950106-00364E
March 2012

EXCAVATOR

Shop Manual

DX225LC-3

Serial Number 1001 and Up

Serial Number 50001 and Up (Europe Only)

Doosan Infracore
Construction Equipment

WARNING

CALIFORNIA PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.

WARNING

CALIFORNIA PROPOSITION 65 WARNING

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. WASH HANDS AFTER HANDLING.

05-2010

Shop Manual
DX225LC-3 EXCAVATOR

Serial Number 1001 and Up

Serial Number 50001 and Up (Europe Only)

DOOSAN and the DOOSAN logo are registered trademarks of DOOSAN Corporation in the United States and various other countries around the world.

950106-00364E

March 2012

Copyright DOOSAN 2012

Product Label

Instructions

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

Pub. No. 950106-00364E

DX225LC-3
Serial Number 1001 and Up
Serial Number 50001 and Up (Europe Only)
Pub.No. 950106-00364E



Table of Contents

Safety

Track Excavator Maintenance Safety SP002322

Specifications

Specifications for DX225LC-3 ..... SP002491

General Maintenance

General Maintenance Instructions SP002454
Standard Torques SP002404

Upper Structure

Cabin SP002324
Counterweight SP002492
Fuel Tank SP002493
Fuel Transfer Pump (Option) SP002534
Swing Bearing SP002329

Lower Structure and Chassis

Track Assembly SP002494

Engine and Drivetrain

Engine Coolant Heater (Option) SP002328
Drive Coupling (Main Pump) SP002495

Hydraulics

Hydraulic System Troubleshooting, Testing and Adjustment SP002535
Accumulator SP002455
Center Joint (Swivel) SP002456
Cylinders SP002497

Swing Device SP002498
Travel Device SP002499
Main Pump SP002502
PTO Server SP002503
Gear Pump SP002500
Main Control Valve SP002403
Remote Control Valve (Work Lever / Joystick) SP002395
Travel Control Valve (with Damper) SP002381
Solenoid Valve Assembly SP002406
Breaker EPPR Valve (Option) SP002458
Dozer Valve SP002529
Hydraulic Schematic (DX225LC-3) SP002507

Electrical System

Electrical System SP002337
Electrical Schematic SP002508

Attachments

Boom and Arm SP002505
Bucket SP002506

Safety

Track Excavator Maintenance Safety

Edition 2

Table of Contents

Track Excavator Maintenance Safety

Safety Instructions 5
Applicable Models 5
Safety Messages 6
Safety Decals 7
General 7
Transportation 20
Operation 22
Maintenance 39
Environment and Circumstances 56

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 and Up

SAFETY MESSAGES

Safety messages and safety decals included in this manual and on the machine provide instructions how to operate, service and maintain the machine. Safety messages and safety decals indicate potential hazards and describe safety precautions required to avoid hazards. Operator and maintenance personnel should read and understand these safety messages and decals before beginning operation or maintenance.

SAFETY ALERT SYMBOL

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

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

Signal Words

The signal words "DANGER", "WARNING", "CAUTION" are used throughout safety messages and safety decals in this manual or on the machine. They indicate an existence of, and the relative seriousness of, a hazard. All three indicate that a safety risk is involved. Observe the precautions indicated whenever a Safety Alert Symbol is present, no matter which signal word appears next to it.

DANGER

DANGER - This signal word is used on safety messages and safety labels and indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING - This signal word is used on safety messages and safety labels and indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION - This signal word is used on safety messages and safety labels and indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

SAFETY DECALS

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.

GENERAL

Safe Operation is Operator's Responsibility

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

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

- Do not operate machine if you are under the influence of drugs or alcohol. An operator who is taking prescription drugs must get medical advice to determine if he or she can safely operate a machine.
- When working with other personnel on a worksite, be sure that all personnel know nature of work and understand all hand signals that are to be used.
- Be sure that all guards and shields are installed in their proper location. Have guards and shields repaired or replaced immediately if damaged.
- Be sure that you understand the use and maintenance of all safety features such as safety lock lever and seat belt. Use them properly.
- Never remove, modify or disable any safety features. Always keep them in good operating condition.
- Always check for and know the location of underground and overhead utility lines before excavating.
- Failure to use and maintain safety features according to instructions in this manual, Safety Manual and Shop Manual can result in death or serious injury.

Know Your Machine

Know how to operate your machine. Know the purpose of all controls, gauges, signals, indicators and monitor displays. Know the rated load capacity, speed range, braking and steering characteristics, turning radius and operating clearances. Keep in mind that rain, snow, ice, loose gravel, soft ground, slopes etc., can change operating capabilities of your machine.

Proper Work Tools and Attachments

Only use work tools and attachments that are recommended by DOOSAN for use on DOOSAN machines. When installing and using optional attachments, read instruction manual for attachment, and general information related to attachments in this manual. Because DOOSAN cannot anticipate, identify or test all attachments that owners may want to install on their machines, contact DOOSAN for written authorization and approval of attachments, and their compatibility with optional kits.

Attachments and attachment control systems that are compatible with the machine are required for safe and reliable machine operation. Do not exceed maximum operating weight (machine weight plus attachment) that is listed on ROPS certification plate.

Make sure that all guards and shields are in place on machine and on work tool. Depending on type or combination of work equipment, there is a potential that work equipment could interfere with the cabin or other parts of machine. Before using unfamiliar work equipment, check if there is any potential of interference, and operate with caution.

While you are performing any maintenance, testing, or adjustments to attachments, stay clear of the following areas: cutting edges, pinch points, and crushing surfaces.

Never use attachment as a work platform or manlift.

Contact your DOOSAN distributor about auxiliary hydraulic kits for attachments installation. If you are in doubt about compatibility of a particular attachment with a machine, consult your DOOSAN distributor.

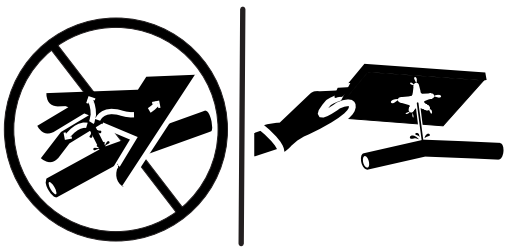
Pressurized Fluids

Pressurized air or fluids can cause debris and/or fluids to be blown out. This could result in death or serious injury.

Immediately after operations are stopped, coolant, engine oil, and hydraulic oil are at their highest temperatures and the radiator and hydraulic tank are still under pressure. Always wait for temperature to cool down. Follow specified procedures when attempting to remove caps, drain oil or coolant, or replacing filters. Always wait for temperature to cool down, and follow specified procedures when performing these operations. Failure to do so can result in death or serious injury.

When pressurized air and/or pressurized water is used for cleaning, wear protective clothing, protective shoes, and eye protection. Eye protection includes goggles or a protective face shield.

Pressure can be trapped in a hydraulic system and should be relieved before maintenance is started.



FG018457

Figure 1

Releasing trapped pressure can cause sudden machine movement or attachment movement. Use caution if you disconnect hydraulic lines or fittings.

High-pressure oil that is released can cause a hose to whip or oil to spray. Fluid penetration can result in death or serious injury. If fluid enters skin or eyes, get immediate medical attention from a physician familiar with this injury.

Obey all local laws and regulations for disposal of liquids.

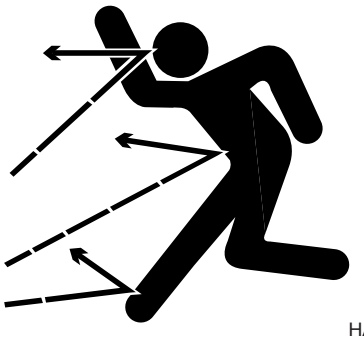
To prevent hot coolant from spraying out, stop engine and wait for coolant to cool. Using gloves, slowly loosen cap to relieve pressure.

Flying or Falling Objects

On work sites where there is a potential hazard that flying or falling objects can hit operator's cabin, select and use a guard to match operating conditions for additional operator protection.

Working in mines, tunnels, deep pits, and loose or wet surfaces, could produce hazard of falling rocks or flying objects. Additional protection for operator's cabin could be required such as an Operator Protection Guard (OPG) or window guards. Contact your DOOSAN distributor for information on available protective guards.

To prevent personnel from being struck by flying objects, keep personnel out of work area.



HAOA110L

Figure 2



HAOA100L

Figure 3

Personal Protective Equipment (PPE)

Do not wear loose clothing and accessories. Secure long hair. These items can snag on controls or on other parts of equipment.

Do not wear oily clothes. They are highly flammable.

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. Breathing masks and/or ear protection may be required.

Wear a hard hat, safety shoes, safety goggles, mask, leather gloves, earplugs and other protective equipment, as required.

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



HAOA020L

Figure 4

Correction of Machine Problems

If any machine problems are found during operation and maintenance (noise, vibration, smell, incorrect gauges, smoke, oil leakage, etc.), or if any abnormal warming alerts are displayed on display monitor, stop the machine and take the necessary corrective actions. Do not operate machine until problem has been corrected.

Crushing and Cutting

Keep objects away from moving fan blades. Fan blades can throw and cut objects.

Do not use a wire rope that is kinked or frayed, or a wire rope with any loss of diameter. Wear leather gloves when handling a wire rope.

When striking a loose retainer pin, it can fly out and can cause a serious injury. Make sure that area is clear of personnel when striking a retainer pin. To avoid injury to your eyes, wear safety goggles when striking a retainer pin.

Do not put your hand, arm or any other part of your body between movable parts. If going between movable parts is necessary, always position and secure work equipment so it cannot move. Properly support equipment before performing any work or maintenance under raised equipment.

If control levers are operated, clearance between machine and work equipment will change and this may lead to serious damage or can result in death or serious injury. Stay clear of areas that may have a sudden change in clearance with machine movement or equipment movement. Stay clear of all rotating and moving parts. Unless instructed, never attempt adjustments while machine is moving or while engine is running.

Do not depend on hydraulic cylinders to support raised equipment. Equipment can fall if a control is moved, or if a hydraulic line breaks or is loosened or disconnected.

If it is necessary to remove guards to perform maintenance, always install guards after maintenance is completed.



HDO1010L

Figure 5

Hot Coolant and Oils - Burn Prevention

Do not touch any part of an operating engine. Immediately after operations are stopped, coolant, engine oil, and hydraulic oil are at their highest temperatures. The radiator and hydraulic tank are still under pressure. Always wait for temperature to cool down. Attempting to remove caps, drain oil or coolant, or replacing filters may lead to serious burns, if done when hot. Relieve all pressure in air system, hydraulic oil system, lubrication system, fuel system, and cooling system, before any lines, fittings or related items are disconnected.



FG019095

Figure 6

To prevent hot oil or coolant from spraying out, stop engine, wait for oil and coolant to cool. Using gloves, slowly loosen cap to relieve pressure.



FG019096

Figure 7

Fire and Explosion Prevention

All fuels, most lubricants and some coolant mixtures are flammable and can cause a fire resulting in death or serious injury, and property damage. Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause fire.

Inspect for and remove all flammable materials such as spilled fuel and oil, and debris from machine. Do not allow any flammable materials to accumulate on machine.

Always observe the following:



HDO1015I

Figure 8

- Add fuel, oil, antifreeze and hydraulic fluid to machine only in a well ventilated area. Machine must be parked with controls, lights and switches turned "OFF". Engine must be "OFF" and any flames, glowing embers, auxiliary heating units or spark causing equipment must be extinguished, or turned "OFF" and kept well clear of machine.
- Dust that is generated from repairing or grinding nonmetallic hoods or nonmetallic fenders can be toxic, flammable and explosive. Repair these components in a well ventilated area away from flames or sparks and wear dust mask when grinding painted parts.



FG018458

Figure 9

Maintenance

The machine and some attachments have components that are at high temperatures under normal operating conditions. The primary source of high temperatures are the engine and exhaust system. If damaged or incorrectly maintained, the electrical system can be a source of arcs or sparks.

Flammable debris (leaves, straw, etc.) must be removed regularly. If flammable debris is allowed to accumulate, it can cause a fire hazard. Clean machine often to avoid this accumulation. Flammable debris in an engine compartment is a potential fire hazard.

The operator's area, engine compartment and engine cooling system should be inspected every day and cleaned. This is necessary to prevent fire hazards and overheating.

Operation

Do not use machine where exhaust, arcs, sparks or hot components can contact flammable material, explosive dust or gases.

Do not operate machine near any flame.

Exhaust shields (if equipped) protect hot exhaust components from oil spray or fuel spray in case of a break in a line, hose, or seal. Exhaust shields must be correctly installed.

Electrical

Check all electrical wiring and connections for damage daily.

Keep battery terminals clean and tight. Repair or replace any damaged part or wires that are loose or frayed. Clean all electrical connections and tighten all electrical connections.

Never check battery charge by placing a metal object across terminal posts. Use a voltmeter or a hydrometer.

Battery gas can explode and can result in death or serious injury. Follow procedures in this manual for connecting battery and for jump-starting. Do not jump-start or charge a frozen or damaged battery. Keep any flames or sparks away from batteries. Do not smoke in battery charging area.

Improper jumper cable connections can cause an explosion that can result in death or serious injury. Refer to Operation and Maintenance Manual, for proper procedure in this manual.

Do not charge a frozen battery. This can cause an explosion.

After market radios or other electric operated equipment in cabin must have a fuse in the electrical circuit.

Hydraulic System

Check hydraulic tubes, hoses and fittings for damage, wear or for leaks. Hydraulic lines and hoses must be properly routed and have adequate support and secure clamps. Leaks can cause fires. Never use a flame or bare skin to check for leaks.

Tighten or replace any parts that show leakage.

Check that all hose and tube clamps, guards, and cushions are securely attached. If they are loose, they can vibrate during operation and rub against other parts. This can cause damage to hoses and cause high-pressure oil to spray on hot surfaces, causing a fire and death or serious injury.

Always clean fluid spills. Do not use gasoline or diesel fuel for cleaning parts. Use commercial nonflammable solvents.

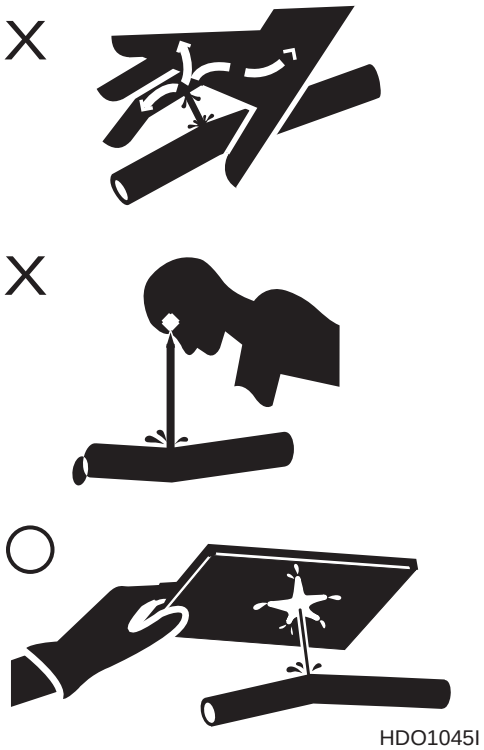


Figure 10

Fueling

Use caution when you are refueling a machine.

Fuel is flammable and can catch fire if it is brought close to a flame.

Stop engine and let it cool before adding fuel. Do not smoke while you are refueling a machine. Do not refuel a machine near flames or sparks. Fill fuel tank outdoors.

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

Store fuels and lubricants in properly marked containers away from unauthorized personnel. Store oily rags and any flammable materials in protective containers.

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

Always place plastic fuel containers on the ground before filling.



ARO1050S

Figure 11

Never Use Ether Starting Aids

Do not use ether or starting fluids on any engine that has glow plugs, or an electric grid type manifold heater. These starting aids can cause an explosion and result in death or serious injury.

Use procedures in this manual for connecting battery and for jump-starting.



FG018458

Figure 12

Welding and Grinding

Always clean machine and attachment, set battery disconnect switch to "OFF" position, and disconnect wiring from electronic controllers before welding. Cover rubber hoses, battery and all other flammable parts. Keep a fire extinguisher near machine when welding.

Toxic dust or gas can be produced when grinding or welding painted parts. Grinding or welding painted parts should be done in a well ventilated area. Wear dust mask when grinding painted parts.

Dust generated from repairing nonmetallic parts such as hoods, fenders or covers can be flammable or explosive.

Repair such components in a well ventilated area away from flames or sparks.

Do not weld on lines or on tanks that contain flammable fluids. Do not flame cut lines or tanks that contain flammable fluid. Clean any such lines or tanks thoroughly with a nonflammable solvent before welding or flame cutting.

If a Fire Occurs

If a fire occurs:

- Do not attempt to move machine or continue operations.
- Turn starter switch to "O" (OFF) position to stop engine.
- Use handrails, guardrails and steps to get off machine.
- Immediately call for help or fire station.
- When using a fire extinguisher, always aim extinguisher at base of fire.
- If an optional fire extinguishing system is in place, be familiar with its operating procedures.

  NOTE: *Depending on job conditions, other procedures could be necessary if a fire occurs.*



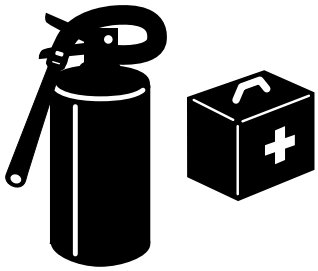
FG018459

Figure 13

Fire Extinguisher and First-Aid Kit (Emergency Medical Kit)

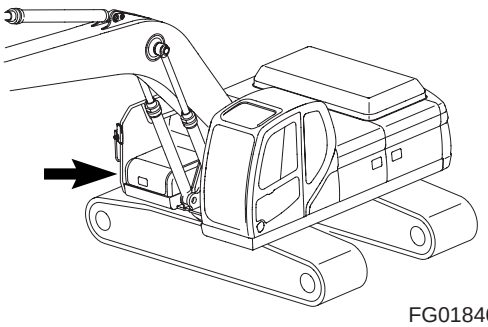
To be prepared in the event of a fire:

- Be sure that fire extinguishers have been provided and read 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 cabin. Check and service fire extinguisher at regular intervals and make sure that all work site crew members are adequately trained in its use.
- Inspect fire extinguisher and service fire extinguisher regularly.
- Follow instructions on extinguisher instruction plate.
- Keep a first aid kit in storage compartment (Figure 15) and keep another kit at work site. Check kit periodically and keep it properly supplied.
- Keep emergency numbers for doctor, ambulance service, hospital and fire department readily available.



HDO1009L

Figure 14



FG018460

Figure 15

Electrical System and Electrical Shock

Never short across starter terminals or across batteries. Shorting could damage electrical system and engine neutral start system.

When engine is running or immediately after it has stopped, high voltage is generated at injector terminal and inside engine controller, so there is a potential for an electrical shock. Never touch injector terminal or inside of engine controller.

NOTE: *If it is necessary to touch injector terminal or inside engine controller, contact your DOOSAN distributor.*

Rollover Protective Structure (ROPS)

The operator's cabin is a ROPS certified structure for protecting the seat belted operator. It absorbs the impact energy of a rollover impact. Do not allow machine weight (mass) to exceed certified value on certification plate. If weight is exceeded, the ROPS structure will not be able to fulfill its safety function.

Do not increase machine weight beyond certified value by modifying machine or by installing attachments on machine. If weight limit of protective equipment is exceeded, protective equipment will not be able to protect operator, and this can result in death or serious injury. Always observe the following:

- This machine is equipped with a protective structure. Do not remove protective structure and perform operations without it.
- Never modify the operator's cabin by welding, grinding, drilling holes or adding attachments unless instructed by DOOSAN in writing. Changes to the cabin can cause loss of operator protection from rollover and falling objects, and result in death or serious injury.
- When protective structure is damaged or deformed by falling objects or by rolling over, its strength will be reduced and it will not be able to adequately protect the operator. Contact your DOOSAN distributor if you have any questions about the ROPS. Never repair a damaged ROPS cabin.
- Always wear your seat belt when operating machine.

ROPS Certification

This DOOSAN excavator has an operator's cabin that meets ROPS requirements. The seat belt must be worn for rollover protection.

The ROPS certification plate (Figure 16) is found on the left side of the cabin on most models. It may vary slightly in its location on some models.

Check the ROPS cabin, mounting, and hardware for damage.

Never modify the ROPS cabin. Replace the cabin and hardware if damaged. See your DOOSAN distributor for parts.

ROPS - Rollover Protective Structure complies with ISO 12117-2:2008.

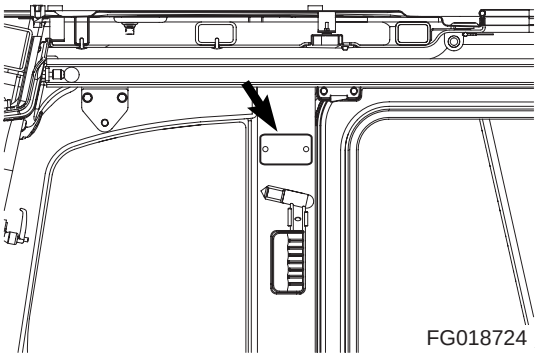


Figure 16

WARNING

AVOID DEATH OR SERIOUS INJURY

Never modify the operator cabin by welding, grinding, drilling holes or adding attachments unless instructed in writing by DOOSAN. Changes to the cabin can cause loss of operator protection from rollover and falling objects, and can result in death or serious injury.

Protecting Cabin from Flying or Falling Objects (Optional)

In a work site where additional operator protection is necessary from falling or flying objects, install adequate protective guards on the cabin.

For breaker operation, install a front guard (1, Figure 17) and apply a laminated coating sheet to front glass. Contact your DOOSAN distributor for recommendations.

When performing demolition or cutting operation, install a front guard and top guard.

Apply a protective laminated coating sheet to outside of front window. This will prevent glass from being scratched by dust when cleaning it or running wipers.

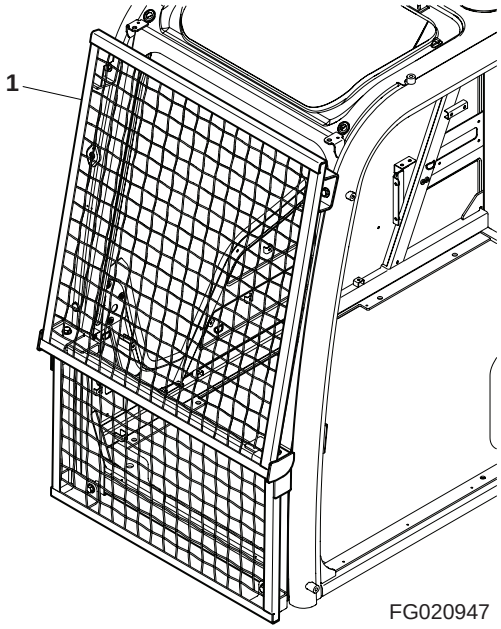


Figure 17

When working in mines, quarries or other work sites where there is a hazard of falling rocks, install Operator Protection Guard (OPG) (2, Figure 18) and apply a laminated coating sheet to front glass.

When OPG is installed, and front window needs to be cleaned, loosen bolts marked with arrows (Figure 18). Be sure to tighten bolts when done.

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 system requires a complete inspection of the structure. Reinstallation, recertification and/or replacement of system may be necessary.

Contact your DOOSAN distributor for available safety guards and/or recommendations to protect against objects that could strike operator's cabin. Make sure that all other work site crew members are kept away from excavator when operating.

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

NOTE: *The preceding instructions assume that conditions are for standard operations, but it may be necessary to add additional guards depending on operating conditions or local rules or regulations for the work site. Always contact your DOOSAN distributor for advice.*

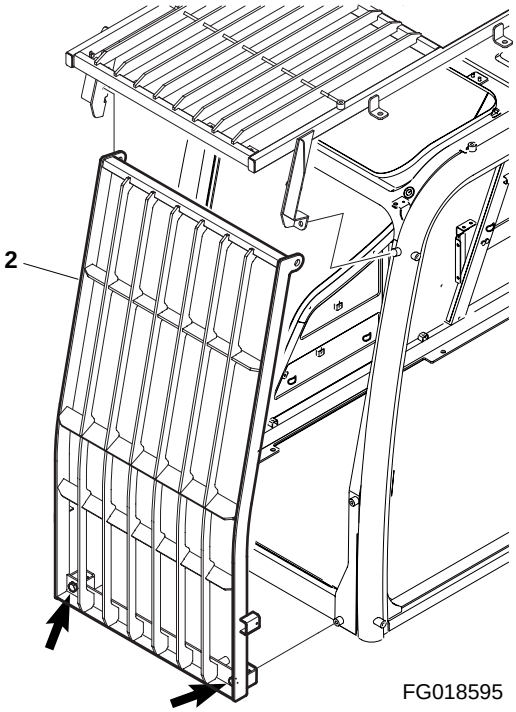
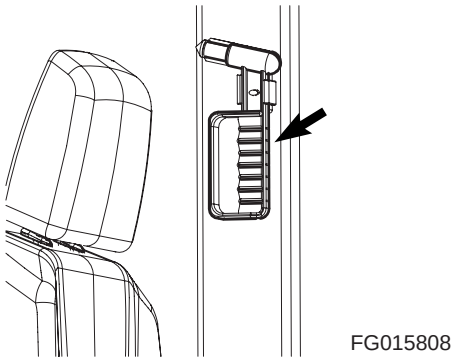


Figure 18

Emergency Exit from Operator's Station

This machine is equipped with a glass breaking tool. It is found on left pillar of cabin. This tool can be used to break the glass to exit from cabin in an emergency. Grip handle firmly and use sharp point to break glass.

- Be careful also not to slip on broken pieces of glass on ground.



FG015808

Figure 19

WARNING

AVOID DEATH OR SERIOUS INJURY

Protect your eyes when breaking the glass.

TRANSPORTATION

Obey State and Local Over-the-Road Regulations

Check federal, state and local laws and regulations regarding weight, width and length of a load before making preparations for transporting on public roads or highways.

The hauling vehicle, trailer and load must be in compliance with applicable regulations for the shipping route.

Partial disassembly of excavator may be necessary to meet travel restrictions or particular conditions at work site. See Shop Manual for information on partial disassembly.

Refer to Operation and Maintenance Manual, for information on loading, unloading and towing.

The machine can be disassembled into parts for transporting. Contact your DOOSAN distributor for assistance with disassembly.

Loading and Unloading

To prevent machine tipping or rollover when loading or unloading machine, always do the following:

- Perform loading and unloading only on firm, level ground. Maintain a safe distance from edge of road or drop-off.
- Never use work equipment to load or unload machine. The machine may fall or tip over.
- Always use loading ramps of adequate strength and capacity. Be sure that ramps are wide, and long enough to provide a safe loading slope. Take steps to prevent ramps from moving out of position or coming off.
- Clean ramp surfaces so they are free of grease, oil, ice and loose materials. Remove dirt from machine tracks and undercarriage. On a rainy day, be careful since ramp surfaces can be slippery.
- Turn auto idle switch "OFF".
- Run engine at low speed and travel slowly.
- When on ramps, do not operate any control lever except for travel lever.
- Never correct your steering on ramps. If necessary, drive off ramps, correct machine direction, then drive back onto ramps.

- When driving up or down ramps, the center of gravity of machine will change suddenly causing the tracks to drop down to the ramps or trailer. This will occur at the joint between the ramps and trailer. Travel slowly over this point.
- For machines equipped with a cabin, always lock door after loading machine to prevent door from suddenly opening during transportation.

Transporting Machine

When transporting machine on a trailer or truck, do the following:

- The weight, transportation height, and overall length of machine may change depending on work equipment attached to it. Always check the machine dimensions and work equipment's dimensions before transporting.
- When passing over bridges or structures on private land, check that structure is strong enough to support weight of machine. Before traveling on public roads, check with appropriate authorities and follow their instructions.

OPERATION

Always make sure that machine is properly maintained.

Before Engine Starting

Machine Condition

Every day before starting engine for first time, perform the following checks and repair machine before operating, as necessary. If these checks are not properly done death or serious injury could result.

- Check coolant, fuel, and hydraulic tank oil levels, and check for clogged air cleaner and damage to electrical wiring.
- Check operation of gauges, cameras (if equipped) and angle of mirrors, and check that safety lever is in LOCKED position.
- Check that work equipment and travel controls move freely, and work controls return to "NEUTRAL" when released.
- Check that attachment is properly attached and locked.

IMPORTANT

Only use Ultra Low Sulfur Diesel (ULSD) fuel and API-CJ-4/ACEA-E9 grade engine oil with this machine.

Make sure that machine is equipped with a lighting system that is adequate for job conditions and lights are working properly.

Before moving machine, check position of undercarriage. The normal travel position is with idler wheels to front under cabin and drive sprockets to rear. When undercarriage is rotated in reversed position, directional or travel controls must be operated in opposite directions.

Before performing checks, move machine to an area where there are no obstructions, and operate slowly. Do not allow personnel near machine.

Know maximum operating dimensions of your machine.

Work Site

Before starting operations, thoroughly check work area for any hazards, such as underground utility lines, overhead electrical lines, unstable ground, excessive slopes, etc.

Before starting engine and moving machine, make sure that no one is underneath machine, around machine, or on machine.

Know width and length of your machine and work equipment to maintain proper clearance when you operate machine or work equipment near fences or near boundary obstacles.

Know appropriate work site hand signals and personnel that are authorized to give hand signals. Follow hand signals from only one person.

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 work site.

Erect barricades or fences, post "No Entry" signs, and take other steps to prevent people from coming close to or entering work site. If people come too close to a moving machine, they may be struck or caught by machine, and this can result in death or serious injury.

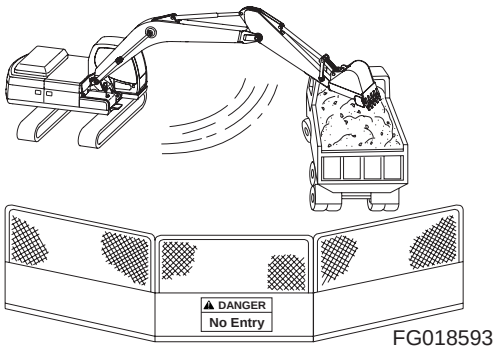


Figure 20

Mounting/Dismounting

Before getting on or off machine, if there is any oil, grease, or mud on handrails, guardrails, 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 machine. In particular, never get on or off a moving machine. These actions can result in death or serious injury.

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

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

Securely latch door. If you grip handrail inside door when moving on top of track shoes, and door latch is not securely engaged, door may move and cause you to fall.

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

Do not carry tools or supplies when you mount or dismount the machine.

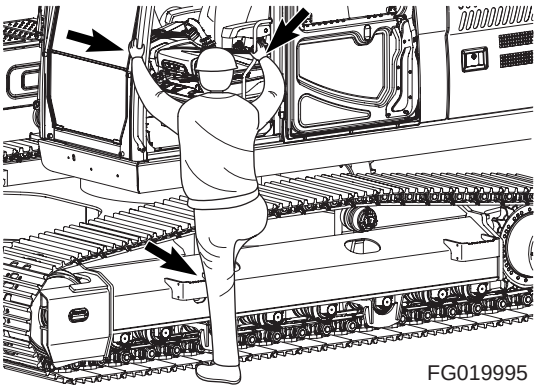


Figure 21

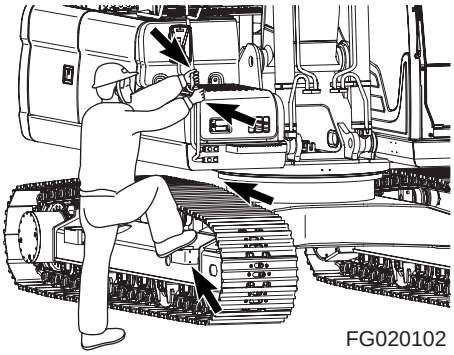


Figure 22

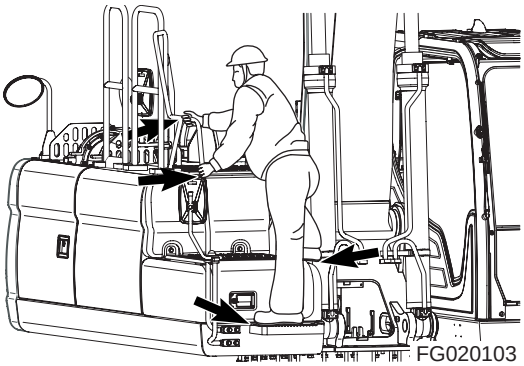


Figure 23

Cleaning

Remove all straw, wood chips, leaves, grass, paper and other flammable debris accumulated in engine compartment, Diesel Particulate Filter (DPF), mufflers and around battery. Remove any dirt from window glass, mirrors, handrails, and steps.

Do not leave tools or spare parts in operator's cabin. Vibration of machine during operation can cause tools or spare parts to fall and damage or break control levers or switches. Tools and spare parts can also get caught in spaces between control levers and cause accidental movement of work equipment causing death or serious injury.

When entering operator's cabin, always remove all mud and oil from your shoes. If you operate travel pedal with mud or oil stuck to your shoes, your foot could slip off the control, or dirt and debris may interfere with proper operation of control levers.

After using ashtray, make sure that any matches or cigarettes are properly extinguished, and be sure to close ashtray.

Clean window glass and working lights for good visibility.

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

Never bring flammable or explosive items into operator's cabin. Do not leave cigarette lighters laying around operator's cabin. If temperature inside operator's cabin becomes too high, there is a potential hazard that lighter could explode.

Secure all loose items such as lunch boxes, and other items that are not a part of equipment.

Operator Station

Inspect condition of seat belt and mounting hardware. Replace any parts that are worn or damaged. Do not use a seat belt extension on a retractable seat belt.

Adjust seat so full pedal travel can be achieved with operator's back against back of seat.

Keep all windows and doors closed on machine.

Adjust operator's seat to a position where it is easy to perform operations, and check that there is no damage or excessive wear to seat belt or mounting clamps.

Adjust and clean mirrors so area to rear of machine can be seen clearly from operator's seat.

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

Seat Belt

Check seat belt daily for correct function.

Inspect seat belt system more often if machine is exposed to severe environmental conditions or applications. Conduct the following inspections and replace seat belt system as necessary:

1. Check webbing. If system is equipped with a retractor, pull webbing completely out and inspect full length of webbing. Look for cuts, wear, fraying, dirt and stiffness.
2. Check buckle and latch for correct operation.
3. Make sure latch plate is not excessively worn, deformed or buckle is not damaged or casing is broken.
4. Check retractor web storage device (if equipped) by extending webbing and checking that it spools out and retracts correctly.
5. Check webbing in areas exposed to ultraviolet (UV) rays from sun or extreme dust or dirt. If original color of webbing in these areas is extremely faded and/or webbing is packed with dirt, webbing strength may be reduced.

NOTE: *Contact your DOOSAN distributor for seat belt system replacement parts.*

WARNING

AVOID DEATH OR SERIOUS INJURY

Failure to properly inspect and maintain seat belt and seat belt system can cause lack of operator restraint and can result in death or serious injury.

Before fastening seat belt, check that there is no problem in belt mounting bracket. If it is worn or damaged, replace seat belt. Fasten seat belt so it is not twisted.

Always wear seat belt when operating machine.

Visibility Information

A rear view camera (if equipped) and mirrors provide the operator with additional means to see the work area.

NOTE: *These devices may vary from one region to another, depending upon local and regional regulations. If a machine is moved or sold into another region or marketplace, it is the owner's responsibility to make sure it complies with all applicable regulations.*

WARNING

AVOID DEATH OR SERIOUS INJURY

Failure to check for and clear people from the surrounding area of a machine can result in death or serious injury. The operator should make sure that visual aids (mirrors and camera(s)) are in proper working condition.

Your machine may be equipped with visual aids such as mirrors or a rear view camera. Even with these aids, there still may be areas around the machine which cannot be seen from the operator's seat. Always keep personnel and bystanders out of the work area. Be careful when operating and always look in direction of travel.

Adjust visual aids for best visibility around machine.

When swinging work equipment or backing up, press camera button (if equipped) to change display mode on display monitor so you can check rear and side of machine.

Before moving machine, look around work site and use mirrors and display monitor to confirm that no one is in the work area.

While operating or traveling in places with poor visibility it may be impossible to confirm condition of work site. Inspect and remove any obstacles around the machine that could be damaged and keep other personnel out of the work area.

Inspect equipment and repair immediately if there are problems with visual aids. If machine cannot be fixed immediately, DO NOT use the machine. Contact your DOOSAN distributor and arrange for repairs.

Work Site Rules

- If visibility cannot be sufficiently assured, use a flagman. The operator should pay careful attention to signals and follow instructions from flagman.
- Signals should only be given by one flagman.
- When working in dark places, turn "ON" work lights and front lights on the machine. Set up additional lighting in area.
- Stop operations if there is poor visibility, such as fog, snow, rain, or sandstorms.

- Check mirrors and rear view camera (if equipped) on machine before starting operations. Clean off any dirt and adjust view for good visibility.

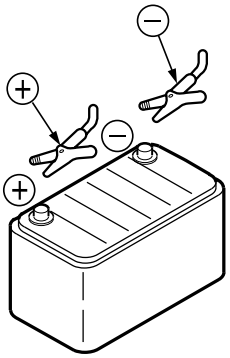
When operating or traveling during poor visibility conditions, follow the preceding work site rules.

It may not be possible to adjust all visual aids to see all the way around the machine. Therefore, additional precautions such as flagman, barricades, etc., should be taken to keep other personnel out of the work area.

Boost Starting or Charging Engine Batteries

Follow these instructions to prevent an explosion or fire when connecting booster cables to batteries:

- Turn "OFF" all electric equipment before connecting leads to battery. This includes electric switches on battery charger or battery booster equipment.
- When boost starting from another machine or vehicle do not allow two machines to touch. Wear safety goggles and gloves while battery connections are made.
- 24 volt battery units consisting of two series connected 12 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 metal frame of the machine being boosted or charged. The final booster cable connection, at metal frame of the machine being charged or boost started, should be as far away from the batteries as possible. Refer to Operation and Maintenance Manual, for proper procedure in this manual.
- Connect positive (+) cable first when installing cables and disconnect negative (-) cable first when removing them.



HAOA310L

Figure 24

Starting Engine

Only operate the machine from the operator's seat with your seat belt fastened.

Only operate controls while engine is running.

Check for proper operation of all controls and all protective devices while you operate the machine slowly in an open area.

- Read and understand control pattern before operating. Check that movement of the machine matches display on control pattern label. If it does not match, replace it immediately with correct control pattern label.
- Check operation of work equipment, travel system and swing system.
- Check for any problem with machine. Check for unusual sounds, vibration, heat, odor, or improper readings from gauges. Check for any oil or fuel leaks.
- If any problem is found, stop operation and perform repairs immediately.

Do not use cellular telephones inside operator's cabin when driving or operating the machine.

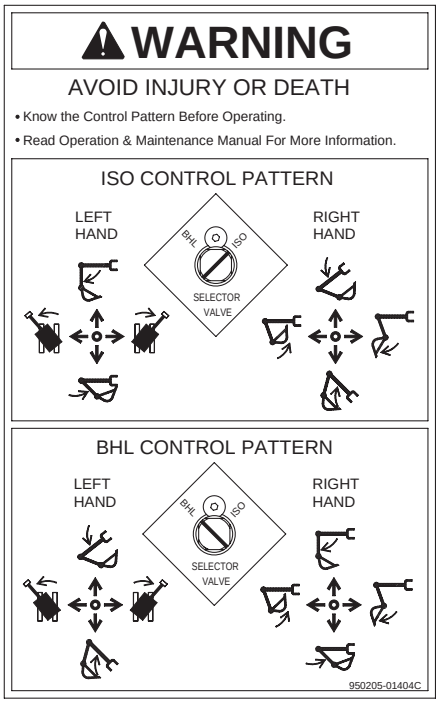
When operating the machine, do not extend your hands or head out of window.

The boom and arm linkage can allow work tool or attachment to contact undercarriage or cabin. Be aware of position of work tool.

- Do not attempt to start engine by short-circuiting engine starting circuit. This can result in death or serious injury, or fire.
- When starting engine, sound horn as a warning to alert personnel in the work area.

If there is a warning tag or "DO NOT OPERATE" tag hanging from work levers (joysticks) or travel control levers, do not start engine or move levers.

- Prevent personnel from walking or standing under raised boom, unless it is properly supported.



FG018704

Figure 25

Swinging or Traveling

As a machine operator, you should know and follow local, state and federal laws and regulations when operating on public roads or highways.

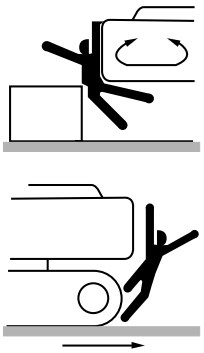
It is important to keep in mind that machine, in comparison with the rest of traffic, is a slow moving and wide vehicle which can cause traffic delays. Pay attention to traffic behind you and allow traffic to pass you.

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

- When changing travel direction from forward to reverse or from reverse to forward, reduce speed and stop machine before changing travel direction.
- Sound horn to alert people in area.
- Check that there is no one in area around machine. There are restricted visibility areas behind machine so, if necessary, swing upper structure slowly to check that there is no one behind machine before traveling in reverse.
- When operating in areas with poor visibility, designate a flagman to direct work site traffic.
- Keep unauthorized personnel away from turning radius or travel path of the machine.

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

- Check that travel alarm works properly and that mirrors are clean, not damaged and properly adjusted.
- Always latch door and windows of operator's cabin in position (open or closed).
- On work sites where there is a hazard of flying or falling objects, or of objects entering operator's cabin, check that door and windows are securely closed. Install additional guards, if work site application requires them.



HAOA190L

Figure 26

Never turn starter switch to "O" (OFF) position when traveling. This can lead to a loss of steering control.

Do not operate attachments while traveling.

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

Never travel over obstacles or excessive slopes that will cause machine to tilt severely. Avoid any slope or obstacle that can cause machine to tilt 10° or more to right or left, or 30° or more from front to rear.

Do not operate steering controls suddenly. Work equipment can hit ground and this can damage machine or structures in area.

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

Always operate within permissible water depth. Permissible water depth is up to centerline of upper track roller(s).

When passing over bridges or structures on private land, check that structure is strong enough to support weight of machine. Before traveling on public roads, check with appropriate authorities and follow their instructions.

Never exceed maximum permitted load for bridges.

Always operate machine with idler wheels to front under cabin and drive sprockets to rear.

Know permitted ground pressure. Ground pressure of the machine may change depending on attachment and load.

Keep height and length of attachment in mind.

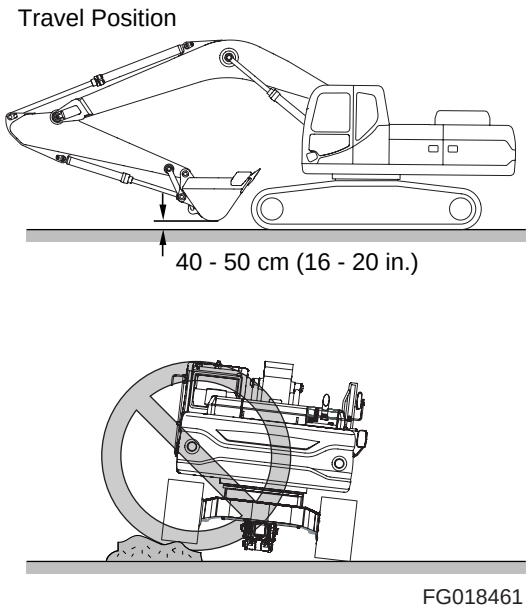


Figure 27

Lifting and Digging

The operator is responsible for any load carried when traveling on public roads and while working with the machine.

- Keep loads secure so they do not fall off while operating.
- Do not exceed maximum load for the machine. Machine operation will be affected when center of gravity changes, caused by extended loads and different attachments.

To lift loads safely when in digging mode, the following must be evaluated by the operator and work site crew.

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

Always watch load. Bring load close to the machine before traveling any distances or swinging load.

Lifting capacity decreases as load is moved further from the machine.

Set tracks at right angles to road shoulder or drop-off with sprocket at rear when performing operations to make it easier to move away from the work area.

Do not suddenly lower, swing, or stop work equipment.

- Do not move bucket over head of other personnel or over the operator's seat of dump trucks or other hauling equipment. The load may spill or bucket can hit dump truck causing property damage or cause death or serious injury.

Operation on Slopes

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

Improper traveling on steep slopes could result in machine tipping, rollover or sliding down the slope. Always fasten your seat belt.

When possible, operate machine up slopes and down slopes. Avoid operating machine across slope.

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

Do not travel on grass, fallen leaves, or wet steel plates. Even slight slopes can cause machine to slide down a slope. Travel at low speed and make sure that machine is always traveling directly up or down slope.

Do not change travel direction on a slope. This could result in tipping or sliding sideways of machine.

Improper operation when working on slopes can cause a tip over. Use caution when swinging or operating work equipment on slopes.

Do not swing work equipment from uphill side to downhill side when bucket is loaded. This could cause machine to tip or rollover.

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

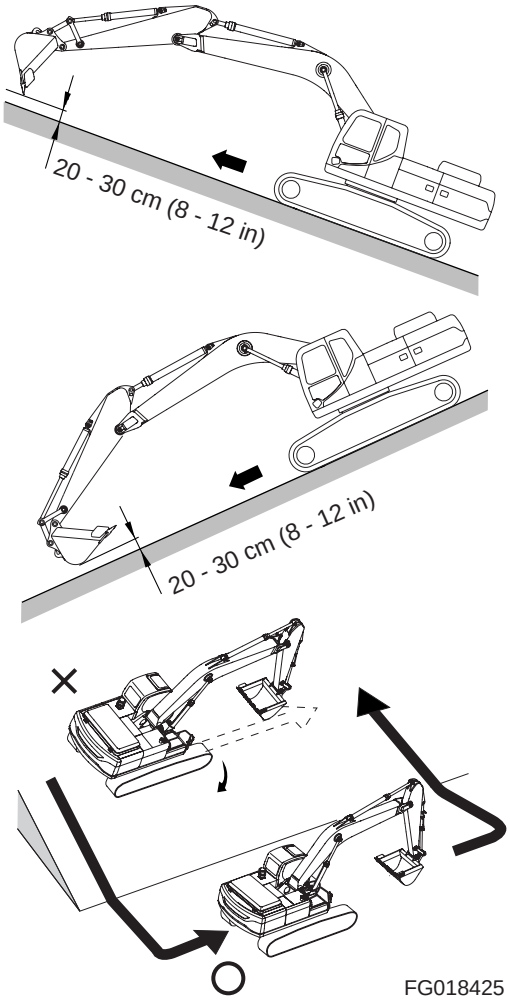


Figure 28

If the machine begins to slide down on a grade, immediately dump load and turn the machine downhill.

Be careful to avoid any ground condition which could cause the machine to tip. Tipping can occur when you work on hills, on banks, or on slopes. Tipping can also occur when you cross ditches, ridges, or travel over unexpected obstructions.

Keep the machine under control. Do not overload the machine beyond capacity.

- When traveling up a steep slope, extend work equipment to front to improve balance, keep work equipment approximately 20 - 30 cm (8 - 12 in) above ground, and travel at low speed.
- Do not turn on slopes or travel across slopes. Always go down to a flat place to change position of the machine, then travel backup the slope again.

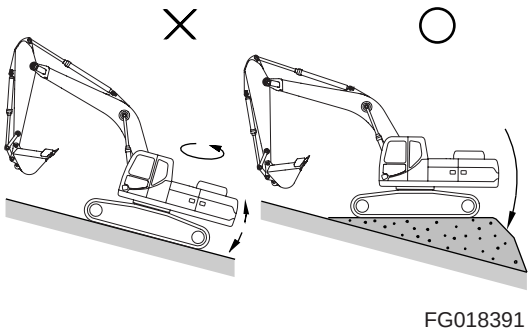
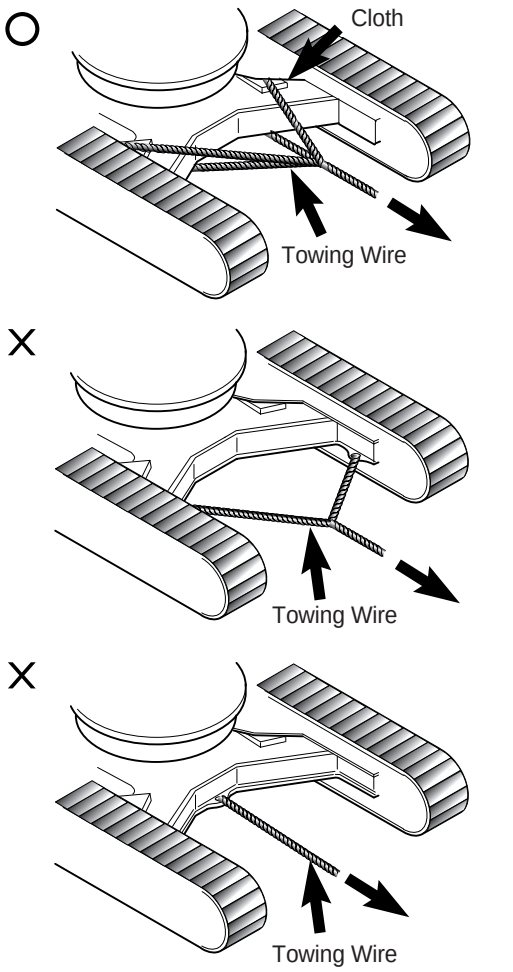


Figure 29

Towing

To prevent death or serious injury when towing, always do the following:

- Follow the instruction given in this manual.
- When performing preparation work for towing with two or more personnel, determine signals to use and correctly follow these signals.
- Always attach wire rope onto left and right hooks and secure in position.
- If engine on machine with problem will not start or there is a failure in brake system, always contact your DOOSAN distributor.
- Never go between towing machine and towed machine during towing operation.
- Do not perform towing on steep slopes. Select a place where slope is gradual. If there is no place where slope is gradual, perform operations to reduce angle of slope before starting towing operation.
- When towing a machine, always use a wire rope with a sufficient towing capacity.
- Do not use a wire rope that is kinked or frayed, or a wire rope with any loss of diameter. Wear leather gloves when handling a wire rope.
- Do not use lightweight towing hook for towing another machine.
- Make sure that towing eyes and towing devices are adequate for towing loads.
- Only connect wire rope to a drawbar or to a hitch.
- Operate the machine slowly and be careful not to apply any sudden load to wire rope.



FG018375

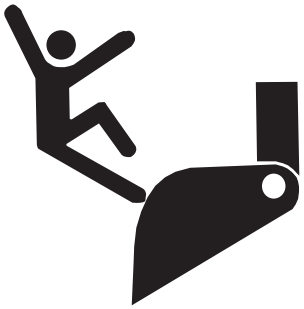
Figure 30

Attachment

Never let anyone ride on any work attachment, such as bucket, crusher, grapple, or clamshell (grab bucket). This creates a falling and crushing hazard, and can result in death or serious injury.

The clamshell, grapple, or magnet can swing in all directions. Move work levers (joysticks) in a continuous motion. Failure to move work levers (joysticks) in a continuous motion can cause clamshell, grapple, or magnet to swing into cabin or into a person in work area. This can result in death or serious injury.

- When using a fork or grapple, do not attempt to pick up an object with its tips. This could damage the machine or cause personal injury, if picked-up object slips off attachment.
- Do not use impact force of work equipment for demolition work. This could damage work equipment, cause broken materials to fly off or tipping. This could result in death or serious injury.
- Do not use work equipment or swing mechanism to pull load in any direction. This could cause the work equipment to move suddenly if the load releases and can result in death or serious injury.



ARO1310L

Figure 31

Equipment Lowering with Engine Stopped

Before lowering any equipment with the engine stopped, clear the area around the equipment of all personnel and bystanders. The procedure to use will vary with the type of equipment to be lowered. Keep in mind most systems use a high-pressure fluid or air to raise or lower equipment. The procedure will cause high-pressure air, or hydraulic pressure, or some other media to be released in order to lower the equipment.

Wear appropriate personal protective equipment and follow the established procedure in the Operation and Maintenance Manual in the Operation Section of the manual.

Engine Stop

Turn engine starter switch to "O" (OFF) position and remove engine starter switch key.

Before lowering any equipment with engine stopped, clear area around equipment of all personnel and bystanders. This procedure will cause high-pressure air or hydraulic pressure to be released to lower equipment.

Do not stop engine immediately after the machine has been operated under load. This can cause overheating and accelerated wear of engine components.

After the machine is parked, allow engine to run for five minutes before stopping the engine. This allows hot areas of engine to cool gradually.

- Do not leave operator's seat when there is a raised load.

Parking Machine

Avoid making sudden stops, or parking machine wherever it happens to be at end of workday. Park machine on firm, level ground away from traffic and away from high walls, drop-offs and any area of potential water accumulation or runoff.
If parking on inclines is unavoidable, block crawler tracks to prevent movement. Lower bucket or other working attachment completely to ground, or to an overnight support saddle. To prevent 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 machine clearly. Park machine so machine, flags, signs and fences do not obstruct traffic.

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

Always close door of operator's cabin and lock all equipment to prevent any unauthorized person from operating the machine.

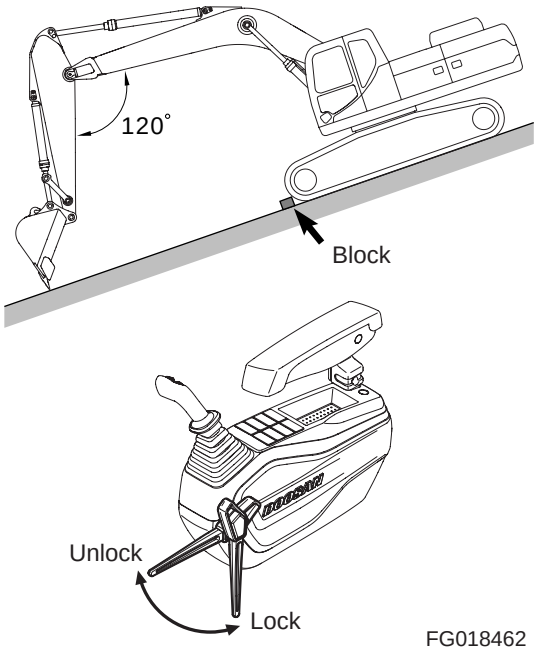


Figure 32

The hydraulic system remains pressurized, due to the accumulator, even when engine is not running. Accumulator pressure should decrease in a short time (approximately one minute). While hydraulic system maintains a charge, hydraulic work tools and machine controls remain functional.

Machine movement will occur if any controls are moved. This can result in death or serious injury.

Always move hydraulic lockout control to "LOCK" position before stopping engine or immediately after engine stops running.

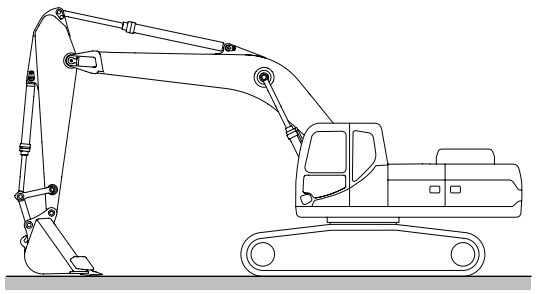


Figure 33

Preservation/Storing Machine

Perform the following if storing excavator for more than one month.

Conditions	Maintenance Required
Cleaning	Pressure wash undercarriage and track assemblies. Inspect for damage or loose or missing parts.
Lubrication	Perform all daily lubrication procedures.
	Apply a coating of light oil to exposed plated metal surfaces, such as hydraulic cylinder rods, etc.
	Apply a coating of light oil to all control linkages and control cylinders (control valve spools, etc.)
Battery	Turn "OFF" the battery disconnect switch.
Cooling System	Inspect coolant recovery tank to make sure that antifreeze level in system is at correct level.
	Every 90 days, use a hydrometer to measure protection level of coolant. Refer to Operation and Maintenance Manual, to determine amount of protection cooling system requires. Add coolant as required.
Hydraulic System	Once a month, start engine and follow procedures in Operation and Maintenance Manual, listed in this manual.

1. Complete the preceding steps.
2. Wash machine and touch up paint finish to avoid rusting.
3. Treat exposed parts with antirust agent, lubricate machine thoroughly and apply grease to unpainted surfaces like lifting and tilting cylinders etc.
4. Fill fuel tank and hydraulic oil tank to "FULL" marks.
5. Cover exhaust pipe (parking outside).
6. Make sure that coolant is at proper concentration for expected lowest temperatures.
7. Park machine on level, firm ground where there is no risk of freezing, landslide or flooding. Avoid parking machine on a slope.

   Keep in mind that theft and burglary risk can be minimized by:

   - Removing starter key when the machine is left unattended.
   - Locking doors and covers after working hours.
   - Turning off electrical current with battery disconnect switch.
   - Park machine where risk of theft, burglary and damage is minimized.
   - Removing valuables from cabin such as cellular phone, computer, radio and bags.

See Operation and Maintenance Manual, for more information.

Check After Long-term Parking

- All oil and fluid levels.
- Tension of all belts.
- Air pressure.
- Air cleaner.
- Batteries and electrical connections.
- Lubricate all greasing points.
- Wipe off grease from piston rods.
- Inspect for signs of nests (i.e. birds, rodents, etc.)

MAINTENANCE

Improper operation and maintenance can result in death or serious injury. Read manual and safety decals before operating or maintaining the machine. Follow all instructions and safety messages.

WARNING

AVOID DEATH OR SERIOUS INJURY

Follow instructions before operating or servicing machine. Read and understand the Operation and Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments, repairs or service. Untrained operators and failure to follow instructions can result in death or serious injury.

- Never service DOOSAN equipment without instructions.
- Always lower bucket and blade to ground before doing any maintenance.
- Use correct procedure to lift and support excavator.
- Cleaning and maintenance are required daily.
- Welding or grinding painted parts should be done in well ventilated areas.
- Wear a dust mask when grinding painted parts. Toxic dust and gas can be produced.
- Vent exhaust to outside when engine must be running for service.
- Exhaust system must be tightly sealed. Exhaust fumes are hazardous and can cause death or serious injury.
- Stop and allow engine to cool and clean engine of flammable materials before checking fluids.
- Never service or adjust machine with engine running unless instructed to do so in this manual.
- Avoid contact with leaking hydraulic fluid or diesel fuel under pressure. It can penetrate skin or eyes.
- Never fill fuel tank while engine running, while smoking, or when near open flame.
- Keep body, jewelry and clothing away from moving parts, electrical contact, hot parts and exhaust.
- Wear eye protection to guard from battery acid, compressed springs, fluids under pressure and flying debris when engines are running or tools are used. Use eye protection approved for welding.

- Lead-acid batteries produce flammable and explosive gases.
- Keep arcs, sparks, flames and lighted tobacco away from batteries.
- Batteries contain acid which burns eyes or skin on contact.
- Wear protective clothing. If acid contacts body, flush well with water. For eye contact flush well and get immediate medical attention from a physician familiar with this injury.
- The maintenance procedures which are given in this manual can be performed by the owner or operator without any specific technical training. Maintenance procedures which are not in this manual must be performed ONLY BY QUALIFIED SERVICE PERSONNEL. Always use genuine DOOSAN replacement parts.
- Only authorized personnel should service and repair the machine. Do not allow unauthorized personnel into work area.
- Lower work equipment and stop engine before performing maintenance.
- Park machine on firm, level ground.
- Turn starter switch to "ON' position and keep safety lock lever in "UNLOCK" position. Cycle work levers (joysticks) back and forth, left and right at full stroke 2 to 3 times to eliminate remaining internal pressure in hydraulic circuit. Then move safety lock lever to "LOCK" position.
- Check that battery relay is "OFF" and main power is shut off. (Wait for approximately one minute after turning "OFF" engine starter switch key and press horn switch. If horn does not sound, the main power is shut off.)
- Put blocks under track to prevent the machine from moving.
- To prevent injury, do not perform maintenance with engine running. If maintenance must be done with engine running, perform maintenance with at least two workers and do the following:
    - One worker must always sit in the operator's seat and be ready to stop engine at any time. All workers must maintain contact with other workers.
    - When maintenance operations are near fan, fan belt, or other rotating parts, there is a potential hazard of being caught in rotating parts. Keep hands and tools away.
- Never drop or insert tools or other objects into rotating fan or fan belt. Parts can break off and hit someone.
- Do not touch any control levers or control pedals. If any control levers or control pedals must be operated, always give a signal to other workers and instruct them to move away.

- When performing maintenance of engine and you are exposed to engine noise for long periods of time, wear hearing protection while working.
- If noise from the machine is too loud, it can cause temporary or permanent hearing problems.
- Do not smoke when you service an air conditioner or if refrigerant gas is present.
- Inhaling fumes either from a flame or gas from a cigarette that has contacted air conditioner refrigerant can cause death or serious injury.
- Never put maintenance fluids into glass containers.
  Drain all liquids into a suitable containers.
- Unless instructed otherwise, perform maintenance with equipment in servicing position. Refer to this manual for procedure for placing equipment in servicing position.

Warning Tag

Alert others that service or maintenance is being performed by attaching a "DO NOT OPERATE" warning tag to the operator's cabin controls – and other machine areas, if required. Use of a chain or cable to keep the safety lock lever in the fully lowered "LOCK" position, complies with OSHA's lockout requirements.



FG018690

Figure 34

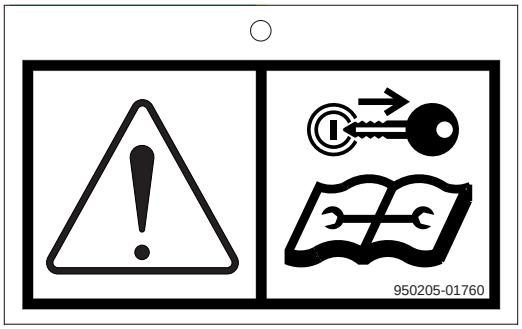
"DO NOT OPERATE" warning tags, are available from your DOOSAN distributor.

- Always attach "DO NOT OPERATE" warning tag to work equipment control lever in the operator's cabin to alert others that you are performing service or maintenance on the machine. Attach additional warning tags on the machine, if necessary.

  Keep warning tags in tool box while it is not used. If there is no tool box then keep them in the owner manual storage pocket.

- If any other person starts engine, and operates control levers or control pedals while you are performing service or maintenance, it can result in death or serious injury.

Attach a "DO NOT OPERATE" warning tag to starter switch or to controls before servicing or repairing equipment. Warning tags (Special Instruction, SEHS7332) are available from your DOOSAN distributor.



FG018596

Figure 35

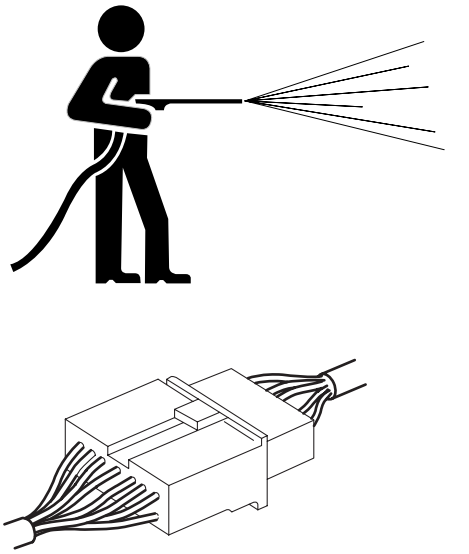
Cleaning

Clean machine before performing inspection and maintenance.

If inspection and maintenance are done when machine is dirty, it will become more difficult to locate problems, and you could slip on steps and work platform areas and injure yourself.

When washing machine, do the following:

- Wear shoes with nonslip soles to prevent slipping and falling.
- Wear safety goggles and protective clothing when washing machine with high-pressure steam or water.
- Do not spray water directly on electrical components (sensors, connectors). If water gets into electrical system, it can cause operation problems.
- Pick up any tools or hammers that are laying in workplace. Wipe up any grease or oil to prevent slippery substances, that can cause tripping or slipping.
- When cleaning cabin top window which is made of polycarbonate material, use tap water. Avoid use of organic solvents for cleaning, such as benzene, toluene or methanol. These solvents can cause a chemical reaction that will dissolve and damage the window.



ARO1330L

Figure 36

Proper Tools and Clothing

Only use tools that are intended for the type of service to be done. Metal pieces from low quality or damaged tools, such as chisels or hammers, can break off and hit a service person in the eyes or face causing serious injury.



HDO1037L

Figure 37

Disassembling Precautions

When using a hammer to remove pins, pins can fly out or metal particles may break off. Always do the following:

- Hitting hard metal pins, bucket teeth, cutting edges or bearings with a hammer, can cause metal pieces to break or fly off resulting in serious injury. Always wear safety goggles and leather gloves. Keep other personnel away.

Use of Lighting

When checking fuel, oil, battery electrolyte, window washer fluid, or coolant, always use proper lighting equipment to prevent arcs or sparks that could cause a fire or explosion resulting in death or serious injury.



HDO1040L

Figure 38

Fire and Explosion Prevention

Fuels, most lubricants and some coolant mixtures are flammable. Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire resulting in property damage or death or serious injury.

Store all fuels and all lubricants in properly marked and approved containers and keep away from all unauthorized personnel.

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

Tighten all fuel and oil caps.

Do not smoke while you refuel 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 electrical wires daily for wires that are loose or frayed. Tighten all loose, and repair or replace all frayed, electrical wires before operating machine.

Remove all flammable materials and debris from the engine compartment, exhaust system components and hydraulic lines.



HDO1015I

Figure 39

Burn Prevention

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

Using gloves, loosen radiator cap slowly to release internal pressure before removing radiator cap.

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

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

Allow cooling system components to cool before draining cooling system.

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

Vent hydraulic tank only after engine has been stopped and hydraulic tank is cool. Using gloves, slowly tilt hydraulic tank air breather to relieve pressure.

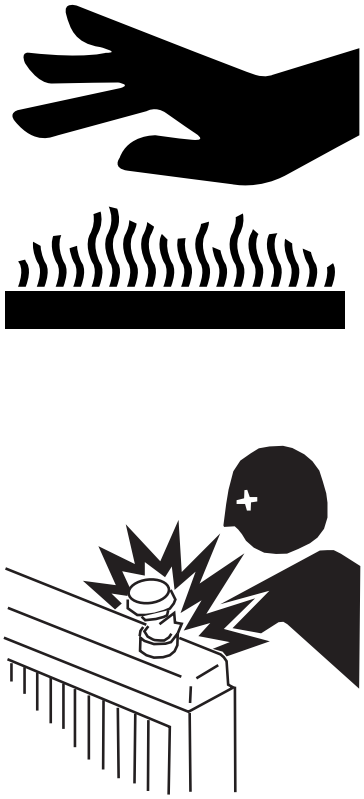
Relieve all pressure in hydraulic oil system, in fuel system, or in cooling system before disconnecting any lines, hoses, fittings, or related components.

Batteries give off flammable fumes that can explode and start a fire.

Do not smoke while you are checking battery electrolyte level.

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

Always wear safety goggles and face protection when working with batteries.



HAAE1980

Figure 40

Rubber That Contains Fluorides

Observe extra great care when it is suspected that you may have to handle rubber that contains fluorides.

Certain seals which have to withstand high operating temperatures (e.g. in engines, transmissions, axles, hydraulic motors and pumps) may be made from rubber that contains fluorides, which, when exposed to high heat (fire), forms hydrogen fluoride and hydrofluoric acid. This acid is very corrosive and cannot be rinsed or washed off from the skin. It causes very severe burns which take a long time to heal.

It usually means that damaged tissue must be surgically removed. Several hours may pass after contact with the acid, before any symptoms appear and therefore one is not given any immediate warning. The acid may remain on the machine parts for several years after a fire.

If swelling, redness or a stinging feeling appears and one suspects that cause may be contact with heated rubber that contains fluorides, contact a medical doctor immediately. If a machine, or part of a machine, has been exposed to fire or severe heat, it must be handled by specially trained personnel. In all handling of machines after a fire, thick rubber gloves and protective goggles must be used.

The area around a part which has been very hot and which may be made of rubber that contains fluorides must be decontaminated by thorough and ample washing with limewater (a solution or suspension of calcium hydroxide, i.e. slaked lime in water). After the work has been completed, the gloves must be washed in limewater and then discarded.

Rubber and Plastics

Polymer materials when heated, can form compounds that create a health hazard and can harm the environment. Scrapped rubber and plastic must never be burned. Extra precautions should be taken when servicing machines that have been in a fire or exposed to extreme heat.

If gas cutting or welding is to be done near such materials, the following safety instructions must be followed:

- Protect the material from heat.
- Use protective gloves, protective goggles and an approved respirator.

Waste Hazardous to the Environment

Painted parts or parts made of plastic or rubber which are to be scrapped must never be burned, but must be taken care of by an approved refuse handling plant.

Batteries, plastic objects and anything else which is suspected of being dangerous to the environment must be taken care of in an environmentally safe way.

Check List After Fire

When handling a machine which has been damaged by fire or been exposed to intense heat, the following instructions should be followed:

Use thick, gloves made of rubber and wear goggles to protect your eyes.

Never touch burned components with your bare hands, as there is a risk that you may come into contact with melted polymer materials. First wash thoroughly with plenty of limewater (a solution or suspension of calcium hydroxide, i.e. slaked lime in water).

As a precaution, seals (O-rings and other oil seals) should always be handled as if they were made of rubber that contains fluorides.

Treat skin, which is suspected of having touched burned rubber that contains fluorides, with Hydrofluoric Acid Burn Jelly or something similar. Seek medical advice. Symptoms may not appear until several hours afterwards.

Discard gloves, rags etc. which are suspected of having touched burned rubber that contains fluorides.

IMPORTANT

When disconnecting or connecting connectors between ECU and engine, or connector between ECU and the machine, always disconnect the battery to prevent damage to ECU.

If you do not follow this procedure, the ECU will be damaged and/or the engine will not operate properly.

When performing welding repairs, perform welding in a properly equipped place. Repairs should be performed by a qualified welder. Welding operations, can create potential hazards, including generation of gas, fire, or electric shock. Never let an unqualified welder do welding.

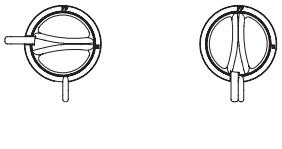
A qualified welder must do the following:

- To prevent battery explosion, turn battery disconnect switch to "OFF" position.
- Disconnect the connector between ECU and machine, and the connector between ECU and engine.
- To prevent generation of gas, remove paint from location of the weld.
- If hydraulic equipment, piping or component ports close to them are heated, a flammable gas or mist could result in an explosion or fire. To prevent this, protect and insulate components from excessive heat.
- Do not weld on pipes or on tubes that contain flammable fluids. Do not flame cut pipes or tubes that contain flammable fluids. Before welding on pipes or tubes, or before flaming cut pipes or tubes, clean them thoroughly with a nonflammable solvent. Make sure pressure inside pipes or tubes does not cause a rupture of the component parts.
- If heat is applied directly to rubber hoses or piping under pressure, they may suddenly break, so cover and insulate them with a fireproof covering.
- Wear protective clothing.
- Make sure there is good ventilation.
- Remove all flammable objects and make sure a fire extinguisher is available.

Preparation for Electrical Welding On Body Structure

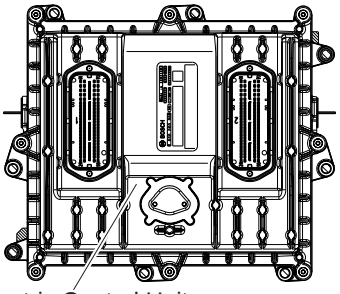
To prevent damage to ECU by electrical welding, observe the following procedures:

1. Turn battery disconnect switch to "OFF" position.
2. Disconnect the connector between ECU and machine, and the connector between ECU and engine.
3. Proceed with welding.
4. After welding, connect the connector between ECU and machine, and the connector between ECU and engine.
5. Clean battery compartment.
6. Turn battery disconnect switch to "ON" position.
7. Close battery compartment door.



FG020630

Figure 41



FG020631

Figure 42

Warning for Counterweight and Front Attachment Removal

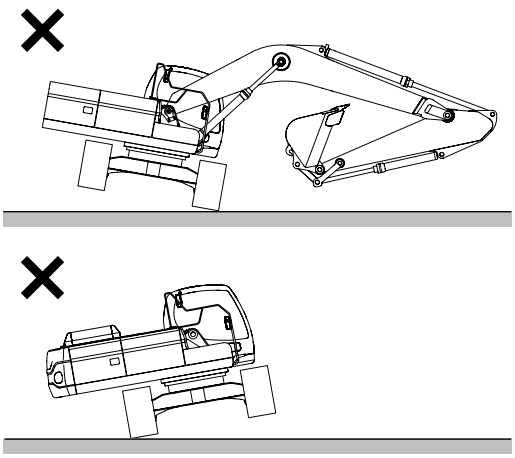
WARNING

AVOID DEATH OR SERIOUS INJURY

Removal of the machine counterweight, front attachment or any other part can affect the stability of the machine. This could cause unexpected movement, and result in death or serious injury.

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.



FG018594

Figure 43

Lock Inspection Covers

When performing maintenance with inspection cover open, use lock bar to secure cover and prevent accidental lowering of the cover caused by wind or movement of the machine.

If maintenance work is done with the inspection cover open but not locked, it could suddenly close because of the wind or movement of the machine and cause injury.

Working on Machine

When performing maintenance operations on machine, prevent tripping and falling by keeping area around your feet clean and free of objects and debris. Always do the following:

- Do not spill oil or grease.
- Do not leave tools laying around.
- Watch your step when walking.
- Never jump down from machine. When getting on or off machine, use steps and handrails, and maintain a three point contact (both feet and one hand or both hands and one foot) to support yourself.
- If job requires it, wear protective clothing.
- To prevent injury from slipping or falling, when working on hood or covers, never stand or walk on areas except areas equipped with nonslip pads.
- If it is necessary to work under raised equipment or the machine, support work equipment and machine securely with blocks and stands strong enough to support weight of work equipment and machine.
- Do not work under the machine if track shoes are lifted off ground and the machine is supported only with work equipment. If any control levers are moved, or there is damage to hydraulic system, work equipment or the machine will suddenly drop causing death or serious injury.



ARO1380L

Figure 44

Accumulator

The pilot control system is equipped with an accumulator. For a short period of time after engine has been stopped, accumulator will store a pressure charge that allow hydraulic controls to be activated. Activation of any controls will allow selected functions to operate under force of gravity.

When performing maintenance on pilot control system, release hydraulic pressure in system as described in Operation and Maintenance Manual.

The accumulator is charged with high-pressure nitrogen gas. If it is improperly handled it can explode causing death or serious injury. Always observe the following precautions:

- Do not drill or punch holes in accumulator or expose it to any flames, fire or external heat source.
- Do not weld on accumulator.
- When performing disassembly or maintenance of accumulator, or when disposing of accumulator, charged nitrogen gas must be properly released. Contact your DOOSAN distributor for assistance.
- Wear safety goggles and leather gloves when working on an accumulator. Hydraulic oil under pressure can penetrate skin and result in death or serious injury. If fluid enters skin or eyes, get immediate medical attention from a physician familiar with this injury.



FG018458

Figure 45

Compressed Air

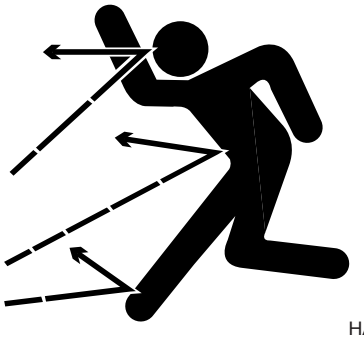
- When cleaning filters, radiator or other components with compressed air, there is a hazard of flying particles that can result in serious injury.
- Always wear safety goggles, dust mask, leather gloves, and other protective devices.

Track Tension Adjustments

Track adjusting systems use grease under high-pressure to keep track under tension. Grease under high-pressure can penetrate body and result in death or serious injury. Watch track or track spring to see if track is being loosened.

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

Keep your face and body away from grease valve. Refer to Operation and Maintenance Manual, for proper procedure in this manual or Shop Manual.



HAOA110L

Figure 46

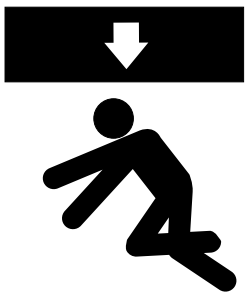
Supports and Blocking for Work Equipment

Do not allow weight or equipment loads to remain suspended and unsupported.

Lower work group to ground before leaving operator's seat.

Do not use hollow, cracked or unsteady wobbling supports.

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



HDO1042L

Figure 47

High-pressure Lines, Tubes and Hoses

When inspecting or replacing high-pressure piping or hoses, check to verify that pressure has been released from circuit. Failure to release pressure can result in death or serious injury. Release pressure as described in Operation and Maintenance Manual.
Always do the following:

- Wear eye protection and leather gloves.
- Fluid leaks from hydraulic hoses or pressurized components can be difficult to see but has enough force to pierce skin and can result in death or serious injury. Always use a piece of wood or cardboard to check for suspected hydraulic leaks. Never use your hands or expose your fingers. Wear safety goggles.
- 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 correctly installed to prevent vibration, rubbing against other parts, and excessive heat during operation.
- Replace hose or components if any of the following problems are found:
  - Damage or leakage from hose end fitting.
  - Wear, damage, cutting of hose covering, or wire braiding is exposed on any hose.
  - Cover portion is swollen in any section.
  - The hose is twisted or crushed.
  - Foreign material is embedded in hose covering.
  - Hose end is deformed.
  - Connection fittings are damaged or leaking.

  NOTE: *Refer to Operation and Maintenance Manual, for additional European regulations.*

High-pressure is generated inside engine fuel lines when engine is running. Before performing inspection or maintenance of fuel line system, wait for at least thirty seconds after stopping engine to let internal pressure drop and tip breather cap up to release residual pressure.

Oil or fuel leaks from high-pressure hoses can cause fire or improper operation, which can result in death or serious injury. If any loose bolts are found, stop work and tighten to specified torque. If any damaged hoses are found, stop operations immediately and contact your DOOSAN distributor for replacement parts.

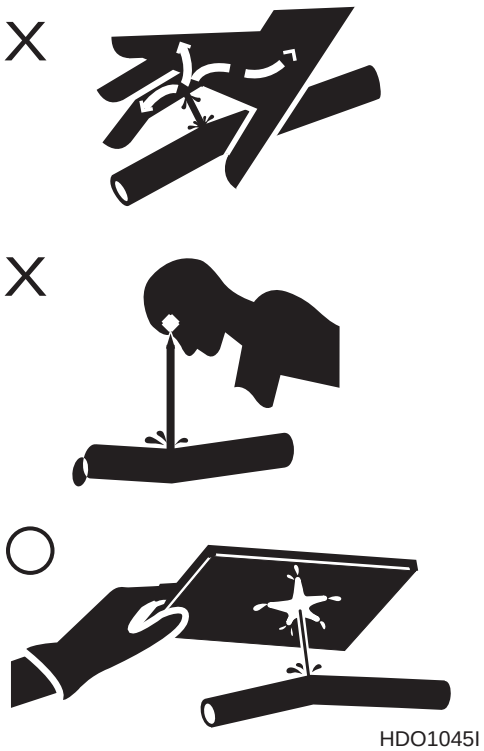


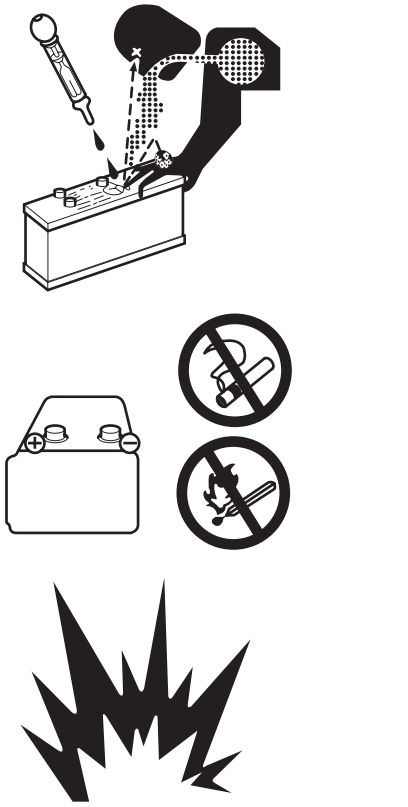
Figure 48

Battery

Battery Hazard Prevention

Battery electrolyte contains diluted sulfuric acid and generates hydrogen gas. Hydrogen gas is highly explosive, and improper handling can cause death or serious injury, or fire. Do not allow electrolyte to contact skin or eyes. Always wear safety goggles and protective clothing when servicing batteries. Wash hands after touching batteries and connectors. Use of acid-resistant gloves is recommended. Always observe the following precautions.

- Do not smoke or bring any flame near battery.
- When working with batteries, Always wear safety goggles, protective clothing, and acid-resistant gloves.
- If you spill battery electrolyte on yourself or your clothes, immediately flush area with water.
- If battery electrolyte gets into your eyes, flush them immediately with large quantities of water and get immediate medical attention from a physician familiar with this injury.
- If you accidentally drink battery electrolyte, call a poison prevention center immediately and get immediate medical attention from a physician familiar with this injury.
- When cleaning top surface of battery, wipe it with a clean, damp cloth. Never use gasoline, thinner, or any other organic solvent or detergent.
- Tighten battery caps.
- If battery electrolyte is frozen, do not charge battery or start engine with power from another source. This could cause the battery to explode and start a fire.
- When charging battery or starting with power from another source, let battery electrolyte thaw and check that there is no leakage of battery electrolyte before starting operation.
- Always remove battery from machine before charging.
- Do not use or charge battery if battery electrolyte level is below LOW LEVEL line. This can cause an explosion. Periodically check battery electrolyte level and add distilled water to bring electrolyte level to FULL LEVEL line.
- Before maintaining or working with batteries, turn starter switch to "O" (OFF) position.



FG018464

Figure 49

Since there is a potential hazard that sparks could be generated, always do the following:

- Do not let tools, rings or other metal objects make any contact between battery terminals. Do not leave tools or other metal objects lying near battery.
- When disconnecting battery terminals, wait for approximately one minute after turning engine starter switch key to "O" (OFF) position, and be sure to disconnect grounding terminal; negative (-) terminal first. Conversely, when connecting them, begin with positive (+) terminal and then grounding (-) terminal, Make sure that all terminals are connected securely.
- Flammable hydrogen gas is generated when battery is charged. Remove battery from machine, take it to a well ventilated place, and remove battery caps, before charging it.
- After charging, tighten battery caps securely.
- After charging, secure battery back in machine.

When repairing or welding electrical system, wait for approximately one minute after turning engine starter switch key "OFF". Then disconnect negative (-) terminal of battery to stop flow of electricity.

ENVIRONMENT AND CIRCUMSTANCES

Work Site Areas Requiring Extra Caution

- Do not operate too close to edge of a quay, ramp, etc.
- Do not operate too close to edge of a steep slope or drop-off. Take care when working in a place where machine may tip over.
- Do not operate on soft ground or near riverbanks that could collapse or where ground may not support weight of excavator.
- Observe changes in ground and traction conditions after a rain or other changes in weather.

Digging Under an Overhang

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

- Do not perform overhead demolition work. This can cause broken objects and debris to fall on top of machine causing death or serious injury, or property damage.

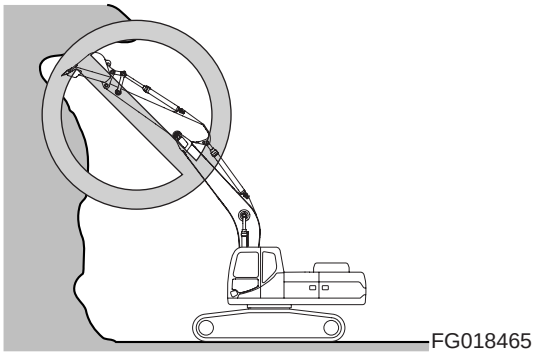


Figure 50

Deep Digging

Do not perform deep digging under front of machine. The ground under machine may collapse and cause machine to fall resulting in death or serious injury.

Working heavy loads on loose, soft or uneven ground, can cause side load conditions resulting in a tip over and injury. Traveling 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.

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

- Do not perform demolition work under machine. There is a hazard that machine may become unstable and tip over.
- When working on or from top of buildings or other structures, check if structure can support weight of machine and attachment. If a building structure collapses, this can cause death or serious injury.

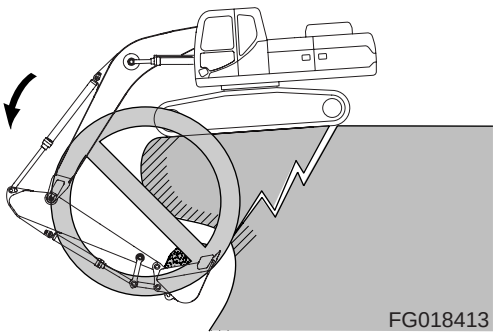


Figure 51

Drop-off or Edge

When working at edge of an excavation or near a drop-off, the machine could tip over, which can result in death or serious injury. Always fasten your seat belt. Check ground conditions of work site before operating to prevent the machine from falling or rollover, and to prevent ground, stockpiles, or banks from collapsing.

Do not travel too close to edge of a drop-off.

Poor Visibility

For good visibility, always do the following:

- When working in dark areas, attach working lights and front lights to the machine. If necessary, set up additional lighting at work site.
- Stop operations when visibility is poor, such as in fog, mist, snow, and rain. Wait for visibility to improve before starting operation.

To avoid hitting work equipment and damaging other property, always do the following:

- When working in tunnels, on bridges, under electrical wires, or when parking the machine or performing other operations in places with limited height, be careful not to hit and damage other equipment or property.
- To prevent hitting objects, operate machine at a slow speed when working in confined spaces, indoors, or in crowded areas.
- Do not swing bucket over the top of personnel or over operator's cabin of dump truck.

Loose or Soft Ground

Do not operate on soft ground or near edge of drop-offs, overhangs, and deep ditches. The ground can collapse because of the weight of the machine causing the machine to fall or rollover.

Check ground conditions before beginning work with the machine. If ground is soft, reposition the machine before operating.

The excavated material must not be dumped too close to edge. How far away from edge of trench excavated material should be dumped depends on soil type and moisture content. If loose clay is being excavated, place it at least 5 m (16 ft) away from edge.

If excavated material is dumped too close to edge, its weight can cause a landslide.

Thawing of frozen ground, rain, traffic, piling and blasting are other factors which increase risk of landslide. The risk also increases on sloping ground. If it is not possible to dig a trench and adequately slope its sides, always install shoring equipment.

Loose ground may easily give way under weight of the machine.

When working on loose or unstable ground, it is important not to dig too deep and to carefully reposition the machine. Do not panic and do not raise bucket, if ground should begin to collapse. Lower work equipment to improve stability of machine.

Never dig under machine, if there is a potential of causing a landslide.

High-voltage Cables

Do not travel or operate machine near electrical cables or overhead power lines. There is a hazard of electric shock, which can cause property damage and result in death or serious injury. The bucket or other attachment does not have to make physical contact with power lines for current to cause an electrocution.

Use a spotter and hand signals to stay away from power lines not clearly visible to operator. On work sites where machine may operate close to electrical cables, always do the following:

- Remember that electrical voltage determines what the minimum distance is to stay away from the power line. See the following table for minimum distances when working near electrical power lines. Electrical flashover can occur and damage machine and cause death or serious injury.

Voltage	Minimum 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")

- Always contact the power company responsible before beginning work near high voltage power lines.

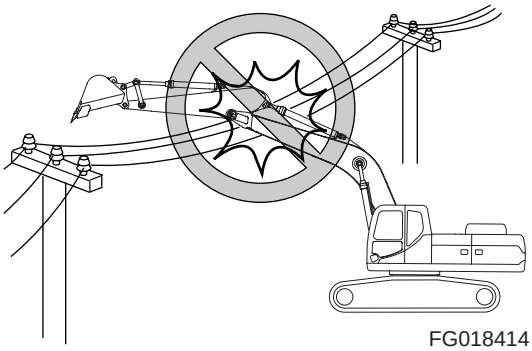

FG018414

Figure 52

Underground Operation

If excavation is in an underground location or in a building, make sure there is adequate overhead clearance, and adequate ventilation.

Special equipment and engines may be required in some countries. Contact your DOOSAN distributor for more information.

Check that there is sufficient room for machine and load.

Move slowly.

Make sure that authorities or companies responsible for underground cables, utilities, and electrical lines have been contacted and that their instructions are followed. Also check which rules apply to ground personnel regarding exposing cables, utilities and electrical lines.

Consider all electrical cables as live.

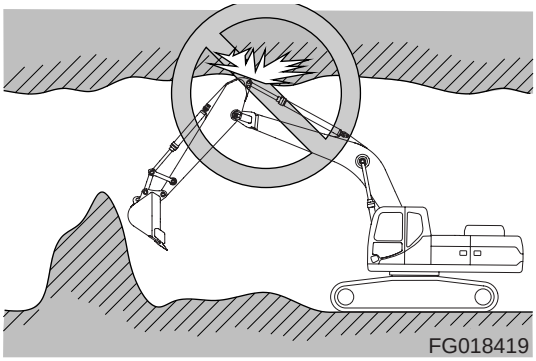


Figure 53

Working in Water

IMPORTANT

Do not exceed maximum permissible water depth. The water level must not reach higher than centerline of upper track roller(s) (1, Figure 54).

After working in water, lubricate all lubrication points on undercarriage, which have been underwater so water is removed. Check that no water has entered travel gearboxes and undercarriage components.

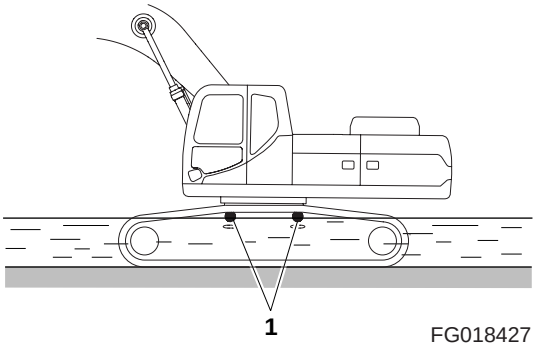


Figure 54

Working in Contaminated Environment

When working within area which is contaminated or where there is a health risk, check local regulations and contact your DOOSAN distributor for assistance with identifying what additional safety precautions need to be taken.

Operation in Extreme Conditions

Operation In Extreme Cold

In extremely cold weather, avoid sudden travel movements and stay away from even slight slopes. The machine could slide down the slope.

Snow accumulation could hide potential hazards and slippery surfaces.

Warming up 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 boom or attachment could cause severe stress in very cold temperatures. Reducing work cycle rate and workload may be necessary.

If machine is to be operated in extremely cold weather temperatures, certain precautions must be taken. The following paragraphs detail checks to be made to be certain machine is capable of operating at these temperatures.

1. Check cooling system for correct mixture of antifreeze solution for lowest expected temperature. Carefully inspect cooling system and repair as necessary.
2. Keep batteries fully charged to prevent freezing. If distilled water is added to batteries, run engine at least one hour to mix electrolyte solution.
3. Keep engine in good mechanical condition for easy starting and good performance during adverse weather.
4. Use engine oil with proper specifications for expected temperatures. Refer to Operation and Maintenance Manual, in this manual or Shop Manual for details.
5. Always keep fuel tank full. Drain condensation from tank before and after operation. Drain and service fuel filter. To eliminate clogging of fuel filters because of wax crystal formation in fuel, be sure that fuel used has a cloud point specification below lowest expected temperature.
6. Lubricate entire machine according to Operation and Maintenance Manual, in this manual or lubrication chart on machine.
7. Start engine and allow it to reach normal operating temperature before operating.
    - If mud and ice collects and freezes on any of moving parts while machine is idle, apply heat to thaw frozen material before attempting to operate machine.
    - Operate hydraulic units with care until they have reached a temperature which enable them to operate normally.
    - Check all machine controls and functions to be sure they are operating correctly.

8. An extra outer air filter should be kept in operator's cabin to replace element that could become iced and cause restricted airflow to engine.

9. Clean off all mud, snow and ice to prevent freezing. Cover machine with a tarp if possible, keep ends of tarp from freezing to ground.

Operation in Extreme Heat

Continuous operation of machine in high temperatures can cause machine to overheat. Monitor engine and hydraulic system temperatures and stop machine to let it cool, when necessary.

1. Make frequent inspections and services of fan and radiator. Check coolant level in radiator. Check grilles and radiator fins for accumulation of dirt, debris and insects which could block cooling passages.

    - Formation of scale and rust in cooling system occurs more rapidly in extremely high temperatures. Change antifreeze each year to keep corrosion inhibitor at full strength.

    - If necessary, flush cooling system periodically to keep passages clear. Avoid use of water with a high alkali content which increases scale and rust formation.

2. Check level of battery electrolyte daily. Keep electrolyte above plates to prevent damage to batteries. Use a slightly weaker electrolyte solution in hot climates. Batteries self-discharge at a higher rate if left standing for long periods at high temperatures. If machine is to stand for several days, remove batteries and store in a cool place.

IMPORTANT

Do not store acid type storage batteries near stacks of tires. Acid fumes can damage rubber.

---

3. Service fuel system as directed in Operation and Maintenance Manual and Operation and Maintenance Manual, of this manual. Check for water content before filling fuel tank. High temperatures and cooling off cause condensation in storage drums.

4. Lubricate as specified in Operation and Maintenance Manual, in this manual or Lubrication Decal on machine.

5. Do not park machine in sun for long periods of time. If possible, park machine under cover to protect it from sun, dirt and dust.

    A. Cover machine if no suitable shelter is available. Protect engine compartment and hydraulics from dirt and debris.

B. In hot, damp climates, corrosion will occur on all parts of machine and will be accelerated during rainy season. Rust and paint blisters will appear on metal surfaces and fungus growth on other surfaces.

C. Protect all unfinished, exposed surfaces with a film of preservative lubricating oil. Protect cables and terminals with ignition insulation compound. Apply paint or suitable rust preventive to damaged surfaces to protect them from rust and corrosion.

Operation In Dusty and Sandy Areas

Operation of machine can cause dust in almost any area. However, when in predominantly dusty or sandy areas, additional precautions must be taken.

1. Keep cooling system fins and cooling areas clean. Blow out with compressed air, if possible, as often as necessary.

WARNING

AVOID DEATH OR SERIOUS INJURY

Wear goggles when using compressed air to prevent face or eye injury.

2. Use care when servicing fuel system to prevent dust and sand from entering tank.
3. Service air cleaner at frequent intervals, check air restriction indicator daily and keep dust cup and dust valve clean. Prevent dust and sand from entering engine parts and compartments as much as possible.
4. Lubricate and perform services outlined on current lubrication chart on machine and Operation and Maintenance Manual. Clean all lubrication fittings before applying lubricant. Sand mixed with lubricant becomes very abrasive and accelerates wear on parts.
5. Protect machine from dust and sand as much as possible. Park machine under cover to keep dust and sand from damaging unit.

Operation in Rainy or Humid Conditions

Operation under rainy or humid conditions is similar to that as in extreme heat procedures previously listed.

1. Keep all exposed surfaces coated with preservative lubricating oil. Pay particular attention to damaged or unpainted surfaces. Cover all paint cracks and chip marks as soon as possible to prevent corrosive effects.

Operation in Saltwater Areas

Saltwater and saltwater spray is very corrosive. When operating in saltwater areas, or in or around snow, observe the following precautions:

1. When exposed to saltwater, dry machine thoroughly and rinse with freshwater, as soon as possible.
2. Keep all exposed surfaces coated with preservative lubricating oil. Pay attention to damaged paint surfaces.
3. Keep all painted surfaces in good repair.
4. Lubricate machine as prescribed on lubrication chart on machine or Operation and Maintenance Manual, in this manual. Shorten lubricating intervals for parts exposed to salt water.
5. Check operating controls to ensure proper functionality and that they return to "NEUTRAL" when released.

Operation at High Altitudes

Operation instructions at high altitudes are the same as those provided for extreme cold. Before operating at high altitudes, engine fuel and air mixture may have to be adjusted according to appropriate engine manual.

1. Check engine operating temperature for evidence of overheating. The radiator cap must make a perfect seal to maintain coolant pressure in cooling system.
    - Perform warming-up operation thoroughly. If machine is not thoroughly warmed up before control levers or control pedals are operated, reaction of machine will be slow.
    - If battery electrolyte is frozen, do not charge battery or start engine with a different power source. There is a potential hazard that could cause a battery explosion or fire.
    - Before charging or starting engine with a different power source, thaw battery electrolyte and check for any leakage of electrolyte before starting.

Operation During Electrical Storms

During electrical storms, do not enter or exit machine.

- If you are off machine, keep away from machine until storm passes.
- If you are in cabin, remain seated with machine stationary until storm passes. Do not touch controls or anything metal.

Exhaust Ventilation



ARO1770L

Figure 55

Engine exhaust gases can cause unconsciousness, loss of alertness, judgment and motor control. This can result in death or serious injury.

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

Check for and be aware of any open windows, doors or ductwork where exhaust may be carried, or blown by wind, exposing others to hazardous exhaust gases.

Ventilation for Enclosed Area

If it is necessary to start engine within an enclosed area, or when handling fuel, flushing oil, or paint; open doors and windows to ensure that adequate ventilation is provided to prevent gas poisoning.

Diesel engine exhaust contains products of combustion which can be harmful to your health.

Always run engine in a well ventilated area. If you are in an enclosed area, vent exhaust to outside.

Asbestos Information

WARNING

AVOID DEATH OR SERIOUS INJURY

Avoid exposure to dust containing asbestos as it can cause death or serious injury to the lungs and other organs (mesothelioma, lung and other cancers, and asbestosis).



ARO1770L

Figure 56

Asbestos dust can be HAZARDOUS to your health if it is inhaled. Materials containing asbestos fiber can be present on work sites. Breathing air that contains asbestos fiber can ultimately cause serious or fatal lung damage or diseases such as mesothelioma, lung and other cancers, and asbestosis. To prevent lung damage from asbestos fiber, observe the following precautions:

- Use an approved respirator that is approved for use in an asbestos-laden atmosphere.
- Use water for cleaning to keep down dust.
- Always observe any regulations related to work site and working environment.
- Avoid brushing or grinding materials that contain asbestos.
- A vacuum cleaner that is equipped with a high efficiency particulate air filter can also be used.
- Comply with applicable laws and regulations for workplace.

- Stay away from areas that might have asbestos particles in air.

Silica Dust Information

WARNING

AVOID DEATH OR SERIOUS INJURY

Avoid exposure to dust containing crystalline silica particles as it can cause serious injury to the lungs (silicosis).



ARO1770L

Figure 57

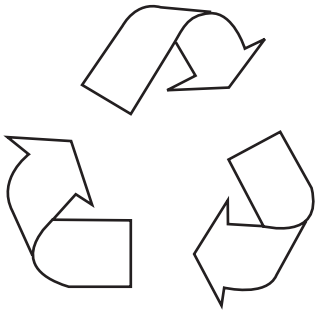
Cutting or drilling concrete containing sand or rock containing quartz can result in exposure to silica dust. Do not exceed Permissible Exposure Limits (PEL) to silica dust as determined by OSHA or other work site rules, laws and regulations. Use a respirator, water spray or other means to control dust. Silica dust can cause lung disease and is known to the state of California to cause cancer.

Disposal of DHazardous Materials

Physical contact with used motor oil or gear oil could create a health risk. Wipe oil from your hands promptly and wash off any remaining residue.

Used motor oil or gear oil is an environmental contaminant and should only be disposed of at approved collection facilities. To prevent pollution of environment, always do the following:

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



FG009156

Figure 58

Improperly disposing of waste can threaten environment. Potentially harmful fluids should be disposed of according to local regulations.

Use all cleaning solutions with care. Report all necessary repairs.

Sound

Sound Level Information: Hearing protection may be needed when machine is operated with an open operator station for extended periods or in a noisy environment.

See Operation and Maintenance Manual for sound levels for your machine.

Vibration

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

Whole Body: The weighted root mean square acceleration to which 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 Reducing Vibrations:

1. Select proper machine, equipment and attachments for a particular application.
2. Replace any damaged seat with a genuine DOOSAN seat. Keep seat properly maintained and adjusted.
    - Adjust seat and suspension for weight and size of operator.
    - Inspect and maintain suspension and adjustment mechanisms for seat regularly.
3. Check that machine is properly maintained.
4. Operate controls smoothly when; steering, accelerating, slowing down, loading, or moving attachments.
5. Adjust machine speed and travel path to reduce vibration level.
    - Slow down when traveling over rough terrain or long distances.
    - Avoid obstacles and rough terrain.

Specifications

Specifications for DX225LC-3

Edition 1

MEMO

Table of Contents

Specifications for DX225LC-3

Safety Instructions 5
Applicable Models 5
General Description 7
Component Locations 8
General Dimensions 10
One - Piece Boom 10
Two - Piece Boom 11
Working Range 12
One - Piece Boom 12
Two - Piece Boom 14
General Specifications 16
Engine Performance Curves (Per KS-R1004 Standard) 18
Approximate Weight of Workload Materials 20
Performance Tests 22
Excavator Performance Measurements 23
Test Conditions 23
Travel Speed and Travel Motor Balance (Steering Deviation) Tests 23
Swing Speed and Deceleration Force Test 25
Cylinder Performance Tests 27

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

GENERAL DESCRIPTION

The excavator has three main component sections:

- The Upper Structure
- 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

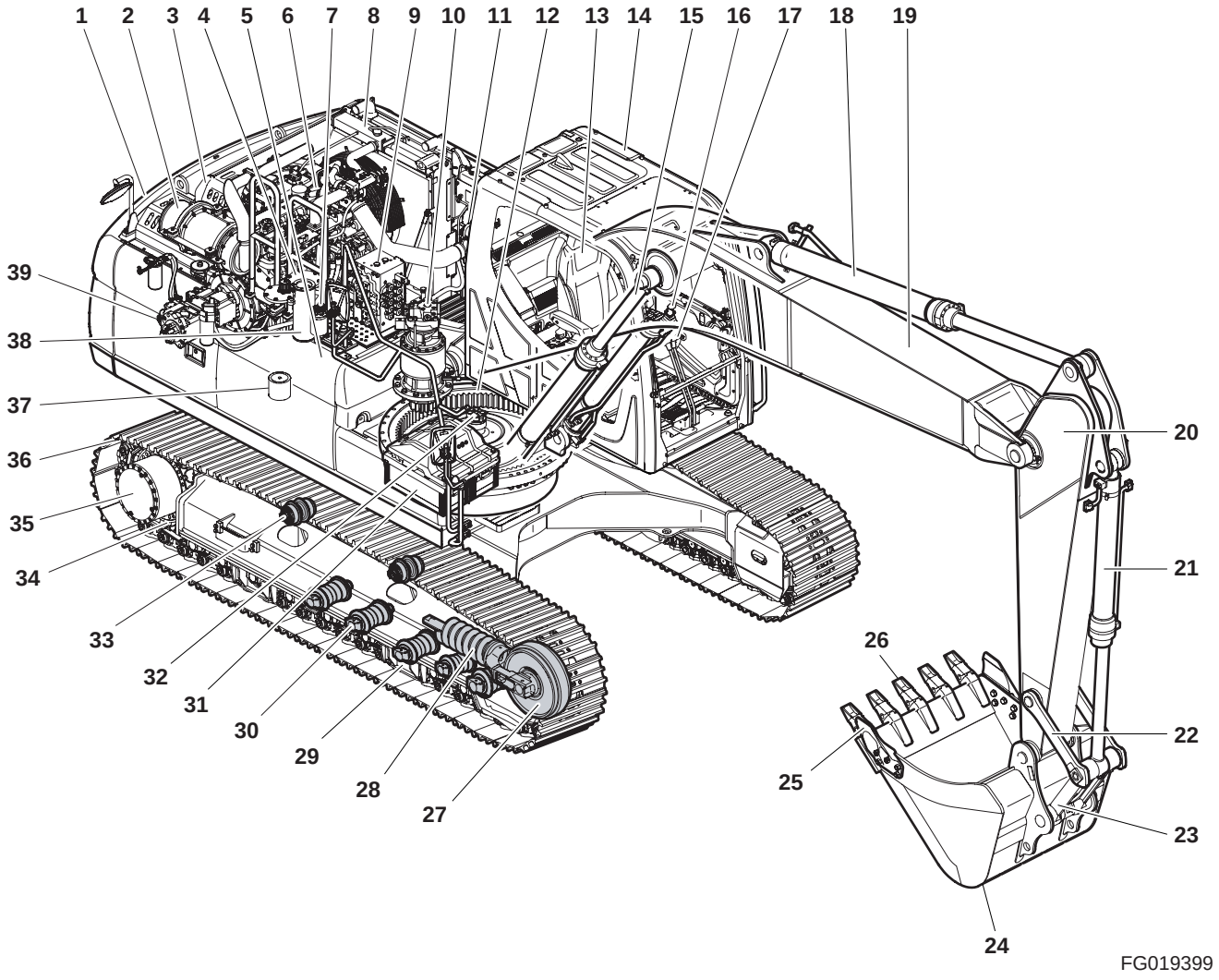


Figure 1

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

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

GENERAL DIMENSIONS

One - Piece Boom

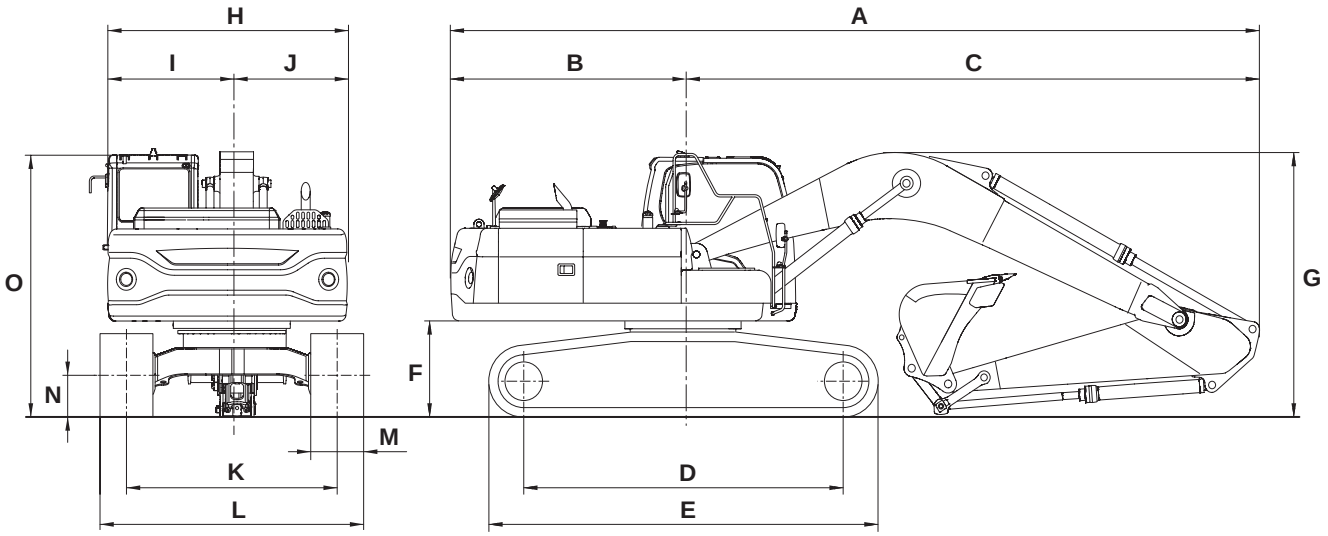


Figure 2

Dimension	5.7 m (18' 8") Boom			8.5 m (27' 11") Boom
	2.9 m (9' 6") Arm	**2.4 m (7' 10") Arm**	**3.5 m (11' 6") Arm**	**6.2 m (20' 4") Arm**
A	9,490 mm (31' 2")	9,540 mm (31' 3")	9,540 mm (31' 4")	12,355 mm (40' 6")
B	2,790 mm (9' 2")			
C	6,710 mm (22')	6,750 mm (22' 2")	6,750 mm (22' 2")	9,565 mm (31' 5")
D	3,650 mm (12' 12")			
E	4,445 mm (14' 7")			
F	1,055 mm (3' 6")			
G (Boom)	2,870 mm (9' 5")	2,970 mm (9' 9")	3,130 mm (10' 3")	3,190 mm (10' 6")
G (Hose)	3,005 mm (9' 10")	3,130 mm (10' 3")	3,330 mm (10' 11")	3,275 mm (10' 11")
H	2,710 mm (8' 10")			
I	1,400 mm (4' 7")			
J	1,310 mm (4' 4")			
K	2,390 mm (7' 10")			
L	2,990 mm (9' 10")			
M	600 mm (1' 12")			
N	480 mm (1' 7")			
O	2,975 mm (9' 9")			

Two - Piece Boom

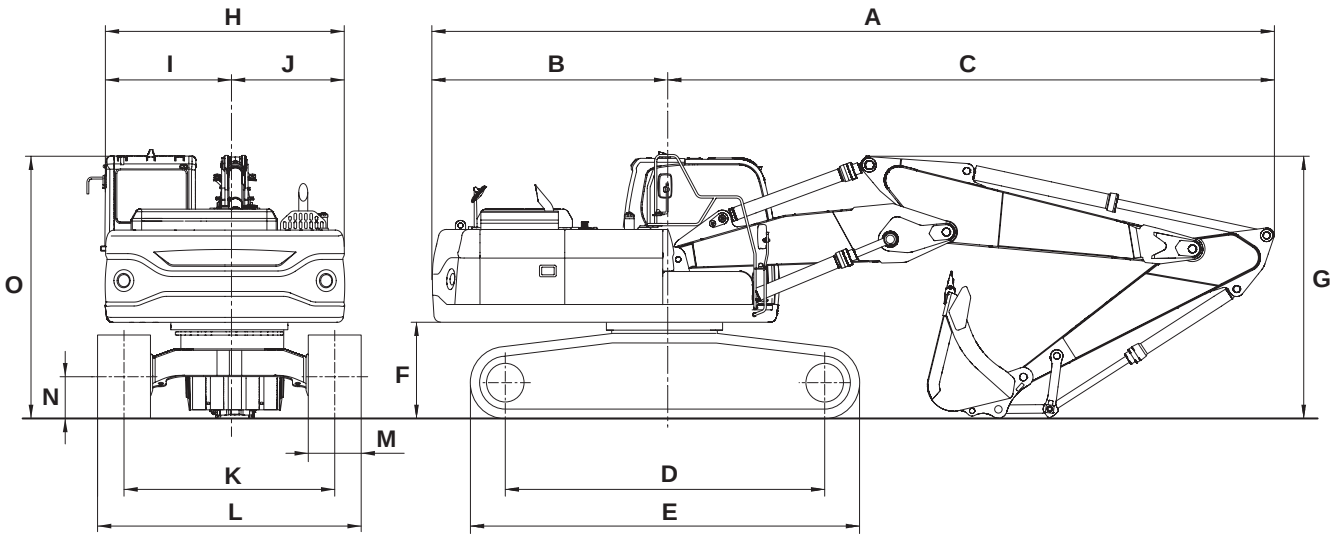


Figure 3

Dimension	5.85 m (19' 2") Boom	
	2.4 m (7' 10") Arm	**2.9 m (9' 6") Arm**
A	9,690 mm (31' 9")	9,680 mm (31' 9")
B	2,790 mm (9' 2")	
C	6,900 mm (22' 8")	6,890 mm (22' 7")
D	3,650 mm (12' 12")	
E	4,445 mm (14' 7")	
F	1,055 mm (3' 6")	
G (Boom)	3,100 mm (10' 2")	3,080 mm (10' 1")
G (Hose)	3,100 mm (10' 2")	3,080 mm (10' 1")
H	2,710 mm (8' 10")	
I	1,400 mm (4' 7")	
J	1,310 mm (4' 4")	
K	2,390 mm (7' 10")	
L	2,990 mm (9' 10")	
M	600 mm (1' 12")	
N	480 mm (1' 7")	
O	2,975 mm (9' 9")	

WORKING RANGE

WARNING

AVOID DEATH OR SERIOUS INJURY

The "L" (Digging Reach) or "L" dimension, 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 death or serious injury and/or equipment damage.

One - Piece Boom

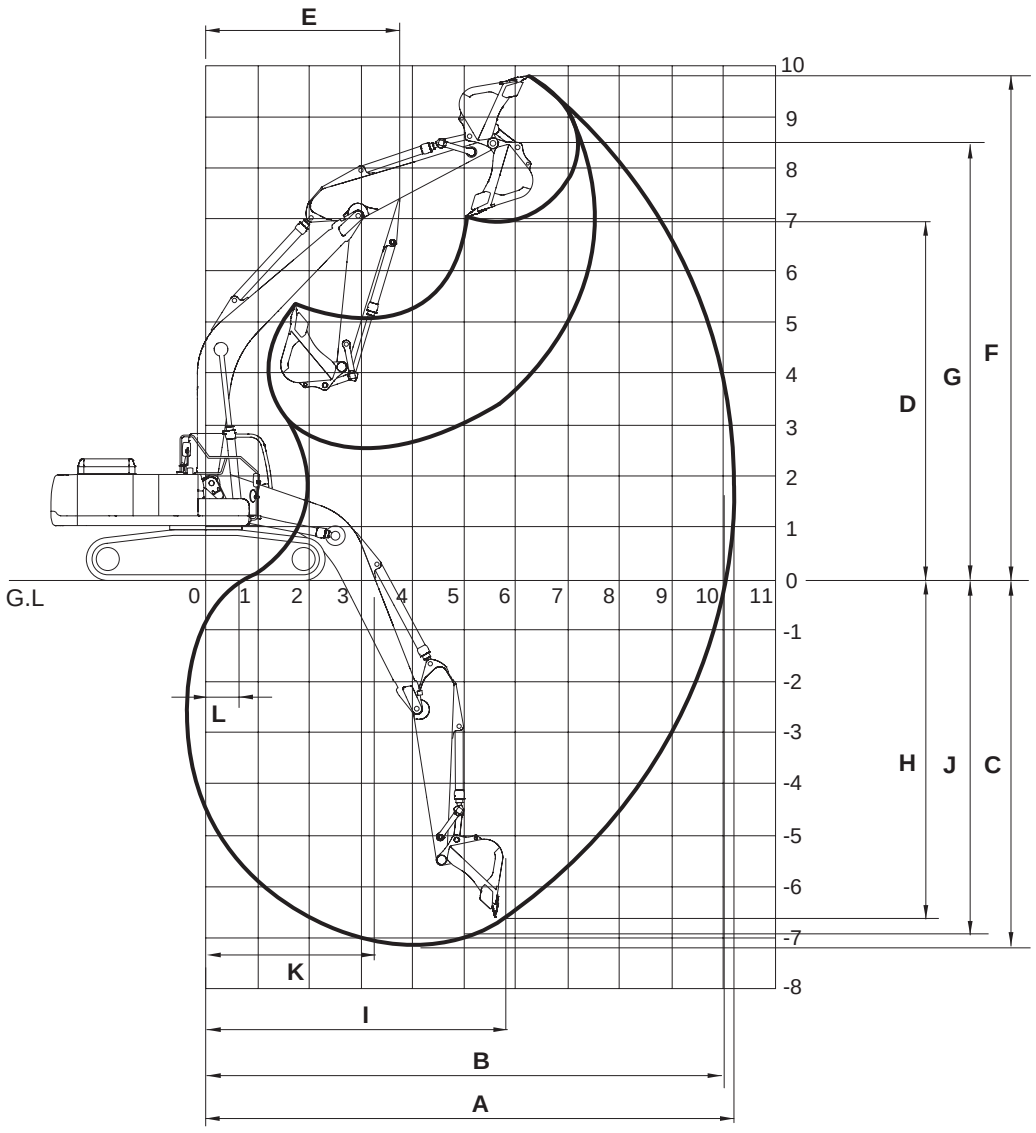


Figure 4

DIM.	Boom	5.7 m (18' 8")			8.5 m (27' 11")
	Arm	**2.4 m (7' 10")**	**2.9 m (9' 6")**	**3.5 m (11' 6")**	**6.2 m (20' 4")**
	Bucket Type (PCSA)	**1.05 m^3 (1.37 yd^3)**	**0.92 m^3 (1.20 yd^3)**	**0.81 m^3 (1.06 yd^3)**	**0.39 m^3 (0.51 yd^3)**
A	Max. Digging Reach	9,470 mm (31' 1")	9,885 mm (32' 5")	10,390 mm (34' 10")	15,380 mm (50' 5")
B	Max. Digging Reach (Ground)	9,280 mm (30' 5")	9,710 mm (31' 10")	10,220 mm (33' 6")	15,265 mm (50' 1")
C	Max. Digging Depth	6,080 mm (19' 11")	6,585 mm (21' 7")	7,190 mm (23' 7")	11,650 mm (38' 3")
D	Max. Loading Height	6,700 mm (21' 12")	6,840 mm (22' 5")	6,980 mm (22' 11")	10,845 mm (35' 7")
E	Min Swing Radius	3,580 mm (11' 9")	3,560 mm (11' 8")	3,620 mm (11' 10")	4,960 mm (16' 3")
F	Max. Digging Height	9,450 mm (31')	9,560 mm (31' 4")	9,660 mm (31' 8")	13,075 mm (42' 11")
G	Max. Bucket Pin Height	8,155 mm (26' 9")	8,295 mm (27' 2")	8,440 mm (27' 8")	12,075 mm (39' 7")
H	Max. Vertical Wall Depth	5,365 mm (17' 7")	5,625 mm (18' 5")	5,975 mm (19' 7")	9,710 mm (31' 10")
I	Max. Radius Vertical	6,025 mm (19' 9")	6,380 mm (20' 11")	6,740 mm (22' 1")	10,065 mm (33')
J	Max. Depth to 2.5 m Line	5,880 mm (19' 3")	6,400 mm (20' 12")	7,020 mm (23')	11,550 mm (37' 11")
K	Min. Radius 2.5 m Line	2,865 mm (9' 5")	2,855 mm (9' 4")	2,825 mm (9' 3")	4,875 mm (15' 12")
L	Min. Digging Reach	1,685 mm (5' 6")	510 mm (1' 8")	-230 mm (-9")	155 mm (6")

Two - Piece Boom

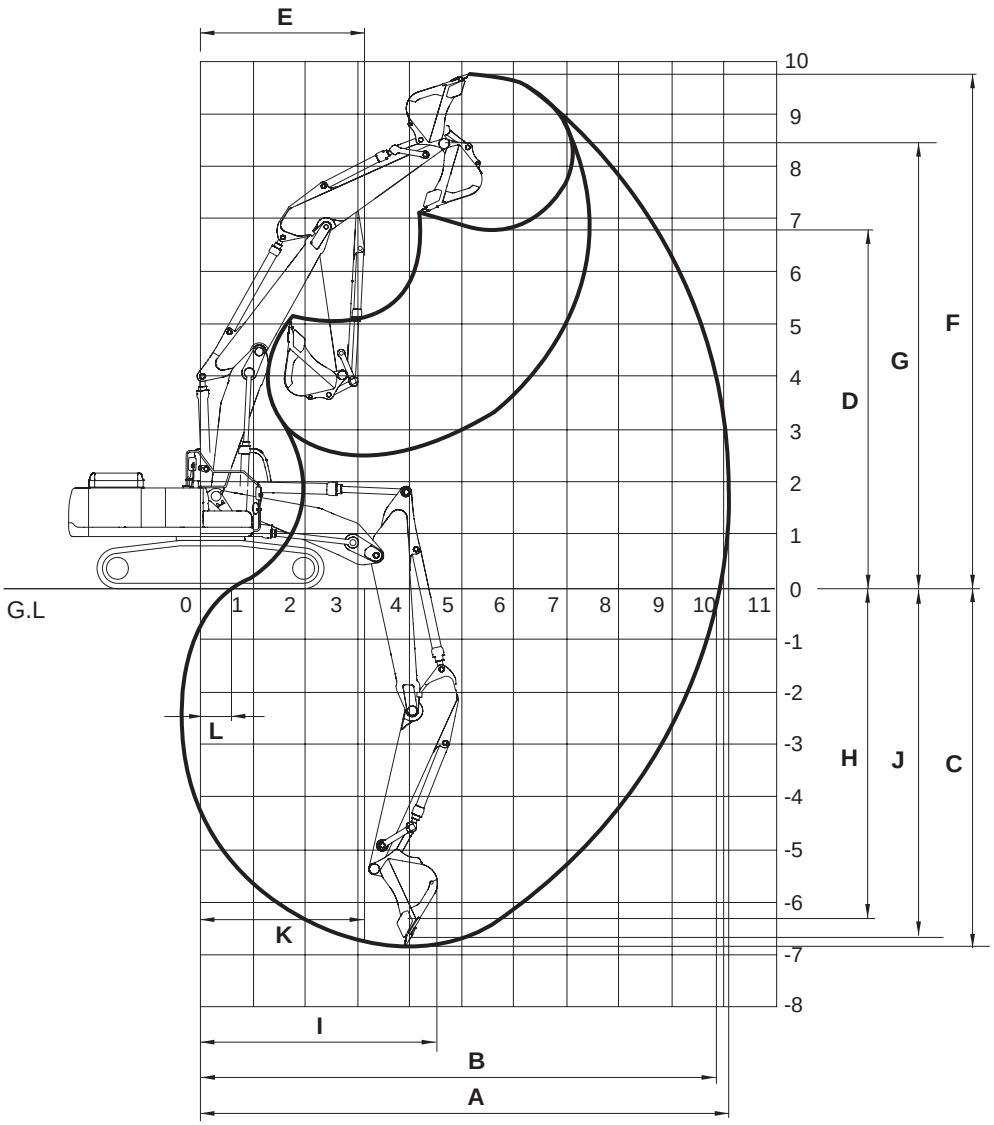


Figure 5

DIM.	Boom	5.85 m (19' 2")	
	Arm	**2.4 m (7' 10")**	**2.9 m (9' 6")**
	Bucket Type (PCSA)	**0.92 m^3 (1.20 yd^3)**	**0.81 m^3 (1.06 yd^3)**
A	Max. Digging Reach	9,680 mm (31' 9")	10,110 mm (33' 2")
B	Max. Digging Reach (Ground)	9,500 mm (31' 2")	9,940 mm (32' 7")
C	Max. Digging Depth	5,980 mm (19' 7")	6,460 mm (21' 2")
D	Max. Loading Height	8,010 mm (26' 3")	8,310 mm (27' 3")
E	Min Swing Radius	2,790 mm (9' 2")	2,625 mm (8' 7")
F	Max. Digging Height	10,910 mm (35' 9")	11,200 mm (36' 9")
G	Max. Bucket Pin Height	9,465 mm (31' 1")	9,770 mm (32' 1")
H	Max. Vertical Wall Depth	4,955 mm (16' 3")	5,355 mm (17' 7")
I	Max. Radius Vertical	6,355 mm (20' 10")	6,620 mm (21' 9")
J	Max. Depth to 2.5 m Line	5,865 mm (19' 3")	6,350 mm (21' 10")
K	Min. Radius 2.5 m Line	1,735 mm (5' 8")	1,735 mm (5' 8")
L	Min. Digging Reach	2,155 mm (7' 1")	1,245 mm (4' 1")

GENERAL SPECIFICATIONS

Shipping Weight	21.5 tons (47,400 lb)
	Includes 10% fuel, 5,700 mm (18' 8") boom, 2,900 mm (9' 6") arm, 0.92 m^3 (1.20 yd^3) backhoe bucket and standard shoes
Operating Weight	Add weight of full fuel tank and operator.
Shipping Weights With Optional Track Shoes	Add 284 kg (626 lb) for 700 mm (28") shoes
	Add 566 kg (1,248 lb) for 800 mm (32") shoes
	Add 850 kg (1,874 lb) for 900 mm (36") shoes
Major Component Weights	Standard Boom 1,427 kg (3,146 lb)
	2,400 mm (7' 10") Arm 566 kg (1,247 lb)
	2,900 mm (9' 6") Arm 651 kg (1,435 lb)
	3,500 mm (11' 2") Arm 793 kg (1,748 lb)
	Boom Cylinders 178 kg (392 lb) each
	Arm Cylinder 257 kg (567 lb)
	Bucket Cylinder 145 kg (320 lb)
	Counterweight 4,300 kg (9,480 lb)
	Upper Structure 5,670 kg (1,250 lb)
	Lower - below Swing Bearing 7,646 kg (16,857 lb)
Digging Forces (At Power Boost, ISO)	
Bucket Cylinder	149 KN or 15,200 kg (33,500 lb) with Mono Boom/Articulated Boom + GP Bucket 98 KN or 10,000 kg (22,050 lb) with SLR + GP Bucket
Arm Cylinder	106 KN or 10,800 kg (23,800 lb) with 2,900 mm (9' 6") Standard Arm
Fuel Tank Capacity	400 liters (106 U.S. gal)
Hydraulic System Capacity	240 liters (63 U.S. gal)
Hydraulic Reservoir Capacity	200 liters (52.8 U.S. gal)
Bucket Heaped Capacity Range	SAE 0.51 - 1.49 m^3 (0.67 - 1.95 yd^3) Mono Boom/Articulated Boom SAE 0.39 - 0.45 m^3 (0.51 - 0.59 yd^3) SLR
	NOTE: Refer to the Load Weight, Bucket and Arm Length Compatibility Table for information on which bucket sizes are approved with which arm length and work load material weights.
Shoe Type	Triple Grouser
Shoe Width and Optional Sizes	600 mm (24") - standard
	700 mm (28") - optional
	800 mm (32") - optional
	900 mm (36") - optional
Ground Pressure Ratings:	
Standard 600 mm (24") shoe	0.46 kg/cm^2 (6.54 psi)
Optional 700 mm (28") shoe	0.40 kg/cm^2 (5.73 psi)
Optional 800 mm (32") shoe	0.36 kg/cm^2 (5.12 psi)
Optional 900 mm (36") shoe	0.32 kg/cm^2 (4.55 psi)

Transport Dimensions	
Overall Shipping Length (standard boom and arm)	9,490 mm (31' 2")
Overall Shipping Width (standard shoes)	2,990 mm (9' 10")
Overall Shipping Height (to top of cylinder hose)	3,005 mm (9' 10")
Track Shipping Length	4,445 mm (14' 7")
Transport Trailer Capacity	22 tons (24 short tons), minimum load capacity
Transport Loading Ramp	
Allowable Slope When Transporting	15° angle **NOTE:** Refer to Operation and Maintenance Manual for Recommended Transportation Instructions.

ENGINE PERFORMANCE CURVES (PER KS-R1004 STANDARD)

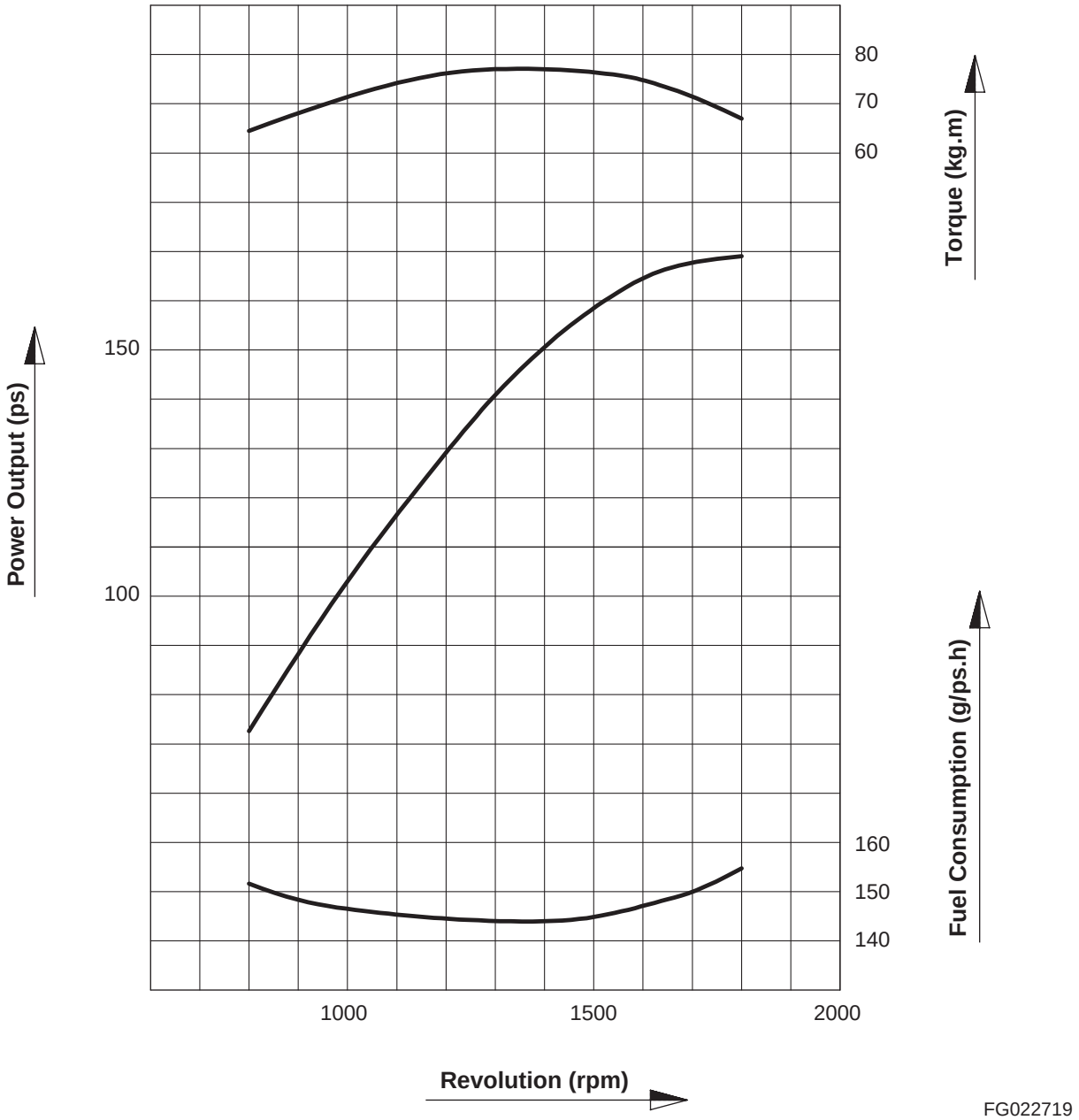


Figure 6

Condition	Specification
Engine Model	DL06K
Barometric Pressure	760 mmHg (20°C (68°F))
Cooling Fan	ø704 mm (28"), 11-Blade, Sucker
Alternator	24V x 60A
Air Cleaner	Installed
Muffler (DPF)	Installed

Performance Standard	KS-R1004
Power	169 ps @ 1,800 rpm (167 hp @ 1,800 rpm)
Max. Torque	77 kg•m @ 1,400 rpm (557 ft lb @ 1,400 rpm)
Fuel Consumption (Rated)	155 g/ps•h (5.55 oz/hp•h)

APPROXIMATE WEIGHT OF WORKLOAD MATERIALS

IMPORTANT

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

Material	Density 1,200 kg/m³ (2,000 lb/yd³), or less	Density 1,500 kg/m³ (2,500 lb/yd³), or less	Density 1,800 kg/m³ (3,000 lb/yd³), or less	Density 2,100 kg/m³ (3,500 lb/yd³), or less
Charcoal	401 kg/m³ (695 lb/yd³)	-	-	-
Coke, blast furnace size	433 kg/m³ (729 lb/yd³)	-	-	-
Coke, foundry size	449 kg/m³ (756 lb/yd³)	-	-	-
Coal, bituminous slack, piled	801 kg/m³ (1,350 lb/yd³)	-	-	-
Coal, bituminous r. of m., piled	881 kg/m³ (1,485 lb/yd³)	-	-	-
Coal, anthracite	897 kg/m³ (1,512 lb/yd³)	-	-	-
Clay, DRY, in broken lumps	1,009 kg/m³ (1,701 lb/yd³)	-	-	-
Clay, DAMP, natural bed	-	-	1,746 kg/m³ (2,943 lb/yd³)	-
Cement, portland, DRY granular	-	-	1,506 kg/m³ (2,583 lb/yd³)	-
Cement, portland, DRY clinkers	-	1,362 kg/m³ (2,295 lb/yd³)	-	-
Dolomite, crushed	-	-	1,522 kg/m³ (2,565 lb/yd³)	-
Earth, loamy, DRY, loose	-	1,202 kg/m³ (2,025 lb/yd³)	-	-
Earth, DRY, packed	-	-	1,522 kg/m³ (2,565 lb/yd³)	-
Earth, WET, muddy	-	-	1,762 kg/m³ (2,970 lb/yd³)	-
Gypsum, calcined, (heated, powder)	961 kg/m³ (1,620 lb/yd³)	-	-	-

Material	Density 1,200 kg/m³ (2,000 lb/yd³), or less	Density 1,500 kg/m³ (2,500 lb/yd³), or less	Density 1,800 kg/m³ (3,000 lb/yd³), or less	Density 2,100 kg/m³ (3,500 lb/yd³), or less
Gypsum, crushed to 3 inch size	-	-	1,522 kg/m³ (2,565 lb/yd³)	-
Gravel, DRY, packed fragments	-	-	-	1,810 kg/m³ (3,051 lb/yd³)
Gravel, WET, packed fragments	-	-	-	1,922 kg/m³ (3,240 lb/yd³)
Limestone, graded above 2	-	1,282 kg/m³ (2,160 lb/yd³)	-	-
Limestone, graded 1-1/2 or 2	-	1,362 kg/m³ (2,295 lb/yd³)	-	-
Limestone, crushed	-	-	1,522 kg/m³ (2,565 lb/yd³)	-
limestone, fine	-	-	1,602 kg/m³ (2,705 lb/yd³)	-
Phosphate, rock	-	1,282 kg/m³ (2,160 lb/yd³)	-	-
Salt	929 kg/m³ (1,566 lb/yd³)	-	-	-
Snow, light density	529 kg/m³ (891 lb/yd³)	-	-	-
Sand, DRY, loose	-	-	1,522 kg/m³ (2,565 lb/yd³)	-
Sand, WET, packed	-	-	-	1,922 kg/m³ (3,240 lb/yd³)
Shale, broken	-	1,362 kg/m³ (2,295 lb/yd³)	-	-
Sulfur, broken	529 kg/m³ (891 lb/yd³)	-	-	-

PERFORMANCE TESTS

1. Main Relief Pressure

   normal operation: 330 kg/cm^2 (4,693 psi)

   with "Pressure Up": 350 kg/cm^2 (4,978 psi)

2. Actuator Speeds

Operation		Unit	Standard Mode	Power Plus Mode
Boom	Up	sec	3.5 ± 0.4	3.0 ± 0.4
	Down	sec	2.5 ± 0.3	2.4 ± 0.3
Arm	Crowd	sec	4.2 ± 0.4	3.8 ± 0.4
	Dump	sec	2.6 ± 0.3	2.4 ± 0.3
Bucket	Crowd	sec	4.5 ± 0.4	3.7 ± 0.4
	Dump	sec	2.6 ± 0.3	2.3 ± 0.3
Swing (3 Revolutions)		sec	18.4 ± 1.5	16.2 ± 1.5
Dozer	Low	sec	1.9 ± 0.4	1.8 ± 0.4
	High	sec	1.9 ± 0.4	1.8 ± 0.4
Jack-up Speed (3 Turns)	Low	sec	36.7 ± 2.0	33.0 ± 2.0
	High	sec	20.0 ± 1.5	18.0 ± 1.5
Travel Speed 20 m (66 ft)	Low	sec	26.7 ± 1.5	24.0 ± 1.5
	High	sec	14.5 ± 1.0	13.0 ± 1.0
Travel Deviation 20 m (66 ft)	High	mm (in)	150 (6)	150 (6)
	Low	mm (in)	150 (6)	150 (6)

EXCAVATOR PERFORMANCE MEASUREMENTS

Evaluation of equipment performance under certain operating conditions can be made by running the excavator through a series of different tests, and recording results with a stopwatch and tape measure.

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

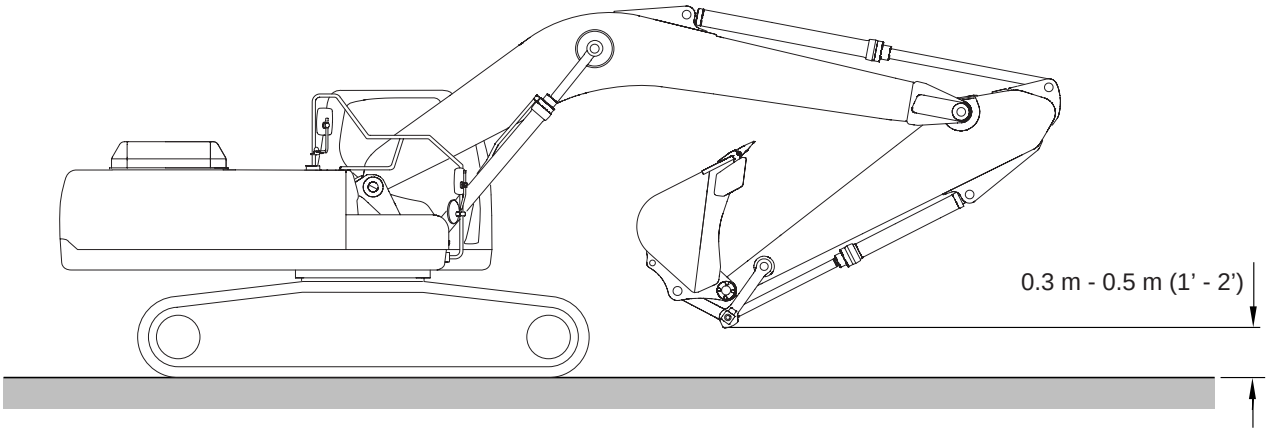
Test Conditions

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. 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 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 7.



FG018735

Figure 7

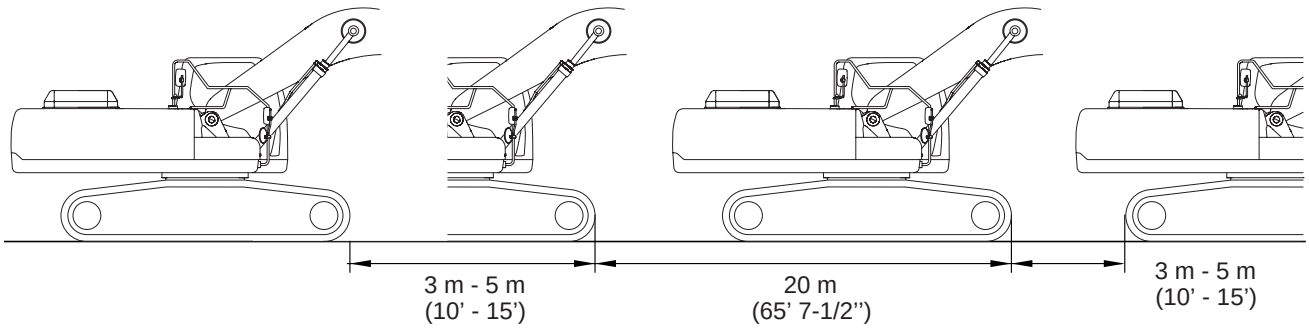
The lowest part of the bucket linkage should be 0.3 - 0.5 m (1' - 2') off the ground.

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 runoff 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:

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



FG018737

Figure 8

Travel Deviation

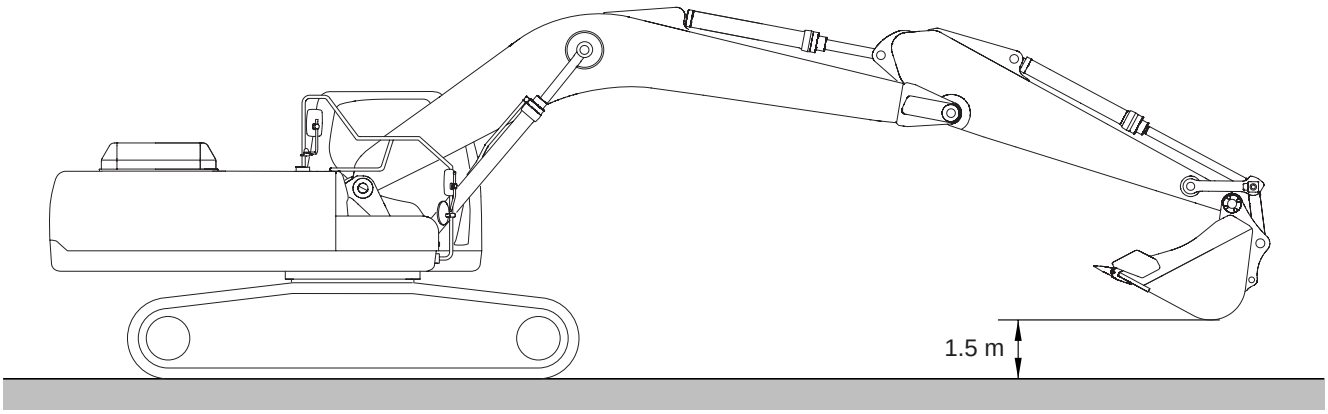
To check steering deviation (travel motor balance), use a long tape or rope, or the edge of a straight road curb or other marker to verify side to side travel motor uniformity.

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 8)

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

Swing Speed and Deceleration Force Test

Swing Speed Test



FG018736

Figure 9

Extend the bucket cylinder completely and retract the arm cylinder, as shown in Figure 9, 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 upper structure and undercarriage, or select alternate measuring locations and use a stopwatch to time three (3) full 360° rotations. The time required for three (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 upper structure so the boom is evenly centered between the side frames, pointing straight ahead. Locate the 90° reference point, perpendicular to the boom. Mark the upper structure and undercarriage with paint at the 90° point.

Make several attempts to rotate the upper structure 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 10.

Record how far the upper structure 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

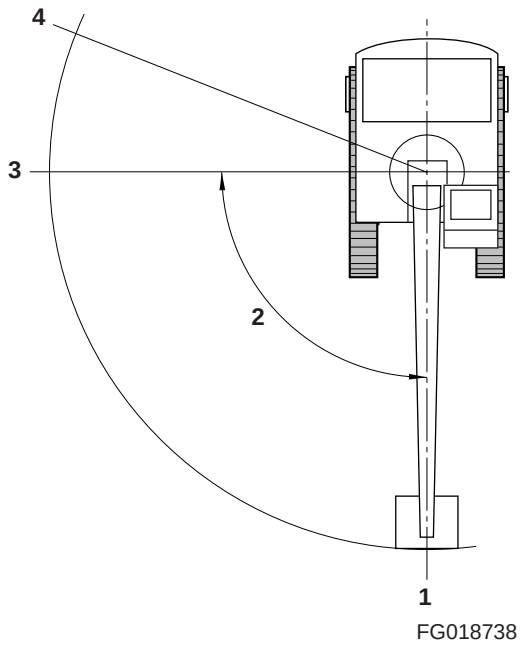


Figure 10

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 Mode and Power Mode.

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 Mode and Power Mode.

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 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 drift after 5 minutes. Bucket cylinder should not show more than 40 mm (1.57") change, while the arm and boom cylinders should not drift down 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 three (3) full rotations, during both high-speed and low speed operation.

General Maintenance

General Maintenance Instructions

Edition 2

Table of Contents

General Maintenance Instructions

Safety Instructions 5
Applicable Models 5
Welding Precautions and Instructions 6
Hydraulic System - General Precautions 7
Maintenance Service and Repair Procedure 9
General Precautions 9
Hydraulic System Cleanliness and Oil Leaks 10
Maintenance Precautions for Hydraulic System Service 10
Oil Leakage Precautions 11
Cleaning and Inspection 12
General Instructions 12
Bearing Inspection 13

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

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 INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

AVOID DEATH OR SERIOUS INJURY

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 result. Always consult *DOOSAN* After Sales Service before welding on integral components (loader arm, frames, car body, track frames, upper structure, 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.

WARNING

AVOID DEATH OR SERIOUS INJURY

Always perform welding procedures with proper safety equipment and adequate ventilation in a dry work area. Keep a fire extinguisher near and wear personal protective equipment.

WARNING

AVOID DEATH OR SERIOUS INJURY

Observe the following safety instructions:

1. **Use adequate safety shielding and keep away from fuel and oil tanks, batteries, hydraulic piping lines or other fire hazards when welding.**
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 could be damaged by weld spatters. Use adequate shielding protection in front of the assembly.**
5. **During welding 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 of removal from a freshly opened container.**

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 tolerances between moving parts (e.g. pistons and cylinders, or shoes and swash plates), 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 because of neglect or careless maintenance, could all produce sufficient fluid loss to cause damage or improper operation.

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 shows 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 lessen 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.

Before starting the machine, a daily walk-around safety inspection, including a quick visual inspection 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 workloads, fluid circulating under high-pressure) make it extremely critical that dust, grit or any other 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 maintenance service or repair is being performed.

NOTE: *If the unit is being used in an extreme temperature environment (in subfreezing 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 because of a mechanical problem inside the pump. However, pressure loss could also be because of 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 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 troubleshooting or service is being performed, it's important to remember that 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 noncombustible, evaporative type, low residue solvent and thoroughly clean exterior surfaces of assemblies before any part of the circuit is opened 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.

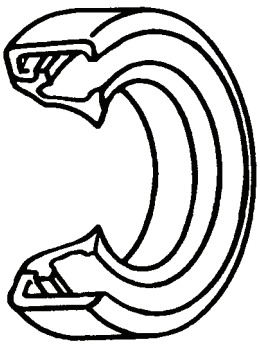
Oil Leakage Precautions

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. 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 suddenly put a stop to normal hydraulic function. You can prevent having to make these types of repairs by the 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.*



0565A

Figure 1

CLEANING AND INSPECTION

General Instructions

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

AVOID DEATH OR SERIOUS INJURY

Do not inhale vapors or allow solvent type cleaners to contact skin. Keep solvent away from open flame, arcs or sparks or other sources of ignition that could start a fire.

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 airstream 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 lightweight 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 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 and on oil seals to assure an oil tight install 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. 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 no twisted splines, 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 for roughness of rotation, scoring, pitting, cracked or chipped races. If any of these defects are found replace the whole bearing assembly. NEVER replace the bearing alone without replacing the mating cup or the cone at the same time.

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

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

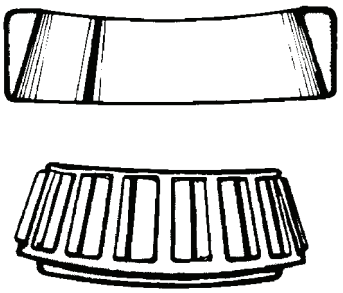
If available, use magna-flux or similar process for checking for cracks that are not visible.

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.

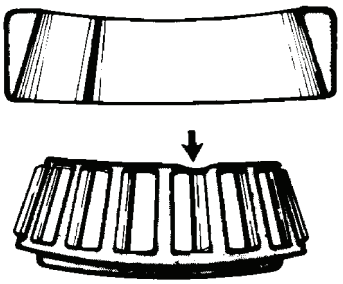


HASA620S

Figure 2

Bent Cage

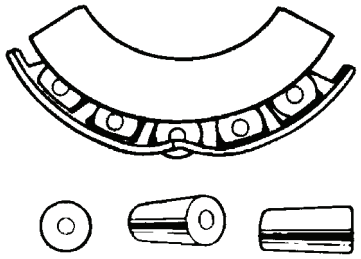
Cage damage because of improper handling or tool usage.



HASA460S

Figure 3

Replace bearing.



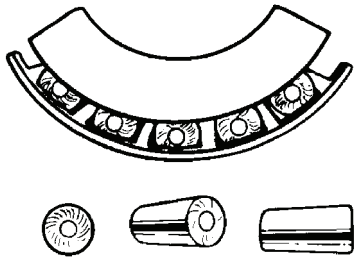
HASA470S

Figure 4

Galling

Metal smears on roller ends because of overheat, lubricant failure or overload.

Replace bearing - check seals and check for proper lubrication.



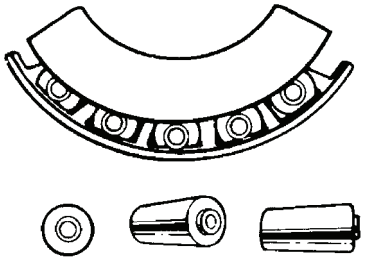
HASA480S

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.



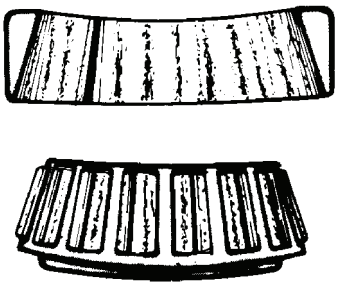
HASA490S

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.



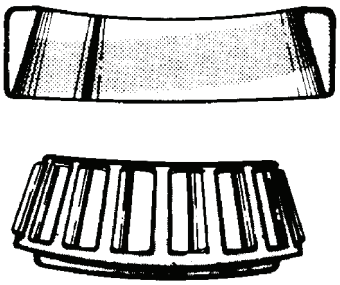
HASA500S

Figure 7

Misalignment

Outer race misalignment because of foreign object.

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



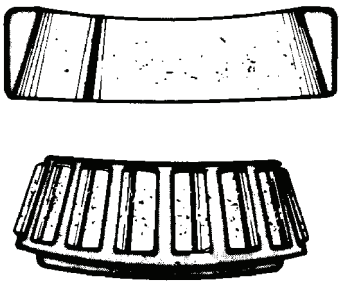
HASA510S

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.



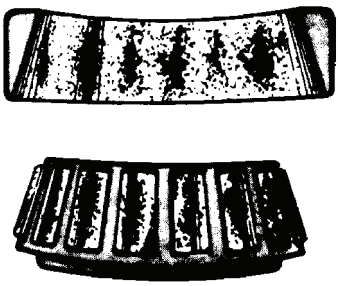
HASA520S

Figure 9

Fatigue Spalling

Flaking of surface metal resulting from fatigue.

Replace bearing - clean all related parts.



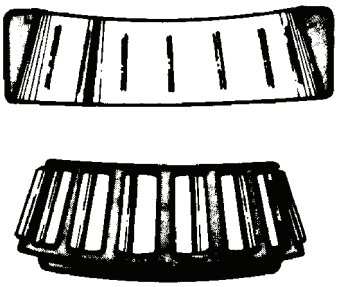
HASA530S

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.



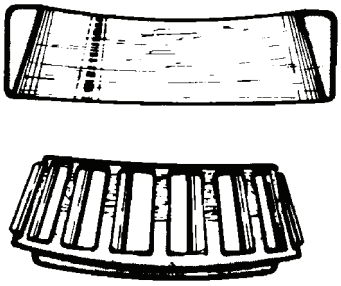
HASA540S

Figure 11

Cage Wear

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

Replace bearings - check seals.



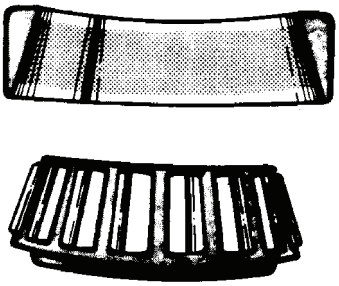
HASA550S

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.



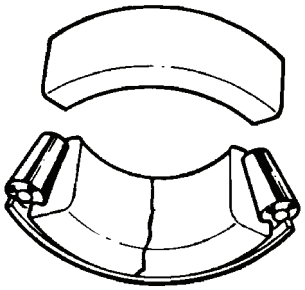
HASA560S

Figure 13

Cracked Inner Race

Race cracked because of improper installation, cocking or poor bearing seat.

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



HASA570S

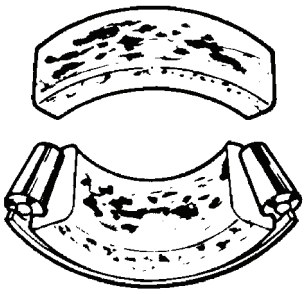
Figure 14

Smears

Smearing of metal because of slippage caused by poor installation, lubrication, overheating, overloads or handling damage.

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

Replace shaft if damaged.



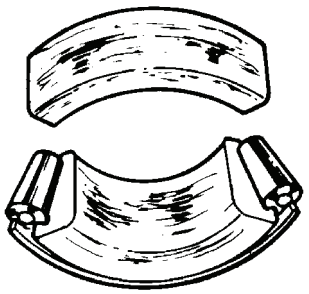
HASA580S

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.



HASA590S

Figure 16

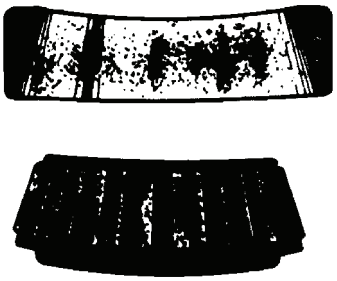
Heat Discoloration

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 overheating damage is indicated. Check seals and other related parts for damage.



HASA600S

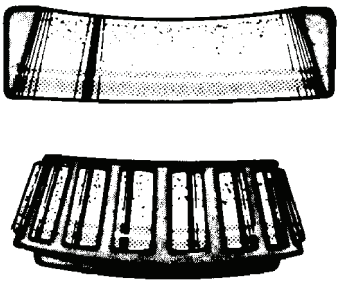
Figure 17

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.



HASA610S

Figure 18

Standard Torques

Edition 2

Table of Contents

Standard Torques

Safety Instructions 5
Applicable Models 5
Torque Values for Standard Metric Fasteners 6
Torque Values for Standard U.S. Fasteners 7
Type 8 Phosphate Coated Hardware 9
Torque Values for Hose Clamps 10
ORFS Swivel Nut Recommended Torque 10
Torque Values for Split Flanges 11
Torque Wrench Extension Tools 12
Torque Multiplication 12
Other Uses for Torque Wrench Extension Tools 13
Tightening Torque Specifications (Metric) 14

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

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 Pitch (mm)	Grade										
	3.6 (4A)	4.6 (4D)	4.8 (4S)	5.6 (5D)	5.8 (5S)	6.6 (6D)	6.8 (6S)	6.9 (6G)	8.8 (8G)	10.9 (10K)	12.9 (12K)
M5 x Std.	0.15 (1.08)	0.16 (1.15)	0.25 (1.80)	0.22 (1.59)	0.31 (2.24)	0.28 (2.02)	0.43 (3.11)	0.48 (3.47)	0.50 (3.61)	0.75 (5.42)	0.90 (6.50)
M6 x Std.	0.28 (2.02)	0.30 (2.16)	0.45 (3.25)	0.40 (2.89)	0.55 (3.97)	0.47 (3.39)	0.77 (5.56)	0.85 (6.14)	0.90 (6.50)	1.25 (9.04)	1.50 (10.84)
M7 x Std.	0.43 (3.11)	0.46 (3.32)	0.70 (5.06)	0.63 (4.55)	0.83 (6.00)	0.78 (5.64)	1.20 (8.67)	1.30 (9.40)	1.40 (10.12)	1.95 (14.10)	2.35 (16.99)
M8 x Std.	0.70 (5.06)	0.75 (5.42)	1.10 (7.95)	1.00 (7.23)	1.40 (10.12)	1.25 (9.04)	1.90 (13.74)	2.10 (15.18)	2.20 (15.91)	3.10 (22.42)	3.80 (27.48)
M8 x 1	0.73 (5.28)	0.80 (5.78)	1.20 (8.67)	1.00 (7.23)	1.50 (10.84)	1.35 (9.76)	2.10 (15.18)	2.30 (16.63)	2.40 (17.35)	3.35 (24.23)	4.10 (29.65)
M10 x Std.	1.35 (9.76)	1.40 (10.12)	2.20 (15.91)	1.90 (13.74)	2.70 (19.52)	2.35 (19.99)	3.70 (26.76)	4.20 (30.37)	4.40 (31.18)	6.20 (44.84)	7.20 (52.07)
M10 x 1.25	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	SAE 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.

