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Brake

Electrical System

Attachments

SAFETY

WHEEL LOADER SAFETY

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

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TO THE OPERATOR OF A DISD WHEEL LOADER

⚠ DANGER!

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

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

Safety information on the following pages is organized into the following topics.

⚠ WARNING!

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

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

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

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

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

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

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

⚠ SAFETY ALERT SYMBOL ⚠

Be Prepared - Get to Know All Operating and Safety Instructions

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

LEARN SIGNAL WORDS USED WITH SAFETY ALERT SYMBOL

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

⚠ CAUTION!

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

⚠ WARNING!

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

⚠ DANGER!

This word is used on safety messages and safety labels and indicates imminent hazard of a situation that, if not avoided, is very likely to cause death or extremely serious injury. It may also be used to alert against equipment that may explode or detonate if handled or treated carelessly.

Safety precautions are described in SAFETY from page 6 on.

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

GENERAL SAFETY ESSENTIALS

ACCESSORY APPLICATIONS

This wheel loader has been designed primarily for moving earth with a bucket. For use as a grapple or for other object handling, contact Hyundai. Lifting-work applications are permitted in approved lift configuration, to rated capacity only, with no side-loading (unless prohibited by local regulation). Do not use machine for activities for which it was not intended. Do not use bucket for lifting work, unless lift slings are used in approved configuration.

LOCATION OF SAFETY LABELS

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

There are several specific warning signs on this machine. The exact location of hazards and the description of the hazards are reviewed in the appropriate Operation and Maintenance Manual.

Please become familiarized with all warning signs.

Make sure that all of the warning signs are legible. Clean the warning signs or replace the warning signs if you cannot read the words. Replace the illustrations if the illustrations are not visible. When you clean the warning signs, use a cloth, water and soap. Do not use solvent, gasoline, or other harsh chemicals to clean the safety signs. Solvents, gasoline, or other harsh chemicals could loosen the adhesive that secures the warning sign. Loose adhesive will allow the warning sign to fall off.

Replace any safety sign that is damaged, or missing. If a safety sign is attached to a part that is replaced, install a safety sign on the replacement part.

UNAUTHORIZED MODIFICATIONS

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

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

GENERAL HAZARD INFORMATION

SAFETY RULES

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

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

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

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

Always observe strictly any other rules related to safety.

SAFETY FEATURES

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

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

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

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

INSIDE OPERATOR'S COMPARTMENT

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

Clean grease and dirt from pedals and controls. This contributes to safe operation. Cleaning also provides an opportunity to inspect equipment. Minor damage can be repaired or corrected before major problems result.

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

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

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

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

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

Never bring any dangerous objects such as flammable or explosive items into the operator's cab. To ensure safety, do not use the radio or music headphones when operating the machine. There is danger that this may lead to a serious accident.

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

When standing up from the operator's seat, always place transmission neutral lock lever in the "LOCK" position and set pilot cutoff switch to "O" (OFF) position. If you accidentally touch the work equipment levers when they are not locked, the machine may suddenly move and cause serous injury or damage.

When leaving the machine, lower the work equipment completely to the ground, set transmission neutral lock lever in the "LOCK" position, set pilot cutoff switch to "O" (OFF) position, "APPLY" parking brake, and shut down engine. Use the key to lock all the equipment. Always remove the key and take it with you.

CLOTHING AND PERSONAL PROTECTIVE ITEMS

Contain long hair, and avoid loose clothing and jewelry. They can catch on controls or in protruding parts and cause serious injury or death.

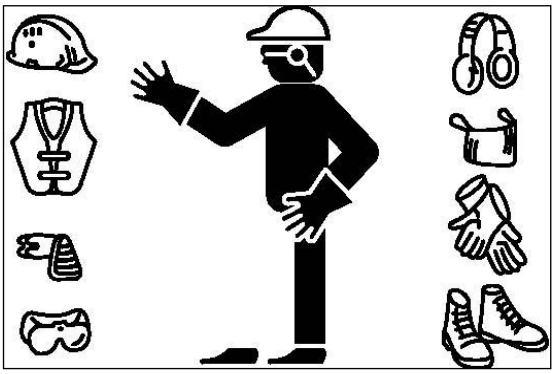


Figure 1

Do not wear oily clothes. They are highly flammable.

Full eye protection, a hard hat, safety shoes and gloves may be required at the work site. While working on the machine, never use inadequate tools.

They could break or slip, causing injury, or they may not adequately perform intended functions.

BREATHING MASKS, EAR PROTECTION MAY BE REQUIRED

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

ASBESTOS DUST HAZARD PREVENTION

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

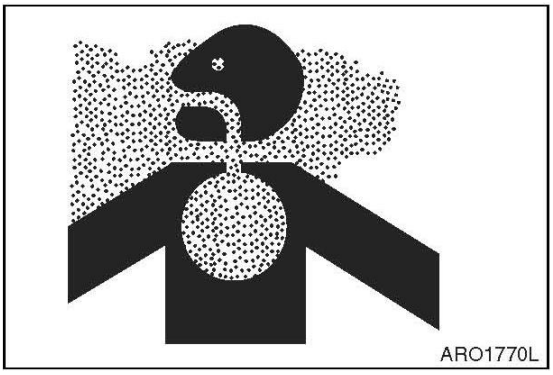


Figure 2

- Use a respirator that is approved for use in an asbestos-laden atmosphere.
- Never use compressed air for cleaning.
- Use water for cleaning to keep down the dust.
- Work on the machine or component with the wind at your back whenever possible.
- Always observe any rules and regulations related to the work site and working environment

MOUNTING AND DISMOUNTING

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

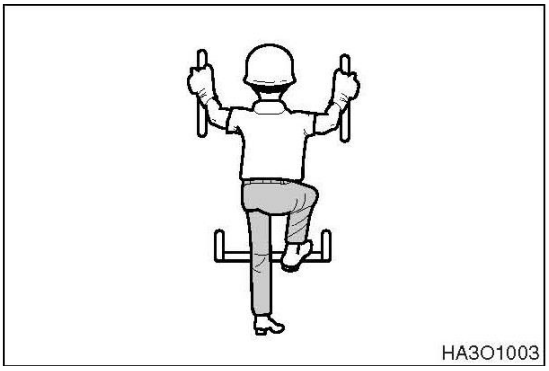


Figure 3

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

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

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

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

FUEL, OIL AND HYDRAULIC FLUID FIRE HAZARDS

Figure 4

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

Always strictly observe the following.

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

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

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

PRECAUTIONS WHEN HANDLING FLUIDS AT HIGH TEMPERATURE

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

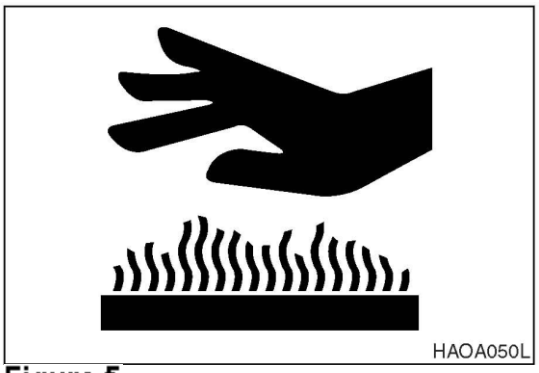


Figure 5

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

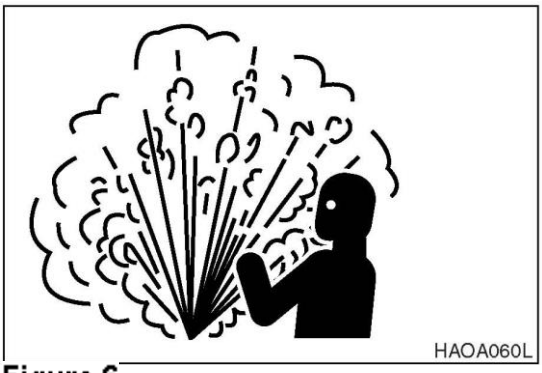


Figure 6

INJURY FROM WORK EQUIPMENT

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

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

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

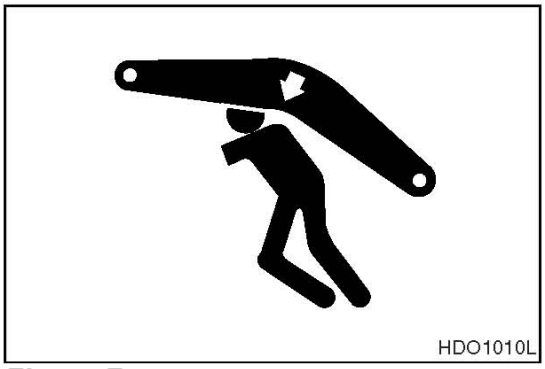


Figure 7

FIRE EXTINGUISHER AND FIRST AID KIT

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

- Be sure that fire extinguishers have been provided and read the labels to ensure that you know now to use them. It is recommended that an appropriately sized (2.27 kg [5 lb] or larger) multipurpose "A/B/C" fire extinguisher be mounted in the cab. Check and service the fire extinguisher at regular intervals and make sure that all work site crew members are adequately trained in its use.

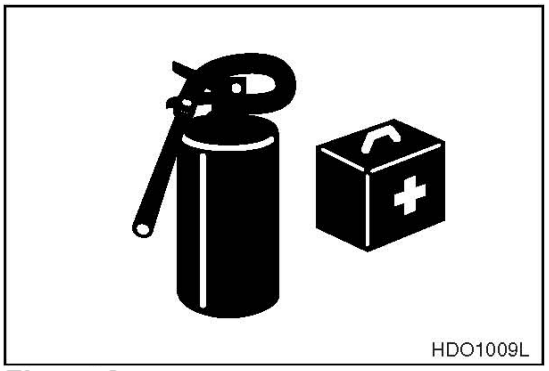


Figure 8

- Provide a first aid kit in the storage compartment and keep another at the work site. Check the kit periodically and make any additions if necessary.
- Know what to do in case of injury from fire.
- Keep emergency numbers for doctor, ambulance service, hospital and fire department you're your telephone.

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

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

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

PROTECTION FROM FALLING OR FLYING OBJECTS

Figure 9

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

Work in mines, tunnels, deep pits or on loose or wet surfaces could produce danger of falling rock, roll over or hazardous flying objects. Additional protection for operator's cab could be required in form of a FOPS/Falling Object Protective Structure and/or ROPS/Roll Over Protective Structure reinforcement system (Option).

Figure 10

Any reinforcement system that is installed on machine must pass safety and certification standards and carry appropriate labeling and rating information. For example, most often added type of reinforcement system, FOPS, must meet or exceed Society of Automotive Engineers standard SAE J1356, "Performance Criteria for Falling Object Guards for Wheel loaders. (Option)"

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

INSTALL ADDITIONAL SAFETY EQUIPMENT IF CONDITIONS REQUIRE

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

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

MAINTAIN STANDARD SAFETY EQUIPMENT IN GOOD CONDITION

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

Safety labels must be replaced if they are damaged or become unreadable. Information on labels gives work crew members an important safety reminder. Part numbers for each decal and required mounting locations are shown on pages 1-2 through 1-4 of this section.

ATTACHMENT PRECAUTIONS

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

ACCUMULATOR

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

When performing maintenance on the pilot control system, the hydraulic pressure in the system must be released as describe in Operation and Maintenance Manual.

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

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

ENGINE VENTILATION

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

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

You should also be aware of open windows, doors or ductwork into which exhaust may be carried, or blown

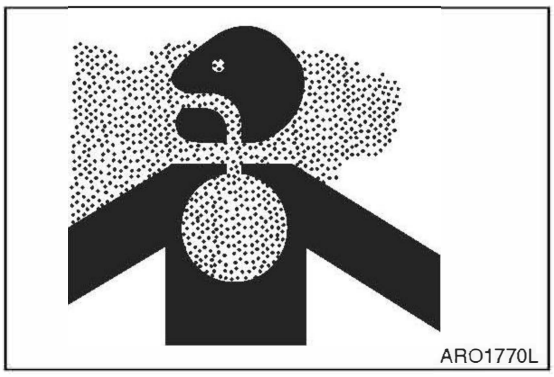


Figure 11

BEFORE STARTING ENGINE

WORK SITE PRECAUTIONS

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

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

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

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

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

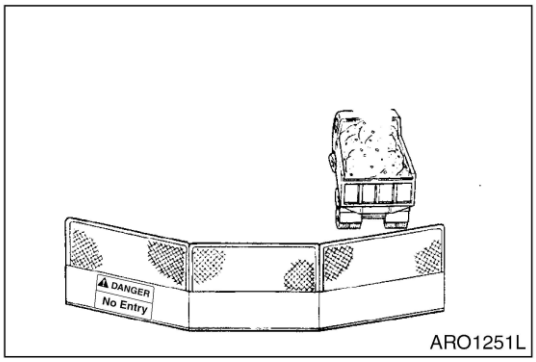


Figure 12

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

NEVER be in water that is in excess of the permissible water depth. Refer to "Operation Manual."

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

Minimum levels of insurance coverage, work permits or certification, physical barriers around the work site or restricted hours of operation may be mandated by governing authorities. There may also be regulations, guidelines, standards or restrictions on equipment that may have to be followed for local requirements.

There may also be regulations related to performing certain kinds of work. If there is any question about whether your machine and work site complies with the applicable standards and regulations contact your local authorities and agencies.

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

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

Remember that the soil after heavy rain, blasting or after earthquakes, is weakened in these areas.

Earth laid on the ground and the soil near ditches is loose. It can collapse under the weight of vibration of your machine and cause your machine to tip over Install the head guard (FOPS) if working in areas where there is danger of falling rocks.

CHECKS BEFORE STARTING ENGINE

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

- Completely remove all wood chips, leaves, grass, paper and other flammable materials accumulated in the engine compartment and around the battery. They could cause a fire.
  Remove any dirt from the window glass, mirrors, handrails, and steps.
- Do not leave tools or spare parts laying around in the operator's compartment. The vibration of the machine when traveling or during operations may cause them to fall and damage or break the control levers or switches. They may also get caught in the gap of the control levers and cause the work equipment to malfunction or move dangerously. This may lead to unexpected accidents.
- Check the coolant level, fuel level, and hydraulic tank oil level, and check for clogged air cleaner and damage to the electrical wiring.
- Adjust the operator's seat to a position where it is easy to operate the machine, and check the seat belt and mounts for damage and wear.
- Check the operation of the gauges and the angle of the mirrors, and check that the safety lever is in "LOCKED" position.
- If any abnormalities are found in the above checks, carry out repairs immediately.

ENGINE STARTING

- Walk around your machine before getting in operator’s cab. Look for evidence of leaking fluid, loose fasteners, misaligned assemblies or any other indications of possible equipment hazard.
- All equipment covers and machinery safety guards must be in place, to protect against injury while machine is being operated.
- Look around work site area for potential hazards, or people or property that could be at risk while operation is in progress.
- NEVER start engine if there is any indication that maintenance or service work is in progress, or if a warning tag is attached to controls in cab.
- A machine that has not been used recently, or is being operated in extremely cold temperatures, could require a warm-up or maintenance service before start up.
- Check gauges and monitor displays for normal operation before starting engine. Listen for unusual noises and remain alert for other potentially hazardous conditions at start of work cycle.
- Check tire inflation and check tires for damage or uneven wear. Perform maintenance before operation.
- Do not short circuit the starting motor to start the engine. This is not only dangerous, but may also damage the machine.
- When starting the engine, sound the horn as an alert.
- Start and operate the machine only while seated.

BEFORE OPERATING MACHINE

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

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

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

MACHINE OPERATION

IMPORTANT

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

OPERATE WHILE SEATED AT OPERATOR'S STATION ONLY

Never reach in through a window to work a control. Do not try to operate wheel loader unless you're in command position - seated at controls. You should stay alert and focused on your work at all times. Do not twist out of seat if job activity behind you (or to the side) requires your attention.

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

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

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

Figure 13

SEAT BELTS SHOULD BE USED AT ALL TIMES

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

Figure 14

MOVEMENT ALARMS

If wheel loader is equipped with an audible travel movement alarm, test alarm on a daily basis. Audible alarm should sound as soon as travel system is engaged.

TRAVEL PRECAUTIONS

When traveling, wheel loader always keeps lights on; make sure that you are in compliance with all state and local regulations concerning warning flags and signs.

Never turn the starter switch to the "O" (OFF) position when traveling. It is dangerous if the engine stops when the machine is traveling. It will be impossible to operate the steering unless the unit is equipped with an emergency steering system.

Pilot control valve lever (joystick) should not be operated while traveling.

Lower work equipment so that it is 400 mm (16 in) above ground.

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

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

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

Always keep to the permissible water depth.

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

SLOPING TERRAIN REQUIRES CAUTION

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

On sloping surfaces, use caution when positioning wheel loader before starting a work cycle. Stay alert for unstable situations to avoid getting into them. For example, you should always avoid working bucket over downhill side of machine when parked perpendicular to slope. Avoid full extensions of bucket in a downhill direction. Lifting bucket too high, too close to machine, while wheel loader is turned uphill can also be hazardous.

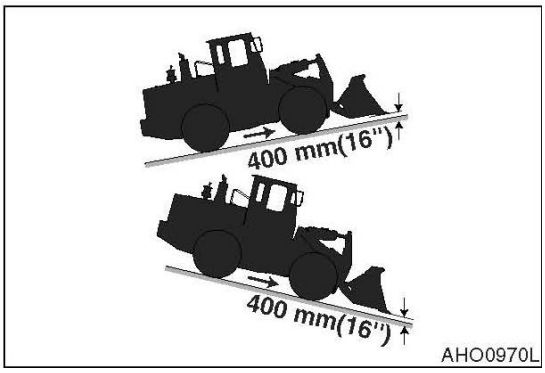


Figure 15

AVOID HIGH-VOLTAGE CABLES

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

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

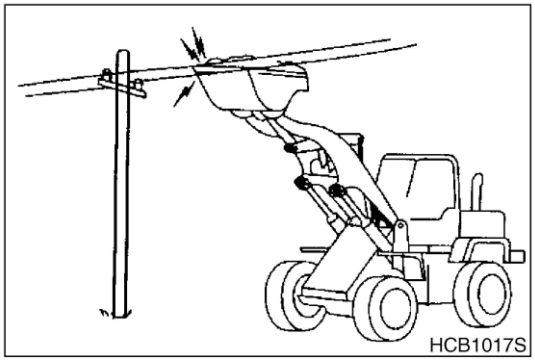


Figure 16

VOLTAGE	MINIMUM SAFE DISTANCE
6.6 kV	3 m (9’ 10")
33.0 kV	4 m (13’ 1")
66.0 kV	5 m (16’ 5")
154.0 kV	8 m (26’ 3")
275.0 kV	10 m (32’ 10")

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

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

BEFORE STARTING TO DIG, CONTACT AUTHORITIES

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

BE AWARE OF HEIGHT OBSTACLES

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

USE CARE ON LOOSE SUPPORT

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

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

USE SOLID SUPPORT BLOCKING

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

Figure 17

DIGGING BENEATH OVERHANGS

Digging beneath an overhang is dangerous. Overhand could collapse on top of operator and cause serious injury or death. Go on to another digging area before steep overhangs are formed. Know height and reach limits of wheel loader and plan ahead while working. Park wheel loader away from overhangs before work shut down.

DIGGING BENEATH WHEEL LOADER

Digging beneath wheel loader is dangerous. Earth beneath could collapse. This could cause wheel loader to tip, which could cause serious injury or death to operator. Working around deep pits, trenching or along high walls may require support blocks, especially after heavy rainfalls or during spring thaws.

STAY ALERT FOR PEOPLE MOVING THROUGH WORK AREA

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

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

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

Figure 18

BE AWARE OF AND CONFORM TO LOCAL REGULATIONS

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

NEVER USE ETHER STARTING AIDS

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

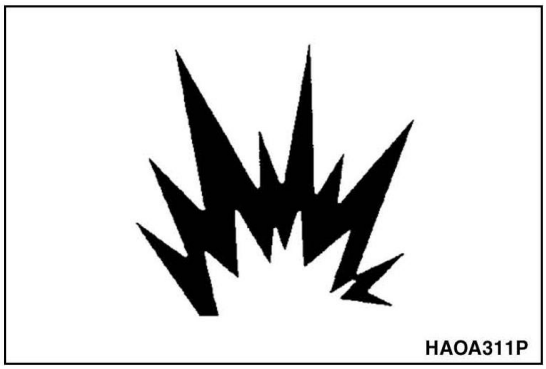


Figure 19

OBSERVE GENERAL SAFETY RULES

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

All personnel at work site should be aware of assigned individual responsibilities and tasks.

Communication and hand signals used should be understood by everyone.

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

TAKE TIME TO PROVIDE GOOD VISIBILITY

Be careful not to go close to the edge of a cliff by mistake.

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

To ensure an ample view, do as follows:

- When working in dark areas, attach working lights and front lights to the machine. If necessary, set up lighting at the work site.
- Stop operations when the visibility is poor, such as in fog, mist, snow, and rain. Wait for the visibility to improve to a level which causes no problems for the operation.
- Keep dirt and dust off of windows and off lens surfaces of work lights. Stop working if lights, windows or mirrors need cleaning or adjustment.

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

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

KEEP "PINCH POINT" AREAS CLEAR – USE CAUTION IN REVERSE

Use a signal person in high traffic areas and whenever operator's view is not clear, such as when traveling in reverse.

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

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

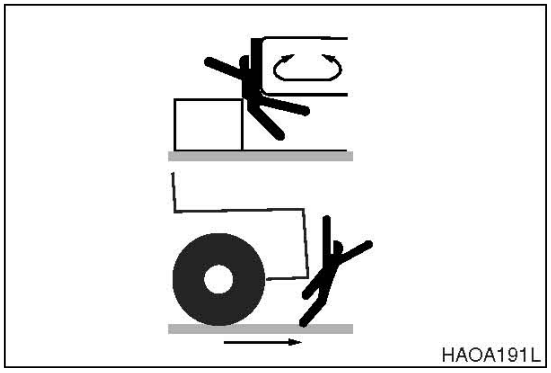


Figure 20

OPERATE CAREFULLY ON SNOW AND ICE AND IN VERY COLD TEMPERATURES

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

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

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

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

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

PARKING MACHINE

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

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

SHUTDOWN CONTROL FUNCTIONS

After bucket has been lowered to overnight storage position, move all switches and controls to "OFF" position. Pull parking brake knob to "APPLIED" position. This will apply parking brake. Move pilot cutoff switch to "LOCK" position. This will disable pilot control valve lever (joystick). Move key in starter switch to "OFF" position, and remove key from switch.

Engage all lock-down security equipment that may have been installed on machine.

IMPORTANT
When hydraulic system maintenance or service work must be performed, be aware that accumulators in system store fluid under pressure after system has been shut down. To release hydraulic pressure in accumulators, operate control with engine "OFF" until accumulator pressure is completely dissipated.

NEVER LET ANYONE RIDE ON ATTACHMENT

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

Figure 21

MAINTENANCE

USE WARNING TAG DURING SERVICE

Alert others that service or maintenance is being performed and tag operator's cab controls - and other machine areas if required - with a warning notice.

Warning tags for controls are available from your distributors; see Figure 22.

Figure 22

CLEAN BEFORE INSPECTION ORMAINTENANCE

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

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

When washing the machine, do the following;

- Wear shoes with nonslip soles to prevent yourself from slipping and falling on wet places.
- Wear safety glasses and protective clothing when washing the machine with high-pressure steam.
- Take action to prevent touching high-pressure water and cutting your skin or having mud fly into your eyes.
- Do not spray water directly on electrical components (sensors, connector) (1, Figure 23). If water gets into the electrical system, there is danger that it will cause defective operation and malfunction.

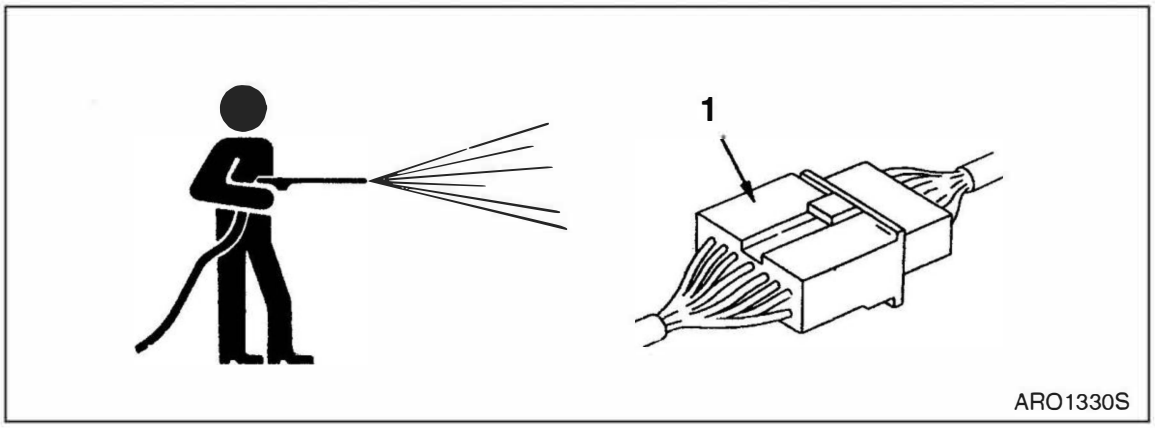


Figure 23

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

PROPER TOOLS

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

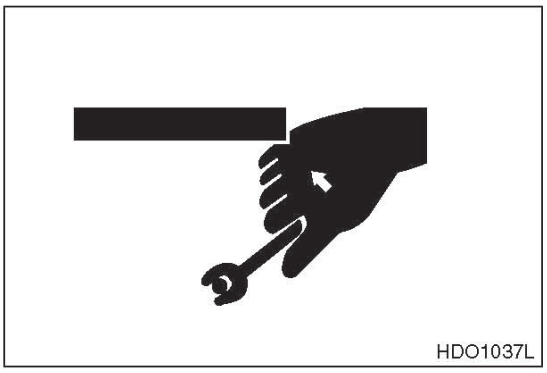


Figure 24

USE OF LIGHTING

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

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

Even if the place is dark, never use a lighter or flame instead of lighting. There is danger of fire.

There is also danger that the battery gas may catch fire and cause and explosion.

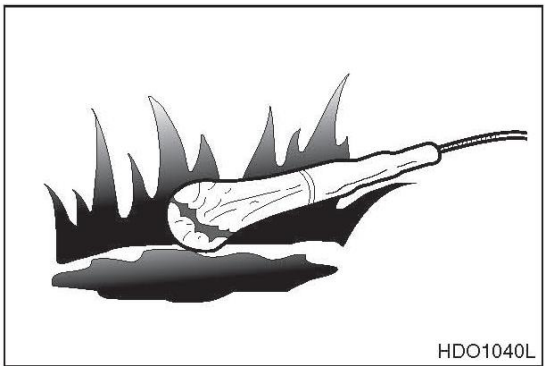


Figure 25

FIRE PREVENTION AND EXPLOSION PREVENTION

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

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

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

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

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

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

Remove all flammable materials before they accumulate on the machine.

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

BURN PREVENTION

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

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

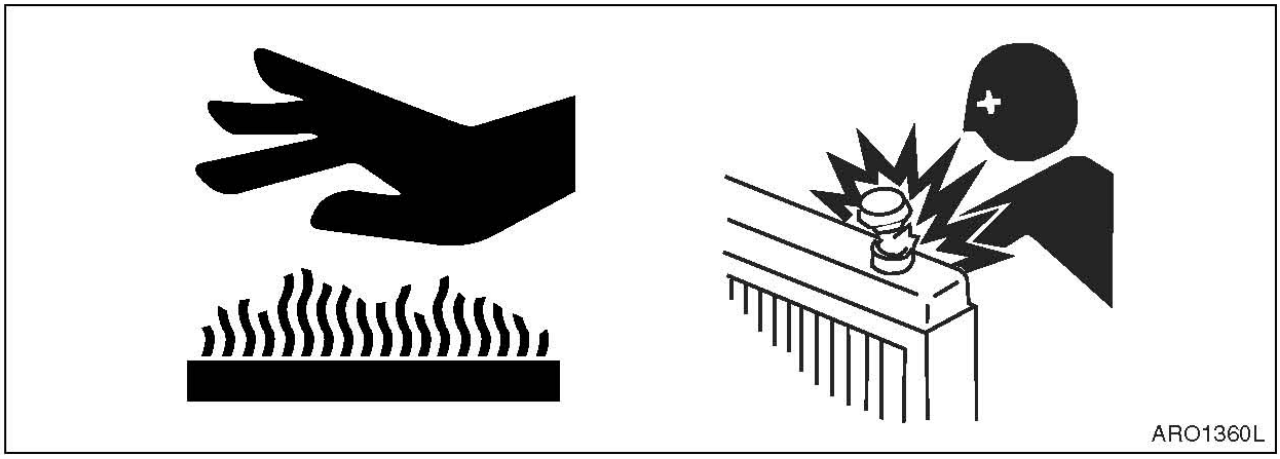


Figure 26

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

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

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

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

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

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

Batteries give off flammable fumes that can explode.

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

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

Always wear protective glasses when you work on batteries.

WELDING REPAIRS

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

The qualified welder must do the following;

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

PRECAUTIONS FOR REMOVAL, INSTALLATION, AND STORAGE OFATTACHMENTS

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

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

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

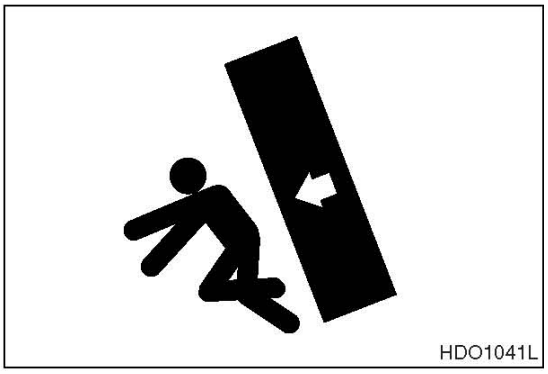


Figure 27

PRECAUTIONS WHEN WORKING ON MACHINE

When carrying out maintenance operations on the machine, keep the area around your feet clean and tidy to prevent you from falling.

Always do the following;

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

Figure 28

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

If the job requires it, wear protective clothing.

To prevent injury from slipping or falling, when working on the hood or covers, never use any part except the inspection passage fitted with nonslip pads.

LOCK INSPECTION COVERS

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

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

CRUSHING PREVENTION AND CUTTING PREVENTION

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

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

Stay clear of all rotating parts and moving parts.

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

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

When you strike a retainer pin, the retainer pin might fly out. The loose retainer pin can injure personnel.

Make sure that the area is clear of people when you strike a retainer pin. To avoid injury to your eyes, wear protective glasses when you strike a retainer pin.

DO NOT RUN ENGINE IF REPAIRS OR WORK ARE BEING PERFORMED ALONE

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

ALWAYS USE ADEQUATE EQUIPMENT SUPPORTS AND BLOCKING

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

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

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

NOTE: *Oil will drain more quickly and completely if it is warm. Do not drain fluids at temperatures exceeding 95°C (203°F), however do not allow full cool down.*

HYDRAULIC CYLINDER SEALS REQUIRE PERIODIC REPLACEMENT

Check cylinder drift rate at regular intervals. Overhaul seal kits are available through DISD.

HIGH PRESSURE HYDRAULIC LINES CAN STORE A GREAT DEAL OF ENERGY

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

PRECAUTIONS WITH HIGH PRESSURE LINE, TUBES AND HOSES

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

- Wear protective glasses and leather gloves.
- Fluid leaks from hydraulic hoses or pressurized components can be difficult to see but pressurized oil has enough force to pierce the skin and cause serious injury. Always use a piece of wood or cardboard to check for suspected hydraulic leaks. Never use your hands or expose your fingers.
- Do not bend high pressure lines. Do not strike high pressure lines. Do not install lines, tubes or hoses that are bent or damaged.
- Make sure that all clamps, guards and heat shields are installed correctly to prevent vibration, rubbing against other parts, and excessive heat during operation.
  - If any of the following conditions are found, replace the part.
  - Damage or leakage from hose end.
  - Wear, damage, cutting of covering, or exposure of strengthening wire layer.
  - Cover portion is swollen in places.
  - There is twisting or crushing at movable parts of hose.
  - Foreign material is embedded in the covering.
  - Hose end is deformed.

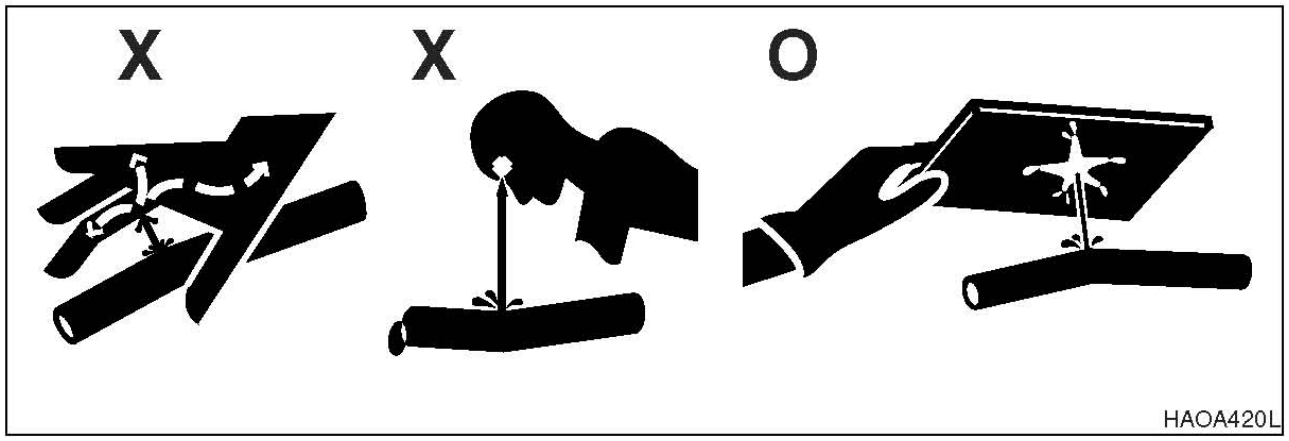


Figure 29

OBTAIN IMMEDIATE MEDICAL ATTENTION IF PRESSURIZED OIL PIERCES SKIN.

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

USE CORRECT REPLACEMENT FASTENERS TIGHTENED TO PROPER TORQUE

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

Poor or incorrect fastener connections can dangerously weaken assemblies.

SAFETY-CRITICAL PARTS MUST BE REPLACED PERIODICALLY

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

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

DISPOSE OF ALL PETROLEUM-BASED OILS AND FLUIDS PROPERLY

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

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

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

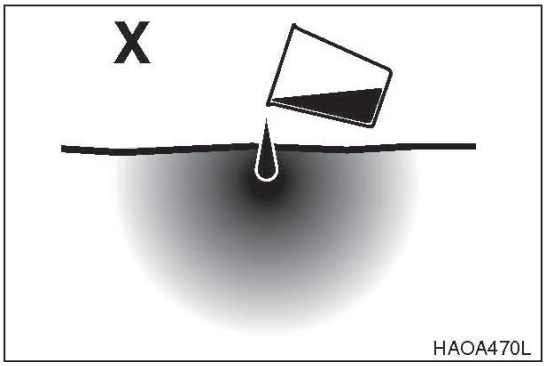


Figure 30

CHECK TIRE PRESSURE AND CONDITION

Maintain tire pressure but do not over inflate. Inspect tires and wheels daily. When inflating tires, follow procedures in Maintenance Section, which include using an extension to allow you to avoid standing in front of or over a tire. Do not change a tire unless you have both experience and proper equipment.

BATTERY HAZARD PREVENTION

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

- Do not smoke or bring any flame near the battery.
- When working with batteries, ALWAYS wear safety glasses and rubber gloves.
- If you spill battery electrolyte on yourself or your clothes, immediately flush the area with water.
- If battery electrolyte gets into your eyes, flush them immediately with large quantities of water and see a doctor at once.
- If you accidentally drink battery electrolyte, drink a large quantity of water or milk, raw egg or vegetable oil. Call a doctor or poison prevention center immediately.
- When cleaning the top surface of the battery, wipe it with a clean, damp cloth. Never use gasoline, thinner, or any other organic solvent or detergent.
- Tighten the battery caps securely.
- Explosive battery gas can be set off by sparks from incidental contact or static discharge. Turn "OFF" all switches and engine when working on batteries. Keep battery terminals tight. Contact between a loose terminal and post can create an explosive spark.
- If the battery electrolyte is frozen, do not charge the battery or start the engine with power from another source. There is danger that the battery may catch fire.
- When charging the battery or starting with power from another source, let the battery electrolyte melt and check that there is no leakage of battery electrolyte before starting the operation.
- Always remove the battery from the machine before charging.

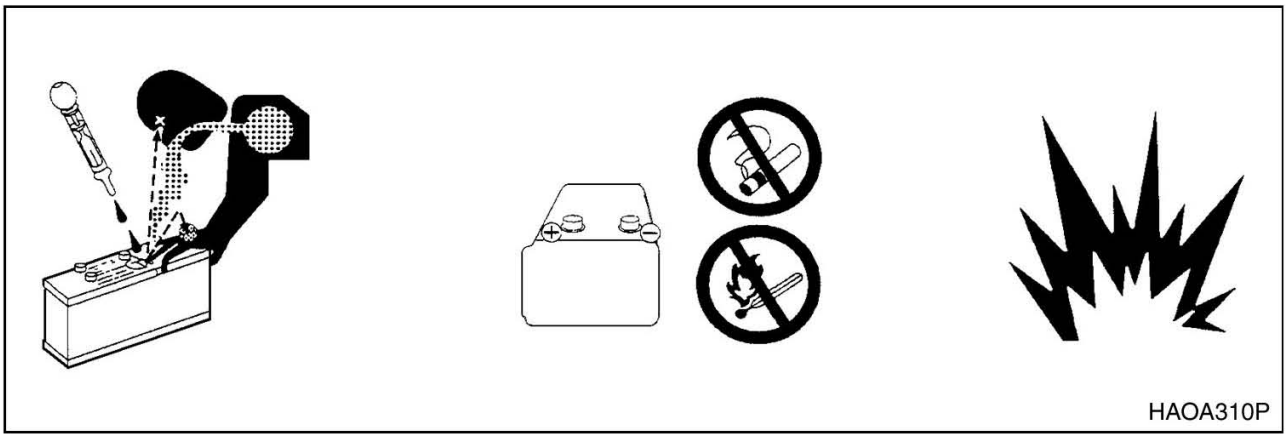


Figure 31

DISCONNECT BATTERIES BEFORE ELECTRICAL SERVICE OR ELECTRICAL WELDING

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

USE LOW HEAT PORTABLE LIGHTING

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

BOOST STARTING OR CHARGING ENGINE BATTERIES

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

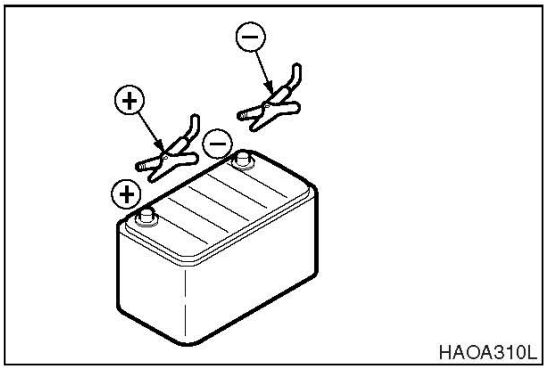


Figure 32

- Turn off all electrical equipment before connecting leads to the battery. This includes electrical switches on the battery charger or boost starting equipment.
- When boost-starting from another machine or vehicle do not allow the two machines to touch. Wear safety glasses or goggles while required battery connections are made.
- 24 volt battery units consisting of two series-connected twelve volt batteries have a cable connecting one positive terminal on one of the 12 volt batteries to a negative terminal on the other battery. Booster or charger cable connections must be made between the nonseries-connected positive terminals and between the negative terminal of the booster battery and the metal frame of the machine being boosted or charged. Refer to the procedure and illustration in Operation and Maintenance Manual.
- Connect positive cable first when installing cables and disconnect the negative cable first when removing them. The final cable connection, at the metal frame of the machine being charged or boost-started, should be as far away from the batteries as possible.

TOWING

PRECAUTIONS WHEN TOWING

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

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

SHIPPING AND TRANSPORTATION

OBEY STATE AND LOCAL OVER-THE-ROAD REGULATIONS

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

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

Partial disassembly or tear-down of wheel loader may be necessary to meet travel restrictions or particular conditions at work site.

Refer to the section "Transportation" section of operation manual.

SUMMARY OF SAFETY PRECAUTIONS FOR LIFTING

⚠WARNING!
Improper lifting can allow load to shift and cause personal injury or damage to the machine

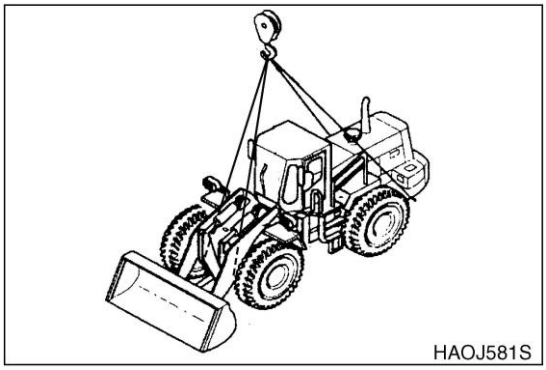


Figure 33

To make safe lifts, the following items must be evaluated by operator and work site crew.

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

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

SPECIFICATIONS

SPECIFICATIONS FOR

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

TABLE OF CONTENTS

COMPONENT LOCATIONS

Figure 1 identifies the location of major machine components.

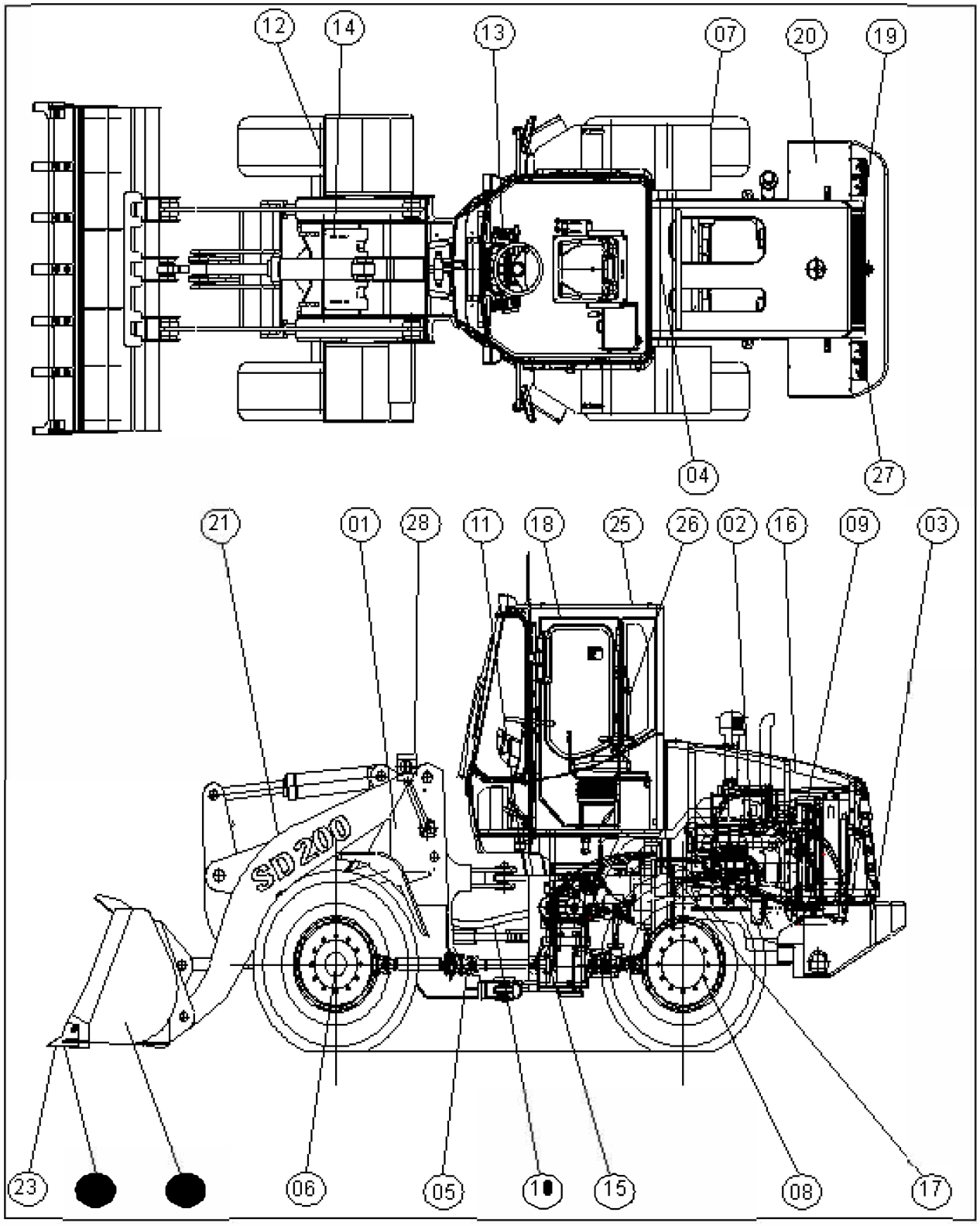


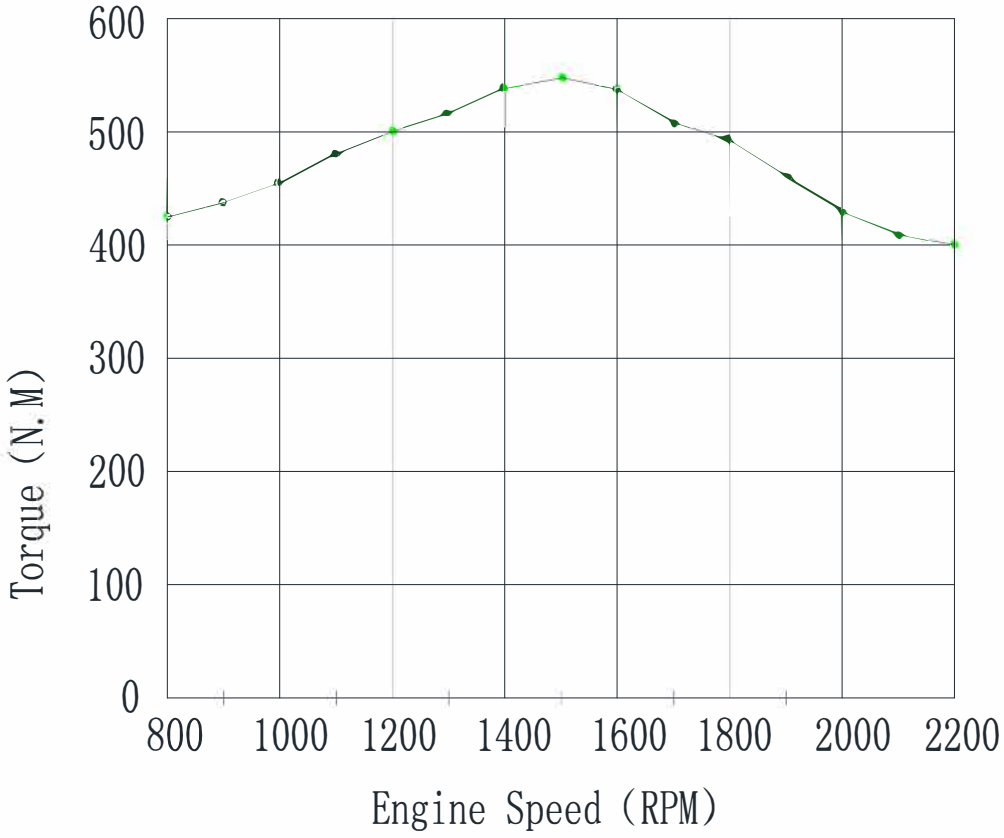
Figure 1

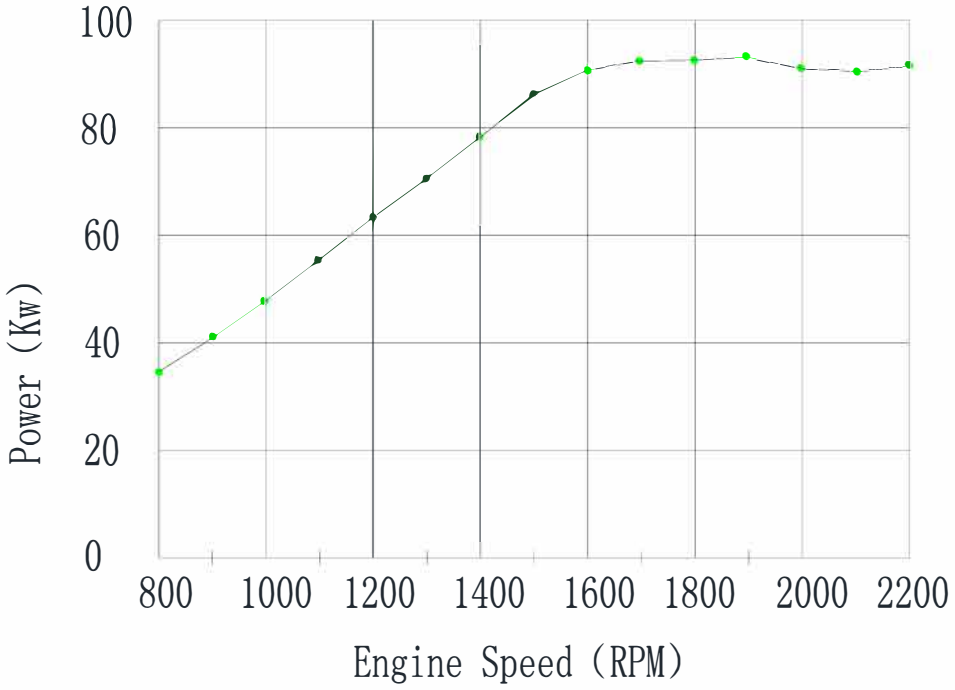
Reference Number	Description	Reference Number	Description
1	Frame	15	Handrail
2	E/G and T/M Ass`y	16	Engine Cover
3	Fuel Tank	17	Damper
4	Oil Tank	18	Cabin Interior
5	Axel and Driving shaft	19	Radiator Grille
6	Axel and Driving shaft	20	Counterweight
7	Tire	21	Working Device
8	Axle Hub	22	Bucket
9	Cooling Pipe line	23	Tooth
10	Main Pipe line	24	Cutting Edge
11	Steering Pipe line	25	Cabin
12	Brake Pipe line	26	Seat
13	Brake System	27	Lamp-Rear
14	Main Control valve	28	Lamp-Front

GENERAL SPECIFICATIONS

Item		HL635AL
Serial Number		
Standard Bucket Capacity		1.70 m^3 (2.22 yd^3)
Vehicle Weight		10,300 kg (22,708 lb)
Engine		
	Type	Weichai
	Rated power (SAE J 1995 gross)	125 ps @ 2,200 rpm (123 hp @ 2,200 rpm)
	Max. Torque (SAE J 1995 gross)	51 kg•m / 1,500 rpm (368 ft lb @ 1,500 rpm)
Transmission		
	Mechanical gear shift	Mechanical gear shift
	Speeds	4 Forward, 2 Reverse
Brake Systems		
	Service Brakes	4 Wheel, Dry Disks, Single Pedal
	Parking Brake	Dry Disc on Transmission
Performance		
	Travel Speed (F1/2/3/4;R1/2)	F8/13/24/36;R9/27 km/h
	Steering Angle	+ 40°
	Min. Tire Turning Radius (Tire Center)	4,241 mm
	Max Tractive Force	9,693 kg (21,772 lb)
	Max. Breakout Force	111,000kg (22,252 lb)
	Bucket Rise Time	4.6 Seconds
	Bucket Dump Time	0.9 Seconds
	Bucket Descent Time	3.7 Seconds
Working Range		
	Dump Height at 45° (w/o teeth)	2,950mm (9’ - 6")
	Dump Reach at 45° (w/o teeth)	1,070 mm (3’ - 1")
	Max Dump Angle at Fully Raised	48°
	Max Tilt Angle at Carry	51°
Travel Dimension		
	Overall Length	6,965 mm (22’ - 8")
	Overall Width	2,496 mm (8’ - 3")
	Overall Height	3,250 mm (10’ - 9")
	Tread	1,860 mm (6’ - 1")
	Axle Base	2,830mm (9’ - 3")
	Ground Clearance	340 mm (1’ - 1")

ENGINE PERFORMANCE CURVES





WORKING RANGE AND DIMENSIONS

Figure 3, illustrates exterior machine dimensions and working range of machine when it is equipped with a standard bucket.

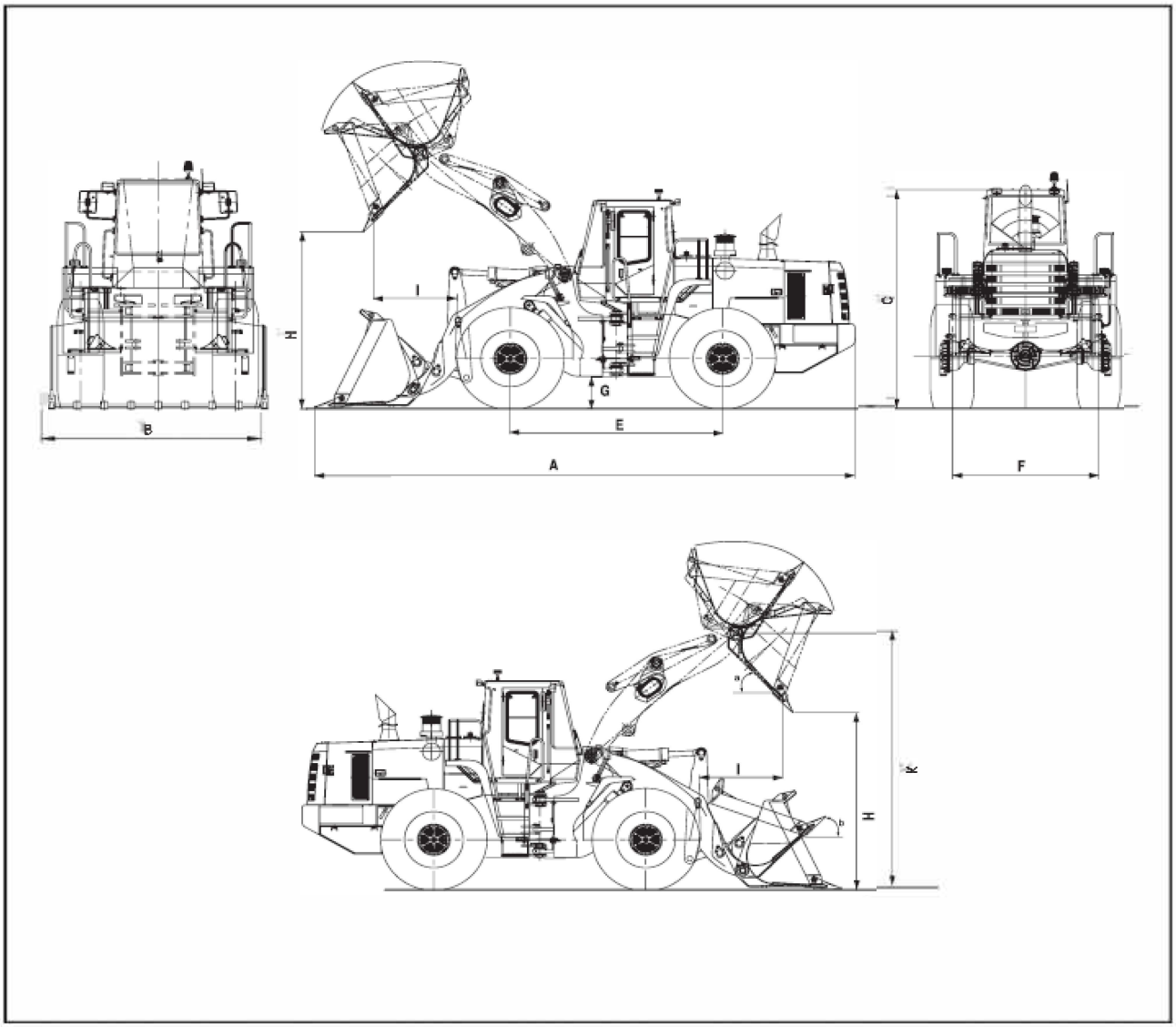


Figure 3

Category	Dimension	Category	Dimension
Overall Length (A)	6,965 mm (22’ - 8")	Dump Height, to tooth (H)	2,808 mm (9’ - 6")
Overall Width (B)	2,496 mm (8’ - 3")	Dump Distance, to Bucket Edge (I)	1,070 mm (3’ - 1")
Overall Height (C)	3,250 mm (10’ - 9")	Dump Height to Bucket Pivot (K)	3,770 mm (12’3")
Axle Base (E)	2,830mm (9’ - 3")	Max. Dump Angle at Fully Raised (a)	48°
Tread (F)	1,850 mm (6’ - 1")	Max. Tilt Angle at Carry (b)	51°
Ground Clearance (G)	330 mm (1’ - 1")	Tire Size	17.5-25

WORKING CAPACITIES

BUCKET CAPACITY

Standard toothed bucket has a capacity of 1.7 m3. An optional bucket equipped with big bucket has a capacity of 2.2 m3.

TIPPING LOAD

Static Tipping Load with bucket at max reach position is 6,900 kg (15,212 lb).

MATERIAL WEIGHT

The data below describes weight of a cubic meter (cubic yard) of many types of workload materials.

APPROXIMATE WEIGHT OF WORKLOAD MATERIALS

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M^3 (1,850 LB/YD^3), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M^3 (2,700 LB/YD^3), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M^3 (3,370 LB/YD^3), OR LESS
Charcoal	401 kg/m^3 (695 lb/yd^3)	----------	----------
Coke, blast furnace size	433 kg/m^3 (729 lb/yd^3)	----------	----------
Coke, foundry size	449 kg/m^3 (756 lb/yd^3)	----------	----------
Coal, bituminous slack, piled	801 kg/m^3 (1,350 lb/yd^3)	----------	----------
Coal, bituminous r. of m., piled	881 kg/m^3 (1,485 lb/yd^3)	----------	----------
Coal, anthracite	897 kg/m^3 (1,512 lb/yd3)	----------	----------
Clay, DRY, in broken lumps	1,009 kg/m^3 (1,701 lb/yd^3)	----------	----------
Clay, DAMP, natural bed	----------	1,746 kg/m^3 (2,943 lb/yd^3)	----------

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M^3 (1,850 LB/YD^3), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M^3 (2,700 LB/YD^3), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M^3 (3,370 LB/YD^3), OR LESS
Cement, Portland, DRY granular	----------	1,506 kg/m^3 (2,583 lb/yd^3)	----------
Cement, Portland, DRY clinkers	----------	1,362 kg/m^3 (2,295 lb/yd^3)	----------
Dolomite, crushed	----------	1,522 kg/m^3 (2,565 lb/yd^3)	----------
Earth, loamy, DRY, loose	----------	1,202 kg/m^3 (2,025 lb/yd^3)	----------
Earth, DRY, packed	----------	1,522 kg/m^3 (2,565 lb/y d^3)	----------
Earth, WET, muddy	----------	----------	1,762 kg/m^3 (2,970lb/yd3)
Gypsum, calcined, (heated, powder)	961kg/m^3 (1,620 lb/yd^3)	----------	----------
Gypsum, crushed to 3 inch size	----------	1,522 kg/m^3 (2,565 lb/y d^3)	----------
Gravel, DRY, packed fragments	----------	----------	1,810 kg/m^3 (3,051 lb/y d^3)
Gravel, WET, packed fragments	----------	----------	1,522 kg/m^3 (3,240 lb/y d^3)
Limestone, graded above 2	----------	1,282 kg/m^3 (2,160 lb/y d^3)	----------
Limestone, graded 1-1/2 or 2	----------	1,362 kg/m^3 (2,295 lb/y d^3)	----------
Limestone, crushed	----------	1,522 kg/m^3 (2,565 lb/y d^3)	
Limestone, fine	----------	----------	1,602 kg/m^3 (2,705 lb/y d^3)
Phosphate, rock	----------	1,282 kg/m^3 (2,160 lb/y d^3)	----------

MATERIAL	LOW WEIGHT OR DENSITY 1,100 KG/M^3 (1,850 LB/YD^3), OR LESS	MEDIUM WEIGHT OR DENSITY 1,600 KG/M^3 (2,700 LB/YD^3), OR LESS	HIGH WEIGHT OR DENSITY 2,000 KG/M^3 (3,370 LB/YD^3), OR LESS
Salt	929 kg/m^3 (1,566 lb/yd^3)	----------	----------
Snow, light density	529 kg/m^3 (891 lb/yd^3)	----------	----------
Sand, DRY, loose	----------	1,522 kg/m^3 (2,565 lb/yd^3)	----------
Sand, WET, packed	----------	----------	1,922 kg/m^3 (3,240 lb/yd^3)
Shale, broken	----------	1,362 kg/m^3 (2,295 lb/y d^3)	----------
Sulphur, broken	529 kg/m^3 (891 lb/yd^3)	----------	----------

IMPORTANT

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

GENERAL MAINTENANCE

GENERAL MAINTENANCE PROCEDURES

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

TABLE OF CONTENTS

WELDING PRECAUTIONS AND GUIDELINES

IMPORTANT

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

⚠ WARNING!

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

⚠ CAUTION!

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

⚠ CAUTION!

Observe the following safety precautions:

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

HYDRAULIC SYSTEM - GENERAL PRECAUTIONS

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

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

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

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

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

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

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

MAINTENANCE SERVICE AND REPAIR PROCEDURE

GENERAL PRECAUTIONS

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

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

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

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

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

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

HYDRAULIC SYSTEM CLEANLINESS AND OIL LEAKS

MAINTENANCE PRECAUTIONS FOR HYDRAULIC SYSTEM SERVICE

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

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

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

  NOTE: *It's just as important to clean the cap and reservoir top before routine fluid changes or quick checks as it is before major repairs. (Accumulated dirt attracts moisture, oil and other fluids - and more dirt.)*
- Keep dismantled parts covered during disassembly. Use clean caps, plugs or tape to protect the disconnected openings of flanges, manifolds and piping.
- Do not allow cleaning solvents or other fluids to mix with the oil in the system. Use clean oil to flush any traces of solvent or other residue before reassembly.
- If metal or rubber fragments are found in the system, flush and replace all fluid in the system and troubleshoot the circuit to identify the source of contamination.

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

OIL LEAKAGE PRECAUTIONS

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

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

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

NOTE: *Grease lip seals before assembly.*

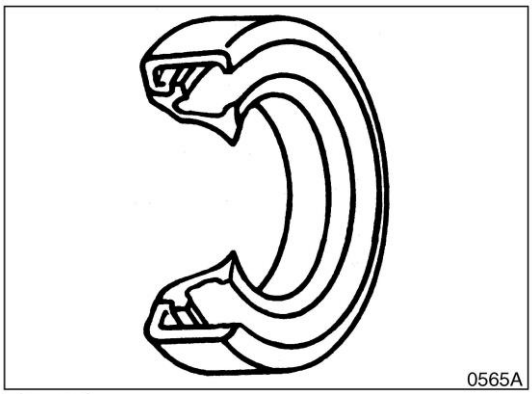


Figure 1

CLEANING AND INSPECTION

GENERAL GUIDELINES

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

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

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

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

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

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

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

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

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

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

BEARING INSPECTION

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

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

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

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

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

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

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

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

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

Normal Bearing

Smooth even surfaces with no discoloration or marks.

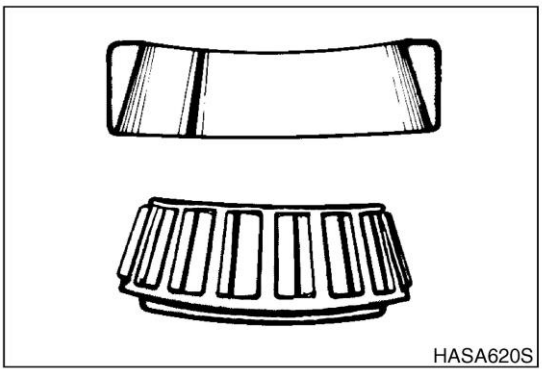


Figure 2

Bent Cage

Cage damage due to improper handling or tool usage.

Replace bearing.

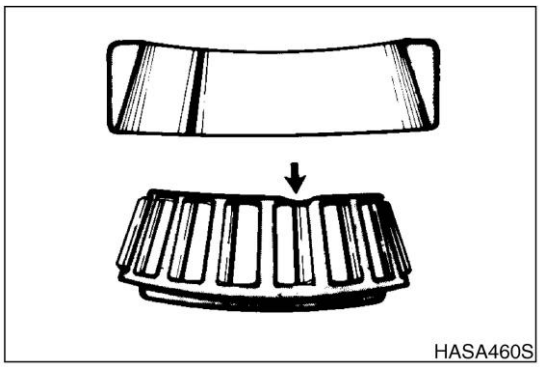


Figure 3

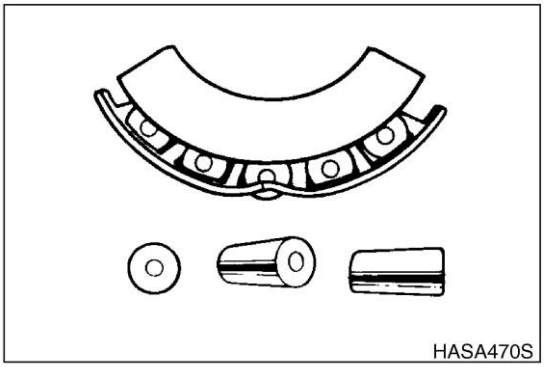


Figure 4

Galling

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

Replace bearing - check seals and check for proper lubrication.

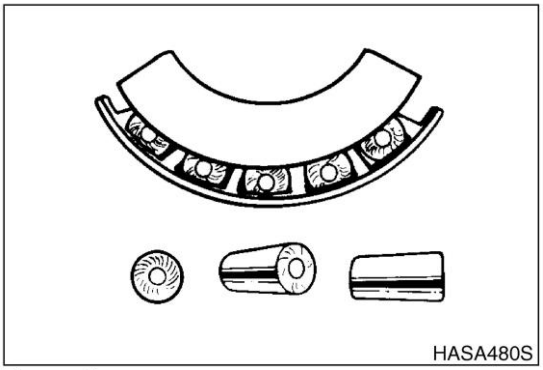


Figure 5

Abrasive Step Wear

Pattern on roller ends caused by fine abrasives.

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

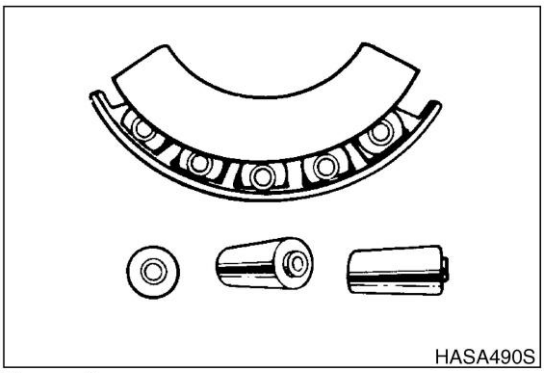


Figure 6

Etching

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

Replace bearings - check seals and check for proper lubrication.

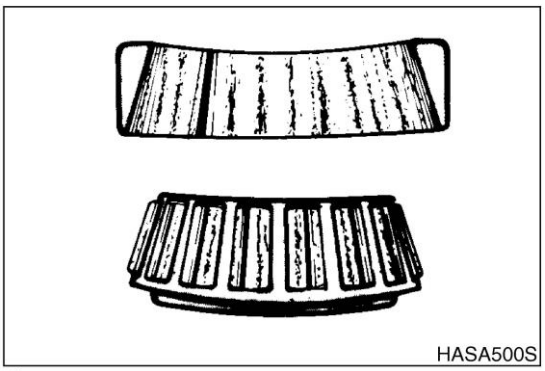


Figure 7

Misalignment

Outer race misalignment due to foreign object.

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

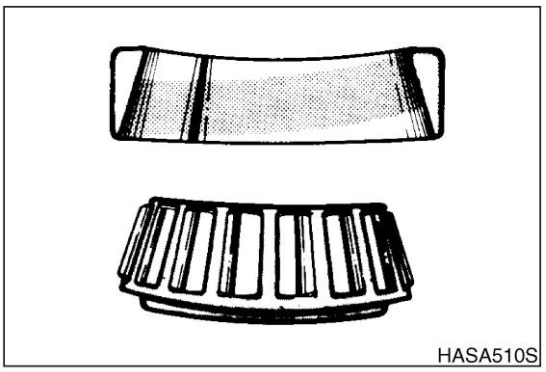


Figure 8

Indentations

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

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

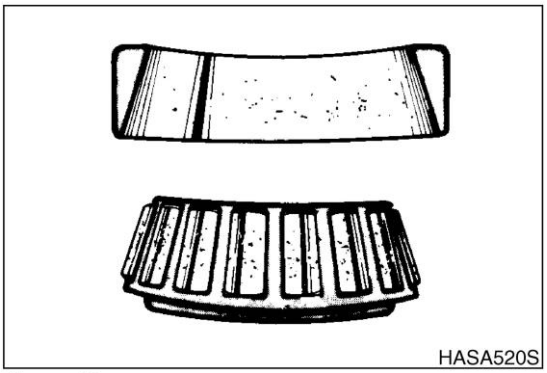


Figure 9

Fatigue Spalling

Flaking of surface metal resulting from fatigue.

Replace bearing - clean all related parts.

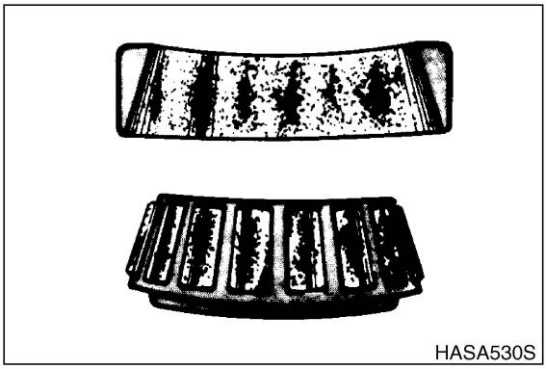


Figure 10

Brinelling

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

Replace bearing if rough or noisy.

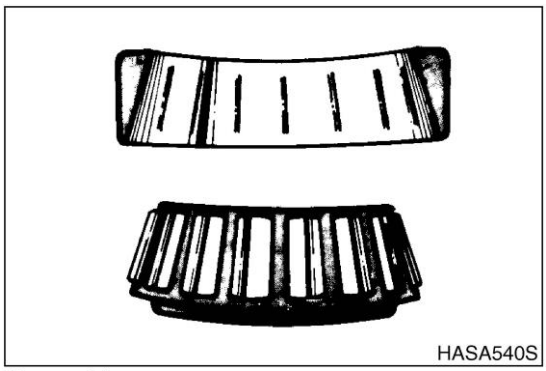


Figure 11

Cage Wear

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

Replace bearings - check seals.

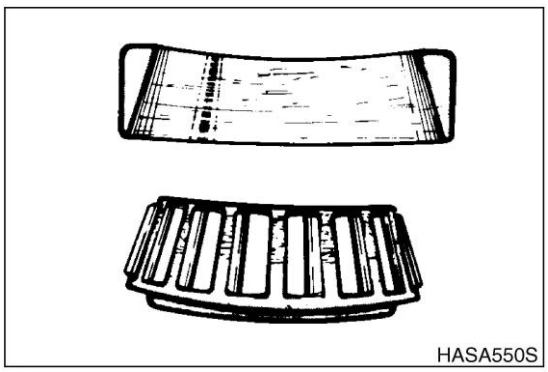


Figure 12

Abrasive Roller Wear

Pattern on races and rollers caused by fine abrasives.

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

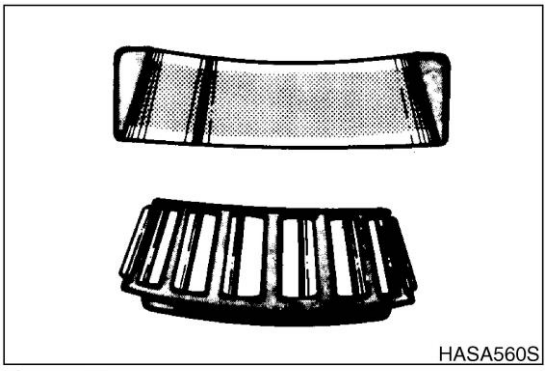


Figure 13

Cracked Inner Race

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

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

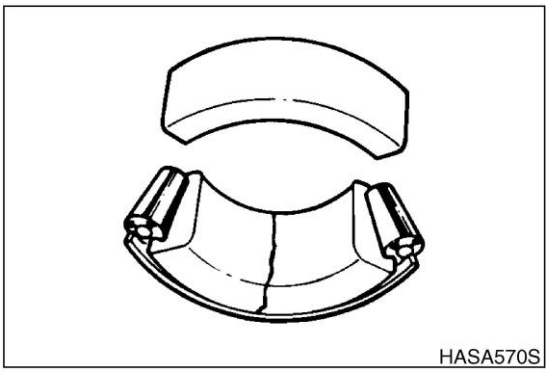


Figure 14

Smears

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

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

Replace shaft if damaged.

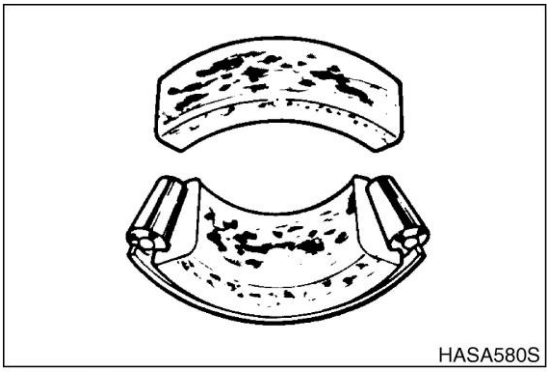


Figure 15

Frottage

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

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

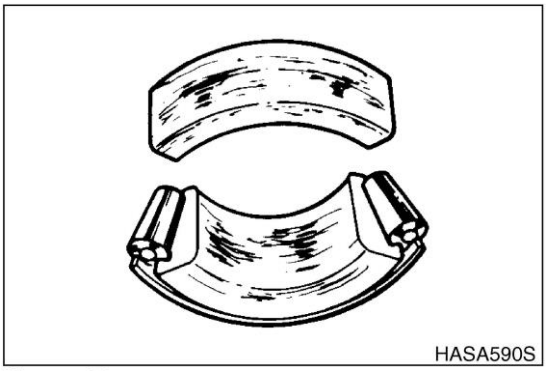


Figure 16

Heat Discoloration

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

Excessive heat can cause softening of races or rollers.

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

Replace bearing if over heating damage is indicated.

Check seals and other related parts for damage.

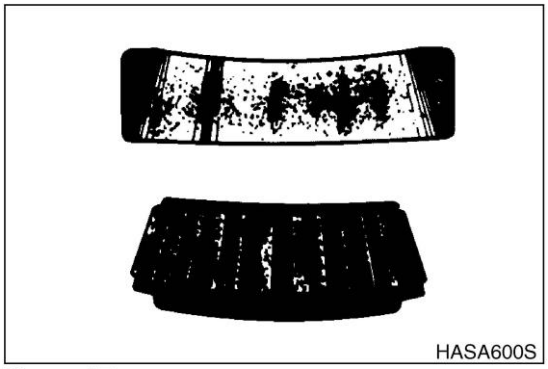


Figure 17

Stain Discoloration

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

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

Check seals and other related parts for damage.

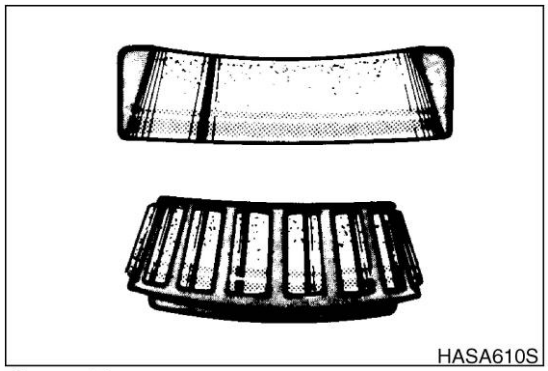


Figure 18

STANDARD TORQUES

⚠ CAUTION!

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

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

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

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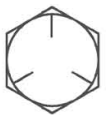
TORQUE VALUES FOR STANDARD METRIC FASTENERS

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

Dia. x Pitch (mm)	Grade										
	3.6 (4A)	**4.6 (4D)**	**4.8 (4S)**	**5.6 (5D)**	**5.8 (5S)**	**6.6 (6D)**	**6.8 (6S)**	**6.9 (6G)**	**8.8 (8G)**	**10.9 (10K)**	**12.9 (12K)**
M5 x Std.	0.15 (1.08)	0.16 (1.15)	0.25 (1.80)	0.22 (1.59)	0.31 (2.24)	0.28 (2.02)	0.43 (3.11)	0.48 (3.47)	0.50 (3.61)	0.75 (5.42)	0.90 (6.50)
M6 x Std.	0.28 (2.02)	0.30 (2.16)	0.55 (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 (1.99)
M8 x Std.	0.70 (5.06)	0.75 (5.42)	1.10 (7.95)	1.00 (7.23)	1.40 (10.12)	1.25 (9.04)	1.90 (13.74)	2.10 (15.18)	2.20 (15.91)	3.10 (22.42)	3.80 (27.48)
M8 x 1	0.73 (5.28)	0.80 (5.78)	1.20 (8.67)	1.00 (7.23)	1.50 (10.84)	1.35 (9.76)	2.10 (15.18)	2.30 (16.63)	2.40 (17.35)	3.35 (24.23)	4.10 (29.65)
M10 x Std.	1.35 (9.76)	1.40 (10.12)	2.20 (15.91)	1.90 (13.74)	2.70 (19.52)	2.35 (19.99)	3.70 (26.76)	4.20 (30.37)	4.40 (31.18)	6.20 (44.84)	7.20 (52.07)
M10 x 1	1.50 (10.84)	1.60 (11.57)	2.50 (18.08)	2.10 (15.18)	3.10 (22.42)	2.80 (20.25)	4.30 (31.10)	4.90 (35.44)	5.00 (36.16)	7.00 (50.63)	8.40 (60.75)
M12 x Std.	2.40 (17.35)	2.50 (18.08)	3.70 (26.76)	3.30 (23.86)	4.70 (33.99)	4.20 (30.37)	6.30 (45.56)	7.20 (52.07)	7.50 (54.24)	10.50 (75.94)	12.50 (90.41)
M12 x 1.5	2.55 (18.44)	2.70 (19.52)	4.00 (28.93)	3.50 (25.31)	5.00 (36.16)	4.50 (32.54)	6.80 (49.18)	7.70 (55.69)	8.00 (57.86)	11.20 (81.00)	13.40 (96.92)
M14 x Std.	3.70 (26.76)	3.90 (28.20)	6.00 (13.23)	5.20 (37.61)	7.50 (54.24)	7.00 (50.63)	10.00 (72.33)	11.50 (83.17)	12.00 (86.79)	17.00 (122.96)	20.00 (144.66)
M14 x 1.5	4.10 (29.65)	4.30 (31.10)	6.60 (47.73)	5.70 (41.22)	8.30 (60.03)	7.50 (54.24)	11.10 (80.28)	12.50 (90.41)	13.00 (94.02)	18.50 (11.26)	22.00 (158.12)
M16 x Std.	5.60 (40.50)	6.00 (43.39)	9.00 (65.09)	8.00 (57.86)	11.50 (83.17)	10.50 (75.94)	15.50 (112.11)	17.90 (129.47)	18.50 (133.81)	26.00 (188.05)	31.00 (224.22)
M16 x 1.5	6.20 (44.84)	6.50 (47.01)	9.70 (70.16)	8.60 (62.20)	12.50 (90.41)	11.30 (81.73)	17.00 (122.96)	19.50 (141.04)	20.00 (144.66)	28.00 (202.52)	35.50 (256.77)
M18 x Std.	7.80 (56.41)	8.30 (60.03)	12.50 (90.41)	11.00 (79.56)	16.00 (115.72)	14.50 (104.87)	21.00 (151.89)	27.50 (198.90)	28.50 (206.14)	41.00 (296.55)	43.00 (311.01)
M18 x 1.5	9.10 (65.82)	9.50 (68.71)	14.40 (104.15)	12.50 (90.41)	18.50 (133.81)	16.70 (120.79)	24.50 (177.20)	27.50 (198.90)	28.50 (206.14)	41.00 (296.55)	49.00 (354.41)
M20 x Std.	11.50 (83.17)	12.00 (86.79)	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)
M20 x 1.5	12.80 (92.58)	13.50 (97.64)	20.50 (148.27)	18.00 (130.19)	25.00 (180.82)	22.50 (162.74)	35.00 (253.15)	39.50 (285.70)	41.00 (296.55)	58.00 (419.51)	68.00 (491.84)
M22 x Std.	15.50 (112.11)	16.00 (115.72)	24.50 (177.20)	21.00 (151.89)	30.00 (216.99)	26.00 (188.05)	42.00 (303.78)	46.00 (332.71)	49.00 (354.41)	67.00 (484.61)	75.00 (542.47)
M22 x 1.5	17.00 (122.96)	18.50 (133.81)	28.00 (202.52)	24.00 (173.59)	34.00 (245.92)	29.00 (209.75)	47.00 (339.95)	52.00 (44.76)	56.00 (405.04)	75.00 (542.47)	85.00 (614.80)
M24 x Std.	20.50 (148.27)	21.50 (155.50)	33.00 (238.68)	27.00 (195.29)	40.00 (289.32)	34.00 (245.92)	55.00 (397.81)	58.00 (419.51)	63.00 (455.67)	82.00 (593.10)	92.00 (655.43)
M24 x 1.5	23.00 (166.35)	35.00 (253.15)	37.00 (267.62)	31.00 (224.22)	45.00 (325.48)	38.00 (202.52)	61.00 (441.21)	67.00 (484.61)	74.00 (535.24)	93.00 (672.66)	103.00 (744.99)

TORQUE VALUES FOR STANDARD U.S. FASTENERS

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

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

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

NOTE: *Multiply the standard torque by:*

0.65 when finished jam nuts are used.

