DX300LCA

Shop Manual

950106-00075E

Serial Number 5001 and Up

DOOSAN 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.

950106-00075E Shop Manual
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DX300LCA
Serial Number 5001 and Up
Pub.No. 950106-00075E

Product Label

Instructions

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

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Edition 1

MEMO

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Track Excavator Safety

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LCA	5001 and Up

TO THE OPERATOR OF A *DOOSAN* 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:

WARNING

Improper operation and maintenance of this machine can be hazardous and could result in serious injury or death.

Operator and maintenance personnel should read this manual thoroughly before beginning operation or maintenance.

Keep this manual in the storage compartment to the rear of the operator's seat, and have all personnel involved in working on the machine read the manual periodically.

Some actions involved in operation and maintenance of the machine can cause a serious accident, if they are not done in a manner described in this manual.

The procedures and precautions given in this manual apply only to intended uses of the machine.

If you use your machine for any unintended uses that are not specifically prohibited, you must be sure that it is safe for any others. In no event should you or others engage in prohibited uses or actions as described in this manual.

***DOOSAN* delivers machines that comply with all applicable regulations and standards of the country to which it has been sent. If this machine has been purchased in another country or purchased from someone in another country, it may lack certain safety devices and specifications that are necessary for use in your country. If there is any question about whether your product complies with the applicable standards and regulations of your country, consult *DOOSAN* or your *DOOSAN* distributor before operating the machine.**

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

This word is used on safety messages and safety labels and 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

This word is used on safety messages and safety labels and indicates potential theat of a hazardous situation that, if not avoided, could result in serious injury or death. It may also be used to alert against highly unsafe practice.

DANGER

This word is used on safety messages and safety labels and indicates an 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 detonate or explode if handled or treated carelessly.

Safety precautions are described in SAFETY from page -10 on.

DOOSAN cannot predict every circumstance that might involve a potential hazard in operation and maintenance. Therefore the safety messages in this manual and on the machine may not include all possible safety precautions. If any procedures or actions not specifically recommended or allowed in this manual are used, you must be sure that you and others can do such procedures and actions safely and without damaging the machine. If you are unsure about the safety of any procedures, contact a *DOOSAN* distributor.

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 *DOOSAN* 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 tag lines to keep the load steady if wind conditions and large surface area are a problem. Work crew hand signals, individual tasks and safe procedures should all be universally understood before the lift is made.

IMPORTANT

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

LOCATION OF SAFETY LABELS

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

Always replace damaged or faded decals.

SUMMARY OF SAFETY PRECAUTIONS FOR LIFTING IN DIGGING MODE

DANGER

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

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

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

Tag lines 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 tag line around your hands or body.

NEVER rely on tag lines or make rated lifts when wind gusts are more than 48.3 km/h (30 MPH). Be prepared for any 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 *DOOSAN* representative.

UNAUTHORIZED MODIFICATIONS

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

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

GENERAL HAZARD INFORMATION

Safety Rules

Only trained and authorized personnel can operate and maintain the machine.

Follow all safety rules, precautions and instructions when operating or performing maintenance on the machine.

Do not operate the machine if you are not feeling well, if you are taking medication that makes you feel sleepy, if you have been drinking, or if you are suffering from emotional problems. These problems will interfere with your sense of judgment in emergencies and may cause accidents.

When working with another operator or with a person on work site traffic duty, be sure that all personnel know the nature of the work and understand all hand signals that are to be used.

Always observe strictly any other rules related to safety.

Safety Features

Be sure that all guards and covers are installed in their proper position. Have guards and covers repaired immediately if damaged.

Be sure that you understand the method of use of safety features such as safety lock lever and the seat belt, and use them properly.

Never remove any safety features. Always keep them in good operating condition.

Failure to use safety features according to the instructions in the Operation and Maintenance Manual could result in serious bodily injury.

Inside Operator's Cabin

When entering the operator's cabin, always remove all mud and oil from the soles of your shoes. If you operate the travel pedal with mud or oil stuck to your shoes, your foot may slip and this may cause a serious accident.

After using the ashtray, make sure that any matches or cigarettes are properly extinguished, and be sure to close the ashtray. If the ashtray is left open, there is a danger of fire.

Do not stick suction pads to the window glass. Suction pads act as a lens and may cause fire.

Do not leave lighters laying around the operator's cabin. If the temperature inside the operator's cabin becomes high, there is a danger that lighter may explode.

Do not use cellular telephones inside the operator's compartment when driving or operating the machine. There is a danger that this may lead to an unexpected accident.

Never bring any dangerous objects such as flammable or explosive items into the operator's cabin.

To ensure safety, do not use the radio or music headphones when operating the machine. There is a danger that this may lead to a serious accident.

When operating the machine, do not put your hands or head out of the window.

When standing up from the operator's seat, always place safety lock lever securely in the "LOCK" position. If you accidentally touch the work equipment levers when they are not locked, the machine may suddenly move and cause serious injury or damage.

When leaving the machine, lower the work equipment completely to the ground, set safety lock lever to the "LOCK" position and shut down engine. Use the key to lock all the equipment. Always remove key and take it with you.

Clothing and Personal Protective Items

Secure long hair, and avoid loose clothing and jewelry. These items have the tendency to catch on controls or protrude into parts and cause serious injury or death.

Do not wear oily clothes. They are highly flammable.

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

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

Figure 1

Breathing Masks, Ear Protection May Be Required

Do not 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.

NOTE: *The equivalent continuous A-weighted sound pressure level at the workstation for this machine is given in the operation manual.*

Measurement is obtained on a dynamic machine following the procedures and cabin conditions as described in ISO 6396.

NOTE: *The guaranteed sound power level emitted by the machinery for this machine is given in the operation manual.*

Measurement is obtained on a dynamic machine with the procedures as described in 2000/14/EC.

Vibration Level Information

Hands/Arms: The weighted root mean square acceleration to which the hands/arms are subjected, is less than 2.5 m/s^2.

Whole body: The weighted root mean square acceleration to which the whole body is subjected, is less than 0.5 m/s^2.

Measurements are obtained on a representative machine, using measuring procedures as described in the following standard: ISO 2631/1. ISO 5349, and SAE J1166.

Recommendations for Limiting Vibrations

1. Select the right machine, equipment and attachments for a particular application.
2. Replace any damaged seat by a genuine *DOOSAN* part. Keep the seat maintained and adjusted.
   - Adjust the seat and suspension for the weight and size of the operator.
   - Inspect and maintain the suspension and adjustment mechanisms of the seat regularly.
3. Check that machine is properly maintained.
   - Tire pressure, brakes, steering, linkages, etc.
4. Steer, brake, accelerate, shift gears, move the attachments and load the attachments smoothly.
5. Adjust the machine speed and travel path to reduce the vibration level.
   - Slow down if it is necessary when traveling through rough terrain.
   - When driving machine, avoid obstacles and excessive rough terrain.
6. Keep the machine on terrain where working and traveling conditions are good.
   - Remove any large rocks or obstacles.
   - Fill any ditches and holes.
   - Provide machines for and schedule time to maintain good terrain conditions.
7. Travel over longer distance (e.g. on public roads) at adjusted (medium) speed.
   - Always adjust the speed to prevent bouncing.

Mounting and Dismounting

Before getting on or off the machine, if there is any oil, grease, or mud on the handrails, steps, or track shoes, wipe it off immediately. Always keep these parts clean. Repair any damage and tighten any loose bolts.

Never jump on or off the machine. In particular, never get on or off a moving machine. These actions may lead to serious injury.

When getting on or off the machine, always face the machine, and maintain three-point contact (both feet and one hand or one foot and both hands) with the handrails, steps, and track shoes to ensure that you support yourself securely.

Never hold any control levers when getting on or off the machine.

Apply the door lock securely. If you grip the handrail inside the door when moving on top of the track shoes, and the door lock is not applied securely, the door may move and cause you to fall.

Use the points marked by arrows in the diagram when getting on or off the machine.

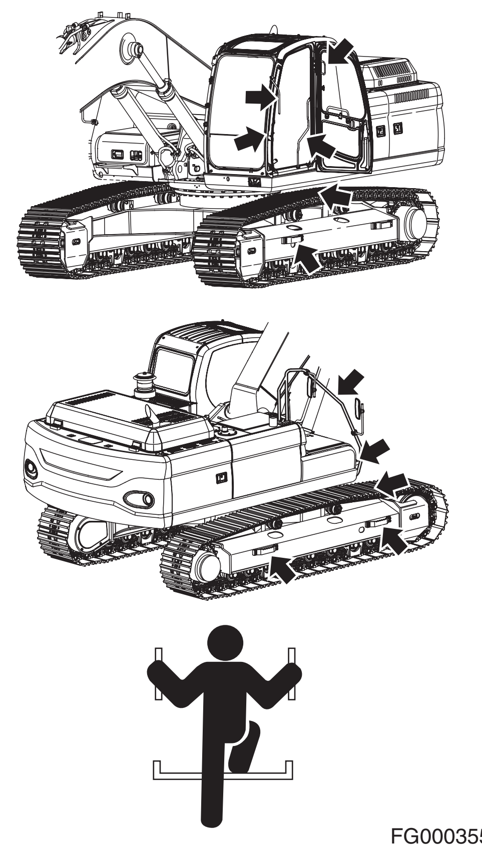


Figure 2

Fuel, Oil and Hydraulic Fluid Fire Hazards

Fuel, oil and antifreeze will catch fire if it is brought close to a flame. Fuel is particularly flammable and can be hazardous.

Always strictly observe the following.

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 extinguished, 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 a 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 3

Precautions When Handling Fluids at High Temperature

Immediately after operations are stopped, the coolant, engine oil, and hydraulic oil are at highest temperatures and the radiator and hydraulic tank are still under pressure. Attempting to remove cap, drain the oil or coolant, or replace the filters may lead to serious burns. Always wait for the temperature to go down, and follow the specified procedures when carrying out these operations.

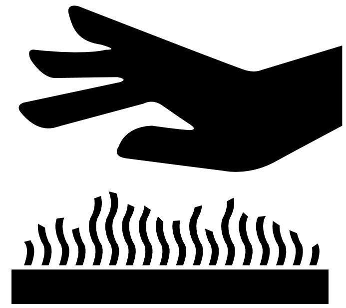

HAOA050L

Figure 4

To prevent hot coolant from spurting out, shut down engine, wait for the coolant to cool, then loosen the cap slowly to relieve the pressure.

To prevent hot oil from spurting out, shut down engine, wait for the oil to cool, then loosen the cap slowly to relieve the pressure.


HAOA060L

Figure 5

Asbestos Dust Hazard Prevention

Asbestos dust can be HAZARDOUS to your health if it is inhaled. Materials containing asbestos fiber can be present on work site. Breathing air that contains asbestos fiber can ultimately cause serious or fatal lung damage. To prevent lung damage from asbestos fiber, observe following precautions:

- Use a respirator that is approved for use in an asbestos-laden atmosphere.
- 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.
- Always observe any regulations related to the work site and working environment.


ARO1770L

Figure 6

Injury from Work Equipment

Do not enter or put your hand, arm or any other part of your body between movable parts, such as between the work equipment and cylinders, or between the machine and work equipment.

If the control levers are operated, the clearance between the machine and the work equipment will change and this may lead to serious damage or personal injury.

If going between movable parts is necessary, always position and secure the work equipment so it cannot move.

Figure 7

Fire Extinguisher and First Aid Kit

As a precaution if any injury or fire should occur, always do the following.

- Be sure that fire extinguishers have been provided and read the labels to ensure that you know how to use them. It is recommended that an appropriately sized (2.27 kg [5 lb] or larger) multipurpose "A/B/C" fire extinguisher be mounted in the cabin. Check and service the fire extinguisher at regular intervals and make sure that all work site crew members are adequately trained in its use.
- Provide a first aid kit in the storage compartment and keep another at the work site. Check the kit periodically and make any additions if necessary.
- Know what to do in case of injury from fire.
- Keep emergency numbers for doctor, ambulance service, hospital and fire department near your telephone.

If the machine catches fire, it may lead to serious personal injury or death. If a fire occurs during operation, escape from the machine as follows:

- Turn the starter switch to the "O" (OFF) position and shut down engine.
- If there is time, use the fire extinguisher to put out as much of the fire as possible.
- Use the handrails and steps to escape from the machine.

The above is the basic method for escaping from the machine, but changing the method may be necessary according to the conditions, so carry out practice drills at the work site.

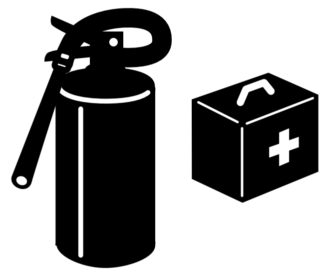
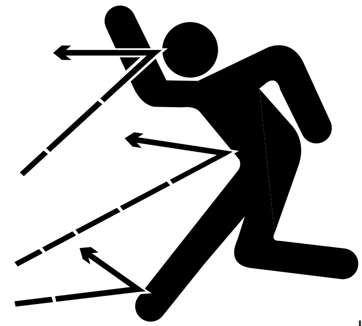


Figure 8

Protection from Falling or Flying Objects

On work sites where there is a danger that falling or flying objects may hit the operator's cabin select a guard to match the operating conditions to protect the operator.

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 cabin could be required in the form of a FOPS (Falling Object Protective Structure) or window guards.



HAOA110L

Figure 9

Never attempt to alter or modify any 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.

HAOA100L

Figure 10

Contact your *DOOSAN* distributor for available safety guards and/or recommendations to prevent danger of getting hit by objects that could strike the operator's cabin. Make sure that all other work site crew members are kept well away from the excavator and safe from possible hazards.

For breaker operation, install a front guard and apply a laminated coating sheet to the front glass. Contact your *DOOSAN* distributor for recommendations.

When carrying out demolition or cutting operation, install a front guard and top guard, and apply a laminated coating sheet to the front glass.

When working in mines or quarries where there is a danger of falling rock, install FOPS (Falling Objects Protective Structure) and apply a laminated coating sheet to the front glass.

If any glass on the machine is broken, replace it with new glass immediately.

Attachment Precautions

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

Accumulator

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

When performing maintenance on the pilot control system, the hydraulic pressure in the system must be released as described in "Handling of Accumulator" in the Operation and Maintenance Manual.

The accumulator is charged with high-pressure nitrogen gas, so it is extremely dangerous if it is handled in the wrong way. Always observe the following precautions:

- Do not drill or make any holes in the accumulator or expose it to any flames, fire or heat source.
- Do not weld on the accumulator, or try attaching anything to it.
- When carrying out disassembly or maintenance of the accumulator, or when disposing of the accumulator, the charged gas must be properly released. Contact your *DOOSAN* distributor.
- Wear safety goggles and protective gloves when working on an accumulator. Hydraulic oil under pressure can penetrate the skin and cause serious injuries.

Indoor Ventilation

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

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

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

ARO1770L

Figure 11

Emergency Exit

This machine is equipped with a glass breaking tool. It is behind the operator seat in the upper right corner of the cabin. This tool can be used in case of an emergency that 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.

⚠ WARNING

Protect your eyes when breaking the glass.

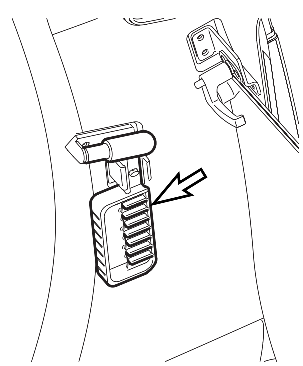


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Figure 12

BEFORE STARTING ENGINE

Work Site Precautions

Before starting operations, thoroughly check the area for any unusual conditions that could be dangerous.

Check the terrain and condition of the ground at the work site, and determine the best and safest method of operation.

Make sure the ground surface is as hard and horizontal as possible before carrying out operations. If there is a lot of dust and sand on the work site, spray water before starting operations.

If you need to operate on a street, protect pedestrians and cars by designating a person for work site traffic duty or by erecting fences and posting "No Entry" signs around the work site.

Erect fences, post "No Entry" signs, and take other steps to prevent people from coming close to or entering the work site. If people come close to a moving machine, they may be hit or caught by the machine, and this may lead to serious personal injury or death.

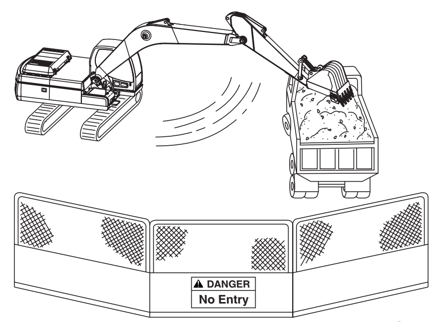

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Figure 13

Waterlines, gas lines, phone lines and high-voltage electrical lines may be buried under the work site. Contact each utility and identify their locations. Be careful not to damage or cut any of these lines.

Check the condition of the riverbed, and the depth and flow of the water before operating in water or crossing a river. NEVER work in water that is more than the permissible water depth.

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

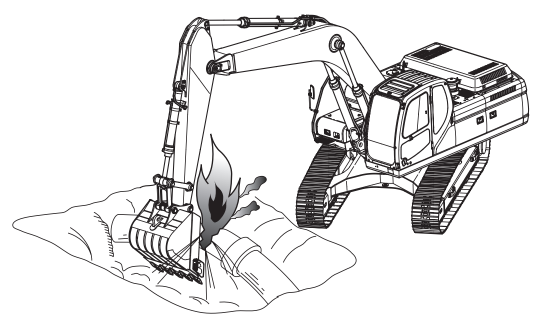

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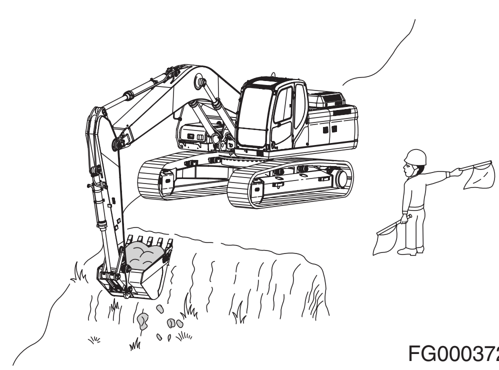
Figure 14

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 regulations, guidelines, standards or restrictions on equipment that may have to be followed for local requirements. There may also be regulations related to performing certain kinds of work. If there is any question about whether your machine and work site complies with the applicable standards and regulations, contact your local authorities and agencies.

Avoid entering soft ground. It will be difficult for the machine to escape.



FG000372

Figure 15

Avoid operating your machine to close to the edge of cliffs, overhangs, and deep ditches. The ground may be weak in such areas. If the ground collapses, the machine could fall or tip over resulting in serious injury or death.

Remember that soil after heavy rain, blasting or after earthquakes, is weakened.

Newly laid earth and the soil near ditches is typically loose. It can collapse under the weight of vibration of your machine and cause your machine to tip over.

Install the head guard (FOPS) if working in areas where there is a danger of falling rocks.

Checks Before Starting Engine

Every day before starting the engine for the first time, carry out the following checks. If these checks are not carried out properly, there is a danger of serious injury.

Remove all wood chips, leaves, grass, paper and other flammable materials accumulated in the engine compartment and around the battery. They could cause a fire. Remove any dirt from the window glass, mirrors, handrails, and steps.

Do not leave tools or spare parts laying around in the operator's cabin. The vibration of the machine when traveling or during operations may cause them to fall and damage or break the control levers or switches. They may also get caught in the gap of the control levers and cause the work equipment to malfunction or move dangerously. This may lead to unexpected accidents.

Check the coolant, fuel, and hydraulic tank oil levels, and check for clogged air cleaner and damage to the electrical wiring.

Adjust the operator's seat to a position where it is easy to operate the machine, and check the seat belt and mounts for damage and wear.

Check the operation of the gauges and the angle of the mirrors, and check that safety lever is in "LOCKED" position.

If any abnormalities are found in the above checks, carry out repairs immediately.

Engine Starting

Walk around your machine before getting in the operator's cabin. 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, 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 cabin.

A machine that has not been used recently, or is being operated in extremely cold temperatures, could require a warm-up or maintenance service before start-up.

Check gauges and monitor displays for normal operation before starting the engine. Listen for unusual noises and remain alert for other potentially hazardous conditions at the start of the work cycle.

Do not short-circuit the starting motor to start the engine. This is not only dangerous, but may also damage the machine.

When starting the engine, sound the horn as an alert.

Start and operate the machine only while seated.

Before Operating Machine

If checks are not carried out properly after starting the engine, it may result in a delay in discovering abnormalities in the machine, and this may lead to personal injury or damage to the machine.

Carry out the checks in an open area where there are no obstructions. Do not let anyone near the machine when carrying out the checks.

- Check the operating condition of the equipment, and the movement of the bucket, arm, boom, travel, and swing systems.
- Check the machine for any abnormal noise, vibration, heat, smell, or abnormality with the gauges. Check also for leakage of air, oil, and fuel.
- If any abnormality is found, repair the problem immediately. If the machine is used without repairing the problems, it may lead to unexpected injury or failure.
- Clear all personnel from directly around machine and from the area.
- Clear all obstacles from the machine's path. Beware of hazards.
- Be sure that all windows are clean. Secure the doors and the windows in the open position or in the shut position.
- Adjust the rearview mirrors for best visibility close to the machine. Make sure that horn, the travel alarm (if equipped), and all other warning devices are working properly.
- Fasten the seat belt securely.
- Warm up the engine and hydraulic oil before operating machine.
- Before moving the machine, check undercarriage position. The normal travel position is with idler wheels to the front under the cabin and the drive sprockets to the rear. When the undercarriage is in the reversed position, the travel controls must be operated in opposite directions.

When Swinging or Changing Direction of Travel

Before operating the machine or the work equipment, always observe the following precautions to prevent serious injury or death.

- Start and operate the machine only while seated.
- When changing travel direction of travel from forward to reverse or from reverse to forward, reduce speed early and stop the machine before changing travel direction.
- Sound the horn to warn people in the area.
- Check that there is no one in the area around the machine. There are blind spots behind the machine, so if necessary, swing the upper structure to check that there is no one behind the machine before traveling in reverse.
- When operating in areas that may be hazardous or have poor visibility, designate a person to direct work site traffic.
- Ensure that no unauthorized person can come within the turning radius or direction of travel.

Be sure to observe the above precautions even if a travel alarm or mirrors are installed.

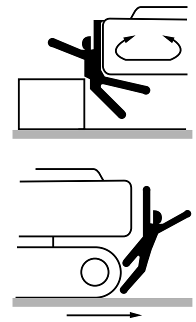


Figure 16

Travel Precautions

Never turn the starting switch to the "O" (OFF) position when traveling. It is dangerous if the engine stops while the machine is traveling. It will be impossible to operate the steering.

Attachment control levers should not be operated while traveling.

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

Fold in work equipment so the outer end of the boom is as close to the machine as possible, and is 40 - 50 cm (16 - 20 in) aboveground.

Never travel over obstacles or slopes that will cause the machine to tilt severely. Travel around any slope or obstacle that causes the machine to tilt 10 degrees or more to the right or left, or 30 degrees or more from front to rear.

Do not operate the steering suddenly. The work equipment may hit the ground and cause the machine to lose its balance, and this may damage the machine or structures in the area.

When traveling on rough ground, travel at low speed, and avoid sudden changes in direction.

Always keep to the permissible water depth. Permissible water depth is to the centerline of the upper track rollers.

When traveling over bridges or structures on private land, check first that bridge or structure can withstand the weight of the machine. When traveling on public roads, check with the local authorities and follow their instructions.

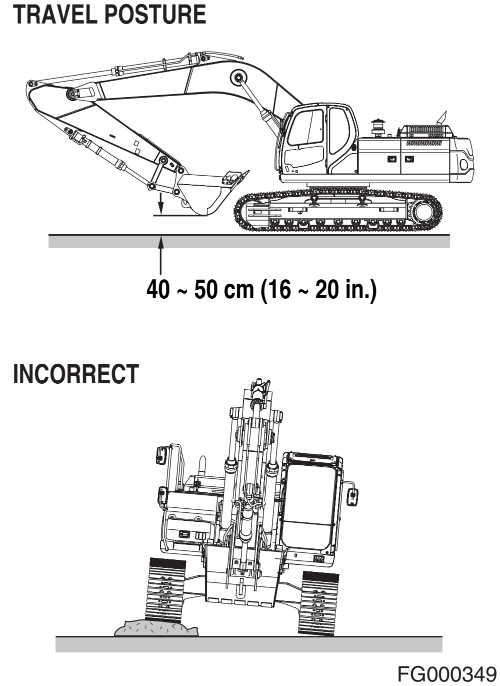


Figure 17

Traveling on Slopes

Never jump onto a machine that is running away to stop it. There is a danger of serious injury.

Traveling on slopes could result in the machine tipping over or slipping.

On hills, banks or slopes, carry the bucket approximately 20 - 30 cm (8 - 12 in) above the ground. In case of an emergency, quickly lower the bucket to the ground to help stop the machine.

Do not travel on grass, fallen leaves, or wet steel plates. Even slight slopes may cause the machine to slip to the side, so travel at low speed and make sure that machine is always traveling directly up or down the slope.

Avoid changing travel direction on a slope. This could result in tipping or sideslipping of the machine.

When possible, operate the machine up slopes and downslopes. Avoid operating the machine across the slope, when possible.

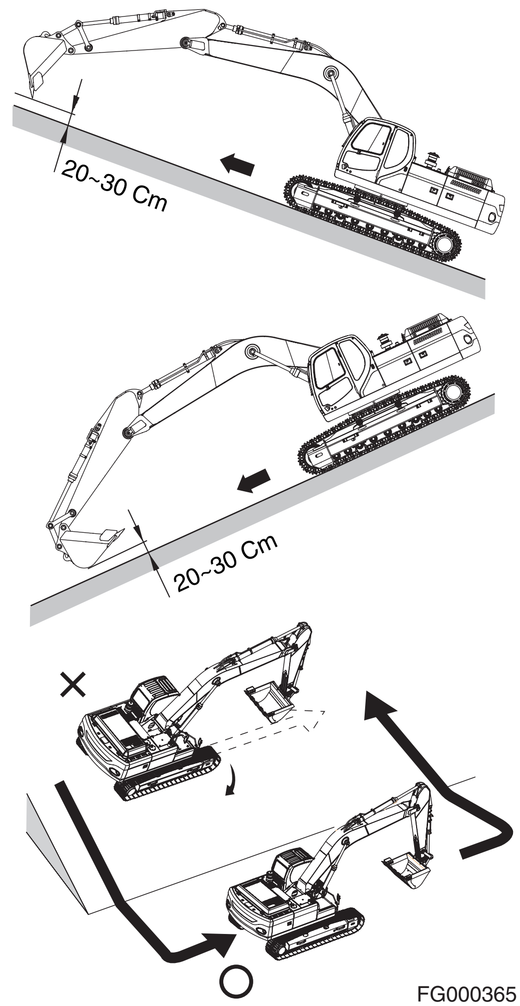


Figure 18

Prohibited Operations

Do not dig the work face under an overhang. This may cause the overhang to collapse and fall on top of the machine.

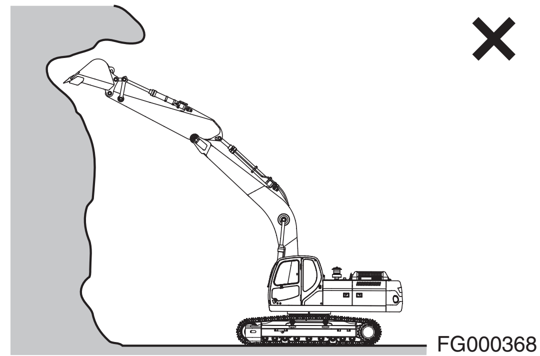


Figure 19

Do not carry out deep digging under the front of the machine. The ground under the machine may collapse and cause the machine to fall.

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

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

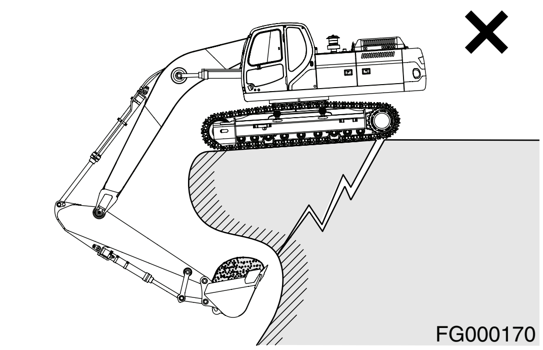


Figure 20

When using the machine, to prevent accidents caused by damage to the work equipment and overturning because of an excessive load, do not use the machine in excess of its ability (in terms of the maximum load and stability determined by the structure of the machine).

When working at the edge of an excavation or on a road shoulder, the machine could tip over, possibly resulting in serious injury or death. Investigate the configuration and ground conditions of the work site beforehand to prevent the machine from falling and to prevent the ground, stockpiles, or banks from collapsing.

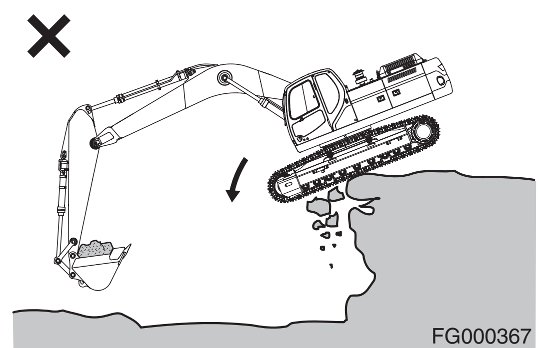


Figure 21

Precautions for Operation

Be careful not to mistakenly travel too close to the edge of a cliff.

Use the machine only for its main purpose. Using it for other purposes will cause failures.

To ensure a good view, always do the following:

- When working in dark areas, attach working lights and front lights to the machine. If necessary, set up lighting at the work site.
- Stop operations when the visibility is poor, such as in fog, mist, snow, and rain. Wait for the visibility to improve to a level which causes no problems for the operation.

To avoid hitting the work equipment, always do the following:

- When working in tunnels, on bridges, under electrical wires, or when parking the machine or carrying out other operations in places with limited height, be careful not to hit the bucket or other parts.
- To prevent collisions, operate the machine at a safe speed when working in confined spaces, indoors, or in crowded areas.
- Do not pass the bucket over the heads of workers or over the operator's cabin of dump truck.

FG000430

Figure 22

Avoid High-Voltage Cables

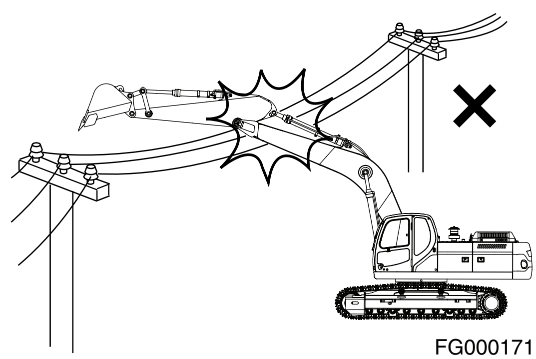
Serious injury or death can result from contact or proximity to high-voltage electrical lines. The bucket does not have to make physical contact with power lines for current to be transmitted.

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

Voltage	Minimum Safe Distance
6.6 kV	3 m (9' 10")
33.0 kV	4 m (13' 1")
66.0 kV	5 m (16' 5")
154.0 kV	8 m (26' 3")
275.0 kV	10 m (32' 10")

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 faraway 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 operation near power lines (either aboveground or buried cable type), you should always contact the power utility company directly and work out a safety plan with them.*



FG000171

Figure 23

Protecting Cabin from Falling Object (Optional)

In a work site where falling objects or flying objects are expected, be sure to install adequate protective devices for covering the cabin.

When using a breaker, be sure to install the front window protection guard (Figure 24).

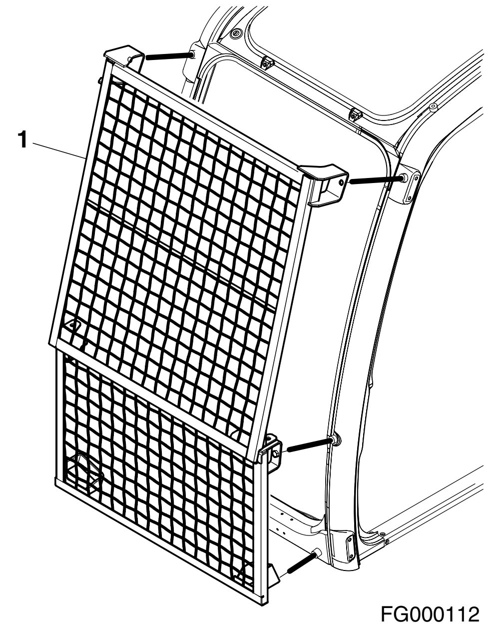


Figure 24

In a work site where falling rocks can cause damage and possibly crush personnel, or in a mining operation, be sure to install the falling object protective structure (Figure 25).

Be sure to install any other additional protective structures required for work site conditions.

When the falling object protective structure is installed, and the front window needs to be cleaned, loosen the bolts marked with an arrow. Be sure to tighten bolts when done.

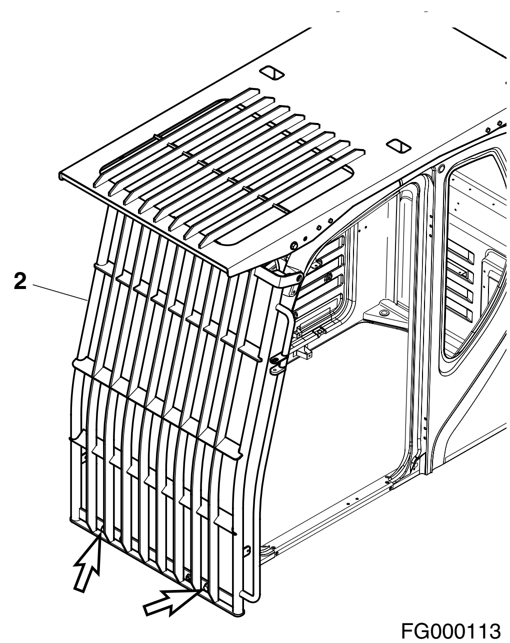


Figure 25

Operate Carefully on Snow, Ice and in Very Cold Temperatures

In icy cold weather avoid sudden travel movements and stay away from even 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 workload may be necessary.

When the temperature rises, frozen road surfaces become soft, and machine travel becomes unstable.

In cold weather, do not touch metal surfaces with your bare hands. If you touch a metal surface in extremely cold weather, your skin may freeze to the metal surface.

Operations on Slopes

When working on slopes. there is a danger that machine may lose its balance and turn over, when swinging, or when work equipment is operated. Always carry out these operations carefully.

Do not swing the work equipment from the uphill side to the downhill side when the bucket is loaded. This operation is dangerous.

If the machine has to be used on a slope, pile the soil to make a platform that will keep the machine as horizontal as possible.

In addition, lower the bucket as far as possible, keep it pulled into the front, and keep the swing speed as low as possible.

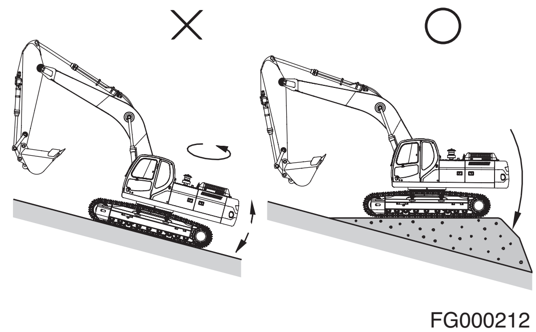


Figure 26

Parking Machine

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

When parking on public roads, provide fences, signs, flags, or lights, and put up any other necessary signs to ensure that passing traffic can see the machine clearly. Park the machine so the machine, flags, and fences do not obstruct traffic.

After the front attachment has been lowered to an overnight storage position and all switches and operating controls are in the "OFF" position, the safety lock lever must be set to the "LOCKED" position. This will disable all pilot circuit control functions.

Always close the door of the operator's cabin.

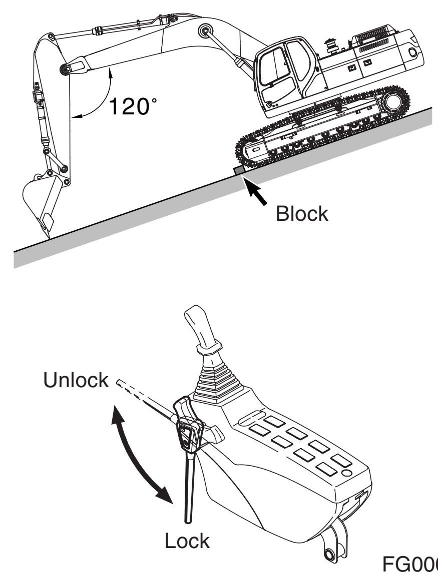


Figure 27

Never Let Anyone Ride on Attachment

Never let anyone ride on any work attachment, such as the bucket, crusher, grapple, or clamshell (grab bucket). There is a danger of the person falling and suffering serious injury.

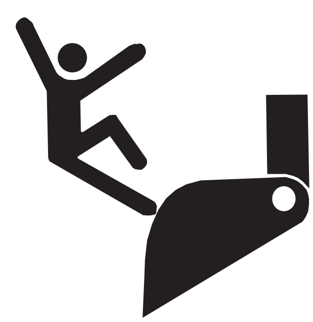


Figure 28

MAINTENANCE

Warning Tag

Alert others that service or maintenance is being performed and tag operator's cabin 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 safety lever in the fully lowered, nonactive position.

Warning tags, for controls are available from *DOOSAN* distributors.

Figure 29

Clean Before Inspection or Maintenance

Clean the machine before carrying out inspection and maintenance. This prevents dirt from getting into the machine and ensures safety during maintenance.

If inspection and maintenance are carried out when the machine is dirty, it will become more difficult to locate the problems, and there is a danger that you may get dirt or mud in your eyes or that you may slip and injure yourself.

When washing the machine, do the following:

- Wear shoes with nonslip soles to prevent yourself from slipping and falling on wet places.
- Wear safety glasses and protective clothing when washing the machine with high-pressure steam.
- Take action to prevent touching high-pressure water and cutting your skin or having mud fly into your eyes.
- Do not spray water directly on electrical components (sensors, connector) (1, Figure 30). If water gets into the electrical system, there is a danger that it will cause defective operation and malfunction.

Pick up any tools or hammers that are laying in the workplace, wipe up any grease or oil or any other slippery substances, and clean the area to make it possible to carry out the operation in safety. If the workplace is left untidy, you may trip or slip and suffer injury.

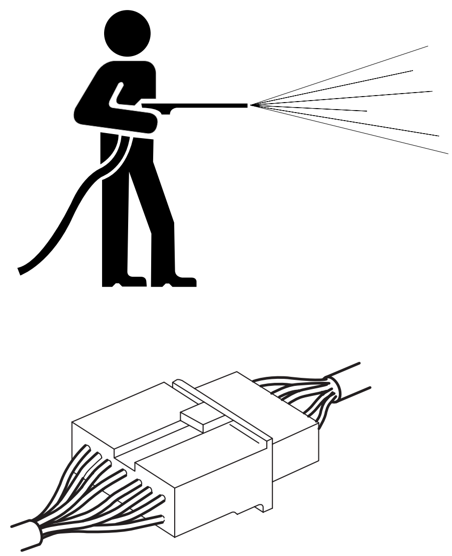


Figure 30

Proper Tools

Use only tools suited to the task. Using damaged, low quality, faulty, or makeshift tools could cause personal injury. There is a danger that pieces from, chisels with crushed heads, or hammers, may get into your eyes and cause blindness.

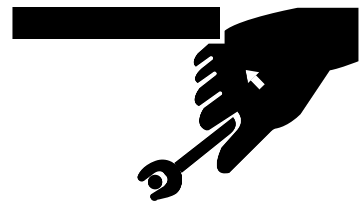

HDO1037L

Figure 31

Use of Lighting

When checking fuel, oil, battery electrolyte, or window washing fluid, always use lighting with antiexplosion specifications. If such lighting equipment is not used, there is a danger of an explosion.

If work is carried out in dark places without using lighting, it may lead to injury, so always use proper lighting.

Even if the place is dark, never use a lighter or flame instead of lighting. There is a danger of fire. There is also danger the battery gas may catch fire and cause an explosion.


HDO1040L

Figure 32

Fire Prevention and Explosion Prevention

All fuels, most lubricants and some coolant mixtures are flammable. Leaking fuel or fuel that is spilled onto hot surfaces or onto electrical components can cause a fire.

Store all fuels and all lubricants in properly marked containers and away from all unauthorized persons.

Store oily rags and other flammable material in a protective container.

Do not smoke while you refuel the machine or while you are in a refueling area.

Do not smoke in battery charging areas or in areas that contain flammable material.

Clean all electrical connections and tighten all electrical connections. Check the electrical wires daily for wires that are loose or frayed. Tighten all lose electrical wires before you operate the machine. Repair all frayed electrical wires before you operate the machine.

Remove all flammable materials before they accumulate on the machine.

Do not weld on pipes or on tubes that contain flammable fluids. Do not flame cut on pipes or on tubes that contain flammable fluids. Before you weld on pipes or on tubes or before you flame cut on pipes or on tubes, clean the pipes or tubes thoroughly with a nonflammable solvent.


HDO1015I

Figure 33

Burn Prevention

When checking the radiator coolant level, shut down engine, let the engine and radiator cool down, then check the coolant recovery tank. If the coolant level in the coolant recovery tank is near the upper limit, there is enough coolant in the radiator.

Loosen the radiator cap gradually to release the internal pressure before removing the radiator cap.

If the coolant level in the coolant recovery tank is below the lower limit, add coolant.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

Allow cooling system components to cool before you drain the cooling system.

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Remove hydraulic tank filter plug only after the engine has been stopped. Make sure that hydraulic tank filter plug is cool before you remove it with your bare hand. Remove hydraulic tank filter plug slowly to relieve pressure.

Relieve all pressure in the hydraulic oil system, in the fuel system, or in the cooling system before you disconnect any lines, fittings, or related items.

Batteries give off flammable fumes that can explode.

Do not smoke while you are checking the battery's electrolyte levels.

Electrolyte is an acid. Electrolyte can cause personal injury. Do not allow electrolyte to contact the skin or the eyes.

Always wear protective glasses when you work on batteries.

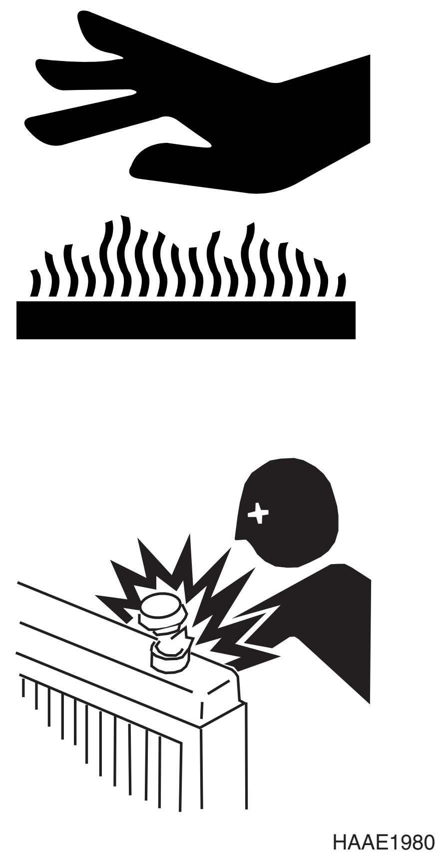


Figure 34

Welding Repairs

When carrying out welding repairs, carry out the welding in a properly equipped place. The welding should be performed by a qualified worker. During welding operations, there is the danger of, generation of gas, fire, or electric shock, so never let an unqualified worker do welding.

The qualified welder must do the following:

- To prevent explosion of the battery, disconnect the battery terminals and remove batteries.
- To prevent generation of gas, remove paint from the location of the weld.
- If hydraulic equipment, piping or places close to them are heated, a flammable gas or mist will be generated and there is a danger of it catching fire. To avoid this, never subject these places to heat.
- Do not weld on pipes or on tubes that contain flammable fluids. Do not flame cut on pipes or on tubes that contain flammable fluids. Before you weld on pipes or on tubes or before you flame cut on pipes or on tubes, clean the pipes or tubes thoroughly with a nonflammable solvent.
- If heat is applied directly to rubber hoses or piping under pressure, they may suddenly break, so cover them with a fireproof covering.
- Wear protective clothing.
- Make sure there is good ventilation.
- Remove all flammable objects and provide a fire extinguisher.

Warning for Counterweight and Front Attachment Removal

DANGER

***DOOSAN* warns any user, that removal of the counterweight from the machine, front attachment or any other part, may affect the stability of the machine. This could cause unexpected movement, resulting in death or serious injuries. *DOOSAN* is not liable for any misuse.**

Never remove counterweight or front attachment unless the upper structure is in-line with the lower structure.

Never rotate the upper structure once the counterweight or front attachment has been removed.

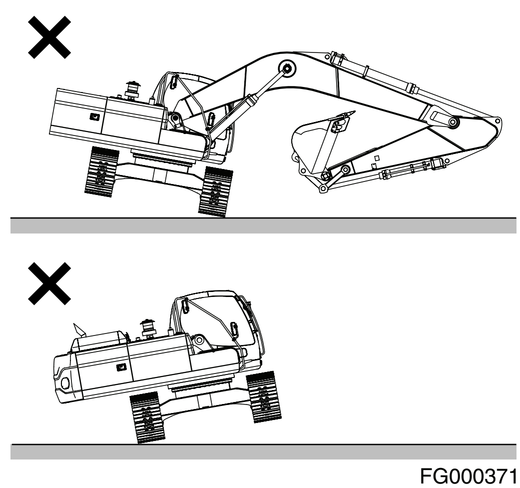


Figure 35

Precautions for Removal, Installation, and Storage of Attachments

Before starting removal and installation of attachments, decide on the team leader.

Do not allow anyone except the authorized workers close to the machine or attachment.

Place attachments that have been removed from the machine in a safe place so they do not fall. Put up a fence around the attachments and take other measures to prevent unauthorized persons from entering.

Figure 36

Precautions When Working on Machine

When carrying out maintenance operations on the machine, keep area around your feet clean and tidy to prevent falls. Always do the following:

- Do not spill oil or grease.
- Do not leave tools laying about.
- Watch your step when walking.

Never jump down from the machine. When getting on or off the machine, use the steps and handrails, and maintain a three-point contact (both feet and one hand or both hands and one foot) to support yourself securely.

If the job requires it, wear protective clothing.

To prevent injury from slipping or falling, when working on the hood or covers, never use any area except the area equipped with nonslip pads.

Figure 37

Lock Inspection Covers

When carrying out maintenance with the inspection cover open, lock the cover securely in position with the lock bar.

If maintenance work is carried out with the inspection cover open but not locked, there is a danger that it may suddenly close and cause injury if there is a gust of wind.

Prevention of Crushing and Cutting

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.

Unless you are instructed otherwise, never attempt adjustments while the machine is moving or while the engine is running.

Stay clear of all rotating parts and moving parts.

Keep objects away from moving fan blades. The fan blades will throw objects and the fan blades can cut objects.

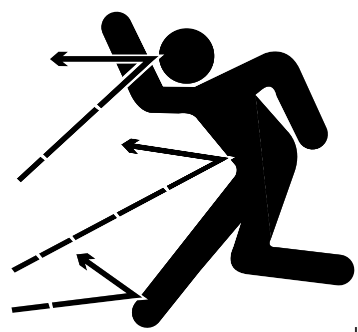
Do not use a wire rope cable that is kinked or frayed. Wear gloves when you handle a wire rope cable.

When you strike a retainer pin, the retainer pin might fly out. The loose retainer pin can injure personnel. Make sure that area is clear of people when you strike a retainer pin. To avoid injury to your eyes, wear protective glasses when you strike a retainer pin.

Track Tension Adjustments Require Caution

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

Keep your face and body away from the valve. Refer to the track adjustment procedure in the Operator and Maintenance Manual or Shop Manual.



HAOA110L

Figure 38

Supports and Blocking for Work Equipment

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 supports.

Do not work under any equipment supported only by a lifting jack.

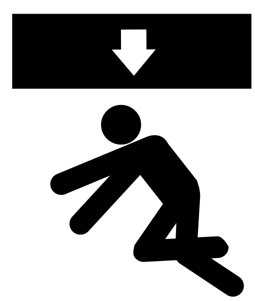


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Figure 39

Action When Abnormality Is Found During Inspection

If any abnormality is found during inspection, always carry out repairs. In particular, if the machine is used when there are still problems with the brake or work equipment systems, it may lead to serious injury.

If necessary depending on the type of failure, please contact your *DOOSAN* distributor for repairs.

Precautions with High-pressure Lines, Tubes and Hoses

When inspecting or replacing high-pressure piping or hoses, check to verify that pressure has been released from the circuit. Failure to release the pressure may lead to serious injury. Always do the following:

- Wear protective glasses and leather gloves.
- 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.
- Do not bend high-pressure lines. Do not strike high-pressure lines. Do not install lines, tubes or hoses that are bent or damaged.
- Make sure that all clamps, guards and heat shields are installed correctly to prevent vibration, rubbing against other parts, and excessive heat during operation.
  - If any of the following conditions are found, replace the part:
  - Damage or leakage from hose end.
  - Wear, damage, cutting of covering, or exposure of strengthening wire layer.
  - Cover portion is swollen in places.
  - There is twisting or crushing at movable parts of hose.
  - Foreign material is embedded in the covering.
  - Hose end is deformed.

NOTE: *Refer to "Hose In-service Lifetime Limit (European Standard ISO 8331 and EN982 CEN)" in the Operation and Maintenance Manual, for additional European regulations.*

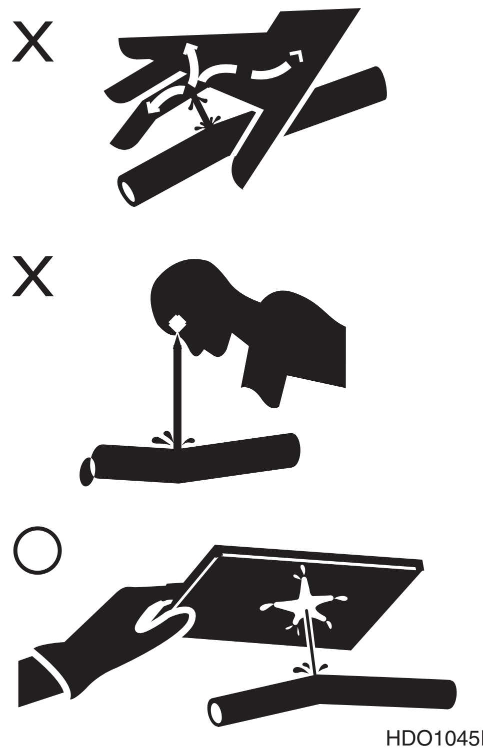

Figure 40

Waste Materials

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. To prevent pollution of the environment, always do the following:

- Never dump waste oil in a sewer system, rivers, etc.
- Always put oil drained from your machine in containers. Never drain oil directly onto the ground.
- Obey appropriate laws and regulations when disposing of harmful materials such as oil, fuel, solvent, filters, and batteries.

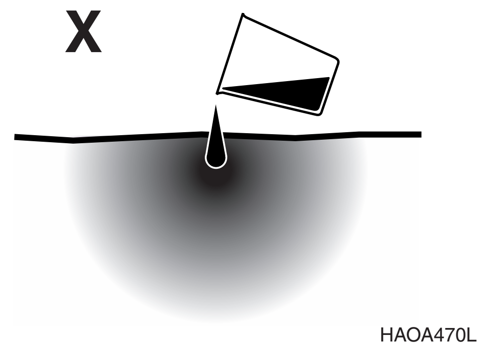

Figure 41

BATTERY

Battery Hazard Prevention

Battery electrolyte contains diluted sulfuric acid and batteries generate hydrogen gas. Hydrogen gas is highly explosive, and mistakes in handling them can cause serious injury or fire. To prevent problems, always do the following:

- Do not smoke or bring any flame near the battery.
- When working with batteries, ALWAYS wear safety glasses and rubber gloves.
- If you spill battery electrolyte on yourself or your clothes, immediately flush the area with water.
- If battery electrolyte gets into your eyes, flush them immediately with large quantities of water and see a doctor at once.
- If you accidentally drink battery electrolyte, drink a large quantity of water or milk, raw egg or vegetable oil. Call a doctor or poison prevention center immediately.
- When cleaning the top surface of the battery, wipe it with a clean, damp cloth. Never use gasoline, thinner, or any other organic solvent or detergent.
- Tighten the battery caps securely.
- If the battery electrolyte is frozen, do not charge the battery or start the engine with power from another source. There is a danger that battery may catch fire.
- When charging the battery or starting with power from another source, let the battery electrolyte melt and check that there is no leakage of battery electrolyte before starting the operation.
- Always remove battery from the machine before charging.

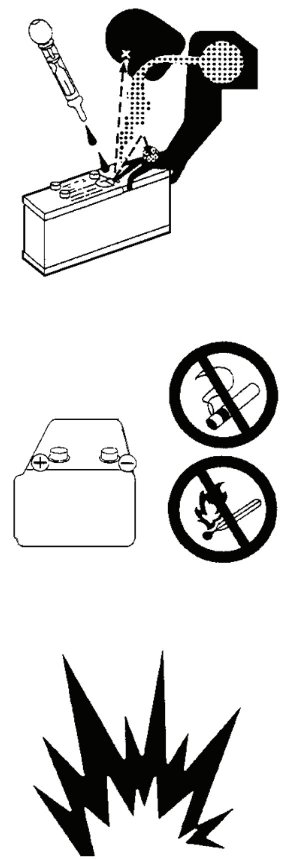

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Figure 42

Boost Starting or Charging Engine Batteries

If any mistake is made in the method of connecting the booster cables, it may cause an explosion or fire. Always do the following:

- 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 battery connections 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 nonseries 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 With a Booster Cable" in the Operation and Maintenance Manual.
- Connect positive cable first when installing cables and disconnect the negative cable first when removing them. The final cable connection, at the metal frame of the machine being charged or boost started, should be as faraway from the batteries as possible.

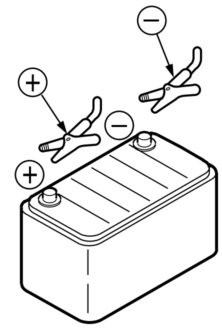


Figure 43

TOWING

Precautions When Towing

If any mistake is made in the method of selecting or inspecting the towing wire or in the method of towing, it may lead to serious personal injury. Always do the following:

- Always use the method of towing given in this Operation and Maintenance Manual. Do not use any other method.
- Use leather gloves when handling the wire rope.
- When carrying out the preparation work for towing with two or more workers, determine the signals to use and follow these signals correctly.
- Always fit the towing rope to the left and right hooks and secure in position.
- If the engine on the problem machine will not start or there is a failure in the brake system. always contact your *DOOSAN* distributor.
- Never go between the towing machine and the towed machine during the towing operation.
- It is dangerous to carry out towing on slopes, so select a place where the slope is gradual. If there is no place where the slope is gradual, carry out operations to reduce the angle of the slope before starting the towing operation.
- When towing a problem machine, always use a wire rope with a sufficient towing capacity.
- Do not use a frayed, kinked rope or a rope with any loss of diameter.
- Do not use the lightweight towing hook for towing another machine.

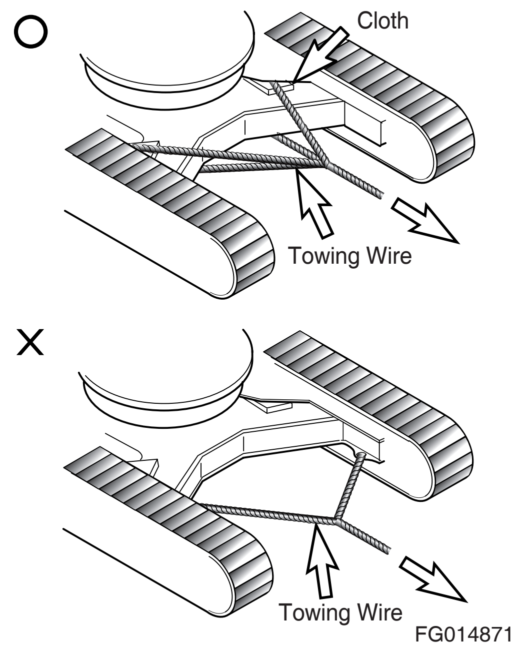


Figure 44

SHIPPING AND TRANSPORTATION

Obey State and Local Over-the-Road Regulations

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

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

Partial disassembly or teardown of the excavator may be necessary to meet travel restrictions or particular conditions at the work 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.

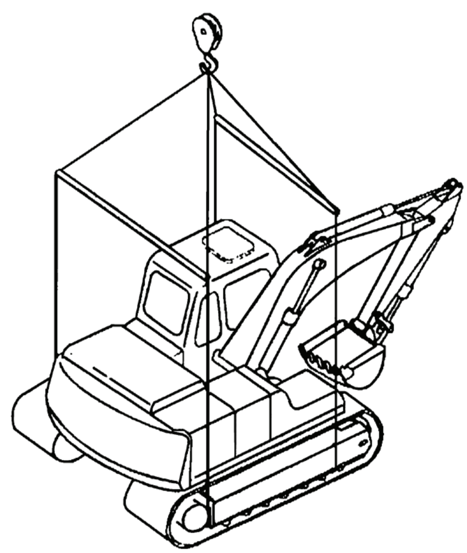
LIFTING WITH SLING

WARNING

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

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

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



HAOJ410L

Figure 45

Specifications

Specification for DX300LCA

Edition 1

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Specification for DX300LC

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LCA	5001 and Up

GENERAL DESCRIPTION

The excavator has three main component sections:

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

The following illustration identifies main components and their locations. (See Figure 1 on page -8.)

COMPONENT LOCATIONS

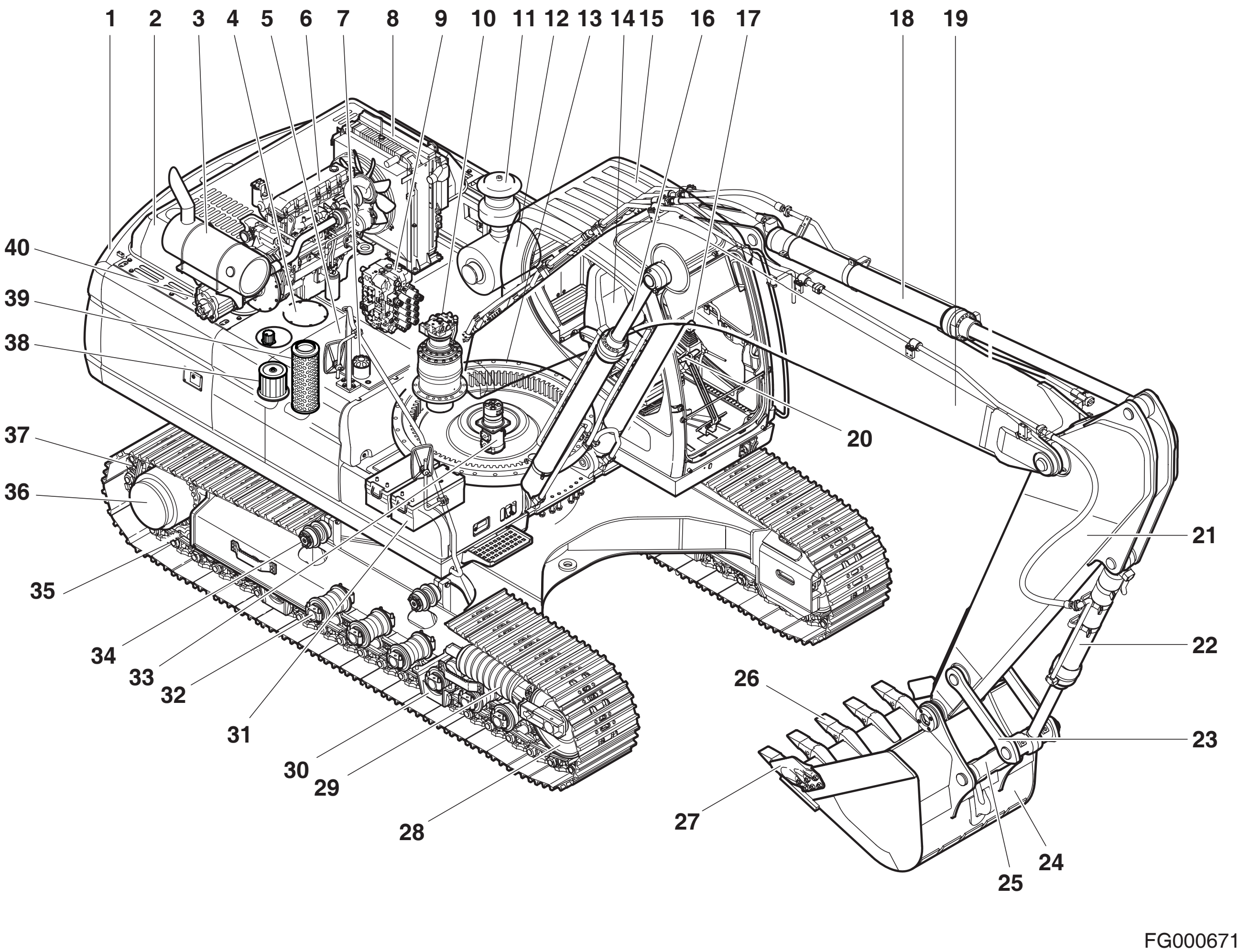

Figure 1

Reference Number	Description
1	Counterweight
2	Hood
3	Muffler
4	Hydraulic Oil Tank
5	Fuel Tank
6	Engine
7	Fuel Tank Fill Cap
8	Radiator and Oil Cooler
9	Control Valves
10	Swing Motor
11	Precleaner
12	Air Cleaner
13	Swing Bearing
14	Seat
15	Cabin
16	Boom Cylinder
17	Work Lever (Joystick) Controls
18	Arm Cylinder
19	Boom
20	Travel Lever

Reference Number	Description
21	Arm
22	Bucket Cylinder
23	Guide Link
24	Bucket
25	Push Link
26	Tooth Point
27	Side Cutter
28	Idler
29	Track Adjuster
30	Track Guide
31	Battery
32	Lower Roller
33	Center Joint
34	Upper Roller
35	Sprocket
36	Travel Motor
37	Track Link and Shoe
38	Suction Filter
39	Return Filter
40	Pumps

GENERAL DIMENSIONS

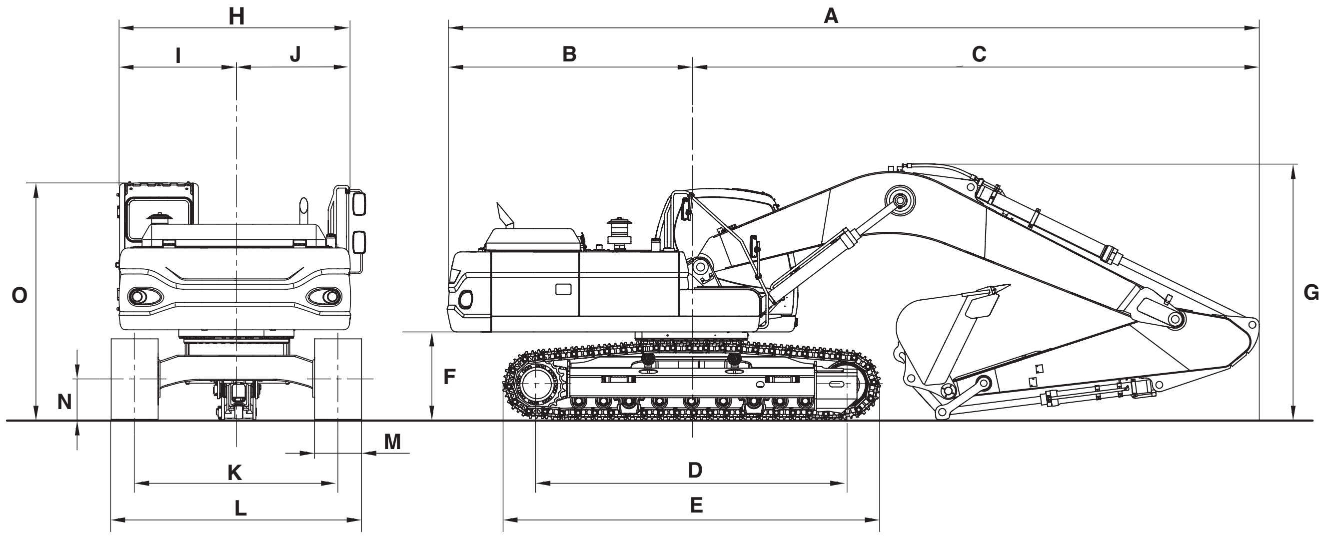

Figure 1

Dimension	6.245 m (20.5 ft) Boom		
	3.1 m (10.17 ft) Arm	**2.5 m (8.2 ft) Arm**	**3.75 m (12.3 ft) Arm**
A	10,620 mm (34' 10")	10,740 mm (35' 3")	10,660 mm (35' 0")
B	3,200 mm (10' 6")		
C	7,420 mm (24' 4")	7,540 mm (24' 9")	7,460 mm (24' 6")
D	4,040 mm (13' 3")		
E	4,940 mm (16' 2")		
F	1,150 mm (3' 9")		
G	3,345 mm (11' 0")	3,475 mm (11' 5")	3,475 mm (11' 5")
H	2,960 mm (9' 9")		
I	1,500 mm (4' 11")		
J	1,460 mm (4' 9")		
K	2,600 mm (8' 6")		
L	3,200 mm (10' 6")		
M	600 mm (23.62 in)		
N	500 mm (19.69 in)		
O	3,065 mm (10' 1")		

WORKING RANGE

WARNING

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

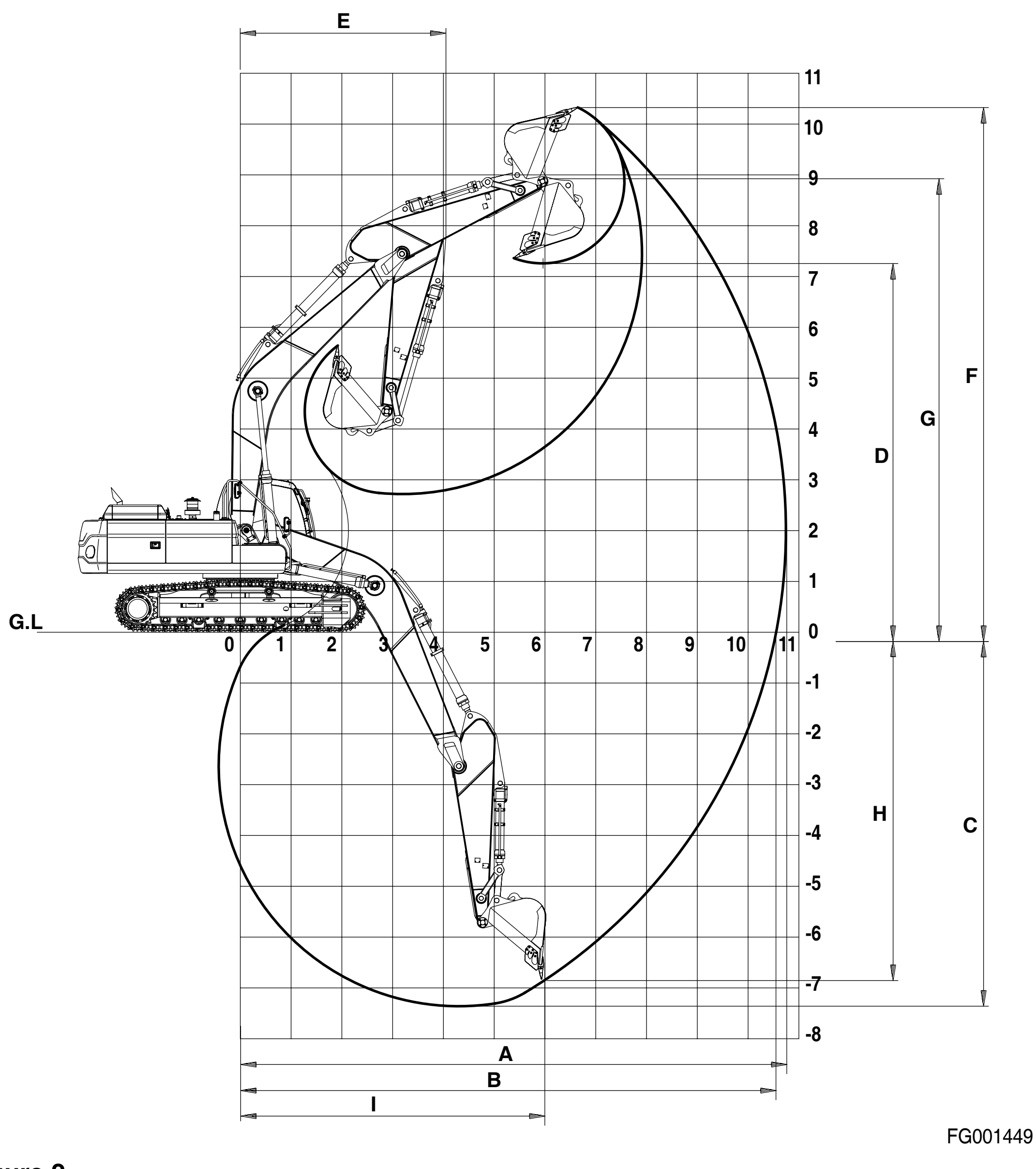

Figure 2

Dim.	Boom Type	One Piece 6.245 m (20.5 ft)		
	Arm Type	3.1 m (10.17 ft)	2.5 m (8.2 ft)	3.75 m (12.3 ft)
	Bucket Type (PCSA)	1.27 m^3 (1.66 yd^3)	1.50 m^3 (1.96 yd^3)	1.75 m^3 (2.29 yd^3)
A	Max. Digging Reach	10,745 mm (35' 3")	10,170 mm (33' 4")	11,270 mm (37' 0")
B	Max. Digging Reach (Ground)	10,550 mm (34' 7")	9,970 mm (32' 9")	11,090 mm (36' 5")
C	Max. Digging Depth	7,380 mm (24' 3")	6,780 mm (22' 3")	8,030 mm (26' 4")
D	Max. Loading Height	7,240 mm (23' 9")	6,910 mm (22' 8")	7,345 mm (24' 1")
F	Max. Digging Height	10,310 mm (33' 10")	9,950 mm (32' 8")	10,390 mm (34' 1")
G	Max. Bucket Pin Height	8,855 mm (29' 1")	8,525 mm (28' 0")	8,960 mm (29' 5")
H	Max. Vertical Wall	6,200 mm (20' 4")	5,425 mm (17' 10")	6,690 mm (21' 11")
I	Max. Radius Vertical	6,820 mm (22' 5")	6,545 mm (21' 6")	7,045 mm (23' 1")
J	Max. Depth to 8 ft Line	7,185 mm (23' 7")	6,505 mm (21' 4")	7,850 mm (25' 9")
K	Min. Radius 8 ft Line	2,990 mm (9' 10")	2,965 mm (9' 9")	2,930 mm (9' 7")
L	Min. Digging Reach	625 mm (2' 1")	1,995 mm (6' 7")	- 305 mm (- 1' 0")
M	Min. Swing Radius	4,055 mm (13' 4")	4,060 mm (13' 4")	4,060 mm (13' 4")

GENERAL SPECIFICATIONS

Shipping Weight	29.2 metric tons (64,375 lb), includes 10% fuel, boom, 3,100 mm (10' 2") arm, 1,334 mm (4' 5") backhoe bucket and standard shoes
Operating Weight	Add weight of full fuel tank and operator.
Shipping Weights With Optional Track Shoes	Add 600 kg (1,320 lb) for 700 mm (27.6") shoes
	Add 900 kg (1,984 lb) for 800 mm (31.5") shoes
	Add 1,200 kg (4,408 lb) for 850 mm (33.5") shoes
Major Component Weights	Standard Boom 2,330 kg (5,137 lb)
	2,500 mm (8' 2") Arm 900 kg (1,984 lb)
	3,100 mm (10' 2") Arm 1,050 kg (2,315 lb)
	3,750 mm (12' 4") Arm 1,060 kg (2,337 lb)
	Boom Cylinders 260 kg (573 lb) each
	Arm Cylinder 340 kg (750 lb)
	Bucket Cylinder 220 kg (485 lb)
	Counterweight 5,300 kg (11,684 lb)
	Upper Turntable 7,700 kg (16,975 lb)
	Lower - below Swing Bearing 10,660 kg (23,500 lb)
Digging Forces:	
Bucket Cylinder	177 KN or 18,000 kg (39,700 lb) - (with either 3,100 mm [10' 2"] or 2,500 mm [8' 2"] arm)
Arm Cylinder	131 KN or 13,400 kg (29,500 lb) with 3,100 mm (10' 2") standard arm
Fuel Tank Capacity	500 liters (132.1 U.S. gal)
Hydraulic System Capacity	280 liters (74 U.S. gal)
Hydraulic Reservoir Capacity	160 liters (42 U.S. gal)
Bucket Heaped Capacity Range	PCSA 0.80 - 1.75 m^3 (1.05 - 2.29 yd^3)
	IMPORTANT: Refer to the Load Weight, Bucket and Arm Length Compatibility Table for information on which bucket sizes may be used safely with which arm length, for load material weights.
Shoe Type	Triple Grouser
Shoe Width and Optional Sizes	600 mm (23.6") - standard
	700 mm (27.6") - optional
	800 mm (31.5") - optional
	850 mm (33.5") - optional
Ground Pressure Ratings:	
Standard 600 mm (23.6") shoe -	0.56 kg/cm^2 (8.0 psi)
Optional 700 mm (27.6") shoe -	0.49 kg/cm^2 (7.0 psi)
Optional 800 mm (31.5") shoe -	0.43 kg/cm^2 (6.1 psi)
Optional 850 mm (33.5") shoe -	0.41 kg/cm^2 (5.8 psi)
Transport Dimensions	
Overall Shipping Length (standard boom and arm)	10,620 mm (34' 10")
Overall Shipping Width (standard shoes)	3,200 mm (10' 6")

Overall Shipping Height (to top of cylinder hose)	3,345 mm (11')
Track Shipping Length	4,940 mm (16' 2")
Transport Trailer Capacity	30 tons (33 short tons), minimum load capacity
Transport Loading Ramp Allowable Slope	15° angle **CAUTION:** Refer to Transport Maximum Procedure for Safe Shipping Instructions.

ENGINE PERFORMANCE CURVES (PER DIN 6270 STANDARD)

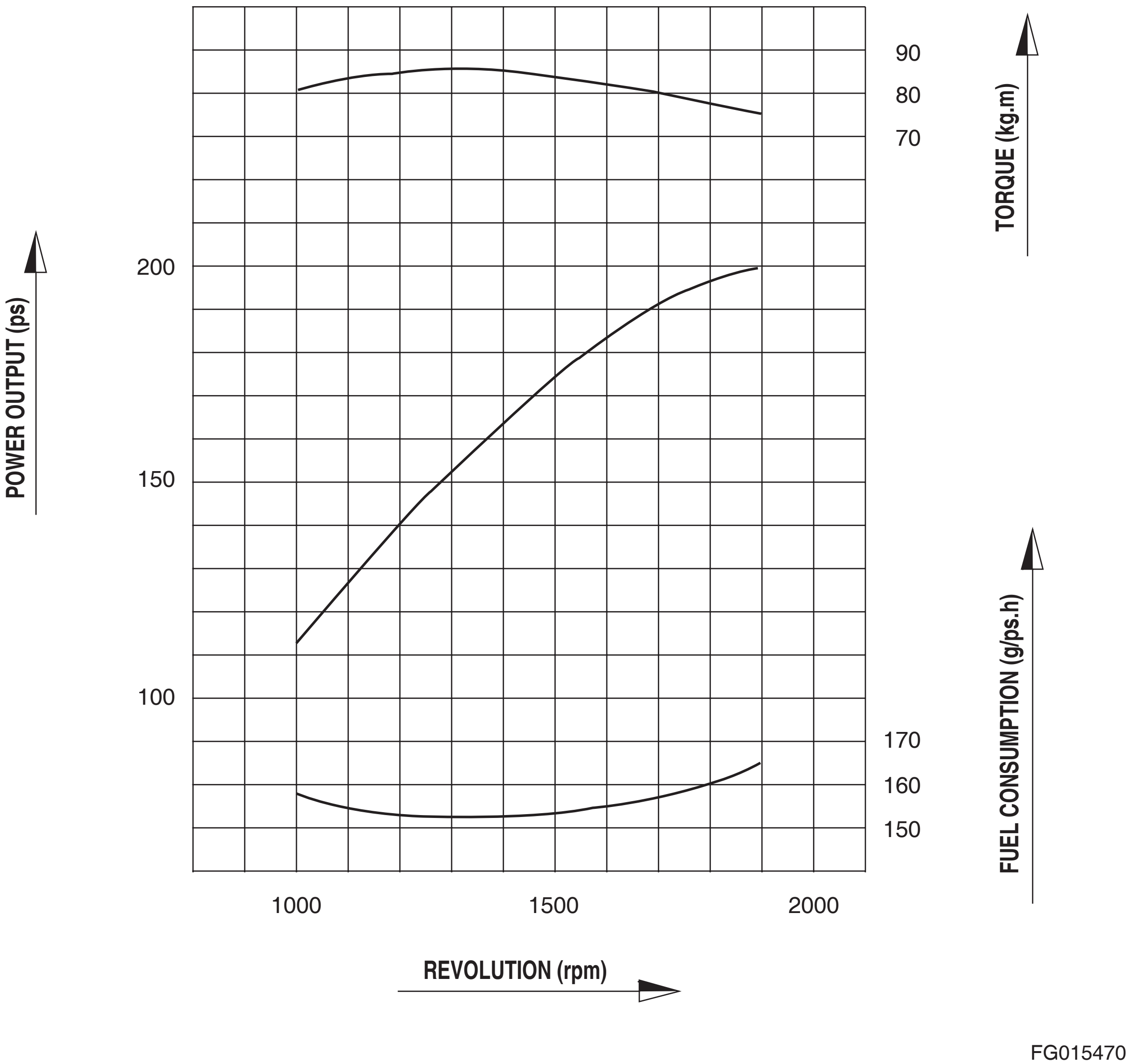

Figure 3

Condition	Specification
Engine Model	DE08TIS
Barometric Pressure	760 mmHg (20°C (68°F))
Cooling Fan	711 mm, SUCKER (28 in)
Alternator	24V x 50A
Air Cleaner	Installed
Muffler	Installed

Performance Standard	KS R1004
Power	200 ps @ 1,900 rpm (197 hp @ 1,900 rpm)
Max. Torque	86 kg•m @ 1,300 rpm (620 ft lb @ 1,300 rpm)
Fuel Consumption (Rated)	165 g/ps•h (5.90 oz/hp•h)

APPROXIMATE WEIGHT OF WORKLOAD MATERIALS

IMPORTANT

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

Material	Low Weight or Density 1,100 kg/m^3 (1,850 lb/yd^3), or Less	Medium Weight or Density 1,600 kg/m^3 (2,700 lb/yd^3), or Less	High Weight or Density 2,000 kg/m^3 (3,370 lb/yd^3), or Less
Charcoal	401 kg/m^3 (695 lb/yd^3)	---------------------	---------------------
Coke, blast furnace size	433 kg/m^3 (729 lb/yd^3)	---------------------	---------------------
Coke, foundry size	449 kg/m^3 (756 lb/yd^3)	---------------------	---------------------
Coal, bituminous slack, piled	801 kg/m^3 (1,350 lb/yd^3)	---------------------	---------------------
Coal, bituminous r. of m., piled	881 kg/m^3 (1,485 lb/yd^3)	---------------------	---------------------
Coal, anthracite	897 kg/m^3 (1,512 lb/yd^3)	---------------------	---------------------
Clay, DRY, in broken lumps	1,009 kg/m^3 (1,701 lb/yd^3)	---------------------	---------------------
Clay, DAMP, natural bed	---------------------	1,746 kg/m^3 (2,943 lb/yd^3)	---------------------
Cement, Portland, DRY granular	---------------------	1,506 kg/m^3 (2,583 lb/yd^3)	---------------------
Cement, Portland, DRY clinkers	---------------------	1,362 kg/m^3 (2,295 lb/yd^3)	---------------------
Dolomite, crushed	---------------------	1,522 kg/m^3 (2,565 lb/yd^3)	---------------------
Earth, loamy, DRY, loose	---------------------	1,202 kg/m^3 (2,025 lb/yd^3)	---------------------
Earth, DRY, packed	---------------------	1,522 kg/m^3 (2,565 lb/yd^3)	---------------------

Material	Low Weight or Density 1,100 kg/m^3 (1,850 lb/yd^3), or Less	Medium Weight or Density 1,600 kg/m^3 (2,700 lb/yd^3), or Less	High Weight or Density 2,000 kg/m^3 (3,370 lb/yd^3), or Less
Earth, WET, muddy	--------------------	--------------------	1,762 kg/m^3 (2,970 lb/yd^3)
Gypsum, calcined, (heated, powder)	961 kg/m^3 (1,620 lb/yd^3)	--------------------	--------------------
Gypsum, crushed to 3 inch size	--------------------	1,522 kg/m^3 (2,565 lb/yd^3)	--------------------
Gravel, DRY, packed fragments	--------------------	--------------------	1,810 kg/m^3 (3,051 lb/yd^3)
Gravel, WET, packed fragments	--------------------	--------------------	1,922 kg/m^3 (3,240 lb/yd^3)
Limestone, graded above 2	--------------------	1,282 kg/m^3 (2,160 lb/yd^3)	--------------------
Limestone, graded 1-1/2 or 2	--------------------	1,362 kg/m^3 (2,295 lb/yd^3)	--------------------
Limestone, crushed	--------------------	1,522 kg/m^3 (2,565 lb/yd^3)	--------------------
Limestone, fine	--------------------	--------------------	1,602 kg/m^3 (2,705 lb/yd^3)
Phosphate, rock	--------------------	1,282 kg/m^3 (2,160 lb/yd^3)	--------------------
Salt	929 kg/m^3 (1,566 lb/yd^3)	--------------------	--------------------
Snow, light density	529 kg/m^3 (891 lb/yd^3)	--------------------	--------------------
Sand, DRY, loose	--------------------	1,522 kg/m^3 (2,565 lb/yd^3)	--------------------
Sand, WET, packed	--------------------	--------------------	1,922 kg/m^3 (3,240 lb/yd^3)
Shale, broken	--------------------	1,362 kg/m^3 (2,295 lb/yd^3)	--------------------
Sulphur, broken	529 kg/m^3 (1,620 lb/yd^3)	--------------------	--------------------

PERFORMANCE TESTS

1. Main Relief Pressure

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

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

2. Actuator Speeds

Operation		Unit	Standard Mode	Power Mode
Boom	Up	sec	3.6 ± 0.4	3.3 ± 0.4
	Down	sec	2.7 ± 0.3	2.5 ± 0.3
Arm	Dump	sec	2.9 ± 0.3	2.8 ± 0.3
	Crowd	sec	4.1 ± 0.4	3.8 ± 0.4
Bucket	Dump	sec	2.9 ± 0.3	2.7 ± 0.3
	Crowd	sec	3.0 ± 0.4	2.7 ± 0.4
Swing (3 Revolutions)		sec	19.5 ± 1.5	18.5 ± 1.5
Jack-up Speed (3 Turns)	High	sec	22.8 ± 1.0	21.7 ± 1.5
	Low	sec	39.3 ± 1.5	37.3 ± 2.0
Travel Speed 20 m (66 ft)	High	sec	15.5 ± 1.0	14.3 ± 1.0
	Low	sec	25.5 ± 1.5	24.2 ± 1.5
Travel Deviation 20 m (66 ft)	High	mm (in)	150 (6)	150 (6)
	Low	mm (in)	150 (6)	150 (6)

EXCAVATOR PERFORMANCE STANDARDS

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

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

Test Conditions

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

Travel Speed and Travel Motor Balance (Steering Deviation) Tests

Speed Test

Prepare the excavator for travel speed tests by extending all hydraulic cylinders - boom, arm and bucket - to the fully extended position, shown in Figure 4.

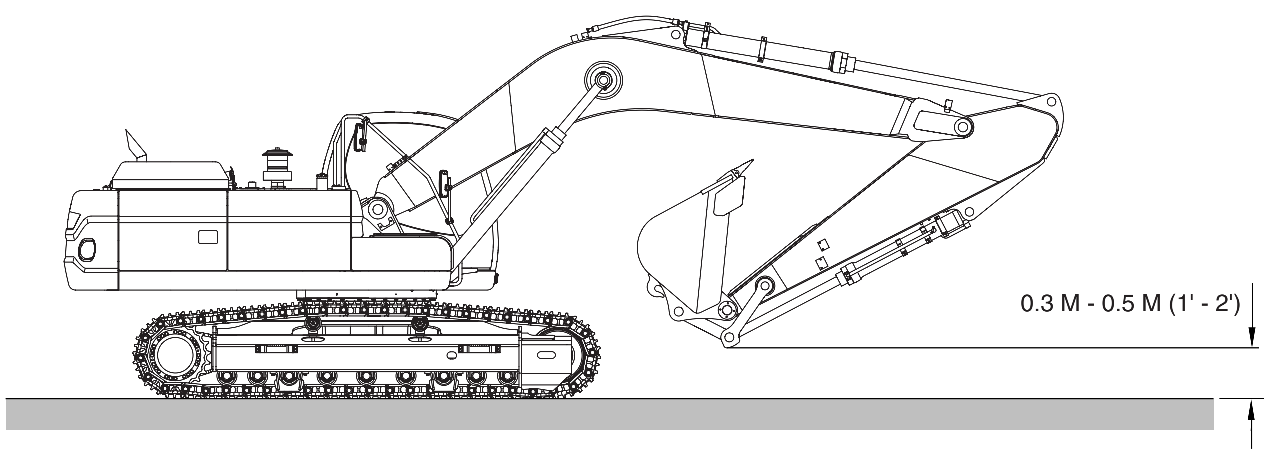

Figure 4

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

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

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

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

Rate of Travel	**Time**	
	Standard Mode	**Power Mode**
High Speed	15.5 ± 1.0 sec	14.3 ± 1.0 sec
Low Speed	25.5 ± 1.5 sec	24.2 ± 1.5 sec

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

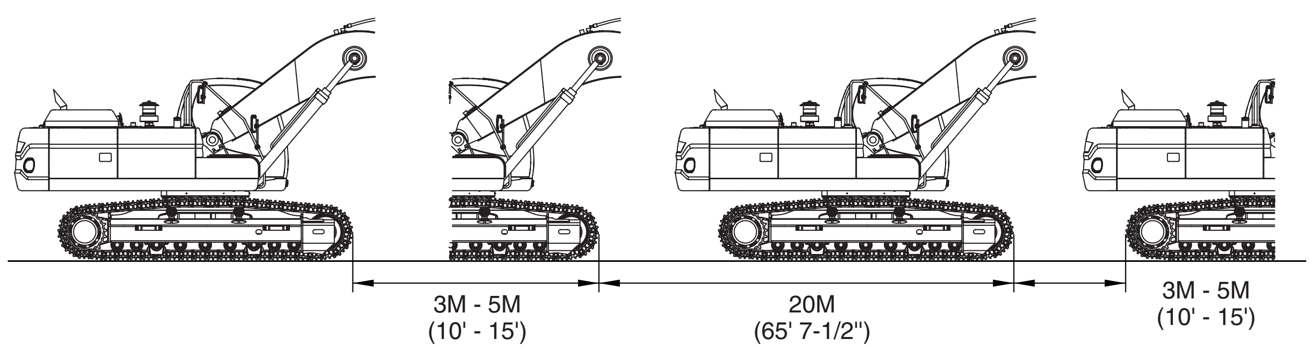

Figure 5

Travel Deviation

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

Deviation distance should always be measured at the 20 m (65' 7-1/2") "finish line." Repeat the test in reverse to measure in both directions, with starting point becoming the finish line, and vice versa. (Figure 5)

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

Rate of Travel	Max. Distance
High Speed	150 mm (6 in)
Low Speed	150 mm (6 in)

Swing Speed and Deceleration Force Test

Swing Speed Test

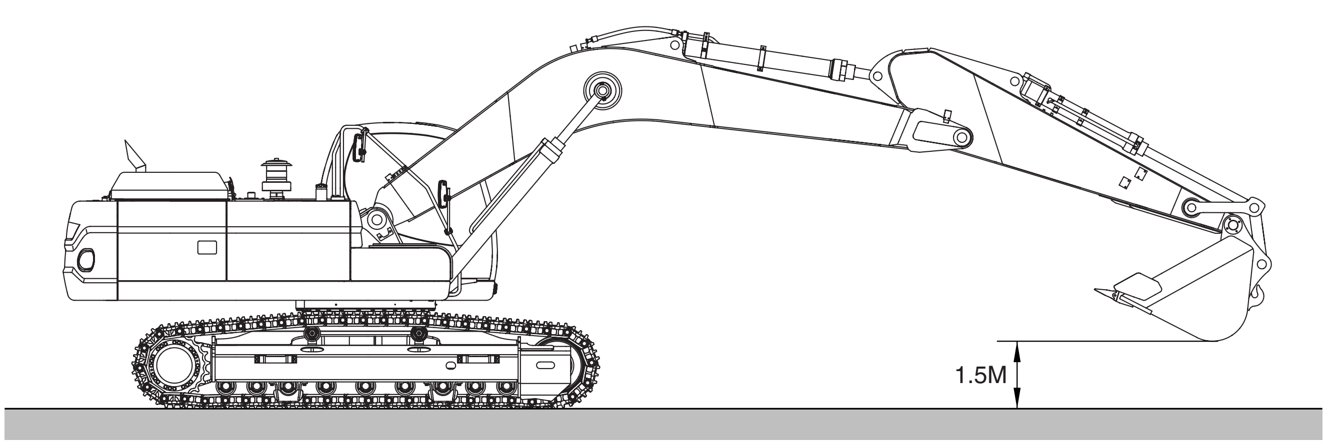

Figure 6

Extend the bucket cylinder completely and retract the arm cylinder, as shown in Figure 6, to test swing speed. The lowest point of the bucket will be approximately 1.5 m (3') off the ground.

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

Swing Deceleration Force Test

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

Make several attempts to rotate the turntable exactly 90°, starting from the boom straight ahead position. Engage the swing lever and brake at the 90° point, shown as "swing stop" in Figure 7.

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

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

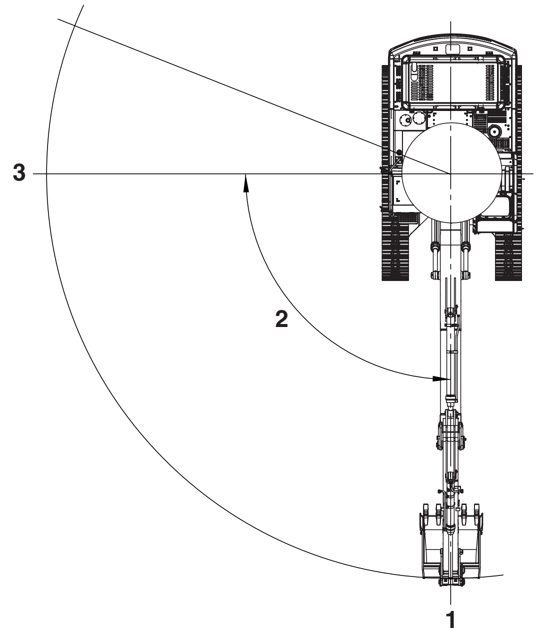

Figure 7

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 Standard Mode and Power Mode.

Arm Cylinder Test

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

Bucket Cylinder Test

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

Operation	Standard Mode	Power Mode
Boom Up	3.2 - 4.0 sec	2.9 - 3.7 sec
Boom Down	2.4 - 3.0 sec	2.2 - 2.8 sec
Arm Dump	2.6 - 3.2 sec	2.5 - 3.1 sec
Arm Crowd	3.7 - 4.5 sec	3.4 - 4.2 sec
Bucket Dump	2.6 - 3.2 sec	2.4 - 3.0 sec
Bucket Crowd	2.6 - 3.4 sec	2.3 - 3.1 sec

Hydraulic Cylinder Natural Drop Test

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

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

Travel Motor Jack-up Test

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

Operation	Standard Mode	Power Mode
High Speed	21.8 - 23.8 sec	20.2 - 23.2 sec
Low Speed	37.8 - 40.8 sec	35.3 - 39.3 sec

General Maintenance

General Maintenance Procedures

Edition 1

MEMO

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General Maintenance Procedures

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
ALL MODELS	ALL RANGES

WELDING PRECAUTIONS AND GUIDELINES

IMPORTANT

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

WARNING

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

CAUTION

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

CAUTION

Observe the following safety precautions:

1. **Use extra caution and adequate safety shielding when welding near fuel and oil tanks, batteries, hydraulic piping lines or other fire hazards.**
2. **Never weld when the engine is running. Battery cables must be disconnected before the welding procedure is started.**
3. **Never weld on a wet or damp surface. The presence of moisture causes hydrogen embrittlement and structural weakening of the weld.**
4. **If welding procedures are being performed near cylinder rods, operator's cabin 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 prefilling with fresh, clean oil if the protective seal on replacement parts has obviously been broken or if seal integrity may have been compromised. When protective seals are removed before installation and reassembly, inspect all replacement parts carefully, before they are installed. If the replacement part is bone dry (with no trace of factory prelube) or has been contaminated by dirt or by questionable oils, flushing and prefilling with clean hydraulic fluid is recommended.

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

A daily walk-around prestart 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 preclean any exterior surface of the system before it is exposed to air. For example, the reservoir fill cap and neck area, hoses that have to be disassembled, and the covers and external surfaces of filter canisters should all be cleaned before disassembly.

MAINTENANCE SERVICE AND REPAIR PROCEDURE

General Precautions

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

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

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

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

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

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

HYDRAULIC SYSTEM CLEANLINESS AND OIL LEAKS

Maintenance Precautions for Hydraulic System Service

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

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

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

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

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

IMPORTANT

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

Oil Leakage Precautions

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

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

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

   NOTE: *Grease lip seals before assembly.*

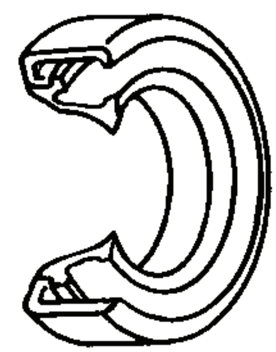


Figure 1

CLEANING AND INSPECTION

General Guidelines

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

WARNING

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

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

   For those bearings that are to be inspected in place; inspect bearings for roughness of rotation, scoring, pitting, cracked or chipped races. If any of these defects are found, replace bearings. Also, inspect defective bearing housing and/or shaft for grooved, galled or burred conditions that indicate bearing has been turning in its housing or on its shaft.
4. It is more economical to replace oil seals, O-rings, sealing rings, gaskets and retaining 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 material. Replace any parts that are deeply grooved or scratched which would affect their operation.

Bearing inspection

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

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

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

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

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

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

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

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

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

Normal Bearing

Smooth even surfaces with no discoloration or marks.

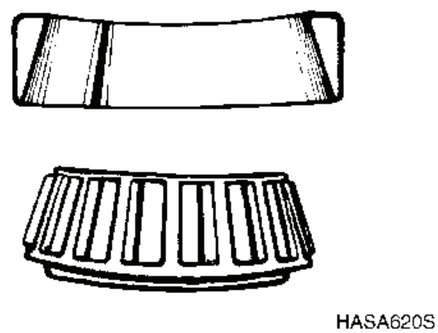


Figure 2

Bent Cage

Cage damage due to improper handling or tool usage.

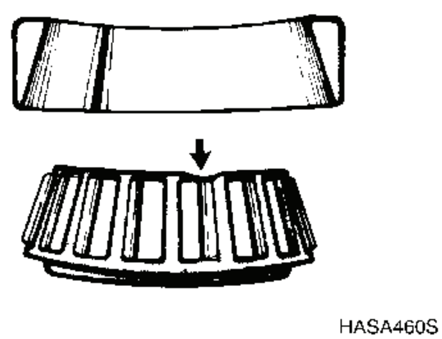


Figure 3

Replace bearing.

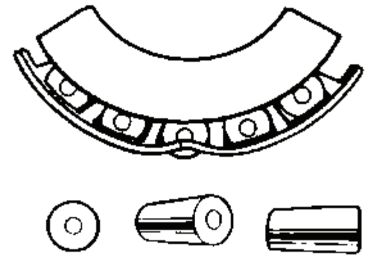


Figure 4

Galling

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

Replace bearing - check seals and check for proper lubrication.

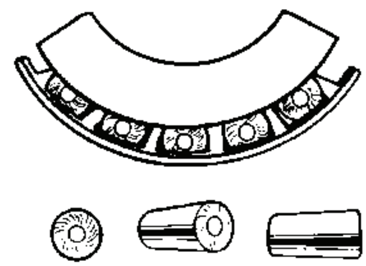


Figure 5

Abrasive Step Wear

Pattern on roller ends caused by fine abrasives.

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

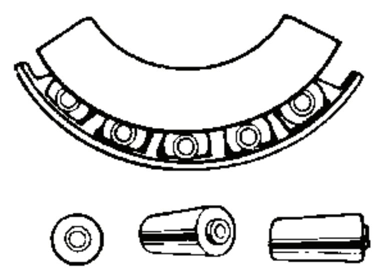


Figure 6

Etching

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

Replace bearings - check seals and check for proper lubrication.

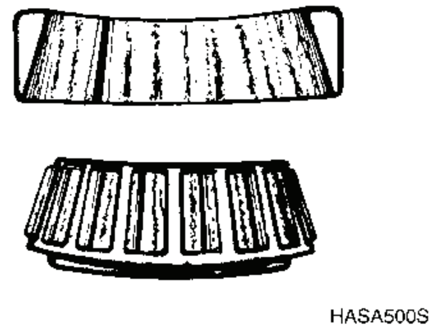


Figure 7

Misalignment

Outer race misalignment due to foreign object.

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

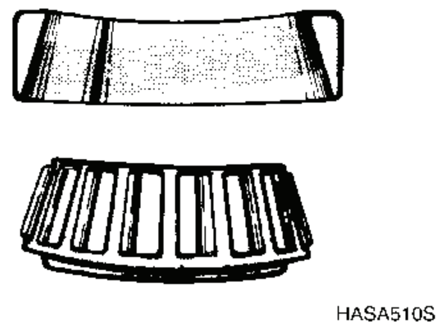


Figure 8

Indentations

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

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

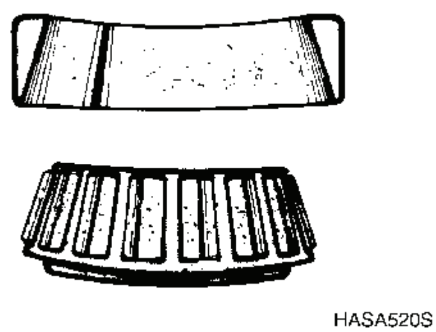


Figure 9

Fatigue Spalling

Flaking of surface metal resulting from fatigue.

Replace bearing - clean all related parts.

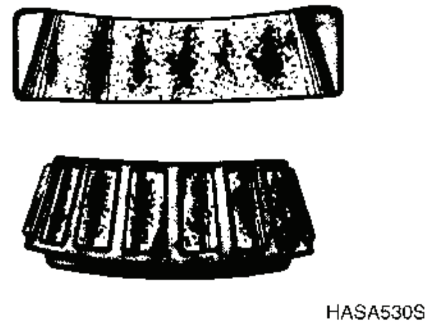


Figure 10

Brinelling

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

Replace bearing if rough or noisy.

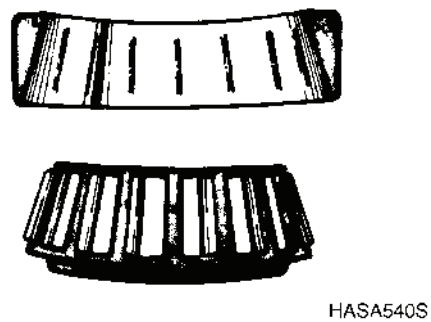


Figure 11

Cage Wear

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

Replace bearings - check seals.

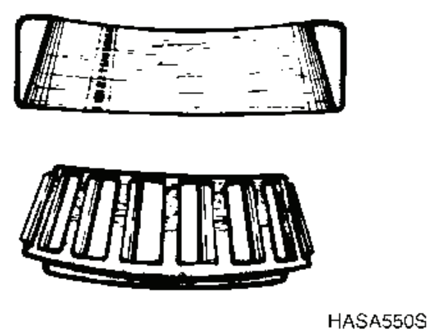


Figure 12

Abrasive Roller Wear

Pattern on races and rollers caused by fine abrasives.

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

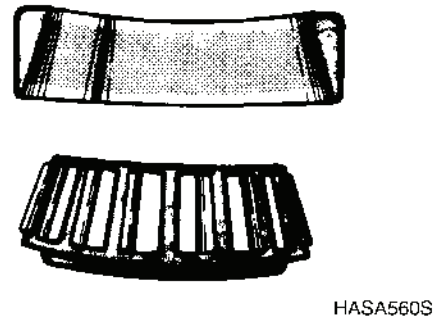


Figure 13

Cracked Inner Race

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

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

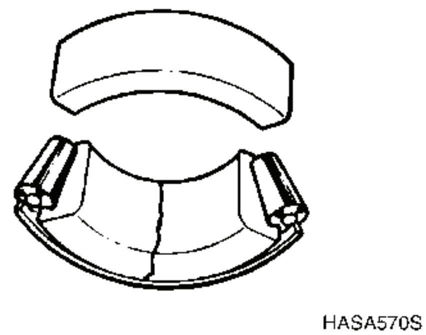


Figure 14

Smears

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

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

Replace shaft if damaged.

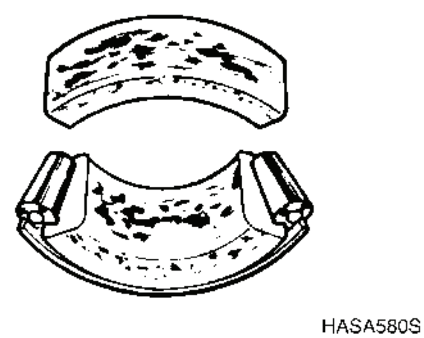


Figure 15

Frettage

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

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

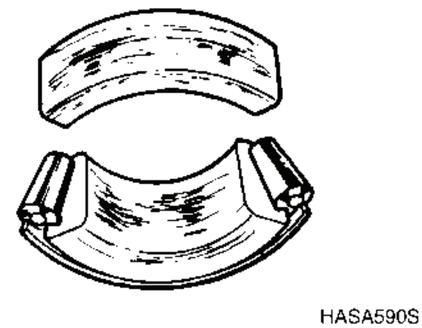


Figure 16

Heat Discoloration

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

Excessive heat can cause softening of races or rollers.

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

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

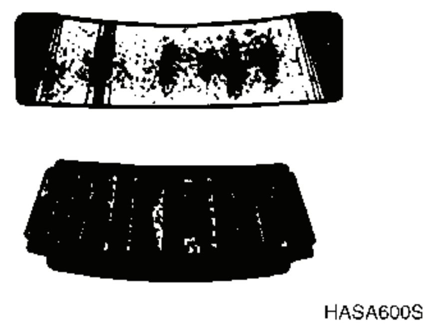


Figure 17

Stain Discoloration

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

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

Check seals and other related parts for damage.

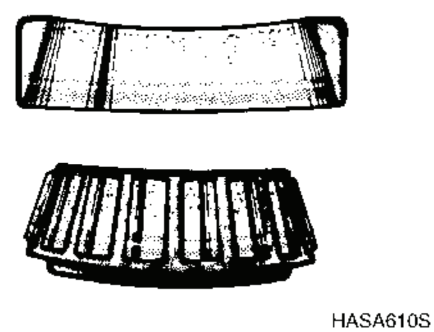


Figure 18

Standard Torques

Edition 1

MEMO

Table of Contents

Standard Torques

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

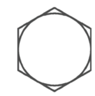
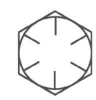
MODEL	SERIAL NUMBER RANGE
ALL MODELS	ALL RANGES

TORQUE VALUES FOR STANDARD METRIC FASTENERS

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

Dia. x Pitc h (mm)	Grade										
	3.6 (4A)	**4.6 (4D)**	**4.8 (4S)**	**5.6 (5D)**	**5.8 (5S)**	**6.6 (6D)**	**6.8 (6S)**	**6.9 (6G)**	**8.8 (8G)**	**10.9 (10K)**	**12.9 (12K)**
M5 x Std.	0.15 (1.08)	0.16 (1.15)	0.25 (1.80)	0.22 (1.59)	0.31 (2.24)	0.28 (2.02)	0.43 (3.11)	0.48 (3.47)	0.50 (3.61)	0.75 (5.42)	0.90 (6.50)
M6 x Std.	0.28 (2.02)	0.30 (2.16)	0.45 (3.25)	0.40 (2.89)	0.55 (3.97)	0.47 (3.39)	0.77 (5.56)	0.85 (6.14)	0.90 (6.50)	1.25 (9.04)	1.50 (10.84)
M7 x Std.	0.43 (3.11)	0.46 (3.32)	0.70 (5.06)	0.63 (4.55)	0.83 (6.00)	0.78 (5.64)	1.20 (8.67)	1.30 (9.40)	1.40 (10.12)	1.95 (14.10)	2.35 (16.99)
M8 x Std.	0.70 (5.06)	0.75 (5.42)	1.10 (7.95)	1.00 (7.23)	1.40 (10.12)	1.25 (9.04)	1.90 (13.74)	2.10 (15.18)	2.20 (15.91)	3.10 (22.42)	3.80 (27.48)
M8 x 1	0.73 (5.28)	0.80 (5.78)	1.20 (8.67)	1.00 (7.23)	1.50 (10.84)	1.35 (9.76)	2.10 (15.18)	2.30 (16.63)	2.40 (17.35)	3.35 (24.23)	4.10 (29.65)
M10 x Std.	1.35 (9.76)	1.40 (10.12)	2.20 (15.91)	1.90 (13.74)	2.70 (19.52)	2.35 (19.99)	3.70 (26.76)	4.20 (30.37)	4.40 (31.18)	6.20 (44.84)	7.20 (52.07)
M10 x 1.25	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 1.25	2.55 (18.44)	2.70 (19.52)	4.00 (28.93)	3.50 (25.31)	5.00 (36.16)	4.50 (32.54)	6.80 (49.18)	7.70 (55.69)	8.00 (57.86)	11.20 (81.00)	13.40 (96.92)
M14 x Std.	3.70 (26.76)	3.90 (28.20)	6.00 (13.23)	5.20 (37.61)	7.50 (54.24)	7.00 (50.63)	10.00 (72.33)	11.50 (83.17)	12.00 (86.79)	17.00 (122.96)	20.00 (144.66)
M14 x 1.5	4.10 (29.65)	4.30 (31.10)	6.60 (47.73)	5.70 (41.22)	8.30 (60.03)	7.50 (54.24)	11.10 (80.28)	12.50 (90.41)	13.00 (94.02)	18.50 (11.26)	22.00 (158.12)
M16 x Std.	5.60 (40.50)	6.00 (43.39)	9.00 (65.09)	8.00 (57.86)	11.50 (83.17)	10.50 (75.94)	15.50 (112.11)	17.90 (129.47)	18.50 (133.81)	26.00 (188.05)	31.00 (224.22)
M16 x 1.5	6.20 (44.84)	6.50 (47.01)	9.70 (70.16)	8.60 (62.20)	12.50 (90.41)	11.30 (81.73)	17.00 (122.96)	19.50 (141.04)	20.00 (144.66)	28.00 (202.52)	35.50 (256.77)
M18 x Std.	7.80 (56.41)	8.30 (60.03)	12.50 (90.41)	11.00 (79.56)	16.00 (115.72)	14.50 (104.87)	21.00 (151.89)	27.50 (198.90)	28.50 (206.14)	41.00 (296.55)	43.00 (311.01)
M18 x 1.5	9.10 (65.82)	9.50 (68.71)	14.40 (104.15)	12.50 (90.41)	18.50 (133.81)	16.70 (120.79)	24.50 (177.20)	27.50 (198.90)	28.50 (206.14)	41.00 (296.55)	49.00 (354.41)
M20 x Std.	11.50 (83.17)	12.00 (86.79)	18.00 (130.19)	16.00 (115.72)	22.00 (159.12)	19.00 (137.42)	31.50 (227.83)	35.00 (253.15)	36.00 (260.38)	51.00 (368.88)	60.00 (433.98)
M20 x 1.5	12.80 (92.58)	13.50 (97.64)	20.50 (148.27)	18.00 (130.19)	25.00 (180.82)	22.50 (162.74)	35.00 (253.15)	39.50 (285.70)	41.00 (296.55)	58.00 (419.51)	68.00 (491.84)
M22 x Std.	15.50 (112.11)	16.00 (115.72)	24.50 (177.20)	21.00 (151.89)	30.00 (216.99)	26.00 (188.05)	42.00 (303.78)	46.00 (332.71)	49.00 (354.41)	67.00 (484.61)	75.00 (542.47)
M22 x 1.5	17.00 (122.96)	18.50 (133.81)	28.00 (202.52)	24.00 (173.59)	34.00 (245.92)	29.00 (209.75)	47.00 (339.95)	52.00 (44.76)	56.00 (405.04)	75.00 (542.47)	85.00 (614.80)
M24 x Std.	20.50 (148.27)	21.50 (155.50)	33.00 (238.68)	27.00 (195.29)	40.00 (289.32)	34.00 (245.92)	55.00 (397.81)	58.00 (419.51)	63.00 (455.67)	82.00 (593.10)	92.00 (655.43)
M24 x 2.0	23.00 (166.35)	35.00 (253.15)	37.00 (267.62)	31.00 (224.22)	45.00 (325.48)	38.00 (202.52)	61.00 (441.21)	67.00 (484.61)	74.00 (535.24)	93.00 (672.66)	103.00 (744.99)

TORQUE VALUES FOR STANDARD U.S. FASTENERS

Type	S.A.E. Grade	Description	Bolt Head Marking
1	1 OR 2	WILL HAVE NO MARKINGS IN THE CENTER OF THE HEAD. Low or Medium Carbon Steel Not Heat Treated.	
5	5	WILL HAVE THREE RADIAL LINES. Quenched and Tempered Medium Carbon Steel.	
8	8	WILL HAVE 6 RADIAL LINES. Quenched and Tempered Special Carbon or Alloy Steel.	

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

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

NOTE: *Multiply the standard torque by:*

0.65 When finished jam nuts are used.

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

0.75 When Parkerized bolts or nuts are used.

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

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

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

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

NOTE: *Torque values listed throughout this manual are lubricated (wet) threads; values should be increased 1/3 for nonlubricated (dry) threads.*

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

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

TYPE 8 PHOSPHATE COATED HARDWARE

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

The torques shown below also apply to the following:

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

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

Nominal Thread Diameter	Standard Torque ±10%	
	Kilogram Meter (kg•m)	Foot Pounds (ft lb)
1/4"	1.1	8
5/16"	2.2	16
3/8"	3.9	28
7/16"	6.2	45
1/2"	9.7	70
9/16"	13.8	100
5/8"	19.4	140
3/4"	33.2	240
7/8"	53.9	390
1"	80.2	580
1 - 1/8"	113.4	820
1 - 1/4"	160.4	1160
1 - 3/8"	210.2	1520
1 - 1/2"	279.4	2020
1 - 3/4"	347.1	2510
2	522.8	3780

TORQUE VALUES FOR HOSE CLAMPS

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

Clamp Type And Size	Torque			
	Radiator, Air Cleaner, Boots, Etc.		Hydraulic System	
	Kilogram Meter (kg•m)	Inch Pounds (in lb)	Kilogram Meter (kg•m)	Inch Pounds (in lb)
"T" Bolt (Any Diameter)	0.68 - 0.72	59 - 63	-------	------
Worm Drive - Under 44 mm (1-3/4 in) Open Diameter	0.2 - 0.3	20 - 30	0.5 - 0.6	40 - 50
Worm Drive - Over 44 mm (1-3/4 in) Open Diameter	0.5 - 0.6	40 - 50	-------	------
Worm Drive - All "Ultra-Tite"	0.6 - 0.7	50 - 60	0.5 - 0.6	40 - 50

TORQUE VALUES FOR SPLIT FLANGES

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

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

Flange Size (*)	Bolt Size	Bolt Torque	
		Kilogram Meter (kg•m)	**Foot Pounds (ft lb)**
1/2"	5/16"	2.1 - 2.5	15 - 18
3/4"	3/8"	3.0 - 3.7	22 - 27
1"	3/8"	3.7 - 4.8	27 - 35
1 - 1/4"	7/16"	4.8 - 6.2	35 - 45
1 - 1/2"	1/2"	6.4 - 8.0	46 - 58
2"	1/2"	7.6 - 9.0	55 - 65
2 - 1/2"	1/2"	10.9 - 12.6	79 - 91
3"	5/8"	19.1 - 20.7	138 - 150
3 - 1/2"	5/8"	16.2 - 18.4	117 - 133

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

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

TORQUE WRENCH EXTENSION TOOLS

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

Common problems that could occur as a result are:

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

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

Torque Multiplication

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

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

I = A x T / A + B where:

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

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

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

B = Length of the extension.

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

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

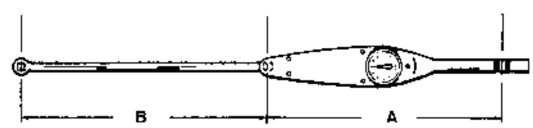


Figure 1

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

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

Other Uses for Torque Wrench Extension Tools

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

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

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

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

Tightening Torque Specifications (Metric)

(For coated threads, prelubricated assemblies.)

CAUTION

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

Use the information on this page as a general guide in selecting specific formulas that will meet the particular requirements of individual assembly installations. *DOOSAN* 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	Breakaway 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/nonclog" formula for high-pressure hydraulic systems. Over application will not restrict or foul system components.	Purple	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)
656	Solvent resistant, higher viscosity tapered thread sealer.	White	Hand tools	4 Hours (or 1/2 hour with Locquic "T" Primer)

III. "Loctite" gasket/flange sealer

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

IV. "Loctite" retaining compounds

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

V. "Loctite" Adhesives

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

Upper Structure

Cabin

Edition 1

Table of Contents

Cabin

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

REMOVAL

CAUTION

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

1. Park on firm and level ground.
2. Lower front attachment (bucket) to ground.
3. Shut down engine.
4. Set safety lever on "RELEASED" position.
5. Turn starter switch to "I" (ON) position.

WARNING

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

6. Fully stroke work levers (joysticks) in all directions to relieve pressure from accumulators.
7. Set safety lever on "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Hang maintenance warning tag on controls.
10. Disconnect the battery cable from the negative (-) battery terminal.
11. Prepare cabin shell for removal by disconnecting wiring connectors for:
    A. Cabin 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 cabin do not need to be disassembled.*

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

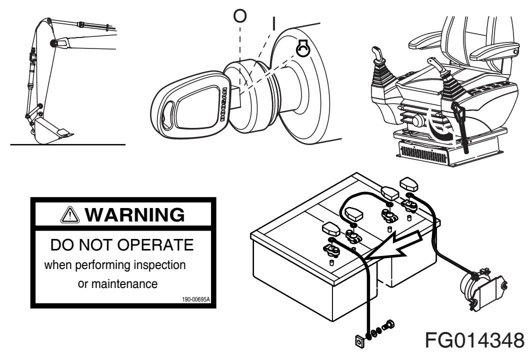


Figure 1

12. Remove floor mat (1, Figure 2).
13. Remove seat (2, Figure 2).

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

14. Remove cup holder (3, Figure 2).

    Remove front cover (4, Figure 2) and side covers (5 and 6, Figure 2). When removing cover(4, Figure 2), disconnect hour meter connector.

    NOTE: *Don't remove monitor panel (7, Figure 2) and switch panel (8, Figure 2).*

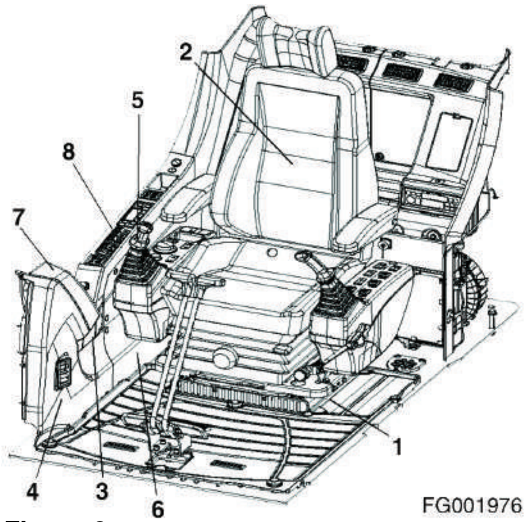


Figure 2

15. After removing rear mat (1, Figure 3), remove rear center cover (2, Figure 3), cassette cover(3, Figure 3) and rear side covers (4 and 5, Figure 3).

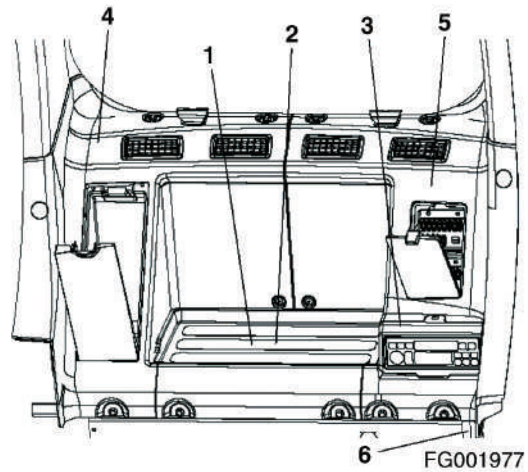


Figure 3

16. Remove fuse box bracket (1, Figure 4) from left side wall without disassembly harness connector.
17. Disconnect cabin ground cable located near fuse box bracket.
18. Remove cassette bracket (2, Figure 4) and disconnet antenna and speaker wire.
19. Remove electric box (4, Figure 4) without disassembly harness connectors.

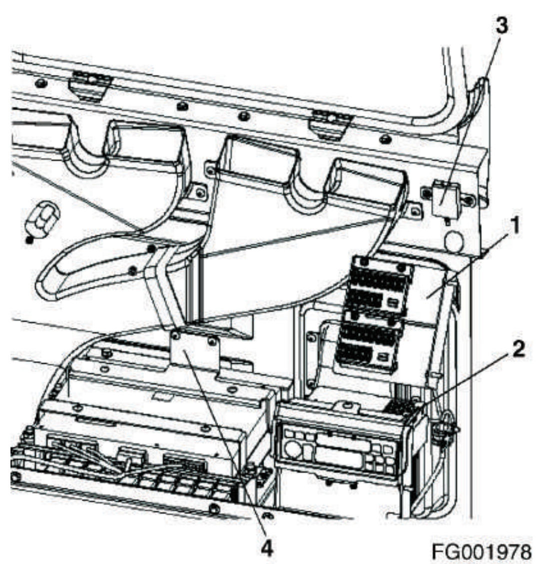


Figure 4

20. Remove air ducts (1, 2, 3 and 4, Figure 5) from cabin rear panel.
21. Remove across bar (5, Figure 5) between left and right side of cabin.

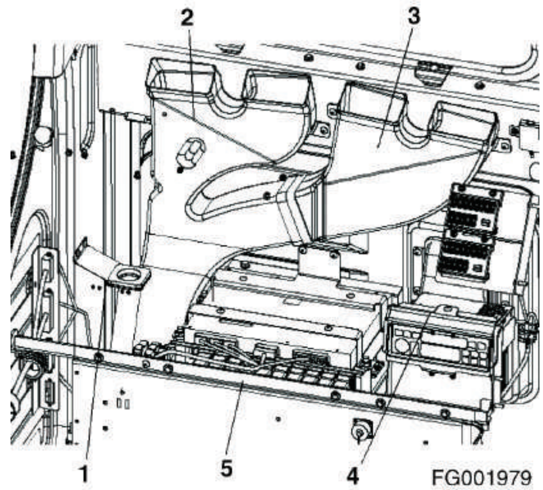


Figure 5

22. Remove air ducts (1, 2, 3, 4 and 5, Figure 6) right side of cabin step by step from the front duct.
23. Disconnect washer hose located at floor plate bottom.
24. Disconnect cabin wiring connectors from main harness.

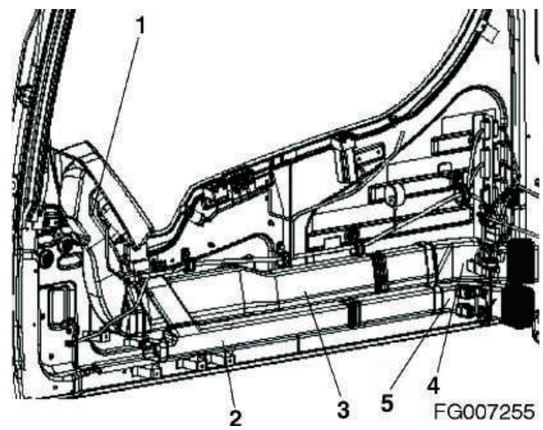


Figure 6

25. Remove four mounting nuts from four corners of cabin floor (1, Figure 7).
26. Remove four M12 hex bolts (2, Figure 7) and two M10 hex bolts (3, Figure 7).

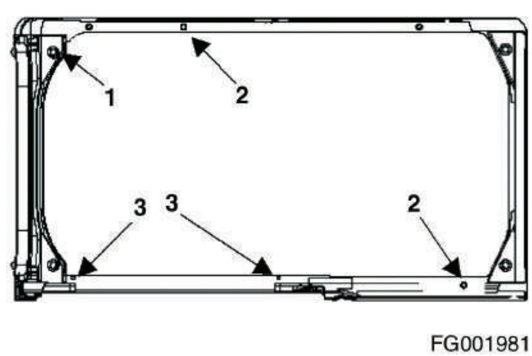


Figure 7

27. Using a suitable lifting device, attach slings to four lift points on top of cab (Figure 8).

NOTE: *Cabin weights approximately 315 kg (700 lb).*

28. Lift cab from 25 ~ 50 mm (1" ~ 2") above deck height. Check that all electrical connections have been disconnected and all other items unbolted.

29. Continue lifting with the assist crane to remove the cab shell. Lower the shell to a prepared safe blocking support.

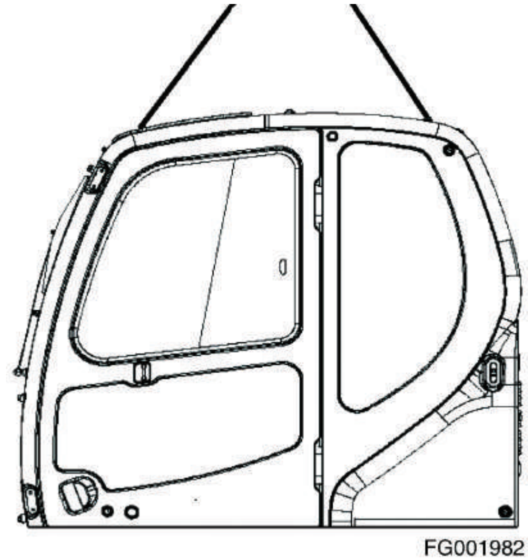


Figure 8

INSTALLATION

1. Using a suitable lifting device, attach slings to four lift points on top of cab (Figure 9).

   NOTE: *Cabin weights approximately 315 kg (700 lb).*

2. Lower cab into position on cab floor.

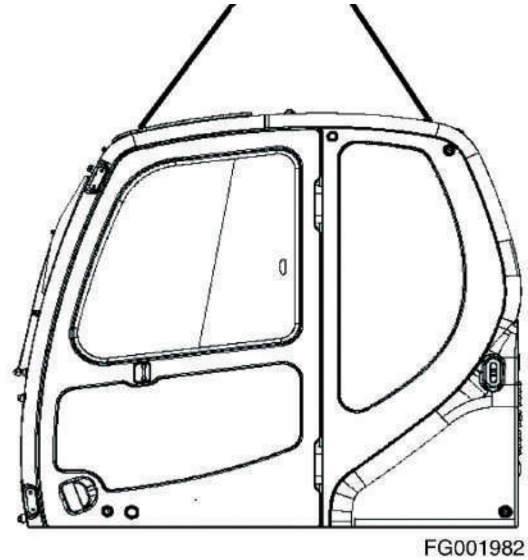


Figure 9

3. Install four mounting nuts from four corners of cabin floor (1, Figure 10).

   NOTE: *Mounting nut torque 21 kg•m (205 N•m, 150 lbf ft).*

4. Install four M12 hex bolts (2, Figure 10) and two M10 hex bolts(3, Figure 10).

   NOTE: *Mounting nut torque*
   M12 - 11 kg•m (108 N•m, 80 lbf ft).
   M10 - 6.5 kg•m (64 N•m, 47 lbf ft).

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

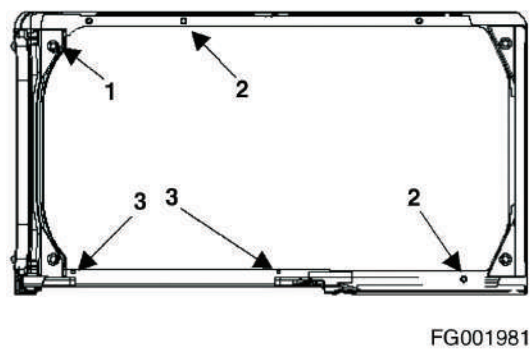


Figure 10

6. Connect cabin wiring connectors to main harness.
7. Connect washer hose located at floor plate bottom.
8. Install air ducts (1, 2, 3, 4 and 5, Figure 11) right side of cabin step by step from the rear duct.

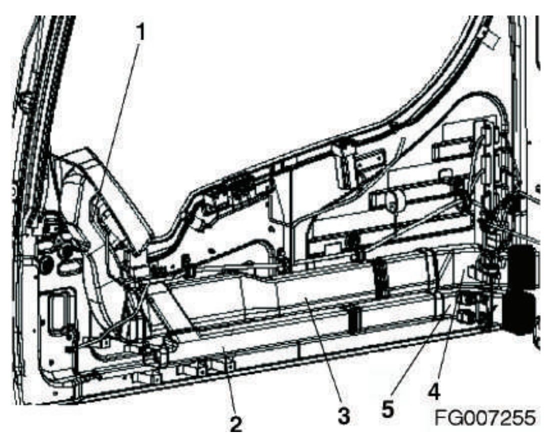


Figure 11

9. Install across bar (5, Figure 12) between left and right side of cabin.
10. Install air ducts (1, 2, 3 and 4, Figure 12) from cabin rear panel.

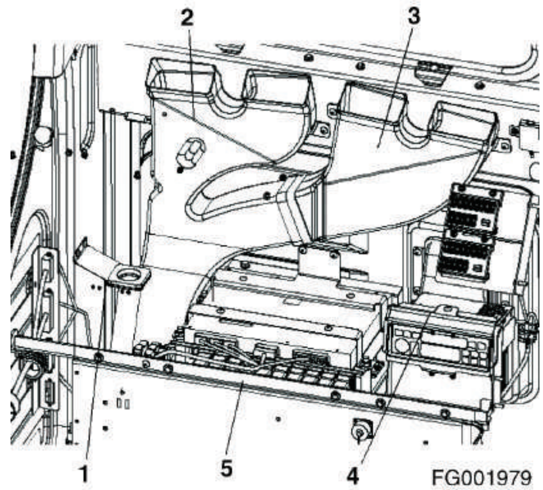


Figure 12

11. Install electric box (4, Figure 13).
12. Install cassette bracket (2, Figure 13) and connet antenna and speaker wire.
13. Connect cabin gound cable located near fuse box bracket.
14. Install fuse box bracket (1, Figure 13) to left side wall of the cab.

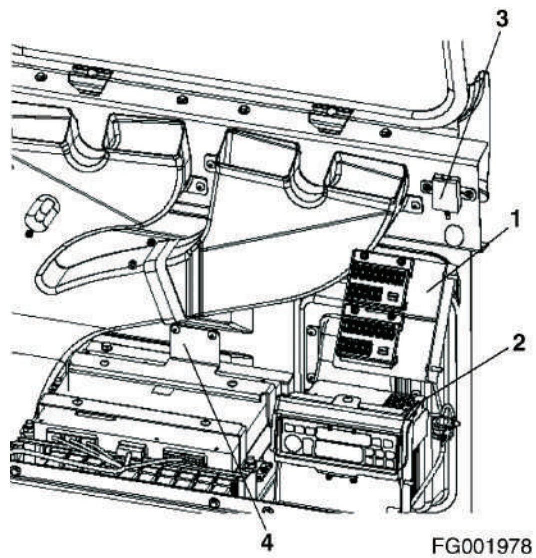


Figure 13

15. Install rear side covers (4 and 5, Figure 14), cassette cover (3, Figure 14) and rear center cover (2, Figure 14), last install rear mat (1, Figure 14).

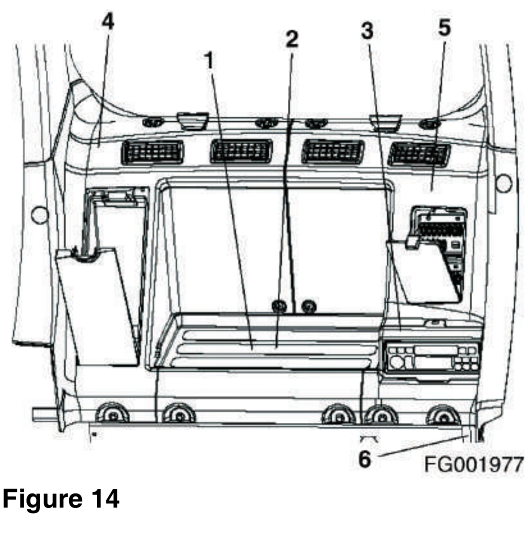


Figure 14

16. Install front cover (4, Figure 15), and side covers (5 and 6, Figure 15), when install cover (4, Figure 15) connect hour meter connector.
17. Install seat (2, Figure 15).

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

18. Install floor mat (1, Figure 15).
19. Connect negative (-) battery cable leading to frame from battery.

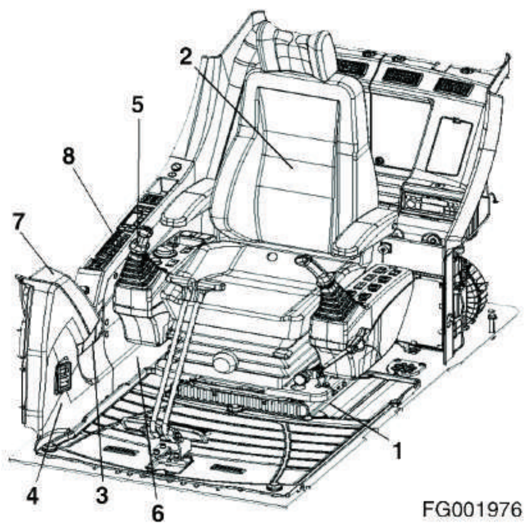


Figure 15

Counterweight

Edition 1

MEMO

Table of Contents

Counterweight

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up

Warning for Counterweight and Front Attachment Removal

DANGER

***DOOSAN* warns any user, that the removal of the counterweight from the machine, front attachment or any other part, may affect the stability of the machine. This could cause unexpected movement, resulting in death or serious injuries. *DOOSAN* is not liable for any misuse.**

Never remove the counterweight or front attachment unless the upper structure is in-line with the lower structure.

Never rotate the upper structure once the counterweight or front attachment has been removed.

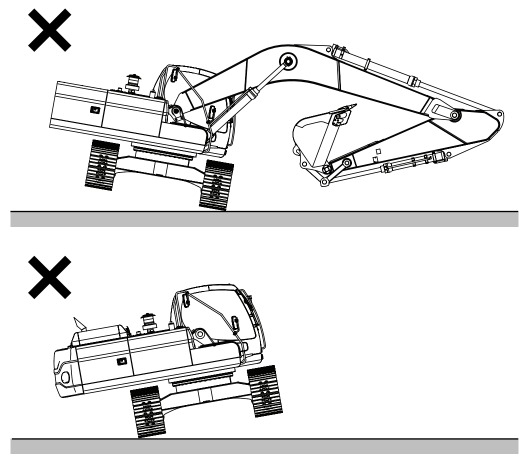

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Figure 1

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

WARNING

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

Model	Weight of Counterweight
DX300LC DX300LCA	5,300 kg (11,685 lb)
	5,900 kg (13,007 lb) (Optional)

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 this procedure has been started.

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

WARNING

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

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

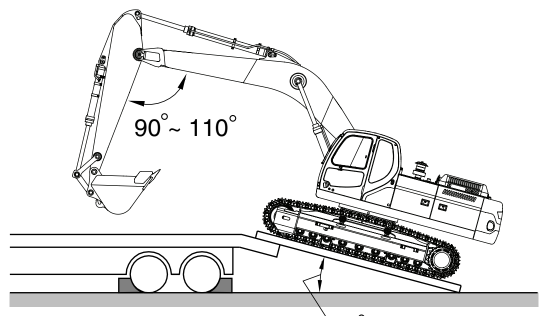

Figure 1

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

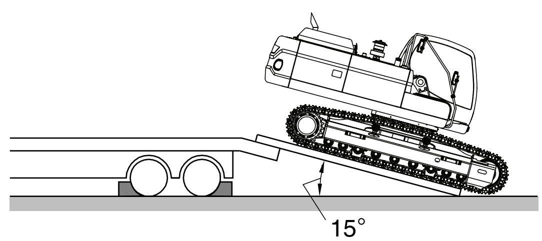

Figure 2

REMOVAL

1. Park on firm and level ground.
2. Lower front attachment (bucket) to the ground.
3. Shut down engine.
4. Set safety lever on "RELEASED" position.
5. Turn starter switch to "I" (ON) position.

WARNING

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

6. Fully stroke work levers (joysticks) in all directions to relieve any pressure from accumulators.
7. Set safety lever on "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Hang maintenance warning tag on controls.
10. Disconnect the battery cable from the negative (-) battery terminal.
11. Remove engine compartment cover.
12. Using a suitable lifting device capable of handling a heavy load, partially support counterweight (1, Figure 4) before loosening four bolts (2). Stop lifting with assist crane as soon as lifting slings are taut.
13. Remove four bolts (2, Figure 4) and washers (3) from counterweight (1).

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

14. 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.

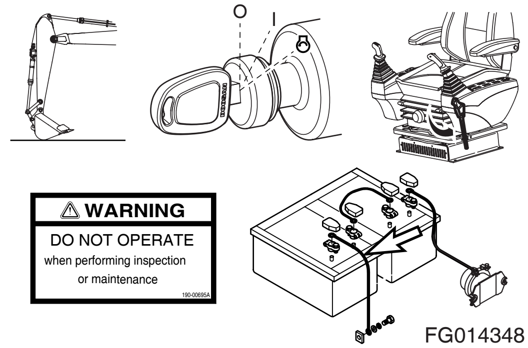

Figure 3

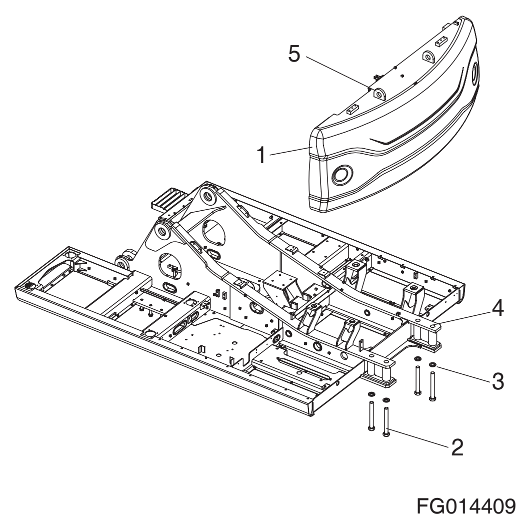

Figure 4

INSTALLATION

1. Using suitable lifting device capable of handling a heavy load, raise counterweight (1, Figure 5) into position just above support frame (4) 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 bolts (2) are started in counterweight mounting holes.*

2. Slide washers (3, Figure 5) onto bolts (2). Apply Loctite #242 to mounting bolt threads.

3. Install four bolts (2, Figure 5) with washers (3) into counterweight until washers contact support frame. Fully lower counterweight onto support frame and finish tightening bolts.

   NOTE: *Torque bolts (2, Figure 5) to values shown in following table.*

Model	Bolt Torque
DX300LC DX300LCA	250 kg•m (1,807 ft lb)

4. Remove lifting device and lifting eyes from counterweight lifting holes (5, Figure 5).

5. Install engine compartment cover.

6. Connect negative (-) battery cable to battery.

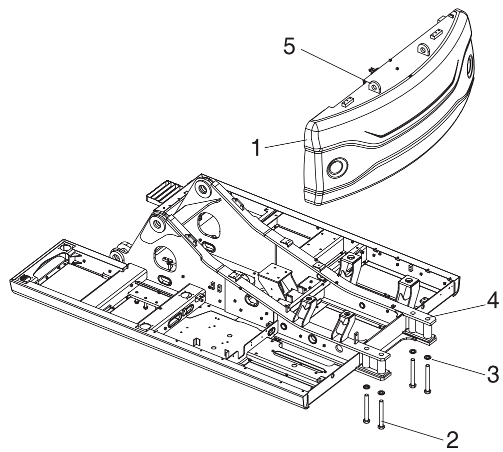

Figure 5

Fuel Tank

Edition 1

MEMO

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Fuel Tank

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LCA	5001 and Up

GENERAL DESCRIPTION

WARNING

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

Parts List

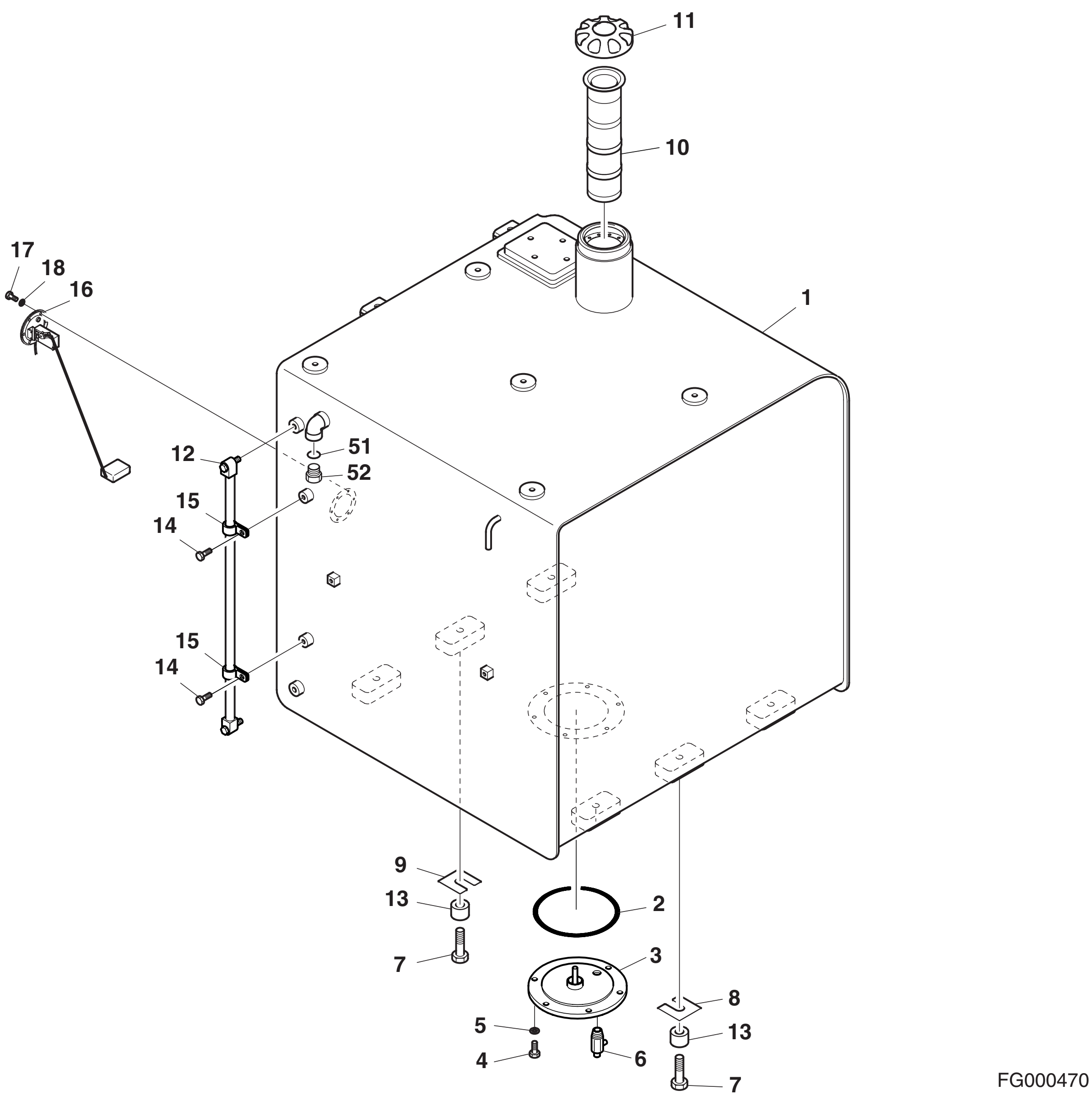


Figure 1

Reference Number	Description
1	Fuel Tank
2	O-ring
3	Cover
4	Bolt
5	Spring Washer
6	Drain Valve
7	Bolt
8	Shim
9	Shim

Reference Number	Description
10	Fuel Strainer
11	Cap
12	Level Gauge
13	Spacer
14	Bolt
15	Clip
16	Fuel Sender
17	Bolt
18	Spring Washer

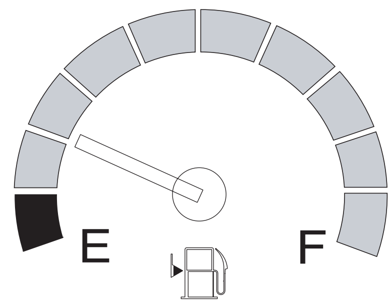
Specifications

Fuel tank capacity is 500 liters (132 U.S. gal).

REMOVAL

1. Look at fuel level display (Figure 2) on instrument panel in operator's cabin to see what it displays. 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.

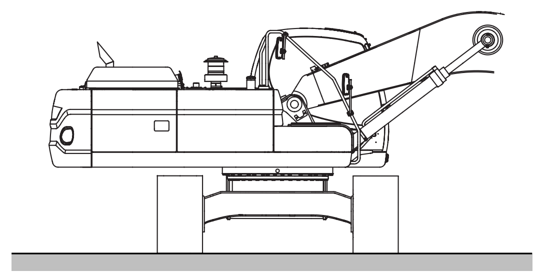
   NOTE: *If possible, work excavator until available fuel supply in tank has been run down as far as possible.*



FG000040

Figure 2

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



FG000471

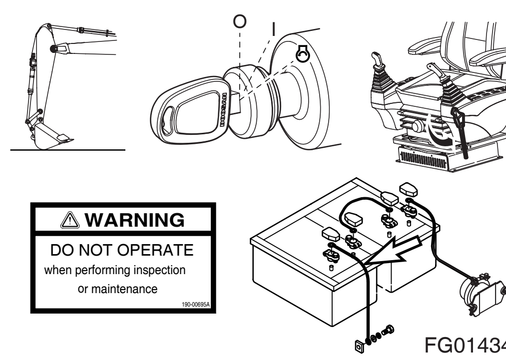
Figure 3

3. Lower front attachment (bucket) to ground.
4. Shut down engine.
5. Set safety lever on "RELEASED" position.
6. Turn starter switch to "I" (ON) position.

WARNING

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

7. Fully stroke work levers (joysticks) in all directions to relieve any pressure from accumulators.
8. Set safety lever on "LOCK" position.
9. Turn key to "O" (OFF) position and remove from starter switch.
10. Hang maintenance warning tag on controls.
11. Disconnect negative (-) battery cable leading to frame from battery.



FG014348

Figure 4

12. Clean area around fuel tank fill cap (11, Figure 5). Open fuel cap.

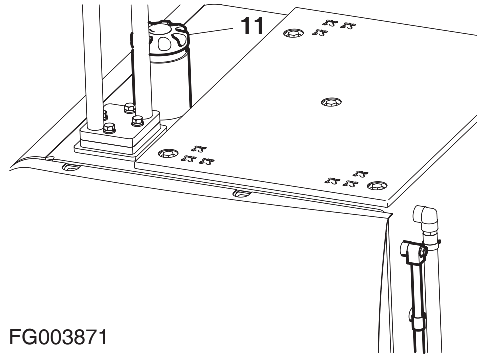


Figure 5

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

    NOTE: *Fuel tank capacity is 500 liters (132 U.S. gal).*

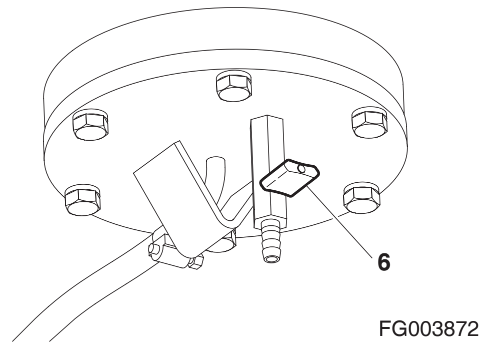


Figure 6

14. Tag and disconnect fuel supply line (21, Figure 7) and fuel return line (19) from fuel tank (1) and carefully drain remaining fuel from lines.

15. Remove clamp (20, Figure 7) holding fuel return line (19) to tank (1).

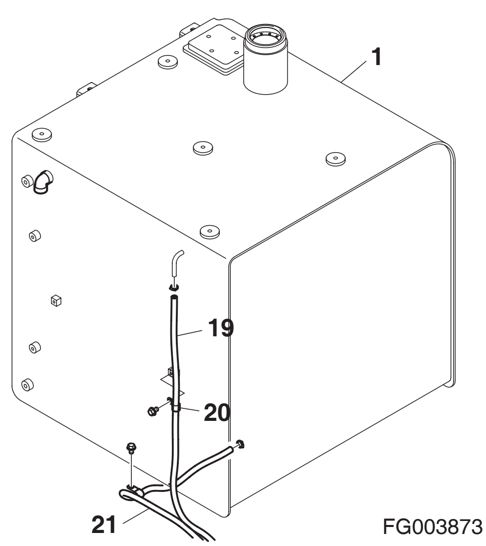


Figure 7

16. If equipped, remove components from fuel filler pump port (22, Figure 8) on side of fuel tank (1).

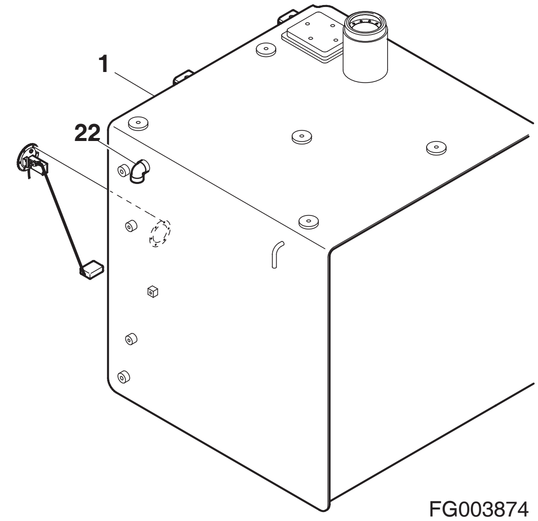


Figure 8

17. Remove five bolts (23, Figure 9) and cover (24) from fuel tank.

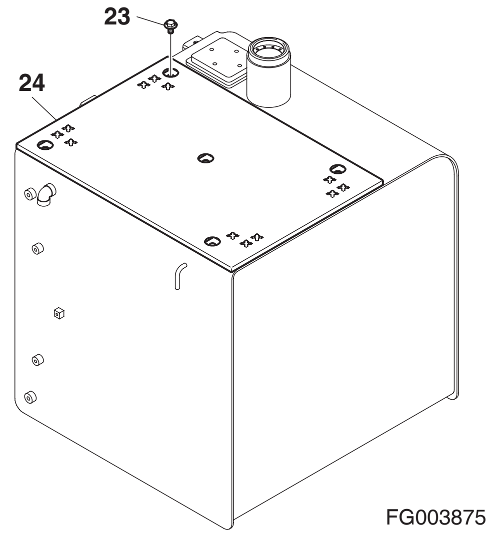


Figure 9

18. Remove six bolts (25 and 26, Figure 10) and stay (27) from fuel tank and frame.

    Remove four bolts (28 and 29) and fuel tank cover (30) from fuel tank.

    Remove two bolts (31) and bracket (32) from tank.

    Remove four bolts (33) and battery cover (34) from frame.