0.9 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 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 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, 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

ORFS SWIVEL NUT RECOMMENDED TORQUE

Dash Size	Hose I.D.	Thread Size	Torque (kg•m) Recommended
4	1/4"	9/16"	2.4 - 2.6
6	3/8"	11/16"	3.3 - 3.9
8	1/2"	13/16"	5.1 - 5.7
12	3/4"	1 3/16"	11.7 - 12.7
16	1"	1 7/16"	15.3 - 17.3
20	1 1/4"	1 11/16"	18.0 - 20.0

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 can 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.

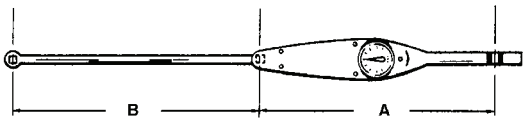
T = Tightening force applied to the nut or bolt (actual Torque).

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:

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



0552A

Figure 1

NOTE: *The formula assumes 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.)

IMPORTANT

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 approve a specific manufacturer or brand name, but the following table of "Loctite" applications is included for which cross-references to other manufacturer's products should also be widely available.

IMPORTANT

Use primer "T" or "N" for all cold weather assembly of fastener adhesives, with Threadlocker 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 3

Table of Contents

Cabin

Safety Instructions 5
Applicable Models 5
Cabin Identification 6
Rollover Protective Structure (ROPS) 6
Removal 8
Installation 12

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 and Up

CABIN IDENTIFICATION

Rollover Protective Structure (ROPS)

General ROPS Instructions for ROPS Certified Cabins

The operator's cabin is a ROPS certified structure for protecting the seat-belted operator. It absorbs the impact energy of a rollover impact. Do not allow machine weight (mass) to exceed certified value on certification plate. If weight is exceeded, the ROPS structure will not be able to fulfill its safety function.

Do not increase machine weight beyond certified value by modifying machine or by installing attachments on machine. If weight limit of protective equipment is exceeded, protective equipment will not be able to protect operator, and operator may suffer death or serious injury. Always observe the following:

- This machine is equipped with a protective structure. Do not remove protective structure and perform operations without it.
- Never modify the operator's cabin by welding, grinding, drilling holes or adding attachments unless instructed by DOOSAN. Changes to the cabin can cause loss of operator protection from rollover and falling objects, and operator may suffer death or serious injury.
- When protective structure is damaged or deformed by falling objects or by rolling over, its strength will be reduced and it will not be able to properly fulfill its function. In these cases, always contact your DOOSAN distributor for advice. Never repair a ROPS cabin.
- Always wear your seat belt when operating machine.

ROPS Certification

This DOOSAN excavator has an operator's cabin that meets ROPS requirements. The seat belt must be worn for rollover protection.

The ROPS certification plate is found on the left side of the cabin on most models. It may vary slightly in its location on some models.

Check the ROPS cabin, mounting, and hardware for damage.

Never modify the ROPS cabin. Replace the cabin and hardware if damaged. See your DOOSAN dealer for parts.

ROPS – Rollover Protective Structure complies with ISO 12117-2:2008.

WARNING

AVOID DEATH OR SERIOUS INJURY

Never modify the operator cabin by welding, grinding, drilling holes or adding attachments unless instructed in writing by DOOSAN. Changes to the cabin can cause loss of operator protection from rollover and falling objects, and can result in death or serious injury.

REMOVAL

1. Park on firm and level ground.
2. Lower bucket or work tool to ground.
3. Stop engine.
4. Move safety lever to "RELEASED" (UNLOCK) position.
5. Turn starter switch to "I" (ON) position.

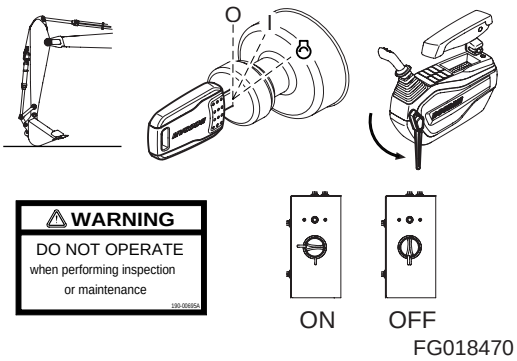


Figure 1

WARNING

AVOID DEATH OR SERIOUS INJURY

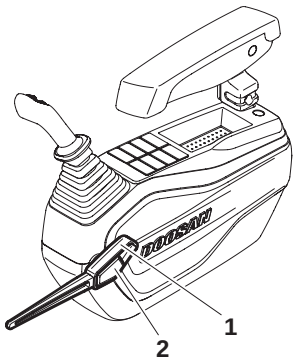
If engine must be running while performing maintenance, use extreme care. Always have one person in the cabin at all times. Never leave the cabin with the engine running.

6. To relieve pressure from accumulators, fully stroke work levers in all directions. Movement may occur.
7. Move safety lever to "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Install 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 cabin is equipped with additional protective guards over cabin openings, they must be removed.*

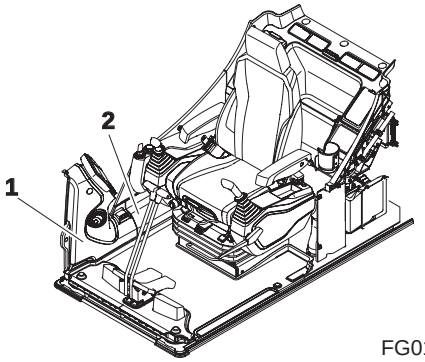
12. Remove mats from steps and floor.
13. Remove safety lever cover (1, Figure 2).
14. Remove two screws (2, Figure 2) in safety lever to remove lever.



FG018676

Figure 2

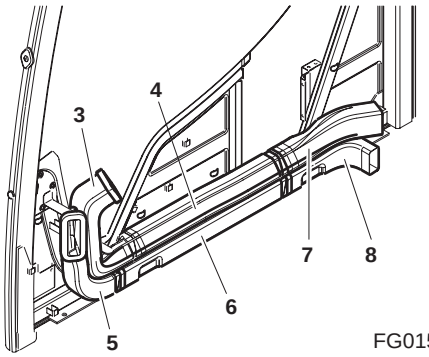
15. Remove duct covers (1 and 2, Figure 3).



FG018677

Figure 3

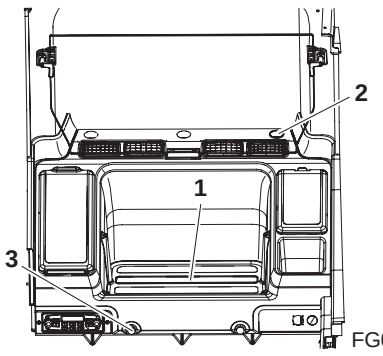
16. Remove air ducts (3 thru 8, Figure 4) on right-hand side of operator's cabin.
17. Disconnect monitor and sun sensor connectors.
18. Disconnect washer hose from floor plate.



FG015886

Figure 4

19. Remove glove box pad (1, Figure 5), and two bolts under pad.
20. Remove three caps (2, Figure 5) from top of rear cover. Remove three bolts securing rear cover in place.
21. Remove two bolts (3, Figure 5) from bottom of rubber mounts in rear cover.
22. Remove rear cover.



FG015887

Figure 5

23. Remove air ducts (4 thru 6, Figure 6). Remove atmospheric air duct (7).

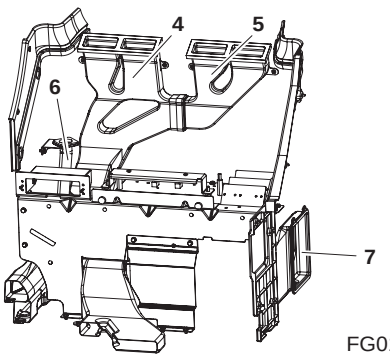


Figure 6

24. Remove all bolts fastening brackets (8 thru 10, Figure 7) to separate brackets from body of operator's cabin.
25. Disconnect connectors on interior lights, speakers and antenna.

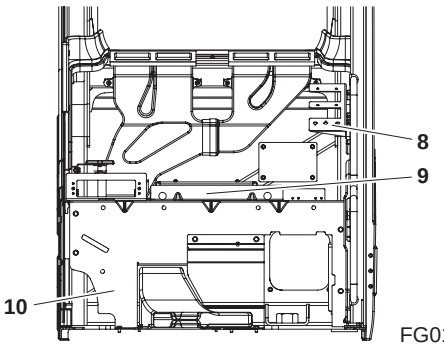


Figure 7

26. Remove four mounting nuts from four corners of cabin floor (2, Figure 8).
27. Remove four bolts (3, Figure 8) from door side of cabin floor.
28. Remove four bolts (1, Figure 8) on right-hand side of floor in operator's cabin.
29. Remove two bolts (4, Figure 8) at front of floor in operator's cabin, and bolt (5, Figure 8) at rear of floor in operator's cabin.

Quantity	Description
4	16 mm nuts at each corner of cabin.
4	12 mm x 1.75 bolts at door side of cabin.
7	12 mm x 1.75 bolts, 4 on right side of cabin and 2 under front window. One bolt is positioned in center of rear part of operator's cabin.

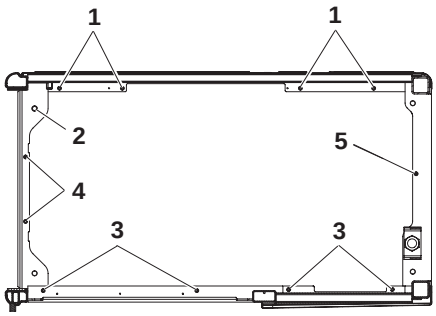


Figure 8

30. Remove bolt which is attaching the plate to prevent loosening of ROPS bolt (1, Figure 9).

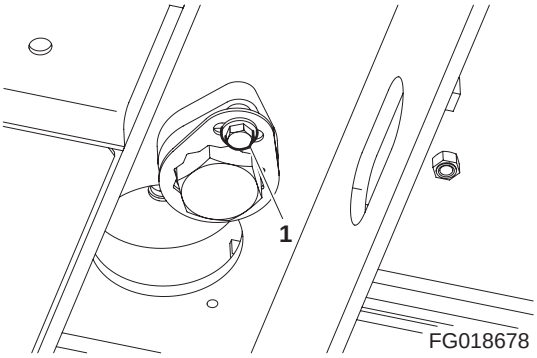


Figure 9

31. Remove ROPS bolt (2, Figure 10).

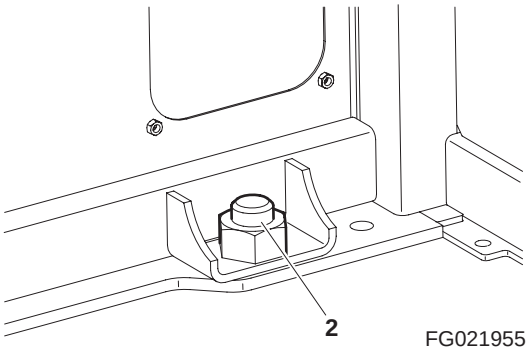


Figure 10

32. Using a suitable lifting device, attach slings to four (4) lift points on top of cabin (Figure 11, Figure 12).

    NOTE: *Cabin weighs approximately 485 kg (1,069 lb)*

33. Lift cabin approximately 25 - 50 mm (1" - 2") above deck. Check that all electrical connections have been disconnected and all other items unbolted.

34. Continue lifting with crane to remove cabin shell. Lower shell and rest on support.

    NOTE: *Lift operator's cabin slowly to prevent damaging controls covers and other components.*

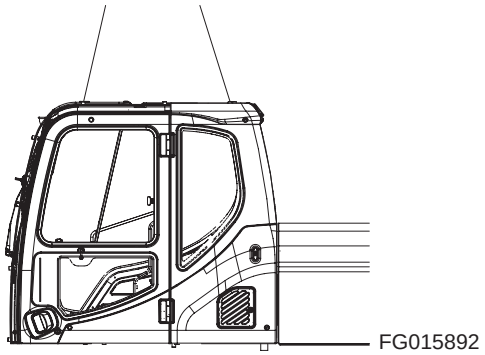


Figure 11

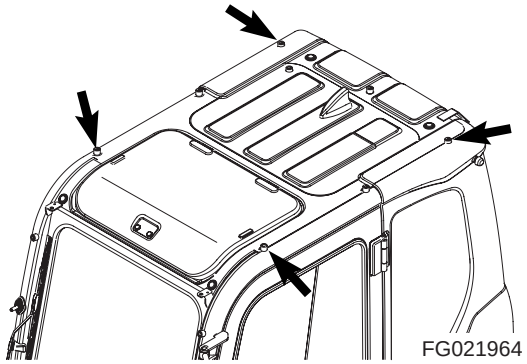


Figure 12

INSTALLATION

1. Using a suitable lifting device, attach slings to four (4) lift points on top of cabin (Figure 13, Figure 14).

   NOTE: *Cabin weighs approximately 485 kg (1,069 lb).*

2. Lower cabin into position on cabin floor.

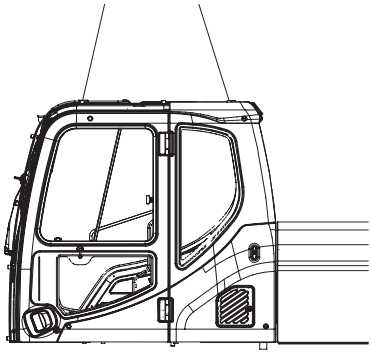


Figure 13

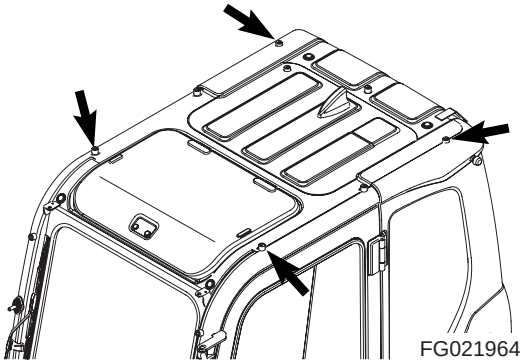


Figure 14

3. Install four mounting nuts in four corners of cabin floor (2, Figure 15).

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

4. Install four bolts (3, Figure 15) in door side of cabin floor.
5. Install four bolts (1, Figure 15) on right of floor in operator's cabin.
6. Install two bolts (4, Figure 15) on front of floor in operator's cabin, and one bolt (5) on rear of floor in operator's cabin.

Quantity	Description
4	16 mm nuts at each corner of cabin.
4	12 mm x 1.75 bolts at door side of cabin.
7	12 mm x 1.75 bolts, 4 on right side of cabin and 2 under front window. One bolt is positioned in center of rear part of operator's cabin.

7. Once cabin is mounted to floor, unhook lifting device.
8. Connect cabin ground cable.
9. Connect cabin light wiring connector.
10. Install stereo assembly with bolts (2, Figure 15) after connecting speaker and antenna wires.

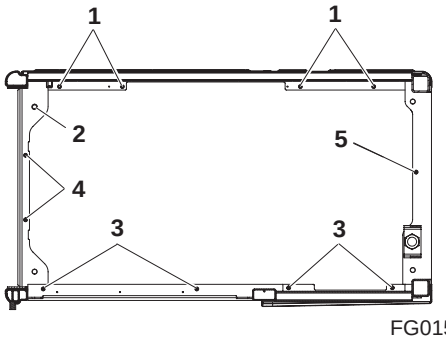


Figure 15

11. Install the bolt which is fixing the plate to prevent loosening of ROPS bolt (1, Figure 16).

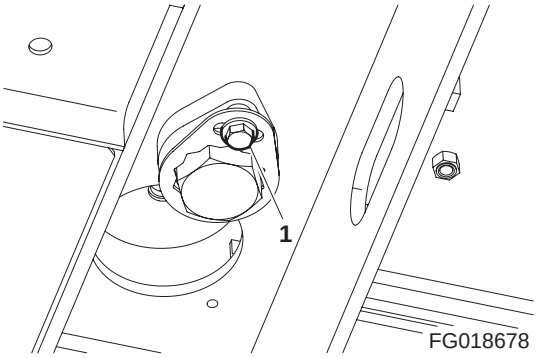


Figure 16

12. Install ROPS bolt (2, Figure 17).

    NOTE: *Mounting nut torque 13 kg•m* (94 ft lb)

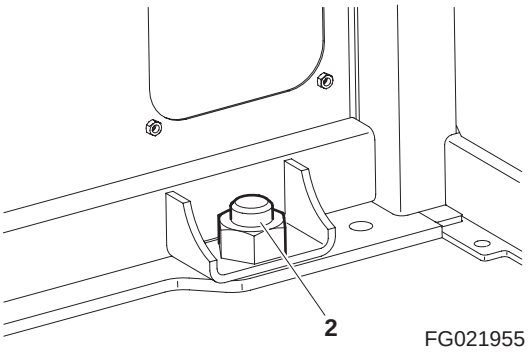


Figure 17

13. Install air ducts (1 thru 5, Figure 18). Install atmospheric air duct (6).

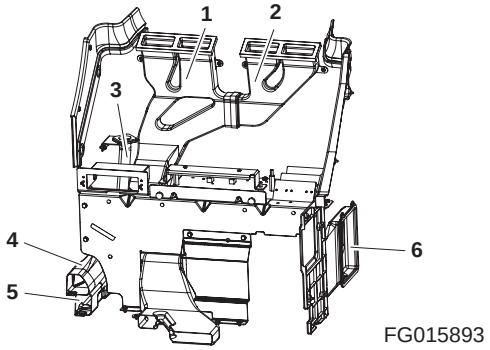


Figure 18

14. Install brackets (7 thru 9, Figure 19) on body of operator's cabin.

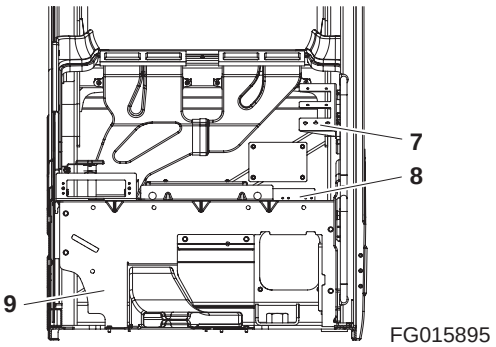
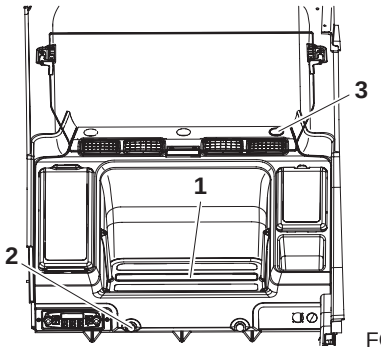


Figure 19

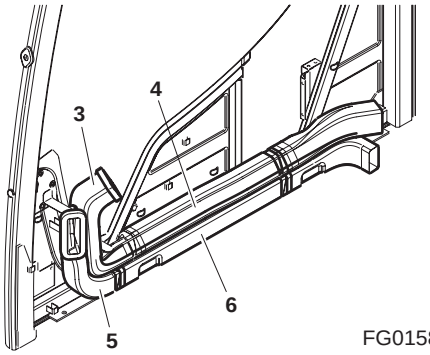
15. Install two bolts (2, Figure 20) and center bolts in center, and three bolts on top to install dashboard cover. Install cap (3, Figure 20) on top of dashboard cover.
16. Install glove box pad (1, Figure 20).
17. Connect washer hose at floor plate bottom.



FG015896

Figure 20

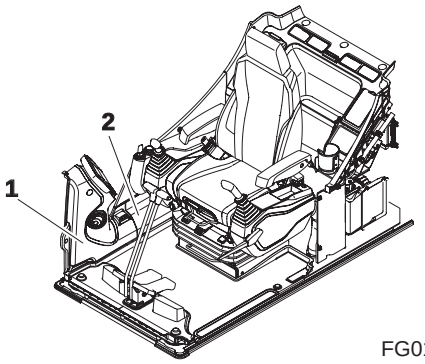
18. Install air ducts (1 thru 4, Figure 21) on right-hand side of cabin.
19. Connect monitor, sun sensor connector, and washer hose.



FG015897

Figure 21

20. Install duct covers (1 and 2, Figure 22).
21. Install safety lever. Apply Loctite on screws when installing lever.
22. Install mats on steps and floor.
23. Connect negative (-) battery cable leading to frame from battery.



FG018677

Figure 22

Counterweight

Edition 1

Table of Contents

Counterweight

Safety Instructions 5
Applicable Models 5
General 6
Warning for Counterweight and Front Attachment Removal 6
Removal 8
Installation 9

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

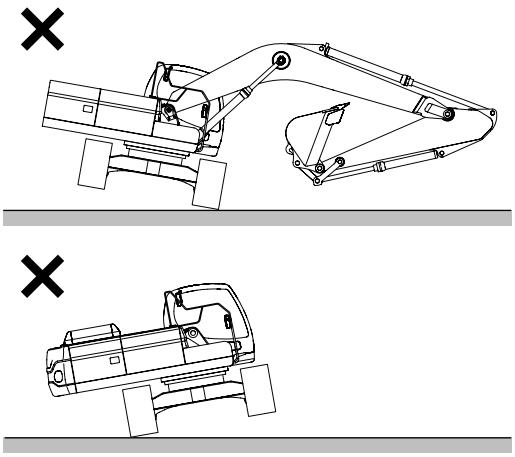
Instructions are necessary before operating or servicing machine. Read and understand the Operation and Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

Warning for Counterweight and Front Attachment Removal



FG018594

Figure 1

WARNING

AVOID DEATH OR SERIOUS INJURY

Removal of the counterweight from the machine, front attachment (boom and arm) or any other part, can affect the stability of the machine. This could cause tipping or rollover, resulting in death or serious injuries.

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.

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

AVOID DEATH OR SERIOUS INJURY

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
DX225LC-3	4,300 kg (9,480 lb)
	5,300 kg (11,700 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.

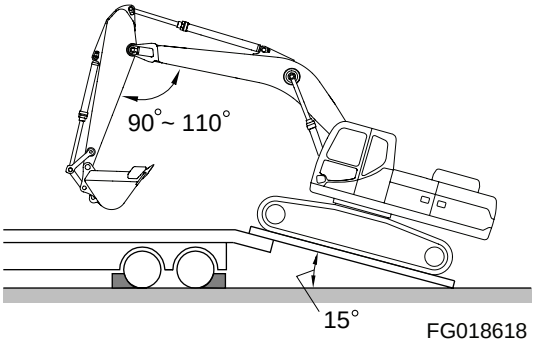
All members of the working crew should know and understand the signals that will be used between the lifting leader, the assist crane operator and the remainder of the work crew.

WARNING

AVOID DEATH OR SERIOUS INJURY

If the upper structure deck has been unbalanced by removal of weight from one end only, traveling with the excavator, swinging the upper structure, movement over bumps or sloping and uneven surfaces could cause loss of control resulting in tipping or rollover.

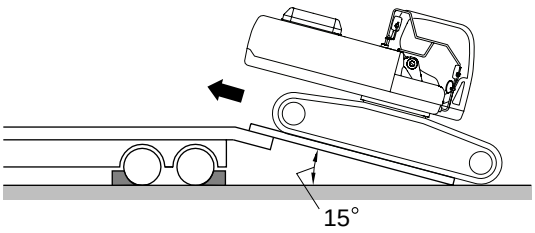
To maintain stability the counterweight should be removed only when the front attachment is taken off the machine.



FG018618

Figure 2

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 with the counterweight uphill (Figure 3).



FG021965

Figure 3

REMOVAL

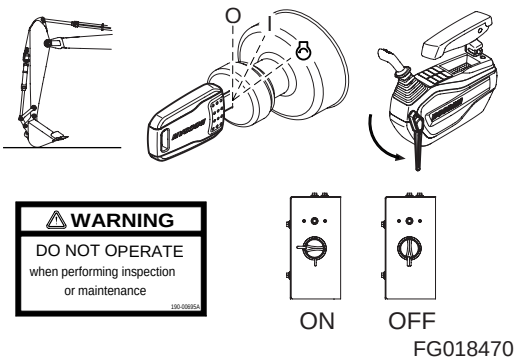
WARNING

AVOID DEATH OR SERIOUS INJURY

Death or serious injury can occur from a counterweight falling during removal or installation. Do not allow personnel under or around the counterweight during removal or installation.

Use certified cables and shackles of adequate load rating. Improper lifting can allow the load to shift and cause death or serious injury.

1. Park on firm, level ground.
2. Lower work tool or bucket to ground.
3. Stop engine.
4. Move safety lever to "UNLOCK" position.
5. Turn starter switch to "I" (ON) position.



FG018470

Figure 4

WARNING

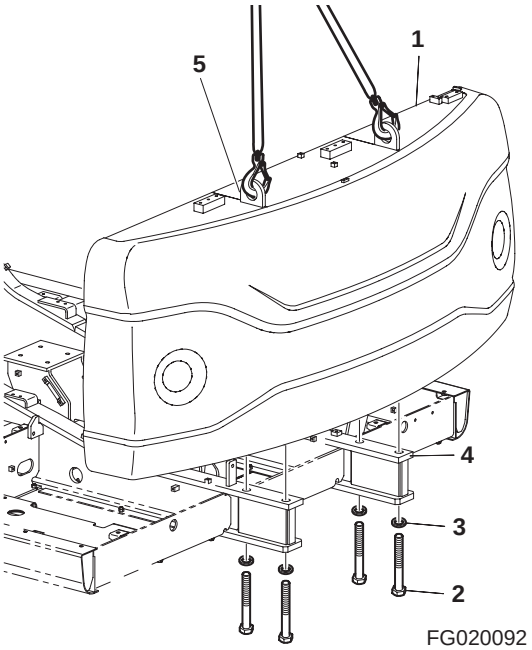
AVOID DEATH OR SERIOUS INJURY

If engine must be running 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. Move safety lever to "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Attach maintenance warning tag on controls.
10. Turn battery disconnect switch to "OFF" position.
11. Make sure all electrical and other items are disconnected.
12. Using a suitable lifting device capable of handling a heavy load, partially support counterweight (1, Figure 5) before loosening four bolts (2, Figure 5). Stop lifting with assist crane as soon as lifting slings are taut.
13. Remove four bolts (2, Figure 5) and washers (3) from counterweight (1).

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

14. When bolts (2, Figure 5) 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.



FG020092

Figure 5

INSTALLATION

1. Using suitable lifting device capable of handling the weight of the counterweight. Raise counterweight (1, Figure 6) into position just above support frame (4) leaving counterweight suspended. Verify that counterweight is level and even.

   NOTE: *Leave counterweight (1, Figure 6) 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 6) onto bolts (2). Apply Loctite #242 to mounting bolt threads.

3. Install four bolts (2, Figure 6) 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 6*) to values shown in the following table.*

Model	Bolt Torque
DX225LC-3	150 kg•m (1,085 ft lb)

4. Remove lifting device from counterweight lifting holes (5, Figure 6)

5. Make sure all electrical and other items are connected.

6. Turn battery disconnect switch to "ON" position.

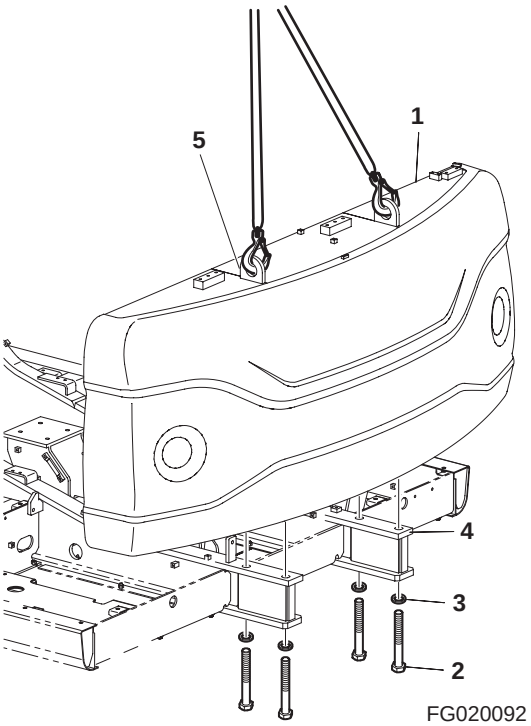


Figure 6

Fuel Tank

Edition 1

Table of Contents

Fuel Tank

Safety Instructions 5
Applicable Models 5
General Description 6
Parts List 6
Specifications 7
Removal 8
Installation 12
Start-up Procedures 15

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

GENERAL DESCRIPTION

WARNING

AVOID DEATH OR SERIOUS INJURY

Diesel fuel is highly flammable and can be potentially explosive. To prevent fires or explosion, keep arcs, sparks or other ignition sources away from diesel fuel or fuel containers.

Parts List

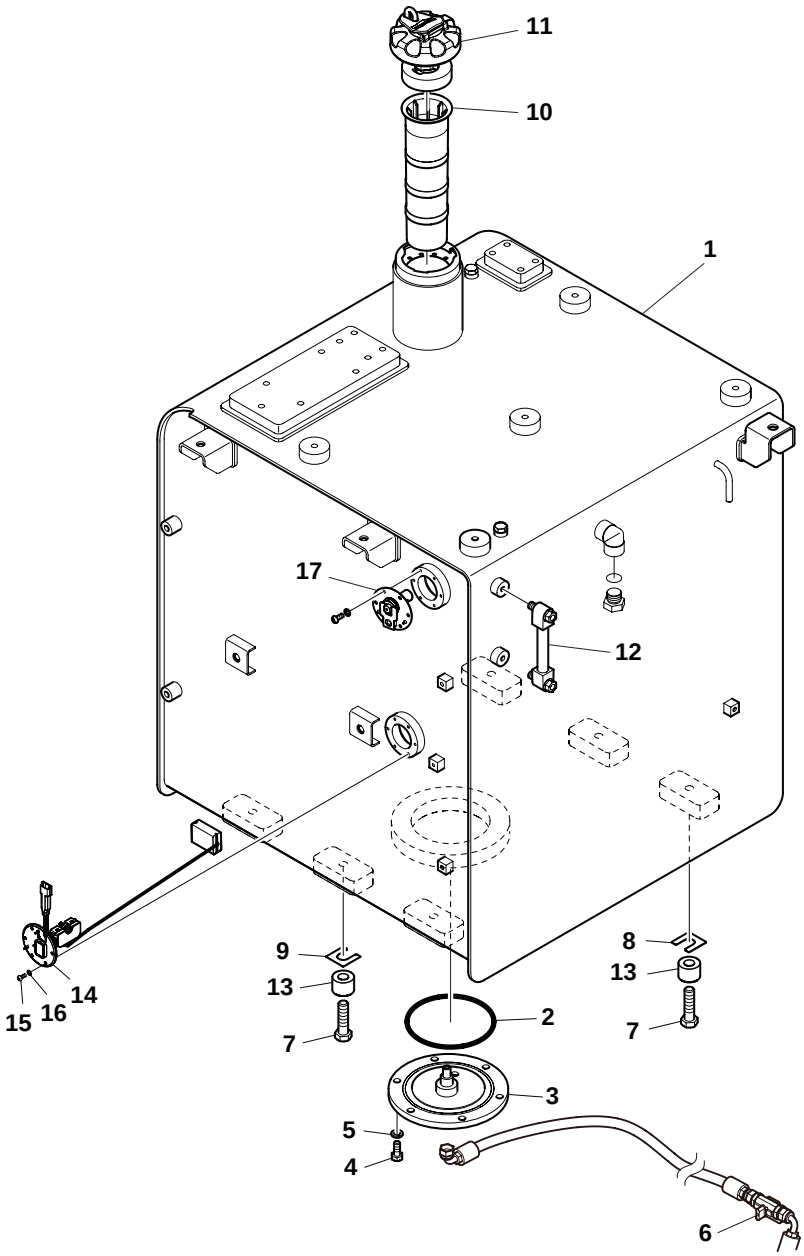


Figure 1

FG022488

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

Reference Number	Description
10	Fuel Strainer
11	Cap
12	Level Gauge
13	Spacer
14	Fuel Sensor
15	Bolt
16	Spring Washer
17	Fuel Float Switch

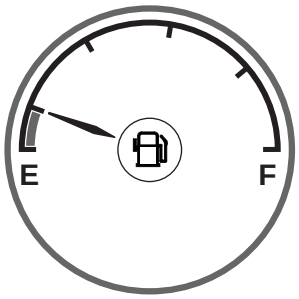
Specifications

Fuel tank capacity is 400 liters (106 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.

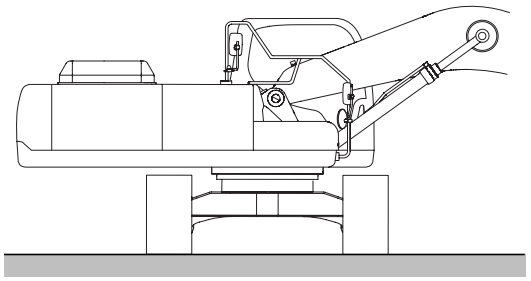
   NOTE: *If possible, operate excavator until available fuel supply in tank has been run down as far as possible.*



FG018115

Figure 2

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



FG018726

Figure 3

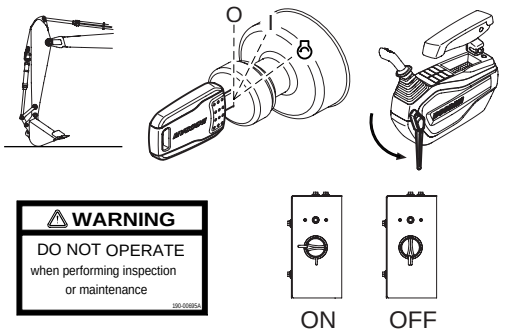
3. Lower bucket (or work tool) to ground.
4. Stop engine.
5. Set safety lever to "RELEASED" (UNLOCK) position.
6. Turn starter switch to "I" (ON) position.

⚠ WARNING

AVOID DEATH OR SERIOUS INJURY

If engine must be running 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 to "LOCK" position.
9. Turn key to "O" (OFF) position and remove from starter switch.
10. Attach maintenance warning tag on controls.
11. Turn battery disconnect switch to "OFF" position.



FG018470

Figure 4

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

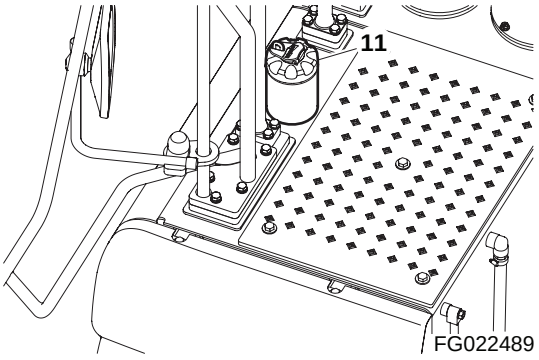


Figure 5

13. Open drain valve (Figure 6) right side door and drain.

    NOTE: *Fuel tank capacity is 400 liters (106 U.S. gal).*

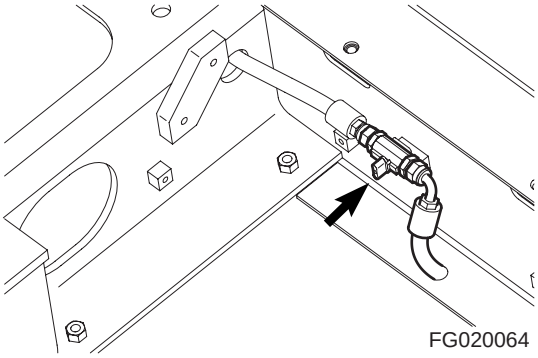


Figure 6

14. Remove five bolts (23, Figure 7) and cover (24) from fuel tank.

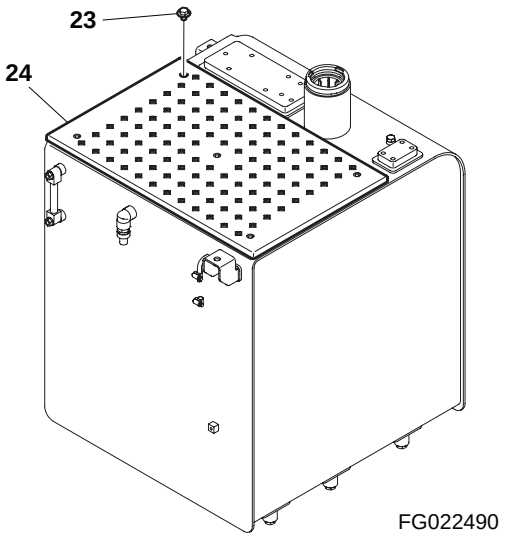


Figure 7

15. Remove ten bolts (25 and 26, Figure 8) and handrail (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 storage box (34) from frame.

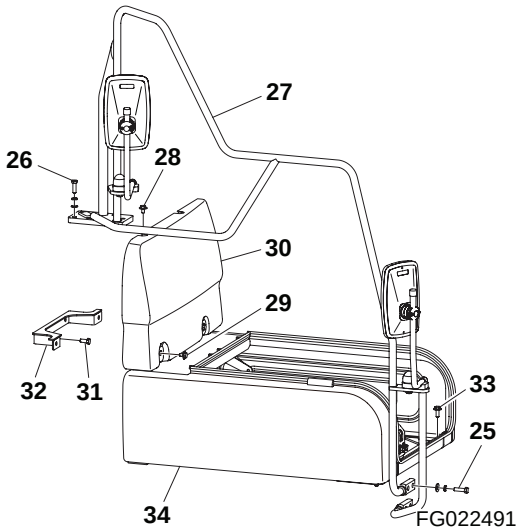


Figure 8

16. Remove four bolts (35 and 36, Figure 9) and cover (37) from fuel tank and support.

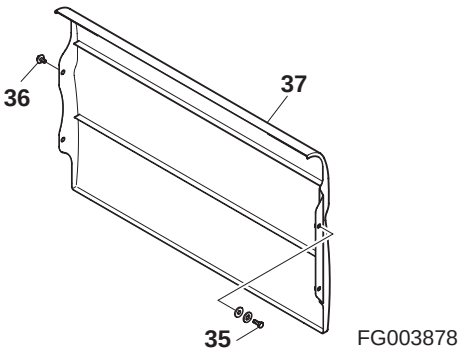


Figure 9

17. Tag and disconnect fuel supply line (21, Figure 10) and fuel return line (19) from fuel tank (1) and carefully drain remaining fuel from lines.

18. Remove clamp (20, Figure 10) holding fuel return line (19) to tank (1).

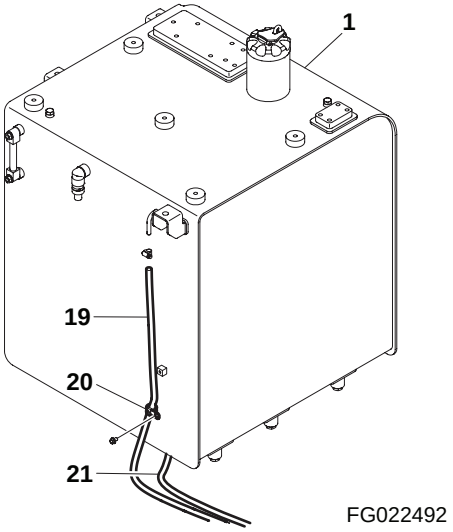


Figure 10

19. If equipped, remove components from fuel filler pump port (22, Figure 11) on side of fuel tank (1).

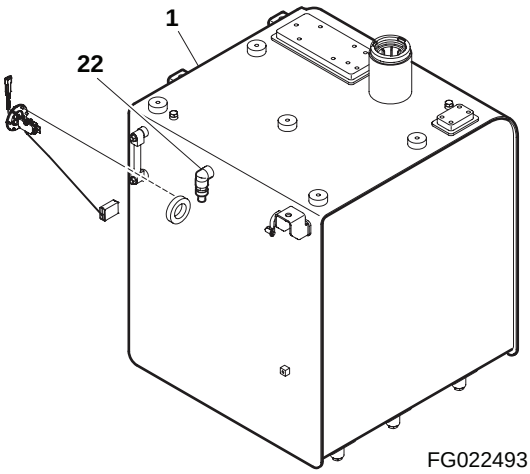


Figure 11

20. Tag and disconnect wires leading to fuel sensor (14) and fuel float switch (17, Figure 12) on side of fuel tank (1).

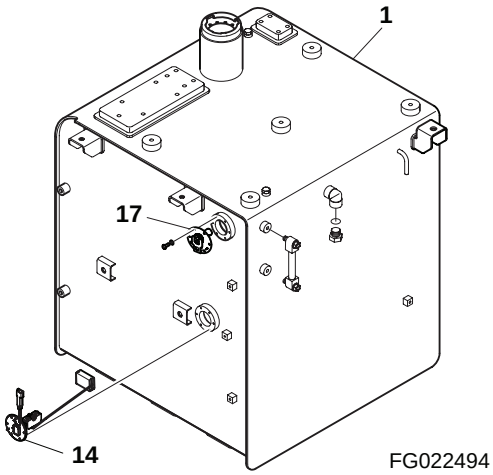


Figure 12

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 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.*

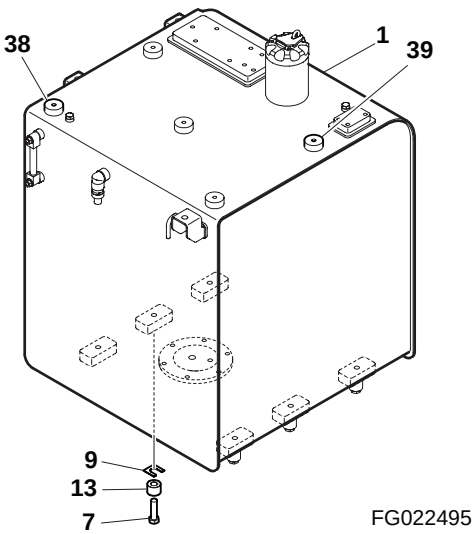


Figure 13

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).*

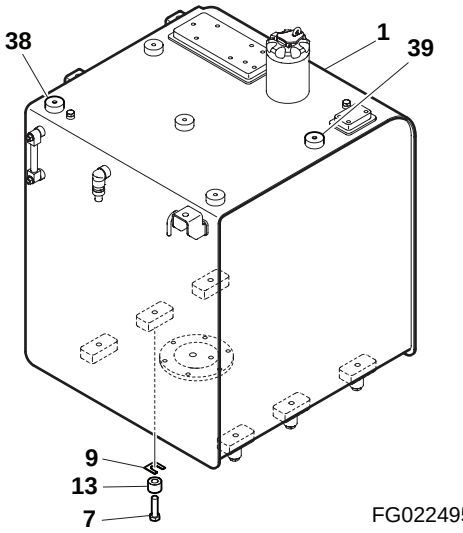


Figure 14

5. Connect wires as tagged to sensor (14) and fuel float switch (17, Figure 15) on side of fuel tank (1).

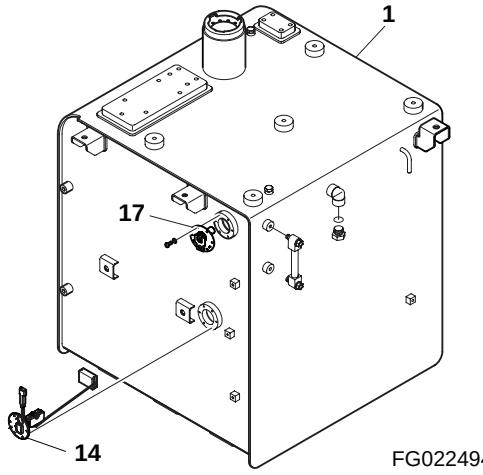


Figure 15

6. If equipped, connect components to fuel filler pump port (22, Figure 16) on side of fuel tank (1).

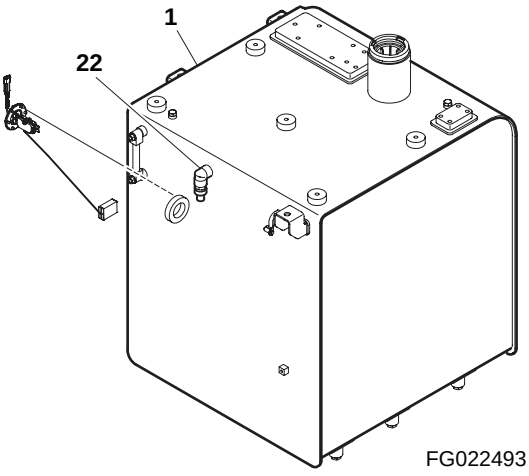


Figure 16

7. Connect as tagged, fuel supply line (21, Figure 17) and fuel return line (19) to fuel tank (1).
8. Install clamp (20, Figure 17) to hold fuel return line (19) to tank (1).

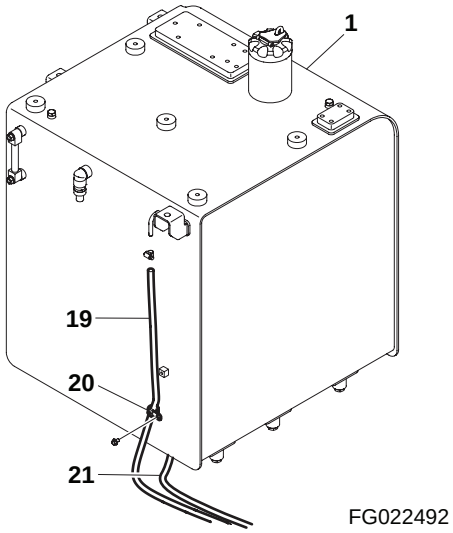


Figure 17

9. Install four bolts (35 and 36, Figure 18) and cover (37) on fuel tank and support.

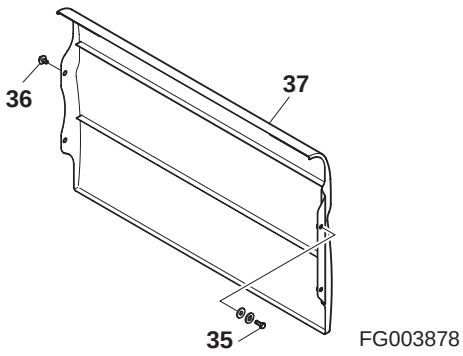


Figure 18

10. Install four bolts (33, Figure 19) and storage box (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 ten bolts (25 and 26) and handrail (27) on fuel tank and frame.

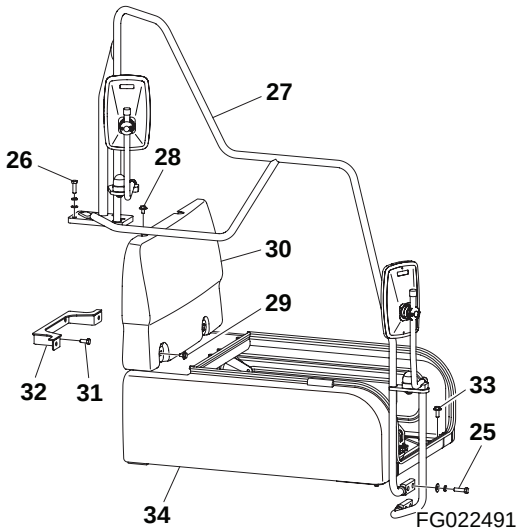


Figure 19

11. Make sure fuel tank drain valve (Figure 20) right side door is closed.
12. Fill fuel tank and check for signs of leaks. Correct any problems found.
13. Turn disconnect switch to "ON" position.

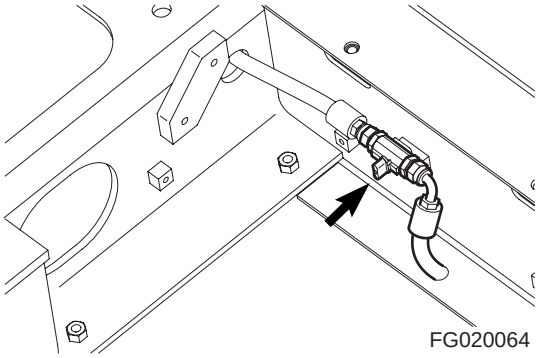


Figure 20

14. Install five bolts (23, Figure 21) and cover (24) on fuel tank.

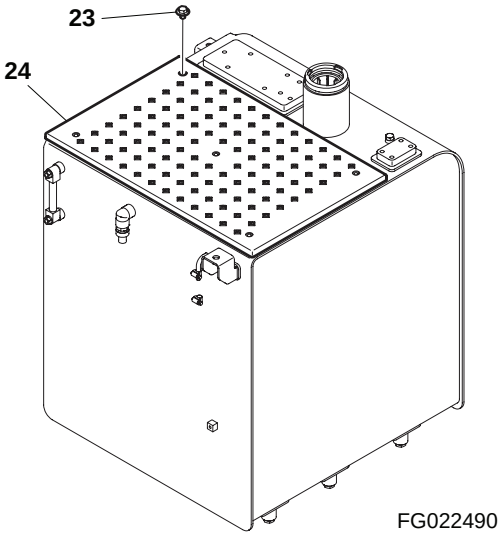


Figure 21

START-UP PROCEDURES

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

1. Turn key to "OFF" position.
2. Open right side door to access fuel filter.

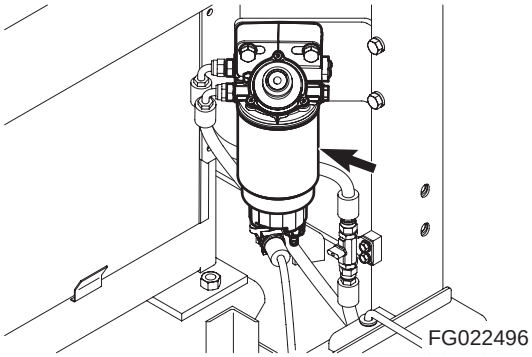


Figure 22

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.

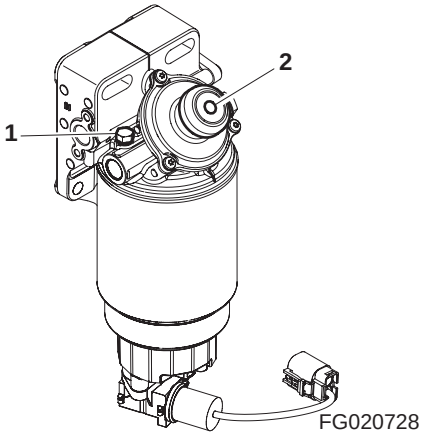


Figure 23

Fuel Transfer Pump (Option)

Edition 1

Table of Contents

Fuel Transfer Pump (Option)

Safety Instructions 5
Applicable Models 5
General Description 6
Theory of Operation 6
Troubleshooting 8
Replacement of Rotor and Vane 8
Replacement of Rear Cover 9
Replacement of Armature 9

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

GENERAL DESCRIPTION

Theory of Operation

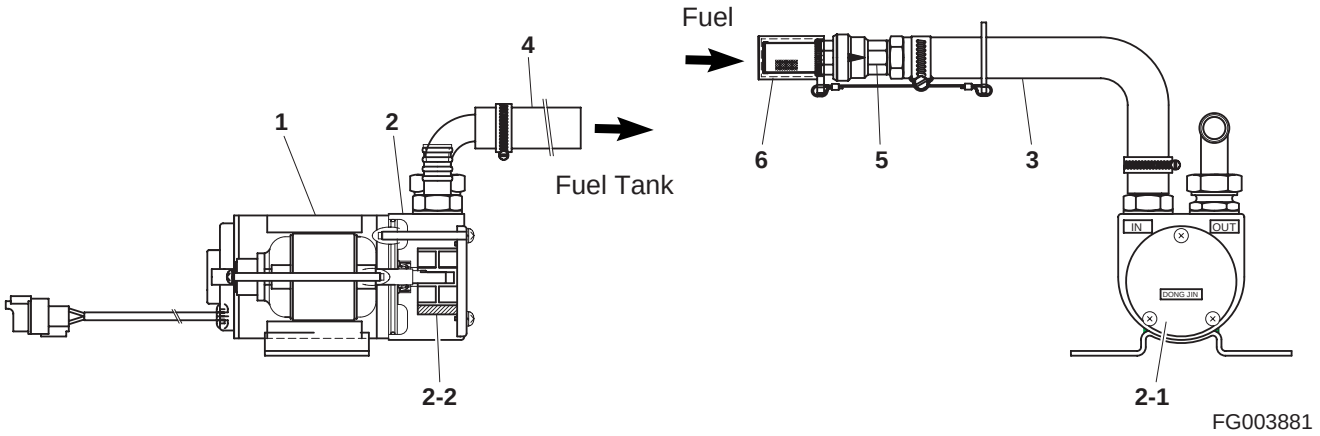


Figure 1

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.

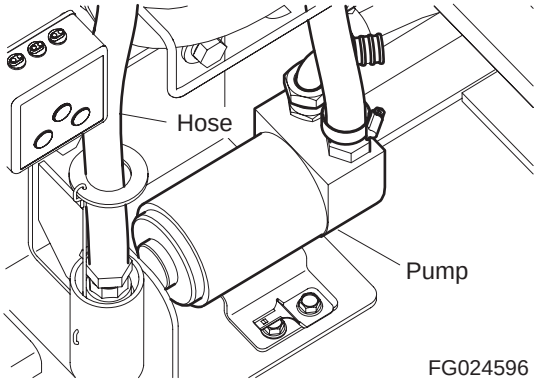


Figure 2

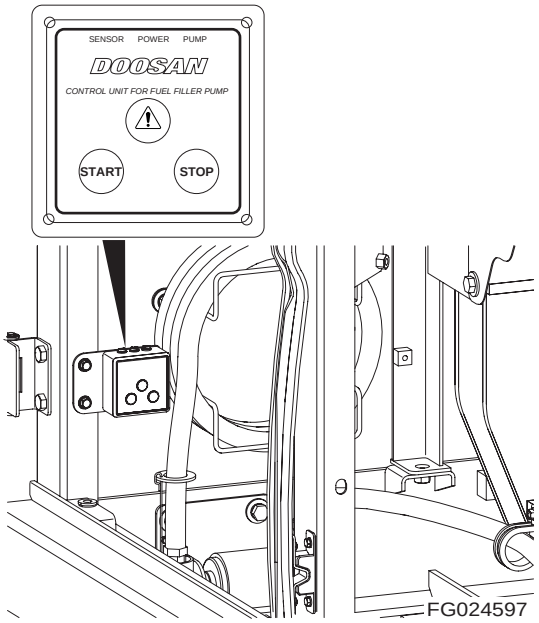


Figure 3

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 because of overheating the pump will stop running. When temperature drops below 143°C (289°F) the circuit will reactivate allowing the pump to restart.*

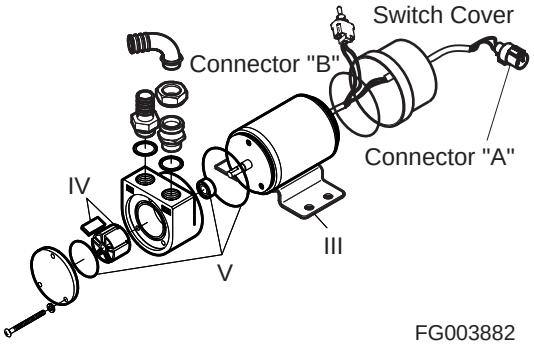


Figure 4 With Toggle Switch

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.

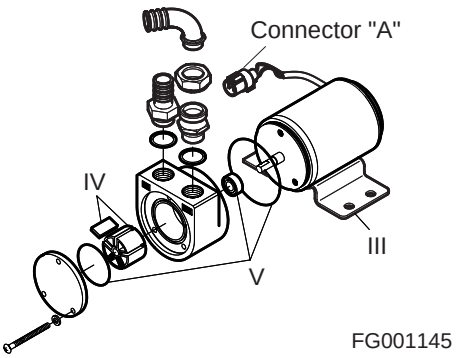


Figure 5 Without Toggle Switch

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 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.

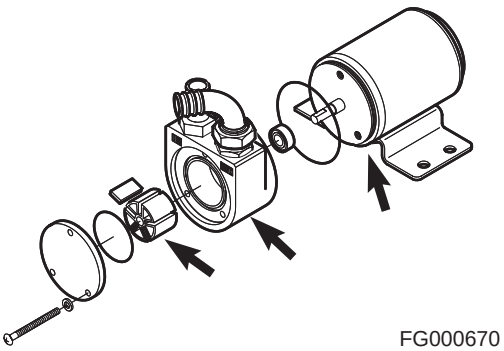
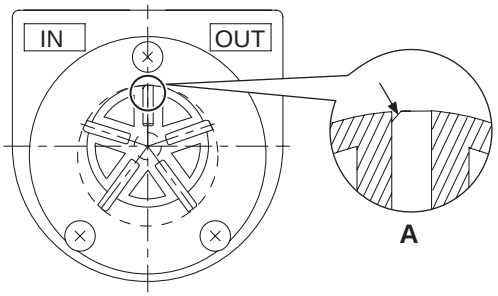


Figure 6 Without Toggle Switch

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.



FG003883

Figure 7

REPLACEMENT OF REAR COVER

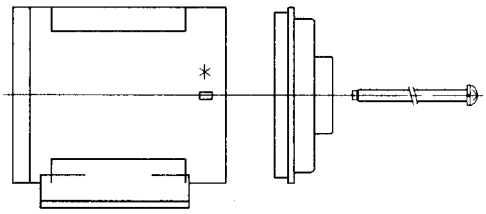
Brush assembly and a thermal limiter are installed in the rear cover. If you find any damage, replace them with new ones.

Remove 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.



HAAG0330

Figure 8

REPLACEMENT OF ARMATURE

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

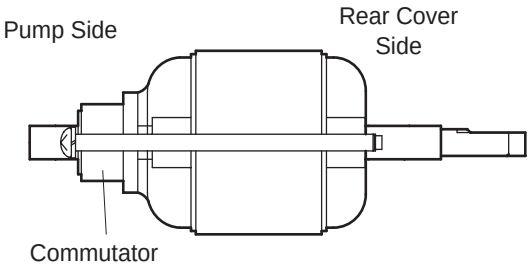
Remove switch cover and rear cover, then remove armature from the housing.

Remove pump cover and remove rotor and vane.

Insert a new armature into the housing.

Refer to “Replacement of Rear Cover” on page -9, 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 -8.



FG001146

Figure 9

Swing Bearing

Edition 2

MEMO

Table of Contents

Swing Bearing

Safety Instructions 5
Applicable Models 5
Swing Bearing Maintenance 6
Operating Recommendation 6
Measuring Swing Bearing Axial Play 6
Measuring Bearing Lateral Play 6
Swing Bearing Basic Operation 7
Disassembly 7
Assembly 9

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 and Up

SWING BEARING MAINTENANCE

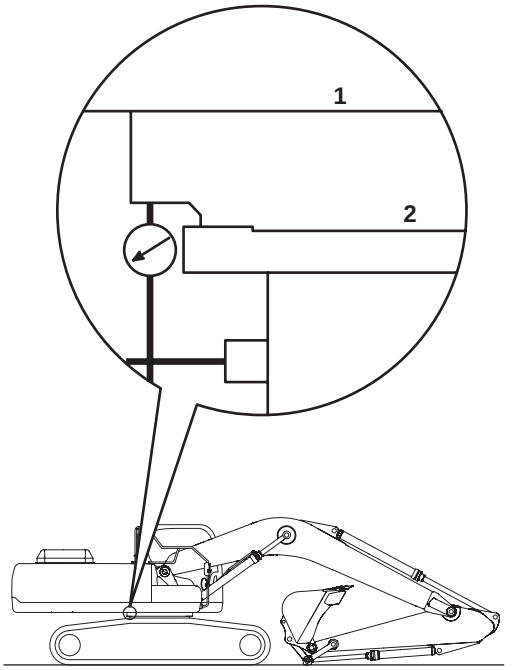
Operating Recommendation

The service life of the swing bearing may be extended if a 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. Repositioning the excavator during the work shift, to work the opposite end of the bearing, will provide a more even and gradual rate of wear and extended service life.

Measuring Swing Bearing Axial Play

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 up the excavator above 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.



FG018734

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 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 increase in value.

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

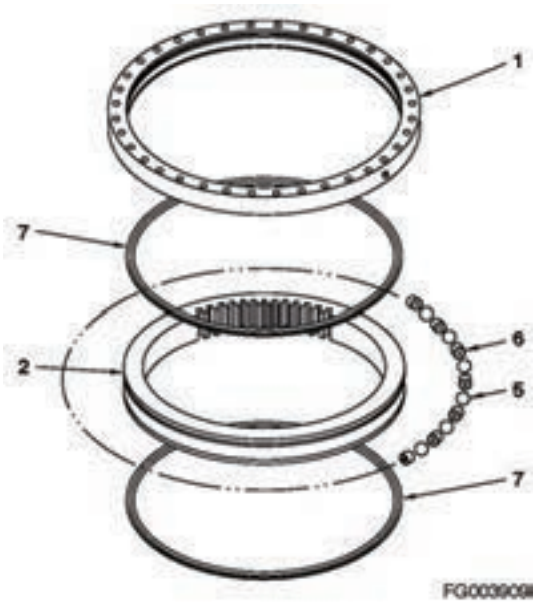


Figure 2

Disassembly

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

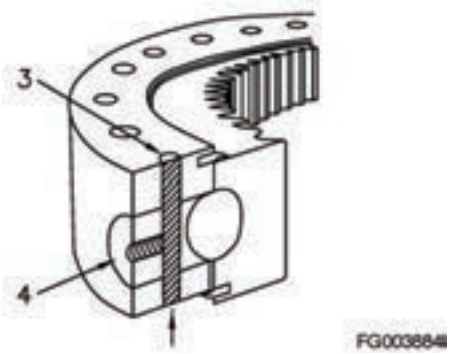


Figure 3

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

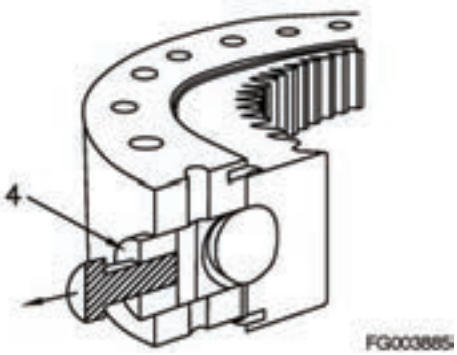


Figure 4

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

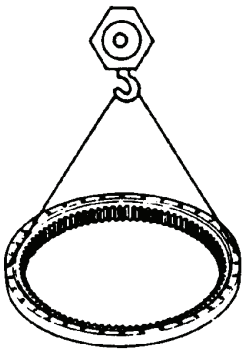


Figure 5

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

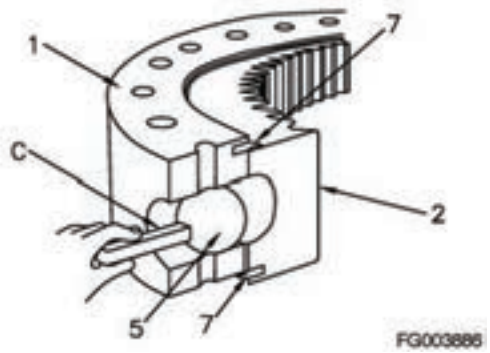


Figure 6

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

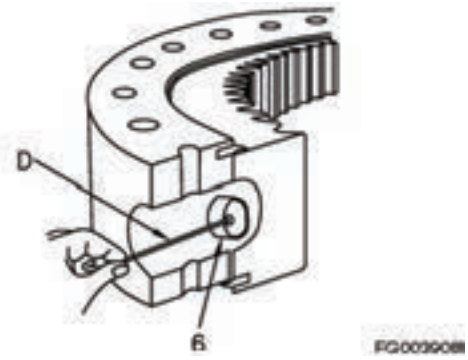


Figure 7

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.

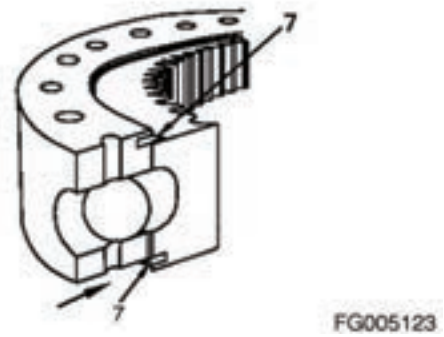


Figure 8

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.

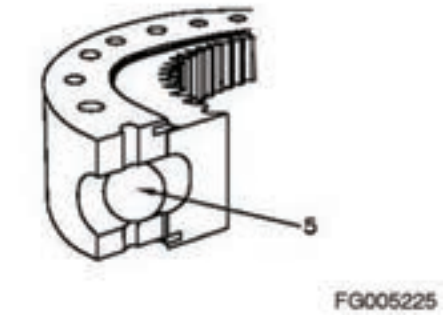


Figure 9

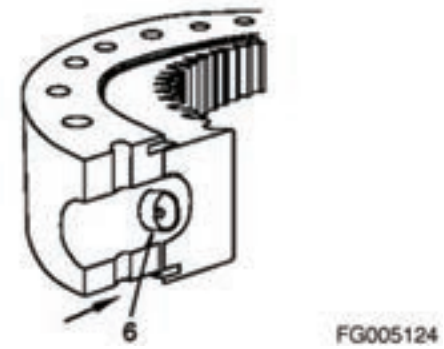


Figure 10

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

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

   Fill grease through the grease fitting.

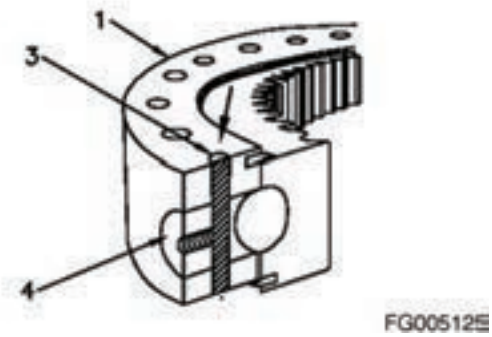


Figure 11

Lower Structure and Chassis

Track Assembly

Edition 1

Table of Contents

Track Assembly

Safety Instructions 5
Applicable Models 5
General Description 6
Track Tension 7
Cleaning and Inspection (Wear Limits and Tolerances) 9
- Track Shoe 10
- Lower Roller 12
- Upper Roller 13
- Front Idler 14

Track Shoes and Links 15
- Track Removal 15
- Track Installation 16

Front Idler Roller 17
- Parts List 17
- Front Idler Roller Disassembly 18
- Front Idler Roller Reassembly 20

Lower Roller 22
- Parts List 22
- Lower Roller Removal 23
- Lower Roller Disassembly 23
- Lower Roller Reassembly 24
- Lower Roller Installation 25

Upper Roller 26
- Parts List 26
- Upper Roller Removal 27
- Upper Roller Disassembly 27
- Upper Roller Reassembly 29

Track Spring and Track Adjusting Cylinder 30
- Parts List 30

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 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

AVOID DEATH OR SERIOUS INJURY

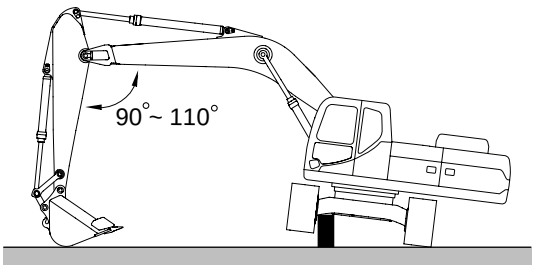
Measuring track tension requires two people. One person must be in the operator's seat, operating the controls while the other person makes dimensional checks. Block frame to make sure the machine won't move or shift position during service. Warm up the engine to prevent stalls, park the excavator in 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 grease pressure too fast. The track tension grease valve should never be loosened more than one (1) complete turn from the fully tightened down position. Bleed off grease pressure slowly. Keep your body away from the valve at all times. Always wear eye and face protection when adjusting track tension.

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.

   Turn the track backward by 1 - 2 turns.



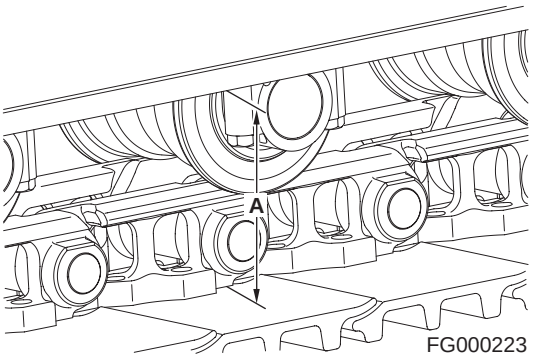
FG018383

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" in below table.

   NOTE: *Clean off the tracks before checking clearance for accurate measurements.*

3. Too little sag in the crawler track (less than clearance distance "B" in 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.



FG000223

Figure 2

4. The increased clearance recommended for muddy, sandy or snowy ground conditions is between distance "C" on below table.

Terrain Type	Recommended Distance "A"
Normal "B"	290 - 310 mm (11.40 - 12.20 in)
Muddy, Sandy or Snowy "C"	310 - 340 mm (12.20 - 13.40 in)

WARNING

AVOID DEATH OR SERIOUS INJURY

The track adjusting mechanism is under very high-pressure. NEVER release grease pressure too fast. The track tension grease valve should never be loosened more than one (1) complete turn from the fully tightened down position. Bleed off grease pressure slowly. Keep your body away from the valve at all times. Always wear eye and face protection when adjusting track tension.

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). Extending the adjustment cylinder, increases 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).

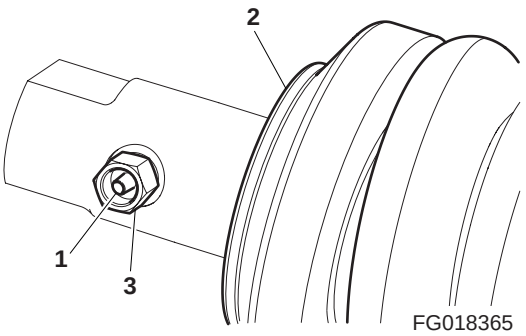


Figure 3

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

CAUTION

AVOID INJURY

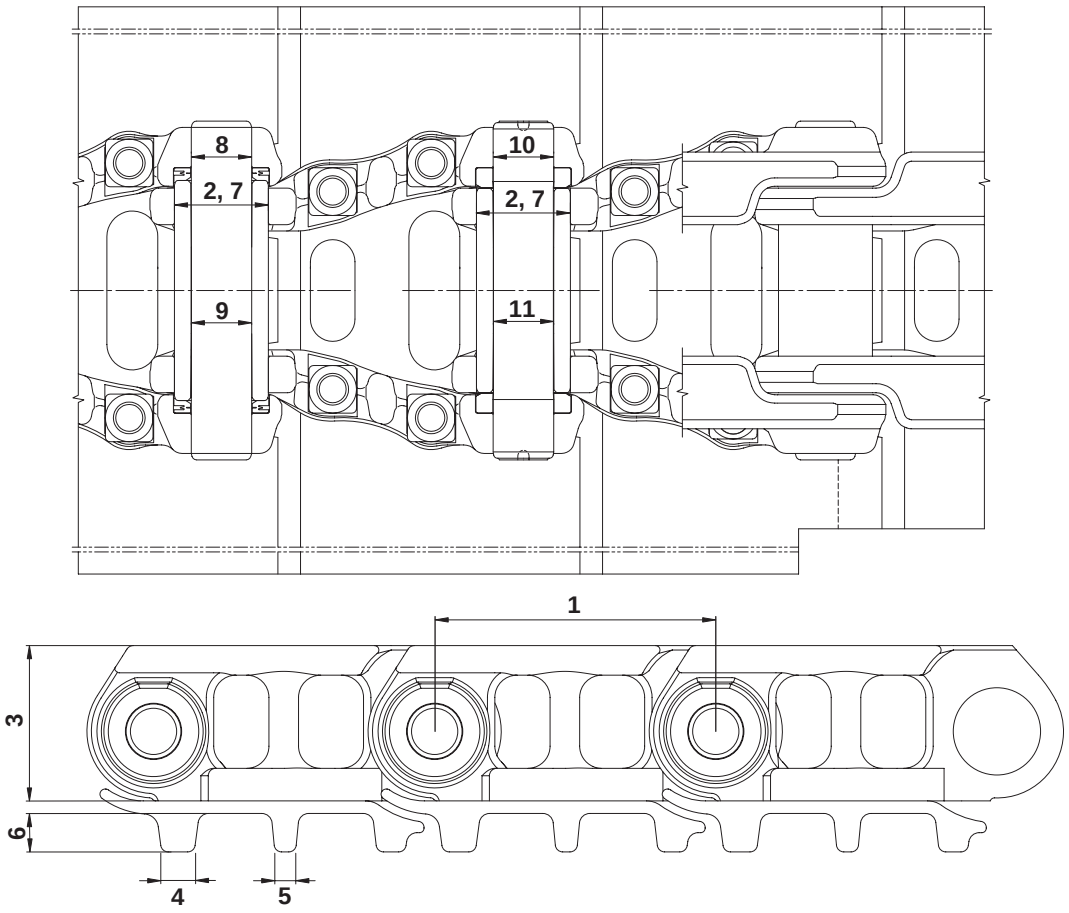
Refer to the "Welding Precautions and Guidelines" information in "General Maintenance Procedures" section for general recommendations and specific safety precautions, before starting any lower travel frame component rebuilding procedure.

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 replace 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

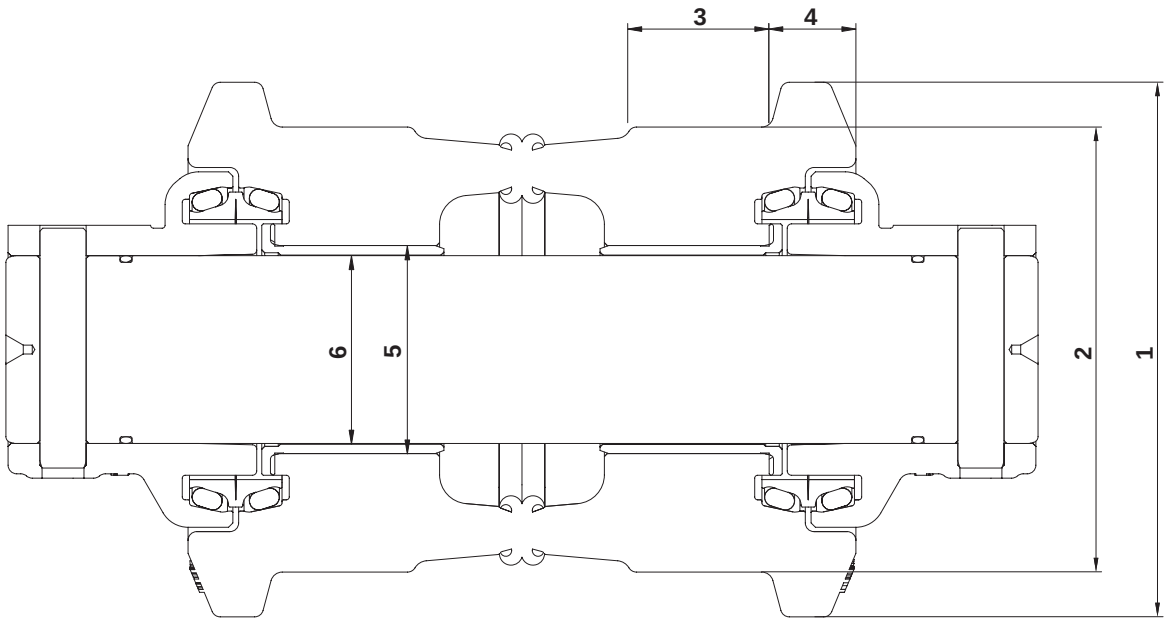


FG023178

Figure 4

No.	Check Item	Standard Dimension			Recommended Limit for Maintenance		Limit for Use (Repair - P or Replace - R)
1	Link Pitch	190 mm (7.48")			193 mm (7.598")		194.5 mm [R] (3.72")
2	Bushing Outside Diameter	59 mm (2.323")			57 mm (2.244")		54.0 mm [R] (2.126")
3	Link Height	105 mm (4.134")			100 mm (3.937")		96 mm [P] (3.78")
4	Length at Tip	21 mm (0.827")					
5	Length at Tip	14 mm (0.551")					
6	Height	26 mm (1.023")			20 mm (0.787")		20 mm (0.787")
7	Interference between bushing and link	Standard Dimension (Bushing)	Tolerance	Standard Dimension (Link)	Tolerance	Standard Interference	Repair Limit
		59 mm (2.323")	+0.434 +0.394	59 mm (2.323")	+0.072 0.0	0.322 - 0.434	
8	Interference between regular pin and link	Standard Dimension (Regular Pin)	Tolerance	Standard Dimension (Link)	Tolerance	Standard Interference	Repair Limit
		38 mm (1.496")	+0.222 +0.165	37.8 mm (1.488")	+0.062 0.0	0.300 - 0.422	
9	Clearance between regular pin and bushing	Standard Dimension (Regular Pin)	Tolerance	Standard Dimension (Bushing)	Tolerance	Standard Clearance	Repair Limit
		38 mm (1.496")	+0.222 +0.162	38.85 mm (1.530")	+0.500 0.0	0.628 - 1.188	
10	Interference between master pin and link	Standard Dimension (Master Pin)	Tolerance	Standard Dimension (Link)	Tolerance	Standard Interference	Repair Limit
		37.8 mm (1.488")	+0.28 +0.25	37.8 mm (1.488")	+0.062 0.0	0.188 - 0.280	
11	Clearance between master pin and bushing	Standard Dimension (Master Pin)	Tolerance	Standard Dimension (Bushing)	Tolerance	Standard Clearance	Repair Limit
		37.8 mm (1.488")	+0.28 +0.25	38.85 mm (1.530")	+0.500 0.0	0.770 - 1.300	

Lower Roller

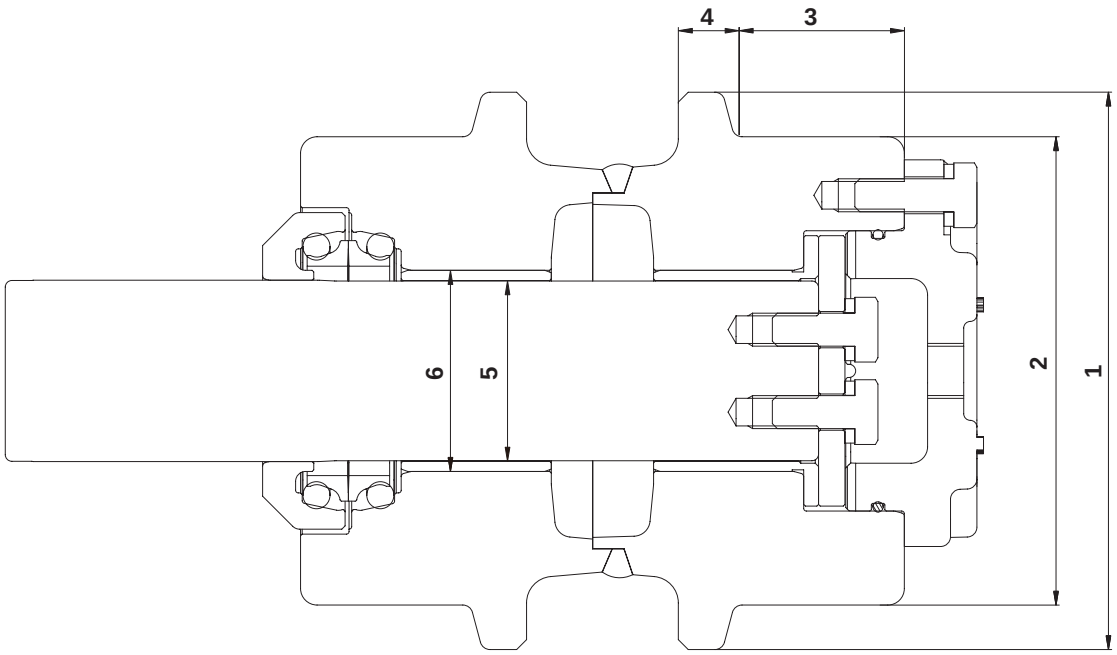


FG022504

Figure 5

No.	Check Item	Standard Dimension		Recommended Limit for Maintenance			Limit for Use (Repair - P or Replace - R)
1	Outside Diameter of Flange	185 mm (7.283")					
2	Outside Diameter of Tread	154 mm (6.063")		150 mm (5.906")			166 mm (P) (6.535")
3	Width of Tread	49 mm (1.929")		55 mm (2.165")			145 mm [P] (5.709")
4	Width of Flange	29.5 mm (1.161")					
5	Clearance between shaft and bushing	Standard Dimension (Shaft)	Tolerance Shaft	Standard Dimension (Bushing)	Tolerance Hole	Standard Clearance	Repair Limit
		65 mm (2.559")	0 -0.03	65.4 mm (2.575")	+0.05 0	0.40 - 0.48	63.3 mm (R) (2.492")
6	Interference between roller and bushing	Standard Dimension (Roller)	Tolerance Roller	Standard Dimension (Bushing)	Tolerance Hole	Standard Interference	Repair Limit
		72 mm (2.835")	+0.035 0	72 mm (2.835")	+0.132 +0.102	0.067 - 0.132	

Upper Roller

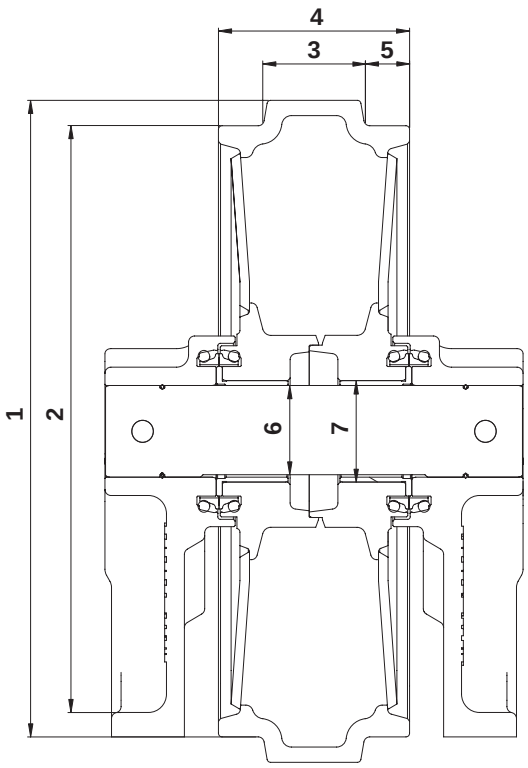


FG022505

Figure 6

No.	Check Item	Standard Dimension		Recommended Limit for Maintenance			Limit for Use (Repair - P or Replace - R)
1	Outside Diameter of Flange	169 mm (6.654")					165 mm (6.496")
2	Outside Diameter of Tread	142 mm (5.591")		136 mm (5.354")			130 mm (P) (5.276")
3	Width of Tread	51.5 mm (2.028")		56.5 mm (2.224")			
4	Width of Flange	17 mm (0.669")					
5	Clearance between shaft and bushing	Standard Dimension (Shaft)	Tolerance	Standard Dimension (Bushing)	Tolerance	Standard Clearance	Repair Limit
		54.5 mm (2.146")	0 -0.03	54.8 mm (2.157")	+0.07 +0.03	0.33 - 0.40	
6	Interference between roller and bushing	Standard Dimension (Roller)	Tolerance	Standard Dimension (Bushing)	Tolerance	Standard Interference	Repair Limit
		61 mm (2.402")	+0.04 +0.03	61 mm (2.402")	+0.12 +0.09	0.05 - 0.09	

Front Idler



FG022506

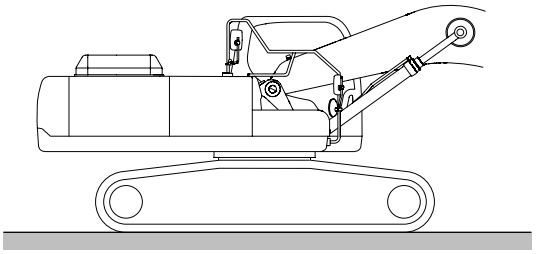
Figure 7

No.	Check Item	Standard Dimension		Recommended Limit for Maintenance			Limit for Use (Repair - P or Replace - R)
1	Outside Diameter of Flange	541.6 mm (21.322")					
2	Outside Diameter of Tread	500 mm (19.685")		488 mm (19.213")			
3	Width of Protrusion	85 mm (3.346")		75 mm (2.953")			65 mm (2.559")
4	Total Width	160 mm (6.299")		150 mm (5.906")			140 mm (5.512")
5	Width of Tread	37.5 mm (1.476")		43 mm (1.693")			
6	Clearance between shaft and bushing	Standard Dimension (Shaft)	Tolerance	Standard Dimension (Bushing)	Tolerance	Standard Clearance	Repair Limit
		75 mm (2.953")	-0.06 -0.09	75 mm (2.953")	+0.415 +0.37	0.430 - 0.505	76 mm [R] (2.992")
7	Interference between idler and bushing	Standard Dimension (Idler)	Tolerance	Standard Dimension (Bushing)	Tolerance	Standard Interference	Repair Limit
		83 mm (3.268")	+0.035 0	83 mm (3.268")	+0.12 +0.09	0.055 - 0.120	

TRACK SHOES AND LINKS

Track Removal

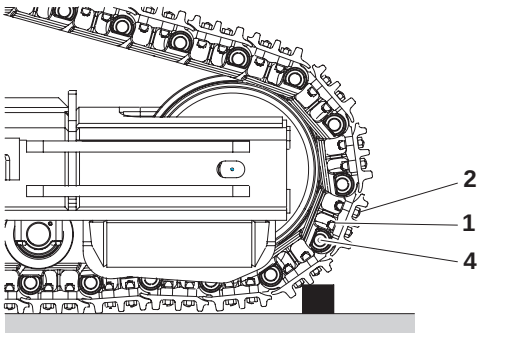
1. Position machine on a smooth level surface with adequate room for forward and reverse travel.



FG019247

Figure 8

2. Release track tension. Refer to “Track Tension” on page -7 in this section for procedure.
3. Move machine until master link (4, Figure 9) is positioned at approximately 4 o'clock from top position on front idle roller.
4. Put a wooden block under track shoes, as shown.



FG004355

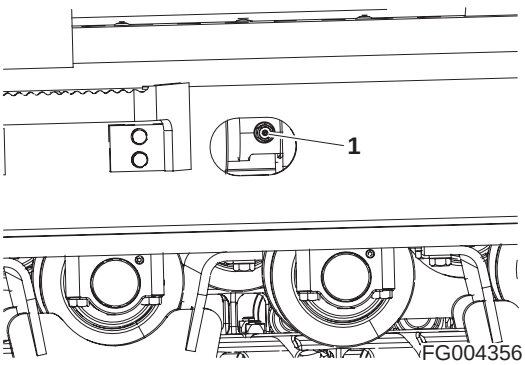
Figure 9

5. Loosen grease valve (1, Figure 10) for track adjuster to drain grease out. Use socket wrench 27 mm

WARNING

AVOID DEATH OR SERIOUS INJURY

The track adjusting mechanism is under very high-pressure. NEVER release grease pressure too fast. The track tension grease valve <u>should never be loosened more than one (1) complete turn from the fully tightened down position</u>. Bleed off grease pressure slowly. Keep your body away from the valve at all times. Always wear eye and face protection when adjusting track tension.



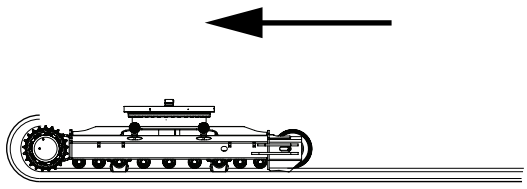
FG004356

Figure 10

6. Remove four nuts and bolts (1 and 2, Figure 9) holding shoe to link. Remove enough shoes to make access to master pin.
7. Remove master pin from master link by hammer or press. Remove pin after detaching shoe.

8. Move unit forward until entire track is laying on ground.

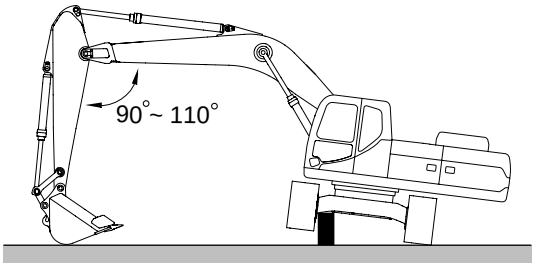
   NOTE: *Do not drive unit off track.*



FG003911

Figure 11

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

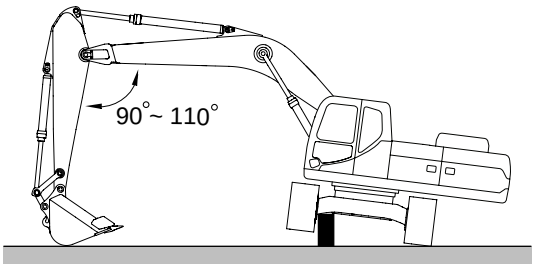


FG018383

Figure 12

Track Installation

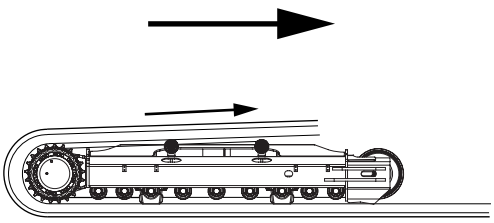
1. Lay rebuilt or new track into position under track frame. End of track should be positioned under drive sprocket.
2. With upper structure at 90° to track frame. Use bucket and boom to raise track frame off blocking.
3. With blocking removed, lower track frame onto track. Make sure all rollers are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



FG018383

Figure 13

4. Move unit forward while feeding track up over drive sprocket. Continue to pull track back until it engages front idle roller.
5. Align master links and install master pin.
6. Install four nuts and bolts (to fix track shoe).
7. Apply track tension. Refer to “Track Tension” on page -7" in this section for procedure.



FG003912

Figure 14

FRONT IDLER ROLLER

Parts List

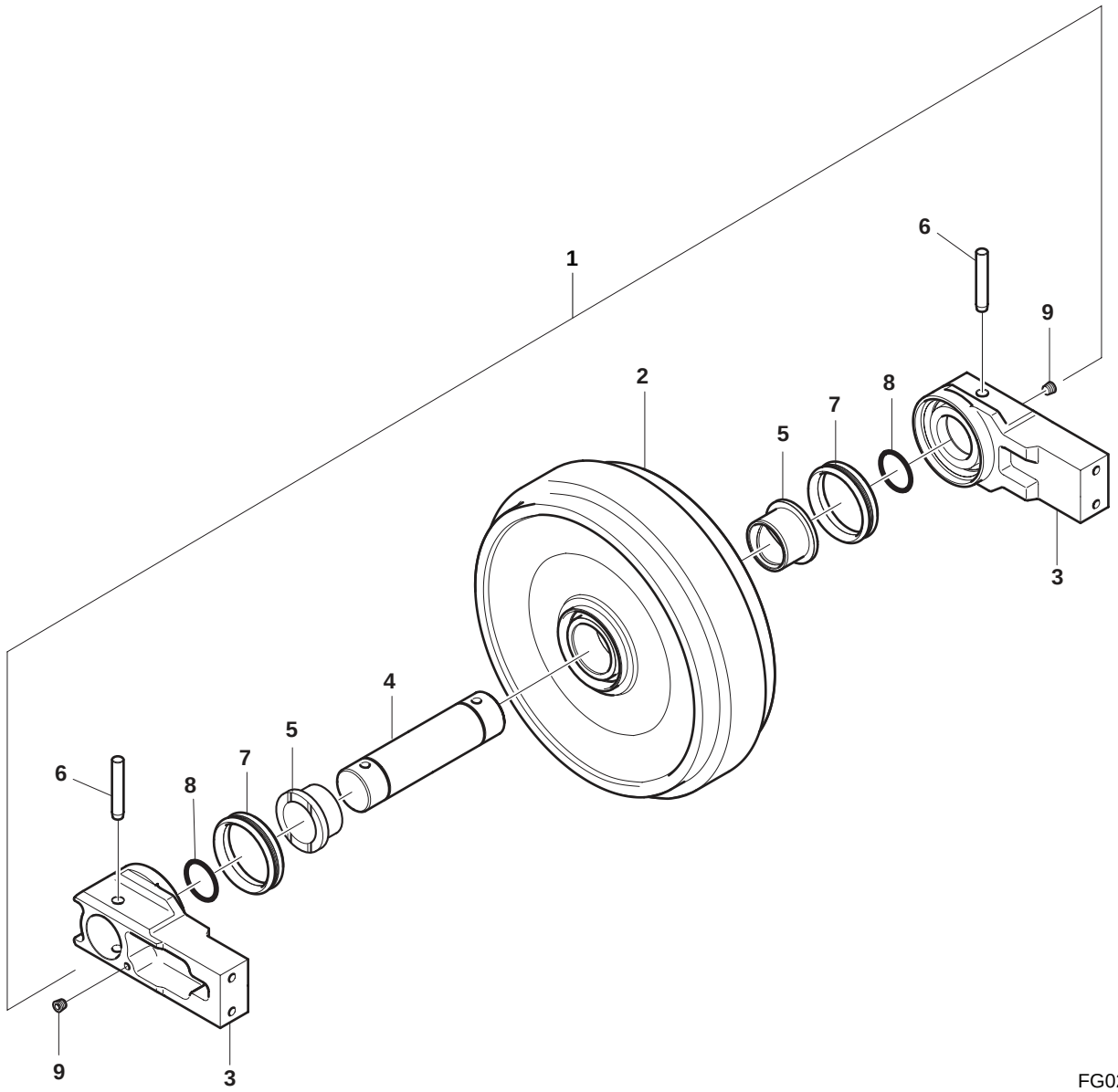


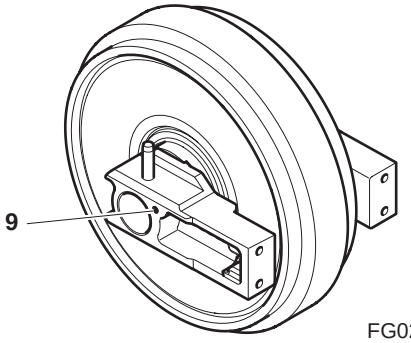
Figure 15

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

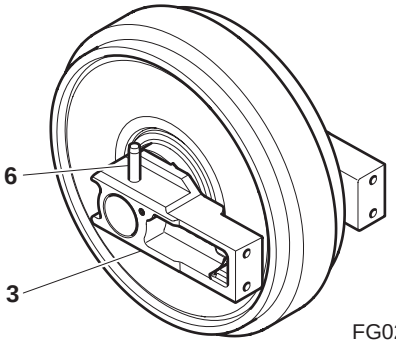
1. Remove plug (9, Figure 16) from idler assembly (1), and drain oil into a suitable container.



FG022246

Figure 16

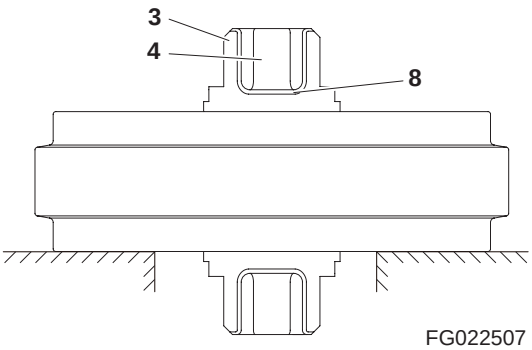
2. Separate the pin (6, Figure 17) from the bearing (3).



FG022247

Figure 17

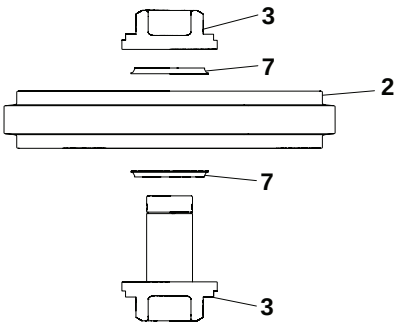
3. Use a press to remove bearing from the axle (4). Separate the O-ring (8, Figure 18) from the axle.



FG022507

Figure 18

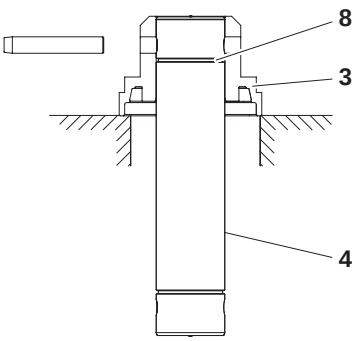
4. Detach the floating seal (7, Figure 19) from the idler (2) and bearing (3).



FG022508

Figure 19

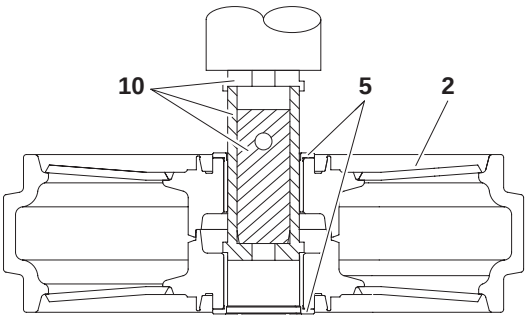
5. Use a press to separate the axle (4, Figure 20), O-ring (8) and bearing (3).



FG022509

Figure 20

6. Remove bushing (5, Figure 21) with the press and special tool (10, ST-1909).



FG022510

Figure 21

Front Idler Roller Reassembly

1. Degrease, clean and dry all parts before reassembly. Insert bushing (5, Figure 21) into the idler (2).
2. Grease O-ring (8, Figure 22) and insert it into the axle.
3. Align the bearing (3, Figure 22) and axle (4) holes and pin (6) them together.

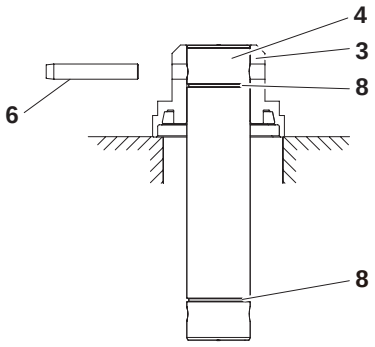


Figure 22

4. Install floating seal (7, Figure 23) inside the idler (2) and bearing (3).

   NOTE: *Apply clean gear oil (ISO VG 220EP) to the joint side of the floating seal. Apply grease to the floating seal O-ring.*

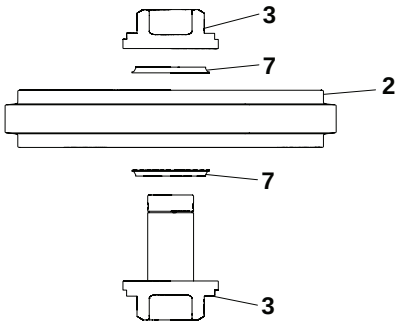


Figure 23

5. Install idler (2, Figure 24) on the axle.
6. Install bearing (3, Figure 24) and pin (6) to the axle.

   NOTE: *Fill the idler assembly with new gear oil (ISO VG 220EP) with approximately 320 cc (10.8 oz).*

7. Install plug (9, Figure 24) on the bearing.

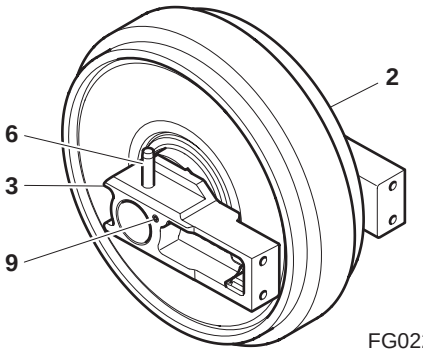
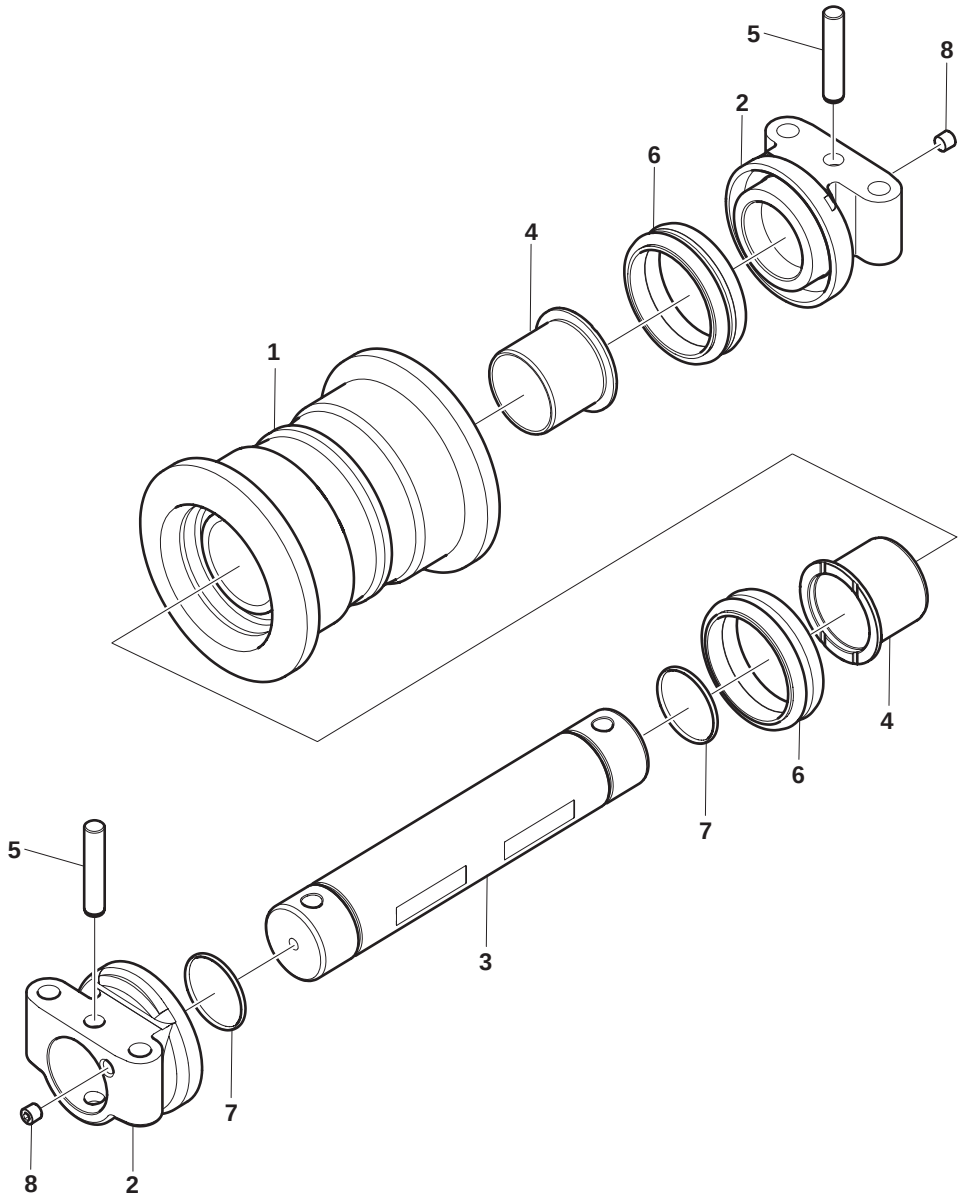


Figure 24

LOWER ROLLER

Parts List



FG022255

Figure 25

Reference Number	Description
1	Roller
2	Collar
3	Shaft
4	Bushing
5	Pin

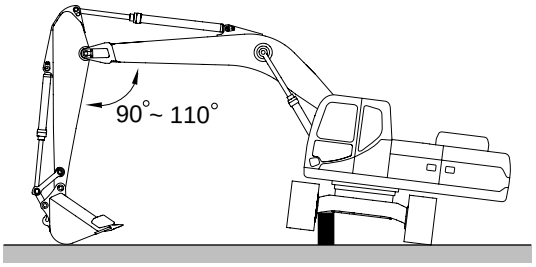
Reference Number	Description
6	Floating Seal
7	O-ring
8	Plug
9	Bolt

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.*

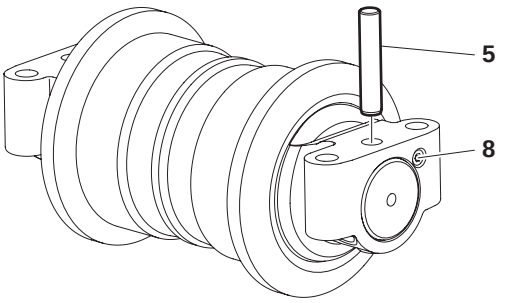


FG018383

Figure 26

Lower Roller Disassembly

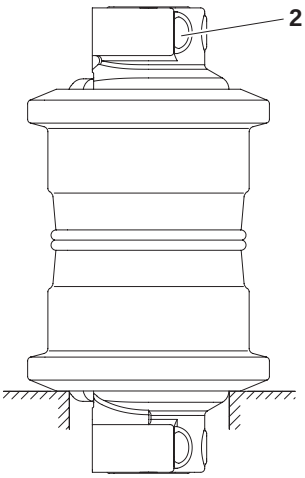
1. Remove plug (8, Figure 27) from the collar and drain oil.
2. Pull the pin (5, Figure 27) from the collar.



FG022513

Figure 27

3. Separate the collar (2, Figure 28) from the axle, using press.



FG022514

Figure 28

4. Detach O-rings (7, Figure 29) from the axle.
5. Separate floating seals (6, Figure 29) from the collar and roller (1).
6. Detach collar (2, Figure 29) and O-rings (7) from the axle, using press.

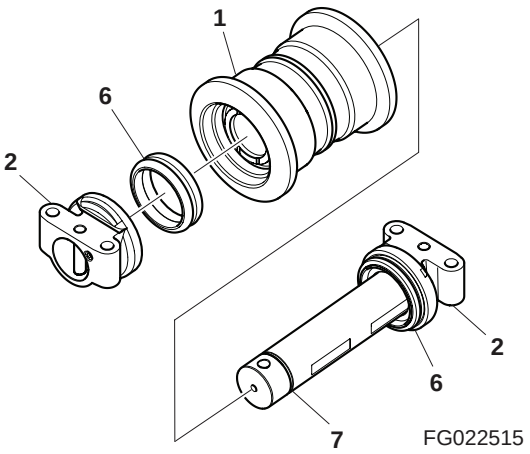


Figure 29

Lower Roller Reassembly

1. Degrease, clean and dry all parts before reassembly. Insert bushing (4, Figure 30) into roller.

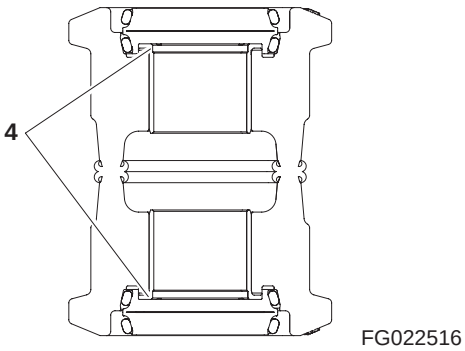


Figure 30

2. Apply grease to the O-rings (7, Figure 31) and insert into axle.
3. Align collar (2, Figure 31) and axle (3) pinholes and pin (5) the collar.

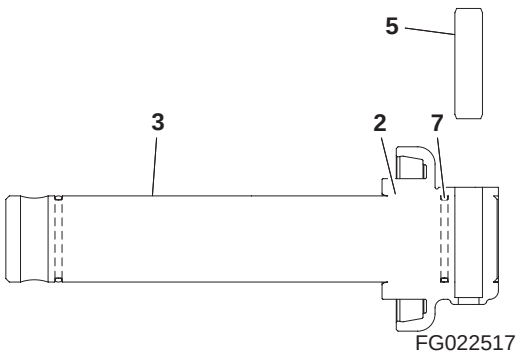


Figure 31

4. Insert floating seals (6, Figure 32) into the roller (1) and collar (2).

   NOTE: *Apply clean gear oil (ISO VG 220EP) to the joint side of the floating seal. Apply grease to the floating seal O-ring.*

5. Slide the axle inside the roller.

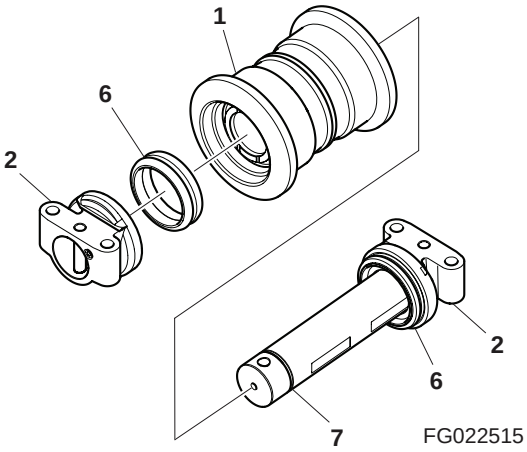


Figure 32

6. Install the collar (2, Figure 33), O-ring (7), and pin (5) on the remaining side.
7. Fill with clean gear oil (ISO VG 220EP) with approximately 280 cc (9.5 oz).
8. Install plug (8, Figure 33) on the collar.

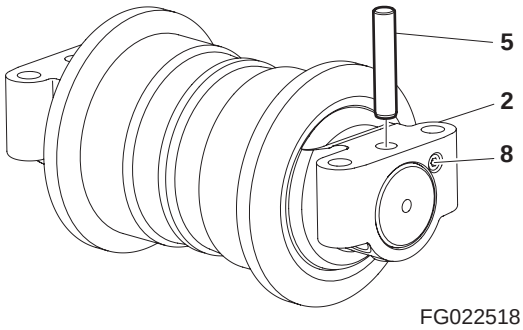


Figure 33

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.*

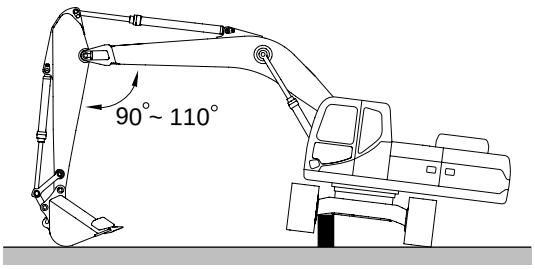


Figure 34

UPPER ROLLER

Parts List

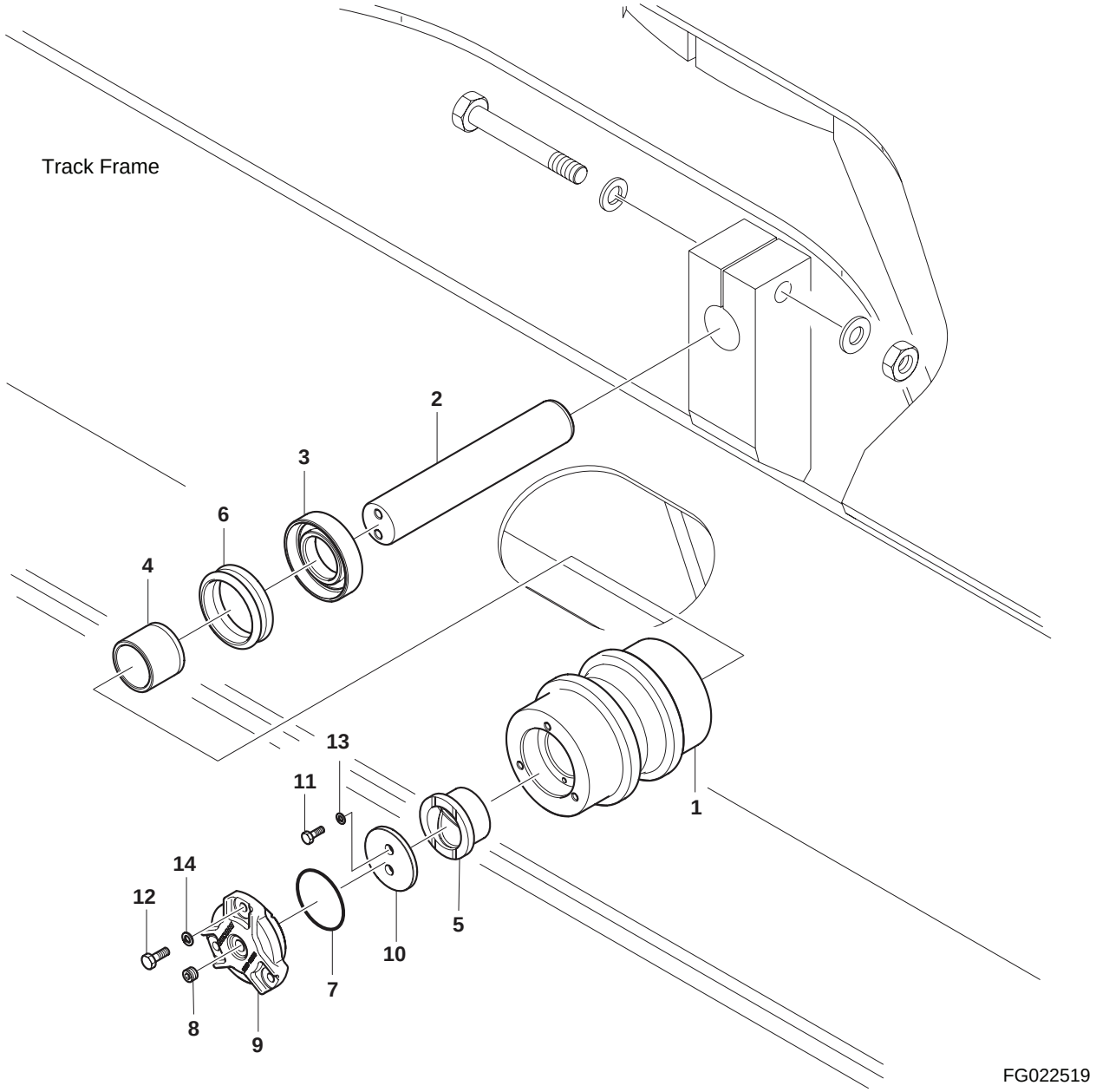


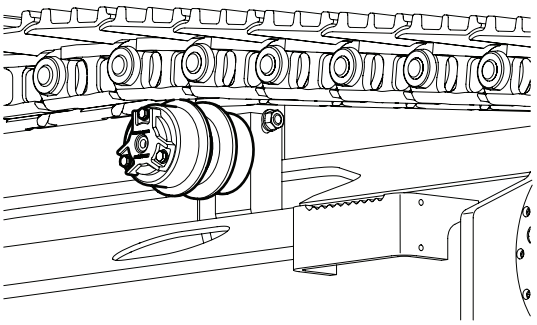
Figure 35

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

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

Upper Roller Removal

1. Relieve track tension. This will allow track to be raised so 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.



FG022520

Figure 36

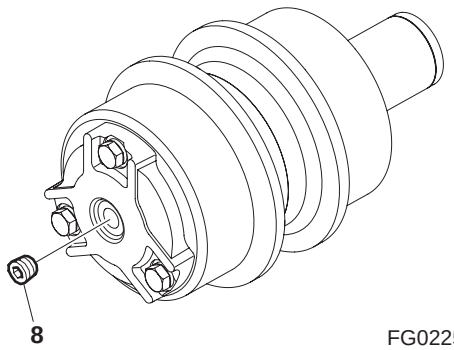
WARNING

AVOID DEATH OR SERIOUS INJURY

The track adjusting mechanism is under very high-pressure. NEVER release grease pressure too fast. The track tension grease valve should never be loosened more than one (1) complete turn from the fully tightened down position. Bleed off grease pressure slowly. Keep your body away from the valve at all times. Always wear eye and face protection when adjusting track tension.

Upper Roller Disassembly

1. Remove plug (8, Figure 37) from the cover and drain oil.



FG022521

Figure 37

2. Remove bolts (12, Figure 38) and cover (9). Detach bolts (11) and washer (10).

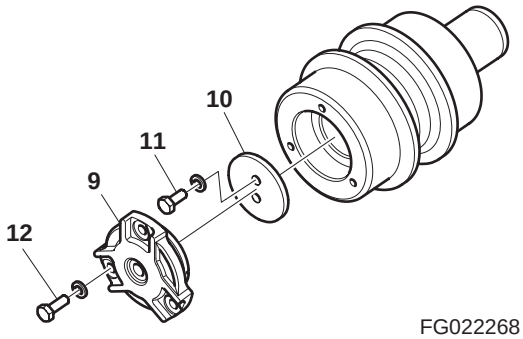


Figure 38

3. Separate the roller (1, Figure 39) from the axle (2).

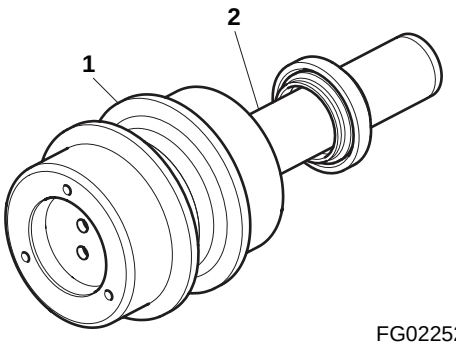


Figure 39

4. Separate the floating seal (6, Figure 40) from the roller.
5. Separate the thrust ring (3) from the axle.

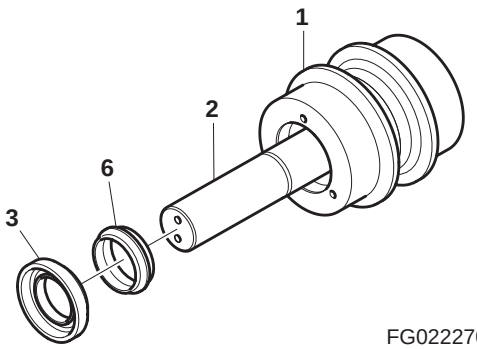


Figure 40

6. Separate the bushing (4 and 5, Figure 41) from the roller with a press and special tool (ST-1919).

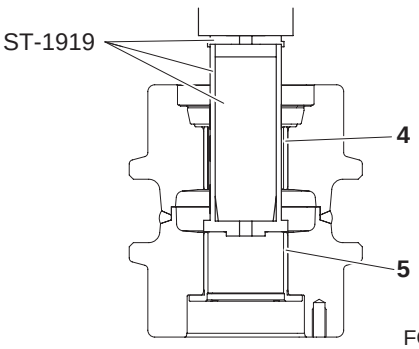


Figure 41

Upper Roller Reassembly

1. Degrease, clean and dry all parts before reassembly. Insert bushing (4 and 5, Figure 42) into the roller (1).

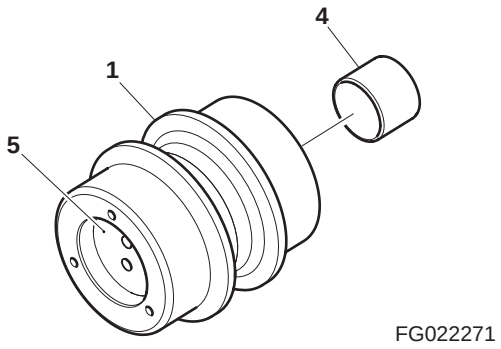


Figure 42

2. Insert floating seal (6, Figure 43) 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) and thrust ring (3).

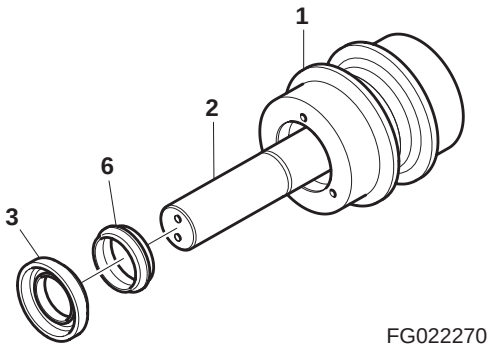


Figure 43

4. Install washer (10, Figure 44) and bolt (11).
5. Insert the O-ring (7, Figure 44) to the cover (9). Attach cover (9) and bolt (12) to the roller.
6. Fill with gear oil (ISO VG 220EP) with 200 cc (6.8 oz).
7. Tighten plug (8, Figure 44).

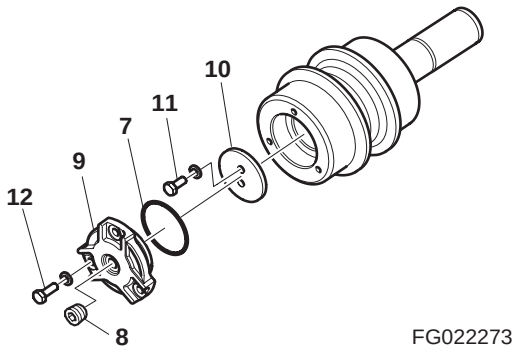


Figure 44

TRACK SPRING AND TRACK ADJUSTING CYLINDER

Parts List

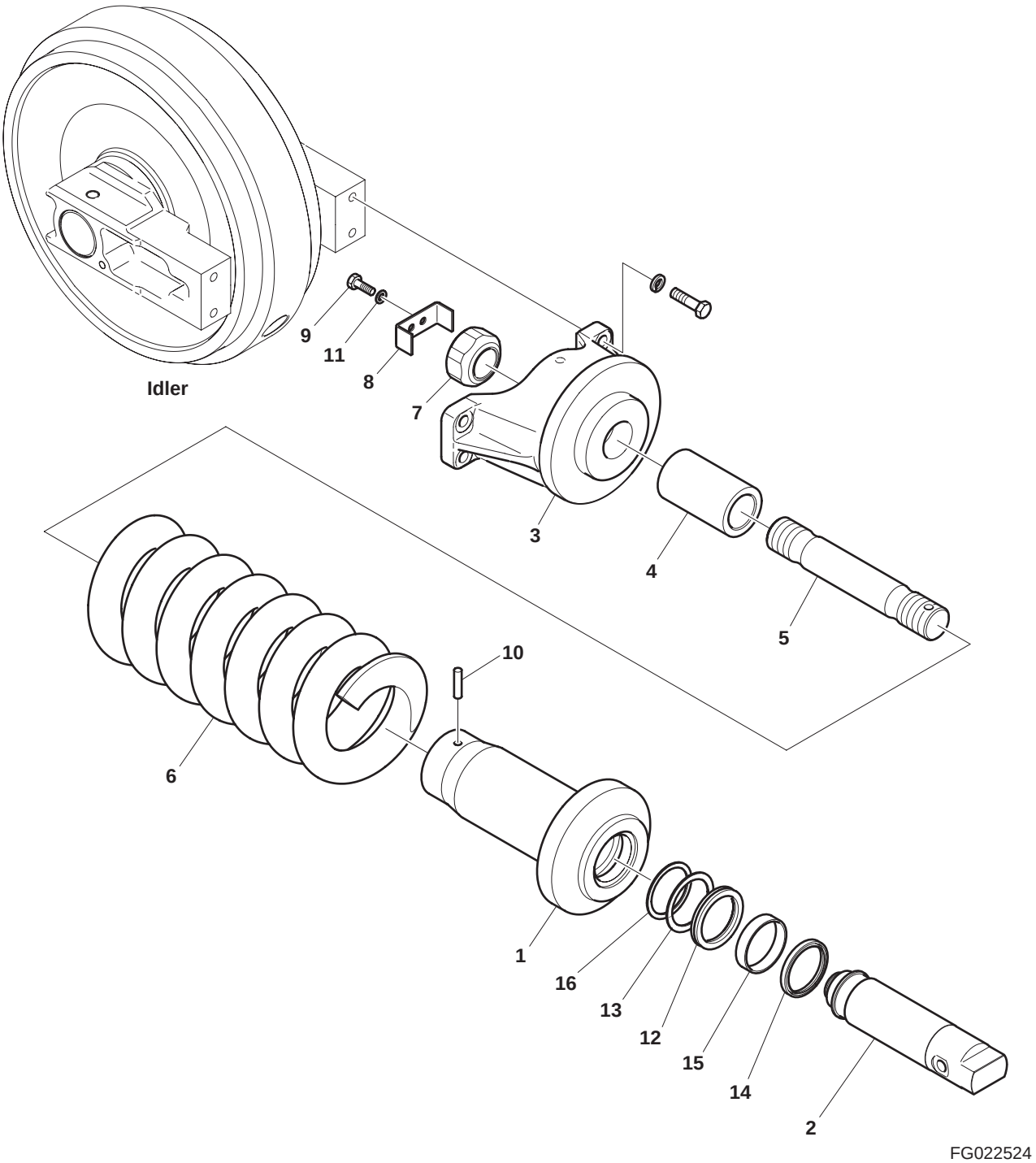


Figure 45

Reference Number	Description
1	Cylinder Body
2	Piston Rod
3	Bracket
4	Spacer
5	Shaft
6	Spring
7	Nut
8	Plate

Reference Number	Description
9	Bolt
10	Spring Pin
11	Washer
12	U Packing
13	Plate
14	Dust Seal
15	Piston Ring
16	Retaining Ring

Engine and Drivetrain

Engine Coolant Heater (Option)

Edition 2

MEMO

Table of Contents

Engine Coolant Heater (Option)

Safety Instructions 5
Applicable Models 5
Disassembly and Assembly 6
Changing the Circulating Pump 6
Changing the Temperature Limiter 8
Changing the Temperature Sensor 9
Changing the Combustion Air Fan 11
Changing the Burner, Flame Monitor and Glow Plug 13
Changing the Burner Head 15
Changing the Heat Exchanger 17

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 and Up

DISASSEMBLY AND ASSEMBLY

Changing the Circulating Pump

Removal

1. Remove heater.
2. Disconnect the electrical connections.
3. Remove screws (4, Figure 1).
4. Remove clip (3, Figure 1) and circulating pump (2, Figure 1).
5. Complete the work on stripped-down components.

Installation

1. Apply acid-free grease to the sealing ring (1, Figure 1).
2. Place the circulating pump (2, Figure 1) in the assembly position and attach with the clip (3, Figure 1) and screws (4, Figure 1).
3. Tighten the screws (4, Figure 1) to 3 Nm ± 10%.
4. Connect the electrical connections.
5. Install the heater.

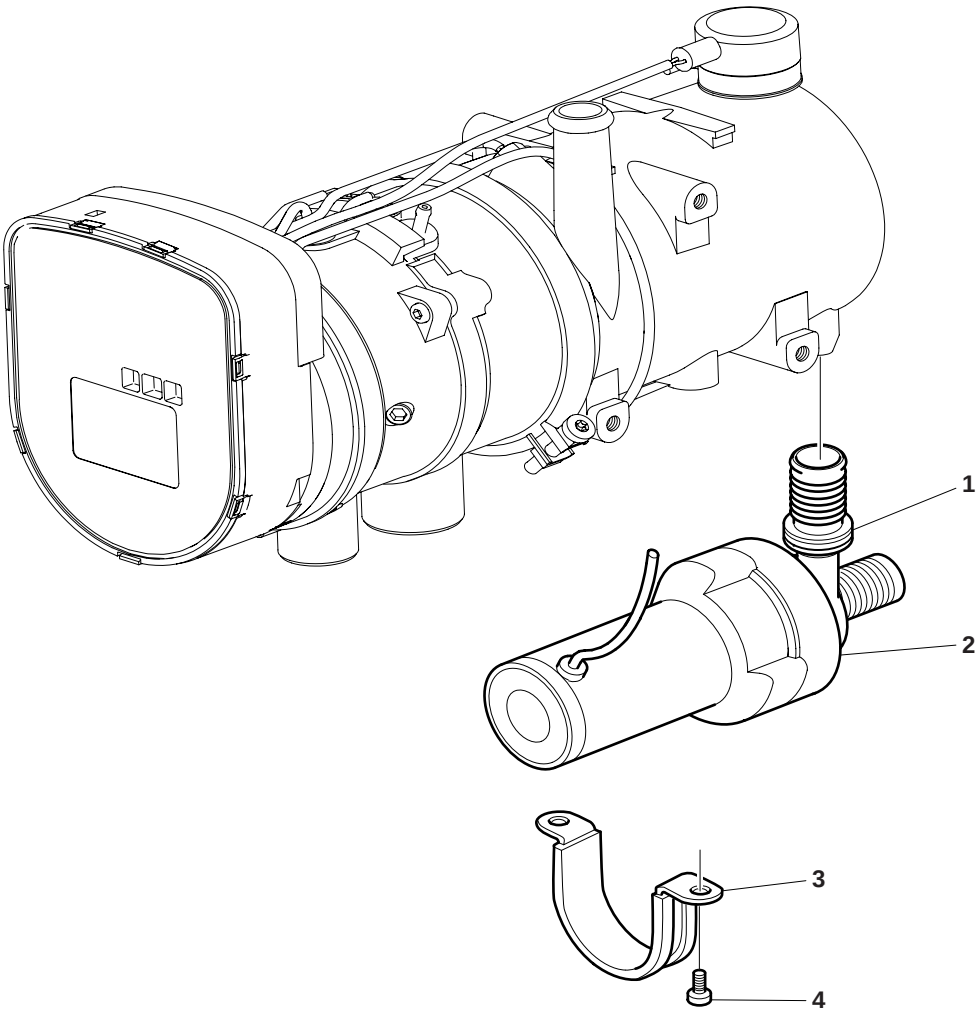


Figure 1 Changing the Circulating Pump

Reference Number	Description
1	Sealing Ring
2	Circulating Pump

Reference Number	Description
3	Clip
4	Screw (2)

NOTE: *A Thermo 90 ST heater is shown. In the Thermo 90 S heater, the control unit can also be arranged on the combustion air fan without having any effect on changing the circulating pump.*

Changing the Temperature Limiter

Removal

NOTE: *The temperature limiter only has to be removed if it is being replaced with a new one.*
The function must be checked in the installed condition.

1. Remove heater.
2. Disconnect the electrical connections.
3. Remove clip (2, Figure 2) and pull off the protective cap (1, Figure 2).
4. Use a screwdriver to lever off the retaining spring and remove temperature limiter (3, Figure 2).
5. Complete the work on stripped-down components.

   NOTE: *It is essential to install a new temperature limiter to replace a removed one!*

Installation

IMPORTANT

Incorrect installation will cause the heat exchanger to melt.

1. Insert the new temperature limiter (3, Figure 2) into the heat exchanger (4, Figure 2) and press in the retaining spring.

   NOTE: *You must be able to hear and feel the spring clip into the groove. Only then is the temperature limiter in the correct installation position.*

   If you do not hear and feel the spring clip in:

   - Clean the contact surface of the temperature limiter on the heat exchanger
   - Clean the groove in the heat exchanger
   - Ensure that detent lugs are present on both sides of the spring. Fit a new temperature limiter if necessary.
2. Put on the protective cap (1, Figure 2) and secure it with the clip (2, Figure 2).
3. Tighten the clip to 1 Nm ± 10%.
4. Connect the electrical connections.
5. Install the heater.

Changing the Temperature Sensor

Removal

1. Remove heater.
2. Disconnect the electrical connections.

WARNING

AVOID DEATH OR SERIOUS INJURY

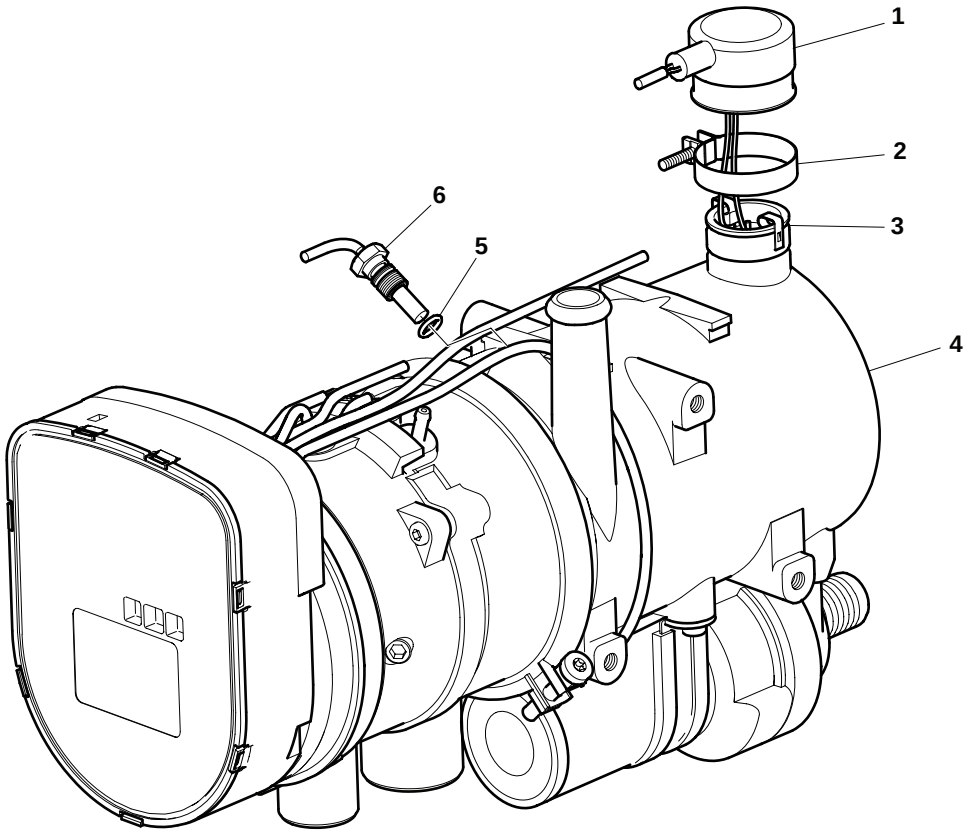
Leaking hot coolant can cause burns.

3. Unscrew and remove temperature sensor (6, Figure 2) and remove it with the round sealing ring (5, Figure 2).
4. Complete the work on stripped-down components.

Installation

1. Apply acid-free grease (Vaseline) to the round sealing ring (5, Figure 2).
2. Install the temperature sensor (6, Figure 2) with the round sealing ring (5, Figure 2) and screw it into the heat exchanger (4, Figure 2).

   Tighten to 1.5 Nm ± 10%.
3. Connect the electrical connections.
4. Install the heater.



FG018671

Figure 2 Changing the Temperature Limiter and Temperature Sensor

Reference Number	Description
1	Protective Cap
2	Clip
3	Temperature Limiter

Reference Number	Description
4	Heat Exchanger
5	Round Sealing Ring
6	Temperature Sensor

NOTE: *A Thermo 90 ST heater is shown. In the Thermo 90 S heater, the control unit can also be arranged on the combustion air fan without having any effect on changing the temperature sensor.*

Changing the Combustion Air Fan

Removal

1. Remove heater.
2. Disconnect the electrical connections.
3. Remove screws (2, Figure 3).
4. Pull the combustion air fan (1, Figure 3) off the burner head (4, Figure 3) and remove with the shaped sealing ring (3, Figure 3).

   NOTE: *Remove control unit if necessary from the Thermo 90 S/Thermo 90 ST heater with flange mounted control unit.*

5. Complete the work on stripped-down components.

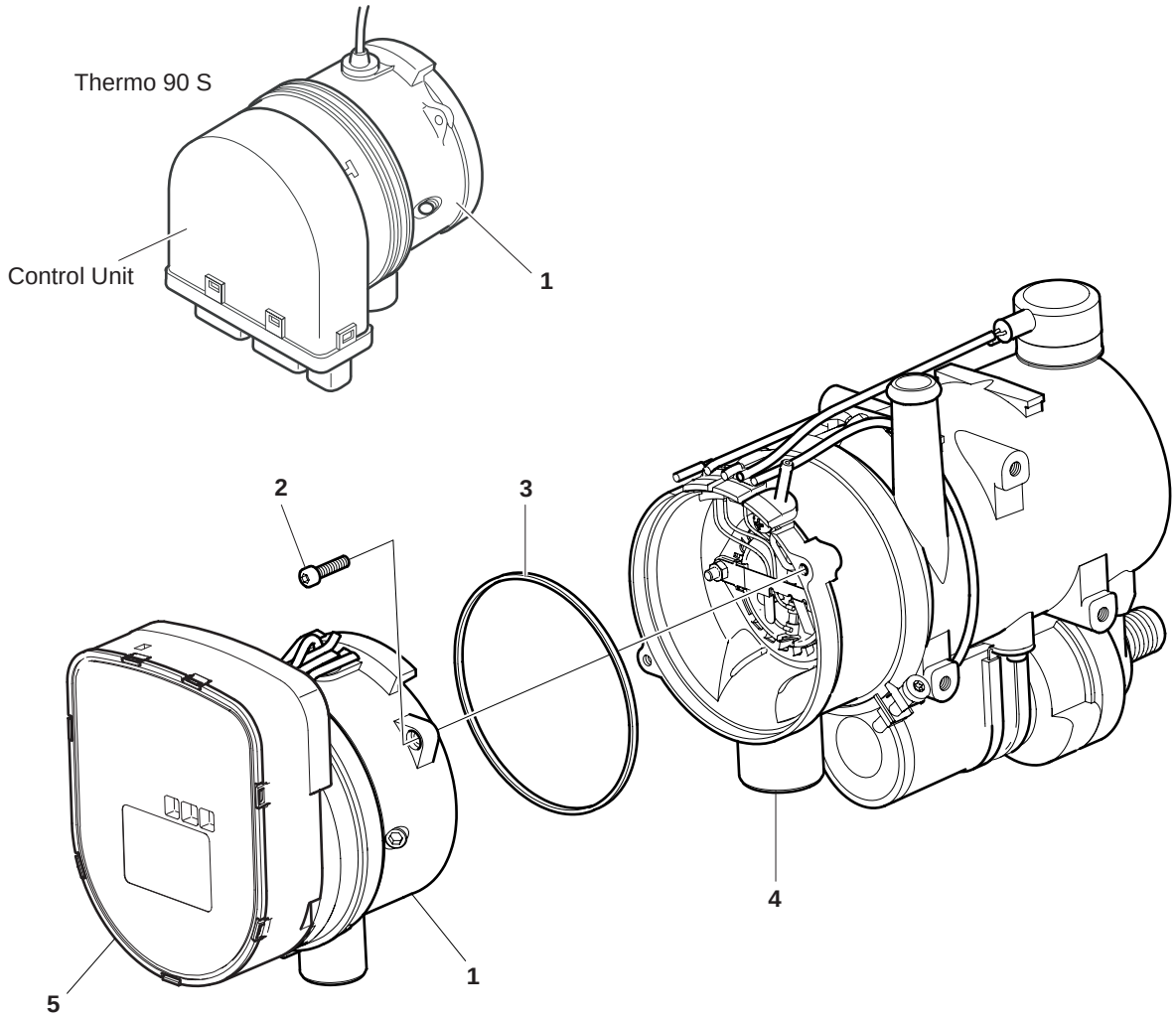
Installation

NOTE: *Insert the shaped seal (3, Figure 3) correctly and grease it (e.g. with Vaseline). Take care not to squash it.*

1. Install the new shaped sealing ring (3, Figure 3) onto the combustion air fan (1, Figure 3). Bring the fan into the assembly position and secure it with screws (2, Figure 3).
2. Tighten the screws (2, Figure 3) to 3 Nm ± 10%.

   NOTE: *Install the control unit if necessary on the Thermo 90 S/Thermo 90 ST heater with flange mounted control unit.*

3. Connect the electrical connections.
4. Install the heater.



FG018672

Figure 3 Changing the Combustion Air Fan

Reference Number	Description
1	Combustion Air Fan
2	Screw (2)
3	Shaped Sealing Ring

Reference Number	Description
4	Burner Head
5	Control Unit

NOTE: *A Thermo 90 ST heater is shown.*

Changing the Burner, Flame Monitor and Glow Plug

Removal

1. Remove heater.
2. Remove combustion air fan.
3. Remove screw (5, Figure 5) and washer (4, Figure 5).
4. Remove nuts (10, Figure 5) and pull off the bar (8, Figure 5).
5. Pull the grommets (11 and 12, Figure 5) out of the slots in the housing of the combustion pipe (3, Figure 5).
6. Pull the grommet (13, Figure 5) and burner (1, Figure 5) out of the burner head and remove with the swirl orifice (2, Figure 5).
7. Pull the flame monitor (7, Figure 5) and glow plug (6, Figure 5) from the burner (1, Figure 5) and remove.
8. Perform a visual check for assessing the burner.
9. Complete the work on stripped-down components.

Installation

1. Place the swirl orifice (2, Figure 5) onto the burner (1, Figure 5).
2. Carefully insert the flame monitor (7, Figure 5) and glow plug (6, Figure 5) into the burner up to the stop and push the grommets (11 and 12, Figure 5) into the slots in the housing of the burner pipe (3, Figure 5).
3. Insert the burner (1, Figure 5) and grommet (13, Figure 5) into the burner head (3, Figure 5).

IMPORTANT

During the following procedure, make sure that cables of the flame monitor (7, Figure 5) and the glow plug (6, Figure 5) are routed as shown in the figure.

4. Push the insulation (9, Figure 5) onto the bar (8, Figure 5) and bring the bar into the assembly position.

   NOTE: *Route the cable of the flame monitor and the glow plug as shown in the figure!*

5. Secure the bar (8, Figure 5) using the nuts (10, Figure 5). Tighten the nuts to 3 Nm ± 10%.
6. Secure the fuel line using the screw (5, Figure 5) and washer (4, Figure 5). Tighten the screw to 3 Nm ± 10%.
7. Install the combustion air fan.
8. Connect the electrical connections.
9. Install the heater.

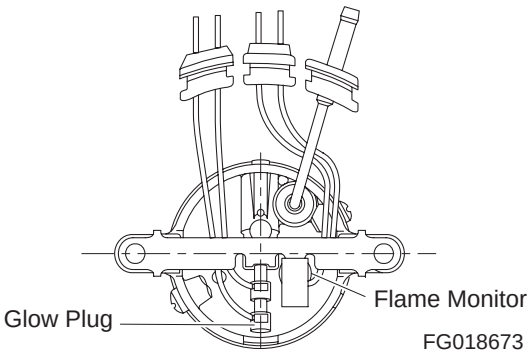
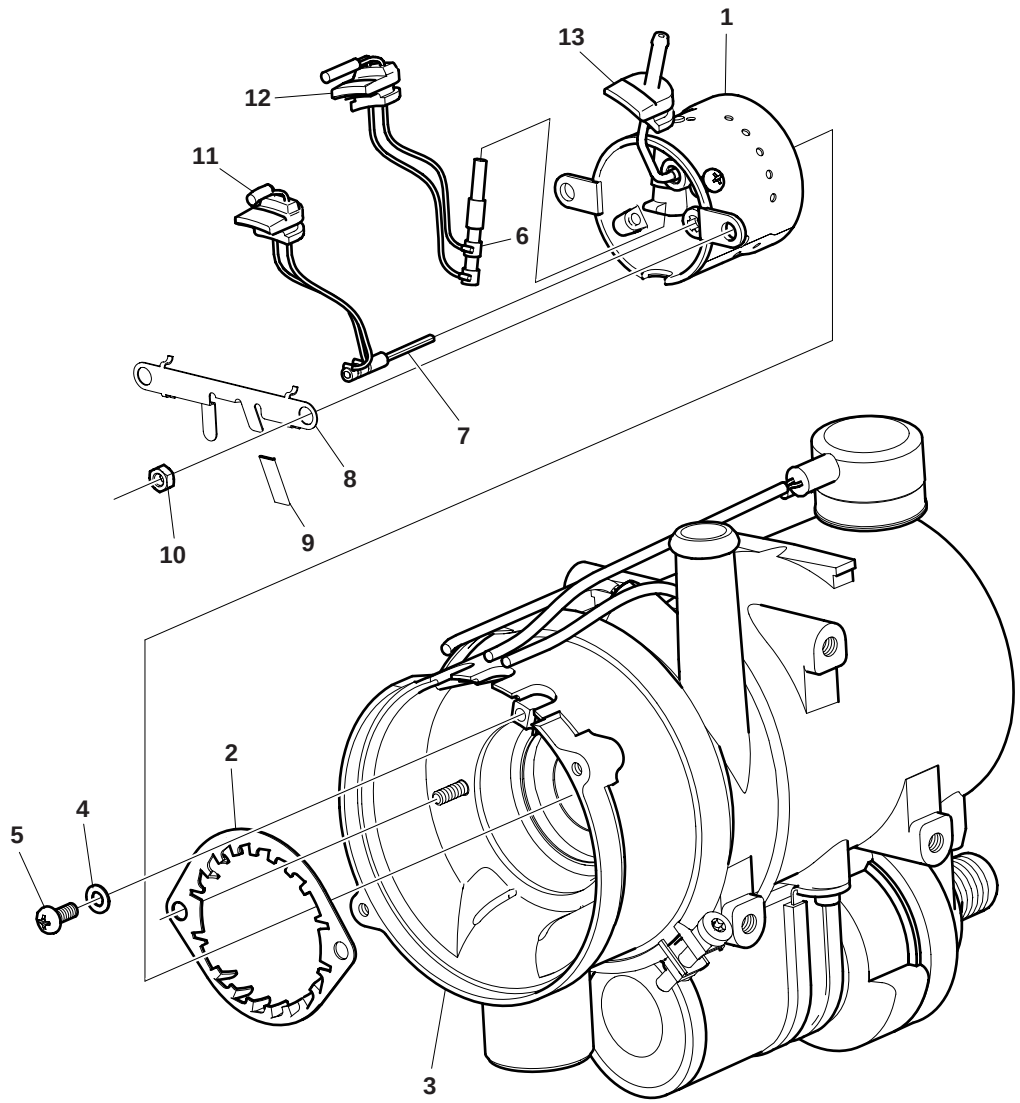


Figure 4



FG018674

Figure 5 Changing the Burner, Flame Monitor and Glow Plug

Reference Number	Description
1	Burner
2	Swirl Orifice
3	Burner Head
4	Washer
5	Screw
6	Glow Plug
7	Flame Monitor

Reference Number	Description
8	Bar
9	Insulation
10	Nut (2)
11	Grommet
12	Grommet
13	Grommet

NOTE: *A Thermo 90 ST heater is shown. The figure can also be used for the Thermo 90 S heater.*

Changing the Burner Head

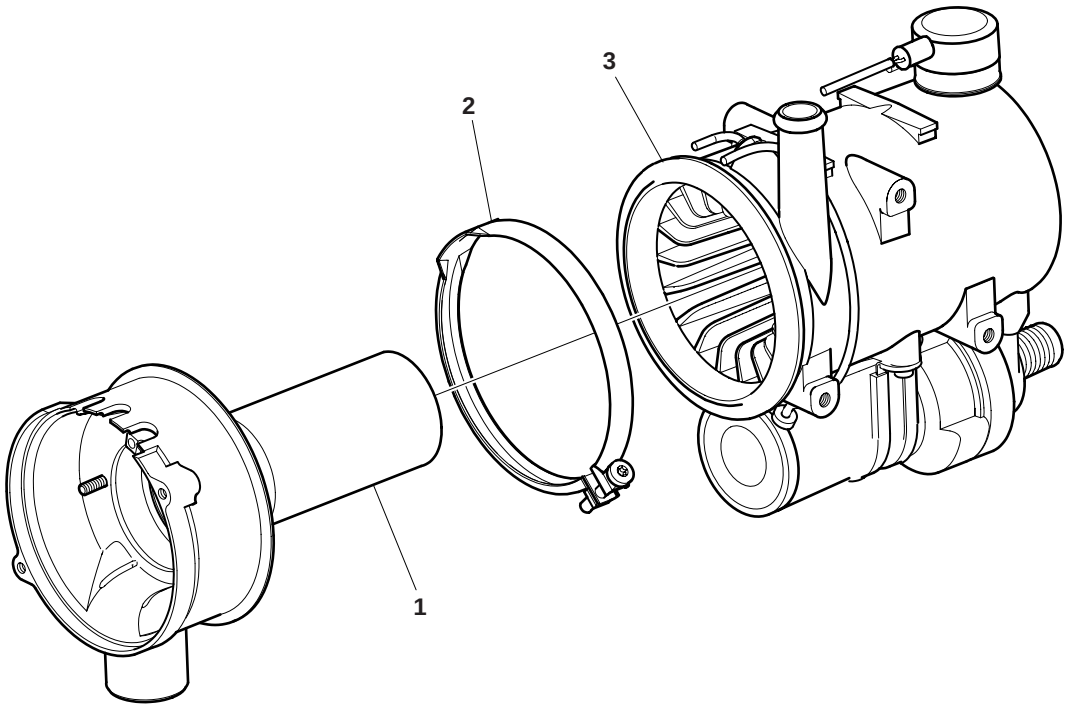
Removal

1. Remove heater.
2. Remove combustion air fan.
3. Remove burner, flame monitor and glow plug.
4. Remove mounting screw of the V-clamping collar (2, Figure 6) and pull off the clamping collar.
5. Pull out and remove burner head (1, Figure 6) from the heat exchanger (3, Figure 6).
6. Complete the work on stripped-down components.

Installation

NOTE: *The burner head and exhaust outlet port can also be aligned during installation in the machine.*

1. Guide the burner head (1, Figure 6) into the heat exchanger (3, Figure 6), align it if necessary and secure with the V-clamping collar (2, Figure 6).
2. If necessary, tighten the mounting screw of the V-clamping collar to 3 Nm ± 10%.
3. Install the burner, flame monitor and glow plug.
4. Attach the combustion air fan.
5. Install the heater.



FG018675

Figure 6 Changing the Burner Head

Reference Number	Description
1	Burner Head
2	V-clamping Collar

Reference Number	Description
3	Heat Exchanger

NOTE: *A Thermo 90 ST heater is shown. The figure can also be used for the Thermo 90 S heater.*

Changing the Heat Exchanger

Removal

1. Remove heater.
2. Remove circulating pump.
3. Remove temperature limiter.
4. Remove temperature sensor.
5. Remove combustion air fan.
6. Remove burner, flame monitor and glow plug.
7. Remove burner head.
8. Remove plug and connector housing.
9. Complete the work on stripped-down components.

Installation

1. Clip the connector housing onto the heat exchanger and insert the plug into the connector housing.
2. Install the burner head.
3. Install the burner, flame monitor and glow plug.
4. Attach the combustion air fan.
5. Install the temperature sensor.
6. Install the temperature limiter.
7. Attach the circulating pump.
8. Install the heater.

Drive Coupling (Main Pump)

Edition 1

MEMO

Table of Contents

Drive Coupling (Main Pump)

Safety Instructions 5
Applicable Models 5
Drive Coupling 6
Special Tools 7
Installation of Drive Coupling 8
Installation Procedure 10

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

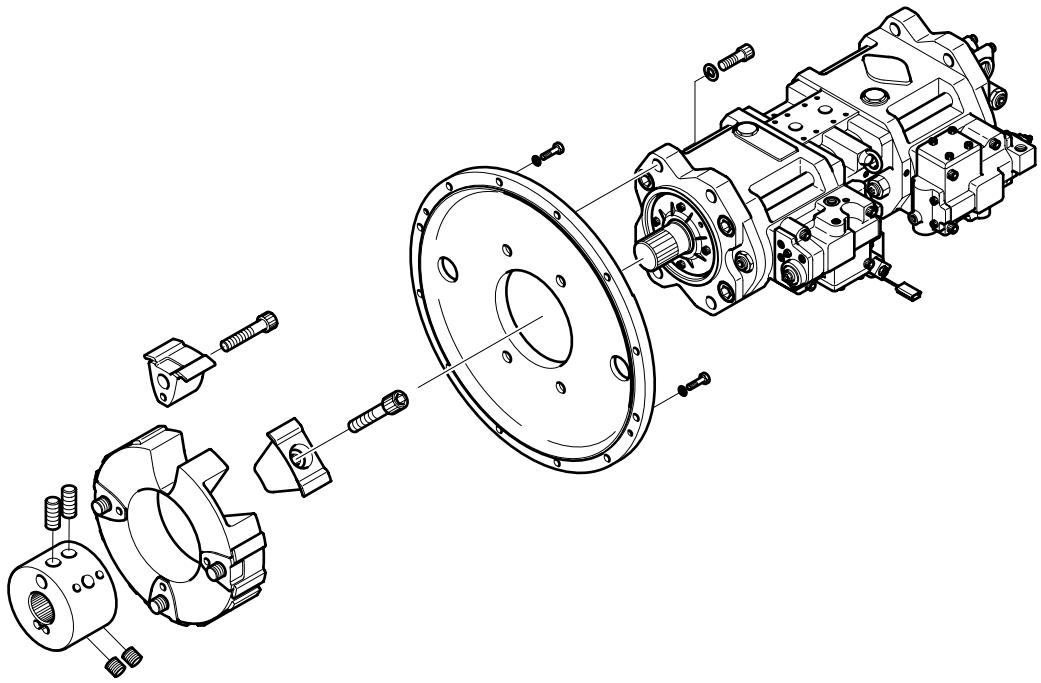
The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

DRIVE COUPLING

It is very important to set specified clearance between the end of the pump driveshaft (the "Dimension H" described below) and the coupling hub surface when installing the main pump in the engine.

The Figure 1 shows installation of a typical drive coupling.



FG019390

Figure 1

SPECIAL TOOLS

This tool is used to adjust the clearance, referred to as "Measure H" in the installation instructions below, between the pump driveshaft and the front side of the drive coupling hub (4, Figure 2).

