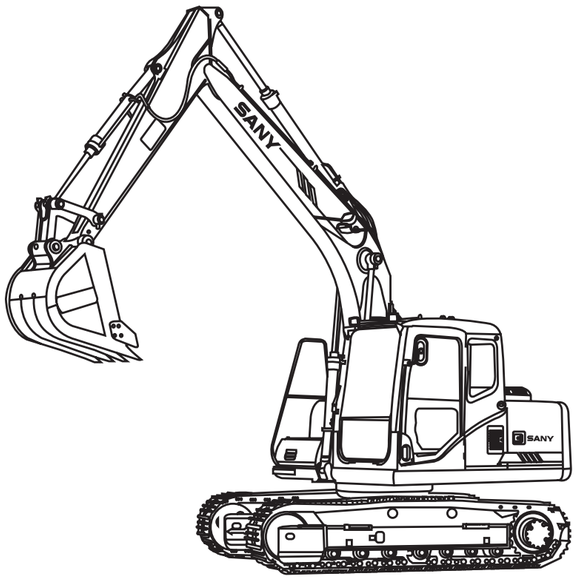
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Quailty Changes the World

Shop Manual

SY215C$_{LC}$



Crawler Hydraulic Excavator

SANY HEAVY MACHINERY LIMITED
318A, Lianggang Road, Lingang Industrial Park, Fengxian District,
Shanghai, P.R. of China 201147

Tel: 0086-21-57008518 Fax: 0086-21-58596210
E-mail: sanyservice@sany.com.cn
Service hotline: 0086-21-58592902
Complaint hotline: 0086-21-58590631
Documentation No.: ZJSYF0301EN(03-12)-SY215CLC



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SY215C$_{LC}$
Crawler Hydraulic Excavator

Shop Manual

- Compiled for experienced technicians, this shop manual aims to provide technical information required for maintenance and repair of the machine.
- Work equipment or optional components not available locally may be included in this shop manual. Consult authorized Sany dealers for information on these parts and components. Material or technical specification is subject to change without prior notice.
- SY215C$_{LC}$ excavators are equipped with CUMMINS QSB6.7 engine.

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⚠ WARNING

Read and follow the safety precautions and instructions in this manual and on the machine decals. Failure to do so can cause serious injury, death or property damage. Keep this manual with the machine for reading and future reference.

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Introduction

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⚠ WARNING

Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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1 INTRODUCTION

1.1 Safety Notice

Proper servicing and repair are extremely important for safe machine operation. The servicing and repair techniques recommended by Sany and described in this manual are both effective and safe. Some of the techniques require the use of tools specially designed by Sany for the specific purpose.

To prevent injury to workers, the symbol ⚠ is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take necessary actions to deal with the situation.

1. General precautions

⚠ **Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully before operating the machine.**

1) Before carrying out any greasing or repairs, read all the safety messages on the machine. For the locations of the safety messages and detailed explanation of precautions, see the Operation and Maintenance Manual.
2) Choose a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the working area clean and make sure that there is no dirt, water, or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

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3) When carrying out any operation, always wear safety shoes and hard hat. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear goggles while striking any parts with a hammer.
   - Always wear goggles while grinding parts with a grinder, etc.
4) When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting the work, hang UNDER REPAIR tags in the operator's cab.
5) Only qualified workers are allowed to carry out work and operation which require license or qualification.
6) Keep all tools in good condition, learn the correct way to use them, and use the proper ones of them. Before starting the work, thoroughly check the tools, machine, forklift, service car, etc.
7) If welding repairs are needed, always have a trained and experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, shielding goggles, cap and other clothes suited for welding operation.
8) Before starting the work, warm up thoroughly to start work under good condition.

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Safety points

1	Good arrangement
2	Correct work clothes
3	Following work standard
4	Making and checking signs
5	Prohibition of operation and handling by unlicensed workers
6	Safety check before starting work
7	Wearing protective goggles (for cleaning or grinding operation)
8	Wearing shielding goggles and protectors (for welding operation)
9	Good physical condition and preparation
10	Precautions against work which you are not used to or you are used to too much

2. Preparations for work

1) Before adding oil or making any repairs, park the machine on a hard and level ground, and apply the parking brake and block the wheels or tracks to prevent the machine from moving.

2) Before starting work, lower the work equipment (blade, ripper, bucket, etc.) to the ground. If this is not possible, insert the lock pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.

3) When disassembling or assembling, support the machine with blocks, jacks, or stands before starting work.

4) Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

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3. Precautions during work

1) Before disconnecting or removing components of the oil, water, or air circuits, first relieve the pressure completely from the circuit. When removing the oil filler cap, a drain plug, or an oil pressure pickup plug, loosen it slowly to prevent the oil from squirting out.
2) The coolant and oil in the circuits are hot when the engine is stopped, so be careful not to get scalded. Wait for the oil and coolant to cool before carrying out any work on the oil or water circuits.
3) Before starting work, stop the engine. When working on or around a rotating part, in particular, stop the engine. When checking the machine without stopping the engine (measuring oil pressure, revolving speed, temperature, etc.), take extreme care not to get rolled or caught in rotating parts or moving parts.
4) Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
5) When raising a heavy component (more than 25 kg), use a hoist or crane. Before starting work, check that the slings (wire ropes, chains, and hooks) are free from damage. Always use slings which have ample capacity and install them to proper places. Operate the hoist or crane slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
6) When removing a cover which is under internal pressure or under pressure from a spring, always leave 2 bolts in diagonal positions. Loosen those bolts gradually and alternately to release the pressure, and then remove the cover.

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7) When removing components, be careful not to break or damage electrical wiring. Damaged wiring may cause electrical fires.

8) When removing piping, stop fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip and can even start fires.

9) As a general rule, do not use gasoline to wash parts. Do not use it to clean electrical parts, in particular.

10) Be sure to assemble all parts again in their original places. Replace any damaged parts and non-reusable part. When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is operated.

11) When installing high pressure hoses, make sure they are not twisted. Damaged hoses are dangerous, so be extremely careful when installing hoses for high pressure circuits. Make sure connecting parts are correctly installed.

12) When assembling or installing parts, always tighten them to the specified torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.

13) When aligning 2 holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.

14) When measuring hydraulic pressure, check if the measuring tools are correctly assembled.

15) Take care when removing or installing the tracks of track-type machines. When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

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16) If the engine is operated for a long time in a poor ventilated place, you may suffer from gas poisoning. Keep windows and doors open to provide enough ventilation.

4. Precautions for sling work and giving signals

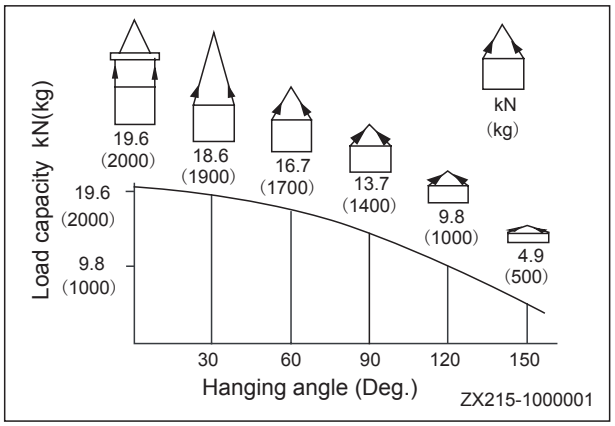
1) Only one appointed worker is allowed to give signals and co-workers must communicate with each other frequently. The appointed signal person must give specified signals clearly at a place where he is seen well from the operator's seat and where he can see the working condition easily. The signal person must always stand in front of the load and guide the operator safely.
   - Do not stand under the load.
   - Do not step on the load.
2) Check the slings before starting sling work.
3) Always wear gloves during sling work. (Wear leather gloves, if available.)
4) Measure the weight of the load by the eye and check its center of gravity.
5) Use proper sling according to the weight of the load and method of slinging. If too thick wire ropes are used to sling a light load, the load may slip and fall.
6) Do not sling a load with 1 wire rope alone. If it is slung so, it may rotate and may slip out of the rope. Install 2 or more wire ropes symmetrically.

⚠ CAUTION

Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

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7) Limit the hanging angle to 60°, as a rule. Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with 2 or more ropes, the force subjected to each rope will increase with the hanging angle. The table below shows the variation of allowable load in kN {kg} when hoisting is made with 2 ropes, each of which is allowed to sling up to 9.8 kN {1,000 kg} vertically, at various hanging angles. When the 2 ropes sling a load vertically, up to 19.6 kN {2,000 kg} of total weight can be suspended. This weight is reduced to 9.8 kN {1,000 kg} when the 2 ropes make a hanging angle of 120°. If the 2 ropes sling a 19.6 kN {2,000 kg} load at a lifting angle of 150°, each of them is subjected to a force as large as 39.2 kN {4,000 kg}.

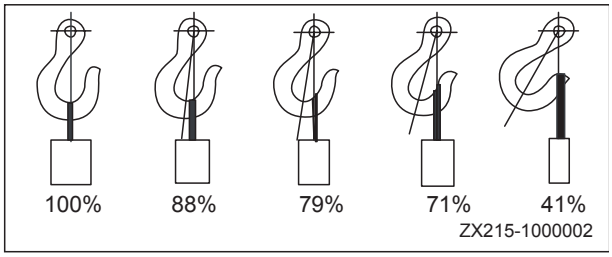


8) When installing wire ropes to an angular load, apply softeners to protect the wire ropes. If the load is slippery, apply proper material to prevent the wire rope from slipping.

9) Use the specified eyebolts and fix wire ropes, chains, etc. to them with shackles, etc.

10) Apply wire ropes to the middle portion of the hook.

- Slinging near the tip of the hook may cause the rope to slip off the hook during hoisting. The hook has the maximum strength at the middle portion.



11) Do not use twisted or kinked wire ropes.

12) When lifting up a load, observe the following.

- Wind in the crane slowly until wire ropes are stretched. When settling the wire ropes with the hand, do not grasp them but press them from above. If

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you grasp them, your fingers may be caught.

- After the wire ropes are stretched, stop the crane and check the condition of the slung load, wire ropes, and softener.
- If the load is unstable or the wire rope or chains are twisted, lower the load and lift it up again.
- Do not lift up the load slantingly.

13) When lifting down a load, observe the following.

- When lifting down a load, stop it temporarily at 30 cm above the floor, and then lower it slowly.
- Check that the load is stable, and then remove the sling.
- Remove kinks and dirt from the wire ropes and chains used for the sling work, and put them in the specified place.

5. Precautions for using mobile crane

⚠ CAUTION

Read the Operation and Maintenance Manual of the crane carefully in advance and operate the crane safely.

6. Precautions for using overhead hoist crane

⚠ CAUTION

When raising a heavy part (heavier than 25 kg), use a hoist, etc. In disassembly and assembly, the weight of a part heavier than 25 kg is indicated after the mark of 

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1) Before starting work, inspect the wire ropes, brake, clutch, controller, rails, over wind stop device, electric shock prevention earth leakage breaker, crane collision prevention device, and power application warning lamp, and check safety.
2) Observe the signals for sling work.
3) Operate the hoist at a safe place.
4) Check the direction indicator plates (east, west, south, and north) and the directions of the control buttons without fail
5) Do not sling a load slantingly. Do not move the crane while the slung load is swinging.
6) Do not raise or lower a load while the crane is moving longitudinally or laterally.
7) Do not drag a sling.
8) When lifting up a load, stop it just after it leaves the ground and check safety, and then lift it up.
9) Consider the travel route in advance and lift up a load to a safe height.
10) Place the control switch on a position where it will not be an obstacle to work and passage.
11) After operating the hoist, do not swing the control switch.
12) Remember the position of the main switch so that you can turn off the power immediately in an emergency.
13) If the hoist stops because of a power failure, turn the power switch OFF. When turning on a switch which was turned OFF by the electric shock prevention earth leakage breaker, check that the devices related to that switch are not in operation state.
14) If you find an obstacle around the hoist, stop the operation.

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15) After finishing the work, stop the hoist at the specified position and raise the hook to at least 2 m above the floor. Do not leave the sling installed to the hook.

7. Selecting wire ropes

Select adequate ropes as per the weight of parts to be hoisted, referring to the table below.

Wire ropes
(Standard "Z" twist ropes without galvanizing)
(JIS G3525, No. 6, Type 6X37-A))

Nominal Diameter of Rope	Allowable Load	
mm	kN	Ton
10	8.8	0.9
12	12.7	1.3
14	17.3	1.7
16	22.6	2.3
18	28.6	2.9
20	35.3	3.6
25	55.3	5.6
30	79.6	8.1
40	141.6	14.4
50	221.6	22.6
60	318.3	32.4

⚠ CAUTION

The allowable load is one-sixth of the breaking strength of the rope used (Safety coefficient: 6).

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1.2 How to Read the Shop Manual

- Some attachments and optional parts in this shop manual may not be delivered to certain areas. If one of them is required, consult Sany distributors.
- Materials and specifications are subject to change without notice.

1. Composition of shop manual

This shop manual contains the necessary technical information for services performed in a workshop. For ease of understanding, the manual is divided into the following sections.

Introduction

This section provides an overview of what is covered in the rest of this manual and how to use this manual,.

Shop Safety

This section covers basic shop safety information relating to this equipment. It also describes what the hazard alerts mean that are used throughout the manual.

Specifications

Technical specification of work equipment and optional parts are given in this section.

Structure and function

This section explains the structure and function of each component. It helps the reader to get a better understanding of the machine structure, and also serves as a reference for troubleshooting.

Standard Values

This section explains the standard values for a new machine and judgement criteria for testing, adjusting, and troubleshooting. This standard value table is used to check the standard values in testing and adjusting and to judge parts in troubleshooting.

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Testing and adjusting

This section details the inspection before and after repair work as well as the adjustment during inspection and repair work. Troubleshooting table that involves “Fault”and “Cause”are also included in this section.

Troubleshooting

This section explains the way to detect faulty parts and the method to repair them. This section is divided into the following parts: Electrical system, Engine, Hydraulic and mechanical system and Monitoring system.

Disassembly and assembly

This section explains the procedures as well as precautions for removing, installing, disassembling and assembling of each component.

System Schematics

This section provides hydraulic circuit diagrams and electrical circuit diagrams.

2. Revision and distribution

Any additions, revisions, or other change of notices will be sent to Sany distributors. Get the most up-to-date information before you start any work.

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3. Symbols

Important safety and quality portions are marked with the following symbols so that the shop manual will be used practically.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing work.
	Weight	Weight of parts of component or parts. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for tightening torque during assembly.
	Coat	Places to be coated with adhesives, etc. during assembly.
	Oil, Coolant	Places where oil, etc. must be added, and capacity.
	Drain	Places where oil, etc. must be drained, and quantity to be drained.

4. Units

In this shop manual, the units are indicated with International System of units (SI). For reference, conventionally used Gravitational System of units is indicated in parentheses { }.

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1.3 Terms for Maintenance Standard

The maintenance standard values necessary for judgment of products and parts are described by the following terms.

1. Standard size and tolerance

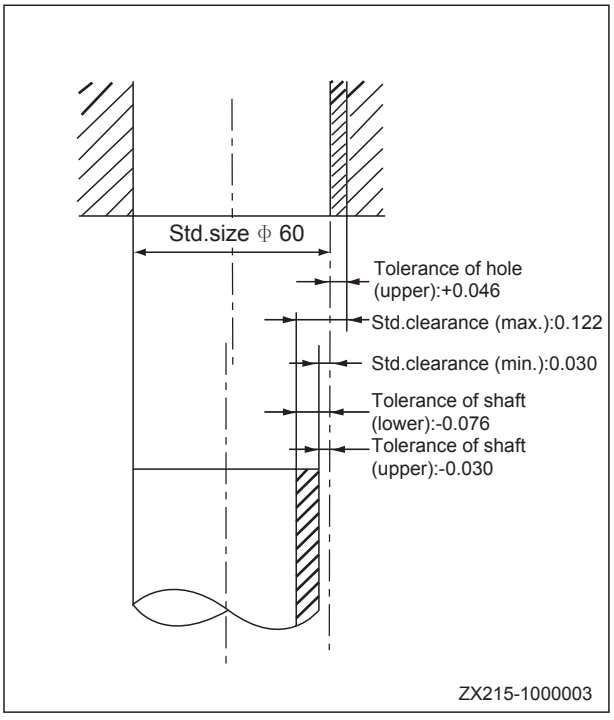
- To be accurate, the finishing size of parts is a little different from one to another.
- To specify a finishing size of a part, a temporary standard size is set and an allowable difference from that size is indicated.
- The above size set temporarily is called the "standard size" and the range of difference from the standard size is called the "tolerance".
- The tolerance with the symbols of + or – is indicated on the right side of the standard size.

Example

Standard size	Tolerance
120	–0.022 –0.126

★ The tolerance may be indicated in the text and a table as [standard size (upper limit of tolerance/lower limit of tolerance)]. Example) 120 (–0.022/–0.126)

- Usually, the size of a hole and the size of the shaft to be fitted to that hole are indicated by the same standard size and different tolerances of the hole and shaft. The tightness of fit is decided by the tolerance.
- Indication of size of rotating shaft and hole and relationship drawing of them.