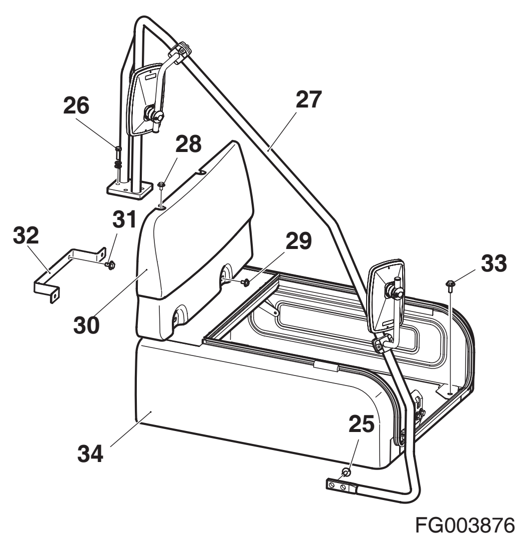


Figure 10

19. Tag and disconnect wires leading to fuel sender (16, Figure 11) on side of fuel tank (1).

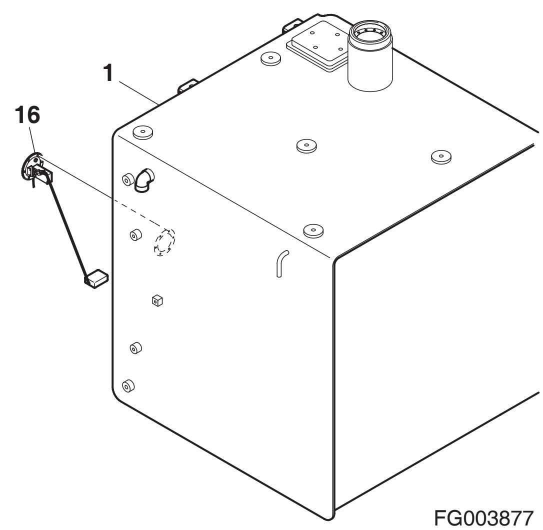


Figure 11

20. Remove four bolts (35 and 36, Figure 12) and cover (37) from fuel tank and support.

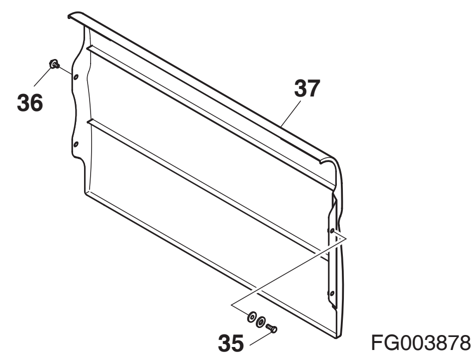


Figure 12

21. Install two 12 mm eyebolts in threaded holes (38 and 39, Figure 13). Using a suitable lifting device, sling eyebolts.
22. Remove six bolts (7) and spacers (13, Figure 13) holding tank (1) 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.*

23. Remove shims (9, Figure 13).

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

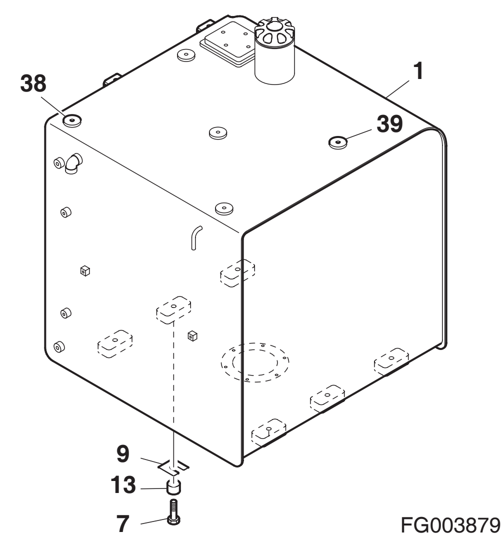


Figure 13

INSTALLATION

1. Install two 12 mm eyebolts in threaded holes (38 and 39, Figure 14). Using a suitable lifting device, sling eyebolts.
2. Set fuel tank (1, Figure 14) into position. Install six bolts (7) and spacers (13) finger tight, to secure tank to frame.

   NOTE: *The clear level gauge on the side of the tank is easily damaged. Be careful of obstacles and wind gusts.*
3. Install shims (9, Figure 14) as needed to prevent tank (1) from rocking or stress from mounting bolts (7).
4. Tighten mounting bolts (7, Figure 14) after shims are installed.

   NOTE: *Bolt torque is 27 kg•m (200 ft lb).*

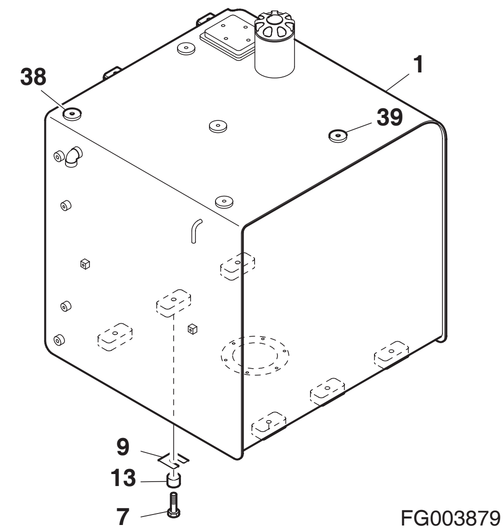


Figure 14

5. Install four bolts (35 and 36, Figure 15) and cover (37) on fuel tank and support.

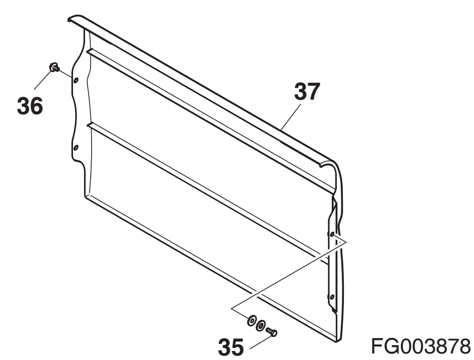


Figure 15

6. Connect wires as tagged to fuel sender (16, Figure 16) on side of fuel tank (1).

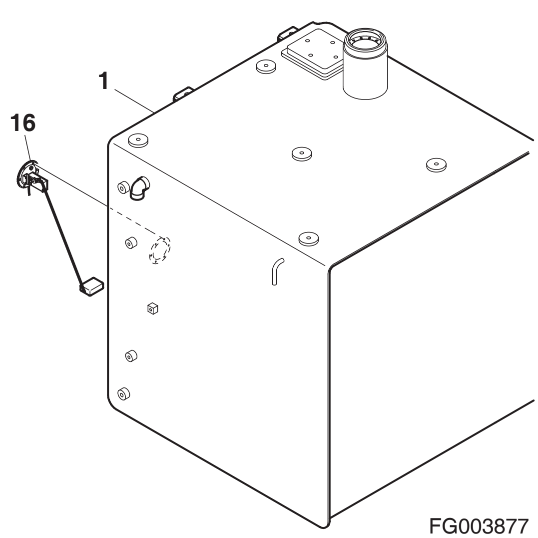


Figure 16

7. Install four bolts (33, Figure 17) and battery cover (34) on frame.

   Install two bolts (31) and bracket (32) on fuel tank.

   Install four bolts (28 and 29) and fuel tank cover (30) on fuel tank.

   Install six bolts (25 and 26) and stay (27) on fuel tank and frame.

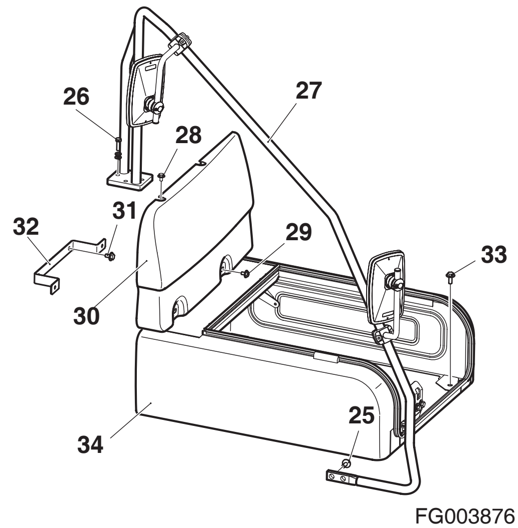


Figure 17

8. Install five bolts (23, Figure 18) and cover (24) on fuel tank.

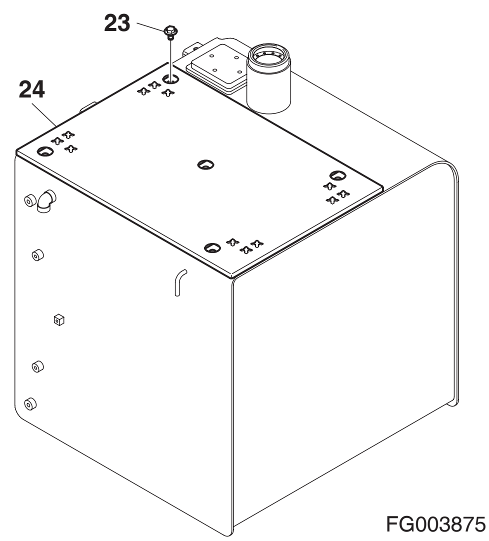


Figure 18

9. If equipped, connect components to fuel filler pump port (22, Figure 19) on side of fuel tank (1).

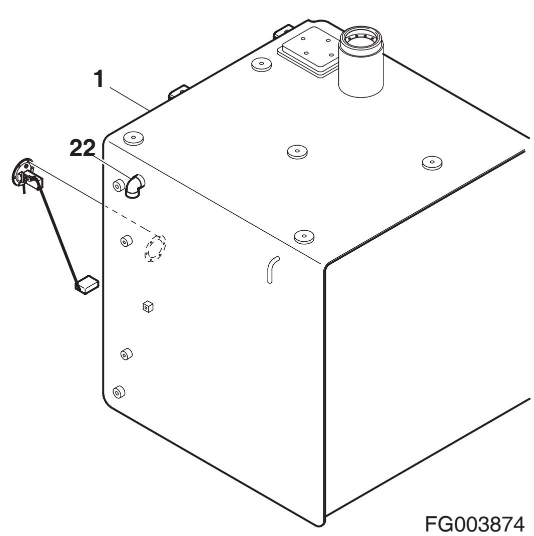


Figure 19

10. Connect as tagged, fuel supply line (21, Figure 20) and fuel return line (19) to fuel tank (1).
11. Install clamp (20, Figure 20) to hold fuel return line (19) to tank (1).

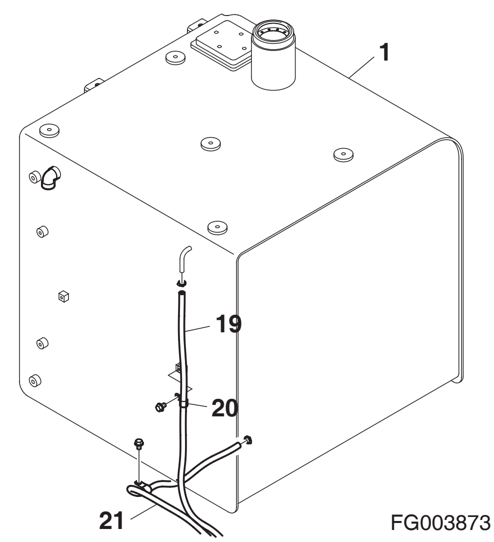


Figure 20

12. Make sure fuel tank drain valve (6, Figure 21) on bottom of tank is closed.
13. Fill fuel tank and check for signs of leaks. Correct any problems found.
14. Connect negative (-) battery cable to battery.

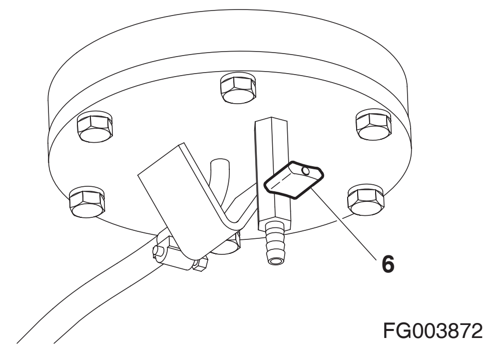


Figure 21

START-UP PROCEDURES

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

1. Stop Engine.
2. Open left side door and then there is fuel filter.

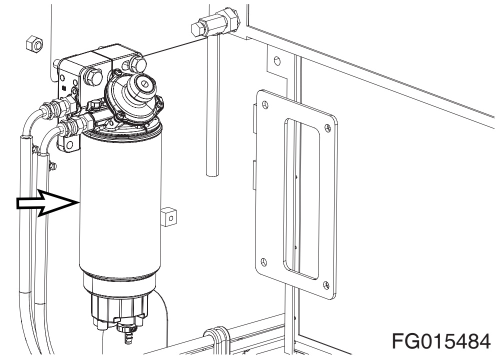


Figure 22

3. Loosen plug (1, Figure 23) on top of fuel filter head.
4. Pump hand operated primer pump (2, Figure 23) by the fuel injection pump. Pump primer until fuel is present at plug hole in fuel filter head.
5. Tighten plug in fuel filter head.
6. Continue to pump primer pump until a strong resistance is felt.
7. Start engine and look for signs of leaks.

Repeat procedure if necessary.

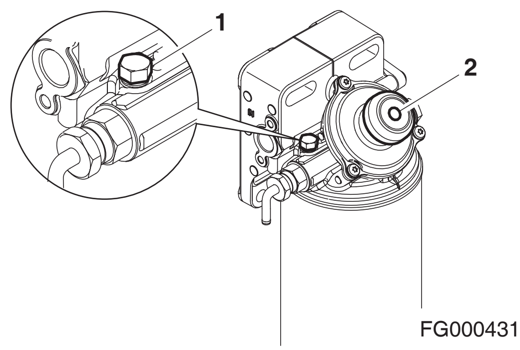


Figure 23

Fuel Transfer Pump (Opt)

Edition 1

MEMO

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Fuel Transfer Pump (Opt)

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

GENERAL DESCRIPTION

Theory of Operation

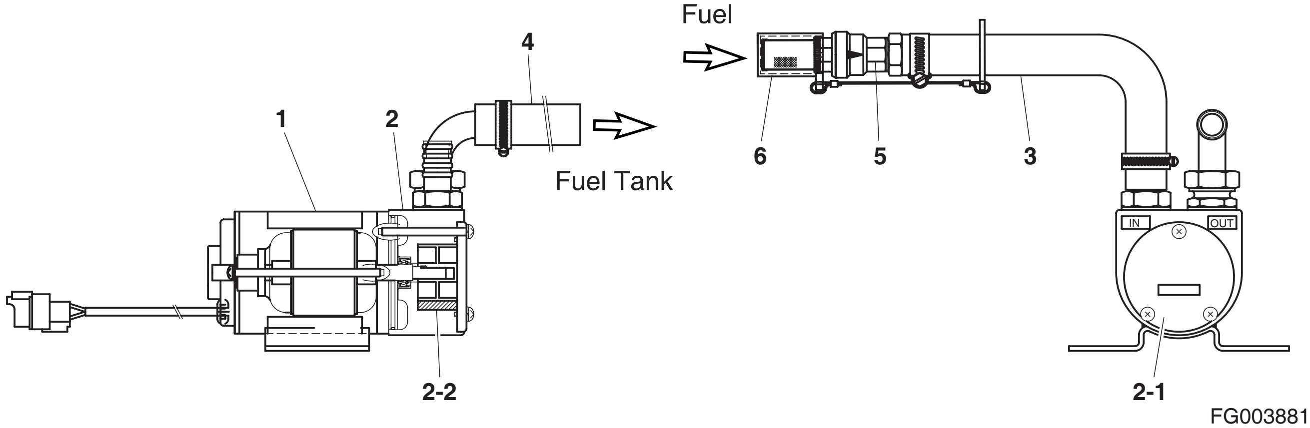

Figure 1

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

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

The fuel pump consists of a motor, pump, switch, and hose assembly.

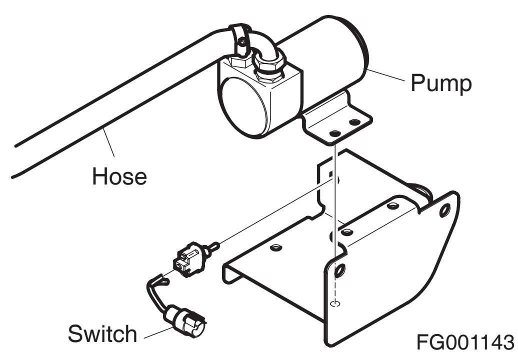

Figure 2

TROUBLESHOOTING

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

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

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

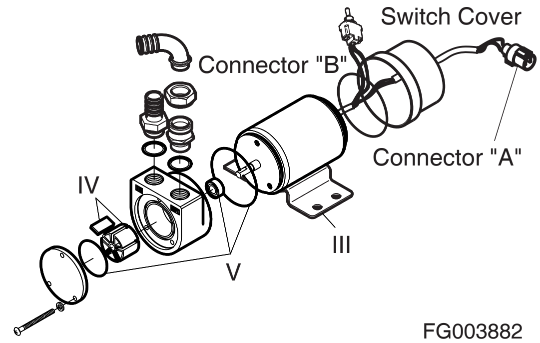

Figure 3 WITH TOGGLE SWITCH

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

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

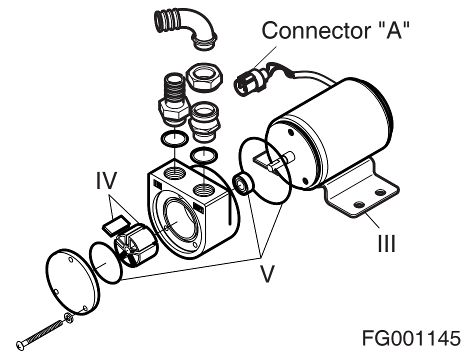

Figure 4 WITHOUT TOGGLE SWITCH

REPLACEMENT OF ROTOR AND VANE

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

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

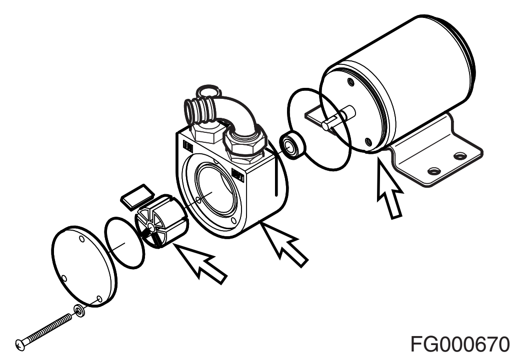

Figure 5 WITHOUT TOGGLE SWITCH

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

Insert a new O-ring during reassembly of pump cover.

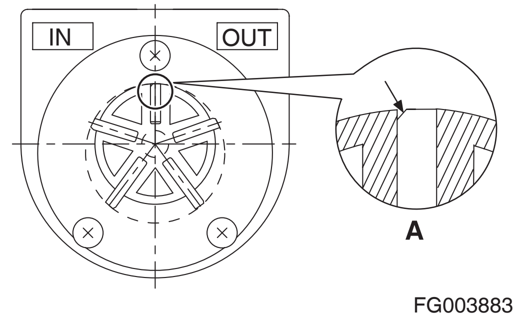

Figure 6

REPLACEMENT OF REAR COVER

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

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

Remove cover.

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

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

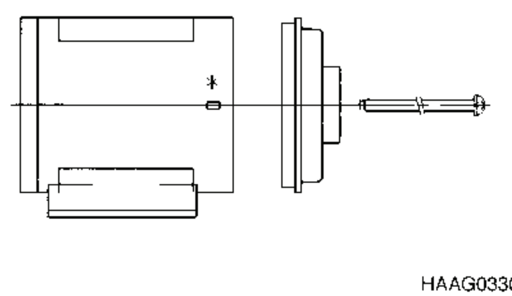

Figure 7

REPLACEMENT OF ARMATURE

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

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

Remove the pump cover and remove the rotor and vane.

Insert a new armature into the housing.

Refer to “Replacement of Rear Cover” on page -8, for installation of the rear cover.

Fit the rotor into the shaft flute of the armature. Insert vane to the rotor being careful of the direction. Refer to “Replacement of Rotor and Vane” on page -7.

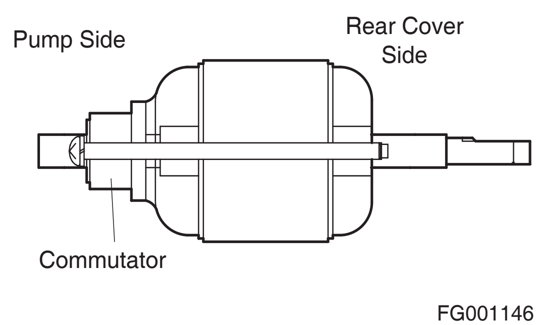

Figure 8

Swing Bearing

Edition 1

MEMO

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Swing Bearing

MEMO

SAFETY PRECAUTIONS

CAUTION

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

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Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

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.

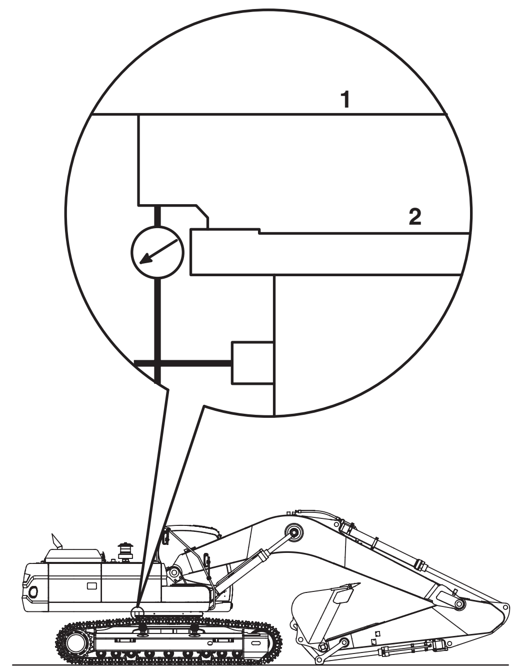

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Figure 1

Measuring Bearing Lateral Play

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

Swing Bearing Basic Operation

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

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

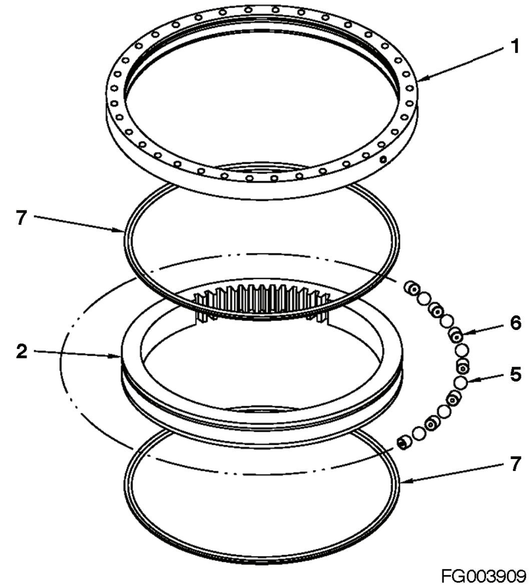


Figure 2

Disassembly

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

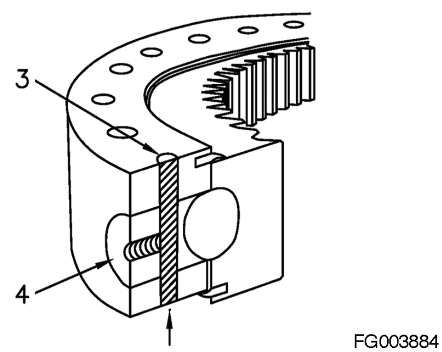


Figure 3

2. Remove plug (4, Figure 4) using a M10 x 1.5 bolt.

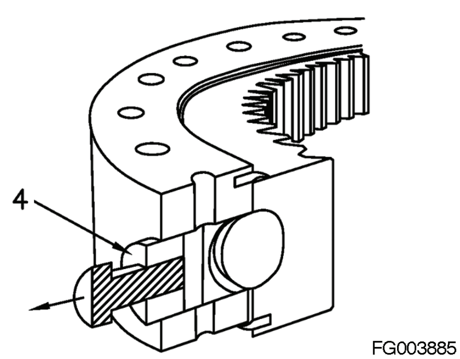


Figure 4

3. Lift outer ring and check that inner ring can move freely. See Figure 5, if not, replace seal (7, Figure 6).

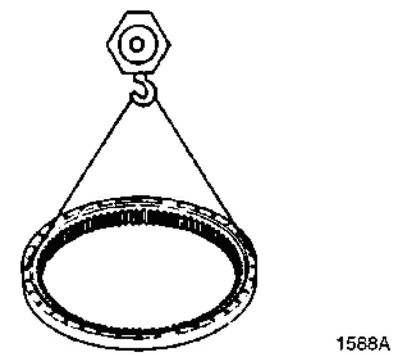


Figure 5

4. Turn inner ring and use magnet bar (C, Figure 6) to remove steel balls (5).

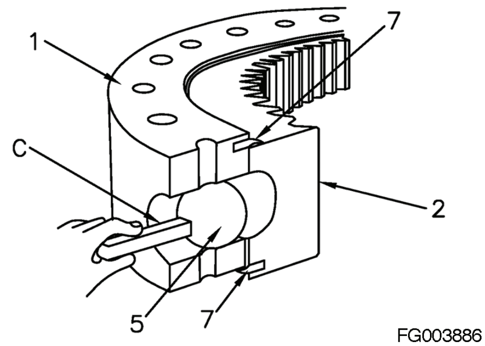


Figure 6

5. Turn inner ring and use wire (D, Figure 7) to remove retainers (6).

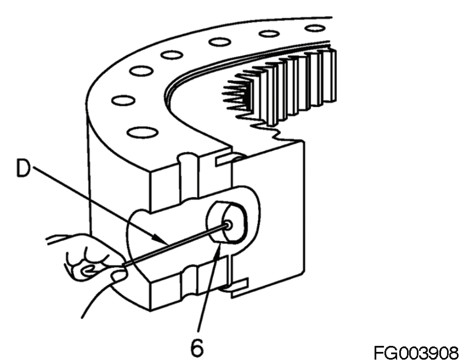


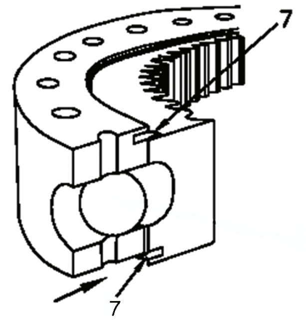
Figure 7

Assembly

1. Clean (degrease) the seal groove for the outer and inner seals (7).

   Apply instant glue to seal (7).

   Install both seals respectively into position.

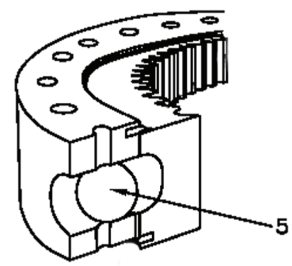


FG005123

Figure 8

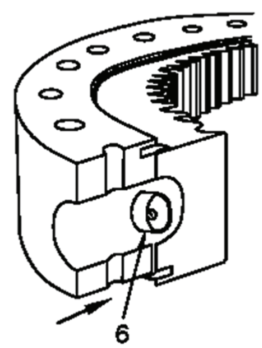
2. Hoist the outer race by crane horizontally and match it with the inner race coaxially.

   Rotating the outer race, insert balls (5), support (6) into the plug (4) hole one by one with a round bar.



FG005225

Figure 9



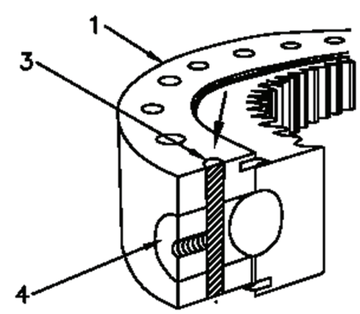
FG005124

Figure 10

3. Top plug (4) into outer race (1) and then, drive pin (3) into the pin hole.

   Caulk the head of pin (3) with a punch.

   Fill grease through the grease fitting.



FG005125

Figure 11

Swing Reduction Gear

Edition 1

MEMO

Table of Contents

Swing Reduction Gear

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LCA	5001 and Up

GENERAL DESCRIPTION

Theory of Operation

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

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

Parts List

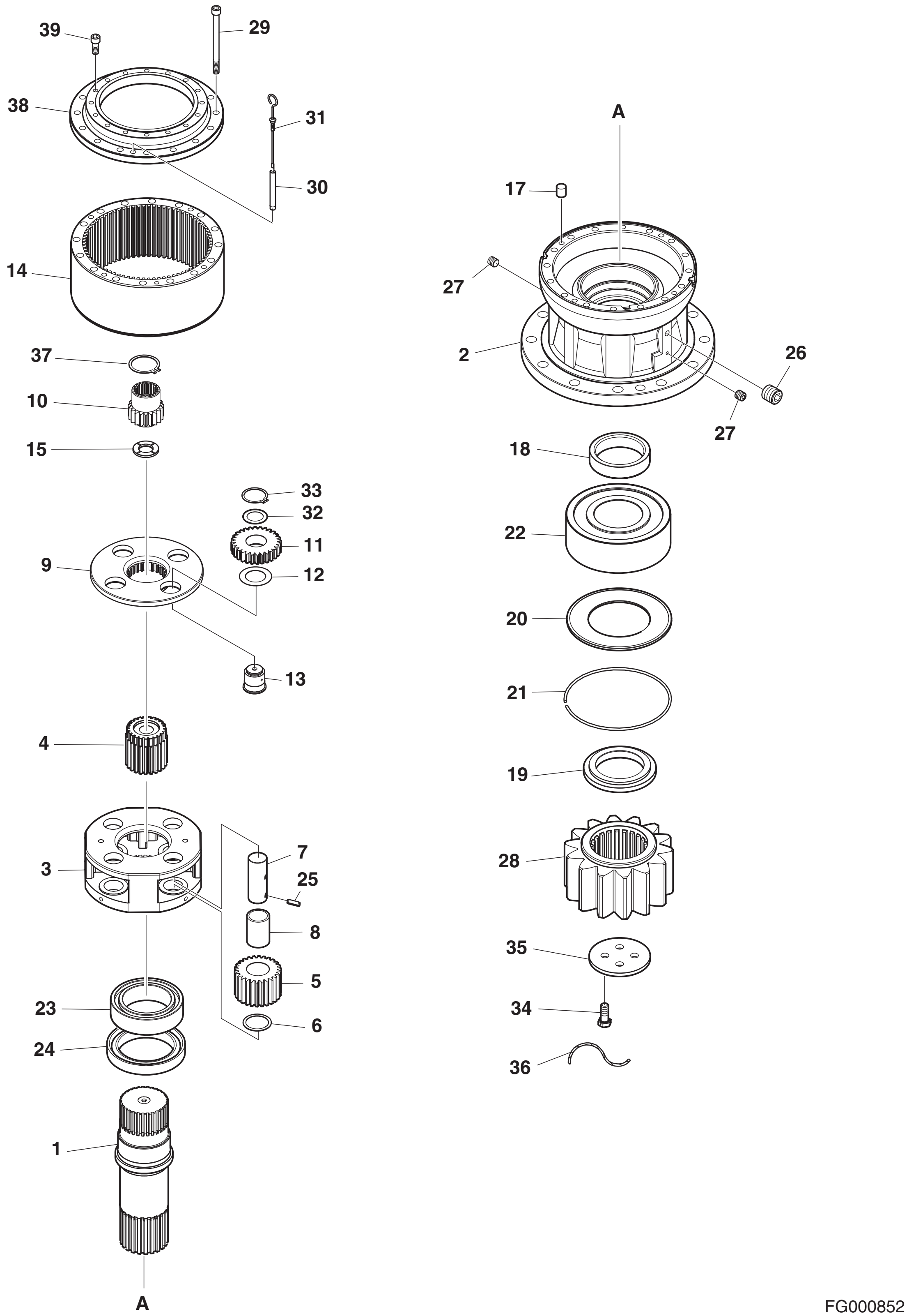


Figure 1

Reference Number	Description
1	Shaft
2	Gear Case
3	No. 2 Carrier
4	No. 2 Sun Gear
5	No. 2 Planetary Gear
6	No. 2 Thrust Plate
7	No. 2 Shaft
8	No. 2 Bushing
9	No. 1 Carrier
10	No. 1 Sun Gear
11	No. 1 Planetary Gear
12	No. 1 Thrust Plate
13	No. 1 Shaft
14	Ring Gear
15	Thrust Plate
17	Lock Pin
18	Spacer
19	Collar
20	Plate
21	Lock Ring
22	Spherical Roller Bearing
23	Spherical Roller Bearing
24	Oil Seal
25	Spring Pin
26	Plug
27	Plug
28	Pinion
29	Socket Head Bolt
30	Pipe
31	Level Gauge
32	No. 3 Thrust Plate
33	Retaining Ring
34	Socket Head Bolt
35	Cover
36	Wire
37	Retaining Ring
38	Case Cover
39	Socket Head Bolt

Specifications

Swing Reduction Gearbox	Specification
Drive Type	Two-stage Planetary Gear
Reduction Ratio	21.968
Maximum Output Speed	59 rpm
Maximum Output Torque	1,870 kg•m (13,525 ft lb)
Weight	400 kg (882 lb)

Pinion Gear	Specification
Type	Spur Gear
Gear P.C.D	196 mm (7.72 in)
No. of Teeth	14
Module	14

TROUBLESHOOTING, TESTING AND ADJUSTMENT

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

HAOE960L

REMOVAL

1. Park on firm and level ground.
2. Lower front attachment (bucket) to ground.
3. Shut down engine.
4. Set safety lever on "RELEASED" position.
5. Turn starter switch to "I" (ON) position.

WARNING

If engine must be running while performing maintenance, always use extreme caution. Always have one person in cab at all times. Never leave cab with engine running.

6. Fully stroke work levers (joysticks) in all directions to relieve any pressure from accumulators.
7. Set safety lever on "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Hang a maintenance warning tag on controls.
10. Disconnect negative (-) battery cable leading to frame from battery.
11. Tag and disconnect hoses from swing motor (1, Figure 3). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.
12. Remove drain plug (3, Figure 3) from reducer (8) and drain oil from reduction gearbox (5, Figure 3).
13. Reassemble drain plug (3) to reducer (8) and disconnect hose (2, Figure 3) from reduction gearbox (5).
14. Disconnect grease lubrication line (7, Figure 3) from reduction gearbox (5).
15. Remove twelve bolts and washers (4, Figure 3) holding swing reduction gearbox (5) to frame.
16. Using a suitable lifting device, sling swing motor (1, Figure 3) and remove swing motor and reduction gearbox (5) as an assembly from unit.

    NOTE: *There are two alignment pins (6*, Figure 3*), on reduction gearbox flange.*

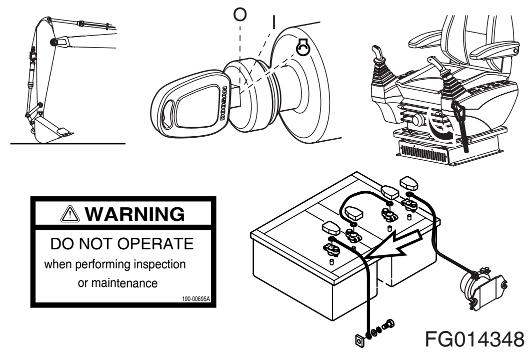


Figure 2

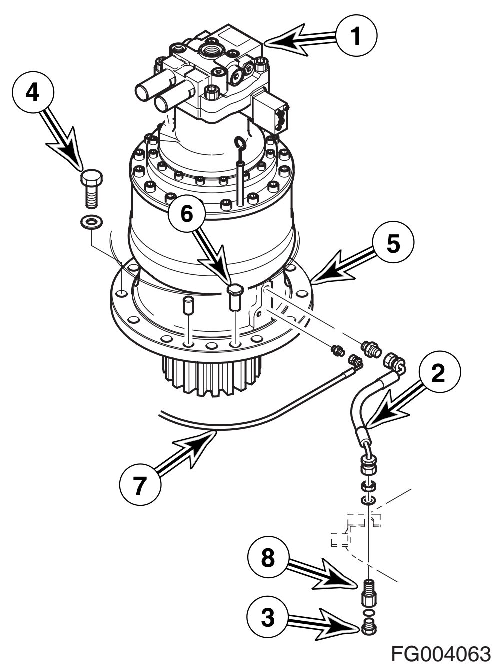


Figure 3

DISASSEMBLY

IMPORTANT

Select a clean place.

Spread a rubber mat or cloth on top of the overhaul workbench to prevent parts from being damaged.

1. Remove bolts and motor from swing reduction case.

CAUTION

The motor should be separated without damage or any foreign substance.

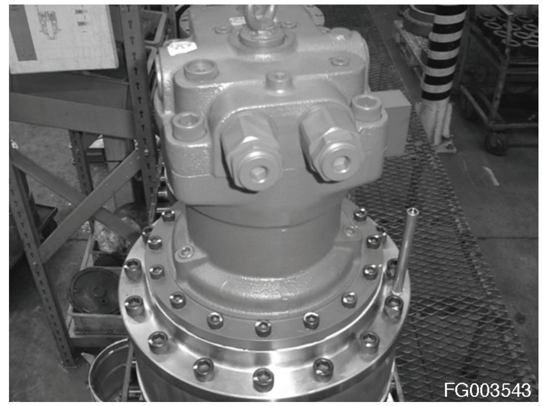


Figure 4

2. Remove level pipe from cover.

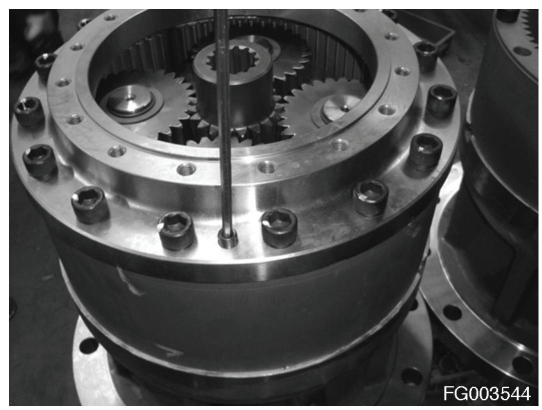


Figure 5

3. Remove bolts and cover from case.

CAUTION

Care should be taken not to damage mounting surface of cover. Carefully remove all gasket material from mounting surfaces.

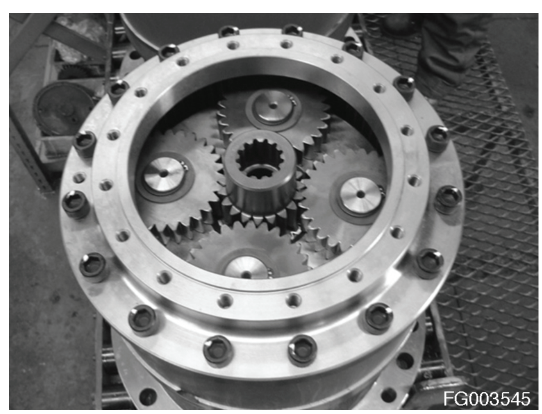


Figure 6

Figure 7

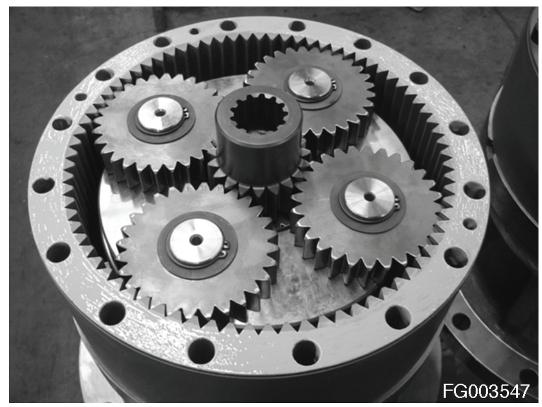


Figure 8

4. Remove No. 1 sun gear from No. 1 carrier.

CAUTION

Care should be taken not to damage teeth of No. 1 sun gear.

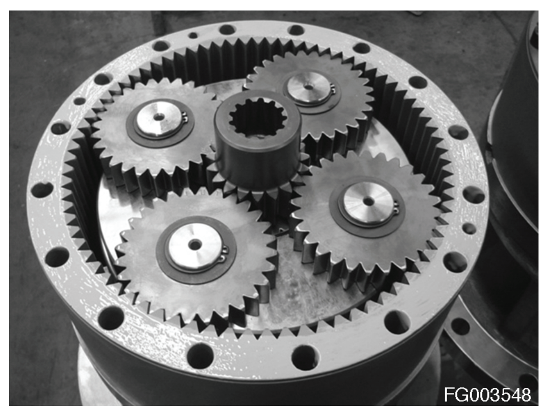


Figure 9

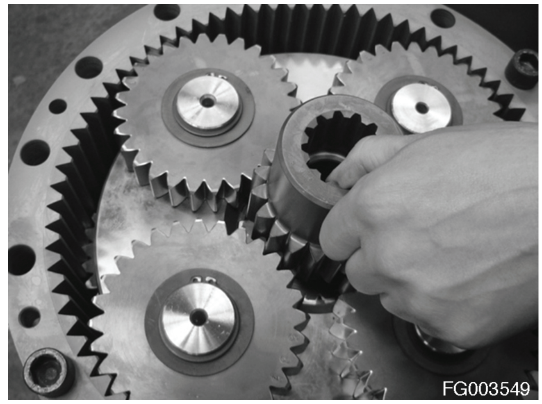


Figure 10

5. Remove No. 1 carrier.

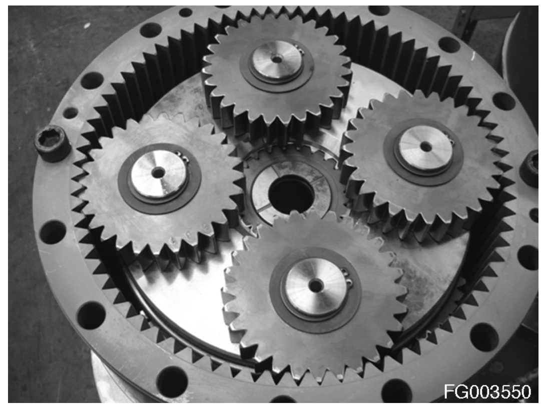


Figure 11

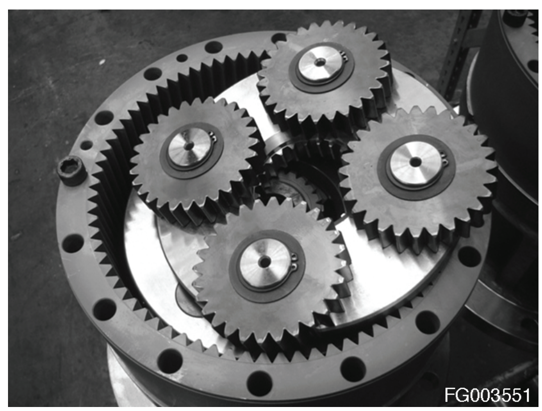


Figure 12

6. Remove washer and No. 2 sun gear.

CAUTION

Care should be taken not to damage teeth of No. 2 sun gear.

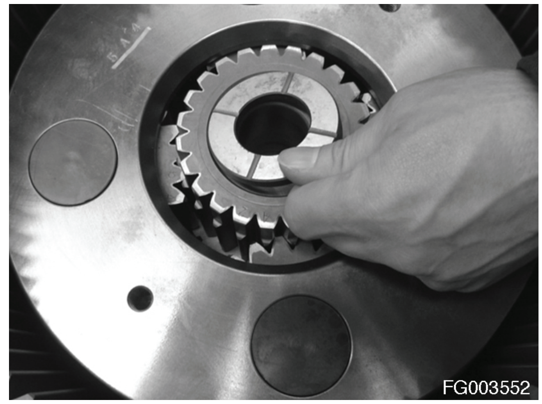


Figure 13

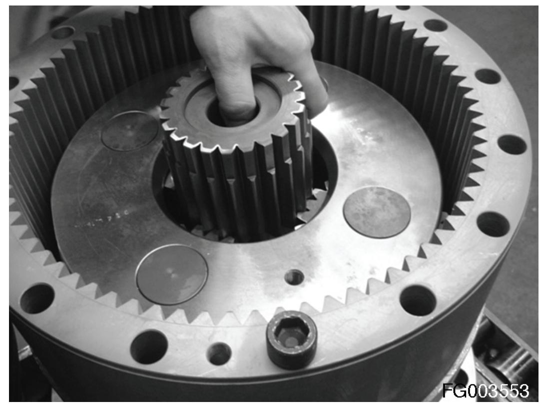


Figure 14

7. Install eye bolts in No. 2 carrier and remove it from ring gear.

CAUTION

Care should be taken not to damage teeth of No. 2 carrier and ring gear.

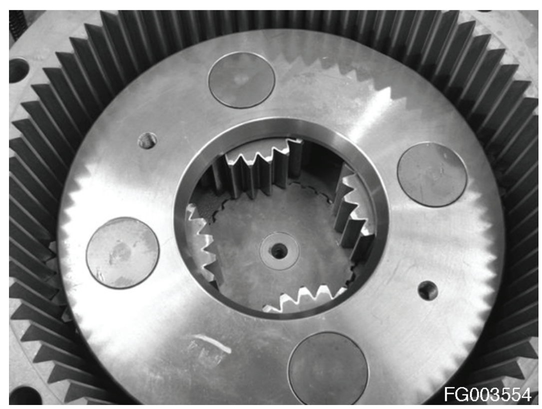


Figure 15

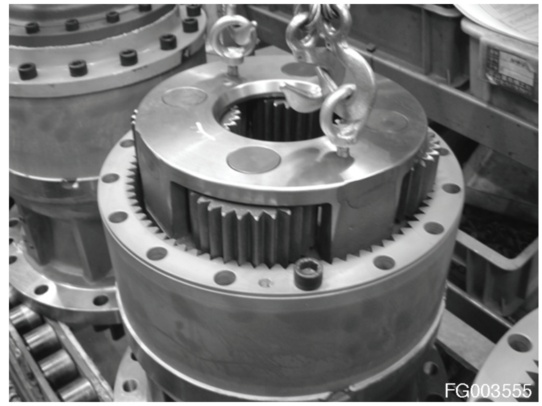


Figure 16

8. Install eye bolts in ring gear and remove it.

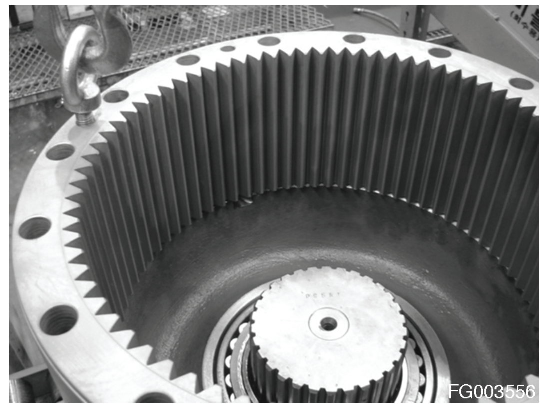


Figure 17

CAUTION

Care should be taken not to damage mounting surfaces of ring gear and case. Carefully remove all gasket material from mounting surfaces.

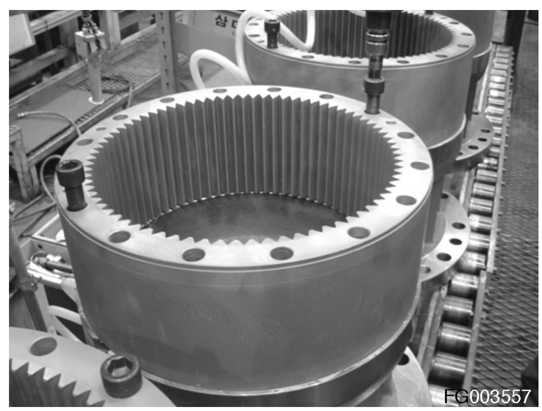


Figure 18

9. Use a rollover machine to turn assembly over, loosen lock wire, bolts and cover.

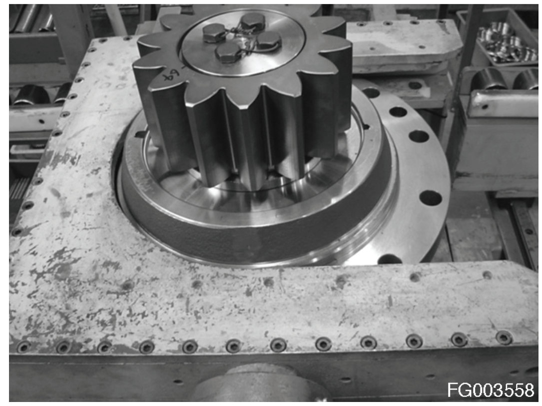


Figure 19

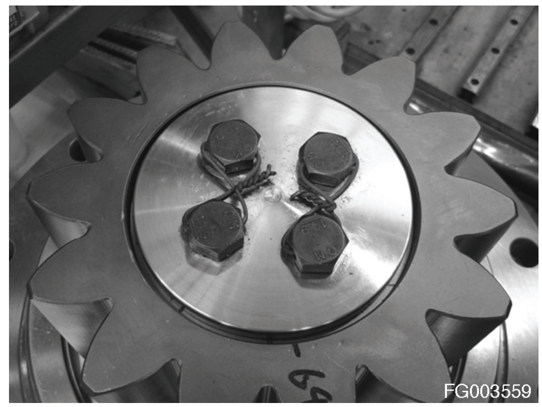


Figure 20

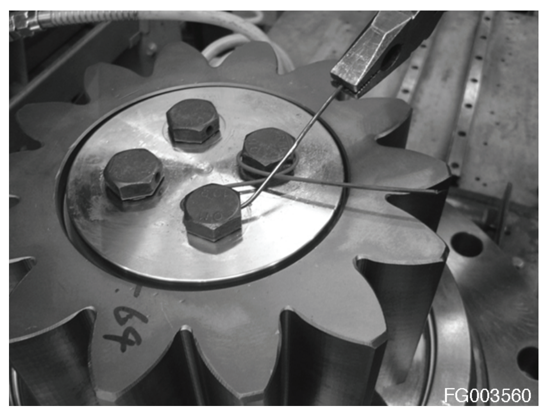


Figure 21

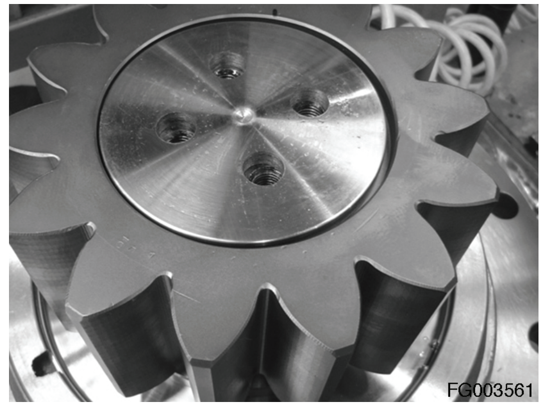


Figure 22

10. Remove pinion gear.

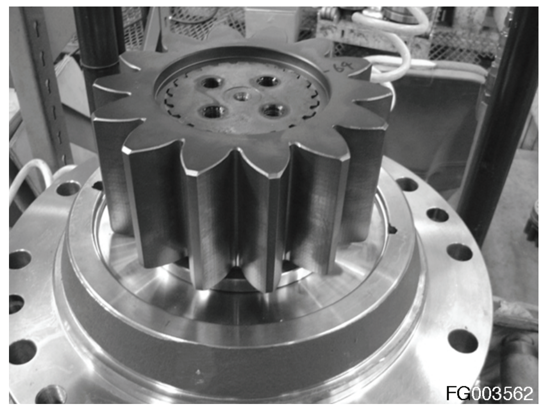


Figure 23

11. Using a gear puller to remove collar.

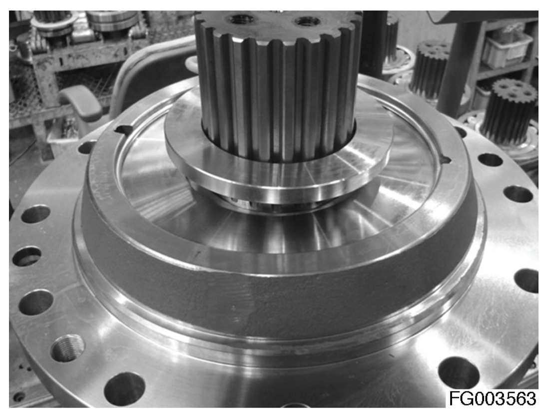


Figure 24

12. Using snap ring pliers, remove lock ring and disassemble plate.

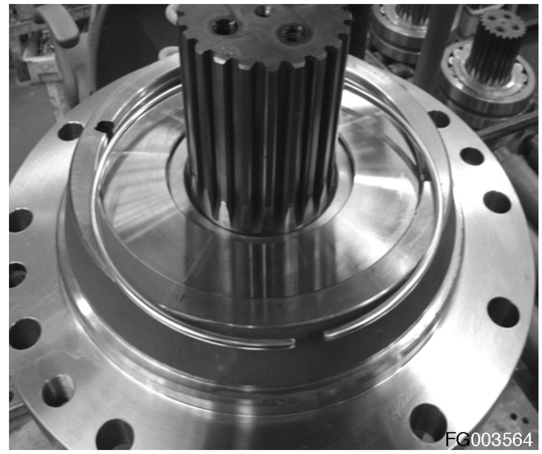


Figure 25

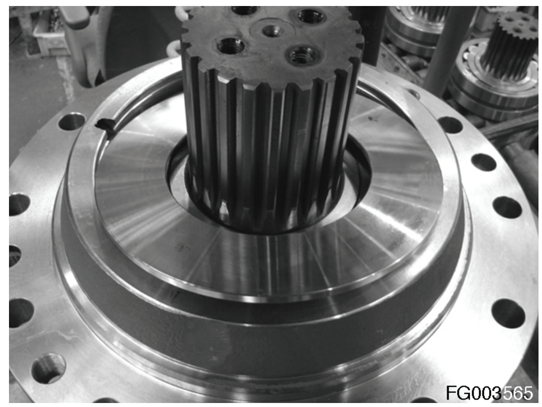


Figure 26

13. Use a rollover machine to turn case over and place a jig on drive shaft. Use a press to remove drive shaft from case.

⚠ CAUTION

Care should be taken not to have drive shaft drop to floor when it is pressed out of case.

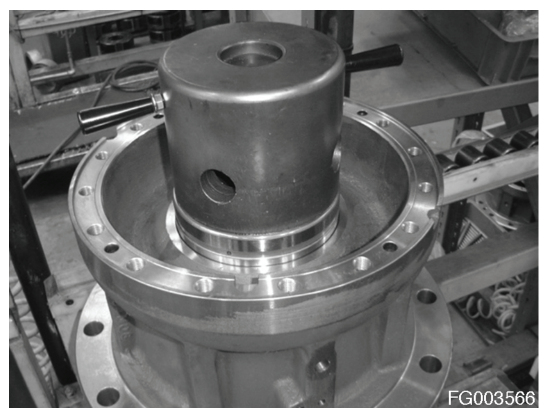


Figure 27

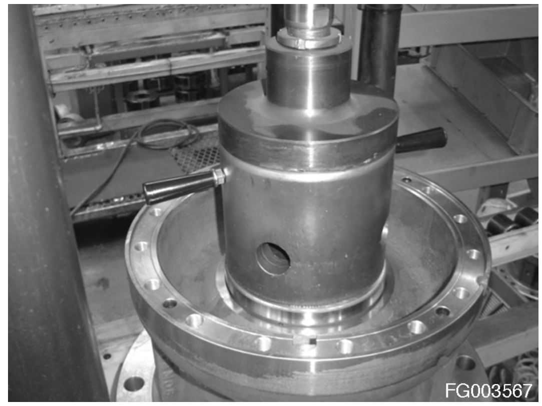


Figure 28

14. Remove bearing from case.

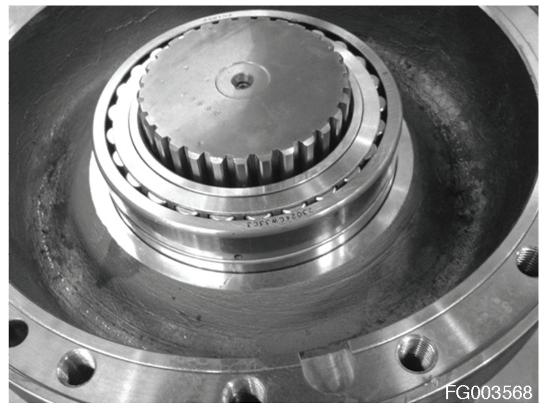


Figure 29

15. Put drive shaft in press, and remove bearing and spacer.

Figure 30

Figure 31

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

REASSEMBLY

Shaft and S/R Bearing Heat-fit

1. To cleaning shaft, remove any remnants of anticorrosion liquid applied on shaft and remove all of foreign substances using an air gun.
2. Insert spacer on cleaned shaft as shown in figure below and heat bearing on a special heater.
3. Stop heating when bearing temperature is between 90° - 100°C (194° - 212°F) and insert it on shaft, holding it with both hands to keep it level. Insert it slowly first by 4 - 5 mm (0.16 - 0.29 in) for bearing to seat itself and then push it hard that it contacts to spacer assembled in shaft completely.
4. After bearing assembly is completed, leave it air cool for 1 - 2 hours.

Assembly of Carrier Subassemblies

Cleaning Carrier

Put carrier, to whose corners grinding was made to remove all foreign substances like burr, on steam washer if there remain any foreign substance and put it on assembly die.

Cleaning Planet Gear

Check if planet gears are washed cleanly and got imprinted and put it on assembly die.

Assembly of No. 1 Carrier

1. Put No. 1 carrier on assembly jig as shown in Figure 32.

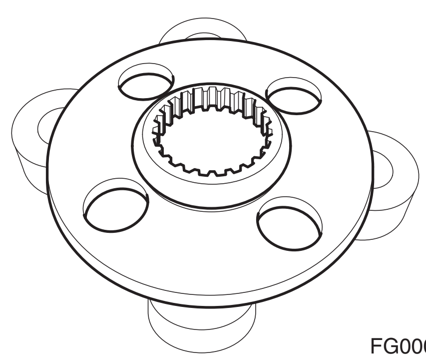


Figure 32

2. Align No. 1shaft with hole and press it into place.

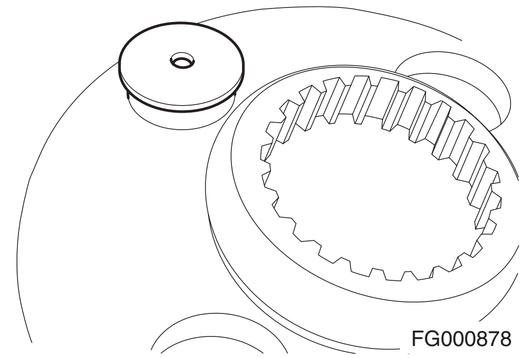


Figure 33

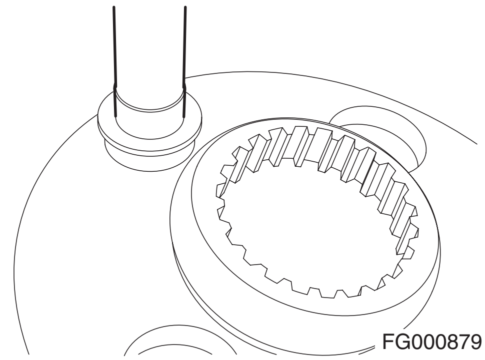


Figure 34

3. Make sure that shaft is fully pressed into position.

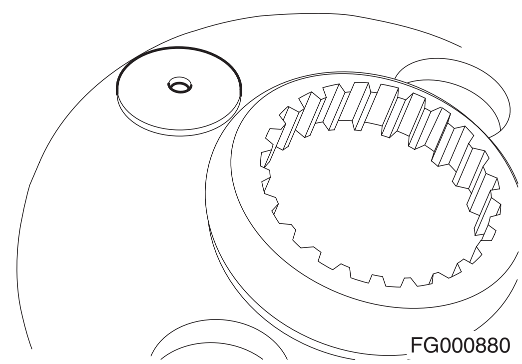


Figure 35

4. Install remaining three No. 1 shafts into carrier in same manner.

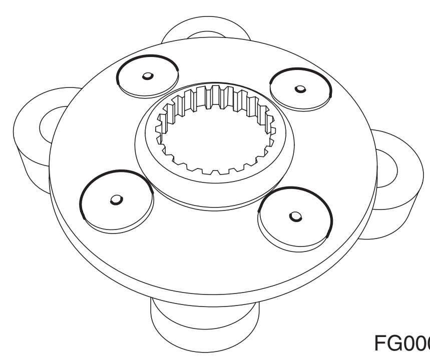
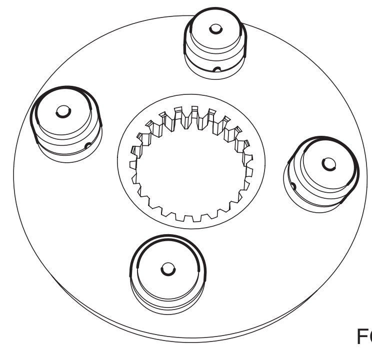


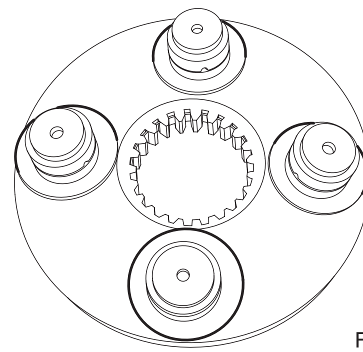
Figure 36

5. Turn over carrier. Install a No. 1 thrust washer onto each of the four shafts.



FG000882

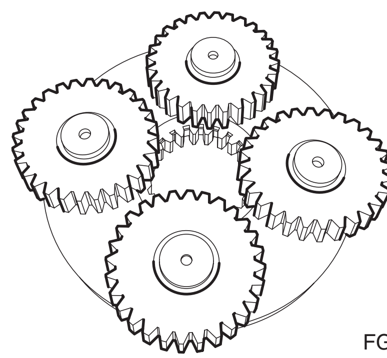
Figure 37



FG000883

Figure 38

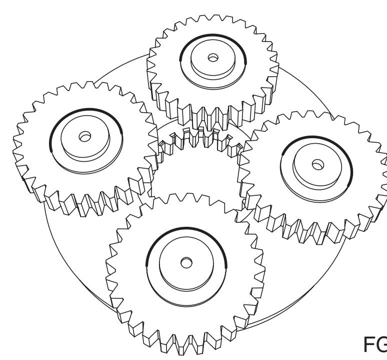
6. Install four No. 1 planetary gears.



FG000884

Figure 39

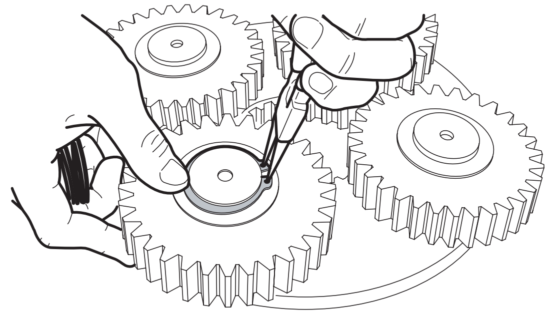
7. Position a No. 3 thrust washer on each gear, as shown in Figure 40.



FG000885

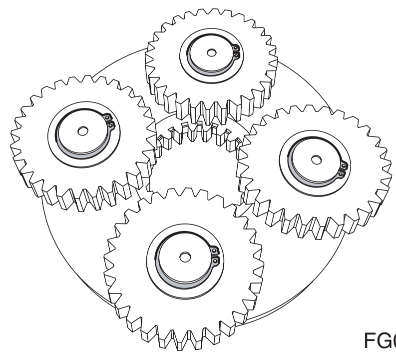
Figure 40

8. Install retaining rings on No. 1 shafts. Make sure that retaining rings are fully seated in grooves. Make sure that gears properly rotate.



FG000886

Figure 41



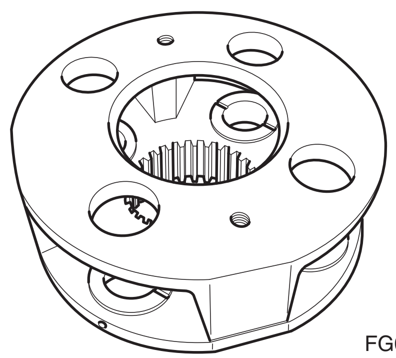
FG000887

Figure 42

Assembly of No. 2 Carrier

1. Put No. 2 carrier on assembly jig as shown in Figure 43.

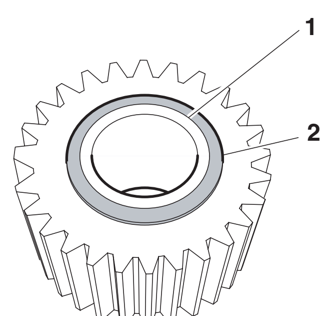
   NOTE: *Lifting eye hole should be facing up.*



FG000888

Figure 43

2. Insert No. 2 bushing into No. 2 planetary gear, and position a No. 2 thrust washer on it.



FG000889

Figure 44

3. Turn over gear assembly and insert it into No. 2 carrier. Align bushing hole with carrier holes.

   NOTE: *Thrust washer must be on bottom side of gear.*

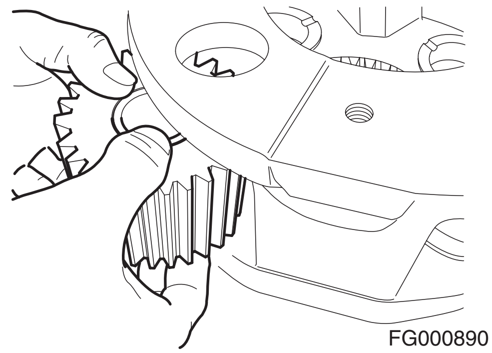


Figure 45

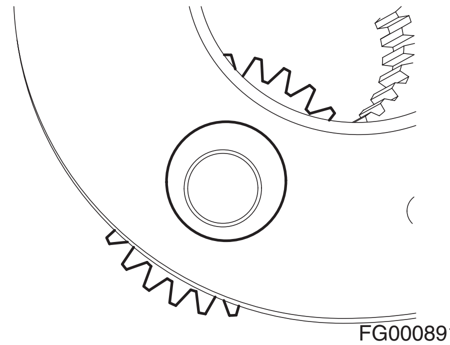


Figure 46

4. Align spring pin hole in No. 2 shaft with spring pin hole of No. 2 carrier. Insert shaft into carrier and No. 2 bushing.

   NOTE: *Shaft may need to be gently tapped with a soft-faced hammer.*

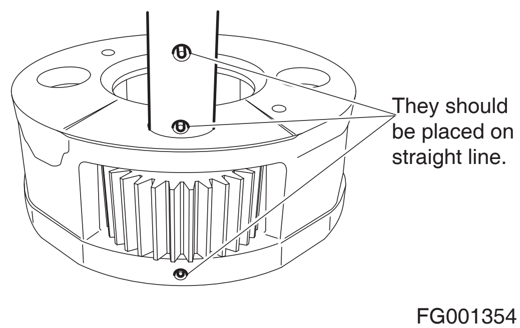


Figure 47

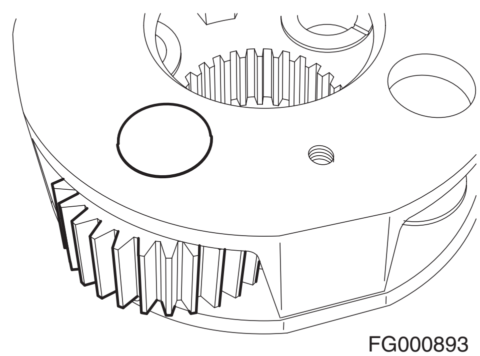


Figure 48

5. Install three remaining No. 2 gears in same manner.

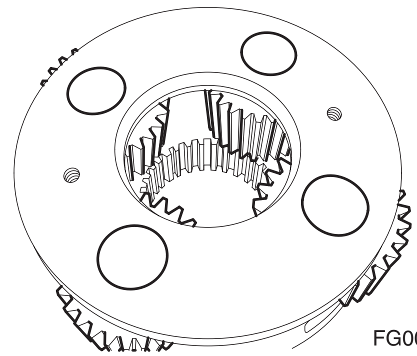


Figure 49

6. After all four shafts are installed, align spring pin with carrier hole and drive it into position using a hammer.

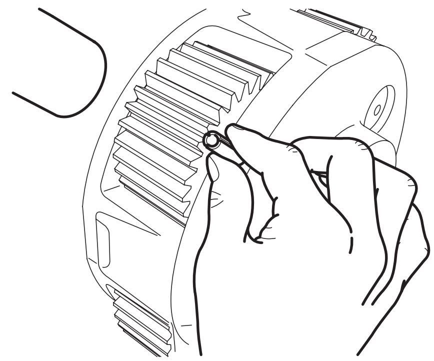


Figure 50

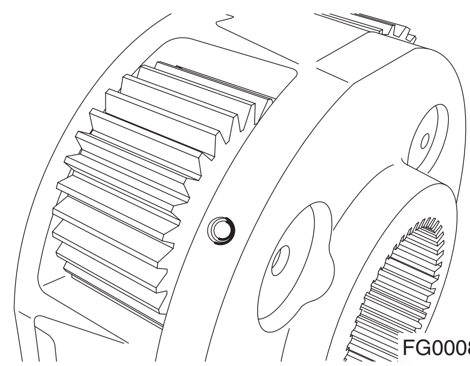


Figure 51

7. Using a hammer and punch, calking spring pin into position.

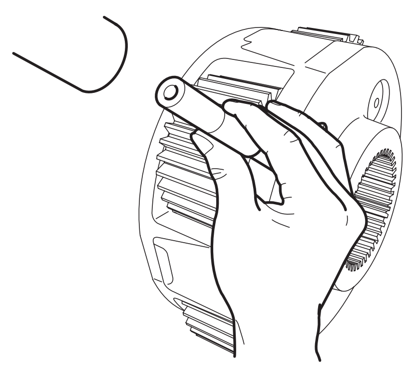


Figure 52

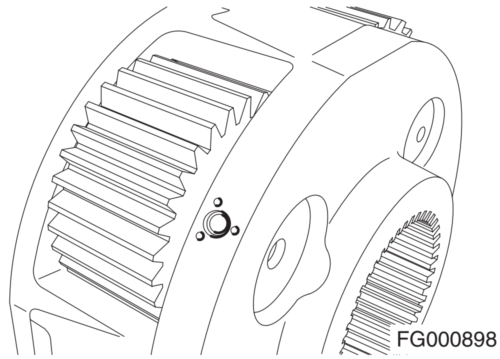


Figure 53

8. Repeat procedure for other three spring pins. Make sure that gears properly rotate.

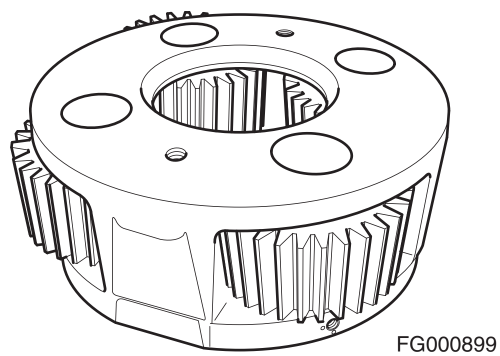


Figure 54

Assembly of Main Case

Cleaning Casing and Other Parts

Steam clean case and other parts, to remove any foreign substances.

- Cleaning fluid: PK6540 (alkali)
- Liquid density: 3 - 5%
- Liquid temperature: 60° - 70°C (140° - 158°F)

Assembly of Shaft and Pinion

1. Insertion of shaft subassembly:
   A. Set gear case as shown in Figure 55.
   B. Using a suitable lifting device, lower shaft subassembly into case.
   C. Using special jig, keep bearing level and press it into case.

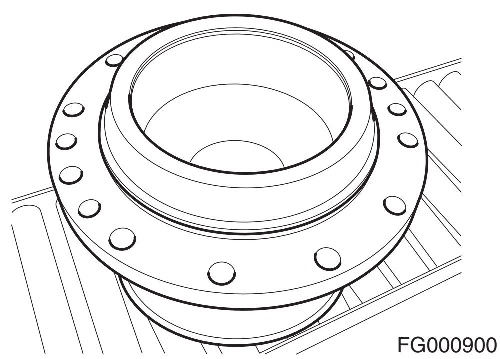


Figure 55

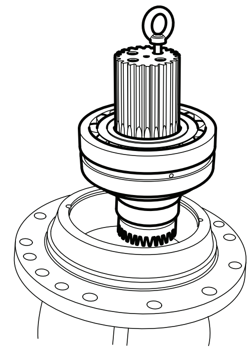


Figure 56

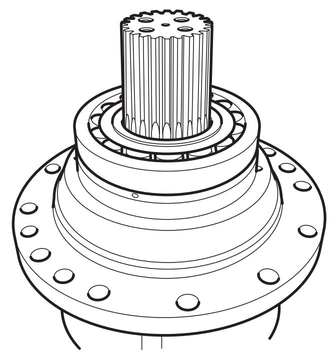


Figure 57

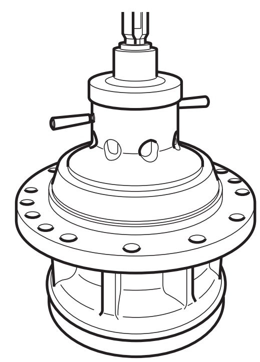


Figure 58

2. Remove bearing insertion jig and assemble plate with its step part so it is facing down, as shown in Figure 59.

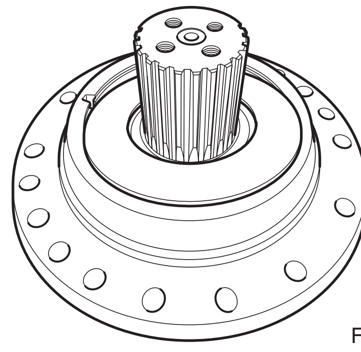


Figure 59

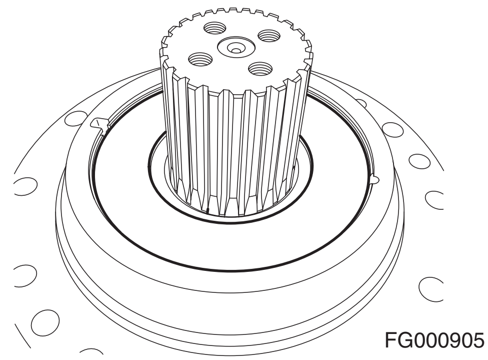


Figure 60

3. Install lock ring in groove of gear case.

   NOTE: *Make sure lock ring is inserted completely into groove.*

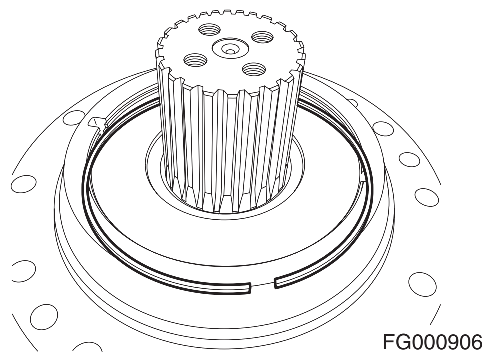


Figure 61

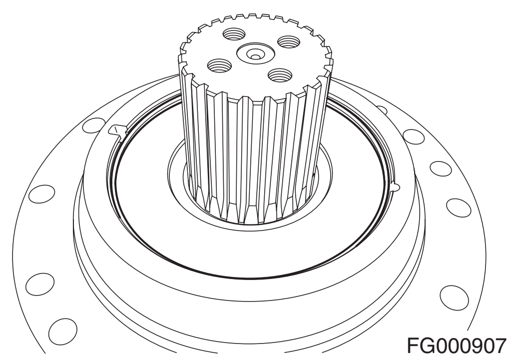


Figure 62

4. Insert collar on shaft, making sure it is properly seated. Install pinion gear and special jig on shaft, and press collar and pinion gear into place on shaft and case.

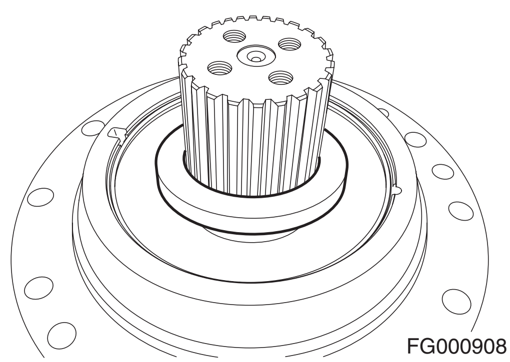


Figure 63

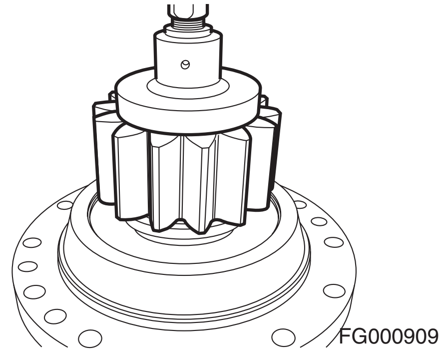


Figure 64

5. Install lock plate and drilled head bolts on end of shaft.

NOTE: *Coat bolts with Loctite #262.*

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

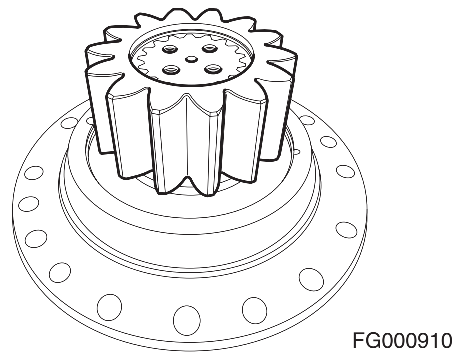


Figure 65

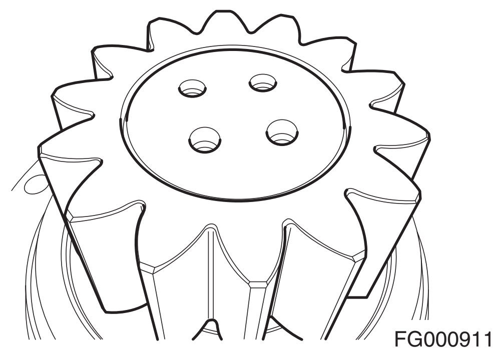


Figure 66

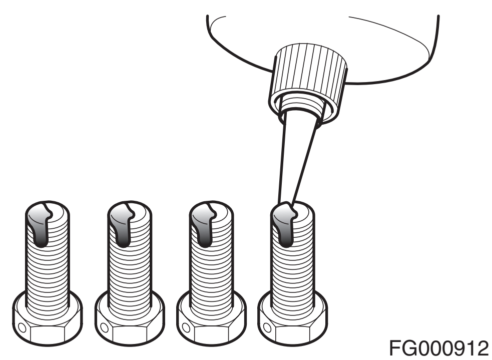
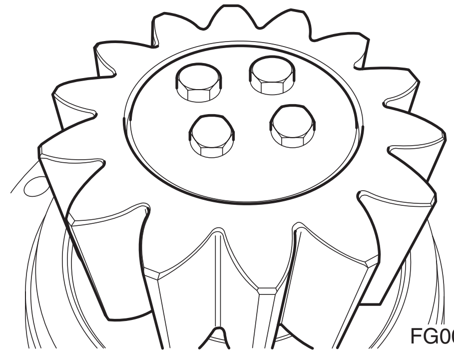


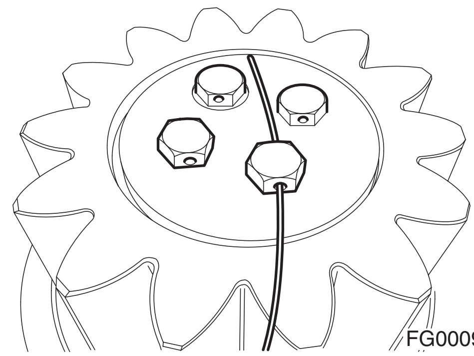
Figure 67



FG000913

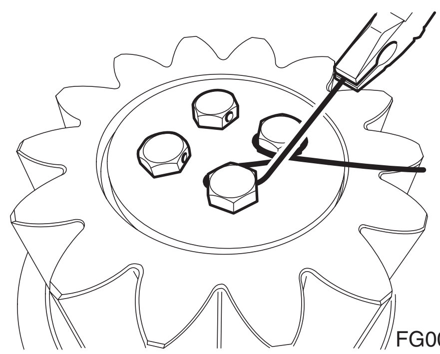
Figure 68

6. Use lock wire to hold drilled head bolts in final position.



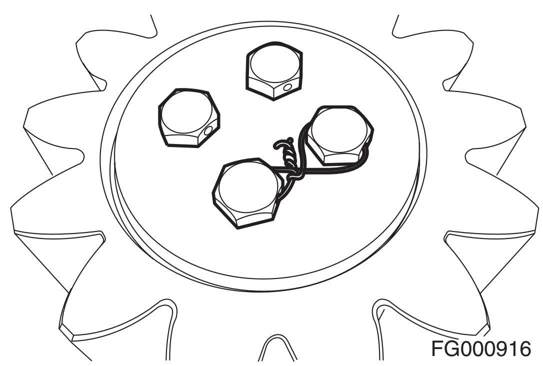
FG000914

Figure 69



FG000915

Figure 70



FG000916

Figure 71

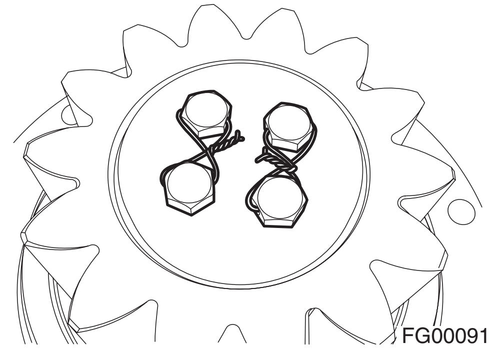


Figure 72

Assembly of Seal and Bearing

1. Postion case so that pinion gear is pointing down.

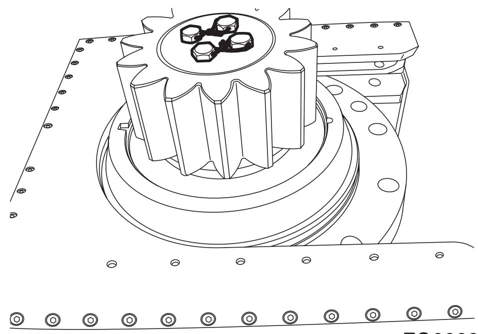


Figure 73

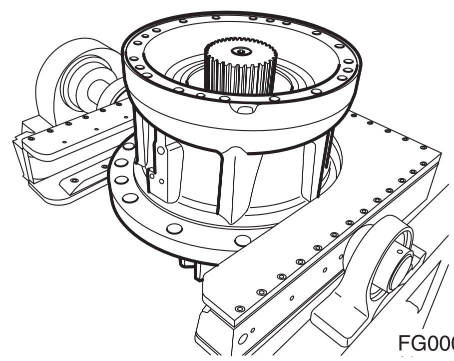


Figure 74

2. Make sure that there is no foreign substance left on seal assembly, apply grease to and around lip of oil seal (TC5001300) as in Figure 75 and Loctite #609 to its external part.
3. Using seal installation jig, press seal into case, keeping it level during installation. Make sure that seall is fully seated.

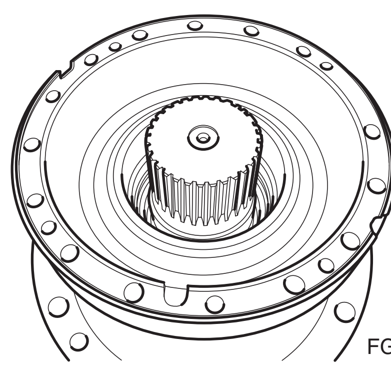


Figure 75

⚠ CAUTION

Make sure that there is no foreign substances on lip area. Use care not to damage seal when inserting it. Chack for proper installation after pressing seal into position.

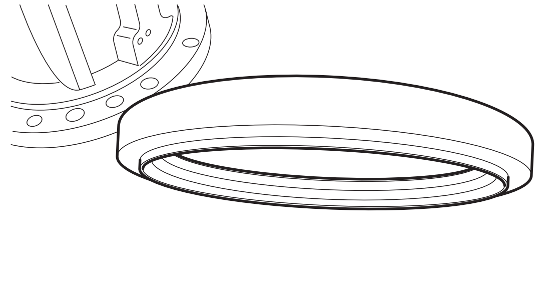

FG000921

Figure 76

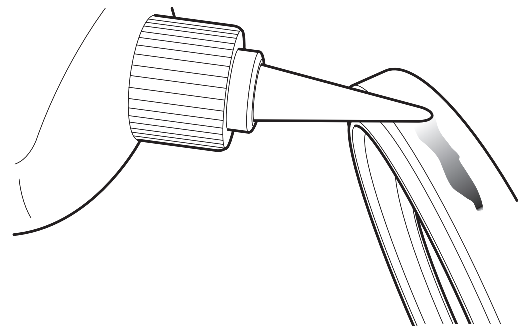

FG000922

Figure 77

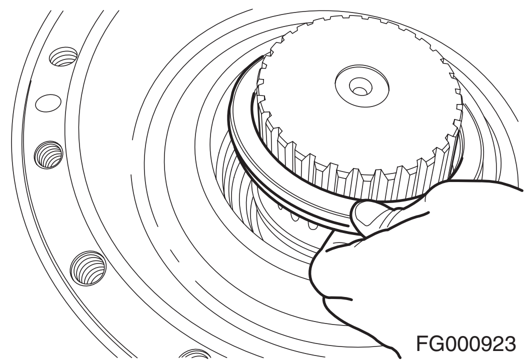

FG000923

Figure 78

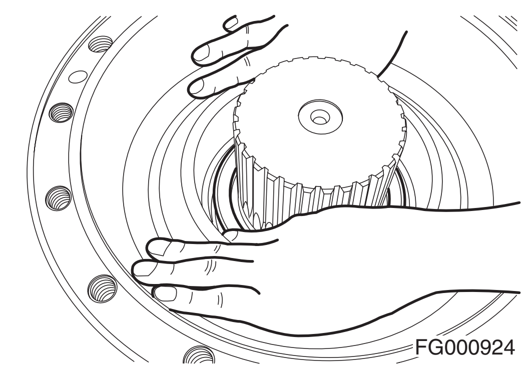

FG000924

Figure 79

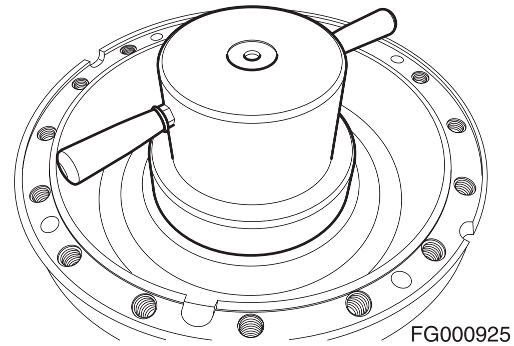


Figure 80

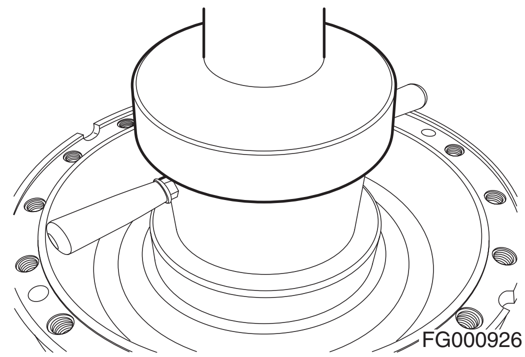


Figure 81

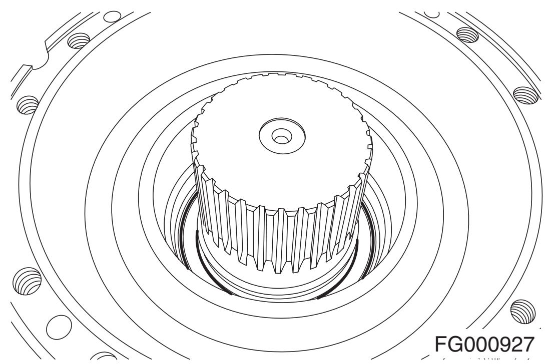


Figure 82

4. Using seal installation jig, position bearing on end of shaft, with bearing trade mark on inner race facing up. Press bearing firmly into place, making sure it is properly seated.

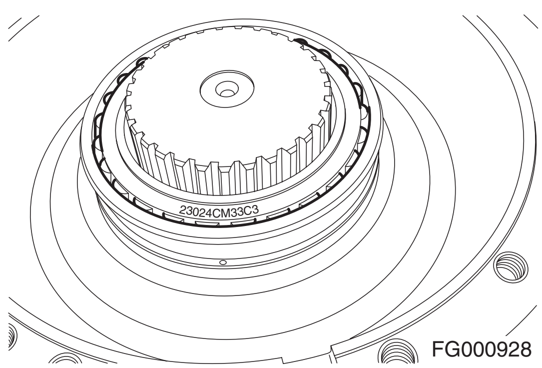


Figure 83

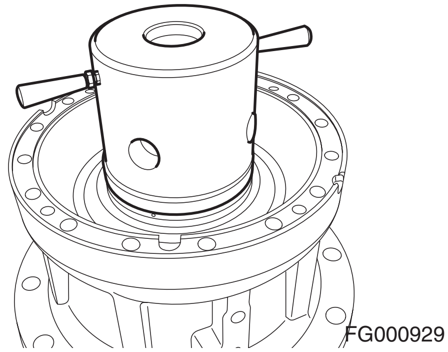


Figure 84

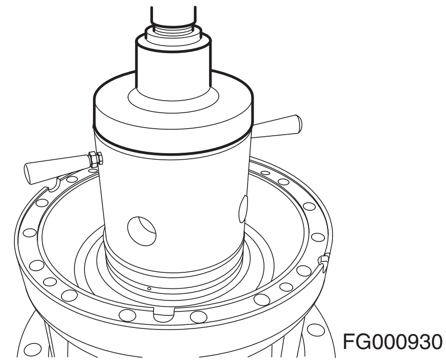


Figure 85

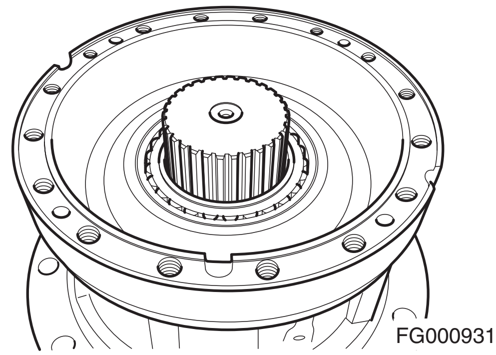


Figure 86

5. Rotate pinion by hand and check if it turns properly.

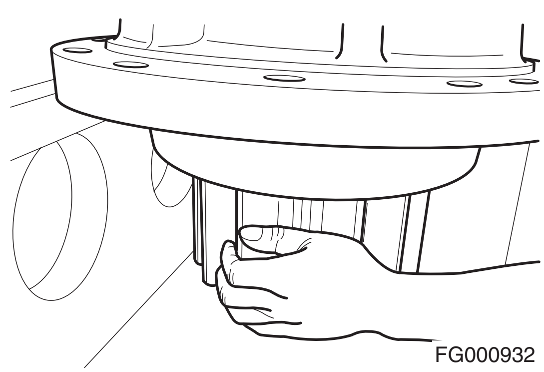


Figure 87

6. Insstall plugs into PT1/2 and PT1/8 drain ports.

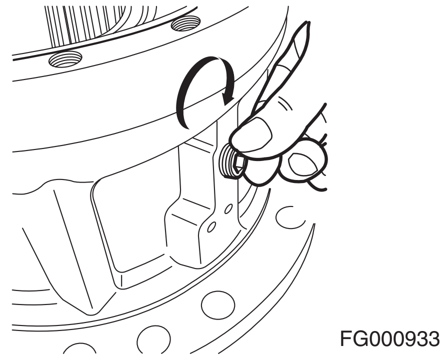


Figure 88

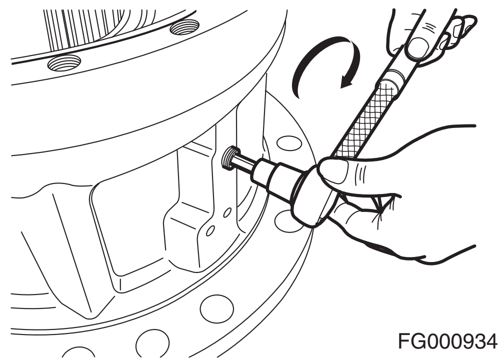


Figure 89

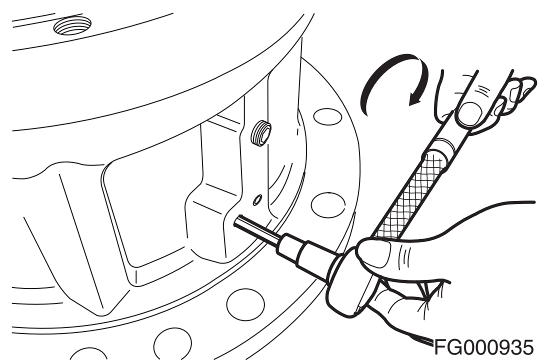


Figure 90

Assembly of Ring Gear

1. Insertion of lock pin.

   Insert four lock pins in four reamed holes of case flange. Tap them into place, by gently hitting them with a soft-face hammer.

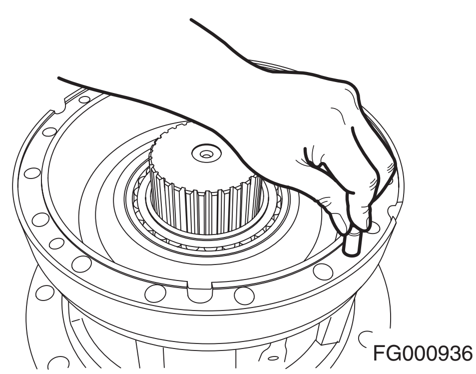


Figure 91

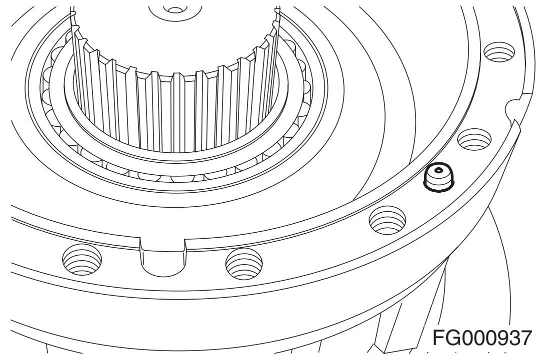


Figure 92

2. Apply liquid gasket (Three Bond #1104) evenly to ring gear assembly of casing.

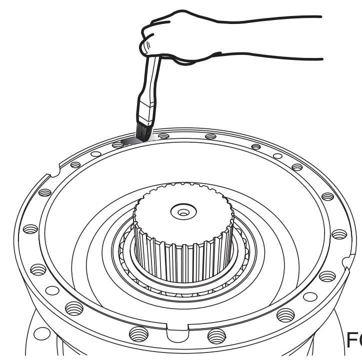


Figure 93

3. Lift ring gear with hoist, wipe its mating surface clean with cloth, match and align holes after checking its assembling direction, and press assembled parts firmly by tightening special bolts (M16x160) on which no Loctite has been applied.

NOTE: *The specail bolts will be removed during Step 6, on page 41.*

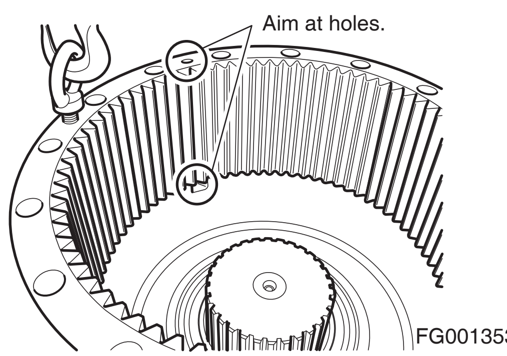


Figure 94

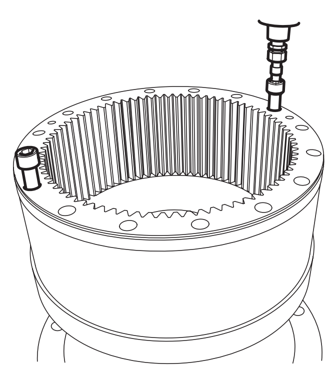


Figure 95

Assembly of Carrier.

1. Using a suitable lifting device, lower No. 2 carrier assembly into ring gear, making sure that planetary gears are engaged. Continue to lower carrier and engaging it onto splines of pinion shaft. Make sure that carrier is resting on bearing.

   NOTE: *Make sure that carrier and drive shaft can rotate.*

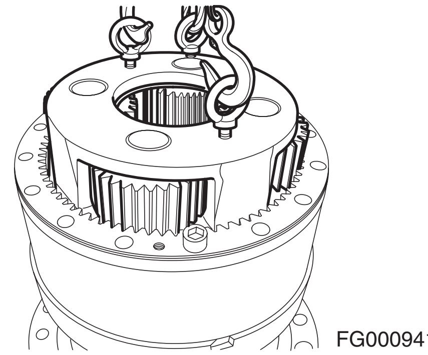


Figure 96

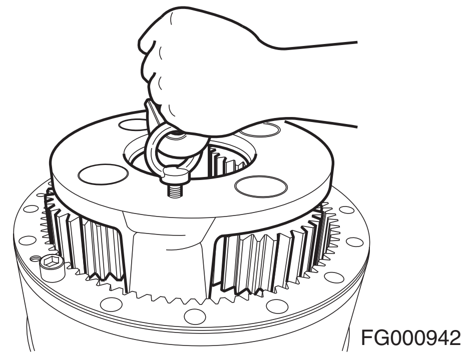


Figure 97

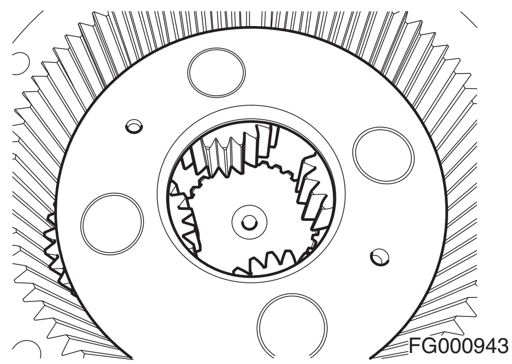


Figure 98

2. Install No. 2 sun gear in No. 2 carrier.
3. Postion thrust plate on No. 2 sun gear.

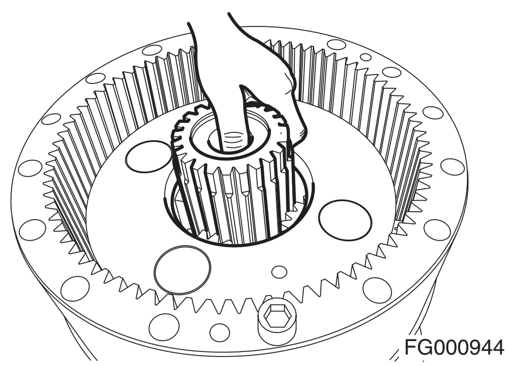


Figure 99

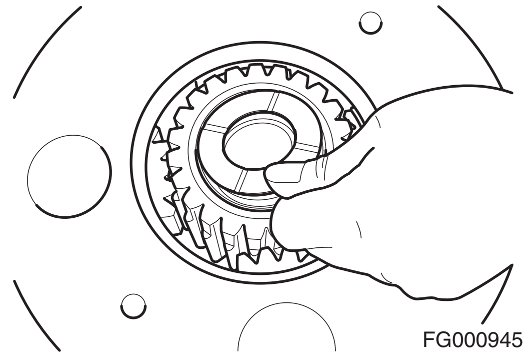


Figure 100

4. Position No. 1 carrier assembly into ring gear making sure it engages No. 2 sun gear.

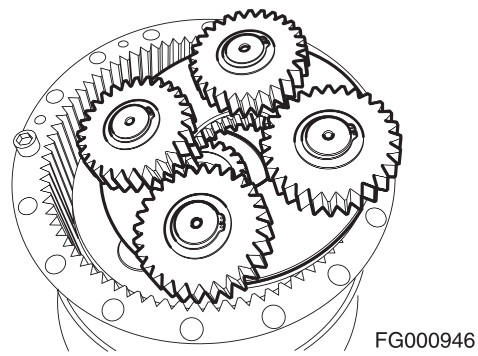


Figure 101

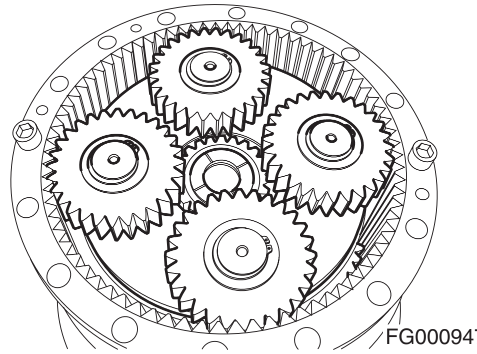


Figure 102

5. Install No. 1 sun gear in middle of No. 1 carrier .

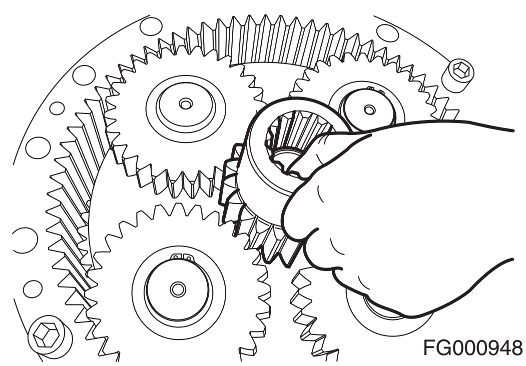


Figure 103

6. Remove press-in bolts that were installed to hold ring gear in position.
7. Apply liquid gasket on ring gear.

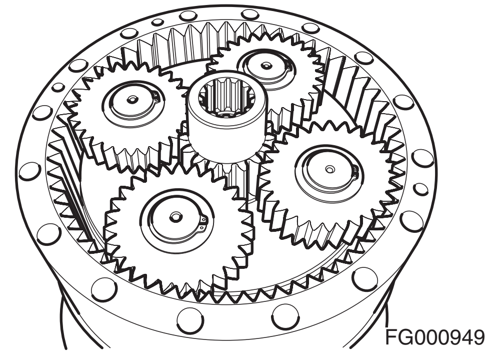


Figure 104

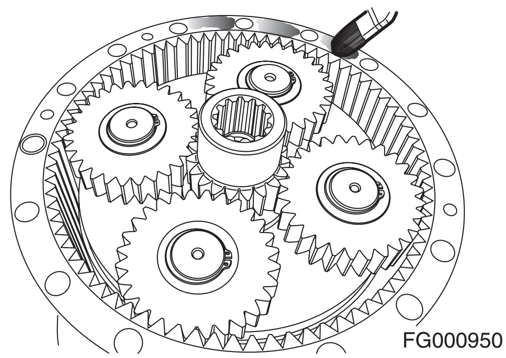


Figure 105

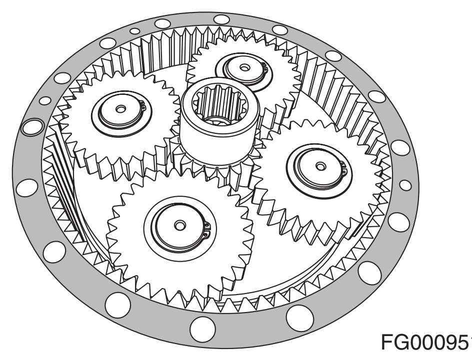


Figure 106

8. Align mounting holes and postion case cover on ring gear.
9. Coat socket head bolts with Loctite and install.

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

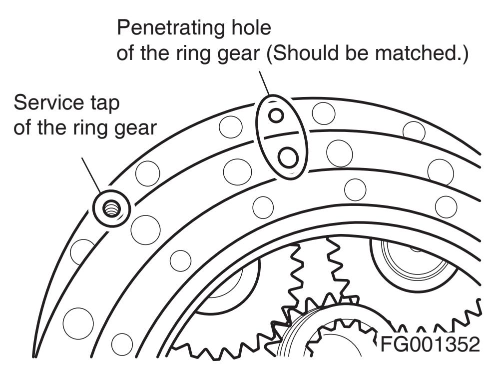


Figure 107

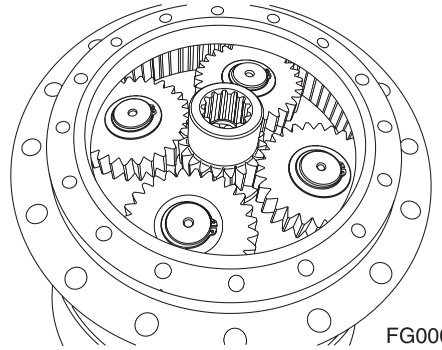


Figure 108

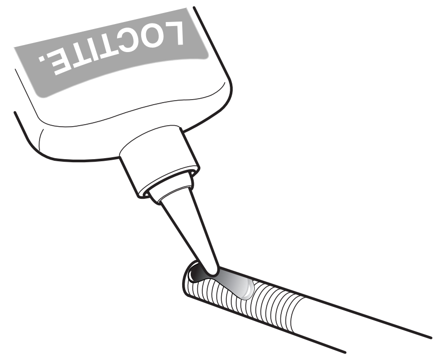


Figure 109

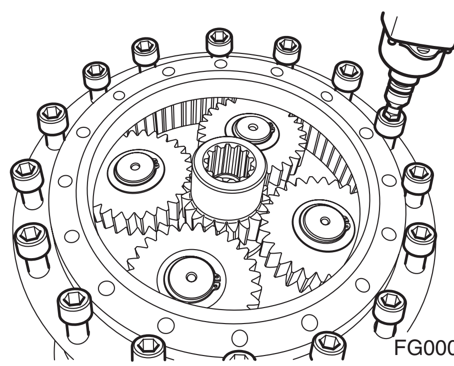


Figure 110

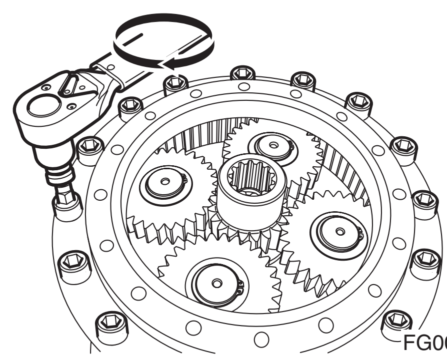


Figure 111

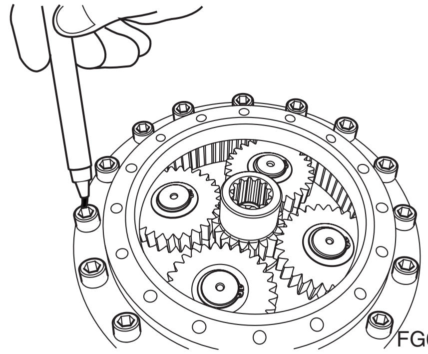


Figure 112

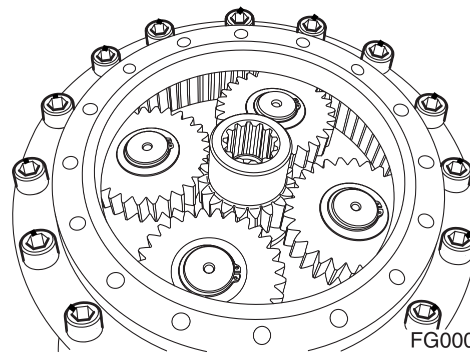
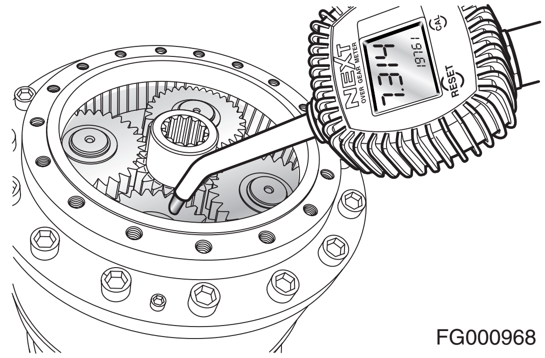


Figure 113

Assembly of Motor

Add Gear Oil

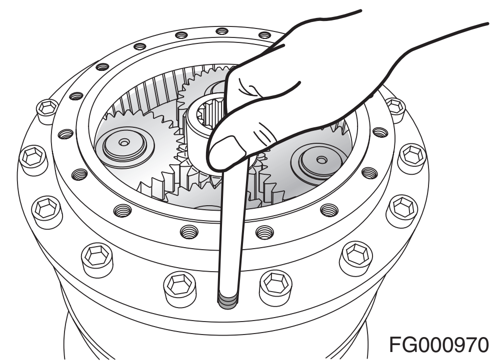
1. Fill case with 7.0 liters (1.8 U.S. gal.) of gear oil (EP80W/ 90).



FG000968

Figure 114

2. Install level pipe in plug hole.

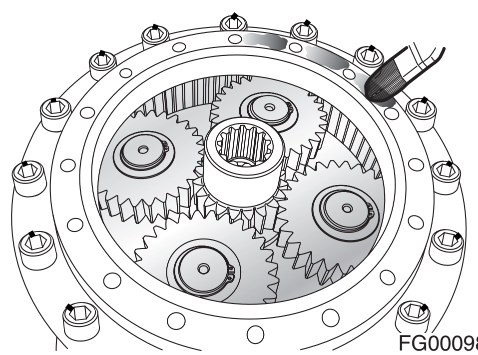


FG000970

Figure 115

Assembly of Motor

1. Apply liquid gasket to cover assembly.



FG000983

Figure 116

2. Lift motor with hoist. Install retaining ring on shaft spline. Align mounting holes and intall motor on case cover.

NOTE: *Gear oil fill plug should point towards fill tube.*

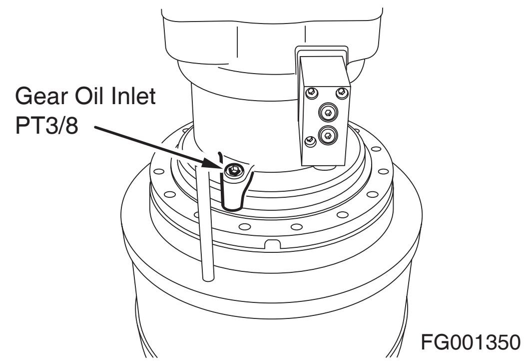


Figure 117

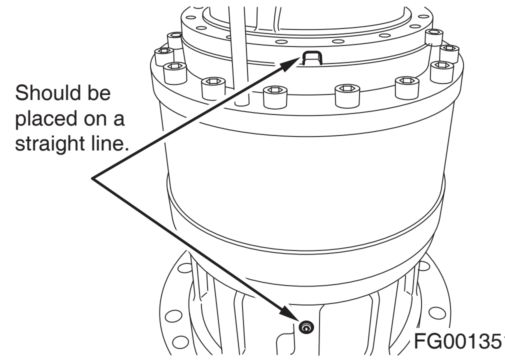


Figure 118

3. Apply Loctite on bolts. Install bolts.

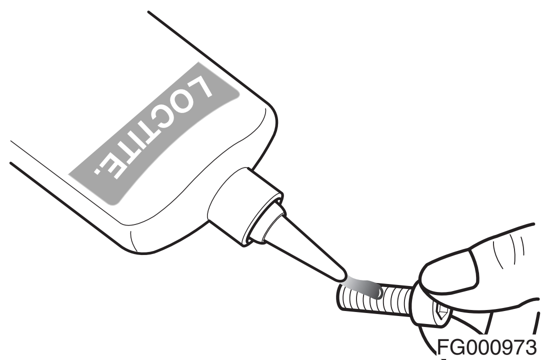


Figure 119

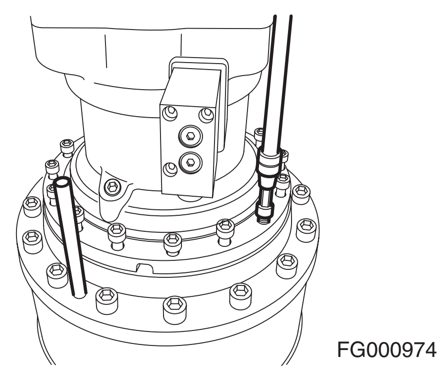


Figure 120

4. Tighten bolts to specified torque. Mark them with paint marker.

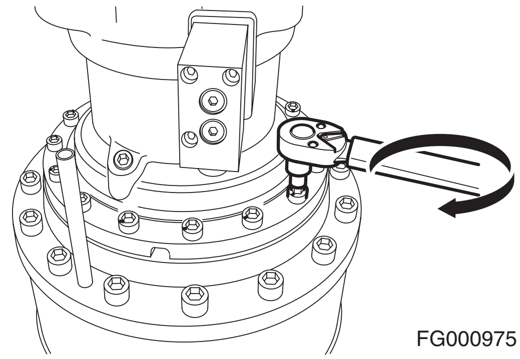


Figure 121

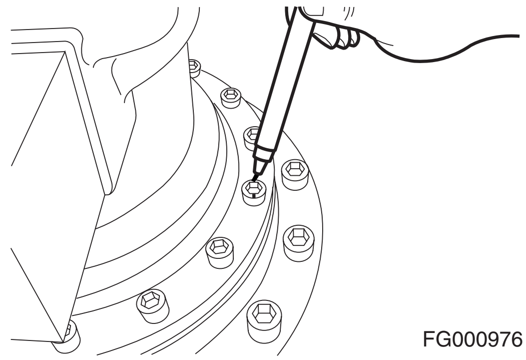


Figure 122

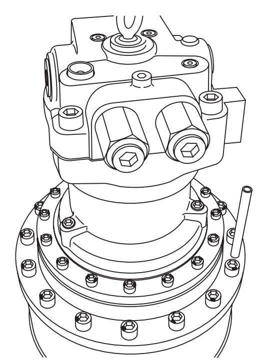


Figure 123

Supply of Grease

1. Install grease fitting in grease inlet and add grease through grease until it starts to be discharged from the opposite hole.

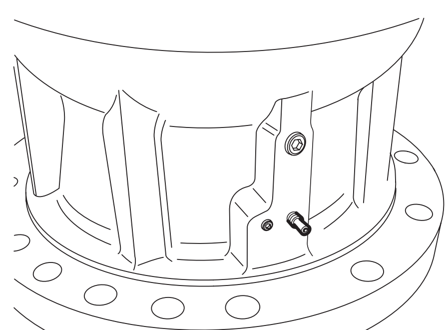


Figure 124

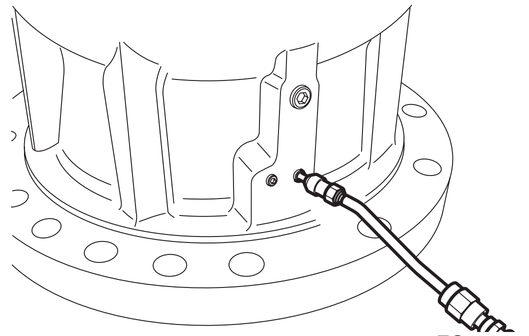


Figure 125

2. Remove grease fitting and install a plastic plug in hole to prvent contamination. A grease hose will be connected during installtion on machine.

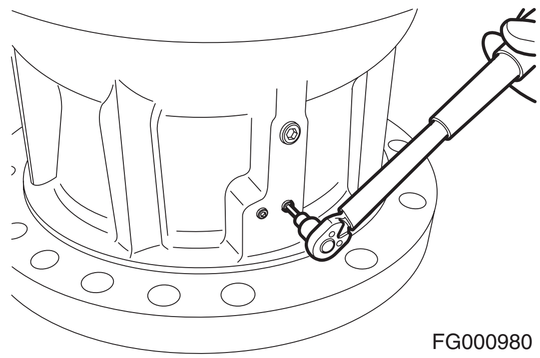


Figure 126

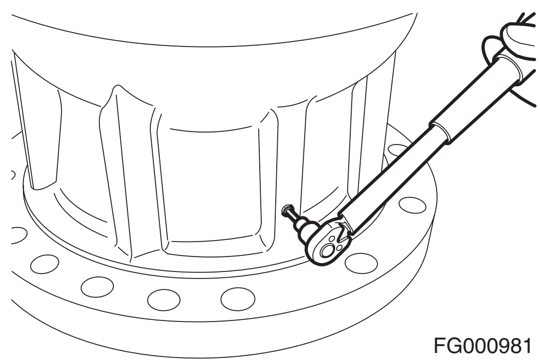


Figure 127

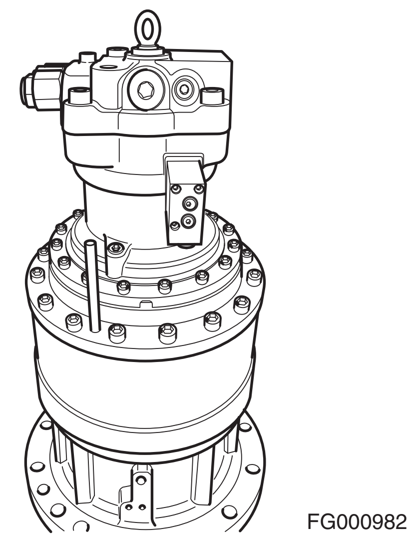


Figure 128

INSTALLATION

1. Coat pinion gear with grease. Refer to operation manual for specifications.
2. Make sure two alignment pins (6, Figure 129) are installed in flange of swing reduction gearbox (5).
3. Using a suitable lifting device, sling swing motor (1, Figure 129) and position swing motor and reduction gearbox (5) as an assembly on unit.
4. Install twelve bolts and washers (4, Figure 129) to secure swing reduction gearbox (5) to frame.

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

   NOTE: *Tighten bolt to 95 kg•m (690 ft lb).*
5. Connect hose (2, Figure 129) to reduction gearbox (5).
6. Connect grease lubrication line (7, Figure 129) to reduction gearbox (5).
7. Connect hoses as tagged during removal to swing motor (1, Figure 129).
8. Fill swing reduction gearbox with oil. Refer to operation manual for specifications.

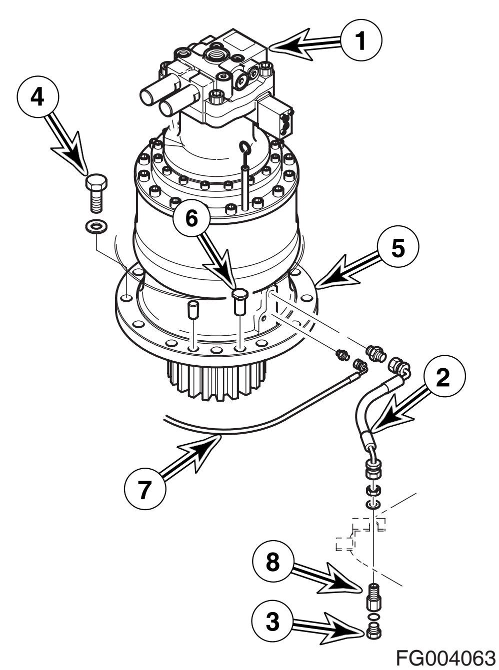


Figure 129

START-UP PROCEDURES

IMPORTANT

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

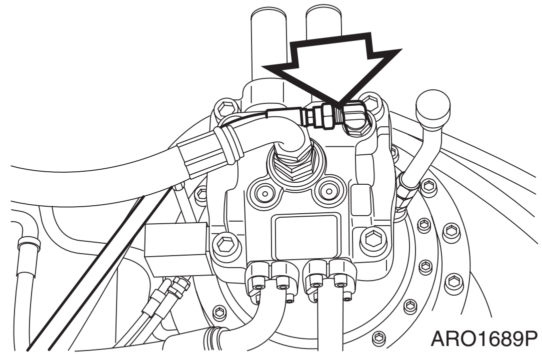


Figure 130

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

Lower Structure and Chassis

Track Assembly

Edition 1

MEMO

Table of Contents

Track Assembly

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up

GENERAL DESCRIPTION

The track assembly is composed of the following major components:

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

TRACK TENSION

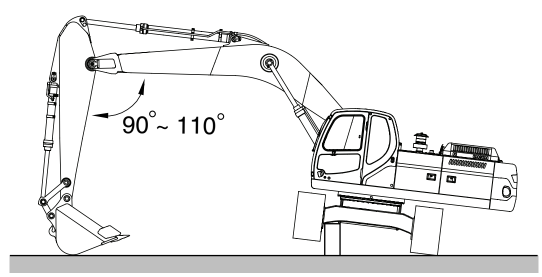
WARNING

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

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

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

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



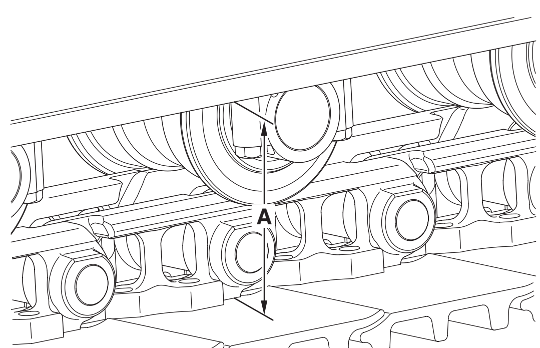
FG000345

Figure 1

2. Measuring the distance (A, Figure 2) between the bottom of the side frame and the top of the lowest crawler shoe. Recommended tension for operation over most types of terrain is distance "B" on below table.

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

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



FG000223

Figure 2

4. The increased clearance recommended for muddy ground conditions is between distance "D" on below table. The clearance should be approximately distance "E" on below table for operation over gravel, rocky terrain, or over sand or snow.

Terrain Type	Distance "A"	
	DX300LC / DX300LCA	DX340LC / DX350LC
Normal "B"	320 - 340 mm (12.60 - 13.39 in)	330 - 360 mm (13.0 - 14.17 in)
Minimum "C"	320 mm (12.60 in)	330 mm (13.0 in)
Muddy "D"	340 - 370 mm (13.39 - 14.57 in)	360 - 410 mm (14.17 - 16.14 in)
Gravel, Rocky, Sand or Snow "E"	370 mm (14.57 in)	410 mm (16.14 in)

WARNING

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

5. Track tension adjustments are made through the grease fitting (1, Figure 3) in the middle of each side frame. Adding grease increases the length of an adjustment cylinder (2). The longer the adjustment cylinder, the greater the pressure on the tension spring pushing the track idler wheel outward.
6. If there is not enough slack or clearance in the tracks and the adjustment is too tight, the idler wheel and adjusting cylinder can be retracted by bleeding off grease through hole in adjustment cylinder (2, Figure 3).

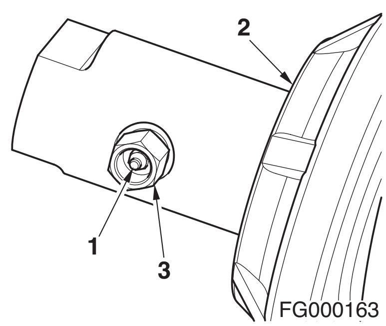


Figure 3

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

CAUTION

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

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

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

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

Track Shoe

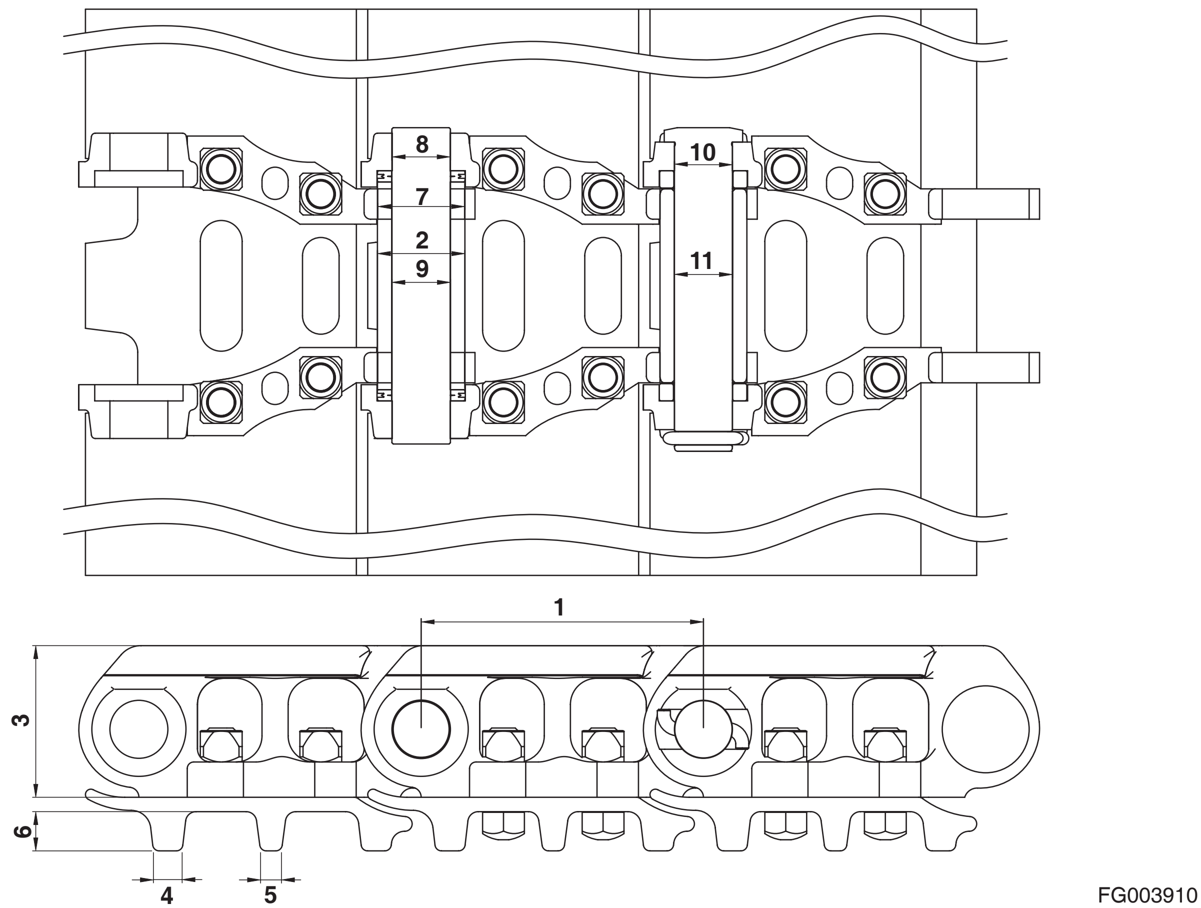
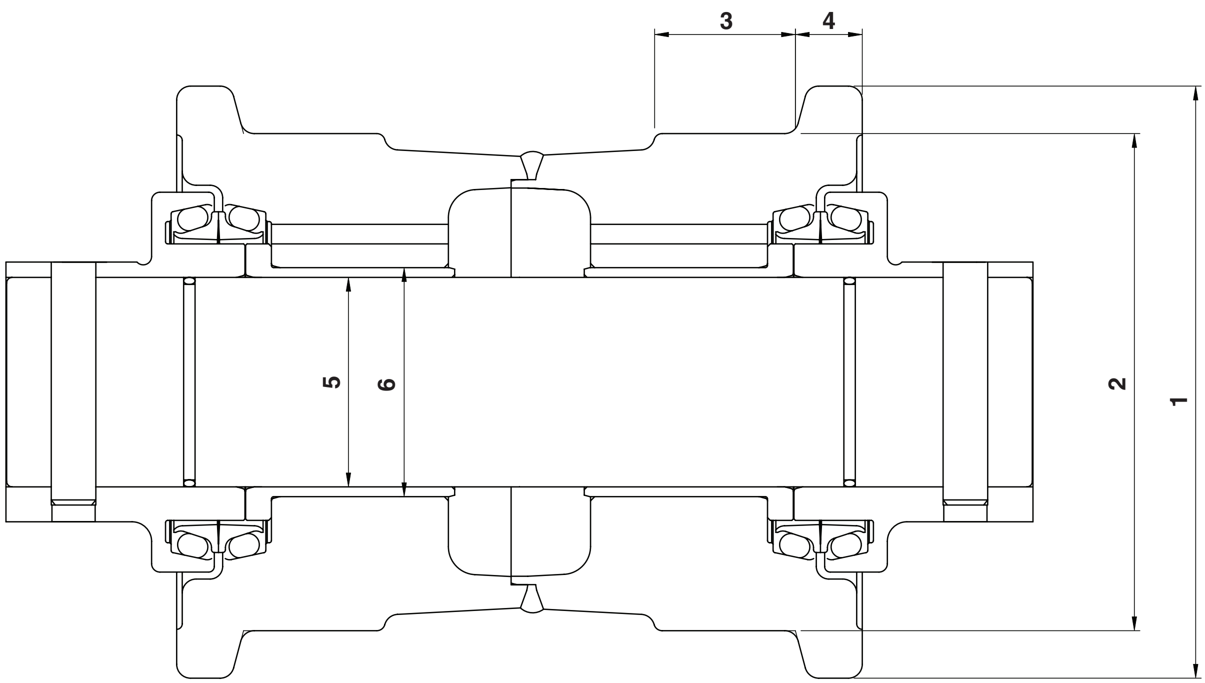


Figure 4

<table>
<tr><th>No.</th><th>Check Item</th><th colspan="2">Standard Dimension</th><th colspan="2">Recommended Limit for Maintenance</th><th>Limit for Use (Repair - P or Replace - R)</th></tr>
<tr><td>1</td><td>Link Pitch</td><td colspan="2">216 mm (8.504")</td><td colspan="2"></td><td></td></tr>
<tr><td>2</td><td>Bushing Outside Diameter</td><td colspan="2">66.5 mm (2.618")</td><td colspan="2">62.5 mm (2.461")</td><td>59 mm [R] (2.323")</td></tr>
<tr><td>3</td><td>Link Height</td><td colspan="2">116 mm (4.567")</td><td colspan="2">108 mm (4.252")</td><td>103 mm [P] (4.055")</td></tr>
<tr><td>4</td><td>Length at Tip</td><td colspan="2">22 mm (0.866")</td><td colspan="2"></td><td></td></tr>
<tr><td>5</td><td>Length at Tip</td><td colspan="2">16 mm (0.630")</td><td colspan="2"></td><td></td></tr>
<tr><td>6</td><td>Height</td><td colspan="2">30 mm (1.181")</td><td colspan="2">24 mm (0.945")</td><td>20 mm (0.787")</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Interference between bushing and link</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>66.5 mm (2.618")</td><td>+0.46
+0.41</td><td>+0.074
0.0</td><td>0.336 - 0.46</td><td></td></tr>
<tr><td rowspan="3">8</td><td rowspan="3">Interference between regular pin and link</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>44.6 mm (1.756")</td><td>+0.235
+0.085</td><td>-0.188
-0.25</td><td>0.273 - 0.485</td><td></td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Clearance between regular pin and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>44.6 mm (1.756")</td><td>+0.235
+0.085</td><td>+1.35
+0.85</td><td>0.615 - 1.265</td><td></td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Interference between master pin and link</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>44.6 mm (1.756")</td><td>-0.205
-0.235</td><td>-0.188
-0.25</td><td>0.0 - 0.045</td><td></td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Clearance between master pin and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>44.6 mm (1.756")</td><td>-0.205
-0.235</td><td>+1.35
+0.85</td><td>1.055 - 1.585</td><td></td></tr>
</table>

Lower Roller

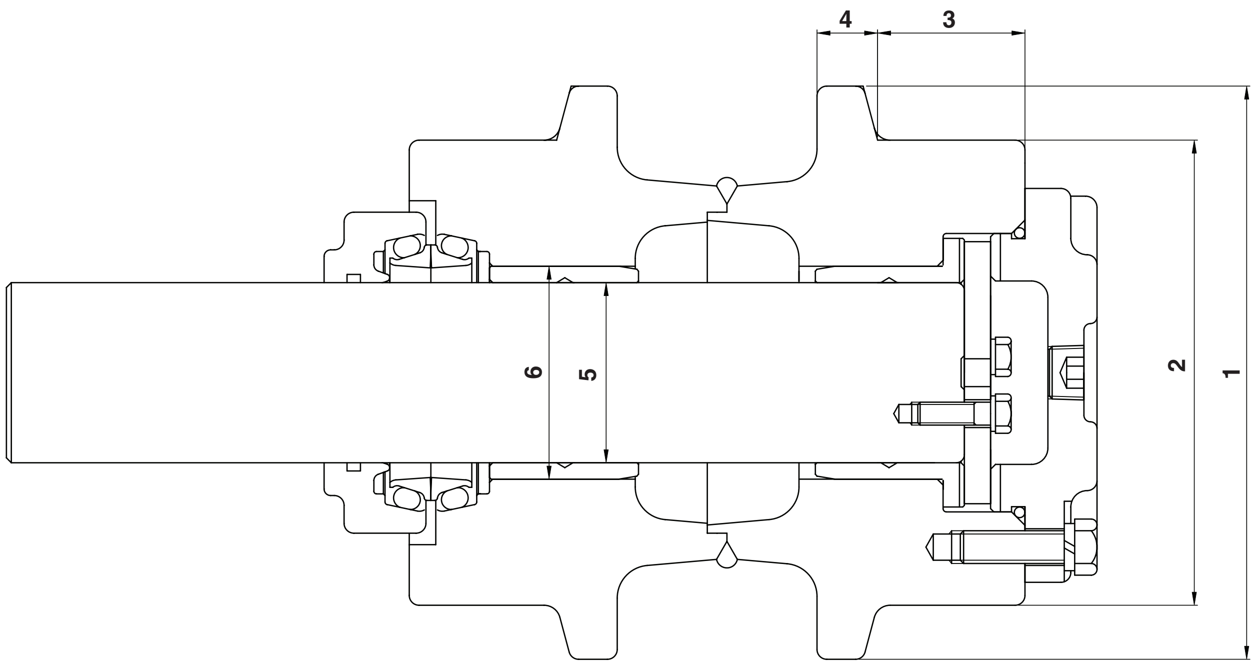


FG000508

Figure 5

<table>
<tr><th>No.</th><th>Check Item</th><th colspan="2">Standard Dimension</th><th colspan="2">Recommended Limit for Maintenance</th><th>Limit for Use (Repair - P or Replace - R)</th></tr>
<tr><td>1</td><td>Outside Diameter of flange</td><td colspan="2">212 mm
(8.346")</td><td colspan="2"></td><td></td></tr>
<tr><td>2</td><td>Outside Diameter of Tread</td><td colspan="2">178 mm
(7.008")</td><td colspan="2">166 mm
(6.535")</td><td>164 mm [P]
(6.457")</td></tr>
<tr><td>3</td><td>Width of Tread</td><td colspan="2">50.5 mm
(1.988")</td><td colspan="2">56.5 mm
(2.224")</td><td>59.5 mm [P]
(2.343")</td></tr>
<tr><td>4</td><td>Width of Flange</td><td colspan="2">24 mm
(0.945")</td><td colspan="2"></td><td></td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>75 mm
(2.953")</td><td>-0.06
-0.09</td><td>+0.390
+0.344</td><td>0.404 - 0.48</td><td>1.5 mm [R]
(0.059")</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Interference between roller and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>82 mm
(3.228")</td><td>+0.190
+0.140</td><td>+0.030
-0.020</td><td>0.11 - 0.21</td><td></td></tr>
</table>

Upper Roller

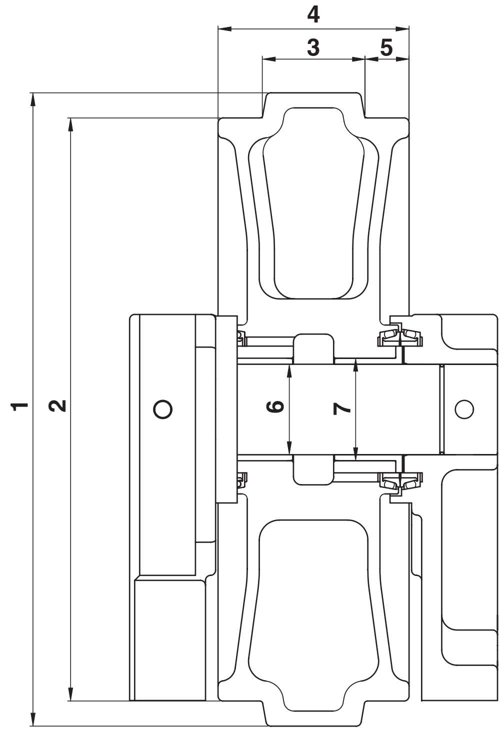


FG000509

Figure 6

<table>
<tr><th>No.</th><th>Check Item</th><th colspan="2">Standard Dimension</th><th colspan="2">Recommended Limit for Maintenance</th><th>Limit for Use (Repair - P or Replace - R)</th></tr>
<tr><td>1</td><td>Outside Diameter of flange</td><td colspan="2">175 mm
(6.890")</td><td colspan="2"></td><td></td></tr>
<tr><td>2</td><td>Outside Diameter of Tread</td><td colspan="2">142 mm
(5.591")</td><td colspan="2">135 mm
(5.315")</td><td>130 mm [P]
(5.118")</td></tr>
<tr><td>3</td><td>Width of Tread</td><td colspan="2">45 mm
(1.772")</td><td colspan="2">52 mm
(2.047")</td><td>54 mm [P]
(2.126")</td></tr>
<tr><td>4</td><td>Width of Flange</td><td colspan="2">18.5 mm
(0.728")</td><td colspan="2"></td><td></td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>55 mm
(2.165")</td><td>-0.01
-0.03</td><td>+0.37
+0.33</td><td>0.34 - 0.40</td><td></td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Interference between roller and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>65 mm
(2.559")</td><td>+0.125
+0.090</td><td>+0.030
0.0</td><td>0.06 - 0.125</td><td></td></tr>
</table>

Front Idler



FG000510

Figure 7

<table>
<tr><th>No.</th><th>Check Item</th><th colspan="2">Standard Dimension</th><th colspan="2">Recommended Limit for Maintenance</th><th>Limit for Use (Repair - P or Replace - R)</th></tr>
<tr><td>1</td><td>Outside Diameter of flange</td><td colspan="2">630 mm
(24.803")</td><td colspan="2"></td><td></td></tr>
<tr><td>2</td><td>Outside Diameter of Tread</td><td colspan="2">580 mm
(22.835")</td><td colspan="2">572 mm
(22.520")</td><td>568 mm [P]
(22.362")</td></tr>
<tr><td>3</td><td>Width of Protrusion</td><td colspan="2">102 mm
(4.016")</td><td colspan="2"></td><td></td></tr>
<tr><td>4</td><td>Total Width</td><td colspan="2">190 mm
(7.480")</td><td colspan="2"></td><td></td></tr>
<tr><td>5</td><td>Width of Tread</td><td colspan="2">44 mm
(1.732")</td><td colspan="2">47 mm
(1.850")</td><td>49 mm
(1.929")</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>90 mm
(3.543")</td><td>-0.072
-0.107</td><td>+0.34
+0.30</td><td>0.372 - 0.447</td><td>1.0 mm [R]
(0.039")</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Interference between roller and bushing</td><td rowspan="2">Standard Dimension</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Interference</td><td rowspan="2">Repair Limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>102 mm
(4.016")</td><td>+0.190
+0.155</td><td>+0.054
0.0</td><td>0.101 - 0.19</td><td></td></tr>
</table>

TRACK SHOES AND LINKS

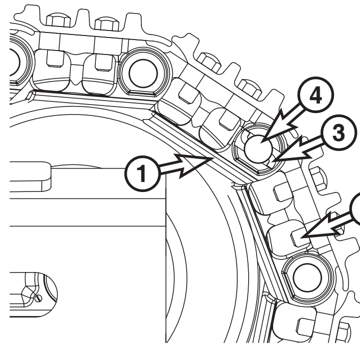
Track Removal

1. Position machine on a smooth level surface with adequate room for forward and reverse travel.
2. Relieve track tension. Refer to "Track Tension" in this section for procedure.
3. Move machine until master link (1, Figure 8) is positioned at approximately 10 o'clock from top position on front idle roller.
4. Remove four nuts and bolts (2, Figure 8) holding shoe to link. Remove enough shoes to make access to lock pin easier.

   NOTE: *Support track shoes with blocking so that when master pin (4,* Figure 8*) is removed track will not fall.*

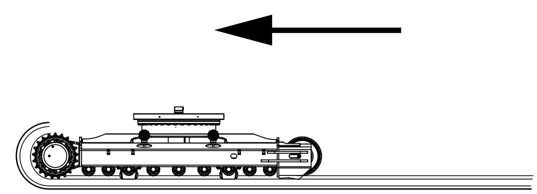
5. Straighten lock pin (3, Figure 8) and remove it from master pin (4). Discard lock pin.
6. Remove master pin from master links.
7. Move unit backward until entire track is laying on ground.

   NOTE: *Do not drive unit off track.*



FG003982

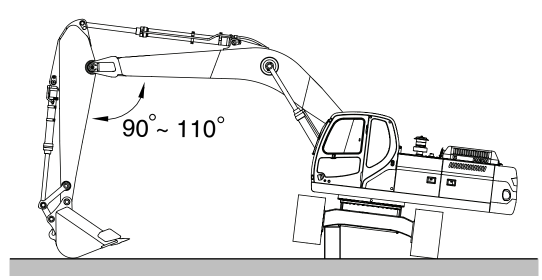
Figure 8



FG003911

Figure 9

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



FG000345

Figure 10

Track Installation

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

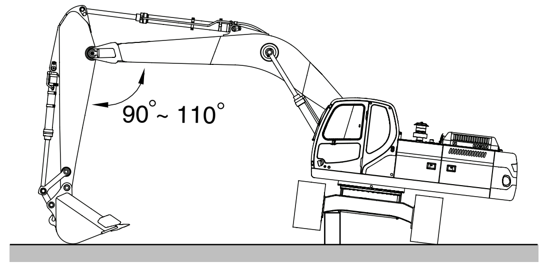


Figure 11

4. Move unit forward while feeding track up over drive sprocket. Continue to pull track back until it engages front idle roller.

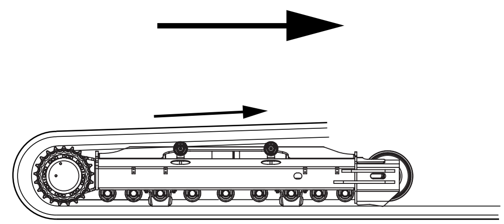


Figure 12

5. Align master links and install master pin.
6. Insert new lock pin in master pin. Bend end of pin over so it is pointing in opposite direction of other end as shown.
7. Apply track tension. Refer to "Track Tension" in this section for procedure.

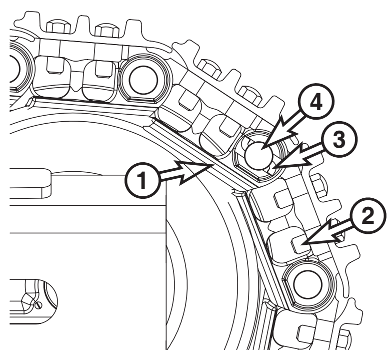


Figure 13

FRONT IDLER ROLLER

Parts List

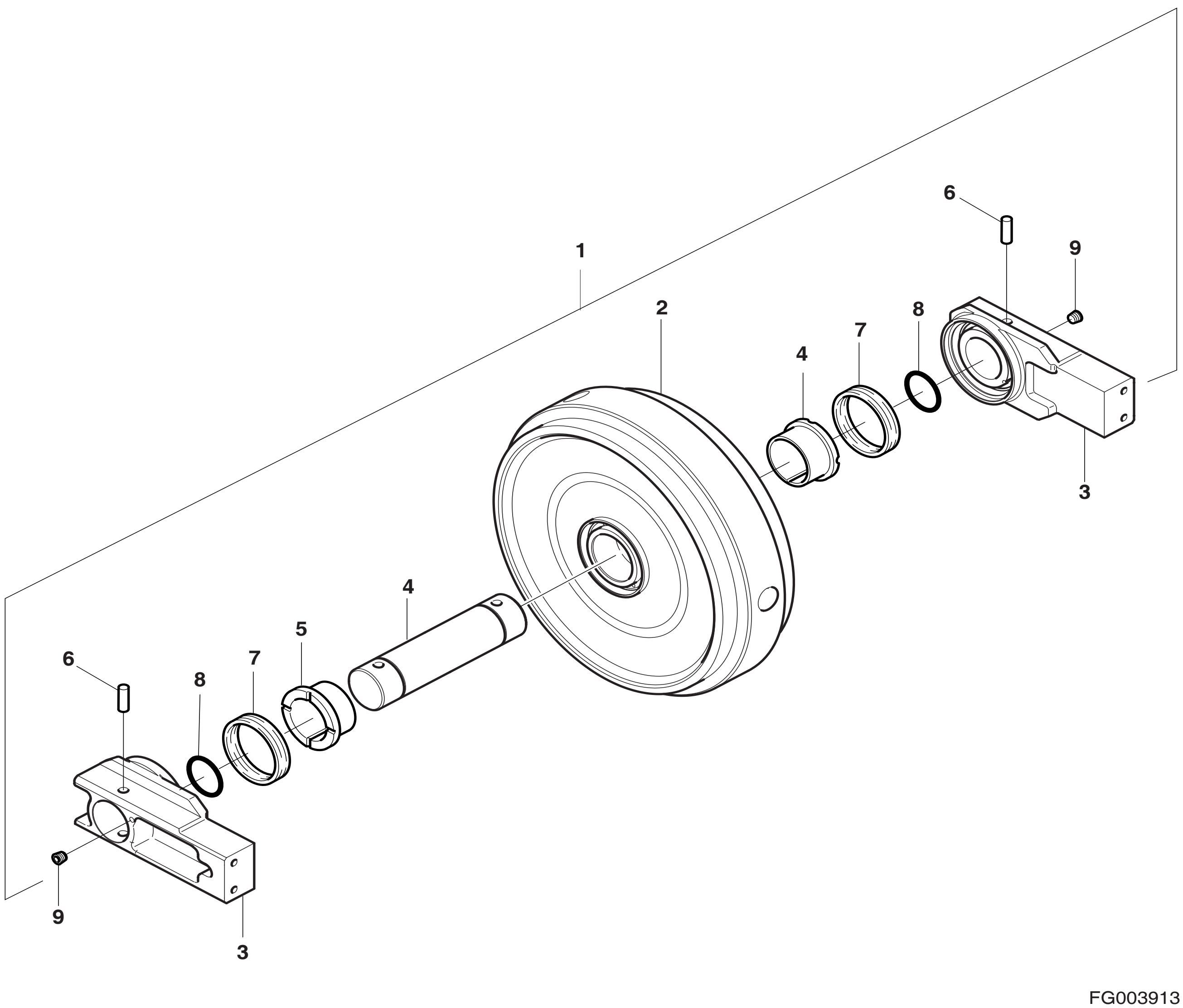


Figure 14

Reference Number	Description
1	Idler Assembly
2	Idler
3	Bearing
4	Shaft
5	Bushing

Reference Number	Description
6	Pin
7	Floating Seal
8	O-ring
9	Plug

Front Idler Roller Disassembly

1. Remove plug (9, Figure 15) from idler assembly (1), and drain into a suitable container.

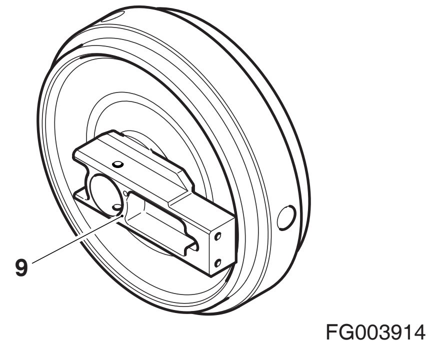


Figure 15

2. Separate the pin (6, Figure 16) from the bearing (3).

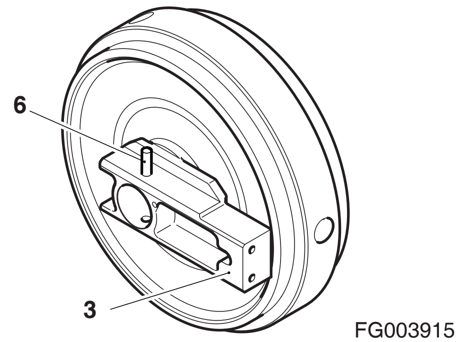


Figure 16

3. Use a press to remove the bearing from the axle (4). Separate the O-ring (8, Figure 17) from the axle.

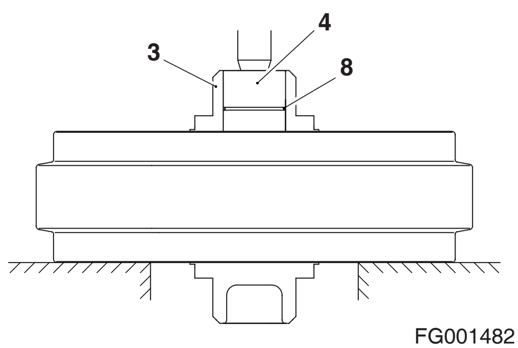


Figure 17

4. Detach the floating seal (7, Figure 18) from the idler (2) and bearing (3).

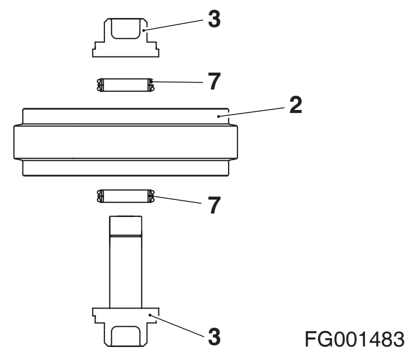


Figure 18

5. Use a press to separate the axle (4, Figure 19), O-ring (8) and bearing (3).

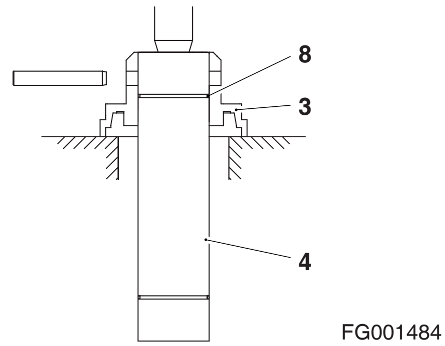


Figure 19

6. Remove bushing (5, Figure 20) with the press and special tool (10, ST-1909).

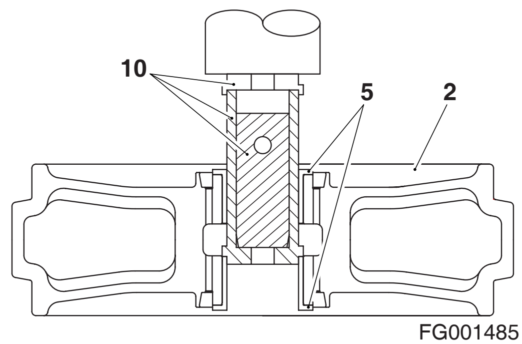


Figure 20

Front Idler Roller Reassembly

1. Degrease, clean and dry all parts before reassembly. Insert bushing (5, Figure 20) into the idler (2).
2. Grease O-ring (8, Figure 21) and insert it into the axle.
3. Align the bearing (3, Figure 21) and axle (4) holes and pin (6) them together.