NOTE: *Dimensions A and B are the same as Measure H in* Figure 3*. Two tools in the figure below are designed for various models, while only their one end may be used in some special models.*

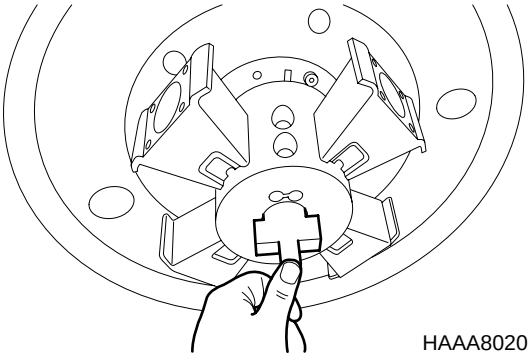


Figure 2

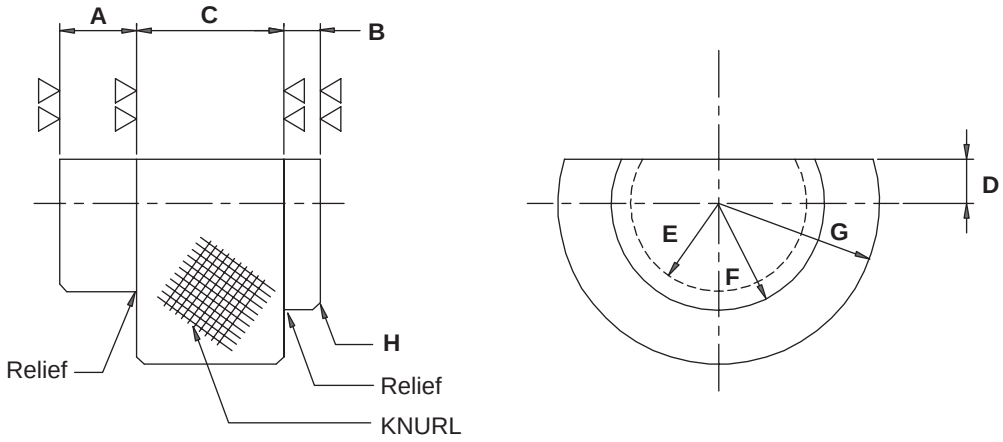
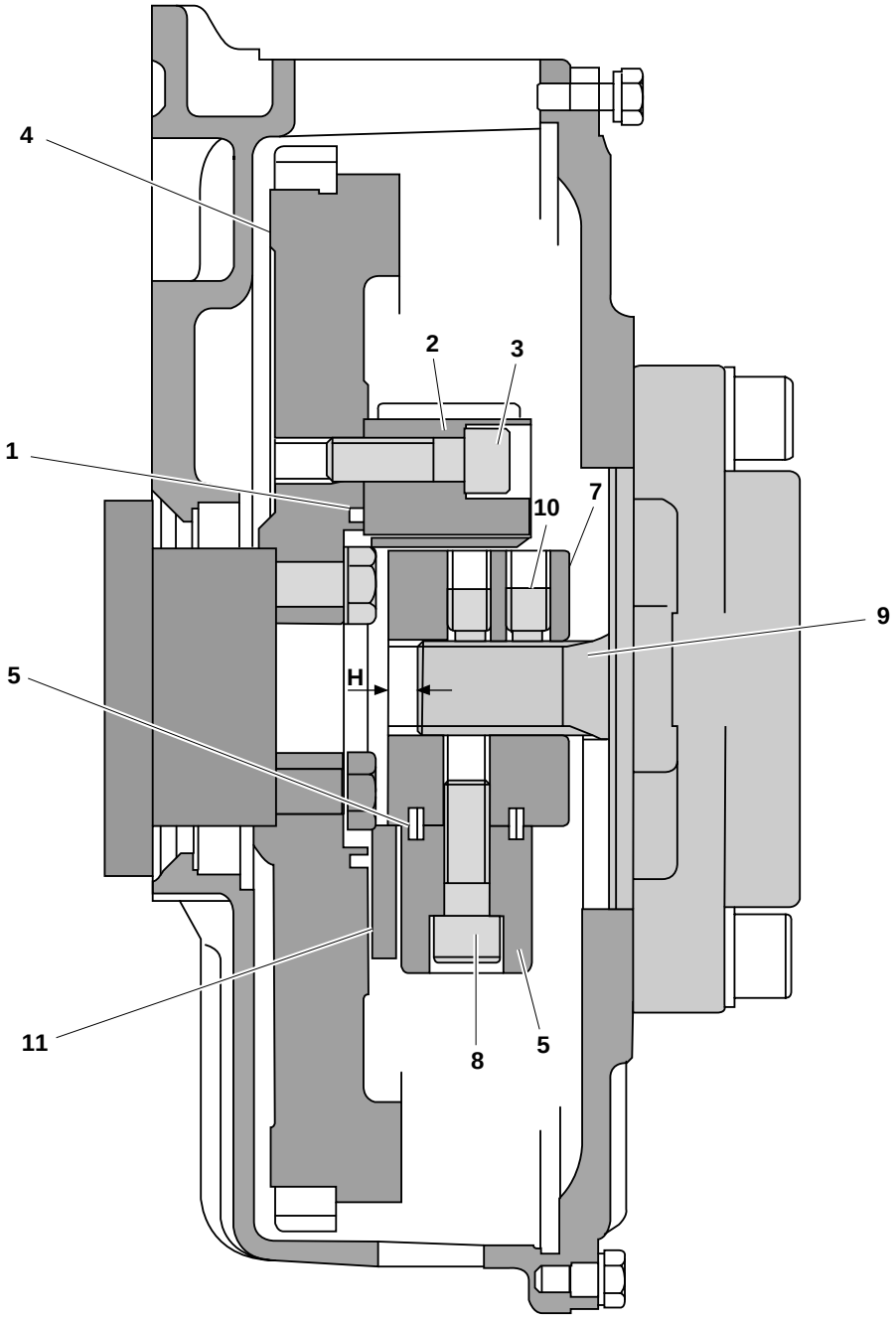


Figure 3

Model	A	B	C	D	E	F	G	H
DX225LC-3	10.5 ± 0.1mm	5.0 ± 0.1mm	20.0mm	7.0 mm	Radius, 12.0 mm	Radius, 14.0 mm	Radius, 25.0 mm	1.0 mm X 45°

INSTALLATION OF DRIVE COUPLING

Follow the installation dimensions and procedures whenever installing the drive coupling in the main pump.



HAAA8040

Figure 4 Installation of Drive Coupling

Parts and Torques			
References	**Parts**	**Q'ty**	**Torque**
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	Fixing Nut	2	Tb
11	Element	1	

Ensure to follow the specification of Measure H from the front hub surface to the pump shaft and tightening torques of bolts and screws.

MODEL	Coupling Part Reference	Measure H	Torque of Ta	Torque of Tb
DX225LC-3	2414-9041	10.0 - 11.0 mm	21 - 23 kg•m	10 - 12 kg•m

Installation Procedure

NOTE: *Refer to Figure 5 for the installation procedure.*

1. Install spring pin (1) and then insert (2) with bolt (3) into engine flywhee (4).

   NOTE: *Tighten the bolt using the torque Ta value specified in the table.*

2. Install two spring pins (5) and then insert (6) bolt (8) in hub (7).

   NOTE: *Tighten the bolt using the torque Ta value specified in the table.*

3. Install the flywheel cover in the main pump with bolts.

4. Connect hub (7) with pump shaft (9) as referred to as Measure H in Table 1 and attach position with screws (10).

   NOTE: *Tighten the screws using the torque Tb value specified in the table.*

   NOTE: *Apply Loctite #262 to fixing screws (10).*

5. Install element (11) in between the engine flywheel (4) and the insert.

6. Install the main pump and hub (7) by gently pushing them with element (11).

7. Bolt down the flywheel cover and the pump housing on the flywheel housing.

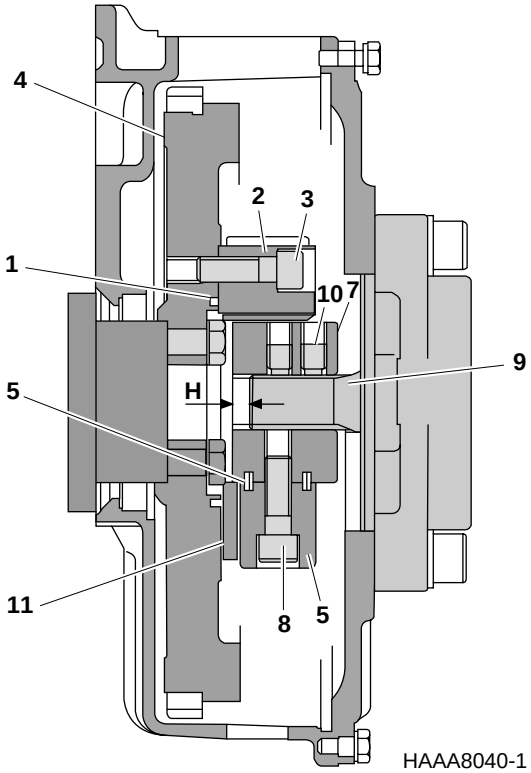


Figure 5

IMPORTANT

Apply the adhesive to bolts (3 and 8) to prevent the loosening of seals. Do not use additional adhesive nor any oil or cleaning solvent. As element (11) cannot resist adhesive, oil, and grease, take care not have it exposed to such materials.

Remove oil and dust on the flywheel cover and the pump shaft before assembly.

Adjust the arrangement allowance between the pump and the engine at below 0.6 mm (0.023 in).

Hydraulics

Hydraulic System Troubleshooting, Testing and Adjustment

Edition 1

MEMO

Table of Contents

Hydraulic System Troubleshooting, Testing and Adjustment

Safety Instructions 5
Applicable Models 5
Hydraulic System - General Notes 6
Hydraulic Schematic 7
General Notes 7
Operation of Working Components 9
Boom Operating Circuit 9
Boom Up Circuit 9
Boom Down Circuit 9
Arm Operating Circuit 10
Arm Crowd Circuit 10
Arm Dump Circuit 10
Bucket Operating Circuit 11
Bucket Crowd Circuit 11
Bucket Dump Circuit 11
Swing Operating Circuit 11
Right Swing Operating Circuit 12
Left Swing Operating Circuit 12
Swing Relief Valve and Makeup Valve 12
Travel Operating Circuit 12
Forward Travel Circuit 13
Reverse Travel Circuit 13
Procedural Troubleshooting Baseline Recommendations 14
Initial Checks and Tests to Establish Operating Condition of the Excavator 14
Pilot Pressure 16
Adjustment and Testing 16
Power Mode Valve 17
Current Signal and Hydraulic Pressure Adjustments 17
Pressure Up Valve 18

Checks and Adjustments 18
Pump Input Power Control 20
Pump Regulator Adjustment 20
Flow Meter and Flow Meter Kit Installation and Testing 23
Swing System Troubleshooting 25
Precautions/Initial Checks 25
Swing Relief Valve Checking and Adjustment 26
Troubleshooting – Swing Gearbox 28
Troubleshooting – Hydraulic Problems 29
Troubleshooting – Control Valve 31
Troubleshooting – Travel Control Valve 32
Troubleshooting – Joystick Control Valve 33

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

HYDRAULIC SYSTEM - GENERAL NOTES

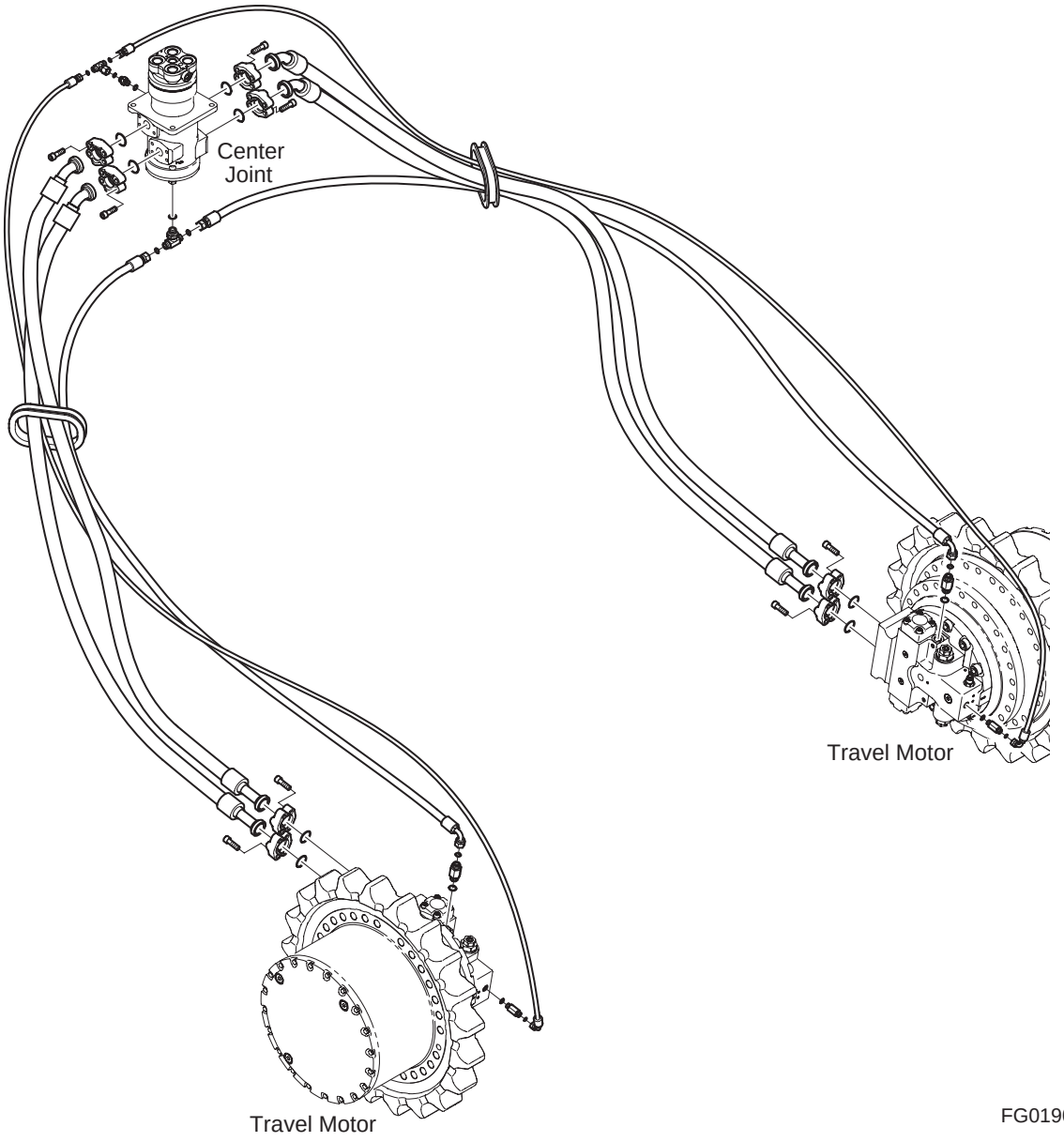


Figure 1

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 several 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, supplied 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 has 10 micron and the pilot circuit line has 30 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 because 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 370 kg/cm^2 (5,265 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.

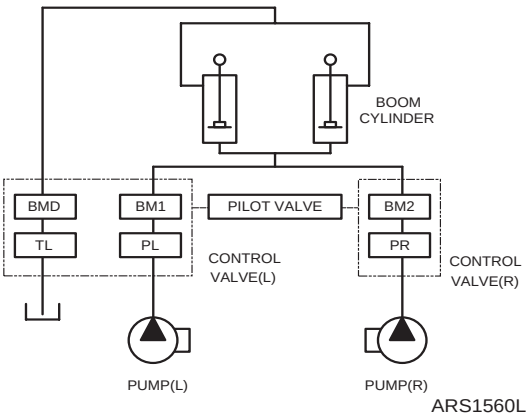


Figure 2

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 oil from only one pump (PUMP (L)) assembly goes to the boom cylinder for boom lowering.

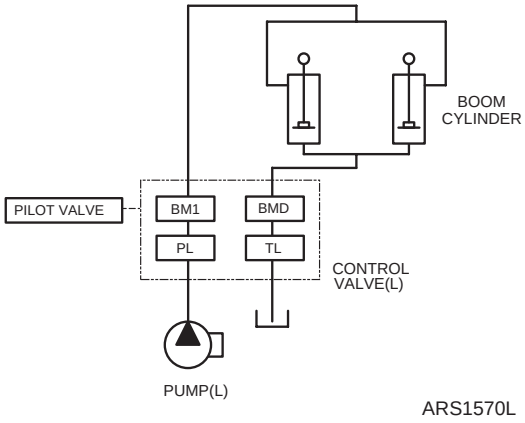


Figure 3

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 370 kg/cm^2 (5,265 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 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.

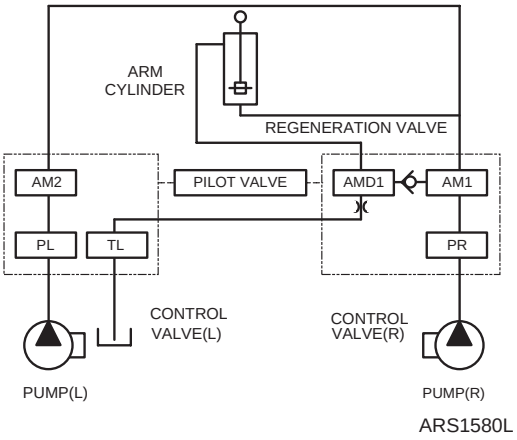


Figure 4

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.

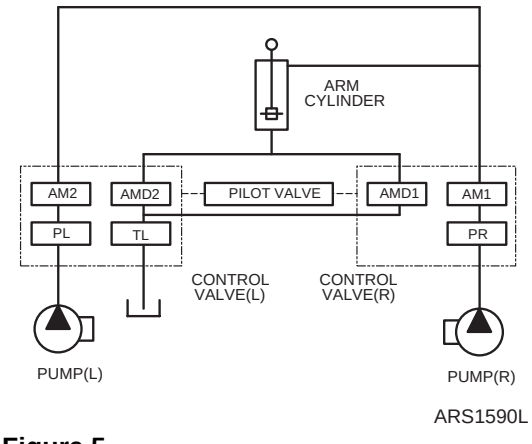


Figure 5

Bucket Operating Circuit

The bucket operating circuit includes the left main pump, the left half of the control valve and the bucket cylinder. 370 kg/cm^2 (5,265 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.

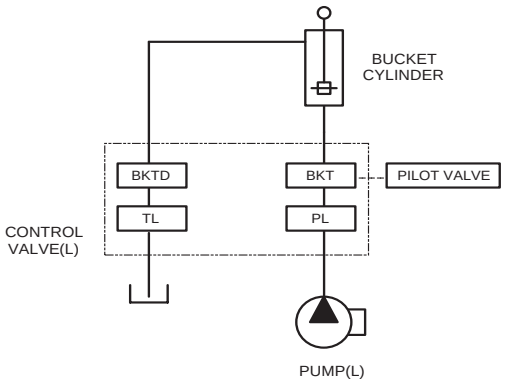


Figure 6

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.

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.

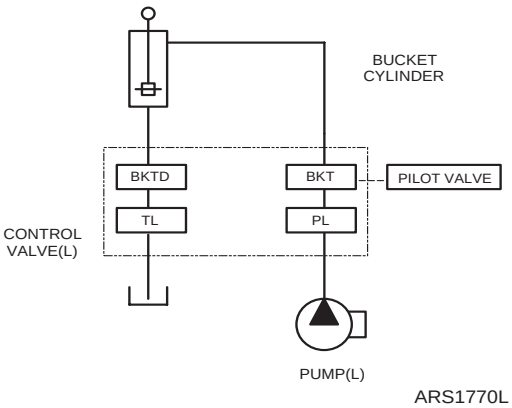


Figure 7

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.

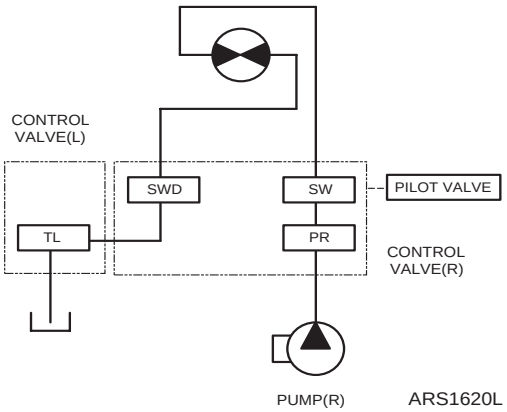


Figure 8

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.

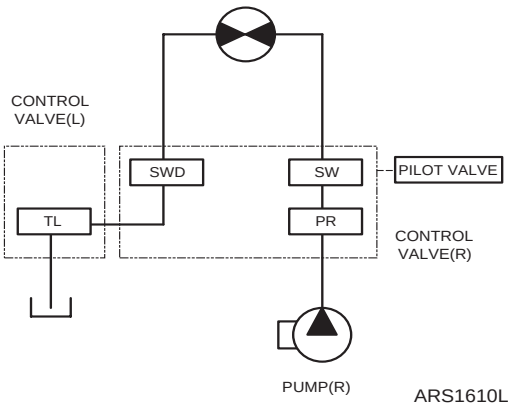


Figure 9

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 structure works and correspondingly reduced pressure at the opposite motor port - could produce cavitation in the circuit. To keep that from happening, a 270 kg/cm^2 (3,840 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.

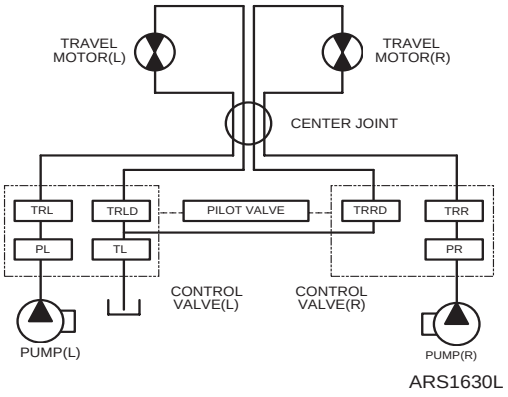


Figure 10

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.

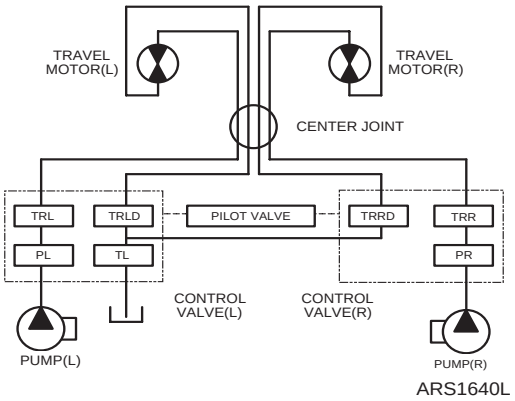


Figure 11

PROCEDURAL TROUBLESHOOTING BASELINE RECOMMENDATIONS

Initial Checks and Tests to Establish Operating Condition of the Excavator

Troubleshooting Recommendations

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

- First hydraulic flow.
- Then hydraulic pressure 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 because of 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 component is worn beyond tolerance limits, while all other hydraulic functions are adequate.*

IMPORTANT

It is suggested that 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

AVOID DEATH OR SERIOUS INJURY

This procedure should be done with two people. To reduce the chance of accidental movement of the excavator, one person should be properly seated at the operator's controls 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 safety lever is in the up (UNLOCK) 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 locknut 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

Refill 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 kg/cm^2 (569 ± 71 psi)	23.5 ± 1.5 kg/cm^2 (334 ± 21 psi)

POWER MODE VALVE

Current Signal and Hydraulic Pressure Adjustments

WARNING

AVOID DEATH OR SERIOUS INJURY

This procedure should be done with two people. To reduce the chance of accidental movement of the excavator, one person should be properly seated at the operator's controls 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 a VOM meter can be connected to the circuit. To set up the testing equipment, stop 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 locknut 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 locknut.*

Mode	Engine rpm	Current	Pressure
Power Plus Mode	High Idle: 1,890 (Auto Idle OFF) 1,800 (Auto Idle ON)	200 ± 20 - 650 ± 65 mA Midrange value corresponding to engine rpm for both current and hydraulic pressure readings.	1.6 - 32.8 kg/cm^2 (22.9 - 466.5 psi)
Power Mode	High Idle: 1,700	240 ± 23 - 650 ± 65 mA	3.8 - 32.8 kg/cm^2 (54 - 466.5 psi)
Standard Mode	High Idle: 1,650	280 ± 28 - 650 ± 65 mA	6.4 - 32.8 kg/cm^2 (91 - 466.4 psi)
Economic Mode	High Idle: 1,600	340 ± 34 - 650 ± 65 mA	10.6 - 32.8 kg/cm^2 (150.8 - 466.5 psi)

PRESSURE UP VALVE

Checks and Adjustments

WARNING

AVOID DEATH OR SERIOUS INJURY

This procedure should be done with two people. To reduce the chance of accidental movement of the excavator, one person should be properly seated at the operator's controls 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) locknut on the relief valve. Turn the adjusting screw clockwise to increase pressure, or counterclockwise to decrease it. Pressure must be 370 kg/cm^2 (5,263 psi), or up to 10 kg/cm^2 (142 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 350 kg/cm^2 (4,975 psi), but less than 355 kg/cm^2 (5,046 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 kg/cm^2 (285 - 570 psi)	40 ± 10 kg/cm^2 (569 ± 142 psi)
Power Mode	Cylinder Stall	330 ± 5 kg/cm^2 (4,693 ± 71 psi)	40 ± 10 kg/cm^2 (569 ± 142 psi)
Power Mode W/ Pressure Up	Cylinder Stall	350 ± 10 kg/cm^2 (4,978 ± 142 psi)	40 ±10 kg/cm^2 (569 ± 142 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

AVOID DEATH OR SERIOUS INJURY

This procedure should be done with two people. To reduce the chance of accidental movement of the excavator, one person should be properly seated at the operator's controls 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 constantly 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.

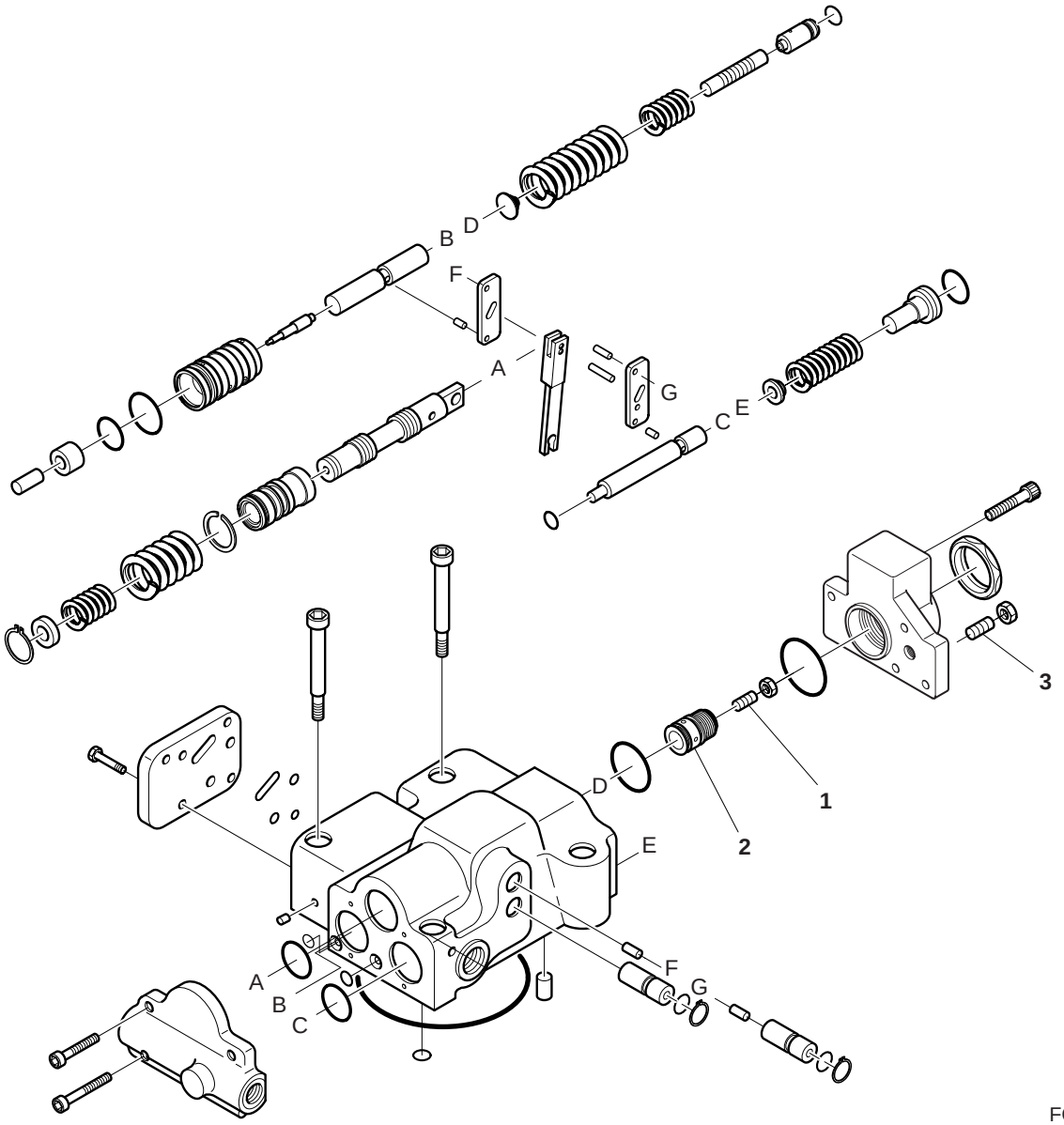


Figure 12

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, 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 locknut 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.

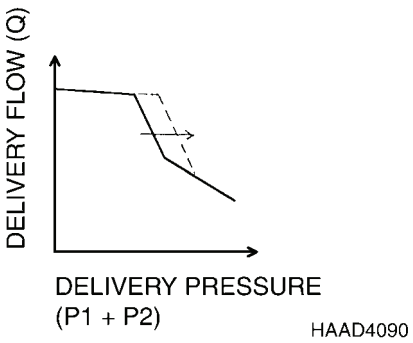


Figure 13

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.

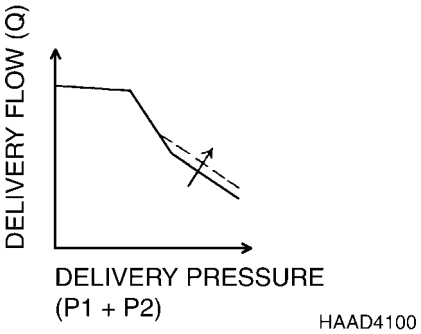


Figure 14

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.

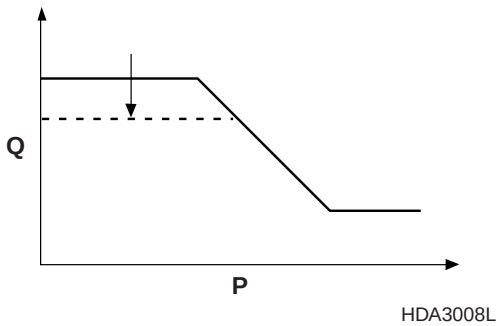


Figure 15

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 performing 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

- Stop 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 deaerate 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 ± 5 kg/cm^2 (1,422 psi)	
	150 ± 5 kg/cm^2 (2,133 psi)	
	200 ± 5 kg/cm^2 (2,844 psi)	
	300 ± 5 kg/cm^2 (4,267 psi)	
	350 ± 5 kg/cm^2 (4,975 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 meet 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.

SWING SYSTEM TROUBLESHOOTING

Precautions/Initial Checks

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

WARNING

AVOID DEATH OR SERIOUS INJURY

Stop operation and park excavator whenever these problems are noticed:

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.
- 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 500 kg/cm^2 (7,112 psi) pressure gauges to the inlet and outlet measuring ports on top of the swing motor.

      Pressure should be between 265 and 275 kg/cm^2 (3,769 psi and 3,911 psi), with both swing locks engaged. With swing locks released, during full acceleration and deceleration, pressure should approach 270 kg/cm^2 (3,840 psi) in each direction.

   B. Connect a 100 kg/cm^2 (1,422 psi) pressure gauge at the "SH" port of the hydraulic brake.

      Pressure should always stay at or above 13 kg/cm^2 (185 psi) when operating swing, boom or arm.

   C. Connect a 10 kg/cm^2 (142 psi) gauge at the motor makeup valve.

      Pressure should stay consistently above 2.5 kg/cm^2 (36 psi). If pressure drops 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, drivetrain 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 kg/cm^2 (185 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 drops 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 drivetrain 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 moving 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 drivetrain.	Replace broken gears and drivetrain 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 driveshaft damage.	Replace swing motor.
	Internal damage to gearbox drivetrain.	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 driveshaft or from bolted connections or other assembled surfaces.	Oil seal damaged. Assembly compound (joint sealer) old and not sealing. Or 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 workload 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 refilled 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 locknut 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 find damaged seals or gaskets that could be the cause of air leaks.*		

Accumulator

Edition 1

Table of Contents

Accumulator

Safety Instructions 5
Applicable Models 5
General Description 6
Specifications 8

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 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

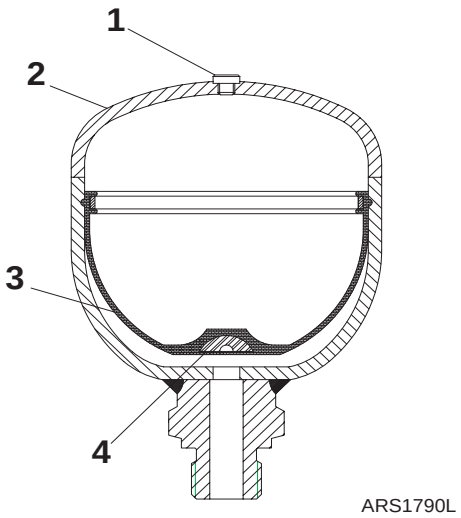


Figure 1

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.*

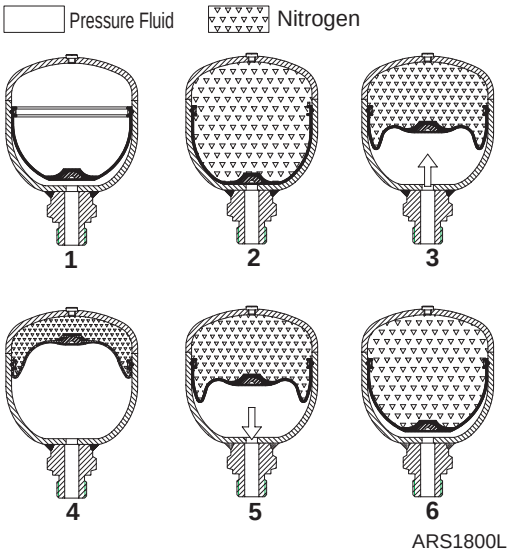


Figure 2

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
DX140LC-3	S/N 1001 and Up S/N 50001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX180LC-3	S/N 1001 and Up S/N 50001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX225LC-3	S/N 1001 and Up S/N 50001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX255LC-3	S/N 1001 and Up S/N 50001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX300LC-3	S/N 1001 and Up S/N 50001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX340LC-3	S/N 1001 and Up S/N 10001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX350LC-3	S/N 1001 and Up S/N 10001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX380LC-3	S/N 10001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX420LC-3	S/N 10001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX490LC-3	S/N 10001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)
DX530LC-3	S/N 10001 and Up	Pilot	10 kg/cm^2 (140 psi)	320 cc (19.53 in^3)

Center Joint (Swivel)

Edition 2

Table of Contents

Center Joint (Swivel)

Safety Instructions 5
Applicable Models 5
General Description 7
Parts List 8
Troubleshooting, Testing and Adjustment 9
Inspection 9
Testing 9
Disassembly 10
Reassembly 13

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 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

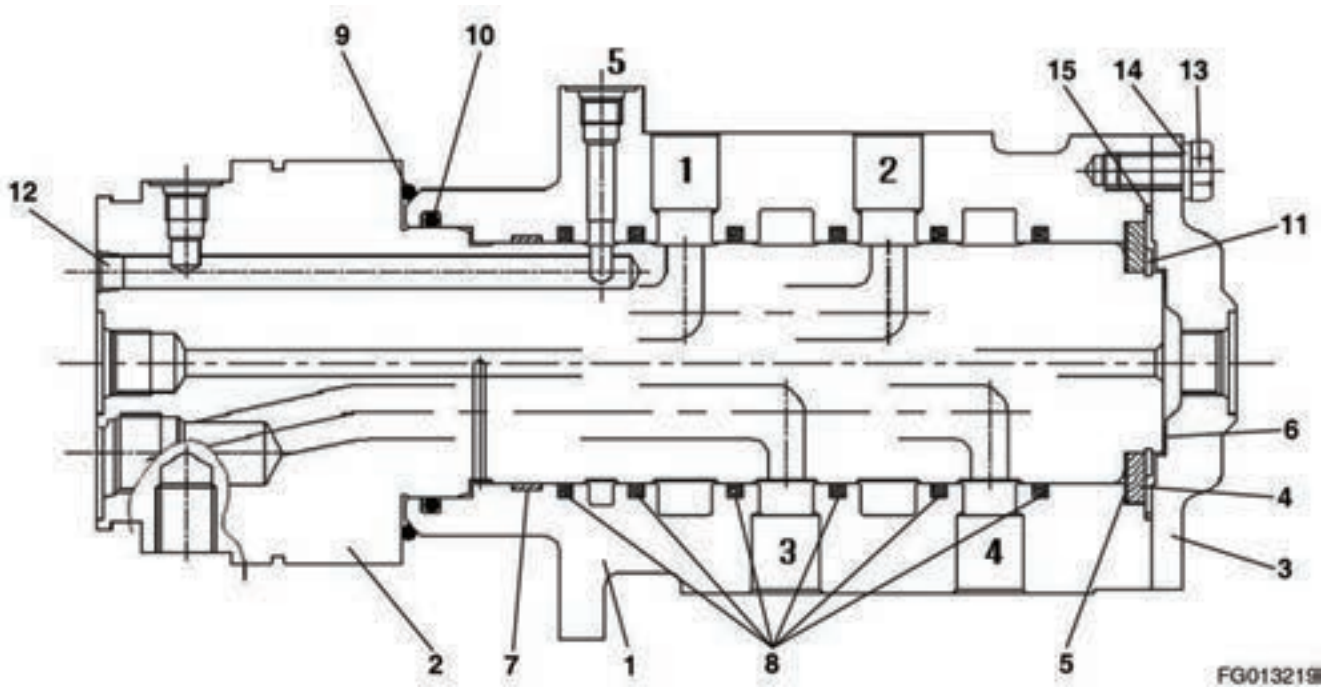


Figure 1

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

Reference Number	Description
9	O-ring (1AP105)
10	O-ring (1BP90)
11	Retaining Ring
12	PT-Plug (PT1/4)
13	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 can 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).*

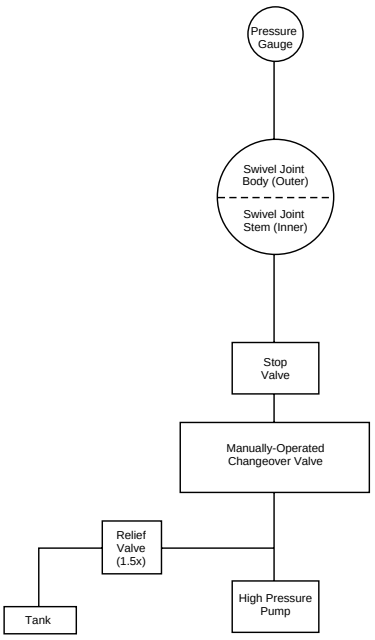


Figure 2

DISASSEMBLY

IMPORTANT

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

WARNING

AVOID DEATH OR SERIOUS INJURY

Due to its weight, use a hoist or a similar device to lift the assembly.

WARNING

AVOID DEATH OR SERIOUS INJURY

The hydraulic oil will be hot after 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 oil remaining in each port with air.
4. Use a 17 mm wrench to loosen cover bolts (1, Figure 3) and remove cover and O-rings (1AG100).
5. Use a pliers to remove retaining ring and disassemble the spacer at the back of the retaining ring.

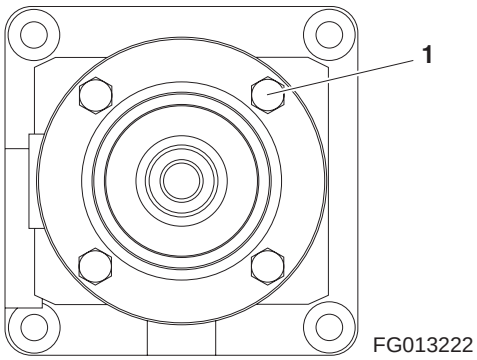


Figure 3

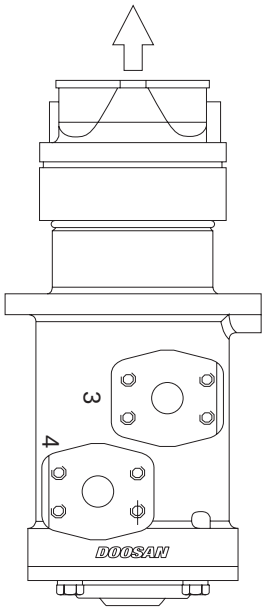
IMPORTANT

Care should be taken not to make a scratch or damage 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 2-10 mm eyebolts 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



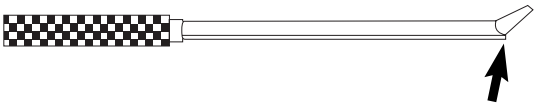
FG013230

Figure 4

8. Separate the hub into (8 each) slipper seals, (1 each) O-ring (1BP80), and (1 each) dust seal (LBH80).

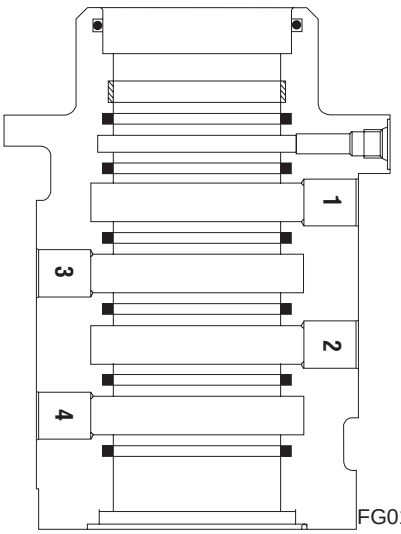
IMPORTANT

Care should be taken not to damage the inside of the hub because it is likely to be damaged when disassembling the slipper seal. It may be disassembled more easily with a screwdriver whose tip is bent as shown in Figure 5.



FG021966

Figure 5

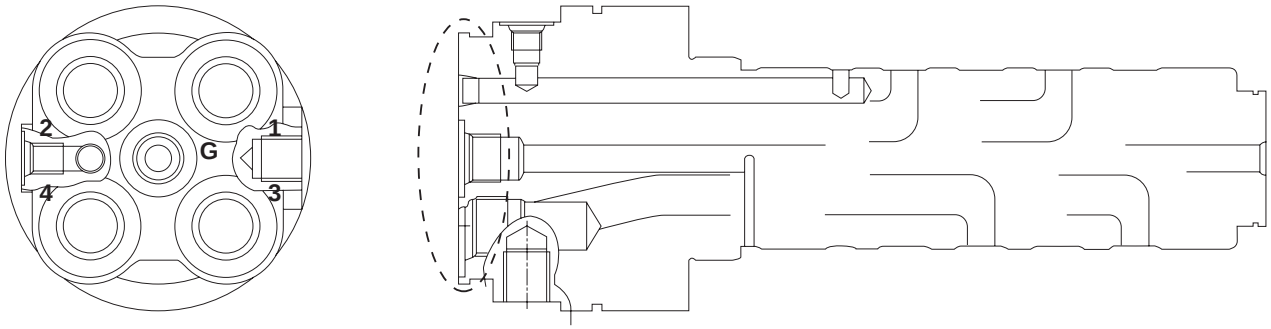


FG013232

Figure 6

9. Remove PT plugs sealing the shaft

   * PT 1/4: 6 mm wrench



FG013237

Figure 7

10. Remove foreign substance on 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 and 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.

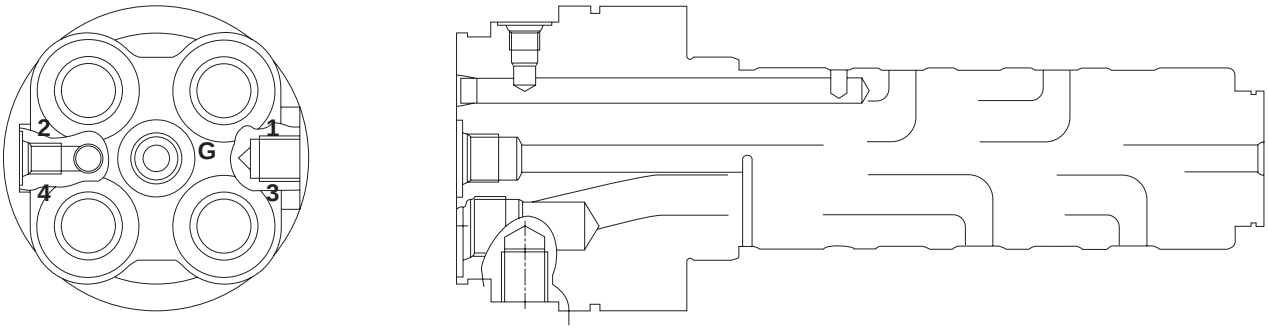
IMPORTANT

The inside of the hub should be air washed and rustproof treated after washing it to prevent rusting.

REASSEMBLY

IMPORTANT

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, evenhanded pressure, using both hands, to slowly push the stem into the body. Seals may be damaged if the stem is pushed in too quickly.



FG013240

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: 6 mm wrench
Engagement torque: 3 - 4 kg•m

3. Assemble the slipper seal and the O-ring into the hub.
4. Assemble the Wear ring (ø80 x ø85 x 10) into the hub.

CAUTION

AVOID INJURY

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

IMPORTANT

For any slipper 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 can cause damage the seal.

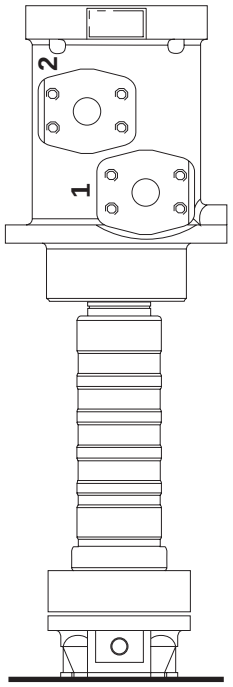
IMPORTANT

Applying oil to the surface of the shaft will help prevent damage to the slipper 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 rubber) hammer to tap the hub until it is inserted completely.

IMPORTANT

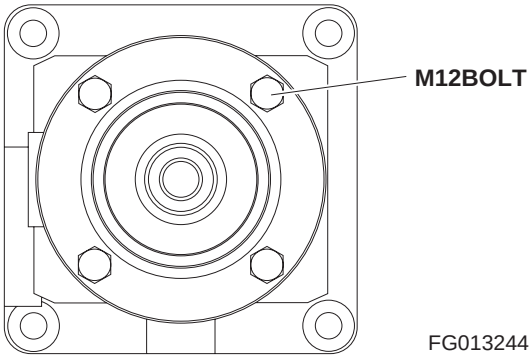
Tap the Hub in a zigzag pattern so that it does not tilt to one side.



FG013243

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 10.
9. Tighten the cover bolts (M12) to a 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 check hydraulic tank fluid level before returning the excavator to service.



FG013244

Figure 10

IMPORTANT

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

Cylinders

Edition 1

Table of Contents

Cylinders

Safety Instructions 5
Applicable Models 5
General Description 6
Theory of Operation 6
Parts List 8
Special Tools and Materials 14
Piston Nut 14
Piston Jig 16
Steel Bushing Jig 19
Dust Wiper Jig 22
Slipper Seal Jig 25
Slipper Seal Straightening Jig 28
Disassembly 31
Reassembly 36

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 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

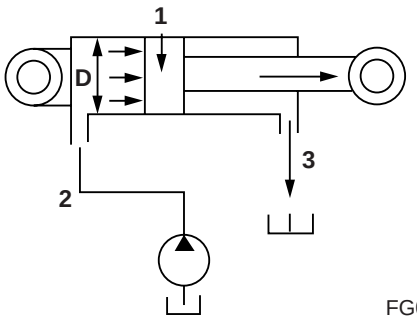
1	**Piston**
2	**Oil Path A**
3	**Oil Path B**

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)



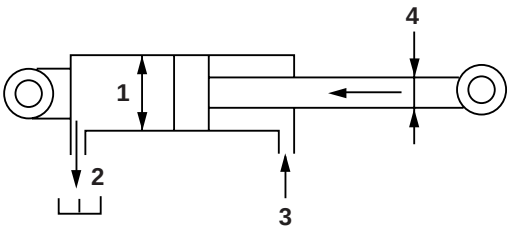
FG001456

Figure 1

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

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.

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



FG001458

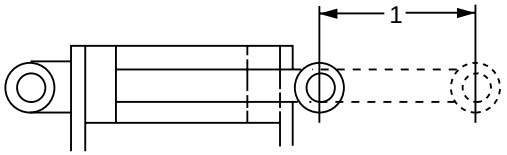
Figure 2

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

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

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

$Q_1 > Q_2$



FG001459

Figure 3

Parts List

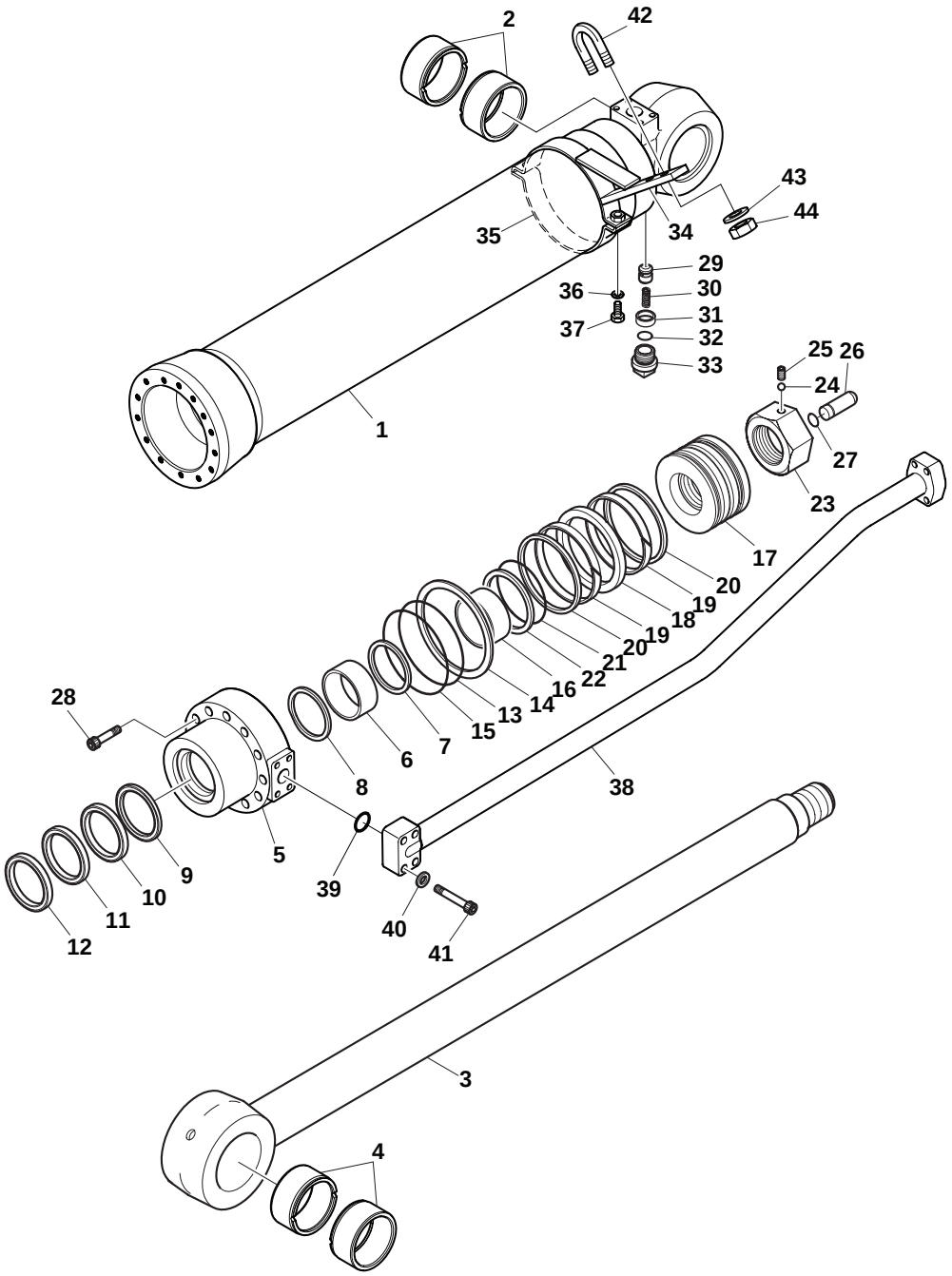
The following parts list is a partial listing only; for complete parts list information, refer to the Hydraulic Equipment Component Parts List.

Cross-section in Figure 4 shows an arm cylinder.

Cross-section in Figure 5 shows a boom cylinder (LH).

Cross-section in Figure 6 shows a boom cylinder (RH).

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



FG022281

Figure 4

Reference Number	Description
1	Tube Ass'y
2	Bush
3	Cylinder Rod
4	Bush
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	Dust Ring
21	O-ring
22	Backup Ring

Reference Number	Description
23	Piston Nut
24	Steel Ball
25	Set Screw
26	Cushion Plunger
27	Stop Ring
28	Socket Bolt
29	Check Valve
30	Spring
31	Spring Support
32	O-ring
33	Plug
34	Pipe Band Ass'y: B
35	Pipe Band
36	Spring Washer
37	Hex Bolt
38	Pipe Ass'y: R
39	O-ring
40	Spring Washer
41	Socket Bolt
42	U-bolt
43	Spring Washer
44	Nut

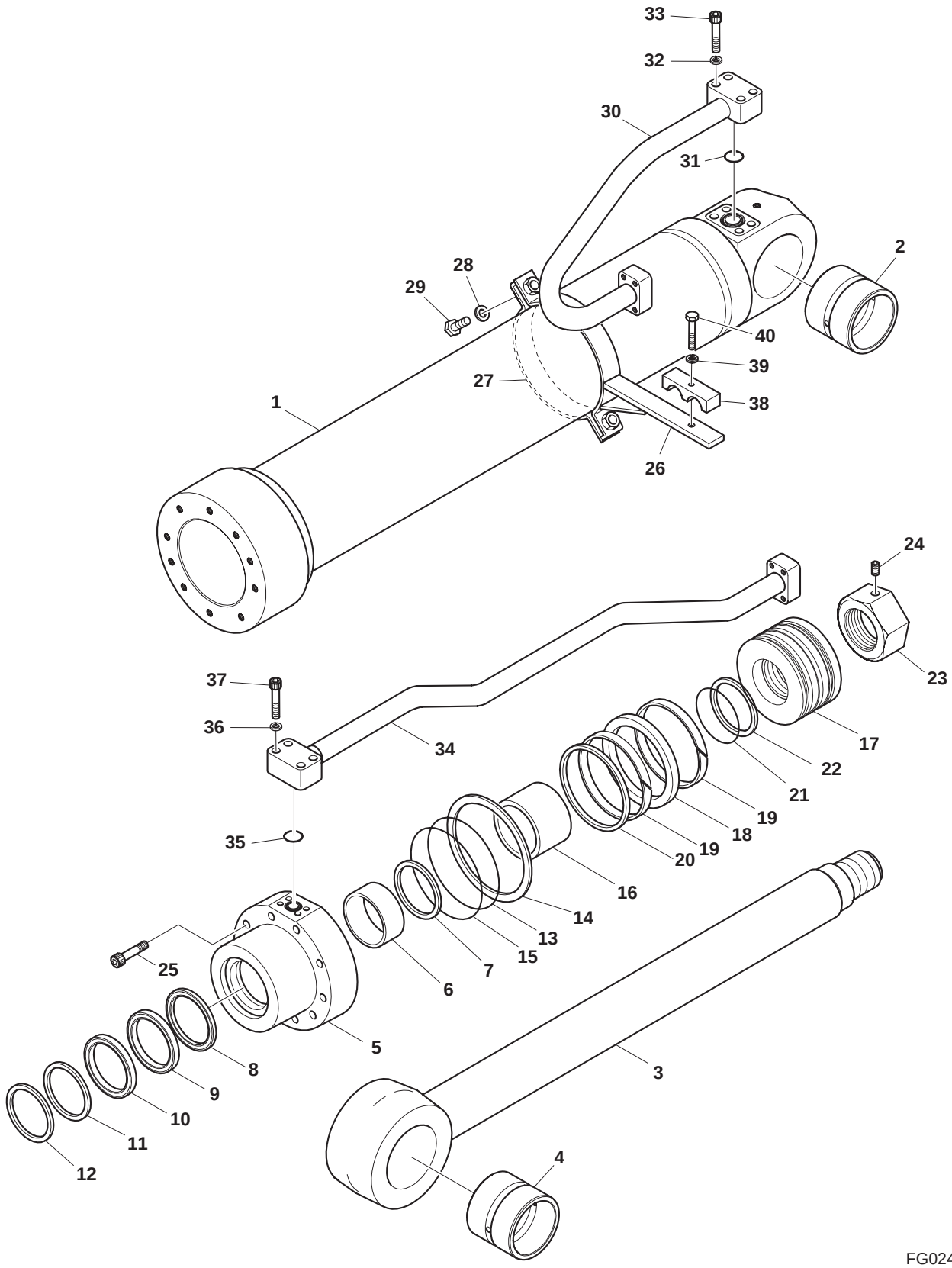

33
32
30
31
2
28
29
40
39
27
38
1
26
24
23
37
36
34
17
22
21
19
18
19
20
35
16
14
13
15
7
25
6
5
8
9
10
11
12
3
4
FG024695

Figure 5

Reference Number	Description
1	Cylinder Tube
2	Bush
3	Cylinder Rod Ass'y
4	Bush
5	Rod Cover
6	DD-bush
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	Dust Ring

Reference Number	Description
21	O-ring
22	Backup Ring
23	Piston Nut
24	Set Screw
25	Socket Bolt
26	Pipe Band Ass'y
27	Pipe Band
28	Spring Washer
29	Bolt
30	H Pipe Ass'y (L.H)
31	O-ring
32	Spring Washer
33	Socket Bolt
34	R Pipe Ass'y (L.H)
35	O-ring
36	Spring Washer
37	Socket Bolt
38	Pipe Clamp
39	Spring Washer
40	Bolt

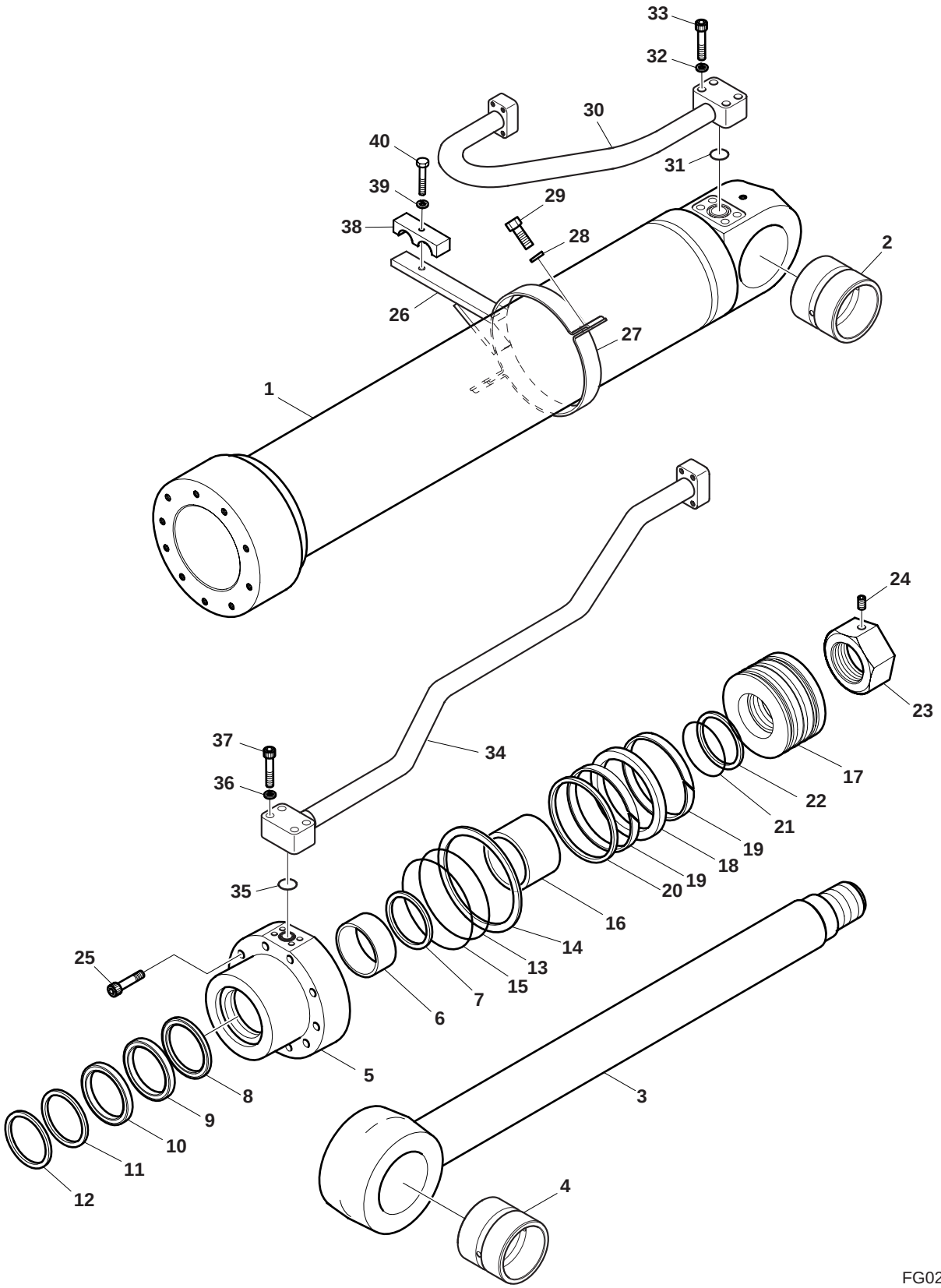

33
32
30
40
31
39
29
38
28
2
26
27
1
24
23
37
34
36
17
22
21
19
18
19
20
35
16
14
25
13
15
7
6
5
8
3
9
10
11
4
12
FG024696

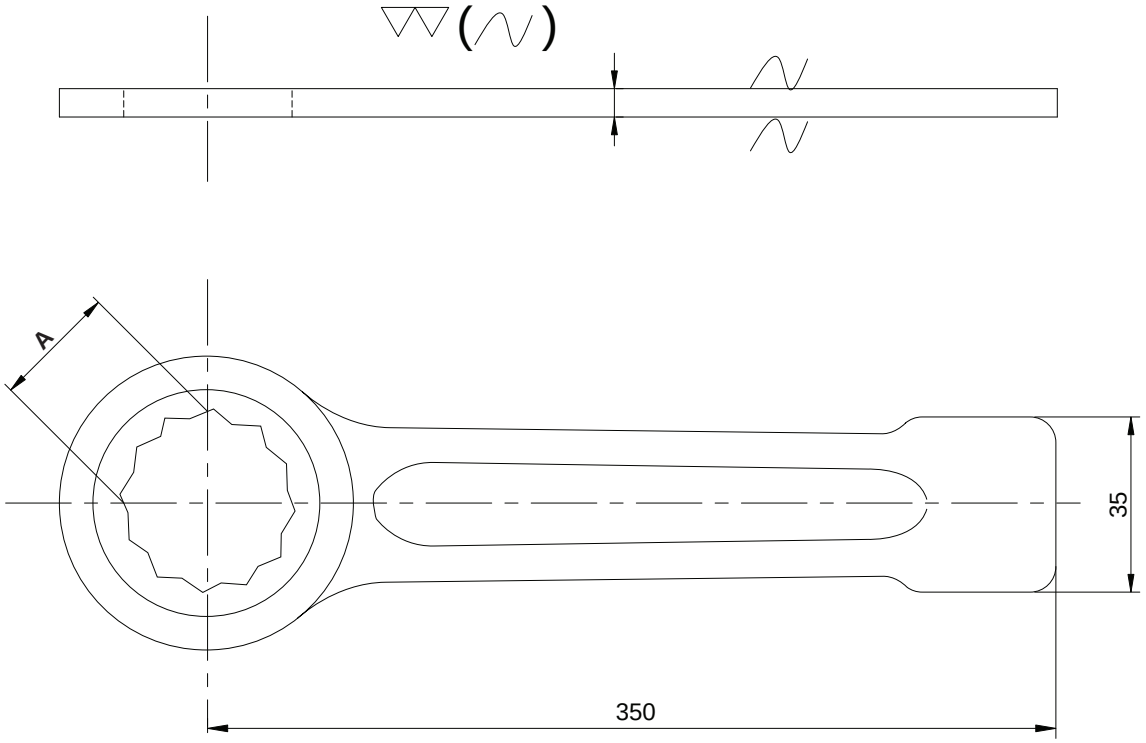
Figure 6

Reference Number	Description
1	Cylinder Tube
2	Bush
3	Cylinder Rod Ass'y
4	Bush
5	Rod Cover
6	DD-bush
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	Dust Ring

Reference Number	Description
21	O-ring
22	Backup Ring
23	Piston Nut
24	Set Screw
25	Socket Bolt
26	Pipe Band Ass'y
27	Pipe Band
28	Spring Washer
29	Bolt
30	H Pipe Ass'y (R.H)
31	O-ring
32	Spring Washer
33	Socket Bolt
34	R Pipe Ass'y (R.H)
35	O-ring
36	Spring Washer
37	Socket Bolt
38	Pipe Clamp
39	Spring Washer
40	Bolt

SPECIAL TOOLS AND MATERIALS

Piston Nut



FG018703

Figure 7

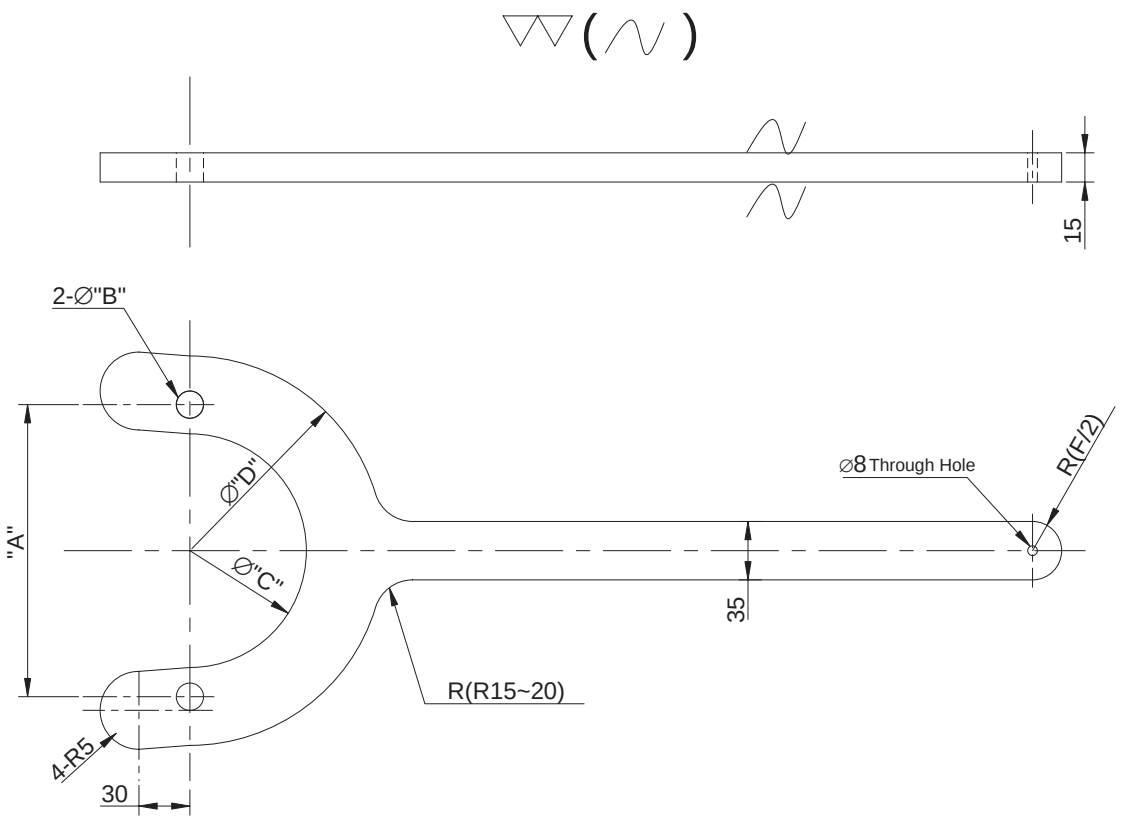
Material SM45C (AISI 1045)

Rockwell Hardened from 22 - 27

Oil Quench

Model	Cylinder	A	Model (Cylinder)
DX140LC-3/ DX140W-3	Boom	Hex 80	
	Arm	Hex 80	
	Bucket	Hex 70	
	Arti	Hex 90	
DX180LC-3/ DX190W-3	Boom	Hex 80	
	Arm	Hex 90	
	Bucket	Hex 80	
	Arti	Hex 100	
DX225LC-3	Boom	Hex 80	
	Arm	Hex 110	
	Bucket	Hex 80	
	Arti	Hex 110	
DX255LC-3	Boom	Hex 90	
	Arm	Hex 110	
	Bucket	Hex 90	
	Arti	Hex 110	
DX300LC-3	Boom	Hex 110	
	Arm	Hex 110	
	Bucket	Hex 100	
DX340LC-3/ DX350LC-3	Boom	Hex 110	
	Arm	Hex 130	
	Bucket	Hex 110	
DX380LC-3	Boom	Hex 110	
	Arm	Hex 130	
	Bucket	Hex 110	
DX420LC-3	Boom	Hex 130	
	Arm	Hex 130	
	Bucket	Hex 120	
DX490LC-3/ DX530LC-3	Boom	Hex 130	
	Arm	Hex 140	
	Bucket	Hex 130	

Piston Jig



ARS4740L

Figure 8

Material SM45C (AISI 1045)

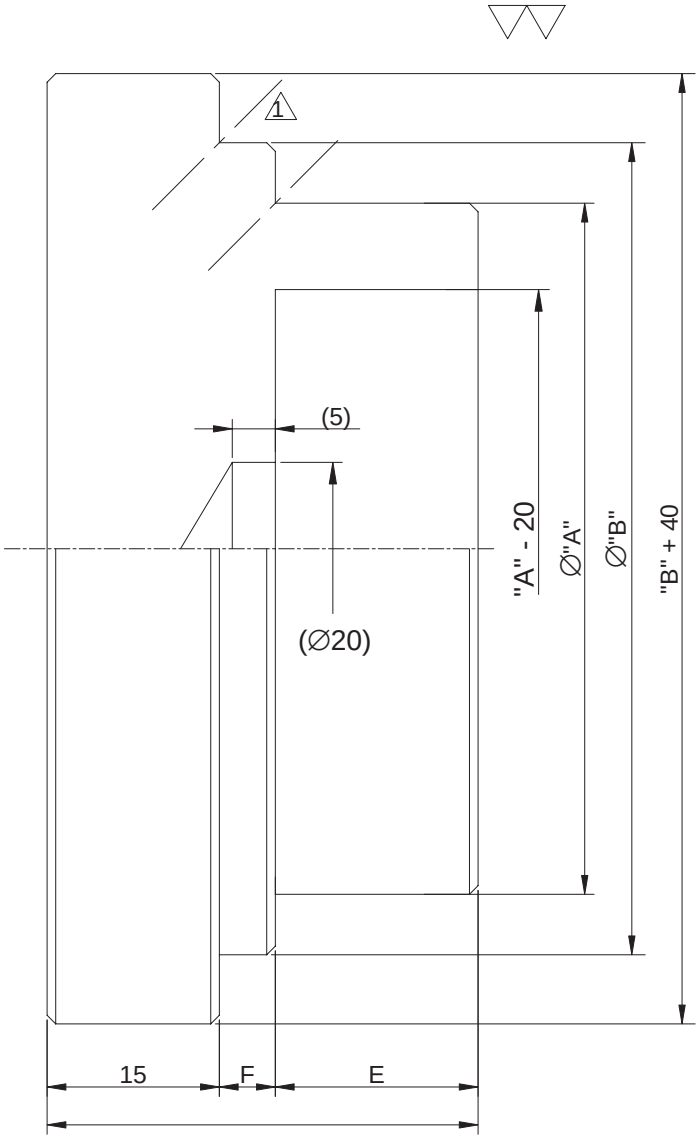
Rockwell Hardened from 22 - 27

Oil Quench

Model	Cylinder	A (±0.1)	øB	øC	øD	Model (Cylinder)
DX140LC-3	Boom	80.0 mm (3.15 in)	11.0 mm (0.43 in)	58.0 mm (2.28 in)	110.0 mm (4.33 in)	
	Arm	90.0 mm (3.54 in)	11.0 mm (0.43 in)	67.0 mm (2.64 in)	115.0 mm (4.53 in)	
	Bucket	75.0 mm (2.95 in)	11.0 mm (0.43 in)	53.0 mm (2.09 in)	100.0 mm (3.94 in)	
	Arti	110.0 mm (4.33 in)	13.0 mm (0.51 in)	76.0 mm (2.99 in)	140.0 mm (5.51 in)	
DX140W-3	Boom	80.0 mm (3.15 in)	11.0 mm (0.43 in)	58.0 mm (2.28 in)	110.0 mm (4.33 in)	
	Arm	90.0 mm (3.54 in)	11.0 mm (0.43 in)	67.0 mm (2.64 in)	115.0 mm (4.53 in)	
	Bucket	70.0 mm (2.76 in)	11.0 mm (0.43 in)	53.0 mm (2.09 in)	95.0 mm (3.74 in)	
	Arti	110.0 mm (4.33 in)	13.0 mm (0.51 in)	76.0 mm (2.99 in)	140.0 mm (5.51 in)	
DX180LC-3	Boom	90.0 mm (3.54 in)	11.0 mm (0.43 in)	67.0 mm (2.64 in)	115.0 mm (4.53 in)	
	Arm	90.0 mm (3.54 in)	13.0 mm (0.51 in)	75.0 mm (2.95 in)	125.0 mm (4.92 in)	
	Bucket	80.0 mm (3.15 in)	11.0 mm (0.43 in)	58.0 mm (2.28 in)	110.0 mm (4.33 in)	
	Arti	120.0 mm (4.72 in)	13.0 mm (0.51 in)	80.0 mm (3.15 in)	160.0 mm (6.30 in)	
DX190W-3	Boom	90.0 mm (3.54 in)	13.0 mm (0.51 in)	67.0 mm (2.64 in)	120.0 mm (4.72 in)	
	Arm	90.0 mm (3.54 in)	13.0 mm (0.51 in)	75.0 mm (2.95 in)	125.0 mm (4.92 in)	
	Bucket	80.0 mm (3.15 in)	11.0 mm (0.43 in)	58.0 mm (2.28 in)	110.0 mm (4.33 in)	
	Arti	120.0 mm (4.72 in)	13.0 mm (0.51 in)	80.0 mm (3.15 in)	160.0 mm (6.30 in)	
DX225LC-3	Boom	90.0 mm (3.54 in)	13.0 mm (0.51 in)	75.0 mm (2.95 in)	125.0 mm (4.92 in)	
	Arm	110.0 mm (4.33 in)	13.0 mm (0.51 in)	85.0 mm (3.35 in)	140.0 mm (5.51 in)	
	Bucket	90.0 mm (3.54 in)	13.0 mm (0.51 in)	67.0 mm (2.64 in)	120.0 mm (4.72 in)	
	Arti	120.0 mm (4.72 in)	13.0 mm (0.51 in)	90.0 mm (3.54 in)	150.0 mm (5.91 in)	
DX255LC-3	Boom	96.0 mm (3.78 in)	13.0 mm (0.51 in)	69.0 mm (2.72 in)	130.0 mm (5.12 in)	
	Arm	110.0 mm (4.33 in)	13.0 mm (0.51 in)	85.0 mm (3.35 in)	140.0 mm (5.51 in)	
	Bucket	100.0 mm (3.94 in)	11.0 mm (0.43 in)	67.0 mm (2.64 in)	125.0 mm (4.92 in)	
	Arti	130.0 mm (5.12 in)	13.0 mm (0.51 in)	90.0 mm (3.54 in)	160.0 mm (6.30 in)	
DX300LC-3	Boom	110.0 mm (4.33 in)	13.0 mm (0.51 in)	85.0 mm (3.35 in)	140.0 mm (5.51 in)	
	Arm	120.0 mm (4.72 in)	13.0 mm (0.51 in)	95.0 mm (3.74 in)	150.0 mm (5.91 in)	
	Bucket	105.0 mm (4.13 in)	13.0 mm (0.51 in)	80.0 mm (3.15 in)	135.0 mm (5.31 in)	
DX340LC-3/ DX350LC-3	Boom	120.0 mm (4.72 in)	13.0 mm (0.51 in)	90.0 mm (3.54 in)	150.0 mm (5.91 in)	
	Arm	135.0 mm (5.31 in)	13.0 mm (0.51 in)	105.0 mm (4.13 in)	170.0 mm (6.70 in)	
	Bucket	120.0 mm (4.72 in)	13.0 mm (0.51 in)	90.0 mm (3.54 in)	150.0 mm (5.91 in)	

Model	Cylinder	A (±0.1)	øB	øC	øD	Model (Cylinder)
DX380LC-3	Boom	130.0 mm (5.12 in)	13.0 mm (0.51 in)	100.0 mm (3.94 in)	160.0 mm (6.30 in)	
	Arm	135.0 mm (5.31 in)	13.0 mm (0.51 in)	105.0 mm (4.13 in)	170.0 mm (6.70 in)	
	Bucket	120.0 mm (4.72 in)	13.0 mm (0.51 in)	90.0 mm (3.54 in)	150.0 mm (5.91 in)	
DX420LC-3	Boom	135.0 mm (5.31 in)	13.0 mm (0.51 in)	105.0 mm (4.13 in)	170.0 mm (6.70 in)	
	Arm	130.0 mm (5.12 in)	13.0 mm (0.51 in)	110.0 mm (4.33 in)	160.0 mm (6.30 in)	
	Bucket	130.0 mm (5.12 in)	13.0 mm (0.51 in)	110.0 mm (4.33 in)	160.0 mm (6.30 in)	
DX490LC-3/ DX530LC-3	Boom	135.0 mm (5.31 in)	13.0 mm (0.51 in)	105.0 mm (4.13 in)	170.0 mm (6.70 in)	
	Arm	150.0 mm (5.91 in)	13.0 mm (0.51 in)	110.0 mm (4.33 in)	190.0 mm (7.50 in)	
	Bucket	135.0 mm (5.31 in)	13.0 mm (0.51 in)	105.0 mm (4.13 in)	170.0 mm (6.70 in)	

Steel Bushing Jig



ARS4750L

Figure 9

Material: SM45C which is done thermal refining <QT> HRC 22 - 28

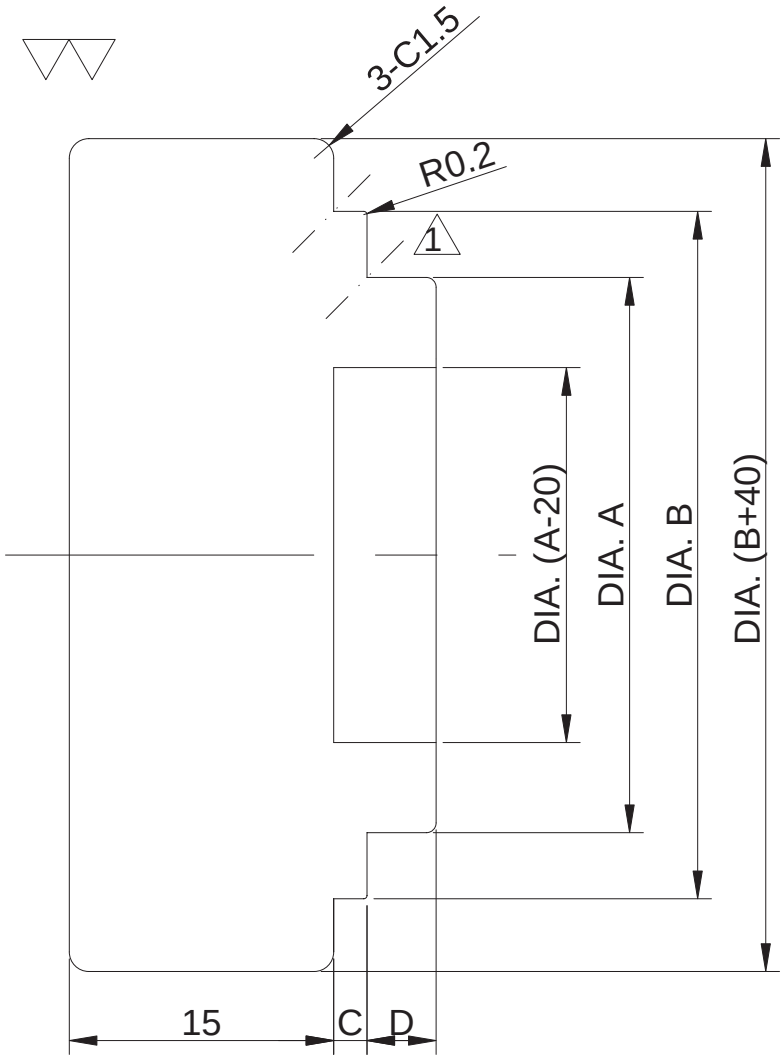
Undefined Chamfer C/R = 0.5 Max.

1 Place: Finally work to used DNMG Tip <Nose R0.4>

Model	Cylinder	$\text{øA}^{-0.05}_{-0.15}$	øB (±0.1)	E	$F^{+0.05}_{0}$	Part	Model (Cylinder)
DX140LC-3	Boom	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Arm	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Bucket	65.0 mm (2.56 in)	80.0 mm (3.14 in)	40.0 mm (1.57 in)	7.0 mm (0.28 in)		
	Arti	80.0 mm (3.15 in)	95.0 mm (3.74 in)	40.0 mm (1.57 in)	7.0 mm (0.28 in)		
DX140W-3	Boom	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Arm	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Bucket	65.0 mm (2.56 in)	80.0 mm (3.15 in)	40.0 mm (1.57 in)	7.0 mm (0.28 in)		
	Arti	80.0 mm (3.15 in)	95.0 mm (3.74 in)	40.0 mm (1.57 in)	7.0 mm (0.28 in)		
DX180LC-3	Boom	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.0 mm (0.24 in)		
	Arm	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.0 mm (0.24 in)		
	Bucket	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	5.5 mm (0.22 in)		
	Arti	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.57 in)	7.0 mm (0.28 in)		
DX190W-3	Boom	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.0 mm (0.24 in)		
	Arm	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	6.0 mm (0.24 in)		
	Bucket	71.0 mm (2.80 in)	86.0 mm (3.39 in)	40.0 mm (1.57 in)	5.5 mm (0.22 in)		
	Arti	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.57 in)	7.0 mm (0.28 in)		
DX225LC-3	Boom	80.0 mm (3.15 in)	95.0 mm (3.74 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Arm	80.0 mm (3.15 in)	95.0 mm (3.74 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Bucket	80.0 mm (3.15 in)	95.0 mm (3.74 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Arti	100.0 mm (3.94 in)	115.0 mm (4.53 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		
DX255LC-3	Boom	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.57 in)	8.0 mm (0.31 in)		
	Arm	80.0 mm (3.15 in)	95.0 mm (3.74 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Bucket	80.0 mm (3.15 in)	95.0 mm (3.74 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Arti	100.0 mm (3.94 in)	115.0 mm (4.53 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		
DX300LC-3	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)		HEAD SIDE
		90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		ROD SIDE
	Arm	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.57 in)	6.5 mm (0.26 in)		
	Bucket	90.0 mm (3.54 in)	105.0 mm (4.13 in)	40.0 mm (1.57 in)	7.0 mm (0.28 in)		

Model	Cylinder	$\text{ØA}^{-0.05}_{-0.15}$	ØB (±0.1)	E	$\text{F}^{+0.05}_{0}$	Part	Model (Cylinder)
DX340LC-3/ DX350LC-3	Boom	105.0 mm (4.13 in)	120.0 mm (4.72 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		HEAD SIDE
		100.0 mm (3.94 in)	115.0 mm (4.53 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		ROD SIDE
	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)		
	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)		
DX380LC-3	Boom	105.0 mm (4.13 in)	120.0 mm (4.72 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		HEAD SIDE
		100.0 mm (3.94 in)	115.0 mm (4.53 in)	45.0 mm (1.77 in)	7.5 mm (0.30 in)		ROD SIDE
	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)		
	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)		
DX420LC-3	Boom	110.0 mm (4.33 in)	130.0 mm (5.12 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		HEAD SIDE
		120.0 mm (4.72 in)	140.0 mm (5.51 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		ROD SIDE
	Arm	110.0 mm (4.33 in)	130.0 mm (5.12 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		
	Bucket	110.0 mm (4.33 in)	130.0 mm (5.12 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		
DX490LC-3/ DX530LC-3	Boom	110.0 mm (4.33 in)	130.0 mm (5.12 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		HEAD SIDE
		120.0 mm (4.72 in)	140.0 mm (5.51 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		ROD SIDE
	Arm	120.0 mm (4.72 in)	140.0 mm (5.51 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		
	Bucket	110.0 mm (4.33 in)	130.0 mm (5.12 in)	50.0 mm (1.97 in)	11.0 mm (0.43 in)		

Dust Wiper Jig



ARS4760L

Figure 10

Material: SM45C which is done thermal refining <QT> HRC 22 - 28

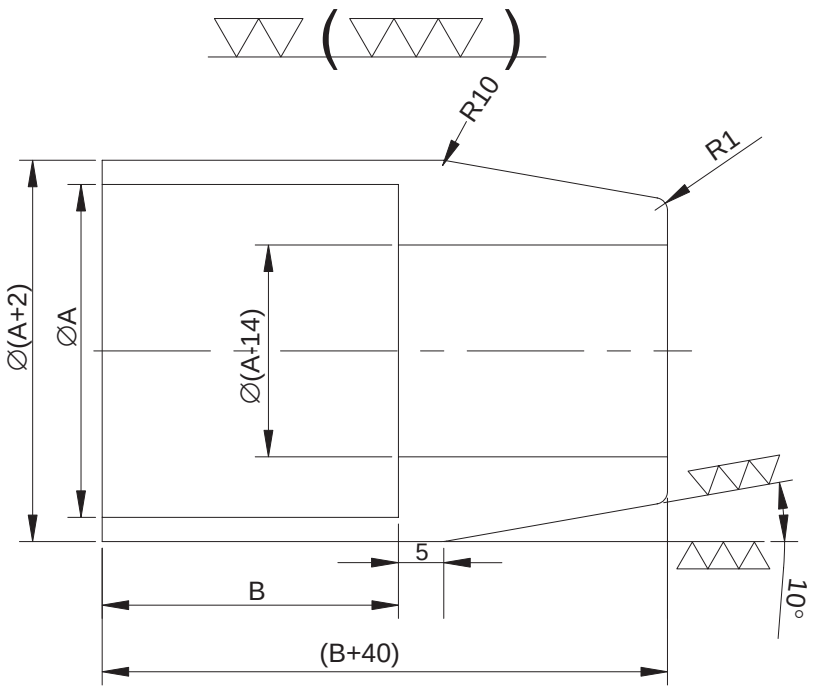
Undefined Chamfer C/R = 0.5 Max.

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)
DX140LC-3	Boom	75.0 mm (2.95 in)	89.0 mm (3.50 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arm	80.0 mm (3.15 in)	94.0 mm (3.70 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Bucket	70.0 mm (2.76 in)	84.0 mm (3.31 in)	5.5 mm (0.22 in)	6.0 mm (0.24 in)	
	Arti	85.0 mm (3.35 in)	99.0 mm (3.90 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
DX140W-3	Boom	75.0 mm (2.95 in)	89.0 mm (3.50 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arm	80.0 mm (3.15 in)	94.0 mm (3.70 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Bucket	65.0 mm (2.56 in)	79.0 mm (3.11 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arti	85.0 mm (3.35 in)	99.0 mm (3.90 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
DX180LC-3	Boom	80.0 mm (3.15 in)	94.0 mm (3.70 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arm	90.0 mm (3.54 in)	104.0 mm (4.09 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Bucket	75.0 mm (2.95 in)	89.0 mm (3.50 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arti	95.0 mm (3.74 in)	109.0 mm (4.29 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
DX190W-3	Boom	85.0 mm (3.35 in)	99.0 mm (3.90 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arm	90.0 mm (3.54 in)	104.0 mm (4.09 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Bucket	75.0 mm (2.95 in)	89.0 mm (3.50 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arti	95.0 mm (3.74 in)	109.0 mm (4.29 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
DX225LC-3	Boom	85.0 mm (3.35 in)	99.0 mm (3.90 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arm	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Bucket	80.0 mm (3.15 in)	94.0 mm (3.70 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arti	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
DX255LC-3	Boom	90.0 mm (3.54 in)	104.0 mm (4.09 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arm	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Bucket	85.0 mm (3.35 in)	99.0 mm (3.90 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
	Arti	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (0.28 in)	
DX300LC-3	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

Model	Cylinder	ØA$^{-0.2}_{-0.3}$	ØB$^{-0.2}_{-0.3}$	C$^{0}_{-0.1}$	D	Model (Cylinder)
DX340LC-3/ DX350LC-3	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)	
	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	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	
DX380LC-3	Boom	105.0 mm (4.13 in)	121.0 mm (4.76 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	100.0 mm (3.94 in)	114.0 mm (4.49 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	
DX420LC-3	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)	
DX490LC-3/ DX530LC-3	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	130.0 mm (5.12 in)	136.0 mm (5.35 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	
	Bucket	115.0 mm (4.53 in)	131.0 mm (5.16 in)	6.0 mm (0.24 in)	7.0 mm (2.28 in)	

Slipper Seal Jig



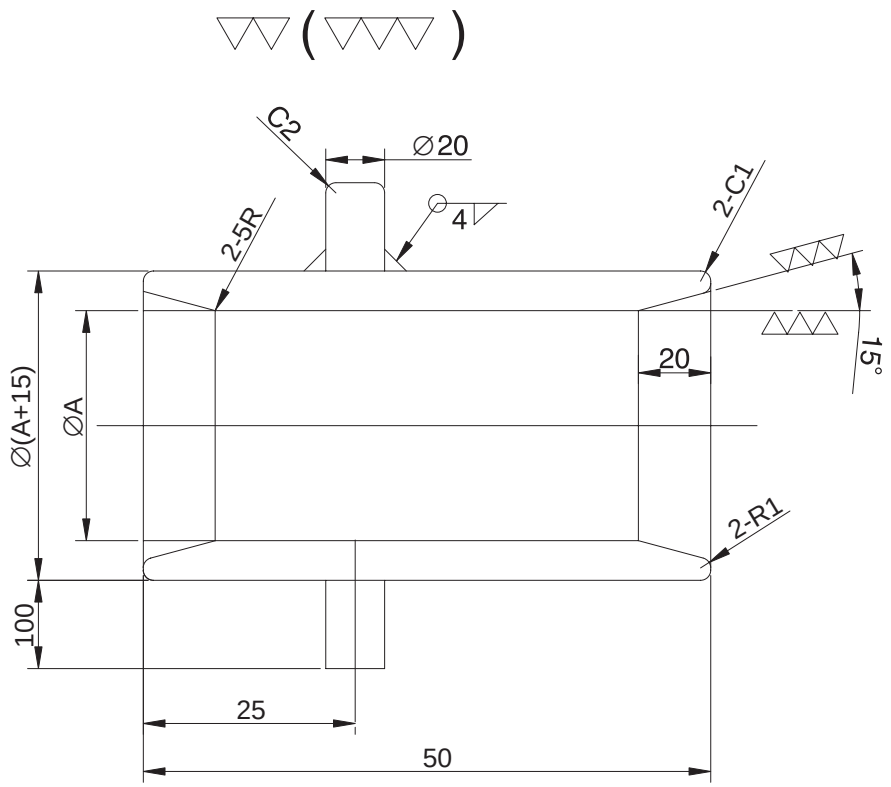
ARS4770L

Figure 11

Model	Cylinder	$\varnothing A^{+0.2}_{+0.1}$	$B^{+0.2}_{+0.1}$	Model (Cylinder)
DX140LC-3	Boom	110.0 mm (4.33 in)	28.5 mm (1.12 in)	
	Arm	115.0 mm (4.53 in)	28.5 mm (1.12 in)	
	Bucket	100.0 mm (3.94 in)	28.5 mm (1.12 in)	
	Arti	140.0 mm (5.51 in)	28.5 mm (1.12 in)	
DX140W-3	Boom	110.0 mm (4.33 in)	28.5 mm (1.12 in)	
	Arm	115.0 mm (4.53 in)	28.5 mm (1.12 in)	
	Bucket	95.0 mm (3.74 in)	28.5 mm (1.12 in)	
	Arti	140.0 mm (5.51 in)	28.5 mm (1.12 in)	
DX180LC-3	Boom	115.0 mm (4.53 in)	28.5 mm (1.12 in)	
	Arm	125.0 mm (4.92 in)	28.5 mm (1.12 in)	
	Bucket	110.0 mm (4.33 in)	28.5 mm (1.12 in)	
	Arti	160.0 mm (6.30 in)	34.5 mm (1.36 in)	
DX190W-3	Boom	120.0 mm (4.72 in)	28.5 mm (1.12 in)	
	Arm	125.0 mm (4.92 in)	28.5 mm (1.12 in)	
	Bucket	110.0 mm (4.33 in)	28.5 mm (1.12 in)	
	Arti	160.0 mm (6.30 in)	34.5 mm (1.36 in)	
DX225LC-3	Boom	125.0 mm (4.92 in)	28.5 mm (1.12 in)	
	Arm	140.0 mm (5.51 in)	28.5 mm (1.12 in)	
	Bucket	120.0 mm (4.72 in)	28.5 mm (1.12 in)	
	Arti	150.0 mm (5.91 in)	28.5 mm (1.12 in)	
DX255LC-3	Boom	130.0 mm (5.12 in)	28.5 mm (1.12 in)	
	Arm	140.0 mm (5.51 in)	28.5 mm (1.12 in)	S/ARM
	Bucket	130.0 mm (5.12 in)	28.5 mm (1.12 in)	S/BUCKET
DX300LC-3	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)	
	Bucket	135.0 mm (5.31 in)	28.5 mm (1.12 in)	
DX340LC-3/ DX350LC-3	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

Model	Cylinder	$\varnothing A^{+0.2}_{+0.1}$	$B^{+0.2}_{+0.1}$	Model (Cylinder)
DX380LC-3	Boom	160.0 mm (6.30 in)	34.5 mm (1.36 in)	
	Arm	170.0 mm (6.69 in)	41.5 mm (1.63 in)	
	Bucket	150.0 mm (5.91 in)	34.5 mm (1.36 in)	
DX420LC-3	Boom	170.0 mm (6.69 in)	34.5 mm (1.36 in)	
	Arm	180.0 mm (7.09 in)	41.5 mm (1.63 in)	
	Bucket	160.0 mm (6.30 in)	34.5 mm (1.36 in)	
DX490LC-3/ DX530LC-3	Boom	170.0 mm (6.69 in)	34.5 mm (1.36 in)	
	Arm	190.0 mm (7.48 in)	41.5 mm (1.63 in)	
	Bucket	170.0 mm (6.69 in)	34.5 mm (1.36 in)	

Slipper Seal Straightening Jig



ARS4780L

Figure 12

Model	Cylinder	ø$A^{+0.2}_{+0.1}$	Model (Cylinder)
DX140LC-3	Boom	110.0 mm (4.33 in)	
	Arm	115.0 mm (4.53 in)	
	Bucket	100.0 mm (3.94 in)	
	Arti	140.0 mm (5.51 in)	
DX180LC-3	Boom	115.0 mm (4.53 in)	
	Arm	125.0 mm (4.92 in)	
	Bucket	110.0 mm (4.33 in)	
	Arti	160.0 mm (6.30 in)	
DX225LC-3	Boom	125.0 mm (4.92 in)	
	Arm	140.0 mm (5.51 in)	
	Bucket	120.0 mm (4.72 in)	
	Arti	150.0 mm (5.91 in)	
DX140W-3	Boom	110.0 mm (4.33 in)	
	Arm	115.0 mm (4.53 in)	
	Bucket	95.0 mm (3.74 in)	
	Arti	140.0 mm (5.51 in)	
DX190W-3	Boom	120.0 mm (4.72 in)	
	Arm	125.0 mm (4.92 in)	
	Bucket	110.0 mm (4.33 in)	
	Arti	160.0 mm (6.30 in)	
DX255LC-3	Boom	130.0 mm (5.12 in)	
	Arm	140.0 mm (5.51 in)	
	Bucket	125.0 mm (4.92 in)	
	Arti	160.0 mm (6.30 in)	
DX300LC-3	Boom	140.0 mm (5.51 in)	
	Arm	150.0 mm (5.91 in)	
	Bucket	135.0 mm (5.31 in)	
DX340LC-3/ DX350LC-3	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

Model	Cylinder	$\text{ø}A^{+0.2}_{+0.1}$	Model (Cylinder)
DX380LC-3	Boom	160.0 mm (6.30 in)	
	Arm	170.0 mm (6.69 in)	
	Bucket	150.0 mm (5.91 in)	
DX420LC-3	Boom	170.0 mm (6.69 in)	
	Arm	180.0 mm (7.09 in)	
	Bucket	160.0 mm (6.30 in)	
DX490LC-3/ DX530LC-3	Boom	170.0 mm (6.69 in)	
	Arm	190.0 mm (7.48 in)	
	Bucket	170.0 mm (6.69 in)	

DISASSEMBLY

IMPORTANT

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 hydraulic fluid 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 piping ports are on top, to allow trapped air to vent.

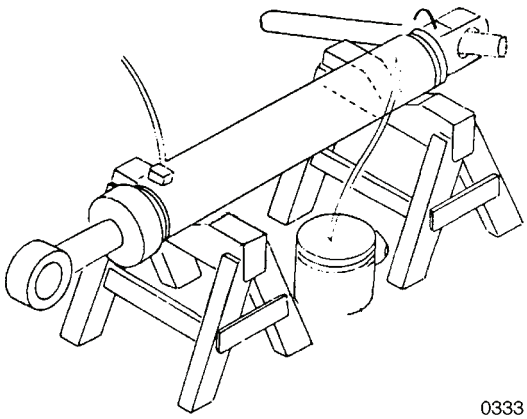


Figure 13

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

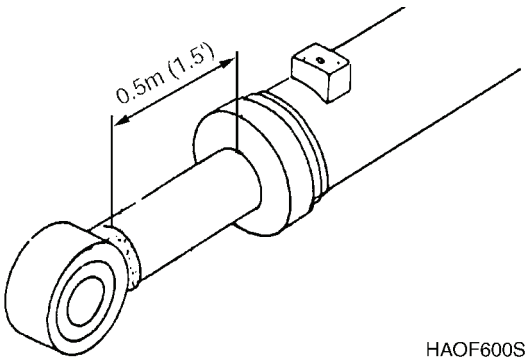


Figure 14

3. Remove bolts (27) 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.*

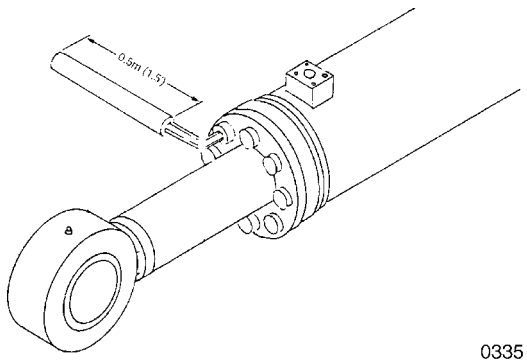
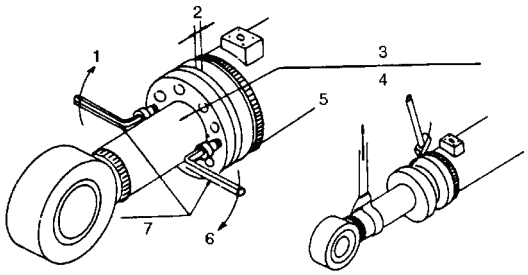


Figure 15

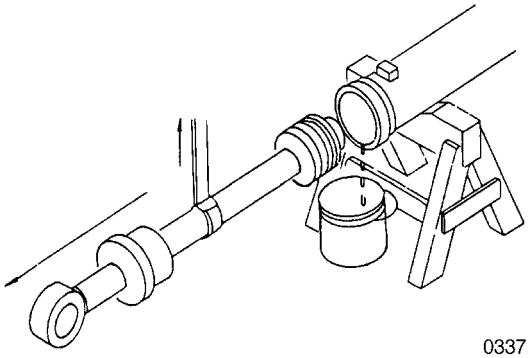
4. Tap two bolts into cover of cylinder head, 180° apart. Tighten them in a staggered, even sequence, to back off piston rod end cover from edge of cylinder wall. Look for adequate clearance between cover and end of cylinder wall before using a plastic or other soft faced hammer for final disassembly.



HAOF610S

Figure 16

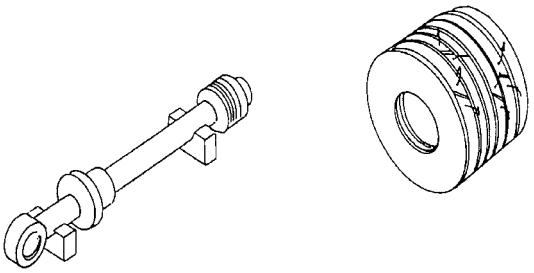
5. Begin withdrawing piston rod assembly, away from cylinder. Attach a lifting support when final 1/3 of rod is still inside barrel of cylinder. Prepare support blocks for piston rod before it has been completely withdrawn.



0337

Figure 17

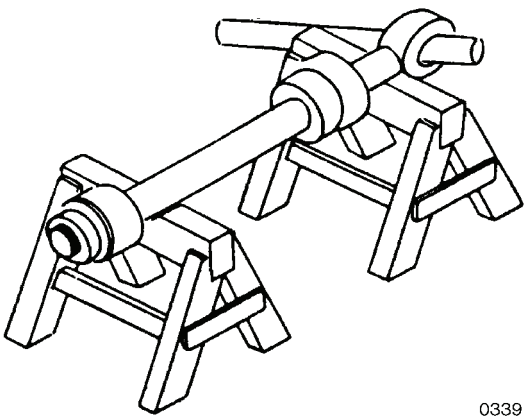
6. Lower piston rod to support blocks and detach wear ring (outer surface) (19) from end of rod.



HAOF620S

Figure 18

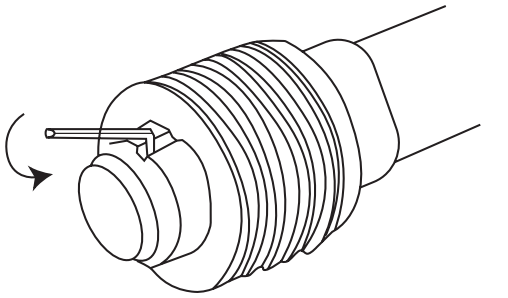
7. Immobilize piston rod by inserting a wooden or other nonscoring, nonmetallic support through end of rod.



0339

Figure 19

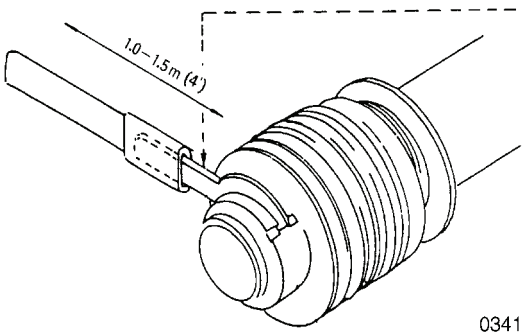
8. Remove set screw using socket wrench.



HAOF340L

Figure 20

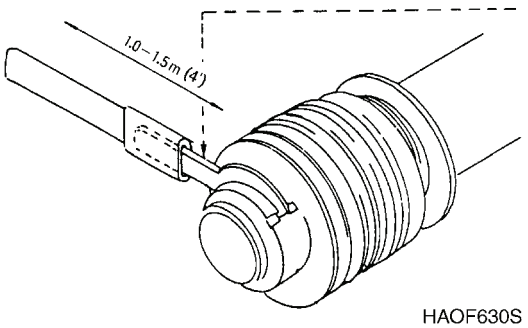
9. Fabricate or purchase a piston nut removal wrench. (Dimensions are called off at beginning of this procedure. This tool may also be ordered through your local *DOOSAN* Parts distributor). Remove nut from end of piston.



0341

Figure 21

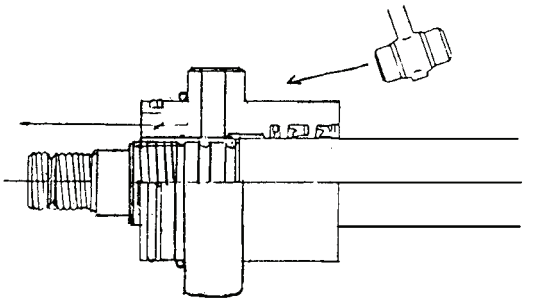
10. Use second piston tool described at beginning of this procedure to separate piston. Detach cushion ring (16), taking care not to damage cushion ring.



HAOF630S

Figure 22

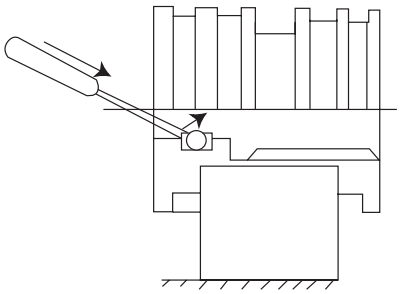
11. Use a plastic hammer to evenly pull off rod cover (5) from end of piston rod. Be careful not to damage rod bushing (6) and dust wiper, U-packing and other seals.



HAOF350S

Figure 23

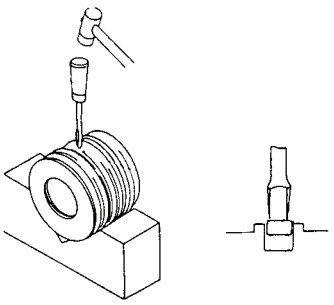
12. Use a dull, rounded tip tool to pry off O-ring (13) and backup ring (14).



HAOF37OL

Figure 24

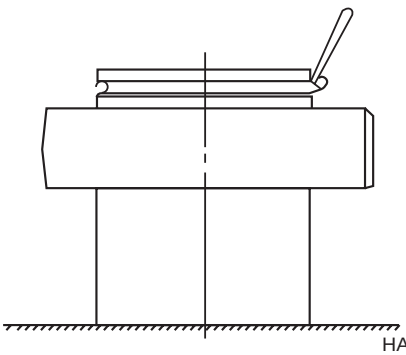
13. Find a screwdriver with an appropriate width tip to facilitate removal of slipper seal (18), wear ring (19) and slide ring (20) from piston (17).



0345

Figure 25

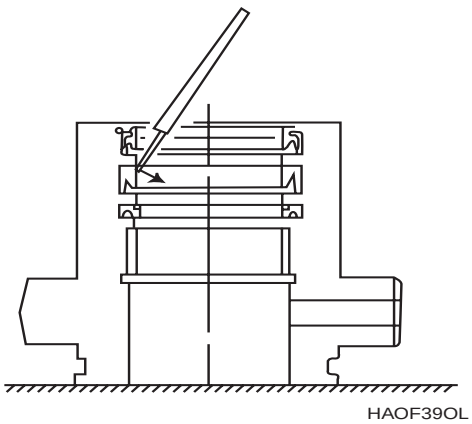
14. Remove O-ring (21) and backup ring (22) from cylinder head.



HAOF38OS

Figure 26

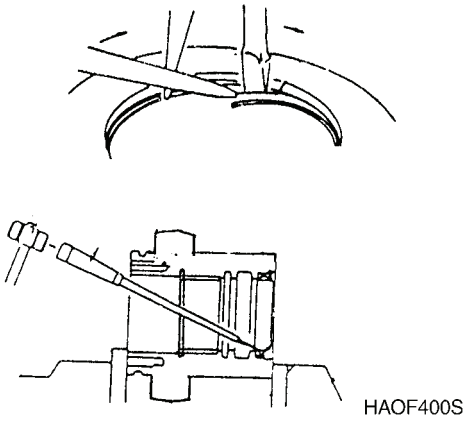
15. During disassembly of cylinder head, be careful not to damage buffer seal (8) and U-packing (9).



HAOF39OL

Figure 27

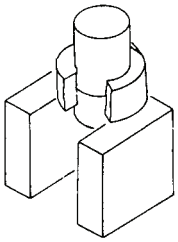
16. Disassemble retaining ring (12) and dust wiper (11). Separate retaining ring (7) and rod bushing (6).



HAOF400S

Figure 28

17. Force out pin bushing (2), (4) from body of cylinder.



0349

Figure 29

REASSEMBLY

IMPORTANT

Before reassembly:

- **Inspect and replace damaged or excessively worn parts.**
- **Clean parts and lubricate with clean hydraulic oil.**
- **Make sure work area is clean.**

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 (2), (4) to piston rod and body of cylinder.

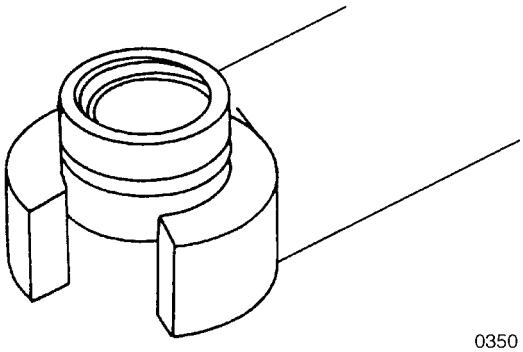
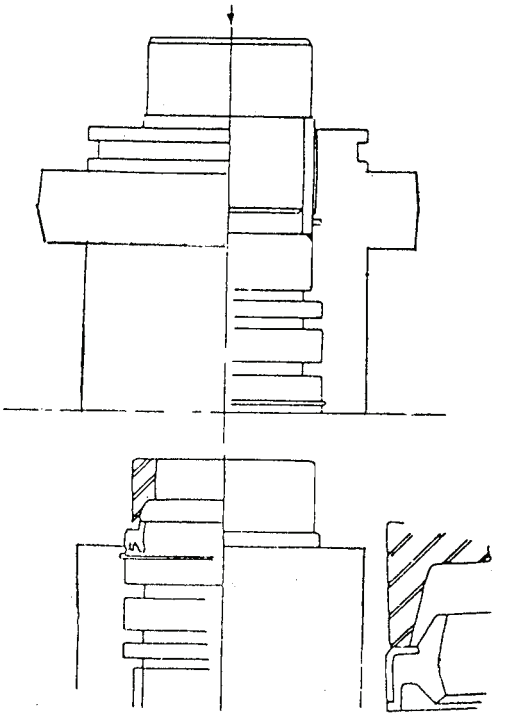


Figure 30

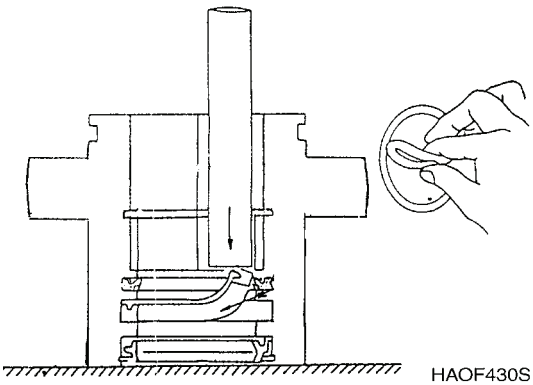
2. Following reassembly of rod cover components, install the dust wiper (11) and rod bushing (6) to the rod cover (5). Insert retaining rings (7 and 12).



HAOF440S

Figure 31

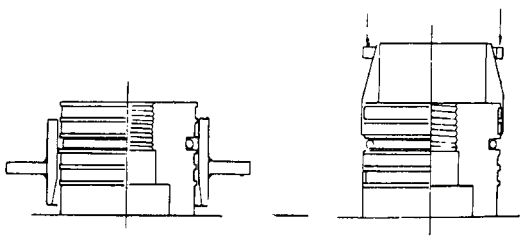
3. Prelubricate O-rings and seals before reassembly (Figure 32).



HAOF430S

Figure 32

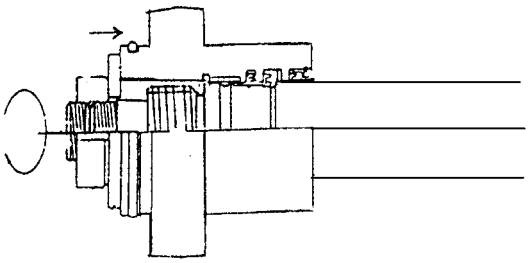
4. Before starting to rebuild piston assembly, heat slipper seal for 5 minutes in an oil bath warmed to 150° - 180°C (302° - 356°F). Use special slipper seal jig (third item in list of specialized tools at the beginning of this procedure) to attach seal. Cool seal by pushing a retracting jig against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



0353

Figure 33

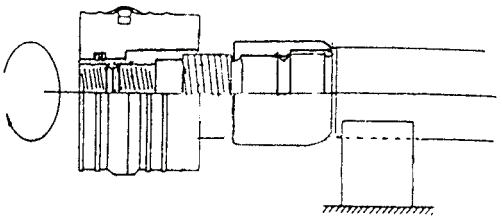
5. Immobilize piston rod on solid support blocks. Assemble O-ring (21) and backup ring (22). Prepare to attach rod cover assembly to piston rod. Push rod cover by tightening piston nut (23).



HAOF450S

Figure 34

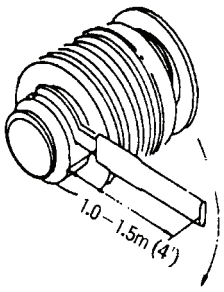
6. Assemble cushion ring (16) and attach piston assembly to piston rod.



HAOF460S

Figure 35

7. Use specially fabricated or factory sourced tool to tighten piston nut (23).

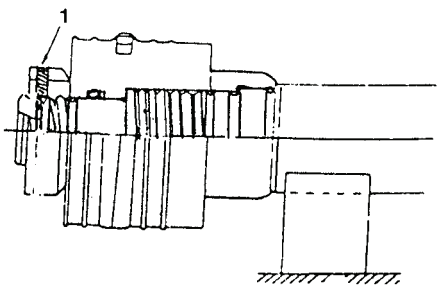


0356

Figure 36

8. Assemble wear ring (19), slide ring (20) and set screw (24) to piston assembly.

Reference Number	Description
1	Set Screw



HAOF470S

Figure 37

9. Immobilize body of cylinder before reassembly.

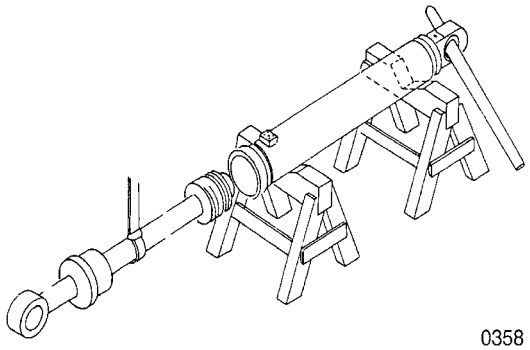


Figure 38

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

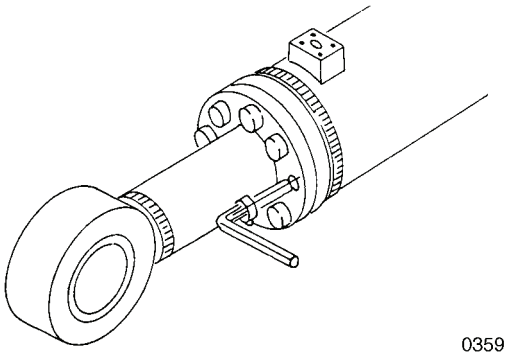


Figure 39

Swing Device

Edition 1

Table of Contents

Swing Device

Safety Instructions 5
Applicable Models 5
Indication of Type 6
Specifications 7
Structure and Principle of Operation 8
- Structure 8
- Principles of Operation 13
- Valve Casing 14
- Brake Part 17

Cautions for Operation 18
- Inspection 18
- Direction of Rotation 18
- External Load at the End of Shaft 19
- Hydraulic Oil and Temperature Range 19
- Filter 20
- Installation and Piping 20
- Oil Filling and Air Breather 21
- Instructions before Starting to Operate 21

Troubleshooting 22
- General Pre-caustions 22
- Examination of Hydraulic Motor 22
- Troubleshooting 23

Disassembly and Reassembly 26
- Disassemble Swing Motor 28
- Reassemble Swing Motor 32
- Disassemble the Reduction Gear 37
- Reassemble the Reduction Gear 41
- Maintenance Instructions 49

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

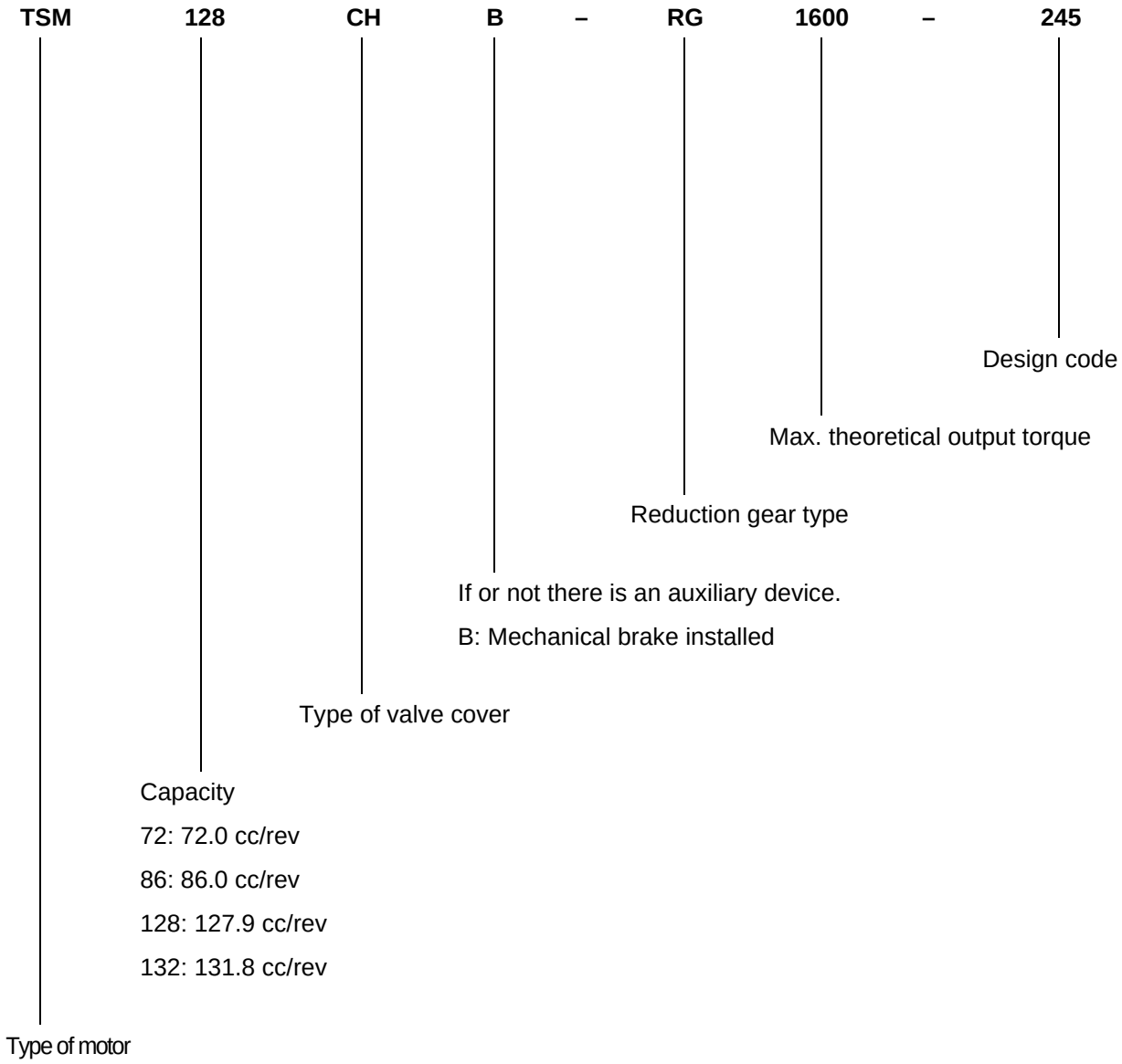
Instructions are necessary before operating or servicing machine. Read and understand the Operation and Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX180LC-3	1001 and Up, 50001 and Up
DX190W-3	1001 and Up
DX225LC-3	1001 and Up, 50001 and Up

INDICATION OF TYPE



SPECIFICATIONS

Model				DX180LC-3	DX190W-3	DX225LC-3
				TSM128CHB-RG1600		
Motor	Displacement		(cc/rev)	128		
	Set Pressure of Relief Valve		(kg/cm^2)	275	275	270
	RPM	Nomal	(min^{-1})	1,250		
		Maximum	(min^{-1})	1,700		
	Theoretical Output Torque		(kg•cm)	56.0	56.0	55.0
	Brake Torque		(kg•m)	63		
	Brake Release Pressure		(kg/cm^2)	23		
	Weight		(kgf)	62		
Swing Reduction Gearbox	No.1 Sun Gear			Module: 3, No. of teeth: 23		
	No.1 Planetary Gear			Module: 3, No. of teeth: 29		
	No.2 Sun Gear			Module: 3, No. of teeth: 22		
	No.2 Planetary Gear			Module: 3, No. of teeth: 29		
	Ring Gear			Module: 3, No. of teeth: 82		
	Reduction Ratio			21.58 : 1		
	Weight		(kgf)	195		
Swing Device	*1, 2) Theoretical Output Torque		(kg•m)	1,209	1,209	1,187
	RPM	Nomal	(min^{-1})	58		
		Maximum	(min^{-1})	79		
	Weight		(kgf)	258		

NOTE: **1. The theoretical value at the rated pressure, not including mechanical efficiency.*

**2. The theoretical value at the rated pressure and the max. speed.*

STRUCTURE AND PRINCIPLE OF OPERATION

Structure

Structural Diagram (Motor)

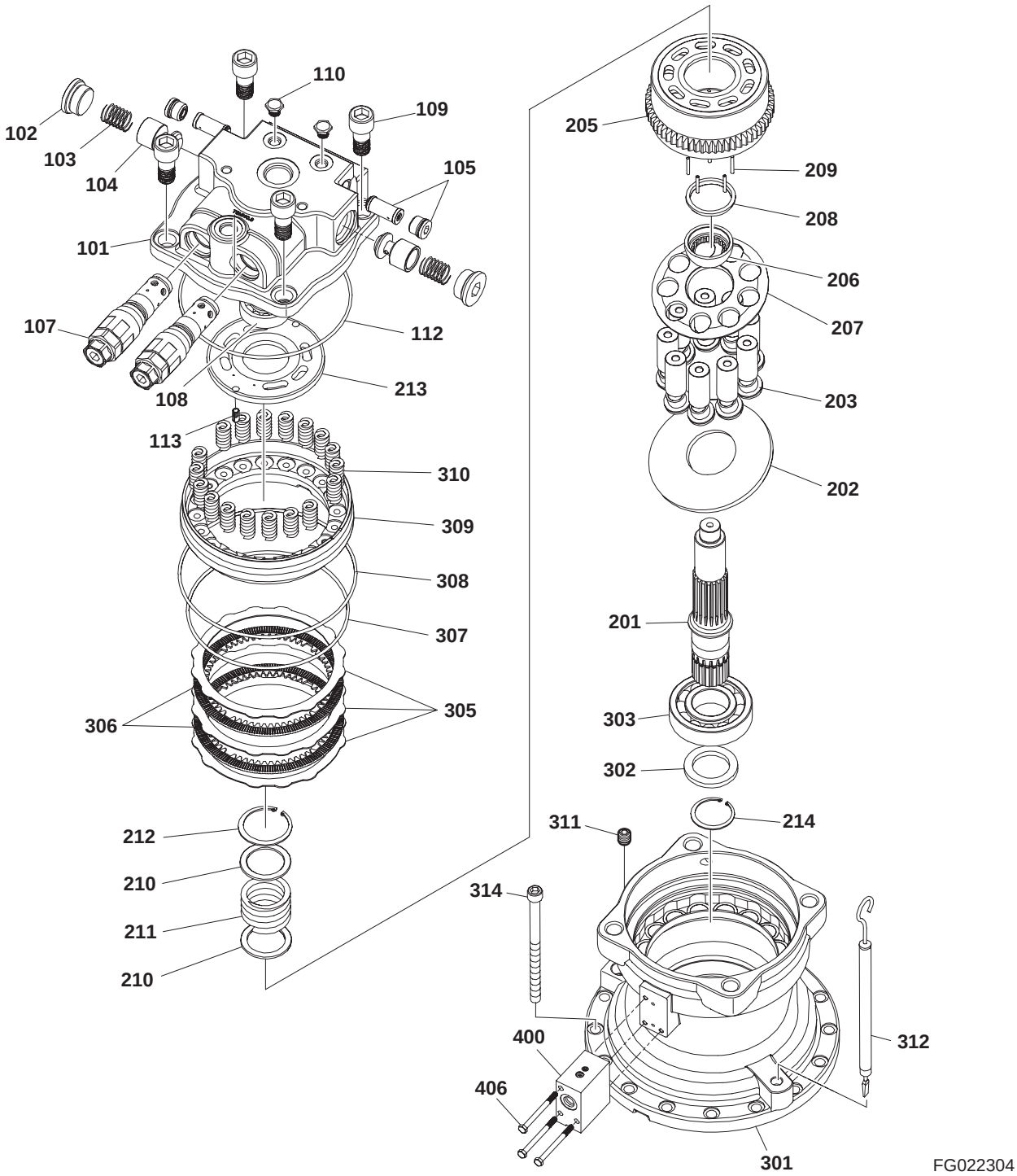


Figure 1 Motor Structure

Reference Number	Description
101	Casing Valve
102	Plug
103	Spring
104	Plunger
105	Swing Reactionless Valve Assembly
107	Relief Valve
108	Ball Bearing
109	Socket Bolt
110	VP Plug
112	O-ring
113	Pin Spring
201	Driveshaft
202	Shoe Plate
203	Shoe
204	Piston
205	Cylinder Block
206	Thrust Ball
207	Retainer Plate
208	Collar

Reference Number	Description
209	Roller
210	Washer
211	Spring
212	Ring Snap
213	Valve Plate
301	Casing S1
302	Oil Seal
303	Roller Bearing
305	Separation Plate
306	Friction Plate
307	O-ring
308	O-ring
309	Brake Piston
310	Brake Spring
311	PT- Plug
312	PT- Plug
400	Brake V/V
406	Bolt

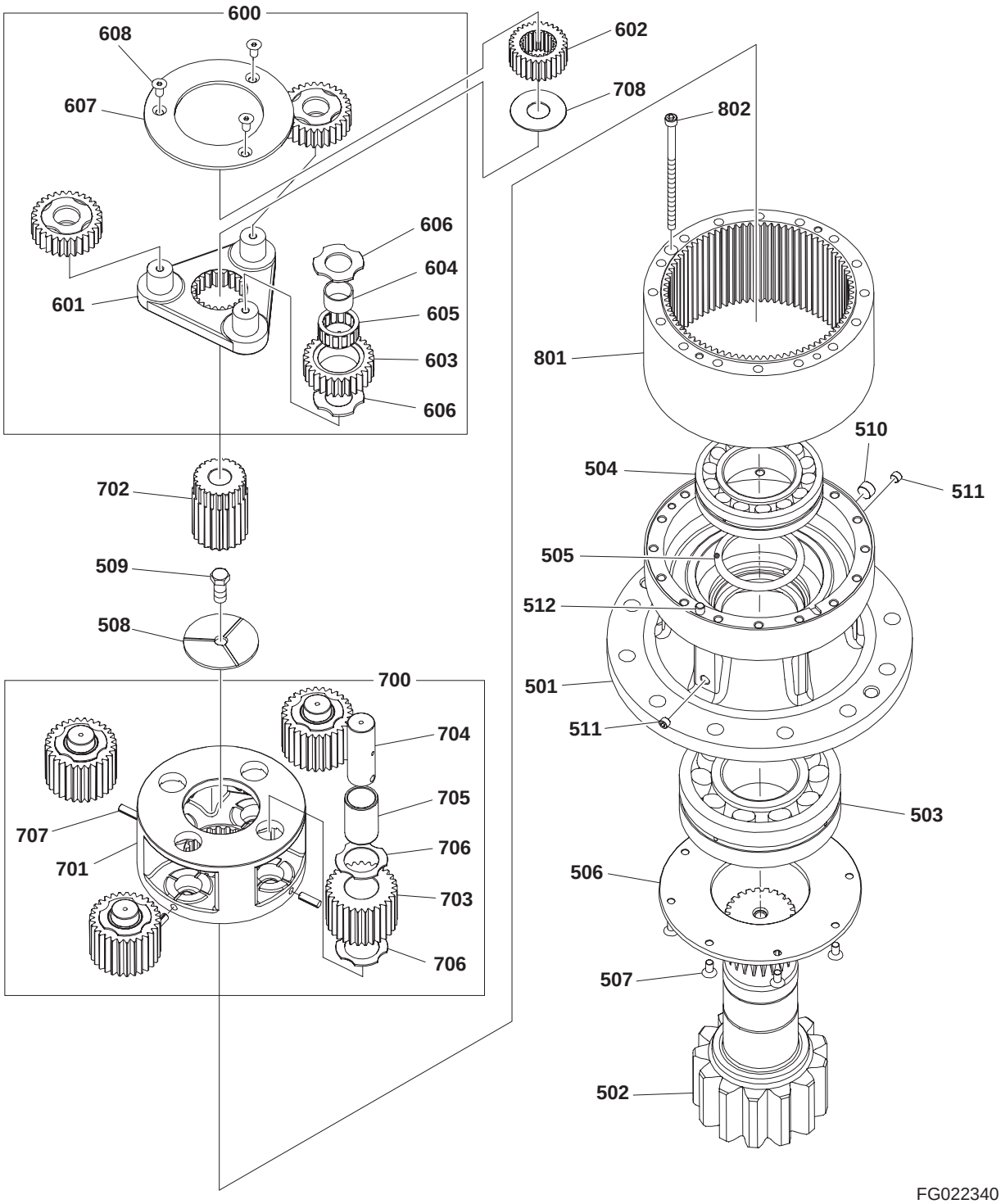


Figure 2 Reduction Gear Structure

Reference Number	Description
501	Casing
502	Pinion Shaft
503	Spherical Roller Bearing
504	Spherical Roller Bearing
505	Oil Seal
506	Cover
507	Flat Head Screw
508	No.3 Thrust Washer
509	Hex Bolt
510	PT Plug
511	PT Plug
512	Pin
601	No.1 Carrier
602	No.1 Sun Gear
603	No.1 Planetary Gear

Reference Number	Description
604	Inner Ring
605	Needle Bearing
606	No.1 Thrust Washer
607	Thrust Plate
608	Flat Head Screw
701	No.2 Carrier
702	No.2 Sun Gear
703	No.2 PL Gear
704	No.2 Pin
705	Bushing
706	No.2 Whrust Washer
707	Spring Pin
708	Thrust Washer
801	Ring Gear
802	Socket Bolt

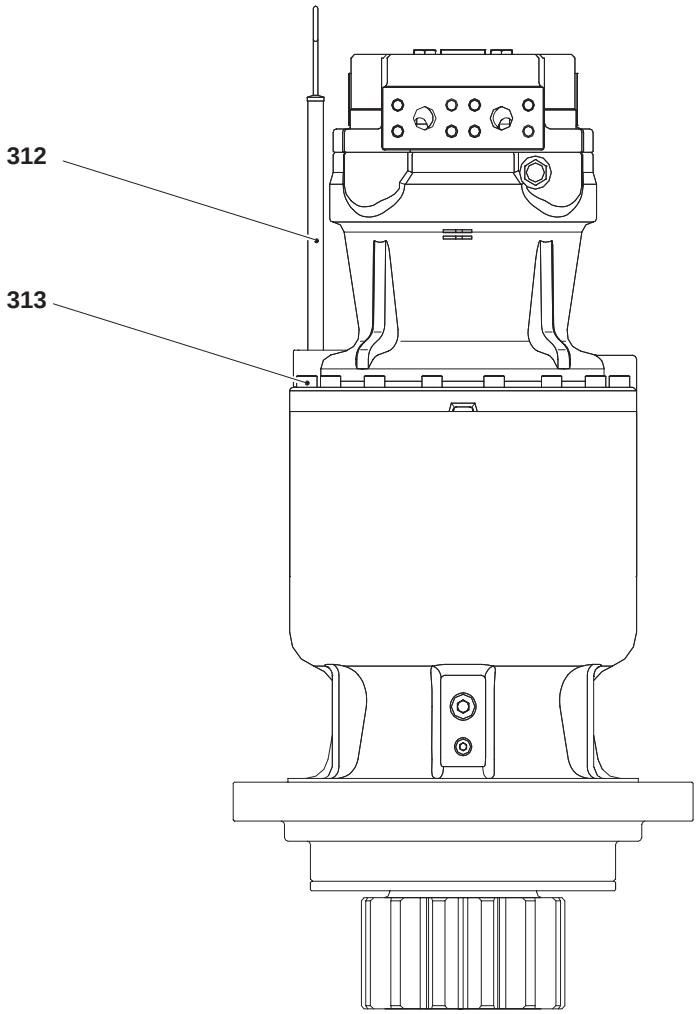


Figure 3 Swing Device Structure

Reference Number	Description
311	Level Gauge

Reference Number	Description
312	Socket Bolt

Hydraulic Motor

High-pressure oil from the control valve is routed through valve casing and valve plate to pistons. When the oil enters the cylinder bores through port, it forces the pistons against the fixed and inclined swash plate (F1, F2). The force (F2) causes the piston shoes to slide on the swash plate forcing the rotating group to turn, thereby rotating the output shaft.

During the second half of the motor's revolution, low-pressure oil is discharged as the pistons ride to toward a higher position on the shoe plate.

A small amount of supply oil flows through the center of each piston to lubricate the piston ball joint and the piston shoe face. The motor is internally lubricated from leakage inside the motor.

To reverse rotation, system oil flow is changed from inlet port to outlet port and vice versa. Theoretical output torque is as follow formula.

$$T = \frac{P \times q}{2 \times \pi}$$

P: effective differential pressure (kg/cm^2)

q: Displacement (cc/rev)

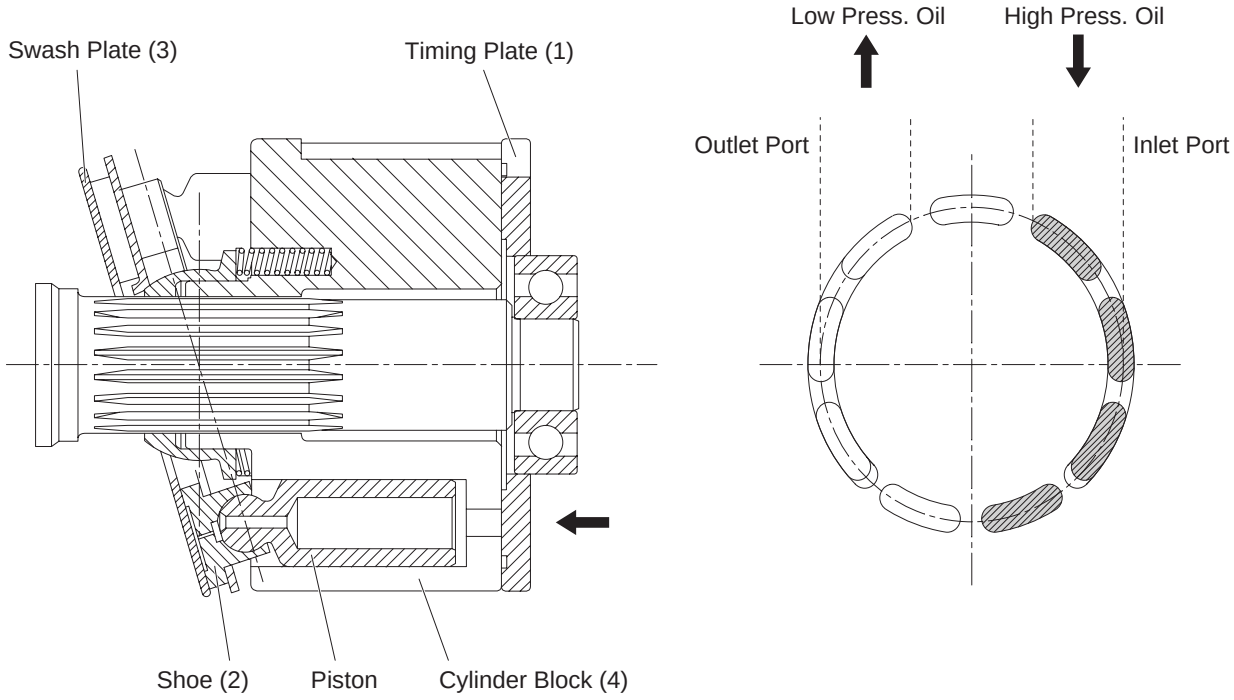


Figure 4 Operation Diagram of Motor

Valve Casing

1. Anticavitation check valve

   The motor can be rotated faster than supplied oil flow because there is no counterbalancing valve to prevent over speed : in order to prevent cavitation of the motor, oil compensation insufficient flow is drawn through the anticavitation check valve.

2. Relief Valve: KRD22EK10C (Figure 5)

   We consider that port P is applied pressure by tank pressure.

   Port P, R are affected by tank pressure at first, as shown (1, Figure 6). The relief valve starts operating when the force that is determined by multiply the pressure area (A1) of plunger (301) by pressure P1 is equal to the sum spring (321) force (Fsp) and the force that is determined by multiply the pressure area (A2) by pressure Pg of room 'g' in the plunger (301).

   Here, Pg is the pressure of room 'g' applied pressure by passing oil through orifice m.

   If Pg arrives at the pressure which is determined by spring (321) pushing the piston (302), the piston moves to left side. When piston (302) moves to left side, room 'h' operates as damping room which is designed at the side of adjustment plug (401) and piston (302).

   Because of this mechanism, the pressure of room 'g' increases smoothly while the piston (302) reaches end of adjustment plug (401).

$$P1 \times A1 = F_{sp} + P_g \times A2$$

$$P1 = \frac{F_{sp} + P_g \times A2}{A1}$$

   If the piston (302) reaches end of adjustment plug (401), it doesn't move left side anymore. So, the pressure of room 'g' is Ps and spring (321) force is Fsp.

   (3, Figure 6) Therefore, the pressure P changes as shown (4, Figure 6). The pressure (Ps) of last state is following equation.

$$P_s \times A1 = F_{sp'} + P_s \times A2$$

$$P_s = \frac{F_{sp'}}{A1 - A2}$$

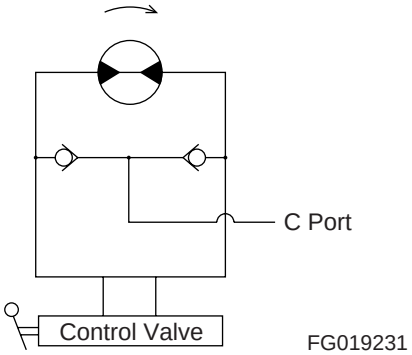


Figure 5

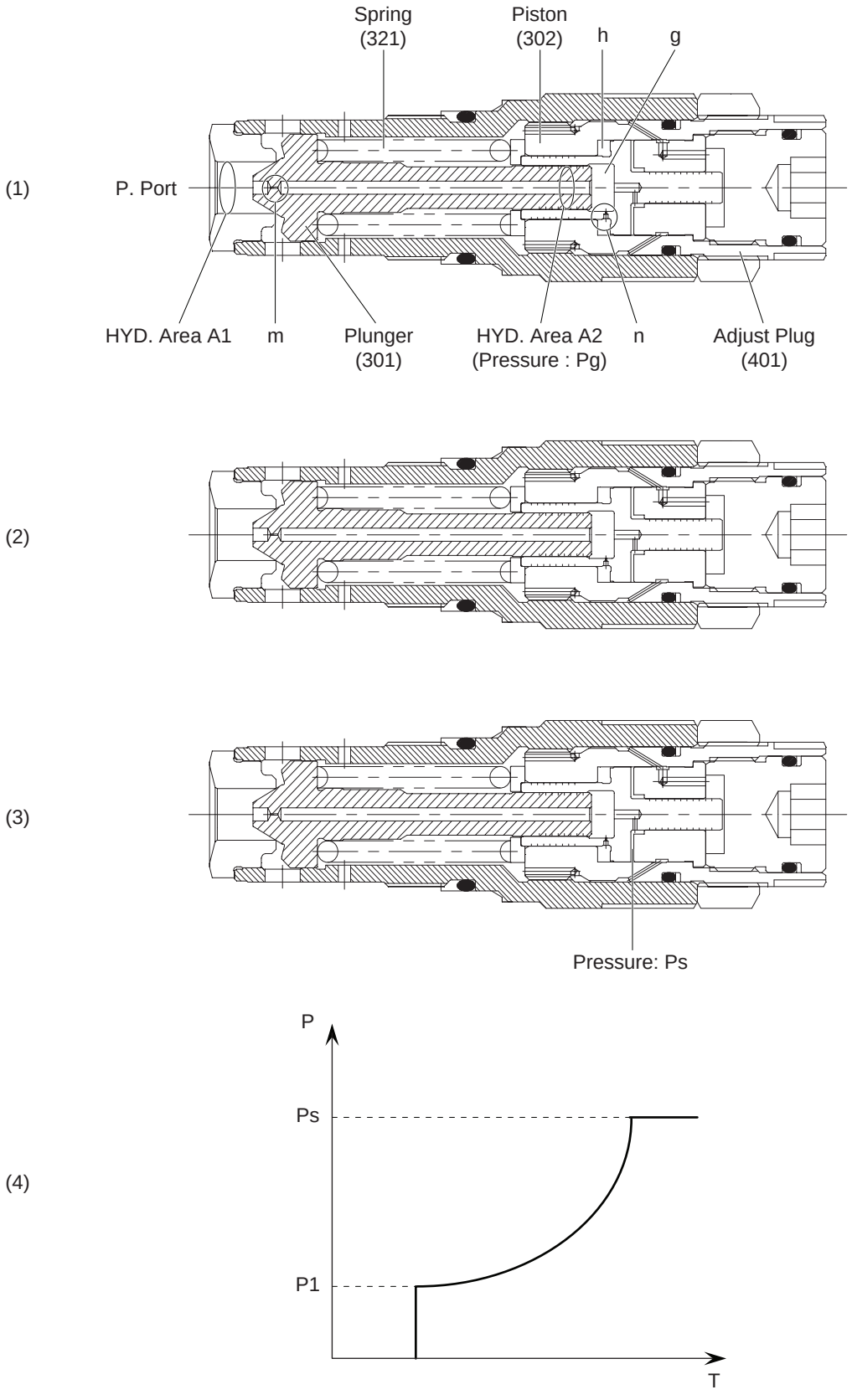


Figure 6 Relief Valve: Operation Diagram of KRD22EK10C

3. Reactionless valve

By the spool's shift in the main control valve, oil is supplied to Hydraulic motor's A port (or B port), and the poppet of reactionless valve moves, then it blocks the bypass. As a result, swing device is operated. (1, Figure 7)

If the spool is returned to neutral position, it blocks the two ports of Hydraulic motor but the swing device tends to swing by inertia-force. The swing force is transmitted to hydraulic motor by reduction gear. After the swing device is stoped by brake pressure which is created in B port (or A port), the swing body tends to shift to the opposite direction. Because of the brake pressure, the swing device stops, first, and tends to reverse. Although the oil pressure of B port tries to shift the poppet to left side, the operating will be delayed by the orifice of the A port. In this case, a bypass is generated between A port and B port, and pressure oil in B port flows into A port through the bypass. (2, Figure 7)

And, the poppet at the port B moves to the left until it stops the bypass channel. (3, Figure 7).

As such, the reaction is prevented and the swing motor stops immediately by bypassing pressure oil to port A when reverse pressure is generated at the port B.

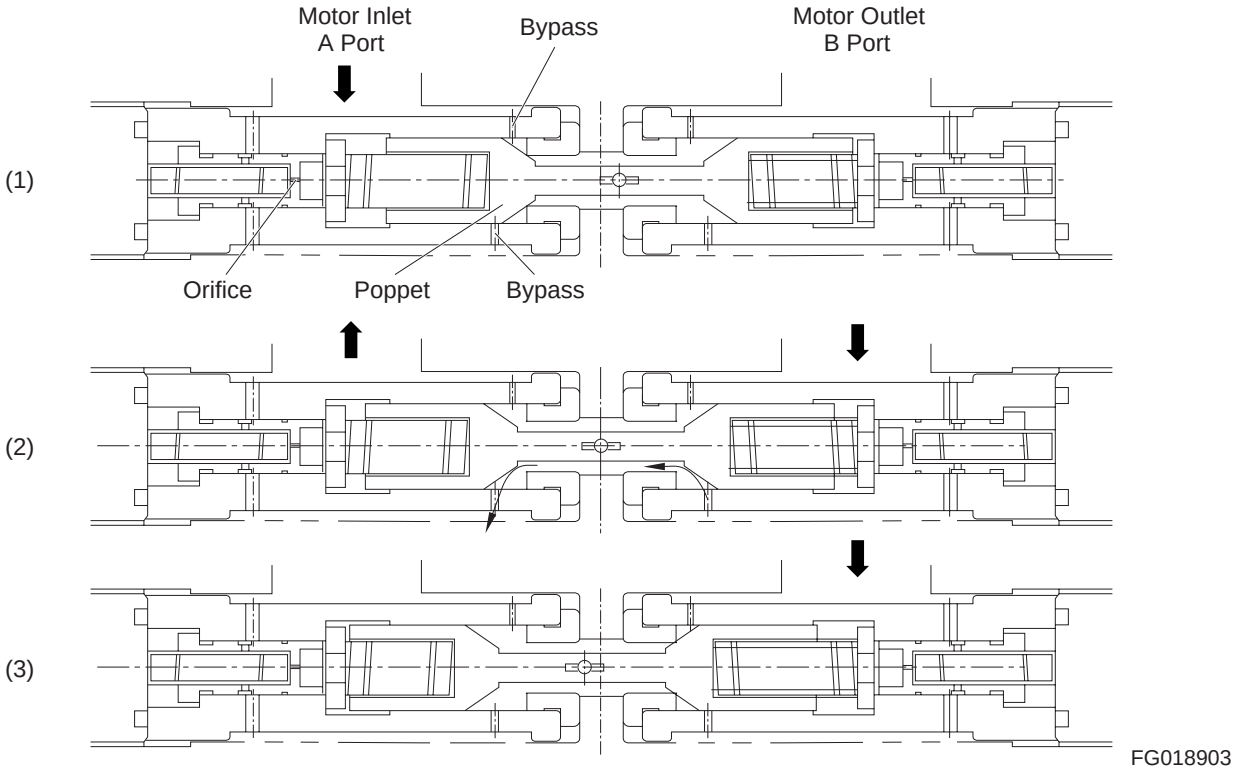


Figure 7 Principle of Operation of Reactionless Valve

Brake Part

The cylinder block (205) consists of the driving shaft (201) and the spline. The separation plate (305) is kept from the revolution in the cylindrical direction by the arc opening processed at the casing.

A friction force occurs among the friction plate (306) in the tooth combination at the circumference of the cylinder block and the casing (301), the separation plate (305), and the brake piston (309) when the friction plate is pressed against the casing through the separation plate, and the brake piston.

This friction force constraints the driving shaft, engaging the brake. Meanwhile, the brake piston moves and the friction plate is separated from the casing to release the brake, as oil pressure force overcomes the spring force by applying a releasing force to the oil chamber formed between the brake piston and the casing.

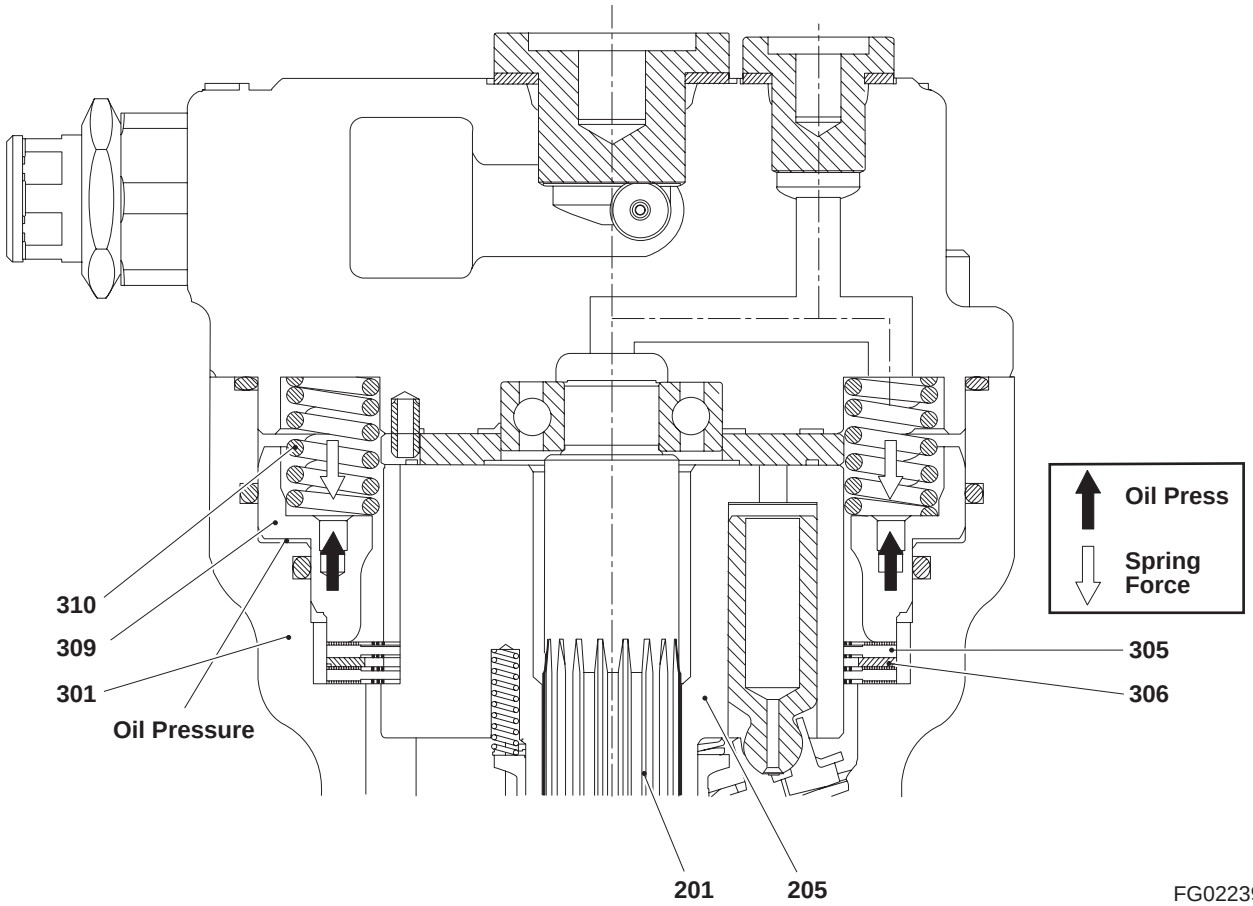


Figure 8 Operation Diagram of Brake

CAUTIONS FOR OPERATION

Inspection

Prior to installation of a new motor, inspect the following items.

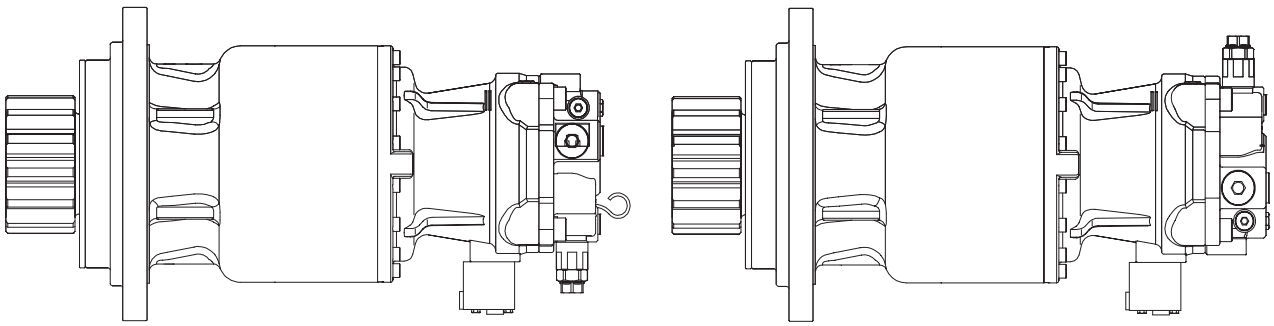
1. Inspect whether or not there is any damage during transit, or if any parts are lost missing.
2. Inspect each tightened part to see if it is loosened or not.
3. Check whether or not covers for flange surface and drain port are perfect, and if the inside of the motor is dirty with intruded dust.

Direction of Rotation

The relation between the oil flow and the revolutionary direction of the shaft is self-explanatory as shown in Figure 9 and Table.

The direction of rotation differs by the direction of the slope of casing.

Be careful for the direction of swing which is differentiated by the shape of casing and direction of flange.



FG022400

Figure 9

Direction	Inlet	Outlet	Revolutionary Direction of Shaft Facing the Shaft Side
Counterclockwise	A	B	Right (handed)
Clockwise	B	A	Left (handed)

External Load at the End of Shaft

In principle, the end of the motor shaft should be free of any external radial or thrust load.

Hydraulic Oil and Temperature Range

1. Oil type

   Generally used mineral hydraulic active oil is recommended, but with additives of extreme pressure, foaming preventive prevention, oxidization prevention, and dampproofing as well as high coefficient of viscosity.

2. Optimal viscosity and temperature of Active oil (Figure 10)

   The allowable viscosity range is between 10 and 1000 cSt,but 10 to 200 cSt is recommended for the optimum efficiency.The temperature range is limited to -25°C to 100°C for the sake of the oil seal and the O-ring.
   For the operation temperature, at most 60°C is recommended taking into consideration the degradation of active oil and seals.