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Example

Standard size	Tolerance	
	Shaft	Hole
φ60	-0.030 -0.076	+0.046 0

2. Standard clearance and standard value

- The clearance made when new parts are assembled is called the "standard clearance", which is indicated by the range from the minimum clearance to the maximum clearance.
- When some parts are repaired, the clearance is generally adjusted to the standard clearance.
- A value of performance and function of new products or equivalent is called the "standard value", which is indicated by a range or a target value.
- When some parts are repaired, the value of performance/function is set to the standard value.

3. Standard interference

- When the size of a hole is smaller than the size of a shaft because of the standard size and tolerance, the difference between these sizes is called the "interference".
- The range (A – B) from the difference (A) between the minimum size of the shaft and the maximum size of the shaft to the difference (B) between the maximum size of the shaft and the minimum size of the hole is the "standard interference".
- After repairing or replacing some parts, measure the size of their hole and shaft and check that the interference is in the standard range.

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4. Repair limit and allowable value

- The size of a part changes due to wear and deformation while it is used. The limit of changed size is called the "repair limit".
- If a part is worn to the repair limit must be replaced or repaired.
- The performance and function of a product lowers while it is used. A value below which the product can be used without causing a problem is called the "allowable value".
- If a product is worn to the allowable value, it must be checked or repaired. Since the permissible value is estimated from various tests or experiences in most cases, however, it must be judged after considering the operating condition and customer's requirement.

5. Clearance limit

- Parts can be used until the clearance between them is increased to a certain limit. The limit at which those parts cannot be used is called the "clearance limit".
- If the clearance between the parts exceeds the clearance limit, they must be replaced or repaired.

6. Interference limit

- The allowable maximum interference between the hole of a part and the shaft of another part to be assembled is called the "interference limit".
- The interference limit shows the repair limit of the part of smaller tolerance.
- If the interference between the parts exceeds the interference limit, they must be replaced or repaired.

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1.4 Handling Electrical and Hydraulic Components

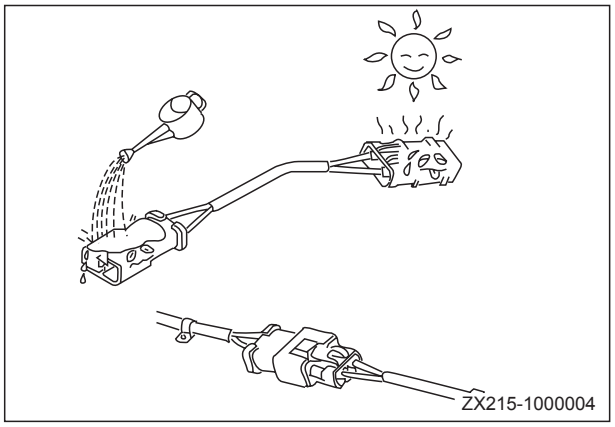
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct "operation", "maintenance and inspection", "troubleshooting", and "repairs" must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on "Handling electric components" and "Handling hydraulic equipment" (particularly gear oil and hydraulic oil).

1.4.1 Points to remember when handling electric components

1. Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.

Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.

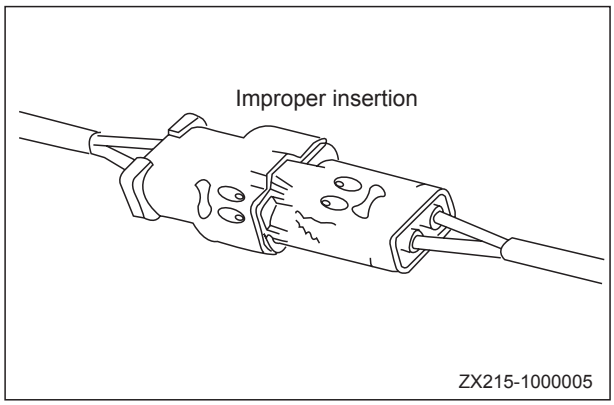

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2. Main failures occurring in wiring harness

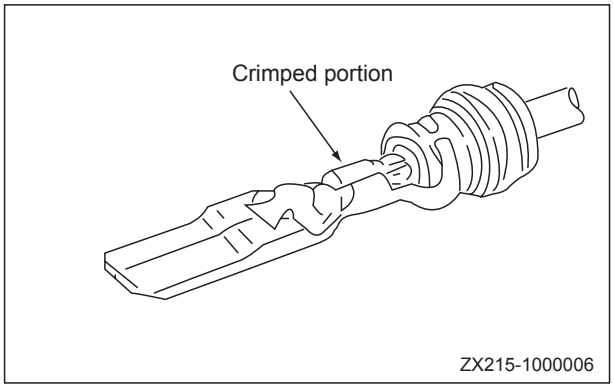
1) Defective contact of connectors (defective contact between male and female)

Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidation of the contact surfaces.



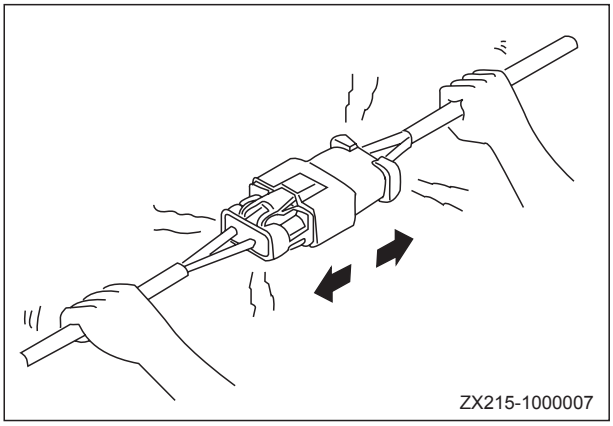
2) Defective crimping or soldering of connectors

The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.



3) Disconnections in wiring

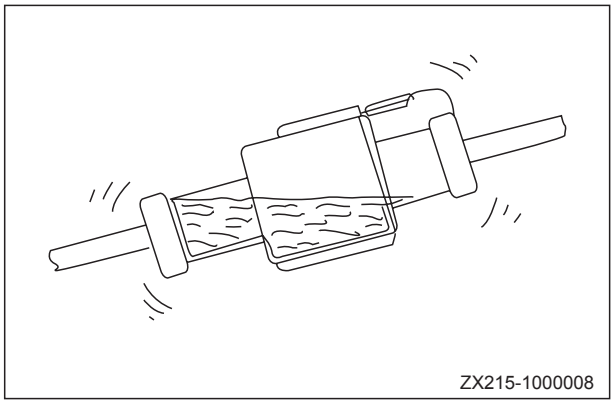
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



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4) High-pressure water entering connector

The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet. Accordingly, take care not splash water over the connector. The connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.

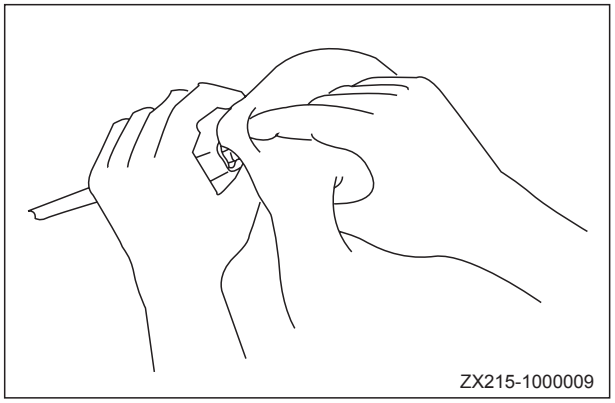

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5) Oil or dirt stuck to connector

If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it dry with compressed air and spray it with a contact restorer.

★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.

★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.


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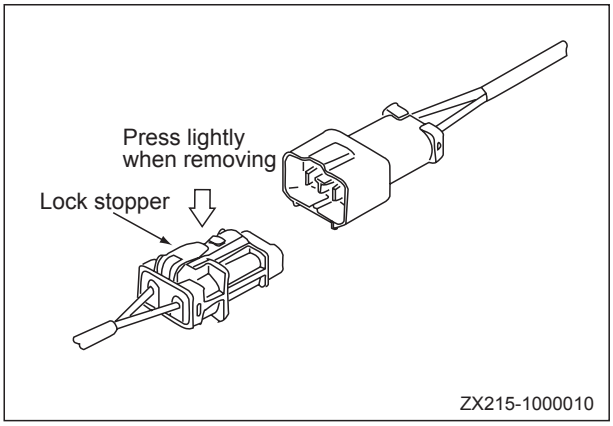
3. Removing, installing, and drying connectors and wiring harnesses

1) Disconnecting connectors

a. Hold the connectors when disconnecting.

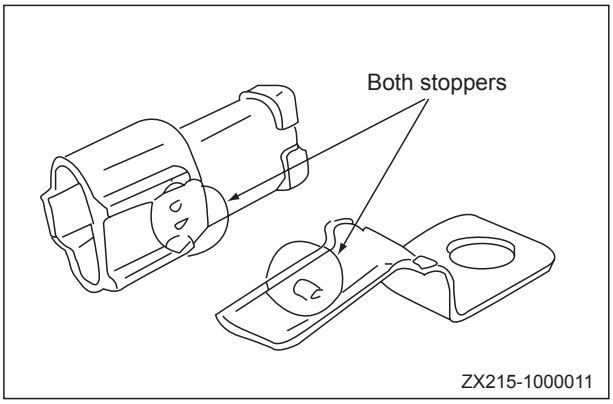
When disconnecting the connectors, hold the connectors. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.

★ Never pull with one hand.



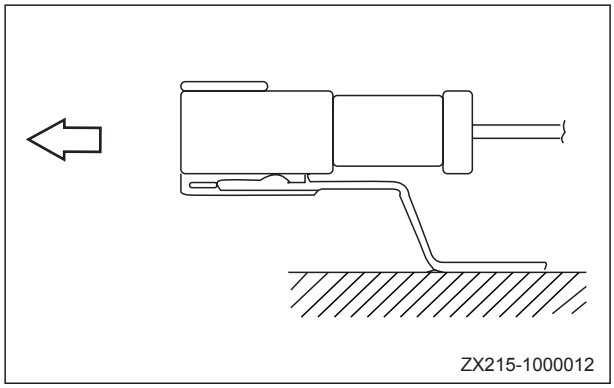
b. When removing from clips

- Both of the connector and clip have stoppers, which are engaged with each other when the connector is installed.



- When removing a connector from a clip, pull the connector in a parallel direction to the clip for removing stoppers.

★ If the connector is twisted up and down or to the left or right, the housing may break.

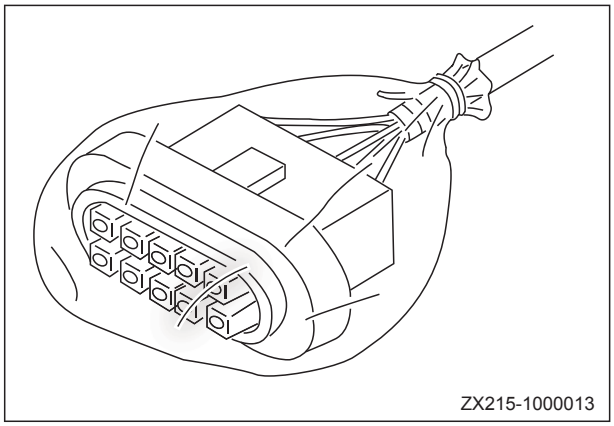


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c. Action to take after removing connectors

After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.

★If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always cover the connector.


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2) Connecting connectors

a. Check the connector visually

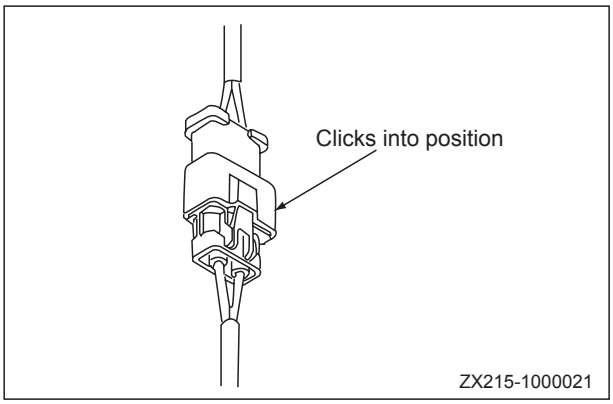
Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).

Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.

Check that there is no damage or breakage to the outside of the connector.

★If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.

★If there is any damage or breakage, replace the connector.



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b. Fix the connector securely.

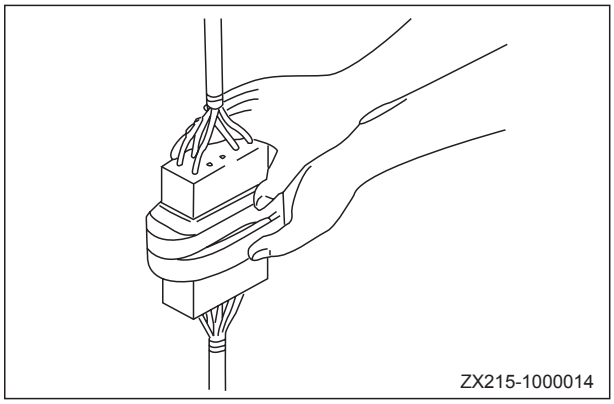
Align the position of the connector correctly, and then insert it securely. For connectors with lock stopper, push in the connector until the stopper clicks into position.

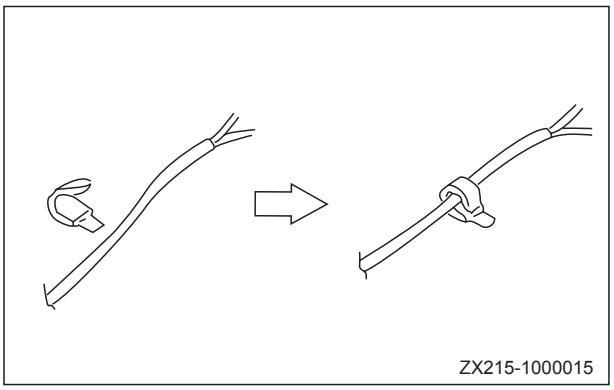
c. Correct any protrusion of the boot and any misalignment of the wiring harness.

For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.

★ If the connector cannot be corrected easily, remove the clamp and adjust the position.

- If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.

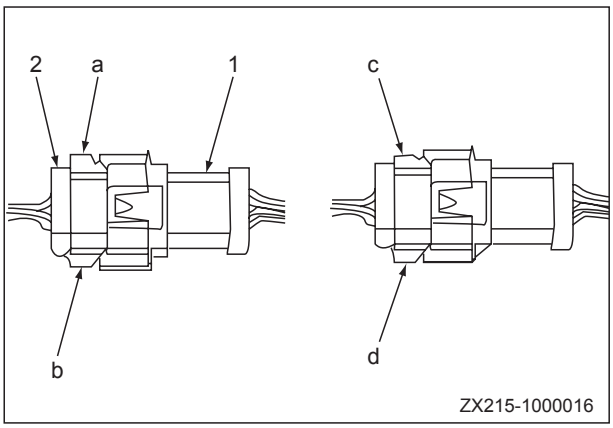

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3) Connecting DT connectors

Since the DT 8-pin and 12-pin heavy duty wire connectors have 2 latches respectively, push them in until they click 2 times.

- Male connector: 1
- Female connector: 2
- Normal locking state (Horizontal): a, b, d
- Incomplete locking state (Diagonal): c



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4) Drying wiring harness

If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.

a. Disconnect the connector and wipe off the water with a dry cloth.

★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.

b. Dry the connector with a dryer.

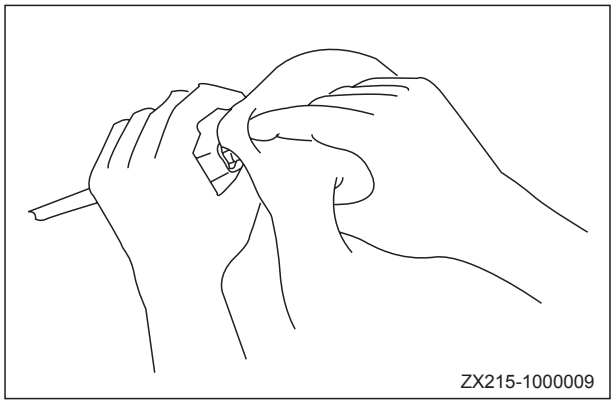
If water gets inside the connector, use a dryer to dry the connector.