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

0.75 when parkerized bolts or nuts are used.

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

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

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

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

NOTE: *TORQUE VALUES LISTED THROUGHOUT THIS MANUAL ARE LUBRICATED (WET) THREADS; VALUES SHOULD BE INCREASED 1/3 FOR 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 (N•m)	FOOT POUNDS (ft lb)	NEWTON METER (N•m)
1/4" - 20	6	8	9	12
1/4" - 28	7	9	11	15
5/16" - 18	13	18	18	24
5/16" - 24	15	20	21	28
3/8" - 16	24	33	34	46
3/8" - 24	27	37	38	52
7/16" - 14	38	52	54	73
7/16" - 20	42	57	60	81
1/2" - 13	58	79	82	111
1/2" - 20	65	88	90	122
9/16" - 12	84	114	120	163
9/16" - 18	93	126	132	179
5/8" - 11	115	156	165	224
5/8" - 18	130	176	185	251
3/4" - 10	205	278	290	393
3/4" - 16	240	312	320	434
7/8" - 9	305	414	455	617
7/8" - 14	334	454	515	698
1" - 8	455	617	695	942
1" - 14	510	691	785	1064
1 1/8" - 7	610	827	990	1342
1 1/8" - 12	685	929	1110	1505
1 1/4" - 7	860	1166	1400	1898
1 1/4" - 12	955	1295	1550	2102
1 3/8" - 6	1130	1532	1830	2481
1 3/8" - 12	1290	1749	2085	2827
1 1/2" - 6	1400	2034	2430	3295
1 1/2" - 12	1690	2291	2730	3701
1 3/4" - 5	2370	3213	3810	5166
2" - 4 1/2	3550	4813	5760	7810

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

TYPE 8 PHOSPHATE COATED HARDWARE

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

The torques shown below also apply to the following:

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

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

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

TORQUE VALUES FOR HOSE CLAMPS

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

CLAMP TYPE AND SIZE	TORQUE			
	RADIATOR, AIR CLEANER, BOOTS, ETC.		HYDRAULIC SYSTEM	
	KILOGRAM METER (kg•m)	INCH POUNDS (in lb)	KILOGRAM METER (kg•m)	INCH POUNDS (in lb)
"T" Bolt (Any Diameter)	0.68 - 0.72	59 - 63	-------	------
Worm Drive - Under 44 mm (1-3/4 in) Open Diameter	0.2 - 0.3	20 - 30	0.5 - 0.6	40 - 50
Worm Drive - Over 44 mm (1-3/4 in) Open Diameter	0.5 - 0.6	40 - 50	-------	------
Worm Drive - All "Ultra-Tite"	0.6 - 0.7	50 - 60	0.5 - 0.6	40 - 50

TORQUE VALUES FOR SPLIT FLANGES

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

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

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

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

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

TORQUE WRENCH EXTENSION TOOLS

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

Common problems that could occur as a result are:

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

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

TORQUE MULTIPLICATION

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

For example, doubling the distance between the bolt and the back (handle) end of the torque wrench doubles the tightening force on the bolt.

It also halves the indicated reading on the scale or dial of the torque wrench. To accurately adjust or convert indicated scale or dial readings, use the following formula:

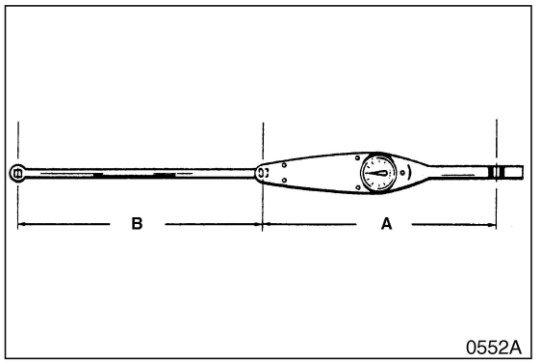


Figure 1

I = A x T / A + B where:

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

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

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

B = Length of the extension.

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

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

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

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

OTHER USES FOR TORQUE WRENCH EXTENSION TOOLS

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

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

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

TIGHTENING TORQUE SPECIFICATIONS (METRIC)

(For coated threads, prelubricated assemblies.)

⚠ CAUTION!

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

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

IMPORTANT

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

I. "Loctite" Fastener Adhesives

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

II. "Loctite" Pipe Thread Sealant

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

III. "Loctite" gasket/flange sealer

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

COUNTERWEIGHT

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

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Specifications

NOTE: ***weight***

	Weight
HL635AL	820 kg (1,027 lb)

Counterweight

1. Parts list

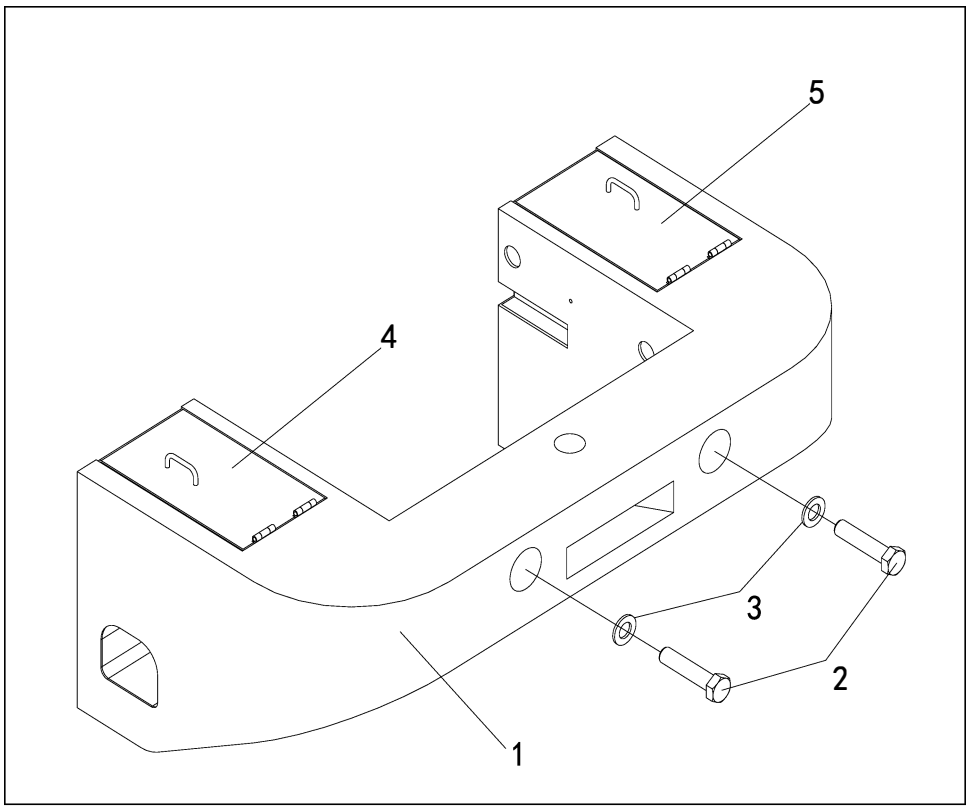

Figure 1

Reference Number	Description	Reference Number	Description
1	COUNTERWEIGHT	4	COVER(R,H)
2	BOLT	5	COVER(L,H)
3	WASHER;HARDEN		

2. TORQUE

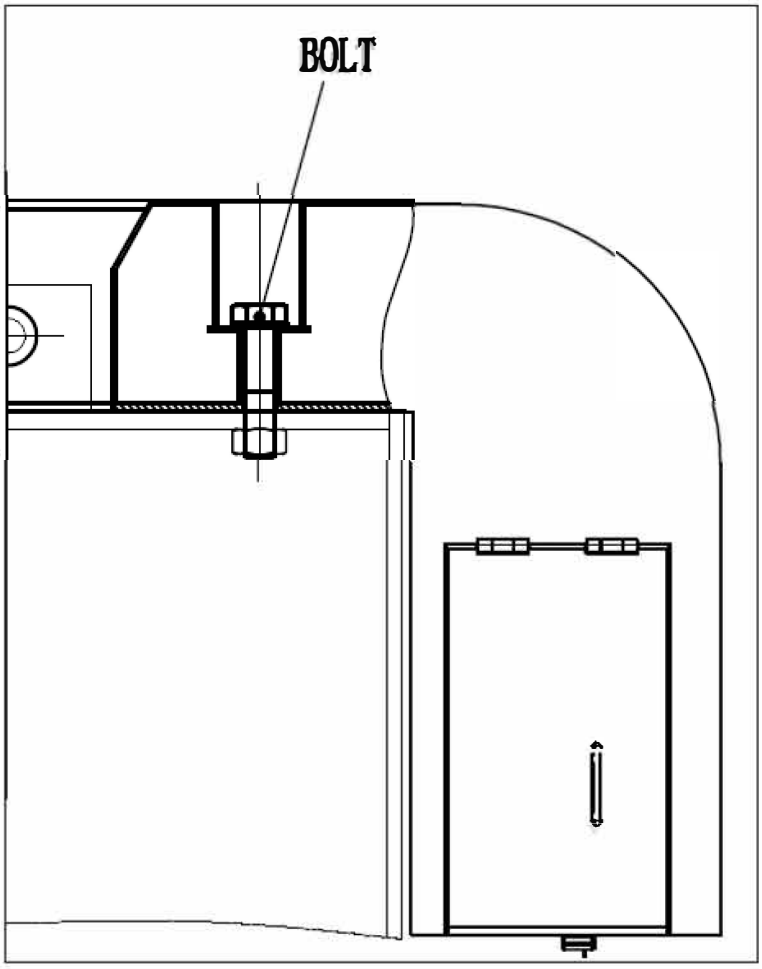

Fig.2

NOTE: *1) Tighten bolt to torque value list in the following table.*

	100kg • m (726 ft lb)

SPC000055

HYDRAULIC OIL TANK

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

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GENERAL DESCRIPTION(PILOT LEVER)

Parts list(Pilot Lever)

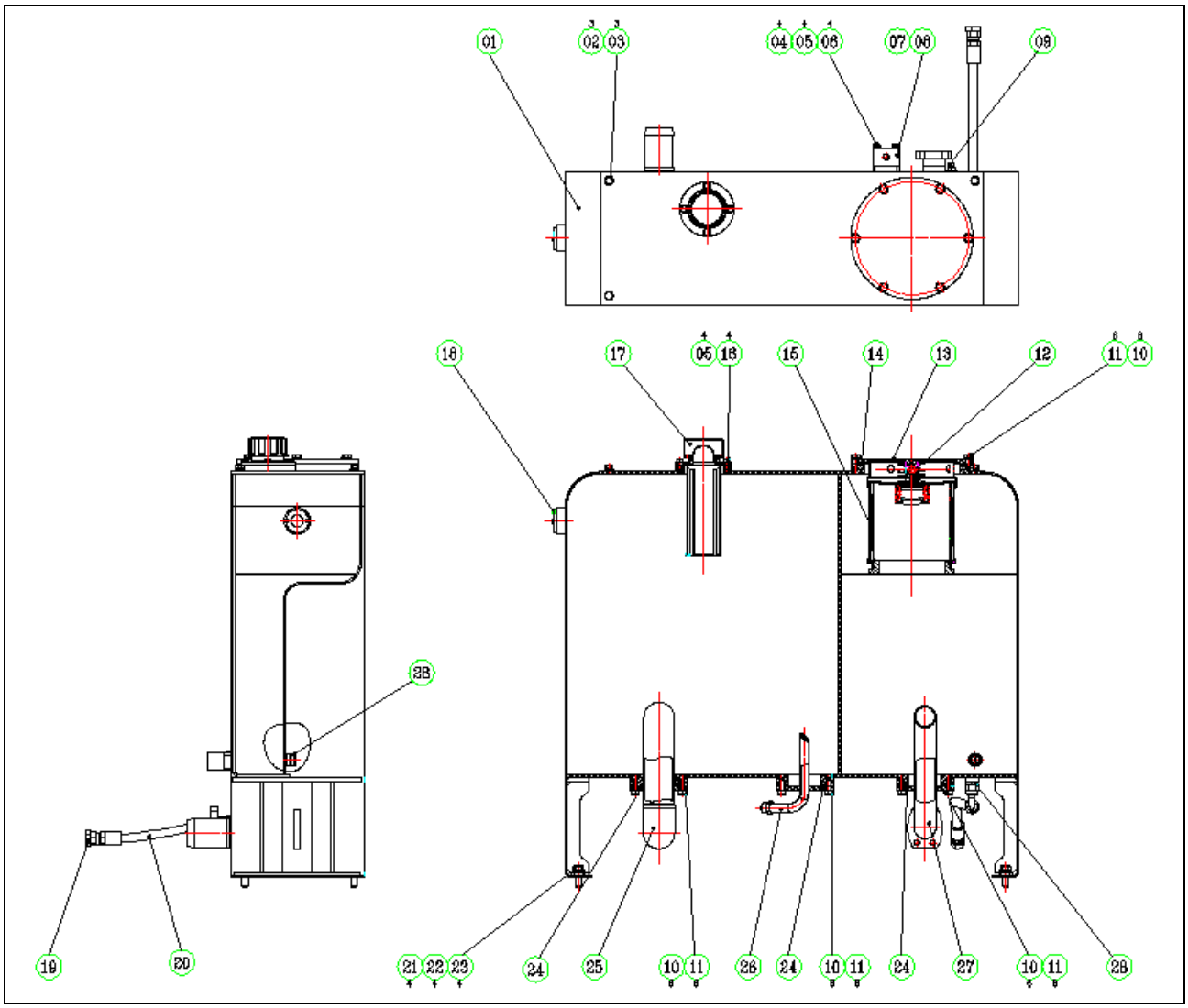

Figure 1

Reference Number	Description	Reference Number	Description
01	Oil Tank	09	Adapter
02	Plug	10	Bolt
03	Ring Seal	11	Washer Plain
04	Bolt	12	Spring
05	Washer Plain	13	Cover
06	Washer Spring	14	O Ring
07	Block	15	Filter Return
08	O Ring	16	Bolt
17	Filter	23	Washer Spring
18	Gauge Level	24	O Ring
19	Plug	25	Suction Tube
20	Hose	26	Pipe
21	Bolt	27	Pipe Return
22	Washer Plain	28	Adapter

Specifications(Pilot Lever)

	HL635AL **(Pilot Lever)**
TYPE	Pressure seal
Capacity (system0	124 L
Air breather	
Starting pressure	0.035 MPa
Return filter	
Filter accuracy	12μ
Pressure descending	0.045 MPa @800L/min

GENERAL DESCRIPTION (MECHANICAL LEVER)

Parts list (MECHANICAL LEVER)

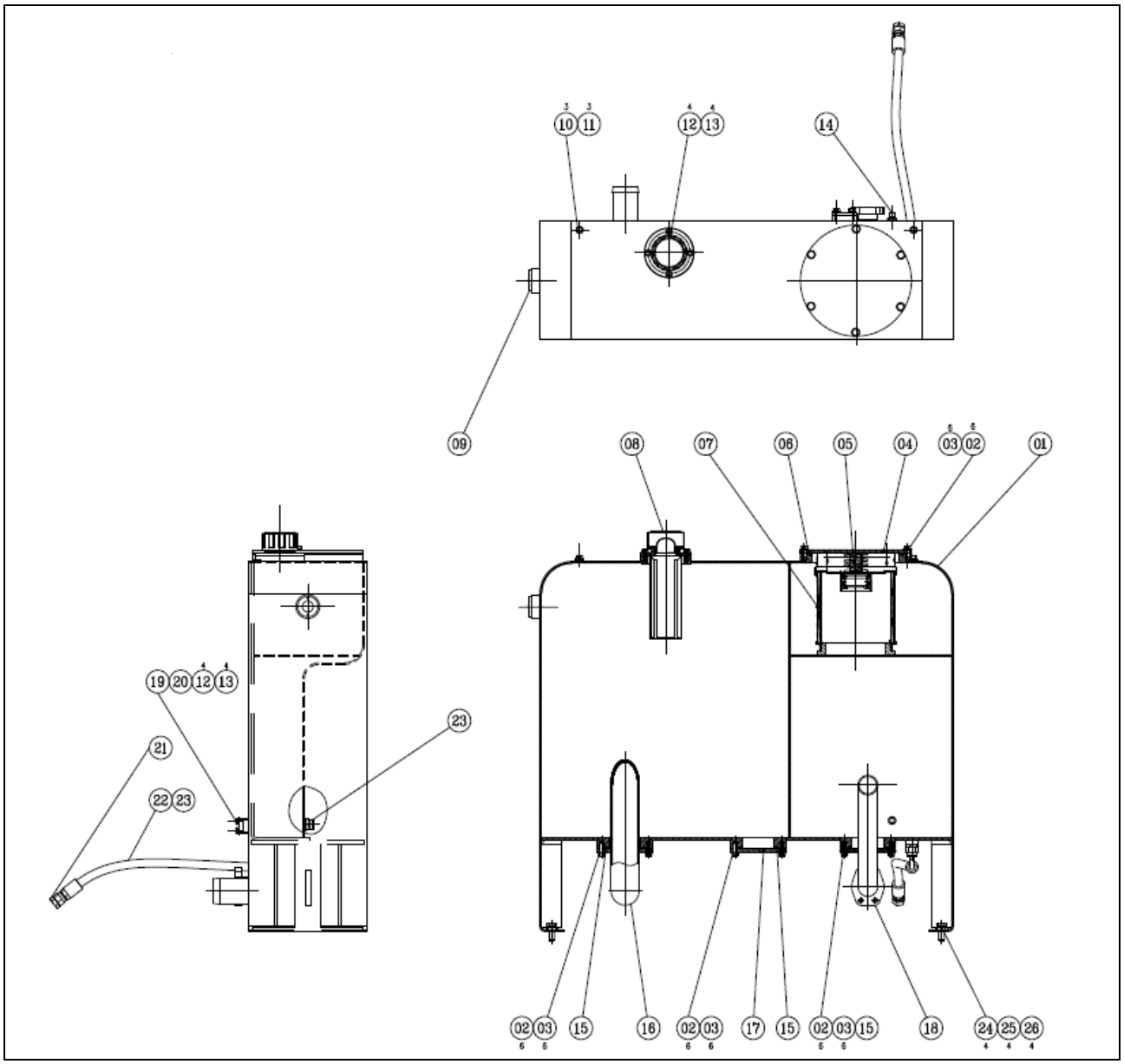

Figure 2

Reference Number	Description	Reference Number	Description
01	Oil Tank	14	Adapter
02	Bolt	15	O Ring
03	Washer Plain	16	Suck Tube
04	Cover	17	Flange
05	Spring	18	Pipe Return
06	O Ring	19	Plate
07	Filter Return	20	O Ring
08	Filter	21	Plug
09	Gauge Level	22	Hose
10	Plug	23	Adapter
11	Washer	24	Washer Plain
12	Bolt	25	Bolt
13	Washer Plain	26	Washer Spring

Specifications (Mechanical Lever)

	HL635AL **(MECHANICAL LEVER)**
TYPE	Pressure seal
Oil Tank Capacity	124 L
Air breather	
Starting pressure	0.035 MPa
Return filter	
Filter accuracy	12μ
Pressure descending	0.045 MPa @800L/min

LOWER STRUCTURE AND CHASSIS

CENTER JOINT
(ARTICULATION JOINT)

⚠ CAUTION!
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General Description

The loader frame is an articulated type: the front frame is joined to the rear frame with two hinge pins around which the loader pivots for steering.

⚠ CAUTION!

When the loader is steered, the area near center hinge pins becomes so narrow that you may get caught between front and rear frames. Before trying to service the loader, make sure to set frame lock plate.

Prior to moving (traveling) the loader, make sure the frame lock plate is set to original position.

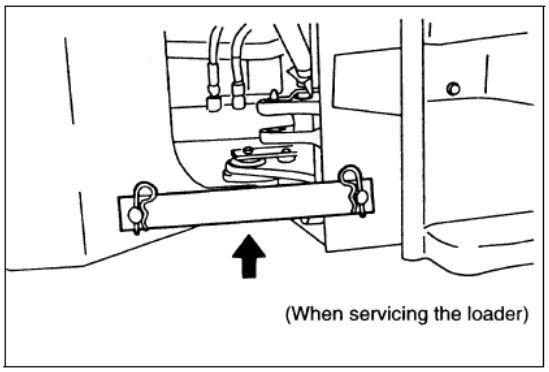

Figure 1

Maintenance Standard

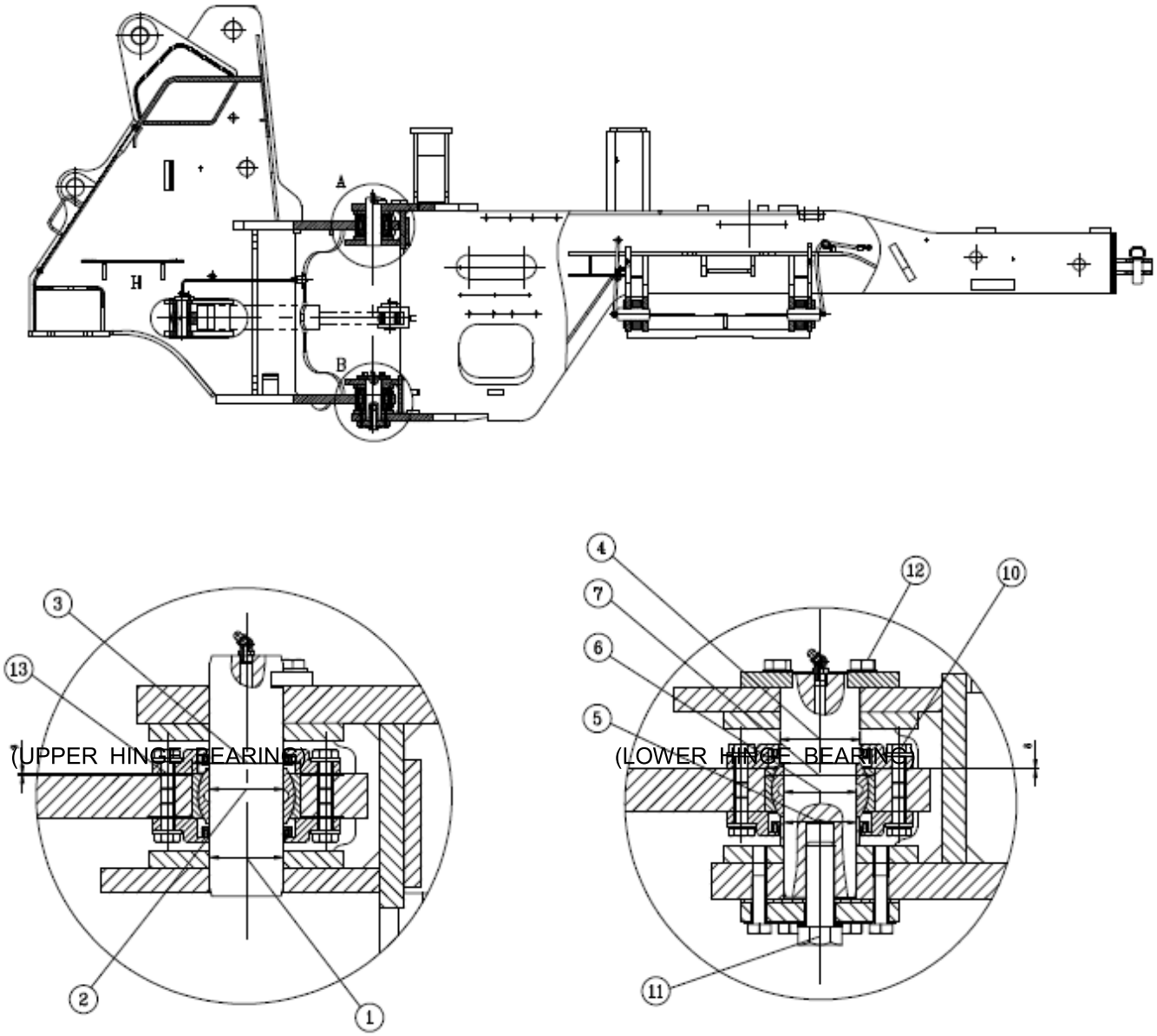

Figure 2

UNIT :*mm*

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between upper hinge pin and front frame</td><td>Standard size</td><td colspan="2">Tolerance</td><td>Standard Clearance</td><td>Clearance limit</td><td rowspan="11">Replace</td></tr>
<tr><td rowspan="2">60</td><td>0</td><td>+0.046</td><td rowspan="2">0-0.065</td><td rowspan="2">-</td></tr>
<tr><td>-0.019</td><td>0</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Clearance between upper hinge pin and bearing</td><td rowspan="2">60</td><td>0</td><td>0</td><td rowspan="2">-0.015-0.019</td><td rowspan="2">-</td></tr>
<tr><td>-0.019</td><td>-0.015</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Clearance between bearing and rear frame</td><td rowspan="2">90</td><td>0</td><td>0</td><td rowspan="2">-0.035-0.015</td><td rowspan="2">-</td></tr>
<tr><td>-0.015</td><td>-0.035</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Clearance between lower hinge pin and front frame</td><td rowspan="2">66</td><td>0</td><td>+0.046</td><td rowspan="2">0-0.12</td><td rowspan="2">-</td></tr>
<tr><td>-0.074</td><td>0</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Clearance between lower hinge pin and spacer</td><td rowspan="2">60</td><td>0</td><td>+0.414</td><td rowspan="2">0.34-0.433</td><td rowspan="2">-</td></tr>
<tr><td>-0.019</td><td>+0.34</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Clearance between lower hinge pin and bearing</td><td rowspan="2">60</td><td>0</td><td>0</td><td rowspan="2">-0.015-0.019</td><td rowspan="2">-</td></tr>
<tr><td>-0.019</td><td>-0.015</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Clearance between lower hinge bearing and rear frame</td><td rowspan="2">90</td><td>0</td><td>0</td><td rowspan="2">-0.035-0.015</td><td rowspan="2">-</td></tr>
<tr><td>-0.015</td><td>-0.035</td></tr>
<tr><td>8</td><td>Shim thickness for lower hinge and cap (rear frame)</td><td>0.5~1.0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>9</td><td>Shim thickness for upper hinge and cap (rear frame)</td><td>0.5~1.0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>10</td><td>Tightening torque of lower hinge cap mounting bolt (M12)</td><td colspan="5">Final value: 9±1.0 kg·m</td><td rowspan="4">Retighten</td></tr>
<tr><td>11</td><td>Tightening torque of lower hinge cap mounting bolt (M24)</td><td colspan="5">Final value: 90±1.0 kg·m</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">Tightening torque of lower hinge pin mounting bolt</td><td colspan="5">When adjusting with shim: 6~7 kg·m</td></tr>
<tr><td colspan="5">Final value: 9±1.0 kg·m</td></tr>
<tr><td>13</td><td>Tightening torque of upper hinge cap mounting bolt</td><td colspan="5">Final value: 9±1.0 kg·m</td><td>Retighten</td></tr>
</table>

ENGINE AND DRIVING TRAIN

Special Notice

- Before operating the diesel engine, please always read this Maintenance Manual carefully, follow the technical operation and maintenance practices therein strictly.
- Fuel injection pump and injector are of precision components, and the users cannot disassemble them at will.
- The turbocharger rotor is of high-speed rotating part, when the machine is runing, please keep any movable objects (such as hand, tool or cotton yarn) away from the turbocharger inlet to avoid personal injury or machine damage; the rotor assembly of turbocharger cannot be dismantled by users.
- For the main bearing bolts, connecting rod bolts and other bolts, there are strict requrements on tightening torques and repeated uses, it is prohibited to unscrew or dismantle at will. The connecting rod bolts are disposable and cannot be reused.
- The diesel engine should be filled with oil and fuel specified in thisMaintenance Manual and they should be filtered with special filtersin filling (the fuel should also be deposited for 72h before filling).Beforestart the diesel engine, be sure that the amounts of fuel, oil and coolant are as specified.
- It's prohibited to run the diesel engine without air filter to avoid the unfiltered air from entering the cylinder directly.
- If the engine is started in cold state, run the engine at idle speed for a while (about 3~5 min) and then increase the engine speed slowly instead of running at high speed suddenly, and do not run it at idle speed for a long time. Afterrunningunder heavy load, run the engine at low speed for 5~10 min before stopping, instead of stop the engine immediately (exceptin special cases).
- Check the engine coolant regularly, and replace it timely. It is prohibited to use water or poor quality coolant.
- Onlyhavethe components of electrical system of diesel engine inspected by professional technicians.
- To prevent corrosion, the diesel engine has been oil sealed before delivery and the oil seal period is generally one year, please check and take necessary measures if exceeds one year.

3ton Diesel Engine

⚠ CAUTION!
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Chapter I General Instructions for Use of the Diesel Engine

Outline Drawings of the Diesel Engine

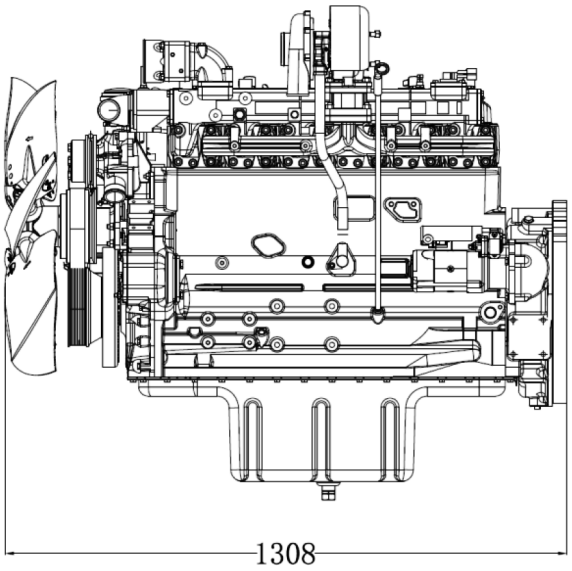


Figure 1 WP6Diesel Engine Outline Drawing

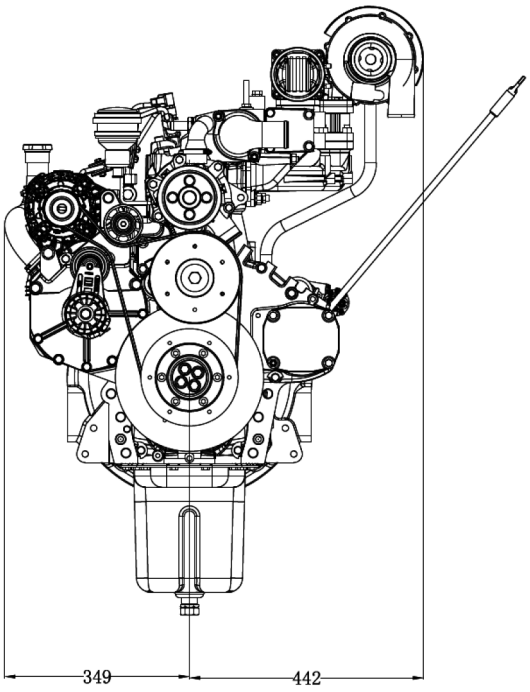


Figure 2 WP6Diesel Engine Outline Drawing

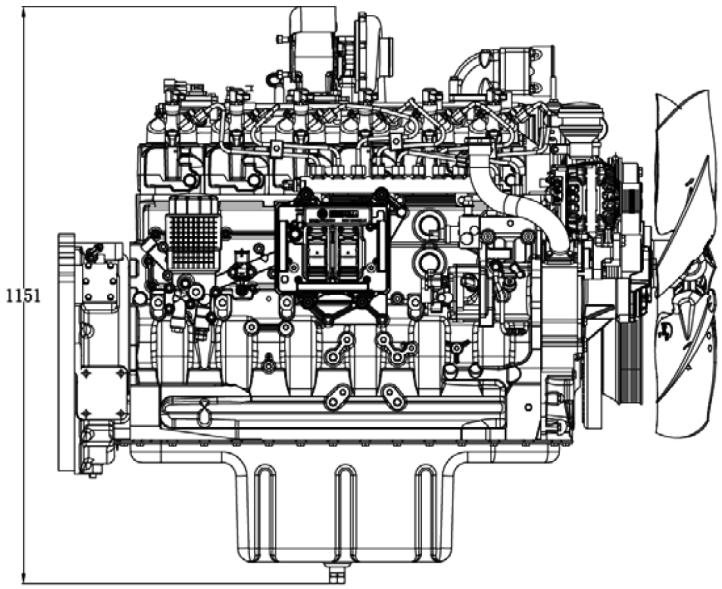


Figure 3 WP6Diesel Engine Outline Drawing

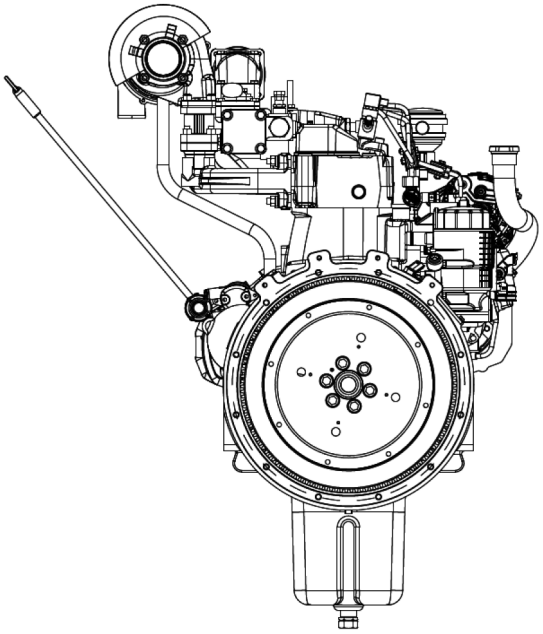
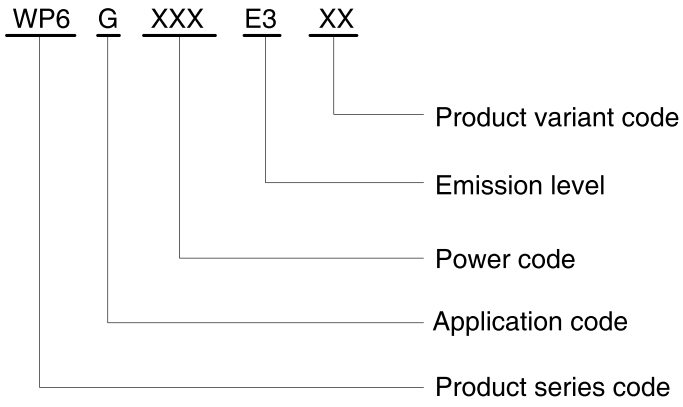


Figure 4 WP6Diesel Engine Outline Drawing

Meaning of Diesel Engine Model



BasicParameters of the Diesel Engine

Table 1-1Main technicaland performance parameters of WP6China III electronic control diesel engine for construction machinery (excavator)

Items	Unit	Parameters	
Engine model		WP6	
		WP6G175E301	WP6G190E301
Engine type	—	4-stroke,water cooled, inline, direct injection, wet cylinder liner, high speed diesel engine	
Aspiration method	—	Turbocharged and intercooled	
Displacement	L	6.75	
Bore×stroke	mm×mm	105×130	
Number of cylinder	—	6	
Valves per cylinder	—	2	
Compression ratio	—	18:1	
Firing order	—	1-5-3-6-2-4	
Fuel injection device	—	Electronic control pump	
Rated power	kW	129	140
Rated speed	r/min	2000	2000
Maximum torque	Nm	760	860
Speed at maximum torque	r/min	1300~1500	
Emission level	—	Non-road China III	
Fuel consumption at rated power	g/(kW•h)	≤250	
Minimum fuel consumption at full load	g/(kW•h)	≤210	
Oil consumption	g/(kW•h)	≤0.5	
Noise at 1m away from the engine	dB(A)	≤115	≤116
B10 life	h	6000	
Oil pan capacity	L	16 (based on the oil dipstick marks)	

Unsealling of the Diesel Engine

After the en gine packingg case is openned, please firrst check the engine and itts accessoriess according too the packingg list, and chheck the engiine appearannce for damaage and loosse connectionns before caarrying out thhe followingg operations:

1) Wipe awaay the rust prooof coat or annti-corrosion agent on the surfaces of eexposed compponents.
2) Drain thee sealing oil ffrom the fuel filter and fueel system commponents (it is allowed too run the engiine with loadd only when thhe sealing oill is used up annd the normaal diesel fuel hhas been suppplied).
   Notice: *The oil seal is onnly effective for one year,and when thhe time is up , please get yyour engine innspected andd take necessaary remedies.*
3) Rotate th e flywheel annd spray solvvent into the iintake pipe uuntil the oil seealing oil in tthe cylinder iis completelyy removed.
4) Spray sol vent into the turbochargerr intake/exhauust ports untill the oil sealinng oil is commpletely removved.
5) Add lubrricating oil off specified grrade to the ooil pan as reqquired.If the ooil containingg running-in accelerant iss filled in the oil pan beforre delivery, it is suggested that the oil sshould be dra ined off afterr running for 50h and thenn fill with neww oil.
6) Base on tthe agreemennt between Doosan and user, if the coolant is already filledd according tto the user'ss requirement before delivery, please chheck the coollant performaance when unnpacking. If tthe antifreezinng capabilityy is suitable ffor -30°C orr -35°C, the PH value iss 7~8 (neutrral), the totall hardness nnumber is 5-15°d [9-15°ff (hardness)], the coolant ccan be used. Otherwise, ddrain the coollant and add nnew coolant which contaiins antifreezee additives.

Hoistinng of the Diesel Engine

When hoistiing the engin e, keep the e ngine cranks haft centerlinne horizontal,, and never hhoist it obliquuely or at onee side (as showwn in figure 5).

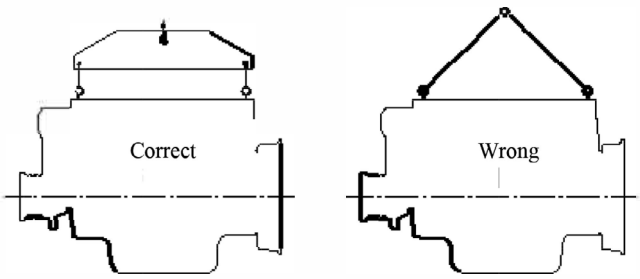


Figure 5

Preparrationsfor Diesel Engine Startingg

1) Check co olant level
   Add coolantt from the fillller port if neecessary. Whhen the enginne is still hott, beforeopenn the filler caap with relieff valve and blleed button, pplease alwayys press downn the bleed bbutton first to release the hhot air. It is prohibited too add a large aamountof cooolant when thhe engine is r elative hot; ootherwise, thee related partss of diesel en gine may gett damaged duue to sudden eexcessive temmperature change. The cooolant (water) sshould be addded via the fillller port untill it overflowss. Start the enngine, and wwhen the engiine is runnin g (at 1000 r//min), continnue to add cooolant till thee liquid level iis stable, andd then close thhe filler cap.
2) Check fueel level
   If the enginee has been innstalled on thee vehicle, turrn on the powwer supply swwitch, and cheeck fuel leve l through thee fuel meter o r check the fuuel tank direcctly.

3) Check en gine oil levell 4) Check accessories of the diesel engine

The engine oil level shall be locatedat between the upper and lower markings of the oil dipstick. If necessary, add engine oil from the filler port.

4) Check accessories of the diesel engine
   Check all accessories of the diesel engine for reliable connections. Check the starting system for normal wiring and check and ensure that the battery is sufficiently charged. Then open the valve of fuel tank, unscrew the bleeding screw onprimary fuel filter, andoperate the manual pump on the injection pump toremove the air inside the fuel system.

Starting of the Diesel Engine

When the startup conditions are met, turn the electric key to start the diesel engine. Ifthe engine fails to be started within 5~10 seconds for the first attempt, start it again 1 minute later. If the engine still fails to be started after three attempts, stop the attempt and find out and solve the malfunction before retry.

After the engine is started, check the readings of instruments. The engine oil pressure meter shall immediately indicate a pressure. Do not immediately have the cold engine running at a high speed.

It is recommended to use the starting aid in case of engine startup at lower temperature. With the action of relay, the electronic heating flange begains to work and then heats the incoming air, allowing a smooth startup of the engine at -30°C.

Running of the Diesel Engine

1) After the engine is started, run it at idle speed for 3 minutes and then increase the speed to 1,000~1,200 r/min and add some load.Only when the water outlet temperature is higher than 60°C and the oil temperature is higher than 50°C, can you operate the engine with full-load. It is recommended to increase the load and speed gradually, and avoid sudden loading or unloading as possible.
2) It is recommended to run the engine with medium load during the running-in period (50h).
3) Reduce the speed timely when driving on a slope. Long term work under large torque condition, too small load, and low rotating speed are not recommend, for which may lead to excessive oil consumption.
4) In normal use, the diesel engine is allowed to run continuously at rated power and rated speed, but it may not run for more than 20 min at the speed 105% ofthe rated speedwith thepower 110% of the rated power. After the diesel engine is unloaded, it is required to run the engine at idle speed for (1~2) min before shutdown.
5) Check the parameters and related components in operation:
   a. Oil pressure in main oil passage: (380~580) kPa;
   b. Oil temperature in main oil passage:(85~105) °C;
   c. Coolant outlet temperature: (72~93)°C;
   d. Exhaust temperature after turbine: ≤550°C;
   e. Check the color of exhaust gas to estimate the working performance of fuel injector and the operating load; if the color is abnormal (i.e., serious black or white smoke), stop the engine for troubleshooting.

Notice: *Check the diesel engine for water, air and oil/fuel leakagesduring operation; and if any, stop the engine for troubleshooting.*

6) The operator should acknowledge the following featuresof the engine:
   a. The fuel consumption is relatively low at max torque, and increases along with the rotation speed rise.
   b. The torque reaches its peak value within the medium speed range (1,200 - 1,600 r/min);
   c. The engine power increases along with the speed, and reaches itsrated value at rated speed.

Notice: *To avoid damage of the diesel engine, do not disconnect the cables of voltage regulator and the battery positive electrode when the engine is running. Different with the DC generator, it is prohibited toinspect the voltage of alternator by temporary grounding.*

7) Precautions for running under cold environments:
   a. Fuel: Choosethe diesel fuel of proper grade depending to the ambient temperature in winter.
   b. Lubricating oil: Choose the lubricating oil ofdifferent viscosities based on the season.
   c. Coolant:Add anti-freeze additives into the cooling system, and determine the antifreeze grade and mixture ratio according to the ambient temperature.
   d. Startup: Use starting aid when necessary in winter. After starting the engine, the running speed and load of diesel engine can be increased only after the oil pressure and water temperature become normal.
   e. Battery: Before the cold season comes, make sure to check the electrolyte level, viscosity and unit voltage of the battery; and if the diesel engine is to be withdrawn out of service for a long time and the ambient temperature is very low, it is recommended to remove the battery and keep it in a warm room.
   f. Shutdown: To stop the engine in cold weathers, unload the engine first, and run it at idle speed for (1~2) minutes, and wait for a while until the water temperature and oil temperature lower down; the coolant with antifreeze should not be drained out after shutdown. However, if the coolant contains no antifreeze additive, make sure todrain off the coolant from the engine block, oil cooler, radiator and water pipes toprevent the engine from being frost cracked.

Chapter II Maintenance Guide of the Diesel Engine

Fuel, Lubricating Oil, Coolantand Auxiliary Material of the Diesel Engine

Fuel

When the ambient temperature is above 5ºC, 0# diesel fuel (GB252) shall be used; and generally -10# light diesel fuel (GB252) shall be used when above -5ºC. And if the ambient temperature is lower than -15ºC and-30ºC, -20# and -35# diesel fuel shall be used respectively.

The fuelsused must conform to the requirements specified in section D.1 of Appendix D to the national standard GB 20891-2014.

Lubricating Oil

For non-road China III diesel engine, grade CH-4 lubricating oil shall be used. See table 2-1 for details.

Table 2-1 Engine Oil Special for Engine

Product name	Product category		Packing specification
Diesel engine oil	CH-4	10W-30 15W-40 20W-50	4L, 18L, 170kg

please select the oil viscosity according to the ambient temperatures with reference to Table 2-2.

Table 2-2 Oil Viscosity and Applicable Temperature

SAE viscosity grade	Ambient temperature (ºC)
10W-30	-25~35
15W-40	-20~40
20W-50	-15~50

Notice:

1) Check the oil level in the oil pan before starting the diesel engine.

2) Do not check the oil level while the diesel engine is running.

3) It is not allowed to mix the special oil with other oils.

The oil filling volume and the number of filters of WP6 engine is shown in Table 2-3.

Table 2-3 Oil FillingVolume and Number of Filters of WP6 engine

Engine model	Oil filling capacity (L)		Number of filters	
		Oil filter	Fuel filter	
WP6	25~28	2	1 (primary filter)	1 (secondary filter)

Coolant

Weichai Power special coolants with freezing points of -25°C, -35°C and -40°C are available. Please choose the coolant based on the local ambient temperatures in such manner that the freezing point of coolant should be 10°C lower than the local air temperature. See Table 2-4.

Table2-4Special Coolant for Weichai Power Heavy-duty Engine

Type	Designation	Packing
Heavy-duty engine coolant	HEC-II-25 HEC-II-35 HEC-II-40	4kg, 10kg

Auxiliary materials

Table 2-5 Auxiliary Materials

No.	Name	Color	Function and application
1	MolykotePulver (fine molybdenum powder)	Black	Applied on flat and smooth metal surfaces to prevent seizing For instance: Applied onto outer surface of cylinder liner
2	Molykote G-N plus (Molybdenum disulfide, oil solution)	Dark grey	Achieve lubrication function before lubricating oil pressure is built up For instance: Applied onto intake valve stem

Daily Maintenance Items of the Diesel Engine

Check the liquid level and temperature of coolant

Check the coolant level through the sight hole, and if it is insufficient, open the filler port cap to add coolant.

Notice: *Before opening the filler cap, press down the air bleeding button to avoid personal injuriescaused by the hot coolant while the engine is hot.*

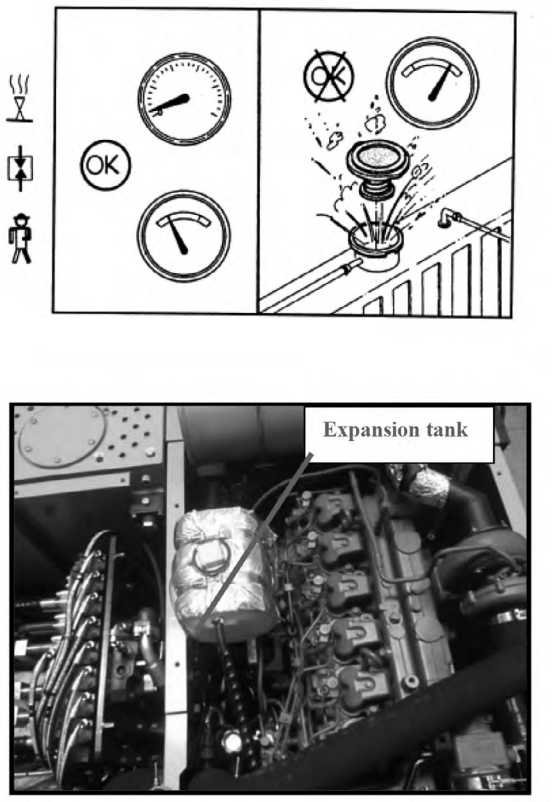


Figure 6

Notice: *Always check the coolant level before starting the diesel engine each time.*

Check oil level

Check the oil level with oil dipstick.When the oil level is below the lower marking or above the upper marking, it is not allowed to start the diesel engine.

When checking the oil level, stop the engine and wait for at least 5 minutes, enabling the oil to flow back to the oil pan.

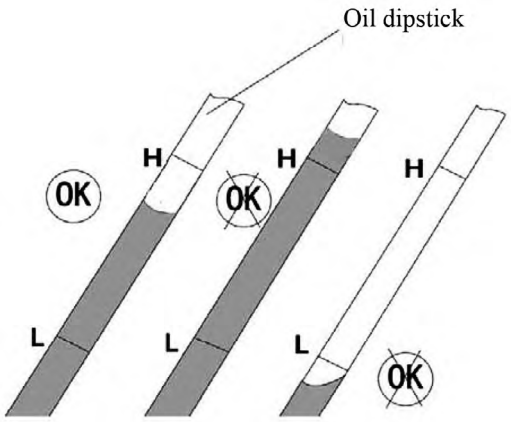


Figure 7

Check fuel level

Check the fuel level through the dashboard (figure 8), and add fuel timely.

Figure 8

Notice: *Always check the fuel level before starting the diesel engine each time.*

Check for air/gas, water and oil/fuel leakage

Check the external surface of diesel engine forwater, air/gas and oil/fuel leakage.

Check the fan

Visually check the fan blade fordeformation and damage (for iron fan, check therivets for looseness) and check the connecting bolts for tightness to ensure the fan works reliably.

Check the belt

The belt is automatically tensioned by thetensioner.Check the tension of belt by pressing the belt with hand.Visually check the V-belt for cracks or scratches, and replace it if necessary.

Check the exhaust color

The normal color of exhaust gas is light grey. Do troubleshooting if the color has changed.

Check the running sound of diesel engine.

Check the speed and vibration of diesel engine.

Periodic Maintenance of the Diesel Engine

Replace the engine oil

Place the diesel engine on a flat and horizontal place, set anoil recycling container under the engine, unscrew the drain plug at the bottom of oil pan (figure 10), drain off the oil completely, then screw in the drain plug again.

Openthe oil filler cap, add fresh new oil through the filler port(figure 9), the oil should be filtered by a strainer when filling; check the oil level through the scale mark of oil dipstick, tighten the filler port cap finally.

Figure 9 Oil filler port

Figure 10 Oil drain plug

Replace theoil filter or filter element

Replace the oil filter as follows:

1) Unscrew the connecting bolts and remove the oil filter assembly;

2)Apply lubricating oil to the rubber sealing ring of new oil filter before assembling;

3) Install the new oil filter assembly onto the engine body, and tighten the bolts;

4) Start the diesel engine and check for oil leakage.

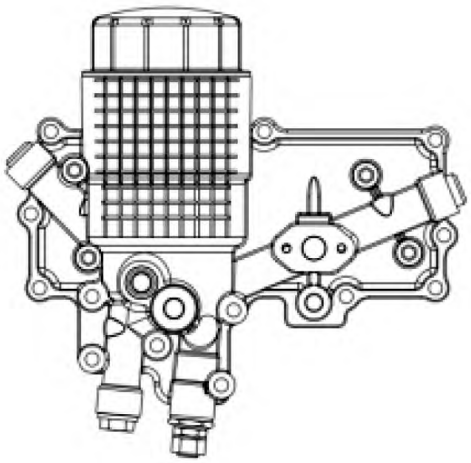


Figure 11 Oil filter

Check and adjust intake/exhaust valve clearance

Check and adjust intake/exhaust valve clearance as follows:

a. With the diesel engine in cold state, turn the flywheel with a bar (along with the running direction of diesel engine crankshaft) to make the pistons of No. 1 cylinder and No. 6 cylinder to TDC, when the notch groove on flywheel should be aligned with the OT groove line on the flywheel housing, as shown in Figure 12.

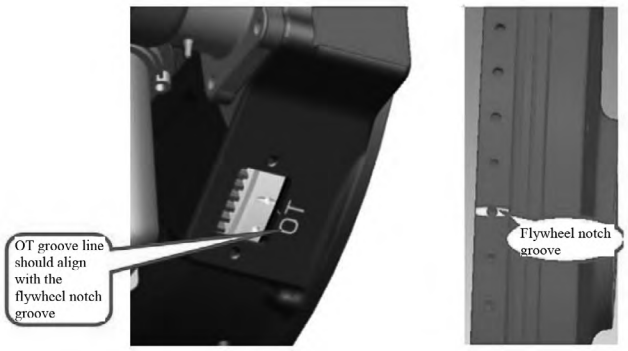


Figure 12 Flywheel notch groove

b. Remove the valve rocker arm cover from the cylinder head, and determine if the No. 1 cylinder or No. 6cylinder is in the compression stroke (as indicated by the existence of clearance between the intake/ exhaust valve and the rocker arm under the compression stroke).

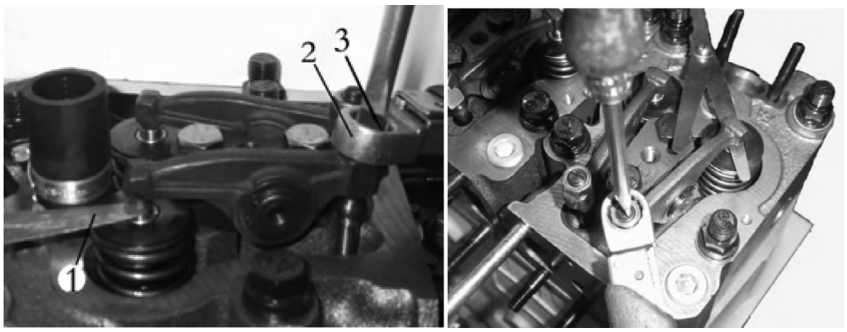


Figure 13 Adjustment of valve clearance

c. Use a feeler gauge to adjust the clearance between the rocker arm and the valve stem head. For WP6 diesel engine, the intake valve clearance and exhaust valve clearance should be 0.4mm and 0.6mm respectively. If the clearance is too large or too small, please regulate the adjusting screw on the rocker arm to achieve the proper valve clearance. As shown in figure 14.

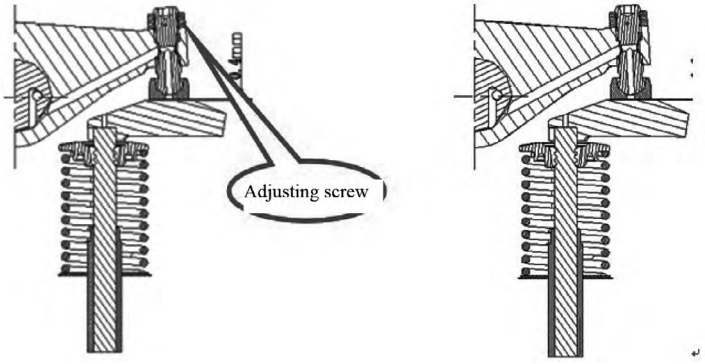


Figure 14 Adjusting screw

d. After the checking of the No. 1 or No. 6 cylinder, turn the flywheel by another 360°, ensuring that the No. 6 cylinder or No. 1 cylinder is at TDC of working stroke, and then adjust the remaining valves.

Table 2-7State of each cylinder when the No. 1 and No. 6 cylinders are in working stroke

	No. 1 cylinder	No. 2 cylinder	No. 3 cylinder	No. 4 cylinder	No. 5 cylinder	No. 6 cylinder
No. 1 cylinder, compression stroke	Intake/exhaust valves	Intake valve	Exhaust valve	Intake valve	Exhaust valve	Non-adjustable
No. 6 cylinder, compression stroke	Non-adjustable	Exhaust valve	Intake valve	Exhaust valve	Intake valve	Intake/exhaust valve

Replace the fuel filter element

Replace the fuel filter element as follows:

a. Remove the used fuel filter element (figure 15), if the water collector installed on the primary filter can be reused, please remove the collector.
b. Lubricate the sealing port.
c. Screw the fuel filter with hands until the sealing port comes into contact with the mating port.
d. Continue to screw the new fuel filter until it is securely installed (about 3/4 turn).
e. Remove the air in the fuel system.
f. Conduct the leakage test.

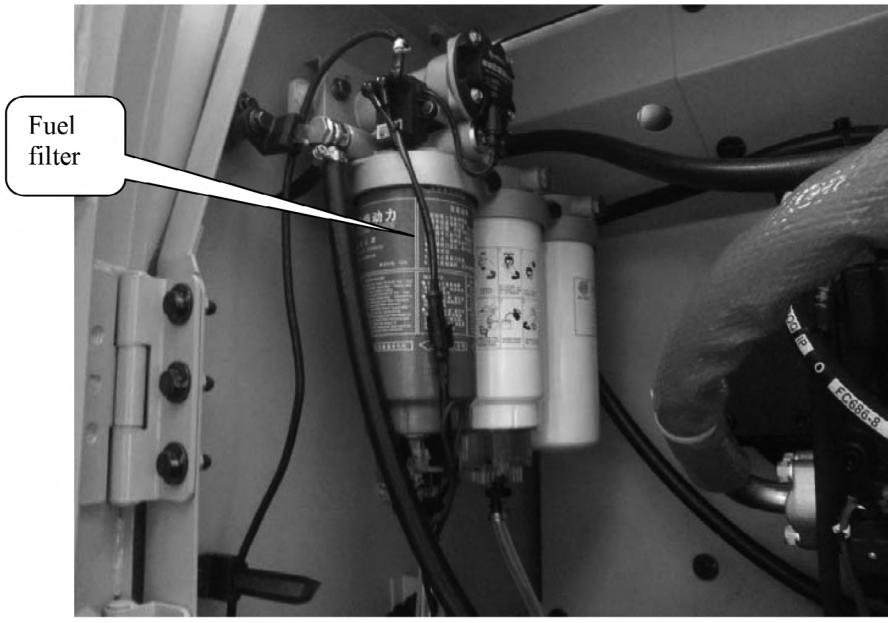


Figure 15 Fuel filter

Check theintake system

Check the intake hose for cracks due to aging, and check the clamp for loosening. When necessary, tighten or replace the related parts to ensure the tightness of intake system.

Maintenance of Diesel Engine for Long-term Storage

Cleaning

Remove the dust with appropriate methods, and clean the parts and positionsto be protectedwith protective agent (such as lubricating oil pipeline, fuel system and turbocharger) thoroughly.

Protection of diesel engine before preservation

a. After warm up of the diesel engine, discharge the engine oil, clean the oil filter, and fill the oil tank or oil pan with rust resisting oil.

b. Drain the diesel fuel out of the fuel system, and fill it with anti-rust oil to protect the fuel pipeline.

c. If the diesel engine is not filled with cooling emulsion, drain out the cooling water, and fill the cooling system with cooling water emulsion and rust resisting oil. Before sealing preservation, start the engine according to the startup procedure and run it at idle speed for 15-25 minutes.

d. Remove the cover plate at the short side of intake pipe, spray rust resisting oil into the intake pipe using a pressure nozzle, at the same time, turn the crankshaft with hand to open the air valve and let the rust resisting oil coming into the combustion chamber. After the sealing preservation is completed, do not turn the crankshaft any more to prevent the oil film attached to the cylinder liner wall from being scraped.

e. Open all drain valves and discharge or pump out the rust resisting oil from the engine base, and drain out the cooling water emulsion from the cooling system

f. Remove the rocker arm cover, and spray rust resisting oil to the valve spring and rocker arm.

g. Apply protective oil to all machined surface of parts of diesel engine.

Notice: *To avoid moisture and foreign matters coming into the diesel engine, it is recommended to cover the inlet and outlet ports of intake pipe, exhaust pipe and cooling water pipe, and cover the diesel engine with a plastic hood in the process of transport and storage.*

Chapter III Diesel Engine Typical Faultsand Troubleshooting

WP6 seriesdiesel engines are designed and manufactured under strict quality management system andeach delivered diesel engine has passed the specified tests. As the diesel engine is of precision machinery, and the long-term guarantee of its functionality is closely related to the normal maintenances. The causes leading to earlier failure of diesel engine are generally as follows:

(1) Operation against the regulations, and improper management and use;
(2) Failure to fulfill maintenance as required, or even repair instead of maintenance;
(3) Poorly manufactured parts, especially the counterfeit products procured due to temptation of cheap prices, which will greatly shorten the service life of diesel engine;
(4) Inappropriate or unqualified fuel and oil are used.

Diagnostic Method

Generally, the common diagnostic methods for malfunctions of diesel engine are as follows:

(1) Observation method: Judge the malfunction situation by observing malfunction features such as exhaust smoke color of diesel engine (figure 16).
(2) Listening diagnosis method: Judge the location, feature and extent of malfunction by listening the abnormal noise of diesel engine (figure 17).

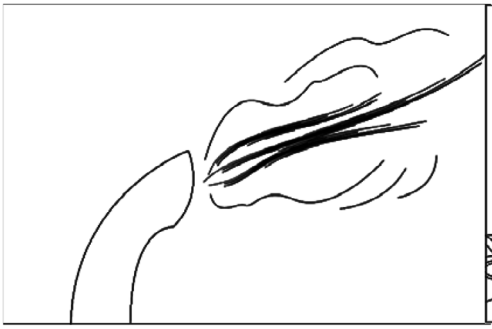


Figure 16

Figure 17

(3) Cylinder deactivation method: Generally, cut off the fuel supply to the suspect malfunctioned cylinder, and compare the working condition of the diesel engine before and after stopping fuel supply to narrow down the scope for further determination of the malfunction location or causes.
(4) Comparison method: Replace a certain assembly or component to determine whether there is failure.

Notice:

(1) The causesof diesel engine malfunction shall be determined carefully. Before the causea are basically found, do not disassemble the diesel engine at will. Orit will not only eliminate the malfunction, but also lead to more serious malfunction due to improper assembly after disassembly.

(2) Inspection and maintenance on critical components(such as injection pump and turbocharger) shall be performed by experienced personnel with special instrument or equipment. Users without experience shall not disassemble or adjust them randomly.

Common Faults and Troubleshooting

Diesel engine cannot be started

Causes	Troubleshooting
(1) Ambient temperature is too low	Use auxiliary starting device.
(2) There is air in fuel system	Expel the air. Check the pipe joints for leakage and repair if any.
(3) The inlet filter screen or hose of fuel supply pump clogged	Remove dirt. Check fuel cleanliness.
(4) Faulty fuel injection pump	Check the plunger and delivery valve. Repair or replace the damaged parts.
(5) Damage or leakage of valve distribution or fuel supply pipe	Check and adjust.
(6) High-pressure fuel pipe damaged or fuel leakage	Repair or replace.
(7) Fuel injector failure	Check the atomization of fuel injector
(8) Insufficient compression pressure in cylinder	Check the valve and cylinder gasket for leakage and check for worn piston rings. Repair or replace the faulty parts if any.

Engine stopped soon after starting

Causes	Troubleshooting
(1) Air trapped in fuel system	Check the fuel pipe and its joint for leakage. Check whether the bleeder screw is securely tightened. Expel the air out of the fuel system.
(2) Fuel filter clogged	Take down the filter body. Remove dirt and moisture. If necessary, replace the filter element.
(3) Poor fuel quality with excessive moisture	Clean the filter, and replace fuel.
(4) Fuel supply pump does not work	Check, clean and repair the piston and valve of the fuel supply pump.
(5) Idle speed too low	Re-adjust.

Insufficient engine power

Causes	Troubleshooting
(1) Intake system (air filter) is clogged	Check the air filter and intake pipe. Clean or replace the filter element.
(2) Exhaust back pressure is too high	Check and adjust the valve timing. Check the exhaust pipe for clogging. Remove clogging if any.
(3) Insufficient pressure in turbocharging system	Check and troubleshoot the leakage in the connecting pipe.
(4) Turbocharger malfunction	Replace the assembly.
(4-1) Compressor, turbine flow passage clogged	Wash or replace.
(4-2) Floating bearing failure	Replace
(4-3) There is carbon or sludge deposit at the back of turbine and compressor	Clean
(5) Intercooler leaks or is damaged	Replace or repair.
(6) Fuel pipe leaks or is clogged	Check the fuel pipe and its joint for leakage. Check the fuel filter for contamination. Tighten and clean the fuel pipe. Replace the fuel filter element.

(7) Poor fuel quality	Clean the fuel tank, fuel filter and fuel pipe. Replace fuel.
(8) Injection pump or speed governor is worn excessively	Repair or replace.
(9) Smoker limiter film of injection pump damaged	Repair or replace.
(10)Air pipe of smoker limiter damaged	Repair
(11)Instable atomization of fuel injector	Check fuel injection pressure. Check the injector for soot deposition. Adjust and repair the injector.
(12)Incorrect valve timing or fuel supply timing	Check and adjust.
(13)The high speed regulated by speed governor is too low	Check and adjust.
(14) Engine oil level in oil pan is too high	Referring to the oil dipstick, discharge excess oil.
(15) Cylinder gasket leaks	Check the compression pressure in the cylinder while the diesel engine is hot. Replace the damaged cylinder gasket.
(16) Piston ring is worn or broken. Bearingshell gap is too large	Replace the worn parts, or overhaul the diesel engine.
(17) Cylinder liner or piston is worn or scratched	Overhaul the diesel engine.

Excessive fuel consumption

Causes	Troubleshooting
(1) Intake system clogged	Check the air filter and intake pipe for clogging. Remove clogging if any.
(2) Exhaust back pressure is too high	Check the exhaust pipe and brake valve for clogging. Remove clogging if any.
(3) Poor fuel quality	Replace fuel in accordance with the requirements.
(4) Fuel pipe clogged	Check the fuel pipe for clogging. Remove clogging if any.
(5) Fuel pipe leaks	Check the fuel pipe for leakage. Remove leakage if any.
(6) Instable atomization of fuel injector	Check, adjust and repair the fuel injector.
(7) Incorrect valve or fuel supply timing	Adjust the valve clearance and fuel supply advance angle in accordance with the requirements.
(8) Cylinder gasket leaks	Check the compression pressure in the cylinder.
(9) Excessive bearing shell gap, diesel engine overhaul is needed	Check and overhaul the diesel engine.
(10) Piston scuffing	Replace the cylinder liner, piston and piston rings.
(11) Insufficient pressure in turbocharging system	Check and troubleshoot the leakage in the connecting pipe.
(12) Turbocharger malfunction	Check and replace the assembly.
(13)Intercooler leaks air or is damaged	Replace or repair.

Engine exhaust gas is black

Causes	Troubleshooting
(1) Intake pipe is clogged or exhaust back pressure is high	Clean the intake or exhaust pipe.
(2) Poor fuel quality	Clean the fuel system, replace fuel.
(3) Incorrect valve or fuel supply timing	Adjust as required.
(4) Instable atomization of fuel injector	Check, repair or replace.
(5) Excessive fuel injection	Check and adjust.
(6) Insufficient pressure in turbocharging system	Check and troubleshoot the leakage in the connecting pipe.
(7) Turbocharger malfunction	Check and replace the assembly.
(8) Intercooler damaged causing leakage	Repair or replace.
(9) Wrong working point of smoke limiter	Readjust by professional plant.

Engine exhaust gas is white or blue

Causes	Troubleshooting
(1) Poor fuel quality with excessive moisture	Replace fuel.
(2) Coolant temperature is too low	Check the operating temperature of the thermostat. Replace it if necessary.
(3) Instable atomization of fuel injector	Check and repair.
(4) Incorrect valve or fuel supply timing	Check and repair.
(5) Low compression pressure, incomplete combustion, piston scuffing	Check the piston rings, cylinder liner and cylinder gasket. Repair the damaged ones.
(6) Insufficient running-in of piston ring and cylinder liner	Continue running-in.
(7) Piston ring gaps are not staggered	Adjust or reassemble.
(8) Oil control ring failure	Replace.
(9) Excessive clearance between piston and cylinder liner	Repair, replace.
(10)Turbocharger sealing ring is worn	Check, replace.
(11)Turbocharger thrust bearing is worn	Check, replace.
(12)Turbocharger oil return pipe clogged	Clean or repair.

Too much oil accumulated at the air inlet port and inlet pipe of turbocharger

Causes	Troubleshooting
(1) Turbocharger sealing failure	Repair or replace.
(2) Oil-gas separator failure	Replace.
(3) Oil pan liquid level is too high, excessive oil	Check and release appropriate amount of oil.

Rotating speed is unstable

Causes	Troubleshooting
(1) Poor fuel quality with moisture or wax	Clean the fuel system, replace the fuel.
(2) Air is sucked into fuel suction pipe	Check the fuel suction pipe and its joint for tightness. Expel the trapped air.
(3) Speed governor weight and spring malfunction	Check and adjust by professional plant.
(4) Uneven fuel supply	Check and adjust by professional plant.
(5) Unstable atomization of fuel injector	Check and repair.
(6) Turbocharger surging	Check and clean the compressor flow passage, remove the fouling and soot deposition.
(7) Turbocharger bearing damaged	Replace.

Engine exhaust gas is white or blue

Causes	Troubleshooting
(1) There is no oil in oil pan or oil is insufficient	Check oil level and check for leakage, add oil.
(2) Engine oil grade is not compliant	Replace with compliant engine oil.
(3) Coolant temperature or engine oil temperature is too high	Check whether the cooling system works normally and eliminate the failure.
(4) Excessive resistance in engine oil filter	Replace with a new filter element.
(5) Engine oil cooler clogged	Check and clean.
(6) Suction filter, engine oil pipe, or washer of pipe joint is clogged or broken	Check the suction filter, pipe joint and oil passage for casting shrinkage porosity.
(7) Leakage from inlet pipe of engine oil pump	Check, repair or replace the inlet pipe and its joint.
(8) Failure of pressure regulator valve in main oil passage	Check, clean or repair the valve.
(9) Main oil passage clogged	Check and clean.
(10) Excessive bearing shell gap, or damaged bearing shell	Check and replace.
(11) Excessive wear of parts and components	Check and overhaul the diesel engine.

Coolant temperature is too high

Causes	Troubleshooting
(1) Coolant level in expansion tank is too low	Check for leakage. Add coolant.
(2) Water pump belt is slack	Adjust the belt tension in accordance with the requirements.
(3) Damaged washer or worn impeller of water pump	Check, repair or replace.
(4) Damaged water pipe is sucking air in	Check the water pipe, pipe joint and washer. Replace the damaged ones.
(5) Thermostat failure	Replace.
(6) Expansion tank clogged	Check, clean and repair the expansion tank.
(7) Oil of oil pan is insufficient	Check the oil level. If any leakage, repair it and add engine oil.

Parts wear too fast

Causes	Troubleshooting
(1) Air filter element is unqualified or damaged	Check and replace the air filter element.
(2) Short circuit of air intake system	Check the intake pipe, gasket and connecting sleeve. Repair or replace the damaged ones.
(3) Engine oil filter element is not replaced timely	Replace the filter element at the required interval.
(4) Insufficient oil in oil pan	Check the oil level. Check for and repair leakage. Add engine oil.
(5) Engine oil grade is not compliant	Use engine oil of proper grade.
(6) Engine oil is unqualified	Replace with compliant engine oil.
(7) Oil passage clogged	Clean the oil passage.
(8) Piston ring is broken or worn	Replace the piston ring.
(9) Cylinder liner or piston is worn or piston scraping	Take down and inspect the piston and cylinder liner. Repair or replace the damaged ones.
(10) Crankshaft axis is not in line with the axis of driven shaft	Check and repair the mounting bracket.
(11) Part/component is worn excessively	Check the cumulative driving distance to see whether overhaul is needed.

Excessive noise level

Causes	Troubleshooting
(1) Poor fuel quality	Replace the fuel.
(2) Coolant temperature is too low	Check the thermostat and replace it if necessary.
(3) Incorrect valve or fuel supply timing	Check, repair or adjust.
(4) Instable atomization of fuel injector	Check, repair or adjust.
(5) Vibration damper is worn	Check and replace.
(6) Excessive fuel injection	Check and replace.
(7) Valve leakage or improperly adjusted	Take down the valve, inspect and adjust.
(8) Excessive gear clearance or broken gear teeth	Check and replace the damaged gear.
(9) Cylinder liner or piston is worn or piston scraping	Check, repair or replace.
(10) Push-rod is bent or broken	Replace.
(11) Piston ring is broken or worn	Check and replaced the damaged piston ring.

Starter motor does not work

Causes	Troubleshooting
(1) Fuse burnt	Replace the fuse.
(2) Poor contact of circuit	Check the circuit, and tighten the terminals.
(3) Insufficient charge of battery	Check, charge or replace the battery.
(4) Short circuit of starter motor	Inspect and repair the starter motor or replace the starter assembly.
(5) Poor contact of electric brush	Clean or replace the electric brush.

Starter motor is powerless

Causes	Troubleshooting
(1) Battery is undercharged	Charge or replace the battery.
(2) Bearing bush is worn	Replace the assembly.
(3) Poor contact of electric brush	Clean or replace the electric brush.
(4) Commutator is dirty or burnt	Clean the oil stain. Polish the commutator by using sandpaper, or replace the commutator assembly.
(5) Terminal desoldering	Resoldering.
(6) Poor contact of switch	Check and repair the switch.
(7) Clutch is worn causing skidding	Adjust the operating torque of the clutch or replace the clutch assembly.

Alternator does not generate electricity at all

Causes	Troubleshooting
(1) Short circuit or open circuit, connector loosened	Check the wires of alternator and ammeter and repair if necessary.
(2) Rotor or stator coil is short circuit or open circuit, or is grounded	Repair or replace the assembly.
(3) The rectifier valve is damaged	Replace the assembly.
(4) Damaged paper insulation of terminal, causing broken wire	Repair.
(5) Regulator voltage is too low	Repair.
(6) Regulator contactor is burnt	Repair or replace the regulator assembly.

Battery cannot be charged fully by alternator

Causes	Troubleshooting
(1) Short circuit or open circuit, connector loosened	Repair.
(2) Rotor or stator coil is open circuit, short circuit or grounded	Repair or replace the assembly.
(3) The alternator belt is slack	Check and adjust the belt tension.
(4) Damaged rectifier valve of alternator, poor contact of battery terminal	Repair.
(5) The regulating voltage of regulator is too low	Adjust.
(6) The field coil or resistor connection of regulator is disconnected	Repair or replace.
(7) Insufficient electrolyte in battery, or battery is too old	Add electrolyte, or replace the battery.

Charging current unstable

Causes	Troubleshooting
(1) The coil of stator or rotor is about to open circuit or short circuit	Repair or replace.
(2) Poor contact of electric brush	Repair.
(3) Loose or poor contact of terminal	Repair.
(4) Voltage regulator is damaged	Repair.
(5) Improper voltage regulation	Check and adjust.

Battery is overcharged by alternator

Causes	Troubleshooting
(1) Short circuit in battery	Repair or replace.
(2) Regulator voltage is too high	Repair or adjust.
(3) Poor grounding of regulator	Repair.
(4) Regulator contact failure or contaminated, or the voltage coil or resistor wire is disconnected	Repair or replace.

Alternator has abnormal sound

Causes	Troubleshooting
(1) Improper alternator installation	Repair.
(2) Rotor has come into contact with stator	Repair or replace.
(3) Bearing is damaged	Replace the bearing.
(4) Short circuited rectifier	Replace.
(5) Short circuited stator coil	Repair or replace.

Chapter IV Disassembly and Assembly of the Diesel Engine

Overview

During disassembly and assembly of the diesel engine, please follow the instructions in this manual strictly and pay attention to the operation steps containing danger and safety signs to ensure personal safety and avoid accidents.
The disassembly of diesel engine components is in the reverse order of assembly, so, if no special notes are required, only one kind of steps will be given in this manual.

DangerSigns

This is a world-recognized warning sign. In the manual, this sign is used to emphasize the importance of the following information. Please make sure that you understand the consequence of hazardous conditions and how to avoid such dangers. In case of any behaviors in violation of the warning information, it may result in damage to property, personal injury and even death.

The common danger signs are usually used to indicate general warning.Warning information in this manual is classified into different types (slight injury, serious injury and death) according to severity of possible consequences.

This warning sign indicates a potential danger, which, if not warded off, may lead to serious injury even death or major property loss.
This warning sign indicates a potential danger, which, if not warded off, may lead to slight injury or property loss. It is also used forwarnings of dangerous operations.

The cautions in this manual are provided to explain how to correctly operate and use the diesel engine of Weichai Power. However, simply reading through this document will not prevent risks from happening. Theconsiderations will not be beneficial to the correct use unless the information contained is properly understood.
The warning information provided herein may not cover all possible conditions! If theproceduresor methodsused beyond those recommended in this manual, make sure that such operation will never cause any danger to you, to others or to the equipment.

Safety Signs

Figure	Definition
	Wear hand protection
	Wear ear protection
	Wear eye protection
	Wear head protection
	Wear foot protection
	Wear a protective mask
	Wear overalls
	Avoid naded flames
	No smoking
	Do not use mobile phone
	Danger: battery acid
	Danger: live cables, electrical shockhazard
	Highly flammable product
	Keep away from hanging loads
	Keep an extinguisher close by

Many potential dangersmay occur unexpectedly without any signs when the engine is in running. Therefore, this manual cannot give warning instructions for all kinds of potential danger. To apply a procedure beyond the special recommendations, make sure that the procedureis safe and do not result in any damage to property.

Tools Used

Figure	Definition
	2.5mmhexagonal wrench
	5mmhexagonal wrench
	8mm socket
	Flat screwdriver
	Special tool
	10mm flathexagonal wrench

To use a method or tool beyond those recommended in this manual, the user shall always ensure the personal safety, avoid danger to the life of user or others, meanwhile, make sure that the use, maintenance or repair methods will not result in damage risk or safety hazard.

Precautions for Health Protection

The following “Precautions for health protection” are specified to reduce the risk of engine maintenance staffs suffering from any contamination.

