. Heat housing from 80° - 85°C (176° - 185°F). See Figure 78.
2. Lubricate and install idle side rotary group. See Figure 79.
3. Install drive side rotary group. See Figure 80.

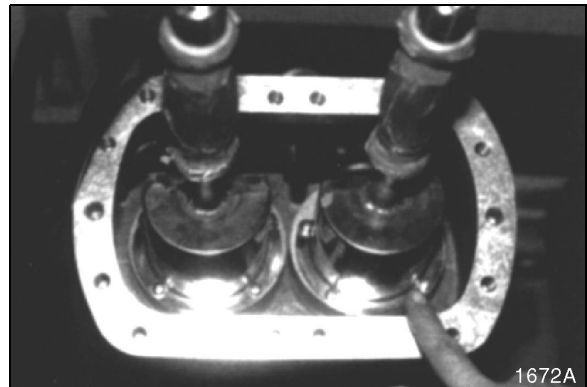


Figure 78

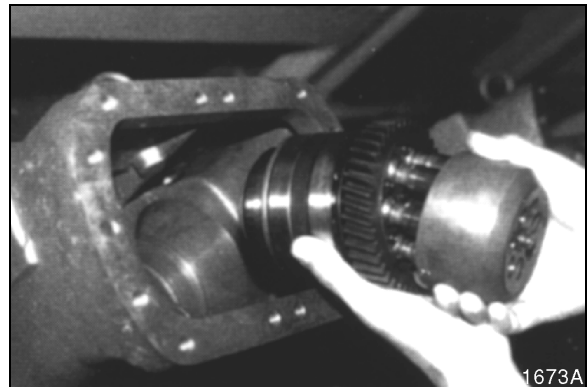


Figure 79

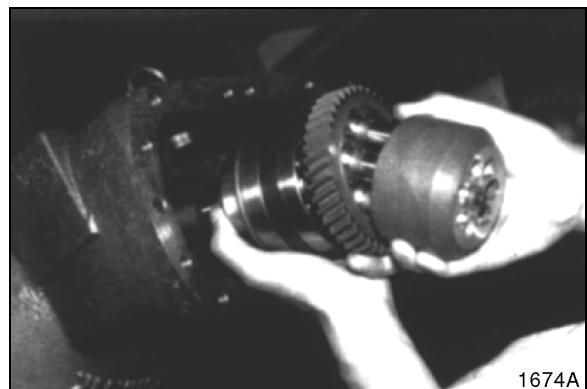


Figure 80

4. Install O-ring on oil seal. See Figure 81.

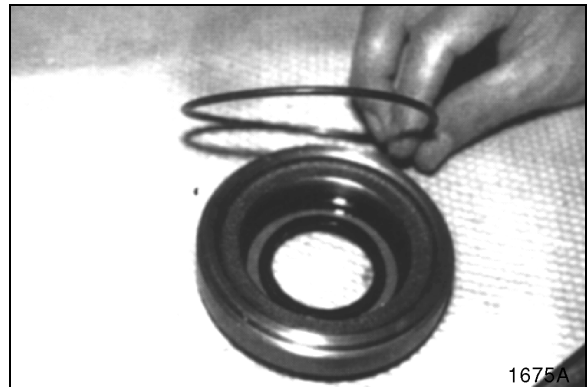


Figure 81

5. Mount oil seal to housing. See Figure 82.



Figure 82

6. Tap with soft pipe and plastic hammer to seat firmly. See Figure 83.

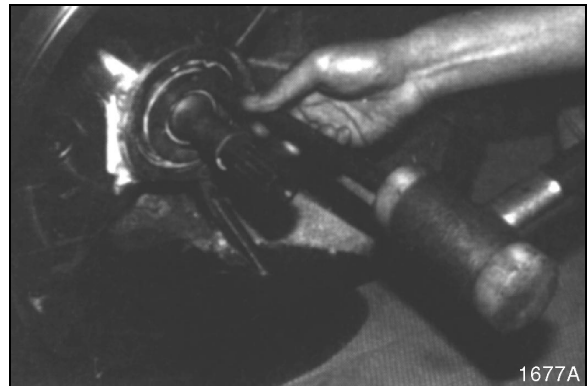


Figure 83

7. Install C-type stop ring in groove in housing; turn ring to check that it is seated. See Figure 84.



Figure 84

8. Attach coupling. See Figure 85.

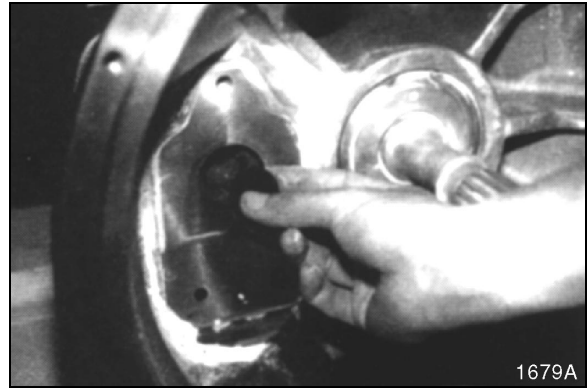


Figure 85

9. Mount pilot pump. See Figure 86.

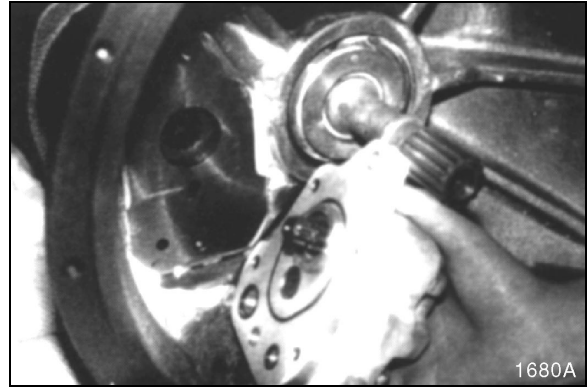


Figure 86

10. Tighten two hex bolts. See Figure 87.

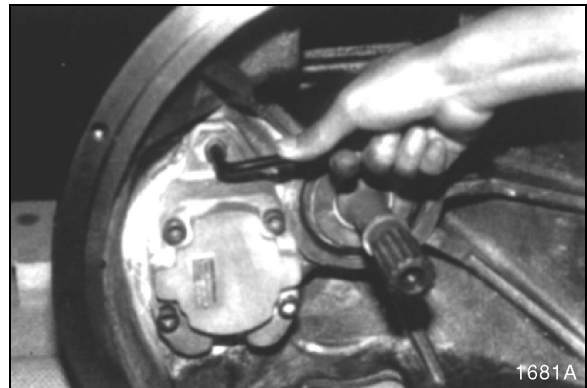


Figure 87

11. Lift housing and insert steel balls. See Figure 88.



Figure 88

12. Insert guide into bore in housing, being careful to note installation position. See Figure 89.



Figure 89

RELIEF VALVE

1. Install filter. See Figure 90.



Figure 90

2. Install relief valve. See Figure 91.



Figure 91

INSTALLING REGULATOR COVER ASSEMBLY

1. Install guide so that side with recess (1) faces up (2). See Figure 92.

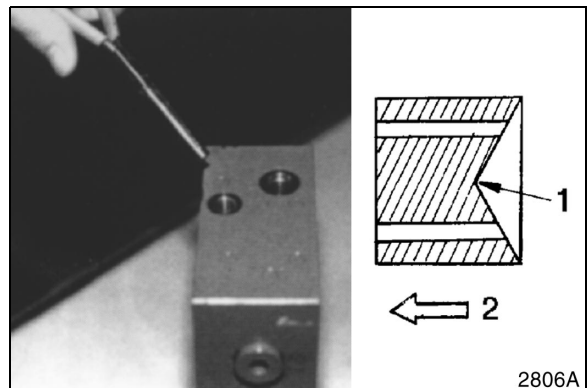


Figure 92

2. Install steel balls. See Figure 93.

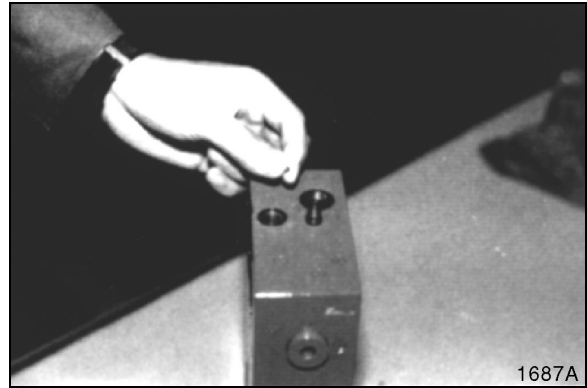


Figure 93

3. Install valve seat and torque to 6.4 Nm (4.7 ft lb). See Figure 94.

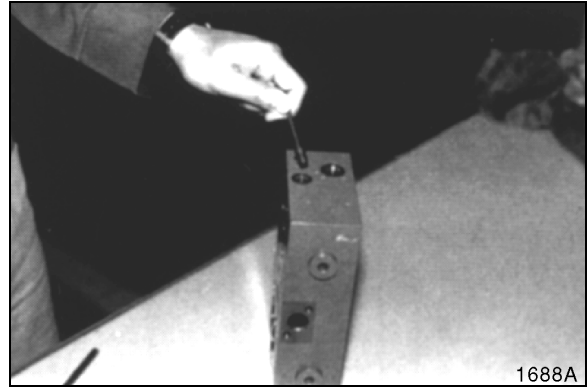


Figure 94

4. Install plug and torque to 2.6 kg m (18.8 ft lb). See Figure 95.

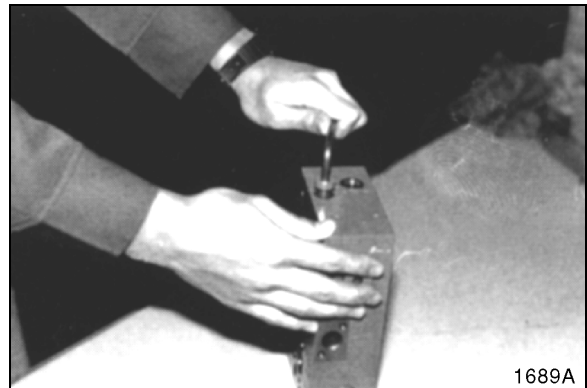


Figure 95

5. Install bushing. See Figure 96.

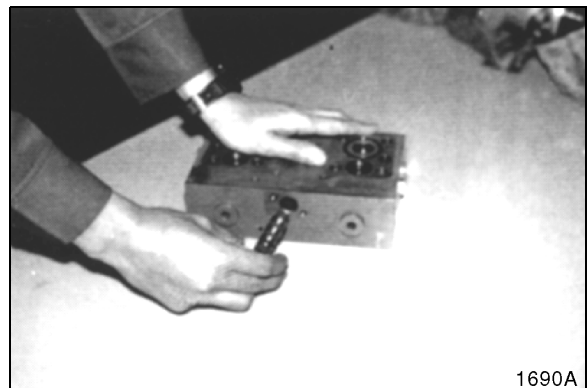


Figure 96

6. Install bushing. See Figure 97.

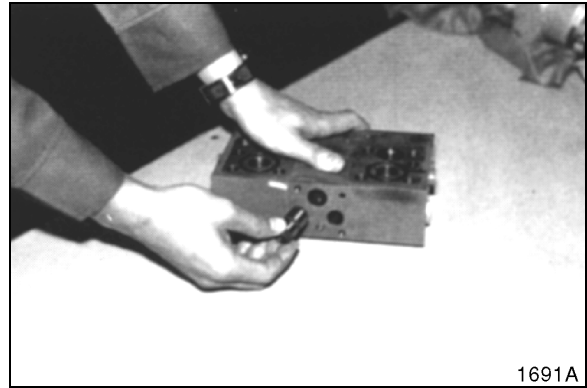


Figure 97

7. Install plate with hex bolt and torque to 1.2 – 1.5 kg m (8.68 – 10.85 ft lb). See Figure 98.

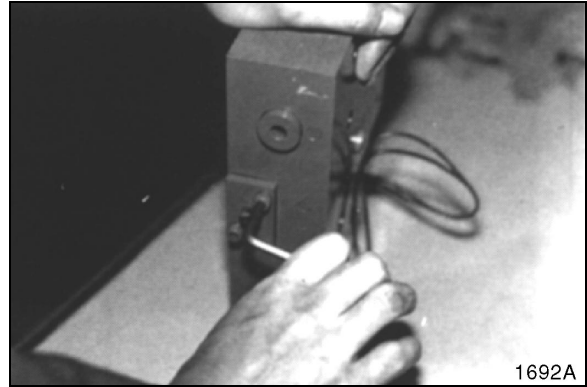


Figure 98

8. Install piston in cover. See Figure 99.

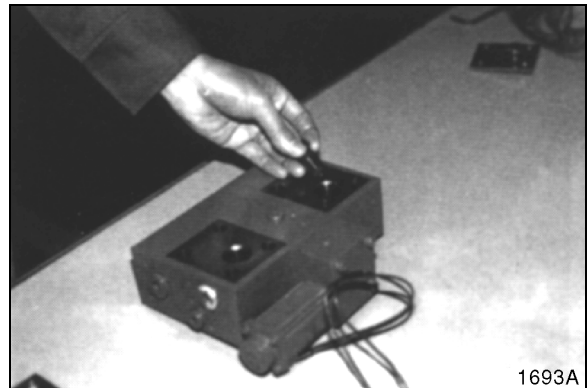


Figure 99

9. Install plate in cover. See Figure 100.

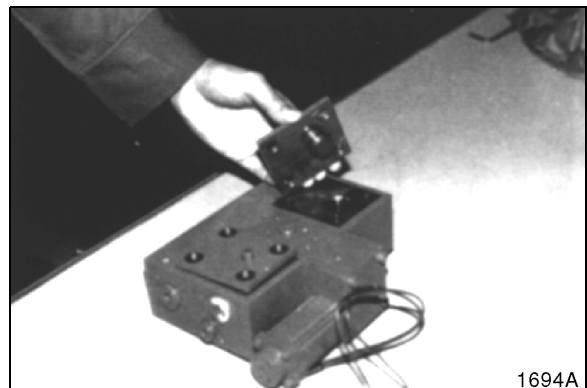


Figure 100

10. Install orifice in cover and torque to 0.32 – 0.4 kg m (2.31 – 2.90 ft lb). See Figure 101.

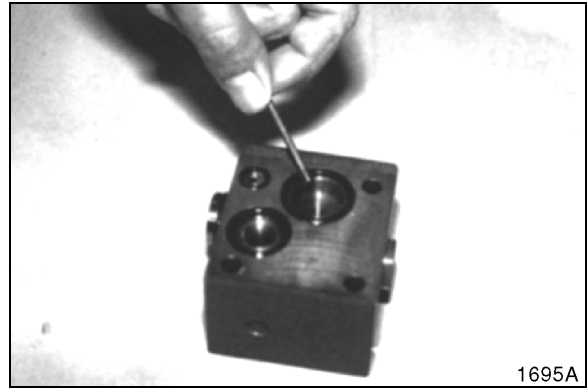


Figure 101

11. Install filter and torque to 1 kg m (7.23 ft lb). See Figure 102.

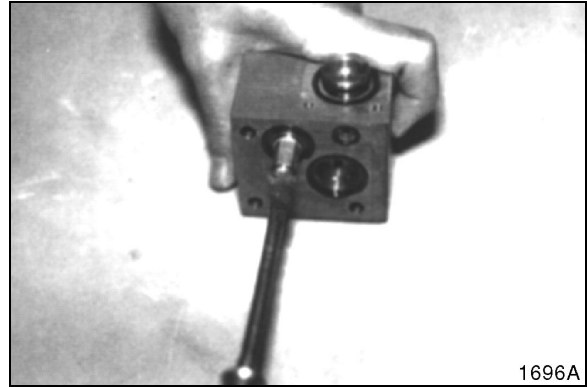


Figure 102

12. Mount on regulator cover. See Figure 103.

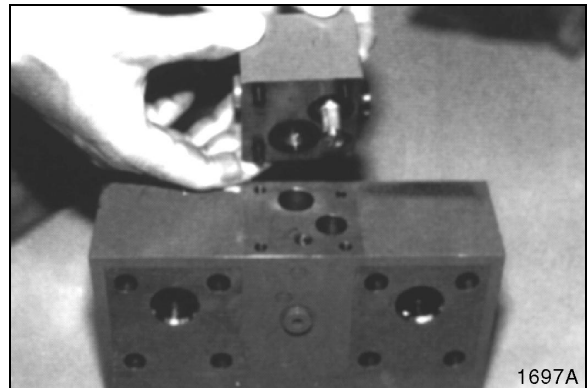


Figure 103

13. Tighten three hex bolts to 1.2 – 1.5 kg m (8.68 – 10.85 ft lb); attach four DRE2K hex bolts and torque to 0.5 – 0.6 kg m (3.62 – 4.34 ft lb). See Figure 104.

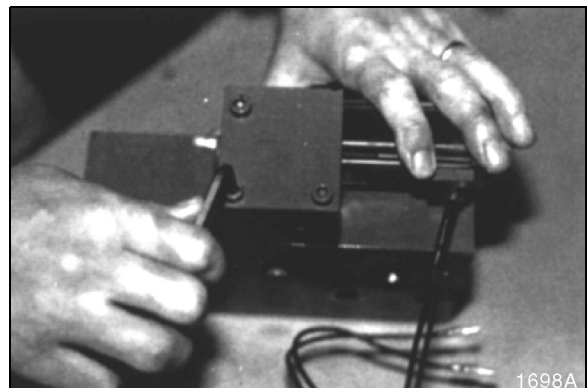


Figure 104

ASSEMBLING REGULATOR

1. Install piston in main control body. See Figure 105.

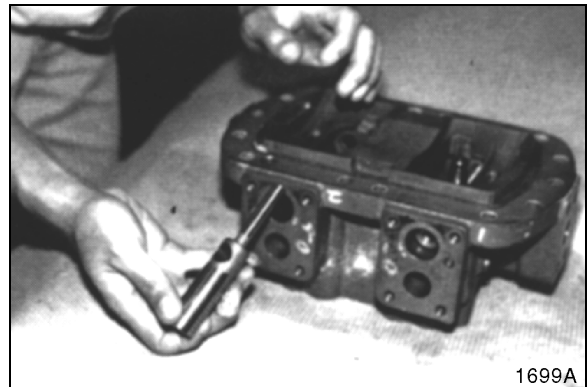


Figure 105

2. Insert rod into piston from inlet side. See Figure 106.

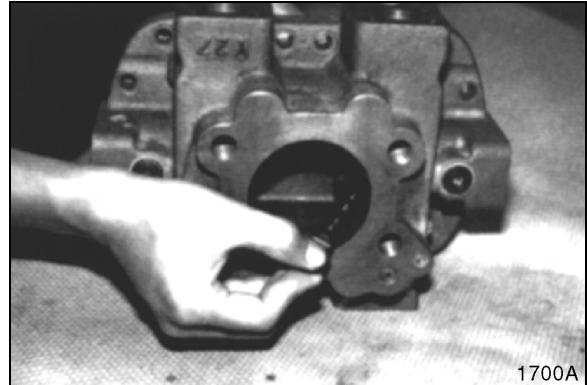


Figure 106

3. Insert rod into piston bore. See Figure 107.

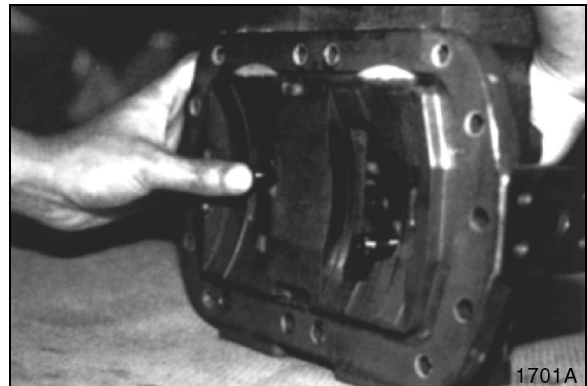


Figure 107

4. Use Three-Bond 1305 on stop screws; line up and secure piston rod, tightening screws to 3 kg m (21.7 ft lb). See Figure 108.



Figure 108

5. Insert rod with spring into main control body. See Figure 109.

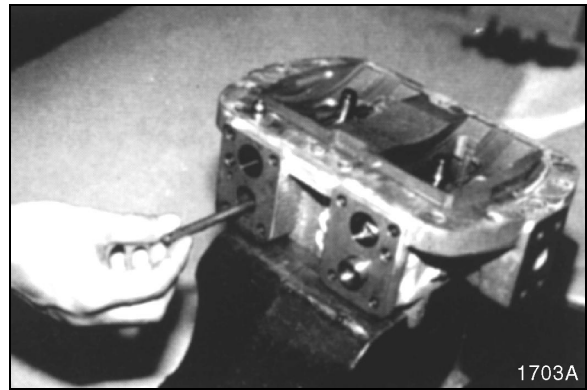


Figure 109

6. Install spool to barrel and attach barrel to main control body. See Figure 110.

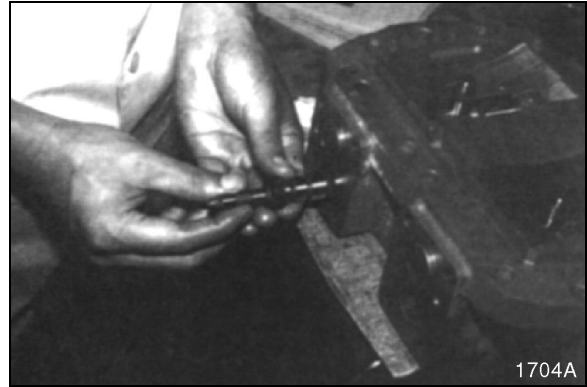


Figure 110

7. Place spring on spring seat. See Figure 111.



Figure 111

8. Install spring. See Figure 112.



Figure 112

9. Install two springs and spring seat in main control body and install adjusting screw and plug. Tighten screw to 7.5 – 9 kg m (54 – 66 ft lb) and plug to 12 kg m (86 ft lb). See Figure 113.

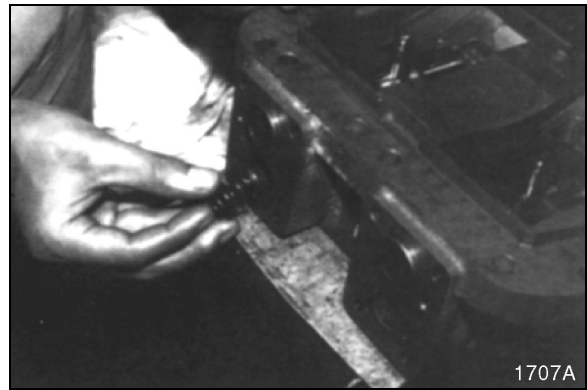


Figure 113

10. Turn main control body upside down and install retainer. See Figure 114.

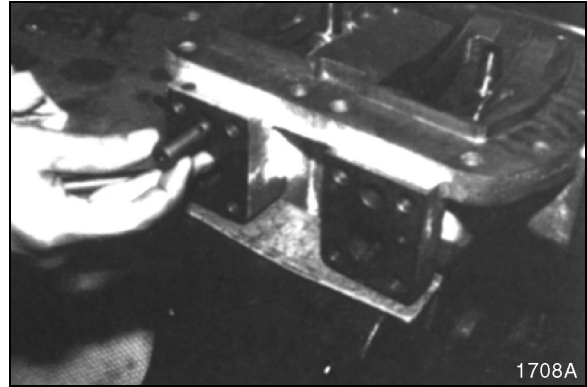


Figure 114

11. Install spring seat. See Figure 115.

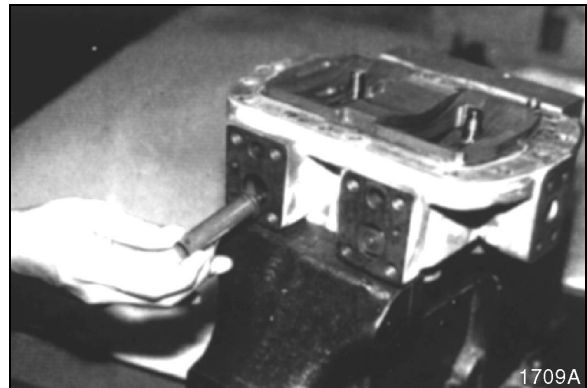


Figure 115

12. Install small spring. See Figure 116.

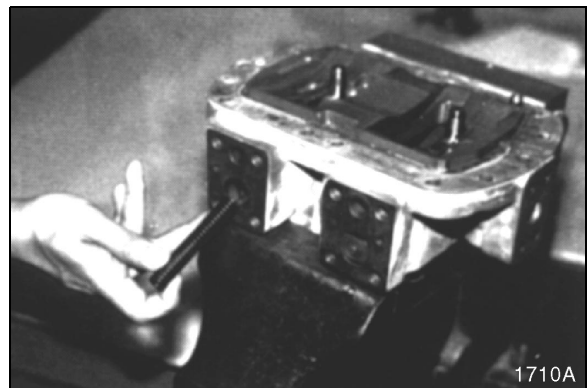


Figure 116

13. Install shim, using same thickness shim removed during disassembly. See Figure 117.

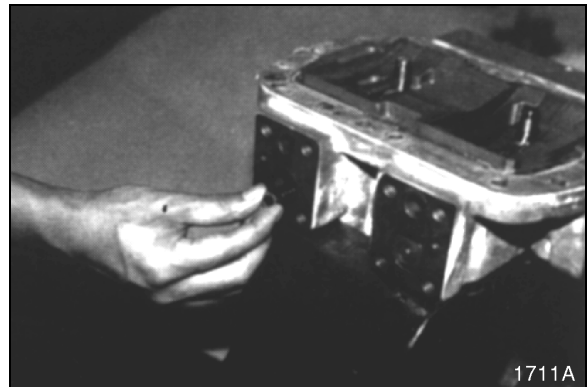


Figure 117

14. Install large spring. See Figure 118.

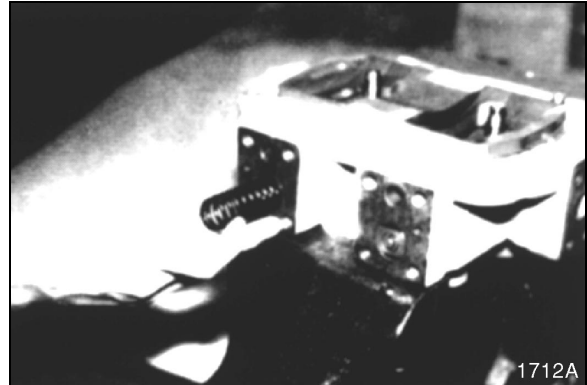


Figure 118

15. Install spring seat. Press seat down and install ring to rod groove. See Figure 119.

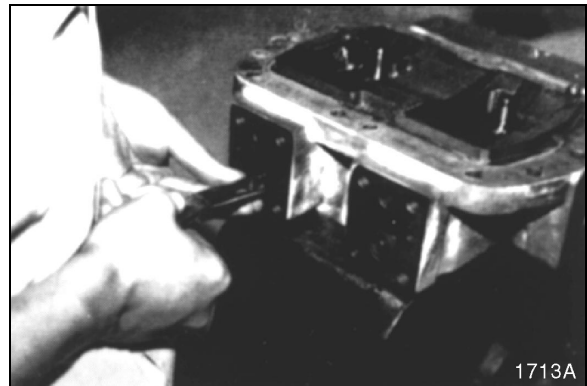


Figure 119

16. The ring is shown installed in Figure 120.

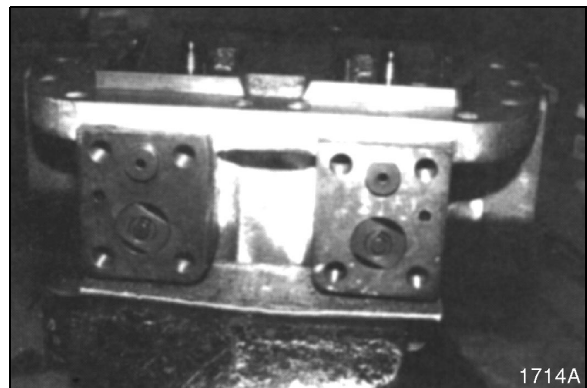


Figure 120

17. Clean mounting surface and apply Three-Bond 1215. See Figure 121.

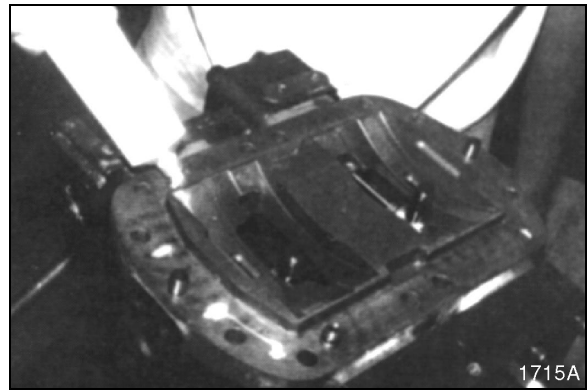


Figure 121

18. Install gasket. See Figure 122.

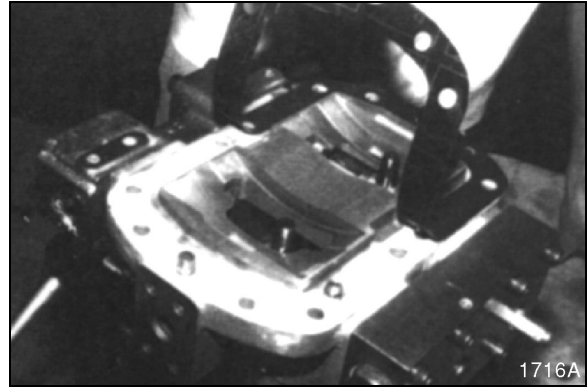


Figure 122

19. Apply Three-Bond 1215 to gasket. See Figure 123.

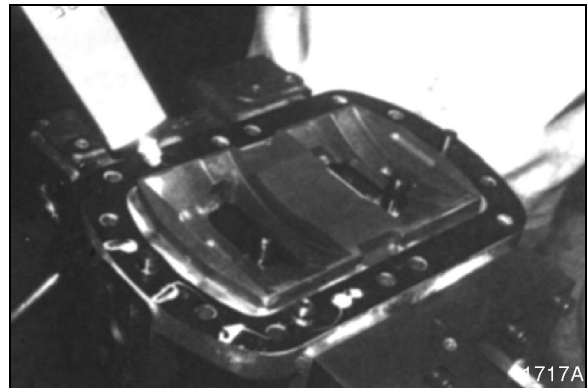


Figure 123

NOTE: Control plates for clockwise and counterclockwise rotation are different and have notches as well as ribs to identify them. See Figure 124.

Reference Number	Description
A	Drive Side (Clockwise)
1	Outlet
2	Inlet
B	Idle Side (Counterclockwise)
3	Outlet
4	Inlet

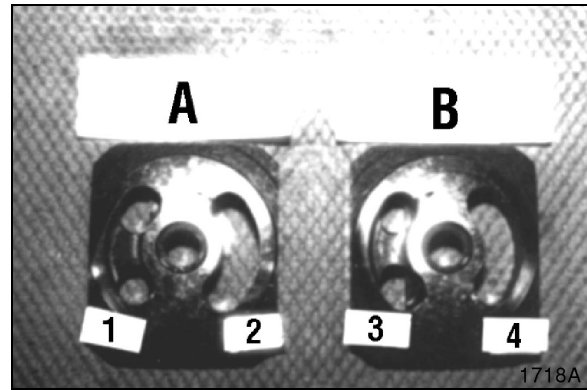


Figure 124

20. Grease back side of control plate. See Figure 125.



Figure 125

21. Install control plates to main control body so that ribs face out. See Figure 126.

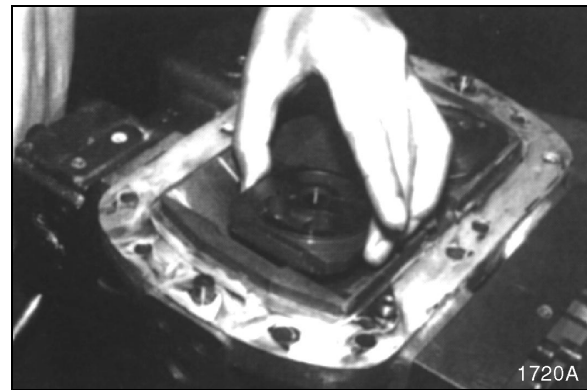


Figure 126

22. Remove hex bolt with rubber disk. See Figure 127.

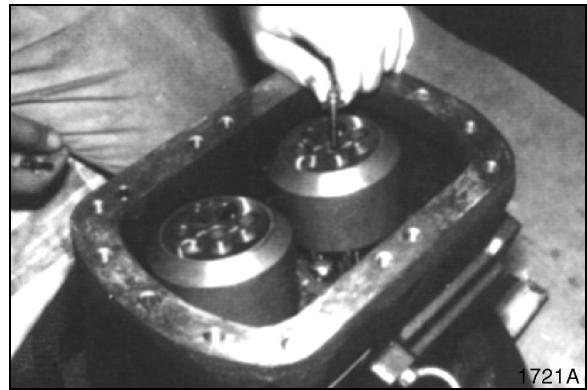


Figure 127

INSTALLING REGULATOR

1. Install main control body. See Figure 128.
2. Secure assembly with hex bolts and torque to 12.5 kg m (90 ft lb). See Figure 129.

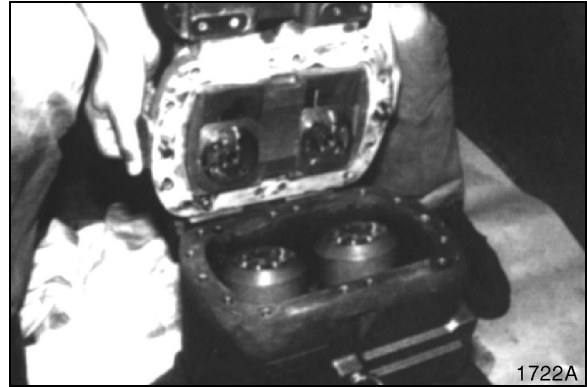


Figure 128

3. Install regulator onto control section using hex bolts. Torque to 5.6 – 7.0 kg m (40 – 50 ft lb). See Figure 130.

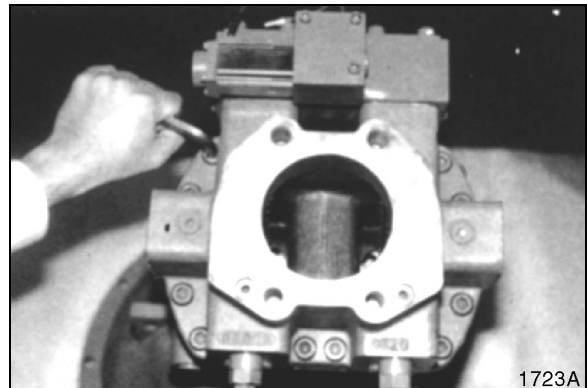


Figure 129



Figure 130

4. Assembly is shown complete in Figure 131.

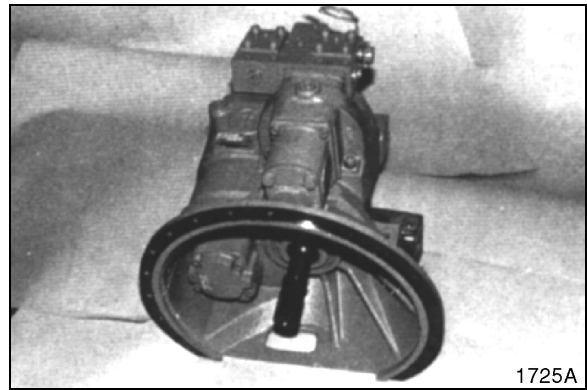


Figure 131



STEERING 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 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	3
Parts List	3
Specifications	4

GENERAL DESCRIPTION

THEORY OF OPERATION

The steering pump is a gear pump that directs hydraulic oil to the steering valve

PARTS LIST

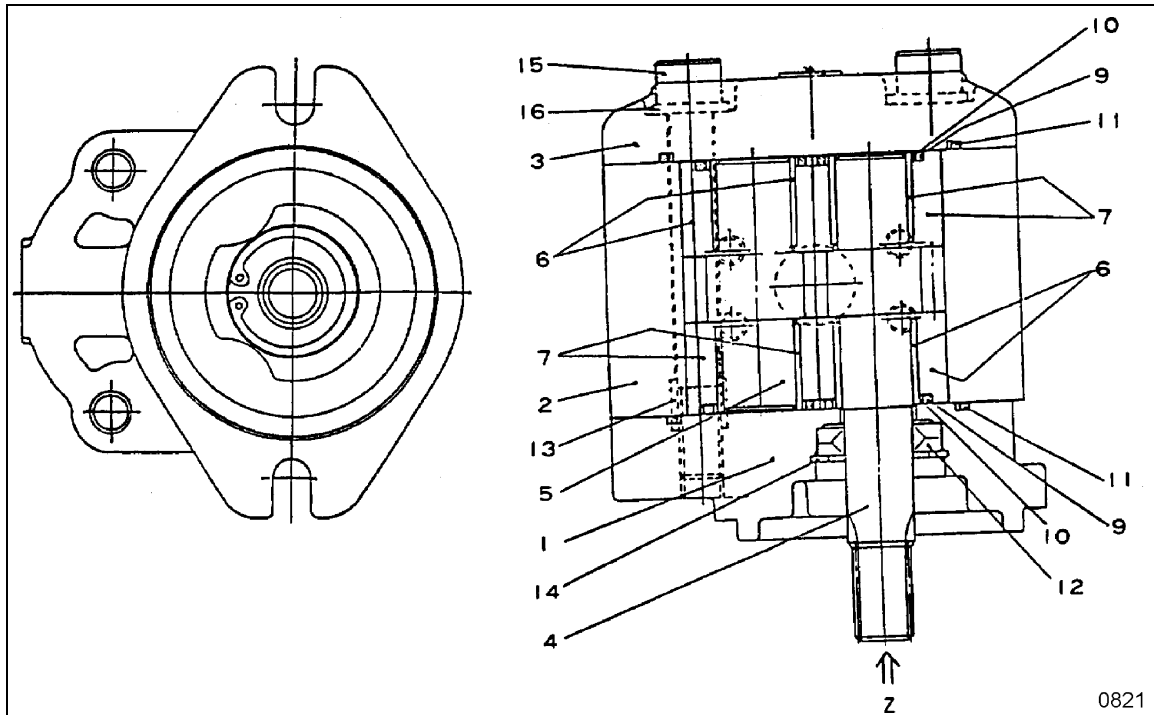


Figure 1

Reference Number	Description
1	Front Cover
2	Body
3	Rear Cover
4	Drive Cover
5	Idle Gear
6	Bushing
7	Bushing
8	-----

Reference Number	Description
9	Seal
10	Seal
11	O-ring
12	Oil Seal
13	Pin
14	Snap Ring
15	Bolt
16	Washer

SPECIFICATIONS

Steering Pump	
Type:	Gear Pump
Displacement:	12.7 cm ³ /rev (0.78 in ³ /rev)
Max Flow Rate:	27.9 l/min (7.4 gal/m) @ 2,200 RPM



BRAKE SUPPLY VALVE



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 130W-V	0001 and Up

TABLE OF CONTENTS

Parts List	4
Specifications	5

PARTS LIST

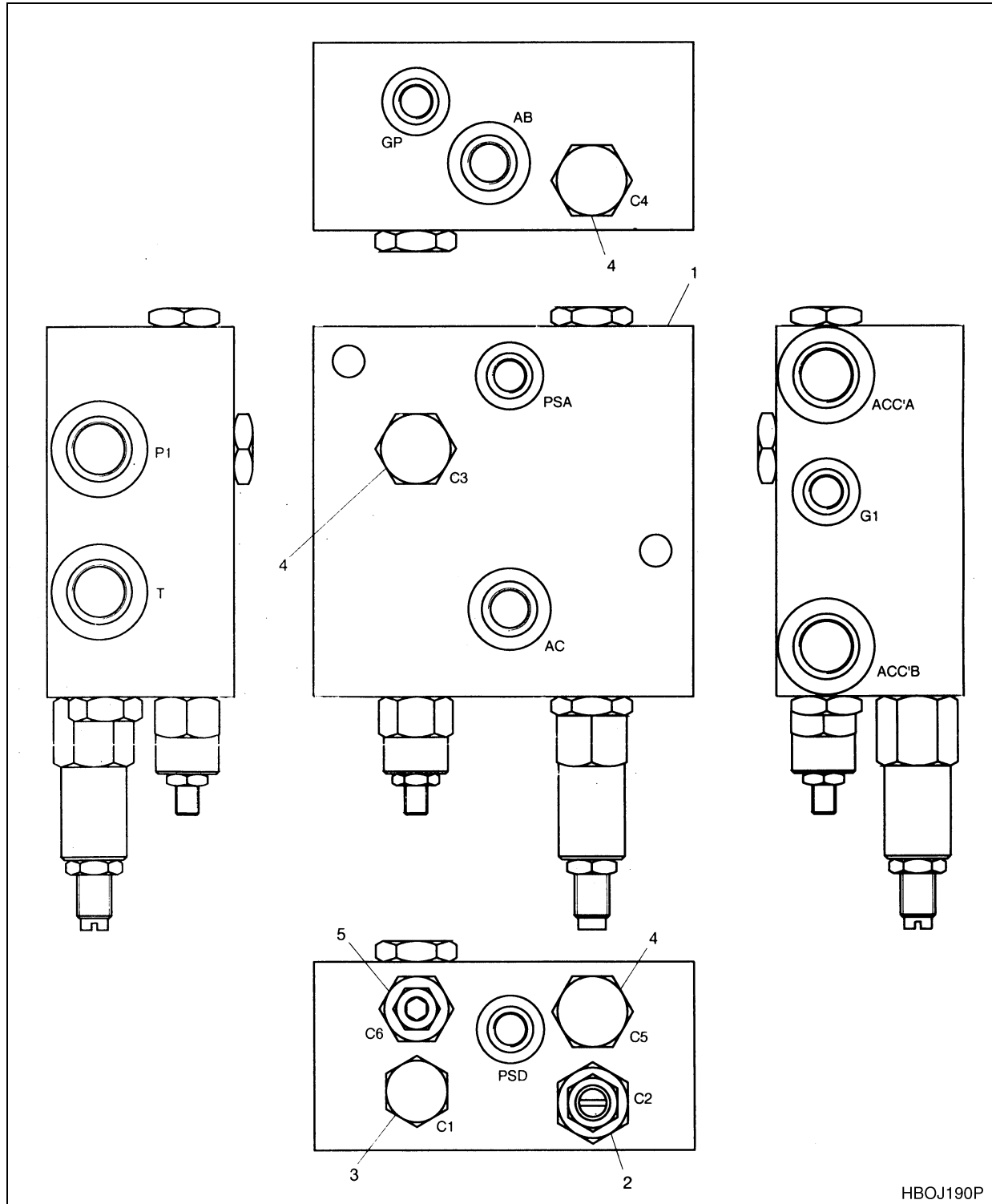


Figure 1

Reference Number	Description
1	Block
2	Relief Valve
3	Logic Valve

Reference Number	Description
4	Check Valve
5	Unloading Valve

SPECIFICATIONS

Brake Supply Valve	
Loading-Unloading Pressure	103 – 125 kg/cm2 (1,465 – 1,778 psi)
Low Pressure Warning	65 kg/cm2 (925 psi)
Pressure Relief Valve	160 kg/cm2 (2,276 psi)



COUNTERBALANCE VALVE



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 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
While Operating to Run Forward.....	3
While Operating to Stop.....	3
While Operating to Bac	3
Adjustment of Relief Valve	4
Troubleshooting	5
Counterbalance Valve	6
Recommended Tools	6
Disassembly.....	6
Order of Disassembly and Torque Values	7
Reassembly	8

GENERAL DESCRIPTION

The counterbalance valve is used in such a way that it is engaged in a running travel motor for the bell-type shovel. It functions as a double counterbalance valve which prevents the vehicle body from overrunning while running forward or backward

WHILE OPERATING TO RUN FORWARD

It refers to running operation which is done by means of applying pressure to motor either for accelerated climbing or for running fast on a flat road like expressway. **B** port working on left side of spool will overpower spring, thanks to pressure, and spool will open completely, causing oil to flow through individual ports (**B** → **B'** → Motor → **A'** → **A**).

The vehicle body will run at higher speed than speed of pump discharge due to inertial force while it is in deceleration or in descent. This will result in decreasing pressure of **B** port, causing power pressing the right side of spool to decline, and the spool to move toward center. This will generate counter pressure at **A'** port, which will control port pressure up to moderate level. At this time, spool will be controlled at level where pump discharged will be counterbalanced with counter pressure, and pressure of **B** port will be the pressure of spring which will be counterbalanced with the controlled level of spool.

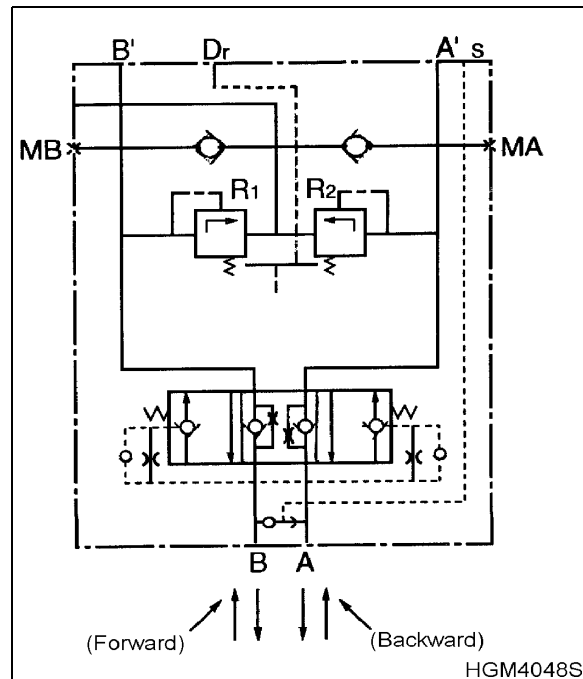


Figure 1

WHILE OPERATING TO STOP

Stop operation involves decrease of pressure of **B** port, causing spool to move to neutral position where only the neutral orifice will work. This set orifice will cause **A'** port to generate counter pressure, allowing the vehicle body with hydraulic brake to stop.

The relief valve regulates pressure of brake which came into operation when the pressure produced, at stop operation, from neutral orifice (counter pressure) reached the set pressure of valve. It also offers such operation as cutoff of surge pressure which is produced, at a rapid operation like an additional manipulation, from **A** port. If there occurs no cavitation at **A'** (**B'**) port, oil is supplied from **T** port. Therefore, there are anti-cavitation check for both sides.

WHILE OPERATING TO BACK

Backward operation also has counterbalancing function like forward operation. The spool moves to left when motor works either for accelerated climbing or for uniform running on a flat road, while oil flows through individual ports (**B** → **B'** to Motor to **A'** to **A**). While in deceleration and in decent, counter pressure is produced at **B'** port, contrary to the case of forwarding, causing vehicle body to be under control. While in operation to stop, spool moves toward neutral position and counter pressure produced from neutral orifice (at **B'** port) produces braking pressure of the relief valve, which forces the vehicle body to stop.

ADJUSTMENT OF RELIEF VALVE

Turning the adjusting screw right with a hexagon wrench will allow pressure to increase, and turning it left will allow pressure to decrease. One turn of an adjusting nut will make change of about 80 kgf/cm².

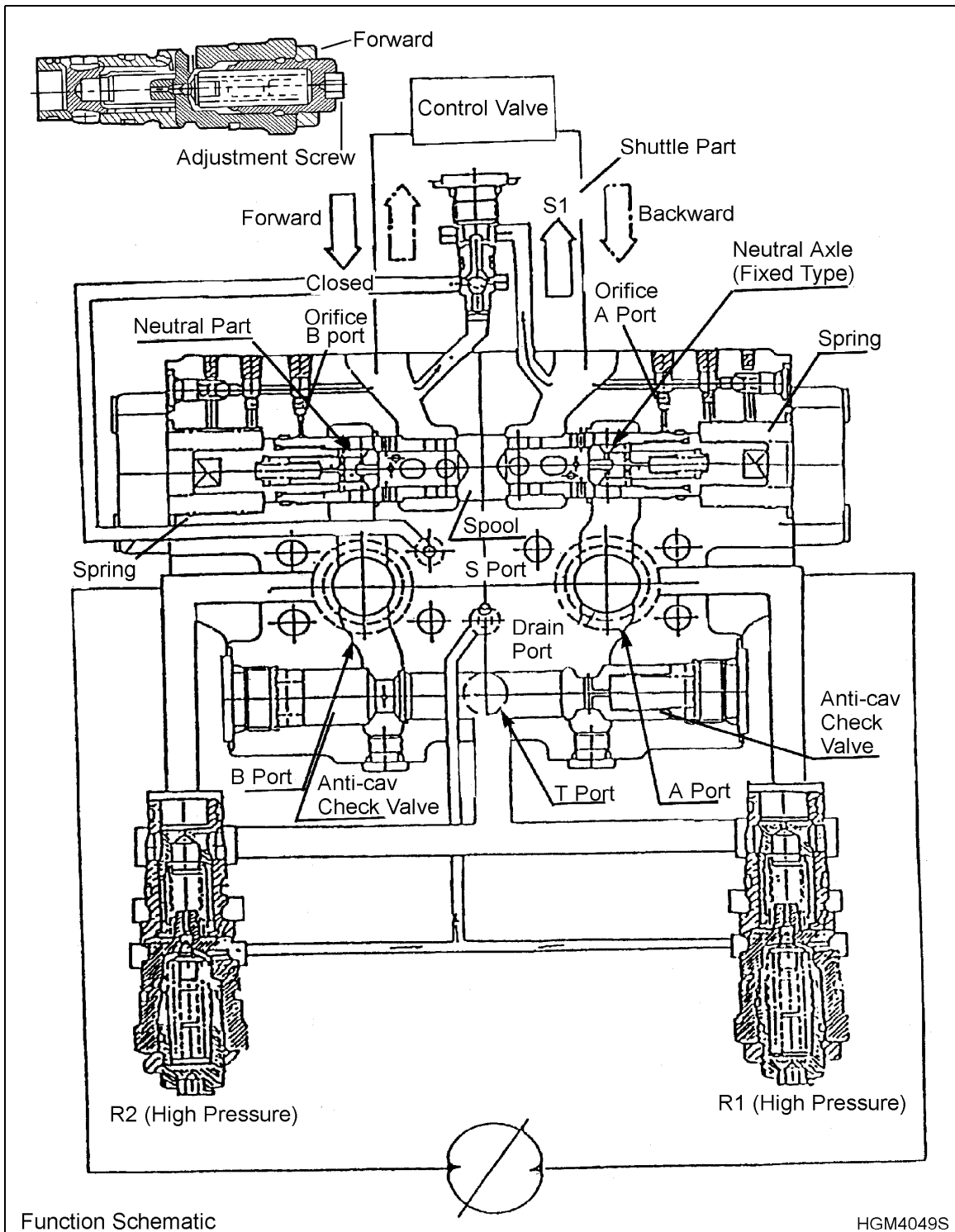


Figure 2

TROUBLESHOOTING

Problem	Possible Cause	Remedy
Motor Does Not Operate	Malfunction of spool (It is on status of deployment).	Retorque mounting bolts. Check for damage, replace or repair.
	Malfunction of check valve of anti-cavitation (Impracticable to adjust).	Retorque mounting bolts. Check for damage, replace or repair.
Acceleration time needs to be taken for operation of Motor	Malfunction of spool (It is on status of deployment).	Retorque mounting bolts. Check for damage, replace or repair.
	Orifice damper for counterbalance is clogged.	Disassemble and clean.
	Relief valve pressure improperly adjusted.	Readjust pressure Check for damage, replace or repair
Deceleration of Motor not Performed Smoothly	Damper for counterbalance is clogged. Neutral part of spool defective	Disassemble and clean.
	Relief valve pressure improperly adjusted.	Readjust pressure Check for damage, replace or repair
Abnormal Sound with Rapid Deceleration at High Speed	Damper for counterbalance is clogged. Neutral part of spool defective	Retorque mounting bolts. Disassemble and clean.

COUNTERBALANCE VALVE

RECOMMENDED TOOLS

Hexagonal Wrench	2.5, 4, 8, 14, 30 mm
Torque Wrench	0.25 - 15 kg•m (17 - 115
Loctite	242, 572
SealTape	150

DISASSEMBLY

NOTE: *Disassemble counterbalance valve in reverse order of assembly.*

REASSEMBLY

1. Install plug (3) and spring (20) to spool (2).

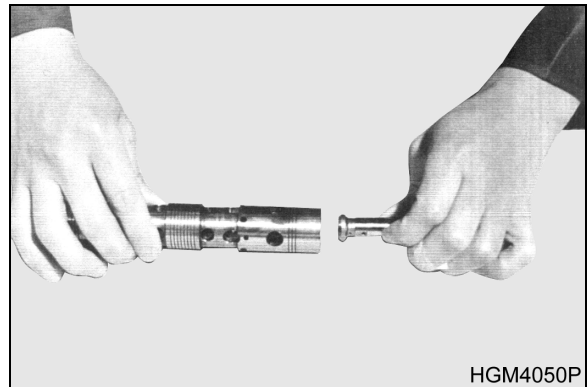


Figure 4

2. Apply Loctite 242 to plug (4) and install into spool (2). Torque to $75.5 \pm 7 \text{ kg}\cdot\text{m}$ ($548 \pm 50 \text{ ft lb}$). Install plugs on other side following steps 1 and 2.

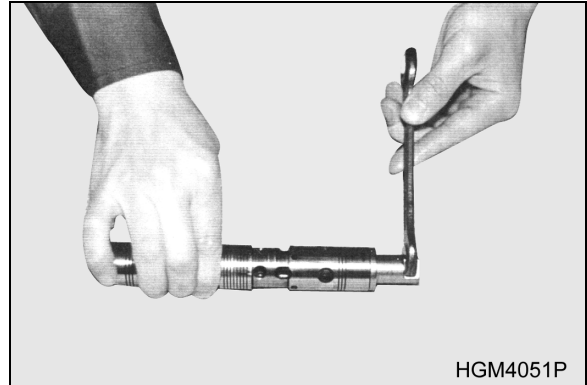


Figure 5

3. Install small ball bearings (12) into body (1).

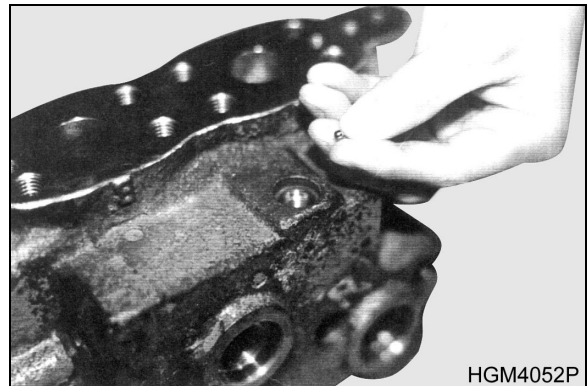


Figure 6

4. Install guide (7) into body (1).

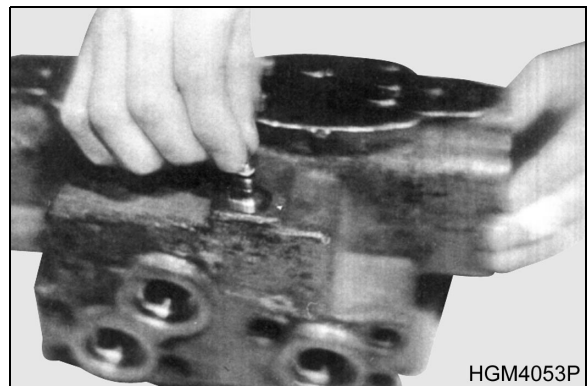


Figure 7

5. Install plug (33) into body and torque to $71.9 \pm 2.3 \text{ kg}\cdot\text{m}$ ($520 \pm 16 \text{ ft lb}$).

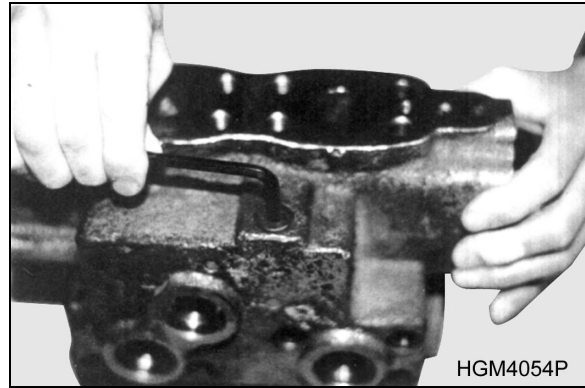


Figure 8

6. Apply Loctite 241 to orifice (17) and install into body (1) (on both sides). Torque to $70.16 \pm 0.20 \text{ kg}\cdot\text{m}$ ($507 \pm 1.45 \text{ ft lb}$).

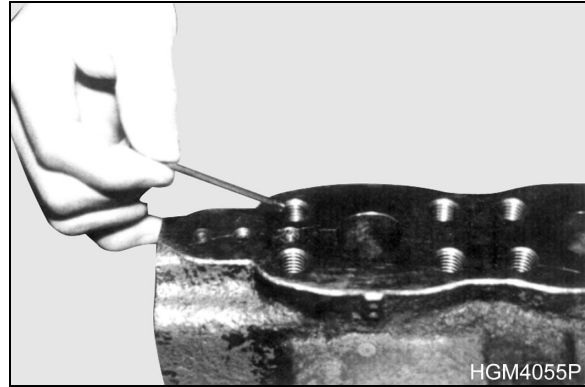


Figure 9

7. Apply Loctite 572 and wind seal tape around plug (16), and install to body (1) (both sides). Torque to $70.25 \pm 0.30 \text{ kg}\cdot\text{m}$ ($508 \pm 2.17 \text{ ft lb}$).

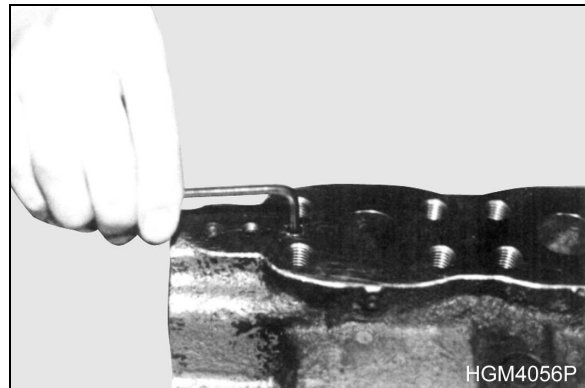


Figure 10

8. Install small ball bearings (11) and spring (21) into body (1) (both sides).

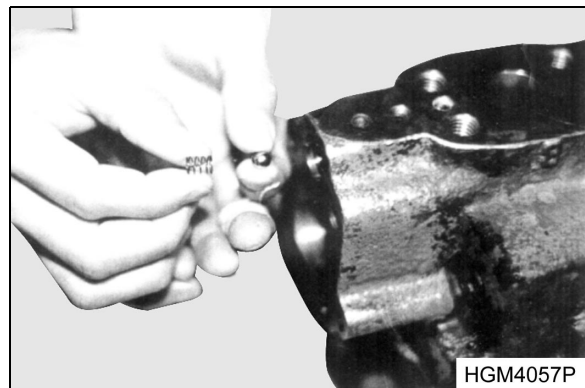


Figure 11

9. Install plug (5) into body (1) (both sides) and torque to $70.75 \pm 0.95 \text{ kg}\cdot\text{m}$ ($511 \pm 7 \text{ ft lb}$).