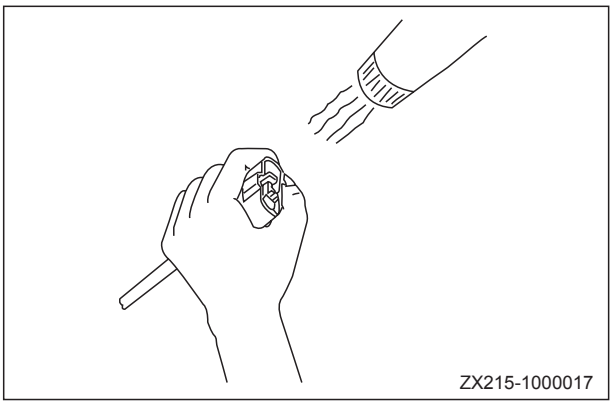
★ Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.

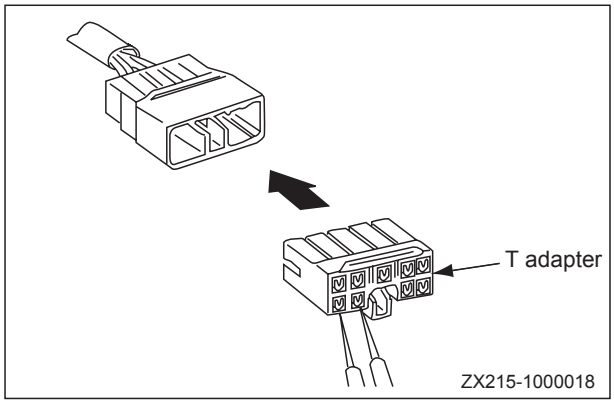
c. Carry out a continuity test on the connector.

After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.

★After completely drying the connector, blow it with contact restorer and reassemble.


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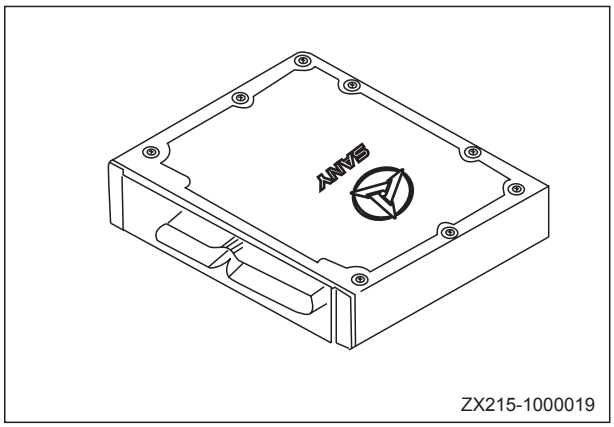


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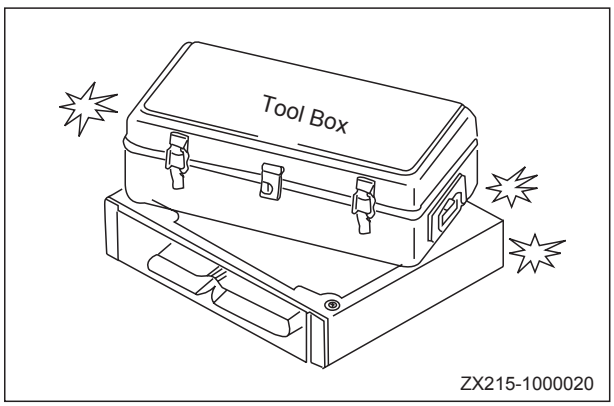
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4. Handling the integrated control monitor

1) The integrated control monitor contains a microcomputer, an electronic control circuits, an LCD monitor and GPS positioning circuit. They control all of the electronic circuits on the machine, so be extremely careful when handling the integrated control monitor.

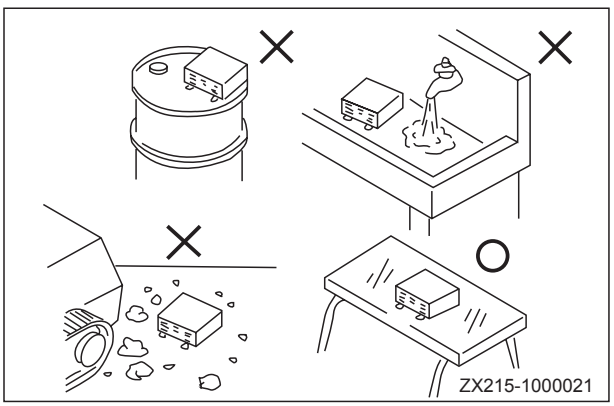


2) Do not place objects on the integrated control monitor.
3) Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts with your hand.
4) Do not leave it where it may be exposed to rain.
5) Do not place the integrated control monitor on oil, water, or soil, or in any hot place, even for a short time.



6) Precautions for arc welding

   When welding on the controller, disconnect all wiring harness connectors connected to the controller. Fit an arc welding ground close to the welding point.



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5. Points to remember when troubleshooting electric circuits

1) Always turn the power OFF before disconnecting or connecting connectors.

2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.

   ★ Disconnect and connect the related connectors several times to check.

3) Always connect any disconnected connectors before going on to the next step.

   ★ If the power is turned ON with the connectors still disconnected, unnecessary abnormality displays will be generated.

4) When carrying out troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), move the related wiring and connectors several times and check that there is no change in the reading of the tester.

   ★ If there is any change, there is probably defective contact in that circuit.

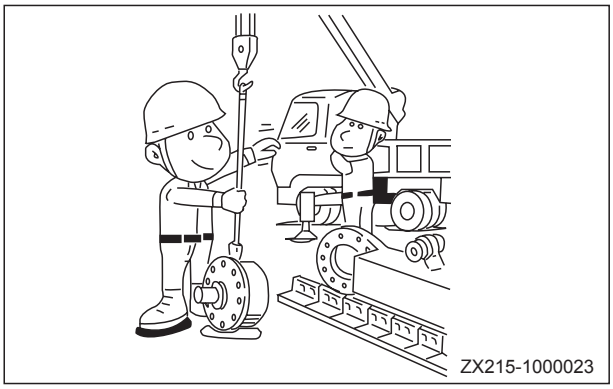
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1.4.2 Points to remember when handling hydraulic equipment

With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

1. Be careful of the operating environment

Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

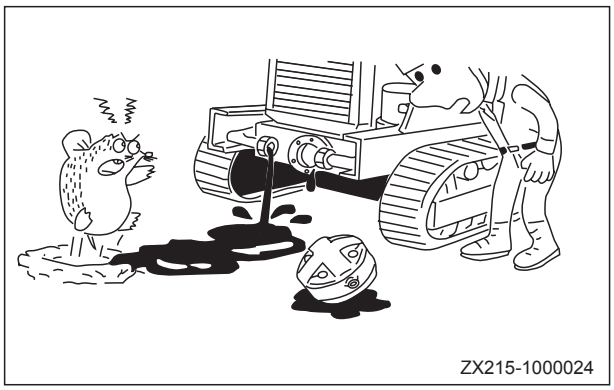

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2. Disassembly and maintenance work in the field

If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to check the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic equipment should be carried out in a specially prepared dust-proof workshop, and the performance should be checked with special test equipment.

3. Sealing openings

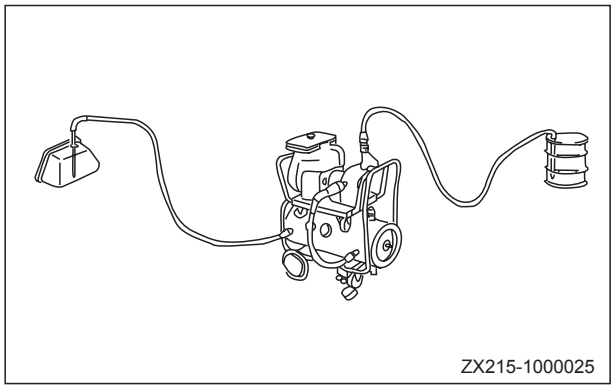
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never do this. Do not simply drain oil out onto the ground, but collect it and ask the customer to dispose of it, or take it back with you for disposal.


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4. Do not let any dirt or dust get in during refilling operations

Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.

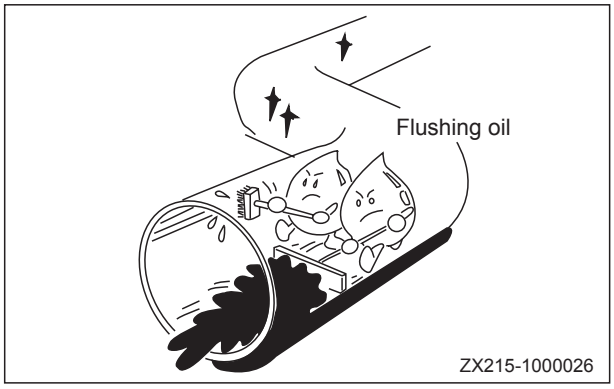

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5. Change hydraulic oil when the temperature is high

When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

6. Flushing operations

After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit. Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.

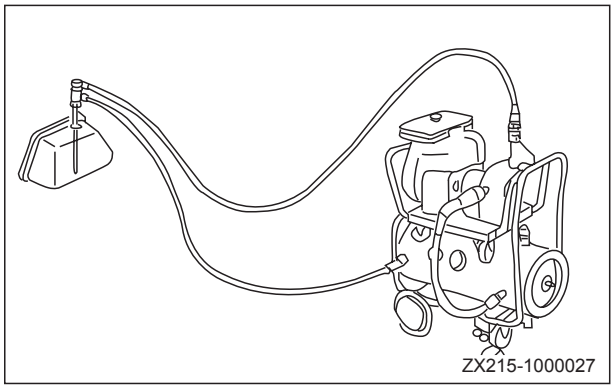


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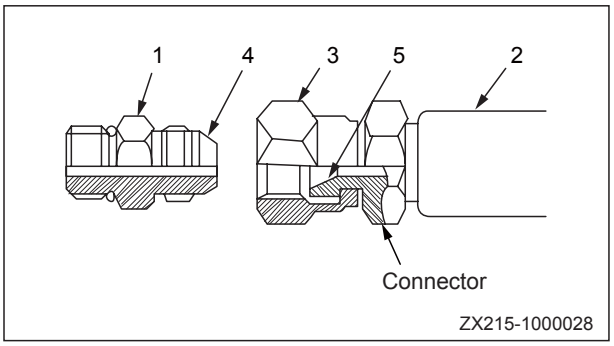
7. Cleaning operations

After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit. The oil cleaning equipment is used to remove the ultra fine (about 3 μ) particles that the filter built in the hydraulic equipment cannot remove, so it is an extremely effective device.



1.5 Hose Connector

Hose connector is used to connect hoses with a small diameter. The metal sealing surface (4) of the joint (1) must be in close contact with the metal sealing surface (5) of the hose (2) to seal pressurized oil.

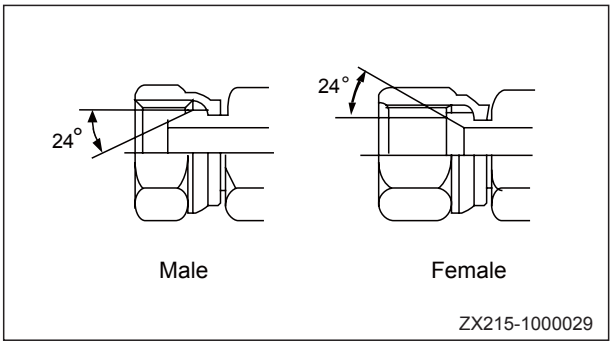


NOTICE

- **Do not over-tighten the nut (3). Excessive force applied on the metal sealing surface (4) and (5) may cause the joint (1) to break. Be sure to tighten nut (3) according to technical specifications.**
- **Scratches or other damages on sealing surface (4) and (5) may cause leaks at the joint. Be extremely careful not to damage the sealing surfaces during connecting and disconnecting work.**

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1.5.1 Type of hose connector



1.5.2 Hose connector tightening torque table

Type	Wrench size mm	Wrench size mm	Tightening torque
	Connecting nut	Hose joint	N·m(kgf·m,lbf·ft)
24° Male	19	19	59(6,44)
	22	22	98(10,72)
	27	27	118(12,87)
	36	36	235(24,173)
	41	41	295(30,218)
	50	50	490(50,361)
	60	60	670(68,494)
	70	70	980(100,723)
24° Female	19	17	44(4.5,32)
	22	19	59(6,44)
	27	22	118(12,87)
	36	30, 32	235(24,173)
	41	36	295(30,218)
	50	46	490(50,361)

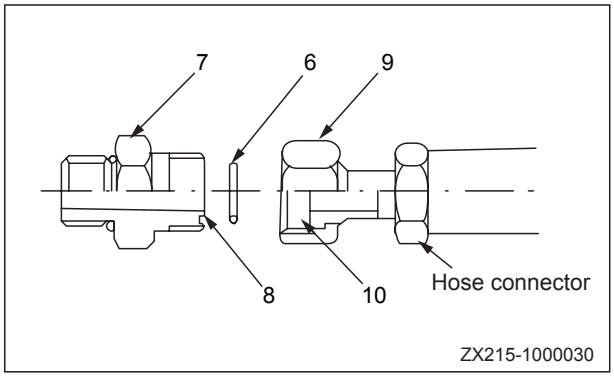
NOTICE

- **The torque values listed in the table are intended for general application.**
- **Do not use torque values listed in this table when different torque values are specified for a special purpose.**

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1.5.3 Connection of O-rings

Place O-ring (6) in contact with the contact surface of the joint (7) to seal the pressurized oil.



NOTICE

- **Replace o-rings (6) with new ones when re-connecting hoses.**
- **Before tightening nut (9), make sure the o-ring (6) has been placed into the o-ring seat (8).Displacement of the o-ring may have it damaged and cause leaks.**
- **Be careful not to damage the o-ring seat (8) or the sealing surface (10). Damaged o-ring (6) may cause oil leakage.**
- **If oil leakage due to loosened nut (9) is detected, do not try to stop the leakage by tightening nut (9). Instead, replace o-ring (6) with a new one and make sure it is well positioned, and tighten nut (9).**

Wrench size mm	Wrench size mm	Tightening torque
Connecting nut	Hose joint	N·m (kgf·m,lbf·ft)
19	17	44(4.5,32)
22	19	59(6,44)
27	22	118(12,87)
36	30, 32	235(24,173)
41	36	295(30,218)
50	46	490(50,361)

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1.6 Table of Standard Tightening Torques

Table of tightening torques for bolts and nuts

★ Unless specified otherwise, tighten metric nuts and bolts to the torque below. (When using torque wrench)

Bolt diameter	Bolt grade	Wrench size	Hex wrench size	Hexagonal bolt			Hexagonal socket head bolt		
				N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M6	10.9	10	4	13.2	1.37	9.74	13.2	1.37	9.74
M8	10.9	13	6	31	3.16	22.87	31	3.16	22.87
M10	10.9	17	8	66	6.73	48.7	66	6.73	48.7
M12	10.9	19	10	113	11.53	83.39	113	11.53	83.39
M14	10.9	22	12	177	18.06	130.6	177	18.06	130.6
M16	10.9	24	14	279	28.47	205.9	279	28.47	205.9
M18	10.9	27	14	382	38.98	281.9	382	38.98	281.9
M20	10.9	30	17	549	56.02	405.16	549	56.02	405.16
M27	10.9	41	19	1320	134.7	974.16	1320	134.7	974.16
M10	12.9	17	6	78	7.96	57.76	78	7.96	57.76
M12	12.9	19	8	137	13.98	101.1	137	13.98	101.1
M16	12.9	24	14	339	34.6	250.18	339	34.6	250.18
M20	12.9	30	17	664	67.75	490	664	67.75	490

NOTICE

The following items apply to fine thread and coarse thread.

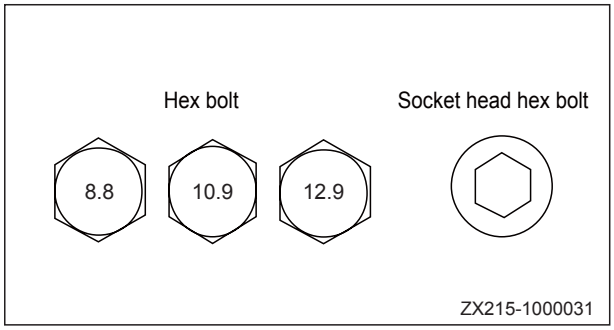
- **Apply grease (zinc white B dissolved in spindle oil) onto the nuts and bolts to reduce the friction coefficient. Thrust bolts do not require greasing.**
- **Torque tolerance is ±10%.**
- **Always use bolts of correct length. The tip of bolts with excessive length may contact the bottom of the bolt hole, resulting in under-tightening. Bolts with inadequate length may result in insufficient fastening.**
- **The torque values listed in the table are intended for general application. If different torque values are specified for a special purpose, the torque values in this table are not applicable any more.**
- **Make sure the threads are free of dirt or rusts before installation of nuts and bolts.**

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1.7 Type of Bolts

Tighten nuts and bolts properly to specified torque values. The type and grade of bolts are illustrated on the right.

Use correct bolts and tighten them properly when assembling machines or components.