(1) Avoid repeated exposure to used oil for a long time;
(2) Wear the protective clothing and water-proof gloves properly, if available;
(3) Do not place the oil-soaked rag in the pocket;
(4) Avoid contaminating clothes especially underwear with oil;
(5) Wash working clothes frequently, and throw away the clothes and shoes that cannot be cleaned up;
(6) In case of cut and injury, take first-aid measures as soon as possible;
(7) Before working, always apply some protective cream which will make it easier to remove the oil in case that the skin is contaminated with mineral oil;
(8) Use soap and hot water, or liquid soap and nail brush to wash hands for the convenience of removing all oil stains. If the grease secreted by skin is washed off, lanolin-containing products can be used to moisturize the skin;
(9) Do not clean the skin with any gasoline, kerosene, fuel, thinner or solvent;
(10) If your skin is discomfort, seek for medical care immediately;
(11) Remove the oil on the parts before transportation, if possible;
(12) If the eyes are endangered, wear goggles or protective mask. Always prepare eyes wash liquid within reach;
(13) To repair the engine, do not splash oil or other liquid on the floor. If hydrocarbon or other liquid leaks unexpectedly, take all essential measures to isolate the area to keep the environment clean and to protect the personnel from injury;
(14) The hydrocarbon, ethylene, glycol or petroleum shall be transferred, stored and recycled under the safety and environment standard in the local country.

Environmental Protection Measures

For used oil and hydrocarbon handling, refer to the relevant environmental protection regulations. Consult the local officials for details.

Considerations forDisassembly and Assembly of DieselEngine

(1) Most accidents in connection with the use, maintenance and repair of diesel engine are resulted from failure to observe the safety rules and basic precautions. So, you shall be aware of the danger lying ahead and take the corresponding measures to avoid the accident. Only the well-trained personnel with required skills and appropriate tools can operate, maintain and repair the diesel engine.
(2) The violation of instructions in the manual can lead to serious accident, and even endanger life. Weichai Power cannot foresee all potential dangers, meanwhile, the rules and instructions specified in this manual are not meant to be comprehensive.
(3) Before continuing the maintenance or repair, place “DO NOT USE” sign board or similar signs on the starter switch.
(4) Take necessary precautions before using barring rod;
(5) Make sure that the maintenancesite and the surroundings are suitable for safe operation;
(6) Make sure that the maintenance workshop or area around the engine is clean and tidy;
(7) Before working, remember to remove the ring, necklace and watch, and wear well-fitted working clothes;
(8) Before working, please check whether the corresponding protective equipment (goggles, gloves, shoes, mask, working cloth, helmet etc.) are within the effective service life;
(9) Do not use the faulty or improper tools.

Caution:Before the maintenance or repair, please stop the engine.

Cylinder Head Group

Disassembly and Assembly of Cylinder Head Group

Exploded View of Cylinder Head Group

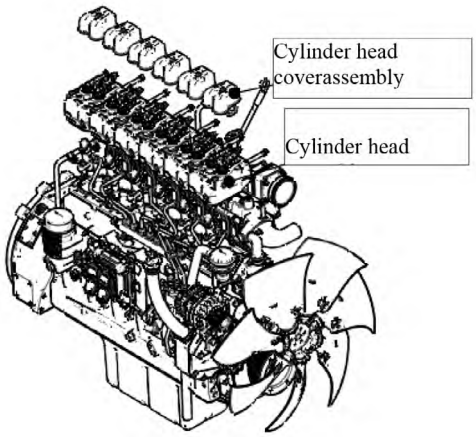


Figure 18 Exploded View of Cylinder Head Group

Disassembling steps of cylinder head group

1) Remove the fan and drive belt;
2) Remove the ventilating device assembly of crankcase;
3) Remove the eye rings and brackets;
4) Remove the high pressure fuel pipes, fuel return pipes;
5) Remove the cylinder head cover assembly;
6) Remove the rocker arm bracket assembly;
7) Remove the cylinder head bolts;
8) Remove the injectors;
9) Remove the cylinder head assembly.

Disassembly and assembly of cylinder head cover

Exploded view of cylinder head cover assembly

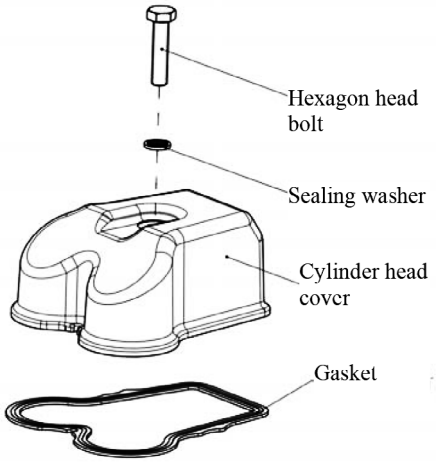


Figure 19 Exploded View of Cylinder Head Cover Assembly

Exploded view of cylinder head cover assembly

1) Loosen the bolts of cylinder head cover in order;
2) Take out the cylinder head cover and its gasket upward vertically.

Inspection and repair of cylinder head cover

1) Check the cylinder head cover for damage (such as cracks). In case of any crack, replace it with a new one;
2) If leakage occurs to the gasket of cylinder head cover, check the gasket for failure and replace it if necessary;
3) The gasket of cylinder head cover can be used onceonly. Always replace it with a new one when it is returned for repair.

Assembling steps of cylinder head cover

1) Before assembling, check the gasket and the surface of cylinder head for defect and damage;
2) Apply clean oil at the connecting places of rocker arm and valve, the connecting place of rocker arm and tappet and at the middle of the two places;
3) Place the gasket of cylinder head cover in place;
4) Set the cylinder head cover;
5) Adjust the gasket to the middle of cylinder head cover so that their U-grooves are aligned with each other and there is gasket appearing around the cylinder head cover;
6) Tighten the bolts of cylinder head cover with a torque of (10~15) Nm. During the tightening, note to prevent the gasket of cylinder head cover deviating from the original position.

Disassembly and assembly of cylinder head assembly

Exploded view of cylinder head assembly

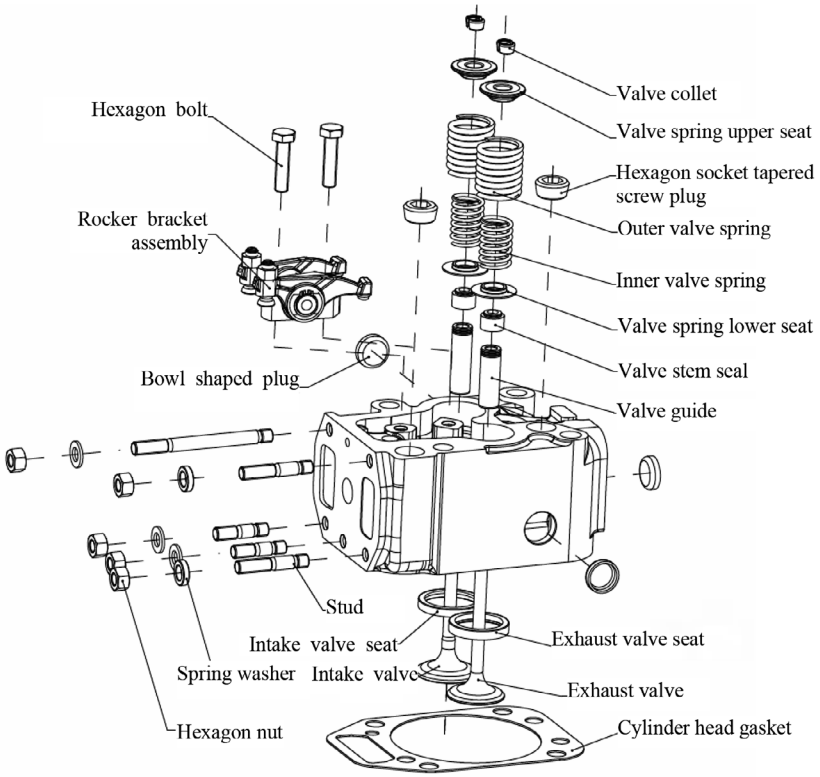


Figure 20 Exploded view of cylinder head assembly

Disassembling steps of cylinder head assembly

1) Remove the rocker bracket assembly;
2) Remvoe the cylinder head bolts;
3) Take out the cylinder head upward vertically. Before removing, always make sure that the fuel injector has been taken down. During removing, do not shake the cylinder head preventing residual coolant flows out. If the gasket is attached to the cylinder head, take it out and place it back onto the cylinder block;
4) Disassemble the cylinder head and place it on the paper board or rubber sheet to avoid the fire side of cylinder headand sealing surface of valve being worn. To disassemble several cylinders, mark the cylinder number on the cylinder head for problem analysis and reassembly;
5) Remove the cylinder head gasket. To disassemble several cylinders, mark the cylinder number on the cylinder head gaskets.

Check and maintenance of cylinder head assembly

(1) Cylinder head

Prior to disassembly, check the cylinder head for water, oil/fuel and air leakages and other abnormalities. Accurately locate and analyze such problems if any.

Clean the cylinder head, particularly the surface of combustion chamber, valve seat, intake and exhaust valves and intake and exhaust ports. Remove the soot deposit and viscose, and check the surface condition.

a. Visual inspection

Carefully check the cylinder head for discoloration and cracks. If cracks are found, dye penetration inspection is required.

b. Valve sinkage

The valve sinkage is measured as the distance from the bottom of the valve to that of the cylinder. The difference between the measured and specified valve sinkage indicates the degree of wear of the valve and its seat. Depth micrometer can be used for measuring the valve sinkage, as shown in Figure 21.

Figure 21 Depth Micrometer

Refer to the following table for specified valve sinkage. If valve sinkage exceeds the specified value, replace the cylinder head to ensure the reliability of the diesel engine; if it falls within the specified value, remove the valve, and check the body and sealing surface of valve seat for signs of excessive wear and damage.

	Specified valve sinkage (mm)
Intake valve	1.0~1.45
Exhaust valve	1.0~1.45

c. Clearanc between valve stem and valve guide

The valve guide inner surface is contacting with the valve stem, if the clearance between the valve guide and valve stemexceeds the specified limits, the guiding function of valve guide may be affected, causing reduced reliability of the diesel engine. The valve guide inner diameter can be measured with inside micrometer, as shown in Figure 22. And the outer diameter of valve guide can be measured with an outside micrometer.The permissible clearance range between the intake/exhaust valve stem and the corresponding valve guide is (0.03-0.06) mm. If the clearance exceeds the specified, pleacereplace the cylinder head to make sure the reliability of diesel engine.

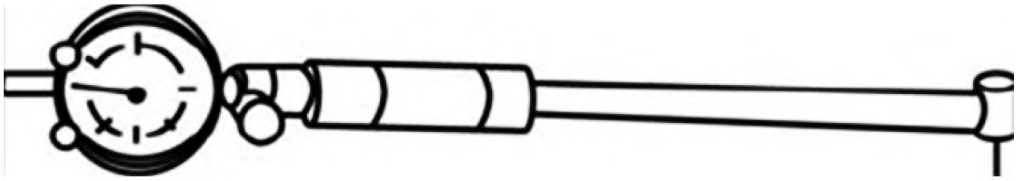


Figure 22 InsideMicrometer

(2) Cylinder head gasket

Replace the cylinder head gasket if it shows signs of air, water or oil/fuel leakage. Check the cylinder head gasket for visible damage, and analyze the cause of damage if any. Once the cylinder head is removed, the gasket must be replaced.

Assembling steps of cylinder head assembly

1) Pre-assemble the rocker bracket assembly;
2) Install the cylinder headgasket (thickness: 1.4mm);
3) Install the cylinder head assembly to the cylinder block;
4) Install the cylinder head boltswithout tightening;
5) Tighten the bolts of cylinder head to 30Nm, rotate them by an angle of 120°±4°, and rotate themby another angle of 120°±4°;
6) Tighten the bolts of cylinder heads from the 1st cylinder to 6th cylinder. For the bolts of each cylinder, the tightening order is shown in figure23.

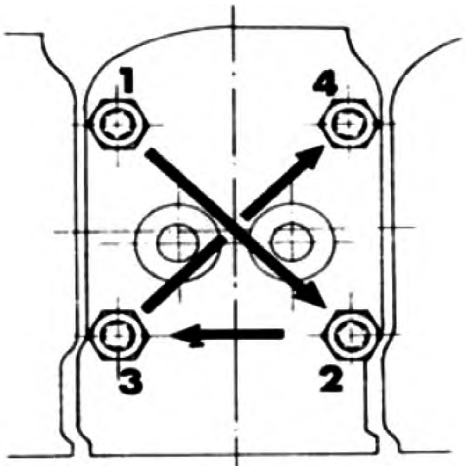
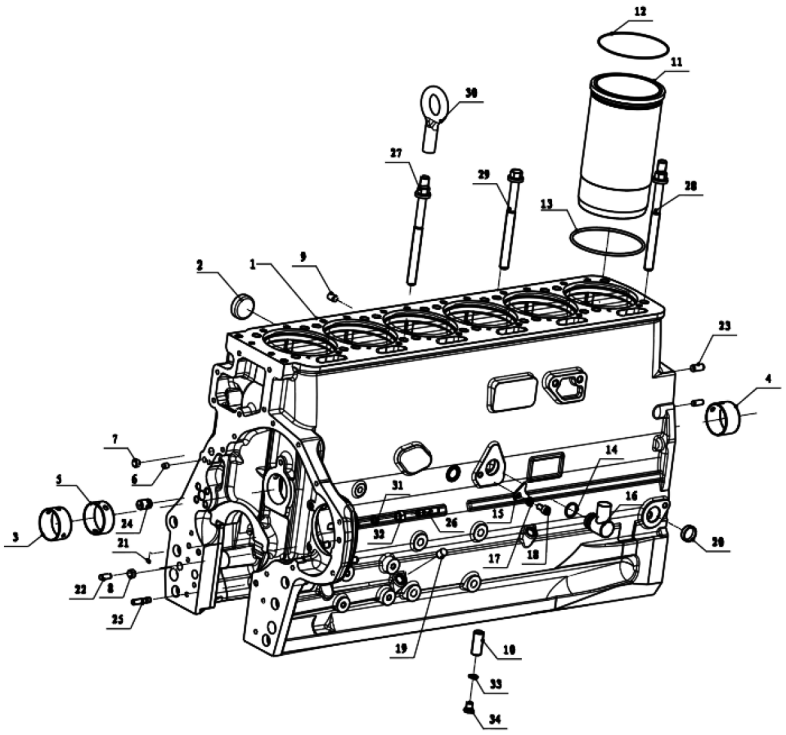


Figure 23

Engine block group

Disassembly and assembly of engine block group

Exploded view of engine block group



1-Engine block; 2, 20-Bowl shaped plug; 3, 4, 5-Camshaft bush; 6, 7, 8, 9-Plug; 11-Cylinder liner;12, 13, 14-O-ring; 15-Retaining plate; 16-Welded elbow; 17, 31-Spring washer; 18-Hexagon socket cap screw; 19, 22, 23-Straight pin; 21-Spring-type straight pin; 24-Pin shaft; 25, 26-Stud; 27, 28, 29-Cylinder head bolt; 30-Eye ring screw; 32-Hexagon nut (Type 2); 34-Hexagon screw plug

Figure 24 Exploded view of engine block group

Disassembling steps of engine blockgroup
1) Unscrew the cylinder head bolts (key point 1);
2) Remove the welded elbow (key point 2);
3) Remove the screw plug and screw thread of vertical oil duct;
4) Remove the cylinder liner (key point 3);
5) Remove the camshaft bushing (key point 4).

Inspection and repair of cylinder blockgroup
Key point 1
Assembly: Apply lubricating oil to the bearing face and threads of cylinder head bolt, and tighten the bolts as specified below:
(1) Use a four-axis tightening machine to tighten the bolts on the assembling line as follows:
a. Tighten to 15Nm;
b. Tighten to 60 Nm;
c. Turn an angle of 230°±4°.
(2) If the four-axis tightening machine is unavailable, tighten with a torque wrench as follows:
a. Tighten to 30Nm;
b. Turn an angle of 120°±4°;
c. Turn an angle of120°±4° again.

The tightening sequence of cylinder head bolts for each cylinder is shown in figure 25.

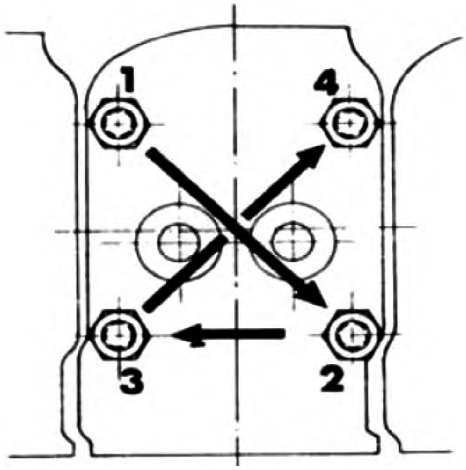


Figure 25

(3) The tightening sequence of cylinder head bolts is:

3rd cylinder –4th cylinder – 5th cylinder – 2nd cylinder– 1st cylinder – 6th cylinder

(4) The tightening torque of cylinder head bolts should be:

M14-12.9: (230~300)Nm;

M14-10.9:(190~285)Nm.

Key point 2

Assembly: Install the greased seal ring to the welded elbow, insert the elbow into the corresponding hole, and fix it on the engine block by using a fixing plate,hexagon socket bolts and spring washers.

Key point 3

Inspection:

1) Check the protrusion height of cylinder liner (it should be 0.05mm to 0.10mm);

Notice: *The protrusion heightof cylinder liner is the average ofthe protrusion measurements in the directions of X and Y without seal rings on engine block and cylinder liner; the grouping mark for cylinder liners of the same engine block should be the same.*

2) Check that the mating face and friction surface are free of dust, scratches and impact damages, and before assembling, apply clean lubricating oil or grease.

Assembly:Place the cylinder liner on the engine block vertically, install the seal rings ofengine block and cylinder liner into position, put the cylinder liners into corresponding bore holes vertically, and knock them in place with a nylon bar.

Key point 4

Disassembly:Remove the camshaft bushing by using special tooling, and be careful not to damage other bushings; Inspection: Before assembling the bushing, always clear the grease on thebacks ofbushing andbearing and the mating bottom hole surface; ensure that the bushing, bearing and bottom hole are free of burrs, flashings and iron chips etc.

Assembly: Apply lubricating oil to the port/hole of cylinder block, install the camshaft bushing into the special tooling, and guide it into the cylinder block,align the camshaft bushing oil duct hole with cylinder block oil passage hole.

Assembling steps of engine blockgroup

Assemble the engine blockgroup with the reverse order of disassembly.

Disassembly and assembly of engine block

Exploded view of engine block assembly

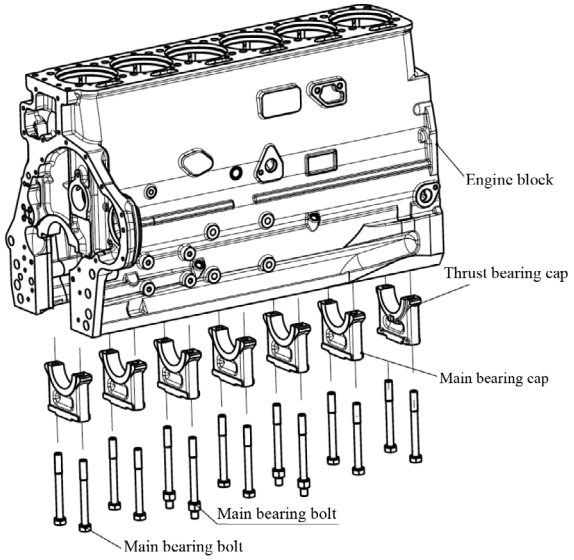


Figure 26 Exploded view of engine block assembly

Disassembling steps of engine block

1) Remove the main bearing bolts (key point 1);

2) Remove the main bearing caps (key point 2).

Inspection and repair of engine block

Key point 1

Inspection:

Check and clean the engine block, including but not limited to: the assembly site must be clean; checking that the machined surface of cylinder block from the cylinder block line is free of impact damages, scratches and rust stains; prevent the parts from beingimpact damaged and scratched in assembling; chamfering the sharp angles and edges unless otherwise specified.

Installation:

For the 6-cylinder engine, a total 14 main bearing bolts (M14-10.9) are used.When tightening, tighten the bolts of the middle bearing firstly, and then that of the adjacent bearings, at last, tighten the bolts of main bearings at two ends (figure 27).The bolts should be tightenedin two times, that is, tighten them with a torque of 70Nm first, and then turn them by angle of 90°±4°.

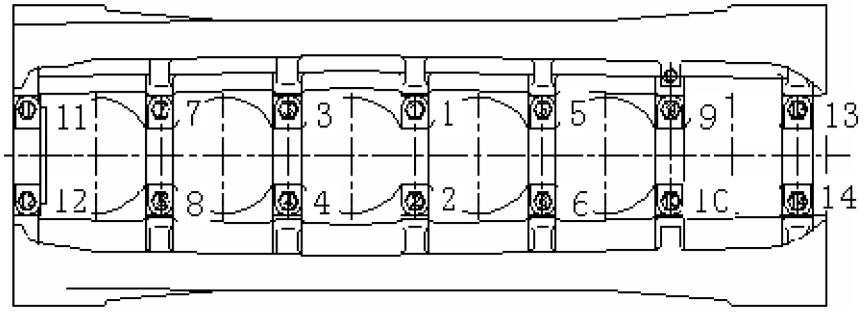


Figure 27 Tighteningsequencefor main bearing bolts

Key point 2

Installation: Install the thrust bearing cap onthe rear end of cylinder block, and install non-thrust bearing caps to other positions. Pay attention to distinguishing two ends of the bearing cap for a proper positioning, and if the bearing cap is reversed, the main bearing bolt cannot be mounted.

Assembling steps of engine block
Assemble the engine blockwith the reverse order of disassembly.

Disassembly and assembly of front end cover

Exploded view of front end cover

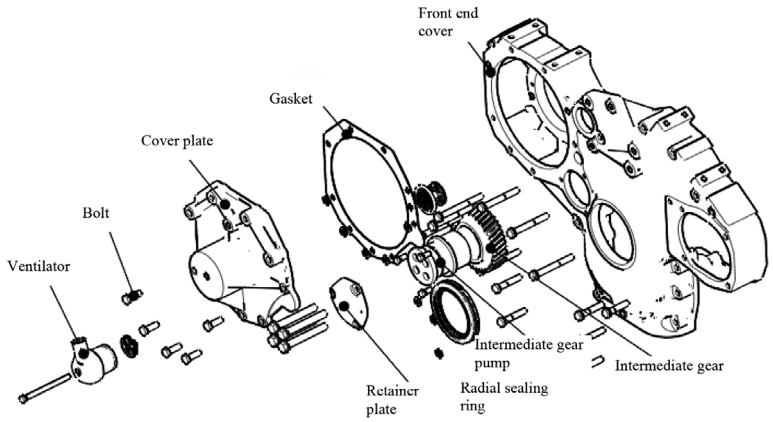


Figure 28 Exploded view of front end cover

Disassembling steps of front end cover
1) Remove the breather;
2) Remove the cover plate;
3)Remove the intermediate gear (key point 1);
4) Unscrew the screw plug;
5) Remove the front end cover (key point 2);
6) Remove the radial seal ring (key point 3).

Inspection and repair of front end cover
Key point 1
Inspection:
1) After the gear is fixed, turn the gear with hand and rotate the flywheel of the engine, and it should feel a clear clearance without blocking.
2) Check the backlash of intermediate gear and timing gear, it should be (0.015~0.30) mm commonly.
Assembly:
1) Install the intermediate gear and shaft and apply lubricating oil to the intermediate gear shaft;
2) Install the intermediate gear with its hole concentric with the shaft;
3) Install the retainer plate, fastening bolts and flange cover plate, with the bolt tightening to (65~70) Nm.
Key point 2
Inspection: Check the front wall cover for cleanness, check the mating face fordamage and burrs, and check the seal ring for damage.
Assembly:
1) Knock the locating pin into position;
2) Use a roller to apply sealant to the mating face of front end cover uniformly;
3) Align the pin holes, set the front end cover onto position, and knock the side of front end cover gently byusing a nylon rod,to make the front end cover contacting with the cylinder block completely.

4) Insert the bolts into the corresponding thread holes, install the matched washers and tighten the bolts with pneumatic wrench or open-end wrench.

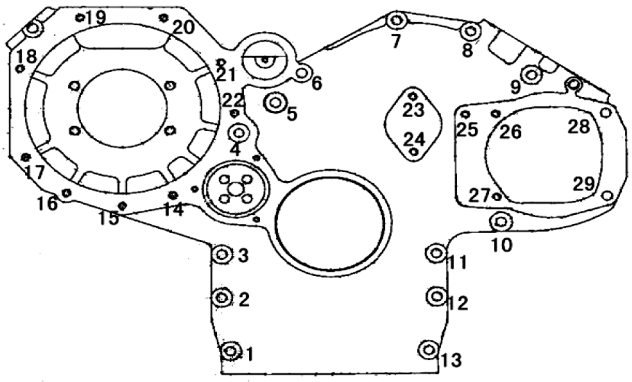


Figure 29

Key point 3
Assembly:
Before assembling, check the oil seals and seal rings are for damage and check the mating face for dirt. If the oil seal or seal ring is relative tight, it is recommended to apply clean oil to the shaft, and use a special tool to press it in slowly with the force uniformly applied to the sides of oil seal or seal ring.
Disassembly:
After the removal of oil seal, replace it with a new one.

Assembling steps of front end cover
Assemble the front end cover with the reverse order of disassembly.

Disassembly and assembly of flywheel housing

Exploded view of flywheel housing

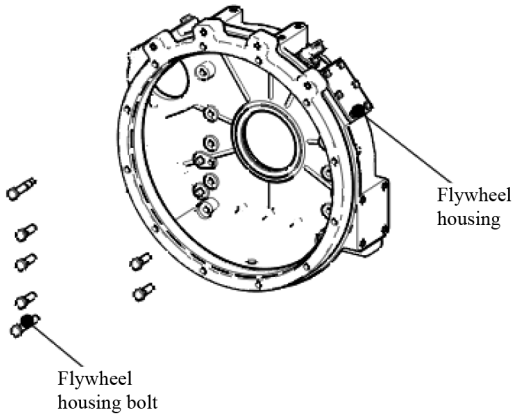


Figure 30 Exploded view of flywheel housing

Disassembling steps of flywheel housing

1) Unscrew the fixing bolts of flywheel housing (key point 1);
2) Unscrew the fixing bolt of inspection window on flywheel housing and remove the inspection window cover;
3) Remove the speed sensor;
4) Remove the flywheel housing.

Inspection and repair of flywheel housing
Key point 1
Assembly: Check the flywheel housing for cleanness. Remove the burs on corresponding mating face of cylinder block with a 240# fine oil stone, clean the surface with ethyl alcohol, and apply sealant to the mating face of flywheel and the cylinder block.
Step 1: Install the bolts;
Step 2: Tighten the bolts. For M10 bolts, tighten them with the torque of (80~85) Nm according to the direction as indicated by the arrowin the following figure; for M12 bolts, tighten them with the torque of (140~145) Nmin sequence of 1-2-3-4-5-6.

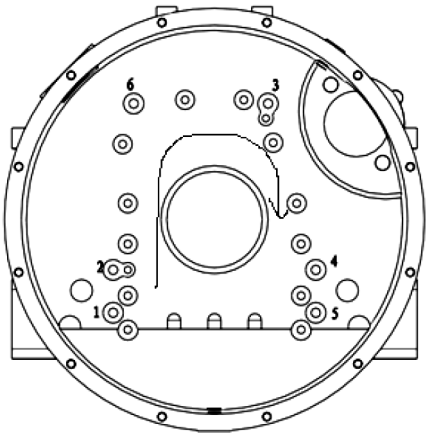


Figure 31

Notice: *Thethreads and bearing face of strengthening bolts above should be applied with lubricating oil before mounting.*

Assembling steps of flywheel housing
Assemble the flywheel housing with the reverse order of disassembly.

Disassembly and assembly of oil pan
Exploded view of oil pan

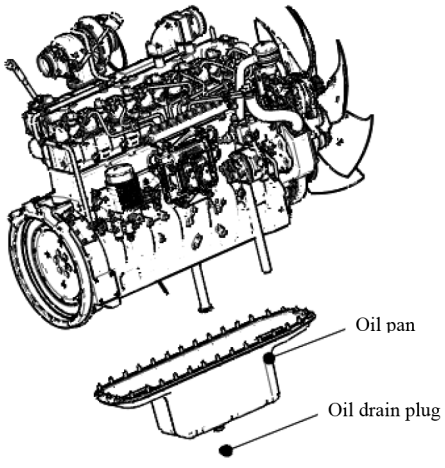


Figure 32 Exploded view of oil pan

Disassembling steps of oil pan
1) Place the diesel engine withoil pan upwards (key point 1);
2) Unscrew the fixing bolts of oil pan (key point 2);
3) Removethe oil pan and gasket;
4) Remove the magnetic screw plug and washer.

Inspection and repair of oil pan
Key point 1
Disassembling: Drain the oil inside before removing the oil pan. For this purpose, place an appropriate container under the drain plug of oil pan, and unscrew the drain plug by using a plug wrench to drain the oil.
Key point 2
Assembly:
1) Apply sealant to cylinder block mating face along the threaded hole inner side;
2) Align the oil pan with the cylinder block mating face gently to avoid damaging the contacting face;
3) Set the bolt and gasket, and use a pneumatic wrench to tighten the bolts with a torque of (20-35) Nm.

Assembling steps of oil pan
Assemble the oil pan with the reverse order of disassembly.

Disassembly and assembly of piston cooling nozzle
Exploded view of piston cooling nozzle

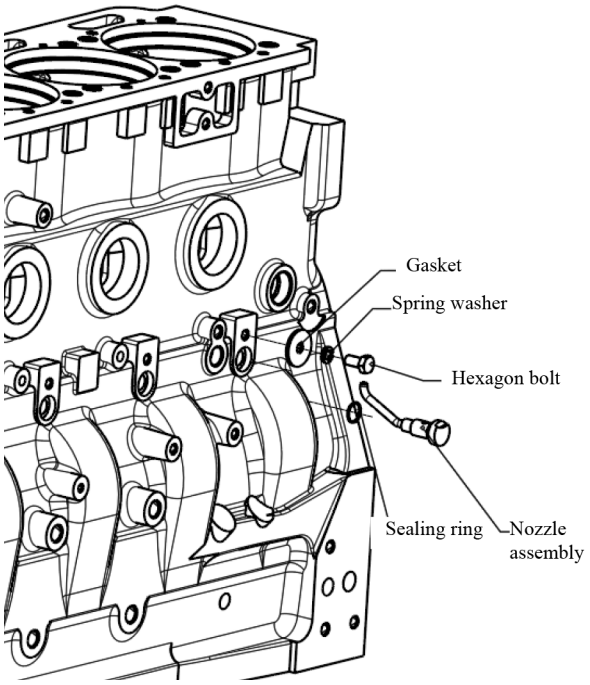


Figure 33 Exploded view of piston cooling nozzle

Disassembling steps of piston cooling nozzle
1) Unscrew the hexagon head bolts (key point 1);
2) Remove the nozzle assembly (key point 2).

Inspection and repair of piston cooling nozzle
Key point 1:
Assembly:
1) Clamp the nozzle assembly with bolts and clamp plate;
2) Place the clamp plate on the concave plane of spray nozzle end face;
3) Tighten the bolt with TOKU pneumatic wrench at second gear.
Key point 2:
Inspection: Check the O-ring for damage, and check the cylinder block nozzle hole for cleanness without burrs.

Assembling steps of piston nozzle
Assemble the piston nozzle with the reverse order of disassembly.

Disassembly and assembly of thrust washer

Exploded view of thrust washer

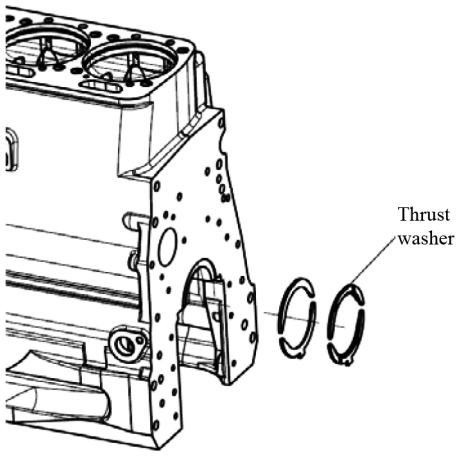


Figure 34 Exploded view of thrust washer

Disassembling steps of thrust washer
1) Remove the main bearing cover;
2) Remove the crankshaft;
3) Remove the thrust washer (key point 1).

Inspection and repair of thrust washer
Key point 1
Assembly: Thrust washers should be used in pair. To assemble the thrust washer, the side with oil grooveshould outwards, and place the "lug" into the thrust bearing cap correspondinglyto avoid wrong installation.

Assembling steps of thrust washer
Assemble the thrust washer with the reverse order ofdisassembly.

Disassembly and assembly of front/rear oil seals
Exploded view of front/rear oil seals

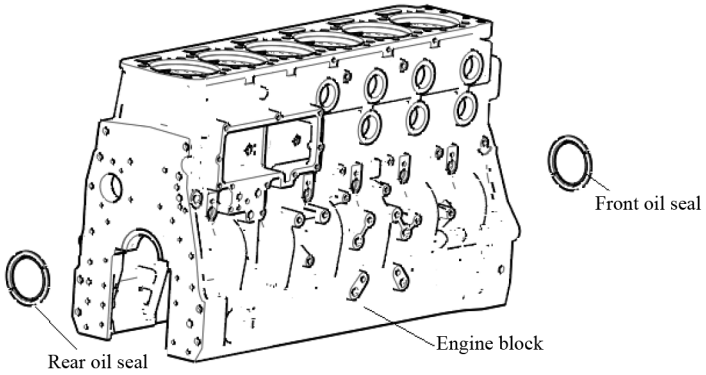


Figure 35 Exploded view of front/rear oil seals

Disassembling steps of front/rear oil seals

1) Remove the front end cover;
2) Remove the front oil seal;
3) Remove the rear oil seal cover; (key point 1);
4) Remove the rear oil seal (key point 2).

Inspection and repair of front/rear oil seals

Key point 1

Inspection: Check the joint faces of rear oil seal cover and engine block, there should be clean with out impact damage.

Assembly:

1) Knock in the two locating pins with hand hammer after cleaning the joint faces;
2) Apply sealant to the joint face of rear oil seal cover.

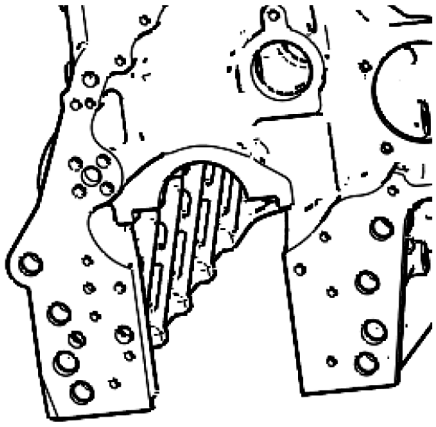


Figure 36

Key point 2

Inspection: Check the seal ring and the oil seal for damage; and check the rear oil seal cover for cleanness and visible scratches on machining face.

Assembling: Apply sealant to the outer side of rear oil seal (radial seal ring), and press it into the rear oil seal cover with a special tooling.

Notice: *The seal ring should be such assembled that its outer end face is flush with the oil seal cover plane without any damage.*

Assembling steps of front/rear oil seals

Assemble the front/rear oil sealswith the reverse order of disassembly.

Crank and connecting rod mechanism

Disassembly and assembly of crank and connecting rod mechanism

Exploded view of crank and connecting rod mechanism

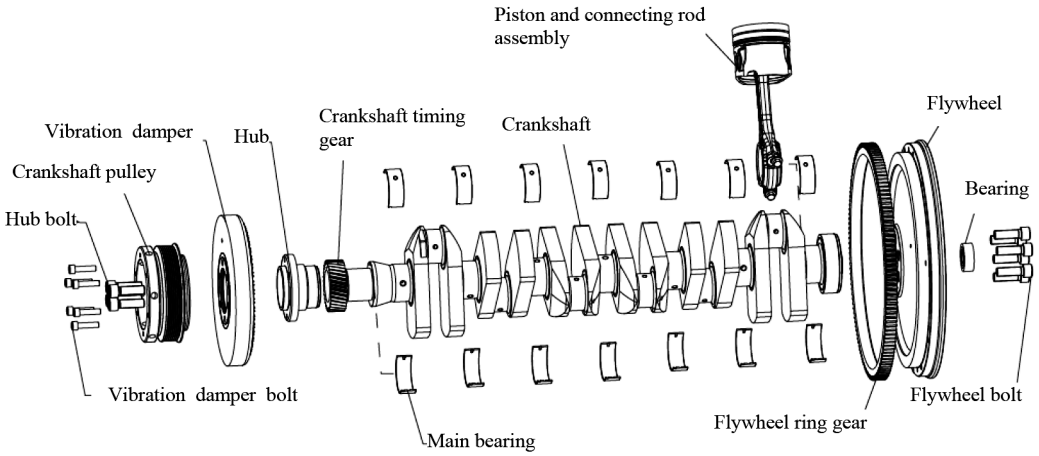


Figure 37 Exploded view of crank and connecting rod mechanism

Disassembling steps of crank and connecting rod mechanism

(1) Checking before disassembling: Check the axial clearance of connecting rod and the tightening torque of connecting rod bolts. Place the engine obliquely, rotate the flywheel to make the pistonto be removed to BDC, and remove the connecting rod cap and bolt; make the piston to TDC, knock out the piston with a wood hammer carefully, preventing the cylinder block from being blocked by connecting rod big end. Remove the remaining pistons following the same method, and place them in order.

(2) Unscrew the vibration damper bolt, hub bolt, and remove the crankshaft pulley, torsional vibration damper and hub etc.

(3) Unscrew the flywheel bolt, and remove the flywheel assembly, bearing and other related parts.

Assembling steps of crank and connecting rod mechanism

Assemble the crank and connecting rod mechanism with the reverse order ofdisassembly.

Disassembly and assembly of piston and connecting rod group

Exploded view of piston and connecting rod group

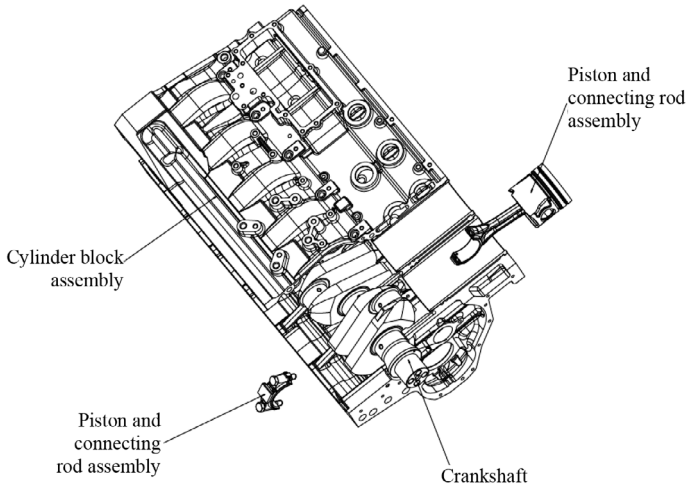


Figure 38 Assembling position of piston and connecting rod group

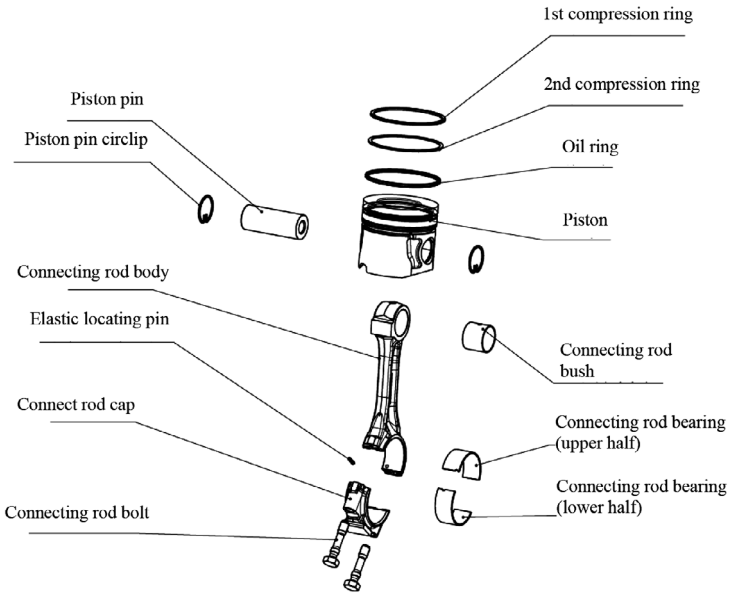


Figure 39 Exploded view of piston and connecting rod assembly

Disassembling steps of piston and connecting rod assembly

(1) Inspections before disassembling. Check the axial clearance of connecting rod and the tightening torque of connecting rod bolt.
(2) Place the engine tilted on its position, rotate the flywheel to make the pistonto be removed to BDC, and remove the connecting rod cap and bolt.
(3) Makethe piston to TDC, knock out the piston with a wood hammer carefully, preventing the cylinder block from being blocked.
(4) Remove the remaining pistons following the same method, and place them in order.
(5) Use internal circlip pliers to remove the circlipsat both sides of piston pin carefully, push out the piston pin and remove the connecting rod body. Number the piston pins and connecting rod bodies respectively, and place them in order.
(6) Use a piston ring pliers to remove the 1st compression ring, 2nd compression ring and the oil control ring, and mark them respectively.

Inspection and repair of piston and connecting rod assembly

(1) Check the rounded corner at the throat of piston combustion chamber and the piston pin seat for cracks; check the skirt and head of piston for cylinder scuffing; check the piston pin hole for excessive wear.
(2) Check the outer perimeter and the upper and lower end faces of the piston ring for excessive wear.
(3) Check if the outer perimeter of the piston ring is excessively worn.
(4) Check the large end bottom hole, body and small end oil hole of connecting rod for cracks; check the alloy layer of connecting rod bush for abnormal wear or spalling; check the connecting rod sides for abnormal wear, and check the connecting rod body for bending.
(5) Check the connecting rod bearing for wear, and the alloy layer for discoloring and metal spalling etc.

Assembling steps of piston and connecting rod

(1) Use internal circlip pliers to install one circlip into the piston circlip groovewith the edged face inwards, and rotate the circlip for secure installation. The opening of piston ring circlipshould be upwards.
(2) Insert the small end of connecting rod into the piston cavity, align the connecting rod small end withthe piston pin hole and install the piston pin; finally, install the piston pin circlip on the other side. Pay attention to that the oblique cut of connecting rod should be in the same direction with the inlet hole of piston cooling oil duct, and the connecting rod small end hole and piston pin should be applied with appropriate clean lubricating oil before assembling.

(3) Arrange the installed piston and connecting rod assemblies in order by the cylinder number, and use a piston ring pliers to install the oil control ring, 2nd compression ring and 1st compression ring into the piston ring grooves in sequence, ensuring that the side with "TOP"of piston ring upwards, and the ring can move flexibly in the ring groove.

(4) Wipe the cylinder inner wall, crank arm and piston and connecting rod assembly, and apply clean lubricating oil to the moving pair parts.

(5) Adjust the opening orientation of rings: the opening of 1st compression ring should be 30° away from the piston pin centerline, the opening of 2nd compression ring should be 120° away from that of the 1st compression ring, and the opening of oil control ring should be 120° away from both openings of the 1st ring and 2nd ring, as shown in figure 40.

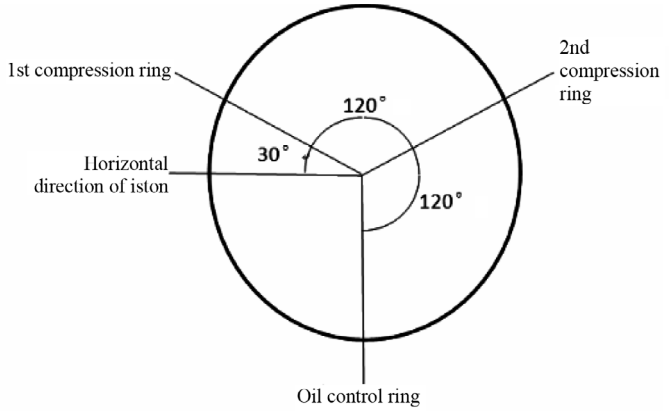


Figure 40 Schematic diagram for included angles between piston rings

(6) Rotate the crankshaft to make the pistons ofNo. 1 cylinder and No. 6 cylinder near the BDC, install the piston and connecting rod assemblies of No. 1 cylinder and No. 6 cylinder, and install the connecting rod bolt without tightening, always with the parting surface of connecting rod towards the left side of cylinder block (i.e. the side of oil cooler). Pay attention to that the piston number should be identical to the cylinder number, the connecting rod cap should be used in pairs with the connecting rod body, and the connecting rod bolt should be applied with clean lubricating oil before installation.

(7) Tighten the connecting rod bolts as follows: Screw on the bolts, and tighten them diagonally with a torque of 30Nm, rotate them by an angle of 58°~65° to a torque of (85~135) Nm finally. Complete the installation for

remaining cylinders following the same method.

Disassembly and assembly of crankshaft group

Exploded view of crankshaft group

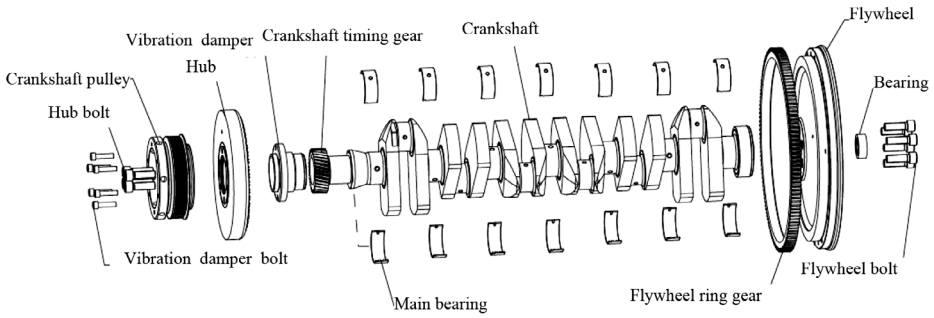


Figure 41 Exploded view of crankshaft group

Disassembling steps of crankshaft group

(1) With the cylinder block cap upwards, remove the main bearing bolts, and place them in order.
(2) Remove the crankshaft, flywheel and then the front/rear thrust washers and the bearing at flywheel end. Takeout the oil seals; place the crankshaft on the carrier frame (the crankshaft should be vertically placed in case of long-time placement).
(3) Place the removed parts as required.

Inspection and repair of crankshaft group

(1) Check rounded corners of the main bearing journal and connecting rod journal, the contacting part ofcrankshaft and bearing shell and the oil duct for cracks or other abnormalities.
(2) Check the main bearing journal and connecting rod journal for wear, visible linear traces, metal spalling and cracks.
(3) Check the wear condition of front/rear oil seals.
(4) Check the main bearing bolts for thread damage or other failures.
(5) Check the threaded holes of crankshaft flange end for cracks.
(6) Check the main journal for wear and check the crankshaft forbending and distortion conditions.

Assembling steps of crankshaft group

(1) Clean the main bearing bottom hole of cylinder block.
(2) Press the upper bearing shell into the main bearing bottom hole of cylinder block, and wipe away the foreign matters scraped at bearing port.
    a. The upper bearing shell should be checked for scratches strictly before installing, and the damaged bearing should not be reused.
    b. The upper bearing shell should be aligned with the oil hole and oil groove on the cylinder block after installation, and any deviation above 1/5-1/4 of the oil hole diameter is not allowed; the upper bearing shell should fit well with the main bearing bottom hole of the cylinder block.
(3) Apply appropriate clean lubricating oil to the inside of main bearing shell.
(4) Remove the oil on the lower surface of cylinder block.
(5) Apply sealant evenly on the lower surface of cylinder block with rubber roller.
(6) Lift the crankshaft, clean the oil duct hole with compressed air, clean the main bearing journal and connecting rod journal with a towel, and place it into the cylinder block gently, preventing the crankshaft from being damaged.
(7) Clean the upper thrust plate and press in cylinder block with the oil groove towards outside (with the oil groove towards the crankshaft).
(8) With the oil seal flat without distortion, place the oil seal flatly into the seal ring groove on the lower plane of cylinder block with special tooling.
(9) Installthe lower main bearing shell and lower thrust plate into the crankcase (with the oil groove facing crankshaft), install the crankshaft.
(10) Apply clean lubricating oil to the thread bearing face of crankshaft bolt and the threads of main bearing bolt, install the main bearing bolts without tightening, and then tighten all main bearing bolts in the sequence as shown in Figure 42. The bolts should be tightenedin twice, that is, tighten them with a torque of 70Nm first, and then rotate them by angle of 90°±4°, thus the assembling of crankshaft is completed.

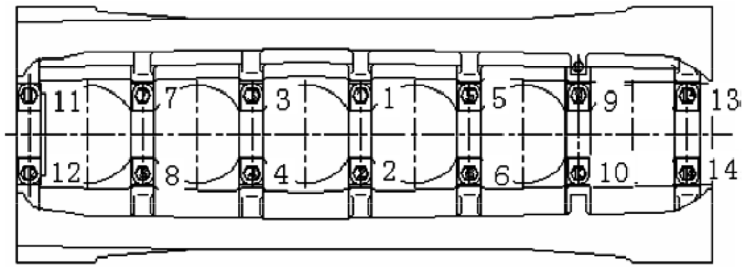


Figure 42 Tightening sequence for main bearing bolts

Disassembly and assembly of flywheel and ring gear

Exploded view of flywheel and ring gear

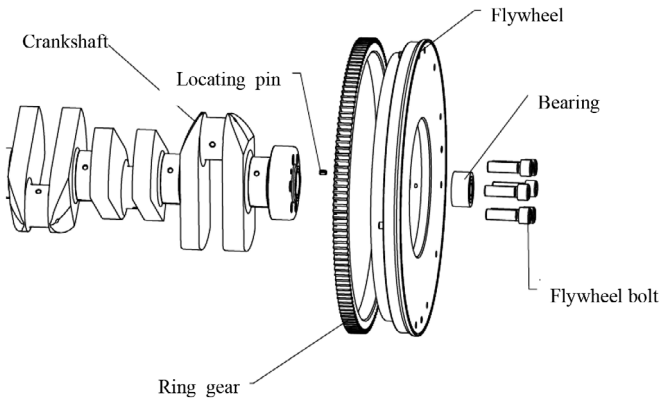


Figure 43 Exploded view of flywheel and ring gear

Disassembling steps of flywheel and ring gear

Disassemble the flywheel and ring gear with the reverse order ofassembly.

Inspection and repair of flywheel and ring gear

(1) Check the flywheel bolts for thread damage or other failures.

(2) Check the flywheel surface for crushing damage.

(3) Check the flywheel ring gear for damage.

Assembling steps of flywheel and ring gear

(1) Bolt the flywheel ring gear together with the flywheel.

(2) Knock a straight pin into the rear end of crankshaft completely.

(3) Insert a guide bar into the crankshaft threaded hole, install the flywheel, and tighten the flywheel bolts diagonally.

Apply lubricating oil to the threads and bearing face of flywheel bolts.

Flywheel bolt specification: M16-12.9 (6 PCS); tightening torque: (285~295) Nm; check value: (285~340) Nm.

Disassembly and assembly of torsional vibration damper, pulley and hub

Exploded view of torsional vibration damper, pulley and hub

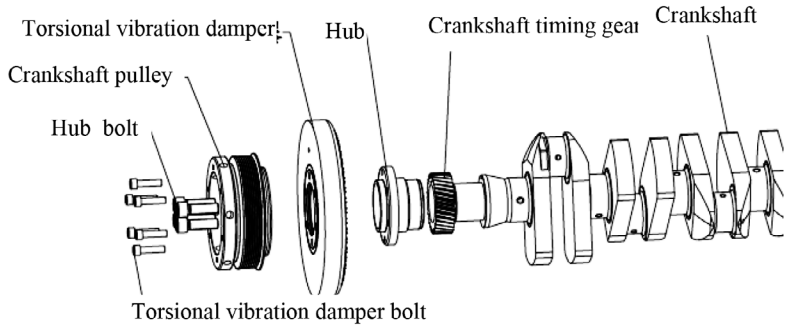


Figure 44 Exploded view of torsional vibration damper, pulley and hub

Disassembling steps of torsional vibration damper, pulley and hub
Remove the pulley bolts, take down the pulley and vibration damper.

Inspection and repair of torsional vibration damper, pulley and hub
(1) Check damper for impactdamage and deformation etc.
(2) Check the pulley and hub for damage and crushing damage.
(3) Check the hub bolt and vibration damper bolt for damage.

Assembling steps of torsional vibration damper, pulley and hub
With timing gear properly installed, install the hub, torsional vibration damper and pulley in sequence
(1) Tighten the hub onto the crankshaft with hub bolts (Bolt specification: M16-12.9 (4 PCS); tightening torque: (300-310) Nm, check value: (300-360) Nm.)
(2) Tighten the pulley and torsional vibration damper onto the hub with vibration damper bolts (Bolt specification: M10-10.9 (6 PCS); tightening torque: (65-70) Nm, check value: (65-80) Nm.)

Disassembly and assembly of crankshaft bearing

Exploded view of crankshaft bearing

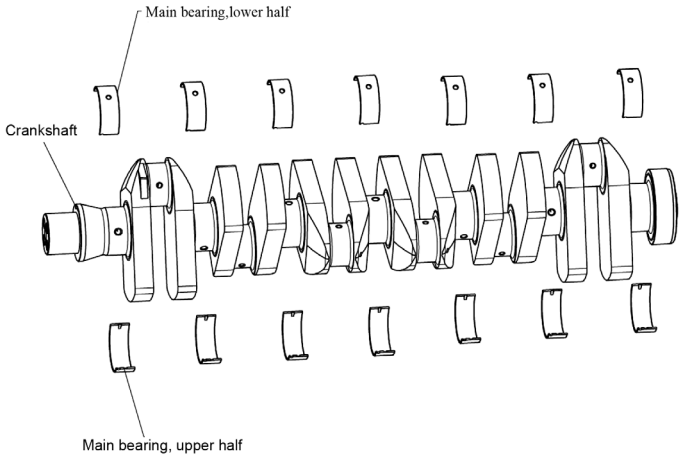


Figure 45 Exploded view of crankshaft bearing

Disassembling steps of crankshaft bearing shell
Push out the bearing shellfrom side with hands, and make marks on the removed bearing shells according to the seat holes of cylinder block and crankcase.

Inspection and repair of crankshaft bearing shell
(1) Clean the bearing shell and check for wear condition.
(2) Check the bearing shell for metal spalling, locating lip damage and transvers cracks.

Assembling steps of crankshaft bearing shell
(1) Clean the main bearing shell and mounting bottom hole.
(2) If the bearing shell is not to be replaced, refitit into the cylinder block (upper bearing) and crankcase (lower bearing) with the reverse order of disassembly (Notice: The upper bearing has oil groove); if the bearing shell is to be replaced, install the new bearing directly. When installing, apply small amount of lubricating oil to the bearingand align the lips of bearing shells.

Valve train

Disassembly and assembly of valve train

Exploded view of valve train

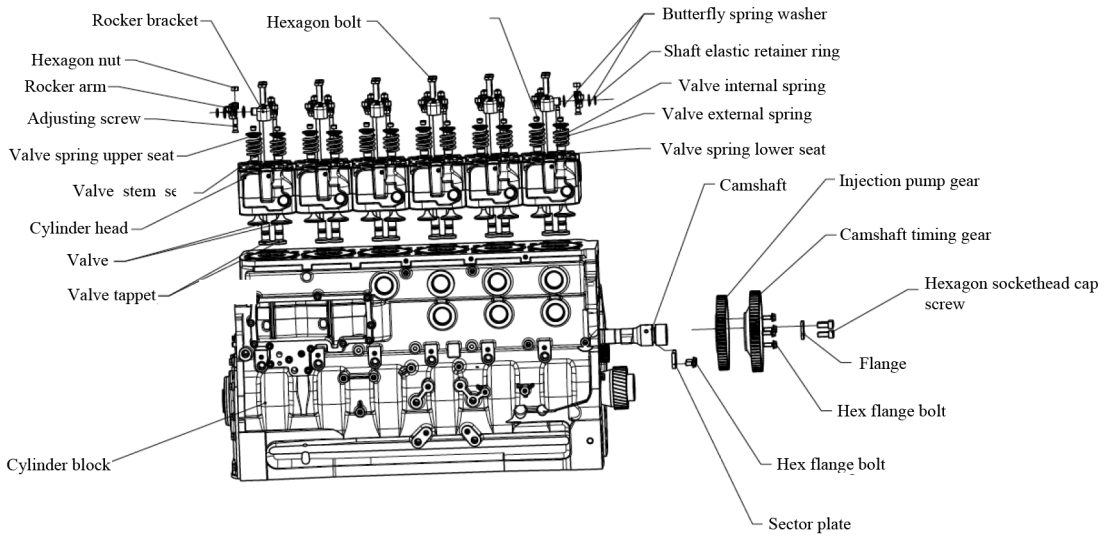


Figure 46 Exploded view of valve train

Disassembling steps of valve train
1) Remove the rocker arm and the rocker arm shaft;
2) Remove the intake/exhaust valve;
3) Remove the tappet and the push rod;
4) Remove the camshaft and the camshaft timing gear.
5) Remove the intermediate gear.

Assembling steps of valve mechanism
Assemble the valve trainwith the reverse order ofdisassembly.

Disassemblyand assembly of camshaft

Exploded view of camshaft

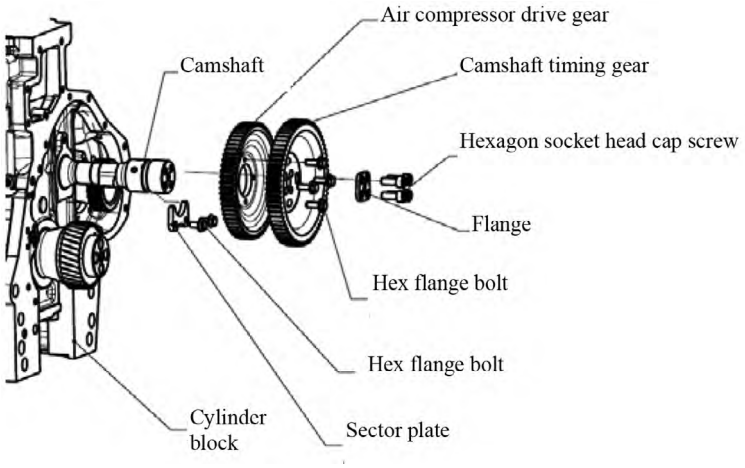


Figure 47 Exploded view of camshaft

Disassembling steps of camshaft
Disssemblethe camshaftwith the reverse order ofassembly.

Inspection and repair of camshaft and timing gear

1) Check the cam surface contacting to the valve tappet for wear and check the main journal for seizure and wear;
2) Check the timing gear fastening hexagon head bolt for deformation, check the camshaft timing gear and the air compressor drive gear for teeth collision damage or the teeth surface for serious wear.

Assembling steps of camshaft

After disassembling the camshaft, check the camshaft, timing gear and air compressor drive gear; if there is any wear or big deviation of part size, repair the related part, or replace with new ones.

1) Check the parts for burrs, impact damages and ensure that the surface has no rust, scratches and impurities such as iron chips.
2) Apply a proper amount of clean oil to the camshaft holes and the valve tappet holes, then install the valve tappet and camshaft.During installation, avoid damages to the camshaft surface and the cylinder block holes, and ensure that the camshaft end with threads is located at the front end cover side.
3) Install the sector plate and tighten the bolts to (35±10)Nm, and then perform paint sealing;
4) Install the camshaft at the front end of the cylinder block,then install the shim, flange, washer, hexagon head bolt and measure the axial clearance of the camshaft which shall be (0.1~0.29) mm; if the clearance is too small, check if there is burrs in between the camshaft and the sector plate; and if the axial clearance above is still not meet the requirements after deburring, replace the camshaft.
5) Rotate the crankshaft to make the “0” point on the timing gear nearest to the camshaft; place the air compressor drive gear on the camshaft, and then install the camshaft timing gear to the camshaft and ensure that the “0” pointson the camshaft gear and the crankshaft timing gear mesh with each other;
6) After alignment of gear mesh points and self-inspection,if it is OK, identify the position of “0” points of camshaft timing gear and crankshaft timing gear with a marker.
7) Adjust and align the asymmetric holes, and screw the clean camshaft gear bolt applied with sealant KB277 into the camshaft by passing through the flange hole and tighten the camshaft timing gear bolt by using a pneumatic wrench, and then tighten the bolt connecting the camshaft timing gear and the air compressor drive gear.

Tightening torque of the gear connecting bolts:
(85-90) Nm for the M10 bolt and (55-60.5) Nm for the M8 bolt.
Then perform paint sealing after tightening. Turn the crankshaft to check if the “0” points on gears mesh with each other.

Disassemblyand assembly of rocker arm and rocker shaft

Exploded view of rocker arm and rocker shaft

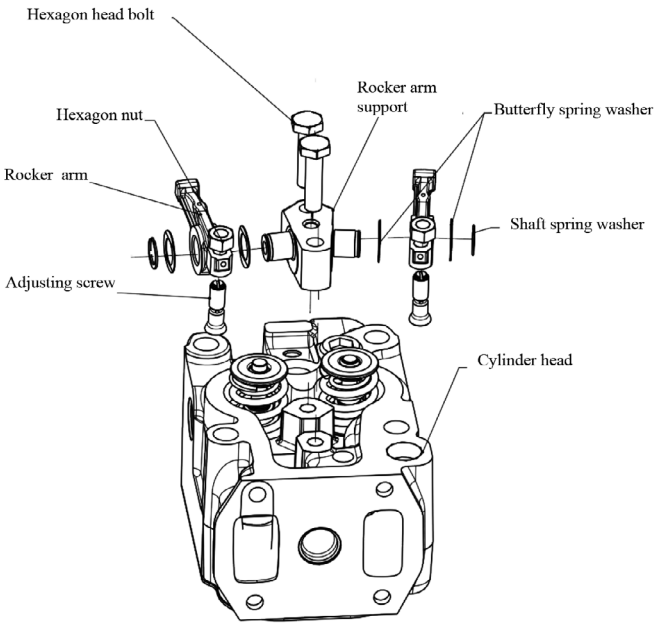


Figure 48 Exploded view of rocker arm and rocker shaft

Disassembling steps of rocker arm and rocker shaft

1) Rotate the crankshaft and check the rocker arm for flexible rotation.
2) Measure the valve clearance and check change of clearances.
3) If the rocker arm cannot rotate flexibly or the valve clearance changes excessively, unscrew the hexagon head screw, then remove the rocker arm support, shaft elastic retainer ring, butterfly spring washer, rocker arm and butterfly spring washer.And then mark them with the cylinder numbers.

Assembling steps of rocker arm and rocker arm shaft

1) Check all parts for cleanness without impact damages, scratches or rust;
2) Install the rocker arm adjusting screw and nut, tighten the screw completely and the tighten the lock nut for 2-3 pitches;
3) Apply a proper amount of lubricating oil on the rocker arm support and rocker arm hole,and install the butterfly spring washer, rocker arm assembly, butterfly spring washer and shaft elastic retainer ring in order to the rocker arm support;
4) Use the hexagon bolt to install the rocker arm support to the cylinder head;
5) Install the valve push rod;
6) Install the rocker arm support, align the rocker arm adjusting screw socket head with the valve push rod ball end, and finally tighten the hexagon head bolt to (40~45) Nm;

Inspection and adjustment of intake/exhaust valve clearance:

1) Turn the crankshaft till the phase pointer aligns with the “0” point of the phase plate, and check and ensure that the crankshaft timing gear “0” point meshes with camshaft gear “0” point; in this case, adjust the valve clearances of No. 1, 2, 3, 6, 7 and 10 rocker armsin the order. To adjust the intake valve: insert a 0.2mm feeler gauge, and use a torque wrench to tighten the nut to (20±5) Nm. And the plug gauge should be able to pullout with hand at this time. Andthen use a 0.25mm feeler gauge to check the clearance; it is acceptable only when the gauge cannot pass through the clearance. To adjust the exhaust valve: insert a 0.3mm feeler gauge, and then use a torque wrench to tighten the nut to (20±5) Nm. And the plug gauge should be able to pullout with hand at this time. And then use a 0.35mm feeler gauge to check the clearance; it is acceptable only when the gauge cannot pass through the clearance.

2) Turn the crankshaft till the phase pointer aligns with the “0” point of the phase plate, and observe and ensure that the crankshaft timing gear “0” point meshes with the 180°point of the “0” pointof camshaft gear. In this case, adjust the valve clearance of No. 4, 5, 8, 9, 11 and 12 rocker armsin the order in the same way withabove.

Disassembly and assembly of tappet and push rod

Exploded view of tappet and push rod

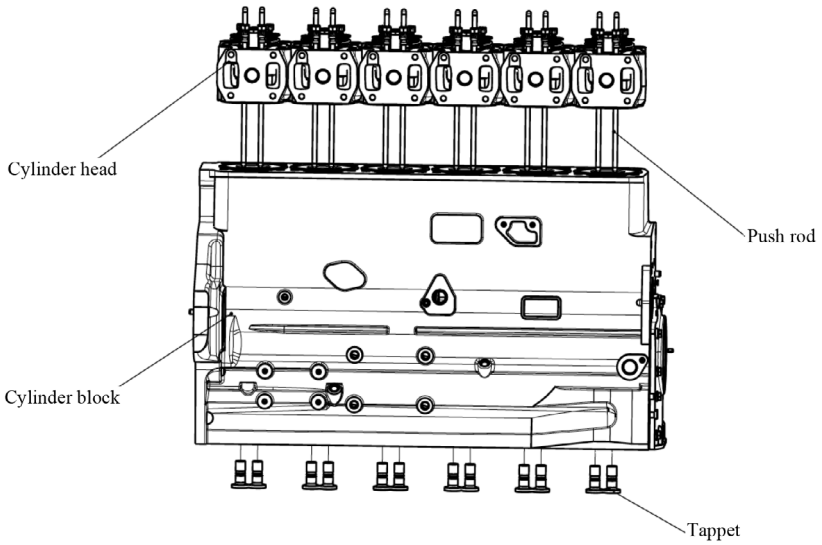


Figure 49 Exploded view of tappet and push rod

Disassembling steps of valve tappet and push rod

1) Remove the rocker arm and rocker shaft, take out the push rods and place them in order;
2) After removal of camshaft, take out the valve tappets and place them in order.

Inspection and repair of valve tappet and push rod

1) Clean the valve tappet and push rod;
2) Check the oil passages of valve tappet and push rod for blockage;
3) Check the push rod for bending and the external surface for wear condition;
4) Check the ball end and concave end of the push rod for wear;
5) Check the valve tappet surface and bottom surface for wear;
6) Check the internal concave end of the valve tappet for wear.

Assembling steps of valve tappet and push rod

1) Check if there is any defect occurs in the valve tappet and push rod; if any, replace with new ones. Before installing the valve tappet, clean it with compressed air, and then check the oil hole for blocking.
2) Apply clean lubricating oil to the cylinder block tappet hole and valve tappet outer side evenly;
3) Slightly place the tappet into the tappet hole from the lower side of cylinder block; the tappet should able to freely rotate in the tappet hole with even resistance. Install the camshaft.
4) Install the rocker arm support to the cylinder head and check the push rod for cleanness and check the welding state.
5) Apply clean lubricating oil to the push rod, and ensure that the ball end is sufficiently lubricated;
6) Install the push rod onto the tappet.

Disassembly and assembly of valve

Exploded view of valve

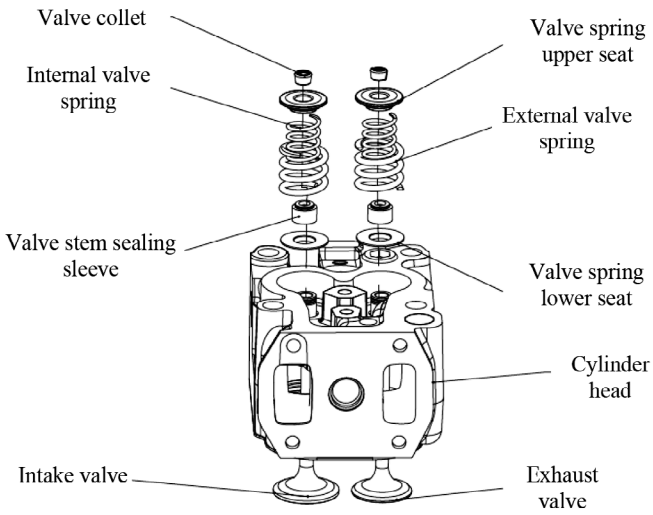


Figure 50 Exploded view of valve

Disassembling steps of valve

1) Compress the valve springs with valve spring compressor, valve spring pliers or other tools, take out the valve collets and remove upper valve spring seat and internal and external valve springs.
2) Remove the valves from valve seats.

Inspection and repair of valve

1) Check the valve rod and its end surface for abrasion.
2) Check the valve cone for abrasion or damage.
3) Check the valve cone for carbon deposit.
4) Check the end surface of valve disc for carbon deposit or sintering.

Disassembly and assembly of intermediate gear

Exploded view of intermediate gear

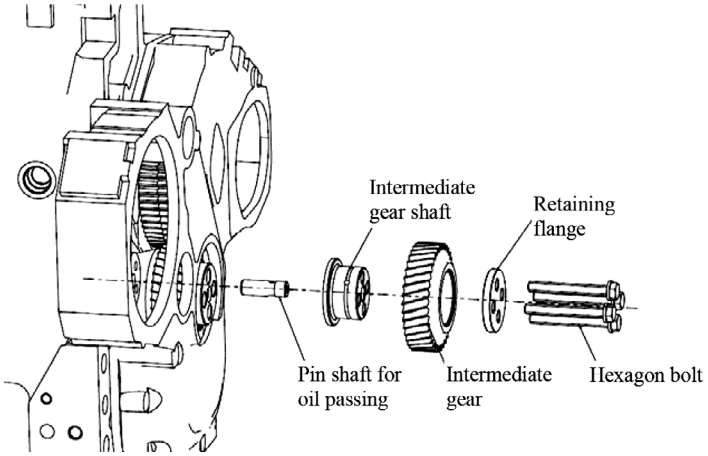


Figure 51 Exploded view of intermediate gear

Disassembling steps of valve

1) Check the mark for mounting of intermediate gearbolts, and make sure the bolts have not rotated.
2) Remove the four M10 hexagon head bolts of the intermediate gear and remove the retaining flange.
3) Screw a M8 bolt into the intermediate gear shaft and pull the shaft out, preventing the intermediate gear falling off in this process;
4) Remove the intermediate gear and idler shaft.

Inspection and repair of intermediate gear

1) Check if the mounting bolt thread is in good condition;
2) Check all gears for tooth metal spalling or breakage, the bolt bearing surface for crushing and the thread hole or through hole in the gear for deformation;
3) Check the intermediate gear shaft, intermediate gear bush, pin shaft for oilpassing and intermediate gear shaft for abnormal wear. Check the oil hole for blockage.

Assembling steps of intermediate gear

1) Install the front end cover onto the engine block as required.
2) Assemble the intermediate gear assembly: apply a proper amount of oil on the intermediate gear shaft, install the intermediate gear shaft and intermediate gear.
3) Place the intermediate gear assembly into the front end cover and insert thepin shaft for oil passing upon alignment.
4) Upon alignment of the retainer flange, install the bolts and tighten them to(65-70) Nm.
5) Check the mounting clearance of gear by moving the gear with hand, and the gear should not being stuck.

Intake/exhaust system

Disassembly and assembly of intake/exhaust system

Exploded view of intake/exhaust system

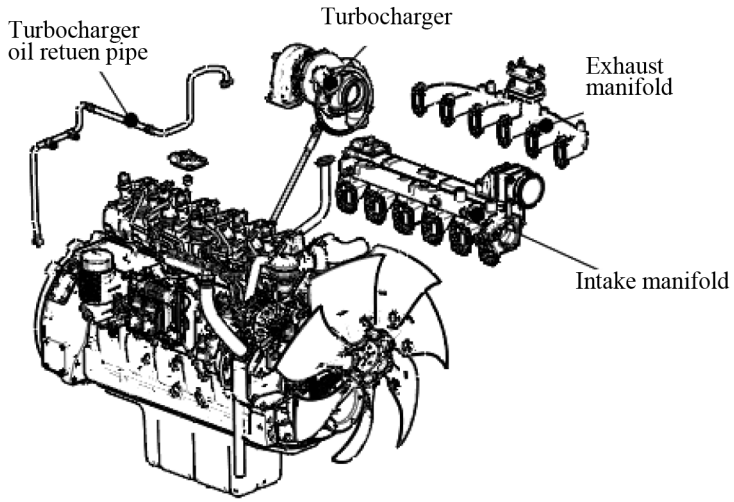


Figure 52 Exploded view of intake/exhaust system

Disassembling steps of intake/exhaust system

1) Remove turbocharger inlet/outlet pipe, unscrew the bolts for oil inlet/retrun pipes;
2) Remove turbocharger;
3) Remove water pipe of EGR and connecting pipe of air passage;
4) Remove EGR cooler, EGR valve and EGR cooler bracket;
5) Remove oil inlet/retrun pipes of turbocharger, remove exhaust connecting pipe;
6) Unscrew the bolts and remove the exhaust manifold and gasket;
7) Unscrew the bolts and remove the intake manifold.

Assembling steps of intake/exhaust system

Assemble the intake/exhaust systemwith the reverse order ofdisassembly.

Disassembly and assembly of intake manifold

Exploded view of intake manifold

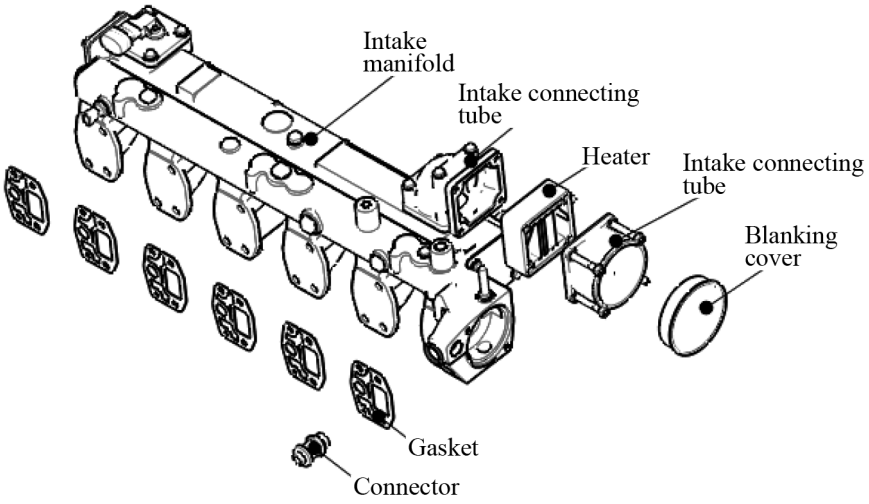


Figure 53 Exploded view of intake manifold

Disassembling steps of intake manifold

1) Unscrew the intake manifold bolts and remove the intake manifold and gasket;
2)Unscrew the hexagon nut and remove the heater and gasket;
3) Unscrew the bolts and remove intake connecting tube and gasket;
4) Unscrew the bolts and remove intake manifold and gasket.

Inspection and repair of intake manifold

1) Check the intake manifold body for welding defects; if any, replace it with a new one.
2) Check the intake manifold gasket for deformation, damage, missing or other defects; if any, replace it.

Assembling steps for intake manifold

Assemble the intake manifoldwith the reverse order ofdisassemblywith bolt tightening torque of 23Nm.

Disassembly and assembly of exhaust manifold

Exploded view of exhaust manifold

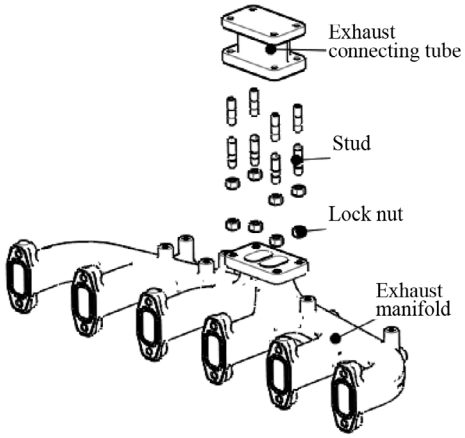


Figure 54 Exploded view of exhaust manifold

Disassembling steps of exhaust manifold

1) Unscrew the nuts and remove the exhaust connecting tube, turbocharger gasket and EGR outlet flange gasket;
2) Unscrew the exhaust manifold bolts and remove the exhaust manifold and gaskets.

Inspection and repair of exhaust manifold

1) Check the exhaust manifold body for crack or other damages, check the flange for deformation; Replace it if necessary;
2) Check the exhaust manifold flange for leakage; Replace the exhaust manifold gasket if necessary;
3) Check the exhaust manifold gasket for deformation, damage, missing or other defects; replace it if necessary;
4) Check the turbocharger gasket for deformation, damage, missing or other defects; replace it if necessary.

Assembling steps of exhaust manifold

Assemble the exhaust manifoldwith the reverse order ofdisassembly.

Notice: *Apply anti-seize compound (molybdenum disulfide) to the exhaust manifold bolts; the tightening torque of bolt shall be (65~80) Nm; and the exhaust manifold bolt can only be used for twice at most.*

Disassembly and assembly of turbocharger system

Exploded view of turbocharger system

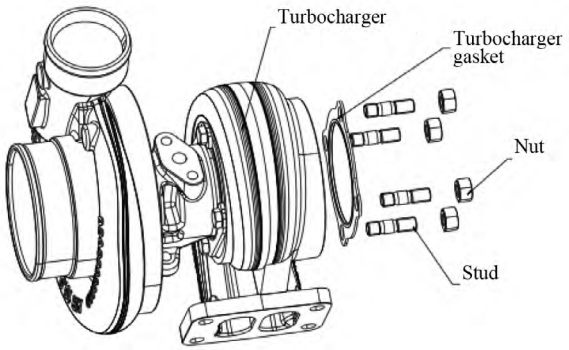


Figure 55 Exploded view of turbocharger system

Disassembling steps of turbocharger system
Disassemble the turbocharger systemwith the reverse order ofassembly.

Inspection and repair of turbocharging system

1) Check the running of rotor
   Turn the air compressor stator with hand; if it rotates for more than one turn, it indicates that it is normal; if it stops rotating soon, it indicates that the bearing is worn abnormally or there is interference between the moving part and the fixed part or the moving part is blocked; in this case, you shall find out the causes and eliminate them.
2) Check the axial play of rotor
   Place the measuring head of the dial indicator against the air compressor end, push and pull the rotating shaft with hand in the axial direction, and measure and record the difference value as shown in the figure 56.
   The rotor axial play shall be in the range of (0.088~0.118) mm; if it goes out of this range, it indicates that the thrust bearing plate or the thrust plate and bearing body are worn; in this case, you shall find out the causes and eliminate them.

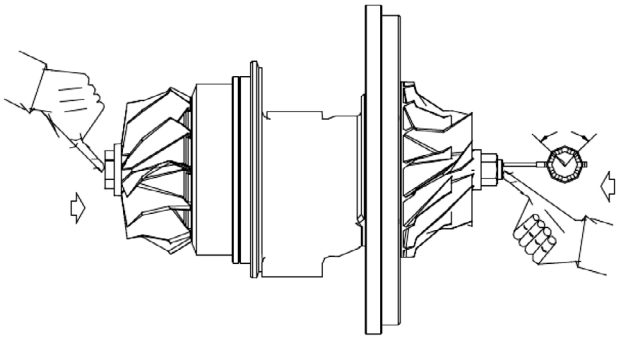


Figure 56 Exploded view of turbocharger system

3) Check radial play of compressor impeller

Press down or hold the compressor impeller by hand in the radial direction, and use the feeler gauge to measure the min/max clearancesbetween the compressor impeller and compressor casing as shown in figure 57. The value shall be in the range of 0.4~0.8mm; if this value is exceeded, check the bearing and eliminate the failures.