Figure 12

10. Install O-ring (25) into body (1) (both sides).

NOTE: *It is recommended to replace O-ring with new.*

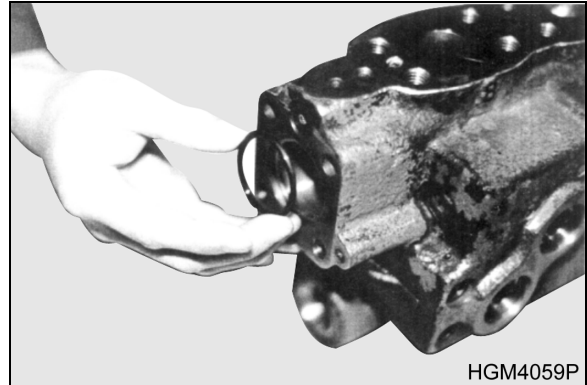


Figure 13

11. Install spool (2) into body (1).

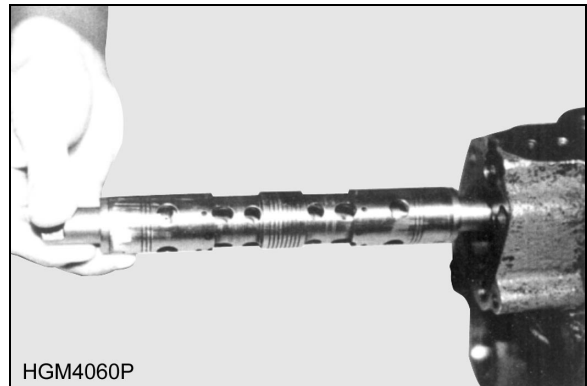


Figure 14

12. Install spring (19) into body (1), then install cover (6).

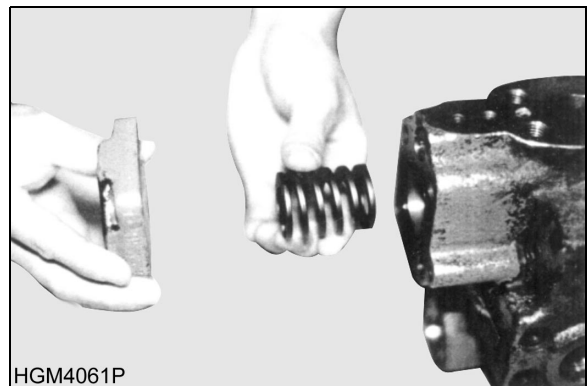


Figure 15

13. Tighten cover (6) (both sides) and torque to $75.6 \pm 7 \text{ kg}\cdot\text{m}$ ($548 \pm 50 \text{ ft lb}$).

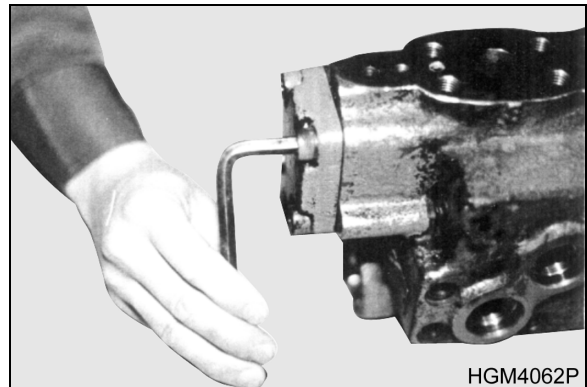


Figure 16

14. Install plunger (8) and spring (18), in that order, into body (1).

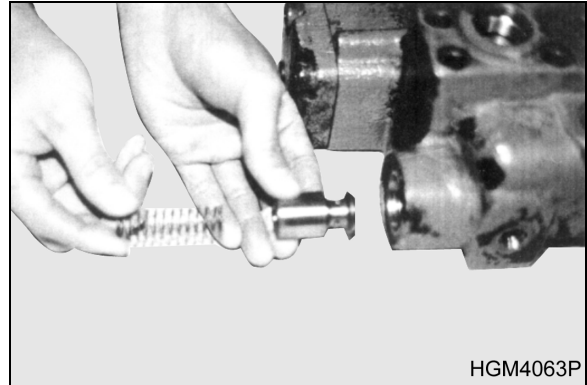


Figure 17

15. Install plug (14) into body (1) (both sides) and torque to $71.2 \pm 1.5 \text{ kg}\cdot\text{m}$ ($505 \pm 10 \text{ ft lb}$).

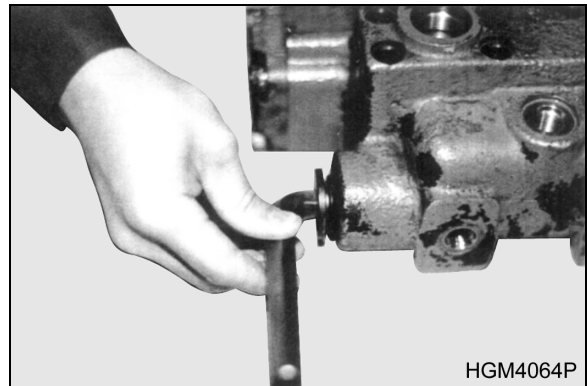


Figure 18

16. Install plug (33) into body (1) (both sides) and torque to $71.9 \pm 2.3 \text{ kg}\cdot\text{m}$ ($520 \pm 16 \text{ ft lb}$).

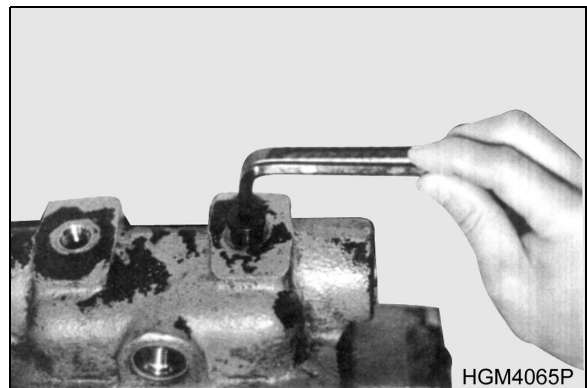


Figure 19

17. Install relief valve (9) into body (1) (both sides).

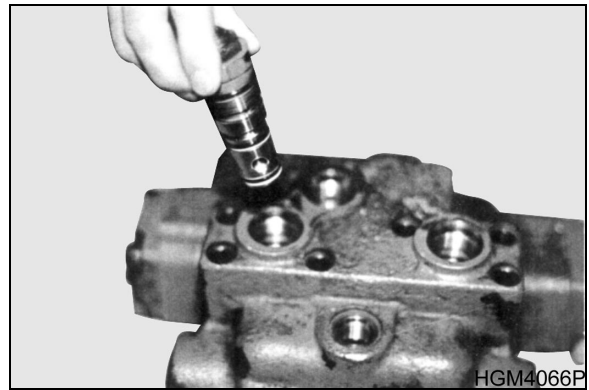


Figure 20

18. Torque to $78 \pm 9 \text{ kg}\cdot\text{m}$ ($564 \pm 65 \text{ ft lb}$).

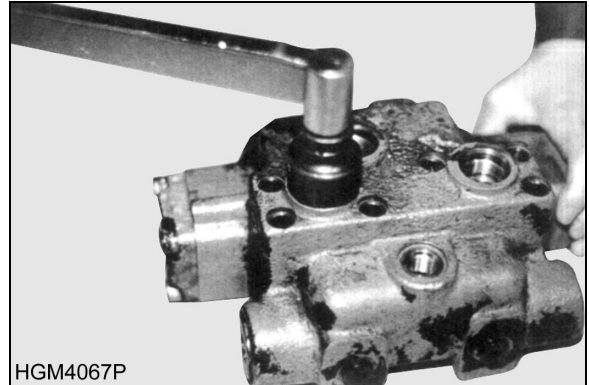


Figure 21

19. Install O-rings (22) and (23) into body (1).

NOTE: *It is recommended to replace O-rings with new.*

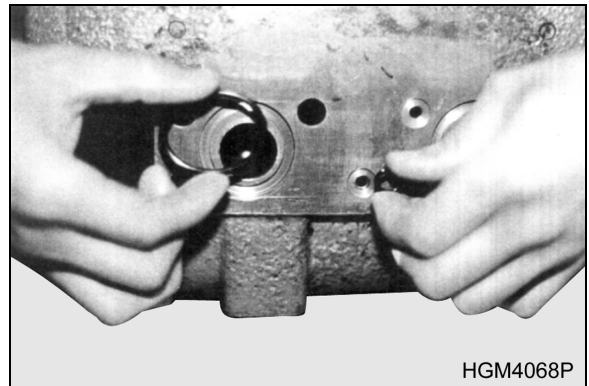


Figure 22

NOTE: *Reassembled counterbalance valve is shown.*

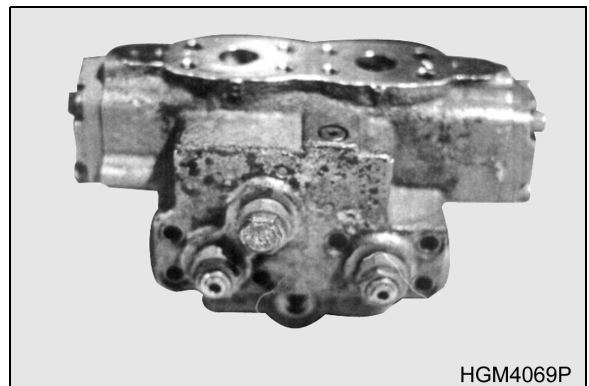


Figure 23



MAIN CONTROL VALVE



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

TABLE OF CONTENTS

Control Valve Operation	4
Swing Priority Circuit.....	4
Arm Priority Circuitry	5
Bucket (Junction) Circuitry	6
Straight Travelling Circuit.....	7
Plunger Replacement.....	9
Main Relief Valve	10
Overload Relief Valve	11
Arm Load Holding Valve	13
Boom Load Holding Valve	16
Arm Regeneration	18
Foot Relief Valve	20
Parts List	21
Specifications	31
Control Valve Drawing and Hydraulic Circuit.....	32
Disassembly and Reassembly	37
General Disassembly	37
General Reassembly.....	37
Main Plunger Element - Disassembly and Assembly	38
Tool.....	38
Main Relief Valve	41
Main Relief Valve Adjustment	42
Overload Relief Valve	44
Overload Relief Valve [BM UP]	46
Arm Load Holding Valve	48
Boom Load Holding Valve	51
Arm Regeneration Valve	53
Foot Relief Valve	54
Center Bypass Valve (CB Valve).....	55
ARm Parallel Switch Valve	56

Tool.....	56
Swing Priority Valve	58
Boom Unity Check Valve.....	60
Straight Travel Selector Valve.....	61
Check Valve - Locations.....	62
Check Valve	63

CONTROL VALVE OPERATION

SWING PRIORITY CIRCUIT

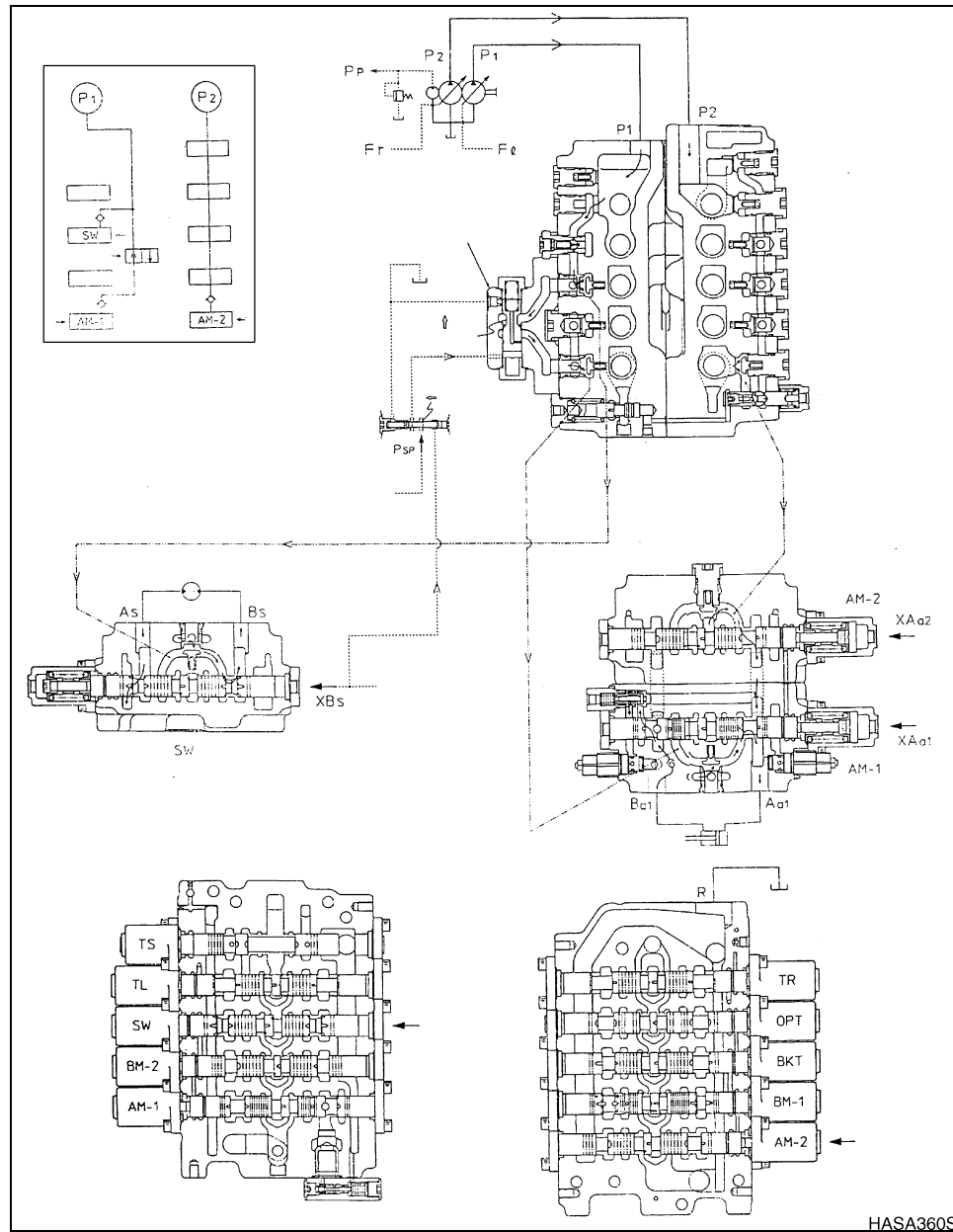


Figure 1

1. Hydraulic oil from P1 pump and swing plunger controlling pilot pressure, act simultaneously on the SP valve while pilot pressure from the solenoid valve triggers spoolSP, stopping all oil flow except to the swing circuitry.
2. Oil from the P2 pump flows through the center bypass and then to the arm.

ARM PRIORITY CIRCUITR

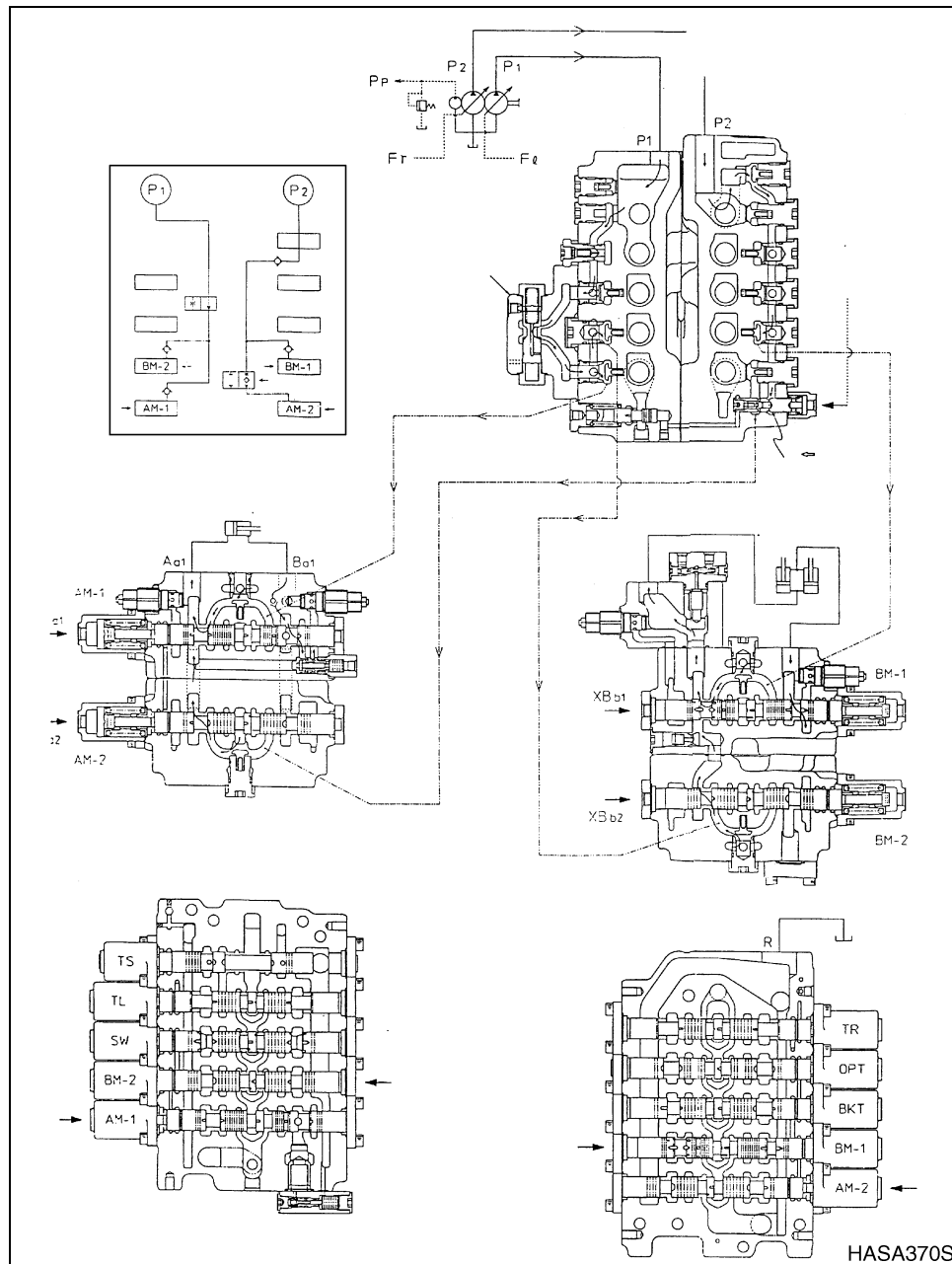
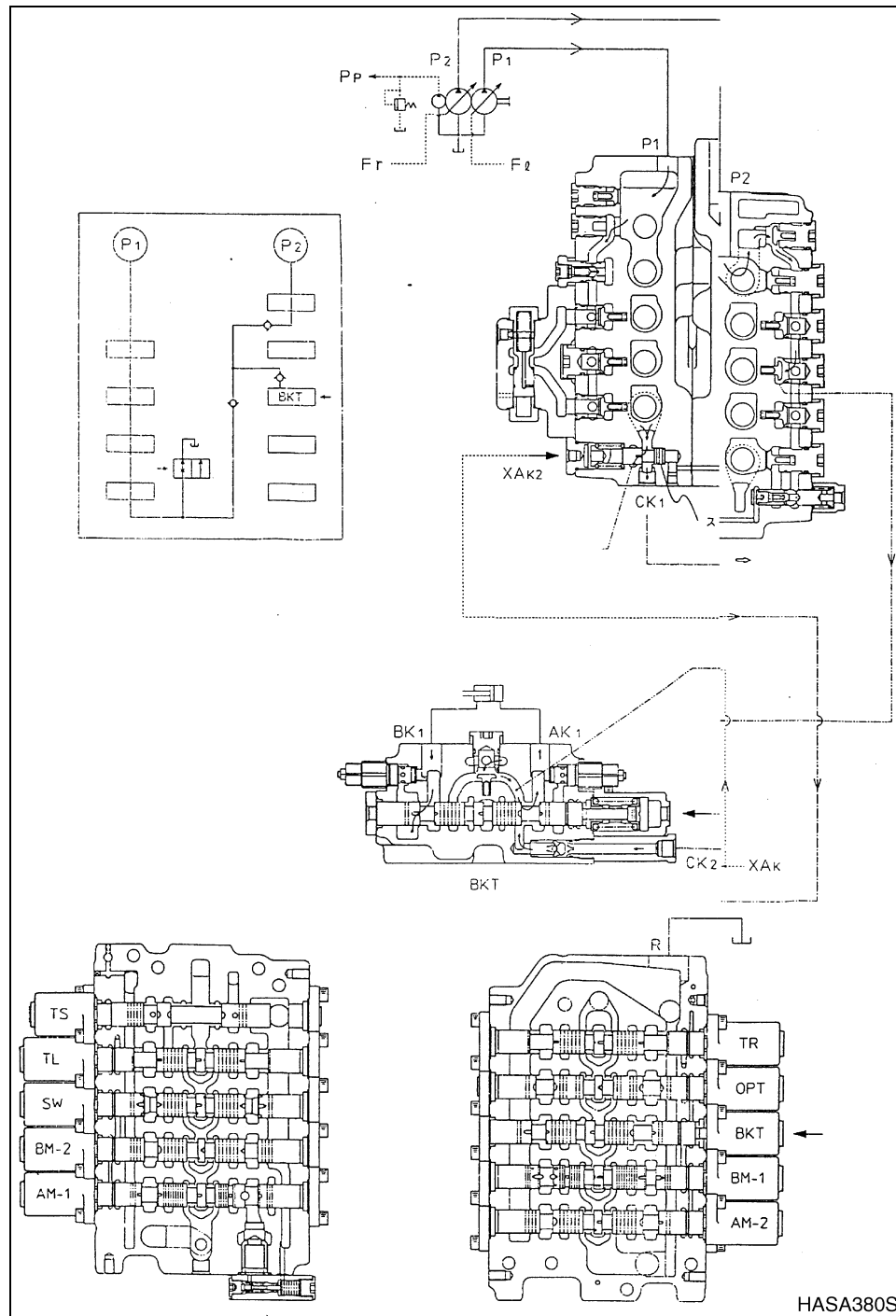


Figure 2

1. When PAP pilot pressure is ON, hydraulic oil from the P2 pump passes through the AP valve to the low (load) arm.
2. Hydraulic oil from the P2 pump does not trigger the AP valve. Oil, therefore, passes through a parallel passage supplying oil to the high (load) arm and to the boom.
3. When PAP pressure is OFF, hydraulic oil from pump P2 triggers the AP valve's spool AP and stops the flow of oil, so that oil is supplied only to the boom.

BUCKET (JUNCTION) CIRCUITRY



1. Hydraulic oil from the P2 pump flows to the bucket. Oil from the P1 pump and the bucket plunger that controls pilot pressure act simultaneously on the center bypass valve triggering spool CB to send oil from the center bypass through an external line (CK1 => CK2) which opens the bucket pressure check valve and joins with oil flow from the P2 pump.

STRAIGHTTRAVELLING CIRCUIT

Straight travelling circuit maintains straight travel of the excavator even if other actuators (SW, AM, BKT, BM) are operated in combination.

1. Straight Travel Circuit (Travel Only)

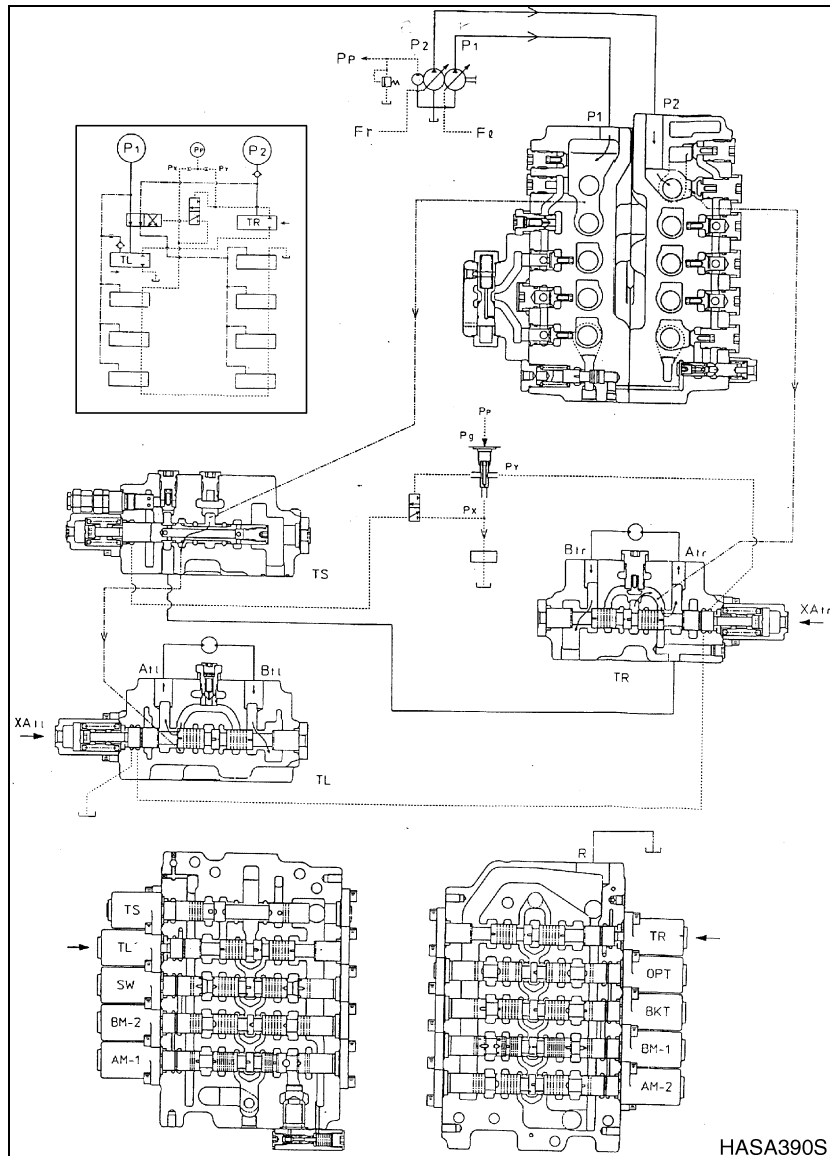


Figure 4

- A. As the plunger is switched on the pilot signal line (Py) is blocked off, but since the signal line (Px) is connected to the tank by the orifice, the hydraulic fluid flow from P1 pump is supplied to the left travel motor without activating the travel straight (TS) switching valve.
- B. The hydraulic fluid flow from P2 pump is supplied to the right travel motor in the same manner. As a result P1 pump powers the left travel motor and P2 pump powers the right travel motor and straight travel is achieved.

2. Travel Straight Circuit (Combined operation with swing)

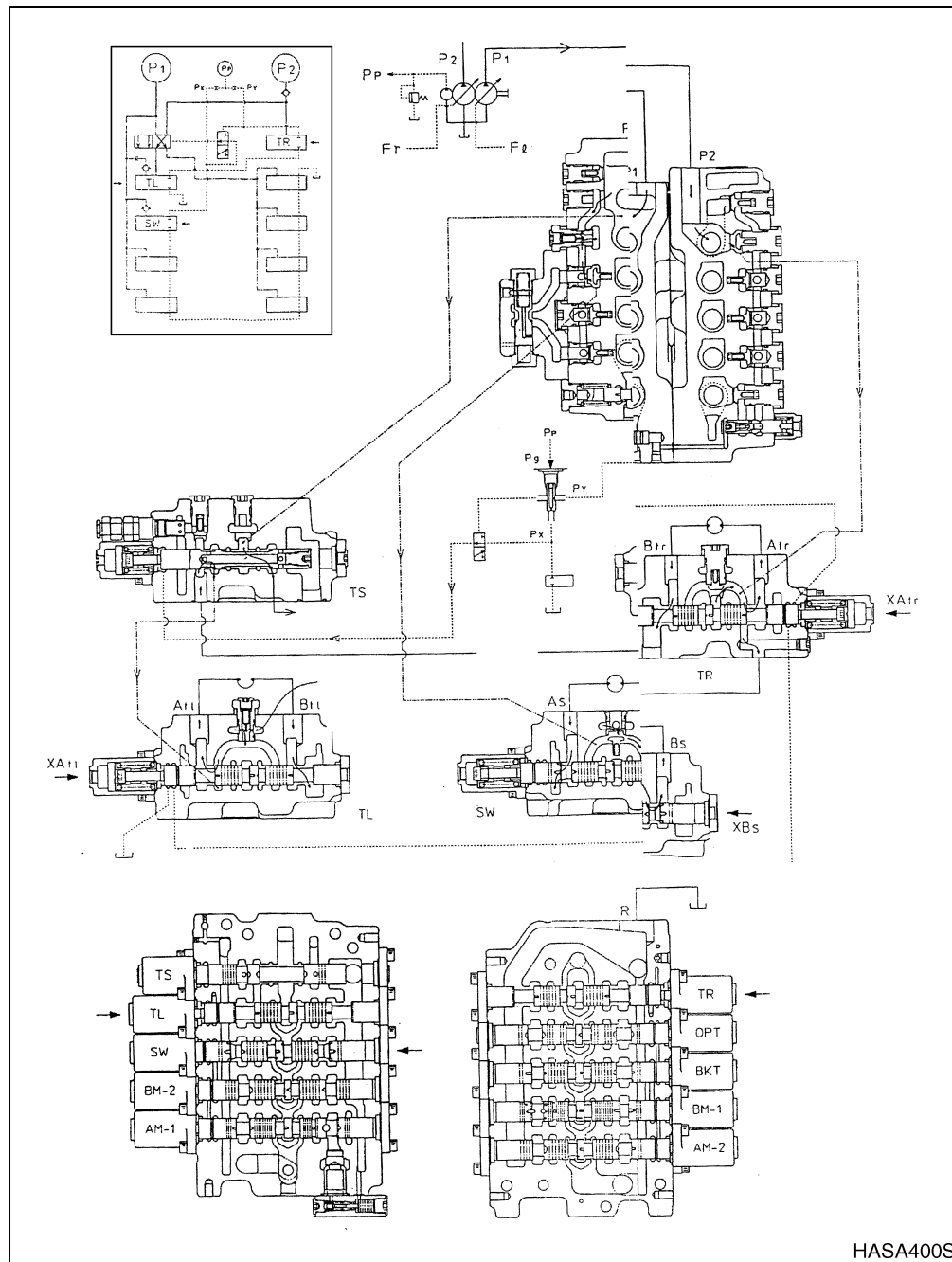


Figure 5

HASA400S

- A. First, when the swing plunger is switched on, the pilot signal (Px) within the control valve is blocked, as a result of that signal pressure travel straight (TS) switch valve will be switched on and provide a supply path to the left and right travel plunger. When the swing plunger is completely switched on the oil flow from the P1 pump is first supplied to the swing and the oil flow from the P2 pump is supplied to the right travel and left travel motors for straight travel and as a result combined operation is made possible.

- B. In addition, orifice C which follows a parallel path to the travel side of the valve, allows flow of surplus hydraulic fluid to the left, right travel motors and acts to minimize sudden changes in travel speeds.

PLUNGER REPLACEMENT

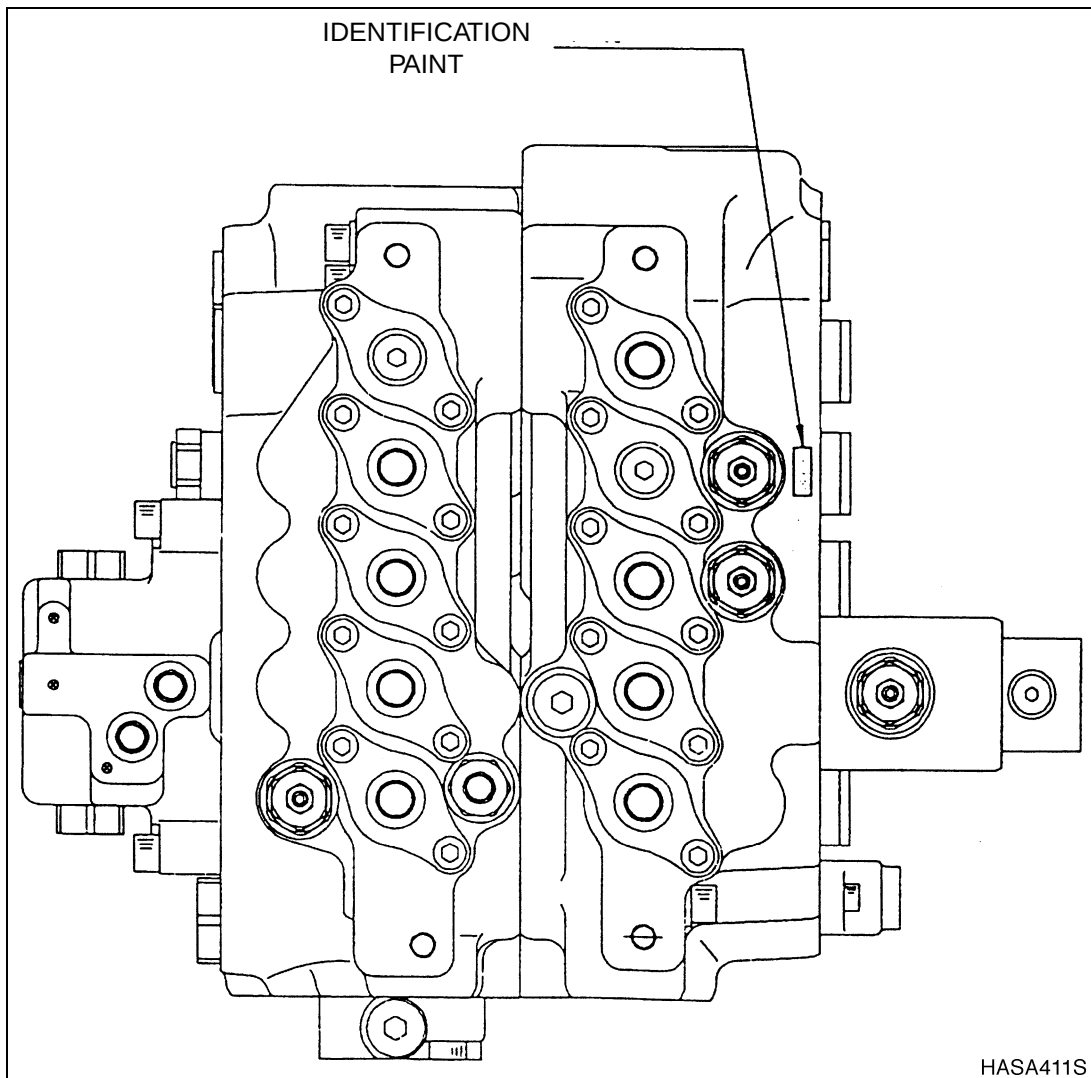


Figure 6

1. The plunger is selected and toothed into the housing; as a result it is a non serviceable part and can not be replaced on site.
 - A. If for some reason it needs to be replaced, please contact us with the following information;
 - Make and/or model number*
 - Identification color for selected teething as inscribed on the name plate.*
 - B. Identification color is painted on the right or left edge of the machine body. It is visible from the bottom if the paint has been removed.

MAIN RELIEF VALVE

1. Normal (low pressure) Operation (Pz pilot signal: OFF)

- Piston (d) is pushed to the right most position by spring (c).
- A. The pressurized oil from the main pump flows into chamber 3 through the orifice (2) of the main poppet A. Main poppet A is completely closed because $d1 > d2$.

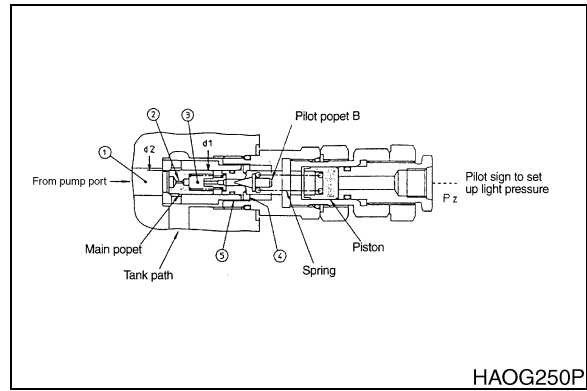


Figure 7

- B. When the oil pressure reaches the set pressure of spring C, the pilot poppet B is opened and oil flows to the tank through paths (4) and (5).

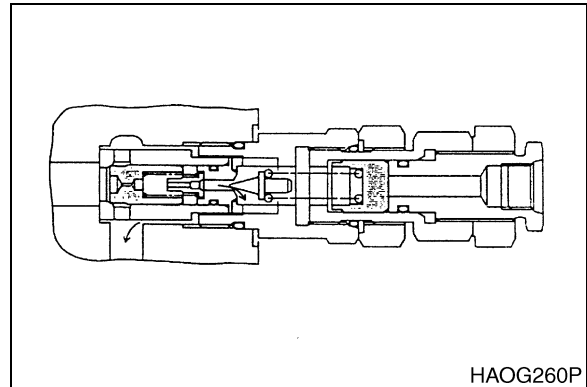


Figure 8

- C. During oil flow when pressure drops in front and back of orifice (2) and pressure of chamber (1) $d2 >$ pressure of chamber (1) $d1$, main poppet A will open and pressurized oil flows to the tank.

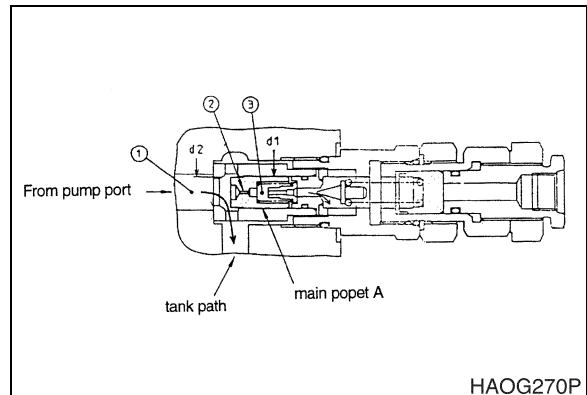


Figure 9

2. High pressure operation (Pz pilot signal: ON)

When piston D is in the left most position and the pressure has increased above the set pressure of spring C, high pressure condition is achieved.

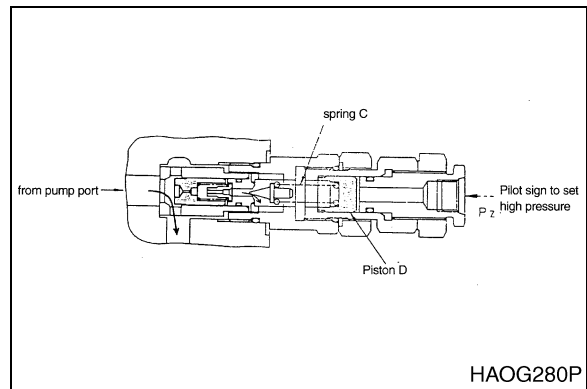


Figure 10

OVERLOAD RELIEF VALVE

1. Operation of overload relief valve
 - A. The pressurized oil from the cylinder port enter into chamber (2) through orifice (3) of piston A. Main poppet B is closed shut due to $d_1 > d_2$.
 - B. When the pressurized oil overcomes the set pressure of spring C, pilot poppet D opens and oil flows to the tank through the transverse hole (4) and path (5).

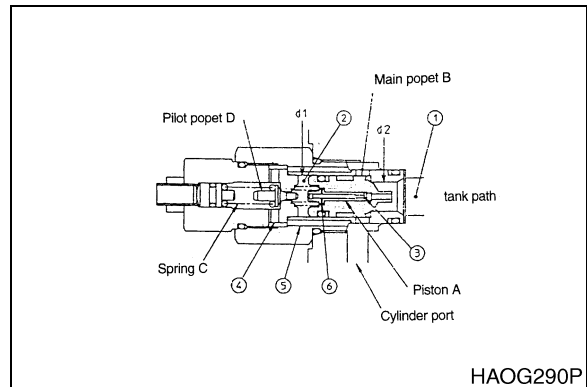


Figure 11

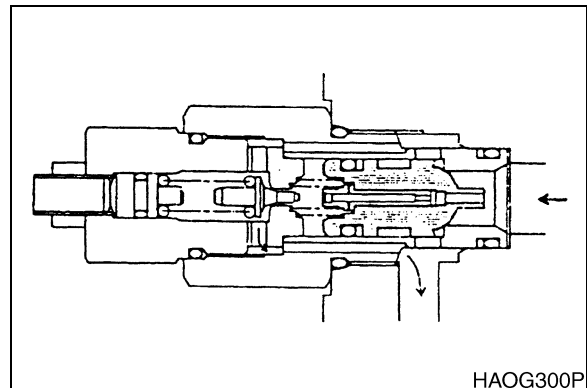


Figure 12

- C. Oil flows and pressure decreases in orifice (3) of piston A moving the piston to the left and seating at the edge of pilot poppet D. The oil in chamber (1) flows to the tank through orifice (6) of piston A, traverse hole (4) and passage (5).

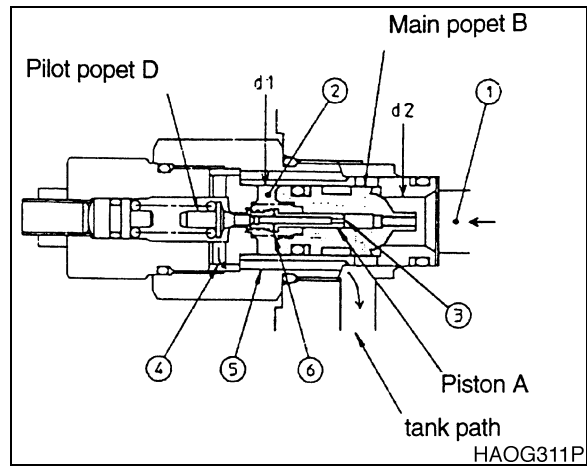


Figure 13

- D. Pressure decreases behind orifice of piston A and if chamber (1) pressure $p_{d2} > p_{d1}$ the main poppet B opens and the pressurized oil of cylinder port flows to the tank to protect the actuator.

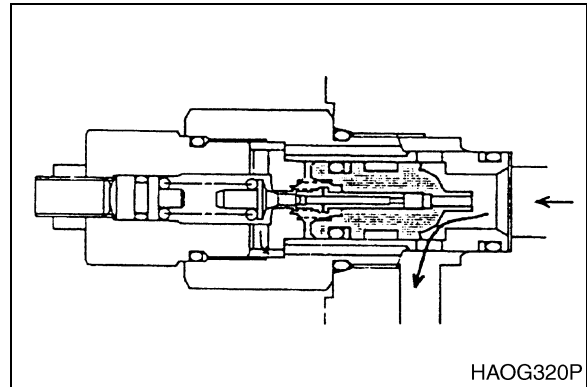


Figure 14

2. Operation of make-up valve

- A. The main poppet area $d1 > d2$ and since the cylinder port pressure is usually higher than the tank pressure the main poppet will be in place. When the cylinder port pressure drops (approaches pressure load), and cylinder port pressure $<$ tank pressure the main poppet B opens due to the area difference $d1$ & $d2$ and the tank pressure and oil flows from the tank to the cylinder port preventing cavitation.

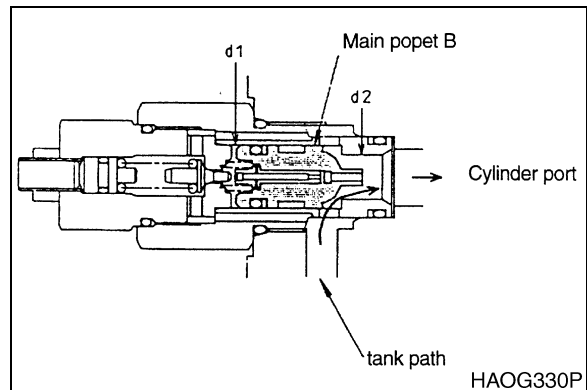


Figure 15

ARM LOAD HOLDING VALVE

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

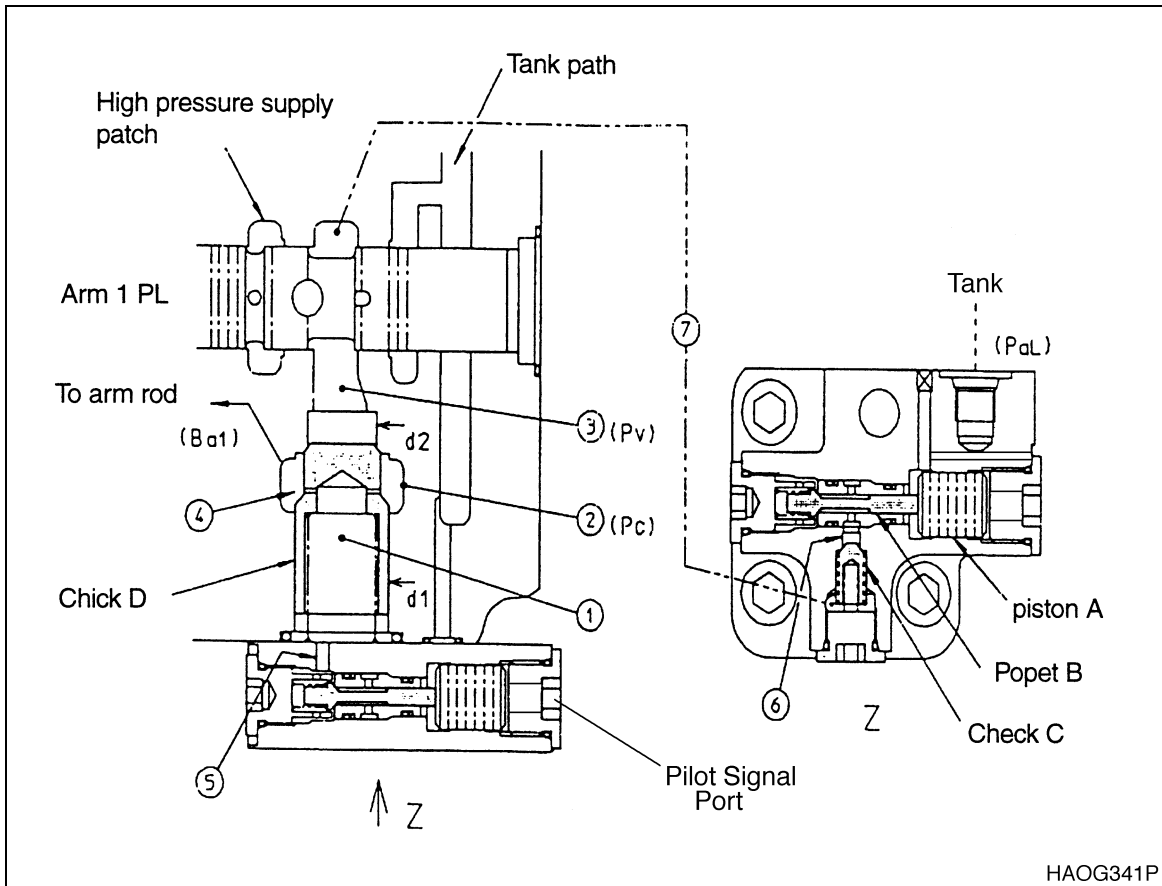


Figure 16

- Piston A and poppet B are in position blocking path 5 & 6. As oil flows from chamber (1) to chamber (2), the pressure at orifice (4) is P_e . Since $d_1 > d_2$, check valve D is seated completely blocking out chambers (2) & (3).

2. When plunger is operated

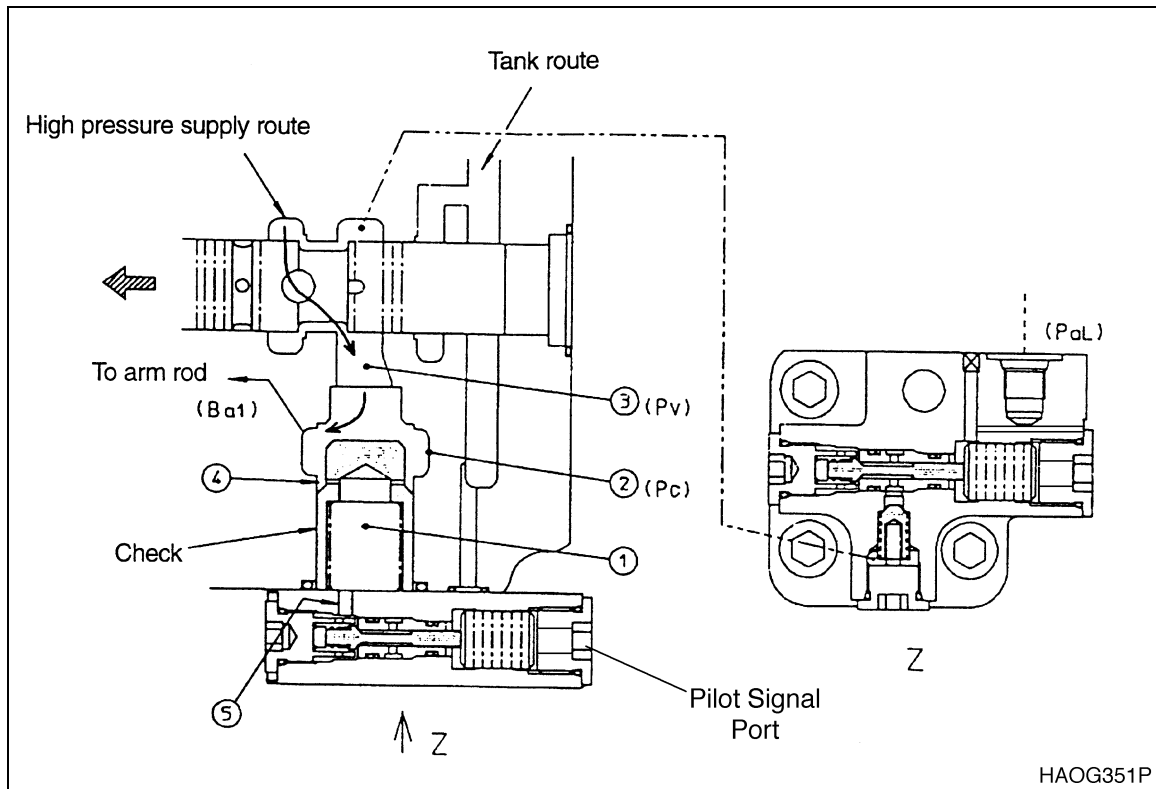


Figure 17

A. Arm Dump Operation ($p_1 > p_c$) (P_{aL} pilot signal: OFF)

Oil passes through path (4) and chamber (1) pressure becomes pressure P_c . At squeeze (2), poppet (D) opens and high pressure oil is supplied to rod side of the cylinder.

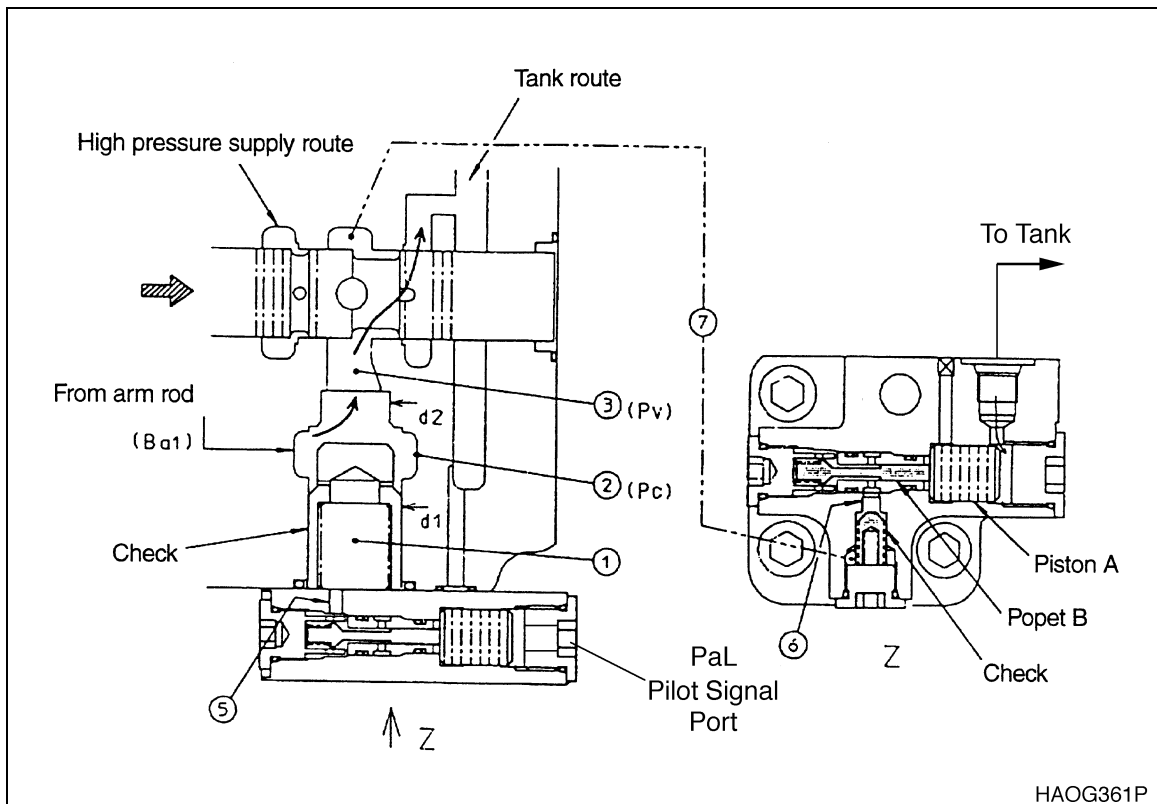


Figure 18

B. Arm Crowd ($P_c > P_v$) (PaL pilot signal: ON)

Pilot signal pressure enters signal port, piston A moves to the left and poppet B is opened and paths (5) & (6) are connected. The oil from chamber (1) flows back to the tank through path (7). The oil pressure in chamber (1) is released allowing the poppet to open, and oil from the rod side flows to the tank.

BOOM LOAD HOLDING VALVE

1. When plunger is neutral (Pi pilot signal: OFF)
 - A. Spool A is in the position as shown closing off the path between chamber (1) and drain (Dr1). Chamber (1) and chamber (2) are connected through squeeze (4) and the pressure is Pc. $d_1 > d_2$, poppet B is seated closing off chamber (2) & chamber (3).

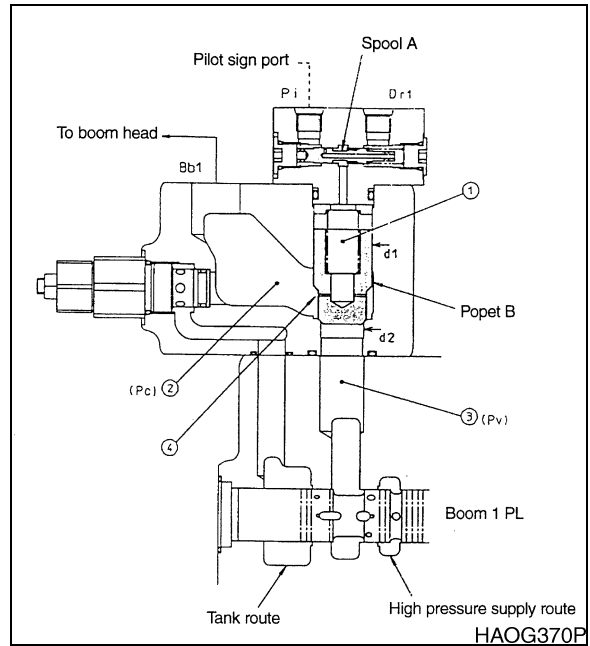


Figure 19

2. When plunger is operated
 - A. Boom-up ($P_v > P_c$) (Pi pilot signal: OFF)

As the plunger is operated, high pressure oil flows in through chamber (3). Chamber (1) and chamber (2) pressures are Pc and equalized through squeeze (4). Pv overcomes set spring pressure and high pressure oil is supplied to the cylinder head.

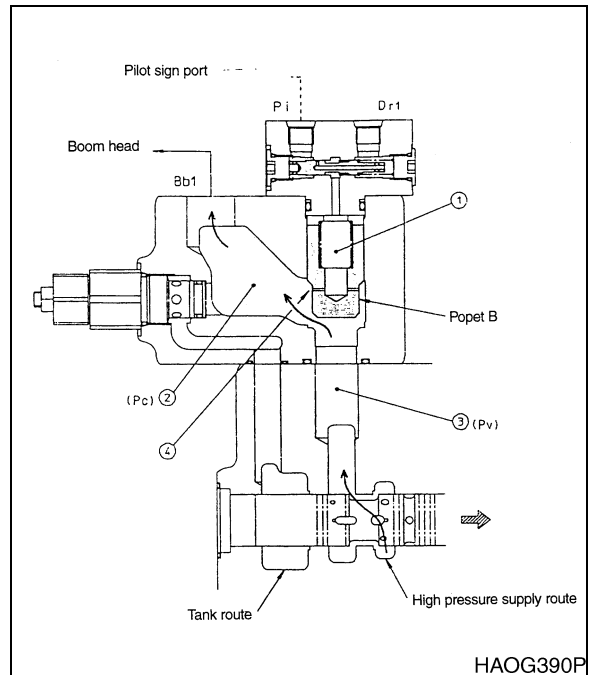


Figure 20

B. Boom-down ($P_c > P_v$) (P_i pilot signal: ON).

Pilot signal pressure enters signal port, spool A moves to the right and chamber (1) and drain (1) are connected allowing chamber (1) to drain. Since pressure P_c is greater than P_v , oil flows through the opened poppet B and flows back to the tank.

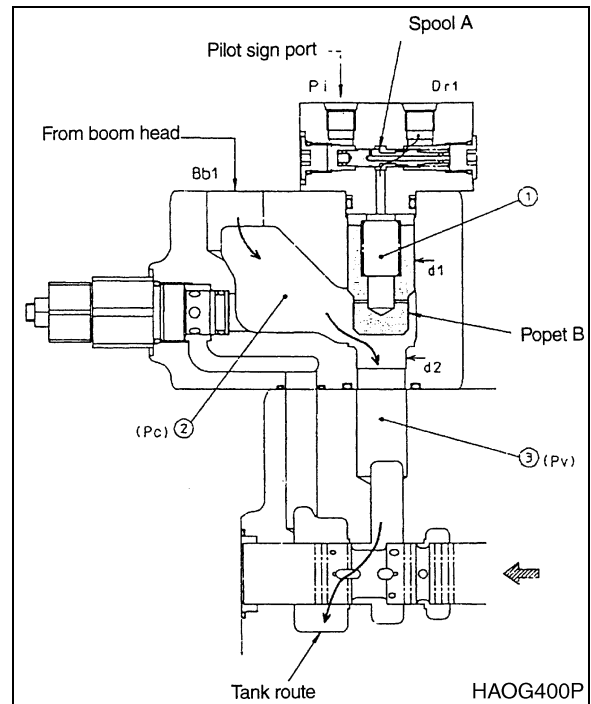


Figure 21

ARM REGENERATIO

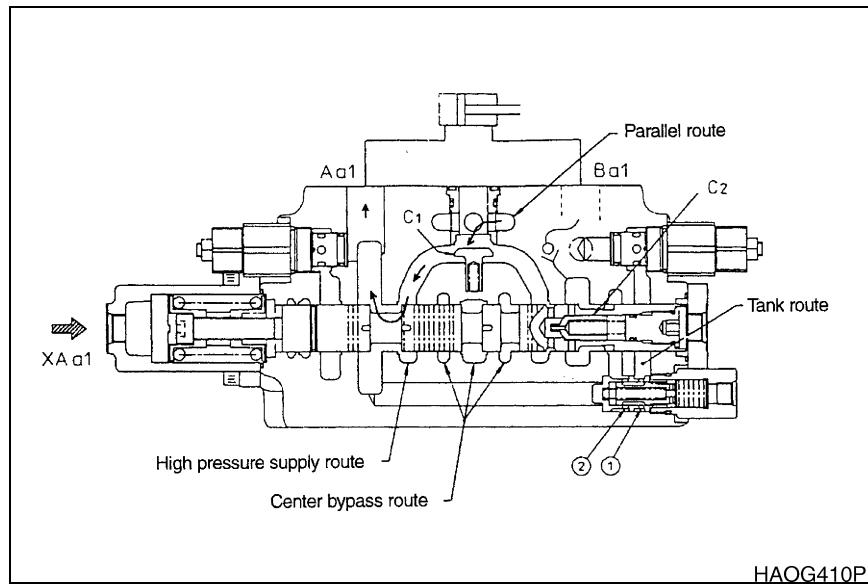


Figure 22

1. If the arm plunger is operated to crowd side, the plunger moves to the right side and the center bypass route is interrupted. The oil from pump opens check valve C1 from parallel route and flows to the cylinder head through the high pressure supply route.

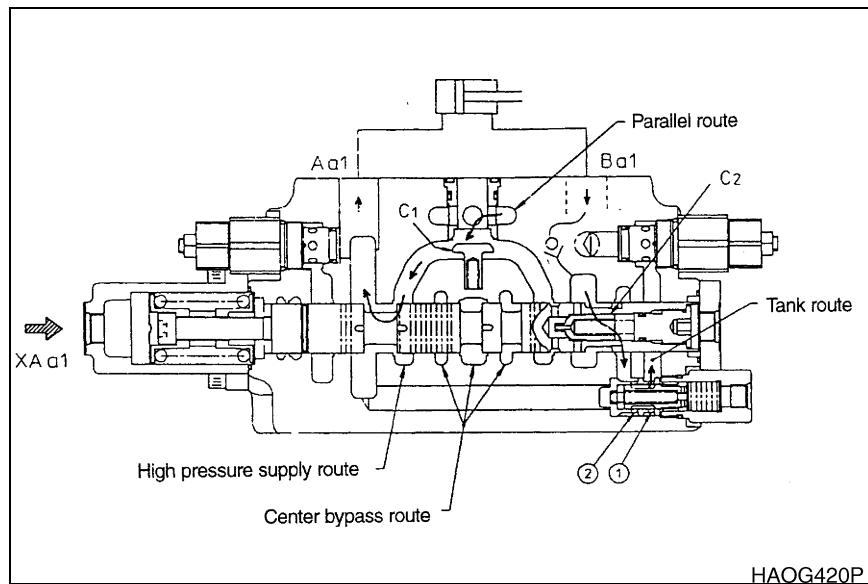


Figure 23

2. Oil returning from the rod side flows back to the tank through regeneration valve route (2) to route (1).

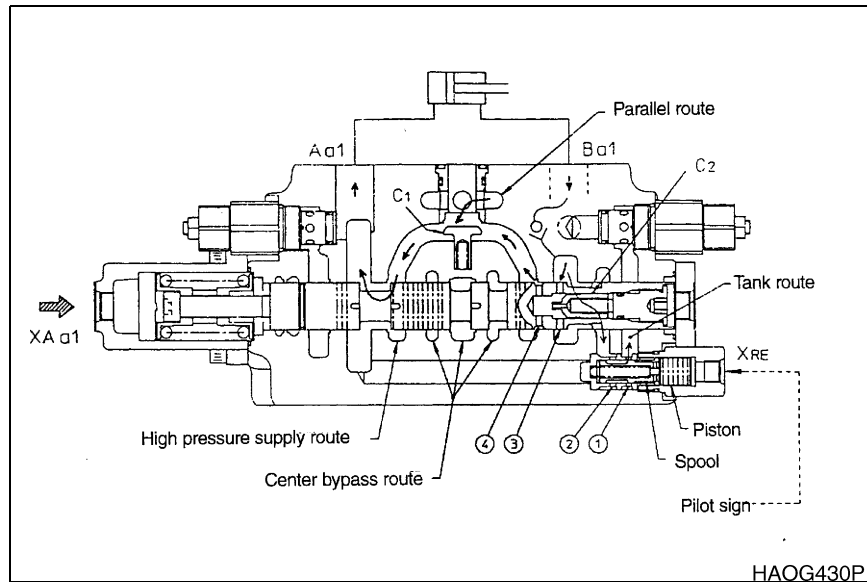


Figure 24

3. When the pilot signal is supplied to port XRE, piston A is moved to the left. Rod side pressure is raised up due to spool B closing route (1) and check valve C2 in plunger is opened, as a result oil is regenerated to the head side through route (3) to route (4) of the plunger.