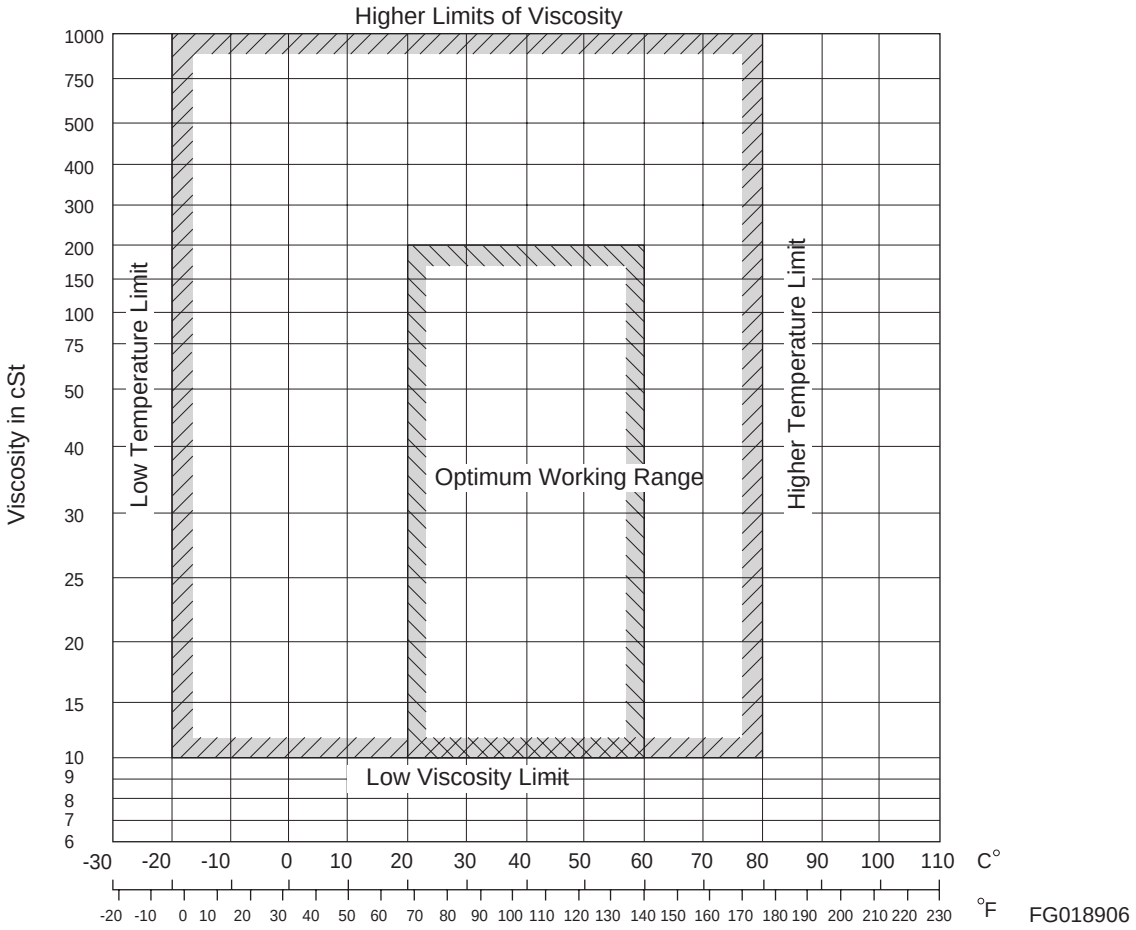


Figure 10 Optimum Viscosity and Temperature Range

3. Active Oil Other than Mineral Oil

   If you are going to use phosphoric acid-, water-glycol, or fatty acid-based active oil, please contact a Doosan distributor for more information. in advance.

Filter

If fine particles of dirt and metal are mixed with oil, they enter into sliding surfaces and accelerate wear in each part, and in the worst case sticking will be likely to occur.

It is recommended, therefore, that customer not only take necessary measures to prevent oil from contamination with such fine particles but also provide an oil filter in the circuit without fail. For satisfactory service life of these motors in application, the operating fluid should be continuously filtered to the minimum cleanliness level of class 8 of NAS. Also, install a 10μ filter in the hydraulic circuit and 2 - 4 mg/100cc or below millipore filter pollution rating is recommended.

Installation and Piping

1. When the motor is installed. its shaft should face downward.
2. The deviation of offset center from driven parts should be equal to or less than 0.05 mm or less.
3. The tightening torque of the bolts used in mounting the motor to bracket must be according to the specifications on the outline drawings.
4. The casing should always be full of oil. The drain of the motor should be positioned in such a place as shown in Figure 11 to allow the casing be full of oil.
5. The pressure in the casing is allowed up to 3 kg/cm^2, but we recommend, 2 kg/cm^2.
6. Pipes should be washed enough, but flushing is not allowed.
7. Avoid excessive force at pipe joints.
8. For the drain piping, use pipes bigger than the port of the motor but as short as possible.

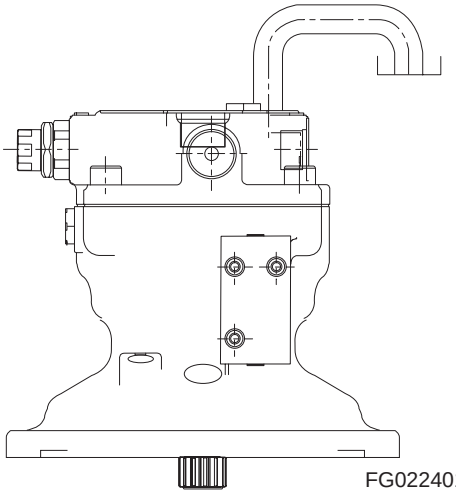


Figure 11

Oil Filling and Air Breather

1. Fill in the casing with oil by using the drain port before the operating.

   In the motor, there are many kinds of high-speed sliding surface like bearing, piston, shoe, spherical bushing, and etc. So If there isn't enough oil, it can make some problem like sticking or damage.

   The PF 1/4 port for venting air

2. All the air in the motor and circuit must be removed, otherwise, it will be likely be causes of imperfect working or a damage of the motor.

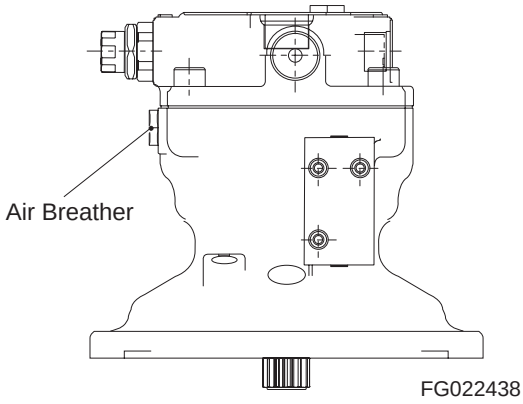


Figure 12

Instructions before Starting to Operate

1. Check if the direction of revolution is correct or not.
2. Check whether or not there is any leakage of oil from the motor.
3. Check if the equipment vibrates abnormally or not operates or when the revolution direction is changed.
4. Check if the oil temperature rises rapidly in spite of running for a short period of time.
5. Check whether the pressure varies to a great extent as compared with the established one.
6. Check if the piping is fully connected or not.

TROUBLESHOOTING

General Pre-caustions

Pre-cautions to be taken when troubles have happened while the motor is in operation are described as below:

As for general precaution.

1. Consider a cause of the trouble before repairing.

   Before setting to work, think whether the same thing has happened before or not.

   Also, think again whether it is the motor that is in trouble.

2. Be careful of foreign material.

   Foreign materials cause abnormal friction and wear. Take care to avoid foreign materials during disassembly and reassembly.

3. Handling part.

   Pay attention to the handling of parts not to damage them, especially to moving parts such as pistons, bearing and valves etc.

4. Take care not to damage O-rings and gasket surfaces

   Once seals have been disassembled, they should be replaced, even if damage is not observed.

Examination of Hydraulic Motor

It is extremely difficult to trace trouble in the hydraulic circuits. Inspect the following items and investigation whether or not the fault is caused by the motor.

1. Inspection the oil in casing.

   Remove the drain plug and inspect the hydraulic oil in the casing. If a large amount of metallic particles come out with the oil, you should suspect a failure of internal parts.

2. Presence of abnormal noise.

   Check whether the motor emits an abnormal noise.

3. Pressure measurement of various points.

   Measure pressures at various points and check for faults, instead of disassembling parts at random.

4. Measurement of drain quantity.

   1) In the case of locking the swing and adding the pressure oil to motor, it's normal the drain rate would be about 25 LPM or less.

   2) In normal swing mode, the drain rate would be under 2 LPM.

Troubleshooting

1. Motor does not rotate

Symptom	Possible Cause	Corrective Action
The pressure of the circuit is not increasing.	1. Setting pressure of relief valve is incorrect. 2. Relief valve malfunction. 1) Plunger sticks. 2) Plunger orifice clogged. 3. Seat defectiveness of plunger.	1. Reset the pressure to correct value. 2. 1) Revise or exchange of stick face. 2) Disassembly or cleaning. 3. Replace for damaged seat part.
The pressure of the circuit is not increasing.	1. Overloaded. 2. Sticking of moving parts. 3. The brake dose not release. 4. Stick of brake piston. 5. Stick of friction plate.	1. Remove load. 2. Check/repair the piston/ shoe, cylinder block, valve plate etc. 3. 1) Check/repair circuit. 2) Check for the break valve. 4. Disassemble and check. 5. Disassemble and check. Replace the sticking part.

2. The direction of rotation is reverse

Symptom	Possible Cause	Corrective Action
Motor rotation is reversed	1. The revolving direction of motor is reverse. 2. The inlet and outlet of pipline are reverse.	1. Assemble correctly. 2. Correct the pipline.

3. Rotating speed fails to reach setting value

Symptom	Possible Cause	Corrective Action
Rotating speed fails to reach setting value.	1. The volume incoming flow is not sufficient.	1. Check discharge volume of pump and circuit up to the motor.
	2. The temperature is too high and too much oil is leaking.	2. Reduce the oil temperature.
	3. Valves/pistons/rings etc. are worn away and broken.	3. Replace it.

4. Brake torque is not sufficient.

Symptom	Possible Cause	Corrective Action
Brake torque is not sufficient	1. Friction plates are worn.	1. Disassemble and check. Replace the part if excessively worn.
	2. Brake piston is sticking.	2. Disassemble and check.
	3. Brake releasing pressure is not working.	3. 1) Check/repair the circuit. 2) Check for the brake valve.
	4. Spline of friction plates are damaged.	4. Disassemble and check. Replace the damaged part.

5. Hydraulic motor has excessive slip

Inspect the drain quantity for motor.

Normal drain rate is 500 cc/min

Symptom	Possible Cause	Corrective Action
Excessive slip when external torque to drive the hydraulic motor is applied.	1. Relief valve is not working correctly.	1. Same as subclause
	2. Bad plunger seat.	2. Replace the damaged part.

6. Oil leak

1) Oil leak at the oil seal

Symptom	Possible Cause	Corrective Action
Oil leak from the oil seal	1. The lip is dirty or damaged. 2. The shaft may be damaged or worn out. 3. Oil seal lip is overturned because of excessively high-pressure in the casing. 4. The shaft is rusty.	1. Replace the oil seal. 2. Replace the driving shaft or defective centering of the driving shaft. 3. Repair clogged pipeline. 4. Disassemble and correct it.

2) Oil leak at joint surface

Symptom	Possible Cause	Corrective Action
Oil leak from joint surface.	1. O-ring is missing. 2. O-ring is dammaged 3. Seal face is defective. 4. The bolt is loose or not tightened.	1. Insert O-ring. 2. Replace it. 3. Disassemble and repair. 4. Tighten to specified torque or replace the bolt.

DISASSEMBLY AND REASSEMBLY

Tightening Torque of Bolts

Table 1 shows tightening torque of bolts used in motor. Observe the specified torque when tightening the bolts.

Table 1

Bolt Size	Type	Tightening Torque (kg•cm)	Part No.
M6	Hexagon Bolt	120 ± 20	400
M20	Hexagon Socket Bolt	4,400 ± 660	109
M22	RO Plug	1,100 ± 100	105
M36	RO Plug	2,450 ± 250	102
PF 1/4	Plug	370 ± 20	111
M33	Relief Valve	1,800 ± 100	107

Tools for Disassembly and Reassembly

Tables 2 and 3 and Figure 13 is shown necessary tools for disassembling and reassembling.

Table 2

Name	Size	2-face Width	Application Part	Tool
Hexagon Bolt	M6	10	Brake Valve	Hexagon Wrench Socket Wrench
Hexagon Socket Bolt	M20	17	Valve Casing	Hexagon Wrench
Plug	M22	10	RO Plug	Hexagon Wrench
Plug	M30	17	RO Plug	Hexagon Wrench
Plug	PF 1/4	19	VP Plug	Hexagon Wrench Socket Wrench
Relief Valve	M33	36	Relief Valve	Hexagon Wrench Socket Wrench

Table 3

Specification / Tools	Size
Pliers (for Lock Ring)	For ø65 axis
Driver	Type 2 ea
Steel Rod	About 10 x 8 x 200. 1 ea
Hammer	One each of plastic hammer and metal hammer
Torque Wrench	Torque range • For 100 - 450 kg•cm • For 400 - 1,800 kg•cm • For 1,200 - 4,800 kg•cm
Slide Hammer Bearing Pliers	-
Special Tool for Removing the Brake Piston	See next page

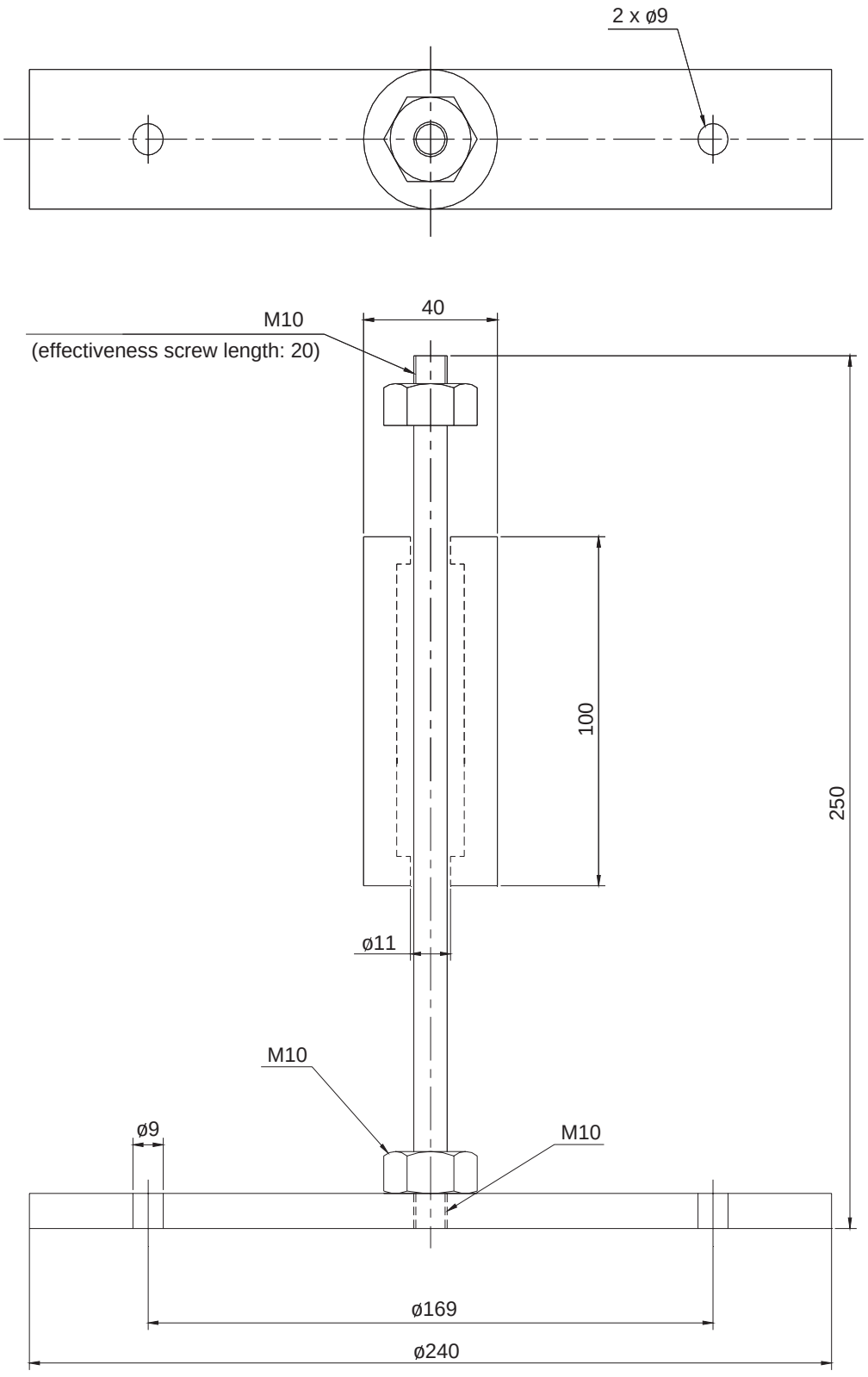


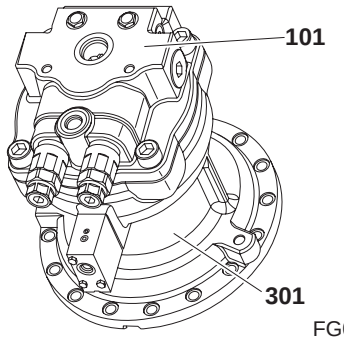
Figure 13 Tools for Break Piston Disassembly

Disassemble Swing Motor

Please use the following procedures for the inspection and repair of the motor.

Numerals given in parentheses following the parts names indicate the parts number shown by the drawing in the instruction and maintenance manual.

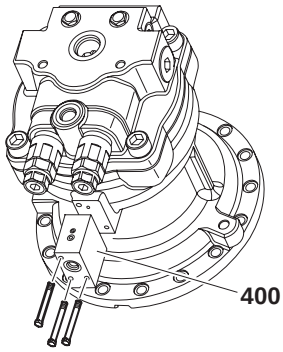
1. Wind the wire rope around motor, Lift up the motor with a crane and clean the motor with cleaning oil. After cleaning, dry with compressed air.
2. Draw the oil out of the casing (301).
3. Point the end of the driveshaft downward and fix it on a disassembly table for easy disassembling. Before disassembling make a match mark on motor casing (301) and valve casing (101).



FG022402

Figure 14

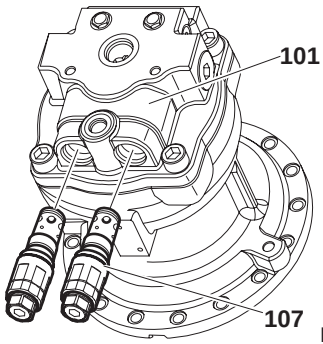
4. Remove brake valve (400).



FG022403

Figure 15

5. Remove relief valve (107) from valve casing (101).



FG022404

Figure 16

6. Remove RO plug (102) and take out spring (103) and plunger (104) from valve casing (101).

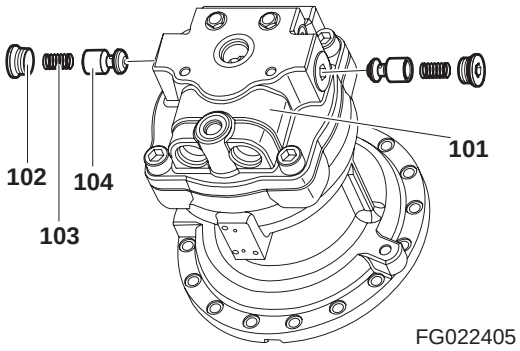


Figure 17

7. Remove swing reactionless valve assembly (105) from valve casing (101).

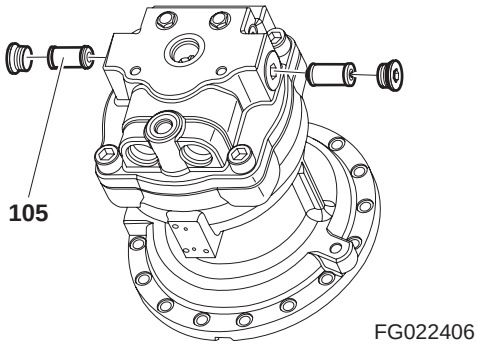


Figure 18

8. Remove hex socket bolts (109, 110) and disassemble valve casing (101) from casing (301). When loosening bolts, the valve casing will be raised by brake springs (310).

   Remove valve plate (213) from the valve casing (101).

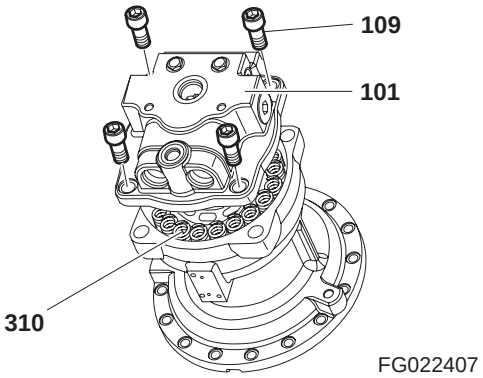


Figure 19

9. Remove brake springs (310) from the brake piston (309).

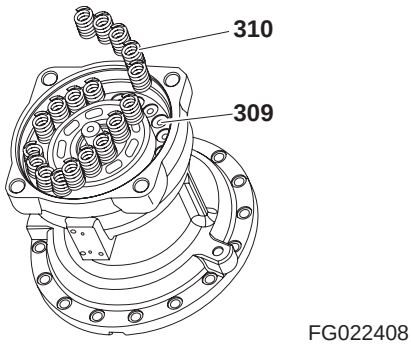
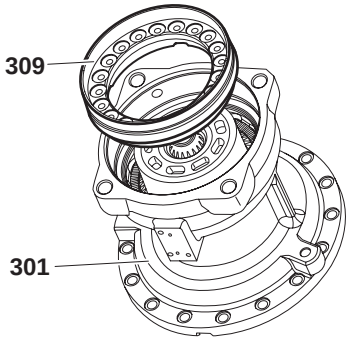


Figure 20

10. Disassemble brake piston (309) from casing (301) by using the special tool for removing the brake piston.

    Lift it up straight by using the bolt hole in the brake piston.



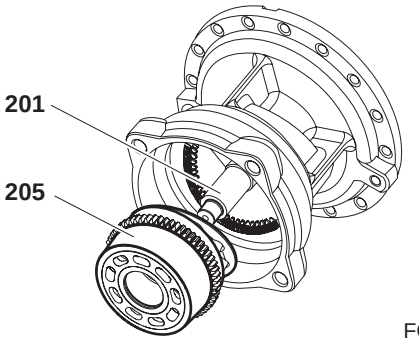
FG022409

Figure 21

11. After placing the motor horizontally, take out cylinder block (205) from casing (301).

    Remove piston assembly (203, 204), retainer (207), thrust ball (206). When taking out the cylinder block, be careful not to pull out roller (209). Be careful not to damage the sliding parts of the cylinder block, thrust ball and shoe.

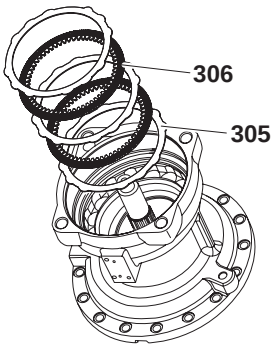
    washer (210, 2 ea), spring (211), retaining ring (212) are not disassemble at the disassembled cylinder block.



FG022410

Figure 22

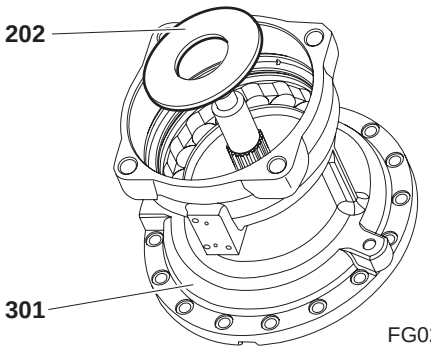
12. Pull out friction plate (306, 2 ea) and separation plate (305, 3 ea) from casing (301).



FG022411

Figure 23

13. Remove shoe plate (202) from casing (301). When removing the shoe plate (202), be careful not to damage the sliding parts of the shoe plate (202).



FG022412

Figure 24

14. Remove driveshaft from casing (301).

    Be careful not to damage the roller bearing and oil seal contact surface. If you beat a driveshaft (201) end with plastic hammer, it is easy to be disassembled.

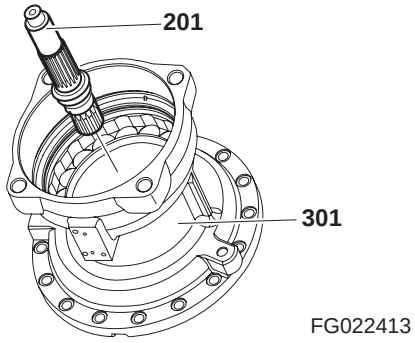


Figure 25

15. Do next step only if required.

    1) Remove roller bearing (303) from casing (301). Do not reuse the disassembling bearing.

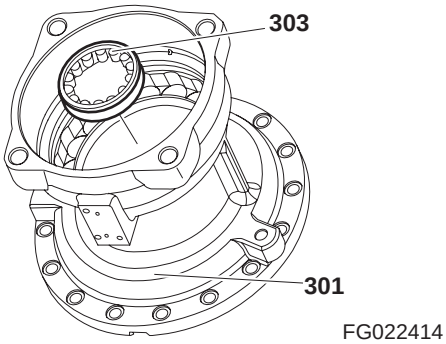


Figure 26

    2) Take out oil seal (302) from the casing (301) with a jig.
    Do not reuse the disassembling oil seal (302).

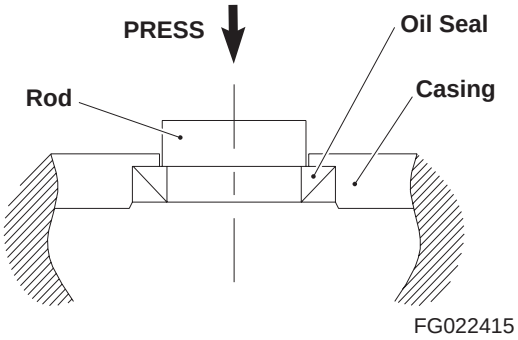


Figure 27

    3) Take out valve plate (213) from the valve casing (101).

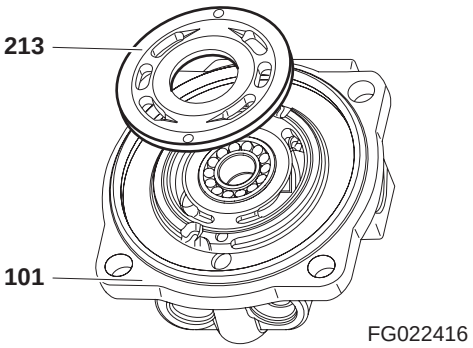
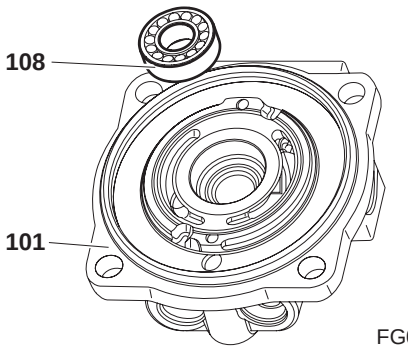


Figure 28

4) Take out ball bearing (108) from the valve casing (101).
Do not reuse the disassembling ball bearing (108).

Disassembling is finished, check each component throughly.



FG022417

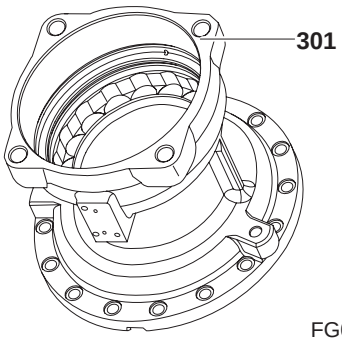
Figure 29

Reassemble Swing Motor

Use care with the following instructions.

1) After disassembly, make sure to repair damaged parts and prepare the parts to be replaced.
2) Wash all the parts with clean washing fluid and dry with compressed air.
3) Apply clean hydraulic oil on the sliding surfaces and bearings.
4) Replace O-rings and oil seals, which is a principle.
5) Tighten screws, bolts and plugs at specified torque using a torque wrench.

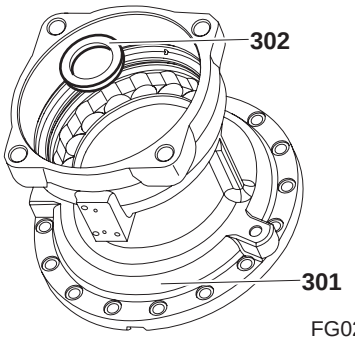
1. Place casing (301) on the work table with the valve casing side downward.



FG022418

Figure 30

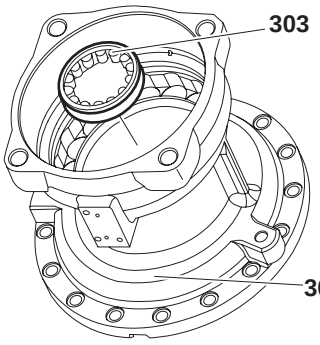
2. (This procedure applies when oil seal was disassembled from the casing.) Insert oil seal (302) at the casing (301) with a tool. (Be careful to note the direction of oil seal and insert until fully seated in the casing.)



FG022419

Figure 31

3. Insert roller bearing (303) at the casing (301) with a tool.

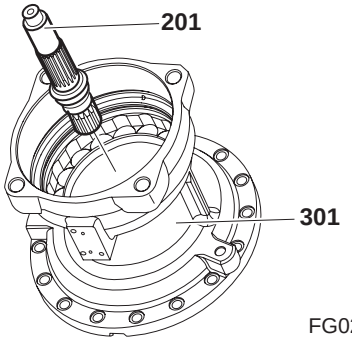


FG022414

Figure 32

4. Insert the driveshaft (201) into casing (301).

   Coat the lip of the oil seal with grease and tape the shaft spline for the protection of spline.
   Tap evenly.

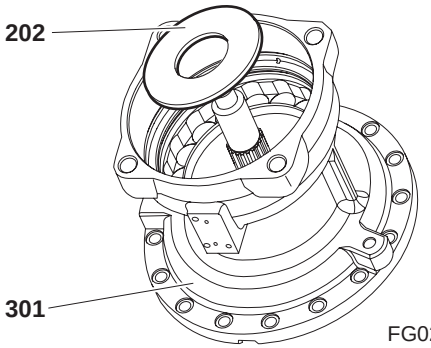


FG022413

Figure 33

5. Assemble shoe plate (202) to casing (301).

   When assembling the shoe plate (202), be careful not to damage the sliding parts of the shoe plate (202).



FG022412

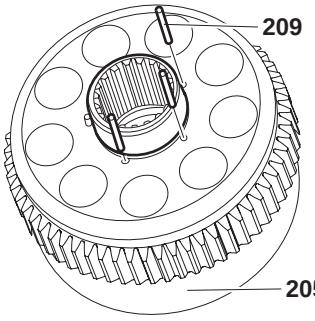
Figure 34

6. Insert roller (209) to cylinder block (205).

   Make sure that cylinder block is assembled with all component.

   (washer (210), spring (211), ring snap (212))

   (Be careful not to damage the sliding surface of the cylinder block.
   Insert roller to each hole one by one.)



FG022420

Figure 35

7. Place collar (208), thrust ball (206) to the cylinder block (205).

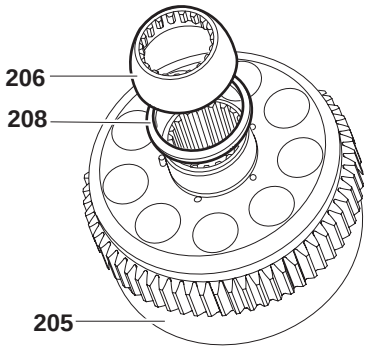


Figure 36

8. Assemble the retainer (207) with the piston sub assembly (203, 204) unit to the cylinder block (205).

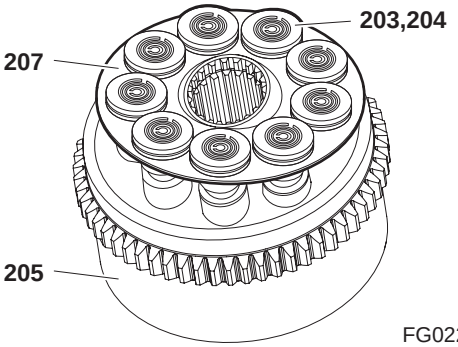


Figure 37

9. Insert cylinder block to driveshaft (201) by aligning with the spline.

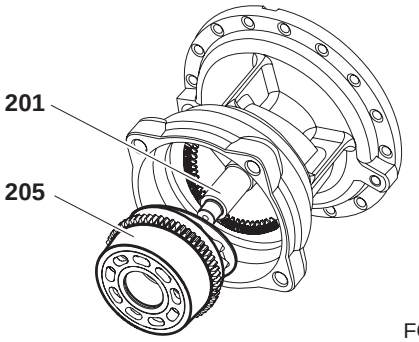


Figure 38

10. Place casing (301) downward and assemble separation plate (305, 3 ea) and friction plate (306, 2 ea) in sequence.

    (Assemble the parts of the friction plate cut-off with four gears at the same phase up and down.)

    (Assemble the parts of the separation plate cut-off with four jaws at the same phase.)

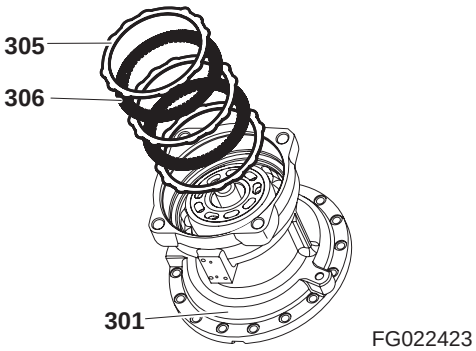
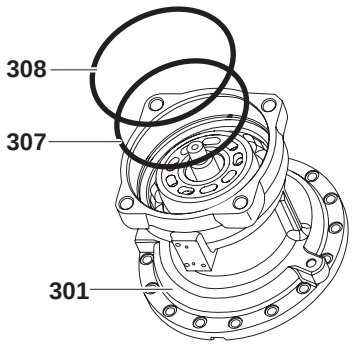


Figure 39

11. Mount O-ring (307, 308) to casing (301).

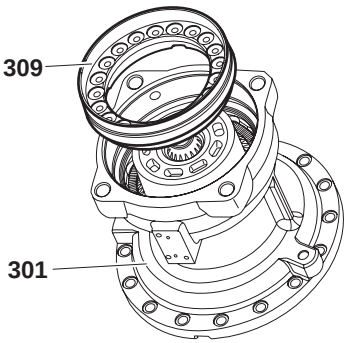
    (Apply grease thinly on the O-rings to prevent being cut during assembling the brake piston.)



FG022424

Figure 40

12. Assemble brake piston (309) to casing (301). If the piston is difficult to assemble because of the restriction of the O-ring; screw in two M8 bolts on the brake piston and tap them gently with plastic hammer.

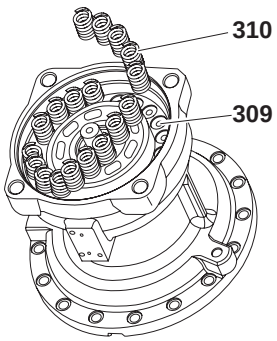


FG022409

Figure 41

13. Assemble brake springs (310) into brake piston (309).

    Confirm the springs are fitted to the brake piston completely.



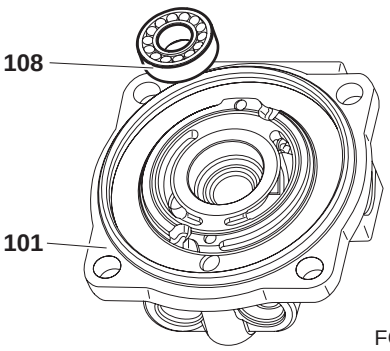
FG022408

Figure 42

14. (This procedure applies when ball bearing (108) was disassembled from the valve casing.)
    Assemble of ball bearing (108). Insert it to valve casing (101) while tapping it lightly.

    Tap evenly on the outer diameter of the outer race with a brass drift until it completely stops.

    Do not use a steel punch or bar on the bearing since it can chip or crack the race.



FG022417

Figure 43

15. Assemble valve plate (213) to valve casing (101) and install O-ring (113).

    Be careful to note the direction of the valve plate.

    Mount the valve plate with its round part toward the opposite side of the flange.

    Coat lightly with grease.

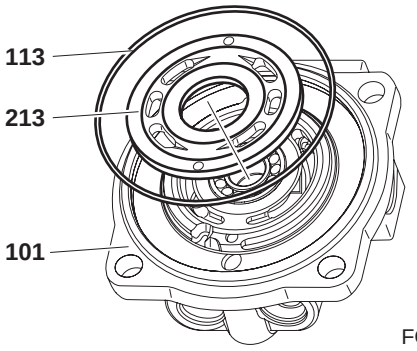


Figure 44

16. Mount valve casing (101) to casing (301) and tighten hex socket bolts (109) to specification.

    Be careful to note the mounting direction of the valve casing. (Reference to the drawing)

    Be careful not to drop the valve plate or let the brake springs pop out.

    Tighten the bolts evenly.

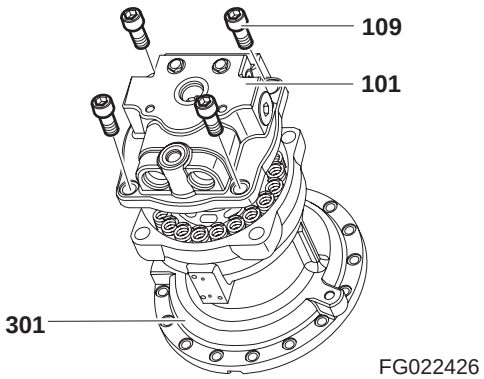


Figure 45

17. Install plunger (104) and spring (103) to valve casing (101) and tighten RO plug (102) with O-ring (106).

    Confirm the smooth movement of the plunger before installing the plug.

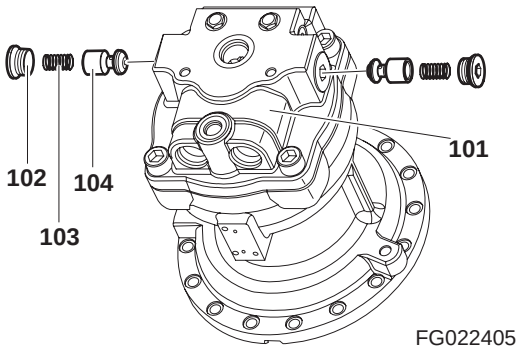


Figure 46

18. Install swing reactionless valve ass'y (105) to valve casing (101).

    Confirm the spring in the swing reactionless valve ass'y (105).

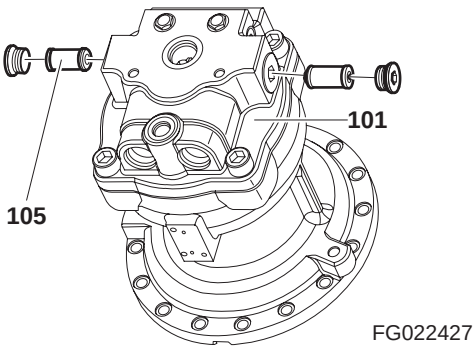
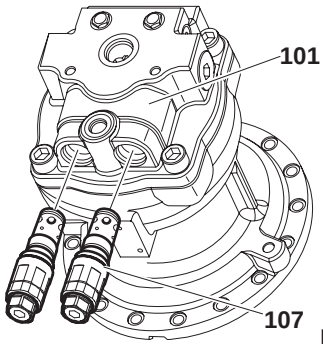


Figure 47

19. Assemble relief valve (107) with O-ring to valve casing (101).

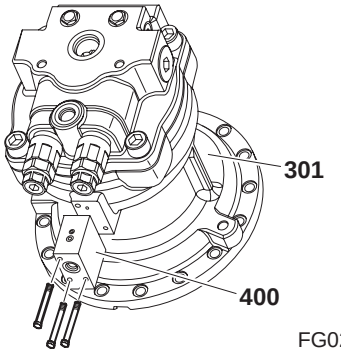


FG022404

Figure 48

20. Assemble brake valve (400) to casing (301) and tightening the hex bolts to specified torque.

The assembly is completed.



FG022428

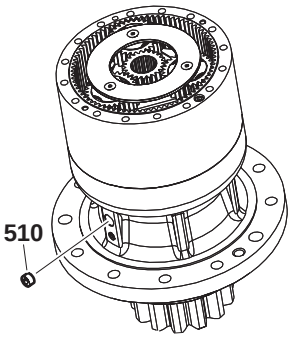
Figure 49

Disassemble the Reduction Gear

Please use the following procedures for the inspection and repair of the reduction gear 2009. 8. 10.

Numerals given in parentheses following the parts names indicate the part number shown by the drawing in the instruction and maintenance manual.

1. Wind the wire rope around reduction gear outside , Lift it up with a crane and clean the reduction gear with cleaning oil. After cleaning, dry with compressed air.
2. Remove the PT plug (510) and drain out gear oil.



FG022429

Figure 50

3. Remove No. 1 sun gear (602) from No. 1 carrier subassembly.

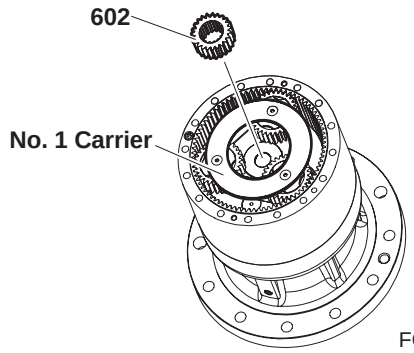


Figure 51

4. Remove No. 1 carrier subassembly.

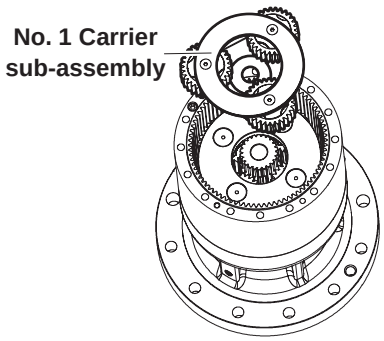


Figure 52

5. Remove No. 2 sun gear (702) from No. 2 carrier subassembly.

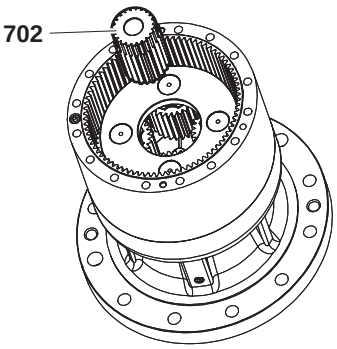


Figure 53

6. Remove bolt (509) in No. 2 carrier.

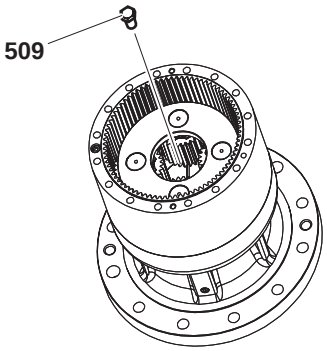
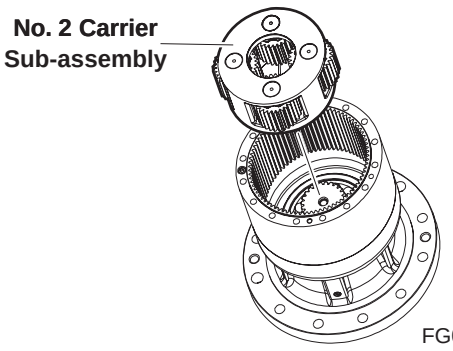


Figure 54

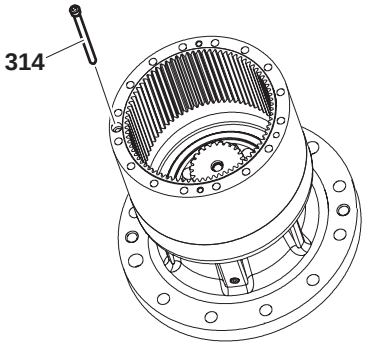
7. Remove No.2 carrier subassembly from ring gear.



FG022452

Figure 55

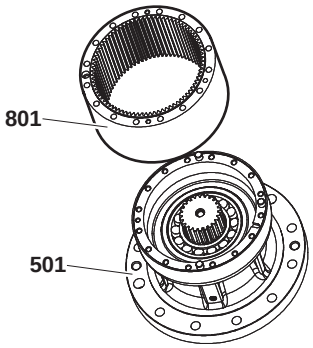
8. Remove bolt (314) in ring gear.



FG022453

Figure 56

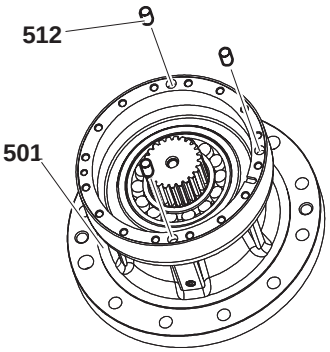
9. Remove ring gear (801) from casing (501).



FG022454

Figure 57

10. Remove pins (512) from casing (501).



FG022455

Figure 58

11. Remove bolt (507) from casing (501).

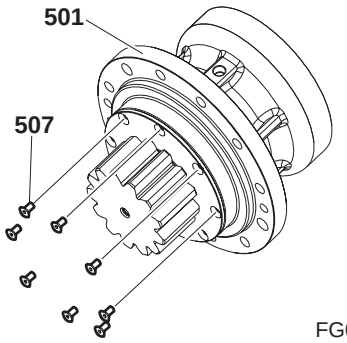


Figure 59

12. Use a rollover machine to turn case over and place a jig on driveshaft. Use a press to remove pinion shaft from case (501).

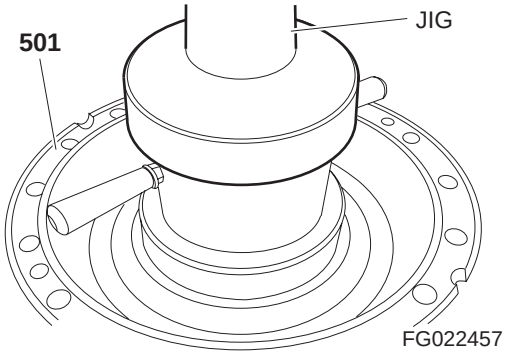


Figure 60

13. Remove bearing (504) from case (501).

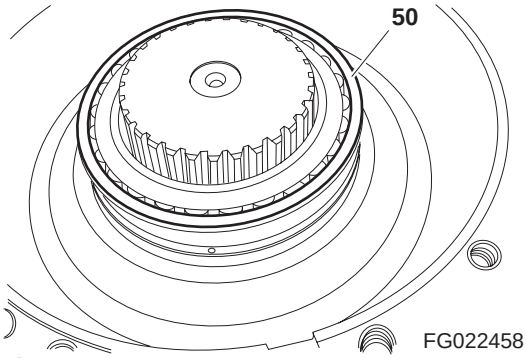


Figure 61

14. Remove pinion shaft (502) from casing.

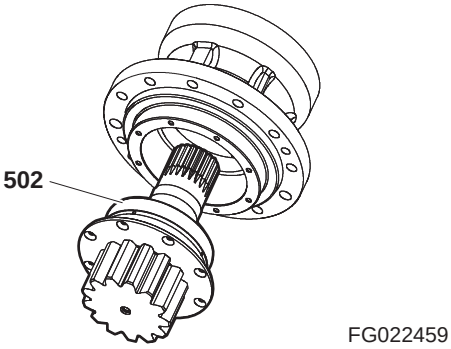
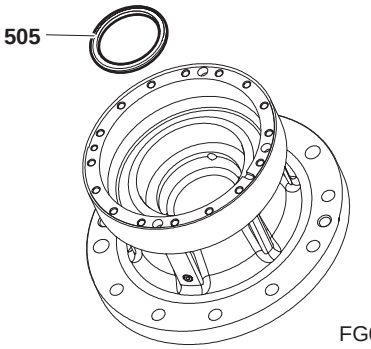


Figure 62

15. Remove oil seal (505).



FG022460

Figure 63

IMPORTANT

Do not reuse oil seal!

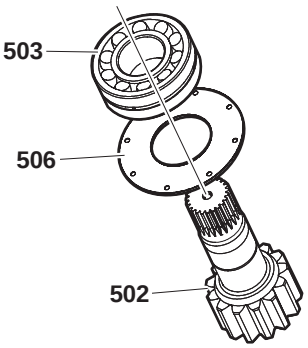
Disassembling is finished, check each component throughly.

Reassemble the Reduction Gear

Assembly should be done in the reverse order of disassembly described above, taking into consideration the following points:

1) Parts damaged during disassembly should be repaired without fail and spare parts should be prepared in advance.
2) Every part should be cleaned enough with cleaning oil and dried with compressed air before starting assembly.
3) Sliding parts and bearings should be applied clean hydraulic oil before their assembly.
4) Seal parts of the O-ring and the oil seal should be replaced according to the standards.
5) Use a torque wrench to tighten or engage bolts and plugs in accordance with “Tightening Torque of Bolts” on page-26.

1. Install the bearing cover (506) and the taper roller bearing (503) on the pinion shaft (502).



FG022461

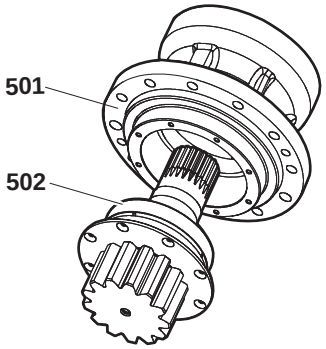
Figure 64

2. Install the pinion shaft (502) and other associated parts.

IMPORTANT

Prior to assembling the pinion shaft,etc.

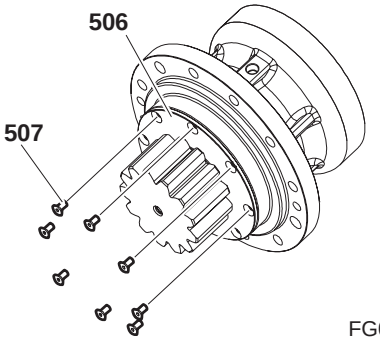
Apply grease slightly on the lip surface to prevent any scratch when installing.



FG022462

Figure 65

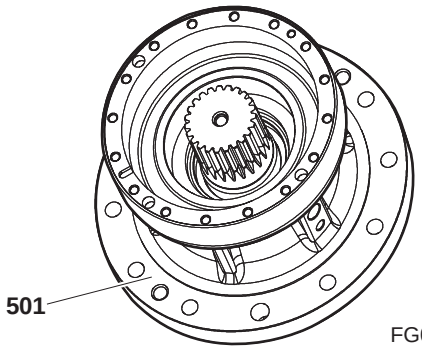
3. Tighten screws (507) to assemble cover (506).



FG022463

Figure 66

4. Mount a casing (501) on a suitable work table or jig.



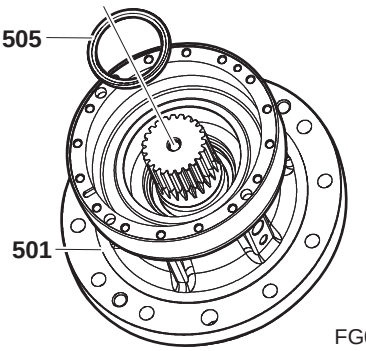
FG022464

Figure 67

5. Apply grease thinly on the outer circumference of the oil seal (505) and insert it into casing (501) by using pressing jig.

IMPORTANT

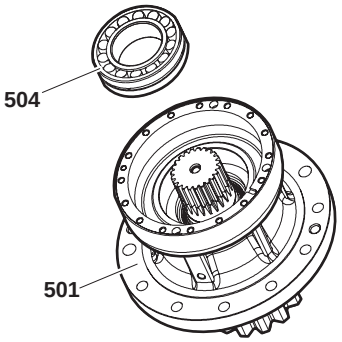
Do not reuse oil seal!



FG022465

Figure 68

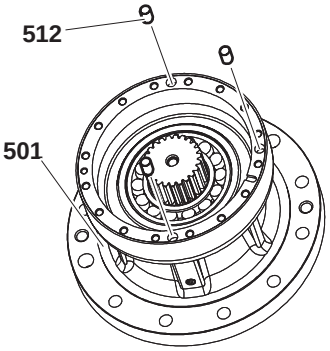
6. Install the taper roller bearing (504) with a using of tool.



FG022466

Figure 69

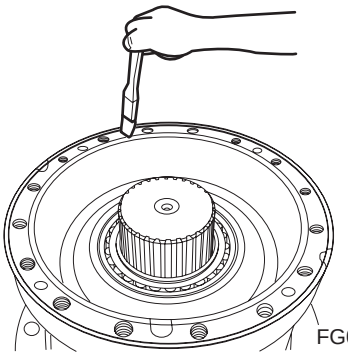
7. Assemble pins (512) with casing (501).



FG022455

Figure 70

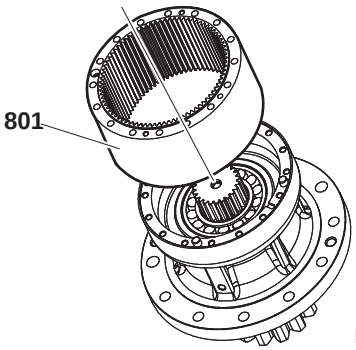
8. Apply sealant evenly to ring gear assembly of casing.



FG022467

Figure 71

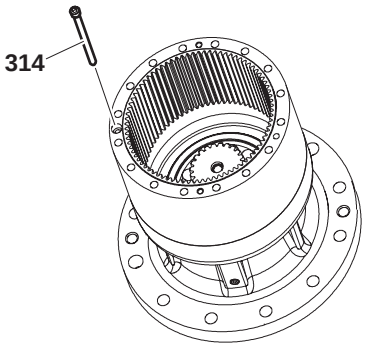
9. Lift ring gear (801) with hoist, wipe its mating surface clean with cloth, Match and align holes and attach to casing.



FG022468

Figure 72

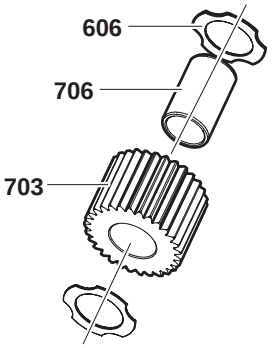
10. Tightening special bolts (314) with no Loctite applied.



FG022453

Figure 73

11. Assemble bushing (705) and the washer (606) onto planet gear No.2 (703) and arrange it on the pinhole of the carrier No.2.



FG022469

Figure 74

12. Turn over gear assembly (703, 705, 606) and insert it and thrust washer (508) into No. 2 carrier.

    Align bushing hole with carrier holes.

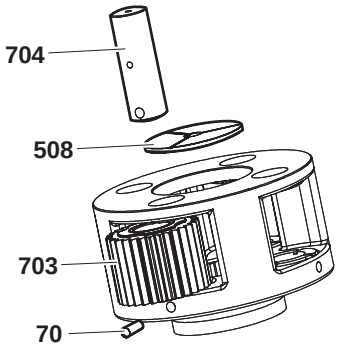
    NOTE: *Thrust washer (606) must be on both side of gear.*

    Align spring pinhole in pin No.2 (704) with spring pinhole of No. 2 carrier.

    Insert no.2 pin (704) into carrier and No. 2 bushing.

    NOTE: *Pin No.2 may need to be gently tapped with a soft faced hammer.*

    After all four No.2 are installed,align spring pin (707) with carrier hole and drive it into position using a hammer.



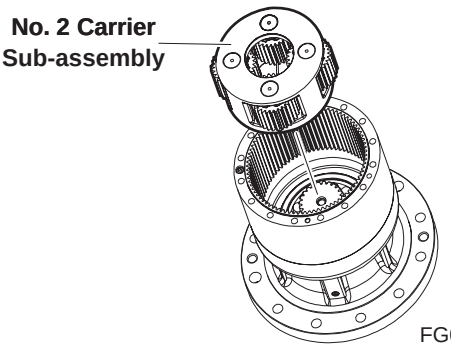
FG022470

Figure 75

13. Using a suitable lifting device, lower No. 2 carrier subassembly 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.

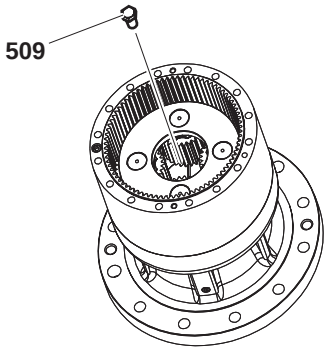
    NOTE: *Make sure that carrier and driveshaft can rotate.*



FG022452

Figure 76

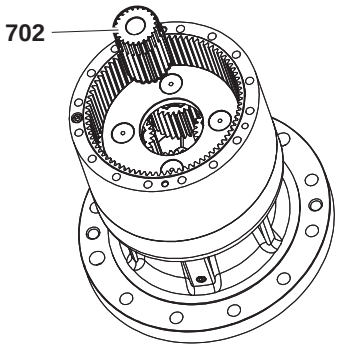
14. After tightening the bolt (509), to attach carrier assembly 2 and use a torque wrench to tighten it up to the standard torque. After checking the torque, bend the longer part of the tongued washer until it sticks to the head of the hexagon bolt (509).



FG022451

Figure 77

15. Install No. 2 sun gear (702) in No. 2 carrier.

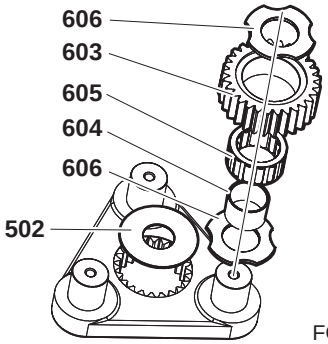


FG022441

Figure 78

16. Assemble the following parts on the carrier No.1.

Reference Number	Description
502	Thrust Washer
603	Planet Gear
604	Innerring
605	Needle Bearing
606	Thrust Washer No.1

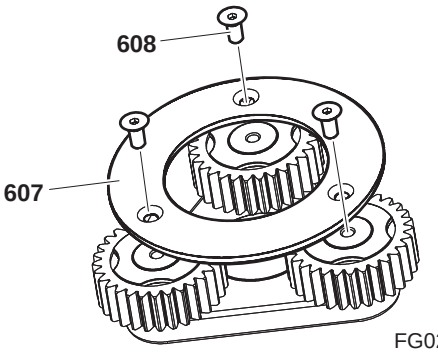


FG022471

Figure 79

17. Assemble the following parts.

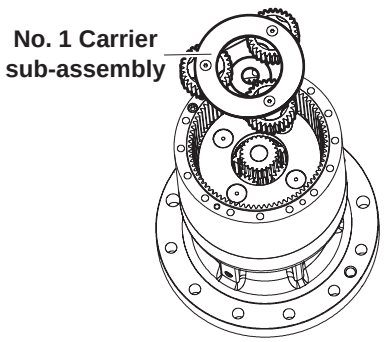
Reference Number	Description
607	Thrust Plate
608	Screw



FG022472

Figure 80

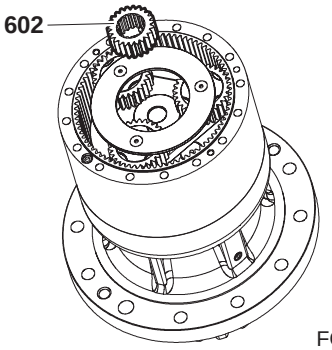
18. Install the carrier No.1 subassembly. Lift the carrier No.1 subassembly and turn it clockwise or counterclockwise gently for it to engage with the spline of the No.2 sun gear (702) and the ring gear (801).



FG022431

Figure 81

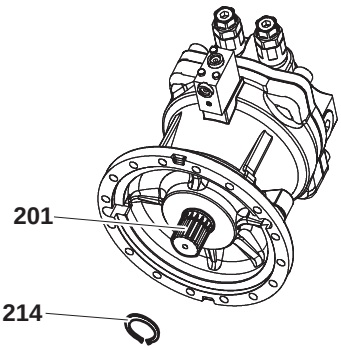
19. Install No. 1 sun gear (602) in No. 1 carrier.



FG022473

Figure 82

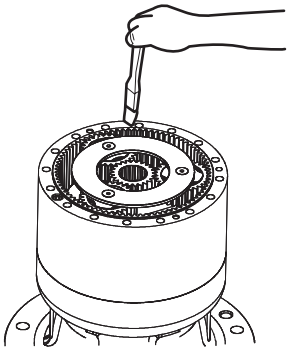
20. Use a hoist to lift the prepared motor, wipe out the assembly, and install the retaining ring (214) on the shaft (201).



FG022474

Figure 83

21. Apply sealant evenly to ring gear assembly of motor.



FG022475

Figure 84

22. Put the motor on the reduction gear carefully as shown in the figure.

    The level gauge port and hole in the ring gear should be alligned.

    Assemble the motor by turning it clockwise or counterclockwise gently so that splines of the shaft shall be engaged with the No.1 sun gear.

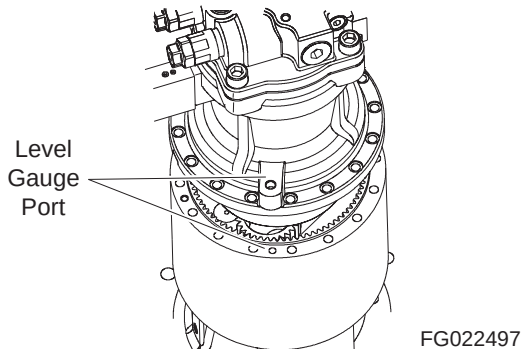


Figure 85

23. Apply Loctite to 16 socket bolts (314).

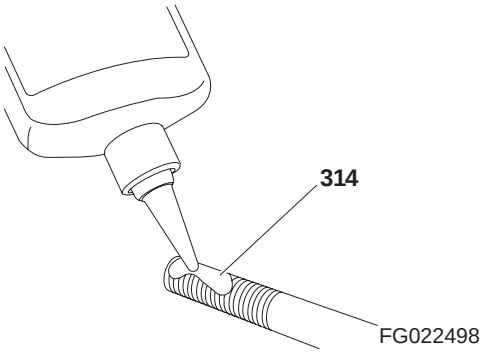


Figure 86

24. Insert bolt into holes, and tighten with an impact wrench.

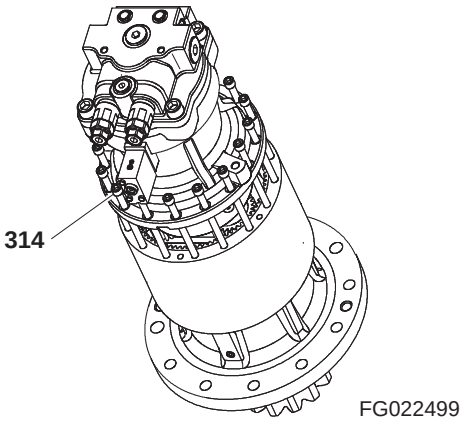
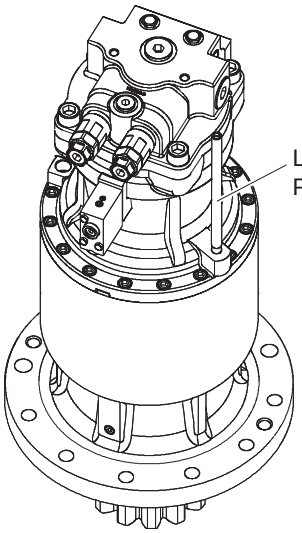


Figure 87

25. Install the level gauge pipe sealed with teflon tape with a pipe wrench.

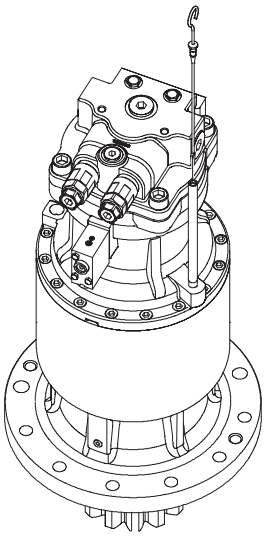


FG022500

Figure 88

26. Fill with the correct hydraulic oil and check the oil level with stick level gauge.

Assembly is done.



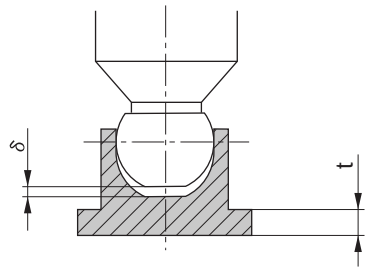
FG022501

Figure 89

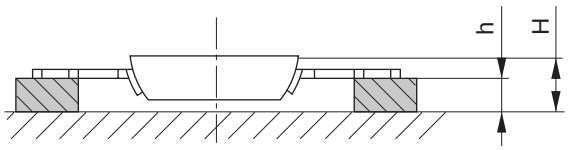
Replacement Standard of Worn Parts

When a part is worn exceeding the criteria below, adjust or replace the part. However, the criteria for parts with distinct damage are not defined.

Item	Standard Size (mm)	Replacement Criteria (mm)	Corrective Action
Clearance between the piston and cylinder block	0.025	0.055	Replace the piston or cylinder block
Clearance between the piston and shoe compressed part (δ)	0.05	0.2	Replace the piston or shoe assembly
Shoe thickness (t)	4.5	4.3	Replace the piston or shoe assembly
Assembled height of the retainer plate and spherical bushing (H-h)	10.8	10.3	Replace the retainer and spherical bushing set
Friction plate thickness	3.5	3.1	Replace



Piston and shoe clearance between the piston and shoe (δ)
Shoe thickness (t)



Assembled height of the retainer and spherical bush (H-h)

FG019002

Figure 90

Standard of Sliding Surface Correction

Correct or replace the part whose surface roughness of the sliding face exceeds the following criteria.

Part Name	Standard Roughness	Roughness Requiring Correction
Shoe	0.8 - Z (Ra = 0.2) (Lapping)	3 - Z (Ra = 0.8)
Shoe Plate	0.4 - Z (Ra = 0.1) (Lapping)	3 - Z (Ra = 0.8)
Cylinder	1.6 - Z (Ra = 0.4) (Lapping)	12.5 - Z (Ra = 3.2)
Valve Plate	0.8 - Z (Ra = 0.2) (Lapping)	6.3 - Z (Ra = 1.6)

NOTE: *1) All the sliding surfaces must be lapped to make the roughness below the standard roughness.*

NOTE: *2) If the sliding surfaces of the retainer or spherical bushing are excessively rough, replace the parts by set unit.*

Travel Device

Edition 1

Table of Contents

Travel Device

Safety Instructions 5
Applicable Models 5
TM40VD Operation Manual 6
Specifications 6
Indication of Type 7
Basic Structure and Diagram 8
Operation Principles 9
Cautions for Operation 16
External Specifications Diagrams 22
Basic Structure and Diagrams 23
TM40VD Maintenance Instructions 26
Precautions 26
Tools List for Disassembly and Reassembly 27
Disassembly Instructions 30
Reassembly 41
Testing 56
List of Seals 58

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

TM40VD OPERATION MANUAL

This Manual contains information needed for the use of TM40VD.

Read it carefully before using the product.

TM40VD, a reduction gear attached hydraulic motor, is characterized by:

1. Traveling motor for excavator consisting of planetary differential reduction gear, axle piston motor, and brake valve.
2. Small and light with high performance and good durability.
3. Directly engaged with the sprocket and seated fully in the crawler.
4. Stand against big external load due to a heavy-duty bearing in it.
5. Two speed, high and low, switching available for high-speed low-torque and low-speed high-torque rotations.

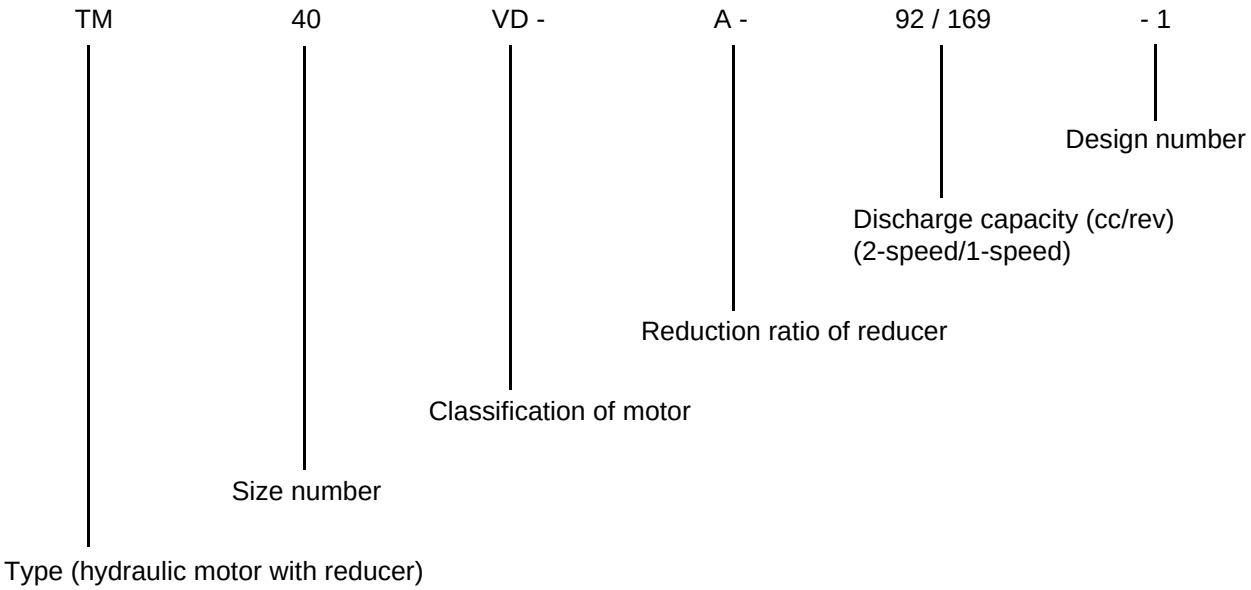
SPECIFICATIONS

Item		Units	TM40VD
Rated Output Torque		kg•m	max. 4650
Max. Speed		r.p.m	max. 60
Gear Ratio			49.95
Hydraulic Motor	Max. Displacement	cc/rev	max. 174.7
	Max. Speed	r.p.m	max. 2800
	Max. Working Pressure	kg/cm^3	max. 350
	2-speed Control Press.	kg/cm^3	20 - 70
Parking Brake	Braking Torque	kg•m	min. 50
	Release Pressure	kg/cm^3	6
Total Weight		(kgw)	285

– Specifications above are for typical performance.

– Performance of parts are illustrated in the External Specifications Diagrams.

INDICATION OF TYPE



Basic Structure and Diagram

Basic Structure of TM Motor

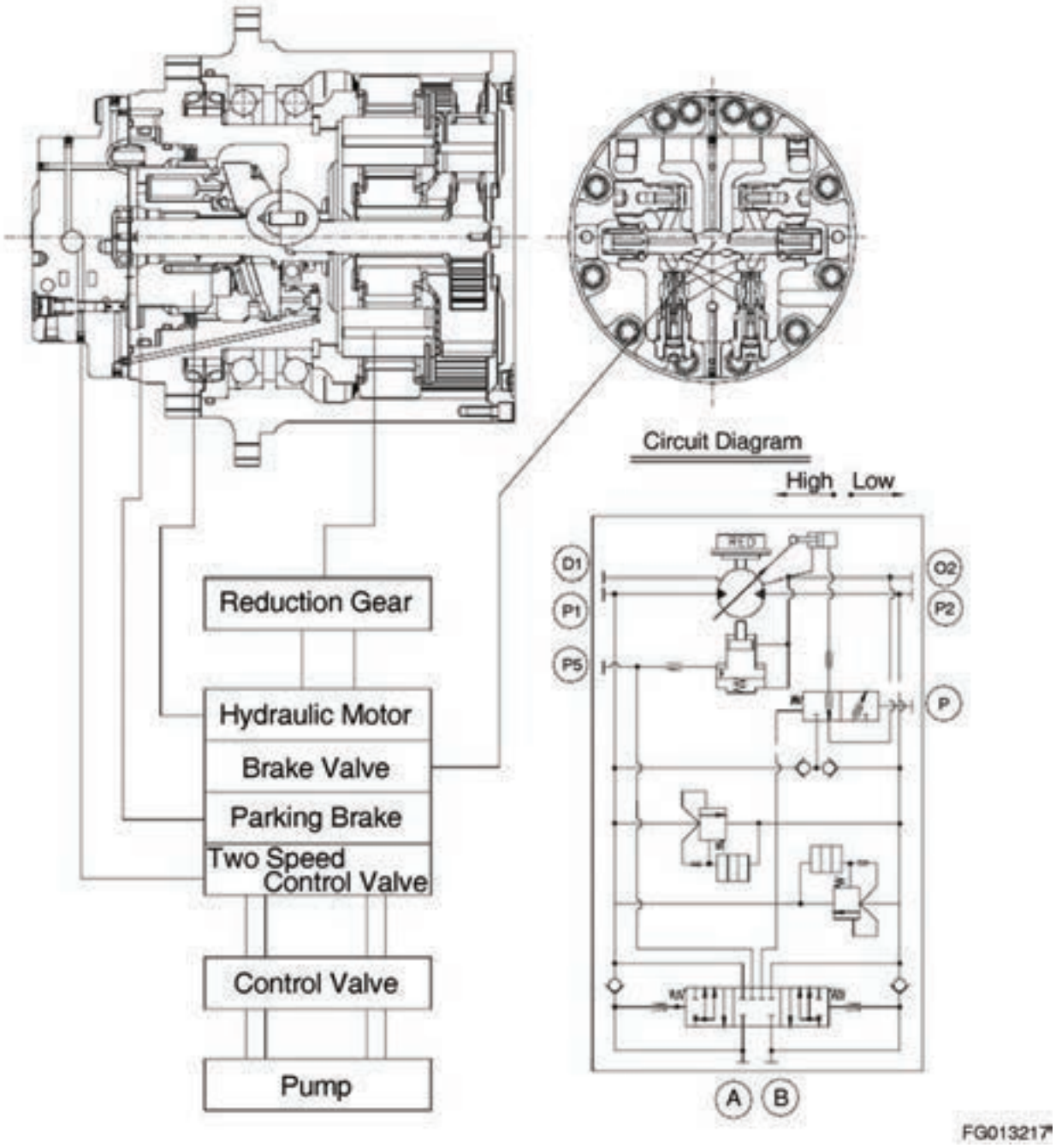


Figure 1

Operation Principles

Reducer

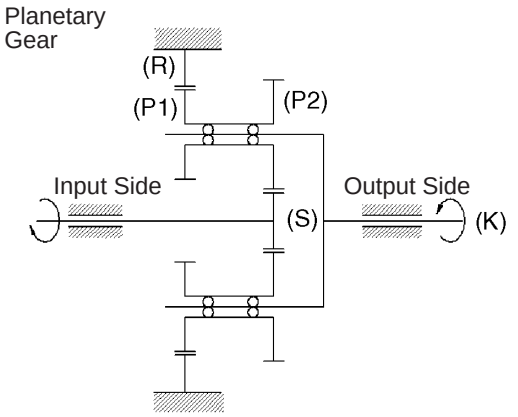
1. Function

   The reducer consists of the planetary automatic combination including the planetary gear and the differential gear, maintaining the high-speed rotation of the hydraulic motor, changing it to torque, and creating the hub (case) rotation.

2. Operation (Principle)

   The rotation of the sun gear (S) at the input side rotates the planetary gear (P) on its on axis to be engaged and revolve with the fixed ring (R). This revolution is transferred to the carrier (K) to create torque.

$$i1 = 1 + \frac{R \bullet P2}{S \bullet P1}$$

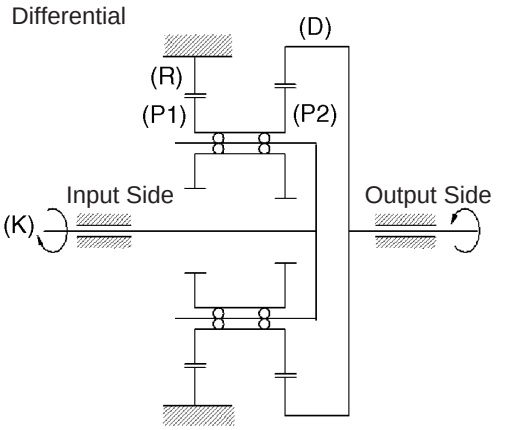


FG007059

Figure 2

   The rotation of the carrier (K) will have planetary gears (P1, P2) revolved. At this time, setting of a proper difference between teeth of (P1), (R) and (P1), (P2) creates the rotation difference at the gear D, for gears (P1) and (P2) are coaxial, to generate torque.

$$i2 = \frac{1}{1 - \frac{R \bullet P2}{D \bullet P1}}$$



FG007060

Figure 3

The rotation of the sun gear (S) will create planetary movement between gears (S, P1, and R) that revolution of gear (P1) rotates carrier (K). Its rotation starts automatic movements among gears (R, P1, P2, and D) and rotates ring gear (D). As the ring gear is connected to the hub (case) of the TM motor, TM starts to rotate.

$$i = i1 \times i2 = \frac{1 + \frac{R \bullet P2}{S \bullet P1}}{1 - \frac{R \bullet P2}{D \bullet P1}}$$

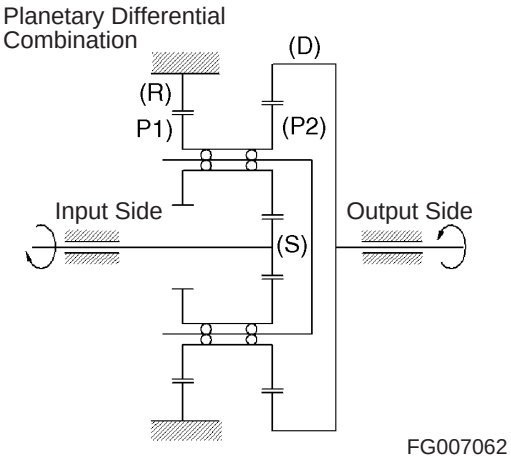


Figure 4

Hydraulic Motor (Brake Valve, Parking Brake, High and Low 2-Speed Shifting)

1. Functions

   A. Function of the Hydraulic Motor

      The hydraulic motor called a swash plate axial piston motor, changes force of pressurized oil from the pump into rotation force.

   B. Function of the Brake Valve

      1) It ensures smooth stop of motor by controlling inertia rotation of the TM motor due to the inertia of its body when shutting down the motor.

      2) It acts like a check valve preventing the cavitation of the hydraulic valve.

      3) It acts like a surge cut valve controlling the brake pressure of the hydraulic valve and a anticavitation valve preventing the cavitation.

   C. Function of High and Low Speed Shifting

      It switches the tilting degree of the swash plate between the high-speed low-torque and low-speed high-torque rotations using the operation of the switching valve and the control valve.

   D. Function of Parking Brake

      Assembled in the hydraulic motor, it uses a friction plated brake to prevent movement of the excavator when it is parked or stopped on a slope.

2. Description and Principles of Operation

A. Hydraulic Motor

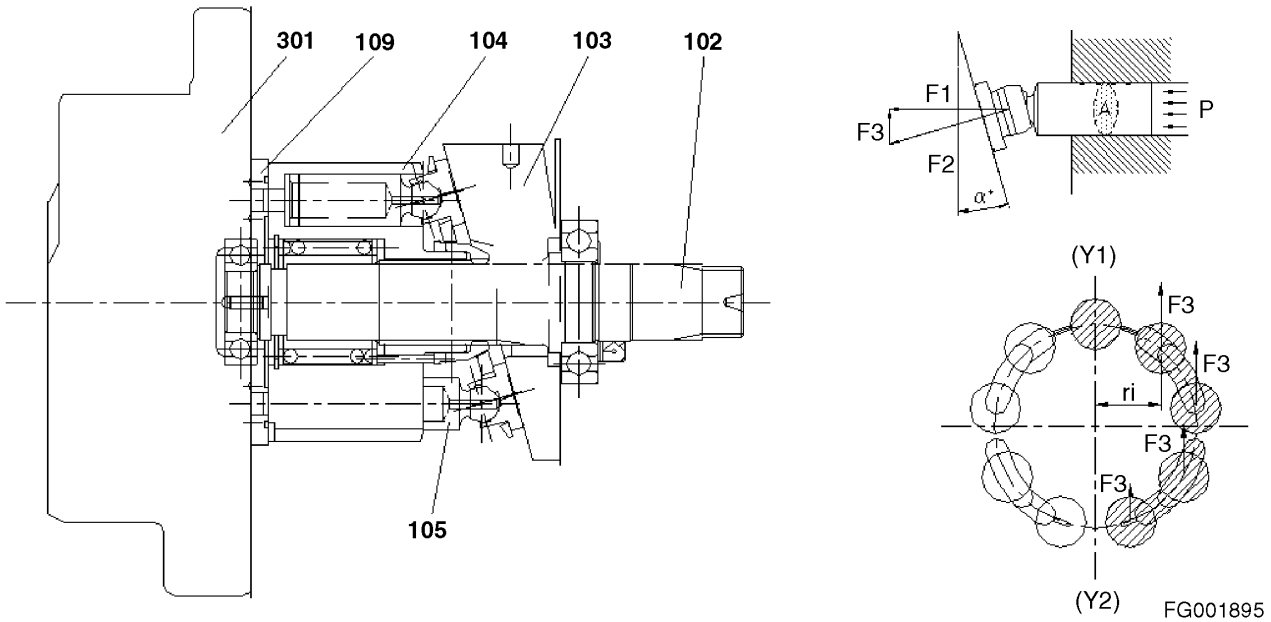


Figure 5

Pressure oil from the hydraulic pump flows into the rear flange of TM motor (101) and through timing plate (109) in the brake valve into the cylinder block (104). This pressure oil is designed to dictate the top and bottom dead centers and to be induced only to the lateral side of (Y1) - (Y2).

Pressure oil in the lateral side of cylinder block (104) press down piston (105) (4 or 5 ea), generating the force F (kgf) = P (kg/cm^2) x A (cm^2). This force acts to swash plate (103) and then is divided into F1 and F3, as the plate is fixed to the axis of driveshaft (102) at the degree of a°. F3, the vertical force of such divided ones. generates torques (T = F3 x ri) for (Y1) - (Y2) each, the sum of which is the rotation power (T = Σ (F3 x ri) and rotates cylinder block (104) through piston (105). As cylinder block (104) is connected to driveshaft (102) and the spline, driveshaft (102) rotates and torque is transmitted.

B. Brake Valve

Consider that the P port is pressurized by the tank pressure.

(When Traveling) - Brake Released -

Oil from port (A) opens valve (227) to flow into port c at the suction side of the motor to enable the rotation of the hydraulic motor.

At the same time, the oil flows into chamber b through channel a by way of a small hole of spool (223) and acts to the surface of spool (223), opening port (D) of bypass line of the hydraulic motor and port (B) at tank which was closed by the force of spring (228) and having the return oil to flow into the tank, which rotates the hydraulic motor.

And, oil flows into (P) port according to the movement of spool (223). Oil in (P) port runs piston (112) of the parking brake to release its force.

(Refer to the Parking Brake for details.)

If oil is supplied from port (B) of the suction and return sides of the hydraulic motor, right and left actions of spool (223) and valve (227) reverse to generate reverse rotation.

(When Stopping) - Brake Applies -

If oil supply from port (A) stops during travel, the hydraulic force is released and spool (223) that was moved to the left side tries to move to the right side (neutral position) trough stopper (225) by the force of spring (228).

This hydraulic oil in chamber b that would flow into port (A) through line (a) in spool (223) controls the returning speed of spool (223) by the back pressure of throttling of line (a) and spool (295). At the same time, the return oil tries to return to B port through a line in the gap between rear flange (101) and hole of spool (223) in port (D).

When spool (223) returns to the neutral position, the line generated in the gap closes completely and the hydraulic motor stops running. In this way hydraulic fluid from the hydraulic motor is slowly controlled according to the return speed and the spool shape of spool (223) to smooth brake and stop the hydraulic motor.

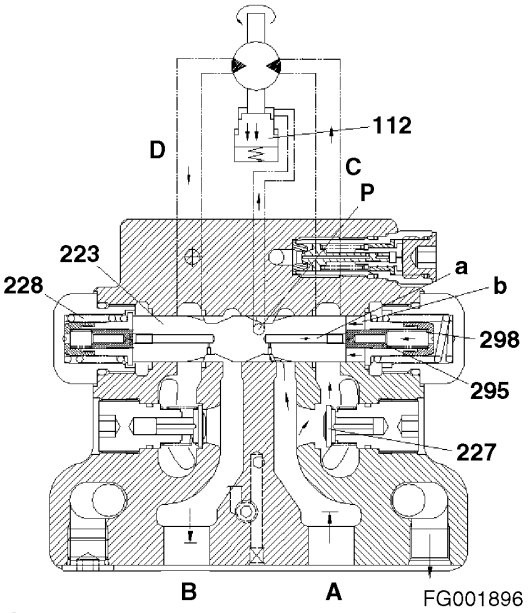


Figure 6

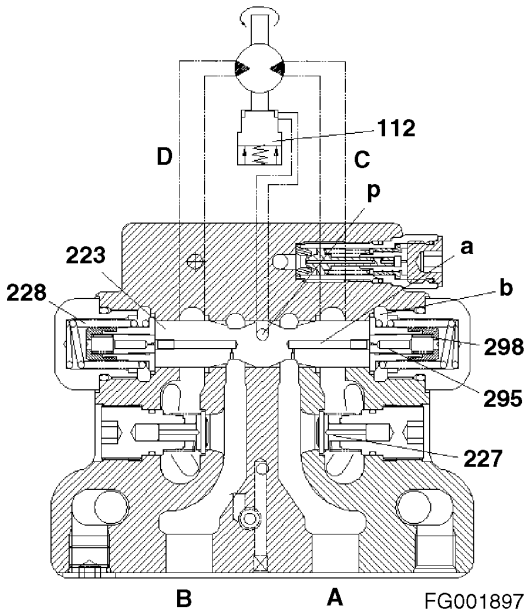


Figure 7

C. Parking Brake

(When Traveling)

Oil is supplied to the brake valve to run the spool in the brake valve of the hydraulic motor and open the line to the parking brake and oil flows into cylinder chamber a consisting of spindle and piston (112) of the reducer.

If hydraulic oil is above 9.5 kg/cm^2, oil surpasses the force of spring (113) to move piston (112). As piston (112) moves, its force pressing plate (116) and friction plate (115) vanishes that friction plate (115) inserted in the cylinder block of the hydraulic motor can move free and the brake force of the motor is released. If oil is above 45 kg/cm^2, it is reduced by the reducing valve to set the pressure of cylinder chamber a at 45 kg/cm^2.

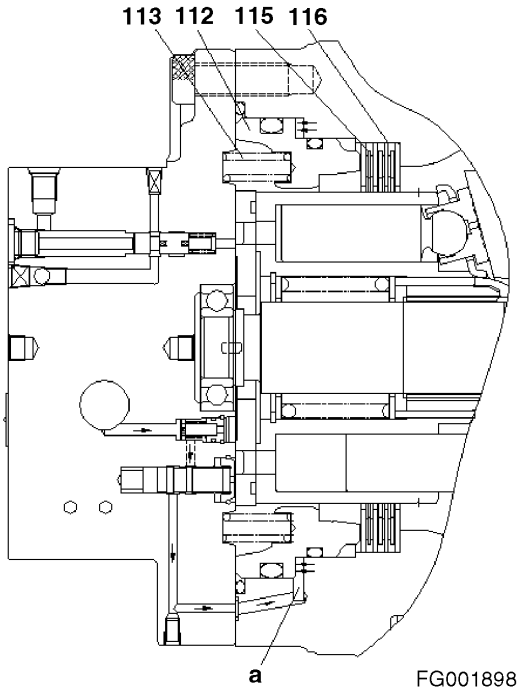


Figure 8

(When Stopping)

If the pressure in cylinder chamber a is below 9.5 kg/cm^2 after oil supply from the brake valve stops, piston (112) tries to return by the force of spring (113)

This force of spring (113) presses down piston (112) to cause mating plate (116) and friction plate (115) that have been free to be pressed against the spindle of the reducer, generating friction that stops rotation of the cylinder block and supplies the hydraulic motor shaft with a braking torque (40.6 kg•m).

And, the smooth operation is ensured due to the control of hydraulic fluid according to its supply line properly.

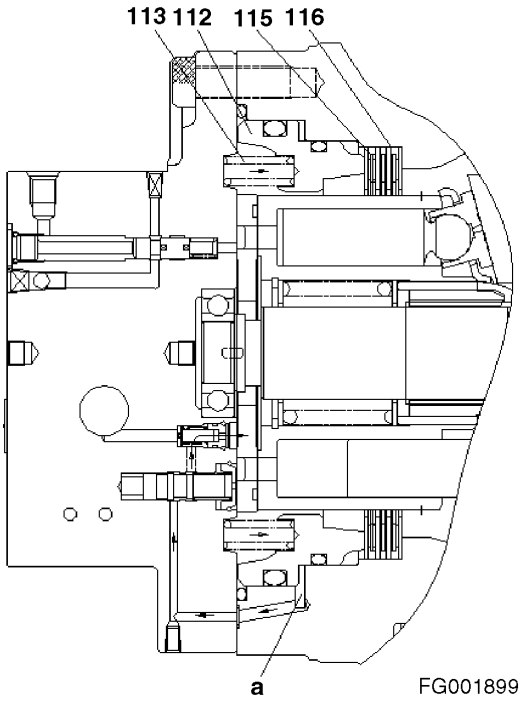


Figure 9

D. High and Low 2-Speed Shifting

(At Low Speed) - Pilot Pressure is Below 10 kg/cm^2

Without pilot pressure from port (A) (pressure is below 10 kg/cm^2), valve (263) moves to the left side by the force of spring (266) to stop hydraulic fluid of supply port (B) but to release hydraulic fluid of chamber (C) into the motor case. So, the Max. tilting angle of swash plate (103) becomes $\theta 1$ and the piston stroke capacity of the hydraulic motor becomes minimum to enable low-speed rotation.

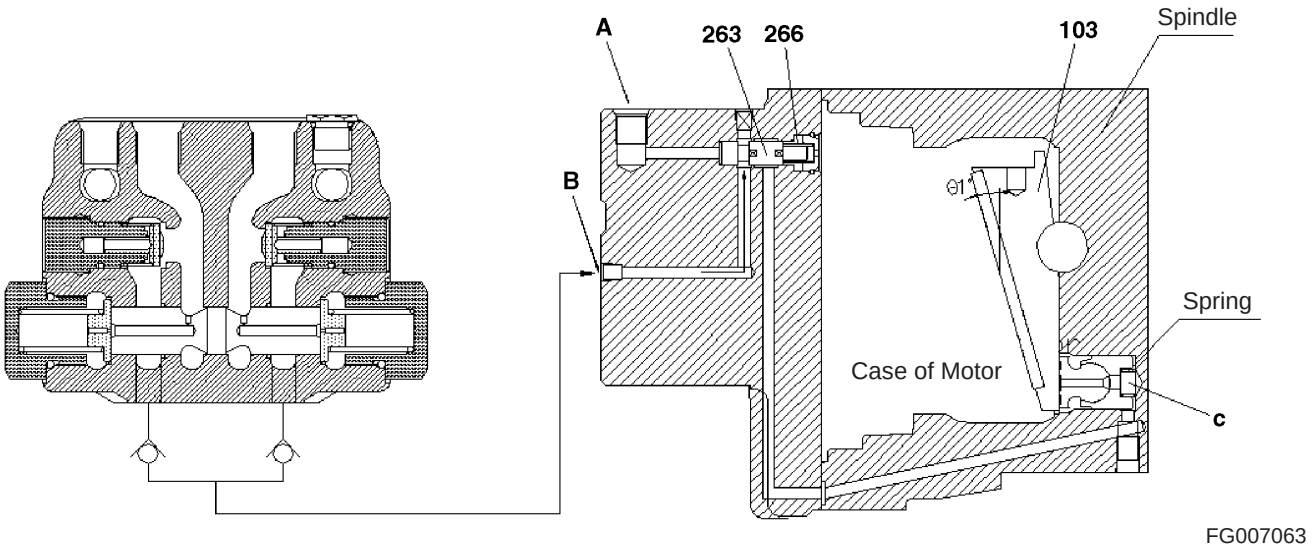


Figure 10

(At High-Speed) - Pilot Pressure is Above 10 kg/cm^2

Without pilot pressure from port (A) (pressure is above 10 kg/cm^2), pilot pressure overcomes the force of spring (266) to move valve (263) to the right side and pressure oil of supply port (B) flows into chamber (C) through valve (263). Oil in chamber (C) presses piston (161) that swash plate (103) touches side (b) of the holder flange and keeps the status. At this time, the minimum tilting degree of swash plate (103) becomes $\theta 2$ and the piston stroke capacity of the hydraulic motor becomes minimum to enable high-speed rotation.

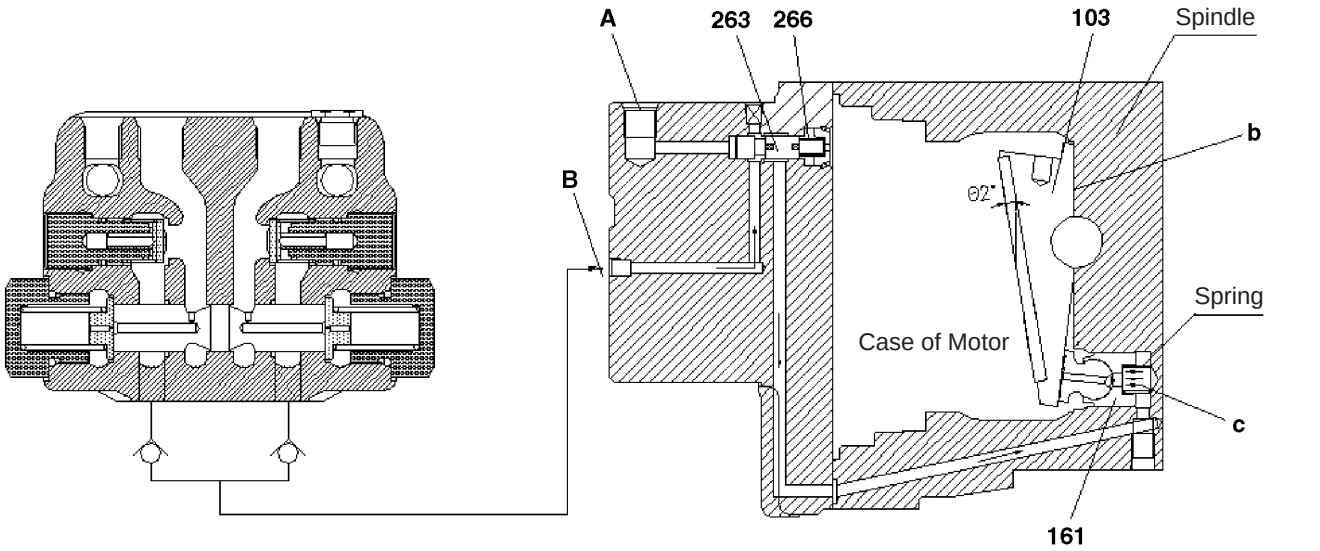
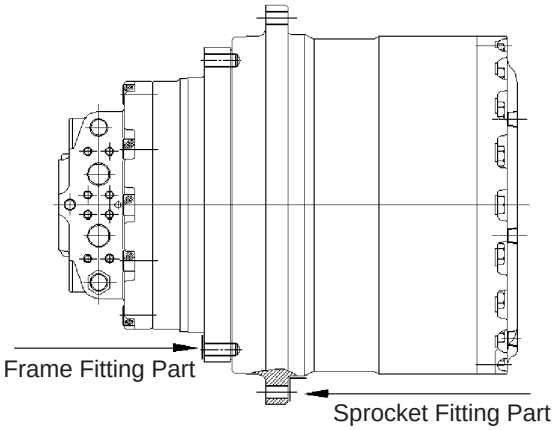


Figure 11

Installation Method (Refer to the External Specifications Diagrams.)



FG007065

Figure 12

Tightening Torques of Mounting Bolts

Categories	Q'ty	Bolt Sizes	Tightening Torques
Body Fitting Bolt	30	M16 (P2.0)	25.7 ± 4.0 kg•m
Sprocket Fitting Bolt	30	M16 (P2.0)	25.7 ± 4.0 kg•m

NOTE: *Use bolts whose JIS strength is above 10.9.*
Do not strike the TM motor with hammer or things like that but use a bolt hole to fix it.

Piping

1. Connect the pipeline after confirming the direction of rotation of the motor (refer to the External Specifications Diagrams.)
2. The product is delivered with its piping ports (of brake valve and motor drain) plugged and capped.
3. Do not remove cover or plug from ports before connecting pipeline, as they are intended to prevent dust or weld scale from entering them.
4. Make sure to fill the motor case with hydraulic oil before starting the motor.
5. Recommended quantity of oil for the case: 1.2 liter
6. Determine the pipeline diameter so that back pressure at the motor drain port is less than 2 kg/cm^2 (or 7 kg/cm^2 at the peak).

Hydraulic Oil

Because the hydraulic motor case is drained at the time of shipping, make sure to fill up the case with hydraulic oil before operation.

1. Selection of Hydraulic Oil

   Take care the following matters when selecting hydraulic oil for TM motor.

   A. Use hydraulic oil equal to ISO VG32-VG56 (SAE 10W-20).

   B. Hydraulic oil should be of wear resistance.

   C. Contact a DOOSAN distributor when selecting other hydraulic oil than those in the table below.

Grade	Viscosity (40°C)	32 CST	46 CST
	ISO VG	VG 32	VG 46
Manufacturers	HOUGHTON	HYDRO DRIVE HP32	HYDRO DRIVE HP46
	GULF	HARMONY 32AW	HARMONY 46AW
	CALTEX	RANDO HD32, AZ	RANDO HD46
	MOBLIL	DTE 24	DTE 25
	SHELL	TELUS 32	TELUS 46

2. Check and Change of Hydraulic Oil

   Change oil according to the following intervals, though its frequency depends on operation conditions.

   The following is the recommended interval of changing hydraulic oil.

   A. Interval - 1000 hours or 1 year

   B. Replacement criteria

Checking Points	Change Standards
Change of Viscosity (40°C)	± 10%
Oxidization (mgKQH/g)	*
Water (%)	0.1 %
Impurities	10mg / 100 ㎖
Insolubility (%)	0.05 %
Color	Excessively changed.

NOTE: For further details, please contact us, since above criteria varies greatly by the type of oil and manufacturer.

Lubricating Oil

Products are shipped with lubricating oil (gear oil) for reducer filled, but check it before operation.

1. Selection of Gear Oil

   Use gear oil equal to SAE #90 containing an extreme pressure additive (above the 4th GL grade, API classification).

2. Interval of Gear Oil Change

   A. 1st oil change after 500 operating hours.

   B. Further oil change every 1000 operating hours or 1 year.

   NOTE: *If gear oil reduces, check its cause, fix the problem, and fill it.*

Location of Lubricating Oil Filling and Drain Ports

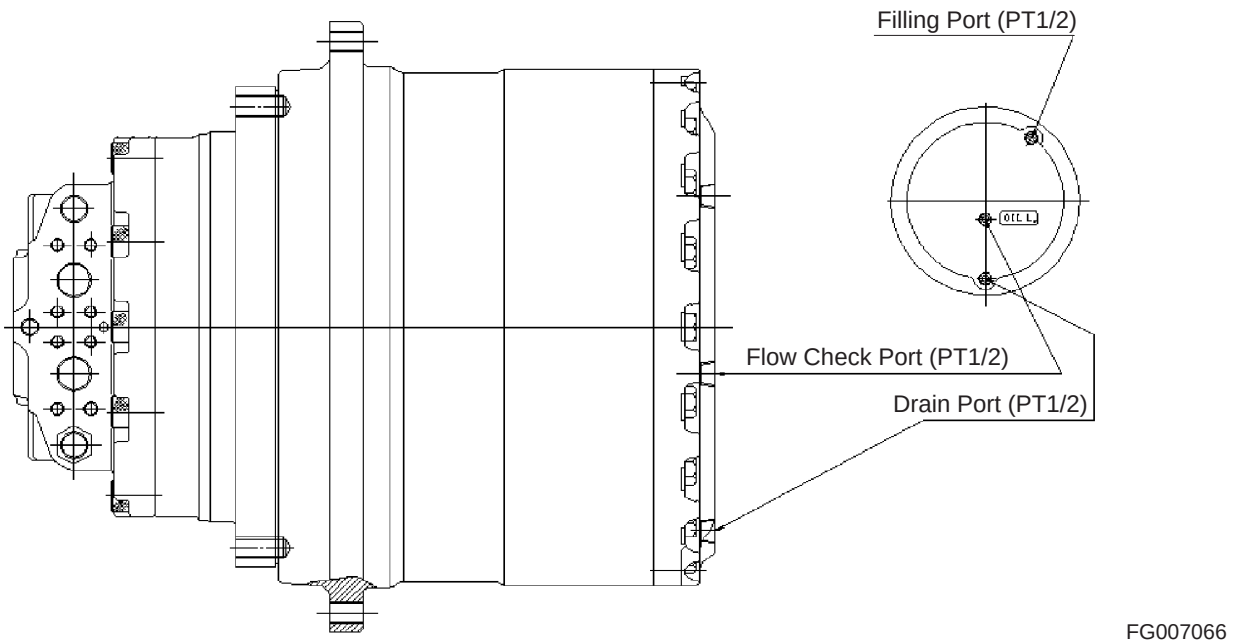


Figure 13

3. Quantity of Lubricating Oil to be Changed - 3.3 liters.

4. Order of Lubricating Oil Change

   Gear oil to be changed or refilled must be of the same kind. Do not mix with a different type or grade of oil.

   A. Make sure that filling and the drain ports should be at right angles with the level surface.

   B. To drain oil, remove both plugs at two ports and drain it.

   C. Refill gear oil until oil overflows from oil level check port.

   D. When installing install plugs at ports, be sure to wrap them with seal tape.

Maintenance

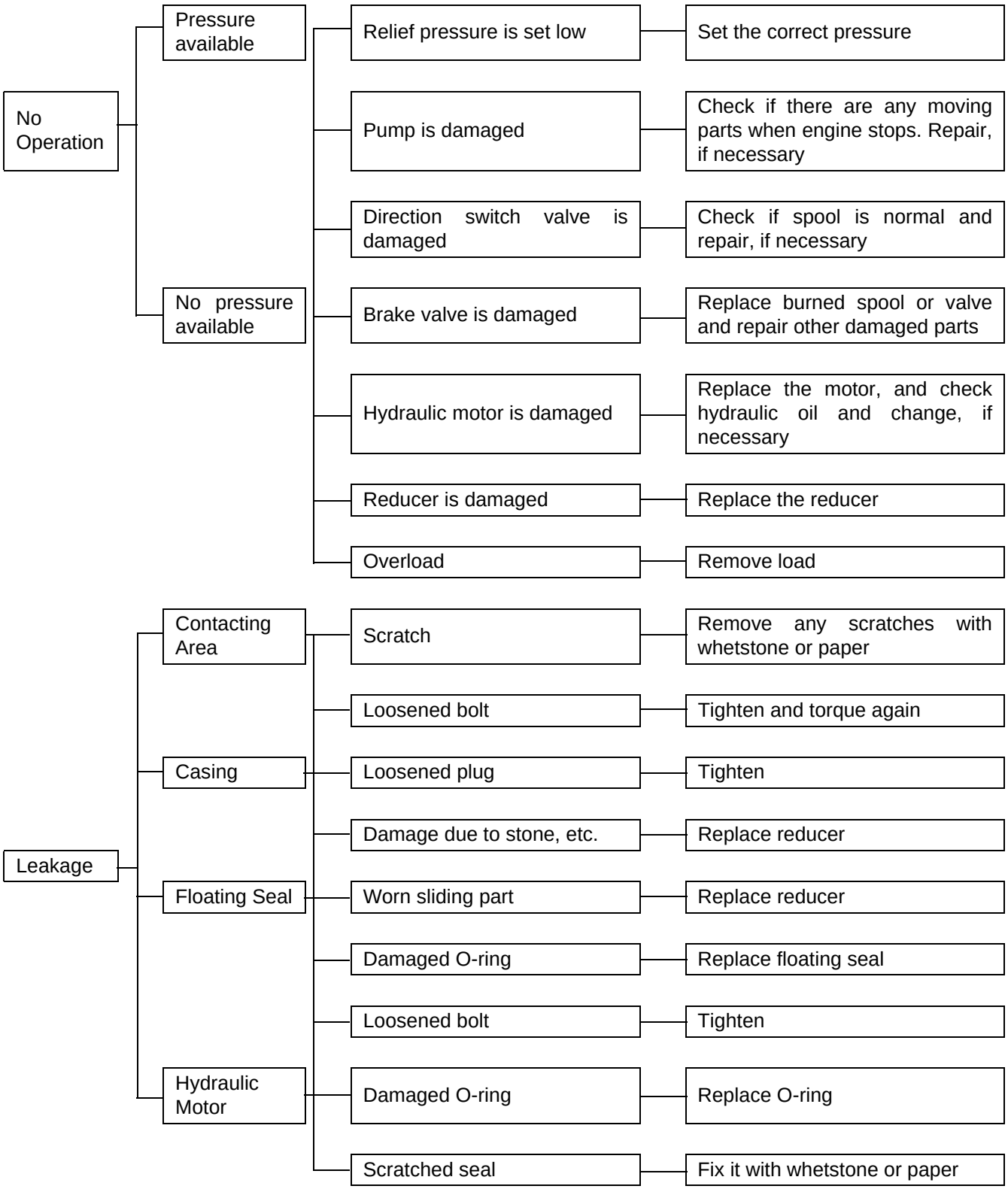
Make sure to check the following lists before operating the TM motor.

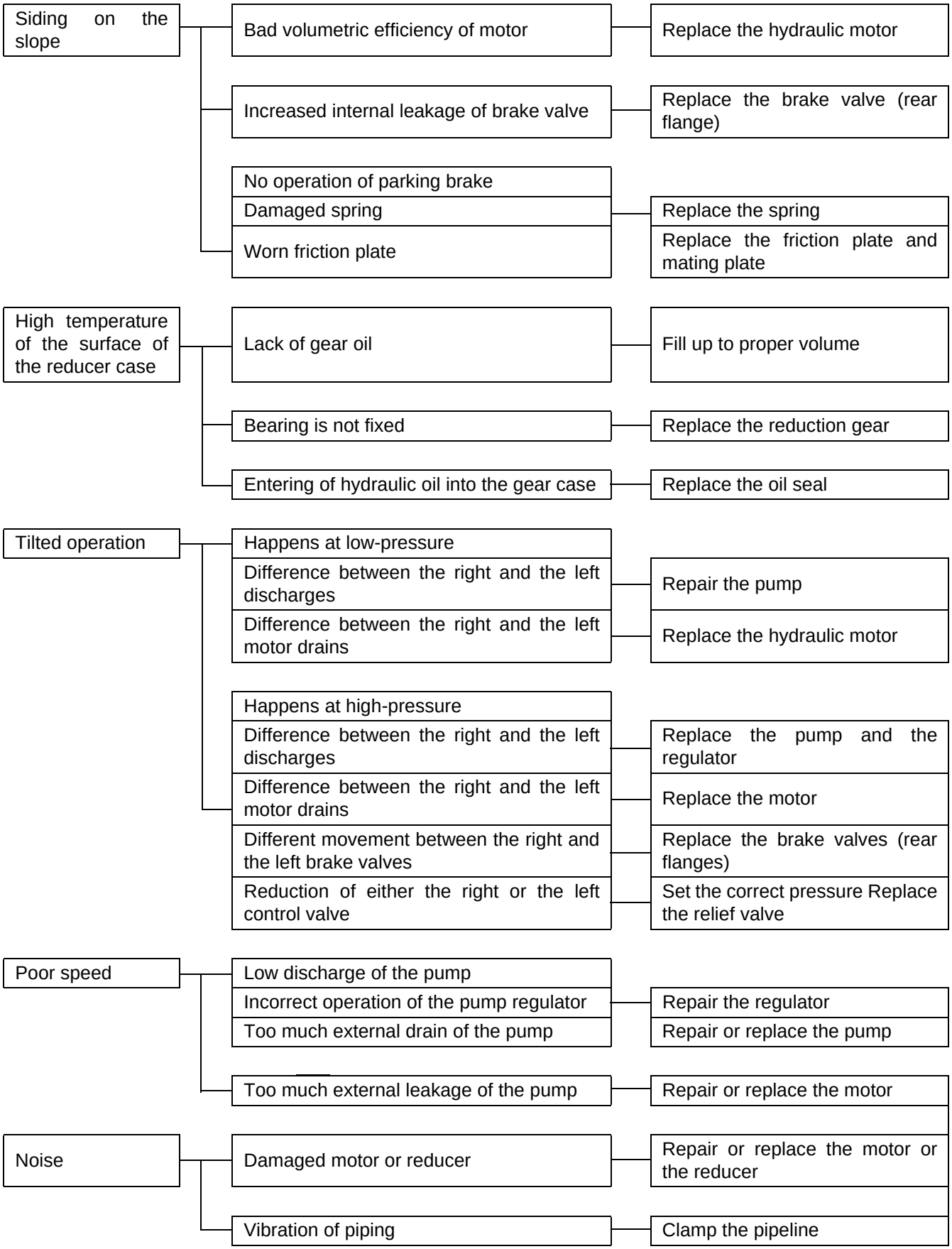
1. If there is any leakage (hydraulic or gear oil).
2. If bolts are loosen.
3. If there is any noise
4. If temperature in the case increases abnormally.

   (External standard temperature of the case during continuous operation = Max. 80°C)
5. If gear oil is changed at proper intervals. (See “Lubricating Oil” on page -18.)
6. Allowed quantity of drain for the hydraulic motor.

   Idle - Number of rotation: 25 rpm

   - Pressure: 50 kg/cm^2 at 4 liter/min


No Operation
Pressure available
No pressure available
Relief pressure is set low
Set the correct pressure
Pump is damaged
Check if there are any moving parts when engine stops. Repair, if necessary
Direction switch valve is damaged
Check if spool is normal and repair, if necessary
Brake valve is damaged
Replace burned spool or valve and repair other damaged parts
Hydraulic motor is damaged
Replace the motor, and check hydraulic oil and change, if necessary
Reducer is damaged
Replace the reducer
Overload
Remove load
Leakage
Contacting Area
Casing
Floating Seal
Hydraulic Motor
Scratch
Remove any scratches with whetstone or paper
Loosened bolt
Tighten and torque again
Loosened plug
Tighten
Damage due to stone, etc.
Replace reducer
Worn sliding part
Replace reducer
Damaged O-ring
Replace floating seal
Loosened bolt
Tighten
Damaged O-ring
Replace O-ring
Scratched seal
Fix it with whetstone or paper


Siding on the slope
Bad volumetric efficiency of motor
Replace the hydraulic motor
Increased internal leakage of brake valve
Replace the brake valve (rear flange)
No operation of parking brake
Damaged spring
Replace the spring
Worn friction plate
Replace the friction plate and mating plate
High temperature of the surface of the reducer case
Lack of gear oil
Fill up to proper volume
Bearing is not fixed
Replace the reduction gear
Entering of hydraulic oil into the gear case
Replace the oil seal
Tilted operation
Happens at low-pressure
Difference between the right and the left discharges
Repair the pump
Difference between the right and the left motor drains
Replace the hydraulic motor
Happens at high-pressure
Difference between the right and the left discharges
Replace the pump and the regulator
Difference between the right and the left motor drains
Replace the motor
Different movement between the right and the left brake valves
Replace the brake valves (rear flanges)
Reduction of either the right or the left control valve
Set the correct pressure Replace the relief valve
Poor speed
Low discharge of the pump
Incorrect operation of the pump regulator
Repair the regulator
Too much external drain of the pump
Repair or replace the pump
Too much external leakage of the pump
Repair or replace the motor
Noise
Damaged motor or reducer
Repair or replace the motor or the reducer
Vibration of piping
Clamp the pipeline

External Specifications Diagrams

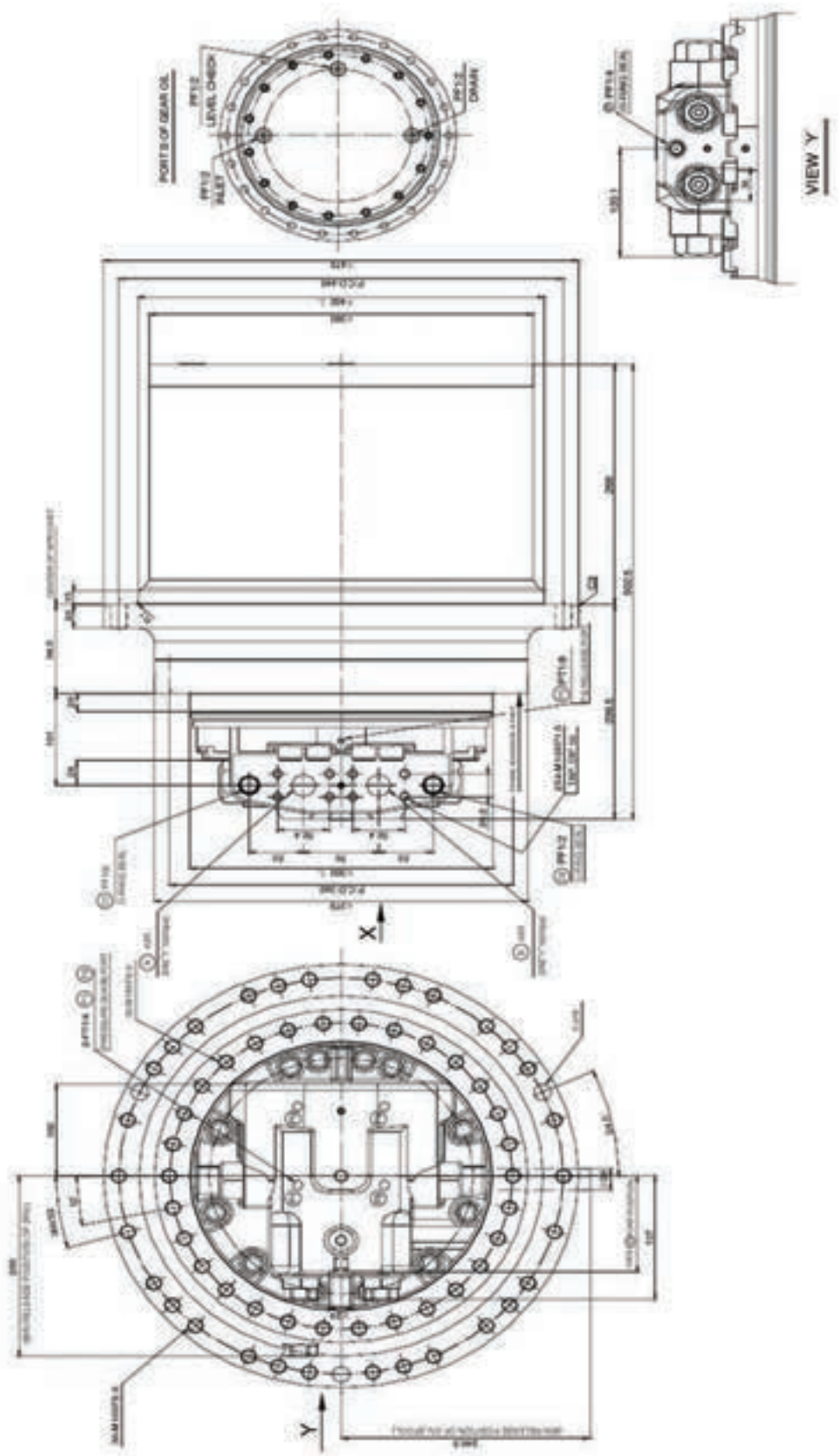


Figure 14

FG013221

Assembly Cross-Section

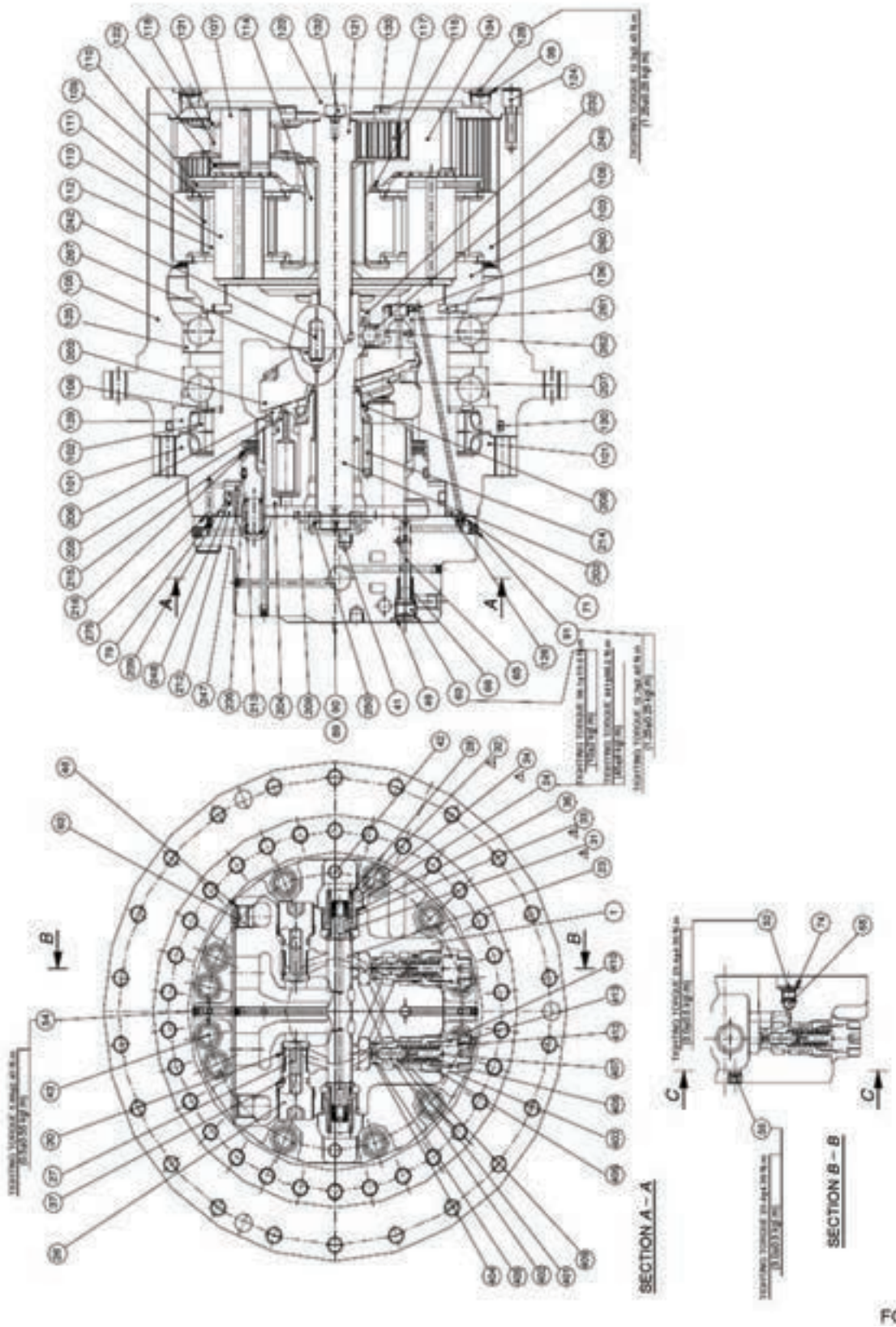


Figure 15

Reference Number	Description
1	Rear Flange
23	Main Spool
24	Plug (for Main)
26	Plug (for Check)
27	Valve Check
28	Spring (for Main)
30	Spring (for Check)
31	Stopper A
32	Stopper B
33	Spool
34	Spring
36	O-ring
37	O-ring
38	O-ring
41	Paralell Pin
43	Socket Bolt
46	O-ring
52	RO Plug (PF1/4)
54	PT Plug
55	PT Plug (PF1/4)
63	RO Plug (PF1/2)
65	Spool (2-speed)
66	Spring (2-speed)
68	Steel Ball
71	Orifice
74	O-ring
79	Filter
89	Nameplate
90	Rivet Screw
91	Plug (PT1/8)
101	Spindle
102	Floating Seal
103	Carrier No.2
105	Hub
106	Distance Piece
107	Shaft Bearing (R)
108	Planetary Gear (F)
109	Thrust Washer (F)
110	Pin Spring
111	Needle Bearing
112	Floating Bushing
113	Shaft Bearing

Reference Number	Description
114	Sun Gear
115	Retaining Ring
117	Planetary Gear (R)
118	Needle Bearing
121	Drive Gear
122	Pin Spring
123	Cover
124	Socket Bolt
125	A/Ball Bearing
126	O-ring
128	RO Plug
129	Seal Ring
130	O-ring
131	Thrust Washer (R)
132	Thrust Washer (M)
133	Thrust Plate (R)
134	Carrier No.1
136	Shim Plate
C	Control Part Assembly
C-1	Rear Flange Assembly
C-2	Rear Flange Kit
C-3	Stopper Assembly
R	Reduction Part
202	Driveshaft
203	Swash Plate (B Type)
204	Cylinder Block
205	Piston
206	Shoe
207	Retainer Plate
208	Thrust Ball
209	Timing Plate
212	Piston (Parking)
213	Spring
214	Spring (Cylinder)
215	Friction Plate
216	Mating Plate
232	Oil Seal
235	O-ring
239	O-ring
242	Parallel Pin
247	Back up Ring
248	Back up Ring

Reference Number	Description
249	Ball Bearing
250	Ball Bearing (HR6206HL1B)
260	Spring (2-speed)
261	Piston (2-speed)
262	Shoe (2-speed)
267	Pivot
275	O-ring
M	Hydraulic Motor Assembly
M-1	Cylinder Block and Piston Kit
M-2	Piston Assembly
M-3	Piston (2-speed) Kit

Reference Number	Description
401	Plunger
402	Piston Seal
403	Body
404	Back up Ring
405	O-ring
406	O-ring
407	Spring Retainer
408	Spring
409	Piston
412	Adjust Plug
413	Locknut

TM40VD MAINTENANCE INSTRUCTIONS

CAUTION

AVOID INJURY

Please read these instructions carefully before the disassembly and reassembly.

Precautions

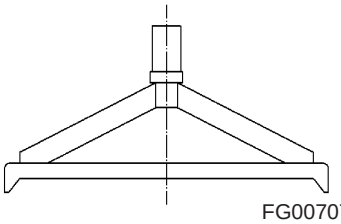
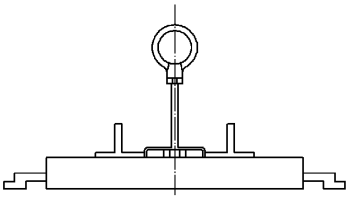
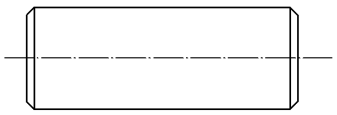
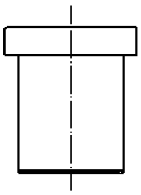
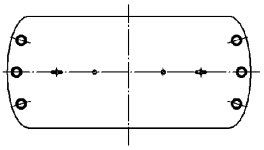
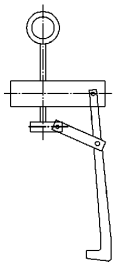
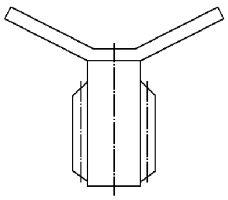
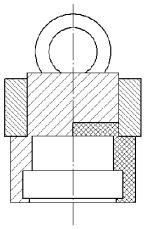
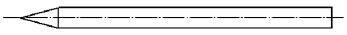
1. The overhaul of this machine should be performed in accordance with instructions stated in this manual.
2. Use tools stated in these instructions for the disassembly and reassembly of the machine.
3. Use parts we produce or recommend for expendables and parts to be replaced.

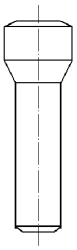
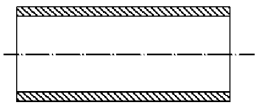
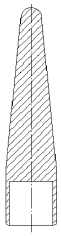
Tools List for Disassembly and Reassembly

Standard Tools

No.	Tools	Description / Sizes	Q'ty
1	Hexagon Wrench (JIS B 4648)	6 (M8) (PF1/4), 8 (M10)	EA1
		10 (M12) (PF1/2)	EA1
		14 (M16), 4 (M6)	1
2	Socket Wrench		
3	Torque Wrench	Nominal 280N dial type	1
		Nominal 850N dial type	1
4	Adapter for Torque Wrench	Socket 22, 30, 32,41, 40 bar 5, 6, 8, 10, 14	EA 1 EA 1
5	Extension Bar (JISB 4637)	150 mm	1
6	Hammer	12	1
7	Plastic Hammer	L = 300	1
8	θ Driver	150 mm	1
9	Retaining Ring Pliers	For shaft, For hole	1
10	Hanger	Weight : Over 300 kgf	1
		Eyebolt (M16)	2
		Eyebolt (M10)	2
		Eyebolt (PF1/2)	2
		Wire	1
11	Press	Press Capacity : Above 200 kgf	1
12	Compressed Air	3 - 5 kg/cm^2, nozzle	1
13	Vessel	General Vessel W450 x D300 x H120	2
14	Heating Vessel	Heating Capacity : Over 100°C	1
		Volume : 500 x 500 x 500	
15	Depth Micro-meter	Measuring Range : 0.04 ~ 0.3 mm	1
16	Air Hammer	BRH-8 (Compressed Air 5 - 6 kg/cm^2)	1
17	Sealant	Silicon Rubber (780-RTV)	1

Machined Tools

No.	Names and Typical Sizes	Q'ty	No.	Names and Typical Sizes	Q'ty
1	Main Bearing Press Fitting Tool  FG007070	1	6	Coupling Gear Hanger  FG007071	1
2	Aluminum Rod  FG007072	1	7	Pressing Tool (1)  FG007073	1
3	Thrust Plate (R) Adjustment Tool  FG007074	1	8	Gap Measuring Tool  FG007075	1
4	Hanger (1)  FG007076	1	9	Sun Gear Positioning Tool  FG007077	1
5	Hanger (2)  FG007078	1	10	Tapered Steel Rod  FG007079	1

No.	Names and Typical Sizes	Q'ty	No.	Names and Typical Sizes	Q'ty
11	Steel Rod FG007080	1	13	Cocking Tool  FG007081	1
12	Insert Tool  FG007082	1	14	Shaft Insertion Guiding Tool  FG007083	1

Disassembly Instructions

General Cautions

1. Spread s rubber or vinyl cover on the workbench.
2. When disassembling the traveling motor, provide a match mark on the mating face or each part.
3. Arrange the detached parts to prevent them from being damaged or lost.
4. The disassembled seals must be replaced with new ones as a rule even if they are free from damage.

For disassembly, therefore, prepare new seals in advance.

Disassembly procedure

1. When inspecting or repairing the TM motors, use the disassembling procedures described below.
2. Numerals in brackets ( ) following the part name denote the part numbers used in the operation manual.
3. Prior to disassembly, install the TM motor on a inversion working bench.
4. Fit the TM motor on the turn-over working die to start its disassembly.

Disassembling the Reduction Gear Part

1. Remove plugs (128) (3 ea) and drain the reduction gear oil.

   NOTE: *Fit the eyebolt in a screw hole for the plug (128). After hook it, remove the cover (123).*

   If it's impossible, please remove the cover using the rod.

2. Loosen socket bolts (124) (16 ea) and remove the cover (123).

   NOTE: *You can have difficulty removing it because Loctite is spread in the socket bolt (124).*

   - Hexagon wrench 8, 10



Figure 16

3. Remove drive gear (121).

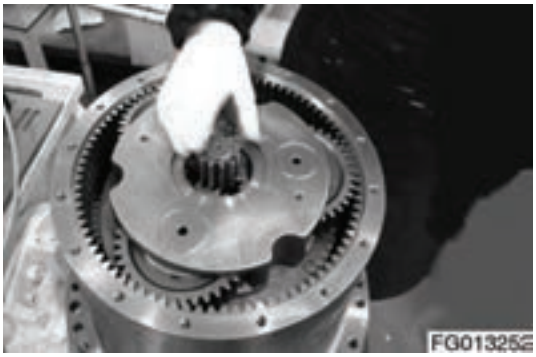


Figure 17

4. Remove carrier no.1 assembly.

   NOTE: *Carrier no. 1 assembly consists of planetary gear (117), needle bearing (118), shaft bearing (107), carrier (134) thrust washer (131), spring pin (122).*



Figure 18

5. Dissembling the carrier no. 1 assembly.

   A. Drive spring pins (122) into shaft bearing (R) (107).

      NOTE: *Please don't remove if repair is not necessary.*

      Do not reuse the spring pin (122).

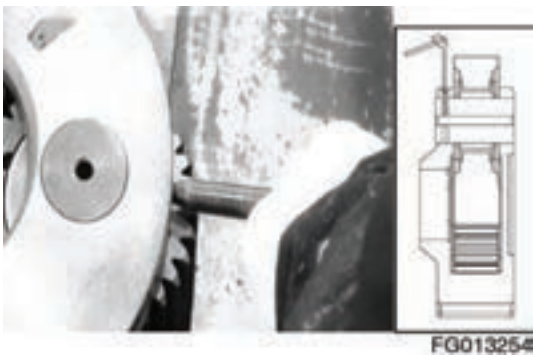


Figure 19

   B. Remove shaft bearing (R) (107), planetary gears (R) (117), thrust washer (R) (131), needle bearings (118) and thrust washer (R) (131).



Figure 20

6. Remove sun gear (114).

NOTE: *Snap ring (115) is assembled in sun gear (114).*

Do not remove it if not necessary.



Figure 21

7. Remove carrier no.2 assembly.

NOTE: *Remove it using a crane after M10 eyebolts are installed.*

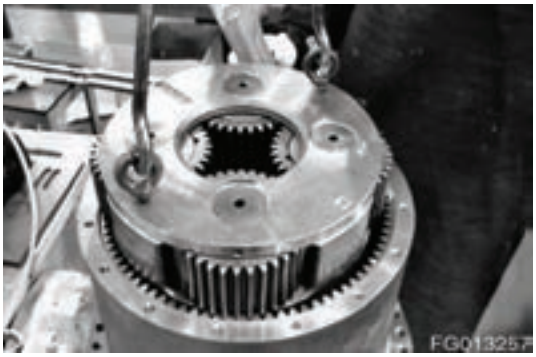


Figure 22

8. Drive spring pins (110) into shaft bearing (F) (113).

NOTE: *Do not reuse the spring pin (110).*

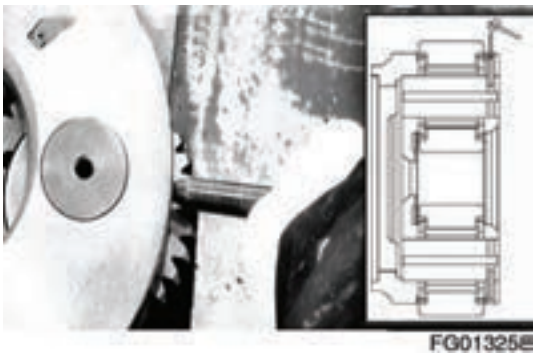


Figure 23

9. Remove shaft bearing (113) (4 ea).



Figure 24

10. Remove the thrust washer (F) (109), planetary gears (F) (108), needle bearings (111), floating bushing (112) from carrier no. 2 (103).

    NOTE: *Each part consists of the 1 st.*



Figure 25

11. Take off lock shim plate (136) by hammering on chisel or on similar tool placed at parting surface.



Figure 26

12. Remove the hub (105) from the spindle (101).

    NOTE: *Remove it using a crane after M16 eyebolts are installed at the hub (105).*

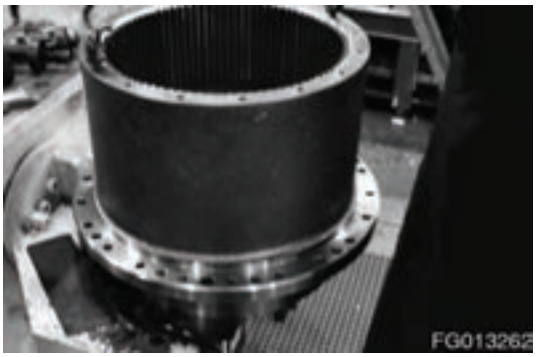


Figure 27

13. Remove the distance piece (106) from the spindle (101).



Figure 28

14. Remove the floating seal (101) from the hub (105) and the spindle (101).

    NOTE: *User can remove easily if using "θ"driver.*

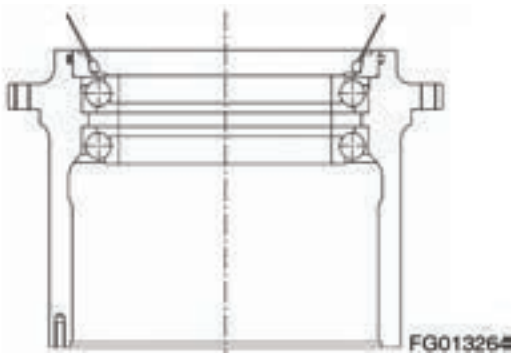


Figure 29

15. The seal (129), the angular bearing (125) (2 ea), the O-ring (130) are assembled on the hub (105) with the floating seal (102).

    NOTE: *Do not remove if not necessary.*

    In case of the removal, be careful not to scratch using aluminum rod or hammer.

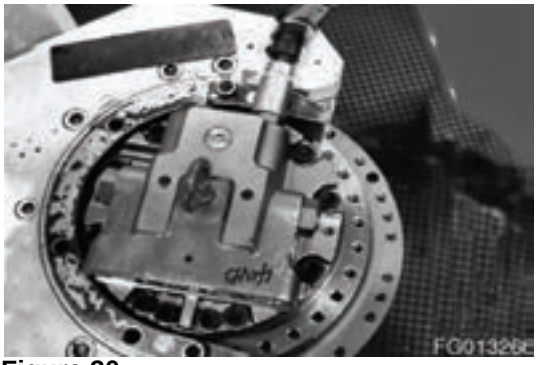


Figure 30

Disassembling Hydraulic Motor Part

1. Remove the relief valve (2 ea) from rear flange (1).

    NOTE: *Hexagon socket 32/Torque wrench.*

2. Remove hex. socket head bolts (43) from the rear flange (1).

    NOTE: *Hexagon wrench 14.*

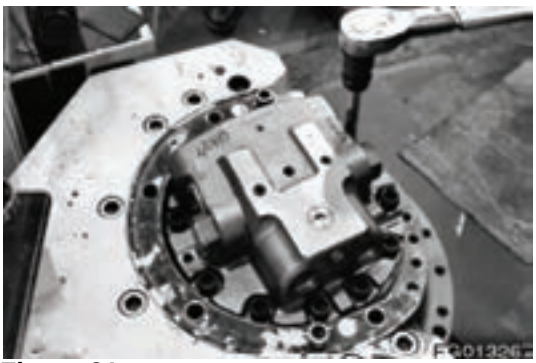


Figure 31

3. Remove the rear flange (1) form the spindle (101).
4. Remove the spring (213) (10 ea) form the rear flange (1).

    NOTE: *Remove rear flange (1) carefully after taken using hands. Be carefully not to detach the timimg plate (209) and the spring (213) if twisted or beated by constraint.*

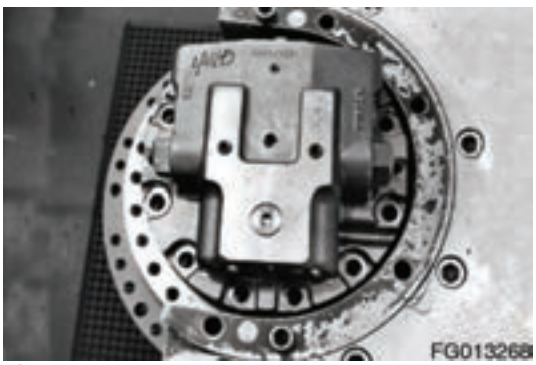


Figure 32

5. Remove the parallel pin (42) from the spindle (101).



Figure 33

6. Remove the O-ring (126) from the spindle (101).

   Do not reuse the O-ring (126).

   NOTE: *Do not reuse the O-ring (126).*



Figure 34

7. Disassembling the rear flange (1) part

   A. Remove the timing plate (9) from the rear flange (1).

      NOTE: *When removing the timing plate, user can have difficulty of the removal due to the close adhesion of rear flange (1) and oil. Remove it after fitting a rod through the hole which is used when a casting is detached.*

      Be careful to not scratch the surfaces if using a sharp tool or leakage can occur.



Figure 35

   B. Remove the parallel pin (41) from the rear flange (1).



Figure 36

C. Remove the ball bearing (250) from the rear flange (1).



Figure 37

8. Disassembling the spool

A. Remove two plugs (24) from the rear flange (1).

NOTE: *Users can work easily if sub-disassembly was done on the reversal table.*

Hexagon socket 41/Torque wrench.

B. Take out two springs (28), two stopper (c-3) from the rear flange (1).

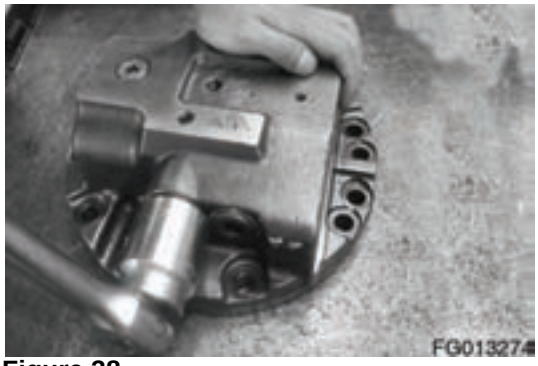


Figure 38

C. Remove the spool (23) from the rear flange (1).

NOTE: *Be careful not to damage the outer surface of the spool (23) and the sliding surface of the rear flange (1).*

Since the rear flange (1) and the spool (23) are of the selective fitting type, replace them together as a kit even if only one of the two parts is damaged.



Figure 39

9. Disassembling the check valve

A. Remove two plugs (26) from the rear flange (1)

NOTE: *Users can work easily if sub-disassembly was done on the reversal table.*

Hexagon wrench 14.

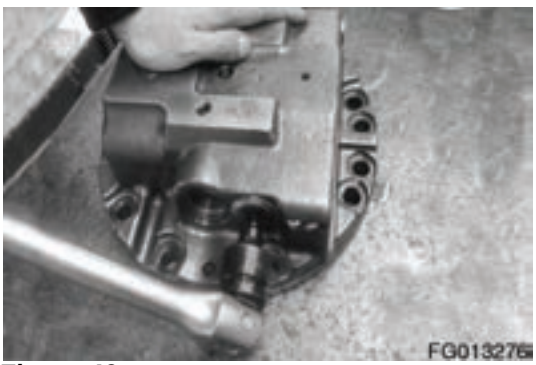


Figure 40

B. Remove the spring (30) (2 ea), valve (27) (2 ea) from rear flange (1).

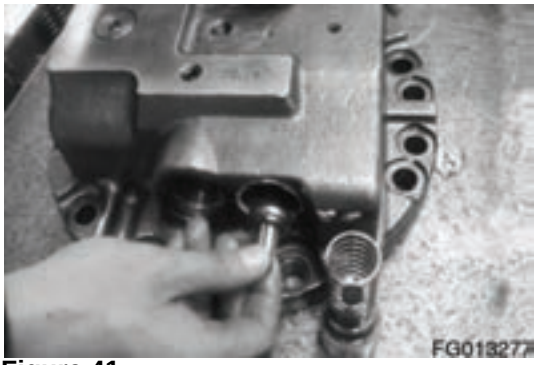


Figure 41

10. Disassembling the two speed valve

A. Remove the plug (63) from the rear flange (1).

NOTE: *Users can work easily if sub-disassembly was done on the reversal table.*

Hexagon wrench 10.

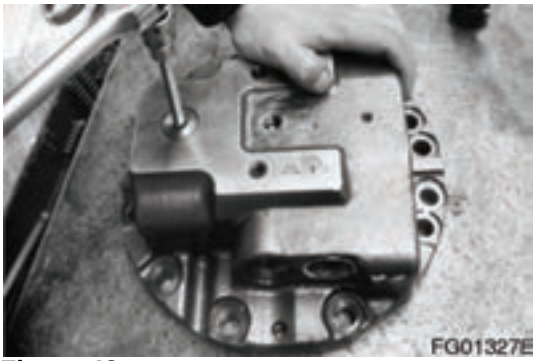


Figure 42

B. Remove the spool (65), spring (66) from rear flange (1).

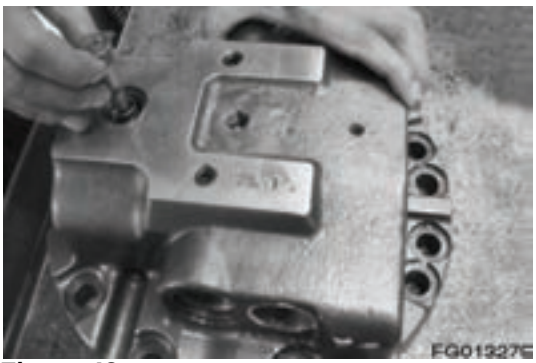


Figure 43

11. Disassembling the parking brake

A. Remove the piston (212) by injecting compressed air from the parking brake access hole in the spindle (101).

NOTE: *Use the protection cover on the upperpart of spindle (101) when using compressed air.*

Otherwise part damage and injury might happen because the piston (212) is rushed out of the spindle (101).



Figure 44

B. Remove the O-rings (235) (239), backup ring (247) (248) from the piston (212).

NOTE: *Do not reuse O-rings (235) (239), backup ring (247) (248) after removal.*



Figure 45

12. Disassembling the hydraulic motor part

A. Lay the TM motor body on the side.

B. Drain out the oil from the TM motor.

NOTE: *Place an oil receptacle under the TM motor to receive the oil flowing out as the motor is being laid on the side.*

C. Hold the cylinder block (204) with both hands, and remove it from the shaft (202).

NOTE: *Before removal, hold the cylinder block (204) with both hands and turn it two to three times in a clockwise and a counterclockwise direction alternately to detach the shoe (206) from the swash plate (203).*


Figure 46

D. Remove the mating plates (216) and friction plates (215) from the cylinder block (204).

NOTE: *Be careful that if an attempt is made to remove the cylinder block (204) without detaching the shoe (206) from the swash plate (203), then the piston, shoe and other parts that are connected to the cylinder block may come the cylinder loose and fall into the spindle.*


Figure 47

13. Disassembling the cylinder block kit

A. Remove the piston assembly (piston (205), shoe (206)) from the removed cylinder block (204).



Figure 48

B. Remove piston (205), shoe (206) from the removed retainer plate (207).



Figure 49

C. Remove thrust ball (208) from the removed cylinder block (204).



Figure 50

D. Remove spring (214) (9 ea) from the removed cylinder block (204).

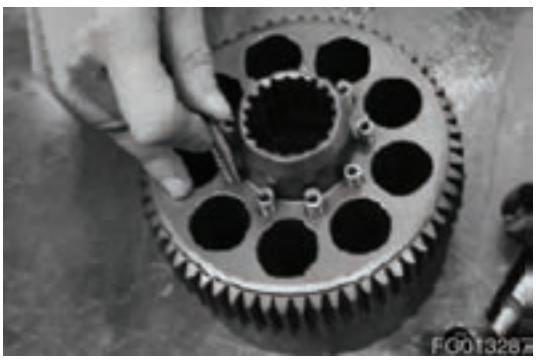


Figure 51

14. Remove swash plate (203) from the shaft (202).
15. Remove shaft (202) from the spindle (101).

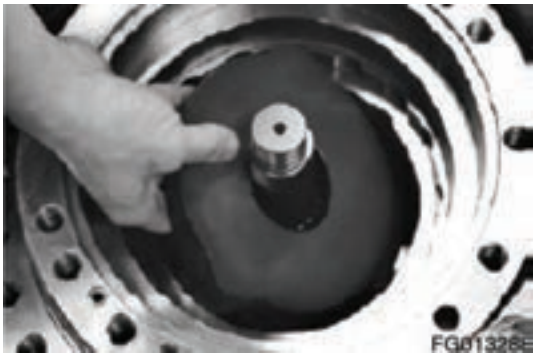


Figure 52

NOTE: *When separating the swash plate, separate and turn it by using hands to free from intervention of the stopper.*

16. Remove speed selector piston assembly (piston (261) and shoe (262)) form the spindle (101) by feeding compressed air from the access hole in spindle (101).

NOTE: *Piston assembly - Piston (261) Shoe (262)*

- Compressed air: 3 - 5 kg/cm^2

17. Remove parallel pin (242) pivot (267) from the spindle (101).

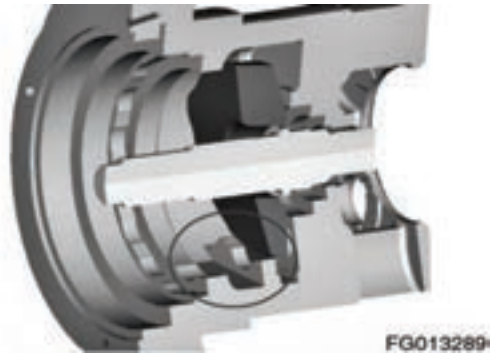


Figure 53

18. Remove ball bearing (249) from the spindle (101)

NOTE: *When piston (261) or shoe (262) is damaged, if exchange is necessary, they have to be exchanged together because the seperation is impossible. Use the protection cover on the upperpart f spindle when users put the pressed air into suddenly. Otherwise part damage and accident might go on because the piston is rushed out of the spindle.*



Figure 54

19. Remove oil seal (232) from the spindle (101).

NOTE: *Remove the oil seal (232) by hammering at the circumference of the oil seal (232) using θ driver.*

Do not reuse the oil seal (232).

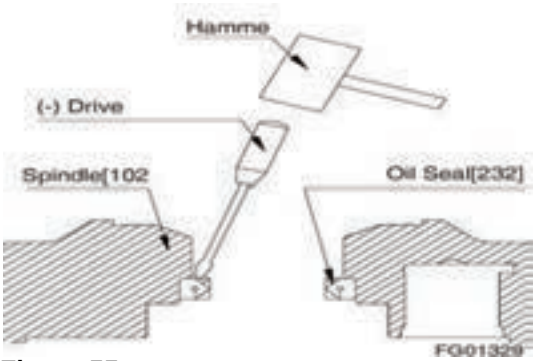


Figure 55

Reassembly

General Precautions

1. Reassemble in a work area that is clean and free from dust and dirt.
2. Handle parts with bare hands to keep them free of linty contaminants.
3. Repair or replace the damaged parts.

   Each parts must be free of burrs on corners.
4. Do not reuse O-rings, oil seal and floating seal that were removed in disassembly.
5. Wash all parts throughly in a suitable solvent.

   Dry throughly with compressed air.

   Do not use the cloths.
6. When reassembling oil motor components of TM motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)
7. Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

Reassembly Procedure

Reassemble the Hydraulic Motor Part

1. Install oil seal (232) into the oil seal hole of spindle (101).

   NOTE: *Apply lithium grease to the lip portion of oil seal (232) position the sqarely over the bore of spindle (101).*



Figure 56

2. Install parallel pin (242) (2 ea) and two speed piston assembly (261) (262) into the spindle (101).



Figure 57

3. Install shaft (202) into the spindle (101).

   NOTE: *Assemble after applying grease on oil seal lip (232).*



Figure 58

4. Install pivot (267) (2 ea) into the spindle (101).



Figure 59

5. Install swash plate (303) to the spindle (101).

   NOTE: *The swash plate (203) and the 2 speed stopper of the spindle will conflict. Install the swash plate (203) after rotating. And then install it as the regular position.*

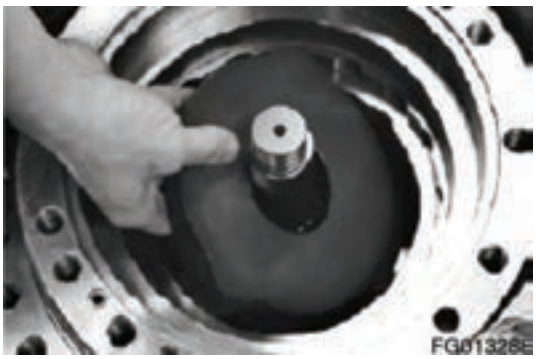


Figure 60

6. Reassemble the cylinder block kit

   A. Install spring (214) (9 ea) to the cylinder block (204).

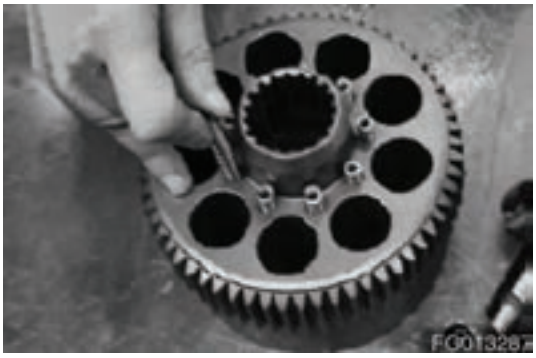


Figure 61

   B. Install thrust ball (208) to the cylinder block (204).

   C. Insert piston assembly (piston (205), shoe (206)) into retainer plate (207).

      NOTE: *After mounting, immerse the entire them in a working fluid.*



Figure 62

   D. Mount the piston assembly in the cylinder block (204).



Figure 63

7. Install cylinder block (204) assembly to the shaft (202).

   NOTE: *After fitting splines of both cylinder block (204) and shaft (202), assemble them.*

   After installing the cylinder (204), confirm whether it revolves or not by turning using both hands.

   Motor is malfunction when it isn't revolve.



Figure 64

8. Reassemble the parking brake

A. Install mating plate (216) first and then a friction plate (215), one by one, into the grooves of the outer surface of the cylinder block (204).

NOTE: *Immerse the friction plates (215) in a working fluid before fitting them into the grooves.*



Figure 65

B. Install O-ring (275) (2 ea) into the spindle (101).

C. Install two O-rings (235), (239) and two backup ring (247), (248) in then O-ring grooves of the piston (212).

NOTE: *Apply a thin coat of grease to the O-rings (235) (239).*



Figure 66

D. Mount a piston (212) in the spindle (101)

NOTE: *If the piston (212) does not fit into the spindle[101] because of the resistance of the O-ring, tap the edge of the piston[212] lightly and equally with a plastic hammer.*

Be careful not to damage the O-ring and backup ring at this time.

E. Insert a O-ring (126) into spindle (101).



Figure 67

F. Insert parallel pin (42) (2 ea) into spindle (101).



Figure 68

Reassemble the Rear Flange Part (1)

1. Reassemble the check valve

   A. Install O-ring (37) (2 ea) on the plug (26) (2 ea).

      NOTE: *Apply grease to the O-ring (37).*

   B. Install spring (30) and a valve (27) into the plug (26).

      NOTE: *Install a spring (30) and a valve (27) into the plug (26), and then grease the spring (30) and the valve (30) and hand-lock the former.*

   C. Install plug (26) into the rear flange (1).

   D. Install plug (26) in conjunction with the spring (30) and the valve (30) into the rear flange (1), and tighten the plug to the required torque.

      – Tightening torque : 26 ± 4.0 kg•m

      NOTE: *Adapter for hexagon wrench 14/Torque wrench*

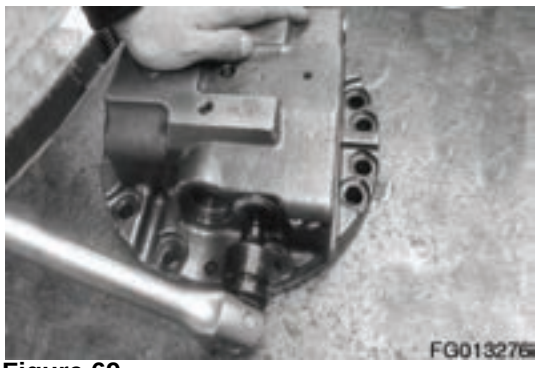


Figure 69

2. Reassemble the spool

   A. Install spool (23) into the rear flange (1).

      NOTE: *Before installing the spool (23), apply hydraulic oil to the spool. Be careful not to damage the spool's surface and the inner of rear flange (1).*

   B. Install O-ring (36) on the plug (24).

   C. Install spring (28) and a stopper (c-3) into the plug (24).

      NOTE: *Apply grease to the O-ring (36).*

      – Tightening torque : 45 ± 9 kg•m

   D. Install plug (24) into the rear flange (1).

      NOTE: *Exchange it as the rear flange KIT if the exchange is necessary, because the rear flange (301), the spool (323) insist of the rear flange KIT.*

      – #41 socket/torque for hexagon wrench



Figure 70

E. Tighten the plug (24) to the required torque.

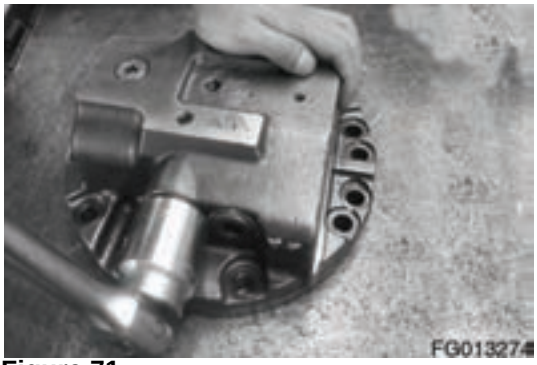


Figure 71

3. Reassemble the two speed valve

A. Install O-rings (46) on plugs (63).

NOTE: *Apply grease to the O-ring (46).*

Apply hydraulic oil to the spool (65), while the spool (65) is installed into the rear flange (1).

B. Insert a spool (65) and spring (66) into the rear flange (1).

NOTE: *Be careful not to damage the hole's liner of the rear flange (1) and the spool (65) outer. It brings on low efficiency of the TM-motor because of the leakage increase after reassembling.*

The shaft center should align with the hole center because of little gap.

It is in order to protect the damage and smooth assembling of the rear flange (1) and the spool (65).

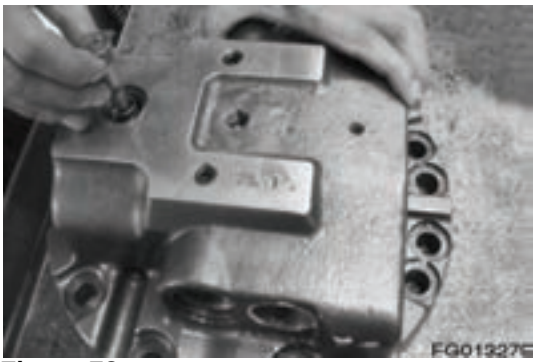


Figure 72

C. Insert a plug (63) into the rear flange (1).

– Tightening torque : 10 ± 2 kg•m

– #10 adapter/torquer wrench for hexagon wrench

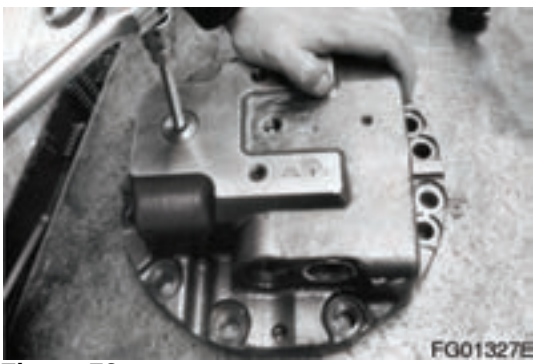


Figure 73

4. Assembling of the rear flange's inner parts

A. After installing the O-ring (74) on the plug (52), install the steel ball (68), the plug (52) into the rear flange (1).

NOTE: *Apply grease to the O-ring (74).*

Do not disassemble and assemble if not necessary.

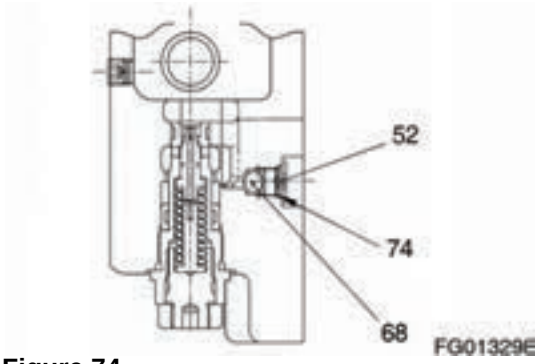


Figure 74

B. Install orifice (71), filter (79) into the rear flange (1).

Caulk it after assembling certainly.