Note: *Measurement shall be carried out at cold state.*

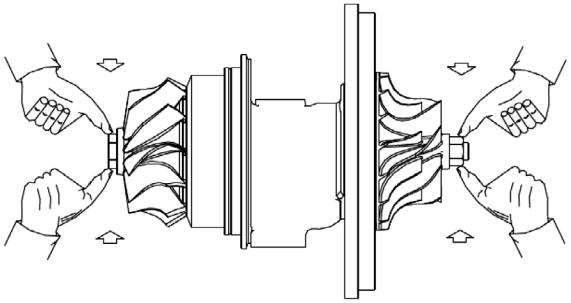


Figure 57 Measuring of radialplay

Daily maintenance:

1) Check the pipeline connecting of turbocharger and engine for looseness; if any, eliminate it.
2) Check the turbocharger for air and oil leakage; if any, eliminate it.
3) Check the turbocharger tightening screw for looseness; if any, eliminate it.
4) Check the air filter; if excessive dust is found, clean it without delay.

Assembling steps for turbocharger system

1) Install the turbocharger gasket to the exhaust manifold flange.
2) Install the gasket on the exhaust manifold flange to install the turbocharger assembly, and loosely install the style 2 all-metal hexagon lock nuts and tighten them.
3) Apply a proper amount of clean lubricating oil to the turbocharger intake port, and wipe the excessive lubricating oil.
4) Install the gasket, studs and connect the muffler.
5) All the gaskets can only be used for once and shall be replaced when repairing.

Fuel system

Disassembly and assembly of fuel system

Exploded view of fuel system

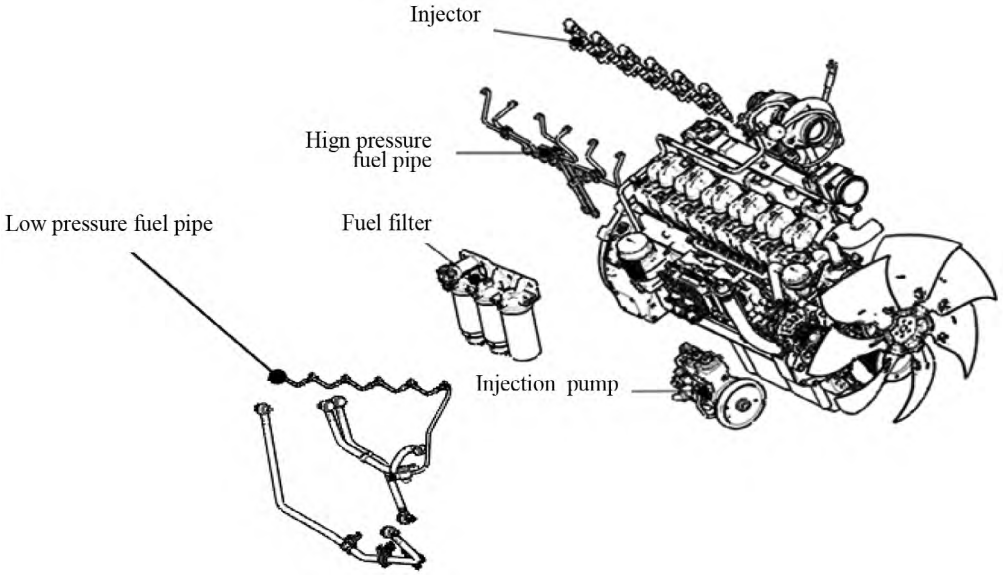


Figure 58 Exploded view of fuel system

Disassembling steps of fuel system

1) Remove the pipeline and wire of fuel system connecting the vehicle;
2) Remove the low pressure fuel pip;
3) Remove the air pipe of smoke limiter;
4) Remove the high pressure fuel pipe assembly;
5) Remove the filter assembly;
6) Remove the injector assembly;
7) Remove the upper cover plate of front end cover;
8) Remove the injection pump assembly.

Assembling steps for fuel system

Assemble the fuel systemwith the reverse order ofdisassembly.

Disassembly and assembly of injection pump

Exploded view of injection pump

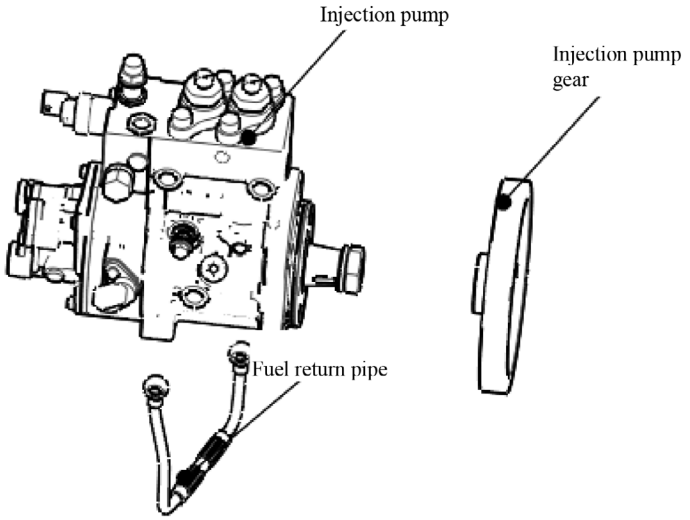


Figure 59 Exploded view of injection pump

Disassembling steps of injection pump

1) Remove the pipeline and wire connecting the injection pump and the vehicle;
2) Remove the hollow bolt connecting the low pressure fuel pipe and the injection pump;
3) Remove the hollow bolt connecting theair pipe of smoke limiter and the injection pump;
4) Remove the hollow bolt connecting the injector return pipe and the injection pump;
5) Remove the nuts connecting injection pump and high pressure fuel pipes;
6) Remove the hollow bolt connecting the lubricating oil pipe and the injection pump;
7) Remove the upper cover plate of front end cover;
8) Remove the injection pump bolt and then remove the injection pump gear and clamp plate;
9) Remove the mounting nut of injection pump and front end cover to remove the injection pump.

Inspection and repair of injection pump

1) Check the injection pump for cracks or leakage; if any, replace it and give feedback to the manufacturer through corresponding processes.
2) Check the injection pump lead seal for damage; if any, replace the injection pump and adjust the fuel amount on the test rigof fuel pump.
3) Check the smoke limiter air pipe for cracks and the joints at two end for air leakage; if any crack occurs, replace the smoke limiter air pipe, and if air leakage occurs, replace the hollow bolt gaskets at both ends.
4) Check the lubricating oil pipe for leakage; if any,replace the lubricating oil pipe or the hollow bolt gaskets at both ends.

Assembling steps of injection pump

Assemble the injection pump with the reverse order ofdisassembly.Notice: When assembling the injection pump gear, rotate the engine crankshaft tomake the injection pump to the position with correct fuel supply advance angle, at the same time, turn the camshaft of injection pump so that the first cylinder (at the drive end) is in fuel supply stroke and then tighten the bolts of injection pump gear.

Disassembly and assembly of high pressure fuel pipe

Exploded view of high pressure fuel pipe

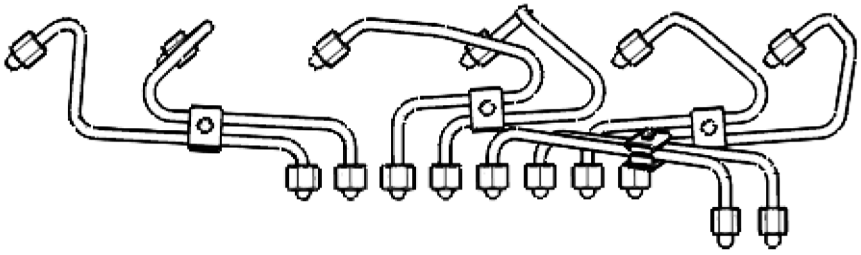


Figure 60 Exploded view of high pressure fuel pipe

Disassembling steps of high pressure fuel pipe

1) Remove the nuts connecting high pressure fuel pipes and injectors.
2) Remove the nuts connecting high pressure fuel pipes and injection pump cylinders.

Inspection and repair of high pressure fuel pipe

1) Check the high pressure fuel pipe for cracks or leakage; if any, replace it and give feedback to the manufacturer through the corresponding processes.
2) Check the joint conical surfaces at both ends of high pressure fuel pipe for defects.

Assembling steps of high pressure fuel pipe

Assemble the high pressure fuel pipe with the reverse order ofdisassembly.The high pressure fuel pipe shall be clean and in good conditions.

Disassembly and assembly of injector

Exploded view of injector

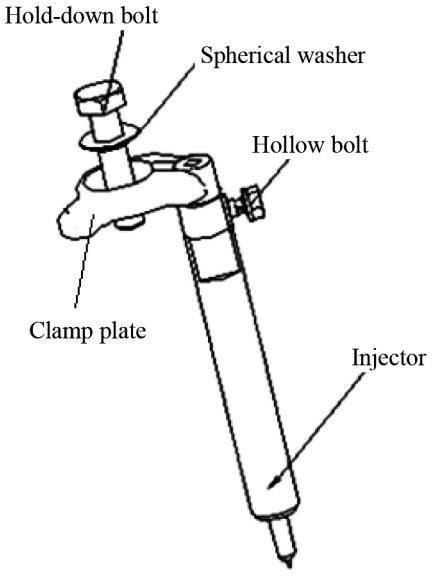


Figure 61 Exploded view of injector

Disassembling steps of injector

1) emove the hollow bolts connecting the injector return pipes and the injectors.
2) Remove the injector hold-down bolt and the injector pressure plate.
3) Remove the injector using special tool.

Inspection and repair of injector

1) Check the copper seal washer for excessive deformation or other damages; if any, replace it, and clean the injector seat bore surface to clear the carbon deposit for ensuring sealing. Notice: Install the injector, seal washer and adjusting shim correctly to ensure that the injection nozzle body lower cone and the nozzle protrusion of sharp end meet the requirements.
2) Check the fuel return pipe of injectorfor damage or fuel leakage; if any, replace it.

Assembling steps of injector

Assemble the injector with the reverse order ofdisassembly.

Disassembly and assembly of fuel filter

Exploded view of fuel filter

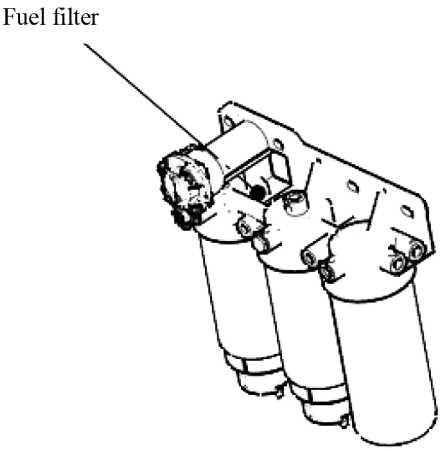


Figure 62 Exploded view of fuel filter

Disassembling steps of fuel filter

1) Remove the hollow bolts connecting the low pressure pipe and the primary (or secondary)fuel filter.
2) Remove the connecting bolts of primary (or secondary)fuel filter and fixing bracket.
3) Disassemble the fuel filter element and the filter seat.

Inspection and repair of fuel filter

1) Check the fuel filter for damage.
2) Check the fuel filter and the filter seat for leakage; if any, replace the related parts.
3) Check the fuel filter for blockage; if any, replace the filter element. When replacing the filter element, remove the old element first, fill clean diesel fuel to the new element and apply lubricating oil to the rubber gasket of the filter seat; install the filter and tighten it for 3/4 to 1 more turns to seal tightly after the rubber gasket contacting the seat,; and finally, remove the bleed screw on filter seat and operate the hand pump on the injection pump to remove the air inside.

Assembling steps of fuel filter

Assemble the fuel filter with the reverse order ofdisassembly.When replacing the filter element, fill clean diesel fuel to the new element and apply lubricating oil to the rubber gasket of the filter seat; install the filter and tighten it for 3/4 to 1 more turns to seal tightly after the rubber gasket contacting the seat,; and finally, remove the bleed screw on filter seat and operate the hand pump on the injection pump to remove the air inside.

Disassembly and assembly of low pressure fuel pipe

Exploded view of low pressure fuel pipe

“Exploded view of fuel system” for details.

Disassembling steps of low pressure fuel pipe

1) Remove thebracketsof low pressure fuel pipe installed on the cylinder head and the cylinder block.
2) Remove the hollow bolt connecting the low pressure fuel pipe and the injection pump.
3) Remove the hollow bolt connecting the low pressure fuel pipe and fuel secondary filter or primary filter.

Inspection and repair of low pressure fuel pipe

1) Check the low pressure fuel pipe for leakage; if any, replace it and give feedback to the manufacturer through the corresponding processes.
2) Check the jointsat two ends of low pressure fuel pipe for oil leakage; if any, replace the hollow bolt gasket.

Assembling steps of low pressure fuel pipe

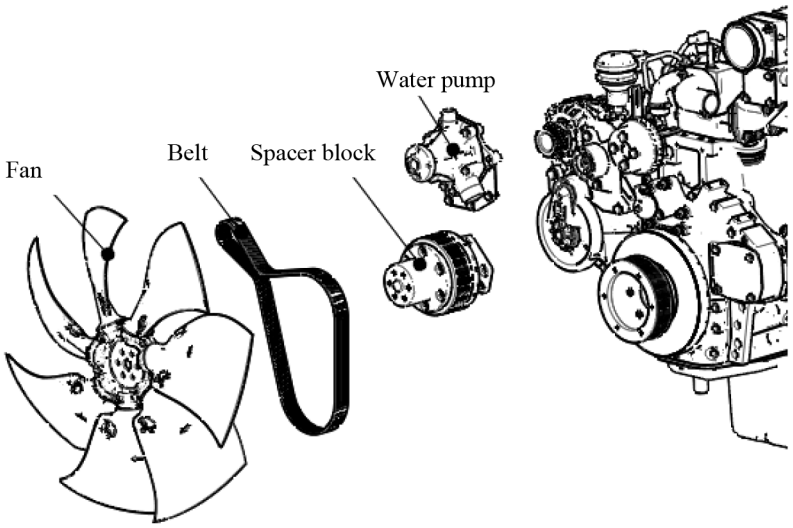
Assemble the low pressure fuel pipe with the reverse order of disassembly.

Cooling system

Disassemblyandassembly of cooling system

Exploded view of cooling system assembly

The function of cooling system is to ensure the continuous work of diesel engine under appropriate temperature, and it is composed of water pump, fan, expansion water tank and thermostat. See figure 63.



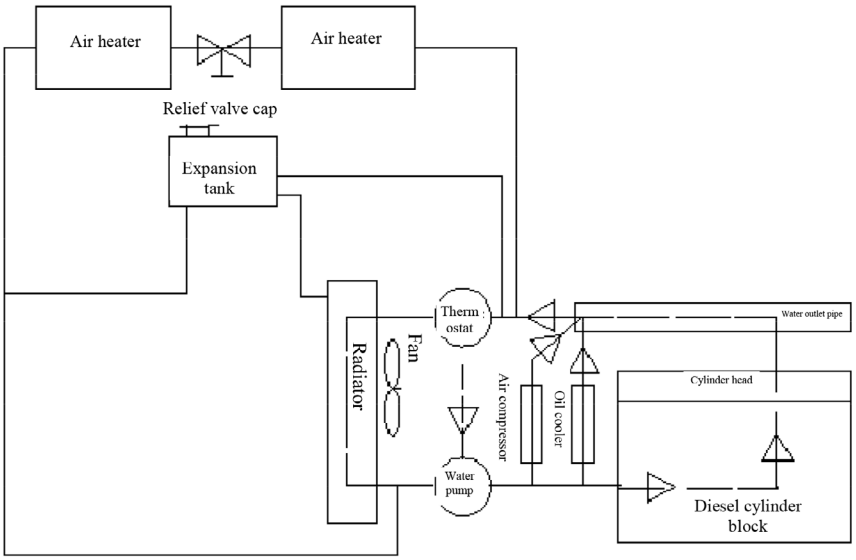


Figure 63 Cooling system loop of WP6 series diesel engine

Disassembling steps of cooling system

1) Remove the fan and adapting flange.
2) Remove the tensioner and belt.
3) Removethe alternator and its bracket, crankshaft pulley and vibration damper.
4) Remove the thermostat, remove the water inlet pipe.
5) Remove the air compressor and hydraulic pump.
6) Remove the water pipe fitting and water pump.
7) Remove thespacer block of water pump.

Assembling steps of cooling system

Assemble the cooling system with the reverse order of disassembly.

Disassembly and assembly of fan

Exploded view of fan assembly

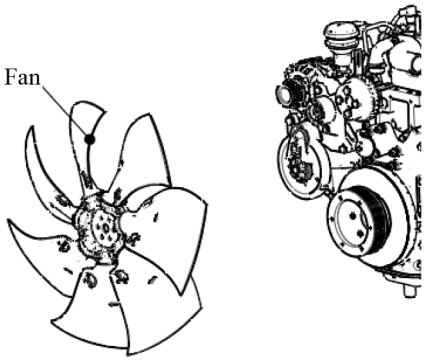


Figure 64 Exploded view of fan assembly

Disassembling steps of fan

1) Remove the bolt and washer connecting the fan and adapting flange and remove the fan.
2) Remove the screw and washer connecting the adapting flange and pulley.
3) Remove the adapting flange.
4) Remove the pulley.

Inspection and repair of fan

Check the fan, adapting flange and pulley for damages such as cracks, and replace them if necessary.

Assembling steps of fan

Assemble the fan with the reverse order of disassembly.

Disassembly and assembly of water pump

Exploded view of water pump assembly

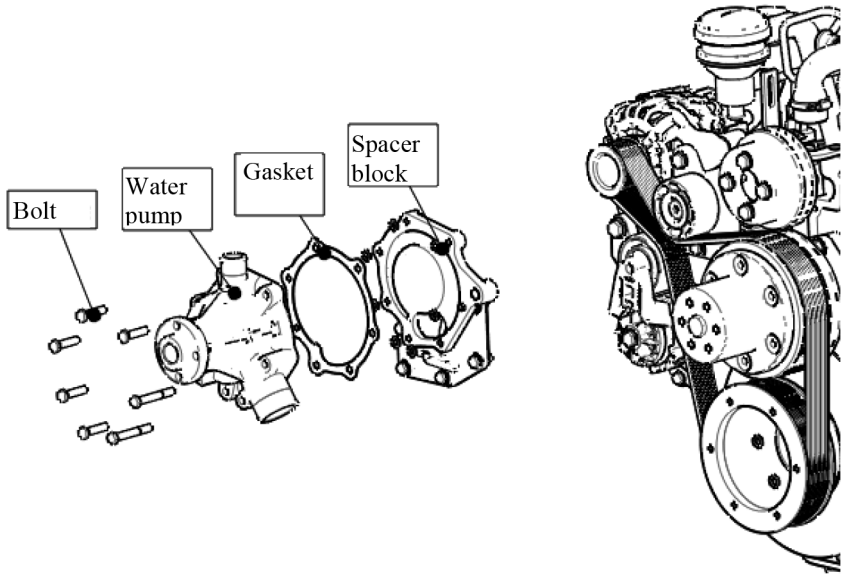


Figure 65 Exploded view of water pump assembly

Disassembling steps of water pump

1) Remove the water pump pulley.
2) Remove the connecting rubber hose and clamps connecting the water inlet pipe and thermostat;
3) Remove hexagonal bolt and spring washer from water pump, remove the water pump.
4) Remove water pump gasket and intermediate spacer block.

Inspection and repair of water pump

1) Check the water pump gasket for damage, and replace it if necessary.
2) Check the bolts and studs for threads damage, and replace them if necessary.
3) Check the water pump and intermediate spacer block for damages, and replace them if necessary.

Assembling steps of water pump

Assemble the water pump with the reverse order of disassembly.

Disassembly and assembly of thermostat

Exploded view of thermostat assembly

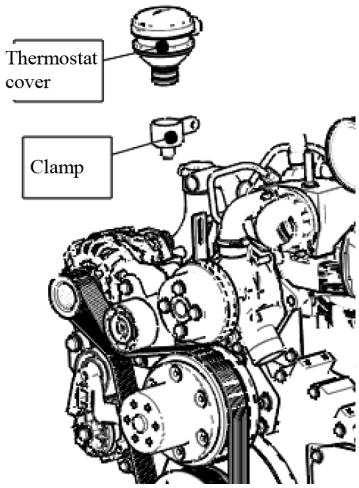


Figure 66 Exploded view of thermostat assembly

Disassembling steps of thermostat

1) Remove the clamp and hose connecting the cooling water pipe and thermostat.
2) Remove the clampand hoseconnecting the water pump and thermostat.
3) Remove thermostat.
4) Remove the coolant rubber hoses.

Inspection and repair of thermostat

1) Check the clamp for damage, and replace it if necessary.
2) Check the coolant connecting rubber hose for damage, and replace it if necessary.
3) Check the thermostat for damage, and replace it if necessary.

Assembling steps of thermostat

Assemble the thermostatwith the reverse order ofdisassembly.

Starting system

Disassembly and assembly of starting system

Exploded view of starting system

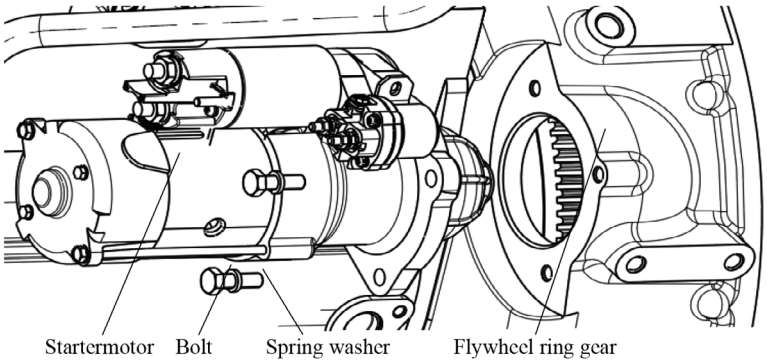


Figure 67 Exploded view of starting system

Disassembling steps of starting system

1) Remove the hexagon bolts and spring washers;
2) Hold the starter motor with hands, and remove it along the rotation axis of starter motor gear.

Inspection and repair of starting system

Check the starter motor gear for damages and replace it if necessary.

Assembling steps of starting system

Assemble the starting system with the reverse order of disassembly.

Accessories

Disassembly and assembly of accessories

Exploded view of accessories

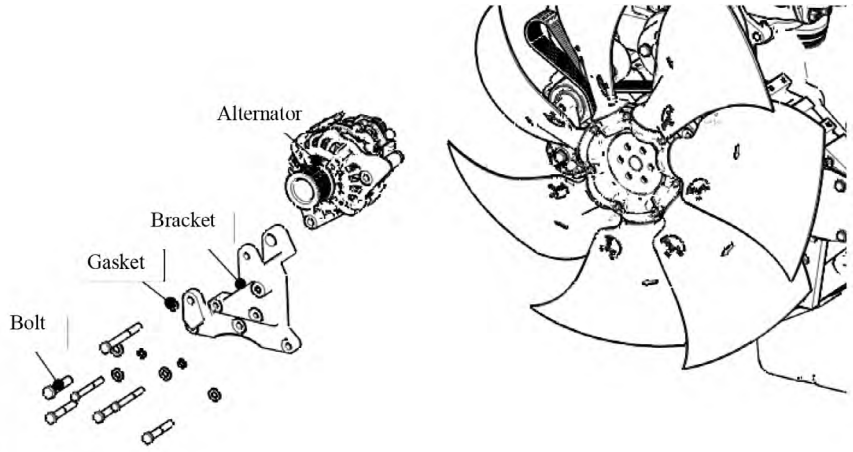


Figure 68 Exploded view of accessories

Disassembling steps of accessories

1) Disassembly steps of alternator group
   a. Unscrew the tension nut of alternator and bolt/nut which connected to tensioning block. Remove the nut, tension bolt and tensioning block.
   b. Unscrew another fixing bolt of alternator, turnthe alternator body, and remove the poly V-belt, fixing bolt and alternator.

Assembling steps of accessories

1) Assembly steps of alternator group
   a. Put the alternator on the bracket, install it onto the bracket and tension rod with fixing bolt.
   b. Install alternator poly V-belt.
   c. Adjust the position of alternator, tension the poly V-belt with the alternator tensioning bolt, and tighten the bolts and nuts of alternator.

Disassembly and assembly of alternator

Exploded view of alternator assembly

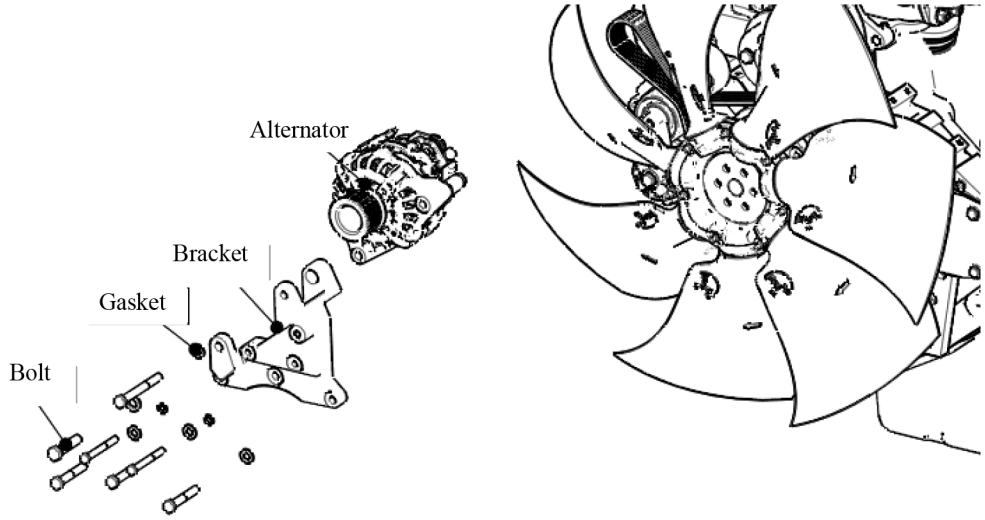


Figure 69 Exploded view of alternator

Disassembly steps of alternator

a. Unscrew the tension nut of alternator and bolt/nut which connected to tensioning bolt spacer block. Remove the nut, tension bolt and spacer block.
b. Unscrew another fixing bolt of alternator, turnthe alternator body, and remove the belt at front end of alternator.
c. Unscrew the fixing bolts and remove the alternator and bracket.

Notice: *Disassembly/assembly and repair of the alternator must be done by professionals. When assembling, check the insulation pad and bushing for damages, replace it if necessary. There should be no short circuit between the alternator positive terminal and the shell. Otherwise, do not install the alternator on the vehicle to avoid serious accidents.*

Failure diagnosis and maintenance of alternator

1) Process of alternator failure diagnosis

When providing warranty service for user, the test on vehicle should be performed to see if it is alternator failure.

Tool: test lamp, the process is as shown in figure 70.

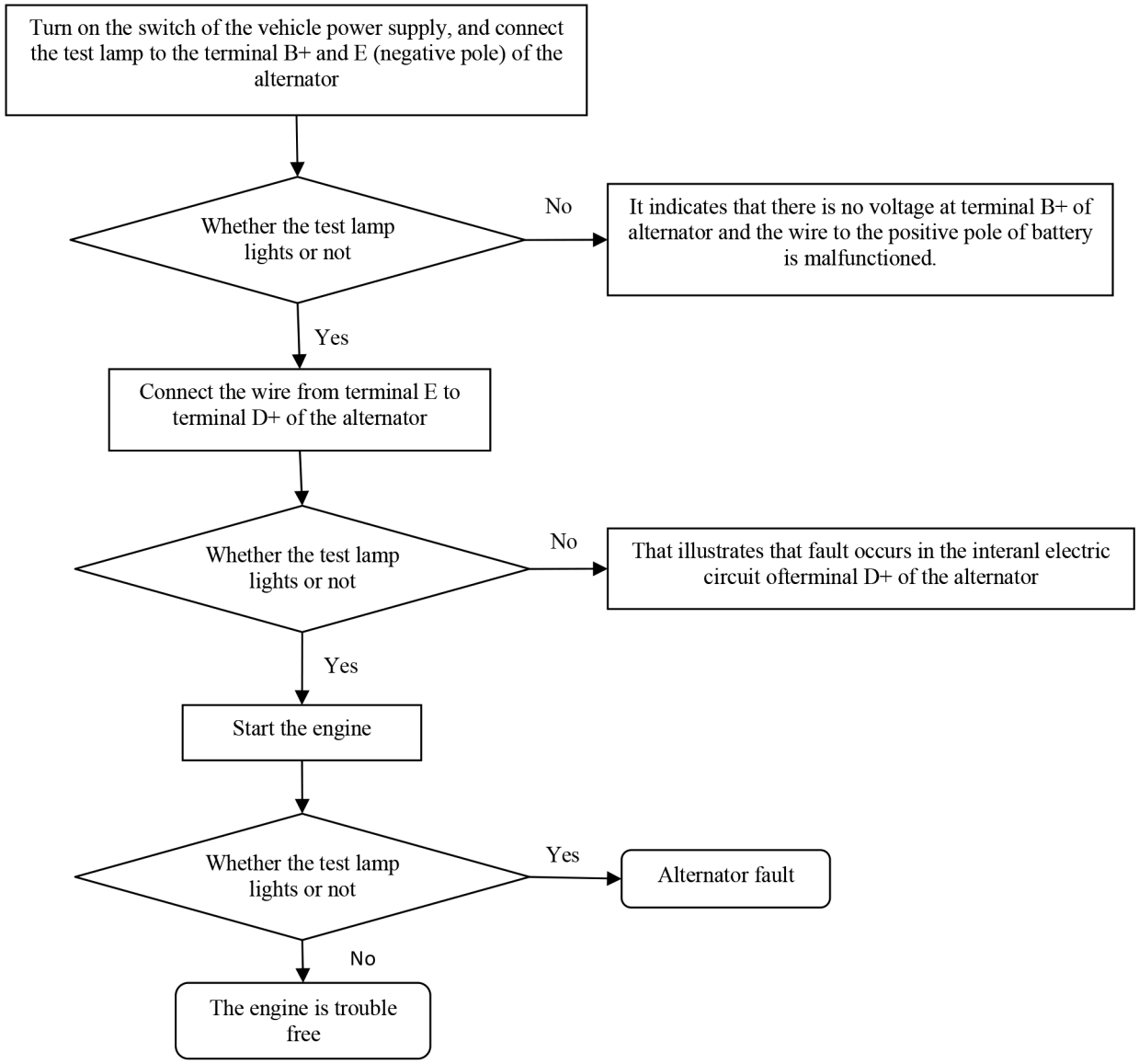


Figure 70 Diagnosis Trouble Flow Chart for Alternator

2) Failure diagnosis & troubleshooting method of charging system

a)Not charging

Failure 1: Not charging		
Vehicle Symptom	Failure testing	Troubleshooting
(1) Charging indicator does not go out when the engine is working	a. Inspect for voltage of alternator excitation terminal to earth, it should be within (1~3) V	a. Extremely low voltage at alternator indicator lamp end indicates too small power of excitation circuit indicator or virtual connection of circuit. Adjust power of indicator lamp or test circuit connector and connection point. b. When the voltage at alternator indicator lamp end is zero, short circuit point may exist at alternator end of excitation circuit, and then inspect the circuit. c. When the voltage at alternator indicator lamp end is battery voltage, vehicle excitation circuit may be failure, meanwhile alternator regulator and excitation tube may be damaged, correct excitation circuit and connect the repaired alternator again.
	b. Test if the voltage of alternator output end B+ to earth is about battery voltage 24V	a. When the voltage of B+ to earth is zero, check the positive and negative wires between alternator and battery. b. When the voltage of B+ to earth is obviously lower than battery voltage, check positive and negative wires from alternator to battery for connection point looseness or battery damage. Recommended testing method: bridge a 2W indicator lamp between alternator output B+ and excitation terminal D+/L, and observe its working condition. Troubleshooting: a. With normal brightness, the indicator lamp goes out after starting engine, and alternator output voltage is 27-28.5V; vehicle excitation circuit has failed and requires to be reconditioned. b. With normal brightness, the indicator lamp does not go out after starting engine, and alternator output voltage is 27-28.5V; alternator regulator has failed and requires to be reconditioned. c. With normal brightness, the indicator lamp does not go out after starting engine, and alternator output voltage is the battery voltage; Alternator regulator, rectifier bridge, stator and interconnector may be failure and require to be repaired or replaced.
(2) Turn on key switch, but charging indicator fails to light up.	a. Inspect charging indicator. b. Inspect whether excitation circuit is open.	a. Test alternator indicator lamp for voltage to earth, and replace the indicator lamp or inspect the circuit if no voltage is tested. b. Alternator regulator or rotor has failed, and if any repair or replace the alternator.

Failure 1: Not charging		
Vehicle Symptom	Failure testing	Troubleshooting
(3) Charging indicator does not go out when engine is at idle speed and does at high speed.	a. Low power indicator or loose parallel excitation resistance b. Low idle speed of engine	a. The (2~6) W bulb is recommended or repair the circuit. b. Adjust engine idle speed.

b) Low charging voltage

Failure2: Low charging voltage		
Vehicle Symptom	Failure testing	Troubleshooting
Battery is often undercharged, charging voltage is low and voltage decreases obviously with open load.	Check if alternator output power and vehicle electrical appliance are properly matched.	Measure voltage at alternator terminal B+ and which should be usually in between 27.8V to 28.4V. A normal voltage indicates wrong voltmeter and its sampling point, and require to be repaired or replaced.
	a. Inspect voltmeter for damage b. Inspect alternator speed.	a. No-load speed of alternator is recommended to be more than 1,600rpm. b. The speed should be ≥2,000rpm or voltage be approximately 27V when alternator operates with high power load like A/C.
	c. Check the quality and tensioning of alternator and related gear train transmission belt.	a. Check the qualities of alternator and related transmission belt, and if the belt is coking, lack of teeth, broken, deformed or if it have fall into pulley groove bottom, replace it timely. b. Retighten alternator and related belts. Notice: If the system with belt to be replaced is of double-belt transmission, then two belts shall be replaced simultaneously.
	d. Inspect alternator pulley	Tighten it if loose.
	e. Inspect whether lead is used properly, and measure voltages at alternator and battery terminals.	a. In the case of voltage difference more than 1V (big voltage drop due to thin lead) under heavy load working condition, replace the lead. Current within 35A, S ≥6mm2; Within 70A, S ≥12mm2; Within 100A, S ≥20mm2; Within 150A, S ≥25mm2. b. If lead or connector becomes hot obviously under heavy load working condition, replace the lead or connector.
	f. Inspect whether charging system lead is connected to bolt firmly, and whether it is oxidized, virtual connected and extremely hot.	a. Polish the lug plate with its surface oxidized and surface of ground bolt housing for subsequent reinstallation. b. Retighten loose nut and lug plate, and reinsert connector into place. Notice: Check if the reinstalled or re tightened parts are still extremely hot after engine runs with heavy load for 3-5 min.

Failure2: Low charging voltage		
Vehicle Symptom	Failure testing	Troubleshooting
	g. Test output voltage at phase terminal of alternator (which should be about half of the output voltage at B+).	When the output voltage at phase terminal (W/R/AC) is greatly different from normal output voltage valve, alternator rectifier bridge or stator may be failed, and reconditioning or replacement should be considered.
	h. Inspect battery for normal charging.	After charging for 10 min, the charging current should drop to about10A, and if the charging current reaches (30~90) A for a long period of time, the battery is damaged and requires to be repaired or replaced.

c) High charging voltage

Failure3: High charging voltage		
Vehicle Symptom	Failure testing	Troubleshooting
Voltmeter shows high voltage.	a. Inspect voltmeter for damage	Measure voltage at alternator terminal B+ and which should be usually within (27~28.4) V. A normal voltage indicates a larger voltmeter calibration value error, and repair or replacement is required.
	b. Inspect charging system leads and connection parts, and check if each terminal stud is loosened, virtual connected and extremely hot, and if leads and alternator housing are short circuited.	a. In the case of poor contact, retighten loosened connection and reinsert connector into place. b. In the case of short circuit, reconnect leads.
	c. Inspect whether battery works normally.	a. Observe if the charging current value changes greatly (drops to a number less than 10A from 50A) in a short period of time while battery is being charged; and replace the battery as early as possible if not. b. Observe if battery surface is clean and dry, and if terminal fits with clamp properly; replacement shall be carried out as early as possible if any damage is found.
	d. Test output voltage at phase terminal of alternator (which should be about half of the output voltage at B+).	When the output voltage at phase terminal (W/R/AC) is greatly different from normal output voltage valve, big voltage drop is caused by alternator with load, alternator rectifier bridge or stator is failure, and reconditioning or replacement should be considered.
	e. The failure symptom does not disappear, though the inspections above have been finished.	Replace alternator regulator, stator or overall unit.

d) Unstable charging voltage

Failure4: Unstable charging voltage		
Vehicle Symptom	Failure testing	Troubleshooting
When engine runs normally, voltmeter indicates charging, with its needle wobbling, and it is impossible to identify its reading (or charging indicator comes on and goes out repeatedly).	a. Alternator and related belt is loose, belt slippage.	Tension alternator and related belt.
	b. All connections of charging circuit get loose and are not connected properly.	Inspect all connections of charging circuit.
	c. Dirt accumulation in collector ring, premature wear of electric brush, or weak and broken brush spring.	Remove dirt, or replace electric brush and its spring.
	d. Regulator damage.	Replace regulator.

e) Abnormal sound from alternator

Failure 5: Abnormal sound from alternator		
Vehicle Symptom	Failure testing	Troubleshooting
Alternator sounds abnormally during its running.	a. Deformed alternator mounting bracket or other external body getting too close	Improve the mounting bracket strength and adjust mounting condition.
	b. Loose and slipping alternator belt	Replace engine belt.
	c. Loose alternator pulley	Tighten pulley
	d. Alternator bearing oil shortage or damage	Replace alternator bearing
	e. Sound from alternator deepens.	Stator coil is short circuited, and should be replaced.
	f. Whistle noise from alternator changes with speed.	It is a sound caused from stator core vibration, and replace stator assembly as appropriate.

Appendix A: Diagnostic Trouble Code Table

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
ADC reference voltage exceeds the upper threshold value	1-1-1	P060B	ECU	Flash code lamp is always on Engine is in limp home mode	ECU internal chip fault	Replace the ECU
ADC reference voltage is below the lower threshold value		P060B				
ADC test pulse voltage exceeds the threshold value		P060B				
Only part of data flow is converted within a certain time		P060B				
Voltage value of accelerator pedal 1 exceeds the upper threshold value	2-2-1	P0123	Accelerator pedal sensor 1	The accelerator fails, and the engine runs at 1000rpm	1. The accelerator pedal signal 1 of the vehicle harness is shorted to power supply 2. Accelerator pedal fault 3. Pin 1.79 of pedal signal 1 open circuited	1. Power on and test the voltage of pedal connector No. 4 pin to ground; if it is 5V, indicating that it is OK; 2. Power on and test the voltage of accelerator pedal; APP1 voltage shall be normally 0.5-0.8V and 3.2-4.0V when not stepping on the pedal and stepping on it respectively, or otherwise the accelerator pedal shall be replaced 3. Power off to test the voltage of pedal connector No. 6 pin to ground, and voltage 0V indicates that it is OK; 4. Power off to test the resistance of connector No. 6 pin to ground; if the resistance value >1MΩ indicates that it is OK.
Voltage value of accelerator pedal 1 is below the lower threshold value		P0122			1. The accelerator pedal signal 1 of the vehicle harness is shorted to ground 2. Accelerator pedal fault	
Untrusted double signal relationship between accelerator pedals 1 and 2		P2135			1. Accelerator pedal signal wiring of the vehicle harness is failure 2. Accelerator pedal fault	

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Voltage value of accelerator pedal 2 exceeds the upper threshold value	2-2-1	P0223	Accelerator pedal sensor 2		1. The accelerator pedal signal 2 of the vehicle harness is shorted to power supply 2. Accelerator pedal fault 3. Open circuit of the pin 1.80 of pedal signal 1	1. Power on and test the voltage of pedal connector No. 3 pin to ground; voltage 5V indicates that it is OK; 2. Power on and test the voltage of accelerator pedal; APP2 voltage shall be normally 0.3-0.4V and 1.6-2.0V when not stepping on the pedal and stepping on it respectively, or otherwise the accelerator pedal shall be replaced; 3. Power off to test the voltage of pedal connector No. 1 pin to ground, and voltage 0V indicates that it isOK; 4. Power off to test the resistance of connector No. 1 pin to ground; the resistance value ~0Ω indicates that it is OK.
Voltage value of accelerator pedal 2 is below the lower threshold value		P0222			1. The accelerator pedal signal 2 is shorted to ground in the vehicle harness; 2. Accelerator pedal fault	
Untrustedtwo times relationship between accelerator pedal 1 and 2 signals		P2135			1. Accelerator pedal signal wiring fault of vehicle harness 2. Accelerator pedal fault	
Atmospheric pressure sensor voltage exceeds the upper threshold value	2-3-2	P2229	Atmospheric pressure sensor (inside the ECU)	Abnormal Atmospheric pressure test	Voltage of ECU power circuit is abnormal, or Atmospheric pressure sensor inside the ECU is damaged	1. Test the voltage of ECU power circuit; 2. Check the plain atmospheric pressure and the normal value should be 1,000hPa; replace the ECU in case of big deviation.
Atmospheric pressure sensor voltage is below the lower threshold value		P2228				
Untrusted Atmospheri c pressure sensor signal from CAN		P0000				
Untrusted Atmospheri c pressure sensor and intake pressure sensor signals		P2227				

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Untrusted accelerator and brake signals	2-2-5	P2299	Brake switchans accelerator pedal position sensors	Accelerator fault	Brake switch and accelerator pedal position sensors or relevant circuit fault	1. Check the accelerator pedal sensor: APP1 and APP2 voltages shall be normally 0.5-0.8V and 0.3-0.4V when not stepping on the pedal; while 3.2-4.0V and 1.6-2.0V separately when stepping on it. 2. Brake switch resistance: the resistance value shall be >1MΩ when releasing the pedal completely, while ~0Ω when stepping on it; 3. Power on and testthe voltage of pin 1.41 to ground when releasing the brake switch, and voltage value 0V indicates that it is OK; while 23-28V indicates the brake circuit is normal when stepping on the brake switch
Normal open failure of inlake heating	3-2-2	P0540	Inlake heating grid or inlake heating relay circuit	Intake heating failure	The inltake heating grid is damaged or the intake heating relay circuit is of open circuit	1. Power off to test the on/off from vehicle harnesses 1.55 and 1.59 to heating relay junctions 1 and 2; the resistance value ~0Ω indicates that it is OK; 2. Test the resistance of intake heating grid, and the resistance value ~0.4Ω indicates that it is OK; 3. Test the voltage of heating relay terminal to ground, and the voltage ~0V indicates that it is OK.
Voltage exceeds the upper threshold value when the intake heater is on	3-2-3	P1020	1. Inltake heating grid 2. Inltake heating grid circuit and relevant harness	1. The inltake heating grid is under abnormal work; 2. The inltake heating drive circuit is under abnormal work		
Voltage is below the lower threshold value when the intake heater is on		P1021				
Voltage exceeds the upper threshold value when the intake heater is off	3-2-3	P1022				
Voltage is below the lower threshold value when the intake heater is off		P1023				

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Intake heater is shorted to the power supply	3-2-1	P0542	Intake heating circuit	Intake heating failure	Intake heater is shorted to the power supply	Power off and test the voltage of intake heating relay to ground; voltage 0V indicates that it is OK.
Intake heater is shorted to ground		P0541			Intake heater is shorted to ground	Power off and remove the vehicle connector and relay plug, to test the resistance of connector 2 to ground, andthe resistance value ~0Ωindicates that it is OK.
Intake pressure sensor voltage exceeds the upper threshold value	2-3-1	P0238	Intake pressure sensor and its harness	Intake pressure is abnormal	Inner short circuit of intake pressure connector, or the harness is shorted to power supply	1. Power off and unplug the ECU sensor and intake pressure sensor connectors to test the on/off of 2.34 to connector terminal 4, and the resistance value ~0Ω indicates that it is OK; 2. Test the resistance between sensor connector terminals 3 and 4, and the resistance value >1MΩ indicates that it is OK; 3. Power off and unplug the intake pressure connector to test the voltage of connector terminal 4 to ground, and the voltage value ~0V indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Intake pressure sensor voltage is below the lower threshold value		P0237			Inner short circuit of intake pressure connector, or the harness is shorted to ground	1. Power off and unplug the ECU sensor and intake pressure sensor connectors to test the on/off of 2.34 to connector terminal 4, and the resistance value ~0Ω indicates that it is OK; 2. Test the resistance between sensor connectors 1 and 4, and the resistance value >1MΩ indicates that it is OK; 3. Power off and unplug the intake temperature sensor connectors to test the voltage of connector terminal 4 to ground, and the voltage~0V indicates that it is OK.
Untrusted intake pressure sensor signal from CAN		P0235			Intake pressure sensor is damaged	Check the intake pressure sensor signal.
Untrusted intake pressure sensor and atmospheric pressure sensor signals		P0236			Intake pressure and atmospheric pressure sensors are aged	Check the intake pressure and ambient pressure, or replace the sensor if necessary.
Original battery voltage exceeds the upper threshold value	1-2-4	P0563	ECU power harness, connecting plug, battery or alternator	ECU is damaged or fails to work normally	Problems on ECU power harness and connecting plug, battery aging or alternator damaged	1. Power off to test the battery voltage, and 23-28V indicates that it is OK; 2. Power off and unplug the ECU vehicle connectors and battery power circuit to test the circuit on/off; the resistance value 0Ω indicates that it is OK; 3. Power on to test the voltage of ECU positive pole to ground and voltage ~24V indicates that it is OK.
Original battery voltage is below the lower threshold value		P0562		ECU fails to work normally		

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Untrusted brake signal from CAN	2-2-3	P0571	Brake signal relay and its circuit	1. The cruise cannot be enabled 2. Accelerator and brake rationality cannot be judged 3. Priority brake function judgement failure	1. Brake signal relay failure 2. Brake signal relay circuit failure	1. Power off and test the on/off from brake signal connector to vehicle circuit 1.41 and 1.04; 2. Test the resistance of brake signal connectors 1 and 2 to ground; the resistance value>1MΩ indicates that it is OK; 3. Test the resistance between pins of brake signal switch; it is OK if the resistance value >1MΩ when not stepping on the clutch, while ~0Ω when stepping on.
Untrusted master and auxiliary brake switch signals		P0504	CAN bus		1. Check the brake signal	Check the clutch switch signal.
Cold starting indicator is shorted to the power supply	3-3-2	P1635	Cold starting indicator harness, connector or cold starting indicator damaged	Cold starting indicator fails to work normally	Cold starting indicator 1.38 is shorted to positive pole of power supply	Power on ECU and unplug the cold starting indicator connector to test the voltage of low end 1.38 to ground, and voltage ~0V indicates that it is OK.
Cold starting indicator is shorted to ground		P1636			Cold starting indicator No. 1.38 pin is shorted to ground	Power off the vehicle and unplug the cold starting indicator connector to test the resistance of low end 1.38 to ground, and resistance value ~0Ω indicates that it is OK.
No cold starting indicator signal		P1637			Cold starting indicator harness is off or the flash code light is damaged	1. Power on ECU and unplug the cold starting indicator connector to test the voltage between 1.04 and 1.38; voltage ~21V indicates that it is OK; 2. Test the resistance of flash code light and the resistance value <2KΩ indicates that it is OK.
Cold starting indicator overheated		P1638			Resistance of cold starting indicator is improper	Test the resistance of cold starting indicator, and it is normal if the resistance is 40-50Ω for common light, while the LED resistance is ~1.6KΩ.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Coolant temperature sensor voltage exceeds the upper threshold value	2-4-1	P0118	Water temperature sensor and its harness	Water temperature is abnormal	Sensor signal circuit 2.15 is shorted to positive pole of power supply	Power off ECU and unplug the water temperature sensor connector to test the voltage of terminal 1 to ground, and the voltage ~0V indicates that it is OK.
Coolant temperature sensor voltage is below the lower threshold value		P0117			Sensor signal circuit 2.15 is shorted to ground	Power off the vehicle and unplug the water temperature sensor connector to test the resistance of signal end 2.15 to ground, and resistance value ~0Ω indicates that it is OK.
Untrusted coolant temperature sensor signal from CAN		P0115			CAN bus communication failure	Test the CAN bus for on/off and the junction for shorted to ground.
Untrusted clutch signal from CAN	2-2-2	P0704	Clutch switch and its relevant harness	Cruise function cannot be activated, drivability is affected	Clutch suction line is open circuit or short circuit	1. Test the on/off from clutch connector to vehicle circuits 1.66 and 1.04; 2. Test the resistance of clutch connector to ground, and the resistance value >1MΩ indicates that it is OK; 3. Test the resistance between pins of clutch switch, and it is normal if the resistance is ~0Ω when not stepping on the clutch, while >1MΩ when stepping on.
Untrusted clutch status signal		P0704			Clutch signal from CAN bus is untrusted	Check the clutch switch signal

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Off-vehicle start/stop button is stuck	3-4-3	P2530	Off-vehicle start/stop button and its harness	Off-vehicle start/stop button fails	Off-vehicle start/stop switch and its harness failure	1. Power off and unplug the vehicle connectors to test the resistance between 1.32, 1.47,1.29 and off-vehicle start and stop switch connector 1, 2 respectively; resistance value ~0Ω indicates that it is OK; 2. Test the resistance of two terminals for off-vehicle start and stop connector to ground; the resistance value >1MΩ indicates that it is OK; 3. When measuring the switch for intactness with multimeter, it is disconnected when the swith is cut off, and the two contactors are connected if pressing down the switch while disconnected if loosening it, which indicates that it is OK.
No camshaft signal	1-1-3	P0340 P0341	Camshaft sensor and its harness	Engine power is limited	Camshaft sensor is loose, or its harness is short circuit or open circuit	1. Check the installation of camshaft sensor for looseness; 2. Power off to test the resistance of sensor connectors 2.09 and 2.10 to junctions 1 and 2; the resistance value ~0Ω indicates that it is OK; 3. Test the resistance of sensor junctions. 1, 2 to vehicle ground; the resistance value >1MΩ indicates that it is OK; 4. Oscilloscope is used to check the crankshaft and camshaft synchronization; if it is abnormal, there may be some problem in the installation or processing of gear ring or oil pump gear.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Only camshaft signal is existed, and enters limp home state	1-1-4	P0008	Crankshaft sensor and its harness, gear ring	Engine power is limited	Camshaft sensor is loose, its harness is short circuit or open circuit, or gear ring installation or processing is improper	1. Check the installation of crankshaft sensor for looseness; 2. Power off to test the resistance of sensor connectors 2.23, 2.19 to junctions 1 and 2; the resistance value ~0Ω indicates that it is OK; 3. Test the resistance of sensor junctions 1, 2 to vehicle ground; the resistance value >1MΩ indicates that it is OK; 4. Oscilloscope is used to check the crankshaft and camshaft synchronization for abnormal; if any, there may be some problem in the installation or processing of gear ring or oil pump gear.
No crankshaft signal	1-1-2	P0335				
Untrusted camshaft signal		P0336				
Crankshaft and camshaft signal deviation exceeds the upper threshold value	5-4-1	P0016	Crankshaft, camshaft sensors and their harnesses, improper installation or processing of gear ring or oil pump gear	Engine power is limited	Crankshaft, camshaft sensors and their harnesses, improper installation or processing of gear ring or oil pump gear	1. Check the camshaft and crankshaft for looseness; 2. Check the camshaft and crankshaft harnesses for abnormal; 3. Check the gear ring and oil pump gear for abnormal installation; 4. Check the synchronizing signal with oscilloscope.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Engine speed exceeds the limit	2-2-6	P0219	Speed sensor	Back to engine idle speed or even flameout	Engine speed is too high when running downhill or speed sensor failure	Check the pulses per revolution of speed sensor and the speed in idling for abnormal.
Exhaust braking butterfly valve is shorted to power supply or overheated	3-1-1	P0478	Exhaust braking solenoid valve	Exhaust braking failure	Exhaust braking drive circuit and its harness	Power off and unplug V4 connectror to test the voltage of the 4th terminal to ground, and voltage 0V indicates that it is normal.
Exhaust braking butterfly valve is shorted to ground		P0477				Power off and unplug V4 connector to test the resistance of the 4th terminal to ground, and resistance value 0Ω indicates that it is normal.
Exhaust braking butterfly valve is open circuit Exhaust braking butterfly valve is overheated		P0476			1. Exhaust braking drive circuit is open; 2. Exhaust braking solenoid valve is damaged Exhaust braking drive circuit is overloaded	1. Test the on/off of exhaust braking drive circuit; 2. Test the working of exhaust braking solenoid valve for abnormal.
Untrusted fuel capacity torque conversion	1-2-5	P1007	ECU data	Engine power is limited	The data calibration FMTC MAP is not monotonic	Correct the data.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Fan actuator (PWM wave) is shorted to power supply	3-1-2	P0692	Fan solenoid valve harness, connector or clutch	The fan cannot work normally, the engine is overheated	Fan actuator (PWM wave) is shorted to power supply	Power off ECU and unplug the fan actuator connector to test the voltage of low end 2.01 to ground, and voltage ~0V indicates that it is normal.
Fan actuator (PWM wave) is shorted to ground		P0691			Fan actuator (PWM wave) is shorted to ground	Power off the vehicle and unplug the fan actuator connector to test the resistance of low end 2.01 to ground, and resistance value ~0Ω indicates that it is normal.
Fan actuator (PWM wave) is open circuit		P0480			Fan actuator (PWM wave) is open circuit	1. Power off ECU to test the on/off between sensor connector and joint end, and resistance value 0Ω indicates that it is normal; 2. Check the fan clutch for damage.
Fan actuator (PWM wave) is overheated		P0483			Fan actuator (PWM wave) is overheated	1. Check the fan actuator harness; 2. Check the fan clutch for damage.
Cooling fan speed exceeds the upper threshold value	3-1-2	P0526	Fan speed sensor	Untrusted fan speed	1. Fan speed sensor fault; 2. Fan sensor harness fault; 3. Fan clutch fault	1. Power on to test the voltage of fan speed sensor connector terminal 3 to ground, and voltage 5V indicates that it is normal; 2. Power off and unplug the connector to test the voltage of speed sensor connector 2 to ground, and votage0V indicates that it is normal; 3. Power off and unplug the connector to test the resistance of connector 2 to ground, and resistance value 0Ω indicates that it is normal; 4. Check the fan clutch for damage.
Cooling fan speed is below the lower threshold value		P0527				

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Electromagnetic clutch relay is shorted to power supply	2-1-6	P1008	Electromag-netic clutch fan	Electrom-agnetic clutch fan cannot work normally	Electromagneti c clutch fan relay harness is shorted to power supply	Power off and unplug the sensor connector to test the voltages of contactor 1 and 2 to ground, and voltage 0V indicates that it is normal;
Electromagnetic clutch relay is shorted to ground		P1009			Electromagneti c clutch fan relay harness is shorted to ground	Power off and unplug the sensor connector to test the resistances of connector 1 and 2 to ground, and the resistance value>1MΩ indicates that it is OK.
Water is detected in the fuel by the sensor	2-1-1	P2269	Fuel moisture sensor	The fuel moisture LED is on, with the water temperature alarm	The water is full in primary fuel filter	Maintain the primary fuel filter
LED 1 (fuel moisture LED) is shorted to power supply	3-3-4	P1623	Fuel moisture LED harness, connector or LED is damaged	Fuel moisture LED cannot work normally	Fuel moisture LED 1.56 is shorted to positive pole of power supply	Power on the ECU and unplug the fuel moisture LED connector to test the voltage of low end 1.56 to ground, and voltage ~0V indicates that it is OK;
LED 1 (fuel moisture indicator light) is shorted to ground		P1624			Fuel moisture LED 1.56 pin is shorted to ground	Power off the vehicle and unplug the fuel moisture LED connector to test the resistance of low end 1.56 to ground, and resistance value ~0Ω indicates that it is OK.
LED 1 (fuel moisture indicator light) is open circuit		P1625			Fuel moisture LED harness is open or flash code light is damaged	1. Power on the ECU and unplug the flash code light connector to test the voltage between 1.04 and 1.56, and voltage ~24V indicates that it is OK; 2. Test the resistance of flash code light, and the resistance value <2KΩ indicates that it is OK.
LED 1 (water-in-oil indicator light) is overheated		P1626			Resistance of fuel moisture LED is improper	Test the resistance of fuel moisture LED, and it indicates that it is OK when the resistance value is 40-50Ω for common light, while ~1.6KΩ for LED light.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Interference to CJ940 communication	2-6-3	P060A	ECU internal chip	Engine flameout	ECU internal chip fault	Check ECU power connection; if it is OK, replace the ECU.
EEPROM read error	2-6-5	P062F	EEPROM (Electronic Erasable Programmable Read-Only Memory)	Fuel consumption /mileage and other accumulation information cannot be recorded	_____	ECU flash, keep the after-run time for 20s
EEPROM writing error		P062F				
EEPROM use the alternative value		P062F				
System repair fault	2-6-1	P0607	ECU internal chip fault	Engine is in limp home mode	ECU internal chip fault	Power off and restart ECU; if the problem is still existed, replace the ECU
System repair fault						
System repair fault						
Too high CJ940 voltage	2-6-3	P1607	ECU internal chip fault	ECU damage	The vehicle harness is still connected during welding, causing breakdown of ECU internal chip	Replace ECU.
Too low CJ940 voltage		P1608				

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Intake temperature sensor voltage exceeds the upper threshold value	2-3-3	P0098	Intake temperature sensor	Intake temperature is abnormal	Inner short circuit of intake temperature sensor connector, or the harness is shorted to power supply	1. Power off and unplug the ECU sensor and intake temperature sensor connectors to test the on/off of 2.36 to connector terminal 2, and resistance value ~0Ω indicates that it is OK; 2. Test the resistance between sensor connector terminal 2 and 3, and the resistance value >1MΩ indicates that it is OK; 3. Power off and unplug the intake temperature sensor connector to test the voltage of connector terminal 2 to ground, and voltage ~0V indicates that it is OK.
Intake temperature sensor voltage is below the lower threshold value		P0097			Inner short circuit of intake temperature sensor connector, or the harness is shorted to ground	1. Power off and unplug the ECU sensor and oil pressure sensor connectors to test the on/off of 2.36 to connector terminal 2, and resistance value ~0Ω indicates that it is OK; 2. Test the resistance between sensor connector 1 and 2, and the resistance value >1MΩ indicates that it is OK; 3. Power off and unplug the intake temperature sensor connector to test the voltage of connector terminal 2 to ground, and voltage ~0V indicates that it is OK.
Untrusted intake temperature sensor voltage signal from CAN		P0099			Intake temperature sensor is damaged	Check the intake temperature sensor signal.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Ideal injection number is limited by the current	1-5-5	P1300	Turbocharger	Engine power is limited	Turbocharger is damaged or unmatched	Check and test the turbocharger.
Ideal injection number is limited by the fuel mass		P1301	High-pressure fuel pump		High-pressure fuel pump is damaged	Check and test the high-pressure fuel pump.
Ideal injection number is limited by the software		P1302	ECU software		ECU damaged	Replace ECU.
High end of fuel injector of cylinder 1, 2 or 3 is shorted to power supply or ground	1-5-1	P1203	Fuel injector harnesses of cylinders 1, 2 and 3	1. Fuel injector of corresponding cylinder faillure 2. Engine performance is influenced 3. Engine flameout	High end of fuel injector of cylinder 1, 2 or 3 is shorted to power supply or ground	1. Power off and unplug the connectors of cylinder 1, 2 and 3 to test the voltage of terminal 1 of each connector to ground, and voltage 0V indicates that it is OK; 2. Test the resistance of terminal 1 of each connector to ground, and the resistance value >1MΩ indicates that it is OK.
Low end of fuel injector in cylinder 1, 2 or 3 is shorted to ground		P1204			Low end of fuel injector of cylinder 1, 2 or 3 is shorted to ground	1. Power off and unplug the connectors of cylinders 1, 2 and 3 to test the voltage of terminal 2 of each connector to ground, and voltage 0V indicates that it is OK; 2. Test the resistance of terminal 2 of each connector to ground, and the resistance value >1MΩ indicates that it is OK.
Fuel injector in cylinder 1, 2 or 3 is open circuit		P1209			Fuel injector in cylinder 1, 2 or 3 is open circuit	1. Power off to test the circuit on/off between fuel injector connector and connector circuit; 2. Unplug the fuel injector connector to test the resistance between both terminals of fuel injector, and resistance value (0.2~1) Ω indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
High end of fuel injector of cylinder 4, 5 or 6 is shorted to power supply or ground	1-5-2	P120B	Fuel injector harnesses of cylinders 4, 5 and 6	1. Fuel injector of corresponding cylinder fails 2. Engine performance is influenced 3. Engine flameout	High end of fuel injector in cylinders 4, 5 or 6 is shorted to power supply or ground	1. Power off and unplug the connectors of cylinders 4, 5 and 6 to test the voltage of terminal 1 of each connector to ground, and voltage 0V indicates that it is OK; 2. Test the resistance of terminal 1 of each connector to ground, and the resistance value >1MΩ indicates that it is OK.
Low end of fuel injector of cylinders 4, 5 or 6 is shorted to ground		P120C			Low end of fuel injector of cylinder 4, 5 or 6 is shorted to ground	1. Power off and unplug the connectors of cylinder 4, 5 and 6 to test the voltage of terminal 2 of each connector to ground, and voltage 0V indicates that it is OK; 2. Test the resistance of terminal 2 of each connector to ground, and the resistance value >1MΩ indicates that it is OK.
Fuel injector of cylinder 4, 5 or 6 is open circuit		P1211			Fuel injector of cylinder 4, 5 or 6 is open circuit	1. Power off to test the circuit on/off between fuel injector connector and connector circuit; 2. Unplug the fuel injector connector to test the resistance between both terminals of fuel injector, and resistance value(0.2-1) Ω indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Low end of fuel injector 1 is shorted to power supply	1-4-1	P0262	Fuel injector 1 harness	Insufficient engine power, unstable speed or the engine is in limp hole mode	Poor contact of fuel injector 1 harness or connector; the harness is open circuit or is shorted to cylinder head due to wear	Power off, unplug the ECU fuel injector connector, and test the voltage of 3.13 pin at fuel injector 1 low end to ground via multimeter, with the voltage ~0V indicates that it is OK.
High end of fuel injector 1 is shorted to its low end		P0261				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 1, and test the resistance between the fuel injector connector 1 and 2 via multimeter, with resistance value>1MΩ indicates that it is OK.
Fuel injector 1 is open circuit		P0201				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 1, and test the resistance between pins 3.04, 3.13 of ECU fuel injector connector and connectors 1, 2 of fuel injector via multimeter, with the resistance value~0Ω indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Low end of fuel injector 2 is shorted to power supply	1-4-2	P0265	Fuel injector 2 harness	Insufficient engine power, unstable speed or the engine is in limp home mode	Poor contact of fuel injector 2 harness or connector; the harness is open circuit or is shorted to cylinder head due to wear	Power off, unplug the ECU fuel injector connector, and test the voltage of fuel injector 2 low end 3.06 pin to ground via multimeter, with the voltage ~0V indicates that it is OK.
High end of fuel injector 2 is shorted to its low end		P0264				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 2, and test the resistance between the connector 1 and 2 of fuel injector via multimeter, with resistance value >1MΩ indicates that it is OK.
Fuel injector 2 is open circuit		P0202				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 2, and test the resistance between pins 3.11, 3.06 of ECU fuel injector connector and connectors 1, 2 of fuel injector via multimeter, with the resistance value ~0Ω indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Low end of fuel injector 3 is shorted to power supply	1-4-3	P0268	Fuel injector 3 harness	Insufficient engine power, unstable speed or the engine is in limp home mode	Poor contact of fuel injector 3 harness or connector; the harness is open circuit or is shorted to cylinder head due to wear	Power off, unplug the ECU fuel injector connector, and test the voltage of fuel injector 3 low end 3.12 pin to ground via multimeter, with the voltage ~0V indicates that it is OK.
High end of fuel injector 3 is shorted to its low end		P0267				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 3, and test the resistance between the connector 1 and 2 of fuel injector via multimeter, with resistance value >1MΩ indicates that it is OK.
Fuel injector 3 is open circuit		P0203				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 3, and test the resistance between pins 3.05, 3.12 of ECU fuel injector connector and connectors 1, 2 of fuel injector connector via multimeter, with the resistance value ~0Ω indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Low end of fuel injector 4 is shorted to power supply	1-4-4	P0271	Fuel injector 4 harness	Insufficient engine power, unstable speed or the engine is in limp home mode	Poor contact of fuel injector 4 harness or connector; the harness is open circuit or is shorted to cylinder head due to wear	Power off, unplug the ECU fuel injector connector, and test the voltage of fuel injector 4 low end 3.14 pin to ground via multimeter, with the voltage ~0V indicates that it is OK.
High end of fuel injector 4 is shorted to its low end		P0270				Power off, unplug the ECU fuel injector connector and two connectors 1and 2 of fuel injector 4, and test the resistance between the connector 1 and 2 of fuel injector via multimeter, with resistance value >1MΩ indicates that it is OK.
Fuel injector 4 is open circuit		P0204				Power off, unplug the ECU fuel injector connector and two connectors 1and 2 of fuel injector 4, and test the resistance between pins 3.03, 3.14 of ECU fuel injector connector and connectors 1, 2 of fuel injector via multimeter, with the resistance value ~0Ω indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Low end of fuel injector 5 is shorted to power supply	1-4-5	P0274	Fuel injector 5 harness	Insufficient engine power, unstable speed or the engine is in limp home mode	Poor contact of fuel injector 5 harness or connector; the harness is open circuit or is shorted to cylinder head due to wear	Power off, unplug the ECU fuel injector connector, and test the voltage of fuel injector 5 low end 3.16 pin to ground via multimeter, with the voltage ~0V indicates that it is OK.
High end of fuel injector 5 is shorted to its low end		P0273				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 5, and test the resistance between connector 1 and 2 of fuel injector via multimeter, with resistance value>1MΩ indicates that it is OK.
Fuel injector 5 is open circuit		P0205				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 5, and test the resistance between pins 3.01, 3.16 of ECU fuel injector connector and connectors 1, 2 of fuel injector via multimeter, with the resistance value ~0Ω indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Low end of fuel injector 6 is shorted to power supply	1-4-6	P0277	Fuel injector 6 harness	Insufficient engine power, unstable speed or the engine is in limp home mode	Poor contact of fuel injector 6 harness or connector; the harness is open circuit or is shorted to cylinder head due to wear	Power off, unplug the ECU fuel injector connector, and test the voltage of fuel injector 6 low end 3.16 pin to ground via multimeter, with voltage ~0V indicates that it is OK.
High end of fuel injector 6 is shorted to its low end		P0276				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 6, and test the resistance between connector 1 and 2 of fuel injector via multimeter, with resistance value >1MΩ indicates that it is OK.
Fuel injector 6 is open circuit		P0206				Power off, unplug the ECU fuel injector connector and two connectors 1 and 2 of fuel injector 6, and test the resistance between pins 3.02, 3.15 of ECU fuel injector connector and connectors 1, 2 of fuel injector via multimeter, with resistance value ~0Ω indicates that it is OK.
Cylinder number under normal working is less than the minimum cylinder number required for system operation	1-5-4	P1225	Fuel injector harness	Engine stop	Fuel injector harnesses over 3 cylinders are in short circuit or open circuit	Check the fuel injector harness of each cylinder as per above fuel injector harness detection method

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Untrusted cruise control signal	3-4-1	P0564	Cruise switch	Cruise control cannot be realized	1. Several cruise switches are pressed down at the same time; 2. Triggering time of button is too long; 3. Button switch circuit fault	Test the cruise control button switch and its harness: 1. Test the on/off of each harness as per the pin diagram, and resistance value ~0Ω indicates that it is OK; 2. Test the voltage value of each switch under normal condition as per the pin diagram, and it is normal if the high level is only appeared at OFF switch; 3. Check the state of each switch at the same time to determine whether two or more switches are pressed down simultaneously.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Main relay 2 is shorted to power supply	1-3-2	P0687	ECU1.04 pin is shorted to power supply	Neutral switch, brake, and clutch failure; cold starting and fuel moistureLED are always on	External power supply of ECU1.04 pin is shorted to power supply	Power off to test the voltage between 1.04 pin and vehicle frame ground wire, and voltage 0V indicates that it is OK.
Main relay 2 is shorted to ground		P0686	ECU1.04 pin is shorted to ground		Neutral switch, AC switch and brake connected with ECU1.04 pin are shorted to ground	Power off to test the resistance between 1.04 pin and vehicle frame ground wire, and the resistance value >1MΩ indicates that it is OK
Multi-power fuel-efficient switch is shorted to power supply	3-2-7	P154 A	ECU1.62, 1.65 pins are shorted to power supply	Multi-power fuel-efficient switch failure	Multi-power fuel-efficient switch or harness is shorted to power supply	Power off and unplug the ECU vehicle connector to test the voltage of 1.62 or 1.65 pin to ground, and the voltage ~0V indicates that it is OK
Multi-power fuel-efficient switch is shorted to ground		P154B	ECU1.62, 1.65 pins are shorted to ground		Multi-power fuel-efficient switch or harness is shorted to ground	Power off and unplug the ECU vehicle connector to test the resistance of 1.62 or 1.65 pin to ground, and the resistance value >1MΩ indicates that it is OK.
Unreliable multi-power fuel-efficient switch signal		P154C	Multi-power fuel-efficient switch		Multi-power fuel-efficient switch is aging, or its resistance is mismatched	Replacewith new multi-power fuel-efficient switch
Main relay 1 is shorted to power supply	1-3-2	P160E	ECU power wire	No power supply to ECU, and engine fails to start	Problem on vehicle connector or ECU power wire	Test the voltage of ECU positive poles (1.02, 1.03, 1.08, 1.09) to its negative poles (1.05,1.06,1.10,1.11), and the voltage 24V indicates that it is OK.
Main relay 1 is shorted to ground		P160F				Test the voltage of ECU positive poles (1.02, 1.03, 1.08, and 1.09) to ground, and voltage 24V indicates that it is OK.
System communication fault	2-6-4	P060C	ECU internal chip	Engine flameout (restart after power off)	Abnormal ECU voltage etc.	Replace ECU

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Oil pressure sensor voltage exceeds the upper limit	2-4-3	P0523	Sensor connector or harness	Untrusted oil pressure	Internal short circuit of oil pressure connector, or its harness is shorted to power supply	1. Power off, unplug ECU sensor connector and oil pressure sensor connector, and test the on/off of 2.27 to connector terminal 4, with resistancevalue ~0Ω indicates that it is OK; 2. Test the resistance between sensor connector terminal 3 and 4, and resistance value >1MΩ indicates that it is OK; 3. Power off, unplug oil pressure sensor connector, and test the voltage of connector terminal 4 to ground, with voltage ~0V indicates that it is OK.
Oil pressure sensor voltage is below the lower limit		P0522			Internal short circuit of oil pressure connector, or its harness is shorted to ground	1. Power off, unplug ECU sensor connector and oil pressure sensor connector, and test the on/off of 2.27 to connector terminal 4, with resistance value ~0Ω indicates that it is OK; 2. Test the resistance between sensor connector terminal 1 and 4, and resistancevalue >1M Ω indicates that it is OK; 3. Power off, unplug oil pressure sensor connector, and test the voltage of connector terminal 4 to ground, with voltage ~0V indicates that it is OK.
Untrusted oil pressure sensor signal		P0520	Sensor connector or harness, or CAN bus signal		Internal short circuit of oil pressure connector, or its harness is shorted to power supply or ground	Check the oil pressure sensor connector and harnesses, check CAN bus and message as per above method

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Too high oil pressure or untrusted oil temperature signal		P0521	Oil pressure sensor connector or harness		The 4 and 3 pins of oil pressure connector are short circuit, or signal wire is shorted to power supply	1. Power off, unplug ECU sensor connector and oil pressure sensor connector, and test the on/off of 2.27 to connector terminal 4, with resistancevalue ~0Ω indicatrs that it is OK; 2. Power off, unplug oil pressure sensor connector, and teste the voltage of connector terminal 4 to ground, with voltage ~0V indicates that it is OK.
Too low oil pressure		P0524	Oil level is too low, or oil pressure sensor connector and harness are open circuit or shorted to ground	Engine is in limp home mode	Oil level is too low, or oil pressure sensor connector and harness are open circuit or shorted to ground	1. Check the oil level; 2. Power off, unplug ECU sensor connector and oil pressure sensor connector, and test the on/off of 2.27 to connector terminal 4, with resistance value ~0Ω indicates that it is OK; 3. Power off, unplug oil pressure sensor connector, and test the voltage of connector terminal 4 to ground, with voltage ~0V indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Oil temperature and cooling water temperature signals		P100 D	Water temperature and oil temperature sensors or harnesses		Water or oil temperature sensor and its harness	1. Check the water temperature sensor; 2. Power off, unplug ECU sensor connector and oil temperature sensor connector, and test the on/off of 2.28 to connector terminal 2, with resistance value ~0Ω indicates that it is OK; 3. Power off, unplug oil temperature sensor connector, and test the voltage of connector terminal 2 to ground, with voltage ~0V indicates that it is OK; 4. Test the resistance between oil temperature sensorconnector 2 and 3, and resistance value >1MΩ indicates that it is OK.
Oil temperature exceeds the limit		P0196	Too low oil level, or oil temperature sensor connector and harnesse	Too high oil temperature	Oil level is too low, or oil temperature sensor connector or harness is shorted to power supply	1. Check the oil level; 2. Power off, unplug ECU sensor connector and oil temperature sensor connector, and test the on/off of 2.28 to connector terminal 2, with resistance value ~0Ω indicates that it is OK; 3. Power off, unplug oil pressure sensor connector, and test the voltage of connector terminal 2 to ground, with voltage ~0V indicates that it is OK; 4. Test the resistance between sensor connector 2 and 3, and resistance value>1MΩ indicates that it is OK.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Fuel injector power-on time exceeds the monitor setting value	2-6-2	P1613	ECU	ECU restart or engine flameout	Too long fuel injector power-on time under motored condition, ECU internal fault	Restart the engine after stopping and powering off for 1 minute
Untrusted engine speed		P1614	Speed sensor	ECU restart	Too high rotate speed due to motor drive or speed sensor fault	
Voltage of sensor power supply 1 exceeds the upper threshold value	1-3-1	P0643	Oil pressure/ temperatur e and intake pressure/ temperature sensors	1. Engine performance is affected; 2. Oil pressure/ temperatur e and intake pressure/ temperatur e sensors failure	Sensor harness fault	Power on ECU, unplug the oil pressure/temperature sensor and intake pressure/temperature sensor connectors, and test the voltage of the 3rd pin 2.32, 2.33 to ground, with voltage 5V indicates that it is OK.
Voltage of sensor power supply 1 is below the lower threshold value		P0642				
Voltage of sensor power supply 2 exceeds the upper threshold value	1-3-1	P0653	Accelerator pedal APP2 power supply module	Accelerator pedal failure, and engine speed is 1000rpm	Accelerator pedal circuit or connector fault	Power on ECU, unplug the accelerator pedal connector, and test the voltage of the 3rd pin 1.84 to ground, with voltage 5V indicates that it is OK.
Voltage of sensor power supply 2 is below the lower threshold value		P0652				
Voltage of sensor power supply 3 exceeds the upper threshold value	1-3-1	P0699	Accelerator pedal APP1 and rail pressure sensor power supplymodule	Accelerator pedal failure, and engine speed is 1000rpm, rail pressure display is abnormal, engine is in limp home mode	Accelerator pedal or rail pressure sensor harness or connector fault	Power on ECU, unplug the accelerator pedal to test the voltage of the 4th pin 1.77 to ground, while unplug the rail pressure sensor connector to test the voltage of terminal 3 pin 2.33 to ground, with voltage 5V indicates that it is OK.
Voltage of sensor power supply 3 is below the lower threshold value		P0698				

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Flash code light is shorted to power supply	3-3-1	P1619	Flash code light, harness, connector is damaged	Flash code light fails to work normally	Flash code light drive circuit 1.30 is shorted to positive pole of power supply	Power off ECU, unplug the flash code light connector, and test the voltage of low end 1.30 to ground, with voltage ~0V indicates that it is OK.
Flash code light is shorted to ground		P161A			Flash code light drive circuit 1.30 is shorted to ground	Power off the vehicle, unplug the flash code light connector, and test the resistance of low end 1.30 to ground, with resistance value~0Ω indicates that it is OK.
Flash code light is open circuit		P161B			Flash code light harness is open circuit or flash code light is damaged	1. Power on ECU, unplug the flash code light connector, and test the voltage between 1.22 and 1.30, with voltage ~24V indicates that it is OK; 2. Test the resistance of flash code light, and resistance value<2KΩ indicates that it is OK.
Flash code light is overheated		P161C			Improper resistance for flash code light	Test the resistance of flash code light, and it is normal if the value is 40-50Ω for common lights while resistance value ~1.6KΩ is normal for LED lights.
T15 signal error	1-2-3	P2533	The fuse is burn out, T15 circuit or key switch fault	Engine cannot be started	The fuse is burn out, T15 circuit or key switch fault	Power on the key and test the voltage of 1.40 pin, and voltage ~24V indicates that it is OK, otherwise, the circuit to battery shall be checked step by step from 1.40 pin.