FOOT RELIEF VALVE

1. Oil from center bypass route flows to tank route through orifice A of poppet. The pressure (f_p) generated by flow passed through orifice is fed back to the pump to control the discharge volume by the pump.

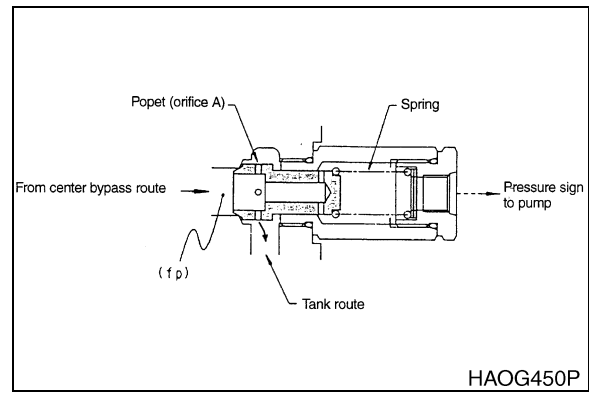


Figure 25

2. A large amount of fluid flow from delayed pump response causes pressure (f_p) to overcome set spring pressure and the poppet is opened, allowing oil to flow to the tank operating as a relief valve.

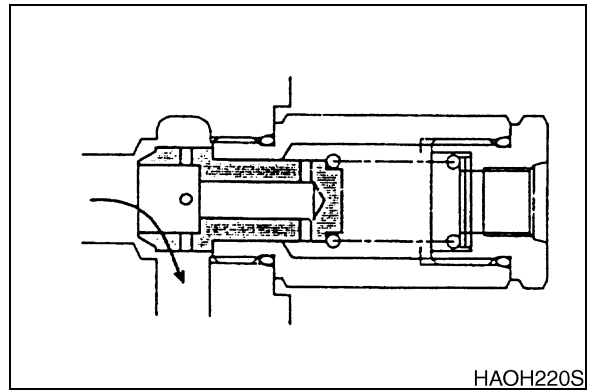


Figure 26

PARTS LIST

Main Plunger Element

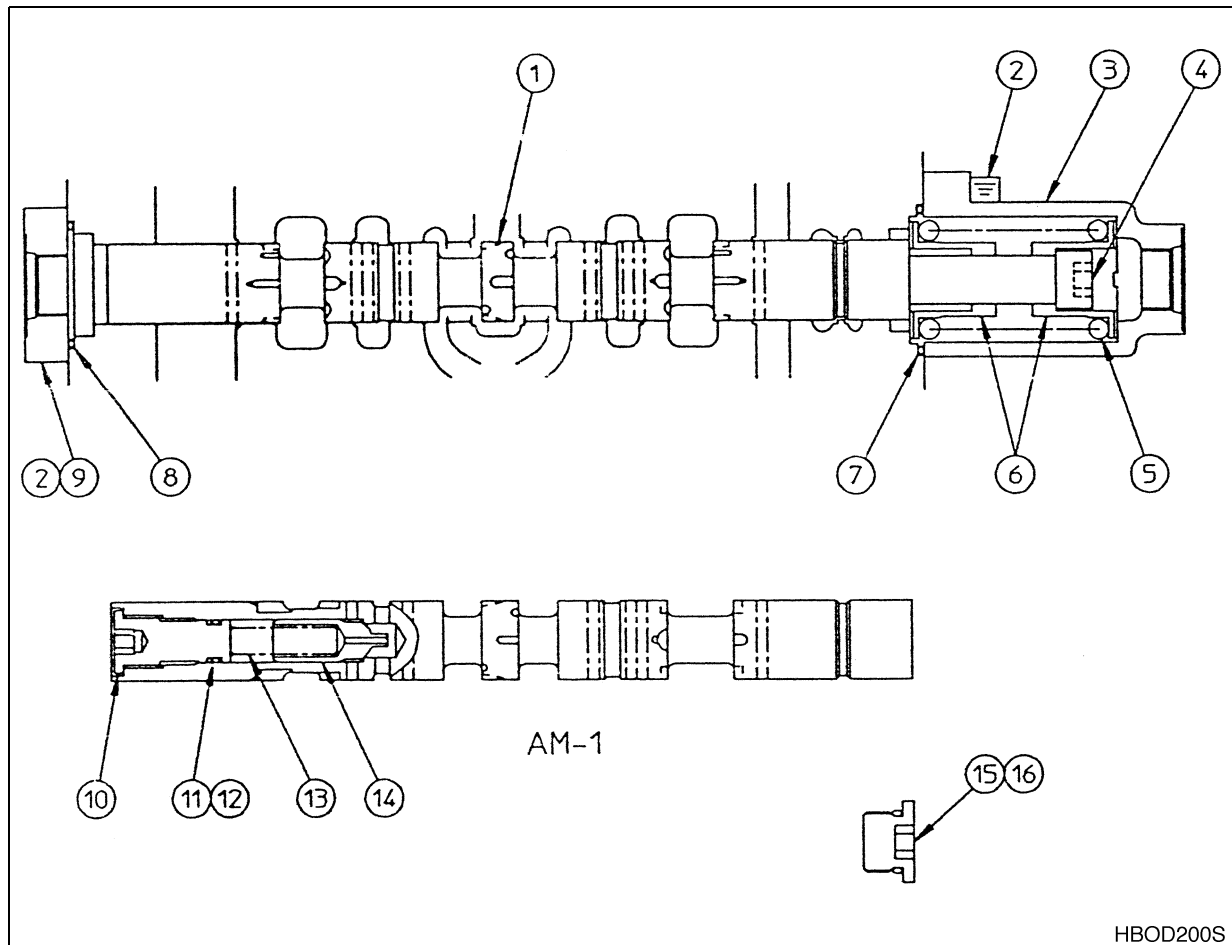


Figure 27

Reference Number	Description
1	Plunger
2	Bolt With Hole
3	Cover
4	Plunger Cap
5	Spring
6	Spring Guide
7	O-ring
8	O-ring

Reference Number	Description
9	Retainer
10	Cap
11	Back-up, Ring
12	O-ring
13	Spring
14	Check Valve
15	Cap (Option Only)
16	O-ring (Option Only)

Main Relief Valve

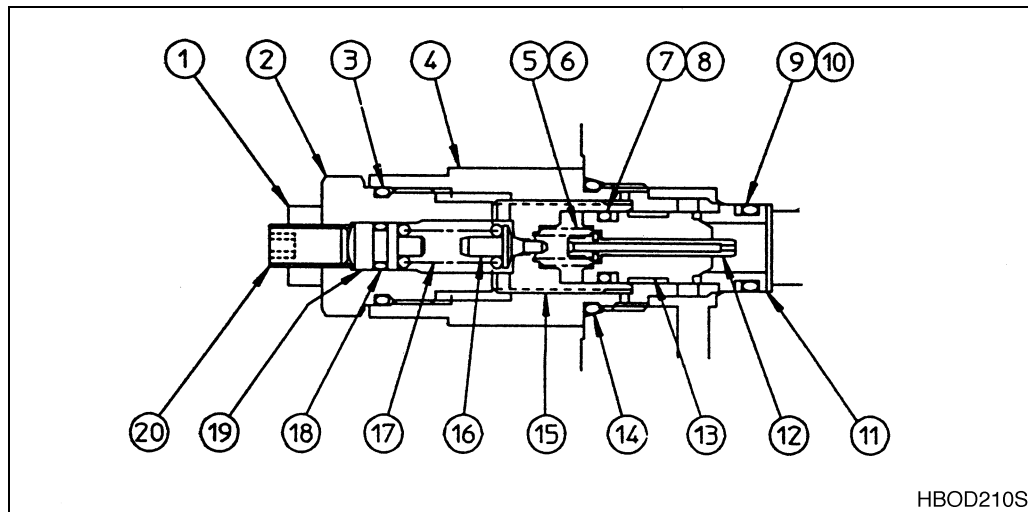


Figure 28

Reference Number	Description
1	Hexagonal Nut
2	Cap
3	O-ring
4	Sleeve
5	Spring
6	Spring
7	O-ring
8	Back-up Ring
9	Back-up Ring
10	O-ring

Reference Number	Description
11	Main Seat
12	Piston
13	Main Poppet
14	O-ring
15	Pilot Seat
16	Pilot Poppet
17	Spring
18	O-ring
19	Spring Seat
20	Adjusting Screw

Overload Relief Valve

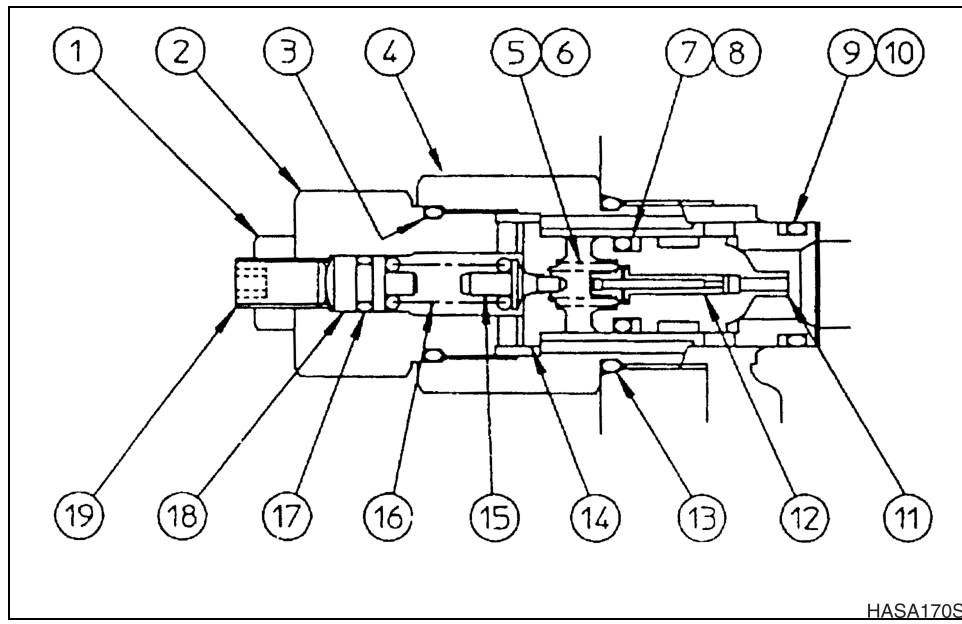


Figure 29

Reference Number	Description
1	Hex Nut
2	Cap
3	O-ring
4	Sleeve
5	Spring
6	Spring
7	O-ring
8	Back-up Spring
9	Back-up Spring
10	O-ring

Reference Number	Description
11	Main Poppet
12	Piston
13	O-ring
14	Pilot Seat
15	Pilot Poppet
16	Spring
17	O-ring
18	Spring Tray
19	Adjusting Screw

Boom Load Holding Valve

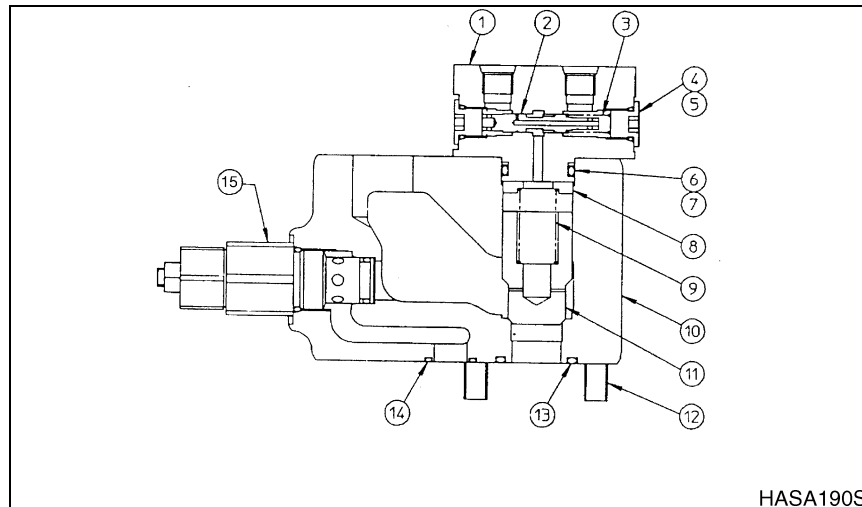


Figure 30

Reference Number	Description
1	Cover
2	Spool
3	Spring
4	Cap
5	O-ring
6	Back-up Spring
7	O-ring
8	Spring Seat

Reference Number	Description
9	Spring
10	Manifold
11	Poppet
12	Bolt With Hole
13	O-ring
14	O-ring
15	Relief Valve

Boom Unity Check

Reference Number	Description
1	Cap
2	O-ring
3	Spring
4	Check

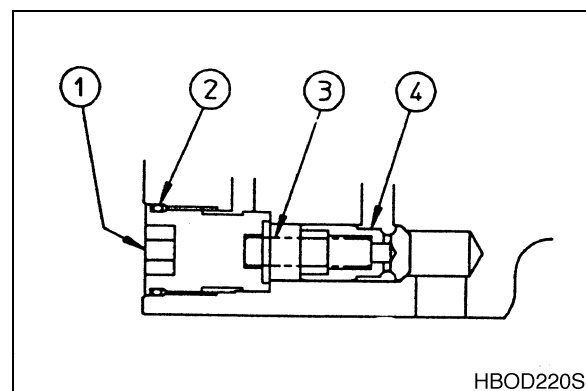


Figure 31

Arm Regeneration Valve

Reference Number	Description
1	Cap
2	Piston
3	O-ring
4	Spool
5	Spring
6	Sleeve

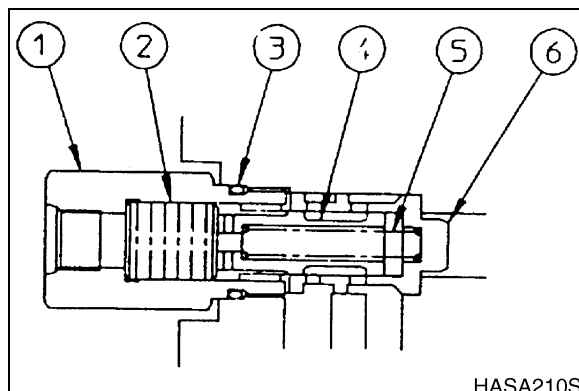


Figure 32

Foot Relief Valve

Reference Number	Description
1	Cap
2	Seam
3	Seam
4	Cap
5	Spring
6	Poppet
7	O-ring

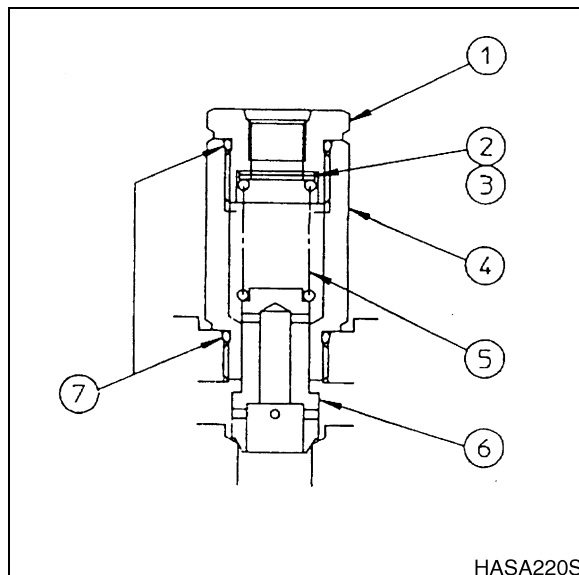


Figure 33

Arm Priority Valve [Ap Valve]

Reference Number	Description
1	Cap
2	O-ring
3	Spring
4	Check
5	Spool BP
6	Spring
7	Cover
8	Bolt With Hole
9	O-ring

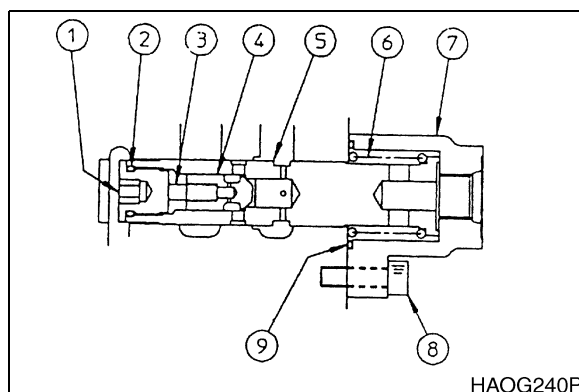


Figure 34

Check Valve [Tr, Am-2]

Reference Number	Description
1	Cap
2	Back-up Ring
3	O-ring
4	Spring
5	Nylon Chip
6	Check

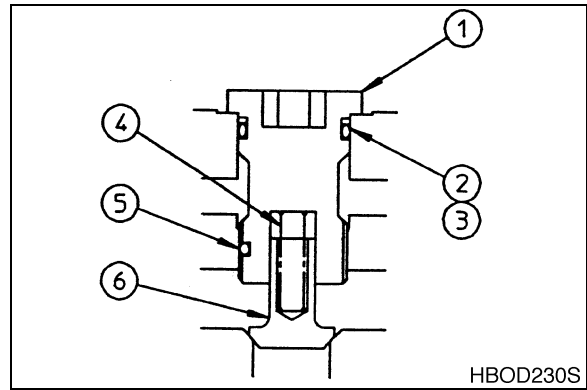


Figure 35

Check Valve [Opt, Bkt, Bm-1, Bm-2]

Reference Number	Description
1	Cap
2	Back-up Ring
3	O-ring
4	Spring
5	Nylon Chip
6	Check

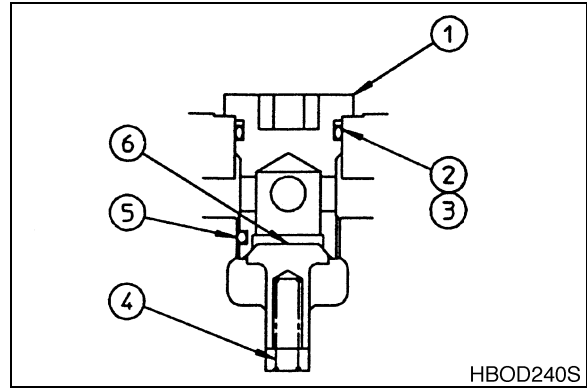


Figure 36

Check Valve

Reference Number	Description
1	Cap
2	Back-up Ring
3	O-ring
4	Nylon Chip
5	Spring
6	Check

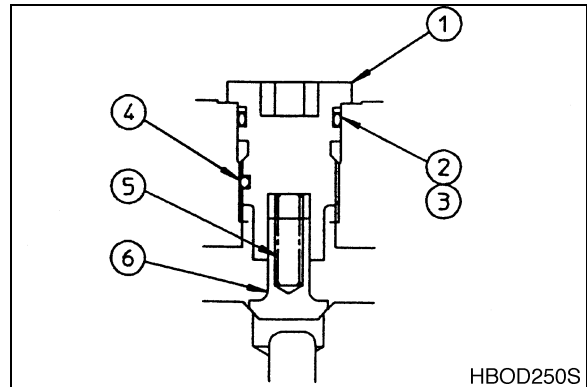


Figure 37

Check Valve [AM1]

Reference Number	Description
1	Sleeve
2	O-ring
3	Back-up Ring
4	Back-up Ring
5	O-ring
6	Check
7	Spring

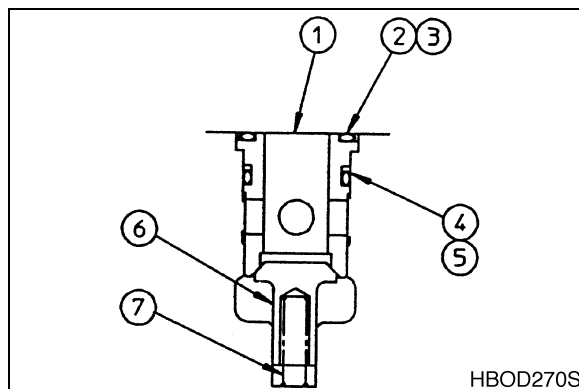


Figure 38

Cap

Reference Number	Description
1	Cap
2	Back-up Ring
3	O-ring
4	Nylon Chip

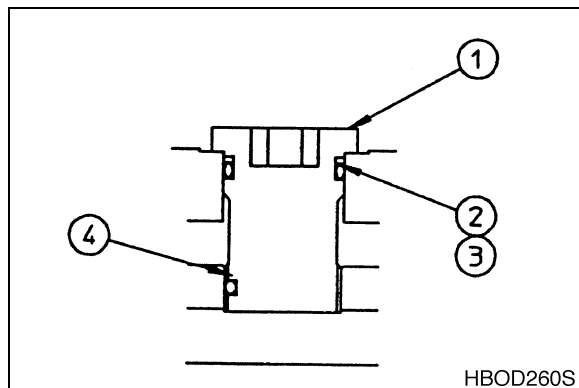


Figure 39

Check Valve [TI]

Reference Number	Description
1	Cap
2	O-ring
3	Cap
4	Spacer
5	Back-up Ring
6	O-ring
7	Spring
8	Check
9	Nylon Chip

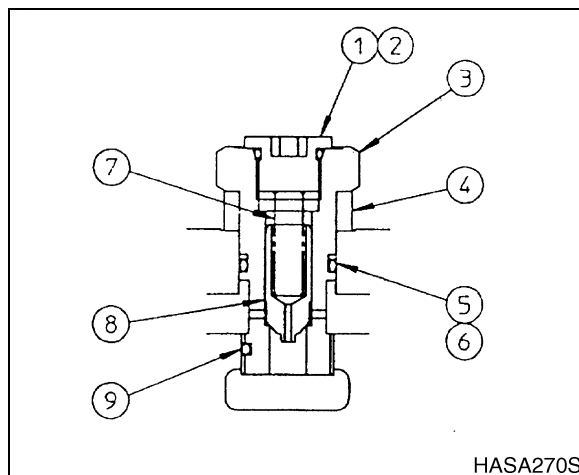


Figure 40

Check Valve [Sw]

Reference Number	Description
1	Sleeve
2	O-ring
3	Back-up Ring
4	Back-up Ring
5	O-ring
6	Check
7	Spring

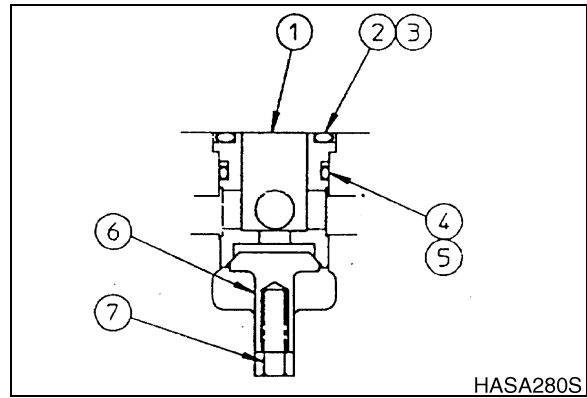


Figure 41

Straight Travel Selector Valve

Reference Number	Description
1	Check
2	O-ring
3	Spring
4	Spool TS

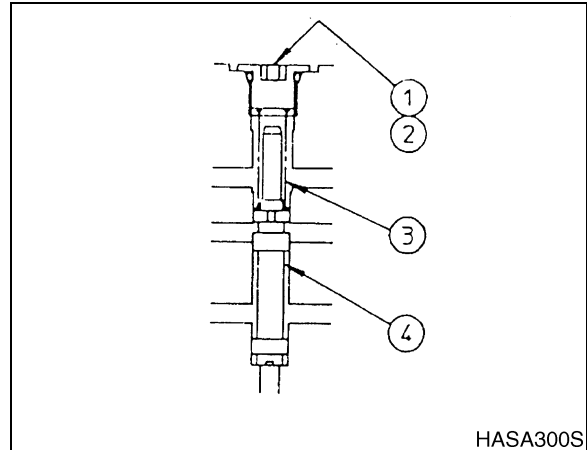


Figure 42

Swing Priority Valve [Sp Valve]

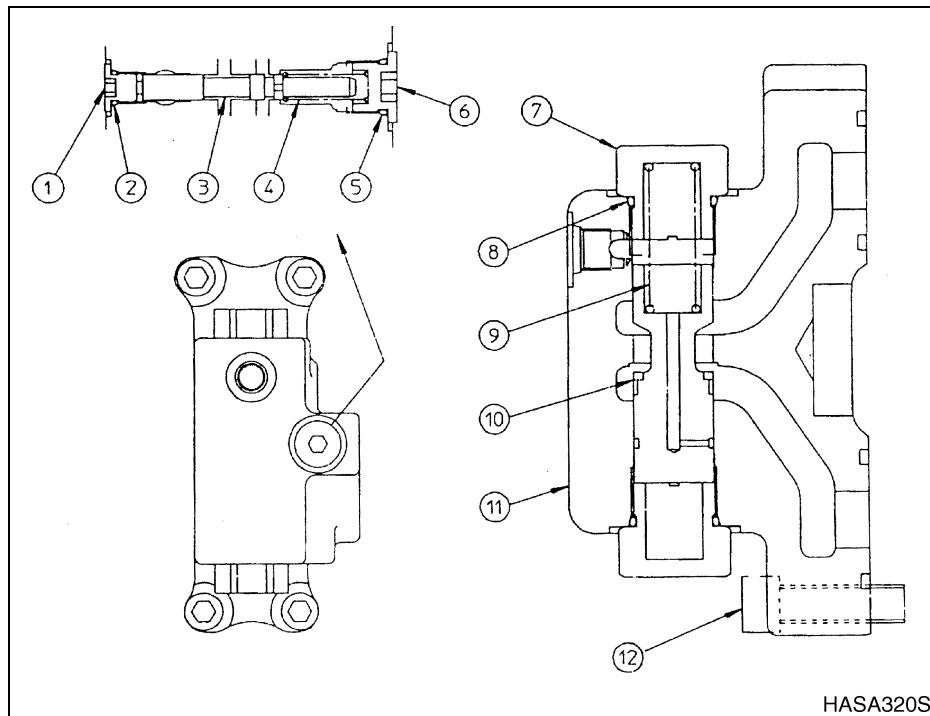


Figure 43

Reference Number	Description
1	Cap
2	O-ring
3	Spool
4	Spring
5	O-ring
6	Cap

Reference Number	Description
7	Cap
8	O-ring
9	Spring
10	Spool SP
11	Manifold
12	Bolt With Hole

Center Bypass Valve [Cb Valve]

Reference Number	Description
1	Check
2	O-ring
3	Spring
4	Spool

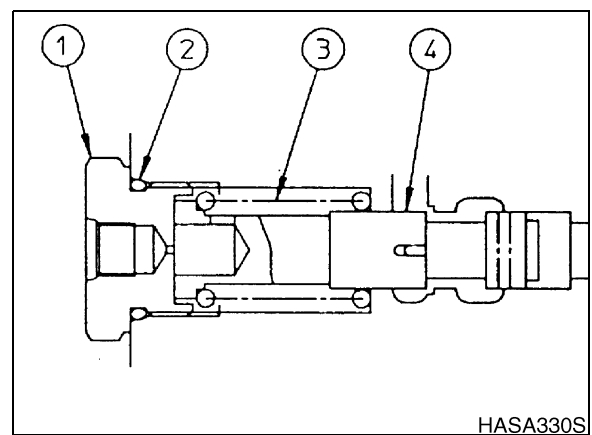


Figure 44

Arm Load Holding Valve

Reference Number	Description
1	Poppet
2	Spring
3	O-ring
4	O-ring
5	O-ring
6	Cap
7	Piston
8	Back-up Ring
9	O-ring
10	Sleeve
11	Back-up Ring
12	O-ring
13	Poppet
14	Spring
15	O-ring
16	Cap
17	Bolt With Hole
18	Cover
19	Cap
20	Spring
21	Check

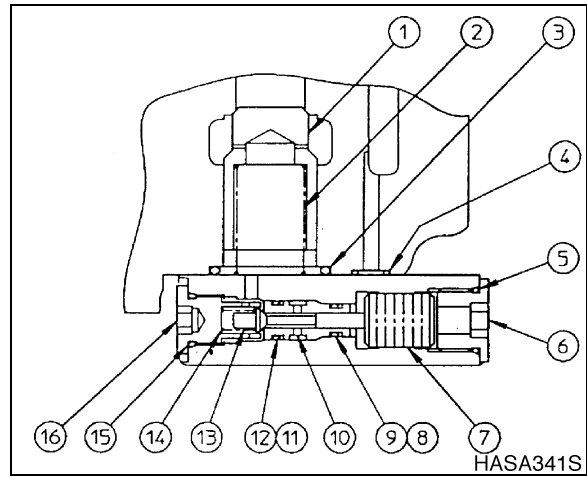


Figure 45

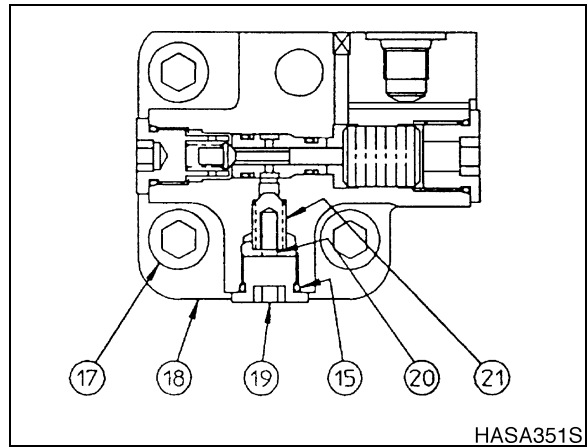


Figure 46

SPECIFICATIONS

Control Valve	Relief Valves (Main):	330 kg/cm ² (4686 psi) – normal, travel 350 kg/cm ² (4970 psi) – pressure up.
	Left Side Spools: (and spool diameter)	Travel: left 28 mm (1.1") diameter Swing: 28 mm (1.1") diameter Boom-2: 28 mm (1.1") diameter Arm-1: 28 mm (1.1") diameter
	Right Side Spools: (and spool diameter)	Travel: right 28 mm (1.1") diameter Option: open 28 mm (1.1") diameter Boom-1: 28 mm (1.1") diameter Bucket: 28 mm (1.1") diameter Arm-2: 28 mm (1.1") diameter
	Overload Relief Pressure:	360 kg/cm ² (5112 psi)

CONTROL VALVE DRAWING AND HYDRAULIC CIRCUIT

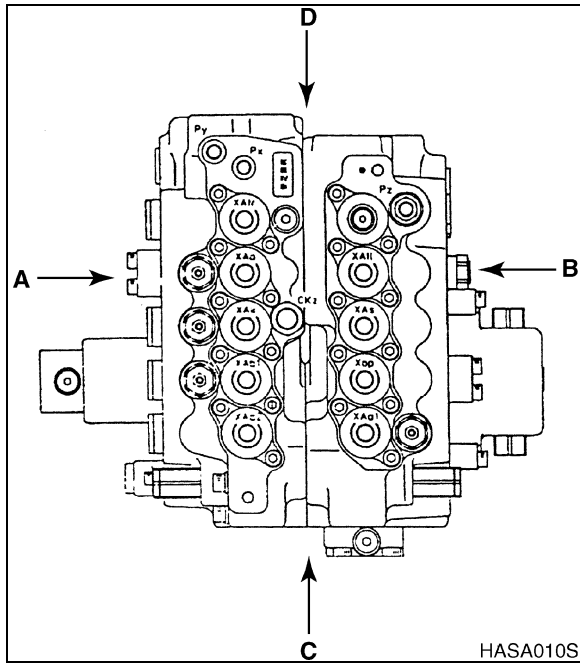


Figure 47 CONTROL VALVE TOP VIEW

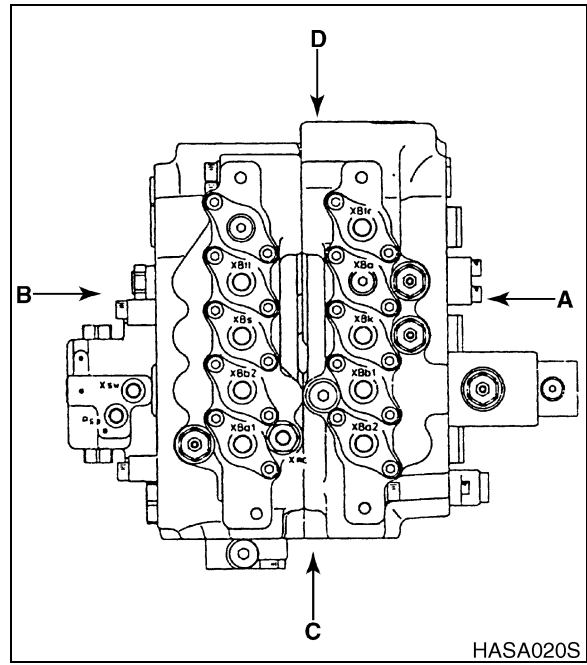


Figure 48 CONTROL VALVE BOTTOM VIEW

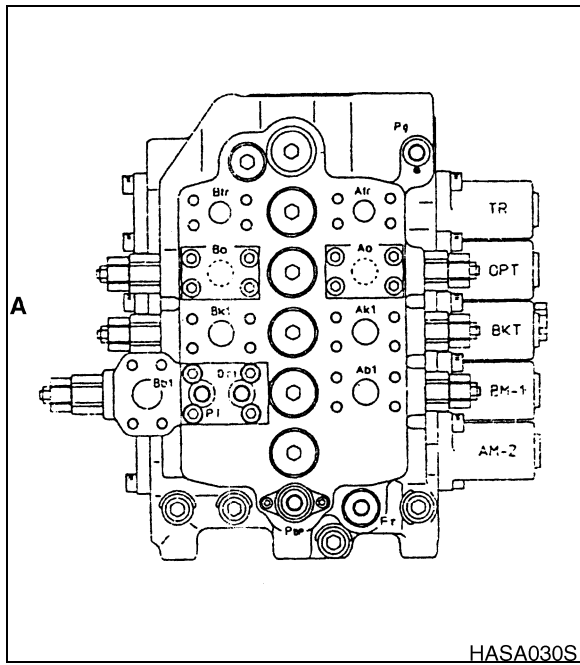


Figure 49 CONTROL VALVE LEFT VIEW

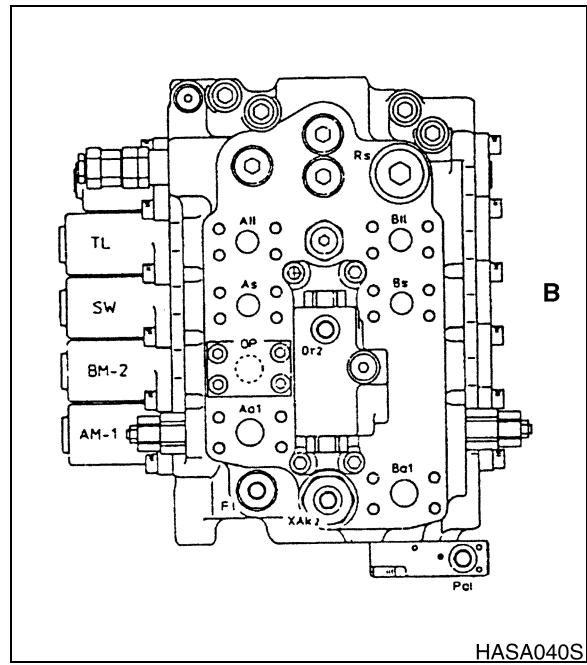


Figure 50 CONTROL VALVE RIGHT VIEW

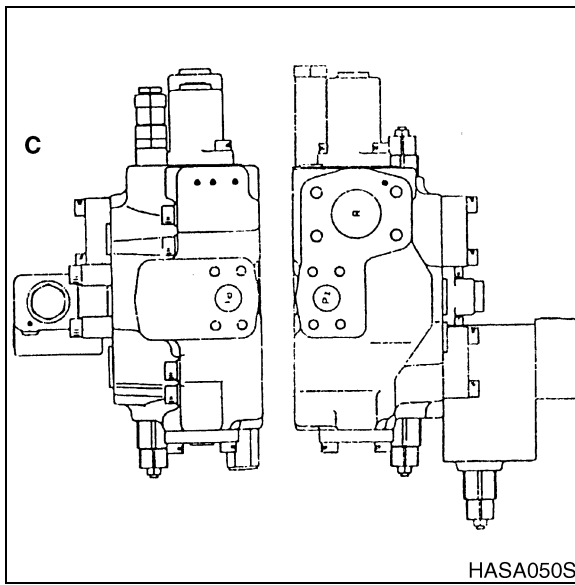


Figure 51

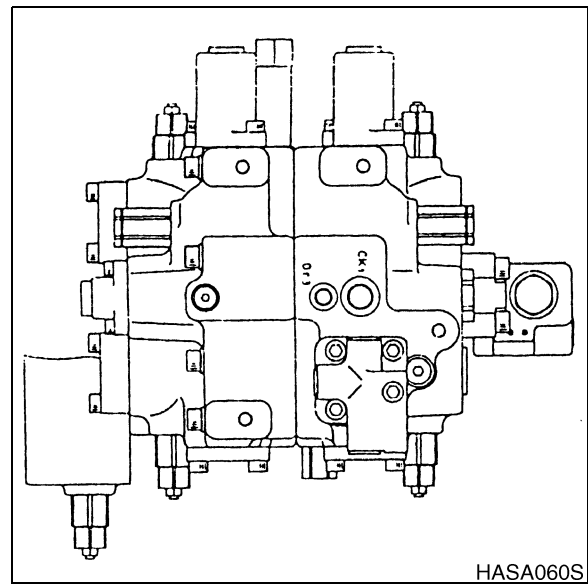


Figure 52

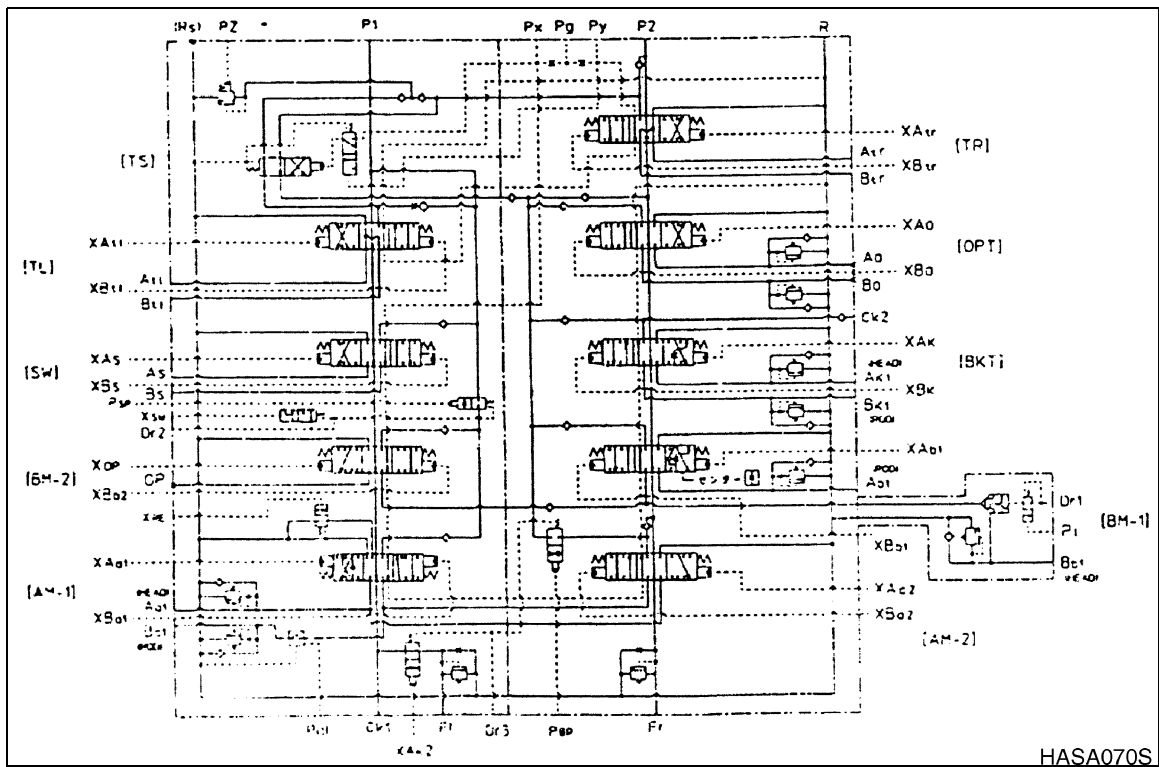


Figure 53 CONTROL VALVE HYDRAULIC CIRCUIT

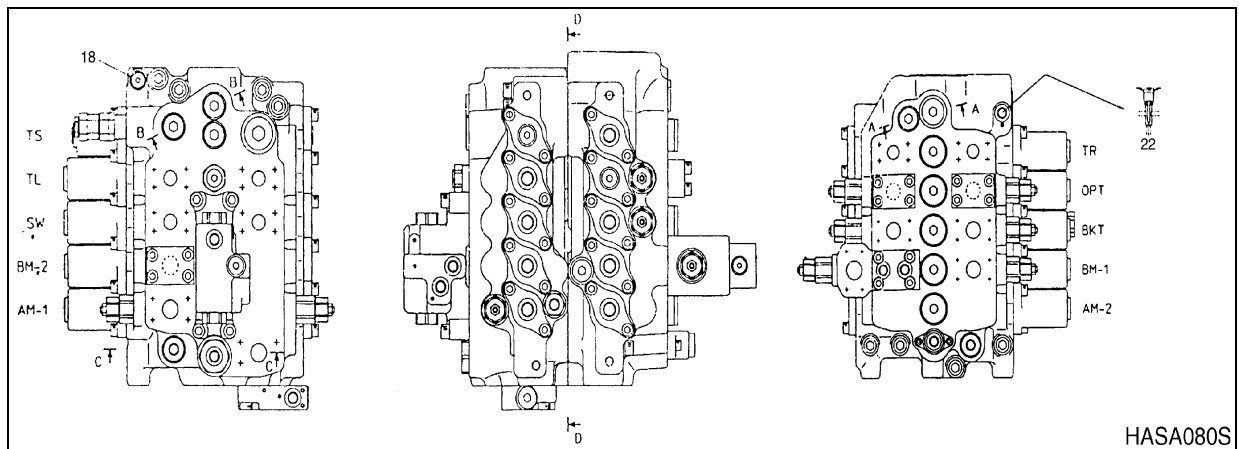


Figure 54

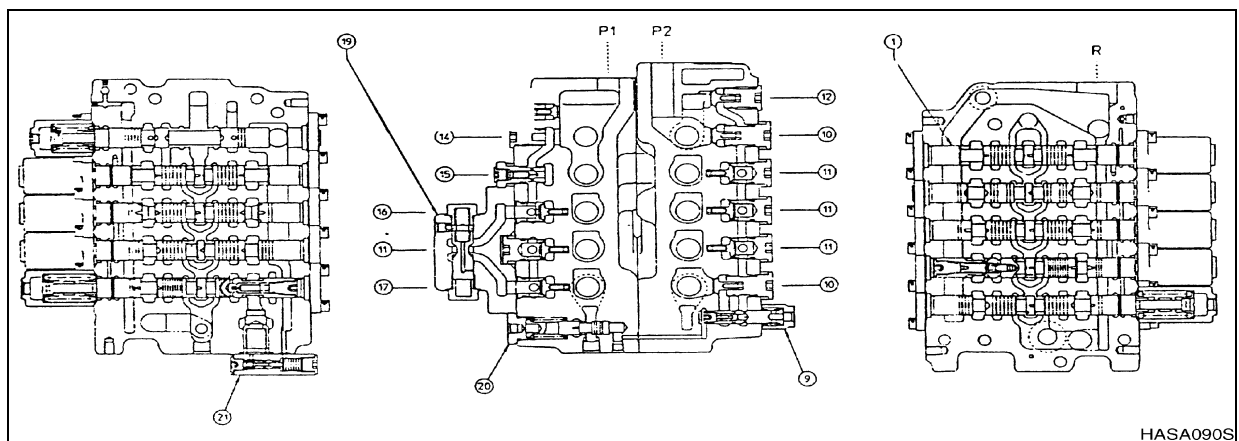


Figure 55

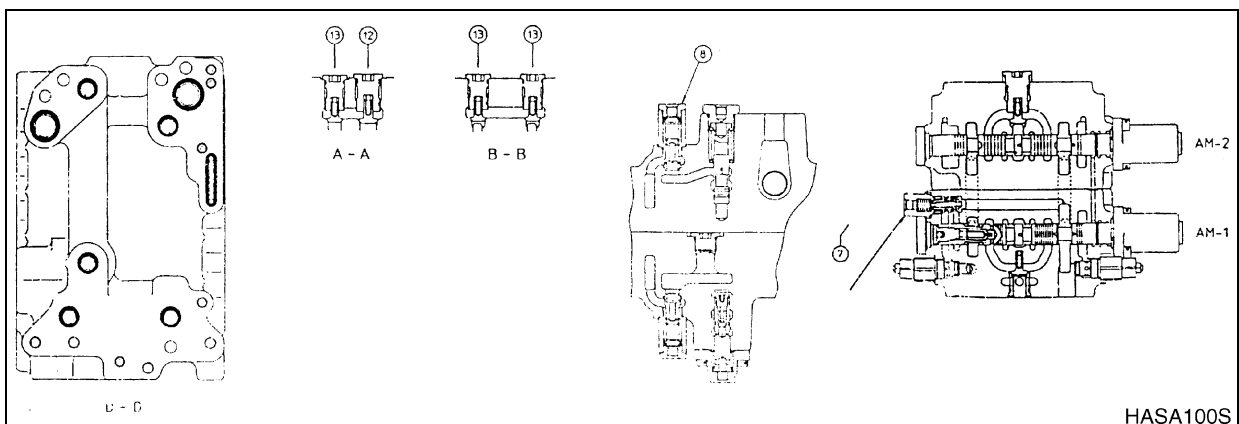


Figure 56

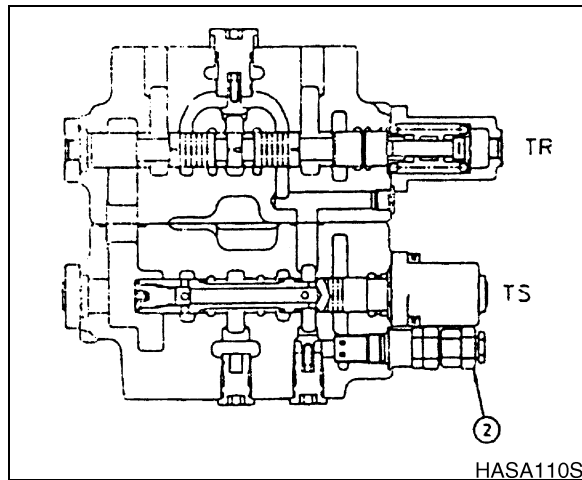


Figure 57

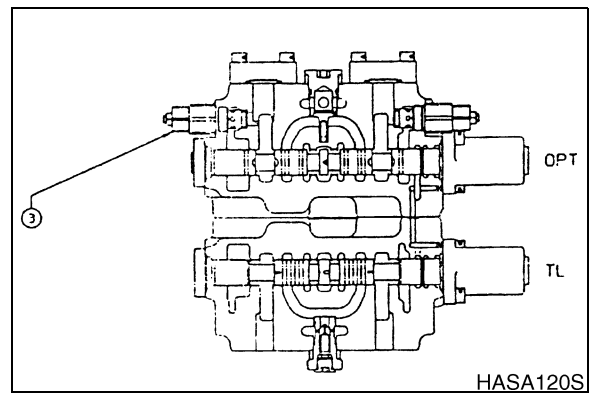


Figure 58

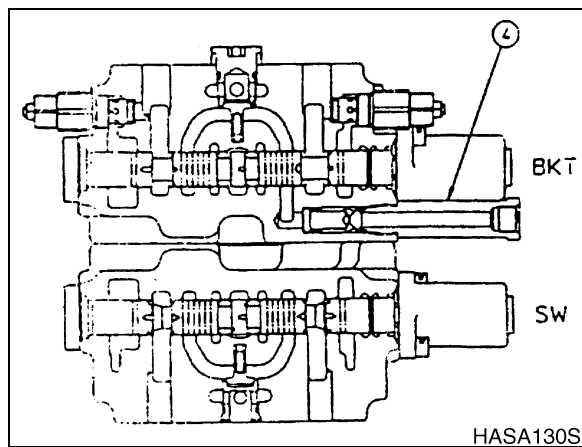


Figure 59

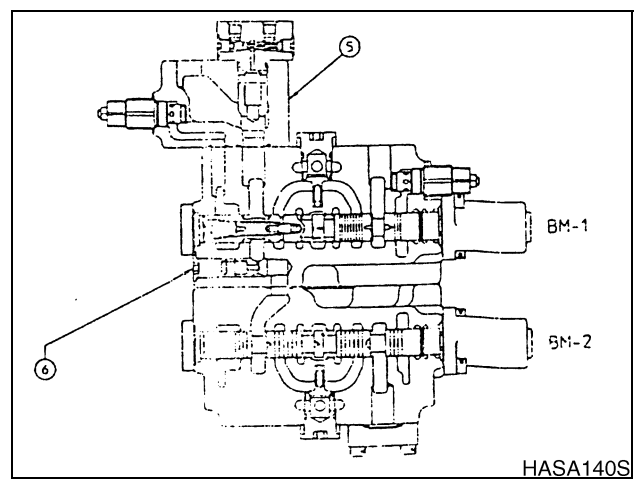


Figure 60

Drawing Reference Number	Part Description	Quantity
1	Main Plunger	10
2	Main Relief Valve	1
3	Overload Relief Valve (AM, BM Down, BKT, OPT)	7
4	Overload Relief Valve (BM Up)	1
5	Boom Holding Valve	1
6	Boom 2-Speed Check	1
7	Arm Regeneration Valve	1
8	Foot Relief Valve	2
9	Arm Priority Valve (AP Valve)	1
10	Check Valve (TR, AM-2)	4
11	Check Valve (OPT, BKT, BM-1, BM-2)	4
12	Check Valve (AM-1)	1
13	Check Valve	2
14	Cap	1
15	Check Valve (TL)	1
16	Check Valve (SW)	1
17	Straight Travel Selector Valve	1
18	Swing Priority Valve (SP Valve)	1
19	Center Bypass Valve (CB Valve)	1
20	Arm Holding Valve	1
21	Orifice (Px, Py)	1

DISASSEMBLY AND REASSEMBLY

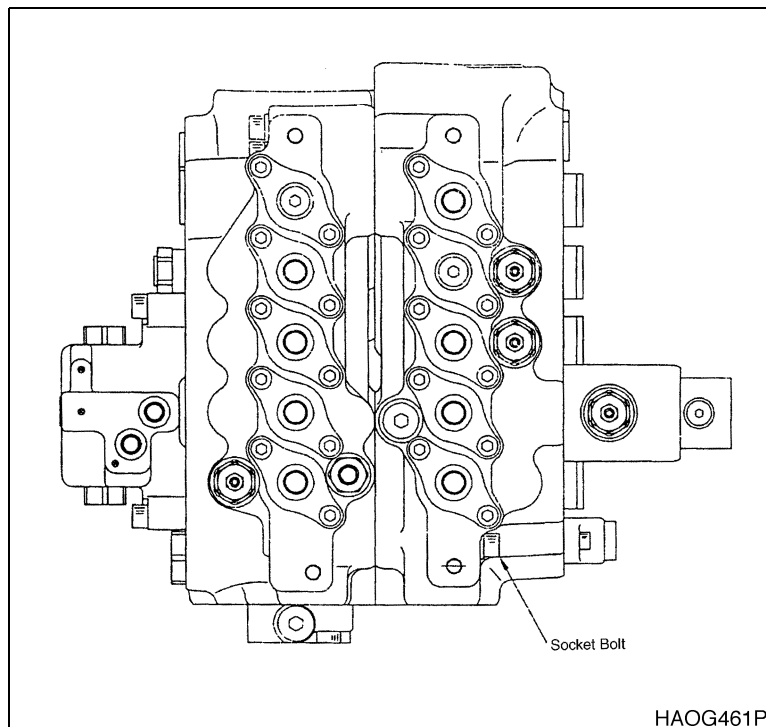


Figure 61

GENERAL DISASSEMBLY

To disassemble control valve, remove bolts from left and right side of the control valve.

Allen Key Size	10 mm
----------------	-------

GENERAL REASSEMBLY

Stand control valve on flat surface and tighten bolts with correct torque.

Socket Bolt Tightening Torque	10 kg m
-------------------------------	---------

IMPORTANT

Be sure to use extreme care when assembling and disassembling control valve. All O-rings should be replaced with new ones. Never reuse old O-rings.

MAIN PLUNGER ELEMENT - DISASSEMBLY AND ASSEMBLY

IMPORTANT

When disassembling Main Plunger element tag and label each component so that all parts can be reassembled in the proper order.

IMPORTANT

The hydraulic control valve used in the S130LC-V uses 3 different plungers. Care should be taken when disassembling and reassembling plunger assemblies.

TOOL

This holding tool is used to clamp and hold plunger for further disassembly, without damaging it. The holder is comprised of 2 halves of a hexagonal rod made from soft brass, with the appropriate size hole and outside dimensions.

Inside Diameter	Outside Diameter Across Flat Surface	Application
21.8 mm	35 mm	Main Plunger

Length	100 mm
--------	--------

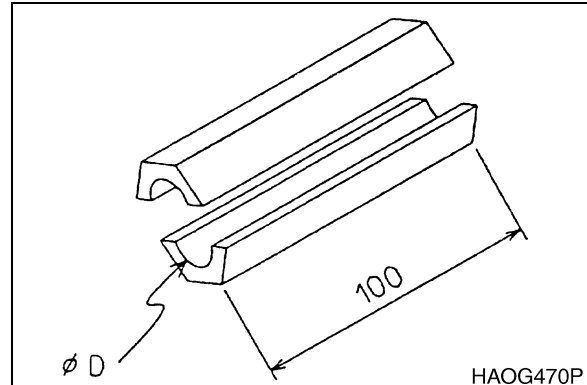


Figure 62

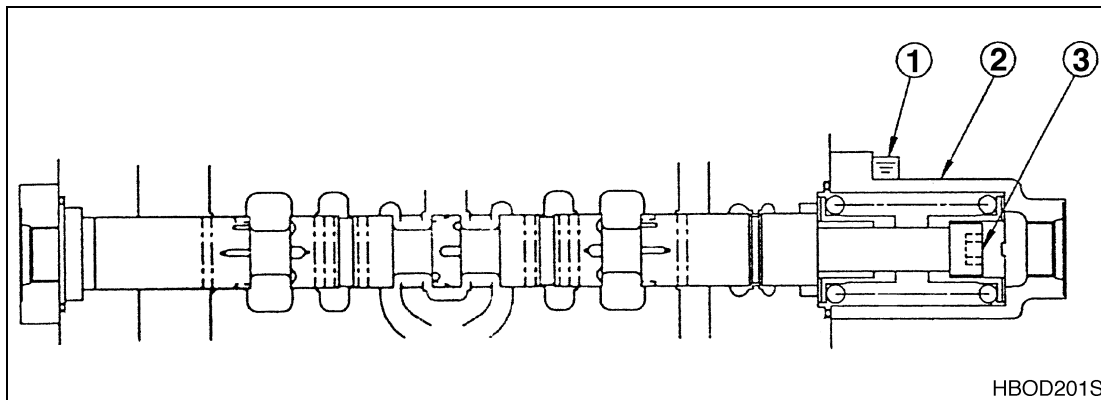


Figure 63

Part Reference	Part Description
1	6 mm Allen head Style Bolts
2	Plunger Cover
3	Plunger cap bolt

1. Remove 2 bolts (1) from cover and remove cover (2) from valve housing.

Allen head style bolt	6 mm
Tightening torque	3 kg m

2. Pull out plunger sub-assembly from housing.

IMPORTANT

Do not force out plunger. Pull out plunger slowly, to avoid damage.

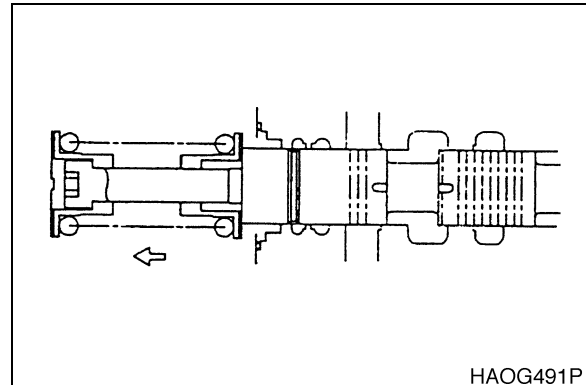


Figure 64

3. Use the holder tool described above to clamp plunger assembly and loosen plunger cap bolt.

Part Reference	Description
1	Plunger Holding Tool
2	Spring Guide
3	Plunger Cap Bolt Tightening Torque: 6 kg m

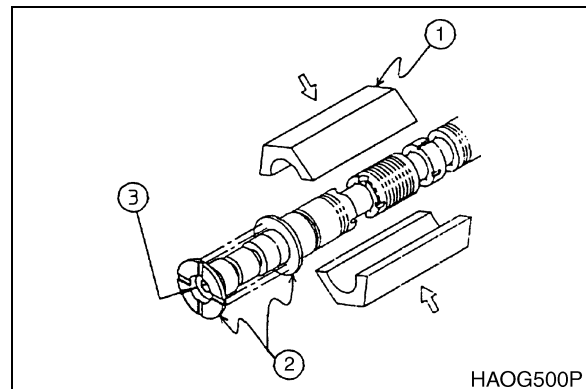


Figure 65

4. Remove plunger cap bolt (3), upper spring guide (4), spring (5) and lower spring guide (4).

IMPORTANT

Use caution when disassembling and assembling plungers. The travel straight spring and plunger cap bolts are different from the others.

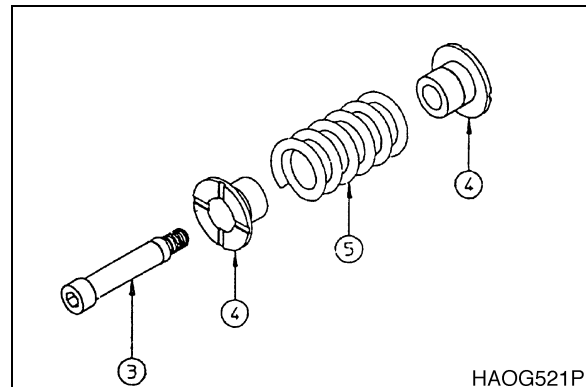


Figure 66

5. Plunger (Lower side)

AM-1: Remove cap (7), O-rings, back-up spring, spring (8) and check valve (9).

Lower cap hex hole	6 mm
Tightening torque	3 kg m

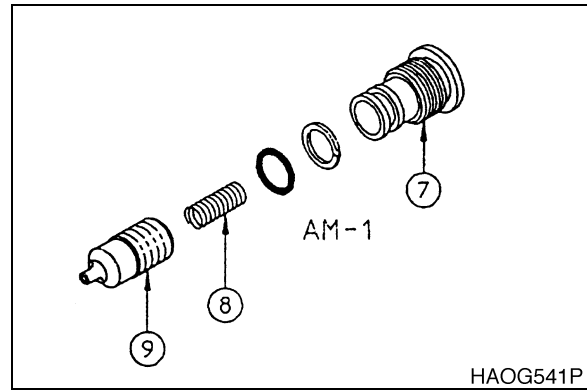


Figure 67

TS: Remove cap (7), O-ring and back-up spring.

Lower cap hex hole	6 mm
Tightening torque	3 kg m

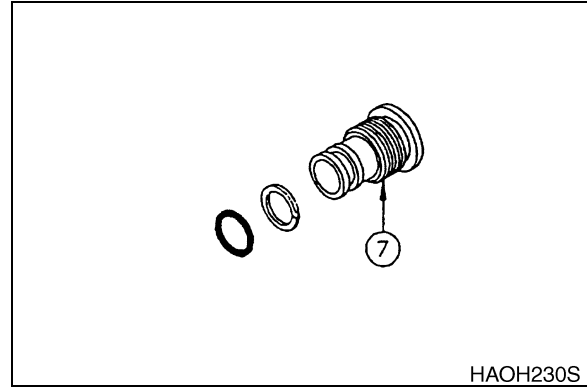


Figure 68

MAIN RELIEF VALVE

Reference Number	Description	Size
1	Adjusting screw	22 mm
2	Hexagonal nut	30 mm
3	Hexagonal nut	30 mm
4	Cap	30 mm
5	Pilot seat	
6	Lower sleeve	
7	Sleeve	27 mm

1. Hold adjusting screw (1) and loosen hexagonal nut (2).
2. Hold cap (4) and loosen hexagonal nut (3).
3. Loosen cap (4) and remove valve assembly by unscrewing cap (4).