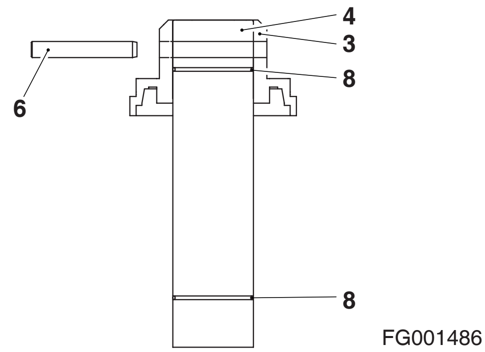


Figure 21

4. Install floating seal (7, Figure 22) inside the idler (2) and bearing (3).

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

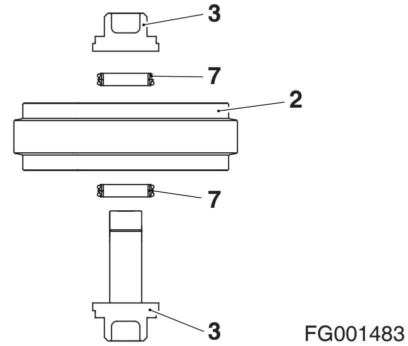


Figure 22

5. Install idler (2, Figure 23) on the axle.
6. Install bearing (3, Figure 23) and pin (6) to the axle.

   NOTE: *Fill the idler assembly with new engine oil with approximately 420 cc (14.2 oz).*

7. Install plug (9, Figure 28) on the bearing.

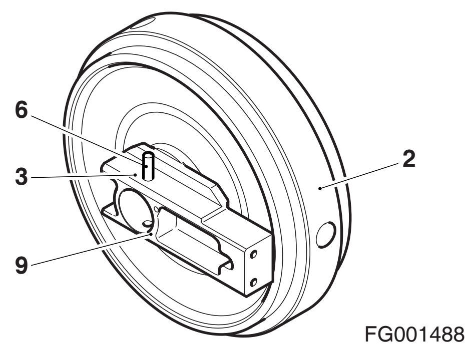


Figure 23

LOWER ROLLER

Parts List

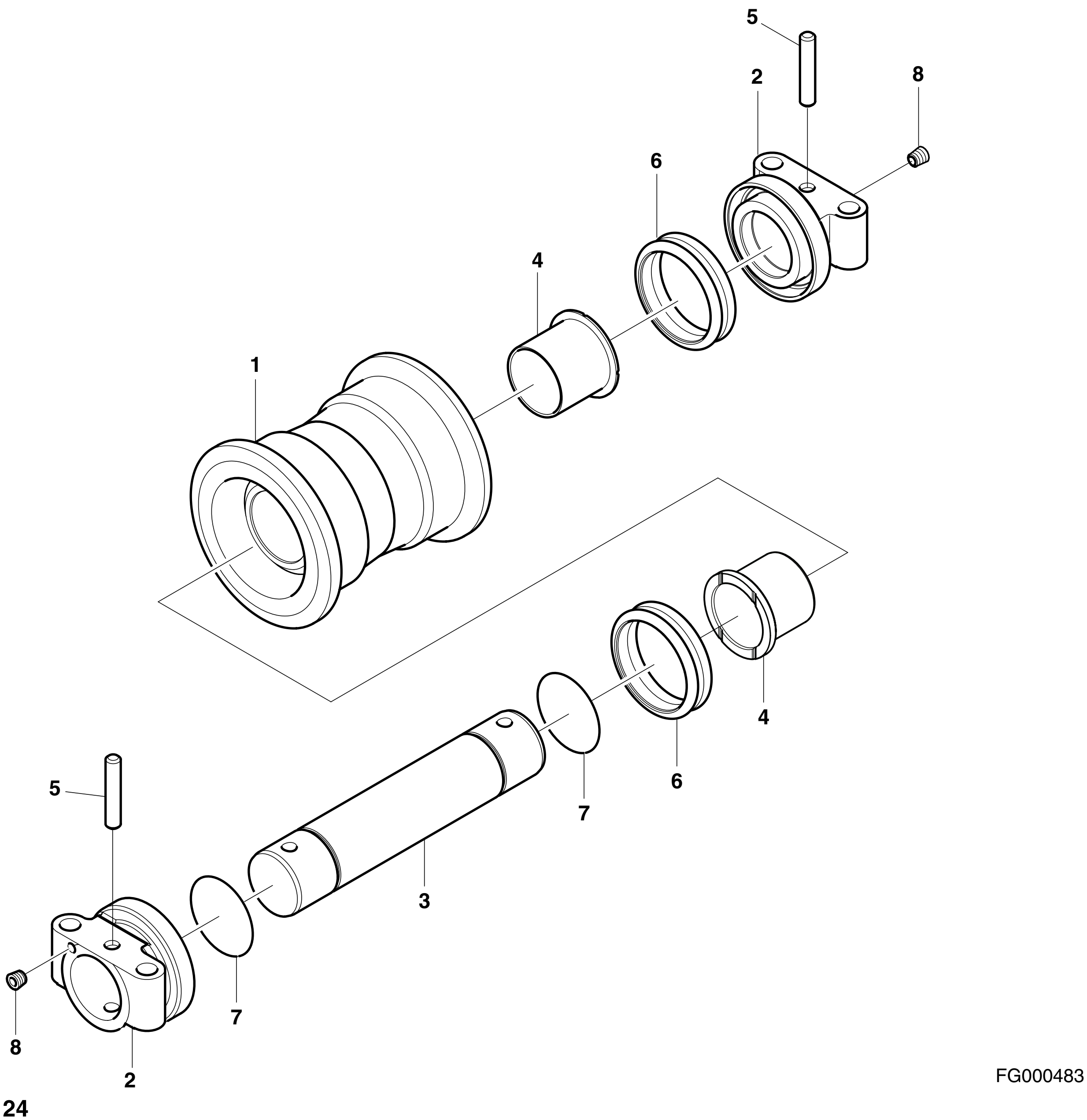


Figure 24

Reference Number	Description
1	Roller
2	Collar
3	Shaft
4	Bushing

Reference Number	Description
5	Pin
6	Floating Seal
7	O-ring
8	Plug

Lower Roller Removal

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

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

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

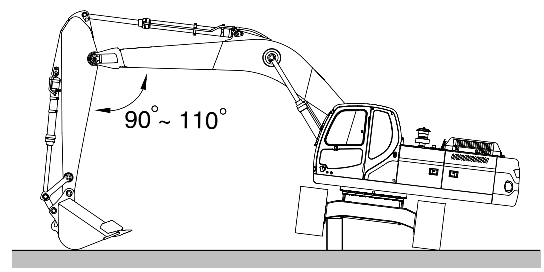


Figure 25

Lower Roller Disassembly

1. Remove plug (8, Figure 26) from the collar and drain oil.
2. Pull the pin (5, Figure 26) from the collar.

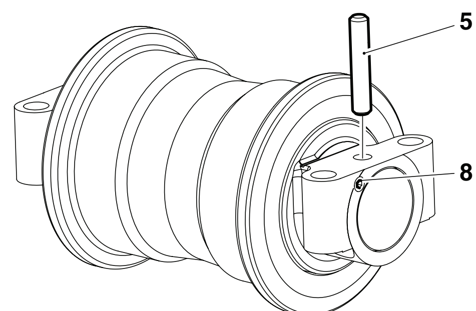


Figure 26

3. Separate the collar (2, Figure 27) from the axle, using press.

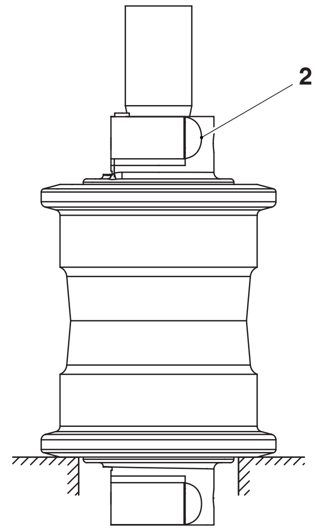


Figure 27

4. Detach O-rings (7, Figure 28) from the axle.
5. Separate floating seals (6, Figure 28) from the collar and roller (1).
6. Detach collar (2, Figure 28) and O-rings (7) from the axle, using press.

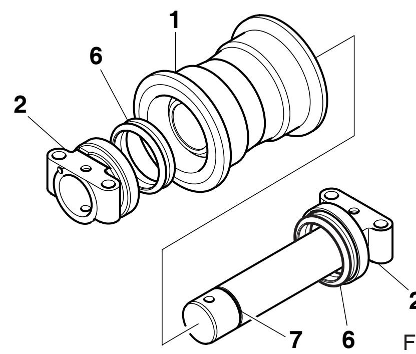


Figure 28

Lower Roller Reassembly

1. Degrease, clean and dry all parts before reassembly. Insert bushing (4, Figure 29) into roller.

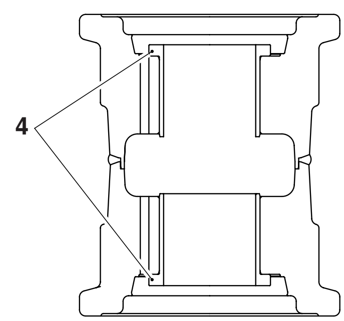


Figure 29

2. Apply grease to the O-rings (7, Figure 29) and insert into axle.
3. Align collar (2, Figure 30) and axle (3) pin holes and pin (5) the collar.

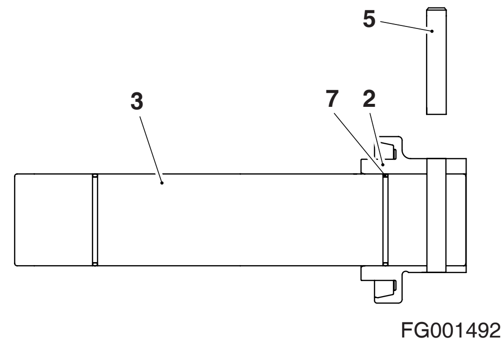


Figure 30

4. Insert floating seals (6, Figure 31) into the roller (1) and collar (2).

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

5. Slide the axle inside the roller.

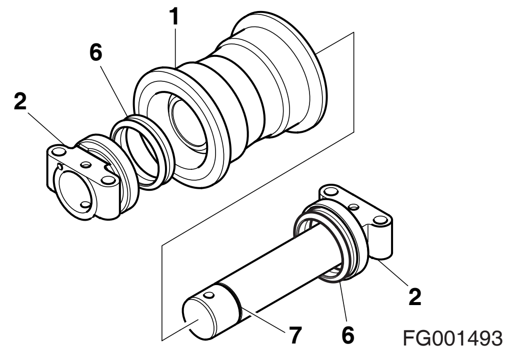


Figure 31

6. Install the collar (2, Figure 32), O-ring (7), and pin (5) on the remaining side.
7. Fill with clean engine oil with approximately 480.0 cc (16.2 oz).
8. Install plug (8, Figure 32) on the collar.

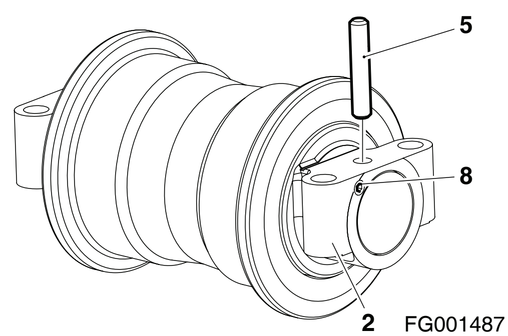


Figure 32

Lower Roller Installation

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

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

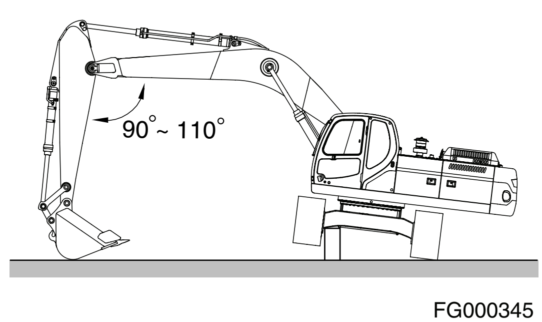


Figure 33

UPPER ROLLER

Parts List

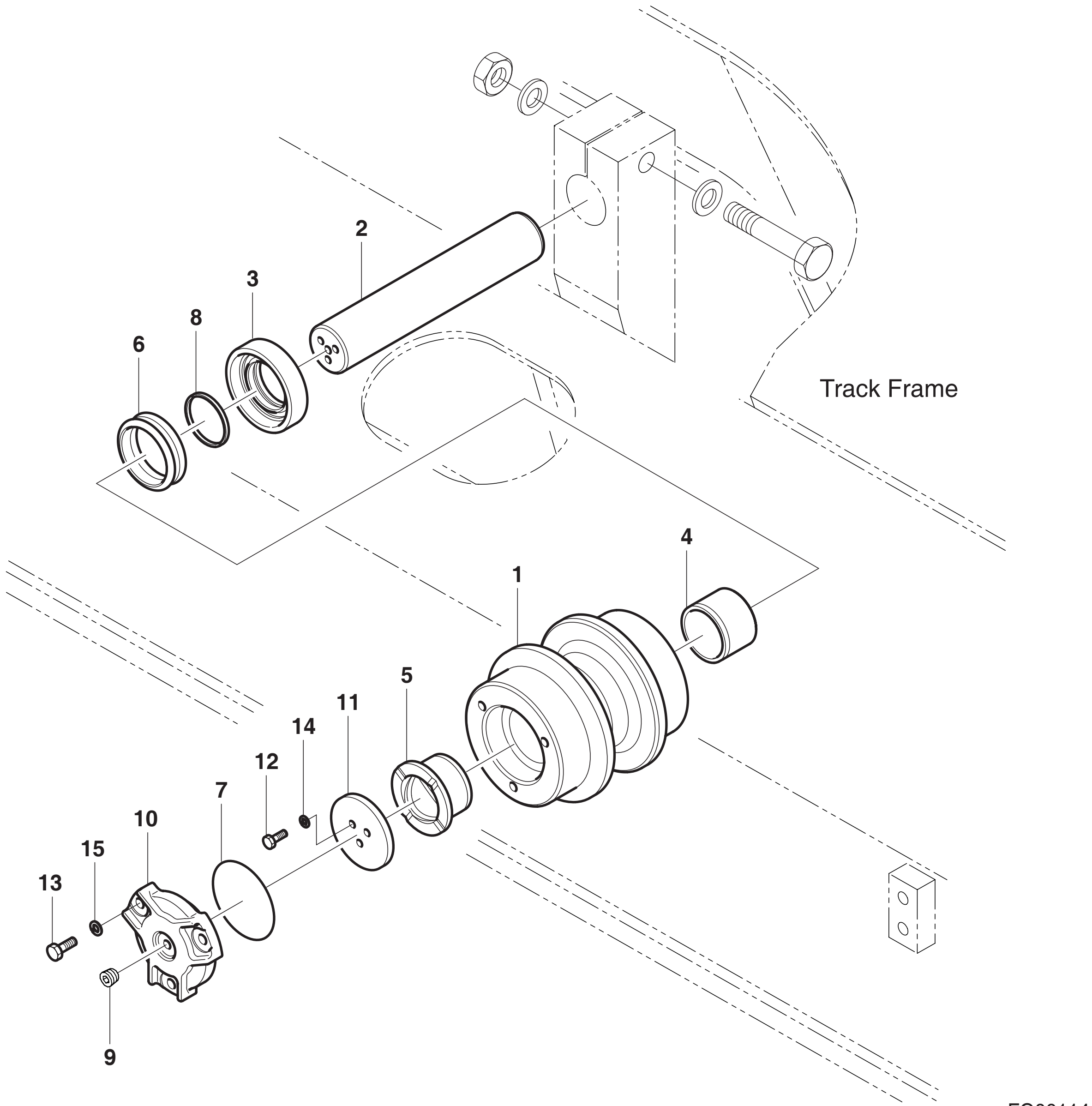


Figure 34

Reference Number	Description
1	Roller
2	Shaft
3	Thrust Ring
4	Bushing
5	Bushing
6	Floating Seal
7	O-ring
8	O-ring

Reference Number	Description
9	Plug
10	Cover
11	Washer
12	Bolt
13	Blot
14	Spring Washer
15	Spring Washer

Upper Roller Removal

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

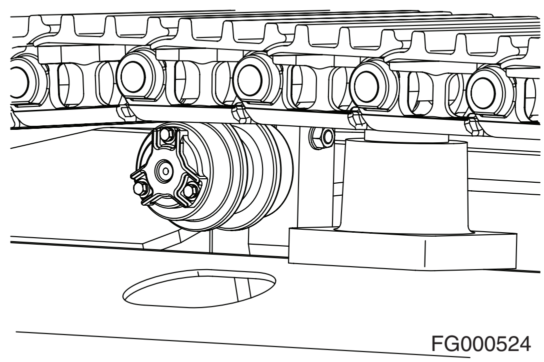


Figure 35

Upper Roller Disassembly

1. Remove the plug (9, Figure 36) from the cover and drain oil.

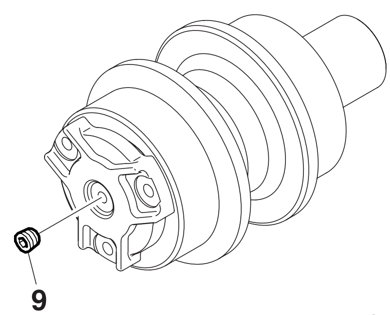


Figure 36

2. Remove the bolts (13, Figure 37) and cover (10). Detach bolts (12) and washer (11).

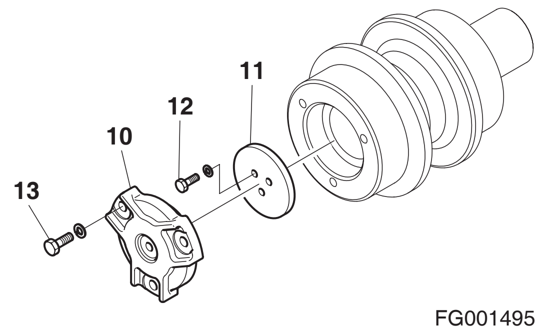


Figure 37

3. Separate the roller (1, Figure 38) from the axle (2).

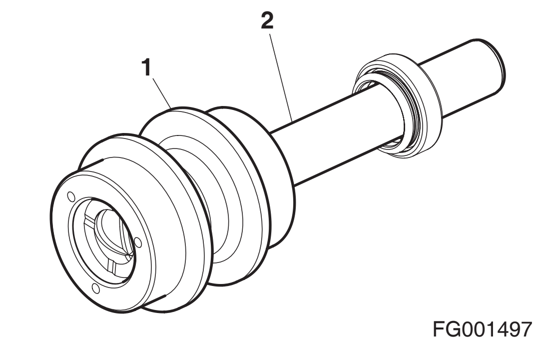


Figure 38

4. Separate the floating seal (6, Figure 39) from the roller.
5. Separate the O-ring (8) and thrust ring (3) from the axle.

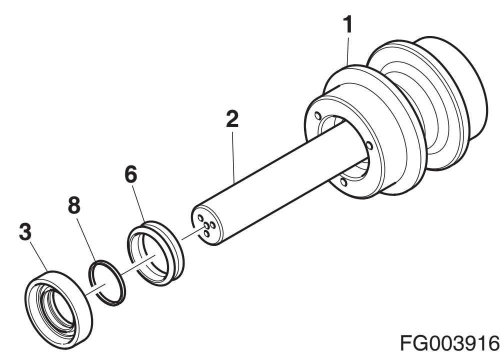


Figure 39

6. Separate the bushing (4 and 5, Figure 40) from the roller with a press and special tool (ST-1919).

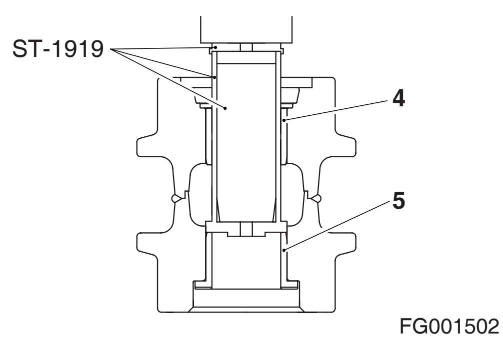


Figure 40

Upper Roller Reassembly

1. Degrease, clean and dry all parts before reassembly. Insert bushing (4 and 5, Figure 41) into the roller (1).

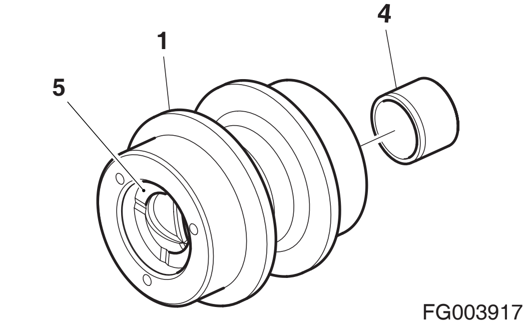


Figure 41

2. Insert floating seal (6, Figure 42) into the roller (1) and bushing.

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

3. Install the axle (2), O-ring (8) and thrust ring (3).

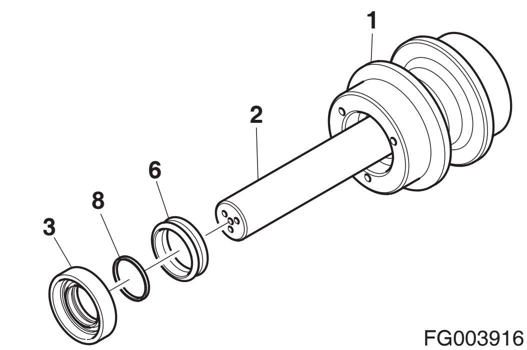


Figure 42

4. Install washer (11, Figure 43) and bolt (12).
5. Insert the O-ring (7, Figure 43) to the cover (10). Attach cover (10) and bolt (13) to the roller.
6. Fill with engine oil with 200cc.
7. Tighten plug (9, Figure 43).

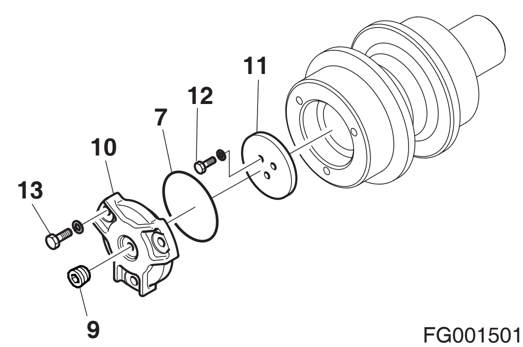


Figure 43

TRACK SPRING AND TRACK ADJUSTING CYLINDER

Parts List

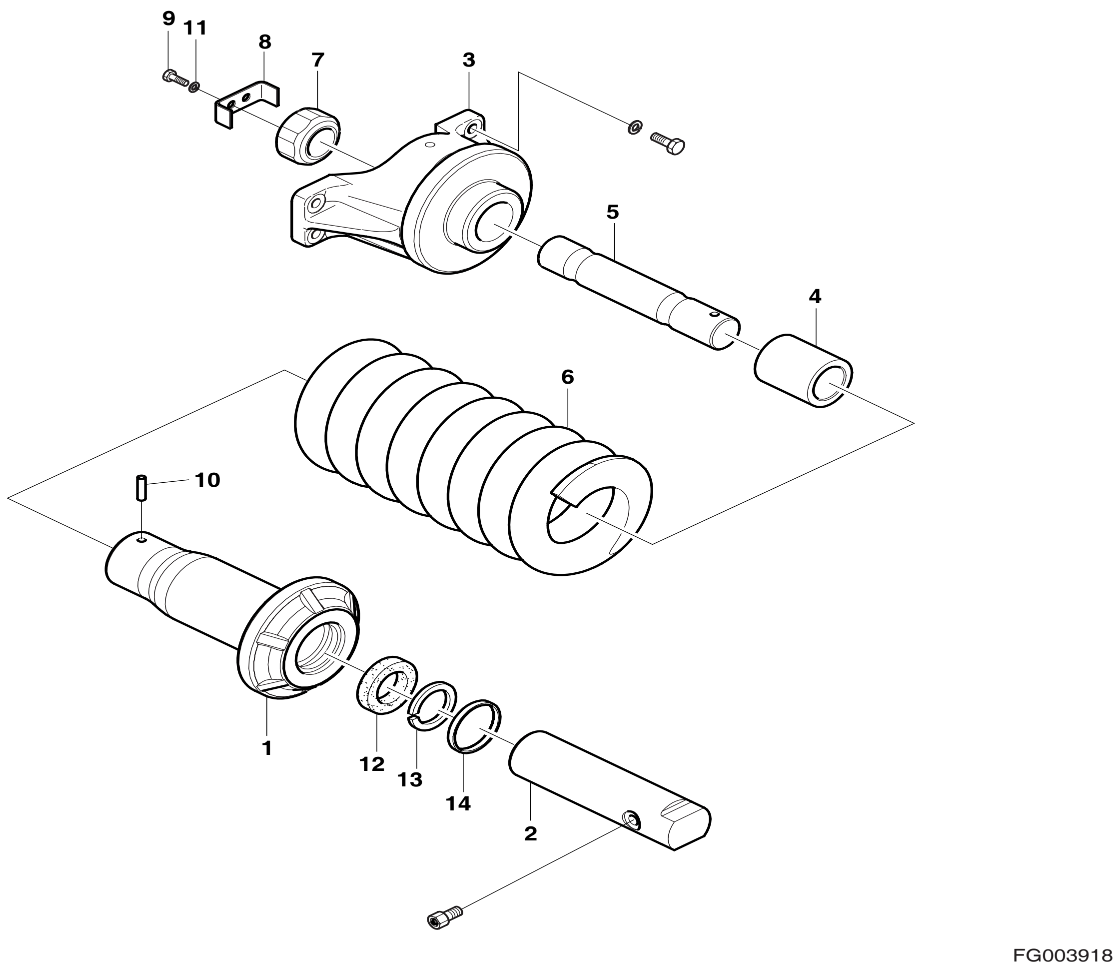


Figure 44

Reference Number	Description
1	Cylinder
2	Piston Rod
3	Yoke
4	Spacer
5	Shaft
6	Spring
7	Lock Nut

Reference Number	Description
8	Lock Plate
9	Bolt
10	Spring Pin
11	Spring Washer
12	Packing
13	Backup Ring
14	Dust Seal

Engine and Drive Train

SP002029

Drive Coupling (Main Pump)

Edition 1

MEMO

Table of Contents

Drive Coupling (Main Pump)

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LCA	5001 and Up

DRIVE COUPLING

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

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

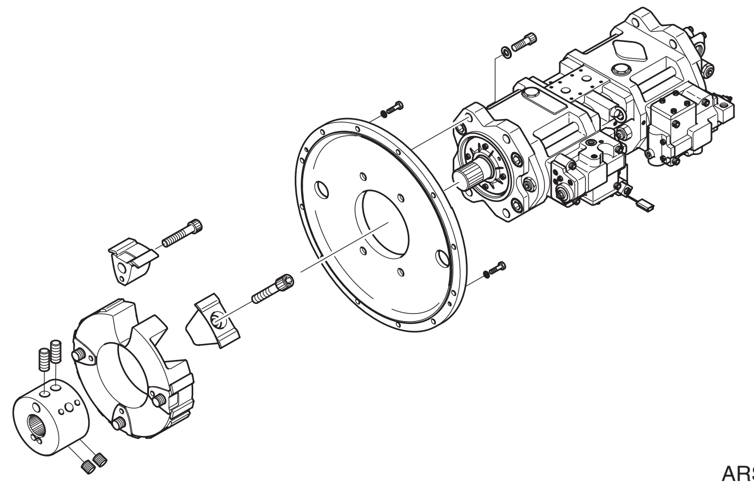


Figure 1

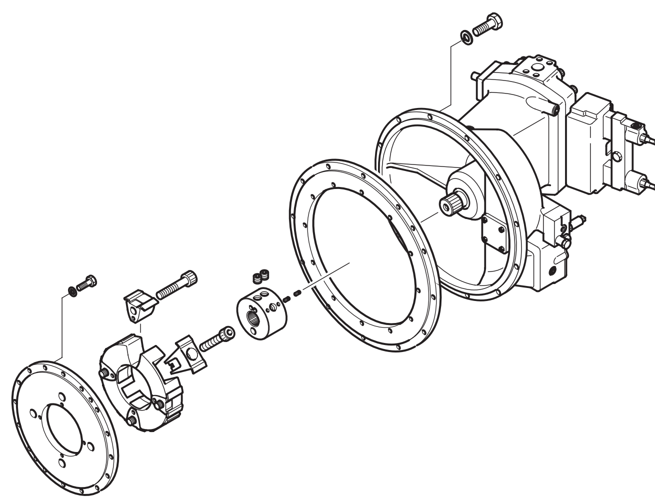


Figure 2

SPECIAL TOOLS

This tool is used to control the distance between the end of the pump drive shaft and the front face of the drive coupling hub (Figure 6 and Figure 5). This distance will be referred to as "Measurement H" in the installation instructions that follow.

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

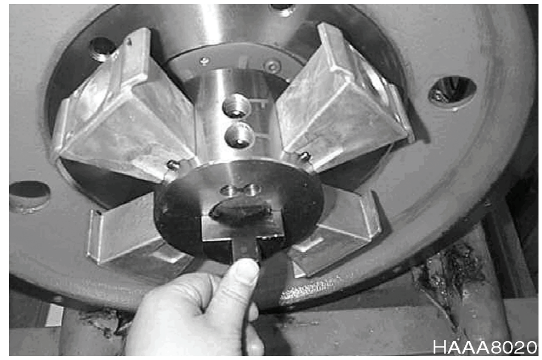


Figure 3

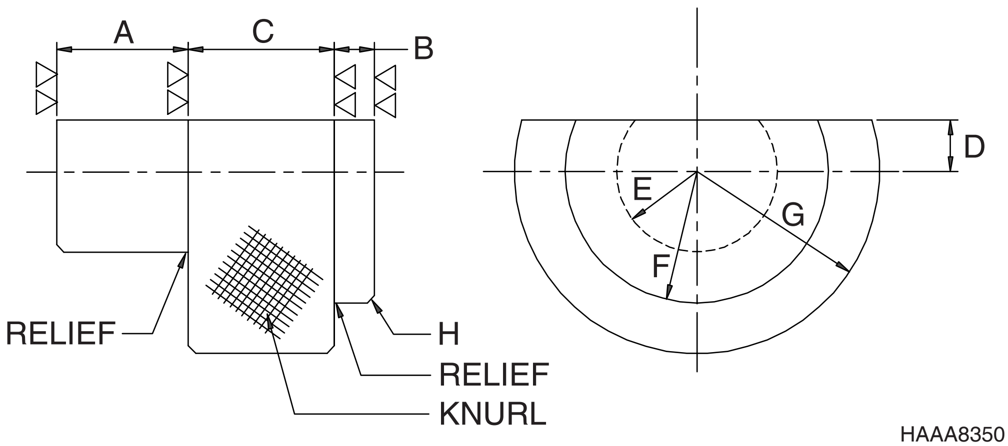


Figure 4

Dimensional Details for Figure 4		
Dimension	**Measurement**	**Models**
A	6 ±0.1 mm (0.2362 ±0.0039 in)	DX300LC, DX300LCA, S300LC-V
B	7 ±0.1 mm (0.2756 ±0.0039 in)	
C	20.0 mm (0.787 in)	
D	7.0 mm (0.275 in)	
E	18.0 mm (0.708 in) Radius	
F	22.0 mm (0.866 in) Radius	
G	30.0 mm (1.181 in) Radius	
H	1.0 mm (0.039 in) x 45° Chamfer	

DRIVE COUPLING INSTALLATION

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

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

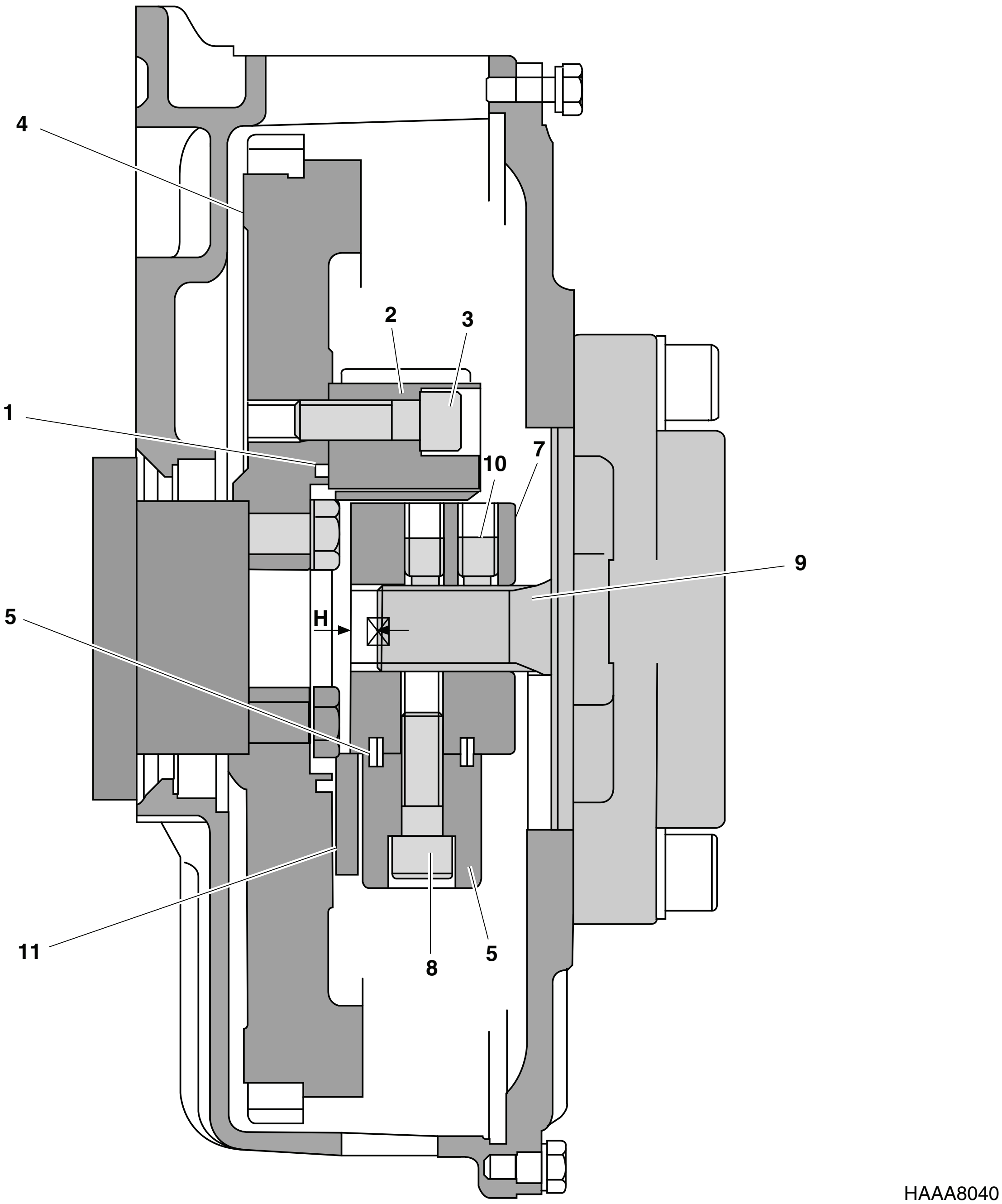


Figure 5 DRIVE COUPLING INSTALLATION

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

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

Table 2 Specification for "Measurement H" and Torque (Refer to Figure 5)				
Model	**Coupling Part Number**	**"Measurement H"**	**Torque Value for "Ta"**	**Torque Value for "Tb"**
DX300LC	414-00040A	5.5 - 6.5 mm (0.216 - 0.256 in)	44 - 49 kg•m (318 - 354 ft lb)	20 - 22 kg•m (145 - 159 ft lb)
DX300LCA				
S300LC-V				
S340LC-V	414-00041A	6.5 - 7.5 mm (0.256 - 0.295 in)	44 - 49 kg•m (318 - 354 ft lb)	20 - 22 kg•m (145 - 159 ft lb)
S420LC-V				
S470LC-V				

Installation Procedure

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

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

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

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

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

3. Attach flywheel cover to the main pump with bolts. (S300LC-V, S340LC-V only.)
4. Slide hub (7) into place on pump shaft (9) as specified in the "Table 2" for "Measurement H" and secure it in position with clamping screws (10).

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

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

5. Install element (11) between inserts (2) on engine flywheel (4)
6. Install main pump and hub (7) by pushing it softly into element (11).
7. Attach flywheel cover / pump housing to flywheel housing with bolts.

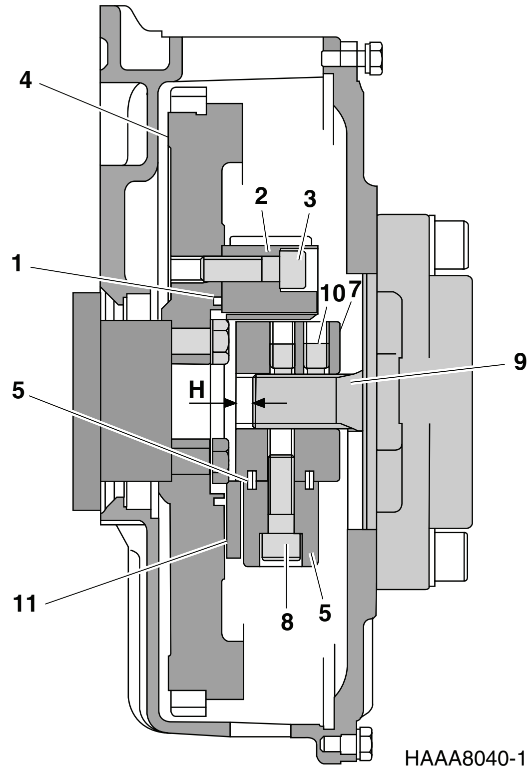


Figure 6

CAUTION

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

Hydraulics

Hydraulic System Troubleshooting, Testing and Adjustment

Edition 1

Table of Contents

Hydraulic System Troubleshooting, Testing and Adjustment

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up

HYDRAULIC SYSTEM - GENERAL NOTES

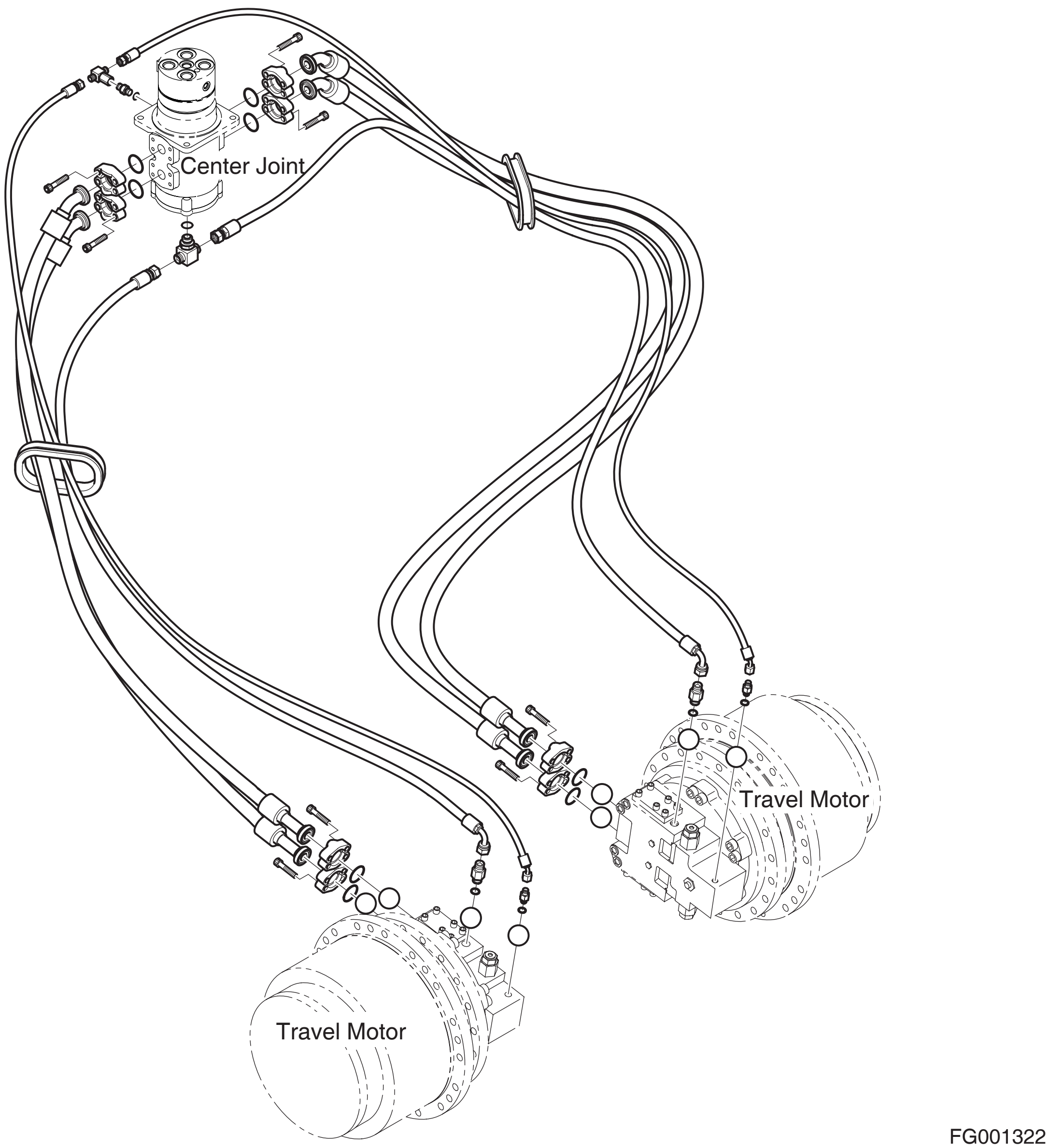


Figure 1

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 two, distinctly different power modes: high-output/rapid cycling maximum speed power mode, and a standard power mode for most types of general operation.

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, swing, boom up and arm functions. The amount of oil flow to the actuators at the output end of each of those circuits is regulated through the movement of each individual valve spool.
- The left half of the hydraulic control valve, fed by the left pump in the pump assembly, has control spools for left travel, bucket, boom and arm operation.
- Two-stage operation is a feature of boom and arm function. All of these circuits can be operated using the output of only one half of the hydraulic pump assembly (one pump or the other), or – since both halves of the control valve have a spool and available circuit for these functions – the output of both pumps can be combined, allowing higher speed operation. Boom up, arm crowd and dumping functions can operate in any one of the two available power modes – the standard or general duty mode, the high speed/ rapid cycling mode.
- Whenever the right travel or left travel control spools are shifted, output from the main pump assembly flows 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 anticavitation valves which protect the hydraulic system from vacuum that could result from external shocks or other unusual conditions. Boom, Arm, and Bucket cylinder circuit are also protected by overload relief valves. Whenever high-pressure is generated as a result of a shock or overload, excess pressure is dumped to the reservoir return circuit through the relief valve.

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

OPERATION OF WORKING COMPONENTS

Boom Operating Circuit

The boom operating circuit includes the right and left main hydraulic pumps (both halves of the main pump assembly), both sides of the control valve and the boom cylinder. The circuit operates in boom down mode through the first shift position and through the second shift position in boom up mode. Overload relief valves set at 360 kg/cm^2 (5,112 psi) protect the hydraulic system from being damaged 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 BOOM1 and BOOM2 spools of the control valve simultaneously. When secondary pilot pressure reaches 7 - 9 kg/cm^2 (100 - 130 psi), boom control valve spools open and oil from both pumps goes to the boom cylinder.

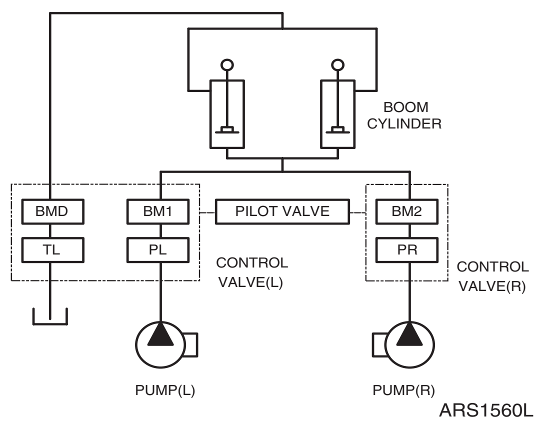


Figure 2

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 BOOM1 spool of the control valve. When secondary pilot pressure reaches 7 - 9 kg/cm^2 (100 - 130 psi), the BOOM1 spool on the left side of the control valve opens so that oil from only one pump (PUMP (L)) assembly goes to the boom cylinder for boom lowering.

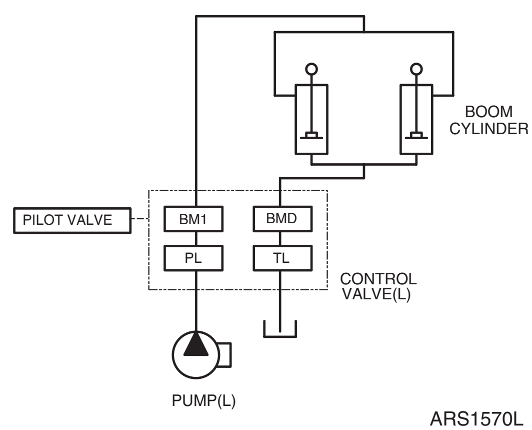


Figure 3

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^2 (5,112 psi) have been installed at the AM 1 and AMD 1 ports on the right side of the control valve to protect the circuit and system components from possible damage caused by shocks and/or overload pressure. Additional protection - to prevent cavitation of the cylinder - is provided by a makeup 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 AM1 and AM2 spools of the control valve simultaneously.

When secondary pilot pressure reaches 7 - 9 kg/cm^2 (100 - 130 psi), the arm control valve spools AM1 and AM2 open. 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 arm cylinder could suddenly be forced out by the weight of the arm and bucket. 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.

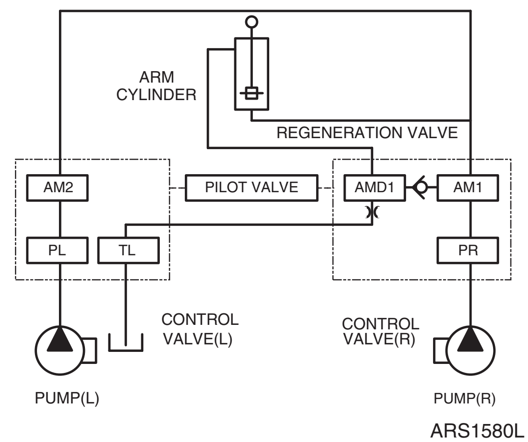


Figure 4

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 spools AM1 and AM2 of the control valve simultaneously.

When pilot pressure reaches 7 - 9 kg/cm^2 (100 - 130 psi), the control spools open, allowing oil from PUMP (L) and PUMP (R) to flow to the arm cylinder.

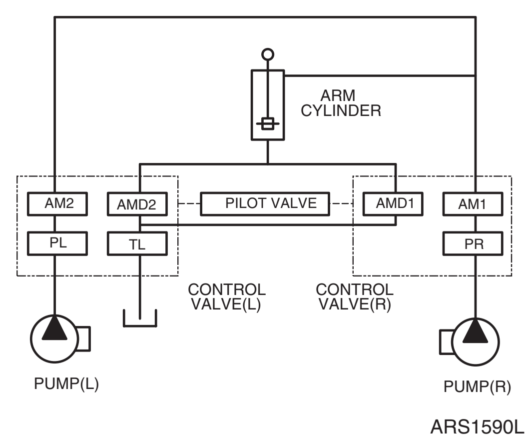


Figure 5

Bucket Operating Circuit

The bucket operating circuit includes the left main pump, the left half of the control valve and the bucket cylinder. 360 kg/cm^2 (5,112 psi) overload relief valves at BKT and BKTD 1 ports of the control valve protect the circuit and its components from being damaged.

Bucket Crowd Circuit

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

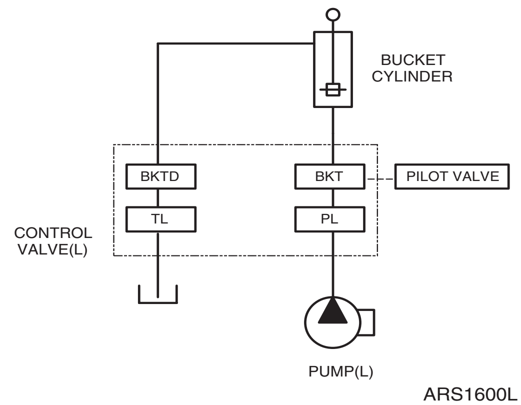


Figure 6

Bucket Dump Circuit

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

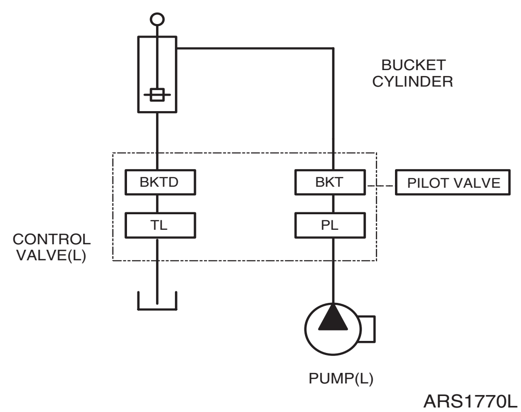


Figure 7

Swing Operating Circuit

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

Right Swing Operating Circuit

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

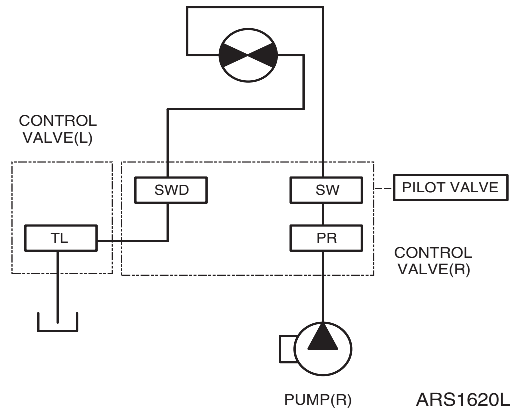


Figure 8

Left Swing Operating Circuit

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

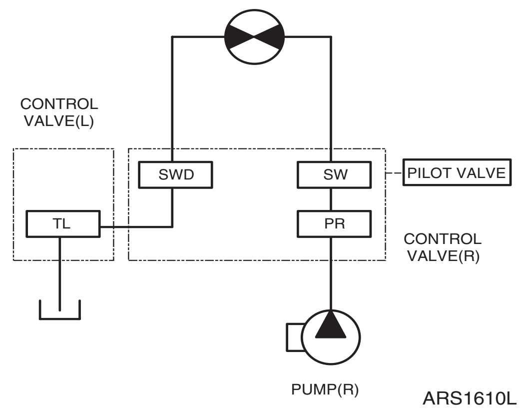


Figure 9

Swing Relief Valve and Makeup Valve

Whenever the spool is shifted to the neutral mode during swing operation, the possibility exists that surge pressure in the circuit - caused by inertial momentum of the upper works and correspondingly reduced pressure at the opposite motor port - could produce cavitation in the circuit. To keep that from happening, a 285 kg/cm^2 (4,052 psi) relief valve is installed in the swing motor and a large capacity makeup valve is connected to the entrance port of the hydraulic reservoir, helping maintain acceptable pressures on both sides of the circuit.

Travel Operating Circuit

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

Forward Travel Circuit

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

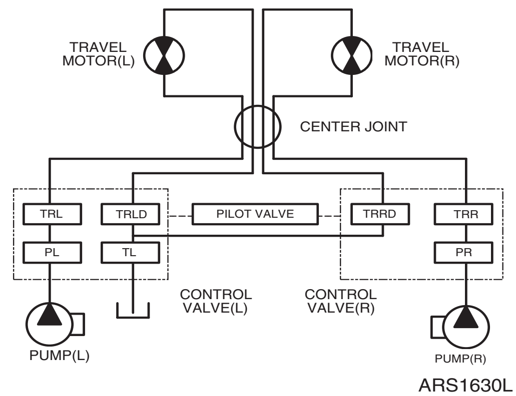


Figure 10

Reverse Travel Circuit

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

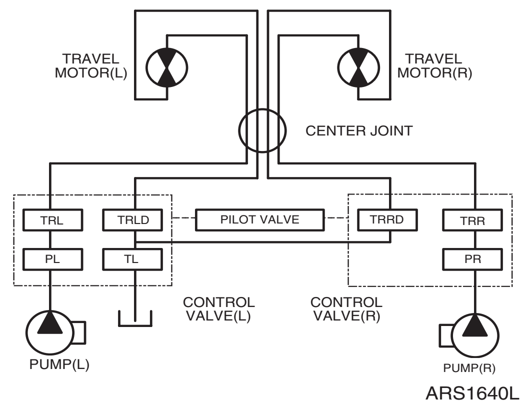


Figure 11

PROCEDURAL TROUBLESHOOTING BASELINE RECOMMENDATIONS

Initial Checks and Tests to Establish Operating Condition of the Excavator

Triage Summary

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

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

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

Check engine operation -

- at 1,950 rpm with no load.
- at 1,950 rpm stall load.

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

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

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

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

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

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

IMPORTANT

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

PILOT PRESSURE

Adjustment and Testing

WARNING

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

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

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

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

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

IMPORTANT

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

Engine RPM	Pilot Pressure @ Pump	Pilot Pressure - Joystick
Minimum Speed Setting (full left) on Speed Control Dial	40 ± 5 bar (580 ± 73 psi)	23.5 ± 1.5 bar (341 ± 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 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 multilead jumper harness is required. The jumper harness (which is available through *DOOSAN* 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, shut down 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 (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 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 recheck current and pressure. Repeat adjustment as required to obtain specified performance and retighten the valve lock nut.*

Mode	Engine RPM	Current	Pressure
Power Mode	High Idle : 2,000 rpm	250 mA Mid-range value corresponding to engine rpm for both current and hydraulic pressure readings.	3.67 bar (53 psi)
Standard Mode	High Idle : 1,950 rpm	400 mA	15 bar (218 psi)
Economy Mode	High Idle : 1,850 rpm	400 mA	15 bar (218 psi)

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.
- 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 two-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 innermost (smallest diameter) screw clockwise to increase the setting, or counterclockwise to decrease it. Pressure should be at least 330 bars (4,785 psi), but less than 335 bars (4,858 psi).

IMPORTANT

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

Power Mode	Operation	Main Pressure and Tolerance	Pilot Pressure and Tolerance
Power Mode	Neutral, No Operation	20 - 40 bar (290 - 580 psi)	30 bar +10 bar (435 psi +145 psi)
Power Mode	Cylinder Stall	330 bar +5 bar (4,785 psi +75 psi)	30 bar +10 bar (435 psi +145 psi)
Power Mode 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 alongside the arm speed control solenoid, in compartment rear of the operator's cabin, 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 onto make any changes of adjustment settings:

- **Verify engine output to the rated speed – 2,050 ± 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.

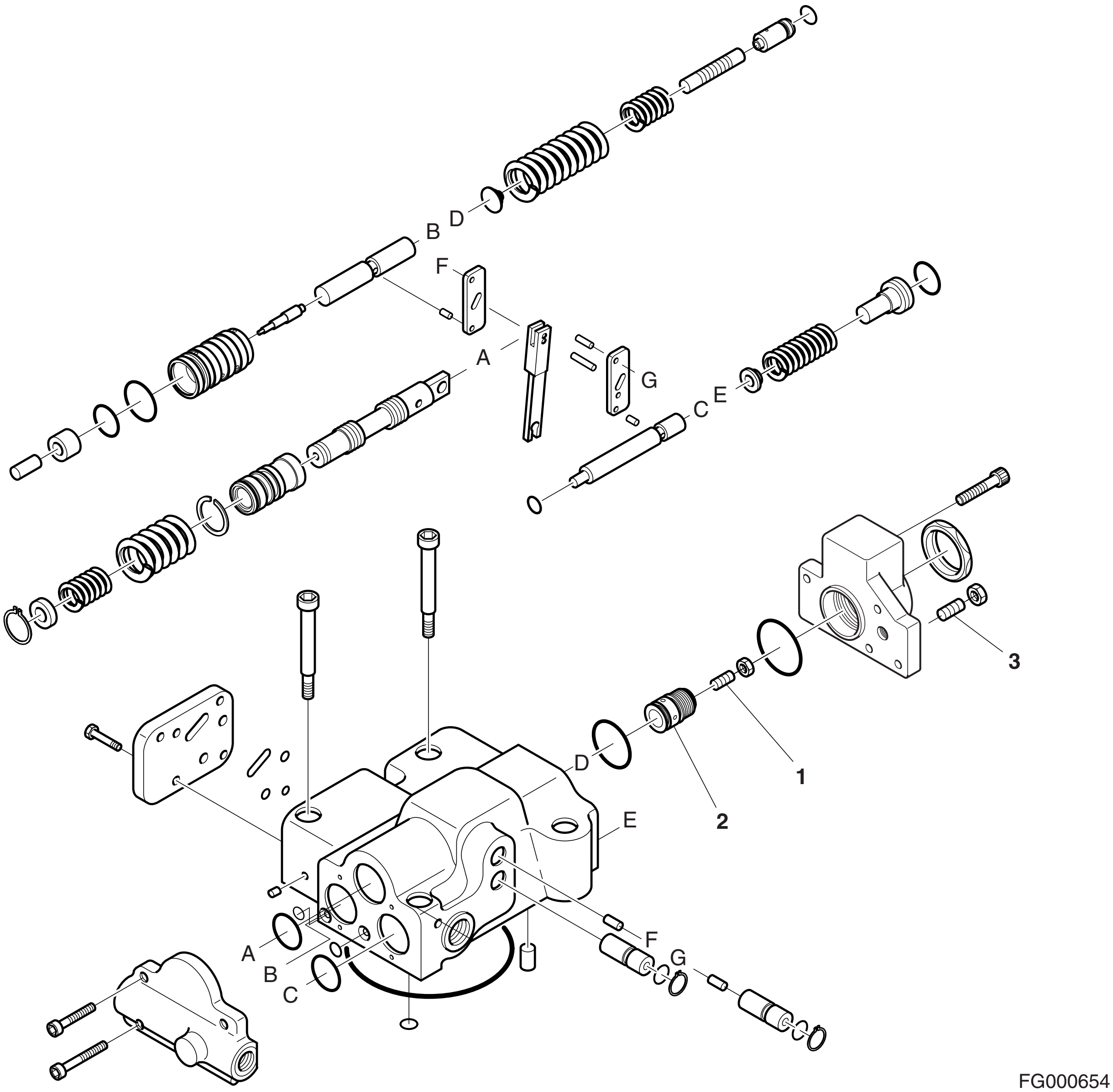


Figure 12

Refer to the illustration of the pump regulator control valve (Figure 12) for the location of adjustment screws (1, 2 and 3). There are two different adjustments, along with the Negacon, negative control, adjustment screw (3, directly below 1 and 2). 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 (2) 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 (2) out will decrease pump input horsepower. 1/4 turn on the adjusting screw is equal to approximately 17 horsepower.

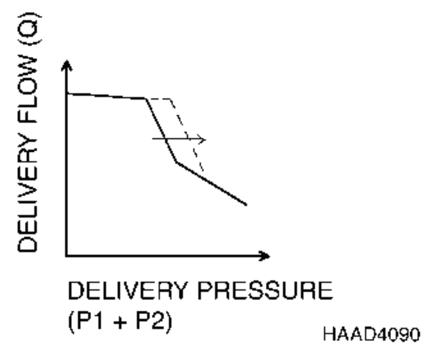


Figure 13

IMPORTANT

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

NOTE: *For each full turn of adjustment on the larger diameter screw (2), 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 (1) clockwise moves the flow curve up, increasing flow and then input horsepower.

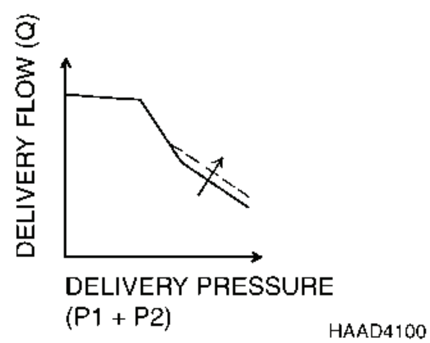


Figure 14

The adjusting screw (1, Figure 12) affects the delivery rate (Q) of the pump. Tightening the adjusting screw decreases the maximum cut flow (as shown in Figure 15) while backing out the screw increases cut flow delivery rate.

Balance both pumps for equal output.

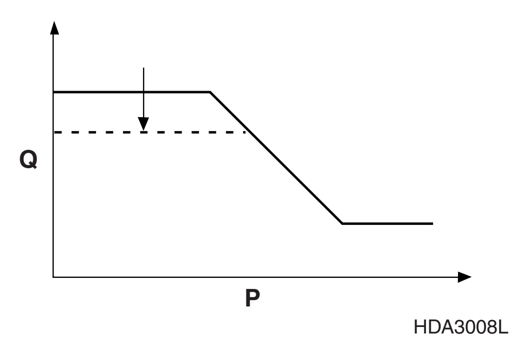


Figure 15

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 *DOOSAN* 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

- Shut down 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.
- Connect a premeasured 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 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)	
	320 kg/cm^2 (4,550 psi)*	
	*See below note.	

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

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

NOTE: *When testing bucket and swing functions, read maximum flow tests at 330 kg/cm^2 (4,785 psi), not 350 kg/cm^2 (5075 psi).*

SWING SYSTEM TROUBLESHOOTING

Precautions/Initial Checks

1. Stop work. Release all weight or any type of load safely before proceeding. Avoid risking injury or adding to damage.
2. Shut down 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 into a clean, clear container. Look for metal shavings/grit, cloudiness/water or foam/air bubbles in the oil.

  NOTE: *Dispose of drained fluids according to local regulations.*
- 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 270 and 280 bar (3,916 psi and 4,060 psi), with both swing locks engaged. With swing locks released, during full acceleration and deceleration, pressure should approach 250 bar (3,625 psi) in each direction.

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

   Pressure should always stay at or above 13 bar (190 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 13 bar (190 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 e-EPOS circuit is causing diminished swing performance. Pull out the e-EPOS indicator panel from underneath the operator's seat and perform the self-diagnostic test. Refer to the Electrical section of this book for more information.*

TROUBLESHOOTING – SWING GEARBOX

Problem	Possible Cause	Remedy
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 "03" reading (e-EPOS 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.
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.

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

Problem	Possible Cause	Remedy
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 makeup 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.
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 Cause	Remedy
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.
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.

Problem	Possible Cause	Remedy
Irregular or uneven pressure.	Poppet seat damaged or pilot piston sticking to main poppet.	Clean/replace.
	Loose lock nut and adjusting screw.	Readjust.
	Components worn out, past wear limits.	Replace.

TROUBLESHOOTING – TRAVEL CONTROL VALVE

Problem	Possible Cause	Remedy
Secondary pressure does not increase.	Low primary pressure.	Check primary pressure.
	Broken spring.	Replace spring.
	Spool sticking.	Clean, repair or replace.
	Excess spool to casing clearance.	Replace spool casing.
	Worn or loose universal joint (handle) subassembly.	Repair or replace U-joint subassembly.
Secondary pressure too high.	Dirt, other interference between valve parts.	Clean, repair or replace.
	Return line pressure too high.	Redirect return line.
Secondary pressure does not hold steady.	Dirt, other interference between valve parts, or worn spool sticking intermittently.	Clean, repair or replace.
	Interference or binding on spool return spring.	Clean, repair or replace.
	Interference, restriction or unsteady pressure in tank return line.	Repair or reroute tank return line.
	Air bubbles in piping (temporary) or air leak.	Vent air, or repair leak.
NOTE: *Look for evidence of leaking oil.*		

TROUBLESHOOTING – JOYSTICK CONTROL VALVE

Problem	Possible Cause	Remedy
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

Edition 1

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Accumulator

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

GENERAL DESCRIPTION

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

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

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

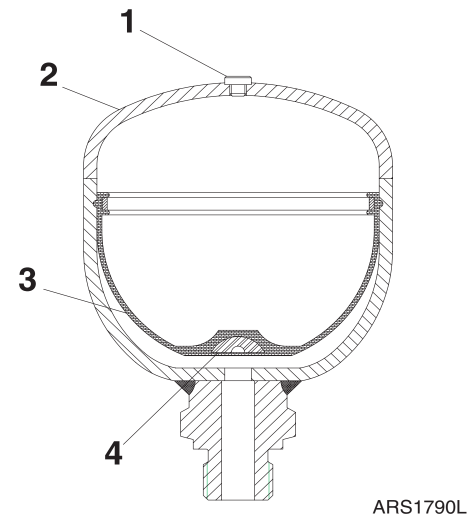

Figure 1

Accumulators are solidly constructed to resist the high operating pressures of the fluids they contain. There are only three main moving parts: a plug at the top allows precharging or expelling gas from the compressible, precharged 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 prepressure charge of gas (usually nitrogen) is introduced through the port at the top of the accumulator, the diaphragm expands to maximum size. The valve button in the center of the diaphragm pushes into the fluid opening in the bottom chamber, sealing off the lower valve. If the pressure of the gas charge exceeds system oil pressure, no fluid enters the accumulator. The button also keeps the diaphragm from protruding into the lower valve opening.

   NOTE: *Precharge 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 precharge pressure should be made by tapping a hydraulic pressure gauge (and 3-way adapter coupling) into the valve on the bottom of the accumulator.*

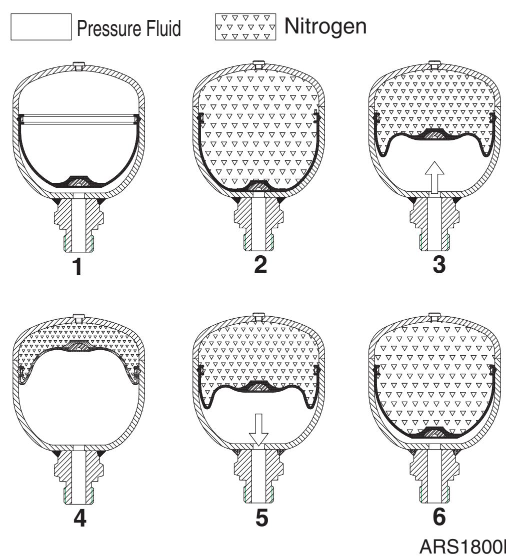

Figure 2

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 counterpressure 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 precharge 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 precharge 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 precharge pressure and hydraulic system oil pressure achieve a rough balance. In this condition a minimal amount of oil is stored in the accumulator.

Specifications

Model	Serial Number	System	Charge Pressure	Volume
DX300LC	S/N 7440 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX300LCA	S/N 5001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX340LC	S/N 5980 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX350LC	S/N 5980 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX420LC	S/N 5327 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX480LC	S/N 5221 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX520LC	S/N 5117 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)

Center Joint (Swivel)

Edition 1

MEMO

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Center Joint (Swivel)

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX225LC	5433 and Up
DX225LCA	5167 and Up
DX300LC	7440 and Up
DX300LCA	5001 and Up

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

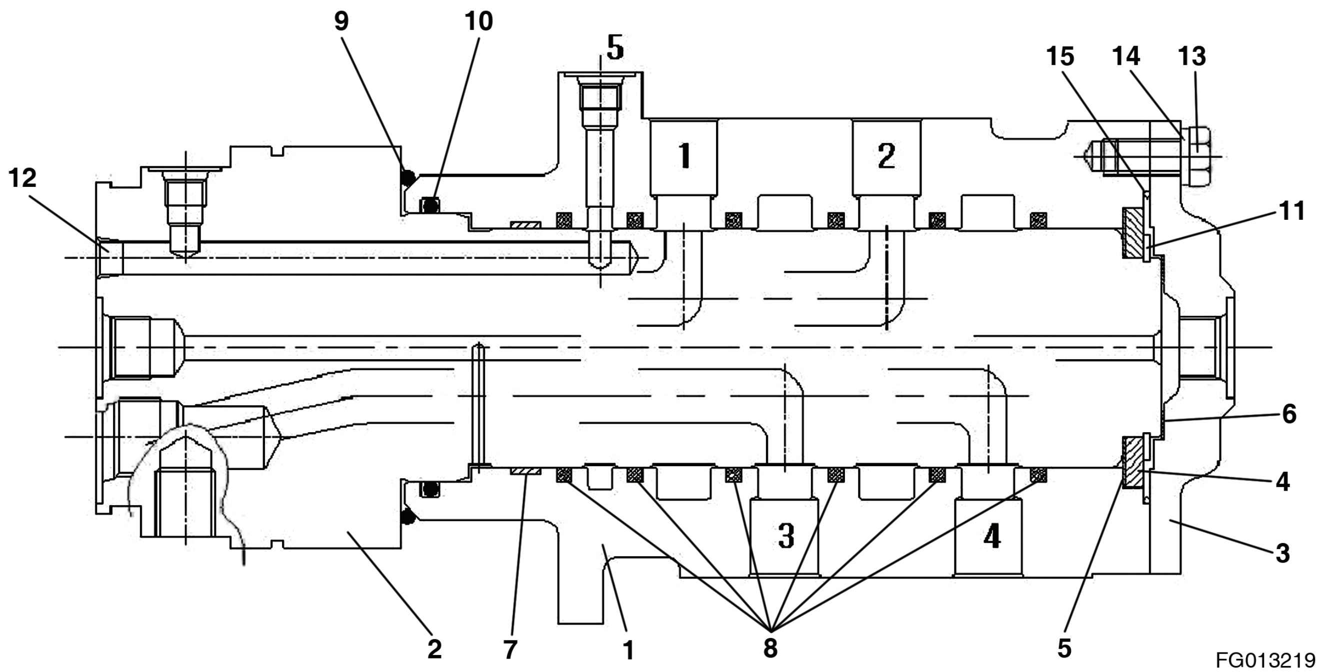

Figure 1

Reference Number	Description
1	Hub
2	Shaft
3	Cover
4	Spacer
5	Shim
6	Shim
7	Wear Ring
8	Sliper Seal

Reference Number	Description
9	O-Ring (1AP105)
10	O-Ring (1BP90)
11	Retaining Ring
12	PT-Plug (PT1/4)
13	HEX-Bolt (M12)
14	Spring Washer
15	O-Ring (1AG100)

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 changeover valve.

Install the changeover 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 changeover 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).*

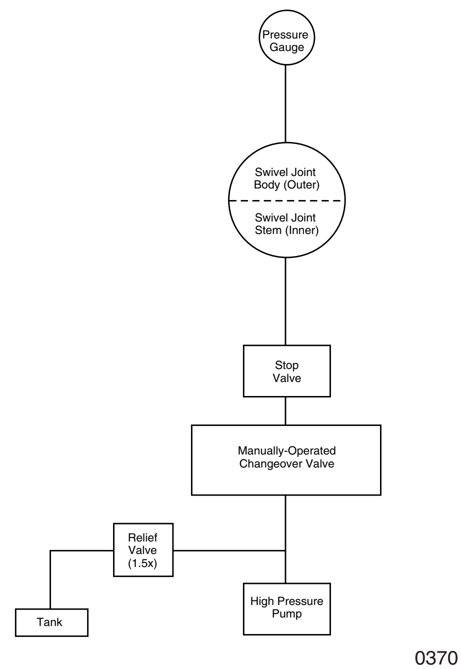

Figure 2

DISASSEMBLY

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.

CAUTION

It is recommended to use a hoist or a similar device for it is heavy.

Remove active oil and wash it out before starting disassembly.

WARNING

The hydraulic oil will be hot after normal machine operation. Allow the system to cool before attempting to service any of the hydraulic components.

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. Remove active oil remaining on each port with air.
4. Use a 17mm spanner to loosen cover bolts (1, Figure 3) and remove the cover and O-rings (1AG100).
5. Use a pliers to remove the retaing ring and disassemble the spacer at the back of the retaing ring.

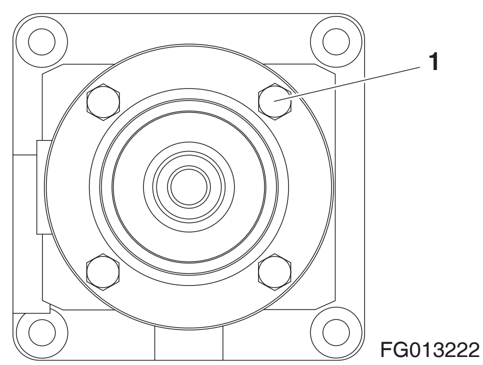

Figure 3

CAUTION

Care should be taken not to make a flaw on the surface of the Shaft when disassembling the Hub of the Shaft assembly.

6. Disassemble the hub from the shaft assembly.

   It can be disassembled easily by fixing the Shaft assembly, tightening at least 2-10mm eye bolts on the Hub, and lifting it with a hoist slowly.

7. If the shaft assembly doesn't separate easily when the thrust plate and retaining ring are removed, use a wooden block and hammer to drive it out of the housing

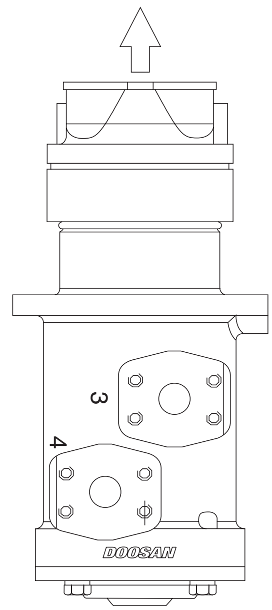

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Figure 4

8. Separate the Hub into 8ea sliper seals, 1ea O-ring(1BP80), and 1ea Dust seal(LBH80).

CAUTION

Care should be taken not to damage the inside of the Hub becasuse it is likely to be damaged when disassembling the slipper seal. It may be disassembled more easily with a driver whose tip is bent as shown in the figure below.

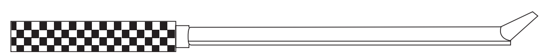
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Figure 5

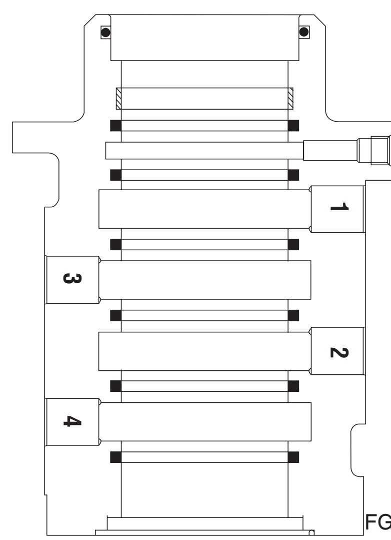

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Figure 6

9. Remove the PT plugs sealing the shaft

   * PT 1/4 : 6mm wrench

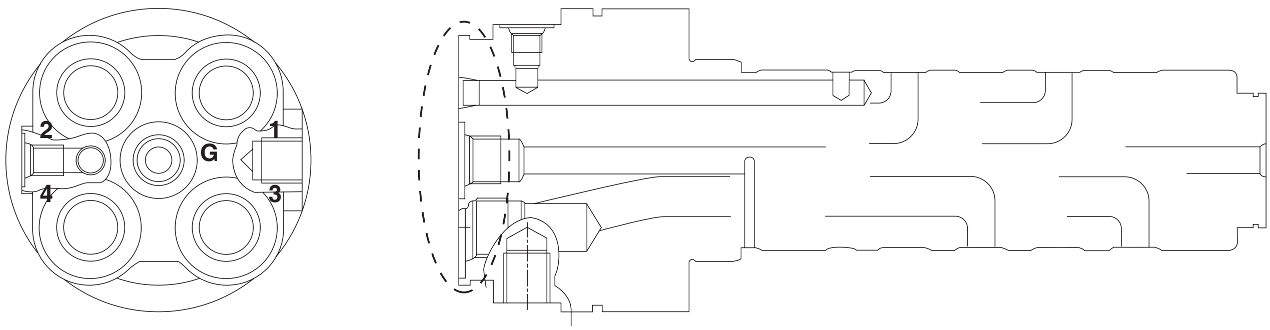

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Figure 7

10. Remove foreign substance at every pieces disassembled and wash them out.
11. Replace disassembled O-rings and slipper seals with new ones, for they cannot be reused.
12. 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 shaft and shim & spacer. Replace any component that shows more than 0.5 mm (o.o20") of visible wear.

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

CAUTION

The inside of the Hub should be air washed and rust-proof treated after washing it, as its material is subject to rust.

REASSEMBLY

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.

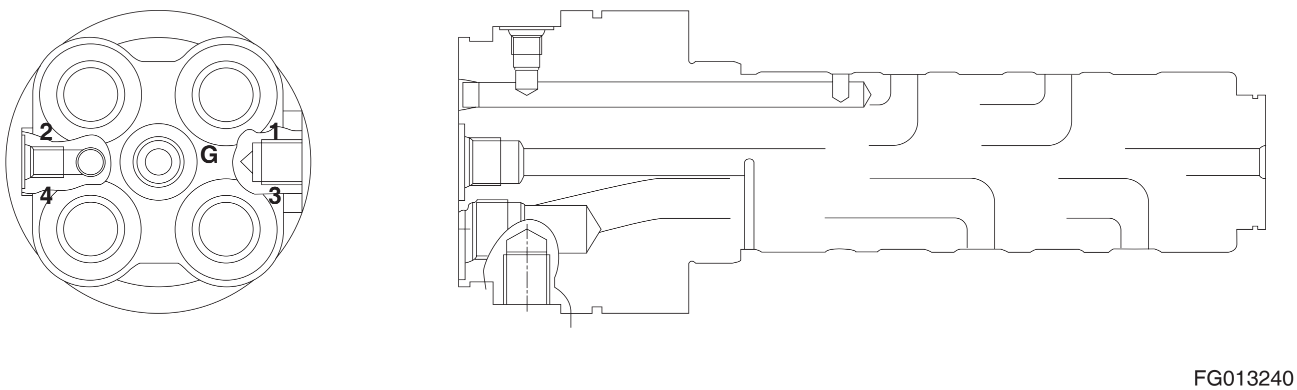

Figure 8

1. Wrap the teflon tape around the PT plug about 6~10 times.
2. Assemble the PT plug into the washed shaft.

PT 1/4 : 6mm wrench
Engagement torque: 3~4 kg•m

3. Assemble the sliper seal and the O-ring into the Hub.
4. Assemble the Wear ring (ø80xø85x10) into the Hub.

CAUTION

After assembling the sliper seal, a manual test should be performed to ensure that every part is assembled for its position properly.

CAUTION

For any sliper seal which is protruded, press it with finger to seat it in its position. Care should be taken when using a driver or a metal tool, which may cause damage to it.

CAUTION

Applying active oil to the surface of the shaft enables the assembly without any damage to the sliper seal.

5. Fix the position of the shaft and press the hub carefully into shaft with both being parallel each other.
6. Use a plastic (or urbber) hammer to tap the hub until it is inserted completely.

CAUTION

Tap the Hub in a zigzag pattern that it does not tilt to one side.

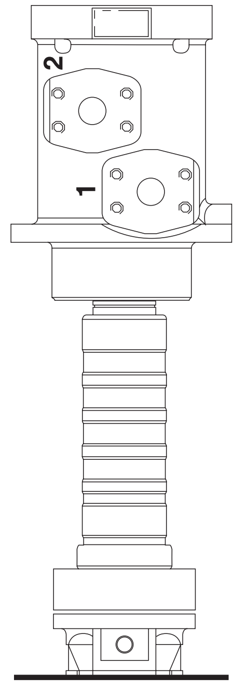

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Figure 9

7. Assemble the shim, spacer and install the retaining ring.
8. Set the O-ring (1AG100) in its place and assemble the cover in the direction as shown in the figure.
9. Engage the cover bolt (M12) at torque of 10~12.5 kg•m
10. Prefill the center swivel with clean hydraulic fluid before reassembly of high-pressure and drain line piping. Clean and prefill piping line ends to reduce the amount of air in the system. Bleed air from the hydraulic system and verify hydraulic tank fluid level before returning the excavator to service.

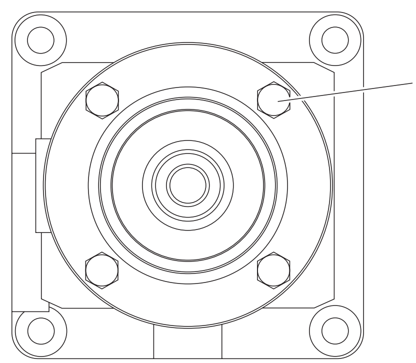

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Figure 10

CAUTION

After the completion of the assembly, a start-up and a rotation torque tests should be performed for the sliper seal to seat in its place properly.

Cylinders

Edition 1

MEMO

Table of Contents

Cylinders

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up

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

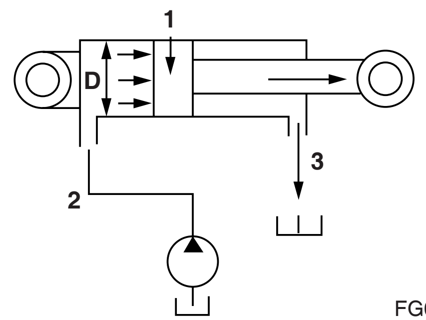

Figure 1

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 D (Figure 1).

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

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

1	Cylinder Inside Diameter - D
2	Oil Path A
3	Oil Path B
4	Rod Diameter - R

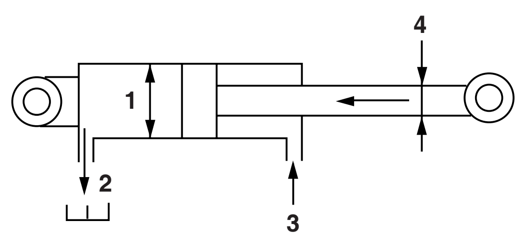

Figure 2

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.

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

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 extend a cylinder than it does to retract it.

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

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

$Q_1 > Q_2$

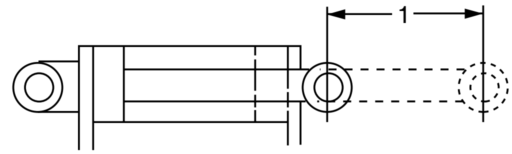

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Figure 3

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.

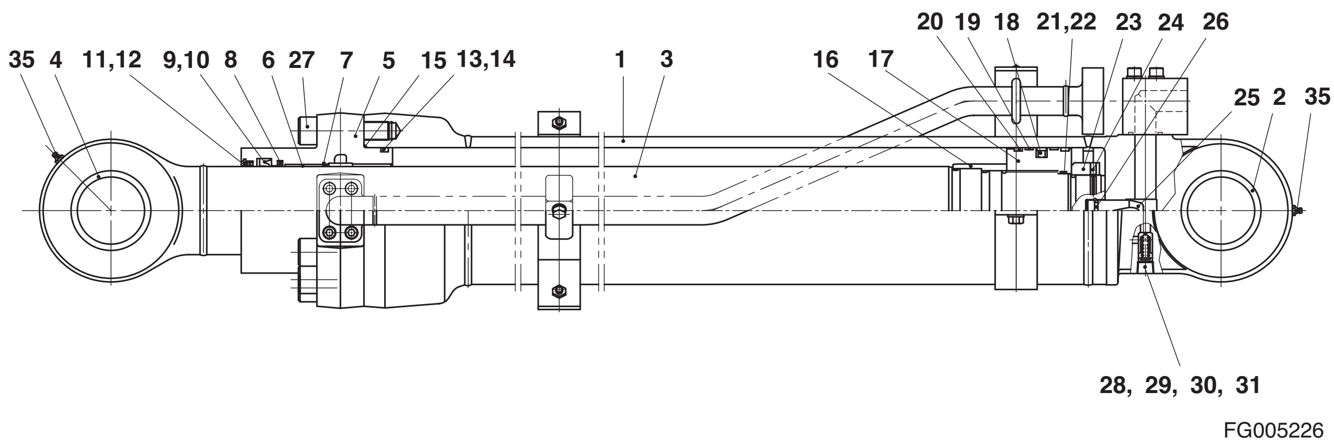


Figure 4

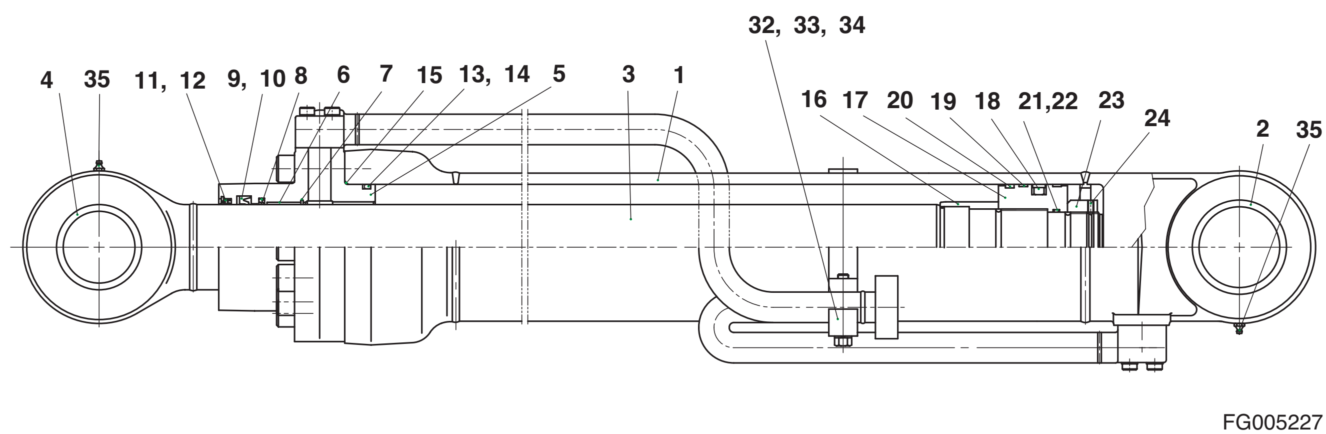


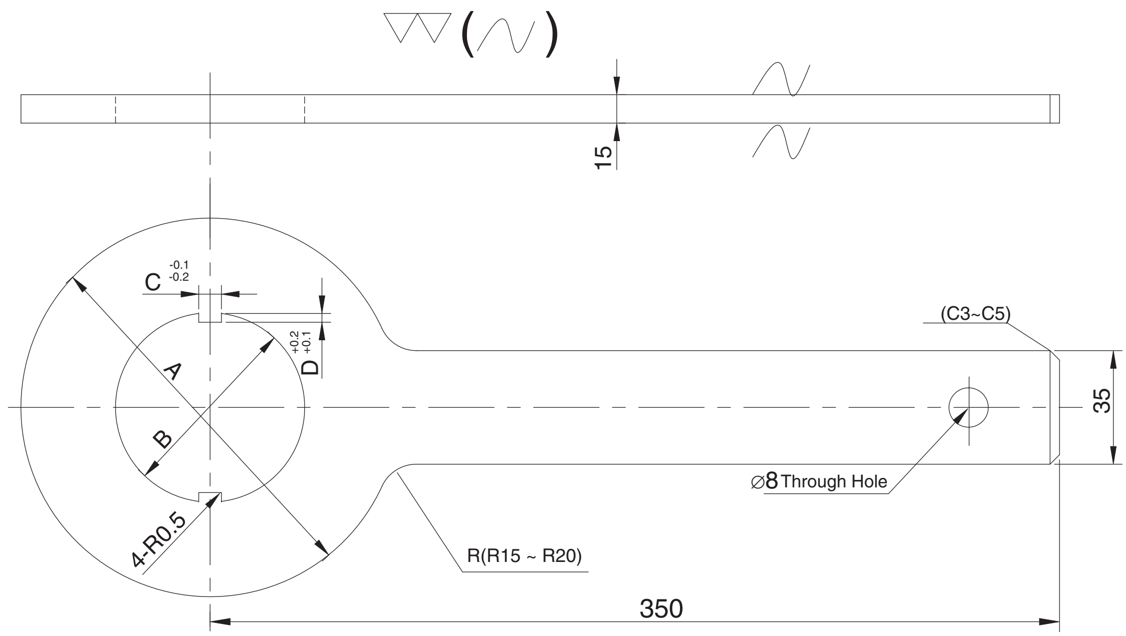
Figure 5

Reference Number	Description
1	Tube Assembly
2	Bushing
3	Rod Assembly
4	Bushing
5	Rod Cover
6	DD-Bushing
7	Retaining Ring
8	Buffer Seal
9	U-Packing
10	Backup Ring
11	Dust Wiper
12	Retaining Ring
13	O-ring
14	Backup Ring
15	O-ring
16	Cushion Ring
17	Piston
18	Slipper Seal
19	Wear Ring
20	Ring

Reference Number	Description
21	O-ring
22	Backup Ring
23	Piston Nut
24	Set Screw
25	Socket Head Bolt
26	Pipe Band Assembly
27	Hex Socket Bolt
28	Check Valve
29	Spring
30	Spring Support
31	Hex Socket Plug
32	Spring Washer
33	Hex Bolt
34	Pipe Assembly
35	Grease Nipple

SPECIAL TOOLS AND MATERIALS

Piston Nut



ARS4730L

Figure 6

Material SM45C (AISI 1045)

Rockwell Harden from 22 - 27

Oil Quench

MODEL	CYLINDER	øA	øB	C	D	MODEL (CYLINDER)
DX300LC / DX300LCA	BOOM	142.0 mm (5.59 in)	102.0 mm (4.02 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	
	ARM	147.0 mm (5.79 in)	107.0 mm (4.21 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	S/ARM
	BUCKET	140.0 mm (5.52 in)	98.0 mm (3.86 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	S/BUCKET
DX340LC / DX350LC	BOOM	145.0 mm (5.71 in)	105.0 mm (4.13 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	OPT BOOM
	ARM	147.0 mm (5.79 in)	107.0 mm (4.21 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	OPT ARM
	BUCKET	145.0 mm (5.71 in)	105.0 mm (4.13 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	OPT BUCKET
DX420LC	BOOM	147.0 mm (5.79 in)	107.0 mm (4.21 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	
	ARM	147.0 mm (5.79 in)	107.0 mm (4.21 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	
	BUCKET	155.0 mm (6.10 in)	115.0 mm (4.53 in)	12.0 mm (0.47 in)	5.0 mm (0.20 in)	

Piston Jig

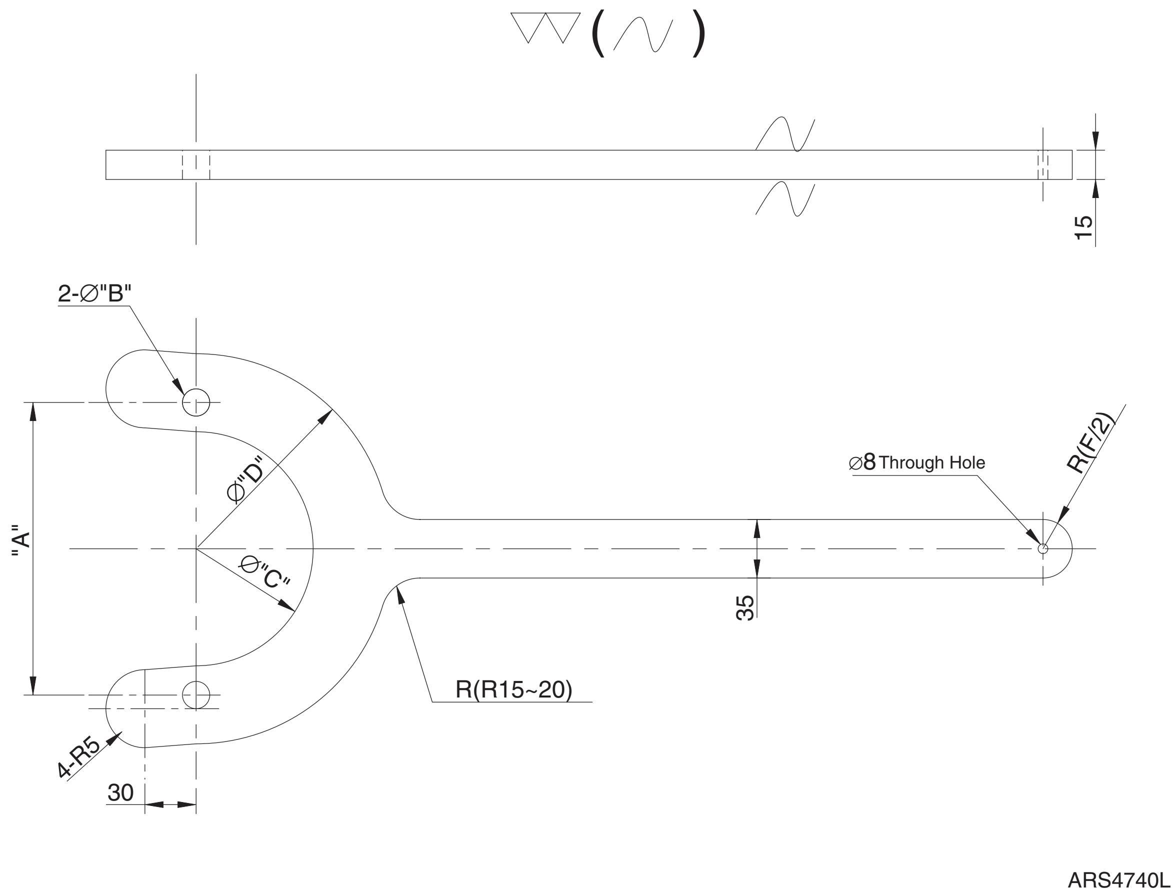


Figure 7

Material SM45C (AISI 1045)

Rockwell Harden from 22 - 27

Oil Quench

MODEL	CYLINDER	A (±0.1)	øB	øC	øD	MODEL (CYLINDER)
DX300LC / DX300LCA	BOOM	110.0 mm (4.33 in)	13.0 mm (0.51 in)	76.0 mm (2.99 in)	140.0 mm (5.51 in)	
	ARM	120.0 mm (4.72 in)	13.0 mm (0.513 in)	85.0 mm (3.35 in)	150.0 mm (5.91 in)	S/ARM
	BUCKET	110.0 mm (4.33 in)	13.0 mm (0.51 in)	76.0 mm (2.99 in)	140.0 mm (5.51 in)	S/BUCKET
DX340LC / DX350LC	BOOM	120.0 mm (4.72 in)	13.0 mm (0.51 in)	85.0 mm (3.35 in)	150.0 mm (5.91 in)	OPT BOOM
	ARM	130.0 mm (5.12 in)	13.0 mm (0.513 in)	93.0 mm (3.66 in)	165.0 mm (6.50 in)	OPT ARM
	BUCKET	120.0 mm (4.72 in)	13.0 mm (0.51 in)	85.0 mm (3.35 in)	150.0 mm (5.91 in)	OPT BUCKET
DX420LC	BOOM	130.0 mm (5.12 in)	13.0 mm (0.51 in)	93.0 mm (3.66 in)	165.0 mm (6.50 in)	
	ARM	130.0 mm (5.12 in)	13.0 mm (0.513 in)	93.0 mm (3.66 in)	165.0 mm (6.50 in)	
	BUCKET	130.0 mm (5.12 in)	13.0 mm (0.51 in)	93.0 mm (3.66 in)	165.0 mm (6.50 in)	

Steel Bushing Jig

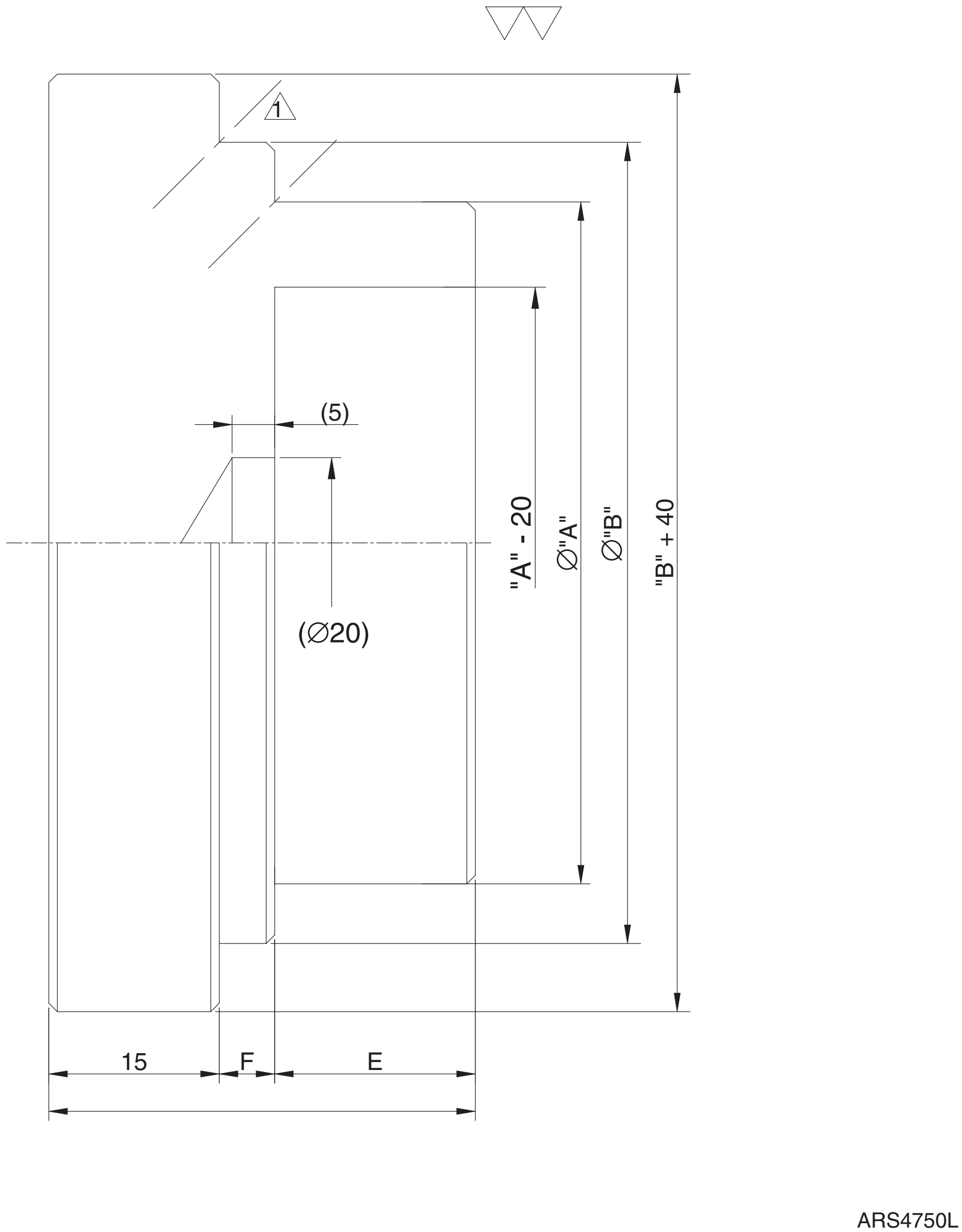


Figure 8

Material: SM45C which is done thermal refining <QT> Hrc 22 - 28

Undefined Chamfer C/R = 0.5 Max.

1 Place: Finally work to used DNMG Tip <Nose R0.4>

MODEL	CYLINDER	$øA^{-0.05}_{-0.15}$	øB (±0.1)	E	$F^{+0.05}_{0}$	Part	MODEL (CYLINDER)
DX300LC / DX300LCA	BOOM	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.58 in)	7.0 mm (0.28 in)		
	ARM	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.58 in)	6.5 mm (0.26 in)		S/ARM
	BUCKET	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.58 in)	7.0 mm (0.28 in)		S/BUCKET
DX340LC / DX350LC	BOOM	100.0 mm (3.94 in)	115.0 mm (4.53 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		OPT BOOM
	ARM	100.0 mm (3.94 in)	115.0 mm (4.53 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		OPT ARM
	BUCKET	100.0 mm (3.94 in)	115.0 mm (4.53 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		OPT BUCKET
DX420LC	BOOM	110.0 mm (4.33 in)	130.0 mm (5.12 in)	70.0 mm (2.76 in)	11.0 mm (0.43 in)		
	ARM	110.0 mm (4.33 in)	130.0 mm (5.12 in)	70.0 mm (2.76 in)	11.0 mm (0.43 in)		
	BUCKET	110.0 mm (4.33 in)	130.0 mm (5.12 in)	70.0 mm (2.76 in)	11.0 mm (0.43 in)		

Dust Wiper Jig

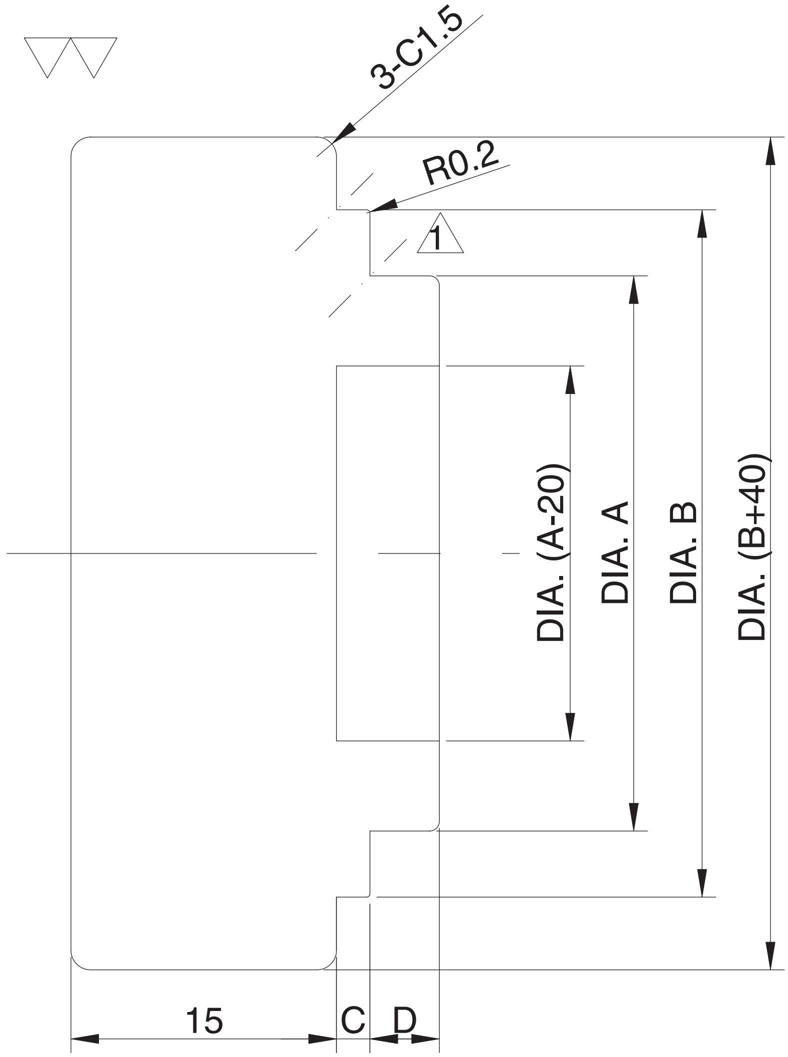


Figure 9

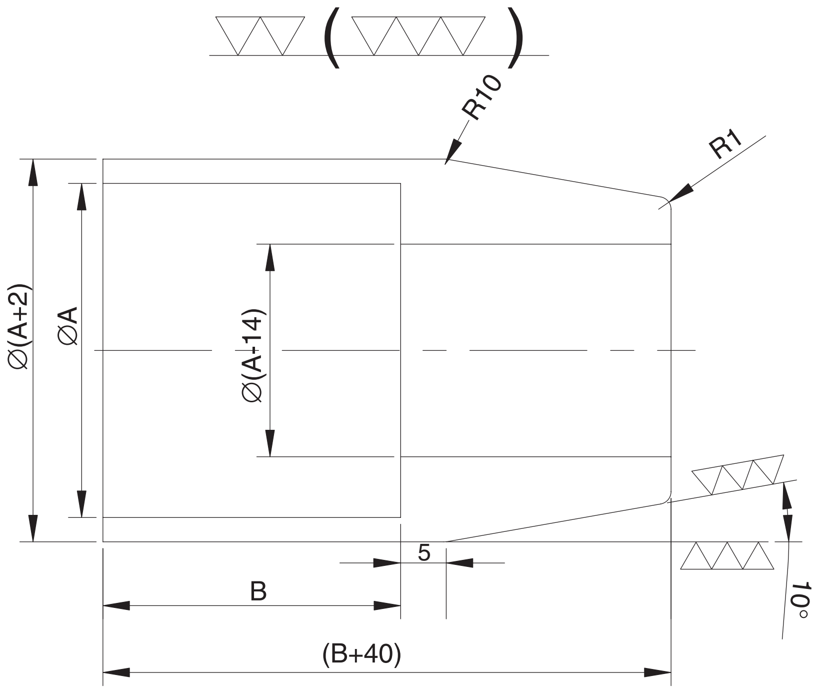
Material: SM45C which is done thermal refining <QT> Hrc 22 - 28

Undefined Chamfer C/R = 0.5 Max.

1 Place: Finally work to used DNMG Tip <Nose R0.4>

MODEL	CYLINDER	$øA^{-0.2}_{-0.3}$	$øB^{-0.2}_{-0.3}$	$C^{0}_{-0.1}$	D	MODEL (CYLINDER)
DX300LC / DX300LCA	BOOM	95.0 mm (3.74 in)	109.0 mm (4.29 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	
	ARM	105.0 mm (4.13 in)	121.0 mm (4.76 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	S/ARM
	BUCKET	90.0 mm (3.54 in)	104.0 mm (4.10 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	S/BUCKET
DX340LC / DX350LC	BOOM	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	OPT BOOM
	ARM	115.0 mm (4.53 in)	131.0 mm (5.16 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	OPT ARM
	BUCKET	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	OPT BUCKET
DX420LC	BOOM	115.0 mm (4.53 in)	131.0 mm (5.16 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	
	ARM	120.0 mm (4.72 in)	136.0 mm (5.35 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	
	BUCKET	110.0 mm (4.33 in)	126.0 mm (4.96 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	

Slipper Seal Jig



ARS4770L

Figure 10

MODEL	CYLINDER	$øA^{+0.2}_{+0.1}$	$B^{+0.2}_{+0.1}$	MODEL (CYLINDER)
DX300LC / DX300LCA	BOOM	140.0 mm (5.51 in)	28.5 mm (1.12 in)	
	ARM	150.0 mm (5.91 in)	28.5 mm (1.12 in)	S/ARM
	BUCKET	140.0 mm (5.51 in)	28.5 mm (1.12 in)	S/BUCKET
DX340LC / DX350LC	BOOM	150.0 mm (5.91 in)	28.5 mm (1.12 in)	OPT BOOM
	ARM	170.0 mm (6.69 in)	34.5 mm (1.36 in)	OPT ARM
	BUCKET	150.0 mm (5.91 in)	28.5 mm (1.12 in)	OPT BUCKET
DX420LC	BOOM	165.0 mm (6.50 in)	34.5 mm (1.36 in)	OPT BOOM
	ARM	180.0 mm (7.09 in)	41.5 mm (1.63 in)	OPT ARM
	BUCKET	160.0 mm (6.30 in)	34.5 mm (1.36 in)	OPT BUCKET

Slipper Seal Straightening Jig

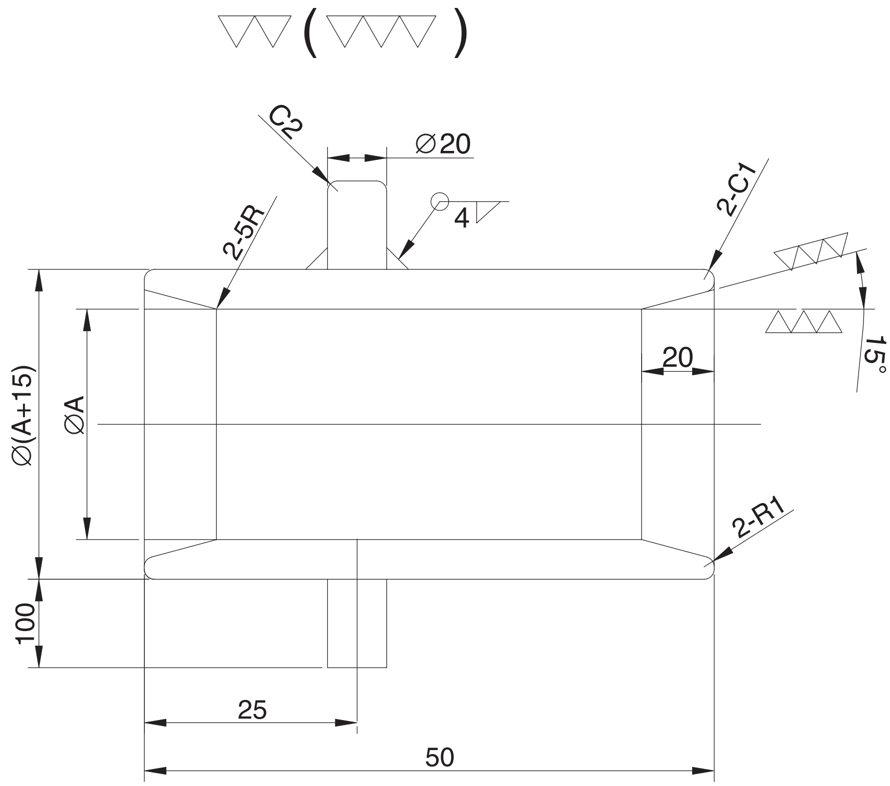


Figure 11

MODEL	CYLINDER	$øA^{+0.2}_{+0.1}$	MODEL (CYLINDER)
DX300LC / DX300LCA	BOOM	140.0 mm (5.51 in)	
	ARM	150.0 mm (5.91 in)	S/ARM
	BUCKET	140.0 mm (5.51 in)	S/BUCKET
DX340LC / DX350LC	BOOM	150.0 mm (5.91 in)	OPT BOOM
	ARM	170.0 mm (6.69 in)	OPT ARM
	BUCKET	150.0 mm (5.91 in)	OPT BUCKET
DX420LC	BOOM	165.0 mm (6.50 in)	OPT BOOM
	ARM	180.0 mm (7.09 in)	OPT ARM
	BUCKET	160.0 mm (6.30 in)	OPT BUCKET

DISASSEMBLY

CAUTION

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

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

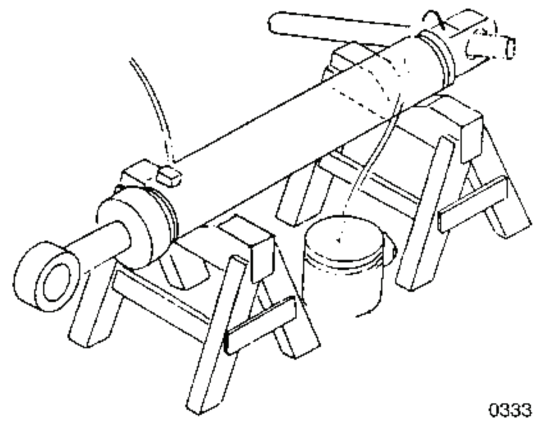


Figure 12

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

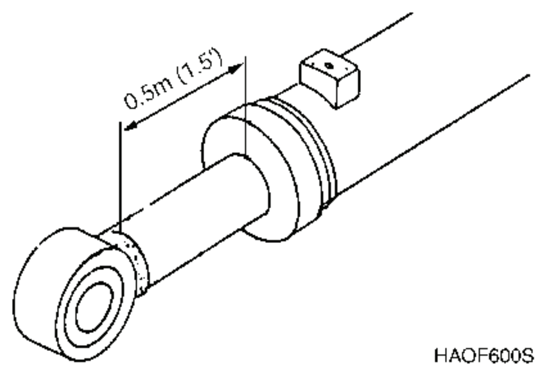


Figure 13

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

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

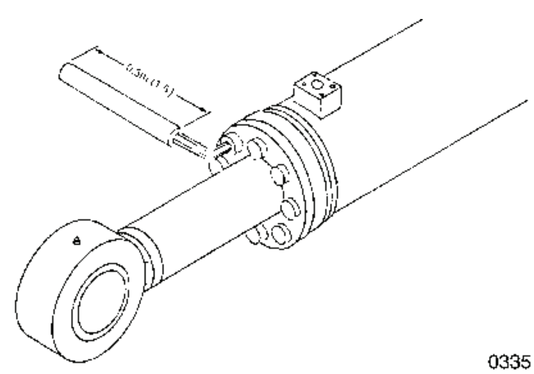


Figure 14

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.

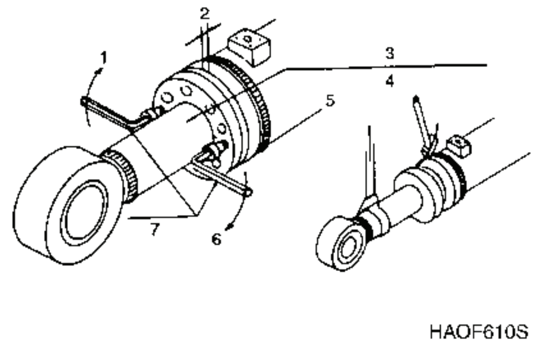


Figure 15

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.

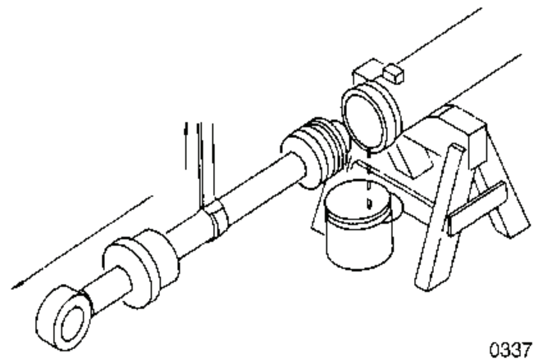


Figure 16

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

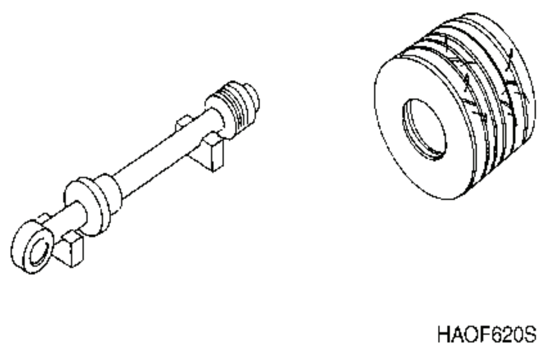


Figure 17

7. Immobilize piston rod by inserting a wooden or other nonscoring, nonmetallic support through end of rod.

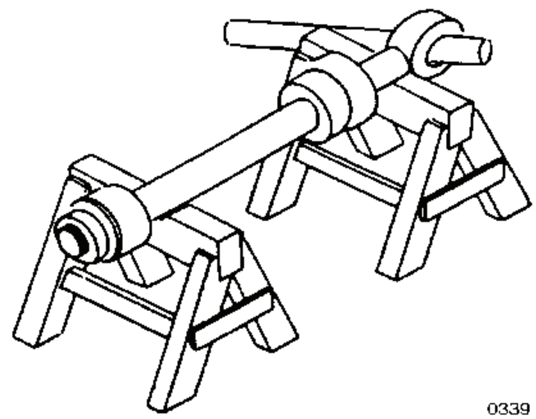


Figure 18

8. Remove set screw using socket wrench.

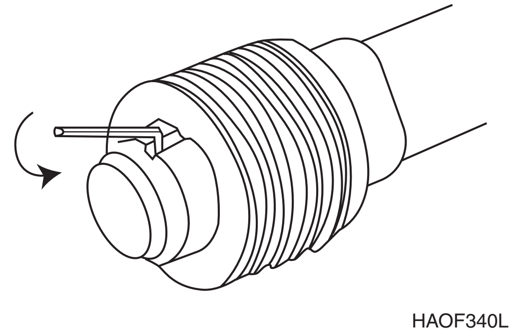


Figure 19

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 *DOOSAN* Parts distributor). Remove nut from end of piston.

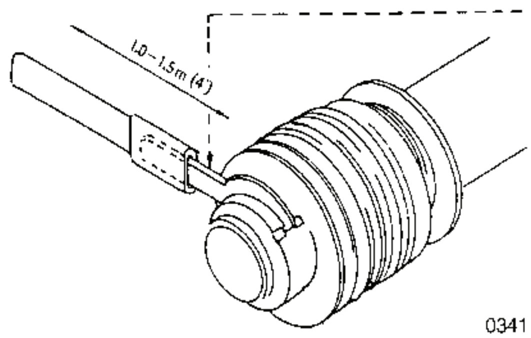


Figure 20

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

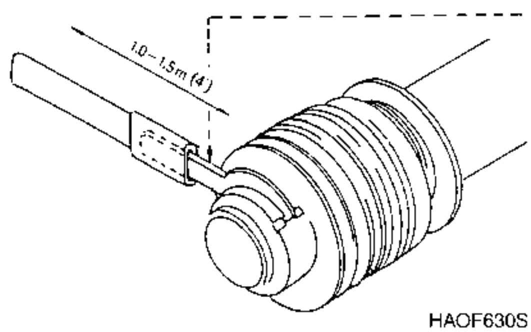


Figure 21

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

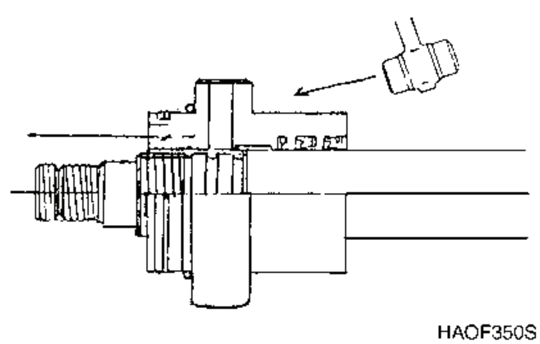
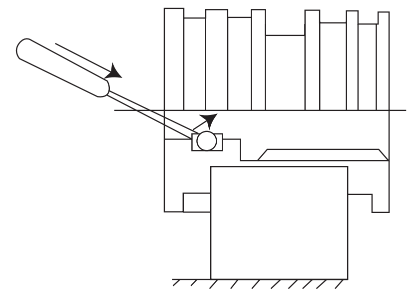


Figure 22

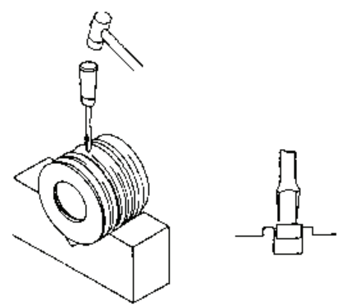
12. Use a dull, rounded tip tool to pry off O-ring (11) and backup ring (12).



HAOF37OL

Figure 23

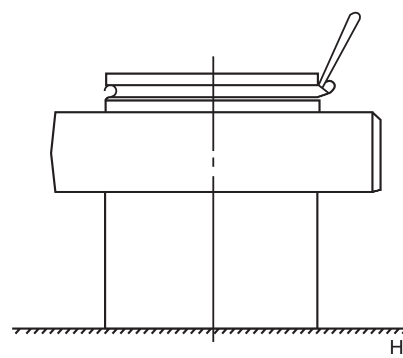
13. Find a screwdriver with an appropriate width tip to facilitate removal of slipper seal (19), wear ring (18) and slide ring (17) from piston (16).



0345

Figure 24

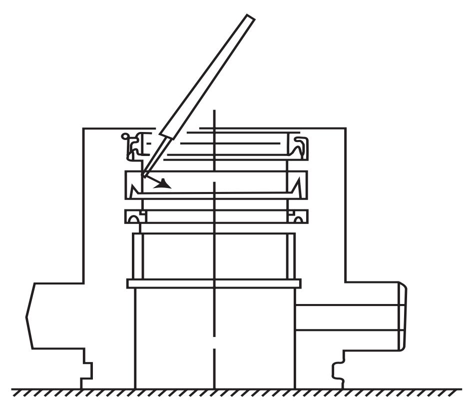
14. Remove O-ring (20) and backup ring (21) from cylinder head.



HAOF38OS

Figure 25

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



HAOF39OL

Figure 26

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

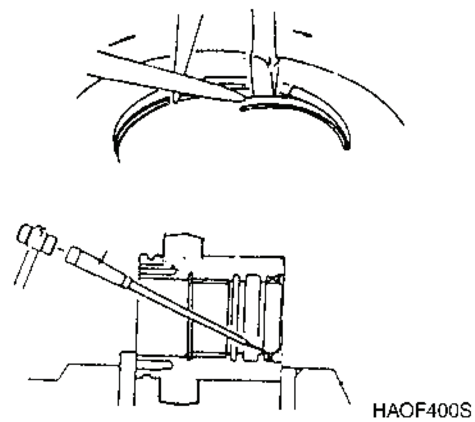


Figure 27

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

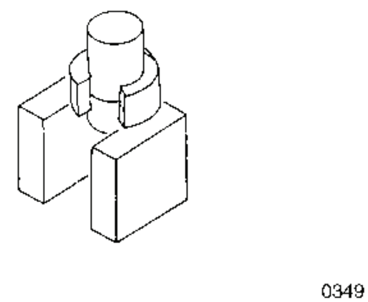


Figure 28

REASSEMBLY

IMPORTANT

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

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

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

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

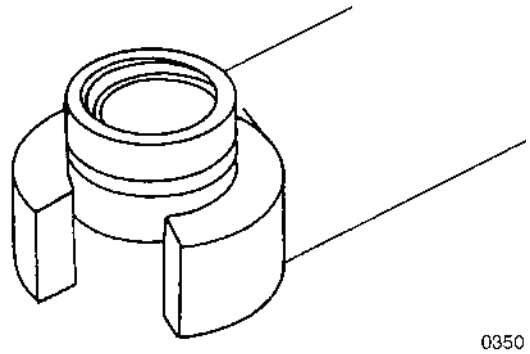


Figure 29

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

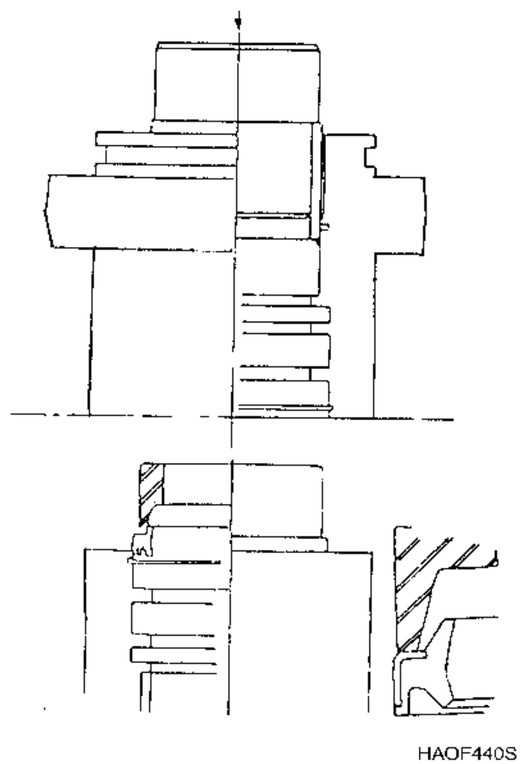


Figure 30

3. Prelubricate O-rings and seals before reassembly (Figure 31).

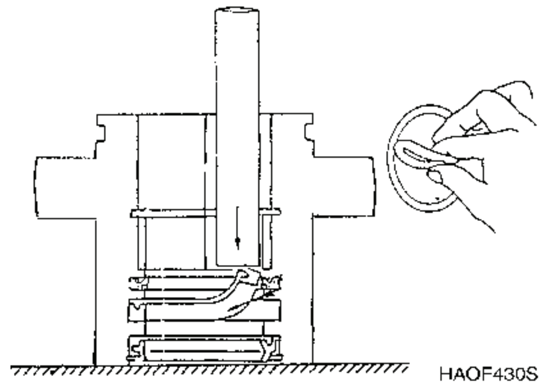


Figure 31

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.

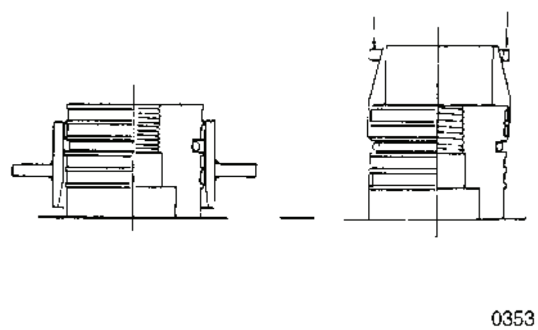


Figure 32

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

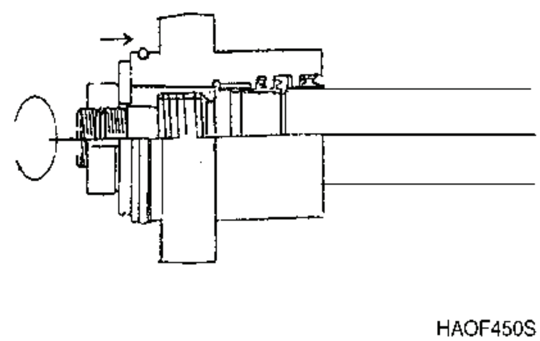


Figure 33

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

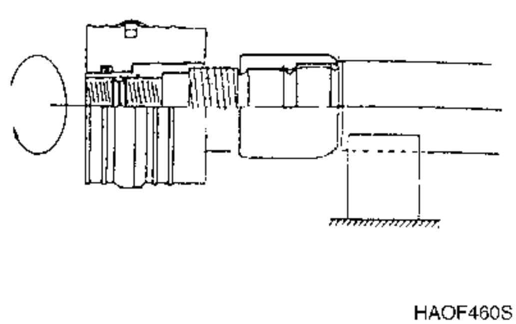


Figure 34

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

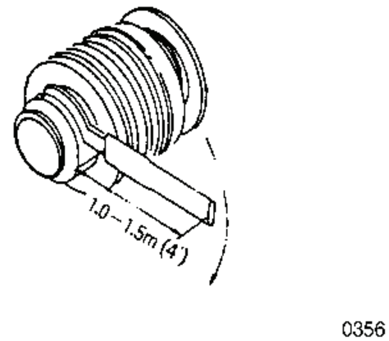


Figure 35

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

Reference Number	Description
1	Set Screw

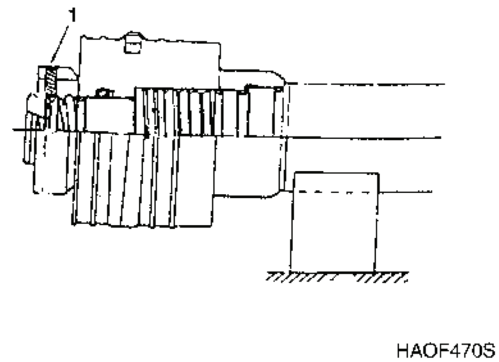


Figure 36

9. Immobilize body of cylinder before reassembly.

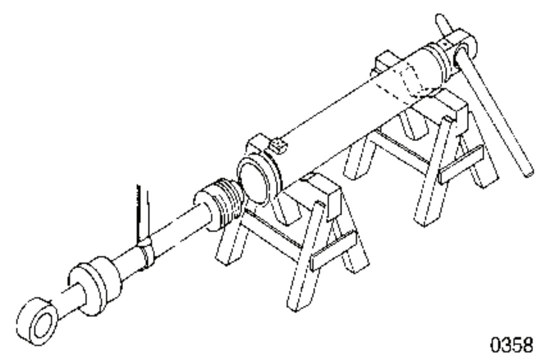


Figure 37

Preapply 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.

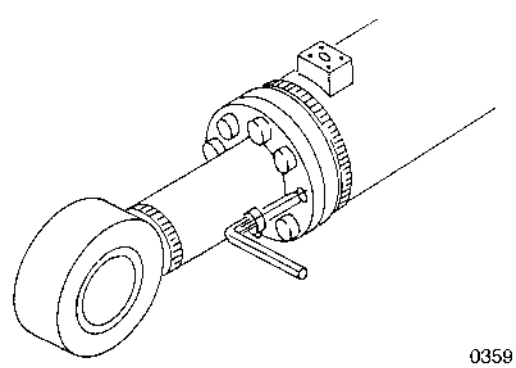


Figure 38

SP000031

Swing Motor

Edition 1

MEMO

Table of Contents

Swing Motor

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7740 and Up
DX300LCA	5001 and Up

GENERAL DESCRIPTION

Theory of Operation

Structure

The hydraulic motor consists of the following five parts:

- Rotary part generating rotary power.
- Relief valve.
- Parking brake.
- Makeup check valve.
- Time delay valve.
- Swing reactionless valve.

Circuit Diagram

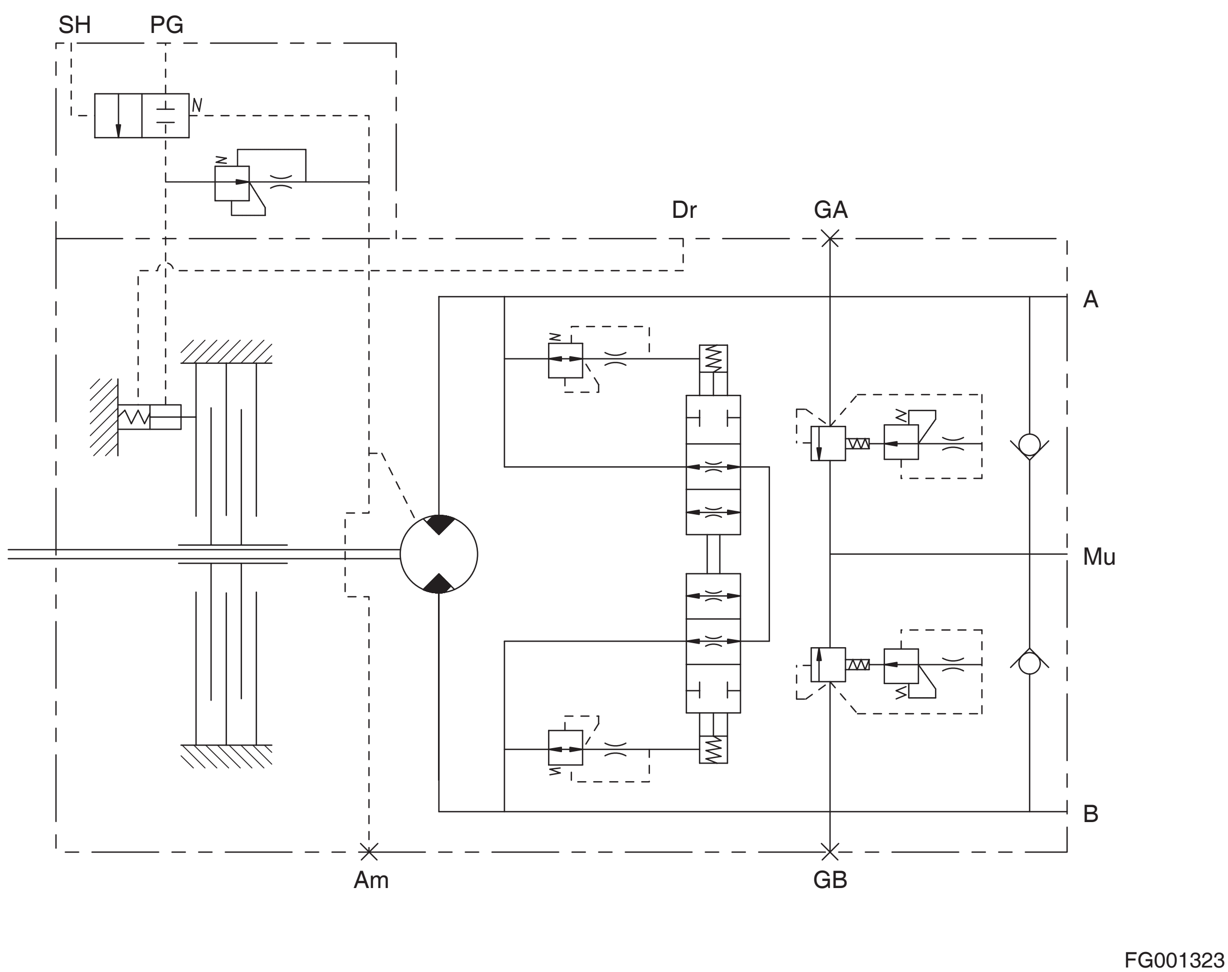
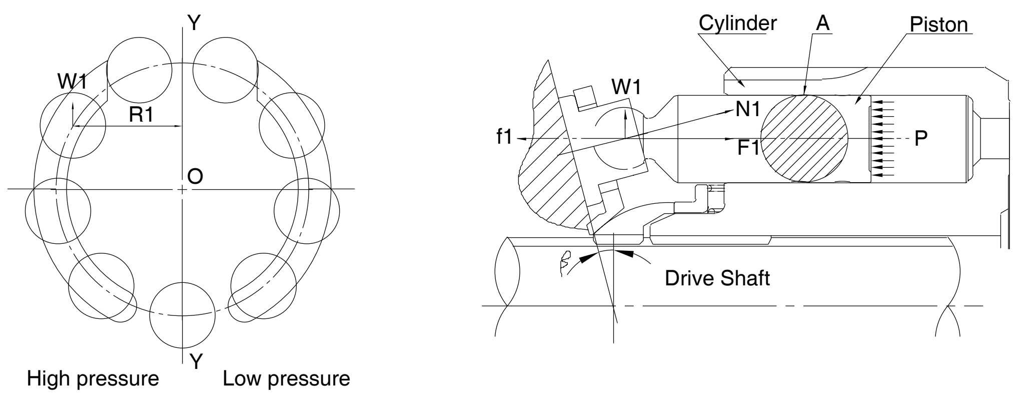


Figure 1

Generation of Rotary Power

High-pressure oil from hydraulic pump flows into the cylinder (9) through the valve casing (1) and the valve plate (22). The motor is designed to only let high-pressure oil to flow into one side with relationship to Y-Y axis (the centerline of top and bottom dead centers of piston (13)).

As shown in the Figure 3, the high-pressure oil acts on the piston to generate F1 = P*A (P: supply pressure, A: hydraulic area). F1 is divided into a N1 thrust component and a W1 radial component in relationship to the swash plate with slope of •·. W1 generates a torque T = W1*R1 in relationship to Y-Y, the centerline of top and bottom dead centers of the piston. This torque generates the rotary power through a resultant force (ΣW1*R1) occurring at (4-5) hydraulic pistons by the high-pressure oil. Rotary power and torque, is transferred through the pistons and cylinder (9) via spline to the drive shaft.



FG005170

Figure 2

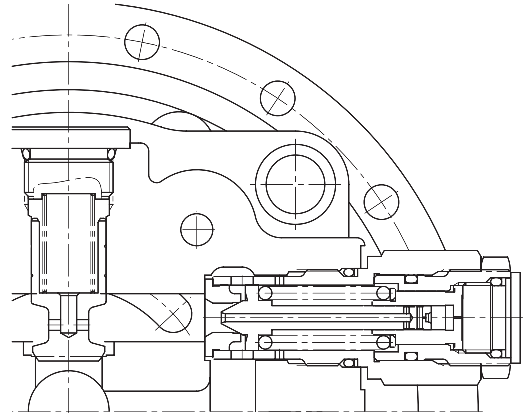
Operation of Relief Valve

The relief valve performs two functions:

1. It maintains uniform pressure when hydraulic motor starts and bypasses surplus oil at the inlet of the motor to the outlet in relationship with acceleration of the inertia weight.
2. Device is forced to stop by the generation of brake pressure at the discharge side when the inertia weight is stopped.

High-pressure oil flowing in to port P increases pressure in the shockless spool through a poppet orifice, which acts to keep a set pressure when it is higher than the spring force.

It maintains a set pressure when the hydraulic motor starts and forces the swing motor to stop by generating brake pressure at the discharge side when the inertia weight stops.



FG001324

Figure 3

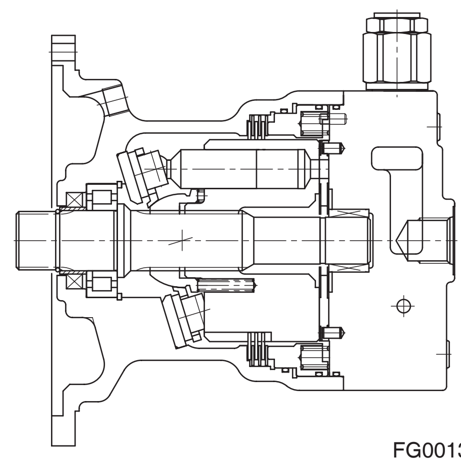
Operation of Parking Brake

1. Swing Brake Off

   Pilot oil moves the swing spool and flows to port SH of time delay valve in swing motor through shuttle valve in case when the swing control lever is in the swing position. This pressure moves the spool to the left against the spring force, causing the port PG oil of the time delay valve to move to the parking piston. The oil moves the parking piston, pressing the friction plate upwards to release the parking brake.

2. Swing Brake On

   When the swing control lever is returned to the neutral position, swing pilot pressure applied to the port SH in the time delay valve through shuttle valve will be blocked. The spool is returned by spring force and the port PG pressure at the time delay valve, which always is ready if the relief valve is interrupted by flow to the parking piston. The orifice then causes a six second time delay at the spool to prevent the discharge of line oil at that time in order to avoid any shock when the swing brake is suddenly applied.



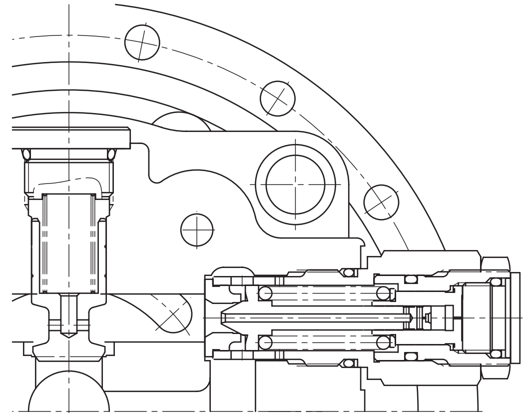
FG001325

Figure 4

Makeup Check Valve

A makeup check valve is installed to compensate for the lack of supply line oil to prevent cavitation due to the lack of oil being supplied when the motor turns faster than the expected oil flow rate to the inlet of the swing motor.

When an excavator suddenly stops swinging, and supply oil stops flowing to the inlet port of the swing motor, the swing motor will try to turn a little further due to inertia force. When this happens, the makeup check valve opens and supplies oil to the inlet port while the pressure in the inlet port is lower then the oil waiting in the makeup check valve port.



FG001324

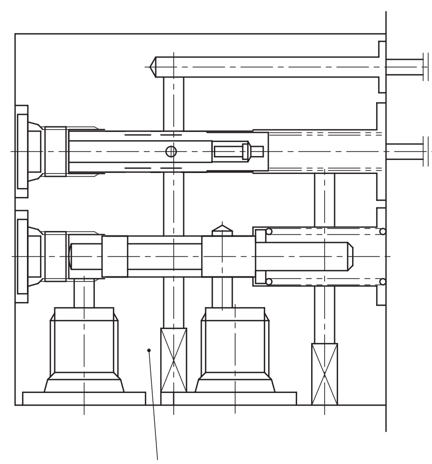
Figure 5

Operation of Time Delay Valve

Capacity of a driving motor depends on the angle of the swash plate (16) which is controlled by the tilting valve.

External Pilot Pressure: When Pi = 0 (Large Tilt Angle)

The high-pressure oil acting on the motor comes to act on the port P of the tilting valve with the high-pressure select function built in the valve casing. The high-pressure oil flows into the port Sb as the spool assembled in the tilting switching part sticks to the plug by spring. This high-pressure oil applies pressure on the chamber A through the valve casing and the channel A' of the shaft casing from the port Sb. Oil in the chamber B comes to flow into the drain line through the channel B °Ê Sa. The tilting piston moves to the right side by high-pressure oil and the swash plate moves to and stops at a position where it sticks to the stopper on the basis of the rotation center, '0'.

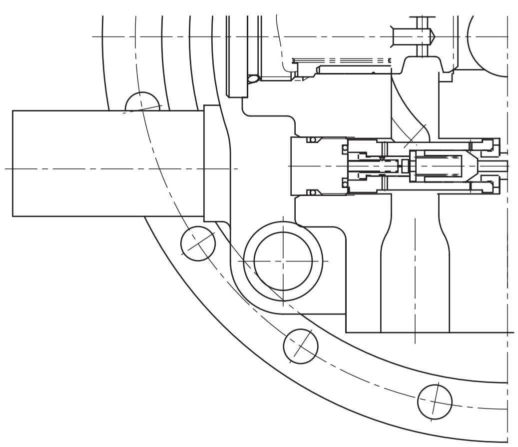


FG001326

Figure 6

Operation of Swing Reactionless Valve

Brake is applied to the lateral port, as the motor receiving pump action has two ports blocked when a rotating device of hydraulic motor starts or stops rotating parts by controlling switching valves. While rotating parts stop operation due to this brake pressure, 4 or 5 inversions take place. The anti-inversion valve blocks both ports during ordinary operation but bypasses some blocked pressure oil to a reverse port for a certain period in case of inversion to ensure the increase of pressure in the motor and the decrease of inversion.



FG001327

Figure 7

Parts List

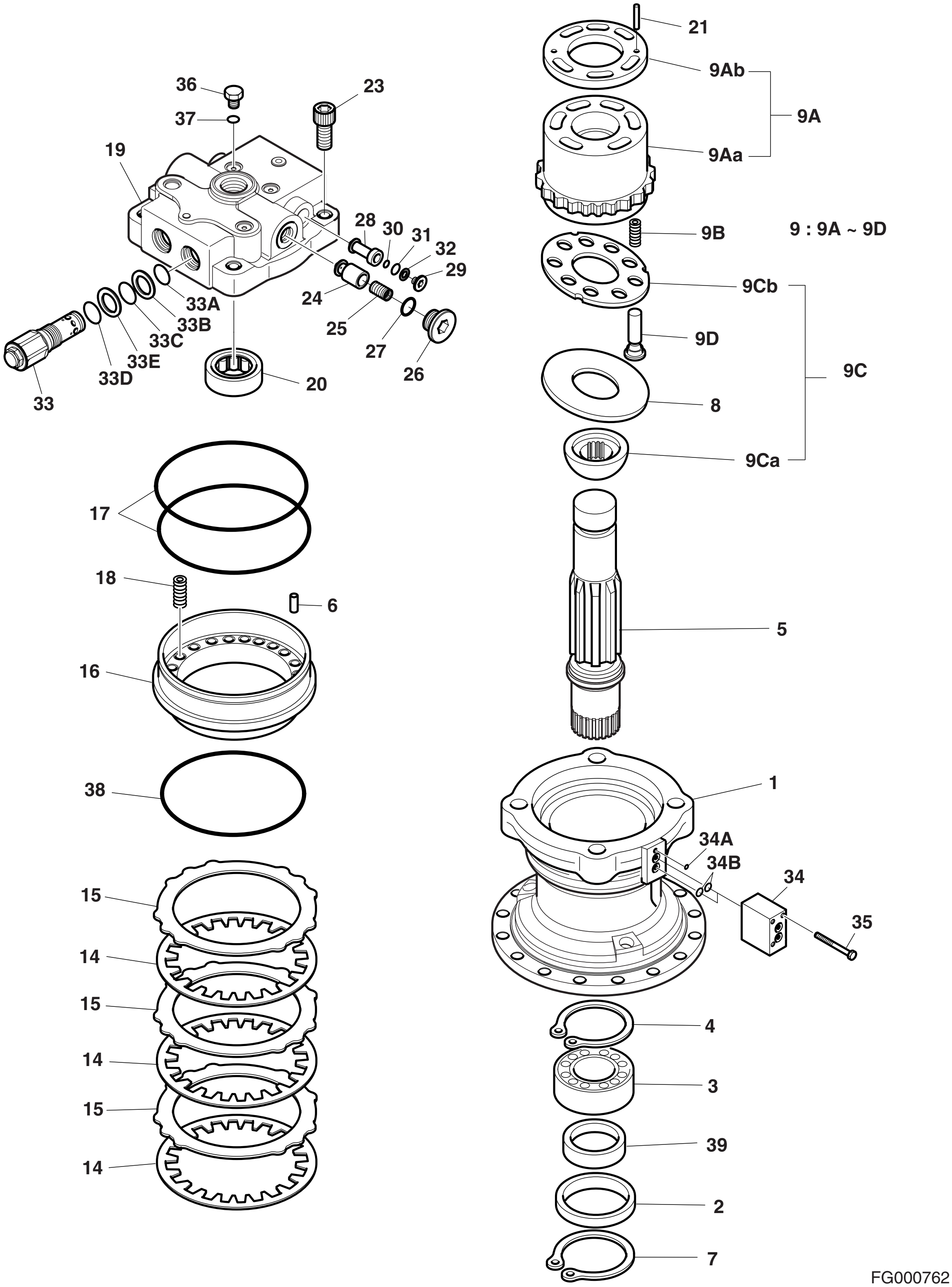


Figure 8

Reference Number	Description
1	Body
2	Oil Seal
3	Roller Bearing
4	Snap Ring
5	Shaft
6	Parallel Pin
7	Stop Ring
8	Shoe Plate
9	Rotary Kit
9A	Cylinder Block Kit
9Aa	Cylinder Block
9Ab	Valve Plate
9B	Spring
9C	Retainer Kit
9Ca	Ball Guide
9Cb	Set Plate
9D	Piston KT
14	Friction Plate
15	Plate
16	Brake Piston
17	O-ring
18	Spring
19	Cover
20	Needle Bearing
21	Parallel Pin

Reference Number	Description
23	Socket Bolt (M20x2.5)
24	Poppet
25	Spring
26	Plug
27	O-ring
28	Reductionless Valve Assembly
29	Plug
30	O-ring
31	O-ring
32	Back up Ring
33	Relief Valve Assembly
33A	O-ring
33B	Back up Ring
33C	O-ring
33D	O-ring
33E	Back up Ring
34	Time Delay Valve Assembly
34A	O-ring
34B	O-ring
35	Socket Bolt (M6x75)
36	Plug
37	O-ring
38	O-ring
39	Bushing

Specifications

Items		Units
Oil Flow		260 l/min (69 gpm)
Set Pressure of Relief V/V (Cracking)		275 kg/cm^2 (3,900 psi)
Motor Displacement		194.5 cc/rev (11.87 in^3/rev)
Motor Output Torque		85.1 kg•m (620 ft lb)
Motor Speed		1280 rpm
Brake Torque		88.2 kg•m (640 ft lb)
Brake Switching	Spool Cracking Pressure	8 kg/cm^2 (114 psi)
	Delay Period	6.5 ±1.5 sec
Weight		60 kg

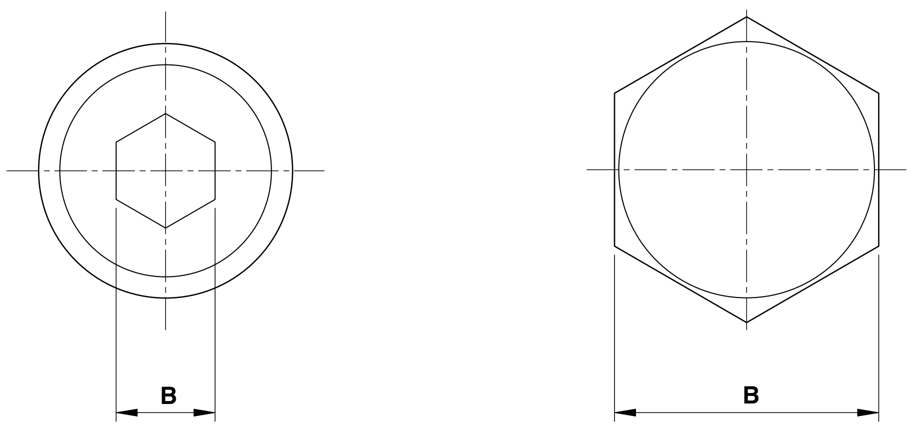
Torques

No.	Tools	Measures	B	Torque
33	Relief Valve	M33	36 mm	1700 - 1900 kg•cm (123 - 137 ft lb)
36	Plug	PT 1/4	36 mm	691 kg•cm (50 ft lb)
37	Plug	PF 1/4	5 mm	691 kg•cm (50 ft lb)
40	Plug	PF 1/2	6 mm	2,090 kg•cm (150 ft lb)
41	Plug	PF 1	6 mm	4,843 kg•cm (350 ft lb)
47	Plug		6 mm	
27	Hex Socket Head Bolt	M18X65L	14 mm	2,000 kg•cm (145 ft lb)
36	Hex Socket Head Bolt	M6X75L	5 mm	163 kg•cm (12 ft lb)

TOOLS AND MATERIALS

Tools

Tools	B Length	Tools to Be Used
Hex L Wrench	5 mm	Plug (37), hex socket head bolt (36)
	6 mm	Plugs (40, 41, and 47)
	14 mm	Hex socket head bolt (27)
Socket Wrench Spanner	36 mm	Plug (39), relief valve assembly (33)
Retaining Ring Pliers (For Orifice And Axis)		Ring stop (4)
Bar Hammer		Needle bearing (22), Pin (8, 23 and 43)
Torque Wrench		Measure:
Oil Seal Assembly Jig		Oil seal (2)
Bearing Induction Heating Device		Roller bearing (3)



ARS3980L

Figure 9

TROUBLESHOOTING, TESTING AND ADJUSTMENT

General Precautions

1. Observe any abnormalities and any possible causes that have noting to do with the motor before starting work.
2. Make sure that no foreign substance is involved when disassembling the machine, which is the most frequent cause of its wear.
3. Treat carefully and pay attention to avoid any damage against it that is machined precisely.

How to Check Faults of Hydraulic Motor

1. Remove the drain plug and check oil in the case. Too much chips and metal dust in oil causes the possible wear of parts in the motor.
2. Abnormal noise. Check any abnormal noise from the main body of the motor.
3. Pressure measurement at each part. Check any possible faults by measuring circuit pressure up to the hydraulic motor before disassembling the motor.

Troubleshooting

Problem	Possible Cause	Remedy
Abnormal operation of driving devices.		
Motor pressure does not increase.	Oil bypassing in relief valve (33)	Replace or repair relief valve.
	Check spring broken.	Replace check spring.
	Crack in channel in valve casing.	Replace valve casing.
	Abnormal wear on check surface.	Replace check.
Pressure increases but hydraulic motor does not rotate.	Friction and/or separation plates stuck.	Replace friction and/or separation plates.
	Slideway stuck.	Replace stuck slideway.
Number of rotations is below specification.		
Insufficient rotation.	Lack of incoming oil.	Check hydraulic circuits up to motor.
	Too high oil temperature.	Low oil temperature.
	Too much leakage.	Replace or repair faulty parts.
Low-pressure.	Low set pressure in relief valve.	Adjust pressure.
Brake released but weak driving force.	Sticking or abnormal wear of slideways.	Replace or repair slideway.
Hard to control brake.		