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
T50 switch-on time exceeds the limit	1-2-2	P2530	T50 circuit or key switch is stuck	T50 switch fault	T50 circuit or key switch	1. Power off to test the pin 1.61for electricity, voltage 0V indicates that it is normal, and if there is electricity, it indicates that the circuit is shorted to power supply; 2. Reset the key after power on, if the electricity is still existed on pin 1.61, it indicates that the key switch is failure.
Time deviation between time processor and system timer exceeds the threshold value	1-1-5	P0607	ECU inner processing unit error	Engine stop and cannot be started	ECU fault	Power off and restart the ECU, if the problem is existed still, replace the ECU.
Vehicle speed 1 exceeds the upper threshold value	3-2-4	P0501	Speed sensor and its harness	The speed is too high, off-vehicle flameout inoperative	Speed sensor and its harness fault	1. Power off to test the on/off from sensors 1.70 and 1.71 to connectors; 2. Replace the speed sensor
VSS or SPS sensor signal failure		P1510	Speed sensor, CAN bus	Untrusted speed	1. CAN bus fault; 2. Speed sensor and its harness fault	1. Check the CAN bus; 2. Check the harness; 3. Replace the speed sensor
Voltage of vehicle speed 2 sensor exceeds the upper threshold value	3-2-4	P2158	Speed sensor and its harnesses	Untrusted speed	Speed sensor and its harness fault	1. Power off to test the on/off from sensor 1.70, 1.71 to connectors; 2. Replace the speed sensor
Voltage of vehicle speed 2 sensor is below the lower threshold value		P2160				
Invalid speed signal from CAN		P2157	Speed sensor, CAN bus		1. CAN bus fault; 2. Speed sensor and its harness fault	1. Check the CAN bus; 2. Check the harness; 3. Replace the speed sensor
Untrusted vehicle speed 2 sensor voltage signal		P2159	Speed sensor harnesses		Speed sensor and its harness fault	Check the speed sensor circuit

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Pulse width of vehicle speed 3 signal exceeds the upper threshold value	3-2-4	P1511	Speed sensor	Untrusted speed	Pulse width of vehicle speed is too big or too small or its cycle is mismatched	Replace and match the speed sensor
Pulse width of vehicle speed 3 signal is below the lower threshold value		P1512				
Average cycle of speed signal is less than threshold value		P1513				
SPI communication error	4-1-4	P0607	ECU internal chip	——	————	Replace ECU
Air conditioning compressor relay is shorted to power supply	3-1-3	P0647	Air conditioning compressor circuit problem	Air conditioning compressor fails to work	Air conditioning compressor circuit failure	Power off to test the voltage of relay pin 2.11 to ground, and voltage ~0V indicates that it is OK;
Air conditioning compressor relay is shorted to ground		P0646				Power off to test the resistance of relay pin 2.11 to ground, and resistance value >1MΩ indicates that it is OK;
Air conditioning compressor relay is open circuit		P0645			Air conditioning compressor is open circuit	Check the air conditioning compressor relay for correct connection; if it is connected, test the relay resistance, and resistance value~0Ω indicates that it is OK.
Air conditioning compressor relay is overheated		P0645			Air conditioning compressor circuit failure	Power off and test the relay for damage

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Fuel meter is open circuit	1-3-5	P0251	Fuel metering unit	Engine is in limp home mode	Fuel metering unit is open circuit	Power off to test the resistance of ECU sensor connector terminals 2.13, 2.12 and 2.14 to connectors 3, 1 and 2, and resistance value ~0Ω indicates that it is OK;
Fuel meter is shorted to power supply		P0254			High end of fuel metering unit circuit is shorted to power supply	Power off to test the voltage of terminal 3.09 of fuel metering unit connector 1 to ground, and voltage ~0V indicates that it is OK;
Fuel meter is shorted to ground		P0253			Low end of fuel metering unit circuit is shorted to power supply	Power off to test the resistance of terminal 3.09 of fuel metering unit connector 1 to ground, and resistanc value ~0Ω indicates that it is OK;
Fuel meter voltage exceeds the upper limit	1-3-5	P025D	Fuel metering unit	Engine is in limp home mode	Fuel metering unit circuit failure	Power off to test the voltage of terminal 3.09 of fuel metering unit connector 1 to ground, and voltage ~0V indicates that it is OK;
Fuel meter voltage is below the lower limit		P025C				Power off to test the resistance of terminal 3.09 of fuel metering unit connector 1 to ground, and resistanc value ~0Ω indicates that it is OK;
Common rail pressure release valve is open	1-3-4	P100E	High/ low pressure fuel pipeline; fuel metering unit; rail pressure sensor	Engine performance is limited	1. High/ low pressure fuel pipeline fault; 2. Rail pressure sensor fault; 3. Fuel metering unit fault	1. Check the high/ low pressure fuel pipeline; 2. Confirm the rail pressure sensor for normal; 3. Confirm the fuel metering unit for normal.
Required time of rail pressure exceeds the limit		P100F				
Common rail pressure release valve is not open when pressure is fluctuating		P1010				

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Rail pressure sensor voltage exceeds the upper threshold value	1-3-3	P0193	Rail pressure sensor harness	Engine performance is limited	Rail pressure sensor harness is shorted to power supply	Power off to test the voltage of rail pressure sensor connector 2 terminal 2.14 to ground, and voltage value ~0V indicates that it is OK;
Rail pressure sensor voltage is below the lower threshold value		P0192			Rail pressure sensor harness is shorted to ground	Power off to test the resistance of rail pressure sensor connector 2 terminal 2.14 to ground, and the resistancevalue >1M Ω indicates that it is OK;

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Rail pressure deviation exceeds the upper threshold value	2-5-1	P1011	High/low pressure fuel pipeline and relevant component fault	Engine performance is limited	High, low pressure fuel pipeline and relevant component	1. Check the high and low pressure fuel pipelines; 2. Check the rail pressure sensor; 3. Check the fuel metering unit; 4. Check the fuel
Rail pressure deviation exceeds the upper threshold value and fuel injection quantity exceeds the limit quantity exceeds the limit	2-5-2	P1012				
Rail pressure deviation is below the lower threshold value and fuel injection quantity is below the threshold value	2-5-4	P1013				
Peak rail pressure is below the lower threshold value	2-5-3	P0087				
Rail pressure peak exceeds the upper threshold value	2-5-3	P0088				
Untrusted fuel metering unit setting under overspeed mode	2-5-5	P1014				
Correction error of variable for identifying the fuel metering unit at idling speed	2-5-8	P4123				
Fuel quantity in fuel meter exceeds the threshold value	2-5-6	P1018				

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Starter motor high end is shorted to power supply	1-2-1	P0617	Start relay and its harness	Starter motor cannot work normally	High end circuit of start relay is shorted to power supply	Power off to test the voltage of start relay connector 1 pin 1.37 to ground, and voltage value ~0V indicates that it is OK;
Starter motor high end is shorted to ground		P0616			High end circuit of start relay is shorted to ground	Power off to test the resistance of start relay connector 1 pin1.37 to ground, and resistance value ~0Ω indicates that it is OK;
Starter motor low end is shorted to power supply	1-2-1	P1638			Low end circuit of start relay is shorted to power supply	Power off to test the voltage of start relay conector 2 pin 1.51 to ground, and voltage value ~0V indicates that it is OK;
Starter motor low end is shorted to ground		P1639			Low end circuit of start relay is shorted to ground	Power off to test the resistance of start relay connector 2 pin 1.51 to ground, and resistanc value ~0Ω indicates that it is OK;
Starter motor is open circuit		P163A			Start relay and its harness	1. Power off to test the resistances of vehicle connectors 1.37 and 1.51 to start relay connectors 1and 2 separately, and resistance value ~0Ω indicates that it is OK; 2. Test the resistance at two terminals of relay, and the value ~0Ω indicates that it is OK.
Cooling water overheating fault	2-4-2	P0217	Water temperature sensor, engine cooling system	Water temperature is too high, and engine power is limited	Cooling system fault	Check the fan, intercooler, water tank, thermostat and relevant cooling system components

Trouble description	Flash code	P code	Parts related	Problem caused	Fault causes	Solutions
Output voltage of remote accelerator pedal 1 exceeds the upper limit	2-2-9	P1C20	Remote accelerator and its harness	Remote accelerator failure	1. Remote accelerator pedal signal 1 of vehicle harnesses is shorted to power supply 2. Accelerator pedal fault 3. Pedal signal 1 pin 2.21 is open circuit	1. Power off and test the voltage of pedal signal 1 pin to ground, with voltage value ~0V indicates that it is OK; 2. Check the accelerator pedal and replace it if necessary
Output voltage of remote accelerator pedal 1 is below the lower limit		P1C21			1. Accelerator pedal signal 1 of vehicle harnesses is shorted to ground 2. Accelerator pedal fault	1. Power off and test the resistance of pedal signal 1 pin to ground, with the value >1MΩ indicates that it is OK; 2. Check the accelerator pedal and replace it if necessary
Untrustedtwo times relationship between remote accelerator pedals 1 and 2 signals		P1C22			1. Accelerator pedal signal wiring fault in vehicle harness 2. Accelerator pedal fault	1. Test the on/off of each pin harness; 2. Check the accelerator pedal and replace it if necessary.
Output voltage of remote accelerator pedal 2 exceeds the upper limit	2-2-9	P1C23			1. Remote accelerator pedal signal 4 of vehicle harnesses is shorted to power supply 2. Accelerator pedal fault 3. Pedal signal 1 pin 2.22 is open circuit	1. Power off and test the voltage of pedal signal 1 pin to ground, with the value ~0V indicates that it is OK; 2. Check the accelerator pedal and replace it if necessary
Output voltage of remote accelerator pedal 2 is below the lower limit		P1C24			1. Accelerator pedal signal 1 of vehicle harnesses is shorted to ground 2. Accelerator pedal fault	1. Power off and test the resistance of pedal signal 1 pin to ground, with the resistance value >1MΩ indicates that it is OK; 2. Check the accelerator pedal and replace it if necessary
Untrusted 1/2 relationship between remote accelerator pedals 1 and 2 signals		P1C25			1. Accelerator pedal signal wiring fault in vehicle harness 2. Accelerator pedal fault	1. Test the on/off of each pin harness; 2. Check the accelerator pedal and replace it if necessary.

Appendix B: Fit Clearance of Main Parts of the Diesel Engine

(Reference values)

No.	Items		Theoretical value (mm)
1	Main bearing clearance		0.08~0.11
2	Connecting rod bearing clearance		0.07~0.10
3	Axial clearance of crankshaft		0.04~0.25
4	Axial clearance of connecting rod plane		0.30~0.50
5	Clearance between connecting rod small end bush and piston pin		0.03~0.08
6	Clearance between piston pin and pin seat		0.003~0.015
7	Clearance between valve stem and valve guide		0.03~0.06
8	Working clearance of piston ring opening at cold state	First ring	0.35~0.55
		Second ring	0.75~1.05
		Oil control ring	0.3~0.6
9	Piston ring end gap at cold state	First ring	
		Second ring	0.06~0.095
		Oil control ring	0.05~0.085
10	Valve sinkage from cylinder head bottom plane		1.0~1.45
11	Cylinder liner higher than the engine body upper plane		0.05~0.10
12	Camshaft axial clearance		0.10~0.29
13	Camshaft bearing clearance		0.04~0.08
14	Clearance between tappet and tappet hole		0.006~0.035
15	Clearance between piston top and cylinder head bottom (compression clearance)		0.88~1.11
16	Piston top higher than engine body upper plane		0.25~0.57
17	Valve clearance (cold state)	Intake valve	0.2~0.3
		Exhaust valve	0.3~0.4
18	Clearance between rocker arm and rocker shaft		0.016~0.052
19	Second order balance mechanism clearance	Radial	0.03~0.07
		Axial	0.20~0.40
20	Backlash of timing gear and intermediate gear		0.07~0.24

FRONT AXLE

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

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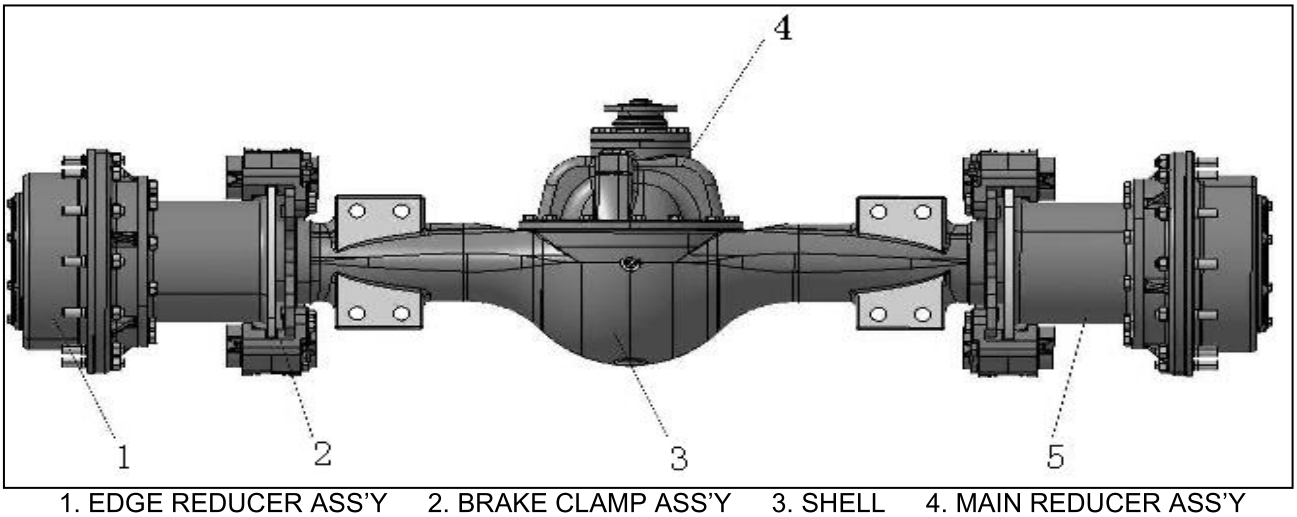
GENERAL DESCRIPTION

Structure chart



1. EDGE REDUCER ASS'Y 2. BRAKE CLAMP ASS'Y 3. SHELL 4. MAIN REDUCER ASS'Y
5. HUB ASS'Y

Basic parameters of drive axle:

Main drive	Type	Spiral bevel gear grade one reduction
	Reduction ratio	4.222
Hub reduction gear	Type	Grade one planet reduction
	Reduction ratio	4.8
Axle oil	GB13895-1992 gear oil	19L

Internal structure of drive axle

Drive axle assembly is one of the most important spare parts of transmission system, its main function is reduce rotation speed from gear box and increase torque, and make wheels at both sides having speed difference. Besides, it also plays the role of bearing and transmitting. Drive axle assembly of loader is mainly composed of shell, main drive (including differential mechanism), semi axis, hub reduction gear, brake caliper assembly and other parts. Of which, the parts having reduction and differential function is main driver and hub reduction gear; power transmission between main drive and hub reduction gear is realized through semi axis, multiple spine at both sides of semi axis and axle shaft gear of differential mechanism and sun gear of hub reduction gear mesh with each other to realize power connection between main drive and hub reduction gear.

PARTS LIST

Disassembling of front and rear axle

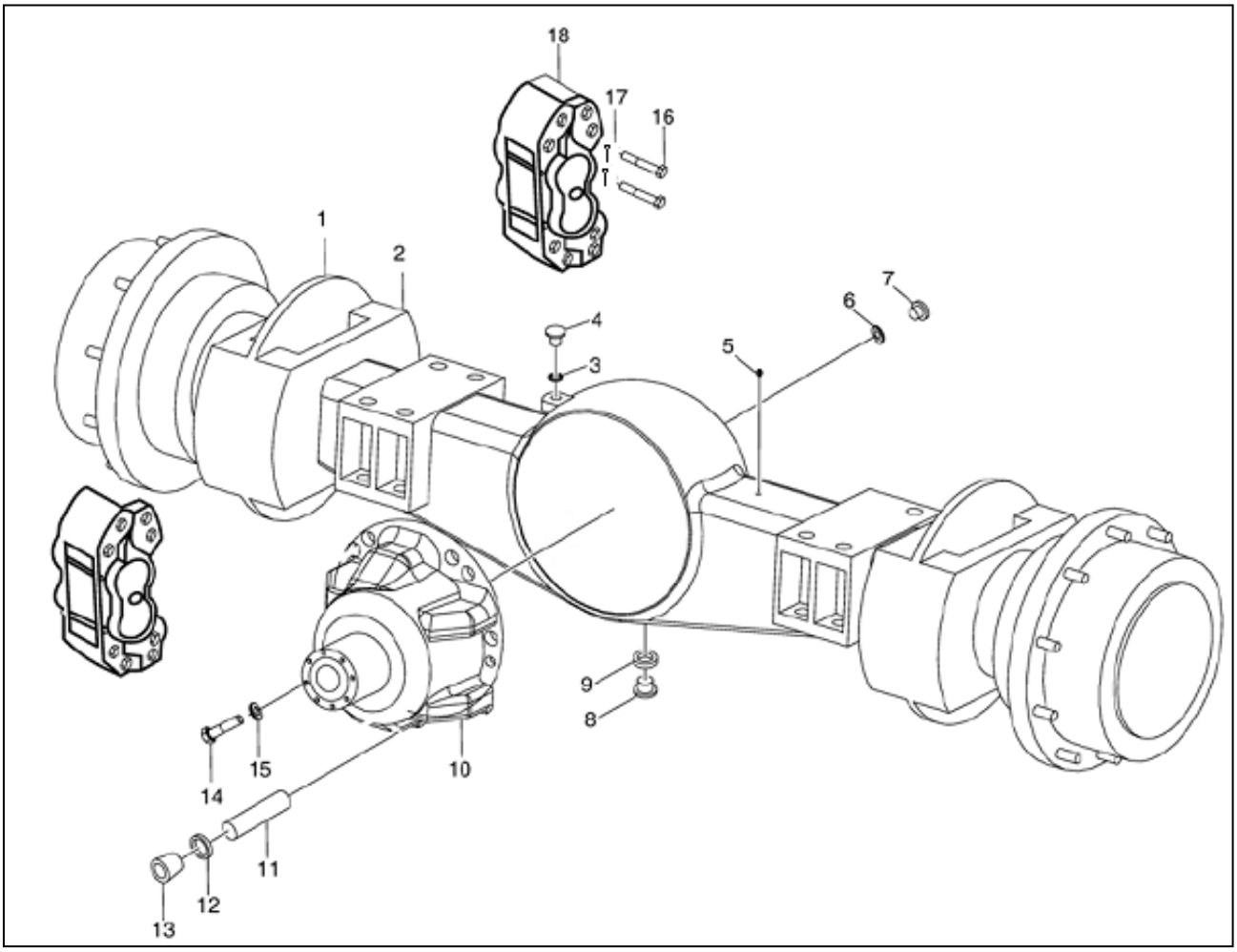


Figure 2

Reference Number	Description	Reference Number	Description
1	WHEEL REDUCER ASS'Y	10	MAIN REDUCER ASS'Y
2	AXLE ASSY;SHELL	11	STUD BOLT
3	GROUP WASHER φ24	12	SPACER 12
4	PLUG,SCREW	13	NUT M12
5	DEFLATION VALVE Z1/8	14	BOLT M12X35-10.9
6	O-RING	15	SPACER 12
7	PLUG,SCREW	16	BOLT
8	PLUG,SCREW	17	PIN
9	O-RING	18	BRAKE ASSY

Assemble of Hub drive axle

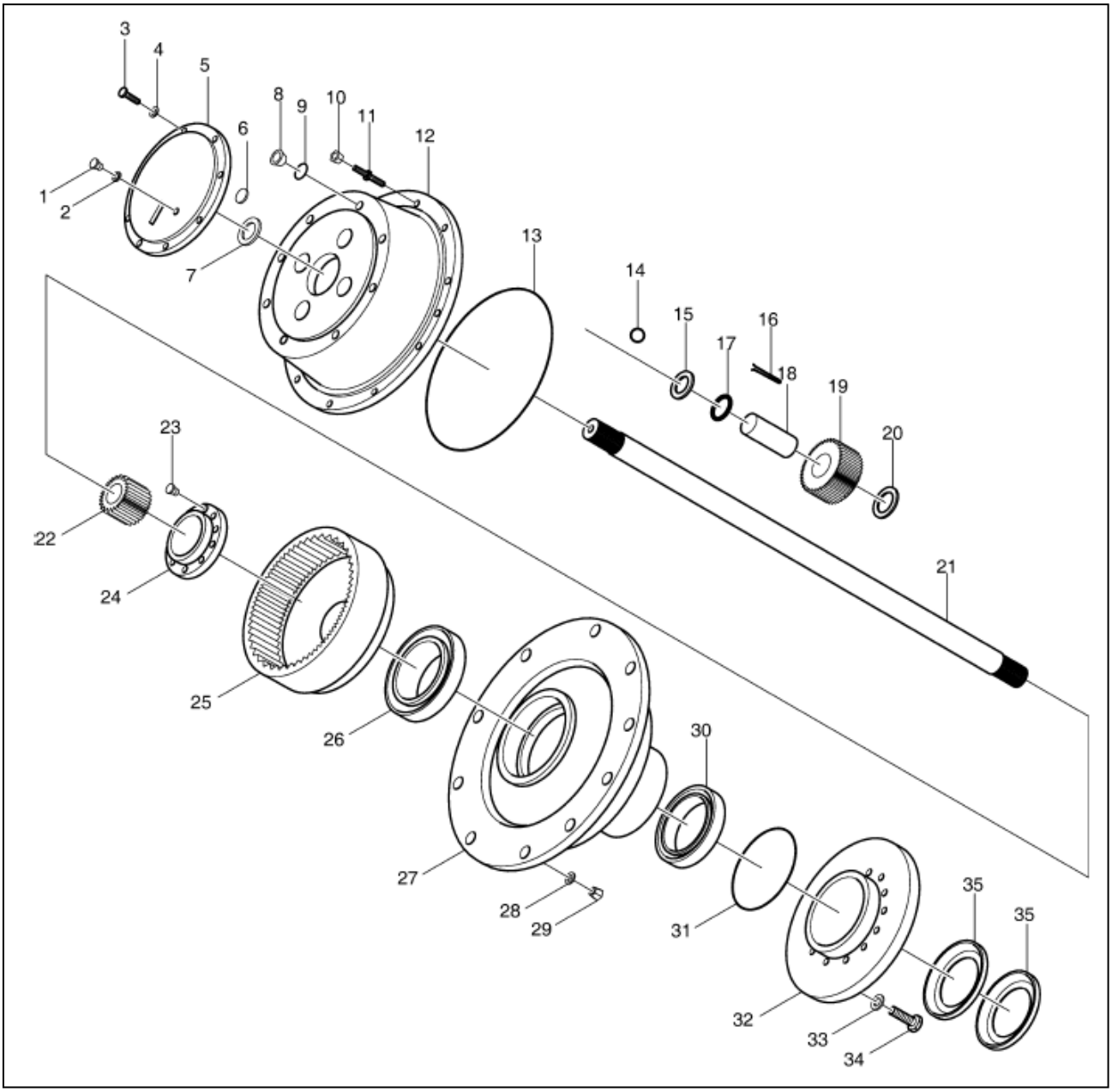


Figure 3

Reference Number	Description	Reference Number	Description
1	PLUG,SCREW	19	PLANET WHEEL
2	O-RING	20	PLANET WHEEL WASHER
3	BOLT M12X1.5-25	21	HALF SHAFT
4	SPACER 12	22	SUN WHEEL
5	COVER	23	SCREW M8X15
6	BLOCK	24	HOLDING NUT
7	RETAINER RING 48	25	INSIDE GEAR
8	PLUG,SCREW	26	BEARING 7521E
9	O-RING	27	HUB
10	HUB NUT	28	SPRING WASHER
11	HUB BOLT	29	NUT M18
12	SHELF,PLANET	30	BEARING 2007122E
13	O-RING SEAL	31	O-RING SEAL
14	STEEL BALL φ6	32	BRAKE DISC
15	PLANET WHEEL WASHER	33	WASHER 16
16	NEEDLE ROLLER 4×23.8	34	BOLT M16X45
17	SAPCER SLEEVE	35	SEAL ASSY,OIL
18	PLANET WHEEL SHAFT		

Brake assembly

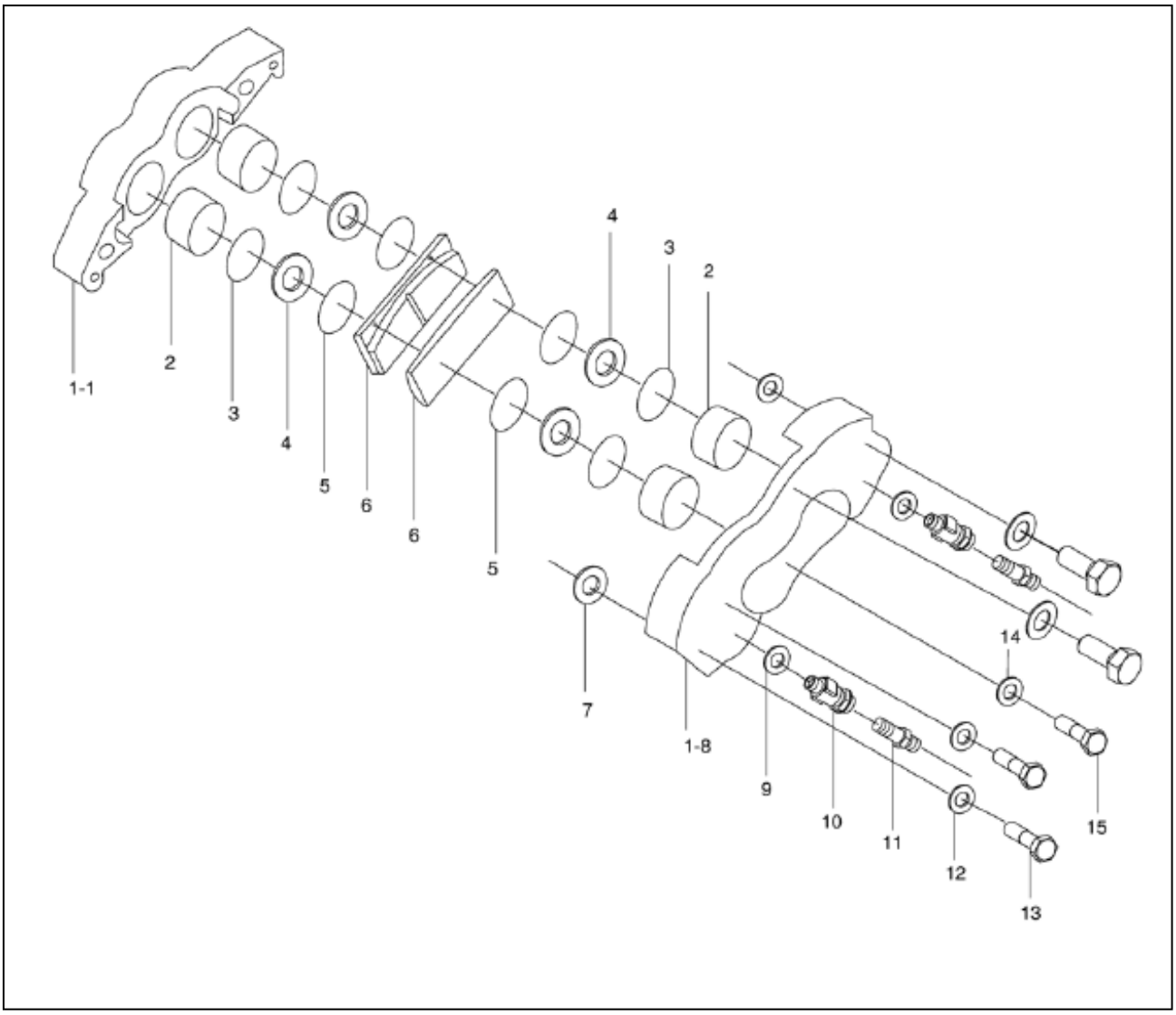


Figure 4

Reference Number	Description	Reference Number	Description
1-1	BRAKE,EXTERIOR	9	WASHER
1-8	BRAKE,INNER	10	CONNECTING
2	PISTON	11	DEFLATING VALVE
3	RECTANGULAR SEAL	12	SPACER 12
4	CASE,DUST	13	BOLT
5	BLOCK RING	14	WASHER SPRING 10
6	BRAKE DISK	15	PIN;BOLT
7	O-RING 20X2.4		

Main drive assembly

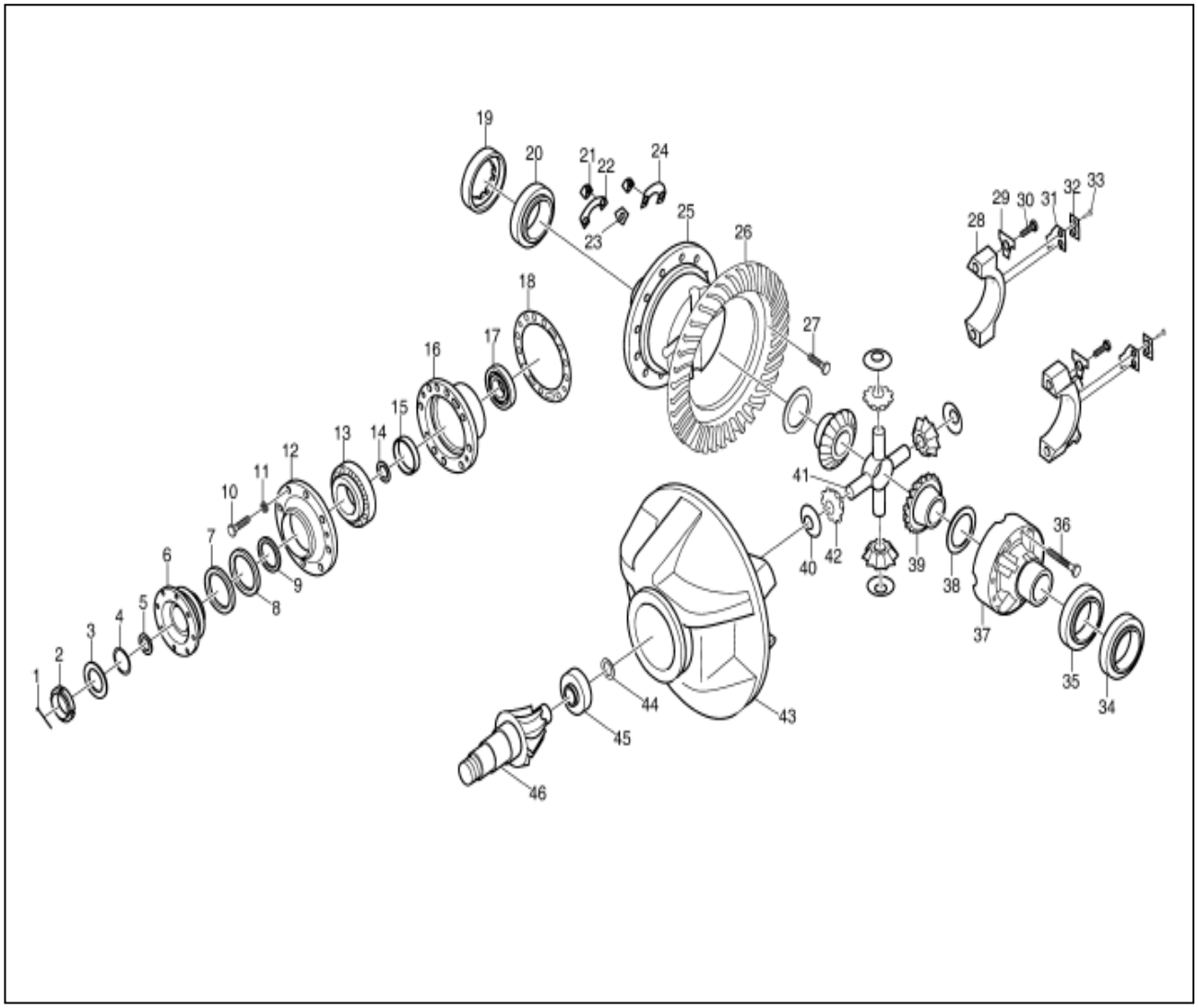


Figure 5

Reference Number	Description	Reference Number	Description
1	PIN 5X45	24	HOLDING PLATE
2	NUT M27×1.5-7H	25	DIFFERENTIAL SHELL –LEFT
3	WASHER	26	GEAR,BEVEL;DRIVE(REAR)
4	O-RING BAFFLE	28	DIFFERENTIAL BEARING COVER
5	O-RING SEAL 40X5.3	29	HOLDING PLATE
6	INPUT FLANGE GROUP	30	BOLT M18×90
7	OIL SEAL B62×93×6	31	HOLDING PLATE
8	OIL SEAL FB62×93×13	32	HOLDING PLATE
9	STOPPER WASHER	33	BOLT M8X12
10	BOLT M12×45-10.9	34	REGULATE NUT
11	SPACER 12	35	BEARING 7516E
12	OIL SEAL SEAT	36	BOLT M14X1.5
13	BEARING 27311E	37	DIFFERENTIAL SHELL – RIGHT
14	REGULATE WASHER	38	HALF SHAFT GEAR WASHER
15	SPACER SLEEVE	39	HALF SHAFT GEAR
16	BEARING SEAT	40	SUPPORT WASHER
17	BEARING 27311E	41	CROSS SHAFT
18	REGULATE WASHER	42	PLANET GEAR
19	REGULATE NUT	43	MAIN REDUCER SHELL
20	BEARING 7516E	44	RETAINER RING 30
21	NUT M14X1.5	45	BEARING 92606E
22	HOLDING PLATE	46	DRIVE GEAR;RIGHT
23	HOLDING PLATE		

SCHEDULED MAINTENANCE

Oil of new drive axle must be replaced after working for 15 days (about 100 working hours), oil shall be replaced once after working for every six months (about 1200 working hours) in following days.

Every month maintenance

1. Check abrasion condition of brake disc, if there is disruptive abrasion; please handle in time if there is any.
2. Check abrasion condition of brake block to guarantee separation and reunion of brake caliper is flexible; it shall be replaced in time when brake block is wearing close to abrasion line (at the bottom of groove).
3. Check if oil level of shell complies with requirements, please add new oil if the oil level descends.
4. Keep axle clean, keep vent pipe smooth, and avoid silt going into axle. Check loosening condition of all fasteners, especially rim nuts, if it is loosed, please refasten again.

Every half year maintenance：

Lubrication oil in axle shall be replaced every half a year, different brands of lubrication oil shall be adopted for different areas and seasons. Please refer to 4.2 for oil replacing method.

Every year maintenance：

Overhaul checking every working year:

1. Check the gap, mesh and abrasion condition of spiral bevel gear of main reducer.
2. Check abrasion condition of differential mechanism gear.
3. Check abrasion condition of hub gear.
4. Check abrasion condition of needle bearing of hub planetary gear.
5. Requirements of installation and debugging items after overhaul checking:
   1) After assembling, axle shaft gear and bevel gear shall move flexibly with hand touching rather than locking. The Min. gear backlash of gear is 0.18-0.23mm. Tooth length and tooth height of contacting area of two gears cannot be less than 50%.
   2) In order to guarantee enough bearing rigidity of active spiral gear, before assembling oil seal and sealing cover, adopt gradually reducing spacer shim between tapered roller bearing to give 1.0-1.5N.m preloaded torque to roller bearing.
   3) Gear backlash between the driving and driven spiral bevel gear is 0.25-0.45mm, the changing amount cannot be more than 0.15mm, gear backlash can be realized through adjusting nuts of both sides of differential mechanism and spacer shim of bearing sleeve. Tooth surface contacting area shall guarantee direction of tooth length and tooth height is not less than 50%, contacting position shall be at the middle side of tooth surface and closer to the smaller side.
   4) Adjusting of bearing clearance of shell at both sides of drive axle: Fasten adjusting nuts, give 28 ~ 38N.m preload to shell roller bearing, and then lock two round nuts with screw fastening

GENERAL DISASSEMBLY AND REASSEMBLY INSTRUCTIONS

⚠ WARNING!

Never use gasoline, solvents, or other flammable fluids to clean components. Only use approved commercial solvents that are nonflammable and nontoxic.

IMPORTANT

Use only GENUINE SPARE PARTS to warrant proper operations and prevent interchangeability problems.

GENERAL INSTRUCTIONS

1. Thoroughly clean and dry axle before disassembly.
2. All components should be thoroughly cleaned and dried before reassembly. Dirt, chips, and foreign material may cause failures.
3. All ducts and castings should be thoroughly cleaned and dried to remove dirt, chips, and foreign material to prevent damage after reassembly.
4. Reassembly should be done in a clean shop, and should be as dust free as possible.
5. Make sure tools and equipment are at hand.
6. When reassembling Daewoo strongly recommends to replace the following parts with new.
   - Seal Rings.
   - O-rings.
   - Gaskets.
   - Threaded rings with notched collar.
   - Any component damaged during disassembly.
7. When mounting heat fitted components, make sure of their proper position and direction of assembly, after they have cooled.
8. To heat bearings, use proper heating plates, piping, or suitable ovens.

NOTE: *Never heat parts by using a torch. Oil bath, heated by a torch, maybe used to warm components.*

9. Lubricate all sections concerned when reassembling shafts, bearings, etc.
10. Lubricate O-rings before installing them in relevant seats to prevent kinking during assembly, such a position would impair proper sealing.
11. Replace gears only in matched sets to make sure of proper tooth mating.

AXLE DISASSEMBLY

1 Disassembly of drive axle

1. Put drive axle on supporting and make sure main driver assembly is upward.

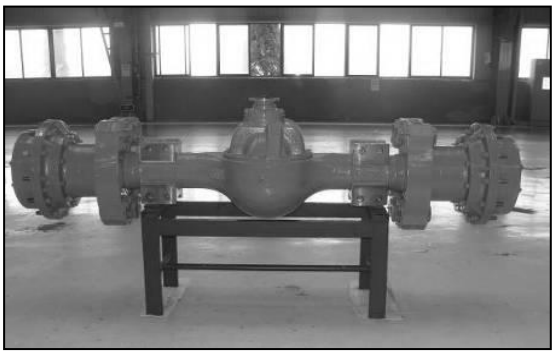


Figure 6

2. Loosen the connection bolts between brake caliper and brake caliper support, dismantle brake caliper assemble.

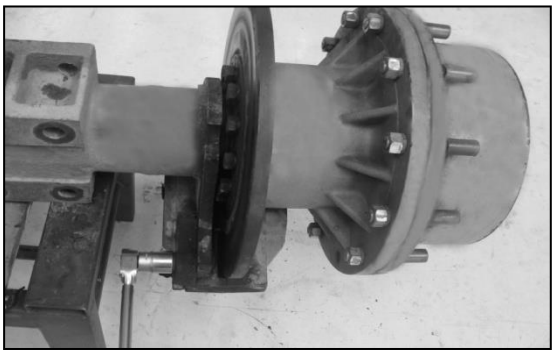


Figure 7

3. Release gear oil from planet carrier

   Loosen hub oil releasing drain plug and shell oil releasing drain plug, turn on slowly with hands to avoid oil spilling.

   Note：*Store gear oil with clean container.*

Figure 8

4. Release gear oil from shell

Turn on oil releasing bolts axle end cap to release gear oil.

Note： *Store gear oil with clean container.*

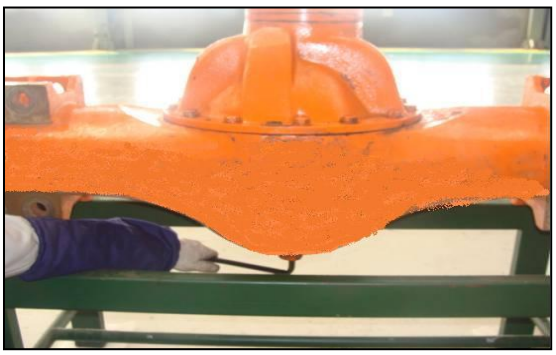


Figure 9

5. Dismantle end cap

Loosen connection bolts between planet carrier and end cap, then get end cap from hub reducer assembly with jackscrew, dismantle end cap.

Figure 10

6. Dismantle locating block

Take down locating block with hands.

Note： *If it is tight when taking down, please use assistant tools to pry out.*

Figure 11

7. Dismantle stop collar

Dismantle stop collar from semi axis with stop collar pincers.

Note： *Before dismantling stop collar, pull out a section of semi axis from shell.*

Note： *It must clamp firmly when using stop collar pincers to avoid safety hazard when it is popup.*

Figure 12

8. Dismantle sun gear

Dismantle semi axis from sun gear.。

Figure 13

9. Dismantle locating block

Dismantle locating block from semi axle with hands.

Figure 14

10. Dismantle semi axis

Take semi axis from shell slightly.

Figure 15

11. Hub reducer

First loosen rim bolts with relative tools, then loosen rim from planet carrier with jackscrew and dismantle planet carrier assembly.

Note： *Please slowly loosen planet carrier to avoid safety hazard resulted from dropping of planet carrier assembly.*

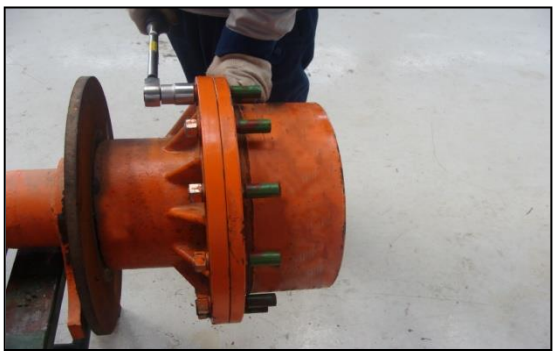


Figure 16

12. Dismantle round bolts

Dismantle round bolts.

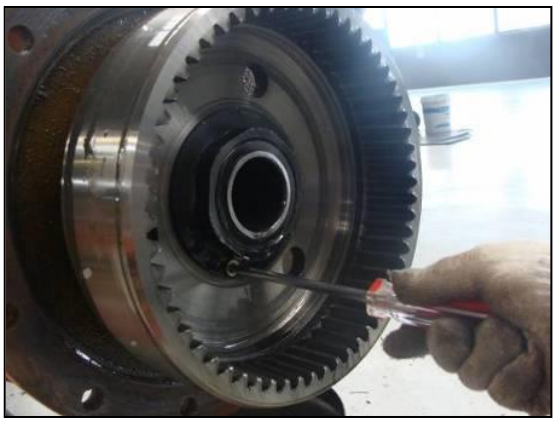


Figure 17

13. Dismantle round nuts

Dismantle round nuts.

Figure 18

14. Dismantle internal gear

Take internal gear out by slightly rocking.

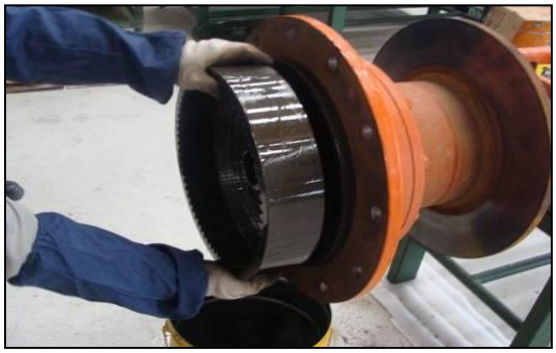


Figure 19

15. Dismantle rolling bearing

Take out rolling bearing with special dismantling tool.

Figure 20

16. Dismantle wheel hub assembly

Take wheel hub assembly from supporting axle.

Note: *During hanging and dismantling process, please keep axis of wheel hub assembly is in line with axis of hub reduction supporting axle to avoid scratching oil surface and internal spare parts during dismantling process.*

Remark: dismantle all parts at the other side of drive axle with the same methods.

Figure 21

17. Dismantle main drive assembly

Dismantle connection bolts between main drive and shell assembly, take out main drive with jackscrew, and suspend main drive assembly.

Note: *When suspending main drive assembly, guarantee suspending and dismantling tools are at the above of main drive assembly to avoid spare parts inside are knocked again during suspending and dismantling process.*

Figure 22

2 Assembly dismantling

2.1 Dismantle planet carrier assembly

1. O ring

Take out O ring.

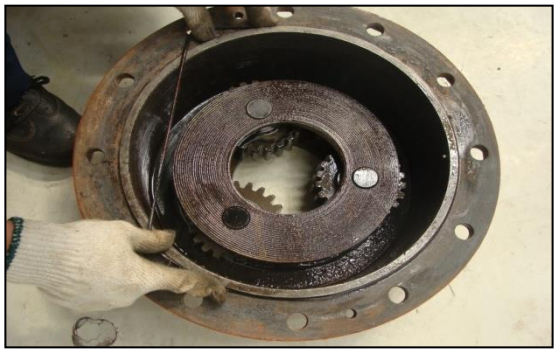


Figure 23

2. Put planet carrier on working platform horizontally.

Figure 24

3. Take out planet axle with tools.

Figure 25

4. Take out steel balls.

Figure 26

5. Take out planet wheel.

Figure 27

6. Take out baffle ring and quill roller from inside of planet wheel.

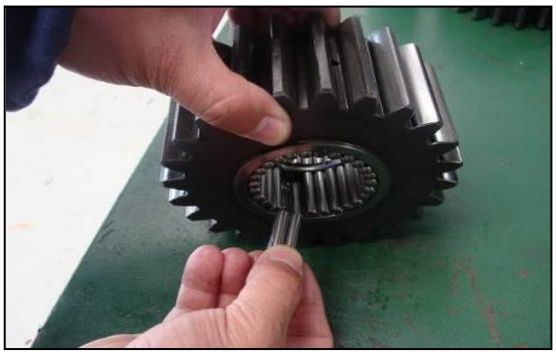


Figure 28

2.2 Dismantle hub assembly

1. Put hub assembly on working platform; loosen connection bolts between brake disc and hub.

Figure 29

2. Take out brake disc.

Figure 30

3. Take out bearing.

Figure 31

4. Take out oil seal.

Figure 32

2.3 Dismantle main drive assembly

1. Put main drive assembly (input flange upward) horizontally and fixed on supporting.

Figure 33

2. Dismantle locknut gasket, O ring and baffle ring.

Figure 34

3. Take out input flange.

Figure 35

4. Dismantle connection bolts between sealing cover and bearing sleeve, take out sealing cover.

Figure 36

5. Turn main drive for 180°, dismantle bolts fastening locking plate, take out locking plate.

Note： *Some of the machine structure may be different from this figure, please adjust working content according to actual structure.*

Figure 37

6. Dismantle connection bolts of bearing seat and take out bearing seat.

Figure 38

7. Dismantle adjusting nuts.

Figure 39

8. Dismantle bearing outer ring.

Figure 40

9. Hang out differential mechanism assembly.

Note： *Keep balance when hanging out to avoid safety hazard.*

Figure 41

10. Separate active spiral bevel gear assembly and bracket with jackscrew.

Figure 42

2.4 Dismantle differential assembly

1. Put differential assembly vertically on working platform, and guarantee it is stable.

Figure 43

2. Dismantle bearing on left and right shell of differential mechanism.

Figure 44

3. Loosen connection nuts between driven spiral bevel gear and right shell of differential mechanism, dismantle driven spiral bevel gear.

Note： *Before taking out driven spiral bevel gear, please check or mark assembling sign first so that it can be placed back to the original position.*

Figure 45

4. Loosen connection nuts of left and right shell, separate left and right shell of differential mechanism.

Note： *Before separating left and right shell of differential mechanism, please check or mark assembling sigh first so that it can be placed back to the original position.*

Figure 46

5. Take out semi axis gear gasket and semi axis gear.

Figure 47

6. Take out joint cross and differential gear together, take out differential gear gasket and gear from joint cross.

Figure 48

7. Take out semi axis gear gasket and gear.

Figure 49

2.5 Dismantle active spiral bevel gear assembly

1. Put active spiral bevel gear assembly on working platform, support flange of bearing sleeve, clamp down on thread end of active spiral bevel gear assembly with down device.

Figure 50

Note：*Do not clamp too much to avoid damaging flange, pull out bearing sleeve from active spiral bevel gear assembly.*

2. Reverse bevel gear assembly and take out bearing.

Figure 51

3. Take out bearing sleeve.

Figure 52

4. Take out adjusting gasket.

Figure 53

5. Take out spacer bush.

Figure 54

AXLE REASSEMBLY

1. Axle assembly

1. Shell

Clean shell and suspend with special supporting. Fasten gummed plug screw at oil inlet and oil filler.

Note：*Plug screw fastening torque：280～330Nm*

Note：*Loctite 262 taper thread sealant.*

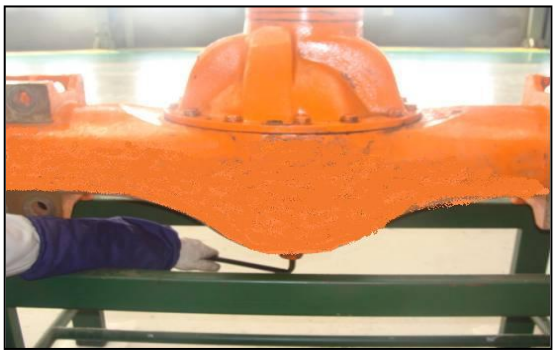


Figure 55

2. Wheel hub assembly

Coat lubrication grease on hub supporting axle of shell assembly; assemble wheel hub assembly on both sides of supporting axle of shell assembly.

Note： *Use lubrication oil.*

Figure 56

3. Rolling bearing

Assemble rolling bearing on hub supporting axle.

Figure 57

4. Internal gear

Assemble internal gear of drive axle at multiple spline at the end of supporting bearing.

Figure 58

5. Round nuts

Assemble round nuts and fasten. Knock internal gear slightly with copper stick to make internal gear in place.

Figure 59

6. Assemble round bolts

1) Grapple the hole on wheel hub with push and pull ergometer, pull ergometer along with tangential direction, indication on ergometer is 160±10N, if the indication is not within the range of 160±10N, adjust tightness degree of round bolts according to the indication until it is within the range of 160±10N. In the end, coat Loctite 262 thread fastening sealant for 5~6 from the second thread hole of internal gear (form a liquid level at 1/3 circle of thread), then fasten bolts, and fix round nuts.

2) Before dynamometry, rotate hub wheel for more than 5 times.

Note： *Loctite 262 thread fastening sealant*

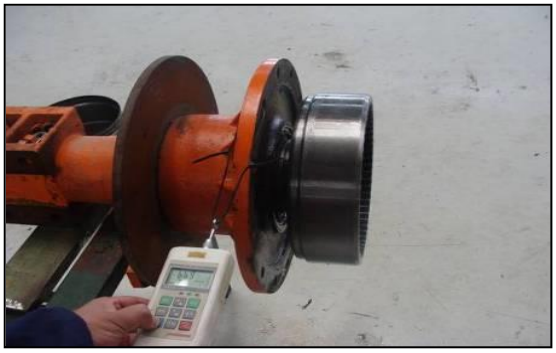


Figure 60

Figure 61

7. Assemble O sealing ring

Assemble O sealing ring on hub assemble.

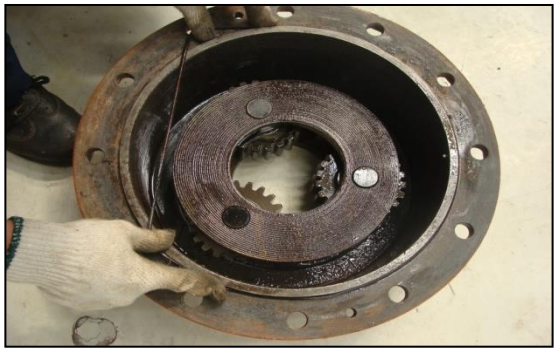


Figure 62

8. Planet carrier assembly

Assemble planet carrier assembly on wheel hub with rim bolts, gaskets and nuts.

Note： *Fastening torque：540～650Nm*

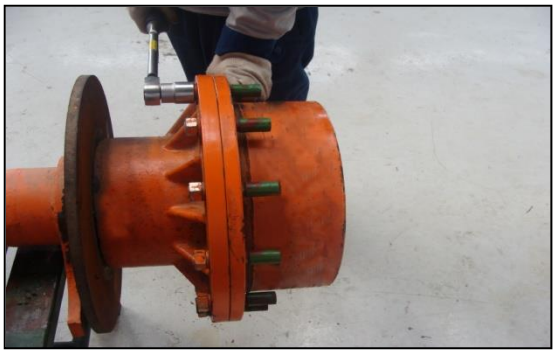


Figure 63

9. Assemble semiaxis

Assemble semiaxis in wheel hub.

Figure 64

10. Assemble sun gear

Assemble sun gear at one side of semiaxis with baffle ring groove (pay attention to semiaxis multiple spline and gear assembly).

Figure 65

11. Assemble baffle ring

Assemble baffle ring with baffle ring used for axle.

Note： *It must be clamped firmly when using baffle ring pincer to avoid safety hazard when it is popping out during assembling process.*

Figure 66

12. Assemble locating block

Stake steel ball on locating block, it can rotate flexibly after staking steel ball.

Figure 67

13. Assemble end cap

Coat Loctite 262 thread fastening sealant on screws, location of sealant is 15mm on top of thread end. Fasten cap with bolts and gaskets.

Note: *Fasten all screws according to symmetrical and crossing principle.*

Note: *Fastening torque：110～130Nm*

Note: *Loctite 262 thread fastening sealant*

Figure 68

14. Assemble brake caliper assembly

Assemble disc brake on brake caliper supporting, fix with bolts and gaskets.

Note: *Fastening torque：540～650Nm*

Note: *Coat Loctite 262 thread fastening sealant at 20mm length at thread end during assembling.*

Figure 69

15. Assemble main drive assembly

Coat Loctite 598 silicon rubber surface sealant at the joint surface between shell and bracket, coatφ3～φ6 glue saluting ring with sealing surrounding inside of thread hole at the large end of shell. The coated sealant cannot be in the air for more than ten minutes.

Note: *Loctite 598 silicon rubber surface sealant*

Figure 70

16. Assemble main drive

Hand up main drive assembly with overhead crane, put main drive at main drive shell of the axle, assemble locating pin.

Figure 71

17. Assemble bolts

Coat proper Loctite 262 threat fastening sealant on bolts, the coating position is 15mm length at thread end. Fasten main drive assembly and shell assembly with bolts and gaskets.

Note：*Fastening torque：110～130Nm*

Note：*Loctite 262 threat fastening sealant*

Note：*Fasten all screws according to symmetrical and crossing principle.*

Figure 72

18. Add oil

Add 10L 85W/90 GL-5 gear oil (GB13895-1992) in axle bag of shell and fasten plug screws.

Note：*Use 85W/90 GL-5 gear oil*

Note：*Anaerobic type pipe threat sealant*

Note：*Fastening torque：280～330Nm*

Figure 73

19. Inject 4.5L (subject to overflowing from planet carrier) 85W/90 GL-5 gear oil (GB13895-1992) into two hub reducers and fasten plug screws.

Note：*Use 85W/90 GL-5 gear oil*

Note：*Anaerobic type pipe threat sealant*

Figure 74

2. Assembly parts assembling

2.1 Install hub assembly

1. Keep the large end of hub upward, assemble bearing outer ring and turn over to keep the small end of hub upward and assemble bearing inner ring.

Figure 75

2. Coat lubrication oil at oil seal end, check completeness of oil seal, coat lubrication oil in groove of oil seal evenly, and assemble oil seal in side of oil seal end.

Figure 76

3. Assemble brake disc on hub and fasten with bolts and gaskets.

Note：*Fastening torque：280～330Nm*

Note：*Fasten all screws according to symmetrical and crossing principle.*

Figure 77

2.2 Assemble planet carrier assembly

1. Stick lubrication grease quill roller (27 units each) on walls of inner holes of planet gears, assemble baffle ring in the middle of quill roller, assemble gaskets at both sides of planet gear, then assemble to the seat hole of planet carrier.

Figure 78

2. Assemble steel balls in holes of planet gear shaft, steel ball shall aim at semi circle of planet carrier, go through the inner hole of planet gear and gasket and assemble on planet carrier. After assembly, planet gear shall rotate flexibly there is no blocking.

Figure 79

2.3 Install of main drive assembly

1. Assemble rolling bearing on bear neck of the terminal with pressure machine, rotate to the left on active spiral bevel gear front axle, and rotate to the right side.

Figure 80

2. Press inner ring into rolling bearing with pressure machine at the other side

Figure 81

3. Turn over gear and assemble outer ring of gear

Figure 82

4. Install spacer bush

Figure 83

5. Install gaskets

Figure 84

6. Install bearing sleeve

Figure 85

7. Press inner ring of antifriction bearing in the end.

Note: *when assembling main reducer, taper rolling bearing shall have certain tightness, that is on the basis of eliminating bearing clearance, and give certain preload. The purpose is to reduce axial force caused during transmission process which will result in axial displacement, improve supporting rigidity, and guarantee normal mesh of bevel gear pair. But if it is too tight, it will accelerate abrasion of taper rolling bearing. Press with P= 5420 kg pressure at the top side of inner ring of rolling bearing, grapple Φ14.5 hole with pull and push ergometer, pull ergometer along with tangential direction, indication of ergometer when pushing shall be 17.34-30.06N, if the indication is not within the range of 17.34-30.06N, increase or reduce thickness of spacer shim, repeat the above process until the indication is within 17.34-30.06N.*

Figure 86

Figure 87

2.4 Assemble of differential assembly

1. Assemble rolling bearing at the bearing position of right shell terminal of differential mechanism.

Figure 88

2. Assemble rolling bearing at the bearing position of left shell terminal of differential mechanism.

Figure 89

3. Assemble semiaxis gear

Assemble semiaxis gear gasket in left shell of differential mechanism.

Note：*The side of gasket with groove shall toward to the direction of joint cross*

Figure 90

4. Install semiaxis gear

Figure 91

5. Assemble joint cross assembly

Assemble bevel gear (internal of small terminal) and bevel gear gasket on four axles of joint cross.

Note： *Lubricate with grease when assembling bevel gear and bevel gear gasket*

Note： *Lubricate lubrication oil*

Figure 92

6. Differential mechanism shell

Assemble joint cross in right shell of differential mechanism to make bevel gear and semiaxis gear mesh, turn over left shell assembly of differential mechanism to assemble right shell assembly of differential mechanism, join right shell and left shells of differential mechanism with bolts and fasten with gaskets and nuts.

Figure 93

Note： *Nuts fastening torque180～210Nm*

Note： *1) Guarantee assembling mark of right shell and left shell of differential mechanism align.*

2) Coat proper Loctite 262 thread fastening sealant at the thread bottom within 12mm length.

3) After assembling, semiaxis gear and taper gear can be rotated manually without blocking.

Figure 94

7. Install driven spiral bevel gear

Aim at assembling mark, fasten driven spiral bevel gear (rotate to the left for rear axle, rotate to the right for front axle) with bolts, gaskets and nuts, and fasten screws.

Figure 95

Note：*Nuts fastening torque 180～210Nm。*

Note：*1) Coat proper Loctite 262 thread fastening sealant at the thread bottom within 12mm length.*

2) Judging method of left and right spiral: face to positive side of gear, right rotation refers to the spiral gear rotates to large terminal clockwise; on the contrary, left rotation refers to the spiral gear rotates to large terminal anticlockwise.

2.5 Install main reducer

1. Install the assembled active sprial bevel gear assembly in bracket, coat sealant line with diameter 2-4mm at the small end, refer to the picture for sealant line; sealant line and diameter of bearing sleeve (the other side of gasket) shall be done according to the above requirements.

Figure 96

2. Assemble sealing cover

Press oil seal in sealing cover.

Figure 97

Note：*Coat a layer of proper lubrication oil when assembling oil seal.*

3. Install input flange

Put gasket on the end face of bracket, install sealing cover assembly (coat lubrication grease on oil seal according to common requirements of drive axle), and connect with bracket with bolts and gaskets.

Note：*Screw fastening torque 110～130Nm。*

Figure 98

4. Install input flange.

Figure 99

5. Install baffle ring, O ring, coat sealant on one end face of gasket, the surface with sealant is downward, install gasket.

Note：*Coat Loctite 598 sealant*

Figure 100

6. Install gasket

Figure 101

7. Install round screws and fasten.

Note： *Screw fastening torque: 320～400Nm 。*

Note： *Before installing flange, install flange on multiple spline on main spiral bevel gear, measure radial play eccentricity of flange, guarantee it cannot be more than 0.08, and mark matching and assembling signs. If it is out of tolerance, rotate flange to certain angle and measure unitl it complies with requirements, otherwise, replace flange.*

Figure102

8. Gasket shall be close to φ2～φ3 glue line.
9. Install differential assembly

   Turnover carrier, install differential assembly in bracket.

Figure103

10. Install bearing seat with gaskets and bolts (bolts shall be a little bit tight).

Figure104

11. Install adjusting nuts.

    Note： *Two bearing seats cannot be exchanged.*

12. Coat proper thread sealant on the length of 15～25mm on thread end surface of bolts.

    Note： *Coat Loctite 262 thread fastening sealant.*

Figure105

13. Adjust spiral bevel gear

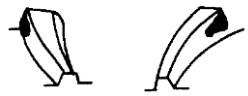
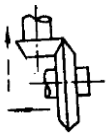
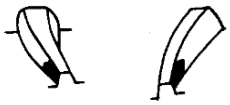
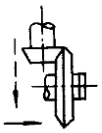
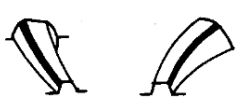
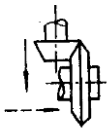
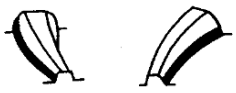
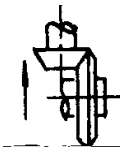
Adjustment of spiral bevel gear mesh condition refers to adjustment of mesh zone and back lash, when adjusting back lash of spiral bevel gear pair, dial gauge can be used to touch the gear surface of large side edge of driven spiral bevel gear, then rotate driven spiral bevel gear to measure back lash directly, the clearance shall be 0.2～0.35mm. Adjusting method of back mesh is to twist adjusting nuts to change position of driven spiral bevel gear (when it is necessary, move active spiral bevel gear assembly to adjust).

Figure 106

If the clearance is larger than the regulated value, approach active spiral bevel gear from driven spiral bevel gear; otherwise be away from it. In order to keep the adjusted preload of taper rolling bearing of differential mechanism, twisting numbers of adjusting nuts at one side shall be equal to twisting numbers of adjusting nuts at the other side.

When adjusting contact zone of spiral bevel gear pair, coat red color (red lead powder) on driven spiral bevel gear teeth (coat three teeth usually), rotate driven spiral bevel gear with hands repeatedly, check contacting moulage. Adjust the correct position of spiral bevel gear mesh moulage: it shall not be less than 50% along with teeth height direction and teeth length direction, mesh moulage of driven bevel gear shall be close to the center, and in the middle of teeth height, smaller than the small end on teeth length direction. Increasing preload of differential bearing: after adjusting back lash of spiral bevel gear well, it shall guarantee the clearance between taper rolling bearings at both sides of differential mechanism is 0. Following is the adjusting methods.

Adjustment of contact zone and back lash when installing spiral bevel gear

Contact zone of driven spiral bevel gear	Adjusting method	Gear moving direction
	Move driven gear to the direction of active gear, if the clearance is too small, move active gear outside	
	Move driven gear away from active gear, if the clearance is too large, move active gear inside	
	Move active gear to the direction of driven gear, if the clearance is too small, move driven gear inside and outside	
	Move active gear away from driven gear, if clearance is too large, move driven gear inside	

Method of adjusting mesh zone is usually increasing and decreasing adjusting gaskets and rotating adjusting nuts. Adjusting of contact zone will affect performance and service life greatly, it shall be carried out carefully.

Note：*After adjusting, clean off red lead powder.*

14. Install locking plate

Fasten the fixed bolts on bearing seat, fastening torque is 380～450Nm. Put locking plate at the right position, fix it on bearing seat with bolts and gaskets, and fasten fixing bolts of locking plate.

Figure 107

Note：*Fastening torque 30～36Nm*

Note：*Coat proper Loctite 262 thread fastening sealant on 5-10mm length at the end surface of fixing bolt.*

Note：*Coat Loctite 262 thread fastening sealant*

REAR AXLE

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

TABLE OF CONTENTS

GENERAL DESCRIPTION

Structure chart

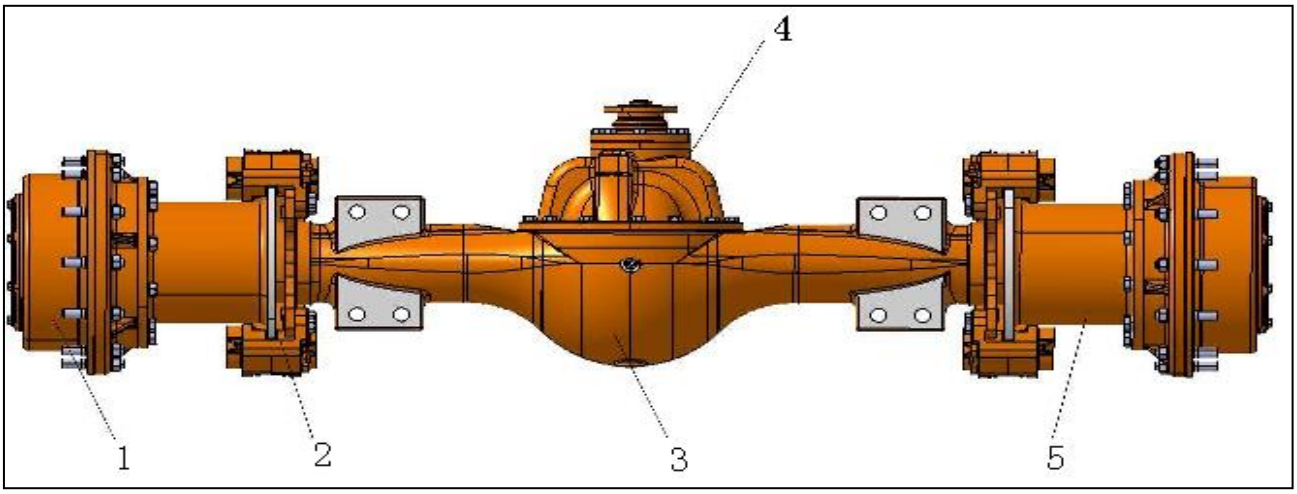


Figure 1

1. EDGE REDUCER ASS'Y 2. BRAKE CALMPS ASS'Y 3. SHELL 4. MAIN REDUCER ASS'Y 5. HUB ASS'Y

Basic parameters of drive axle:

Main drive	Type	Spiral bevel gear grade one reduction
	Reduction ratio	4.222
Hub reduction gear	Type	Grade one planet reduction
	Reduction ratio	4.8
Axle oil	GB13895-1992 gear oil	19L

Internal structure of drive axle

Drive axle assembly is one of the most important spare parts of transmission system, its main function is reduce rotation speed from gear box and increase torque, and make wheels at both sides having speed difference. Besides, it also plays the role of bearing and transmitting. Drive axle assembly of loader is mainly composed of shell, main drive (including differential mechanism), semiaxis, hub reduction gear, brake caliper assembly and other parts. Of which, the parts having reduction and differential function is main driver and hub reduction gear; power transmission between main drive and hub reduction gear is realized through semiaxis, multiple spline at both sides of semiaxis and axle shaft gear of differential mechanism and sun gear of hub reduction gear mesh with each other to realize power connection between main drive and hub reduction gear.

PARTS LIST

Disassembly of rear axle

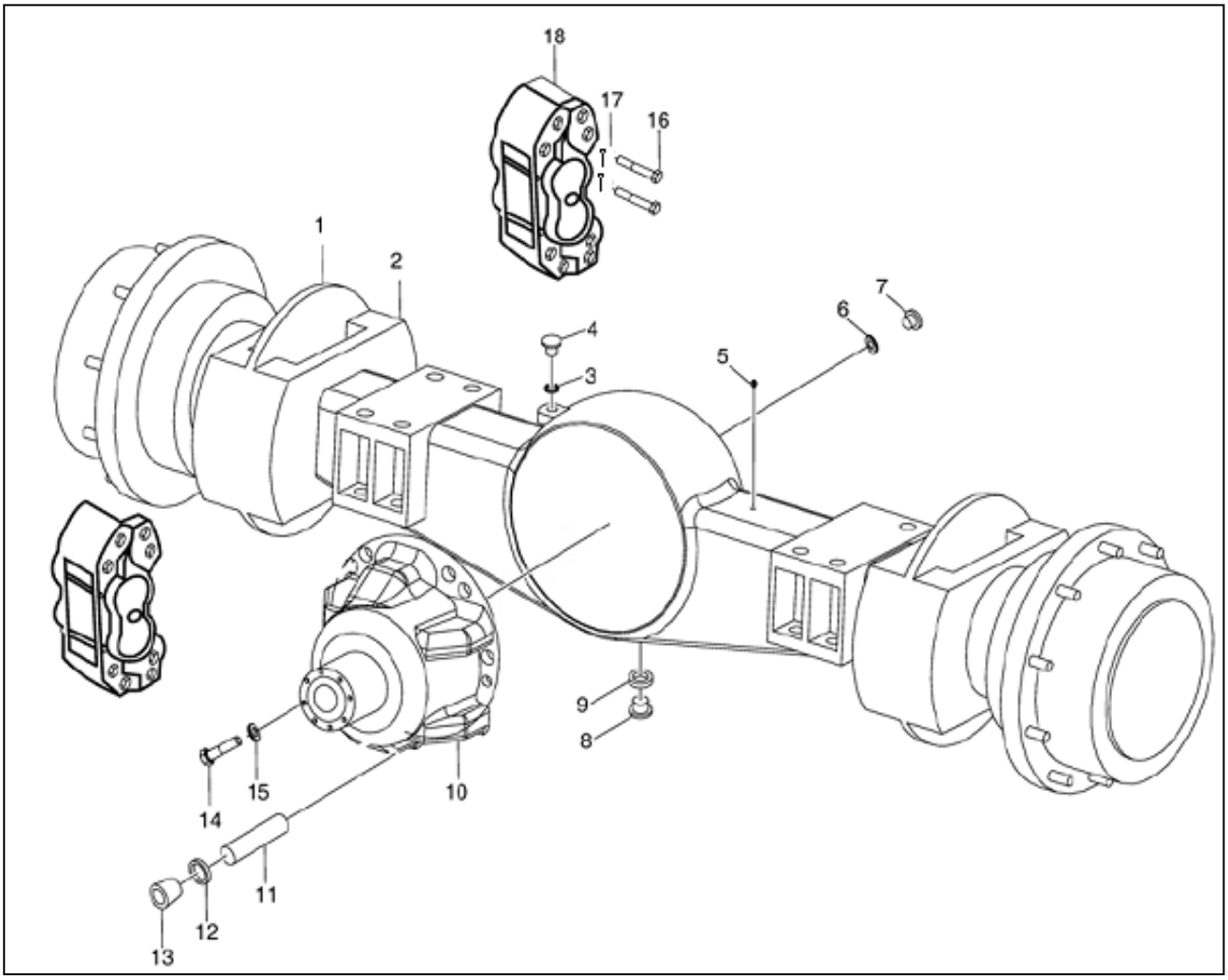


Figure 2

Reference Number	Description	Reference Number	Description
1	WHEEL REDUCER ASS'Y	10	MAIN REDUCER ASS'Y
2	AXLE ASSY;SHELL	11	STUD BOLT
3	GROUP WASHER φ24	12	SPACER 12
4	PLUG,SCREW	13	NUT M12
5	DEFLATION VALVE Z1/8	14	BOLT M12X35-10.9
6	O-RING	15	SPACER 12
7	PLUG,SCREW	16	BOLT
8	PLUG,SCREW	17	PIN
9	O-RING	18	BRAKE ASSY

Assembly of hub drive axle

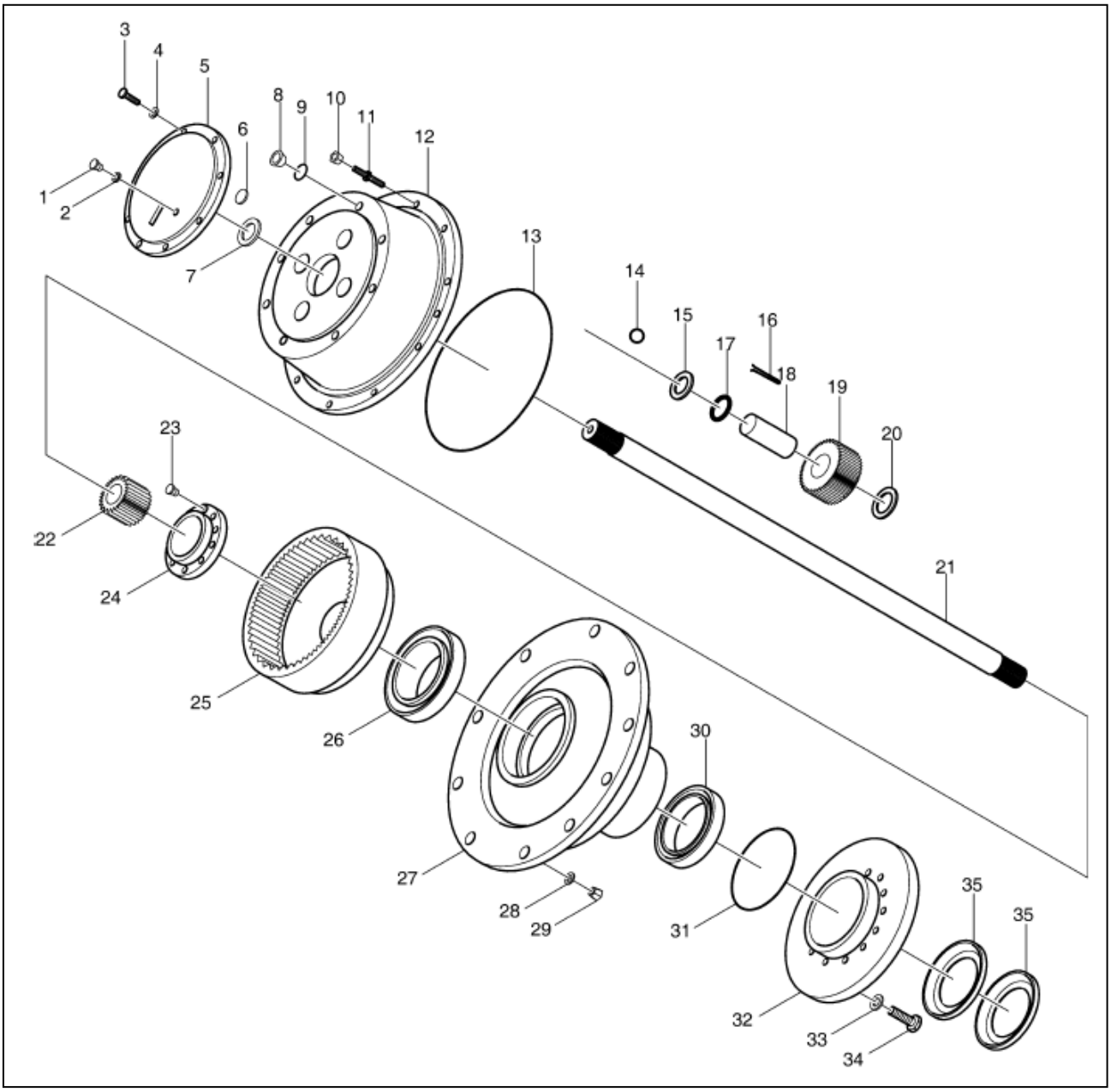


Figure 3

Reference Number	Description	Reference Number	Description
1	PLUG,SCREW	19	PLANET WHEEL
2	O-RING	20	PLANET WHEEL WASHER
3	BOLT M12X1.5-25	21	HALF SHAFT
4	SPACER 12	22	SUN WHEEL
5	COVER	23	SCREW M8X15
6	BLOCK	24	HOLDING NUT
7	RETAINER RING 48	25	INSIDE GEAR
8	PLUG,SCREW	26	BEARING 7521E
9	O-RING	27	HUB
10	HUB NUT	28	SPRING WASHER
11	HUB BOLT	29	NUT M18
12	SHELF,PLANET	30	BEARING 2007122E
13	O-RING SEAL	31	O-RING SEAL
14	STEEL BALL φ6	32	BRAKE DISC
15	PLANET WHEEL WASHER	33	WASHER 16
16	NEEDLE ROLLER 4×23.8	34	BOLT M16X45
17	SAPCER SLEEVE	35	SEAL ASSY,OIL
18	PLANET WHEEL SHAFT		

Brake assembly

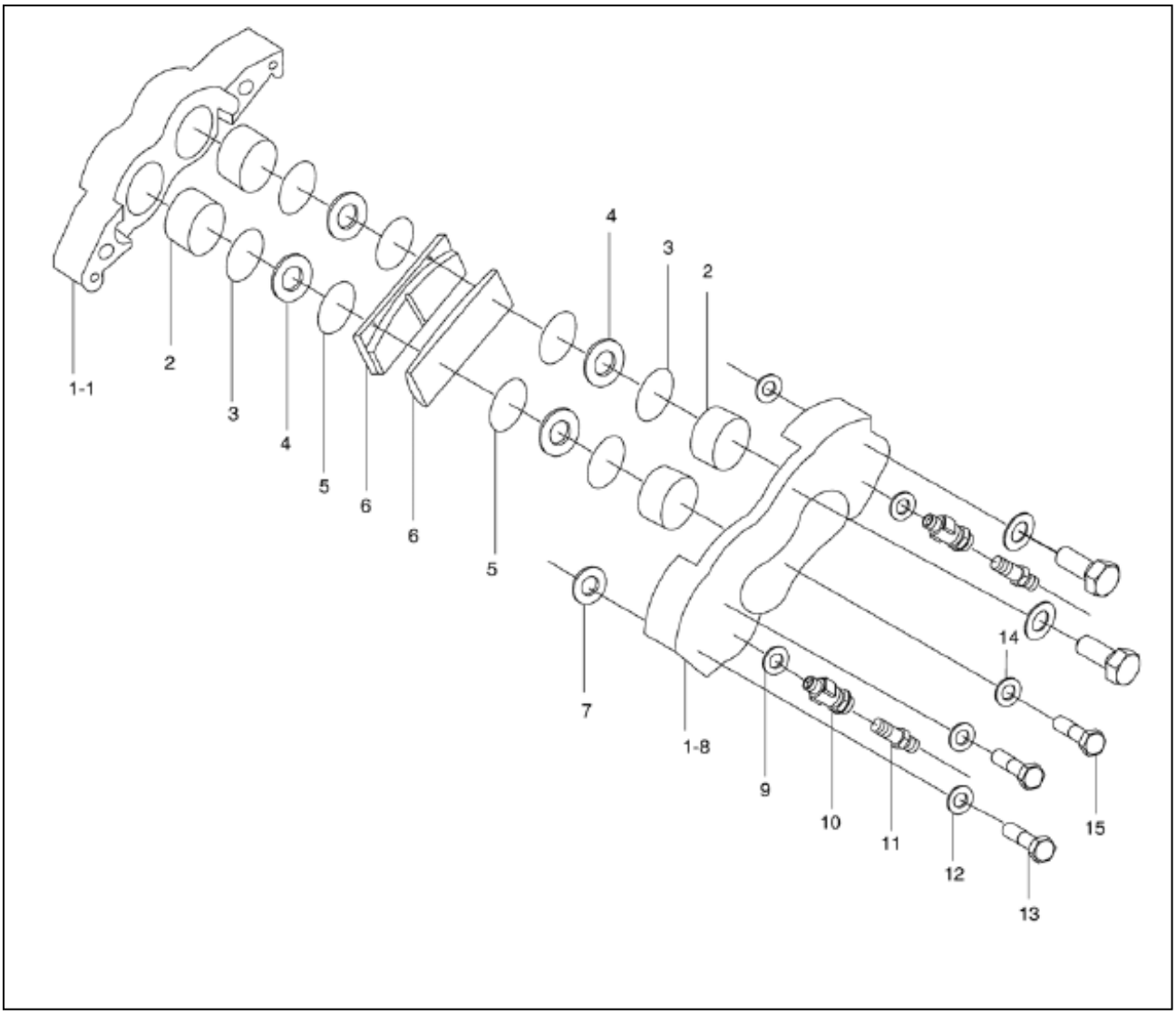


Figure 4

Reference Number	Description	Reference Number	Description
1-1	BRAKE,EXTERIOR	9	WASHER
1-8	BRAKE,INNER	10	CONNECTING
2	PISTON	11	DEFLATING VALVE
3	RECTANGULAR SEAL	12	SPACER 12
4	CASE,DUST	13	BOLT
5	BLOCK RING	14	WASHER SPRING 10
6	BRAKE DISK	15	PIN;BOLT
7	O-RING 20X2.4		

Main drive assembly

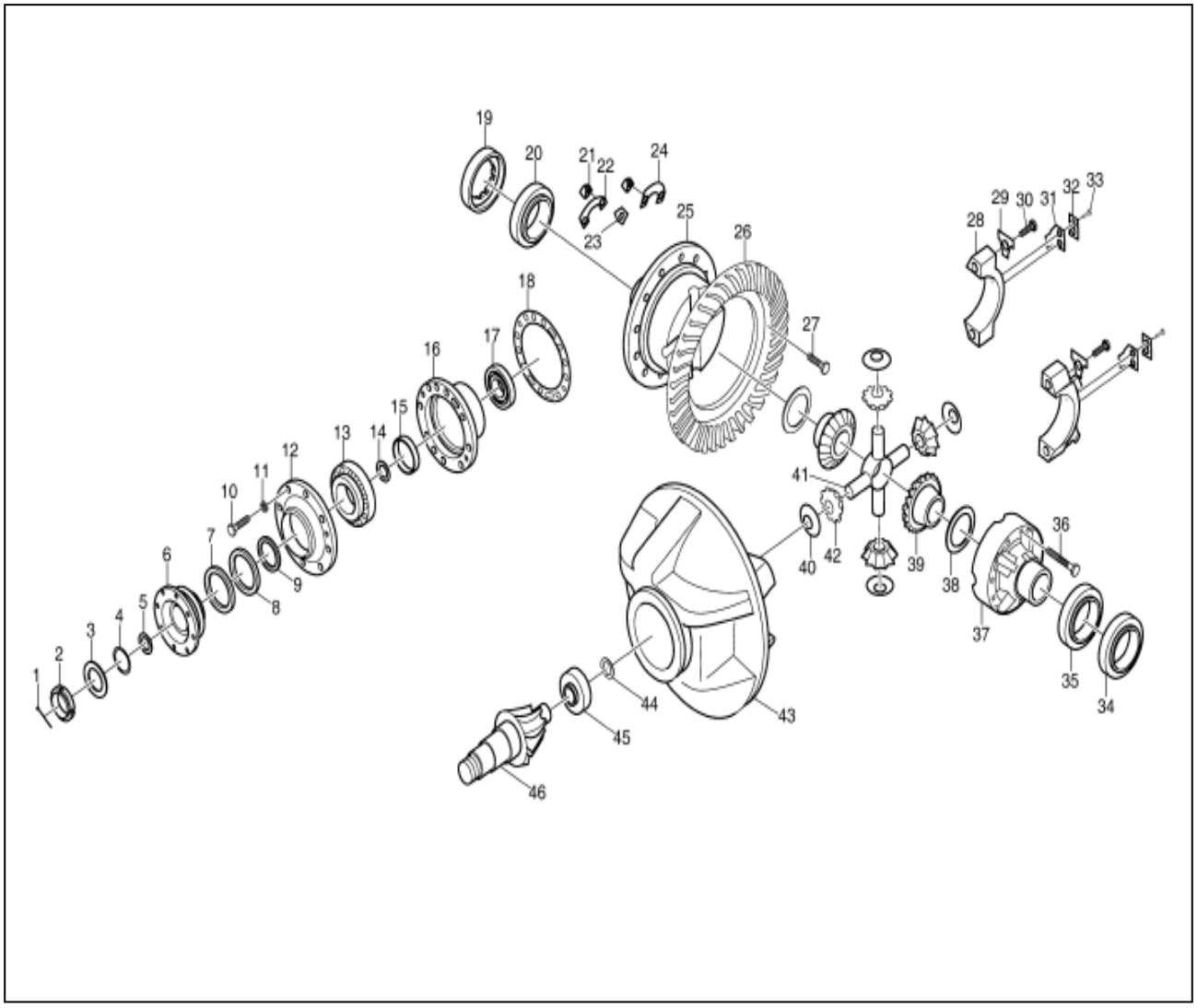


Figure 5

Reference Number	Description	Reference Number	Description
1	PIN 5X45	24	HOLDING PLATE
2	NUT M27×1.5-7H	25	DIFFERENTIAL SHELL –LEFT
3	WASHER	26	GEAR,BEVEL;DRIVE(REAR)
4	O-RING BAFFLE	28	DIFFERENTIAL BEARING COVER
5	O-RING SEAL 40X5.3	29	HOLDING PLATE
6	INPUT FLANGE GROUP	30	BOLT M18×90
7	OIL SEAL B62×93×6	31	HOLDING PLATE
8	OIL SEAL FB62×93×13	32	HOLDING PLATE
9	STOPPER WASHER	33	BOLT M8X12
10	BOLT M12×45-10.9	34	REGULATE NUT
11	SPACER 12	35	BEARING 7516E
12	OIL SEAL SEAT	36	BOLT M14X1.5
13	BEARING 27311E	37	DIFFERENTIAL SHELL – RIGHT
14	REGULATE WASHER	38	HALF SHAFT GEAR WASHER
15	SPACER SLEEVE	39	HALF SHAFT GEAR
16	BEARING SEAT	40	SUPPORT WASHER
17	BEARING 27311E	41	CROSS SHAFT
18	REGULATE WASHER	42	PLANET GEAR
19	REGULATE NUT	43	MAIN REDUCER SHELL
20	BEARING 7516E	44	RETAINER RING 30
21	NUT M14X1.5	45	BEARING 92606E
22	HOLDING PLATE	46	DRIVE GEAR;RIGHT
23	HOLDING PLATE		

SCHEDULED MAINTENANCE

Oil of new drive axle must be replaced after working for 15 days (about 100 working hours), oil shall be replaced once after working for every six months (about 1200 working hours) in following days.