Reference number	Description
6	Lower sleeve
8	Piston
9	Spring
10	Orifice

4. Remove lower sleeve (6) from cap (4) by gently pulling sleeve out of cap. Remove piston (8), spring (9) and orifice (10) from lower sleeve.

IMPORTANT

Further disassembly of pilot sheet from the cap is not recommended, as it is pressed in at the factory.

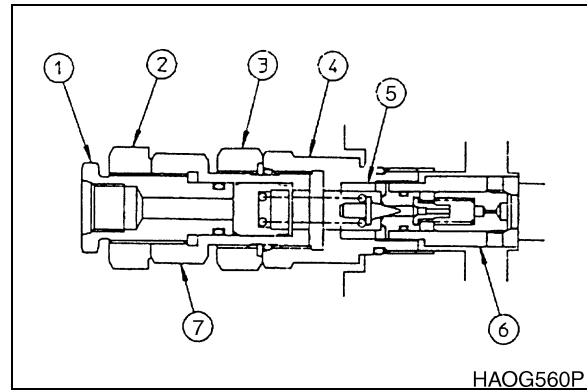


Figure 69

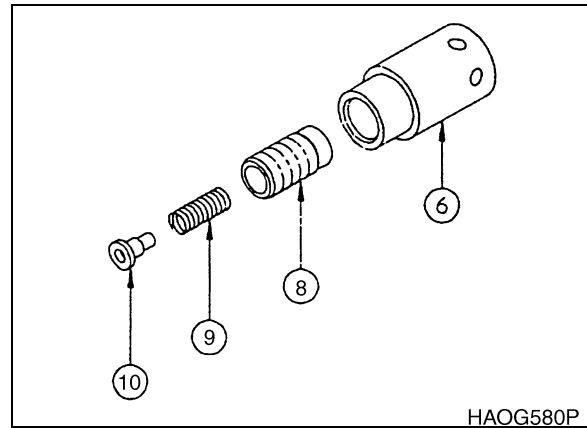


Figure 70

MAIN RELIEF VALVE ADJUSTMENT

IMPORTANT

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

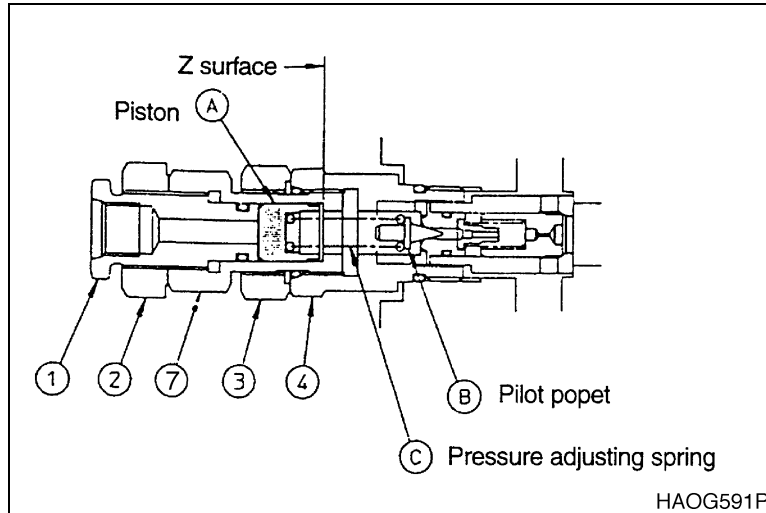


Figure 71

IMPORTANT

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

Main Relief Valve - Reassembly

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

Tightening torque	10 kg m
--------------------------	---------

High Pressure Adjustment

1. Install an accurate pressure gauge at the discharge outlet of the hydraulic pump.
2. Start the engine and drive hydraulic pump at normal RPM.
3. Completely stroke one of Bm-Up, AM or BKT plungers and read pressure gauge.
4. Adjust pressure by turning sleeve (7) while monitoring pressure gauge. Each 1/4 turn changes pressure by approximately 45 kg/cm².

IMPORTANT

The relief valve is extremely sensitive and sudden extreme changes should be avoided.

5. Tighten hexagonal nut (3) while sleeve (7) is secured. Recheck high side pressure.

Tightening torque

6 kg m

Low Pressure Adjustment

1. After the High Pressure adjustment has been completed, Low Pressure adjustment can be made by turning the Adjust screw (1).
2. After the desired pressure has been adjusted, tighten hexagonal nut (2) while adjust screw (1) is secured. Recheck low side pressure

Tightening torque

6 kg m

OVERLOAD RELIEF VALVE

IMPORTANT

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

IMPORTANT

Do not disassemble the pressure adjustment element. The pressure is factory set and can not be correctly adjusted on the vehicle.

IMPORTANT

Each Overload Relief Valve must be reinstalled into its original position.

1. Loosen sleeve (1) and remove valve assembly

Reference Number	Description
1	Sleeve
2	Cap

Sleeve hexagonal base	27 mm
Tightening torque	6 kg m

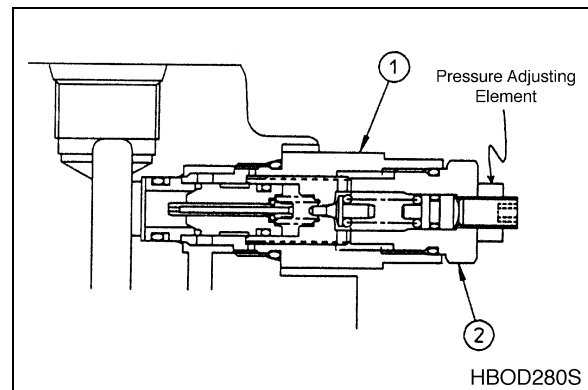


Figure 72

2. Loosen cap (1) subassembly from sleeve assembly and remove O-ring, spring (2) and pilot poppet (3).

Reference Number	Description
2	Cap
3	Spring
4	Poppet

Cap hexagonal base	24 mm
Tightening torque	6 kg m

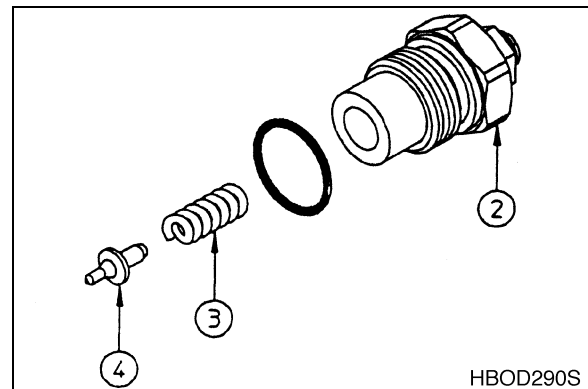


Figure 73

3. Remove pilot seat (5), outer spring (6), inner spring (7), piston (8), O-ring, back-up spring and main poppet (9).

Reference Number	Description
5	Pilot seat
6	Outer spring
7	Inner spring
8	Piston
9	Main Poppet

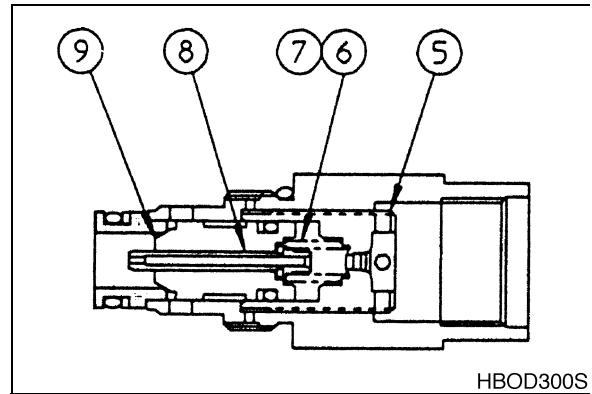


Figure 74

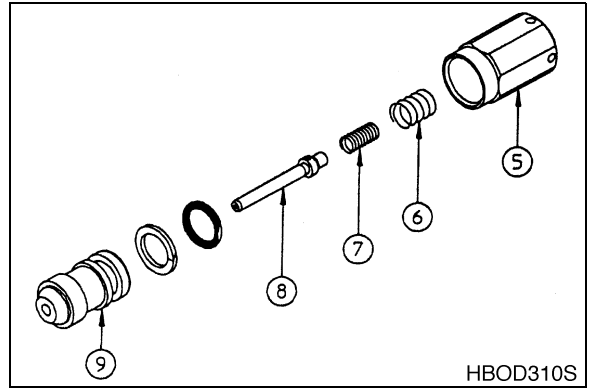


Figure 75

OVERLOAD RELIEF VALVE [BM UP]

IMPORTANT

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

IMPORTANT

Do not disassemble the pressure adjustment element. The pressure is factory set and can not be correctly adjusted on the vehicle.

IMPORTANT

Each Overload Relief Valve must be reinstalled into its original position.

1. Loosen sleeve (1) and remove valve assembly

Reference Number	Description
1	Sleeve
2	Cap

Sleeve hexagonal base	27 mm
Tightening torque	6 kg m

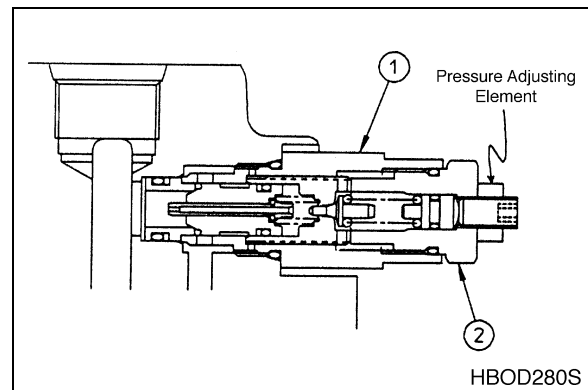


Figure 76

2. Loosen cap (1) subassembly from sleeve assembly and remove O-ring, spring (2) and pilot poppet (3).

Reference Number	Description
2	Cap
3	Spring
4	Poppet

Cap hexagonal base	24 mm
Tightening torque	6 kg m

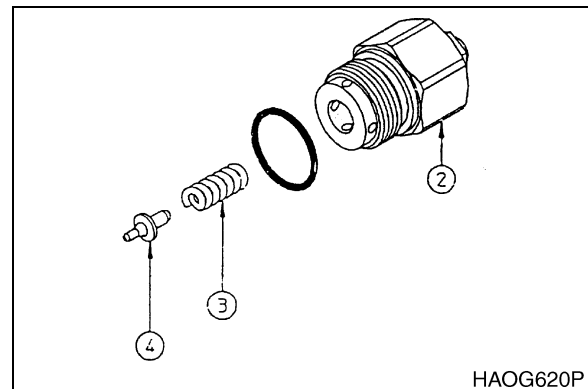


Figure 77

3. Remove pilot seat (5), outer spring (6), inner spring (7), piston (8), O-ring, back-up spring and main poppet (9).

Reference Number	Description
5	Pilot seat
6	Outer spring
7	Inner spring
8	Piston
9	Main Poppet

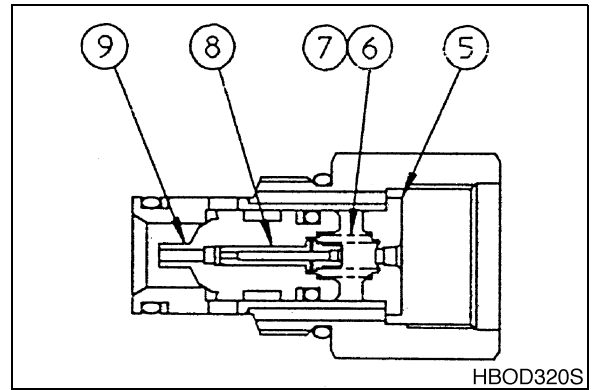


Figure 78

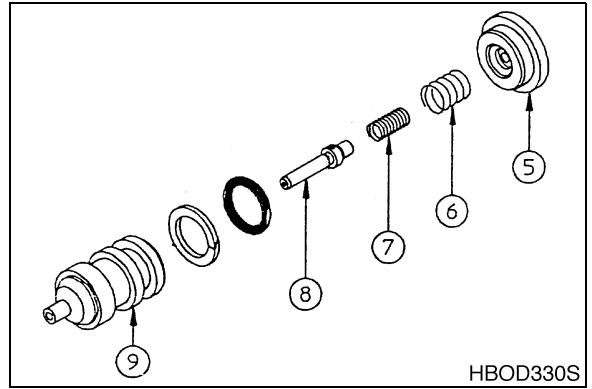


Figure 79

ARM LOAD HOLDING VALVE

IMPORTANT

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

Check Valve Main Body

1. Remove allen-style bolts (1) and cover (2).

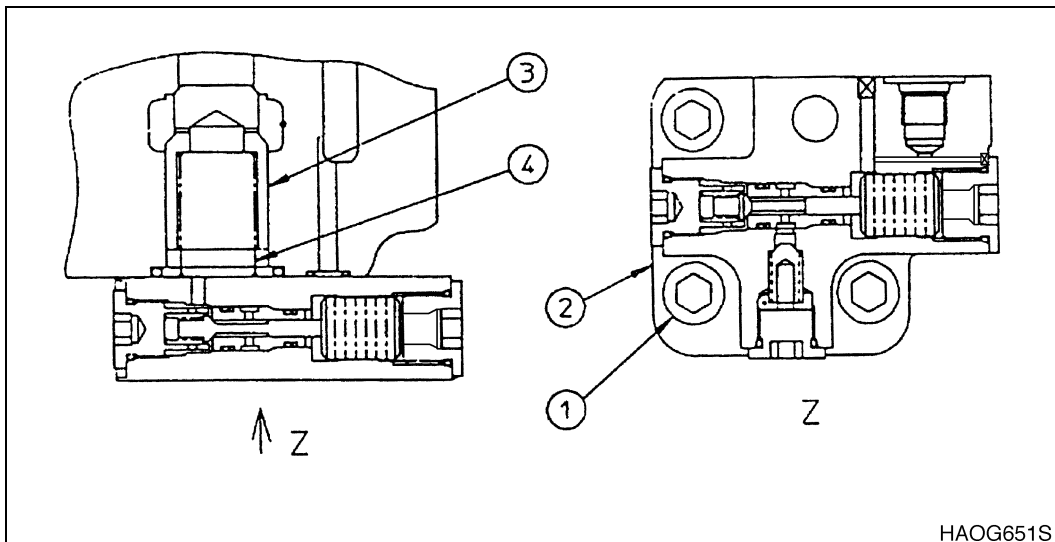


Figure 80

Mounting Bolt Allen Socket	10 mm
Tightening Torque	10 kg m

IMPORTANT

When assembling cover, inspect O-rings for any damage and replace as necessary.

2. Remove spring (3) and poppet (4).

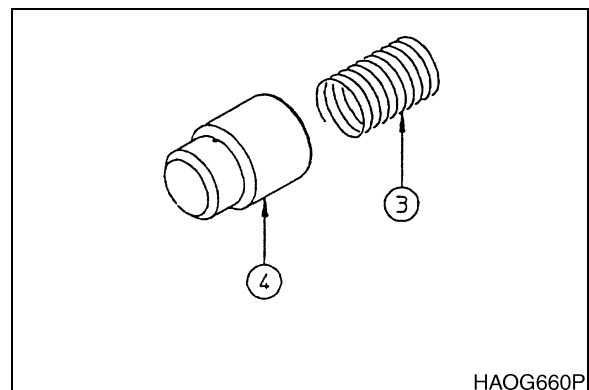


Figure 81

Cover Assembly

Part Reference Number	Description
1	Cap
2	Spring
3	Check
4	Cap
5	Piston
6	Sleeve
7	Poppet
8	Spring
9	Cap

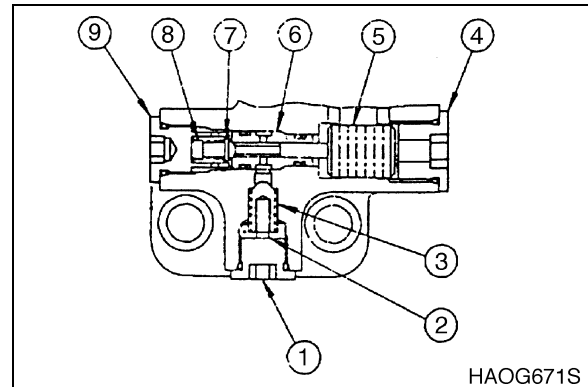


Figure 82

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

Cap hex hole size	8 mm
Tightening torque	5 kg m

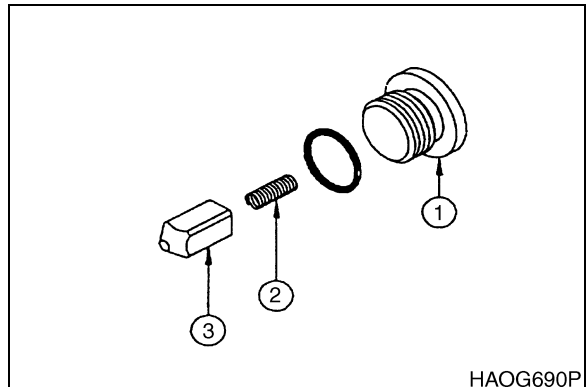


Figure 83

2. Loosen cap (4) and remove piston (5).

Cap hex hole size	10 mm
Tightening torque	6 kg m

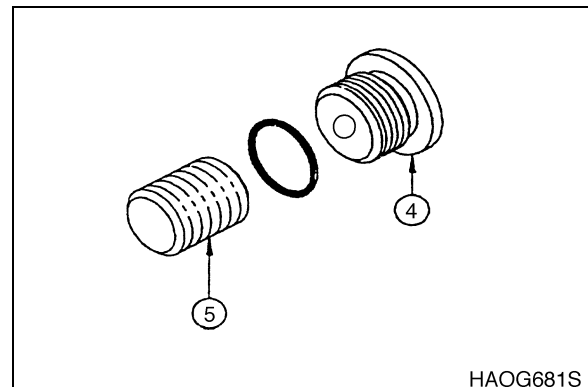


Figure 84

3. Loosen cap (9) and remove spring (8) and poppet (7).

Cap hex hole size	8 mm
Tightening torque	5 kg m

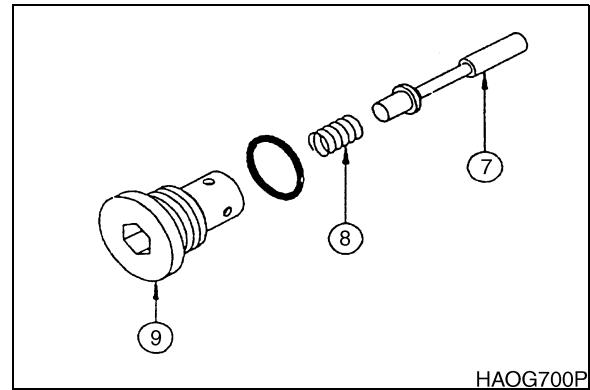


Figure 85

4. Remove sleeve from poppet bore by gently tapping it from the right side.

IMPORTANT

Be careful not to damage the edges of the inner and outer surfaces of the sleeve.

BOOM LOAD HOLDING VALVE

IMPORTANT

When disassembling Boom Load Holding Valve, tag and label each component so that all parts can be reassembled in the proper order.

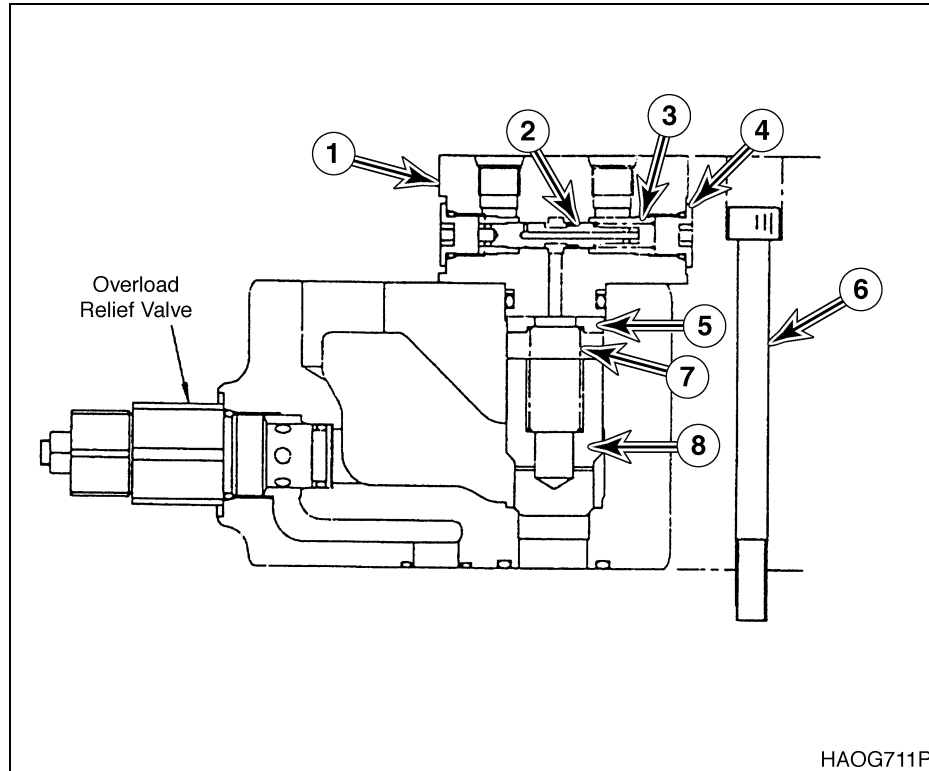


Figure 86

Reference Number	Description
1	Cover
2	Spool
3	Spring
4	cap

Reference Number	Description
5	Spring Seat
6	Allen Head Bolt
7	Spring
8	Poppet

1. Remove allen head bolts (6) and remove cover (1).

Allen head bolt size	8 mm
Tightening torque	5 kg m

IMPORTANT

When assembling cover, inspect O-rings for any damage and replace as necessary.

2. Remove Spring Seat (5), Spring (7) and Poppet (8) from manifold bore.

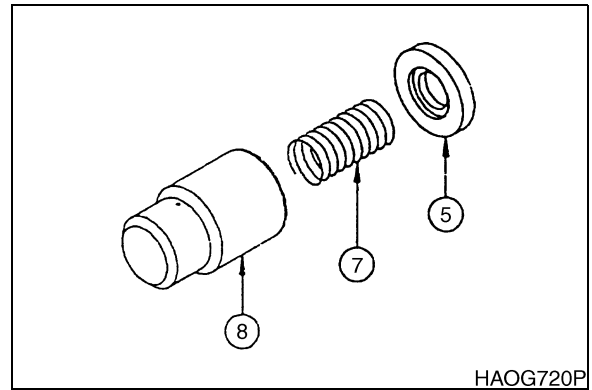


Figure 87

3. Loosen cap (4) and remove spring (3) and spool (2).

Cap allen hole size	6 mm
Tightening torque	3 kg m

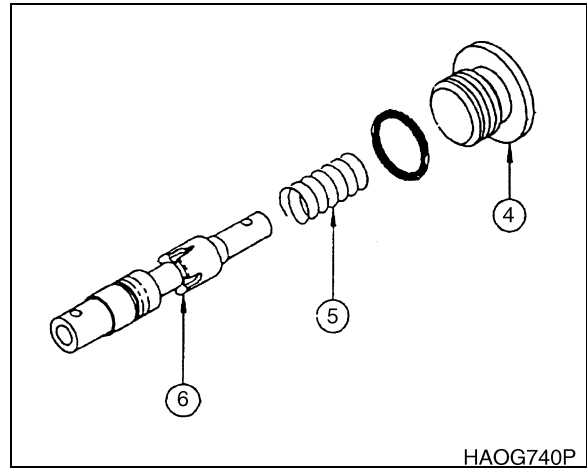


Figure 88

ARM REGENERATION VALVE

IMPORTANT

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

Reference Number	Description
1	Cap
2	Piston
3	Spool
4	Spring
5	Sleeve

1. Loosen cap (1) and remove piston (2).

Cap wrench size	27 mm
Tightening torque	10 kg m

2. Remove spool (3), spring (4) and sleeve (5) from housing.

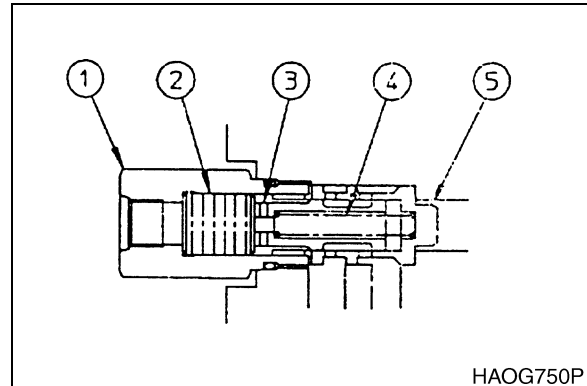


Figure 89

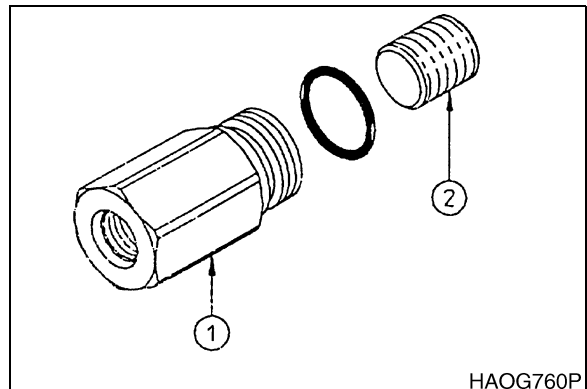


Figure 90

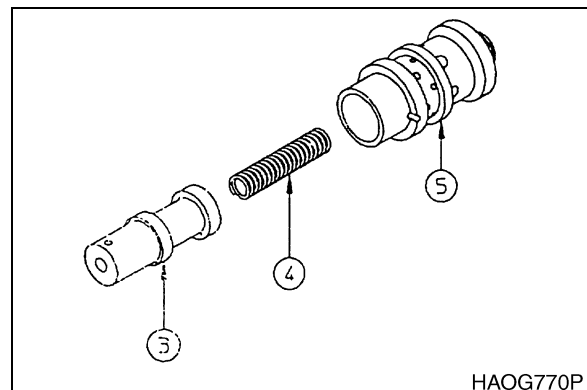


Figure 91

FOOT RELIEF VALVE

IMPORTANT

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

Reference Number	Description
1	Cap
2	Poppet
3	Cap
4	Shim
5	Spring

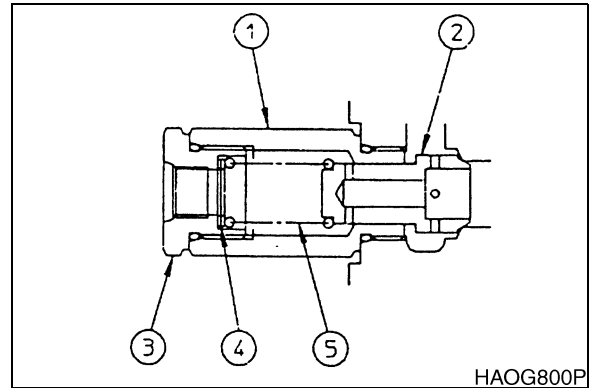


Figure 92

- Loosen cap (1) and remove poppet (2).

Cap wrench size	30 mm
Tightening torque	6 kg m

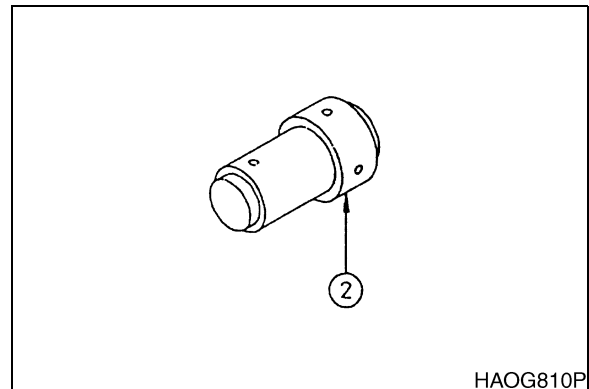


Figure 93

- Loosen cap (3) and remove shim (4) and spring (5).

Cap wrench size	30 mm
Tightening torque	6 kg m

IMPORTANT

Shim is necessary for correct pressure adjustment and must not be left out.

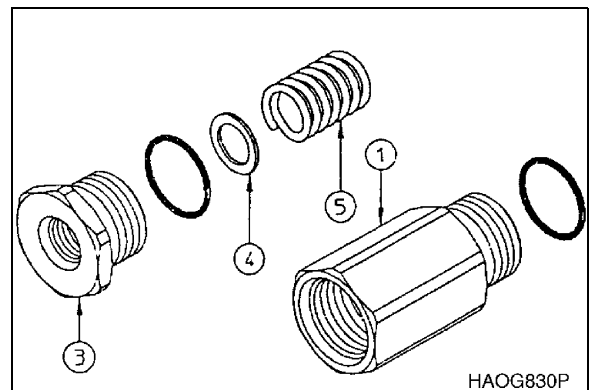


Figure 94

CENTER BYPASS VALVE (CB VALVE)

IMPORTANT

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

Reference Number	Description
1	Cap
2	Spring
3	Spool

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

Cap wrench size	36 mm
Tightening torque	8 kg m

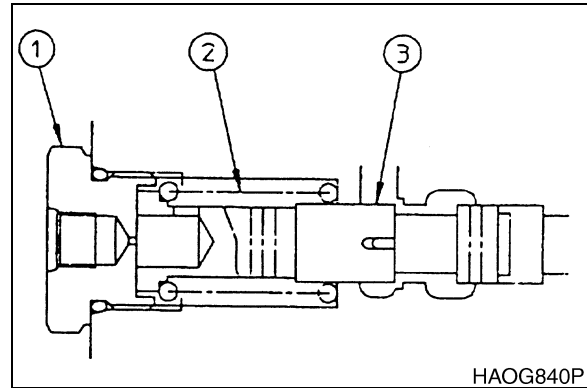


Figure 95

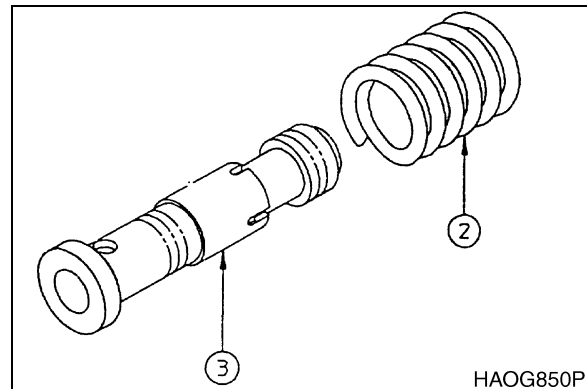


Figure 96

ARM PARALLEL SWITCH VALVE

IMPORTANT

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

TOOL

This holding tool is used to clamp and hold BP Spool for further disassembly, without damaging it. The holder is comprised of 2 halves of a hexagonal rod made from soft brass, with the appropriate size hole and outside dimensions.

Inside Diameter	Outside Diameter	Application
19.0 mm	32 mm	BP Spool

Length	100 mm
--------	--------

Reference Number	Description
1	Allen head style bolt
2	Cover
3	Spring
4	Cap
5	Spring
6	Check

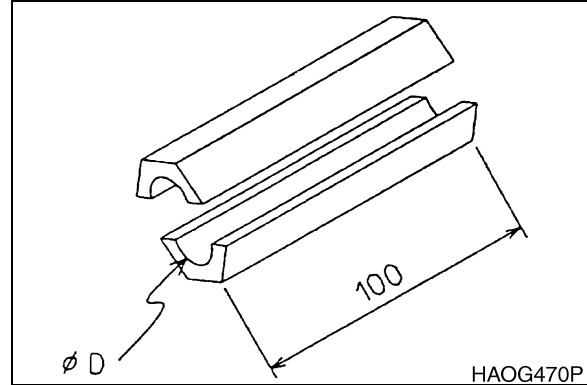


Figure 97

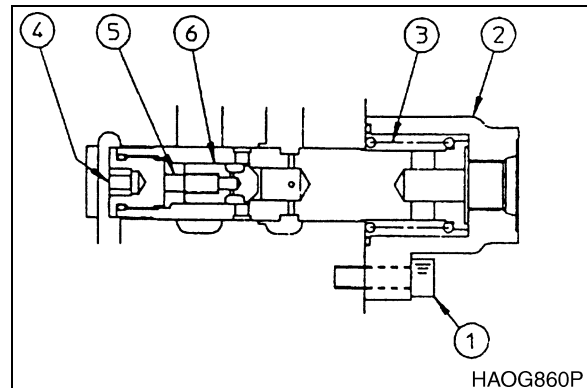


Figure 98

1. Remove allen head bolts (1) and cover (2).

Allen hole size	5 mm
Tightening torque	1.2 kg m

IMPORTANT

When assembling cover, inspect O-rings for any damage and replace as necessary.

2. Slide out spool assembly and remove spring (3).

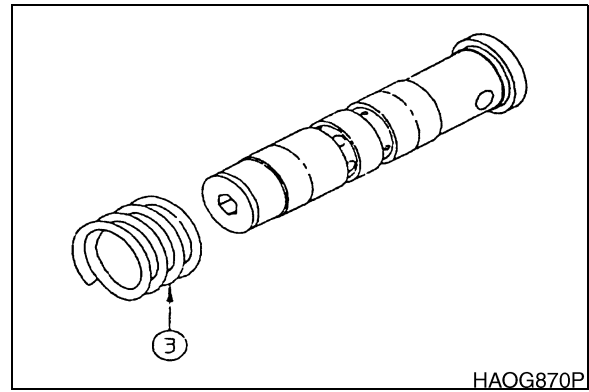


Figure 99

3. Using the tool described above, clamp and hold the spool in place. Remove cap (4), Spring (5) and check (6).

Allen hole size	6 mm
Tightening torque	3.5 kg m

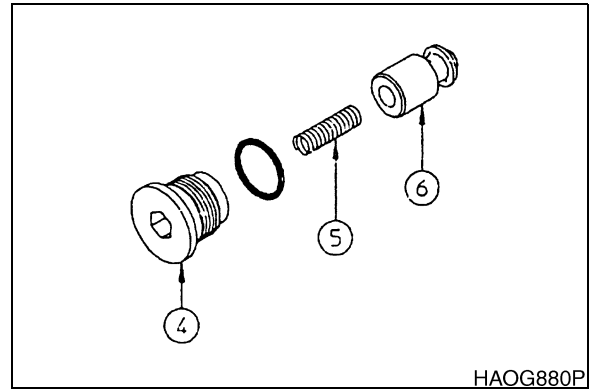


Figure 100

SWING PRIORITY VALVE

IMPORTANT

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

IMPORTANT

When assembling components, inspect O-rings for any damage and replace as necessary.

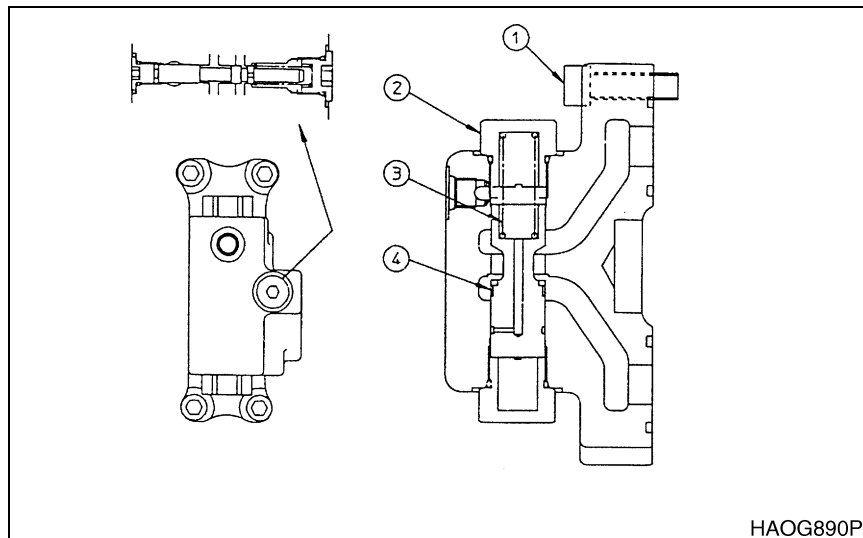


Figure 101

Reference Number	Description
1	Allen head bolt
2	Cap

Reference Number	Description
3	Spring
4	Spool

1. Remove allen head styled bolts (1) and manifold assembly.

Cap hole size	8 mm
Tightening torque	6 kg m

2. Loosen cap (2) and remove spring (3) and spool (4).

Cap hole size	32 mm
Tightening torque	10 kg m

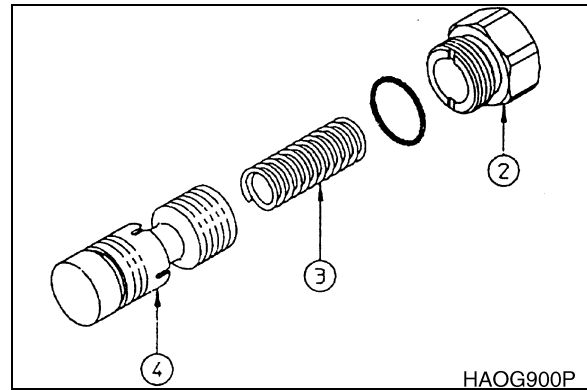


Figure 102

Pilot Switch Element

3. Loosen cap (5), remove spring (6) and spool (7).

Reference Number	Description
5	Spool
6	Spring
7	Cap

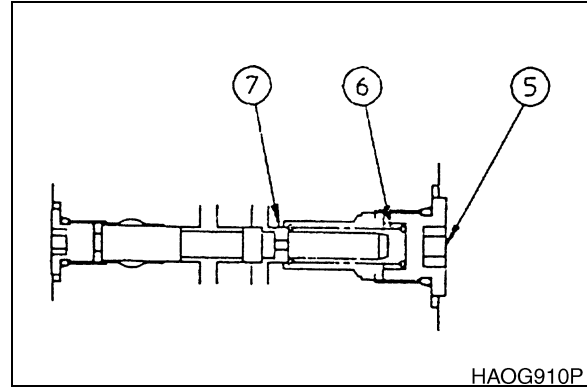


Figure 103

Cap hole size	8 mm
Tightening torque	4 kg m

IMPORTANT

When assembling components, inspect O-rings for any damage and replace as necessary.

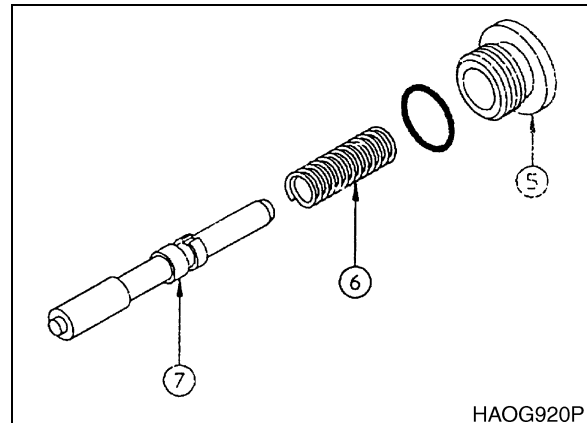


Figure 104

BOOM UNITY CHECK VALVE

IMPORTANT

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

IMPORTANT

When assembling components, inspect O-rings for any damage and replace as necessary.

Reference Number	Description
1	Cap
2	Spring
3	Check

1. Loosen cap (1), remove stopper (2), spring (3) and check (4).

Cap hole size	12 mm
Tightening torque	10 kg m

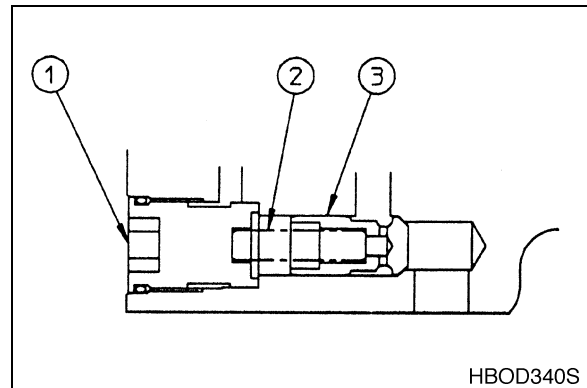


Figure 105

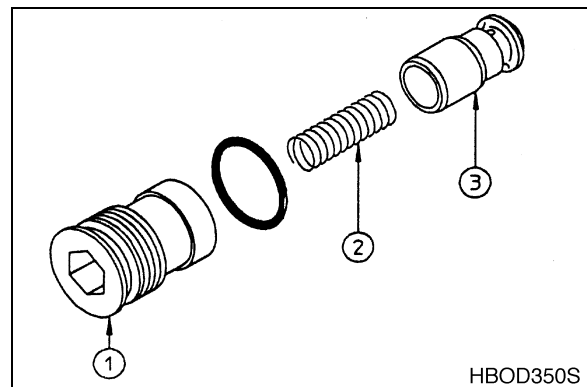


Figure 106

STRAIGHT TRAVEL SELECTOR VALVE

IMPORTANT

When disassembling Swing Straight Travel Valve, tag and label each component so that all parts can be reassembled in the proper order.

IMPORTANT

When assembling components, inspect O-rings for any damage and replace as necessary.

Reference Number	Description
1	Cap
2	Stopper
3	Spring
4	Check

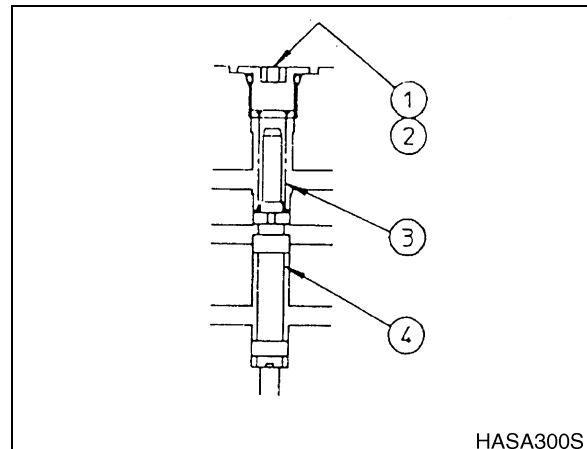


Figure 107

1. Loosen cap (1), remove stopper (2), spring (3) and check (4).

Cap hole size	8 mm
Tightening torque	4 kg m

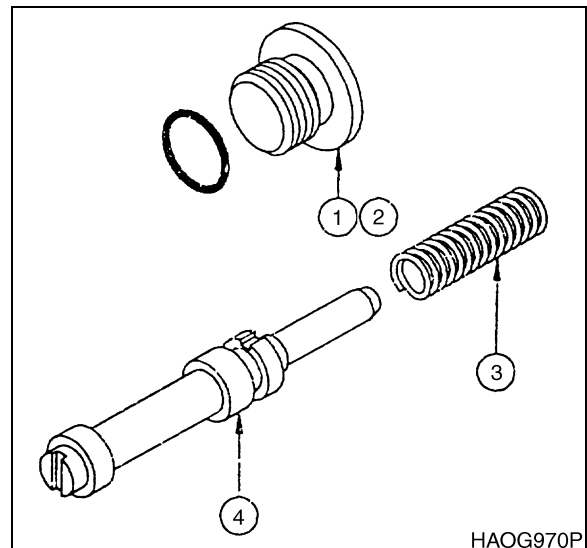


Figure 108

CHECK VALVE - LOCATIONS

Valve Location Reference	Description
A	TR, AM2
B	BKT, OPT, BM1, BM2
C	-
D	SW
E	TL
F	AM1
G	Cap Only

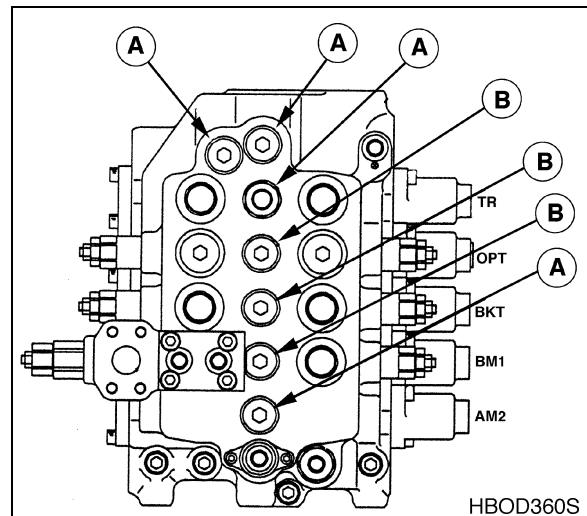


Figure 109

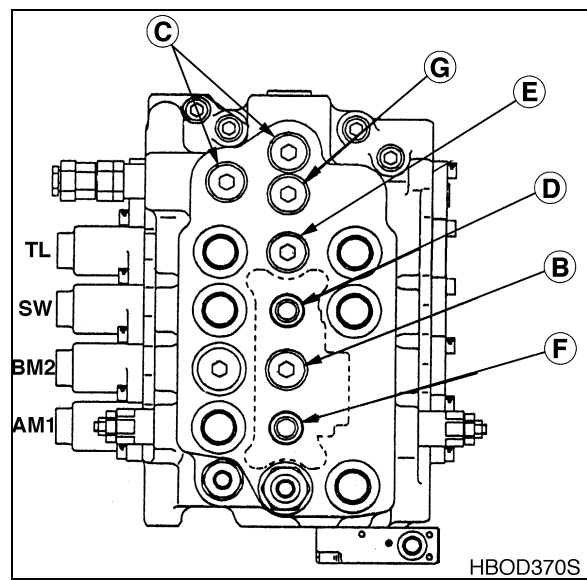


Figure 110

CHECK VALVE

IMPORTANT

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

A: Check Valve [TR, AM2]

Reference Number	Description
1	Cap
2	Spring
3	Check

Cap hole size	12 mm
Tightening torque	15 kg m

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

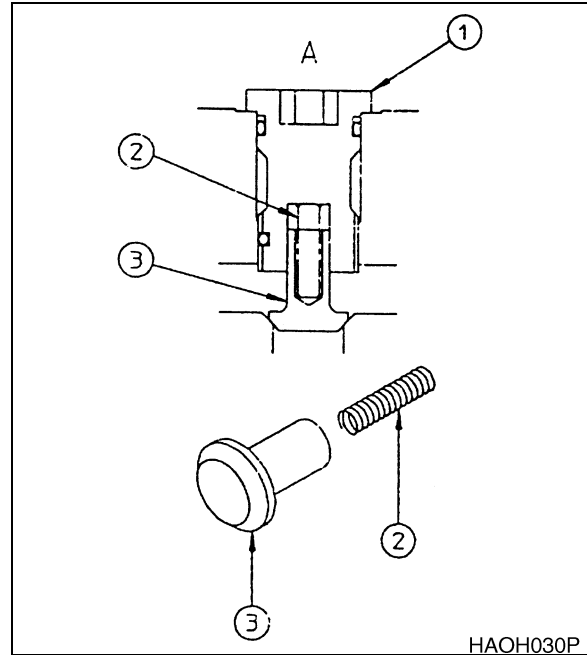


Figure 111

B: Check Valve [OPT, BKT, BM1, BM2]

Reference Number	Description
1	Cap
2	Spring
3	Check

Cap hole size	12 mm
Tightening torque	15 kg m

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

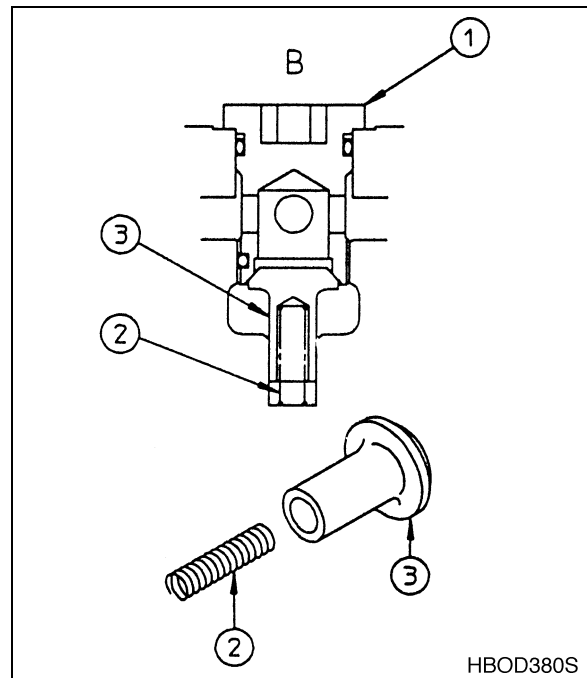


Figure 112

C: Check Valve

Reference Number	Description
1	Cap
2	Spring
3	Check

Cap hole size	12 mm
Tightening torque	15 kg m

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

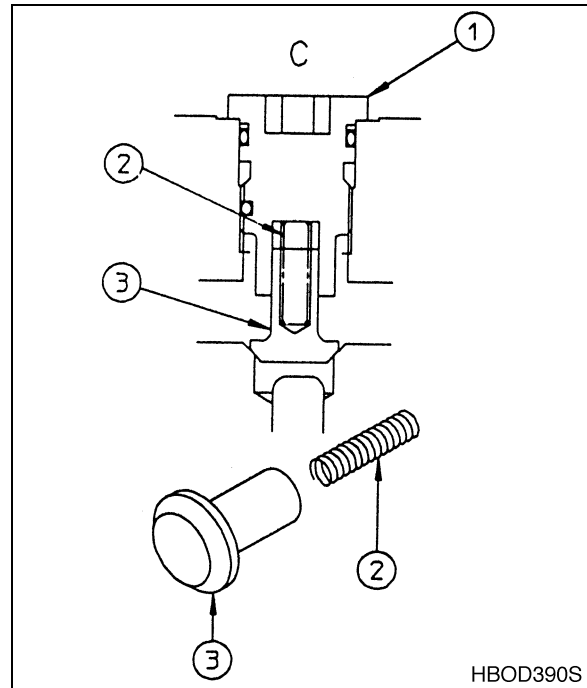


Figure 113

D: Check Valve [AM-1]

IMPORTANT

SP valve must be removed first, before removing AM-1 valve

Reference Number	Description
1	Sleeve
2	Spring
3	Check

1. Pull out sleeve (1), spring (2) and check (3).

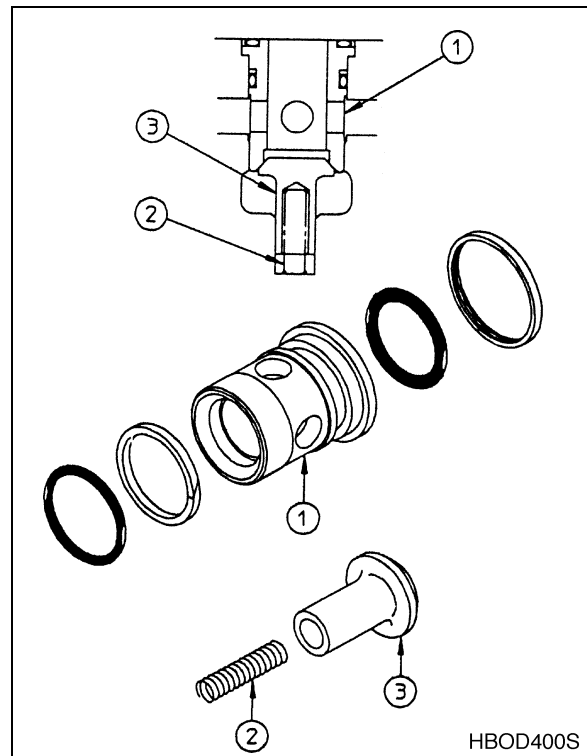


Figure 114

E: Check Valve [TL]

Reference Number	Description
1	Cap
2	Cap
3	Spring
4	Check

Cap 1 hole size	32 mm
Tightening torque	10 kg m

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

Cap 2 hole size	8 mm
Tightening torque	4 kg m

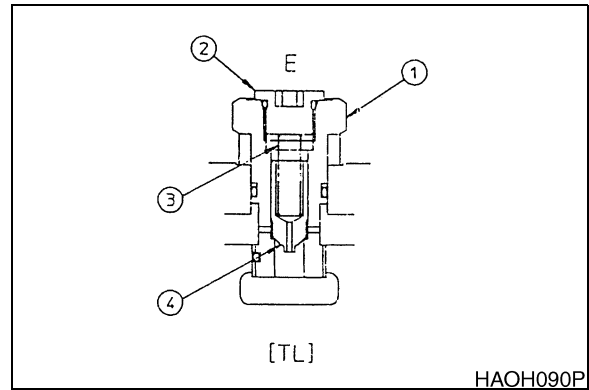


Figure 115

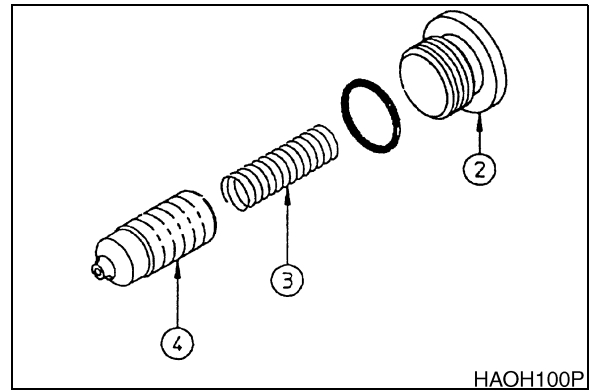


Figure 116

F: Check Valve [SW]

IMPORTANT

SP valve must be removed first, before removing SW valve.

IMPORTANT

The SW & AM-1 sleeves may look similar but are different and can not be interchanged.

Reference Number	Description
1	Sleeve
2	Check
3	Spring

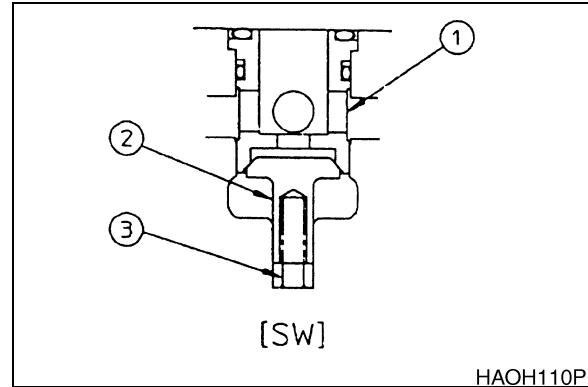


Figure 117

1. Pull out sleeve (1) by using traverse holes.

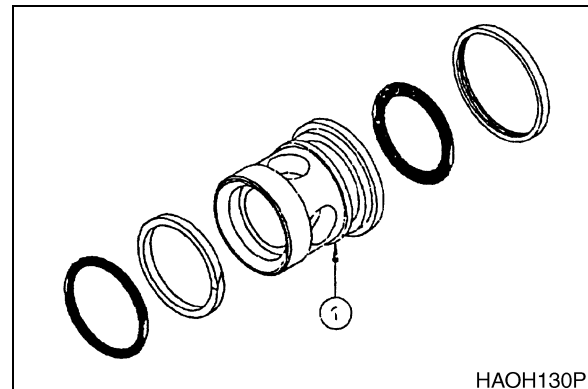


Figure 118

2. Remove check (2) and spring (3).

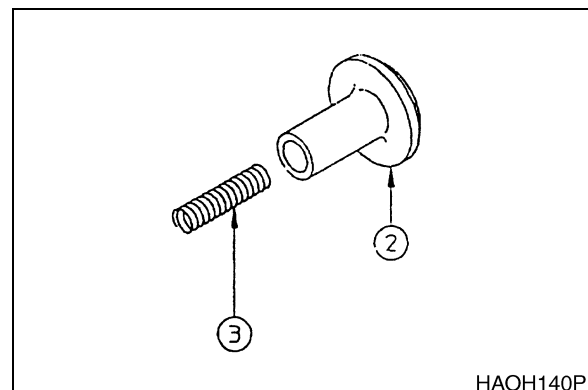


Figure 119



REMOTE 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 130LC-V	0001 and Up
Solar 130W-V	0001 and Up
Solar 220LC-V	0001 and Up
Solar 220LL	1001 and Up
Solar 220N-V	1001 and Up
Solar 290LC-V	0001 and Up
Solar 290LL	1001 and Up
Solar 330LC-V	1001 and Up
Solar 400LC-V	1001 and Up

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	3
Parts List	4
Specifications	5
Hydraulic Specifications	6
SpecialTools	7
Disassembly	8
Reassembly.....	13

GENERAL DESCRIPTION

THEORY OF OPERATION

The remote control valve contains four push rods, a spring holder and return spring, 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.

Neutral Mode

When the lever is in neutral mode, the spool (12) is thrust upward by return spring (11), and the force of balance spring (18), 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.

Control Mode

When push rod (6) is pushed, the balance spring (18) begins to compress, and spring force is conveyed to the spool (12). 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 (12), thrusting the spool upward until it is balanced with the power of the balance spring (18). The secondary pressure (output pressure), therefore, changes in proportion to the compression force of the balance spring.

PARTS LIST

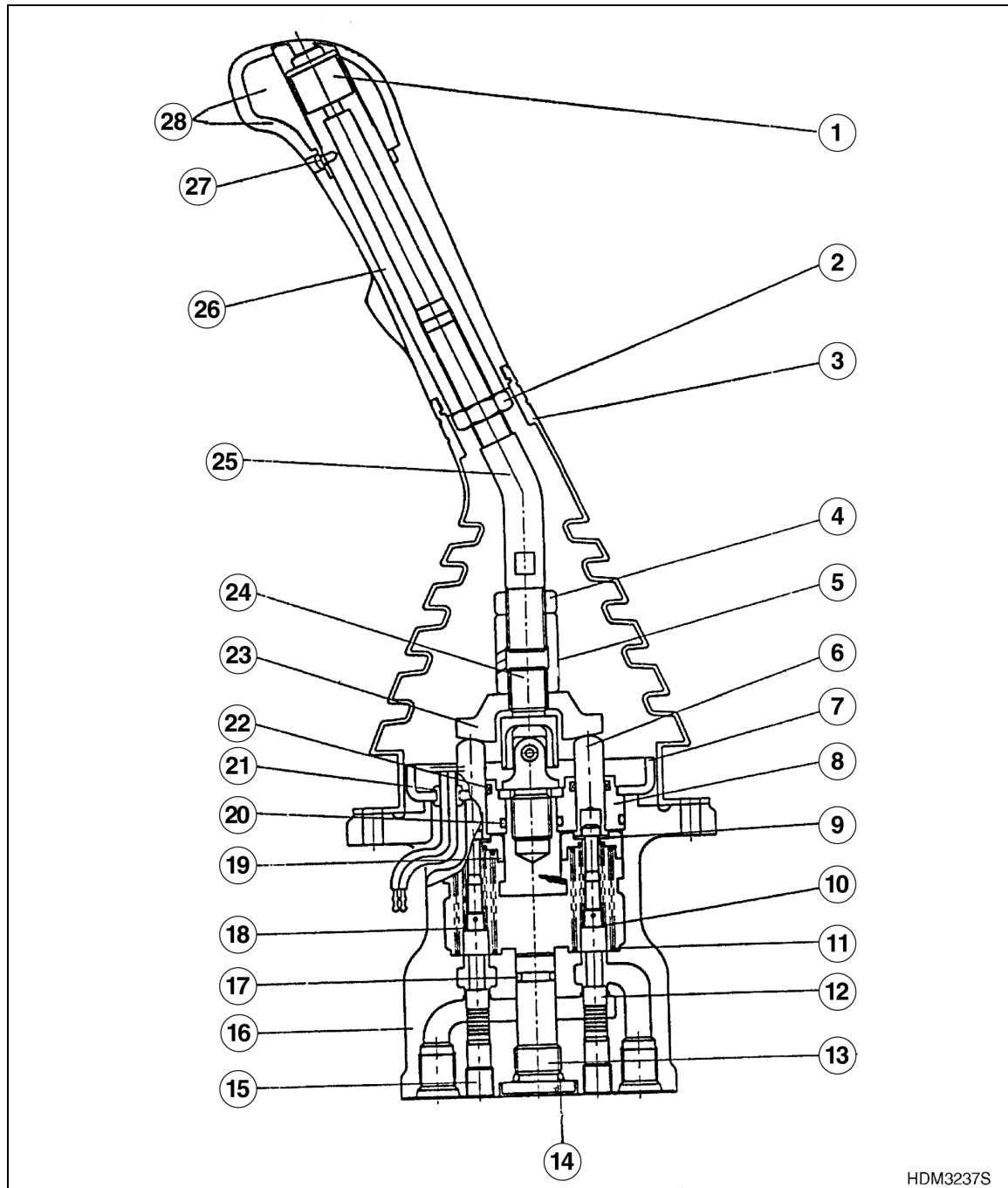


Figure 1

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

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

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

SPECIFICATIONS

Torques

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

Performance

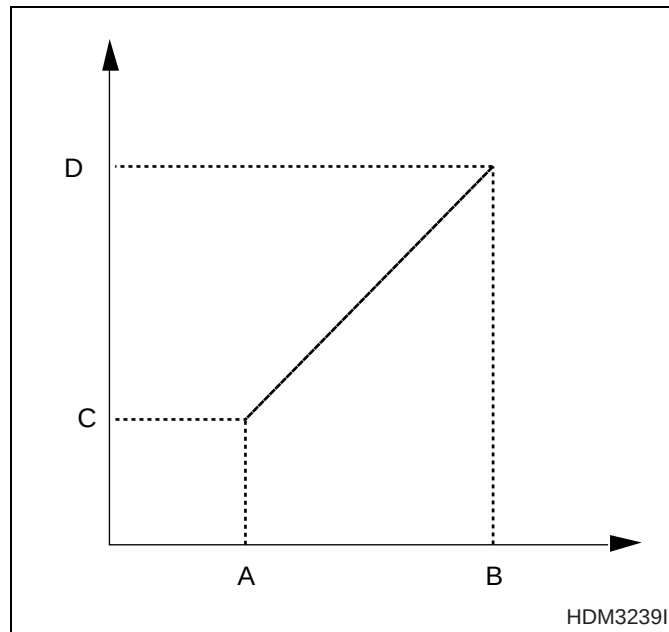


Figure 2

A	1.10 mm (0.04 in.)
B	6.50 mm (0.26 in.)
C	5 ±1 bar (72.52 ±14.50 psi)
D	28 ±1.5 bar (406.11 ±21.76 psi)

HYDRAULIC SPECIFICATION

Implement Control Valve	Type:	Pilot Control
	Pressure/Stroke:	28 kg/cm ² (398 psi) @ 6.5 mm (0.256") stroke
	Weight:	4.8 kg (10.6 lb)

SPECIAL TOOLS

Tool	Size
Spanner	22.0 mm (0.87 in.)
Spanner	27.0 mm (1.06 in.)
Socket Wrench	6.0 mm (0.24 in.)
Phillips Screwdriver	
Slotted Screwdriver	
Special Tool	

DISASSEMBLY

1. Lift up the boot (3) and pull the switch cord through the hole in the housing.



Figure 3



Figure 4

2. Loosen nut (4) from hex nut (5) and detach handle assembly.

NOTE: *Handle assembly may vary from model to model depending upon front attachments. (Example; breakers, scrap grapples, logging grapples, etc.)*



Figure 5

3. Remove hex nut (5) and plate (23).



Figure 6

4. Detach joint (24) using special tool.

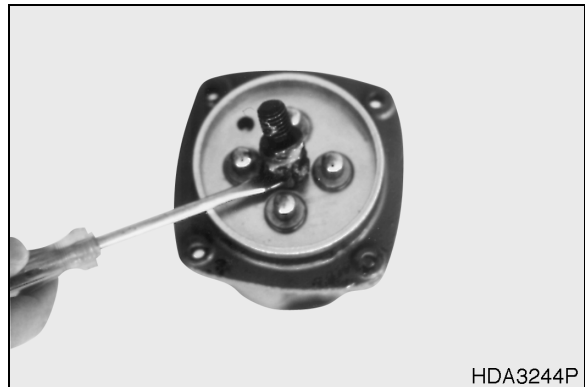


Figure 7

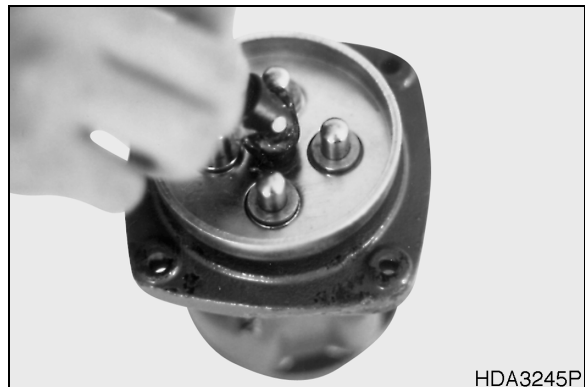


Figure 8

5. Remove plate (23).

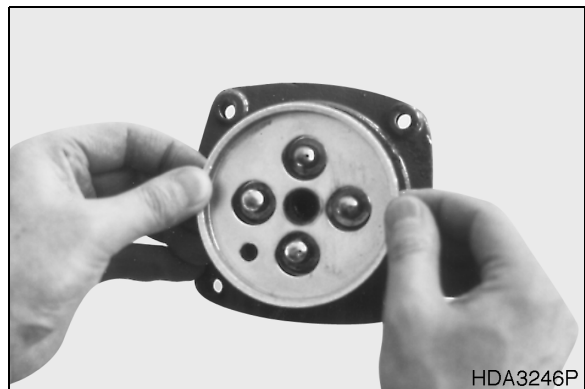


Figure 9



CAUTION!