Problem	Possible Cause	Remedy
Low brake torque.	Wear of friction and/or separation plates.	Replace worn parts.
	Damage of brake spring.	Replace brake spring.
No brake operation.	Sticking of inner brake parts.	Replace parts.
Oil leakage.		
Leakage from oil seal (2).	Oil seal or shaft slidway damaged.	Replace damaged parts and remove any foreign substance.
	High-pressure in case.	Check the drain line.
Leakage from assembled parts.	O-ring damaged.	Replace the O-ring.
	Volt or plug loosened.	Tighten up to specified torque.
Main ways stuck.		
Piston and shoe. Shoe and swash plate. Piston and cylinder. Cylinder and valve plate. Front plate and spherical bushing.	Overload rotation of motor. Increase of temperature. Insufficient intensity of illumination on slideway. Improper oil or lubrication.	Check the operation of the relief valve. Check circuits. Repair or replacement of faulty parts. Replace oil.

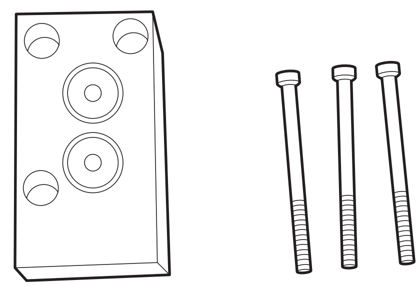
DISASSEMBLY

General Cautions

1. Prepare for a clean place for disassembly. Place a rubber sheet on place to prevent any damage to parts.
2. Wash out dust and foreign substance in motor and deceleration assembly.
3. Take care not to damage connecting parts and ways of O-ring, oil seal, seal surface, gear, pin, and surface of bearings.
4. Numbers in parentheses indicate those on sectional plans of motor.

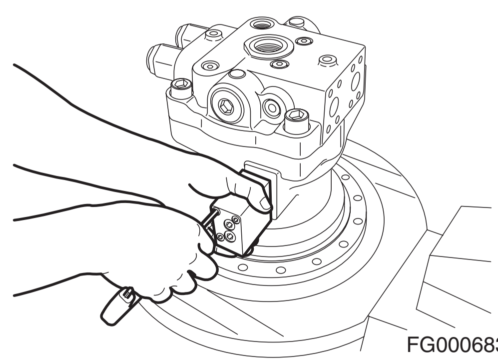
Disassembly

1. Remove hex socket head bolt and disassemble time delay valve assembly, beginning with rear cover (19).



FG000682

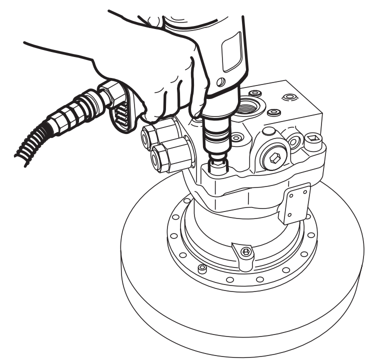
Figure 10



FG000683

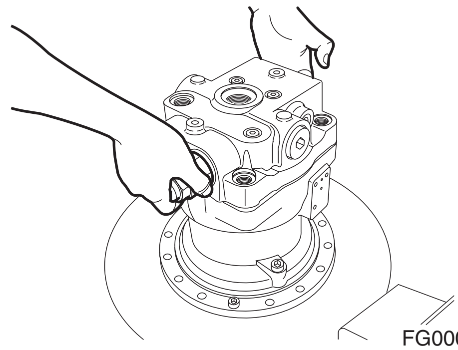
Figure 11

2. Remove rear cover from body (1) by removing hex socket head bolt (23) of its assembly with impact.



FG000685

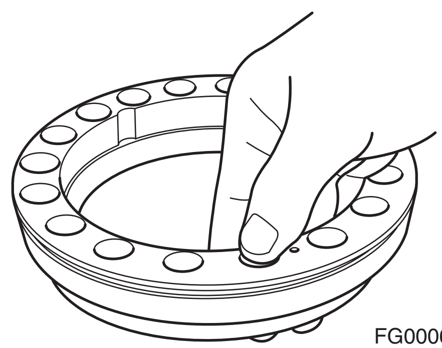
Figure 12



FG000686

Figure 13

3. Remove brake piston assembly from body (1) using jig.



FG000687

Figure 14

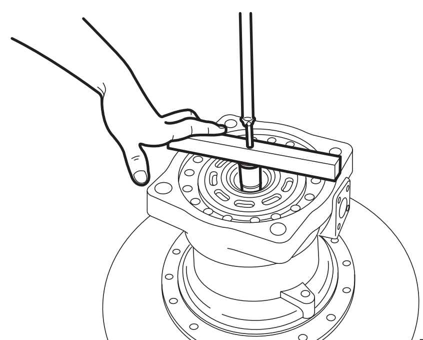


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Figure 15

4. Remove cylinder block assembly, friction plate (14), and plate (15) from body (1).

NOTE: *Pay attention to order of plates and friction plates.*

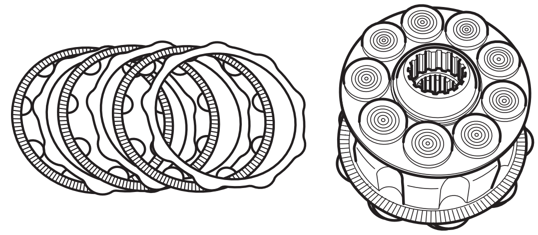


Figure 16

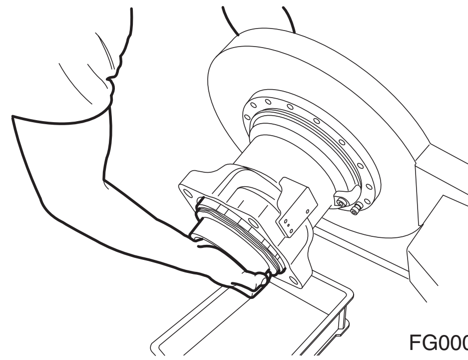


Figure 17

5. Remove O-ring (38) from body (1).

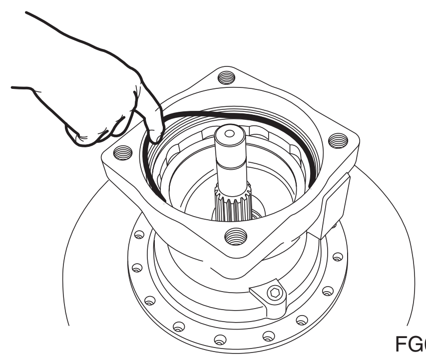


Figure 18

6. Remove shoe plate (8) from body (1) using jig.

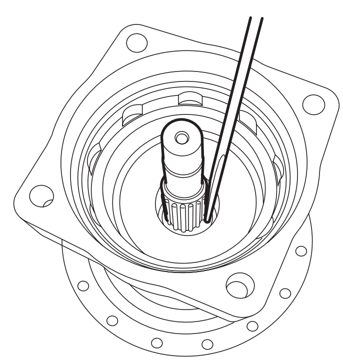


Figure 19

7. Remove retaining ring (4) from body (1) using retaining ring pliers.

8. Turn body over, and separate shaft assembly using steel bar.

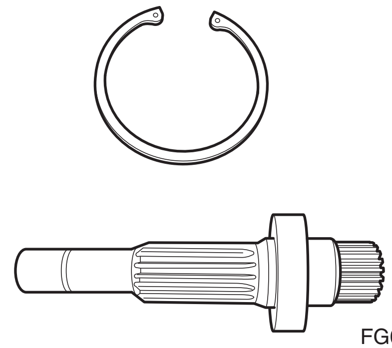


Figure 20

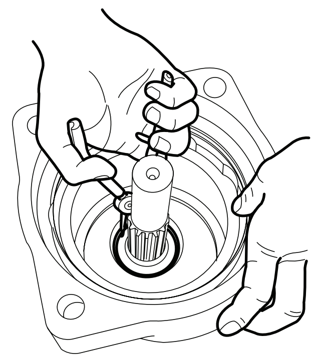


Figure 21

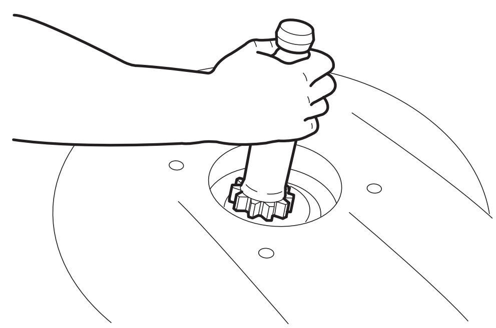


Figure 22

9. Separate piston assembly (13) from cylinder block assembly.

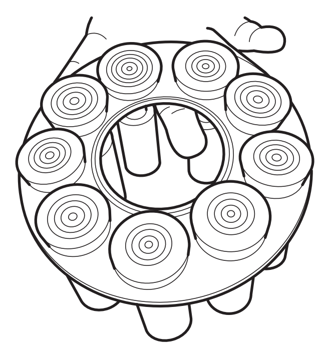
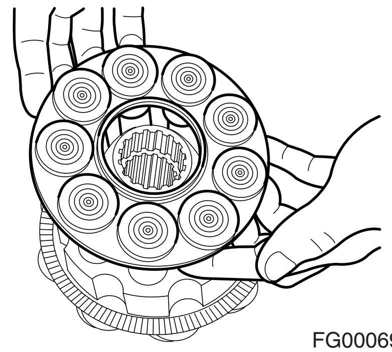


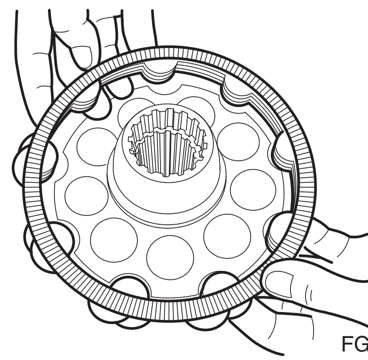
Figure 23



FG000697

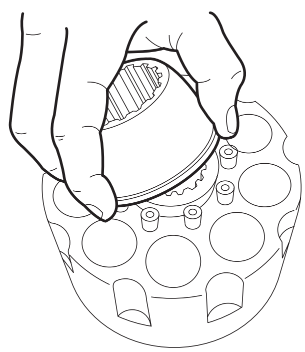
Figure 24

10. Remove friction plate (12), plate (15), ball guide (11), and spring (10) from cylinder block.



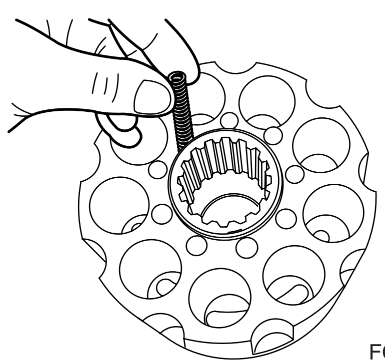
FG000698

Figure 25



FG000699

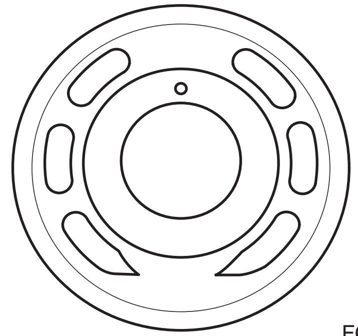
Figure 26



FG000700

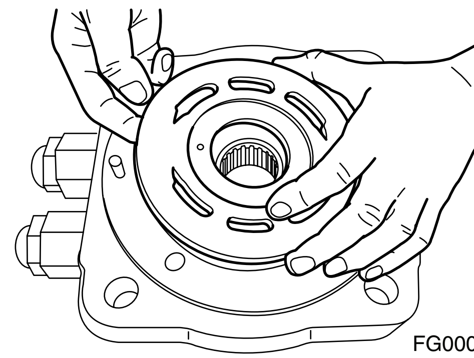
Figure 27

11. Separate valve plate (22) from rear cover (19).



FG000701

Figure 28



FG000703

Figure 29

12. Remove O-ring (17) from rear cover (19).

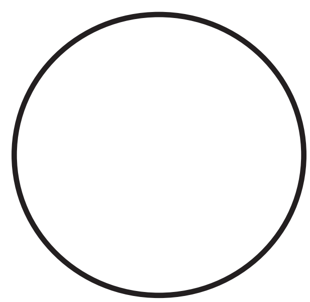


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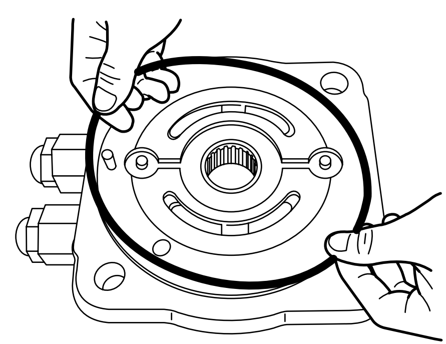
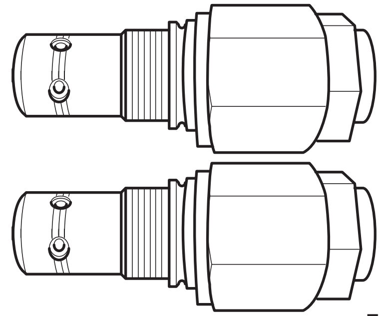
Figure 30



FG000705

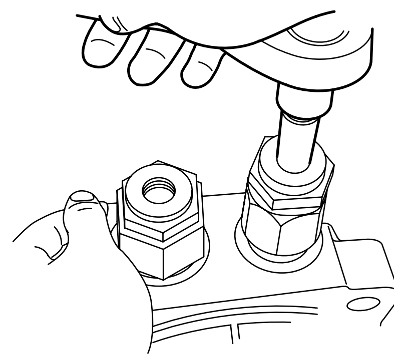
Figure 31

13. Remove two relief valve assemblies (33) from rear cover (19).



FG000706

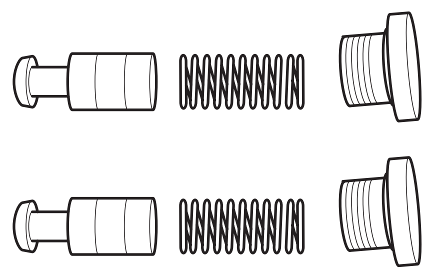
Figure 32



FG000707

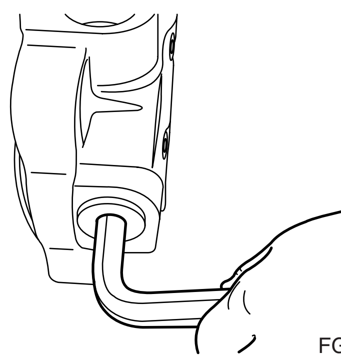
Figure 33

14. Remove check valve assemblies from rear cover (19) with L wrench, and disassemble it in order of plug (26), spring (23), and poppet (24).



FG000708

Figure 34



FG000709

Figure 35

15. Remove plug (29) from rear cover (19) with L wrench and disassemble it in order of backup ring (50), O-ring (49), O-ring (48), spring, and anti-inversion valve assembly (28).

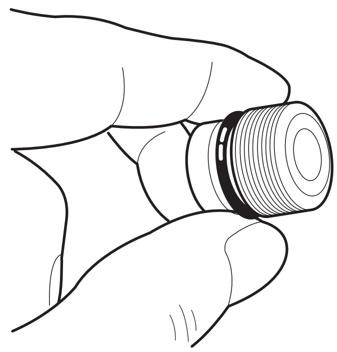

FG000710

Figure 36

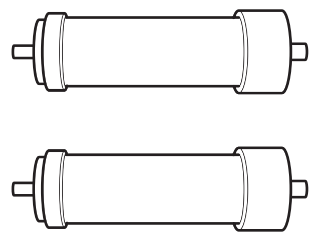

FG000711

Figure 37

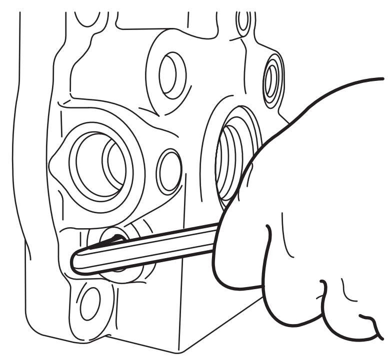

FG000712

Figure 38

16. Remove plugs (36 and 37) from rear cover (19) with L wrench

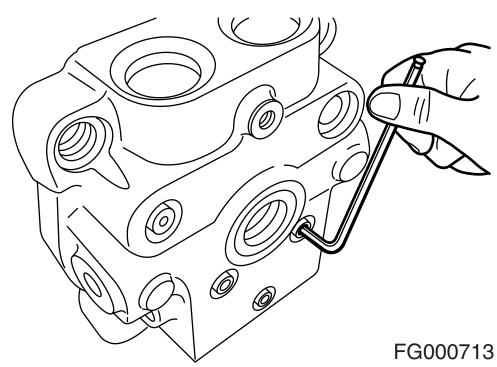

FG000713

Figure 39

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

REASSEMBLY

General Cautions

1. Wash and clean each part. Then dry them with compressed air. The friction plate, however, should not be washed with treated oil.
2. Each connecting parts should be tightened according to its assigned torque.
3. Only use a plastic soft-faced hammer.

Assembly

1. Put roll bearing (3) and bushing (39) on a heater and apply heat to their inner race (inlet temperature: 290°C for 2 minutes).

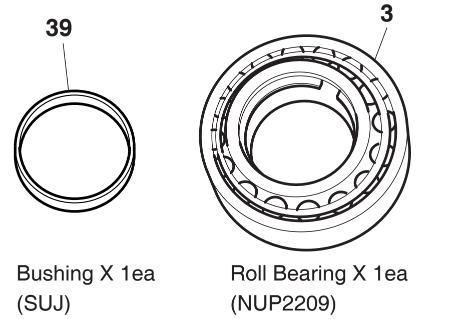


Figure 40

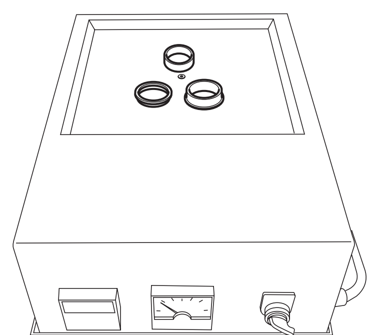
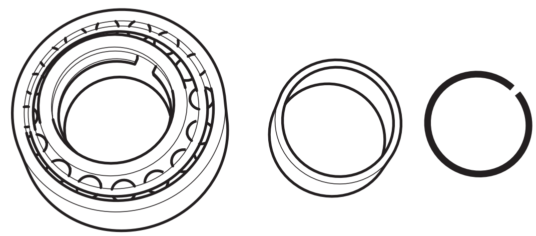


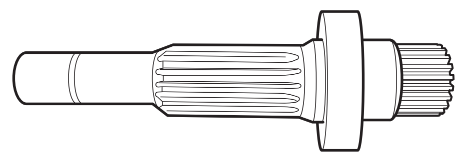
Figure 41

2. Assemble heated roll bearing (3) and bushing (39). Use retaining ring pliers to assemble install retaining ring (7).



FG000716

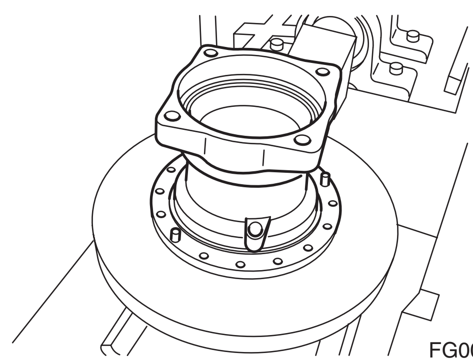
Figure 42



FG000717

Figure 43

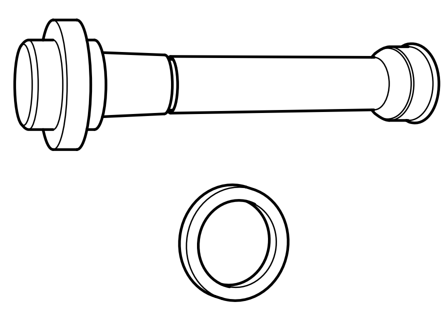
3. Put body (1) on assembly jig and secure it so it cannot move.



FG000718

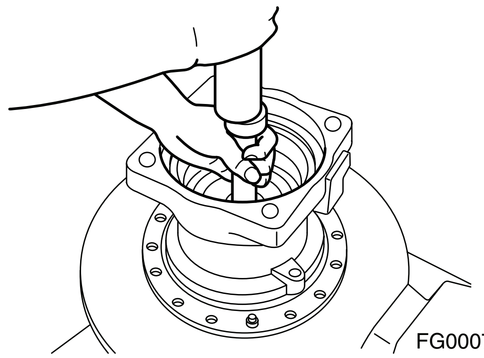
Figure 44

4. Assemble oil seal (2) in body (1) using bar hammer.



FG000719

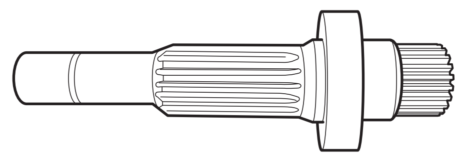
Figure 45



FG000720

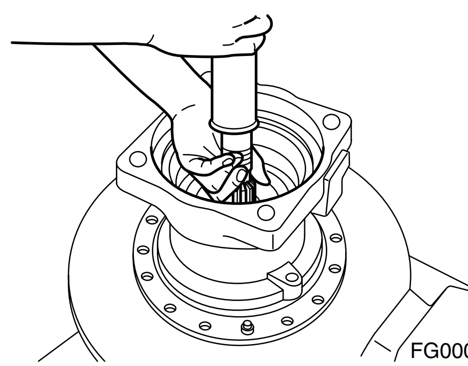
Figure 46

5. Install shaft in body (1) using bar hammer.



FG000717

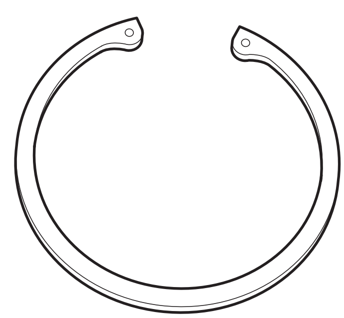
Figure 47



FG000721

Figure 48

6. Secure shaft with retaining ring (4) using retaining ring pliers.



FG000722

Figure 49

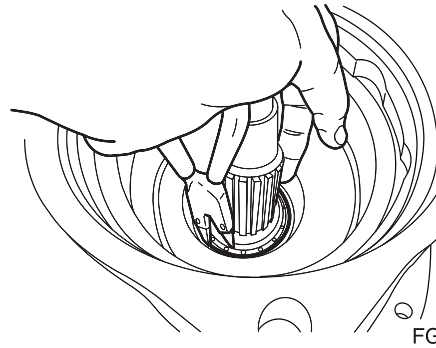

FG000723

Figure 50

7. Coat shoe plate (8) with grease, and assemble it into body.

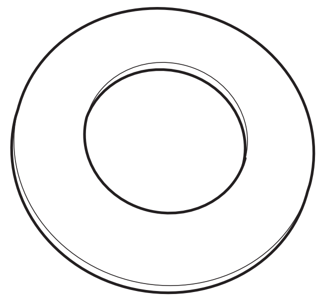

FG000724

Figure 51

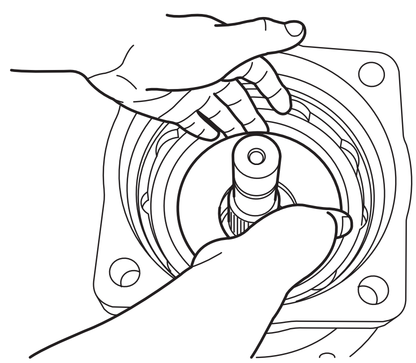

FG000725

Figure 52

Assembly of Cylinder Block Assembly Subassembly

8. Insert nine sets of springs (1 thru 9) in cylinder block (9).

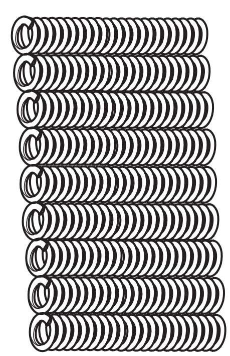

FG000726

Figure 53

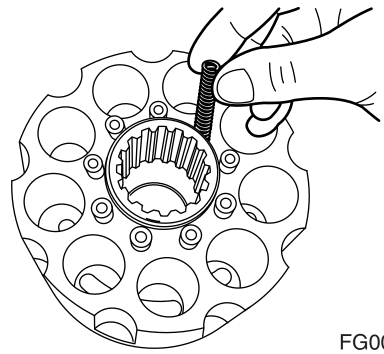

FG000727

Figure 54

9. Insert ball guide (1-B-11) in cylinder block (9).

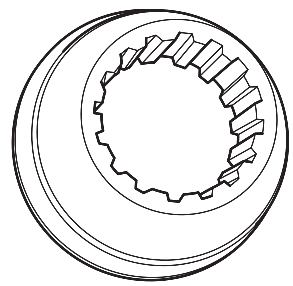

FG000728

Figure 55

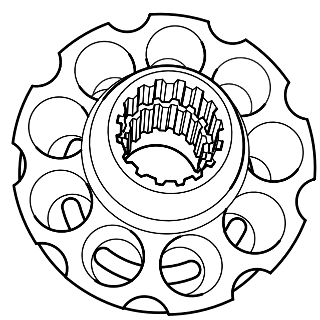

FG000729

Figure 56

10. Assemble friction plate (14) and plate (15) into cylinder block (9)

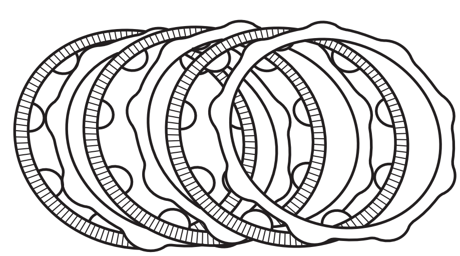
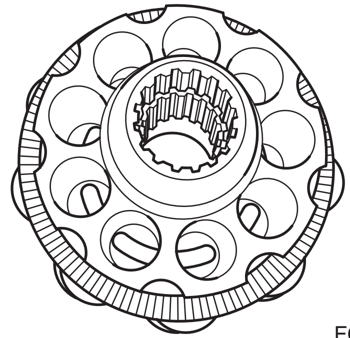

FG000759

Figure 57

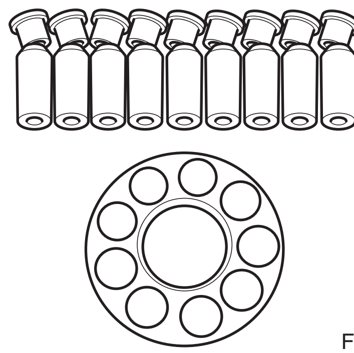


FG000730

Figure 58

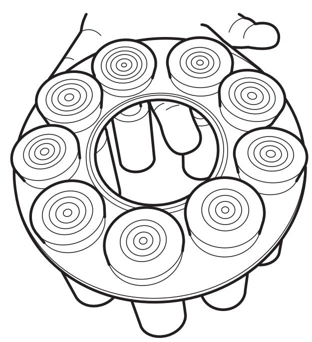
11. Insert piston assembly (1-C-13) in set plate (1-B-12) and assemble it into cylinder block (9).

    NOTE: *Coat piston with clean hydraulic oil.*



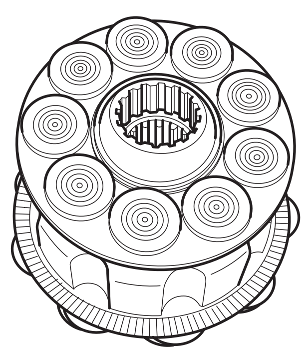
FG000731

Figure 59



FG000696

Figure 60



FG000732

Figure 61

12. Assemble cylinder block into body (1).

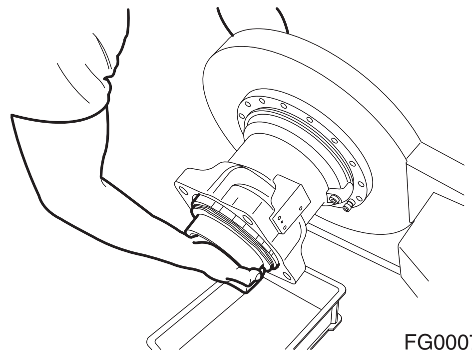


Figure 62

13. Insert O-ring (38) in body (1).

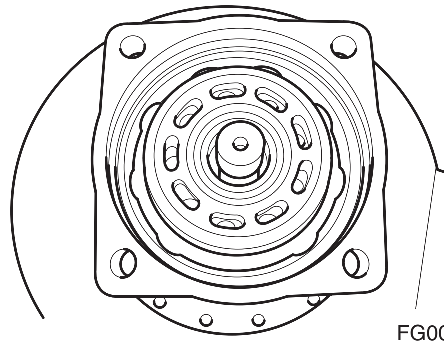


Figure 63

14. Assemble O-ring (17) into brake piston (16).

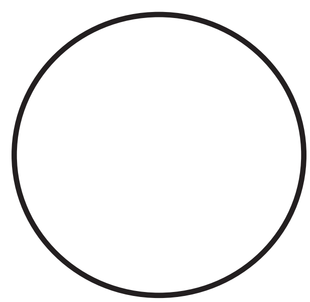


Figure 64

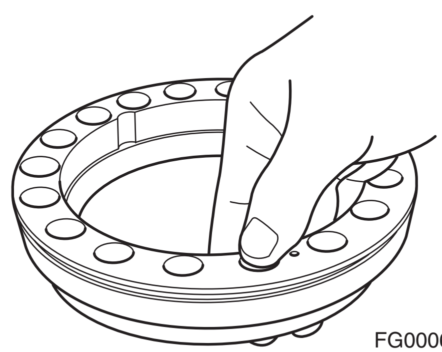
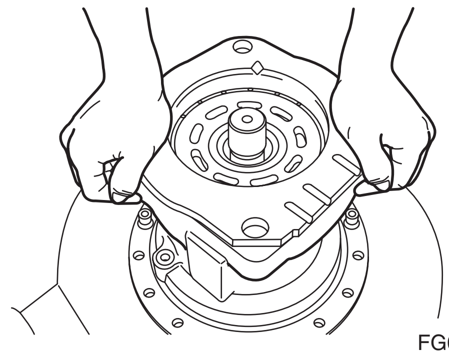


Figure 65

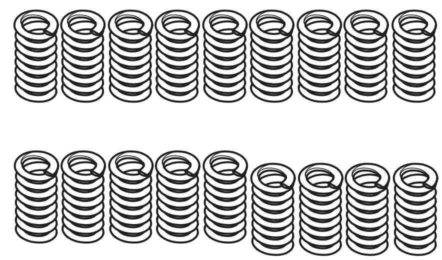
15. Insert brake piston assembly in body and secure it using jig.



FG000735

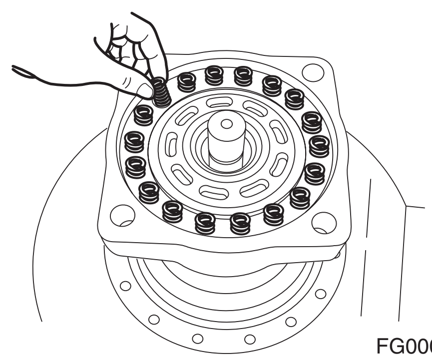
Figure 66

16. Insert eighteen springs (18) into brake piston (16).



FG000736

Figure 67

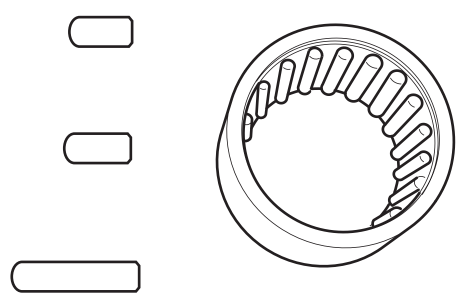


FG000737

Figure 68

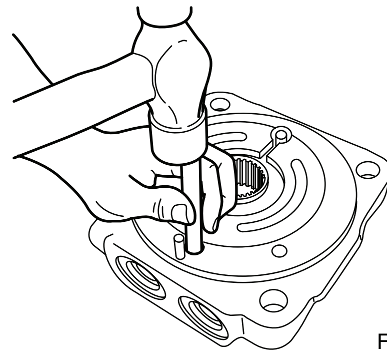
Assembly of Rear Cover Assembly Subassembly

1. Insert pins (6 and 21) in rear cover (19) with bar hammer and assemble needle bearing (20) using jig.



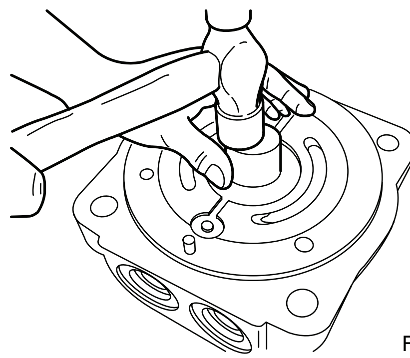
FG000738

Figure 69



FG000739

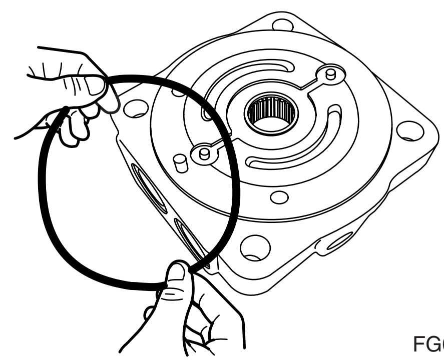
Figure 70



FG000740

Figure 71

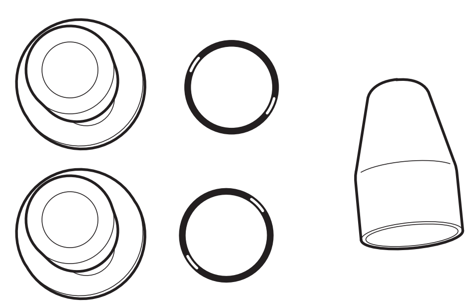
2. Assemble O-ring (17) into rear cover (19).



FG000741

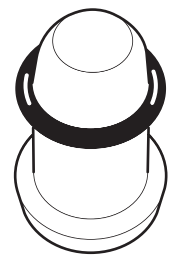
Figure 72

3. Assemble check valve. Install O-ring (27) using jig.



FG000742

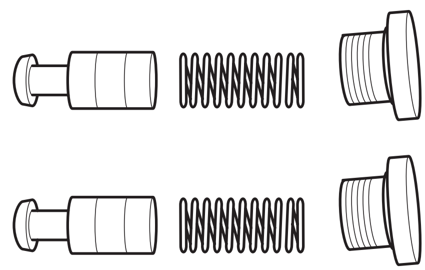
Figure 73



FG000743

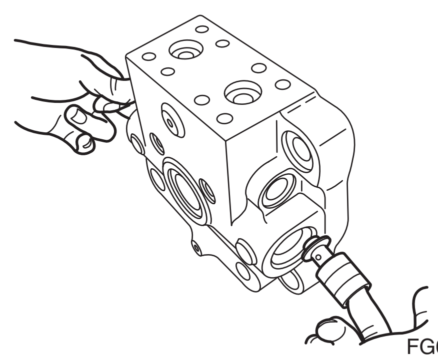
Figure 74

4. Insert poppet (24), spring (25), and plug (26) in rear cover (19). Tighten plug with L wrench. (Left and right symmetrically.)



FG000708

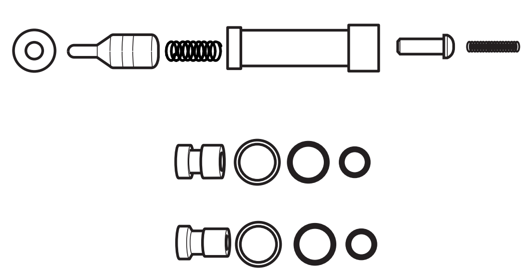
Figure 75



FG000744

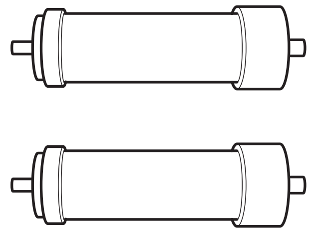
Figure 76

5. Assemble anti-inversion valve. Assemble body, spring seat, spring, poppet, poppet seat, stopper, and spring. Then assemble O-ring (31), backup ring (32), and O-ring (30).



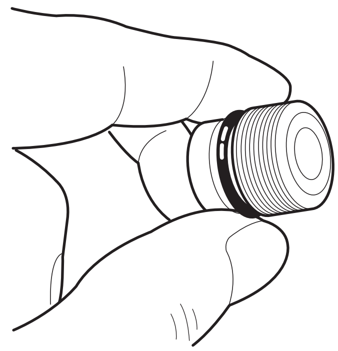
FG000745

Figure 77



FG000711

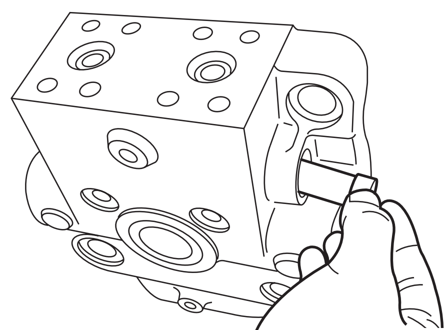
Figure 78



FG000710

Figure 79

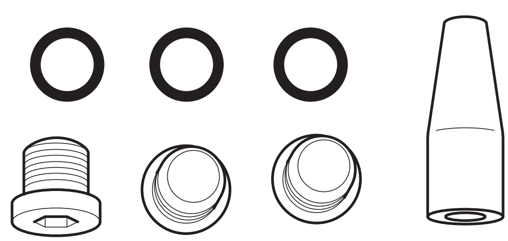
6. Assemble anti-inversion valve set. Assemble anti-inversion valve set and plug assembly (29) into rear cover (19) and tighten them with L wrench.



FG000746

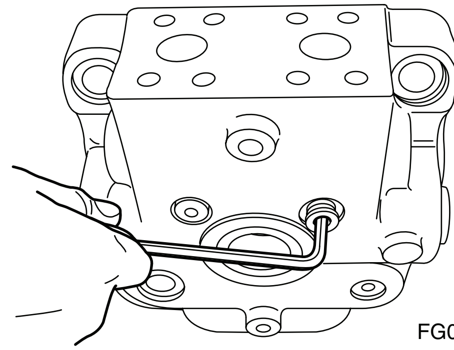
Figure 80

7. Assemble plug assembly (36) into rear cover (19) with L wrench.



FG000747

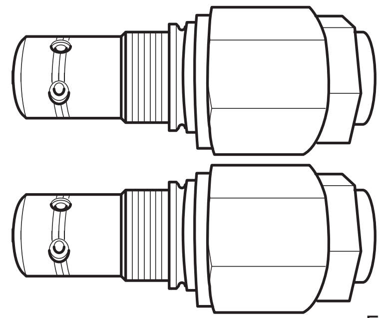
Figure 81



FG000748

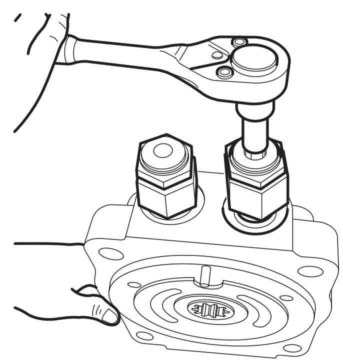
Figure 82

8. Assemble two relief valve assemblies into rear cover (19) with torque wrench. (Left and right symmetrically.)



FG000706

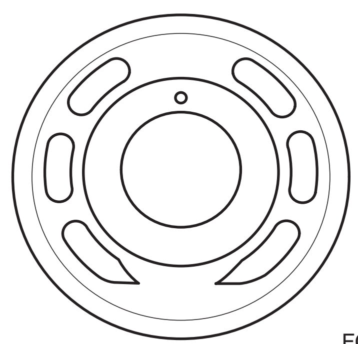
Figure 83



FG000749

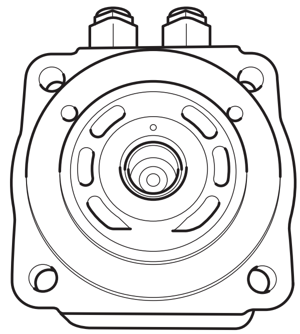
Figure 84

9. Coat valve plate (1-A-22) with grease and attach it to rear cover (19).



FG000701

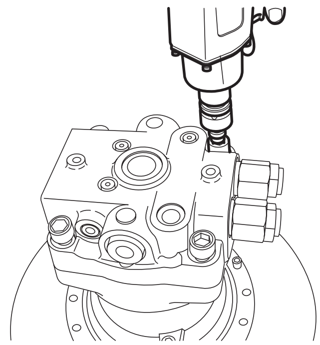
Figure 85



FG000750

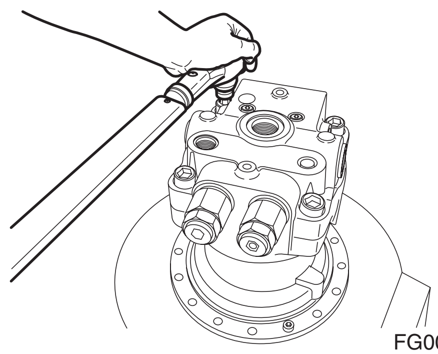
Figure 86

10. Position rear cover assembly on body (1) and tighten hex socket head bolt (23).



FG000751

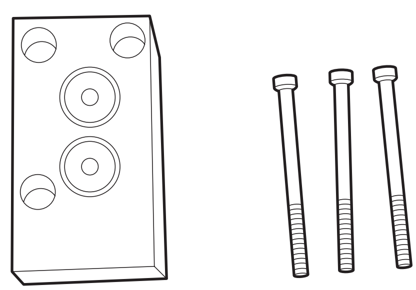
Figure 87



FG000752

Figure 88

11. Install time delay valve assembly onto rear cover (19) with hex socket head bolts (35).



FG000682

Figure 89

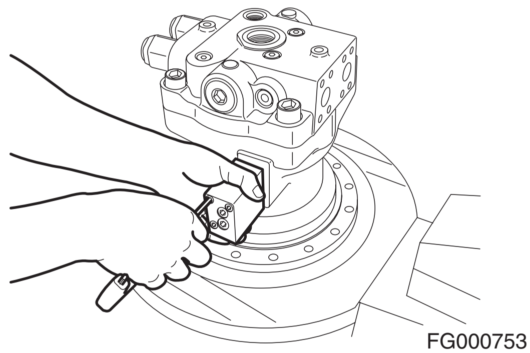


Figure 90

Air Pressure Test

Apply air pressure into assembled motor, dip it in treated oil for one minute and check any leakage from it.

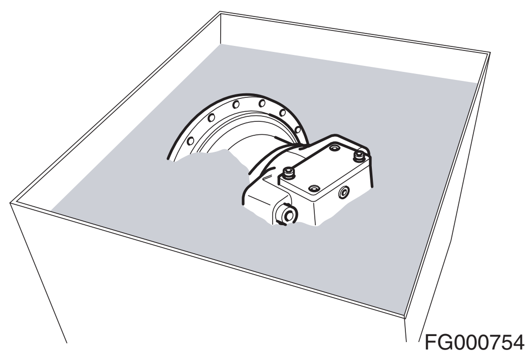


Figure 91

Oil Leakage Check

Wash motor with Color Check No.1, spray No.3, and check for any oil leakage.

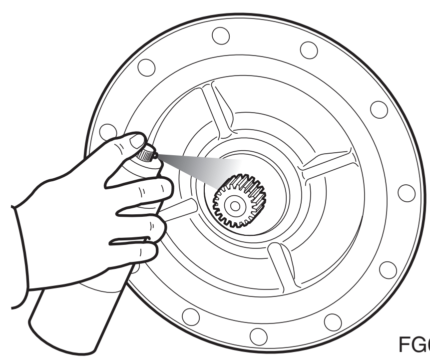


Figure 92

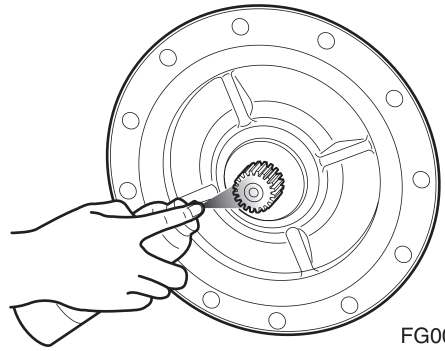


Figure 93

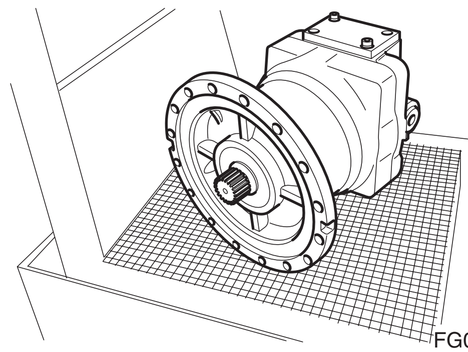


Figure 94

Travel Motor

Edition 1

MEMO

Table of Contents

Travel Motor

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up

GENERAL DESCRIPTION

Structure

The hydraulic motor consists of five parts:

- Rotary part generating rotary power.
- Cross-over relief valve.
- Negative brake.
- Counterbalance valve.
- Tilting switching part.

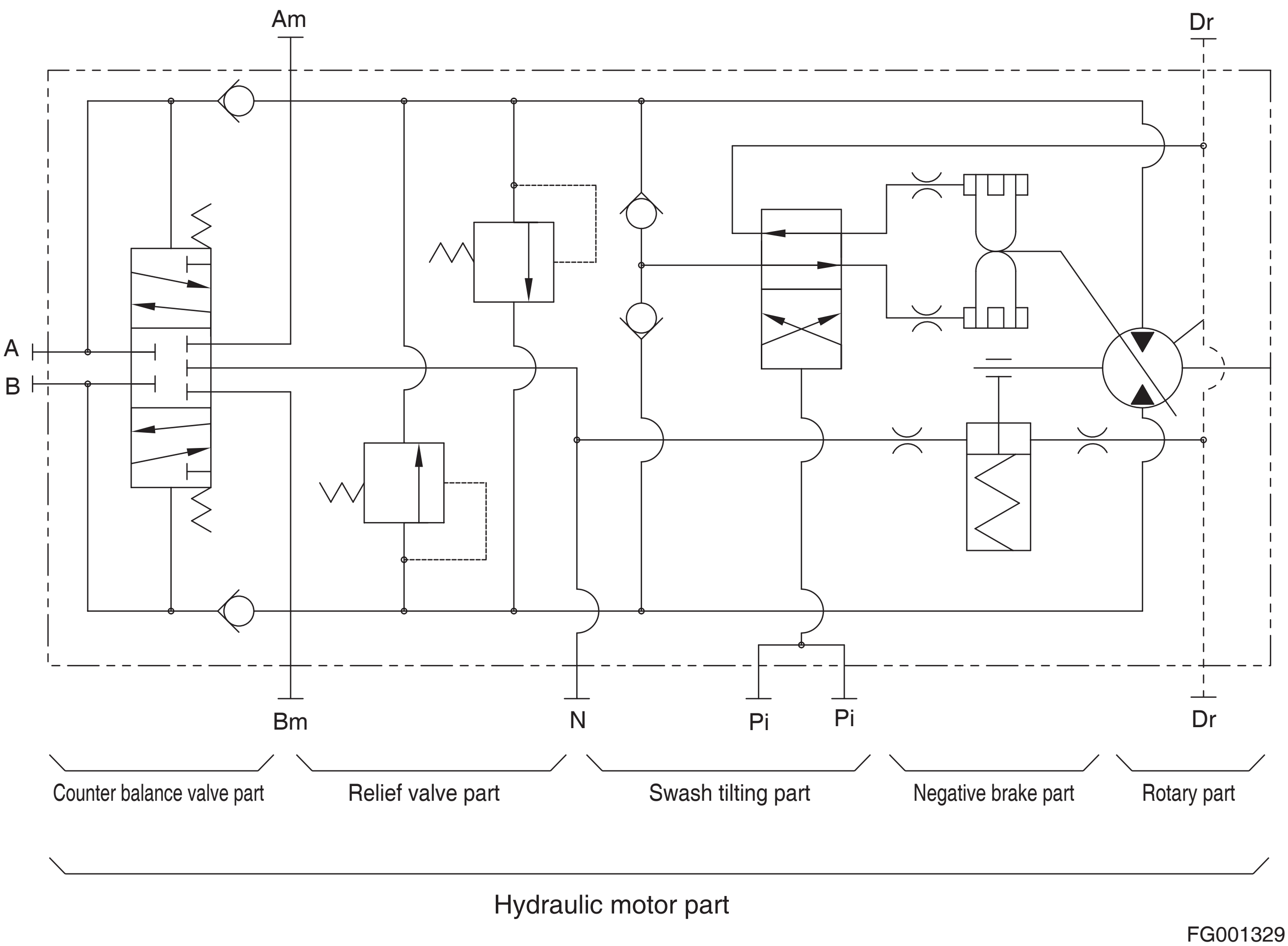


Figure 1

Operation Basics

Generation of Rotary Power

High-pressure oil from hydraulic pump flows into cylinder (111) through valve casing (303) and valve plate (131). The high-pressure oil is designed to flow only to one side in relationship to Y-Y, the connection line of top and bottom dead centers of piston (121).

As shown in figure below, high-pressure oil acts on piston to generate F1 = P*A (P: supply pressure, A: hydraulic area). F1 is divided into a N1 thrust component and a W1 radial component in relationship to swash plate (201) with slope of β, W1 generates a torque T = W1*R1 in relationship to Y-Y, the connection line of top and bottom dead centers of piston. This torque generates rotary power through resultant force ($\sum$W1*R1) occurring at (4~5 ea) hydraulic pistons by the high-pressure oil. The drive shaft turns and rotary power is transferred for this torque transfers the rotary power to cylinder (111) through piston and the cylinder is connected via spline.

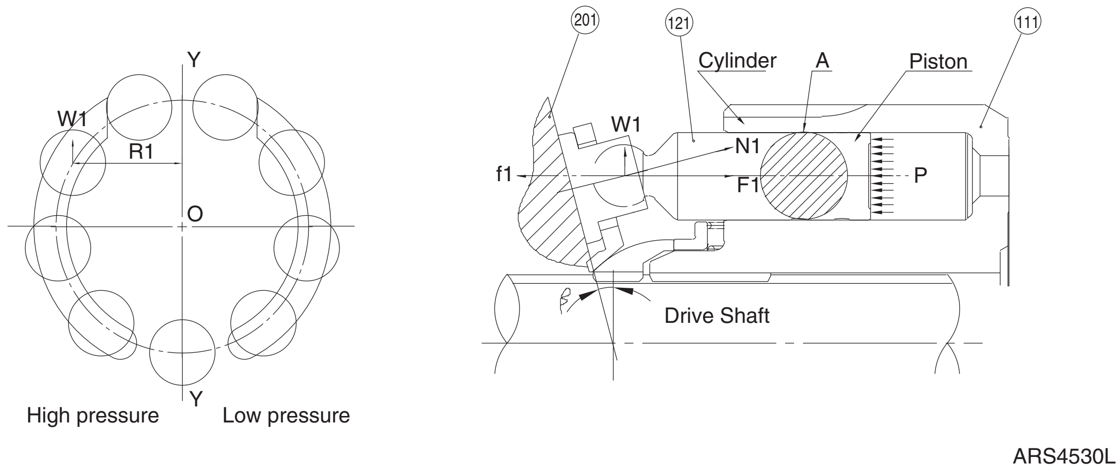


Figure 2

Operation of Relief Valve

The relief valve performs two functions:

1. It maintains uniform pressure when the hydraulic motor starts and bypasses surplus oil at the inlet of the motor to the outlet in relationship with acceleration of the inertia weight.
2. Device is forced to stop by the generation of brake pressure at the discharge side when the inertia weight stops. Chamber A is connected to port A of the motor. Hydraulic oil flows from chamber A to port B because, when the pressure in the port A increases, poppet A is opened; when it is above the spring setting pressure, Poppet A opens and hydraulic flows from chamber A to port B.

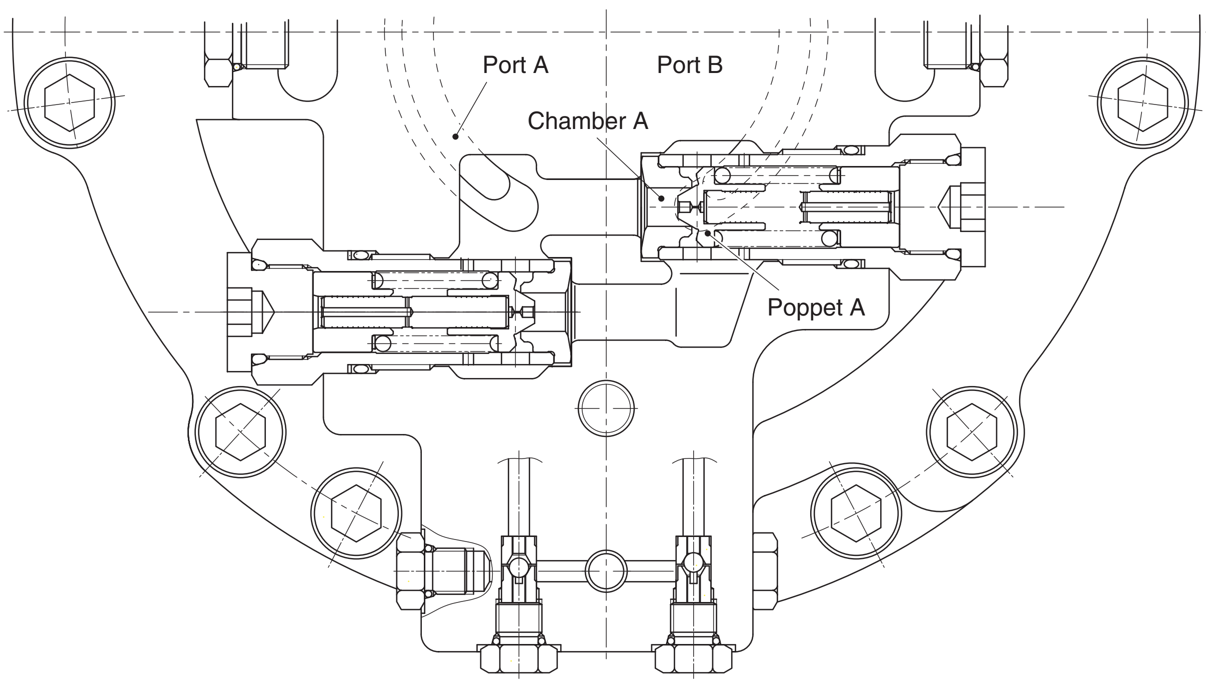


Figure 3

Operation of Negative Brake

Pressurized oil entering through counterbalance spool in valve casing (303), forces brake piston (702) to release the brake. When hydraulic oil pressure, is not present, the brake is spring applied by ten springs (705).

Brake force is generated by frictional force between separator plate (741) (which is fixed by pin pressed into shaft casing) and friction plate (742) (which is connected to shaft casing, brake piston (702) and spline of cylinder block (111)).

When no oil pressure is applied to the brake piston, the brake spring presses the brake piston and oil brake cavity flows to the drain of the motor through an orifice. And the brake piston presses the separator and friction plates located between it and the shaft casing together, due to the force from 10 brake springs (705). This frictional force activates the brake that slows the drive shaft (101) connected to the cylinder block (111).

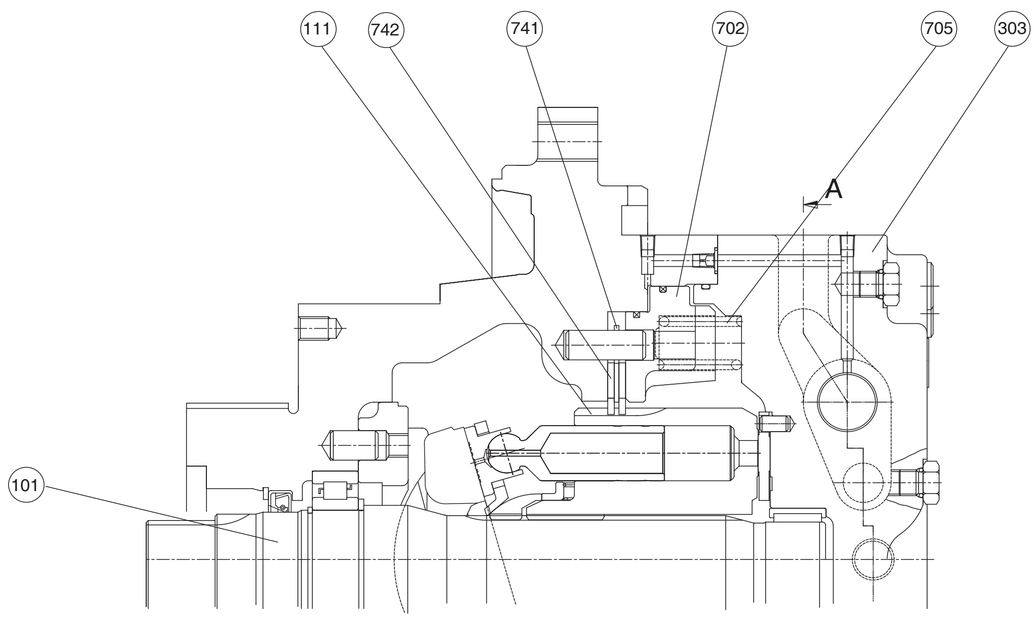


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Figure 4

Counterbalance Valve

The port Av is connected to hydraulic pump. Port Bv is connected to hydraulic oil tank. The oil supplied from the hydraulic pump tries to turn the hydraulic motor by opening the check valve poppet, allowing oil to flow from; Av → Cv → C' → L → Am of the hydraulic motor.

Even though oil tries to turn the motor, the motor cannot turn due to the negative brake. Pressurized oil from pump rises, and it is transmitted through passage G and orifice 1' to spring chamber M. As pressure in chamber M exceeds spring force keeping the spool centered in neutral, the spool is then moved to the right. Oil in the chamber N (at the opposite end of the spool), flows to the chamber Dv through orifice 1, and is discharged to the hydraulic oil tank through port Bv. The spool continues to move to the right and oil starts to flow from K → Dv → Bv. Once the spool is moved far enough to the right, passage H is opened. With passage H opened, oil now flows from Cv → H → port P. The spool will be moved slowly because oil in the chamber N is discharged through orifice 1.

When the pump decreases flow to port Av, the spring of the chamber N moves the spool back to the left. Oil in the chamber M flows to the chamber Cv through orifice 1' and is discharged to the port Av.

The spool returns to the neutral position when the hydraulic oil pressure in chamber M and port Av, equals the hydraulic oil tank pressure in chamber N.

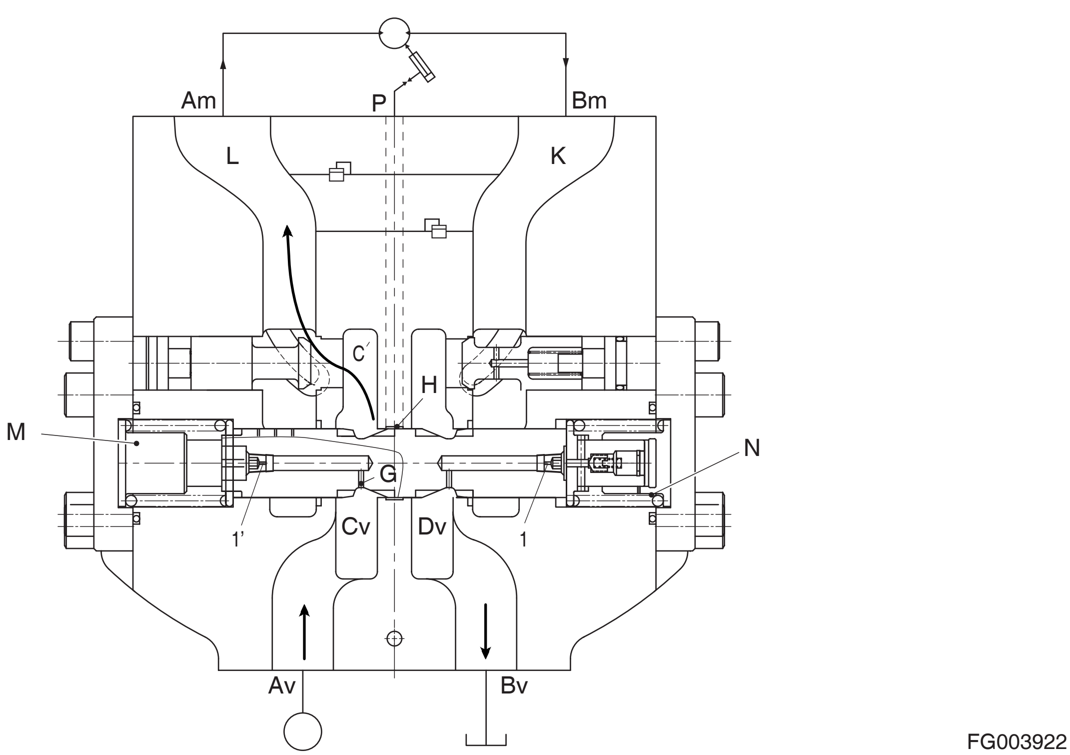


Figure 5

Operation of Swash Plate Control

Capacity of traveling motor varies with the change of swash plate (201) tilting angle. The tilt angle is controlled by tilting valve.

NOTE: *The smaller the tilt angle is, the faster the motor will rotate, while creating less torque.*

NOTE: *The larger the tilt angle is, the slower the motor will rotate, while creating more torque.*

1. External pilot pressure: Pi = 0 (Large tilt angle)

   If pilot pressure does not act on tilting valve, the position of swash plate (201) is set at a large tilting angle. Swash plate (201) has a movable round surface to tilt on. High-pressure oil flows through port Sa and Sb of tilting valve and passages, and forces swash piston (501) to move until swash piston (502) is stopped by stopper (503), and the position of swash plate (201) is in large tilting.

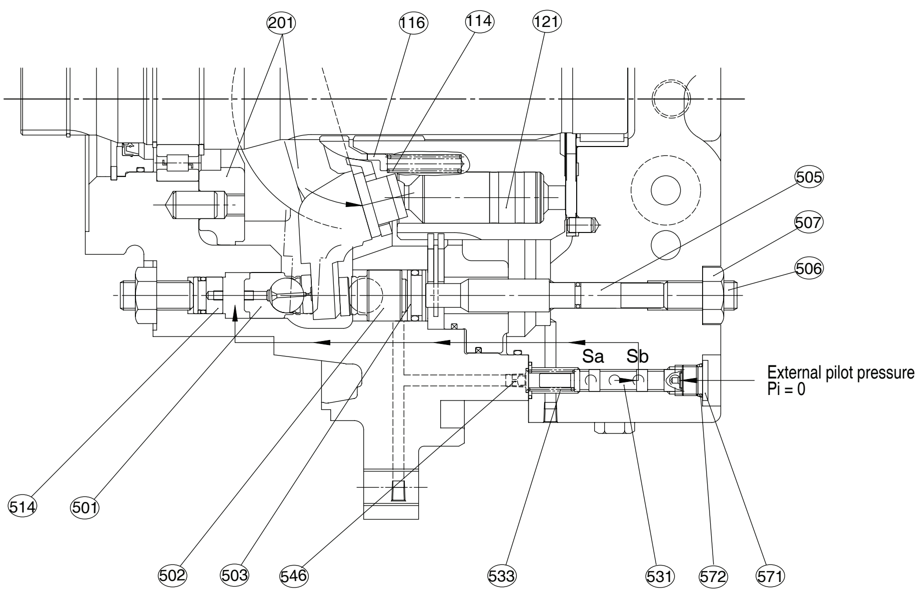


Figure 6

2. External pilot pressure: Pi ≥ 20 kg/cm^2 (284 psi) (Small tilt angle)

If pilot pressure acts on tilting valve, the force acting to spool (531) is greater than the swash spring (533). This forces the swash spool (531) to move to the left. High-pressure oil flows through port Sa and Sb of tilting valve and passages, and acts on swash piston (502) until swash piston (501) is stopped by stopper (514). The position of swash plate (201) is now at a small tilt angle.

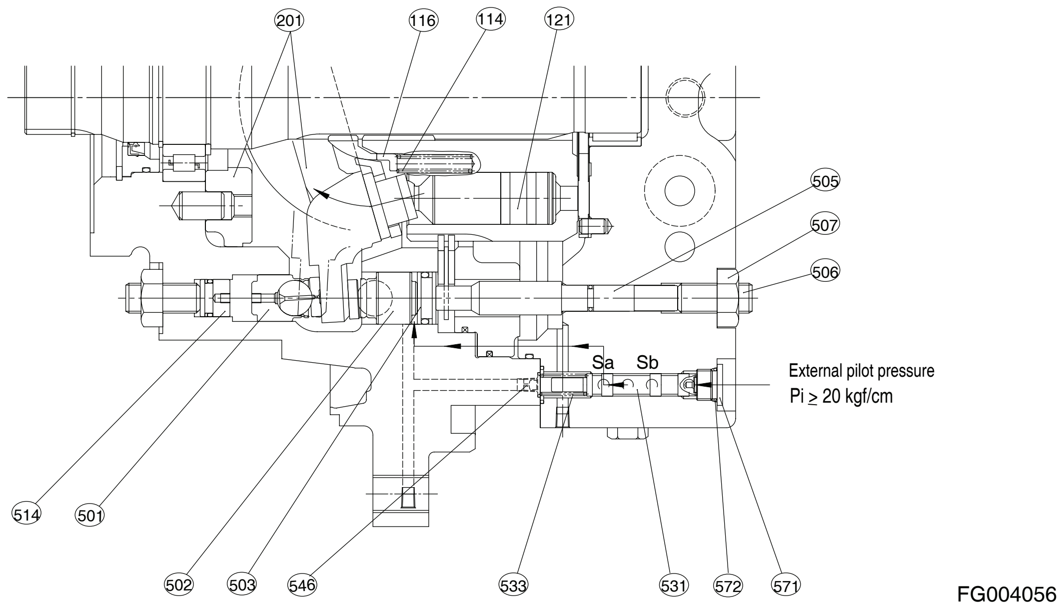


Figure 7

Parts List

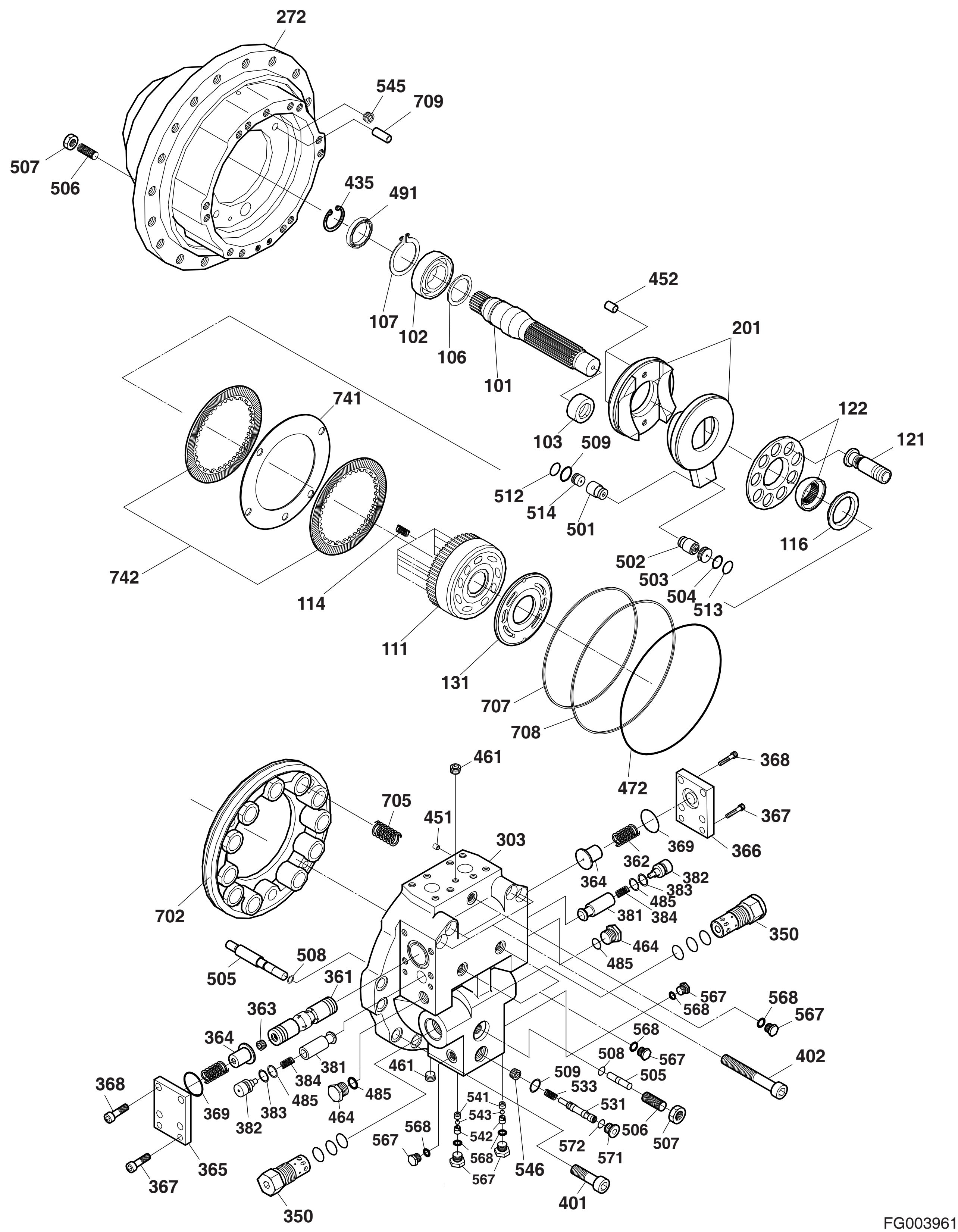


Figure 8

Reference Number	Description
101	Shaft
102	Roller Bearing
103	Needle Bearing
106	Spacer - Bearing
107	Retaining Ring
111	Cylinder Block
114	Spring Cylinder
116	Spacer
121	Piston and Shoe Assembly
122	Bushing and Push Plate Assembly
131	Valve Plate
201	Swash Assembly
272	Shaft Casing
281	Name Plate
303	Valve Casing
350	Relief Valve Assembly
361	Spool - Counterbalance Valve
362	Spring - Counterbalance Valve
363	Orifice Screw
364	Damping Check Assembly
365	Cap - Counterbalance Valve (Left)
366	Cap - Counterbalance Valve (Right)
367	Hex Socket Head Bolt
368	Hex Socket Head Bolt
369	O-ring
381	Plunger- Counterbalance Valve
382	Stopper - Check
383	Backup Ring
384	Spring - Check
401	Hex Socket Head Bolt
402	Hex Socket Head Bolt
435	Lock Ring
451	Valve Plate Pin
452	Support Pin
461	Plug
464	HP Plug

Reference Number	Description
472	O-ring
485	O-ring
491	Oil Seal
501	Swash Piston
502	Swash Piston
503	Stopper (Left)
504	O-ring
505	Swash Rod
506	Lock Screw
507	Hex Nut
508	O-ring
509	O-ring
512	Backup Ring
513	Backup Ring
514	Stopper (S)
531	Swash Spool
533	Swash Spring
541	Seat
542	Stopper
543	Ball
545	Orifice Screw
546	Orifice Screw
567	HP Plug
568	O-ring
571	Plug
572	O-ring
702	Brake Piston
705	Brake Spring
707	Piston Ring
708	Piston Ring
709	Brake Pin
741	Separator Plate
742	Friction Plate

Specifications

Items	Specification
Input Flow	260 l/min (69 gpm)
Set Pressure of Relief V/V (Cracking)	330 kg/cm^2 (4,700 psi)
Motor Displacement	173/101 cc/rev (10.56 - 6.16 in^3)
Motor Output Torque	90.9/53.1 kg•m (657 - 384 ft lb)
Theoretical Output Speed	1503/2574 rpm
Theoretical Brake Torque	40 kg•m (290 ft lb)
Brake Release Pressure	9 kg/cm^2 (128 psi)
Allowable Drain Pressure	Normal: 2 kg/cm^2 (28.4 psi) Surge: 10 kg/cm^2 (142 psi)
Weight	154 kg (340 lb)

Connection Torque

No.	Tools	Measures	B	Torque
350	Relief valve	HEX 46	46	1,700 - 1,900 kg•cm (123 - 137 ft lb)
461	Plug	NPTF 1/16	4	70 - 110 kg•cm (5 - 8 ft lb)
464	HP Plug	PF 1/2	27	1,100 kg•cm (80 ft lb)
507	Hex Nut	M16	24	2,400 kg•cm (175 ft lb)
571	Plug	PF 3/8	8	750 kg•cm (55 ft lb)
567	HP Plug	PF 1/4	19	370 kg•cm (27 ft lb)
545, 546	Orifice Screw	NPTF 1/16	4	70 kg•cm (5 ft lb)
368	Hex Socket Head Bolt	M12X30L	10	1,000 kg•cm (72 ft lb)
367	Hex Socket Head Bolt	M10X30L	8	670 kg•cm (48 ft lb)
401	Hex Socket Head Bolt	M16X50L	14	2,400 kg•cm (175 ft lb)
402	Hex Socket Head Bolt	M16X120L	14	2,400 kg•cm (175 ft lb)

SPECIAL TOOLS AND MATERIALS

Tools	B Length	Tools to Be Used
Hex L wrench	4 mm	Plug (461), orifice screws (545 and 546)
	8 mm	Hex socket head bolt (367), lock screw (506), plug (571)
	10 mm	Hex socket head bolt (368)
	46 mm	Relief Valve (350)
Socket wrench spanner	19 mm	HP plug (567)
	24 mm	Hex nut (507)
	27 mm	HP plug (464)
Retaining ring pliers (for orifice and axis)		Ring stop (107), lock ring (435)
Bar hammer		Needle bearing (103), Pin (451, 452 and 709)
Torque wrench		Measure: 500 and 3000
Oil seal assembly Jig		Oil seal (491)
Bearing induction heating device		Roller bearing (102)

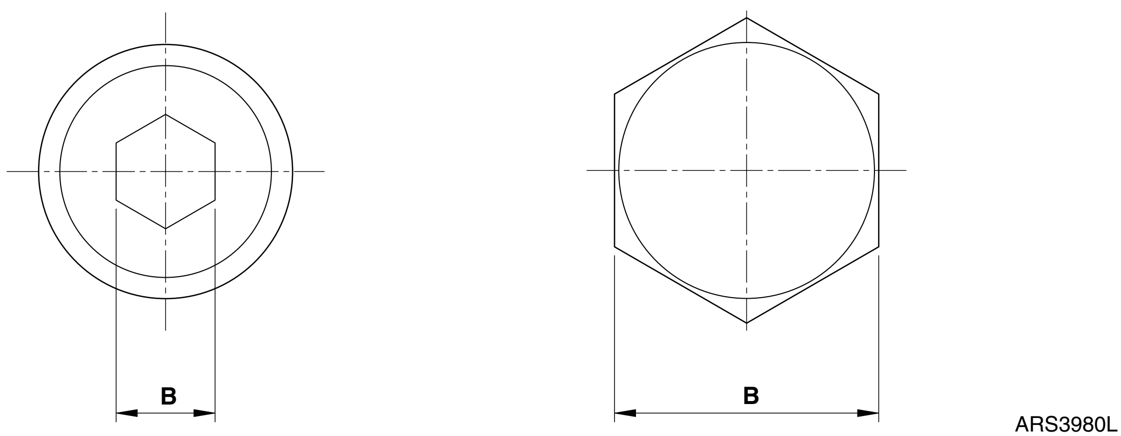


Figure 9

TROUBLESHOOTING, TESTING AND ADJUSTMENT

General Precautions

1. Observe any abnormalities and any possible causes that have noting to do with the motor before starting work.
2. Make sure that no foreign substance is involved when disassembling the machine, which is the most frequent cause of its wear.
3. Treat carefully and pay attention to avoid any damage against it that is machined precisely.

How to Check Faults of Hydraulic Motor

1. Remove the drain plug and check oil in the case. Too much chips and metal dust in oil causes the possible wear of parts in the motor.
2. Abnormal noise. Check any abnormal noise from the main body of the motor.
3. Pressure measurement at each part. Check any possible faults by measuring circuit pressure up to the hydraulic motor before disassembling the motor.

Troubleshooting

Problem	Possible Cause	Remedy
Abnormal operation of driving devices.		
Motor pressure does not increase.	Oil bypassing in relief valve (350).	Replace or repair relief valve.
	Check spring broken.	Replace check spring.
	Valve spring of counterbalance valve broken.	Replace the valve spring of counterbalance valve.
	Crack in channel in valve casing.	Replace valve casing.
	Abnormal wear on check surface.	Replace check.
	Excessive clearance between valve casing and counterbalance spool.	Replace valve casing and/or counterbalance spool.
	Coupling of deceleration assembly damaged.	Disassemble deceleration assembly and replace the coupling.
Pressure increases but hydraulic motor does not rotate.	Orifice screw (363) blocked.	Wash or replace orifice screw.
	Piston ring (707 and 708) damaged.	Replace piston ring.
	Friction and/or separation plates stuck.	Replace friction and/or separation plates.
	Slideway stuck.	Replace stuck slideway.
	Orifice screw in counterbalance spool blocked.	Wash or replace orifice screw.
	Gear of deceleration assembly damaged.	Disassemble deceleration assembly and replace the gear.

Problem	Possible Cause	Remedy
Number of rotation is below specification.		
Insufficient rotation.	Lack of incoming oil.	Check hydraulic circuits up to motor.
	Too high oil temperature.	Decrease oil temperature.
	Too much leakage.	Replace or repair faulty parts.
	Each way worn or broken that tilting angle not switched (small to large angle). - Orifice at small tilting side blocked. - Leakage at small tilting chamber (excessive clearance in shaft casing, swash piston, or stopper L).	Replace or repair faulty parts. - Wash or replace orifice. - Replace faulty parts.
Driving power is below specification.		
Low-pressure.	Low set pressure in relief valve.	Adjust pressure.
Brake released but weak driving force.	Sticking or abnormal wear of slideways.	Replace or repair slideway.
Hard to control brake.		
Low brake torque.	Wear of friction and/or separation plates.	Replace worn parts.
	Damage of brake spring.	Replace brake spring.
No brake operation.	Sticking of inner brake parts.	Replace parts.
Tilting angle not switched.		
Tilting angle is not switched.	Orifice at the tilting channel of shaft casing blocked.	Wash or replace orifice.
	Tilting angle adjustment spool (531) and case stuck.	Replace faulty parts.
	Leakage due to excessive clearance among shaft casing, swash piston, and stopper.	
	Outer diameter of swash piston and spheral face stuck.	
	High-pressure select valve in valve casing not operating.	
Oil leakage.		
Leakage from oil seal (491).	Oil seal or shaft slidway damaged.	Replace damaged parts and remove any foreign substance.
	High-pressure in case.	Check drain line.
Leakage from assembled parts.	O-ring damaged.	Replace O-ring.
	Volt or plug loosed.	Tighten with specified torque.
Main ways stuck.		
Piston and shoe. Shoe and swash plate. Piston and cylinder. Cylinder and valve plate. Front plate and spherical bushing.	Overload rotation of motor. Increase of temperature. Insufficient intensity of illumination on slideway. Improper oil or lubrication.	Check the operation of relief valve. Check circuits. Repair or replacement of faulty parts. Replace oil.

DISASSEMBLY

General Cautions

1. Prepare for a clean place for disassembly. Place a rubber sheet on place to prevent any damage to parts.
2. Wash out dust and foreign substance in motor and deceleration assembly.
3. Take care not to damage connecting parts and ways of O-ring, oil seal, seal surface, gear, pin, and surface of bearings.
4. Numbers in parentheses indicate those on sectional plans of motor.
5. Mark piping part of motor as rear and its discharge part as front.
6. To reassemble, use liquid gasket and make sure to remove any oil before appling sealer.
7. Bolt should be tightened after Loctite #262 is applied on threads using torque wrench according to specified torque.

Disassembly

1. Secure motor on jig with four bolts (M16x60L).

   NOTE: *Secure motor so that drain plug (464) points down when disassembly/reassembly jig rotates 90°.*

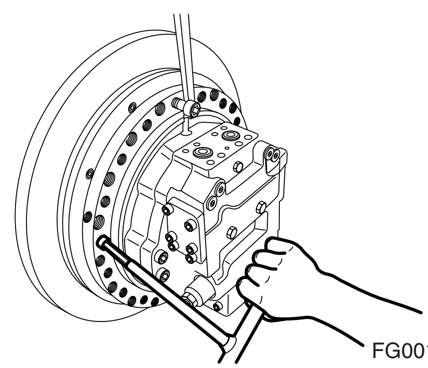


Figure 10

2. Remove drain plug (464) and drain oil from motor case.

   NOTE: *Check if processed chips or metal substance are in drained oil.*

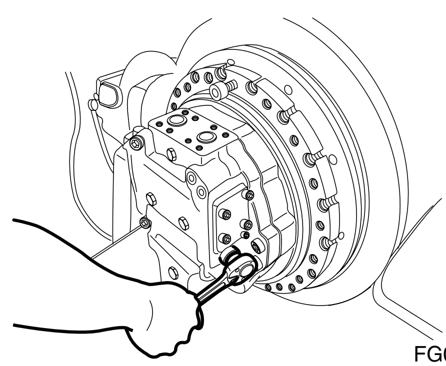
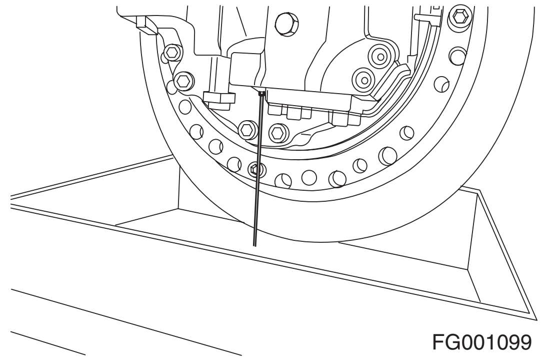


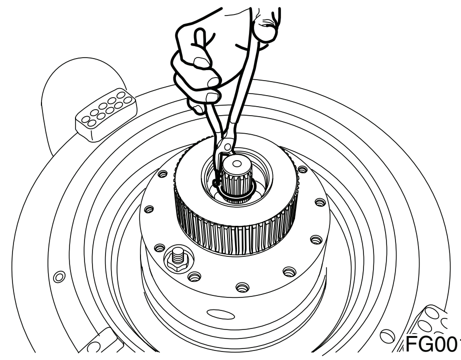
Figure 11



FG001099

Figure 12

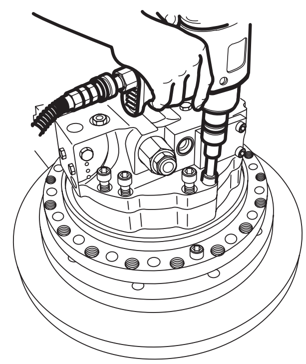
3. Rotate disassembly/reassembly jig 90°, so hydraulic motor shaft is pointing up. Remove lock ring (435) using retaining ring pliers.



FG001100

Figure 13

4. Remove hex socket head bolts (401 and 402) holding valve casing.



FG001101

Figure 14

5. Remove valve casing subassembly and valve plate (131).

NOTE: *If valve plate is excessively worn, replace it with new one.*

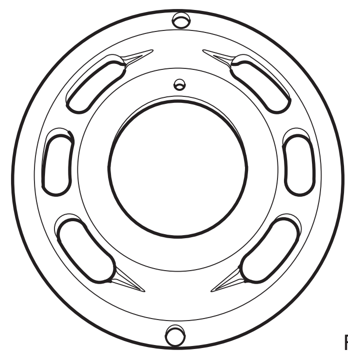


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Figure 15

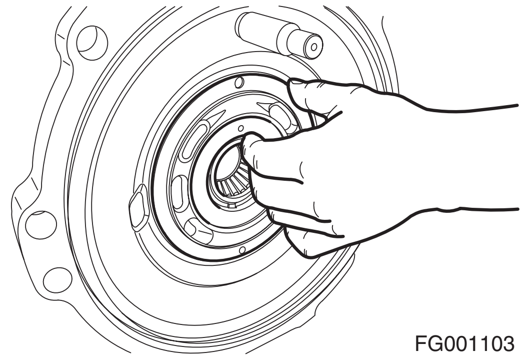

Figure 16

6. Remove brake spring (705) and brake piston by connecting two M16 bolts to piston (702) and pulling them upwards.

   NOTE: *There are ten brake springs.*

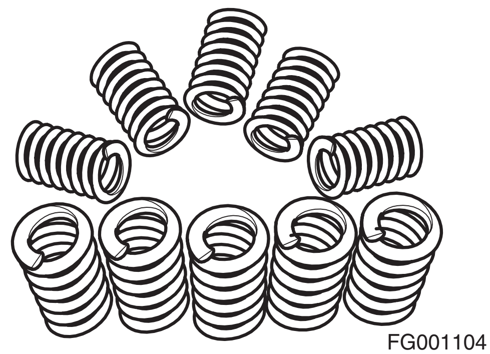

Figure 17

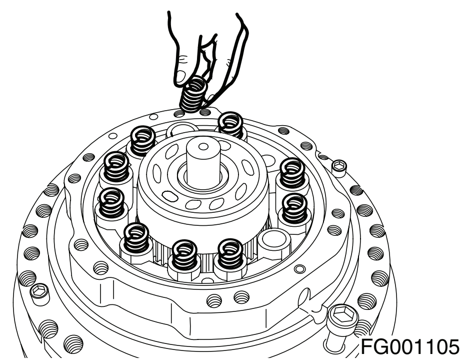

Figure 18

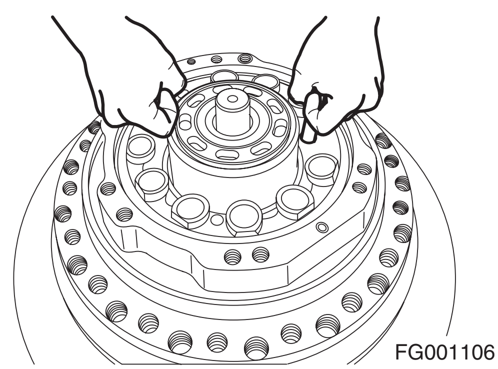

Figure 19

7. Rotate disassembly/reassembly jig 90° so motor is horizontal. Remove cylinder and piston subassembly.

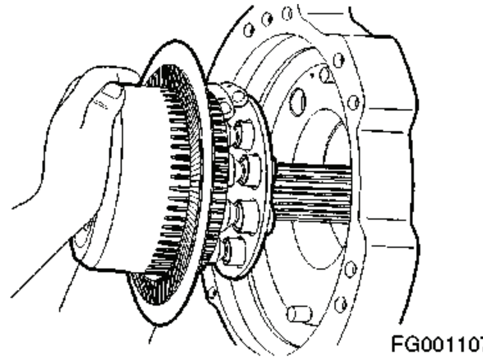

Figure 20

8. Disassemble stopper L (503) and swash plate piston (502).

   NOTE: *Swash plate piston: M5 bolt used.*

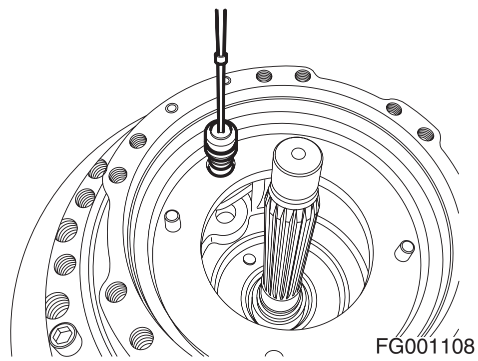

Figure 21

9. Remove swash plate (201).

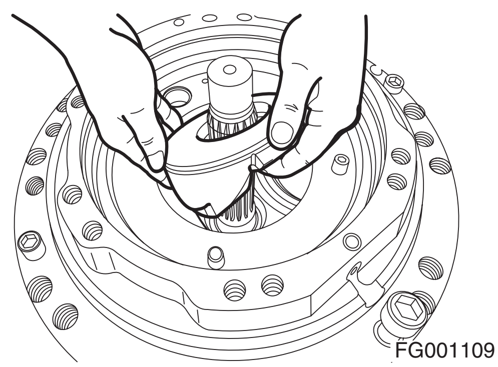

Figure 22

10. Insert M12 bolts in support (201) and disassemble support.

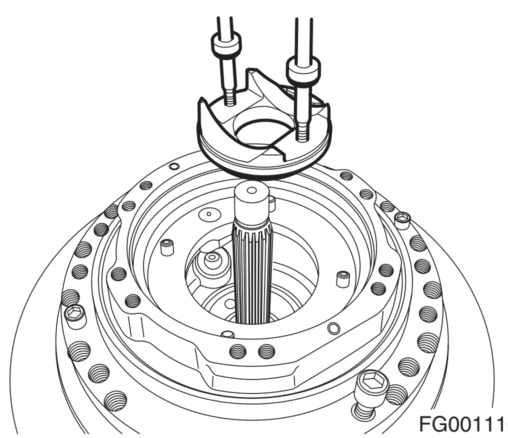

Figure 23

11. Disassemble swash plate piston (501) and stopper (S) (514).

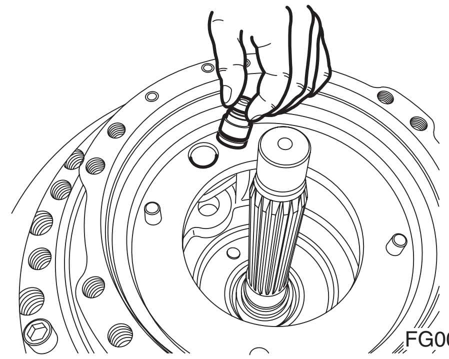

Figure 24

12. Rotate disassembly/reassembly jig 90° so drive shaft (101) points up. Tap bottom of shaft using hammer to separate it from shaft casing.

    NOTE: *Take care not to damage roller bearing (102).*

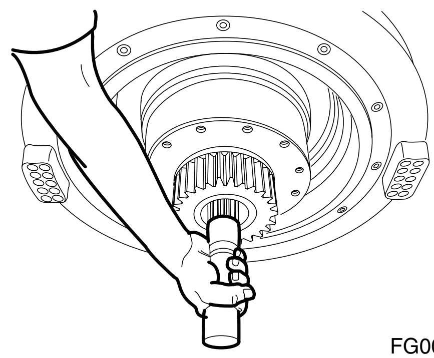

Figure 25

Disassembly of Valve Casing Subassembly

NOTE: *Take care not to damage needle bearing (103).*

1. Remove tilting rod (505), automatic switching spring (533), and automatic switching spool (531).

    NOTE: *Do not touch hex nut (507) and lock screw (506). If tilting spool or spring is damaged, replace it with a new one.*

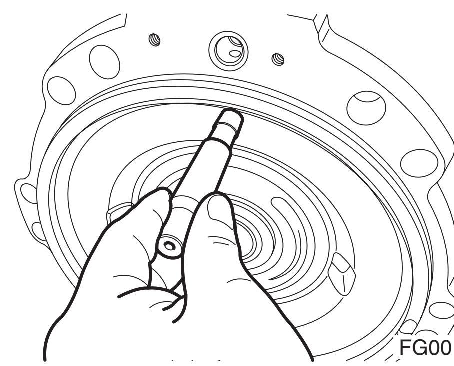

Figure 26

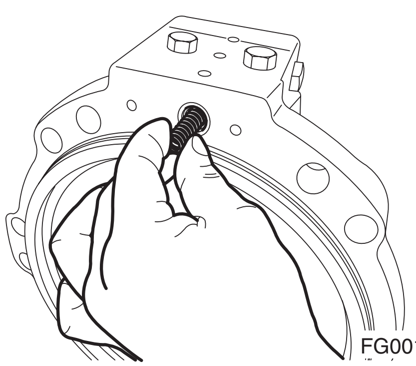

Figure 27

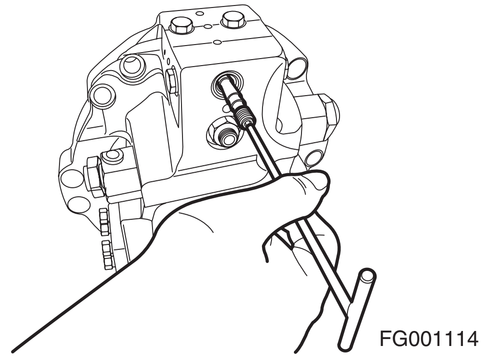

Figure 28

2. Remove hex socket head bolts (367 and 368), remove caps (365 and 366), and disassemble counterbalance valve (361).

   NOTE: *Pay attention to direction of left and right sides of plunger when disassembling counterbalance valve.*

   NOTE: *If spool or spring is damaged, replace it with a new one.*

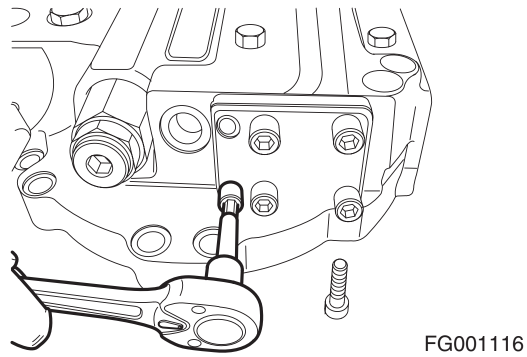

Figure 29

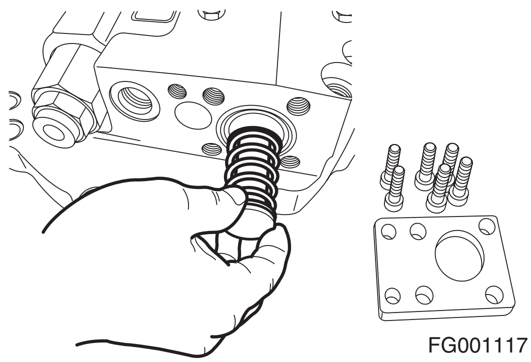

Figure 30

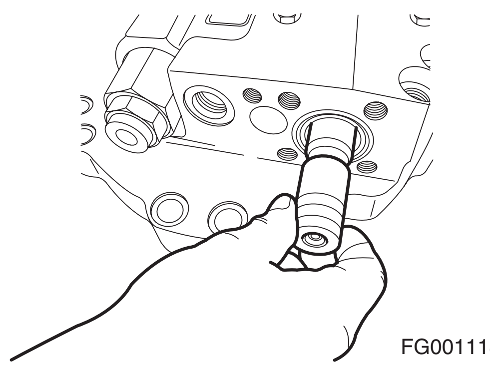

Figure 31

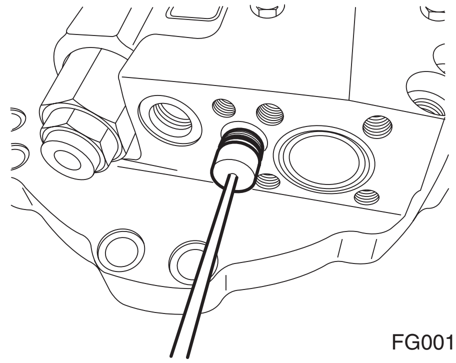
FG001119

Figure 32

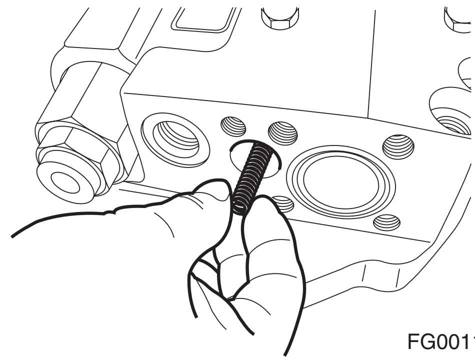
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Figure 33

Disassembly of Cylinder Subassembly

1. Remove push plate (122) and piston (121).

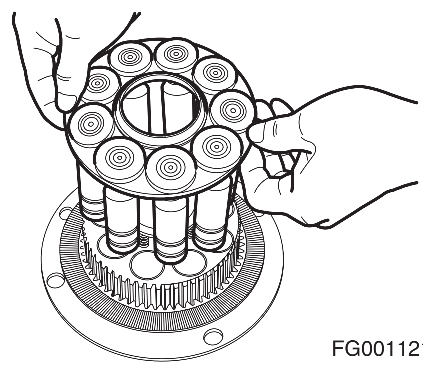
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Figure 34

2. Remove friction plate (742) and separation plate (741).

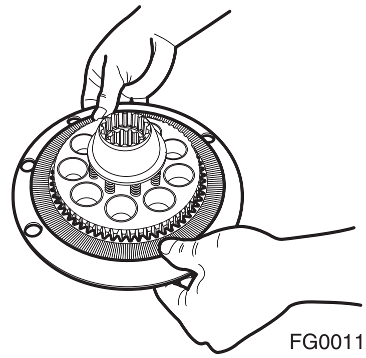

FG001122

Figure 35

3. Remove bush plate (122), spacer (116), and spring (114).

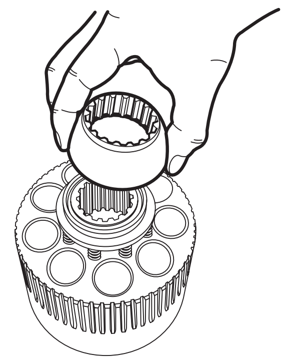

FG001123

Figure 36

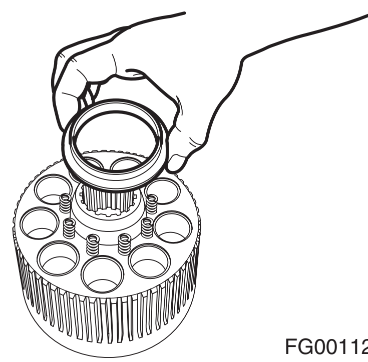

FG001124

Figure 37

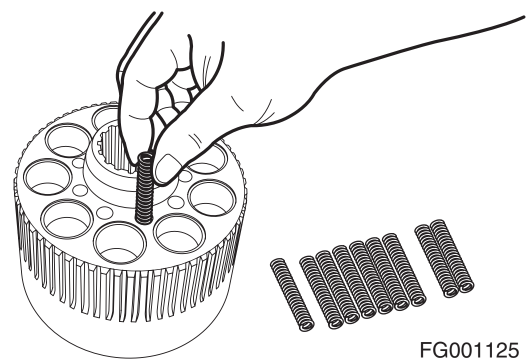

FG001125

Figure 38

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

Maintenance Standard

Change parts with standard of the following table. If parts have damages of external appearance, change without the following table.

Changing Standard of Hydraulic Motor Part

Parts name and inspection item		Standard dimension	Recommended value of replacement	Remedy
Clearance between piston and cylinder bore		0.035	0.06	Replace
Vertical direction vibration of piston and shoe		0.05	0.3	
Shoe thickness		5.5	5.3	
Height difference between spherical bush and pressure plate		13.5	13	Replace with set
Free length of cylinder spring		47.9	47.3	Replace
Over pin diameter (4.5) of drive shaft	Drive spline	43.91	43.31	Even if one each of recommended value of replacement is not reached, replace.
	Cylinder spline	49.06	48.46	
Over pin diameter (4.5) of spline inside of cylinder and spherical bush		35.25	35.75	Replace
Thickness of separate plate		3.3	3	
Thickness of friction plate		2.3	2.1	
Free length of brake spring		46.6	45.97	
Base tangent length of cylinder outside (7 each)		49.97	49.37	
Over pin diameter (4.5) of inside gear of friction plate		145.77	146.37	
Roughness of sliding surface	Swash plate/ shoe	0.8S	3.2S	Lap each
	Cylinder	1.6S	3.2S	Lap
	valve plate	0.8S	3.2S	
	Swash plate/ swash plate support	6.3sS	12.5S	Joint lapping
	Pressure plate/ spherical bush	1.6S	6.3S	
Roller bearing/needle bearing				If there are flaking on sliding surface, replace.

Parts name and inspection item	Standard dimension	Recommended value of replacement	Remedy
O-ring/Oil seal			When disassembling, replace as a rule.
Kinds of bolt			If there are crushing parts, replace.
Piston ring			If there are signs of sticking or deforming, replace.

1. Clearance between piston and cylinder bore: D-d

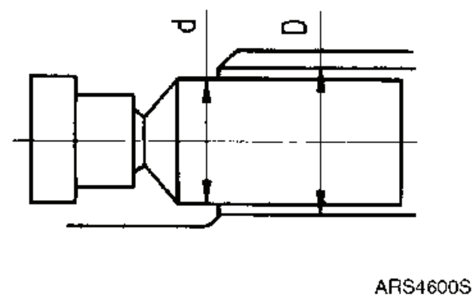


Figure 39

2. Thickness of shoe: t

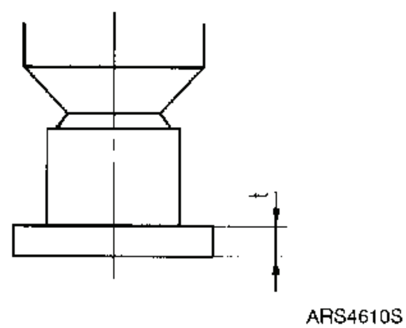


Figure 40

3. Vibration of vertical direction of piston and shoe: δ

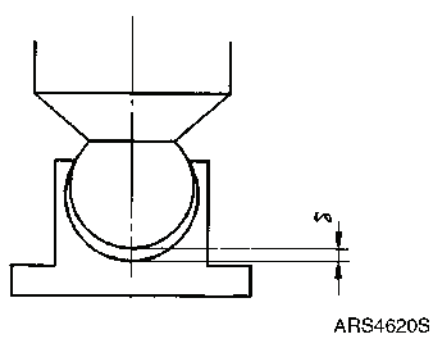


Figure 41

4. Height difference of spherical bush and pressure plate: H-h

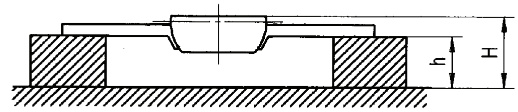


Figure 42

Parts Inspection and Inspection Standard of Reduction Gear

1. This reduction gear has few parts and designing life of each part is about the same. And so a state of single part can be supplied, but when changing there are many parts to change simultaneously for structure and function.
2. Inspection and inspection standard: It is a rule to change damaged parts unconditionally.

Inspection item		Standard	Standard of replacement	Remark
Backlash	Sun gear + Cluster gear	0.160 - 0.320	1.00	
	Cluster gear + Ring gear No.1	0.200 - 0.395	1.00	
	Cluster gear + Ring gear No.2	0.200 - 0.395	1.00	
	Ring gear No.2 + Coupling gear	0.200 - 0.608	1.30	
	Coupling + Sun gear spline	0.1-0.2	0.5	
OPD	Ring gear No.1	386.106 - 368.514		
	Ring gear No.2	337.482 - 337.678		
Base tangent length	Cluster gear No.1	63.259 - 63.344		4 Teeth
	Cluster gear No.2	65.845 - 65.930		4 Teeth
	Sun	27.791 - 27.858		2 Teeth
Each kind of gear	Pitting		Pitting size of one each is over 1 mm. Area rate:10%	
	Crack			
Angular ball bearing		Flaking, pressing marks, and other damages		

Inspection item		Standard	Standard of replacement	Remark
Carrier assembly	Clearance between cluster gear and thrust washer	0.3 - 0.7	1.2	
	Smoothing turn and noise of cluster gear			
Floating seal	Seal		Damage of sliding surface	
	O-ring		Damage	
Thrust bearing		5.0	Below 4.7	
		5.5	Below 5.2	
		6.0	Below 5.7	
Gear oil		Refer to Operation Manual	Change after first 250 hours of operation and every 1,000 hours thereafter. - But, change unconditionally when disassembling.	

REASSEMBLY

General Cautions

1. Wash and clean each part. Then dry them with compressed air. The friction plate, however, should not be washed with treated oil.
2. Each connecting parts should be tightened according to its assigned torque.
3. Only use a plastic soft-faced hammer.

Reassembly of Drive Shaft Subassembly

1. Assemble bearing spacer (106) into drive shaft and insert cylindrical roller bearing (102) by heating it.

   NOTE: *For heat installation of cylindrical roller bearing, use an induction heater. Heat bearing to 100°C.*

   NOTE: *Take care not to damage oil seal slideway of drive shaft.*

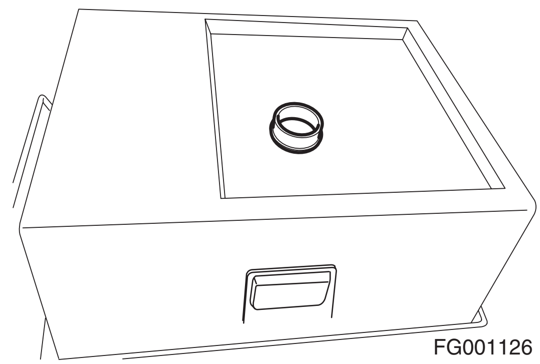

FG001126

Figure 43

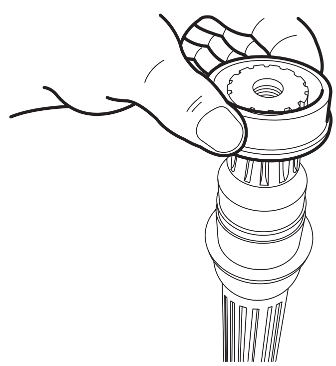

FG001127

Figure 44

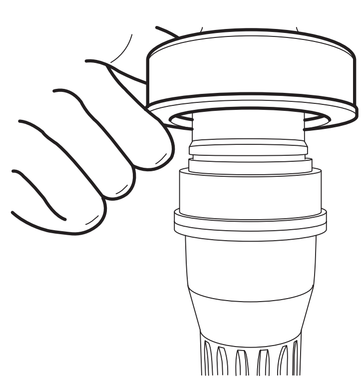

FG001128

Figure 45

2. Assemble ring stop (107) using retaining ring pliers.

NOTE: *Pay attention to direction of ring stop (its round part faces bearing).*

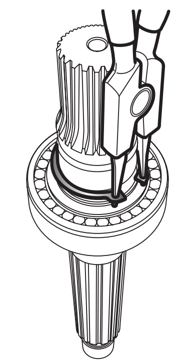


Figure 46

Assembly of Valve Casing Subassembly

1. Connect 5 plugs (461) to valve casing (303) according to a specified torque.

NOTE: *Wrap sealing tape around plug, or spread Loctite before starting assembly.*

NOTE: *Connection Torque: 70 ~ 110 kg•cm (5 ~ 8 ft lb).*

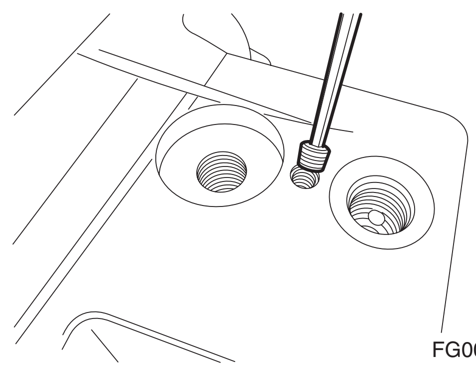


Figure 47

2. Insert pin (451).

NOTE: *Use hammer to adjust pin that its height is 5 mm (0.20 in) above valve plate surface.*

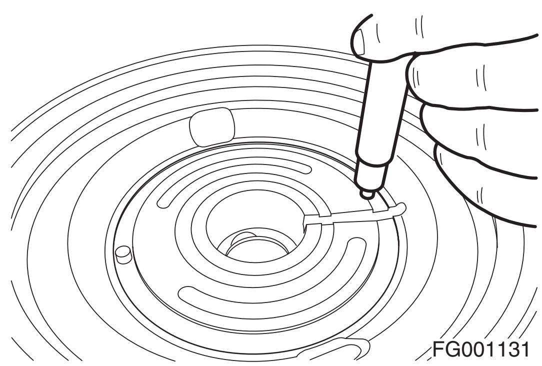


Figure 48

3. Assemble needle bearing (103).

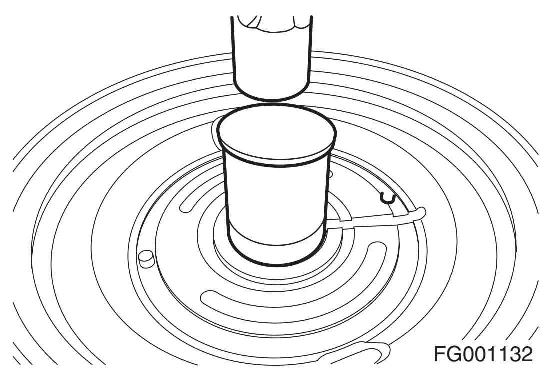


Figure 49

4. Assemble in proper order, sheet (541), ball (543), stopper (542), and O-ring (568).

NOTE: *Pay attention to assembly order and direction of sheet and stopper.*

NOTE: *Connection torque: 370 kg•cm (27 ft lb).*

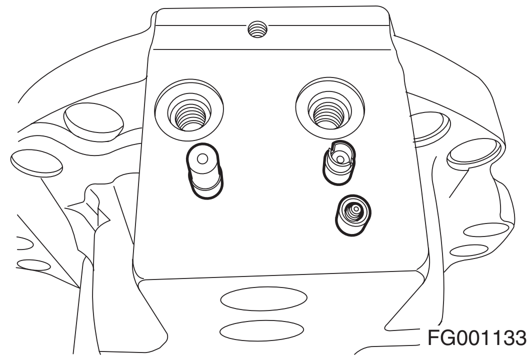


Figure 50

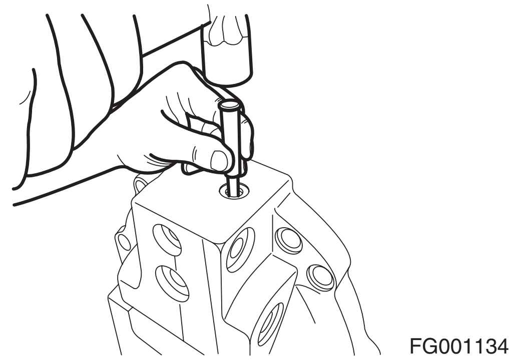


Figure 51

5. Assemble HP plug (567) to which O-ring (568) is attached.

NOTE: *Five places.*

NOTE: *Connection torque: 370 kg•cm (27 ft lb).*

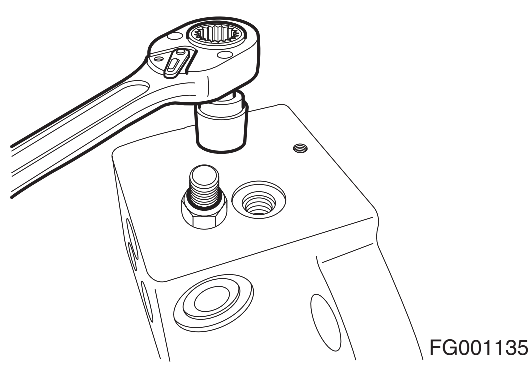


Figure 52

6. Install orifice screws (363) both ends of counterbalance spool (361).

NOTE: *Connection torque: 70 kg•cm (5 ft lb).*

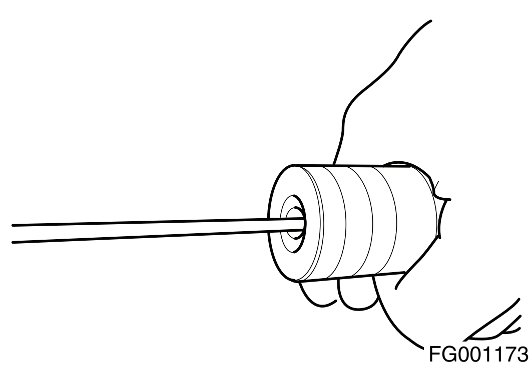
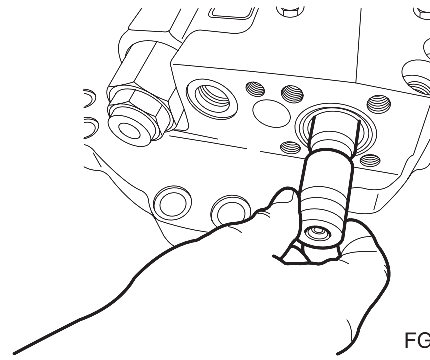


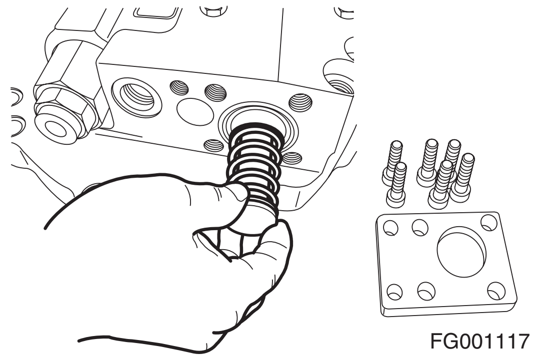
Figure 53

7. Insert counterbalance spool (361) and damper check (364) in valve casing.



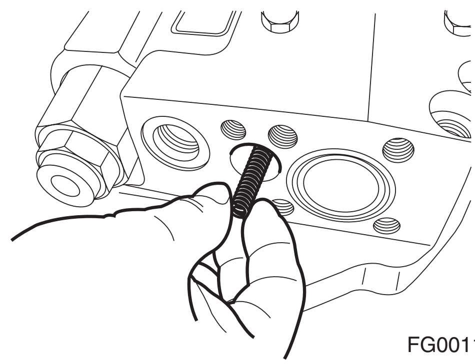
FG001118

Figure 54



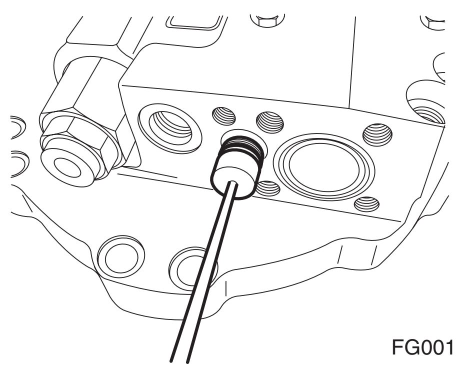
FG001117

Figure 55



FG001120

Figure 56



FG001119

Figure 57

8. Connect caps R (366) and L (365) with hex socket head bolts (367 and 368).

NOTE: *Take care not to change connection points of Caps R and L.*

NOTE: *Connection torque:*

M12: 1,000 kg•cm (72 ft lb) -- (368)

M10: 670 kg•cm (48 ft lb) -- (367)

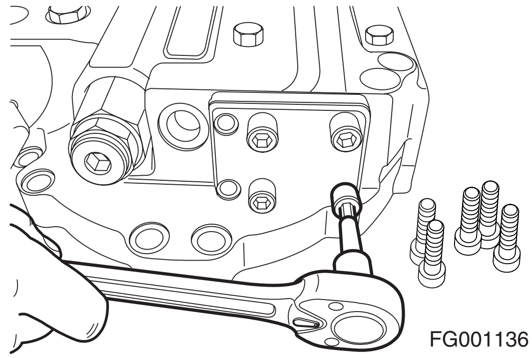


Figure 58

9. Insert automatic switching spool (531), spring (533), and O-ring (509).

NOTE: *Connection torque: 750 kg•cm (54 ft lb).*

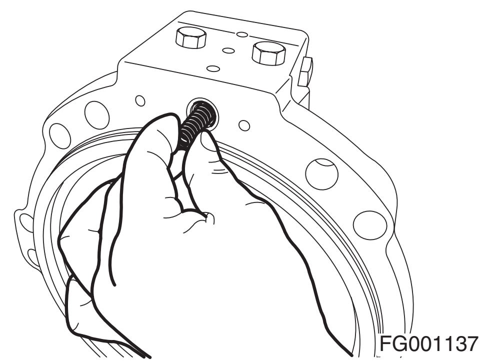


Figure 59

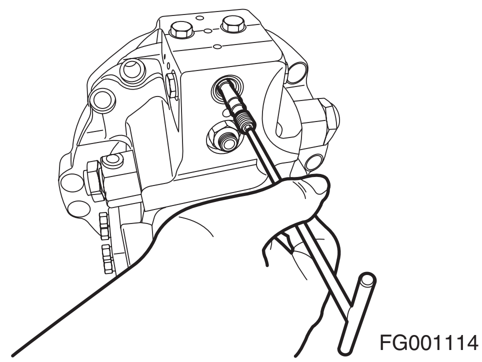


Figure 60

10. Install swash rod (505) with O-ring (508).

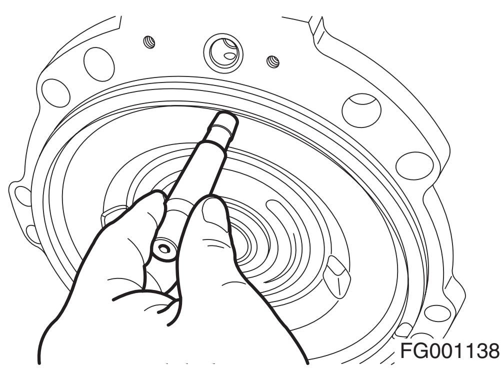
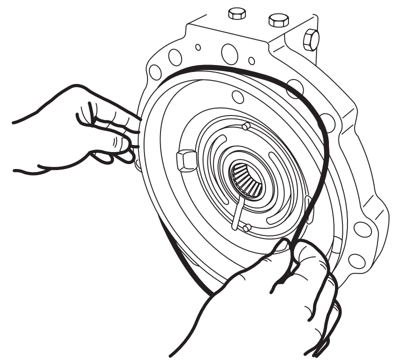


Figure 61

11. Install O-ring (472) on valve casing.

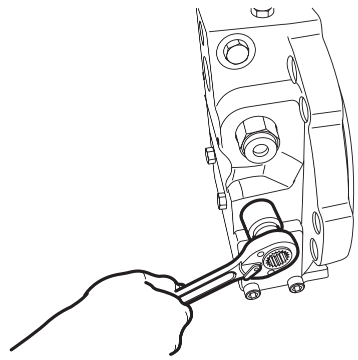


FG001139

Figure 62

12. Connect drain plug (464) with O-ring (485).

NOTE: *Connection torque: 1,100 kg•cm (80 ft lb).*



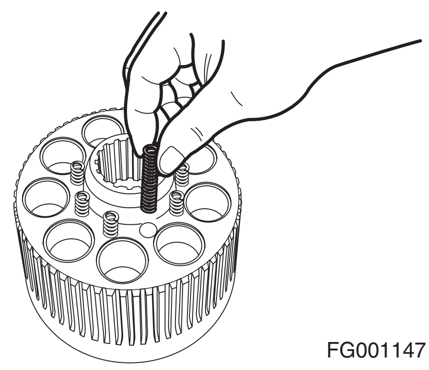
FG001140

Figure 63

Assembly of Cylinder Subassembly

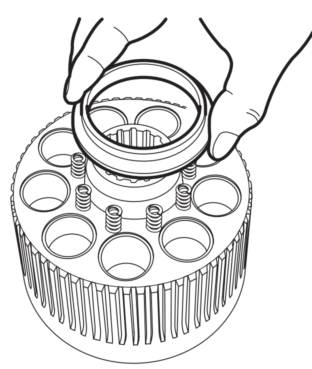
1. Assemble cylinder spring (114), spacer (116), and bush plate (112) into cylinder (111).

NOTE: *Match positions of cylinder and spool line of spherical bushing.*



FG001147

Figure 64



FG001148

Figure 65

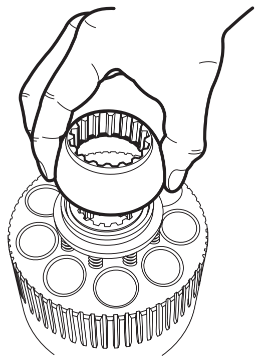

FG001149

Figure 66

2. Assemble friction plate (742) and separation plate (741) into cylinder.

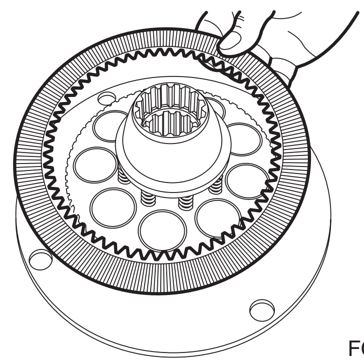

FG001150

Figure 67

3. Insert piston shoe (121) in push plate (122) and assemble it into cylinder.

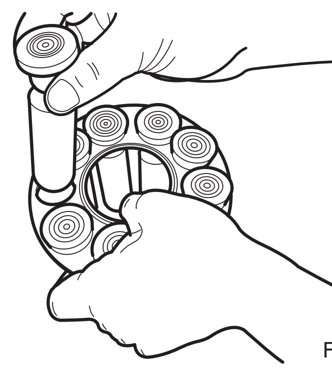

FG001151

Figure 68

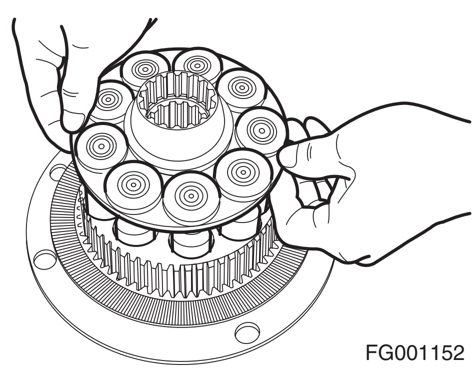

FG001152

Figure 69

4. Insert oil seal (491) in shaft casing (272) using jig. Make sure it is properly seated.

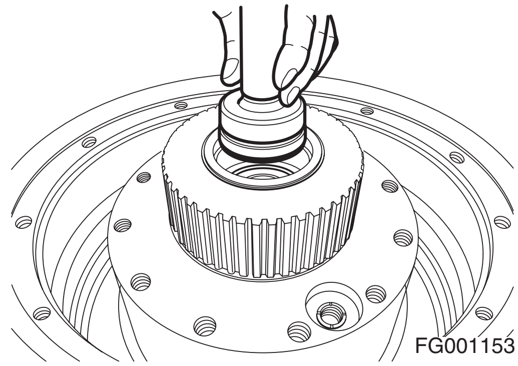


Figure 70

Assembly of Motor Body

1. Connect 5 plugs (461) to shaft casing (303) according to a specified torque.

   NOTE: *Wrap sealing tape around plug, or spread Loctite before starting assembly.*

   NOTE: *Connection torque: 70 - 110 kg•cm (5. - 8 ft lb).*

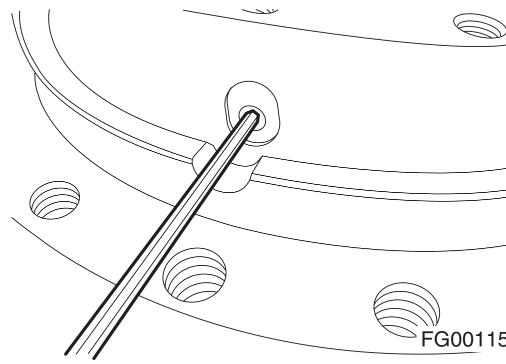


Figure 71

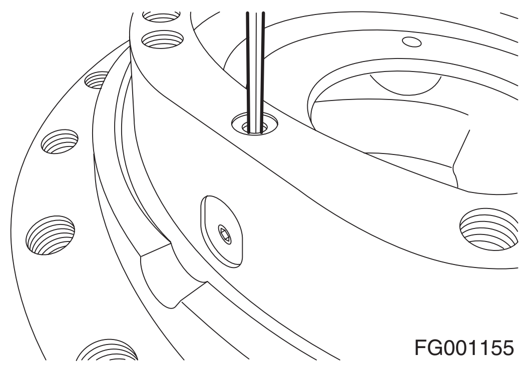


Figure 72

2. Insert pins (452 and 709) using hammer or a round bar.

   NOTE: *Two pins (452: Adjust their height to be 10 mm (0.39 in) above swash plate support surface.*

   NOTE: *Four pins (709): Adjust their height to be 19 mm (0.75 in) above machined shaft casing surface.*

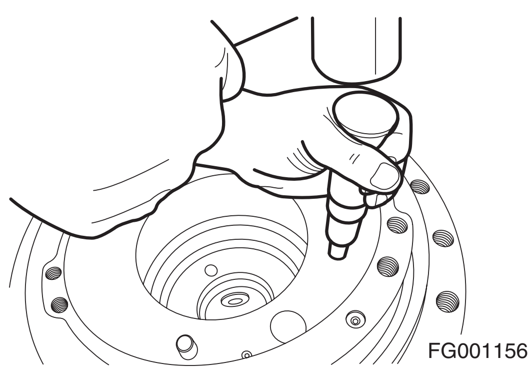


Figure 73

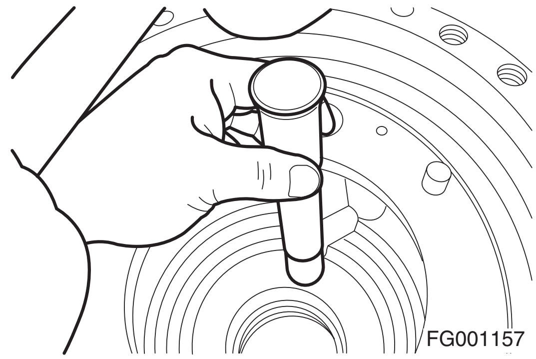


Figure 74

3. Assemble drive shaft subassemblies.

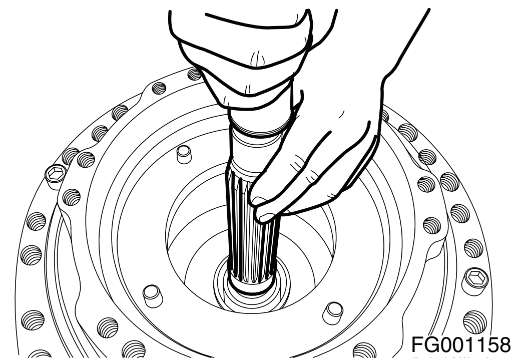


Figure 75

4. Use M12 bolts when assembling swash plates (201).

NOTE: *Pay attention to insertion direction of swash plate supports.*

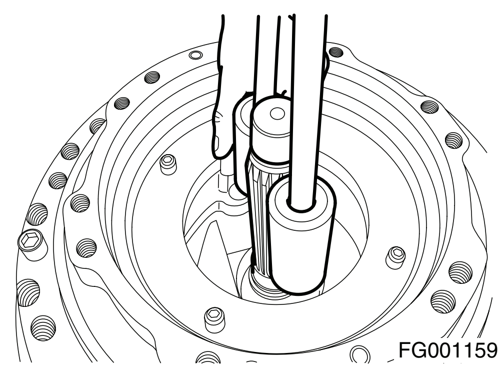


Figure 76

5. Assemble swash plate supports (201) into swash plates.

NOTE: *Apply grease to slideway of swash plate.*

NOTE: *Check for smooth movement of swash plate.*

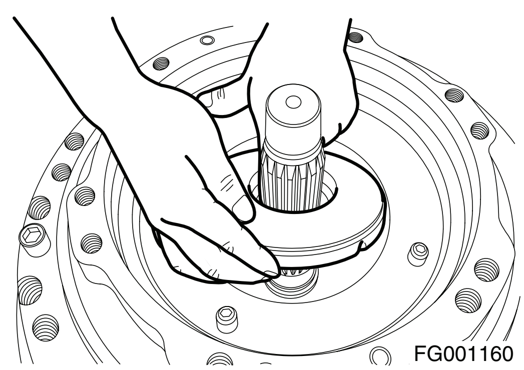


Figure 77

6. Assemble stopper L (503) where tilting piston (502) and O-ring (504) are inserted.

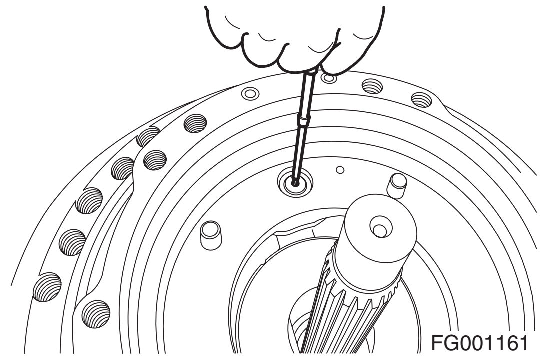


Figure 78

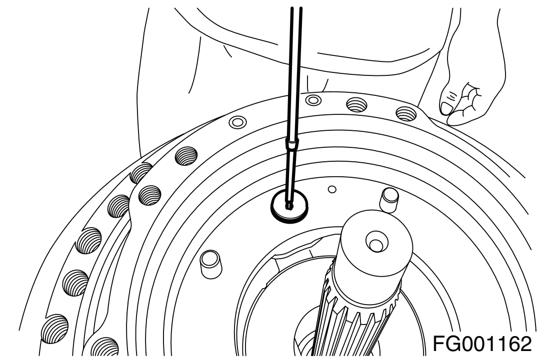


Figure 79

7. Rotate disassembly/reassembly jig 90° to change shaft direction from vertical to horizontal.

   NOTE: *Take care that swash plate does not fall apart from its support.*

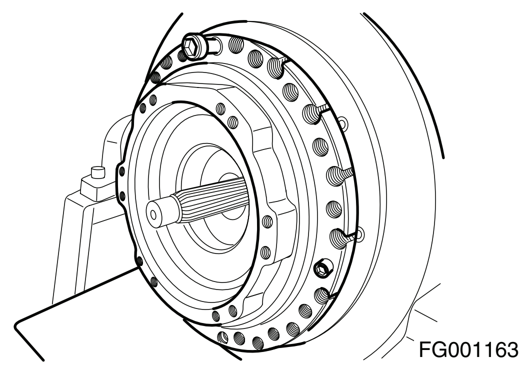


Figure 80

8. Assemble cylinder subassembly.

   NOTE: *Align holes of separation plate with pins.*

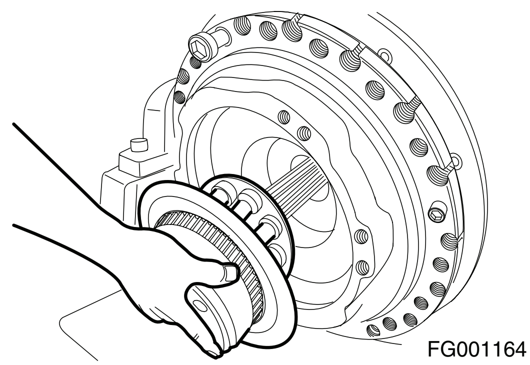
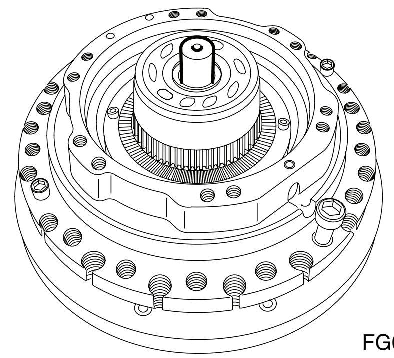


Figure 81

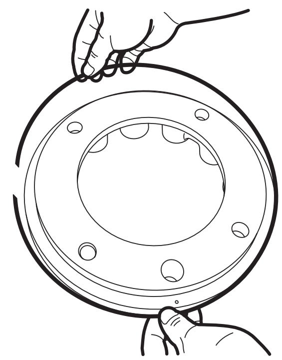
9. Rotate disassembly/reassembly jig 90° to change shaft direction from horizontal to vertical.



FG001165

Figure 82

10. Install piston rings 252 (707) and 278 (708) onto brake piston (702).

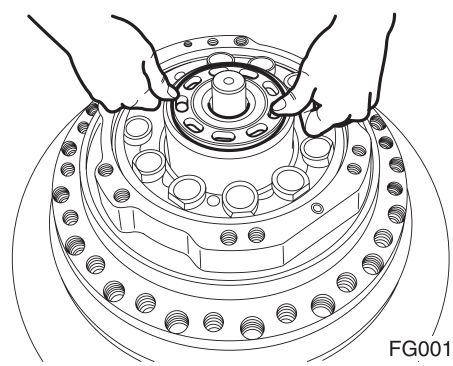


FG001166

Figure 83

11. Install brake piston into shaft casing.

NOTE: *Pay attention to direction of assembling brake piston.*



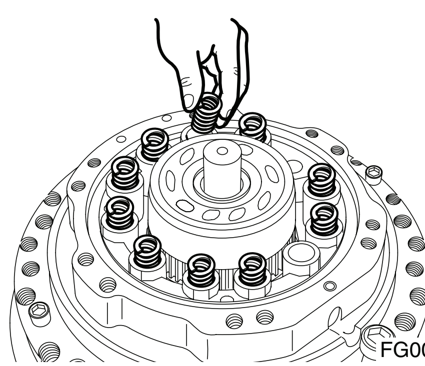
FG001167

Figure 84

12. Install brake spring (705).

NOTE: *Qty: Ten springs and eleven holes.*

NOTE: *The top brake piston shall not be assembled.*



FG001168

Figure 85

13. Install orifice screw (545 and 546) according to a specified torqued and insert O-ring (509).

NOTE: *Qty and size:*
2 (546) with ø0.8
1 (545) with ø1.5

NOTE: *Connection torque: 70 kg•cm (5 ft lb).*

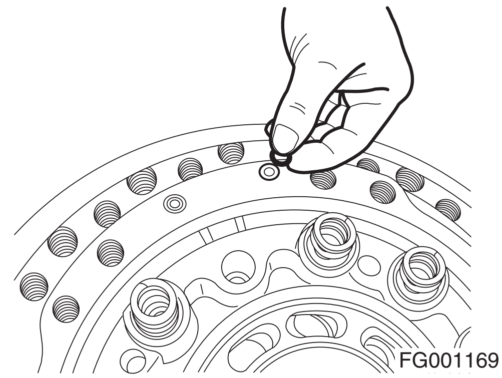

FG001169

Figure 86

14. Insert valve plate (131) in valve casing and connect it to shaft casing with a hex socket head bolt (401 and 402).
    A. Apply grease to rear side of valve plate to prevent it from falling out.
    B. Use a suitable lifting device, to assemble it into valve plate shaft casing.
    C. Assembly should be done so that holes in valve plate face entrance of valve casing.
    D. Apply grease to tilting spool in tilting spring to prevent it from falling out of spring.
    E. Connection torque: 2,400 kg•cm (175 ft lb).

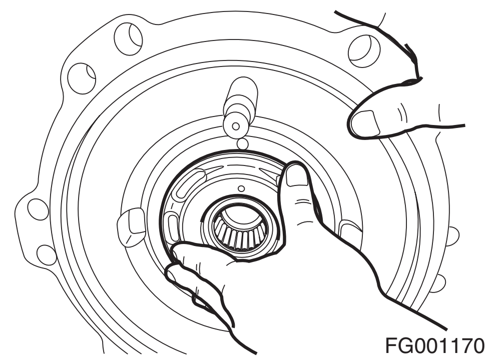

FG001170

Figure 87

15. Install relief valve (350) according to a specified torque.

NOTE: *Connection torque: 1800 ±100 kg•cm (130 ±7 ft lb).*

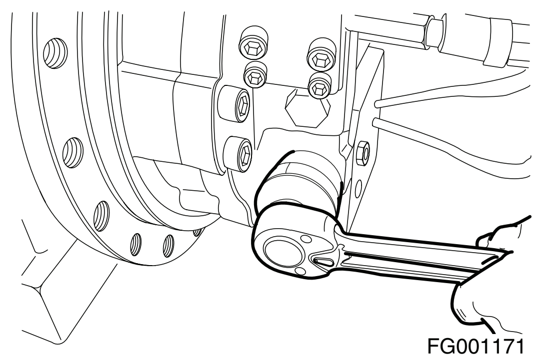

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Figure 88

16. Remove four bolts (M20x50L) holding motor and remove it from jig.

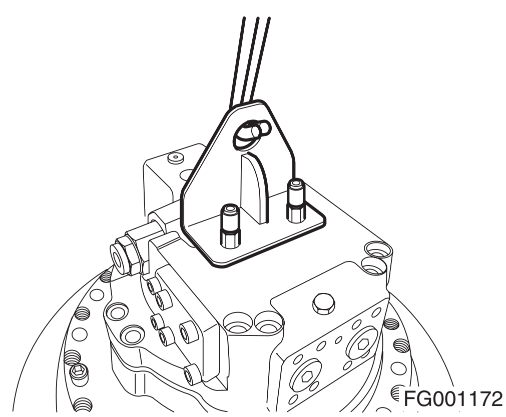

FG001172

Figure 89

Axial Piston Pump

Edition 1

MEMO

Table of Contents

Axial Piston Pump

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up

AXIAL PISTON PUMP

General Description

Model Number Designation

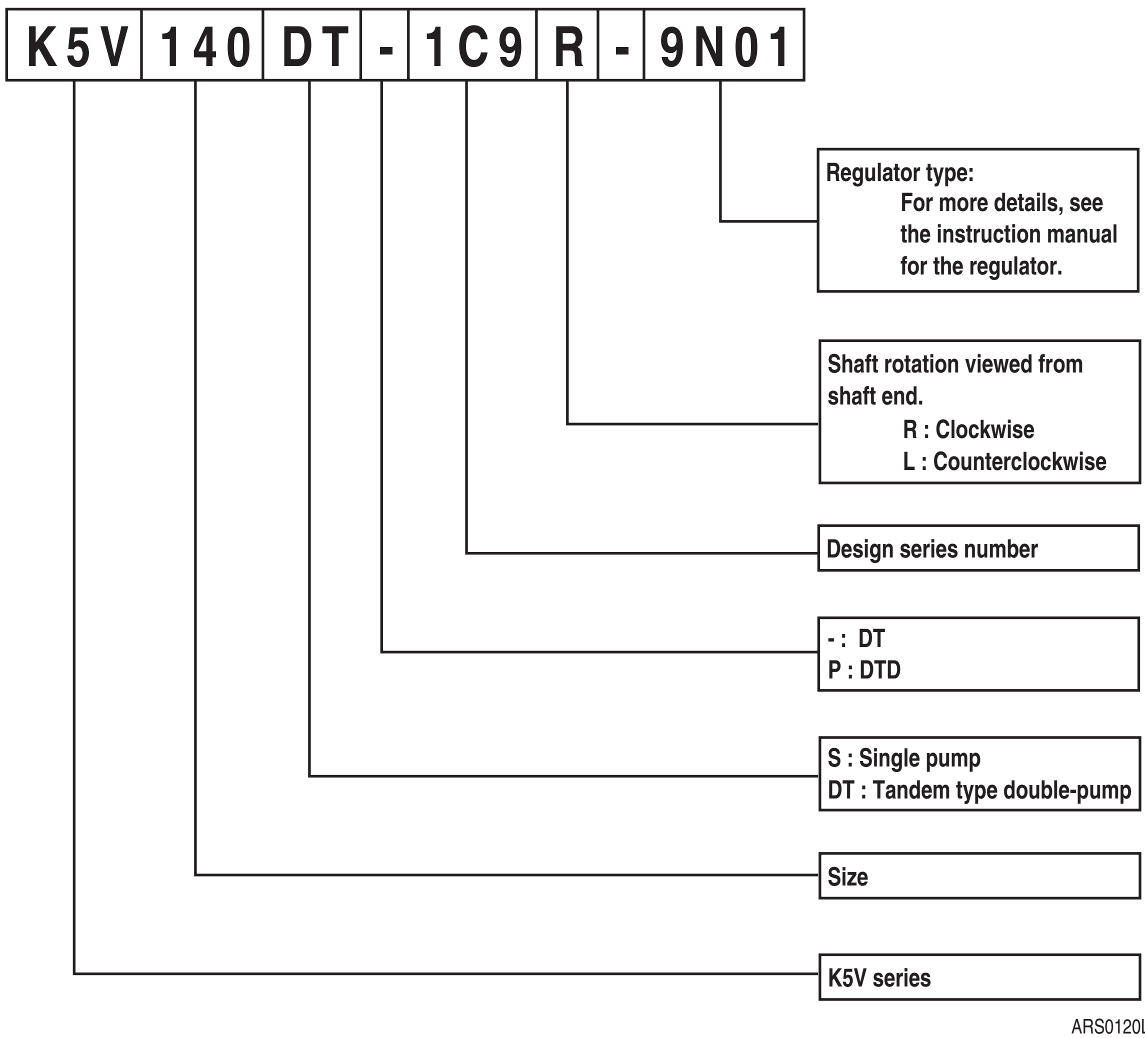


Figure 1

Theory of Operation

Construction

This pump assembly consists of two pumps connected by a spline inside 1st gear (116). The two pumps can be driven simultaneously as the rotation of the prime mover (engine) is transferred by the drive shaft (F) (111) on the front side. The suction and discharge ports are integrated at the connecting part of the two pumps; i.e. in valve block (312): The suction port serves both the front pump and the rear pump.

Function

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

1. Rotary Group

   The rotary group consists of a drive shaft (F) (111), cylinder block (141), piston shoes (151, 152), set plate (153), spherical bushing (156) and cylinder spring (157). The drive shaft is supported by bearings (123 and 124) at both ends. The shoe is caulked to the piston to form a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and to take hydraulic balance so that it slides lightly over the shoe plate (211). The subgroup is composed of a piston and shoe pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush.

   Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.

2. Swash Plate Group

   The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bushing (214), tilting pin (531) and servo piston (532).

   The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

   The servo piston moves to the right and left as hydraulic oil, controlled by the regulator is transmitted to each hydraulic chamber on both ends of the servo piston. The swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle (α).

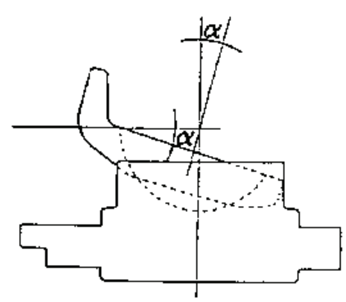


Figure 2 SWASH PLATE GROUP

3. Valve Block Group

The valve block group consists of valve block (312), valve plate (313) and valve plate pin (885). The valve plate has two melon-shaped ports, that are mated to the valve block. These feed and collect oil to and from the cylinder block.

The oil changed over by the valve plate is connected to an external pipeline by way of valve block.

When the drive shaft is driven by the prime mover (engine), it rotates the cylinder block via a splined coupling. If the swash plate is tilted as in Figure 2, the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block. If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (or oil discharging process) in the rest of 180 degrees. When the swash plate has no tilt angle (zero degrees), the piston does not stroke and neither discharges or draws oil.

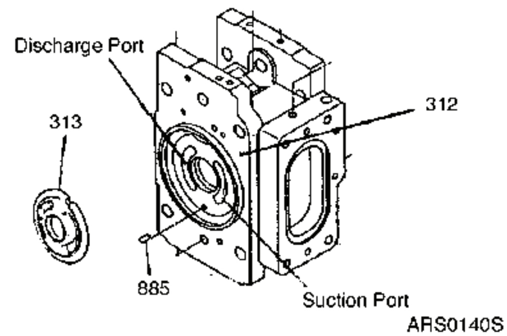


Figure 3 VALVE BLOCK GROUP

Parts List

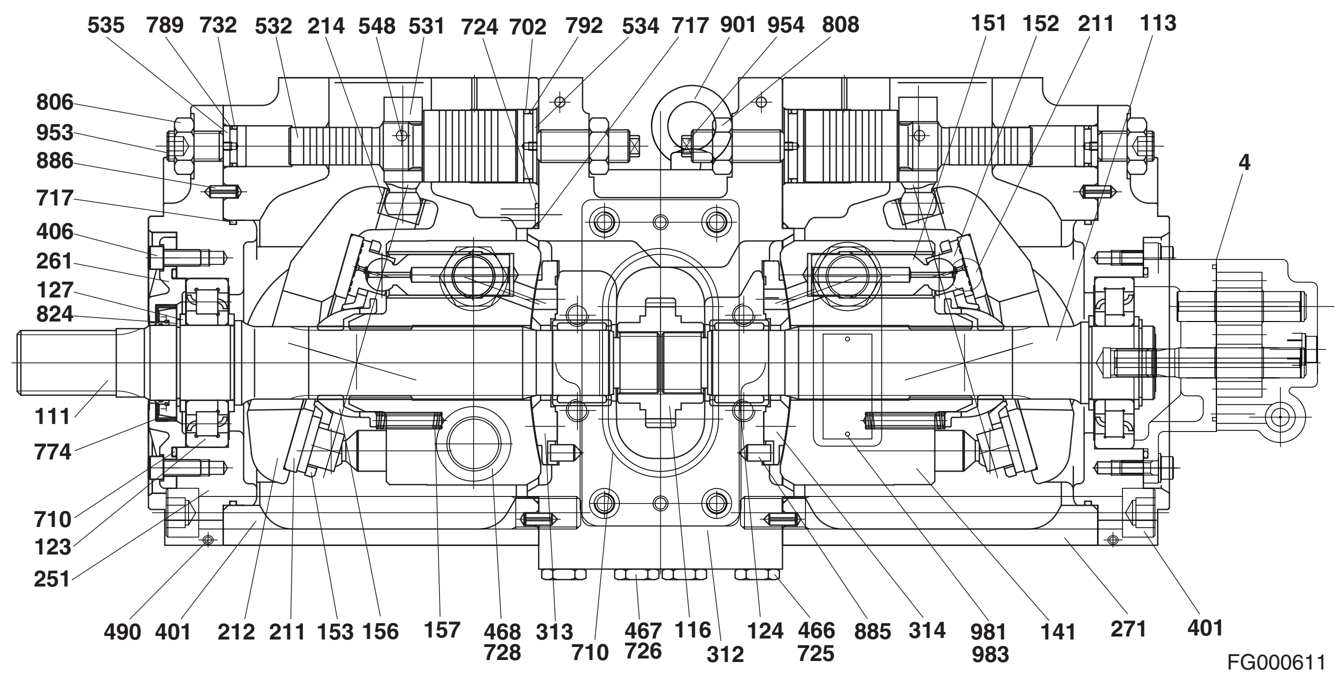
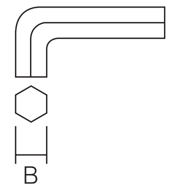


Figure 4

Reference Number	Description
04	Gear Pump
111	Drive Shaft (F)
113	Drive Shaft (R)
116	1st Gear
123	Roller Bearing
124	Needle Bearing
127	Bearing Spacer
141	Cylinder Block
151	Piston
152	Shoe
153	Set Plate
156	Spherical Bushing
157	Cylinder Spring
211	Shoe Plate
212	Swash Plate
214	Tilting Bushing
251	Swash Plate Support
261	Seal Cover (F)
271	Pump Casing
312	Valve Block
313	Valve Plate (R)
314	Valve Plate (L)
401	Hex Socket Head Bolt
406	Hex Socket Head Bolt
466	VP Plug
467	Plug
468	RO Plug

Reference Number	Description
490	Plug
531	Tilting Pin
532	Servo Piston
534	Stopper (L)
535	Stopper (S)
548	Feed Back Pin
702	O-ring
710	O-ring
717	O-ring
719	O-ring
724	O-ring
725	O-ring
728	O-ring
732	O-ring
774	Oil Seal
789	Backup Ring
792	Backup Ring
806	Nut
808	Nut
824	Retaining Ring
885	Valve Plate Pin
886	Spring Pin
901	Eyebolt
953	Set Screw
954	Set Screw
981	Name Plate
983	Pin

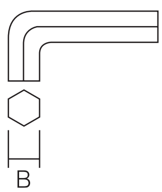
Torques

Part Name	Size	Tightening Torque (kg•cm)	Tool Name (B)	
Hex socket head bolt (Material: SCM 435)	M5	70	4	Allen wrench 
	M6	120	5	
	M8	300	6	
	M10	580	8	
	M12	1000	10	
	M14	1600	12	
	M16	2400	14	
	M18	3400	14	
	M20	4400	17	
PT plug (Material: S45C) Wind a seal tape $1^{1}/_{2}$ - 2 turns round the plug.	PT 1/16	70	4	Do.
	PT 1/8	105	5	
	PT 1/4	175	6	
	PT 3/8	350	8	
	PT 1/2	500	10	
PF plug (Material: S45C)	PF 1/4	300	6	Do.
	PF 1/2	1000	10	
	PF 3/4	1500	14	
	PF 1	1900	17	
	PF $1^{1}/_{4}$	2700	17	
	PF $1^{1}/_{2}$	2800	17	

Special Tools and Materials

Tools

The tools necessary to disassemble / reassemble the K3V pump are shown in the following list. The sizes of the bolts and plugs depend on the pump type.

Tool Name and Size		Necessary Tool (Marked with O)		Part Name			
		Pump Type					
Name	**B**	**K5V80**	**K5V140**	**Hex Socket Head Bolt**	**PT Plug (PT thread)**	**PO Plug (PF thread)**	**Hex Socket Head Setscrew**
Allen wrench	2						M4
	2.5						M5
	3						M6
	4	O	O	M5	BP-1/16		M8
	5	O	O	M6	BP-1/8		M10
	6	O	O	M8	BP-1/4	PO-1/4	M12 M14
	8	O		M10	BP-3/8	PO-3/8	M16 M18
	10			M12	BP-1/2	PO-1/2	M20
	12			M14			
	14	O		M16 M18	BP-3/4	PO-3/4	
	17		O	M20 M22	BP-1	PO-1, $1^1/_4$, $1^1/_2$	
	19			M24 M27			
	21						
	22			M30		PO-2	

Tool Name and Size		Necessary Tool (O)		Part Name		
		Pump Type				
Name	**B**	**K5V80**	**K5V140**	**Hex headed bolt**	**Hex nut**	**VP plug (PF thread)**
Double ring spanner, Socket wrench, Double (single) open end spanner.	19	O	O	M12	M12	VP-1/4
	22					
	24		O	M16	M16	
	27	O		M18	M18	VP-1/2
	30		O	M20	M20	
	36		O			VP-3/4
	41					VP-1
	50					VP-1$^{1}/_{4}$
	55					VP-1$^{1}/_{2}$
Adjustable angle wrench		O	O	Medium size, 1 set		
Screwdriver		O	O	Minus type screwdriver, medium size, 2 set		
Hammer		O	O	Plastic hammer, 1 set		
Retaining Ring Pliers		O	O	For retaining ring, TSR-160		
Steel bar		O	O	Steel bar of key material approx. 10x8x200		
Torque wrench		O	O	Capable of tightening with the specified torques		

Troubleshooting, Testing and Adjustment

General Cautions

This section describes the countermeasures to be taken if any abnormality is detected during the operation of the Kawasaki swash plate type axial piston pump.