Every month maintenance

1. Check abrasion condition of brake disc, if there is disruptive abrasion; please handle in time if there is any.
2. Check abrasion condition of brake block to guarantee separation and reunion of brake caliper is flexible; it shall be replaced in time when brake block is wearing close to abrasion line (at the bottom of groove).
3. Check if oil level of shell complies with requirements, please add new oil if the oil level descends.
4. Keep axle clean, keep vent pipe smooth, and avoid silt going into axle. Check loosening condition of all fasteners, especially rim nuts, if it is loosed, please refasten again.

Every half year maintenance

Lubrication oil in axle shall be replaced every half a year, different brands of lubrication oil shall be adopted for different areas and seasons. Please refer to 4.2 for oil replacing method.

Every year maintenance

Overhaul checking every working year:

1. Check the gap, mesh and abrasion condition of spiral bevel gear of main reducer.
2. Check abrasion condition of differential mechanism gear.
3. Check abrasion condition of hub gear.
4. Check abrasion condition of needle bearing of hub planetary gear.
5. Requirements of installation and debugging items after overhaul checking:
   1）After assembling, axle shaft gear and bevel gear shall move flexibly with hand touching rather than locking. The Min. gear backlash of gear is 0.18-0.23mm. Tooth length and tooth height of contacting area of two gears cannot be less than 50%.
   2）In order to guarantee enough bearing rigidity of active spiral gear, before assembling oil seal and sealing cover, adopt gradually reducing spacer shim between tapered roller bearing to give 1.0-1.5N.m preloaded torque to roller bearing.
   3）Gear backlash between the driving and driven spiral bevel gear is 0.25-0.45mm, the changing amount cannot be more than 0.15mm, gear backlash can be realized through adjusting nuts of both sides of differential mechanism and spacer shim of bearing sleeve. Tooth surface contacting area shall guarantee direction of tooth length and tooth height is not less than 50%, contacting position shall be at the middle side of tooth surface and closer to the smaller side.
   4）Adjusting of bearing clearance of shell at both sides of drive axle: Fasten adjusting nuts, give 28-38N.m preload to shell roller bearing, and then lock two round nuts with screw fastening.

GENERAL DISASSEMBLY AND REASSEMBLY

INSTRUCTIONS

⚠ WARNING!
Never use gasoline, solvents, or other flammable fluids to clean components. Only use approved commercial solvents that are nonflammable and nontoxic.

IMPORTANT
Use only GENUINE SPARE PARTS to warrant proper operations and prevent interchangeability problems.

GENERAL INSTRUCTIONS

1. Thoroughly clean and dry axle before disassembly.
2. All components should be thoroughly cleaned and dried before reassembly. Dirt, chips, and foreign material may cause failures.
3. All ducts and castings should be thoroughly cleaned and dried to remove dirt, chips, and foreign material to prevent damage after reassembly.
4. Reassembly should be done in a clean shop, and should be as dust free as possible.
5. Make sure tools and equipment are at hand.
6. When reassembling Daewoo strongly recommends to replace the following parts with new.
   - Seal Rings.
   - O-rings.
   - Gaskets.
   - Threaded rings with notched collar.
   - Any component damaged during disassembly.
7. When mounting heat fitted components, make sure of their proper position and direction of assembly, after they have cooled.
8. To heat bearings, use proper heating plates, piping, or suitable ovens.

NOTE: *Never heat parts by using a torch. Oil bath, heated by a torch, maybe used to warm components.*

9. Lubricate all sections concerned when reassembling shafts, bearings, etc.
10. Lubricate O-rings before installing them in relevant seats to prevent kinking during assembly, such a position would impair proper sealing.
11. Replace gears only in matched sets to make sure of proper tooth mating.

AXLE DISASSEMBLY

1 Drive axle disassembly

1. Put drive axle on supporting and make sure main driver assembly is upward.

Figure 6

2. Dismantle brake caliper assembly

   Loosen the connection bolts between brake caliper and brake caliper support, dismantle brake caliper assemble.

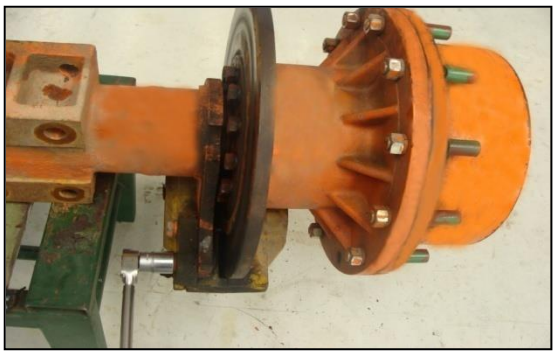


Figure 7

3. Release gear oil from planet carrier

   Loosen hub oil releasing drain plug and shell oil releasing drain plug, turn on slowly with hands to avoid oil spilling.

   Note： *Store gear oil with clean container.*

Figure 8

4. Release gear oil from shell

Turn on oil releasing bolts axle end cap to release gear oil.

Note： *Store gear oil with clean container.*

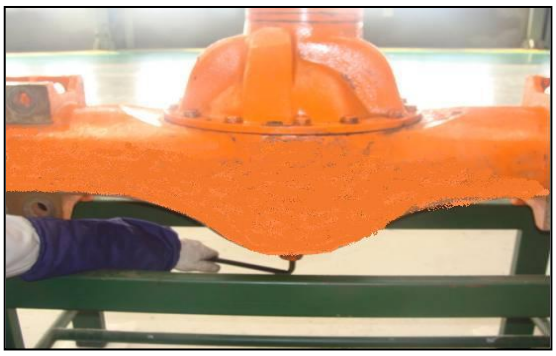


Figure 9

5. Open end cap

Loosen connection bolts between planet carrier and end cap, then get end cap from hub reducer assembly with jackscrew, dismantle end cap.

Figure 10

6. Dismantle locating block

Take down locating block with hands.

Note： *If it is tight when taking down, please use assistant tools to pry out.*

Figure 11

7. Dismantle stop collar

Dismantle stop collar from semiaxis with stop collar pincers.

Note： *Before dismantling stop collar, pull out a section of semiaxis from shell.*

Note： *It must clamp firmly when using stop collar pincers to avoid safety hazard when it is popup.*

Figure 12

8. Dismantle sun gear

Dismantle semiaxis from sun gear.。

Figure 13

9. Dismantle locating block

Dismantle locating block from semi axle with hands.

Figure 14

10. Dismantle semiaxis

Take semiaxis from shell slightly.

Figure 15

11. Hub reducer

First loosen rim bolts with relative tools, then loosen rim from planet carrier with jackscrew and dismantle planet carrier assembly.

Note: *Please slowly loosen planet carrier to avoid safety hazard resulted from dropping of planet carrier assembly.*

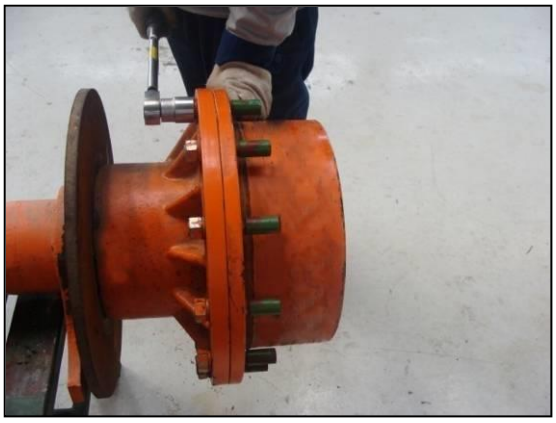


Figure 16

12. Dismantle round bolts

Dismantle round bolts.

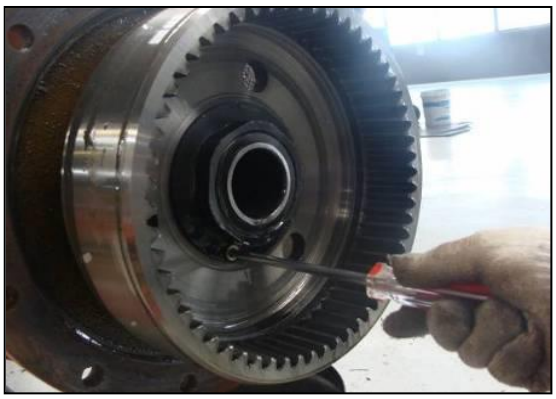


Figure 17

13. Dismantle round nuts

Dismantle round nuts.

Figure 18

14. Dismantle internal gear

Take internal gear out by slightly rocking.

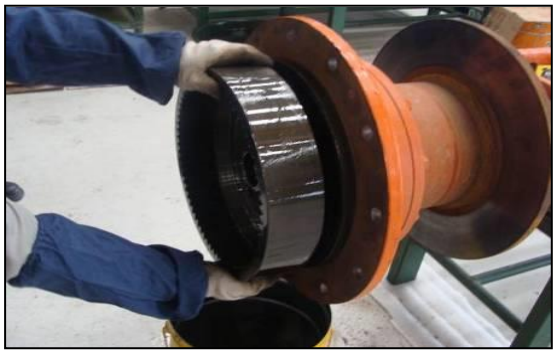


Figure 19

15. Dismantle rolling bearing

Take out rolling bearing with special dismantling tool.

Figure 20

16. Dismantle wheel hub assembly

Take wheel hub assembly from supporting axle.

Note：*During hanging and dismantling process, please keep axis of wheel hub assembly is in line with axis of hub reduction supporting axle to avoid scratching oil surface and internal spare parts during dismantling process.*

Remark: dismantle all parts at the other side of drive axle with the same methods.

Figure 21

17. Dismantle of main drive assembly

Dismantle connection bolts between main drive and shell assembly, take out main drive with jackscrew, and suspend main drive assembly.

Note：*When suspending main drive assembly, guarantee suspending and dismantling tools are at the above of main drive assembly to avoid spare parts inside are knocked again during suspending and dismantling process.*

Figure 22

2. Assembly dismantling

2.1 Dismantle planet carrier assembly

1. O ring

Take out O ring.

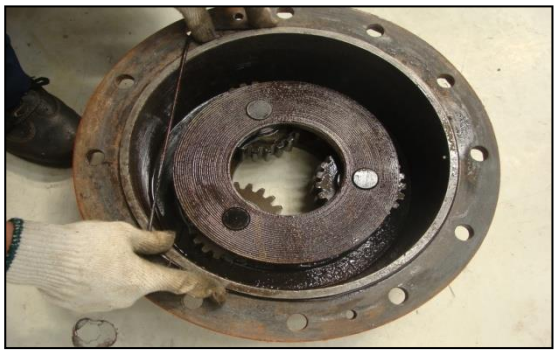


Figure 23

2. Put planet carrier on working platform horizontally.

Figure 24

3. Take out planet axle with tools.

Figure 25

4. Take out steel balls.

Figure 26

5. Take out planet wheel.

Figure 27

6. Take out baffle ring and quill roller from inside of planet wheel.

Figure 28

2.2 Dismantle hub assembly

1. Put hub assembly on working platform, loosen connection bolts between brake disc and hub.

Figure 29

2. Take out brake disc.

Figure 30

3. Take out bearing.

Figure 31

4. Take out oil seal.

Figure 32

2.3 Dismantle main drive assembly

1. Put main drive assembly (input flange upward) horizontally and fixed on supporting.

Figure 33

2. Dismantle locknut gasket, O ring and baffle ring.

Figure 34

3. Take out input flange.

Figure 35

4. Dismantle connection bolts between sealing cover and bearing sleeve, take out sealing cover.

Figure 36

5. Turn main drive for 180°, dismantle bolts fastening locking plate, take out locking plate.

Note： *Some of the machine structure may be different from this figure, please adjust working content according to actual structure.*

Figure 37

6. Dismantle connection bolts of bearing seat and take out bearing seat.

Figure 38

7. Dismantle adjusting nuts.

Figure 39

8. Dismantle bearing outer ring.

Figure 40

9. Hang out differential mechanism assembly.

Note：*Keep balance when hanging out to avoid safety hazard.*

Figure 41

10. Separate active spiral bevel gear assembly and bracket with jackscrew.

Figure 42

2.4 Dismantle differential assembly

1. Put differential assembly vertically on working platform, and guarantee it is stable.

Figure 43

2. Dismantle bearing on left and right shell of differential mechanism.

Figure 44

3. Loosen connection nuts between driven spiral bevel gear and right shell of differential mechanism, dismantle driven spiral bevel gear.

Note：*Before taking out driven spiral bevel gear, please check or mark assembling sign first so that it can be placed back to the original position.*

Figure 45

4. Loosen connection nuts of left and right shell, separate left and right shell of differential mechanism.

Note：*Before separating left and right shell of differential mechanism, please check or mark assembling sigh first so that it can be placed back to the original position.*

Figure 46

5. Take out semiaxis gear gasket and semiaxis gear.

Figure 47

6. Take out joint cross and differential gear together, take out differential gear gasket and gear from joint cross.

Figure 48

7. Take out semiaxis gear gasket and gear.

Figure 49

2.5 Dismantle active spiral bevel gear assembly

1. Put active spiral bevel gear assembly on working platform, support flange of bearing sleeve, clamp down on thread end of active spiral bevel gear assembly with down device.

   Note： *Do not clamp too much to avoid damaging flange, pull out bearing sleeve from active spiral bevel gear assembly.*

Figure 50

2. Reverse bevel gear assembly and take out bearing.

Figure 51

3. Take out bearing sleeve.

Figure 52

4. Take out adjusting gasket.

Figure 53

5. Take out spacer bush.

Figure 54

AXLE REASSEMBLY

1. Axle assembly

1. Shell

Clean shell and suspend with special supporting.

Fasten gummed plug screw at oil inlet and oil filler.

Note：*Plug screw fastening torque：280～330Nm*

Note：*Loctite 262 taper thread sealant.*

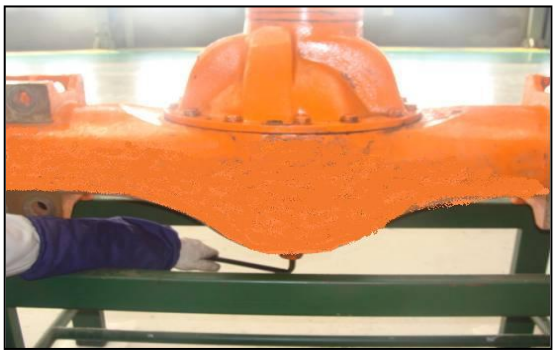


Figure 55

2. Wheel hub assembly

Coat lubrication grease on hub supporting axle of shell assembly; assemble wheel hub assembly on both sides of supporting axle of shell assembly.

Note： *Use lubrication oil.*

Figure 56

3. Rolling bearing

Assemble rolling bearing on hub supporting axle.

Figure57

4. Internal gear

Assemble internal gear of drive axle at multiple splines at the end of supporting bearing.

Figure 58

5. Round nuts

Assemble round nuts and fasten. Knock internal gear slightly with copper stick to make internal gear in place.

Figure 59

6. Assemble round bolts

1) Grapple the hole on wheel hub with push and pull ergometer, pull ergometer along with tangential direction, indication on ergometer is 160±10N, if the indication is not within the range of 160±10N, adjust tightness degree of round bolts according to the indication until it is within the range of 160±10N. In the end, coat Loctite 262 thread fastening sealant for 5~6 from the second thread hole of internal gear (form a liquid level at 1/3 circle of thread), then fasten bolts, and fix round nuts.

2) Before dynamometry, rotate hub wheel for more than 5 times.

Note：*Loctite 262 thread fastening sealant*

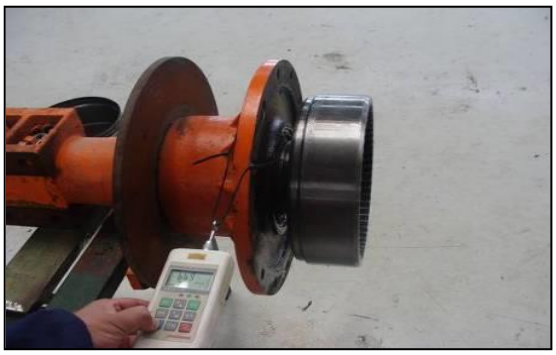


Figure 60

Figure 61

7. Assemble O sealing ring

Assemble O sealing ring on hub assemble.

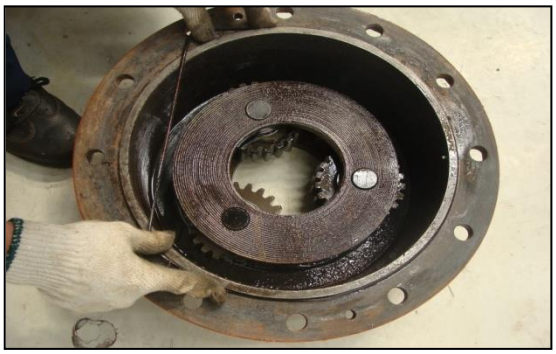


Figure 62

8. Planet carrier assembly

Assemble planet carrier assembly on wheel hub with rim bolts, gaskets and nuts.

Note：*Fastening torque：540～650Nm*

Figure 63

9. Assemble semiaxis

Assemble semiaxis in wheel hub.

Figure 64

10. Assemble sun gear

Assemble sun gear at one side of semiaxis with baffle ring groove (pay Note to semiaxis multiple spline and gear assembly).

Figure 65

11. Assemble baffle ring

Assemble baffle ring with baffle ring used for axle.

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard when it is popping out during assembling process.*

Figure 66

12. Assemble locating block

Stake steel ball on locating block, it can rotate flexibly after staking steel ball.

Figure 67

13. Assemble end cap

Coat Loctite 262 thread fastening sealant on screws, location of sealant is 15mm on top of thread end. Fasten cap with bolts and gaskets.

Note：*Fasten all screws according to symmetrical and crossing principle.*

Note：*Fastening torque：110～130Nm*

Note：*Loctite 262 thread fastening sealant*

Figure 68

14. Assemble brake caliper assembly

Assemble disc brake on brake caliper supporting, fix with bolts and gaskets.

Note：*Fastening torque：540～650Nm*

Note：*Coat Loctite 262 thread fastening sealant at 20mm length at thread end during assembling.*

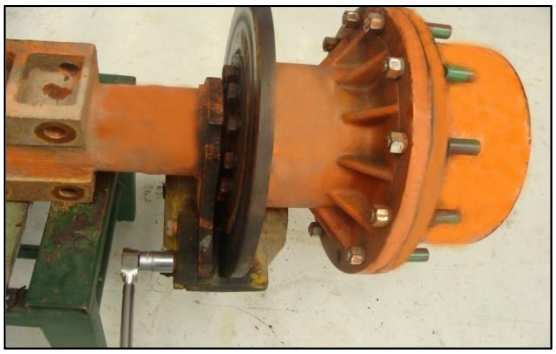


Figure 69

15. Assemble main drive assembly

Coat Loctite 598 silicon rubber surface sealant at the joint surface between shell and bracket, coatφ3～φ6 glue saluting ring with sealing surrounding inside of thread hole at the large end of shell. The coated sealant cannot be in the air for more than ten minutes.

Note：*Loctite 598 silicon rubber surface sealant*

Figure 70

16. Assemble main drive

Hand up main drive assembly with overhead crane, put main drive at main drive shell of the axle, assemble locating pin.

Figure 71

17. Assemble bolts

Coat proper Loctite 262 threat fastening sealant on bolts, the coating position is 15mm length at thread end. Fasten main drive assembly and shell assembly with bolts and gaskets.

Note：*Fastening torque：110～130Nm*

Note：*Loctite 262 threat fastening sealant*

Note：*Fasten all screws according to symmetrical and crossing principle.*

Figure 72

18. Add oil

Add 10L 85W/90 GL-5 gear oil (GB13895-1992) in axle bag of shell and fasten plug screws.

Note：*Use 85W/90 GL-5 gear oil*

Note：*Anaerobic type pipe threat sealant*

Note：*Fastening torque：280～330Nm*

Figure 73

Figure 74

2 Assembly parts assembling

2.1 Install hub assembly

1. Keep the large end of hub upward, assemble bearing outer ring and turn over to keep the small end of hub upward and assemble bearing inner ring.

Figure 75

2． Coat lubrication oil at oil seal end, check completeness of oil seal, coat lubrication oil in groove of oil seal evenly, and assemble oil seal in side of oil seal end.

Figure 76

3. Assemble brake disc on hub and fasten with bolts and gaskets.

Note: *Fastening torque：280～330Nm*

Note： *Fasten all screws according to symmetrical and crossing principle.*

Figure 77

2.2 Install planet carrier assembly

1. Stick lubrication grease quill roller (27 units each) on walls of inner holes of planet gears, assemble baffle ring in the middle of quill roller, assemble gaskets at both sides of planet gear, then assemble to the seat hole of planet carrier.

Figure 78

2. Assemble steel balls in holes of planet gear shaft, steel ball shall aim at semi circle of planet carrier, go through the inner hole of planet gear and gasket and assemble on planet carrier. After assembly, planet gear shall rotate flexibly there is no blocking.

Figure 79

2.3 Assemble of main drive assembly

1. Assemble rolling bearing on bear neck of the terminal with pressure machine, rotate to the left on active spiral bevel gear front axle, and rotate to the right side.

Figure 80

2. Press inner ring into rolling bearing with pressure machine at the other side

Figure 81

3. Turn over gear and assemble outer ring of gear,

Figure 82

4. Install spacer bush

Figure 83

5. Assemble gasket

Figure 84

6. Assemble bearing sleeve

Figure 85

7. Press inner ring of antifriction bearing in the end.

Note: when assembling main reducer, taper rolling bearing shall have certain tightness, that is on the basis of eliminating bearing clearance, and give certain preload. The purpose is to reduce axial force caused during transmission process which will result in axial displacement, improve supporting rigidity, and guarantee normal mesh of bevel gear pair. But if it is too tight, it will accelerate abrasion of taper rolling bearing. Press with P= 5420 kg pressure at the top side of inner ring of rolling bearing, grapple Φ14.5 hole with pull and push ergometer, pull ergometer along with tangential direction, indication of ergometer when pushing shall be 17.34-30.06N, if the indication is not within the range of 17.34-30.06N, increase or reduce thickness of spacer shim, repeat the above process until the indication is within 17.34-30.06 N.

Figure 86

Figure 87

2.4 Assemble of differential assembly

1. Assemble rolling bearing at the bearing position of right shell terminal of differential mechanism.

Figure 88

2. Assemble rolling bearing at the bearing position of left shell terminal of differential mechanism.

Figure 89

3. Assemble semiaxis gear

   Assemble semiaxis gear gasket in left shell of differential mechanism

   Note：*The side of gasket with groove shall toward to the direction of joint cross*

Figure 90

4. Assemble semiaxis gear

Figure 91

4. Assemble joint cross assembly

Assemble bevel gear (internal of small terminal) and bevel gear gasket on four axles of joint cross.

Note：*Lubricate with grease when assembling bevel gear and bevel gear gasket*

Note：*Lubricate lubrication oil*

Figure 92

6. Differential mechanism shell

Assemble joint cross in right shell of differential mechanism to make bevel gear and semiaxis gear mesh, turn over left shell assembly of differential mechanism to assemble right shell assembly of differential mechanism, join right shell and left shells of differential mechanism with bolts and fasten with gaskets and nuts.

Figure 93

Note：*Nuts tightening torque180～210Nm*

Note：*1) Guarantee assembling mark of right shell and left shell of differential mechanism align.*

2) Coat proper Loctite 262 thread fastening sealant at the thread bottom within 12mm length.

3) After assembling, semiaxis gear and taper gear can be rotated manually without blocking.

Figure 94

7. Assemble driven spiral bevel gear

Aim at assembling mark, fasten driven spiral bevel gear (rotate to the left for rear axle, rotate to the right for front axle) with bolts, gaskets and nuts, and fasten screws.

Figure 95

Note：*Nuts fastening torque 180～210Nm。*

Note：*1) Coat proper Loctite 262 thread fastening sealant at the thread bottom within 12mm length.*

2) Judging method of left and right spiral: Face to positive side of gear, right rotation refers to the spiral gear rotates to large terminal clockwise; on the contrary, left rotation refers to the spiral gear rotates to large terminal anticlockwise.

2.5 Assemble main reducer

1. Install the assembled active spiral bevel gear assembly in bracket, coat sealant line with diameter 2-4mm at the small end, refer to the picture for sealant line; sealant line and diameter of bearing sleeve (the other side of gasket) shall be done according to the above requirements.

Figure 96

2. Assemble sealing cover

Press oil seal in sealing cover.

Figure 97

Note：*Coat a layer of proper lubrication oil when assembling oil seal.*

3. Install input flange

Put gasket on the end face of bracket, install sealing cover assembly (coat lubrication grease on oil seal according to common requirements of drive axle), and connect with bracket with bolts and gaskets.

Note： *Screw fastening torque 110～130Nm.*

Figure 98

4. Install input flange.

Figure 99

5. Install baffle ring, O ring, coat sealant on one end face of gasket, the surface with sealant is downward, install gasket.

Note： *Coat Loctite 598 sealant*

Figure 100

6. Install gasket

Figure 101

7. Install round screws and fasten.

Note： *Screw fastening torque: 320～400Nm 。*

Note： *Before installing flange, install flange on multiple spline on main spiral bevel gear, measure radial play eccentricity of flange, guarantee it cannot be more than 0.08, and mark matching and assembling signs. If it is out of tolerance, rotate flange to certain angle and measure until it complies with requirements, otherwise, replace flange.*

Figure 102

8. Gasket shall be close to φ2～φ3 glue line.

9. Install differential assembly

Turnover carrier, install differential assembly in bracket.

Figure 103

10. Install bearing seat with gaskets and bolts (bolts shall be a little bit tight).

Figure 104

11. Install adjusting nuts.

Note： *Two bearing seats cannot be exchanged.*

12. Coat proper thread sealant on the length of 15～25mm on thread end surface of bolts.

Note： *Coat Loctite 262 thread fastening sealant.*

Figure 105

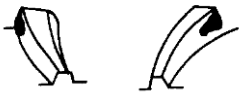
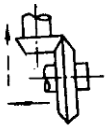
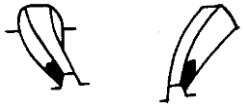
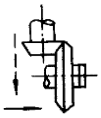
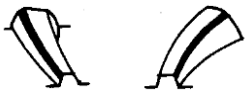
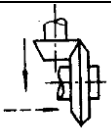
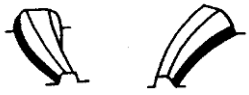
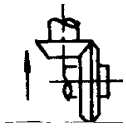
13. Adjust spiral bevel gear

Figure106

Adjustment of spiral bevel gear mesh condition refers to adjustment of mesh zone and back lash, when adjusting back lash of spiral bevel gear pair, dial gauge can be used to touch the gear surface of large side edge of driven spiral bevel gear, then rotate driven spiral bevel gear to measure back lash directly, the clearance shall be 0.2～0.35mm. Adjusting method of back mesh is to twist adjusting nuts to change position of driven spiral bevel gear (when it is necessary, move active spiral bevel gear assembly to adjust). If the clearance is larger than the regulated value, approach active spiral bevel gear from driven spiral bevel gear; otherwise be away from it. In order to keep the adjusted preload of taper rolling bearing of differential mechanism, twisting numbers of adjusting nuts at one side shall be equal to twisting numbers of adjusting nuts at the other side.

When adjusting contact zone of spiral bevel gear pair, coat red color (red lead powder) on driven spiral bevel gear teeth (coat three teeth usually), rotate driven spiral bevel gear with hands repeatedly, check contacting moulage. Adjust the correct position of spiral bevel gear mesh moulage: it shall not be less than 50% along with teeth height direction and teeth length direction, mesh moulage of driven bevel gear shall be close to the center, and in the middle of teeth height, smaller than the small end on teeth length direction. Increasing preload of differential bearing: after adjusting back lash of spiral bevel gear well, it shall guarantee the clearance between taper rolling bearings at both sides of differential mechanism is 0. Following is the adjusting methods.

Adjustment of contact zone and back lash when installing spiral bevel gear

Contact zone of driven spiral bevel gear	Adjusting method	Gear moving direction
	Move driven gear to the direction of active gear, if the clearance is too small, move active gear outside	
	Move driven gear away from active gear, if the clearance is too large, move active gear inside	
	Move active gear to the direction of driven gear, if the clearance is too small, move driven gear inside and outside	
	Move active gear away from driven gear, if clearance is too large, move driven gear inside	

Method of adjusting mesh zone is usually increasing and decreasing adjusting gaskets and rotating adjusting nuts. Adjusting of contact zone will affect performance and service life greatly, it shall be carried out carefully.

Note： *After adjusting, clean off red lead powder.*

14. Install locking plate

Fasten the fixed bolts on bearing seat, fastening torque is 380～450Nm. Put locking plate at the right position, fix it on bearing seat with bolts and gaskets, and fasten fixing bolts of locking plate.

Figure 107

Note： *Fastening torque 30～36Nm*

Note: *Coat proper Loctite 262 thread fastening sealant on 5-10mm length at the end surface of fixing bolt.*

Note： *Coat Loctite 262 thread fastening sealant*

Transmission and Torque Converter

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

TABLE OF CONTENTS

Brief Introduction

Structure of transmission

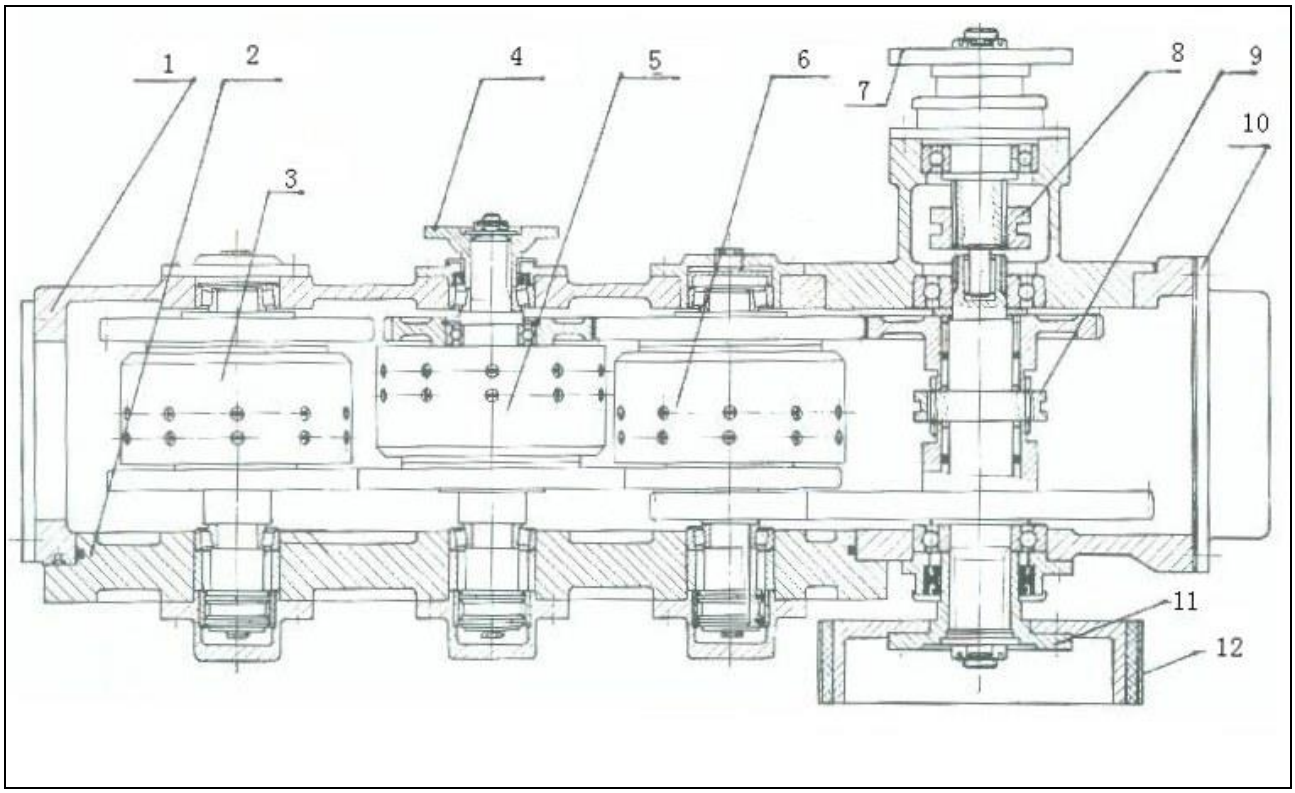


Figure 1

Reference Number	Description	Reference Number	Description
1	Transmission housing	7	Rear output Flange
2	Cover	8	Release Sliding sleeve
3	Rear shaft ass'y	9	Gear ring
4	Input shaft flange	10	Oil sump
5	Input shaft ass'y	11	Front output flange
6	Mid shaft ass'y	12	Parking break

Basic parameters of transmission

Model of bivariant assembly	ZL30 T/M
Applicable model	SD200 Wheel Loader
Hydraulic torque converter type	Single Stage, Four Part, Two turbo T/M
Max. input rotate speed	2500 r/min
Max. input torque	650 Nm
Max. input power	74 kW
Torque ratio	3.0~3.6
Type of oil cooling	Cooling Water Circulating
Working pressure	1.1~1.5MPa
Gearbox type	Dead Axle, Constant Mesh Gear, Shifting fork
Gears	Four Front Gears and Two Rear Gears
I gear ratio	3.82
II gear ratio	2.08
III gear ratio	1.09
IV gear ratio	0.59
I reverse gear ratio	3.05
II reverse gear ratio	0.87
Gear box oil	6#Fluid Drive Oil
Allowable oil temperature at the bottom of oil pan	100℃
Manipulate pressure of brake safety valve	>0.55MPa

Transmission principle

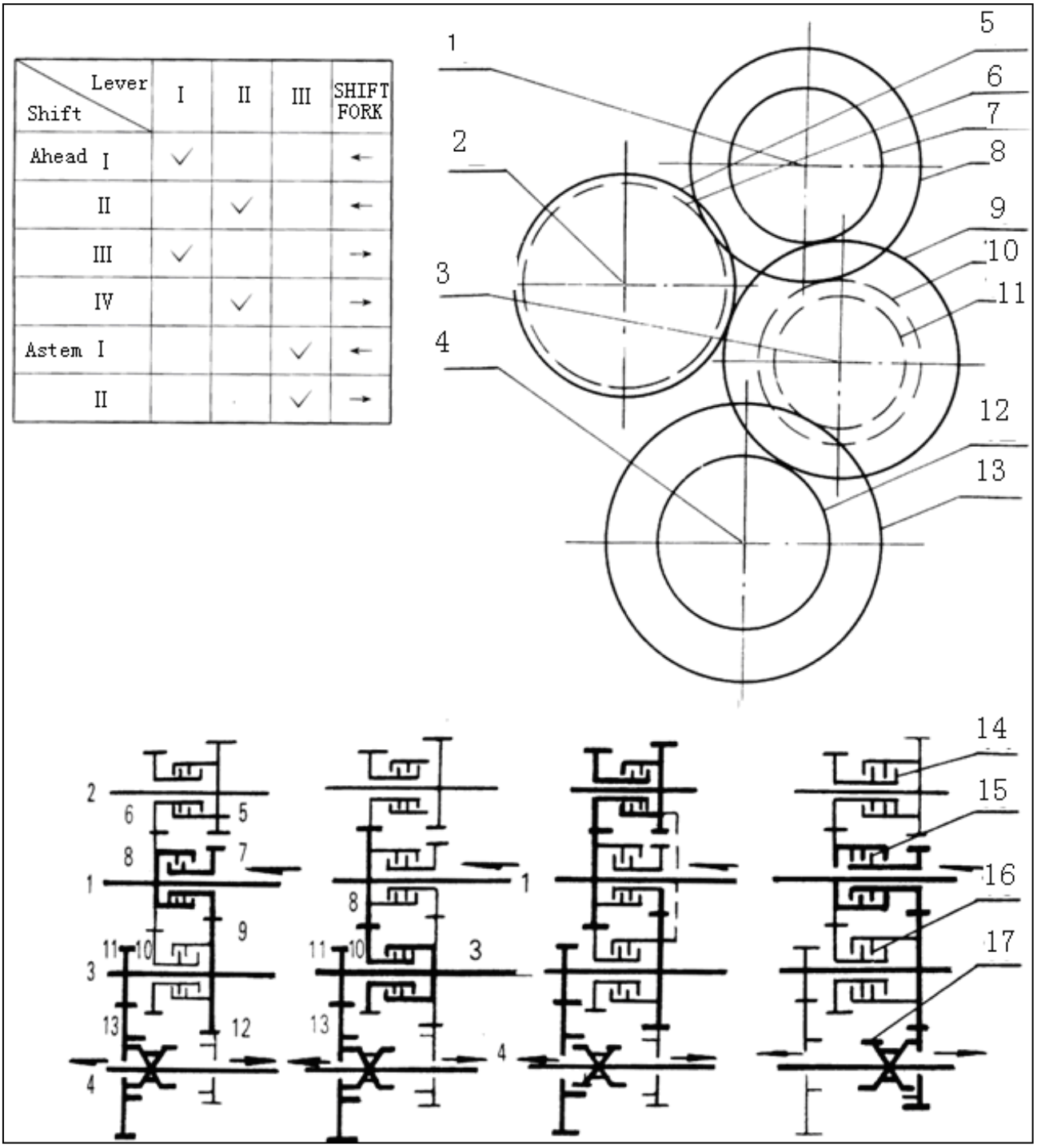


Figure 2

Working principle of torque converter

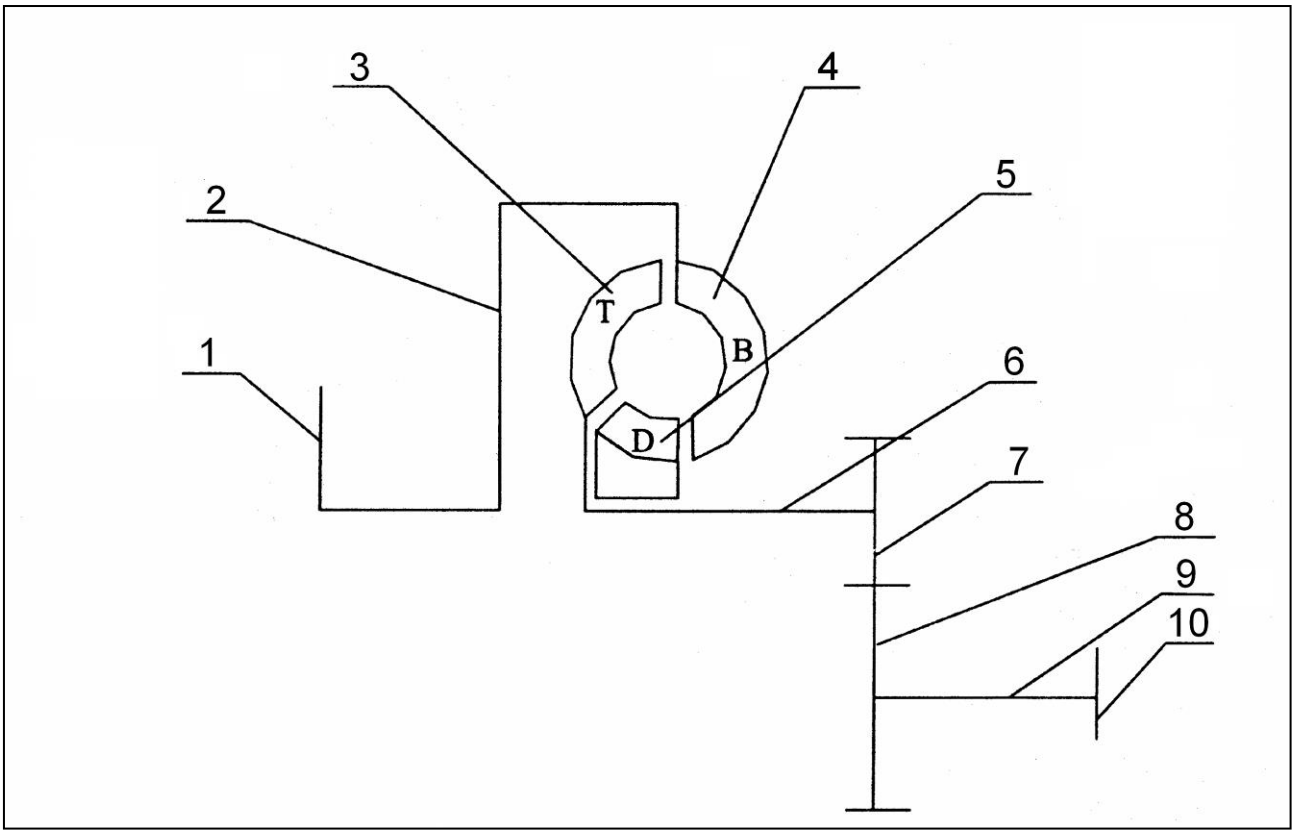


Figure 3

Reference Number	Description	Reference Number	Description
1	Spring plate	6	Turbine shaft
2	Turbine cover	7	Output initiative gear
3	turbine	8	Output driven gear
4	Pump pulley	9	Output shaft
5	guide pulley	10	Output flange

Disassembly of transmission

Disassembly of transmission assembly

1. Put transmission horizontally on working platform with oil pan upward.

Figure 4

2. Dismantle oil pan

   Use relative tools (such as sleeve, open spanner, same with following conditions, and will not state again). Loosen fixed bolts on oil pan, and dismantle oil pan.

Figure 5

3. Dismantle fixing block of oil pan

   Knock out with tools and take out fixing block.

Figure 6

4. Dismantle shifting fork

   Twist fixed blots and take out shifting fork.

Figure 7

5. Dismantle supporting seat of tie bar of shifting fork twist fixed bolts, take out supporting seat.

Figure 8

6. Turn over transmission, make the side with brake caliper upward, dismantle end cap and twist fixed bolts, take out end cap.

Figure 9

7. Dismantle speed change valve
Twist fixed bolts and get out speed change valve.

Figure 10

8. Take out clutch end cap of the first and the third gear twist fixed bolts and take out end cap.

Figure 11

9. Take out brake caliper assembly

Twist fixed bolts and take out brake caliper assembly.

Figure 12

10. Take out fixed plate, sealing ring and cover plate of front output flange, then take out front output flange.

Figure 13

11. Overturn transmission; take out screw fixing plate, sealing ring and cover plate of front output flange, then take out output flange.

Figure 14

12. Take out output flange end cap

Twist fixed bolts and take out end cap.

Figure 15

13. Take down bearing

Take down bearing with special tool.

Figure 16

14. Take down spacer bush.

Figure 17

15. Take down high speed gear.

Figure 18

16. Take down sliding tooth set

Figure 19

17. Take out output axle

Knock out output axle with tools and take out.

Figure 20

18. Take out low speed gear

Figure 21

19. Take out bearing

Knock out bearing with tools and take out.

Figure 22

20. Take out adjusting screws of the II gear, the IV gear and reverse gear.

Figure 23

21. Take out nuts, gaskets and flange of input axle

Figure 24

22. Take out end cap.

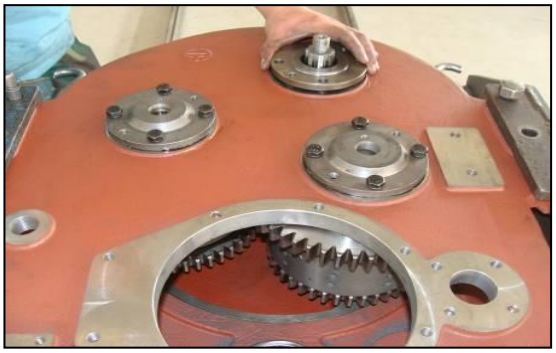


Figure 25

23. Overturn transmission; twist fixed bolts of the cover

Figure 26

24. Take out clutch end cap of the second gear, the fourth gear and reverse gear.
Twist fixed bolts and take out end cap.

Figure 27

25. Take out sealing ring of each clutch

Figure 28

26. Take out end cap of transmission.
    Twist fixed bolts and take out end cap.

Figure 29

27. Take out clutch of the first and the third gear, the second and the fourth gear and reverse gear.

Figure 30

28. Take out fixed set of brake caliper
    Twist fixed bolts and take out fixed seat.

Figure 31

29. Take out end cap of output axle

Twist fixed bolts and take out end cap.

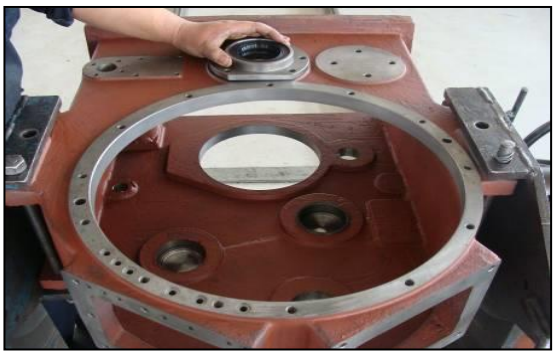


Figure 32

30. Take out bearing of output axle.

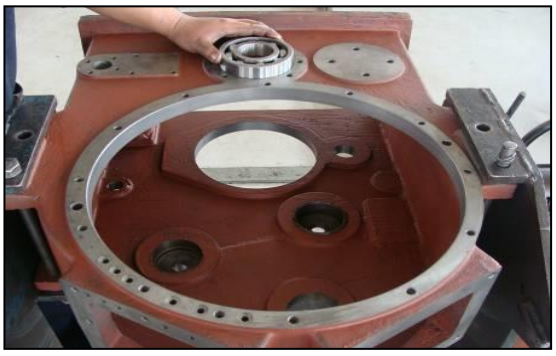


Figure 33

31. Take out sleeve of clutch.

Figure 34

32. Overturn transmission; take out clutch end cap of the second and the fourth gear and reverse gear.

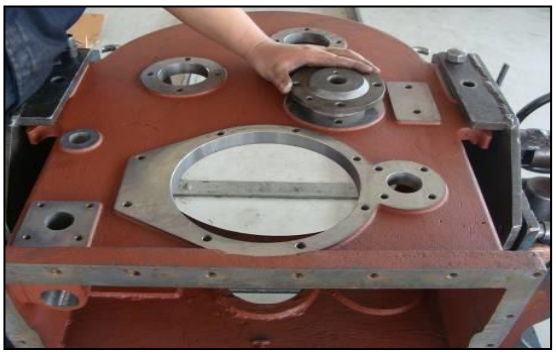


Figure 35

Assembly parts dismantling

Disassembling of torque converter assembly

1. Put torque converter on work platform horizontally.

Figure 36

2. Dismantle fixed plate of spring plate.
   Twist fixed bolts, take out fixed plate.

Figure 37

3. Dismantle elastic plate.

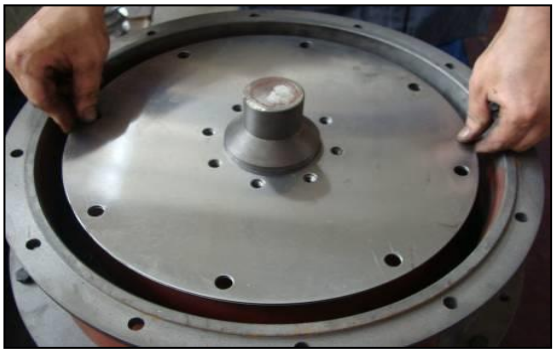


Figure 38

4. Dismantle cover wheel
   Twist fixed bolts and take out cover wheel.

Figure 39

5. Dismantle baffle ring

Note：*It must be clamped reliably when using baffle ring pincer to avoid safety hazard.*

Figure 40

6. Dismantle turbine shell

Figure 41

7. Take out sealing ring

Figure 42

8. Take out baffle ring

Note：*It must be clamped reliably when using baffle ring pincer to avoid safety hazard.*

Figure 43

9. Take out guide wheel

Figure 44

10. Take out pump pulley

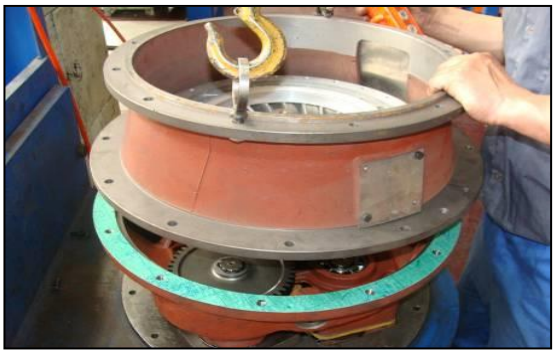


Figure 45

11. Take out gear baffle ring

Note: *It must be clamped reliably when using baffle ring pincer to avoid safety hazard.*

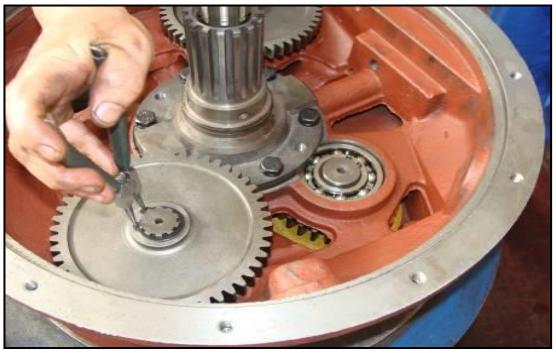


Figure 46

12. Take out gear

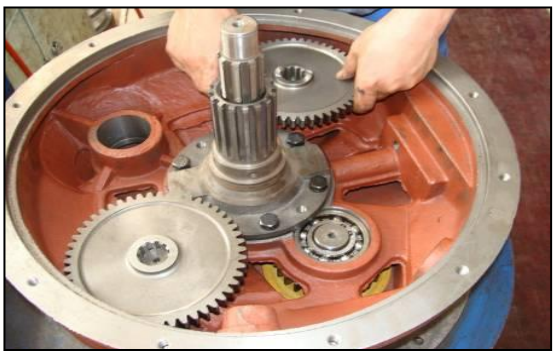


Figure 47

13. Take out guide wheel seat

Figure 48

14. Take out bearing

Figure 49

15. Overturn torque converter and take out flange.
    Twist bolts and take out flange.

Figure 50

16. Take out all output axles.

Figure 51

17. Take out baffle ring and shaft sleeve.

Figure 52

18. Take out bearings

Figure 53

19. Take out output flange

    Twist fixed bolts and take out flange.

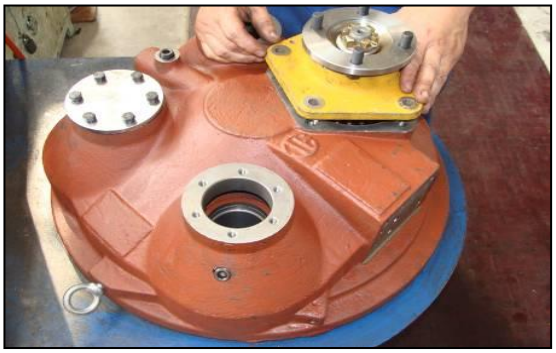


Figure 54

20. Take out sealing end cap.

Figure 55

Assembling of transmission

Assembling of transmission assembly

1. Put transmission shell on work platform horizontally.

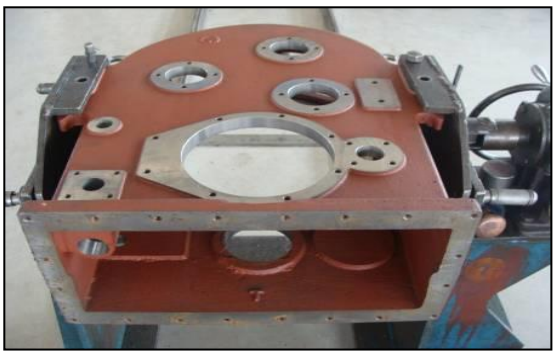


Figure 56

2. Install clutch end cap of reverse gear and the II and the IV gear

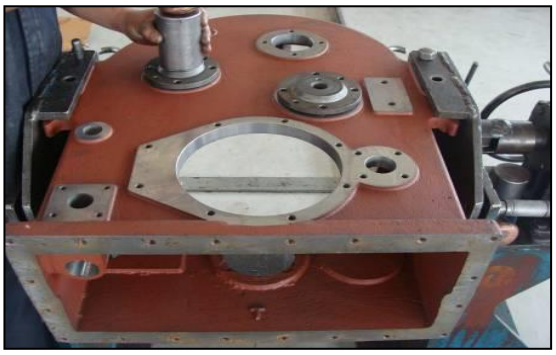


Figure 57

3. Overturn shell and put on work platform horizontally.

Figure 58

4. Install end cap spacer bush of reverse gear and the second and fourth gear.

Figure 59

5. Install output axle bearing.

Figure 60

6. Install output flange.

Note：*45～59Nm*

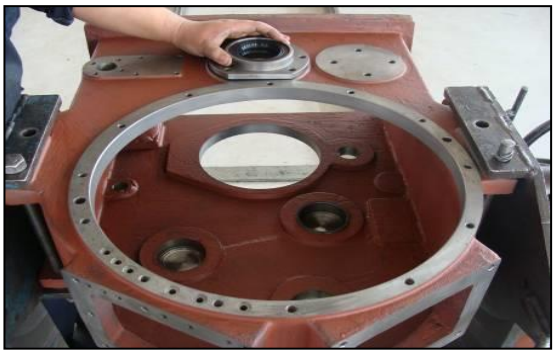


Figure 61

7. Install fixed supporting seat of hand brake disc.

Note：*Bolts fastening torque 45～59Nm*

Figure 62

5. Install bearing sleeve of the second and fourth gear.

Figure 63

9. Install clutch of the II and IV gear.

Figure 64

10. Install reverse gear bearing sleeve and reverse gear clutch.

Figure 65

11. Install bearing sleeve of the first and third gear and clutch of the first and third gear.

Figure 66

12. Install sealing ring of transmission end cap.

Figure67

13. Install end cap.

Note： *Bolts fastening torque is 45～59Nm*

Note： *Use Loctite 262 thread fastening sealant*

Note： *Use Loctite 598 surface sealant*

Figure 68

14. Install shaft sleeve of all clutches.

Figure 69

15. Install sealing rings of all clutches.

Figure 70

16. Install end cap of the first and third gear and reverse gear.

Note： *Bolts fastening torque is 45～59Nm*

Note： *Use Loctite 262 thread fastening sealant*

Note： *Use Loctite 598 surface sealant*

Figure 71

17. Overturn transmission, and put on work platform horizontally.

Figure 72

18. Install end cap of the first and third gear.

    Note：*Bolts fastening torque is 45～59Nm*

    Note：*Use Loctite 262 thread fastening sealant*

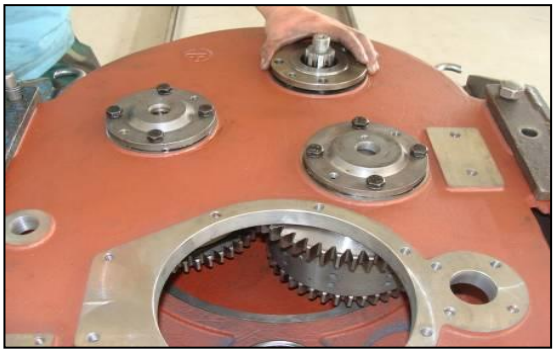


Figure 73

19. Install input flange.

Figure 74

20. Install adjusting nuts of the second and fourth gear and reverse gear

    Align teeth of the second and fourth gear and reverse gear; the horizontal height difference shall be controlled at 20-30.

Figure 75

21. Install output axle bearing.

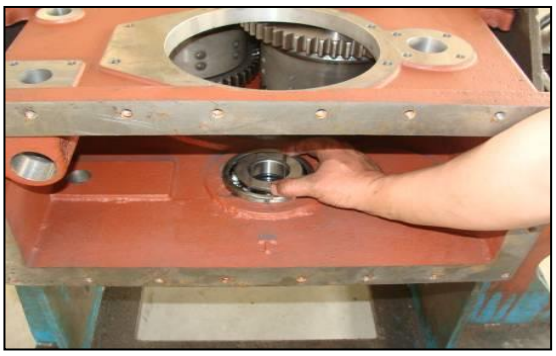


Figure 76

22. Install output low speed gear.

Figure 77

23. Install output axle.

Figure 78

24. Install sliding teeth set.

Figure 79

25. Install output axle high speed gear.

Figure 80

26. Install space ring.

Figure 81

27. Install bearing.

Figure 82

28. Install rear output axle end cap.

Note：*Bolts fastening torque is 45～59Nm*

Note：*Use Loctite 598 surface sealant*

Note：*Use Loctite 262 thread fastening sealant*

Figure 83

29. Install output flange

Figure 84

30. Install sealing ring, pressing plate and bolt stator of output flange.

Note：*Screw fastening torque is 45～59Nm*

Figure 85

31. Turnover transmission, install flange of front output axle.

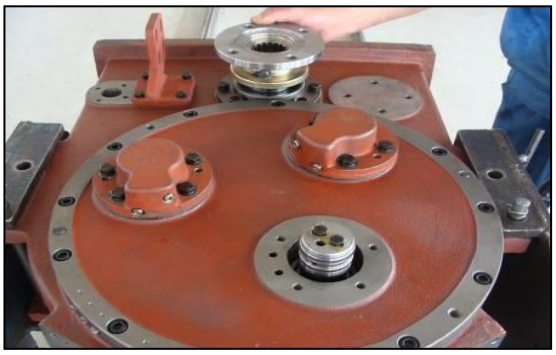


Figure 86

32. Install sealing ring, pressing plate and bolts stator respectively for front output flange.

Note：*Screw fastening torque is 45～59Nm*

Figure 87

33. Install hand brake assembly

Note： *Screw fastening torque is* 124～165Nm

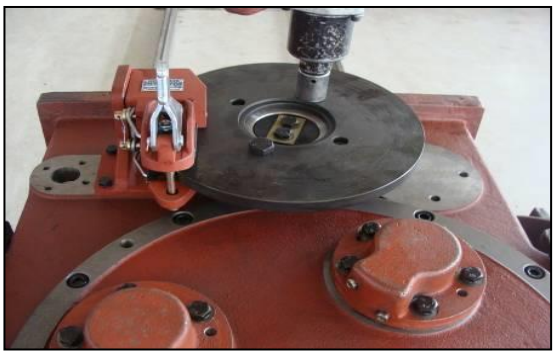


Figure 88

34. Install reverse gear bearing sleeve

Figure 89

35. Install reverse gear clutch end cap

Note： *Use Loctite 598 surface sealant*

Note： *Screw fastening torque is45～59Nm*

Note： *Use Loctite 262 thread sealant*

Figure 90

36. Install speed change control valve.

Note： *Use Loctite 262 thread sealant*

Note： *Screw fastening torque is45～59Nm*

Figure 91

37. Install end cap

Figure 92

38. Install supporting seat of shifting fork

Note：*Screw fastening torque is45～59Nm*

Figure 93

39. Install shifting fork

Note：*Screw fastening torque is45～59Nm*

Figure 94

40. Bind shifting fork with iron wire to avoid dropping of bolts.

Figure 95

41. Install fixed seat of oil pan

Figure 96

42. Install sealing gasket of oil pan.

Figure 97

43. Install oil pan

Note: *Screw fastening torque is45～59Nm*

Note: *Use Loctite 598 surface sealant*

Figure 98

Assembly parts assembling

Installation of II & IV gear clutch

1. Install low speed gear on gear ring

Figure 99

2. Install stator and screw down bolts.

Note： *Screw fastening torque is22～30Nm*

Note： *Use Loctite 262 thread sealant*

Figure 100

3. Tilt the surrounding edge of stator with tool

Figure 101

4. Put clutch gear ring on platform horizontally

Figure 102

5. Install piston sealing ring

Figure 103

6. Install piston

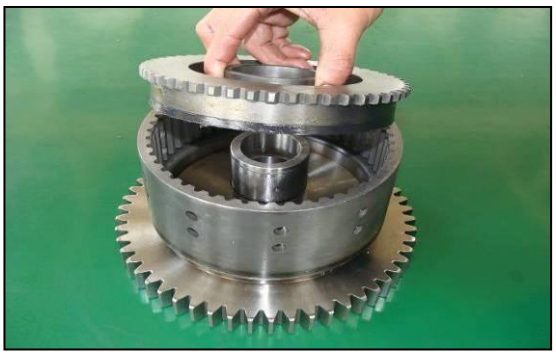


Figure 104

7. Install bearing sleeve

Figure 105

8. Install return spring

Figure 106

9. Install spring fixing seat

Figure 107

10. Install baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 108

11. Install driven and driving friction plate

Figure 109

12. Install fixed block

Figure 110

13. Install spring lamination

Figure 111

14. Install axle

Figure 112

15. Install baffle ring of driven gear

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 113

16. Install driven gear

Figure 114

17. Install bearing

Figure 115

18. Install baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 116

19. Install high speed gear

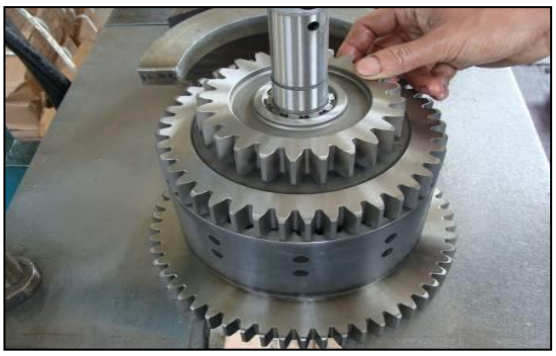


Figure 117

20. Install bearing

Figure 118

21. Install located block

Figure 119

22. Install bearing

Figure 120

23. Install cover plate

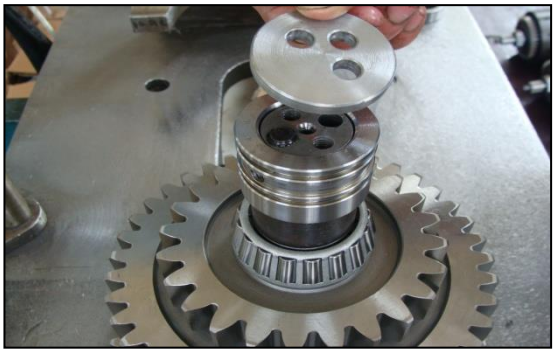


Figure 121

24. Install location

Figure 122

25. Screw down bolts and tilt the edge of stator with tool.

Note：*Screw fastening torque is22～30Nm*

Note：*Use Loctite 262 thread sealant*

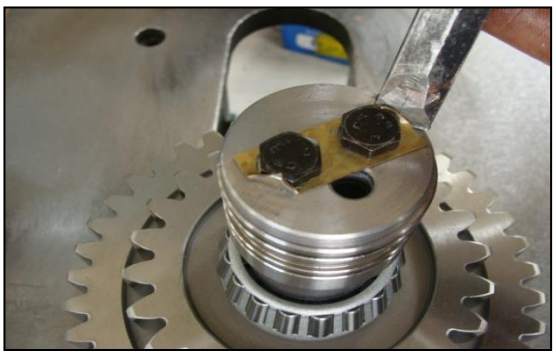


Figure 123

26. Reverse assembly, put it on work platform and install bearing.

Figure 124

Installation of reverse gear clutch

1. Install low speed gear on gear ring

Figure 125

2. Install stator and screw down bolts

Note：*Screw fastening torque is22～30Nm*

Note：*Use Loctite 262 thread sealant*

Figure 126

3. Tilt edge of stator with tools

Figure 127

4. Turnover gear ring and put it on work platform

Figure 128

5. Install piston sealing ring

Note：*Use lubrication oil*

Figure 129

6. Install piston

Note：*Use lubrication oil*

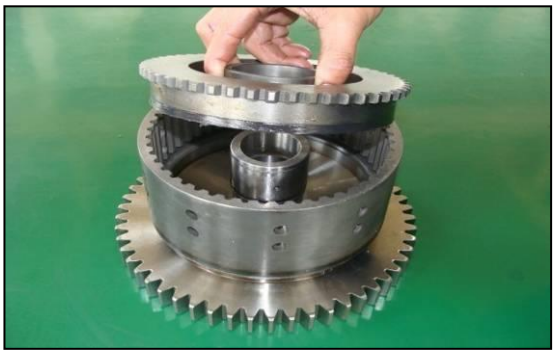


Figure 130

7. Install bearing sleeve

Figure 131

8. Install return spring

Figure 132

9. Install spring fixed seat

Figure 133

10. Install baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 134

11. Install driven and driving friction plate.

Figure 135

12. Install located block

Figure 136

13. Install spring plate

Figure 137

14. Install bearing

Figure 138

15. Install baffle ring on driven gear

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 139

16. Install driven gear

Figure 140

17. Install 2 bearings with press machine

Figure 141

18. Install baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 142

19. Install spacer bush

Figure143

20. Install bearing

Figure 144

21. Install location block

Figure 145

22. Install shaft sleeve

Figure 146

23. Install cover plate

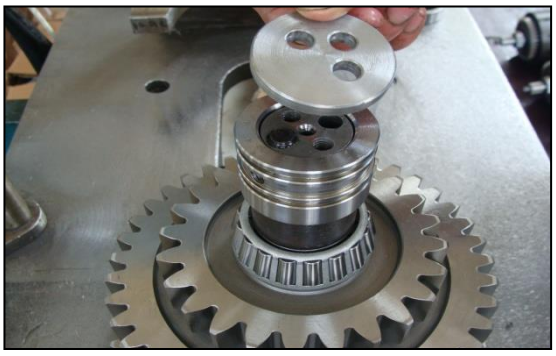


Figure 147

24. Install location plate

Figure 148

25. Screw down bolts and tilt edge of stator with tools

Note：*Bolts fastening torque is 22～30Nm*

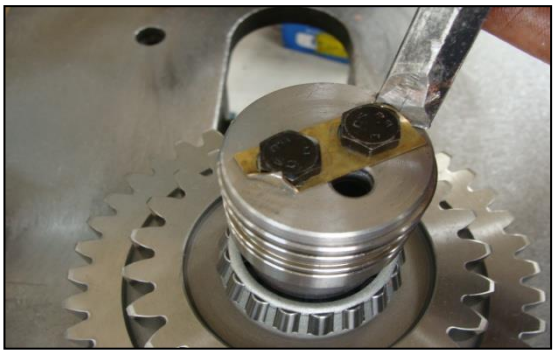


Figure 149

26. Reverse assembly and put it on work platform and install bearing

Clutch structure of I & III gear and reverse gear clutch are the same, but just size of gear is different, so installation process will not be repeated here.

Figure 150

Installation of torque converter assembly

1. Put torque converter shell on installation platform horizontally.

Figure 151

2. Install end cap

Note： *Screw fastening torque is22～30Nm*

Note： *Use Loctite 262 thread sealant*

Figure 152

3. Screw on plug

Note： *Bolt fastening torque is 193～257Nm*

Figure 153

4. Install output flange

Note： *Screw fastening torque is110～130Nm*

Note： *Use Loctite 262 thread sealant*

Figure 154

5. Install working pump and steering pump bearing

Figure 155

6. Install space ring on top of bearing

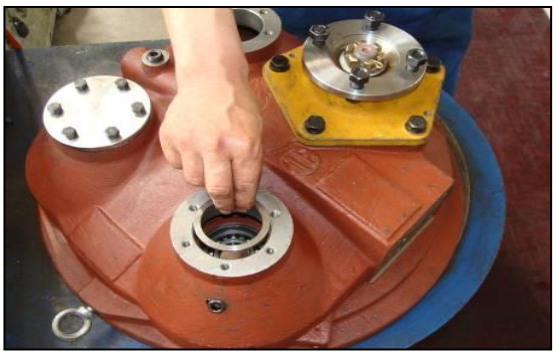


Figure 156

7. Install baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 157

8. Install output axle

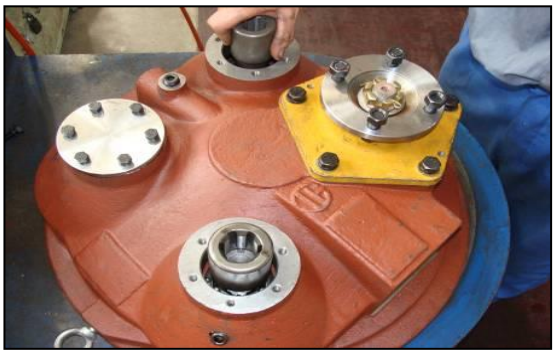


Figure 158

9. Install output flange

Note：*Screw fastening torque is110～130Nm*

Note：*Use Loctite 262 thread sealant*

Figure 159

10. Overturn torque converter and put it on work platform horizontally

Figure 160

11. Install spacer bush and bearing of working pump and steering pump

Figure 161

12. Install guide wheel seat

Note：*Use lubrication oil*

Figure 162

13. Install gear

Figure 163

14. Install baffle ring

Note： *It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 164

15. Install sealing gasket

Figure 165

16. Hang transmission shell on pump pulley shell.

Note： *Bolt fastening torque is 22～30Nm*

Note： *Use Loctite 598 surface sealant*

Note： *Guarantee suspending tool is on top of main drive assembly to avoid knocking spare parts inside during suspending process.*

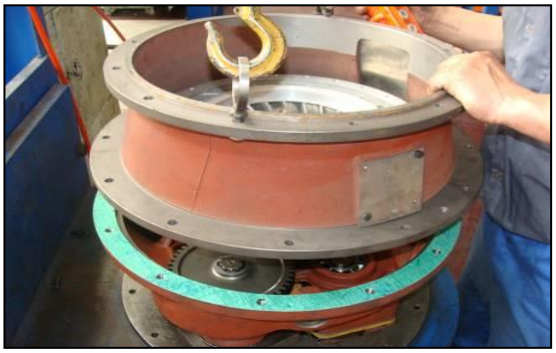


Figure 166

17. Install bearing

Figure 167

18. Install guide wheel

Figure 168

19. Install guide wheel baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 169

20. Install O ring

Figure 170

21. Install turbine

Note：*Bolt fastening torque is 22～30Nm*

Figure 171

22. Install turbine baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 172

23. Install turbine spacer bush

Figure 173

24. Install spacer bush baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 174

25. Install pump pulley shell

Note：*Bolt fastening torque is 45～59Nm*

Figure 175

26. Install elasticity plate

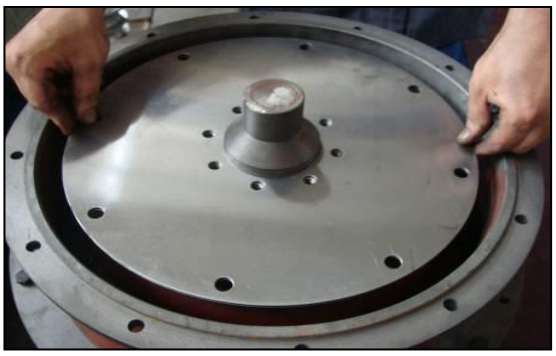


Figure 176

27. Install gasket

Note：*Bolt fastening torque is 45～59Nm*

Figure 177

28. Install sealing gasket on pressure regulating valve

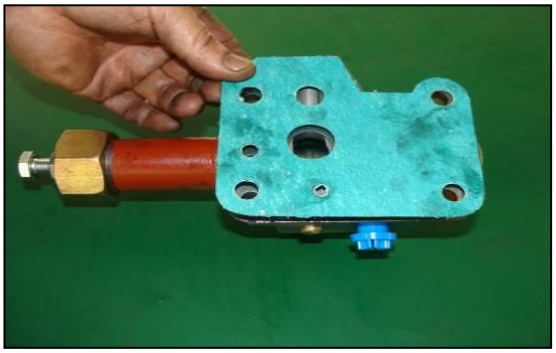


Figure 178

29. Install pressure regulating valve

Note：*Bolt fastening torque is 45～59Nm*

Note：*Loctite 598 surface sealant*

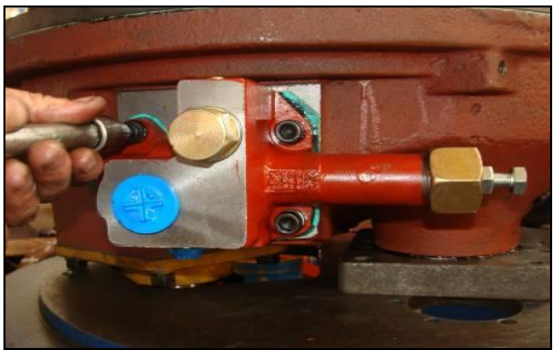


Figure 179

Installation of guide wheel seat assembly

⚠ Put guide wheel on installation platform horizontally

Figure 180

2. Install shaft sleeve

Figure 181

3. Install shaft

Figure 182

4. Install bearing

Figure 183

5. Install baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

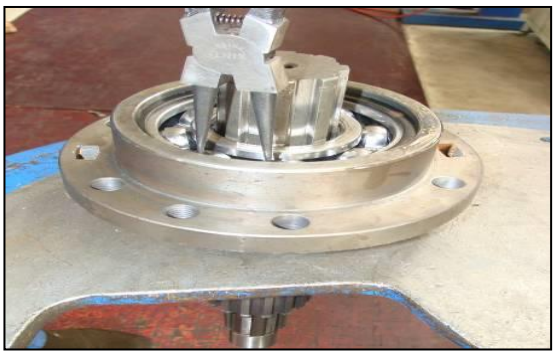


Figure184

6. Install gear

Figure 185

7. Install gear baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 186

Installation of output flange

- Put flange on work platform horizontally, install bearing

Figure 187

2. Install bearing baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 188

3. Install shaft

Figure 189

4. Install gear

Figure 190

5. Install bearing

Figure 191

6. Install bearing baffle ring

Note：*It must be clamped firmly when using baffle ring pincer to avoid safety hazard.*

Figure 192

7. Reverse output flange and put it on work platform

Figure 193

8. Install flange

Figure 194

9. Install shock insulator, sealing ring, shock insulator and hold-down but, and fix bolts with cotter pin.

Figure 195

HYDRAULICS

CYLINDERS

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

TABLE OF CONTENTS

General Description

Working principle

It is usually composed of cylinder body, piston rod and sealing parts, internal of cylinder body is divided into two parts and connect with a oil hold respectively. Since compression of liquid is very small, when oil coming into one oil hole, piston will be propelled to make oil going out from another oil hole, piston drives piston rod stretching (compressing), on the contrary as before.

Cylinder is the implementing part of the straight line movement of output force and piston effective area and the pressure difference at both sides. It is used to change hydraulic energy into mechanic energy. The input of cylinder is flow rate and pressure of fluid, the output is speed and force of straight line movement. Piston of cylinder can finish straight line alternating motion, the output straight line displacement is limited. Cylinder is the energy converting device from hydraulic energy to mechanic energy for alternating straight line movement. Cylinder is basically composed of cylinder barrel, cylinder cover, piston, piston rod, sealing device and cushioning device.