Plug (8) may fly out due to the spring (11) tension.

6. While pressing down spring (11), remove plug (8).

IMPORTANT

Tag or label valve position so that each valve can be replaced to their original position.

7. Remove pressure reduction valve assembly and spring (11).
8. Remove plug (15).
9. Remove stopper (9) from pressure reduction valve assembly using a screwdriver

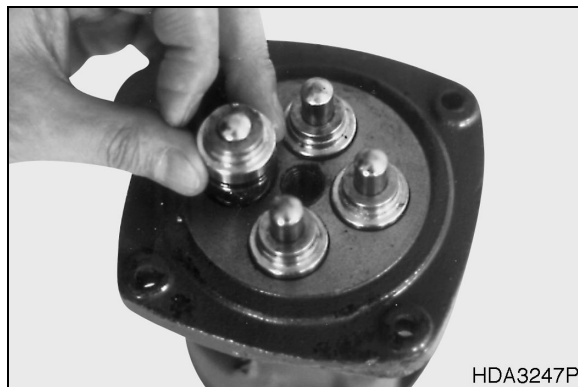


Figure 10



Figure 11

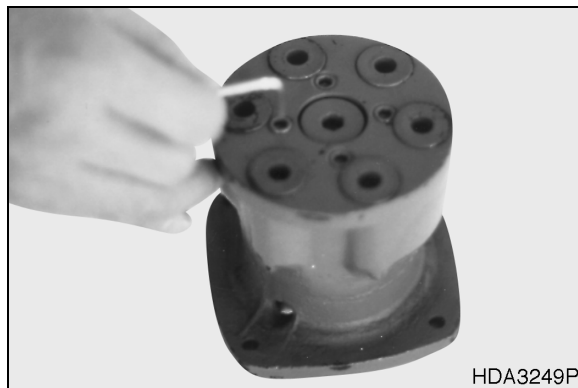


Figure 12



Figure 13

10. Detach spool (12), spring seat (19), spring (18) and shim (10).



Figure 14

11. Detach plug (8) from push rod (6).



Figure 15

12. Remove O-ring (20) and seal (22), from plug (8).



Figure 16



Figure 17

13. Remove boot (3) and nut (2) from handle assembly

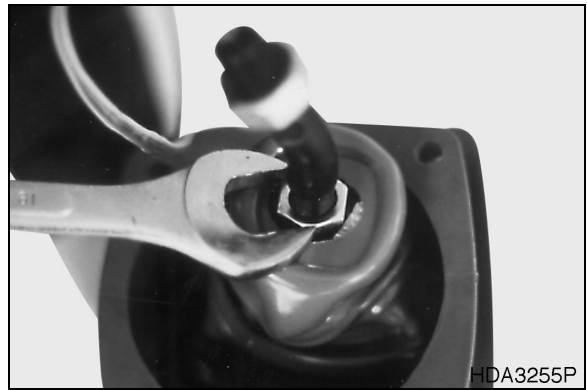


Figure 18

REASSEMBLY

1. Clean all parts and dry them with compressed air. Keep all parts and tools free from dust. Lubricate all moving parts.
2. Tighten plug (15) slowly and diagonally.

NOTE: Plug tightening torque 350.0 kg/m (2,531.55 ft. lbs.)

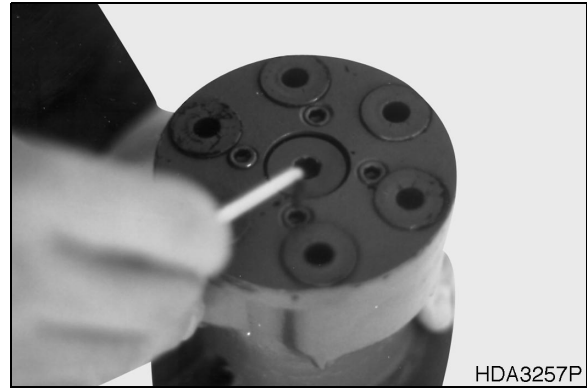


Figure 19

3. Assemble shim (10), spring (18) and spring seat (19).

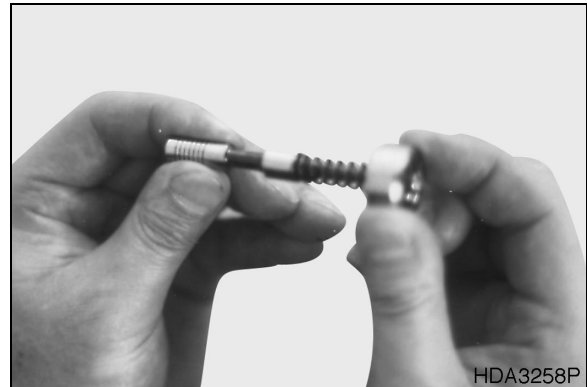


Figure 20

4. While pressing down spring seat (19), insert stopper (9).



Figure 21

5. After attaching spring (11) to housing, install pressure reduction valve assembly

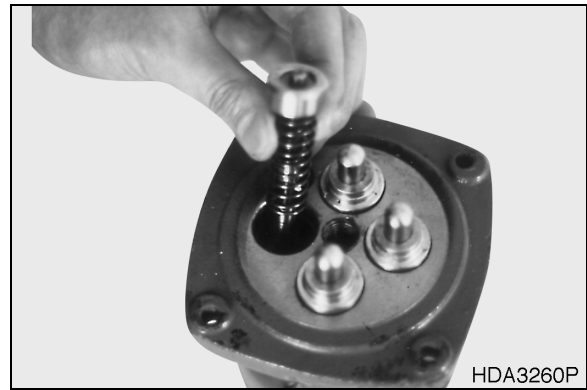


Figure 22

6. Insert O-ring (20) into plug (8).

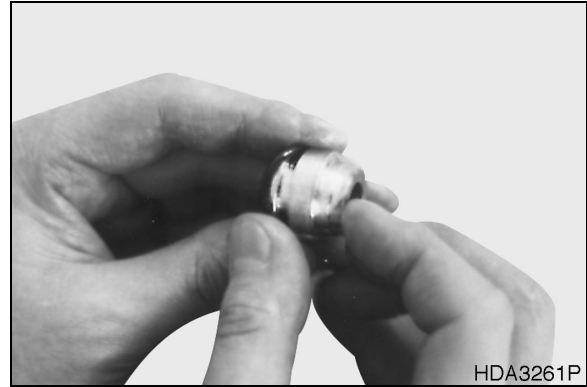


Figure 23

7. Attach seal (22) to plug (8).



Figure 24

8. Insert push rod (6) into plug (8).



Figure 25

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



Figure 26

Reference Number	Description
1	Seal
2	Plug
3	Hydraulic Oil

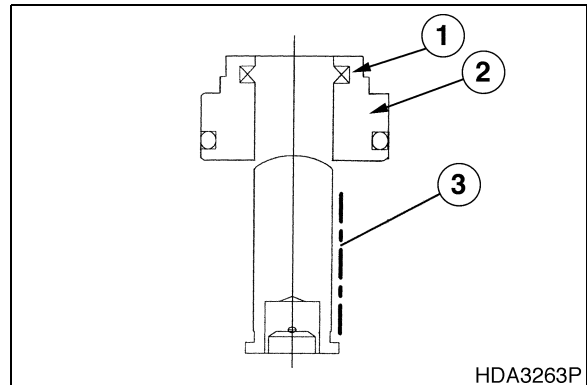


Figure 27

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



Figure 28

11. Attach swatch plate (23) to joint.



Figure 29

12. After attaching hex nut (5), tighten plate (18).



Figure 30

13. Attach boot (3) and nut (2) to handle assembly



Figure 31

14. Pull cord and tube out through the hole of the hex nut (5).



Figure 32

15. Adjust the direction of the handle so that the bent part of the handle faces the seat, tighten the hex nut and outer nut.

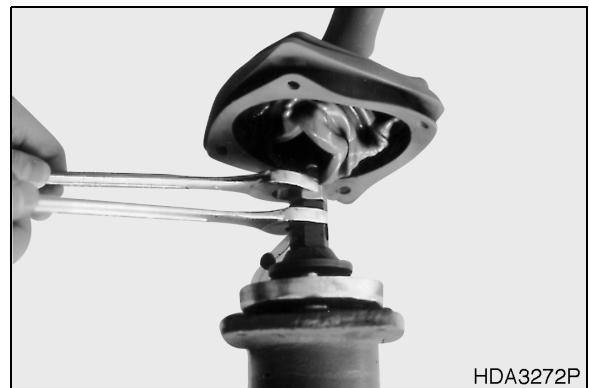


Figure 33

16. Lubricate joint (24), plate (23) and push rod (6).

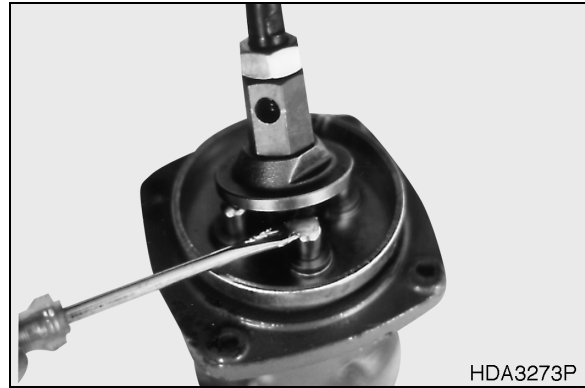


Figure 34

17. Install boot.
18. Apply evaporative, anti-seize compound to ports.



Figure 35



STEERING VALVE



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 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	4
Parts List	6
Specifications	7
Disassembly and Reassembly	8
Tools Needed	8
Valve Disassembly	9
Valve Reassembly	15

GENERAL DESCRIPTION

Turning the steering wheel causes hydraulic oil to be sent from the steering gear type pump to the steering valve which directs oil to the steering cylinders.

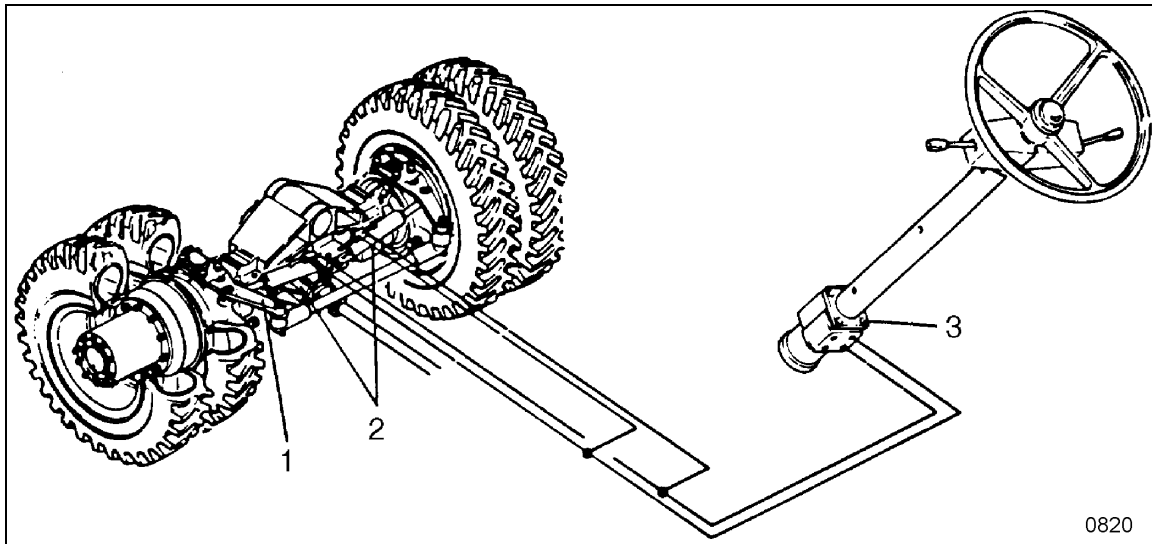


Figure 1

Reference Number	Description
1	Knuckle Arm
2	Steering Cylinder

Reference Number	Description
3	Steering Valve

THEORY OF OPERATION

The steering valve, which directs hydraulic oil from the pump to the steering cylinder, is comprised of a housing, control sleeve, control spool and drive. Turning the steering wheel counterclockwise causes oil to flow to the steering cylinder L. Return oil goes through passage R to passage T. Oil supplied to the rotor turns the rotor and transmits oil to the control sleeve through the drive or spring. Turning the wheel clockwise sends oil through passage R, while return oil passes from L of the cylinder to passage T. With the steering wheel in a neutral position, oil returns to the tank through passages P and T.

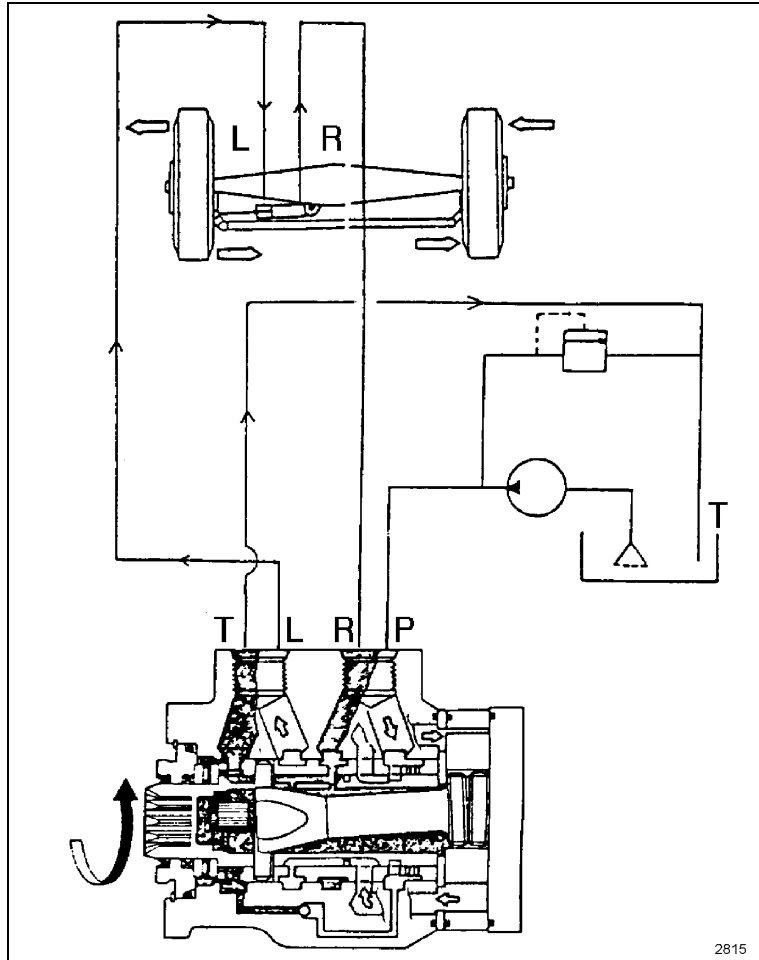


Figure 2

PARTS LIST

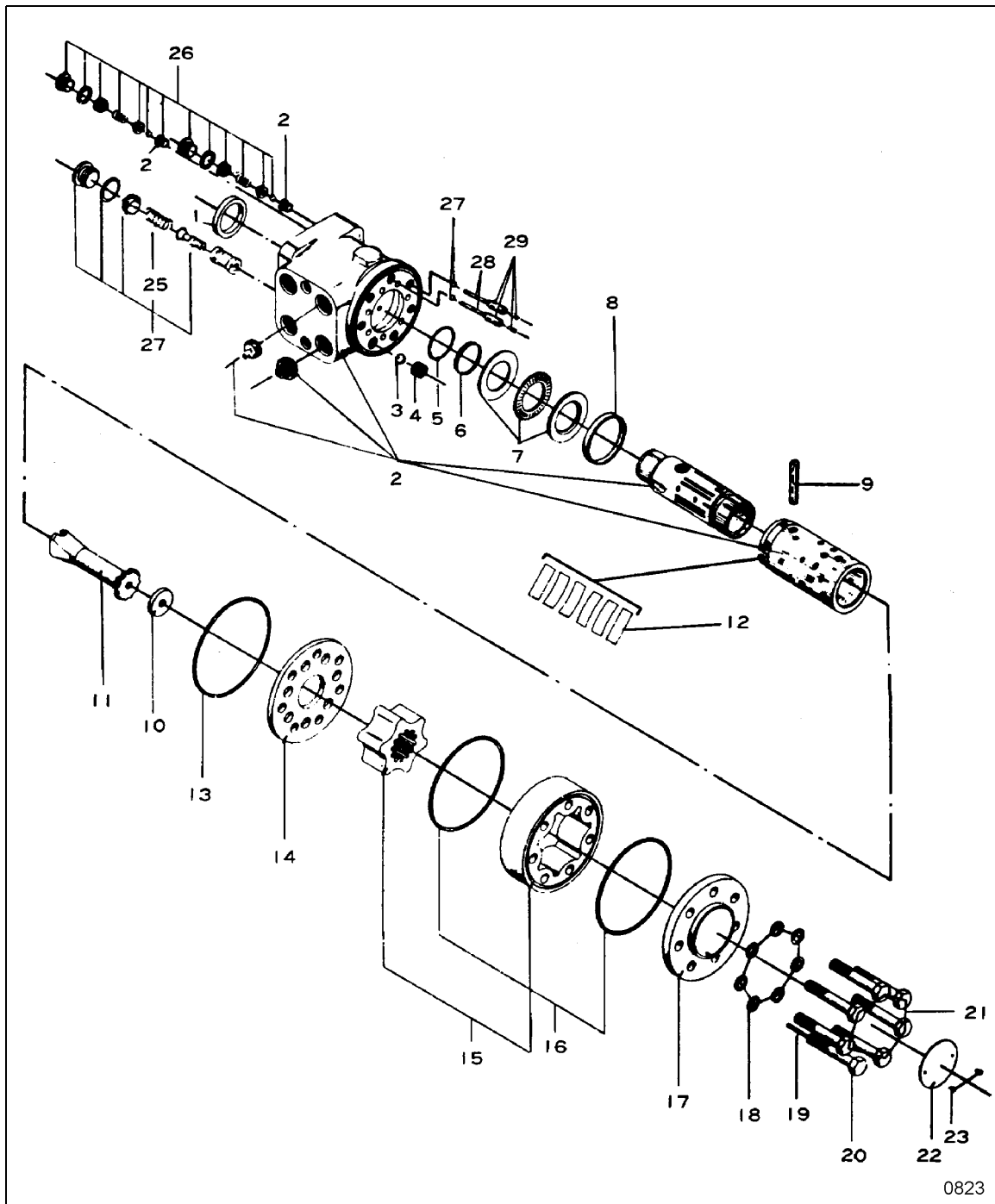


Figure 3

Reference Number	Description
1	Dust Seal Ring
2	Spool Housing Assembly
3	Ball
4	Threaded Bushing
5	O-ring
6	Ring
7	Bearing Assembly
8	Ring
9	Cross Pin
10	Spacer
11	Drive
12	Spring Set
13	O-ring
14	Distributor Plate
15	Gear Wheel Set

Reference Number	Description
16	O-ring
17	End Cover
18	Washer
19	Rolled Pin
20	Screw
21	Screw
22	Name Plate
23	Drive Screw
24	Relief Valve Assembly
25	Wire Spring
26	Shock Valve Assembly
27	Ball
28	Spring
29	Rolled Pin
*	Seal Kit (1, 5, 6, 13, and 18)

SPECIFICATIONS

Steering Unit	
Type	Open Center, Non Reaction
Displacement	200 cm ³ /r (12.2 in ³ /r)
Relief Valve Set Pressure	140 kg/cm ² (1,991 psi)
Overload Relief Valve Set Pressure	200 kg/cm ² (2,845 psi)

DISASSEMBLY AND REASSEMBLY

TOOLS NEEDED

Tool Required	Remarks
Hex Socket Wrench	6, 8 mm
Vise	
Press	
Pumice Stone	Marking Spool/Sleeve alignment (if necessary)
SpecialTool	Spool Installation
SpecialTool	Dust Seal Ring Installation
Mineral Oil	500 cst viscosity @ 20 ⁰ C (68 ⁰ F) Seal and O-ring Installation
Torque Wrench	
Plastic Hammer	
Pressure Tester	

VALVE DISASSEMBLY

1. Remove steering column and secure steering valve in a vise. Remove screws from end cover (six screws plus one special screw, used as a special tool).



Figure 4

2. Slide end cover to one side.

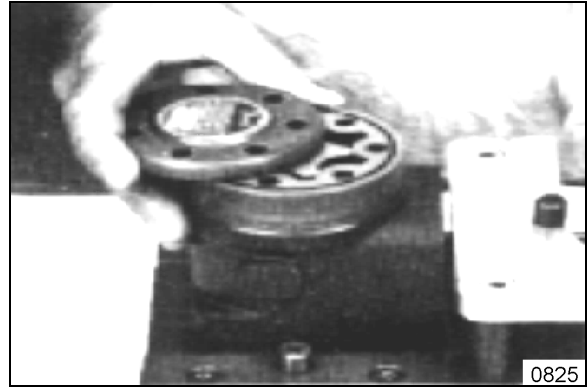


Figure 5

3. Lift gear wheel set, with spacer on some models, off unit. Remove two O-rings.



Figure 6

4. Remove cardan shaft.

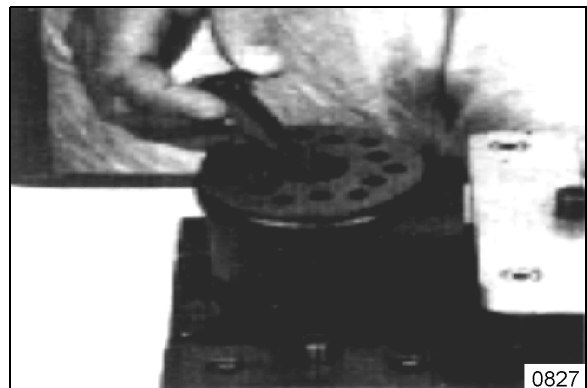


Figure 7

5. Remove distributor plate.

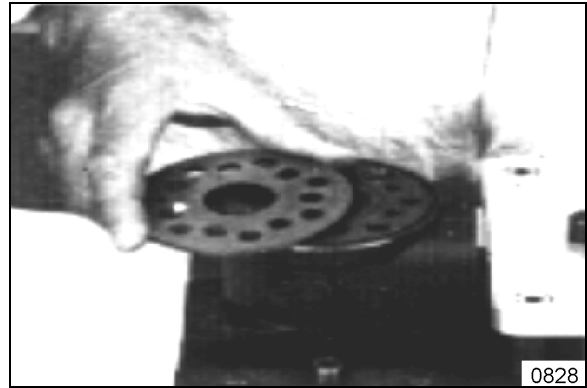


Figure 8

6. Screw out threaded bushing over check valve.

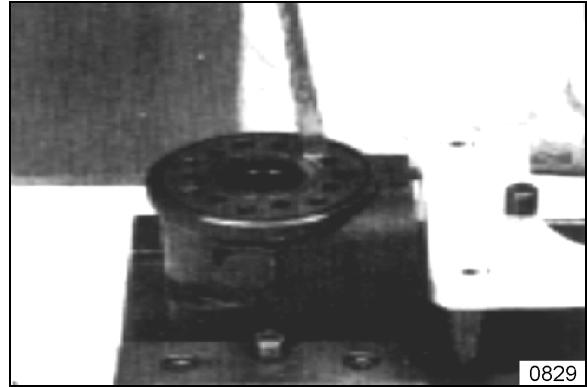


Figure 9

7. Remove O-ring.



Figure 10

8. Shake out check valve ball, and suction valve pins and balls.



Figure 11

9. Taking care to keep cross pin in sleeve and spool horizontal, press spool in and push sleeve, ring, bearing races and needle bearing out of housing together.



Figure 12

10. Remove ring, bearing races and needle bearing from sleeve and spool. Check that outer, thin bearing race is not stuck in housing.



Figure 13

11. Press out cross pin, using special screw from end cover.



Figure 14

NOTE: *If there are no alignment marks on spool and sleeve, close to one of the slots for neutral position springs, mark with pumice stone before removing springs.*

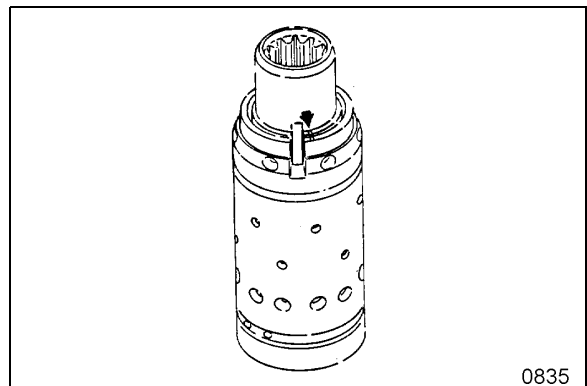


Figure 15

12. Carefully press spool out of sleeve.



Figure 16

13. Press neutral springs out of their slots in spool.



Figure 17

14. Remove dust seal and O-ring.

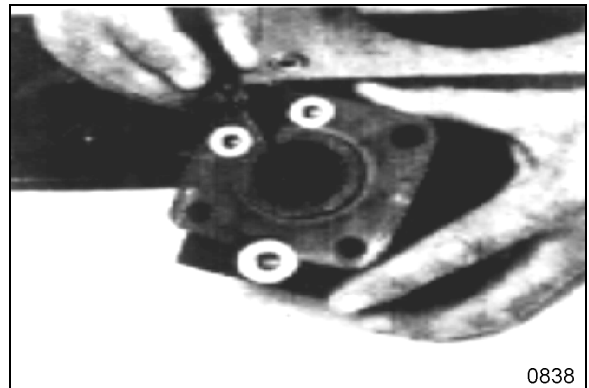


Figure 18

15. Remove plugs from shock valves using a 6 mm hex socket spanner.

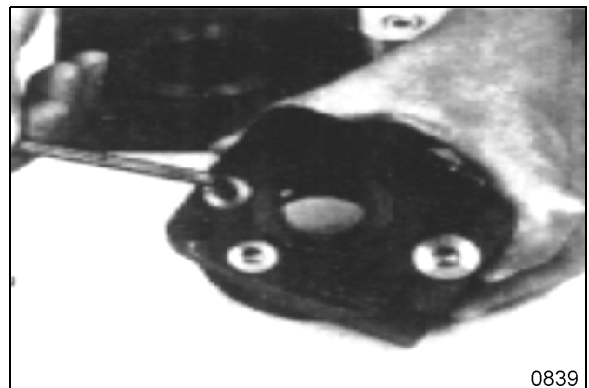


Figure 19

16. Remove two seal washers.

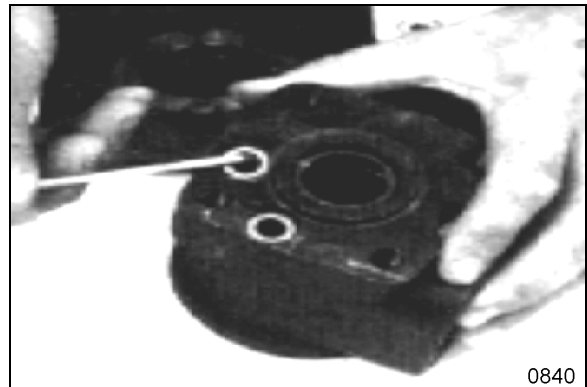


Figure 20

17. Unscrew set screws using 6 mm hex socket spanner.



Figure 21

18. Shake two springs and valve balls out of housing.

NOTE: *Valve seats are bonded into housing and cannot be removed.*



Figure 22

19. Dual Shock Valves are shown disassembled.

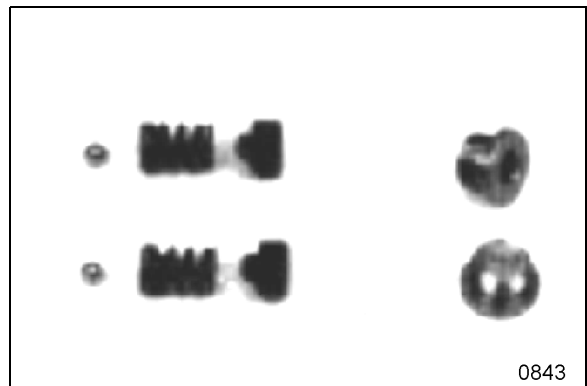
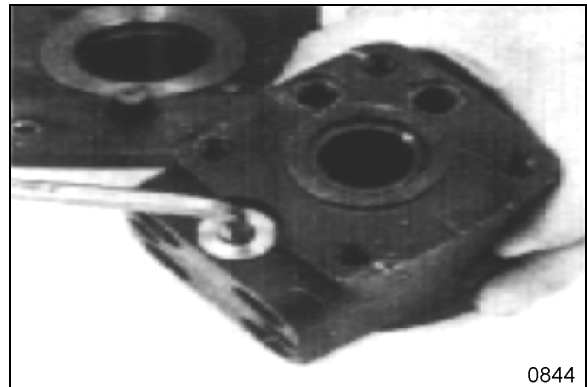


Figure 23

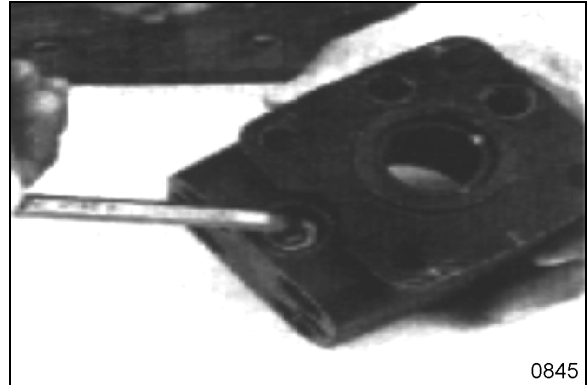
20. Screw out plug using 8 mm hex socket spanner. Remove seal washers.



0844

Figure 24

21. Unscrew set screw using 8 mm hex socket spanner.



0845

Figure 25

22. Shake out spring and piston. (Note: valve seat is bonded into housing and cannot be removed).



0846

Figure 26

23. Pressure relief valve is shown disassembled.



0847

Figure 27

VALVE REASSEMBLY

1. Assemble spool/sleeve, making sure marks on spool and sleeve are lined up.



Figure 28

2. Place two, flat, neutral position springs in slot. Place curved springs between flat springs and press into place.



Figure 29

3. Line up spring set.



Figure 30

4. Guide spool into sleeve.



Figure 31

5. Press springs together and push neutral position springs into place in sleeve.



Figure 32

6. Line up springs and center them.

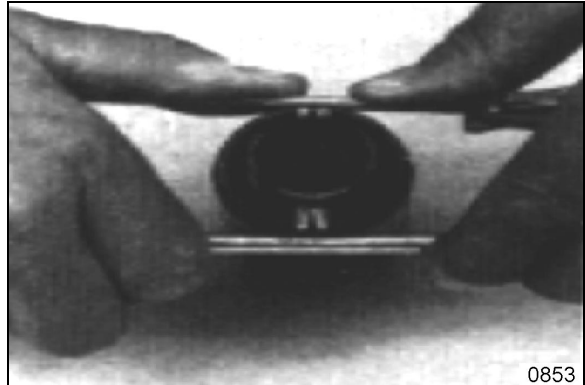


Figure 33

7. Guide ring down over sleeve so that ring can turn free of the springs.

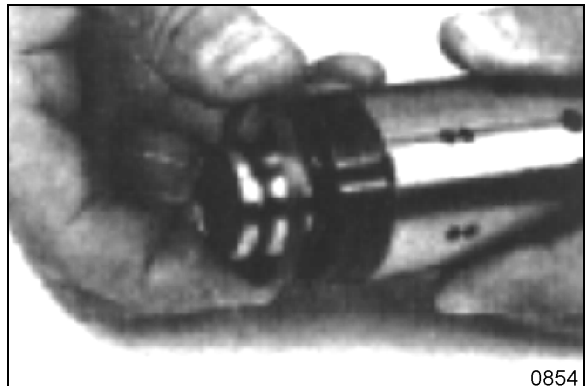


Figure 34

8. Fit cross pin into spool/sleeve



Figure 35

9. Assemble bearing races and needle bearing as shown in Figures 36 and 39.



Figure 36

Reference Number	Description
1	Outer Bearing Race
2	Needle Bearing
3	Inner Bearing Race
4	Spool
5	Sleeve

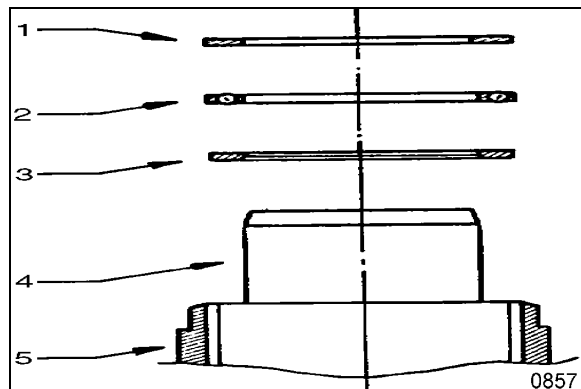


Figure 37

10. Turn unit until bore is horizontal. Guide outer part of assembly tool into bore of spool/ sleeve.

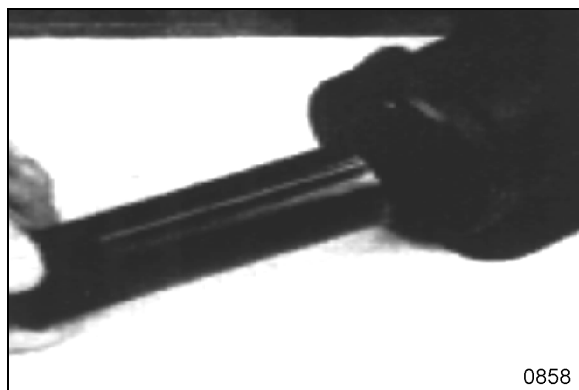


Figure 38

11. Grease O-ring and ring with oil and place on tool.



Figure 39

12. Hold outer part of assembly tool in bottom of housing and guide inner part of tool to bottom.



Figure 40

13. Press and turn O-ring and ring into position in housing.



Figure 41

14. Draw inner and outer parts of assembly tool out of housing bore, leaving guide from inner part inside.

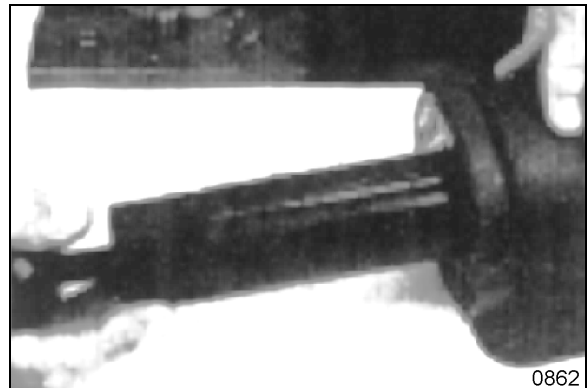


Figure 42

15. Lubricate lip seal and place on assembly tool.



Figure 43

16. Guide assembly tool to bottom of housing.

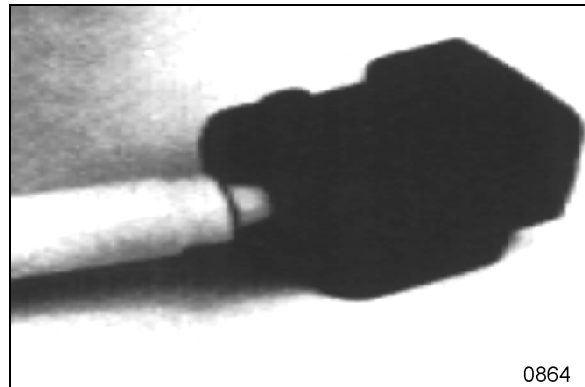


Figure 44

17. Press and turn lip seal into place in housing.



Figure 45

18. Holding cross pin horizontal, guide spool and sleeve into bore with light turning movement.



Figure 46

NOTE: *O-ring and ring are now in position; spool set will push out assembly tool guide*



Figure 47

19. Turn steering until bore is vertical. Place check valve ball into hole shown in illustration.



Figure 48

20. Screw threaded bushing lightly into check valve bore so that top of bushing lies just below housing surface.

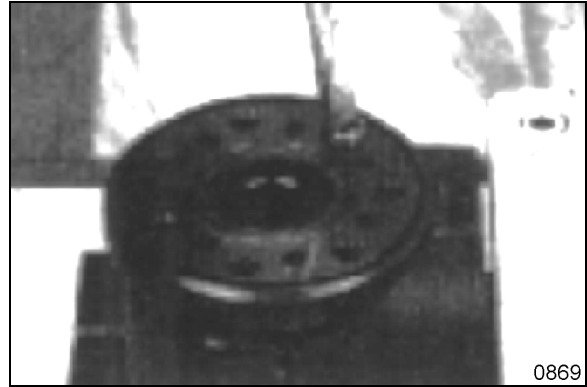


Figure 49

21. Place ball in two holes shown in illustration.

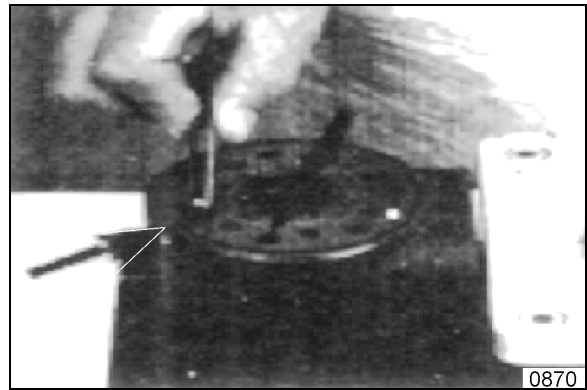


Figure 50

22. Place pin in holes.



Figure 51

23. Install pin, with spring on some models, into housing.

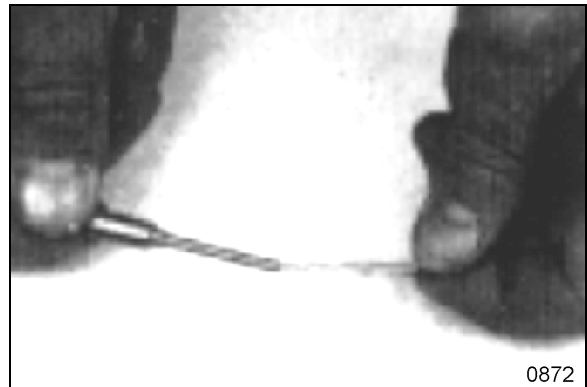


Figure 52

24. Grease O-ring with mineral oil (500 cst viscosity at 20°C [68°F]).

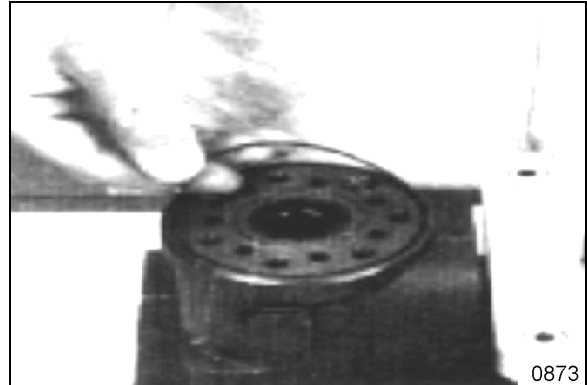


Figure 53

25. Install distributor plate so that channel holes match holes in housing.

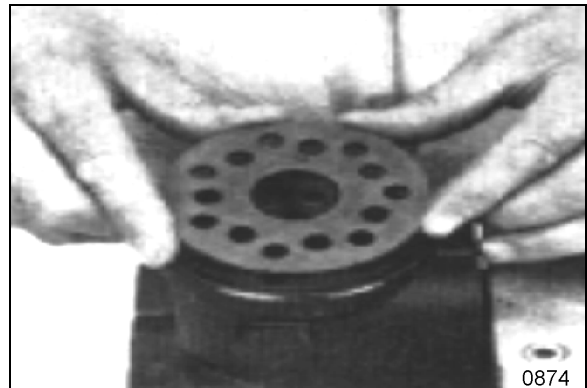


Figure 54

26. Guide cardan shaft into bore so that slot is parallel with connection flange.

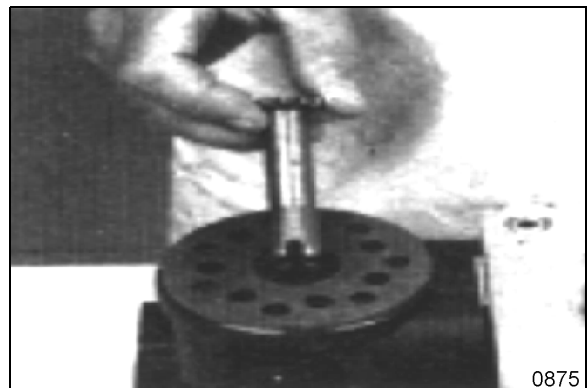


Figure 55

27. Place cardan shaft so that it is held in position by mounting fork.

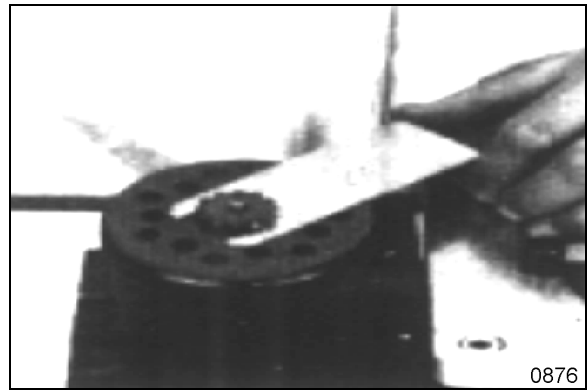


Figure 56

28. Grease two O-rings with mineral oil (500 cst viscosity at 20°C [68°F]) and place in grooves in rear rim. Fit gearwheel and rim on cardan shaft.

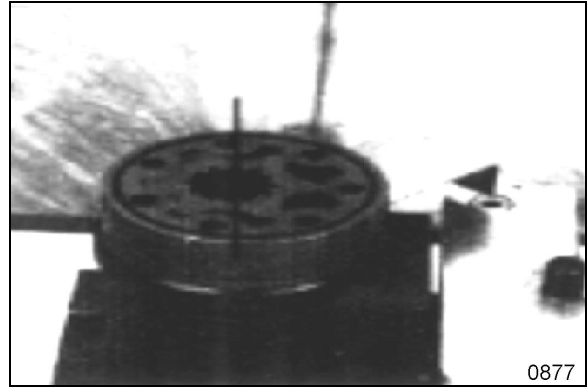


Figure 57

29. Fit gearwheel (rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to shaft slot as shown. Turn gear rim so that seven holes match holes in housing.

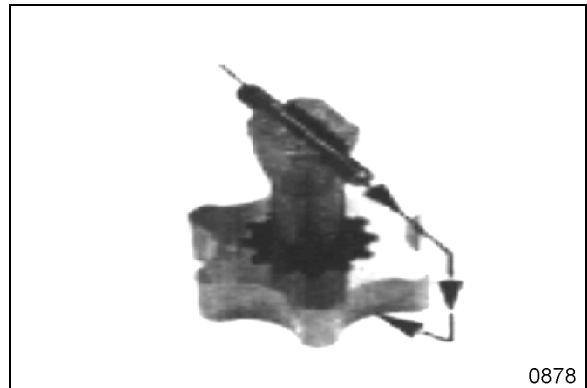
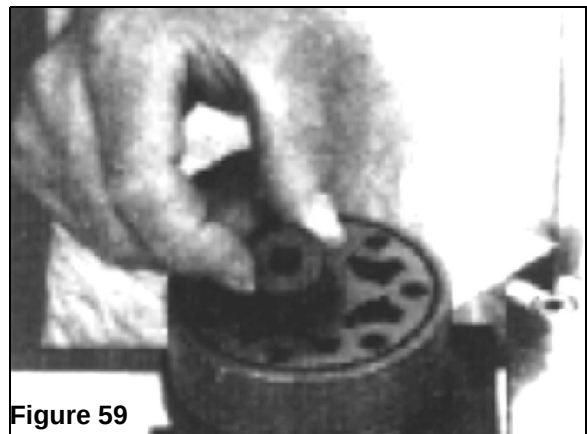


Figure 58

30. Install spacer, if used.



31. Place end cover in position.

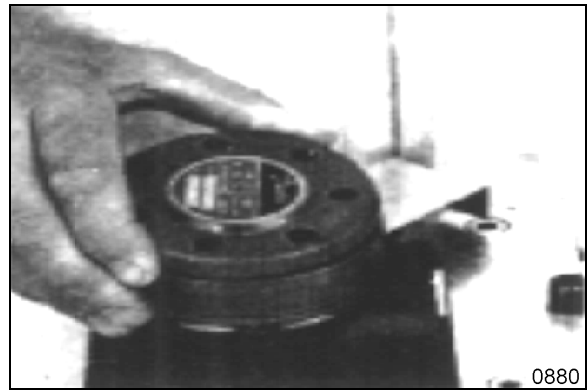


Figure 60

32. Fit special screw with washer and place in hole shown.

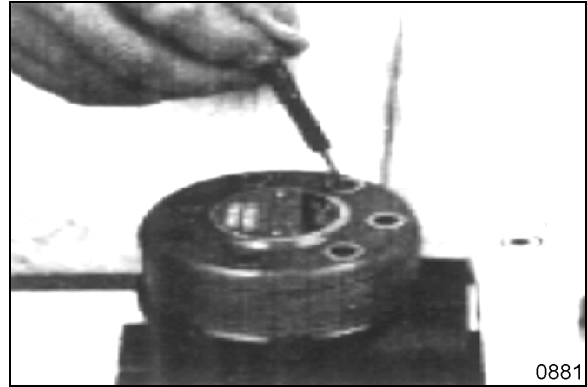


Figure 61

33. Fit six screws with washers and install. Cross-tighten screws and roll pin to 3.0 6 0.6 Nm (0.674 6 0.134 ft lb).



Figure 62

34. Place dust seal ring in housing after pressure relief valve and shock valves are installed.



Figure 63

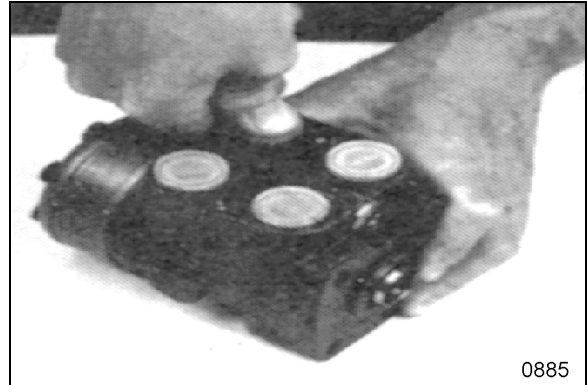
35. Install dust seal ring to housing using special tool and plastic hammer.



0884

Figure 64

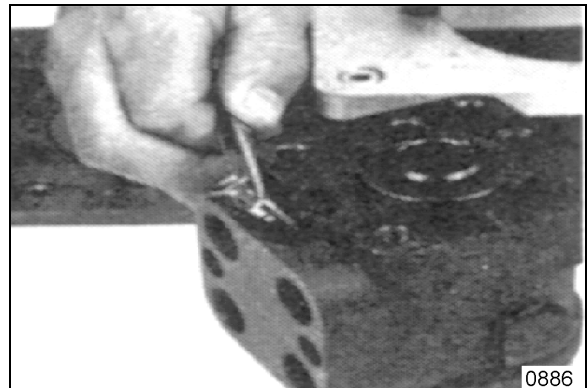
36. Press plastic plugs into connection ports, by hand, **DO NOT** use hammer.



0885

Figure 65

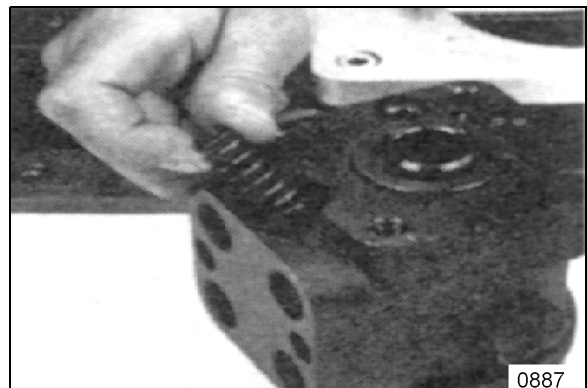
37. Install piston.



0886

Figure 66

38. Install spring.



0887

Figure 67

39. Screw in set screw using 8 mm hex socket spanner and set pressure setting as follows.

Spring Dia.	Pressure
1.7 mm (0.066")	50–70 bar (725–1,015 psi)
1.9 mm (0.075")	70–105 bar (1,015–1,522 psi)
2.1 mm (0.083")	110–155 bar (1,595–2,248 psi)

40. Screw plug with dust seal into housing using 8 mm hex socket spanner. Tighten to 5 ± 1 Nm (1.12 ± 0.22 ft lb).

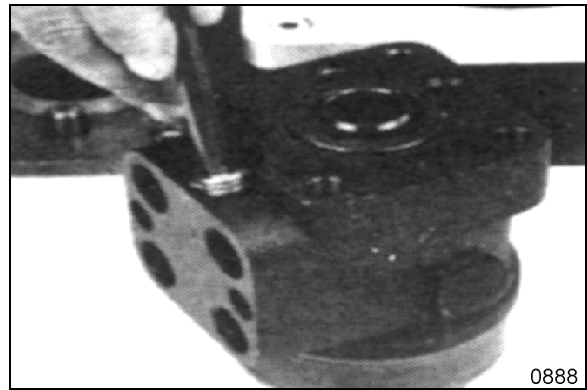


Figure 68

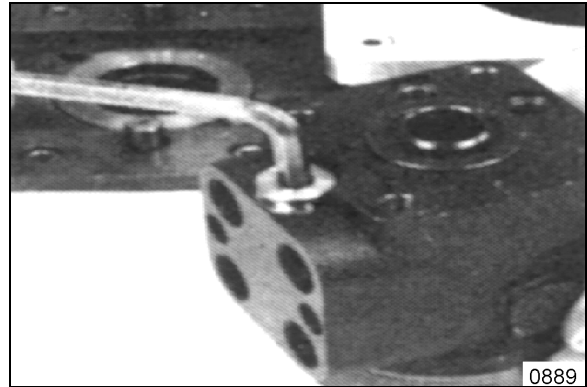


Figure 69



STEERING 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 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Theory of Operation	3
Parts List	3

GENERAL DESCRIPTION

THEORY OF OPERATION

The steering pump is a gear pump that directs hydraulic oil to the steering valve

PARTS LIST

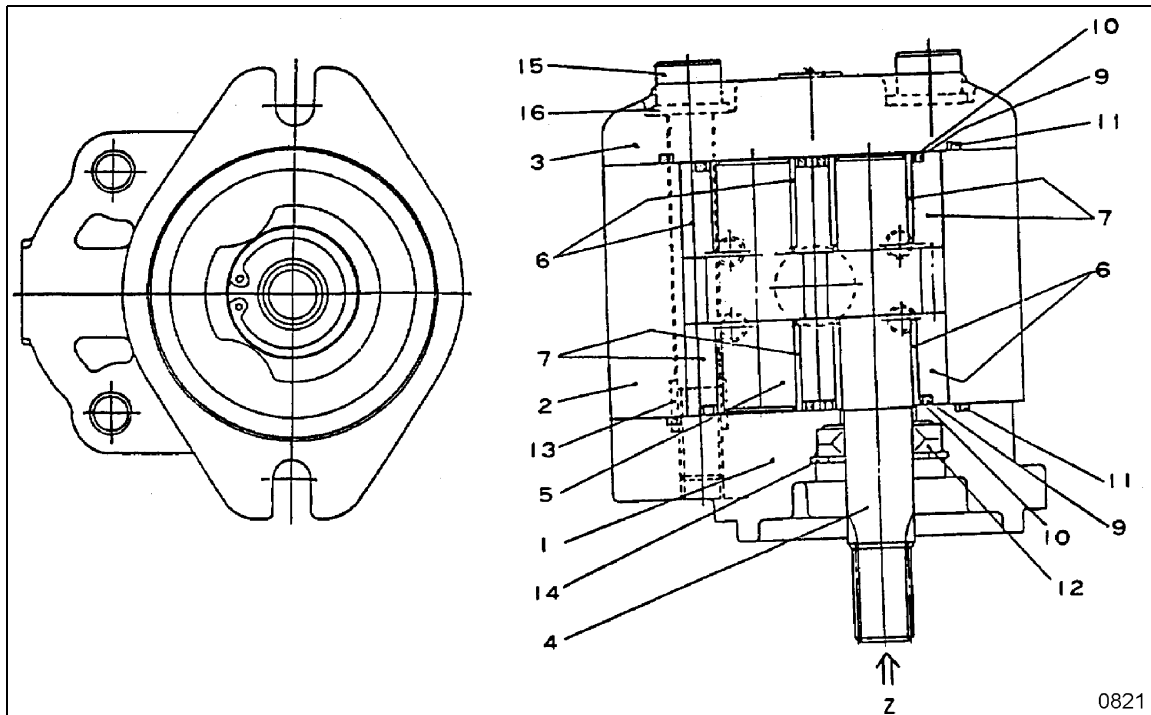


Figure 1

Reference Number	Description
1	Front Cover
2	Body
3	Rear Cover
4	Drive Cover
5	Idle Gear
6	Bushing
7	Bushing
8	-----

Reference Number	Description
9	Seal
10	Seal
11	O-ring
12	Oil Seal
13	Pin
14	Snap Ring
15	Bolt
16	Washer



DOZER CONTROL VALVE



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 130W-V	0001 and Up

TABLE OF CONTENTS

Parts List	3
Specifications	3

PARTS LIST

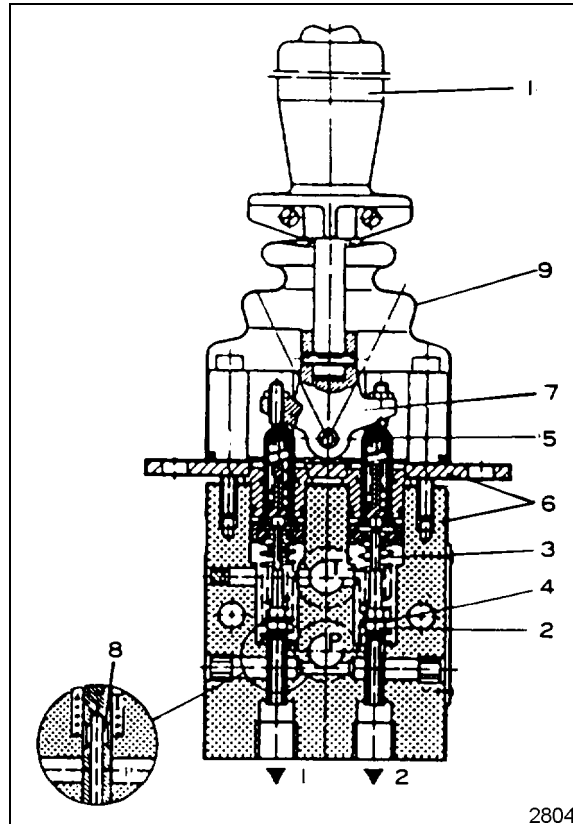


Figure 1

Reference Number	Description
1	Knob
2	Spool
3	Return Spring
4	Spring
5	Plunger

Reference Number	Description
6	Valve
7	Plate
8	Adjuster
9	Bellows

SPECIFICATIONS

Remote Blade (Dozer) Control Valve Type: Pressure/Stroke:	Pilot Control 22 kg/cm ² (313 psi) at 7.5 mm (0.295") stroke
--	--

ELECTRICAL SYSTEM



ELECTRICAL SYSTEM



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 130W-V	0001 and Up

TABLE OF CONTENTS

Troubleshooting - Electrical System	4
Wiring Harness Illustrations	5
Overview	5
Electric Supply System	6
Engine Starting Circuit	8
Operation During Start Process.....	8
Operation After Start Process.....	10
Engine Preheating System.....	12
Engine Stop System.....	13
Charging System.....	17
Monitoring System	18
Instrument Panel and Steering Console.....	19
iNstrument Panel and Steering Console Function Check	20
Monitoring System Schematic.....	22
Operation.....	24
Instruments	24
Mode Select Switch.....	25
Pilot Lamp	26
Initial Operation	27
Electronic Hydraulic Control System (EPOS - V)	28
Power Mode Control	30
Operation	32
Throttle Position Sensor	36
Power Mode Control - Circuit Diagram	37
Work Mode Control	38
Operation	39
Work Mode Control - Circuit Diagram	40
Engine Control System.....	41
Engine Control Motor	42
Engine Speed Control Dial	43

Engine Control Circuit Diagram.....	44
Automatic Deceleration Control (Auto Idle Control).....	45
Engine Overheat Protection System	46
Power Boost Mode	47
Operation	47
Power Boost Control - Circuit Diagram.....	48
Cruise Control	50
Function	50
Cruse Control Circuit.....	52
Adjusting Method of Engine Control Unit	53
Adjusting Method of Engine Control System.....	53
Adjusting Method of Engine RPM	55
Adjustment of TPS (Throttle Position Sensor) (Refer to Figure 44 thru Figure 46)	61
Self-diagnostic Function	64
EPOS-V Controller	64
Engine Throttle Controller	68

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 engine speed control 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 not switchable	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
	EPOS-V controller defective	Replace
	Engine RPM not controllable	See preceding list
Work mode selection not switchable	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
	EPOS-V controller defective	Replace
	Engine RPM not controllable	Replace
	Solenoid valve defective	Replace

WIRING HARNESS ILLUSTRATIONS

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

OVERVIEW

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

Electric Wire Color

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

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

NOTE: *RW: Red wire with White stripe*
R - Base Color, W - Stripe Color

NOTE: *0.85G: Nominal sectional area of wire core less insulator = 0.85 mm²*

ELECTRIC SUPPLY SYSTEM

The electric power circuit supplies electric current to each electric component. It consists of a battery, battery relay, start switch, circuit breaker, fusible link and fuse box.