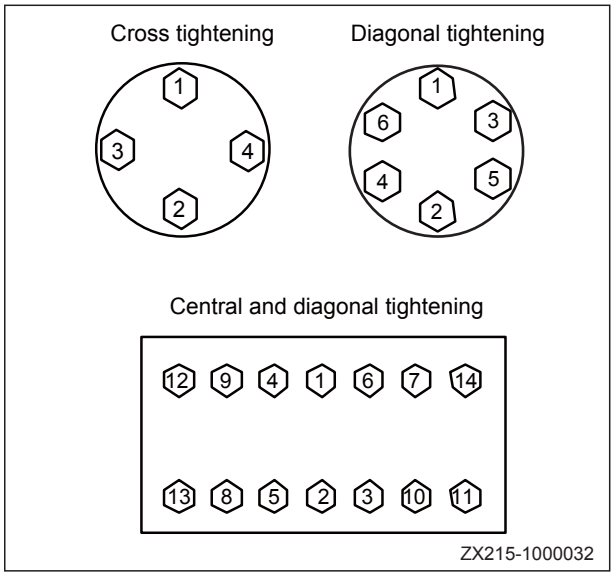


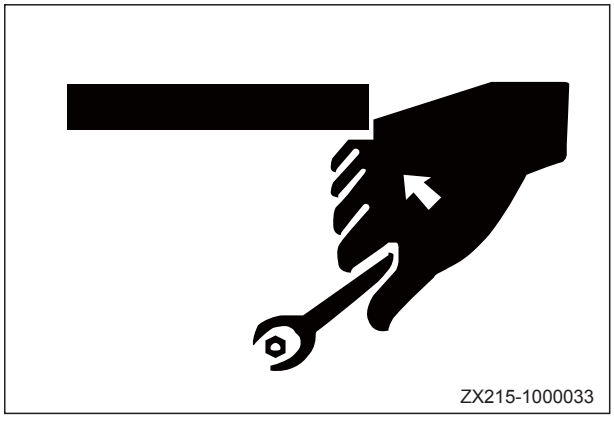
1.8 Tightening Sequence

When two or more bolts are being tightened, follow the tightening sequence shown on the right to ensure even tightening.

CAUTION

- **Always use suitable tools for specific work. Use of improper tools and methods may cause a hazardous situation.**
- **Use tools of correct sizes when loosening or tightening the nuts or bolts. Otherwise, the tools may slide and cause personal injury.**

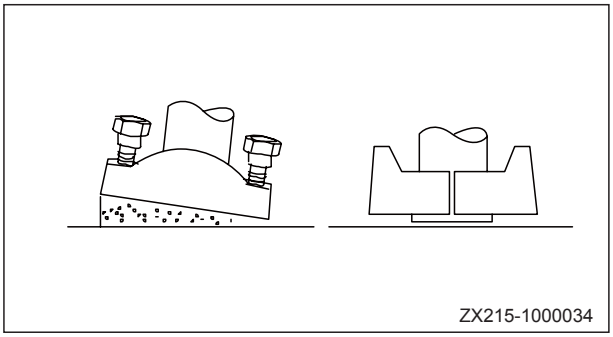




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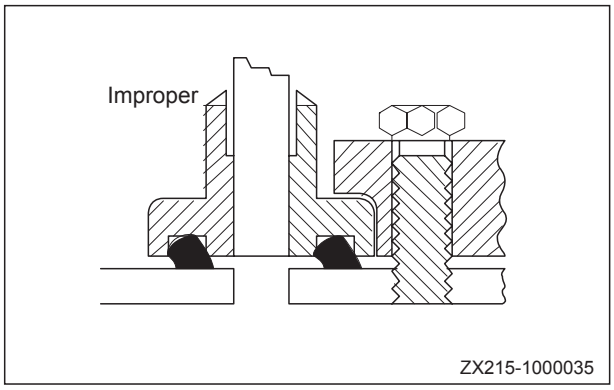
1.9 Maintenance of Half Flanges

1. Clean the sealing surface of the flange and check it carefully. Scratches and coarseness cause leaks or abrasion of seals. Uneven surface may squeeze the seal out. If these faults are not corrected properly, parts may have to be replaced.


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2. Always use specified O-rings. Check that the O-rings are not damaged. Do not file the surface of the O-ring. Apply grease onto the O-ring to locate it.

3. Tighten the half flanges carefully. Locate the opening at the center so that it is perpendicular to the oil opening. Tighten the bolt manually to maintain the location of the components.



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1.9.1 Table of tightening torques for half flange bolts

★ Unless specified otherwise, tighten the half flange bolts to the torques below.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
10	14	59~74	6.0~7.5
12	17	98~123	10.0~12.5
16	22	235~285	23.5~29.5

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1.10 Conversion Table

1.10.1 Method of using conversion table

The conversion table in this section is provided to enable simple conversion of figures. For details of the method of using the conversion table, see the example given below.

Example:

Method of using the conversion table to convert from millimeters to inches

1. Convert 55 mm into inches

1) Locate the number 50 in the vertical column at the left side, take this as (A), and then draw a horizontal line from (A).
2) Locate the number 5 in the row across the top, take this as (B), then draw a perpendicular line down from (B).
3) Take the point where the two lines cross as (C). This point (C) gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

2. Convert 550 mm into inches

1) The number 550 does not appear in the table, so divide it by 10 (move the decimal point one place to the left) to convert it to 55 mm.
2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

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Millimeters to Inches

1mm=0.03937in

(B)

(A)	0	1	2	3	4	5	6	7	8	9
0	0.000	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.535
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	(C) 2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.031	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to Inches

1mm=0.03937in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.535
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.031	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

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Kilogram to Pound

1kg=2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	90.39	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	112.43	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	134.48	55.12	57.32	59.52	61.73	63.93
30	66.14	68.34	70.55	72.75	156.53	77.16	79.37	81.57	83.77	85.98
40	88.18	90.39	92.59	94.80	178.57	99.21	101.41	103.62	105.82	108.03
50	110.23	112.43	114.64	116.84	200.62	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	222.66	143.30	145.50	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	244.71	165.35	167.55	169.75	171.96	174.16
80	176.37	178.57	180.78	182.98	266.76	187.39	189.60	191.80	194.00	196.21
90	198.41	200.62	202.82	205.03	288.80	209.44	211.64	213.85	216.05	218.26

Liters to U.S. Gallons

1ℓ=0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.114	2.378
10	2.642	2.906	3.170	3.435	3.699	3.963	4.227	4.491	4.756	5.020
20	5.284	5.548	5.812	6.077	6.341	6.605	6.869	7.133	7.398	7.662
30	7.926	8.190	8.454	8.719	8.983	9.247	9.511	9.775	10.040	10.304
40	10.568	10.832	11.096	11.361	11.625	11.889	12.153	12.417	12.682	12.946
50	13.210	13.474	13.738	14.003	14.267	14.531	14.795	15.059	15.324	15.588
60	15.852	16.116	16.380	16.645	16.909	17.173	17.437	17.701	17.966	18.230
70	18.494	18.758	19.022	19.287	19.551	19.815	20.079	20.343	20.608	20.872
80	21.136	21.400	21.664	21.929	22.193	22.457	22.721	22.985	23.250	23.514
90	23.778	24.042	24.306	24.571	24.835	25.099	25.363	25.627	25.892	26.156

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Liters to U.K. Gallons

1ℓ=0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.739	3.959	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.779
50	10.999	11.218	11.438	11.658	11.878	12.098	12.318	12.538	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.038	18.258	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft.lb

1 kgm=7.233 ft.lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.3	390.6	397.8	405.0	412.3	419.5	426.7
60	434.0	441.2	448.4	455.7	462.9	470.1	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.6	1048.8	1056.0	1063.3	1070.5	1077.7
150	1085.0	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1229.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.2	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

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kg/cm^2 to lb/in^2

1 kg/cm^2=14.2233 lb/in^2

	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.3	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.0	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	996	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2133	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2390	2404
170	2418	2432	2446	2461	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2774	2788	2802	2816	2830
200	2845	2859	2873	2887	2902	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3342	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

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1.10.2 Temperature

Fahrenheit-Centigrade conversion: A simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center (boldface column) of figures. These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column to be a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column to be a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

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°C		°F	°C		°F	°C		°F	°C		°F
-40.0	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	177.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-7.2	19	66.2	12.2	54	129.2	31.7	89	192.2
-26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	30	86.0	18.3	65	149.0	37.8	100	212.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0.0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.8	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	175	347.0

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SANY

Shop Safety

2 Shop Safety

2.1 Hazard Alert Information 2-3
2.2 General Shop Safety 2-6

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⚠ WARNING

Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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2 SHOP SAFETY

2.1 Hazard Alert Information

Most accidents are usually caused by the failure to follow fundamental repair procedures and safety rules for the system under repair. To avoid accidents it is important to read and understand all information outlined in this manual before performing repairs on the machine system.

The following (ANSI/ISO) signal words are used to inform you that there is a potentially hazardous situation that may lead to damage, personal injury or even death. In this manual, on the machine, part or component decals and different signal words are used to express the potential level of a hazard.

⚠ DANGER

Indicates an imminent hazard which WILL result in serious injury or death if message is ignored.

⚠ WARNING

Indicates a potentially hazardous situation which COULD result in serious injury or death if message is ignored.

⚠ CAUTION

Indicates a potentially hazardous situation which COULD RESULT IN MINOR OR MAJOR INJURY if message is ignored.

NOTICE

Indicates THE MACHINE MAY BE DAMAGED if improperly operated or maintained.

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This is to alert the user of a hazard. It is usually used in a graphic.



This symbol is used in a graphic to alert the user to not do something.

SANY cannot predict every circumstance that might involve a potential hazard in a repair of the machine. Therefore the safety message in this manual and on the machine may not include all possible safety precautions.

If any procedures or actions not specified, recommended or allowed in this manual are used, you must be sure that you and others can perform such procedures and actions safely and without damaging the machine. If you are unsure about the safety of some procedures, contact your SANY representative.

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⚠ WARNING

- **Improper repair procedures on this machine can be hazardous and could result in serious injury or even death.**
- **All personnel involved with the repair of this machine must read this manual thoroughly before performing any procedures on this equipment.**
- **Some actions involved in the operation or repair of this machine could cause a serious accident if they are not performed in the manner described in this manual.**
- **All precautions outlined in this manual apply only to intended repair procedures of the machine or system. If you perform any repairs not specifically prohibited, you must be sure that it is safe for you and others. In no event should you or others engage in prohibited uses or actions as described in this manual.**
- **SANY delivers machines that comply with all applicable regulations and standards of the country to which the machines have been shipped. If this machine has been purchased in another country or purchased from someone in another country, it may lack certain safety features 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, contact your SANY representative before performing repairs on this machine.**

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2.2 General Shop Safety

It's important to establish good shop safety rules for everyone who enters or uses the shop area. Implementing shop safety rules will keep employees safe and provide the most productive environment for working or learning. Post rules where they can clearly be viewed at all times. If necessary, provide shop personnel with a written copy of the rules and discuss any questions or confusion with them.

Always keep in mind, shop safety is NOT something to be studied at the start of a project and then forgotten; most accidents are caused by carelessness, being in a hurry or by simply disreguarding safety rules. Remember this, if you are DILIGENT and follow instructions outlined in this shop manual with care, repair operations can be safe and enjoyable. Safe work practices, should become a force of habit.

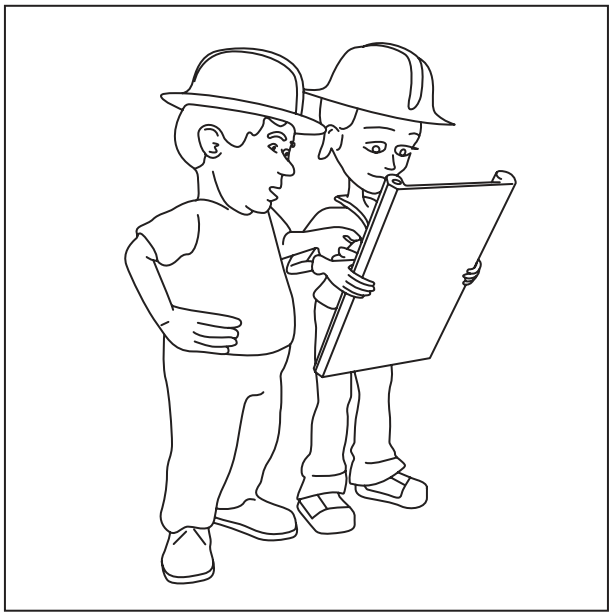
⚠ WARNING

Mistakes in operation are extremely hazardous. Read the Safety, Operation & Maintenance Manual that came with the machine carefully before operating the machine. Failure to follow this alert could result in serious injury or death.

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2.2.1 Rules and shop behavior

- Study all shop rules relating to the procedure carefully and constantly apply them. When in doubt about any task, get help! DO NOT take chances.
- Know your job. It is foolish, and often disastrous, to make repairs to a machine without first receiving proper instructions. Always use the shop manual when performing any repair tasks. Get additional help if you are NOT sure what must be done or how a task should be performed.
- The shop is a place to work, not play. It is NOT a place for “horseplay”. A “joker” in a repair shop is a “walking hazard” to everyone. Daydreaming or socializing on the job also increases your chances of injury.
- If you must smoke, smoke only in the area provided for smoking. Never smoke while on the shop floor or work area.



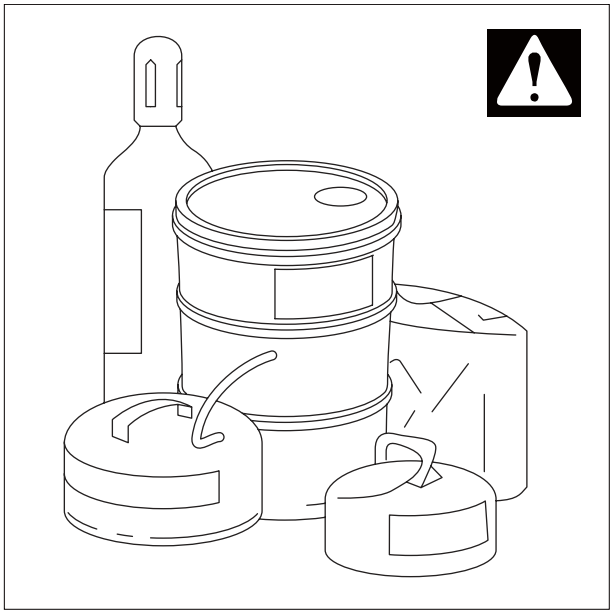
2.2.2 Housekeeping

- Oils, grease, fuel, antifreeze or any fluid spills should be mopped up immediately. These items pose a serious slip hazard. Regardless of who was responsible for the spill, it is your job as a shop employee to secure and clean up the spill area.
- Keep the shop clean. Scrap or old parts should be disposed of properly. Never allow them to remain on the bench or shop floor.
- All equipment and tools must be put back in their proper storage areas after each use. It's imperative that you do not let a shop become cluttered and disorganized in order to prevent accidents.
- Always keep in mind, proper house cleaning is vital for a safe and pleasant work environment.



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2.2.3 Shop Liquids Storage



- Liquids, cleaning solvents or machine fluids should be properly stored in an area away from work locations. These storage areas should be ventilated to an outdoor location to avoid any vapor accumulation in a confined shop area. Follow all OSHA regulations regarding fluid storage.
- Never leave open containers of liquids sitting around. These could spill or catch fire. Always read the container label for information on storage and handling of the liquids.
- Never store liquids in containers that are not properly labeled for that liquid. Confusion could result in equipment damage, fire or an unexpected explosion.
- Never smoke or bring open flames around liquids, doing so could result in an unexpected fire or explosion.
- Never handle liquids without using personal protective equipment. Treat all liquids with caution.

2.2.4 Cleaning Parts

Never use gasoline, diesel fuel or similar flammable liquids to clean parts. Always use approved non-flammable solvents to clean parts. Failure to do so could result in explosion or fire.



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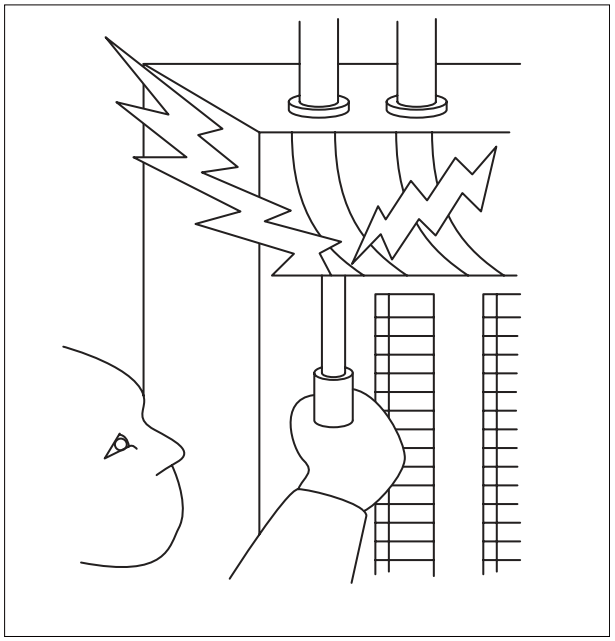
2.2.5 Jacking Up the Machine

- If you will be working under the machine always use approved jack stands that will support the weight of the machine you are working on.
- Never rely on the hydraulics of the machine or a hydraulic jack to support the machine during repairs.
- Always lower the work equipment to the ground and check the stability of the machine before going under the machine.