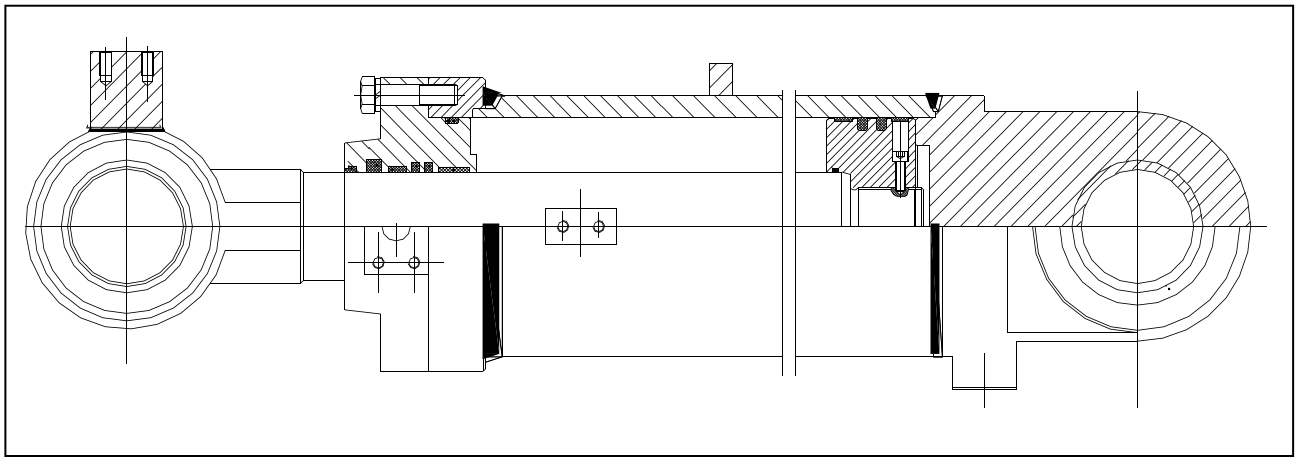


Figure 1

Detailed list of spare parts

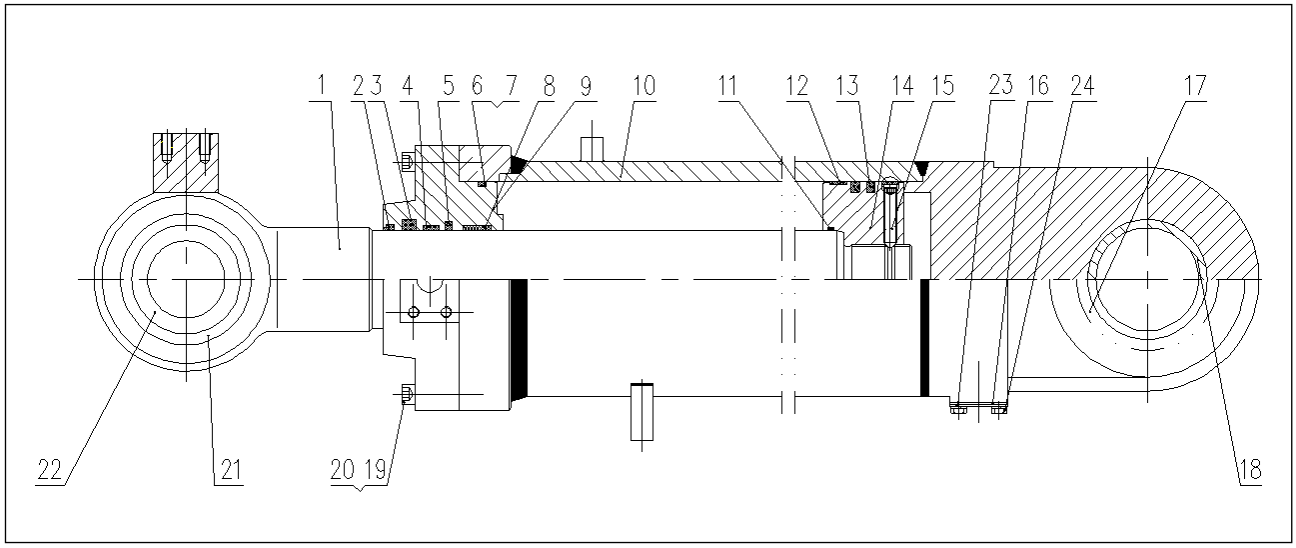


Figure 2

Reference Number	Description	Reference Number	Description
1	Cylinder rod	12	Support ring
2	Dust ring	13	SPGO
3	Obturating ring	14	Piston
4	Support ring	15	Socket head cap screw
5	Cushion seal	16	Port protecting cover
6	Support ring	17	Hole protecting cover
7	Four fluorine block circle	18	Oil cup
8	O-RING	19	Cylinder end bush
9	Guide sleeve	20	Bush
10	Cylinder block	21	Bolt
11	O-RING	22	Washer

Disassembling and assembling steps

Disassembling steps

Note: *Prepare a container which can store all hydraulic oil of the maintained cylinder, hydraulic oil will flow out from cylinder*.

1. Put the cylinder on special supporting vertically, screw down bolts of cylinder cover with pneumatic wrench or torque wrench.

Figure 3

2. Hang piston rod assembly out from cylinder and put it on special protective support.

Figure 4

3. Twist piston lock screw with special tools.

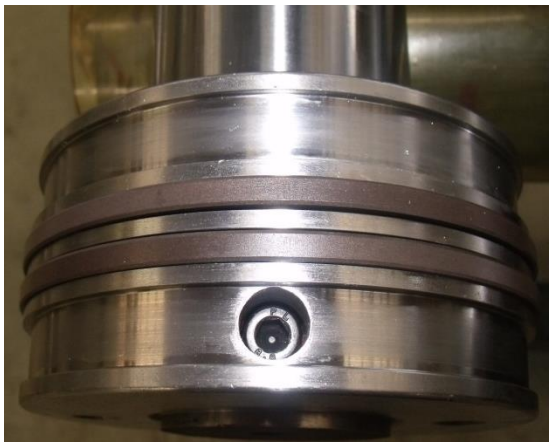


Figure 5

4. Dismantle piston with special piston tightening tool and jackhammer.

Figure 6

5. Dismantle piston and cylinder cover assembly.

Figure 7

6. Dismantle sealing parts with special tools.

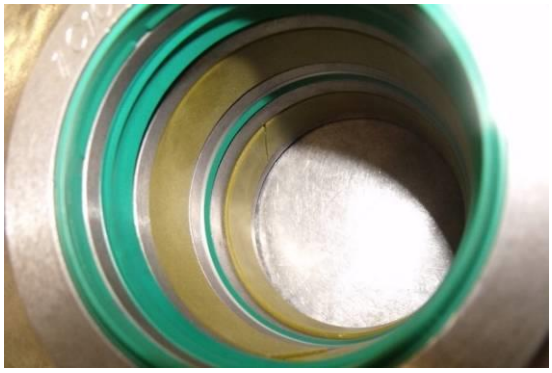


Figure 8

Assembling steps

1. Install sealing parts of cylinder.

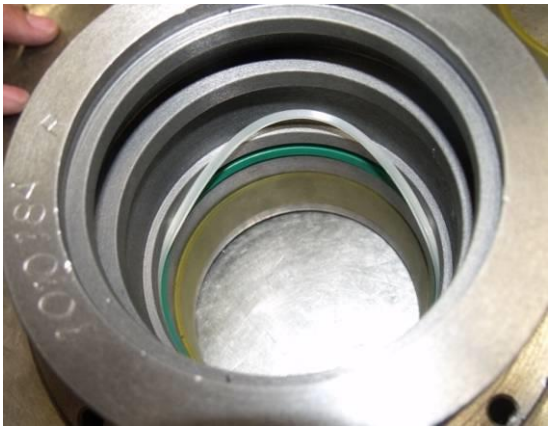


Figure 9

2. Install cylinder cover assembly.

Figure 10

3. Install piston with special tools.

Figure 11

4. Screw down piston bolts with special tools.

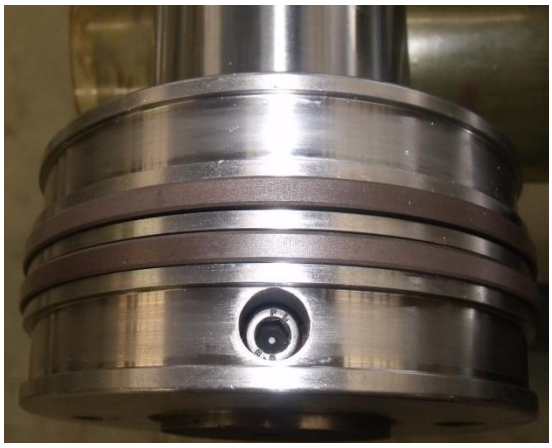


Figure 12

5. Put piston rod in cylinder barrel.

Figure 13

6. Screw down bolts of cylinder cover and cylinder barrel.

Figure 14

Main Pump

⚠ CAUTION!
Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section. **Always use tools and equipment that is in good working order.** **Use lifting and hoisting equipment capable of safely handling load.** **Remember, that ultimately safety is your own personal responsibility.**

TABLE OF CONTENTS

General description

Work principle

Function of main pump is to convert mechanic energy of diesel into pressure energy of working liquid. Main pump is a kind of hydraulic pump with simple structure and wide application, it has small size, light weight, reliable work, low cost and not too sensitive to hydraulic oil, convenient for maintenance and repair, and therefore it is widely applied in hydraulic system of loaders.

Main pump has many types, according to different pressure grade, it can be divided into four types which are: low pressure (P＜2.5MPa), medium pressure (P＞2.5—8MPa), mesohigh pressure (P＞8—16MPa) and high pressure (P＞16—31.5MPa). At present, mesohigh pressure main pumps are used often for loaders. According to difference of gear mesh form, it can be divided into main pump with external mesh and main pump with internal mesh. Of which main pumps with external mesh are more popular.

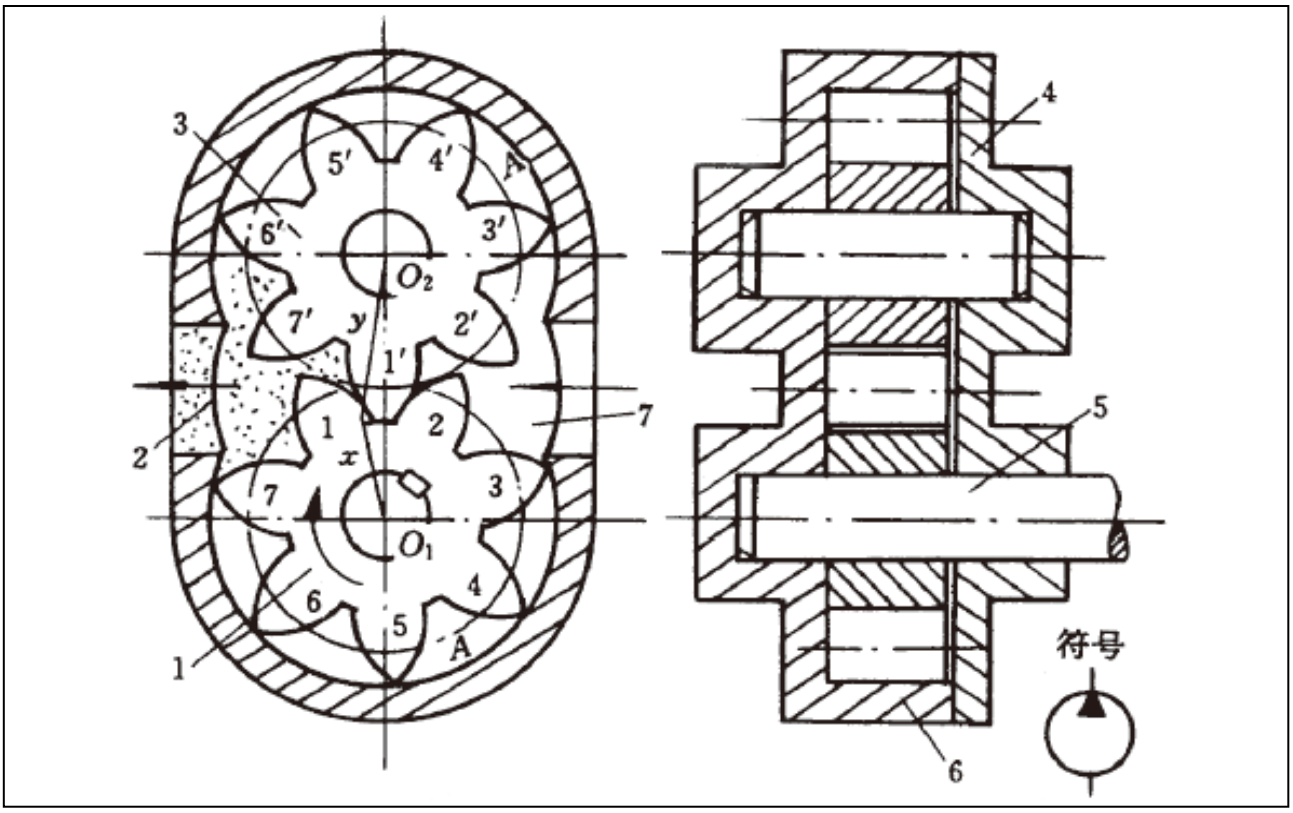


Figure 1

1. Driving gear 2. Extrusion chamber 3. Driven gear 4. End cap 5. Transmission shaft 6. Pump body 7. Suction chamber

Detailed list of spare parts

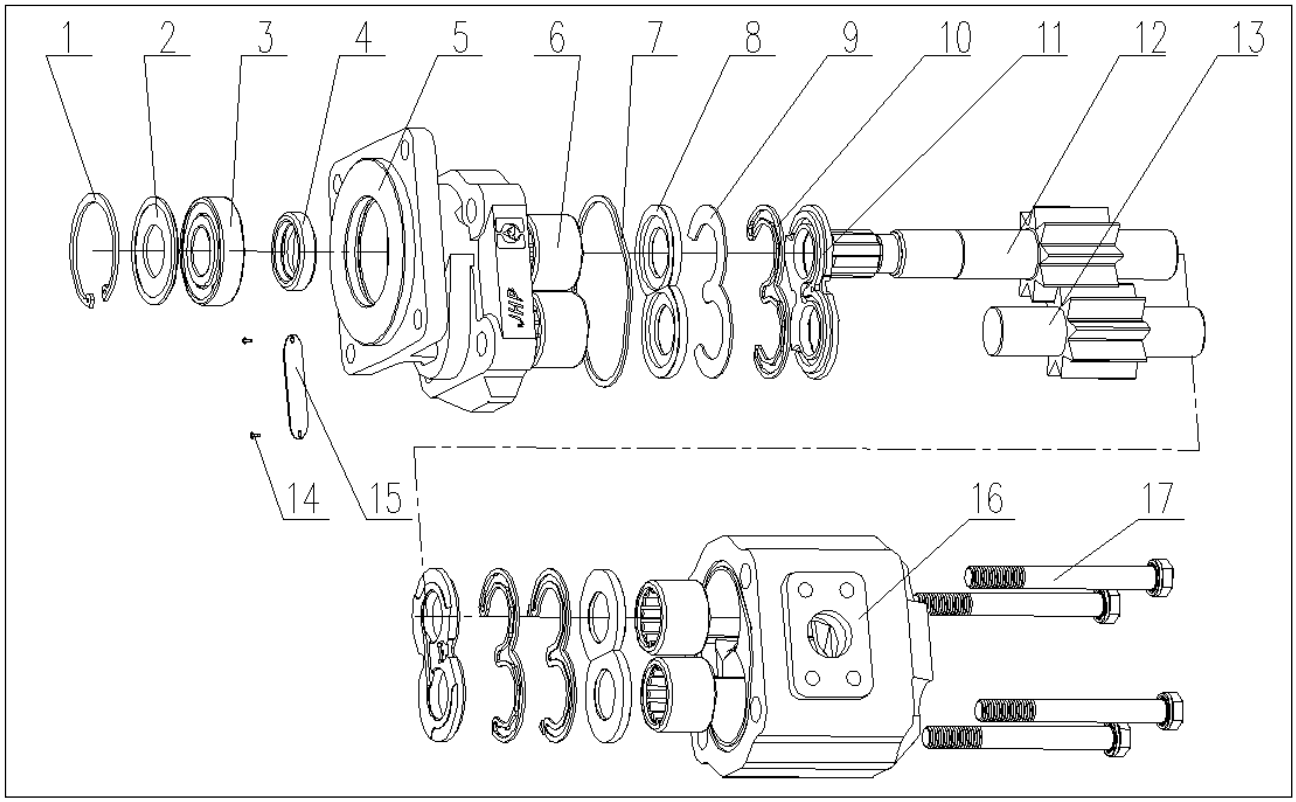


Figure 2

Reference Number	Description	Reference Number	Description
1	Circlip	10	Seal Ring
2	Shim	11	Side Plate
3	Bearing	12	Drive Gear
4	Seal Ring	13	Driven Gear
5	Front Cover	14	Rivet
6	Bearing	15	Nameplate
7	Seal Ring	16	Rear Body
8	Shim	17	Bolt
9	Baffle		

Parts replacement principle

If main pump needs to be repaired to reach the original performance index, parts replacement principle must be followed to replace parts, following is the detailed replacing rules:

1. Side plate: replace side plate when it is scratched, there is pit, spray and finishing layer sheds, burnt, deformed and cavitations corrosion.
2. Gear: replace gear when one of the following conditions happens: shaft diameter of gear shaft is scratched or worn in sealing zone; teeth surface of gear is worn, scratched, broken or deformed; addendum circle is damaged seriously; multiple spline or flat key and spindle nose are worn, deformed and broken.
3. Castings (front cover, pump body, and rear cover):
   3.1 If there is flaw on castings, and sealing zone has chip, rust, deformed pin hole, then replace castings.
   3.2 Replace pump body when one of the following conditions happens: oil mouth is broken, pump body is broken and rusty; when bore depth of pump body ＞0.08mm.
4. Round pin: round pin must be replaced when the matching does not comply with requirements, pin is broke and deformed, replace the front cover, pump body and rear cover matched with round pin when it is necessary.
5. Rolling bearing: new parts must be replaced when quill roller drops, retainer is damages, quill roller has surface pitting, roller path has surface pitting, over sintering.
6. Second sealing ring: replace with new parts when there is inner diameter abrasion, end face abrasion, thickness is milled, deformed, surface is coarse.
7. Non-metal sealing parts: all non-metal sealing parts must be replaced.
8. Outboard bearing: replace with new parts when parts are worn and rusty.
9. Fastener: replace it when it is drawn out, deformed and damaged.

Preparation before disassembling

1. Clean the surface of pump, and check if the surface has chip and rust.
2. Check model and factory releasing number on nameplate, if there is no nameplate on pump, check factory releasing number at seam allowance of front cover.
3. Fill in relative information on main pump returned for maintenance card before disassembling, such as manufacturer, applicable machine model, applicable working condition, pump model, factory releasing number, factory releasing date, head and marks of fabricator, working parameters (pressure, rotation, impact and the constant running time at the highest pressure) on main machine, total working time of main pump and reason for returning for maintenance, etc.
4. Make sure the production is released from the factory as a whole and it is not disassembled after releasing, otherwise it is not maintained.
5. If there is external leaking, do gas tightness checking to the entire pump and find out leaking position.
6. Check tightening torque of bolts (screw down bolts again with torque wrench, record the Max. tightening torque), learn if tightening torque of all bolts have reached the required specification.

Disassembly and assembly steps

Disassembly steps

1. Dismantle front end cap.

Figure 3

2. Dismantle jump ring with jump ring pincer.

Figure 4

3. Take out framework oil seal.

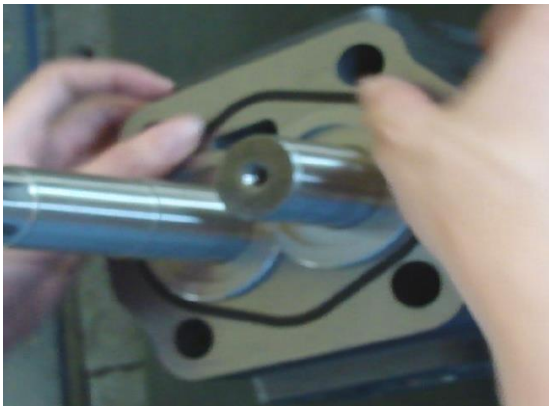


Figure 5

4. Take out support wire.

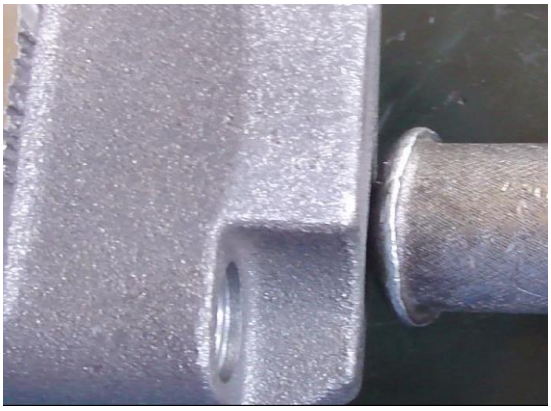


Figure 6

5. Dismantle sealing ring.

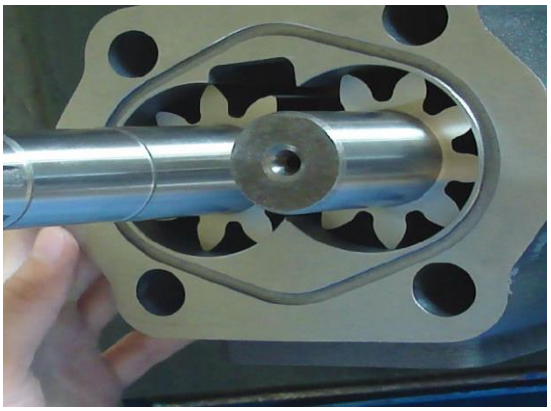


Figure 7

6. Dismantle bearing.

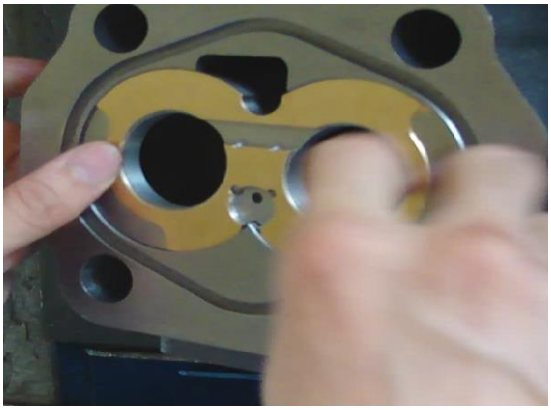


Figure 8

7. Dismantle front ear type sealing ring

Figure 9

Installation steps

1. Install bearing.

Figure 10

2. Install sealing ring.

Figure 11

3. Install limitation wire.

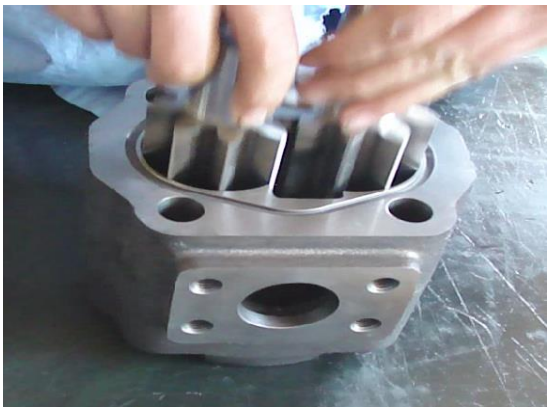


Figure 12

4. Install rear cover.

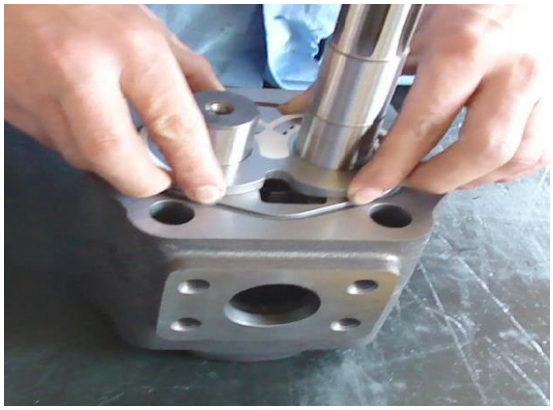


Figure 13

5. Install rear cover bolts.

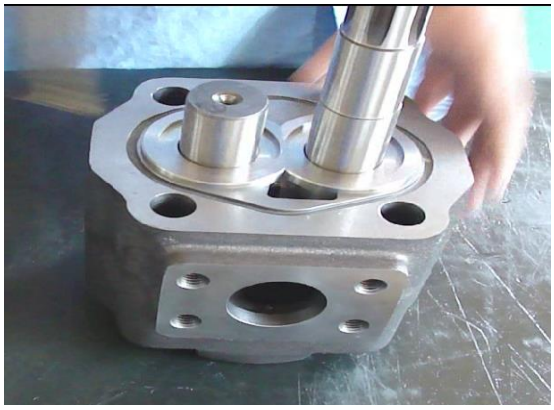


Figure 14

6. Install active gear.

Figure 15

7. Install driven gear.

Figure 16

8. Install side plate.

Figure 17

9. Install ear type sealing ring.

Figure 18

10. Install front ear type sealing ring.

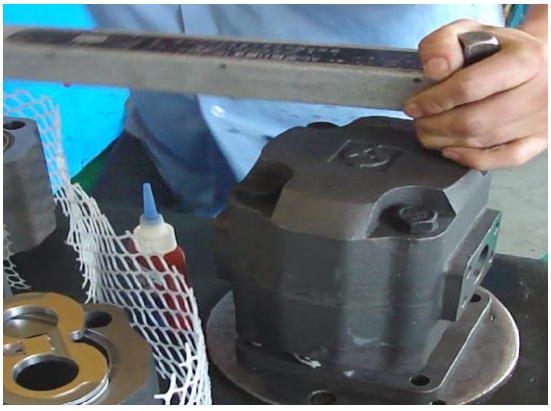


Figure 19

11. Rotate pump axis and check it.

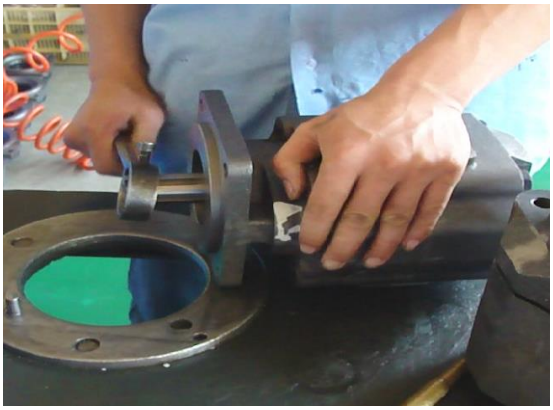


Figure 20

Note:

1. Clean parts with cleaning agent, do not use rag to avoid remaining any clothing fiber.
2. Slide touching parts and bearing, coating with hydraulic oil and assemble after cleaning.
3. Replace O ring and sealing parts with new ones:

   Disassembling order: front cover →framework oil seal→ O ring →bearing →sealing ring →side plate →driven gear →active gear →rear cover →O ring →bearing.

   Assembling order: bearing →O ring →rear cover→ active gear→ driven gear→ side plate →sealing ring→ bearing→ O ring→ framework →oil seal→ front cover.

Main Control Valve

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General description (Pilot Lever)

1. Source: the hydraulic multi-way directional valve is domestic assorting parts for 950B, 966D and 980S wheel loaders introduced in from abroad.
2. Purpose: the valve is combined with DJS pilot valve, mainly used for ZL40, ZL50, ZL60 and other medium and large size loaders, it can also be used for hydraulic system of bulldozers and other medium and large size engineering machines.
3. Characteristics:
   a. Adopt decompression type pilot valve to control which reduce reversing operating force greatly.
   b. Improve jogging feature of multi-way valve greatly.
   c. Relief valve, overload valve, oil compensating valve and check valve adopt plug-in mounting which has good generality and easy for maintenance.
   d. Four floating is easily realized on the basis of three main valves, which make four main valve structure simple.
4. Schematic diagram

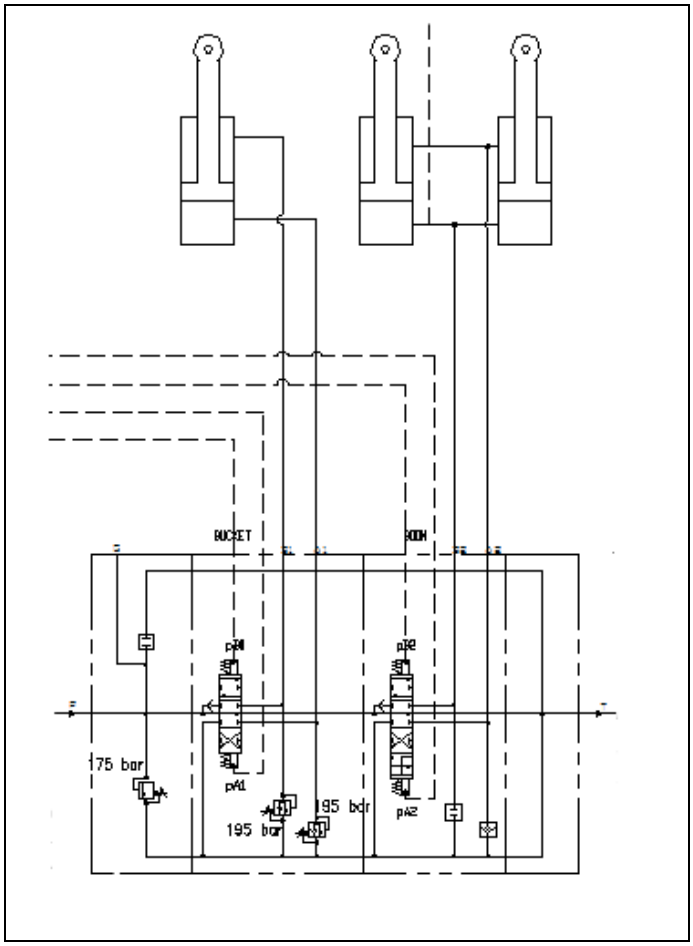

Figure 1

Detailed list of spare parts

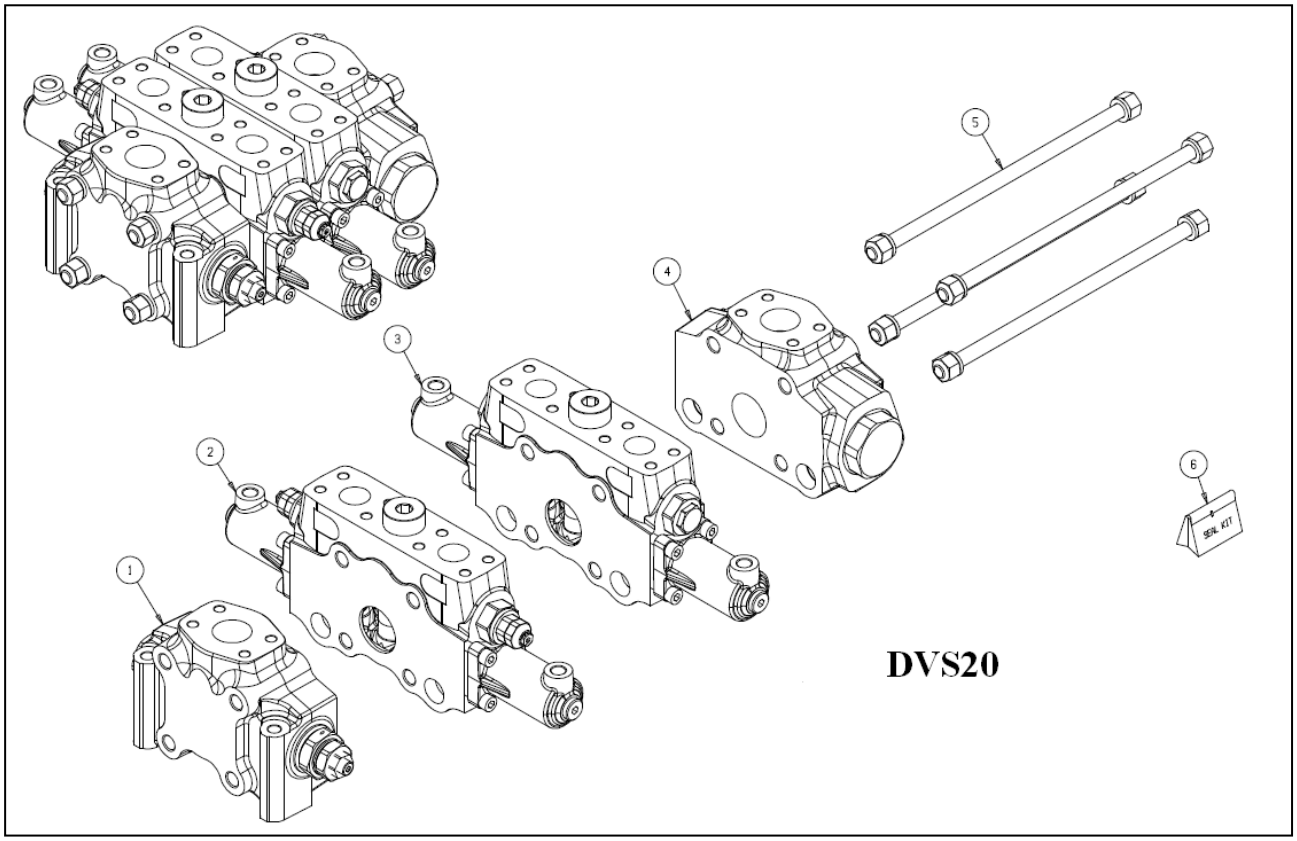

Figure 2

Pos	Code	Description	UM	Q.ta
1	60130557MQ	HC-DVS20 COLL.E. (IL 009 180 A S07)	N	1
2	60130558MQ	HC-DVS20 SIZ. (W001A H005 RT S05 04PA190 04PB190)	N	1
3	60130559MQ	HC-DVS20 SIZ. (H005 RT S05 02PA 05PB)	N	1
4	60110260DD	HC-DVS20 COLL.U. (TK A S07)	N	1
5	300188001	DVS20/2 TIRAN.PASSO 61	N	4
6	JSP18800025	KIT GUARNIZIONI-HC-DVS/2 H005 PAS	N	1

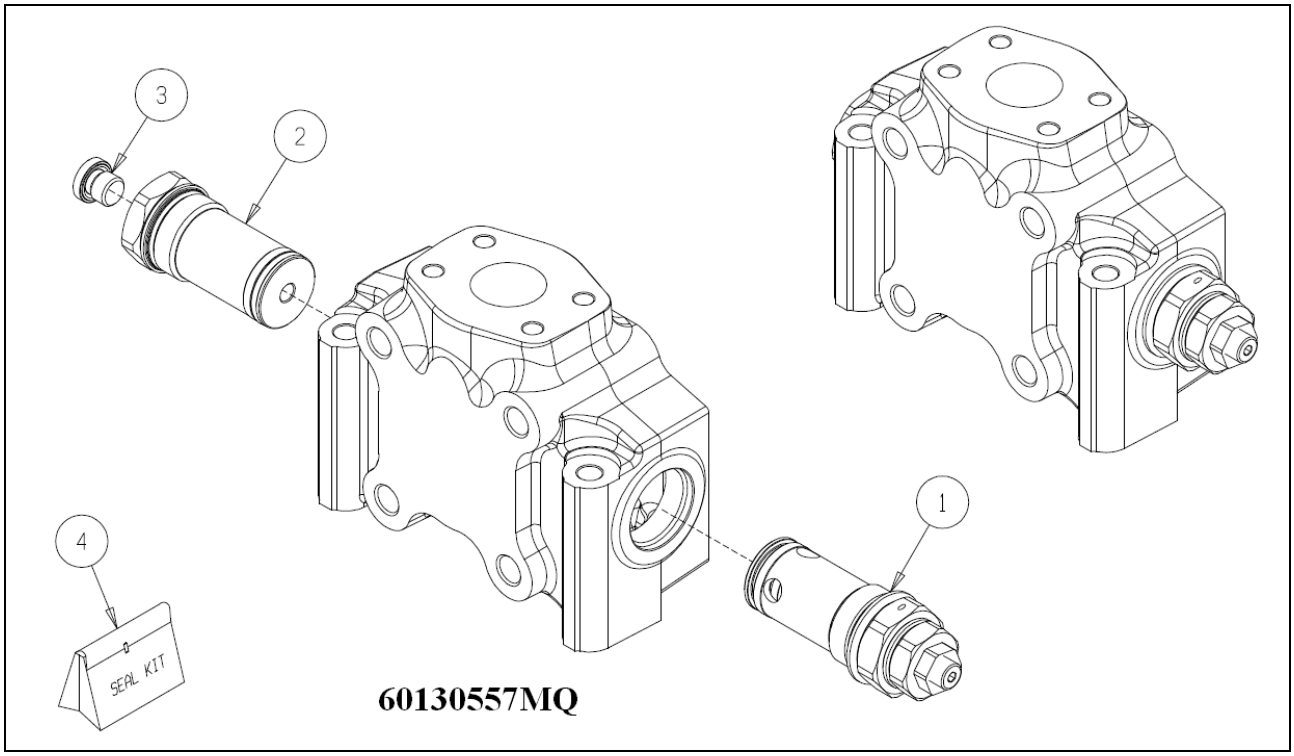

Figure 3

Pos	Code	Description	UM	Q.ta
1	86491	DVS20 V.MAX.PIL. (180DAR)	N	1
2	430188002	DVS20 ASS.TAPPO SOST.V.MAX.P+ATT.1/4"G	N	1
3	430000017	ASS.TAPPO 1/4" DIN 3852 E	N	1
4	JSP18800018	KIT GUARNIZIONI-HC-DVS20 COLLETTORE	N	1

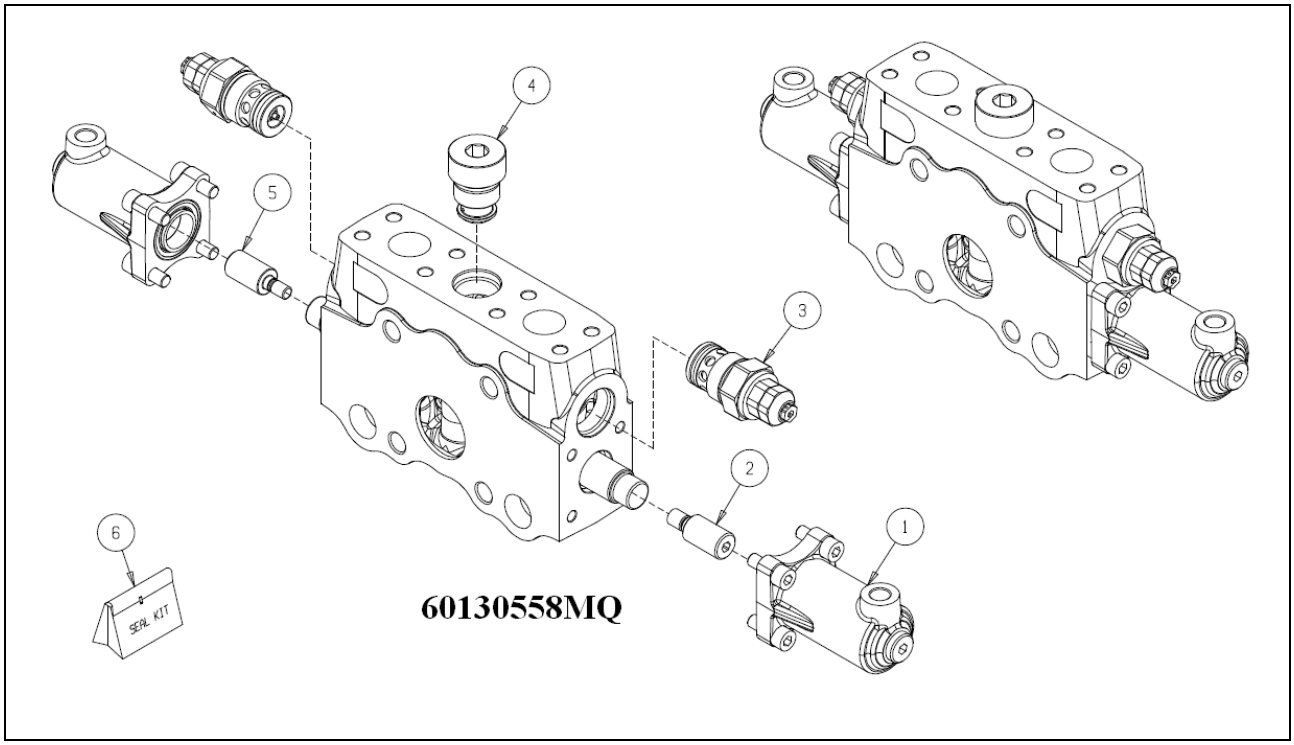

Figure 4

Pos	Code	Description	UM	Q.ta
1	320507027	D12 COM.IDR.GH. 1/4"G. H006U	N	2
2	422501218	TAPPO STL.C.I.ANT. DVS20	N	1
3	86492	DVS20: 04-PA=PB(190 BAR)	N	2
4	320288001	DVS20 KIT VR	N	1
5	422501204	TAPPO STL.C.I.ANT. POST.	N	4
6	JSO18800011	KIT GUARNIZIONI-HC-DVS20 SEZ.DE CV	N	1

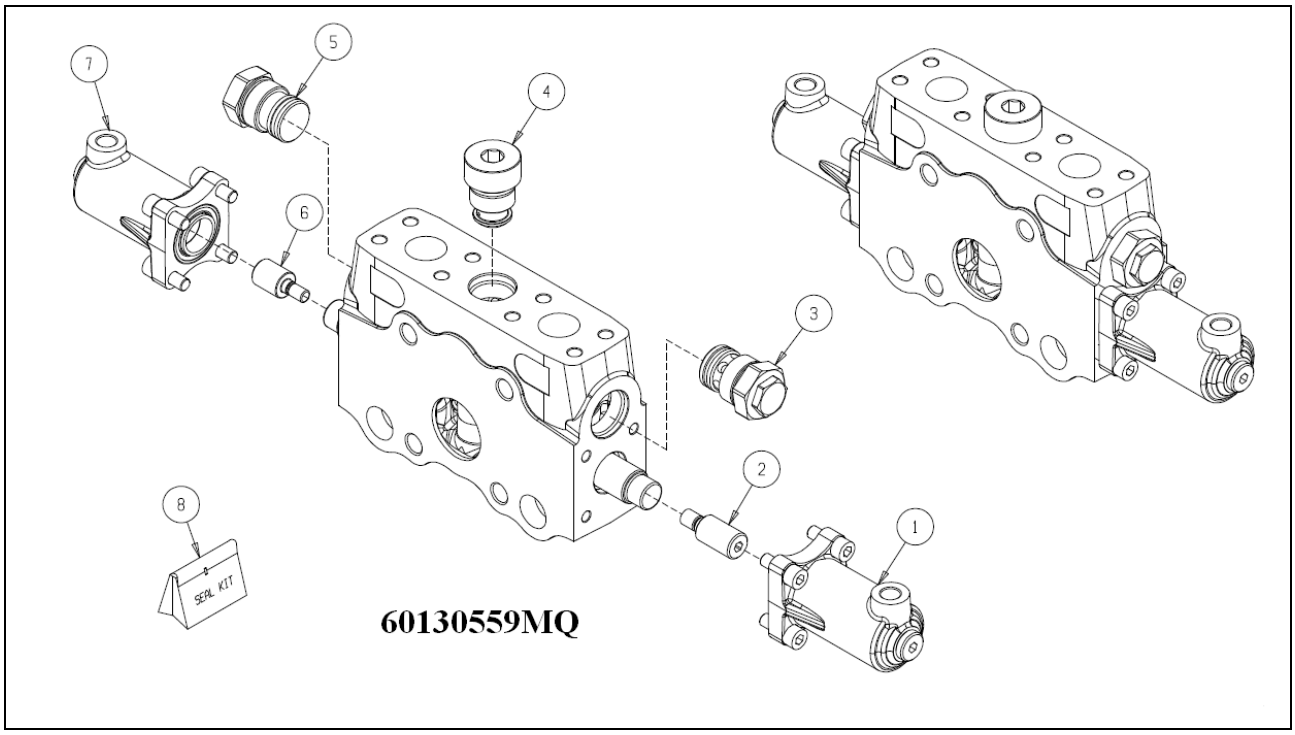

Figure 5

Pos	Code	Description	UM	Q.ta
1	320507026	D12 COM.IDR.FLOAT ANT.GH.1/4"G HOO6G	N	1
2	422501218	TAPPO STL.C.I.ANT.	N	1
3	915088801	DVS20: 02-PA=PB	N	1
4	320288001	DVS20: KIT V.R	N	1
5	430488001	DVS20: 05-PA=PB	N	1
6	422501216	TAPPO STL.C.I.FLOAT DVS20	N	1
7	320588010	DVS20 COM.IDR.FLOAT POST.GH.1/4"G.	N	1
8	JSP18800024	KIT GUARNIZIONI-HC-DVS20 SEZ. (H005)	N	1

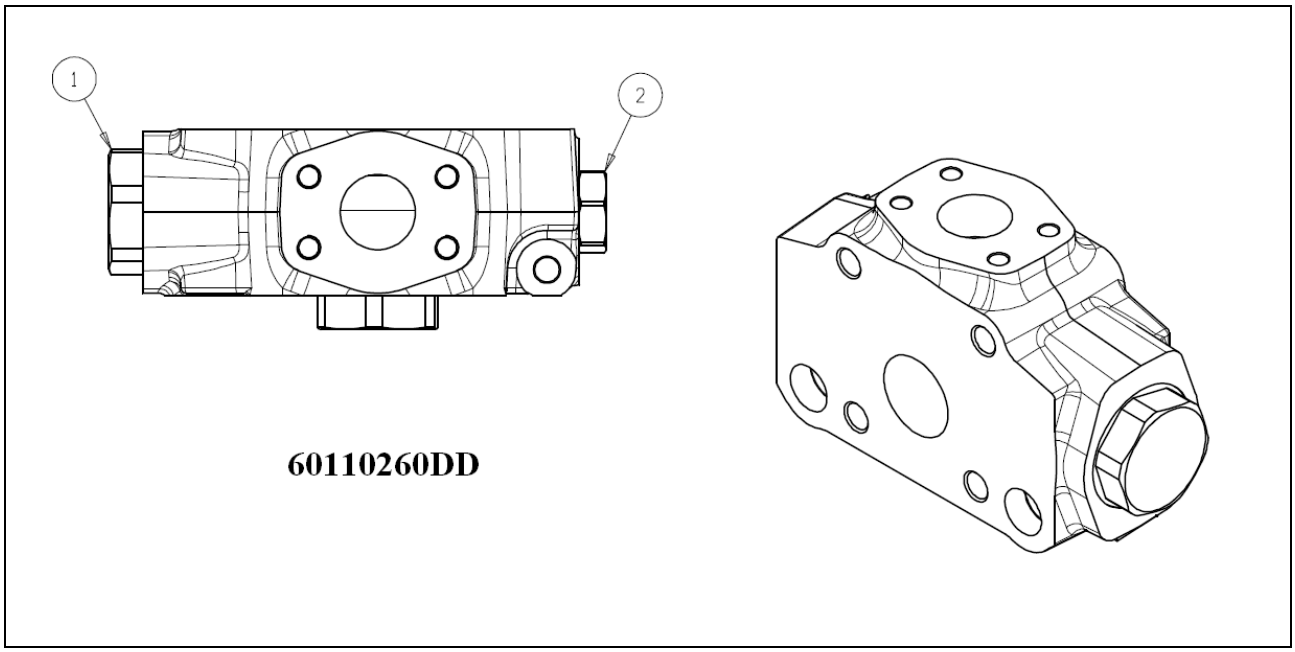

Figure 6

Pos	Code	Description	UM	Q.ta
1	300009002	KIT TAPPO 1\1/16.12 UNF D12	N	2
2	200007002	KIT TAPPO 1"5/8-12 UNF	N	1

Basic faults and overcoming

S/N	Faults	Reasons	Overcoming methods
1	Working pressure is not enough	Pressure of relief valve is regulated too low	Adjust pressure of relief valve
		Slide valve of relief valve is blocked	Dismantle, clean and assemble again
		Pressure regulation spring is broken	Replace with new one
		System pipe pressure is lost too much	Replace pipeline or regulate pressure of relief valve within the allowable pressure range
2	Working flow is not enough	Oil supply of the system is not enough	Check oil source, check oil pump
		Leakage in valve is large	
		a. Oil temperature is too high, viscosity decreases	a. Take measures to reduce oil temperature
		b. Selection of oil is improper	b. Replace oil
		c. Clearance between slide valve and valve is too large	c. Replace slide valve according to reasonable clearance
		Fault of relief valve	Repair relief valve
3	Resetting does not work	Resetting spring is damaged or deformed	Replace new ones
		There is pollutant between valve rod and valve	Clean parts
4	External leakage	Sealing ring is damaged	Replace new ones
		Fasteners are loosed	Screw down fasteners
5	Slippage of swing arm is large	Clearance between multi-way valve and valve rod increases	Replace valve rod
6	Rotating bucket falls	Overload valve or oil compensating valve is blocked by pollutant	Dismantle, clean and reassemble

Priority Valve

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General description

Work principle

When steering unit is in the middle, if the engine misses, oil pump does not supply oil, control spring of priority valve will push spool to the right side to connect with CF oil way. When diesel engine is started, priority valve will distribute pressure oil to CF oil way, pressure will be reduced after going through meso-position throttle mouth of steering unit, pressure at both sides of throttle mouth will be transferred to both sides of priority spool, the caused hydraulic force will balance with spring force of control spring and liquid power which will make spool balance. Since fluid resistance at throttle mouth is big, very few flow will create enough differential pressure to push priority valve spool moving to the left side and will push spool move to the left, EF valve is opened larger and CF valve is smaller, then flow rate of CF oil way is small.

When turning steering wheel, meso-position throttle mouth of steering unit closes, fluid flowing through steering unit creates pressure drop. Pressure from both sides of throttle changing mouth is transferred to both sides of priority valve spool and forces spool to find a new balanced position. If rotation of steering wheel is improved, throttle changing mouth is larger at the moment of changing, at this time, only more flow rate can create pressure drop before rotation speed is different at throttle mouth so that priority valve spool can be pushed to move to the left side. Therefore, open of valve mouth of CF oilway connecting with priority valve will increase with improving of steering wheel rotation. In the end, oil supplying quantity of priority valve steering unit is equal to rotation of steering wheel plus displacement of steering unit.

When steering cylinder reaches the travelling terminal, if steering wheel is continued to be turned, pressure oil cannot flow to cylinder, then overload pressure will rise quickly, pressure difference between both sides of throttle changing mouth will reduce quickly, when pressure of steering cylinder exceeds regulated value of safety valve, the valve is turned on to discharge load. Pressure drop is created when pressure oil flowing through throttle mouth, the pressure drop is transferred to both sides of priority valve spool and push spool to move to the left side which will force valve mouth connecting with CF oilway get smaller, and valve mouth connecting with EF oilway get bigger, and pressure of steering oilway decreases.

When turning flames out, steering unit can play the role of manual oil pump. Input pressure oil pushes steering cylinder piston, oil from cylinder turns to upstream of throttle mouth of check valve, that is turning when flaming out has nothing to do with priority valve.

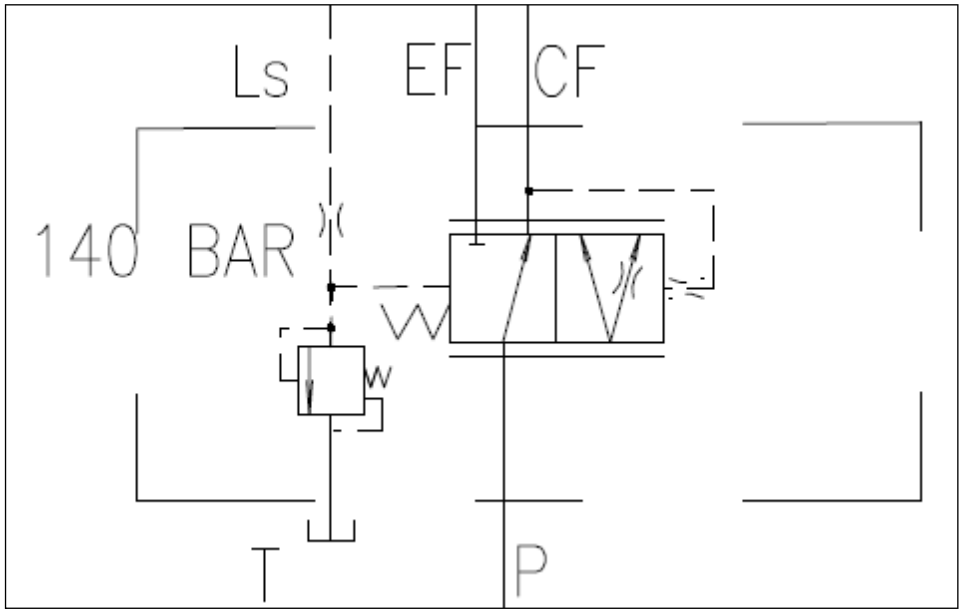

Figure1

Detailed list of spare parts

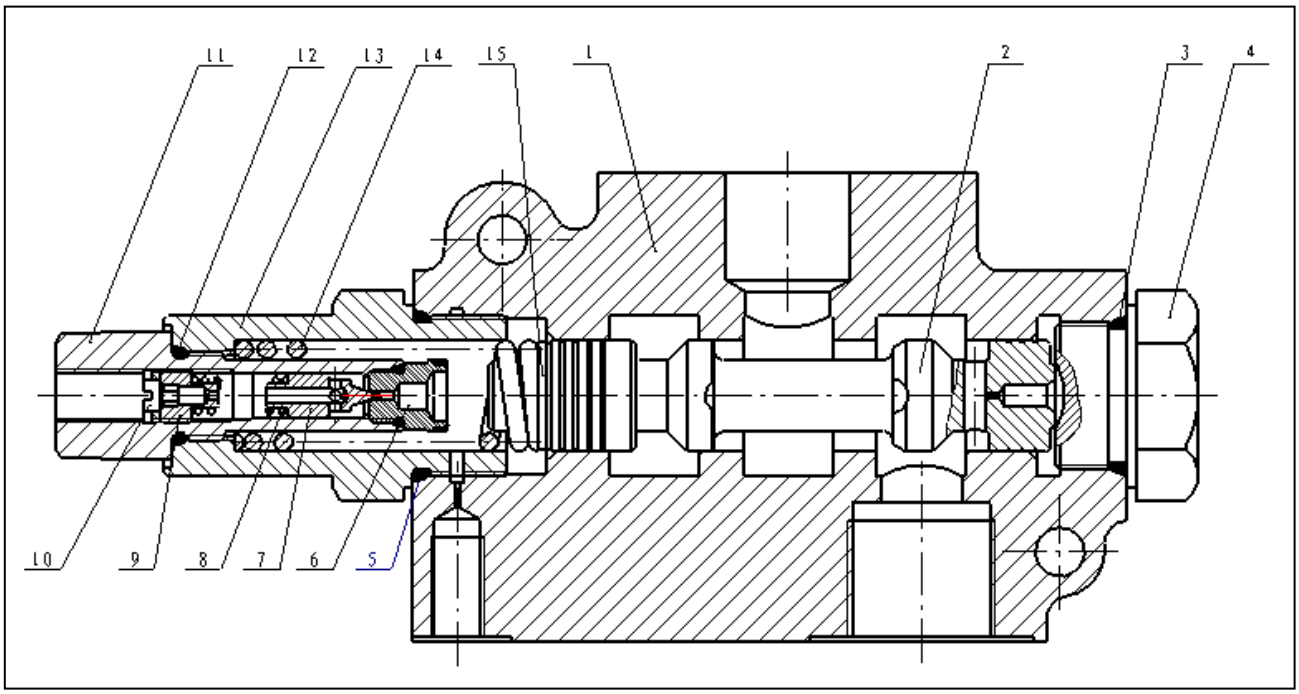

Figure2

Reference Number	Description	Reference Number	Description
1	Valve body	9	Adjustable Bolt
2	Valve spool	10	Locking Ring
3	O-Ring35X3.1	11	Relief Valve body
4	Plug	12	O-Ring 22X2.4
5	O-Ring38X3.1	13	Relief Valve seat 2
6	Relief Valve seat 1	14	Spring
7	Relief Valve spool	15	Gasket
8	Relief Valve Spring		

Disassembly steps of priority valve

1. Turn on relief valve on the left side.

   Tools: pneumatic wrench, M24 sleeve

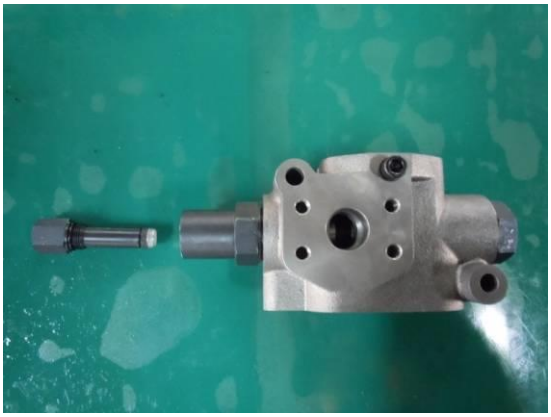

Figure 3

2. Turn on valve seat 2 of relief valve on the left to take out spring.

   Tools: pneumatic wrench, self made sleeve (41# wrench)

Figure 4

3. Turn on screw plug on the right to take out spool and gasket.

Figure 5

4. Screw out lock ring and adjustable bolt of relief valve to take out spring and relief spool, then take our valve seat 1 of relief valve.

   Tools: 4mm inner hexagonal wrench, special screwdriver (plain screwdriver), 14 #wrenches

Figure 6

5. Screw out bolts of pressure mouth

   Tool: 8mm inner hexagonal wrench

Figure 7

Matters need attention for disassembling priority valve

1. All parts shall be taken slightly during disassembling process, spool shall be pulled out slightly to avoid knock and scratch parts.
2. Step two and step three cannot be reversed (avoid screw out the screw plug on the right and spring pop out spool and cause danger).
3. Dismantle bolts of pressure mouth according to requirements.
4. Check if O ring is deformed, trimmed and aged after disassembling, usually O ring cannot be used again after disassembling.
5. After disassembling, valve body and spool shall be cleaned with 32# hydraulic oil, check if spool surface has obvious scratch; do not use spool and valve body if there is scratch.

Assembling steps of priority valve

1. Screw on bolts of pressure mouth.

   Tool: 8mm inner hexagonal wrench

Figure 8

2. Screw on valve seat 1 of relief valve, install spool and spring, then install adjustable bolts and lock ring.

   Tools: 4mm inner hexagonal wrench, special screwdriver (plain screwdriver), 14# wrench

Figure 9

3. Install spool and gasket.

Figure 10

4. Install spring, screw on valve seat 2 of relief valve and screw plug.

Tools: pneumatic wrench, self made sleeve (41# wrench)

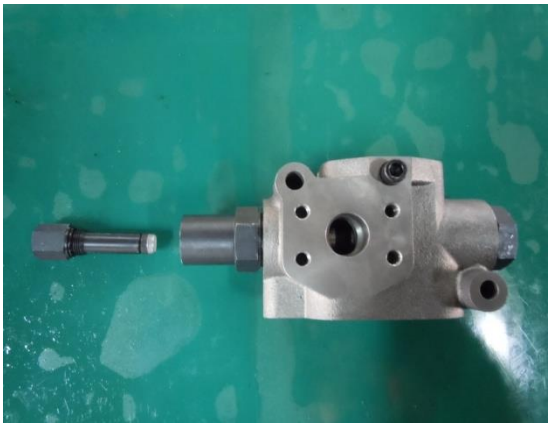

Figure 11

5. Screw on valve seat 1 of relief valve.

Tools: pneumatic wrench, M24 sleeve

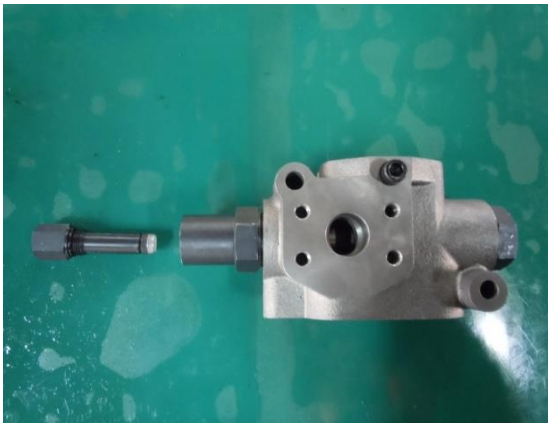

Figure 12

Matters need attention for assembling priority valve

1. Keep all parts clean before assembling.
2. During installation, all spools shall be installed slowly and guarantee they can slide flexibly, if there is blockage, grind spool surface and sharp corner slightly with find abrasive paper, clean the valve again.
3. Avoid to damage trim of O ring when screwing on screw plug, it is better to coat grease on the surface before installation.

Tools for disassembly and assembly

Main tools for disassembly and assembly are:

Torque wrench (Electric wrench)

M27 sleeve

M22 sleeve

M16 sleeve

M6 inner hexagonal spearhead

Figure 9

Steering Unit

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General description

Work principle

When steering unit is in the middle, spool and valve bush is at meso-position with the effect of spring lamination, oil from oil pump will enter spool from two rows of holes of valve bush and spool, then returns to oil tank through T oil mouth.

When steering wheel turns right (or left), spool is driven to turn to the right (or left), since the Max. rotation quantity between spool and valve bush is 10.5°, so spool rotates against valve bush, at this moment, oil groove is connected with oil inlet way of valve bush, oil goes through valve bush and oil groove of spool, returns to rotor and stator from valve bush, drives rotor rotating against stator. At the same time, oil from rotor and stator enters one of the chamber of cylinder through oil mouth A (or B) to make cylinder piston stretch out (compress inside), and push steering wheel turns right (or left), oil from the other chamber of cylinder enters valve bush through oil mouth B (or A), returns oil groove through spool, and goes back to oil tank through T oil mouth from valve bush. The relative rotation angle of spool and valve bush is 1.5°, oil way is connected, and rotation of rotor makes oil connects with cylinder, oil supplying quantity and rotation angle of steering wheel become direct ratio.

When steering wheel turns right (or left) for an angle and keeps the state, since the above mentioned oilway is open and oil from oil pump will push rotor to turn right (left), when rotation angle of rotor is the same with rotation angle of steering wheel, since valve bush and rotor is connected through linkage axle, so rotor will drive valve bush to turn right (or left) to keep the same angle with steering wheel. At this moment, valve bush and spool form the position without rotation angle, oilway going to rotor and oil cylinder is closed, oil from oil pump will go into spool through two rows of holes through valve bush and spool, oil goes back to oil tank through T oil way from valve bush. At this time, tyre stops moving, this is hydraulic feedback servo action.

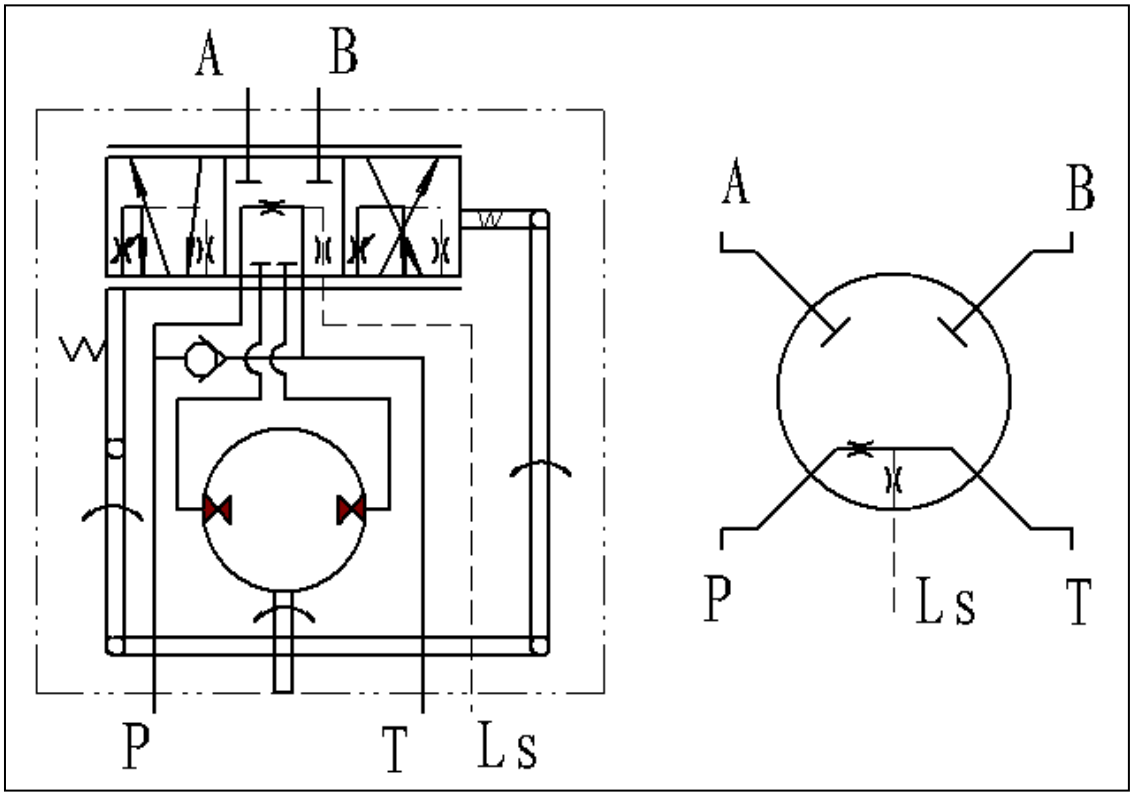

Figure 1

Detailed list of spare parts

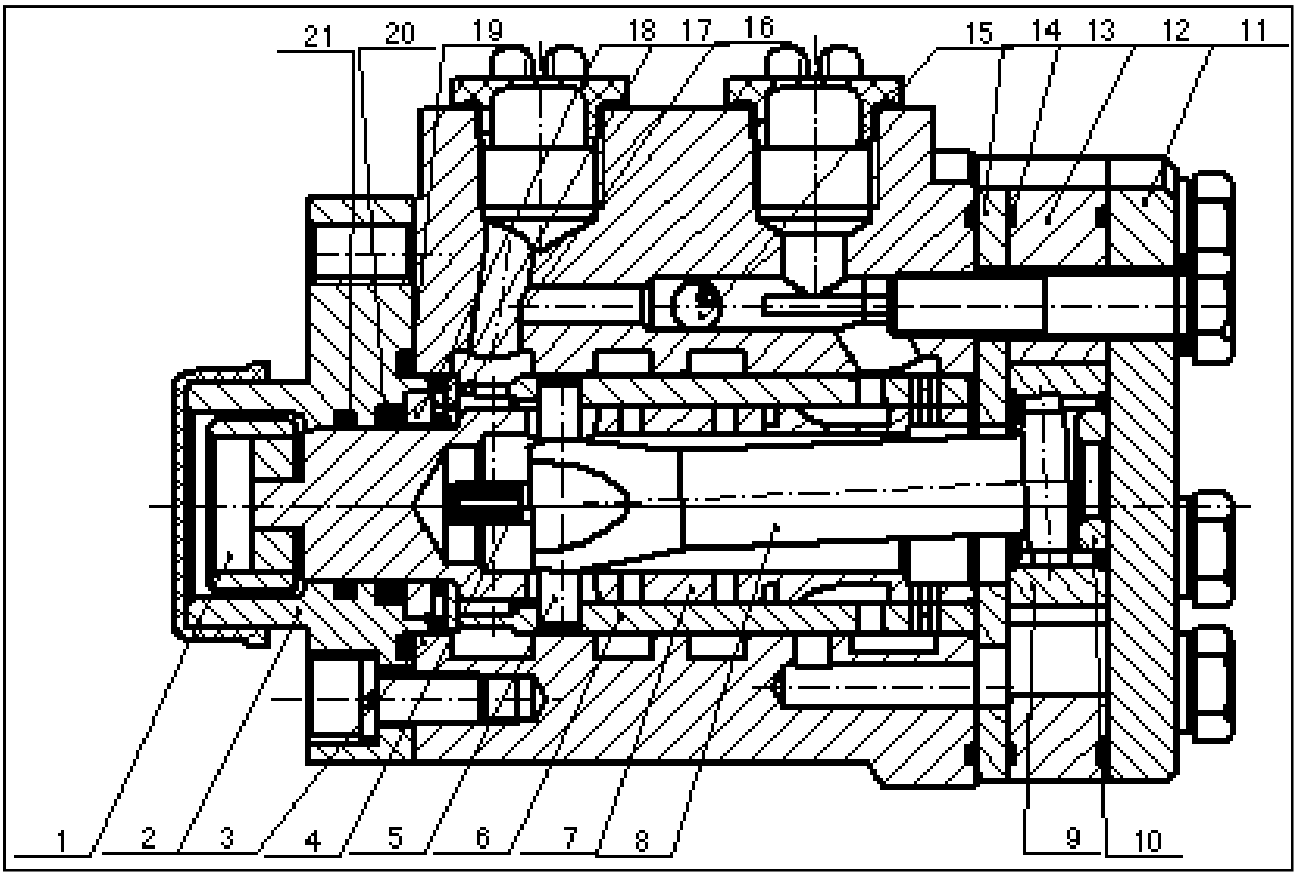

Figure 2

Reference Number	Description	Reference Number	Description
1	Link block	12	Stator
2	Front cover	13	O-Ring
3	Valve body	14	Plate
4	Spring lamination	15	Steel ball
5	Pin	16	Big Baffle ring
6	Valve bush	17	Baffle ring
7	Valve spool	18	Baffle ring
8	Shaft	19	O-Ring
9	Rotor	20	X-Ring
10	Limited post	21	O-Ring
11	Rear cover		

Disassembly steps of steering unit

1. Take out link block.

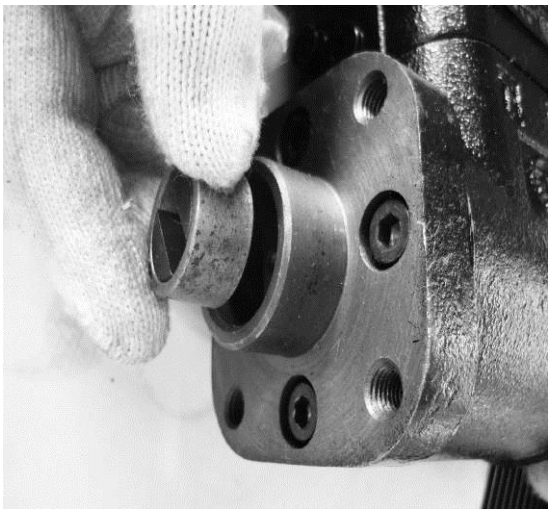

Figure 3

2. Take out front cover.

Figure 4

3. Take out multi-roll bearing

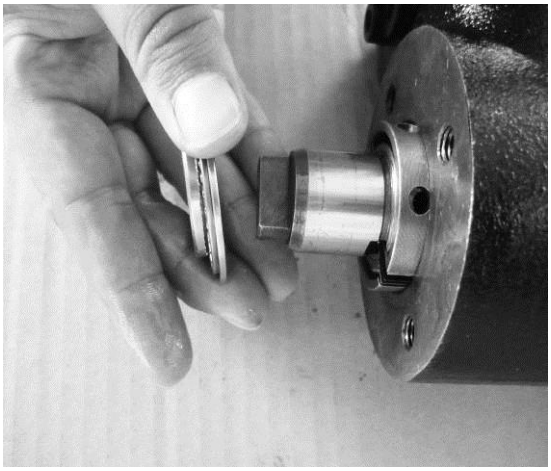

Figure 5

4. Take out bolts of rear cover.

Figure 6

5. Take out rear cover.

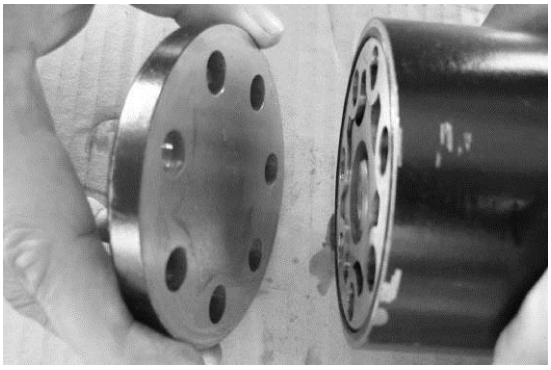

Figure 7

6. Dismantle stator

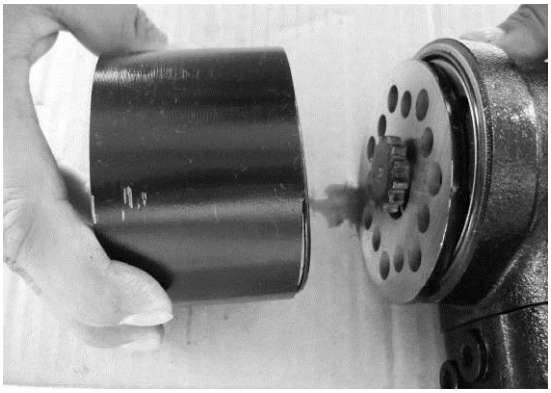

Figure 8

7. O-RING Dismantle O-RING

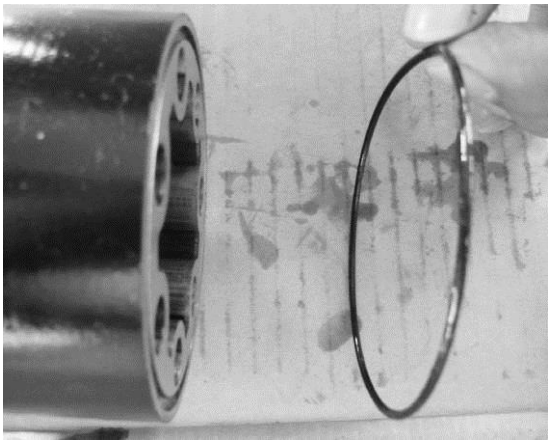

Figure 9

8. Dismantle rotor.

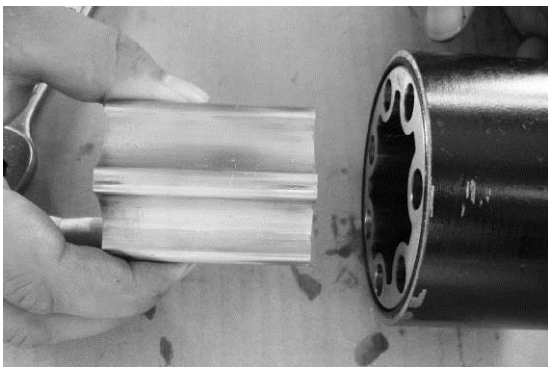

Figure 10

9. Take out limitation block

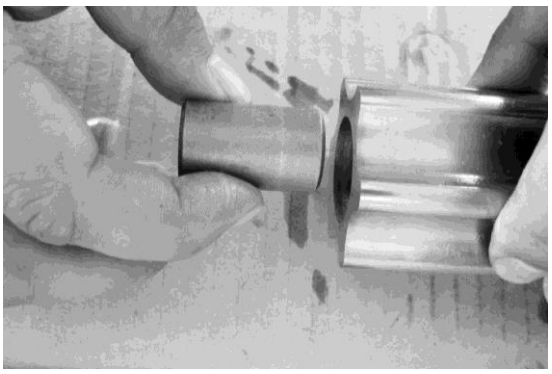

Figure 11

10. Take out link axle

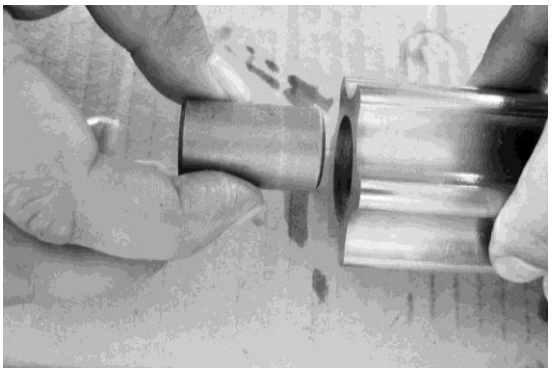

Figure 12

11. Take out clapboard

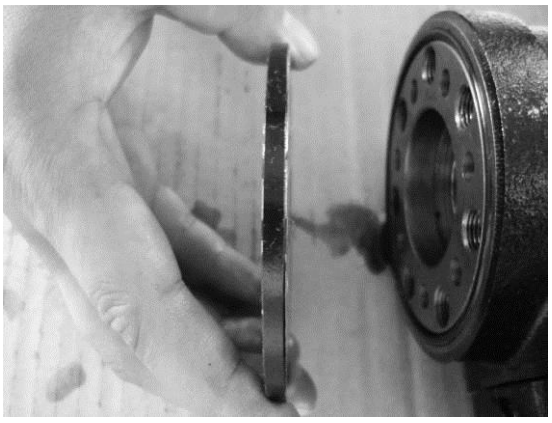

Figure 13

12. Take out valve bush and spool assembly

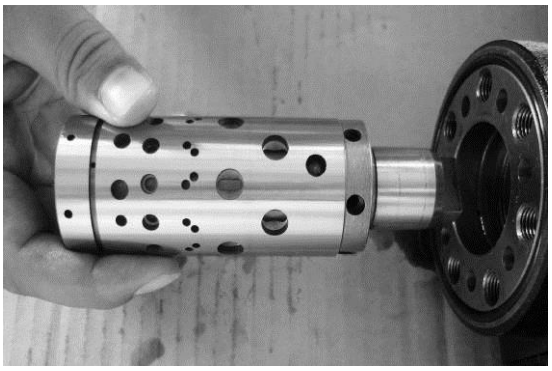

Figure 14

13. Take out dial pin

Figure 15

14. Take out spring lamination

Figure 16

15. Take out valve spool

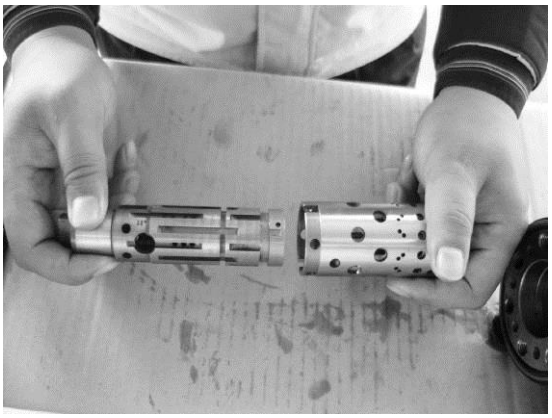

Figure 17

16. Dismantle valve block

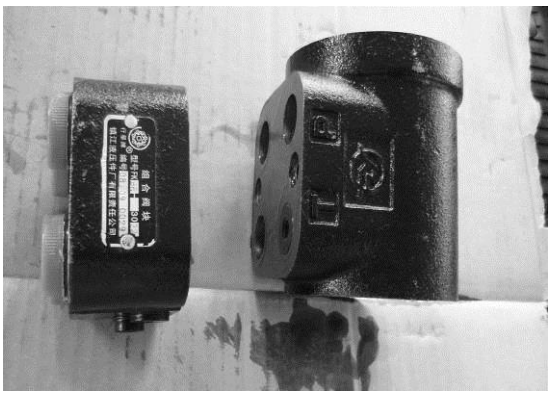

Figure 18

17. Take out check valve

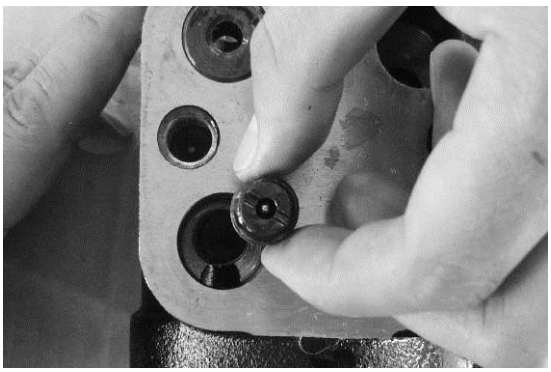

Figure 19

18. Take out oil return throttle valve

Figure 20

19. Take out oil inlet throttle valve

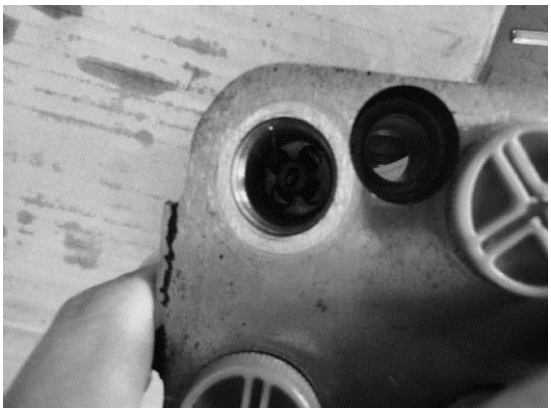

Figure 21

20. Take out oil compensating valve (4EA)

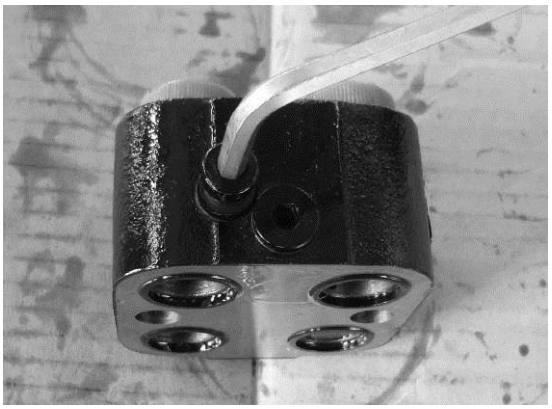

Figure 22

Assembly steps of steering unit

1. Keep four bolt holes of valve body upward.

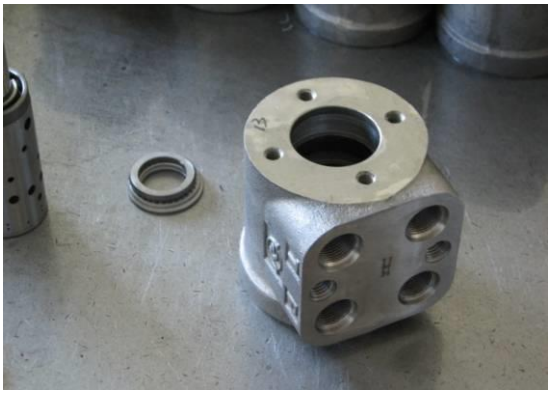

Figure 23

2. Install valve spool, valve bush, spring lamination and dial pin.

Figure 24

3. Install well assembled valve spool and valve bush into valve body

Figure 25

4. Install big baffle ring, needle roller thrust bearing and small baffle ring

Figure 26

5. Install front cover with well assembled sealing ring

Figure 27

6. Keep fourteen holes of steering unit upward

Figure 28

7. Install sealing ring

Figure 29

8. Put Φ8mm steel balls into the thread holes as shown in the picture

Figure 30

9. Install spacer plate and align the holes.

Figure 31

10. Install couple axle, stop dial pin with linkage shaft

Figure 32

11. Install turn stator vice (note: mark on linkage shaft shall align with groove on rotor)

Figure 33

12. Install upper limitation column and sealing ring

Figure 34

13. Install rear cover, combined gasket, bolts, the position shown in the picture by arrow is cotter bolt.

Figure 35

Matters need attention during assembling

1. Clean all parts (except rubber ring) with gasoline or kerosene before assembling. If there is paint on combination surface, clean with acetone, it is forbidden to clean parts with cotton yarn or cloth, soft banister brush or silk shall be used to clean parts, it is better to blow with compressed air, after steering unit is installed well, add 50-100ml hydraulic oil before install in machines, turn around spool, install in machine for test if everything is normal
2. Combination surface of valve body, spacer plate, stator and rear cover must be highly clean, do not knock or scratch.
3. There are spot mark on end surface of rotor and linkage shaft, that is teeth of linkage shaft groove shall align with multiple spline groove inside rotor teeth bottom, pay attention to the relative position during installation.
4. Bolts of rear cover shall adopt qualified combined gaskets.
5. when fastening seven bolts of rear cover, screw on every two bolts in order, screw on gradually, the fastening torque is 40～50 N.m.
6. (Note) “P”, ”T”, ”A”, “B” oil mouth of valve body and valve block shall align with each other one by one during installation.