The general cautions are as follows:

1. Consider the condition before starting work.
2. Judge the nature of the abnormality, before starting work. Especially, judge if it is a problem in the circuit or caused by the regulator or attached valves and determine that something is truly wrong with the pump or not.
3. Read and understand the maintenance manual before disassembling and follow the right disassembling procedures.
4. Even when any section is to be disassembled, not to make dust or let it enter into the pump.
5. Since the parts are finely finished, handle them carefully to prevent damage.

Check Pump Proper for Abnormalities

The pump is often fitted with a regulator, accessory valves and associated pump. It is very difficult to find the cause of the failure. Investigate the following items, and the abnormal point will be revealed.

1. Check filter and drain oil.

   Check filters for excessive amount of abnormal impurities. Since the shoes and cylinder may give off worn metal particles, a small quantity may be detected there. However if a excessive amount of metal particles is found in the filters, it should be considered that shoes may be damaged. Similarly, check drain oil in the pump casing.

2. Existence of abnormal noises or vibrations.

   Check the pump for abnormal noises and vibrations. If any, investigate if it is a noise in the regular frequency, such as hunting of the regulator or the relief valve of an accessory valve, or not. If it is an abnormal vibration or noise, it may be the result of cavitation or damage inside the pump.

3. Case where two pumps are used.

   For the circuit with two single pumps or motors or for the duplex pump, exchange the piping of one pump with that of the other one. With the results of this exchange, it will be determined if the trouble is the problem of the circuit downstream the pump or not.

4. Pressure measurement at various points.

If the failure is a problem in control, do not unnecessarily overhaul the pump, but measure pressures at various areas to investigate the abnormal position.

Overload of Prime Mover

Possible Cause	Remedy	Remark
Is the speed pressure higher than their specified values?	Set them as specified.	
Is not the torque setting of the regulator higher?	Reinvestigate the regulator.	See the instruction manual of the regulator.
Seizure or damage of a part inside the pump.	Replace the damaged part.	Check the filter and drain oil for abnormal worn metal particles.
Wrong installation of the regulator piping.	Correct the regulator piping.	

Extreme Decrease of Pump Delivery Flow and Nonincrease of Delivery Pressure

Possible Cause	Remedy	Remark
Failure of the regulator.	Repair the regulator.	See the instruction manual of the regulator.
Seizure or damage of a part inside the pump.	Replace the damaged part.	Check the filters and drain oil.
Failure of the associated pump.	Replace the damaged part.	Remove the associated pump and check the shaft coupling.
Failure of the accessory valve.	Check the accessory valves. (Especially check the poppets, seats and springs).	See the instruction manual of the accessory valves.
Wrong installation of the regulator piping.	Correct the regulator piping.	

Abnormal Noises and Abnormal Vibrations

Possible Cause	Remedy	Remark
Cavitation.	Prevention from cavitation. Check working oil for emulsion.	Low boost press. Failure of the associated pump. Air leakage at the suction pipe. Increased suction resistance.
Damage in the caulking suction of the shoe.	Replace the piston shoe, plate, etc.	
Cranking of the cylinder.	Replace the cylinder.	
Wrong installation of the pump.	Correct installation.	
Hunting of the regulator.	Repair the regulator.	See the instruction manual for the regulator.
Hunting of the relief valve of the accessory valve.	Repair the accessory valve.	See the instruction manual for the accessory valve.

Disassembly

For disassembling the pump, read this section thoroughly and disassemble it in the following sequence. The figures in parentheses after part names show the items in Figure 22 construction of pump.

This maintenance manual describes the disassembling procedures for both the single pump and tandem type double-pump. Disassemble the pump, referring to the contents for its appropriate type.

In addition, for the double-pump, take care not to exchange parts from one pump with the same ones of the other pump.

1. Select place suitable to disassembling.

IMPORTANT

Select a clean place.

Spread a rubber mat or cloth on top of the overhaul workbench to prevent parts from being damaged.

2. Remove dust, rust, etc., from pump surface with cleaning oil or equivalent.
3. Remove drain port plug (468) and drain oil from pump casing.

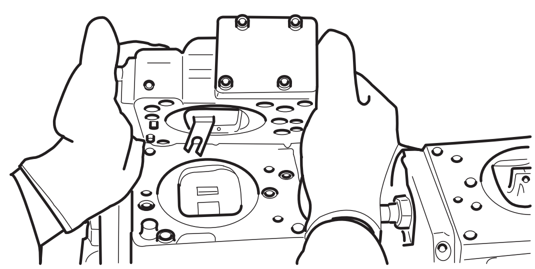
IMPORTANT

For tandem type pump, remove plugs from both front and rear pumps.

4. Remove hex socket head bolts (412 and 413) and regulator.
5. Remove hex socket head bolts (401) which secure swash plate support (251), pump casing (271) and valve block (312).

IMPORTANT

If a gear pump is attached to rear face of pump, remove it before proceeding.



HDM3016P

Figure 5

6. Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve block (312).

IMPORTANT

Before laying this surface down, spread rubber mat on workbench to prevent this surface from being damaged.

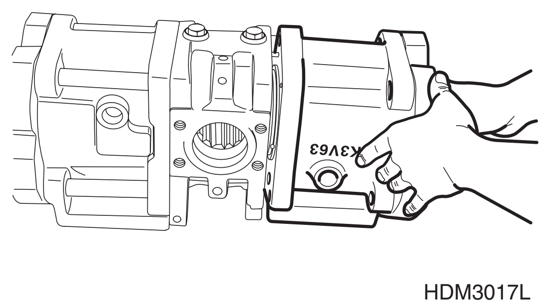


Figure 6

7. Pull cylinder (141) out of pump casing (271) straight over drive shaft (111). Pull out pistons (151), set plate (153), spherical bushing (156) and cylinder springs (157) simultaneously.

IMPORTANT

Do not damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

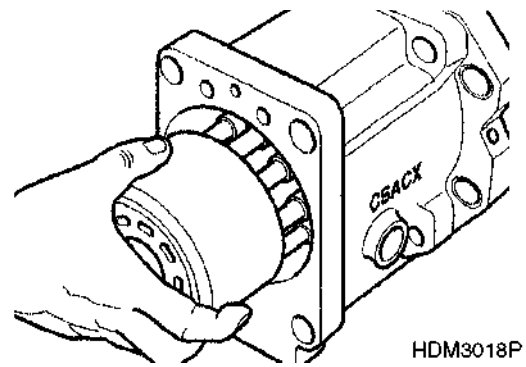


Figure 7

8. Remove hex socket head bolts (406) and seal cover (F) (261).

IMPORTANT

Install bolt into pulling-out tapped hole of seal cover (F), and cover can be removed easily.

Since oil seal is attached on seal cover (F), do not damage it when removing cover.

[In case fitting a gear pump, first, remove gear pump]

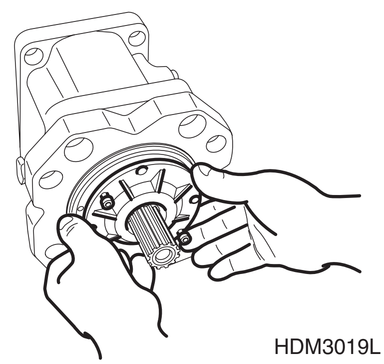


Figure 8

9. Lightly tapping fitting flange section of swash plate support (251), on its pump casing side, separate swash plate support from pump casing.

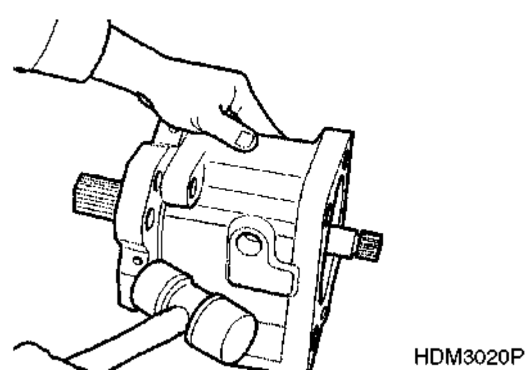


Figure 9

10. Remove shoe plate (211) and swash plate (212) from pump casing (271).

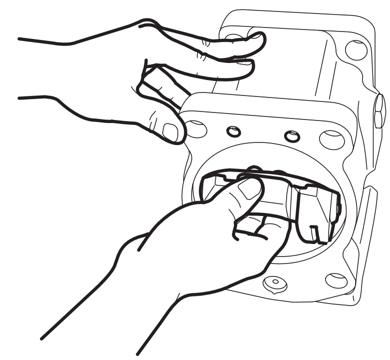


Figure 10

11. Lightly tapping shaft ends of drive shafts (111 and 113) with plastic hammer, remove drive shafts from swash plate supports.

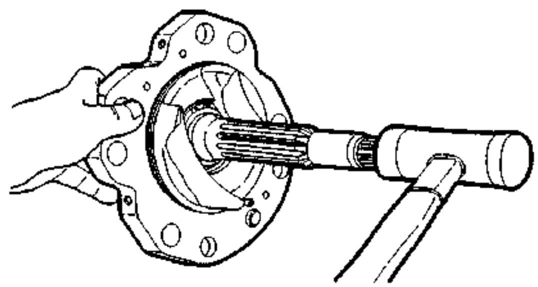


Figure 11

12. Remove valve plates (313 and 314) from valve block (312).

IMPORTANT

These may be removed in work 6.

13. If necessary, remove stopper (L) (534), stopper (S) (535), servo piston (532) and tilting pin (531) from pump casing (271). Remove needle bearing (124) and splined coupling (114) from valve block (312).

IMPORTANT

When removing tilting pin, use a protector to prevent pin head from being damaged.

Since Loctite is applied to mounting areas of tilting pin and servo piston, do not damage servo piston.

Do not remove needle bearing if possible, except when it is considered to be worn out.

Do not loosen hex nuts of valve block and swash plate support. If loosened, flow setting will be changed.

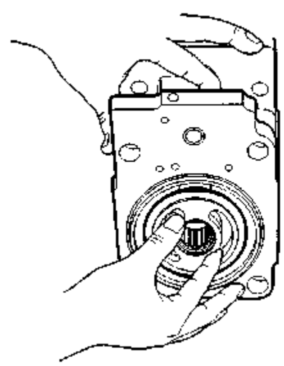


Figure 12

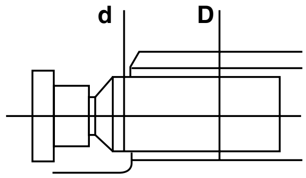
Cleaning and Inspection (Wear Limits and Tolerances)

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

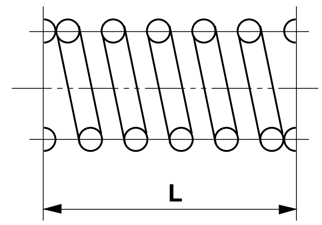
Worn Part Replacement Criteria

When a part exceeds any of the following criteria, replace or readjust it. However, when a part is damaged seriously in appearance, replace it without fail.

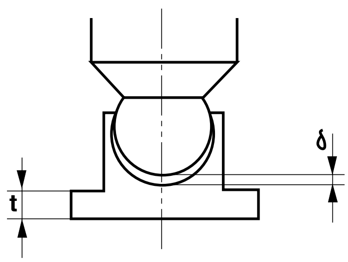
Part Name and Inspection Item	Standard Dimension / Recommended Replacement Value		Countermeasures
	Pump Type		
	K3V63 / K5V80	K5V140	
Clearance between piston and cylinder bore (D-d)	0.028 / 0.056	0.043 / 0.070	Replace piston or cylinder.
Play between piston and shoe caulking section (δ)	0-0.1 / 0.3	0-0.1 / 0.3	Replace assembly of piston and shoe.
Thickness of shoe (t)	3.9 / 3.7	4.9 / 4.7	Replace assembly of piston and shoe.
Free height of cylinder spring (L)	31.3 / 30.5	41.1 / 40.3	Replace cylinder spring.
Combined height of set plate and spherical bushing (H-h)	19.0 / 18.3	23.0 / 22.0	Replace retainer or set plate.



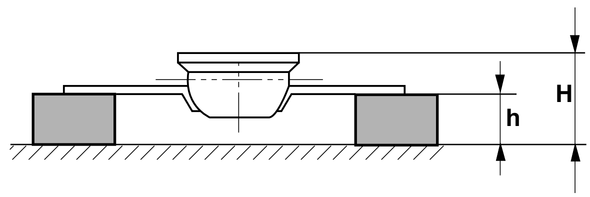
Clearance between Piston & Cylinder Bore : D-d



Free Height of Cylinder Spring : L



Play between Piston & Shoe : δ
Thickness of Shoe : t



Combined Height of Set Plate & Spherical Bush : H-h

FG001294

Figure 13

Correction Criteria for Cylinder, Valve Plate and Swash Plate (Shoe Plate)

Surface roughness for valve plate (sliding face), swash plate (shoe plate area) and cylinder (sliding face)	Surface roughness necessary to be corrected.	3-Z
	Standard surface roughness (Corrected value).	0.4-Z or lower (Lapping)

Reassembly

For reassembling reverse the disassembling procedures, paying attention to the following items.

- Do not fail to repair parts damaged during disassembling, and prepare replacement parts in advance.
- Clean each part fully with cleaning oil and dry it with compressed air.
- Do not fail to apply clean oil to sliding sections, bearings, etc. before assembling them.
- Replace seal parts, such as O-rings, oil seals, etc.
- For fitting bolts, plug, etc., tighten them with torques shown in “Torques” on page 10.
- For double-pump, take care not to exchange parts of the front pump with those of the rear pump.

1. Fit swash plate support (251) to pump casing (271), tapping it lightly with a hammer.

IMPORTANT

After servo piston, tilting pin, stopper (L) and stopper (S) are removed, Install them on pump casing in advance for reassembling.

When tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply Loctite (medium strength) to their threaded sections.

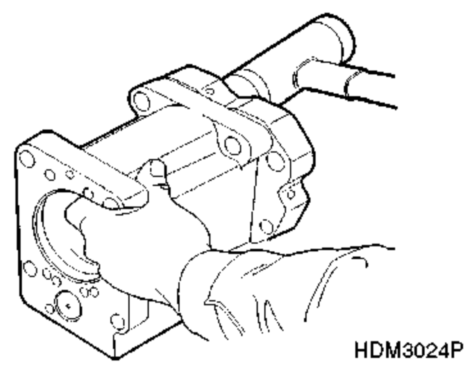


Figure 14

2. Place pump casing with its regulator-fitting surface down, fit tilting bushing of swash plate to tilting pin (531), and fit swash plate (212) to swash plate support (251) correctly.

IMPORTANT

Confirm with fingers of both hands that swash plate can be moved smoothly.

Apply grease to sliding sections of swash plate and swash plate support, so drive shaft can be easily installed.

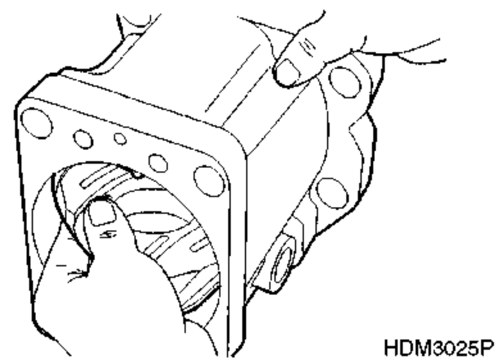


Figure 15

3. On swash plate support (251), secure drive shaft (111), set bearing (123), bearing spacer (127) and retaining ring (824).

IMPORTANT

Do not tap drive shaft with hammer.

Assemble them into support, lightly tapping outer race of bearing with plastic hammer. Fully seat them, using steel bar.

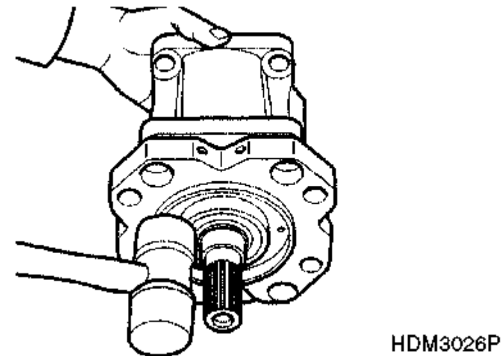


Figure 16

4. Assemble seal cover (F) (261) to pump casing (271) and secure it with hex socket head bolts (406).

IMPORTANT

Lightly apply grease to oil seal in seal cover (F).

Assemble oil seal, taking full care not to damage it.

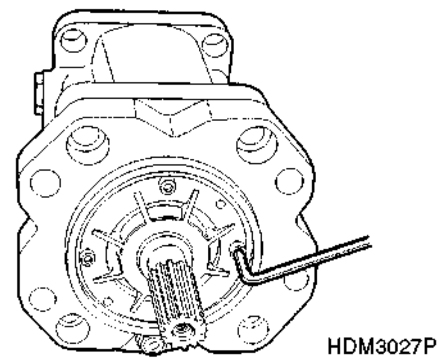


Figure 17

5. Assemble piston cylinder subassembly [cylinder (141), piston subassembly (151 and 152), set plate (153), spherical bushing (156) and cylinder spring (157)].

   Align spline of retainer and cylinder.

   Insert piston cylinder subassembly into pump casing.

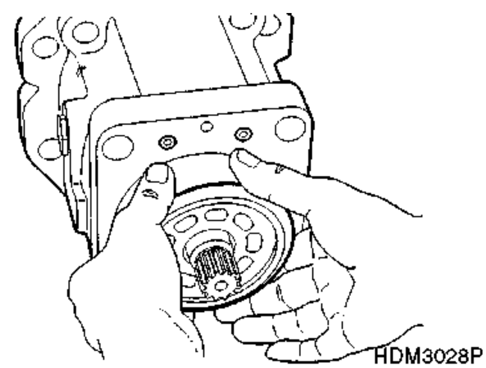


Figure 18

6. Position valve plate (313) to valve block (312), entering pin into pin hole.

IMPORTANT

Do not mistake suction / delivery directions of valve plate.

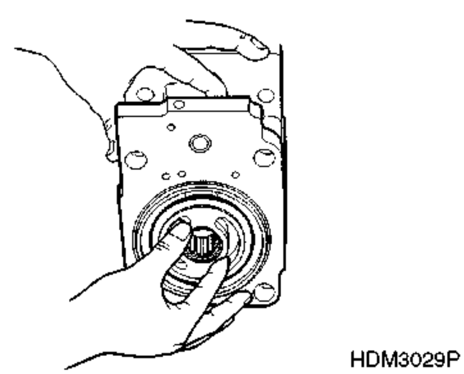


Figure 19

7. Position valve block (312) in pump casing (271) and tighten hex socket head bolts (401).

IMPORTANT

Assemble the rear pump side first, to make the procedure easier.

Do not mistake direction of valve block.

Clockwise rotation (viewed from input shaft side) - Install block with regulator up and with delivery flange left, viewed from front side.

Counterclockwise rotation (viewed from input shaft side) - Install block with regulator up and with delivery flange right, viewed from front side.

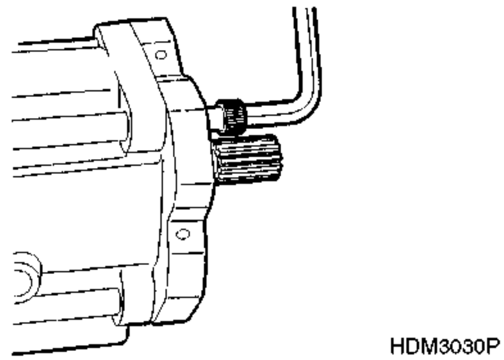


Figure 20

8. Place feedback pin on tilting pin into feedback lever in regulator. Attach regulator with hex socket head bolts (412 and 413).

IMPORTANT

Do not mistake regulator of front pump for that of rear pump.

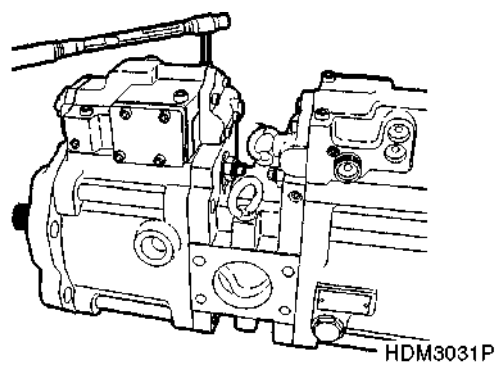


Figure 21

9. Install drain port plug (468).

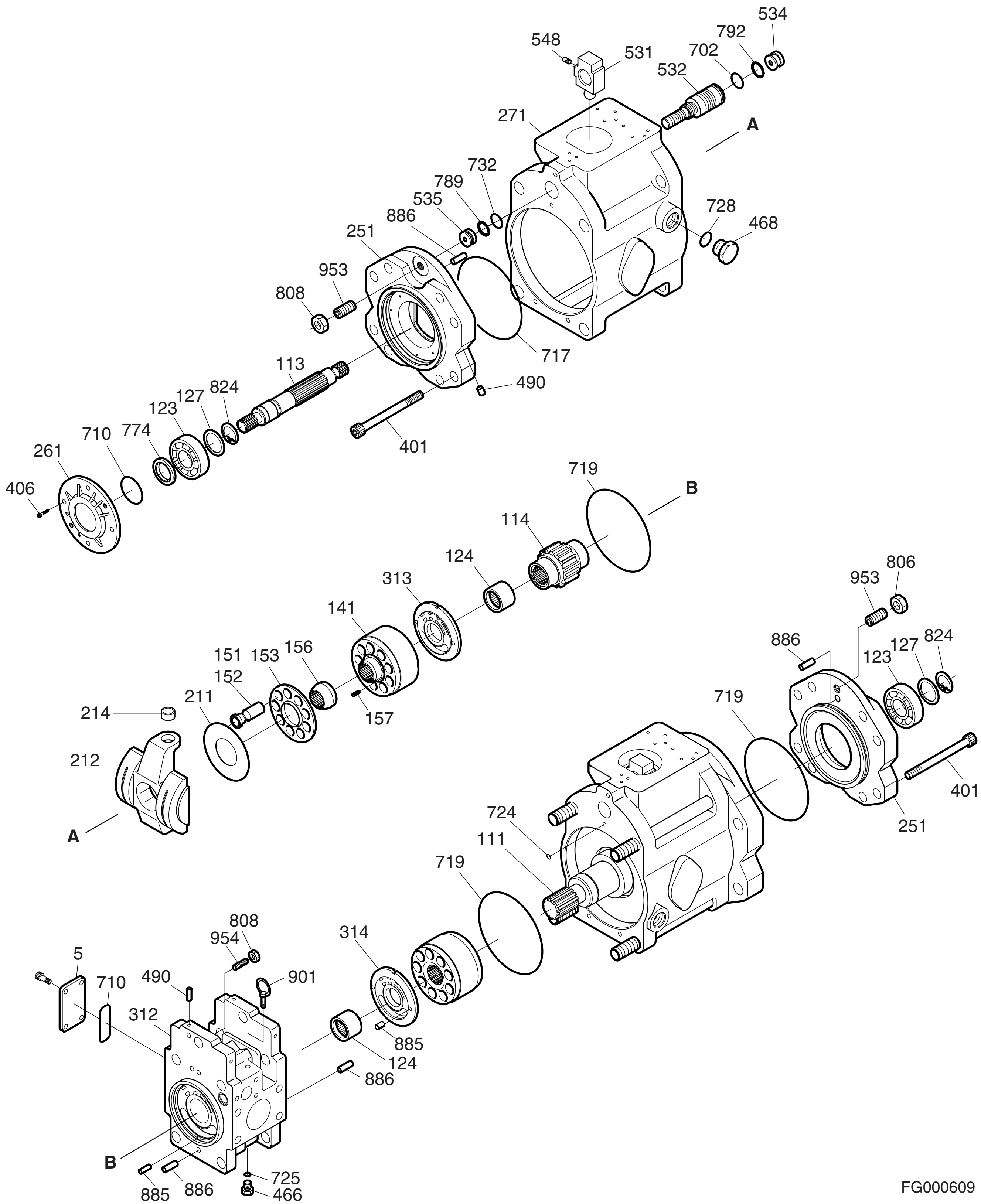

534
792
548
531
702
532
271
A
732
789
535
886
728
468
251
953
808
717
113
490
127
824
123
774
710
261
401
406
719
B
114
124
806
313
953
141
886
127
824
151
153
156
123
152
211
157
719
214
212
401
251
724
A
111
719
808
314
954
5
490
901
710
312
885
124
886
B
725
885
886
466
FG000609

Figure 22

Start-up Procedures

Oil filling and Air Venting

Item	Caution	Applied Type
Oil filling.	Fill the pump casing with oil. Inside the pump there are high-speed sliding and moving parts, such as bearings, pistons/ shoes, retainer, etc. If not filled with oil, these parts may suffer some serious problems, such as seizures damage.	All types.
Air venting.	When air is left in the circuit or pump, it may cause a malfunction or damage. Completely vent air.	All types.

Cautions During Starting Operation

1. Check pipings for proper installation.
2. Check that the rotating and suction / delivery directions are correct.
3. Before starting the prime mover, make sure the pump free of any load.
4. After starting, continue the idling for a while to vent air completely from the circuit.
5. Check the pump and pipings for oil leaks and abnormal vibrations.
6. When the pump is attached to a gear box, check that the box is full of oil to its proper level.

REGULATOR FOR AXIAL PISTON PUMP

General Description

Model Number Designation

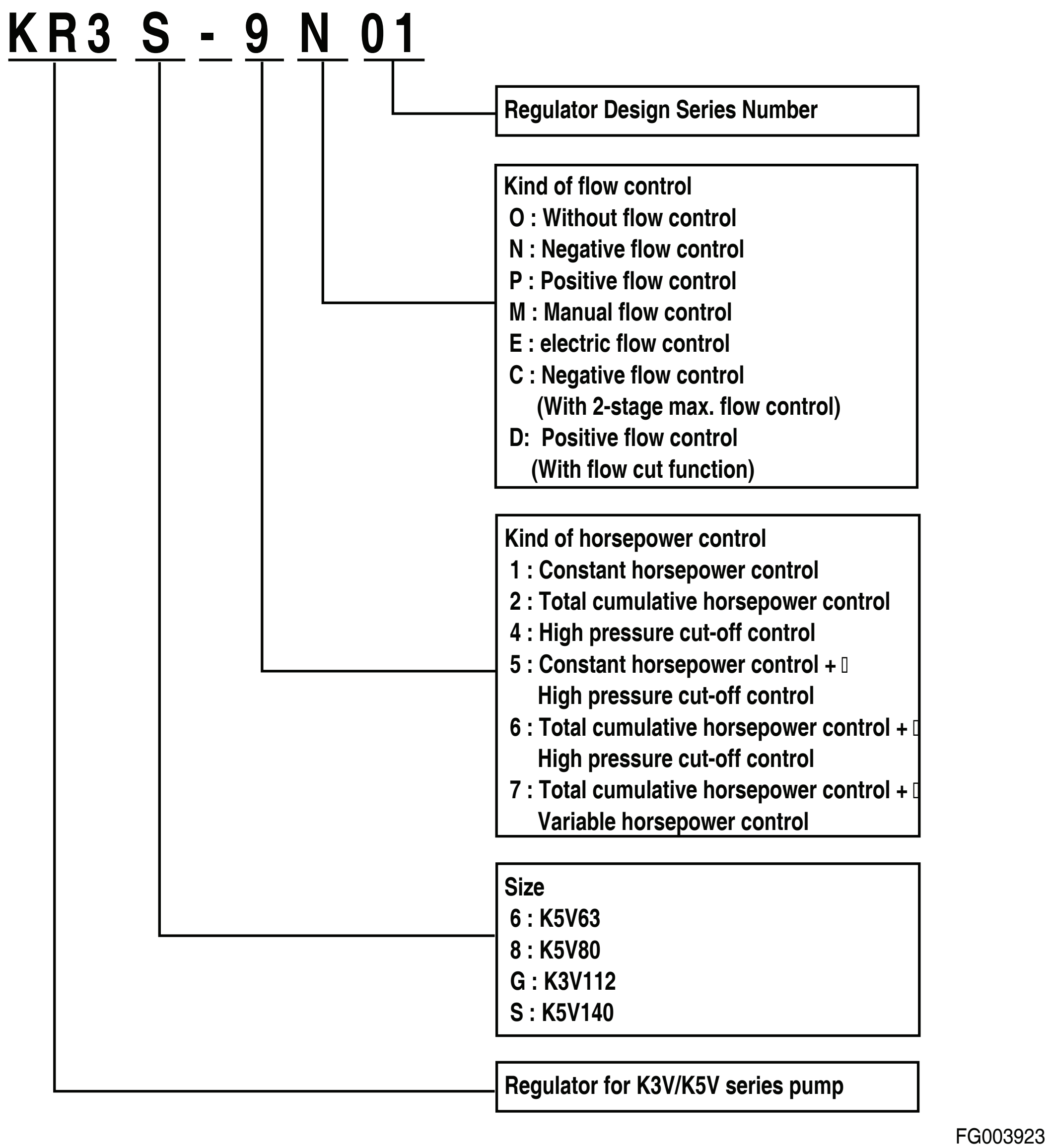


Figure 23

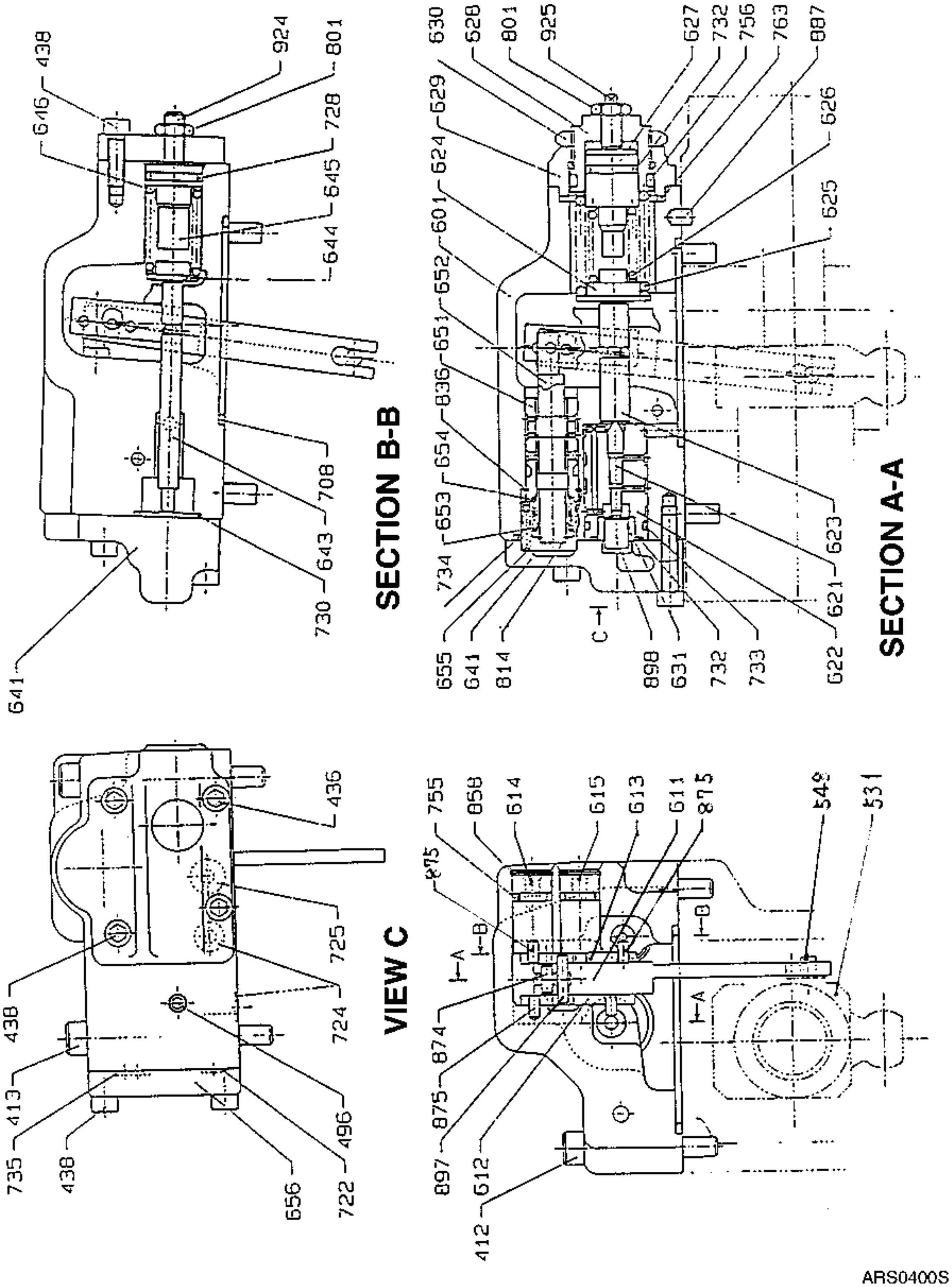

SECTION B-B
SECTION A-A
VIEW C
438
646
924
801
728
645
644
708
643
730
641
630
628
801
925
627
732
756
763
887
629
624
601
652
651
836
654
653
734
626
625
623
621
622
655
641
814
898
631
732
733
755
858
614
615
613
611
875
875
874
875
897
612
412
549
531
436
725
724
438
413
735
438
656
722
496
ARS0400S

Figure 24

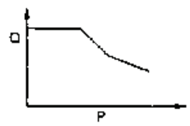
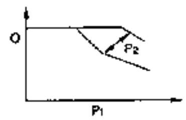
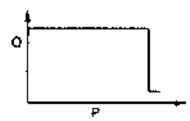
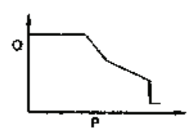
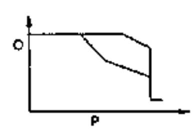
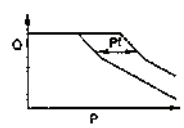
Reference Number	Description
412	Hex Socket Head Screw
413	Hex Socket Head Screw
436	Hex Socket Head Screw
438	Hex Socket Head Screw
496	Plug
531	Tilting Pin
548	Feedback Pin
601	Casing
611	Feedback Lever
612	Lever (1)
613	Lever (2)
614	Fulcrum Plug
615	Adjusting Plug
621	Compensating Piston
622	Piston Case
623	Compensating Rod
624	Spring Seat (C)
625	Outer Spring
626	Inner Spring
627	Adjusting Ring (C)
628	Adjusting Screw (C)
629	Cover (C)
630	Lock Nut
631	PF Sleeve
641	Pilot Cover
643	Pilot Piston
644	Spring Seat
645	Adjusting Ring (Q)
646	Pilot Spring
651	Sleeve

Reference Number	Description
652	Spool
653	Spring Seat
654	Return Spring
655	Set Spring
656	Block Cover
708	O-ring
722	O-ring
724	O-ring
725	O-ring
728	O-ring
730	O-ring
732	O-ring
733	O-ring
734	O-ring
735	O-ring
755	O-ring
756	O-ring
763	O-ring
801	Nut
814	Retaining Ring
836	Retaining Ring
858	Locking Ring
874	Pin
875	Pin
887	Pin
897	Pin
898	Pin
924	Adjusting Screw
925	Adjusting Screw (QI)

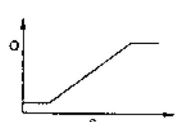
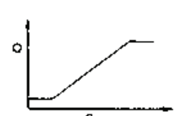
Outline

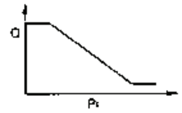
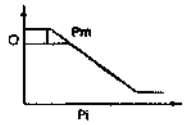
The regulator for the K3V Series Kawasaki in-line type axial piston pump has various models to satisfy various kinds of specifications required. Therefore, the customer can select the appropriate model to its intended application.

Horsepower Control

Code	Control Type	Control Curve	Function and Features
1	Constant horsepower control		According to the rise of delivery pressure of a pump, the tilting angle of the pump is automatically controlled and torque control is achieved.
2	Total horsepower control	 P2 Companion pump pressure	According to the rise of delivery pressure of a pump, the tilting angle of the pump is automatically controlled and torque control is achieved. (compensation control) The total horsepower control can be achieved by decreasing the horsepower of a pump depending upon the pressure of its companion pump.
4	High-pressure cutoff	 Pressure cutoff	If the pressure rises above the set value, the pump outlet flow is automatically decreased by the pressure cutoff control.
5		 Horsepower control pressure cutoff	
6		 Total horsepower control pressure cutoff	
9	Variable horsepower control		Variable horsepower control can be obtained by supplying pilot pressure or electric current.

Flow Control

Code	Control Type	Control Curve	Function and Features
M	Manual flow control	 Lever stroke	With the manual control, the outlet flow can be freely controlled.
P	Positive flow control	 Pilot pressure	Positive flow control can be carried out by using the pilot pressure.

Code	Control Type	Control Curve	Function and Features
N	Negative flow control		Negative flow control can be carried out by using the pilot pressure.
C	Two-stage max. flow control		Two-stage max. flow control can be obtained by supplying external pilot pressure. (only in negative flow control)

One flow control and one horsepower control pump can be combined for use. When these controls function simultaneously, the lower tilting angle (lower flow) will prevail through the mechanical calculation mentioned below.

Specifications

- Working oil: Wear resistant hydraulic oil, ISO VG 32, 46 and 68
- Temperature range: -20 °C - +95°C
- Viscosity range: 10 - 1000 cSt (During normal operation: 10 - 200 cSt)
- Miscellaneous: With proportional pressure reducing valve (In case of type KR3*-9***)

Functional Explanations

The regulator for Kawasaki in-line axial piston pump K3V Series consists of the following control functions.

1. Negative flow control
2. Total cumulative horsepower control
3. Variable horsepower control

Regulator Function Diagram

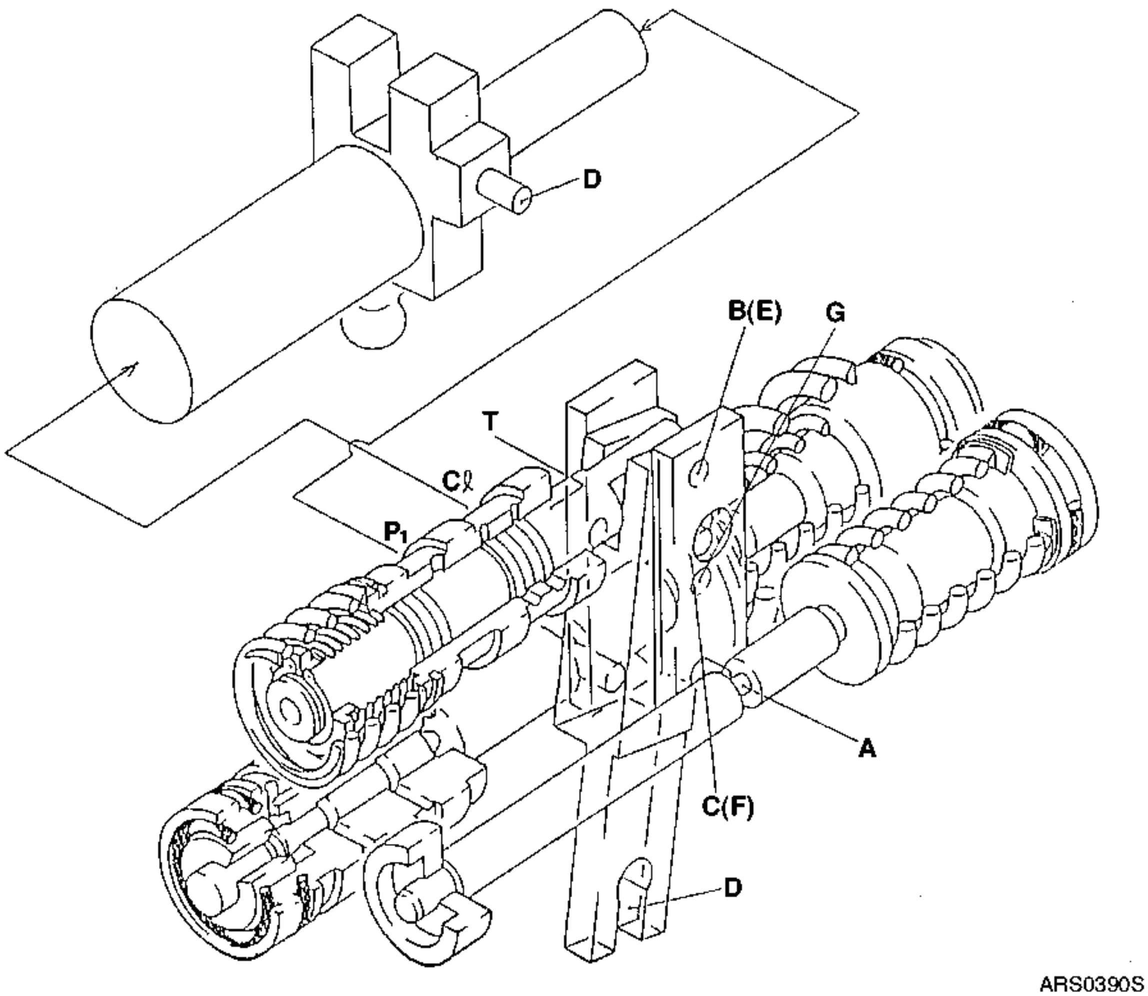


Figure 25

Negative Flow Control

By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in Figure 26.

This regulator is a negative flow control in which the delivery flow Q decreases as the pilot pressure Pi rises. With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, so it does not consume unnecessary power.

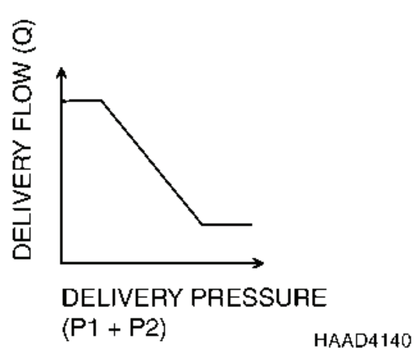


Figure 26

1. Functional Explanation

   A. Flow reducing Function

      As the pilot pressure Pi rises, the pilot piston (643) moves to the right to a position where the force of the pilot spring (646) balances with the hydraulic force.

The groove (A) in the pilot piston is attached with pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B (fixed by the fulcrum plug (614) and pin (875). Since the large-hole section (C, Figure 25) of lever 2 contains a protruding pin (897) fixed to the feedback lever (611), the pin (897) moves to the right as lever 2 rotates. Since the opposing-flat section (D) of the feedback lever is attached with the pin (548) fixed by the tilting pin (531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin (897) moves. Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

The movement of the spool causes the delivery pressure P1 to connect to port C liter through the spool and to be admitted to the large-diameter section of the servo position. The delivery pressure P1 that is constantly admitted to the small-diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.

When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring (654) and is tensioned to the left at all times, and so the pin (897) is pressed against the large-hole section (C) of lever2. Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve (651) and spool (652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

B. Flow Increasing Function

As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point B. Since the pin (897) is pressed against the large-hole section (C) of lever 2 by the action of the return spring (654) via the spool (652), pin (874), and feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the left. Port C liter opens a way to the tank port as the spool moves. This deprives the large-diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P1 in the small-diameter section, resulting in an increase in the flow rate.

As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

2. Adjustment of flow control characteristic

The flow control characteristic can be adjusted with the adjusting screw.

Adjust it by loosening the hex nut (801) and by tightening (or loosening) the hex socket head screw (924).

Tightening the screw shifts the control chart to the right as shown in the Figure 27.

NOTE: *Adjusting values are shown in the attached Table. See “Summary of Regulator Adjustment Values” on page 38.*

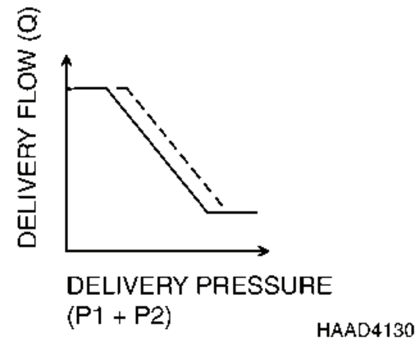


Figure 27

Total Horsepower Control

The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump. (The input horsepower is constant when the speed is constant.)

Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.

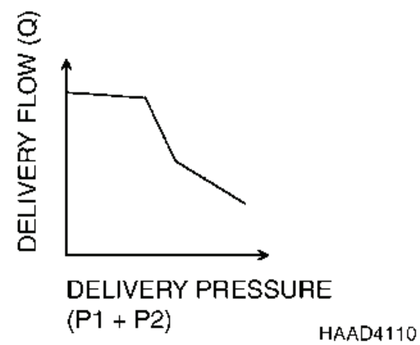


Figure 28

1. Functional explanation

Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same values as represented by the following equation:

- $T\ in = P1 \times q/2\pi + P2 \times q/2\pi = (P1 + P2) \times q/2\pi$

The horsepower control function is the same as the flow control function and is summarized in the following. (For detailed behaviors of respective parts, refer to the section of flow control).

A. Overload Preventive Function

When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force. The movement of the compensating rod is transmitted to Lever 1 via pin (875). Lever 1 rotates around the pin (875) (E) attached to the casing (601).

Since the large-hole section (F) of Lever 1 contains a protruding pin (897) attached to the feedback lever (611), the feedback lever rotates around the fulcrum of Point D as Lever 1 rotates, and then the spool (652) is shifted to the right.

As the spool moves, the delivery pressure P1 is admitted to the large-diameter section of the servo piston via Port C liter, causes the servo piston move to the right, reduces the pump delivery flow rate, and prevents the prime mover from being overloaded.

The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool and sleeve (651) is closed.

B. Flow Reset Function

As the self pump delivery pressure P1 or the companion pump delivery pressure P2 decreases, the compensating rod (623) is pushed back by the action of the springs (625 and 626) to rotate Lever 1 around point E. Rotating of Lever 1 causes the feedback lever to rotate around the fulcrum of point D and then the spool to move to the left. As a result, Port C liter opens a way to the tank port. This causes the servo piston to move to the left and the pump's delivery rate to increase.

The movement of the servo piston is transmitted to the spool by the action of the feedback mechanism to move it till the opening between the spool and sleeve is closed.

2. Low tilting angle (low flow) command preferential function

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C and F) of levers 1 and 2. However, since sections C and F have the pins (∅4) protruding from the large hole (∅8), only the lever lessening the tilting angle contacts the pin (897); the hole (∅8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

3. Adjustment of Input horsepower

Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one pump is loaded.

A. Adjustment of outer springs

Adjust it by loosening the hex nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the Figure 29. Since turning the adjusting screw C by N turns changes the setting of the inner spring, return the adjusting screw CI (925) by NxA turns at first.

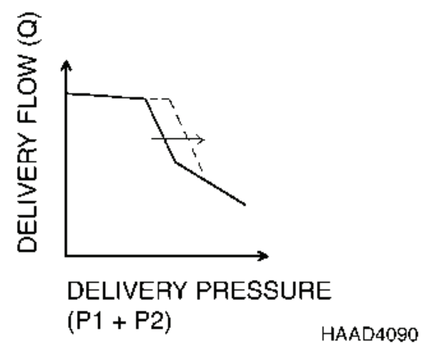


Figure 29

B. Adjustment of inner spring

Adjust it by loosening the hex nut (801) and by tightening (or loosening) the adjusting screw CI (925). Tightening the screw increases the flow and then the input horsepower as shown in the Figure 30.

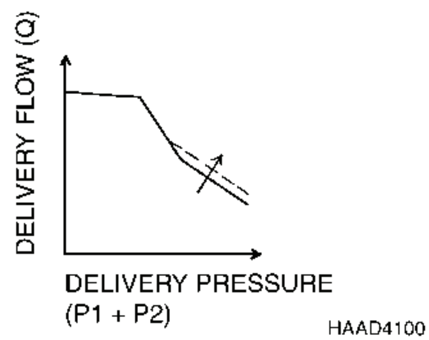


Figure 30

Variable Horsepower Control

The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided. However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level. This function permits arbitrary setting of the Pump output power, thereby providing the optimum power level according to the operating condition.

1. Functional explanation

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the Figure 31.

As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621). This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

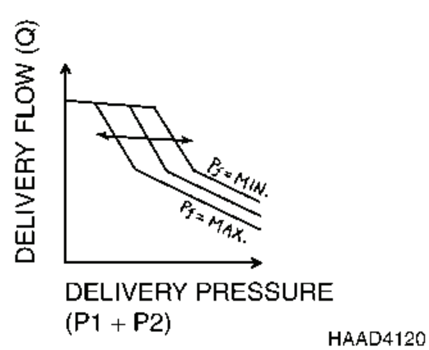
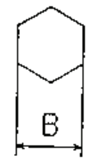


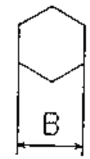
Figure 31

Tightening Torque

Part Name	Size	Tightening Torque	Tool Name	
Hex socket head bolt (Material: SCM 435)	M 5	70 kg•cm	B = 4	 Allen wrench
	M 6	120 kg•cm	5	
	M 8	300 kg•cm	6	
	M 10	580 kg•cm	7	
	M 12	1,000 kg•cm	8	
	M 14	1,600 kg•cm	10	
	M 16	2,400 kg•cm	12	
	M 18	3,400 kg•cm	14	
	M 20	4,400 kg•cm	17	
PT filling plug (Material: S45C) Wind a seal tape 1 1/2 - 2 turns round the plug.	PT 1/16	70 kg•cm	4	Do.
	PT 1/8	105 kg•cm	5	
	PT 1/4	175 kg•cm	6	
	PT 3/8	350 kg•cm	8	
	PT 1/2	500 kg•cm	10	
PO plug (Material: S35C)	PF 1/4	300 kg•cm	6	Do.
	PF 1/2	1,000 kg•cm	10	
	PF 3/4	1,500 kg•cm	14	
	PF 1	1,900 kg•cm	17	
	PF 1 1/4	2,700 kg•cm	17	
	PF 1 1/2	2,800 kg•cm	17	

Special Tools and Materials

Tools

Name	Description
Allen Wrench	4,5,6 (Dimension B mm) 
Socket Wrench, Double-ended (Single-ended) Wrench	
Adjustable Wrench	Small size (max. 36 mm)
Screwdriver	
Plastic Hammer	
Torque Wrench	
Pliers	2 sets for retaining ring
Steel Bar	4 mm or less in dia., L=100 mm
Pincers	
Bolt	M4, L = about 50 mm

Troubleshooting, Testing and Adjustment

In case a functional fault probably resulting from the regulator occurs, disassemble and inspect it, referring to the maintenance manual.

Prime Mover is Overloaded

Determine which is faulty, the front pump or rear pump, by loading each pump independently. When both pumps are found faulty, investigate the following (1 and 2). Begin investigation with (3), when only one pump is found faulty. (1 and 2) are only for cases of the variable horsepower contr28

ol.

1. Check that the power shift command current I is normal.
2. The power shift pressure is low:
   - Check the amplifier dither.
   - Replace the proportional pressure reducing valve.
3. The compensating piston (621) and compensating rod (623) are stuck with each other:
   - Disassemble and clean the regulator.
4. The Pin (898) is stuck:
   - Disassemble and clean the regulator.

Maximum Flow Is Not Available

1. Check that the pilot pressure Pi is normal.
2. The pilot piston (643) is stuck:
   - Disassemble and clean the regulator.
3. The spool (652) is stuck:
   - Disassemble and clean the regulator.
4. The piston QMC stopper (647) and piston (648) are stuck with each other:
   - Disassemble and clean the regulator.
5. The spool (COV) (637) is stuck:
   - Disassemble and clean the regulator.

NOTE: *Replace faulty parts that are deeply scored.*

(1 and 2) are only for cases of the pilot control.

(4) is only for cases of the two-stage max. flow control.

(5) is only for cases of the cutoff control.

Adjustment of Maximum and Minimum Flows

The regulator can adjust the maximum and minimum flows with the adjusting screws.

NOTE: *Their respective adjustment values are shown in the attached Table. See "Summary of Regulator Adjustment Values" on page 38.*

Adjustment of Maximum Flow

Adjust it by loosening the hex nut (809) and by tightening (or loosening) the set screw (954). The maximum flow only is adjusted without changing other control characteristics.

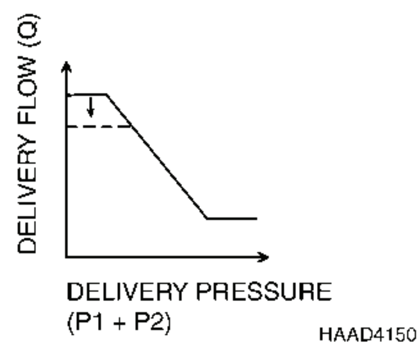


Figure 32

Adjustment of Minimum Flow

Adjust it by loosening the hex nut (909) and by tightening (or loosening) the hex socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not chanced. However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure (or during relieving) may increase.

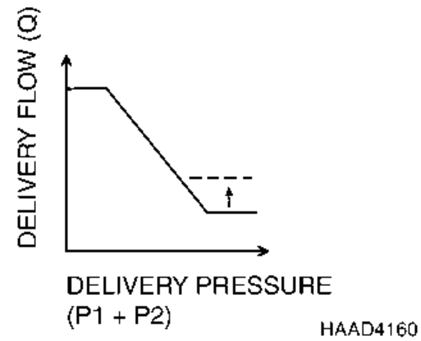


Figure 33

Summary of Regulator Adjustment Values

Item			**Specification**
Speed			1900 min-1
Adjustment of Maximum Flow		Tightening amount of adjusting screw (954).	+1/4 Turn
		Flow change amount.	-5.9 l/min
Adjustment of Minimum Flow		Tightening amount of adjusting screw (953).	+1/4 Turn
		Flow change amount.	+4.7 l/min
Adjustment of Input Horsepower	Adjustment of outer spring.	Tightening amount of adjusting screw (C) (628).	+1/4 Turn
		Compensating control starting pressure change amount.	+19 kg/cm^2
		Input torque change amount.	+6.9 kg•m
		A	1.9
	Adjustment of inner spring.	Tightening amount of adjusting screw (QI) (925).	+1/4 Turn
		Flow Change Amount	+11 l/min
		Input torque change amount.	+5.8 kg•m
Adjustment of flow control characteristic.		Tightening amount of adjusting screw (924).	+1/4 Turn
		Flow control starting pressure change amount.	+1.8 kg/cm^2
		Flow change amount.	+15.4 l/min

Preparation for Disassembly

1. Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated. For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.
2. The numbers in parentheses after part names represent those in the “Parts List” on page 26.

Regulator Disassembly

1. Choose a place for disassembly.

CAUTION

1. Choose a clean place.

2. Spread rubber mat or cloth, on top of workbench to prevent parts from being damaged.

3. Remove dust, rust, etc. from surfaces of regulator with cleaning oil.
4. Remove hex socket head screws (412,413) and regulator main body from pump main body.

IMPORTANT

Do not lose O-ring.

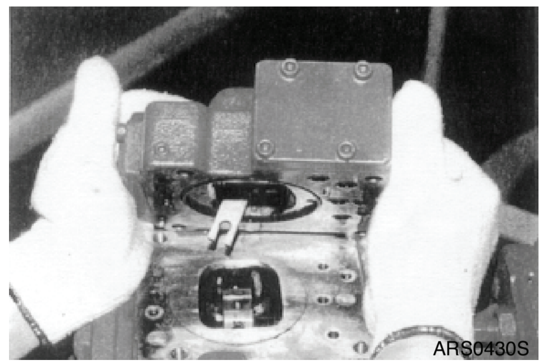


Figure 34

5. Remove hex socket head screws (488) and cover (C) (629).

IMPORTANT

Cover (C) is attached with adjusting screw (C), (QI) (628, 925), adjusting ring (C) (627), lock nut (630), hex nut (801) and adjusting screw (924). Do not loosen these screws and nuts. If they are loosened, adjusted pressure flow setting will vary.

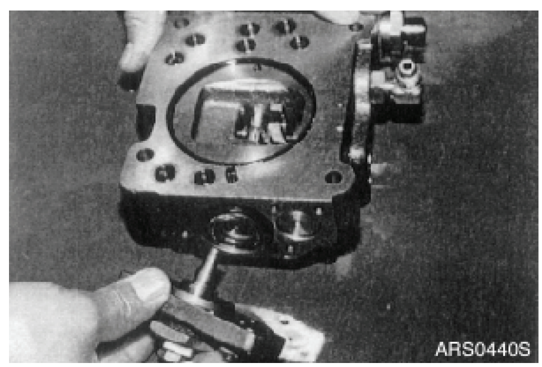


Figure 35

6. After removing cover (C) (629) subassembly, remove outer spring (625), inner spring (626) and spring seat (C) (624) from compensating section. Then draw out adjusting ring (Q) (645), pilot spring (646) and spring seat (644) from pilot section.

IMPORTANT

Adjusting ring (Q) (645) can easily be drawn out with M4 bolt.

Figure 36

7. Remove hex socket head screws (436, 438) and pilot cover (641). After removing pilot cover, remove set spring (655) from pilot section.

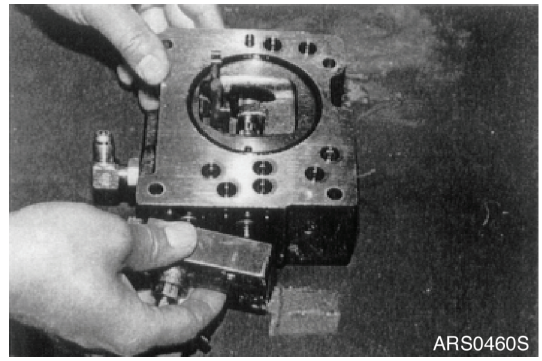


Figure 37

8. Remove retaining ring (814), spring seat (653), return spring (654) and sleeve (651).

IMPORTANT

Sleeve (651) is attached with retaining ring (836).

When removing retaining ring (814), return spring (654) may pop out. Take care not to lose it.

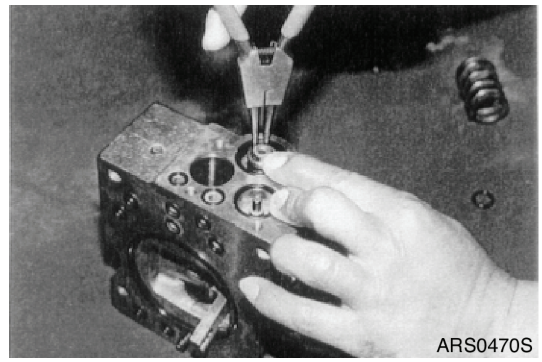


Figure 38

9. Remove locking ring (858), fulcrum plug (614) and adjusting plug (615).

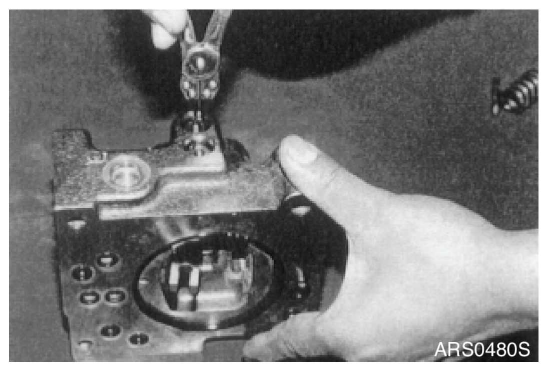


Figure 39

IMPORTANT

Fulcrum plug (614) and adjusting plug (615) can be easily taken out with M6 bolt.

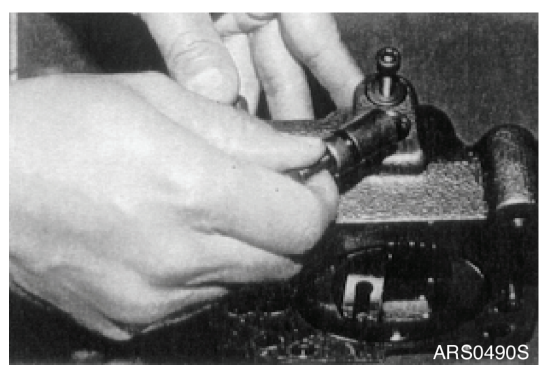


Figure 40

10. Remove lever (2) (613). Do not draw out pin (875).

IMPORTANT

Work will be promoted by using pincers.

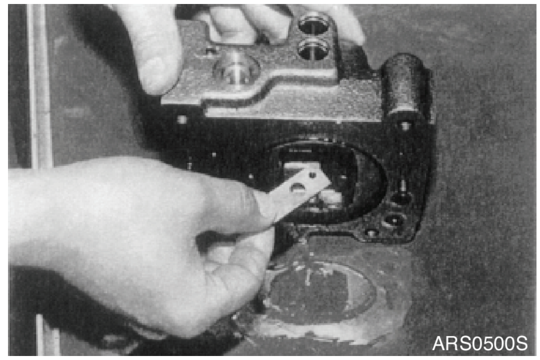


Figure 41

11. Draw out pin (874) and remove feedback lever (611).

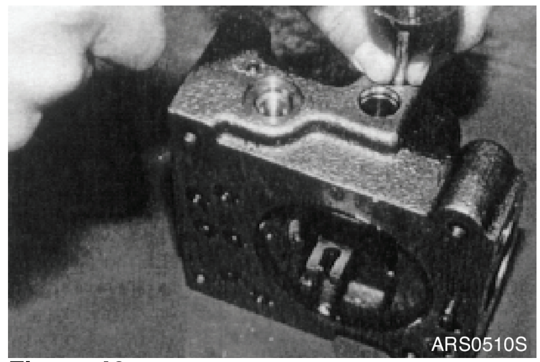


Figure 42

IMPORTANT

Push out pin (874) (4 mm (0.16 in) in dia.) from above with slender steel bar so that it may not interfere with lever (1) (612).

12. Remove lever (1) (612). Do not draw out pin (875).
13. Draw out pilot piston (643) and spool (652).
14. Draw out piston case (622), compensating piston (621) and compensating rod (623).

NOTE: *Since component parts are small, do not lose them.*

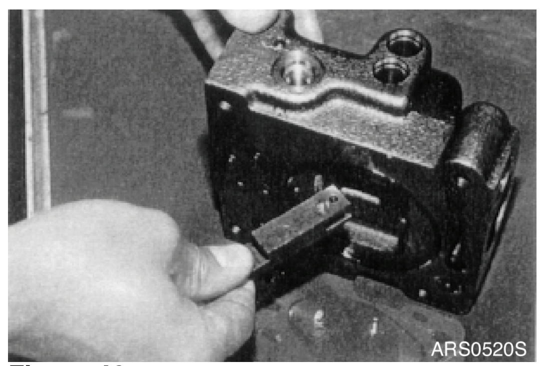


Figure 43

Regulator Reassembly

For assembly, reverse disassembly procedures, but pay attention to the following.

- Always repair parts that were scored at disassembly. Get replacement parts ready beforehand.
- Mixing of foreign material will cause malfunction. Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.
- Always tighten bolts, plugs, etc. to their specified torques.
- Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.
- Replace seals such as O-rings with new ones as a rule.

1. Put compensating rod (623) into compensating hole of casing (601).
2. Press fit pin in lever (1) (612) into groove of compensating rod and fit lever (1) to pin press fitted in casing.
3. Install spool (652) and sleeve (651) into hole in spool of casing.

IMPORTANT

Confirm that spool and sleeve slide smoothly in casing without binding.

Pay attention to orientation of spool.

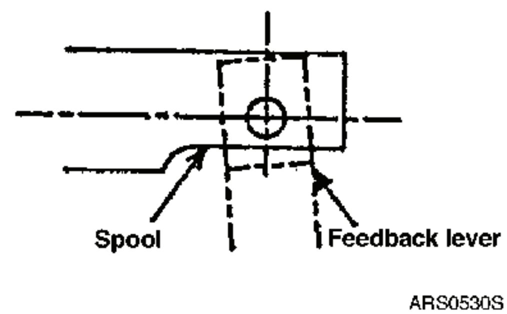


Figure 44

4. Install feedback lever (611), matching its pin hole with pin hole in spool. Then insert pin (874).

IMPORTANT

Insert pin in feedback lever a little to ease operation.

Do not mistake direction of feedback lever.

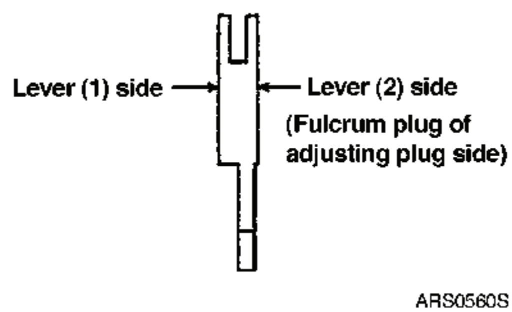


Figure 45

5. Insert pilot piston (643) into pilot hole of casing.

IMPORTANT

Confirm that pilot piston slides smoothly without binding.

6. Press fit pin in lever (2) (613) into groove of pilot piston. Then attach lever (2).

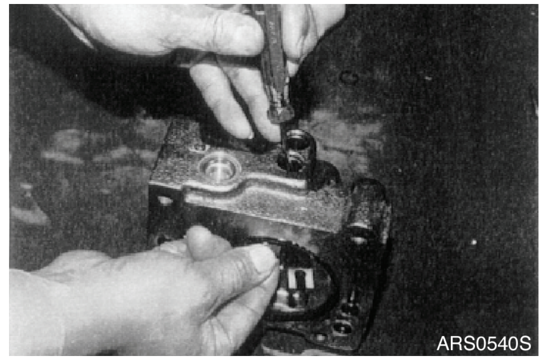


Figure 46

7. Install fulcrum plug (614) so that pin pressed into fulcrum plug (614) can be inserted into pin hole of lever (2). Then attach locking ring (858).
8. Insert adjusting plug (615) and install locking ring.

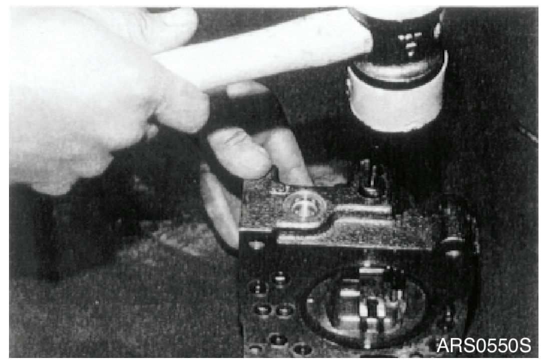


Figure 47

IMPORTANT

Do not mistake inserting holes for fulcrum plug and adjusting plug.

Now move feedback lever to confirm that it has no large play and is free from binding.

9. Install return spring (654) and spring seat (653) into spool hole. Install retaining ring (814).

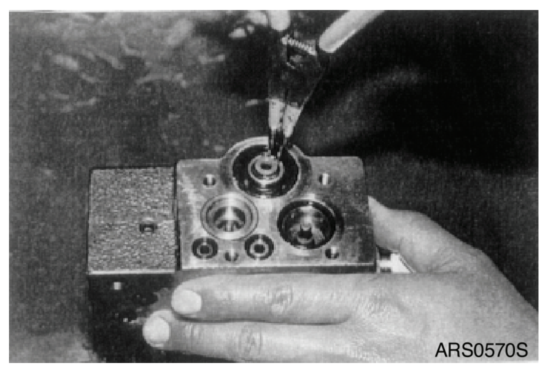


Figure 48

10. Install set spring (655) in spool hole. Slide compensating piston (621) and piston case (622) into compensating hole.
11. Install pilot cover (641) and secure it in place with hex socket head screws (436 and 438).

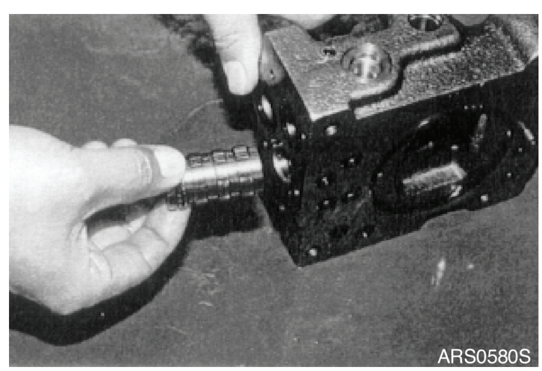


Figure 49

12. Insert spring seat (644), pilot spring (646) and adjusting ring (Q) (645) into pilot hole.
13. Install spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

IMPORTANT

When fitting spring seat, do not mistake direction of spring seat.

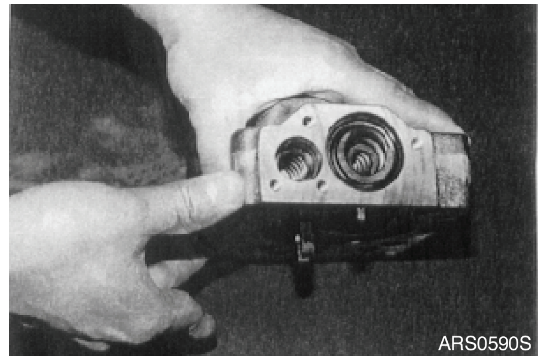


Figure 50

14. Install cover (C) (629) with adjusting screws (628 and 925), adjusting ring (C) (627), lock nut (630), hex nut (801) and adjusting screw (924). Secure them with hex socket head screws (438).

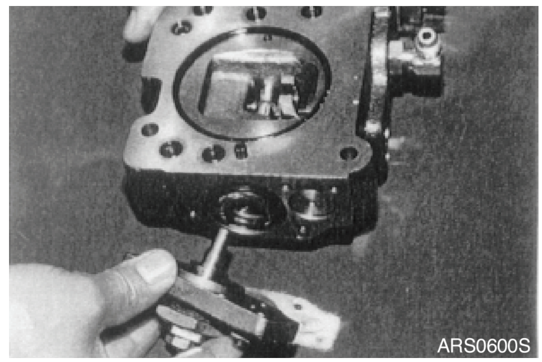


Figure 51

Gear Pump

Edition 1

MEMO

Table of Contents

Gear Pump

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

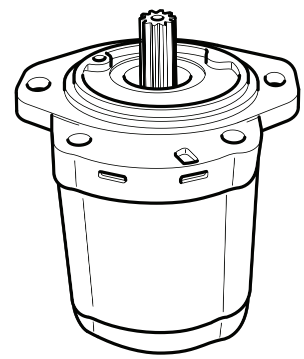
The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up

SINGLE GEAR PUMP

Disassembly

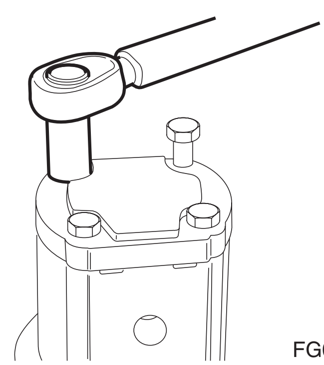
1. Clean exterior of pump.



FG001072

Figure 1

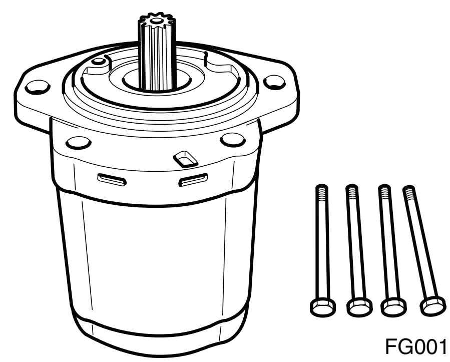
2. Remove clamp bolts.



FG001074

Figure 2

3. Cover sharp edges of drive shaft with adhesive tape and coat shaft end extension with clean grease, to avoid any damage to lip of shaft seal when removing mounting flange.



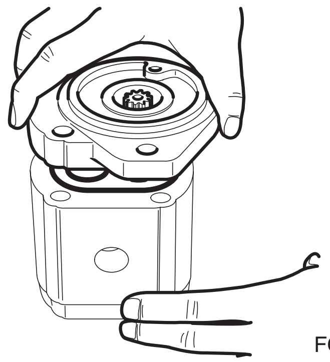
FG001073

Figure 3

4. Remove mounting flange taking care to keep flange as straight as possible during removal.

   If mounting flange is stuck, tap around edge with rubber mallet in order to break it away from body.

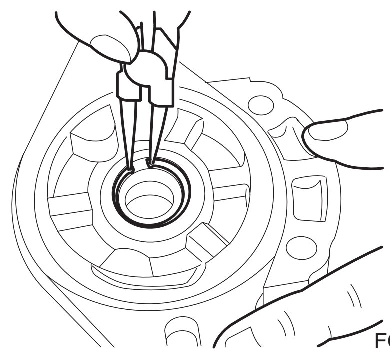
   NOTE: *Make sure that while removing mounting flange, shaft and other components remain in position.*



FG001075

Figure 4

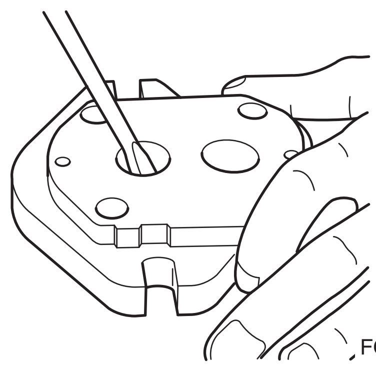
5. Remove retaining ring, if replacement is necessary.



FG000834

Figure 5

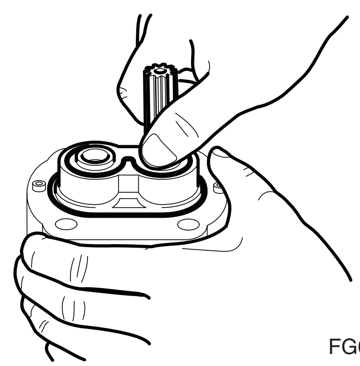
6. Remove shaft seal taking care not to damage surface of shaft hole, if replacement is necessary.



FG000835

Figure 6

7. Pull drive gear up to facilitate removal of front plate.



FG001076

Figure 7

8. Remove driving gear and driven gear, keeping gears as straight as possible.

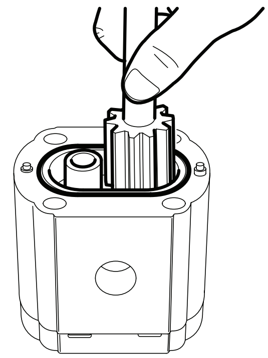


Figure 8

9. Remove rear plate and end cover.

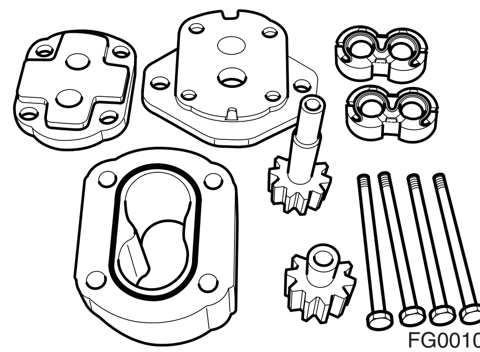


Figure 9

Reassembly

1. Clean all components with care.

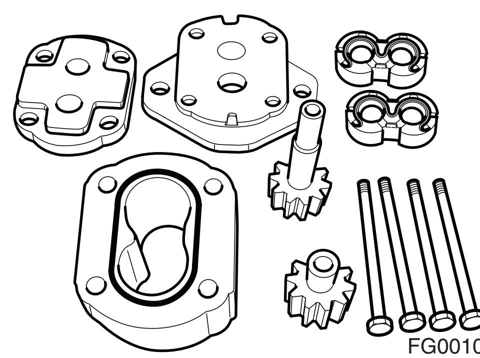


Figure 10

2. Using a suitable driver, install shaft seal in mounting flange.

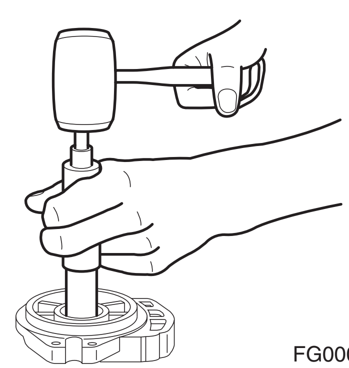


Figure 11

3. Install retaining ring in groove.

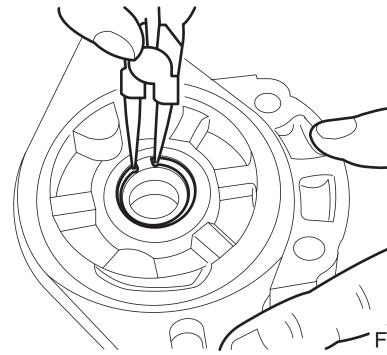


Figure 12

4. Install O-ring on both sides of rear section of body.

   NOTE: *Coat O-rings with grease to hold O-rings in body.*

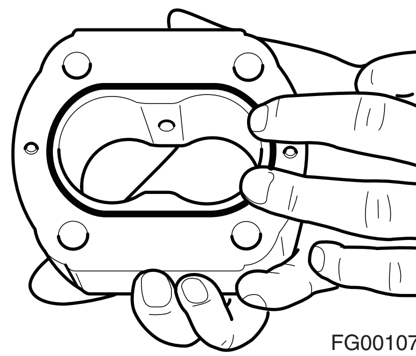


Figure 13

5. Install rear section body on rear cover.

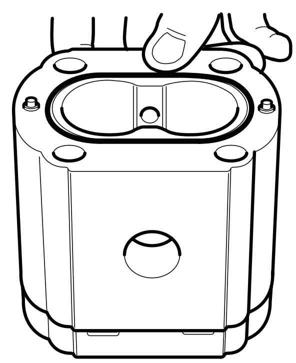


Figure 14

6. Install seals in pressure plate(s) groove. Then install backup ring in groove with seals. Coat seals with grease.

   NOTE: *The front and rear pressure plates and seals and backup rings are the same.*

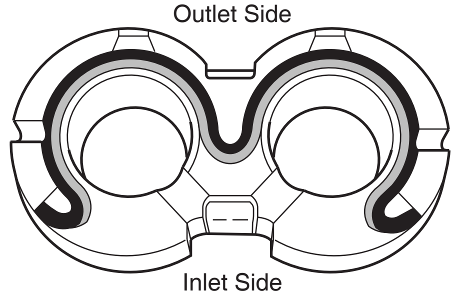


Figure 15

7. Insert pressure plate assembly into body while keeping it straight.

   NOTE: *Seal side should face to rear cover, opposite side of gears.*

   NOTE: *Pay attention to installation direction of seal.*

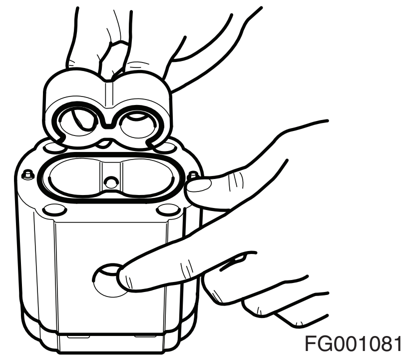


Figure 16

8. Install drive gear and driven gear.

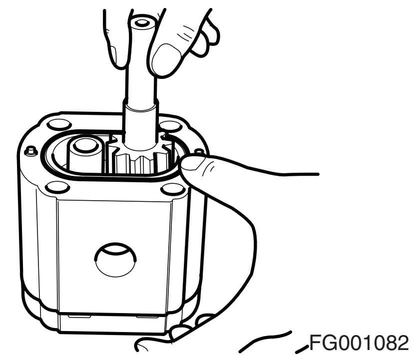


Figure 17

9. Insert pressure plate into body in proper direction.

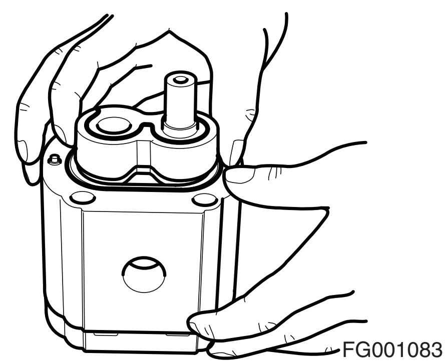


Figure 18

10. Locate mounting flange in right position.

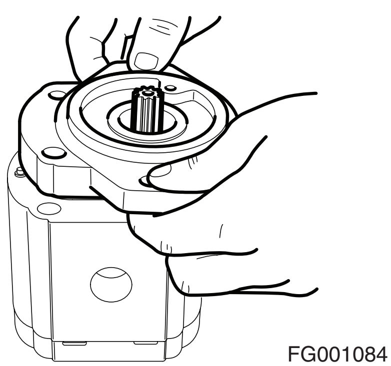


Figure 19

11. Tighten bolts with washer in a crisscross pattern to a torque value of 45 Nm.

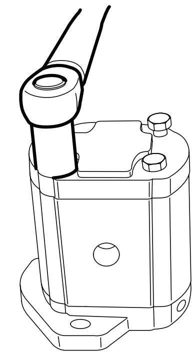


Figure 20

12. Check that pump rotates freely when drive shaft is turned by hand. If not a pressure plate seal may be pinched.

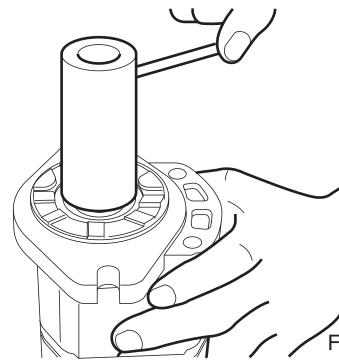


Figure 21

DOUBLE GEAR PUMP

Disassembly

1. Clean exterior of pump.

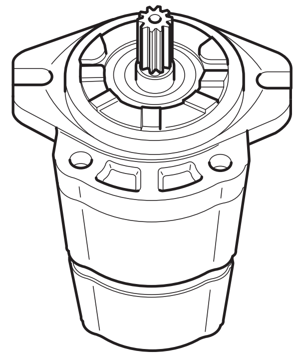


Figure 22

2. Remove clamp bolts.

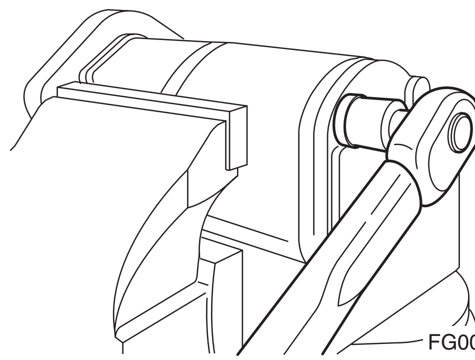


Figure 23

3. Cover sharp edges of drive shaft with adhesive tape, and coat shaft end extension with clean grease, to avoid any damage to lip of shaft seal when removing mounting flange.

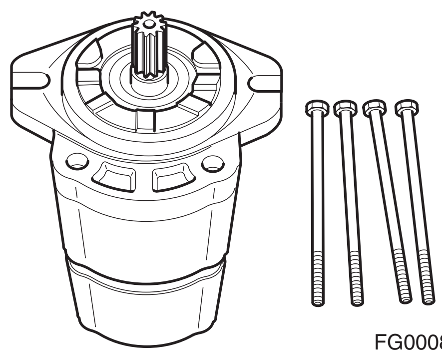


Figure 24

4. Remove mounting flange taking care to keep flange as straight as possible during removal.

   If mounting flange is stuck, tap around edge with rubber mallet in order to break it away from body.

   NOTE: *Make sure that while removing mounting flange, shaft and other components remain in position.*

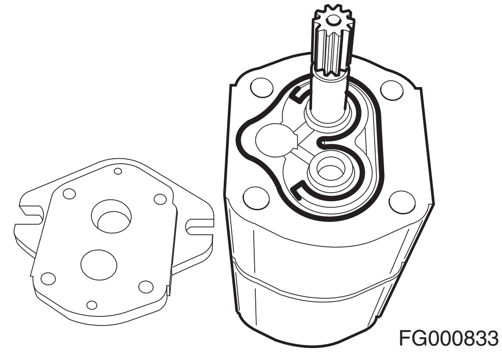


Figure 25

5. Remove retaining ring, if replacement is necessary.

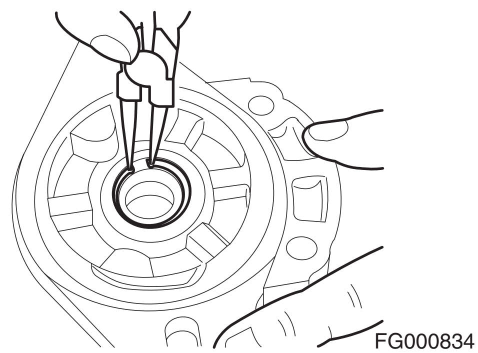


Figure 26

6. Remove shaft seal taking care not to damage surface of shaft hole, if replacement is necessary.

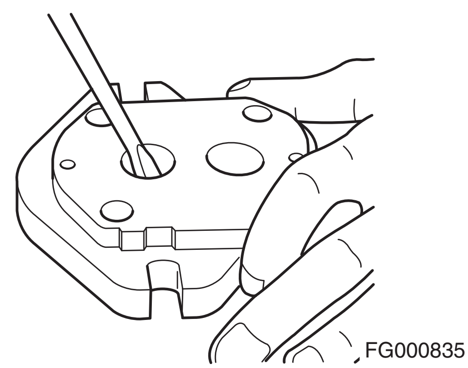


Figure 27

7. Pull drive gear up to facilitate removal front plate.

   Remove drive gear, driven gear, rear plate, keeping gears as straight as possible.

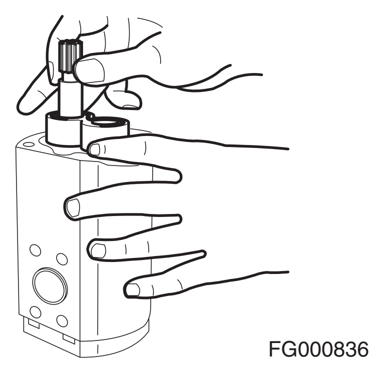
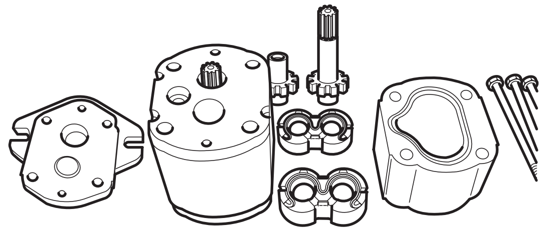


Figure 28

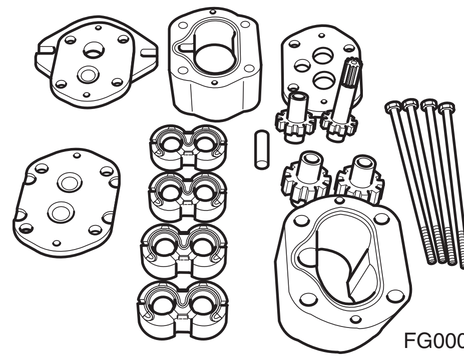
8. Remove intermediate cover and through shaft.



FG000837

Figure 29

9. Remove all remaining components in same manner as first section.

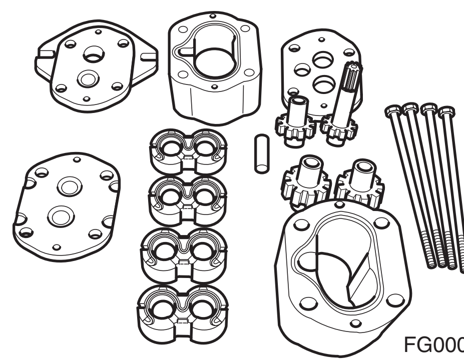


FG000838

Figure 30

Reassembly

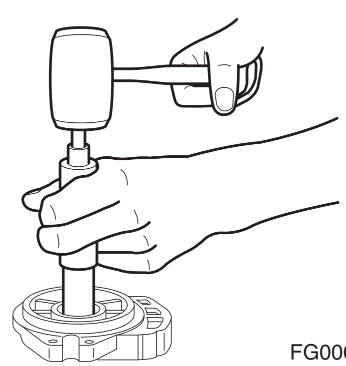
1. Clean all components with care.



FG000838

Figure 31

2. Using a suitable driver, install shaft seal in mounting flange.



FG000839

Figure 32

3. Install retaining ring in groove.

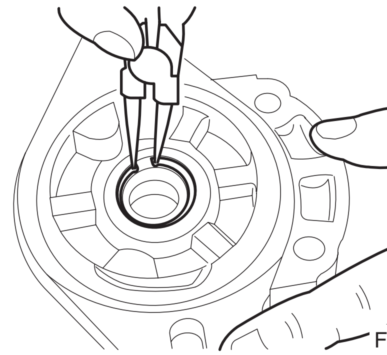

FG000840

Figure 33

4. Install O-ring on both sides of rear section of body.

   NOTE: *Coat O-rings with grease to hold O-rings in body.*

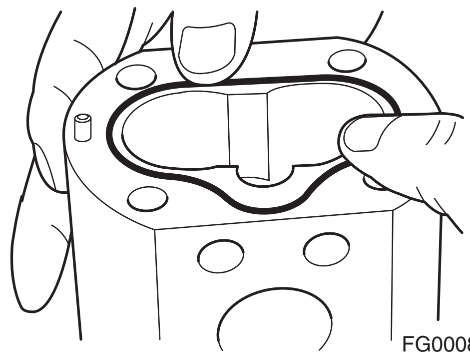

FG000841

Figure 34

5. Install rear section body on rear cover.

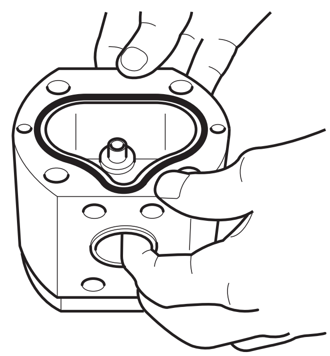
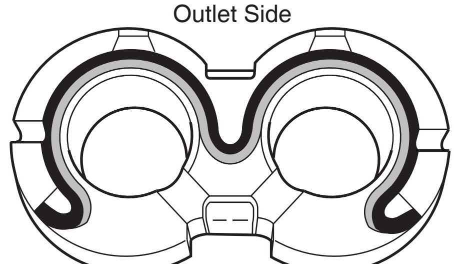

FG000842

Figure 35

6. Install seals in pressure plate(s) groove. Then install backup ring in groove with seals. Coat seals with grease.

   NOTE: *The front and rear pressure plates and seals and backup rings are the same.*



FG001401

Figure 36

7. Insert pressure plate assembly into body while keeping plate straight.

   NOTE: *Seal side should face to rear cover, opposite side of gears.*

   NOTE: *Pay attention to direction of seal.*

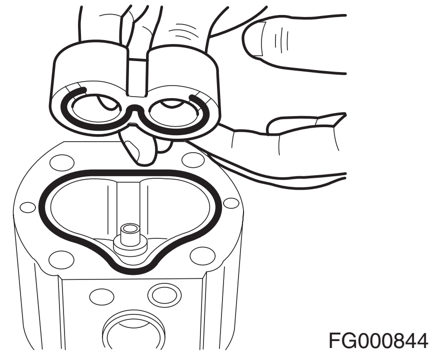


Figure 37

8. Install drive gear and driven gear.

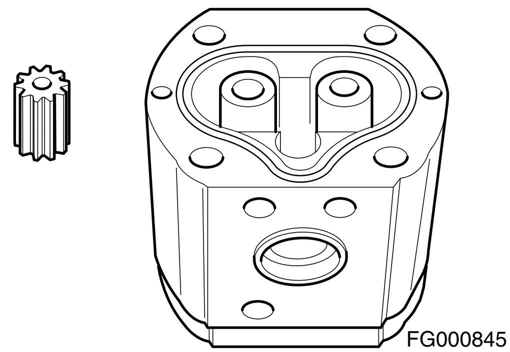


Figure 38

9. Insert pressure plate into body in proper direction.

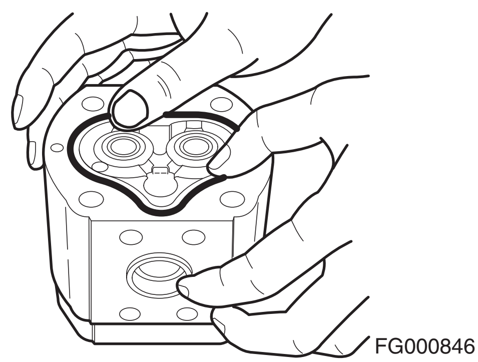


Figure 39

10. Install intermediate cover, one rear section, and through shaft.

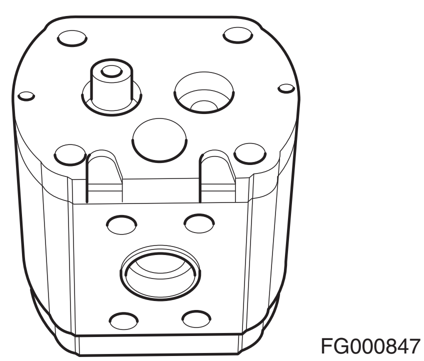


Figure 40

11. Install remaining section using preceding procedure.

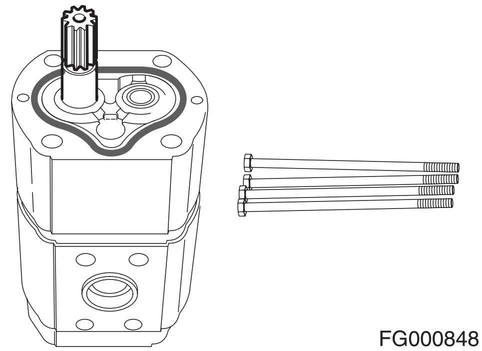


Figure 41

12. Locate mounting flange in right position.

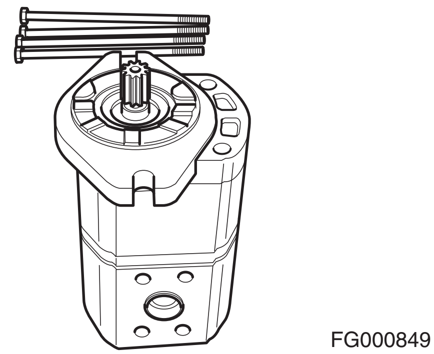


Figure 42

13. Tighten bolts with washer in a crisscross pattern to a torque value of 45 Nm.

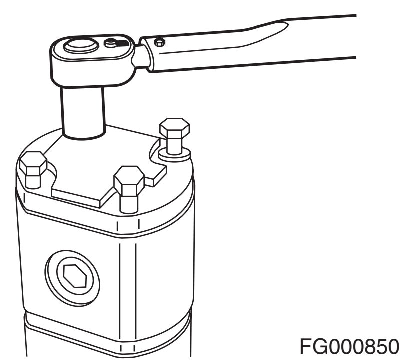


Figure 43

14. Check that pump rotates freely when drive shaft is turned by hand. If not a pressure plate seal may be pinched.

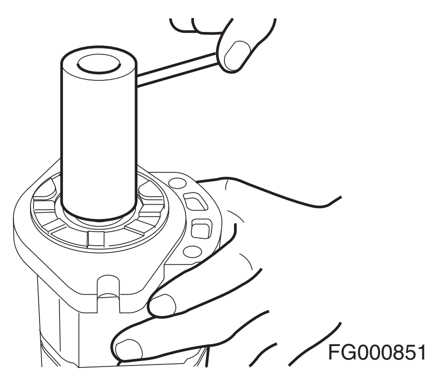


Figure 44

Main Control Valve

Edition 1

MEMO

Table of Contents

Main Control Valve

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up

GENERAL DESCRIPTION

Theory of Operation

When All Spools are in Neutral

Neutral Passage

The oil supplied from the port (P1) enters into the tank passage (Ta) through the orifice (Lc 1) of negative relief from the neutral passage (L1) and returns to ports (T1, T2 and T3).

The oil supplied from the port (P2) passes the tank passage (Ta) through orifice (Rc 1) of negative relief from the neutral passage (R1) and returns to port (T1, T2 and T3).

The pressure of chambers (L2 and R2) flowing over the negative relief, flows into pump from ports (ps1 and ps2), to control the volume of pump P1 and P2.

In addition, when excessive oil flows excessive into the neutral passage, the negative relief operates to prevent the abnormally high-pressure on ports (ps1 and ps2).

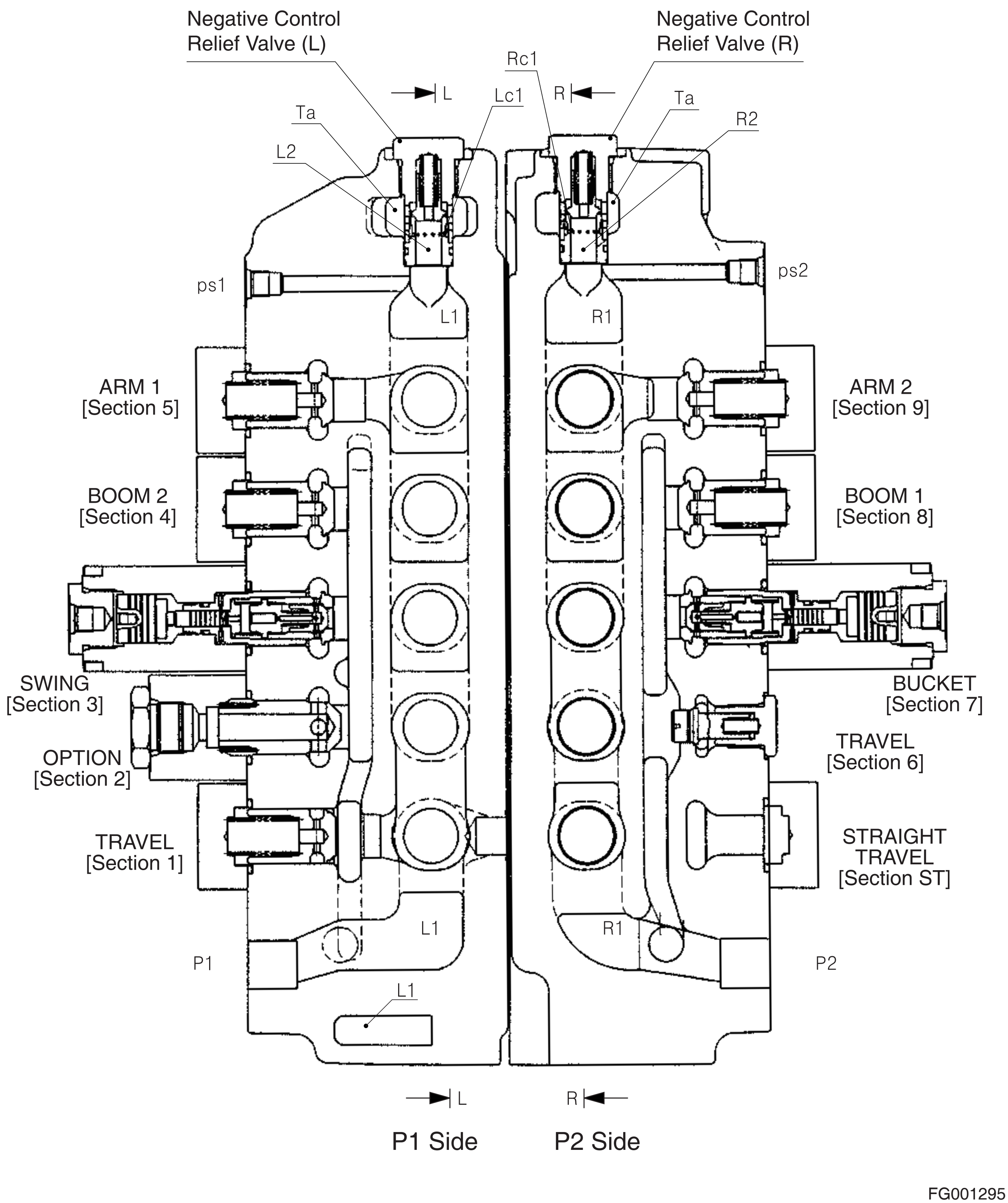

Negative Control
Relief Valve (L)
Negative Control
Relief Valve (R)
Rc1
L
Lc1
R
Ta
Ta
R2
L2
ps1
ps2
L1
R1
ARM 1
[Section 5]
ARM 2
[Section 9]
BOOM 2
[Section 4]
BOOM 1
[Section 8]
SWING
[Section 3]
BUCKET
[Section 7]
OPTION
[Section 2]
TRAVEL
[Section 6]
TRAVEL
[Section 1]
STRAIGHT
TRAVEL
[Section ST]
L1
R1
P1
P2
L1
L
R
P1 Side
P2 Side
FG001295

Figure 1

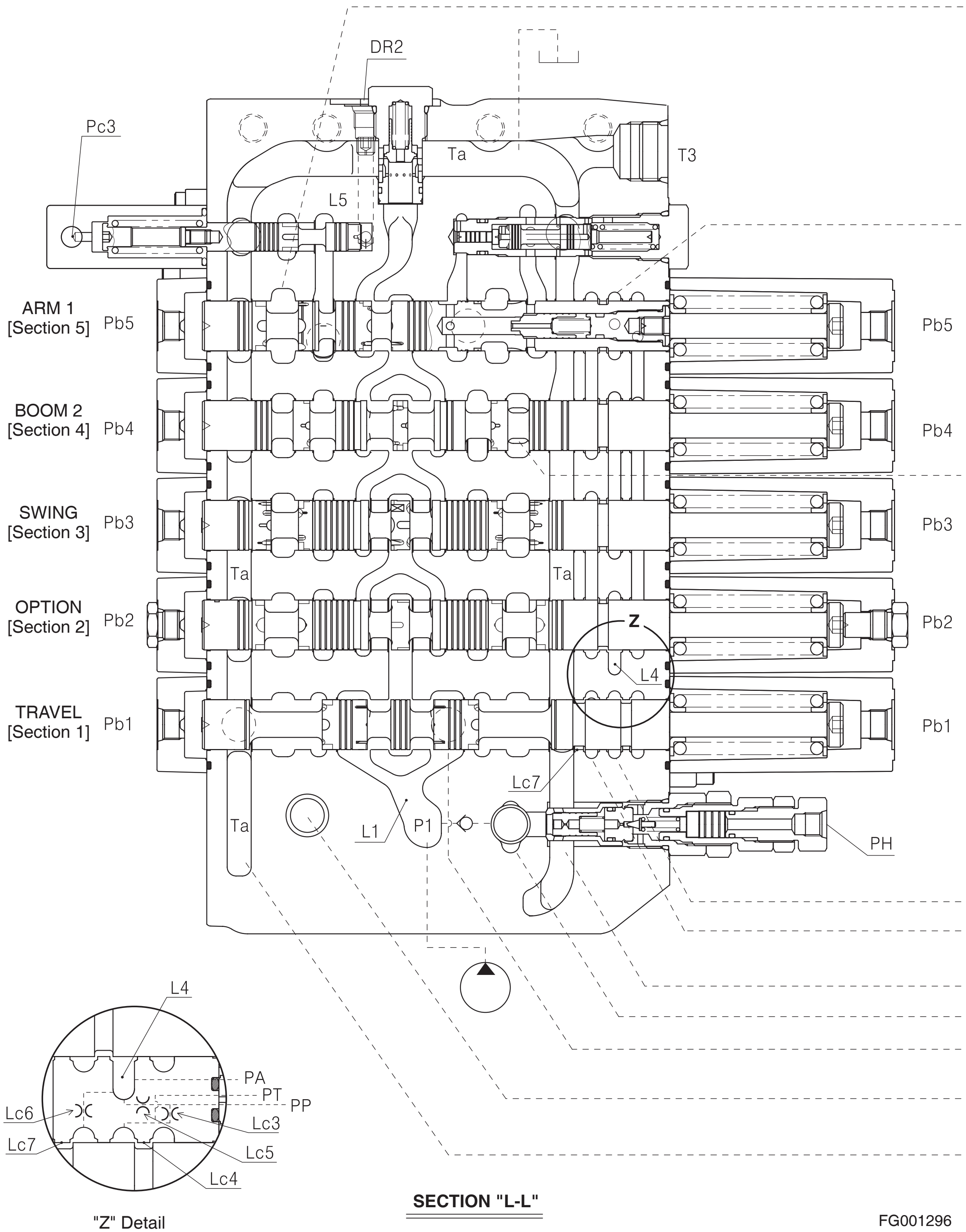

DR2
Pc3
Ta
T3
L5
ARM 1
[Section 5]
Pb5
Pb5
BOOM 2
[Section 4]
Pb4
Pb4
SWING
[Section 3]
Pb3
Pb3
Ta
Ta
OPTION
[Section 2]
Pb2
Z
Pb2
L4
TRAVEL
[Section 1]
Pb1
Pb1
Lc7
Ta
L1
P1
PH
L4
PA
PT
PP
Lc6
Lc3
Lc7
Lc5
Lc4
SECTION "L-L"
"Z" Detail
FG001296

Figure 2

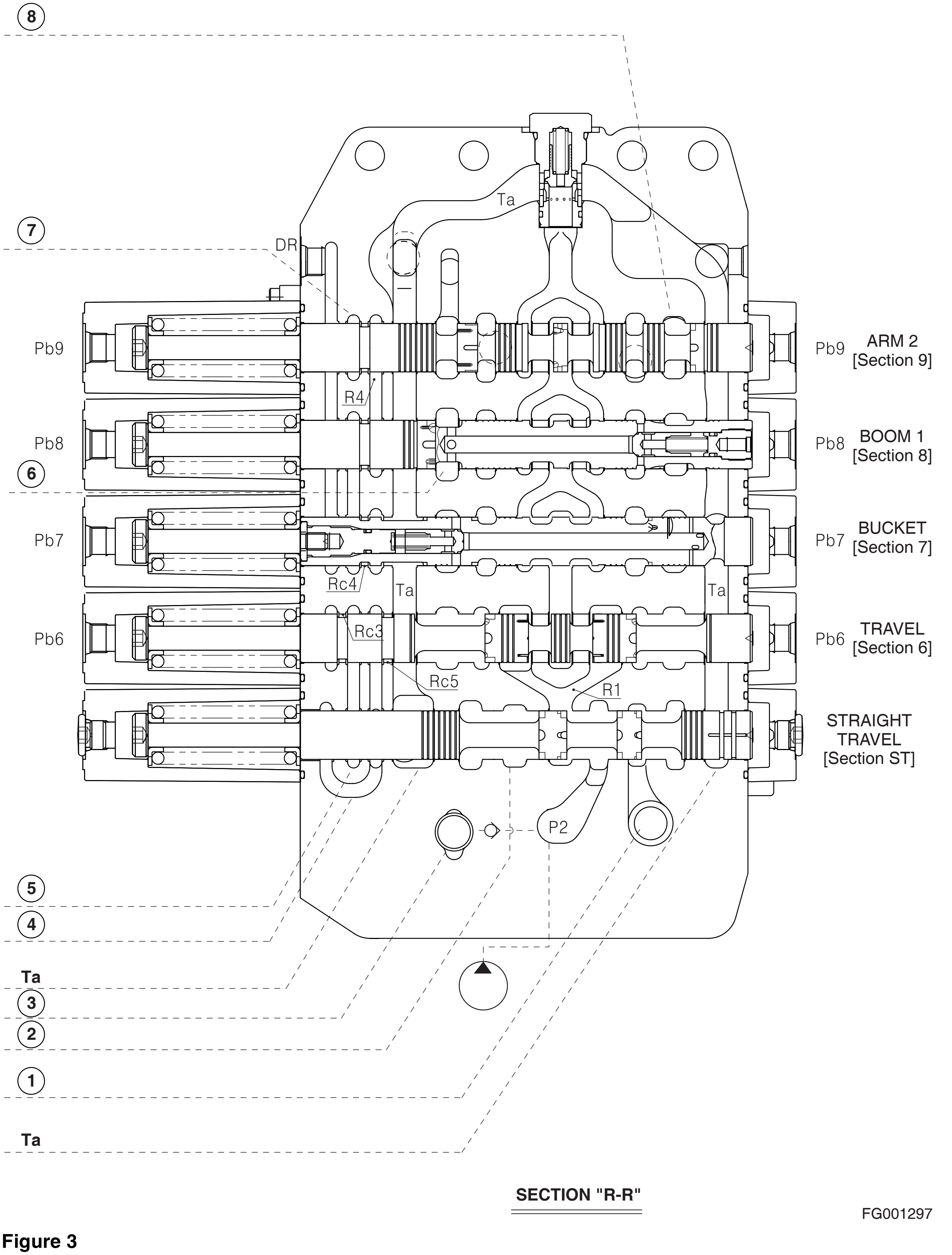

8
7
DR
Ta
Pb9
Pb9
ARM 2
[Section 9]
R4
Pb8
Pb8
BOOM 1
[Section 8]
6
Pb7
Pb7
BUCKET
[Section 7]
Rc4
Ta
Ta
Pb6
Rc3
Pb6
TRAVEL
[Section 6]
Rc5
R1
STRAIGHT
TRAVEL
[Section ST]
P2
5
4
Ta
3
2
1
Ta
SECTION "R-R"
FG001297

Figure 3

Signal Passage

Oil supplied to port (PP) flows through orifice (Lc3) to port (PT) and simultaneously flows through land (Lc4), passage (5), and land (Rc3) into tank passage (Ta).

The same oil supplied to port (PP), then flows through orifice (Lc5) into port (PA), and it also flows through passages (L4, 7 and R4) to bucket spool land (Rc4) and then flows into drain passage (DR).

The oil passing through orifice (Lc6) flows through land (Lc7) to tank passage (Ta) or flows through passage (4) to travel spool land (Rc5) and then flows into tank passage (Ta).

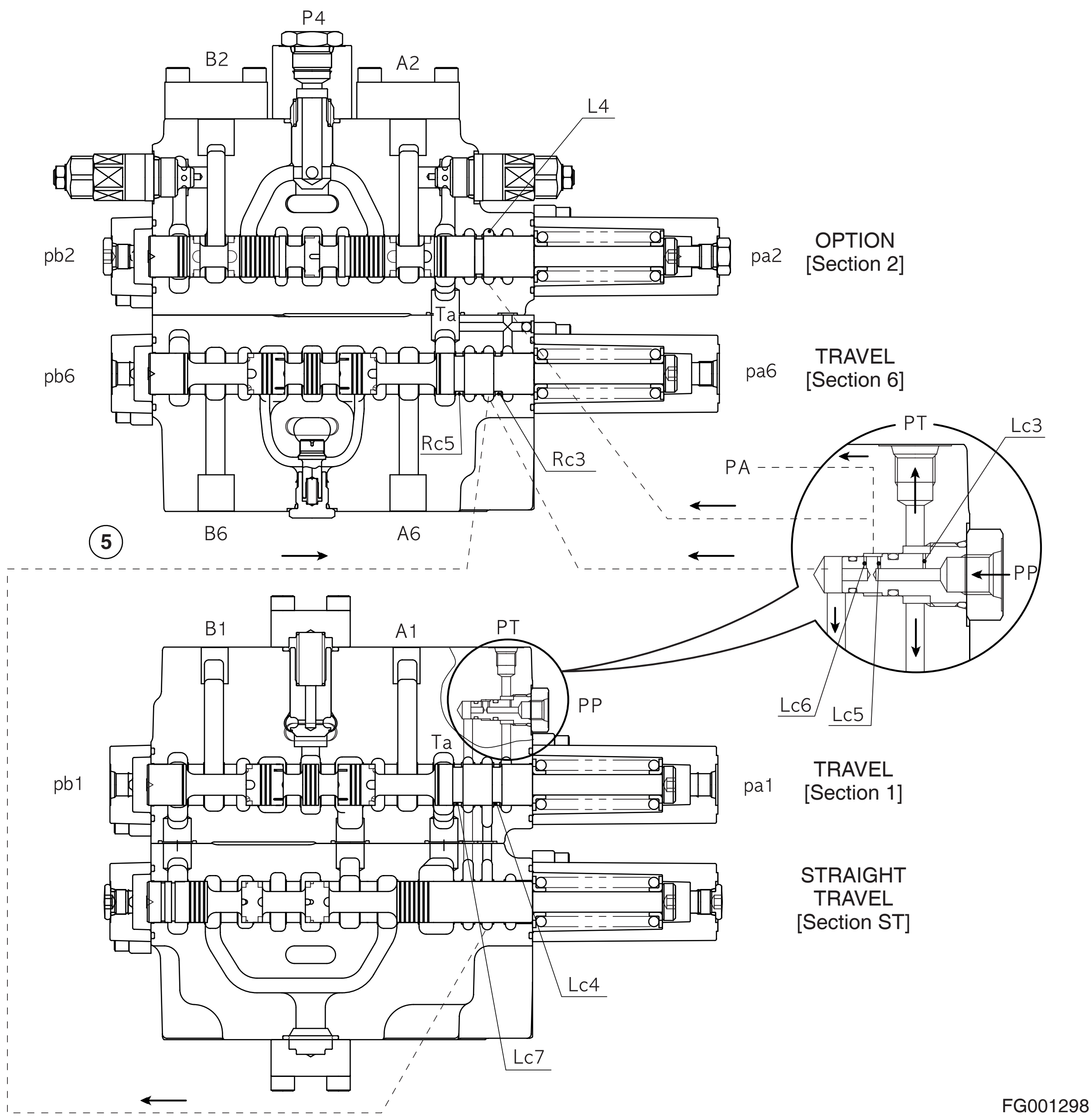


Figure 4

Single Operation

Travel Spool Shift

When shifting travel spool by increasing pressure of travel (Section 1) pilot port (Pb1 (Pa1)), oil supplied to port (P1) flows through neutral passage (L1) to spool and flows to port (B1 (A1)). Return oil flows through port (A1 (B1)), to spool and returns to tank passage (Ta).

When shifting travel spool by increasing pressure of travel (Section 6) pilot port (Pb6 (Pa6)), oil supplied to port (P2) flows through neutral passage (R1) to spool or passage (S6-1) and flows to port (B6 (A6)). At this time, pressure of parallel passage (R3) and passage (S6-1) are equal, so poppet (S6-2) does not open. Return oil flows through port (A6 (B6)) to spool and returns to tank passage (Ta).

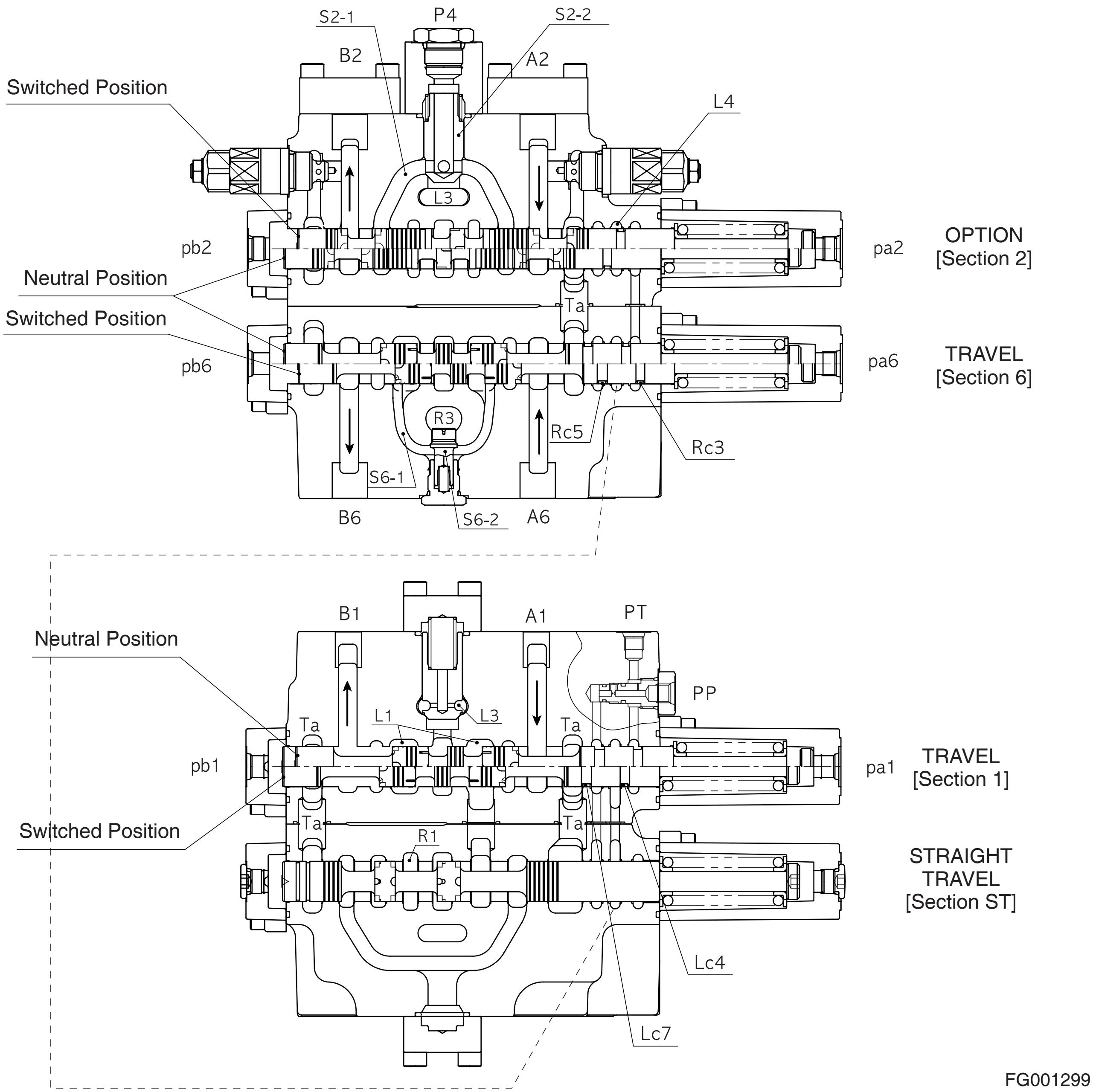
When shifting either spool (Section 1 or 6), land (Lc4) or (Rc3) is closed. Oil supplied from port (PP) does not flow into tank passage, so that pressure at port (PT) rises.

Option Spool Shift

When shifting option spool by increasing pressure of option (Section 2) pilot port (Pb2 (Pa2)), neutral passage (L1) is closed. Oil supplied to port (P1) flows through parallel passage (L3), load check valve (S2-2), passage (S2-1), and spool, it then flows to port (B2 (A2)).

Return oil flows through port (A2 (B2)) to spool and returns to tank passage (Ta).

When oil is also supplied from port (P4), it flows through load check valve (S2-2) and is combined at passage (S-1).



S2-1
P4
S2-2
B2
A2
Switched Position
L4
L3
pb2
pa2
OPTION
[Section 2]
Neutral Position
Ta
Switched Position
pb6
pa6
TRAVEL
[Section 6]
R3
Rc5
Rc3
S6-1
B6
S6-2
A6
B1
A1
PT
Neutral Position
PP
L1
L3
Ta
Ta
pb1
pa1
TRAVEL
[Section 1]
Ta
Ta
Switched Position
R1
STRAIGHT
TRAVEL
[Section ST]
Lc4
Lc7
FG001299

Figure 5

Swing Spool Shift

When shifting swing spool by increasing pressure of swing (Section 3) pilot port (Pb3 (Pa3)), neutral port (L1) is closed. Oil supplied to port (P1) flows through parallel passage (L3), load check valve (S3-2), passage (S3-1) and spool, it then flows to port (B3 (A3)).

Return oil flows through port (A3 (B3)) to spool and is returned to tank passage (Ta).

Bucket Spool Shift

Oil flow control in bucket section portion of valve is different from other sections because it has a regeneration function that works against pilot port pressure.

1. Dump

   When bucket spool is shifted by increasing pressure of bucket (Section 7) pilot port (Pa7), neutral passage (R1) is closed. Oil supplied to port (P2) flows through parallel passage (R3), load check valve (S7-2), passage (S7-1), spool and into port (B7).

   Oil returns through port (A7) and spool to tank passage (Ta).

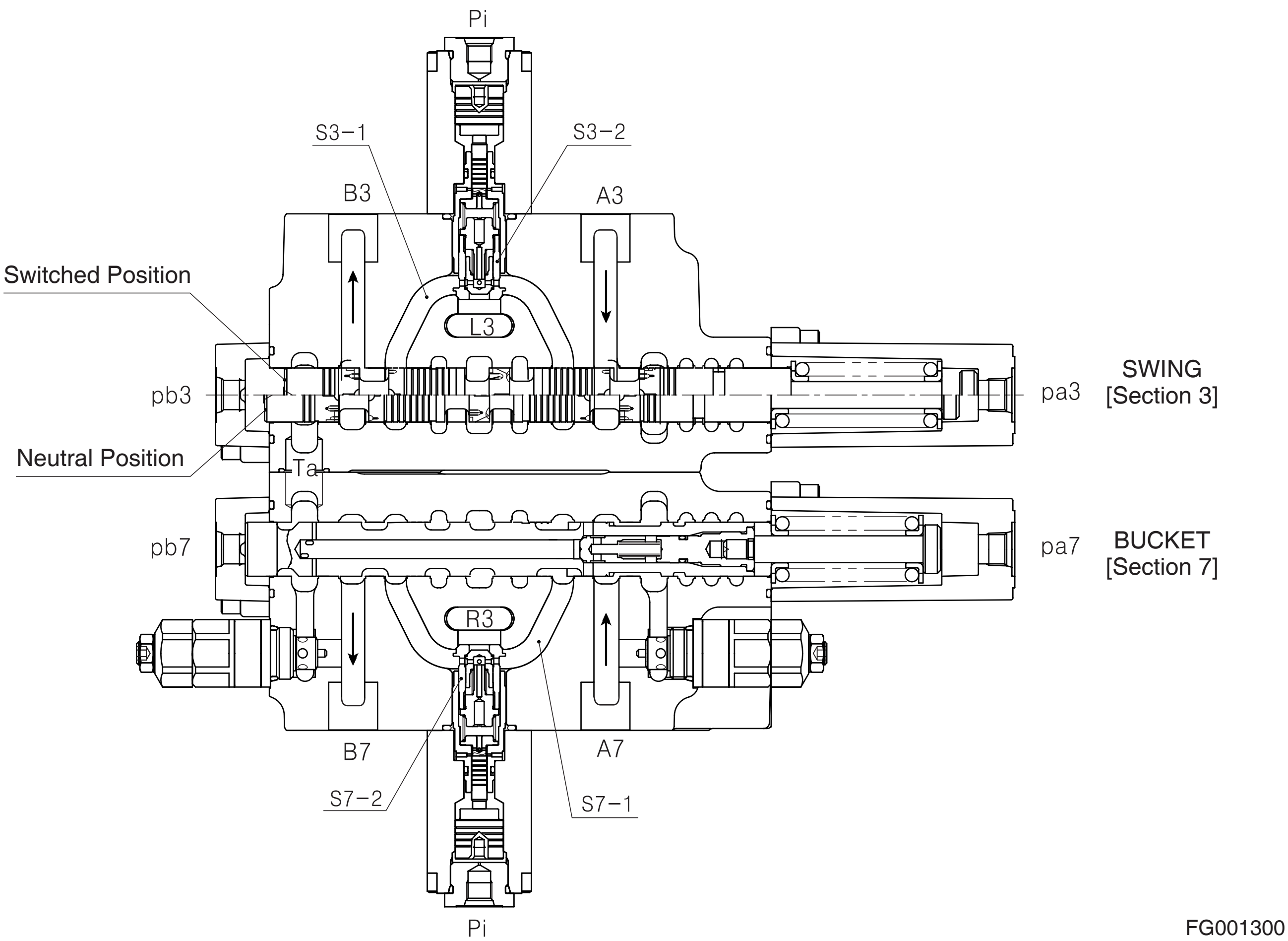

Pi
S3-1
S3-2
B3
A3
Switched Position
L3
pb3
pa3
SWING
[Section 3]
Neutral Position
Ta
pb7
pa7
BUCKET
[Section 7]
R3
B7
A7
S7-2
S7-1
Pi
FG001300

Figure 6

2. Regeneration

When bucket spool is shifted by increasing pressure of bucket (Section 7) pilot port (Pb7), neutral passage (R1) is closed. Oil supplied to port (P2) flows through parallel passage (R3), load check valve (S7-2), passage (S7-1), spool and into port (A7).

Oil flows through port (B7) and one portion of the oil returns through spool to tank passage (Ta), and the other portion of oil flows through inside of spool, and pushes up load check, and then is combined at port (A7).

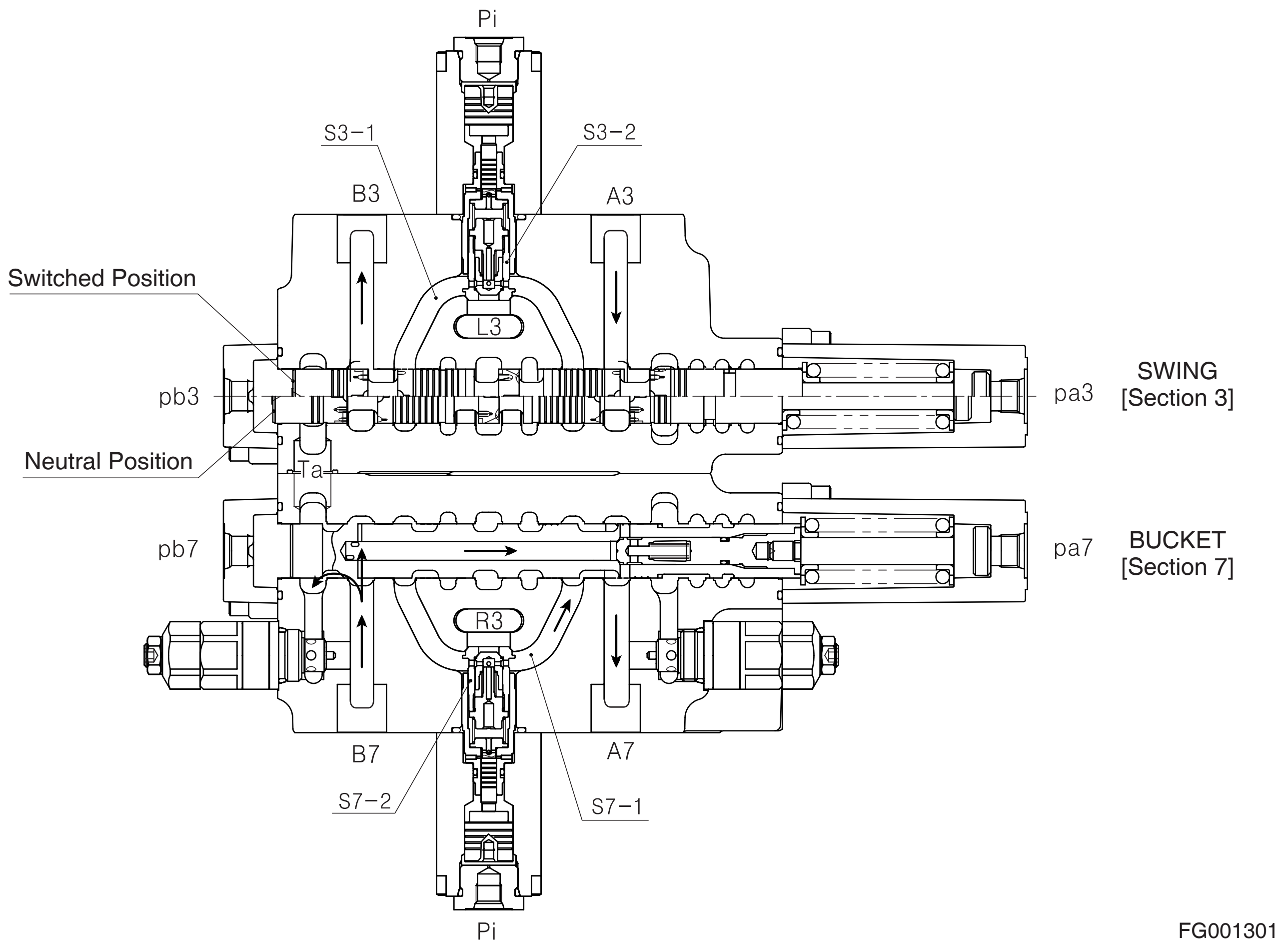


Figure 7

Boom Spool Shift

1. Neutral

   This valve also works with anti drift valves that are installed on the bottom side of each boom cylinder.

   When in neutral, poppet (AD1) is closed by port (A8) pressure that is sent through passage (AD2), spool (AD3) to spring chamber (AD4).

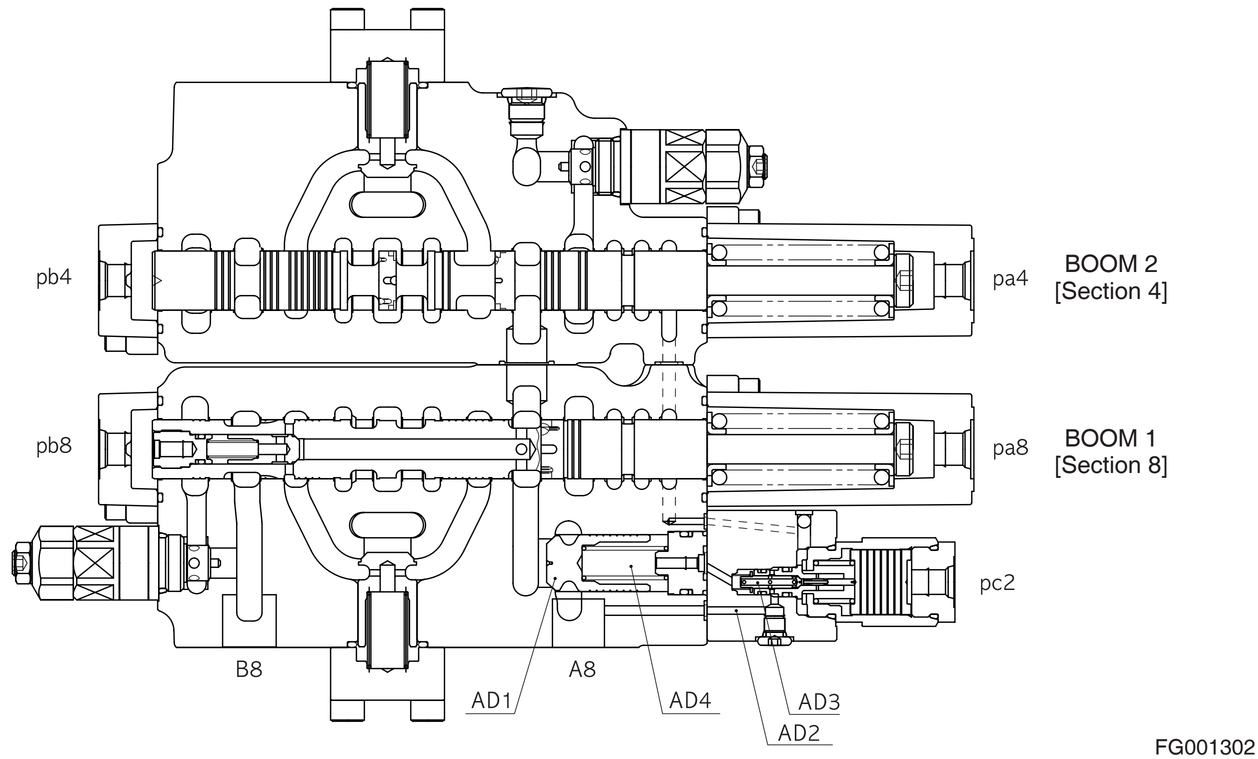


Figure 8

2. Boom up (2-pump confluence)

When boom 1 spool is shifted by increasing pressure of boom 1 (Section 8) pilot port (Pa8), neutral passage (R1) is closed. Oil supplied to port (P2) flows through parallel passage (R3) and load check valve (S8-2) to spool and flows into port (A8).

When boom 2 spool is shifted by increasing pressure of boom 2 (Section 4) pilot port (Pb4), neutral passage (L1) is closed. Oil supplied to port (P1) flows through parallel passage (L3), load check valve (S4-2), spool, and to passage (6) and joins at port (A8). Return oil flows from port (B8) to spool and returns to tank passage (Ta).

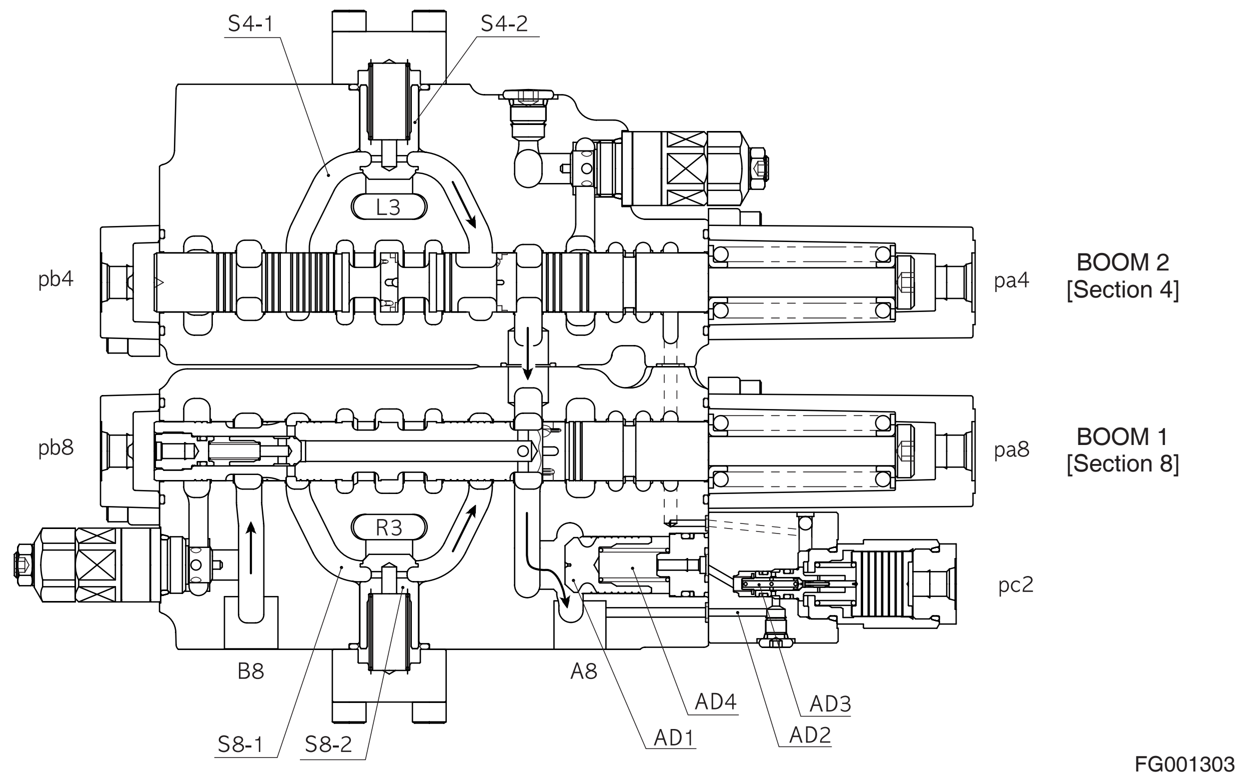


Figure 9

3. (Boom down (regeneration)

When boom 1 (Section 8) spool is shifted by increasing pressure of boom 1 pilot port (Pb8), neutral passage (R1) is closed. Oil supplied to port (P2) flows through parallel passage (R3) and load check valve (S8-2) to spool and flows into port (B8).

When spool (AD3) of antidrift valve is shifted by increasing pressure of port (P2), poppet (AD1) is opened by decreasing of pressure of spring chamber (AD4), and return oil from port (A8) flows to tank passage. Some return oil opens poppet (S8-3) in boom 1 spool, flows through passage (S8-2), joins at port (B7), and then prevents cavitation of cylinder rod side.

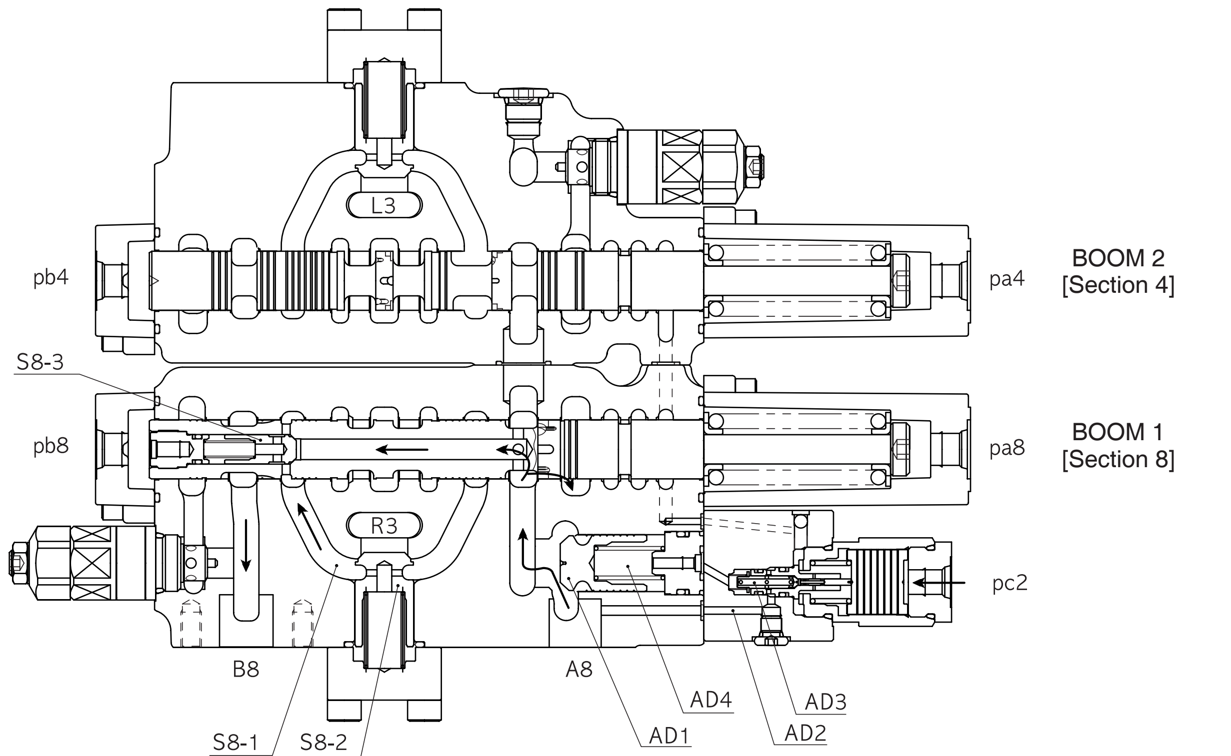


Figure 10

Arm Spool Shift

1. Neutral

   This valve also works with an anti drift valve that is installed on rod side of the arm cylinder.

   When in neutral, poppet (AD1) is closed by port (A5) pressure that is sent through passage (AD2), spool (AD3) and to spring chamber (AD4).

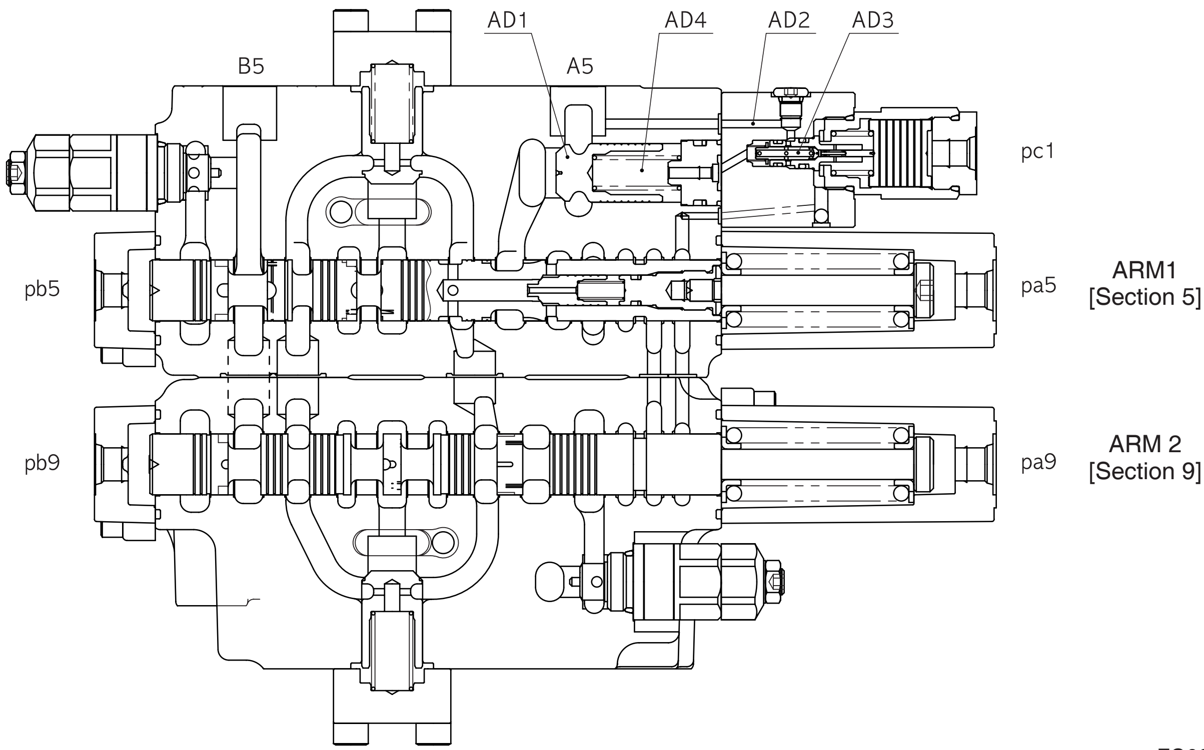


Figure 11

2. Arm in

A. 2-pump confluence

When arm 1 spool is shifted by increasing pressure of arm 1 (Section 5) pilot port (Pb5), oil supplied to port (P1) flows through neutral passage (L1), load check valve (S5-2), passage (S5-1) and spool into port (B5).

When arm 2 spool is shifted by increasing pressure of arm 2 (Section 9) pilot port (pb9), oil supplied to port (P2) flows through neutral passage (R1), load check valve (S9-1), passage (S9-2), and spool to passage (8) and joins at port (B5).

The return oil from port (B5) flows through regeneration check valve in spool, and then flows to port B to regenerate, and some oil returns through variable regeneration release valve to tank (Ta). (Refer to section 2-2)

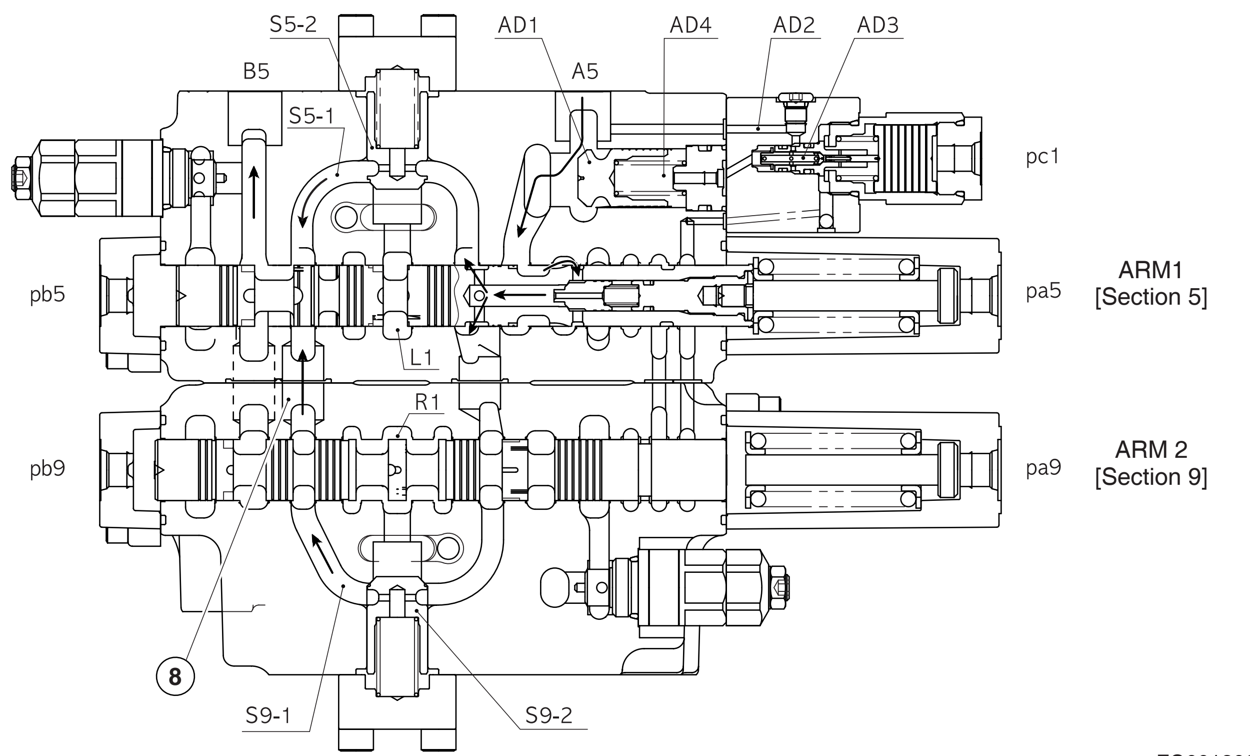


Figure 12

B. Variable regeneration

When crowding arm, after return oil from port (A5) flows through notch (a), one portion of the oil returns through fixed orifice (d), passage (e) and variable orifice (f) and to tank passage (Ta). The other portion of the oil flows through fixed orifice (b), regeneration check (c), and fixed orifice (i) in arm 1 spool, and joins in bridge passage (S5-1).

From there, if load pressure of port (B) is increased, it flows through regeneration release valve piston (g) and pushes regeneration release spool (h), as a result area of variable orifice (f) is increased, and oil returning to tank (Ta) is increased, and some oil to regenerate in port (B5) is decreased.

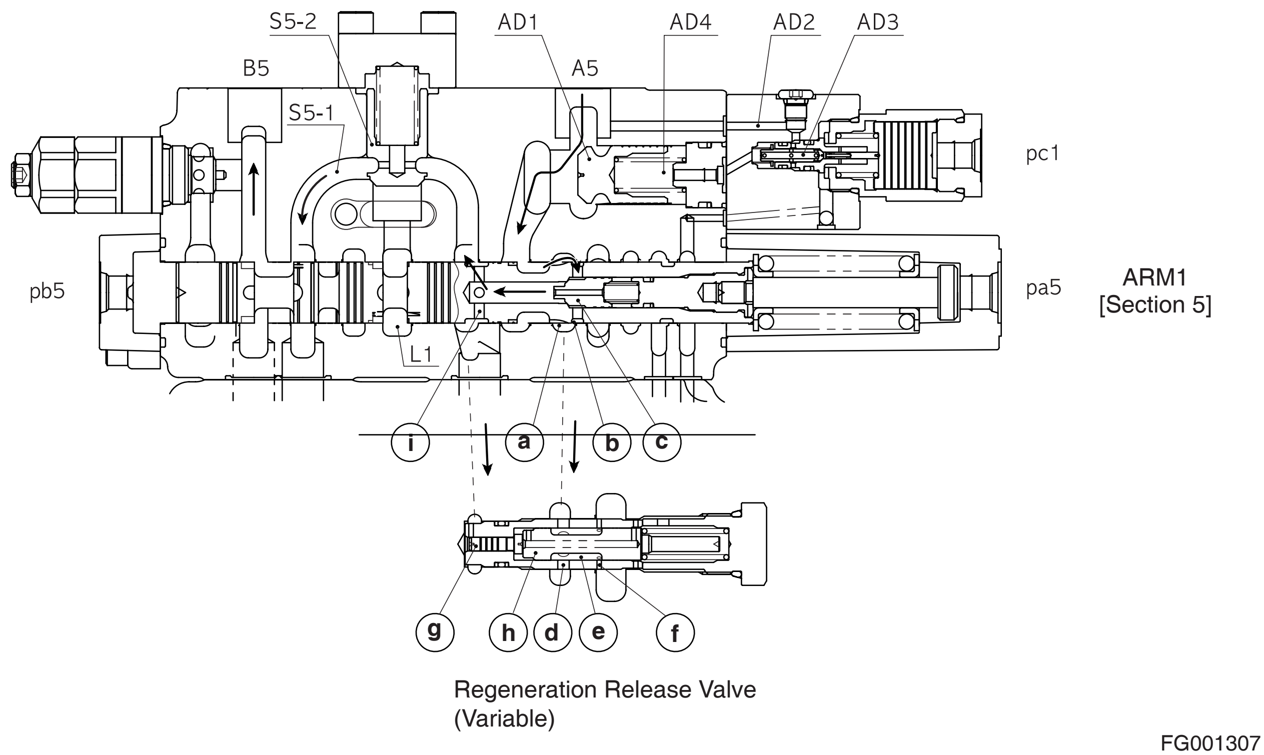


Figure 13

3. Arm out (2-pump confluence)

When arm 1 spool is shifted by increasing pressure of arm 1 (Section 5) pilot port (Pa5), oil supplied to port (P1) flows through neutral passage (L1), load check valve (S5-2), passage (S5-1) and spool and into port (A5).

Oil supplied to port (P2) flows through neutral passage (R1), load check valve (S9-2), passage (S9-1), spool and passage (8) and joins at port (A5). Return oil from port (B5) returns through spool to tank passage (Ta).