The negative terminal of the battery is grounded to the vehicle body.

Even when the start switch is in the "OFF" position, electric current is supplied to the following components through battery → fusible link → fuse circuit.

1. Cabin lamp, fuel pump switch, No. 1 terminal of DC-DC converter (back up for car stereo memory)
2. 'B' terminal of start switch and No. 22 terminal of air-conditioner control panel.
3. Power terminal 'B' of engine stop motor.
4. Hazard warning switch - Turn signal switch

When the start switch is in the "PREHEAT, ON and START" positions, the current flows from the battery → fusible link → fuse → start switch 'B' terminal/start switch 'BR' terminal → battery relay '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.

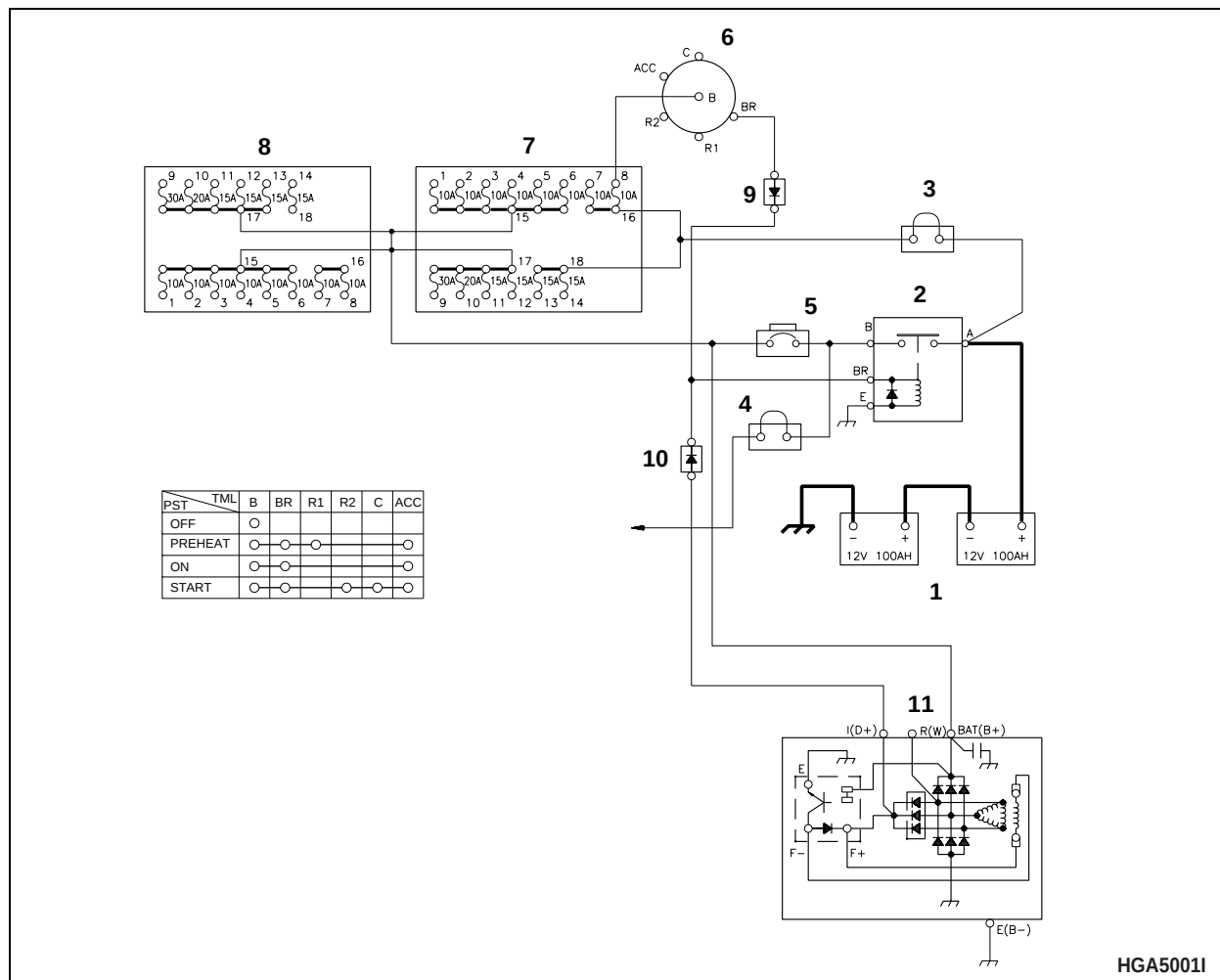


Figure 1 ELECTRIC POWER CIRCUIT DIAGRAM

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link I
4	Fusible Link II
5	Circuit Breaker
6	Start Switch

Reference Number	Description
7	Fuse Box I
8	Fuse Box II
9	Diode I
10	Diode II
11	Alternator

ENGINE STARTING CIRCUIT

OPERATION DURING START PROCESS

When the start switch is turned to the "START" position, the 'S' and 'E' terminals of the starter controller are connected. At this time the contacts in the starter relay (8) are closed by the current flow from the battery (1) → fusible link (3) → 'B' terminal of the start switch (5) → 'C' terminal of the start 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 → ground.

The contact point 'B' and 'PP' of starter relay (8) are connected, the pinion gear of the starter (4) 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) → '30' terminal of the starter (4). The starter motor is rotated and the engine is started.

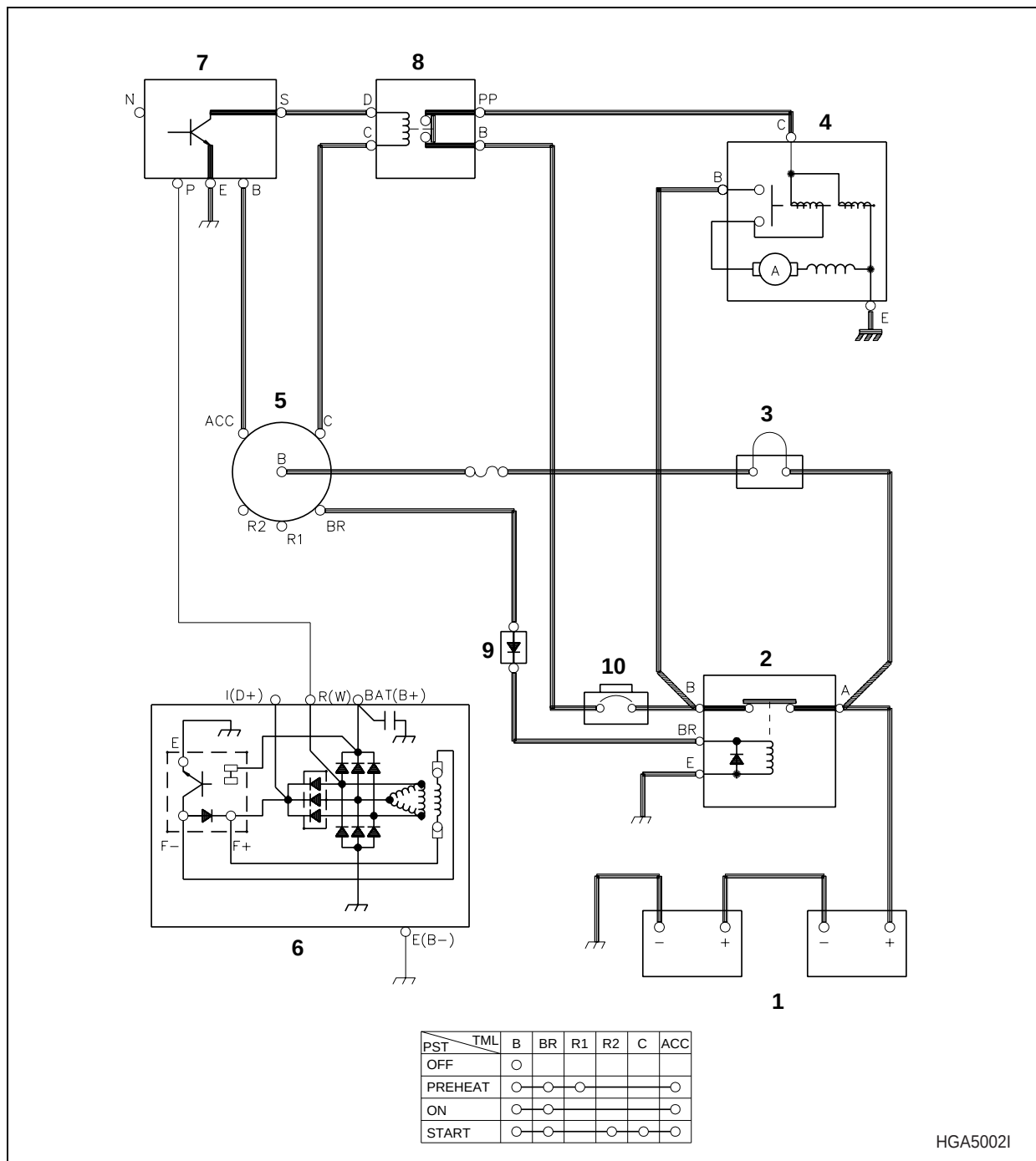


Figure 2 STARTER CIRCUIT (1) - WHILE STARTING

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Starter
5	Start Switch

Reference Number	Description
6	Alternator
7	Starter Controller
8	Starter Relay
9	Diode
10	Circuit Breaker

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Starter
5	Start Switch

Reference Number	Description
6	Alternator
7	Starter Controller
8	Starter Relay
9	Diode
10	Circuit Breaker

ENGINE PREHEATING SYSTEM

Cylinder preheat plugs are installed into each cylinder of the engine.

When the start switch (6) is turned to the 'Preheat' position, the current flows from the battery (1) → fusible link (3) → 'B' terminal of start switch (6) → 'R1' terminal of start switch → 'C' terminal of preheat relay (6) → ground and the contact points of the preheat relay are closed.

When the contact points of the preheat relay are closed, the glow plugs, heated by current flowing from the battery (1) → battery relay (2) → circuit breaker (5) → preheat relay (12) → glow plugs (7) → ground.

The preheat time is approximately 3.5 seconds. A built-in timer in the instrument panel will activate an indicator lamp approximately 19 seconds after the preheat process has been selected.

Even after the start switch (6) has been moved to the "START" position the current will continue to flow through the 'R2' terminal of the start switch (6) to the coil of the preheat relay (12) without disruption of the preheat process.

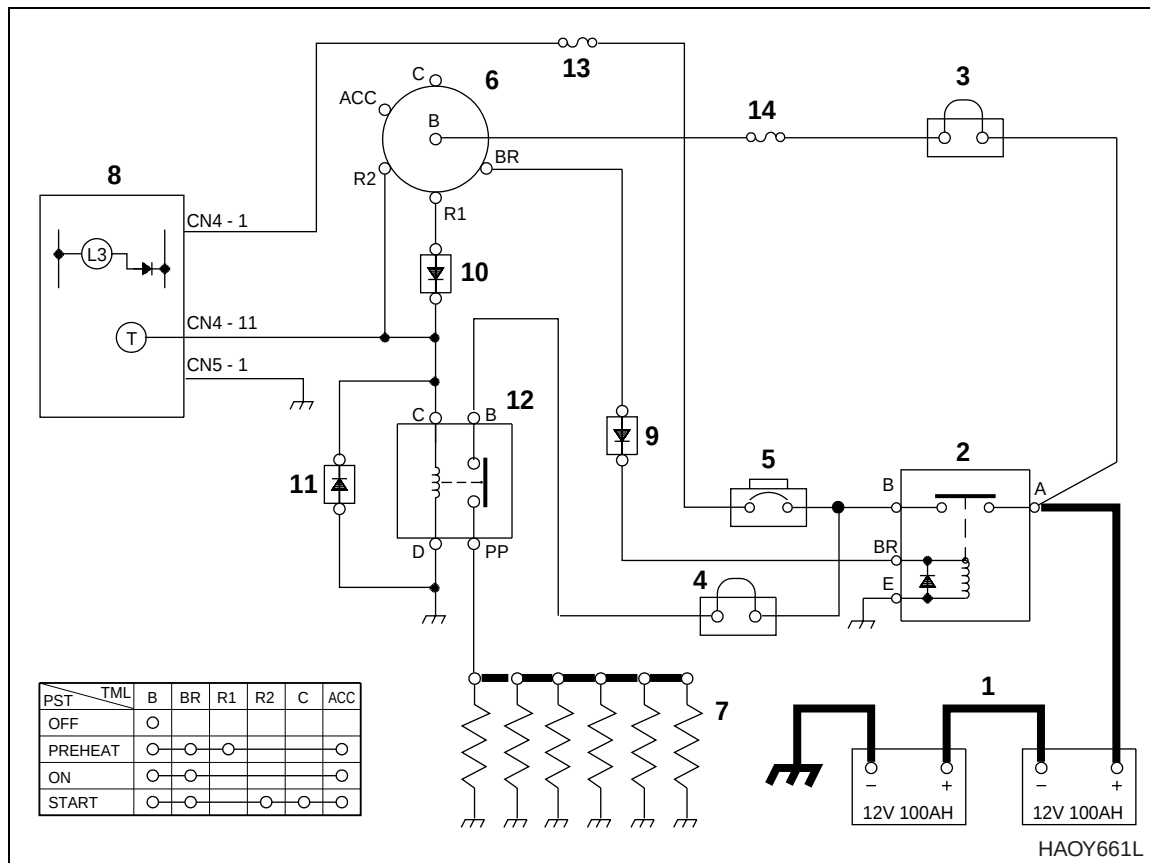


Figure 4 ENGINE PREHEAT CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link (I)
4	Fusible Link (II)
5	Circuit Breaker
6	Starter Switch

Reference Number	Description
7	Preheat (Glow) Plugs
8	Instrument Panel
9, 10, 11	Diode
12	Preheater Relay
13, 14	Fuse

ENGINE STOP SYSTEM

The engine stop circuit consists of a start switch (3), engine stop motor (4) and engine stop relay (5). There are two modes of operation - engine running and engine stop.

Operation In Engine Running Mode

When the start 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 start switch (3) → 'ACC' terminal of start switch (3) → '86' terminal of engine stop relay (5) → '85' terminal of engine stop relay (5) → ground.

As a result, the engine stop motor (4) is rotated by the current flow from the battery (1) → fusible link (2) → 'B' terminal of the engine stop motor (4) → 'P2' terminal of engine stop motor (4) → '87' terminal of engine stop relay (5) → '30' terminal of the engine stop relay (5) → 'A' terminal of engine stop motor (4) → 'E' terminal of engine stop motor (4) → 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.

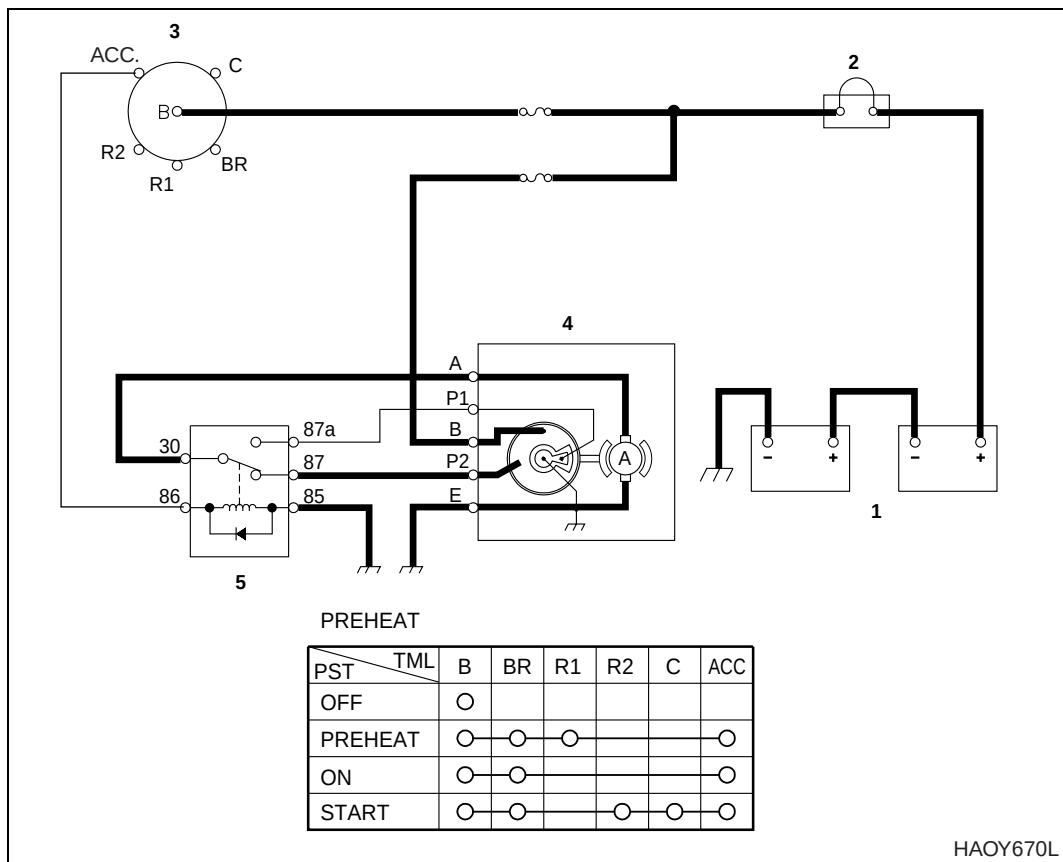


Figure 5 ENGINE STOP CIRCUIT - RUNNING MODE

Reference Number	Description
1	Battery
2	Fusible Link
3	Start Switch

Reference Number	Description
4	Engine Stop Motor
5	Engine Stop Relay

When the start switch is in the 'ON' position, the internal components of the engine stop motor's cam switch is in the position shown.

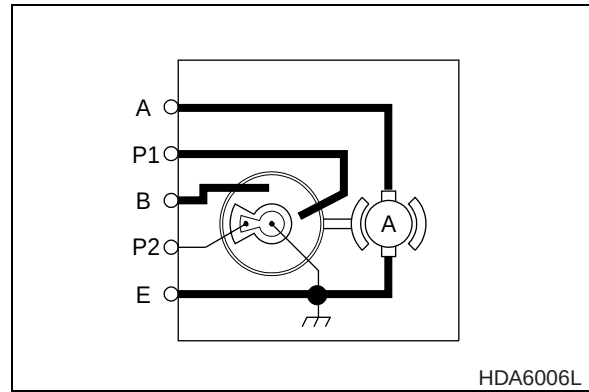


Figure 6

Operation In Engine Stop Mode

When the start 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 (4) → 'P1' terminal of engine stop motor (4) → '87a' terminal of engine stop relay (5) → '30' terminal of engine stop relay (5) → 'A' terminal of engine stop motor (4) → 'E' terminal of engine stop motor (4) → 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.

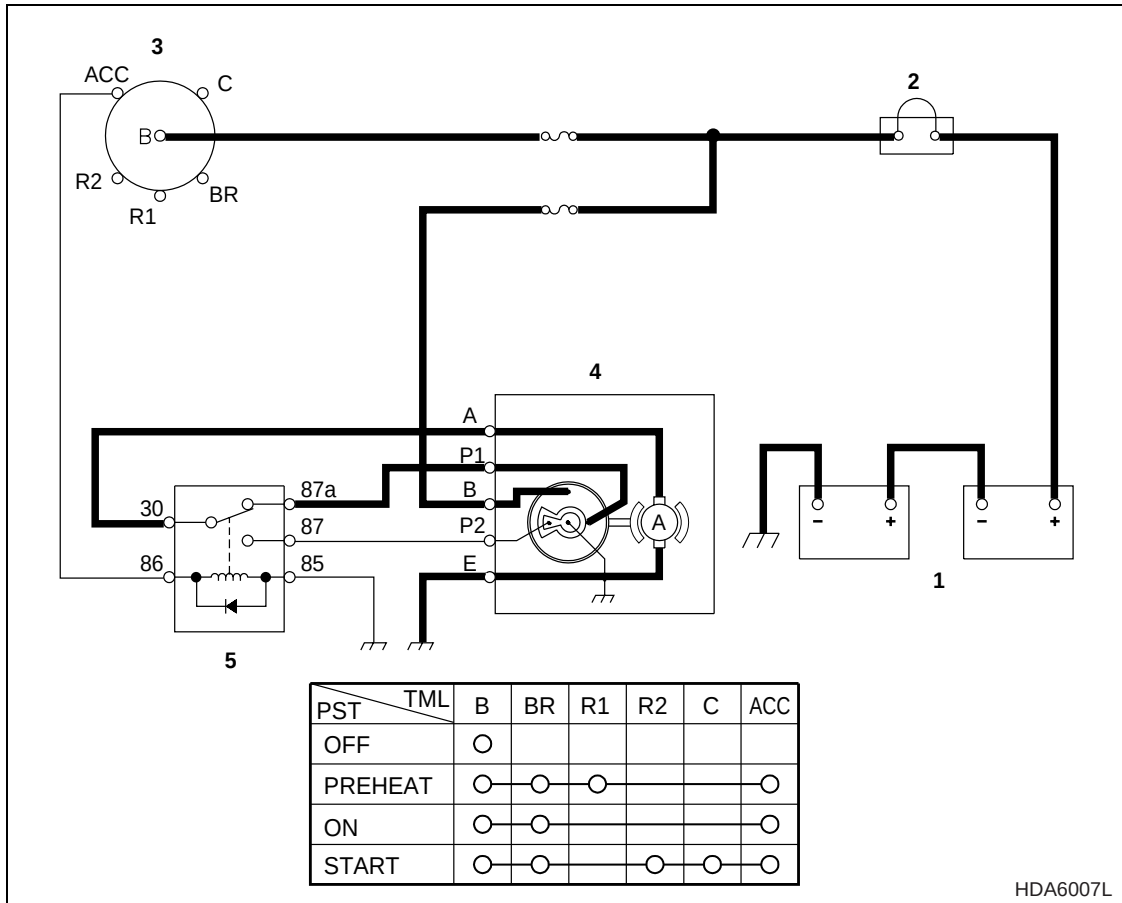


Figure 7 ENGINE STOP CIRCUIT - STOP MODE

Reference Number	Description
1	Battery
2	Fusible Link
3	Start Switch

Reference Number	Description
4	Engine Stop Motor
5	Engine Stop Relay

When the start switch is in the 'OFF' position, the internal components of the engine stop motor's cam switch is in the position shown.

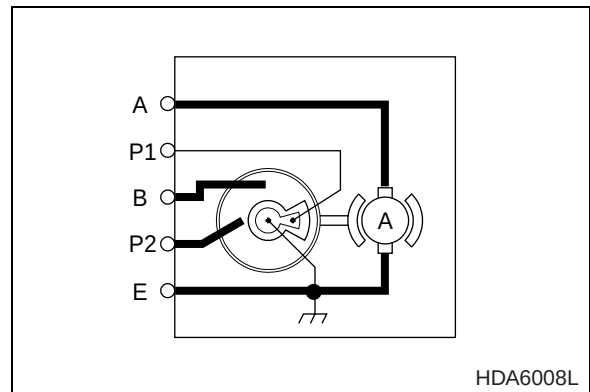


Figure 8

CHARGING SYSTEM

When the start switch (3) is turned to the 'ON' position, an initial excited current flows to the field coil of the alternator (5) through the battery relay (2) and circuit breaker (4). When the engine is started from this condition the alternator (5) starts charging. The current flows from the 'B+' terminal of alternator (5) → circuit breaker (4) → battery relay (2) → battery (1).

The alternator also supplies electric current to other electrical components. When the alternator (5) starts to operate, a current flows from the 'I (D+)' terminal of alternator → diode (6) → 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.

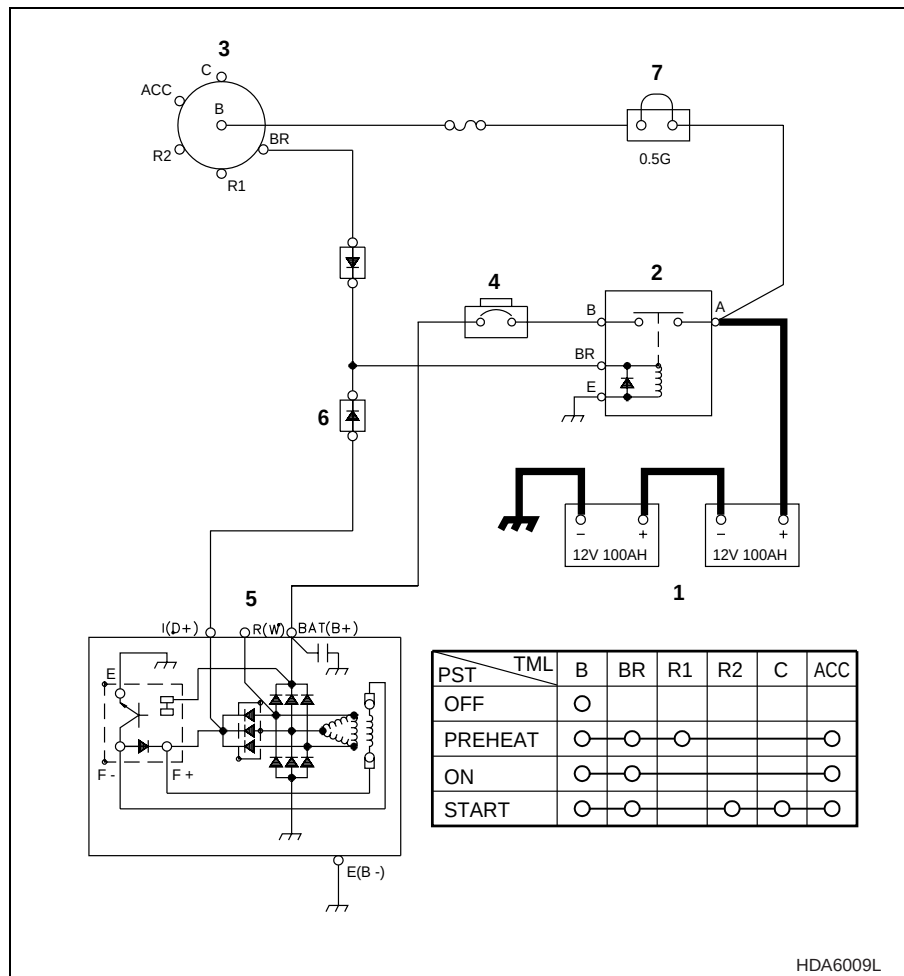


Figure 9 CHARGING CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Start Switch
4	Circuit Breaker

Reference Number	Description
5	Alternator
6	Diode
7	Fusible Link

MONITORING SYSTEM

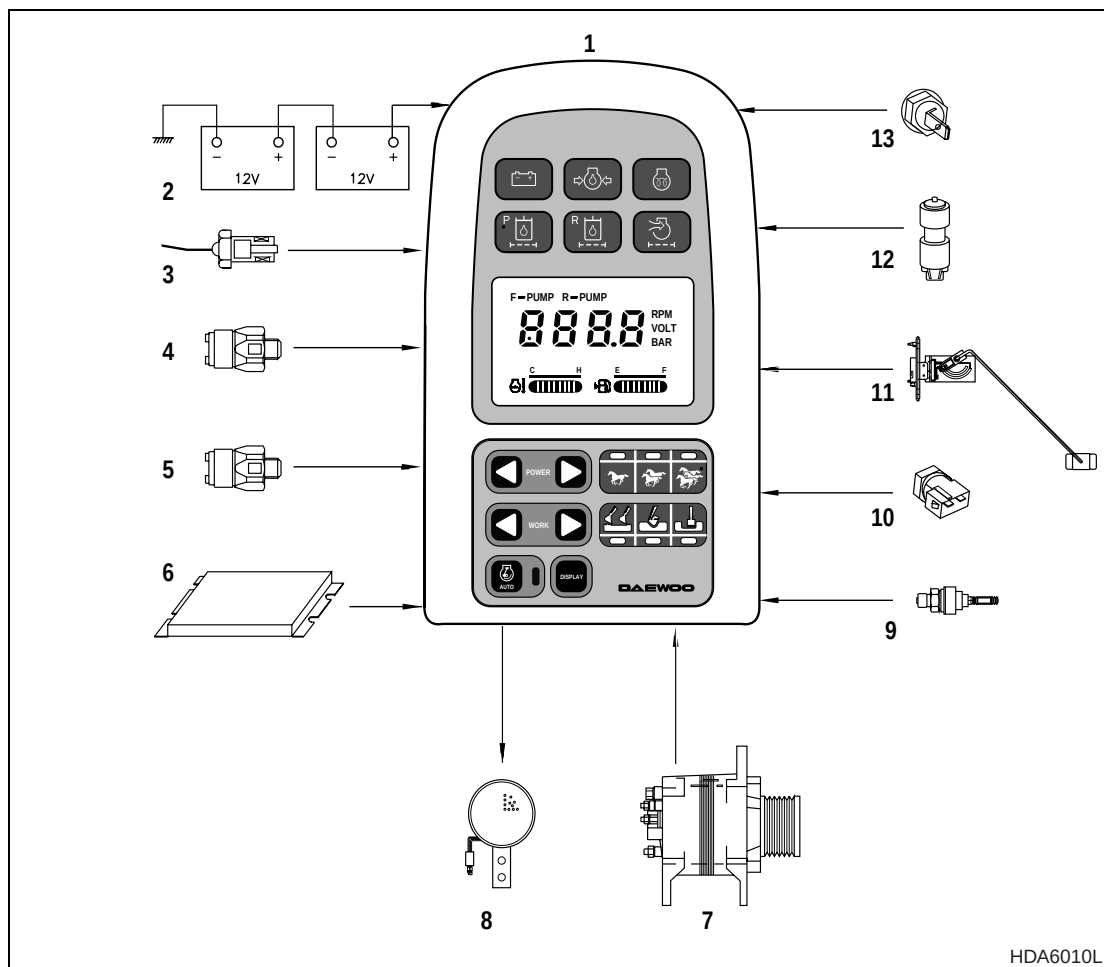


Figure 10

Reference Number	Description
1	Instrument Panel
2	Battery
3	Engine Speed Sensor
4	Return Filter Switch
5	Pilot Filter Switch
6	EPOS-V Controller
7	Alternator

Reference Number	Description
8	Warning Buzzer
9	Pump Discharge Pressure Sensor
10	Engine Coolant Temperature Sensor
11	Fuel Sensor
12	Air Cleaner Indicator
13	Engine Oil Pressure Switch

The monitoring system displays the various data and warning signals onto the instrument panel by processing the information gathered from the various sensors throughout the equipment.

The operator can select the information to be displayed on the instrument panel.

INSTRUMENT PANEL AND STEERING CONSOLE

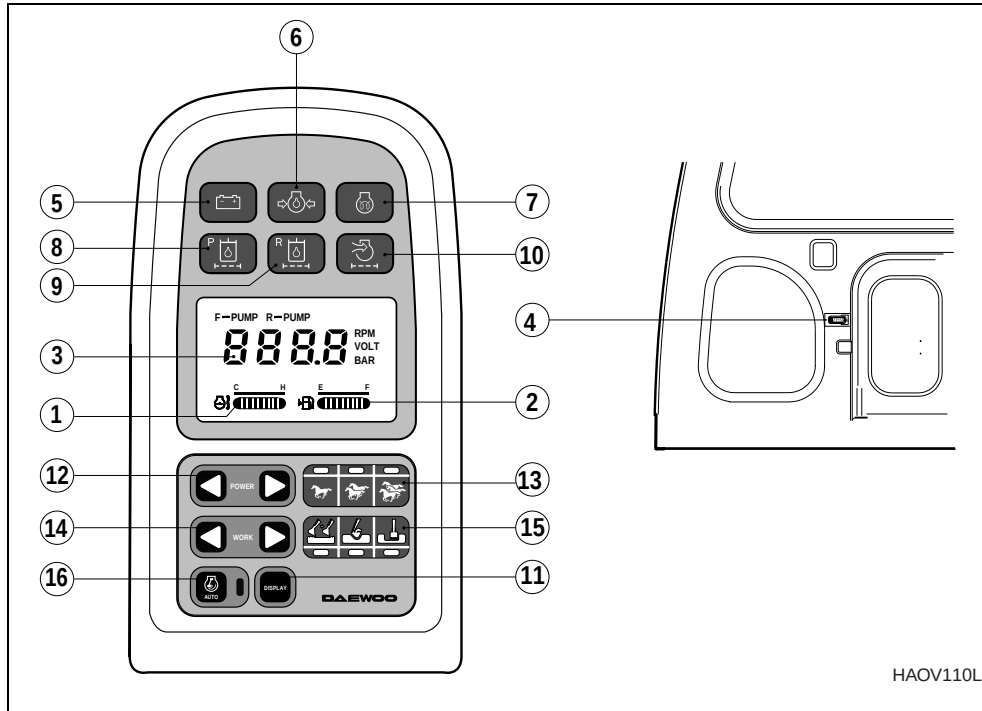


Figure 11

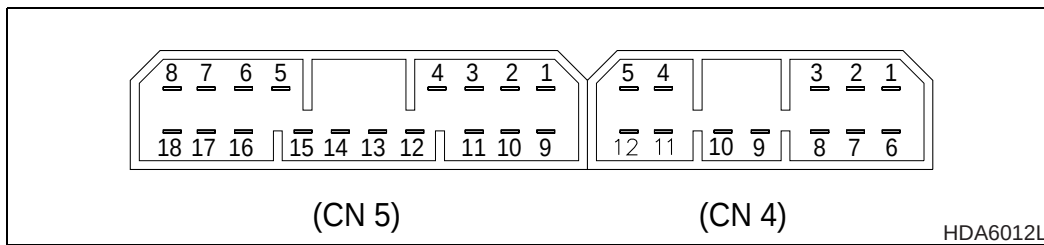


Figure 12 AMP 070 SERIES CAP HOUSING - CONNECTOR AND TERMINAL NUMBERS

Reference Number	Description
1	Coolant Temperature Gauge
2	Fuel Gauge
3	Multi-function Display
4	Hourmeter
5	Charging Warning Lamp
6	Engine Oil Pressure Warning Lamp
7	Preheat Completion Lamp
8	Pilot Filter Clogging Warning Lamp
9	Return Filter Clogging Warning Lamp

Reference Number	Description
10	Air Cleaner Clogging Warning Lamp
11	Multi-function Display Control Switch
12	Power Mode Selection Switch
13	Power Mode Lamp
14	Work Mode Selection Switch
15	Work Mode Lamp
16	Auto Idle Switch And Lamp

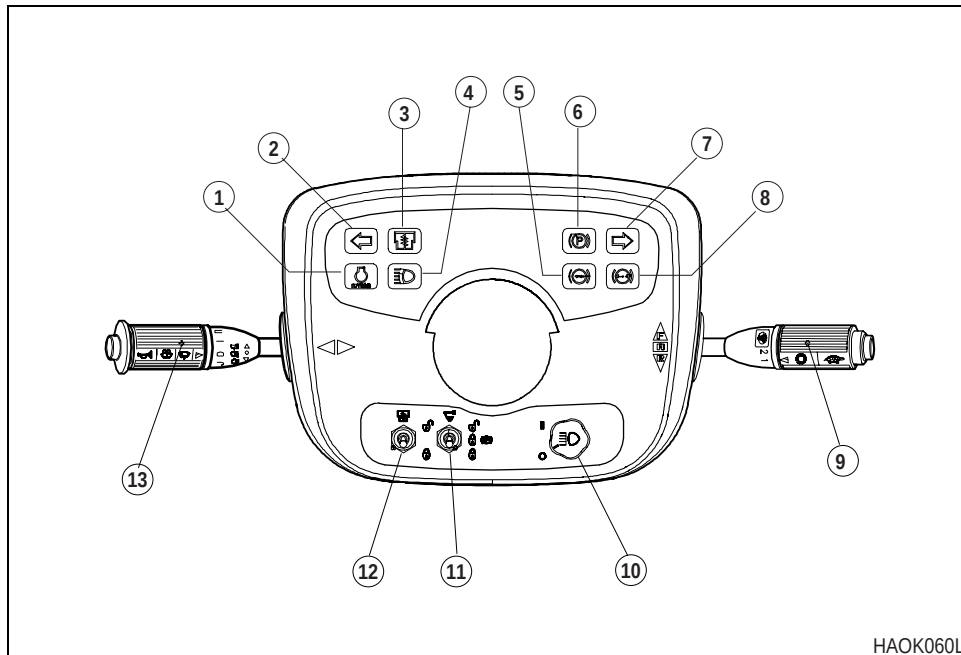


Figure 13

Reference Number	Description
1	Abnormal Engine Speed Warning Light
2	Directional / Hazard Indicator Light
3	Ram Lock Indicator Light
4	High Beam Indicator Light
5	Brake Fluid Pressure Warning Light
6	Parking Brake Indicator Light
7	Directional / Hazard Indicator Light

Reference Number	Description
8	Brake Filter Clogged Warning Light
9	Right Side Combination Switch
10	Headlight Switch
11	Work, Park, Travel Select Switch
12	Ram Switch
13	Left Side Combination Switch

INSTRUMENT PANEL AND STEERING CONSOLE FUNCTION CHECK

When the start switch is turned to the "ON" position, all displays, switch lamps and warning lamps will be lit for two seconds and the warning buzzer will sound. Any lamps which do not light up during the function check should be replaced.

MONITORING SYSTEM SCHEMATIC

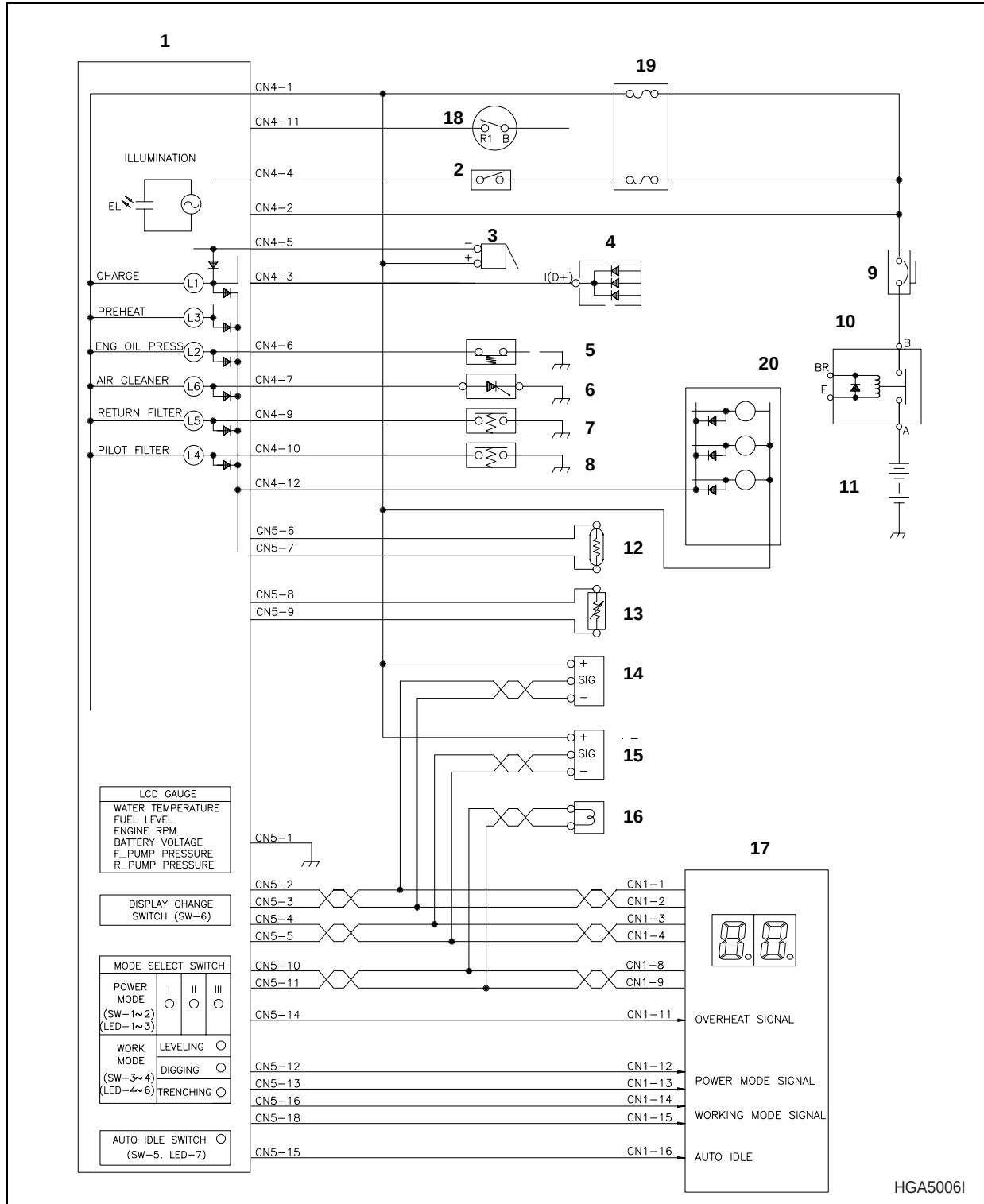


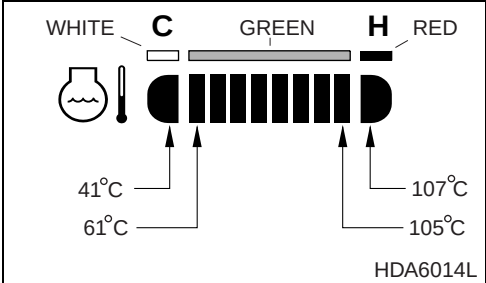
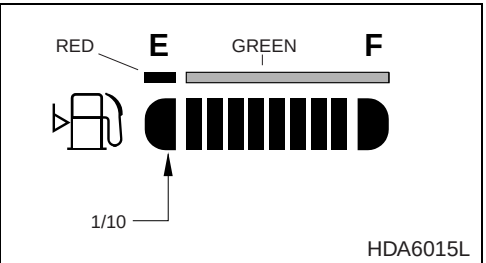
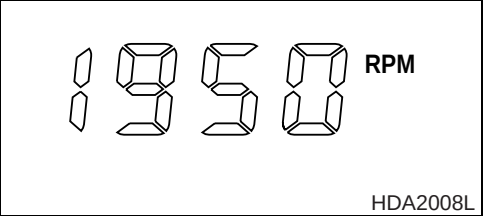
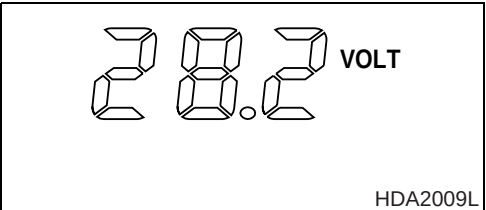
Figure 14

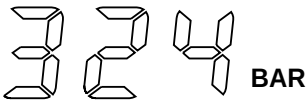
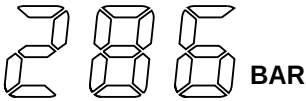
Reference Number	Description
1	Instrument Panel
2	Head Lamp Switch
3	Warning Buzzer
4	Alternator
5	Engine Oil Pressure Switch
6	Air Cleaner Indicator
7	Return Filter Switch
8	Pilot Filter Switch
9	Circuit Breaker
10	Battery Relay
11	Battery

Reference Number	Description
12	Coolant Temperature Sensor
13	Fuel Level Sensor
14	Pump Discharge Pressure Sensor (Front Pump)
15	Pump Discharge Pressure Sensor (Rear Pump)
16	Engine Speed Sensor
17	EPOS-V Controller
18	Start Switch
19	Fuse Box
20	Console

OPERATION

INSTRUMENTS

Function	Displa	Sensor Specification	
		Input Terminal	Input Specification
Engine Coolant Temperature		CN5-6 CN5-7	41°C → 1,372 ohms 61°C → 855 ohms 102°C → 160 ohms 105°C → 147 ohms 107°C → 128 ohms
Fuel Level Gauge		CN5-8 CN5-9	1/10 LCD Blinking → over 5K ohms FULL → under 525 ohms
Tachometer		CN5-10 CN5-11	$N = 60/129 \times F$ N = Engine speed (RPM) F = Frequency of engine speed sensor (Hz) Open the cover of the rear panel and adjust the dip switch to the given value for this particular model.
Voltmeter		CN4-2	0 - 32 VDC

Function	Displa	Sensor Specification	
		Input Terminal	Input Specification
Main pump discharge pressure (front pump)	F – PUMP  HDA2010I	CN5-2 CN5-3	Sensor output voltage (volts) = 0.00816 x pressure (bar) + 1
Main pump discharge pressure (rear pump)	R – PUMP  HDA2011L	CN5-4 CN5-5	Sensor output voltage (volts) = 0.00816 x pressure (bar) + 1

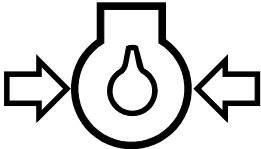
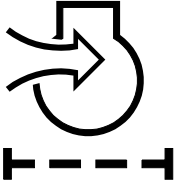
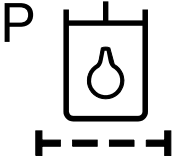
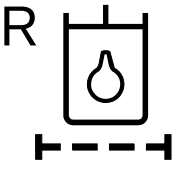
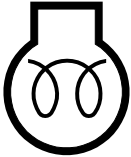
MODE SELECT SWITCH

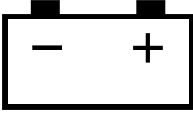
Function	Operation			
	Mode Selection	Output (Terminal)		Operating Mode LED display
		(CN5-12)	(CN5-13)	
Mode Select Switch	Power Mode I	10 - 12 V	0 V	Selected Mode LED lit
	Power Mode II	0 V	0 V	
	Power Mode III	0 V	10 - 12 V	

Function	Operation				
	Mode Selection	DIP SW (No. 4)	Output (Terminal)		Operating Mode LED display
			(CN5-16)	(CN5-18)	
Mode Select Switch	Leveling Mode Switch		10 - 12 V	10 - 12 V	Selected Mode LED lit
	Digging Mode Switch	ON	0 V	10 - 12 V	
	Trenching Mode Switch		10 - 12 V	0 V	

Function	Operation			
	Input (Switch)	Condition	Output (Terminal)	Operating Mode LED display
			(CN5 - 15)	
Auto Idle Select Switch	Auto Idle Toggle Switch	ON	12 V	LED lights in High Output Mode
		OFF	0 V	

PILOT LAMP

Symbol	Description	Input Terminal	Operation	Remarks
 HAOH240L	Engine Oil Pressure	CN4 - 6	Lights up when oil pressure drops below 0.3 kg/cm ² .	After starting engine, if engine oil pressure is insufficient after 8 seconds, a warning buzzer will sound.
 HAOH250L	Air Cleaner	CN4 - 7	Lights up when air cleaner is clogged	
 HAOH260L	Pilot Filter	CN4 - 10	Lights up when pressure increases over 1kg/cm ² .	
 HAOH270L	Return Filter	CN4 - 9	Lights up when pressure increases over 1kg/cm ² .	
 HAOH280L	Preheat	CN4 - 11	Lights up when preheat process is completed. (Approximately 3.5 seconds from start.)	

Symbol	Description	Input Terminal	Operation	Remarks
 HAOH290L	Charge	CN4 - 3	Lights up when not charging and I (D+) terminal output drops below 24V.	Under normal conditions, will light up before engine start up and shut off once engine is running.

INITIAL OPERATION

Item	Input (Terminal)	Output (Operation and initial setting mode)
Initial Operation	When battery voltage is input to CN4 - 1 (start switch is turned from 'OFF' to 'ON' position).	- All LCD, LED and warning lamps are turned on and turned off after 2 ± 0.2 seconds. - Warning buzzer is activated and turned off after 2 ± 0.2 seconds. - Power mode: Power Mode II - Work Mode: Digging Mode I (Domestic models), Digging Mode II (Export models) * (Can be selected by adjusting DIP Switches behind panel) - Auto Idle: High Output - Multi-function numerical display: Engine RPM

ELECTRONIC HYDRAULIC CONTROL SYSTEM (EPOS - V)

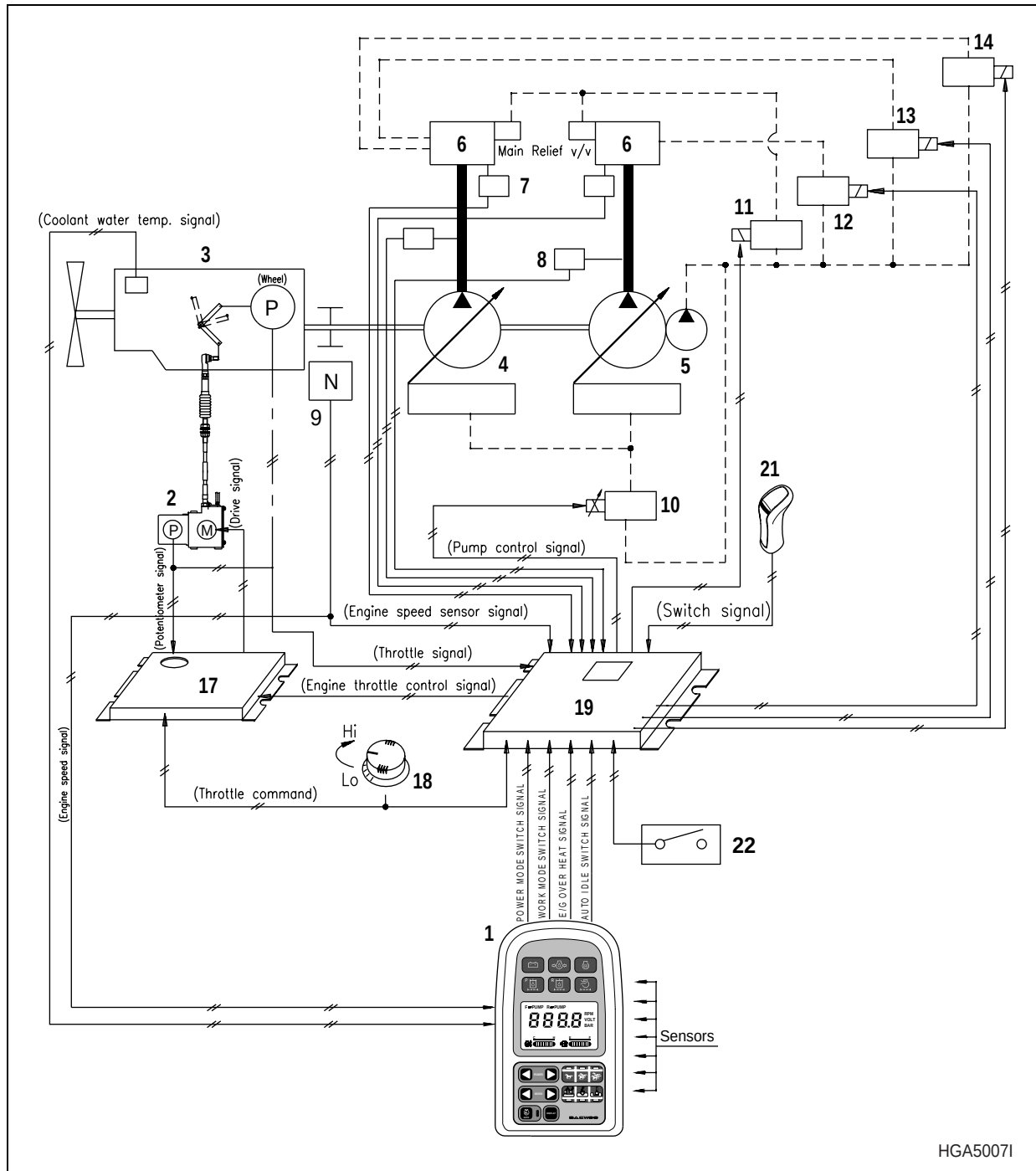


Figure 15 EPOS V CONTROL SYSTEM

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)
11	Solenoid Valve (For 2 Stage Relief Valve)

Reference Number	Description
12	Solenoid Valve (Control Valve Control)
13	
14	
15	Solenoid Valve (Travel II - Speed)
16	Travel Motor
17	Engine Throttle Control
18	Engine Speed Control Dial
19	EPOS - V Controller
20	-----
21	Power Max Switch (Right Work Lever)
22	Work/Travel Section Switch

POWER MODE CONTROL

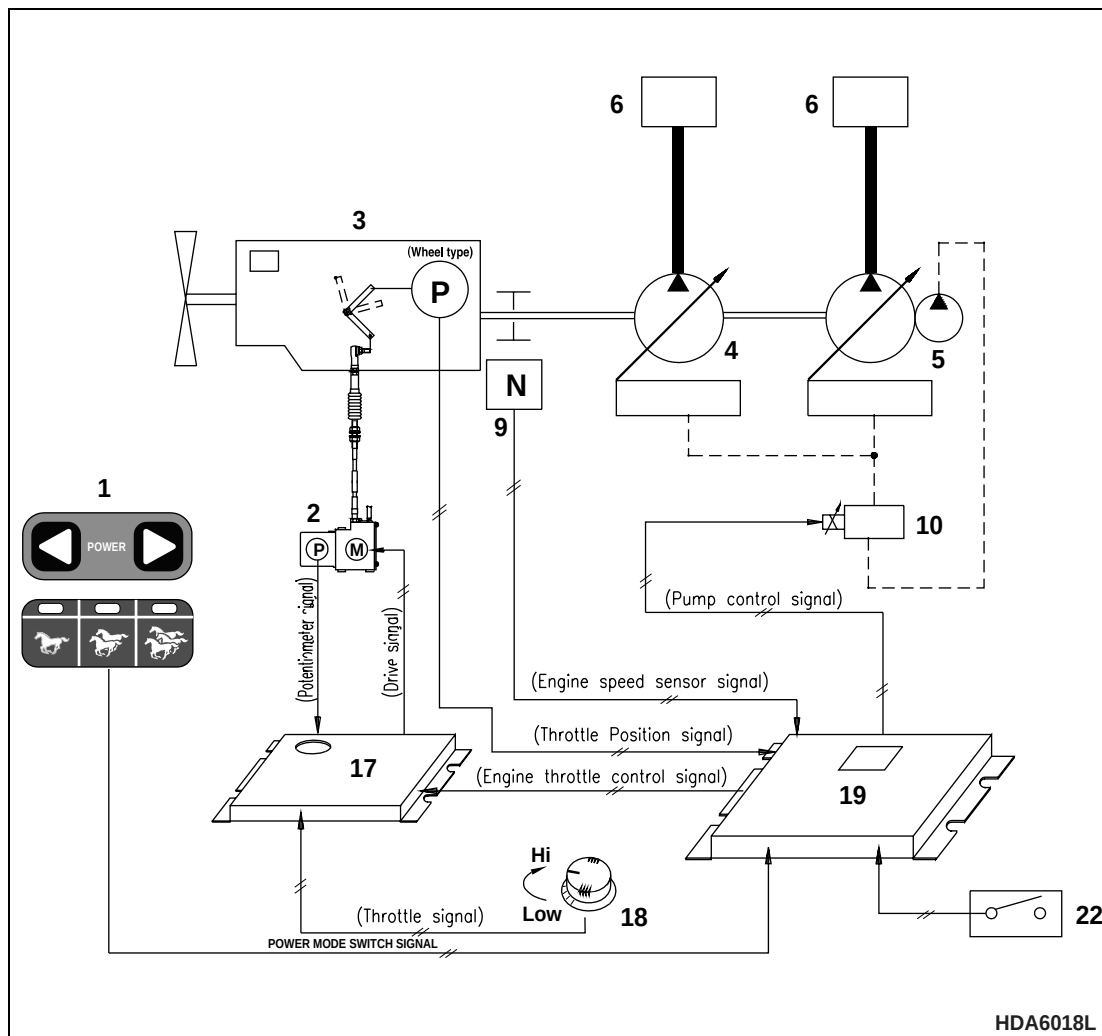


Figure 16

Reference Number	Description
1	Instrument Panel (Power Mode Selection Switch)
2	Engine Control Motor
3	Engine
4	Main Pump
5	Control Pump
6	Control Valve

Reference Number	Description
9	Engine Speed Sensor
10	E.P.P.R. Valve
17	Engine Throttle Controller
18	Engine Speed Control Dial
19	EPOS - V Controller
22	Work / Travel Selection Switch (WheelType)

The power mode switch permits the selection of the appropriate engine power depending on the working condition. One of the three, Power Mode I, II or III, settings can be selected. The initial setting at engine start-up is Power Mode II. The desired mode can be selected by pressing the select button on the instrument panel. The indicator lamp will light up 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 power mode is determined by the maximum engine speed and is listed in the following table.

Mode	Power Mode I	Power Mode II	Power Mode III
Output (%)	Approximately 68%	Approximately 80%	100%

OPERATION

1. Power Mode III

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 EPOS - V controller compares the target engine speed with the actual engine speed and controls the signal to the EPP.R. (Electric Proportional Pressure Reducing) valve which in turn varies the pump output quantity.

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 III, 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.

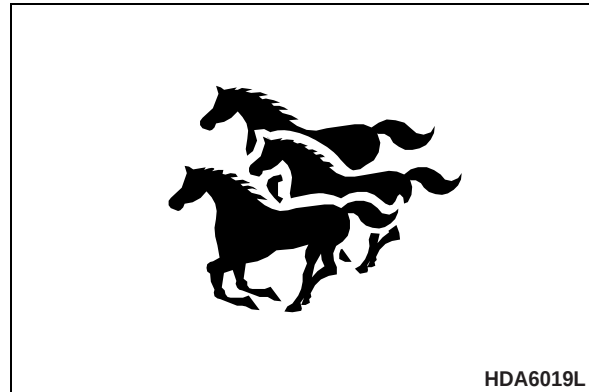


Figure 17

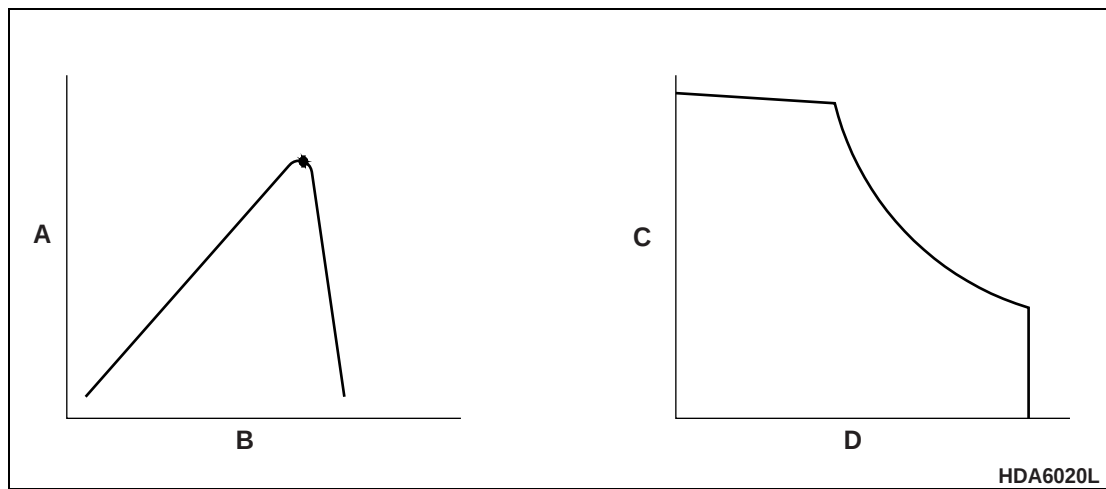


Figure 18

Reference Number	Description
A	Engine Horsepower (HP)
B	Engine Speed (RPM)
C	Pump Discharge Volume (liters/min)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm ²)

2. Power Mode II

Power Mode II is used for general work. When this mode is selected it will reduce noise and fuel consumption in comparison with Power Mode III. The current to the E.P.R. valve is shut off and when the engine speed control dial is set to the highest position the engine speed is set to 150 RPM less than the maximum speed.

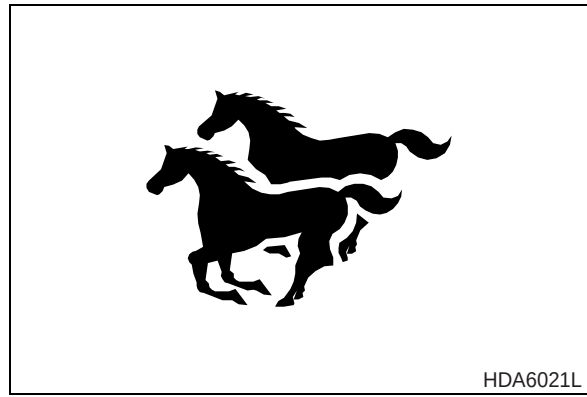


Figure 19

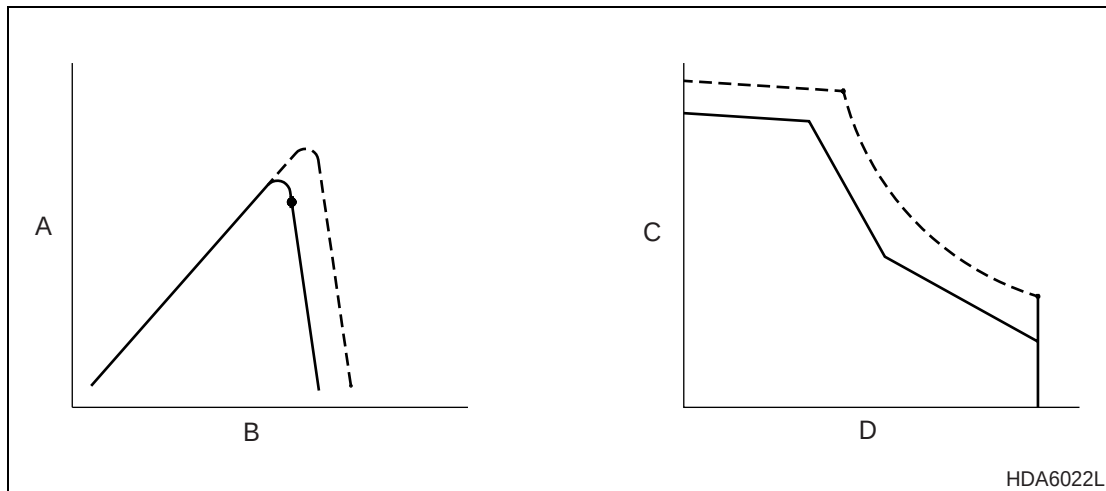


Figure 20

Reference Number	Description
A	Engine Horsepower (HP)
B	Engine Speed (RPM)
C	Pump Discharge Volume (liters/min)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm ²)

3. Power Mode I

Power Mode I is used for light work which does not require high speed operation. This mode is ideal for precise minute work. The noise and fuel consumption is lower than Power Mode II.