2.2.6 Electrical Dangers

- When testing electrical circuits, always be aware of what you will be checking in these systems. High voltage or high amp circuits could damage your equipment or cause a spark, explosion or possible fire.
- Before performing any repairs or testing on an electrical system be sure of the system voltage dangers. Always check the circuit to be sure it is off before performing any repairs.
- When working around flammable liquids or explosive systems, use only approved anti-explosion proof work lamps. Non-approved work lamps can cause an explosion or fire.



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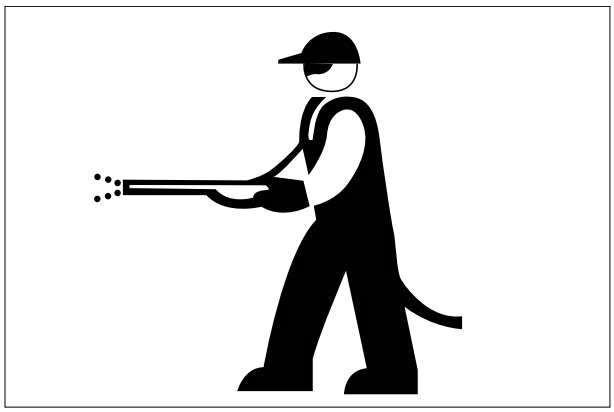
2.2.7 Removing Attachments

- If you will be removing large heavy attachments from the machine, always be sure to use the correct lifting equipment rated for the capacity of the load you will be lifting.
- After the attachment or part has been removed, store it where it cannot fall or move. Always be sure what you are storing is sitting stable on a stable surface and clear of all walkways or fire exits.



2.2.8 Cleaning the Machine

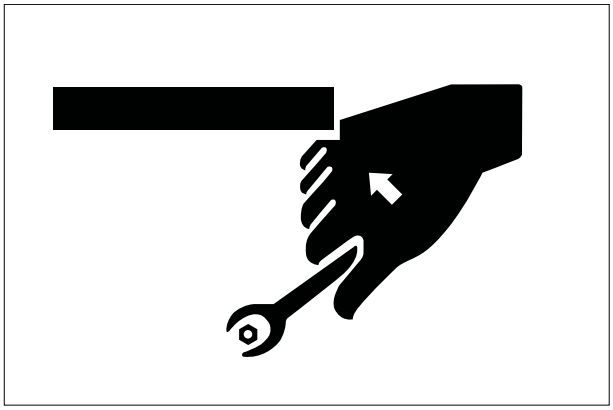
- Always use high-pressure hot water and mild, nonflammable grease-cutting soaps or cleaning agents to clean the machine parts. Never use flammable or caustic cleaning agents.
- Never use high-pressure steam cleaners to clean the machine. Steam cleaners will damage the paint, hoses or electrical system.
- Never pressure-wash or flood the inside of an operator cab. This will damage sensitive electrical components.



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2.2.9 Using the Correct Tools

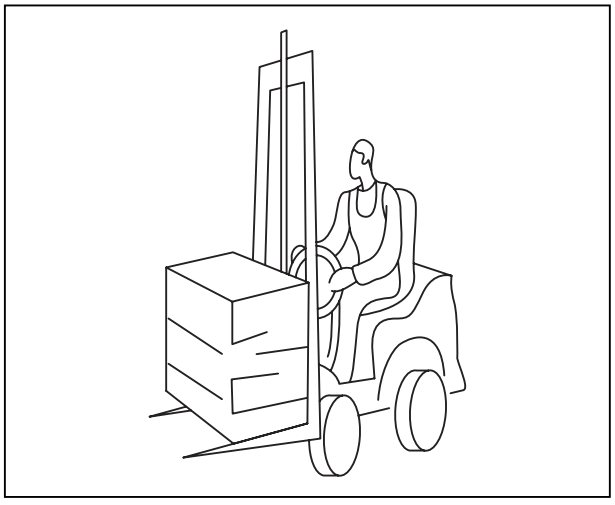
- Always use the proper authorized tools for the job. Using tools that are not authorized, incorrect for the job, defective or damaged could cause serious injury.
- Keep all tools in good condition, learn the correct way to use them.
- Before starting the work, thoroughly check the tools, machine, forklift, crane, service car, etc.
- Keep your tools clean, and when the job is complete, take inventory of the tools you were using to be sure no tools were left in the machine.
- Always put shop tools back in there proper storage location when finished.
- If welding repairs are needed, always have a trained, experienced or certified welder carry out the work.



2.2.10 Hoisting a Load

If you will be lifting parts or components that weigh more than 35 lbs (16 kg), it is important to follow some basic rules.

- Always use the appropriate lifting equipment such as hoist, crane, forklift etc. to handle a loads if possible.
- Be sure the lifting equipment is in good condition and rated for the load you are about to lift.
- If straps are to be used, ensure they are in good condition and rated for the load to be lifted with them.
- If you must lift the load by hand, keep your back straight and parallel with the load, and lift the load using your leg muscles to avoid back injuries. Always ask for a lifting assistant.



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2.2.11 Appropriate Working Apparel

Improper or loose clothing, casual dress clothing, jewelry, incorrect shoes or long hair can result in possible injury.

Make a list of the types of clothing that are not allowed in the shop area. Go over the list with personnel before they start a job.

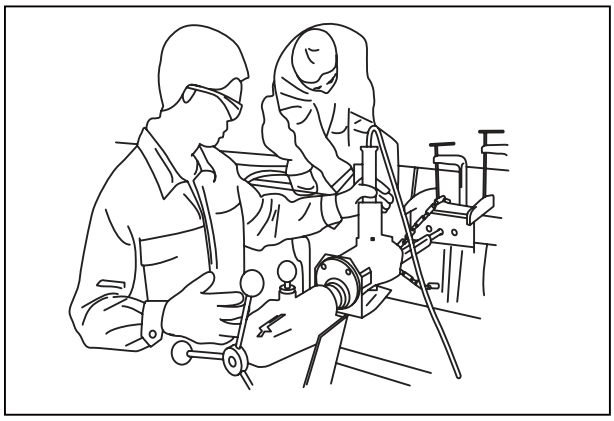


2.2.12 Safety Partners

No one should be allowed to perform work operations in any shop alone. It should be a general shop safety rule for a minimum of two people in the shop area at all times when work procedures are performed. A person alone in the shop might not be able to get emergency help in the event of a shop accident.

When working together always maintain clear contact with each other at all times to avoid the occurrence of unexpected incidents.

When carrying out any operation with two or more workers, always agree on the operating procedures and signals before starting.



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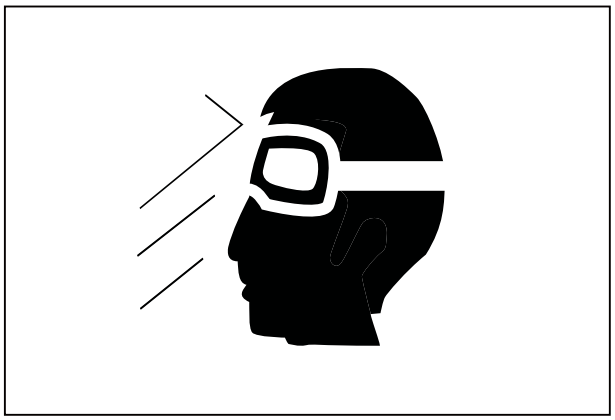
2.2.13 Two people when engine running

In order to prevent injury, do not perform the service while the engine is running. If the service must be performed while the engine is running, operate only when two people are on the spot and follow the regulations below:

- Always have one operator sit on the operation seat and be ready to turn off the engine at any time. All the operators must keep in touch with each other.
- Set the safety lock control lever to the lock position.
- Do not touch any control lever. If some control lever must be operated, send signal to other people and warn them to transfer to safe place quickly.
- Do not drop or insert the tools and other objects into the fan or fan belt, or the parts will be broken or thrown out.

2.2.14 Driving Pins

When using a hammer to drive pins, metal particles may fly off. This may lead to serious eye injuries. Always do the following:

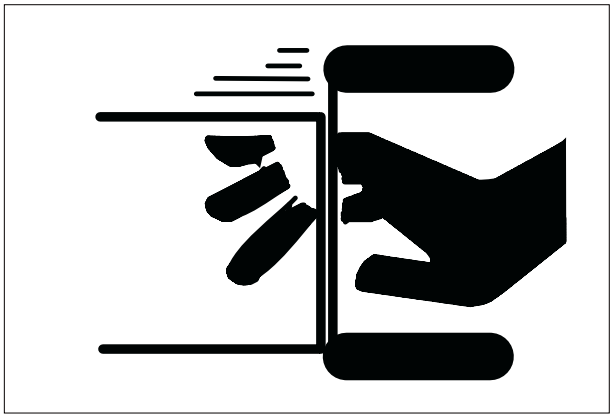


- Always wear a face shield or goggles when striking a metal object with a metal hammer.
- Before performing any of these procedures, be sure all personnel are clear of your work area.
- If possible, avoid using a steel hammer to drive a component or pins in place. Damage to the component may result. Always use a soft or non-ferrous hammer to drive a component or a pin.

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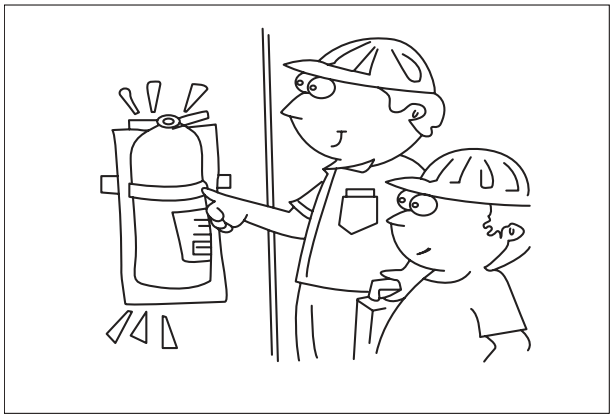
2.2.15 Aligning Parts or Components

- Be careful when installing or aligning parts or components.
- Avoid using your fingers or hands to position holes or part mating surfaces, serious injury could result if your hand or fingers should get ought between the surfaces.
- Always use tools to align a part or component to avoid any finger or hand injuries.



2.2.16 Fire Extinguisher and Emergency Exits

- It is important to know where all emergency exits and fire extinguishing equipment are located if a fire should occur in the shop.
- Before preparing for work, take time and walk around the shop to make a mental note of where all exits and fire equipment are located. If you are performing repairs in the field, always have a fire extinguisher handy and within reach.
- If you do not know how to use a fire extinguisher contact someone who can instruct you in the proper use of this equipment.



2.2.17 Personal Protective Equipment

If your shop specifies the use of safety equipment, OSHA requires this equipment to be used when on the shop floor or in the area where this equipment is required.

Never allow personnel in the shop area without the proper personnel protective equipment even for a moment.

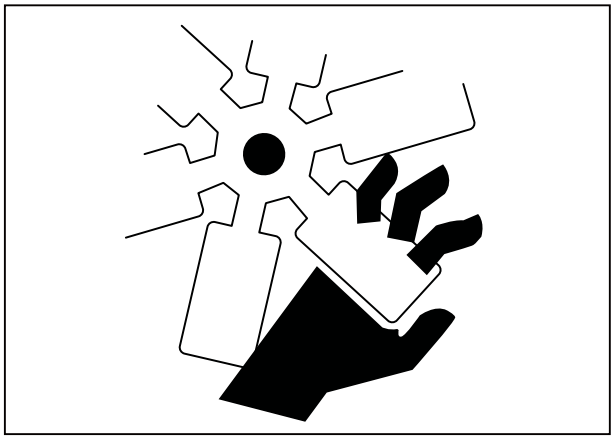
Always keep personnel protective equipment in good condition and replace them as required.



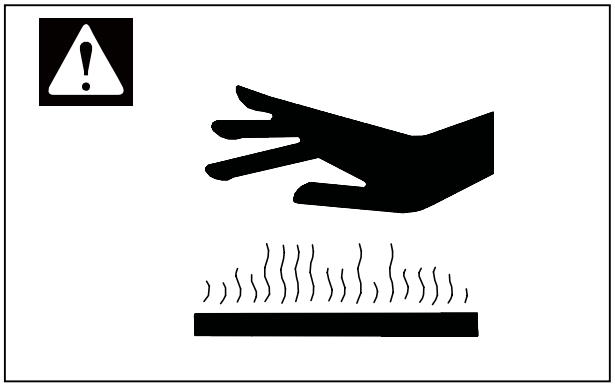
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2.2.18 Running the Machine

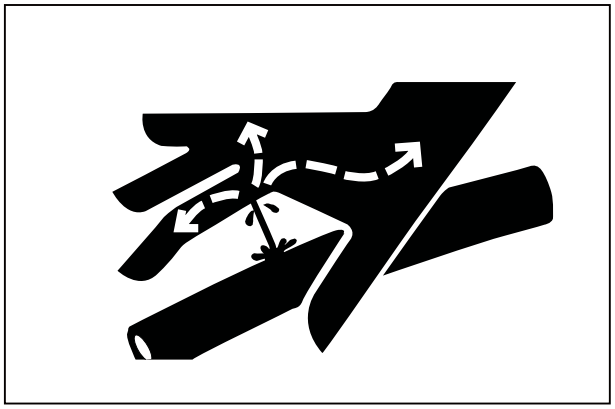
Run the machine during repair procedures ONLY if directed to do so in this shop manual. If the machine must be run when making repairs, it is important to follow some basic safety rules.



- Always be aware of rotating components.
- During repair operations while the engine is running, one worker must remain in the operator seat of the machine with clear contact between the person performing the repairs on the machine at all times.
- If equipped, all lock levers must be in the LOCK position or the parking brake must be in the PARK position.



- The person in the cab must never touch any controls. If a control lever must be operated, always maintain a clear view to the person doing the repair and signal them when you are about to move the control lever.
- Be aware of hot surfaces. During running operations, most surfaces will be hot, and some surfaces will be extremely hot. If necessary, use personnel protective equipment when working around high temperature surfaces.



- Keep in mind that during running operations, hydraulic systems, cooling systems and fuel systems will be under extremely high pressure and at high temperatures.
- Always use caution when working on or near these systems.

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2.2.19 Accumulator

If the machine is equipped with an accumulator charged with high-pressure nitrogen gas, it is important to follow these basic precautions.

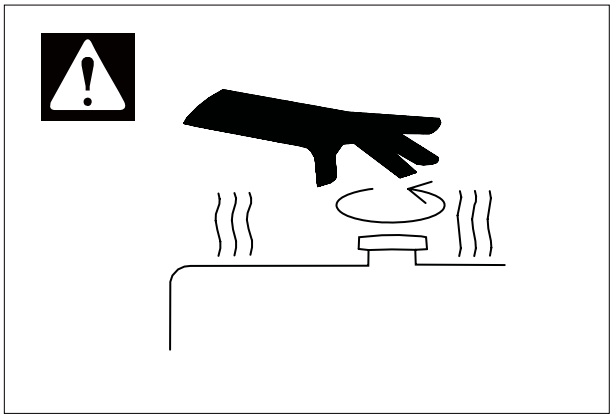


- Do not disassemble the accumulator.
- Never expose the accumulator to high heat or open flames.
- Never weld on the accumulator.
- Never drill or cut on the accumulator.
- Never strike the accumulator.
- Use only nitrogen gas to charge the accumulator. Unapproved gases could be explosive.

2.2.20 Adding Fluids to a System

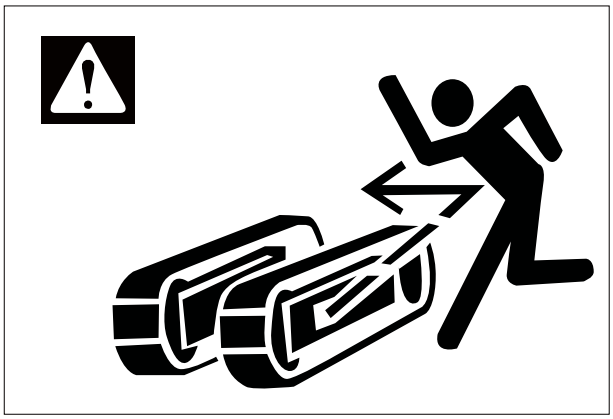
If it should be necessary to add fluids to a system during running operations, always be aware that these systems may be hot and under high pressure.

Before adding fluids, shut the machine down and allow the systems to cool down to outdoor ambient temperatures before removing any caps. Failure to do so may result in serious burns or a sudden loss of fluid.