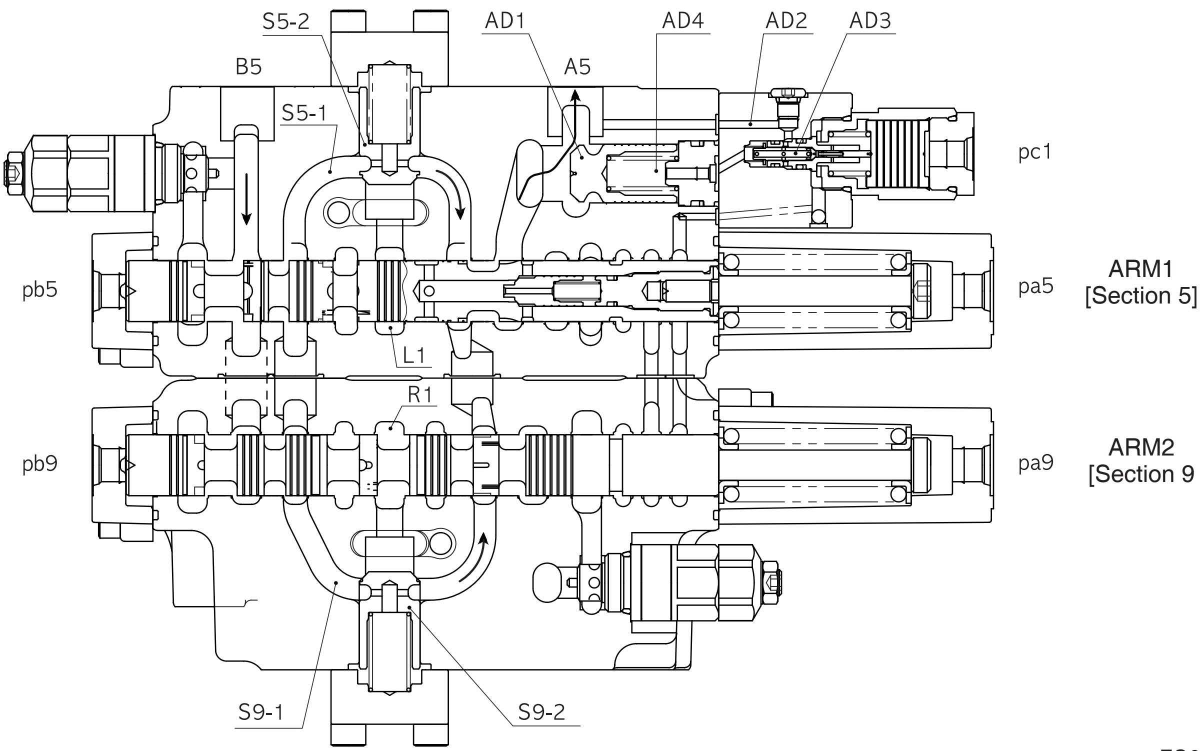


Figure 14

Parallel Orifice for Arm

The orifice, that is installed in parallel passage for arm 1, controls arm speed when operating in a combined operation. Oil supplied from parallel passage (L3) of arm 1 (Section 5) pushes open poppet (S5-3). It then flows through orifice (Lc8) of variable orifice spool, and then is connected to passage (L5). From here, flow of orifice (Lc8) can be varied by increasing or decreasing pressure against pilot poppet (Pc3).

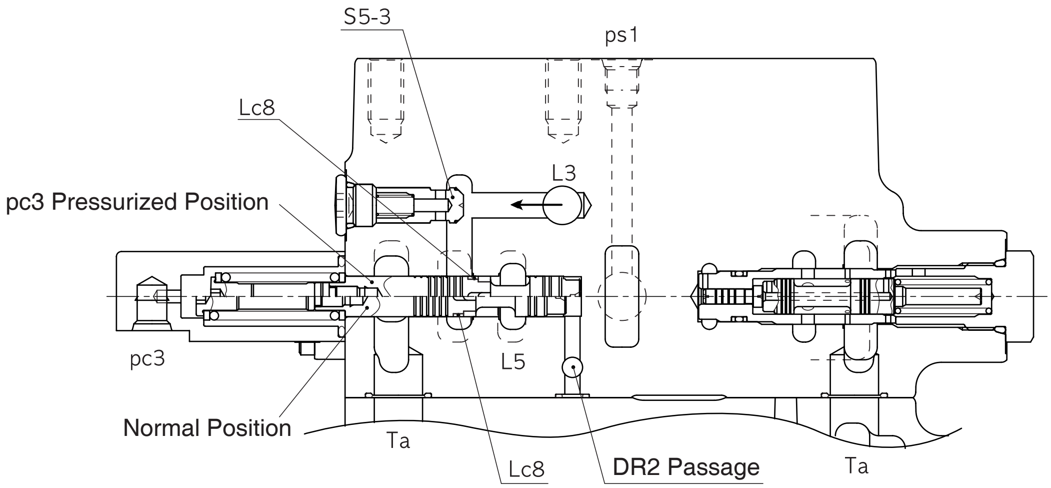


Figure 15

Relief Valve

1. Main relief valve

   Oil supplied to port (P1) flows through poppet (LP). Oil supplied to port (P2) flows through poppet (RP) and passage (3). They join at the main relief valve. The highest pressure of pump (P1 and P2) is controlled by reaction of main relief valve.

2. Overload relief valve

   The overload relief valve, that is installed in each cylinder port of boom 1, arm 1 and bucket, prevents pressure of actuator from increasing extremely high from outside forces. This relief valve, when pressure of cylinder port is negative, has a function to prevent cavitation by drawing oil from tank.

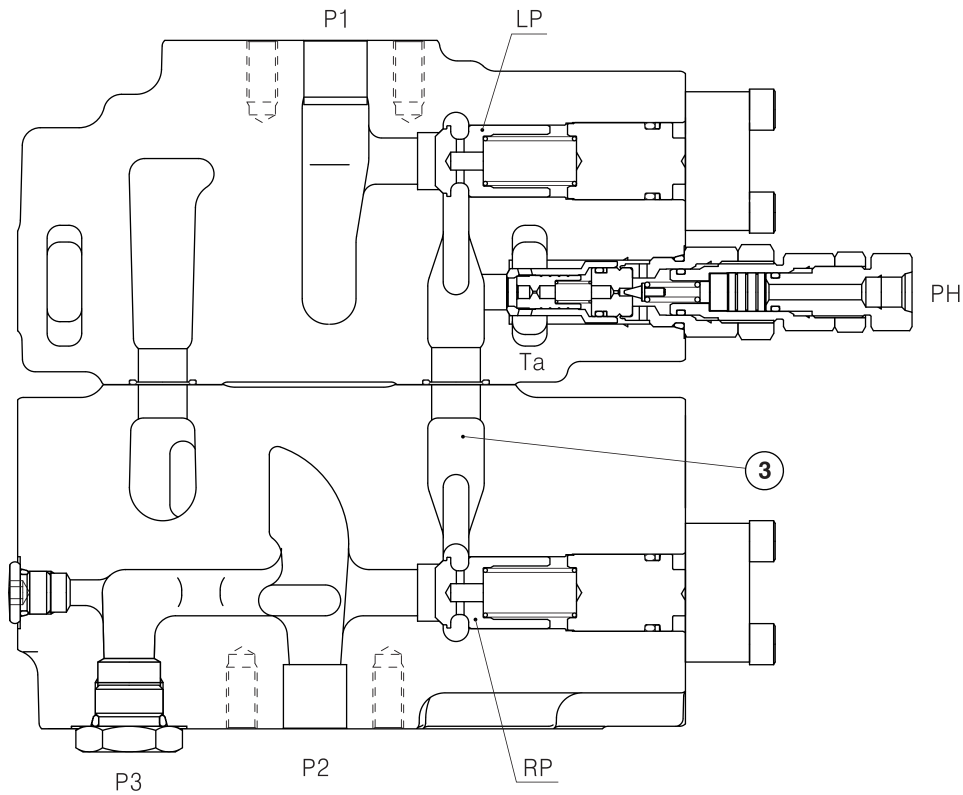


Figure 16

Compound Operation

Travel Compound Operation

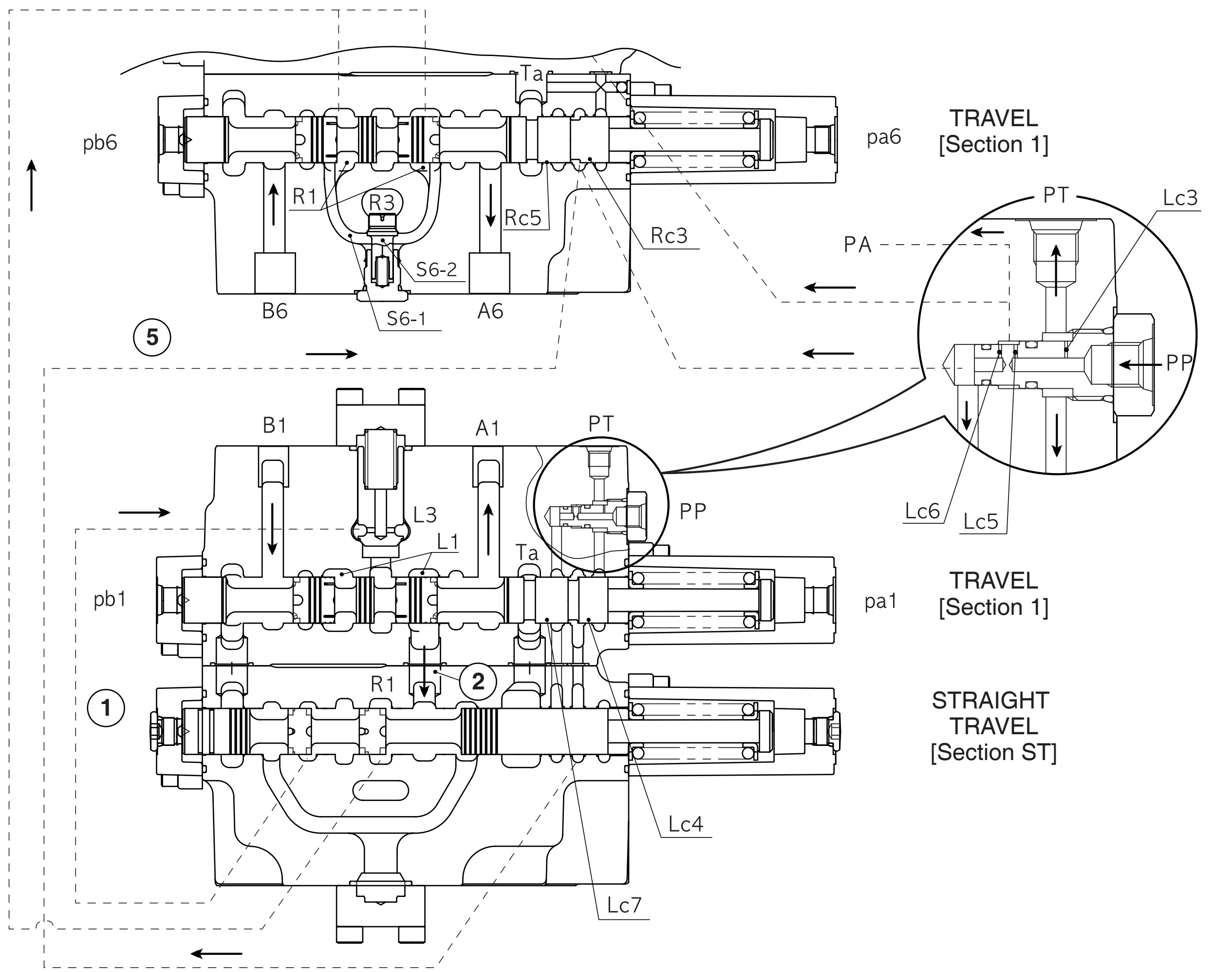
In the event of operating another function when the traveling left or right (when advancing, backing, or pivot turning) or operating for travel operation during the operation other than traveling, the oil supplied from the port (PP) is cut off from the tank passage (Ta) in the signal land part of the section other than the travel shifted from the land (Lc4), (Lc7), (Rc3), and (Rc5), and the pressure of the signal passage is increased to the relief set pressure of the oil origin for signal.

Due to the increase of the signal pressure, the spool before traveling is shifted to cause an increase of pressure in ports (PT and PA).

When the straight travel spool is shifted, the oil supplied from port (P1) flows to travel (section1) from neutral passage (L1) while oil supplied to port (P2) flows into travel (section 6) after passing through passage (2), straight travel spool head, and neutral passage (R1) flowing into the parallel passage (L3) after passing the straight travel spool head, and passage (1).

In the event that load pressure of section other than traveling is higher than the travel (Section 6) load pressure, some of the oil supplied from port (P2) pushes and opens poppet (S6-2), and it merged into the passage (S6-1) after passing the orifice of the poppet.

The operation is made by oil supplied from travel (Section 1 and 6) port (P1), and work device other than traveling is operated by the oil supplied from the port (P2), and projection is prevented when operating with travel operation and other work device.



Ta
pb6
pa6
TRAVEL
[Section 1]
R1
R3
Rc5
Rc3
S6-2
B6
S6-1
A6
5
PT
Lc3
PA
PP
B1
A1
PT
L3
L1
PP
Lc6
Lc5
Ta
pb1
pa1
TRAVEL
[Section 1]
R1
2
1
STRAIGHT
TRAVEL
[Section ST]
Lc4
Lc7
FG001310

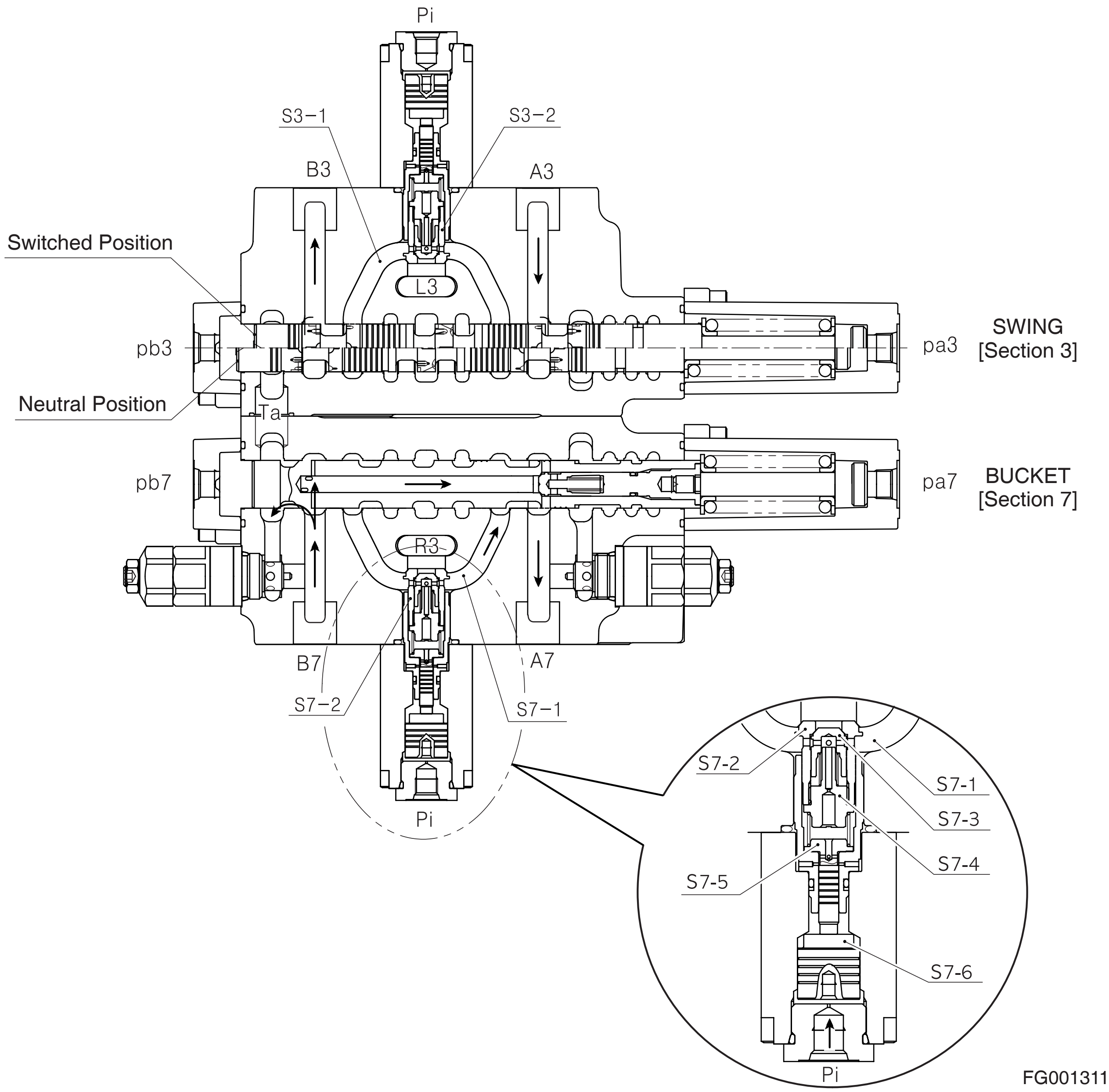
Figure 17

Bucket Compound Operation

A priority control valve is installed in bucket (Section 7). This valve controls oil flow entering into bucket when operating during a combined operation with travel, boom 1, and arm 2 sections, on P2 side.

If pressure at port (Pi) is increased when operating bucket, piston (S7-6), piston (S7-5) and plug (S7-4) are pressed, and poppet assembly (S7-2) is seated on valve housing. This causes oil flowing from parallel passage (R3) to open poppet (S7-3) in poppet assembly and flow into passage (S7-1).

As a result, passage diameter is smaller during combined operation, than passage diameter during a single operation. This smaller passage reduces flow of oil to port (A7, B7). Remaining oil flows through parallel passage (R3) and primarily flows to section being operated at P2 side during a combine operating procedure.



Pi
S3-1
S3-2
B3
A3
Switched Position
L3
pb3
pa3
SWING
[Section 3]
Neutral Position
Ta
pb7
pa7
BUCKET
[Section 7]
R3
B7
A7
S7-2
S7-1
S7-2
S7-1
S7-3
S7-4
S7-5
S7-6
Pi
Pi
FG001311

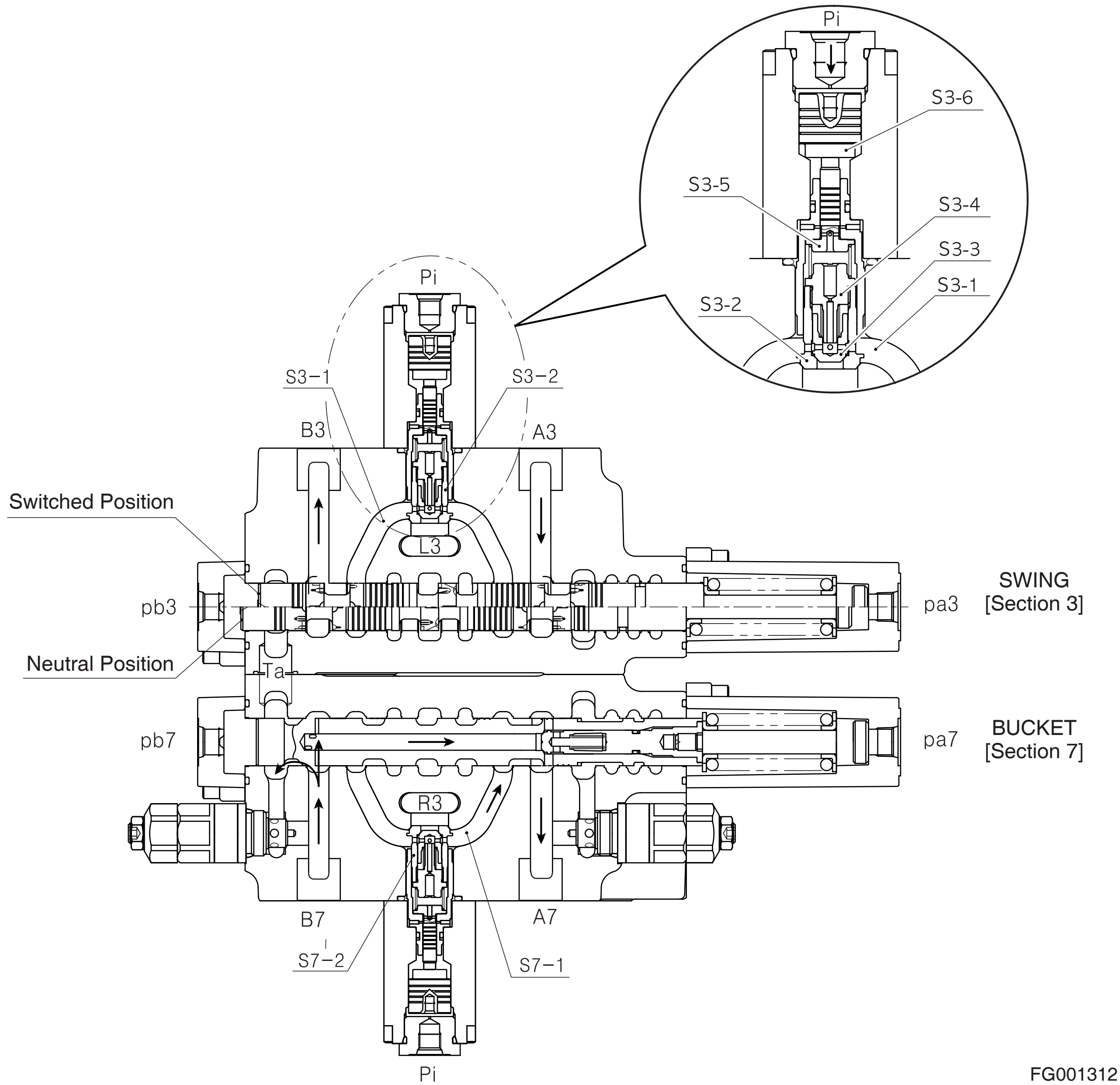
Figure 18

Swing Compound Operation

The valve's swing Section (Section 3) is equipped with the control valve that adjusts the flux that flows into the swing when combined operating with the Section (travel, boom 2, arm 1) of P1.

If port (Pi) is pressurized when operating swing function, piston (S3-6) is pushed to have the poppet assembly (S3-2) to be pressed under the seat part of the valve housing through the piston (S3-5) and plug (S3-4). In this way, the oil in the parallel passage (L3) is flowing into the passage (S3-1) by pushing up the poppet (S3-3) inside the poppet assembly.

As a result, the passage at the time of compound operation is tightened more than when single operation that the flux flowing into A3 (B3) is reduced, and the surplus flux is advanced to the section that P1 is simultaneously operated through the parallel passage (L3).



Pi
S3-6
S3-5
S3-4
S3-3
S3-1
S3-2
Pi
S3−1
S3−2
B3
A3
Switched Position
L3
SWING
[Section 3]
pb3
pa3
Neutral Position
Ta
BUCKET
[Section 7]
pb7
pa7
R3
B7
A7
S7−2
S7−1
Pi
FG001312

Figure 19

Antidrift Valve

The antidrift valve is installed on the cylinder port on the arm load (boom bore) for the natural antidrift of the arm (boom) cylinder. (For typical example, arm (A5) is shown.)

1. Neutral condition (maintaining port (A5))

   A. The holding pressure of port (A5) is sent through passages (a, b, and c), and into spring chamber (d) of poppet (1). At this time pressurized oil flow, from port (A5) is cut off by seats (S1 and S2).

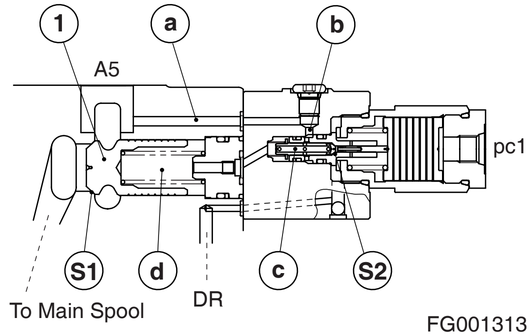


Figure 20

2. Oil passage cut off condition of the port (A5) and the spring chamber.

   A. If port pc1 is pressurized, piston (2) is moved and spool (3) reacts.

   B. Spool (3) activates poppet (4).

   C. Then by moving poppet (4), port (A5) and spring chamber (d) is cut off by part (T1).

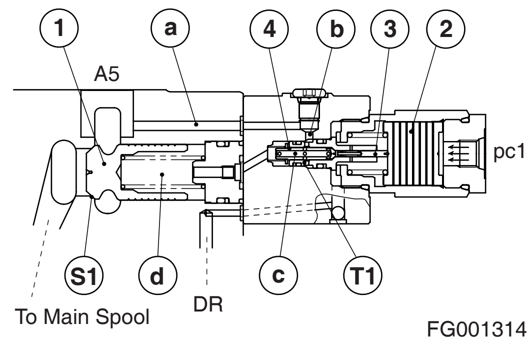


Figure 21

3. Main poppet operation condition.

   A. When the piston (2) starts, the spring chamber (d) passes from the passage (c) to the passage (e) and connect the oil passage by the part (T2) to the drain chamber (DR).

   B. The spring chamber (d) drains pressure and the main poppet (1) starts to unseat.

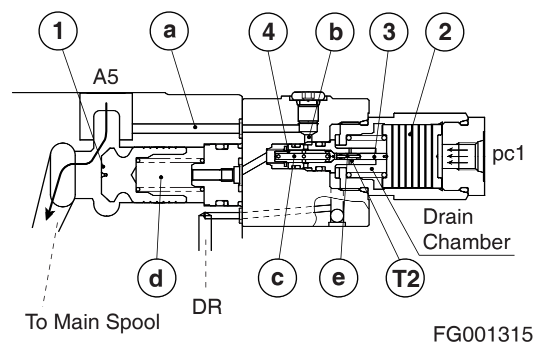


Figure 22

Main Relief Valve

1. The main relief valve is between neutral oil passage (HP, Figure 23) and low-pressure oil passage (LP). Pressurized oil flows into neutral oil passage (HP) through orifice in the main poppet (C) to fill internal cavity (D). Due to the difference in areas between (A and B), on which hydraulic pressure acts, main poppet (C) seats on sleeve (E).

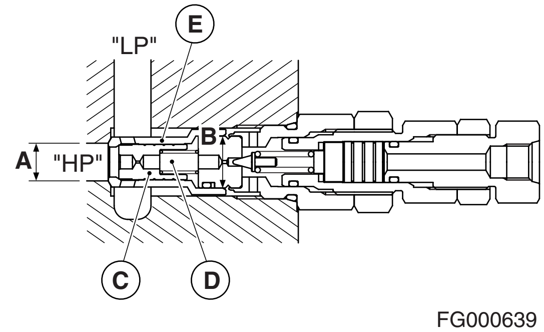


Figure 23

2. When pressure in neutral oil passage (HP) rises and exceeds relief valve setting, pilot poppet (F) opens. Pressurized oil flows through pilot poppet (F) into low-pressure oil passage (LP), passing through hole (G).

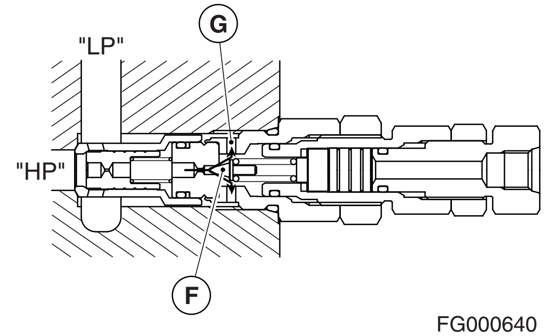


Figure 24

3. As pilot poppet (F) opens, pressure in internal cavity (D) lowers to move main poppet (C) so that pressurized oil flows into neutral oil passage (HP) and directly into low-pressure oil passage (LP).

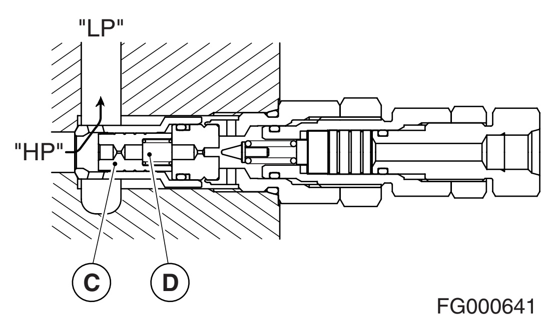


Figure 25

4. Pressure up operation

   If pressure is applied to pilot port "PH," piston (H) moves to the pressure setting position of plug (I) so that the force of spring increases, thus increasing pressure in the neutral oil passage (HP).

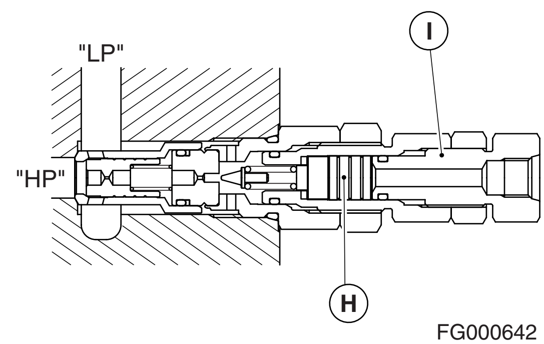


Figure 26

Overload Relief Valve

Operation

1. The overload relief valve is between cylinder port (HP) and low-pressure oil passage (LP). Pressurized oil at cylinder port (HP), flows through an orifice in piston (C), to fill internal cavity (G). Due to the difference in area between (A and B) on which the hydraulic pressure acts, main poppet (D) seats on sleeve (K).

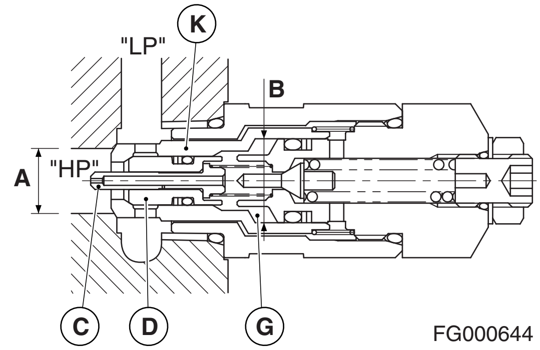


Figure 27

2. When pressure in cylinder port (HP) rises and exceeds the relief valve setting, pilot poppet (E) opens. Pressurized oil then flows through pilot poppet (E) into low-pressure oil passage (LP), passing through hole (H).

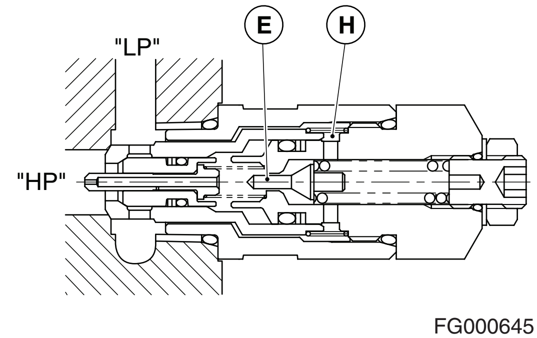


Figure 28

3. As pilot poppet (E) opens, pressurized oil flows through orifice (I) so that pressure on back of piston (C) lowers to move piston (C). As a result, piston (C) seats on pilot poppet (E).

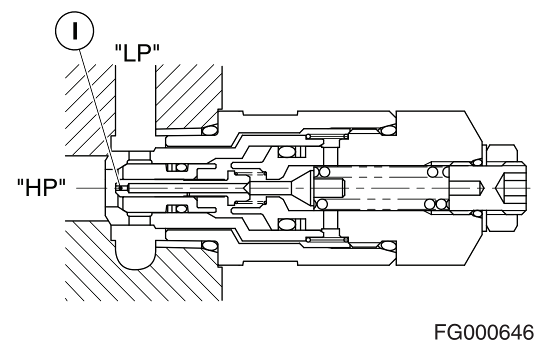


Figure 29

4. Pressurized oil in passage (HP) flows through orifice (F) in piston (C) so that pressure on back of main poppet (D) moves main poppet (D). Pressurized oil then flows into passage (HP) and directly into passage (LP).

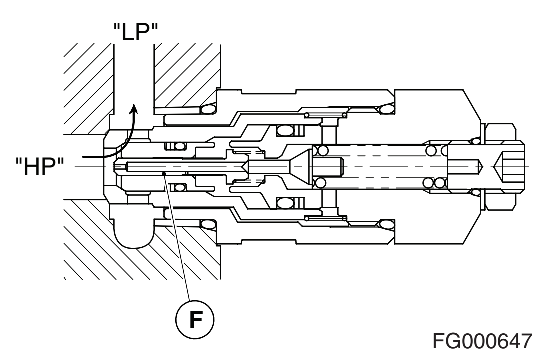


Figure 30

Absorption Operation

An anti void unit is installed in cylinder port (HP) to prevent the development of cavitation. If pressure at cylinder port (HP) becomes lower than that of oil passage (LP), sleeve (K) moves so that oil is supplied from the low-pressure oil passage (LP) to cylinder port (HP) to eliminate cavitation.

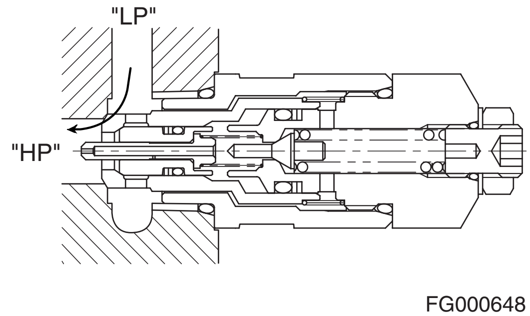


Figure 31

Low-pressure Relief Valve

1. Signal pressure

   Oil supplied from pump port (P1 (P2)) flows through neutral passage (L1 (R1)), low-pressure relief valve passage (L2 (R2)), and orifice (Lc1 (Rc1)) to tank passage (Ta).

   Now, pressure generated at passage (L2 (R2)) by orifice (Lc1 (Rc1)) moves to low-pressure relief signal port (Ps1 (Ps2)).

   If main spool of upper reaches of L2 (R2)) operates, signal pressure of Ps1 (Ps2) decreases because oil flowing to L2 (R2) decreases.

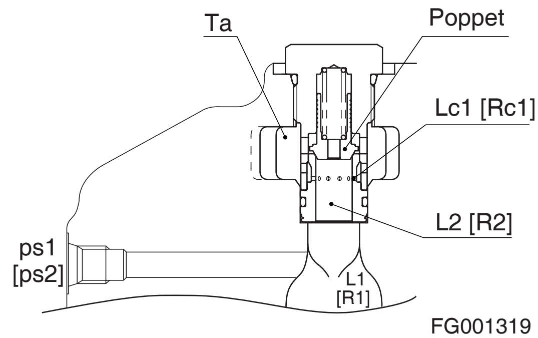


Figure 32

2. Operation of relief

   If excessive oil flows into passage (L2 (R2)), pressure generated at passage (L2 (R2)) by orifice (Lc1 (Rc1)) goes to back chamber of poppet, and poppet operates by the difference of pressurized area between passage and back chamber.

   By operation of this poppet, oil flows from passage through plug and drill hole to tank passage (Ta). By this action, generation of excessive pressure in low-pressure relief signal port is prevented.

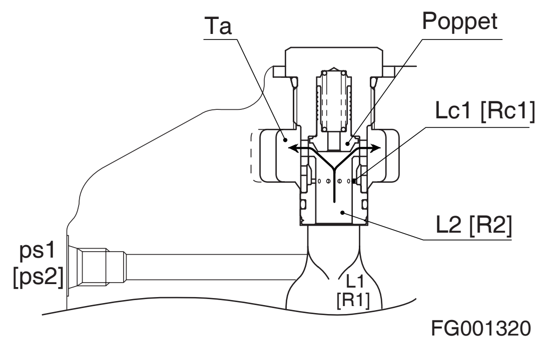


Figure 33

Parts List

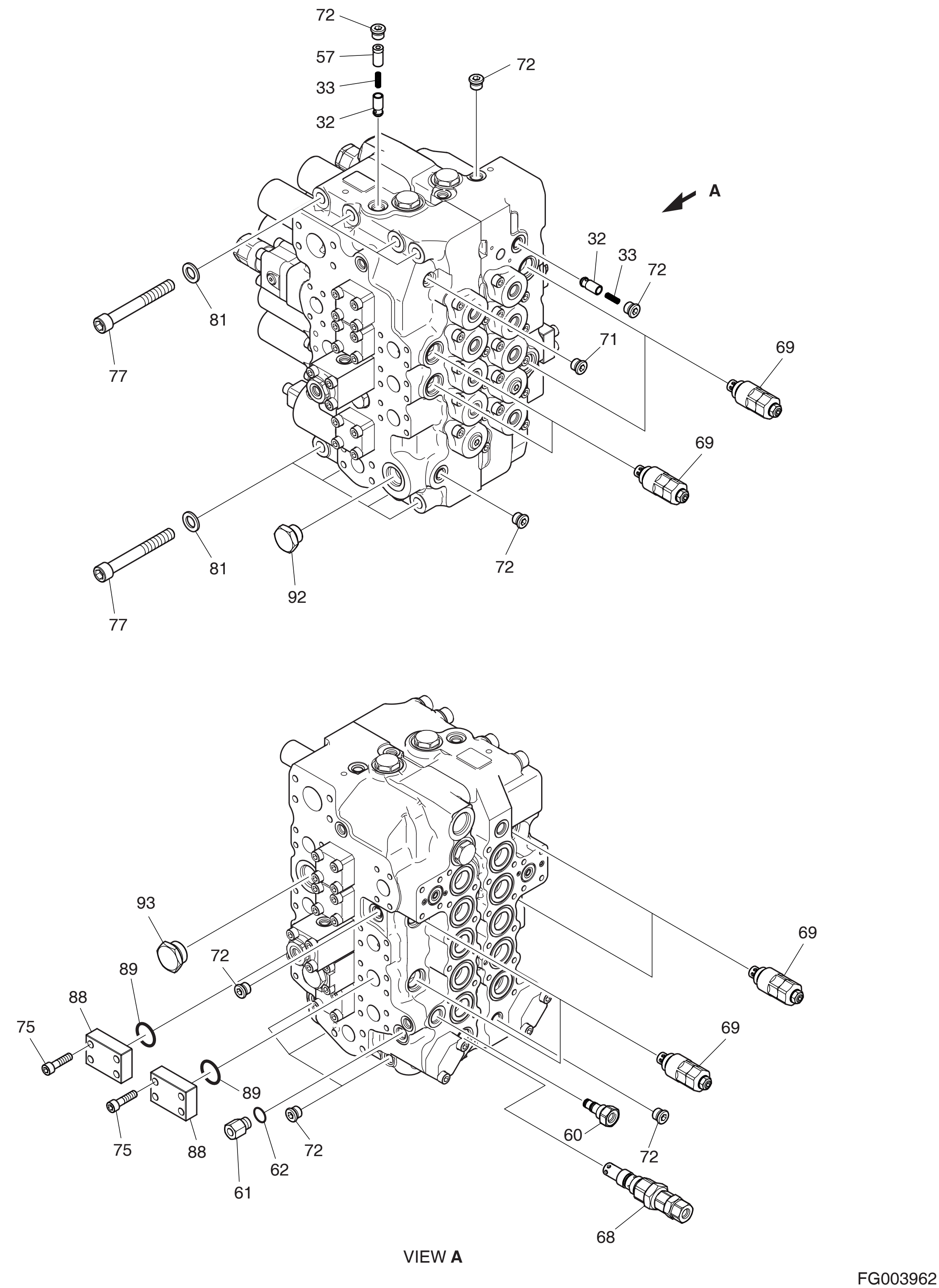


Figure 34

Reference Number	Description
32	Poppet
33	Spring
57	Spacer
60	Plug Assembly
61	Plug
62	O-ring
68	Main Relief Valve
69	Overload Relief Valve
71	Plug Assembly

Reference Number	Description
72	Plug Assembly
75	Socket Bolt (M10 x40L)
77	Socket Bolt (M16 x130L)
81	Washer
88	Cap
89	O-ring
92	Plug Assembly
93	Plug Assembly

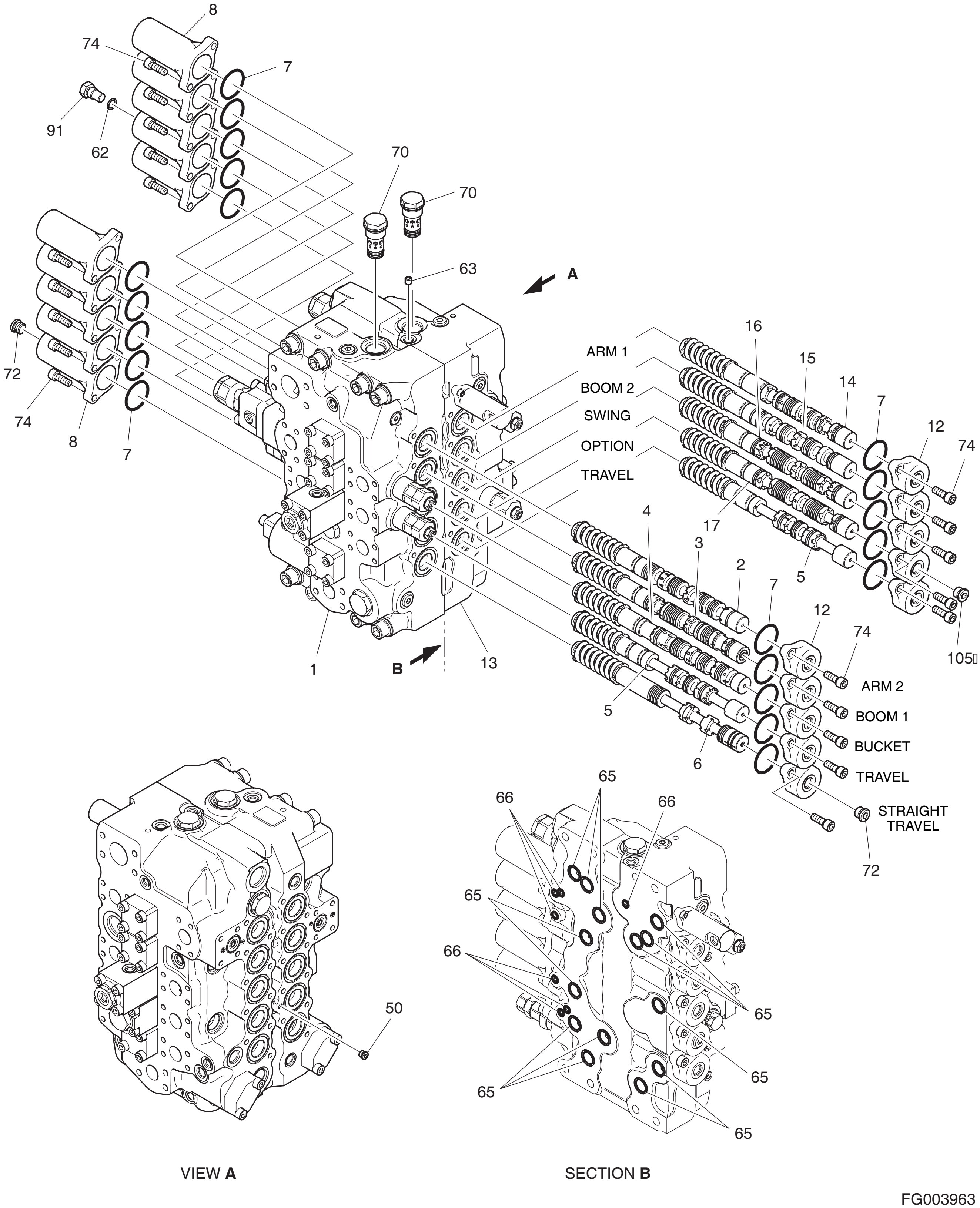
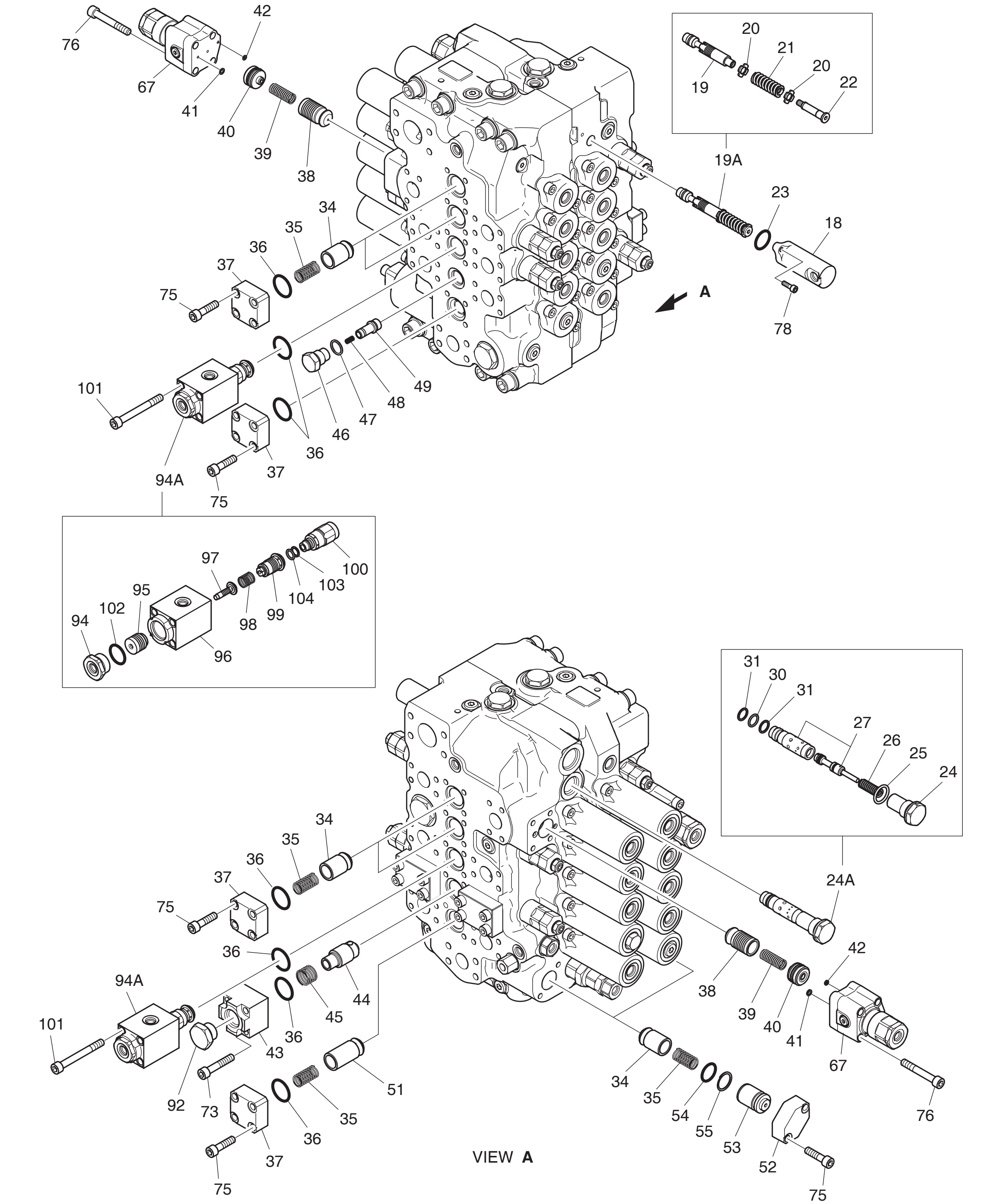

8
74
7
91
62
70
70
63
A
72
74
8
7
16
15
14
7
12
74
ARM 1
BOOM 2
SWING
OPTION
TRAVEL
4
17
3
2
7
5
12
74
105
1
B
13
5
ARM 2
BOOM 1
BUCKET
TRAVEL
6
STRAIGHT
TRAVEL
72
65
66
66
65
66
50
65
65
65
65
VIEW A
SECTION B
FG003963

Figure 35

Reference Number	Description
1	Housing Valve
2	Arm Spool Assembly 2
3	Boom Spool Assembly 1
4	Bucket Spool Assembly
5	Travel Spool Assembly
6	T/S Spool Assembly
7	O-ring
8	Cap
12	Cap
13	Housing Valve
14	Arm Spool Assembly 1
15	Boom Spool Assembly 2

Reference Number	Description
16	Swing Spool Assembly
17	Option Spool Assembly
50	Plug
62	O-ring
63	Orifice Plug
65	O-ring
66	O-ring
70	Foot Relief Valve
72	Plug Assembly
74	Socket Bolt (M10x28L)
91	Plug
105	Plug Assembly



76
42
67
41
40
39
38
20
21
20
19
22
19A
23
18
34
35
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37
75
A
78
49
48
47
46
36
101
94A
37
75
97
100
103
95
104
102
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94
98
96
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30
31
27
26
25
24
34
35
36
37
75
24A
36
42
94A
44
38
39
40
45
41
101
36
43
67
92
73
51
34
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54
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53
76
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37
VIEW A
52
75
75
FG003964

Figure 36

Reference Number	Description
18	Cap
19A	SP Valve
19	Spool
20	Spring Seat
21	Spring
22	End Spool
23	O-ring
24A	Arm Regen Assembly
24	Plug
25	O-ring
26	Spring
27	Spool
30	O-ring
31	Backup Ring
34	Poppet
35	Spring
36	O-ring
37	Flange
38	Poppet
39	Spring
40	Spacer Assembly
41	O-ring
42	O-ring
43	Flange
44	Poppet
45	Spring
46	Plug

Reference Number	Description
47	O-ring
48	Spring
49	Poppet
51	Poppet
52	Flange
53	Spacer
54	O-ring
55	Backup-ring
67	Anti-drift Valve Assembly
73	Socket Bolt (M10x55L)
75	Socket Bolt (M10x40L)
76	Socket Bolt (M10x70L)
78	Socket Bolt (M6x20L)
92	Plug Assembly
94A	Boom Priority Valve
94	Plug
95	Piston
96	Body
97	Piston
98	Spring
99	Sleeve
100	Poppet Assembly
102	O-ring
103	Backup-ring
104	O-ring
101	Socket Bolt (M10x90L)

Specifications

Rated flux: 270 L/min

However, 50L/min. in neutral

Rated pressure: 34.3MPa

Permitted pressure: Max. pressure of 1.5MPa or less

Used pressure of 0.5MPa or less

Permitted use of oil temperature: Normally -20 - 80°C

Highest 100°C

(Use of the rubber for thread.)

TROUBLESHOOTING, TESTING AND ADJUSTMENT

Troubleshooting

Overall Control Valve

Problem	Possible Cause	Remedy
Spool does not move.	Oil temperature is abnormally increased.	Remove part with resistance of oil leakage within pipeline.
	Pollution of operation oil.	Replace operation oil and wash circuit at same time.
	Overly tighten pipe port joint.	Check Torque.
	Valve housing is skewed in loading.	Loosen and confirm loading bolt.
	Pressure is too high.	Check pressure of pump and cylinder port.
	Spool is bent.	Replace valve assembly.
	Return spring is damaged.	Replace damaged part.
	Spring or cap is not in line.	Loosen cap to release load.
	The temperature distribution in valve is inconsistent.	Warm up entire circuit.
	The valve is clogged by dust.	Remove (flushing) dust.
	The pilot pressure is insufficient.	Check pilot valve and pilot relief pressure.
Load is not maintained.	Oil is leaking from cylinder.	Check chamber part of cylinder.
	Oil is bypassed from spool.	Check groove of spool.
	Oil is leaking from overload relief valve.	Wash valve housing seat part and relief valve seat part.
	Oil is leaking from antidrift valve.	Disintegrate antidrift valve and wash seat part of each part. In event that there is grooves on seat part, replace poppet or wrap poppet and seat part. In event of having malfunction in antidrift valve spool, spool and sleeve make pair that both shall be replaced.
When spool is shifted to up position from neutral, load is dropped.	The load check valve has dust.	Disintegrate check valve and wash.
	The poppet or seat part of check value has groove.	Replace poppet or wrap poppet and seat part.

Relief Valve

Problem	Possible Cause	Remedy
Press does not increase.	Main poppet, sleeve or pilot poppet are stuck open and valve seat part has dust.	Replace relief valve.
Unstable relief pressure.	The seat part of pilot poppet has groove.	
	Piston or main poppet gets stuck.	
Abnormal relief pressure.	Abrasion of seat part by dust.	
	Locking screw and adjustment equipment are loosened.	Re-set pressure and tighten locking screw with regular Torque.
Oil leakage.	Damage to relief valve seat part.	Replace relief valve.
	Each part is stuck with dust.	
	The O-ring is worn out.	Replace adjustment equipment or O-ring of loading part.

Overall Oil Pressure

Problem	Possible Cause	Remedy
Oil pressure condition is bad or not operate at all.	Breakdown of pump.	Check pressure or replace pump.
	Breakdown of relief valve.	Replace relief valve.
	Breakdown of cylinders.	Repair or replace.
	Pump load pressure is significant.	Check circuit pressure.
	Valve has crevice.	Replace valve assembly.
	Spool does not make full stroke.	Check operation of spool.
	Tank surface is too low.	Add operation oil.
	Filter in circuit is clogged.	Wash or replace filter.
	Circuit pipeline is tightened.	Check pipeline.

Adjustment of Valves

Main Relief Valve

1. Connect an accurate pressure gauge to inlet port.
2. Start engine and maintain rated pump speed.
3. Shift control valve spool and read pressure gauge from stroke end of cylinder.

   NOTE: *Shift a spool that the actuator pressure setting of the overload relief valve is higher than the pressure of the main relief valve.*

4. High-pressure adjustment (1st stage) (Refer to Figure 38 on page 54.)

   A. Loosen lock nut (7) and tighten plug (8) until piston contacts step (* mark) of plug (6). Plug (8) should be torque below 2.0 kg•m (15 ft lb). While plug (8) is tightened, plug (6) should not be turned. Distance A (Figure 38 on page 54) must be more than 4.0 mm (0.16 in). Tighten lock nut (7).

B. Loosen lock nut (4) and turn adjusting plug (6) clockwise to raise relief pressure of preceding step. Turn adjusting plug (6) counterclockwise to lower relief pressure. One turn varies pressure by approximately 28.4 MPa [9,290 kg/cm^2 (4,120 psi)]. Tighten lock nut (4) after pressure has been adjusted.

5. Low-pressure adjustment (second stage)

   A. Loosen lock nut (7) and turn adjusting plug (8) counterclockwise to lower relief pressure at state of 4. One turn varies pressure by approximately 21.3 MPa [217 kg/cm^2 (3,090 psi)]. Tighten lock nut (7) after pressure has been adjusted.

6. Recheck pressure setting by raising pressure once more.

Overload Relief Valve

CAUTION

If pressure of main relief valve is higher than the specified pressure for it, change main relief valve assembly setting without adjusting overload relief valve.

---

1. Shift control valve spool and read pressure gauge from stroke end of cylinder.
2. Loosen lock nut (3) and turn adjusting plug clockwise to raise pressure. Item number (69: six places). One turn varies pressure by approximately 21.2 MPa [216 kg/cm^2 (3,075 psi)].
3. Tighten lock nut (3) after pressure has been adjusted. Lock nut (3) should be torque to 2.8 - 3.2 kg•m (20 - 23 ft lb).
4. Recheck pressure setting by raising pressure once more.

DISASSEMBLY

Caution in Disassembly

1. Shut down engine when pressure of actuator is not indicated.

   It is dangerous to disassemble control valve while it is under pressure. High-pressure oil can squirt out or components can spring out. When partially disassembling control valve that is on machine, be careful to follow the following caution.

   CAUTION

   When disassembling assembly, when pressure is not fully released, or bucket is not lowered to ground, is very dangerous. A poppet in an antidrift valve may spring out and drop the bucket at the same time. Always lower bucket to ground and fully release pressure before disassembling.

2. Vent pressurized air from hydraulic oil tank.
3. Clean all exterior surfaces of valve before to disassembly and protect it from dirt and foreign materials.
4. Match mark the disassembled parts to make sure of proper reassembling position.
5. Replace all sealing parts such as O-rings and backup rings with a new ones.
6. Do not replace spools, they are matched with valve housing and sleeve.

   NOTE: *The further part numbers of an assembly part are shown as (assembly part number - further part number).*

Disassembly of Main Spool Part

1. Remove socket head bolt (74, two places per each section, width across flats: 8 mm) and cap (8, ten places).
2. Remove plug assembly (72, width across flats: 8 mm) and plug (91, width across flats: 22 mm) according to necessity.
3. Remove O-ring (7, one place per each section) from valve housing (1 and 13).
4. Remove all spool subassemblies from valve housing

CAUTION

When removing spool, be careful not to damage it.

Attach label to each spool in order to install it in the correct position when reassembling.

5. Remove socket head bolt (74, two places per each section, width across flats: 8 mm) and cap (12, ten places).
6. Remove O-ring (7, one place per each section) from valve housing (1 and 13).
7. Disassembly of spool.

CAUTION

Work with spool gripped in vise with wood (see Figure 37) so as not to scratch outside diameter of spool.

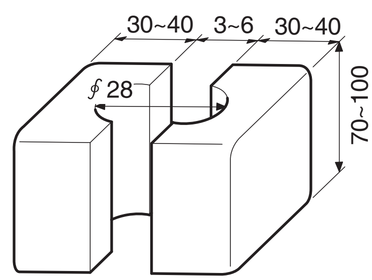
Because Loctite is applied to threaded portion of spool end, heat outside surface of spool with industrial drier to release Loctite.

Heat spool until spool end is easily loosened, and remove immediately after heating it to 200° - 250°C (392° - 482°F).°

If it is over heated, change spring to new one.

A. Remove spool end (width across flats: 8 mm), spring seat and spring from spool assembly (2-6 and 14-17).

NOTE: *There is a poppet, spring and plug in spool assembly. Do not disassemble unless absolutely necessary. If disassembly is necessary, heat spool outside surface to release Loctite in screw portion and remove plug. When reassembling, replace O-ring and backup ring to new ones.*



FG001316

Figure 37

Disassembly of Arm 1 Para-turn Spool Part

1. Remove socket head bolt (78, width across flats: 5 mm) and cap (18).
2. Remove O-ring (23) from cap (18).
3. Remove spool (19) from valve housing under subassembly conditions.
4. Disassembly of spool.

CAUTION

Work with spool gripped in vise with wood (see Figure 37), so as not to scratch outside diameter of spool.

Because Loctite is applied to threaded portion of spool end, heat outside surface of spool with industrial drier to release Loctite.

Heat spool until spool end is easily loosened, and remove immediately after heating it to 200° - 250°C (392° - 482°F).

If it is over heated, replace spring with a new one.

A. Remove spool end (22, width across flats: 5 mm), spring seat (20) and spring (21) from spool (19).

Disassembly of Arm Regeneration Release Valve Part

NOTE: *The part including assembly is shown (assembly number -part number).*

CAUTION

When removing a plug, when pressure is not fully released, or bucket is not lowered to ground, is very dangerous. A part in the valve may spring out and drop the bucket at the same time. Always lower bucket to ground and fully release pressure before disassembling.

1. Remove plug (24, width across flats: 32 mm) and O-ring (25).
2. Remove spring (26) and spool (27-1) from sleeve (27-2).
3. Remove sleeve (27-2) from valve housing.
4. Remove piston (27-3), O-ring (30) and backup ring (31) from sleeve (27-2).

CAUTION

Removing a plug, when pressure is not fully released, or bucket is not lowered to ground, is very dangerous. A part in the valve may spring out and drop the bucket at the same time. Always lower bucket to ground and fully release pressure before disassembling.

1. Remove socket head bolt (75, four places per each section, width across flats: 8 mm) and flange (37, seven places).
2. Remove spring (35), poppet (34) (poppet (51)) and O-ring (36) from valve housing.

CAUTION

Be careful, there is not a poppet and spring in travel straight valve section (Section H-H).

3. Remove socket head bolt (75, width across flats: 8 mm) and flange (52, two places).
4. Remove spacer (53) from valve housing. Remove O-ring (54) and backup ring (55) from spacer (53).
5. Remove spring (35) and poppet (34) from valve housing.
6. Remove plug (72, width across flats: 8 mm) (Section C-C).
7. Remove spring (33) and poppet (32) from valve housing.
8. Remove plug (72, width across flats: 8 mm) (Section L-L).
9. Remove spacer (57), spring (33) and poppet (32) from valve housing.
10. Remove plug (92, width across flats: 36 mm) (Section G-G).
11. Remove socket head bolt (73, four places, width across flats: 8 mm) and flange (43).
12. Remove spring (45), poppet (44) and O-ring (36) from valve housing.
13. Remove plug (46, width across flats: 27 mm) and O-ring (47).
14. Remove spring (48) and poppet (49) from valve housing.
15. Remove socket head bolt (101, four places, width across flats: 8 mm) from body (96, one places).
16. Remove body (96) from valve housing. Remove sleeve (99), piston (97), spring (98), poppet assembly (100), backup ring (103), and O-ring (104).
17. Remove O-ring (36).
18. Grip body (96) in vise. Remove plug (94), piston (95) and O-ring (102).

Disassembly of Antidrift Valve Part

NOTE: *The part including the assembly is shown (assembly number-part number).*

CAUTION

Removing antidrift valve seat, when pressure is not fully released, or bucket is not lowered to ground, is very dangerous. A part in the valve may spring out and drop the bucket at the same time. Always lower bucket to ground and fully release pressure before disassembling.

1. Remove socket head bolt assembly (76, four places per section, width across flats: 8 mm) and antidrift valve assembly (67, two places).
2. Remove O-ring (41 and 42) from valve housing. Remove O-ring (40-4) from spacer assembly.
3. Screw socket head bolt (78, M6*1) into spacer, and remove spacer assembly (40) from valve housing.
4. Remove O-ring (40-2) and backup ring (40-3).
5. Remove spring (39) and poppet (38) from valve housing.
6. Disassembly of antidrift valve assembly

CAUTION

Removing inner parts of antidrift valve, when pressure is not fully released, or bucket is not lowered to ground, is very dangerous. A part in the valve may spring out and drop the bucket at the same time. Always lower bucket to ground and fully release pressure before disassembling.

Slowly loosen plug assembly (67-14) and plug (67-3), check if there is a resistance by remaining pressure and remove.

A. Remove plug assembly (67-14, width across flats: 38 mm) and O-ring.

B. Remove piston (67-4), spool (67-5), and spring (67-7).

C. Remove plug (67-3, width across flats: 38 mm) and O-ring (67-13).

D. Remove sleeve (67-6) and poppet (67-2) from body. Remove O-ring (67-9 and 10) and backup ring (67-11 and 12) from outside diameter of sleeve.

E. Pull spring seat (67-16) and spring (67-8) out of inside hole.

F. Remove plug assembly (67-15) if necessary.

NOTE: *Do not remove steel ball (67-14) because it is pressed in body.*

Disassembly of Relief Valve

CAUTION

Removing relief valve, when pressure is not fully released, or bucket is not lowered to ground, is very dangerous. A part in the valve may spring out and drop the bucket at the same time. Always lower bucket to ground and fully release pressure before disassembling.

Do not loosen adjusting plug for pressure setting or lock nut.

Adjusting plug for pressure setting is dangerous because pressure setting will be changed which may result in a dangerous situation.

1. Remove overload relief valve (69, six places, width across flats: 32 mm).
2. Remove main relief valve (68, width across flats: 32 mm).
3. Remove relief valve assembly (70, two places, width across flats: 32 mm) and O-ring (70- 5 and 70-6).

Disassembly of Option Section Part

1. Remove socket head bolt (75, width across flats: 8 mm), cap (88, two places) and O-ring (89).

Disassembly of Other Plugs

1. Remove plug assembly (60, width across flats: 27 mm) and O-ring (Section J-J).
2. Remove plug (61, width across flats: 22 mm) and O-ring (62) (Section K-K).
3. Remove orifice plug (63, width across flats: 5 mm) (Section A1-A1).
4. Remove plug assembly (92, width across flats: 36 mm) and O-ring.
5. Remove plug assembly (71, width across flats: 6 mm) and O-ring.
6. Remove plug assembly (72, width across flats: 8 mm) and O-ring.

Disassembly of Valve Housing Bolt

CAUTION

Do not disassemble combined bolt (77) if it is unnecessary.

If it is necessary to disassemble it, work by placing it horizontally on a work bench.

Prepare spare O-ring (65 and 66).

1. Remove socket head bolt (77, eight places, width across flats: 14 mm) and washer (81, eight places).
2. Remove O-ring (65 and 66) from valve housing mating surface.

Disassembly of Main Relief Valve

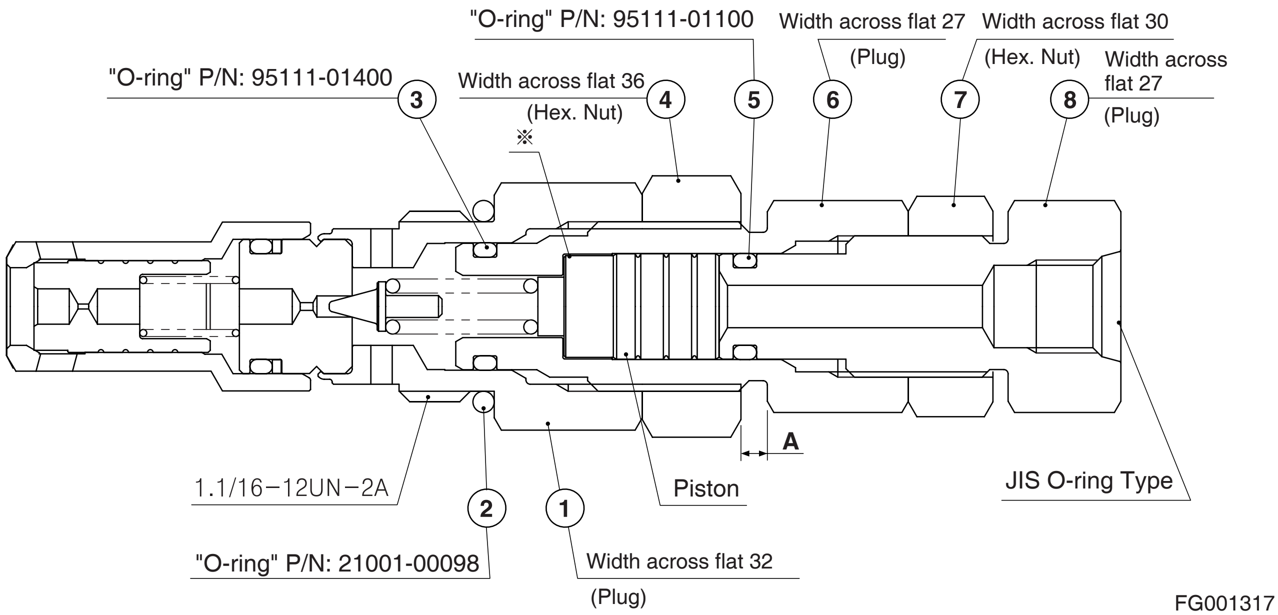


Figure 38

1. This relief valve should be replaced as an assembly. When replacing it, remove plug (1, width across flats: 32 mm), and O-ring (2). If oil is leaking from nut (4), remove nut (4) and plug (1), and replace O-ring (3). If oil is leaking from nut (7), remove nut (7) and plug (8), and replace O-ring (3).

Disassembly of Overload Relief Valve

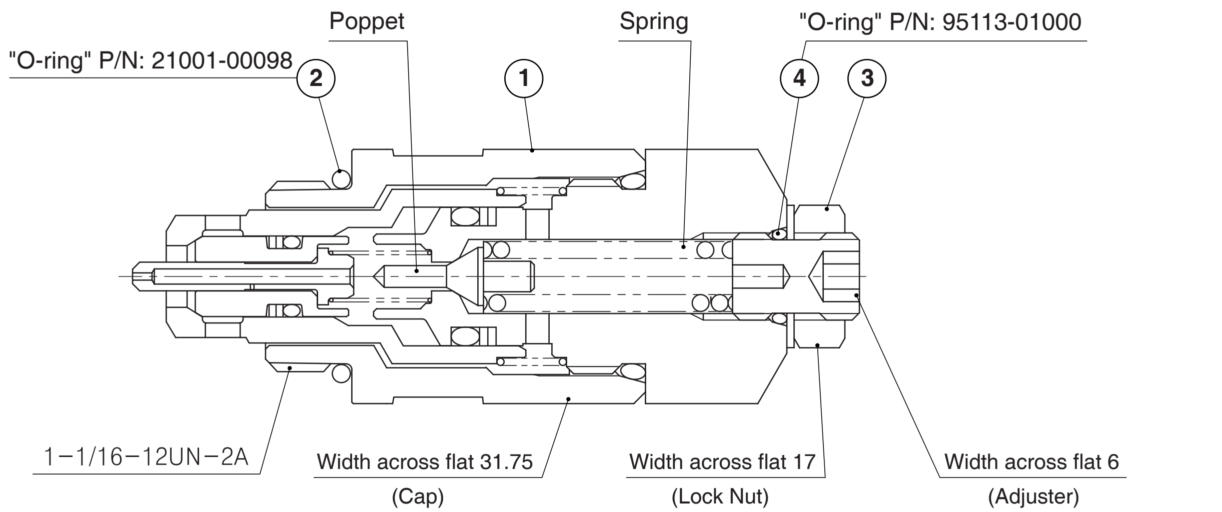


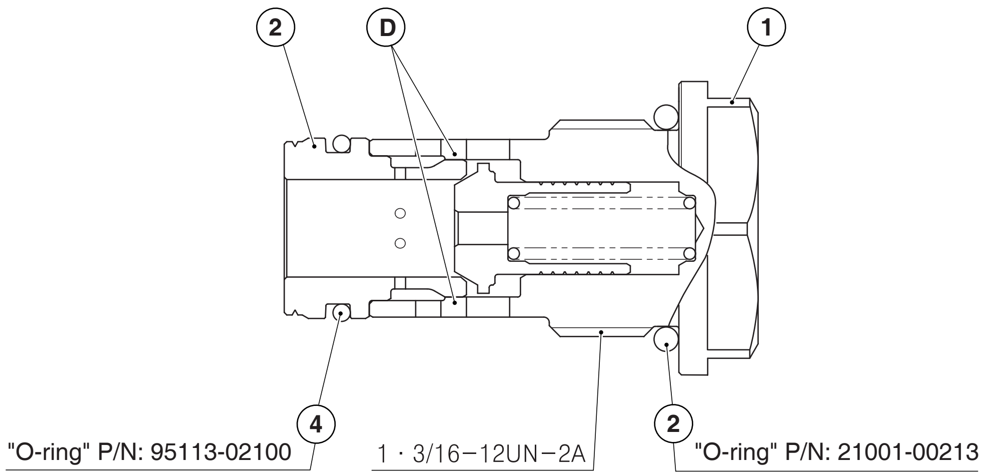
Figure 39

1. This relief valve should be replaced as an assembly. When replacing it, remove cap (1, width across flats: 32 mm) and O-ring (2). If oil is leaking from nut (4), remove nut (4) and plug (1), and replace O-ring (3). If oil is leaking from nut (7), remove nut (7) and plug (8), and replace O-ring (3).

   NOTE: *This relief valve should be replaced as an assembly. When replacing it, Remove cap (1, width across flats: 32 mm) and O-ring (2). If oil is leaking from adjusting kit (3), remove adjusting kit (3), and replace O-ring (4).*

CAUTION

When disassembling adjuster kit, be careful not to let parts spring out or lose poppet because of spring force.



FG001321

Figure 40

1. This unit has press fit portion (D) and it should be replaced as a complete assembly.

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

Cleaning

Clean all parts thoroughly using a suitable cleaning fluid and dry them with moisture free compressed air. Put them on a clean paper or a vinyl for inspection.

Inspection

Inspect all parts for scratches, notches and other defects.

1. Inspect load check seat surface of valve housing for scratches, scores, dirt, notches and corrosion. Remove small scratches with oilstone.
2. Inspect exterior surface of spool for scratches and notches. Remove small scratches with oilstone.
3. Sliding parts should be moved lightly and foreign materials should be removed in all grooves and passages.
4. Replace any springs that are damaged, heavy deformed or worn.
5. If relief valve malfunction, inspect it using relief valve maintenance procedure.
6. Replace all O-rings and backup rings with new.
7. After disassembling cap or plug, check whether there are paint chips around body hole or plug. If paint chips penetrate into valve, they can cause malfunction or valve to leak.

REASSEMBLY

Caution on Assembly

Caution on Handling O-ring

1. Do not use O-ring which has any defect or scratches from handling.
2. Apply grease or hydraulic oil to installation portion of O-ring grooves and O-ring to ease installation.
3. Do not stretch O-ring beyond permanent set.
4. When installing O-ring, be careful not to twist it. (A twisted O-ring, is very difficult to return to its original shape after installing it. This could also cause a leak.)

Caution on Handling Spool

1. Rated torque should be kept because over torque of screw portion, can cause a malfunction of spool.
2. Be careful that each spool, spring and spool end should be reassembled like before disassembling.

Method of Painting the Adhesives (screw part and arm screw part of parts requiring the adhesiveness)

NOTE: *Male and female screw threads of parts which need to adhere.*

CAUTION

When working with Loctite, work in a place that is well ventilated.

---

1. Cleaning (removal of grease)

   Remove grease with steam, acetate, etc. or clean with an alkali cleanser.

2. Dry

   Dry Loctite surface with moisture free air or naturally. If it is not completely dried, the effect of Loctite is weakened.

3. Primer painting

   Slightly spray Loctite primer T effect promoter to Loctite surface and leave it for three or five minutes to dry.

4. Loctite application

   Lightly apply Loctite #274 or equivalent to two or three threads of spool female inlet. At this time, be careful not to touch coated part to spring seat.

Sequence of Subassembly

⚠ CAUTION

Check number of each part, installation position and tools needed before reassembling.

Spool Assembly (Main Spool)

1. Apply Loctite to threaded portion of spool (2-6 and 14-17) and install spring seat, spring and spool end.
2. After gripping spool in vise with wood (that is used when disassembling it), tighten spool end. Tightening torque: 2.04 - 2.24 kg•m (15 - 16 ft lb).

⚠ CAUTION

Be careful not to get Loctite into spool by over applying it.

Be careful that spool operation does become deteriorated by over torquing spool end.

When reassembling it and A56, be careful because there are two different types of springs.

Arm 1 Para-turn Spool Assembly

1. Apply Loctite to threaded portion of spool (19) and install spring seat (20), spring (21) and spool end (22).
2. After gripping spool in vise with wood (that is used when disassembling it), tighten spool end. Tightening torque: 1.94 - 2.24 kg•m (14 - 16 ft lb).

⚠ CAUTION

Be careful not to get Loctite into spool by over applying it.

Be careful that spool operation does become deteriorated by over torquing spool end.

Antidrift Valve Assembly

1. Install O-ring (67-9 and 67-10) and backup ring (67-11 and 67-12) in groove of sleeve (67-6).

CAUTION

Be careful of installation position of O-ring and backup ring.

If they are reversed, the O-ring will be damaged and drift speed of actuator can be increased.

2. Insert poppet (67-2) and spool (67-5) in sleeve hole.
3. Install spring seat (67-16) on small diameter of poppet end. Insert spring (67-8) and poppet assembly with sleeve into body (67-1).

CAUTION

It Is better to apply grease to seat surface when installing spring and spring seat onto seat of poppet.

4. Install spring (67-7) and piston (67-4) in plug (67-3).
5. Tighten plug assembly (67-14) with O-ring installed on plug (67-3). Tightening torque: 15 - 16 kg•m (108 - 116 ft lb).
6. Install O-ring (67-13) on plug (67-3). Install it in body (67-1). Tightening torque: 15 - 16 kg•m (108 - 116 ft lb).
7. Tighten plug assembly (67-15) with O-ring in body (67-1). Tightening torque: 1.4 - 1.8 kg•m (10 - 13 ft lb).

Assembly Sequence of Main Body of the Control Valve

CAUTION

When reassembling safety valve, securely tighten plug that is installed in body.

Do not loosen adjusting plug for pressure setting or lock nut.

Adjusting plug for pressure setting is dangerous because pressure setting will be changed which may result in a dangerous situation.

Assembly of Relief Valve

1. Install main relief valve (68). Tightening torque: Tightening torque: 7.95 - 8.97 kg•m (58 - 65 ft lb).
2. Install overload relief valve (69, six places) in each section. Tightening torque: 7.95 - 8.97 kg•m (58 - 65 ft lb).
3. Install spring seat (67-16) on small diameter of poppet. Then insert spring (67-8) and them with sleeve to body (67-1). Tightening torque: 11 - 12 kg•m (76 - 83 ft lb).

Assembly of Load Check Valve

1. Install O-ring (36) on arm (1 and 2, section D-D), boom (1 and 2, section E-E) and swing section (Section F-F). Install poppet (34) and spring (35). Mount flange (37) and install socket head bolt (75). Tightening torque: 5.91 - 6.53 kg•m (43 - 47 ft lb).
2. Install O-ring (36) on travel section (Section H-H). Install poppet (51) and spring (35). Mount flange (37) and install socket head bolt (75). Tightening torque: 6 - 6.5 kg•m (43 - 47 ft lb).
3. Install O-ring (36) on travel straight section (Section H-H). Mount flange (37) and install socket head bolt (75). Tightening torque: 5.91 - 6.53 kg•m (43 - 47 ft lb).
4. Install poppet (51) and spring (35) in common (Section I-I). Insert spacer (53) with O-ring (54) and backup ring (55). Tightening torque: 3.98 - 4.49 kg•m (29 - 32 ft lb).

CAUTION

Be careful of installation position of O-ring and backup ring.

If they are reversed, the O-ring will be damaged and an oil leak can occur.

5. Install O-ring (36) on option section (Section G-G). Install poppet (44) and spring (45). Mount flange (43) and install socket head bolt (96). Tightening torque: 6 - 6.5 kg•m (43 - 47 ft lb).
6. Tighten flange assembly (92) with O-ring. Tightening torque: 21 - 23 kg•m (151 - 167 ft lb).
7. Insert poppet (49) and spring (48) in travel section (Section G-G). Install plug (46) with O-ring (47). Tightening torque: 10.91 - 11.93 kg•m (79 - 86 ft lb).
8. Bucket section (Section F-F)
   A. Insert piston (95) and O-ring (102) on plug (94) and install in body (96). Tightening torque: 11 - 12 kg•m (76 - 83 ft lb).

B. Insert backup ring (103), O-ring (104), spring (98) and poppet assembly (100) in sleeve (99), and install it to body (96).

C. Install O-ring (36) in valve housing and fasten body using socket head bolt (101). Tightening torque: 5.91 - 6.53 kg•m (43 - 47 ft lb)

9. Insert poppet (32) and spring (33) in arm 1 para turn part (Section C-C). Install plug assembly (72) with O-ring. Tightening torque: 7.44 - 8.06 kg•m (54 - 58 ft lb).

10. Insert poppet (32), spring (33), and spacer (57) in arm 2 para turn part (Section L-L). Install plug assembly (72) with O-ring. Tightening torque: 7.44 - 8.06 kg•m (54 - 58 ft lb).

Assembly of Antidrift Valve

1. Install O-rings (41 and 42) on surfaces of antidrift valve assembly of arm 1 section (Section D-D) and boom 1 section (Section E-E).

2. Insert poppet (38) and spring (39). Install spacer assembly (40) with O-ring and backup ring.

CAUTION

Be careful of installation position of O-ring and backup ring.

If they are reversed, the O-ring will be damaged and an oil leak can occur.

Check installing of O-ring (40-4) on spacer assembly and be careful of installation direction.

3. Install antidrift valve assembly (67, two places) and socket head bolt. Tightening torque: 3.98 - 4.49 kg•m (29 - 32 ft lb).

Assembly of Option Section Part

1. Install O-ring (89) on cap (88, two places) and fasten it in place with socket head bolt (75). Tightening torque: 5.91 - 6.53 kg•m (43 - 47 ft lb).

Assembly of Arm Regeneration Release Valve

1. Install O-ring (30) and backup ring (31, two places) on spool assembly (27).

2. Install piston (29) and spool (27) in sleeve. Insert sleeve in valve housing.

3. Install O-ring (25) on plug (27), insert spring (26) and install it in valve housing. Tightening torque: 11 - 12 kg•m (76 - 83 ft lb).

Assembly of Arm 1 Para-turn Spool

1. Install spool subassembly (19) into valve housing.

CAUTION

After inserting spool, check to see if it slides easily.

2. Install O-ring (23) on cap (18) and fasten it in place with socket head bolt (78). Tightening torque: 0.90 - 1.10 kg•m (6.49 - 7.97 ft lb).

Assembly of Main Spool

1. Install O-ring (7, twenty places) on mating surface of valve housing cap.
2. Install spool of subassembly condition (2-6 and 14-17) in same positions that they were remove from during disassembly

CAUTION

Align spool with hole and insert it slowly.

After inserting spool, check to see if it slides easily.

If spool is inserted when it is in a poor operating condition with a scratch, it can cause a malfunction of the spool.

3. Install cap (12, ten places) and fasten it in place with socket head bolt (74). Tightening torque: 3.98 - 4.49 kg•m (29 - 32 ft lb).
4. Install cap (8, ten places) and fasten it in place with socket head bolt (74). Tightening torque: 3.98 - 4.49 kg•m (29 - 32 ft lb).
5. Install O-ring on plug assembly (72) and tighten it to two sides of cap of travel straight section (Section H-H). Tightening torque: 3.98 - 4.49 kg•m (29 - 32 ft lb).
6. Install O-ring (62) on plug assembly (91) and install it on long cap of spare section (Section G-G). Install O-ring (62) on plug assembly (105). Install plug assembly on short cap of spare section (Section G-G). Tightening torque: 3.98 - 4.49 kg•m (29 - 32 ft lb).

CAUTION

When tightening plug to cap, be careful not to over tighten. If it is over tighten, threads of cap can be damaged.

Assembly of Other Plugs

1. Install O-ring on plug assembly (60) and install. Tightening torque: 11 - 12 kg•m (76 - 83 ft lb)
2. Install O-ring (62) on plug assembly (61) and install. Tightening torque: 4 - 4.5 kg•m (29 - 32 ft lb)
3. Tighten orifice plug (63). Tightening torque: 1.4 - 1.8 kg•m (10 - 13 ft lb).
4. Install O-ring on plug assembly (92) and install. Tightening torque: 21 - 23 kg•m (151 - 167 ft lb).
5. Install O-ring on plug assembly (71) and install. Tightening torque: 1.4 - 1.8 kg•m (10 - 13 ft lb).
6. Install O-ring on plug assembly (72) and install. Tightening torque: 7.5 - 8 kg•m (54 - 58 ft lb)

Maintenance of Relief Valves

Reassembly of Main Relief Valve

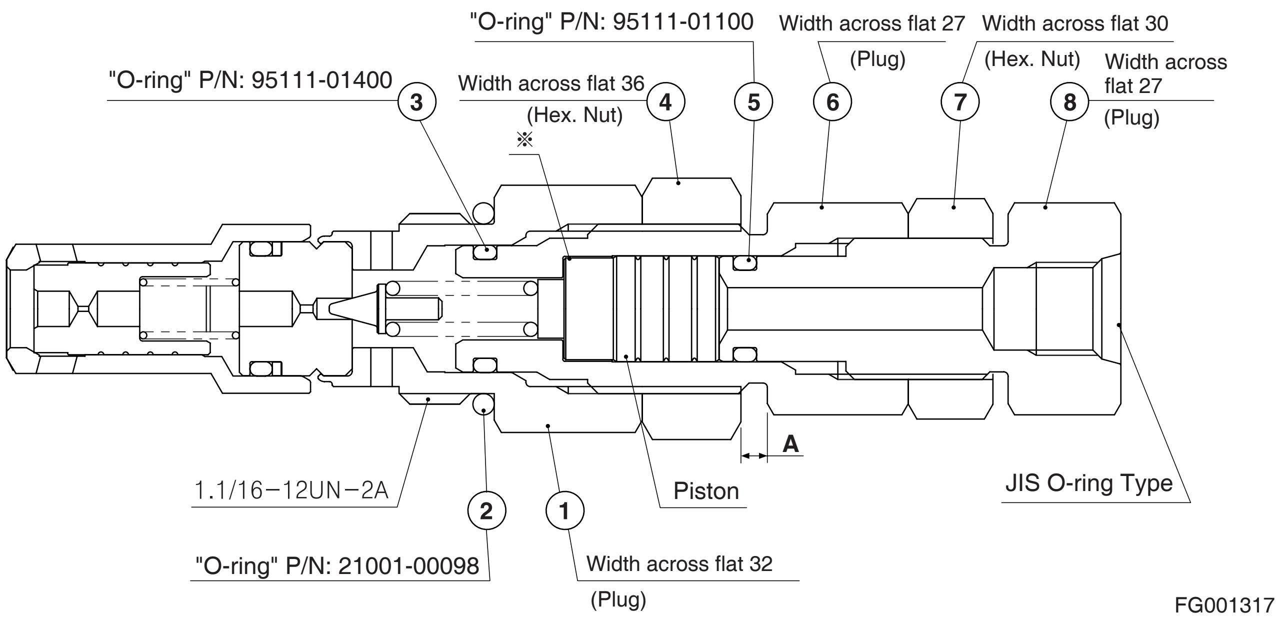


Figure 41

1. Check if there is dirt and paint chips around threads of plug (1, 6 and 8) and nut (4 and 7). Replace O-ring with new one. Clean installation portion of relief valve and valve housing. Install valve, and then tighten plug (1, width across flats: 32 mm). Tightening torque: 7.95 - 8.97 kg•m (58 - 65 ft lb).

   NOTE: *The torque values are based on use of lubricated threads.*

   NOTE: *If relief valve was disassembled, adjust pressure by referring to "Main Relief Valve" on page 45.*

Reassembly of Overload Relief Valve (69, Total of 6 Places)

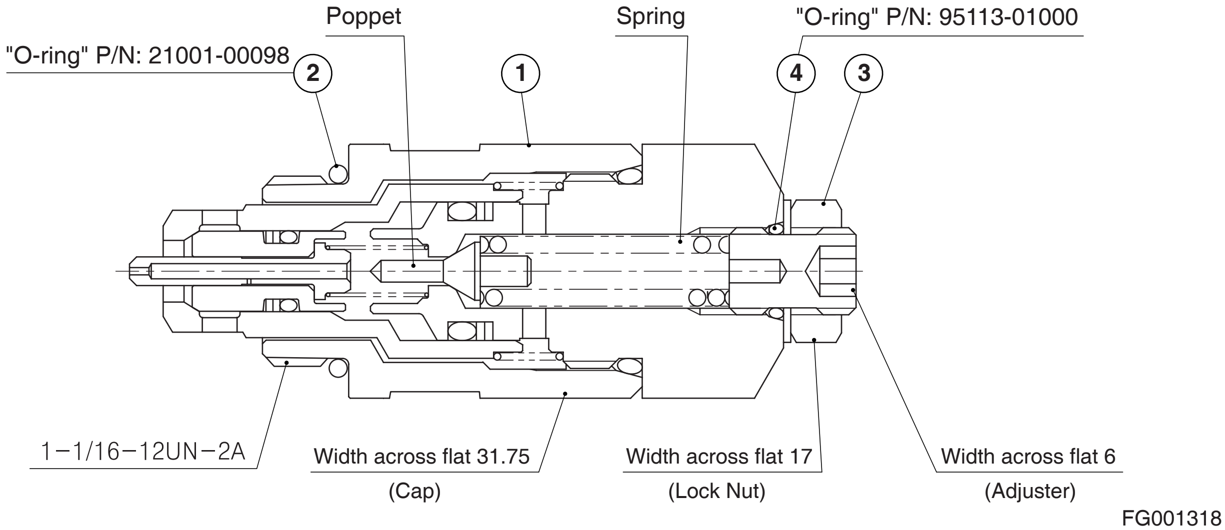


Figure 42

1. Check if there is dirt and paint chips around cap (1). Replace O-ring with new one. Clean installation portion of relief valve and valve housing. Install relief valve and tighten cap (1). Torque: 7.95 - 8.97 kg•m (58 - 65 ft lb).

NOTE: *The torque values are based on use of lubricated threads.*

NOTE: *If relief valve was disassembled, adjust pressure by referring to "Overload Relief Valve" on page 46.*

CAUTION

In the event of disassembling the adjustment kit, be careful for popping out of parts by the spring or the loss of the poppet.

Reassembly of Low-pressure Relief Valve (70, Total of 2 Places)

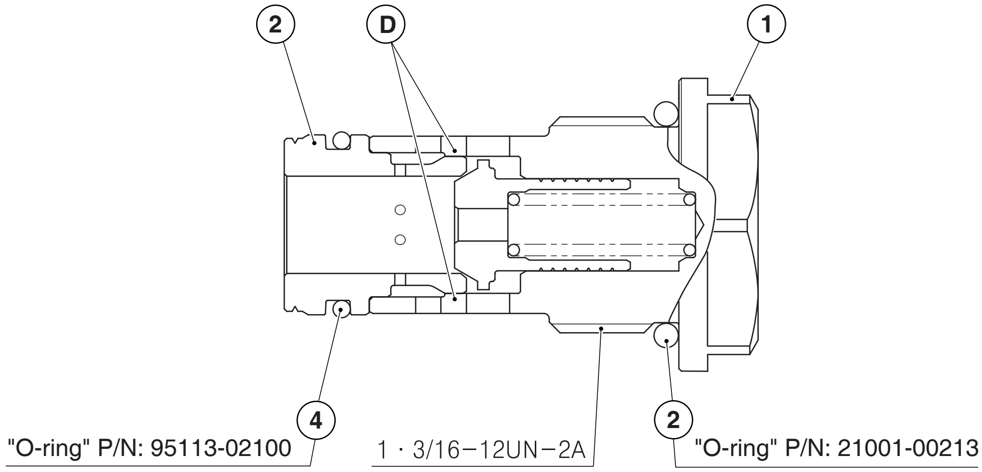


Figure 43

1. Check if there is dirt and paint chips around plug (1). Replace O-ring (3) with new one. Install new O-ring (4) on sleeve (2). Clean installation portion of relief valve and valve housing. Tighten plug (1, width across flats: 32 mm) of relief valve. Torque: 11 - 12 kg•m (76 - 83 ft lb).

   NOTE: *The torque values are based on use of lubricated threads.*

CAUTION

The sources of all tightening torque is coating with the operation oil.

INSTALLATION

1. Be careful not to apply stress on control valve when attaching piping and hoses. Unnecessary stress may cause spools to bind and the control valve from functioning properly.
2. Tighten the assembling bolts alternately and evenly to the specified torque.
3. If welding procedures are being performed near the control valve, the valve could damaged by weld spatter and heat. Use adequate shielding to protect valve.
4. Valve ports should be covered with caps, plugs or tape to protect them from dust and other foreign materials, until pipe laying work is started.

START-UP PROCEDURES

1. Before operating machine, make sure that oil passages and hydraulic oil are clean.
2. Hydraulic oil of which annealing point is 82° - 113°C (180° - 235°F) should be used in the hydraulic system.
3. Relief valve pressure should not be raised above specified pressure setting.
4. The difference between main relief valve setting pressure and overload relief valve setting pressure should not be over 2.0 MPa [20.39 kg/cm^2 (290 psi)].
5. Before operating machine, the hydraulic system should be fully warmed up. If machine is operated with cold hydraulic oil and valve, be careful of the following, to prevent spool sticking due to heat shock.

   NOTE: *Do not operate main relief valve or overload relief valve suddenly and continuously. Cycle oil through all actuators and warmed up cold hydraulic oil in the lines and components uniformly.*

   NOTE: *Slight or compound work should not be suddenly operated at cold weather because heat is developed partly at all the orifices.*

Remote Control Valve (Work Lever / Joystick)

Edition 1

MEMO

Table of Contents

Remote Control Valve (Work Lever / Joystick)

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up

GENERAL DESCRIPTION

Theory of Operation

Structure

The remote control valve contains four push rods, spring holders, spools and return springs, which are 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 button is installed in the valve handle.

Gear pump pressure is used for operating control spools.

Function

1. Neutral Position

   When the lever is in neutral mode, the spool is pushed upward by return spring. The force of balancing spring, which determines the secondary discharge pressure, is not transmitted to the spool. The input port is closed and the pressure of the output port is the same as the pressure of the tank port T.

2. Control Switch

   Pressing of the push rod starts to press the balance spring, whose force is transferred to the spool to connect the P and T ports, transferring the pilot pressure. Output pressure acts on the bottom of the spool and press the spool upwards until it is balanced with the force of the balance spring.

   In short, the second pressure (output pressure) changes in proportion to the pressing force of the balance spring.

Parts List

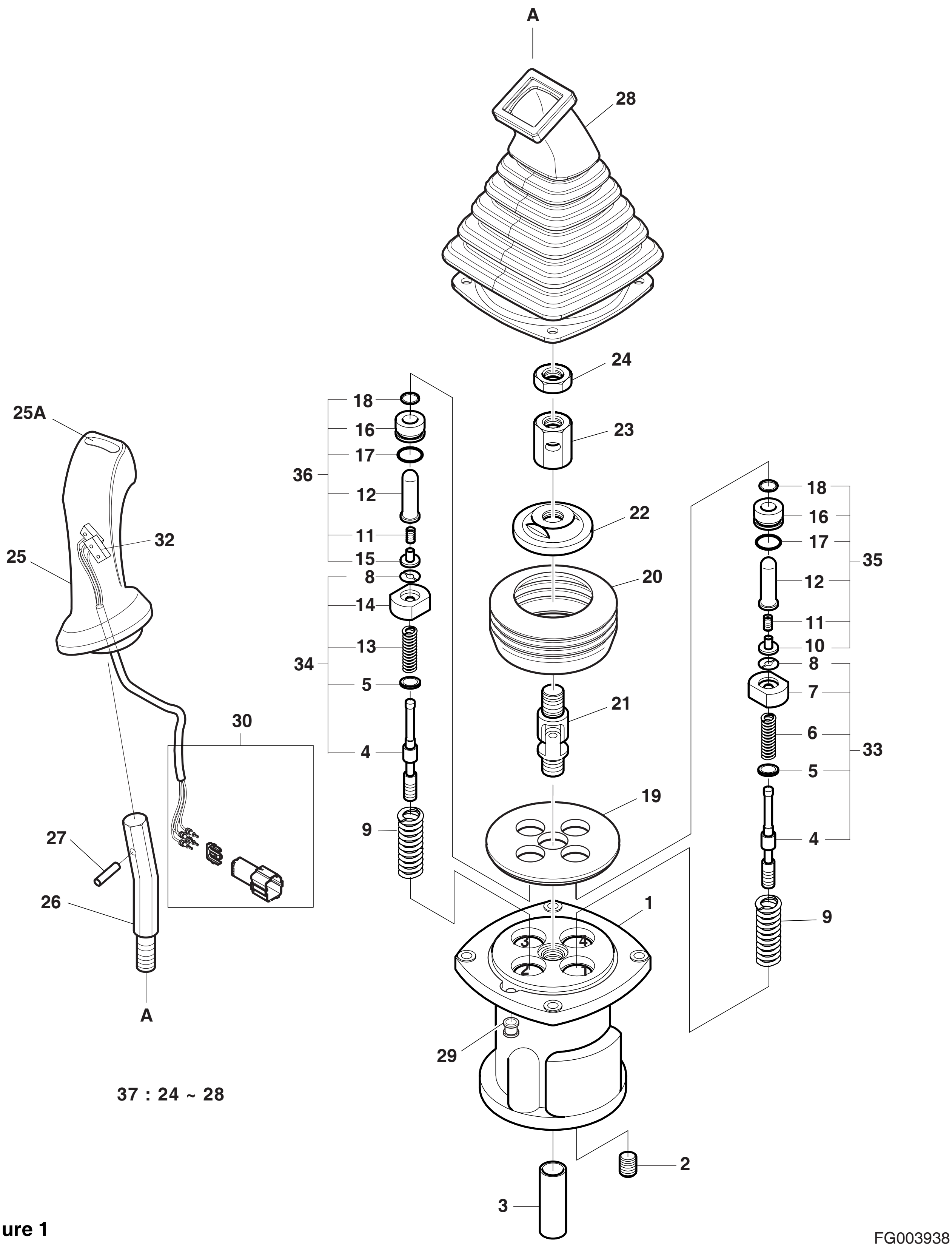


Figure 1

Reference Number	Description
1	Case
2	Plug
3	Bushing
4	Spool
5	Shim
6	Spring
7	Spring Seat
8	Stopper
9	Spring
10	Stopper
11	Spring
12	Push Rod
13	Spring
14	Spring Seat
15	Stopper
16	Plug
17	O-ring
18	Rod Seal
19	Plate
20	Boot

Reference Number	Description
21	Joint Assembly
22	Swash Plate
23	Nut
24	Nut
25	Handle Assembly (L) Handle Assembly (R)
25A	Cap
26	Handle Bar
27	Spring Pin
28	Bellows
29	Bushing
30	Connector Assembly
32	Switch Assembly
33	Spool Kit 1, 3
34	Spool Kit 2, 4
35	Plug Kit 1, 3
36	Plug Kit 2, 4
37	Handle Kit (Left) Handle Kit (Right)

Specifications

Performance

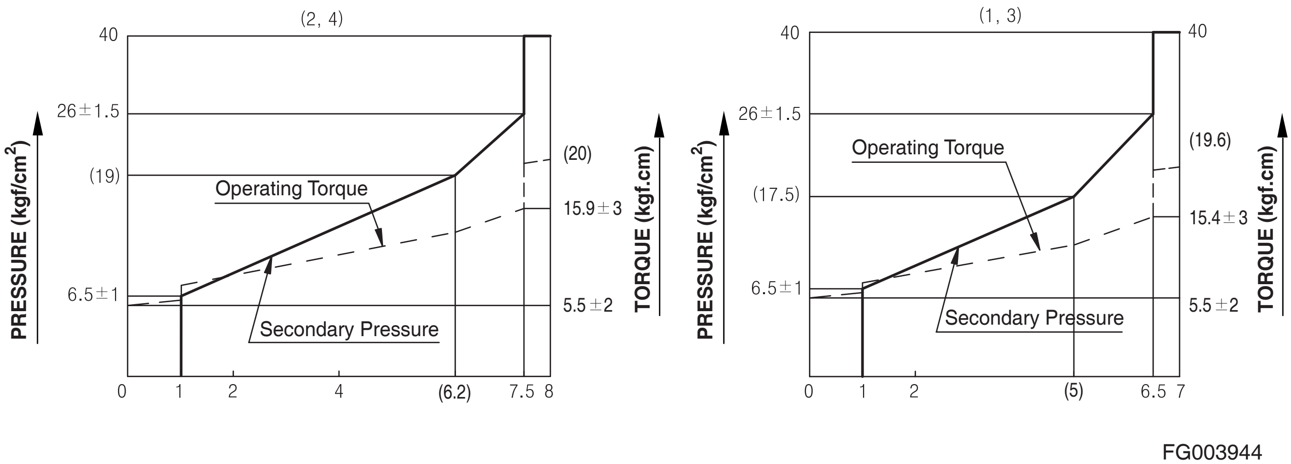


Figure 2

Torques

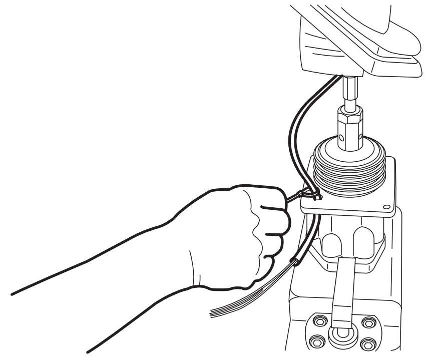
No.	Tool	Standard	Remark
3	Plug	PF 3/8	500 kg•cm (36 ft lb)
19	Swash Plate	27 mm	1,660 kg•cm (120 ft lb)
20	Hex Nut	22 mm	1,660 kg•cm (120 ft lb)
22	Nut	22 mm	1,660 kg•cm (120 ft lb)

TOOLS AND MATERIALS

No.	Tool	Standard	Remark
3	L Wrench	8 mm	
19	Spanner	27 mm	
20	Spanner	22 mm	
22	Spanner	22 mm	

DISASSEMBLY

1. Remove lead wire from bushing (29).



FG000804

Figure 3

2. Remove lever assembly from case (1).

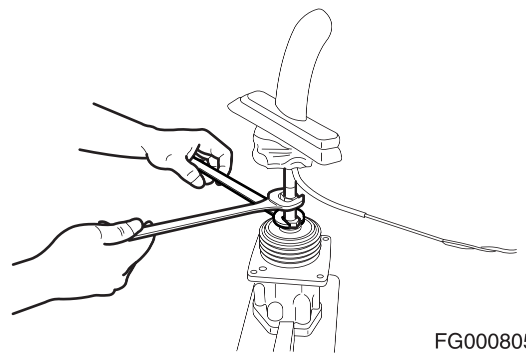


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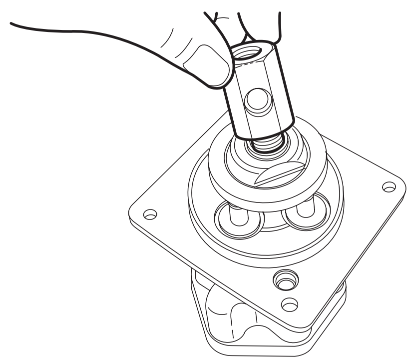
Figure 4

3. Remove hex nut (23) and swash plate (22) from case.



FG000806

Figure 5

4. Remove joint assembly (21) from case.

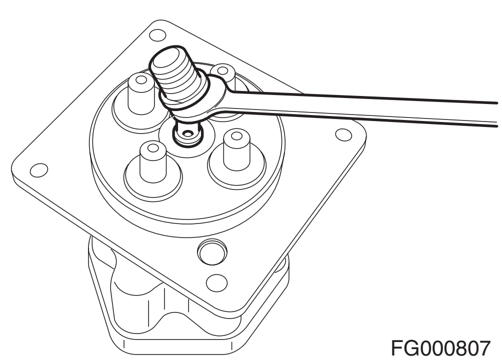


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Figure 6

5. Remove plate (19) from case (1).

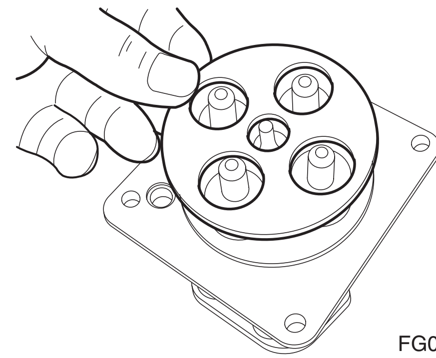

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Figure 7

6. Remove plug kit assembly, stopper (10), and spring (11) from case (1).

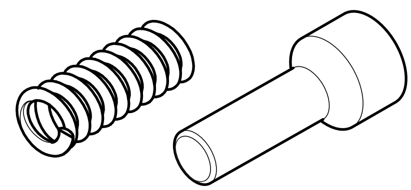

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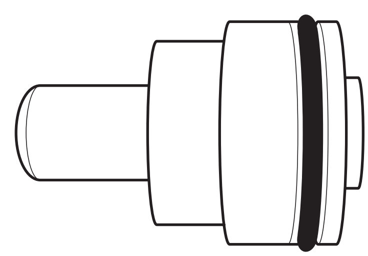
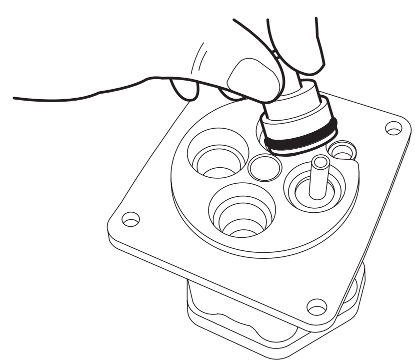
Figure 8



FG000810

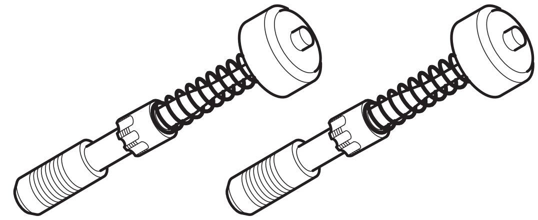
Figure 9



FG000811

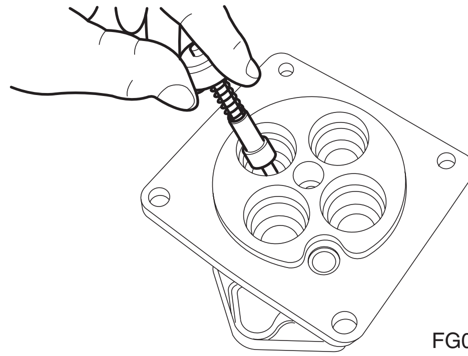
Figure 10

7. Remove four spool kit assemblies from case (1).



FG000812

Figure 11



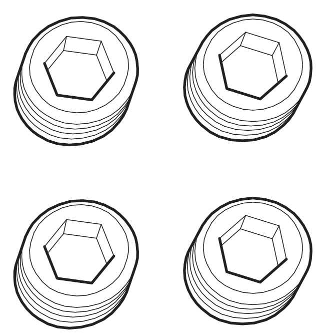
FG000813

Figure 12

8. The bushing (3) and plug cannot be removed from case (1).

FG000814

Figure 13



FG000815

Figure 14

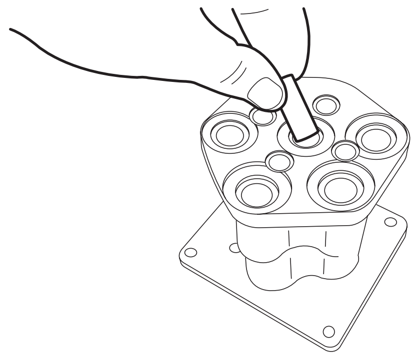


Figure 15

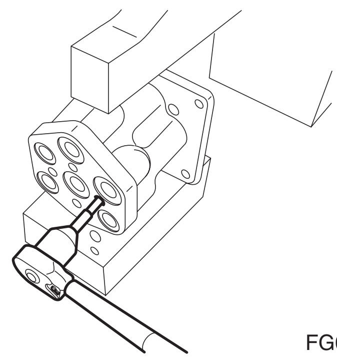


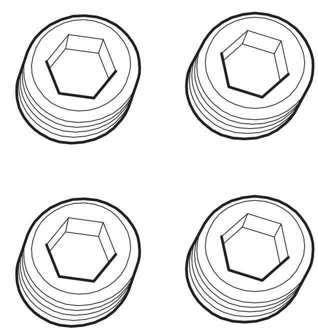
Figure 16

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

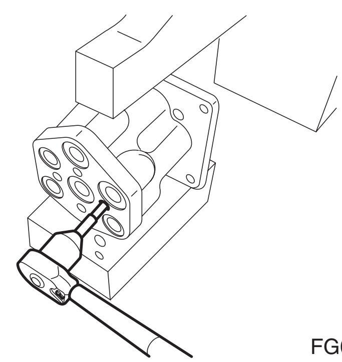
REASSEMBLY

1. Install four plugs (2) into case (1).



FG000815

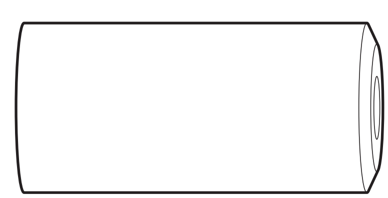
Figure 17



FG000817

Figure 18

2. Install bushing (3) into case (1) using jig.



FG000814

Figure 19

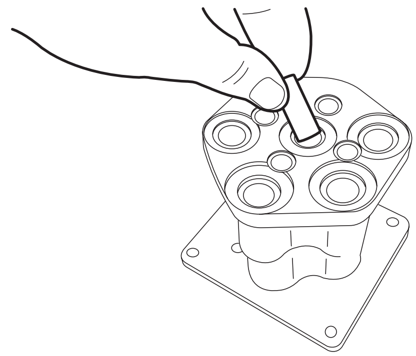


Figure 20

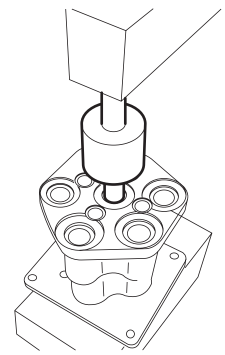


Figure 21

3. Take care when assembling spool kit assemblies (1 and 3, 2 and 4). They should be assembled in same way).

   The assembly order is; spool (4), shim (5), spring (6), spring seat (7), and stopper (8).

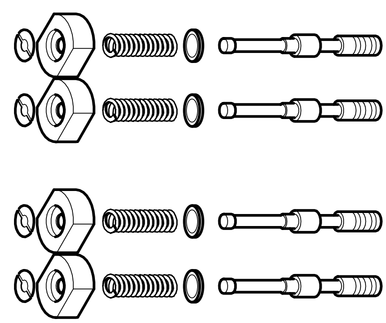


Figure 22

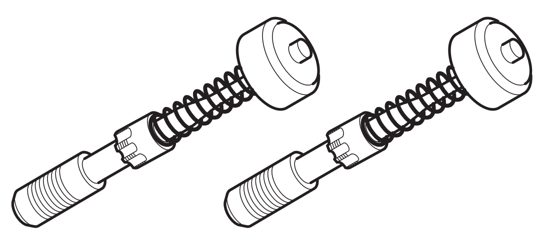
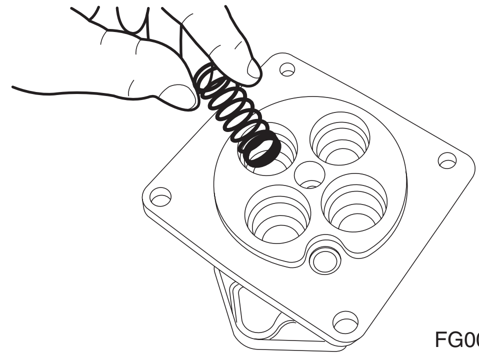


Figure 23

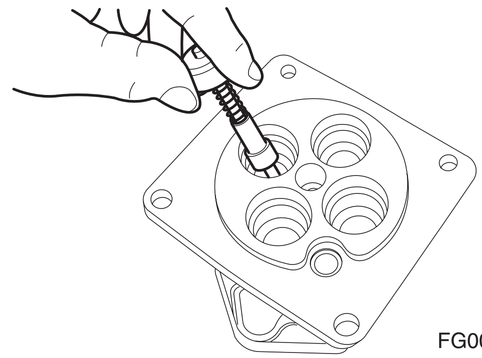
4. Install spring (9) into case (1).



FG000820

Figure 24

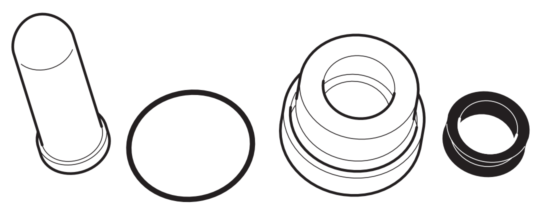
5. Install spool kit assembly into case (1). (The same way is used for four parts.)



FG000821

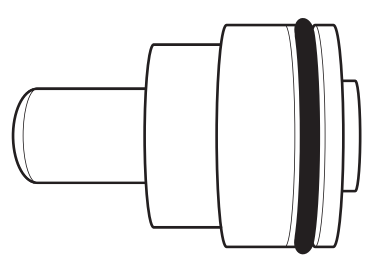
Figure 25

6. Assemble plug kit insert rod seal (18), O-ring (17), and push rod (2) into plug (16) in proper order.



FG000822

Figure 26

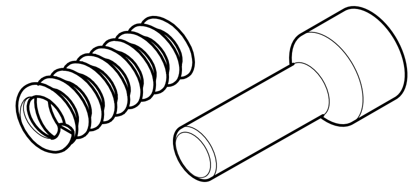


FG000810

Figure 27

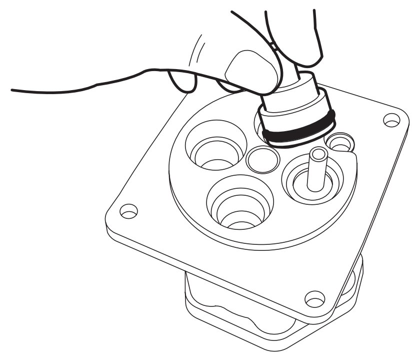
7. Assemble four springs (11) and stoppers (10) and insert assembled set in case (1) to form a plug kit assembly.

   NOTE: *Pay attention to measurement specifications of stoppers (1 and 3, 2 and 4).*



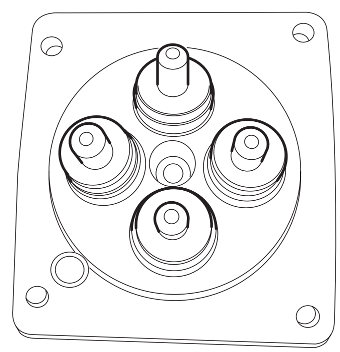
FG000809

Figure 28



FG000811

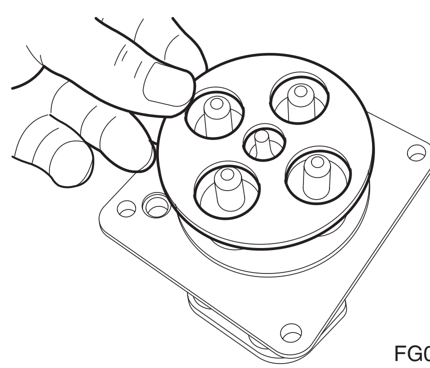
Figure 29



FG000823

Figure 30

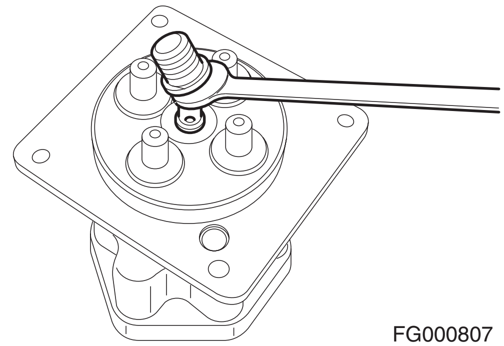
8. Install plate (19) into case (1).



FG000808

Figure 31

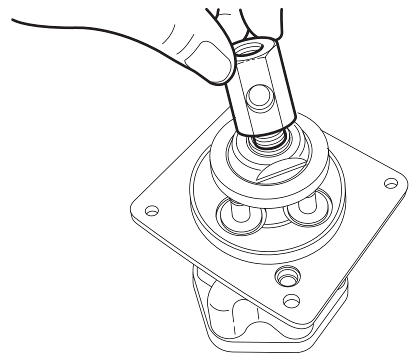
9. Install joint assembly (21) into case (1).



FG000807

Figure 32

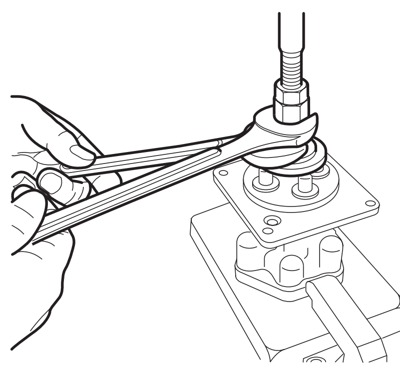
10. Install wash plate (22) and hex nut (23) into case (1).



FG000806

Figure 33

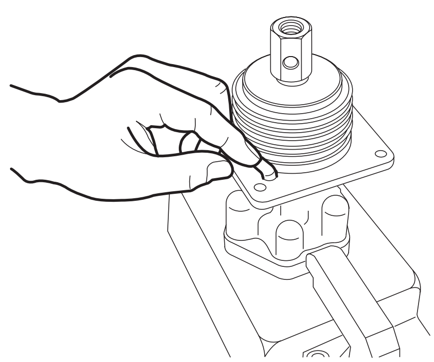
11. Insert bar and tighten it with a spanner to check balance of joint assembly.



FG000824

Figure 34

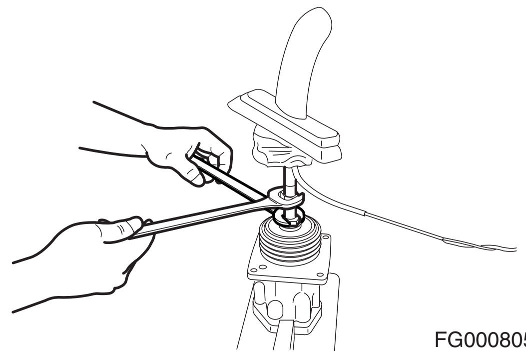
12. Install boot (20) and bushing (29) into case (1).



FG000825

Figure 35

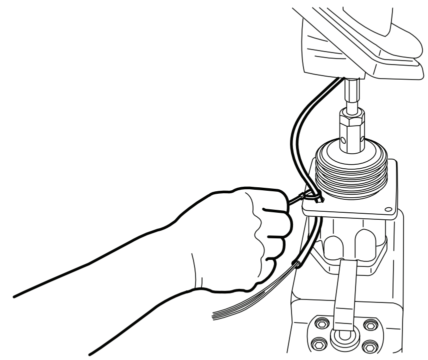
13. Install lever assembly into case (1).



FG000805

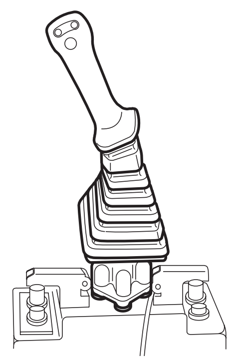
Figure 36

14. Put lead wire in bushing (29), tie it, and arrange boot.



FG000826

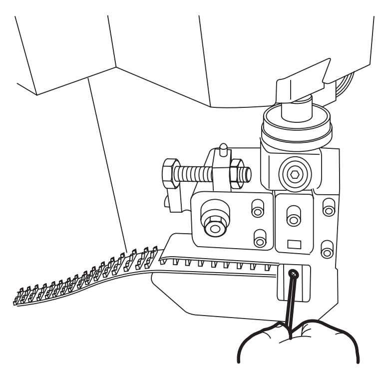
Figure 37



FG000827

Figure 38

15. Install lead wire terminal into connector terminal pressing them together.



FG001097

Figure 39

16. Assemble connector assembly (30), and connect it to lead wire terminal, and properly route wiring.

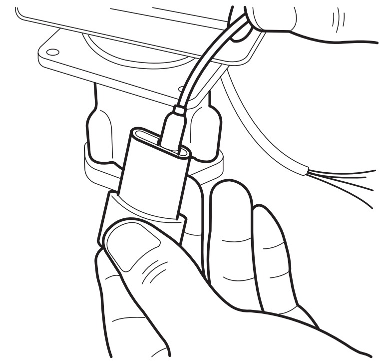

FG000828

Figure 40

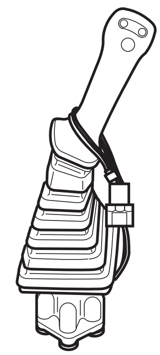
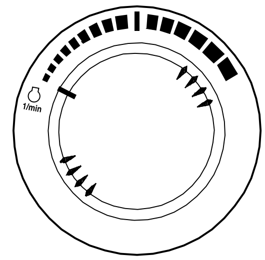

FG000829

Figure 41

START-UP PROCEDURES

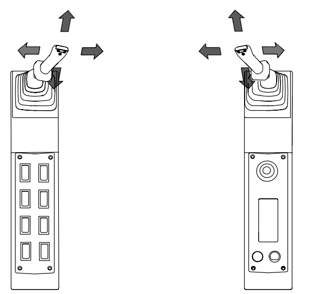
1. Start engine and set throttle at "LOW IDLE."
2. Set safety lever on "UNLOCK" position.



HAOB290L

Figure 42

3. Slowly cycle boom, arm, bucket cylinders and swing motor about five times without a load to vent air from pilot lines. Do this for five minutes.



ARO0470L

Figure 43

Travel Control Valve (With Damper)

Edition 1

MEMO

Table of Contents

Track Assembly

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

GENERAL DESCRIPTION

Theory of Operation

The damper valve is divided into two areas of operation. There is the pressure reducing valve (a) and the damper mechanism (b). The following hydraulic circuit is an example of a remotely located control valve.

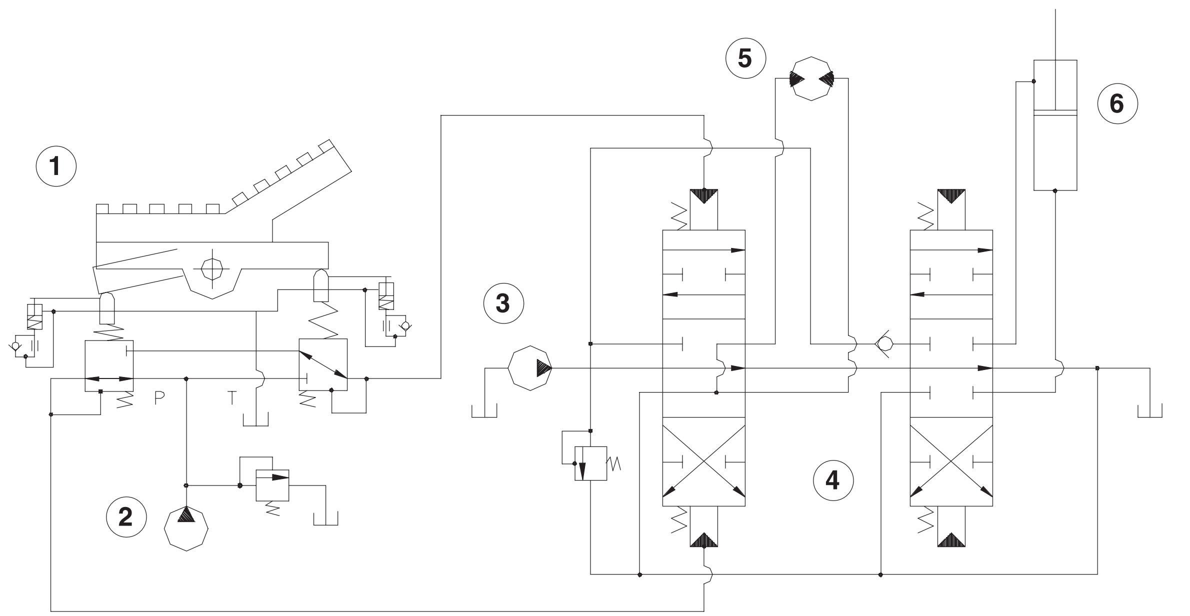


Figure 1

Reference Number	Description
1	Remote Control Valve
2	Pilot Pump
3	Main Pump

Reference Number	Description
4	Control Valve
5	Hydraulic Motor
6	Hydraulic Cylinder

Deceleration Valve

1. In neutral position, the damper spool is pushed to the neutral position by return spring which is seated on the spring seat (and washer. As a result of the damper spool's switching function, the output port is connected to port T and the pressure at the output port and port T is the same.

2. When the cam of the remote control valve is operated and moved from the neutral position to the clockwise direction, the push rod and damper spool of port 1 is moved down within the constraints of washer 1, spring seat, secondary pressure select spring, washer 2 and washer 3. As a result port P and port 1 are connected and oil pressure from the pilot pump flows through port 1, generating pressure.

   When the pressure of port 1 reaches the selected pressure of the secondary pressure select spring, the oil pressure and the spring set pressure will equalize and the output pressure of port 1 is maintained at a constant rate.

   The damper spool in port 2 is in the neutral position, oil returning from the control valve is discharged through port T. In cases where the controls are operated to the maximum position, the push rod makes direct contact with the damper spool forcing port P to make a direct path with the discharge port, permitting the pressure to equalize at these ports.

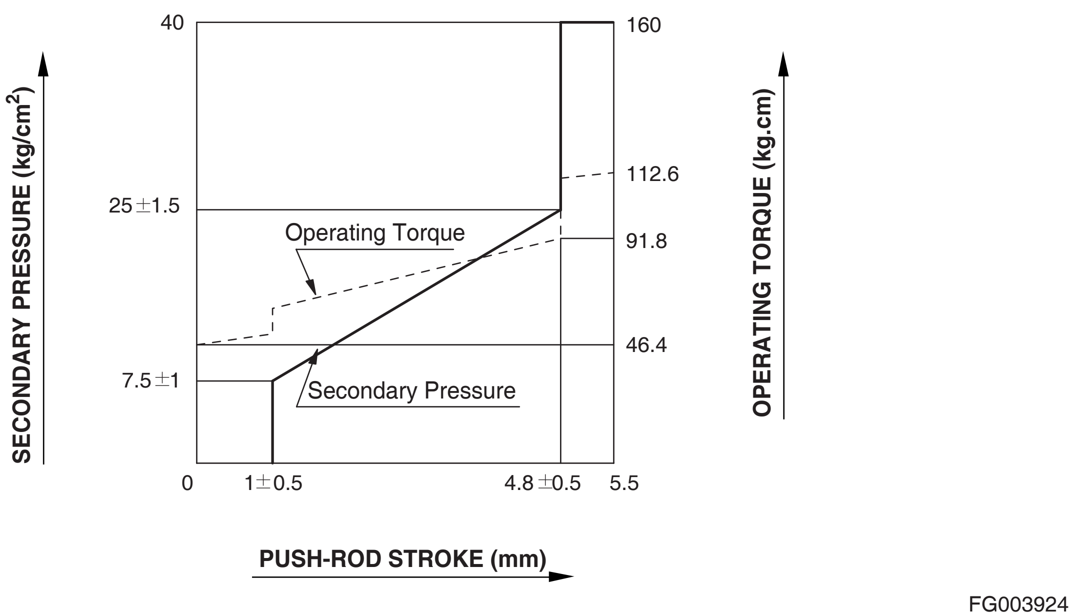


Figure 2

Dampening Parts of the Control Section

1. In the neutral position, the push rod is pushed up to its neutral position by the return spring and damper spring.
2. When the cam is moved in the clockwise direction from the neutral position, the push rod and damper spool of port 1 are moved in a downward direction. At this time, the pressurized oil in the damper spool is discharged through the orifice and the dampening pressure is generated. Meanwhile, the push rod in port 2 moves up with the damper spring and the damper spool between them. At the same time, the oil from the oil tank passes through the check ball (3 positions) consisting of a spring and steel ball, and flows out through port T in the upper portion of the casing to tank.
3. When the operating levers are moved to the extreme opposite position: When the cam is moved to the counterclockwise position from the clockwise most position, the push rod and piston in port 2 is moved in the downward direction. As in the case described above, the oil in the damping piston chamber is discharged through the orifice and the dampening pressure is generated in this chamber, providing dampening force. In port 1, the push rod is moved up by the action of the return spring and damper spring. At the same time, the oil from the oil tank passes through the check ball (3 positions) consisting of a spring and steel ball, and flows out through port T in the upper portion of the casing to tank

The damping operation is effective in both operations, when the levers are moved from the neutral position to the maximum travel position and when the levers are moved from the maximum travel position to the neutral position as well.

A. When moving lever from the neutral position

Moving the lever from the neutral position to the right forces oil in the right damper spool to discharged through the orifice, generating pressure that creates a dampening force.

Moving the lever in the opposite direction, causes the left damper spool to assume the function of the right spool.

Thus, a dampening force is generated at both ways.

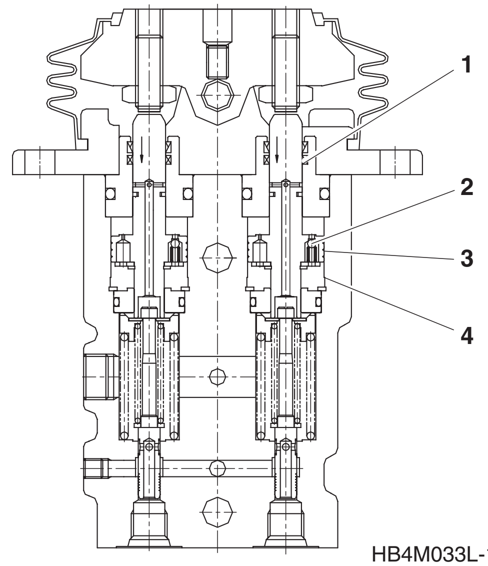


Figure 3

B. Operation of forward and reverse lever control

Oil outside the damper spool runs out through the channel from the top of the casing to the port (T). And oil in the damper spool is discharged through orifice, generating pressure that creates a dampening force.

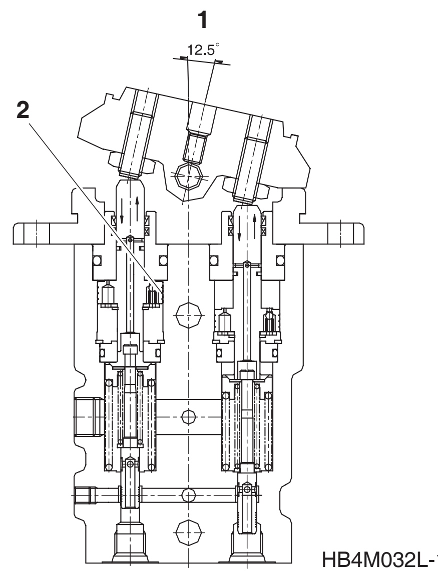


Figure 4

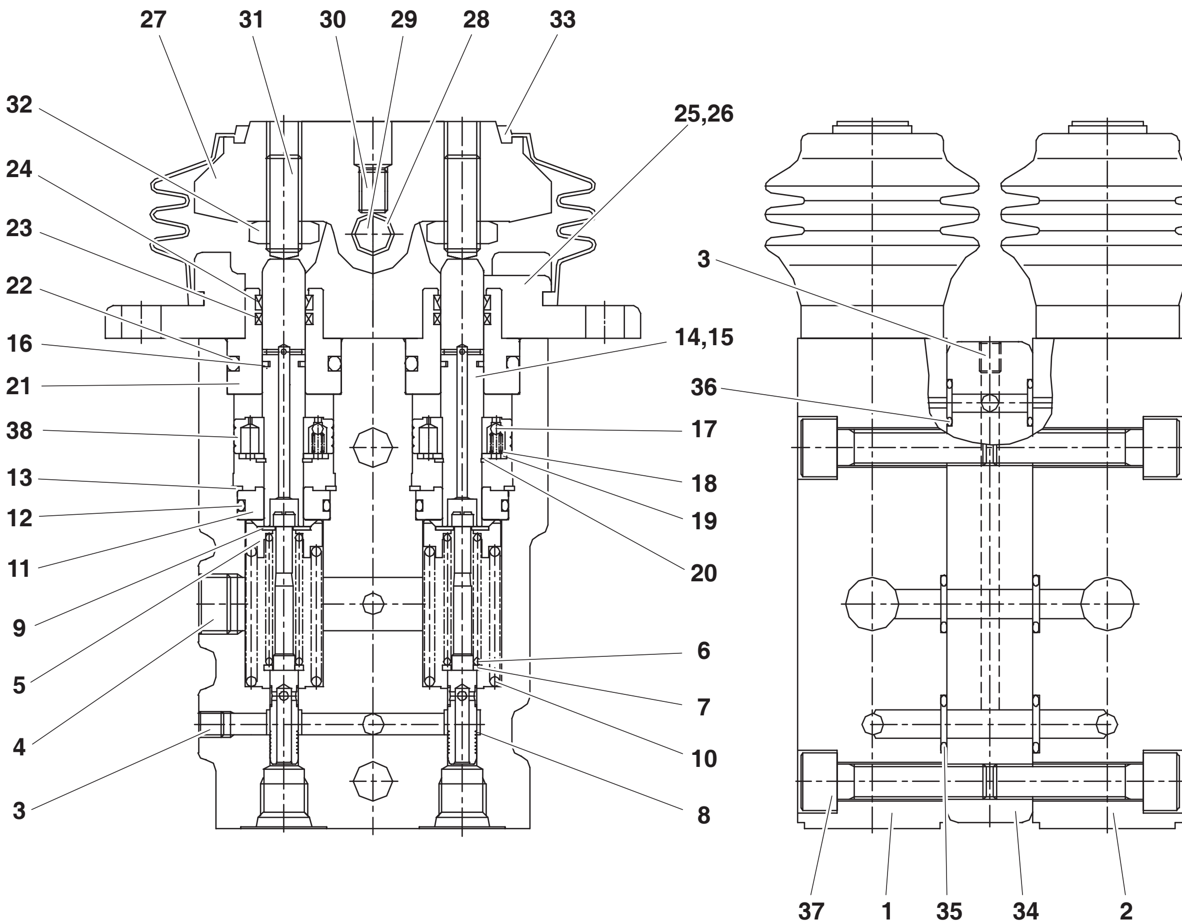
CAUSES OF FAULTS AND MEASURES

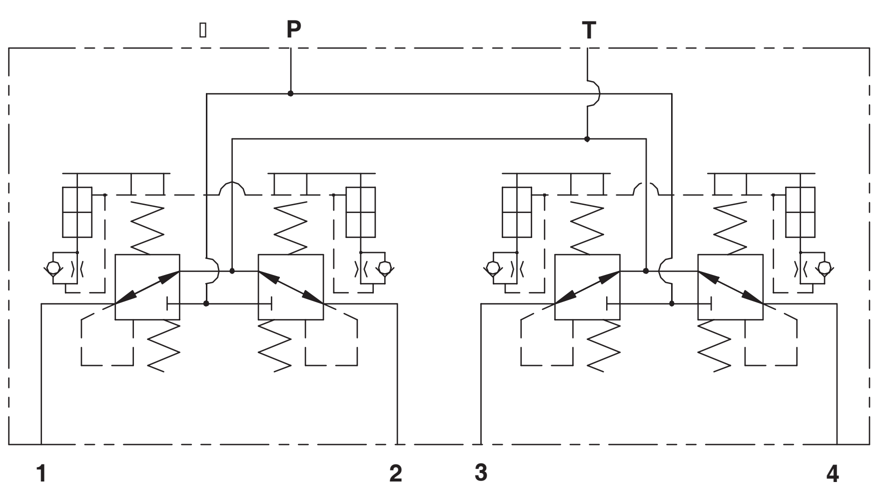
At times it may be difficult to pinpoint the source of the problem. The following table lists some of the possible problems, possible causes and remedies. Refer to this table for possible causes and remedies to assist in correcting the sometimes difficult problems.

The table only lists some general problems, possible causes and their remedies. In many cases the problem is not caused by the failure of a single part but, may be the result of a combination of problems from related parts and their components. Possible problems other than the ones list are not being specified but that is not to say that these are the only possible problems that can occur. The technician must diagnose the problem, considering all possible causes and repair the source of the malfunction.

Problem	Possible Cause	Remedy
Secondary pressure will not increase.	Low primary pressure.	Adjust primary pressure.
	Defective secondary pressure select spring.	Replace with new spring.
	Gap between damper spool and casing is abnormally large.	Replace damper spool casing assembly.
	Defective operating parts and components.	Disassemble/reassemble and replace defective parts.
Unstable secondary pressure.	Jamming of interconnected parts.	Repair/replace cause of jamming.
	Unstable tank line pressure.	Install direct line to hydraulic tank.
	Air in hydraulic lines.	Vent air from system.
Abnormally high secondary pressure.	High tank line pressure.	Install direct line to hydraulic tank.
	Jamming of interconnected parts.	Repair/replace cause of jamming.
No dampening.	Air in piston chamber.	Vent air from system.
	Jamming of interconnected parts.	Repair/replace cause of jamming.
	Worn damper springs.	Replace with new parts.
	Worn damper spool and housing.	Replace damper spool and housing assembly.
	Defective/damaged check valve.	Disassemble and examine check valve.
	Worn damper spool orifice.	Replace damper spool.
Damper spool feels heavy.	Defective interconnected components.	Repair/replace defective parts.
	Restricted movement of damper spool.	Repair/replace damaged piston.

Parts List





FG003925

Figure 5

Reference Number	Description
1	Body (1)
2	Body (2)
3	Plug
4	Plug
5	Spring Seat
6	Damper Spring
7	Spring Seat
8	Damper Spool
9	Stopper
10	Return Spring
11	Rod Guide
12	O-ring
13	Retaining Ring
14	Push Rod
15	Spring Pin
16	Seal
17	Steel Ball
18	Damper Spring
19	Cam Plate

Reference Number	Description
20	Retaining Ring
21	Plug
22	O-ring
23	Rod Seal
24	Dust Seal
25	Cover
26	Hex Socket Head Bolt
27	Cam
28	Bushing
29	Camshaft
30	Set Screw
31	Set Screw
32	Hex Nut
33	Bellows
34	Spacer
35	O-ring
36	O-ring
37	Hex Socket Head Bolt
38	Piston

Specifications

Travel Control Valve	Specification
Type	Pilot Control (With Damper)
Pressure / Stroke	25 kg/cm^2 @ 4.8 mm Stroke (356 psi @ 0.1890 in Stroke)
Weight	7.8 kg (17 lb)

Torques

Part Reference Number	Bolt Size	Tool	Tightening Torque
26	M6	5 mm L-Wrench	88 kg•cm (6 ft lb)
30	M8	4 mm L-Wrench	100 kg•cm (7 ft lb)
32	M10	17 mm Spanner	440 kg•cm (32 ft lb)
37	M10	8 mm L-Wrench	440 kg•cm (32 ft lb)

REMOVAL

1. Park on firm and level ground.
2. Lower front attachment (bucket) to ground.
3. Shut down engine.
4. Set safety lever on "RELEASED" position.
5. Turn starter switch to "I" (ON) position.

WARNING

If engine must be running while performing maintenance, always use extreme caution. Always have one person in the cab at all times. Never leave the cab with engine running.

6. Fully stroke work levers (joysticks) in all directions to relieve any pressure from accumulators.
7. Set safety lever on "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Hang a maintenance warning tag on controls.
10. Disconnect negative (-) battery cable leading to frame from battery.
11. Remove cabin under cover by loosening bolts.
12. Tag and disconnect hoses from pedal valve (1, Figure 7). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.

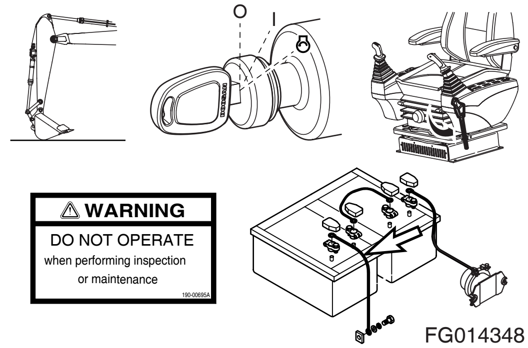


Figure 6

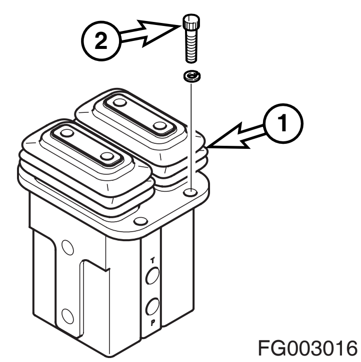


Figure 7

DISASSEMBLY

1. Remove bellows (33).

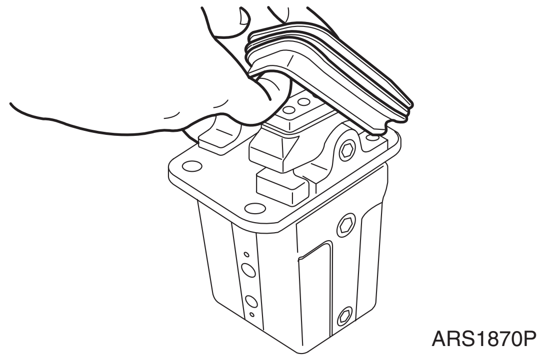


Figure 8

2. Remove set screw (30) from cam (27).

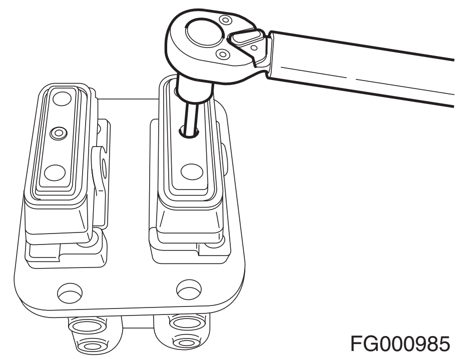


Figure 9

3. Remove cam shaft (29) and cover (25) from cam (27).

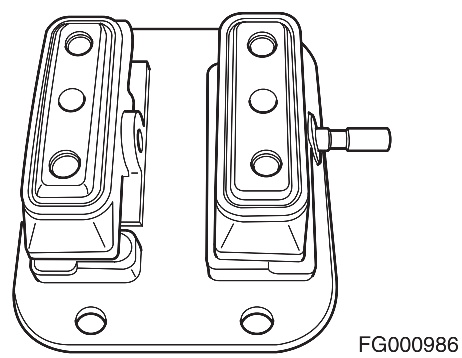


Figure 10

4. Remove hex nut (32) and swash plate (31) from cam.

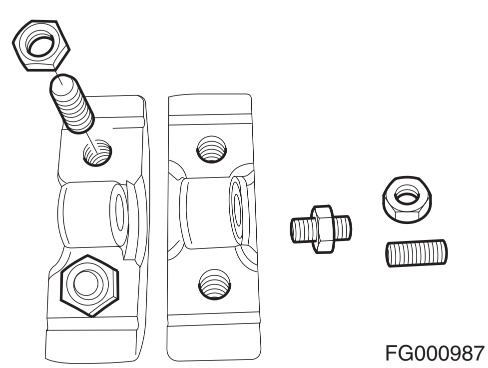


Figure 11

5. Remove hex socket head bolt (26) and cover (25) from each body (1 and 2).

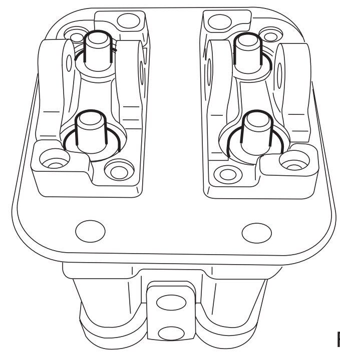


Figure 12

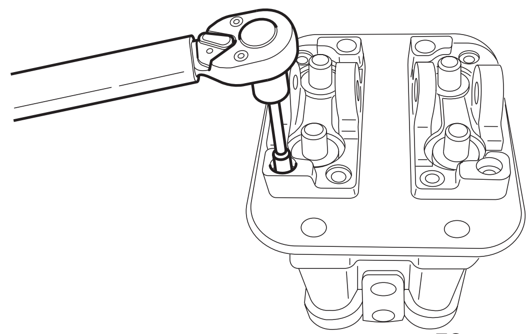


Figure 13

6. Remove push rod assembly from each body (1 and 2).

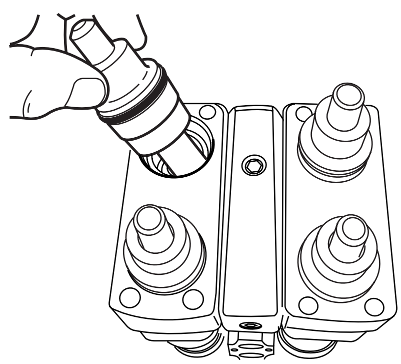


Figure 14

7. Remove retaining ring (13).

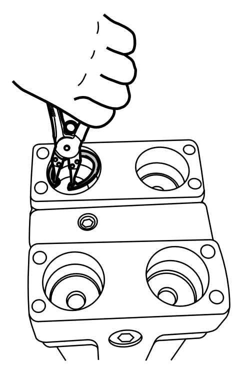
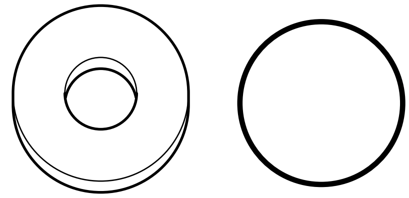


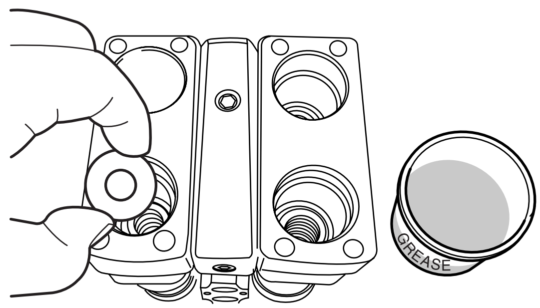
Figure 15

8. Remove rod guide (11) from each body (1 and 2).



FG000992

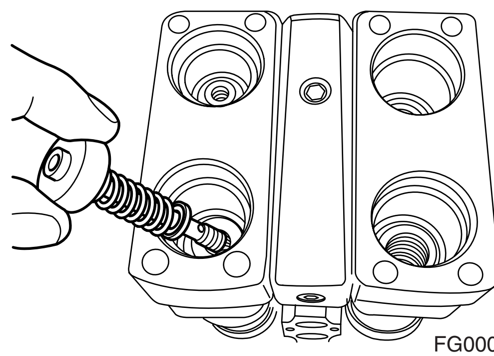
Figure 16



FG000993

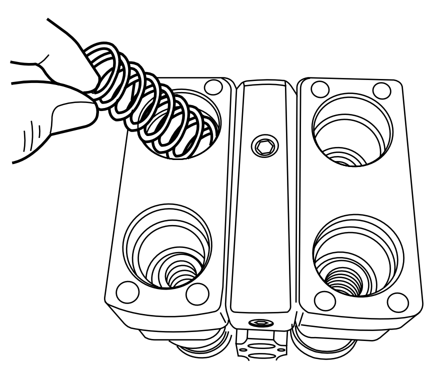
Figure 17

9. Remove damper spool assembly and spring (10) from each body (1 and 2).



FG000994

Figure 18



FG000995

Figure 19

10. Remove hex socket head bolt (37) from each body (1 and 2). Disassemble each body (1 and 2) and spacer (34). Remove plugs (3 and 4) and O rings (35 and 36).

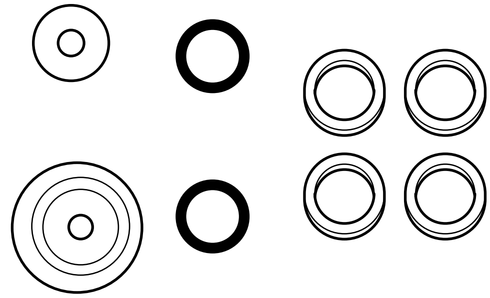


Figure 20

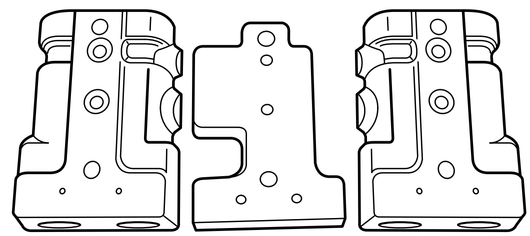


Figure 21

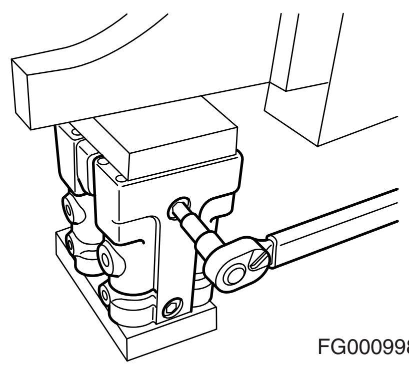


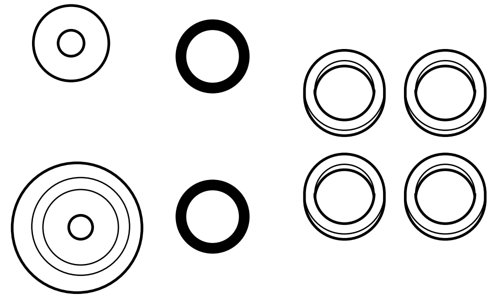
Figure 22

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

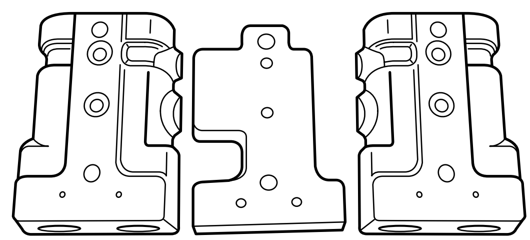
ASSEMBLY

1. Assemble plugs (3 and 4) and O rings (35 and 36) into each body (1 and 2) and spacer (34). Install hex socket head bolt (37) using torque wrench.



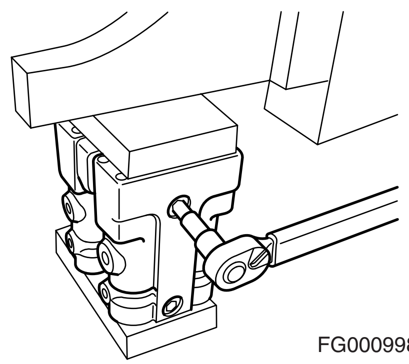
FG000996

Figure 23



FG000997

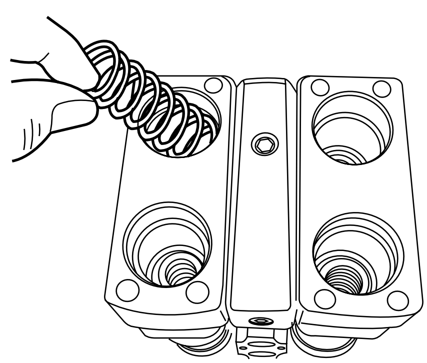
Figure 24



FG000998

Figure 25

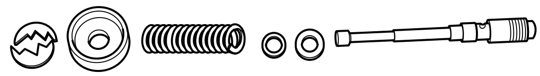
2. Insert spring (10) into each body (1 and 2).



FG000995

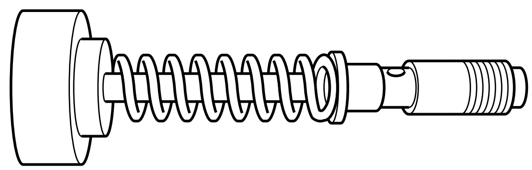
Figure 26

3. Assemble in proper order, damper spool (8), shim (7), spring (6), spring seat (5), and stopper (9).



FG000999

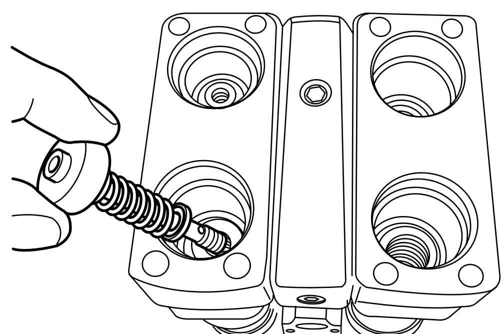
Figure 27



FG001000

Figure 28

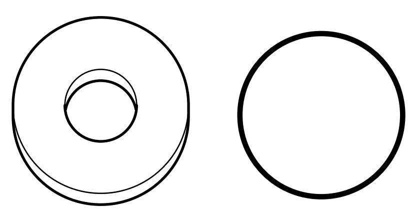
4. Install damper spool assembly into each body (1 and 2).



FG000994

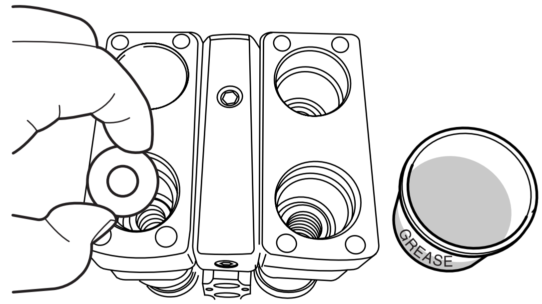
Figure 29

5. Install O-ring (12) on rod guide (11). Coat guide assembly with grease, and slide it into each body (1 and 2).



FG000992

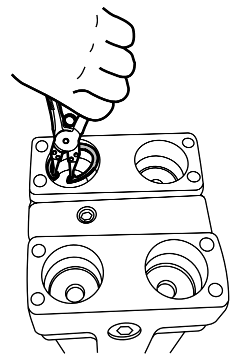
Figure 30



FG000993

Figure 31

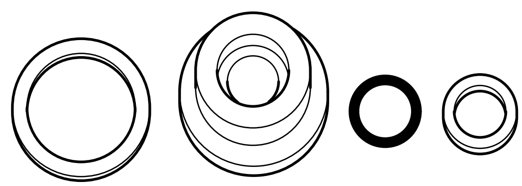
6. Install retaining ring (13). Make sure that it is properly seated.