NOTE: *Do not disassemble and assemble if not necessary.*

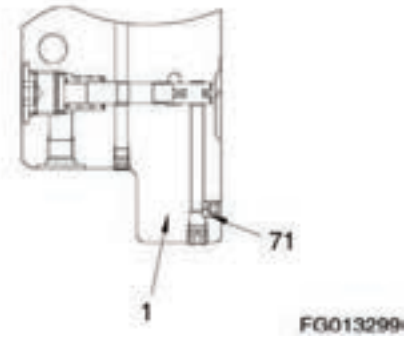


Figure 75

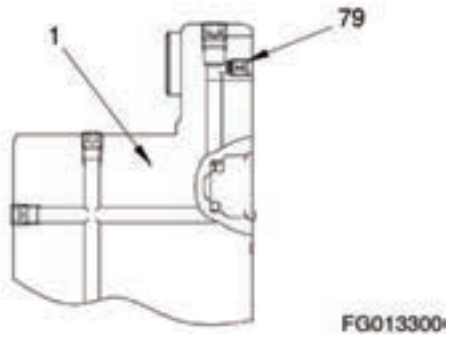


Figure 76

5. Insert a ball bearing (250), timing plate (209), parallel pin (41) (1 ea) and spring (213) (12 ea) into the rear flange (1).

NOTE: *Be careful not to seperate the spring (213) and the timing plate (209) should not separate from the rear flange (1).*

Apply hydraulic oil to the ball bearing (250).



Figure 77



Figure 78

6. Reassemble the rear flange (1) and spindle (101).

   A. Mount the rear flange (1) on the spindle (101).

      NOTE: *When the rear flange (1) is mounted on the spindle (101), fix the spring (13) with applied grease so it does not drop.*

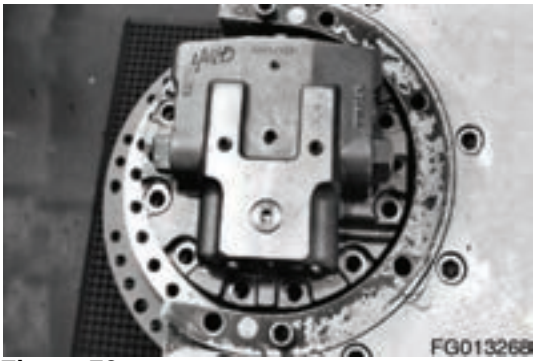


Figure 79

   B. Tighten the socket bolt (43) into the spindle (101) to the required torque.

      – Tightening torque : 5.9 ± 1.0 kg•m

      – #14 adapter/torque wrench for wrench

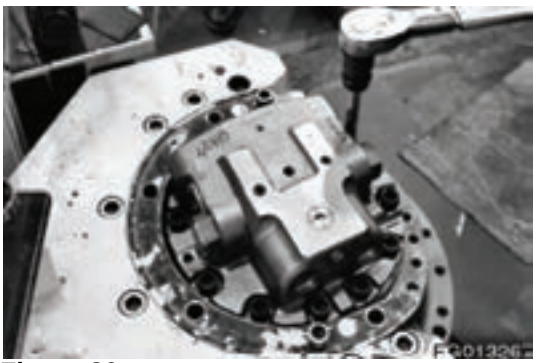


Figure 80

7. Tighten the relief valve into the rear flange (1) to the required torque.

      – Tightening torque : 25 ± 5 kg•m

      – #32 socket/torque for wrench

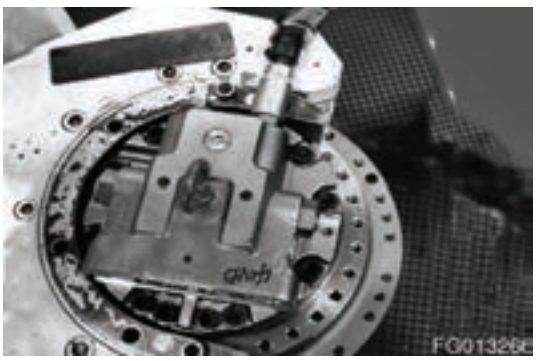


Figure 81

The Reduction Gear Assembly

1. Rotate the TM motor through 180 degrees to make the spindle side face upward.
2. Install floating seal (102) on the spindle (101).



Figure 82

NOTE: *Apply grease to the floating seal (102).*

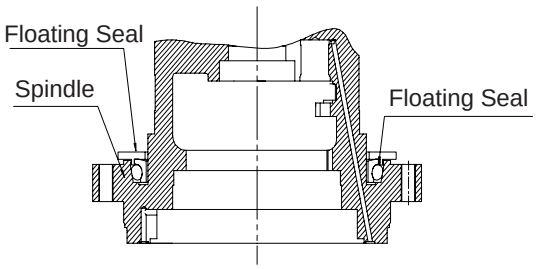


Figure 83

Hub Assembly

1. Install angular bearing (125) into the hub (105).

NOTE: *Be careful of the insert direction.*

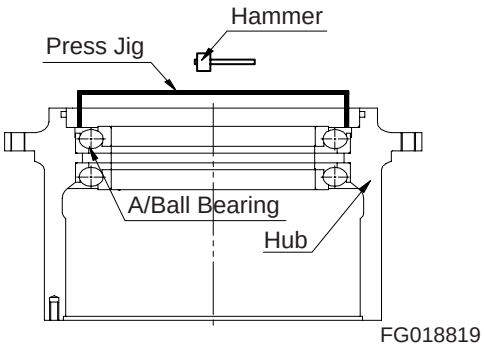


Figure 84

2. Insert the O-ring (130), the sealing (129) in the hub (105).

NOTE: *Apply a thin layer of grease to the O-ring (130)*

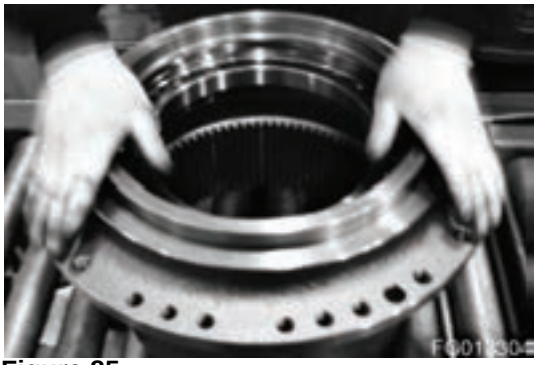


Figure 85

3. Install floating seal (102) on the hub (102).



Figure 86

NOTE: *Apply grease to the floating seal* (105).

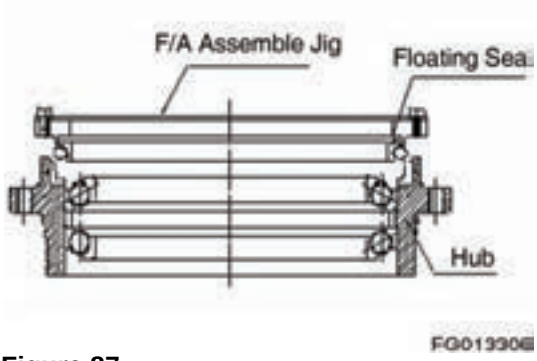


Figure 87

4. Install distance piece (106) into the spindle.



Figure 88

5. Install the hub assembly into the spindle.

6. Use a press, and press inner lace of bearing（125）into its full depth.

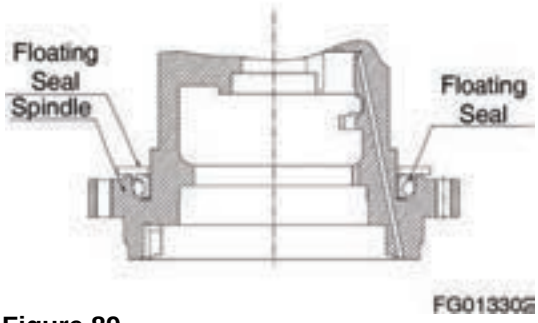


Figure 89

7. While pressing flange of spindle (101), install Shimplate[136] into groove.



Figure 90

8. Assemble thrust washer (F) (109) planetary gears (F) (108), needle bearings (111), floating bushing (112) into carrier no.2 (103).



Figure 91

9. Install shaft bearing (113) into the carrier no.2 (103).



Figure 92

10. Install spring pin (110) into the carrier no.2 (103).

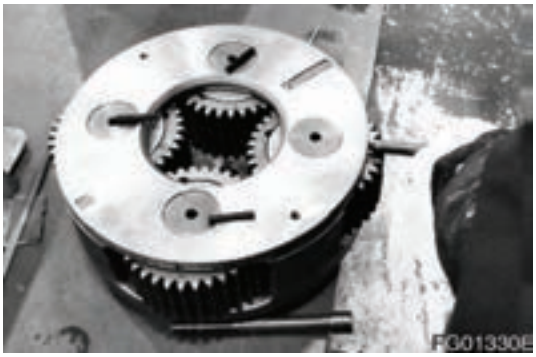


Figure 93

11. Place carrier no.2 assembly into hub (105).

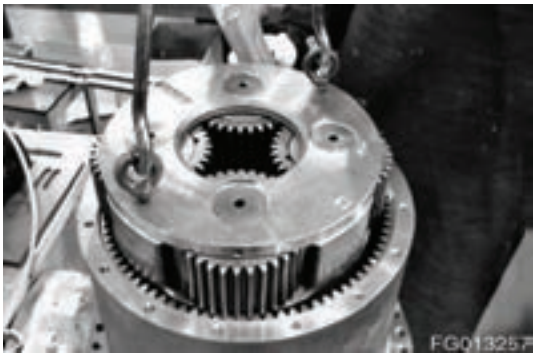


Figure 94

12. Attach the retaining ring (115) on the sun gear (114).

    NOTE: *Snap ring pliers (Snap ring C-75 (S))*

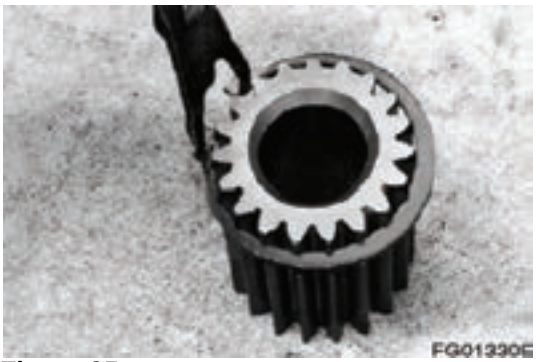


Figure 95

13. Install sun gear (114).



Figure 96

14. Assemble thrust washer (R) (131), planetary gears (R) (117), needle bearings (118), shaft bearing (R) (107) into carrier no.1 (134).



Figure 97

15. Install the spring pin (122) into the carrier no.1 (134).



Figure 98

16. Place carrier no.1 assembly into hub (105).



Figure 99

17. Install drive gear (121) in the carrier no.1 assembly.

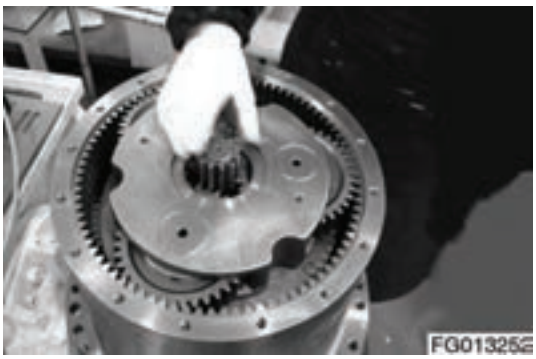


Figure 100

18. Install thrust plate (133) in the cover (123).

NOTE: *Apply grease to the thrust plate (133).*

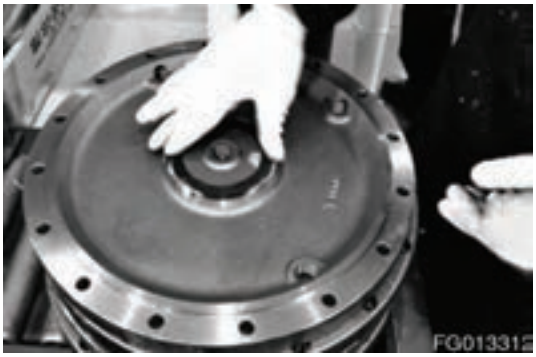


Figure 101

19. Install thrust washer (M) (132) in the cover (123).

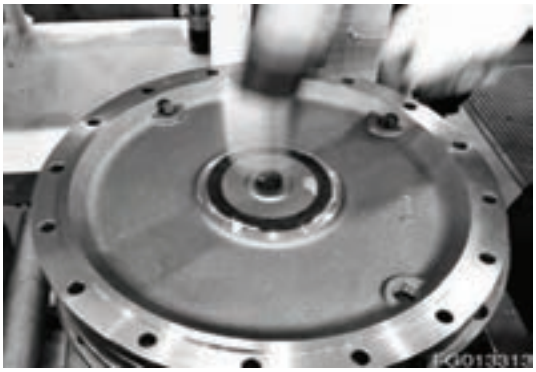


Figure 102

20. Apply sealant to the cover (123) after intalling with the hub (107).

NOTE: *Sealant - (silicon rubber) (780-RTV)*

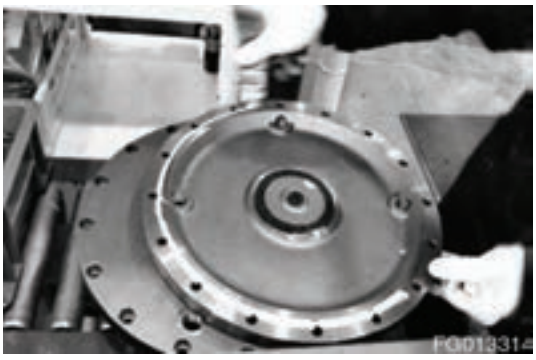


Figure 103

21. Mount the cover (123) on the hub (105).



Figure 104

22. Tighten the socket bolt (124) (16 ea) to the specified torque.
    - Tightening torque : 5.9 ± 1.kg•m
    - #8 adapter/torquer wrench for hexagon wrench

    NOTE: *Apply Loctite to the socket bolt (124) and then install it.*

23. Install O-ring (38) on the plug (128).

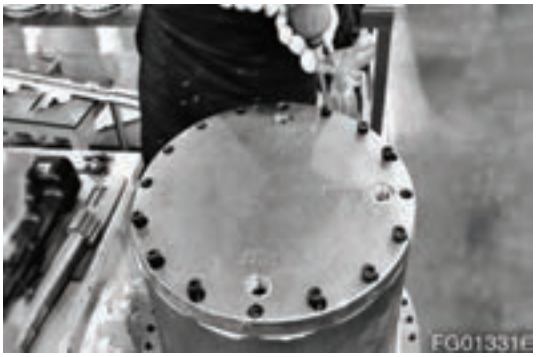


Figure 105

24. Tighten the plug (128) to the specified torque into the cover (123).

    NOTE: *Apply grease to the O-ring (38).*
    - Tightening torque : 10 ± 2 kg•m
    - #10 adapter/torquer wrench for hexagon wrench



Figure 106

Checking Facts After Assembly

1. Air test of reduction gear

   Disassemble plug (32) of reduction gear part, When compressed air (0.3 kg/cm^2) is applyed through the plug hole under water for 2 minutes, there must be no observable air bubble.
   - Gear oil : 3.3 liter

2. Air Test Of Hydraulic Motor

   With one port opened and the other ports closed, compressed air (3 kg/cm^2) is injected under water for 2 minutes, there must be no observable air bubble.
   - Working fluid : 1.0 liter

Testing

The motor case must be filled up with a working fluid before starting performance verification tests.

After completion of TM motor maintenance, the performance verification tests listed below must be performed.

1. When a testing apparatus is available

   If internal parts have been replaced, carry out running in operation, followed by performance tests.

   A. Conditions for running in operation

      1) 20r.p.m, no-load pressure, 1 minute, clockwise/ counterclockwise rotation

      2) 10r.p.m, 200 kg/cm^2, 1 minute, clockwise/ counterclockwise rotation

      3) 25r.p.m, no-load pressure, 1 minute, clockwise/ counterclockwise rotation

   B. Conditions for performance tests

      1) Working fluid : ISO VG #46 wear resistant type

      2) Lubricating oil : Gear oil

      3) Temperatures :

         Ambient temperature -- Room temperature

         Working fluid temperature -- 50 ± 5 degrees C

         Casing temperature of reducer section -- 40 to 80 degrees C

      4) Drainage pressure : 0.8 kg/cm^2 or less

   C. Efficiency tests (for the first speed)

TM type	Volume efficiency	Machine efficiency	External drainage amount (Referential date)
	89% or more	83% or more	
TM40VD	Differential pressure : 250 kg/cm^2 Revolutions : 10rpm		2.0l/min or less

   D. Second-speed volume efficiency verification tests

Second-speed selection	Volume efficiency	Hydraulic motor drainge amount
Differential pressure :80 kg/cm^2 Revolutions : 25rpm	95% or more	2.0l/min or less

E. Second-speed volume efficiency verification tests

During the no-load tests under the running-in operating conditions for (C) and (D) above, make sure that motor will change from the low speed over to the high-speed when fluid pressures of 20 kg/cm^2 or more are applied from the second-speed selector pilot port (D-port).

Also, ensure that motor changes over to the low speed at fluid pressures of 10 kg/cm^2 or less.

2. When field performance verification tests are to be conducted without using a testing apparatus :

Install the TM motor in the vehicle and provide piplines without attaching the shoe. carry out running-in operation, followed by performance tests.

A. Conditions for running-in operation

1) 10 r.p.m, no-load pressure, one minute, clockwise/counterclockwise rotation

2) 20 r.p.m, no-load pressure, one minute, clockwise/counterclockwise rotation

B. Conditions for running-in operation

1) Temperatures

Working fluid temperature ------ 50±5 degrees C

Casing temperature of reducer section ----- 40 to 80 degrees C

C. No load driving pressure (Differential pressure)

First speed	10rpm	20 kg/cm^2 or less
Second speed	20rpm	30 kg/cm^2 or less

D. Motor drainage amount measurement

Both first and second speeds	10rpm	2.0l/min or less

List of Seals

Ref. Nos	Parts	Description Sizes	Q'ty	Remarks
1	O-ring	1BP8	2	275
2	O-ring	1AG230	1	126
3	Floating Seal	90626501	2	102
4	O-ring	1BP18	5	46, 38
5	Oil Seal	TCN48 x 70 x 12	1	232
6	O-ring	1BP180	1	235
7	O-ring	1BP210	1	239
8	Backup Ring	1BP180	1	247
9	Backup Ring	1BP210	1	248
10	O-ring	1BP16	6	405
12	Backup Ring	T2-P16	4	404
13	O-ring	1BP29	2	406
14	Piston Seal	SPGO 7.5-10.5-1.5	2	402
15	O-ring	1BP32	2	36
16	O-ring	1BP22A	2	37
17	O-ring	1BP11	2	74
18	O-ring	JIS1516W-P82	2	130

Main Pump

Edition 1

Table of Contents

Main Pump

Safety Instructions 5
Applicable Models 5
Pump Maintenance 6
Component Locations 6
Parts List 8
Tools 10
Tightening Torque 11
Disassembly 12
Reassembly 15
Pump Body Maintenance Standards 18
Change Standards of Worn Parts 18
Fix Standards of Cylinder Block, Valve Plate, and Swash Plate (Shoe Plate) 19

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

PUMP MAINTENANCE

Component Locations

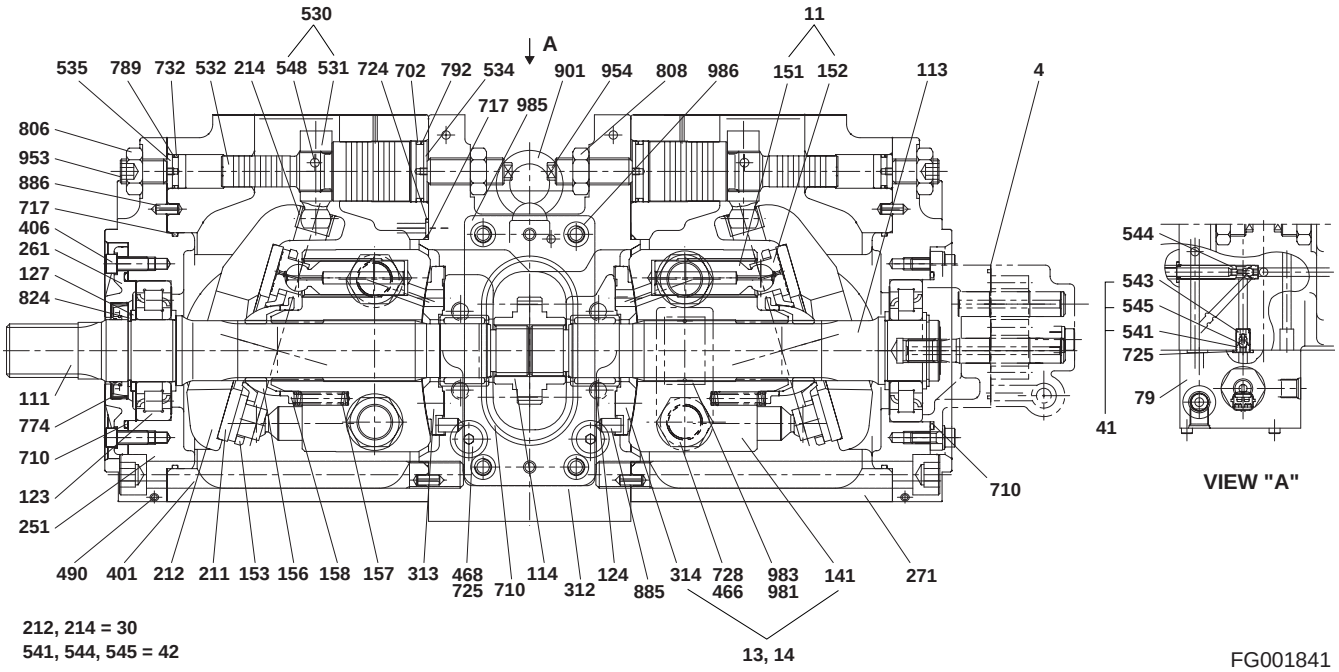


Figure 1

Reference Number	Description
11	Piston and Shoe Assembly
13	Cylinder Block and Valve (R)
14	Cylinder Block and Valve (L)
30	Swash Plate Assembly
41	Check 1 Assembly
42	Check 2 Assembly
79	Professional Valve
111	Driveshaft
113	Driveshaft
114	Gear
123	Roller Bearing
124	Spacer Bearing
127	Bearing Spacer
153	Push Plate
156	Flexible Bushing
157	Cylinder Spring
158	Spacer
211	Shoe Plate
250	Support Kit
251	Support
261	Seal Cover
271	Pump Casing
312	Valve Block
401	Socket Bolt
406	Socket Bolt
466	Plug

Reference Number	Description
468	Plug
490	Expander
530	Tilted Pin Assembly
532	Piston
534	Stopper
535	Stopper
702	O-ring
710	O-ring
717	O-ring
724	O-ring
725	O-ring
723	O-ring
732	O-ring
774	Oil Seal
789	Backup Ring
792	Backup Ring
806	Nut
808	Nut
824	Retaining Ring
885	Pin
886	Spring Pin
901	Eyebolt
953	Set Screw
954	Adjustment Screw
985	Cover
986	Socket Bolt

Parts List

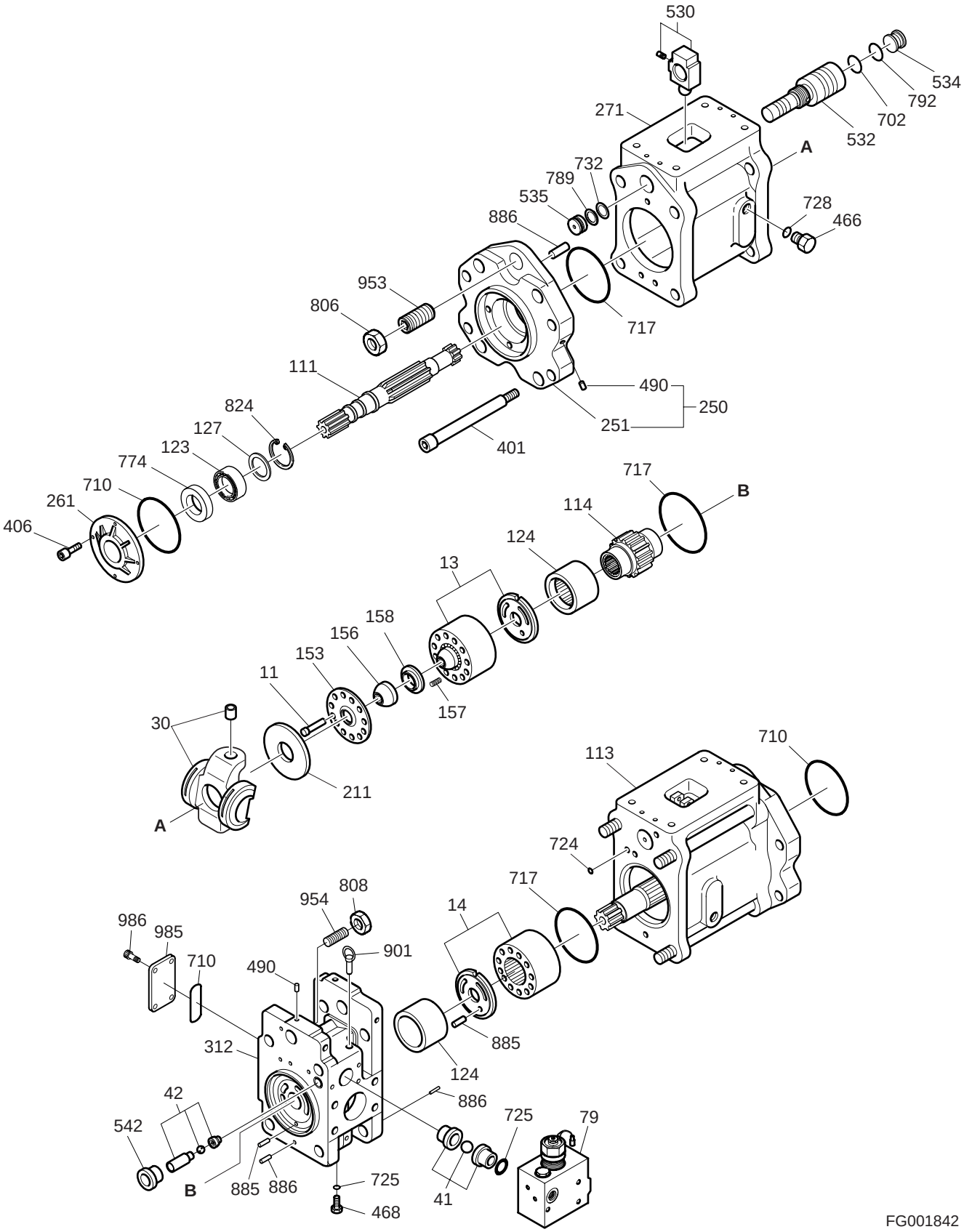


Figure 2

Reference Number	Description
11	Piston and Shoe Assembly
13	Cylinder Assembly(R)
14	Cylinder Assembly(L)
30	Swash Plate Assembly
41	Check 1 Assembly
42	Check 2 Assembly
79	Proportional Valve
111	Driving Shaft (F)
113	Driving Shaft (R)
114	Gear
123	Roller Bearing
124	Spacer Bearing
127	Bearing Spacer
153	Push Plate
156	Spherical Bushing
157	Cylinder Spring
211	Shoe Plate
250	Support Kit
251	Support
261	Seal Cover (F)
271	Pump Casing
312	Block Valve
401	Socket Bolt
406	Socket Bolt
466	Plug
467	Plug
468	Plug

Reference Number	Description
490	Plug
530	Tilting Pin Assembly
532	Piston
534	Stopper (L)
535	Stopper (S)
702	O-ring
710	O-ring
717	O-ring
724	O-ring
725	O-ring
727	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	Pin
886	Spring Pin
901	Eyebolt
953	Set Screw
954	Adjust Screw
985	Cover
986	Socket Bolt

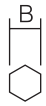
Tools

The following table contains tools required for the disassembly and reassembly of the T5V pump.

Each type of pump uses different bolts and plugs.

Tools and Sizes		Necessary tools marked 0		Parts			
		Pump Types					
Tools	**B**	**T5V 80**	**T5V 112**	**Socket Bolts**	**PT Plugs (NPTF Screws)**	**PF Plugs**	**Adjustment Screws**
Hex Wrench	4	O	O	M5	BP-1/16		M8
	5	O	O	M6	BP-1/8		M10
	6	O	O	M8	BP-1/4	PF-1/4	M12, M14
	8	O	O	M10	BP-3/8	PF-3/8	M16, M18
	10			M12	BP-1/2	PF-1/2	M20
	14	O		M16,M18	BP-3/4	PF-3/4	
	17		O	M20,M22	BP-1	PF-1,1 1/4,1 1/2	
Socket Wrench	19	O	O	M12		VP-1/4	
	22	O				VP-3/8	
	24	O	O	M16			
	27	O		M18		VP-1/2	
	30		O	M20			
	36		O	M5		VP-3/4	
Monkey Wrench		O	O	1, mid-size			
Driver		O	O	2, - type, mid-size			
Hammer		O	O	1, plastic			
Flyer		O	O	TSR-160 for stop ring			
Steel Rod		O	O	Key grade steel rod, about 10 x 8 x 200			
Torque Wrench		O	O	Suitable for specified torques			

Tightening Torque

Parts	Sizes	Tightening Torque (kgf•m)	Tools	
			Size(mm)	Names
Socket Bolts (Quality: SCL435)	M5	0.7	B=4	 Hex Wrench
	M6	1.2	5	
	M8	3	6	
	M10	5.8	8	
	M12	10	10	
	M14	16	12	
	M16	24	14	
	M18	34	14	
	M20	44	17	
PT Plugs (Quality: S45C). Wrap thread tape 1.5~2 times.	PT 1/16	0.9	4	Hex Wrench
	PT 1/8	1.05	5	
	PT 1/4	1.75	6	
	PT 3/8	3.5	8	
	PT 1/2	5.0	10	
PF Plugs (Quality: S45C)	PF 1/4	3.0	6	Hex Wrench
	PF 1/2	10	10	
	PF 3/4	15	14	
	PF 1	19	17	
	PF 1 1/4	27	17	
	PF 1 1/2	28	17	

DISASSEMBLY

Read the disassembly instructions throughly before starting to disassemble the pump, and follow the procedures below.

Numbers in the parenthesis following the parts indicate the reference numbers in the next pump figures.

1. Select a place to disassemble the pump.

IMPORTANT

1. The place should be clean.

2. Put a rubber sheet of cloth on the floor to prevent any damage to parts.

3. Remove dust or rust on the surface of the pump using lubricating oil.

4. Remove drain plug (468) to drain hydraulic oil in the pump casing.

IMPORTANT

Drain the oil from both the front and the rear pumps.

5. Remove socket bolts (412, 413) to disassemble the regulator and PTO.

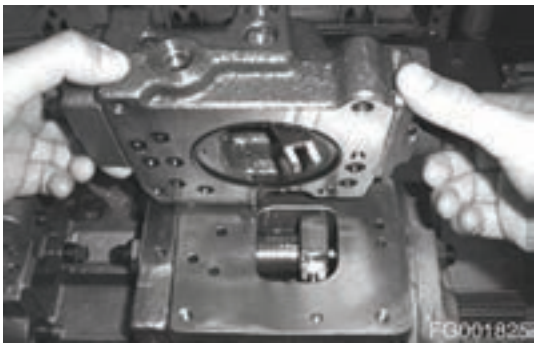


Figure 3

IMPORTANT

1. Refer to the regulator manual for its disassembly.

2. Refer to the PTO manual for its disassembly.

3. Loosen socket bolts (401) retaining swash plate support (251), pump casing (271), and valve block (312).

IMPORTANT

Gear pump and other parts, if attached to the rear side of the pump, should be removed before continuing this procedure.

4. Put the pump flat on the working die with its regulator connection part facing downward and remove pump casing (271) and valve block (312).

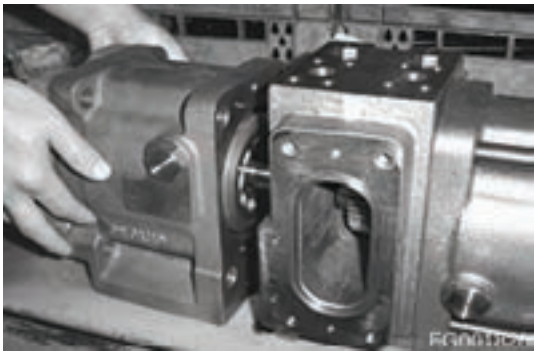


Figure 4

IMPORTANT

1. **Always put a rubber sheet or similar protection on the working die to prevent any damage to the regulator connection part facing downward.**
2. **When removing pump casing and valve block, remove the gear #1 too.**

3. Take out cylinder block (141) from pump casing (271) while keeping it perpendicular to driveshaft (111) along with piston (151), push plate (153), flexible bushing (156), and cylinder spring (157).

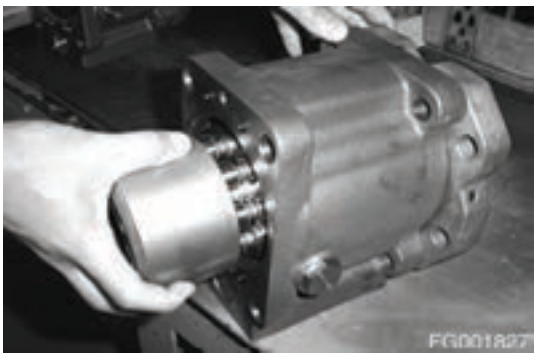


Figure 5

IMPORTANT

Take care not to damage sliding parts of cylinder block, flexible bushing, shoe, and swash plate.

4. Unscrew socket bolt (406) to remove seal cover (F)(261).

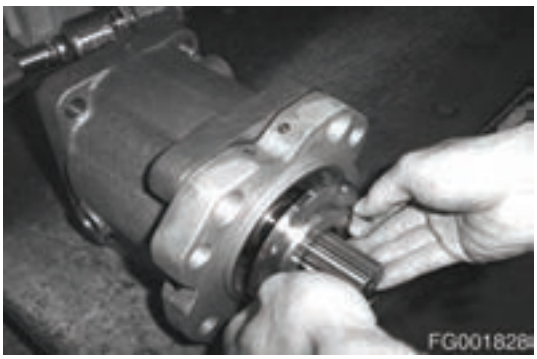


Figure 6

IMPORTANT

1. **You can remove seal cover (F) (261) easily by inserting a bolt in its hole (M6 screw) and taking it out.**
2. **Take care not to damage oil seal installed in seal cover (F) when removing it.**

3. Unscrew hex bolt (408) and remove rear cover (263).
4. Disengage swash plate (251) from pump casing (271) by gently knocking the connecting flange part of swash plate at the shaft of pump casing with plastic hammer.



Figure 7

5. Remove shoe plate (211) and swash plate (212) from pump casing (271).



Figure 8

6. Remove driveshaft from the swash plate support by gently knocking the end of driveshafts (111, 113) with plastic hammer.



Figure 9

7. Remove valve block (312) from valve plates (313, 314).

IMPORTANT

Sometimes this procedure may not be necessary.

8. If necessary, remove stopper (L)(534), stopper (S)(535), servo piston (532), and tilting pin (531) from pump casing (271) and needle bearing (124) and spool line coupling (114) from valve block (312).

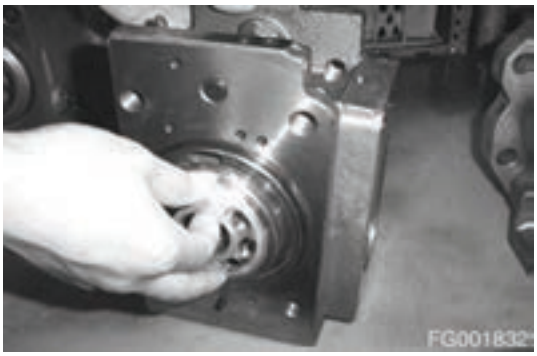


Figure 10

IMPORTANT

1. **Use a proper tool when removing tilting pin to prevent any damage to its head.**
2. **Take care not to damage servo piston, for the inserting area of tilting pin and servo piston is applied Loctite.**
3. **Do not remove needle bearing up to its life, if possible practically.**
4. **Do not unscrew hex nut (808) of the swash plate support, valve bloc, or setting value of oil volume may change.**

REASSEMBLY

Reassembly shall be done in the reverse order of disassembly, but with cautions for:

- Repair any parts damaged during disassembly and have spare parts at hand.
- Wash each part sufficiently with lubricating oil and dry them with compressed air before their reassembly.
- Always apply clean lubricating oil to sliding parts and bearing before their reassembly.
- Make it a rule to replace O-rings and oil seals.
- Tighten fixing bolts and plugs with proper torque wrenches and with torques specified in the Maintenance Standards.
- For the tandem pump, take care not to mix parts of the front and the rear pumps.

1. Install swash plate support (251) in pump casing (271) by gently knocking it with plastic hammer.

IMPORTANT

1. **Insert removed servo piston, tilting pin, stopper (L), and stopper (S) in pump casing first.**
2. **Use a proper tool to connect servo piston and tilting pin to prevent any damage to the head of tilting pin or feedback pin. Apply Loctite (of middle grade) to screws.**



Figure 11

3. Put the pump casing with its regulator connection part facing downward, insert the tilting bushing of swash plate in tilting pin (531), and set swash plate (212) on its support (251) properly.

IMPORTANT

1. **Use tips of both fingers to check if swash plate moves smoothly.**
2. **Apply grease to moving parts of swash plate and its support to facilitate the connection of the driveshaft.**



Figure 12

3. Install driveshaft (111) containing bearing (123), bearing spacer (127), and stop ring (824) in swash plate support (251).



Figure 13

IMPORTANT

1. **Do not strike driveshaft with hammer or a hard object.**
2. **Use a plastic hammer to gently knock the rim of bearing to insert it and use a steel rod to insert it up to the end firmly.**

3. Insert seal cover (F)(261) in pump casing (271) and fix it with socket bolts (406).



Figure 14

IMPORTANT

1. **Apply a thin grease coating to the oil seal of seal cover (F).**
2. **Take care not to damage the oil seal during reassembly.**
3. **For the tandem pump, assemble parts up to rear cover (263) in the same way as for seal cover (262).**

4. Assemble the piston cylinder subassembly [cylinder block (141), piston sub (151, 152), push plate (153), flexible bushing (156), spacer (158), and cylinder spring (157)] and install it in pump casing by arranging it to the spool line of cylinder block and flexible bushing.

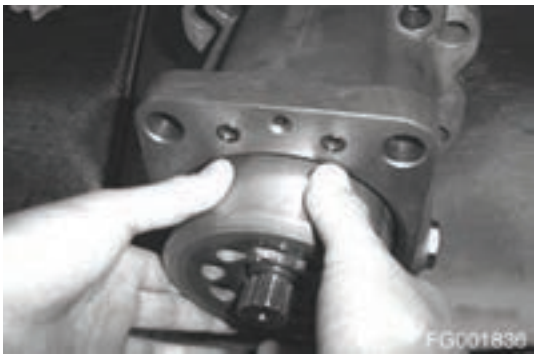


Figure 15

5. Install valve plate (313) in valve block (312) by arranging pin (885).

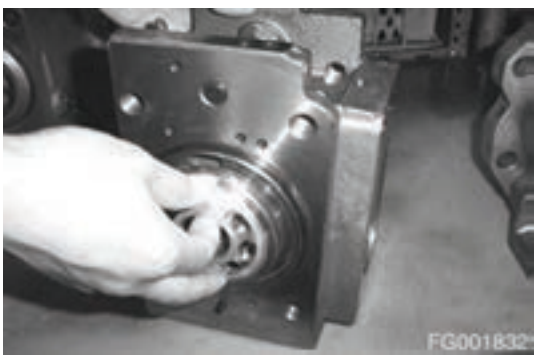


Figure 16

IMPORTANT

Take care to set correct directions of suction and discharge of the valve plate.

6. Install valve block (312) in pump casing (271) and tighten socket bolts (401).

IMPORTANT

1. **Start to reassemble from the rear pump, which facilitates the reassembly.**
2. **Take care not to set valve block in the wrong direction (the ball regulator should be at the top and the suction flange at the right side when observed from the front side).**
3. **Insert gear #1 in valve block and connect it to spool line of the driveshaft.**

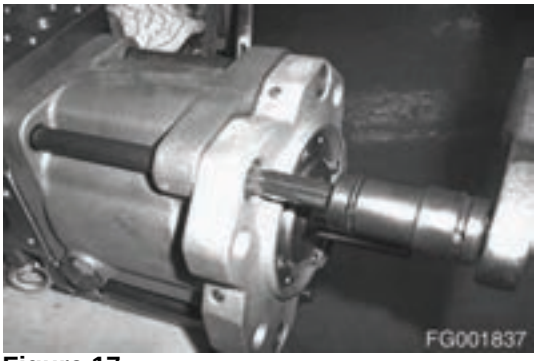


Figure 17

4. Insert feedback pin (548) of tilting pin (531) in the feedback lever of the regulator, connect the regulator and the PTO sub, and tighten socket bolts (412, 413).

IMPORTANT

Do not confuse the front and rear regulators with each other.

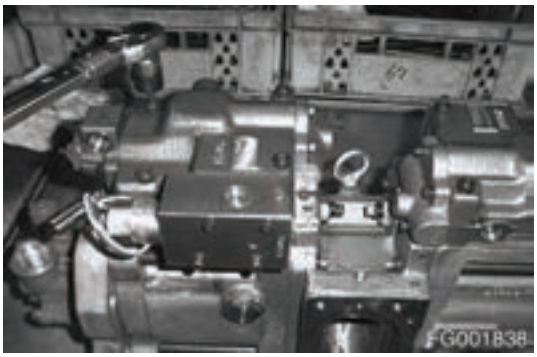


Figure 18

5. Install drain plug (468) to complete the reassembly procedure.

PUMP BODY MAINTENANCE STANDARDS

Change Standards of Worn Parts

Change or readjust parts which are worn more than references below. Always change, however, any parts which have clearly visible damage.

Parts and Checks	Standard References/Change References		Remarks
	Pump Types		
	T5V80	T5V112	
Gap between Piston and Cylinder Bore (ØD- Ød) (See Figure 1)	0.028 0.056	0.039 0.067	Change piston or cylinder block.
Gap between Piston and Shoe Pressing Part (and) (See Figure 2)	0~0.1 0.3	0~0.1 0.3	Change piston and shoe assembly.
Thickness of Shoe (t) (See Figure 2)	3.9 3.7	4.9 4.7	Change piston and shoe assembly.
Free Field of Cylinder Spring (L) (See Figure 3)	31.3 30.2	41.1 40.3	Change cylinder spring.
Height of Push Plate and Flexible Bushing Assembly (See Figure 4)	10.5 9.8	12.0 11.0	Change push plate or flexible bushing

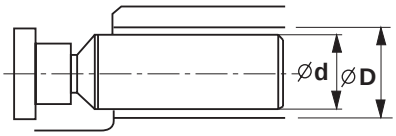


Fig. 1 Gap between Piston and Cylinder Bore

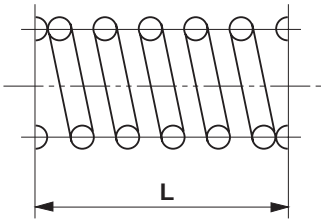


Fig. 3 Free Field of Cylinder Spring : L

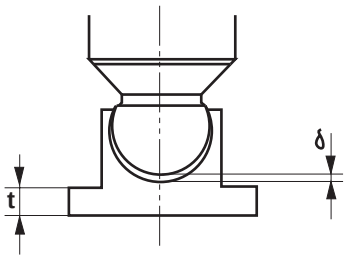


Fig. 2 Gap between Piston and Shoe Pressing Part : δ
Thickness of Shoe : T

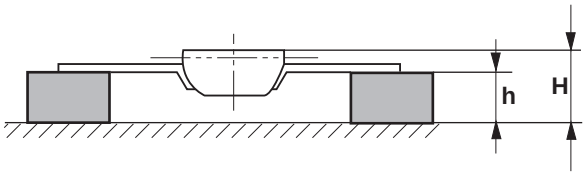


Fig. 4 Height of Push Plate and
Spherical Bushing Assembly : H-h

FG007123

Figure 19

Fix Standards of Cylinder Block, Valve Plate, and Swash Plate (Shoe Plate)

Valve Plate (Sliding Part) Swash Plate (Shoe Plate Part)	Adjustment Needed Surface Intensity of Illumination	0.8a (3.2z)
Intensity of Illumination Each Face of Cylinder Block (Sliding Part)	Standard Surface Intensity of Illumination (Adjusted Value)	Below 0.1a (0.4z) (Lopping)

PTO Server

Edition 1

Table of Contents

PTO Server

Safety Instructions 5
Applicable Models 5
Pump Maintenance 6
Disassembly 7
Reassembly 9
Maintenance Standards of Pump Body 10

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

PUMP MAINTENANCE

1. Tools

The following tools are needed for the disassembly and reassembly of the PTO server:

Tools	B	Parts List
Hex Wrench	10	Hex Bolt (M10) Flange Socket Bolt (10)
Flyer TRR150 TRR200	/	Retaining Ring RR-20 Retaining Ring RR-72

2. Tightening Torque

Parts	Size	Torque Values (kgf·m)
Socket Bolt (Material: SOM435) Flange socket Bolt	M10 M10	5.8 3.4

DISASSEMBLY

Read this Disassembly instructions throughly before starting to disassemble the PTO server, and follow the procedures below.

Numbers in the parentheses following the parts indicate the reference numbers in the next pump figures.

1. Select a place to disassemble the pump.

   NOTE: *The place should be clean.*
   Put a rubber sheet of cloth on the floor to prevent any damage to parts.

2. Remove dust or rust on the surface of the pump using lubricating oil.

3. Remove oil plug (468) to drain hydraulic oil in the pump casing.

   NOTE: *Drain the oil from both the front and the rear pumps.*

4. Remove the flange socket bolts and then the gear pump.

5. Remove hex socket bolt (414) and then the PTO server.

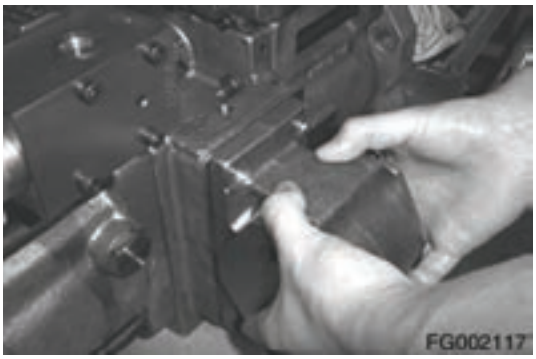


Figure 1

6. Remove retaining ring (827) and disassemble idle shaft (115), and remove the gear 2 (117), roller bearing (126), and bearing space (128).

   NOTE: *Do not remove roller bearing (126) from the gear 2 (117).*

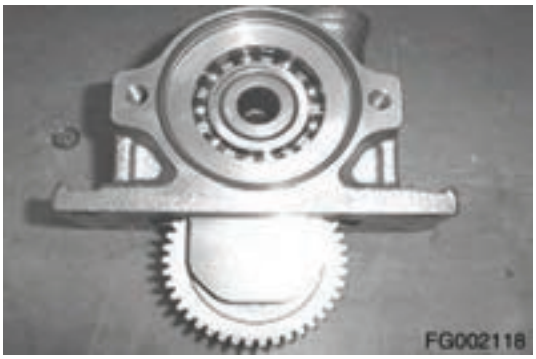


Figure 2

7. Remove retaining ring (825) and disassemble the gear 3 (118) and the ball bearing.

   NOTE: *Do not remove ball bearing (125) from the gear 3 (118).*

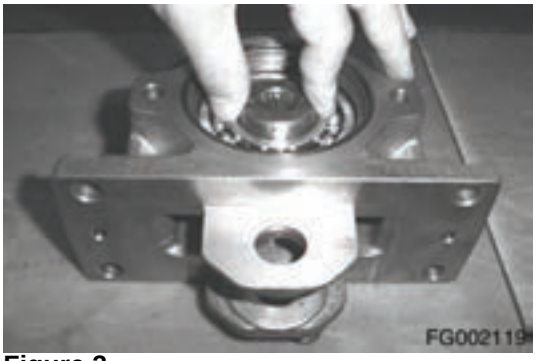


Figure 3

REASSEMBLY

Reassembly is the reverse order of the disassemble with cautions for:

1. Repair damaged parts during the disassembly and have spare parts prepared by hand.
2. Wash each part sufficiently with lubricating oil and dry them with compressed air before their reassembly.
3. Always apply clean lubricating oil to sliding parts and bearing before their reassembly.
4. Make it a rule to replace O-rings and oil seals.
5. Tighten fixing bolts and plugs with proper torque wrenches and with torques specified in the Maintenance Standards.

MAINTENANCE STANDARDS OF PUMP BODY

1. Standards to Replace Worn Parts

   Replace gears 2 (117) and 3 (118) whose teeth have pitting (the size of 1 ft is the same and below 1 mm or is more than 5% of the area). Any parts whose appearance is severly damaged should be replaced also.

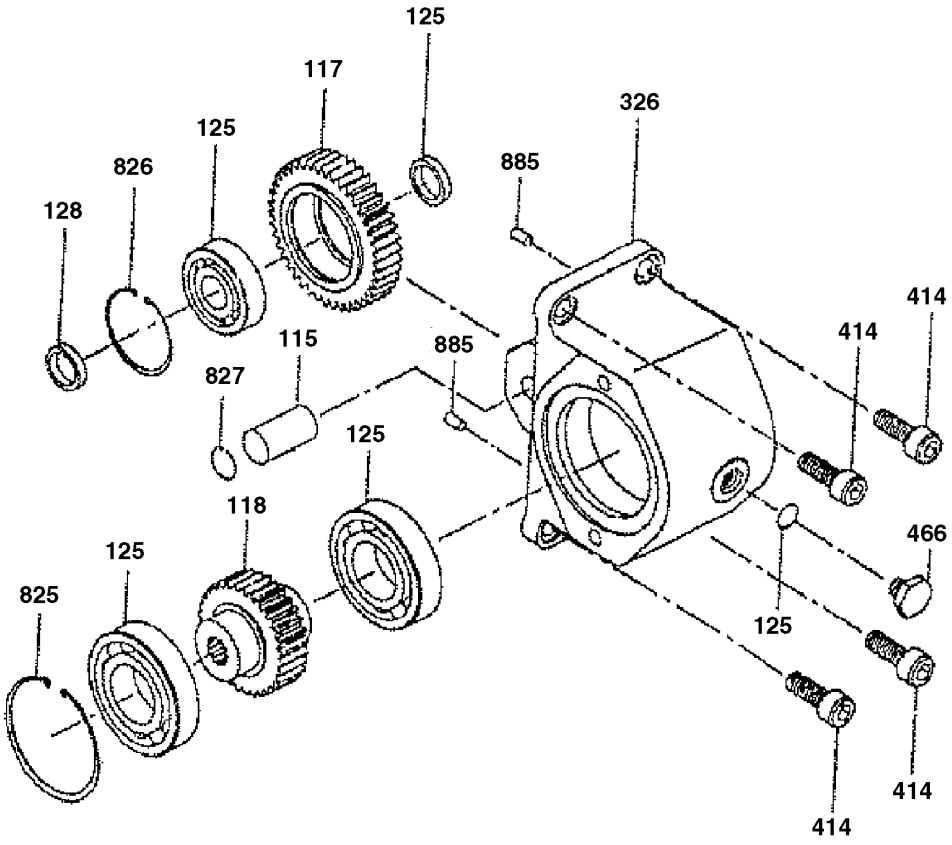


Figure 4

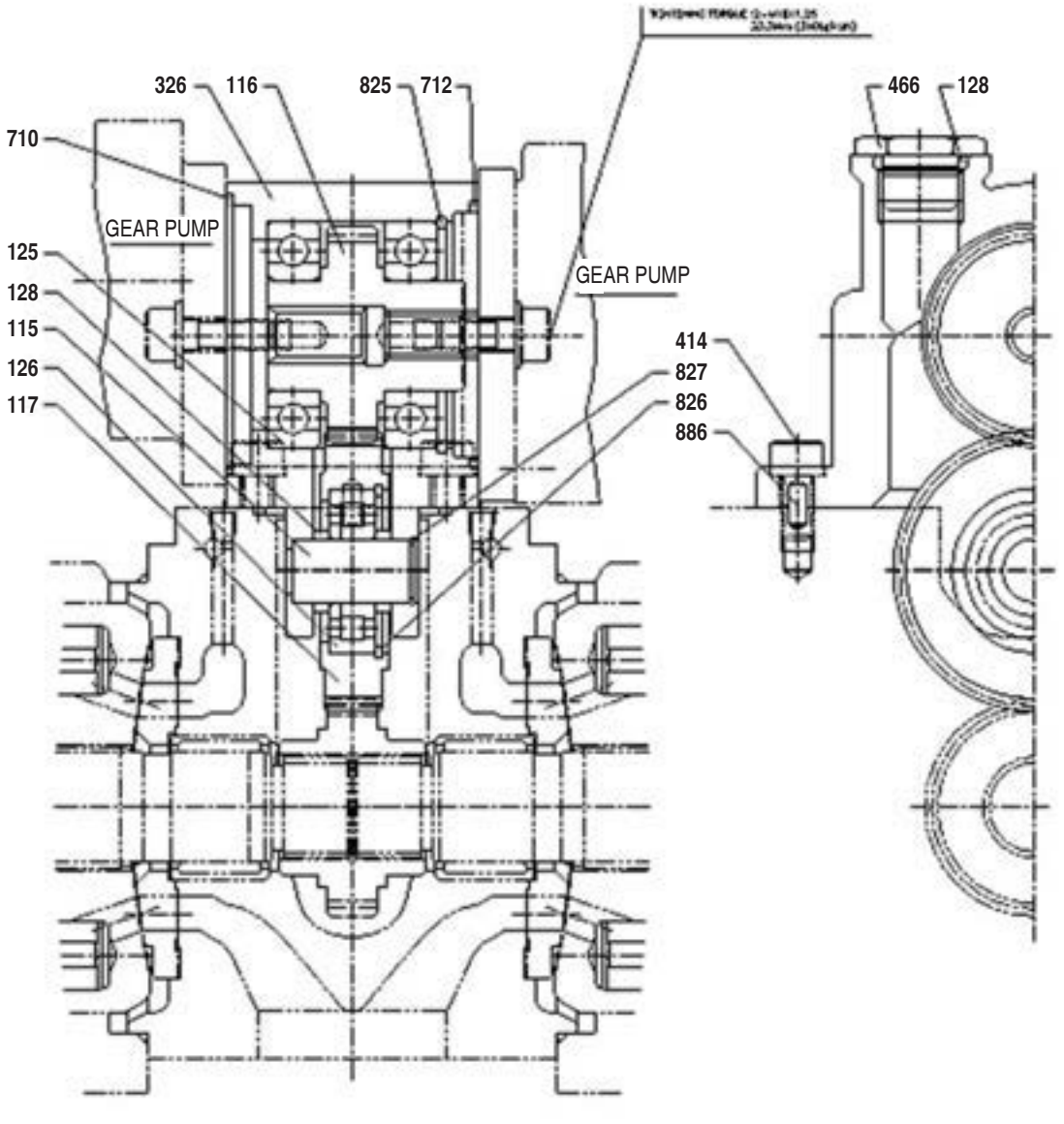


Figure 5

Reference	Parts
886	Pin
827	Retaining Ring
826	Retaining Ring
825	Retaining Ring
728	O-ring
712	O-ring
710	O-ring
466	VP Plug

Reference	Parts
414	Socket Bolt
326	Gear Case
128	Bearing Spacer
126	Roller Bearing
125	Ball Bearing
118	Gear 3
117	Gear 2
115	Idle Shaft

Gear Pump

Edition 1

MEMO

Table of Contents

Gear Pump

Safety Instructions 5
Applicable Models 5
Single Gear Pump 6
Disassembly 6
Reassembly 8

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

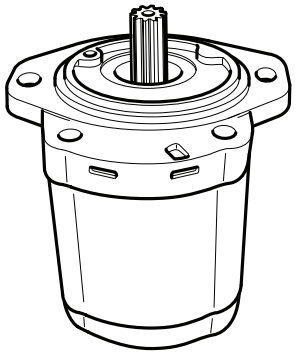
The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

SINGLE GEAR PUMP

Disassembly

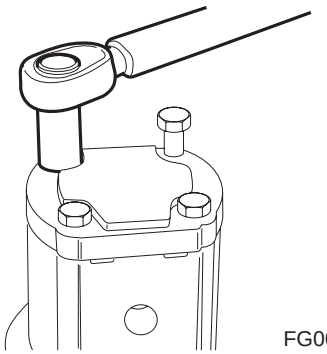
1. Clean exterior of pump.



FG001072

Figure 1

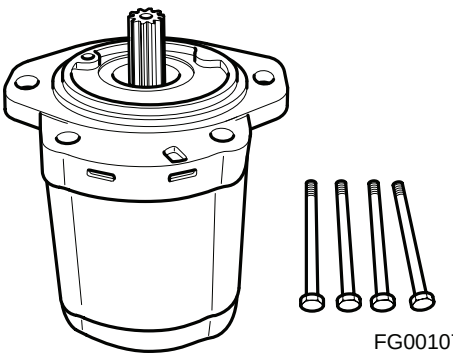
2. Remove clamp bolts.



FG001074

Figure 2

3. Cover sharp edges of driveshaft 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.*

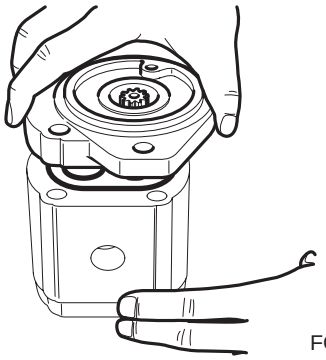

FG001075

Figure 4

5. Remove retaining ring, if replacement is necessary.

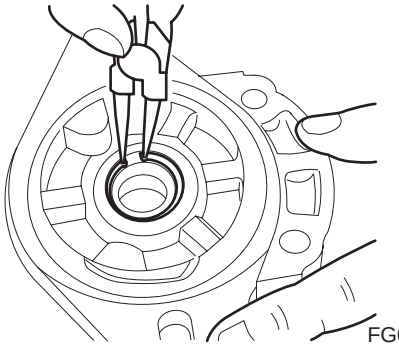

FG000834

Figure 5

6. Remove shaft seal taking care not to damage surface of shaft hole, if replacement is necessary.

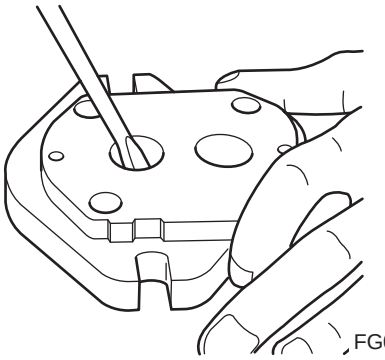

FG000835

Figure 6

7. Pull drive gear up to facilitate removal of front plate.

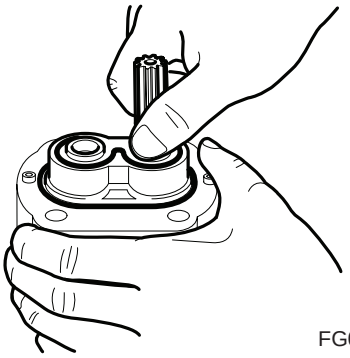

FG001076

Figure 7

8. Remove driving gear and driven gear, keeping gears as straight as possible.

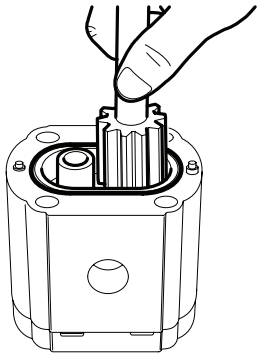


Figure 8

9. Remove rear plate and end cover.

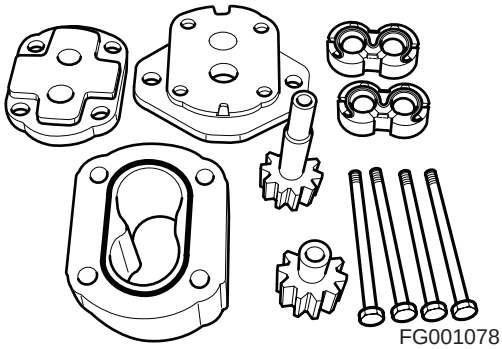


Figure 9

Reassembly

1. Clean all components with care.

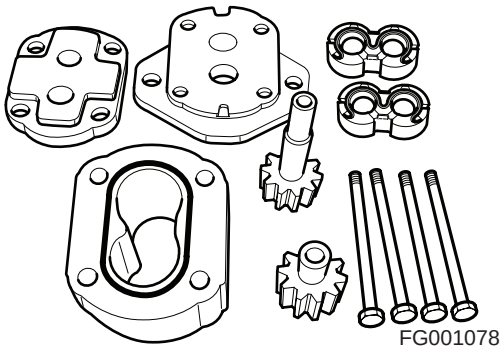


Figure 10

2. Using a suitable driver, install shaft seal in mounting flange.

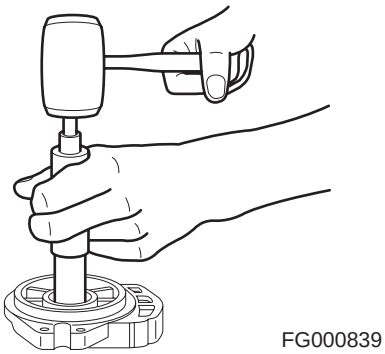


Figure 11

3. Install retaining ring in groove.

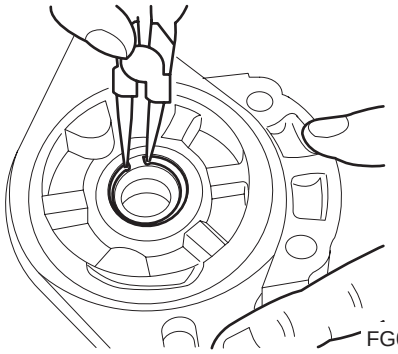


Figure 12

4. Install O-ring on both sides of rear section of body.

   NOTE: *Coat O-rings with grease to hold O-rings in body.*

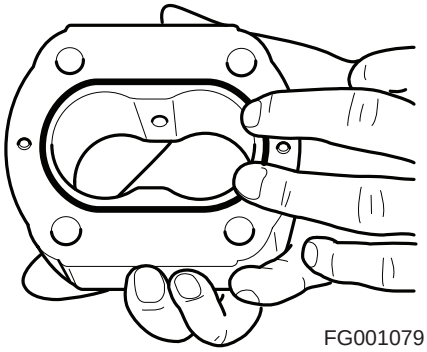


Figure 13

5. Install rear section body on rear cover.

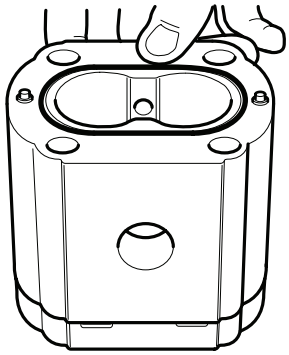


Figure 14

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.*

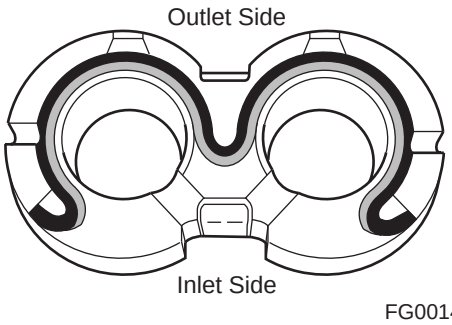


Figure 15

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.*


FG001081

Figure 16

8. Install drive gear and driven gear.

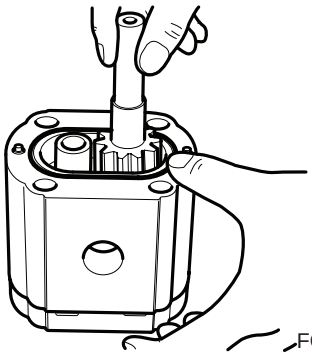

FG001082

Figure 17

9. Insert pressure plate into body in proper direction.

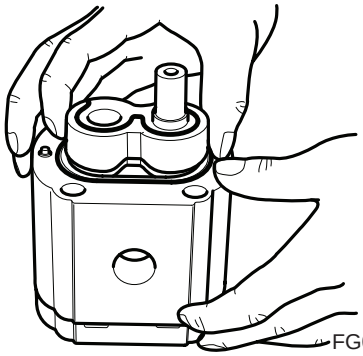

FG001083

Figure 18

10. Locate mounting flange in right position.

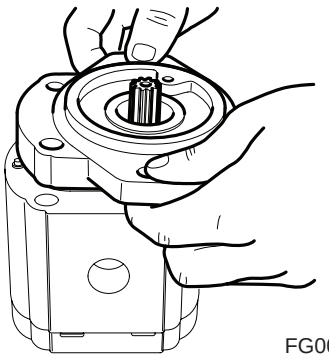
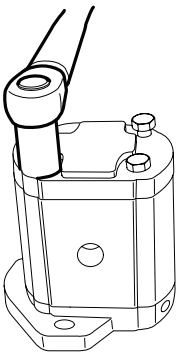

FG001084

Figure 19

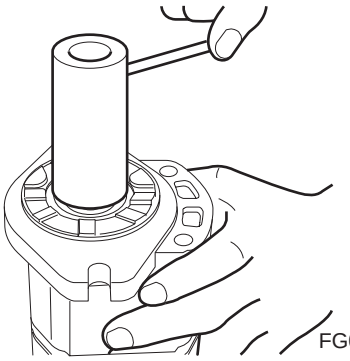
11. Tighten bolts with washer in a crisscross pattern to a torque value of 45 Nm.



FG001085

Figure 20

12. Check that pump rotates freely when driveshaft is turned by hand. If not a pressure plate seal may be pinched.



FG000851

Figure 21

Main Control Valve

Edition 1

MEMO

Table of Contents

Main Control Valve

Safety Instructions 5
Applicable Models 5
General Description 6
Theory of Operation 6
Parts List 38
Specifications 43
Troubleshooting, Testing and Adjustment 44
Troubleshooting 44
Adjustment of Valves 45
Removal 47
Disassembly 48
Cleaning and Inspection (Wear Limits and Tolerances) 57
Cleaning 57
Inspection 57
Reassembly 58
Caution on Assembly 58
Sequence of Subassembly 59
Maintenance of Relief Valves 65
Installation 68
Start-up Procedures 69

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up

GENERAL DESCRIPTION

Theory of Operation

When All Spools are in Neutral

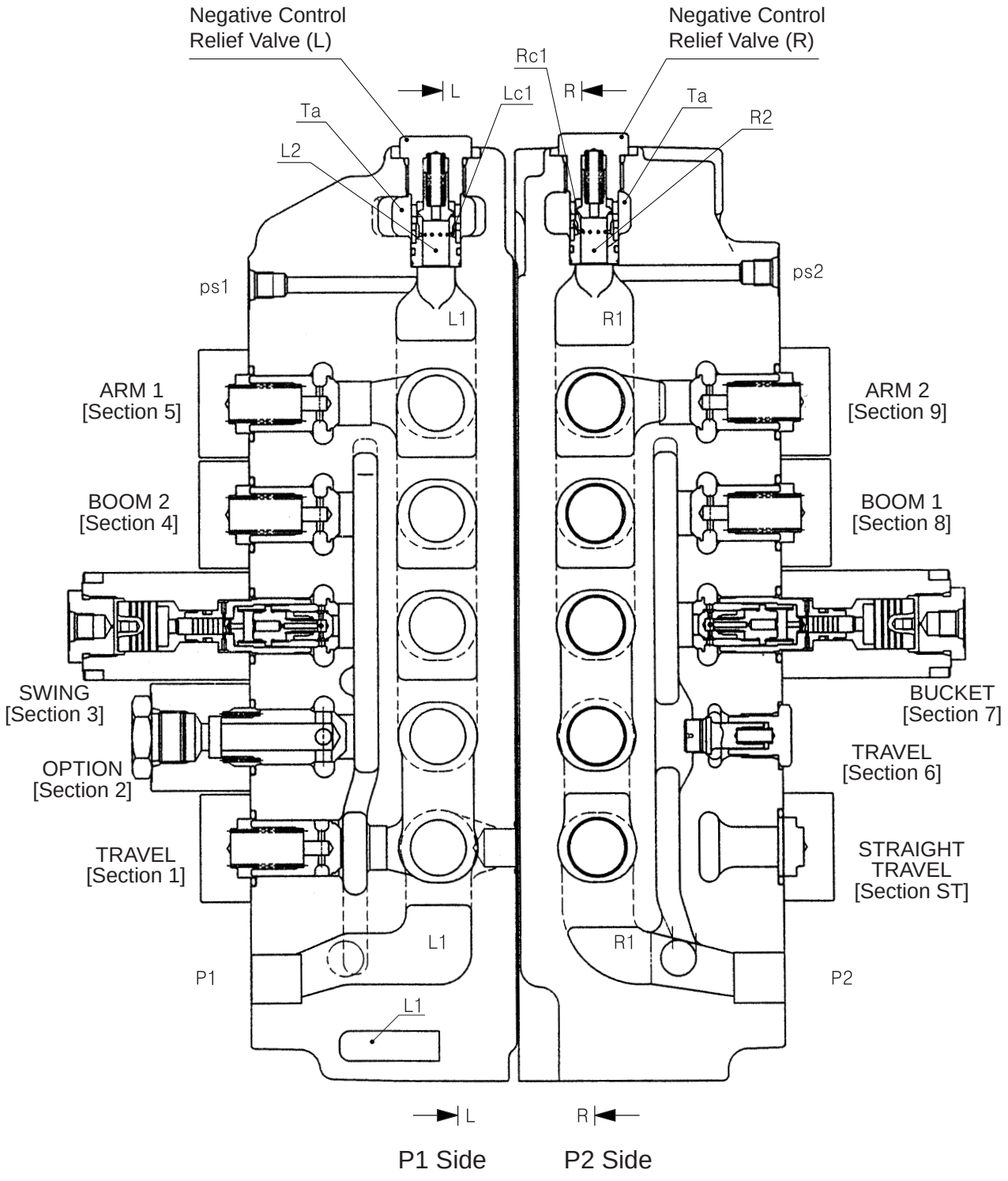
Neutral Passage

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 into the neutral passage, the negative relief operates to prevent the abnormally high-pressure on ports (ps1 and ps2).



FG001295

Figure 1

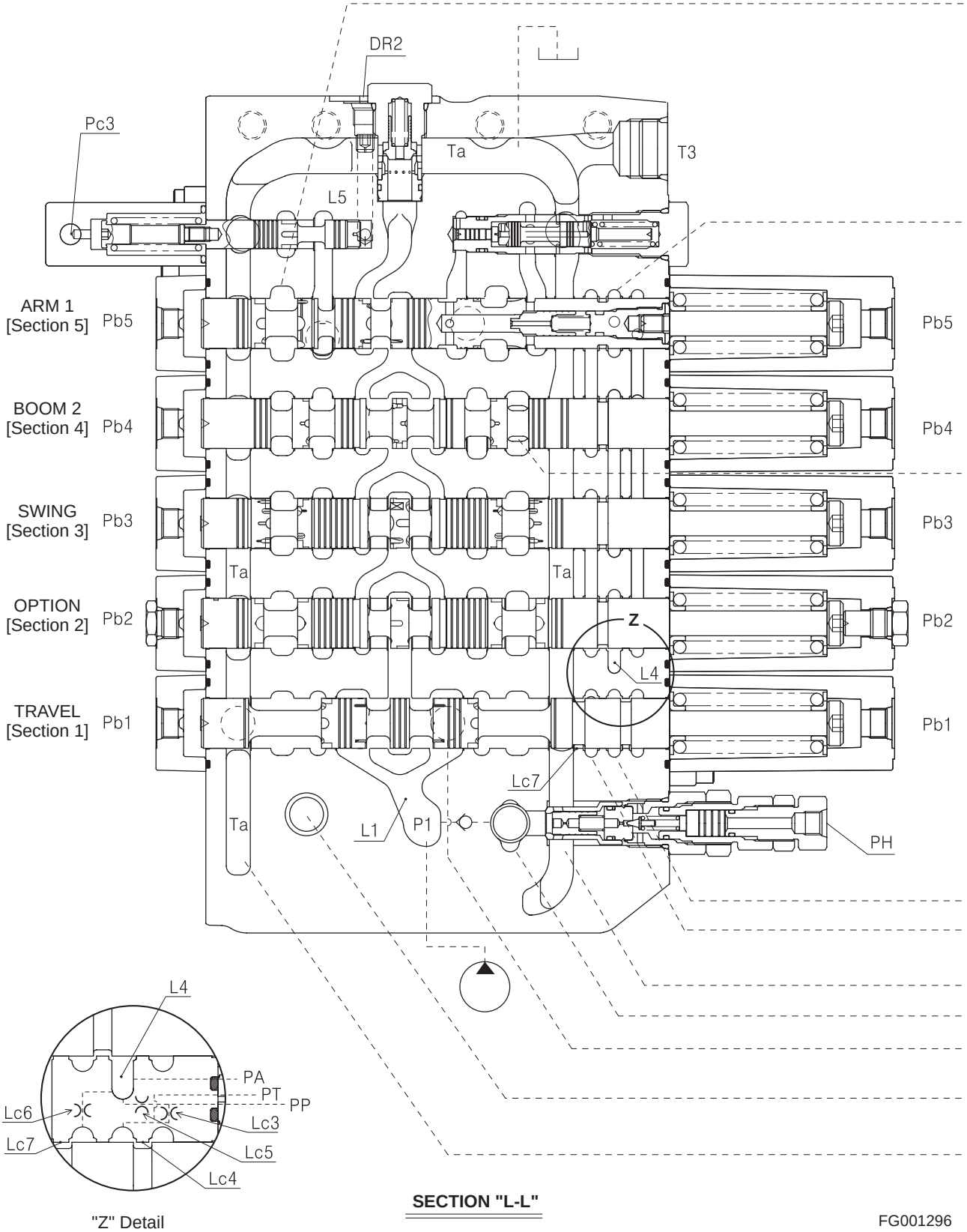
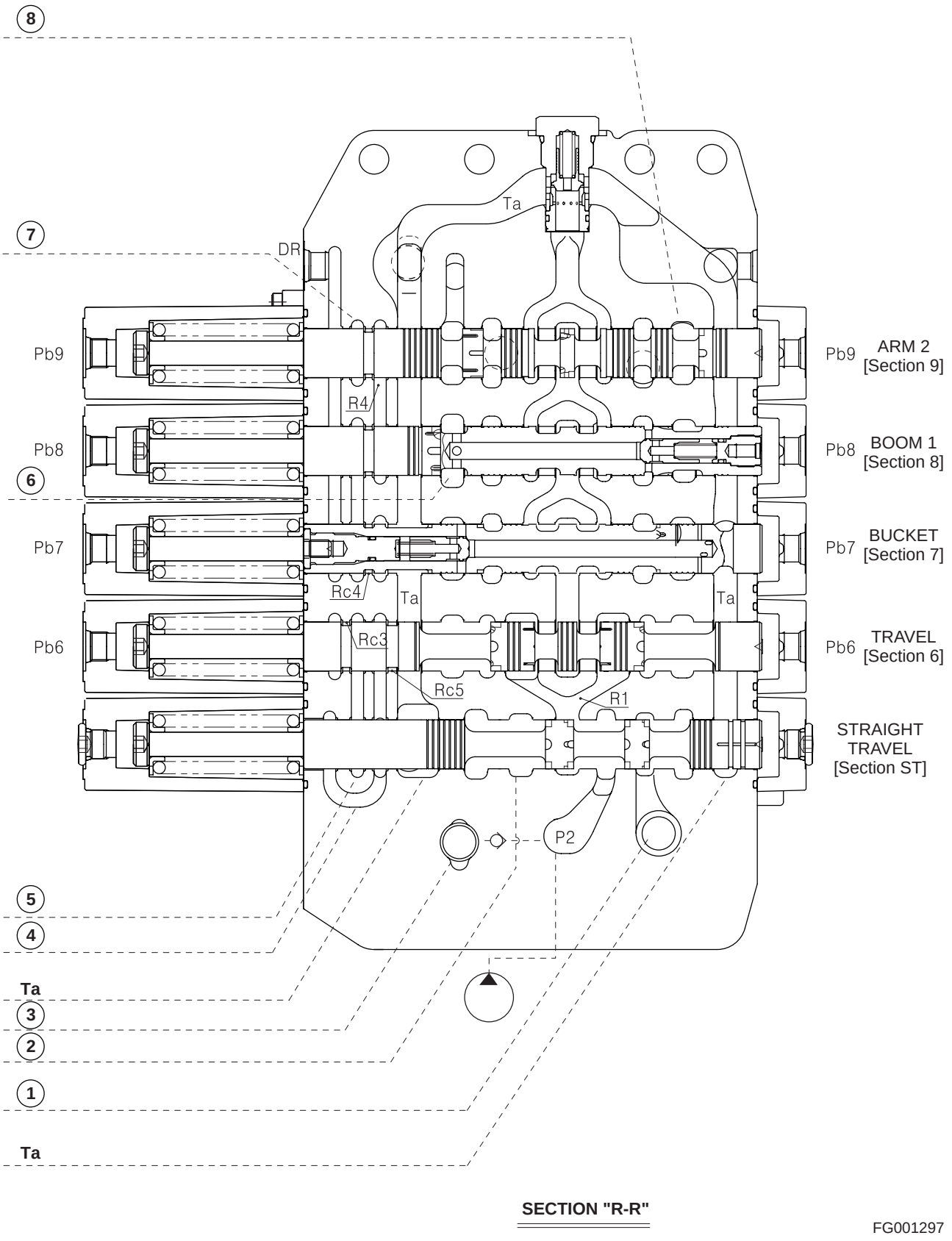

DR2
Pc3
Ta
T3
L5
ARM 1
[Section 5]
Pb5
BOOM 2
[Section 4]
Pb4
SWING
[Section 3]
Pb3
OPTION
[Section 2]
Pb2
TRAVEL
[Section 1]
Pb1
Ta
Ta
Z
L4
Lc7
Ta
L1
P1
PH
L4
PA
PT
PP
Lc6
Lc3
Lc7
Lc5
Lc4
"Z" Detail
SECTION "L-L"
FG001296

Figure 2



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).

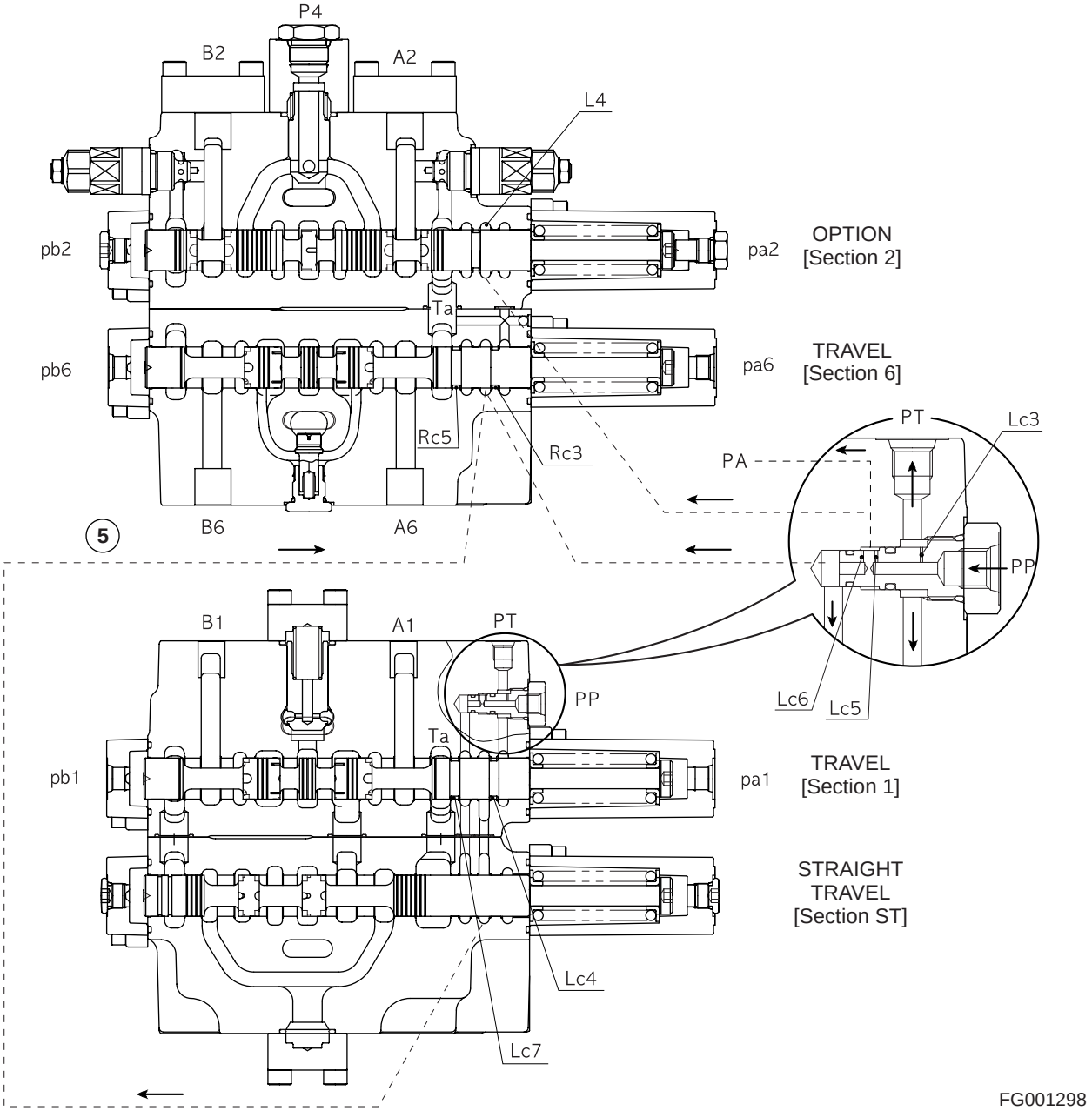


Figure 4

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)). Now, 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 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).

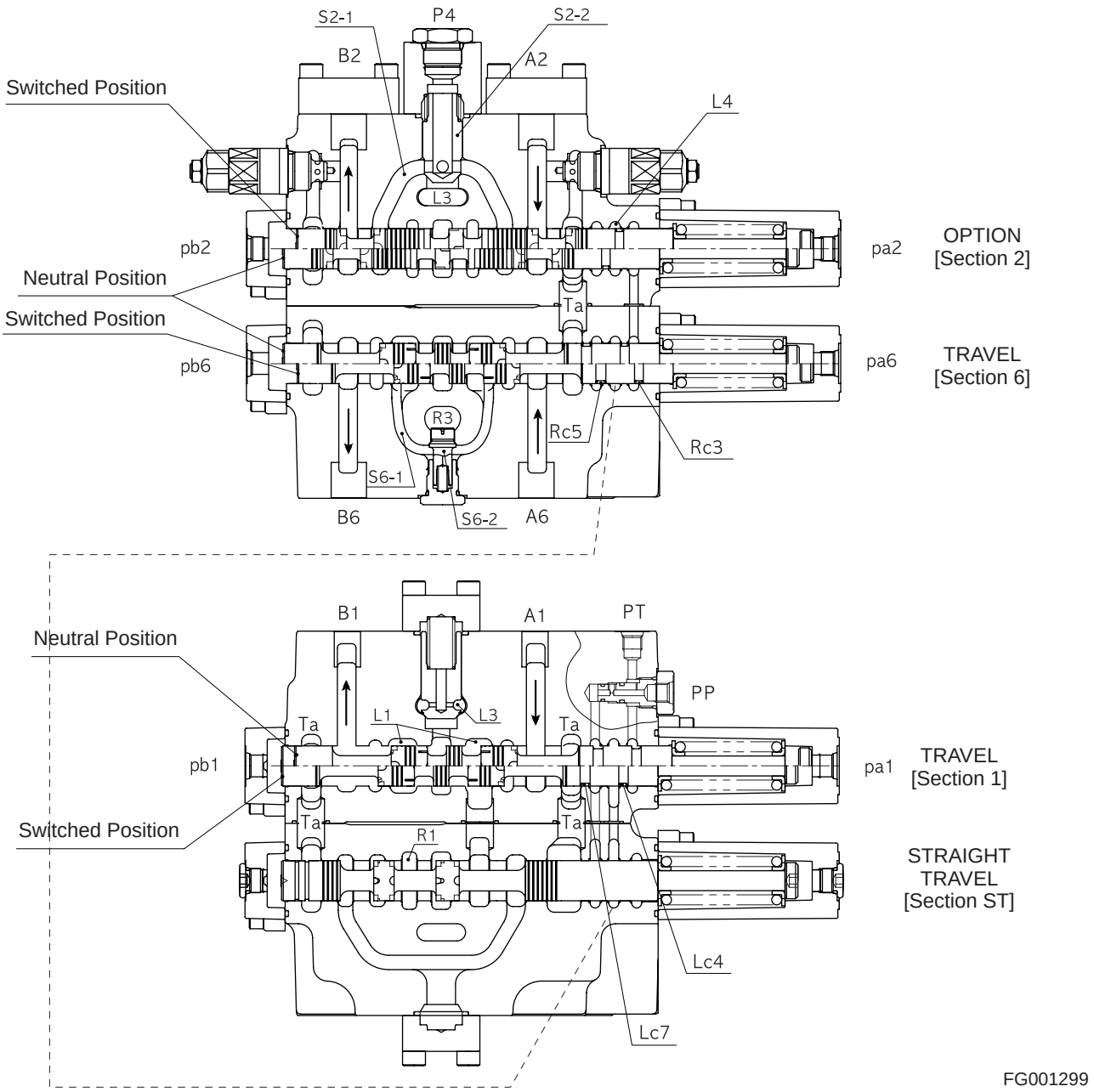

S2-1
P4
S2-2
B2
A2
Switched Position
L4
L3
pb2
pa2
OPTION
[Section 2]
Neutral Position
Switched Position
Ta
pb6
pa6
TRAVEL
[Section 6]
R3
Rc5
Rc3
S6-1
B6
S6-2
A6
B1
A1
PT
Neutral Position
PP
L1
L3
Ta
Ta
pb1
pa1
TRAVEL
[Section 1]
Switched Position
Ta
Ta
R1
STRAIGHT
TRAVEL
[Section ST]
Lc4
Lc7
FG001299

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).

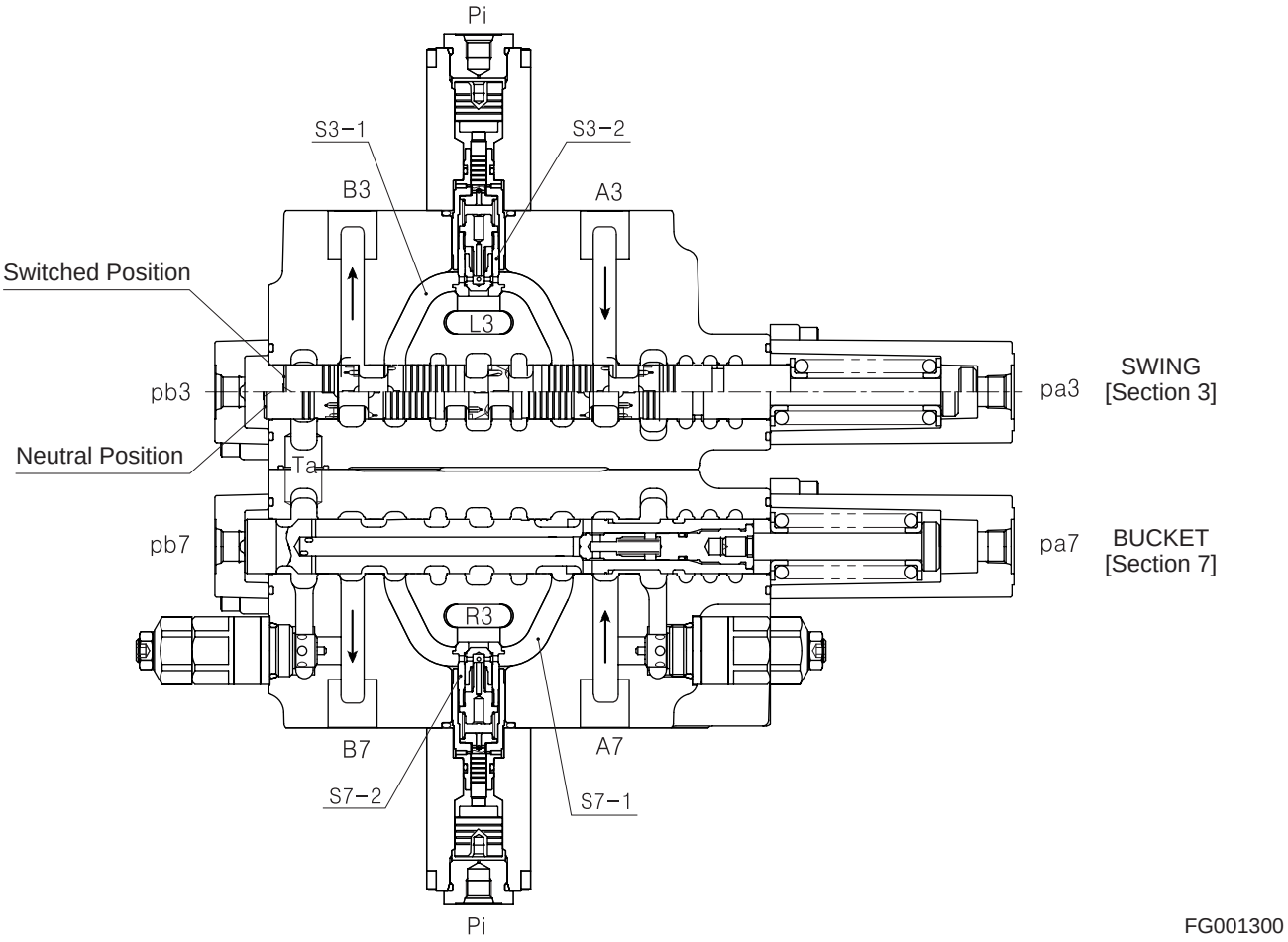

Pi
S3-1
S3-2
B3
A3
Switched Position
L3
pb3
pa3
SWING
[Section 3]
Neutral Position
Ta
pb7
pa7
BUCKET
[Section 7]
R3
B7
A7
S7-2
S7-1
Pi
FG001300

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).

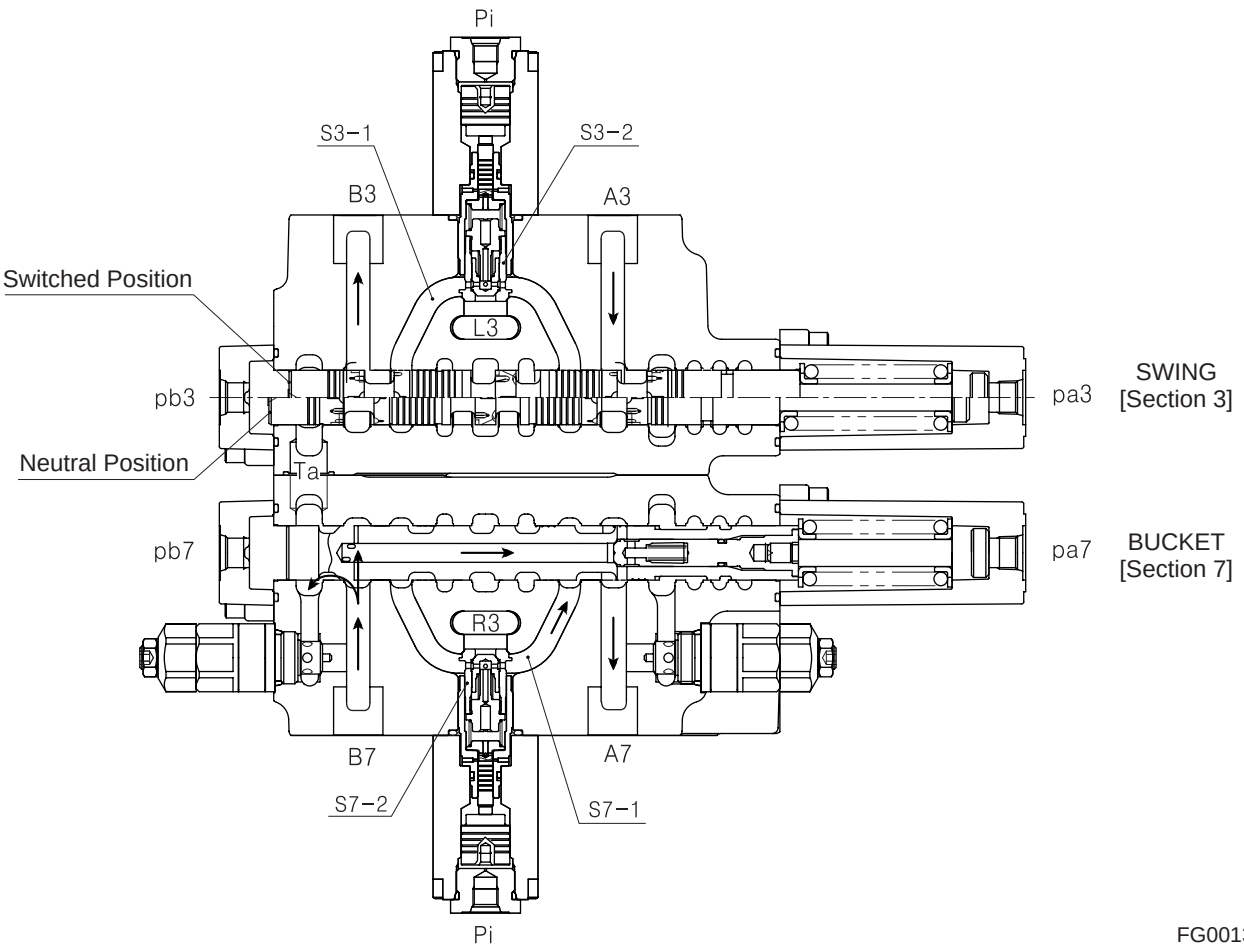


Figure 7

Boom Spool Shift

1. Neutral

   This valve also works with antidrift 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).

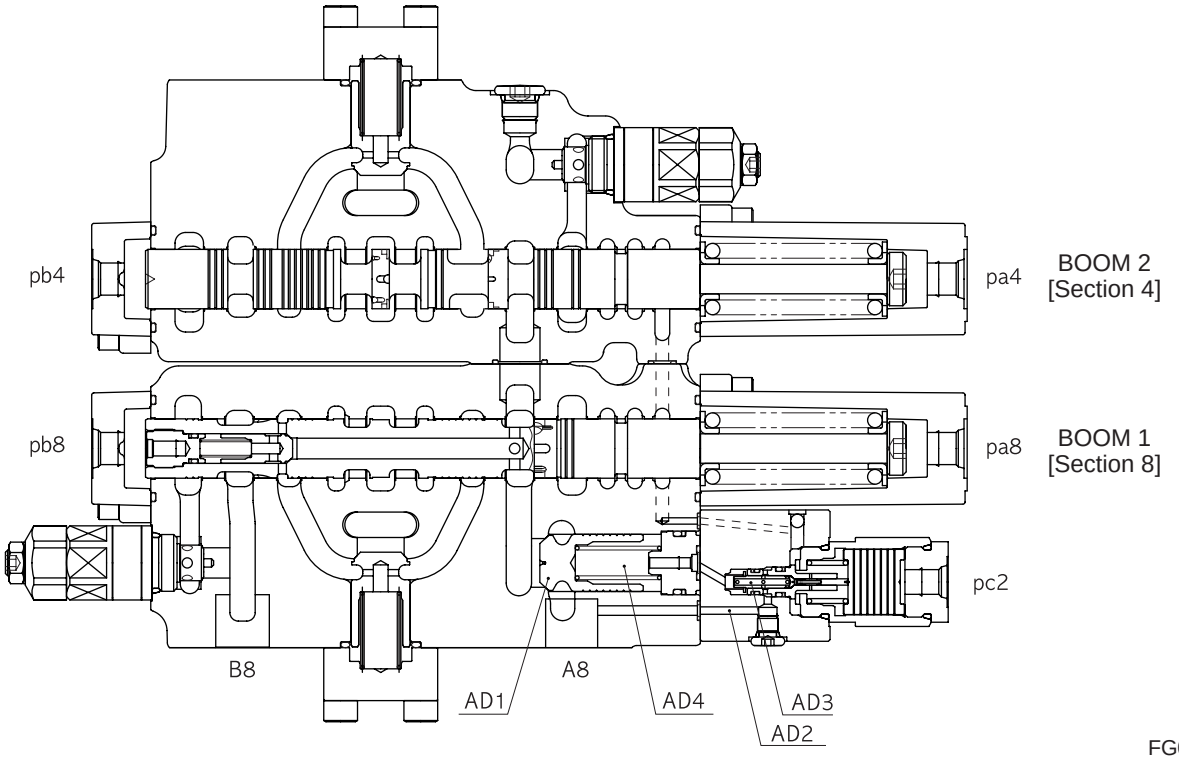


Figure 8

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).

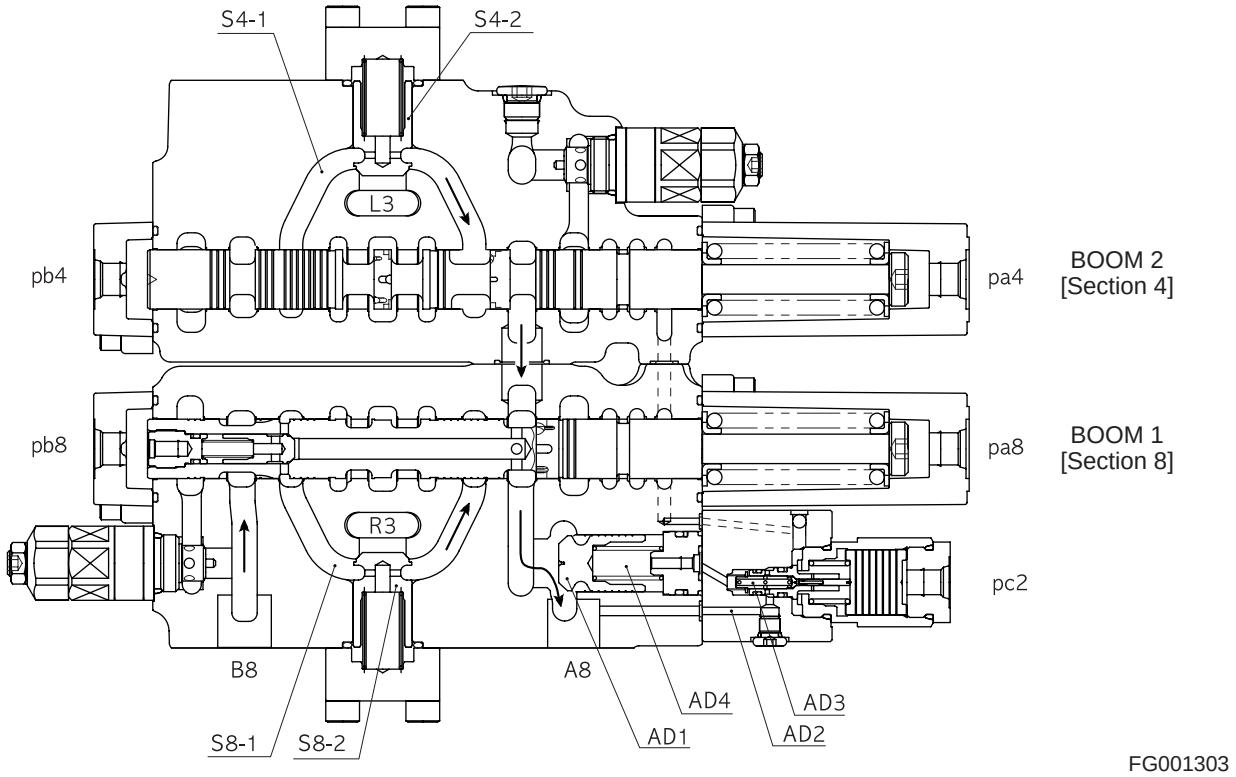


Figure 9

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.

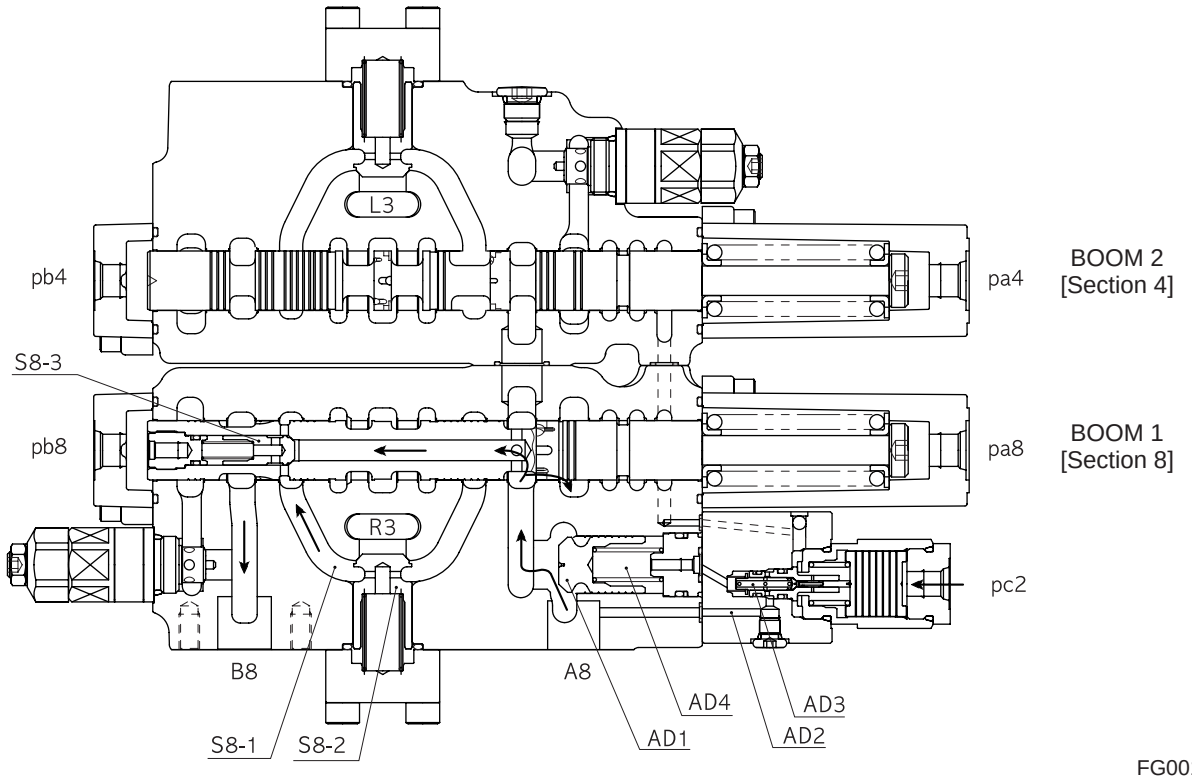


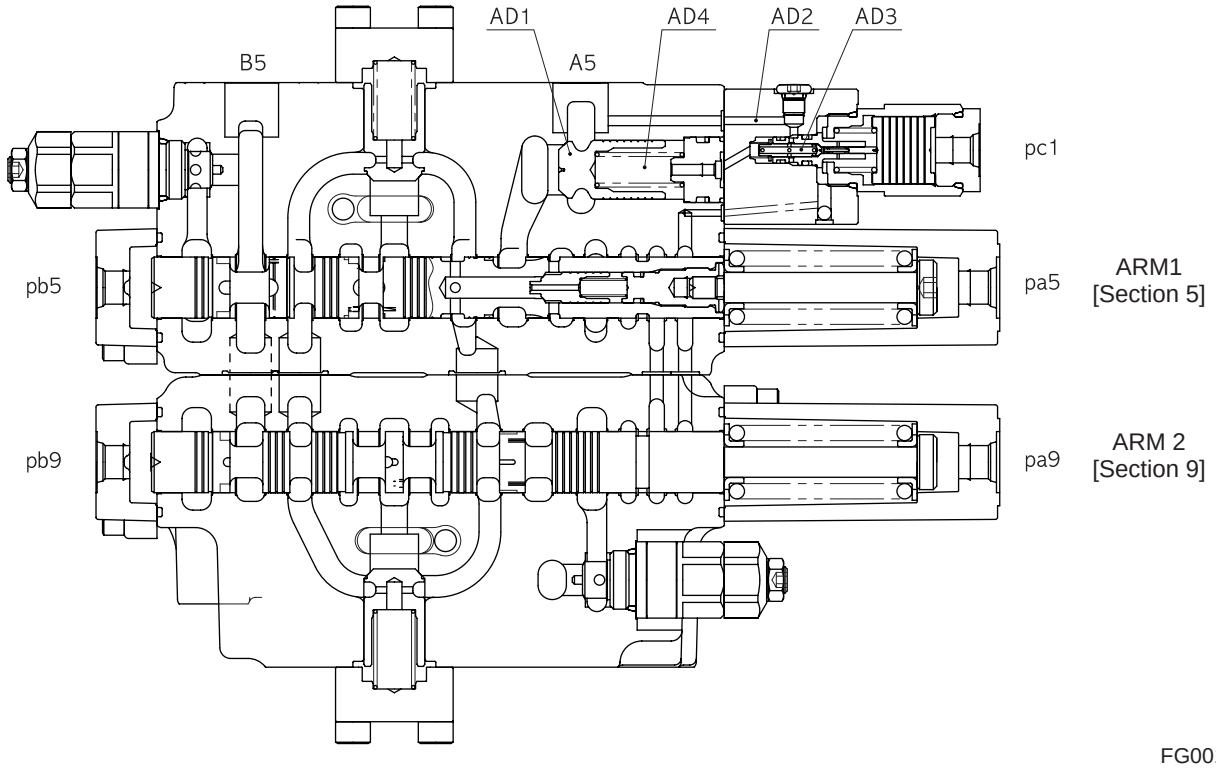
Figure 10

Arm Spool Shift

1. Neutral

   This valve also works with an antidrift 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).



FG001305

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)

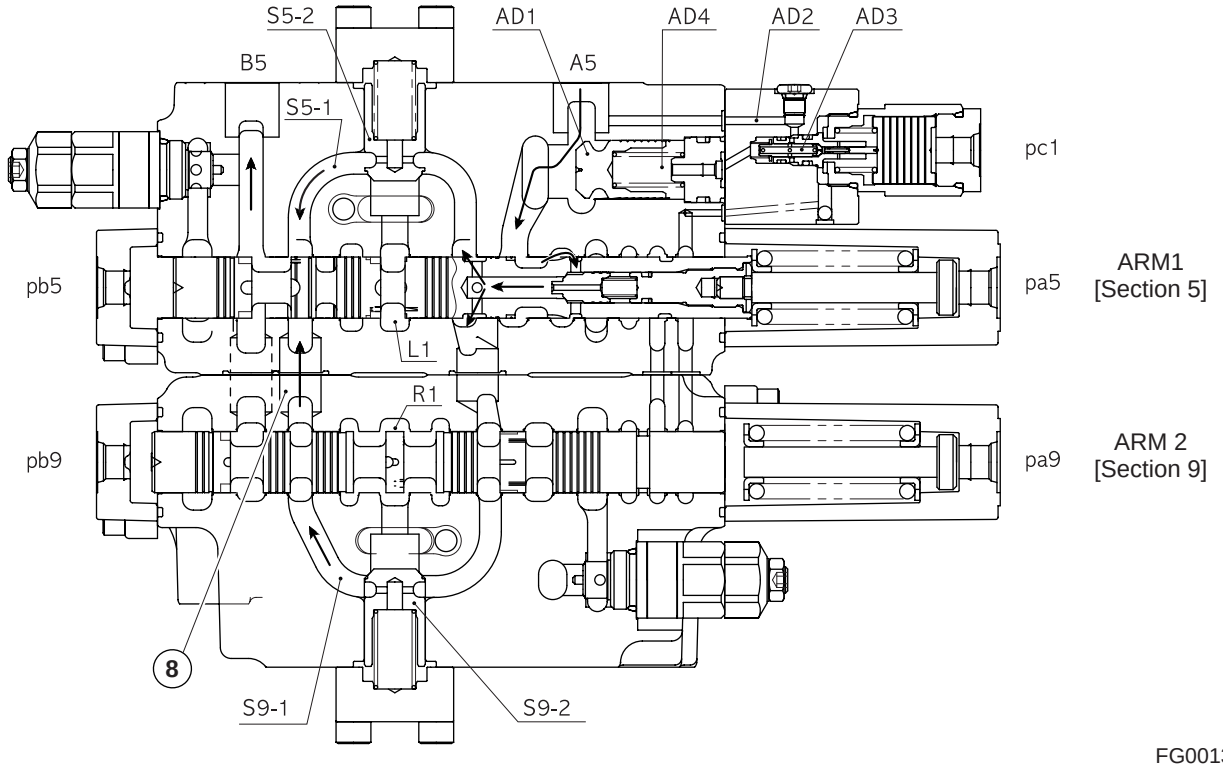


Figure 12

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.

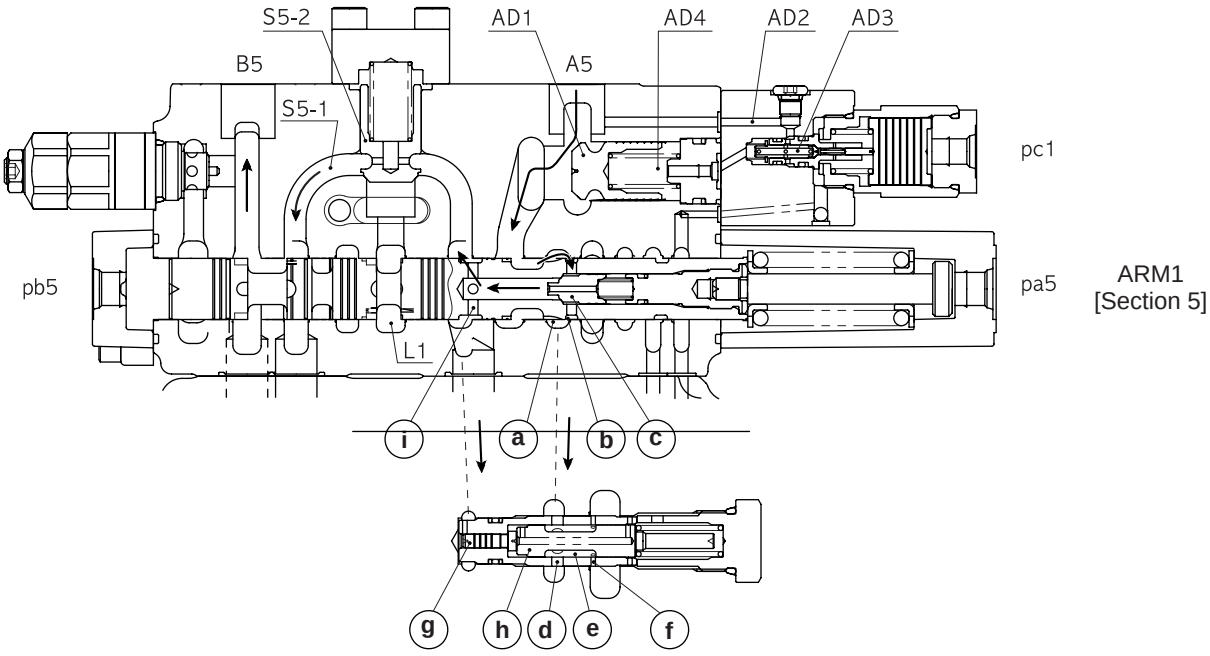
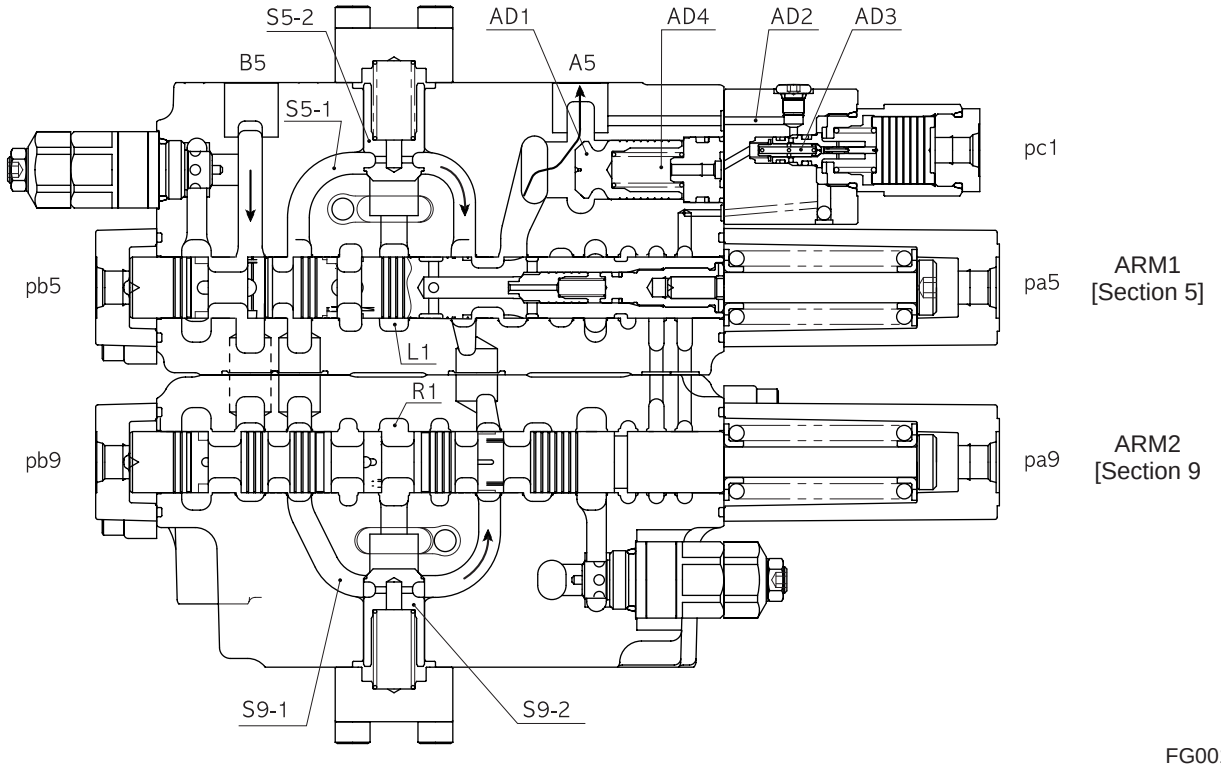


Figure 13

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).

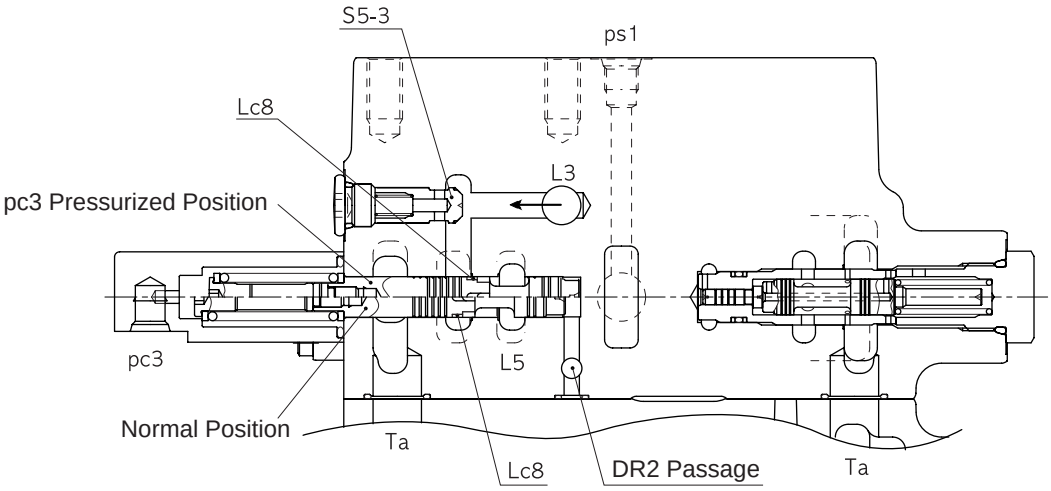


FG001308

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).



FG001309

Figure 15

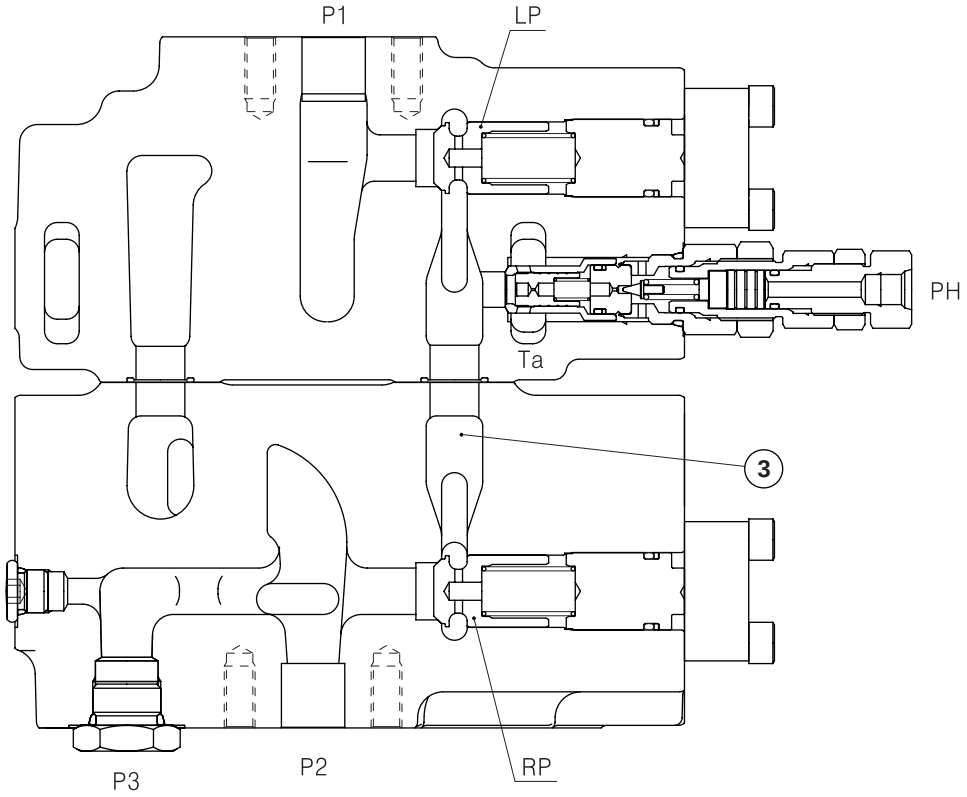
Relief Valve

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.



FG000631

Figure 16

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).

If the 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.

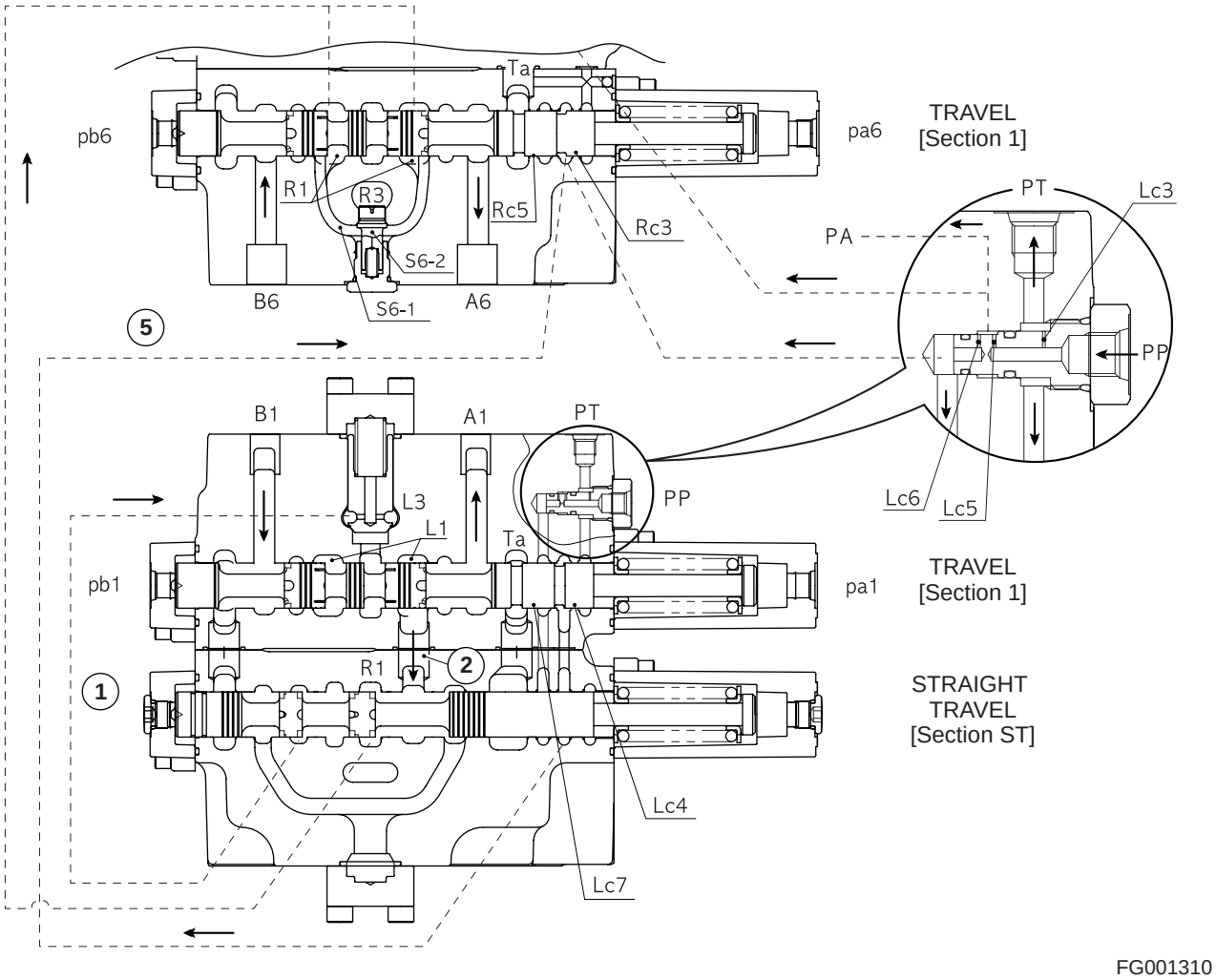

Ta
pb6
pa6
TRAVEL
[Section 1]
R1
R3
Rc5
Rc3
S6-2
S6-1
B6
A6
5
PT
Lc3
PA
PP
Lc6
Lc5
B1
A1
PT
L3
L1
PP
Ta
pb1
pa1
TRAVEL
[Section 1]
R1
2
1
STRAIGHT
TRAVEL
[Section ST]
Lc4
Lc7
FG001310

Figure 17

Bucket Compound Operation

A priority control valve is installed in bucket (Section 7). This valve controls oil flow entering 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.

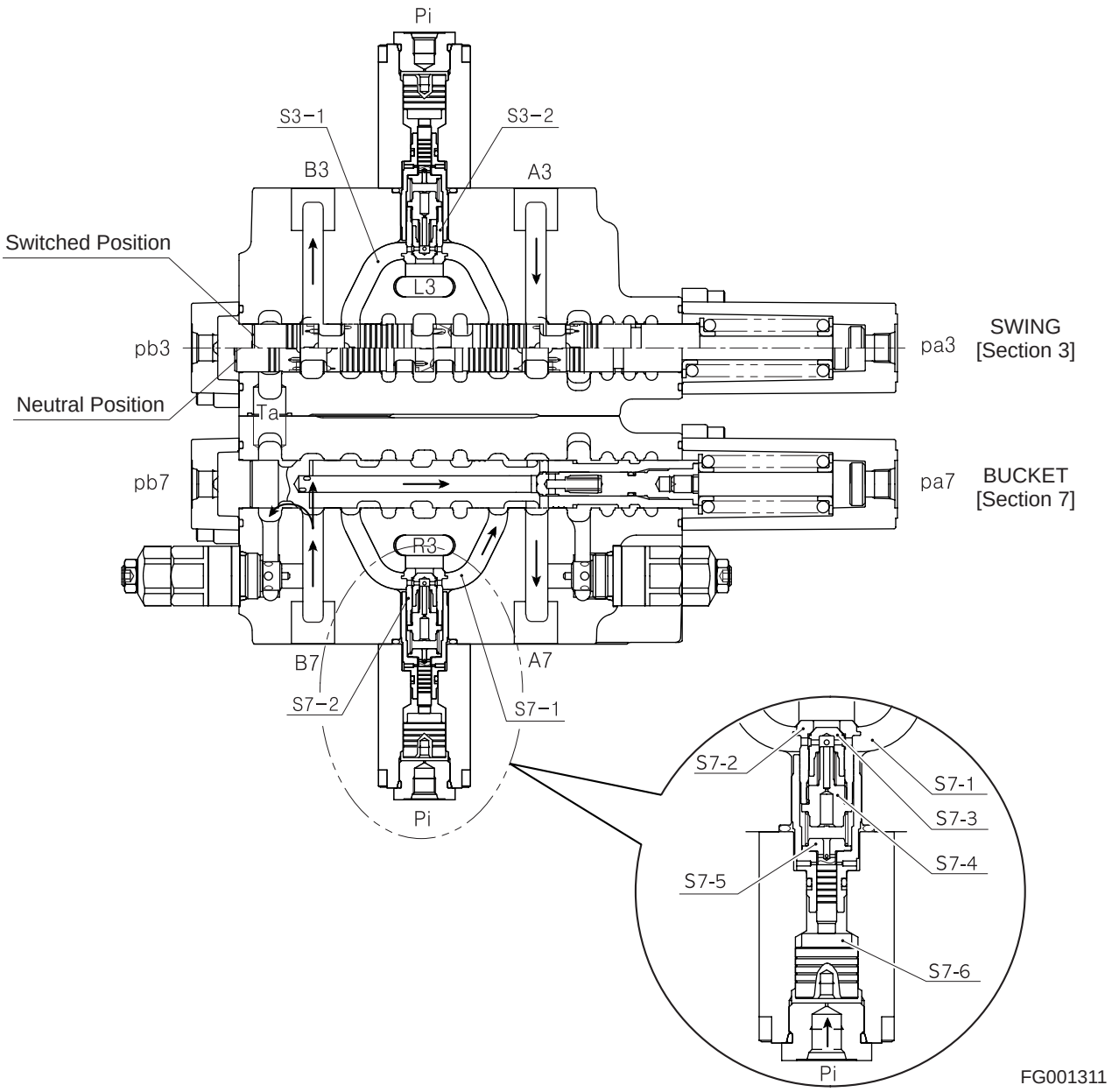

Pi
S3−1
S3−2
B3
A3
Switched Position
L3
pb3
pa3
SWING
[Section 3]
Neutral Position
Ta
pb7
pa7
BUCKET
[Section 7]
R3
B7
A7
S7−2
S7−1
Pi
S7-2
S7-1
S7-3
S7-4
S7-5
S7-6
Pi
FG001311

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 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).

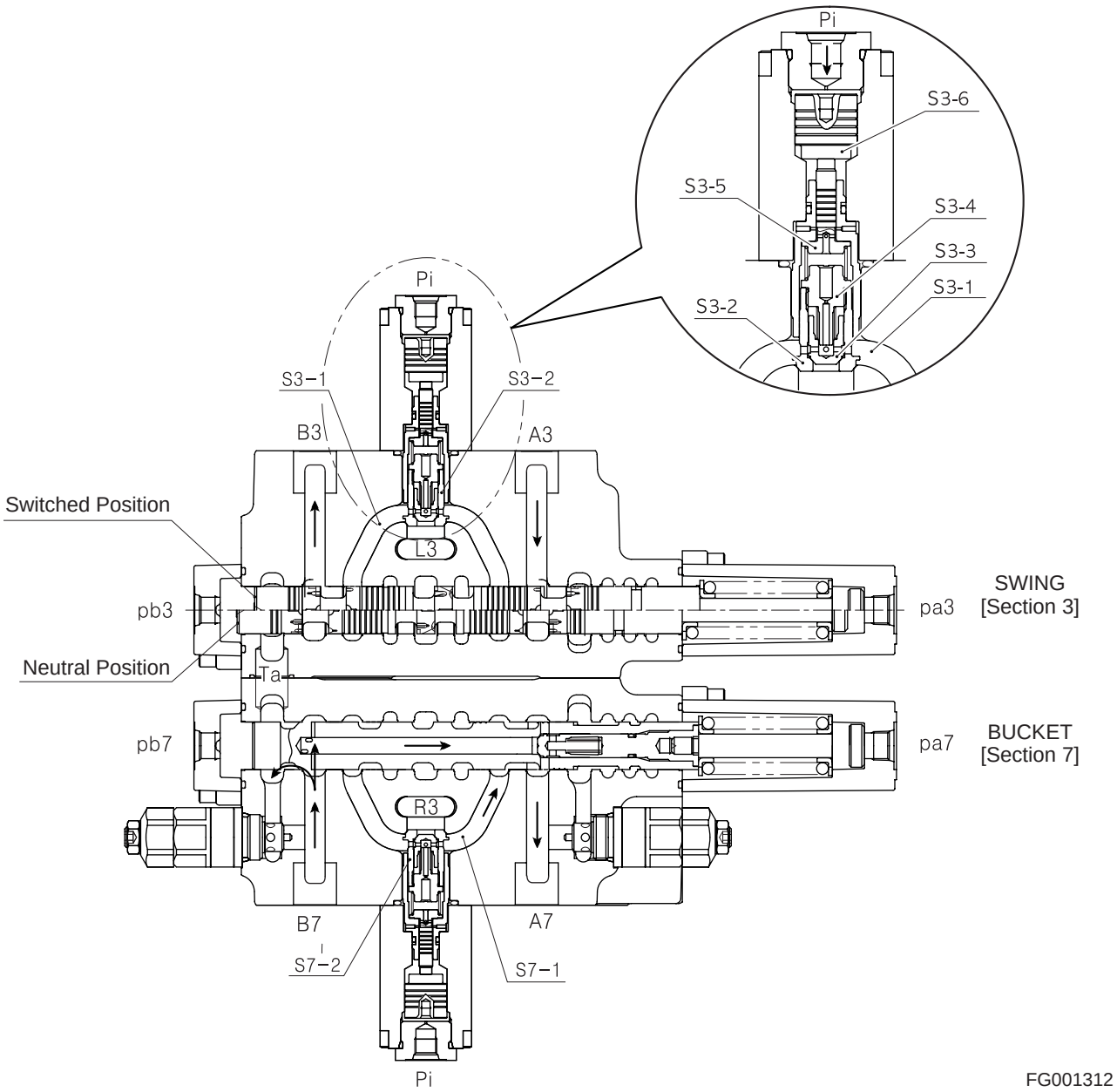

Pi
S3-6
S3-5
S3-4
S3-3
S3-1
S3-2
Pi
S3−1
S3−2
B3
A3
Switched Position
L3
pb3
pa3
SWING
[Section 3]
Neutral Position
Ta
pb7
pa7
BUCKET
[Section 7]
R3
B7
A7
S7−2
S7−1
Pi
FG001312

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). Now pressurized oil flow, from port (A5) is cut off by seats (S1 and S2).

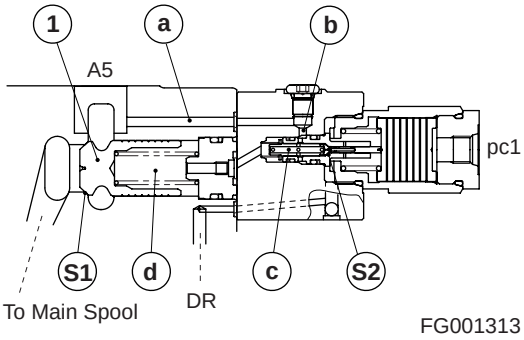


Figure 20

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).

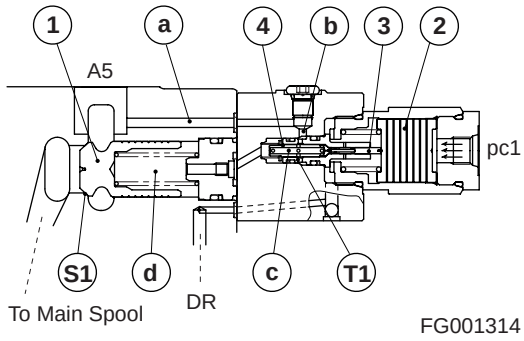


Figure 21

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.

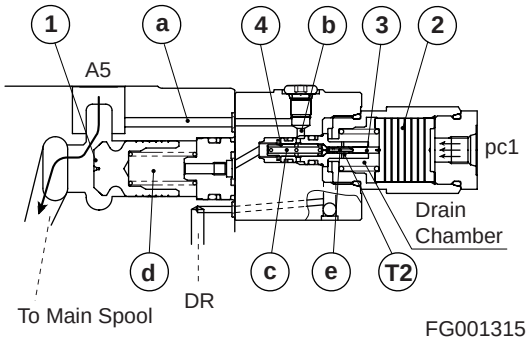
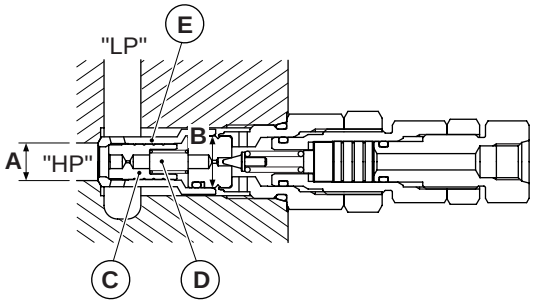


Figure 22

Main Relief Valve

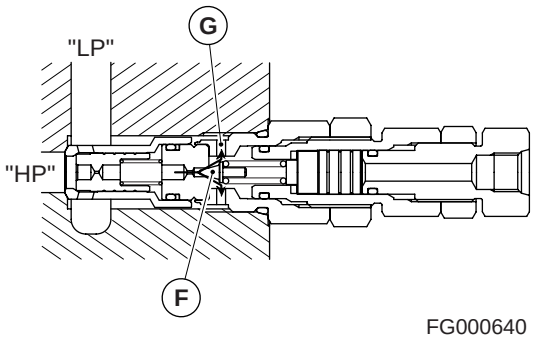
1. The main relief valve is between neutral oil passage (HP, Figure 23) and low-pressure oil passage (LP). Pressurized oil flows into neutral oil passage (HP) through orifice in the main poppet (C) to fill internal cavity (D). Due to the difference in areas between (A and B), on which hydraulic pressure acts, main poppet (C) seats on sleeve (E).



FG000639

Figure 23

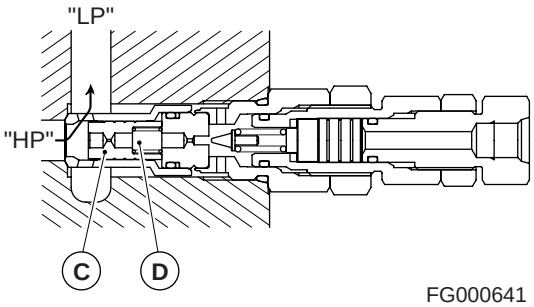
2. When pressure in neutral oil passage (HP) rises and exceeds relief valve setting, pilot poppet (F) opens. Pressurized oil flows through pilot poppet (F) into low-pressure oil passage (LP), passing through hole (G).



FG000640

Figure 24

3. As pilot poppet (F) opens, pressure in internal cavity (D) lowers to move main poppet (C) so pressurized oil flows into neutral oil passage (HP) and directly into low-pressure oil passage (LP).

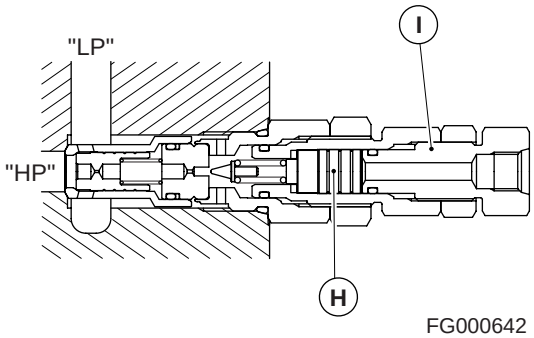


FG000641

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 the force of spring increases, thus increasing pressure in the neutral oil passage (HP).



FG000642

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).

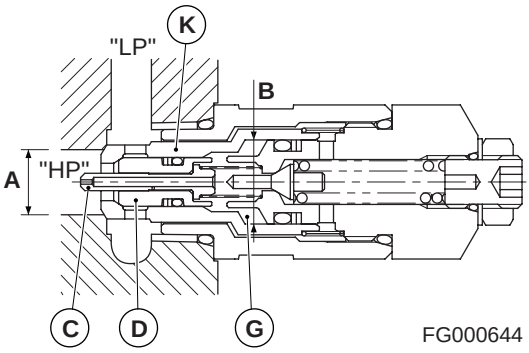


Figure 27

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).

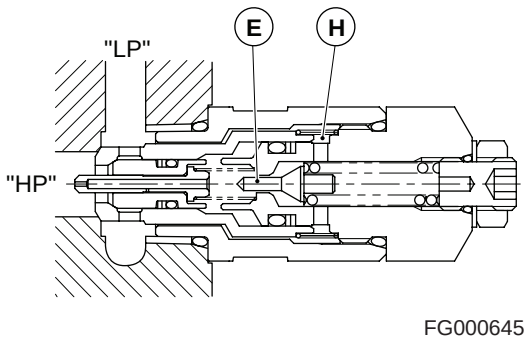


Figure 28

3. As pilot poppet (E) opens, pressurized oil flows through orifice (I) so pressure on back of piston (C) lowers to move piston (C). As a result, piston (C) seats on pilot poppet (E).

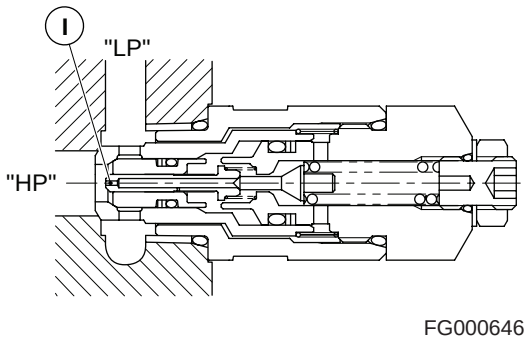


Figure 29

4. Pressurized oil in passage (HP) flows through orifice (F) in piston (C) so pressure on back of main poppet (D) moves main poppet (D). Pressurized oil then flows into passage (HP) and directly into passage (LP).

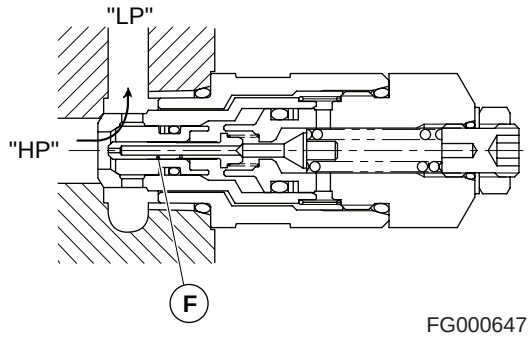
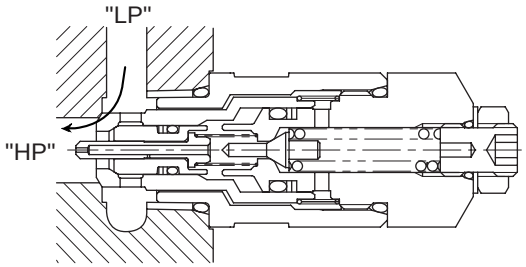


Figure 30

Absorption Operation

An anticavitation 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 oil is supplied from the low-pressure oil passage (LP) to cylinder port (HP) to eliminate cavitation.



FG000648

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 poppet operates upward, signal pressure of Ps1 (Ps2) decreases because oil flowing to L2 (R2) decreases.

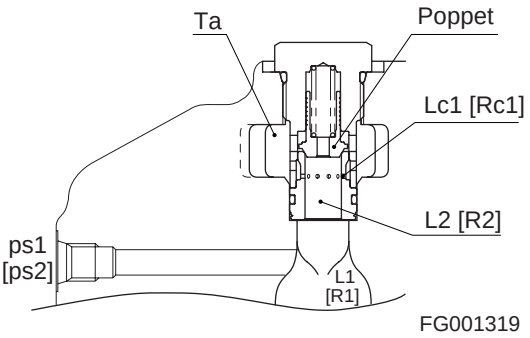


Figure 32

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.

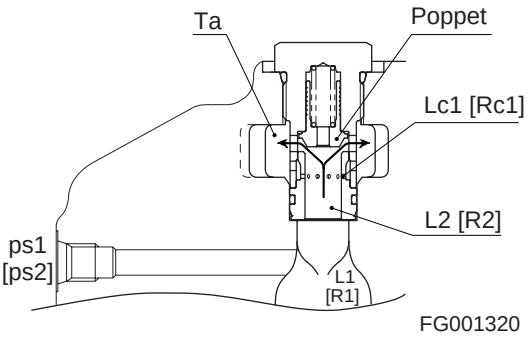


Figure 33

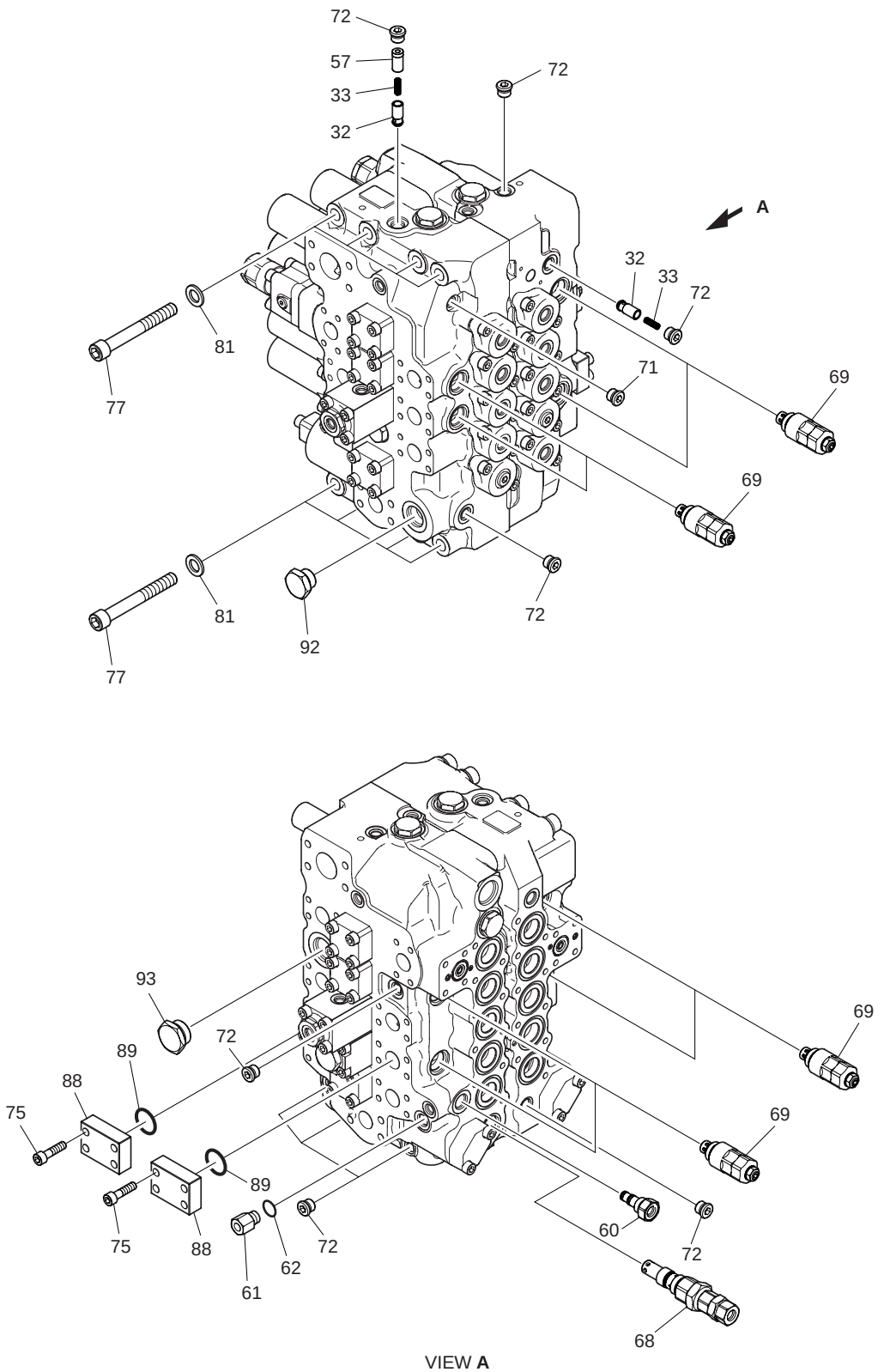
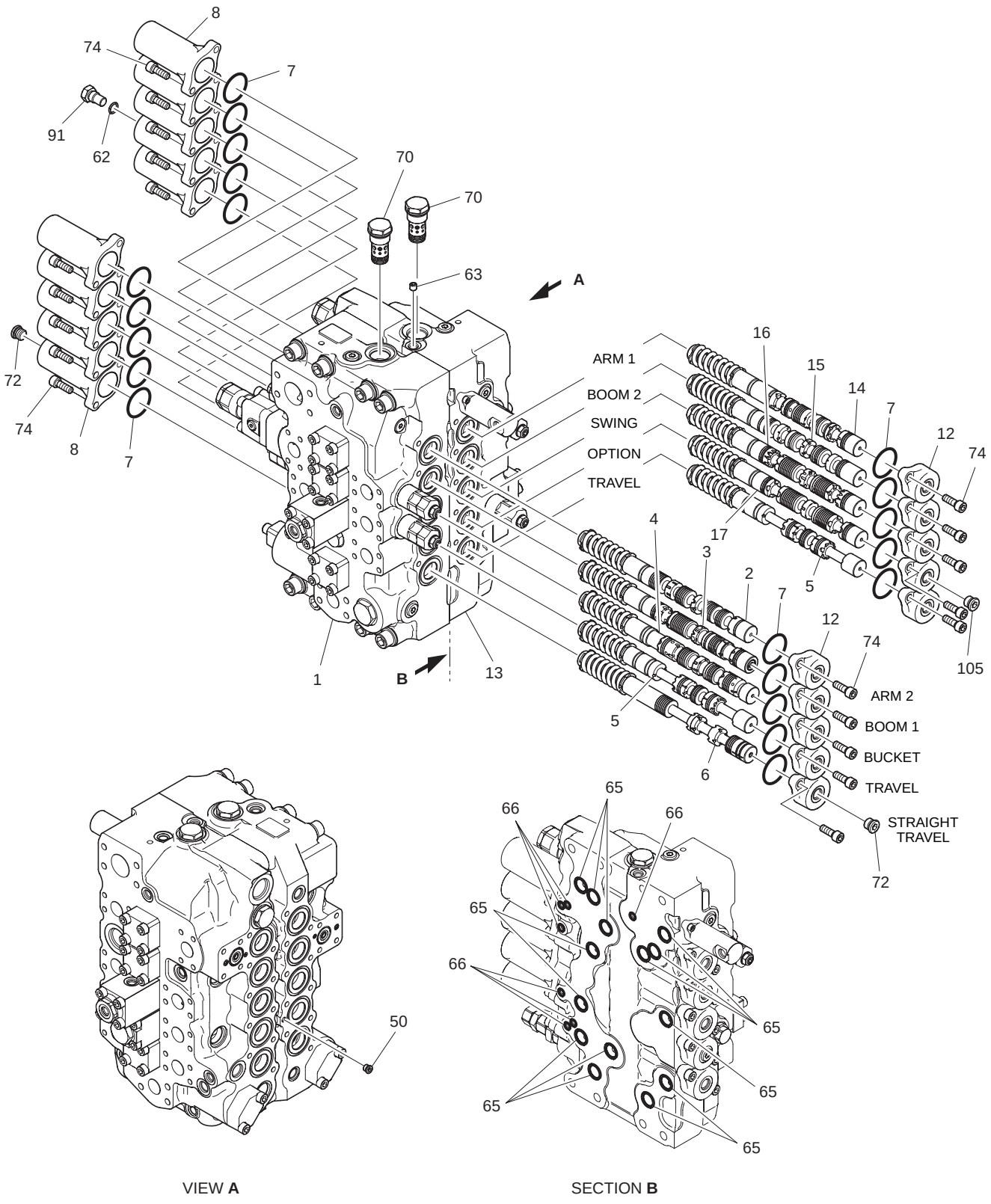

72
57
33
32
72
A
32
33
72
81
77
71
69
69
81
92
72
77
93
72
89
88
75
69
89
75
88
61
62
72
60
72
68
VIEW A
FG003962

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 x 40L)
77	Socket Bolt (M16 x 130L)
81	Washer
88	Cap
89	O-ring
92	Plug Assembly
93	Plug Assembly



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 (M10 x 28L)
91	Plug
105	Plug Assembly

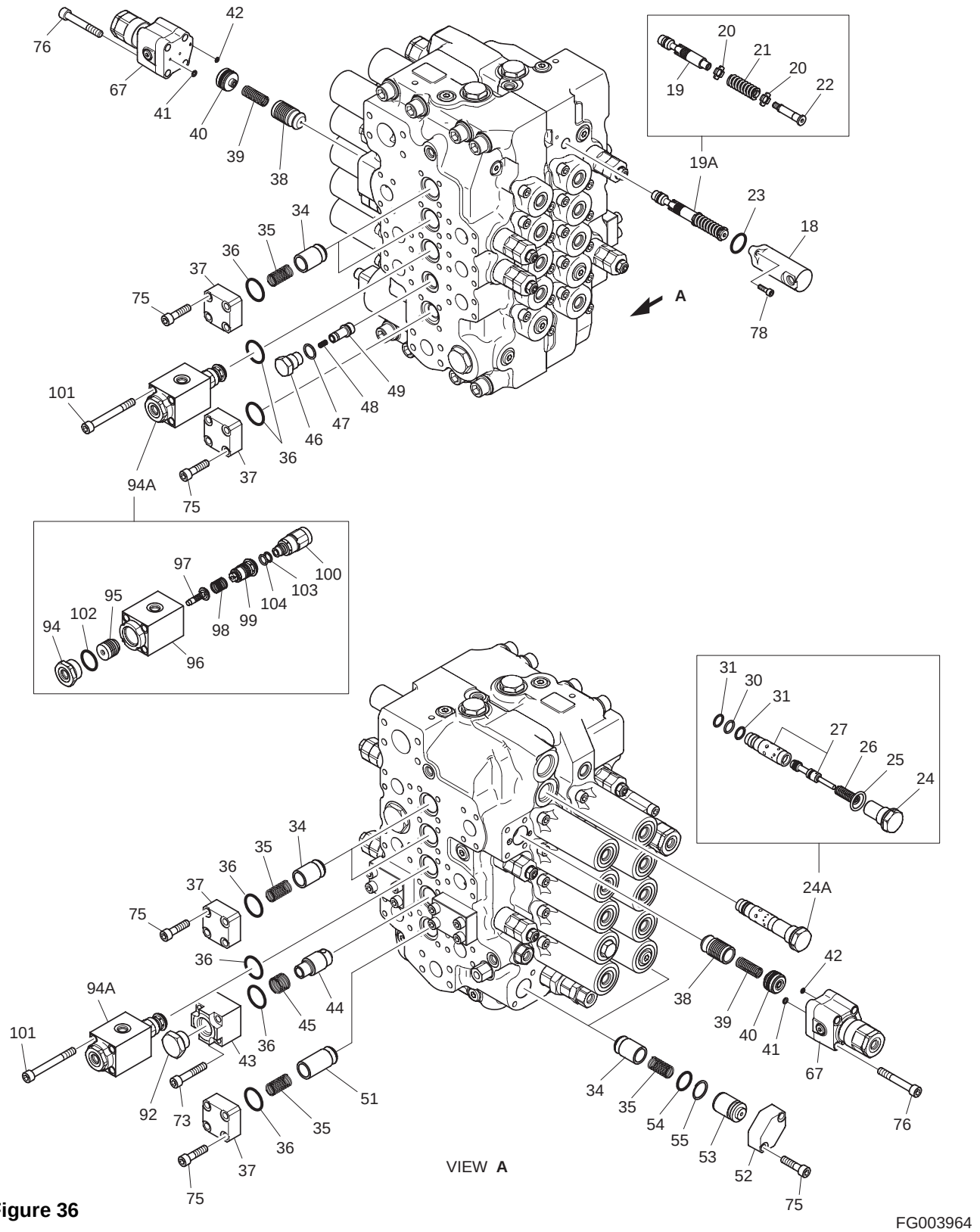


Figure 36

FG003964

Reference Number	Description
18	Cap
19A	SP Valve
19	Spool
20	Spring Seat
21	Spring
22	End Spool
23	O-ring
24A	Arm Regeneration 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	Antidrift Valve Assembly
73	Socket Bolt (M10 x 55L)
75	Socket Bolt (M10 x 40L)
76	Socket Bolt (M10 x 70L)
78	Socket Bolt (M6 x 20L)
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 (M10 x 90L)

Specifications

Rated flux: 270 lpm

However, 50 lpm in neutral

Rated pressure: 34.3 MPa

Permitted pressure: Max. pressure of 1.5 MPa or less

Used pressure of 0.5 MPa 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 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
Pressure 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.	Reset 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 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 39 on page -54.)

   A. Loosen locknut (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 39 on page -54) must be more than 4.0 mm (0.16 in). Tighten locknut (7).

B. Loosen locknut (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 locknut (4) after pressure has been adjusted.

5. Low-pressure adjustment (second stage)

   A. Loosen locknut (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 locknut (7) after pressure has been adjusted.

6. Recheck pressure setting by raising pressure once more.

Overload Relief Valve

IMPORTANT

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 locknut (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 locknut (3) after pressure has been adjusted. Locknut (3) should be torque to 2.8 - 3.2 kg•m (20 - 23 ft lb).
4. Recheck pressure setting by raising pressure once more.

REMOVAL

WARNING

AVOID DEATH OR SERIOUS INJURY

Release any pressure in the hydraulic oil tank before doing any work.

1. Remove all hoses and connectors from control valve (1, Figure 37). Cap the hoses and control valve (1, Figure 37). Attach identification tags to the removed hoses for reassembling.
2. Install eyebolts (M10 x 1.5) (2 used) to control valve (1, Figure 37).
3. Remove bolts (2, Figure 37) (4 used) and spacers (4 used) from control valve (1, Figure 37).
   - Control valve weight: 193 kg (426 lbs)
4. Hoist and remove control valve from the bracket.