The current to the EP.P.R. valve controlling the pump discharge volume is shut off. If the engine speed control dial is set to the highest position, the engine speed is reduced to approximately 80% of the maximum speed.

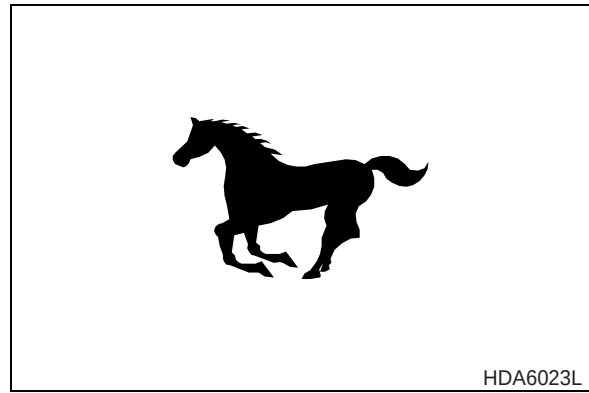


Figure 21

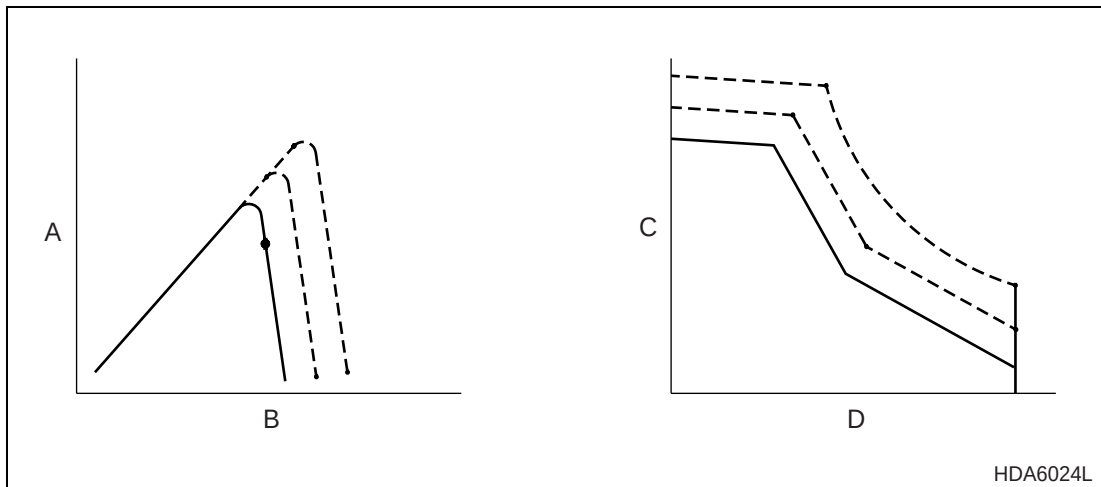


Figure 22

Reference Number	Description
A	Engine Horsepower (HP)
B	Engine Speed (RPM)
C	Pump Discharge Volume (liters/min)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm ²)

THROTTLE POSITION SENSOR

As sensor that senses the engine fuel levers position (angle), in case of selecting III speed mode, by informing the position of fuel lever to EPOS-V controller. it will act a role to determine the rated engine RPM in the sensing control of rotation.

As shown in the graph below, in case that the fuel lever changes from low to high speed, the output voltage between No.2 terminal and No.3 terminal will change from 3.75V to 1.0V.

NOTE: *If the throttle position sensor is not adjusted properly, since the performance of the equipment may not be displayed or overloaded at the work, the accurate adjustment is required.*

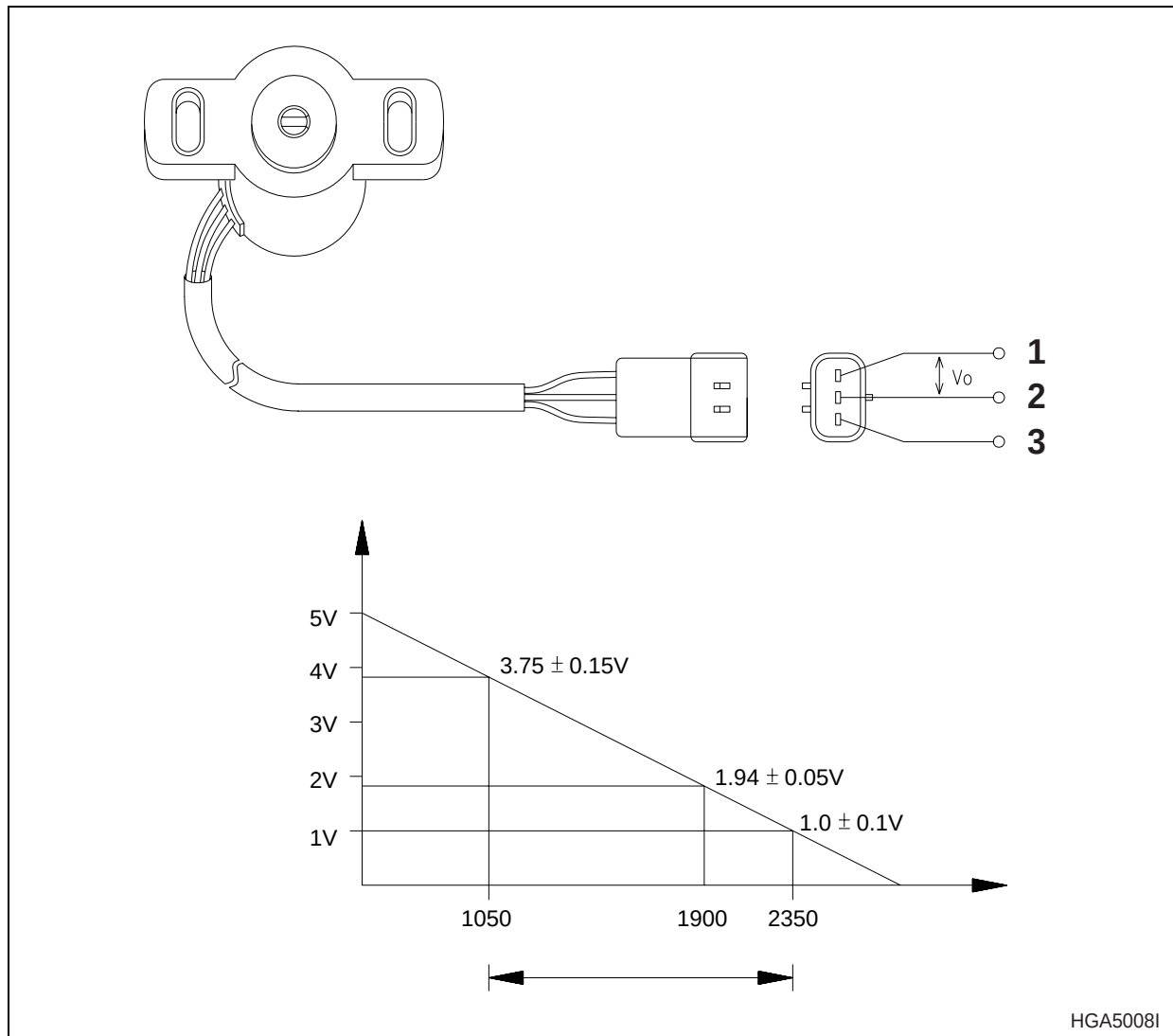


Figure 23

Reference Number	Description
1	Ground (-)
2	Output

Reference Number	Description
3	5V Input (+)

POWER MODE CONTROL - CIRCUIT DIAGRAM

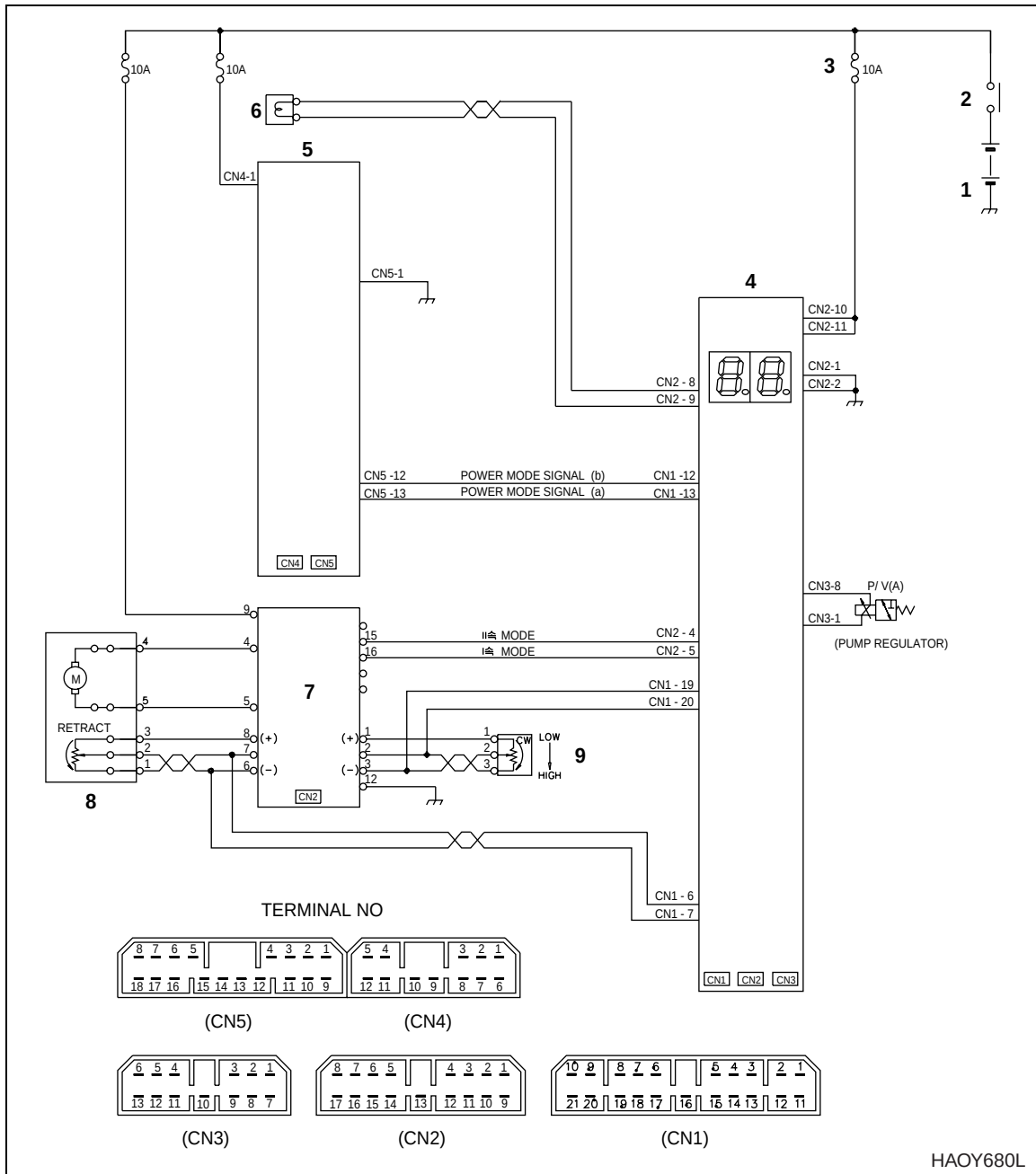


Figure 24

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	EPOS - V Controller
5	Instrument Panel

Reference Number	Description
6	Engine Speed Sensor
7	Engine Throttle Controller
8	Engine Control Motor
9	Engine Speed Control Dial

WORK MODE CONTROL

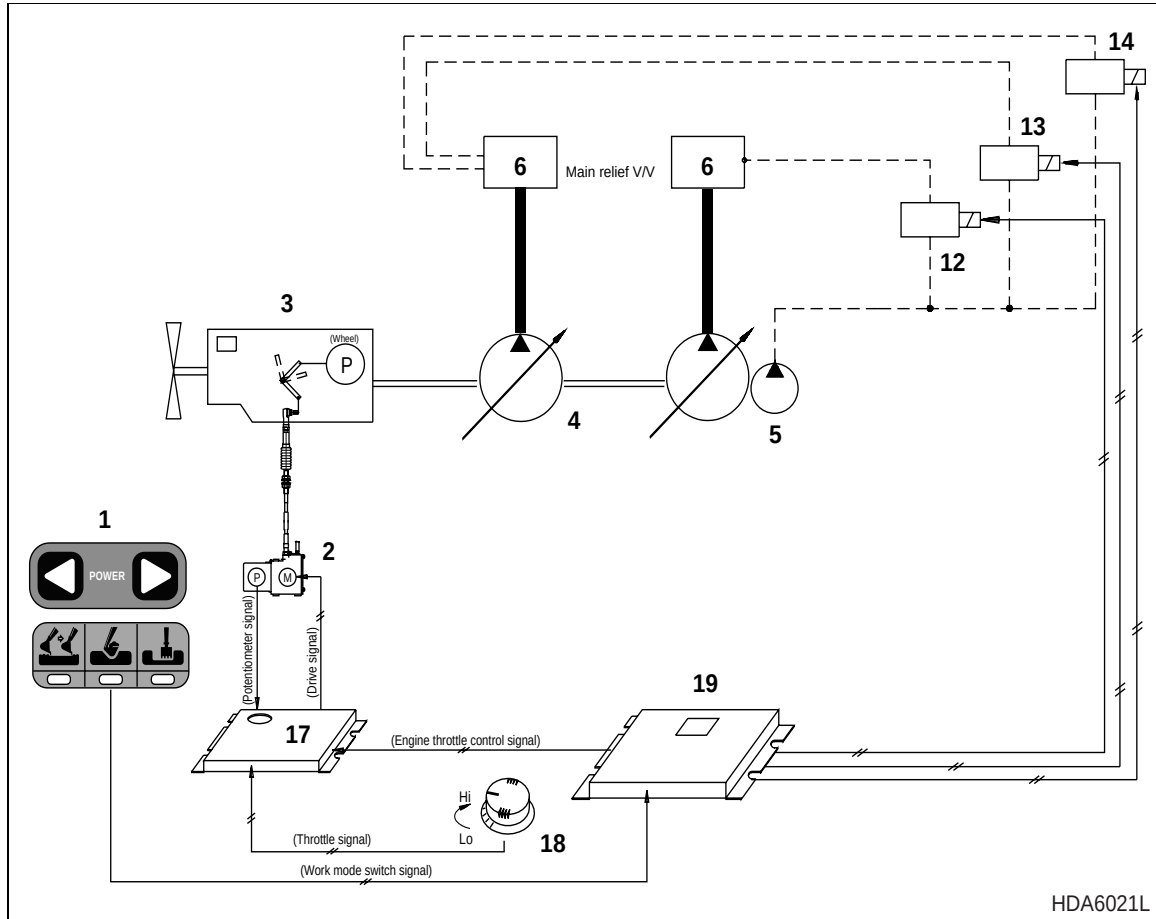


Figure 25

Reference Number	Description
1	Instrument Panel (Work Mode Select Switch)
2	Engine Control Motor
3	Engine
4	Main Pump
5	Control Pump
6	Control Valve
12	Solenoid Valve (Swing Priority Control)

Reference Number	Description
13	Solenoid Valve (Arm Priority Control)
14	Solenoid Valve (Arm Regeneration Control)
17	Engine Throttle Control
18	Engine Speed Control Dial
19	EPOS - V Controller

One of three work modes, leveling, digging and trenching, can be selected from the select switch on the instrument panel.

The initial setting at the time of engine start-up is digging mode.

Depending on the work mode selected, the control valve solenoid adjusts the assignment of hydraulic oil flow to each device on the equipment.

OPERATION

1. Leveling Mode

This mode is used for precise ground leveling work. Among the three control valve solenoids, the current is switched to the arm regeneration valve. As a result the oil pressure which operates the arm regeneration valve and the arm two speed spool of the control valve is shut off, reducing the arm speed and giving increased arm control.

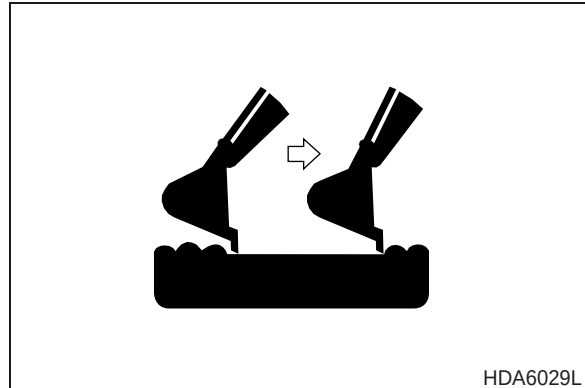


Figure 26

2. Digging Mode

This mode is used for general digging work, loading work and ground leveling work requiring quick stops. Among the three control valve solenoids, the voltage is assigned to the arm priority control valve and becomes operational. When the arm priority control valve is selected the oil pressure activates the arm priority valve and a path is made to the two speed spool.



Figure 27

3. Trenching Mode

This mode is used for heavy duty ditch digging work or for loading work requiring big swing angles. Among the three control valve solenoids, 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.

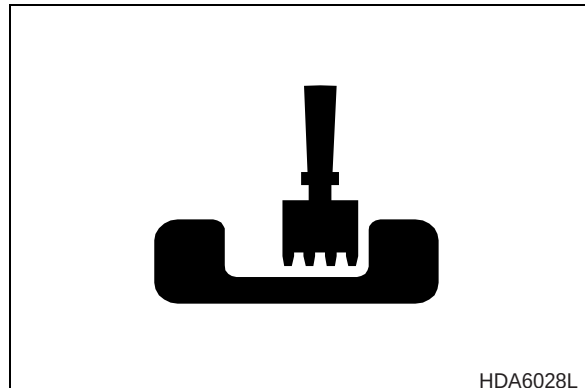
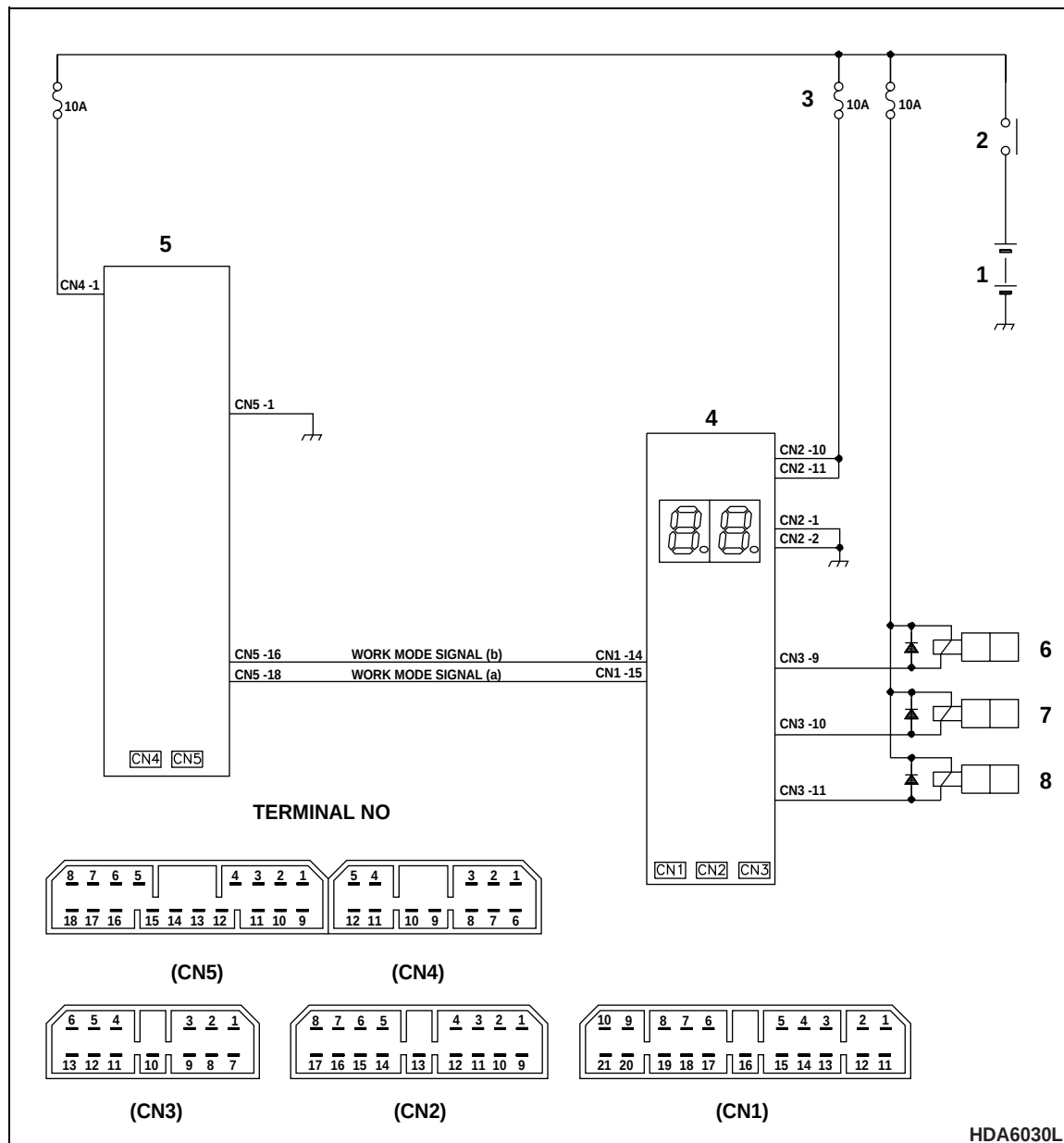


Figure 28

WORK MODE CONTROL - CIRCUIT DIAGRAM



Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	Epos-v Controller
5	Instrument Panel

Reference Number	Description
6	Solenoid Valve (Swing Priority Control)
7	Solenoid Valve (Arm Regeneration Control)
8	Solenoid Valve (Arm Priority Control)

ENGINE CONTROL SYSTEM

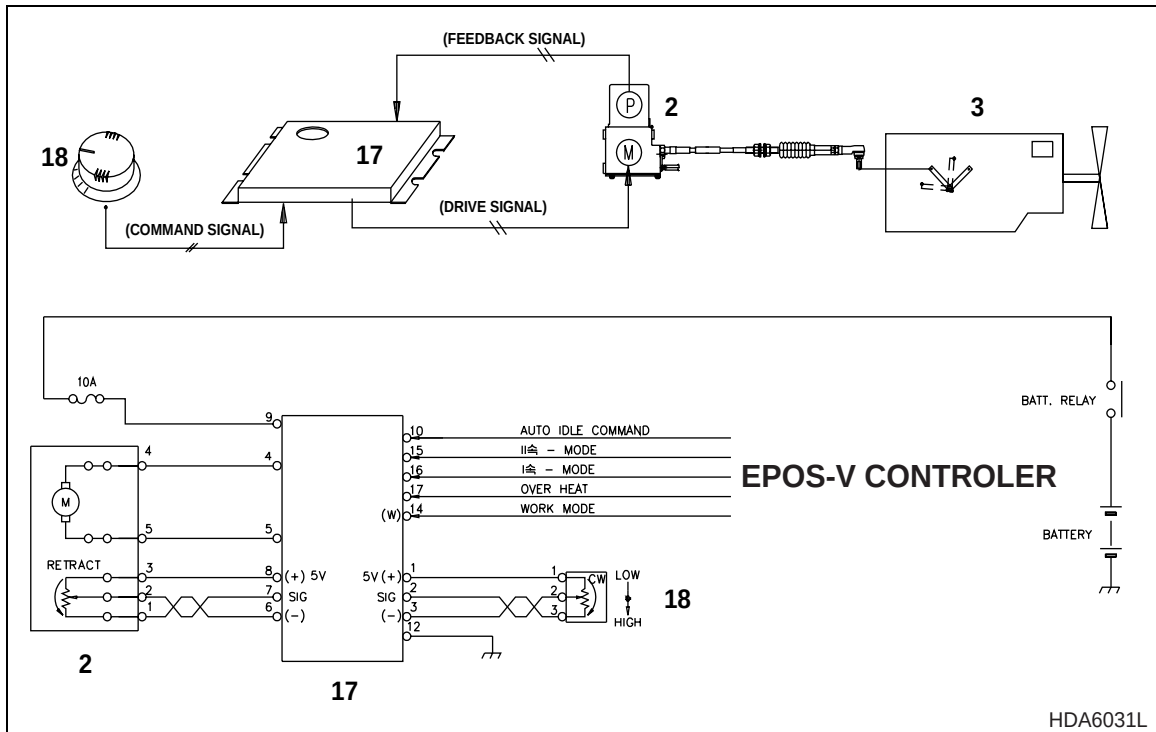


Figure 30

Reference Number	Description
2	Engine Control Motor
3	Engine

Reference Number	Description
17	Engine Throttle Controller
18	Engine Speed Control Dial

When the engine speed 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 control dial with the feedback signal from the throttle position sensor built in to the engine control motor and drives the motor to the position set by the engine speed 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

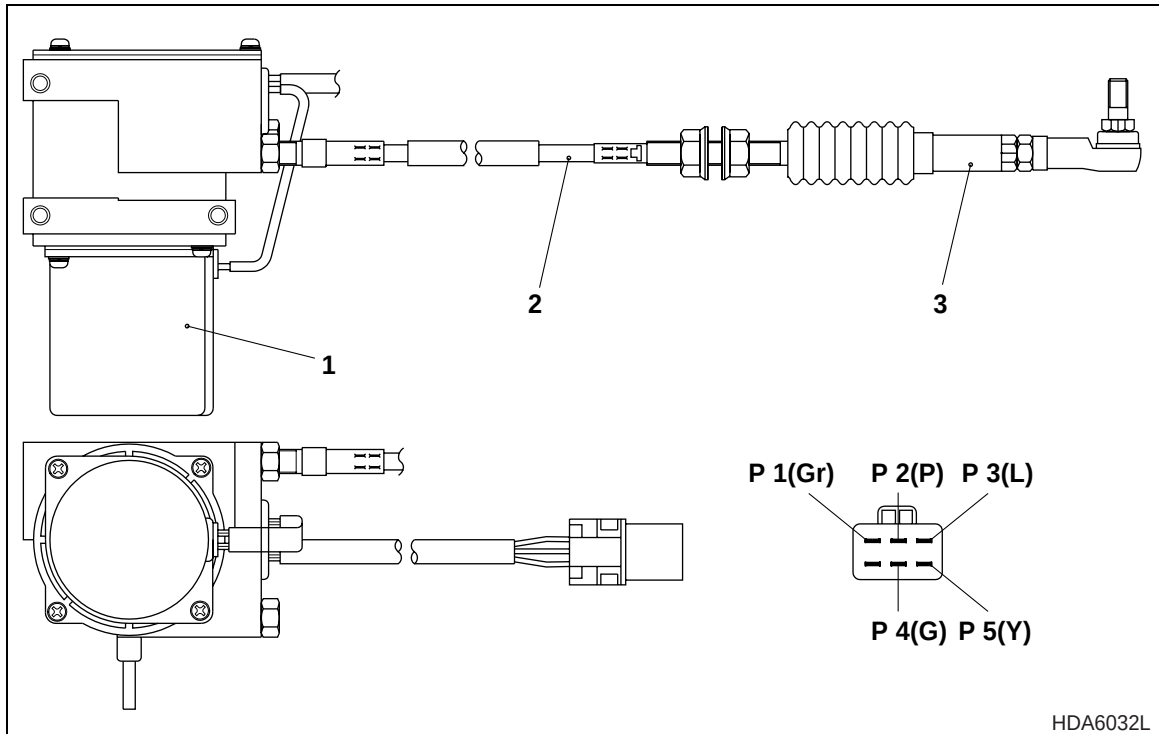


Figure 31 HDM6032L

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 speed control dial is moved.

The start switch should be turned off and the cause of abnormal load should be repaired and the start switch can be turned on again. The engine speed 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 SPEED CONTROL DIAL

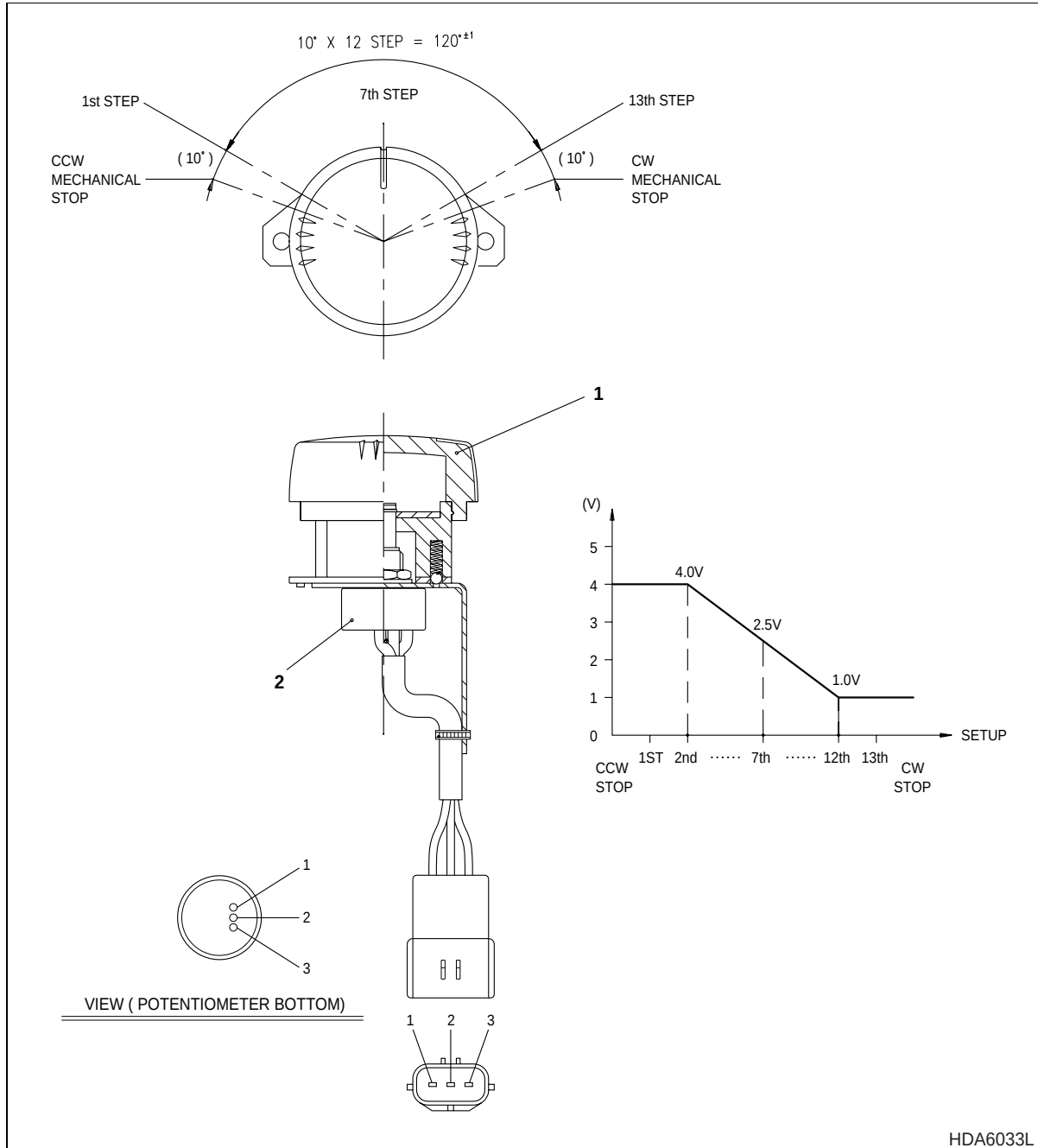


Figure 32

Reference Number	Description
1	Knob
2	Potentiometer (Variable Resistor)

The engine speed 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

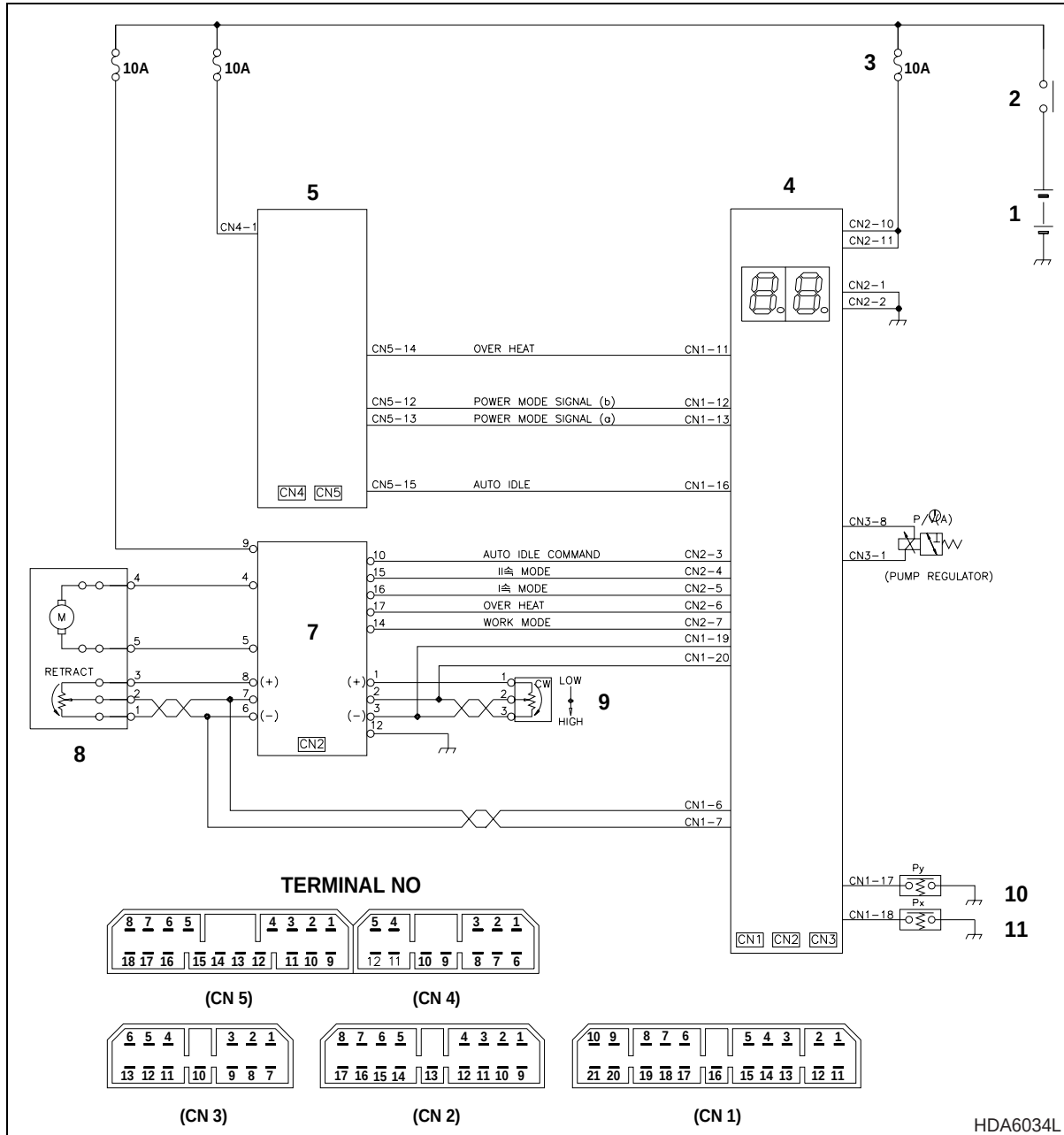


Figure 33

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

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

AUTOMATIC DECELERATION CONTROL (AUTO IDLE CONTROL)

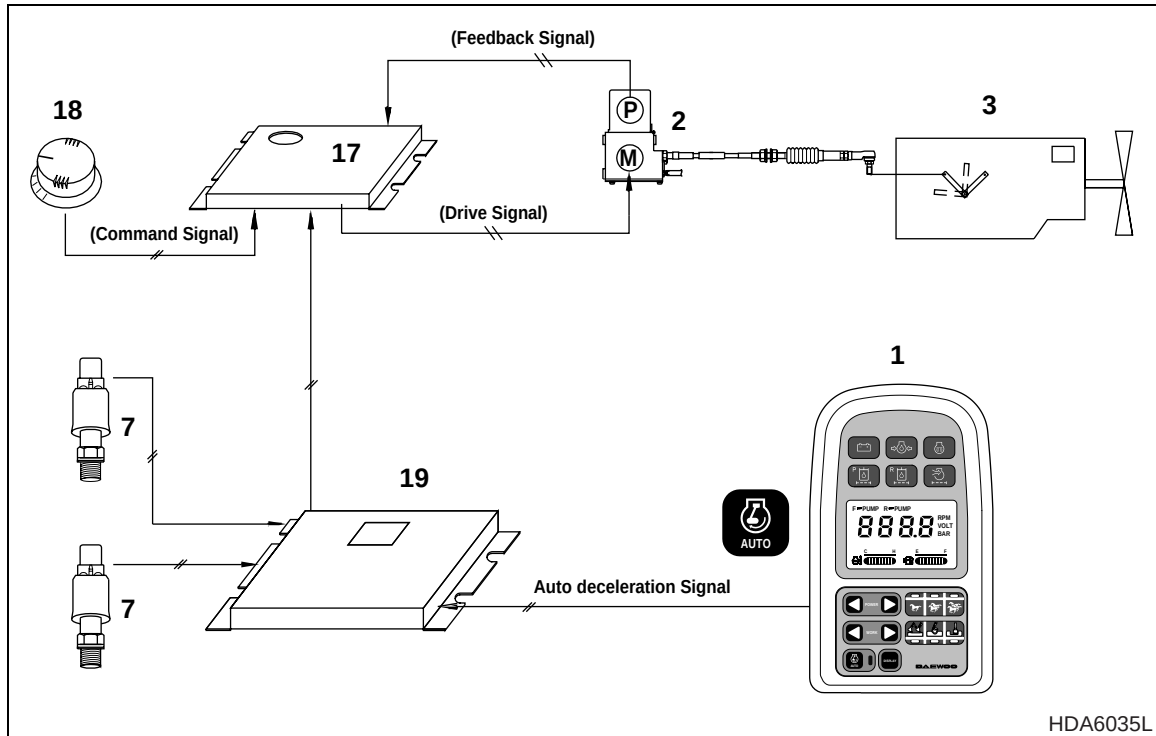


Figure 34

Reference Number	Description
1	Instrument Panel
2	Engine Control Motor
3	Engine
7	Pressure Switch

Reference Number	Description
17	Engine Throttle Controller
18	Engine Speed Control Dial
19	EPOS - V 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 located 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 EPOS - V controller sends an automatic reduction signal to the throttle controller. When the engine controller receives this signal, it is compared with the signal set by the engine speed 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 located in the control valve. When the work levers are in the neutral position, the switch is in the off position.

The preset automatic deceleration engine speed is 1400 RPM.

ENGINE OVERHEAT PROTECTION SYSTEM

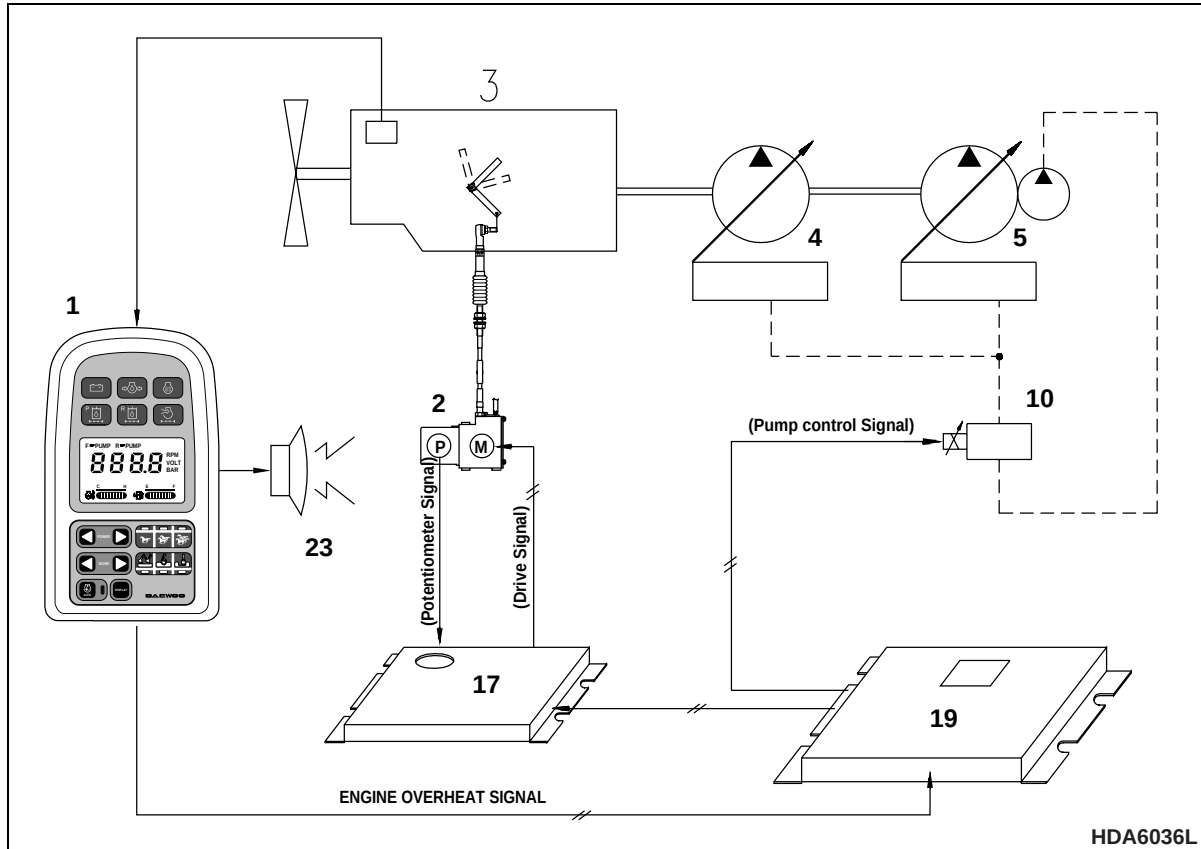


Figure 35

Reference Number	Description
1	Instrument Panel
2	Engine Control Motor
3	Engine
4	Main
5	Control Pump

Reference Number	Description
10	E.P.R. Valv
17	Engine Throttle Controller
19	EPOS - V Controller
23	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 EPOS - V controller and the overheat warning buzzer will sound. The EPOS - V controller will send a signal to the engine throttle controller and the engine speed is adjusted to power mode II. 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, power mode II 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

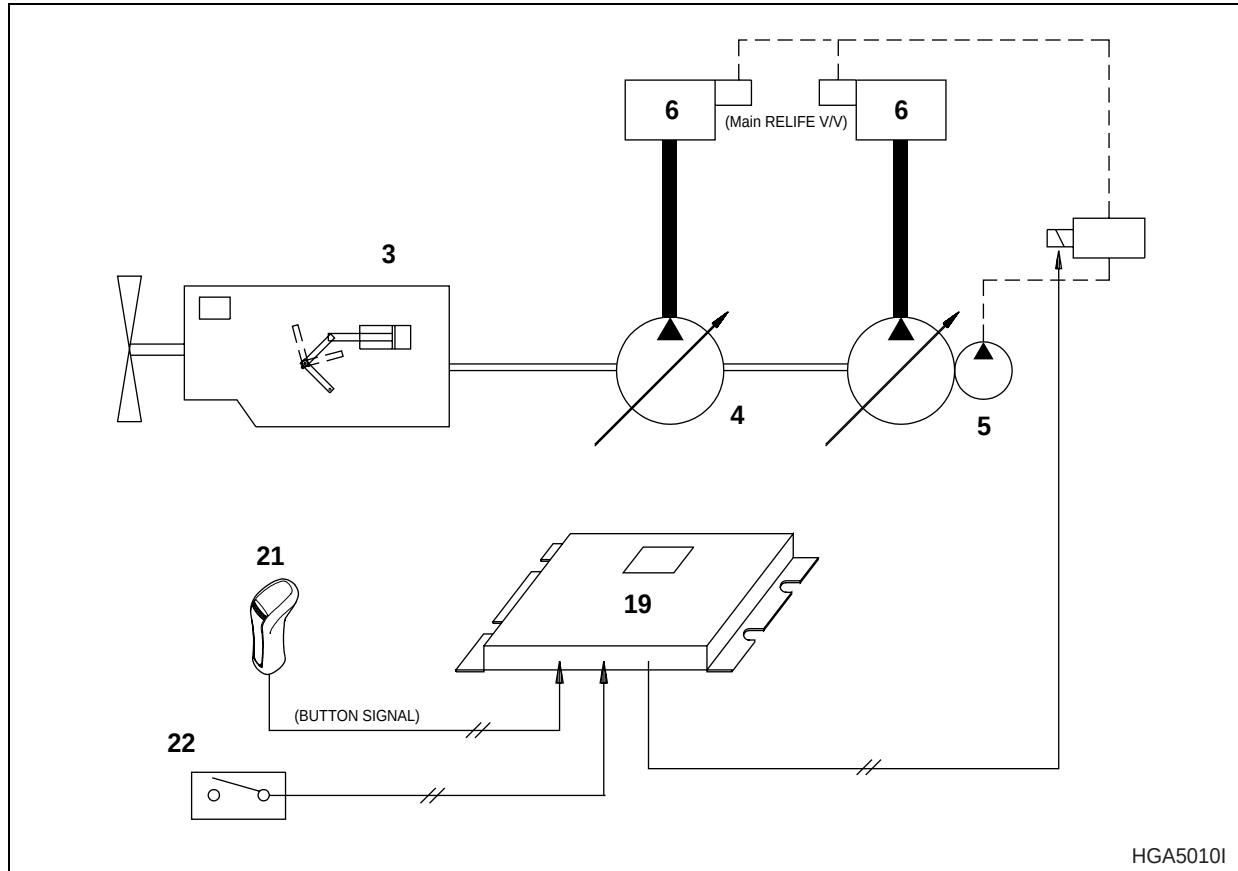


Figure 36

Reference Number	Description
3	Engine
4	Main Pump
5	Control Pump
6	Control Valve
11	Solenoid Valve

Reference Number	Description
19	EPOS - V Controller
21	Power Max Switch (Top Of Right Work Lever)
22	Work/Park/Run Select Switch

The Power Boost function is used to temporarily increase the main relief pressure to enhance excavation ability. When the switch button located on top of the right work lever is pressed during work, the EPOS-V controller will activate the power boost solenoid valve and increase the relief valve pressure from 330 - 350 kg/cm² (4,698 - 4,978 psi). The excavation ability is increased by approximately 6%.

NOTE: If the Work/Park/Run switch is set to RUN, it will activate the solenoid valve for pressure increase. In this situation, the relief valve setting pressure is always maintained at about 350 kg/cm² (4,978 psi).

POWER BOOST CONTROL - CIRCUIT DIAGRAM

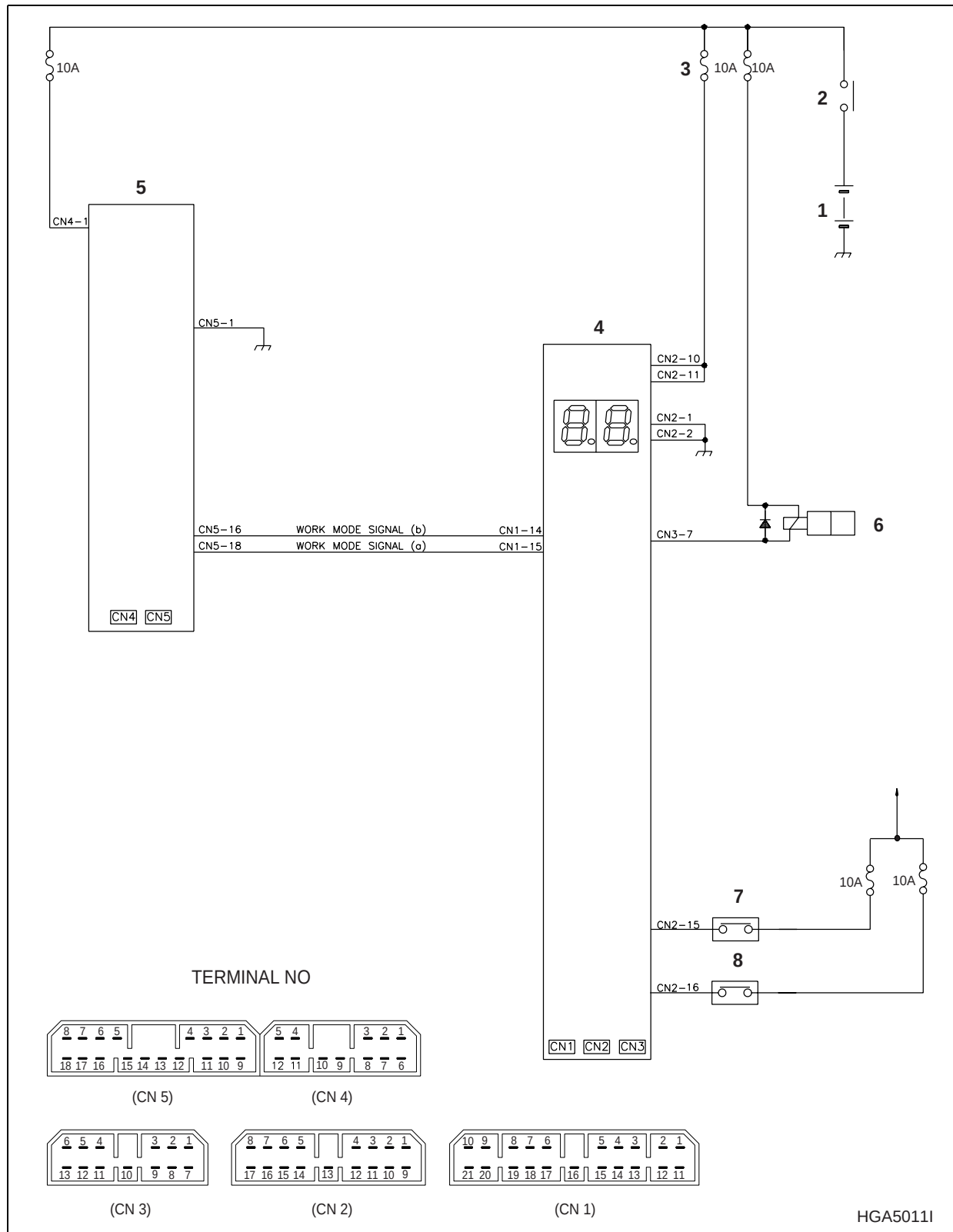


Figure 37

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse
4	EPOS-V Controller
5	Instrument Panel

Reference Number	Description
6	Solenoid Valve (Boost)
7	Power Boost Switch (Top Of Right Work Lever)
8	Work/Park/Travel Section Switch

CRUISE CONTROL

Cruise control is used for the purpose of reducing operator's fatigue during long travel distances.

FUNCTION

Run Method

Forward/reverse lever is placed at forward position (F), although accelerator pedal is not stepped on, the unit can travel. At this time, faster or slower travel speed can be obtained by adjusting the engine speed control dial. When engine speed control dial is adjusted to desired speed, the unit will travel at a constant speed. If there is a change in the load, a change of travel speed can occur.

Cancel

When the brake is applied the cruise control will be canceled.

Bringing the forward/reverse lever back to neutral (N), will also cancel the cruise control.

If the engine is running at an excessive RPM when the cruise control is canceled, reduce the engine RPM setting.

NOTE: *If the auto idle is "ON" when the cruise control is canceled, the engine will return to idle in approximately four seconds. When the cruise control is turned back "ON" the engine will return to the RPM setting control by the engine speed control dial*

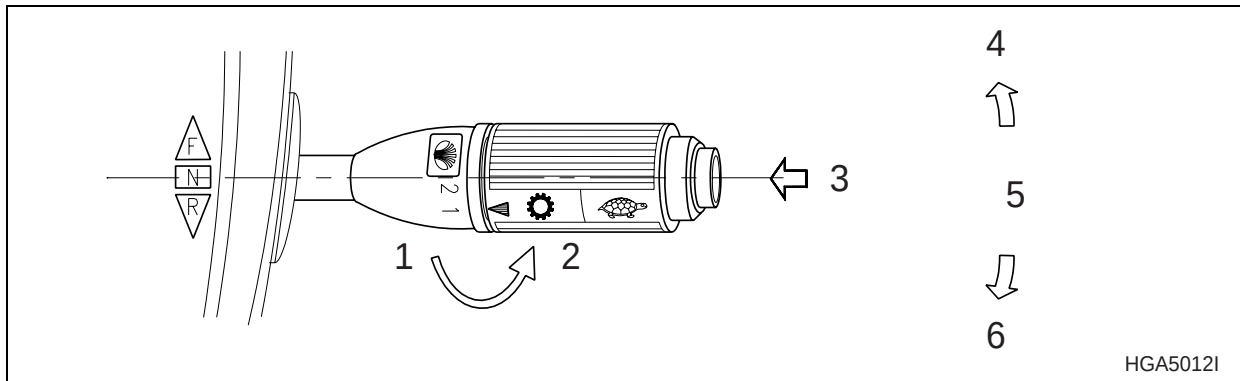
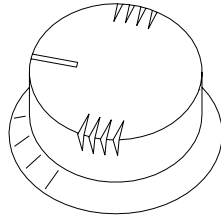


Figure 38 CRUISING SPEED CONVERSION SWITCH

Reference Number	Description
1	Low Speed Run
2	High Speed Run
3	Cruise Switch

Reference Number	Description
	Forward Run
	Neutral
	Backward Run



HGA5013I

Figure 39 ENGINE SPEED CONTROL DIAL

CRUISE CONTROL CIRCUIT

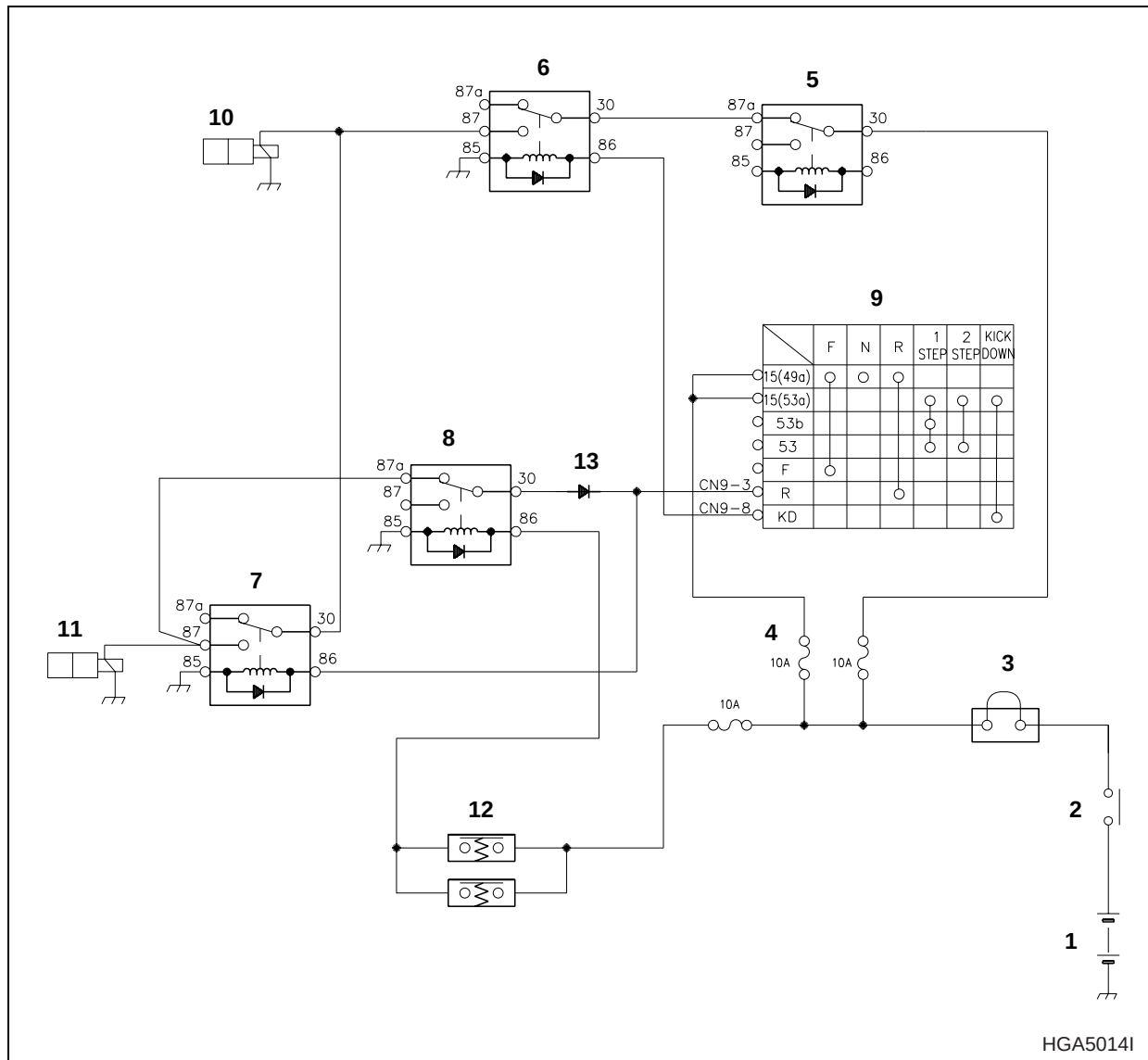


Figure 40

Reference Number	Description
1	Battery
2	Battery Relay
3	Circuit Breaker
4	Fuse
5	Pilot Pressure Rela
6	Forward Relay
7	Cruise 1 Relay

Reference Number	Description
8	Cruise 2 Relay
9	Travel Speed Control Switch
10	Forward Solenoid Valve
11	Cruise Control Solenoid Valve
12	Brake Light Switch
13	Diode

ADJUSTING METHOD OF ENGINE CONTROL UNIT

NOTE: *If the adjustment of engine control unit is improper, it may cause overloading of the engine, and lowering speed of Work/Run. This will affect the performance of equipment During repair and adjustment of engine control system, use the following directions.*

ADJUSTING METHOD OF ENGINE CONTROL SYSTEM

Accelerator Pedal (Refer to Figure 42)

1. Assembled length of rod (B, Figure 42) must be adjusted to 250 mm.
2. With rod (B, Figure 42) adjusted to 250 mm, adjust stop bolt (C) so that pedal (A) touches plunger (K) of run modulation valve.

NOTE: *Make sure that plunger (K , Figure 42) is not being depressed.*

3. After the rod (H, Figure 42) is temporarily assembled to bracket, install spring (G) between lever (D) and rod (H). Adjust the rod (H) to an initial installation length of 67 mm. Spring (G) should be adjusted to a length of 140 mm.
4. Extend cable (J, Figure 42) out of cable sheath 150 mm, attach end of cable to clevis (F, Figure 42). Attach the cable to bracket.

At this time, adjust the insertion depth of cable (J, Figure 42) end into clevis (F). Then adjust cable in bracket so that it is again adjusted to 150 mm.