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2.2.21 Track Recoil Springs

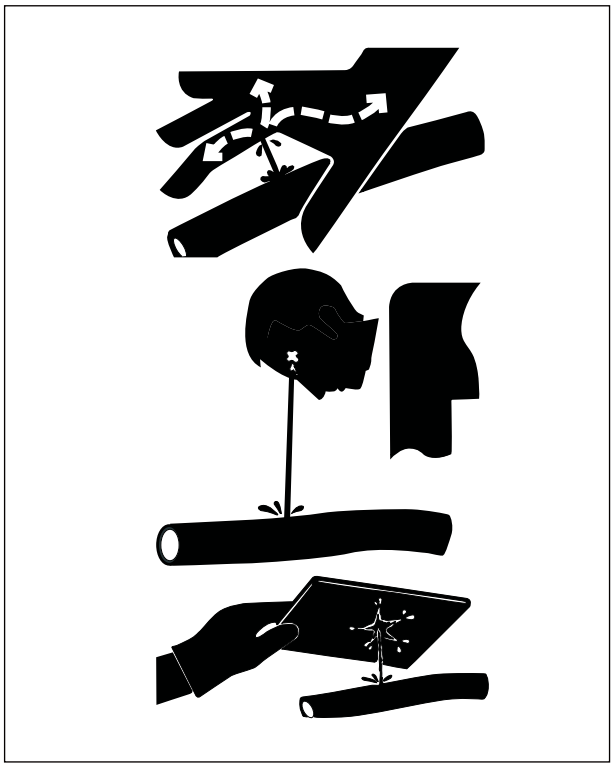


If you are making repairs to a machine equipped with tracks, always be aware of the dangers involved with track recoil springs. This spring is under extreme pressure at all times. If it is disassembled by mistake, the spring may fly out and cause serious injury.

Be careful when removing or installing tracks on track-type machines. When removing the master track link the track system may separate suddenly and cause possible injury.

Always stand clear of the track travel path when separating the master link section of the track.

2.2.22 High-Pressure Fluid Lines



Always keep in mind that these systems are under high pressure. When inspecting or replacing piping or hoses, always check to be sure the pressure in the system has been relieved before proceeding. Working on a system still under pressure could lead to serious injury, always do as follows:

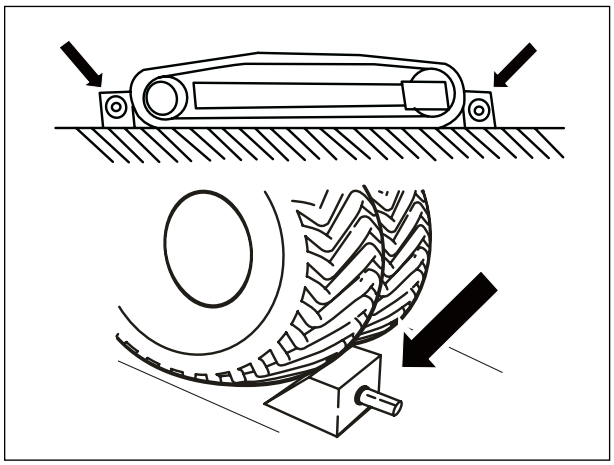
- If you will be removing a line or component with fluid in the system, always cap and seal the opening to avoid leakage or system contamination.
- Never carry out inspections or replace items while the system is under pressure.
- Never use any part of your body to check or feel for leaks. Always wear safety glasses and leather gloves when checking for leaks and use a piece of wood or cardboard when checking for leaks from small holes.
- If high pressure fluids should penetrate your skin or get into your eyes, seek medical attention immediately.

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2.2.23 Safe Work Preparations

Before starting any repairs, be sure the machine is sitting on a level stable surface.

Lower all the work equipment to a safe and stable position on the ground. Turn the engine OFF and neutralize the work equipment controls by rotating them to the left and right (joystick control) or moving them back and forth (lever control). This function will relieve system pressure.



Block the tracks (if equipped) or wheels (if equipped) with chocks to prevent the machine from moving.

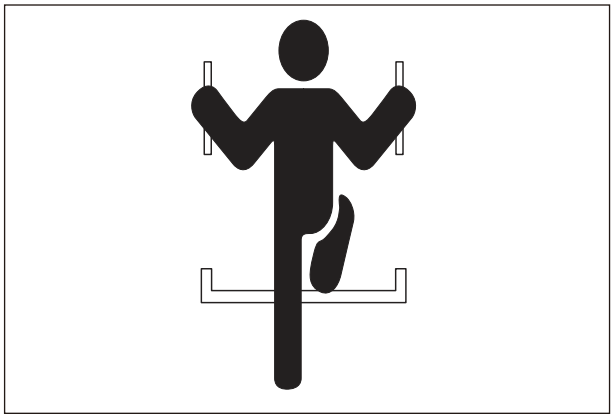
If equipped, set the hydraulic lock lever in the LOCKED position. If equipped, set the parking brake in the PARK position.

Be sure all personnel and equipment is clear of your work area and you can be seen by all working personnel especially if performing repairs in the field.

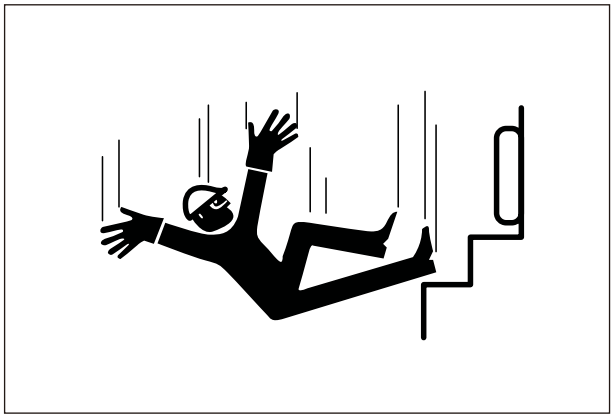
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2.2.24 Mounting and Dismounting

It is important to follow these procedures when mounting or dismounting the equipment:



- Use all hand-holds and step plates on your equipment.
- Never jump off or onto the equipment.
- Wipe off any oil, grease, or mud from your shoes, rails, steps or platforms before getting on the equipment; always keep these areas clean and in good condition.
- Never get on or off moving equipment. These actions may lead to serious injury. Always bring the equipment to a full stop and turn the engine OFF.
- When getting on or off the equipment, always face the equipment and maintain a three-point contact (both feet and one hand or one foot and both hands) with the handrails, steps and platforms to ensure that you support yourself correctly.

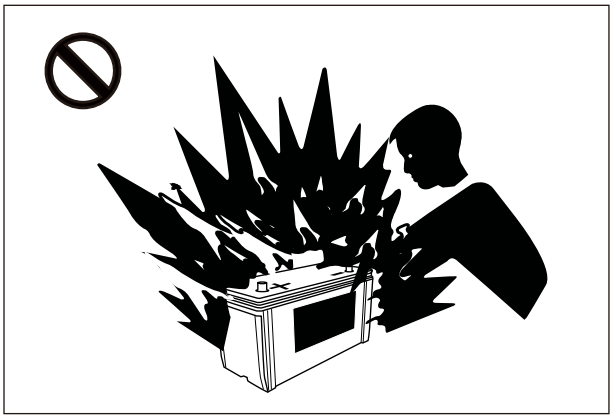


- Never climb on areas of the machine that are not designated walk areas.
- Never climb on or off the machine with tools, parts or similar objects in your hands.
- Never use machine controls or non-specified points on the equipment to get on or off the machine.
- Use all hand-holds when on the machine.

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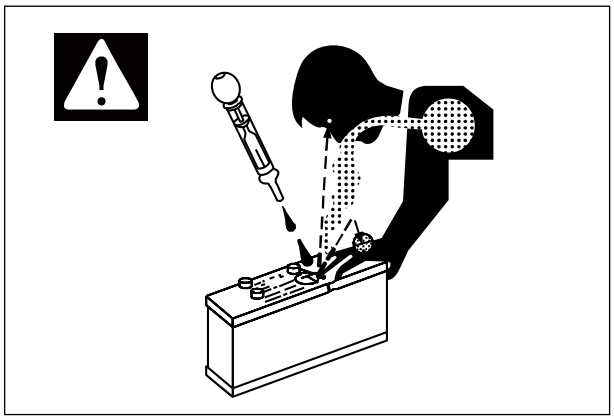
2.2.25 Battery Hazards

Working around batteries always poses a hazard, especially if the battery has been in service for a long period of time.

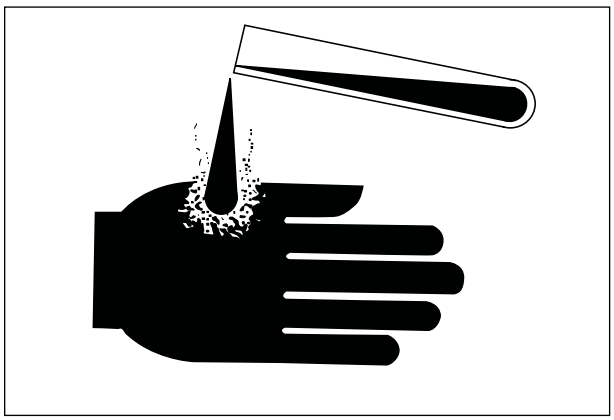


Listed below are some basic precautions to be aware of when servicing or working around batteries.

- Always wear personal protective equipment when working around batteries.
- Battery gasses are extremely explosive. When opening a battery compartment, always allow ample time for the gasses to escape before servicing the battery.
- When working with batteries, always work in a wellventilated area.
- If the battery is corroded, flush the area with a baking soda and warm water mix.



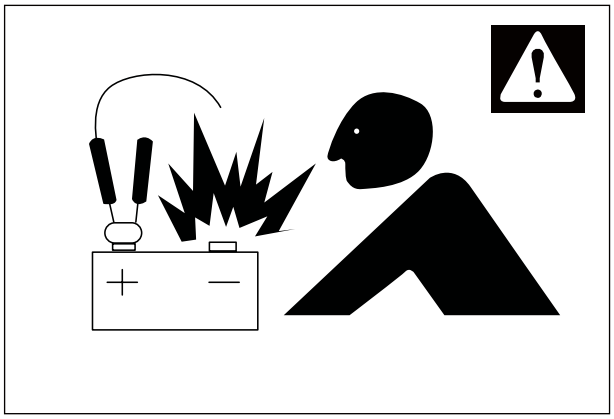
- If battery acid should get on your skin or in your eyes, flush the area immediately with fresh water and seek medical attention.



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2.2.26 Jump-Start Safety

When using jumper cables to start the machine, connect the positive (+) jumper first, then the negative (-) jumper to a remote location on the chassis away from the battery.



⚠ CAUTION

Never use a welder or a machine with a higher voltage system to jump-start the machine. Doing so may damage the machine's electrical system or cause an unexpected explosion or fire resulting in minor or major injury.

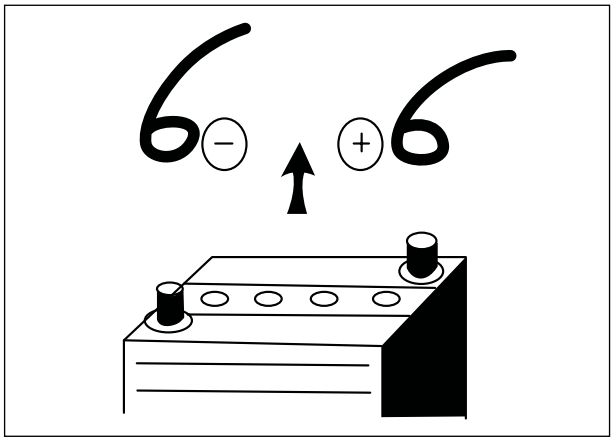
2.2.27 Disconnecting the System Power

Before starting any repair operations, remove the battery leads from the battery or set the main disconnect on the machine in the OFF position.

For the location of the machine main electrical disconnect switch, refer to the machines Safety, Operation & Maintenance Manual for location and procedures.

If the battery must be disconnected, remove the negative (-) terminal clamp first then remove the positive (+) clamp last.

When reconnecting the battery, be sure every electrical system switch is in the OFF position, connect the positive clamp (+) first, then the negative clamp(-) last.



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2.2.28 LOCKOUT/TAGOUT

Due to the size and complexity of this machine, Lockout and Tagout procedures may be required by your company to ensure the safety of yourself and others involved in the repair process of the machine. While work is in progress, all power sources must be disabled, locked and tagged with a warning label. Lockout/Tagout procedure establishes the minimum requirements used to isolate all power sources from potentially hazardous energy, and to ensure that the machine is “locked out and tagged out” before anyone performs repairs on the machine.

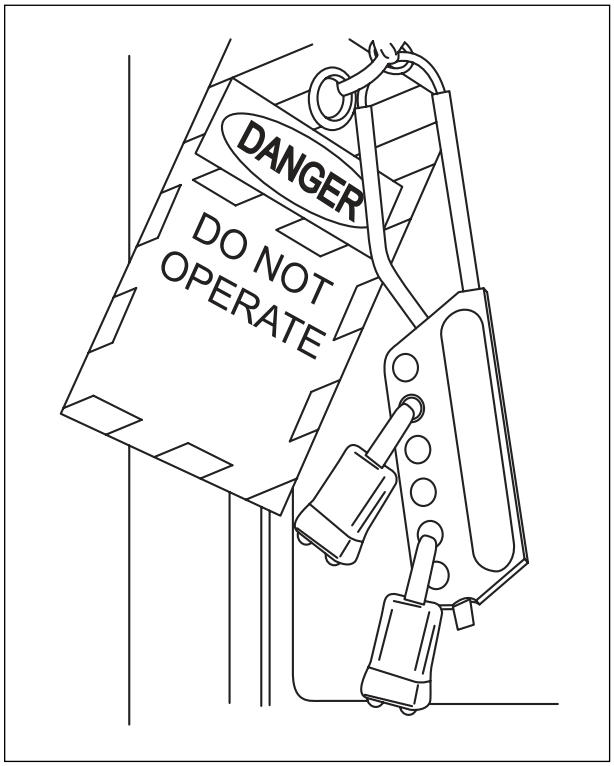
2.2.29 Sequence of Procedures

Only authorized employees performing repairs on the machine shall perform Lockout/Tagout in accordance with this procedure listed below.

If the employee performing repairs to the machine is issued

a lock and key, the employee shall not share the lock or key with other employees until all repair procedures are complete and the machine is ready to put back into service.

The following steps shall be performed in the sequence listed when the equipment is to be either locked-out or tagged-out for repair.



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Locking out of service

1. Notify all employees who may be potentially affected by the repair process on the machine.
2. Secure the machine in a safe position. If equipped, set the parking brake or hydraulic lock lever in the PARK or LOCKED position.
3. Identify, remove or disconnect all power or energy sources and be sure to install a Lockout/Tagout device on them. If the machine is equipped with a Maintenance Alert Tag, attach this tag to the machine controls.
4. Be sure all employees involved in the repairs have installed there lock on the power source before performing any repairs. Once an employee has completed there repair procedure, they must remove there lock and not access the machine in any manor.



Returning to service

1. The authorized person who performed the Lock out/Tagout procedure shall check the area around the machine to ensure that no one is exposed to any hazard before start-up.
2. The authorized person who performed the Lock out/Tagout shall ensure that all guards have been reinstalled to their proper place, all tools and equipment have been removed and all locks are removed.
3. The authorized person who performed the Lock out/Tagout shall verify that all controls are in the neutral or “off” position and all personnel are aware of the time the machine will be back in service.
4. Remove the Lockout/Tagout equipment and any additional alert equipment and re-energize the machine for return to service.

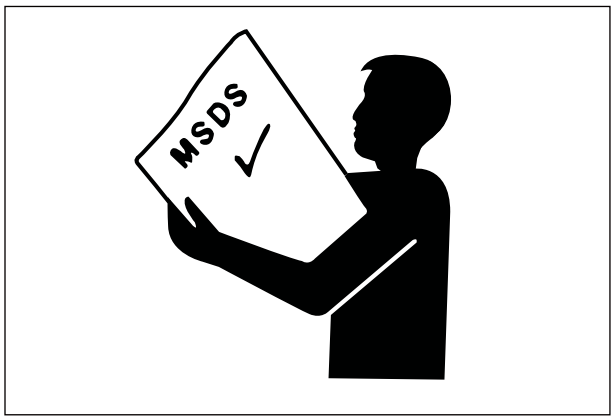
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2.2.30 CHEMICAL HAZARDS

Exposure to hazardous chemicals pose a serious danger if released or mishandled. Handling hazardous materials often releases substances that could pose a hazard. Temporary implication or possible residual injury may result unless proper precautions are observed while working with these materials. All workers involved in handling hazardous materials should use approved personal protective equipment and follow all environmental safety regulations.

2.2.31 Material Safety Data Sheets (MSDS)

Material Safety Data Sheet (MSDS) information relating to the materials the workers could be exposed to.