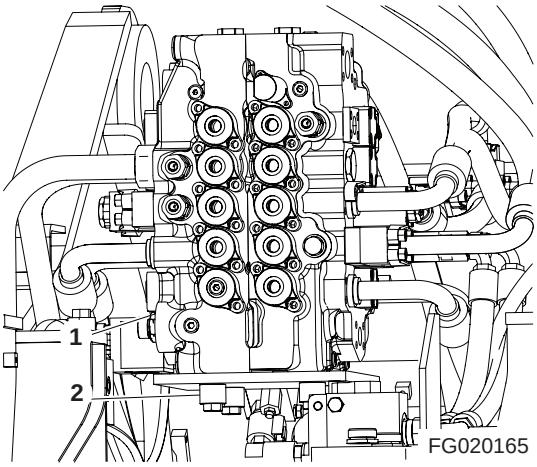


Figure 37

DISASSEMBLY

Caution in Disassembly

1. Stop 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.

WARNING

AVOID DEATH OR SERIOUS INJURY

Always relieve hydraulic pressure and fully lower bucket (or attachment) to the ground, before disassembly. Failure to follow instructions can cause sudden release of component parts or boom dropping, resulting in death or serious injury.

---

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 on 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 on each section) from valve housing (1 and 13).
4. Remove all spool subassemblies from valve housing

IMPORTANT

When removing spool, be careful not to damage it.

Attach label to each spool to install it in the correct position when reassembling.

5. Remove socket head bolt (74, two places on each section, width across flats: 8 mm) and cap (12, ten places).
6. Remove O-ring (7, one place on each section) from valve housing (1 and 13).
7. Disassembly of spool.

IMPORTANT

Work with spool gripped in vise with wood (see Figure 38) so as not to scratch outside diameter of spool.

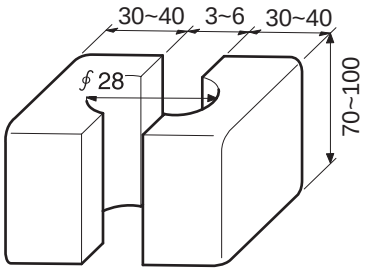
Because Loctite is applied to threaded portion of spool end, heat outside surface of spool with industrial drier to release Loctite.

Heat spool until spool end is easily loosened, and remove immediately after heating it to 200° - 250°C (392° - 482°F).

Replace spring before re-assembly.

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 38

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.

IMPORTANT

Work with spool gripped in vise with wood (see Figure 38), 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).

Replace spring before re-assembly.

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).*

WARNING

AVOID DEATH OR SERIOUS INJURY

Always relieve hydraulic pressure and fully lower bucket (or attachment) to the ground, before disassembly. Failure to follow instructions can cause sudden release of component parts or boom dropping, resulting in death or serious injury.

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).

Disassembly of Load Check Valve Part

WARNING

AVOID DEATH OR SERIOUS INJURY

Always relieve hydraulic pressure and fully lower bucket (or attachment) to the ground, before disassembly. Failure to follow instructions can cause sudden release of component parts or boom dropping, resulting in death or serious injury.

1. Remove socket head bolt (75, four places on 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.

IMPORTANT

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).*

WARNING

AVOID DEATH OR SERIOUS INJURY

Always relieve hydraulic pressure and fully lower bucket (or attachment) to the ground, before disassembly. Failure to follow instructions can cause sudden release of component parts or boom dropping, resulting in death or serious injury.

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

WARNING

AVOID DEATH OR SERIOUS INJURY

Always relieve hydraulic pressure and fully lower bucket (or attachment) to the ground, before disassembly. Failure to follow instructions can cause sudden release of component parts or boom dropping, resulting in death or serious injury.

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. Slowly 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

WARNING

AVOID DEATH OR SERIOUS INJURY

Always relieve hydraulic pressure and fully lower bucket (or attachment) to the ground, before disassembly. Failure to follow instructions can cause sudden release of component parts or boom dropping, resulting in death or serious injury.

WARNING

AVOID DEATH OR SERIOUS INJURY

Do not loosen adjusting plug or change pressure setting.

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

IMPORTANT

Do not disassemble combined bolt (77).

If it is necessary to disassemble it, place it horizontally on a workbench.

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

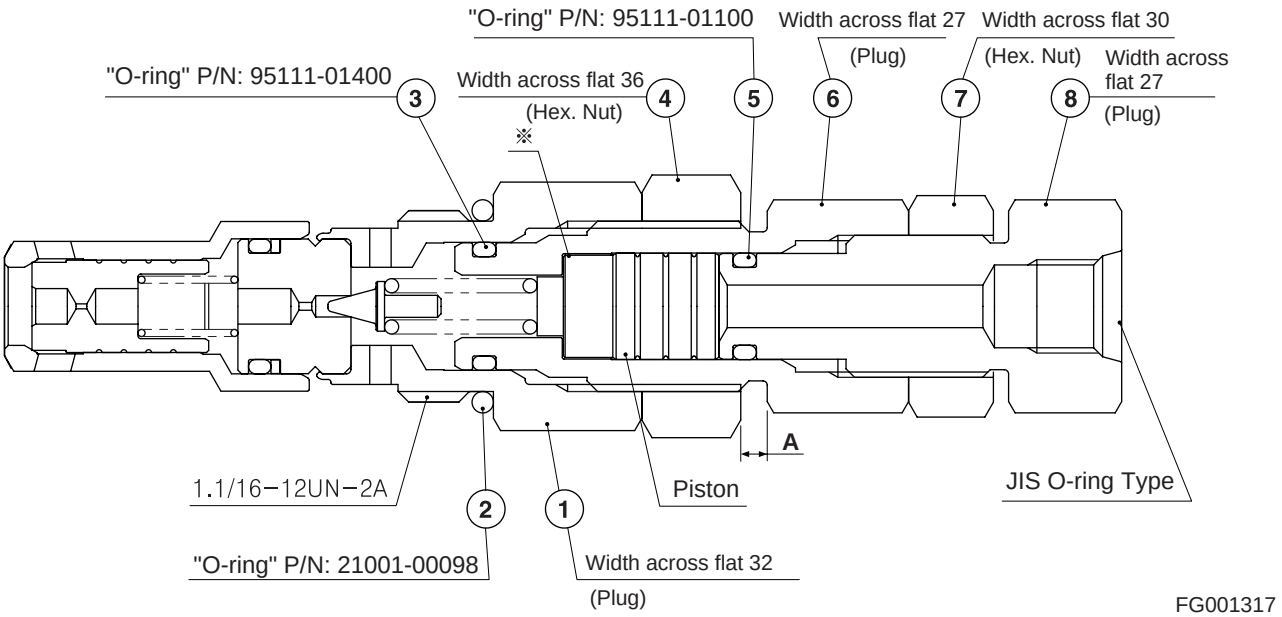


Figure 39

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

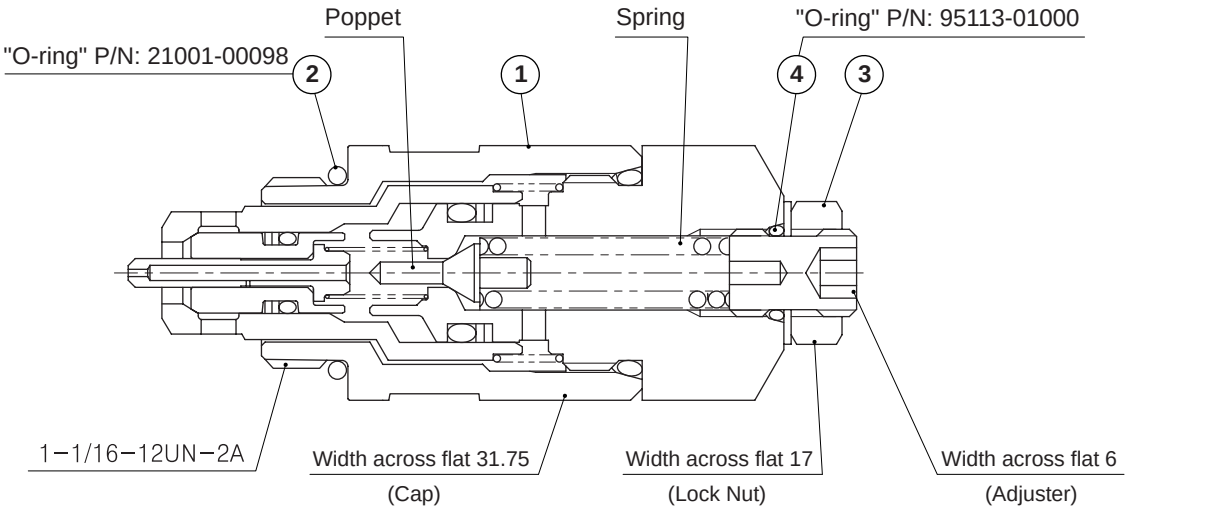


Figure 40

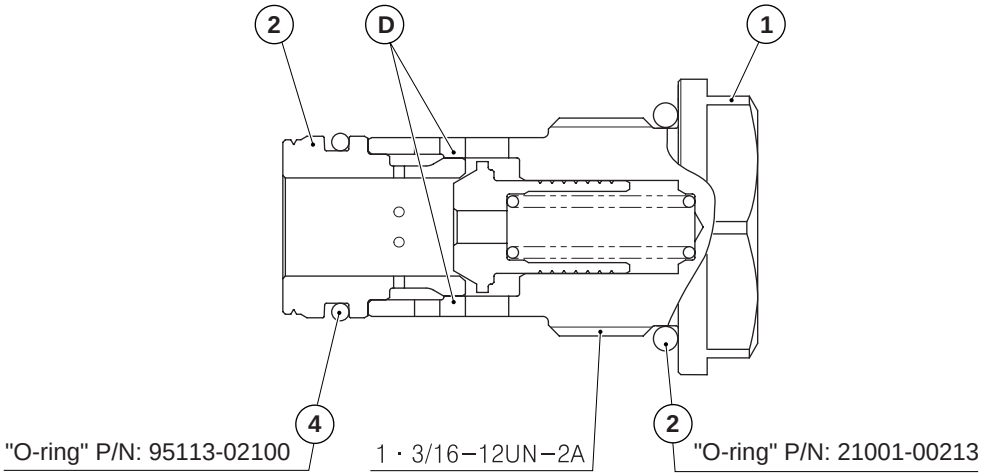
1. This relief valve should be replaced as an assembly. When replacing it, remove cap (1, width across flats: 32 mm) and O-ring (2). If oil is leaking from nut (4), remove nut (4) and plug (1), and replace O-ring (3). If oil is leaking from nut (7), remove nut (7) and plug (8), and replace O-ring (3).

   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).*

IMPORTANT

When disassembling adjuster kit, be careful not to let parts spring out or lose poppet because of spring force.

Instruction of Disassembly and Assembly of Low-pressure Relief Valve



FG001321

Figure 41

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

AVOID INJURY

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. Now, be careful not to touch coated part to spring seat.

Sequence of Subassembly

IMPORTANT

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).

IMPORTANT

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).

IMPORTANT

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).

IMPORTANT

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).

IMPORTANT

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

WARNING

AVOID DEATH OR SERIOUS INJURY

Do not loosen adjusting plug or change pressure settings.

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 poppet assembly with sleeve into 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).

IMPORTANT

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 in 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.

IMPORTANT

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.

IMPORTANT

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

IMPORTANT

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 improper operation 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).

IMPORTANT

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

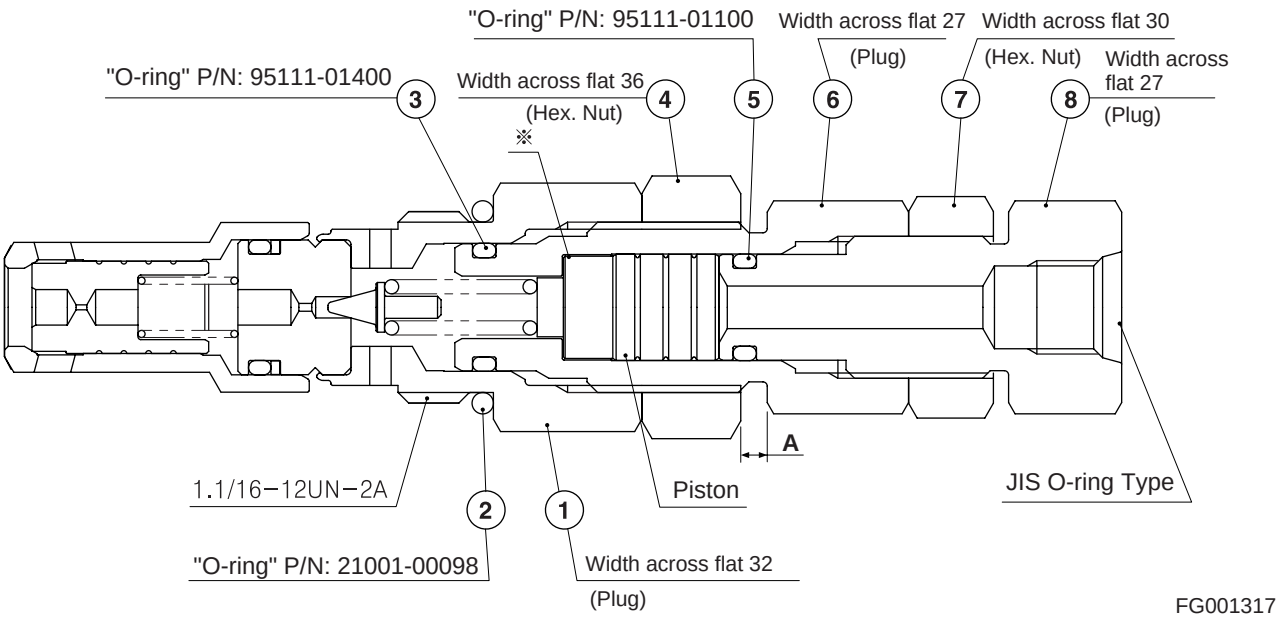


Figure 42

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 1-45.*

Reassembly of Overload Relief Valve (69, Total of 6 Places)

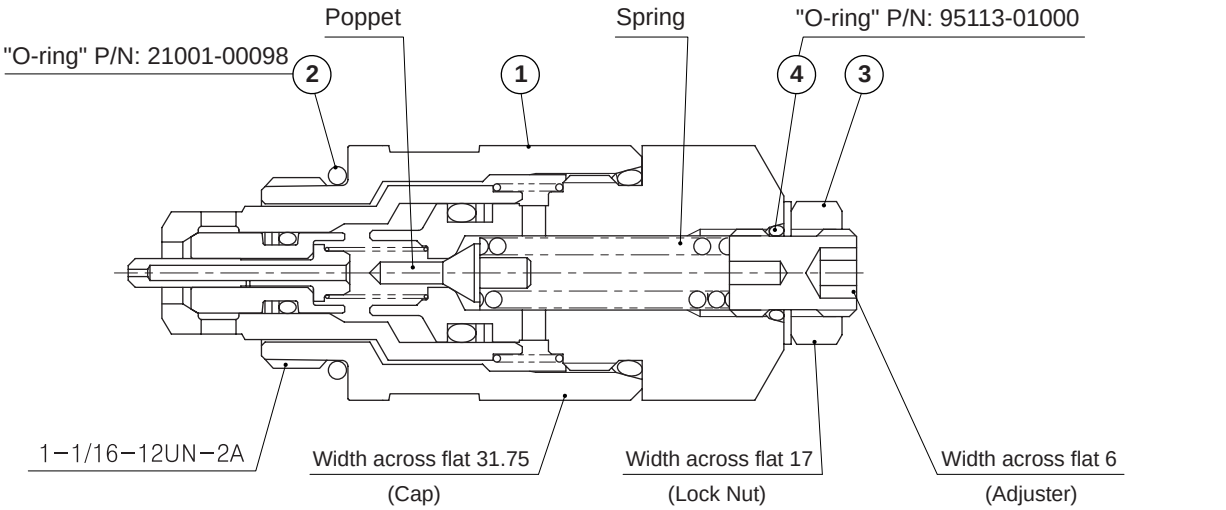


Figure 43

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).

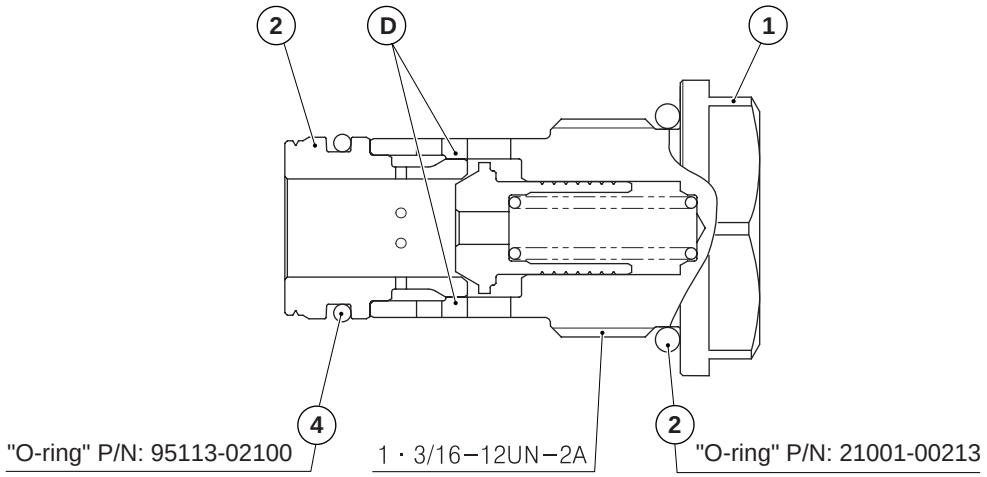
   NOTE: *The torque values are based on use of lubricated threads.*

   NOTE: *If relief valve was disassembled, adjust pressure by referring to "Overload Relief Valve" on page 1-46.*

IMPORTANT

When disassembling the adjustment kit, parts can fall out because of spring pressure. Do not lose poppet or other parts. 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)



FG001321

Figure 44

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.*

IMPORTANT

Torque values should be measured when using lubricated threads.

INSTALLATION

1. Install eyebolts (M10 x 1.5) (2 used) to control valve (1, Figure 45).
   - Control Valve weight: 193 kg
2. Hoist and align control valve (1, Figure 45) with the mounting position in bracket.
3. Install control valve (1, Figure 45) to the bracket with bolts (2, Figure 45) (4 used) and spacers (4 used).
   - Torque: 166 - 167 Nm
4. Remove eyebolts (M10 x 1.5) (2 used) from control valve (1, Figure 45).
5. Install all hoses and connectors to control valve.

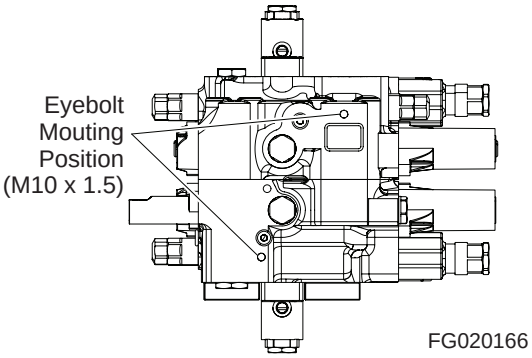


Figure 45

IMPORTANT

After completing the work, check the oil level. Start the engine and check for any oil leaks.

1. Be careful not to apply stress on control valve when attaching piping and hoses. Unnecessary stress can 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 because of 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 2

MEMO

Table of Contents

Remote Control Valve (Work Lever / Joystick)

Safety Instructions 5
Applicable Models 5
General Description 7
Theory of Operation 7
Parts List 8
Specifications 10
Torques 10
Tools and Materials 10
Disassembly 11
Reassembly 14
Start-up Procedures 22

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX140W-3	1001 and Up, 50001 and Up
DX170W-3	1001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX190W-3	1001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 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

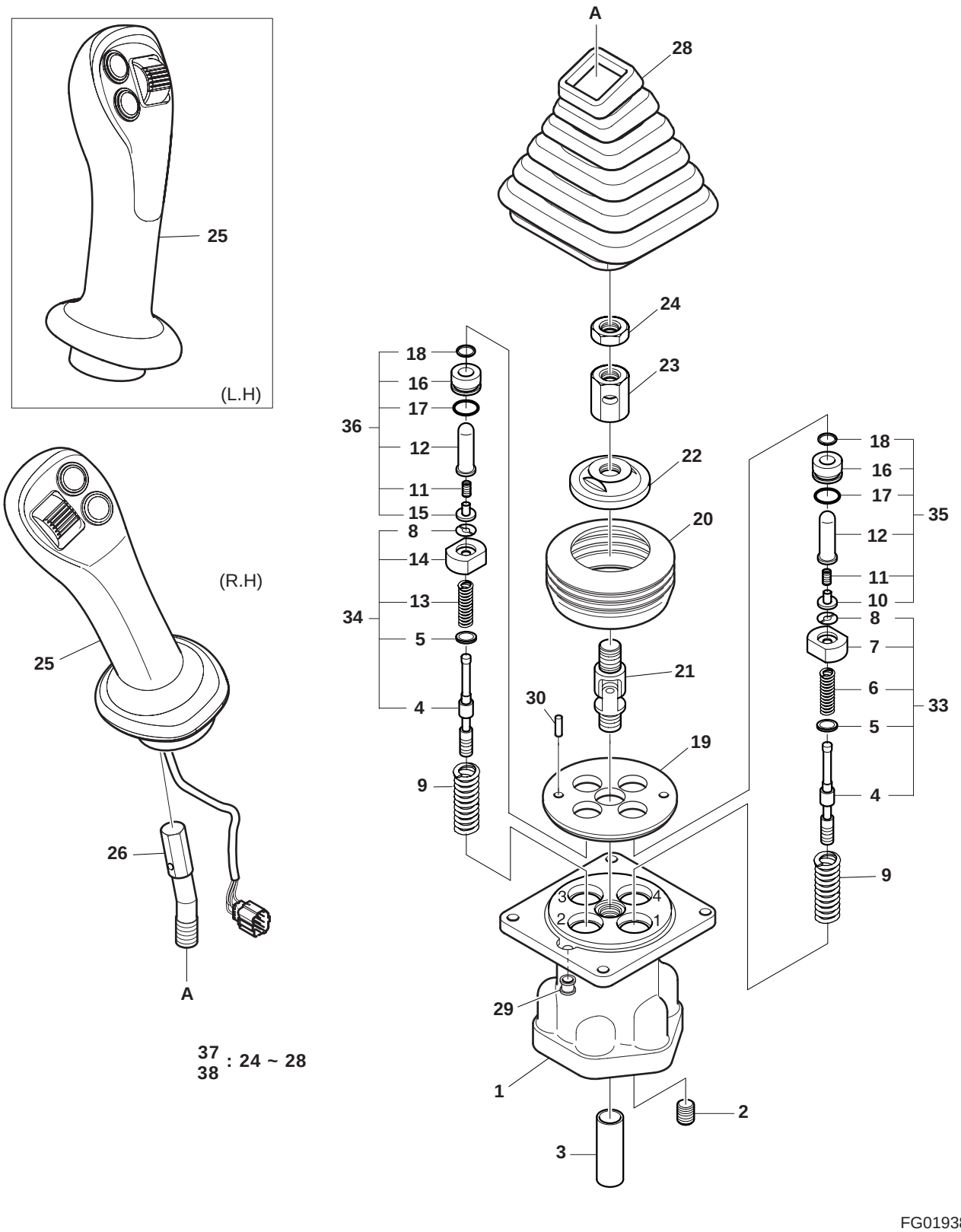
   When the lever is in neutral mode, the spool is pushed upward by return spring. The force of balancing spring, which determines the secondary discharge pressure, is not transmitted to the spool. The input port is closed and the pressure of the output port is the same as the pressure of the tank port 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



FG019389

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

Reference Number	Description
19	Plate
20	Boot
21	Joint Assembly
22	Swash Plate
23	Nut
24	Nut
25	Joystick (LH)
	Joystick (RH)
26	Handle Bar
28	Bellows
29	Bushing
30	Spring Pin
33	Spool Kit 1, 3
34	Spool Kit 2, 4
35	Plug Kit 1, 3
36	Plug Kit 2, 4
37	Handle Kit (RH)
38	Handle Kit (LH)

Specifications

Performance

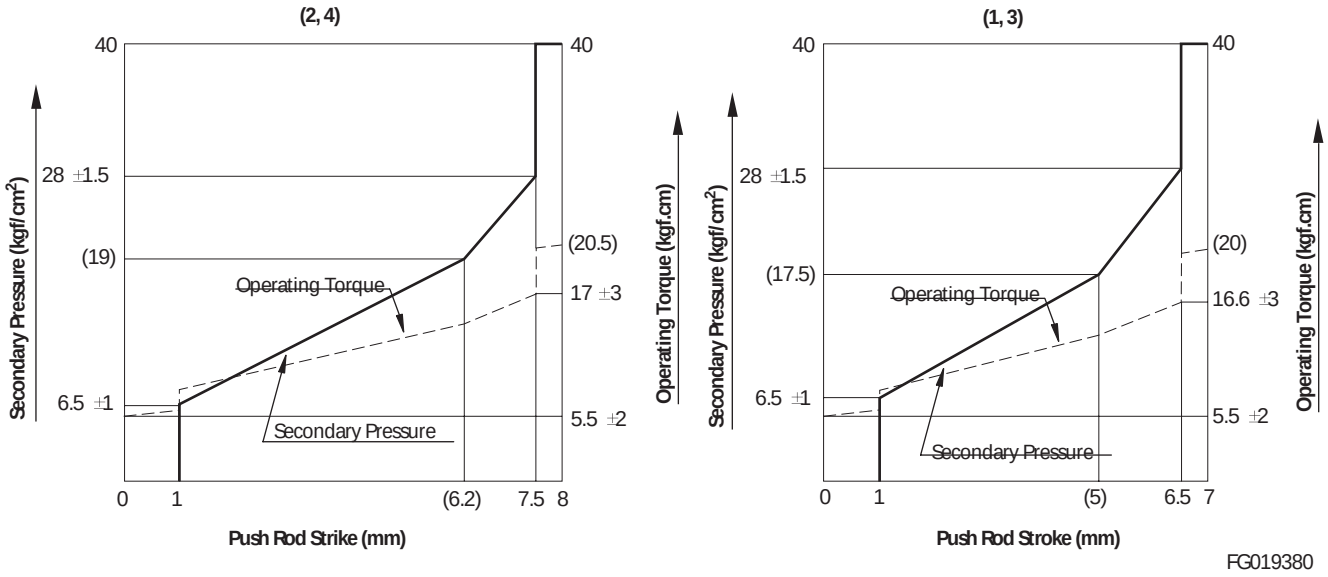


Figure 2

Torques

No.	Tool	Standard	Remark
2	Plug	PT 1/8	370 kg•cm (27 ft lb)
22	Swash Plate	27 mm	1,660 kg•cm (120 ft lb)
23	Hex Nut	22 mm	1,660 kg•cm (120 ft lb)
24	Nut	22 mm	1,660 kg•cm (120 ft lb)

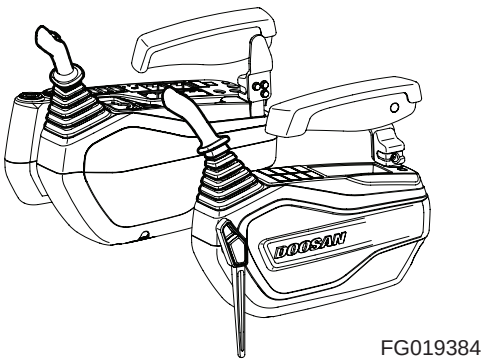
TOOLS AND MATERIALS

No.	Tool	Standard	Remark
2	L-Wrench	PT1/8	plug
22	Wrench	27 mm	swash plate
23	Wrench	22 mm	hex nut
24	Wrench	22 mm	nut

DISASSEMBLY

1. Prepare the necessary tools.

   (+Type screwdriver, long-nose pliers (M), 13 mm hex socket and ratchet, hex wrench set)

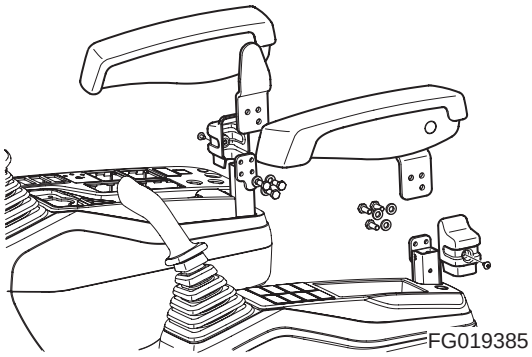


FG019384

Figure 3

2. Remove armrest. (M8 bolt 3 each)

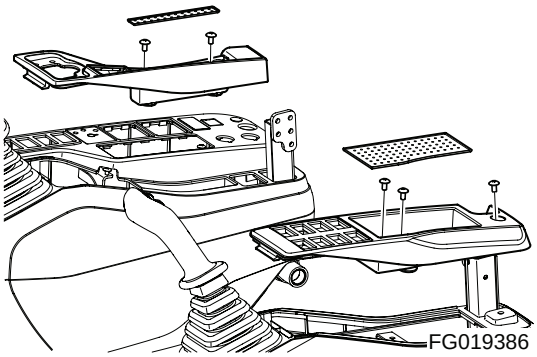
   Remove armrest cover. (M5 screw 1 each)



FG019385

Figure 4

3. Remove rubber pad then unscrew M6 screws and disassemble S/W cover.

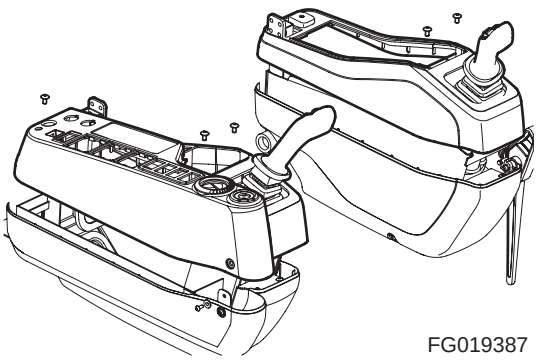


FG019386

Figure5

4. Unscrew socket bolt (1 each) and M6 screws.

   Then disassemble upper cover.



FG019387

Figure 6

5. Remove bracket. (M5 screw 2 each)
   Disassemble joystick. (Socket bolt 4 each)

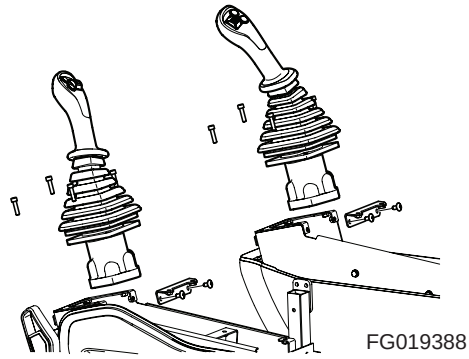


Figure 7

6. Remove lead wire from bushing (29).

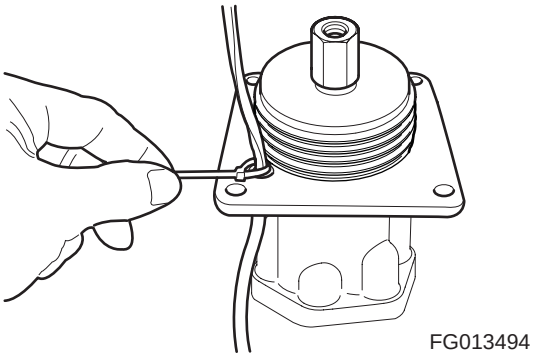


Figure 8

7. Remove lever assembly from case (1).

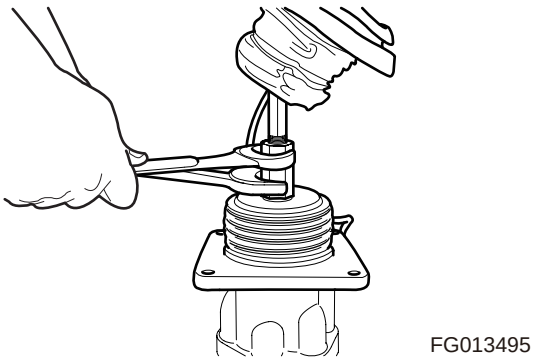


Figure 9

8. Remove hex nut (23) and swash plate (22) from case (1).

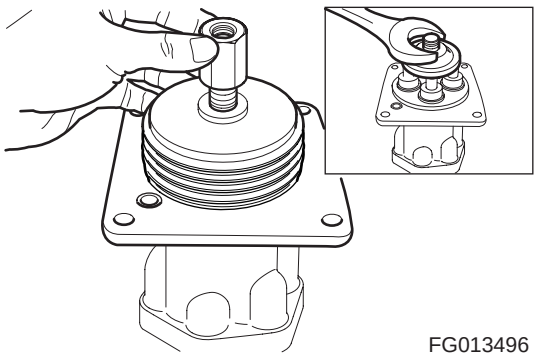


Figure 10

9. Remove joint assembly (21) from case (1).

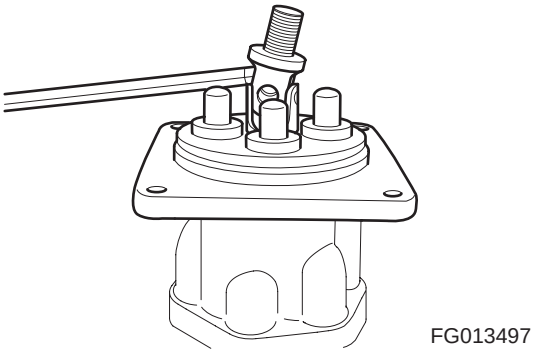


Figure 11

10. Install lead wire terminal into connector terminal pressing them together.

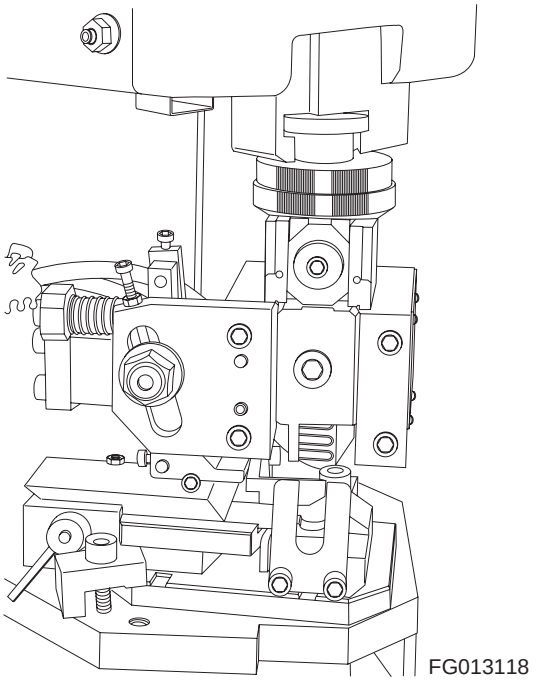


Figure 12

11. Assemble connector assembly, and connect it to lead wire terminal, and properly route wiring.

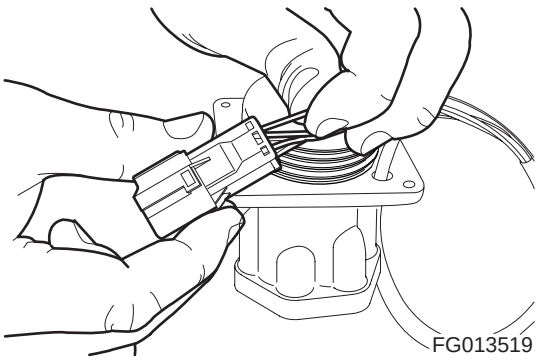
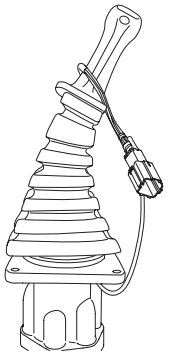


Figure 13

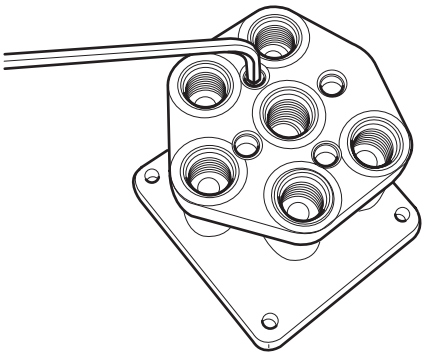


FG013520

Figure 14

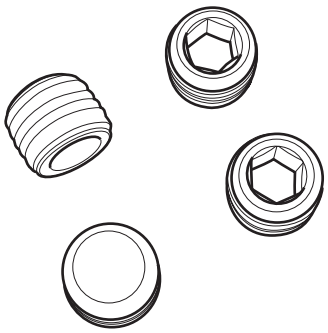
REASSEMBLY

1. Install four plugs (2) into case (1).



FG013504

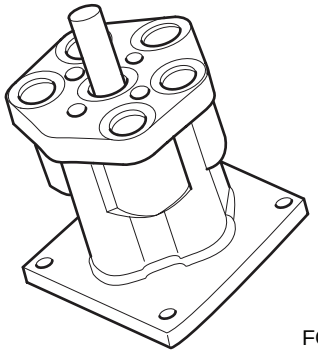
Figure 15



FG013507

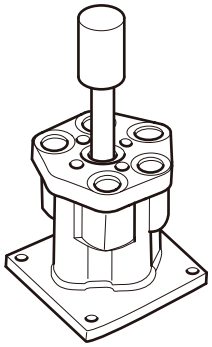
Figure 16

2. Install bushing (3) into case (1) using jig.



FG013506

Figure 17

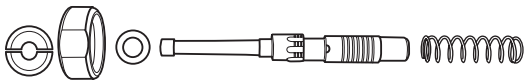


FG013508

Figure 18

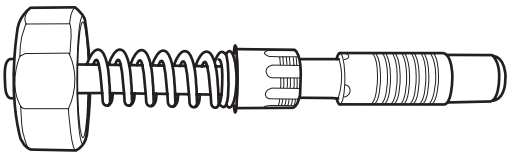
3. Take care when assembling spool kit assemblies (1 and 3, 2 and 4). (They should be assembled in same way).

   The assembly order is; spool (4), shim (5), spring (6), spring seat (7), and stopper (8).



FG013509

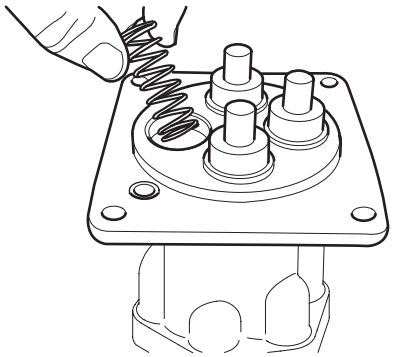
Figure 19



FG013503

Figure 20

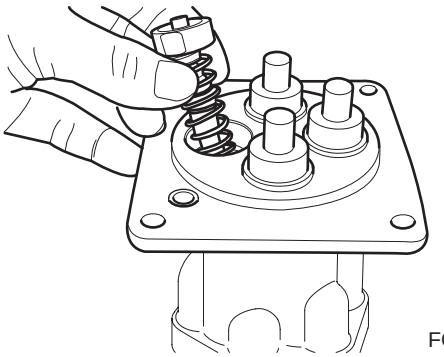
4. Install spring (9) into case (1).



FG013499

Figure 21

5. Install spool kit assembly into case (1). (The same way is used for four parts.)



FG013502

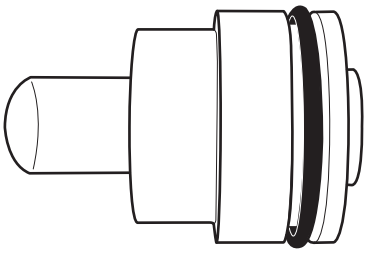
Figure 22

6. Assemble plug kit insert rod seal (18), O-ring (17), and push rod (12) into plug (16) in proper order.



FG013511

Figure 23

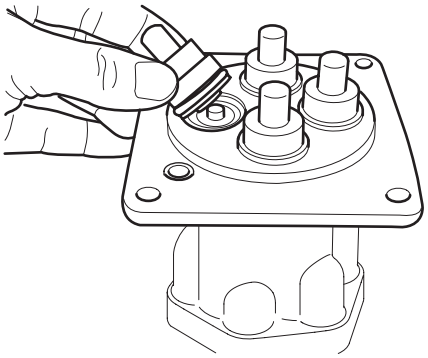


FG013512

Figure 24

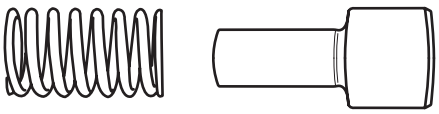
7. Assemble four springs (11) and stoppers and insert assembled set in case (1) to form a plug kit assembly.

   NOTE: *Pay attention to measurement specifications of stoppers (1 and 3, 2 and 4).*



FG013499

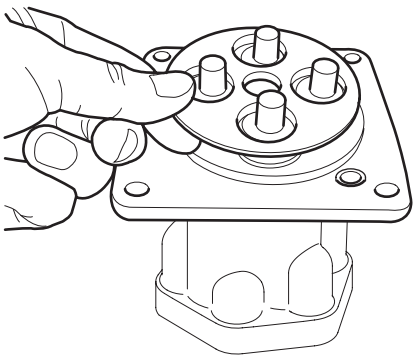
Figure 25



FG013501

Figure 26

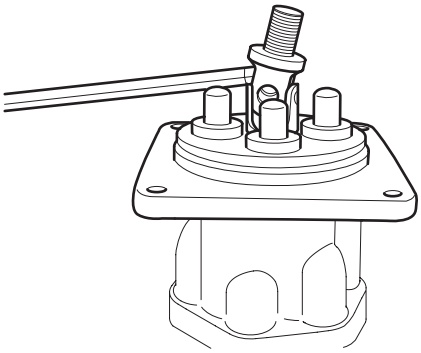
8. Install plate (19) into case (1).



FG013498

Figure 27

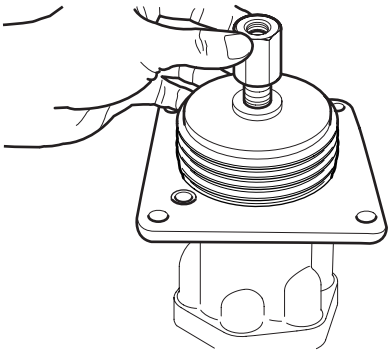
9. Install joint assembly (21) into case (1).



FG013497

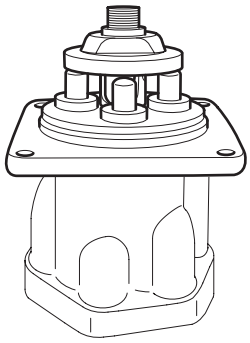
Figure 28

10. Install boot and swash plate (22) and hex nut (23) into case (1).



FG013513

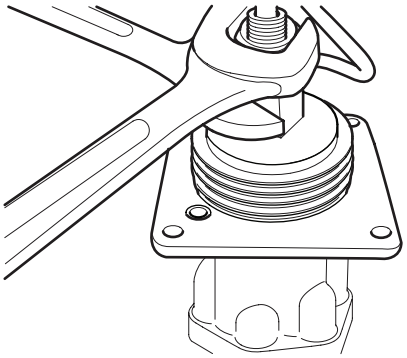
Figure 29



FG013514

Figure 30

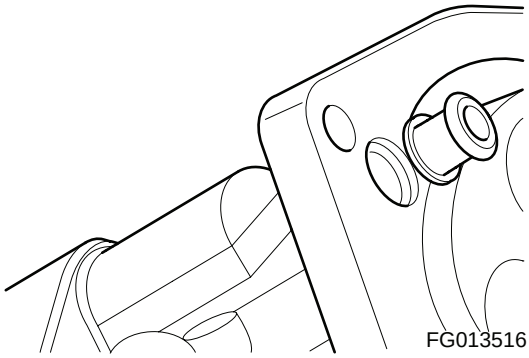
11. Insert bar and tighten it with a wrench to check balance of joint assembly.



FG013515

Figure 31

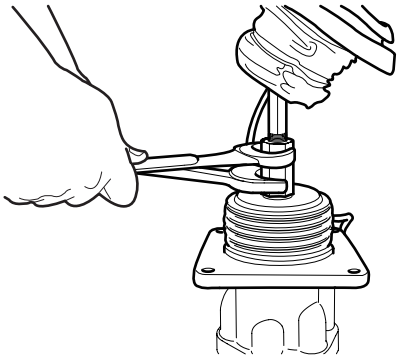
12. Install bushing (29) into case (1).



FG013516

Figure 32

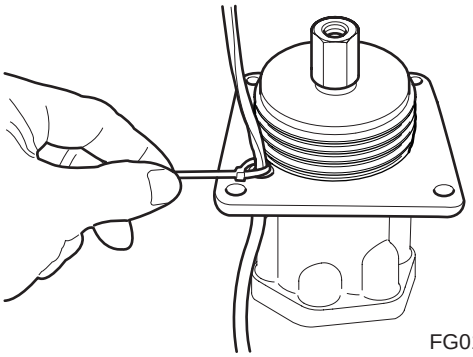
13. Install lever assembly into case (1).



FG013495

Figure 33

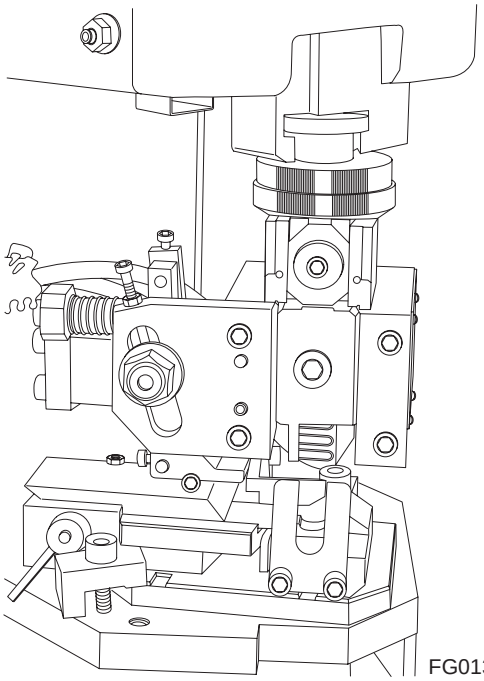
14. Put lead wire in bushing (29), tie it, and arrange boot.



FG013494

Figure 34

15. Install lead wire terminal into connector terminal pressing them together.



FG013118

Figure 35

16. Assemble connector assembly (30), and connect it to lead wire terminal, and properly route wiring.

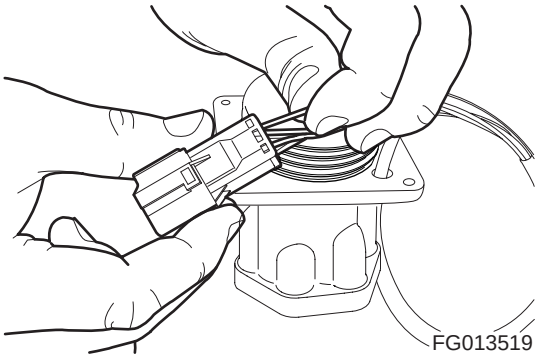


Figure 36

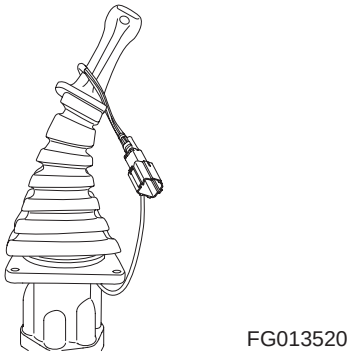


Figure 37

17. Assemble joystick. (Socket bolt 4 each)

    Assemble bracket. (M5 screw 2 each)

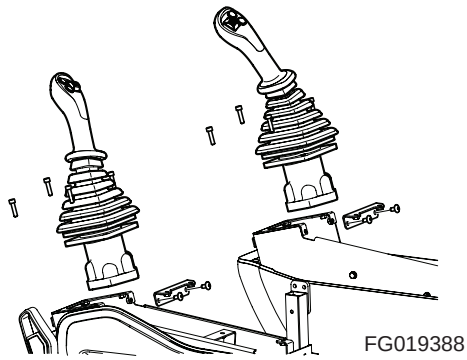


Figure 38

18. Assemble upper cover.

    Then add socket bolt (1 each) and M6 screws.

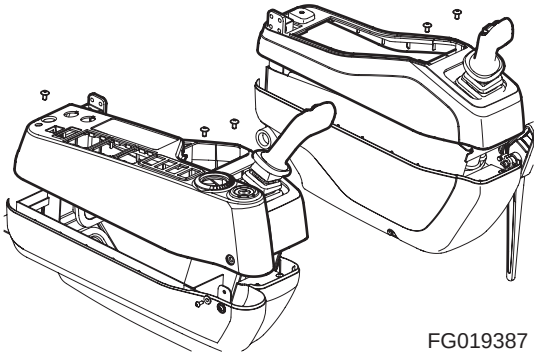


Figure 39

19. Assemble S/W cover then add M6 screws.
    And add the rubber pad.

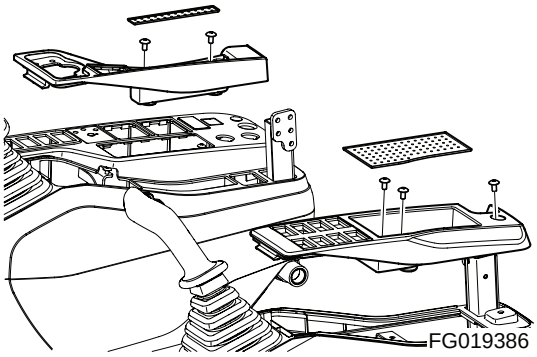


Figure 40

20. Assemble armrest. (M8 bolt 3 each)
    Assemble armrest cover. (M5 screw 1 each)

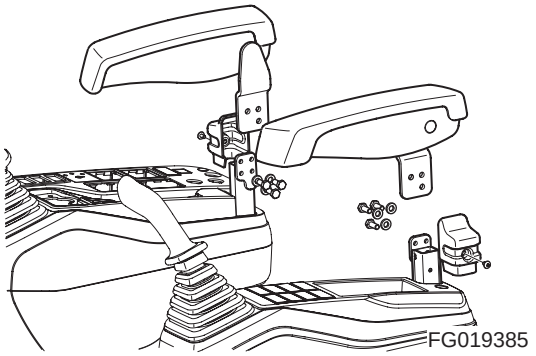


Figure 41

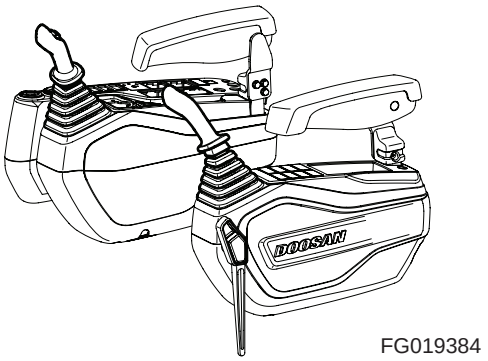
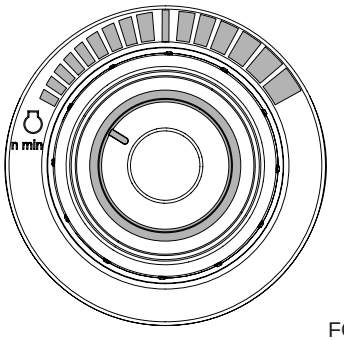


Figure 42

START-UP PROCEDURES

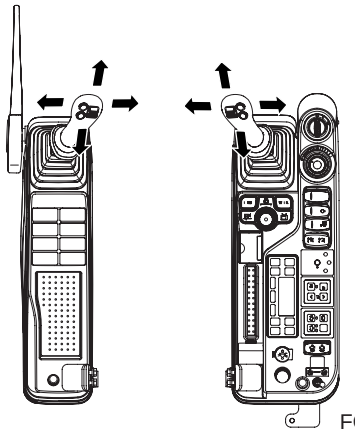
1. Start engine and set throttle at "LOW IDLE."
2. Set safety lever to "UNLOCK" position.



FG019382

Figure 43

3. Slowly cycle boom, arm, bucket cylinders and swing motor about five times without a load to vent air from pilot lines. Do this for five minutes.



FG019383

Figure 44

Travel Control Valve (with Damper)

Edition 2

Table of Contents

Travel Control Valve (with Damper)

Safety Instructions 5
Applicable Models 5
General Description 6
Theory of Operation 6
Pressure Reducing Valve 7
Operating Theory of Damper Mechanism 8
Causes of Faults and Measures 9
Parts List 10
Specification 12
Torques 12
Removal 13
Disassembly 16
Cleaning and Inspection (Wear Limits and Tolerances) 18
Reassembly 19
Installation 24
Start-up Procedures 27

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

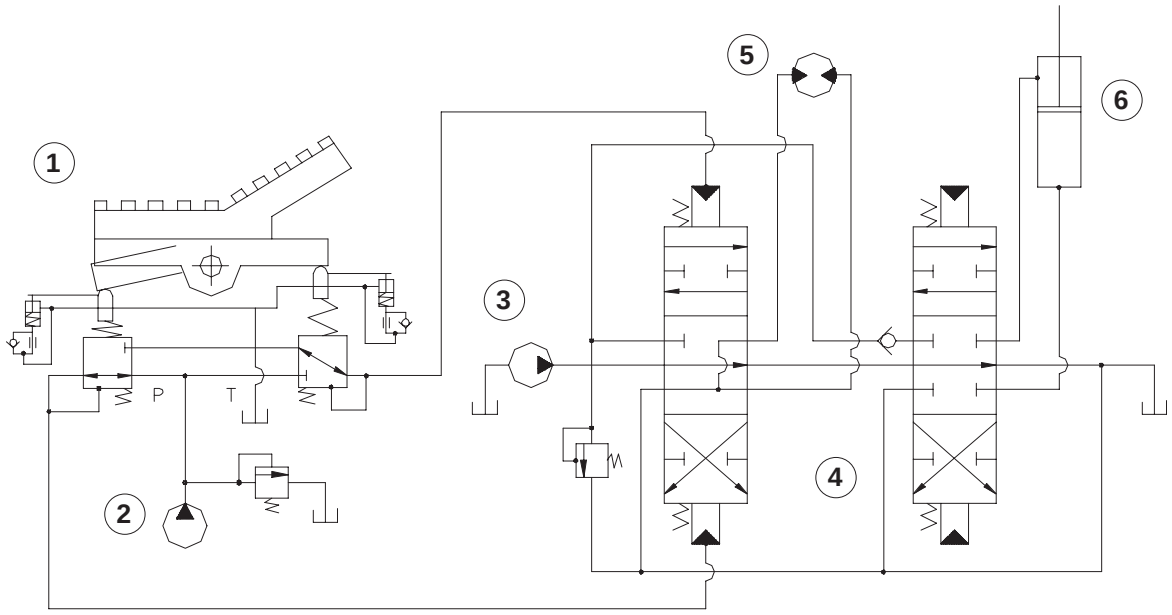
The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 and Up

GENERAL DESCRIPTION

Theory of Operation

The damper valve is divided into two areas of operation. The pressure reducing valve (a) and the damper mechanism (b). The following hydraulic circuit is an example of a remotely located control valve.



ARS1810L

Figure 1

Reference Number	Description
1	Remote Control Valve
2	Pilot Pump
3	Main Pump

Reference Number	Description
4	Control Valve
5	Hydraulic Motor
6	Hydraulic Cylinder

Pressure Reducing Valve

1. Neutral Condition

   If pedal is in neutral, the spool is pushed up by return spring and spring seat. Port (P) is blocked by bottom part of spool and four operating ports (left forward and backward, right forward and backward) are connected to port (T) through inner hole of spool.

2. Half Operation Condition

   If pedal is moved, the push rod moves down, and they transmit this force through spring seat and control spring to spool. If spool is moved, primary pressure is transmitted through an inner hole of spool to operating port. If lever is stopped in middle position, compressed control spring force and secondary pressure transmitted through hole acts on bottom part of spool, balance is maintained by hydraulic force acting upward, and then this pressure is transmitted to traveling spool of control valve. In short, primary pressure is transmitted to operating port as secondary pressure equivalent to control spring force compressed by spool.

3. Full Operating Condition

   If pedal is moved to a maximum, the bottom part of push rod presses spool seat to a maximum, and compresses control spring to a maximum. Primary pressure is transmitted through inner hole of spool to operation port, secondary pressure transmitted through spool overcomes control spring force and pushes spool up, but spool is restricted by push rod and does not move any more. In short, when pedal lever is moved to a maximum, control spring does not function. The spool is restricted by push rod, and then primary pressure equalizes to secondary pressure.

Operating Theory of Damper Mechanism

1. Operation When Operating Lever

   When pushing the pedal, the force against the push rod and spool presses the cylinder, return spring and the hydraulic oil in cylinder is compressed. The piston coming down compresses the oil in the vibration prevention chamber which flows through the orifice to the low-pressure upper chamber. The ball check valve then closes due to the high-pressure in the lower part of the vibration prevention chamber.

2. Operation When Operating Lever In Neutral Condition

   The spring acting on the push rod raises the piston and the oil pressure in the upper vibration prevention chamber prevents the push rod from quickly returning to neutral, and damping is achieved.

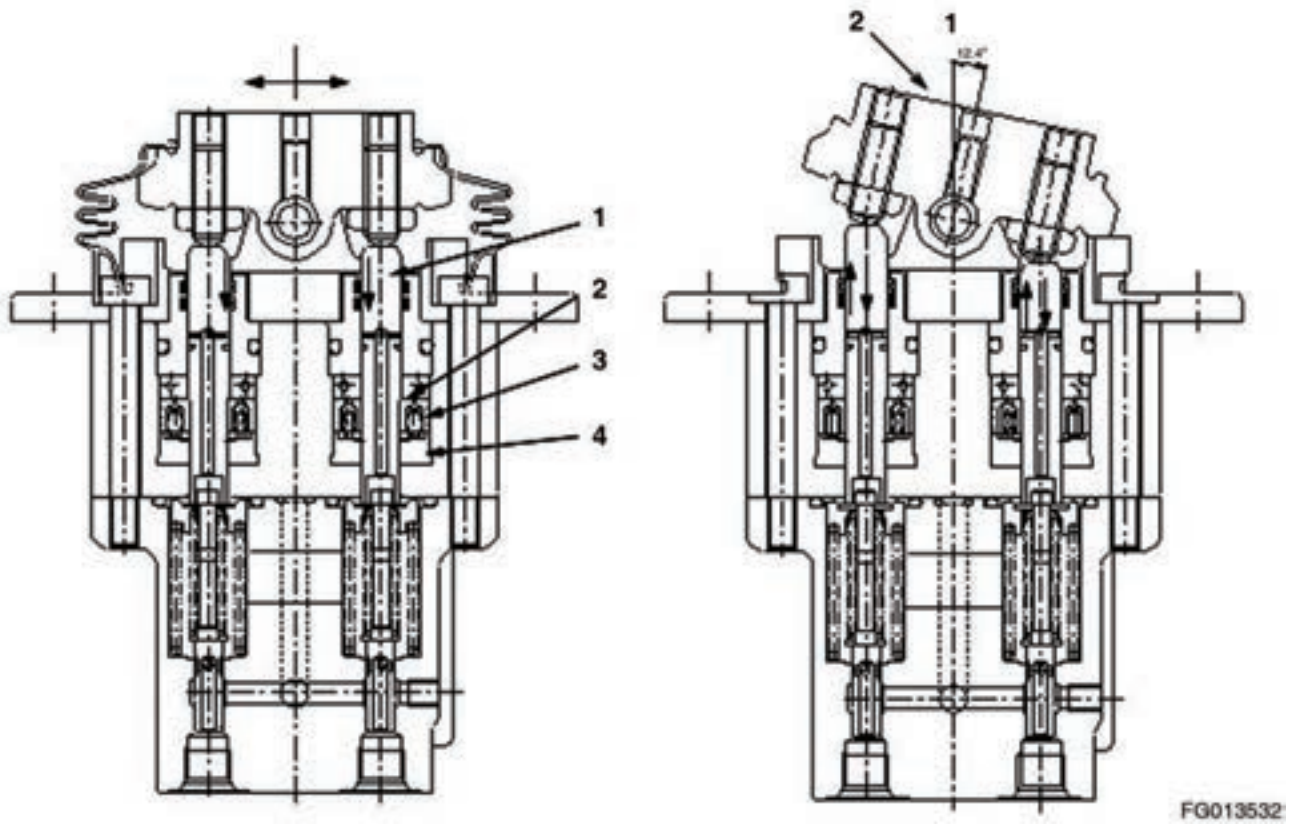


Figure 2

Reference Number	Description
1	Push Rod
2	Orifice
3	Piston
4	Piston Chamber

Reference Number	Description
1	Neutral Position
2	Maximum Operating Angle 12.4"

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. Often the problem is not caused by the failure of a single part but, may be the result of a combination of problems from related parts and their components. Possible problems other than the ones 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.

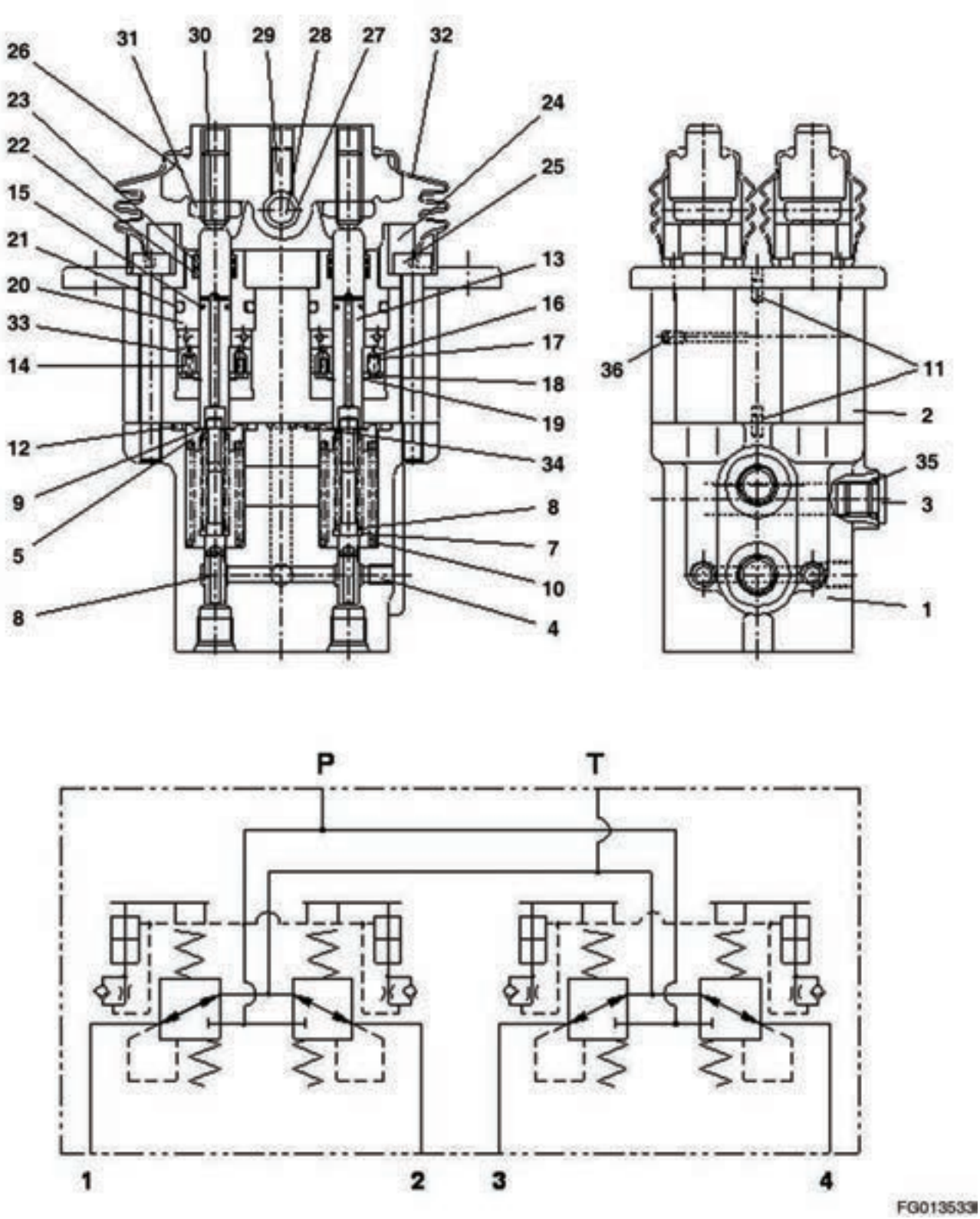
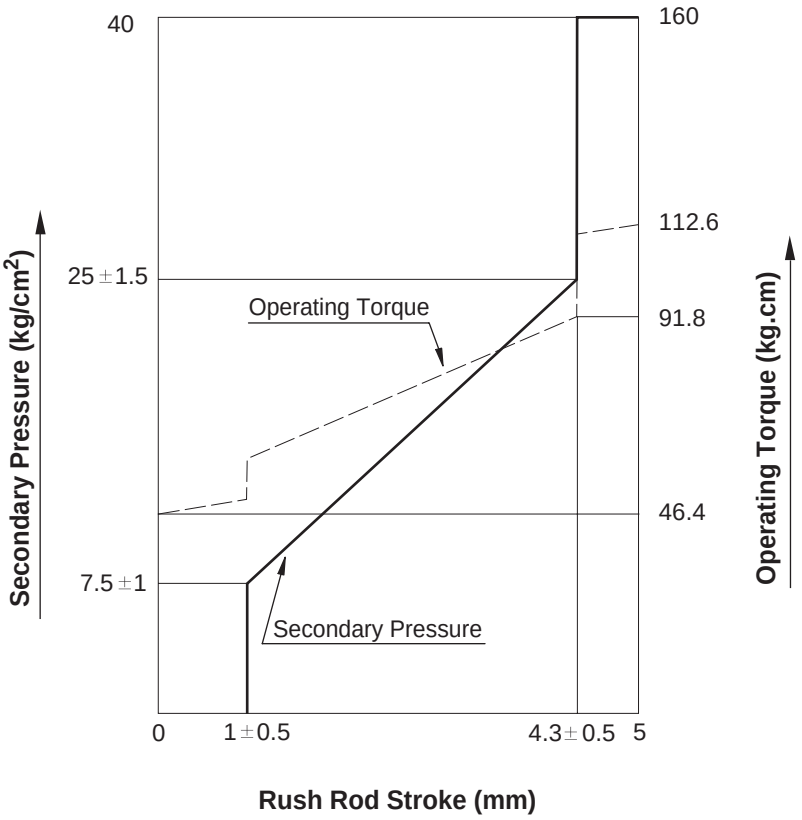

26
31
30
29
28
27
32
23
24
22
25
15
21
13
20
16
33
17
14
18
19
12
34
9
8
5
7
10
8
4
36
11
2
35
3
1
P
T
1
2
3
4
FG013533

Figure 3

Reference Number	Description
1	Body (1)
2	Body (2)
3	Plug
4	Plug
5	Spring Seat
6	Spring
7	Shim
8	Spool
9	Stopper
10	Spring
11	Spring Pin
12	O-ring
13	Push Rod
14	Spring Pin
15	Seal
16	Steel Ball
17	Spring
18	Plate
19	Retaining Ring
20	Plug

Reference Number	Description
21	O-ring
22	Rod Seal
23	Dust Seal
24	Cover
25	Hex Socket Head Bolt
26	Cam
27	Bushing
28	Camshaft
29	Set Screw
30	Set Screw
31	Hex Nut
32	Bellows
33	Piston
34	O-ring
35	O-ring
36	Expand
37	Spool Kit
38	Plug Kit
39	Cam Kit

Specification



FG024460

Figure 4

Travel Control Valve	Specification
Type	Pilot Control (With Damper)
Pressure / Stroke	25 kg/cm² @ 4.3 mm Stroke (356 psi @ 0.1692 in Stroke)
Weight	7.8 kg (17 lb)

Torques

No	Bolt Size	Tool	Tightening Torque
26	M6	PT1/8	88 kg•cm (6 ft lb)
30	M8	27 mm	100 kg•cm (7 ft lb)
32	M10	22 mm	440 kg•cm (32 ft lb)
37	M10	22 mm	440 kg•cm (32 ft lb)

REMOVAL

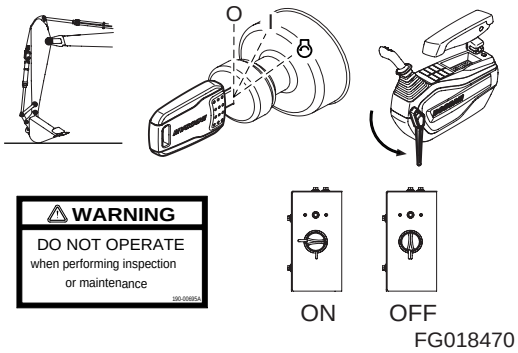
1. Park on firm and level ground.
2. Lower bucket (or work tool) to ground.
3. Stop engine.
4. Set safety lever to "RELEASED" position.
5. Turn starter switch to "I" (ON) position.

WARNING

AVOID DEATH OR SERIOUS INJURY

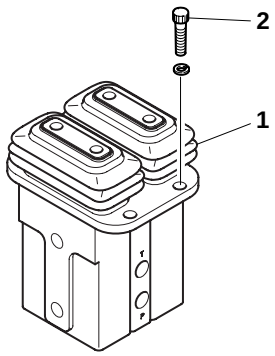
If engine must be running while performing maintenance, always use extreme caution. Always have one person in the cabin at all times. Never leave the cabin with engine running.

6. Fully stroke work levers (joysticks) in all directions to relieve any pressure from accumulators.
7. Set safety lever to "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Hang a maintenance warning tag on controls.
10. Turn battery disconnect switch to "OFF" position.
11. Remove cabin under cover by loosening bolts.
12. Tag and disconnect hoses from pedal valve (1, Figure 6). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.



FG018470

Figure 5



FG003016

Figure 6

13. Remove hex bolts (1) and washer.

    Remove cover (2) from frame (3).

    - : 19 mm

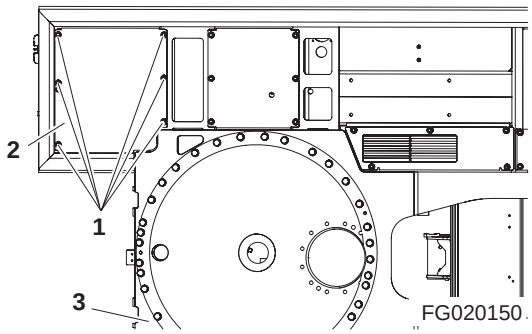


Figure 7

14. Remove hoses (1) from travel control valve (2). Attach identification tags to the removed hoses for reassembling.

    - : 17 mm, 22 mm

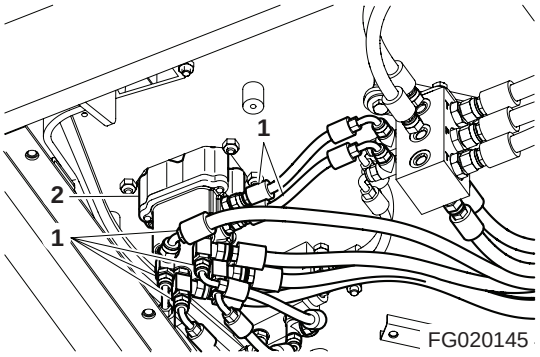


Figure 8

15. Remove floor mat (1) from the cabin.

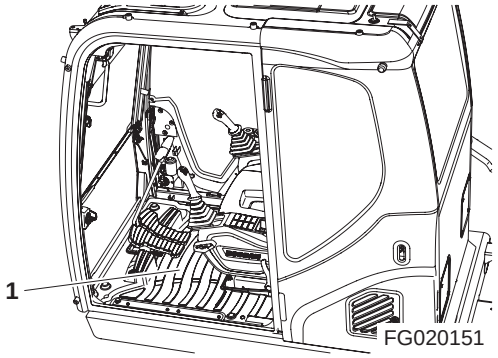


Figure 9

16. Remove bolts (1) and washer.

    Remove footrest (2) from floor plate (3).

    - : 17 mm

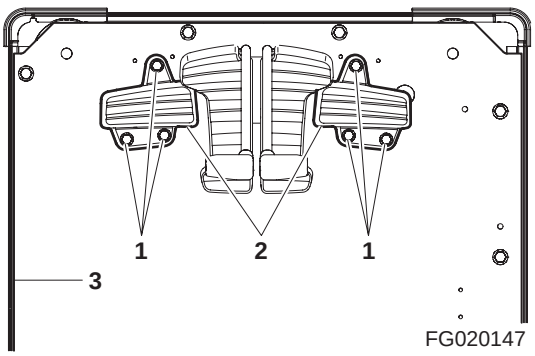


Figure 10

17. Remove bolts (1) and washer (2).

    Remove travel pedal (3) from travel pedal bracket (4).

    - : 17 mm

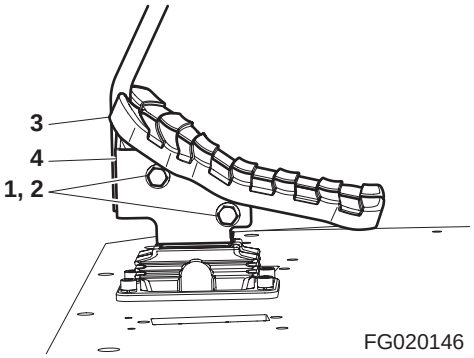


Figure 11

Remove socket bolts (1) and washer (2).

Remove travel pedal bracket (3) from travel control valve (4).

- : 8 mm

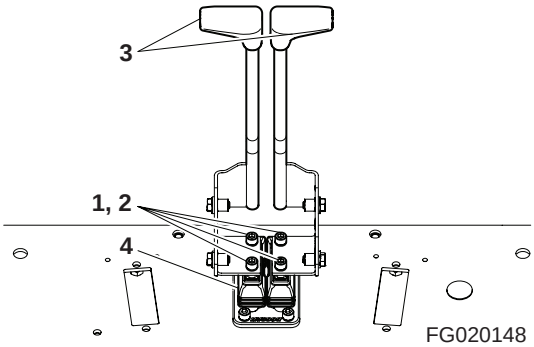


Figure 12

Remove socket bolts (1) and washer (2).

Remove travel control valve (3) from floor plate (4).

- : 8 mm

Move travel control valve (3) from floor plate (4).

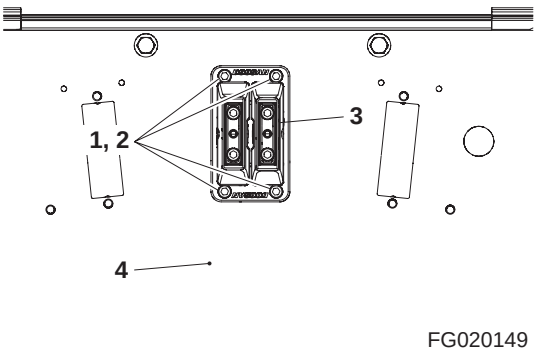
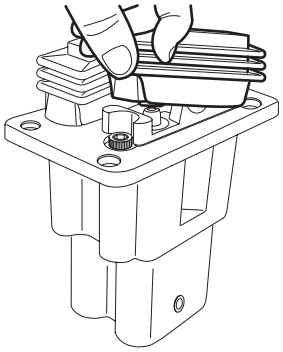


Figure 13

DISASSEMBLY

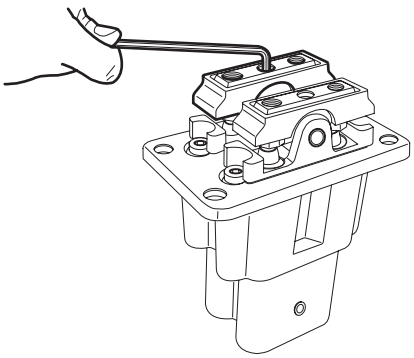
1. Remove bellows (32).



FG013535

Figure 14

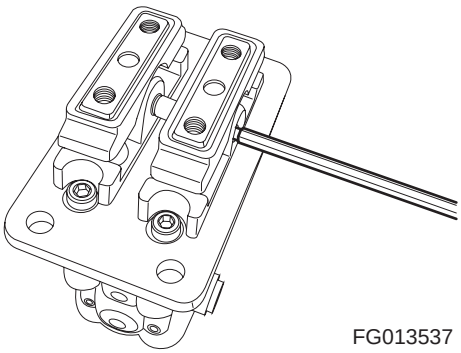
2. Remove set screw (29) from cam (26).



FG013536

Figure 15

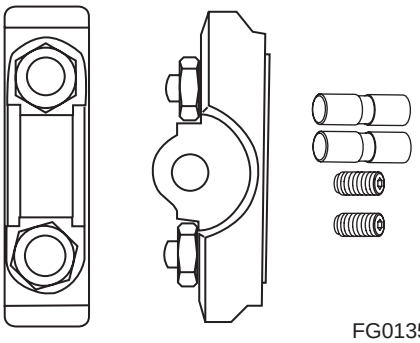
3. Remove camshaft (28) from cam (26).



FG013537

Figure 16

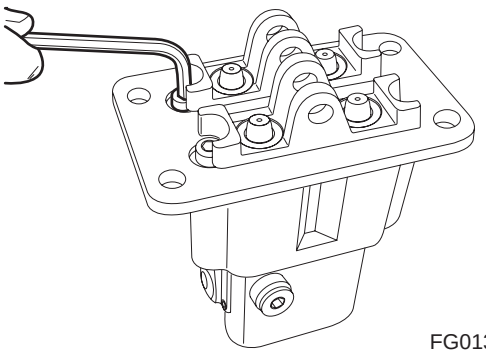
4. Remove hex nut (31) and set screw (30) from cam (27).



FG013538

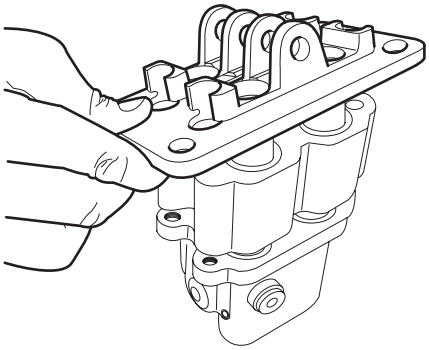
Figure 17

5. Remove hex socket head bolt (25) and cover (24) from each body (1 and 2).



FG013539

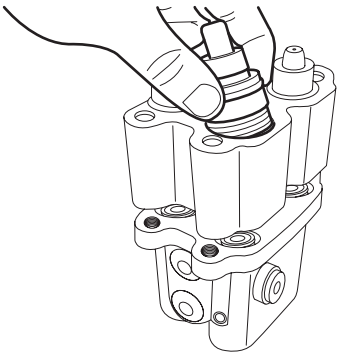
Figure 18



FG013540

Figure 19

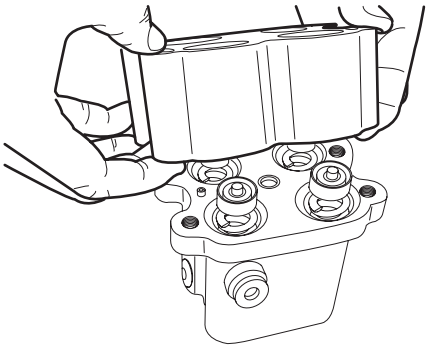
6. Remove push rod assembly from body (2).



FG013541

Figure 20

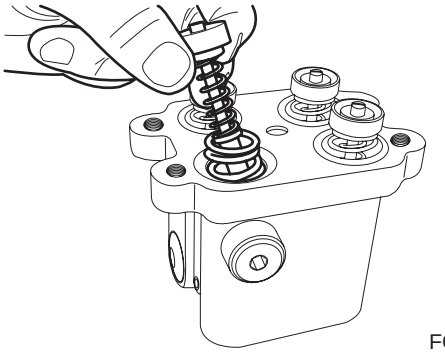
7. Remove body (2) from body (1).



FG013542

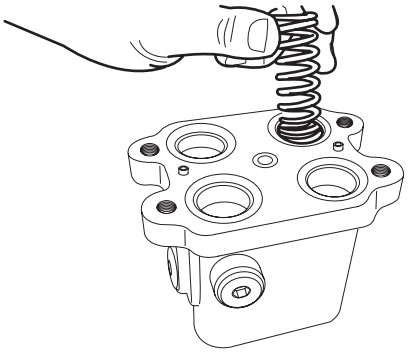
Figure 21

8. Remove damper spool assembly and spring (10) from body (1).



FG013543

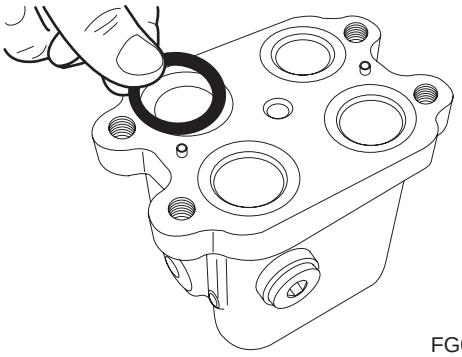
Figure 22



FG013544

Figure 23

9. Remove plug (3 and 4) and O-rings (12 and 34).



FG013545

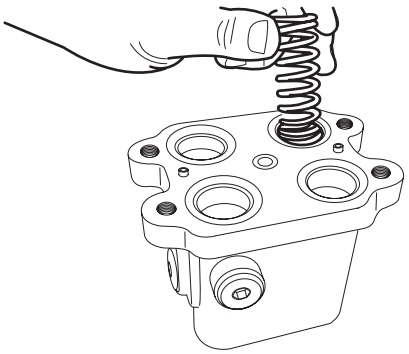
Figure 24

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

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

REASSEMBLY

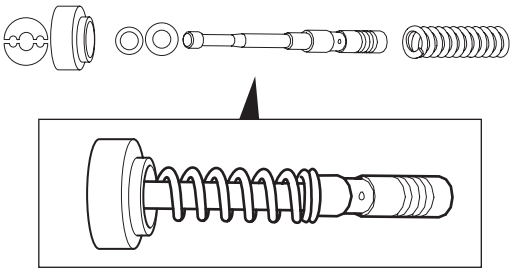
1. Insert spring (10) into body (1).



FG013544

Figure 25

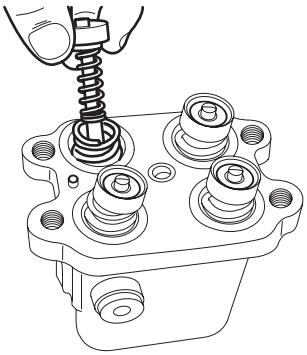
2. Assemble in proper order, damper spool (8), shim (7), spring (6), spring seat (5) and stopper (9).



FG013546

Figure 26

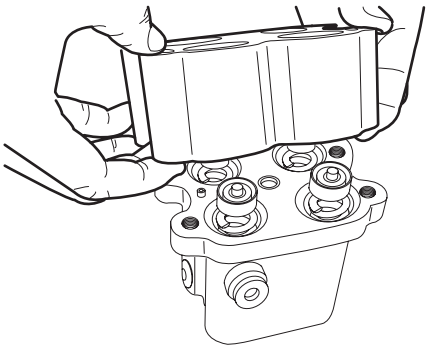
3. Install damper spool assembly into body (1).



FG013547

Figure 27

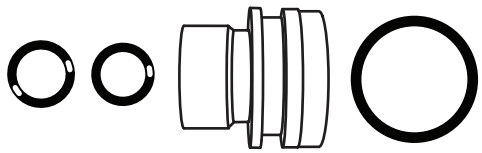
4. Assemble body (2) onto body (1).



FG013542

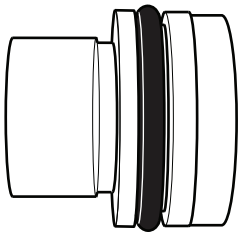
Figure 28

5. Assemble rod seal (22), dust seal (23) and O-ring (21) into plug (20).



FG013548

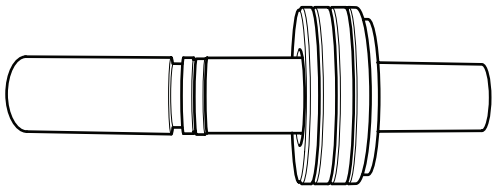
Figure 29



FG013549

Figure 30

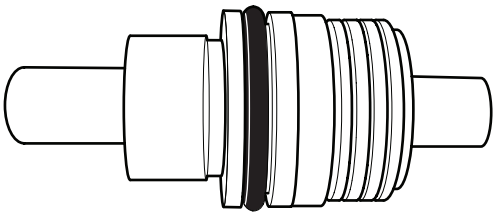
6. Assemble seal (15), piston (33), steel ball (16), plate (18), spring (17) and retaining ring (19) into push rod (13).



FG013550

Figure 31

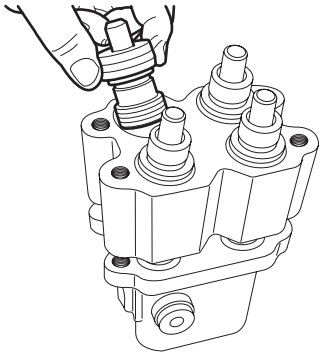
7. Assemble push rod and plug.



FG013551

Figure 32

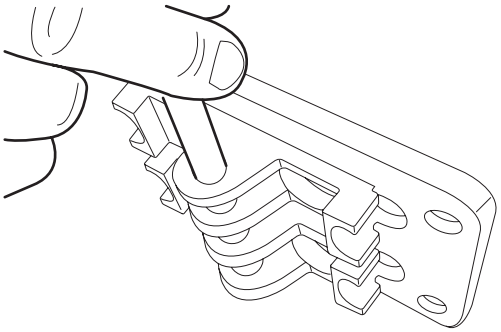
8. Install push rod assembly into body (2).



FG013552

Figure 33

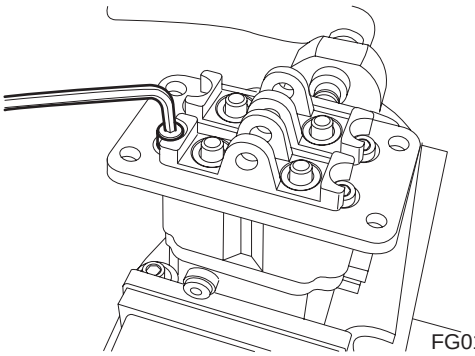
9. Install bushing (27) in cover (24) using jig.



FG013553

Figure 34

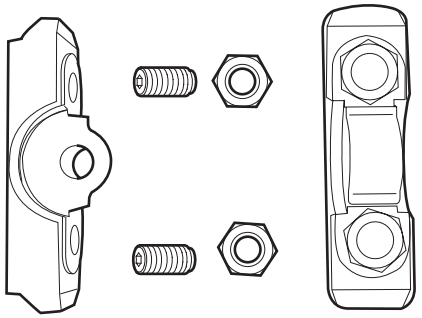
10. Assemble cover (24) onto each body (1 and 2) and install hex socket head bolt (25) using torque wrench.



FG013554

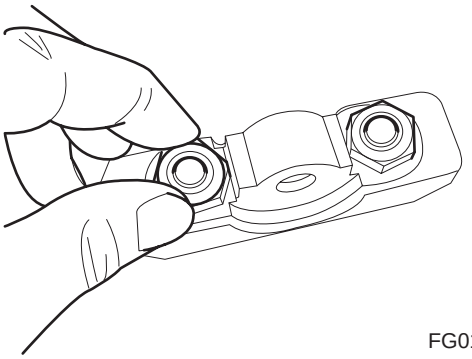
Figure 35

11. Install set screws (30) and hex nut (31) into cam (26) and tighten it.



FG013555

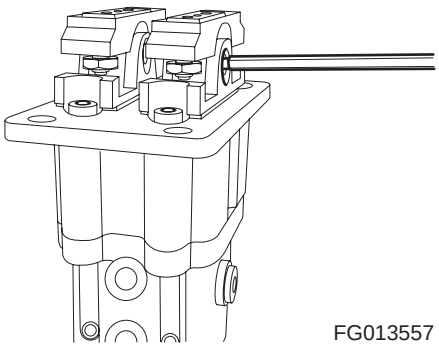
Figure 36



FG013556

Figure 37

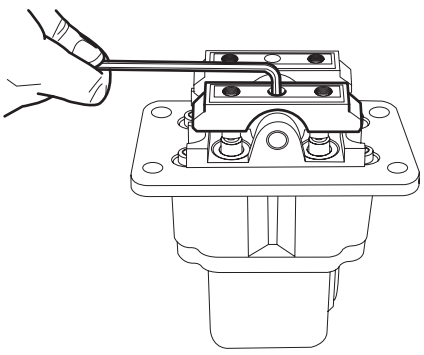
12. Position cam (26) on cover (24) and insert camshaft (29) using hammer.



FG013557

Figure 38

13. Install set screw (29) in cam (26) and tighten it using torque wrench.



FG013558

Figure 39

14. Check cam balance.

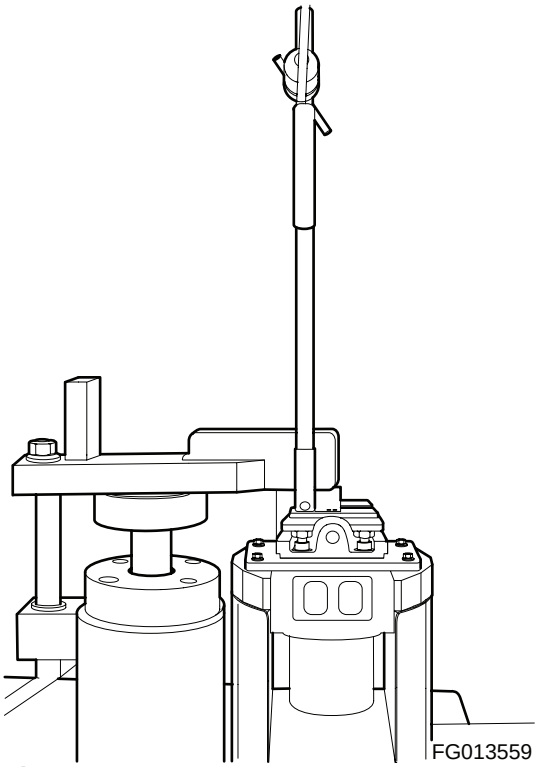


Figure 40

15. Install bellows.

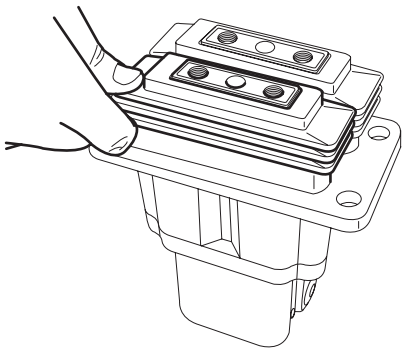


Figure 41

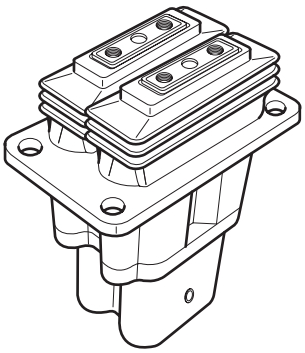


Figure 42

INSTALLATION

1. Position pedal valve (1, Figure 43) on cabin floor plate and install four bolts and washers (2).

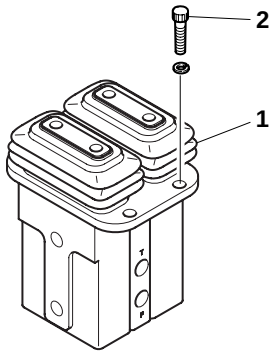


Figure 43

2. Install pedal brackets (3, Figure 44) on pedal valve and install four bolts and washers (2).
3. Install plastic pedals (1).

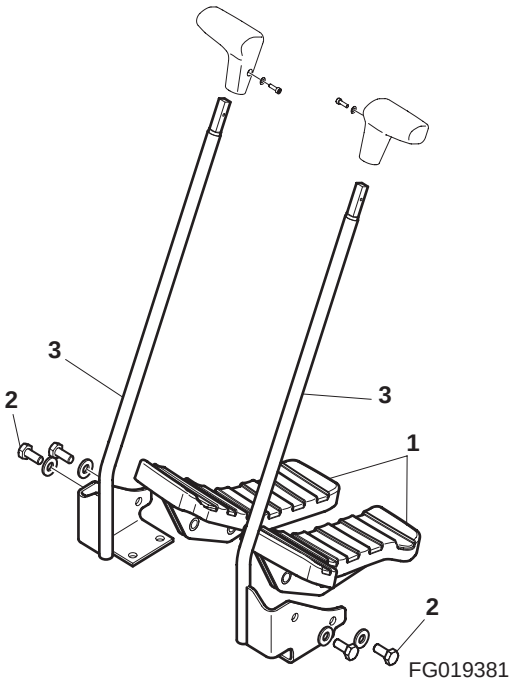


Figure 44

4. Connect hoses as tagged during removal to pedal valve (1, Figure 45).
5. Install cabin under cover by tightening bolts.

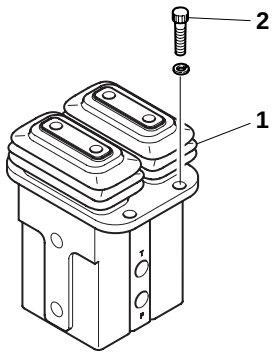
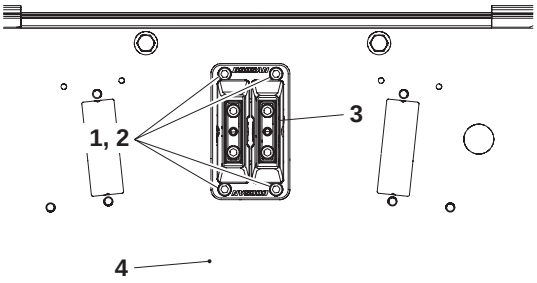


Figure 45

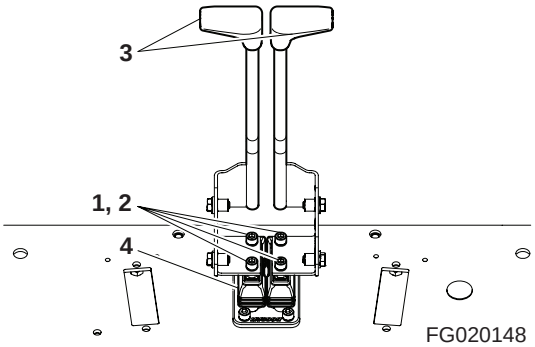
6. Move travel control valve (3) to floor plate (4).
   Install travel control valve (3) to floor plate (4).
   Install socket bolts (1) and washer (2).
   - : 8 mm



FG020149

Figure 46

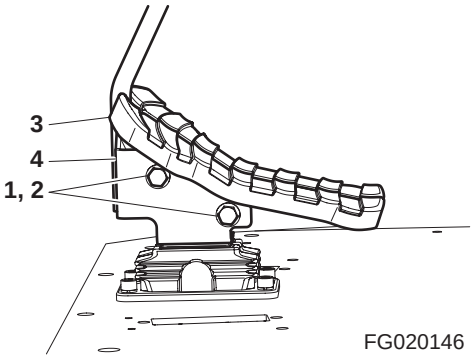
   Install travel pedal bracket (3) to travel control valve (4).
   Install socket bolts (1) and washer (2).
   - : 8 mm



FG020148

Figure 47

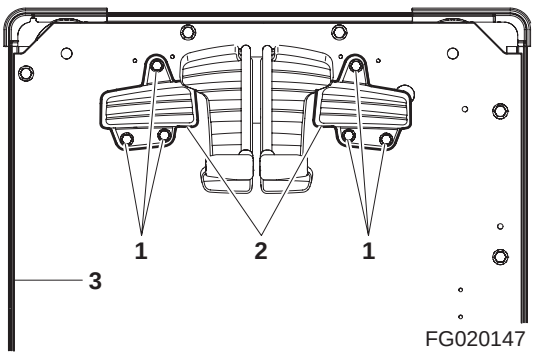
7. Install travel pedal (3) to travel pedal bracket (4).
   Install bolts (1) and washer (2).
   - : 17 mm



FG020146

Figure 48

8. Install footrest (2) to floor plate (3).
   Install bolts (1) and washer.
   - : 17 mm



FG020147

Figure 49

9. Install floor mat (1) to the cabin.

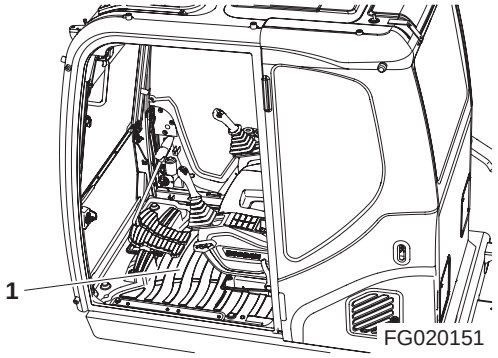


Figure 50

10. Detach identification tags from the removed hoses for reassembling. Install hoses (1) to travel control valve (2).

    - : 17 mm, 22 mm

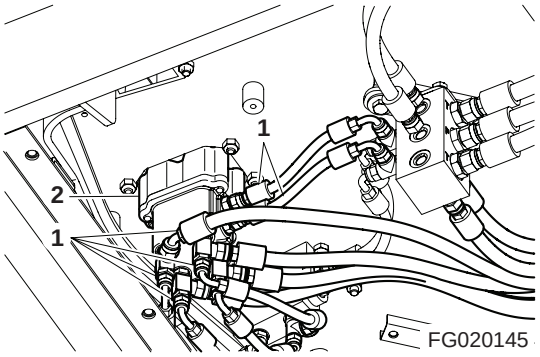


Figure 51

11. Install cover (2) to frame (3).

    Install hex bolts (1) and washer.

    - : 19 mm

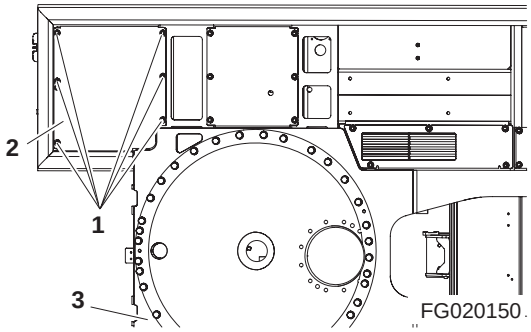
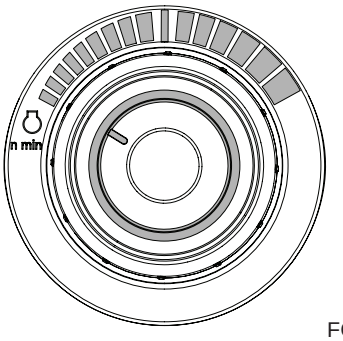


Figure 52

START-UP PROCEDURES

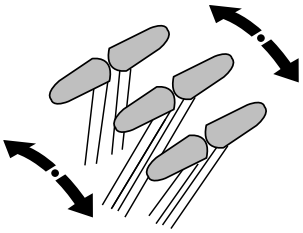
1. Start engine and set throttle at "LOW IDLE."
2. Set safety lever to "UNLOCK" position.



FG019382

Figure 53

3. Slowly push and pull both travel levers about five times without a load to vent air from pilot lines.



HAOB903L

Figure 54

Solenoid Valve Assembly

Edition 2

MEMO

Table of Contents

Solenoid Valve Assembly

Safety Instructions 5
Applicable Models 5
5-Solenoid Valve 6
Parts List 6
Functions of 5-Solenoid Valve Assembly 7
Assembly Diagram and Tools Required 8
Cautions During Disassembly and Reassembly 9
Solenoid Valve Diagram 10
Check Points and Solutions for Problems 11

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

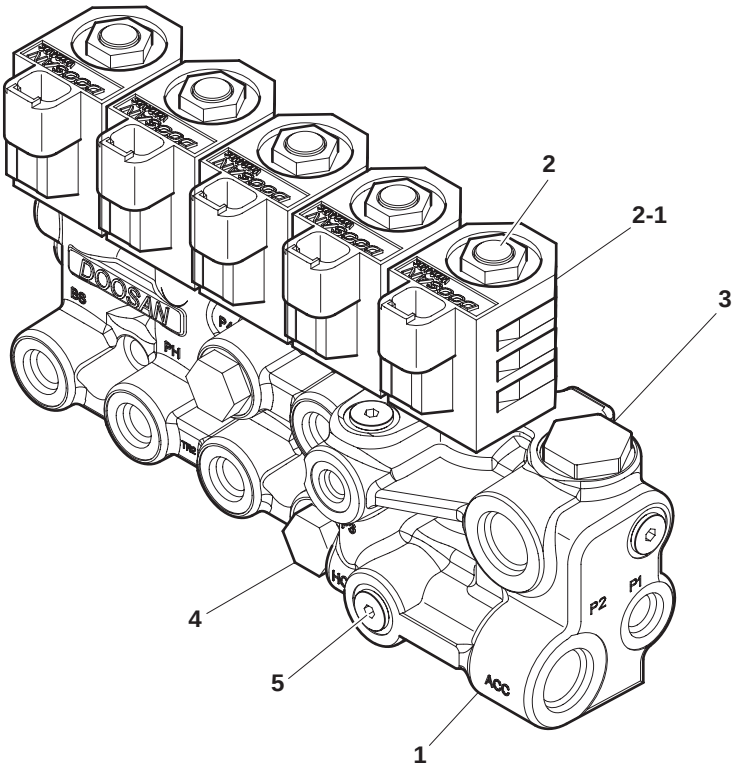
The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 and Up

5-SOLENOID VALVE

Parts List

Figure 1, shows components used in the 5-solenoid valve.



FG020607

Figure 1

Reference Number	Description	Sizes	Quantity	Remarks
1	Block Body	78 x 82 x 263	1	FB-EXDS01657
2	Solenoid Valve	SQ-S3A-00	5	C1 - C5
2-1	Coil (Deutsch Type)	VDD24VDC	5	C1 - C5
3	Check Valve	FD-DCP-0-A	1	C6
4	Plug	PF 1/4"	3	P3, P4, H0
5	Plug	PF 1/8"	6	

Functions of 5-Solenoid Valve Assembly

The solenoid valve assembly controls the following functions.

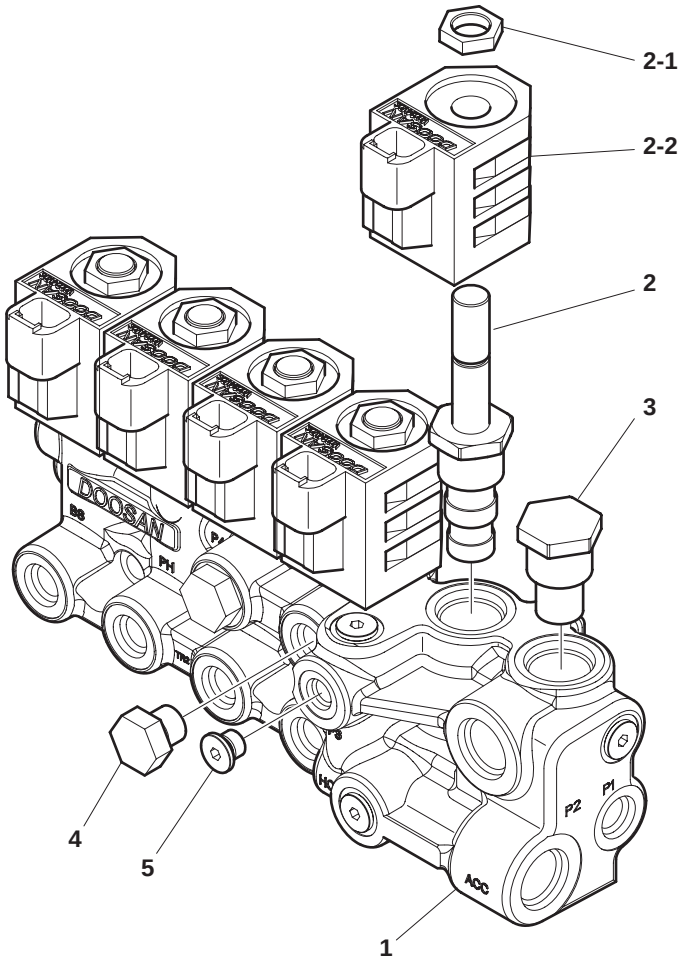
1. Pilot Cutoff
2. Breaker Pressure Supply
3. High/Low Travel Speed
4. Main Pressure (Power Boost) Increase
5. Two-Pump Mode Selection

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	Temporarily increases the pressure setting of the main relief valve, to increase the excavation power.	
C5	Two-Pump Mode Selection	Supplies pilot pressure to two-pump valve that controls the two-pump function so it ready to work in the two-pump mode during breaker/shear mode.	

Assembly Diagram and Tools Required

Figure 2, shows assembly torques recommended for components in the solenoid valve. Designated tools and torques should be used.



FG020608

Figure 2

Reference Number	Description	Sizes	Torques (kg•cm)	Tools
2	Solenoid Valve	UNF7/8 - 14"	350 ± 25	Torque Wrench/1," Hex
2-1	Coil Locknut	UNF1/2 - 20"	60 ± 2	Torque Wrench/19 mm, Hex
2-2	Coil			
3	Check Valve	UNF7/8 - 14"	350 ± 25	Torque Wrench/1," Hex
4	PF 1/4" Plug	PF 1/4	250 ± 25	Torque Wrench/19 mm, Hex
5	PF 1/8" Plug	PF 1/8	100 ± 25	Torque Wrench/5 mm, 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.

IMPORTANT

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.

IMPORTANT

Excessive torque can 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

Reference Number	Description
1	Coil Locknut
2	Coil
3	Connector
4	Tube and Retainer
5	Case

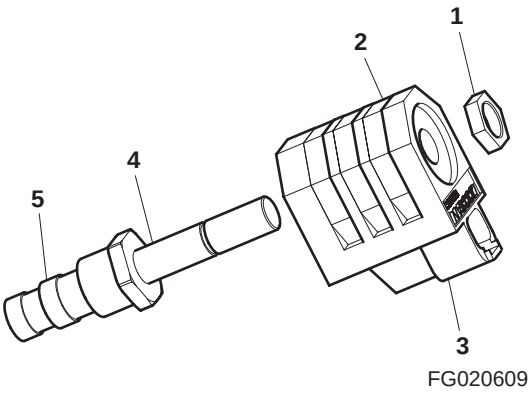


Figure 3

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 connector (valve side) and housing (where harness is attached) are grounded properly.	Replace coil or housing.
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 BS 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, BS	PF1/4" O-ring BOSS	Operate the solenoid valve (ON).

Breaker EPPR Valve (Option)

Edition 2

Table of Contents

Breaker EPPR Valve (Option)

Safety Instructions 5
Applicable Models 5
Structure 6
Parts List 6
Functions and Operation 7
Cautions for Operation 7
Maintenance Instructions 8
Maintenance 8
Disassembly 9
Assembly 10

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 and Up
DX340LC-3	1001 and Up, 10001 and Up
DX350LC-3	1001 and Up, 10001 and Up
DX380LC-3	10001 and Up
DX420LC-3	10001 and Up
DX490LC-3	10001 and Up
DX530LC-3	10001 and Up

STRUCTURE

Parts List

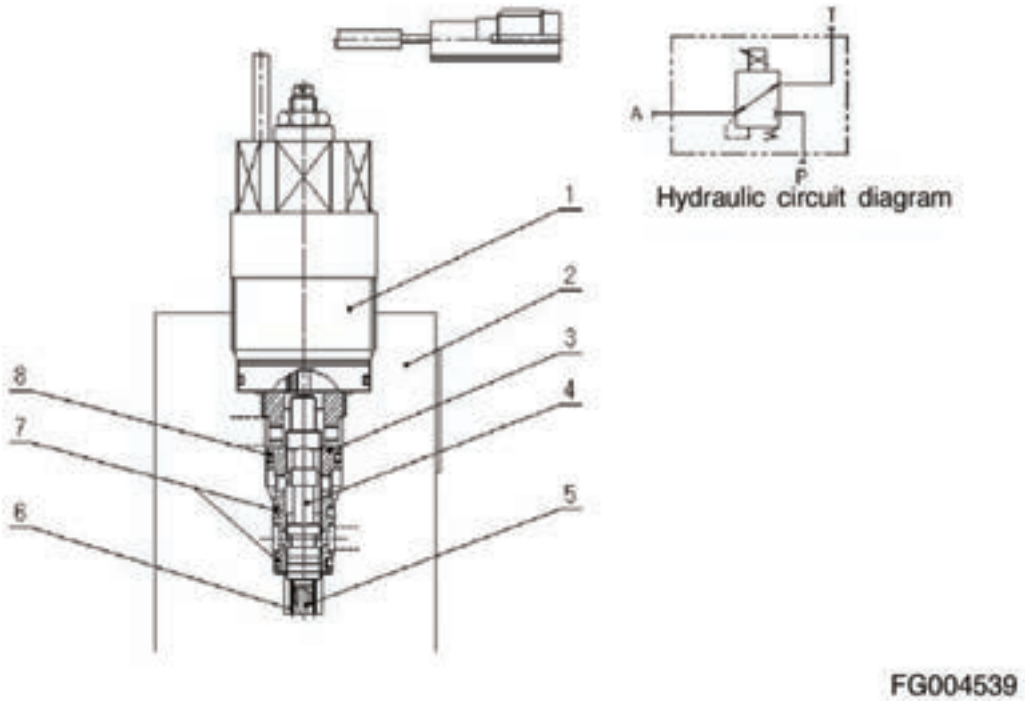


Figure 4

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 so that its reduced pressure is proportional to the current pressure 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 stuck	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 stuck	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 (kg•cm)
M 35	Hex bolt	450 ± 50
M 10	Hex bolt	200 ± 20
NPTF 1/16	Plug	90

Tools Used for Disassembly and Assembly

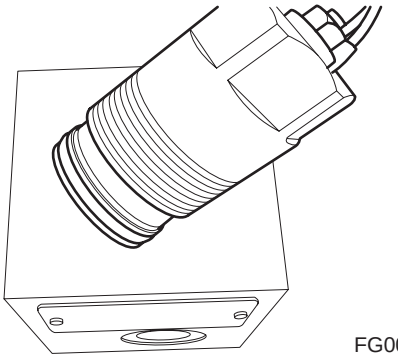
Table 2 shows tools necessary for disassembly and assembly.

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	Wrench
Sleeve	M 10	200 ± 20	Hex bar wrench
NPTF plug	1/16	90	Hex bar wrench

Disassembly

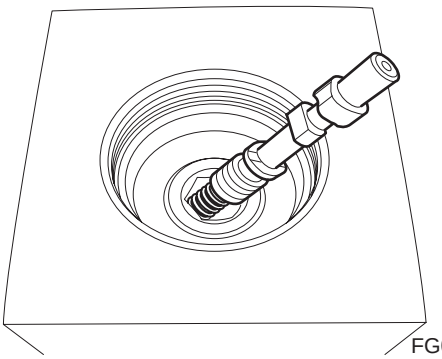
1. Determine a place for disassembly.
   - It should be clean.
   - Lay a rubber board or a cloth on the table and take care not to damage parts.
2. Remove dust and rust of the proportional pressure reducing valve with cleansing oil.
3. Disassemble the solenoid
   - Take care not to damage O-rings of the solenoid.



FG003690

Figure 5

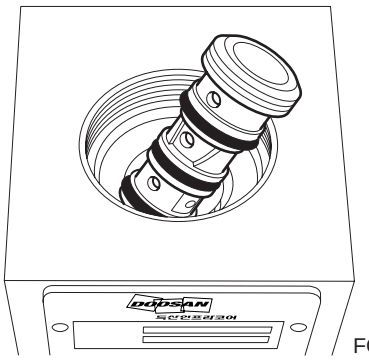
4. Disassemble the spool, the spring, and the pin.



FG003691

Figure 6

5. Disassemble the sleeve.
   - Take care not to damage O-rings of the sleeve.



FG003692

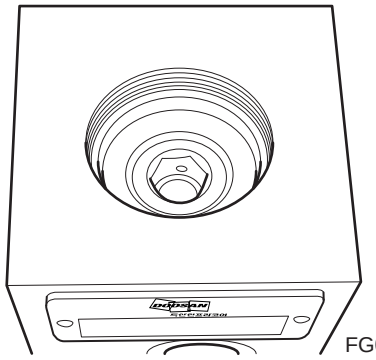
Figure 7

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 thoroughly with cleaning oil and dried with compressed air before starting assembly.
- Sliding parts and bearings should be applied clean active oil before their assembly.
- Make it a rule to replace O-rings and oil seals.
- Use a torque wrench to tighten or engage bolts and plugs according to reference torques as described in Maintenance Guide.

1. Assemble the sleeve.



FG003693

Figure 8

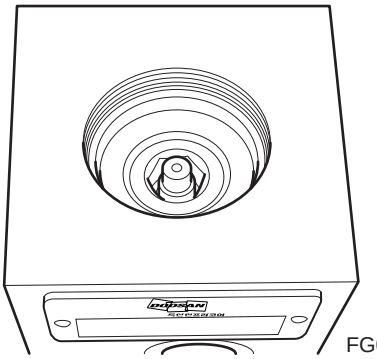
- Take care not to damage O-rings of the sleeve.



FG003694

Figure 9

2. Assemble the spool, the spring, and the pin.



FG003695

Figure 10

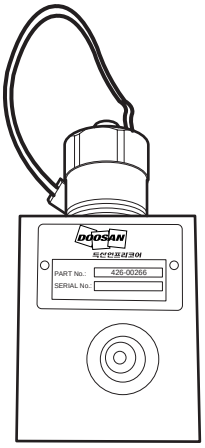
- Make sure that the spring and the pin do not fall off.



FG003696

Figure 11

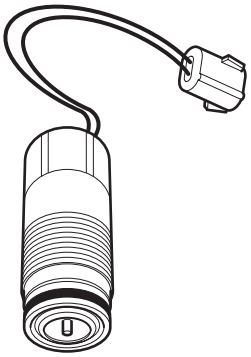
3. Assemble the solenoid correctly.



FG003697

Figure 12

- Take care not to damage O-rings of the solenoid.



FG003698

Figure 13

Dozer Valve

Edition 1

Table of Contents

Dozer Valve

Safety Instructions 5
Applicable Models 5
Structure Diagram 6
Performance Specification 7
Hydraulic Pressure Circuit Diagram 7
Parts List 8
Disassembly and Assembly ToolS 9
Disassembly 9
Assembly Method 11

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

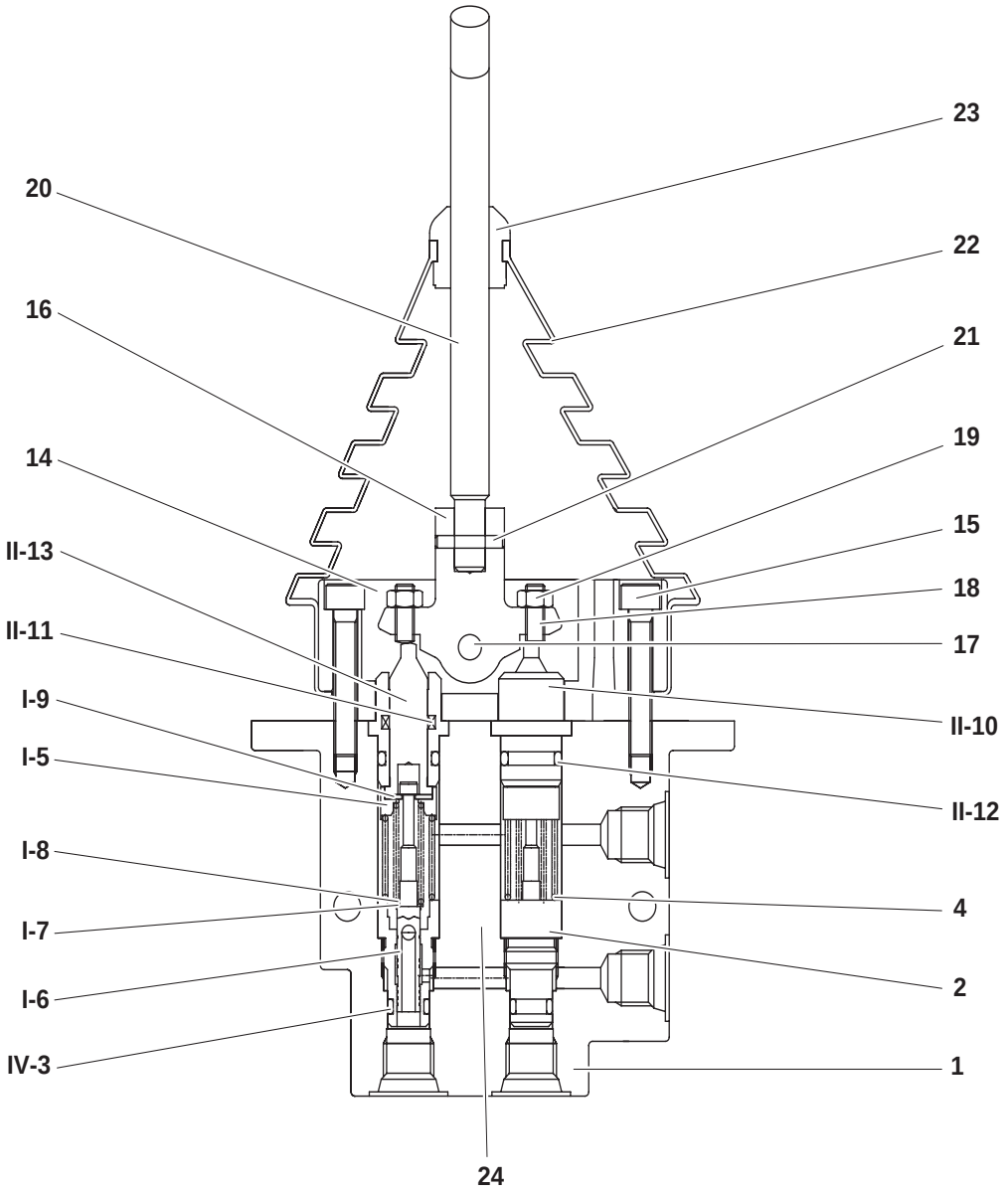
Instructions are necessary before operating or servicing machine. Read and understand the Operation and Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up

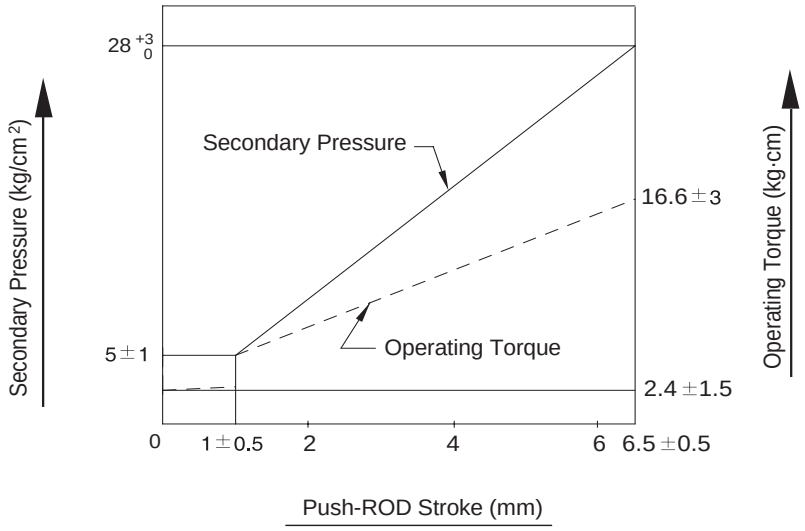
STRUCTURE DIAGRAM



FG023116

Figure 1

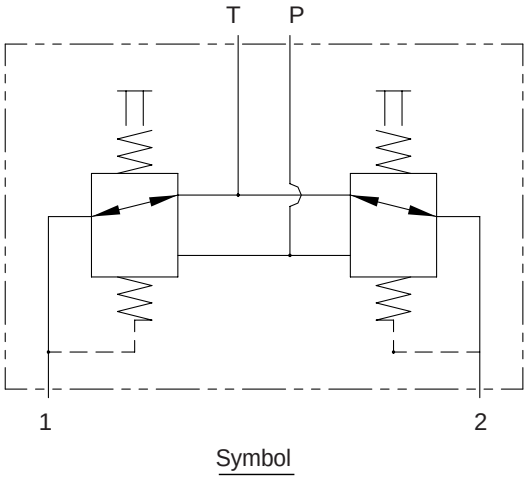
PERFORMANCE SPECIFICATION



FG023115

Figure 2

HYDRAULIC PRESSURE CIRCUIT DIAGRAM



FG011415

Figure 3

PARTS LIST

No.	Part Name	Standard	Material	Q'TY	Remark	RSP
1	Body			1	JA3H1001	O
2	Plug			2	J96H2002	O
IV-3	O-ring	P8	N.B.R	2	PO 08	X
4	Spring			2	JAOL6001	O
I	Spool Kit				JA6J8010	O
I-5	Spring Seat			2	J96H2004	X
I-6	Spool			2	J96H2005	X
I-7	Spring Seat			2	AJV12D103	X
I-8	Spring			2	JAOL6002	X
I-9	Stopper			2 set	AJV12D106	X
II	Plug Kit				JA6J8011	O
II-10	Plug			2	J96H2007	X
II-11	Rod Seal	DYR 10	N.B.R	2	RSY 10	X
II-12	O-ring	P14	N.B.R	2	po 014	X
II-13	Push Rod			2	J96H2008	X
14	Cover			1	J96H2009	O
15	Wrench Bolt	M6 x 35L	SCM440	2	WBM0635	O
16	Guide			1	J96H2010	O
17	Pin			1	J96H2011	O
18	Socket Bolt	M5 x 15L		2	J96H2012	O
19	Nut	M5	SCM440	2	HNM05	O
20	Lever			1	JA2C1001	O
21	Spring Pin	ø3 x 18L		1	SP0318	O
22	Boot			1	JA2C1003	O
23	Bushing			1	JA2C1002	O
24	Nameplate			1	JA6J8001	O
III	Seal Kit	III-3, II-11, 12			JA6J8012	O

DISASSEMBLY AND ASSEMBLY
TOOLS

Part No.	Tool	Specification	Remarks
15	Torque Wrench	L35 mm	150 kg/cm^2
17	L Wrench	10 mm	
18	L Wrench	15 mm	
19	Wrench	8 mm	

DISASSEMBLY

1. Separate the boot (22).

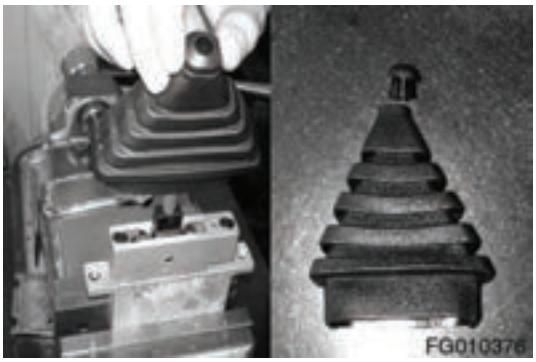


Figure 4

2. Remove the pin (17) and separate the lever (20).



Figure 5

3. Loosen the fixated wrench bolt (15) and separate the cover (14).



Figure 6

4. Separate the plug kit (II) from the body (1).



Figure 7

5. Separate the spool kit (I) from the body (1).



Figure 8

6. Separate the spring (4) from the body (1).



Figure 9

7. Separate the plug (2) from the body (1).

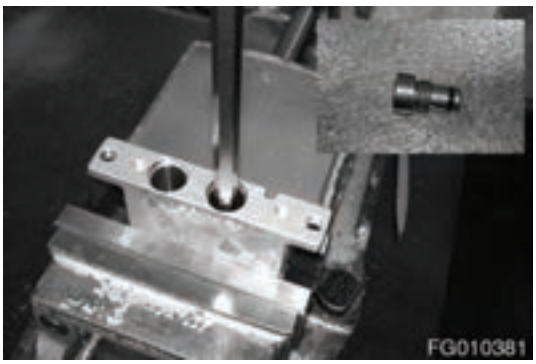


Figure 10

ASSEMBLY METHOD

1. Assemble the plug (2) to the body (1).

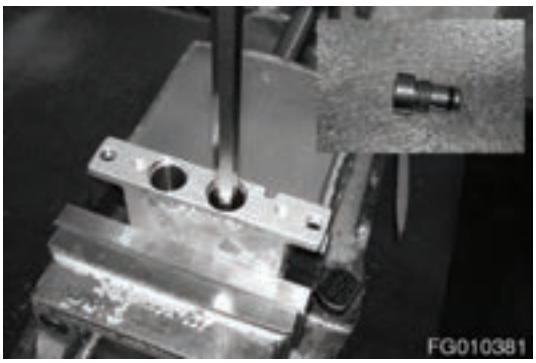


Figure 11

2. Assemble the spring (4) to the body (1).



Figure 12

3. Assemble the spool kit (I).
   Assemble spring seat (I-5), spring (I-8), spring seat (I-5) stopper (I-9) to spool (I-6) in this order.



Figure 13

4. Assemble the spool kit (I) to the body (1).



Figure 14

5. Assemble the plug kit (II).
Assemble the rod seal (II-11), O-ring (II-12) and push rod (II-13) to the plug (II-10) in this order.



Figure 15



Figure 16

6. Assemble the plug kit (II) to the body (1).

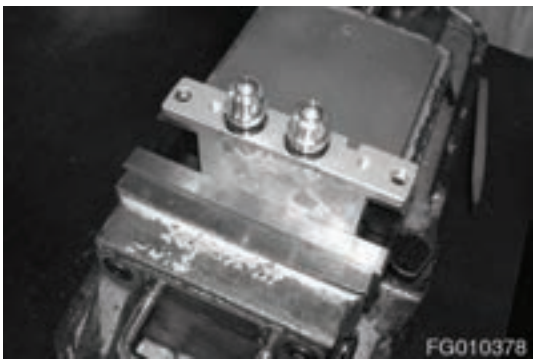


Figure 17

7. Assemble the cover (14) to the body (1).



Figure 18

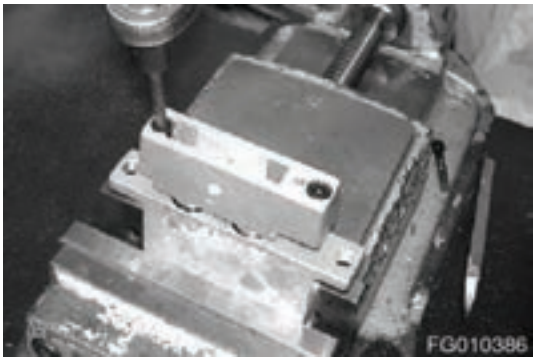


Figure 19

8. After assembling the lever (20) and guide (16), then install it on the body (1) and attach the assembly with the pin (17).

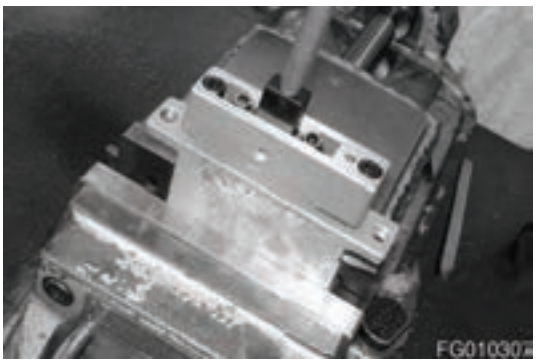


Figure 20



Figure 21

9. Adjust the gap between the guide (16) and push rod (II-13).

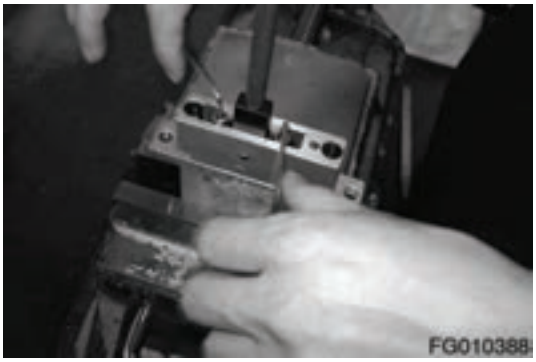


Figure 22

10. Assemble the boot (22).

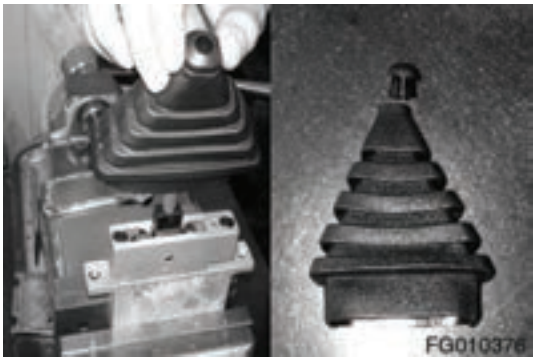


Figure 23

Hydraulic Schematic (DX225LC-3)

Edition 1

MEMO

Table of Contents

Hydraulic Schematic (DX225LC-3)

Safety Instructions 5
Applicable Models 5
DX225LC-3 7

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

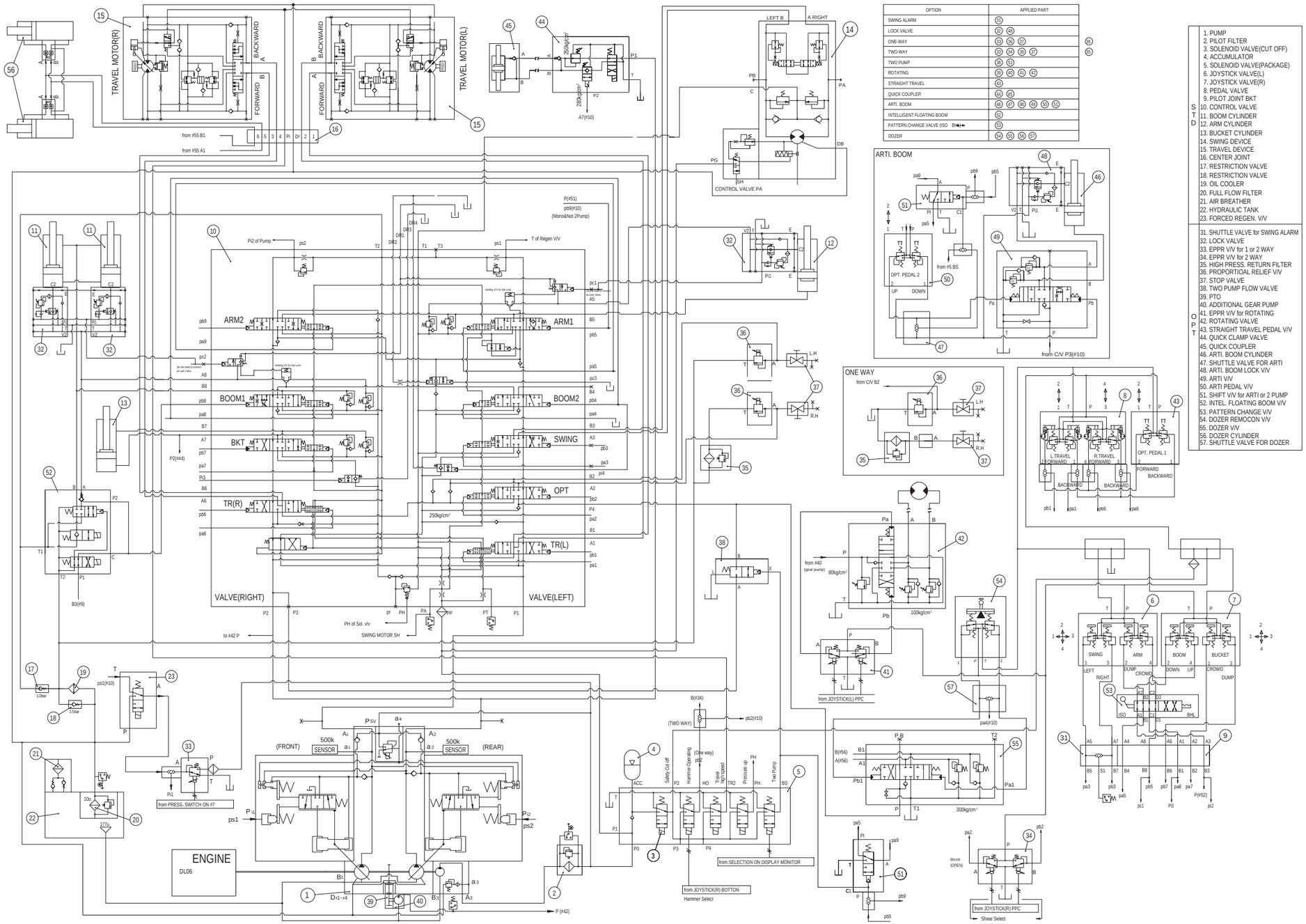
Instructions are necessary before operating or servicing machine. Read and understand the Operation and Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 and Up

DX225LC-3



OPTION	APPLIED PART
SWING ALARM	31
LOCK VALVE	32 48
ONE-WAY	33 35 37
TWO-WAY	33 34 36 37
TWO PUMP	38 51
ROTATING	39 40 41 42
STRAIGHT TRAVEL	43
QUICK COUPLER	44 45
ARTI. BOOM	46 47 48 49 50 51
INTELLIGENT FLOATING BOOM	52
PATTERN CHANGE VALVE (ISO BHL)	53
DOZER	54 55 56 57

STD
1. PUMP
2. PILOT FILTER
3. SOLENOID VALVE(CUT OFF)
4. ACCUMULATOR
5. SOLENOID VALVE(PACKAGE)
6. JOYSTICK VALVE(L)
7. JOYSTICK VALVE(R)
8. PEDAL VALVE
9. PILOT JOINT BKT
10. CONTROL VALVE
11. BOOM CYLINDER
12. ARM CYLINDER
13. BUCKET CYLINDER
14. SWING DEVICE
15. TRAVEL DEVICE
16. CENTER JOINT
17. RESTRICTION VALVE
18. RESTRICTION VALVE
19. OIL COOLER
20. FULL FLOW FILTER
21. AIR BREATHER
22. HYDRAULIC TANK
23. FORCED REGEN. V/V

OPT
31. SHUTTLE VALVE for SWING ALARM
32. LOCK VALVE
33. EPPR V/V for 1 or 2 WAY
34. EPPR V/V for 2 WAY
35. HIGH PRESS. RETURN FILTER
36. PROPORTIOAL RELIEF V/V
37. STOP VALVE
38. TWO PUMP FLOW VALVE
39. PTO
40. ADDITIONAL GEAR PUMP
41. EPPR V/V for ROTATING
42. ROTATING VALVE
43. STRAIGHT TRAVEL PEDAL V/V
44. QUICK CLAMP VALVE
45. QUICK COUPLER
46. ARTI. BOOM CYLINDER
47. SHUTTLE VALVE FOR ARTI
48. ARTI. BOOM LOCK V/V
49. ARTI V/V
50. ARTI PEDAL V/V
51. SHIFT V/V for ARTI or 2 PUMP
52. INTEL. FLOATING BOOM V/V
53. PATTERN CHANGE V/V
54. DOZER REMOCON V/V
55. DOZER V/V
56. DOZER CYLINDER
57. SHUTTLE VALVE FOR DOZER

FG024463

Figure 1

Electrical System

Electrical System

Edition 2

MEMO

Table of Contents

Electrical System

Safety Instructions 7
Applicable Models 7
Introduction 8
Electrical Supply System 10
Engine Starting Circuit 12
- Start Operation 12
- After Start 14

Engine Preheating System 16
Engine Stop 18
Charging System 20
Monitoring System 21
- Instrument Panel 22
- Functional Check 22
- Monitoring System Schematic 24

Operation 26
- Instruments 26

Warning and Indicator Lights 28
- Indication of Warning Lights 28
- Indication of Multifunction Gauge 30

Initial Operation 31
Graphic Information Area Display 32
- Overview 32
- Main Menus for the Graphic Display Area 32
- Menu Selector Buttons 32

User Menu 33
- User Menu - Access and Escape Methods 33

Special Menu 65
- Entering/Accessing and Exiting/Escaping Menus 65
- Special Menu Selections 66

Electronic Hydraulic Control System (e-EPOS) .. 92

Control System Schematic 92
Power Plus Mode Control 94
Operation 96
Power Mode Control - Circuit Diagram 98
Engine Control System 100
Engine Control Dial 101
Engine Control Circuit Diagram 102
Automatic Deceleration Control (Auto Idle Control) 104
Engine Overheat Protection System 106
Power Boost Mode 108
Operation 108
Power Boost Control - Circuit Diagram 110
Automatic Travel Speed Control 112
Automatic Travel Speed Control - Circuit Diagram 114
Self-diagnostic Function 115
e-EPOS Controller 115
Air Conditioner System 117
Outline 117
Internal and External Filters 118
Air-Conditioning System Layout 120
Air Conditioner/heater Circuit Diagram 121
Air Conditioner/heater Unit 122
Ambient Air Temperature Sensor 127
Sun Sensor 128
Control Panel 128
Compressor 136
Receiver Dryer 136
Troubleshooting 137
Weight of R134a Gas Used In Machines 139
Refrigerant System Repairs 140
Refrigerant Safe Handling Procedures 140

Repair and Replacement Procedure 141
Refrigerant Recovery 143
Vacuuming Refrigerant System 143
Leakage Check 145
Refrigerant Charging 145
Inspecting System For Leakage 147
Wiper System 148
Wiper Circuit 148
Wiper operation 149
Lighting System 152
Lighting System Circuit Diagram 152
Kind of Light 153
Operation 153
Overload Warning Device 154
Overload Warning Device Circuit Diagram 154
Audio Controller 155
Audio Controller Circuit Diagram 155

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up
DX300LC-3	1001 and Up, 50001 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 electrical 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.

Electrical 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 = 0.8$^{5\ mm2}$*

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 machine 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 "5" of stereo.
2. Terminal "B" of starter switch.
3. Hour meter.
4. Engine controller.
5. Terminal "2" of fuel auto shutoff controller.
6. Terminal "6" of wiper motor.
7. Terminal "13" of wiper controller.
8. Terminal "CN7-5, CN7-6" of instrument panel controller.
9. Terminal "CN9-6" of air conditioner panel.
10. Cabin light
11. Terminal "11" of diesel heater timer.

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).

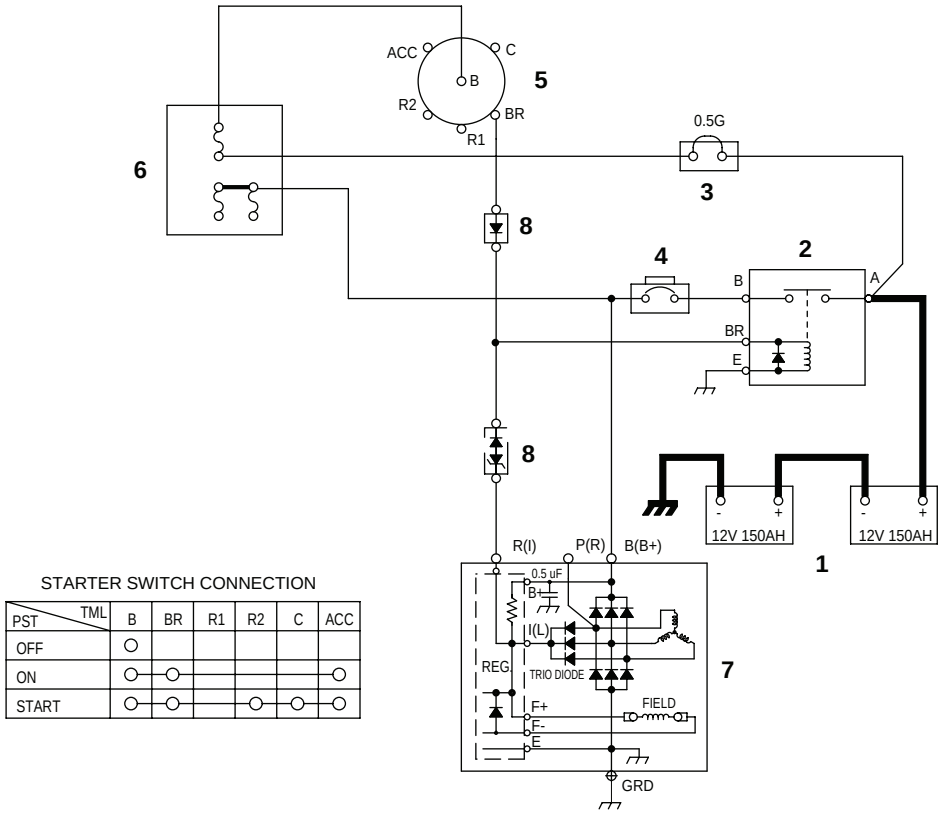


Figure 1 Electric Power Circuit Diagram

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

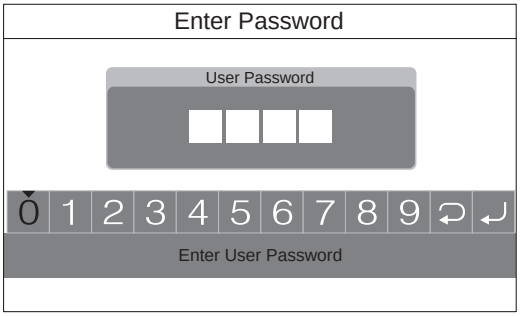
When the starter switch is turned to the "START" position, the "S" and "E" terminals of the starter controller (7) are connected. Now the contacts in the starter relay (8) are closed by the current flow from the battery (1) →fusible link (3) →fuse box (6) → "B" terminal of starter switch (5) →"C" terminal of starter switch (5) →"30" terminal of starter relay (12) - "87a" terminal →"86" terminal of starter relay (8) - "85" terminal →"S" terminal of starter controller (7) - "E" terminal →ground.

When the contact point "30" and "87" of starter relay (8) are connected, the pinion gear of the starter (9) is pushed forward and contacts 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, the 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.*

If 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) →"CN2-96" 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.



FG018473

Figure 2

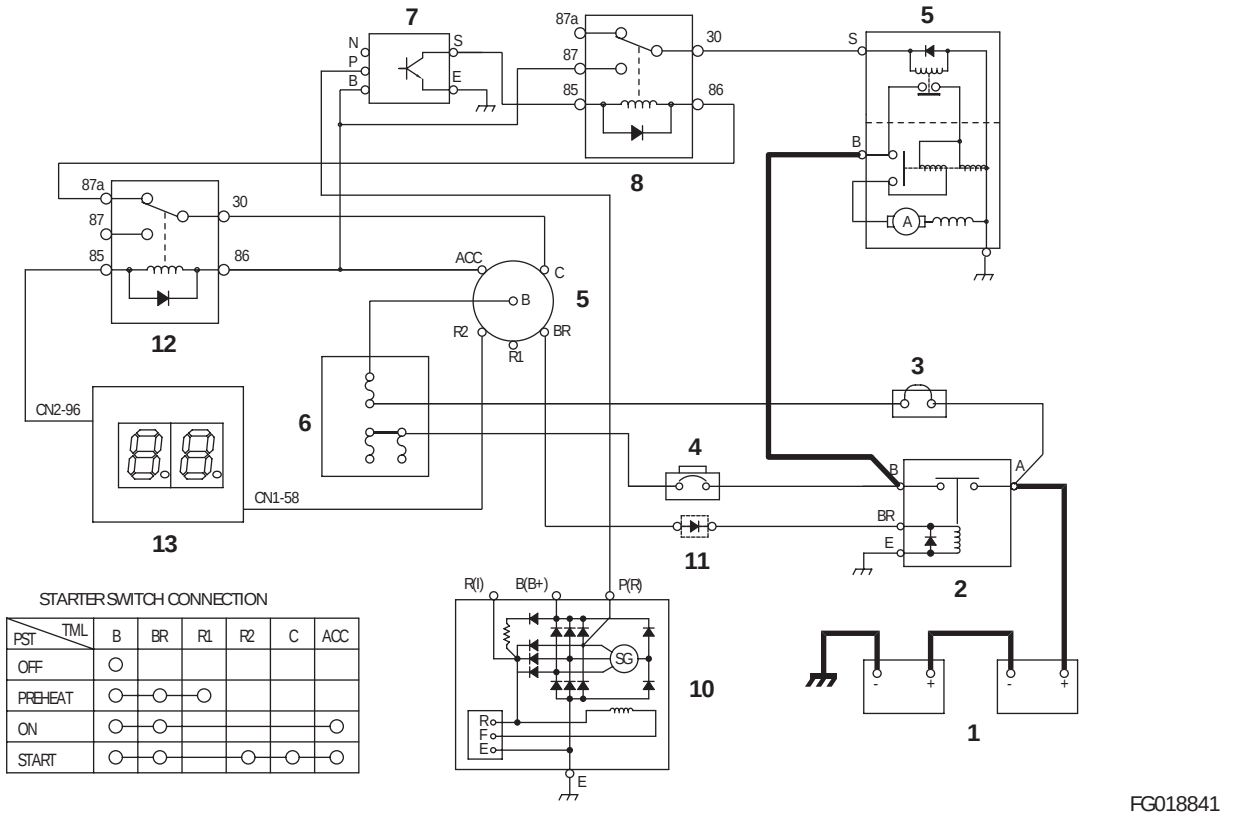


Figure 3 Starter Circuit (1) - While Starting

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

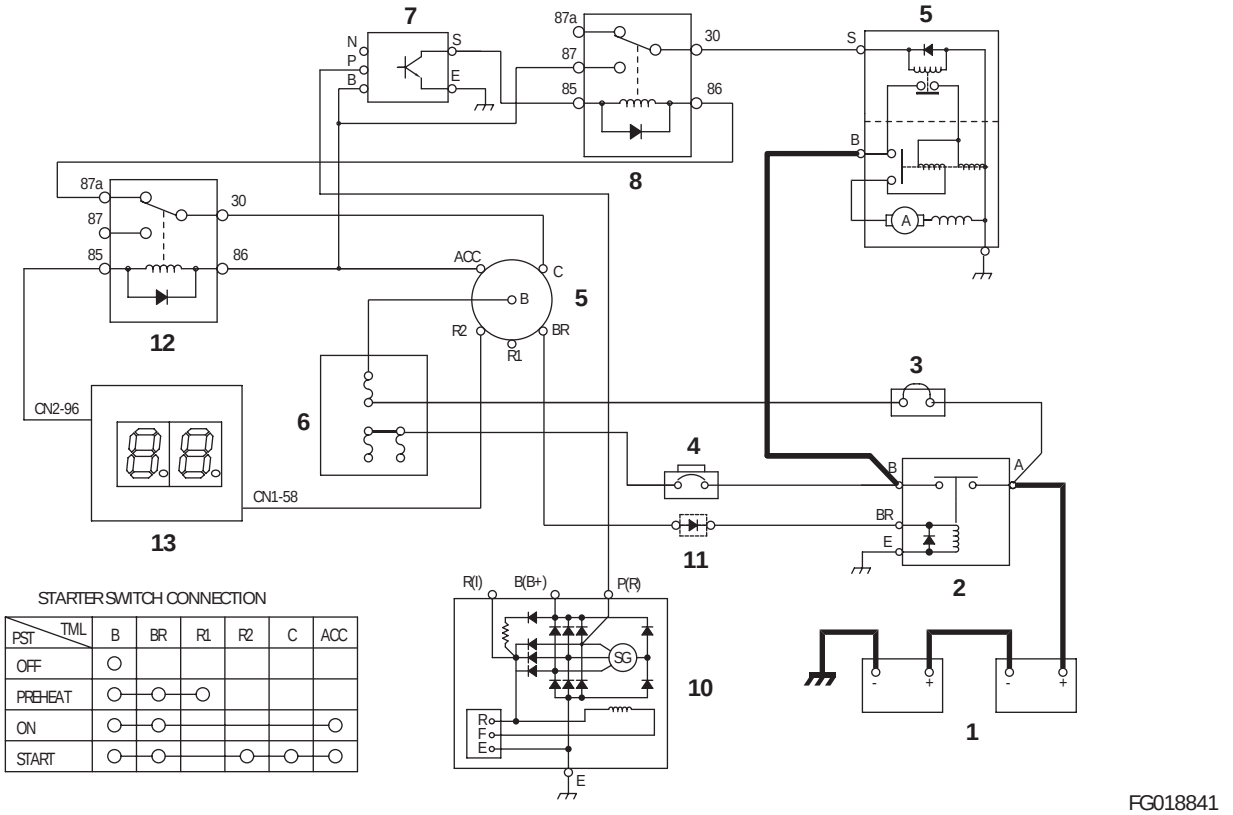


Figure 4 Operation of Start Circuit (2) - Immediately After Start

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" terminal of starter switch (5) →"1-69" terminal of engine controller (12), causing current to flow though "1-74" terminal of engine controller (12) →"C and D" terminals of preheat relay (7) →"1-83" 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 fuse (13) →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.

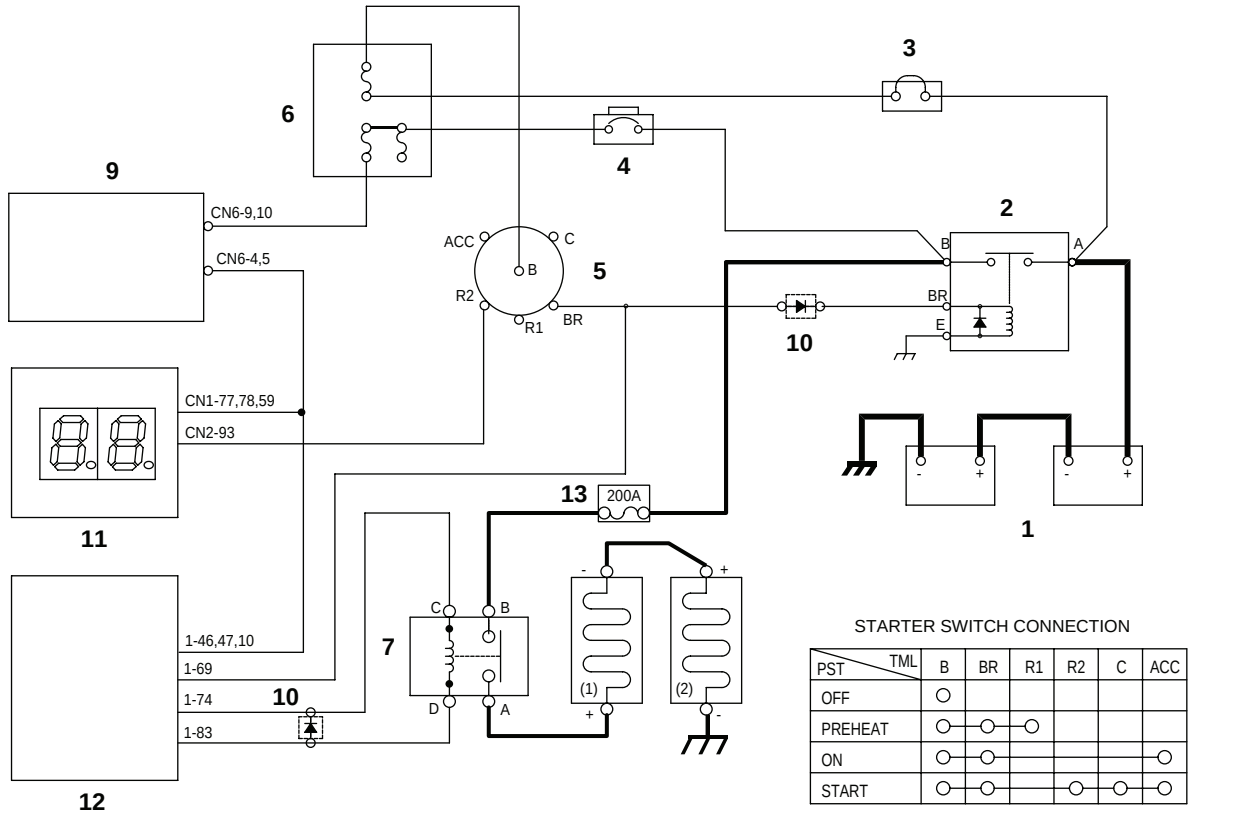


Figure 5 Engine Preheat Circuit

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box
7	Preheat Relay

Reference Number	Description
8	Air Heater
9	Preheat Indicator Light
10	Diode
11	e-EPOS Controller
12	Engine Controller
13	Preheat Relay Fuse

ENGINE STOP

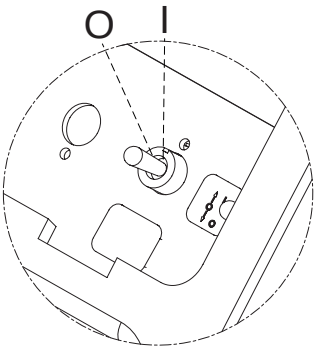
When starter switch (5) is turned "ON" the engine controller (8) is activated. The engine controller monitors and controls the engine including the injector solenoid (9). It controls the fuel deliver rate and the injection timing for each cylinder.

NOTE: *There is an individual injector solenoid (9) for each of the six cylinders. Only one solenoid 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 injected into the engine cylinder, thus stopping the engine.

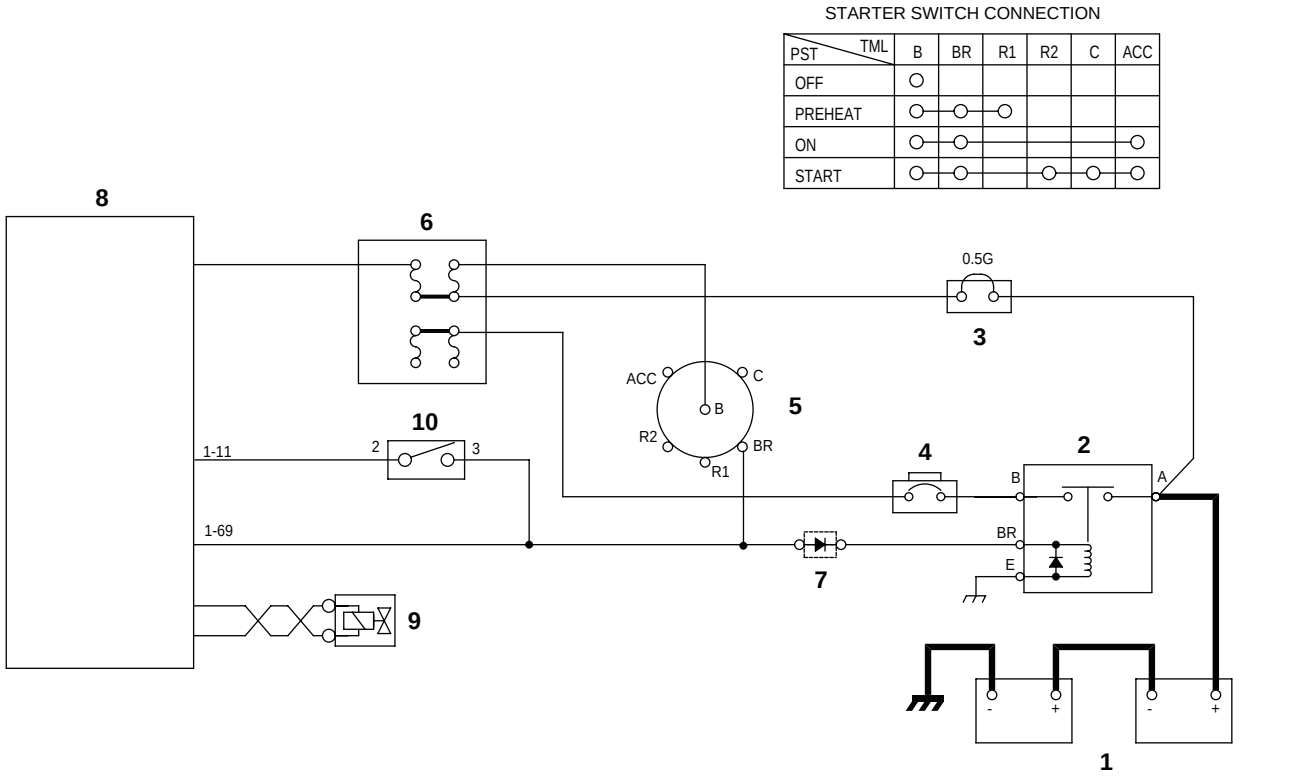
If the engine cannot be shut down using the starter switch (5), an emergency stop switch (10) is provided to stop engine. To activate the emergency stop switch, move it to the "I" (EMERGENCY STOP) position.