NOTE: *Clevis pin should be 207.5 mm from bracket.*

NOTE: *During assembling, if the cable is pulled on either end, the assembly length will change, take care not to apply any force.*

5. Grease into nipple (E, Figure 42) to ensure proper lubrication.

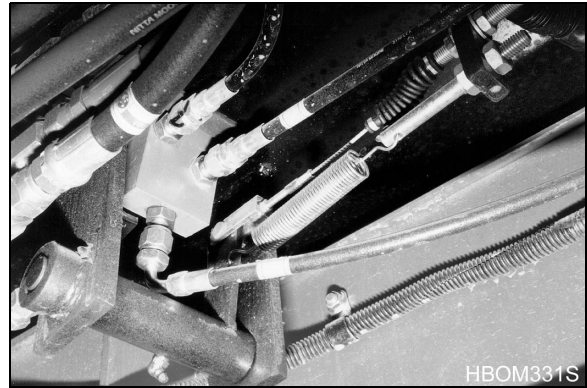


Figure 41 ACCELERATOR PEDAL LINKAGE

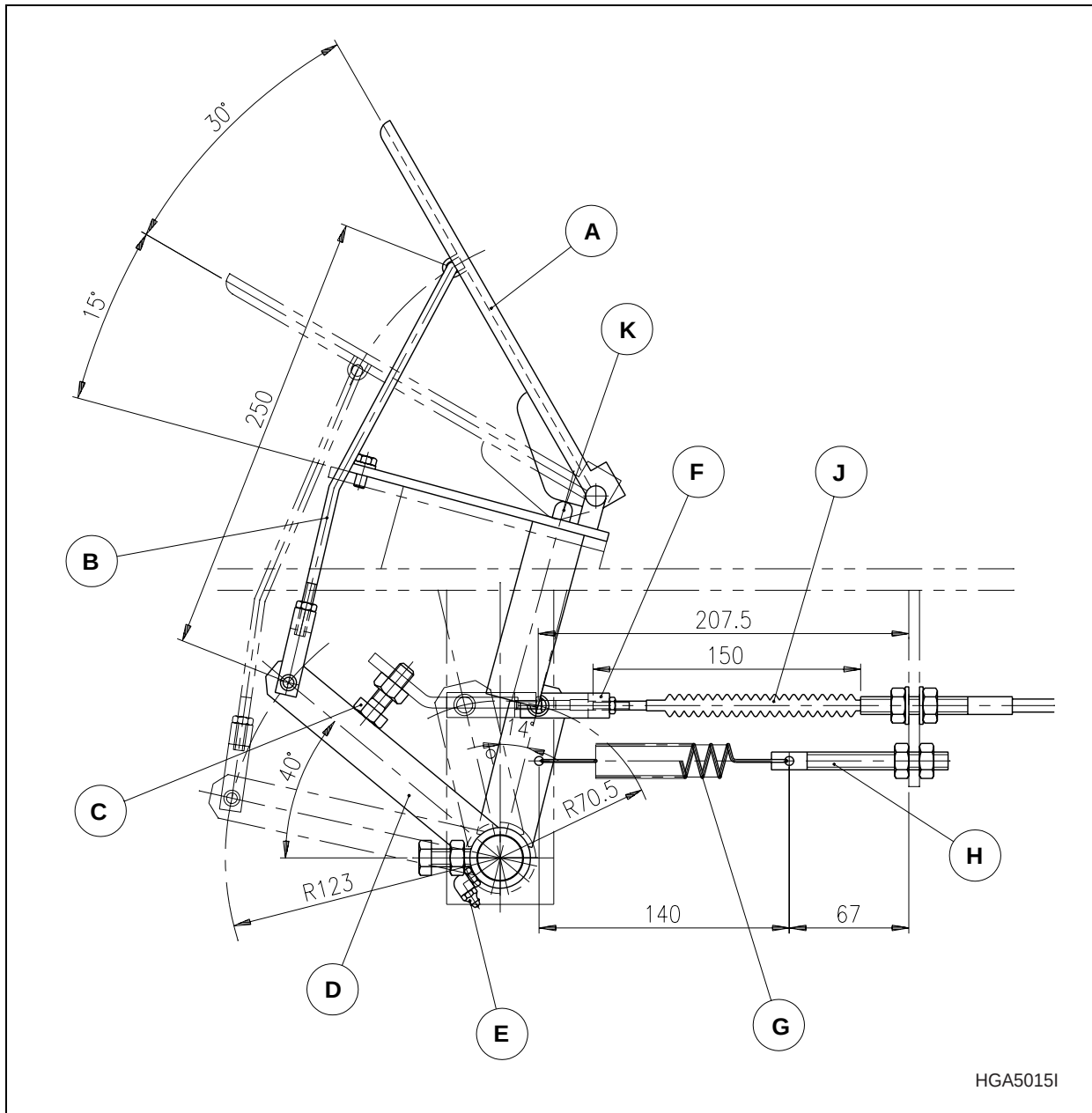


Figure 42

Engine Control Motor (Refer to Figure 43 and Figure 44)

1. The engine control motor (Figure 43) holds the cable length that was set pulled at maximum when responding to a "HIGH IDLE" position.
2. When installing the motor on frame, be careful not to bend cable, connect it to bracket (B, Figure 44) temporarily with nuts.

ADJUSTING METHOD OF ENGINE RPM

Inspection Before Adjustment (Refer to Figure 44)

1. Adjust bolt (E, Figure 44), so that its head is at the minimum height "Lb."
2. Turn start switch "ON" and position engine speed control dial to "LOW IDLE."
3. Adjust accelerator pedal cable (J, Figure 44) and engine control motor cable (K, Figure 44) using the following method.
 - A. Attach cables (J and K, Figure 44) to levers (C) and (C), in the hole positions shown in Figure 44.
 - B. Cable (J, Figure 44) has a tendency to hang-up once in a while on the accelerator pedal end. Before attaching cable (J) to bracket (B), pull cable (J) to ensure it is extended all the way. (Do not apply excessive force.)
 - C. Attach cables (J and K) to bracket (B) so that levers (C) and (C) touch the stop plate on lever (N). Adjust cables so they do not hang down.

NOTE: *Lever (N) is located between the two (C) levers. There are a total of three levers.*

Travel Mode RPM adjustment (Refer to Figure 44)

Engine RPM adjustment is performed at no load state.

Start engine, set work/park/travel select switch to "TRAVEL" and check if forward/reverse lever is in "NEUTRAL."

NOTE: *Work/park/travel select switch is located at left side end on the console below steering wheel.*

Adjust according to following steps.

1. Adjustment of High Idle RPM - Engine Control Motor
 - A. Turn start switch "ON," select "POWER MODE III", turn auto idle switch "OFF," and set work/park/travel select switch to "TRAVEL."
 - B. Set engine speed control dial to "HIGH IDLE" position. This will make engine control motor cable (K) be pulled to maximum.
 - C. Adjust the screw part of cable (K) in bracket (B) so that lever (A) touches the high idle stop.
2. Adjustment of Low Idle RPM - Engine Control Motor.
 - A. Set engine speed control dial to "LOW IDLE." This will make engine control motor cable (K) be extended to its maximum position.
 - B. Check that lever (A) touches engine low idle stop and that cable installation is correct.
 - C. If lever (A) does not touch the low idle engine stop, move cable (K) one stage down in holes on lever (C). If cable is extending to far (with excessive bending) move cable one stage up on holes in lever (C). When cable is moved either up or down on lever (C), adjust the cable position in bracket (B) up or down so that the end of cable (K) is not pointing up or down.

NOTE: *Lightly pull levers (C) and (C) toward high idle position. Levers should not come out of contact with stop on lever (N), When released, lever (A) should not come out of contact from engine low idle stop.*

3. Repeat preceding steps and try to satisfy both high idle and low idle adjustments.

4. When above procedure is completed, set engine speed control dial to "HIGH IDLE." Loosen the left side attachment nut of cable (K) and tighten the right side nut 2/3 - 1 turn more so the cable is pulled 1 ~ 1.25 mm more.

NOTE: *Securely hold the right side nut and cable (K) in position, while tightening left side nut.*

5. Adjustment of High Idle RPM - Accelerator Pedal

- A. Set engine speed control dial to "LOW IDLE." Fully depress accelerator pedal.
- B. Adjust the screw part of cable (J, Figure 44) installed on bracket (B, Figure 44) so that lever (A) just touches engine high idle stop.

NOTE: *By adjusting cable (J, Figure 44) at bracket (B, Figure 44) this will ensure that the accelerator pedal is properly depressing plunger (K, Figure 42).*

6. Adjustment of Low Idle RPM - Accelerator Pedal

- A. Release accelerator pedal.
- B. Check that lever (A, Figure 44) touches the engine low idle stop and the cable's installation position is proper.
- C. If lever (A, Figure 44) does not touch the engine low idle stop this means that there is not enough cable stroke.
 - 1) Move the screw part of cable (J, Figure 44) to the left till lever (A, Figure 44) touches the engine low idle stop.
 - 2) When fully depressing accelerator pedal, adjust length of rod (B, Figure 42) longer (more than 250mm) so that lever (A, Figure 44) touches the high idle stop.

NOTE: *If length of rod (B, Figure 42) is made excessively long, lever (A, Figure 44) will touch the engine high idle stop before the accelerator pedal (A, Figure 42) fully depresses plunger (K, Figure 42). Check whether the plunger is fully depressed or not.*

- D. In case that cable (J) hanging is excessive. (Pedal stroke excessive.)
 - 1) If cable is hanging, it should still function properly. The excessive play will not effect the normal operation of plunger (K).

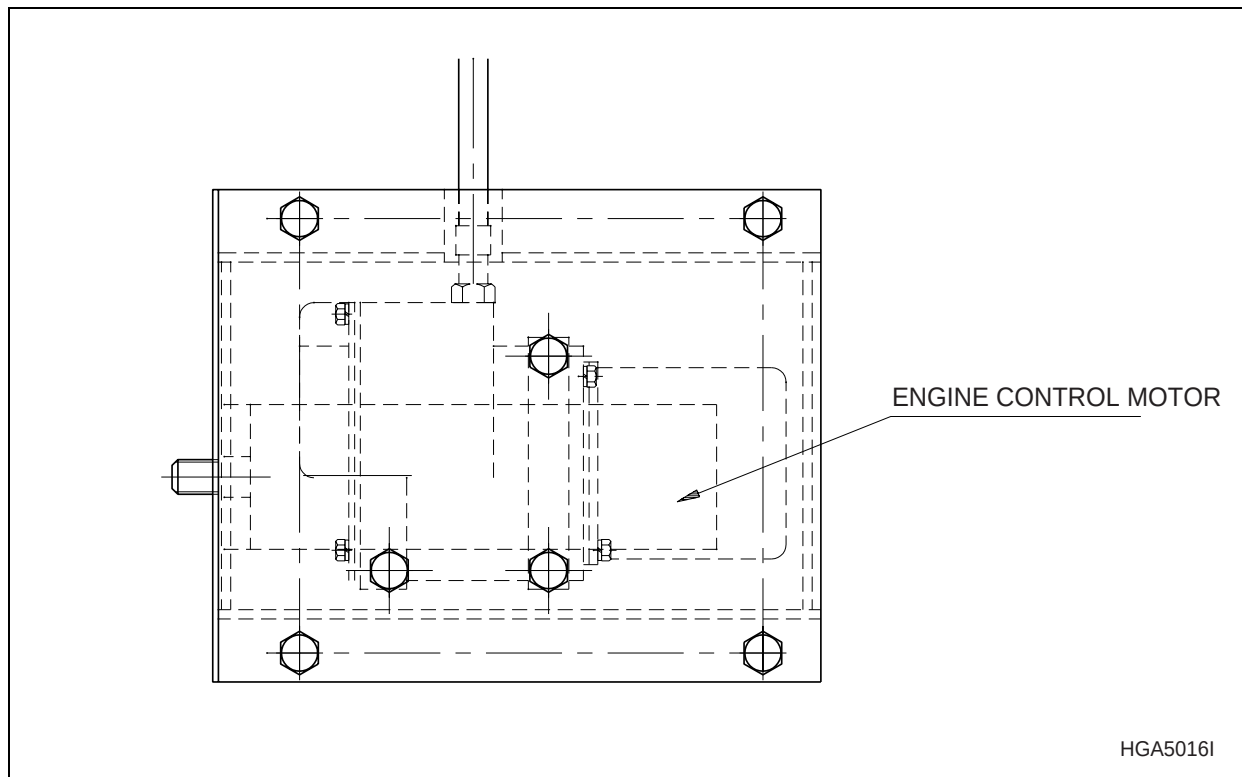


Figure 43

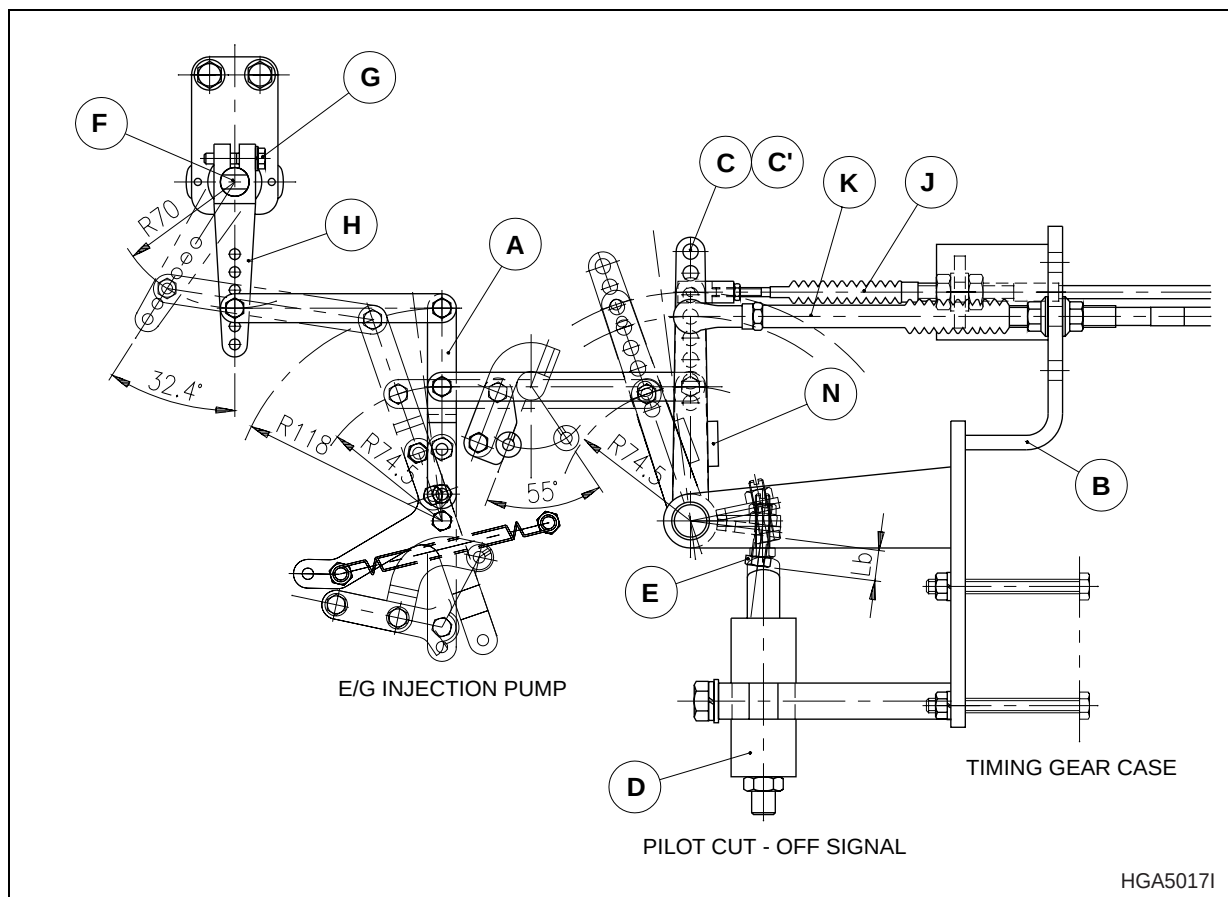


Figure 44

Adjustment of Work Mode RPM (Refer to Figure 46)

1. Engine Control Motor Adjustment

- A. Start engine, set to "III speed" for power mode, "OFF" for auto idle switch.
- B. Set work/park/travel select switch to "WORK," and check that forward/reverse lever is in "NEUTRAL."
- C. Set engine speed control dial to "HIGH IDLE."
- D. With a small screw driver adjust the variable resistor "VR4" shown in Figure 46. Adjust it until the engine is at 1900 ± 50 RPM.
- E. Check the 1900 ± 50 RPM setting by turning the engine speed control dial from "LOW IDLE" to "HIGH IDLE," and work/park/travel select switch to "TRAVEL"/"WORK."

NOTE: The values of the engine RPM may vary as the engine speed is changed from high to low and low to high. This deviation is normal.

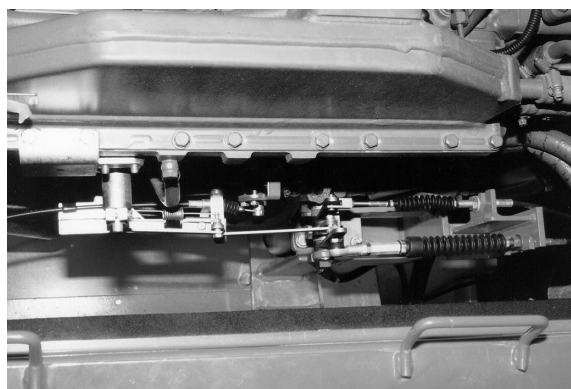


Figure 45 ENGINE THROTTLE LINKAGE

2. Accelerator Pedal Adjustment

- A. Lower left side control stand. (Pilot Cut-off Switch "ON")
- B. Check that plunger (D, Figure 44) of engine speed limiter (pilot cut-off signal) works as work/park/travel select switch is set to "WORK" or "TRAVEL."

NOTE: *When in "WORK" mode the plunger should be extended. When in "TRAVEL" mode the plunger should be retracted to about 6 mm.*

NOTE: *In case of operating in "WORK" mode, for in order for plunger to be shrunken, adequate external force is required, confirm by pressing plunger.*

- C. When operational check is over, set work/park/travel select switch to "WORK" position.
- D. Step on accelerator pedal slowly to maintain the engine speed at 1900 ± 50 RPM. Adjust length of stop bolt (E) till its head contacts plunger (D). Tighten jam nut.
- E. Step on the accelerator pedal two to three times to check if engine is running at 1900 ± 50 RPM.

Adjustment of Auto Idle and Other RPM (Refer to Figure 46)

1. Adjustment of Auto Idle

- A. Start engine, set engine speed control dial to "HIGH IDLE" position.
- B. Set work/park/travel select switch to "WORK," select "POWER MODE III," and auto idle switch to "ON."
- C. With a small screw driver adjust the variable resistor "VR1" shown in Figure 46. Adjust it until the engine is at 1250 ± 50 RPM.

2. III Speed Mode RPM

- A. Set engine speed control dial at "HIGH IDLE."
- B. Set work/park/travel select switch to "TRAVEL," select "POWER MODE II," and auto idle switch to "OFF."
- C. With a small screw driver adjust the variable resistor "VR2" shown in Figure 46. Adjust it until the engine is at 1750 ± 50 RPM.

3. I Speed Mode RPM

- A. Set engine speed control dial at "HIGH IDLE."
- B. Set work/park/travel select switch to "TRAVEL," select "POWER MODE I," and auto idle switch to "OFF."
- C. With a small screw driver adjust the variable resistor "VR3" shown in Figure 46. Adjust it until the engine is at 1600 ± 50 RPM.

Mode	Variable Resistor	Engine Speed Control Dial Position and Mode Setting(s)	Engine Speed Setting
Auto Idle (Automatic Deceleration)	VR1	   ENGINE SPEED HAOH300L	1250 ±50 RPM
Power Mode II	VR2	  ENGINE SPEED HAOH310L	1750 ±50 RPM
Power Mode I	VR3	  ENGINE SPEED HAOH320L	1600 ±50 RPM
Work Mode	VR4	   (WORK) ENGINE SPEED HAOH321L	1900 ±50 RPM

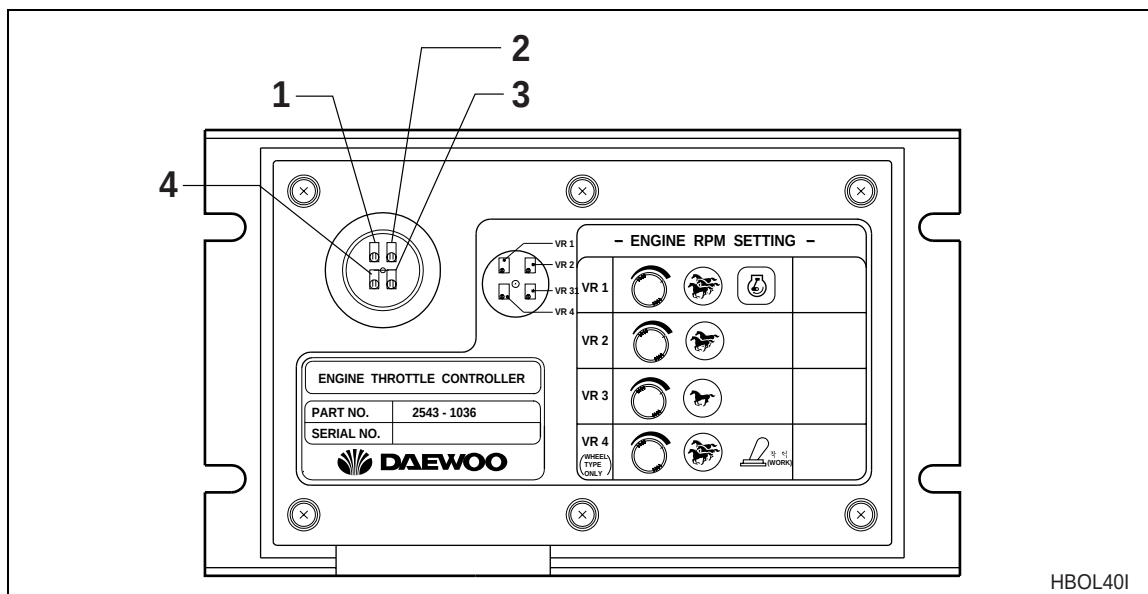


Figure 46

Reference Number	Description
1	VR1 (Auto Idle Adjusting Variable Resister)
2	VR2 (Power Mode II Engine Speed Adjusting Variable Resister)
3	VR3 (Power Mode I Engine Speed Adjusting Variable Resister)
4	VR4 (Work Mode In Power Mode III Adjusting Variable Resister)

ADJUSTMENT OF TPS (THROTTLE POSITION SENSOR) (REFER TO FIGURE 46 THRU FIGURE 48)

NOTE: *If TPS adjustment is not correct, the performance of equipment will not be exerted and may become the cause of overloading and so correct adjustment is necessitated.*

1. After connecting the harness for test to TPS, install multi-tester, and select DC voltage (DCV) (Refer to "Figure 47").
2. Set work/park/travel select switch at "WORK."
3. Set engine speed control dial at "HIGH IDLE" position.
4. After reading the engine RPM at gauge panel, look for the corresponding TPS voltage value.
5. Rotate shaft (F, Figure 44) so that the TPS voltage value matches the value found on the table and tighten bolt (G).
6. Set work/park/travel select switch to "TRAVEL," select "POWER MODE III" and turn the engine speed control dial to "HIGH IDLE."
7. Read the engine speed displayed on the gauge panel and find the corresponding TPS voltage on table "Figure 48".
8. Check to see if the TPS voltage matches the voltage found on the table.
9. Turn the engine speed control dial to "LOW IDLE" position and check to see if the TPS voltage matches the voltage found on the table "9-7".
10. If the measured voltage is greater than the listed voltage on the table, move the H lever one hole lower than the present position; if it is less than the voltage listed on the table move the lever one hole higher than the present position.
11. By repeating steps 2-10 the maximum engine RPM voltage for work mode and the maximum RPM voltage for travel mode can be simultaneously set.

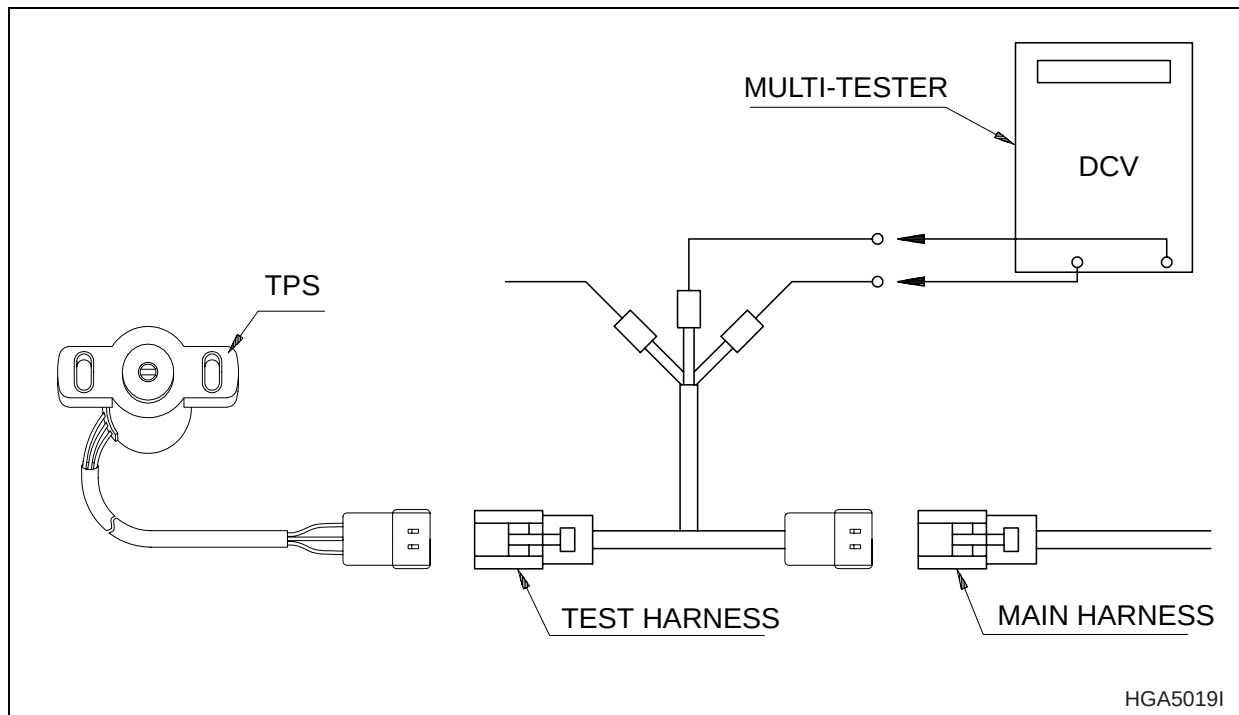


Figure 47

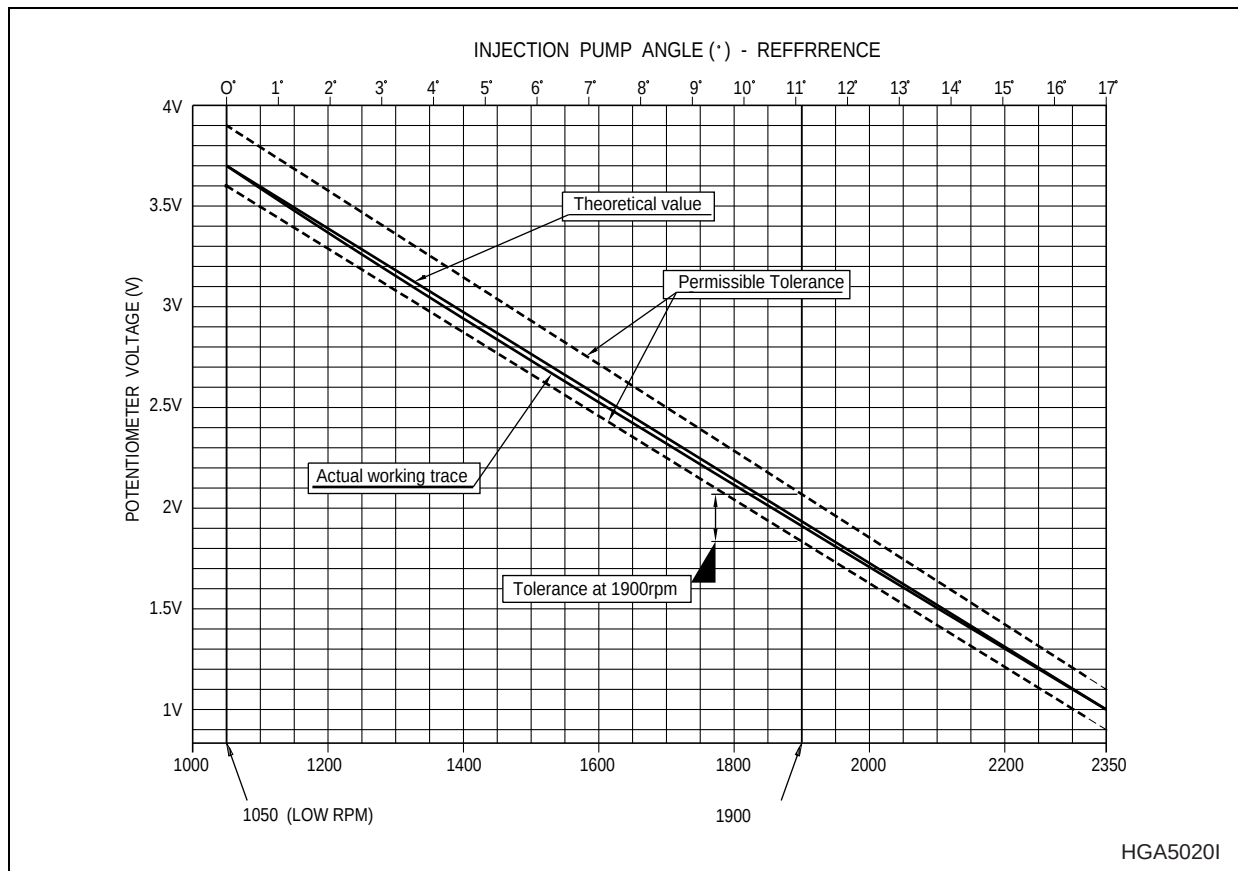


Figure 48

Engine Speed		Engine Speed		Engine Speed	
Speed Below	Tolerance	Speed	Tolerance	Speed Above	Tolerance
1050 RPM	3.60 - 3.90 V	1850 RPM	2.04 V	2350 RPM	0.90 - 1.10 V
1060 RPM	3.58 - 3.88 V	1860 RPM	2.02 V	2340 RPM	0.92 - 1.12 V
1070 RPM	3.56 - 3.86 V	1870 RPM	2.00 V	2330 RPM	0.94 - 1.14 V
1080 RPM	3.54 - 3.84 V	1880 RPM	1.98 V	2320 RPM	0.96 - 1.16 V
1090 RPM	3.52 - 3.81 V	1890 RPM	1.96 V	2310 RPM	0.98 - 1.19 V
1100 RPM	3.50 - 3.79 V	1900 RPM	1.93 V	2300 RPM	1.00 - 1.21 V
		1910 RPM	1.91 V		
		1920 RPM	1.89 V		
		1930 RPM	1.87 V		
		1940 RPM	1.85 V		
		1950 RPM	1.83 V		

SELF-DIAGNOSTIC FUNCTION

EPOS-V CONTROLLER

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

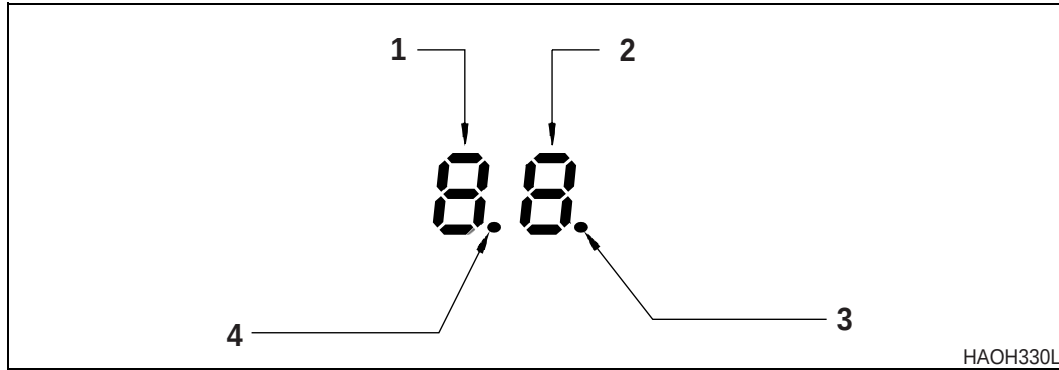


Figure 49

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

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

1. Power Monitor

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

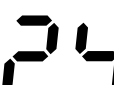
2. Engine Speed Monitor

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

3. Normal Operation Display Readout

Mode Selection		Display Readout		Operation Status
		Upper Digit	Lower Digit	
Power Mode	Power Mode III	9 HAOH340L		Normal Operation Power Mode III
	Power Mode II	7 HAOH350L		Normal Operation Power Mode II
	Power Mode I	6 HAOH360L		Normal Operation Power Mode I
Work Mode	Digging		0 HAOH370L	Normal Operation Digging Mode
	Trenching		2 HAOH380L	Normal Operation Trenching Mode
	Leveling		3 HAOH390L	Normal Operation Leveling Mode

4. Malfunction Display Readout And Reset Procedure					
No.	Fault Area	Cause	Display Readout	Action	Reset Procedure
1	Pump Discharge Volume Control Valve (E.PPR Valve)	Short Circuit	01 HAOH400L	Cut Off Output Current (0 mA)	After correcting problem, turn start switch from OFF to ON.
2	Relief Pressure Up Solenoid Valve	Short Circuit	02 HAOH410L	Cut Off Output Current (0 mA)	After correcting problem, turn start switch from OFF to ON.
3	Travel Speed - II Solenoid Valve	Short Circuit	03 HAOH420L	Cut Off Output Current (0 mA)	After correcting problem, turn start switch from OFF to ON.
4	Swing Priority Control Solenoid Valve	Short Circuit	04 HAOH430L	Cut Off Output Current (0 mA)	After correcting problem, turn start switch from OFF to ON.
5	Arm Regeneration Control Solenoid Valve	Short Circuit	05 HAOH440L	Cut Off Output Current (0 mA)	After correcting problem, turn start switch from OFF to ON.
6	Arm Priority Control Solenoid Valve	Short Circuit	06 HAOH450L	Cut Off Output Current (0 mA)	After correcting problem, turn start switch from OFF to ON.
7	Relief Pressure Up Solenoid Valve	Open Circuit	12 HAOH460L		Automatic reset when problem is corrected.
8	Travel Speed - II Solenoid Valve	Open Circuit	13 HAOH470L		Automatic reset when problem is corrected.
9	Swing Priority Control Solenoid Valve	Open Circuit	14 HAOH480L		Automatic reset when problem is corrected.
10	Arm Regeneration Control Solenoid Valve	Open Circuit	15 HAOH490L		Automatic reset when problem is corrected.

4. Malfunction Display Readout And Reset Procedure					
No.	Fault Area	Cause	Display Readout	Action	Reset Procedure
11	Arm Priority Control Solenoid Valve	Open Circuit	 HAOH500L		Automatic reset when problem is corrected.
12	Engine Speed Control Dial	Output Voltage: over 4.6 ± 0.2 V Abnormal: under 0.4 ± 0.2 V	 HAOH510L		Automatic reset when problem is corrected.
13	Engine Control Motor (Potentiometer)	Output Voltage: over 4.6 ± 0.2 V Abnormal: under 0.4 ± 0.2 V	 HAOH520L		Automatic reset when problem is corrected.
14	Front Pump Pressure	Output Voltage: over 4.6 ± 0.2 V Abnormal: under 0.4 ± 0.2 V	 HAOH530L		Automatic reset when problem is corrected.
15	Rear Pump Pressure	Output Voltage: over 4.6 ± 0.2 V Abnormal: under 0.4 ± 0.2 V	 HAOH540L		Automatic reset when problem is corrected.
16	Mode Select Signal Input	CN1 - 12 and CN1 - 13 Terminals At High Level (12 V)	 HAOH550L		Automatic reset when problem is corrected.

ENGINE THROTTLE CONTROLLER

Under the rubber cap located on the surface of the engine controller, there are 3 LEDs. Based on the equipment status the following LEDs will light up.

Throttle Controller Input Signal	Status	LED Status			Voltage At Control Motor Terminal
		Red	Green	Yellow	
Engine Speed Control Dial Voltage < Motor Potentiometer Voltage	While Control Motor Is Operating (Increasing RPM)	X	Δ	O	Approximately +24 V
Engine Speed Control Dial Voltage > Motor Potentiometer Voltage	While Control Motor Is Operating (Decreasing RPM)	Δ	X	O	Approximately - 24 V
Engine Speed Control 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 start switch from 'OFF' to the 'ON' position and normal operation will resume.



ELECTRICAL SCHEMATIC (S130W-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 130W-V	0001 and Up

TABLE OF CONTENTS

General Description.....	3
Solar 130W-V	4

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.

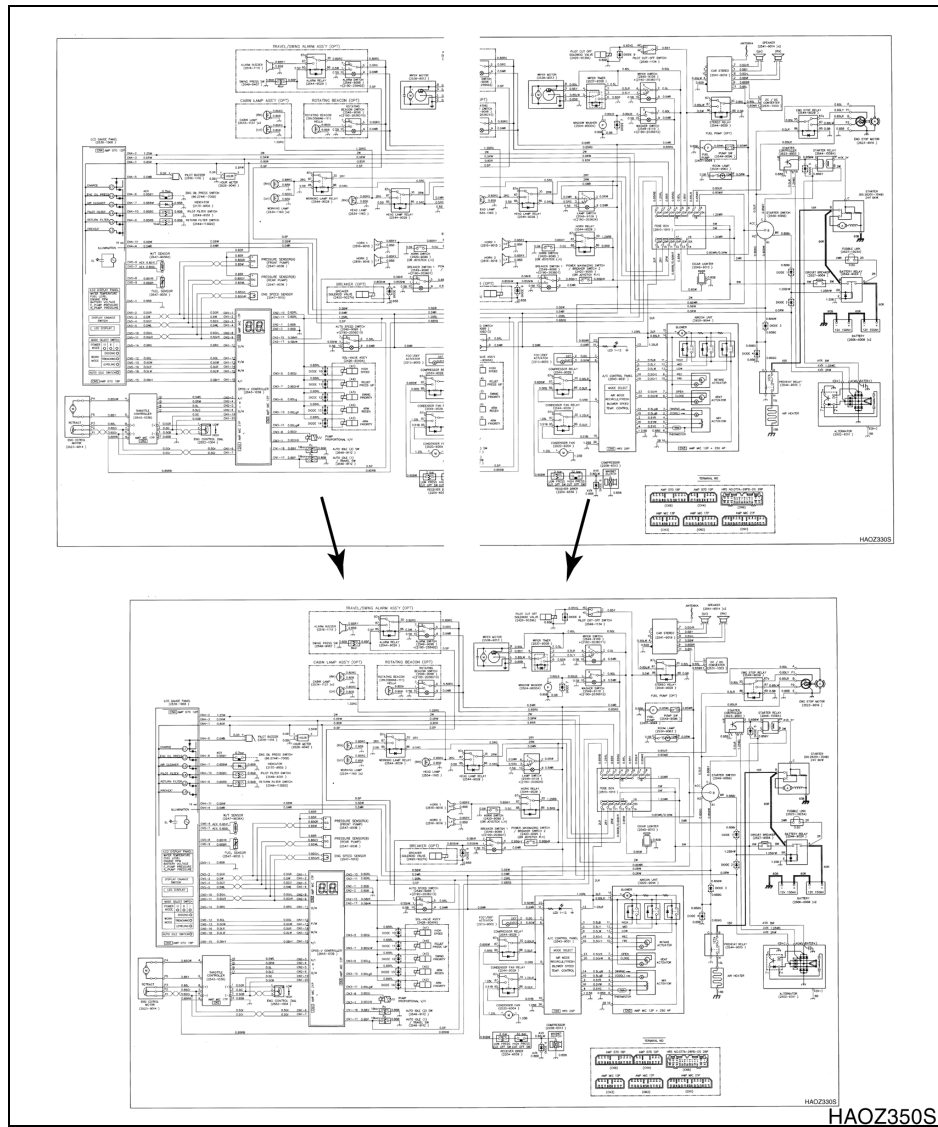


Figure 1

SOLAR 130W-V

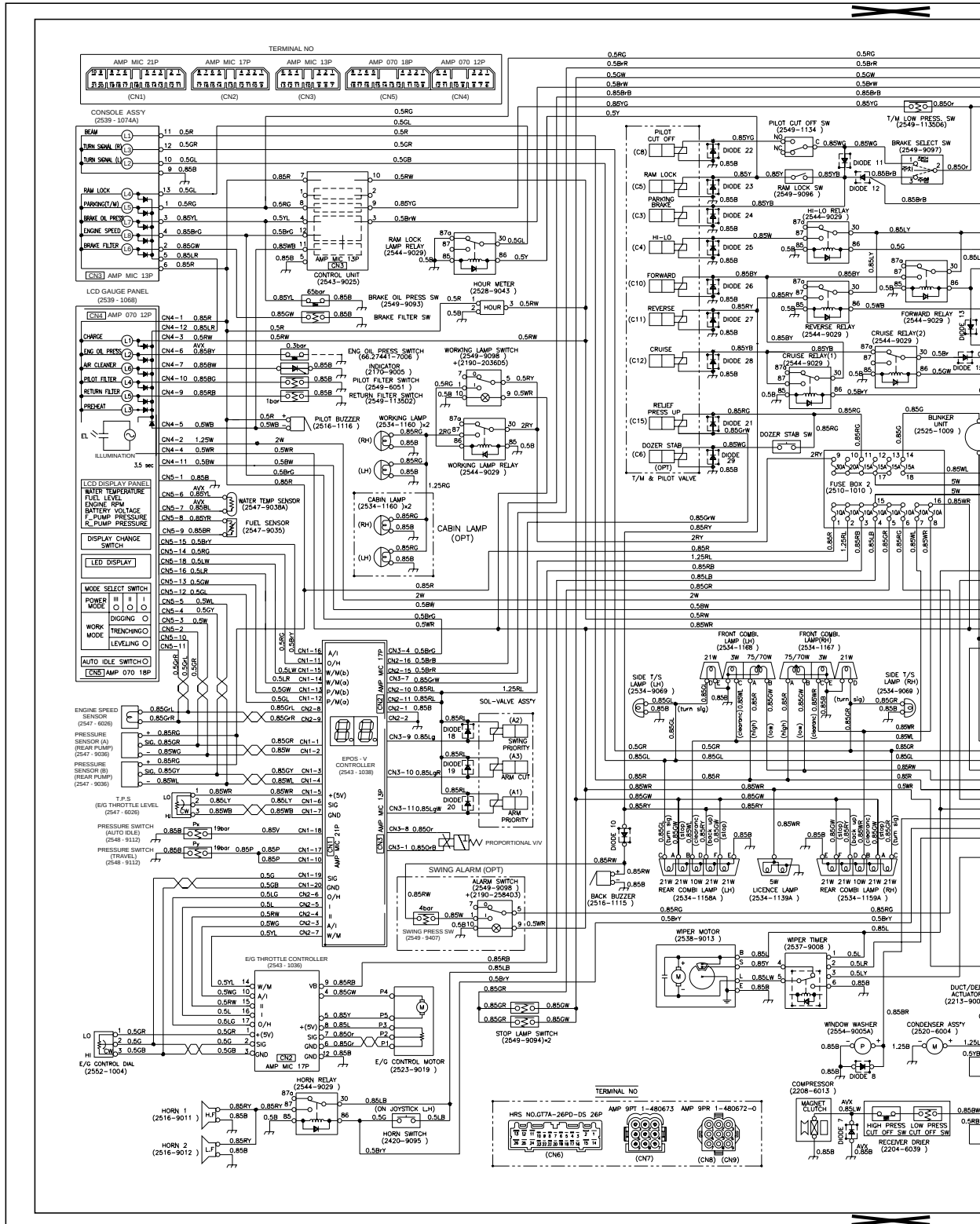
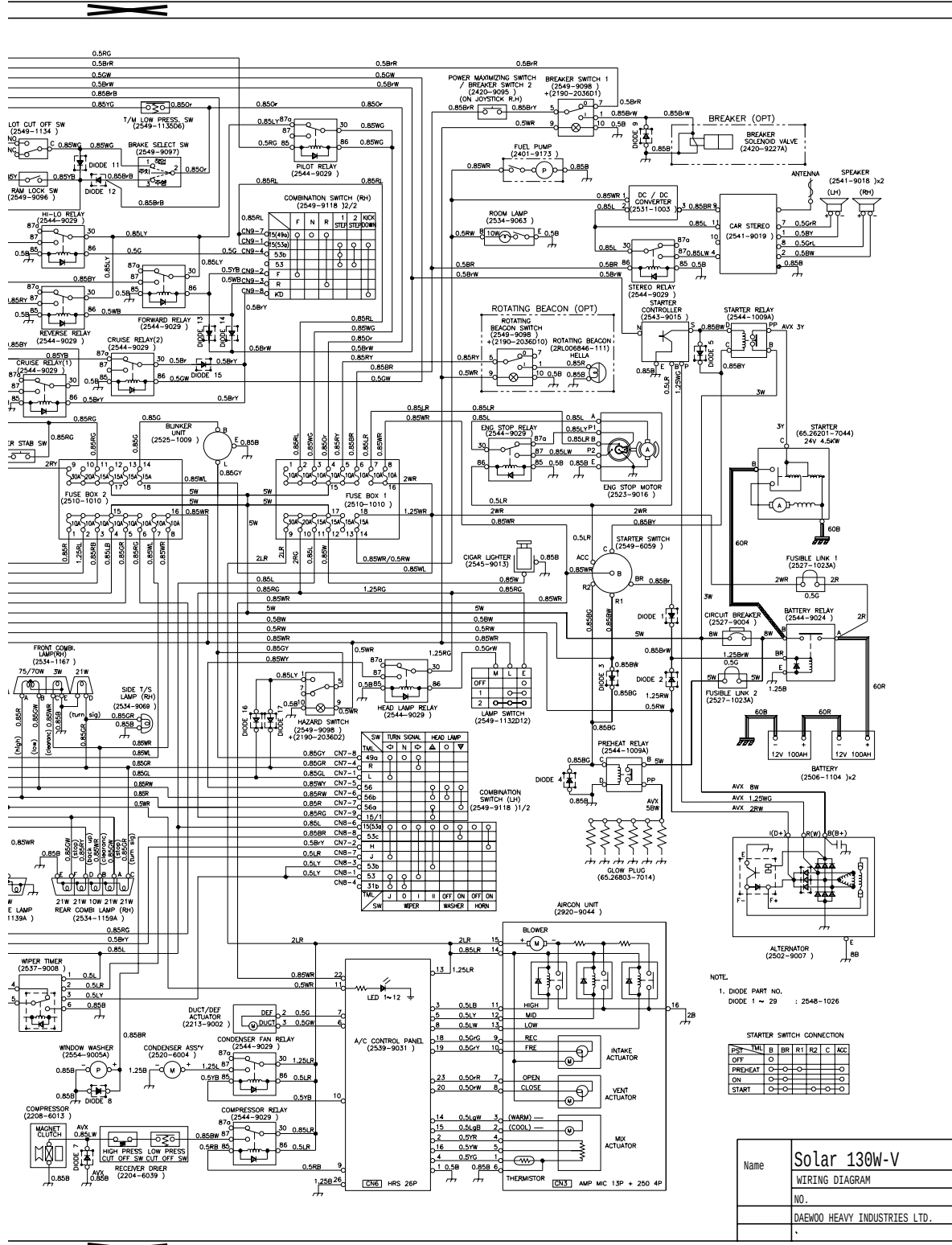


Figure 2



HASA920I

ATTACHMENTS



BOOM AND ARM



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 130W-V	0001 and Up

TABLE OF CONTENTS

Front Attachment Pin Specifications.....	3
Front Attachment - Removal and Installation	4
Arm Removal Procedure	4
Boom Removal Procedure	6
Installation	7
Arm Installation Procedure.....	7
Boom Installation Procedure	7
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	71.0 mm (2.80 in.)	651.0 mm (25.63 in.)
B	71.0 mm (2.80 in.)	176.0 mm (6.93 in.)
C	71.0 mm (2.80 in.)	670.0 mm (26.38 in.)
D	71.0 mm (2.80 in.)	413.0 mm (16.26 in.)
E	71.0 mm (2.80 in.)	201.0 mm (7.91 in.)
F	71.0 mm (2.80 in.)	201.0 mm (7.91 in.)
G	65.0 mm (2.56 in.)	380.0 mm (14.96 in.)
H	65.0 mm (2.56 in.)	431.0 mm (16.97 in.)
I	65.0 mm (2.56 in.)	187.0 mm (7.36 in.)
J	65.0 mm (2.56 in.)	380.0 mm (14.96 in.)
K	65.0 mm (2.56 in.)	431.0 mm (16.97 in.)

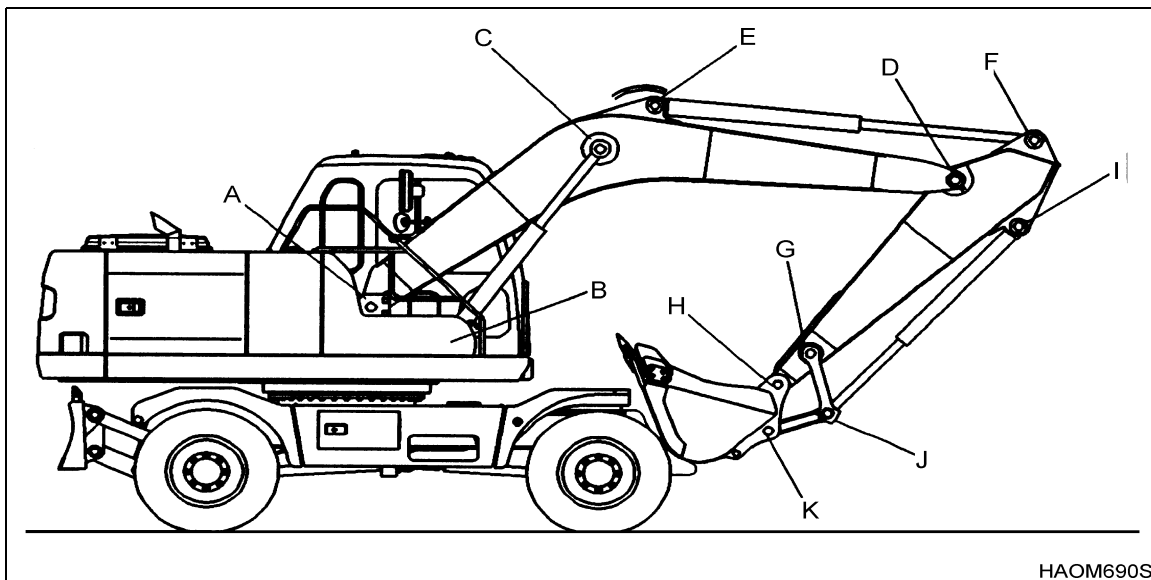


Figure 1

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 on to 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 in to 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 spraycleaner. 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.

FRONT ATTACHMENT - 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.



S0904000
R2

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 015	0001 and Up
Solar 130LC-V	0001 and Up
Solar 130W-V	0001 and Up
Solar 220LC-V	0001 and Up
Solar 290LC-V	0001 and Up
Solar 330LC-V	1001 and Up
Solar 400LC-V	1001 and Up
Solar 55	0001 and Up

TABLE OF CONTENTS

Bucket Tooth Inspection and Replacement	3
Bucket O-ring Replacement	4
Bucket Shimming Procedures	6
New Bucket Installation	6
Shimming Procedures for Installed Bucket	6
Bucket Attachment, Removal and Reversal	7
Detaching the Bucket	7
Attaching The bucket.....	7
Reversing the Bucket	8

BUCKETTOOTH INSPECTION AND REPLACEMENT

There are several different types of attachment methods for replaceable bucket teeth. One of the most common type is shown in the drawings on this page.

Bucket teeth are usually replaced in sets but it may sometimes be necessary to replace individual teeth.

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.

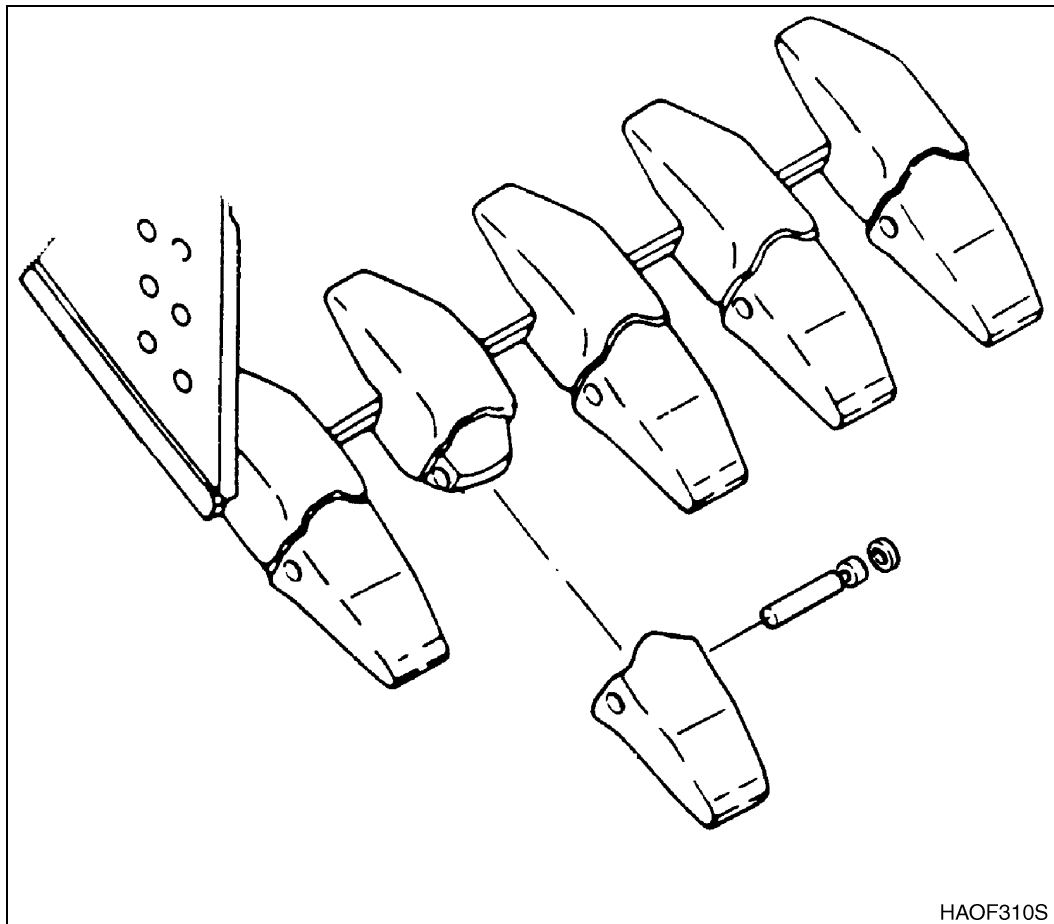


Figure 1

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.

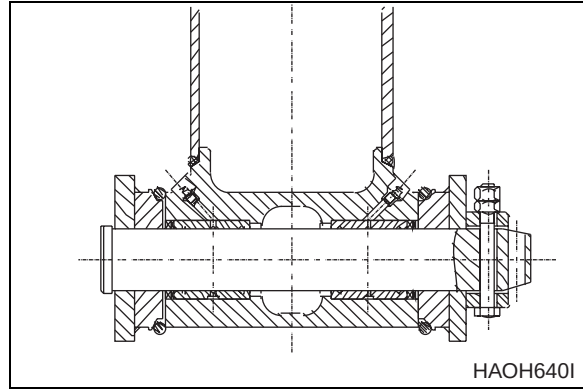


Figure 2

2. Roll the old O-ring (1, Figure 3) 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.

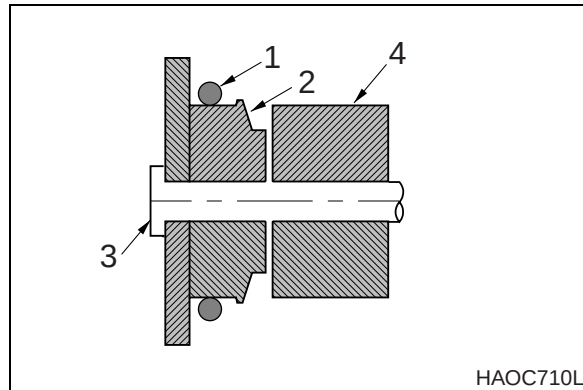


Figure 3

3. Remove the old O-ring and temporarily install the new O-ring (1, Figure 4) 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 3).

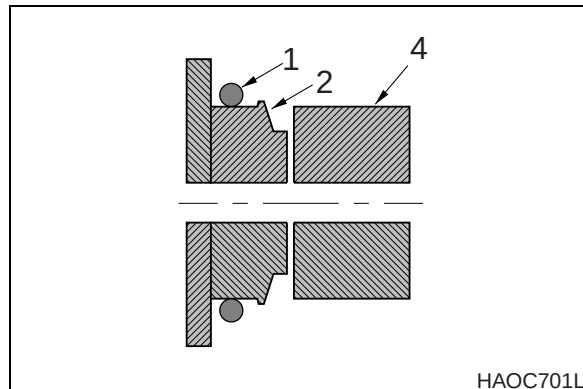


Figure 4

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

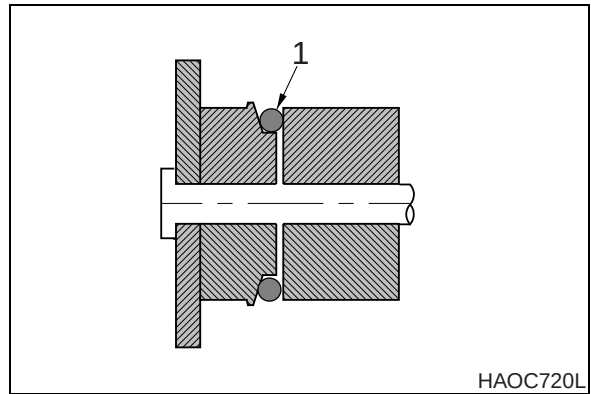


Figure 5

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 6). 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 6) 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).

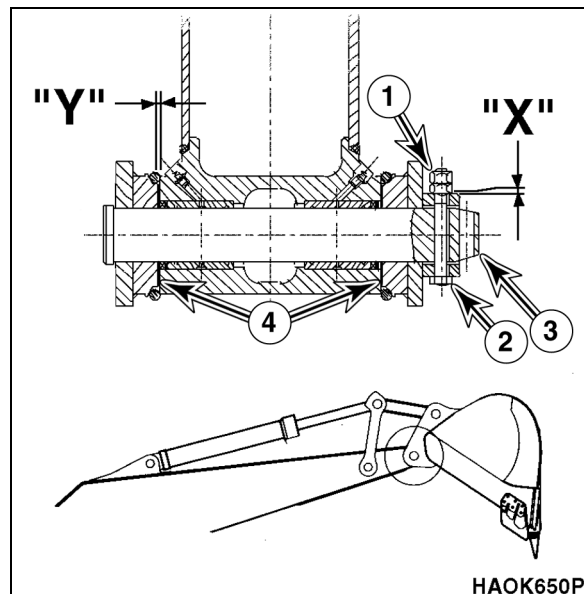


Figure 6

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.

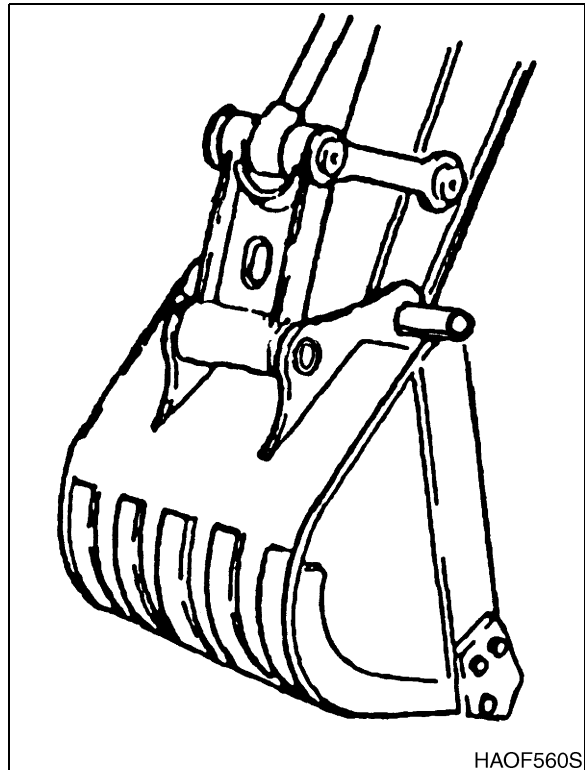


Figure 7

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.

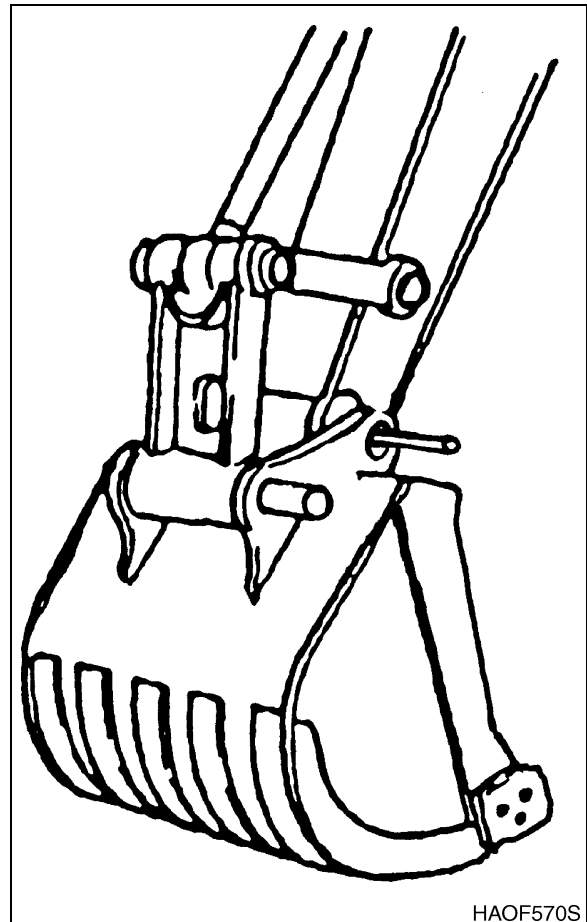


Figure 8