FG000991

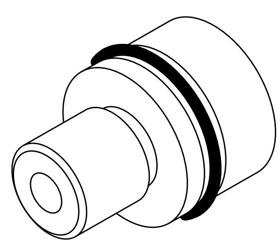
Figure 32

7. Assemble rod seal (23), dust seal (24), and O-ring (22) into plug (21).



FG001001

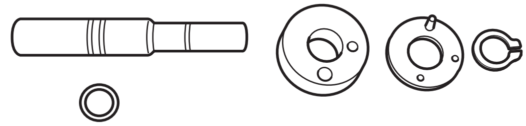
Figure 33



FG001002

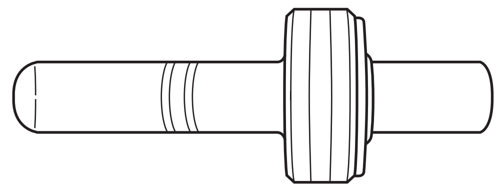
Figure 34

8. Assemble seal (16), piston (38), steel ball (17), plate (19), spring (18), and retaining ring (20) into push rod (14).



FG001003

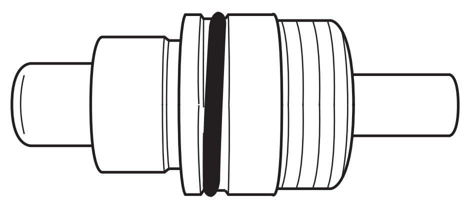
Figure 35



FG001004

Figure 36

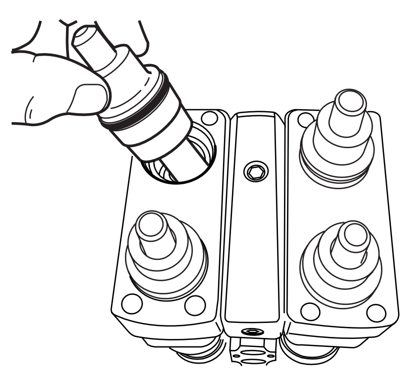
9. Assemble push rod and plug.



FG001005

Figure 37

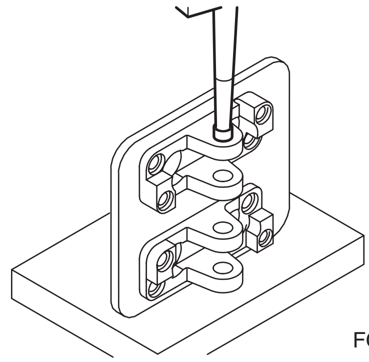
10. Install push rod assembly into each body (1 and 2).



FG000990

Figure 38

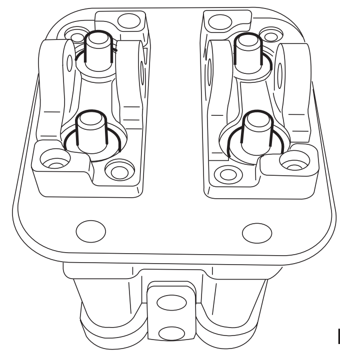
11. Install bushing (28) in cover (25) using jig.



FG001006

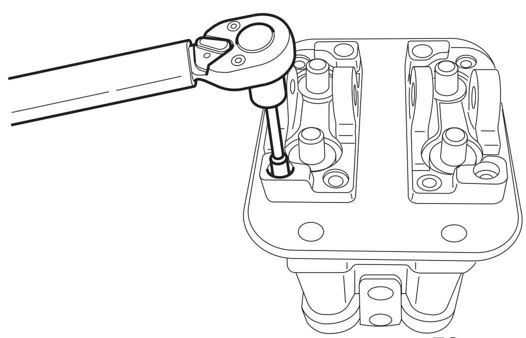
Figure 39

12. Assemble cover (28) onto each body (1 and 2) and install hex socket head bolt (26) using torque wrench.



FG001007

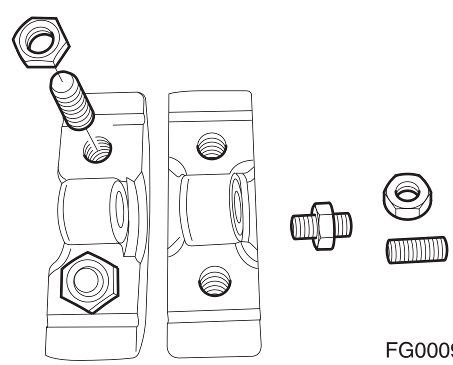
Figure 40



FG000989

Figure 41

13. Install set screws (31) and hex nut (32) into cam (27) and tighten it.



FG000987

Figure 42

14. Position cam (27) on cover (25), and insert cam shaft (29) using hammer.

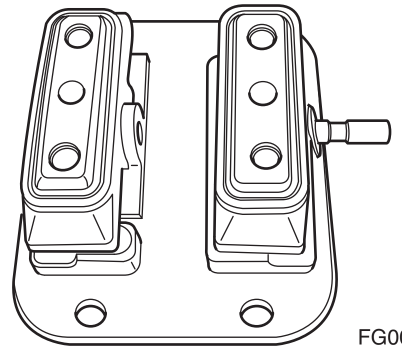


Figure 43

15. Install set screw (30) in cam (27) and tighten it using torque wrench.

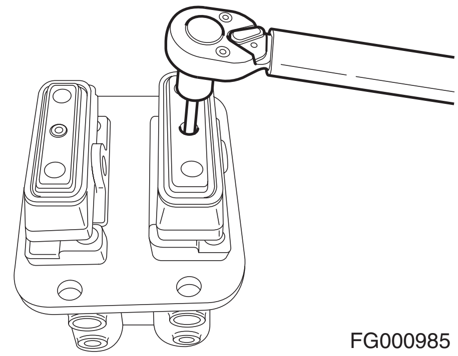


Figure 44

16. Check cam balance.

Figure 45

17. Install bellows.

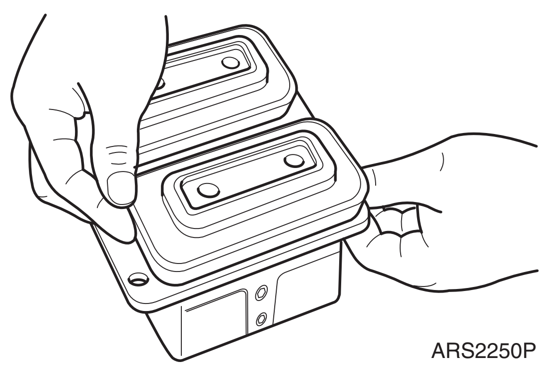


Figure 46

INSTALLATION

1. Position pedal valve (1, Figure 47) on cabin floor plate and install four bolts and washers (2).

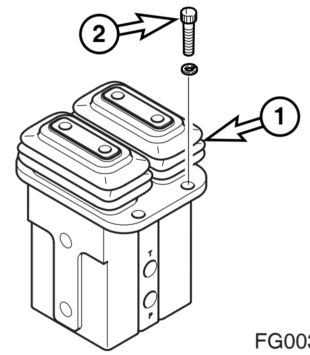


Figure 47

2. Install pedal brackets (3) and levers (4, Figure 48) on pedal valve and install four bolts and washers (2).
3. Install rubber boots (1, Figure 48).

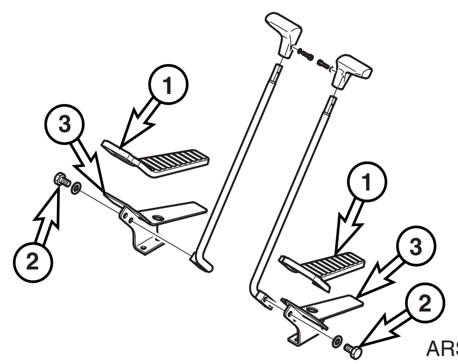


Figure 48

4. Connect hoses as tagged during removal to pedal valve (1, Figure 49).
5. Install cabin under cover by tightening bolts.

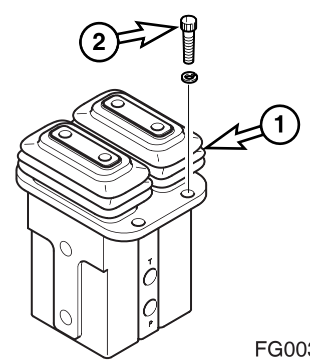
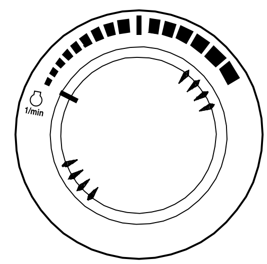


Figure 49

START-UP PROCEDURES

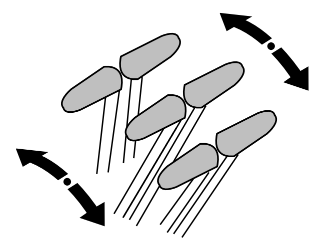
1. Start engine and set throttle at "LOW IDLE."
2. Set safety lever on "UNLOCK" position.



HAOB290L

Figure 50

3. Slowly push and pull both travel lever about five times without a load to vent air from pilot lines.



HAOB903L

Figure 51

Solenoid Valve Assembly

Edition 1

MEMO

Table of Contents

Solenoid Valve Assembly

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

5-SOLENOID VALVE

Parts List

Figure 1, shows components used in the 5-solenoid valve.

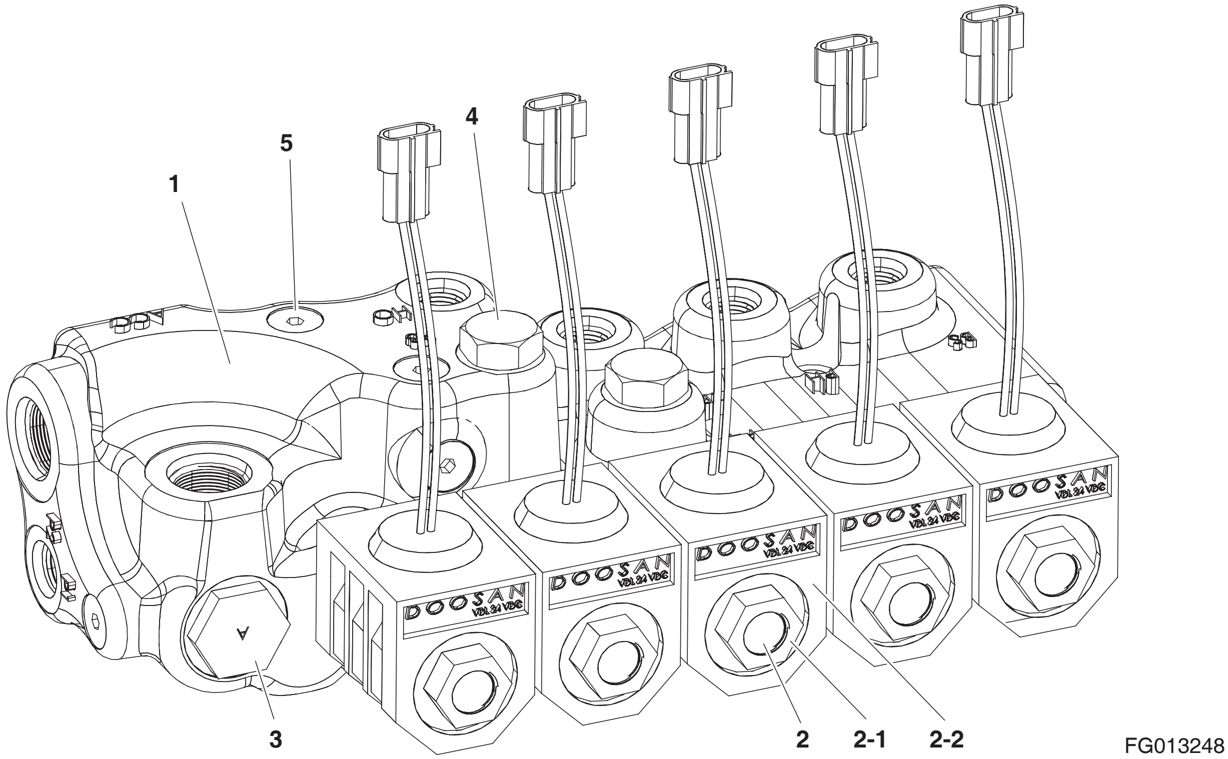


Figure 1

Reference Number	Description	Sizes	Quantity	Remarks
1	Block Body	79x82x272.5	1	1-A0098-07-0
2	Solenoid Valve	QF-S3A-0421	5	C1, C2, C3, C4, C5
2-1	Coil	VDL24VDC	5	C1, C2, C3, C4, C5
3	Check Valve	FD-DCP-0-A	1	C6
4	Plug	PF 1/4"	3	P3, P4, H0
5	Plug	PT 1/8"	6	

Functions of 5-Solenoid Valve Assembly

The solenoid valve assembly controls the following functions.

1. Pilot Cut-off
2. Breaker Pressure Supply
3. High/Low Travel Speed
4. Main Pressure (Power Boost) Increase
5. Breaker/Shear Mode Selection

Functions and Operations of Solenoid Valves

Reference Number	Function	Operations	Remarks
C1	Pilot Cut-off	Provides pressurized oil coming from the pilot pump for the pilot pressure supply solenoid valve to operate each work system.	
C2	Breaker Pressure Supply	Supplies pilot pressure for the pedal valve assembly and shuttle valve.	
C3	High/Low Travel Speed	Sets low and high travel speed. Shifts speed between both depending on the state of the solenoid valve or a signal detected in the e-EPOS controller.	
C4	Main Pressure (Power Boost) Increase	Temporally increases the pressure setting of the main relief valve, to increase the excavation power.	
C5	Breaker/Shear Mode Selection	Supplies pilot pressure to shear valve that controls the front option attachment so it is ready to work in the breaker mode.	

Detailed Functions and Operations of Solenoid Valves

1. Pilot Cut-off Solenoid Valve (C1)

   It provides pressurized oil coming from the pilot pump to the;

   - Breaker solenoid valve (C2)
   - High/low travel speed solenoid valve (C3)
   - Main pressure (power boost) increase solenoid valve (C4)
   - Breaker/shear mode selection solenoid valve (C5)

   NOTE: *Port "P3" from 5-solenoid valve assembly, is connected to a 2-solenoid valve assembly that is used to control a shear.*

   Pulling up the safety lever, located on the left side of the operator's seat, allows the electrical power from the pilot cutoff switch to activate the pilot cutoff solenoid valve. The pilot cutoff solenoid valve then supplies pressurized oil to each of the other solenoid valves.

2. Breaker Pressure Supply Solenoid (C2)

   Pressing the breaker switch on the joystick operates the breaker solenoid valve (C2). This supplies pilot pressure to the option valve in the main control valve. The pilot pressure shifts the option valve spool, which then allows pressurized oil from the main pump to flow to the breaker system for operation.

3. High/Low Travel Speed Solenoid (C3)

   When the travel speed selector switch is moved to the "O" position, the travel speed is set to low speed. The solenoid valve is not activated.

   When the travel speed selector switch is moved to the "I" position the travel speed is set to high-speed. The solenoid valve is activated.

   When the travel speed selector switch is moved to the "II" position, the travel speed switches to automatic.

   NOTE: *Turning the automatic travel switch to the "II" position, the e-EPOS controller detects the discharge pressure from the main pump, and automatically turns the high travel speed control "ON" or "OFF" depending on if the travel load is high or low to switch the travel speed to speed "I" or "II." The travel load is detected by two pressure sensors located on the discharge line of the front and rear pumps.*

   If the load is high (pressure about 300 kg•cm^2), the solenoid valve turns "OFF" for travel at low speed.

   If the load is low (pressure about 160 kg•cm^2), the solenoid valve turns "ON" for the travel at high-speed.

   If the engine control dial is set to 1400 rpm or below, however, the solenoid valve always turns "ON" for the travel at low, though the automatic travel switch is set to the automatic travel (2nd place).

4. Main Pressure (Power Boost) Increase Solenoid (C4)

   Pressing the power boost button on the work lever sends a signal from the e-EPOS controller to activate the pressure increase solenoid valve. This temporally increases the pressure setting of the main relief valve to increase the hydraulic power. When it is activate, the pressure setting of the main relief valve increases from 330 kg•cm^2 to 350 kg•cm^2, which in turn increases the hydraulic power.

5. Breaker/Shear Mode Selection Solenoid (C5)

The breaker/shear switch activates the solenoid valve when the front option attachment is changed from shear to breaker.

When the switch is set to breaker, pilot pressure is supplied to shear valve shifting the spool inside. with the pressurized oil from the main pump supplied to breaker.

Assembly Diagram and Tools Required

Figure 2, shows assembly torques recommended for components in the solenoid valve. Designated tools and torques should be used.

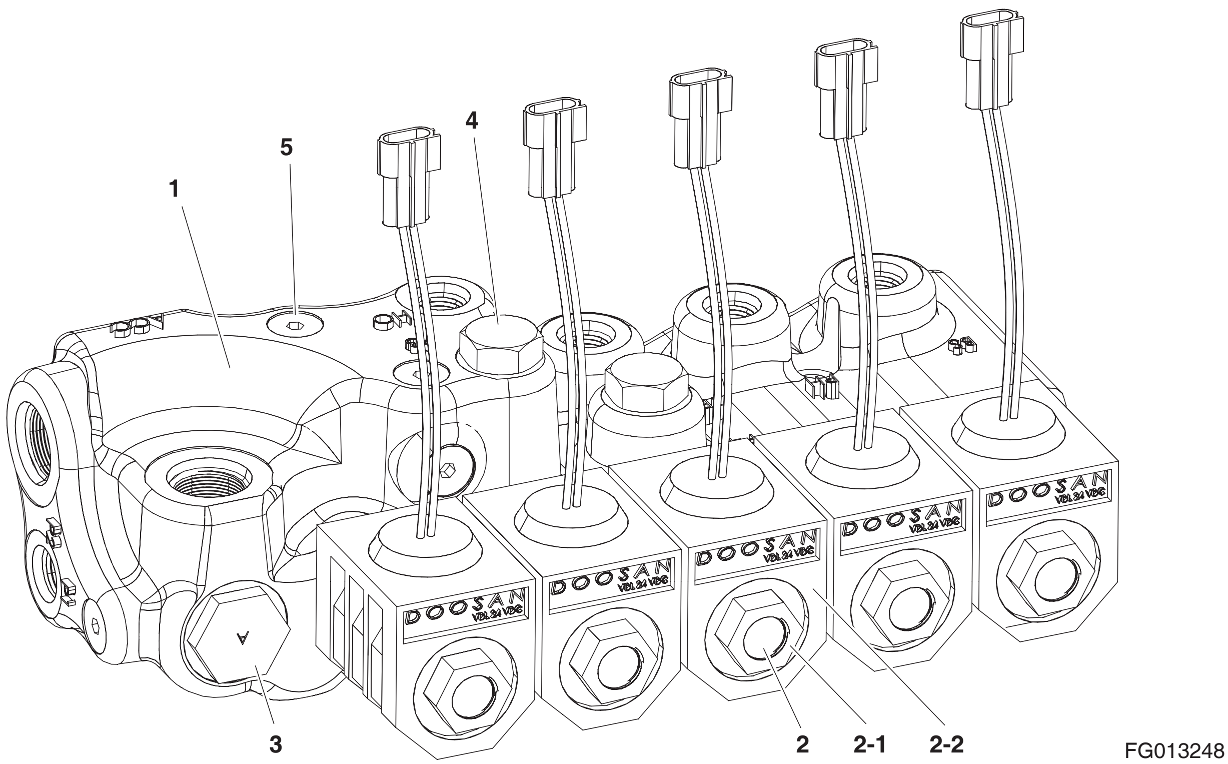


Figure 2

Reference Number	Description	Sizes	Torques (kg•cm)	Tools
2	Solenoid Valve	UNF7/8 - 14"	200 ± 25 kg•cm (170 ± 20 in lb)	Hex torque wrench/1," socket
2-1	Coil Locknut	UNF1/2 - 20"	60 ± 2 kg•cm (50 ± 2 in lb)	Hex torque wrench/19 mm, socket
3	Check Valve	UNF7/8 - 14"	400 ± 2 kg•cm (350 ± 2 in lb)	Hex torque wrench/1," socket
4	PT 1/4" Plug	UNF1/4 - 19"	250 ± 25 kg•cm (220 ± 20 in lb)	Hex torque wrench/19 mm, socket
5	PT 1/8" Plug Bolt	UNF1/8 - 28"	280 kg•cm (240 in lb)	Hex torque wrench/5 mm, wrench socket

Cautions During Disassembly and Reassembly

1. Choose a work area for disassembly.

   NOTE: *(1) Choose a clean work area.*

   (2) Use a rubber mat or other protective covering on the workbench area to prevent damage or scratching of any precision machined components.

2. For disassembly and reassembly, use torques and tools listed in tables.
3. The directions of disassembly and reassembly are same as the "Disassembly Direction" and "Reassembly Direction" as shown in Figure 2.
4. Disassembly and reassembly of the solenoid valve

   A. Remove coil locknut (2-1) from tube and retainer.

   CAUTION

   Take care not to damage the valve tube and retainer when removing the coil locknut.

   If the valve tube and retainer is damaged (bent or deformed), the solenoid valve may not operate.

   B. Remove coil (2-2) by hand.

   C. Remove solenoid valve (2).

   D. Check disassembled components for damage, and reassemble them in the reverse order of the disassembly.

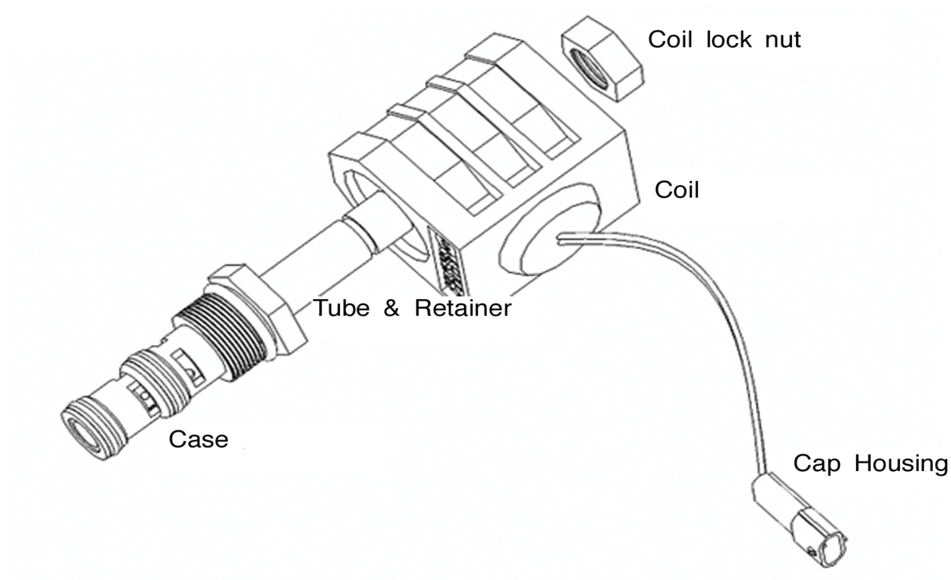
   E. Do not use excessive torque when assembling he solenoid valve and coil.

   CAUTION

   Excessive torque may damage the solenoid valve.

5. Do not allow any contamination to enter the valve during disassembly and reassembly procedures.
6. Every component should be washed out before reassembly.

Solenoid Valve Diagram



FG004537

Figure 3

Check Points and Solutions for Problems

Symptoms	Causes	How to Check	Solutions
Malfunction of solenoid valve	Foreign substance, dirt and dust in solenoid valve.	Disassemble the solenoid valve and check if there is any contamination such as a foreign substance and sludge between the case and the spool.	Remove contaminant, wash, and assemble components.
	Tube or retainer of solenoid valve damaged.	Disassemble the solenoid valve and check if there is any deformation (bending or reduction) in the tube or the retainer.	Replace solenoid valve.
	Coil broken, short, or burned.	Disassemble the solenoid valve and check the coil resistance. Spec: 26.7Ω @ 20°C Disconnection: ∞ Short: Low or excessive resistance Disassemble the solenoid valve and check the outside of the coil to see if its casing is burned and melted.	Replace coil.
	Connector terminal ground defect.	Check if the cap housing (where coil lead is attached) and the housing (across its length) are grounded properly.	Replace housing or terminal.
Pilot pressure fails to generate;	Pilot pressure.	Remove plug of the "P5" port, install a pressure gauge, and check the pilot pressure discharged from the pilot pump when operating the pilot cut-off valve (C1).	Refer to "Causes" and "How to Check" of the solenoid valve above.
	Pilot relief valve.	Check if the relief valve installed in the pilot line operates properly. • Check if pressure is bypassing because of the presence of foreign substance.	Remove foreign substance, reassemble, and replace the relief valve.
	Pilot pump.	Check if the pilot pump works properly.	Replace the pilot pump.
	Pilot filter.	Check if the mesh screen of the pilot filter is contaminated by foreign substance.	Wash, reassemble, and replace the filter.
Poor Actuator Performance	Pilot system.	Check any defect of the pilot system considering findings from "Pilot pressure fails to generate;" category.	Repair defect (s) accordingly.
	Solenoid valve.	Install a pressure gauge at each outlet port of the solenoid valve (HO, TR2, PH, and SP ports) and check the pressure value discharged from the pilot pump when operating the solenoid valve.	Refer to "Causes" and "How to Check" of the solenoid valve above.
	Main control valve.	Check if main control valve of each component works properly.	Repair according to findings.
	Other components.	Check if each component works properly.	Repair according to findings.

Checking of Pilot Pressure for Defects

Port where pressure gauge set up	Screw Size	Remark
P1, P3, P4, P5, P6, TR2, PH, HO, SP	PF1/4" O-ring BOSS	Operate the solenoid valve (ON).

2-SOLENOID VALVE

Parts List

Figure 4, shows components used in the 2-solenoid valve.

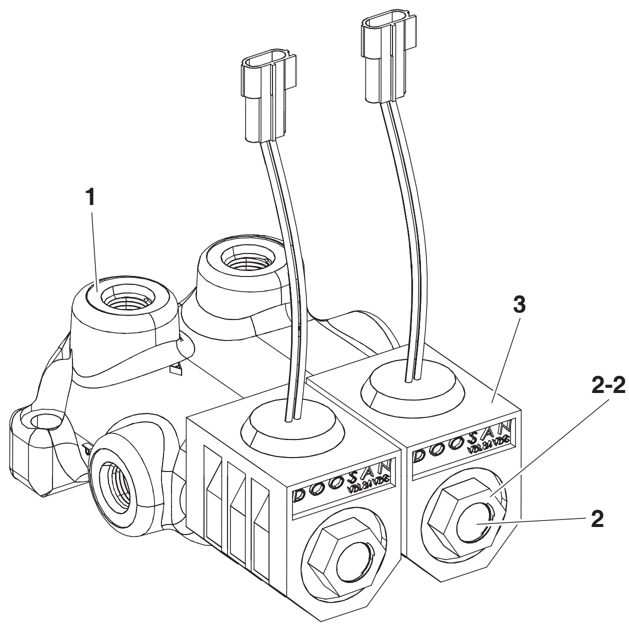


Figure 4

Reference Number	Description	Size	Quantity	Remarks
1	Block Body	57x73x105	1	1-A1097-07-0
2	Solenoid Valve	QF-S3A-0421	2	C1, C2

Assembly Diagram and Tools Required

The assembly torque of each part in the solenoid valve is described in the table below.

Observe the specified torque values using the right tool.

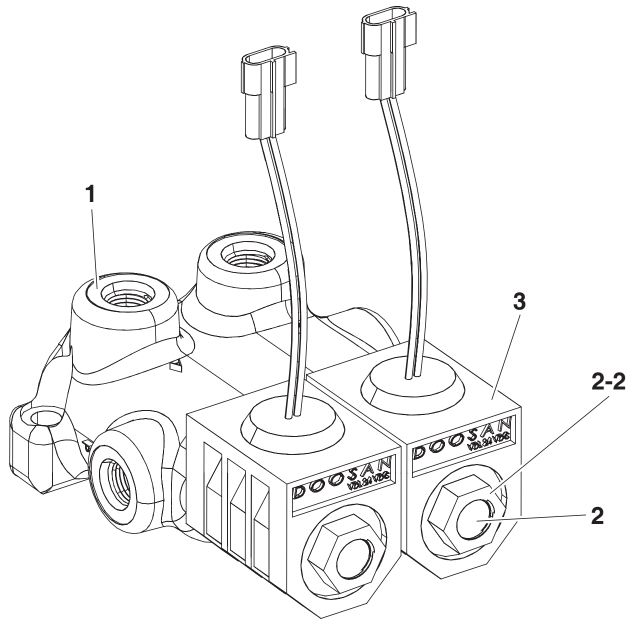


Figure 5

Reference Number	Description	Sizes	Torques (kg•cm)	Tools
2	Solenoid Valve	UNF7/8-14"	200 ±25 kg•cm (170 ±20 in lb)	Torque wrench/1" hex. socket
2-1	Coil Locknut	UNF1/2-20"	200 ±25 kg•cm (170 ±20 in lb)	Torque wrench/ 19 mm hex. socket

Cautions During Disassembly and Reassembly

1. Choose a work area for disassembly.

   NOTE: *(1) Choose a clean work area.*

   (2) Use a rubber mat or other protective covering on the workbench area to prevent damage or scratching of any precision machined components.

2. For disassembly and reassembly, use torques and tools listed in tables.
3. The directions of disassembly and reassembly are same as the "Disassembly Direction" and "Reassembly Direction" as shown in Figure 2.
4. Disassembly and reassembly of solenoid valve

   A. Remove coil locknut (2-1) from tube and retainer.

   CAUTION

   Take care not to damage the valve tube and retainer when removing the coil locknut.

   If the valve tube and retainer is damaged (bent or deformed), the solenoid valve may not operate.

   B. Remove coil (3) by hand.

   C. Remove tube and retainer (2).

   D. Check disassembled components for damage, and reassemble them in the reverse order of the disassembly.

   E. Do not use excessive torque when assembling he solenoid valve and coil.

   CAUTION

   Excessive torque may damage the solenoid valve.

5. Do not allow any contamination to enter the valve during disassembly and reassembly procedures.
6. Every component should be washed out before reassembly.

Solenoid Valve Diagram

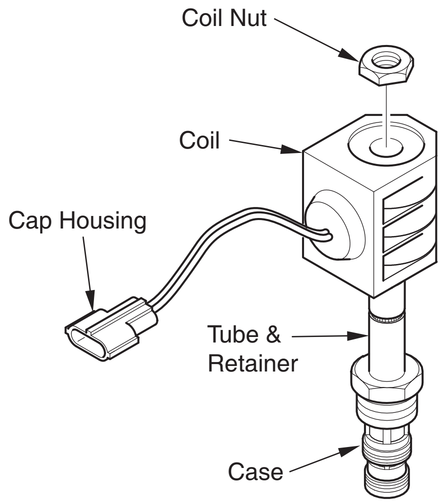


Figure 6

Troubleshooting Guide

Symptoms	Causes	How to Check	Solutions
Solenoid valve will not function properly	Foreign substance, dirt and dust in solenoid valve.	Disassemble the solenoid valve and check if there is any contamination such as a foreign substance and sludge between the case and the spool.	Remove contaminant, wash, and assemble components.
	Tube or retainer of solenoid valve damaged.	Disassemble the solenoid valve and check if there is any deformation (bending or reduction) in the tube or the retainer.	Replace solenoid valve.
	Coil broken, short, or burned.	Disassemble the solenoid valve and check the coil resistance. Spec: 26.7Ω @ 20°C Disconnection: ∞ Short: Low or excessive resistance Disassemble the solenoid valve and check the outside of the coil to see if its casing is burned and melted.	Replace coil.
	Connector terminal ground defect.	Check if the cap housing (where coil lead is attached) and the housing (across its length) are grounded properly.	Replace housing or terminal.

Breaker EPPR Valve (Opt)

Edition 1

MEMO

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Breaker EPPR Valve (Opt)

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

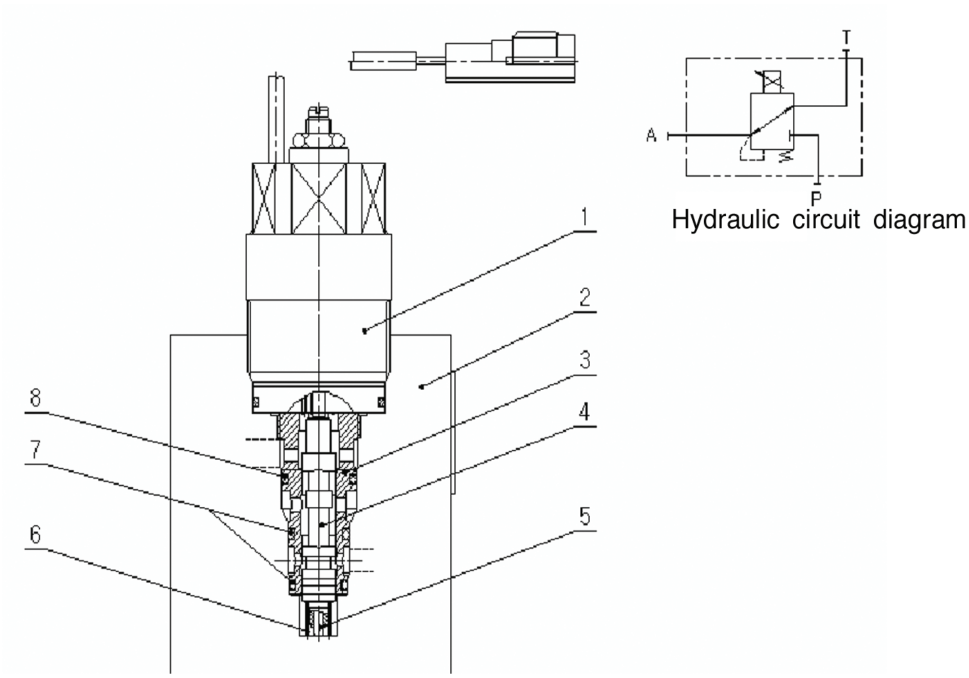
APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

STRUCTURE

Numbers and Names of Parts



FG004539

Figure 7

Reference Number	Description
1	Solenoid
2	Valve casing
3	Sleeve
4	Spool

Reference Number	Description
5	Pin
6	Spring
7	O-ring
8	O-ring

FUNCTIONS AND OPERATION

The proportional reducing valve shall be adjusted that its reduced pressure is proportional to the current of the solenoid.

The proportional solenoid shall be changed with pressure proportional to the electrical input signal. Flow increases corresponding to the force of the solenoid. As the solenoid (1) receives pressure, the spool (4) opens and oil flows from P to A. Pressure of the port A influences the top surface of the pin (5). When it reaches the valve set of the solenoid, the spool starts to move and oil flow from P to A decreases.

CAUTIONS FOR OPERATION

1. Wiring of the solenoid
   - The solenoid has no polarity.
2. Input electricity
   - Do not supply electric current more than 0.7A to the solenoid coil.
3. Adjustment screw
   - It was adjusted to the standard.
   - The pressure of the port A increases when turning the adjustment screw clockwise.
4. Symptoms and Solutions of Problems

Symptoms	Causes	Solutions
Pressure does not increase nor change	Poor wiring	Fix wiring
	Solenoid damaged	Replace the solenoid
	Piston or spool sticked	Fix, or clean and grind
	Amplifier damaged	Repair or replace the amplifier
Unnatural pressure change	Poor opening space Too wide Too narrow	Readjust
	Piston or spool sticked	Fix, or clean and grind
Unnatural pressure	Poor opening space Too wide Too narrow	Readjust
Slow reaction	Low pressure supplied	Readjust

MAINTENANCE INSTRUCTIONS

Maintenance

Bolt Tightening Torque

Table 1 shows torques used to tighten bolts of the motor.

Make sure that assembly work should be done according to Table 1.

Bolt Sizes	Names	Used Torques (kgf.cm)
M 35	Hex bolt	450 ± 50
M 10	Hex bolt	200 ± 20
NPTF 1/16	Plug	90

Tools Used for Disassembly and Assembly

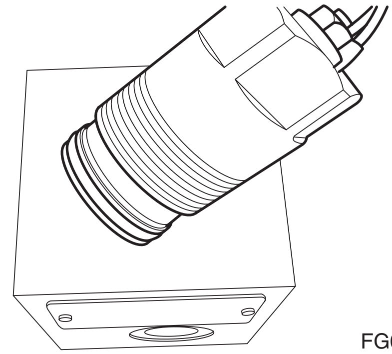
Table 2 shows tools necessary for disassembly and assembly.

As bolts and plugs to be used depend on types, they should be checked accordingly in advance.

For	Sizes	Used Torques	Used Tools
Solenoid	M 35	450 ± 50	Spanner
Sleeve	M 10	200 ± 20	Hex bar spanner
NPTF plug	1/16	90	Hex bar spanner

Disassembly

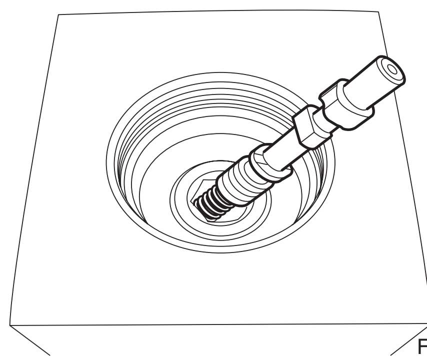
1. Determine a place for disassembly.
   - It should be clean.
   - Lay a rubber board or a cloth on the table and take care not to damage parts.
2. Remove dust and rust of the proportional pressure reducing valve with cleansing oil.
3. Disassemble the solenoid
   - Take care not to damage O-rings of the solenoid.



FG003690

Figure 8

4. Disassemble the spool, the spring, and the pin.



FG003691

Figure 9

5. Disassemble the sleeve.
   - Take care not to damage O-rings of the sleeve.

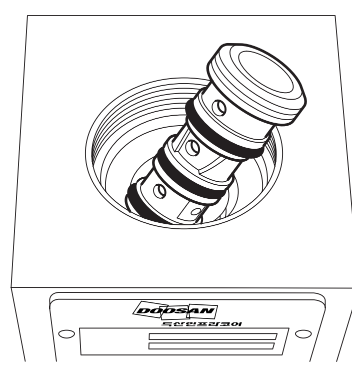


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Figure 10

Assembly

Assembly shall be done in the reverse order of disassembly described above, taking into consideration the following points.

- Parts damaged during disassembly should be repaired without fail and spare parts should be prepared in advance.
- Every part should be cleaned enough with cleaning oil and dried with compressed air before starting assembly.
- Sliding parts and bearings should be applied clean active oil before their assembly.
- Basically, parts of the O-ring and the oil seal should be replaced.
- Use a torque wrench to tighten or engage bolts and plugs in accordance with reference torques as described in Maintenance Guide.

1. Assemble the sleeve.

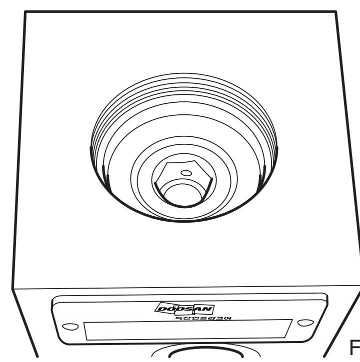


Figure 11

- Take care not to damage O-rings of the sleeve.

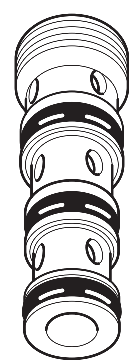


Figure 12

2. Assemble the spool, the spring, and the pin.

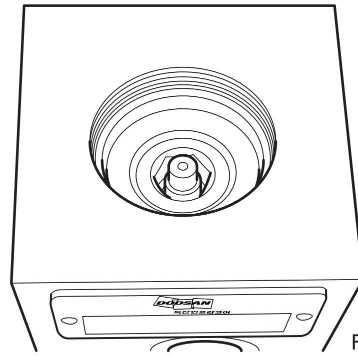

FG003695

Figure 13

- The spring and the pin should not be fell off.

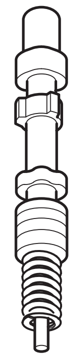
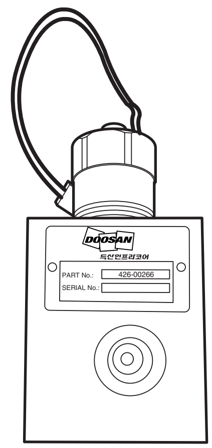

FG003696

Figure 14

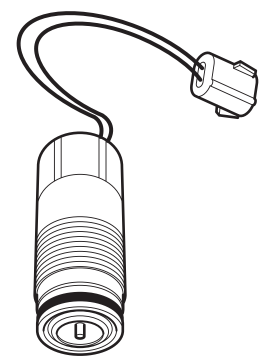
3. Assemble the solenoid correctly.



FG003697

Figure 15

- Take care not to damage O-rings of the solenoid.



FG003698

Figure 16

Hydraulic Schematic DX300LC/ DX300LCA

Edition 1

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Hydraulic Schematic DX300LC/DX300LCA

SAFETY PRECAUTIONS

CAUTION

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APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up

DX300LC/DX300LCA

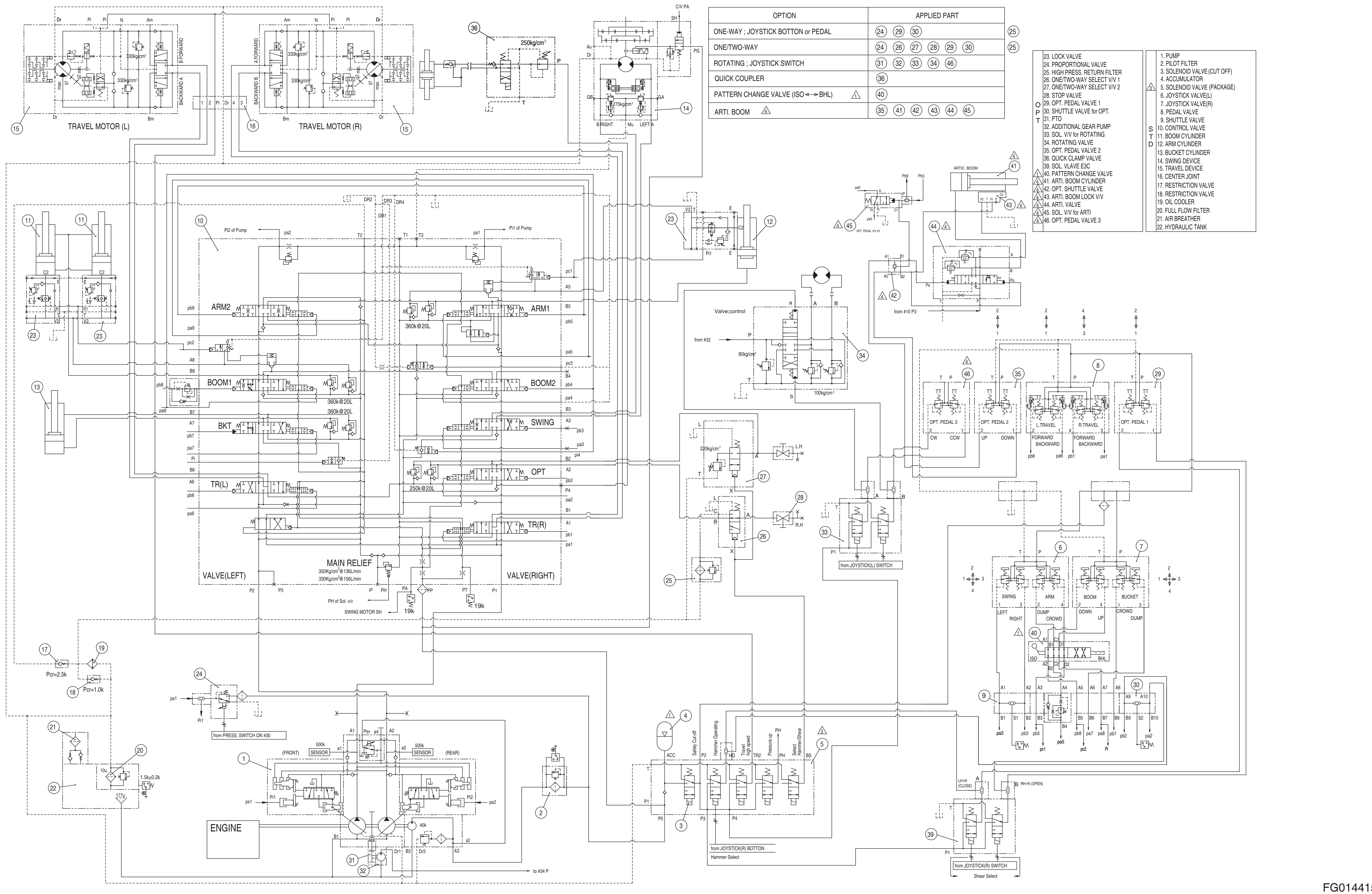

Figure 1

Electrical System

Electrical System

Edition 1

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Electrical System

MEMO

SAFETY PRECAUTIONS

CAUTION

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APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LCA	5001 and Up

INTRODUCTION

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 stereo and the air-conditioning control actuator. The system contains two 12 volt batteries connected in series and a three phase AC generator with a rectifier. The electric wiring used in the system is easily identifiable by the insulator color. The color symbols used in the electrical system are listed in the following chart.

Electric Wire Color

Symbol	Color
W	White
G	Green
Or	Orange
B	Black
L	Blue
Lg	Light green
R	Red
Gr	Gray
P	Pink
Y	Yellow
Br	Brown
V	Violet

NOTE: *RW: Red wire with White stripe*

R - Base Color, W - Stripe Color

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

ELECTRICAL SUPPLY SYSTEM

The electric power circuit supplies electric current to each electric component. It consists of a battery, battery relay, starter switch, circuit breaker, fusible link and fuse box.

The negative terminal of the battery is grounded to the vehicle body.

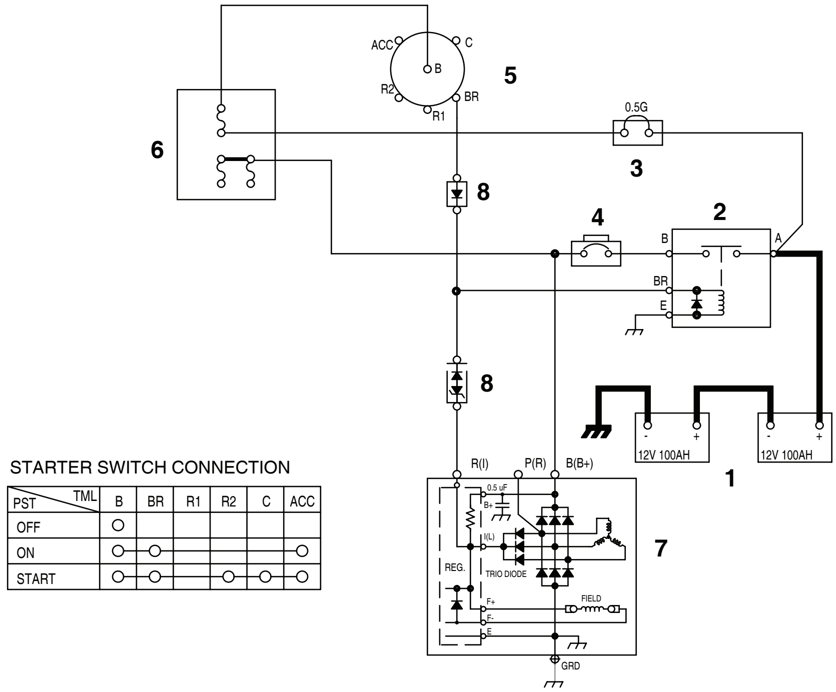
Even when the starter switch (5) is in the "OFF" position, electric current is supplied to the following components through battery (1) → fusible link (3) → fuse box (6).

1. Terminal "1" of DC-DC converter (for memory backup of stereo)
2. Terminal "B" of starter switch
3. Hour meter
4. Engine controller
5. Fuel feeder pump switch
6. Terminal "6" of wiper motor
7. Terminal "13" of wiper controller
8. Terminal "CN6-11" of instrument panel
9. Terminal "CN9-6" of air conditioner panel
10. Cabin light

When the starter switch (5) is in the "ON or START" positions, the current flows from the battery (1) → fusible link (3) → fuse box (6) → "B" terminal of starter switch (5) → "BR" terminal of starter switch (5) → "BR" terminal of battery relay (2) which activates the coil of the battery relay and the electric supply system is energized.

When the battery relay's contacts are connected, all electric devices can be operated.

While the engine is not running, the electric power for all electric devices are supplied by the battery. Once the engine is started the power is supplied from the alternator (7).



FG007233

Figure 1 ELECTRIC POWER CIRCUIT DIAGRAM

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Alternator
8	Diode

ENGINE STARTING CIRCUIT

Start Operation

When the starter switch is turned to the "START" position, the "S" and "E" terminals of the starter controller (7) are connected. At this time the contacts in the starter relay (8) are closed by the current flow from the battery (1) → fusible link (3) → fuse box (6) → "B" terminal of starter switch (5) → "C" terminal of starter switch (5) → "30" terminal of starter relay (12) - "87a" terminal → "C" terminal of starter relay (8) - "D" terminal → "S" terminal of starter controller (7) - "E" terminal → ground.

When the contact point "B" and "PP" of starter relay (8) are connected, the pinion gear of the starter (9) is pushed forward and makes contact with the ring gear of the flywheel and the internal contacts of the starter are connected. The current flows from the battery (1) → "A" terminal of the battery relay (2) → "B" terminal of the battery relay (2, Figure 3) → "B" terminal of the starter (9). The starter motor is rotated and the engine is started.

If the instrument panel has the password function activated , input number should match the set number, otherwise the start circuit closes and the engine does not start.

NOTE: *If the security system is "LOCKED," a four-digit password will be required to start the engine. If the system is "UNLOCKED," no password will be required and this display screen will not appear.*

In the event the security system is locked, current flows from battery (1) → fusible link (3) → fuse box (6) → "B" terminal of starter switch (5) → "ACC" terminal of starter switch (5) → "86" terminal of starter relay (12) → "85" terminal of starter relay (12) → "CN1-15" terminal of e-EPOS (13) → ground. This current flow causes the coil in starter relay (12) to be activated, opening contacts at "87a" terminal. This prevents starter relay (8) from functioning.

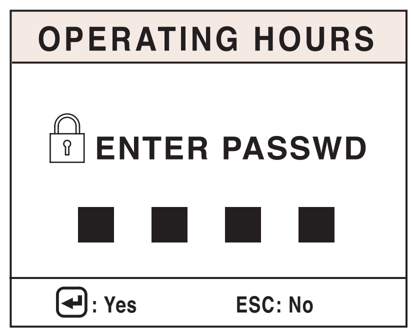


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Figure 2

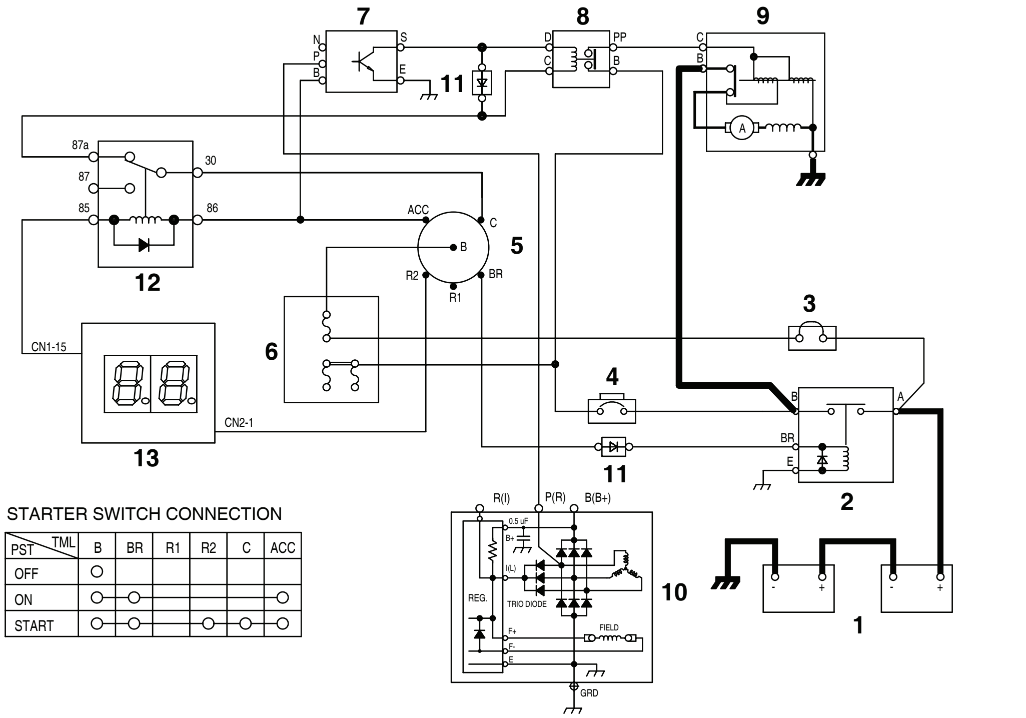

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Figure 3 STARTER CIRCUIT (1) - WHILE STARTING

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box
7	Starter Controller

Reference Number	Description
8	Starter Relay
9	Starter
10	Alternator
11	Diode
12	Starter Relay 2
13	e-EPOS Controller

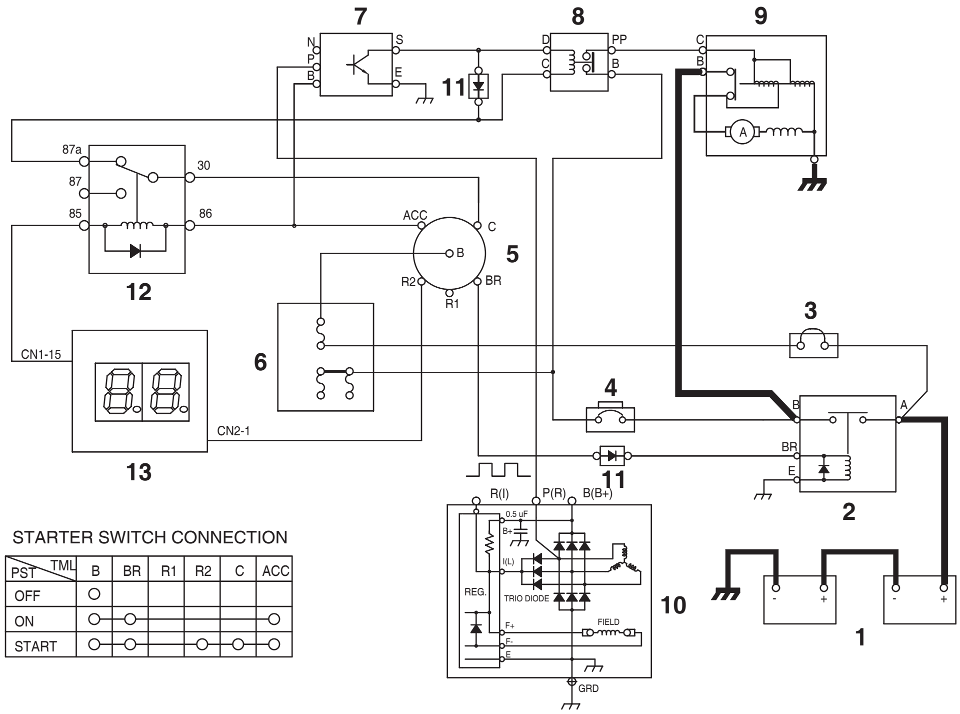
After Start

Once the engine has been started, the belt driven alternator (10) generates a current.

The output generated by the alternator (10) is a square wave pulse voltage through the "P" terminal and the frequency of the pulse voltage is proportional to the rotation of the alternator.

The starter controller (7) monitors the frequency of the output current. Once the frequency is equivalent to 500 rpm, it is sensed and the connection between "S" and "E" terminals and the connection between "B" and "PP" terminals are opened. As a result the rotation of the starter (9) is stopped. Once the engine is running, the starter (9) will not operate even if the starter switch (5) is moved to the start position, preventing possible damage to the starter.

Operation of the Start Circuit (2) - Immediately After Start



TML / PST	B	BR	R1	R2	C	ACC
OFF	O					
ON	O	O				O
START	O	O		O	O	O

FG007237

Figure 4 OPERATION OF START CIRCUIT (2) - IMMEDIATELY AFTER START

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box
7	Starter Controller

Reference Number	Description
8	Starter Relay
9	Starter
10	Alternator
11	Diode
12	Starter Relay 2
13	e-EPOS Controller

ENGINE PREHEATING SYSTEM

An air heater (8) is installed in the intake manifold of the engine. When the starter switch (5) is turned "ON," the current flows from the battery (1) → fusible link (3) → fuse box (6) → "B" terminal of starter switch (5) → "BR" terminalof starter switch (5) → "1-39" terminal of engine controller (12), causing current to flow though "1-16" terminal of engine controller (12) → "C and D" terminals of preheat relay (7) → "1-04" terminals of engine controller (12) → ground.

This current flow causes the coil in preheat relay (7) to be activated, closing contacts.

When the contacts of the preheat relay (7) are closed, the heating coils of the air heating device (8) are heated by current flowing from the battery (1) → battery relay (2) → preheat relay (7) → air heater (8) → ground.

The duration of the heating cycle depends on the temperature of engine coolant. The preheat indicator light in the instrument panel (9) will turn "ON" during preheating cycle.

The preheat relay (7) is controlled by the engine controller (12) and operates only at temperatures of 10°C (50°F) and below.

The longer the preheating period, the lower the temperature of coolant is.

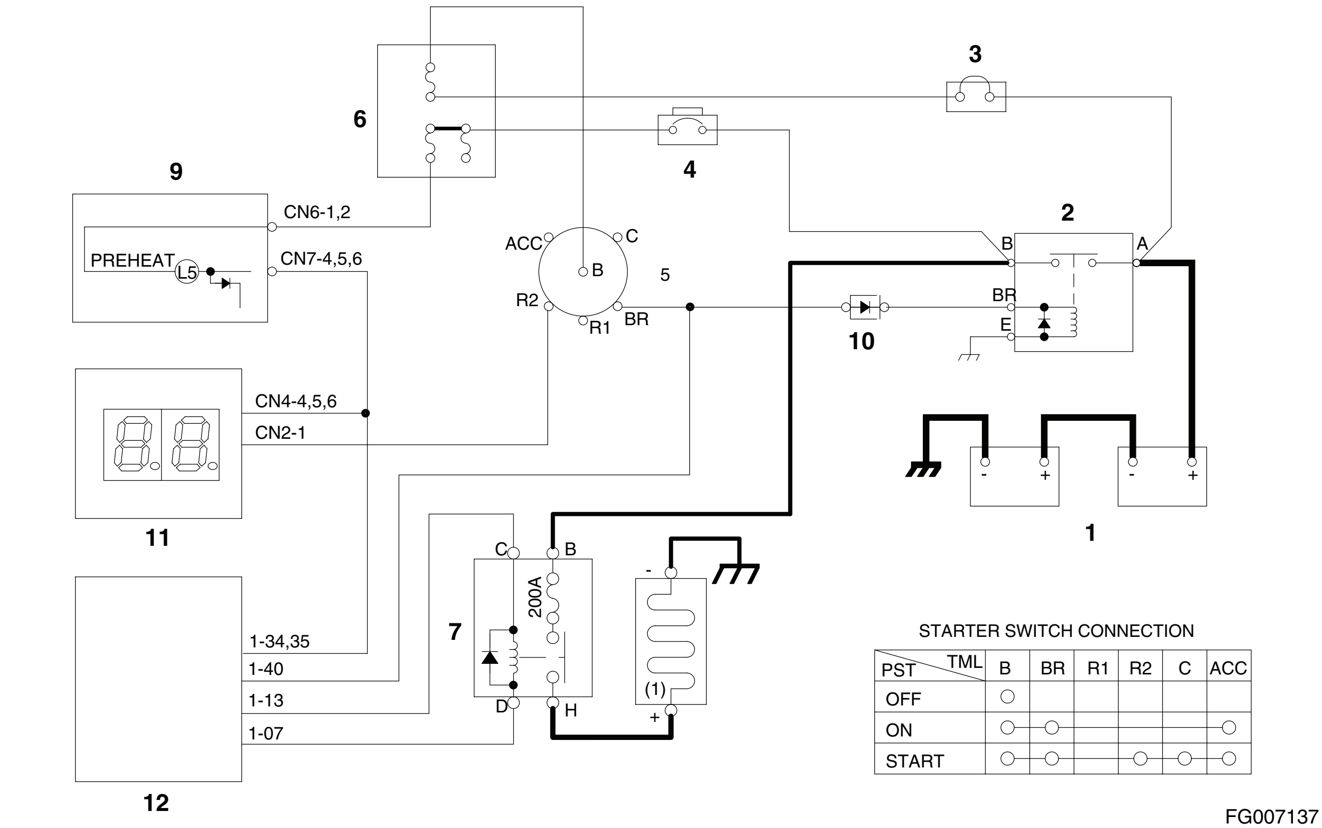


Figure 5 ENGINE PREHEAT CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box

Reference Number	Description
7	Preheat Relay
8	Air Heater
9	Preheat Indicator Light
10	Diode
11	e-EPOS Controller
12	Engine Controller

ENGINE STOP

When starter switch (5) is turned "ON" the engine controller (8) is activated. The engine controller monitors and controls the engine including the injector solenoid (9). It controls the fuel deliver rate and the injection timing for each cylinder.

NOTE: *There is an individual injector solenoid (9) for each of the six cylinders. Only one soleniod is shown in Figure 7.*

When starter switch (5) is turned "OFF," the engine controller stops suppling power to the injector solenoid (9). This stops fuel from being injexted into the engine cylinder, thus stopping the engine.

In the event that the engine can be shut down using the starter switch (5), an emergency stop switch (10) is provided to shut down engine. To activate the emergancy stop switch, move it to the "I" (EMERGENCY STOP) position.

The emergency stop switch (10) is in its "O" (OFF) position during normal operation. The switch must be moved and held in the "I" (EMERGENCY STOP) position until the engine stops. When released it will automatically move back to the "O" (OFF) position.

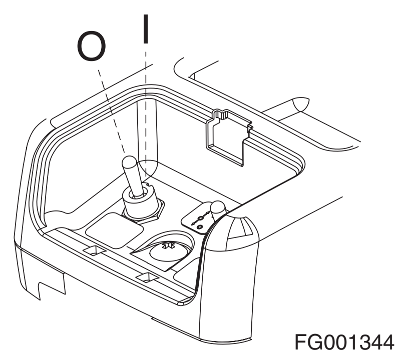


Figure 6 ENGINE EMERGENCY STOP SWITCH

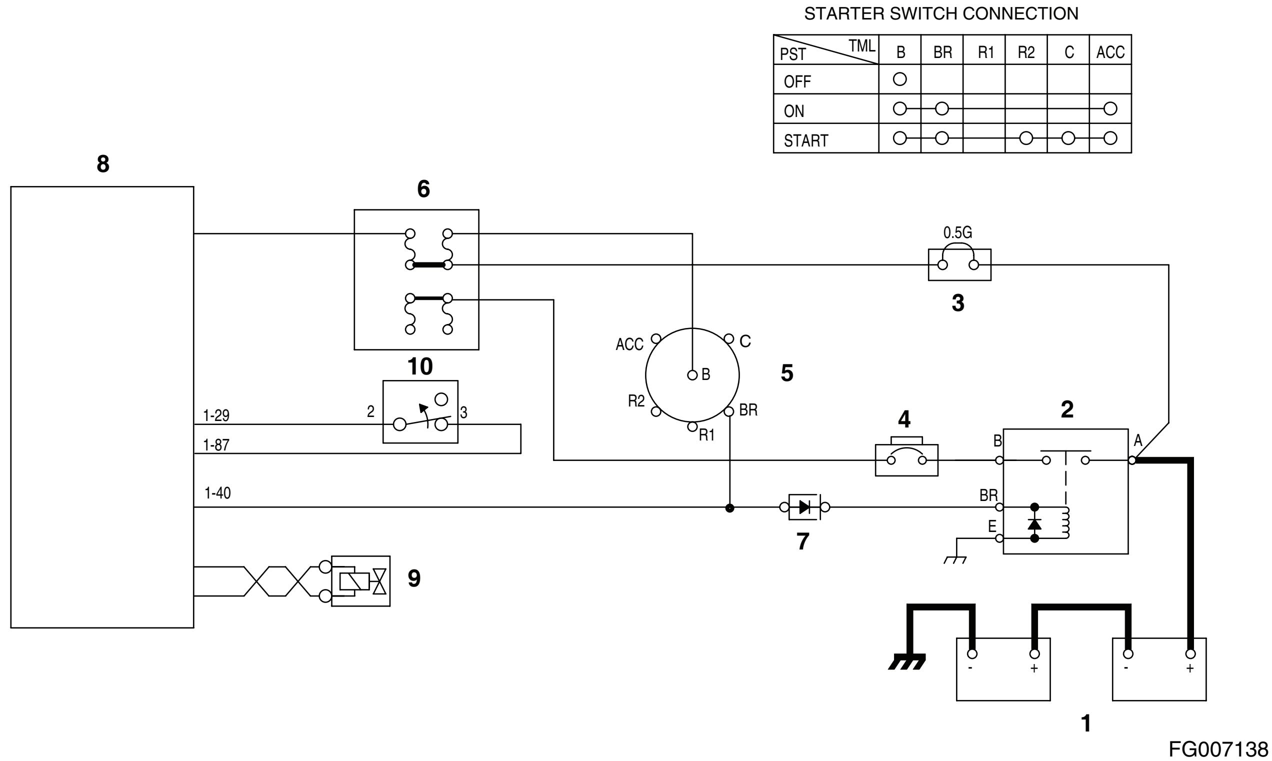


Figure 7 ENGINE STOP CIRCUIT

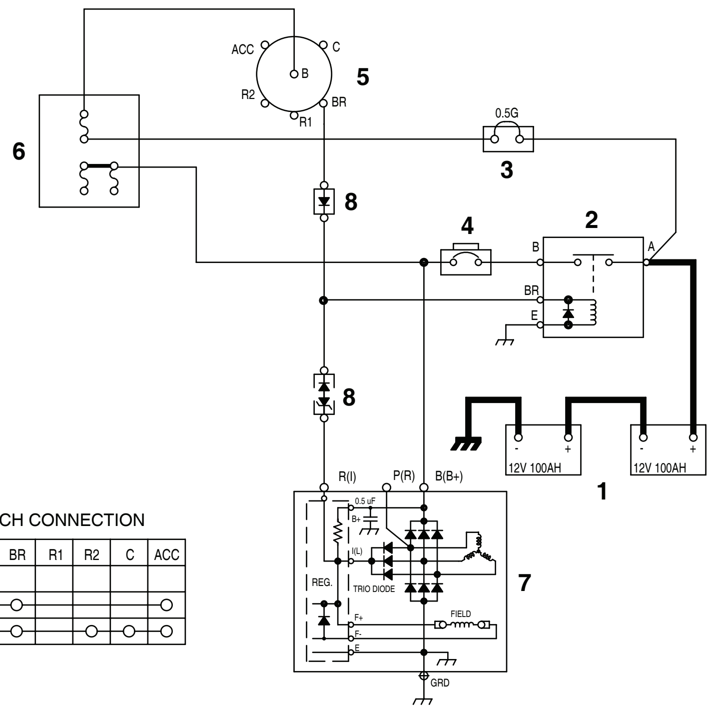
Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch

Reference Number	Description
6	Fuse Box
7	Diode
8	Engine Controller
9	Injector Solenoid
10	Emergency Stop Switch

CHARGING SYSTEM

When the starter switch (5) is turned to the "ON" position, an initial excited current flows to the field coil of the alternator (7) through the battery relay (2) and circuit breaker (4). When the engine is started from this condition the alternator (7) starts charging. The current flows from the "B(B+)" terminal of alternator (7) → circuit breaker (4) → battery relay (2) → battery (1).

The alternator also supplies electric current to other electrical components. When the alternator (7) starts to operate, a current flows from the "R(I)" terminal of alternator → diode (8) → battery relay (2) coil securing a path for the charging current to the battery (1). Thus preventing the possibility of a high voltage build up and possible damage to the electric system.



STARTER SWITCH CONNECTION

PST \ TML	B	BR	R1	R2	C	ACC
OFF	O					
ON	O	O				O
START	O	O		O	O	O

FG007238

Figure 8 CHARGING CIRCUIT

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Alternator
8	Diode

MONITORING SYSTEM

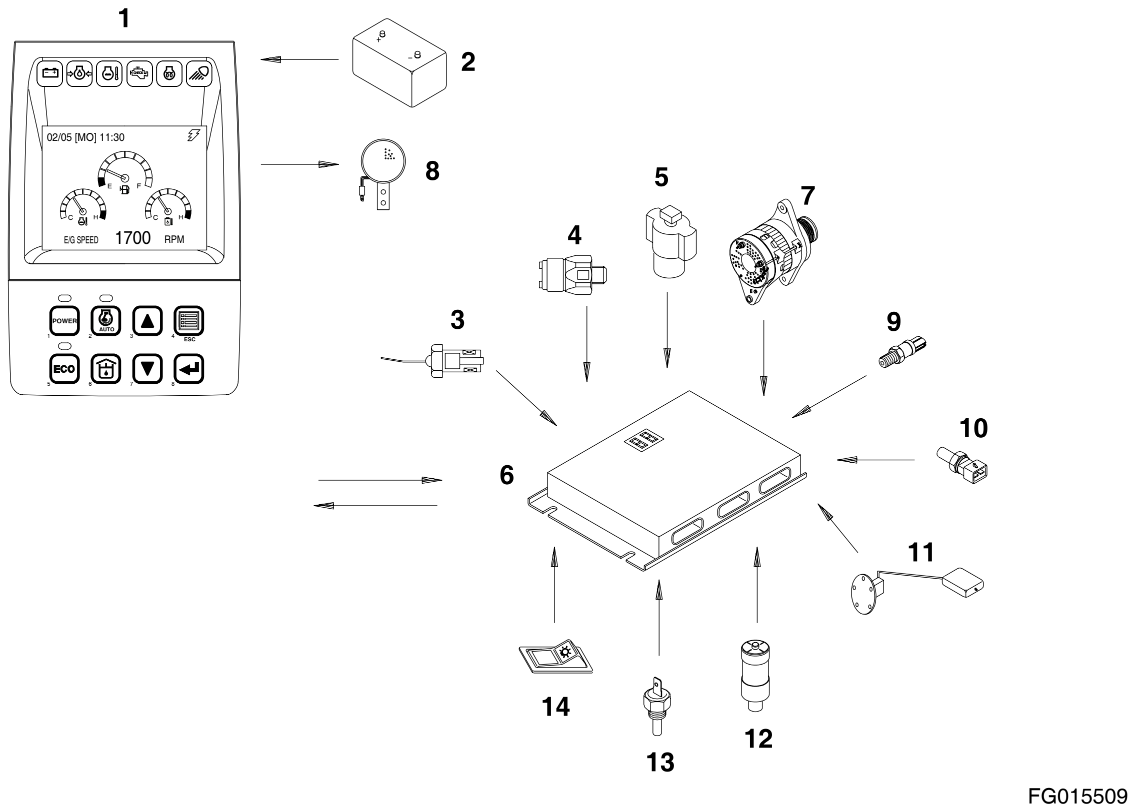


Figure 9

Reference Number	Description
1	Instrument Panel
2	Battery
3	Engine Speed Sensor
4	Return Filter Switch
5	Pilot Filter Switch
6	e-EPOS Controller
7	Alternator
8	Warning Buzzer

Reference Number	Description
9	Pnmp Discharge Pressure Sensor
10	Engine Coolant Temperature Sensor
11	Fuel Sensor
12	Air Cleaner Indicator
13	Engine Oil Pressure Switch
14	Light Switch

The monitoring system displays the various data and warning signals onto the instrument panel by processing the information gathered from the e-EPOS controller. It displays information selected by the operator.

Instrument Panel

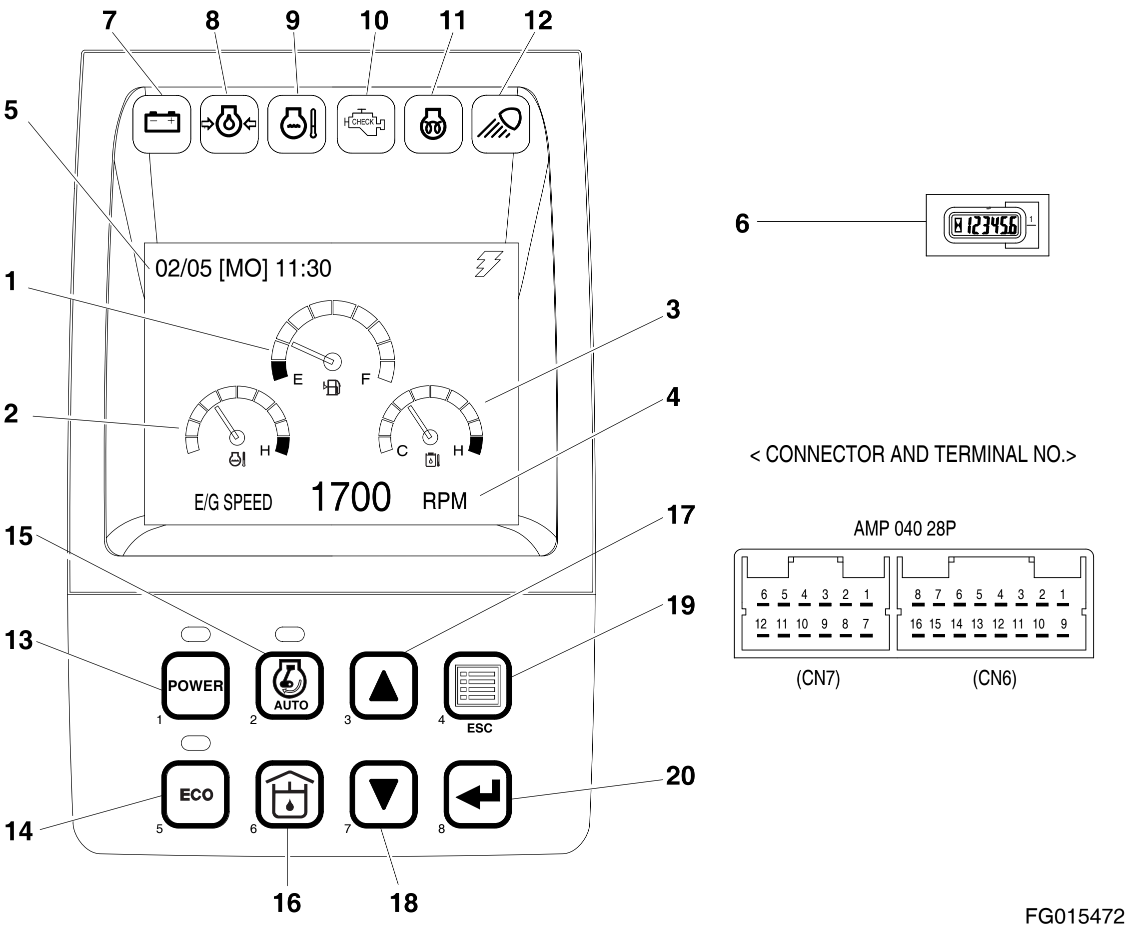


Figure 10

Gauges	Warning Lights	Mode Selector Switches
1. Fuel Gauge 2. Engine Coolant Temperature Gauge 3. Hydraulic Oil Temperature Gauge 4. Multifunction Gauge and Letter Information Area 5. Digital Clock 6. Hour Meter	7. Charge Warning Light 8. Engine Oil Pressure Warning Light 9. Coolant Temperature Warning Light 10. Engine Check Warning Light 11. Preheat Indicator Light 12. Work Light Indicator Light	13. Power Mode Selector Switch and Indicator 14. Economy Mode Selector Button 15. Auto Idle Switch and Indicator 16. Flow Adjusting Switch 17. Up Button Switch 18. Down Button Switch 19. Display Selector Button 20. Selector Button Switch

When the engine starter switch is turned to the "I" (ON) position, all gauge bands, switch/button indicator lights and indicator/ warning lights will turn "ON" and the alarm buzzer will sound about two seconds.

During this functional check, a LOGO will appear on the multi function gauge in the graphic information area

Monitoring System Schematic

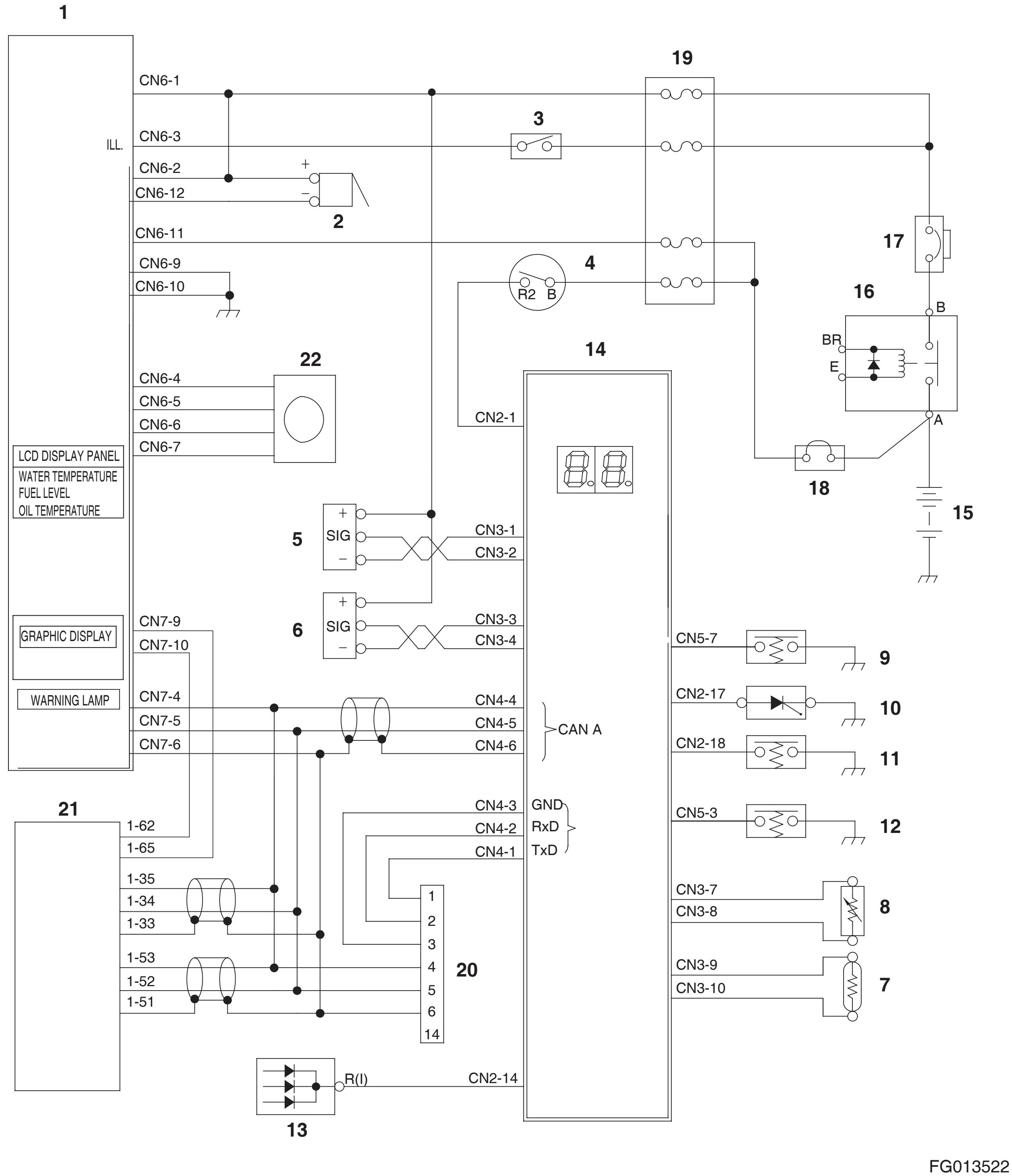


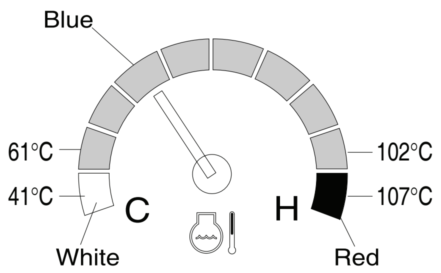
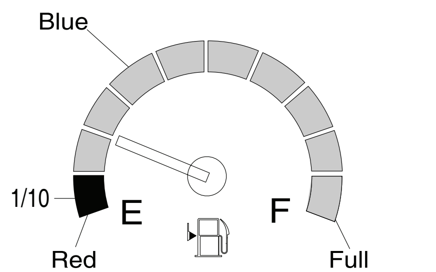
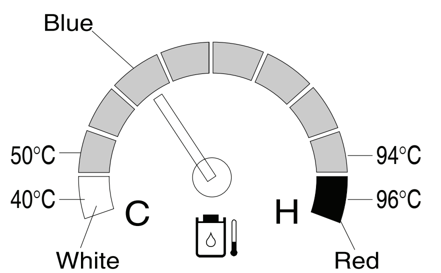
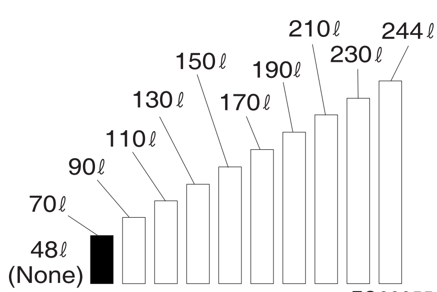
Figure 11

Reference Number	Description
1	Instrument Panel
2	Pilot Buzzer
3	Light Switch
4	Starter Switch
5	Front Pump Pressure Sensor
6	Rear Pump Pressure Sensor
7	Hydraulic Oil Temperature Sensor
8	Fuel Sensor
9	Pedal Pressure Switch (Optional)
10	Air Cleaner Indicator
11	Pilot Filter Switch

Reference Number	Description
12	Return Filter Switch
13	Alternator
14	e-EPOS Controller
15	Battery
16	Battery Relay
17	Circuit Breaker
18	Fusible Link
19	Fuse Box
20	Check Connector
21	Engine Controller
22	Rearview Camera

OPERATION

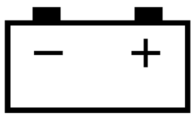
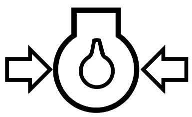
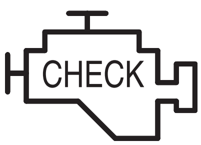
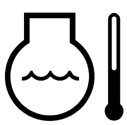
Instruments

Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Coolant Temperature	 FG000550	ECU-CAN Communication	
Fuel Level	 FG000552	CN3-7 CN3-8	1/10 LCD (Red Zone) Blinking → over 5K ohms FULL → under 525 ohms
Hydraulic Oil Temperature	 FG000551	CN3-9 CN3-10	40°C (104°F) → 1,397 ohms 50°C (122°F) → 1,139 ohms 60°C (140°F) → 881 ohms 94°C (201°F) → 190 ohms 96°C (205°F) → 177 ohms (When reading increase)
Flow Adjusting	 FG000553	(Output Terminal) CN1-19 CN1-20	48 l/min → 615 mA 70 l/min → 583 mA 90 l/min → 555 mA 130 l/min → 495 mA (Default Set) 210 l/min → 376 mA 244 l/min → 260 mA

Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Tachometer	**E/G SPEED 1700 RPM** FG000049	ECU-CAN Communication	N = 162 f / 60 N = Engine speed (rpm) f = Frequency of engine speed sensor (Hz)
Voltmeter	**BATTERY 28.0 VOLT** FG000050	CN2-14	0 - 32 VDC
Main pump discharge pressure (front pump)	**FRONT PUMP 320 BAR** FG000051	CN3-1 CN3-2	V = 0.00816 x P + 1.0 V: Sensor output voltage (V) P: Displayed pressure (Bar)
Main pump discharge pressure (rear pump)	**REAR PUMP 313 BAR** FG000052	CN3-3 CN3-4	

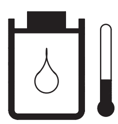
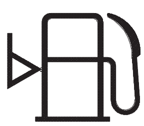
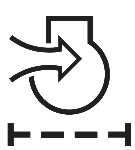
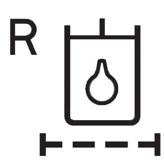
WARNING AND INDICATOR LIGHTS

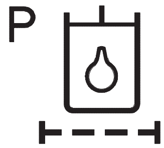
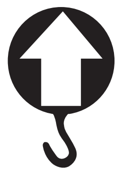
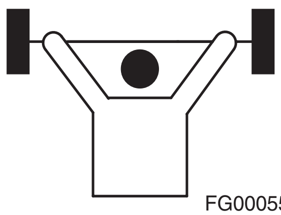
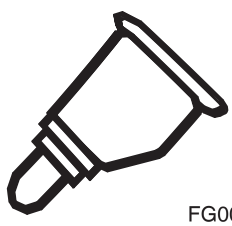
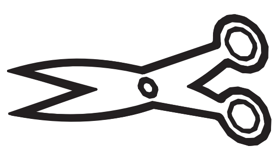
Indication of Warning Lights

Description	Symbol	Input Terminal	Operation	Remarks
Charge	 HAOA610L	CN2 - 14	This symbol appears in case of no charge [voltage of "R(I)" terminal is below 12 ±1V] or overcharge [voltage of "R(I)" terminal is above 33(V)].	Normally, it lights when starting engine and is out after engine starts.
Engine Oil Pressure	 HAOA620L	ECU-CAN Communication	This symbol appears when engine oil pressure is below the reference.	After starting engine, if engine oil pressure is insufficient after 8 seconds, a warning buzzer will sound.
Engine Check	 FG000045	ECU-CAN Communication	This symbol appears in case of failure in engine system.	
Coolant Temperature	 HAOD350L	ECU-CAN Communication	This symbol appears when engine coolant temperature sensor resistant is below about 128 ohms.	
Preheating	 HAOA639L	CN5-2	This symbol appears during preheating ("CN5-2" terminal voltage is below 2V) and disappears after completion of preheating.	Preheating period depends on coolant temperature. No preheating at above 10°C 10 sec preheating at 5°C 20 sec preheating at below 0°C

Description	Symbol	Input Terminal	Operation	Remarks
Work Light	 HB4O2003	CN2 - 6	This symbol appears when work light turns "ON" (24V applied).	

Indication of Multifunction Gauge

Description	Symbol	Input Terminal	Operation	Remarks
Hydraulic Oil Temperature	 FG000056	CN3-9 CN3-10	When hydraulic oil temperature is above about 96°C.	
Fuel Exhausted	 FG000057	CN3-7 CN3-8	When fuel is almost exhausted.	
Air Cleaner	 FG000053	CN2-17	When air cleaner is clogged.	
Return Filter	 FG000054	CN5-3	When return filter pressure is above about 1.50 kg/cm² (21 psi)	

Pilot Filter	 FG000055	CN2-18	When pilot filter pressure is above about 1 kg/cm² (14 psi)	
Overload Warning	 FG000253	CN3-5 CN3-6	Warning buzzer also starts when boom pressure sensor output voltage is about 2.7V while overload warning switch is "ON."	It flickers in case of 2.71V and above and lights continuously in case of 2.8V and above (and warning buzzer also starts).
Boost	 FG000554	CN2-2	It lights when boost is selected.	
Breaker	 FG001470	CN2-10	It lights when breaker is selected.	
Shear	 FG001471	CN2-9	It lights when shear is selected.	

INITIAL OPERATION

Item	Input (Terminal)	Output (Operation and initial setting mode)
Initial Operation	When "CN6-1,2" is applied battery voltage (starter switch shifts from "OFF" to "ON"	• LCD, all of LED and warning lights are turned "ON" and turned "OFF" after about 2 seconds. • Warning buzzer is activated and turned "OFF" after about 2 seconds. • Power mode: Standard mode. • Auto Idle: High Output (Activation). • Display: Indicating coolant temperature, Fuel level, Hydraulic oil temperature, Engine speed. • Clock: Current time display.

NOTE: *Refer to method for setting clock in operation manual for setting time.*

MODE SELECTOR SWITCH

Power Mode Switch

Operation Mode		Output Check (Operation mode display)	e-EPOS Output		
			Electromagnetic Proportional Pressure Reducing Valve (E.P.P.R Valve) Current (mA)	Swing Priority Solenoid Valve	7-Segment Display
Power Mode	Power Mode	ON	No-load: 150 ± 20mA Load: Variable output (Max. current: 400 ± 20mA)	-	9 x
	Standard Mode	OFF	No-load: 300 ± 20mA Load: Variable output (Max. current: 600 ± 60mA)	-	7 x
	Economy Mode		No-load: 400 ± 20mA Load: Variable output (Max. current: 600 ± 60mA)	-	5 x

NOTE: *When the engine speed is below 1,000 rpm, the output current of E.P.P.R valve is fixed to be 600 ± 60mA.*

Auto Idle Switch

Operation Mode		Output Check (Operation mode display LED)
Auto Idle	Activation	ON
	Cancellation	OFF

GRAPHIC INFORMATION AREA DISPLAY

Overview

Many kinds of condition of machine are displayed on the letter information display department. The information display department is divided into two menus. One is main menu for user and the other is special menu for specialist. These menus can be moved from normal display mode by the combination of selector buttons.

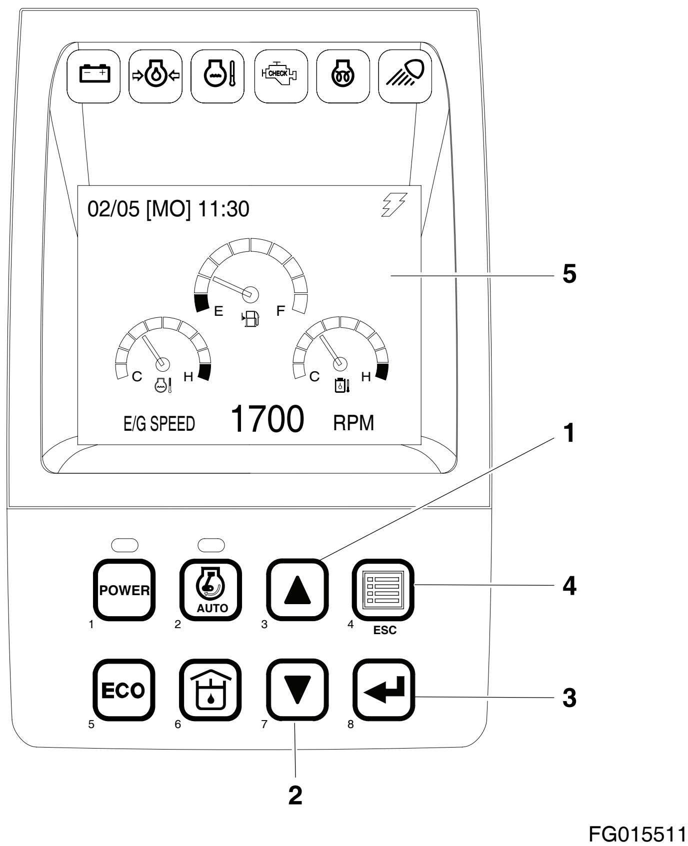


Figure 12

Selector Buttons	Graphic Display Area
1. Up Arrow Button	5. Letter Information Display Department
2. Down Arrow Button	
3. Enter Button	
4. Escape Button	

Main Menus for the Graphic Display Area

1. Main menu: Language setting, Time setting, Filter/Oil information, Brightness adjustment, Password
2. Special menu: Information of machine status, failure information, Information of machine operation.

Menu Selector Buttons

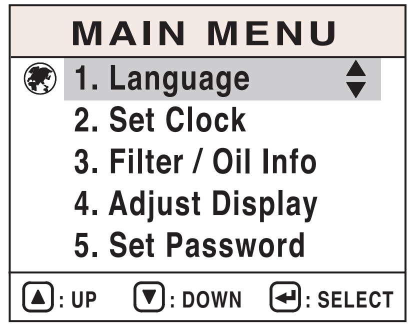
1. Up Arrow Button (▲, 1 on Figure 12): Move the cursor to up, left and previous screen.
2. Down Arrow Button (▼, 2 on Figure 12): Move the cursor to down, right and next screen.
3. Enter Button (↵, 3 on Figure 12): Move the menu to selected mode. When setting the menu, this button is used to function as the selector button.
4. Escape Button (ESC, 4 on Figure 12): Move a screen to previous menu or main menu.
5. Home Button (HOME, 5 on Figure 12): Move a screen to default menu.

MAIN MENU

When the "ESC" button is pressed for more than 3 seconds, the main menu screen is displayed.

Main menu offers sub-menus (language setting, time setting, or filter/oil information, brightness adjustment, password) to the operator.

Refer to the "Operation and Maintenance Manual" for details.



FG000072

Figure 13

Language

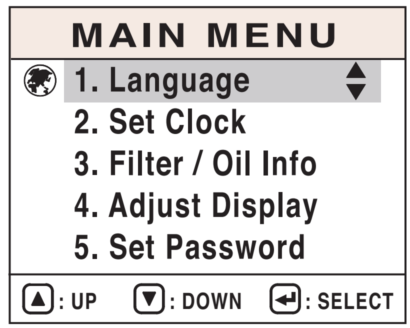
Put the cursor on Language in the main menu and put the Enter Button (↵, 3 on Figure 12) and the language select view appears.

The default language is Korean, but it will memorize and use the newly set language.

Use the Up Arrow Button (▲, 1 on Figure 12) or Down Arrow Button (▼, 2 on Figure 12) to move cursor to a language to be selected on the Language Select display and press the Enter Button (↵, 3 on Figure 12) and the selected language is indicated in the right bottom of the screen.

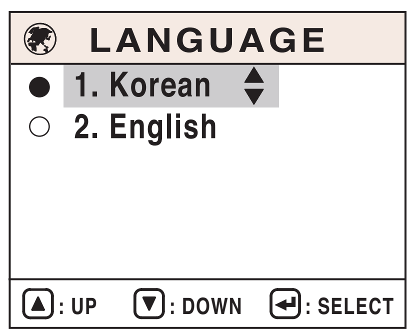
At this point pressing the Enter Button (↵, 3 on Figure 12) or the Escape Button (ESC, 4 on Figure 12) more than 1 second brings the main menu with changed language and then pressing the ESC button again shows the default view.

Without pressing a button more than 20 seconds, the default view appears.



FG000072

Figure 14



FG000783

Figure 15

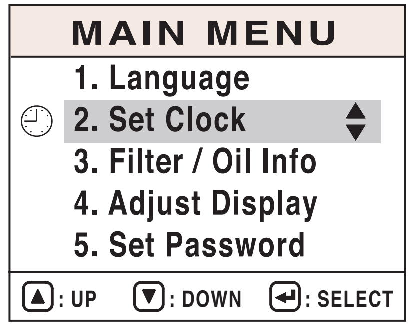
Set Clock

It is used to adjust time of the digital clock.

Pressing the Enter Button (↵, 3 on Figure 12) in the Main Menu after putting cursor on Set Clock brings Set Clock display.

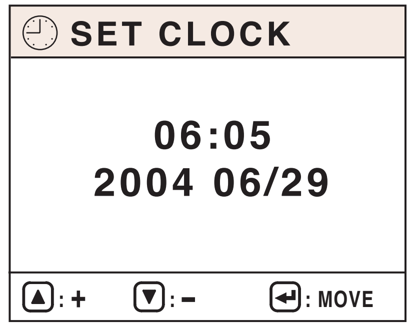
Without pressing a button more than 20 seconds, the default view appears.

Please refer to the Operation Manual for detailed information on Time Setting.



FG000075

Figure 16



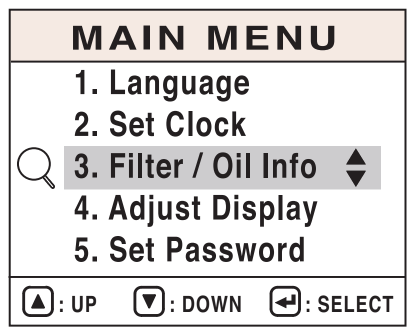
FG000076

Figure 17

Filter/Oil Info

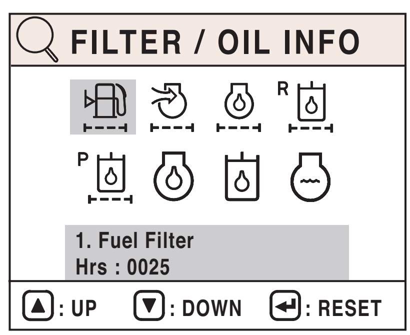
This mode displays total operating hours of filters and oils.

After changing the filter and oil, reset the operating hour and then the operating hours until the next service interval can be easily checked.



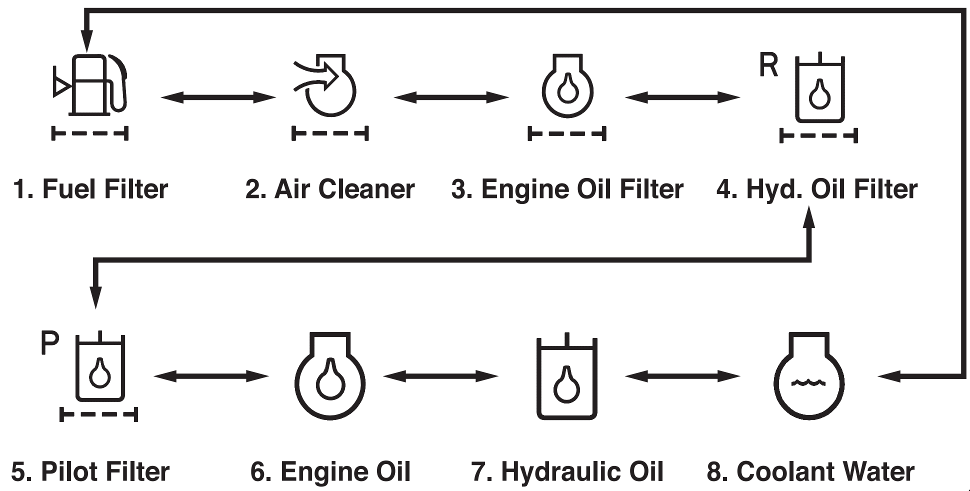
FG000077

Figure 18



FG000078

Figure 19



FG001358

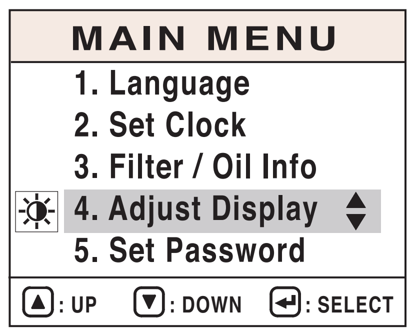
Figure 20

Adjust Display

Pressing the Enter Button (↵, 3 on Figure 12) in the main menu after putting cursor on Adjust Display brings Adjust Display.

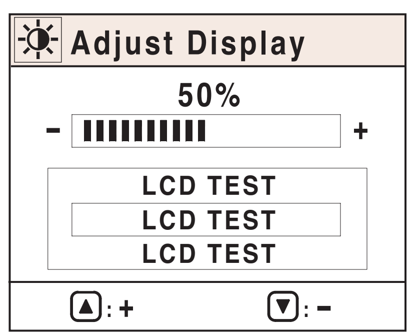
Screen brightness can be adjusted using the Up Arrow Button (▲, 1 on Figure 12) or the Down Arrow Button (▼, 2 on Figure 12).

The default brightness is set to 50%.



FG000080

Figure 21



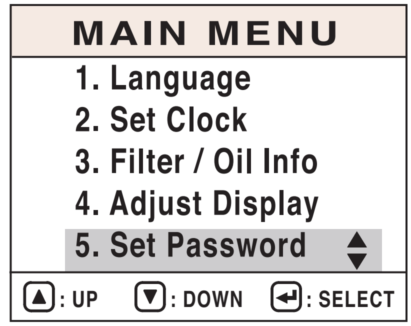
FG000081

Figure 22

Set Password

This menu is used to apply (lock), release, or change password.

Please refer to the Operation Manual for detailed information on Password Setting.



FG000227

Figure 23

SPECIAL MENU

In this menu, many types of operating conditions and functions can be accessed and displayed, including the e-EPOS controller. This menu is mainly used for machine testing and failure diagnostics.

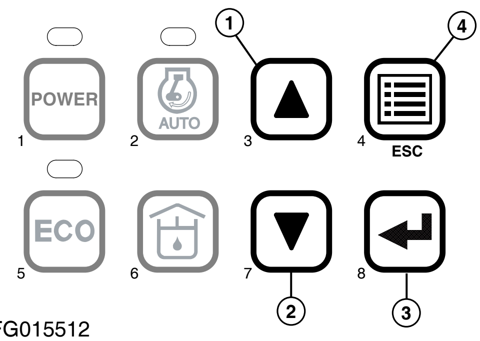
The special menu offers three sub-menus:

1. Machine status.
2. Failure information.
3. Information on machine operation.

Entering/Accessing and Exiting/Escaping Menus

Entering/Accessing Menus

When normal mode screen is displayed, if the enter button (↵, 3) and escape button (ESC, 4) are pressed simultaneously for more than 3 seconds, normal mode screen (Figure 24) will be changed to special menu screen (Figure 24).

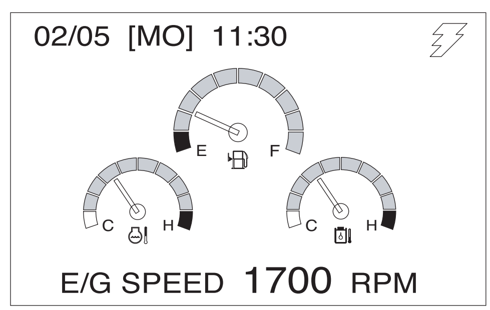


FG015512

Figure 24

Normal Mode Screen

NOTE: *Normal mode screen can display many kinds of display mode by selecting, for example, engine speed (RPM), battery voltage (VOLT), front pump pressure (BAR), rear pump pressure (BAR) and so on by selecting.*



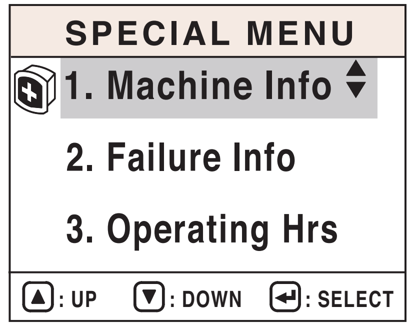
FG000043

Figure 25

Special Menu Screen

NOTE: *Displayed language on the special menu screen consists of Korean and English.*

If any language except for Korean is selected during language selection mode of main menu, only English will be displayed on special menu screen.



FG000558

Figure 26

Exiting/Escaping Menus

1. If escape button (ESC, 4 on Figure 24) is pressed for more than 1 second, the special menu screen will be returned to the normal mode screen.
2. If this special menu is "ON" without any activity, for more than 20 seconds, it will turn to the normal mode screen.
3. After the turning starter switch to the "OFF" position, turn it back to the "ON" position, and the normal mode screen displayed once again.

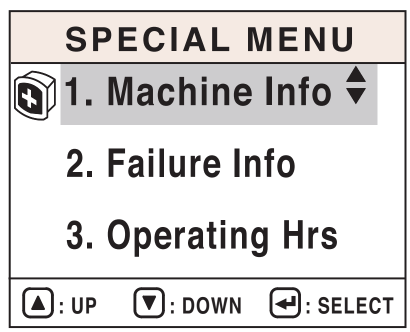
Special Menu Selections

Submenu Selection Method

Various sub-menus can be selected by pressing "Up (▲, 1 on Figure 24)" and "Down (▼, 2 on Figure 24)" button.

Move the cursor to desired menu and a selected menu will be inverse displayed.

When the selected menu is inverse displayed, press the "Enter (↵, 3 on Figure 24)" button for menu selection.

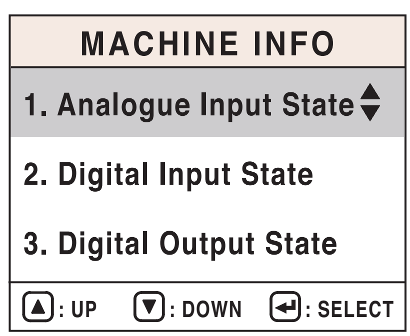


FG000558

Figure 27

Information of Machine Status

1. Entering Sub-menus: When cursor is located on "Machine Info" of special menu screen, press "Enter (↵, 3 on Figure 24)" button and the "Machine Info" will be displayed.
2. Exiting Sub-menus: If escape button (ESC, 4 on Figure 24) is pressed for more than 1 second, display will be turned to previous screen.



FG000559

Figure 28

Analog Inputs Description

Analog Input Items	Display	Remark
1. Pump P/V	mA	Current in pump proportional valve.
2. Cooling Fan P/V	mA	N.A.
3. Flow Control P/V	mA	Current in flow control proportional valve.
4. Dial	mV	Indicating dial voltage.
5. TPS	mV	N.A.
6. E/G Control Motor	mV	N.A.
7. Boom Pressure	BAR	Boom cylinder head pressure.
8. Pilot Gear Pump Press	BAR	N.A.
9. Boost Pressure	BAR	Pump pressure for boost.
10. Intake Manifold Temperature	°C	Temperature of air incoming to intake manifold.
11. E/G Oil Pressure	BAR	Engine oil pressure.
12. Fuel Temperature	°C	Fuel temperature.
13. E/G Oil Temperature	°C	Engine oil temperature.
14. Load At Current Speed	%	Current load ratio of equipment.

Submenu Selections

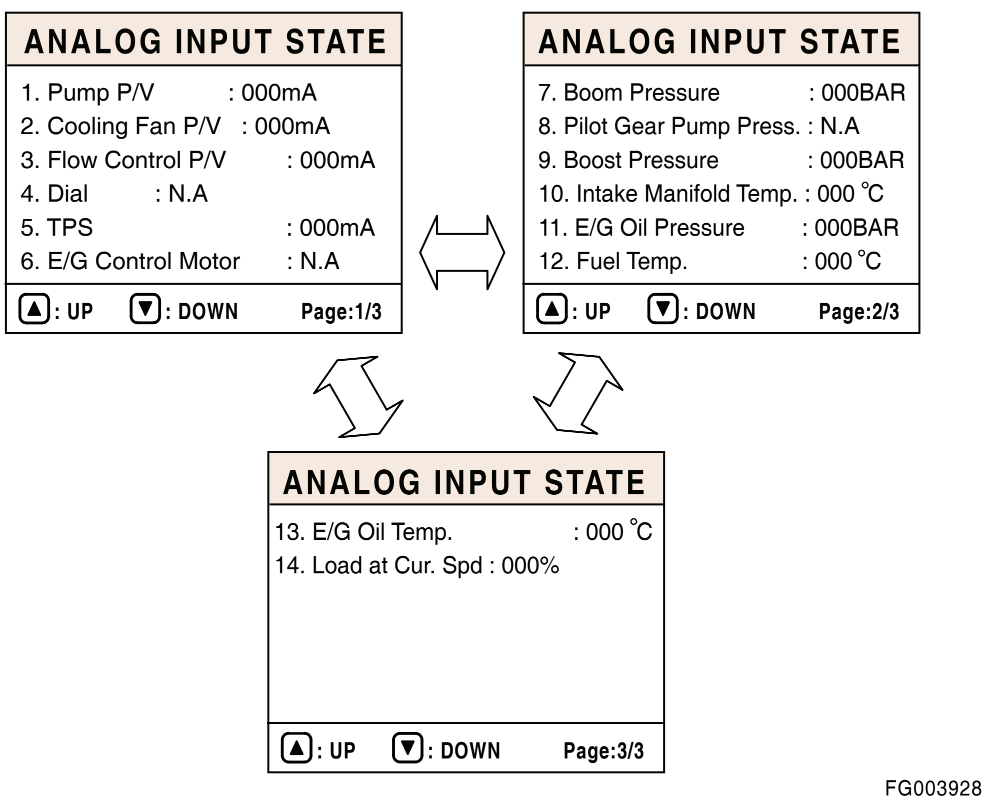


Figure 29

Digital Inputs Descriptions

Digital Inputs Items	Mark	Remark
1. Alternator	ON / OFF	Lights up when output at alternator "R(I)" terminal is above 12 ± 1V.
2. Travel Select SW		N.A. (only for wheel type equipment)
3. High Speed Sel. SW (M)		Lights up when the travel speed selector switch is set to the "I" position.
4. High Speed Sel. SW (A)		Lights up when the travel speed selector switch is set to the "II" position.
5. Pressure SW (Py)		Lights up when the pressure switch (Py) is "ON."
6. Pressure SW (Px)		Lights up when the pressure switch (Px) is "ON."
7. E/G Oil Press. SW		Lights up when the engine oil pressure switch is "ON."
8. Air Cleaner Clogged		Lights up when the air cleaner indicator contact is "ON."
9. Return Filter Clogged		Lights up when the return filter pressure switch is "ON."
10. Pilot Filter Clogged		Lights up when the pilot filter pressure switch is "ON."
11. OWD Warning SW		Lights up when the overload warning selector switch is "ON."
12. Brake Oil Press. SW		N.A. (only for wheel type equipment)
13. Pedal Press. SW		Lights up when the pedal pressure switch is ON.
14. One Way Sel. SW		Lights up when the selector switch is turned to breaker.
15. Two-way Sel. SW		Lights up when the Selector Switch is turned to "SHEAR."
16. Power Max. SW		Lights up when the boost button is "ON" with the Select switch turned to "BOOST."
17. Breaker SW		Lights up when the boost button is "ON" with the selector switch turned to "BREAKER."
18. Preheat Select		Lights up during preheating (CN5-2) terminal voltage is below 2V.
19. Quick Coupler		Lights up when the Quick Coupler switch is "ON."
20. F and R Lever		N.A. (only for wheel type equipment)
21. Preheat Select		N.A.
22. Reverse Fan SW		N.A.
23. Pilot Cutoff SW		Lights up when the pilot cutoff switch is "ON."

Menu Select

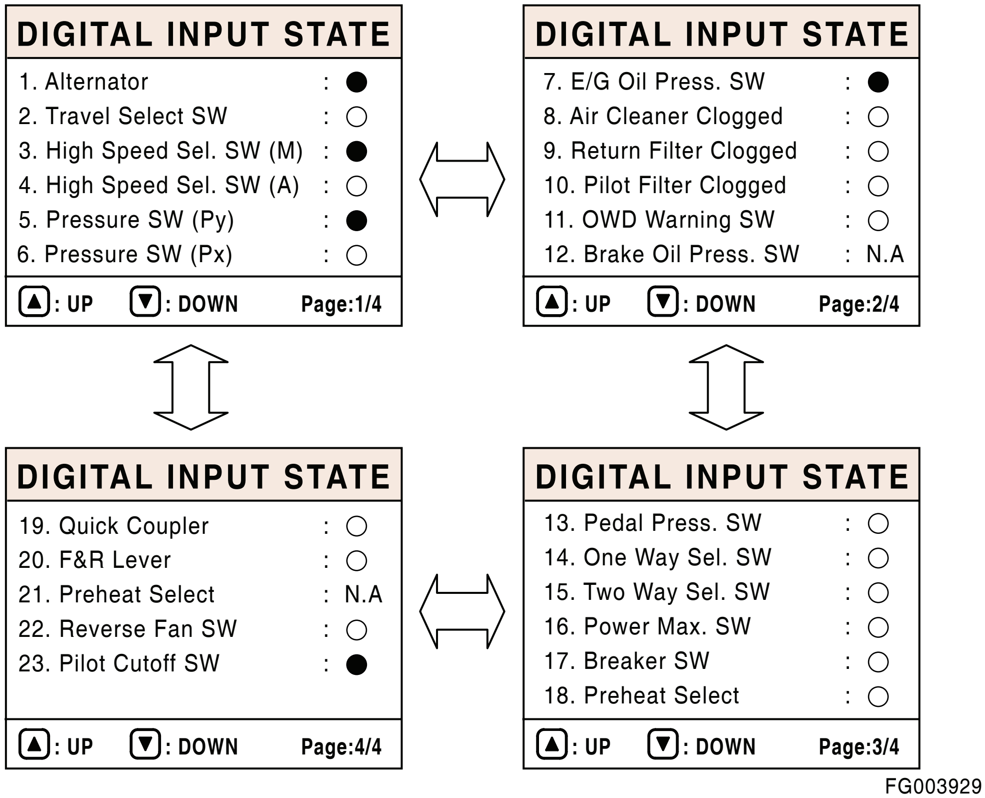
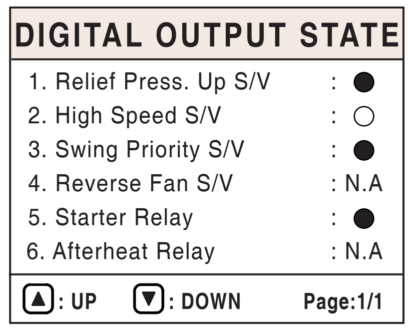


Figure 30

Digital Outputs Descriptions

Digital Outputs Items	Mark	Remark
1. Relief Press. Up S/V	ON / OFF	Lights up when the relief press up solenoid valve is "ON."
2. High Speed S/V		Lights up when the high speed solenoid valve is "ON."
3. Swing Priority S/V		Lights up when the swing priority solenoid valve is "ON."
4. Reverse Fan S/V		N.A.
5 Starter Relay		When the starter relay is "ON."
6. After Heat Relay		N.A.

Menu Select

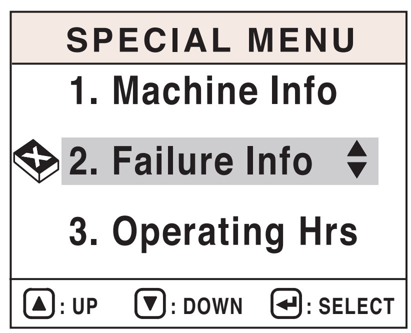


FG003930

Figure 31

Failure Information

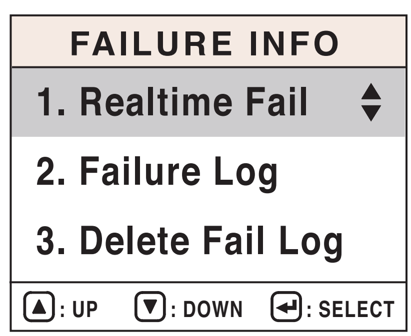
1. Entering Sub-menus: When a cursor is located in "Failure Info" of special menu screen press enter button (↵, 3 on Figure 24) and "Failure Info" screen is displayed.
2. Exiting Sub-menus: If escape button (ESC, 4 on Figure 24) is pressed for more than 1 second, this information screen will be returned to previous screen.



FG000563

Figure 32

* Real-time Failure:
  Current status of failure is displayed.
* Failure Log:
  Memorized record of past failure is displayed.
* Delete Fail Log:
  This mode is used to delete all of the memorized record of past failure.



FG000564

Figure 33

A. Current failure information

Current status of failure is displayed (Failure code, failure contents).

When a number of failures are produced, failure information can be checked using "UP" (▲, 1 on Figure 24) or "DOWN" (▼, 2 on Figure 24) button.

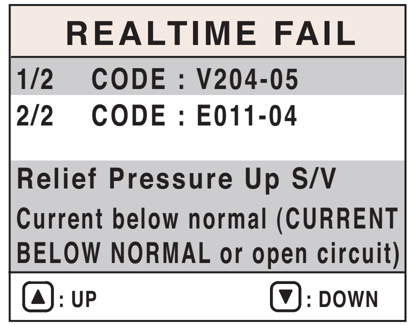
* 1/2: A serial number of current failure/ total quantity of failure.

* Vxxx-xx: Vxxx is a unique code and xx is a FMI (Failure Mode Identifier) number.

- V: Machine related failure code
- E: Engine related failure code

Refer to the failure information code for unique codes and FMI numbers.

This example shows one of two failures.



FG000565

Figure 34

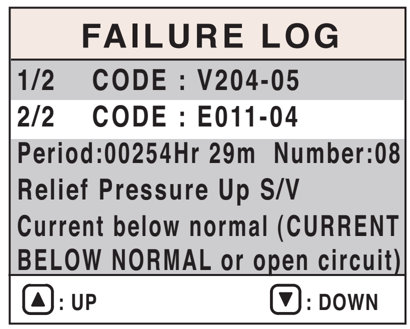
B. Past failure information

Memorized record of past failure is displayed (Failure code, failure contents).

When a number of failures are produced, failure information can be checked using "UP" (▲, 1 on Figure 24) or "DOWN" (▼, 2 on Figure 24) button.

NOTE: *" Number: xxx ": "xxx" means that the totally counted number of the same failure.*

" Period:xxxxxHrxxm ": It indicates the period for which machine has operated until a failure takes place. (For more than two occurrences of the same failure, until the first occurrence time.)



FG000566

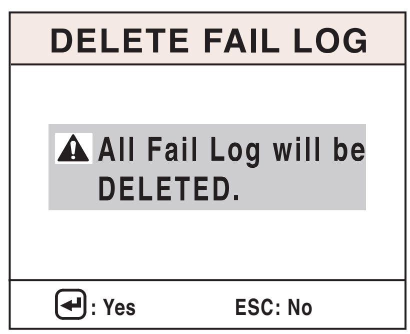
Figure 35

C. Failure record deletion

This mode is used to delete the memorized record of past failure. If this mode is selected, all records will be deleted.

When "YES" (↵, 3 on Figure 24) button is pressed, the memorized record will be deleted.
At this time, deletion signal will be displayed and the screen will move to previous menu after deletion.

This screen will be displayed during 3 seconds.

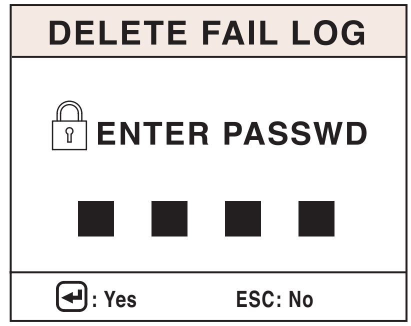


FG000567

Figure 36

Input your password with one of No. 1 - 8 switches.

When "NO" (ESC, 4 on Figure 24) button is pressed, the screen will recover to previous menu without deletion.

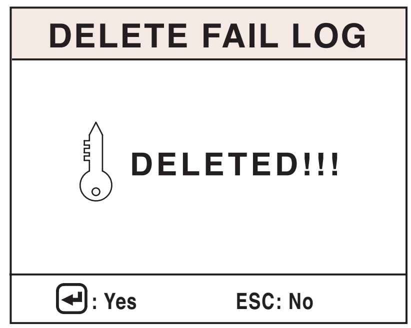


FG000568

Figure 37

Delete Completed screen will appear 3 seconds and the screen will move to Failure Info screen.

It has been shown 3 seconds upon deleting Fail Log.

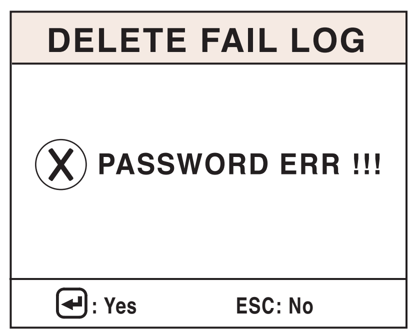


FG000569

Figure 38

The screen shown on the left will appear 3 seconds in case of wrong password input and then Enter Password screen appears again.

It has been shown 3 seconds in case of password failure.



FG000570

Figure 39

Failure Information Code at Machine Side

Code	Failure Component	Measuring Points	Correct Value		Remarks
			Active	Passive	
V201	Gauge Panel Communication Error	CN7-4 CN7-5	-	R = 60 ± 5 Ω	It is a composite resistance of CAN line. This value has to be measured by connected condition of CAN line.
V202	ECU Communication Error	CN4-4 CN4-5	-	R = 60 ± 5 Ω	
V210	Pump P/V	CN1-10 CN1-21	-	R = 18 ± 2 Ω (25°C (77°F))	Pump proportional pressure reducing valve.
V211	Cooling Fan P/V		-	-	N.A.
V212	Flow Control P/V	CN1-19 CN1-20	-	R = 14 ± 2 Ω (25°C (77°F))	Flow control proportional pressure reducing valve.
V213	Relief Pressure Up S/V	CN1-1 CN1-11	V = V_volt (Note 4.)	R = 26.2 ± 2 Ω (25°C (77°F))	Breaker/boost/ shear selector switch has to be selected as a boost function and the boost switch on the right-hand joystick is "ON" status.
V214	High Speed S/V	CN1-1 CN1-12	V = V_volt	R = 26.2 ± 2 Ω (25°C (77°F))	Voltage is only measured when the pressure switch (Py) is turned "ON."
V216	Reverse Fan Speed S/V		-	-	N.A.
V217	Starter Relay	CN1-1 CN1-15	V = V_volt	-	It has to be measured in engine start up state.
V218	After Heat Relay	1-16 1-04	-	-	N.A.
V220	Front Pump Press. Sensor	CN3-1 CN3-2	V = 1V	-	It has to be measured in engine stop state.
V221	Rear Pump Press. Sensor	CN3-3 CN3-4	V = 1V	-	

Code	Failure Component	Measuring Points	Correct Value		Remarks
			Active	Passive	
V222	Hyd. Oil Temperature Sensor	CN3-9 CN3-10	-	R = 2.45 ± 0.25 kΩ (25°C (77°F)) R = 320 ± 32 Ω (80°C (176°F))	
V223	Water Temperature Sensor		-	-	N.A.
V224	Engine Speed Sensor		-	-	N.A.
V225	Fuel Level Sensor	CN3-7 CN3-8	-	Empty: 5 ± 0.25 kΩ Full: 320 ± 32 Ω	
V226	Alternator Potential	CN2-14 CN1-8	V = 2 ± 1V	-	It has to be measured in engine stop state.
V227	Dial	CN3-16 CN3-17	-	R = 1.0 ± 0.3 kΩ R = 4.0 ± 1.5 kΩ	
V228	Tps (Wheel)		-	-	N.A.
V229	Parking Brake Press. Sensor		-	-	N.A.
V230	E/g Control Motor Sensor		-	-	N.A.
V232	Water Seperator Sensor	CN3-19 CN3-20	V = 0.5V less than V = 4.5V excess	-	N.A.

NOTE: *1. Active value: Starter switch has to be turned "ON"*

Measuring points between component and wire harness have to be connected.

2. Passive value: Starter switch has to be turned "OFF"

Measuring points between component and wire harness have to be disconnected.

3. Measuring points are engine controller's points and passive value is each component's value.

4. V_batt: Source power of equipment.

Failure Information Code at Engine Side

Code	Failure Component	Measuring Points	Current Valve		Remarks
			Active	Passive	
E011	Coolant temperature sensor	2-15 2-26	-	R=186 ± 5 Ω (100°C (212°F))	
E012	Fuel temperature sensor	2-35 2-26	-	R=186 ± 5 Ω (100°C (212°F))	
E013	Boost air temperature sensor	2-36 2-25	-	R=186 ± 5 Ω (100°C (212°F))	
E014	Boost air pressure sensor	2-34 2-33	V = 1,071±58mV (at 23°C (73°F) and absolute pressure 1bar)	-	It has to be measured in engine running state.
E017	E/G oil temperature sensor	2-28 2-24	-	R=186 ± 5 Ω (100°C (212°F))	
E018	E/G oil pressure sensor	2-27 2-32	V = 2,318±80mV (at 23°C (73°F) and absolute pressure 3bar)	-	It has to be measured in engine running state.
E021	Battery voltage	1-03 1-06	V = V_volt (Note 4.)	-	
E022	Fuel pressure sensor	2-14 2-12	V = 1,833±28mV (at 23°C (73°F) and absolute pressure 300bar)	-	It has to be measured in engine running state.
E032	Fuel pressure monitoring MPROP	3-09 3-10	-	R=2.60 ± 3.15 Ω (20°C (68°F))	
E037	CAN - B Line	1-35 1-34	-	R=60 ± 5 Ω (20°C (68°F))	It is a composite resistance of CAN line. This value has to be measured by connected condition of CAN line.
E038	Engine overspeed		-	-	
E039	Main relay SCG (ECU)		-	-	Engine ECU fail.
E041	Redundant shutoff path		-	-	Abnormal engine stop.
E042	E/G speed (Crankshaft)	2-23 2-19	-	R=860 ± 6 Ω (20°C (68°F))	

Code	Failure Component	Measuring Points	Current Valve		Remarks
			Active	Passive	
E043	E/G speed (Camshaft)	2-09 2-10	-	-	
E044	Engine speed sensor		-	-	Synchronizing error between crank shaft speed sensor and cam shaft speed sensor.
E045	EEPROM		-	-	Data storing error when engine stop.
E046	Recovery		-	-	
E047	Monitoring of PRV		-	-	When the pressure sensor of common rail or high-pressure pump has a defect.
E048	Power Supply	1-03 1-06	V = V_volt	-	
E049	Main Relay SCB (ECU)		-	-	Engine ECU fail.
E051	Main Relay (ECU)		-	-	Engine ECU fail.
E058	Solenoid power stage 1	3-04 3-13	-	R=0.31 ± 0.42 Ω (20°C (68°F))	
E059	Solenoid power stage 2	3-11 3-06	-	-	
E061	Solenoid power stage 3	3-05 3-12	-	-	
E062	Solenoid power stage 4	3-03 3-14	-	-	
E063	Solenoid power stage 5	3-01 3-16	-	-	
E064	Solenoid power stage 6	3-02 3-15	-	-	
E065	Fuel HI pressure pump (E/G: Current controlled Highside power stage 1)	-	-	-	Fuel metering unit error of high-pressure pump.

Code	Failure Component	Measuring Points	Current Valve		Remarks
			Active	Passive	
E068	Preheat relay (E/G: Highside Power stage 1)	1-13 1-07	V = V_volt	R=40 ± 5 Ω (25°C (77°F))	Voltage is only measured when afterheat function is operating status.
E083	Preheat light (E/G: Lowside Power stage 2)	1-13 1-56	-	-	
E091	CAN - A Line	1-53 1-52	-	R=60 ± 5 Ω (20°C (68°F))	It is a composite resistance of CAN line. This value has to be measured by connected condition of CAN line.
E097	Monitoring of misfire cylinder 1	-	-	-	Injector error Speed signal error of cam shaft speed sensor or crank shaft speed sensor.
E098	Monitoring of misfire cylinder 2	-	-	-	
E099	Monitoring of misfire cylinder 3	-	-	-	
E101	Monitoring of misfire cylinder 4	-	-	-	
E102	Monitoring of misfire cylinder 5	-	-	-	
E103	Monitoring of misfire cylinder 6	-	-	-	
E104	Monitoring of misfire multiple cylinder	-	-	-	
E105	Monitoring of overrun	-	-	-	
E106	Engine speed redundant	-	-	-	

NOTE: *1. Active value: Starter switch has to be turned "ON"*

Measuring points between component and wire harness have to be connected.

2. Passive value: Starter switch has to be turned "OFF"

Measuring points between component and wire harness have to be disconnected.

3. Measuring points are engine controller's points and passive value is each component's value.

4. V_batt: Source power of equipment.

FMIs (Failure Mode Identifier)

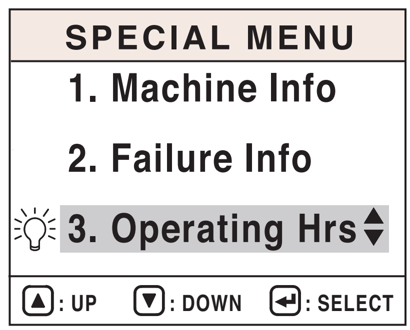
FMI 0	Above normal range (DATA VALID but ABOVE NORMAL OPERATIONAL RANGE)
FMI 1	Below normal range (DATA VALID but BELOW NORMAL OPERATIONAL RANGE)
FMI 2	Incorrect signal (DATA ERRATIC, INTERMITTENT OR INCORRECT)
FMI 3	Voltage above normal (VOLTAGE ABOVE NORMAL OR SHORTED TO HIGH SOURCE)
FMI 4	Voltage below normal (VOLTAGE BELOW NORMAL OR SHORTED TO LOW SOURCE)
FMI 5	Current below normal (CURRENT BELOW NORMAL OR OPEN CIRCUIT)
FMI 6	Current above normal (CURRENT ABOVE NORMAL OR GROUNDED CIRCUIT)
FMI 8	Abnormal signal (ABNORMAL FREQUENCY OR PULSE WIDTH OR PERIOD)
FMI 11	Failure mode not identifiable (ROOT CAUSE NOT KNOWN - Malfunction)
FMI 31	NOT AVAILABLE OR CONDITION EXISTS

Information of Machine Operation

Accumulated operation hour of each mode and status is displayed.

1. Operating Hour Information

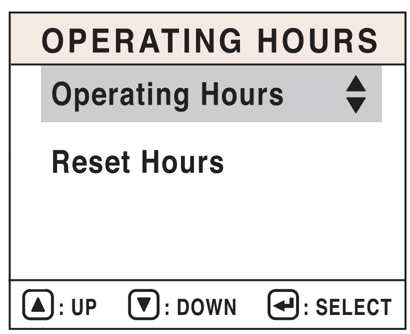
   A. Entering Sub-menus: When a cursor is located in "Operating Hrs" of special menu screen (Figure 40) press enter button (↵, 3 on Figure 24) and "Operating Hrs" screen will be displayed (Figure 41).



FG000571

Figure 40

   B. Information screen of machine operation (Figure 41).

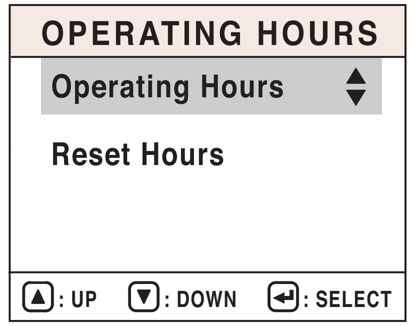


FG000572

Figure 41

C. Operating Hours Screen

D. Exiting Sub-menus: If escape button (ESC, 4 on Figure 24) is pressed for more than 1 second, this information screen will be returned to previous screen.



FG000572

Figure 42

Information contents of operation hour

Item	Information Contents	Detection Method
Power Mode	Operation hours used power mode are displayed.	Power mode switch (Instrument panel) - "ON" status and Alternator signal (CN2-14) is "HI"
Economy Mode	Operation hours used economy mode are displayed.	Economy mode switch (Instrument panel) - "ON" status and Alternator signal (CN2-14) is "HI"
Auto Idle	Operation hours used auto idle status are displayed.	Auto idle switch (Instrument panel) - "ON" status and Alternator signal (CN2-14) is "HI"
Travel Speed: -1st - 2nd	Operation hours used low speed and high speed are displayed.	1st: High speed s/v "OFF" status 2nd: High speed s/v and travel pressure switch "Py" (control valve) - "ON" status.
Hydraulic Oil Temperature Distribution (°C (°F))	Temperature of hydraulic oil is classified 6 steps. And operation hours of each step are displayed Under 30°C (87°F) 31 - 50°C (88 - 123°F) 51 - 75°C (124 - 168°F) 76 - 85°C (169 - 186°F) 86 - 95°C (187 - 203°F) Over 96°C (204°F)	The resistance delivered from temperature sensor of hydraulic oil is classified 6 steps. And operation hours of each step are displayed. (Alternator output HI status)
Coolant Temperature Distribution (°C (°F))	Temperature of coolant is classified 6 steps. And operation hours of each step are displayed. Under 40°C (105°F) 41 - 60°C (106 - 141°F) 61 - 85°C (142 - 186°F) 86 - 95°C (187 - 204°F) 96 - 105°C (205 - 222°F) Over 106°C (223°F)	The resistance delivered from coolant sensor is classified 6 steps. And operation hours of each step are displayed. (Alternator output HI status)

Menu Selection of Operation Hour Information

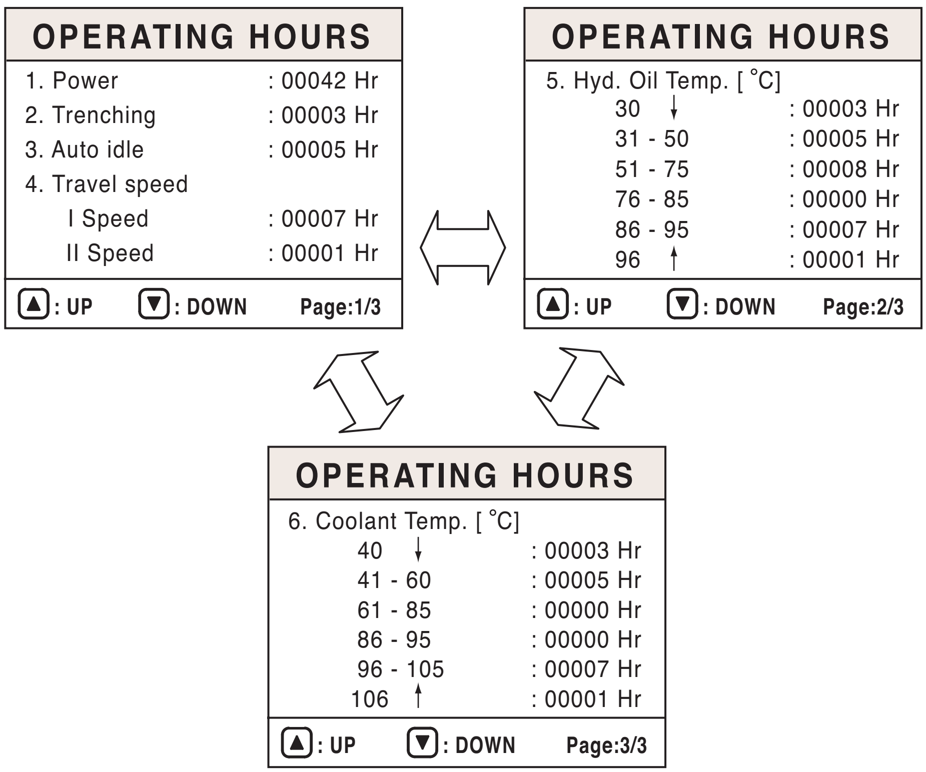
1. Power Mode ↔ 2. Economy Mode ↔ 3. Auto Idle ↔ 4. Travel Speed 1st, 2nd

6. Coolant Temperature Distribution ↔ 5. Hydraulic Oil Temperature Distribution

FG013856

Figure 43

Example of Machine Operation Info Screen

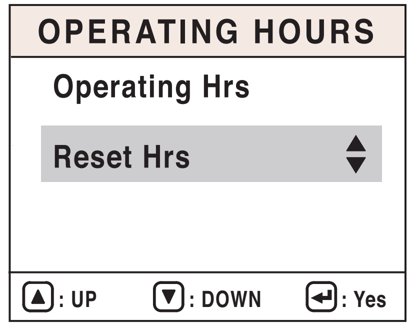


FG000575

Figure 44

2. Operation hour reset

   A. Entering Sub-menus: When cursor is located in "Reset Hrs" of information screen of operating hours press enter button (↵, 3 on Figure 24) and "Machine Operation Info" screen will be displayed.



FG000578

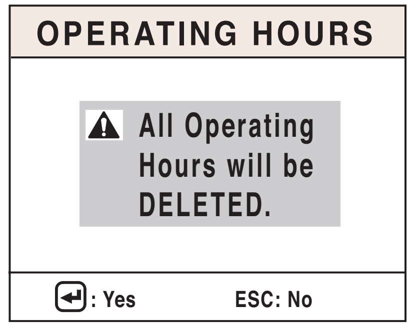
Figure 45

   B. Reset screen of operation hour

   C. Exiting Sub-menus: If escape button (ESC, 4 on Figure 24) is pressed for more than 1 second, this information screen will be returned to previous screen.

NOTE: *When "YES" (↵, 3 on* Figure 24*) button is pressed, operation hours will reset.*
At this time, resetting signal will be displayed and the screen will move to previous menu after resetting.

NOTE: *When "NO" (ESC, 4) button is pressed, the screen will recover to previous menu without resetting.*

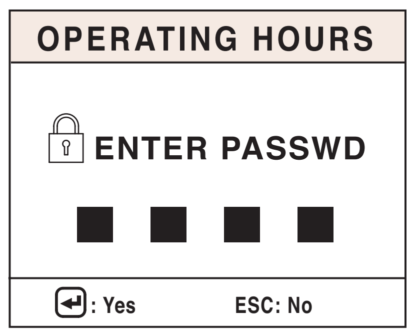


FG000579

Figure 46

Machine Operation Info Screen

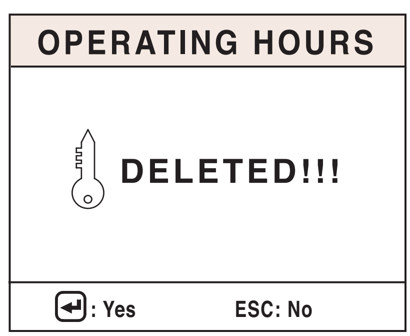
1. If you press the YES" (↵, 3 on Figure 24) button, password entrance screen appears.



FG000576

Figure 47

2. When right password is input, machine operation periods will be deleted and Reset Completed screen will appear 3 seconds.



FG000577

Figure 48

3. If you press the "NO" (ESC, 4) button, the previous screen appears without resetting operation periods.

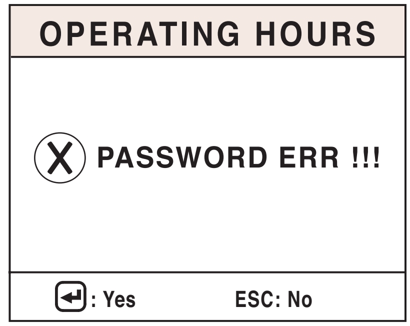


Figure 49

ELECTRONIC HYDRAULIC CONTROL SYSTEM (e-EPOS)

Control System Schematic

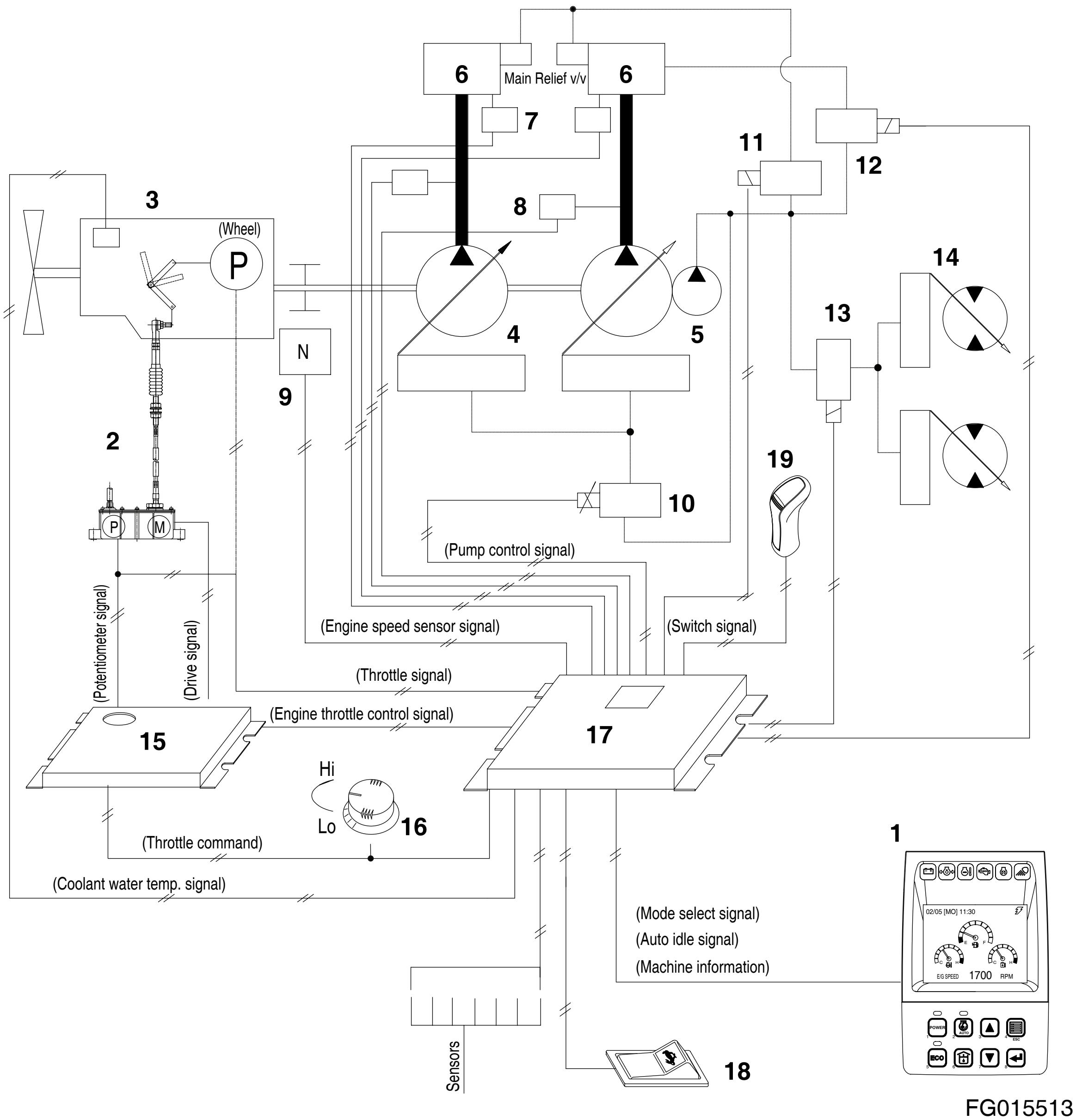


Figure 50

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	Electromagnetic Proportional Pressure Reducing Valve (E.P.P.R. Valve)

Reference Number	Description
11	Solenoid Valve (Pressure Up)
12	Solenoid Valve (Swing Priority)
13	Solenoid Valve (High Speed)
14	Travel Motor
15	Engine Throttle Control
16	Engine Control Dial
17	e-EPOS Controller
18	Auto Travel Selector Switch
19	Boost Switch (Right Work Lever)

POWER MODE CONTROL

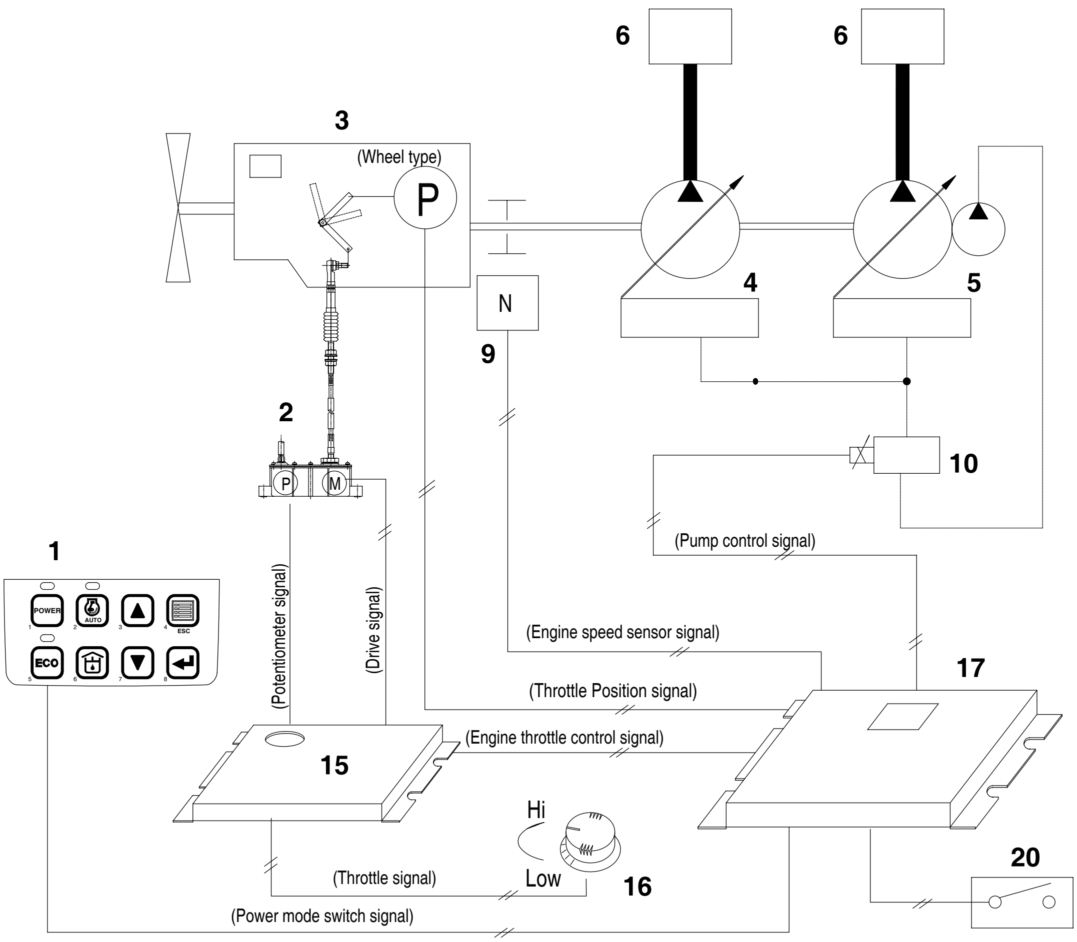


Figure 51

Reference Number	Description
1	Instrument Panel (Power Mode SelectIon Switch)
2	Engine Control Motor
3	Engine
4	Main Hydraulic Pump
5	Control Pump
6	Control Valve
9	Engine Speed Sensor

Reference Number	Description
10	Electromagnetic Proportional Pressure Reducing Valve (E.P.P.R. Valve)
15	Engine Throttle Control
16	Engine Control Dial
17	e-EPOS Controller
20	Work / Travel Selection Switch (Wheel Type)

The power mode switch permits the selection of the appropriate engine power depending on the working condition. One of the two, Power Mode or Standard Mode, setting can be selected. When the engine start switch is turned "ON," the power mode is automatically defaulted to standard mode. The desired mode can be selected by pressing the select button on the instrument panel. When the power mode is selected, the indicator lamp will turn "ON" to display the selected mode.

The quantity of oil discharged by the pump and the engine speed are determined by the mode selected by the operator. The pump output in each mode is determined by the mode selection and is listed in the following table

Mode	**Standard Mode**	**Power Mode**
Output (%)	Approximately 85%	100%

Operation

1. Power Mode

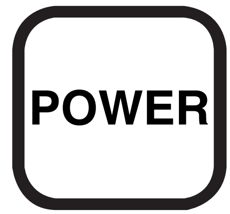
This mode should be selected for high speed work. In this mode the engine output is most efficiently utilized due to the discharged oil volume being controlled based on the equivalent horsepower curve at various loaded pressures. The e-EPOS controller compares the target engine speed with the actual engine speed and controls the signal to the E.P.P.R. (Electromagnetic 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.

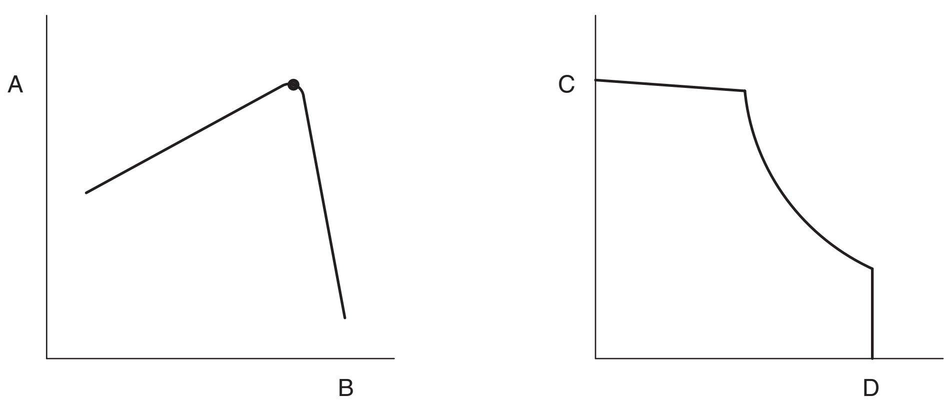
By repeating these control operations, the engine speed is maintained at the rated speed so that maximum power can be generated.

In Power Mode, the e-EPOS controller receives engine speed signals from the engine control dial and the engine controller (ECU) 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.



FG015516

Figure 52



FG000580

Figure 53

Reference Number	Description
A	Engine Horsepower (hp)
B	Engine Speed (rpm)
C	Pump Discharge Volume (lpm)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm^2)

2. Standard Mode

Standard Mode is used for general work. When this mode is selected it will reduce noise and fuel consumption in comparison with Power Mode. The epos controller compares the target engine speed with the actual engine speed and controls the signal to the E.P.P.R. valve which in turn varies the pump output quantity and it is the same method with power volume.

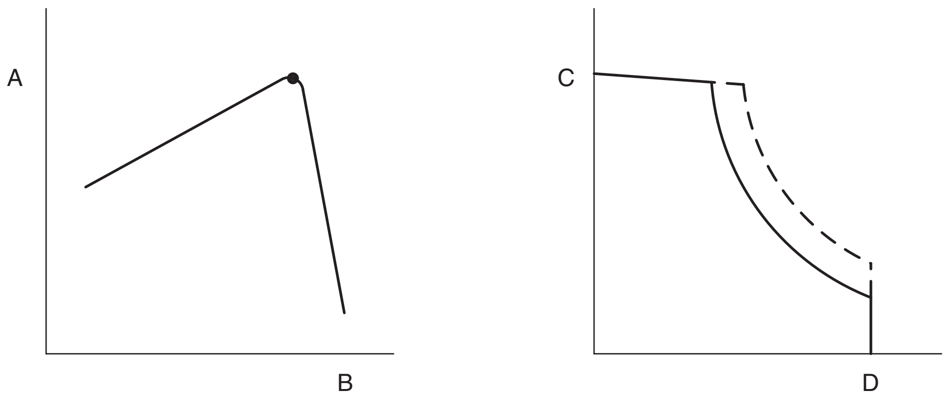


Figure 54

Reference Number	Description
A	Engine Horsepower (hp)
B	Engine Speed (rpm)

Reference Number	Description
C	Pump Discharge Volume (lpm)
D	Pump Discharge Pressure (kg/cm^2)

3. Economy Mode

Economy mode is used for light loading work. When this mode is selected, it will reduce noise and fuel consumption in comparison with standard mode.