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 engine stops. When released it will automatically move back to the "O" (OFF) position.



FG016039

Figure 6 Engine Emergency Stop Switch



FG018843

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 excitation 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 electrical system.

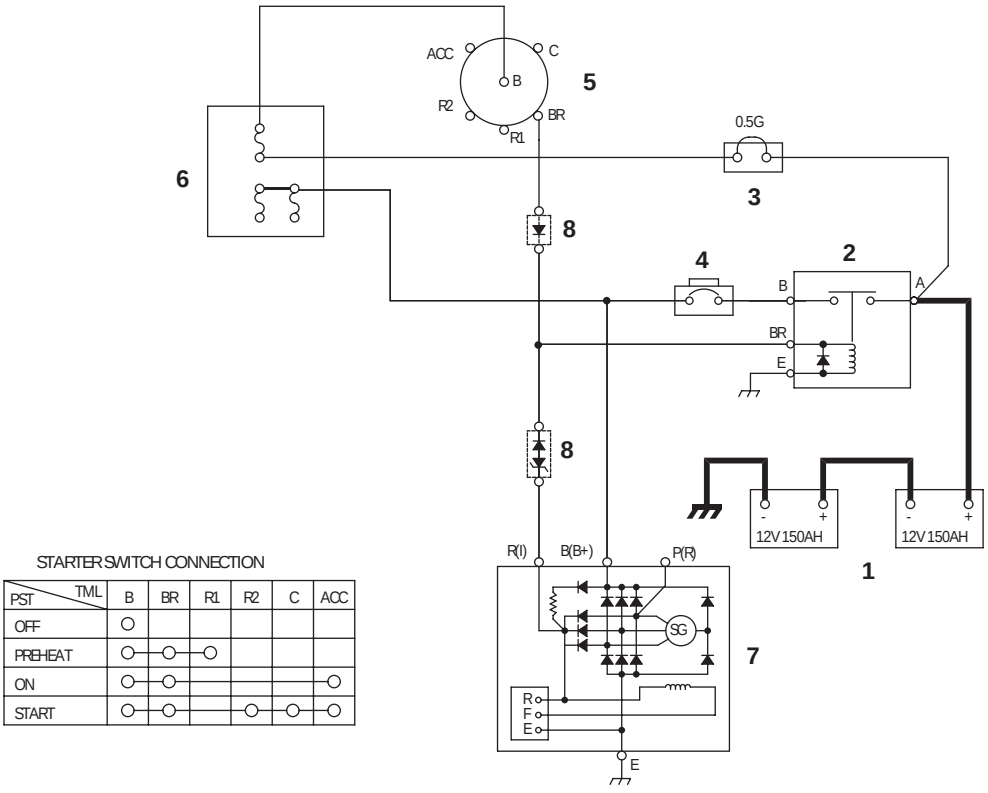
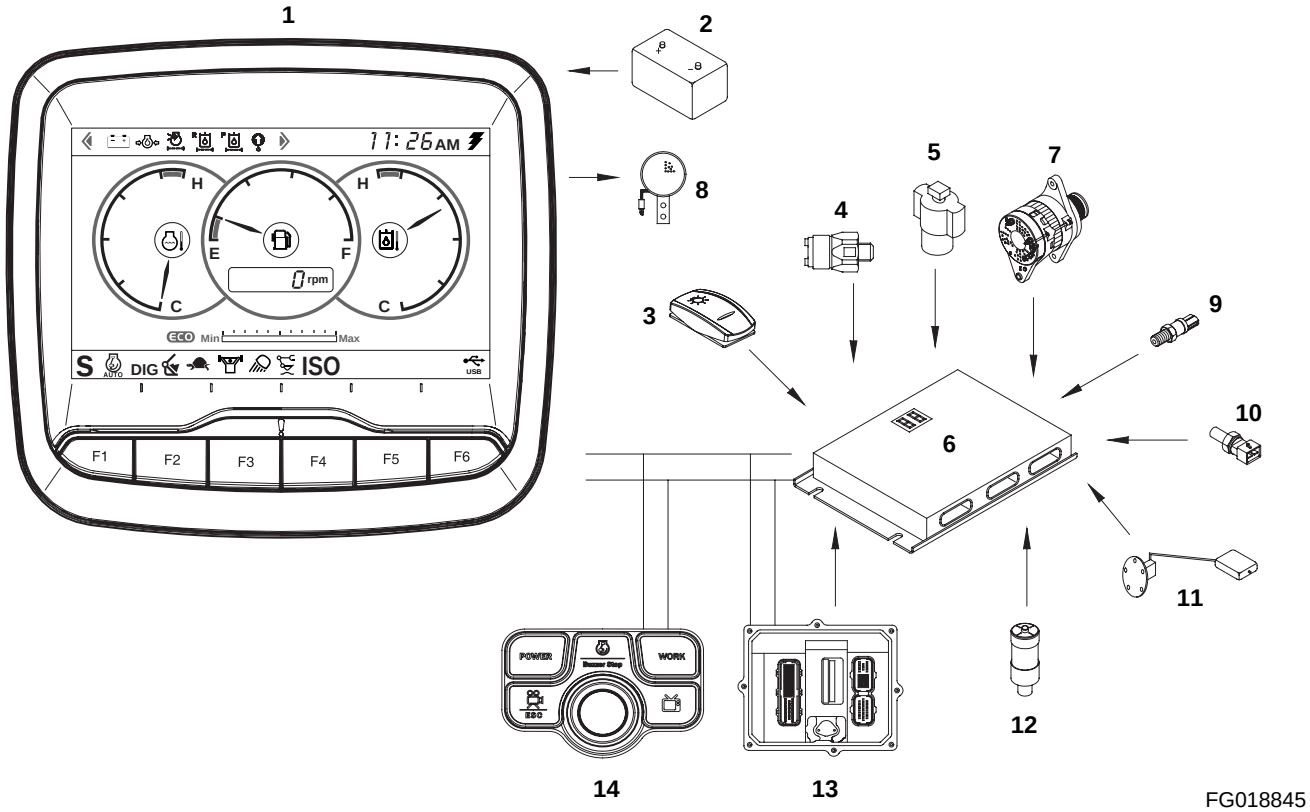


Figure 8 Charging Circuit

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker

Reference Number	Description
5	Starter Switch
6	Fuse Box
7	Alternator
8	Diode

MONITORING SYSTEM



FG018845

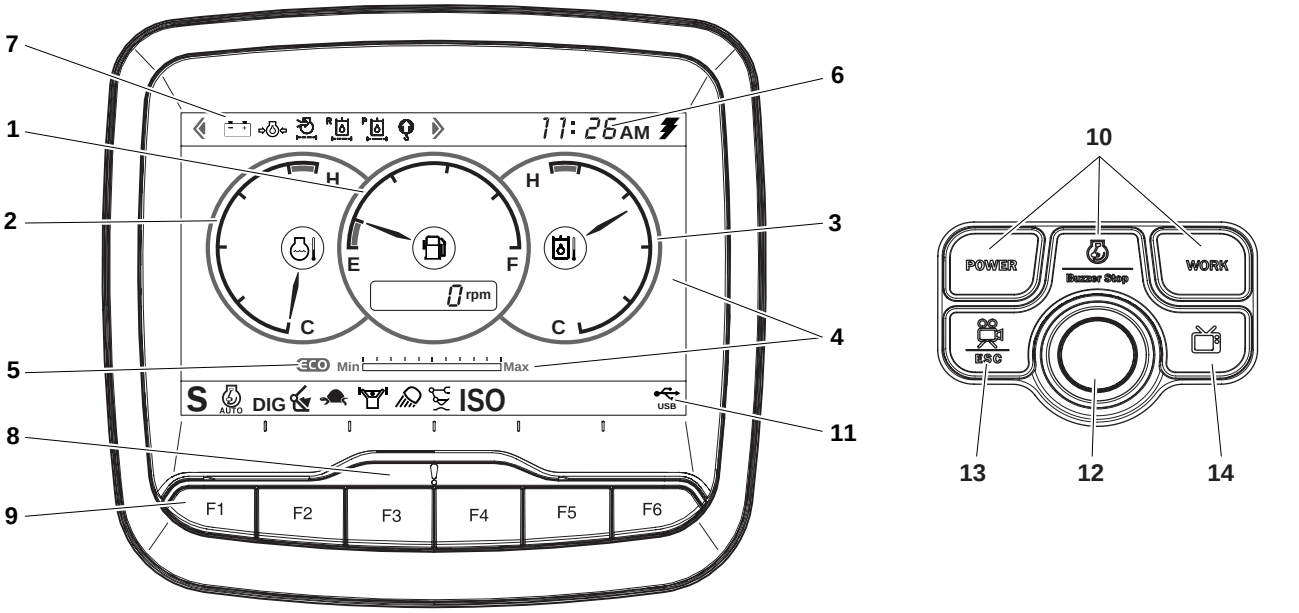
Figure 9

Reference Number	Description
1	Instrument Panel
2	Battery
3	Light Switch
4	Return Filter Switch
5	Pilot Filter Switch
6	e-EPOS Controller
7	Alternator
8	Warning Buzzer

Reference Number	Description
9	Pump Discharge Pressure Sensor
10	Hydraulic Oil Temperature Sensor
11	Fuel Sensor
12	Air Cleaner Indicator
13	Engine Controller
14	Jog Switch Control Panel

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



FG018710

Figure 10

Reference Number	Description
1	Fuel Gauge
2	Engine Coolant Temperature Gauge
3	Hydraulic Oil Temperature Gauge
4	Multifunction Gauge and Graphic Information Area
5	ECO Gauge
6	Digital Clock
7	Display Warning Symbols

Reference Number	Description
8	Warning Light
9	Function Buttons
10	Mode Selector Buttons
11	Selector Function Display
12	Jog Switch
13	Camera Mode Selector/ESC Button
14	Multimedia Selector Button

Functional Check

When the engine starter switch is turned to the "I" (ON) position, all gauge bands, switch/button indicator lights and warning lights will turn "ON" and the alarm buzzer will sound for about two (2) seconds.

During this functional check, a LOGO will appear on the multifunction gauge in the graphic information area (3 and 4, Figure 10).

Monitoring System Schematic

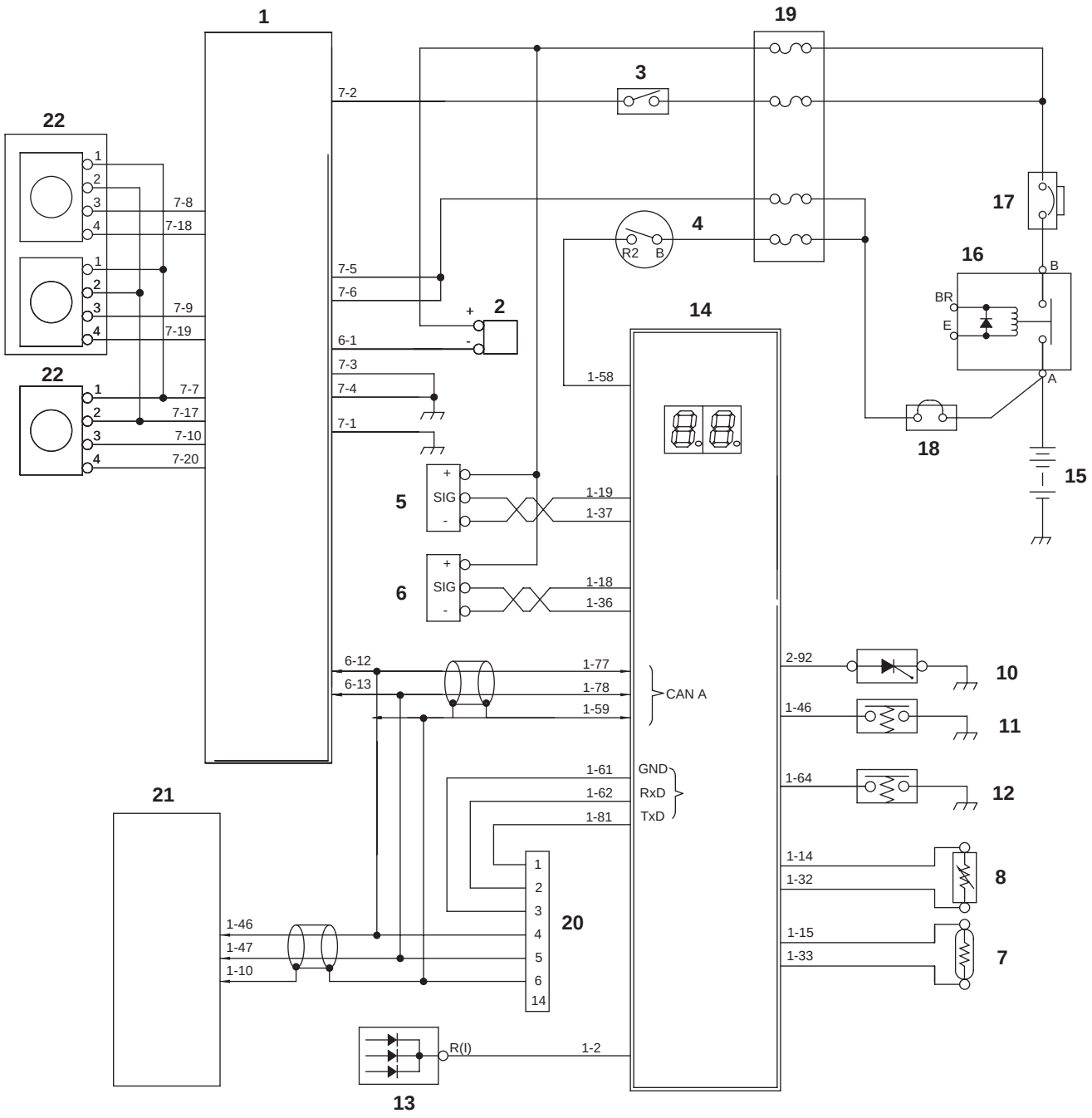


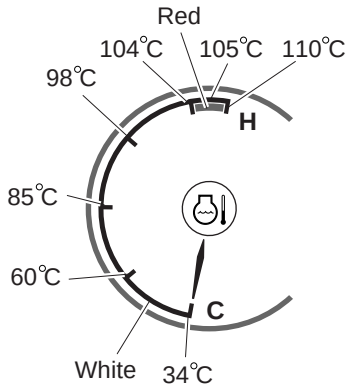
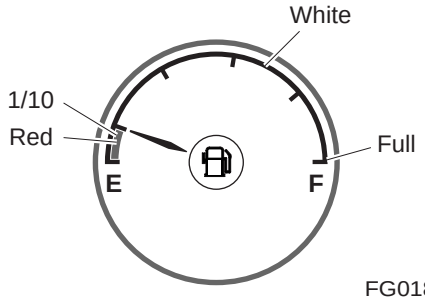
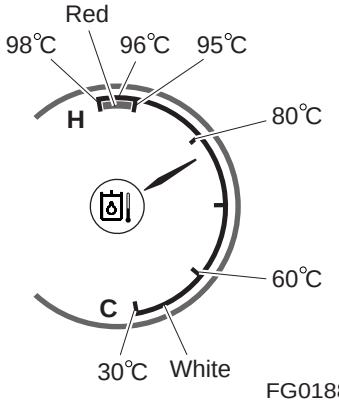
Figure 11

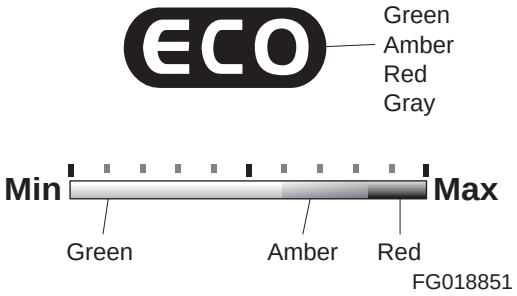
Reference Number	Description
1	Instrument Panel
2	Pilot Buzzer
3	Light Switch
4	Starter Switch
5	Front Pump Pressure Sensor
6	Rear Pump Pressure Sensor
7	Hydraulic Oil Temperature Sensor
8	Fuel Sensor
9	Pedal Pressure Switch (Optional)
10	Air Cleaner Indicator
11	Pilot Filter Switch

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

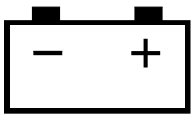
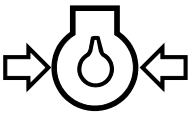
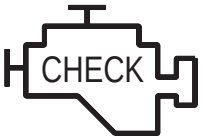
Instruments

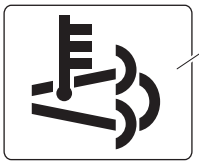
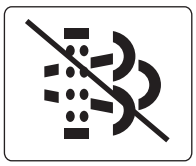
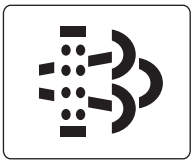
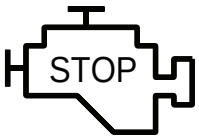
Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Coolant Temperature	 FG018847	ECU-CAN Communication	
Fuel Level	 FG018848	CN1-14 CN1-32	1/10 LCD (Red Zone) Blinking →over 5K ohms FULL →under 525 ohms
Hydraulic Oil Temperature	 FG018849	CN1-15 CN1-33	30°C (86°F) →1,397 ohms 60°C (140°F) →881 ohms 80°C (176°F) →881 ohms 95°C (203°F) →190 ohms 96°C (205°F) →177 ohms 98°C (208°F) →177 ohms (When reading increase)

Function	Display	Sensor Specification	
		Input Terminal	Input Specification
Tachometer	**1750 RPM** FG018850	ECU-CAN Communication	N = 146 f / 60 N = Engine speed (rpm) f = Frequency of engine speed sensor (Hz)
ECO Gauge	 FG018851	ECU-CAN Communication	ECO symbol: The instant workload - Green: Normal operation - Amber: Idling operation - Red: Heavy loading operation - Gray: ECO symbol off ECO gauge: The average fuel efficiency for 1 minute - Green: Fuel efficiency is good - Amber: Fuel efficiency is normal - Red: Fuel efficiency is not good

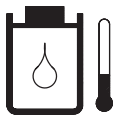
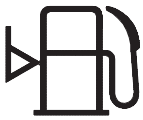
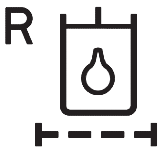
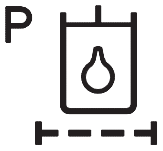
WARNING AND INDICATOR LIGHTS

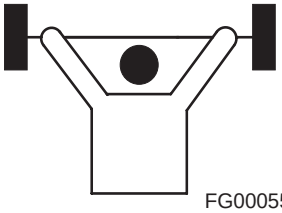
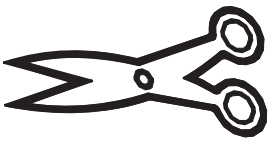
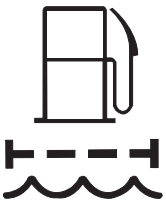
Indication of Warning Lights

Description	Symbol	Input Terminal	Operation	Remarks
Charge	 HAOA610L	CN1-2	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	CN2-93	This symbol appears during preheating ("CN2-93" terminal voltage is below 2 V) 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	CN1-74	This symbol appears when work light turns "ON" (24 V applied).	
HEST	 FG018852	ECU-CAN Communication	This symbol appears in case of DPF manual regeneration or DPF automatic regeneration	Green -> DPF automatic regeneration Amber -> DPF manual regeneration
DPF Inhibit	 FG018854	ECU-CAN Communication	This symbol appears when the operator inhibits regeneration	
DPF	 FG018853	ECU-CAN Communication	This symbol appears in case manual regeneration is needed.	Steady symbol -> Required manual regeneration Blinking symbol -> Required manual regeneration urgently
Engine Stop	 FG019003	ECU-CAN Communication	This symbol appears in case of failure in DPF regeneration	If manual regeneration is not performed despite requirement/alarm for manual regeneration, this symbol can appear.

Indication of Multifunction Gauge

Description	Symbol	Input Terminal	Operation	Remarks
Hydraulic Oil Temperature	 FG000056	CN1-15 CN1-33	When hydraulic oil temperature is above about 96°C.	
Fuel Exhausted	 FG000057	CN1-14 CN1-32	When fuel is almost exhausted.	
Air Cleaner	 FG000053	CN2-92	When air cleaner is clogged.	
Return Filter	 FG000054	CN1-64	When return filter pressure is above about 1.50 kg/cm² (21 psi)	
Pilot Filter	 FG000055	CN1-46	When pilot filter pressure is above about 1 kg/cm² (14 psi)	
Overload Warning	 FG000253	CN1-20 CN1-38	Warning buzzer also starts when boom pressure sensor output voltage is about 2.7V while overload warning switch is "ON."	It flashes in case of 2.71V and above and lights continuously in case of 2.8V and above (and warning buzzer also starts).

Boost	 FG000554	Jog Switch CAN Communication	This symbol appears when boost is selected.	
Breaker	 FG001470	Jog Switch CAN Communication	This symbol appears when breaker is selected.	
Shear	 FG001471	Jog Switch CAN Communication	This symbol appears when shear is selected.	
Water Separator	 FG010520	CN1-21 CN1-39	This symbol appears when the water separator is full. This symbol appears when water separator sensor output voltage is about 1.5V below.	

INITIAL OPERATION

Item	Input (Terminal)	Output (Operation and Initial Setting Mode)
Initial Operation	When "CN7-2" 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: When Fuel Saving Mode is disabled, the power mode is the previous mode. When Fuel Saving Mode is enable, the power mode is standard mode or economy 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.*

GRAPHIC INFORMATION AREA DISPLAY

Overview

Machine condition is displayed in the letter information display department. The information display department is divided into two menus. One is main menu for the user and the other is a special menu for the specialist. These menus can be changed from normal display mode by the jog switch.

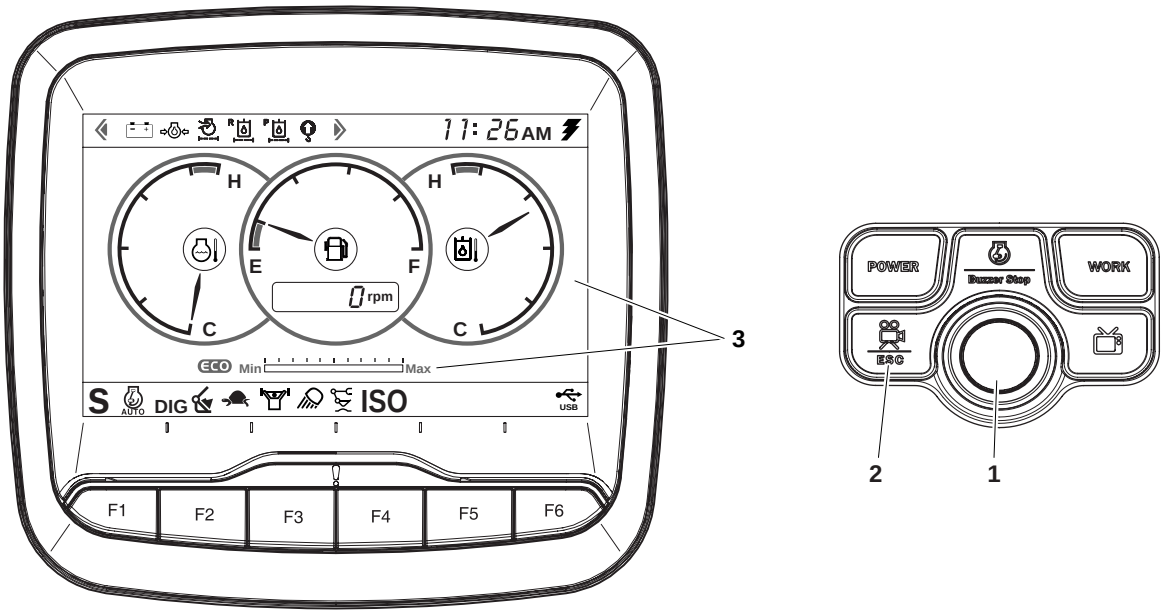


Figure 12 FG018855

Selector Buttons	Graphic Display Area
1. Jog Switch	3. Letter Information Display Department
2. Escape Button	

Main Menus for the Graphic Display Area

1. User menu: Language setting, Time setting, Filter/Oil information, Brightness adjustment, Password
2. Special menu: Information of machine status, fault information, Information of machine operation.

Menu Selector Buttons

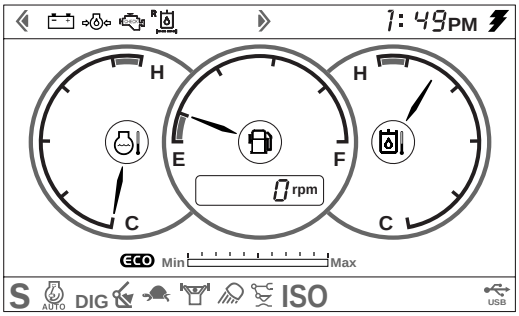
1. Jog Switch (1 on Figure 12): Move cursor and set menu.
2. Escape Button (ESC, 2 on Figure 12): Move a screen to previous menu or main menu.

USER MENU

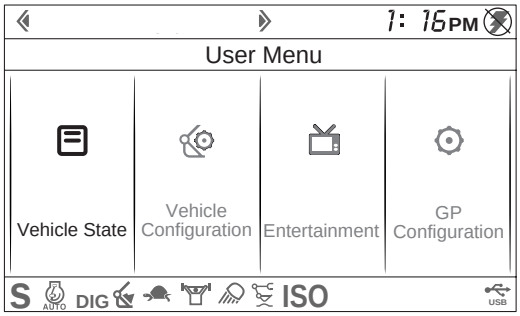
User Menu - Access and Escape Methods

Access Method

On the normal display screen, click on the jog switch to access the user menu screen.



<Normal Indication Monitor>



<Main Menu Monitor>

FG018478

Figure 13

Escape Method

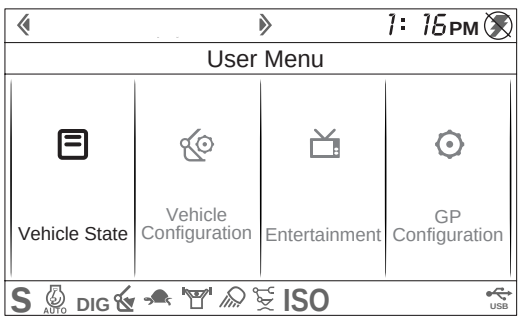
1. Press the ESC button to move to the normal display screen.
2. If 20 seconds have passed without the operation of the button, the normal display screen will be displayed.
3. Turning "OFF" the starter switch to cutoff power, you will move to the normal display screen.

User Menu

Turn the jog switch and move the cursor to see a reversed display on the desired menu. Then, click on the jog switch to select the menu.

Vehicle State ↔ Vehicle Configuration ↔ Entertainment ↔ GP Configuration

Press the ESC button to return to the previous screen.



FG018479

Figure 14

WARNING

AVOID DEATH OR SERIOUS INJURY

Do not use vehicle state menu when traveling or operating.

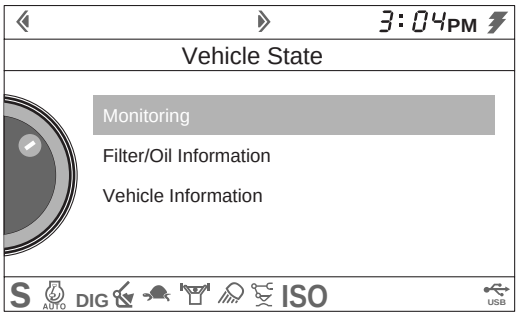
1. Vehicle State

This is used to check the current vehicle state, filter/oil information, vehicle information, etc.

Turn the jog switch and move the cursor to see a reversed display on the desired menu. Then, click on the jog switch to select the menu.

Monitoring ↔ Filter/Oil Information ↔ Vehicle Information

Press the ESC button to return to the previous screen.



FG018480

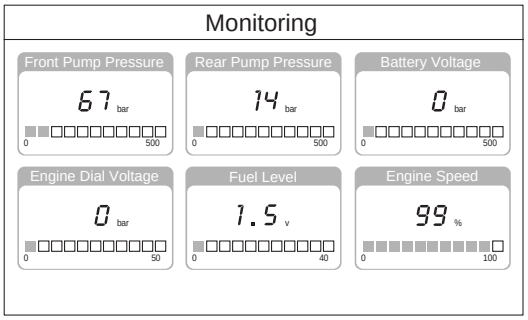
Figure 15

A. Monitoring

The monitoring screen displays the information on vehicle pump pressure, voltage, fuel level, etc.

At the vehicle state, if the cursor is placed on Monitoring, click on the jog switch to display the Monitoring screen.

Press the ESC button to return to the previous screen.



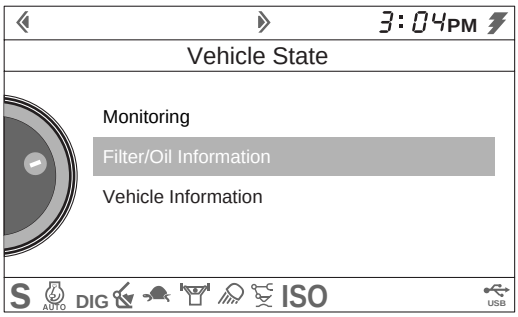
FG018483

Figure 16

B. Filter/Oil Information

The screen displays the information on filter/oil use time, replacement period, and remaining time.

At the vehicle state, if the cursor is placed on the filter/oil information, click on the jog switch to display the filter/oil information.



FG018481

Figure 17

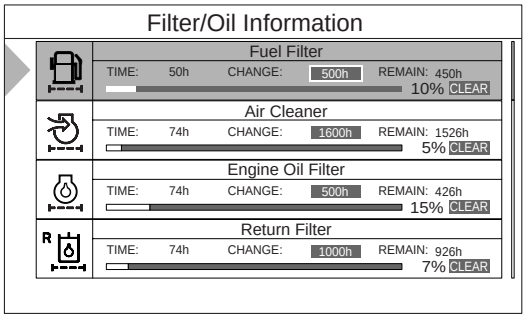
Reset Method/Replacement Period Change Method

Turn the jog switch to locate the cursor to reset the operation hour or change the replacement period.

Click on the jog switch once to display the selection screen on clear at the right bottom. Then, click on the jog switch to display a screen to select the operation hour reset.

Turn the jog switch to locate it at YES. Then, click on the jog switch to reset the operation hour.

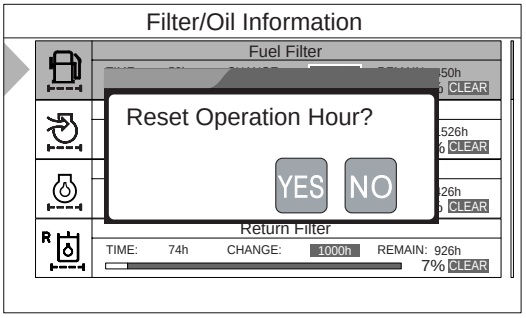
Turn the jog switch to locate it at NO. Then, click on the jog switch to allow the pop-up window to disappear without resetting the operation hour.



FG018484

Figure 18

– The filter/oil use time shows the hours of operation after initializing the engine. It begins again with 0 hr after initialization following the replacement of filter/oil.



FG018485

Figure 19

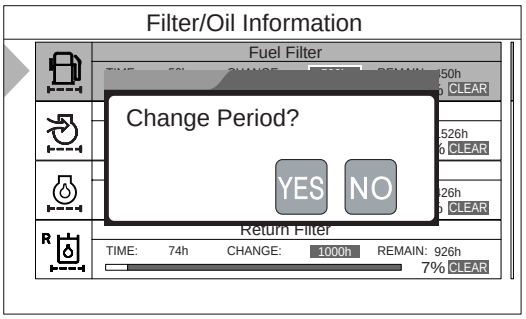
With the selection screen being displayed on clear, turn the jog switch counterclockwise to display the selection screen on the replacement period.

Click on the jog switch to change the selection screen to a flickering state. Then, turn the jog switch counterclockwise to reduce the period. Turn clockwise to extend the period.

With the replacement period change being completed, click on the jog switch to create a pop-up window to select the period change.

Turn the jog switch to locate it at YES. Then, click on the jog switch to change the replacement period.

Turn the jog switch to locate it at NO. Then, click on the jog switch to allow the pop-up window to disappear without the replacement period being changed.



FG018486

Figure 20

Filter/Oil Period Setup Table

Unit: time (hr)

Kind	Replacement Period		
	Basic Setup Value	Minimum Available Setup Value	Change Value By Step
Fuel filter	500	100	50
Air cleaner	2,000	1,000	50
Engine oil filter	500	100	50
Return filter	1,000	100	50
Pilot filter	1,000	100	50
Engine oil	500	100	50
Hydraulic oil	2,000	1,000	50
Coolant water	2,000	1,000	50
DPF filter	4,500	100	50

Symbol Description

Filter/ Oil Name	Fuel Filter	Air Cleaner	ENG Oil Filter	Return Filter	Pilot Filter	ENG Oil	HYD. Oil	Coolant Water	DPF Filter
Icon									

FG024693

Figure 21

If the remaining time for filter/oil replacement is less than 10 hours, this pop-up window will be created. Press the ESC button or the jog switch to allow the pop-up window to disappear.

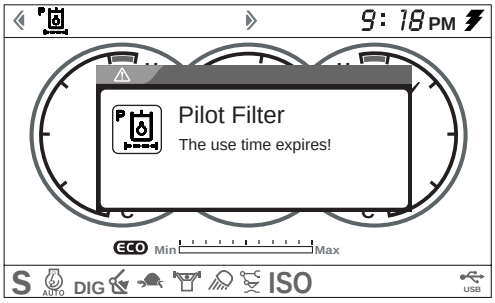


FG018516

Figure 22

If the filter/oil replacement period is expired, this pop-up window will be created.

Press the ESC button or the jog switch to allow the pop-up window to disappear.



FG018515

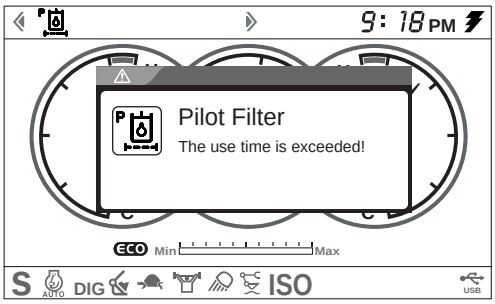
Figure 23

If the filter/oil replacement period is exceeded, this pop-up window will be created. Press the ESC button or the jog switch to allow the pop-up window to disappear.

WARNING

AVOID DEATH OR SERIOUS INJURY

Do not use vehicle state menu when traveling or operating.



FG018517

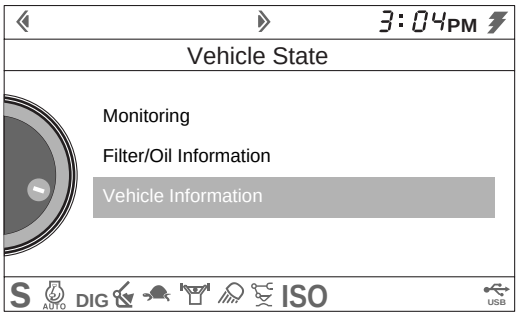
Figure 24

C. Vehicle Information

This is used to check the machine name, engine type and attachment options.

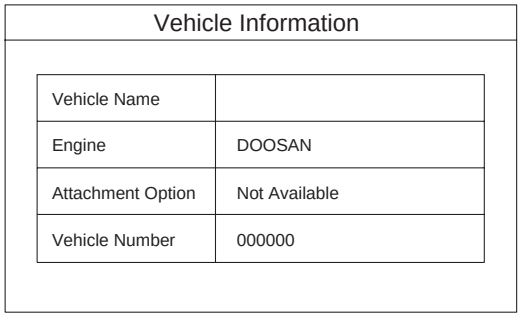
At the vehicle state, if the cursor is placed on the vehicle information, click the jog switch to access the vehicle information screen.

Click the ESC button to return to the previous screen.



FG018482

Figure 25



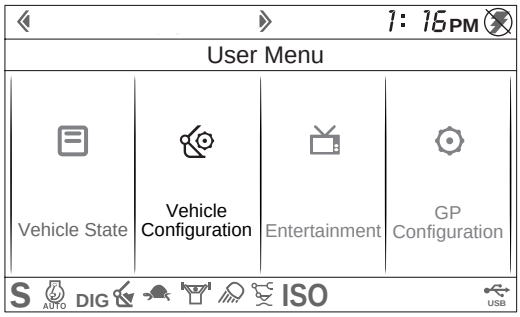
FG024557

Figure 26

2. Vehicle Configuration

This is used when selecting the functions such as attachment select, attachment setting, camera setting, and jog shuttle for dial.

Turn the jog switch and move the cursor to see an reversed display on the desired menu. Then, click the jog switch to select the menu.

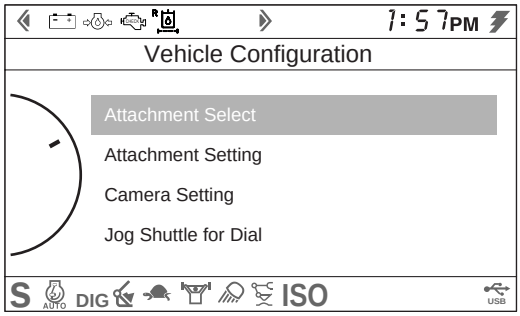


FG018488

Figure 27

Attachment Select ↔ Attachment Setting ↔ Camera Setting ↔ Jog Shuttle for Dial

Press the ESC button to return to the previous screen.



FG018489

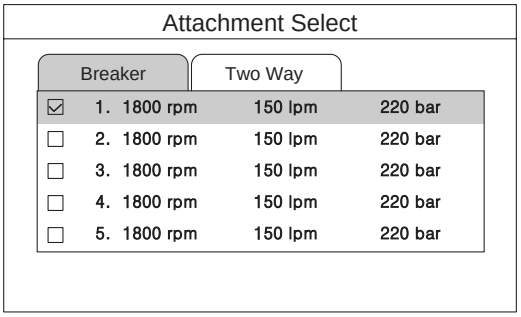
Figure 28

A. Attachment Select (Optional)

The attachment select screen is used to select attachments among the already set-up available attachments.

At the vehicle configuration, if the cursor is placed on the attachment select, click on the jog switch to access the attachment select screen.

Press the ESC button to return to the previous screen.



FG020156

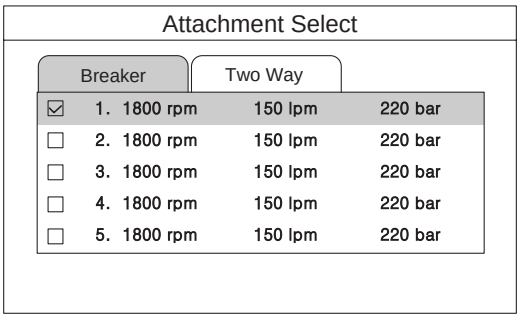
Figure 29

How to Select Attachments

When you access the attachment select screen, the initial screen locates the cursor at breaker/two-way at the top.

Operate the jog switch clockwise/counterclockwise to select breaker/two-way. Then, click on the jog switch to move the cursor to the selectable lists.

When the cursor is placed on the list, operate the jog switch clockwise/counterclockwise to move the cursor. Then, click on the jog switch to select attachments to use.

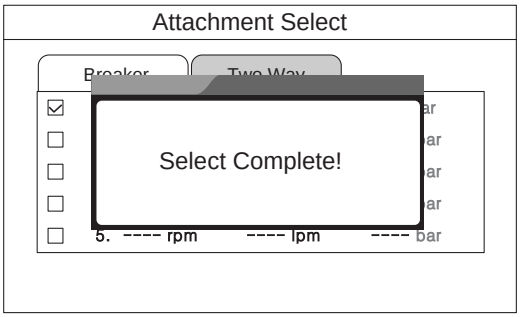


FG020156

Figure 30

When the selection is completed, the "Select Complete!" pop-up window is displayed for 3 seconds, and the checkbox of the selected list is updated.

The cursor can only be moved from the selectable lists. The selectable list items at the attachment setting are set as "Enable" in the use or non-use of attachments in the attachment setting.



FG020153

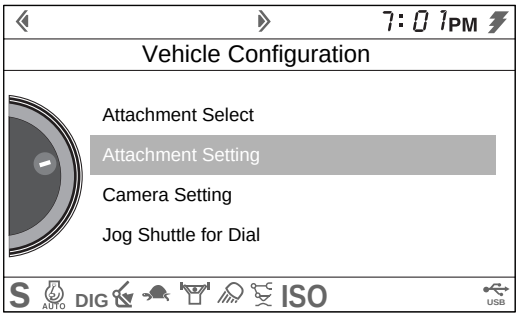
Figure 31

B. Attachment Setting

The attachment setting screen is used to set up the use or non-use of attachments, max. engine limit, and max. attachment flow rate, etc.

At the vehicle configuration, when the cursor is placed on attachment setting, click on the jog switch to access the attachment setting list screen.

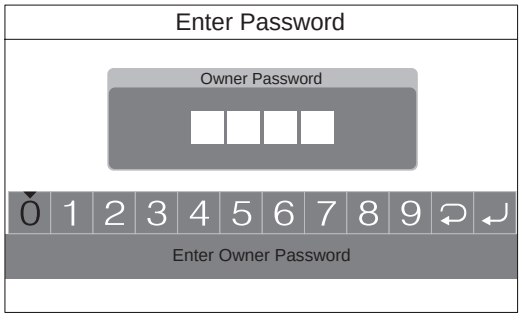
If the system is set up as the owner's password locked, access the attachment setting list screen by using owner's password input screen.



FG018493

Figure 32

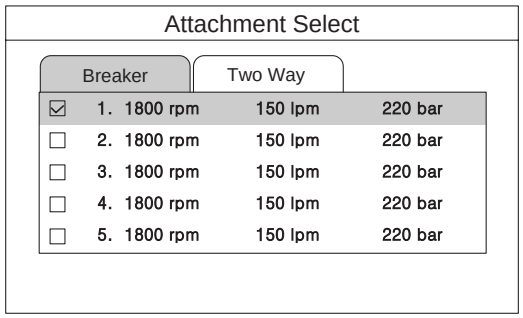
On the owner's password input screen, press the ESC button to return to the previous screen.



FG018474

Figure 33

If you access the attachment setting list screen, the initial screen locates the cursor at breaker/two-way at the top.



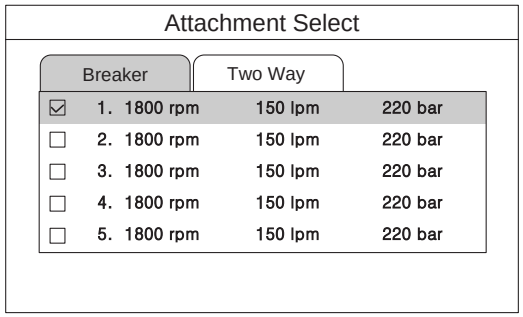
FG020156

Figure 34

Operate the jog switch clockwise/counterclockwise to select breaker/two-way. Then, click on the jog switch to move the cursor to the attachment list.

When the cursor is placed on the list, operate the jog switch clockwise/counterclockwise to move the cursor. Then, click on the jog switch to select the attachments to be set up and move to the attachment setting screen.

On the attachment setting list screen, when the cursor is placed on the list, press the ESC button to locate the cursor at breaker/two-way at the top. When the cursor is placed at breaker/two-way at the top, press the ESC button to return to the previous screen.



FG020156

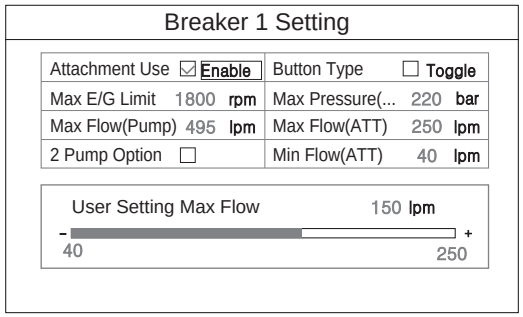
Figure 35

How to Set Up Attachments

Attachment setting items include attachment use, max E/G limit, max flow (ATT), min flow (ATT), and user setting max flow. Operate the jog switch clockwise/counterclockwise to locate the cursor. Then, click on the jog switch to set up relevant items.

The cursor movement order goes like this:

Attachment Use ↔ **Max E/G Limit** ↔ **Max Flow** ↔ **Min Flow** ↔ **User Setting Max Flow**



FG019412

Figure 36

Attachment Use

The attachment use is designed to determine whether relevant attachments are used or not.

If set up is enabled, the relevant attachment can be used.

If set up is disabled, the relevant attachment cannot be used.

Locate the cursor at the attachment use. Then, click on the jog switch to set up enable/disable.

NOTE: *If you select an attachment set up as disable, the pop-up window "Currently Used Item!" is displayed for three (3) seconds disabling the setup.*

NOTE: *If an attachment is enabled it can be a selectable attachment in the attachment select.*

Max E/G Limit

The max E/G Limit is set up to define the flow rate limit discharged when using attachments.

Operate the jog switch to move the cursor to the max E/G limit. Then, click on the jog switch to convert into the editing mode.

At the editing mode, operate the jog switch clockwise/ counterclockwise to determine the desired max. engine limit. Then, click the jog switch to complete setup.

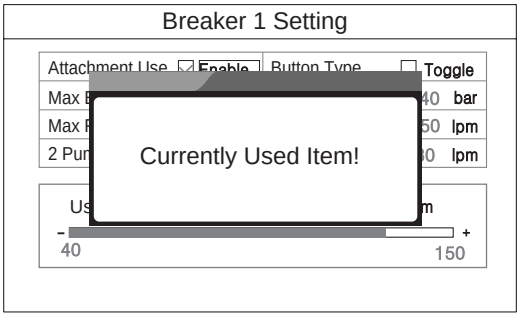
At the editing mode, press the ESC button to disable the editing mode and the saving of the setup value.

The change value by stage in the jog switch operation is 100 rpm.

Max Flow (Pump)

The max flow (pump) is the pump's max. flow rate discharged when using attachments.

It needs not to be set up by the user, and it is automatically determined according to the max. engine limit setup value.



FG018497

Figure 37

Max Flow (ATT) / Min Flow (ATT)

The max flow (ATT) /min flow (ATT) can be set up as the max/min flow rate value of the attachment by the user according to the attachment's specifications.

For instance, if the relevant attachment's use capacity is 90 - 120 lpm, the user can set up 120 lpm for the max. flow rate, and 90 lpm for the min. flow rate.

The setup method is the same as the above max. engine limit setup method. The change value by stage in the jog switch operation is 10 lpm.

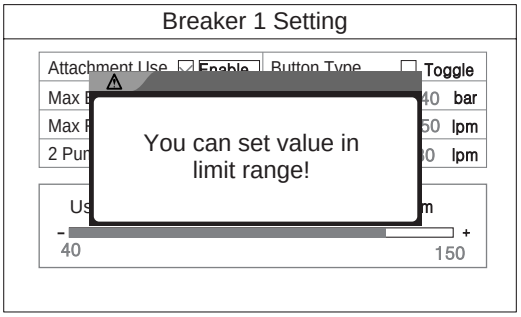
User Setting Max Flow

The user setting max flow is designed to set up the flow rate segment of the attachment to be used by the user.

Within the above setup max. flow rate (pump), max. flow rate (ATT), and min. flow rate (ATT) scope, the user can set up the max. flow rate value of the attachment to be used.

The setup method is the same as the above max. engine limit setup method. The change value by stage in the jog switch operation is 10 lpm.

When setting up all above items, the setup limits are outlined as follows. If these limits are exceeded, a pop-up window is displayed for 3 seconds, saying "You can set value in limit range!."



FG018498

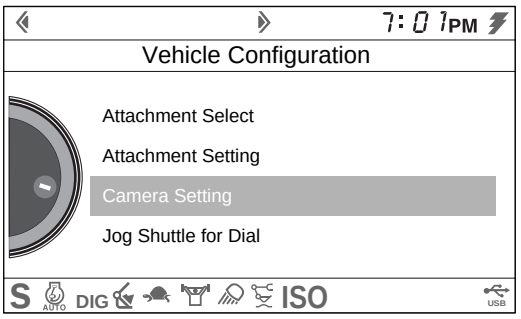
Figure 38

	Max. Limit	Min. Limit
Max E/G Limit	1,500 rpm	1,000 rpm
Max Flow (Pump)	Conforms to the max. engine limit	Conforms to the max. engine limit
Max Flow (ATT)	1,000 lpm	Min. flow rate (ATT) + 10 lpm
Min Flow (ATT)	40 lpm	Of the max. flow rate (pump/ATT), the smaller value - 10 lpm

C. Camera Setting

The camera setting screen is designed to set up various cameras' ON/OFF and normal/mirror.

From the vehicle configuration, select camera setting to access the camera setting list screen.



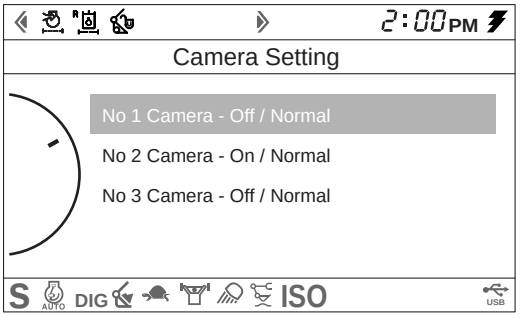
FG018499

Figure 39

The camera setting list screen displays various camera states (ON/OFF, NORMAL/MIRROR).

Select a camera and click the jog switch to access the relevant camera setting screen.

Press the ESC button to return to the previous screen.

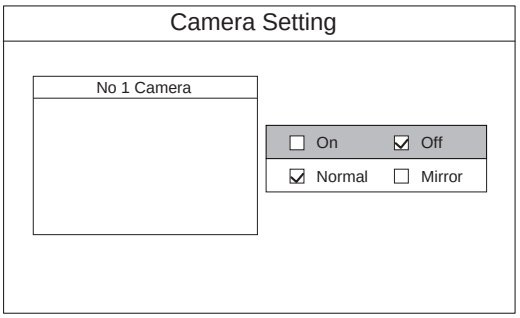


FG018500

Figure 40

On the camera setting screen, set up the camera state (ON/OFF, NORMAL/MIRROR).

Also, see the actual image of the currently installed camera.



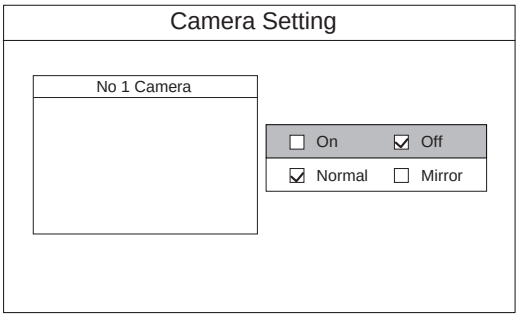
FG018501

Figure 41

If a camera is not installed, the camera image section is shown as a blue screen.

If the cursor is placed on "ON/OFF," click on the jog switch to set up "ON" ↔ "OFF."

Turn the jog switch to locate the cursor at normal/ mirror. Then, click on the jog switch to set up normal ↔ mirror.



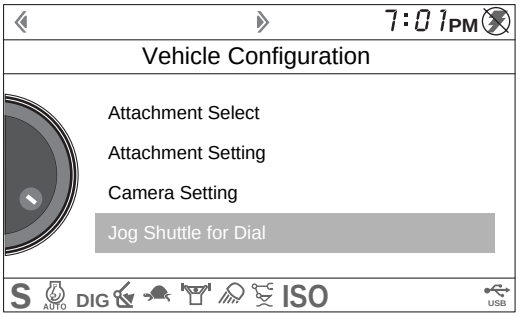
FG018501

Figure 42

D. Jog Shuttle for Dial

The jog shuttle for dial screen provides a method whereby to use the gauge panel's jog switch and control the engine rpm, replacing the engine control dial.

From the vehicle configuration, select the jog shuttle for dial to access it.

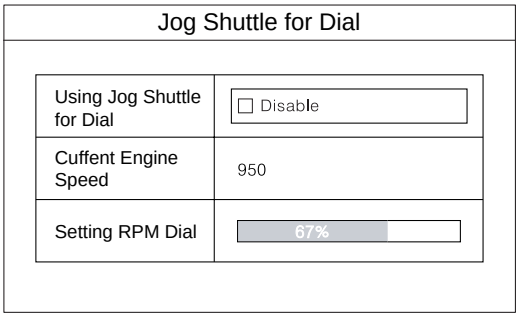


FG018502

Figure 43

If you access the jog shuttle for dial screen, the initial cursor is located at the using jog shuttle for dial.

If the using jog shuttle for dial is shown as disable, the cursor cannot be moved.



FG018503

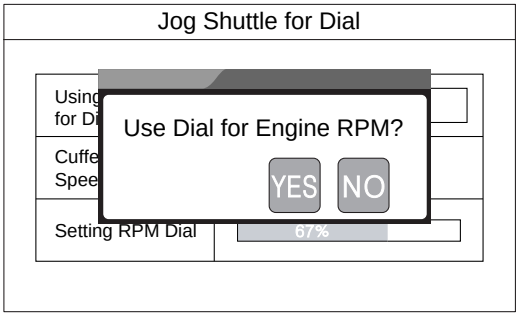
Figure 44

When the cursor is placed at the using jog shuttle for dial, if you click on the jog switch, a pop-up window will be created, saying "Use dial for engine rpm?."

Operate the jog switch and select "YES/NO" to determine whether to use jog shuttle for dial.

If you select "YES," then using jog shuttle for dial is enabled, causing the pop-up window to disappear.

If you select "NO," then using jog shuttle for dial remains disabled, causing the pop-up window to disappear.



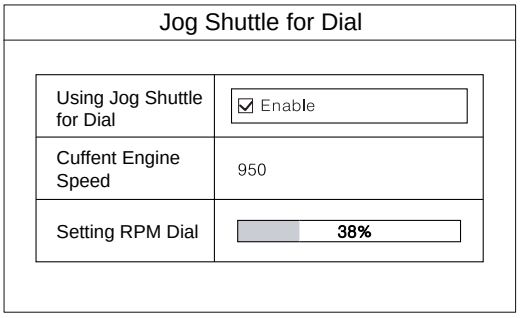
FG018504

Figure 45

If the using jog shuttle for dial is shown as enable, operate the jog switch clockwise and move the cursor to the setting rpm dial. When the cursor is placed at the setting rpm dial, click on the jog switch to cause the cursor to flicker, changing into an editing mode to set up the rpm dial. When the cursor is placed at the editing mode, operate the jog switch clockwise/ counterclockwise, thus setting up the engine rpm.

When the cursor is at the editing mode, press the ESC button to disable the editing mode. When the cursor is not at the editing mode, press the ESC button to return to the previous screen.

Before keying off the gauge panel or disabling the using jog shuttle for dial, control the jog rpm only with the shuttle of the gauge panel's jog shuttle.



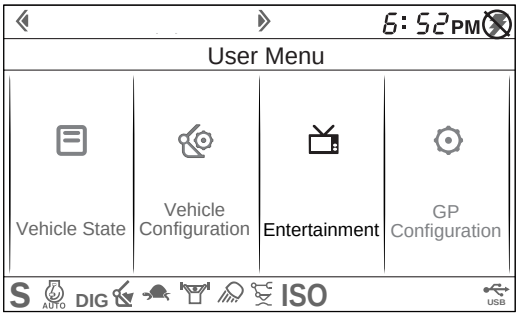
FG018505

Figure 46

3. Entertainment

This menu is used to replay videos and MP3.

Turn the jog switch and move the cursor to see a reversed display on the desired menu. Then, click on the jog switch to select the menu.

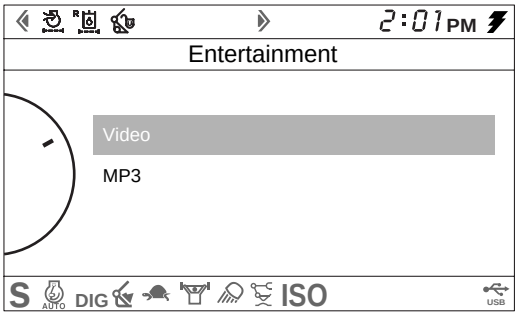


FG018506

Figure 47

Video ↔ MP3

Press the ESC button to return to the previous screen.



FG018507

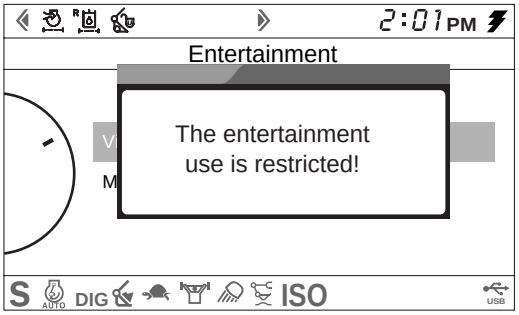
Figure 48

If the use of entertainment is limited, this pop-up window will be created.

To lift the use limits, you should change the limit setup in the GP configuration.

The pop-up window will automatically disappear in 3 seconds. Press the ESC button or the jog switch to remove pop-up window.

For details, See “GP Configuration” on page -52.



FG018514

Figure 49

If the use of entertainment is not limited, this pop-up window will be created. The pop-up window will automatically disappear in 3 seconds.

Press the ESC button or the jog switch to remove pop-up window.

WARNING

AVOID DEATH OR SERIOUS INJURY

Listening to entertainment clips, such as video, music, etc., can cause an accident, resulting in death or serious injury.

Do not play entertainment files when operating the machine.

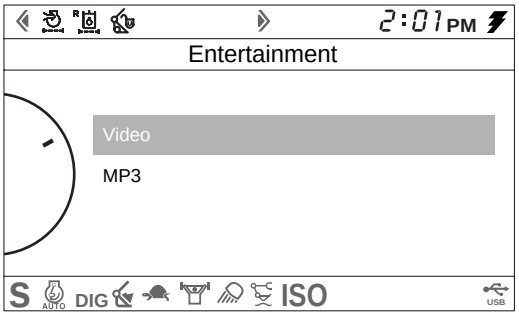


FG018508

Figure 50

A. Video

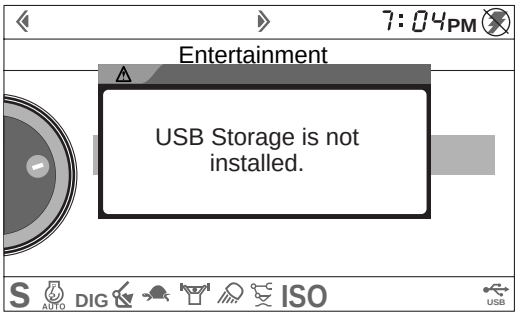
From the entertainment screen, select video to access it.



FG018507

Figure 51

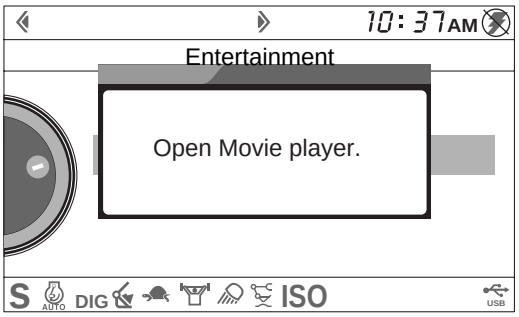
When there is no USB storage system, a pop-up window is displayed for 3 seconds, saying "USB" Storage is not installed." and the video is not played.



FG018510

Figure 52

When there is a USB storage system, a pop-up window will be created, saying "Open Movie player." and the video player is run.

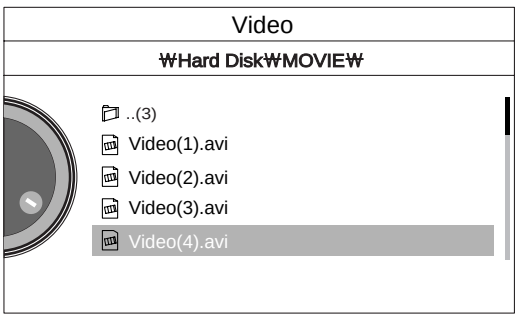


FG018513

Figure 53

When initially accessing the video player, the USB storage system file tree is displayed on the screen, operate the jog switch clockwise/counterclockwise to select and play a video.

If there is a video file that played last, it will automatically be replayed.



FG018511

Figure 54

If the format is not supported, a pop-up window is displayed for 3 seconds, saying "This file is not available!" and the video is not played.



FG020115

Figure 55

Formats that can be supported are given below.

Formats that can be supported	
File Type	AVI (DIVX), MP4, WMV (VERSION 8)
Supported Resolution	720*480, 720*384, 720*304, 704*448, 704*304, 640*480, 640*360, 640*272, 640*352, 672*288, 512*384, 576*432, 480*320, 480*360, 320*240
Supported Video Codec	H.264 (ITU H.264 BASELINE L1.3, L3.0), MPEG4, DIVX4.0, 5.0, WMV8, Xvid
Supported Audio Codec	MPEG L3, AAC
MP3 Bit Rate	128 - 320 Kbps
Supported File Size	Under 1.7 Gbyte

The screen composition of the video player is given below.

The top section displays the name of the file being played and the current playing time of the total playing time.

The screen center shows the video being played.

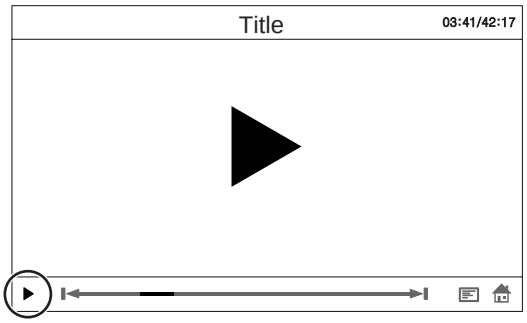
The bottom displays the video player function operation symbol and cursor.

The video player function operation symbol and jog switch are operated in the following order.

Play/Pause ↔ Replay the Previous File ↔ Video Progress Bar ↔ Replay the Next File ↔ Video Files List ↔ Adjust Video Brightness

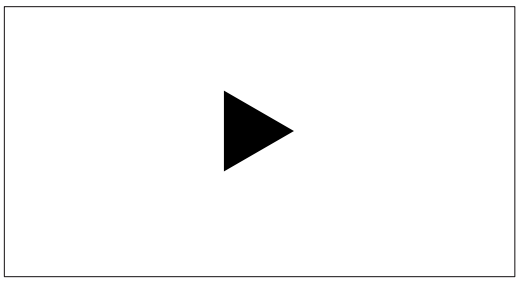
If no operation continues for more than 5 seconds, the video will automatically be converted into the whole screen.

On the whole screen, click on the jog switch or the ESC button to remove whole screen.



FG020116

Figure 56



FG018214

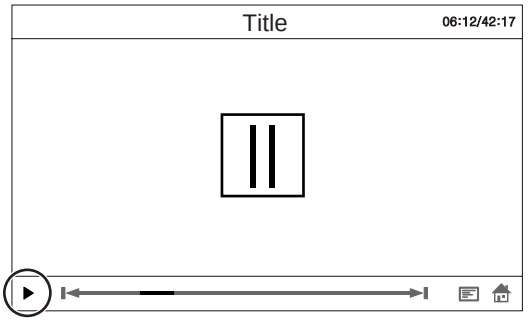
Figure 57

Play/Pause

Locate the cursor on the play/pause symbol and click on the jog switch to execute the video's play/pause functions.

With the play being on, click on the jog switch to display the pause symbol at the center of the screen, thus allowing the video to pause.

With the pause being on, click on the jog switch to cause the pause symbol at the center of the screen to disappear, resuming the video playing.

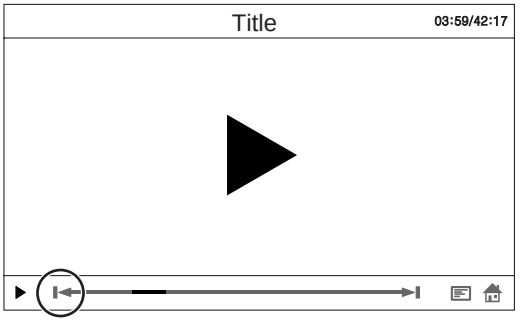


FG020117

Figure 58

Replay the Previous File

Locate the cursor at the replay the previous file symbol and click on the jog switch to replay the previous file.



FG020118

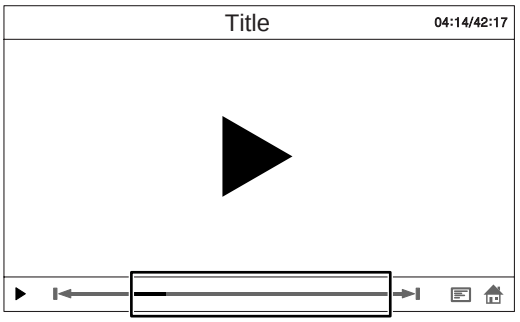
Figure 59

Locate the cursor at the video progress bar and click on the jog switch to convert into the fast forward/ rewinding mode.

On the fast forward/rewinding mode, operate the jog switch clockwise/counterclockwise to conduct fast forward/rewinding.

Fast forward/rewinding can be conducted at an interval of 30 seconds per click during which the jog switch is turned.

On the fast forward/rewinding mode, press the ESC button to disable the fast forward/rewinding mode.

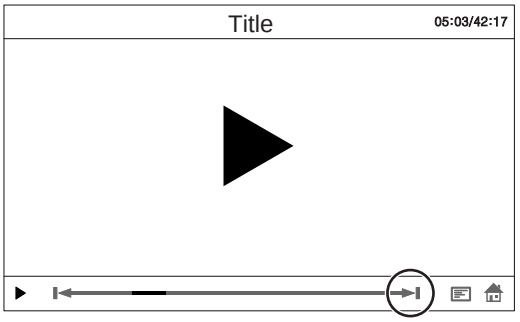


FG020119

Figure 60

Replay the Next File

Locate the cursor at the replay the next file symbol and click on the jog switch to replay the next file.

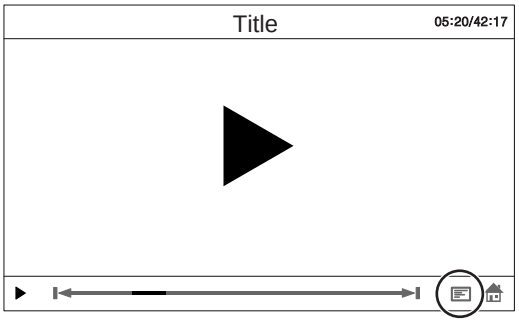


FG020120

Figure 61

Video Files List

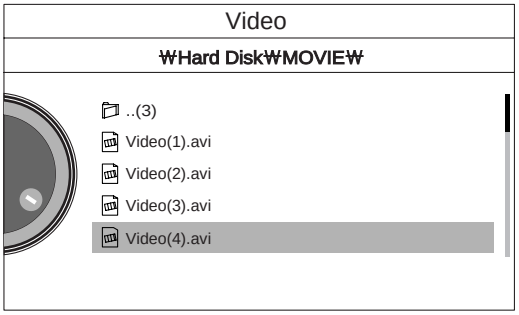
Locate the cursor at the video files list symbol and click on the jog switch to move to the video file list screen.



FG020121

Figure 62

Select and replay a video.



FG018557

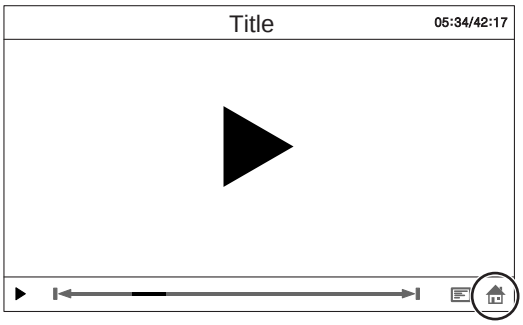
Figure 63

Set Up Video Brightness

Move the cursor to the set up video brightness symbol and click on the jog switch to create the video brightness setup window.

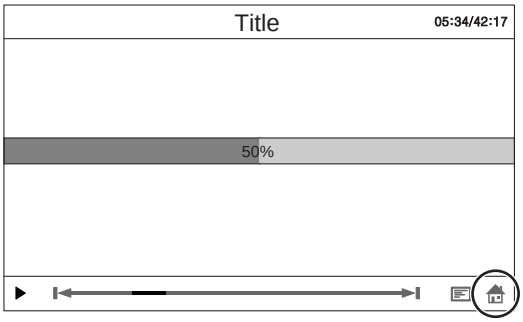
With the video brightness setup window being created, operate the jog switch clockwise/ counterclockwise to set brightness.

After completing the setup, click on the jog switch to return to the previous screen.



FG020122

Figure 64

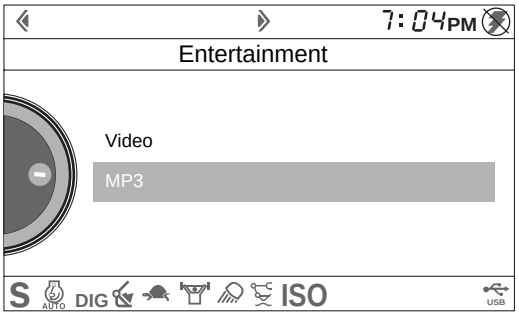


FG020123

Figure 65

B. MP3

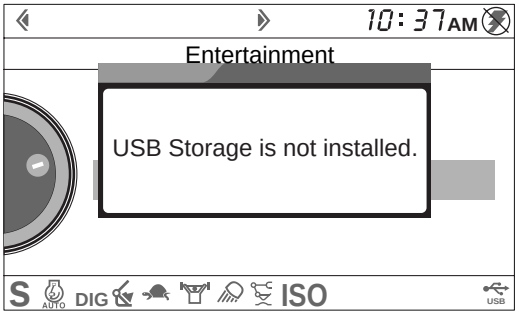
From the entertainment screen, select MP3 to access it.



FG018524

Figure 66

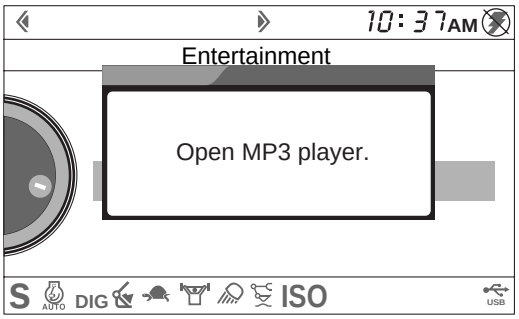
If there is no USB storage system, a pop-up window is displayed for 3 seconds, saying "USB Storage is not installed." and the MP3 player is not run.



FG018523

Figure 67

If there is a USB storage system, a pop-up window is created, saying "Open MP3 player." and the MP3 player is run.

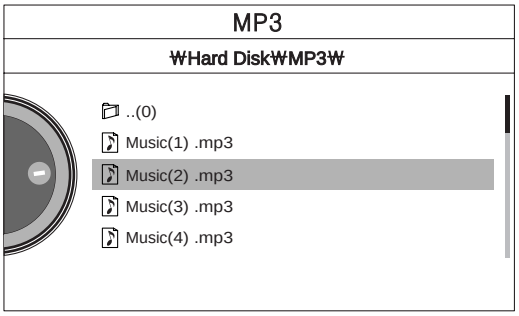


FG018520

Figure 68

When initially accessing the MP3 player, the file tree screen of USB storage system is displayed. Operate the jog switch clockwise/counterclockwise to select and play an MP3 file.

If there is an MP3 file played last, the file will automatically be played.



FG018560

Figure 69

The screen composition of MP3 player is given below.

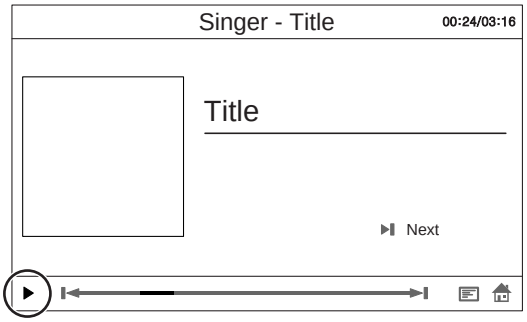
The top section displays the name of the file being played and the current playing time of the total playing time.

The screen center shows the album image of the file being played, the album name, the song name and the name of the next file to be played.

The bottom displays the MP3 player function operation symbol and cursor.

The MP3 player function operation symbol and jog switch are operated in the following order.

Play/Pause ↔ Replay the Previous File ↔ MP3 Progress Bar ↔ Replay the Next File ↔ MP3 Files List ↔ Background MP3 Play



FG020124

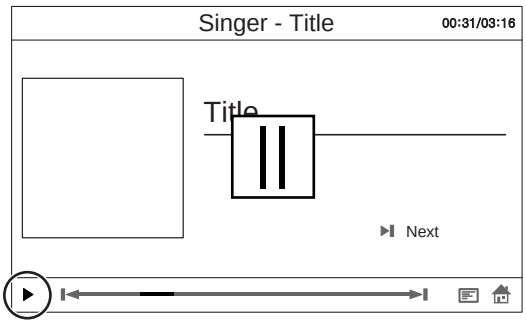
Figure 70

Play/Pause

Locate the cursor at the play/pause symbol and click on the jog switch to execute the MP3 play/pause functions.

With play being on, click the jog switch to display the pause symbol at the center of the screen, causing the MP3 to pause.

With pause being on, click on the jog switch to cause the pause symbol at the center of the screen to disappear, resuming the MP3 playing.

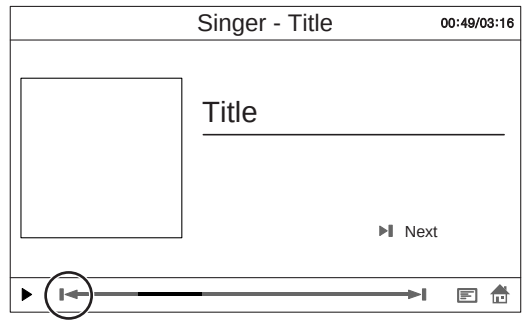


FG020125

Figure 71

Replay the Previous File

Locate the cursor at the replay the previous file symbol, and click on the jog switch to replay the previous file.



FG020126

Figure 72

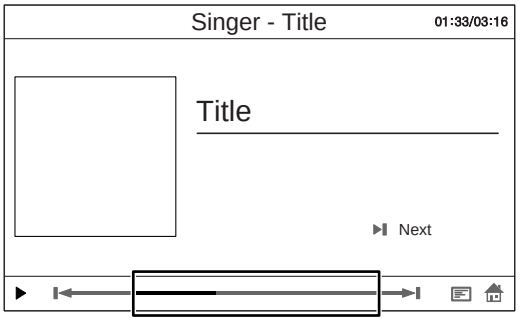
Fast Forward/Rewinding

Locate the cursor at the video progress bar and click on the jog switch to convert into the fast forward/ rewinding mode.

On the fast forward/rewinding mode, operate the jog switch clockwise/counterclockwise to conduct fast forward/rewinding.

Fast forward/rewinding can be conducted at an interval of 30 seconds per click during which the jog switch is turned.

On the fast forward/rewinding mode, press the ESC button to disable the fast forward/rewinding mode.

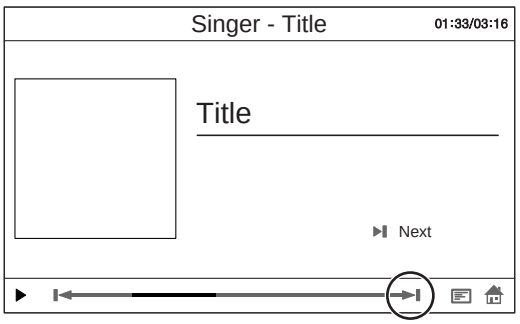


FG020127

Figure 73

Replay the Next File

Locate the cursor at the replay the previous file symbol and click on the jog switch to replay the next file.

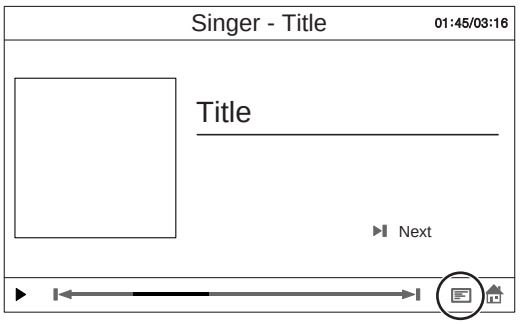


FG020128

Figure 74

MP3 Files List

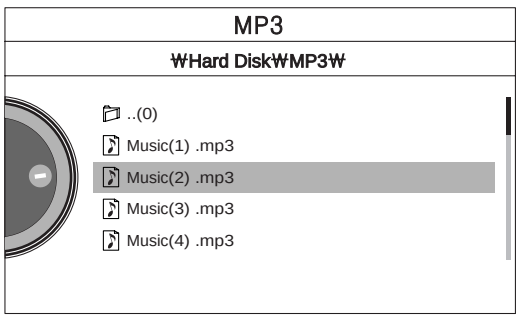
Locate the cursor at the MP3 files list symbol and click on the jog switch to move to the file list screen.



FG020129

Figure 75

Select a file and replay the MP3.

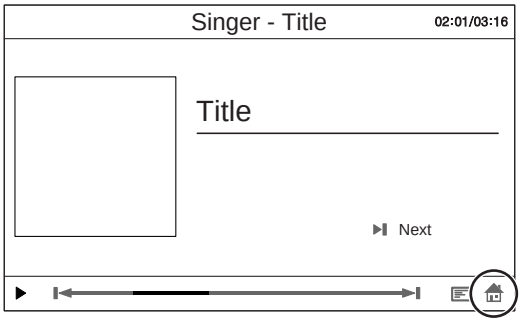


FG018560

Figure 76

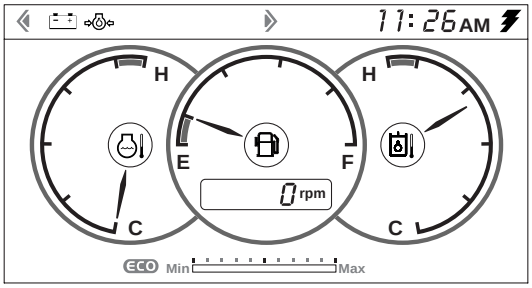
BackGround MP3 Play

Position the cursor on the Home button and pressing the jog switch, MP3 is played by the initial screen.



FG020130

Figure 77



FG018118

Figure 78

4. GP Configuration

This menu is used to set up password, brightness, default screen and time, and to input service phone number. Turn the jog switch and move the cursor to see an reversed display on the desired menu. Then, click on the jog switch to select the menu.

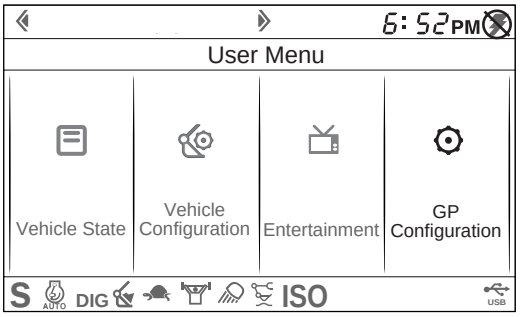
Password Setting ↔ Brightness Setting ↔ Default Screen Setting ↔ Default Power Mode Setting ↔ Time Setting ↔ Service Phone Number Setting ↔ Unit Setting ↔ Language Setting ↔ Notification Setting ↔ Entertainment Use Setting

Press the ESC button to return to previous screen.

A. Password Setting

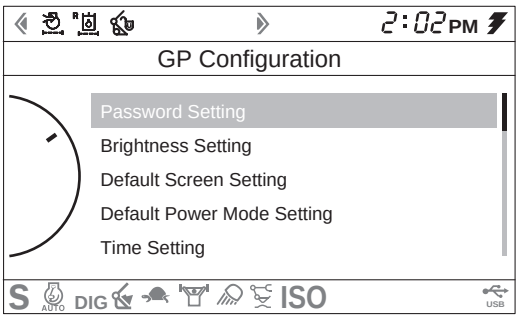
The owner and user password can be set.
(Only the owner password is selected for password setting, when the product is delivered first.)

Machine start-up and function use can be managed, using the password setting function.



FG018521

Figure 79



FG022138

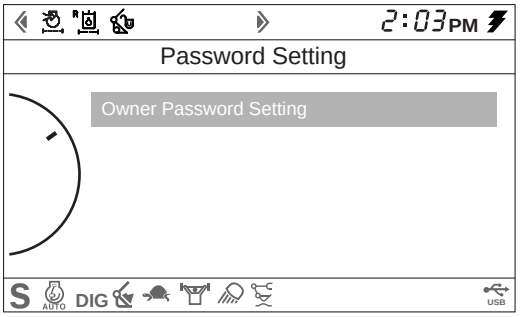
Figure 80

Owner Password Setting

1) Selection

The owner password can be set that manages equipment functions and user's equipment use rights.

To set the owner password, press the jog switch (or "ENTER" on the keypad) when the cursor is on "Owner Password Setting" on the "Password Setting" window.

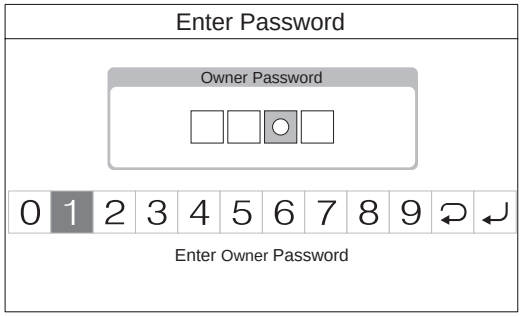


FG020168

Figure 81

2) Password input

When the "Enter Password" screen appears, input the password to enter the setting window using the jog switch (or keypad). The factory setting password is "1111."



FG020169

Figure 82

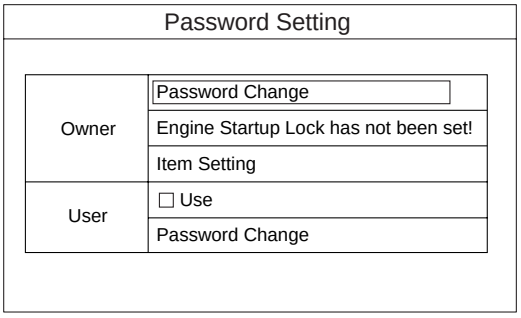
How to Input Password

Turn your jog switch and select a number (0 - 9) from the below section and press the Enter on the jog switch to input the number.

If the incorrect password is entered, it can be deleted using the ⮌ button at the right bottom of the screen.

3) Composition

Owner password setting is composed of password change, start-up limitation setting, functional item setting, user password setting, and user password change.

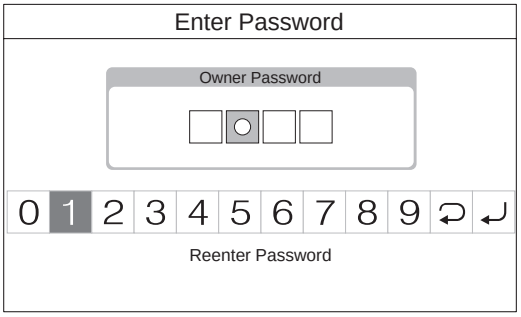


FG020170

Figure 83

a) Password Change

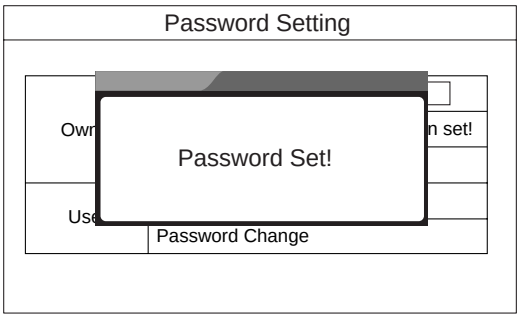
To change the owner password, select "Password Change" and change the password using the jog switch (or keypad).



FG020171

Figure 84

If the owner password is changed successfully, the "Password Set!" popup message will appear.



FG020172

Figure 85

b) Item Setting

"Item Setting" enables the owner to select the use of Engine Start-up, Attachment Setting, and Entertainment Use Setting, and assign the use right to the user.

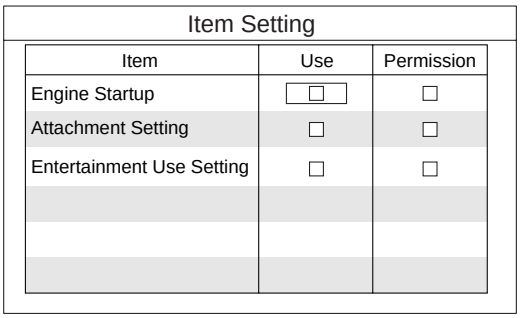
If the owner sets the "Use" item only without "Permission" setting, only the owner password can be used when using Attachment Setting and Entertainment Use Setting.

However, the owner and user password can be used at the same time when using Engine Start-up.

The "Permission" items can be set only when the "Use" items are selected, and used to assign the use right to the user.

Once the permission is set, the user has the same right with the owner. User's equipment setting will take precedence over that of the owner.

No item is selected when first shipped.



FG020173

Figure 86

Engine Start-up

The password input function can be set for equipment start-up.

Attachment Setting

The password input function can be set for attachment setting.

Entertainment Use Setting

The password input function can be set for entertainment (video/MP3) use setting.

c) Engine Start-up Setting

When the "Engine Start-up" in "Item Setting" is selected, the password re-input time can be set when starting up the engine. (See “Engine Start-up” on page -54.)

No engine start-up password is set when delivered first.

Always

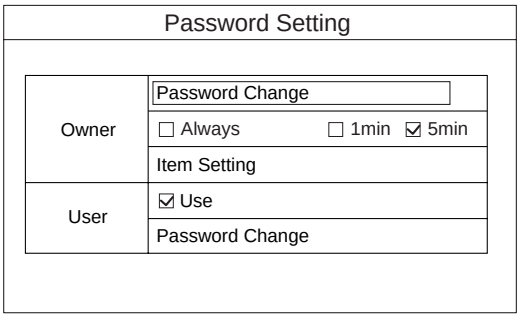
Password input is required whenever the engine is started.

1 min

If the engine is restarted within one minute after password input and key-off at the time of engine start-up, password input is not required.

5 min

If the engine is restarted within five minutes after password input and key-off at the time of engine start-up, password input is not required.



FG020174

Figure 87

d) User Password Setting

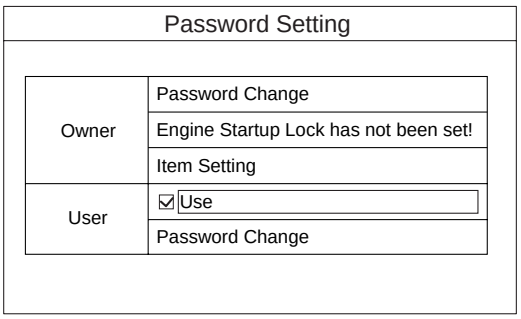
Setting "Use User Password"

The user password is used.

If the "User Password" item is not selected, only the owner password can be used.

User Password Change

The owner can change the user password after setting permission on the use of the user password



FG020175

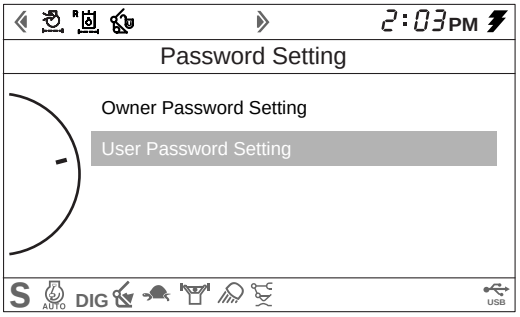
Figure 88

User Password Setting

1) Selection

If the owner selects the "Use" checkbox besides "User Password" in the "Owner Password Setting" window, the "User Password Setting" item will appear on the "Password Setting" window that allows user password setting.
(See “User Password Setting” on page -55.)

To set the user password, press the jog switch (or "ENTER" on the keypad) when the cursor is on "User Password Setting" on the "Password Setting" window.



FG020176

Figure 89

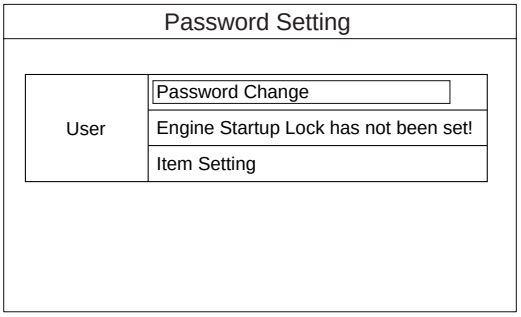
2) Password input

When the "Enter Password" screen appears, input the password to enter the setting window using the jog switch (or keypad).
(See “Password input” on page -53.)

The factory setting password is "1111."

3) Composition

User password setting is composed of password change, start-up limitation setting, functional item setting.

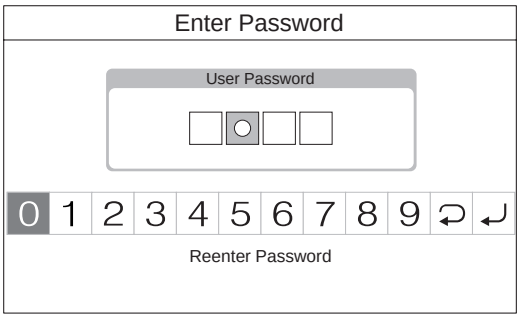


FG020177

Figure 90

a) Password Change

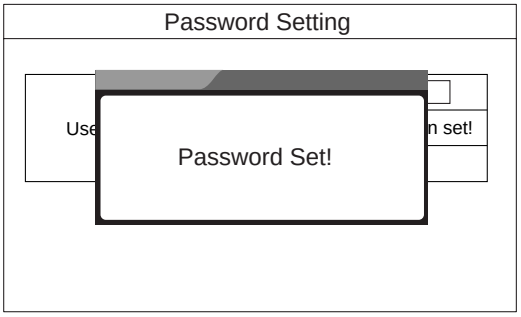
To change the user password, select "Password Change" and change the password using the jog switch (or keypad).



FG020178

Figure 91

If the user password is changed successfully, the "Password Set!" popup message will appear.



FG020179

Figure 92

b) Item Setting

"Item Setting" enables the user to select the use of Engine Start-up, Attachment Setting, and Entertainment Use Setting.

The user can set the item only when the owner assign the right. (See “Owner Password Setting” on page -53.)

Engine Start-up

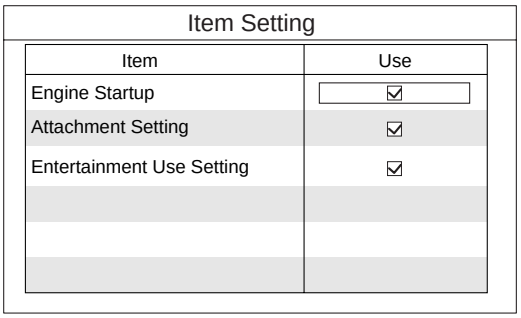
The password input function can be set for equipment start-up.

Attachment Setting

The password input function can be set for attachment setting.

Entertainment Use Setting

The password input function can be set for entertainment (video/MP3) use setting.



FG020180

Figure 93

c) Engine Start-up Setting

When the "Engine Start-up" in "Item Setting" is selected, the password re-input time can be set when starting up the engine. (See “Engine Start-up” on page -57.)

Always

Password input is required whenever the engine is started.

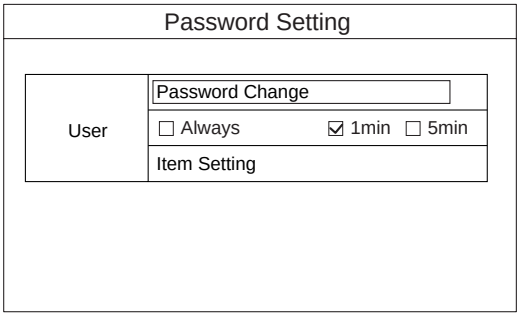
1 min

If the engine is restarted within one minute after password input and key-off at the time of engine start-up, password input is not required.

5 min

If the engine is restarted within five minutes after password input and key-off at the time of engine start-up, password input is not required.

If the owner uses the Engine Start-up function but doesn't assign the right to the user, the user cannot select the use of the Engine Start-up function but can set the password re-input time.



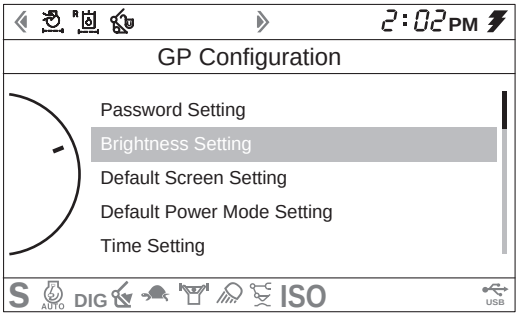
FG020181

Figure 94

B. Brightness Setting

On the GP configuration screen, when the cursor is placed on the brightness setting, click on the jog switch to display the screen brightness setting and camera brightness setting screen.

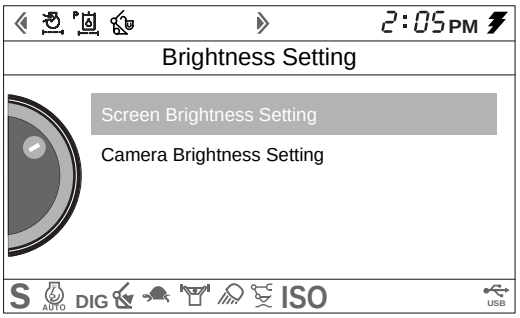
Brightness can be set up in two ways, day/night.



FG022139

Figure 95

If you want to change the screen brightness, select the screen brightness setting to display the brightness adjustment screen.



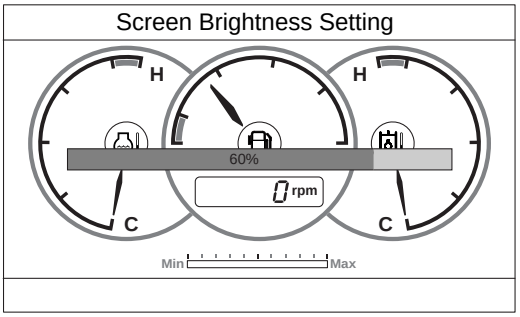
FG018530

Figure 96

Turn the jog switch and adjust the brightness of 0 - 100% at an interval of 10%.

The screen brightness when manufactured is set as 60%.

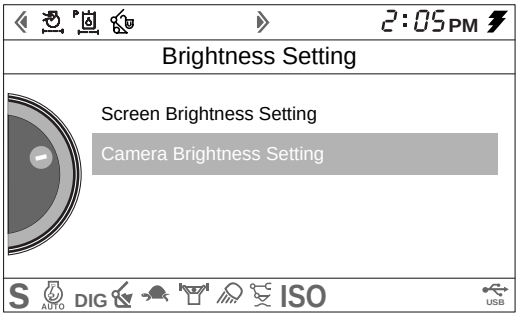
Press the ESC button to return to the previous screen.



FG018532

Figure 97

If you want to change the camera screen brightness, select the camera brightness setting to display the camera screen brightness adjustment screen.



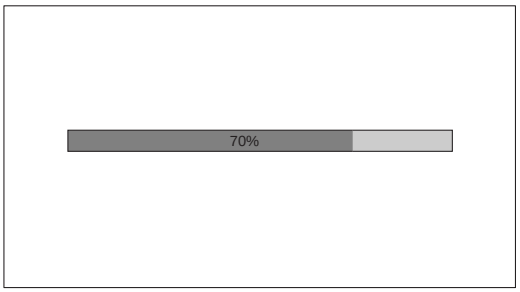
FG018531

Figure 98

Turn the jog switch to adjust the brightness of 0 - 100% at an interval of 10%.

The camera screen brightness at the machine release time is set as 60%.

Press the ESC button to return to the previous screen.



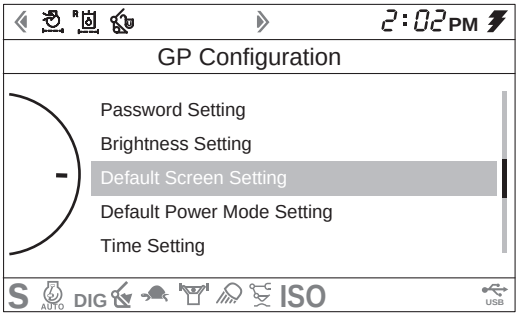
FG018244

Figure 99

C. Default Screen Setting

On the GP configuration screen, when the cursor is placed on the default screen setting, click on the jog switch to access the default screen setting.

On the default screen setting, turn the jog switch and locate the cursor at a desired style. Then, click on the jog switch to select the style.

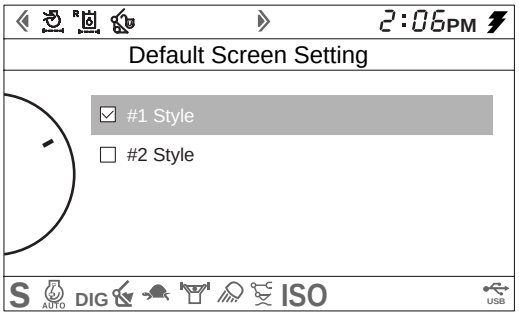


FG022140

Figure 100

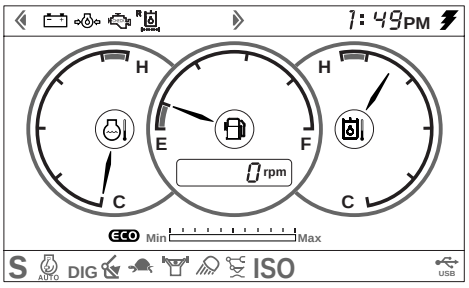
The selected style screen is displayed as the normal display screen.

The screen when manufactured is set as #1 style.

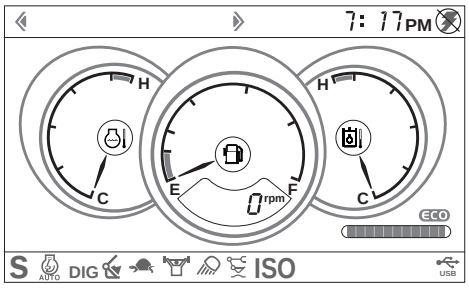


FG018536

Figure 101



<1 Style>



<2 Style>

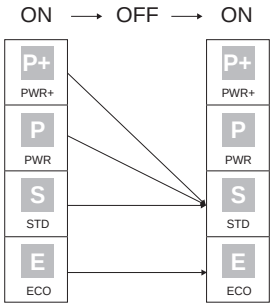
FG018537

Figure 102

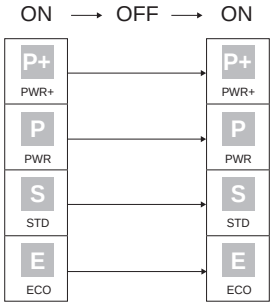
D. Default Power Mode Setting

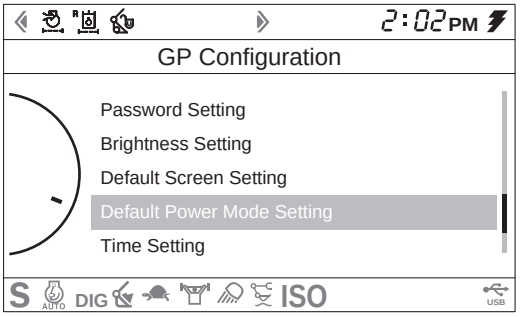
On the GP configuration screen, when the cursor is placed on the default power mode setting, click on the jog switch to access the default power mode setting.

Fuel Saving Mode is Enable



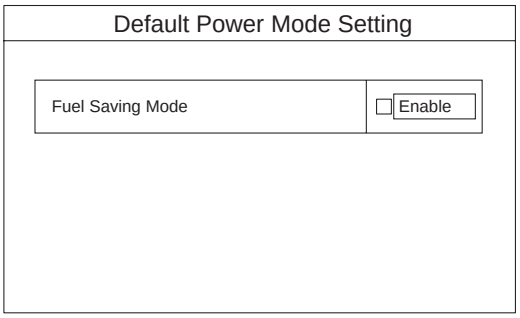
Fuel Saving Mode is Disable





FG022141

Figure 103



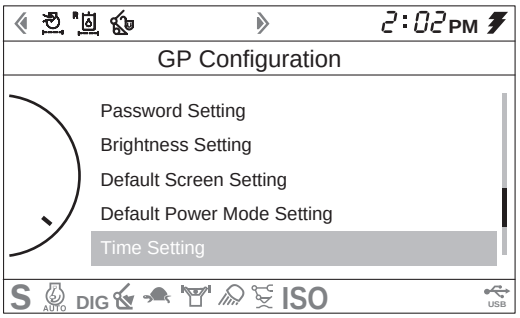
FG022142

Figure 104

E. Time Setting

On the GP configuration screen, when the cursor is placed on the time setting, click the jog switch to access the time setting.

Turn the jog switch and locate the cursor at a target of change. Then, click on the jog switch to change the target.



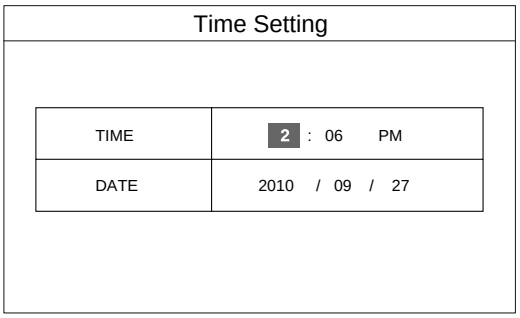
FG022144

Figure 105

Turn the jog switch to change numbers of each item.

If the setup is completed, click on the jog switch to store the setup details.

Press the ESC button to return to the previous screen.

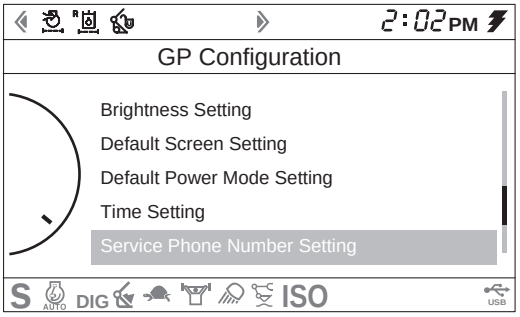


FG018538

Figure 106

F. Service Phone Number Setting

On the GP configuration screen, when the cursor is placed on the service phone number setting, click on the jog switch to access the service phone number setting.

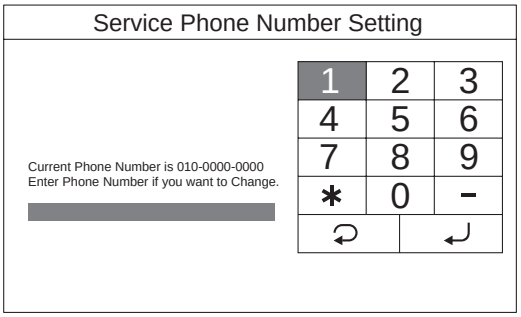


FG022145

Figure 107

Turn the jog switch and locate the cursor at a desired number. Then, click on the jog switch to input the number. If number input is completed, press the ↵ key to enter the input phone numbers.

Use the ↩ key and delete erroneously input numbers.



FG018539

Figure 108

When you input service phone numbers, if warning/ alarm is issued, check the input phone numbers in the pop-up window.

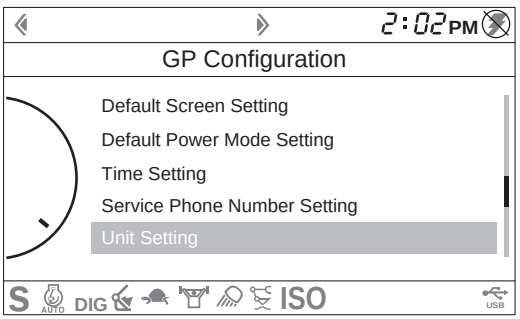


FG018590

Figure 109

G. Unit Setting

On the GP configuration screen, when the cursor is placed on the unit setting, click the jog switch to access the unit setting.



FG022146

Figure 110

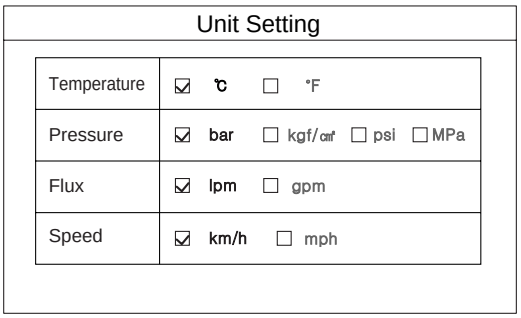
On the unit setting screen, change the units of temperature, pressure, flow rate, and speed. These figures at the machine release time are set as below:

Temperature: °C

Pressure: bar

Flow rate: lpm

Speed: km/h

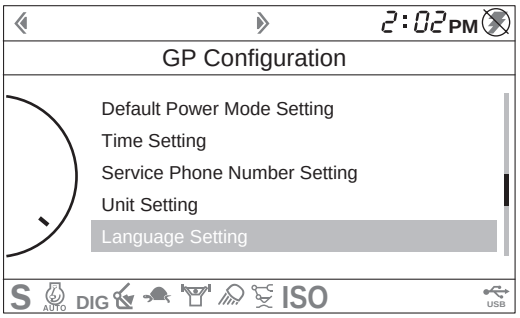


FG018546

Figure 111

H. Language Setting

On the GP configuration screen, when the cursor is placed on the language setting, click on the jog switch to access the language setting.

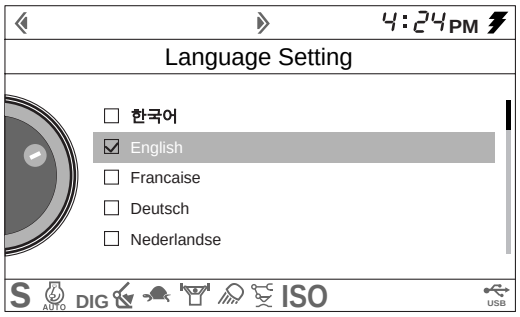


FG022147

Figure 112

On the language selection screen, turn the jog switch and move the cursor to select a language. Then, click on the jog switch to adopt the selected language.

Press the ESC button to return to the previous screen.

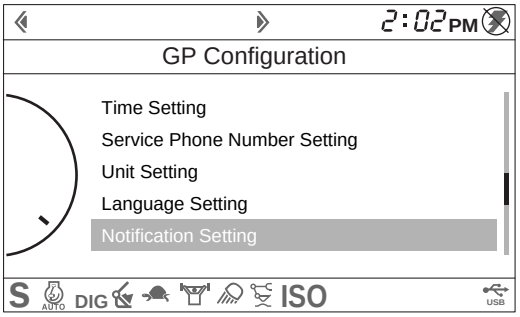


FG018544

Figure 113

I. Notification Setting

On the GP configuration screen, when the cursor is placed on the notification setting, click on the jog switch to access the notification setting.



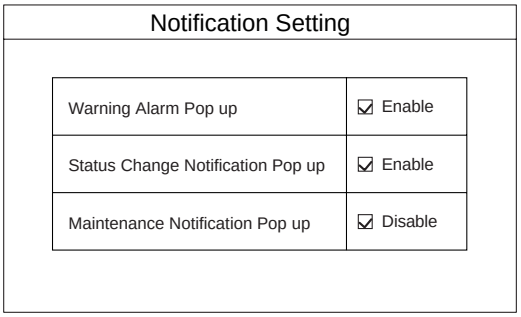
FG018542

Figure 114

Depending on the notification setting screen details, pop-ups are created or not created on the main screen when warning/alarm is issued, when the switch is operated, and when the supplies replacement period expires.

On the notification setting screen, turn the jog switch and move the cursor to a desired location. Then, click on the jog switch to select enable or disable.

All notice items on a new machine are set as Enable.

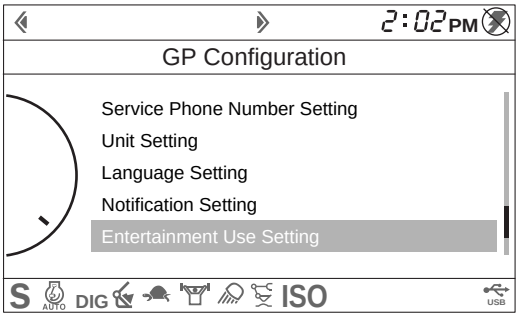


FG018545

Figure 115

J. Entertainment Use Setting

On the GP configuration screen, when the cursor is placed on the entertainment use setting, click on the jog switch to access the entertainment use setting.

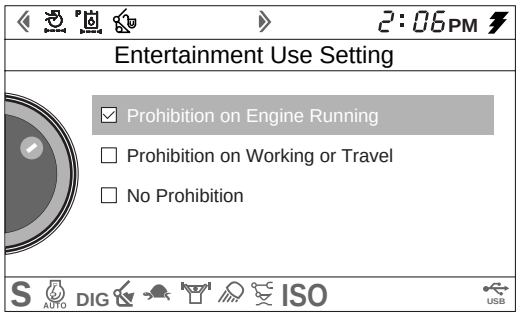


FG018543

Figure 116

Depending on the entertainment use setting details, the use of video and MP3 is limited.

The setup when manufactured is set as not limited.



FG018547

Figure 117

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 fault diagnostics.

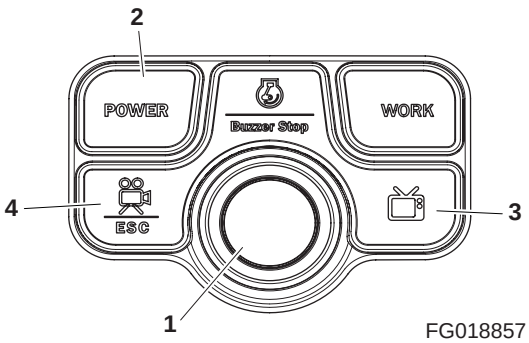
The special menu offers three submenus:

1. Monitoring.
2. Graph.
3. Failure Information.
4. Operating Hour Information.
5. Vehicle Configuration.

Entering/Accessing and Exiting/Escaping Menus

Entering/Accessing Menus

When normal mode screen is displayed, if jog switch (1, Figure 118), power mode selector button (2, Figure 118) and multimedia button are pressed simultaneously for more than 3 seconds, normal mode screen (Figure 119) will be changed to special menu screen (Figure 120).

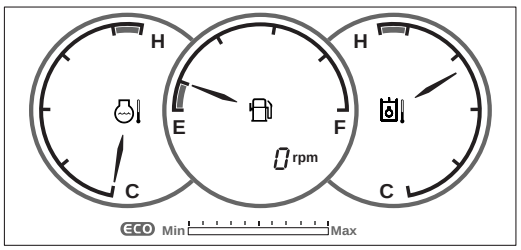


FG018857

Figure 118

Normal Mode Screen

NOTE: *Normal mode screen display fuel gauge, engine coolant temperature gauge, hydraulic oil temperature gauge, ECO gauge and engine speed (rpm).*



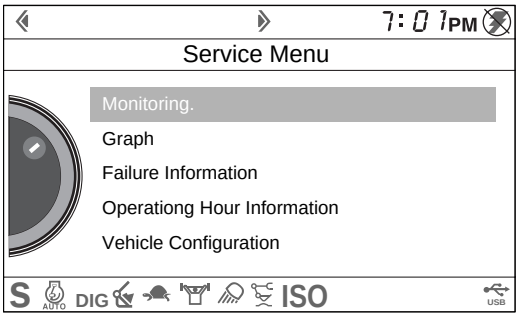
FG018856

Figure 119

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.



FG018858

Figure 120

Exiting/Escaping Menus

1. If escape button (ESC, 4 on Figure 118) 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 return 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.

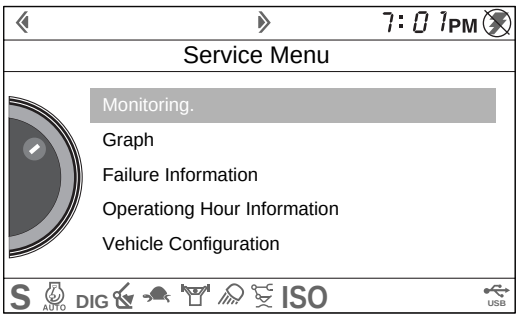
Special Menu Selections

Submenu Selection Method

Various submenus can be selected by turning the jog switch and moving the cursor to see an reversed display on the desired menu. Then, click on the jog switch to select the menu.

Press the ESC button to return to the previous screen.

Entering Submenus: When cursor is located on "Machine Info" of special menu screen, press "Enter (↵, 3 on Figure 118)" button and the "Machine Info" will be displayed.

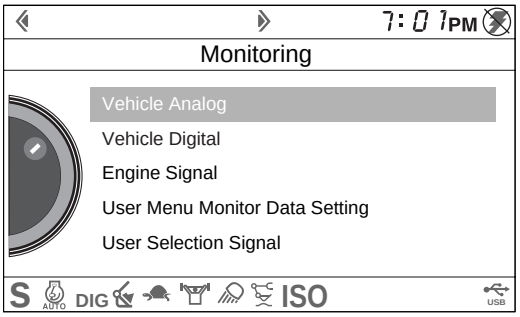


FG018858

Figure 121

Monitoring

1. Entering Submenus: When cursor is located on "Monitoring" of special menu screen, press the jog switch and the "Monitoring" will be displayed.
2. Exiting Submenus: If escape button (ESC, 4 on Figure 118) is pressed for more than 1 second, display will be turned to previous screen.



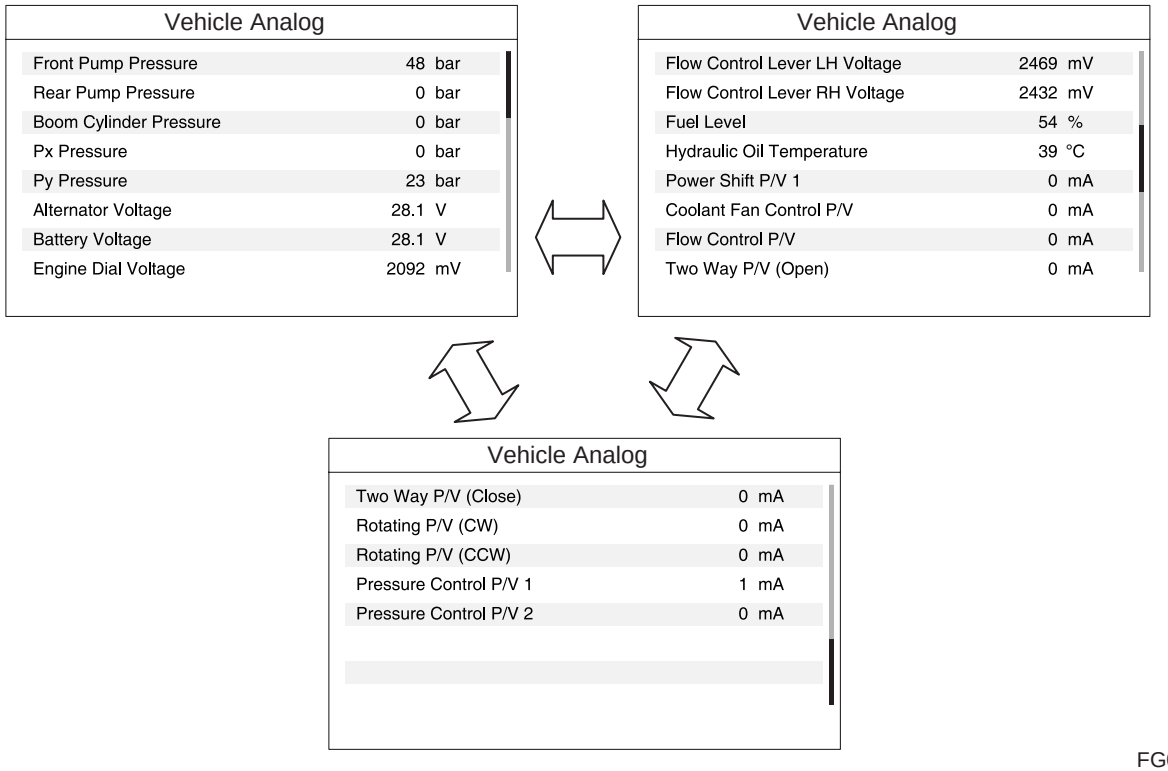
FG018859

Figure 122

Vehicle Analog Description

Analog Items	Display	Remark
1. Front Pump Pressure	bar	Front pump pressure
2. Rear Pump Pressure	bar	Rear pump pressure
3. Boom Cylinder Pressure	bar	Boom cylinder head pressure
4. Px Pressure	bar	Px pressure
5. Py Pressure	bar	Py pressure
6. Alternator Voltage	V	Indicating alternator voltage.
7. Battery Voltage	V	Indicating battery voltage.
8. Engine Dial Voltage	mV	Indicating dial voltage.
9. Flow Control Lever LH Voltage	mV	Indicating LH joystick thumb wheel switch voltage
10. Flow Control Lever RH Voltage	mV	Indicating RH joystick thumb wheel switch voltage
11. Fuel Level	%	Fuel residual quantity radio of fuel tank
12. Hydraulic Oil Temperature	°C	Hydraulic oil temperature
13. Power Shift P/V 1	mA	Current in pump proportional valve.
14. Coolant Fan Control P/V	mA	Current in coolant fan control proportional valve.
15. Flow Control P/V	mA	Current in flow control proportional valve.
16. Two-way P/V (Open)	mA	Current in two-way (open) flow control proportional valve.
17. Two-way P/V (Close)	mA	Current in two-way (close) flow control proportional valve.
18. Rotating P/V (CW)	mA	Current in rotating (CW) flow control proportional valve.
19. Rotating P/V (CCW)	mA	Current in rotating (CCW) flow control proportional valve.
20. Pressure Control P/V 1	mA	Current in 1 way pressure proportional valve.
21. Pressure Control P/V 2	mA	Current in 2 way pressure proportional valve.

Submenu Selections



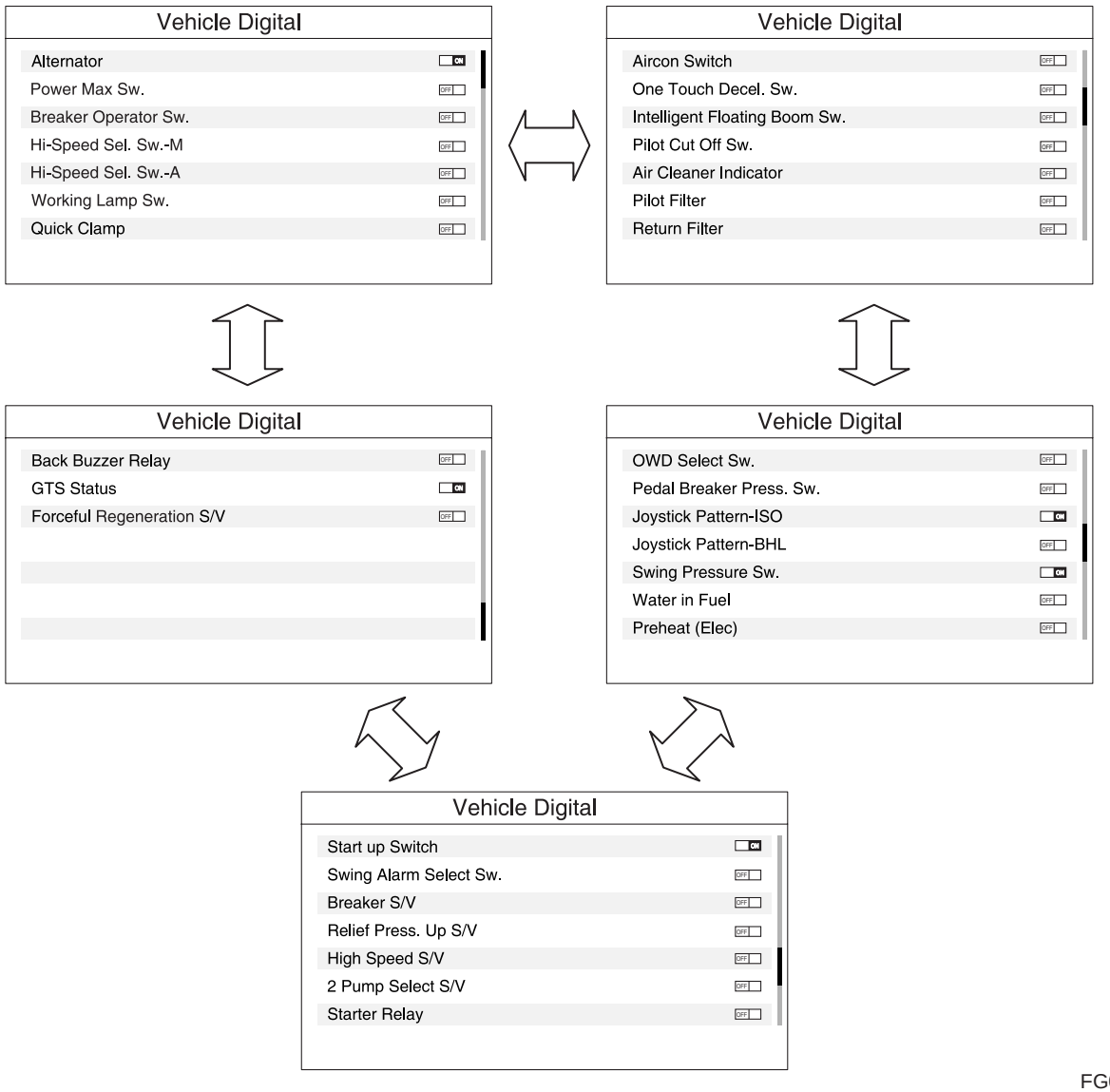
FG018860

Figure 123

Vehicle Digital Descriptions

Digital Items	Mark	Remark
1. Alternator	ON / OFF	Lights up when output at alternator "R (I)" terminal is above 12 ±1 V.
2. Power Max Switch		Lights up when the boost button is "ON" with the work mode selected to "BOOST."
3. Breaker Operator Switch		Lights up when the boost button is "ON" with the work mode selected to "BREAKER."
4. Hi-Speed Selector Switch (Manual)		Lights up when the travel speed selector switch is set to the "I" position.
5. Hi-Speed Selector Switch (Manual)		Lights up when the travel speed selector switch is set to the "II" position.
6. Working Light Switch		Lights up when the light switch is set to the "II" position.
7. Quick Clamp		Lights up when the quick coupler switch is "ON."
8. Air Conditioner Switch		Lights up when the air-conditioning relay in the air-conditioning unit is "ON."
9. One Touch Deceleration Switch		Lights up when the one touches deceleration button is "ON."
10. Intelligent Floating Boom Switch		Lights up when the intelligent floating boom switch is set to the "I" position or the "II" position.
11. Pilot Cut Off Switch		Lights up when the pilot cutoff switch is "ON."
12. Air Cleaner Indicator		Lights up when the air cleaner indicator contact is "ON."
13. Pilot Filter		Lights up when the pilot filter pressure switch is "ON."
14. Return Filter		Lights up when the return filter pressure switch is "ON."
15. OWD Select Switch		Lights up when the overload warning selector switch is "ON."
16. Pedal Breaker Press. Switch		N.A
17. Joystick Pattern-ISO		
18. Joystick Pattern-BHL		
19. Swing Pressure Switch		Lights up when the swing pressure switch is "ON."
20. Water in Fuel		Lights up when WIF sensor is "ON."
21. Preheat (Elec)		
22. Start up Switch		Lights up when the starter switch is "START"
23. Swing Alarm Select Switch		
24. Breaker S/V		Lights up when the breaker operating solenoid valve is "ON."
25. Relief Press. Up S/V		Lights up when the relief press up solenoid valve is "ON."
26. High-Speed S/V		Lights up when the high-speed solenoid valve is "ON."
27. 2 Pump Select S/V		Lights up when the 2 pump select solenoid valve is "ON."
28. Starter Relay		Lights up when the starter relay is "ON."
29. Back Buzzer Relay		Lights up when the back buzzer relay is "ON."
30. GTS Status		Lights up when TMS is "ON."
31. Forceful Regeneration S/V		

Submenu Selections



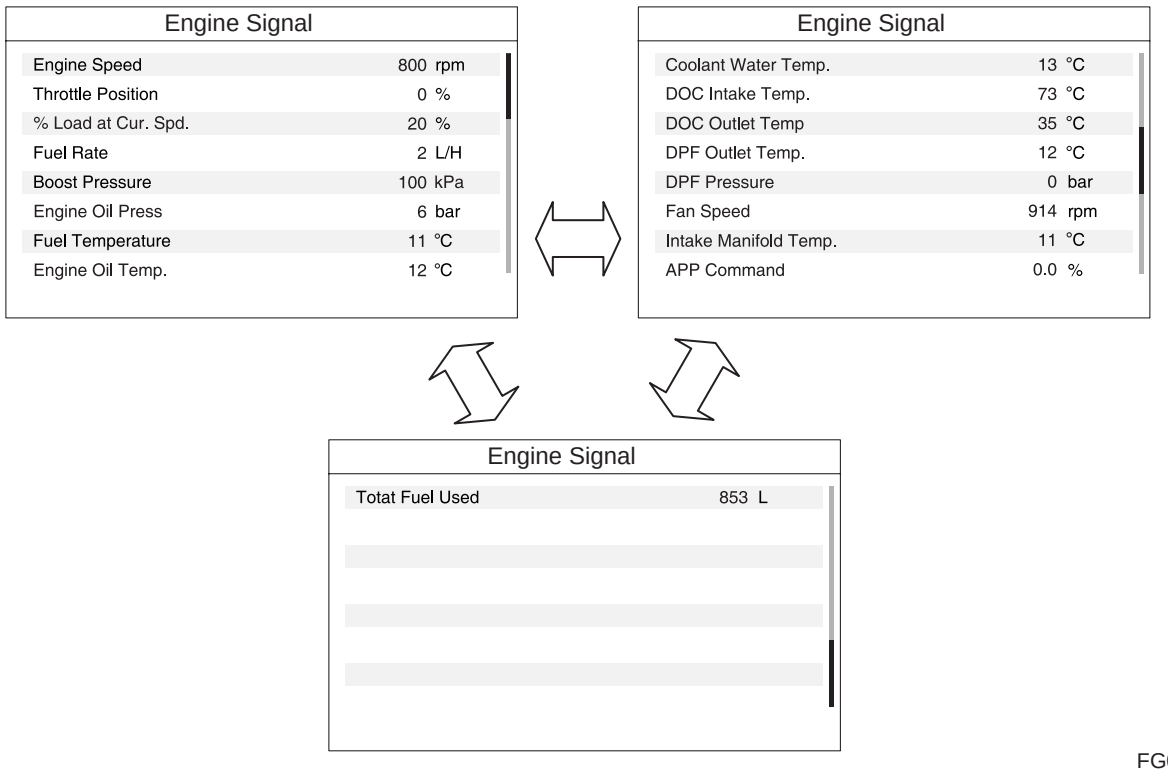
FG018866

Figure 124

Engine Signal Description

Analog Items	Display	Remark
1. Engine Speed	rpm	Engine Speed
2. Throttle Position	%	Throttle Position
3. % Load at Current Speed	%	Current load ratio of equipment
4. Fuel Rate	L/H	Fuel Rate
5. Boost Pressure	kPa	Pump pressure for boost
6. Engine Oil Pressure	bar	Engine Oil Pressure
7. Fuel Temperature	°C	Fuel Temperature
8. Engine Oil Temperature.	°C	Engine Oil Temperature
9. Coolant Water Temperature.	°C	Coolant Coolant Temperature Gauge
10. DOC Intake Temperature.	°C	DOC Intake Temperature
11. DOC Outlet Temperature.	°C	DOC Outlet Temperature
12. DPF Outlet Temperature.	°C	DPF Outlet Temperature
13. DPF Pressure	bar	DPF Pressure
14. Fan Speed	rpm	Fan Speed
15. Intake Manifold Temperature.	°C	Intake Manifold Temperature
16. App Command	%	App Command
17. Total Fuel Used	L	Total Fuel Used

Submenu Selections



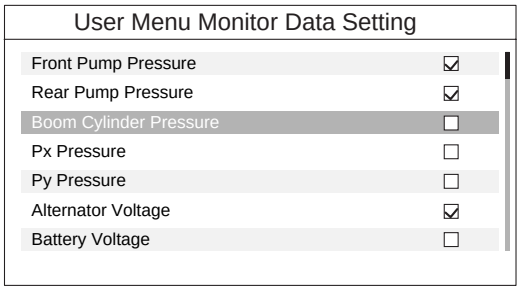
FG018861

Figure 125

User Menu Monitor Data Setting

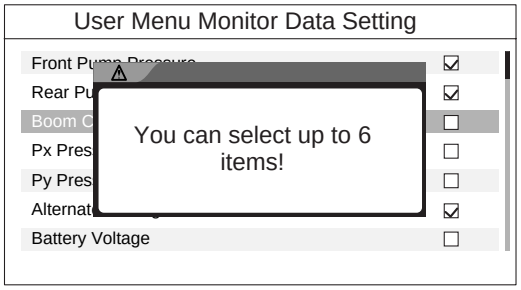
User can be monitor data setting.

The maximum limit of the monitor data setting is 6.



FG018862

Figure 126



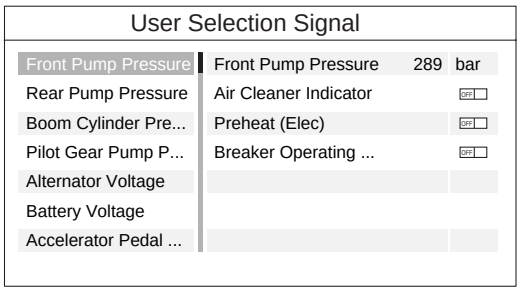
FG018863

Figure 127

User Selection Signal

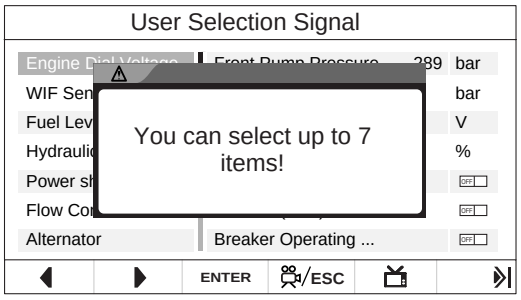
User can select signals of all monitoring items.

The maximum limit of monitoring signal is 7.



FG018864

Figure 128

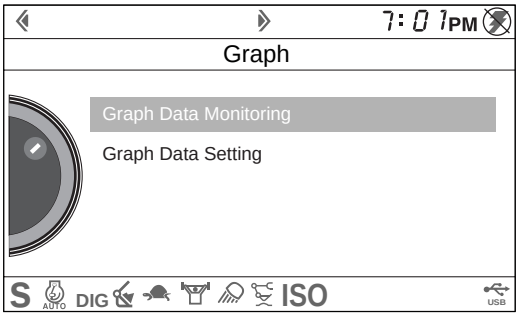


FG018865

Figure 129

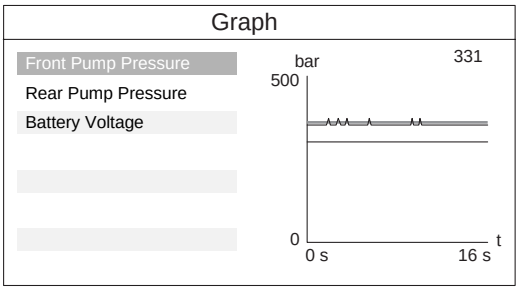
Graph

1. Entering Submenus: When a cursor is located in "Failure Info" of special menu screen press enter jog switch (1 on Figure 118) and "Failure Info" screen is displayed.
2. Exiting Submenus: If escape button (ESC, 4 on Figure 118) is pressed for more than 1 second, this information screen will be returned to previous screen.



FG018867

Figure 130

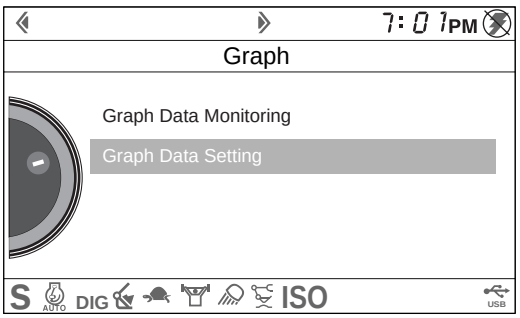


FG018868

Figure 131

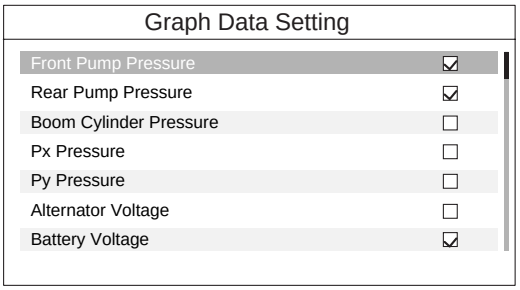
Graph Data Monitoring

Real time monitoring of the selected data.



FG018870

Figure 132



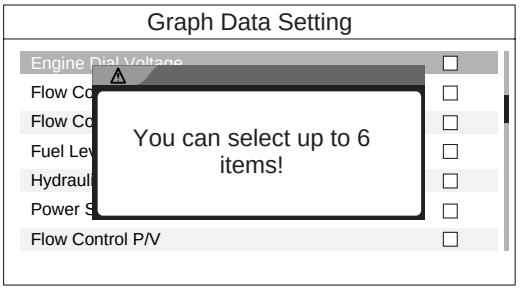
FG018871

Figure 133

Graph Data Setting

User can be graph data setting.

The maximum limit of the graph data setting is 6.

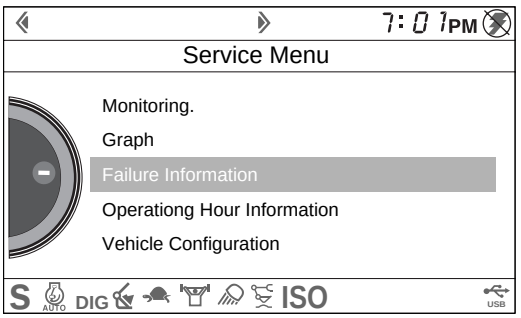


FG018872

Figure 134

Failure Information

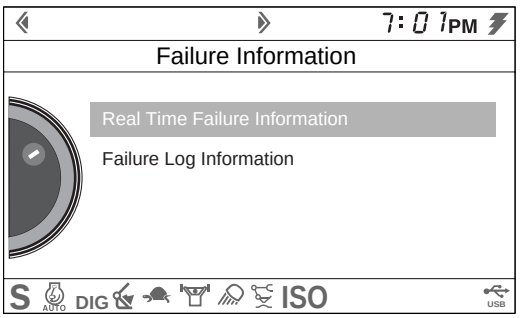
1. Entering Submenus: When a cursor is located in "Failure Info" of special menu screen press jog switch (1 on Figure 118) and "Failure Info" screen is displayed.
2. Exiting Submenus: If escape button (ESC, 4 on Figure 118) is pressed for more than 1 second, this information screen will be returned to previous screen.



FG018873

Figure 135

* Real-time Failure:
  Current status of fault is displayed.
* Failure Log:
  Memorized record of past fault is displayed.



FG018874

Figure 136

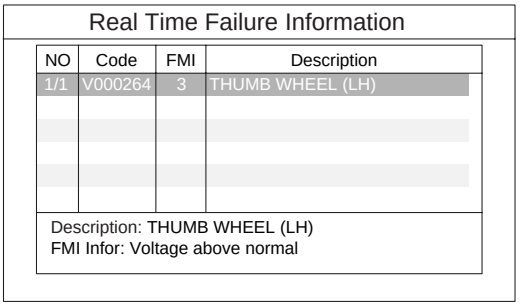
A. Current fault information

Current status of fault is displayed (Failure code, failure contents).

When several fault are produced, failure information can be checked using the jog switch (1, Figure 118).

* 1/2: A serial number of current failure.
* Vxxxxxx: Vxxxxxx is a unique code.
  - V: Machine related fault code
  - E: Engine related fault code

FMI is (Failure Mode Identifier) number.



FG018875

Figure 137

Refer to the failure information code for unique codes and FMI numbers.

This example shows one of two fault.

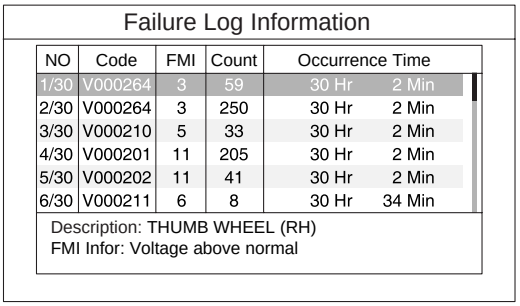
B. Past failure information

Memorized record of past failure is displayed (Failure code, fault contents).

When several fault are produced, failure information can be checked using the jog switch (1, Figure 118).

NOTE: *"Count: xxx": "xxx" means that totally counted number of the same* fault*.*

"Occurrence Time": It indicates the period for which machine has operated until a fault *takes place. (For more than two occurrences of the same* fault*, until first occurrence time.)*



FG018876

Figure 138

Failure Code at Machine

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks
			Active	Passive	
V000201	Gauge Panel Error	CN6-4, CN6-5		R = 60 ±5 Ω	It is a composite resistance of CAN line. This value has to be measured by connected condition of CAN line.
V000202	E-ECU Error	CN1-72, CN1-78			
		CAN H, GND CAN L, GND			
V000210	Pump P/V (A)	CN2-119, CN2-114		R = 13.5 ±2 Ω (25°C (77°F))	
V000211	Pump P/V (B)	CN3-16, CN3-8		R = 12.5 ±2 Ω (25°C (77°F))	
V000212	Flow Control P/V (C) 2-way LH-H	CN2-88, CN2-95			R = 18 ±2 Ω (25°C (77°F))
V000213	Flow Control P/V (D) 2-way RH-H	CN2-89, CN2-97			R = 18 ±2 Ω (25°C (77°F))
V000214	Flow Control P/V (E) Rotating CW	CN2-103, CN2-104			R = 18 ±2 Ω (25°C (77°F))
V000215	Flow Control P/V (F) Rotating CCW	CN2-105, CN2-113			R = 18 ±2 Ω (25°C (77°F))
V000216	Flow Control P/V (G)	CN2-115, CN2-120		R = 13.5 ±2 Ω (25°C (77°F))	
V000217	Press. Control1 P/V (H)	CN2-112, CN2-111		R = 9.5 ±2 Ω (25°C (77°F))	
V000218	Press. Control 2 P/V (I)	CN2-110, CN2-109		R = 9.5 ±2 Ω (25°C (77°F))	
V000219	Fan Control P/V (J)	CN2-116, CN2-121		R = 22.5 ±2 Ω (25°C (77°F))	
V000220	Travel Straight P/V (L)	CN3-15, CN3-7			R = 18 ±2 Ω (25°C (77°F))
V000223	Breaker Operating S/V	CN1-1, CN1-25	V = V_volt (Note 4)		
V000224	Relief Press. Up S/V (B)	CN1-1, CN1-6	V = V_volt		
V000225	High-speed S/V (C)	CN1-1, CN1-7	V = V_volt	Inching Relay	
V000226	Spare S/V (D)	CN1-1, CN1-26	V = V_volt	Low Speed Relay	
V000227	Reverse Fan S/V (E) - Negacon Cut	CN1-1, CN1-87	V = V_volt	Hi Speed Relay	
V000228	Cruise S/V (F)	CN1-1, CN2-106	V = V_volt		

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks
			Active	Passive	
V000229	Forward S/V (G)	CN1-1, CN2-108	V = V_volt		
V000230	Reverse S/V (H)	CN1-1, CN2-107	V = V_volt		
V000231	2 Pump Select S/V (I)	CN1-1, CN1-8	V = V_volt		
V000232	Bypass Cut Off S/V (J)	CN1-1, CN3-4	V = V_volt		
V000233	Swing Brake Release S/V (K)	CN1-1, CN3-12	V = V_volt		
V000234	Starter Relay	CN1-1, CN2-96	V = V_volt		
V000235	Back Buzzer Relay	CN1-1, CN2-99	V = V_volt		
V000236	Pilot Relay	CN1-1, CN2-98	V = V_volt		
V000237	Front Pump Press. Sensor	CN1-19, CN1-37	V = 1 V		It has to be measured in engine stop
V000238	Rear Pump Press. Sensor	CN1-18, CN1-36	V = 1 V		
V000239	OWD Press. Sensor	CN1-20, CN1-38	V = 1 V		
V000240	Px (Front) Press. Sensor	CN1-22, CN1-40	V = 1 V		
V000241	Py (Travel) Press. Sensor	CN1-23, CN1-41	V = 1 V		
V000242	Parking Brake Press. Sensor	CN1-24, CN1-42	V = 1 V		
V000243	Boom Up Press. Sensor	CN5-4, CN5-14	V = 1 V		
V000244	Boom Down Press. Sensor	CN5-2, CN5-12	V = 1 V		
V000245	Bucket CR Press. Sensor	CN5-3, CN5-13	V = 1 V		
V000246	Bucket Dump Press. Sensor	CN5-1, CN5-11	V = 1 V		
V000247	Arm In Press. Sensor	CN4-1, CN4-7	V = 1 V		
V000248	Arm Out Press. Sensor	CN4-2, CN4-8	V = 1 V		
V000249	Travel Left Press. Sensor	CN4-3, CN4-9	V = 1 V		
V000250	Travel Right Press. Sensor	CN4-4, CN4-10	V = 1 V		
V000251	Swing Press. Sensor	CN4-5, CN4-11	V = 1 V		

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks
			Active	Passive	
V000252	Att (Option) Press. Sensor	CN4-6, CN4-12	V = 1 V		
V000253	Oil Temp. Sensor	CN1-15, CN1-33	-	R = 2.45 ±0.25 Ω (25°C (77°F)) R = 320 ±32 Ω (80°C (176°F))	
V000254	Accelerator Pedal Sensor	CN1-20, CN1-38		R = 2.5 ±0.3 kΩ	
V000255	Machine Speed Sensor	CN2-91, CN2-84	-	-	
V000256	Fuel Sensor	CN1-14, CN1-32		Empty: 5 ±0.2 kΩ Full: 320 ±32 Ω	
V000257	Alternator Potential	CN1-2	V = 2 ±1 V		It has to be measured in engine stop state.
V000258	Dial	CN1-16, CN1-34		R = 1.0 ±0.3 kΩ R = 4.0 ±1.5 kΩ	
V000259	Angle Sensor (A)	CN5-10, CN5-20	V = 0.5 V excess V = 4.5 V less than		
V000260	Angle Sensor (B)	CN5-9, CN5-19	V = 0.5 V excess V = 4.5 V less than	-	
V000261	WIF Sensor	CN1-21, CN1-39	V = 0.5 V excess V = 4.5 V less than		26.4 kΩ (25°C (77°F))
V000262	Accelerator Pedal Switch	CN2-82	-	-	
V000263	Thumb Wheel (RH)	CN1-11, CN1-30	V = 0.7 ±0.2 V V = 2.5 ±0.2 V neutral V = 4.3V ±0.2 V	R = 4.5 ±0.3 kΩ	
V000264	Thumb Wheel (LH)	CN1-12, CN1-31	V = 0.7 ±0.2 V V = 2.5 ±0.2 V neutral V = 4.3 ±0.2 V	R = 4.5 ±0.3 kΩ	

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 Code at Engine

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks	
			Active	Passive		
E000051	Throttle Valve Position Sensor	2.15, 2.40	Position angle: 0° = 4.5 V ± 1% Position angle: 90° = 0.713V ± 3.5% (Supply voltage: 5 ± 0.1 V)		Intake throttle opening degree: unknown. * Default value = 0 % * Torque limit 10% * EGR valve = 0 %	
E000091	Accelerator Pedal Position	1.79, 1.80			CAN Message	
E000100	Oil Pressure Sensor	2.35, 2.06	150 kPa (1.5 bar): V = 0.921 ± 0.07 V 500 kpa (5 bar): V = 2.395 ± 0.06 V (Ambient temperature 23 ± 5°C) (Supply voltage: 5± 0.25 V)		Engine oil pressure is default value setting.	
E000102	Boost Pressure Sensor	2.86, 2.90	70 kPa (0.7bar): V = 0.729 ± 0.048 V 360 kpa (3.6 bar): V = 4.043 ± 0.048 V (Ambient temperature 23 ± 5°C) (Supply voltage: 5± 0.25 V)		Boost pressure is default value setting. Boost pressure correction is stopped.	
E000108	Barometric Pressure Sensor in ECU	ECU internal			* Torque limit 10% * EGR valve = 0 %	Signal range 4877.8 mV/ 178.4 mV
E000110	Coolant Temperature	2.39, 2.59		20°C: R = 2.5 kΩ± 5% 100°C: R=0.186kΩ± 2%	Default value of coolant temperature at engine start: -20°C during engine running: 90°C Torque limit = 1	
E000129	Rail Pressure Sensor	2.36, 2.60	0 MPa (0 bar): V = 0.5 V ± 2% 200 MPa (2,000 bar): V = 4.5V ± 2% (Ambient temperature 23 ± 5°C) (Supply voltage: 5 ± 0.25 V)		Actual rail pressure is default value setting. Torque limit level = 1	
E000132	Air Mass Flow Sensor	2.54, 2.30	1 g/s: 3,138 ± 25.0 HZ 16 g/s: 7,750 ± 2.5 HZ (Ambient temperature 22 ± 2°C) (Supply voltage: 13.5 ± 0.3 V)		Default value of MAF sensor: 250g/sec. EGR = 0, Torque level 1	
E000157	CP Metering Unit				Torque Limiter 3	
E000158	Battery	1.73, 1.03			No Torque limit	key on 24 V, Engine run 27 V

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks
			Active	Passive	
E000105	Air Intake Manifold Temperature	2.37, 2.90		20°C: R = 2.5 kΩ ± 5% 100°C: R = 0.186 kΩ ± 2%	Default value of intake air temperature: -10°C
E000173	DPF Downstream Temperature	1.40, 1.43		25°C: R = 220.1Ω ± 1.9Ω 100°C: R = 276.4Ω ± 1.9Ω	No Torque limit, No action
E000174	Fuel Temperature Sensor	2.12, 2.59		20°C: R = 2.5 kΩ ± 5% 100°C: R = 0.186 kΩ ± 2%	Fuel temperature is default value setting.
E000175	Oil Temperature Sensor	2.13, 2.06		20°C: R = 2.5 kΩ ± 5% 100°C: R = 0.186 kΩ ± 2%	Failure Code stored. No Torque limit
E000606	Overspeed Detection in Component Engine Protection				No torque limit
E000734	Solenoid Power Stage 1 (Cylinder 1)	2.49, 2.73			No torque limit
E000735	Solenoid Power Stage 2 (Cylinder 5)	2.25, 2.01			Torque level limit 1/Large vibration, rough idle, output power reduction, rev up failure, deterioration of exhaust emissions/6 cylinder: Activate Q limit for regeneration stop.
E000736	Solenoid Power Stage 3 (Cylinder 3)	2.50, 2.74			
E000737	Solenoid Power Stage 4 (Cylinder 6)	2.26, 2.02			
E000738	Solenoid Power Stage 5 (Cylinder 2)	2.51, 2.75			
E000739	Solenoid Power Stage 6 (Cylinder 4)	2.27, 2.03			
E000977	Auto Fan Clutch PWM Out	1.74, 1.87		Coil R = 25Ω ± 10% (at 20°C)	No torque limit
E001207	Engine ECU Temperature				No torque limit
E001322	Monitoring Misfire Detection Multiple Cylinder				No torque limit
E001323	Injection Misfire Detection Cylinder 1	2.49, 2.73			No torque limit
E001324	Injection Misfire Detection Cylinder 5	2.25, 2.01			No torque limit
E001325	Injection Misfire Detection Cylinder 3	2.50, 2.74			No torque limit
E001326	Injection Misfire Detection Cylinder 6	2.26, 2.02			No torque limit
E001327	Injection Misfire Detection Cylinder 2	2.51, 2.75			No torque limit
E001328	Injection Misfire Detection Cylinder 4	2.27, 2.03			No torque limit

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks	
			Active	Passive		
E001482	Time Out Error of CAN Receive Frame TCU	CAN signal			Torque limit = 1 Only loader	
E001639	Auto Fan Clutch Speed	1.65, 1.64			No torque limit	
E003242	DPF Upstream Temperature	1.17, 1.18		25°C: R = 220.1Ω ± 1.9Ω 100°C: R = 276.4Ω ± 1.9Ω	* Inhibit the HC dosing * Torque limit level = 2 * EGR valve = 0%	
E003464	Throttle Valve Control	2.05, 2.29			Display code DC motor unpowered/position angle 89 deg/Voltage 14.25% + -3.5% (0.713 V)	
E003509	Monitoring of 12 V Sensor Supply Voltage in ECU	2.84, 2.30			No torque limit	12 V level
E003609	DPF Pressure Sensor Physical Range Check	1.55, 1.43	0 kPa (0 bar): V = 0.5 V ± 2% 100 kPa (1 bar): V = 4.5 V ± 2% (-40 - 135°C) (Supply voltage: 5 ± 5% V)		Torque limit level = 1	
E003719	Maximum Soot Mass in Particulate Filter				Torque limit level = 3	
E004765	DOC Upstream Temperature	1.16, 1.18		25°C: R = 220.1 Ω ± 1.9Ω 100°C: R = 276.4 Ω ± 1.9Ω	Torque limit level = 2	
E004767	Diesel Oxidation Catalyst Differential Pressure	1.90, 1.55	0 kPa (0 bar): V = 0.5 V ± 2% 100 kPa (1 bar): V = 4.5 V ± 2% (-40 - 135°C) (Supply voltage: 5 ± 5% V)		Torque level = 1	
E005456	MU Hydrocarbon Doser Intake Fuel Temperature	1.42, 1.33		20°C: R = 2.416 kΩ ± 3.4% 100°C: R = 0.182 kΩ ± 2.0%	Display Code	
E005465	Pressure Control Regulator				Display code	
E520196	Rail Pressure Monitoring				Torque limit level = 3	
E520197	Time Out Error of CAN Module C	CAN moduleC 2.17, 2.18				
E520199	Crankshaft Sensor	2.65, 2.66		R = 860 Ω ± 10% (at 20°C)	Engine runs based on cam sensor signal.	
E520200	Camshaft Sensor	2.67, 2.68		R = 860 Ω ± 10% (at 20°C)	During engine running, engine runs based on crank sensor signal. After engine stop, engine restart is not possible. (avoidance of engine failure)	
E520201	EEPROM Error	Internal fault			No Torque limit / Without output power change	

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks
			Active	Passive	
E520203	Monitoring of PRV	2.36, 2.60			Torque limit level = 2
E520206	Time Out Error of CAN Module A	CAN signal			No Torque limit
E520336	Engine Temperature Sensor Plausibility				No Torque limit
E520602	Hydraulic Oil Temperature CAN Time Out	CAN signal			No Torque limit
E520603	Time Out Error of CAN Receive Frame DEC1V	CAN signal			Display Code
E520604	ECU Hardware Chip CY146 Error	Internal fault			No torque limit
E520605	DPM system error	Internal fault			Torque limit level = 3
E520606	Time Out Error of CAN Receive Frame EGR Valve	CAN signal			Air control problem, EGR = 0/ Torque level 1
E520607	EGR Valve Actuator Error	Smart Actuator			EGR = 0, Torque level 1
E520608	Error Message from VGT Actuator	CAN signal			Torque limit level 2
E520609	Air Control Governor Deviation Error	Internal fault			EGR = 0, Torque level 1
E520610	Power Stage for Intake Air Heater	1.83			
E520611	Time Out Error of CAN Receive Frame Vehicle Cutoff Switch	CAN signal			No torque limit
E520612	Accelerator Pedal CAN Max Error	CAN signal			Torque level = 2
E520613	Vehicle Cutoff Switch Error	CAN signal			No torque limit
E520614	Time Out Error of CAN Receive Frame VGT	CAN signal			Torque limit = 1
E520615	Performance Limit Activation	Internal fault			Torque limit level = 3
E520616	ECU Power Stage Test	Internal fault			No Torque limit
E520617	Metering Unit Supply Voltage	DPM pin number			Display code
E520618	Monitoring of ADC	Internal fault			No torque limit
E520619	Monitoring of Communication Module	Internal fault			No torque limit
E520620	Completely Damaged Particulate Filter	Internal fault			No torque limit
E520621	Mon Pressure Differential Characteristics				Torque limit level = 2
E520622	Disconnected DPF Pressure Sensor Hose Line				No torque limit
E520623	MU Differential Pressure MIN	1.90, 1.55			Display Code
E520624	Monitoring of Injection	Internal fault			No torque limit

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks	
			Active	Passive		
E520625	Detection of Failed Engine Start	Internal fault			No torque limit	
E520626	Injection Bank	Refer to injector connector			No torque limit	
E520628	MU Hydrocarbon Dosing Valve	1.22, 1.24		R = 15.95 Ω± 5% (at 20°C)	Display code	
E520631	MU Downstream Pressure Sensor	1.56, 1.33	150 kPa (1.5 bar): V = 1.1 V (± 20 kPa) 500 kpa (5 bar): V = 2.5 V (± 20 kPa) (Supply voltage: 5 ± 0.25 V)		Display Code	
E520633	ECU Power Stage Module	Internal fault			No Torque limit	
E520636	MU Upstream Pressure Sensor	1.30, 1.33	150 kPa (1.5 bar): V = 0.881 ± 0.07 V 500 kpa (5 bar): V = 2.214 ± 0.06 V (Ambient temperature 23 ± 5 °C) (Supply voltage: 5 ± 0.25 V)		Display code	
E000172	Air Mass Flow Sensor Temperature	2.38, 2.30		20°C: R = 3.511 kΩ± 2.68% 100°C: R = 0.178 kΩ ± 2.28%	No torque limit	
E520637	Actuator Relay 0 Error	Internal fault			No torque limit	
E520638	Actuator Relay 1 Error	Internal fault			No torque limit	
E520639	Actuator Relay 2 Error	Internal fault			No torque limit	
E520640	Actuator Relay 3 Error	Internal fault			No torque limit	
E520601	ECU Hardware Chip CY320 Error	Internal fault			No torque limit	
E520641	Monitoring of Complete ROM Test	Internal fault			No torque limit	
E520642	ECU Shut Off Path Error	Internal fault			Torque limit level = 2	
E520643	Monitoring of Overrun	Internal fault			Display code	
E520644	Monitoring of Voltage Supply	1.49, 1.28			Display code	24V level
E520645	ECU Main Relay	1.69			No torque limit	Ignition switch on 24V
E520646	DPF Pressure Sensor Hose Line Check				No torque limit	
E520647	DPF Pressure Sensor Offset Diagnostic				No torque limit	

GP Display Code	GP Display Description	Measuring Point	Correct Value		Remarks
			Active	Passive	
E520651	Monitoring for Maximum Ash Mass in DPF	Internal fault			No torque limit
E520648	Monitoring of the Engine Protection				Torque limit level = 2
E520649	Monitoring of Incomplete Regeneration				No torque limit
E520650	Regeneration Locked				No torque limit
E520652	Forced Regeneration Switch	1.59			No torque limit
E520653	Forced Regeneration Inhibit Switch	1.58			No torque limit
E520654	MSC Errors of R2S2	1.70			No torque limit
E520655	MU Shut Off Valve	1.20, 1.45	R = 3.3Ω ± 5% (at 20°C)		Display code

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)

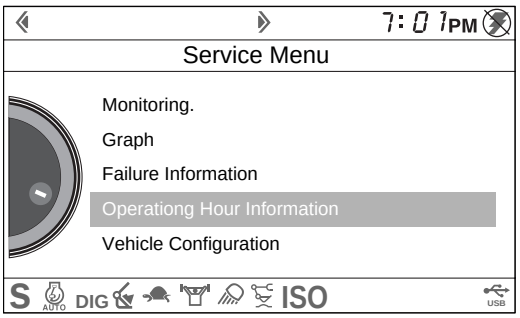
FMI 0	Above normal range (DATA VALID but ABOVE NORMAL OPERATIONAL RANGE)
FMI 1	Below normal range (DATA VALID but BELOW NORMAL OPERATIONAL RANGE)
FMI 2	Incorrect signal (DATA ERRATIC, INTERMITTENT OR INCORRECT)
FMI 3	Voltage above normal (VOLTAGE ABOVE NORMAL OR SHORTED TO HIGH SOURCE)
FMI 4	Voltage 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.