- MSDS data sheets provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. Information includes physical data, health effects, first aid, reactivity, storage, disposal and protective equipment required.
- Be sure all personnel involved are familiar with all MSDS-related information as it relates to the hazardous materials they could be exposed to. Keep MSDS data sheets handy in site of all employees and emergency personnel where they can be easily accessed.
- Never handle hazardous materials without the proper MSDS information. Always verify the data on the MSDS sheet before handling any hazardous materials.

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Specifications

3 Specifications

3.1 Dimensions 3-3
3.2 Working Ranges 3-4
3.3 Technical Specifications 3-5
3.4 Weight Table 3-6
3.5 Fuel and Coolant 3-7
3.6 Engine Performance Curve 3-9

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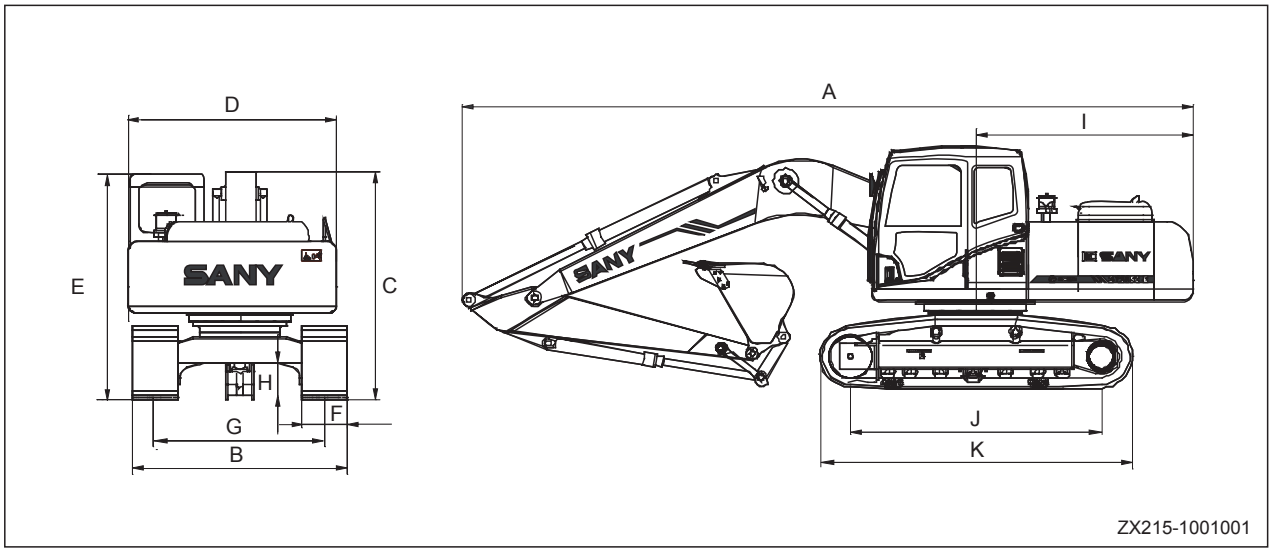
⚠ WARNING

Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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3 SPECIFICATIONS

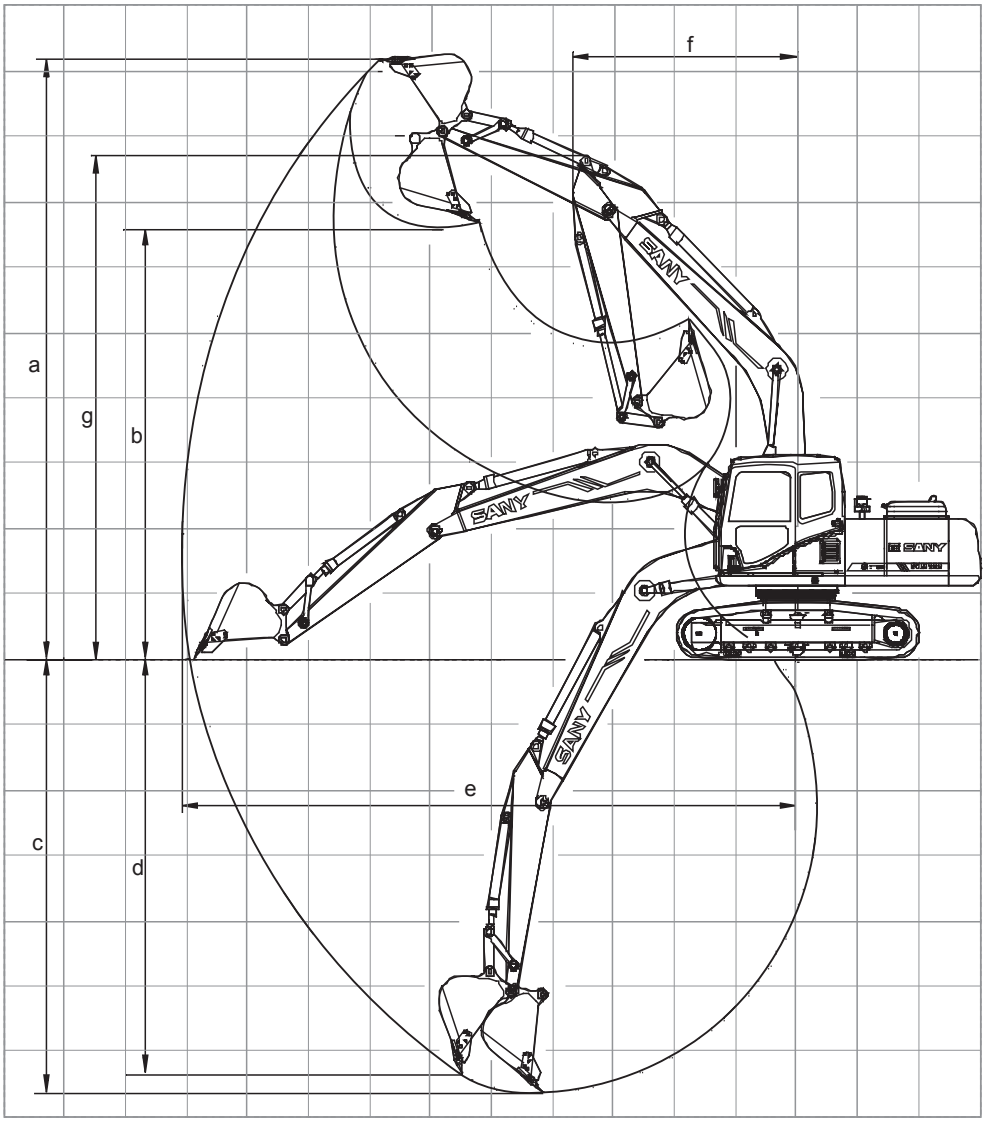
3.1 Dimensions



Boom length		5700 mm (18'8")
Arm length		2900 mm (9'7")
A	Overall length (shipping)	9397 mm (30'10")
B	Overall width	3180 mm (10'5")
C	Overall height (Shipping)	2956 mm (9'8")
D	Width (top)	2710 mm (8'11")
E	Overall height (to cab roof)	2930 mm (9'7")
F	Std. track shoe width	800 mm (2'7")
G	Track gauge	2380 mm (7'10")
H	Min. ground clearance	440 mm (1'5")
I	Tail swing radius	2873 mm (9')
J	Length of track on ground	3640 mm (11'11")
K	Track length	4450 mm (14'7")

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3.2 Working Ranges



ZX215-1001002

Boom length		5700 mm (18'8")
Arm length		2900 mm (9'7")
a	Max. cutting height	9305 mm (30'7")
b	Max. dumping height	6485 mm (21'3")
c	Max. digging depth	6630 mm (21'9")
d	Max. vertical digging depth	5980 mm (19'7")
e	Max. digging reach	9885 mm (32'5")
f	Min. swing radius	3630 mm (11'11")
g	Max. height at min. swing radius	7570 mm (24'10")

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3.3 Technical Specifications

Machine model			SY215C$_{LC}$		
Machine	Bucket capacity		0.9 m³ (1.18 yd³)		
	Operating weight		21,600 kg (47,620 lb)		
	Max. bucket digging force – SAE		138 kN (31,080 lb)		
	Max. arm digging force – SAE		100 kN (22,481 lb)		
	Swing speed		12.5 rpm		
	Travel speed (Hi/Lo)		5.5/3.2 km/h (3.4/2.0 mph)		
	Gradeability		70%, 35°		
	Ground pressure		36 kPa (5.2 psi)		
Engine	Model		CUMMINS QSB6.7–C155		
	Type		6-cylinder, 4-cycle, water-cooled, in-line, high-pressure, common rail		
	No. of cylinders-bore x stroke		6–Φ107mm × 124mm (Φ4.2 in × 4.9 in)		
	Piston displacement		6.7 L (409 in³)		
	Performance	Rated power – SAE J1995, gross	116 kW (155 hp) @ 2,000 rpm		
		Max. torque	618 N·m (456 lb·ft) @ 1,500 rpm		
		Max. speed at no load	2,000±50 rpm		
		Min. speed at no load	600±10 rpm		
		Min. fuel consumption	215 g/KWh (0.353 lb/hph)		
	Starter motor		24V, 7.5kW		
	Alternator (EPA Tier 3 Emission certified)		70A		
Under-carriage	Carrier roller (each side)		2		
	Track roller (each side)		9		
	Track shoe (each side)		49		
Hydraulic system	Hydraulic pump	Type	2 × variable displacement piston type		
		Max. flow	2×210 L/min (55.5 gal/min)		
	Relief valve setting		34.3 MPa (4,975psi)		
	Implement relief power boost		37.3 MPa (5,400psi)		
	Travel motor		2 × axial piston motors with parking brake		
	Swing motor		1 × axial piston motor with swing holding brake		
	Cylinder	Type	Boom	Arm	Bucket
			Double acting piston		
		Bore	120 mm (4.7 in)	135 mm (5.3 in)	115 mm (4.5 in)
		Rod	85 mm (3.3 in)	90 mm (3.5 in)	80 mm (3.1 in)
		Stroke	1,285 mm (50.6 in)	1,490 (58.7 in)	1,120 mm (44.1 in)
	Hydraulic tank		Closed type		
	Hydraulic oil filter element		Tank return side		
	Hydraulic oil cooler		Air-cooling type		

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3.4 Weight Table

Machine Model	SY215CLC
Engine	485 kg (1,069 lb)
Radiator assembly	92 kg (203 lb)
Hydraulic tank assembly (without hydraulic oil)	148 kg (326 lb)
Fuel tank assembly (without fuel)	143 kg (315 lb)
Revolving frame	1764 kg (3,889 lb)
Operator cab	340 kg (750 lb)
Operator seat & control console	76 kg (168 lb)
Counterweight	3900 kg (8,598 lb)
Hydraulic pump	120 kg (265 lb)
Control valve	132 kg (291 lb)
Swing reducer assembly	289 kg (637 lb)
Final drive assembly	2×404 kg (891 lb)
Center swivel joint	48 kg (106 lb)
Track frame Swing bearing Idler Tensioning device Carrier roller Track roller	3004 kg (6,623 lb) 293 kg (646 lb) 2×113 kg (249 lb) 2×115 kg (254 lb) 4×25.5 kg (56 lb) 18×40 kg (88 lb)
Boom assembly	1689 kg (3,724 lb)
Arm assembly	708 kg (1,561 lb)
Boom cylinder assembly	2×206 kg (454 lb)
Arm cylinder assembly	262 kg (578 lb)
Bucket cylinder assembly	188 kg (414 lb)
Linkage	68 kg (150 lb)
Rocker	2×20 kg (44 lb)

Note:

This weight table is intended as a reference when handling or transporting the components.

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3.5 Fuel and Coolant

Reservoir	Fluid type	Ambient temperature -22 -30 / -4 -20 / 14 -10 / 32 0 / 50 10 / 68 20 / 86 30 / 104 40 / 122°F 50°C
Engine oil pan	Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Carrier roller Idler Track roller	Engine oil	SAE 30
Swing mechanism Travel mechanism	Gear oil	
Hydraulic system	Engine oil	SAE 10W SAE 10W-30 SAE 15W-40
	Hydraulic oil	L-HV32 Low-temp, wear-resistant hydro oil L-HM46 Wear-resistant hydro oil L-HM68 Wear-resistant hydro oil
Fuel tank	Diesel fuel	ASTM D 975 No.2 GB252 Super-20 Diesel fuel GB252 Super-35 Diesel fuel
Grease fitting	Grease	NLGI No.2
Cooling system	Coolant	Add anti-freeze

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- Machine oil above API CF-4 (no lower than APC CD) is recommended.
- Gear oil GL-5 is recommended.
- Obtain genuine oil from Sany Heavy Machine or its authorized dealers.

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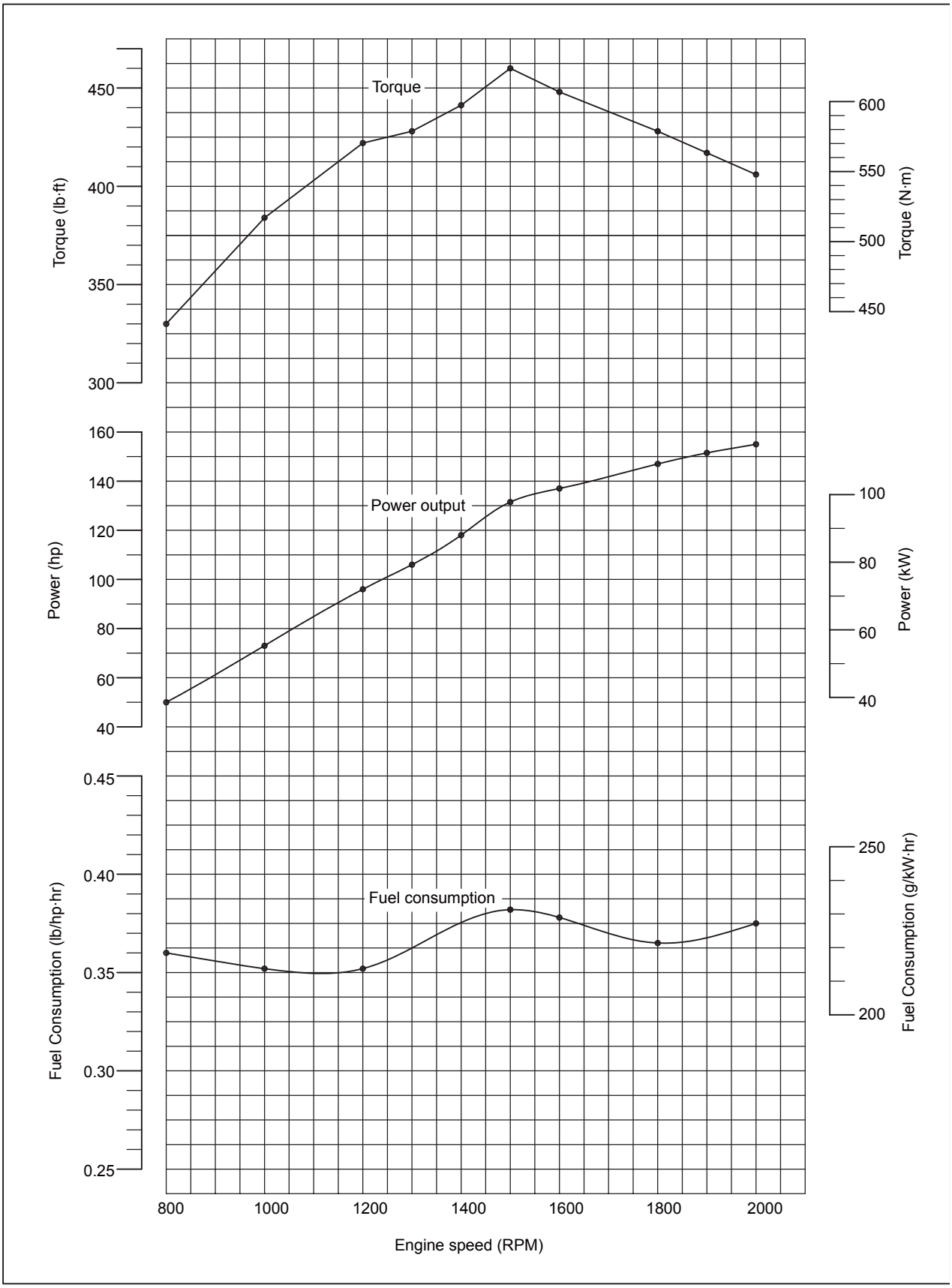
3.6 Engine Performance Curve

Cummins QSB6.7-C155

Testing condition:

1) 100kPa {29.61 in Hg} barometric pressure, 91m {300 ft} attitude and 25°C {77°F}] inlet air temperature.
2) Alternator and fan not included.