Engine torque curve is changed by ECU.

The e-EPOS controller compares the target engine speed with the actual engine speed and controls the signal to the E.P.P.R. valve which in turn varies the pump output quantity and it is the same method with power volume.

Figure 55

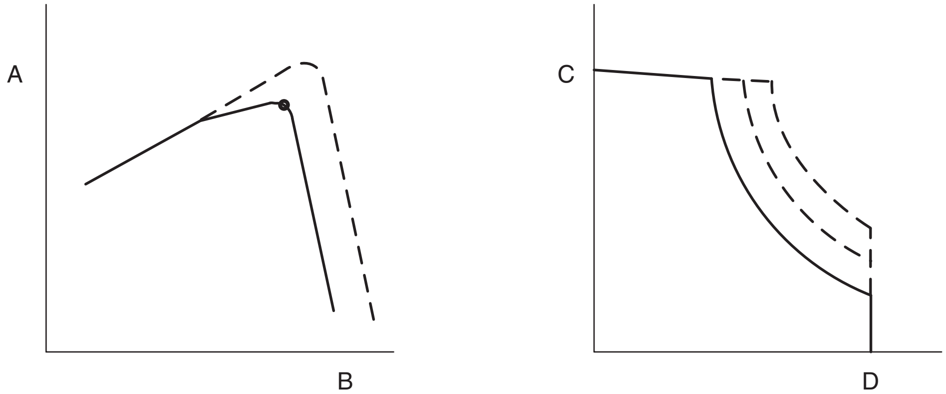


Figure 56

Reference Number	Description
A	Engine Horsepower (hp)
B	Engine Speed (rpm)

Reference Number	Description
C	Pump Discharge Volume (lpm)
D	Pump Discharge Pressure (kg/cm^2)

POWER MODE CONTROL - CIRCUIT DIAGRAM

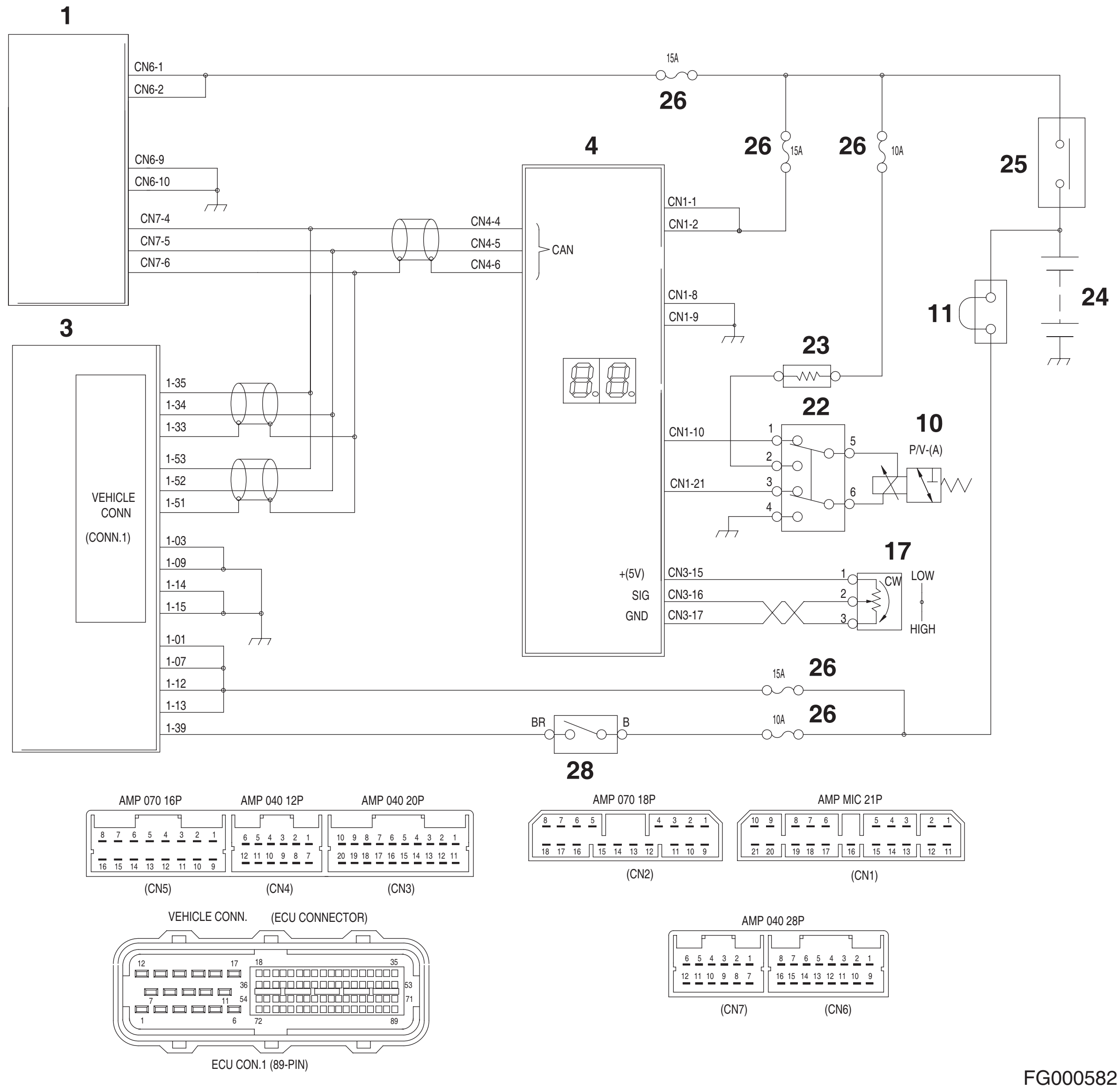


Figure 57

Reference Number	Description
1	Instrument Panel
3	Engine Controller
4	e-EPOS Controller
10	E.P.P.R. Valve (Electromagnetic Proportional Pressure Reducing)
17	Engine Control Dial
22	Aux Mode Switch

Reference Number	Description
23	Aux Mode Resistor
24	Battery
25	Battery Relay
26	Fuse
27	Fusible Link
28	Starter Switch

ENGINE CONTROL SYSTEM

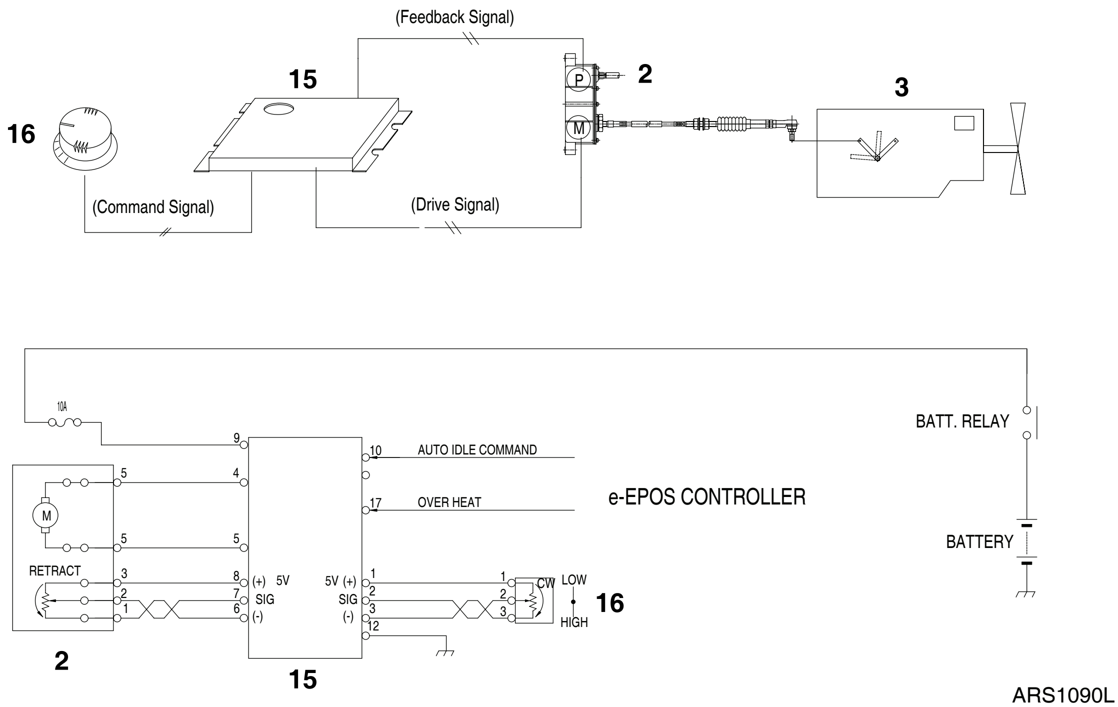


Figure 58

Reference Number	Description
2	Engine Control Motor
3	Engine

Reference Number	Description
15	Engine Throttle Controller
16	Engine Control Dial

When the engine control dial is moved the output voltage changes according to the dial position. This signal is input to the engine throttle controller. The engine throttle controller then compares the input voltage from the engine speed dial with the feedback signal from the throttle position sensor built into the engine control motor and drives the motor to the position set by the control dial. When the command signal and the potentiometer feed back signals are the same the engine controller shuts off the current to the control motor. The engine control motor cable is a solid type and is connected to the engine fuel injection control lever. The engine speed is controlled by the movement of the fuel injection lever which is directly linked with the rotation of the control motor.

ENGINE CONTROL MOTOR

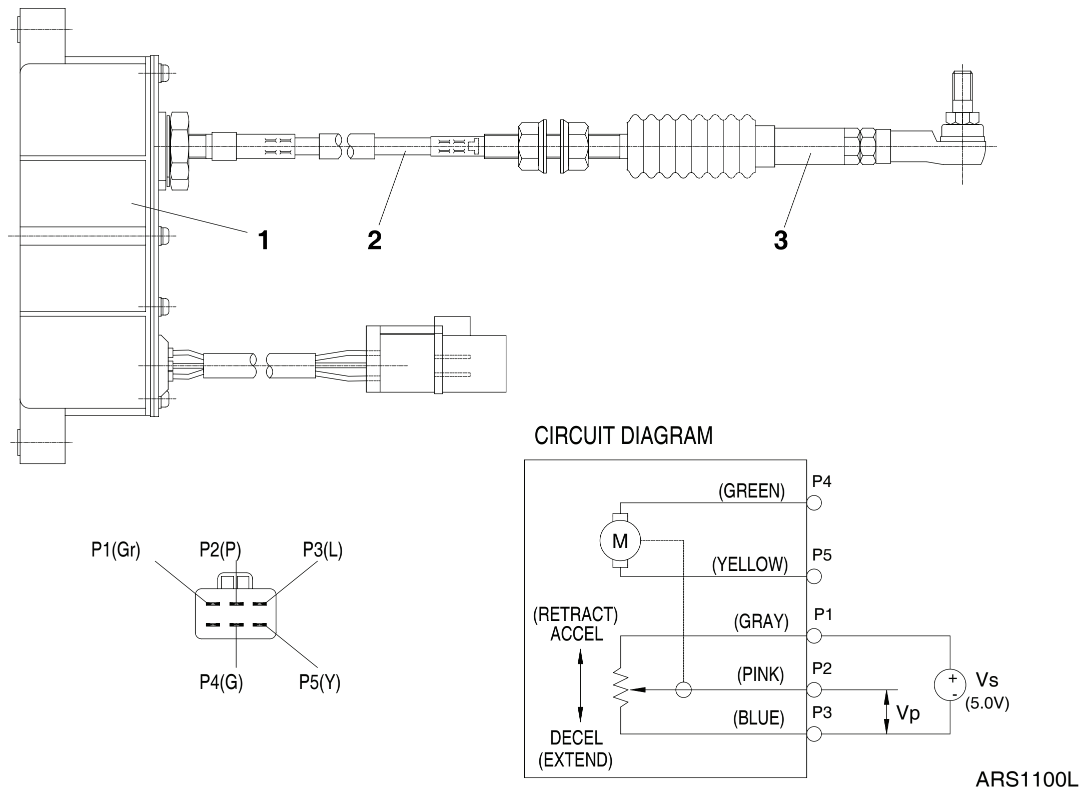


Figure 59

Reference Number	Description
1	Motor Assembly
2	Cable

Reference Number	Description
3	Spring Assembly

The engine control motor uses a D.C. motor with a built in potentiometer to sense the position of the control cable. If an abnormal load (worn or kinked control cable) is sensed in the control motor, the engine controller cuts off the electric current flowing to the engine control motor to protect the system. In such a case, the engine control motor will not operate even though the engine control dial is moved.

The starter switch should be turned off and the cause of abnormal load should be repaired and the starter switch can be turned on again. The engine control dial can once again be used to control the engine speed.

IMPORTANT

When the engine control motor has been replaced or repaired refer to Adjusting the Engine Control Device for correct adjustment of the engine control system. The engine will not perform to its maximum efficiency if it is not adjusted properly.

ENGINE CONTROL DIAL

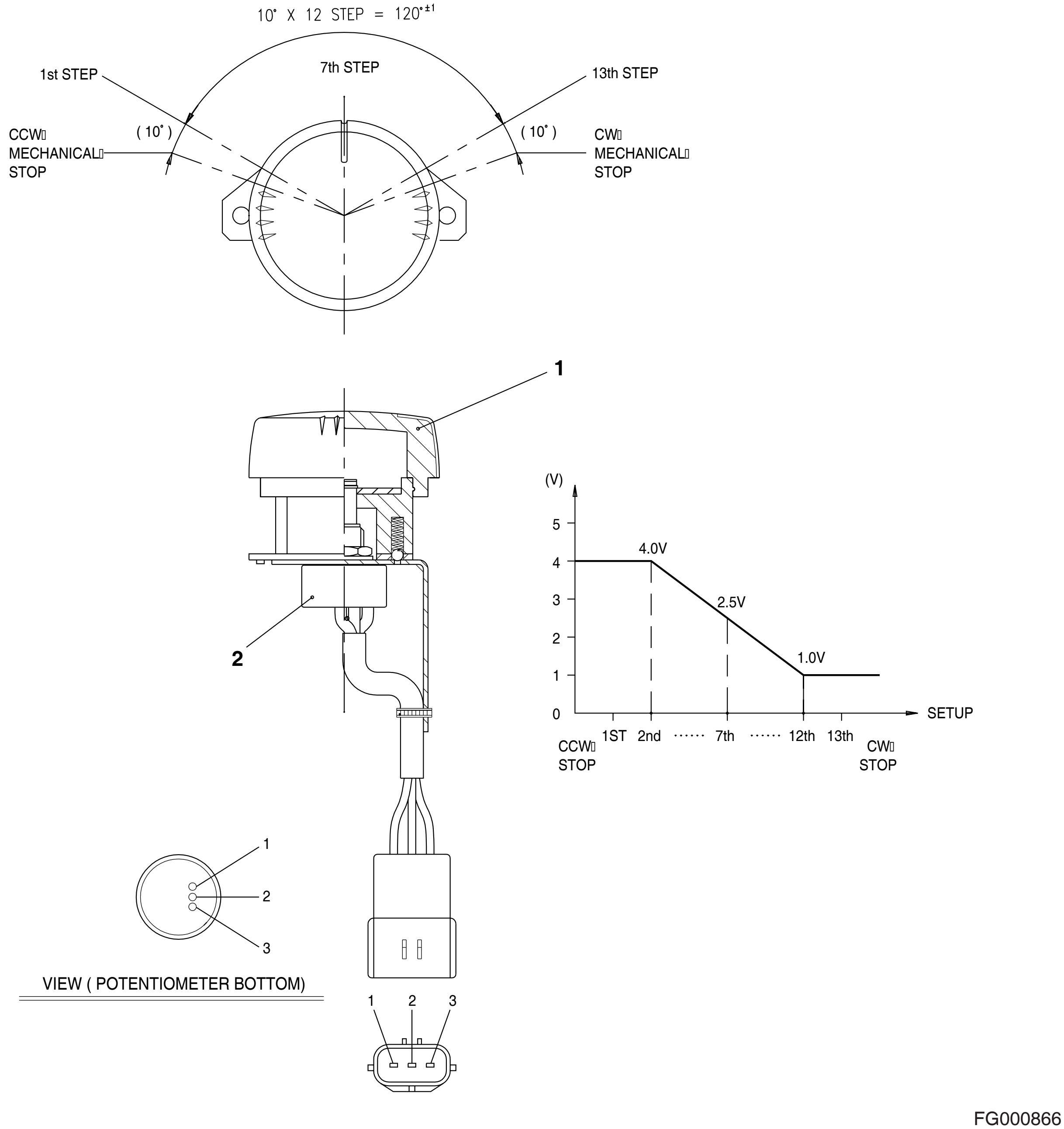


Figure 60

Reference Number	Description
1	Knob

Reference Number	Description
2	Potentiometer (Variable Resistor)

The engine control dial has a built in potentiometer. When the control knob is moved the output voltage (through "2 and 3" terminals) will vary from the 5 V supplied from the e-EPOS controller as shown in the graph.

ENGINE CONTROL CIRCUIT DIAGRAM

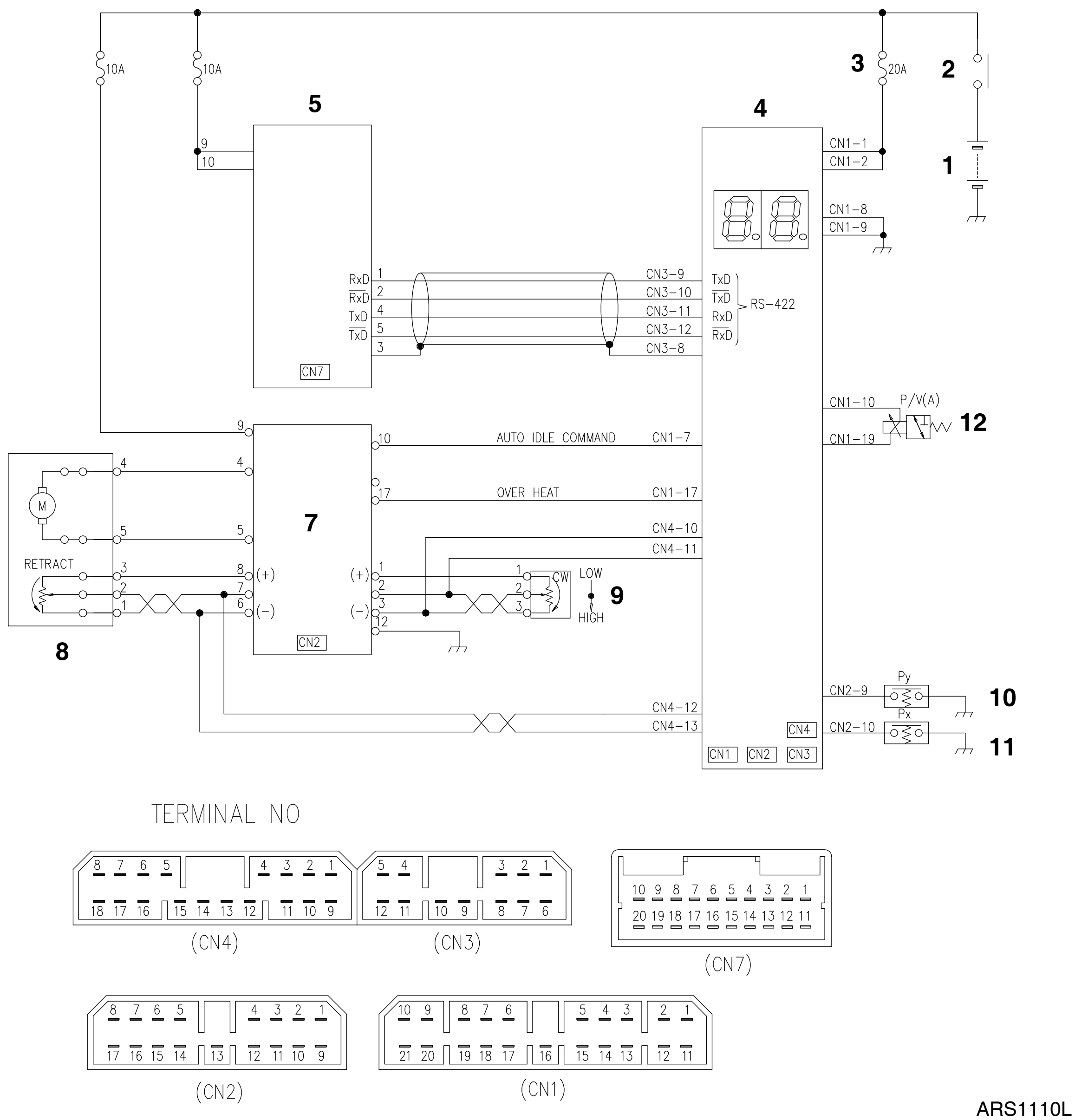


Figure 61

Reference Number	Description
1	Instrument Panel
3	Engine Controller
4	e-EPOS Controller
17	Engine Control Dial
24	Battery
25	Battery Relay

Reference Number	Description
26	Fuse
27	Starter Switch
28	Fusible Link
29	Pressure Switch (Py)
30	Pressure Switch (Px)

AUTOMATIC DECELERATION CONTROL (AUTO IDLE CONTROL)

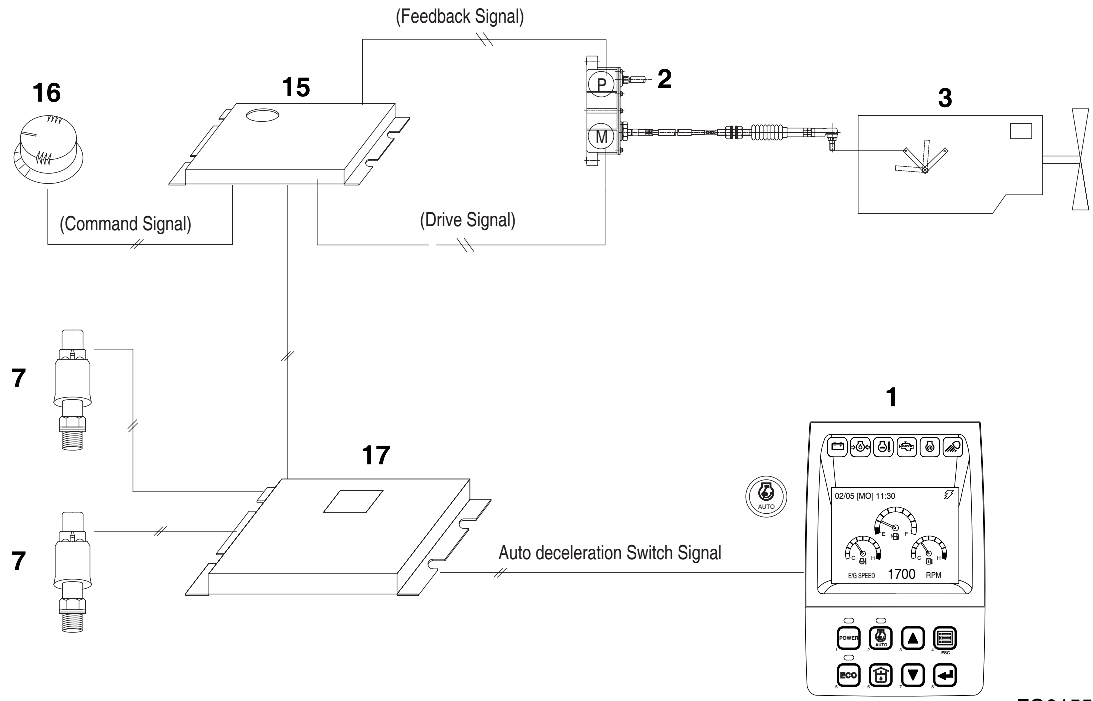


Figure 62

Reference Number	Description
1	Instrument Panel (Auto Idle Switch)
2	Engine Control Motor
3	Engine

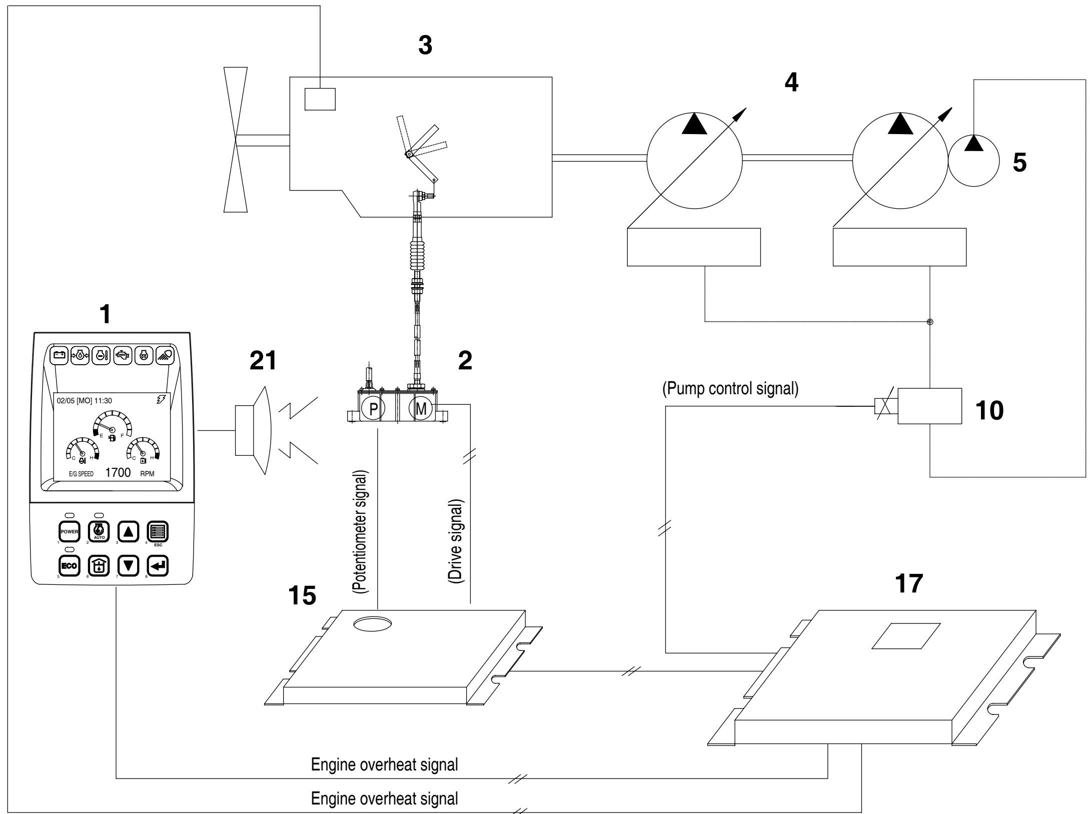
Reference Number	Description
7	Pressure Switch
15	Engine Throttle Controller
16	Engine Control Dial
17	e-EPOS Controller

If the machine is idling without the controls being operated or is waiting for a dump truck the engine speed is automatically lowered. Once the controls are operated and work is being started the machine will be restored to the previous settings. As a result, noise and fuel consumption will be reduced. This function can be selected or cancelled through the Auto Idle Selector Switch on the instrument panel.

The initial setting at start-up is with this switch in the select position. Approximately 4 seconds after this function is selected, if all work levers are in the neutral position, the e-EPOS controller compares the automatic reduction signal with the signal set by engine control dial. The lower of the two signals is selected, the e-EPOS controller sends a signal to the engine controller to control the engine speed.

The neutral status of the machine is detected by the two pressure switches in the control valve. When the work levers are in the neutral position, the switch is in the "OFF" position.

ENGINE OVERHEAT PROTECTION SYSTEM



FG015519

Figure 63

Reference Number	Description
1	Instrument Panel
2	Engine Control Motor
3	Engine
4	Main Pump
5	Contro Pump

Reference Number	Description
10	E.P.P.R. Valve (Electromagnetic Proportional Pressure Reducing Valve)
15	Engine Throttle Controller
17	e-EPOS Controller
21	Warning Buzzer

When the engine coolant temperature increases to over 107°C (225°F), the engine controller detects it from the sensor mounted in the coolant line and will send a signal to the e-EPOS controller. The e-EPOS controller sends a overheat signal to the instrument panel turning "ON" the warning light and buzzer simultaneously.

Also, the e-EPOS controller returns an overheat signal to the engine controller and changes power mode to standard mode. The engine speed is then set to a low speed by the engine controller.

When coolant temperature falls below 95°C (203°F), normal operation will resume.

POWER BOOST MODE

Operation

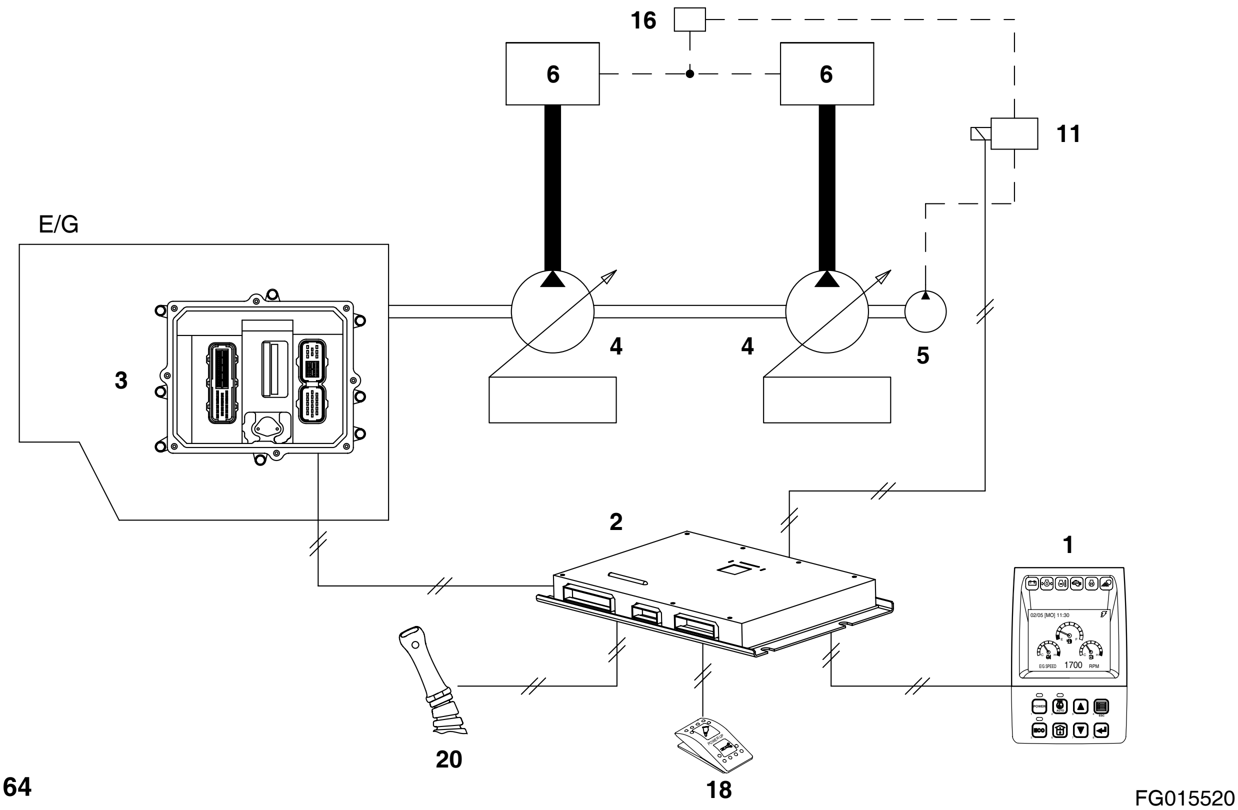


Figure 64

Reference Number	Description
1	Instrument Panel
2	e-EPOS Controller
3	Engine Controller
4	Main Pump
5	Aux Pump
6	Control Valve

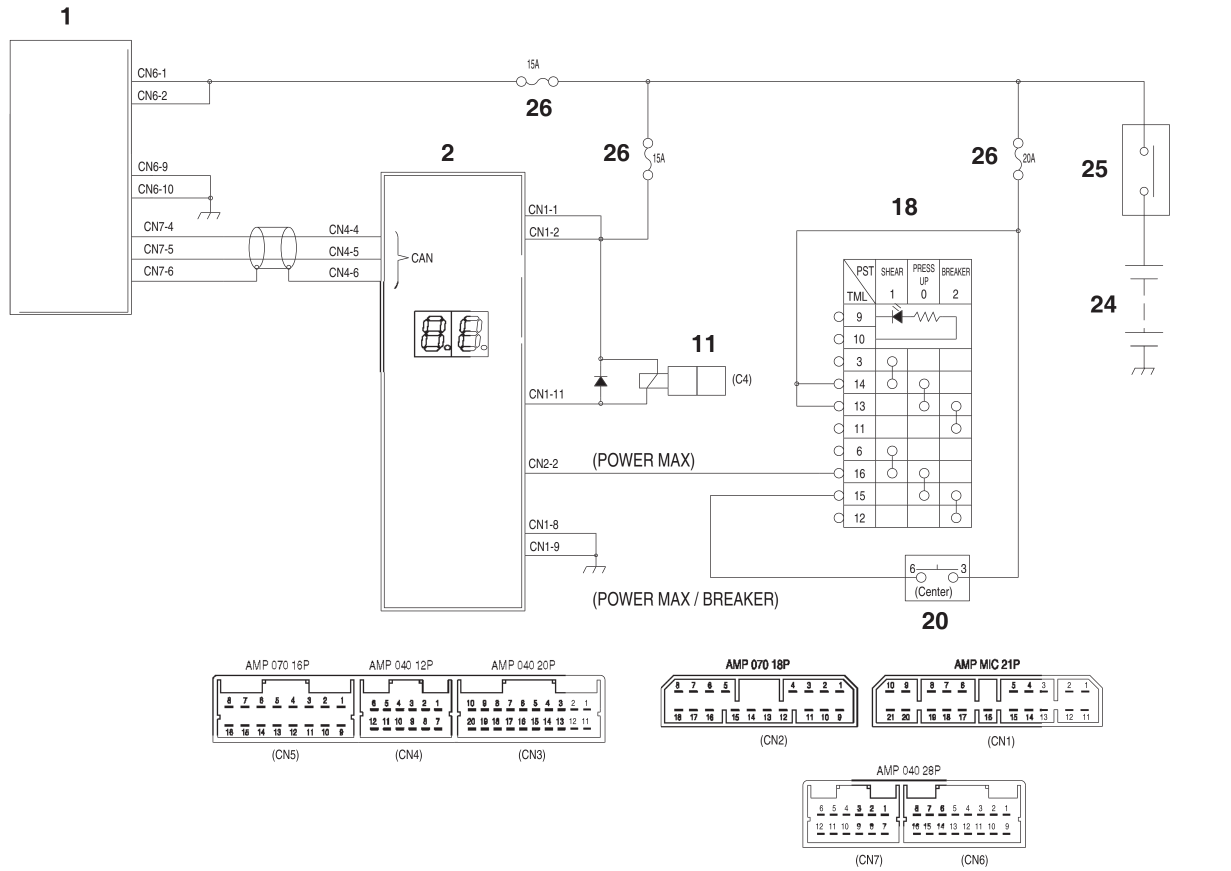
Reference Number	Description
11	Solenoid Valve (Boost)
16	Main Relief Valve
18	Breaker/Boost/Shear Selector Switch
20	Power Boost Switch (Top of Right Work Lever)

The Power Boost function is used to temporarily increase the main relief pressure to enhance excavation ability. When the breaker/boost/shear selector switch is set to "BOOST" and the power boost button on the center of the right-hand work lever (joystick) is pressed during work, the e-EPOS controller will activate the power boost solenoid valve and increase the relief valve pressure from 330 - 350 kg/cm^2 (4,700 - 5,000 psi). The excavation ability is increased by approximately 6%.

When the power boost function is in activated, a power boost symbol appears on the information display department of instrument panel.

NOTE: *Do not use this switch for more than 10 seconds.*

Power Boost Control - Circuit Diagram



FG000586

Figure 65

Reference Number	Description
1	Instrument Panel
2	e-EPOS Controller
11	Solenoid Valve (Pressure Up)
18	Breaker/Boost/Shear Selector Switch

Reference Number	Description
20	Power Boost Switch (Top of Right Work Lever)
24	Battery
25	Battery Relay
26	Fuse

AUTOMATIC TRAVEL SPEED CONTROL

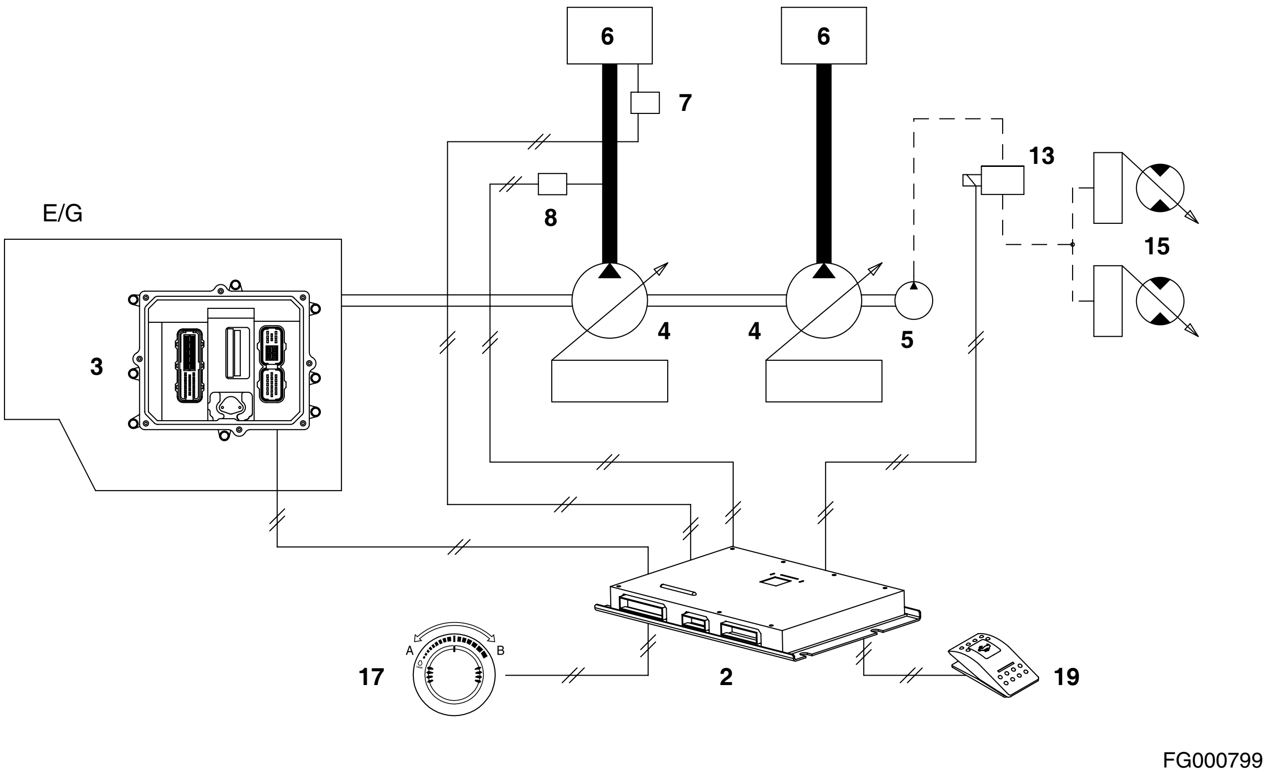


Figure 66

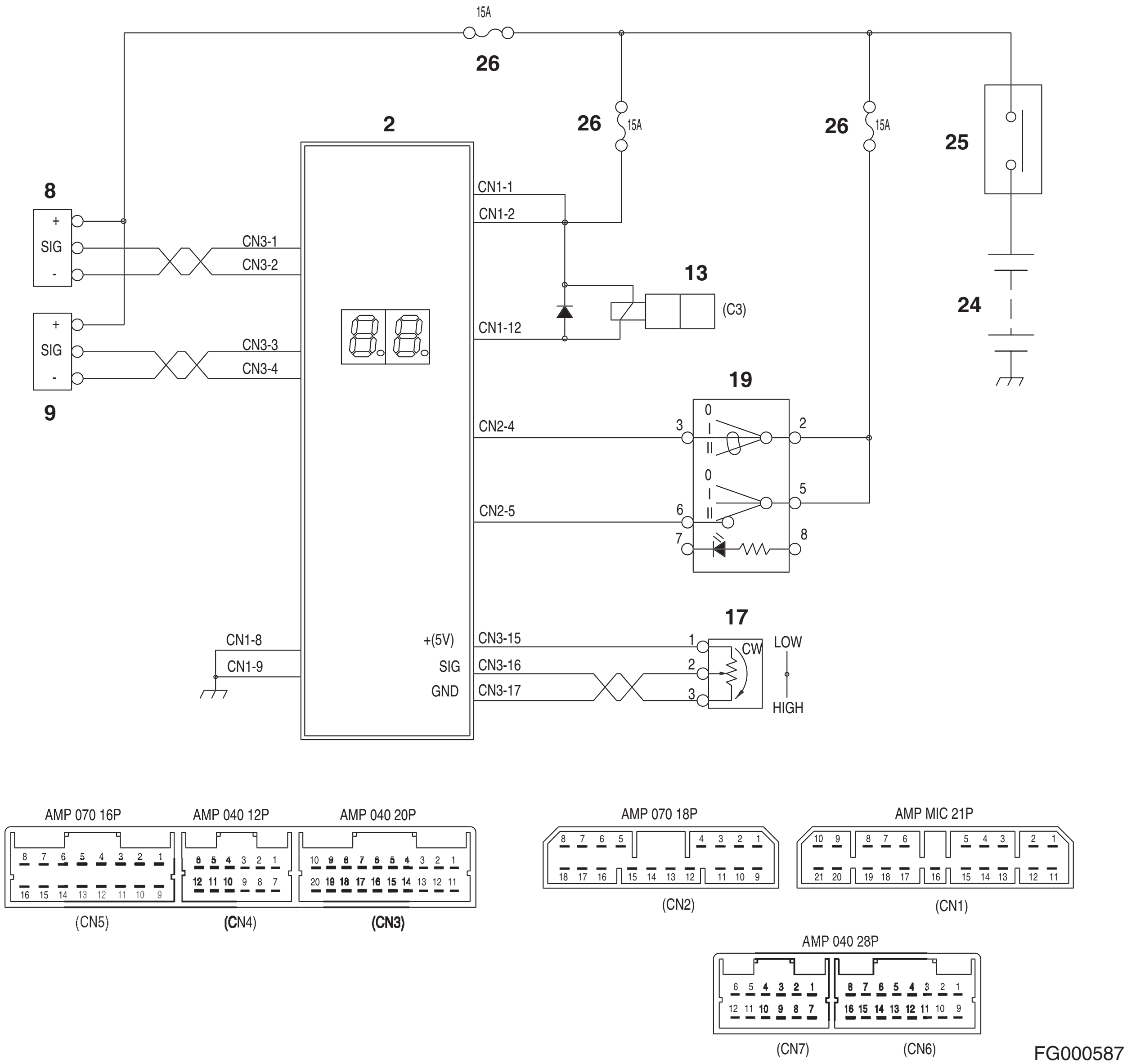
Reference Number	Description
2	e-EPOS Controller
3	Engine Controller
4	Main Pump
5	Aux Pump
6	Control Valve
7	Pressure Switch (Py Port)

Reference Number	Description
8	Pump Pressure Sensor
13	Solenoid Valve (High speed)
15	Travel Motor
17	Engine Control Dial
19	Selector Switch For Automatic Travel

If the automatic travel speed control switch is set to the "OFF" position, the travel motor will run in the I-speed (low speed) range. If the selector switch is set to the "I" position, the travel motor will run in the II-speed (high speed) range. If the selector switch is set to the "II" position, the e-EPOS controller will monitor the main pump discharge pressure and automatically select the "ON" - "OFF" status of the II - speed travel solenoid valve based on the travel load. The travel speed is changed between the I-speed and the II-speed mode.

The travel load is monitored by the two pressure sensors in the discharge lines of the front (upper) and rear (lower) pumps. When the travel load is high (pressure over 300 kg/cm^2 (4,300 psi) the solenoid valve is turned "OFF" and I-speed (low) is selected. In the case when the travel load is low (pressure under 160 kg/cm^2 (2,280 psi), the solenoid valve will be turned "ON" and the II-speed will be selected. But, if the engine speed control switch dial is set below approximately 1400 rpm, the travel speed will be set to I-speed mode.

Automatic Travel Speed Control - Circuit Diagram



FG000587

Figure 67

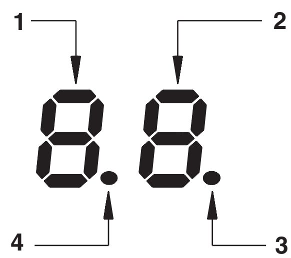
Reference Number	Description
2	e-EPOS Controller
8	Pressure Sensor (Front Pump)
9	Pressure Sensor (Rear Pump)
13	Solenoid Valve (High speed)
17	Engine Control Dial

Reference Number	Description
19	Selector Switch For Automatic Travel
24	Battery
25	Battery Relay
26	Fuse

SELF-DIAGNOSTIC FUNCTION

e-EPOS Controller

The system operation status and malfunction codes can be checked through the display on top of the e-EPOS controller box the rear cover behind the operator's seat.



FG000588

Figure 68

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,)

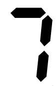
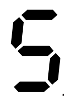
1. **Power Monitor**

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

2. **Engine Speed Monitor**

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

3. Normal Operation Display Readout

Mode Selection		Display Readout		Operation Status
		Upper Digit	Lower Digit	
Power Mode	Power Mode	 HAOH340L	 HAOH370L	Normal Operation Power Mode
	Standard Mode	 HAOH350L	 HAOH370L	Normal Operation Standard Mode
	Economy Mode	 FG013637	 HAOH370L	Normal Operation Economy Mode

4. Communication Monitor

What are shown in the 7-SEGMENT LED are same as those in the Error Codes.

Error Code	Indication Code	Fault Location
V201	01	Communication error in instrument panel.
V202	02	Communication error in engine controller.

AIR CONDITIONER SYSTEM

Outline

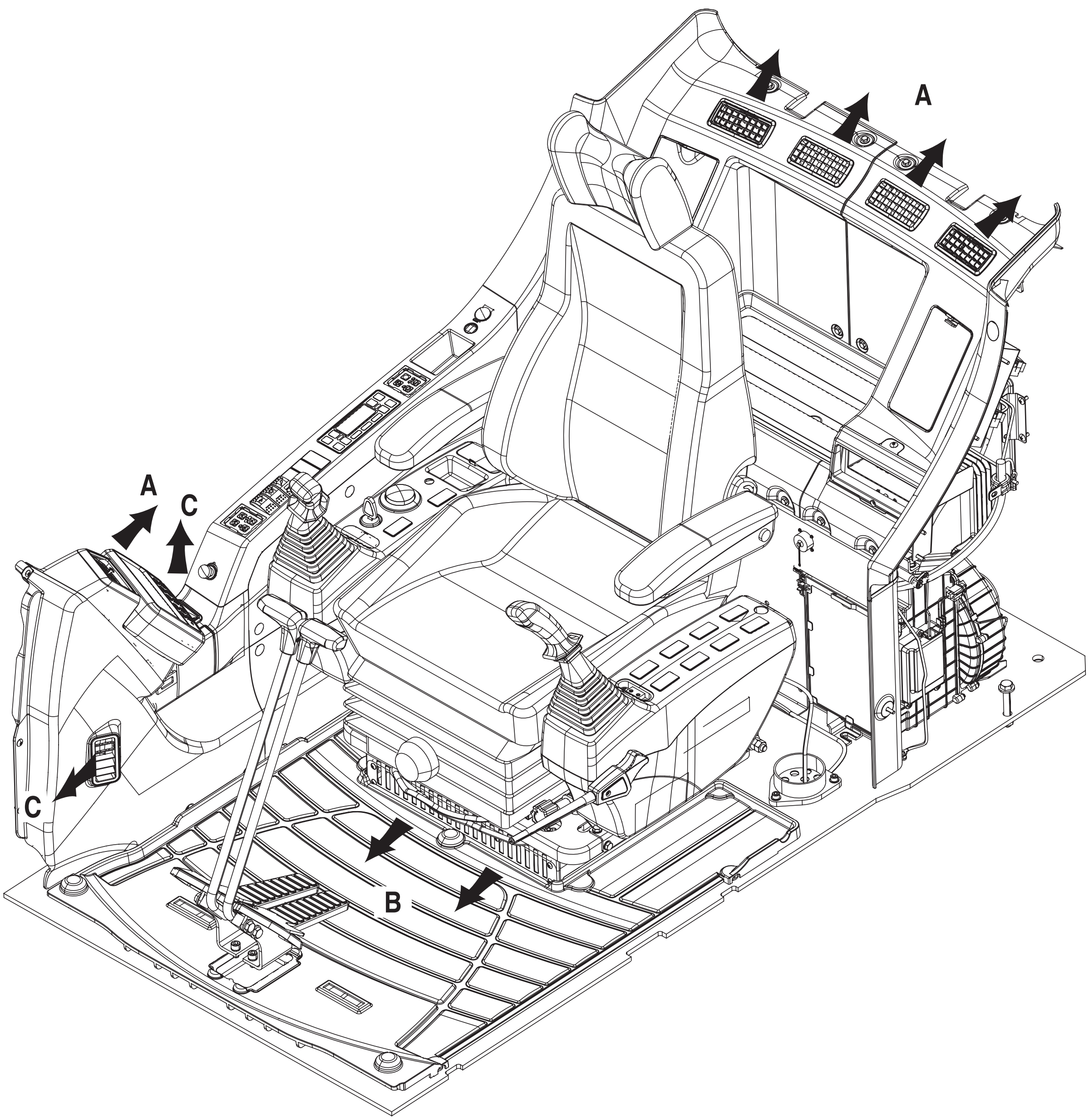


Figure 69

Solid-type heater and air conditioner are installed in the cover behind the operator's seat.

Temperature of the operator's room is adjusted automatically to the temperature set by operator.

(Please refer to the Operation Manual for detailed full automatic control.

Vent mode selects the direction of discharged air.

Outlets by vent modes

Modes					
Outlets	A	A+B	B	B+C	C

Internal and External Filters

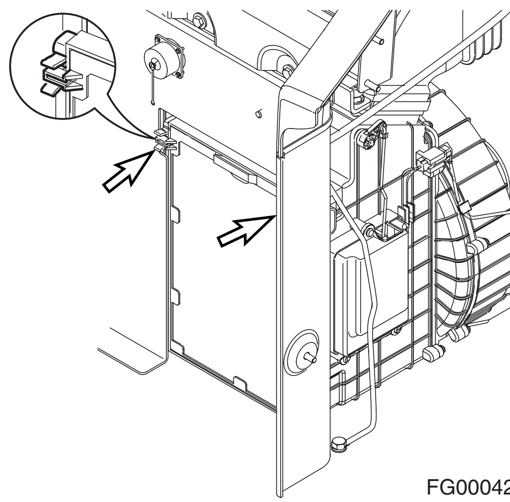
Internal and external air purification filters are installed for the operator's room.

Filters should be cleaned every 500 hours.

If machine operates in an excessively contaminated environment, filters should be cleaned more frequently and if necessary, replaced with new ones.

How to Check Internal Air Filter

1. Press both levers on the left and right side at the top of the filter installed at the rear of the operator's seat.

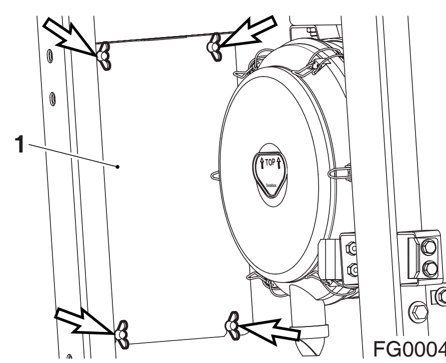


FG000422

Figure 70

How to Check External Air Filter

1. Open the door at the left side of machine and loosen four marked bolts to remove the cover (1, Figure 71).



FG000440

Figure 71

2. Turn marked knobs (1, Figure 72) at the rear side of the cabin to open the cover.

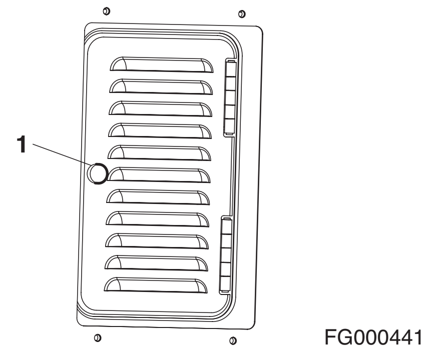


Figure 72

3. Remove the filter attached to the cover and clean the contaminated filter using compressed air.
4. Close the cover, replace the knobs, and secure the cover to the support with butterfly bolts.

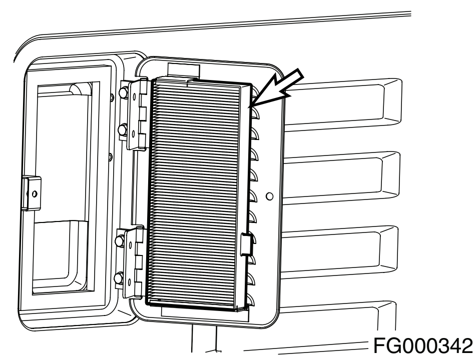


Figure 73

Air-Conditioning System Layout

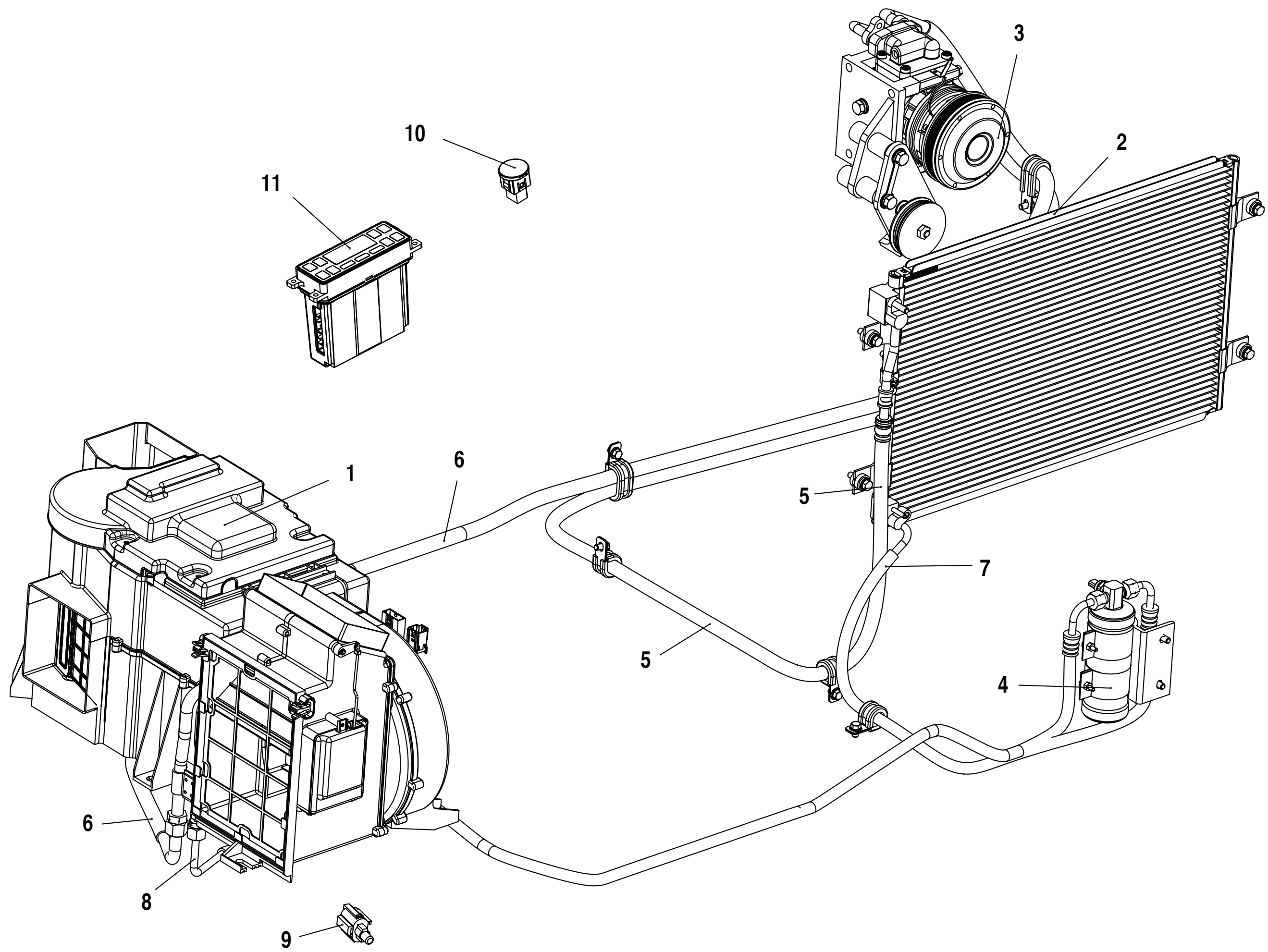
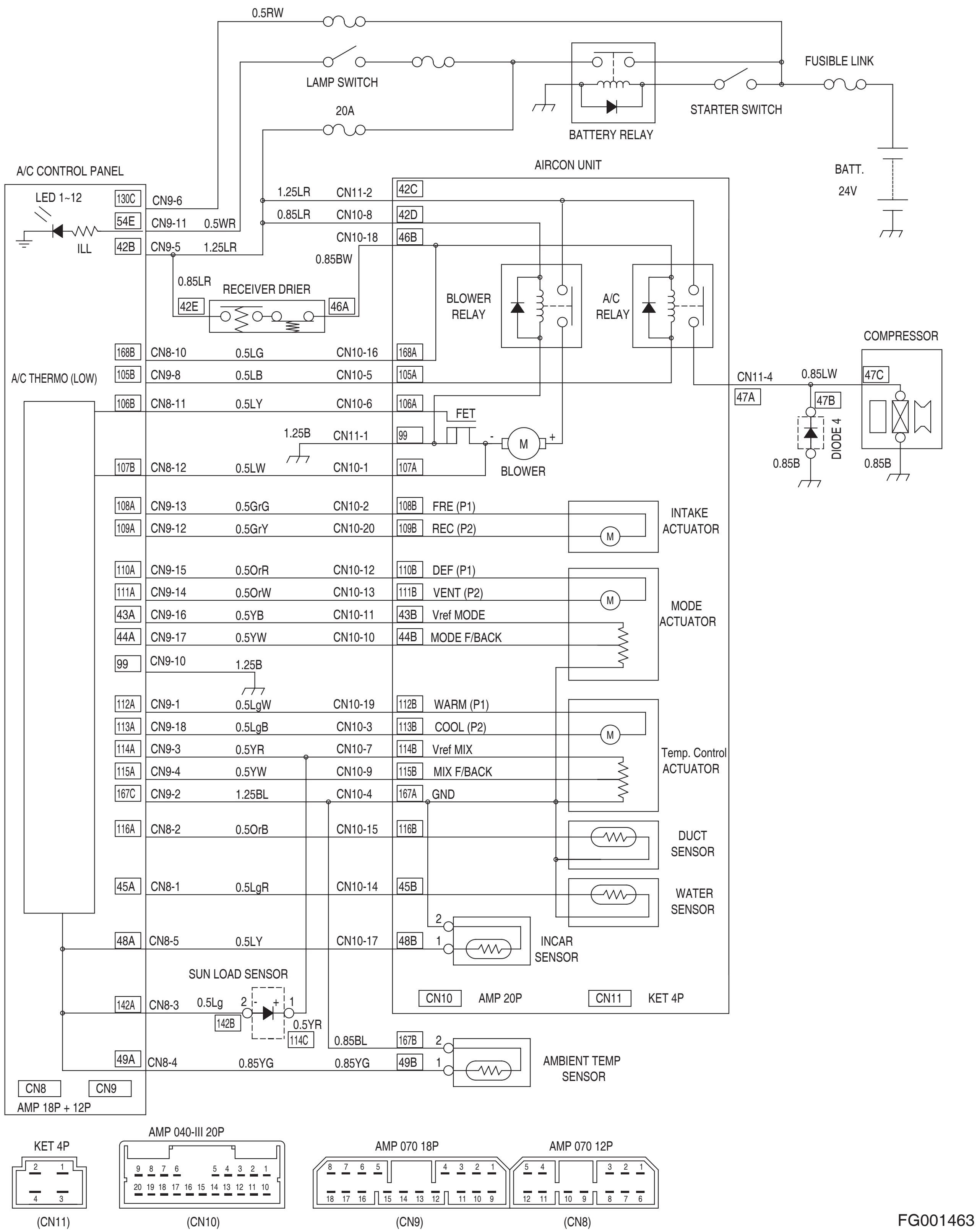


Figure 74

Reference Number	Description
1	Air Conditioner/heater Unit
2	Condenser
3	Compressor
4	Receiver Dryer
5	Discharge Hose
6	Suction Hose

Reference Number	Description
7	Liquid Hose (1)
8	Liquid Hose (2)
9	Ambient Temperature Sensor
10	Sun Sensor
11	Control Panel

Air Conditioner/heater Circuit Diagram



FG001463

Figure 75

Air Conditioner/heater Unit

Air Flow Diagram

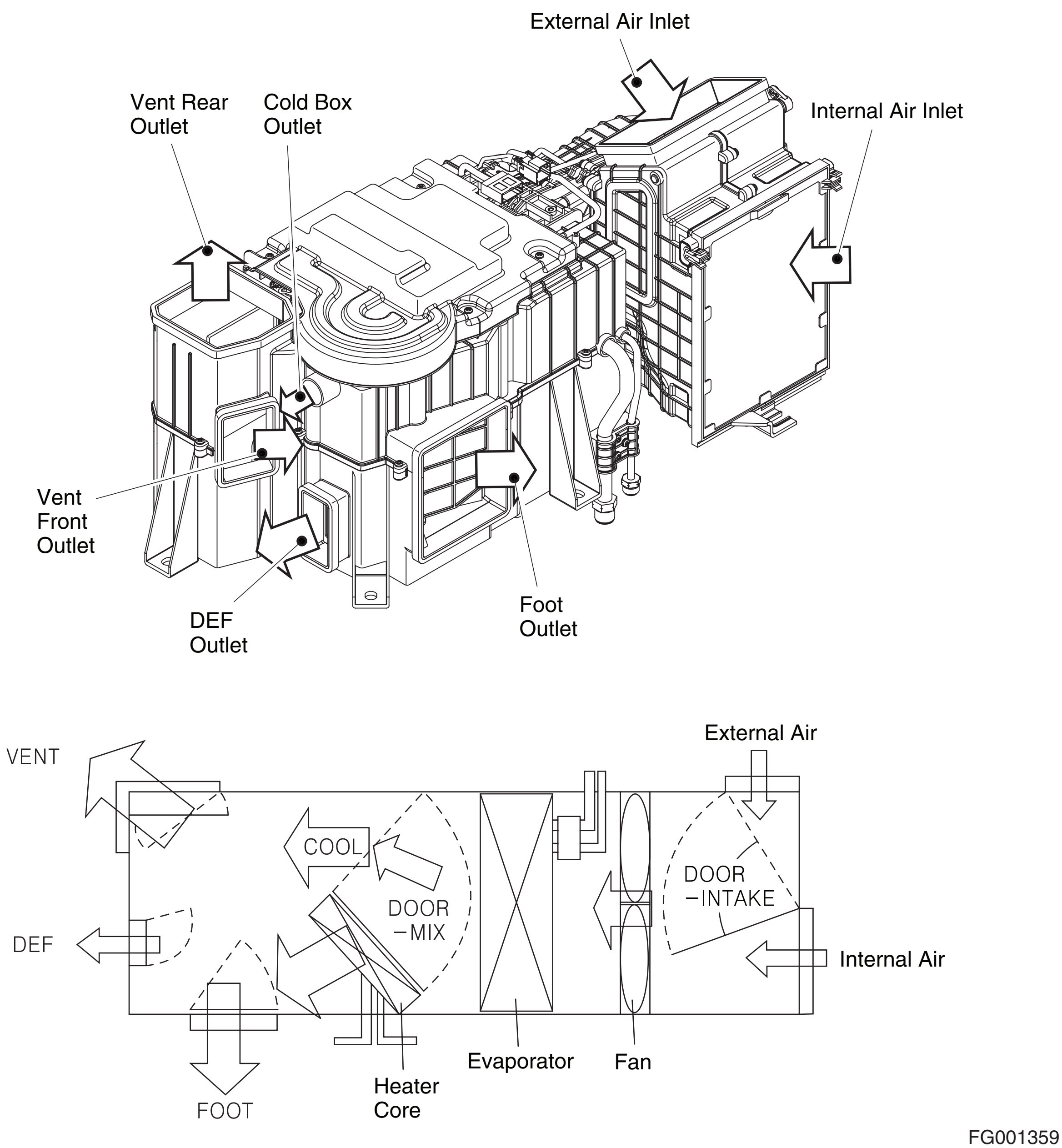


Figure 76

Door Open by Vent Modes

Door	Mode				
	Vent	**Bi-level**	**Foot**	**Def/foot**	**Def**
Vent	100	60	0	0	0
Foot	0	40	100	80	60
Def	0	0	0	20	40

Main Components

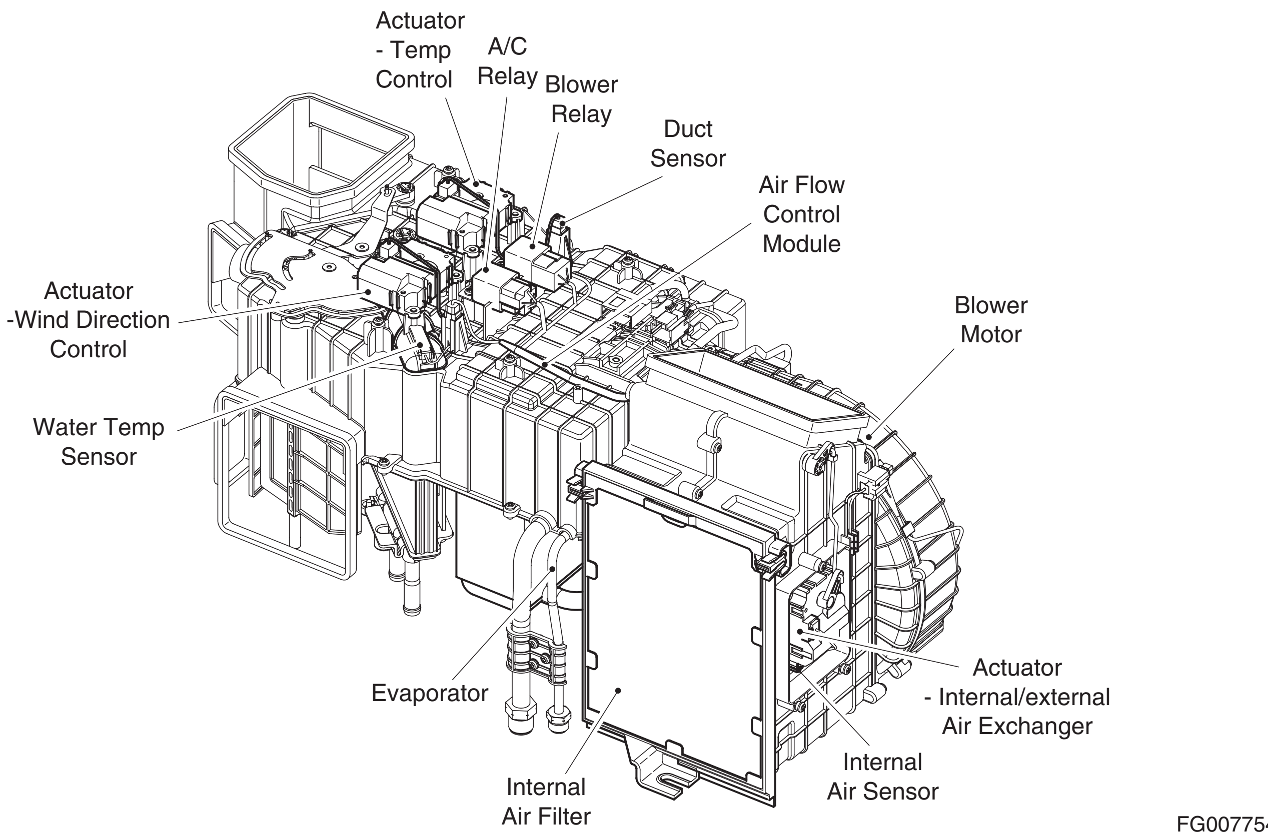


Figure 77

Actuator - Wind Direction Control

Change of discharged air flow according to selected wind direction mode

Change of wind direction: Direction changes in the order of VENT→ BI-LEVEL → FOOT → FOOT/DEF → VENT.

Actuator - Temperature Control

Change of discharged air temperature by controlling the position of temperature control door.

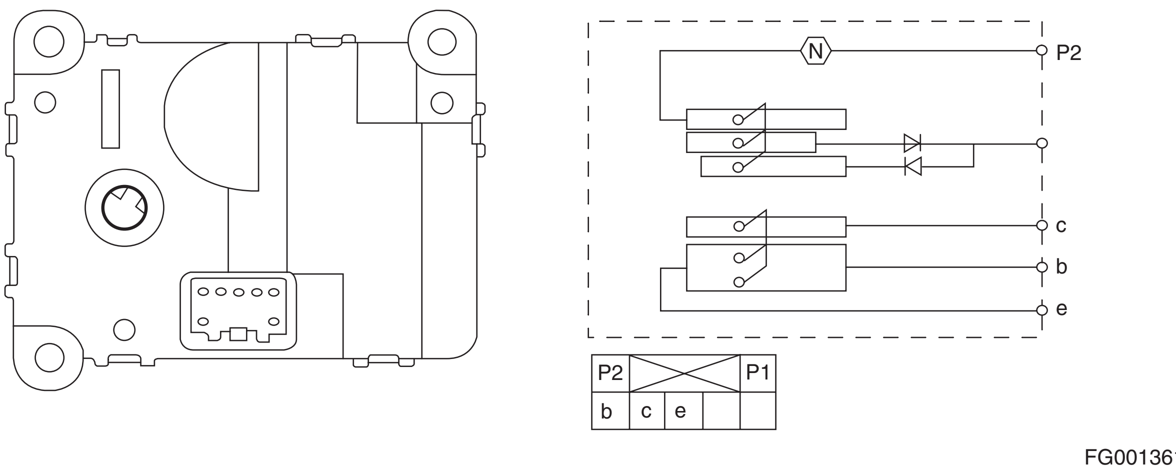


Figure 78

Actuator - Wind Direction Control

Wind Direction Mode	Output Terminal	Voltage
Vent	c(+): CN10-10 b(-): CN10-4	0.5 ± 0.2V
Bi-level		1.3 ± 0.2V
Foot		2.45 ± 0.2V
Foot/def		3.5 ± 0.2V
Def		4.5 ± 0.2V

Actuator - Temperature Control

Set Temperature	Output Terminal	Voltage
Max cooling	c(+): CN10-9	Below 0.4V
Max heating	b(-): CN10-4	Above 4.5V

Actuator - Internal/external Air Exchange

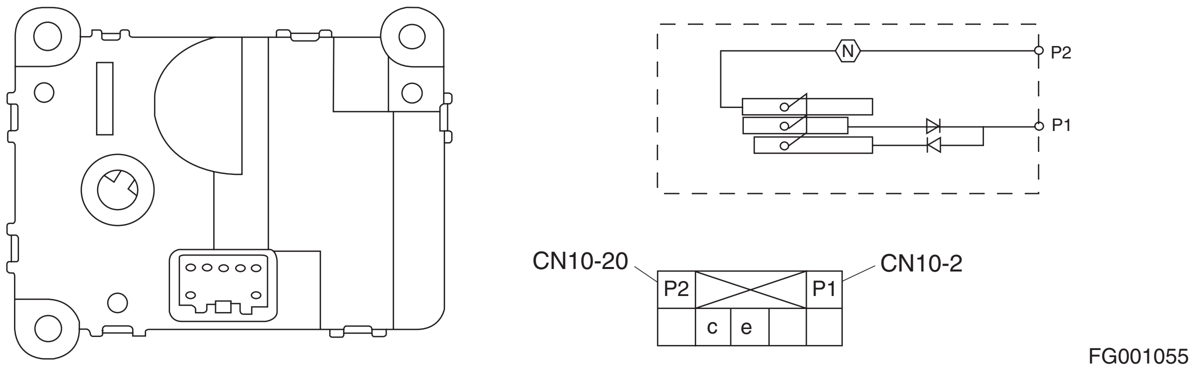


Figure 79

Mode	Output Terminal	Output
Intake	P1(+), P2(-)	Moving of exchange door by selecting intake.
Recirculate	P1(-), P2(+)	Moving of exchange door by selecting recirculate.

Air Flow Control Module

Air flow is controlled through the control of voltage between GATE and SOURCE.

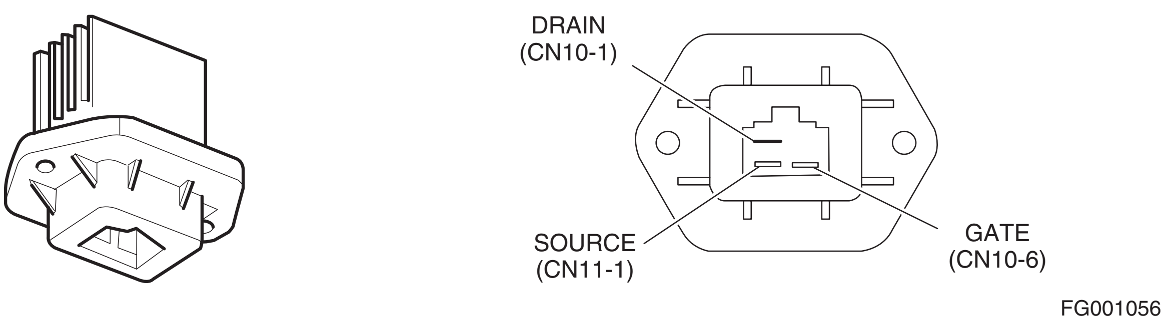


Figure 80

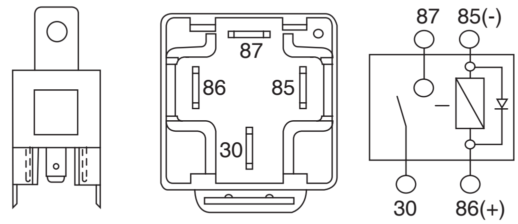
Air flow	Output Terminal		Output
1st			10 ± 0.5V
2nd			12.5 ± 0.5V
3rd			15 ± 0.5V
4th	CN11-2	CN10-1	17.5 ± 0.5V
5th			20.0 ± 0.5V
6th			22.0 ± 0.5V
7th			More than 25V

Input voltage is 27.5V.

The air flow is based on manual set.

Relay - Blower: Power is supplied to the blower motor when the system is turned "ON."

Specifications	
Rated voltage	24V
Rated current	20A

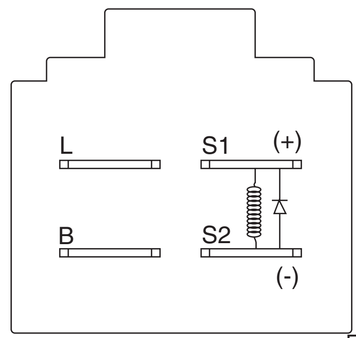


FG001057

Figure 81

Relay - A/C: Power is supplied to the magnetic clutch of the compressor.

Specifications	
Rated voltage	24V
Rated current	10A



FG001058

Figure 82

Duct Sensor: It is inserted in the core of the evaporator to prevent freezing of the evaporator.

The sensor consist of negative characteristic thermistor that resistant value increases and decreases when the temperature rises and falls, respectively.

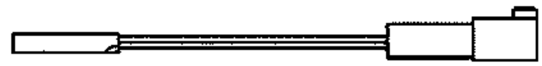

FG001059

Figure 83

Temperature (°C)	Resistance (KΩ)
0	11.36 ± 0.1
2	10.39 ± 0.2
2.5	10.17 ± 0.2
3	9.95 ± 0.2
3.5	9.73 ± 0.2
4	9.52 ± 0.2
5	9.12 ± 0.2
10	7.36 ± 0.15
25	4.02 ± 0.08
30	3.33 ± 0.07

Water Temperature Sensor: It senses the temperature of coolant water in the heater core.

Temperature (°C)	Resistance (KΩ)
-10	55.8 ± 1.7
0	32.9 ± 0.9
15	15.76 ± 0.5
25	10.0 ± 0.3
35	6.5 ± 0.2

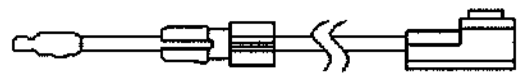


FG001060

Figure 84

Internal Air Temperature Sensor: Built in the internal air filter, it senses the internal temperature.

Temperature (°C)	Resistance (KΩ)
-15	218.2 ± 7.5
0	97.83 ± 0.9
15	47.12 ± 0.7
25	30.0 ± 0.36
35	19.60 ± 0.3



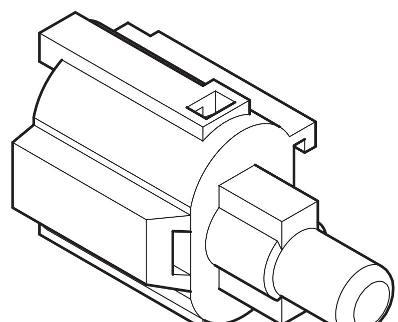
FG001061

Figure 85

Ambient Air Temperature Sensor

Built at the bottom of the cockpit, it senses the temperature of external air.

Temperature (°C)	Resistance (KΩ)
-10	163 ± 4.9
0	96.9 ± 2.9
10	59.4 ± 1.8
20	37.4 ± 1.1
25	30 ± 0.9
30	24.2 ± 0.7

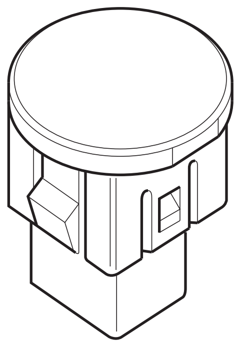


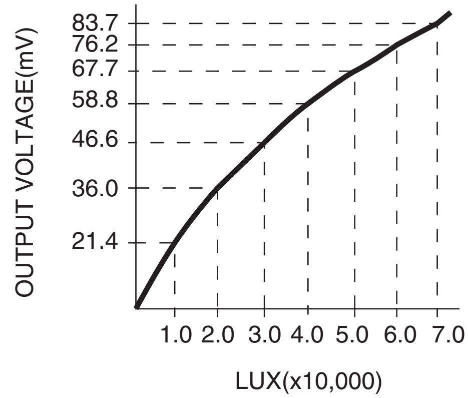
FG001064

Figure 86

Sun Sensor

Built beside the socket of spare power, it senses the quantity of the sun radiation to optimize discharge temperature and air flow as set by operator.



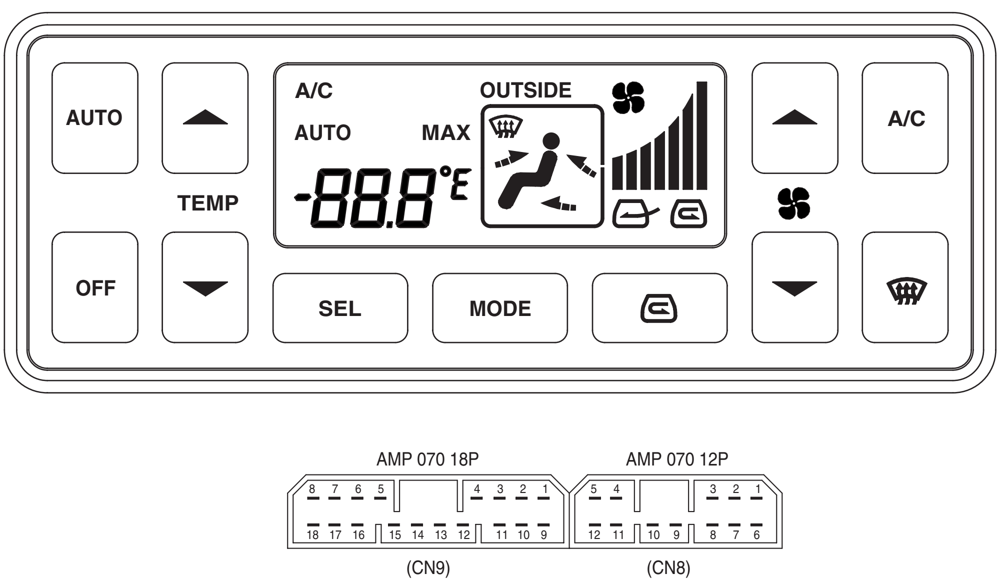


FG001062

Figure 87

Control Panel

Appearance and Terminal Arrangement



FG001063

Figure 88

Refer to "Air Conditioner and Heater" of operation manual.

Terminal Terms

CN	Term No.	Terms
CN9	1	Temperature control (warm)
	2	Sensor ground
	3	Temperature control Power (5V)
	4	Mix feedback
	5	Power (KEY "ON")
	6	Back-up
	7	-
	8	A/C output (LOW)
	9	-
	10	Ground
	11	Illumination
	12	Intake/Recirculate (Recirculate)
	13	Intake/Recirculate (Intake)
	14	Wind direction control (VENT)
	15	Wind direction control (DEF.)
	16	Wind direction control Power (5V)
	17	Wind direction control (feedback)
	18	Temperature control (cool)

CN	Term No.	Terms
CN8	1	Water temperature sensor
	2	Duct sensor
	3	Sun sensor
	4	Ambient air temperature sensor
	5	Internal air temperature sensor
	6	-
	7	-
	8	-
	9	-
	10	D.P.S CHECK
	11	Air flow module (gate)
	12	Blower motor (feedback)

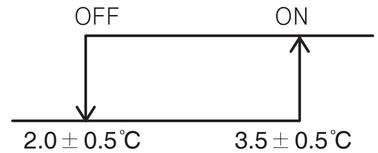
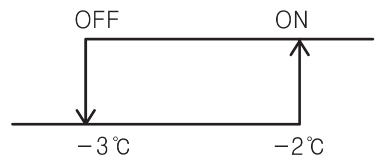
Control Logic

Categories	Inputs	System Operation
AUTO	Set temperature Internal air temperature sensor Ambient air temperature sensor Water temperature sensor Sun sensor	1. Automatically adjust room temperature as set and then next items. Temperature, Wind direction, Recirculate/Intake, Air flow, Compressor 2. Auto mode is released when manually setting any switch except, Temperature Control switch in Auto mode. 3. Upon the releasing of Auto mode, all of functions except selected switch are controlled automatically.

<table>
<tr><th>Categories</th><th>Inputs</th><th>System Operation</th></tr>
<tr><td>Sensor compensation</td><td>Set temperature
Internal air temperature sensor
Ambient air temperature sensor
Water temperature sensor</td><td>1. In case of sensor failure, following defaults are applied:
Internal air temperature sensor: 25°C, Ambient air temperature sensor: 25°C, Duct sensor: -2°C
Temperature control actuator:
- Set Temperature 17 - 24.5°C: Max cooling, Set Temperature 25 - 32°C: Max heating
Wind direction mode actuator
- VENT: VENT fix, modes other than VENT: Fixed to DEF
* Sun sensor is not compensated.</td></tr>
<tr><td>Max cooling/ heating control</td><td>Auto Setting</td><td>1. Set Temperature 32°C: Max heating
2. Set Temperature 17°C: Max cooling
<table>
<tr><th></th><th>Max Cooling (17 °C)</th><th>Max Heating (32 °C)</th></tr>
<tr><td>Temp Control Actuator</td><td>FULL COOL</td><td>FULL HOT</td></tr>
<tr><td>Air Flow</td><td>MAX HI</td><td>AUTO HI</td></tr>
<tr><td>Compressor</td><td>Forced ON</td><td>OFF</td></tr>
<tr><td>Intake/Recircle</td><td>Recircle</td><td>Intake</td></tr>
<tr><td>Wind Direction Mode</td><td>VENT</td><td>FOOT</td></tr>
</table>
* Max cooling/heating control is possible only in Auto mode.</td></tr>
<tr><td>Starting Control of Cooling</td><td>Auto mode
Duct sensor</td><td>1. Prevention of discharge of hot air before discharge temperature drops enough in hot summer weather
2. Start conditions (AND condition)
(1) A/C on (AUTO or manual)
(2) Temperature sensed by the duct sensor is above 30°C
(3) Air flow: Auto mode
3. One time control in the cycle of engine OFF → engine run
4. Initial cooling control is executed when the Auto switch is "ON" in the manual status (A/C "OFF" and manual control of air flow) in 5 seconds after engine run.
5. Initial cooling control should be before max cooling.
6. Release condition (OR condition)
(1) A/C "OFF"
(2) Air flow: Manual control
(3) Release is possible with the "OFF" switch but not allowed within 12 seconds (after Start "ON") while the system is off using the "OFF" switch and during the time of initial cooling control.</td></tr>
</table>

Categories	Inputs	System Operation
Starting control of heating (1)	Water temperature sensor Internal air temperature sensor Auto mode Set Temperature	1. Start condition (AND condition) (1) When wind direction mode is one of the following modes in the Auto or manual control mode - BI-LEVEL, FOOT or FOOT/DEF (2) The Water temperature sensor is stable and the water temperature < 73°C (3) Air flow: Auto mode (4) Set temperature > Internal air temperature + 3°C * Air flow falls gradually up to 12 seconds when operation released. 2. One time control in the cycle of engine OFF → engine run 3. Initial heating control should be before max heating. 4. Air flow is controlled only when the wind direction is in the manual mode and BI-LEVEL, FOOT, or FOOT/DEF is set. 5. Control through the water temperature sensor for start. 6. Starting control of heating (2) starts in case of fault of the water temperature sensor during controlling. 7. Operation release (OR condition) (1) Only air flow is released if it is selected manually. (2) When handling the wind direction mode switch, only wind direction is released but the air flow control is performed only for the remaining period of the starting control of heater. (3) When Max Cooling (17°C) is selected. (4) Water temperature sensor > 73°C.

Categories	Inputs	System Operation
Starting control of heating (2)	Water temperature sensor Ambient air temperature sensor Internal air temperature sensor Auto mode	1. Entry condition (AND condition) (1) Auto Mode (2) Ambient air temperature < 5°C and difference between ambient and internal air temperature ≤ 5°C (3) Failure of water temperature sensor 2. Only one time of engine OFF → engine run 3. Starting control of heating is before max heating. 4. Operation release (OR condition) (1) Air flow: Manual selection (2) When handling the wind direction mode switch, only wind direction is released but the air flow control is performed only for the remaining period of the starting control of heater. (3) Difference between internal and ambient air temperature>15°C (4) When Max Cooling (17°C) is selected. 5. Exceptional case Starting control of heating is performed only once during the remaining period if the entry condition is satisfied within the starting control period that is the accumulation of initial start times. (Inclusive of Auto mode "ON" case within the period of starting control of heater.) * Air flow should be reduced slowly for up to 12 seconds in case of exceptional entry case.

<table>
<tr><th>Categories</th><th>Inputs</th><th>System Operation</th></tr>
<tr><td rowspan="2">Compressor control</td><td>Duct sensor</td><td>1. Function: Magnetic clutch of compressor is turned "ON/OFF" depending on temperature of the duct sensor to prevent the freezing of the evaporator with A/C being "ON."
2. Control pattern.

</td></tr>
<tr><td>External temperature sensor</td><td>1. Function: Prevention of compressor in winter.
2. Control pattern.


*Only for Auto mode.</td></tr>
</table>

Self Diagnosis

How to start self diagnosis

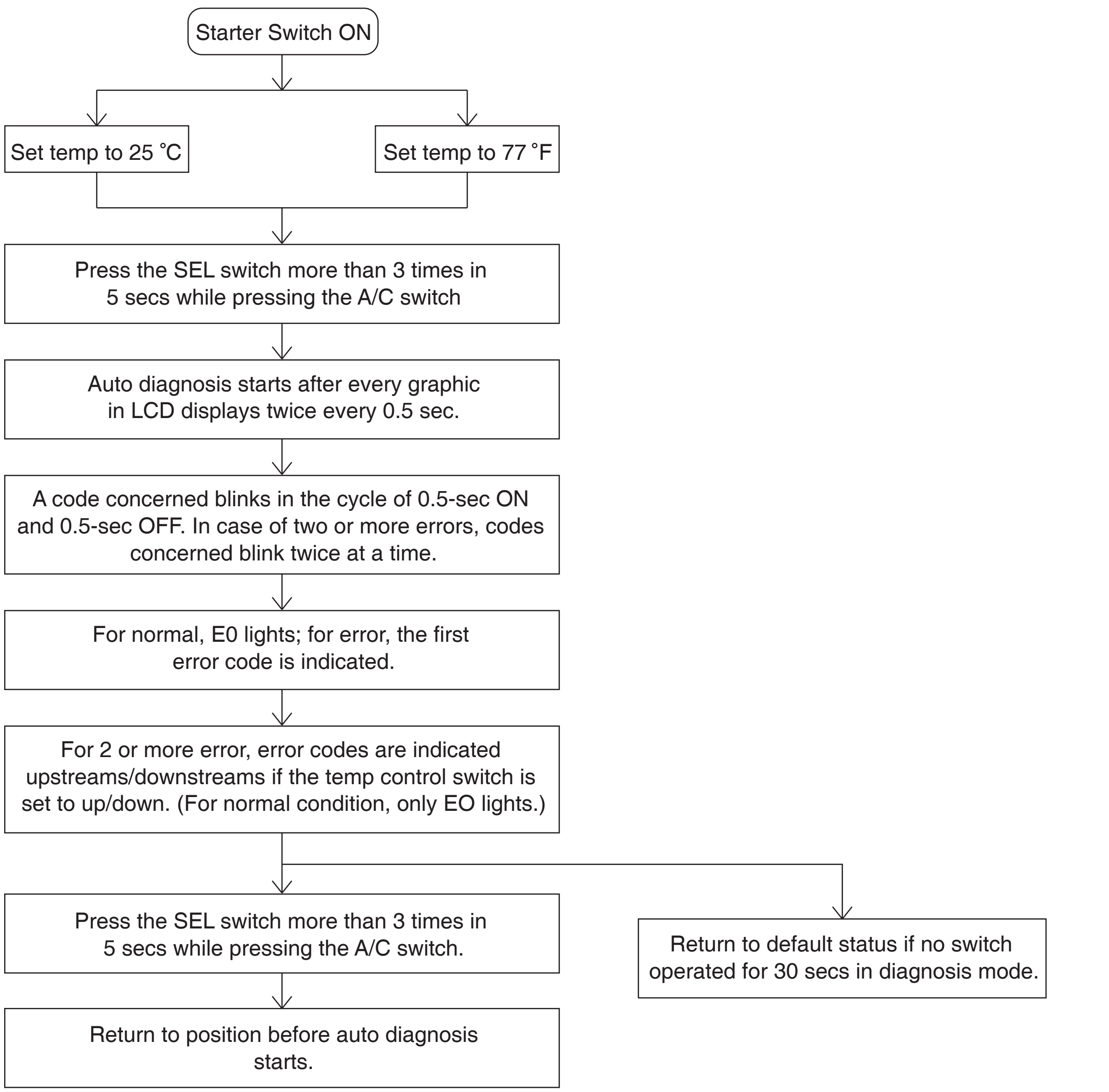


Figure 89

Error codes

Code	Description
E0	Normal
E1	Internal air temperature sensor short
E2	Internal air temperature sensor open
E3	Ambient air temperature sensor short
E4	Ambient air temperature sensor open
E5	Duct sensor short
E6	Duct sensor open
E7	Sun sensor short
E8	Sun sensor open
E9	Water temperature sensor short
E10	Water temperature sensor open
E11	D.P.S open
E12	Position error of wind direction actuator
E13	Position error of temperature control actuator

NOTE: *The position error means that it fails to move to designated place in 40 seconds.*

Sun sensor displays E8 in case of no sunlight.

2 and more fails: Codes concerned blinks twice at a time.

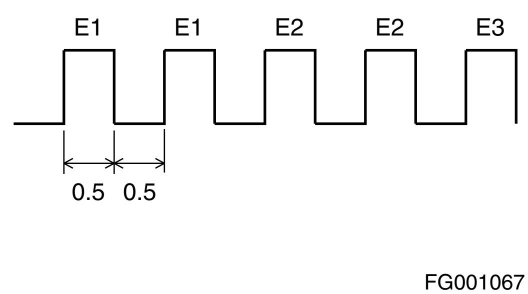


Figure 90

Ambient Temperature Display

Selection of both the SEL and MODE switch for more than 3 seconds indicates the ambient temperature in the set temperature display department.

- Range of temperature display: -40 - +60°C

NOTE: *Display of ambient temperature may be released in the same way for its entry way.*

It returns automatically to default mode 5 seconds after entering the ambient air temperature display mode.

Compressor

Categories	Specifications
Output	155.3 cc/rev
Oil Level	120 cc (ND-OIL8)
Refrigerant	R134a
Rated Voltage	24V
Relief Valve	Open: 35 - 42.2 kg/cm^{2}G Close: 28.1 kg/cm^{2}G

Compressor sucks in refrigerant which evaporates completely in the evaporator and discharges it to the condenser.

Refrigerant undergoes repeated status change in the order of liquid, gas, and liquid in the freezing cycle, and the compressor makes evaporated refrigerant a high temperature and high-pressured gas to freeze it in the condenser.

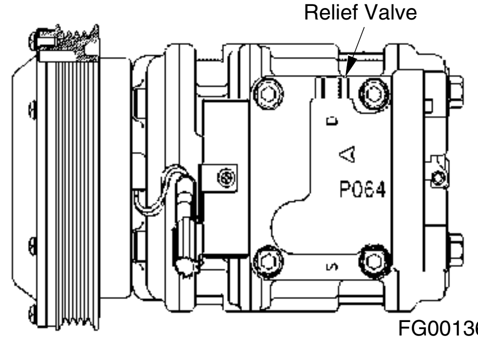


Figure 91

Receiver Dryer

The receiver dryer reserves refrigerant enough to ensure smooth freezing cycle responding immediately to the change of level in the freezing cycle.

As liquid refrigerant from the condenser may contain refrigerant gas with bubbles whose presence in the expansion valve decreases the freezing power excessively, it separates liquid and gas and sends liquid only to the expansion valve.

Water in refrigerant shall be eliminated with dryer and through filter.

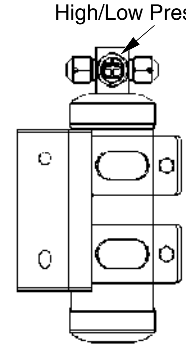


Figure 92

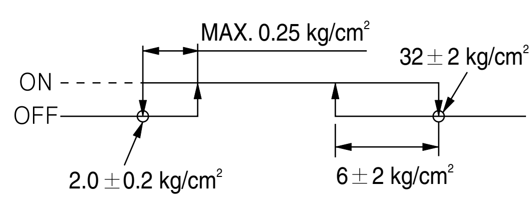


Figure 93

Volume of refrigerant by model

Model	Volume of Refrigerant
DX225LC	800 ± 20 grams
DX225NLC	800 ± 20 grams
DX300LC	800 ± 20 grams
DX300LCA	800 ± 20 grams
DX340LC	800 ± 20 grams
DX420LC	800 ± 20 grams
DX480LC	800 ± 20 grams
DX520LC	800 ± 20 grams

Refrigerant Pressure Check

1. Open all doors and windows.
2. Install manifold gauge set.
3. Start engine and maintain engine speed at 1,800 - 2,000 rpm.

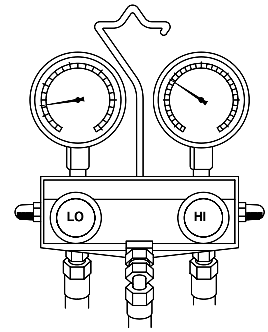


Figure 94

4. Check high / low-pressure of refrigerant.

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

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

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

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

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

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

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

WEIGHT OF R134a GAS USED IN MACHINES

Model	Weight of Gas
DX225LC	800 ± 20 grams (28 ± 0.7 oz)
DX225NLC	800 ± 20 grams (28 ± 0.7 oz)
DX300LC	800 ± 20 grams (28 ± 0.7 oz)
DX300LCA	800 ± 20 grams (28 ± 0.7 oz)
DX340LC	800 ± 20 grams (28 ± 0.7 oz)
DX420LC	800 ± 20 grams (28 ± 0.7 oz)
DX480LC	800 ± 20 grams (28 ± 0.7 oz)
DX520LC	800 ± 20 grams (28 ± 0.7 oz)

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

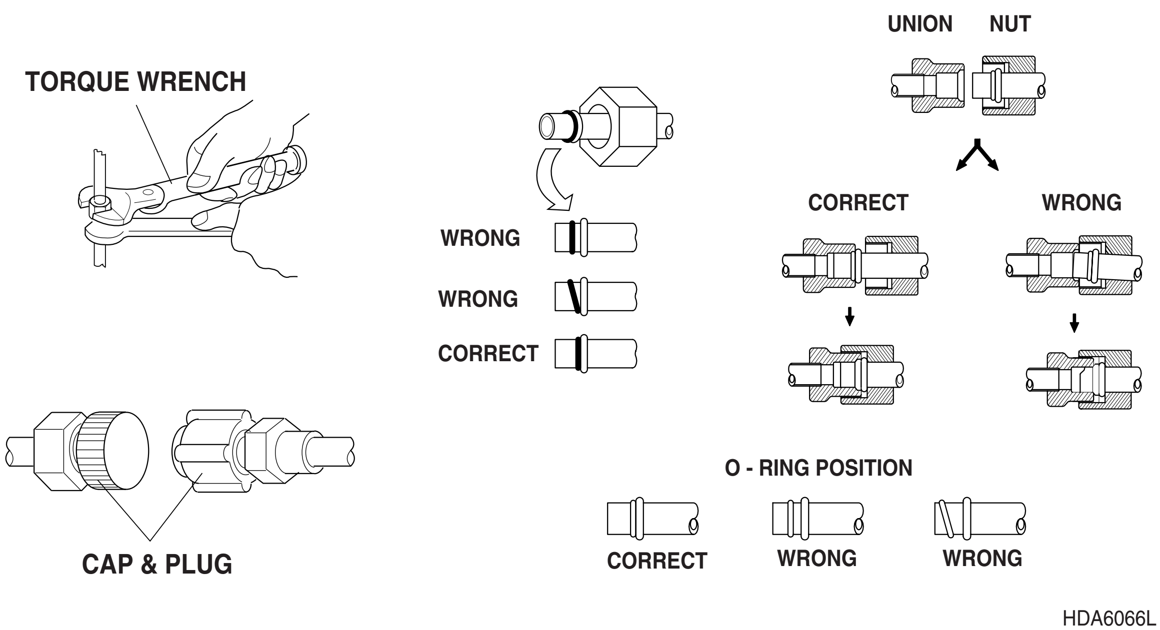


Figure 95

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

1. Use an approved recovery / charging device which can safely perform vacuum and charge work simultaneously.
2. The new refrigerant has improved cooling characteristics than the old type and care should be used not to overcharge the system.

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

Repair and Replacement Procedure

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

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

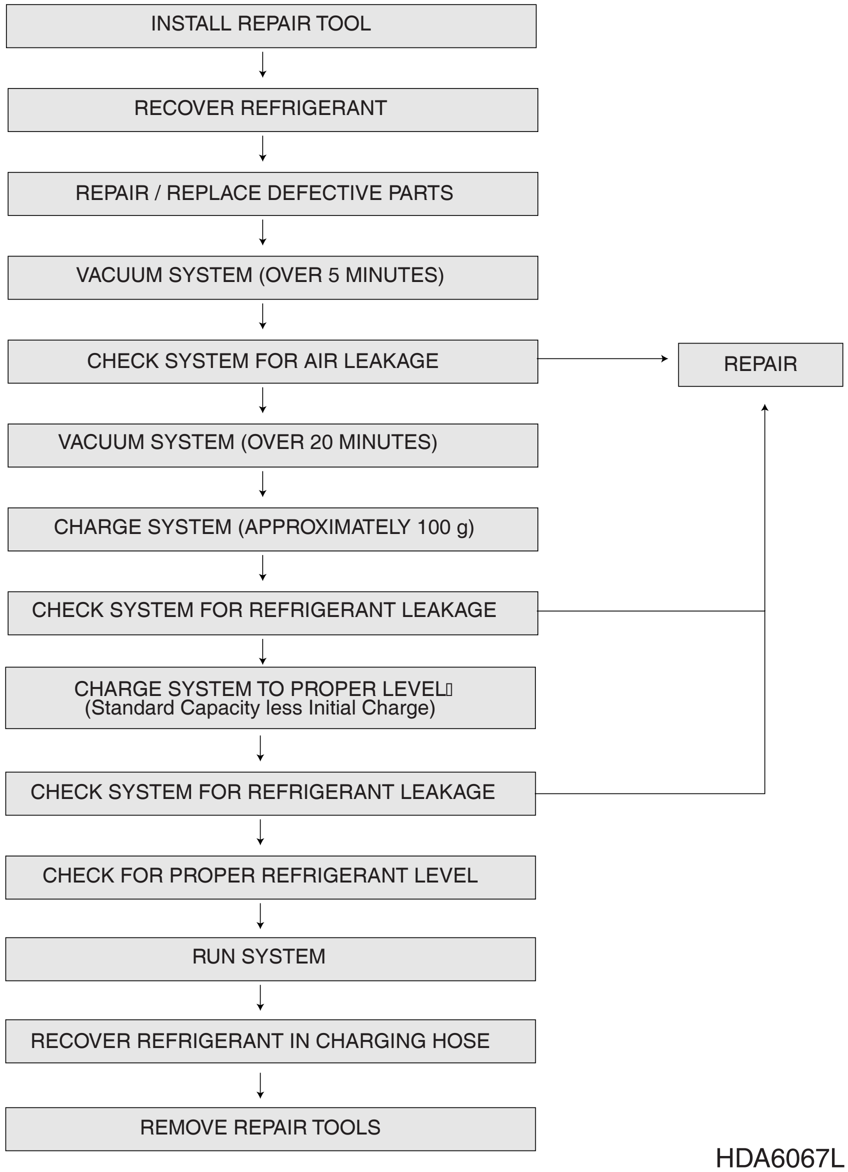

INSTALL REPAIR TOOL
RECOVER REFRIGERANT
REPAIR / REPLACE DEFECTIVE PARTS
VACUUM SYSTEM (OVER 5 MINUTES)
CHECK SYSTEM FOR AIR LEAKAGE
REPAIR
VACUUM SYSTEM (OVER 20 MINUTES)
CHARGE SYSTEM (APPROXIMATELY 100 g)
CHECK SYSTEM FOR REFRIGERANT LEAKAGE
CHARGE SYSTEM TO PROPER LEVEL
(Standard Capacity less Initial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

Figure 96

Refrigerant Recovery

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

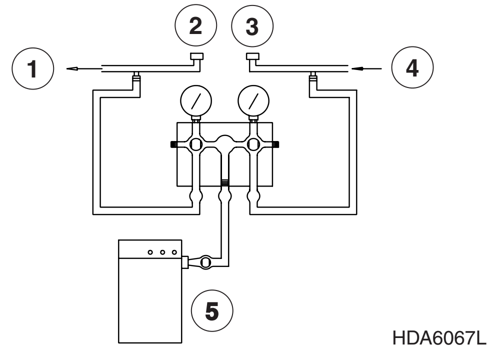


Figure 97

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

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

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

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

3. When the manifold gauge dial falls below 3.5 kg/cm^2 (50 psi), slowly open the low-pressure valve.

4. Open both the high and low-pressure valves slowly until the manifold gauge dials indicates 0 kg/cm^2 (0 psi).

Vacuuming Refrigerant System

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

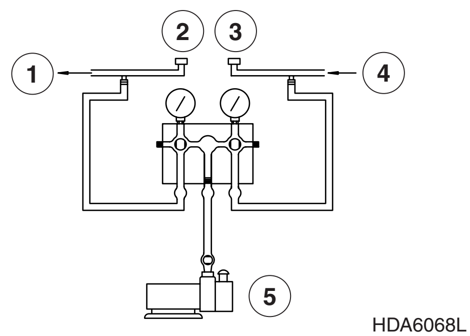


Figure 98

1. Vacuuming Procedure

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

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

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

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

2. Check system for vacuum leak.

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

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.

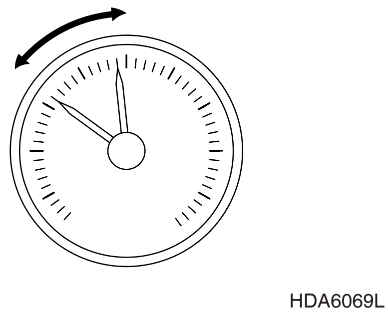


Figure 99

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 counterclockwise 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 disk 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 counterclockwise 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.

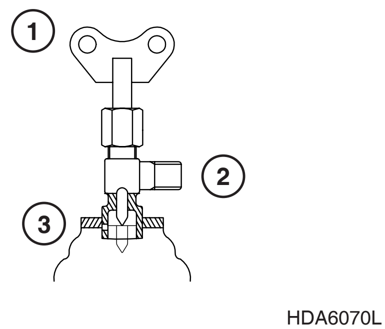


Figure 100

Leakage Check

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

1. After attaching the manifold gauge, open the high side valve.
2. Charge system until the low side gauge dial indicates a pressure of 1 kg/cm^2 (14 psi) and close the high side valve.
3. Using a refrigerant leak detector or soapy water check each joint for leakage.

Reference Number	Description
1	Refrigerant Leak Detection Device

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

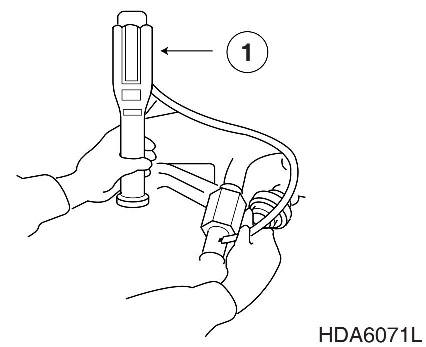


Figure 101

WARNING

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

Refrigerant Charging

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

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

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

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

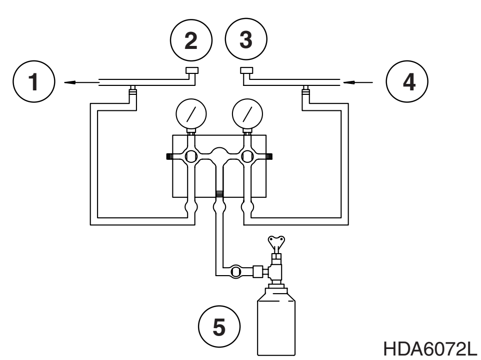


Figure 102

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

   Initial charge amount: 100 g (3.5 ounces).

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

   - Temperature control switch setting: Maximum Cooling

     Blower Speed Setting: Hi (3 step)

     Engine Speed: 1,300 - 1,500 rpm

WARNING

When charging refrigerant system with the engine running:

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

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

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

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

WARNING

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

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

Inspecting System For Leakage

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

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

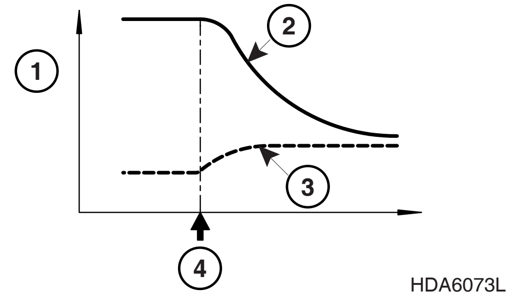


Figure 103

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

Inspection Procedure

1. High-pressure Side

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

2. Low-pressure side

   Compressor inlet → air conditioner unit outlet.

3. Compressor

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

4. Receiver dryer

   Pressure switch and plug area.

5. Connection valve area

   Inspect all valve areas.

   Verify all valves are capped to prevent leaking.

   Check for foreign material inside of valve cap.

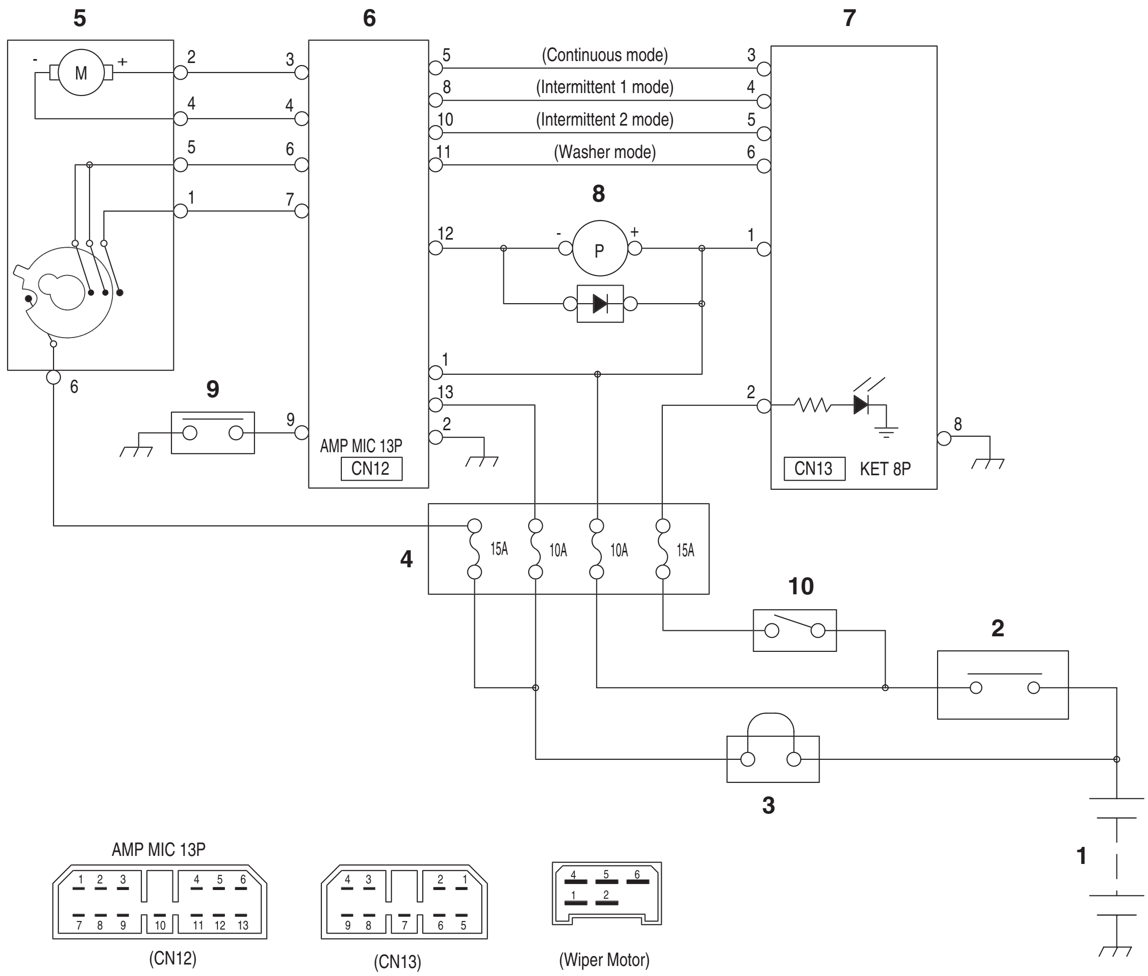
6. Interior of air-conditioning unit.

   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.*

WIPER SYSTEM

Wiper Circuit



FG000589

Figure 104

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Fuse Box
5	Wiper Motor

Reference Number	Description
6	Wiper Controller
7	Wiper Switch Panel
8	Window Washer
9	Wiper Cutoff Switch
10	Light Switch

Wiper operation

Continuous operation

- Operation of wiper motor

Pressing the successive operation switch on the wiper switch panel (7) changes the voltage of the "5" terminal of the wiper controller (6) from HIGH (about 5.5 ± 0.5V) to LOW (0+0.5V) and also current flows via the "3" terminal of the wiper controller (6) → the "2" and "4" terminals of the wiper motor (5) → the "4" terminal of the wiper controller (6) to run the wiper motor (5) continuously.

- Stop of wiper motor

Pressing again the successive operation switch on the wiper switch panel (7) changes the voltage of the "5" terminal of the wiper controller (6) from LOW (0+0.5V) to HIGH (about 5.5 ±0.5V). As the "5" and "6" terminals of the wiper motor are connected still that power is supplied to the "6" terminal of the wiper controller (6),

However, the controller (6) runs the wiper motor continuously and then rotates the motor reversely by " letting current flow via the "4" terminal of the wiper controller (6) → the "2" and "4" terminals of the wiper motor (5) → the "3" terminal of he wiper controller (6) when the "1" and "6" terminals of he wiper motor (5) are connected and thus power voltage is supplied to the "7" terminal of the wiper controller (6).

The Wiper motor (5) stops reverse revolution when the contact of a cam switch connected to the "6" terminal of the wiper motor (5) moves to an insulation area of the cam plate to disconnect the "5" and "6" terminals of the wiper motor (5).

When the wiper motor (5) stops, arm and blade connected to it move to the stop positions of the right pole in the cabin.

Intermittent operation

- Intermittent 1st (3-second)

Pressing once the Intermittent switch in the switch panel (7) changes voltage of the "8" terminal in the wiper controller (6) from HIGH (about 5.5 ±0.5V) to LOW (0+0.5V) and current flows through the "3" terminal in the wiper controller (6) → the "2" and "4" terminals in the wiper motor (5) → the "4" terminal in the wiper controller (6) to start the cycle that wiper stops 3 seconds after every operation.

- Intermittent 2nd (6-second)

Pressing twice the Intermittent switch in the switch panel (7) changes voltage of the "10" terminal in the wiper controller (6) from HIGH (about 5.5 ±0.5V) to LOW (0+0.5V) and current flows through the "3" terminal in the wiper controller (6) → the "2" and "4" terminals in the wiper motor (5) → the "4" terminal in the wiper controller (6) to start the cycle that wiper stops 6 seconds after every operation.

- Stopping the intermittent action

Pressing three times the Intermittent switch in the switch panel (7) while the wiper is operating stops the action of the wiper motor.

NOTE: *The wiper system does not work when the wiper cutoff switch (9) is "ON."*

LIGHTING SYSTEM

Lighting System Circuit Diagram

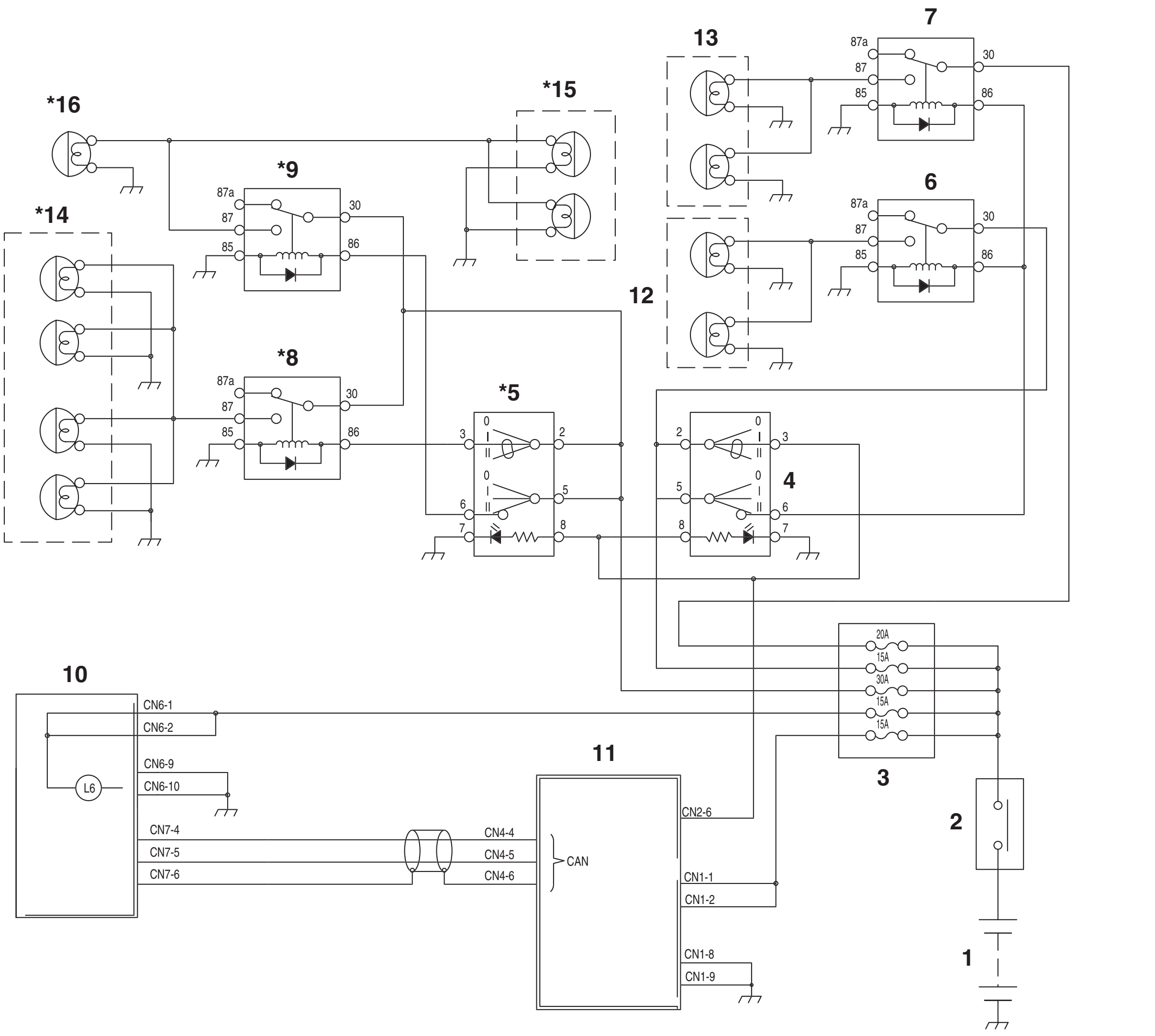


Figure 105

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse Box
4	Light Switch
5	Cabin Light Switch
6	Headlight Relay (Work Light Indicate Light)
7	Work Light Relay
8	Front Cabin Light Relay

Reference Number	Description
9	Front Cabin Light / Rear Work Light Relay
10	Instrument Panel
11	e-EPOS Controller
12	Headlight (2 ea.)
13	Work Light (2 ea.)
14	Front Cabin Light (4 ea.)
15	Rear Cabin Light (2 ea.)
16	Rear Work Light (1 ea.)

NOTE: *The "*" mark are optional parts.*

Kind of Light

The lighting system is consists of headlights, work lights, cabin lights (optional), relays and switches.

Operation

Switch	Position	Connected Terminal of switch	Activated Relay	Lit Light
Light Switch	1	"2-3" Terminal	-	Illumination Light of Switch
	2	"2-3" Terminal	-	Illumination Light of Switch
		"5-6" Terminal	Headlight Relay	Headlight (2 Ea.)
			Work Relay	Work Light (2 Ea.) Symbol Light of Work Light
Cabin Light Switch	1	"2-3" Terminal	Front Cabin Light Relay	Front Cabin Light (2 Ea.) or Front Cabin Light (4 Ea.)
	2	"2-3" Terminal	Front Cabin Light Relay	Front Cabin Light (2 Ea.) or Front Cabin Light (4 Ea.)
		"5-6" Terminal	Rear Cabin Light Relay / Rear Work Light Relay	Rear Cabin Light (2 Ea.) and Rear Work Light (1 Ea.)

OVERLOAD WARNING DEVICE

Overload Warning Device Circuit Diagram

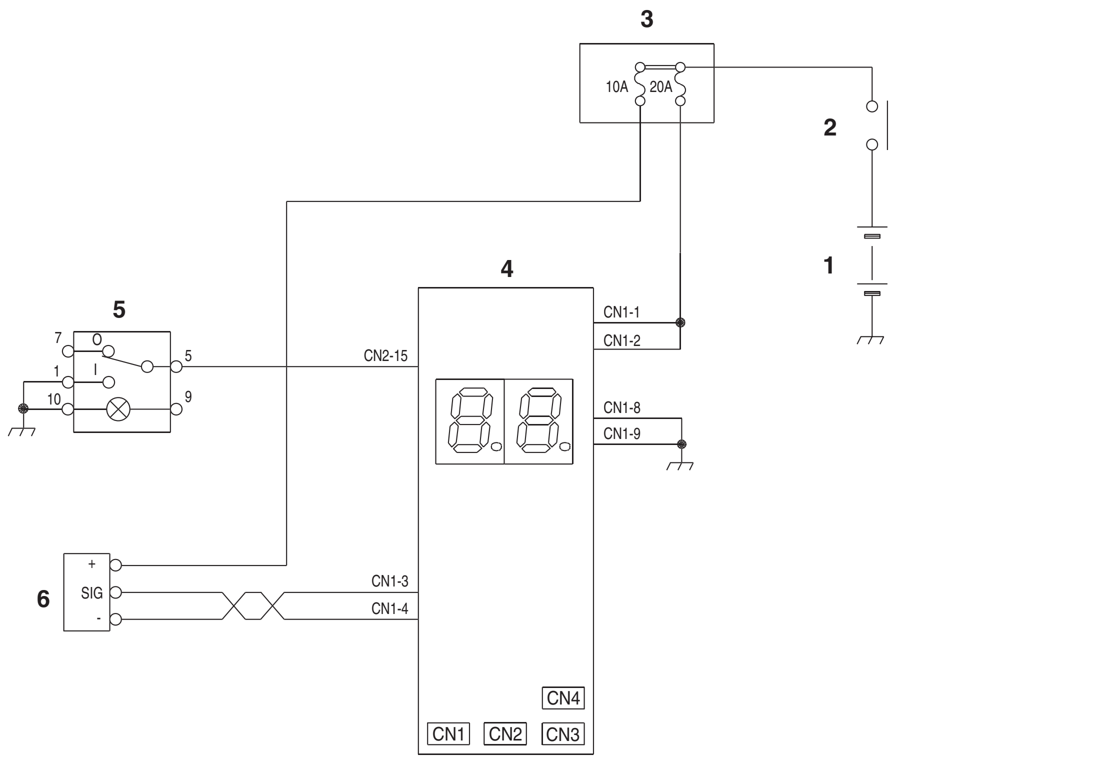


Figure 106

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse Box

Reference Number	Description
4	e-EPOS Controller
5	OWD Selector Switch
6	Pressure Sensor

AUDIO CONTROLLER

Audio Controller Circuit Diagram

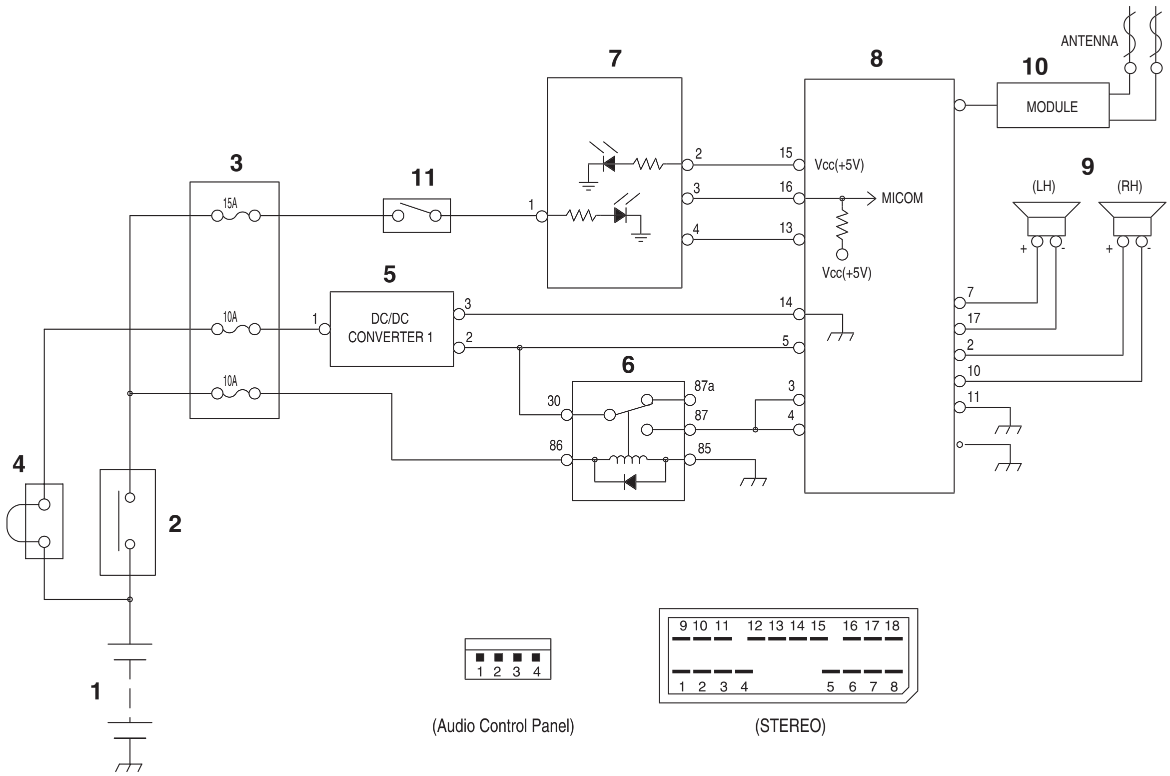


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Figure 107

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse Box
4	Fusible Link
5	Converter
6	Stereo Relay

Reference Number	Description
7	Audio Control Panel
8	Stereo
9	Speaker
10	Antenna Module
11	Light Switch

Operations Via Audio Control Panel

Switch	Connected Terminal of switch	Measured values	Operations
PWR	"3-4"	4.36 ± 0.2V	Stereo ON, OFF
▲		1.24 ± 0.2V	Volume up
▼		0 + 0.2V	Volume down
SCAN		2.49 ± 0.2V	Frequency selection

Electrical Schematic DX300LCA

Edition 1

MEMO

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Electrical Schematic DX300LCA

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SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LCA	5001 and Up

DX300LCA

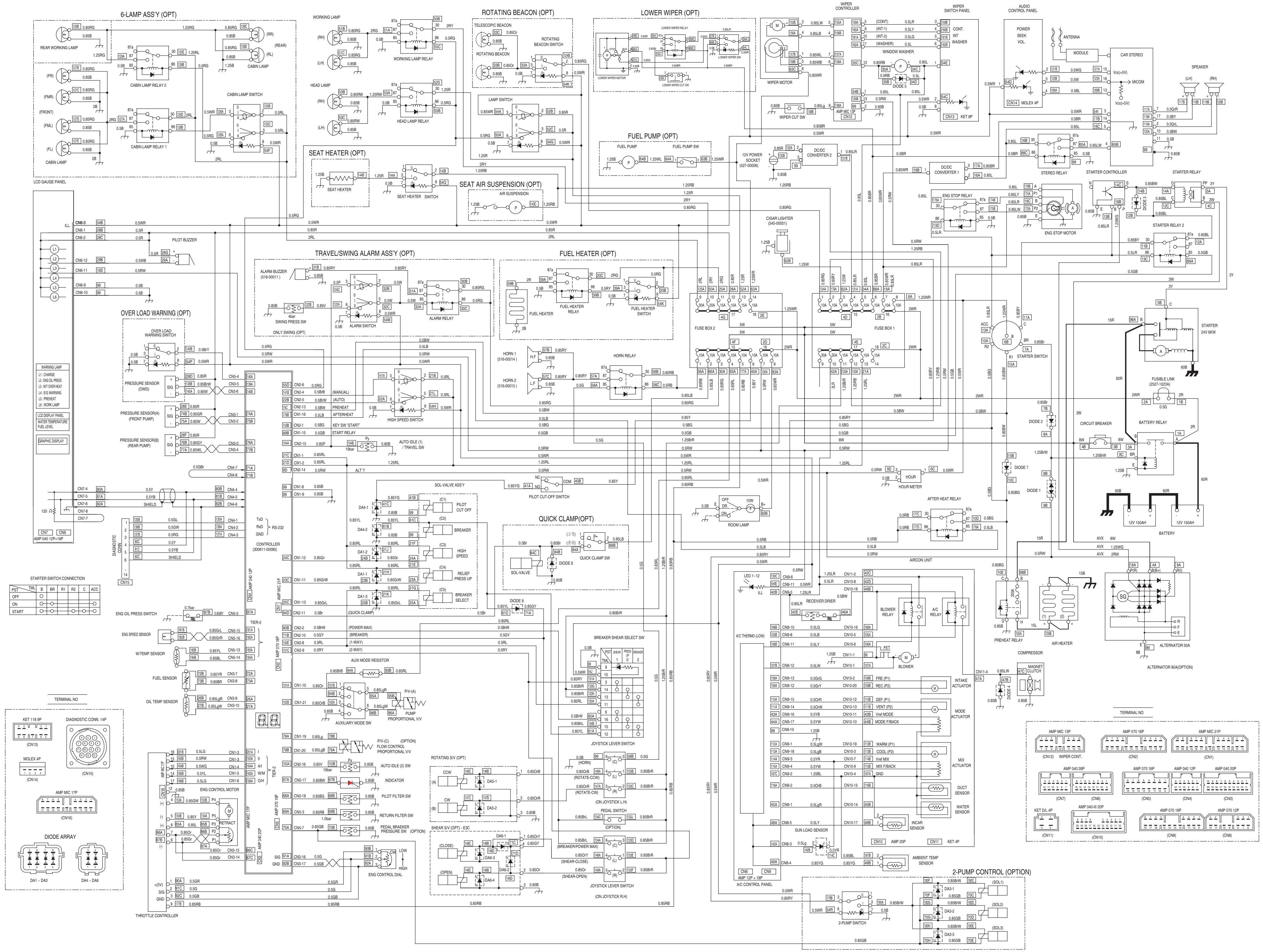

Figure 1

Attachments

Boom and Arm

Edition 1

MEMO

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Boom and Arm

MEMO

SAFETY PRECAUTIONS

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 are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up
DX480LC	5221 and Up
DX520LC	5117 and Up

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 DOOSAN After Sales Service for information on wear tolerances and replacement limits for mounting pins.*

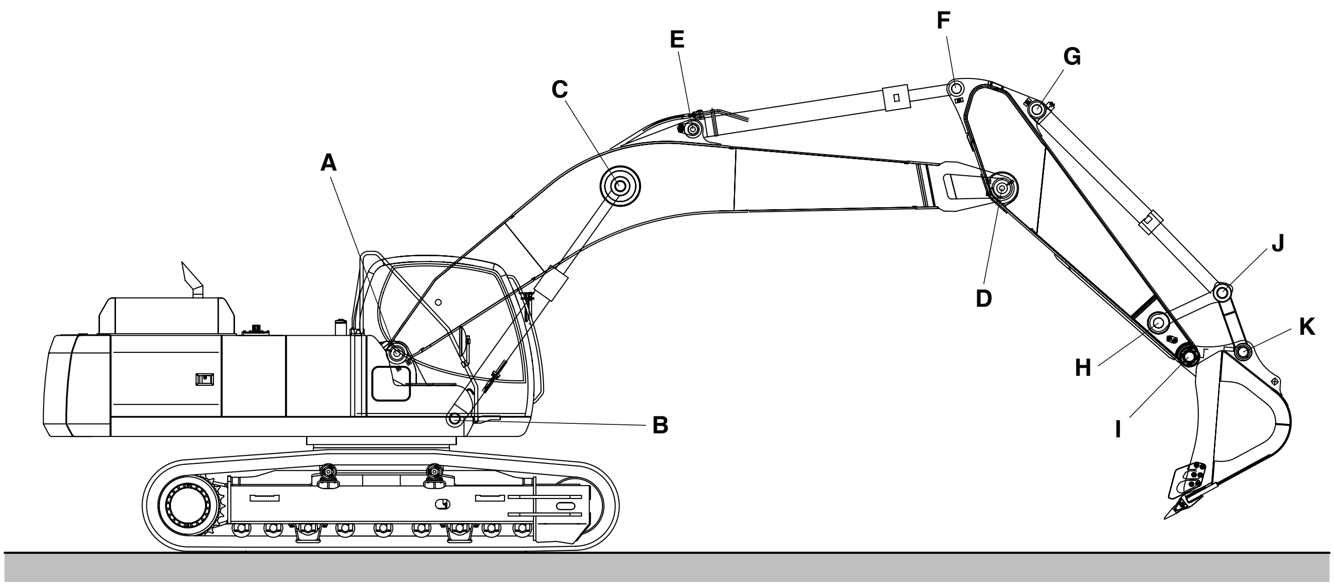

Figure 1

Mark	Measuring Part	Criteria					Remedy
		Standard Size	Tolerance		Standard Clearance	Clearance Limit	
			Pin	Hole			
A	Boom Foot	105 mm (4.134")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	Replace
B	Boom Cylinder Head	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
C	Boom Center	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
D	Boom End	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
E	Arm Cylinder Head	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
F	Arm Cylinder Rod	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
G	Bucket Cylinder Head	80 mm (3.150")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
H	Arm Link	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 ~ 0.29	2.0	
I	Arm End	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
J	Bucket Cylinder Rod	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
K	Push Link to Bucket	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	

Mark	Measuring Part	Criteria					Remedy
		Standard Size	Tolerance		Standard Clearance	Clearance Limit	
			Pin	Hole			
A	Boom Foot	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	Replace
B	Boom Cylinder Head	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
C	Boom Center	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
D	Boom End	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
E	Arm Cylinder Head	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
F	Arm Cylinder Rod	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
G	Bucket Cylinder Head	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
H	Arm Link	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
I	Arm End	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
J	Bucket Cylinder Rod	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
K	Push Link to Bucket	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	

Mark	Measuring Part	Criteria					Remedy
		Standard Size	Tolerance		Standard Clearance	Clearance Limit	
			Pin	Hole			
A	Boom Foot	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	Replace
B	Boom Cylinder Head	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
C	Boom Center	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
D	Boom End	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
E	Arm Cylinder Head	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
F	Arm Cylinder Rod	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
G	Bucket Cylinder Head	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
H	Arm Link	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
I	Arm End	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
J	Bucket Cylinder Rod	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
K	Push Link to Bucket	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	

Mark	Measuring Part	Criteria					Remedy
		Standard Size	Tolerance		Standard Clearance	Clearance Limit	
			Pin	Hole			
A	Boom Foot	125 mm (4.921")	-0.05 -0.10	+0.18 +0.03	0.08 ~ 0.28	1.5	Replace
B	Boom Cylinder Head	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
C	Boom Center	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
D	Boom End	125 mm (4.921")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
E	Arm Cylinder Head	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
F	Arm Cylinder Rod	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	
G	Bucket Cylinder Head	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
H	Arm Link	100 mm (3.937")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
I	Arm End	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
J	Bucket Cylinder Rod	110 mm (4.331")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	2.0	
K	Push Link to Bucket	120 mm (4.724")	-0.10 -0.15	+0.18 +0.03	0.13 ~ 0.33	1.5	

FRONT ATTACHMENT - REMOVAL AND INSTALLATION

DANGER

DOOSAN **warns any user, that the removal of the counterweight from the machine, front attachment or any other part, may affect the stability of the machine. This could cause unexpected movement, resulting in death or serious injuries.** ***DOOSAN*** **is not liable for any misuse.**

Never remove the counterweight or front attachment unless the upper structure is in-line with the lower structure.

Never rotate the upper structure once the counterweight or front attachment has been removed.

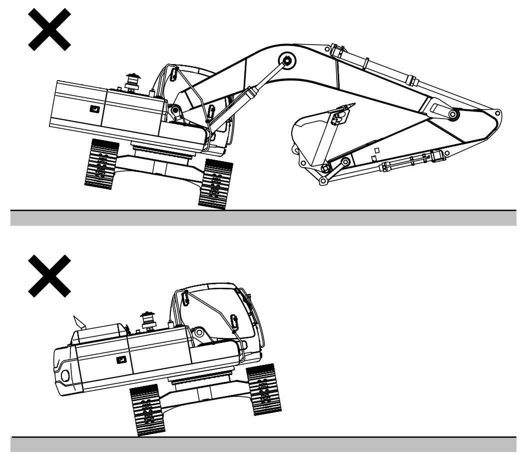

Figure 2

IMPORTANT

Always break down the front attachment by removing outermost sections first - the bucket before the arm, the arm before the boom. Reinstallation of the attachment should begin with the boom and end with the bucket.

Refer to the appropriate Bucket section for its removal and installation procedure before going onto the initial step of the front attachment removal or installation procedure.

Arm Removal Procedure

WARNING

This procedure is only intended for routine removal or replacement of the attachment, while working under normal, safe operating conditions. In the event of a major structural collapse of some part of the attachment, an accident or complete loss of attachment hydraulic function, DO NOT proceed with attachment disassembly unless you are completely sure of what you are doing. Please call your local ***DOOSAN*** **distributor or** ***DOOSAN*** **After Sales Service for assistance. DO NOT allow personnel to stand underneath a weakened or only partially supported attachment section. Keep clear of hydraulic lines that may have fluid escaping at high-pressure - it can cause severe or even fatal injuries.**

Complete the bucket end removal procedure by pulling out the two bucket linkage pins and the bucket cylinder mounting pin, on the arm. Use an assist crane or hoist to lift the cylinder and relieve weight on mounting pins.

Park the excavator away from obstructions and all traffic on clear, flat, level ground. Extend the arm cylinder and crowd the arm into the boom. Partially retract the boom cylinder so that the boom is stretched out in front of the excavator, as low to the ground as possible, with the arm crowded under the boom.

The tip of the arm point should be lowered to secure blocking that will safely support the weight of the arm. Place the blocking directly in front of the excavator and make sure that it will not be unbalanced with an initial weight load that is all to one end, under the arm point.

Shut off the engine and release hydraulic system pressure - move any of the control levers with the engine off to release pressure built up in the accumulator. Manually vent residual hydraulic pressure in the tank by moving the lever near the cap, on top of the reservoir.

WARNING

Secure the swing lock and tag and lock out controls in the operator's cabin to keep anyone from moving or inadvertently starting the engine. Restrict access to the work site while sections of the attachment are in the air, or while they are being supported by the assist crane. The safe lifting capacity of the assist crane or hoist that is used must exceed the weight of the heaviest section of the attachment, the boom (approximately 2,000 kg [4,400 lb], not including the weight of accessories or fixtures).

Before beginning the disassembly of attachment mounting pins, disconnect the arm cylinder hydraulic hose couplings and put a clean plug in the end of each one. Use any and all reasonable precautions necessary to avoid introducing dirt or other contaminants into the hydraulic system. Wipe down coupling points before disconnecting hydraulic lines and use evaporative type solvent spray cleaner. Tag and mark hoses for reassembly, if necessary.

Place a sling under the arm cylinder (the cylinder used to extend and retract the attachment arm, pinned to the top of the boom). Lift the sling so that the weight load on the rod end of the arm cylinder (pinned to the ears on the inner end of the arm) is released. Prepare blocking under the arm that will securely support the weight of the arm and arm cylinder.

CAUTION

To make sure that the polished surfaces of cylinder rod ends will not suffer accidental damage during disassembly or removal procedures, wrap exposed rod surfaces (especially those of boom cylinders) with a protective covering material. Immediately following disassembly and removal, cylinder rods should always be fully retracted. This eases handling problems and also avoids possible damage.

Remove retainers on the end of the mounting pin for the arm cylinder rod end. Use the assist crane to relieve the weight load and withdraw the pin. Lower the arm down to the blocking support for any continued disassembly procedures.

Boom Removal Procedure

NOTE: *Boom removal may be simplified if the shell of the operator's cabin is taken off the turntable deck first. Refer to the Operator's Cabin Removal procedure before continuing, if both components are to be removed from the excavator.*

After the bucket, arm and arm cylinder have been removed, lower the end of the boom to a stable, secure blocking support.

Attach the assist crane sling to the body of either boom cylinder, break the mounting pin connection to the boom by tapping through the pin from the same side of the boom and repeat for the opposite cylinder.

Release hydraulic pressure and disconnect line couplings as previously outlined in the Arm Removal Procedure, observing the same precautions.

Disconnect wiring for work light assemblies and any other accessory lines or connections. Locate the sling of the assist crane near the center of gravity, optimum lift point for the boom, and use the crane to take pressure off the boom foot pin. Drive out the pin after disassembling retainers and carefully lift away the boom.

WARNING

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

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

INSTALLATION

Arm Installation Procedure

Reattach 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 *DOOSAN* 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. Pregrease 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.

SP001852

Bucket

Edition 1

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Bucket

MEMO

SAFETY PRECAUTIONS

CAUTION

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Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX300LC	7440 and Up
DX300LCA	5001 and Up
DX340LC	5980 and Up
DX350LC	5980 and Up
DX420LC	5327 and Up

BUCKET TOOTH INSPECTION AND REPLACEMENT

There are several different types of attachment methods for replaceable bucket teeth. Some of the most common types are shown in the following drawings.

Bucket teeth are usually replaced in sets but it may sometimes be necessary to replace individual teeth.

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.

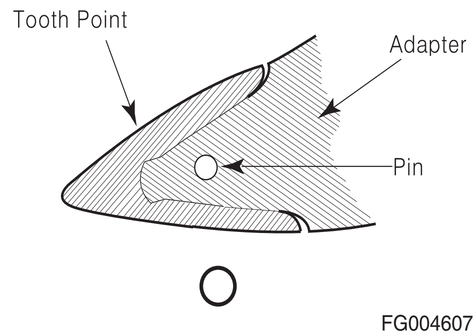

Figure 1

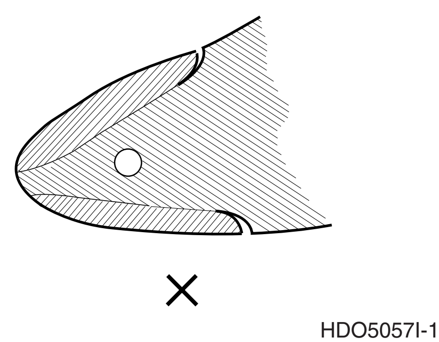

Figure 2

1. On a routine basis, inspect the bucket teeth to make sure that tooth wear or breakage has not developed. Do not allow the replaceable bucket teeth to wear down to the point that the bucket adapter is exposed. See Figure 1.
2. To replace a tooth (1, Figure 3), use a hammer and punch to drive the locking pin (2) and lock washer (3) out of the tooth adapter (4).
3. Once the worn tooth has been removed, use a putty knife to scrape the adapter as clean as possible.
4. Slide the new tooth into position and insert the lock washer.
5. Insert the locking pin into the tooth and with a hammer, drive the pin in until the lock washer seats in the locking groove.

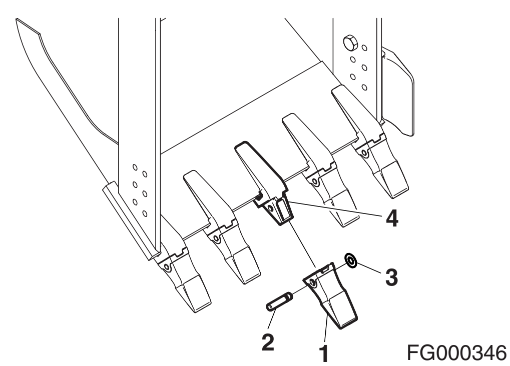

Figure 3

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.

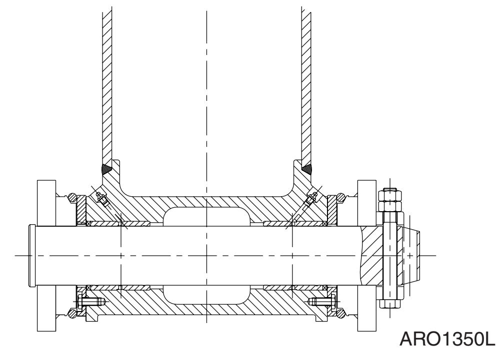

Figure 4

2. Roll the old O-ring (1, Figure 5) 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.

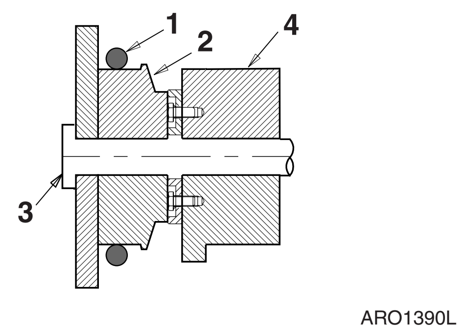

Figure 5

3. Remove the old O-ring and temporarily install the new O-ring (1, Figure 6) 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 5).

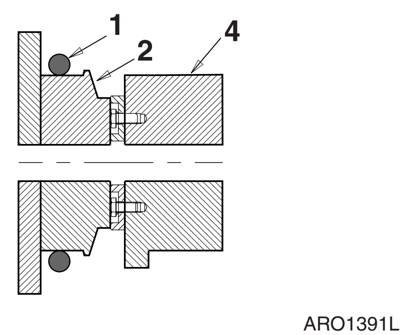

Figure 6

5. Roll the new O-ring (1, Figure 7) into the O-ring groove.

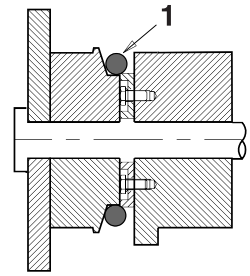

Figure 7

BUCKET SHIMMING PROCEDURES

New Bucket Installation

WARNING

When performing this adjustment, put the hydraulic cativation control lever in the LOCKED position and stop the engine.
Improperly adjusted clearance could cause galing on the contact surfaces of the bucket and arm, resulting in excessive noise and damaged O-ring.

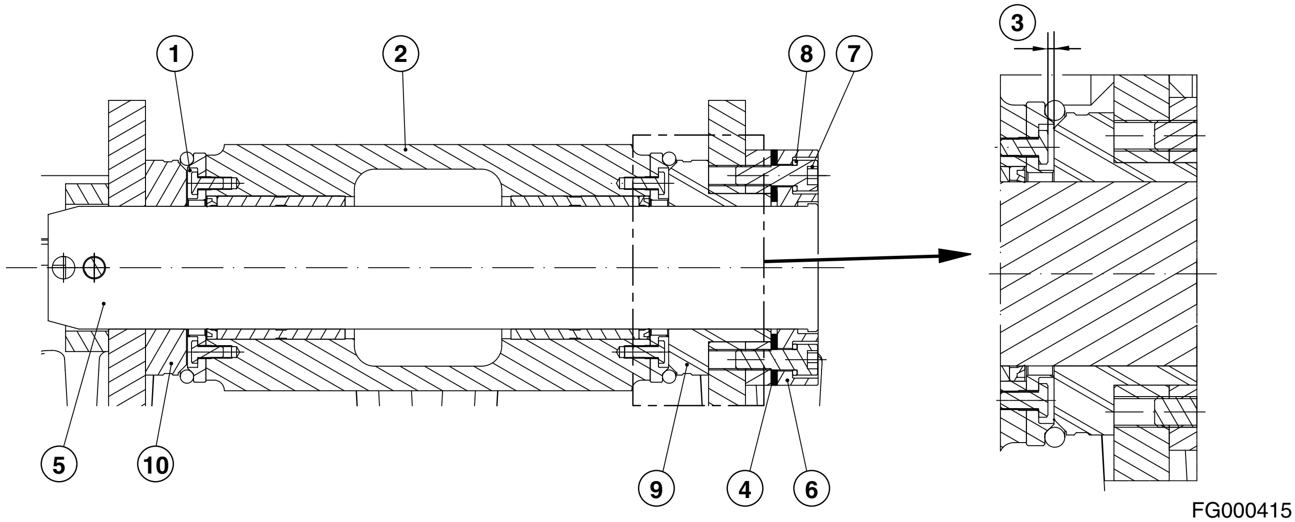

Figure 8

Reference Number	Description
1	No Gap
2	Arm Boss
3	Bucket Clearance
4	Shim
5	Pin

Reference Number	Description
6	Stopper
7	Bolt
8	Hard Washer
9	Flange
10	Bucket Boss

Shimming Procedures for Installed Bucket

The clearance of the bucket linkage on this machine can be adjusted by shimming. If the gap between the bucket and the arm becomes excessive, adjust bucket clearance to 1.0 mm.

The thickness of the shims are 1.0 mm (0.04 inch)

1. Position the machine on a level surface and lower the bucket to the ground.
2. Slowly operate the swing control lever until arm boss (2) and the bucket boss (10) are in full face contact at no gap (1).
3. Place the hydraulic activation control lever in the LOCKED position and stop the engine.
4. Measure bucket clearance (3), determine the number of shim that need to be removed from shims (4) by using the following calculation;
   Subtract 1mm from bucket clearance (3).
5. Remove the appropriate number of shim at location (9) in order to meet the above thickness. To remove the shim, detach stopper (6) and bolts (7) from bucket.
6. After correcting the number of shim, install stopper (6) and tighten bolts (7).

   NOTE: *Bolt torque: 27 kg•m (195 ft lb)*

7. After installation, make sure that bucket clearance (3) is still correct.

BUCKET ATTACHMENT, REMOVAL AND REVERSAL

Detaching the Bucket

Park the excavator away from obstructions on clear, flat, level ground. Lower the bucket carefully to preassembled 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. Prelube 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.

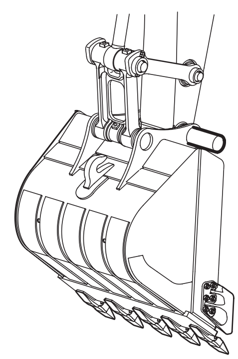

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Figure 9

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.

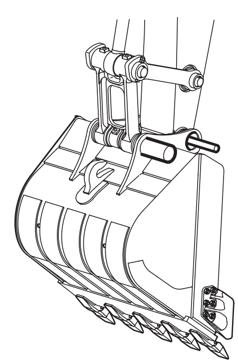

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Figure 10

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.