Hydraulic Schematic

⚠ CAUTION!
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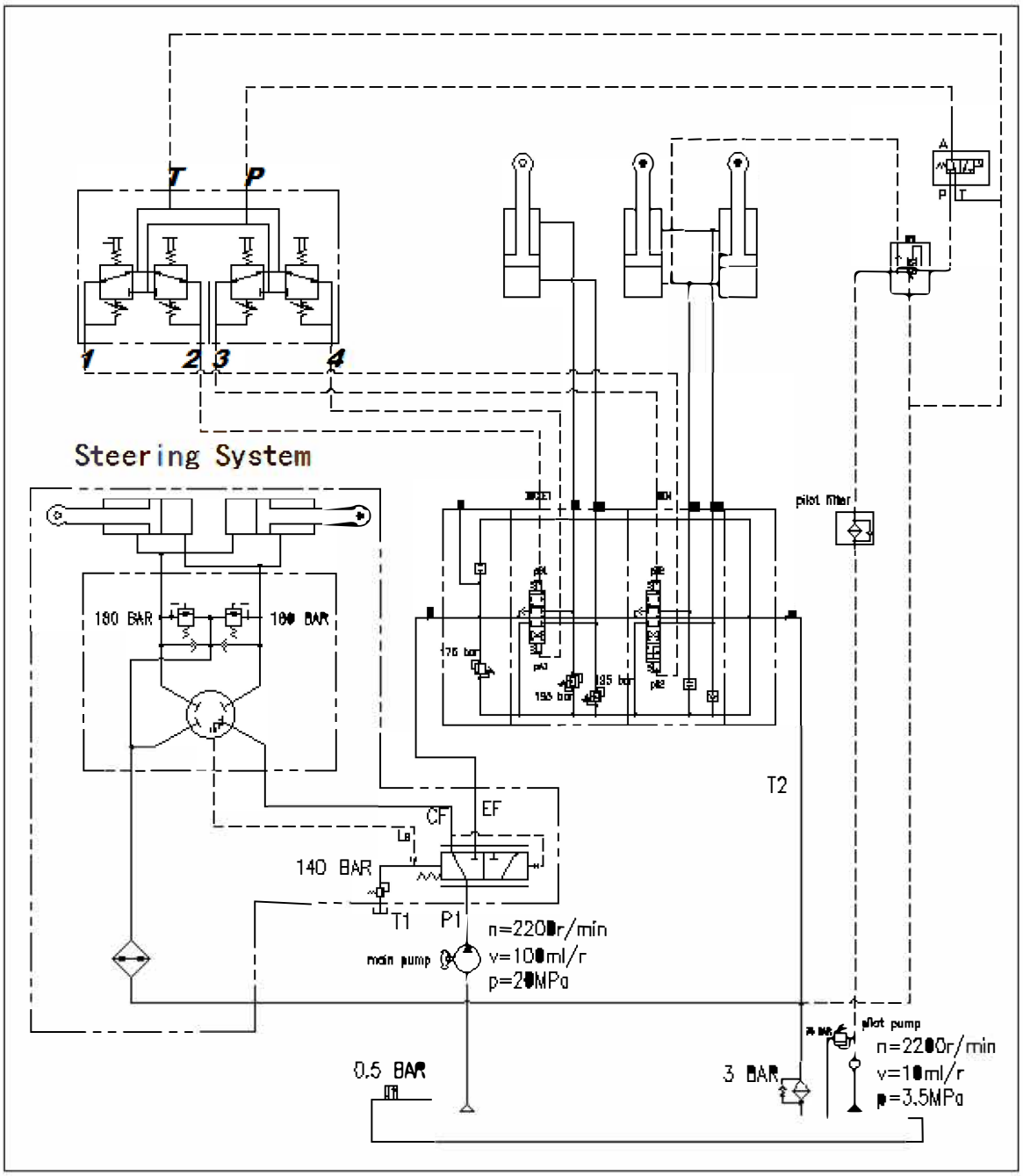
General description(Pilot Lever)

Schematic diagram



BRAKE

BRAKE SYSTEM

⚠ CAUTION!
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General Description

Structure of travelling brake

It usually includes air compressor, oil-water separation combination valve (oil-water separator, pressure control valve), air tank, pneumatic brake valve, air booster pump and caliper disc brake. In air circuit of brake system, there are some other accessories, such as switch of brake light etc.

Working Principle of Travelling Brake

Compressed air is output from air compressor driven by engine, and enters into air tank through oil-water separation combination valve (oil-water separator, pressure control valve). When air pressure in air tank reaches the highest braking pressure (usually around 0.784MPa) of brake system, pressure control valve will close the exit going to air tank, open load discharging mouth and discharge the compressed air from air compressor to the air directly. When compressed air in air tank reaches the lowest pressure (usually around 0.71MPa) of brake system, pressure control valve will open the exit going to air tank, and close load discharging mouth to let compressed air from air compressor into air tank for supplementation until the compressed air in air tank reaches the highest working pressure of brake system.

Following is the fundamental diagram

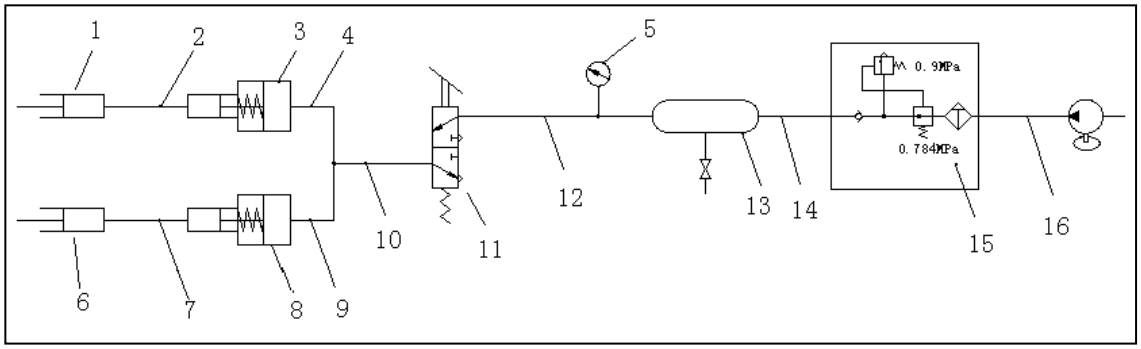

Figure 1

Reference Number	Description	Reference Number	Description
1	REAR AXLE	9	HOSE
2	HOSE	10	HOSE
3	PUMP	11	PEDAL
4	HOSE	12	HOSE
5	SWITCH;PRESSURE	13	ACCUMULATOR
6	FRONT AXLE	14	HOSE
7	HOSE	15	VALVE
8	PUMP	16	HOSE

PARTS LIST

Structure Chart of Brake System

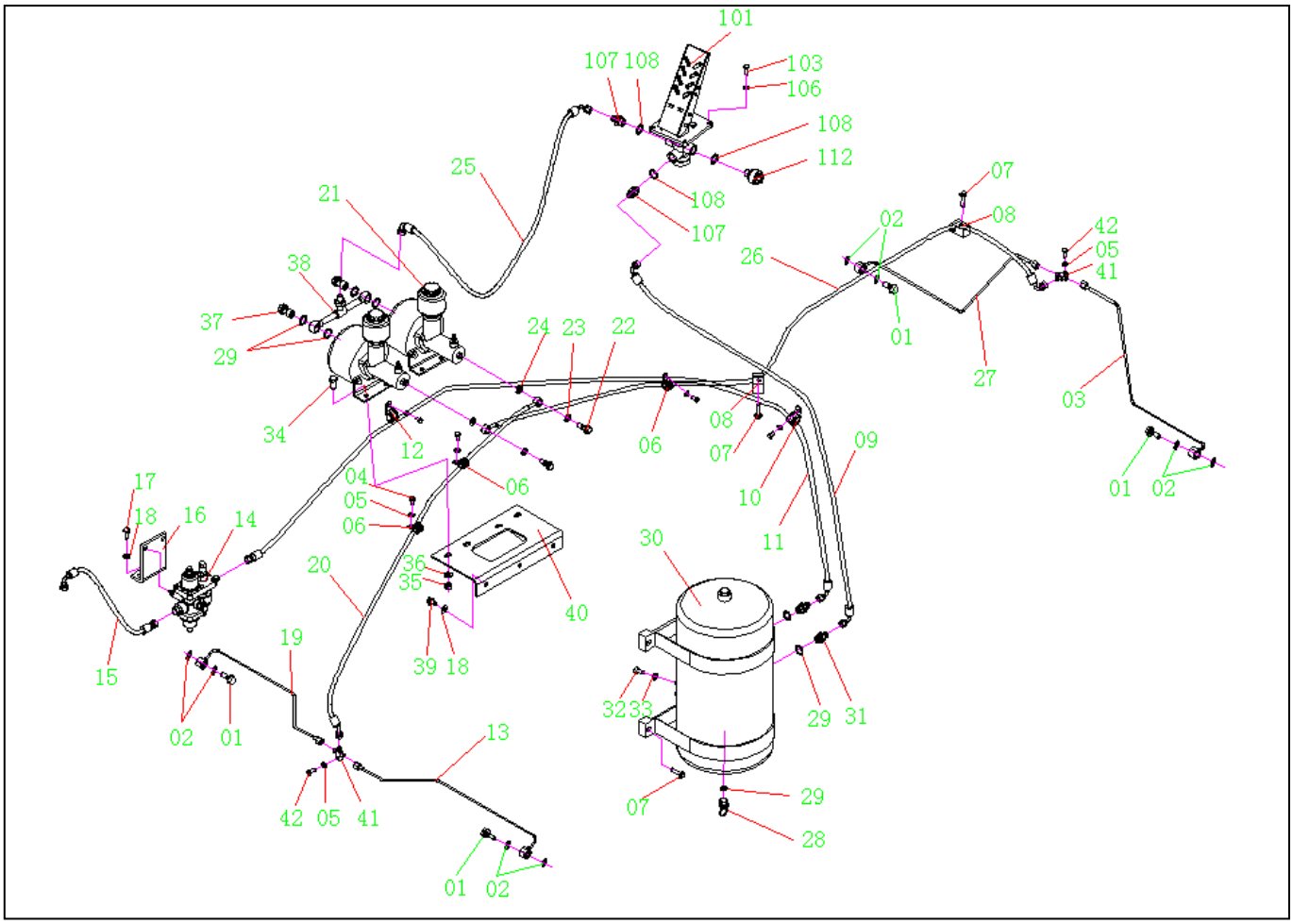

Figure 2

Reference Number	Description	Reference Number	Description
1	BOLT	26	HOSE
2	O-RING	29	TUBE
3	TUBE	30	VALVE
5	BOLT	31	WASHER
7	WASHER PLAIN	32	ACCUMULATION
8	CLAMP	33	ADAPTER
9	BOLT	34	PLUG
10	CLAMP	35	NUT
11	HOSE	36	WASHER;PLAIN
12	CLAMP	38	BOLT
13	HOSE	40	TUBE
14	CLAMP	41	BOLT
15	TUBE	42	BRACKET
16	VALVE		
17	HOSE	101	VALVE;BRAKE PEDAL
18	PLATE	103	BOLT
20	BOLT	106	WASHER;PLAIN
21	PUMP	107	ADAPTER
22	BOLT	108	WASHER
23	SEAL RING	112	SWIICH;LAMP
24	SEAL RING		
25	HOSE		

Oil-water separator

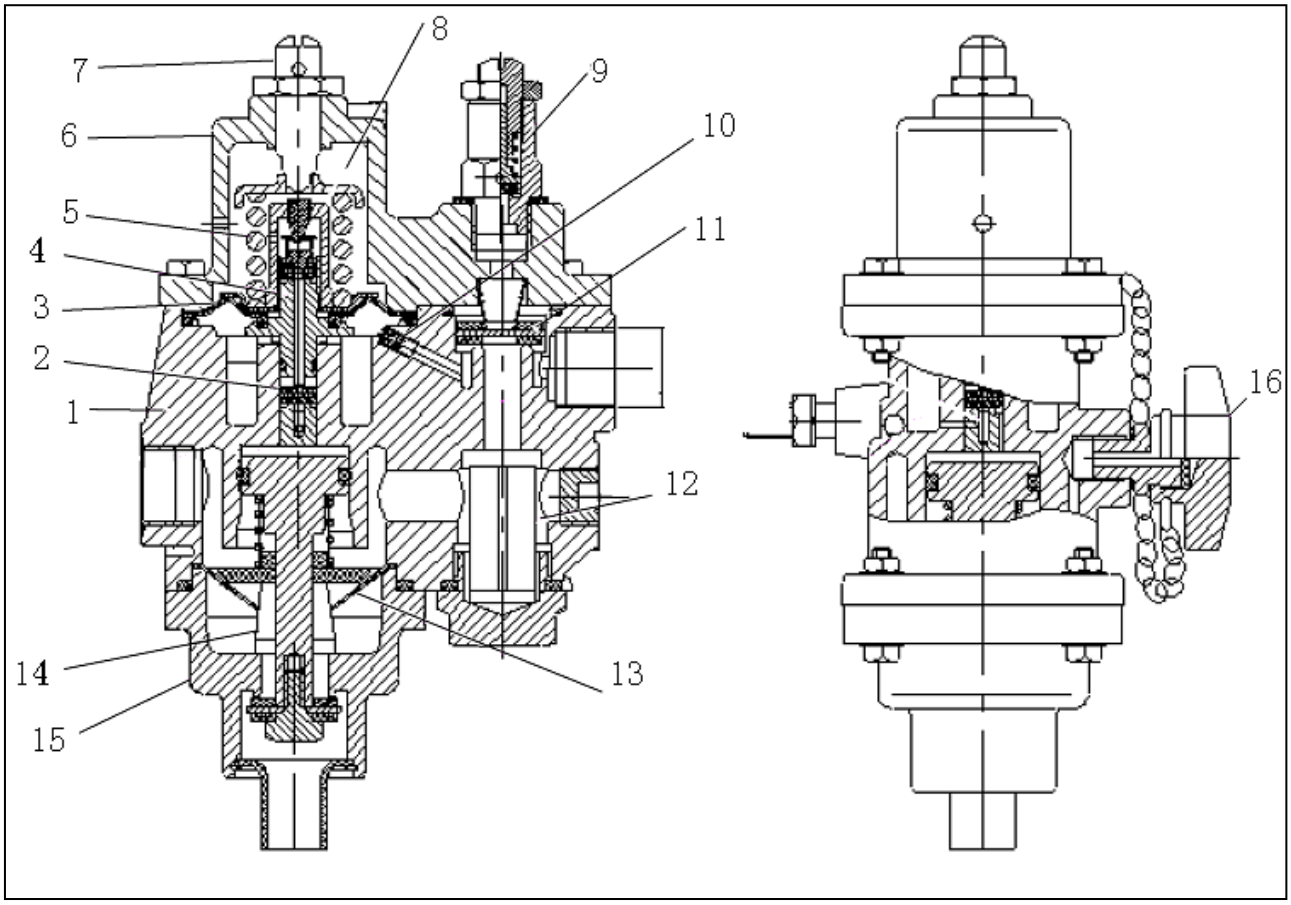

Figure 3

Reference Number	Description	Reference Number	Description
1	SHELL ASS'Y	9	RELIEF VALVE ASS'Y
2	REGULATING VALVE	10	ORIFICE PLUG
3	EAR DRUM	11	ONE-WAY VALVE
4	STEM	12	FILTER ASS'Y
5	REGULATING SPRING	13	OIL COLLECTOR
6	UPPER COVER	14	AIR BLEEDING PISTON
7	REGULATING SCREW	15	LOWER SHELL
8	CONTROLING PISTON ASS'Y	16	AEROFIOL NUT

Pneumatic brake valve

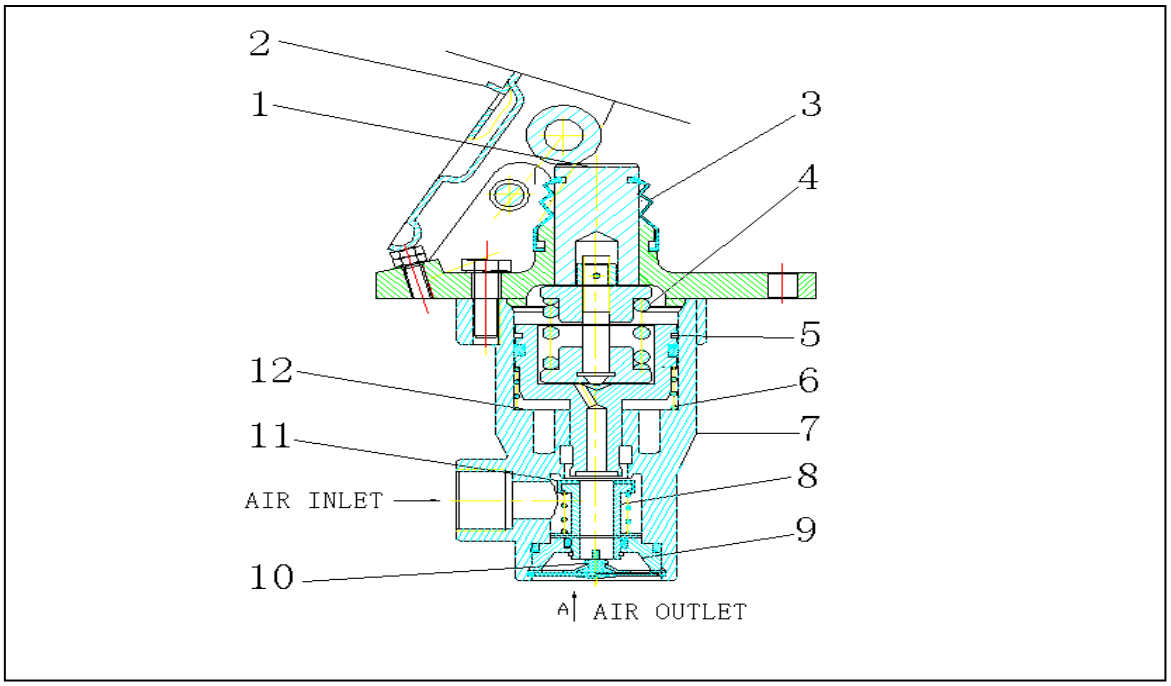

Figure 4

Reference Number	Description	Reference Number	Description
1	MANDRIL	7	VALVE BODY
2	PEDAL ASS'Y	8	INTAKE VALVE ASS'Y
3	ANTIDUST COVER	9	VALVE ASS'Y
4	BALANCING SPRING	10	OUTLET VALVE ASS'Y
5	PISTON ASS'Y	11	SEALING FIN
6	PISTON FOUR SPRING	12	SPRING SEAT

Booster pump

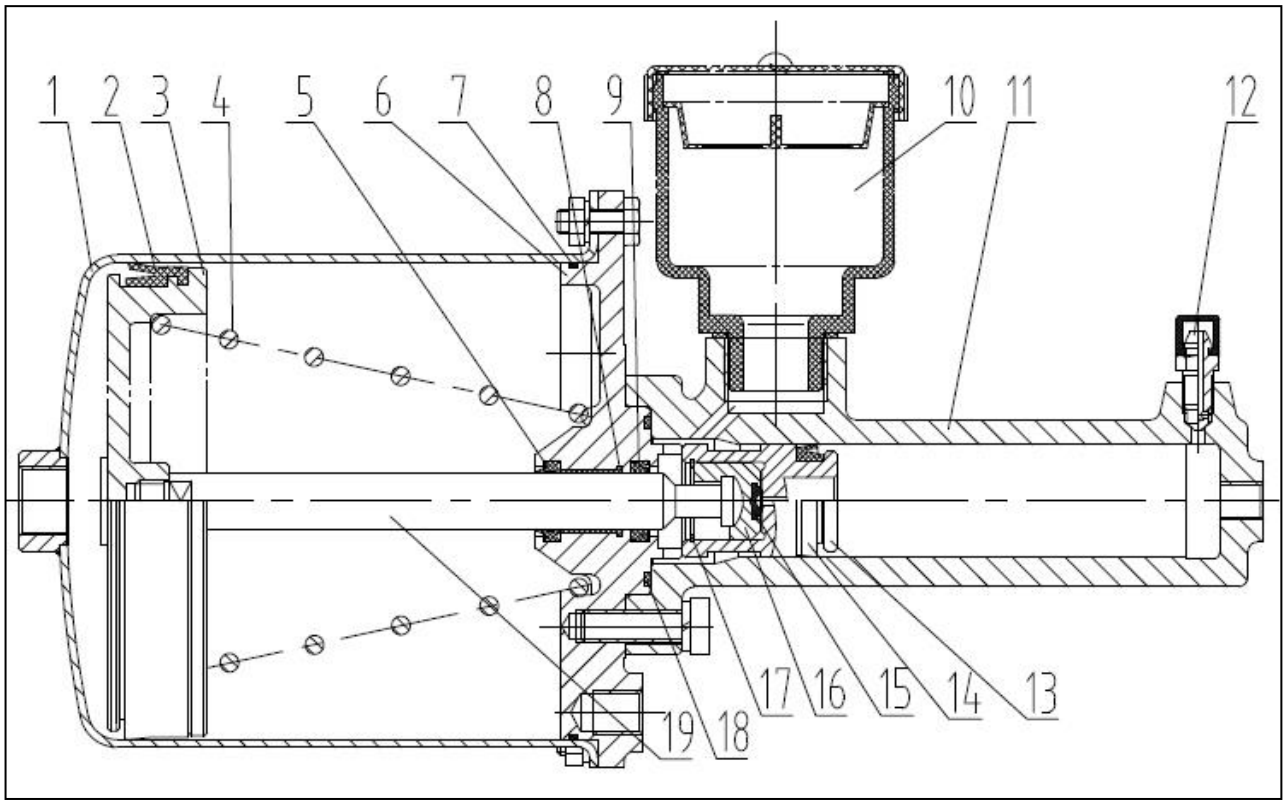

Figure 5

Reference Number	Description	Reference Number	Description
1	STRENGTH CYLINDER	8	PISTON
2	Y-SEAL RING	9	BREAKING PUMP
3	PISTON	10	AIR OUTLET SCREW
4	RELEASING SPRING	11	PUSHING BORER
5	ENDPLATE	12	MAIN PUMP FUR BOWL
6	STORAGE CUP	13	X-SEAL RING
7	PUTTING SEAT		

System Maintenance and Failures Analysis

Brake caliper is locking

The so called “locking” failure refers to brake caliper does not return to the original position, that is one of the common failures of brake system. There are many reasons causing such kind failures, such as brake caliper is blocked, booster pump is blocked or brake caliper valve is blocked. If the brake caliper of front and rear bridge is locking, it is may caused by blocking of pneumatic brake caliper. When the failures are solved, loosen pipeline between booster pump and brake caliper, manually check if the brake caliper can return, if it does not work, it may be caused by blocking of brake caliper, if it can be returned manually, but booster pump may be blocked.

No brake or brake distance is too long

1. Pressure adjustment is improper, which causes pressure of compressed air is too low, brake moment is too small. Adjust pressure gauge to the regulated range.
2. It may be caused because air compressor is air leaking or air inlet and outlet valve are blocked because wearing of cylinder barrel and piston ring is too much, driving belt is too loosened. The worn parts shall be replaced in time.
3. Foot brake valve is adjusted improperly, when brake pedal is stepped to the end, air inlet valve of brake valve is not totally opened, air throttle is caused, air pressure becomes weak when going through foot brake valve, and it cannot reach rated working pressure. Adjust the adjusting screw of brake pedal.
4. Failure of booster pump: sealing ring of booster pump is worn, compressed air goes into low pressure chamber, and movement of brake pump piston is slow, or even there is no moving distance, which cause braking power is not enough; compensation hole of brake pump is blocked by dirt, brake fluid cannot go into ante chamber of piston and oil in brake oil way is not enough.

Brake lags behind

1. Air in brake system is not evacuated, air is compressed when braking, air resets when releasing brake, which affects returning of friction plate.
2. Brake air pressure is not enough;
3. Piston of brake caliper is blocked;
4. Foot brake air bleeder or filter screen is blocked, return spring of valve core is broken, piston cannot return and blocks outlet of air hole, which makes brake air discharging is not smooth, brake pressure and oil pressure cannot reduce quickly, brake moment cannot be released, thus it is lagged behind.
5. The hole of non-pressure chamber of booster pump connecting with air is blocked or return spring is broken, which affects sensitivity of chamber piston return and cause lag.

Braking deviation

The direct reason of braking deviation is the brake moments of the left side and right side wheels are different, the common phenomenon are:

1. Brake caliper of one side of the wheel is locking, it is hard to trip off during travelling, and usually the rectangle sealing ring of brake caliper is broken.
2. When stepping foot pedal, one side brake caliper is braking, while the other side is inside leaking and oil way is blocked, brake fluid cannot go into brake caliper, which makes different brake moments and causes deviation. Under such kind of condition, please check if the sealing rings of gas cap and brake caliper are turned up or the pipelines are blocked.

There is bridle during braking, and brake is hot

1. Connection screws between brake caliper and drive axle are loosed, they rub, impact or abrade each other.
2. There are hard things between brake lining and brake disc.

Storage and usage of brake fluid

1. Brake fluid belongs to inflammable goods; please pay Note to avoid evaporation and fire during usage and storage.
2. Brake fluid shall be stored in warehouse or other assigned place, but it cannot be stored in open air and close to hot source to avoid deteriorating and become invalid.
3. The using department shall set up independent room for storage and there must be obvious marks.
4. It is forbidden to mix and use brake fluid of different brands to avoid layering and lose braking effect.
5. There must be special containers to store brake fluid to avoid mixing of other oil and cause reaction and invalidity.
6. Containers storing brake fluid must be clean and covered to avoid mechanical sundries and water. If the surface of brake fluid has dust and sundries, they must be removed before using, do not mix them, clean and special tool shall be used to add brake fluid.

Replacement of brake fluid and Notes:

Technicians shall guide clients to use and replace brake fluid strictly, when following conditions appear, all brake fluid must be replaced immediately.

1. When brake fluid is mixed with mineral substance, such as gas oil and diesel.
2. When vehicle is travelling normally, brake is light and heavy.
3. When brake fluid in the system is less or when the vehicle having liquid level is warning.
4. When oil color of brake fluid is muddy or there are sundries and sediment.

Notes during replacement:

1. When replacing brake fluid, clean the residual liquid in brake system, and check new brake liquid.
2. When replacing brake fluid, try to reduce the contacting time between brake fluid and air to avoid reducing performance of brake fluid.
3. Before replacing brake fluid, it is better to clean brake system with alcohol, release air in the oil way after replacement.

Treatment of air source

1. Clean air filter core in time.
2. Release water from air tank in time.

PARKING SYSTEM

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TABLE OF CONTENTS

General Description

Structure of parking brake

Driven method is hand flexible shaft control. The handle is located on the floor of the cabin on the right side of the seat, connected to the braking caliper in front-end of the Transmission box through a flexible shaft.

Working principle of parking brake:

After the wheel loader stops, pull up the parking brake handle, tensing the connecting flexible shaft, clamping the power output flange in front of the gearbox by the braking caliper, then the vehicle will be braking. When the need to move the loader, press the button on the top of the parking brake handle, and press the parking brake handle at the same time, you can release the parking brake. When the parking brake handle is pulled up, parking brake indicator lights; release the parking brake handle, parking brake lights off. Before move the Vehicle, the parking brake handle must be released, and brake indicator light is out. Otherwise it will accelerate wear brake disk, and cause the loss of engine power.

PARTS LIST

Assembly structure chart

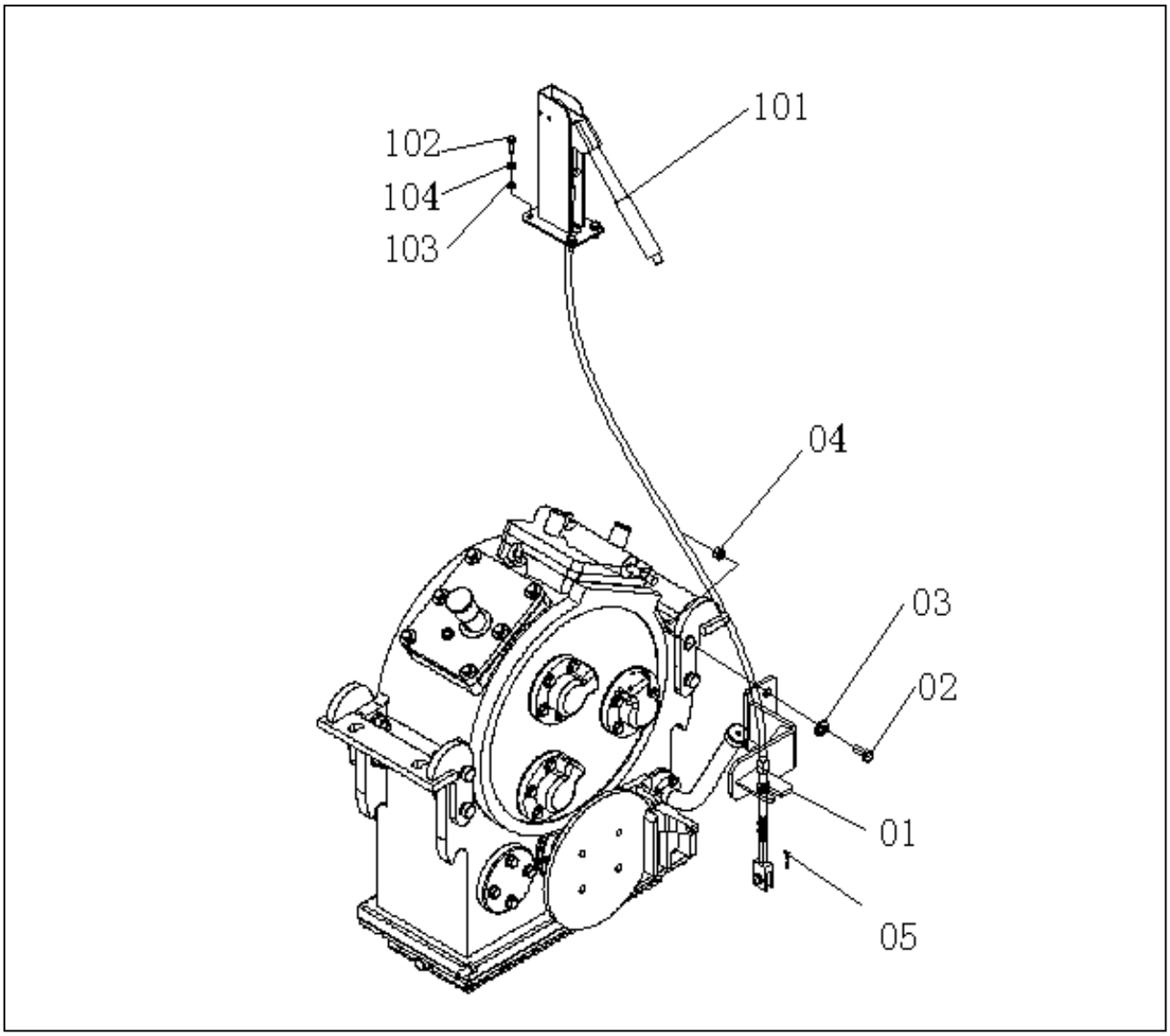

Figure 1

Reference number	Description	Reference number	Description
1	BRACKET	101	BRAKE PAKING
2	BOLT	102	BOLT
3	SPRING WASHER	103	WASHER
4	NUT	104	SPRING;WASHER
5	PIN		

ELECTRICAL SYSTEM

SPC000076

Air Conditioner

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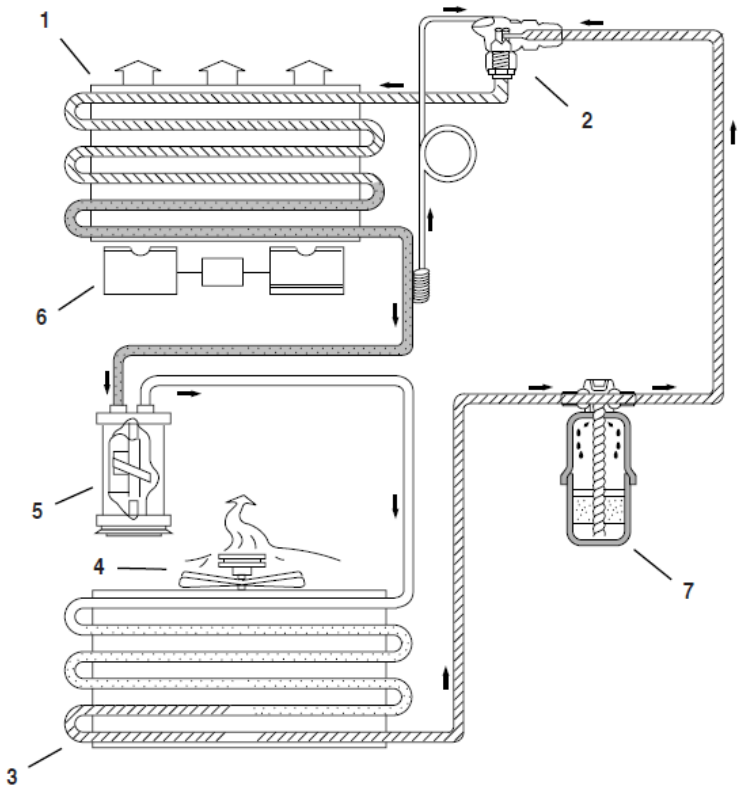
Air Conditioner

Applicable Models

The heater and air conditioner are combined into one blower unit under the operator's seat. If
necessary, the operator can control inner temperature using the operation panel installed in the top of the evaporator;

REFRIGERANT CIRCULATION



Reference Number	Description
1	Evaporator
2	Expansion Valve
3	Condenser
4	Condenser Fan
5	Condenser Fan
6	Blower Fan
7	Receiver Dryer

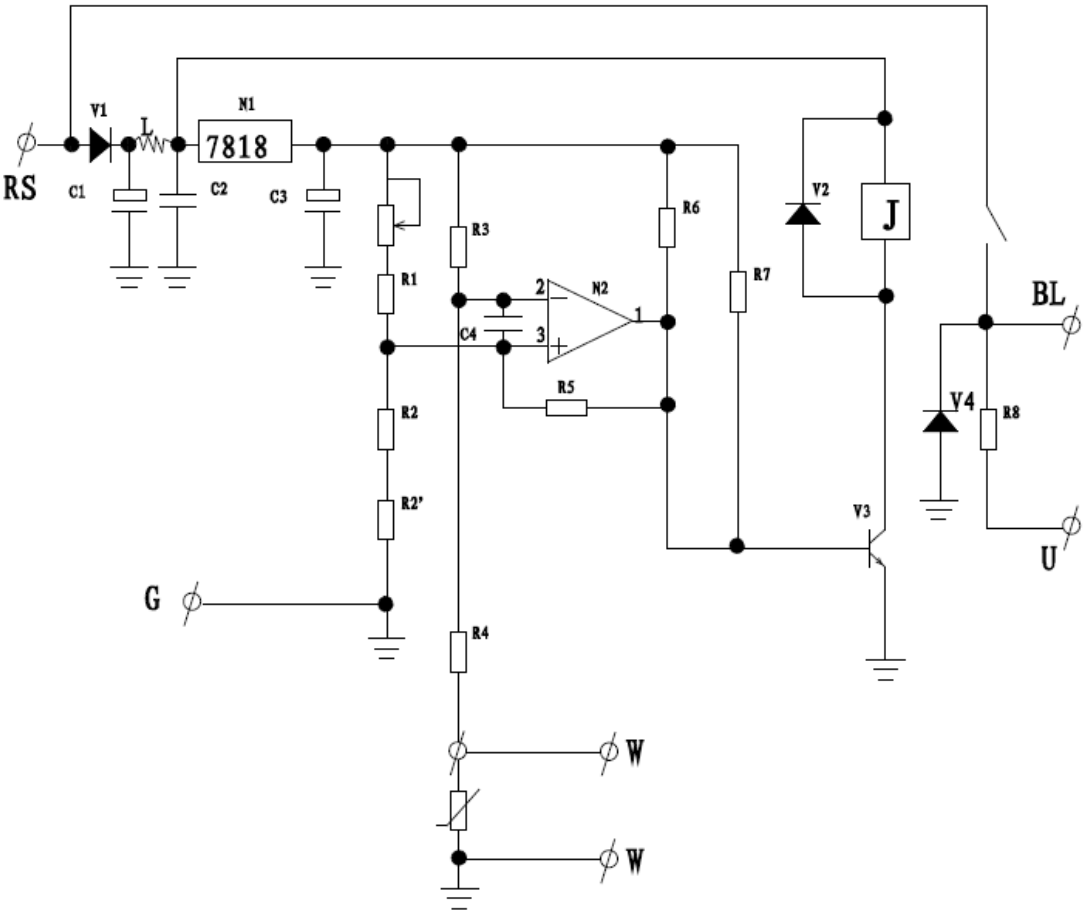
Shading	Temperature	Refrigerant State
	High	High-pressure Gas
	High	High-pressure Liquid
	Low	Low-pressure Liquid
	High	High-pressure Gas/Liquid
	Low	Low-pressure Gas

• Refrigerant (R134a) is compressed to approximately 15 kg/cm2 (213 psi) within the compressor.
• The compressed refrigerant flows into the condenser at high temperature (approximately 80°C (176°F)).
• The refrigerant in the condenser is cooled to approximately 60° by the condenser fan. At this time the refrigerant changes from the gas to the liquid state, even though the temperature has only been reduced 20°C (68°F). (From 80° - 60°C (176° - 140°F)).
• The refrigerant in its liquid form is injected into the evaporator through the expansion valve. At this time the pressure is reduced by approximately 2 kg/cm2 (28 psi) and the temperature is also reduced. As a result, the refrigerant absorbs the heat from the air surrounding the evaporator creating a cooling effect and changes from the gas to the liquid state.
• The refrigerant again flows into the compressor in the gaseous state and the process is repeated.

WARNING!

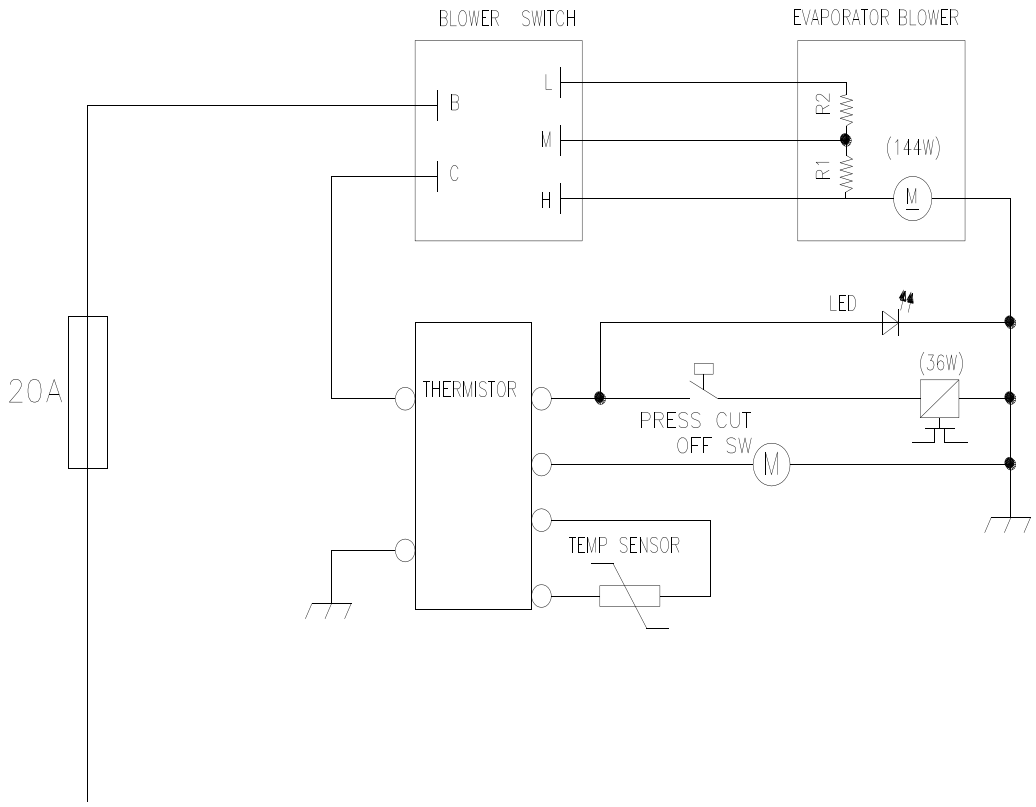
Refrigerant gas is pressurized and sealed in the air-conditioning system. Special precautions are required for the proper recharging or release of refrigerant. Release of refrigerant into the atmosphere is strictly regulated by law. Make sure that you are in compliance with all mandated federal, state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

CONTROL PANEL



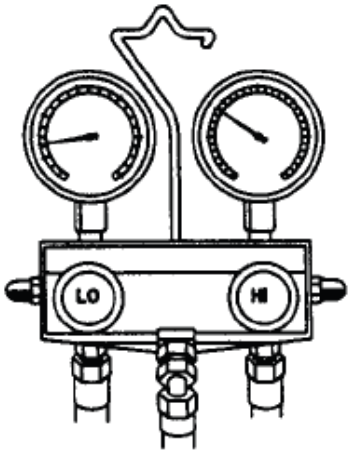
AIR-CONDITIONING SYSTEM

CIRCUIT DIAGRAM



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.

4. Check high / low-pressure of refrigerant.

1	**High-pressure: 8 - 10 kg/cm^2 (114 - 142 psi)** **Low-pressure: Approximately 1 kg/cm^2 (14 psi)**		
Possible Cause: Low Refrigerant Level			
Step	**Inspection Item**		**Remedy**
1	Check for traces of refrigerant oil.	Yes	Reassemble using correct tightening torque.
		No	Go to next step.
2	Using a leak detection device or soapy water check for refrigerant leakage at all major components and joints.	Yes	Repair leaking component.
		No	Recharge system to correct pressure.

2	**High-pressure: Over 23 kg/cm^2 (327 psi)** **Low-pressure: Approximately 2.5 - 3 kg/cm^2 (36 - 43 psi)**		
Possible Cause: Overcharge, Frost on condenser			
Step	**Inspection Item**		**Remedy**
1	Check for condenser pin damage or contamination.	Yes	Clean, repair or replace condenser.
		No	Refrigerant overcharge.

3	**High-pressure: Approximately 20 - 25 kg/cm^2 (284 - 356 psi)** **Low-pressure: Approximately 2.5 - 3.5 kg/cm^2 (36 - 50 psi)**
Possible Cause: Air in system.	
1. Recover any remaining refrigerant. 2. Vacuum out system. 3. Recharge system. **NOTE:** *If the system has been exposed to the air for a long period of time, replace the receiver dryer.*	

4	**High-pressure: Over 6 kg/cm^2 (85 psi)** **Low-pressure: Approximately 760 mmHg (Negative Pressure)**		
Possible Cause: Refrigerant does not circulate			
Step	**Inspection Item**		**Remedy**
1	1. Connect manifold gauge and start engine. 2. Turn on air conditioner. 3. Set blower switch to HIGH position. 4. Turn air conditioner OFF and wait 10 minutes. 5. Recheck high / low-pressure readings. High-pressure: 13 - 19 kg/cm^2 (185 - 270 psi) Low-pressure: 1.5 - 3.3 kg/cm^2 (21 - 47 psi)	Yes	Moisture in system, replace receiver dryer.
		No	Contaminated system, replace expansion valve. (Replace evaporator core assembly.)

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

6	**High-pressure: Over 22 - 23 kg/cm^2 (313 - 327 psi)** **Low-pressure: 2.5 kg/cm^2 (36 psi)**		
Possible Cause: Refrigerant pressure problem due to defective expansion valve or temperature sensor.			
Step	**Inspection Item**		**Remedy**
1	Inspect whether the temperature sensor is installed properly.	Yes	Replace expansion valve.
		No	Exchange duct sensor.

7	**High-pressure: Over 7 - 11 kg/cm^2 (100 - 156 psi)** **Low-pressure: 4 - 6 kg/cm^2 (57 - 85 psi)**
Possible Cause: Low refrigerant pressure due to poor compressor compression	
Inspect and replace compressor if necessary.	

Electrical System

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SAFETY PRECAUTIONS

CAUTION!

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

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

OVERVIEW

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

Electric Wire Color

SymbolW White	Color
G	Green
Or	Orange
B	Black
L	Blue
Lg	Light green
R	Red
Gr	Gray
P	Pink
Y	Yellow
Br	Brown
V	Violet

NOTE: *RW: Red wire with White stripe*

R - Base Color, W - Stripe Color

NOTE: *0.85G: Nominal sectional area of wire core less insulator = 0.85 mm2 (0.03 in2).*

ELECTRIC SUPPLY SYSTEM

The electric power circuit supplies electric current to each electric component. It consists of a battery, battery relay, starter switch, main switch, fusible link and fuse box.

The negative terminal of the battery is grounded to the vehicle body.

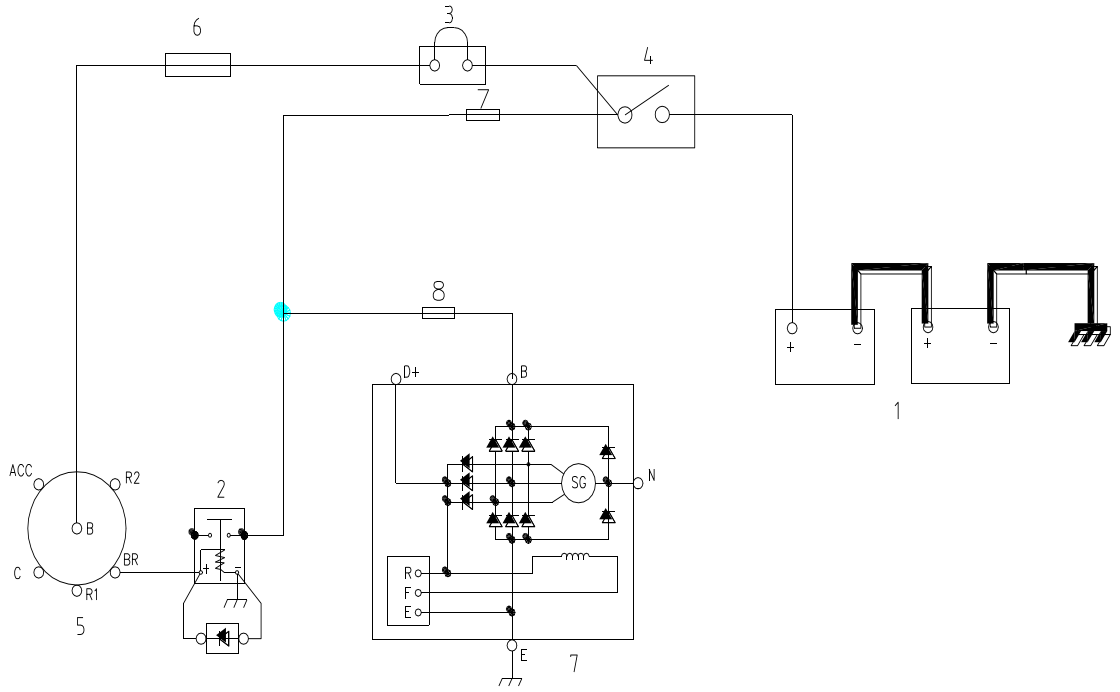
Even when the starter switch is in the "OFF" position, electric current is supplied to the following components through battery, to the main switch, and then to the fuse box.

1. Cabin light
2. "B" terminal of starter switch
3. "B" terminal of blinker unit (for hazard warning light)
4. The source terminal of electric power of engine control unit (ECU).

When the starter switch (5) is in the " ON and START" positions, the current flows from the battery (1), to the main switch(5), to fusible link(3), to the fuse box (6), to the starter switch (5) "B" terminal/ starter switch "BR" terminal, and then to the battery relay (2) "BR" terminal. which activates the coil of the battery relay (2) 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.



STARTER SWITCH CONNECTION

PST \ TML	B	BR	R1	R2	C	ACC
OFF	○					
PREHEAT	○	○	○			
ON	○	○				○
START	○	○		○	○	○

ELECTRICAL POWER CIRCUIT DIAGRAM

Reference Number	**Description**
1	Battery
2	Power Relay
3	Fusible Link
4	main switch

Reference Number	**Description**
5	Starter switch
6	Fuse
7	Alternator
8	Fuse

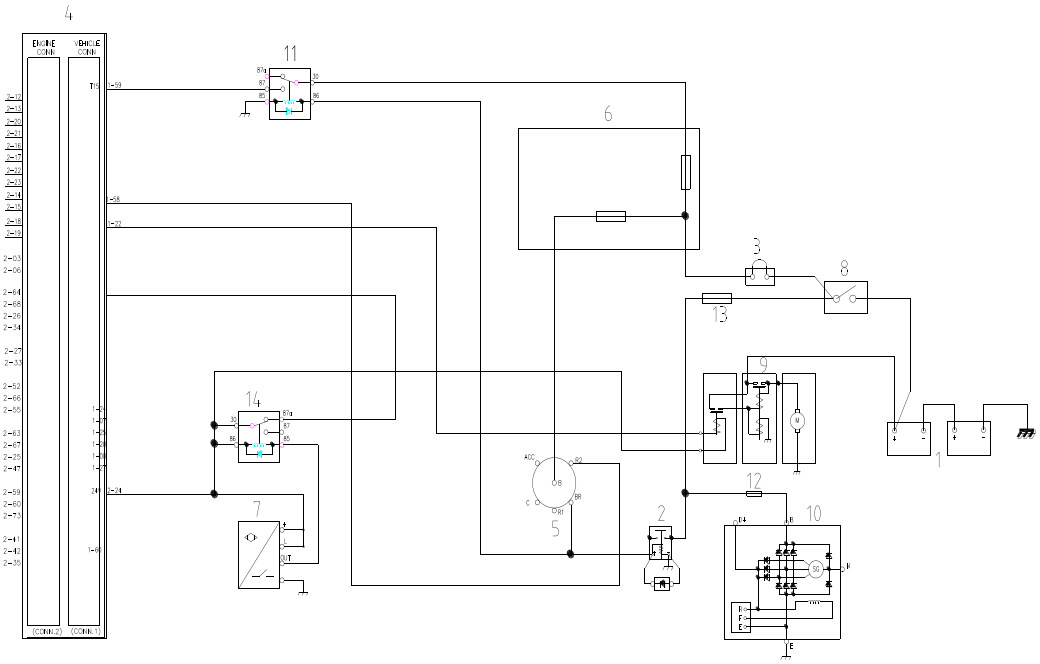
ENGINE STARTING CIRCUIT

Operation During Start Process

When the starter switch is turned to the start position, the ECU relay (11) is closed ,and the current flow from ECU “24”terminal to start relay than back to ECU”22”terminal;than the current flow from battery(1) to the start motor(9) ;
The engine can be cranked only when the transmission selector switch is the neutral position. If the transmission selector switch is in the forward or reverse, the current flow from ECU to neutral relay(14) to sensor (7),so the ECU terminal “54” no current, This prevents the start relay from closing.

STARTER SWITCH CONNECTION

PST \ TML	B	BR	R1	R2	C	ACC
OFF	○					
PREHEAT	○	○	○			
ON	○	○				○
START	○	○		○	○	○

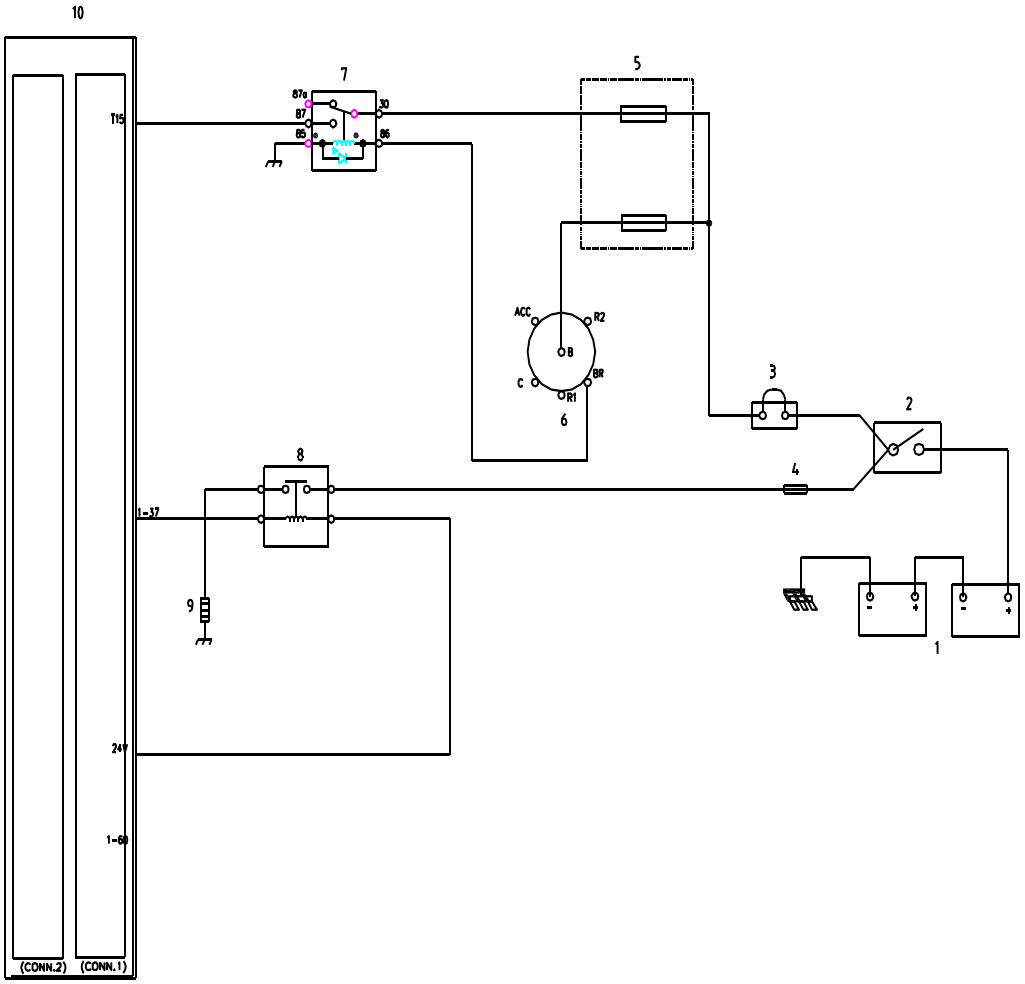


Reference Number	Description
1	Battery
2	Power Relay
3	Fusible Link
4	Engine Control Unit (ECU)
5	Starter Switch
6	Fuse Box
7	Sensor
8	Main Switch

Reference Number	Description
9	Starter
10	Alternator
11	ECU Relay
12	Fuse
13	Fuse
14	Neutral Relay
15	

ENGINE PREHEATING SYSTEM

Intaking air heaters are implanted at two places. When the starter switch (6) is turned to the "ON" position, resistence equivalent to engine temperature sensor is sent to engine control unit (10).
The engine control unit (10) read the temperature according to the checked resistence. When the temperature is below specified coolant temperature the engine control unit (10) flows current from CN2-24 terminals to heater relay (8).
The current from air heater relay (8) through "C" an "D" terminals activate the coil, then current flow sequently from battery (1), to main switch (2), to fuse(4) than to terminal of air heater relay (8), to air heater (9) to finally preaheat the engine.
While the preheating lamp lights on the gauge pannel.
Preheating time can be different each time according to the engine temperature.



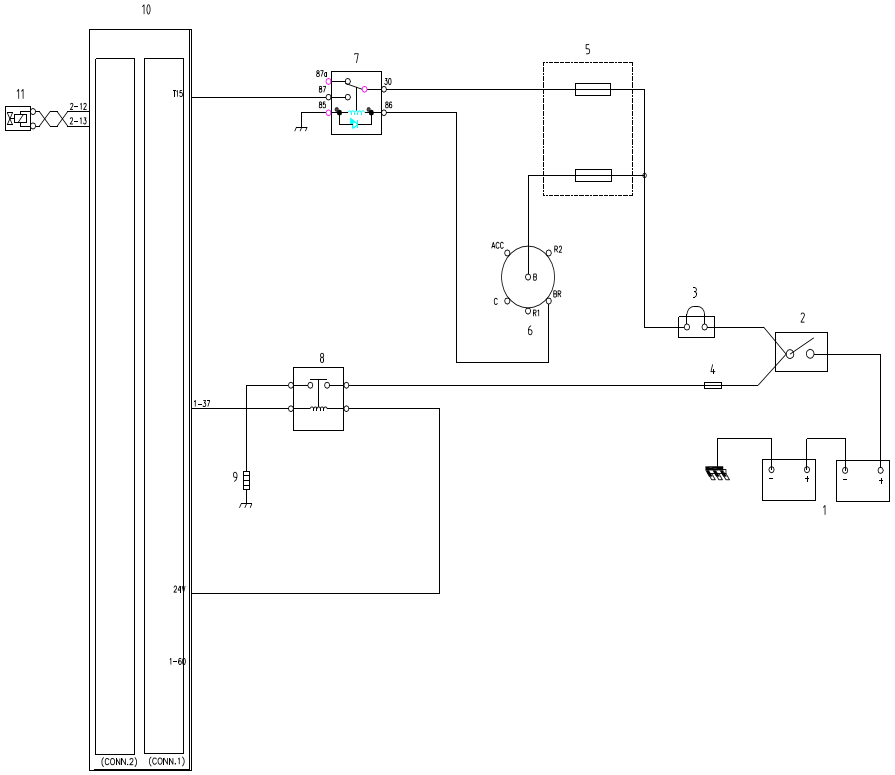
Reference Number	Description
1	Battery
2	Main Switch
3	Fusible Link
4	Fuse
5	Fuse Box

Reference Number	Description
6	Starter Switch
7	ECU Relay
8	Preheat Relay
9	Heater
10	ECU

ENGINE STOP SYSTEM

This system has no engine stop system for special use like an engine stop motor or a fuel shutoff valve and so stops the engine by shutting off fuel when the fuel injector solenoid(11) controlling engine output acts opening and shutting movement according to the position of the starter switch(6).

When the starter switch(6) is in off position, CN1-59 terminal voltage of engine control unit(10) is shut off, the source of electric power of injector solenoid(11) is shut off, and fuel supplying to engine cylinder is shut off and so the engine is stopped.



Reference Number	Description
1	Battery
2	Main Switch
3	Fusible Link
4	Fuse
5	Fuse Box
6	Starter Switch

Reference Number	Description
7	ECU Relay
8	Preheat Relay
9	Heater
10	ECU
11	Injector Solenoid

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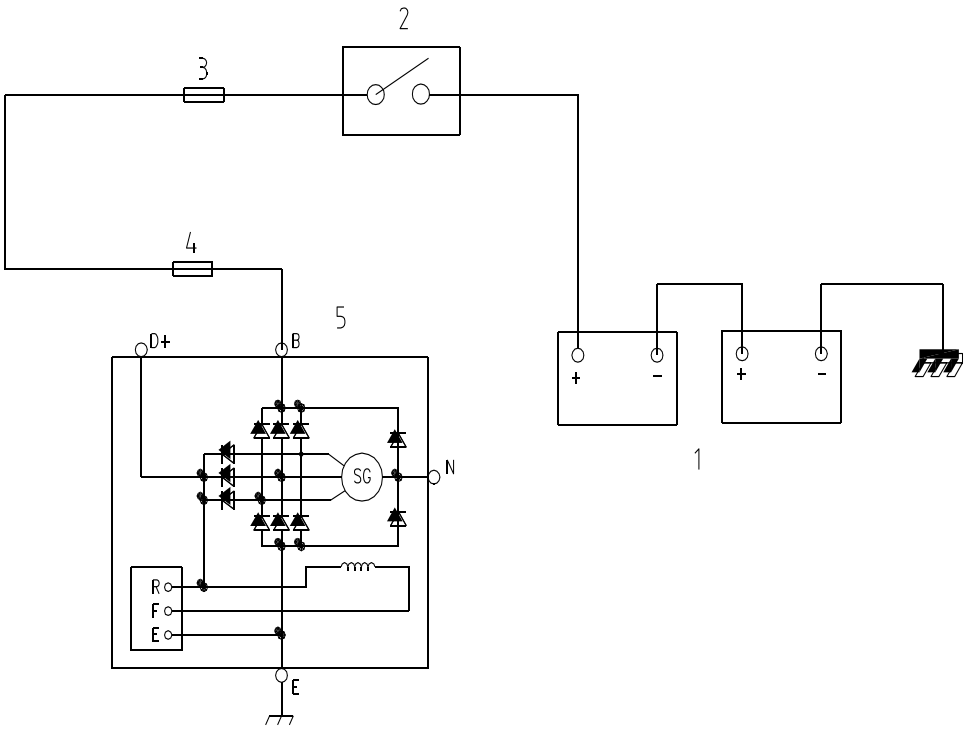
CHARGING SYSTEM

When the engine is started from this condition the alternator (5) starts charging. The current flows from the "B" terminal of alternator (5), to the fuse (4), to the fuse (3), and to the main switch(2) to the battery (1).

The alternator also supplies electric current to other electrical components. When the alternator (5) starts to operate,;

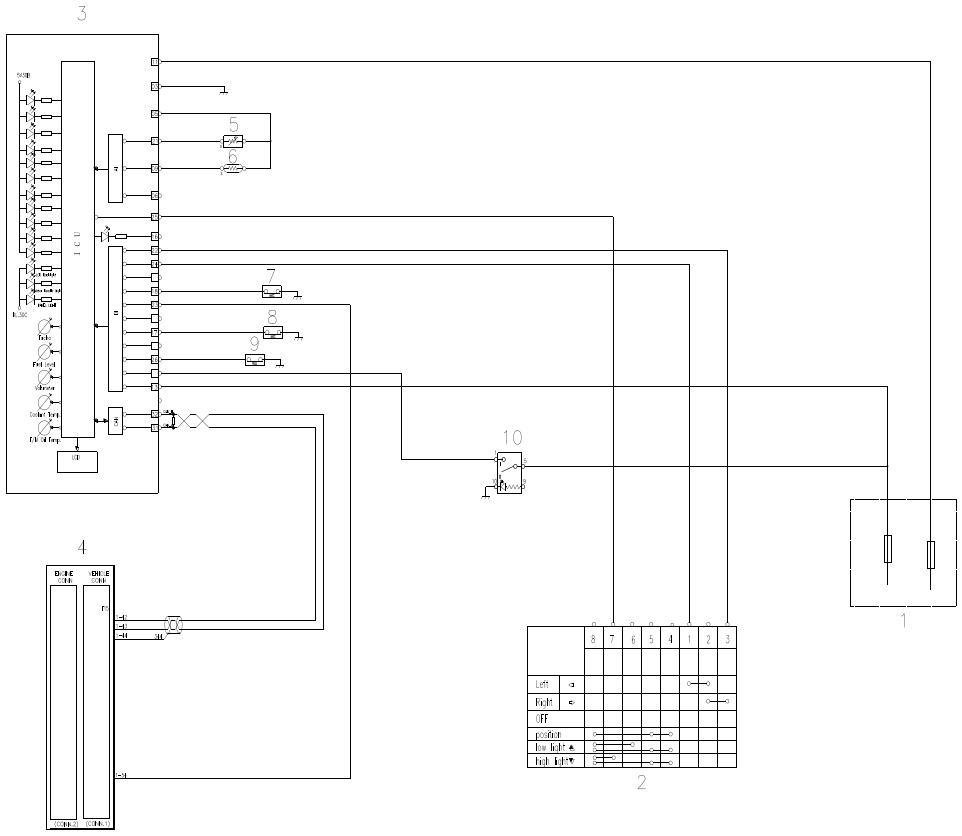


Reference Number	Description
1	Battery
2	Main Switch
3	Fuse
4	Fuse
5	Alternator
6	

Instrument Panel Function Check

When the starter switch is turned to the "ON" position, all
displays, switch lights and warning lights will be turned "ON" for two seconds.

Monitoring System Schematic



Reference Number	Description
1	Fuse box
2	Combin. switch
3	Gauge panel
4	ECU
5	FUEL LEVEL SENSOR
6	T/C OIL TEMP. SENSOR
7	PARKING BRAKE SW
8	T/M OIL-PRESSURE SW
9	Air-PRESSURE SW
10	Pilot lock SW

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WINDSHIELD WIPER

You can control windshield wiper by operating wiper washer switch (3) and (5).

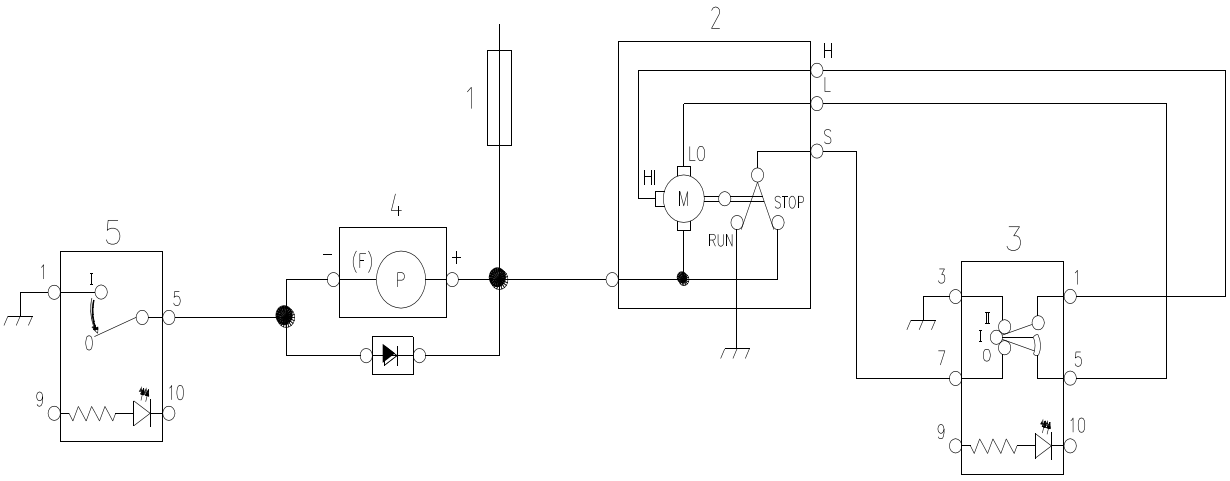
1. Low speed wiper action (1st).

Wiper acts in low speed through fuse box (1) to the power terminal of wiper to the L terminal of wiper motor (2) then to the wiper switch(3) ,then back to the S terminal of the wiper motor then to the ground;

2. High speed wiper action (2nd).

Wiper acts in high speed through Fuse box (1) to the power terminal of wiper to the H terminal of wiper motor (2). then to the wiper switch(3) ,then back to the S terminal of the wiper motor then to the ground;

3. When you turn off switch during Low speed wiper action (1st) or High speed wiper action (2nd), electric currents flow through Fuse box (1) to the power terminal of wiper motor (2) to the stop terminal of wiper , than the wiper stops.



Reference Number	Description
1	Fuse box
2	Wiper
3	Wiper Switch
4	Washer
5	Washer Switch

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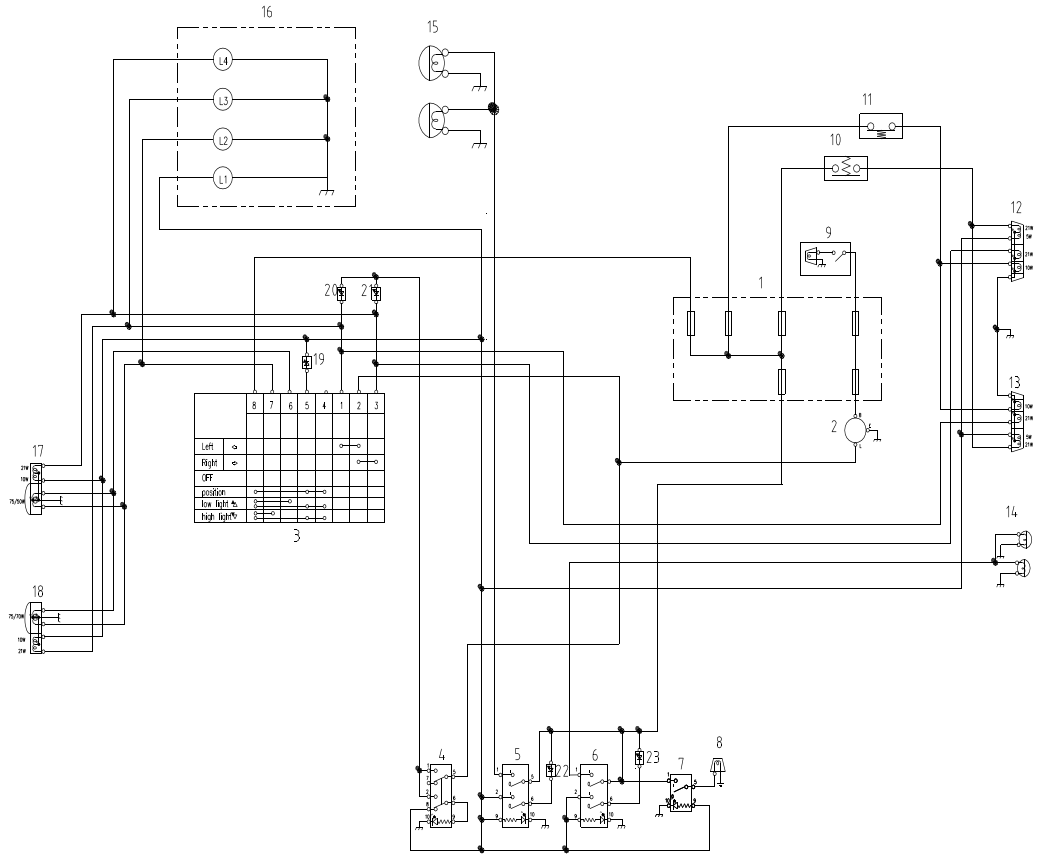
LIGHTING SYSTEM

Light Circuit



Reference Number	Description
1	Fuse box
2	Blinker Unit
3	Combination Switch
4	Hazard Switch
5	Front Working Light Switch
6	Rear Working Light Switch
7	Rotating lamp swtich
8	Rotating lamp
9	Room Lamp
10	Stop Light Switch
11	Back Light Switch
12	Rear Combination Light (R)

Reference Number	Description
13	Rear Combination Light (L)
14	Rear Working Light
15	Front Working Light
16	Gauge
17	Headlight (R)
18	Headlight (L)
19	DIODE
20	DIODE
21	DIODE
22	DIODE
23	DIODE
24	

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1. When the combination switch (3) is in the "←" (or "→")position, the current flows from the fuse box (1), to the blinker unit (2), to the combination switch (3), to the front combination light (L) (18) and the rear combination light (L) (13). (or to the front combination light (R) (17) and the rear combination light (R) (12)). This current makes the turn signal light turn "ON." At the same time the current flows to the instrument panel(16) and the turn signal light indicator will be turned "ON."

2. If you operates the hazard light switch (4), the current flows from to the fuse box (1), to the blinker unit (2), to the hazard switch (4), to the diode (20)(21), to the front combination light (L) (18) and the front combination light (R) (17), to the rear combination light (L) (13) and rear combination light (R) (12). This current makes the turn signal light turn "ON." At the same time through the hazard switch (4), the voltage is applied to the indicator light used to light the symbol will be turned "ON." Also the current flows to the instrument panel (16) and the turn signal light indicator will be turned "ON."

3. When the shift lever is in the "R" position, the Back pressure switch (11) is closed ,and current flowing from the fuse box (1), to the Back pressure switch (11) to rear combination light (L) (13) and rear combination light (R) (12), and the reverse light will be turned "ON."

4. When the brake pedal is depressed and at the same time the stop light switch (10) is turned "ON," the current flows the from fuse box (1), to the stop light switch (10) and to the rear combination light (L) (113) and rear combination light (R) (12), and the stop light will be turned "ON."

5. When the front working light switch (5) is in the "ON" position, the current flows from the fuse box (1), to the front working light switch (19) and to the front working light (15).This current makes the front working lights turn "ON."

6. When the rear working light switch (6) is in the "ON" position, the current flows from the fuse box (1), to the rear working light (14). As aresult the rear working light (14) light turns "ON."

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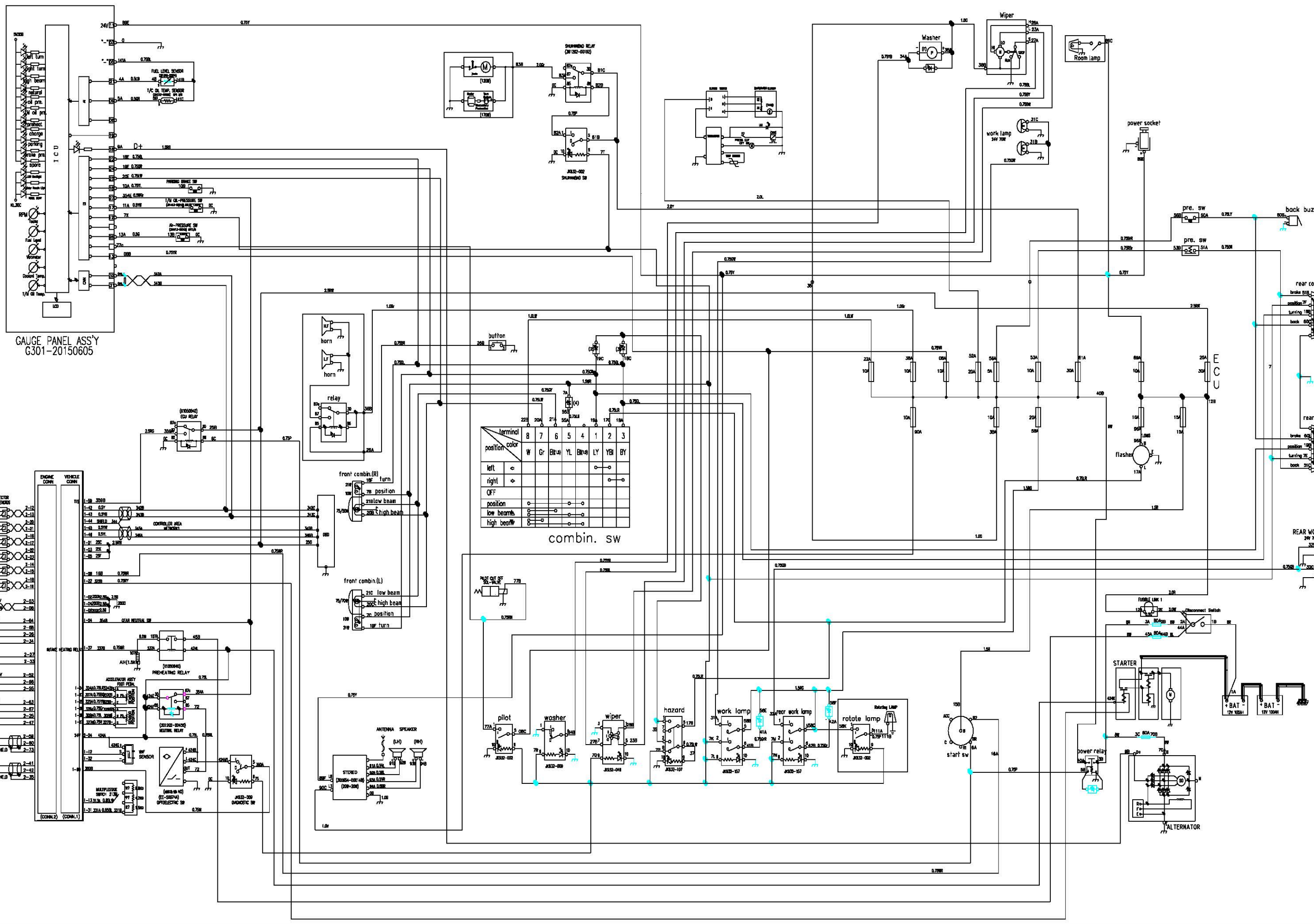
CIRCUIT



GAUGE PANEL ASS'Y
G301-20150605
Wiper
Washer
Room lamp
work lamp
power socket
back buzzer
pre. sw
rear combin. (R)
rear combin. (L)
REAR WORKING
horn
relay
button
front combin.(R)
front combin.(L)
flasher
combin. sw
ECU
STARTER
ALTERNATOR
power relay
start sw
pilot
washer
wiper
hazard
work lamp
rear work lamp
rotate lamp
STEREO
PREHEATING RELAY