Operating Hour Information

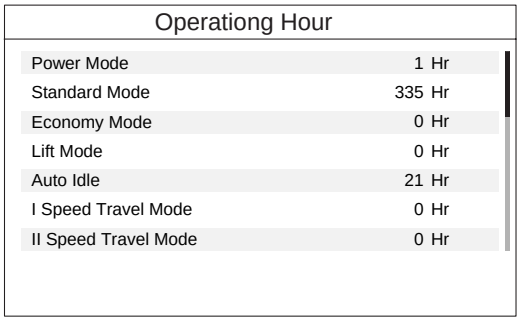
1. Entering Submenus: When a cursor is located in "Operating Hrs" of special menu screen (Figure 139) press jog switch (1 on Figure 118) and "Operating Hrs" screen will be displayed (Figure 140).



FG018877

Figure 139

2. Operating Hours Screen



FG018878

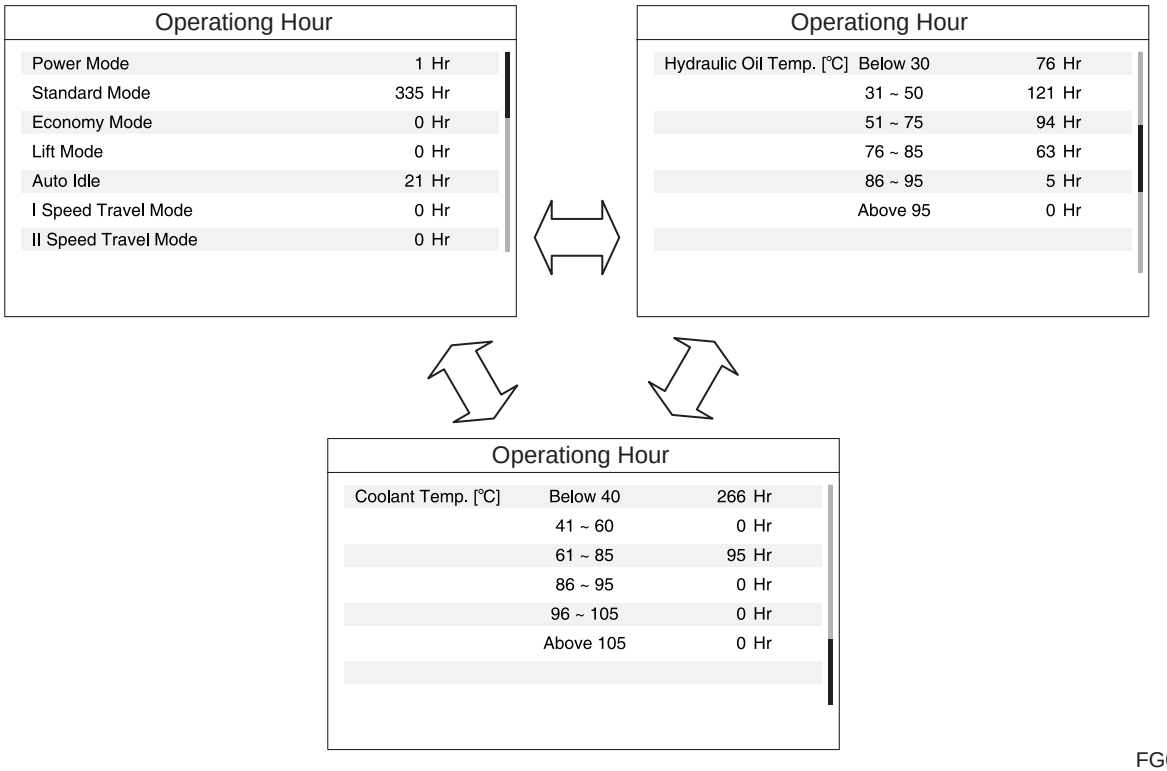
Figure 140

3. Exiting Submenus: If escape button (ESC, 4 on Figure 118) is pressed for more than 1 second, this information screen will be returned to previous screen.

Information contents of operation hour

Item	Information Contents	Detection Method
Power Plus Mode	Operation hours used Power Plus Mode are displayed.	Power Plus Mode status (Instrument panel) and Alternator signal (CN1-2) is "HI"
Power Mode	Operation hours used Power Mode are displayed.	Power Mode status (Instrument panel) and Alternator signal (CN1-2) is "HI"
Economy Mode	Operation hours used economy mode are displayed.	Economy Mode status (Instrument panel) and Alternator signal (CN1-2) is "HI"
Auto Idle	Operation hours used auto idle status are displayed.	Auto Idle Mode status (Instrument panel) and Alternator signal (CN1-2) 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 sensor "Py" (control valve) - over 15.5 bar.
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)

Example of Machine Operation Info Screen



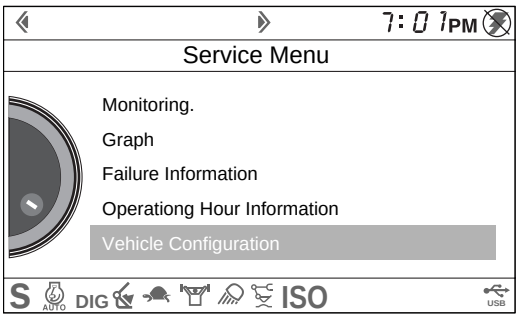
FG018879

Figure 141

Vehicle Configuration

1. Vehicle Configuration

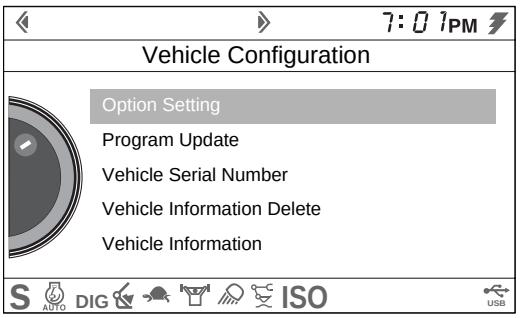
   A. Entering Submenus: When a cursor is located in "Vehicle Configuration" of special menu screen (Figure 142) press jog switch (1 on Figure 118) and "Vehicle Configuration" screen will be displayed (Figure 143).



FG018880

Figure 142

   B. Vehicle Configuration Screen (Figure 143).



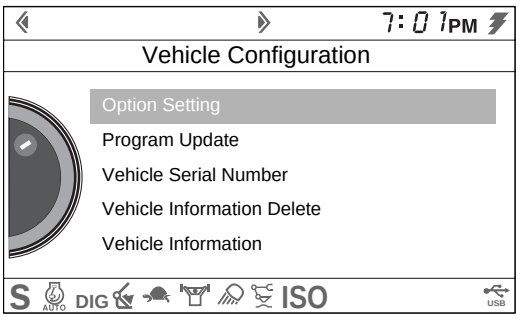
FG018881

Figure 143

   C. Exiting Submenus: If escape button (ESC, 4 on Figure 118) is pressed for more than 1 second, this information screen will be returned to previous screen.

Option Setting

1. Entering Submenus: When a cursor is located in "Option Setting" of special menu screen (Figure 144) press jog switch (1 on Figure 118) and "Option Setting screen" will be displayed (Figure 145)



FG018881

Figure 144

2. Option Setting

   - Attachment Option

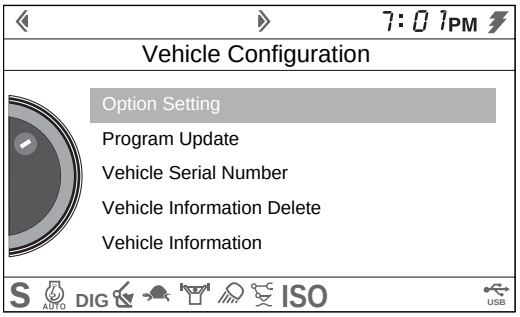
     When a cursor is located in check box of breaker or two-way, press jog switch (1 on Figure 118) and then, the check box light turns "ON."

   - DMB Option

     When a cursor is located in check box of DMB, press jog switch (1 on Figure 118) and then, the check box light turns "ON."

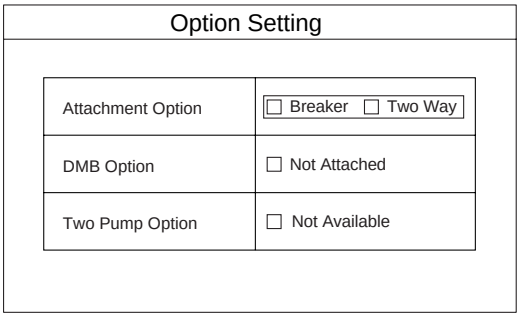
   - Two Pump Option

     When a cursor is located in check box of two pump. Option, press jog switch (1 on Figure 118) and then, the check box light turns "ON."



FG018881

Figure 145



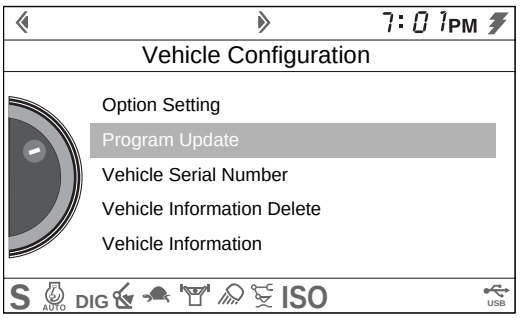
FG018884

Figure 146

3. Program Update

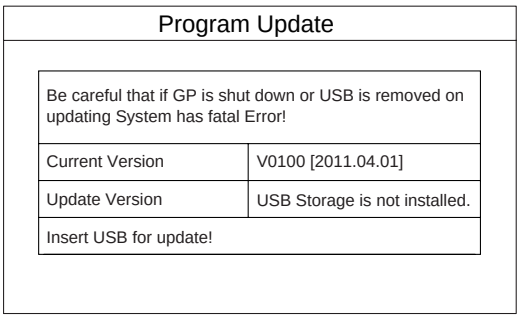
   Entering Submenus: When a cursor is located in "Program Update" of special menu screen (Figure 147) press jog switch (1 on Figure 118) and "Program Update Screen" will be displayed (Figure 148).

   NOTE: *When USB memory is installed in jack assy, program update can be updated.*



FG018885

Figure 147



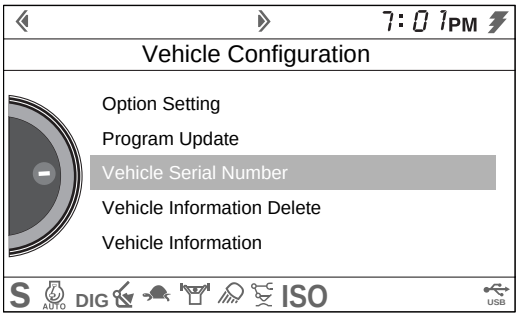
FG018886

Figure 148

4. Vehicle Serial Number

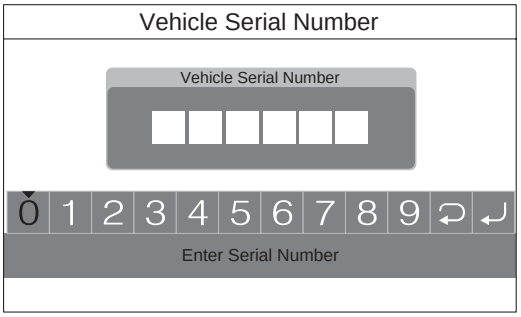
Entering Submenus: When a cursor is located in "Vehicle Serial Number" of special menu screen (Figure 149) press jog switch (1 on Figure 118) and "Vehicle Serial Number Screen" will be displayed (Figure 150).

Vehicle serial number can be input by turning the jog switch and pressing the jog switch.



FG018887

Figure 149



FG018888

Figure 150

5. Vehicle Information Delete

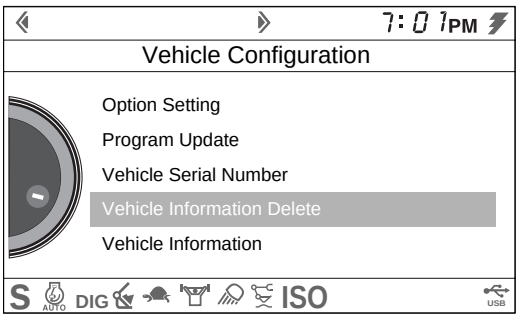
Entering Submenus: When a cursor is located in "Vehicle Information Delete" of special menu screen (Figure 151) press jog switch (1 on Figure 118) and "Vehicle Information Delete Screen" will be displayed (Figure 152)

NOTE: *When press* jog *switch (1 on Figure 118) in the selected menu the menu will be initialized.*

- Delete Failure Log

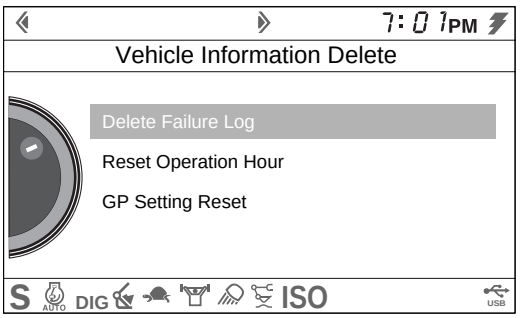
- Reset Operation Hour

- GP Setting Reset



FG018889

Figure 151

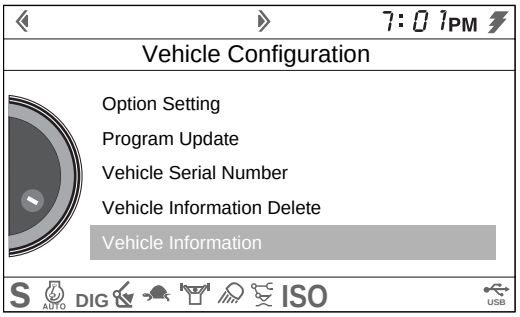


FG018890

Figure 152

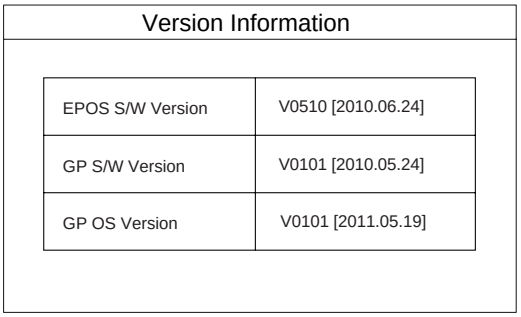
6. Version Information

Entering Submenus: When a cursor is located in "Version Information" of special menu screen (Figure 153) press jog switch (1 on Figure 118) and "Version Information Screen" will be displayed (Figure 154).



FG018891

Figure 153



FG018893

Figure 154

ELECTRONIC HYDRAULIC CONTROL SYSTEM (e-EPOS)

Control System Schematic

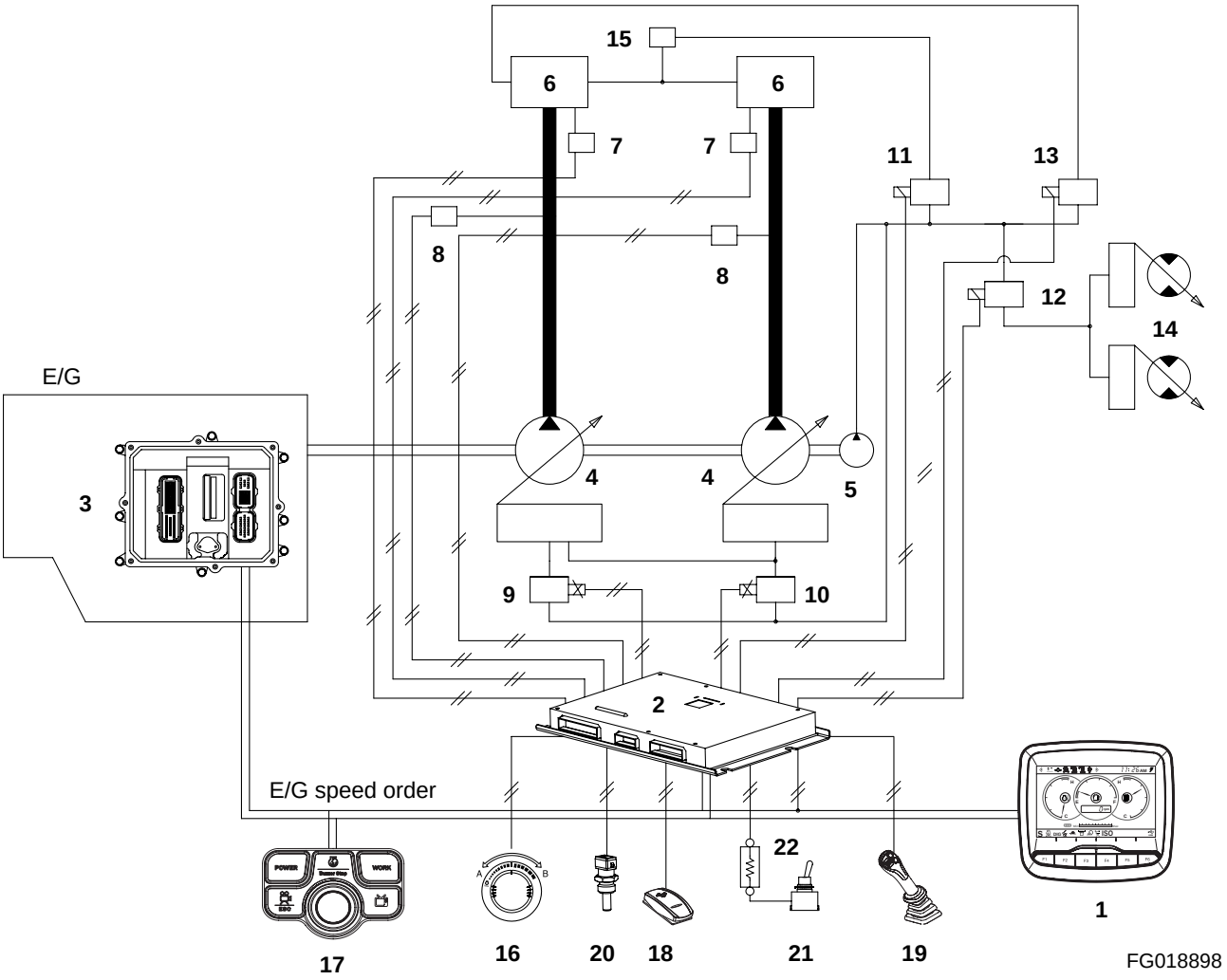
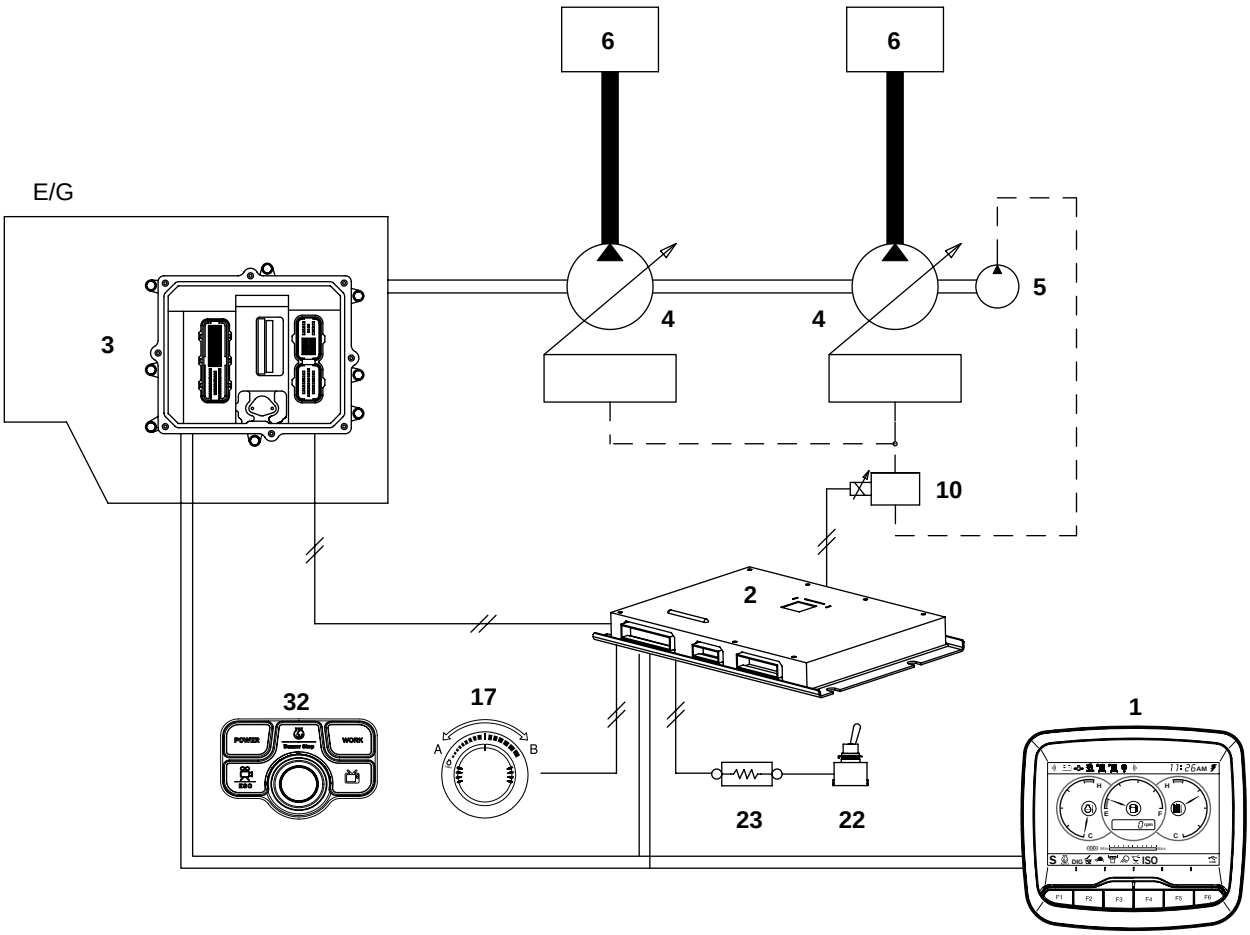


Figure 155

Reference Number	Description
1	Instrument Panel
2	e-EPOS Controller
3	Engine Controller (ECU)
4	Main Pump
5	Aux Pump
6	Control Valve
7	Pressure Switch
8	Pump Pressure Sensor
9	Electromagnetic Proportional Pressure Reducing Valve (Attachment)
10	Electromagnetic Proportional Pressure Reducing Valve (Mode Control)

Reference Number	Description
11	Solenoid Valve (Boost)
12	Solenoid Valve (High-speed)
13	Solenoid Valve (Breaker)
14	Travel Motor
15	Main Relief Valve
16	Engine Control Dial
17	Jog Switch Control Panel
18	Auto Travel Selector Switch
19	Boost Switch (Right Work Lever)
20	Sensor
21	Aux Mode Switch
22	Aux Mode Resistor

POWER PLUS MODE CONTROL



FG018899

Figure 156

Reference Number	Description
1	Instrument Panel (Power Mode Selector Switch)
2	e-EPOS Controller
3	Engine Controller (ECU)
4	Main Pump
5	Aux Pump
6	Control Valve

Reference Number	Description
10	Electromagnetic Proportional Pressure Reducing Valve (Mode Control)
17	Engine Control Dial
22	Aux Mode Switch
23	Aux Mode Resistor
32	Jog Switch Control Panel

The Jog Switch Control Panel permits the selection of the appropriate engine power depending on the working condition. One of the four. Power Plus Mode, Power Mode, Standard Mode or Economy Mode setting can be selected. When the engine starter switch is turned "ON," the power mode is automatically defaulted to standard mode. The desired mode can be selected by pressing the jog switch on the jog switch control panel. When the power mode is selected, the indicator light 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	Power Plus Mode	Power Mode	Standard Mode	Economy Mode
Output (%)	100%	Approximately 90%	Approximately 80%	Approximately 75%

1. Power Plus Mode

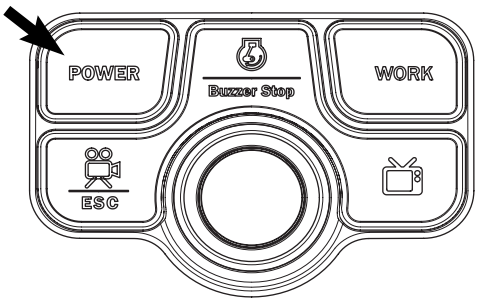
This mode should be selected for high-speed work. In this mode the engine output is most efficiently utilized because of the discharged oil volume being controlled based on the equivalent horsepower curve at various loaded pressures. The e-EPOS controller compares the target engine speed with the actual engine speed and controls the signal to the EPPR (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.

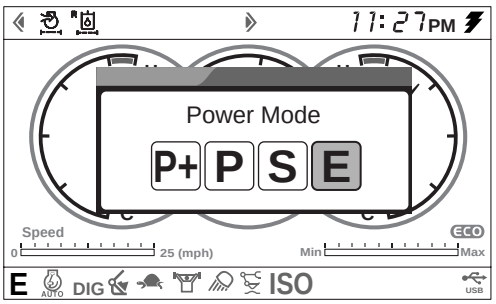
By repeating these control operations, the engine speed is maintained at the rated speed so maximum power can be generated.

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 EPPR valve. Now the EPPR 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.



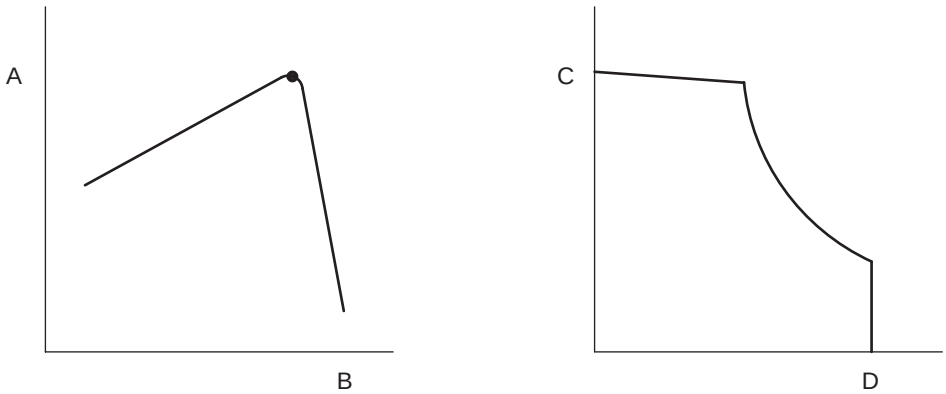
FG018900

Figure 157



FG018901

Figure 158



FG000580

Figure 159

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. Power Mode, Standard Mode, Economy Mode

Power Mode, Standard Mode or Economy Mode is selected on the work type. When the standard/economy mode is selected it will reduce noise and fuel consumption in comparison with Power Plus Mode. The EPOS controller compares the target engine speed with the actual engine speed and controls the signal to the EPPR valve which in turn varies the pump output quantity and it is the same method with power volume.

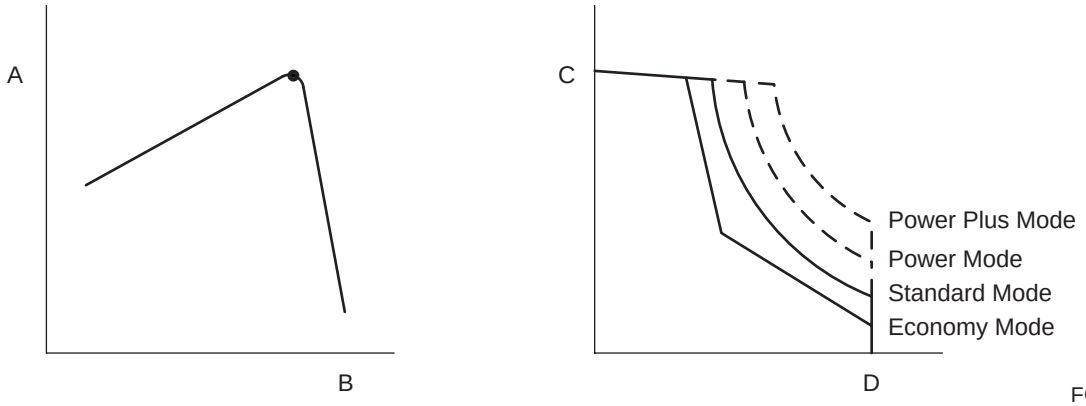
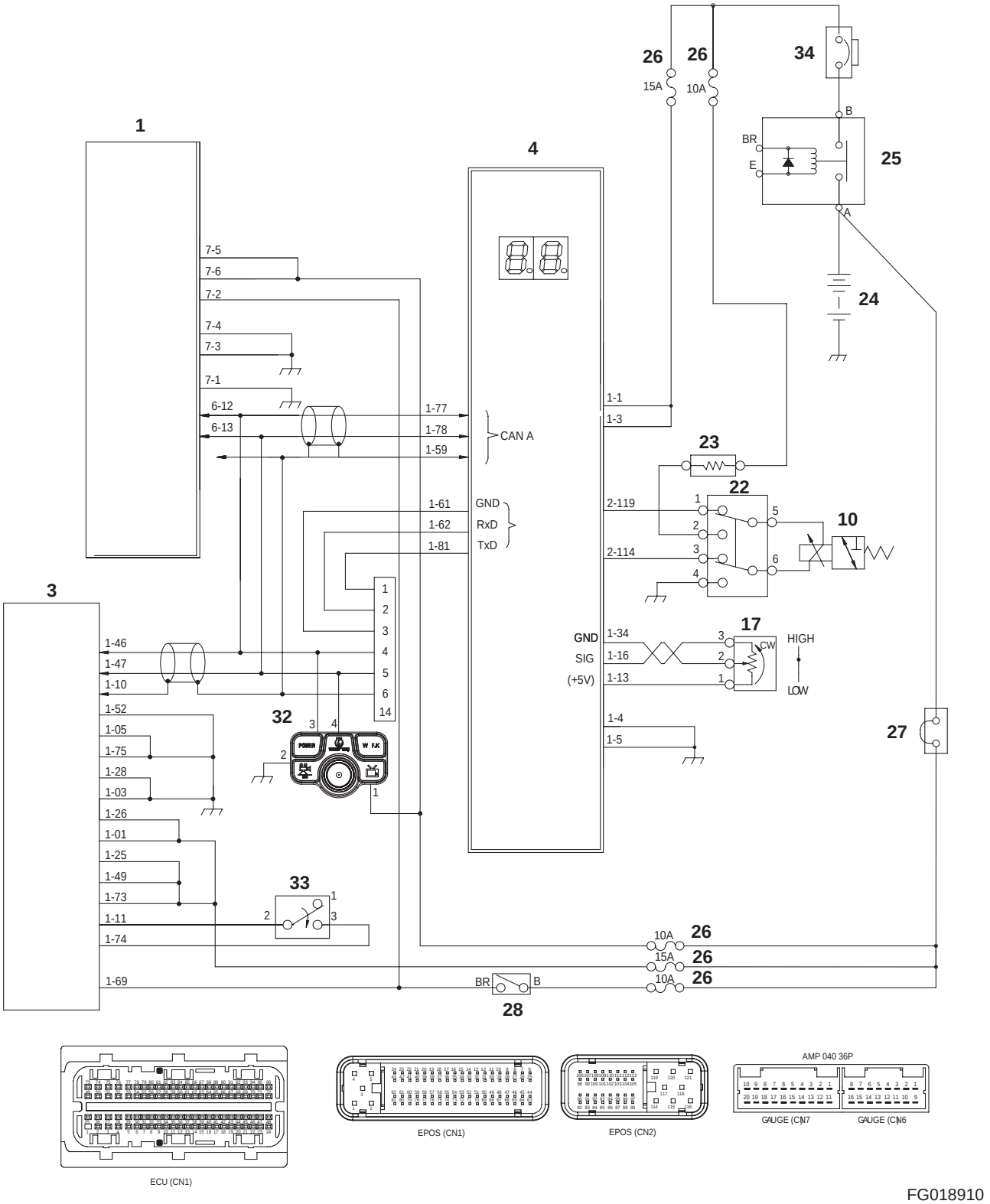


Figure 160

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

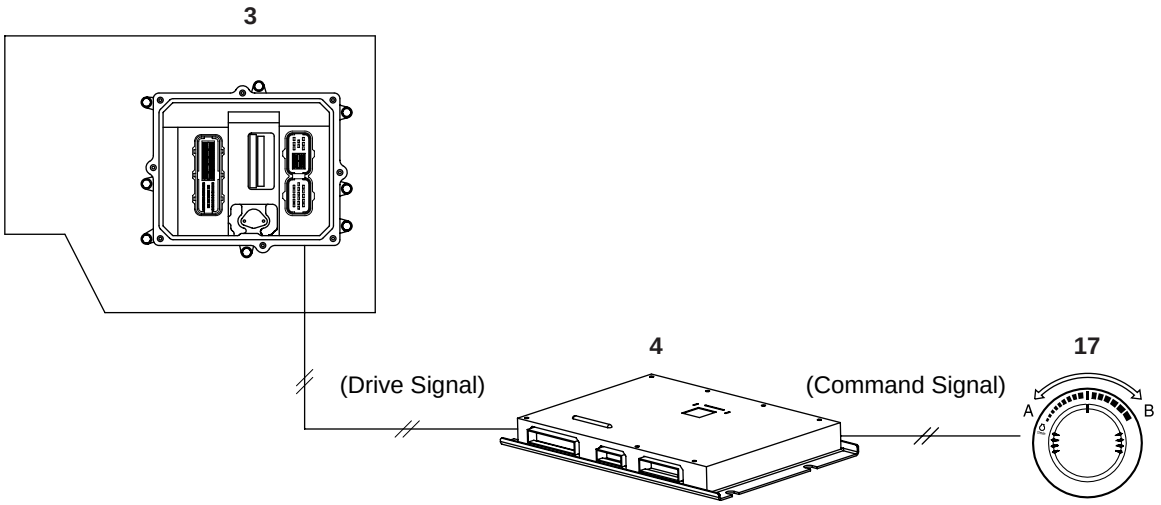


FG018910

Figure 161

Reference Number	Description
1	Instrument Panel
3	Engine Controller
4	e-EPOS Controller
10	EPPR Valve (Electromagnetic Proportional Pressure Reducing)
17	Engine Control Dial
22	Aux Mode Switch
23	Aux Mode Resistor

Reference Number	Description
24	Battery
25	Battery Relay
26	Fuse
27	Fusible Link
28	Starter Switch
32	Jog Switch Control Panel
33	Engine Emergency Stop Switch
34	Circuit Breaker



FG000584

Figure 162

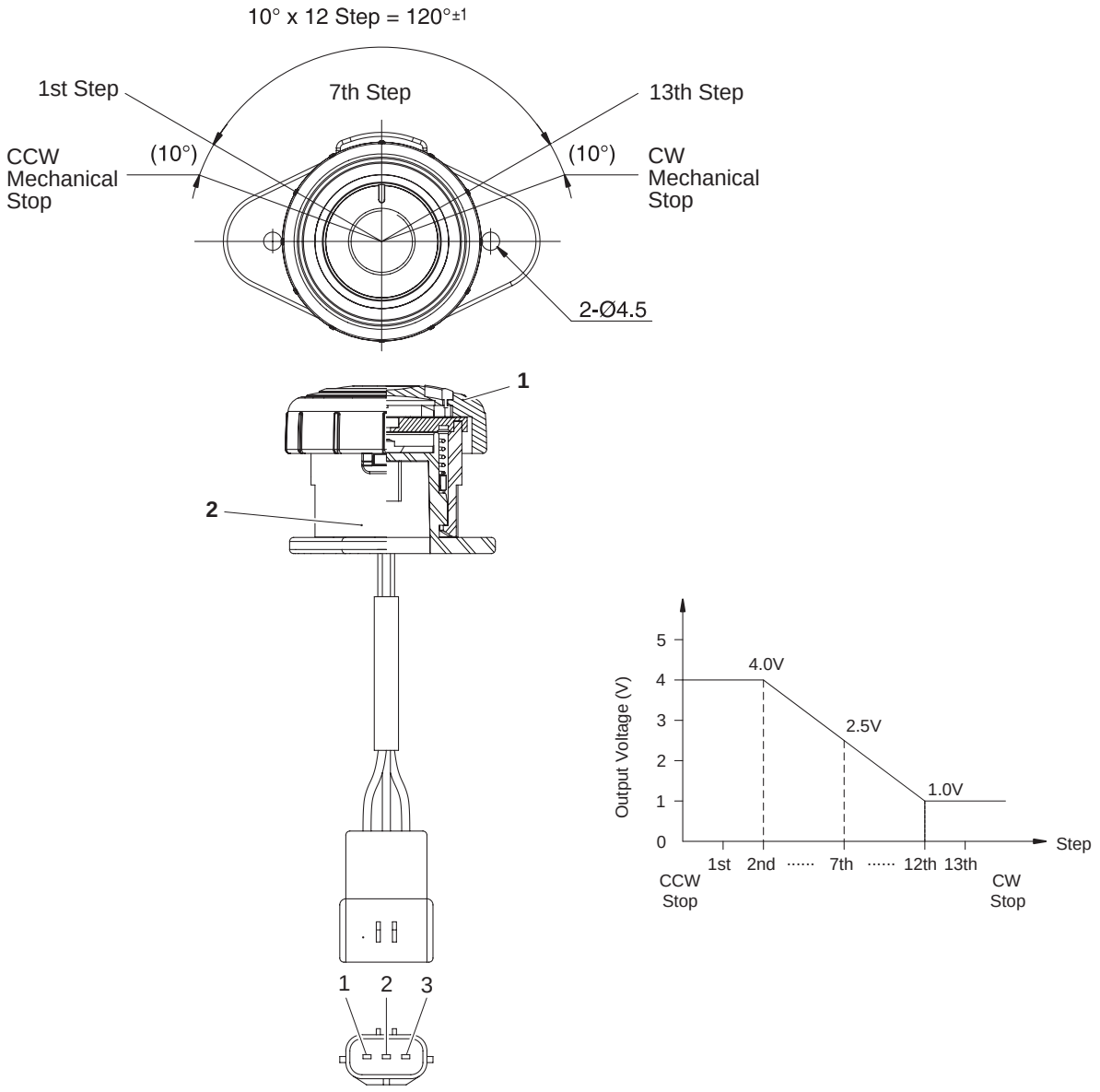
Reference Number	Description
3	Engine Controller
4	e-EPOS Controller

Reference Number	Description
17	Engine Control Dial

When the engine control dial is moved the output voltage changes according to the dial position.

The e-EPOS controller converts this output voltage of dial to digital signal and sends it to the engine controller by CAN line. According to the dial command, the quantity of fuel injection is adjusted.

ENGINE CONTROL DIAL



FG018941

Figure 163

Reference Number	Description
1	Knob

Reference Number	Description
2	Hall Effect Sensor

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

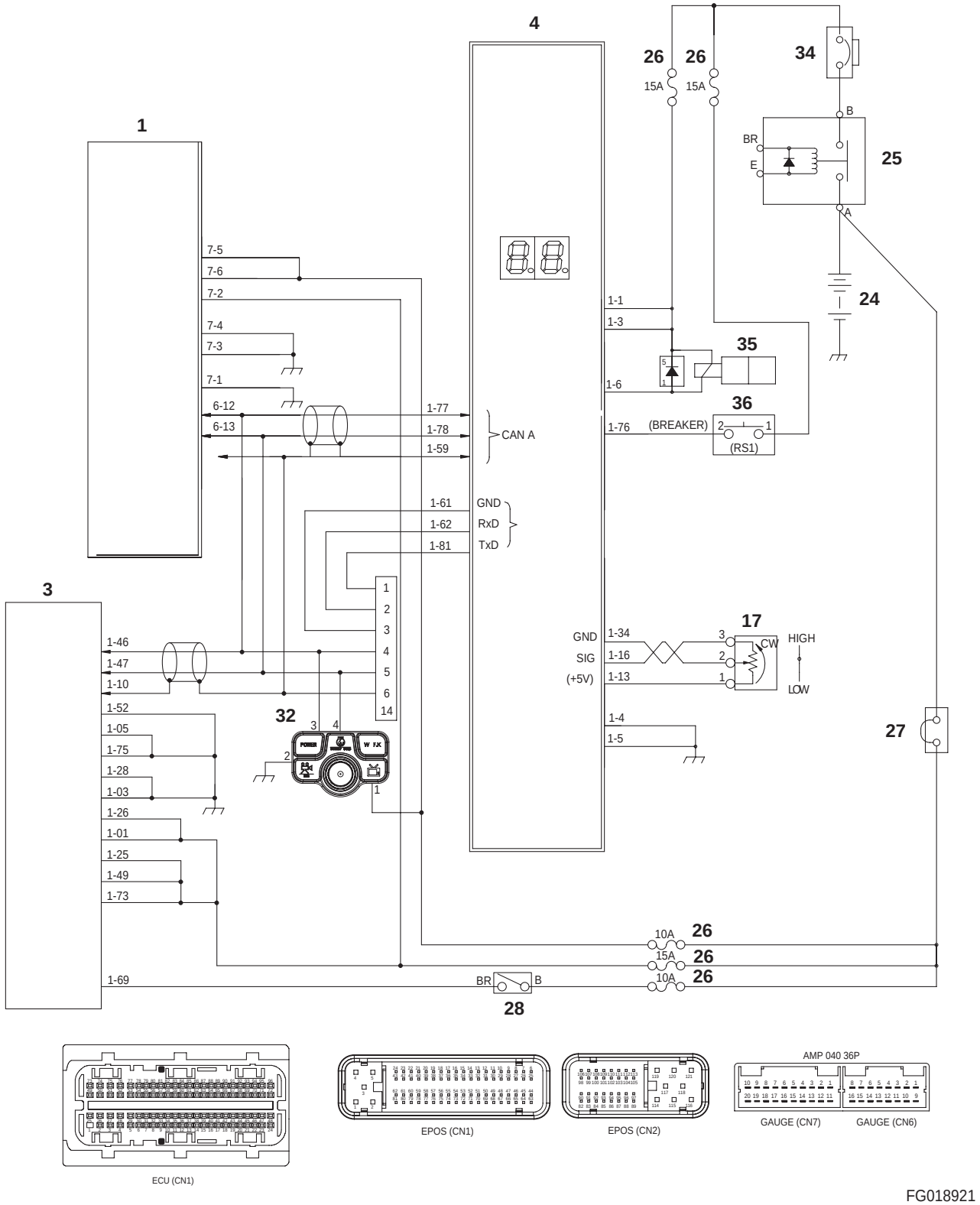
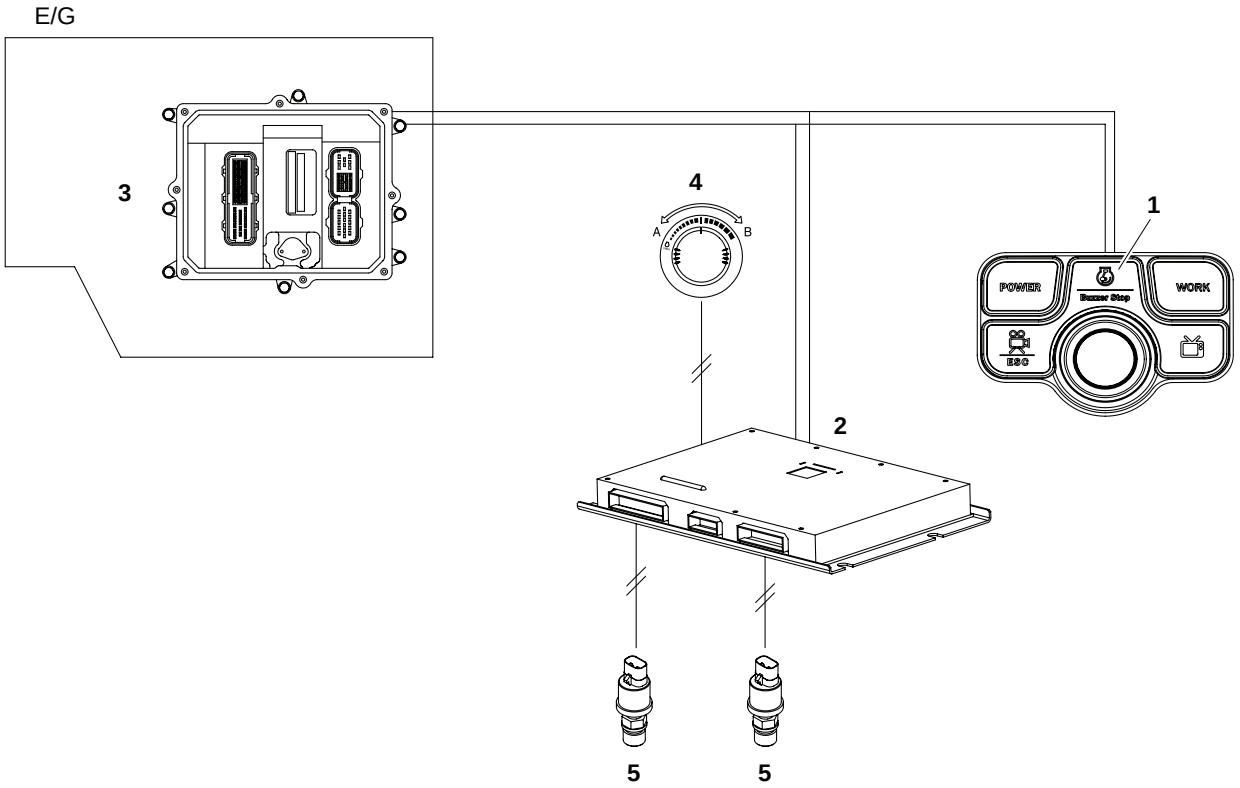


Figure 164

Reference Number	Description
1	Instrument Panel
3	Engine Controller
4	e-EPOS Controller
10	EPPR Valve (Electromagnetic Proportional Pressure Reducing)
17	Engine Control Dial
24	Battery
25	Battery Relay
26	Fuse

Reference Number	Description
27	Fusible Link
28	Starter Switch
32	Jog Switch Control Panel
33	Engine Emergency Stop Switch
34	Circuit Breaker
35	Solenoid Valve (Pressure Up)
36	Power Boost Switch

AUTOMATIC DECELERATION CONTROL (AUTO IDLE CONTROL)



FG018916

Figure 165

Reference Number	Description
1	Jog Switch Control Panel (Auto Idle Switch)
2	e-EPOS Controller

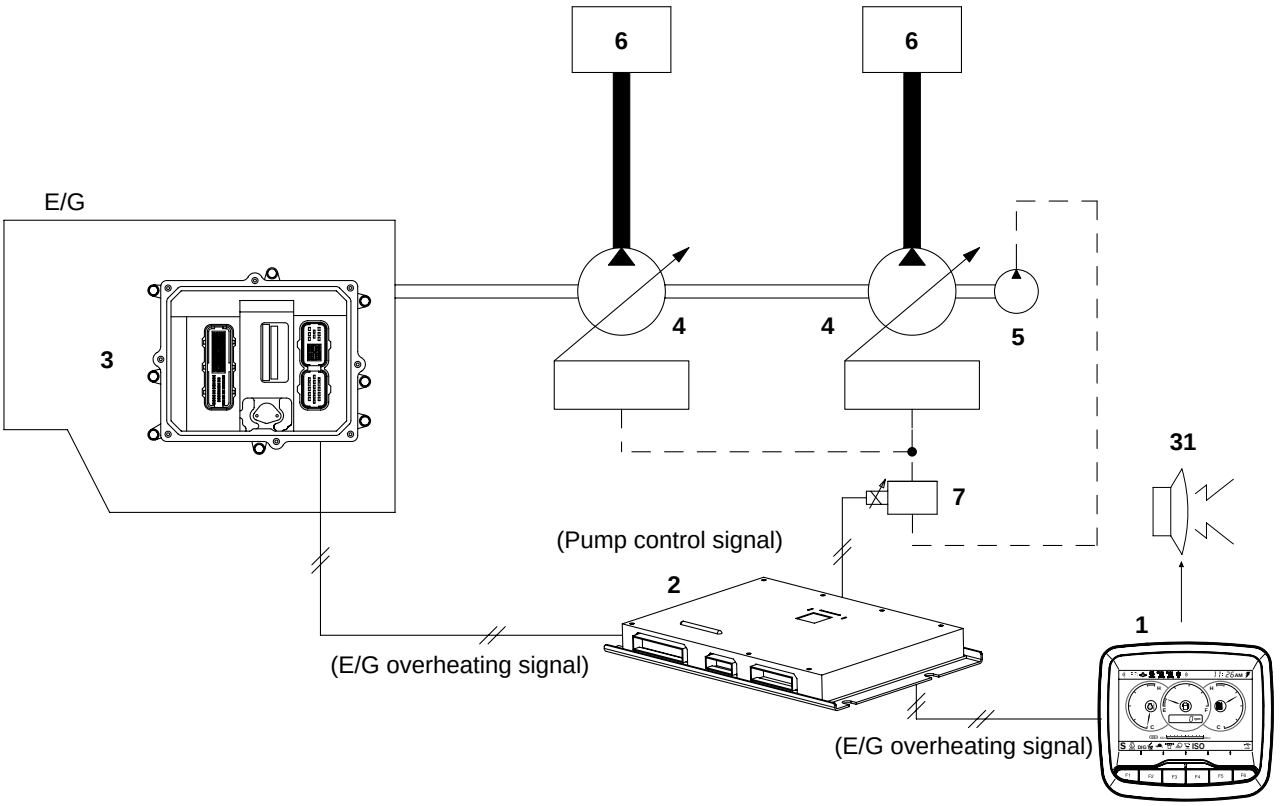
Reference Number	Description
3	Engine Controller
4	Engine Control Dial
5	Pressure Sensor

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 canceled 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 sensors in the control valve. When the work levers are in the neutral position, the sensor is below 15.5 bar.

ENGINE OVERHEAT PROTECTION SYSTEM



FG018917

Figure 166

Reference Number	Description
1	Instrument Panel
2	e-EPOS Controller
3	Engine Controller
4	Main Pump
5	Aux Pump

Reference Number	Description
6	Control Valve
10	EPPR Valve (Electromagnetic Proportional Pressure Reducing Valve)
31	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

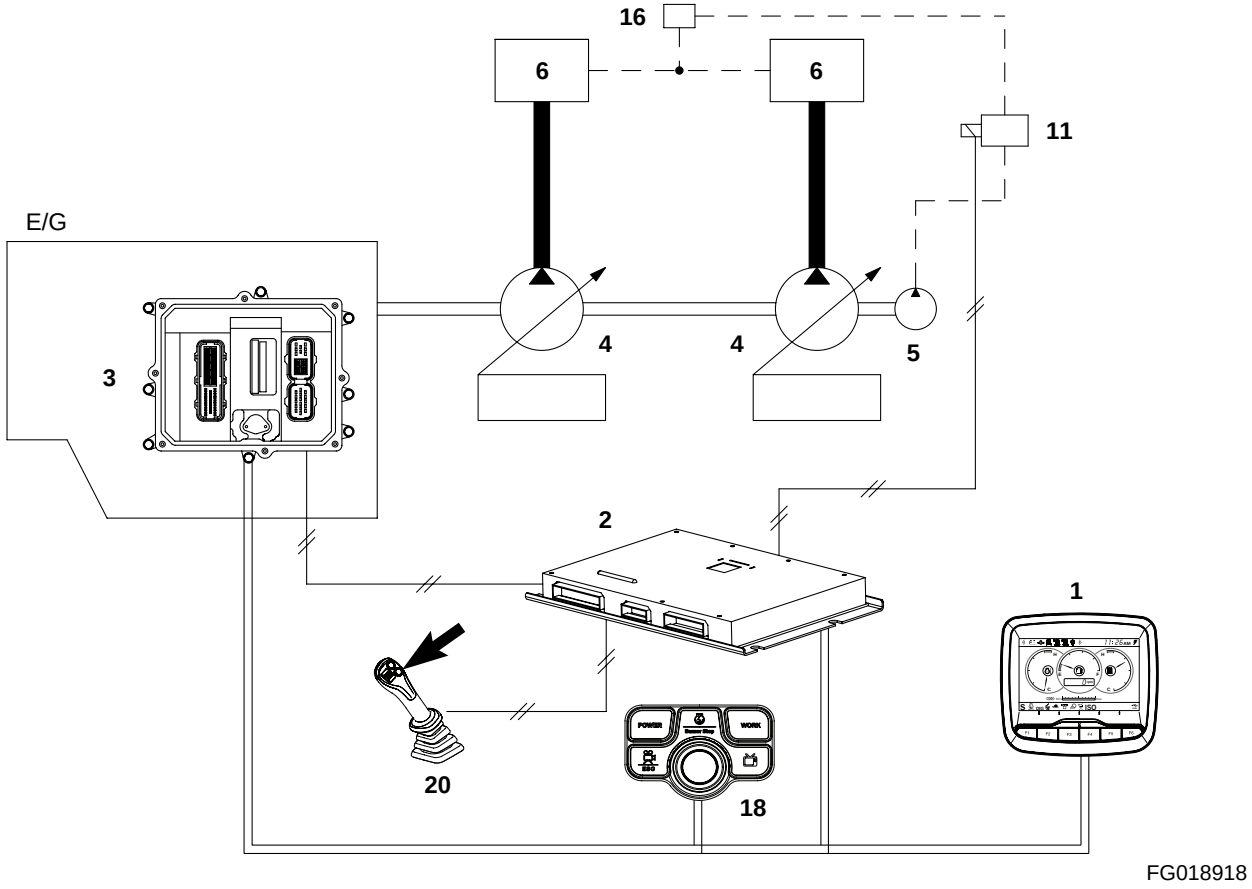


Figure 167

Reference Number	Description
1	Instrument Panel
2	e-EPOS Controller
3	Engine Controller
4	Main Pump
5	Aux Pump
6	Control Valve

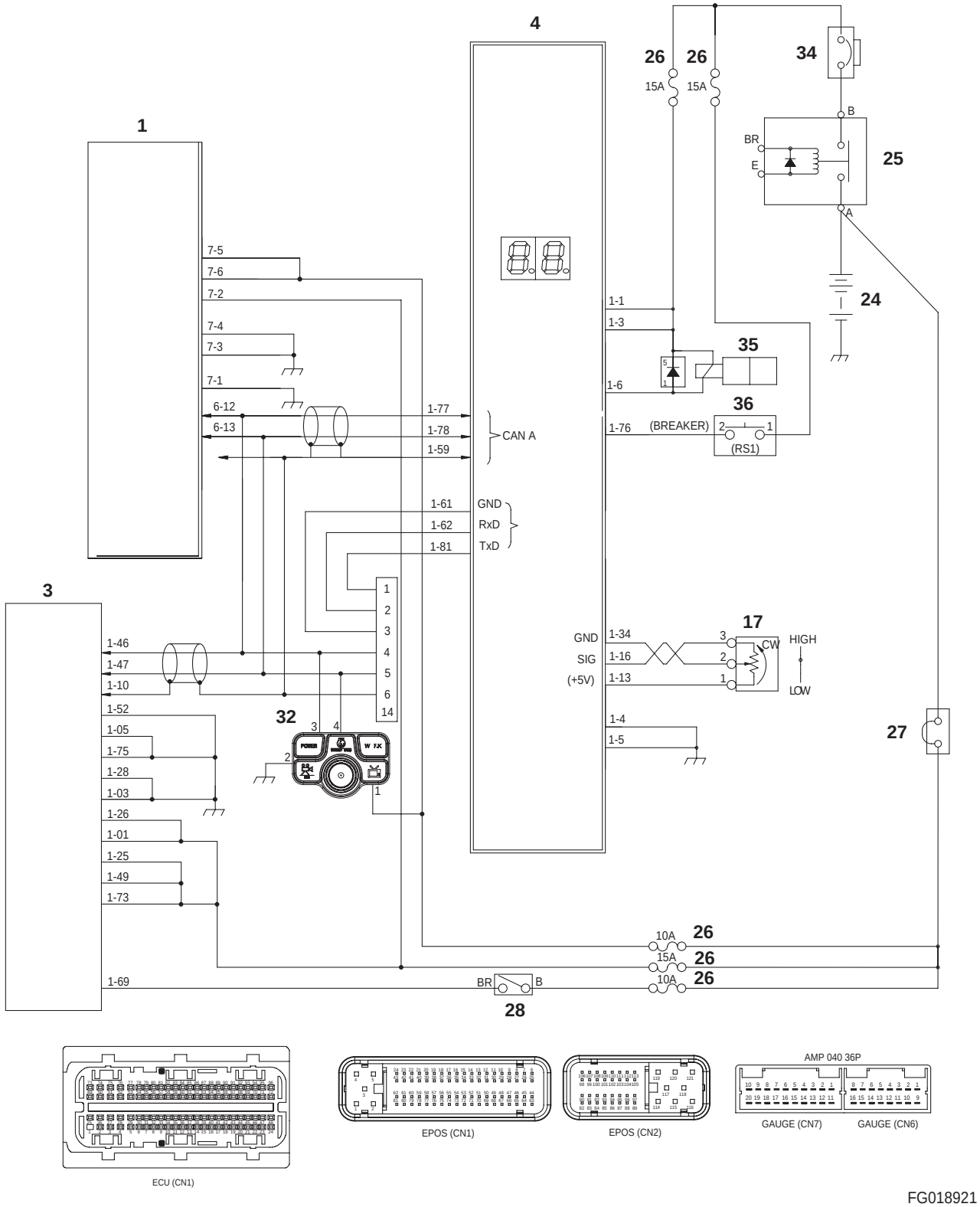
Reference Number	Description
11	Solenoid Valve (Boost)
16	Main Relief Valve
18	Jog Switch Control Panel
20	Power Boost Switch (Top of Right Work Lever)

The Power Boost function is used to temporarily increase the main relief pressure to enhance excavation ability. When the Work Mode is set to "BOOST" by the jog switch control panel and the power boost button on 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 350 to 370 kg/cm^2 (4,980 - 5,260 psi) for 7 seconds. 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



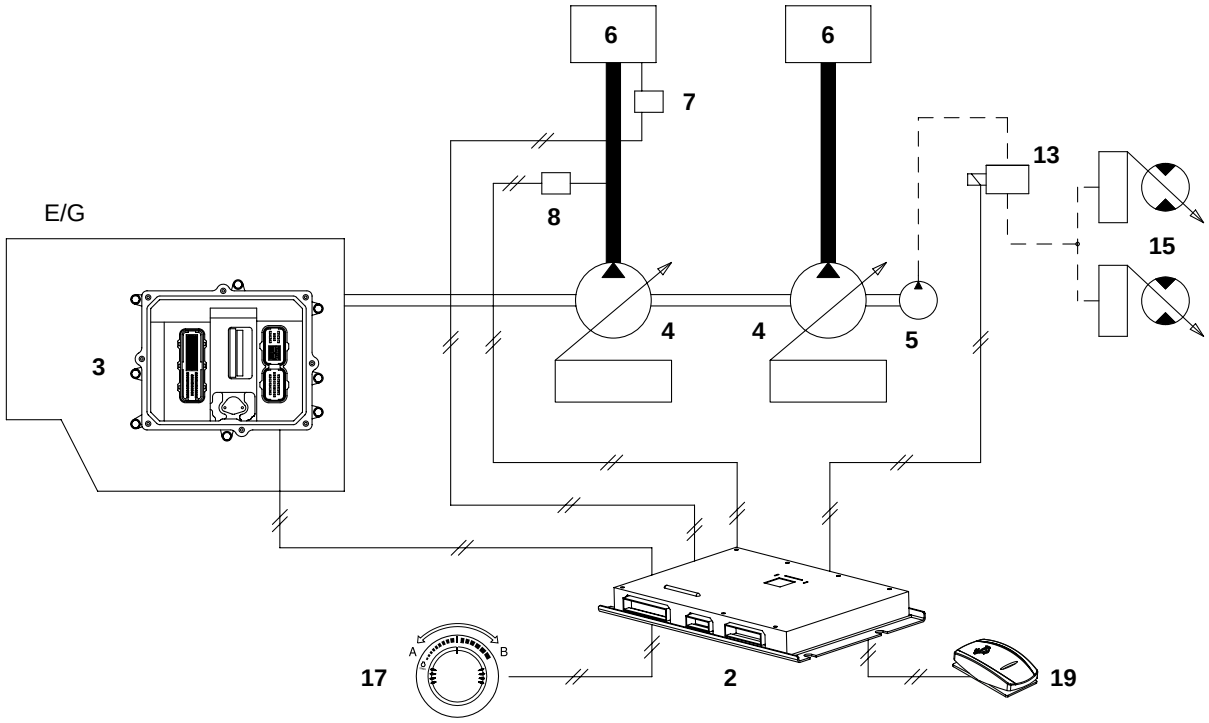
FG018921

Figure 168

Reference Number	Description
1	Instrument Panel
3	Engine Controller
4	e-EPOS Controller
17	Engine Control Dial
24	Battery
25	Battery Relay
26	Fuse
27	Fusible Link

Reference Number	Description
28	Starter Switch
32	Jog Switch Control Panel
34	Circuit Breaker
35	Solenoid Valve (Pressure Up)
36	Power Boost Switch (Top of Right Work Lever)

AUTOMATIC TRAVEL SPEED CONTROL



FG016914

Figure 169

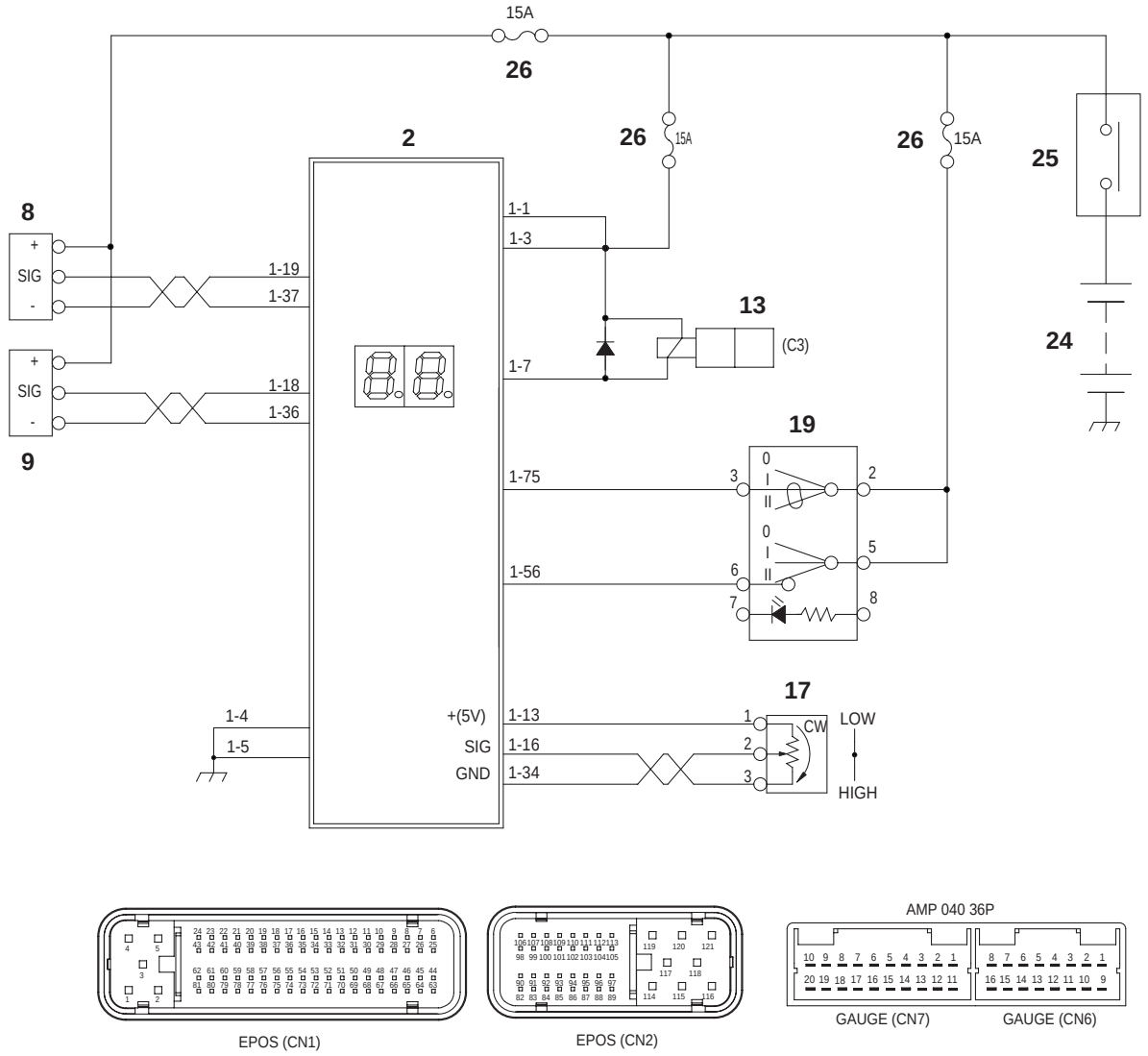
Reference Number	Description
2	e-EPOS Controller
3	Engine Controller
4	Main Pump
5	Aux Pump
6	Control Valve
7	Pressure Switch (Py Port)

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 1,400 rpm, the travel speed will be set to I-speed mode.

Automatic Travel Speed Control - Circuit Diagram



FG018931

Figure 170

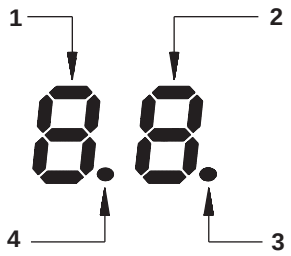
Reference Number	Description
2	e-EPOS Controller
8	Pressure Sensor (Front Pump)
9	Pressure Sensor (Rear Pump)
13	Solenoid Valve (High-speed)
17	Engine Control Dial

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 171

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		Display		System Condition
		Higher Digit	Lower Digit	
Power Mode	P+, P	 HAOH340L	FG018940	Normal Operation Power Mode
	S	 FG018938	FG018940	Normal Operation Standard Mode
	E	 HAOH350L	FG018940	Normal Operation Economy Mode
Work Mode	Digging	FG018940	 HAOH370L	Normal Operation Digging Mode
	Lift	FG018940	 FG018939	Normal Operation Lift Mode

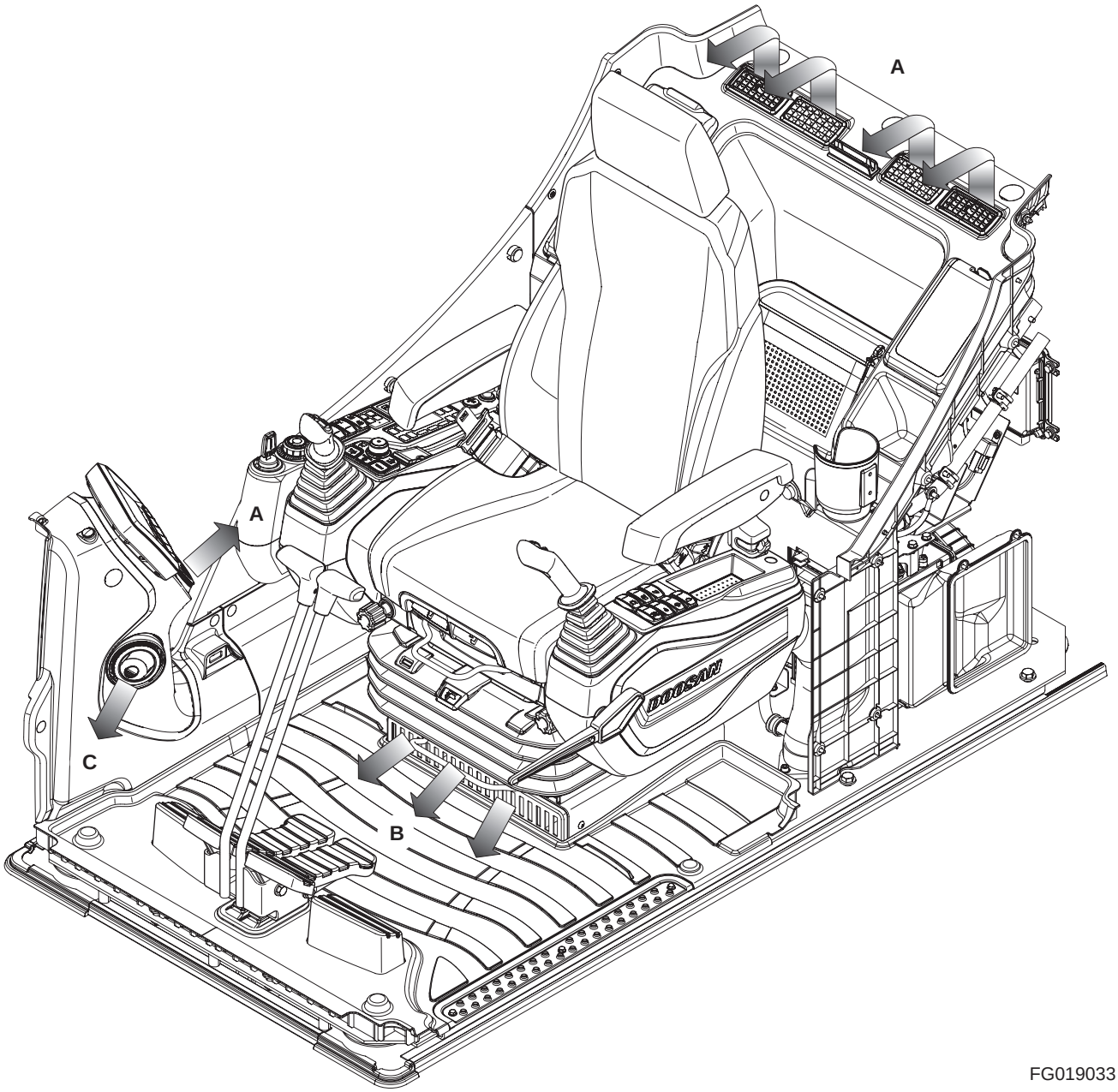
4. Communication Monitor

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



FG019033

Figure 172

Solid-type heater and air conditioner are installed in the cover behind the operator's seat.

Temperature of the operator's cabin is adjusted automatically to the temperature set by operator.

(Please refer to the Operation and Maintenance 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

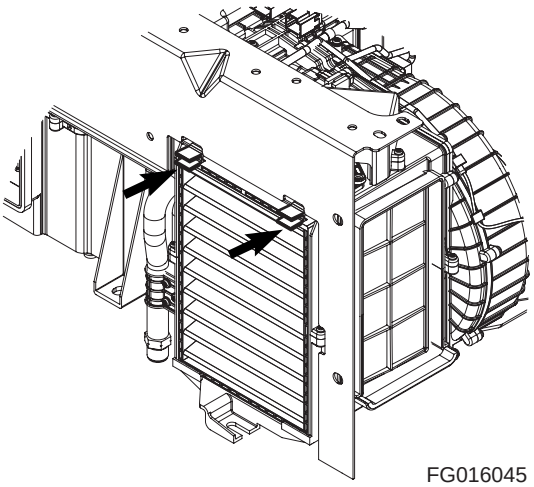
Internal and external air purification filters are installed for the operator's room.

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.

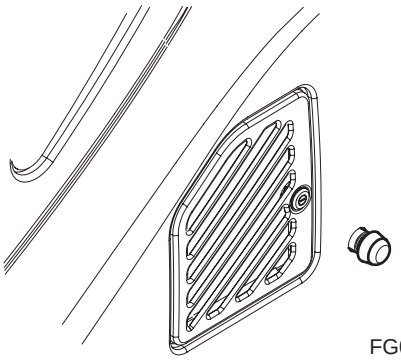


FG016045

Figure 173

How to Check External Air Filter

1. Open the door at the left side of machine and loosen four marked bolts to remove cover.



FG016043

Figure 174

2. Turn marked knobs at the rear side of the cabin to open the cover.
3. Remove 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.

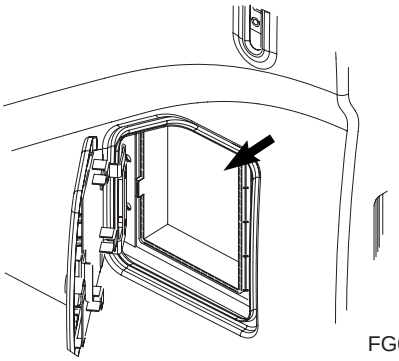
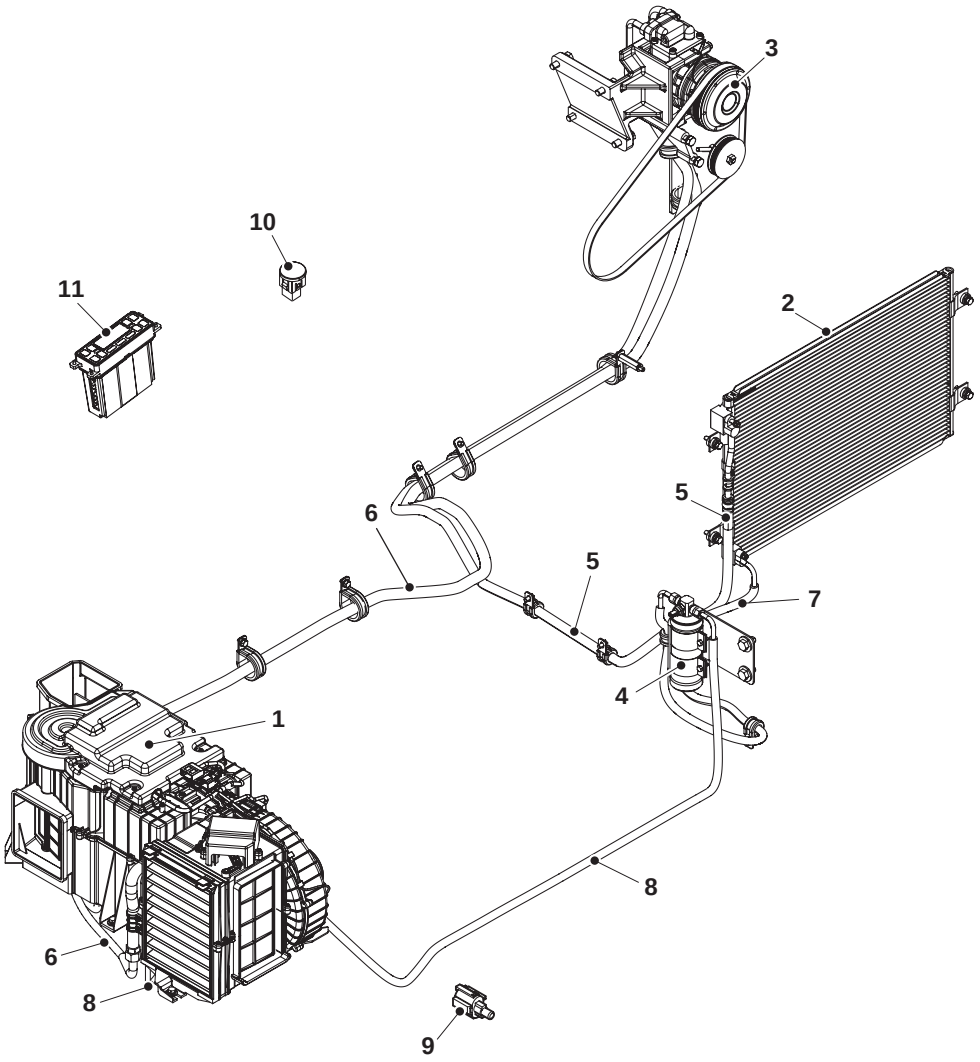


Figure 175

Air-Conditioning System Layout



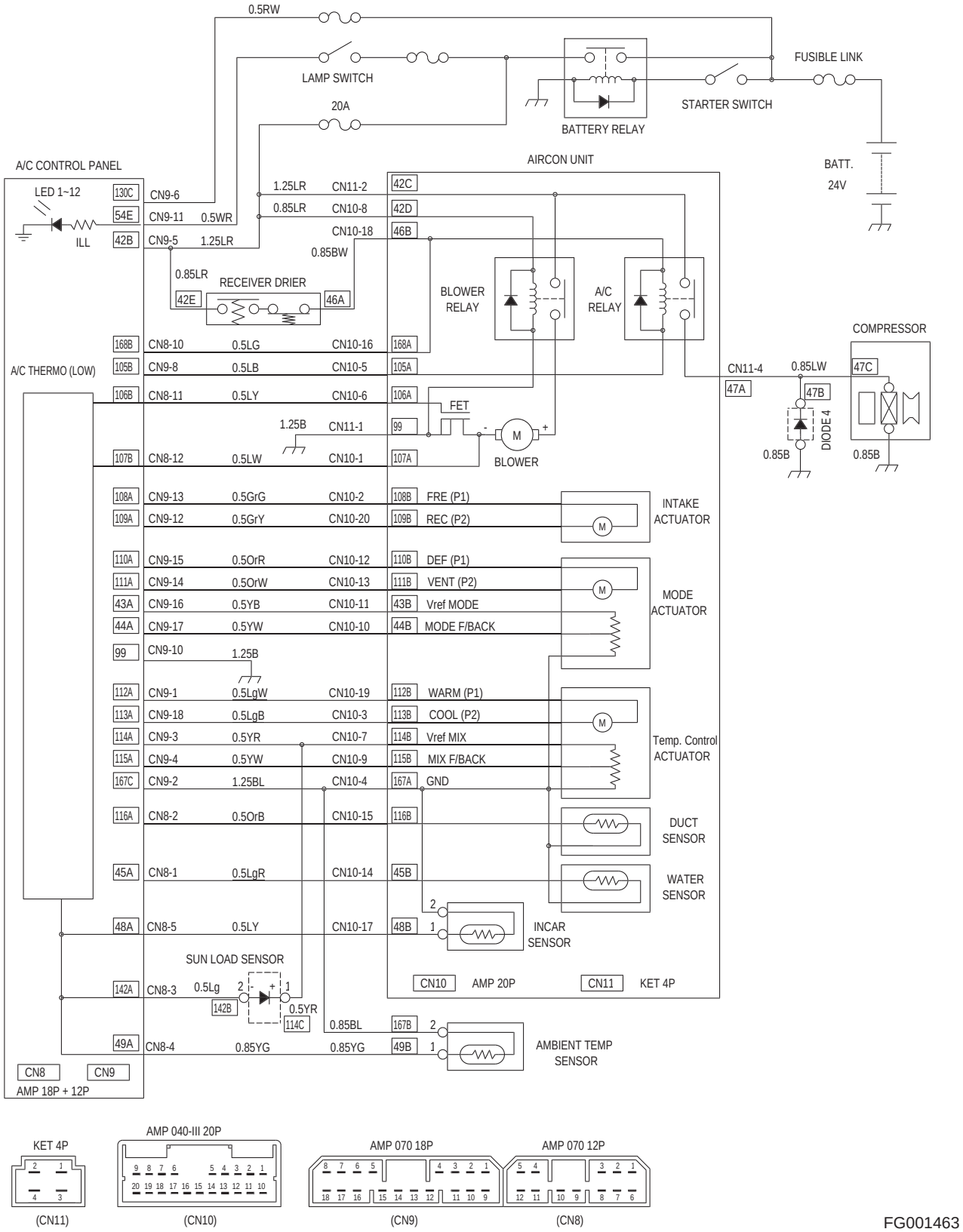
FG016941

Figure 176

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 177

Air Conditioner/heater Unit

Airflow Diagram

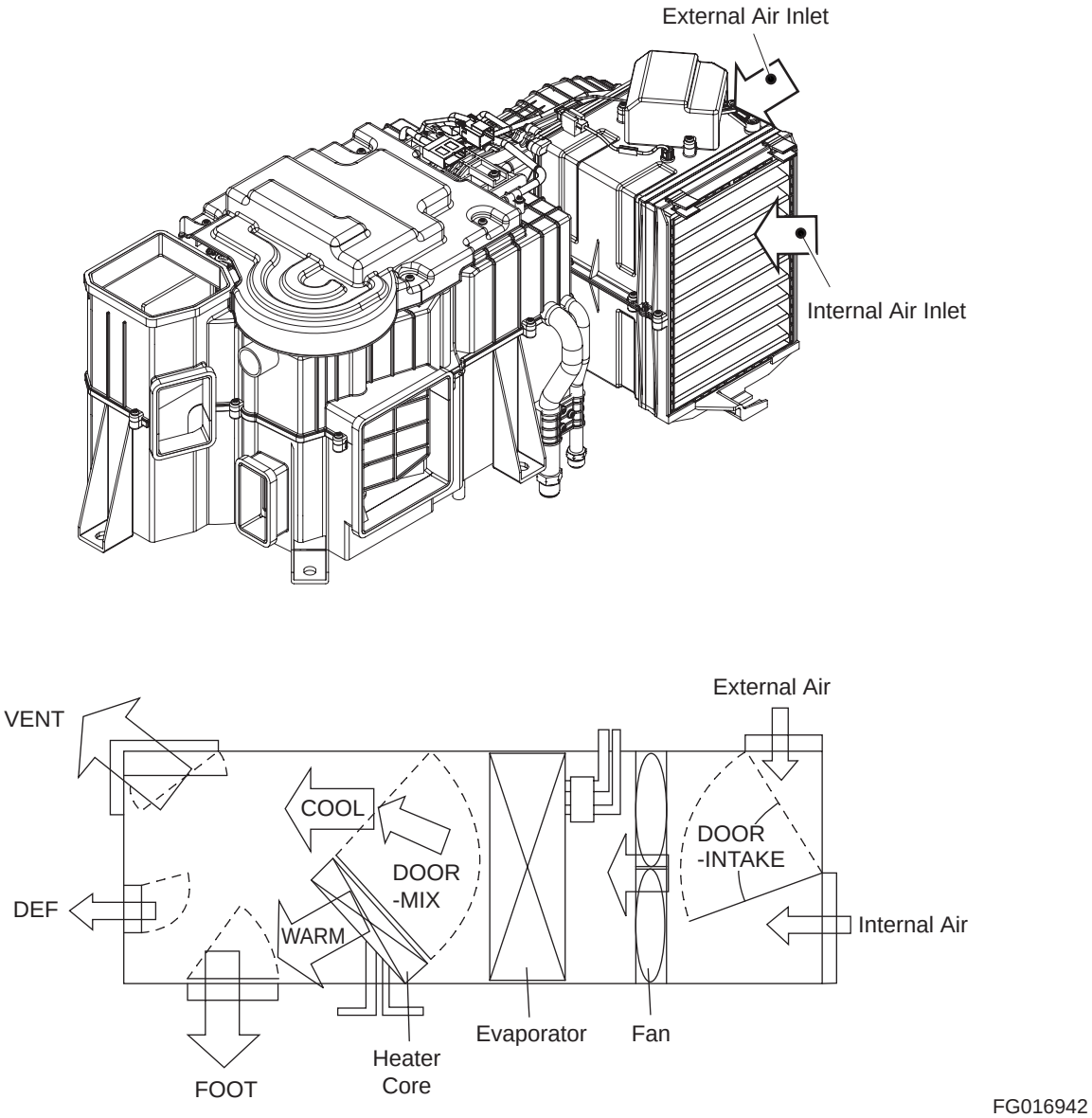
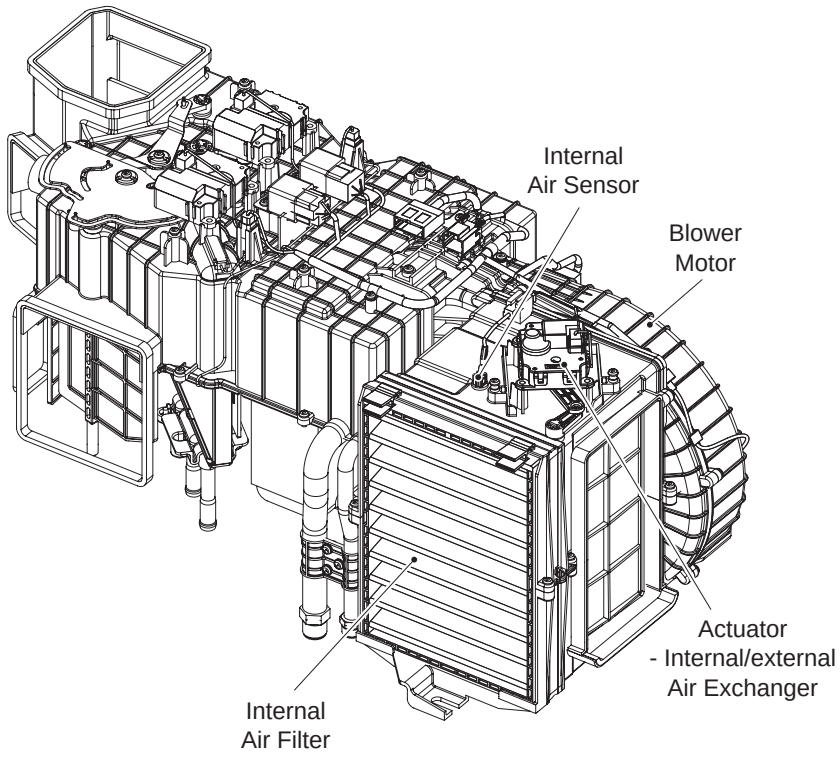


Figure 178

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



FG016943

Figure 179

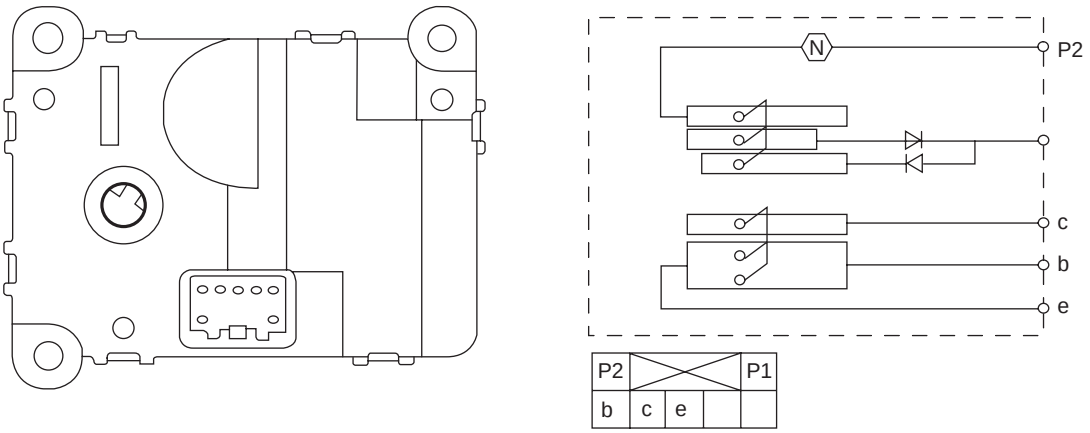
Actuator - Airflow Direction Control

Change of discharged airflow according to selected airflow direction mode

Change of airflow 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.



FG001361

Figure 180

Actuator - Airflow Direction Control

Airflow 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 b (-): CN10-4	Below 0.4V
Max heating		Above 4.5V

Actuator - Internal/external Air Exchange

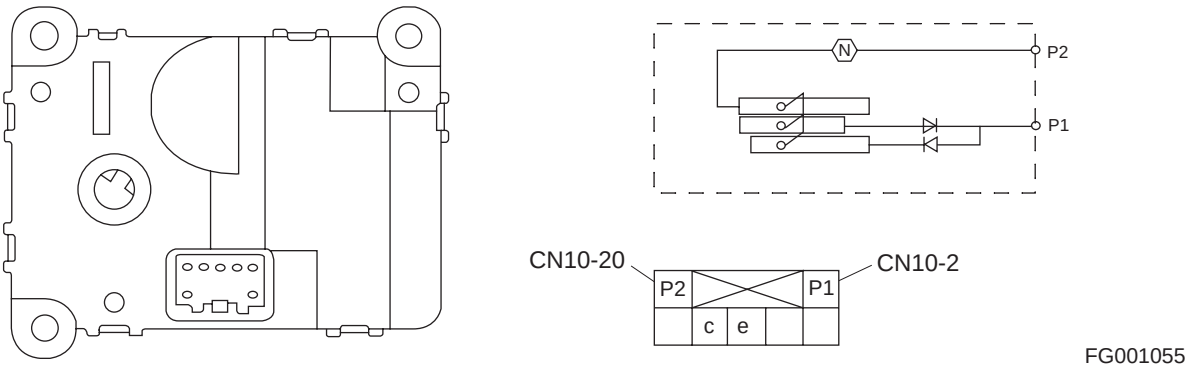


Figure 181

Mode	Output Terminal	Output
Intake	P1 (+), P2 (-)	Moving of exchange door by selecting intake.
Recirculate	P1 (-), P2 (+)	Moving of exchange door by selecting recirculate.

Airflow Control Module

Airflow is controlled through the control of voltage between GATE and SOURCE.

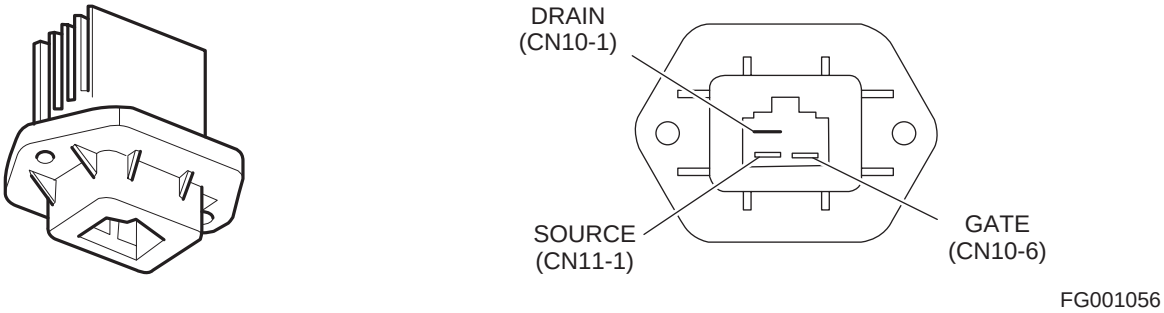


Figure 182

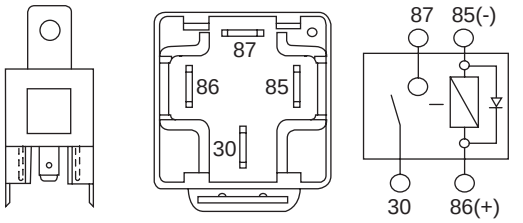
Airflow	Output Terminal		Output
1st	CN11-2	CN10-1	10 ± 0.5V
2nd			12.5 ± 0.5V
3rd			15 ± 0.5V
4th			17.5 ± 0.5V
5th			20.0 ± 0.5V
6th			22.0 ± 0.5V
7th			More than 25V

Input voltage is 27.5V.

The airflow 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

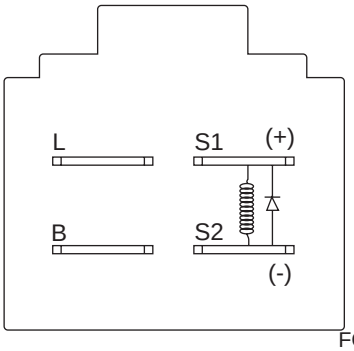


FG001057

Figure 183

Relay - A/C: Power is supplied to the magnetic clutch of the compressor.

Specifications	
Rated voltage	24V
Rated current	10A



FG001058

Figure 184

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.

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

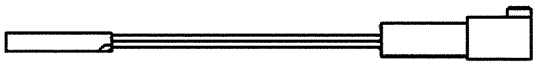


FG001059

Figure 185

Coolant Temperature Gauge 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

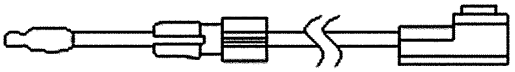


FG001060

Figure 186

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



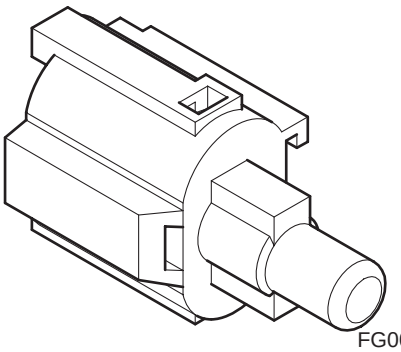
FG001061

Figure 187

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

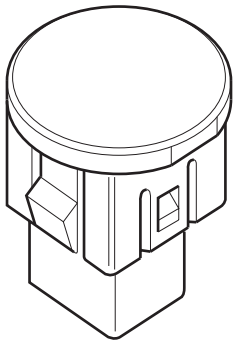


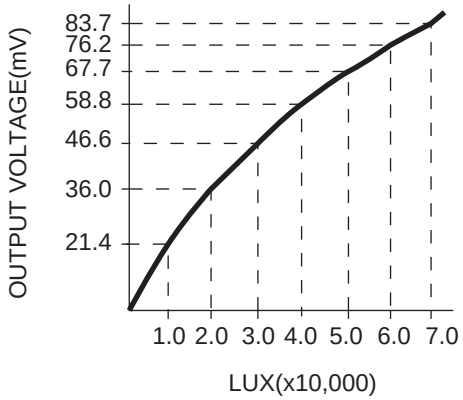
FG001064

Figure 188

Sun Sensor

Built beside the socket of spare power, it senses the quantity of the sun radiation to regulate discharge temperature and airflow as set by operator.



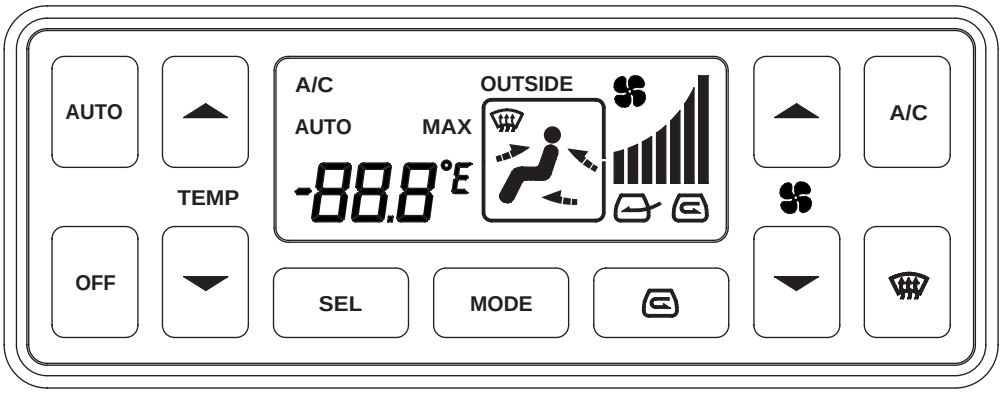


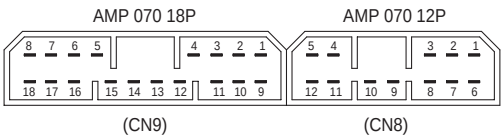
FG001062

Figure 189

Control Panel

Appearance and Terminal Arrangement





FG001063

Figure 190

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	Backup
	7	-
	8	A/C output (LOW)
	9	-
	10	Ground
	11	Illumination
	12	Intake/Recirculate (Recirculate)
	13	Intake/Recirculate (Intake)
	14	Airflow direction control (VENT)
	15	Airflow direction control (DEF.)
	16	Airflow direction control Power (5V)
	17	Airflow direction control (feedback)
	18	Temperature control (cool)

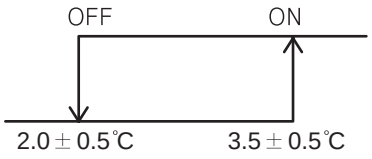
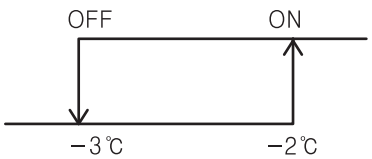
CN	Term No.	Terms
CN8	1	Coolant temperature gauge sensor
	2	Duct sensor
	3	Sun sensor
	4	Ambient air temperature sensor
	5	Internal air temperature sensor
	6	-
	7	-
	8	-
	9	-
	10	D.P.S CHECK
	11	Airflow module (gate)
	12	Blower motor (feedback)

Control Logic

<table>
<tr><th>Categories</th><th>Inputs</th><th>System Operation</th></tr>
<tr><td>AUTO</td><td>Set temperature
Internal air temperature sensor
Ambient air temperature sensor
Coolant temperature gauge sensor
Sun sensor</td><td>1. Automatically adjust room temperature as set and then next items.
Temperature, airflow direction, Recirculate/Intake, Airflow, 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.</td></tr>
<tr><td>Sensor compensation</td><td>Set temperature
Internal air temperature sensor
Ambient air temperature sensor
Coolant temperature gauge sensor</td><td>1. In case of sensor fault, the 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
Airflow 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>
</table>

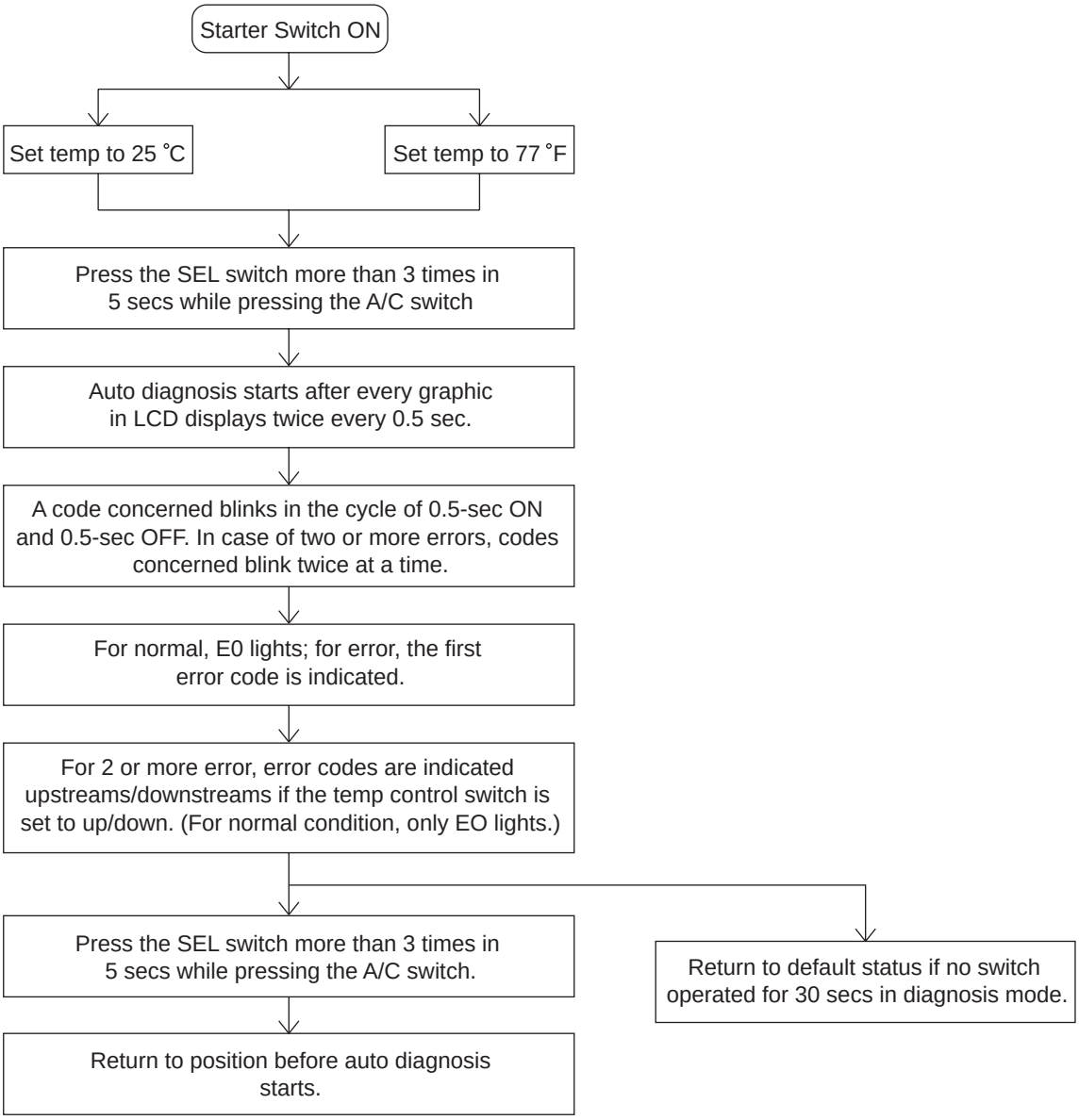
Categories	Inputs	System Operation
Starting Control of Cooling	Auto mode Duct sensor	1. Prevention of discharge of hot air before discharge temperature drops enough in hot summer weather 2. Start conditions (AND condition) A. A/C on (AUTO or manual) B. Temperature sensed by the duct sensor is above 30°C C. Airflow: 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 airflow) in 5 seconds after engine run. 5. Initial cooling control should be before max cooling. 6. Release condition (OR condition) A. A/C "OFF" B. Airflow: Manual control C. 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.

Categories	Inputs	System Operation
Starting control of heating (1)	Coolant temperature gauge sensor Internal air temperature sensor Auto mode Set Temperature	1. Start condition (AND condition) A. When airflow direction mode is one of the following modes in the Auto or manual control mode - BI-LEVEL, FOOT or FOOT/DEF B. The coolant temperature gauge sensor is stable and the coolant temperature gauge < 73°C C. Airflow: Auto mode D. Set temperature > Internal air temperature + 3°C * Airflow 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. Airflow is controlled only when the airflow direction is in the manual mode and BI-LEVEL, FOOT, or FOOT/DEF is set. 5. Control through the coolant temperature gauge sensor for start. 6. Starting control of heating (2) starts in case of fault of the coolant temperature gauge sensor during controlling. 7. Operation release (OR condition) A. Only airflow is released if it is selected manually. B. When handling the airflow direction mode switch, only airflow direction is released but the airflow control is performed only for the remaining period of the starting control of heater. C. When Max Cooling (17°C) is selected. D. Coolant temperature gauge sensor > 73°C.

Categories	Inputs	System Operation
Starting control of heating (2)	Coolant temperature gauge sensor Ambient air temperature sensor Internal air temperature sensor Auto mode	1. Entry condition (AND condition) A. Auto Mode B. Ambient air temperature < 5°C and difference between ambient and internal air temperature ≤5°C C. Failure of coolant temperature gauge sensor 2. Only one time of engine OFF →engine run 3. Starting control of heating is before max heating. 4. Operation release (OR condition) A. Airflow: Manual selection B. When handling the airflow direction mode switch, only airflow direction is released but the airflow control is performed only for the remaining period of the starting control of heater. C. Difference between internal and ambient air temperature>15°C D. 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.) * Airflow should be reduced slowly for up to 12 seconds in case of exceptional entry case.
Compressor control	Duct sensor	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. 
	External temperature sensor	1. Function: Prevention of compressor in winter. 2. Control pattern.  *Only for Auto mode.

Self-diagnossi

How to start self-diagnosis



FG001367

Figure 191

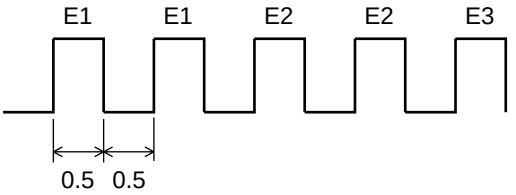
Error codes

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	Coolant temperature gauge sensor short
E10	Coolant temperature gauge sensor open
E11	D.P.S open
E12	Position error of airflow 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.



FG001067

Figure 192

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.*

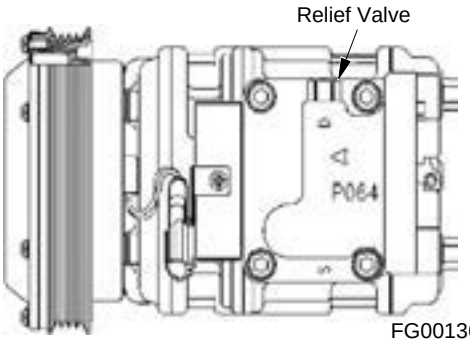
It returns automatically to default mode 5 seconds after entering the ambient air temperature display mode.

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.



FG001365

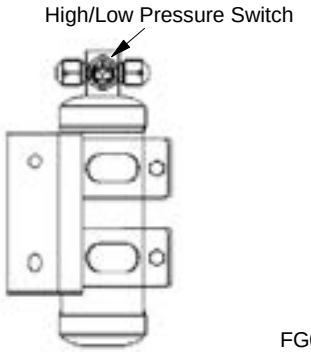
Figure 193

Receiver Dryer

The receiver dryer reserves refrigerant enough to ensure smooth freezing cycle responding immediately to the change of level in the freezing cycle.

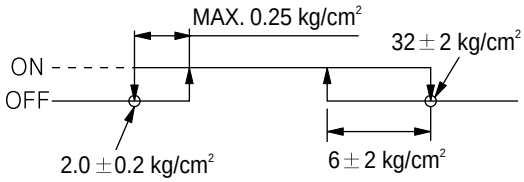
As liquid refrigerant from the condenser may contain refrigerant gas with bubbles whose presence in the expansion valve decreases the freezing power excessively, it separates liquid and gas and sends liquid only to the expansion valve.

Water in refrigerant shall be eliminated with dryer and through filter.



FG001366

Figure 194



FG001462

Figure 195

TROUBLESHOOTING

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.

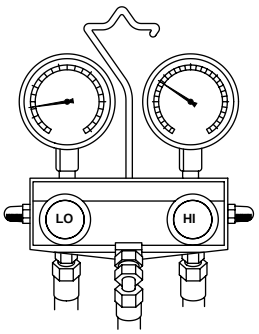


Figure 196

4. Check high / low-pressure of refrigerant.

1	**High-pressure: 8.0 - 10.0 kg/cm² (114 - 142 psi)** **Low-pressure: Approximately 1.0 kg/cm² (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/cm² (327 psi)** **Low-pressure: Approximately 2.5 - 3.0 kg/cm² (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/cm² (285 - 356 psi)** **Low-pressure: Approximately 2.5 - 3.5 kg/cm² (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 time, replace the receiver dryer.*	

4	**High-pressure: Over 6 kg/cm² (85 psi)** **Low-pressure: Approximately 760 mmHg (Negative Pressure)**		
Possible Cause: Refrigerant does not circulate			
Step	**Inspection Item**		**Remedy**
1	1. Connect manifold gauge and start engine. 2. Turn on air conditioner. 3. Set blower switch to HIGH position. 4. Turn air conditioner OFF and wait 10 minutes. 5. Recheck high / low-pressure readings. High-pressure: 13.0 - 19.0 kg/cm² (185 - 270 psi) Low-pressure: 1.5 - 3.3 kg/cm² (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/cm² (85 - 256 psi)** **Low-pressure: 500 mmHg (Negative Pressure) - Dial indicator needle unstable.**
Possible Cause: Moisture in system has iced up the expansion valve.	
NOTE: *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 time, replace the receiver dryer.*	

6	**High-pressure: Over 22.0 - 23 kg/cm² (313 - 327 psi)** **Low-pressure: 2.5 kg/cm² (36 psi)**		
Possible Cause: Refrigerant pressure problem because of defective expansion valve or temperature sensor.			
Step	**Inspection Item**		**Remedy**
1	Inspect whether the temperature sensor is installed properly.	Yes	Replace expansion valve.
		No	Exchange duct sensor.

7	**High-pressure: Over 7.0 - 11.0 kg/cm² (100 - 156 psi)** **Low-pressure: 4.0 - 6.0 kg/cm² (57 - 85 psi)**
Possible Cause: Low refrigerant pressure because of poor compressor compression.	
Inspect and replace compressor if necessary.	

WEIGHT OF R134a GAS USED IN MACHINES

Model	Weight of Gas
DX140LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX180LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX225LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX255LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX300LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX340LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX350LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX380LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX420LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX490LC-3	800 ± 20 grams (28 ± 0.7 oz)
DX530LC-3	800 ± 20 grams (28 ± 0.7 oz)

REFRIGERANT SYSTEM REPAIRS

WARNING

AVOID DEATH OR SERIOUS INJURY

Always wear safety goggles 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

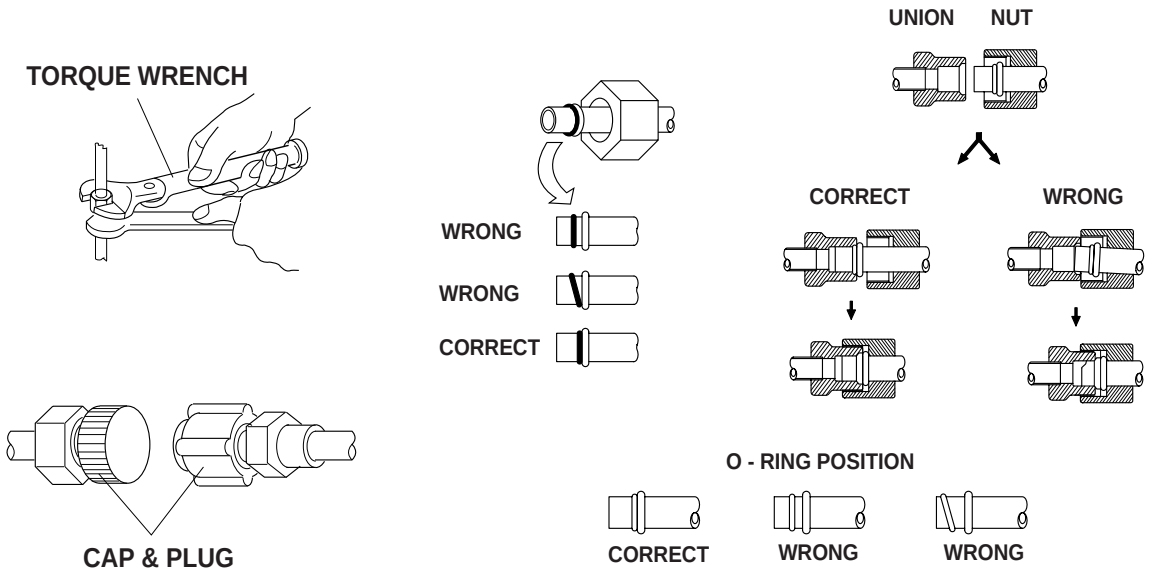


Figure 197

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 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.*

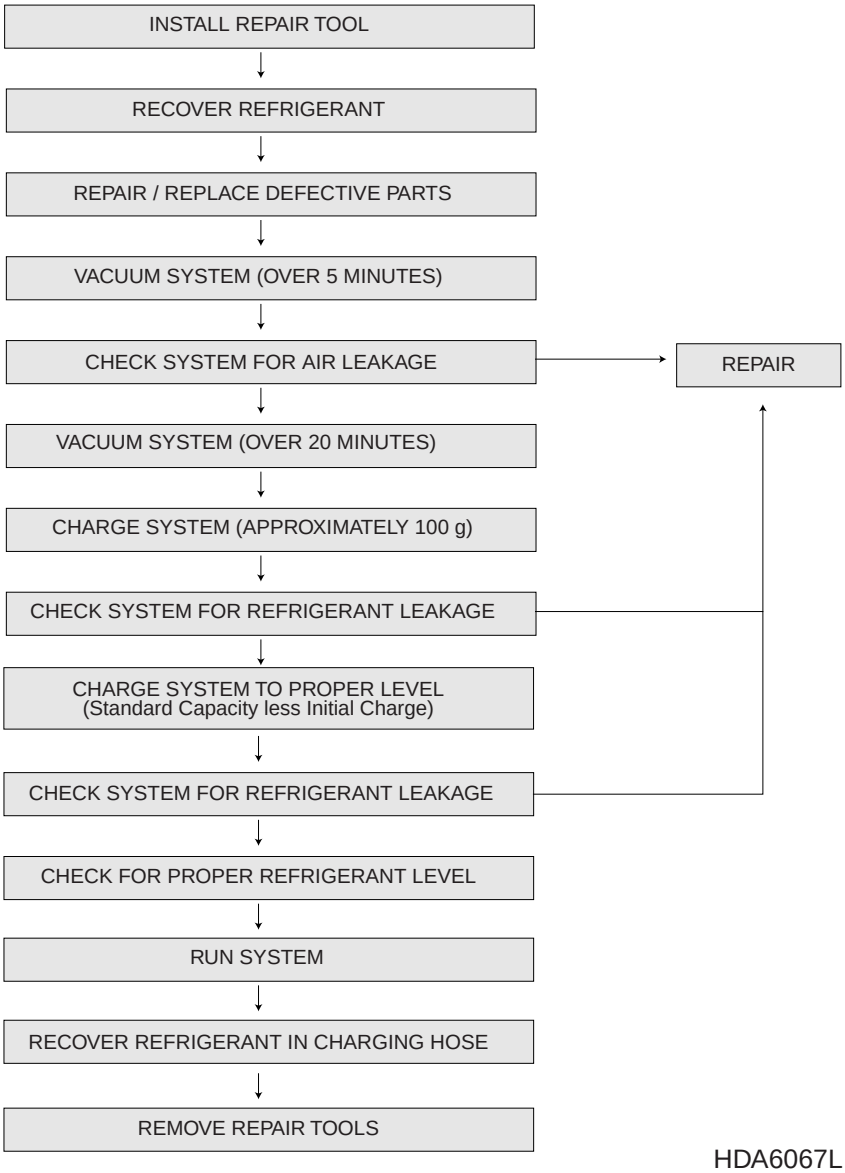
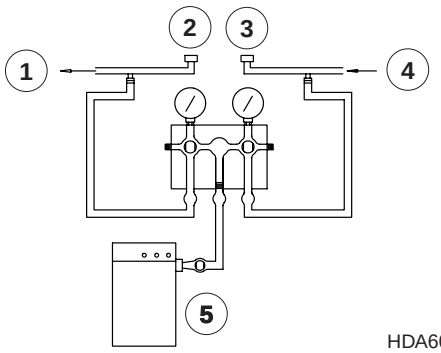

INSTALL REPAIR TOOL
RECOVER REFRIGERANT
REPAIR / REPLACE DEFECTIVE PARTS
VACUUM SYSTEM (OVER 5 MINUTES)
CHECK SYSTEM FOR AIR LEAKAGE
REPAIR
VACUUM SYSTEM (OVER 20 MINUTES)
CHARGE SYSTEM (APPROXIMATELY 100 g)
CHECK SYSTEM FOR REFRIGERANT LEAKAGE
CHARGE SYSTEM TO PROPER LEVEL
(Standard Capacity less Initial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

Figure 198

Refrigerant Recovery

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



HDA6067L

Figure 199

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.

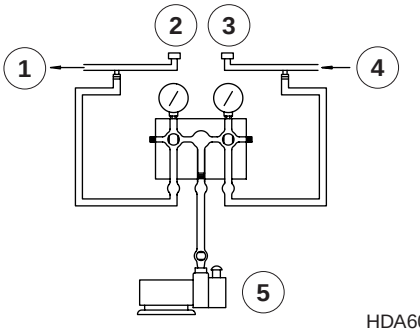
   NOTE: *Open the valve slowly, while checking to see that refrigerant is not leaking out.*

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 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



HDA6068L

Figure 200

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 low-pressure gauge dial reads approximately 750 mmHg.

   C. Close both valves and stop the vacuum pump.

4. Installation of Refrigerant Container

Reference Number	Description
1	Handle
2	Hose Connection
3	Mounting Disk

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

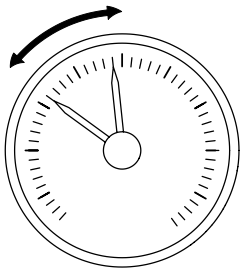
   B. Attach the manifold gauge center hose to the valve assembly.

   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.

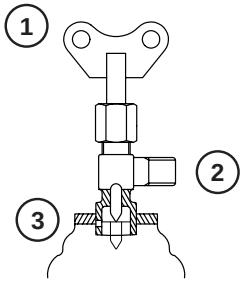
   E. Once the can has been punctured, turn the handle in the counterclockwise direction so the refrigerant can flow into the manifold gauge center hose. Now, do not open the low and high-pressure valves of the manifold gauge.

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



HDA6069L

Figure 201



HDA6070L

Figure 202

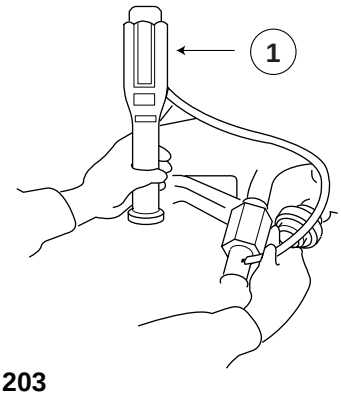
Leakage Check

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

1. After attaching the manifold gauge, open the high side valve.
2. Charge system until 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.



HDA6071I

Figure 203

WARNING

AVOID DEATH OR SERIOUS INJURY

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

Refrigerant Charging

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

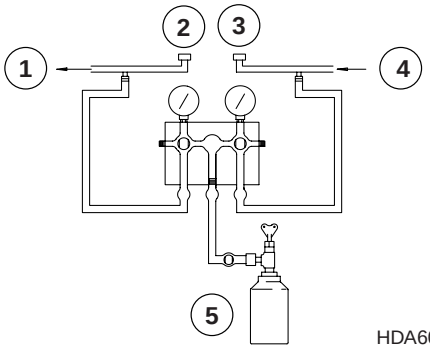
   NOTE: *First charge the refrigerant system with 100g (3.5 ounces) of refrigerant with the engine off. Then using the manifold gauges as a guide fully charge the system with the engine running.*

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

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

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

   Initial charge amount: 100 g (3.5 ounces).



HDA6072L

Figure 204

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

AVOID DEATH OR SERIOUS INJURY

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.*

IMPORTANT

- **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.**

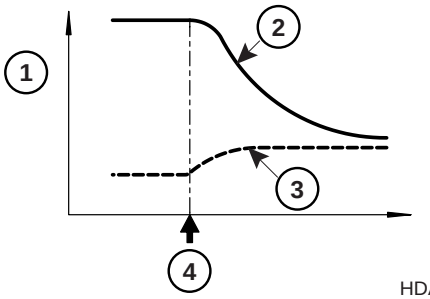
5. Close low-pressure side valve.
6. Shut off engine and close refrigerant supply container adapter valve. Disconnect manifold gauge hoses from machine.

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 an accurate test.*

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



HDA6073L

Figure 205

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.

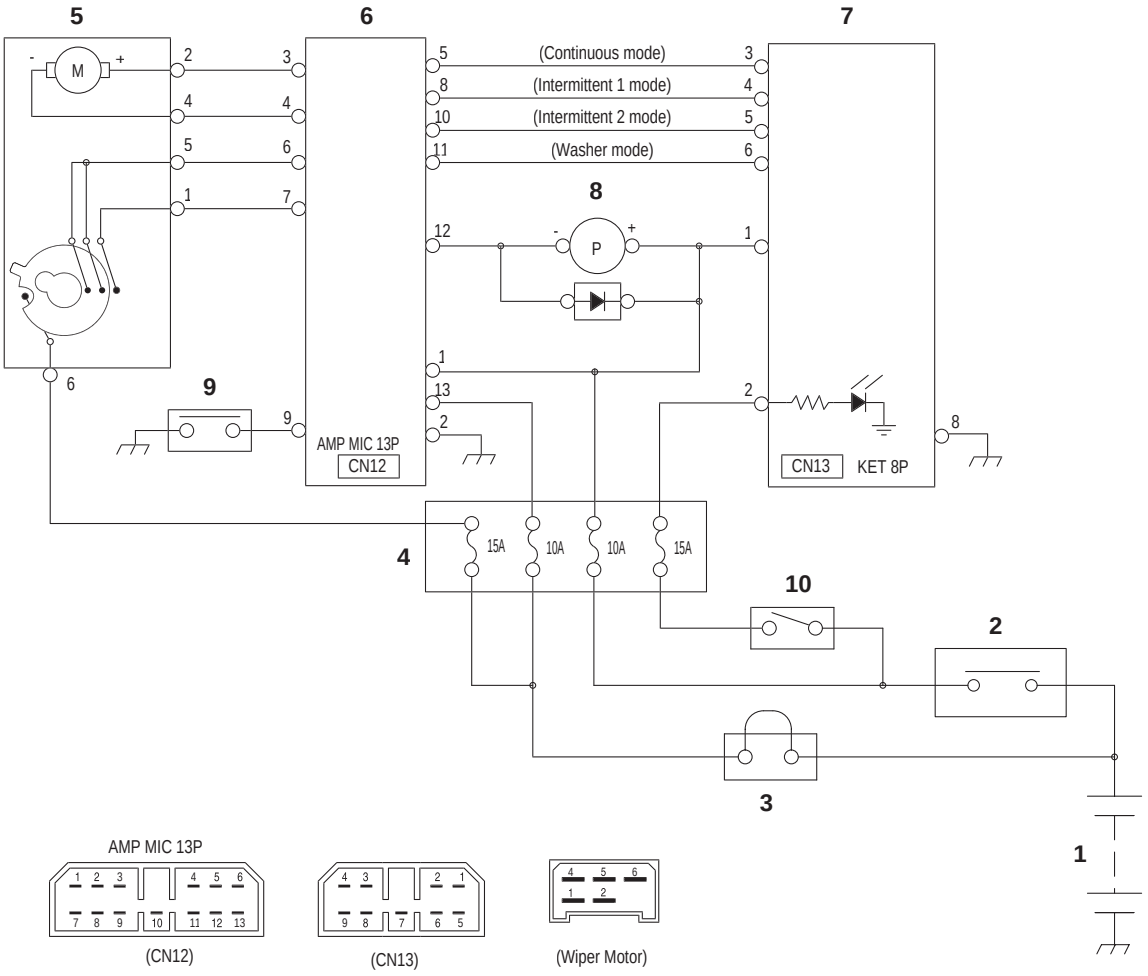
6. Interior of air-conditioning unit.

   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 206

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 current flows by 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 by 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 ±0.5 V) to LOW (0+0.5 V) 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 ±0.5 V) to LOW (0+0.5 V) 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.

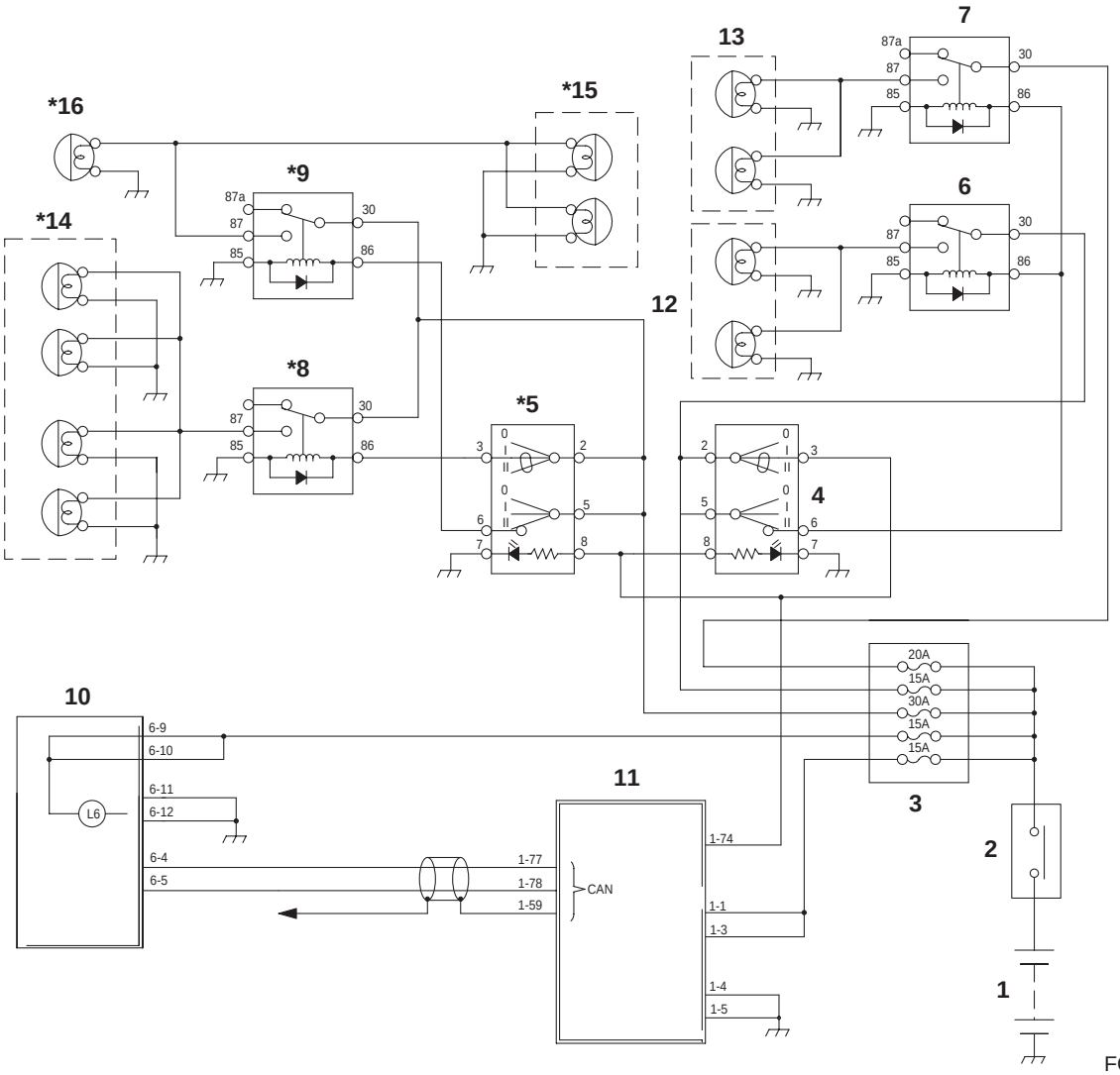
- Stopping the intermittent action

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



FG018942

Figure 207

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

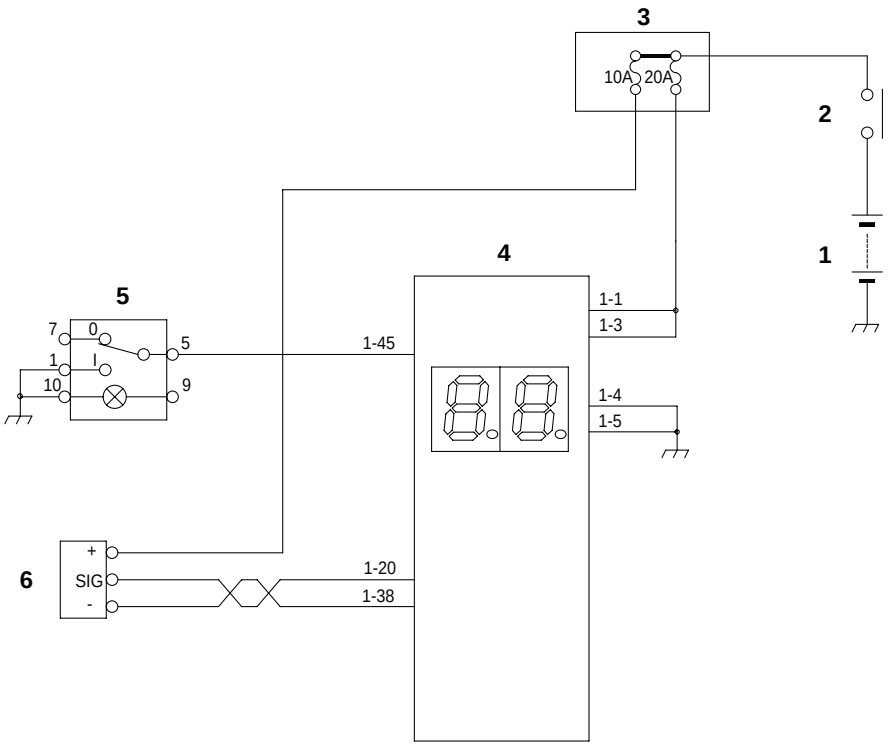
The lighting system is consists of headlights, work lights, cabin lights (optional), relays and switches.

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



FG018950

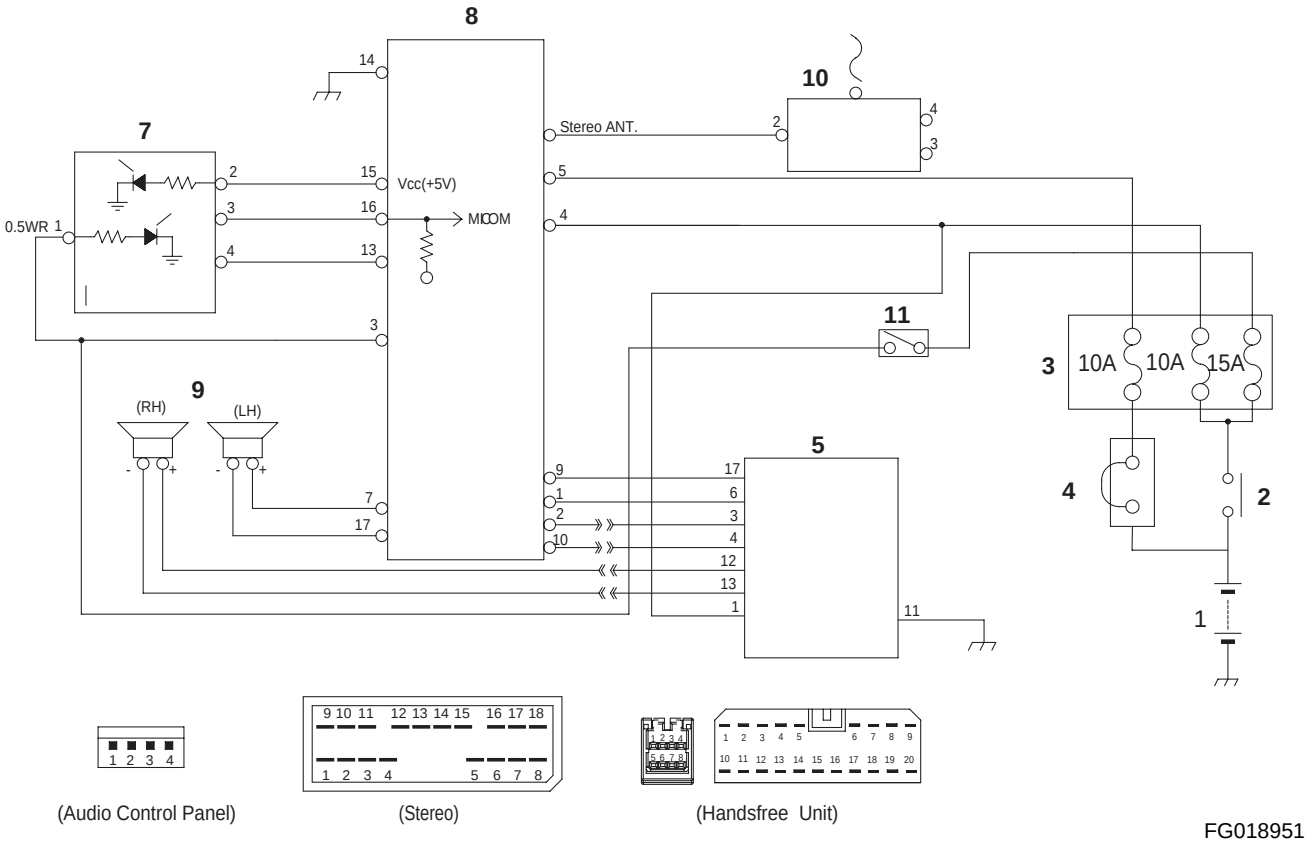
Figure 208

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



FG018951

Figure 209

Reference Number	Description
1	Battery
2	Battery Relay
3	Fuse Box
4	Fusible Link
5	Hands-free Unit

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

Edition 1

MEMO

Table of Contents

Electrical Schematic

Safety Instructions 5
Applicable Models 5
DX140LC-3/DX180LC-3/DX225LC-3/
DX255LC-3 7

MEMO

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

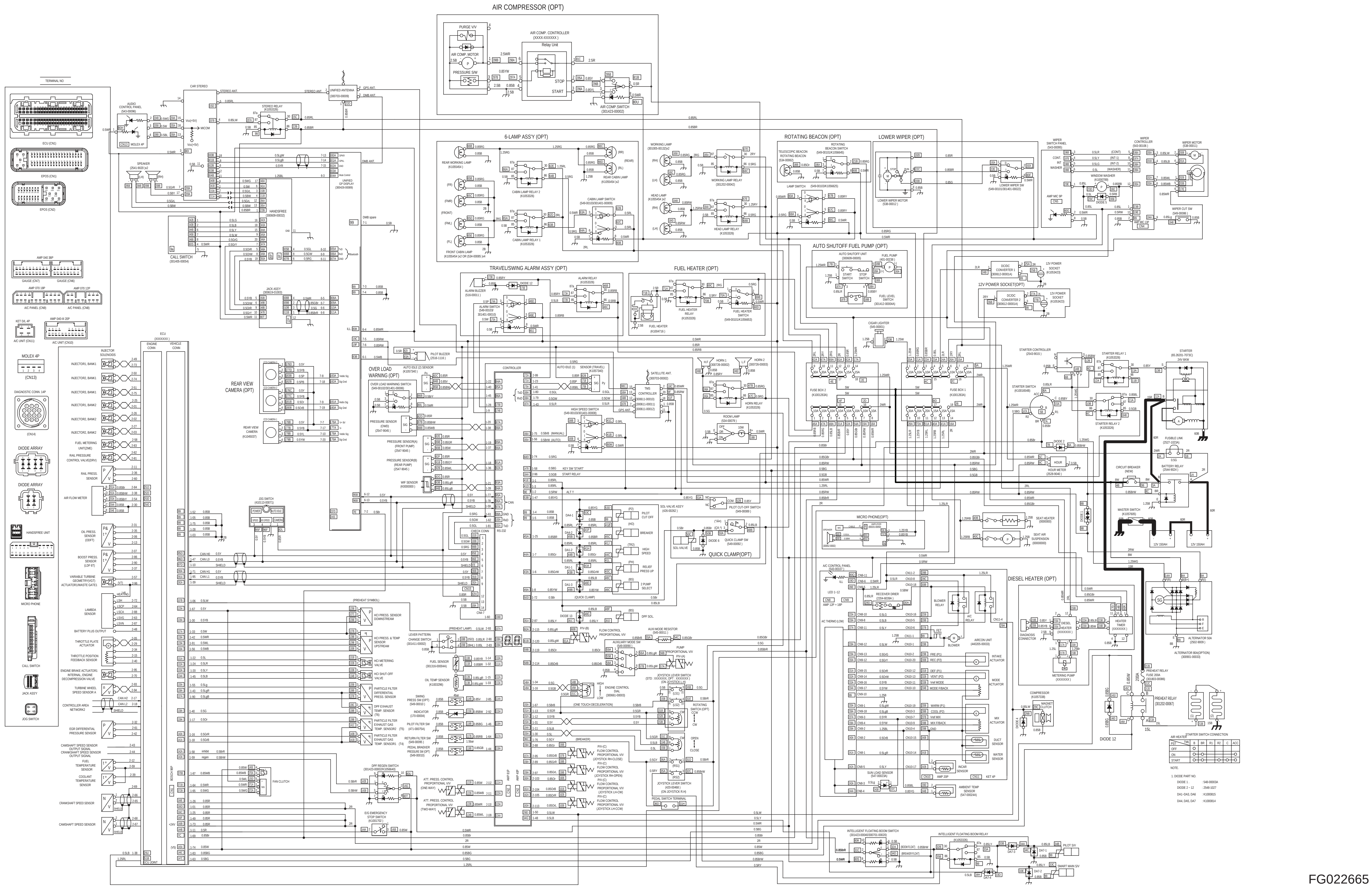
Instructions are necessary before operating or servicing machine. Read and understand the Operation and Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up

DX140LC-3/DX180LC-3/DX225LC-3/DX255LC-3



FG022665

Figure 1

Attachments

Boom and Arm

Edition 1

Table of Contents

Boom and Arm

Safety Instructions 5
Applicable Models 5
Front Attachment Pin Specifications 6
DX225LC-3 7
Front Attachment - Removal and Installation 8
Arm Removal Procedure 8
Boom Removal Procedure 10
Installation 11
Arm Installation Procedure 11
Boom Installation Procedure 11
Start-up Procedures 12

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX225LC-3	1001 and Up, 50001 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.*

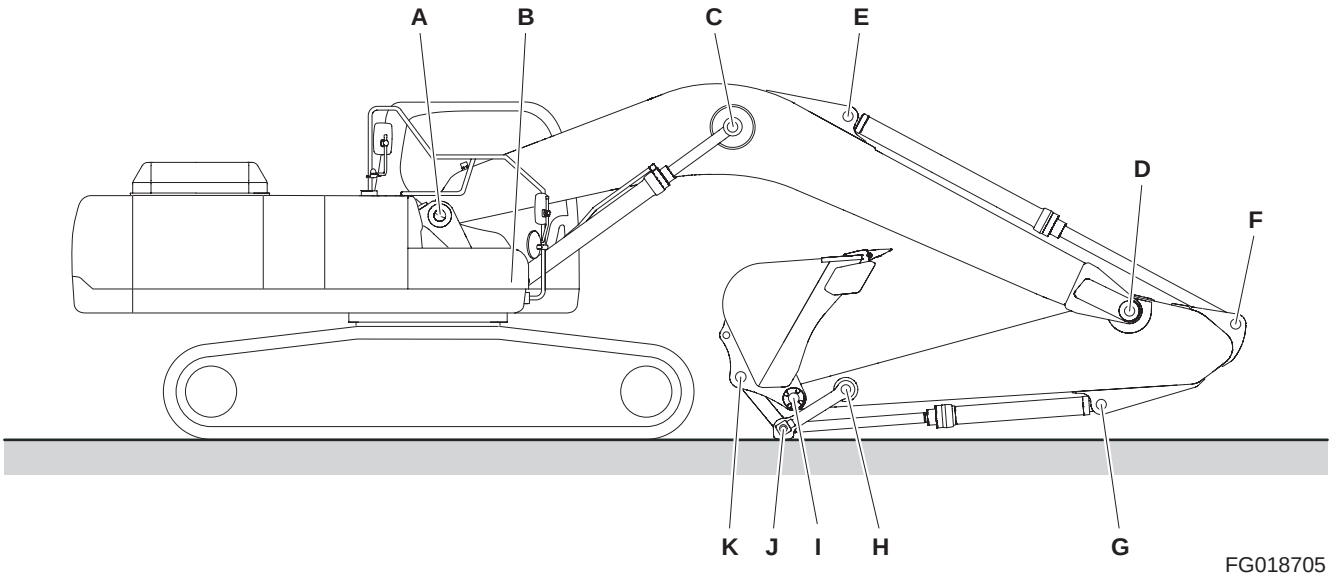


Figure 1

Mark	Measuring Part	Criteria					Remedy
		Standard Size	Tolerance		Standard Clearance	Clearance Limit	
			Pin	Hole			
A	Boom Foot	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 - 0.33	1.5	Replace
B	Boom Cylinder Head	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	1.5	
C	Boom Center	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	1.5	
D	Boom End	90 mm (3.543")	-0.10 -0.15	+0.18 +0.03	0.13 - 0.33	1.5	
E	Arm Cylinder Head	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	1.5	
F	Arm Cylinder Rod	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	1.5	
G	Bucket Cylinder Head	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	1.5	
H	Arm Link	71 mm (2.795")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	2.0	
I	Arm End	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	2.0	
J	Bucket Cylinder Rod	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	2.0	
	Push Link_Guide Link			+0.18 +0.03	0.09 - 0.29	2.0	
K	Push Link to Bucket	80 mm (3.150")	-0.06 -0.11	+0.18 +0.03	0.09 - 0.29	2.0	

FRONT ATTACHMENT - REMOVAL AND INSTALLATION

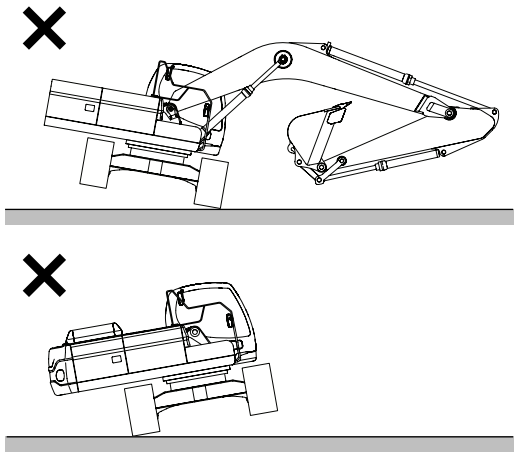
WARNING

AVOID DEATH OR SERIOUS INJURY

Removal of the counterweight from the machine, front attachment or any other part, can affect the stability of the machine. This could cause unexpected movement, and result in death or serious injury.

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.



FG018594

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

AVOID DEATH OR SERIOUS INJURY

This procedure is intended for routine removal or replacement of the attachment by ONLY authorized and trained service persons. Call you local Doosan distributor for assistance.

DO NOT allow other personnel to go under the boom, arm or attachment sections, if not properly supported.

Keep away from pressurized hydraulic lines to prevent death or serious injury from high-pressure oil.

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 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

AVOID DEATH OR SERIOUS INJURY

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 (weighs approximately 1,430 kg (3,153 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 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 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.

IMPORTANT

To make sure that polished surfaces of cylinder rod ends are not damaged 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 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 upper structure 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

AVOID DEATH OR SERIOUS INJURY

If either the front attachment or counterweight has been removed, stability of the excavator will be affected. Never travel with the excavator, swing the upper structure or drive over uneven or sloping terrain if one of these components have been removed. Tipping or a rollover could result in death or serious injury.

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

AVOID DEATH OR SERIOUS INJURY

Before assembling the front attachment, make sure that individual boom, arm and bucket sections are all compatible for work intended. Refer to the Safety Section, 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.

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 sling from around the rod end arm cylinder pin, withdraw the pin and lift the body of the arm cylinder to repin 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.

Bucket

Edition 1

Table of Contents

Bucket

Safety Instructions 5
Applicable Models 5
Bucket Tooth Inspection and Replacement 6
Bucket O-ring Replacement 7
Attachments 9
Bucket Replacement and Reversal 9
Replacement 10
Reversal 11

SAFETY INSTRUCTIONS

WARNING

AVOID DEATH OR SERIOUS INJURY

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

APPLICABLE MODELS

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

MODEL	SERIAL NUMBER RANGE
DX140LC-3	1001 and Up, 50001 and Up
DX180LC-3	1001 and Up, 50001 and Up
DX225LC-3	1001 and Up, 50001 and Up
DX255LC-3	1001 and Up, 50001 and Up

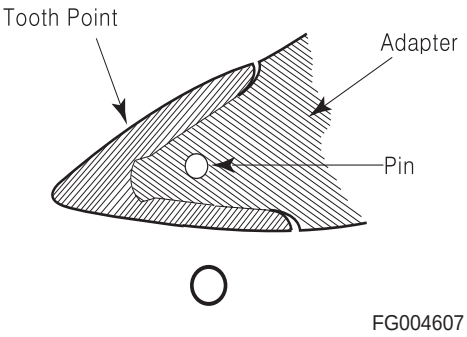
BUCKET TOOTH INSPECTION AND REPLACEMENT

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.

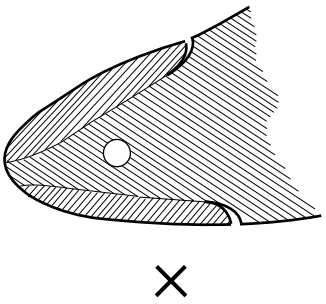
Look for the following indications of wear or damage:

- 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 pinhole.
- 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.



FG004607

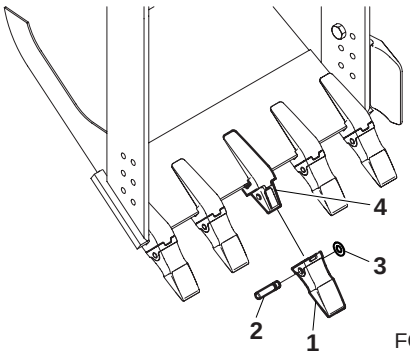
Figure 1



HDO5057I-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 bucket adapter is exposed. See Figure 2.
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 lock washer seats in the locking groove.



FG000346

Figure 3

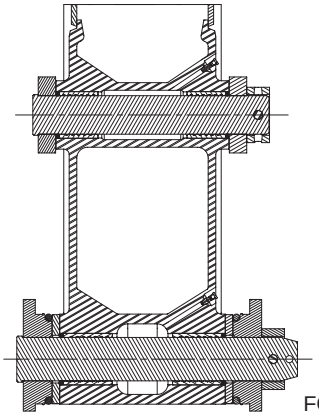
BUCKET O-RING REPLACEMENT

WARNING

AVOID DEATH OR SERIOUS INJURY

Prevent injury from flying metal objects. Always wear safety helmet, protective gloves and eye protection when changing pins.

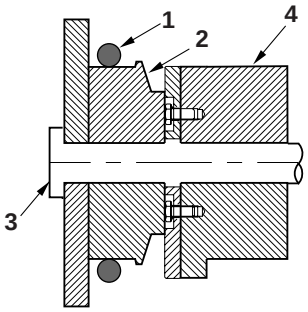
1. Inspect the bucket O-rings on a routine basis. If worn or damaged, replacement is necessary.



FG019862

Figure 4

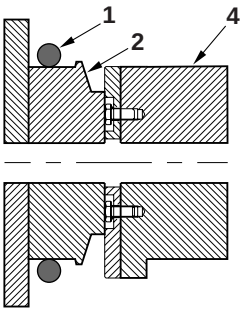
2. Roll the old O-ring (1, Figure 5) onto the boss (2) around the bucket pin (3). Remove bucket pin and move the arm or bucket link (4) out of the way.



FG019071

Figure 5

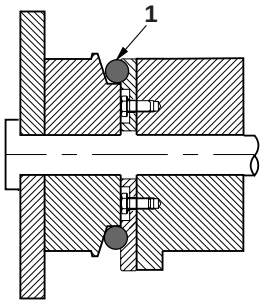
3. Remove old O-ring and temporarily install the new O-ring (1, Figure 6) onto the bucket boss (2). Make sure that O-ring groove on both the bucket link (4) and boss have been cleaned.
4. Realign the arm or link with the bucket pinhole and insert the bucket pin (3, Figure 5).



FG019074

Figure 6

5. Roll the new O-ring (1, Figure 7) into the O-ring groove.



FG019075

Figure 7

ATTACHMENTS

Bucket Replacement and Reversal

WARNING

AVOID DEATH OR SERIOUS INJURY

When pins are knocked in with a hammer, pieces of metal may fly and cause serious injury.

When carrying out this operation, always wear goggles, hard hat, gloves, and other protective equipment.

When the bucket is removed, place it in a stable condition.

If pins are hit with a strong force, there is a hazard that pin may fly out and injure people in the surrounding area. Make sure that there is no one in the surrounding area before starting the operation.

When removing the pins, do not stand behind the bucket. In addition, be extremely careful not to put your foot under the bucket while standing at the side for the work.

When removing or inserting pins, be extremely careful not to get your fingers caught.

Never insert your fingers into the pinholes when aligning the holes.

Stop the machine on a firm and flat surface and do the work. When performing joint work, appoint a lead and follow that person's instructions and signals.

Replacement

1. Place the bucket in contact with a flat surface.

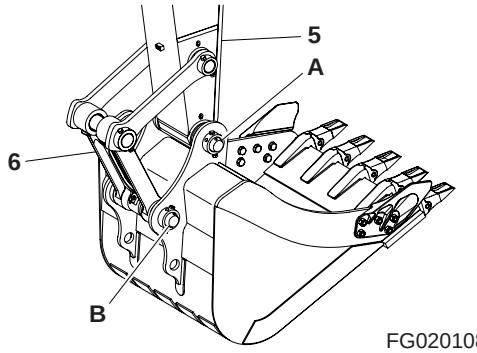
IMPORTANT

When removing the pins, place the bucket so it is in light contact with the ground.

If the bucket is lowered strongly to the ground, the resistance will be increased and it will be difficult to remove pins.

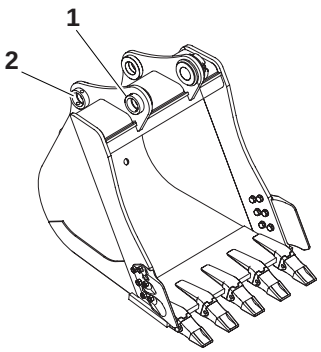
After removing the pins, make sure that mud or sand does not get on them. Dust seals are fitted at both ends of the bushings, be careful not to damage them.

2. Remove the double nut on the stopper bolt for arm pin (A) and link pin (B), remove the bolt, pull out arm pin (A) and link pin (B), and then remove the bucket.
3. Align the arm (5) with holes (1) of the replacement bucket and the link (6) with holes (2), then insert grease-coated pins (A) and (B) into hole (1) and hole (2) respectively.



FG020108

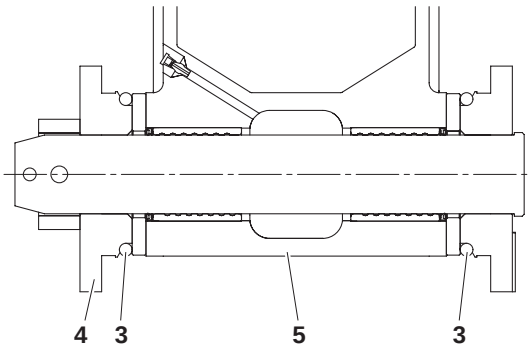
Figure 8



FG018432

Figure 9

4. When installing the bucket, for arm pin portion (A), fit O-ring (3) to bucket (4) in the position shown in the diagram on the right. After inserting the pin, fit it in the standard groove.
5. Install the stopper bolts and nuts for each pins.
6. Lubricate with grease thoroughly until the grease comes out from the end face.



FG019639

Figure 10

IMPORTANT

When replacing the bucket, replace the dust seal if it has been damaged. If a damaged seal is used without being replaced, sand and dirt may enter the pin portion and cause abnormal wear of the pin.

Reversal

1. Place the bucket in contact with a flat surface.

IMPORTANT

When removing the pins, place the bucket so it is in light contact with the ground. If the bucket is lowered strongly to the ground, the resistance will be increased and it will be difficult to remove pins.

After removing the pins, make sure that mud or sand does not get on them.

Dust seals are fitted at both ends of the bushings, be careful not to damage them.

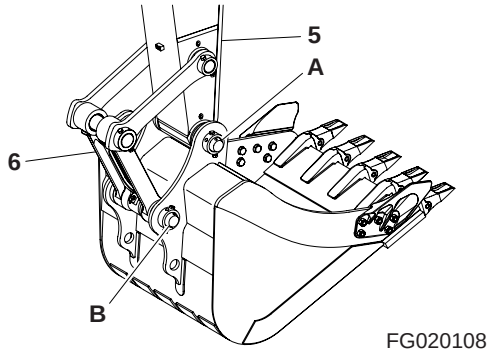


Figure 11

2. Remove the double nut on the stopper bolt for arm pin (A) and link pin (B), remove the bolt, pull out arm pin (A) and link pin (B), and then remove the bucket.

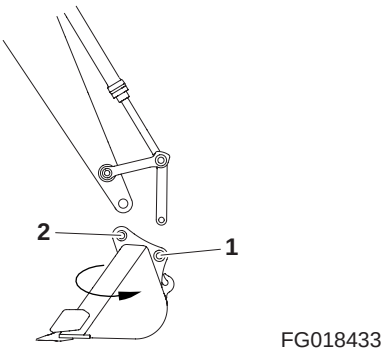


Figure 12

3. After removing the bucket, reverse it.
4. Align arm (5) with replacement bucket hole (1), then align link (6) with hole (2), then insert greased-coated pins (A) and (B) into hole (1) and hole (2) respectively..

IMPORTANT

When reversing, do not install an O-ring. Keep the O-ring in a safe place until using it next.

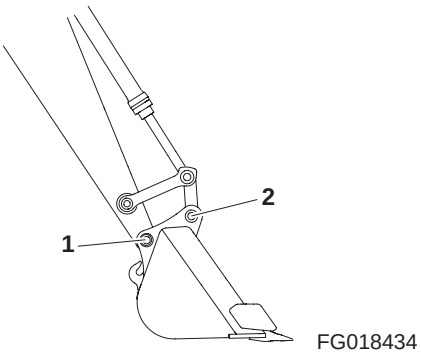


Figure 13

5. Install the stopper bolts and nuts for each pin.
6. Lubricate with grease thoroughly until the grease comes out from the end face.

IMPORTANT

When replacing the bucket, replace the dust seal if it has been damaged. If a damaged seal is used without being replaced, sand and dirt may enter the pin portion and cause abnormal wear of the pin.