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Structure and Function

4 Structure and Function

4.1 Engine and Cooling System 4-3
4.2 Power Train 4-5
4.3 Undercarriage and Frame 4-13
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4.8 Engine Control 4-166
4.9 Electrical Control System 4-172
4.10 Monitoring System 4-203

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⚠ WARNING

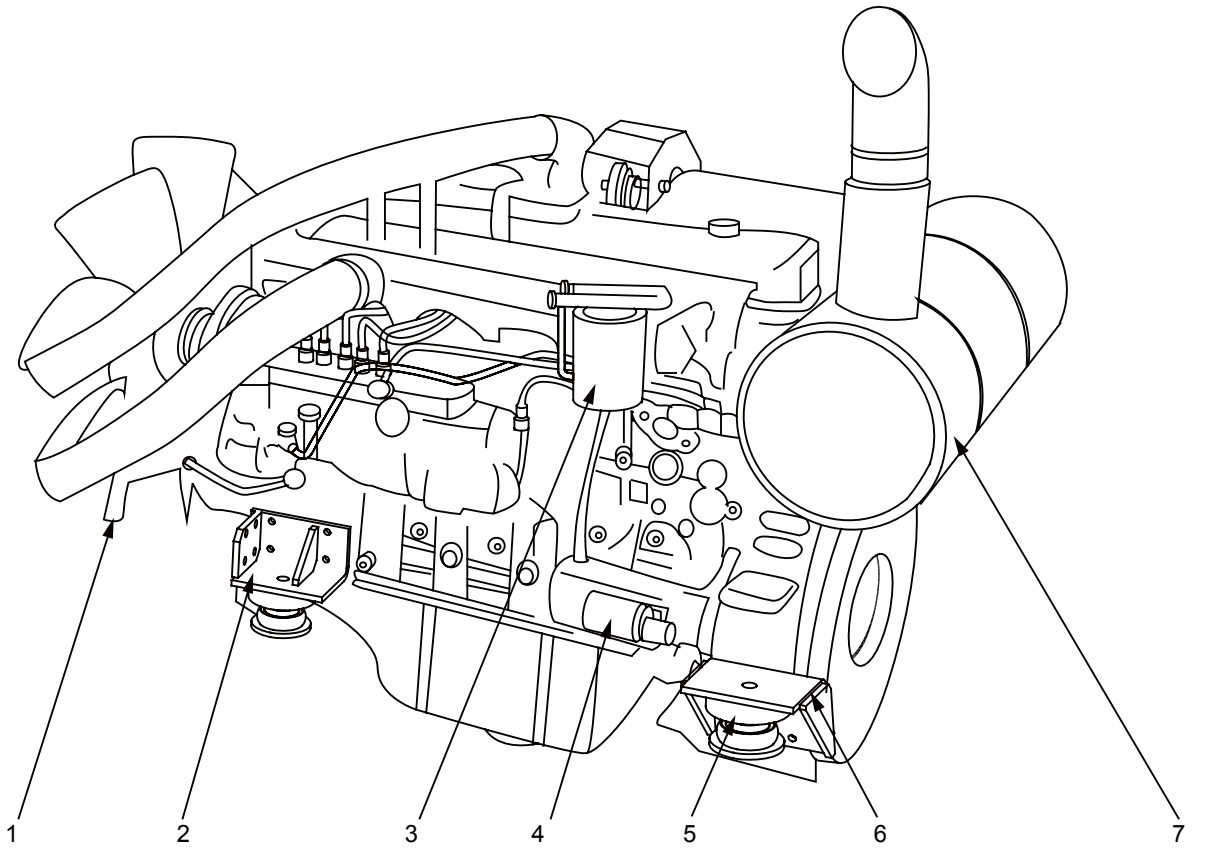
Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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4 STRUCTURE AND FUNCTION

4.1 Engine and Cooling System

4.1.1 Engine-related parts



ZX215-1002001

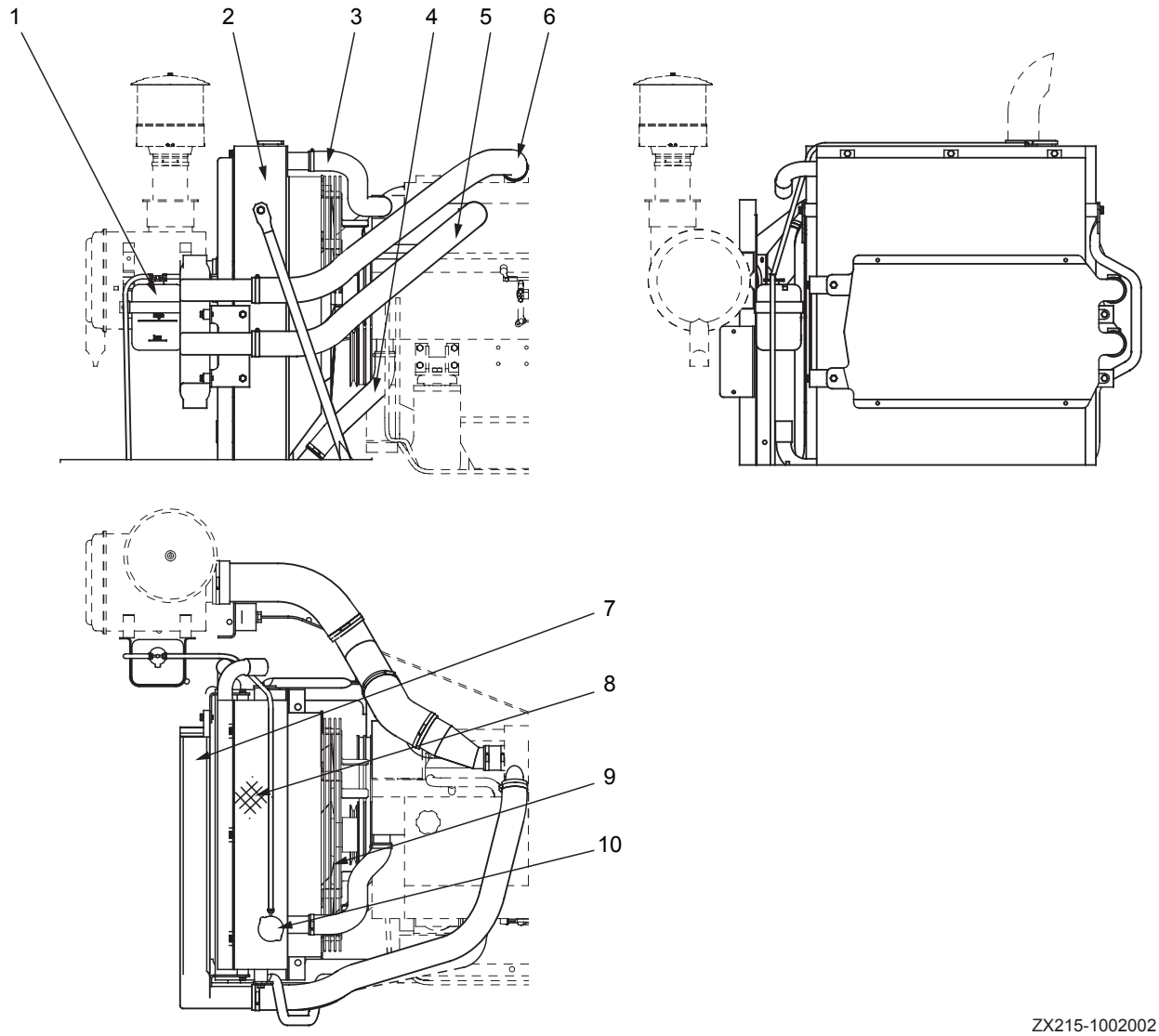
1- Fan
2- Front engine mount
3- Fuel filter
4- Start motor
5- Rubber damper assembly
6- Rear engine mount
7- Muffler

Specification

Oil capacity: 22 L

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4.1.2 Radiator and intercooler



ZX215-1002002

1- Reservoir
2- Radiator assembly
3- Radiator inlet hose
4- Radiator outlet hose
5- Inlet air pipe
6- Outlet air pipe
7- Intercooler
8- Guard net
9- Guard
10- Radiator cap

Specifications

Radiator assembly: ME444275

Aluminum pipe, belt-type radiator

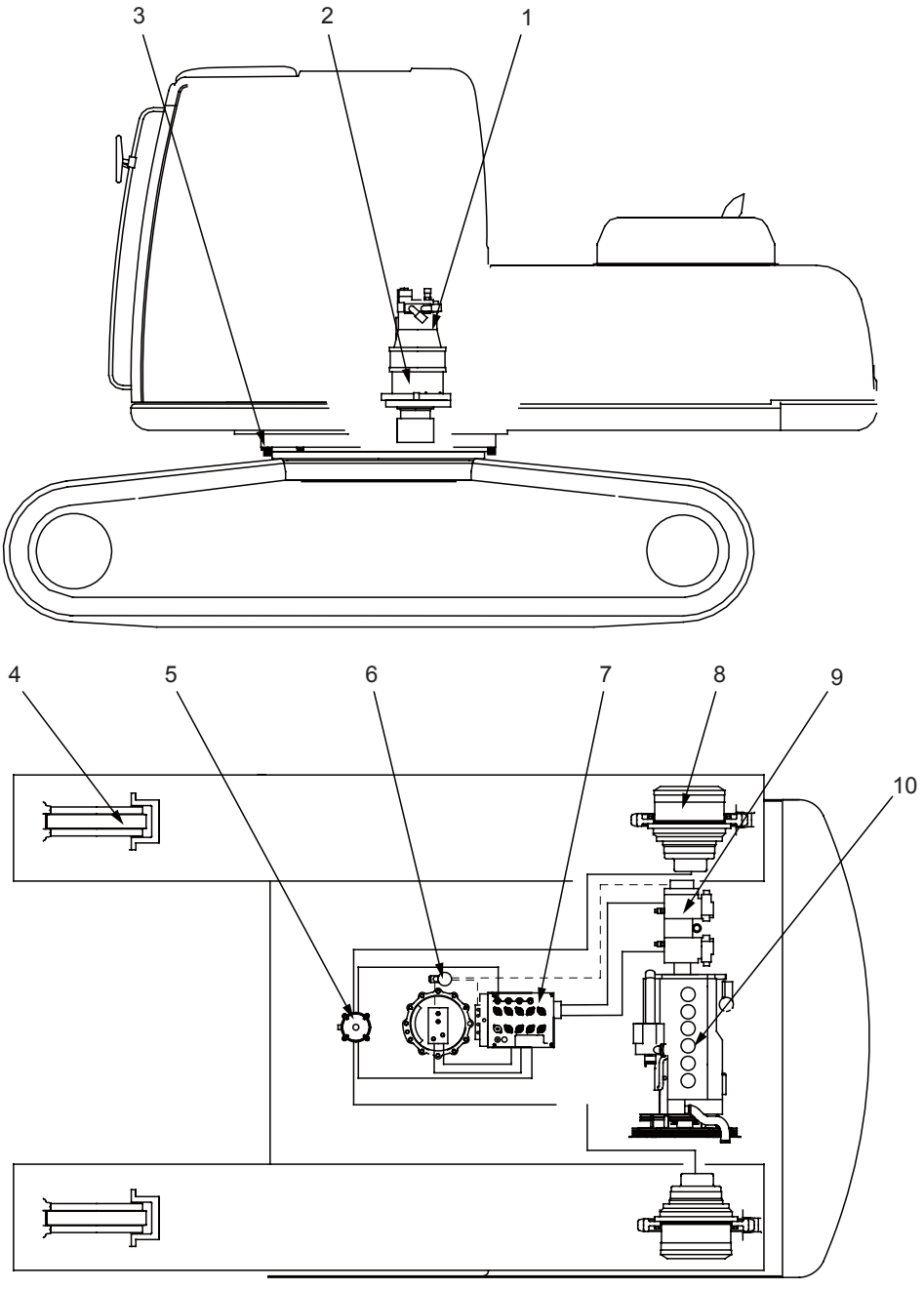
Inter-cooling, oil radiation/water radiation series connection type.

Reservoir capacity: 11.5L

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4.2 Power Train

4.2.1 Power transmission system

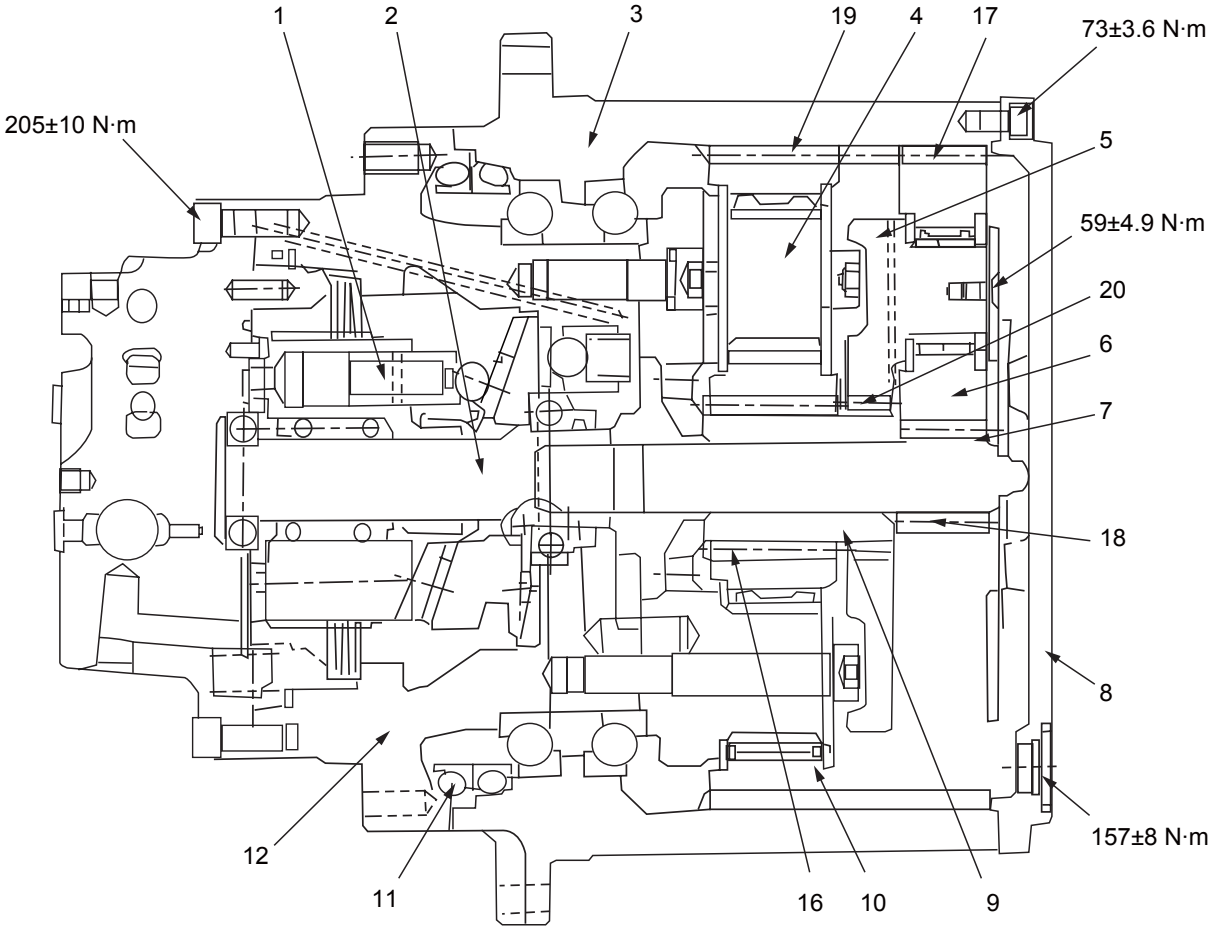


ZX215-1002003

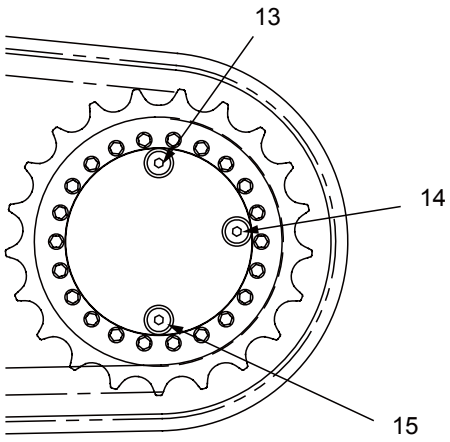
1- Swing motor (M5X130CHB-12A-51A/260-169)
2- Swing reducer (RG14D20A5)
3- Swing bearing
4- Idler
5- Center swivel joint
6- Accumulator
7- Control valve (KMX15RB)
8- Final drive AS (GM35VL-E-75/130-3)
9- Hydraulic pump(K3V112DTP1N9R)
10- Engine (QSB6.7-C155)

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4.2.2 Final drive AS (KYB)



ZX215-1002004



ZX215-1002005

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1- Cylinder GP
2- Shaft
3- Gear hub (No. of teeth: 85)
4- No. 2 planetary carrier
5- No. 1 planetary carrier
6- No. 1 planetary gear (No. of teeth: 36)
7- No. 1 sun gear (No. of teeth: 12)
8- End cover
9- No. 2 sun gear (No. of teeth: 19)
10- No. 2 planetary gear (No. of teeth: 36)
11- Seal ring
12- Travel motor
13- Fill port
14- Level port
15- Drain port

Specifications

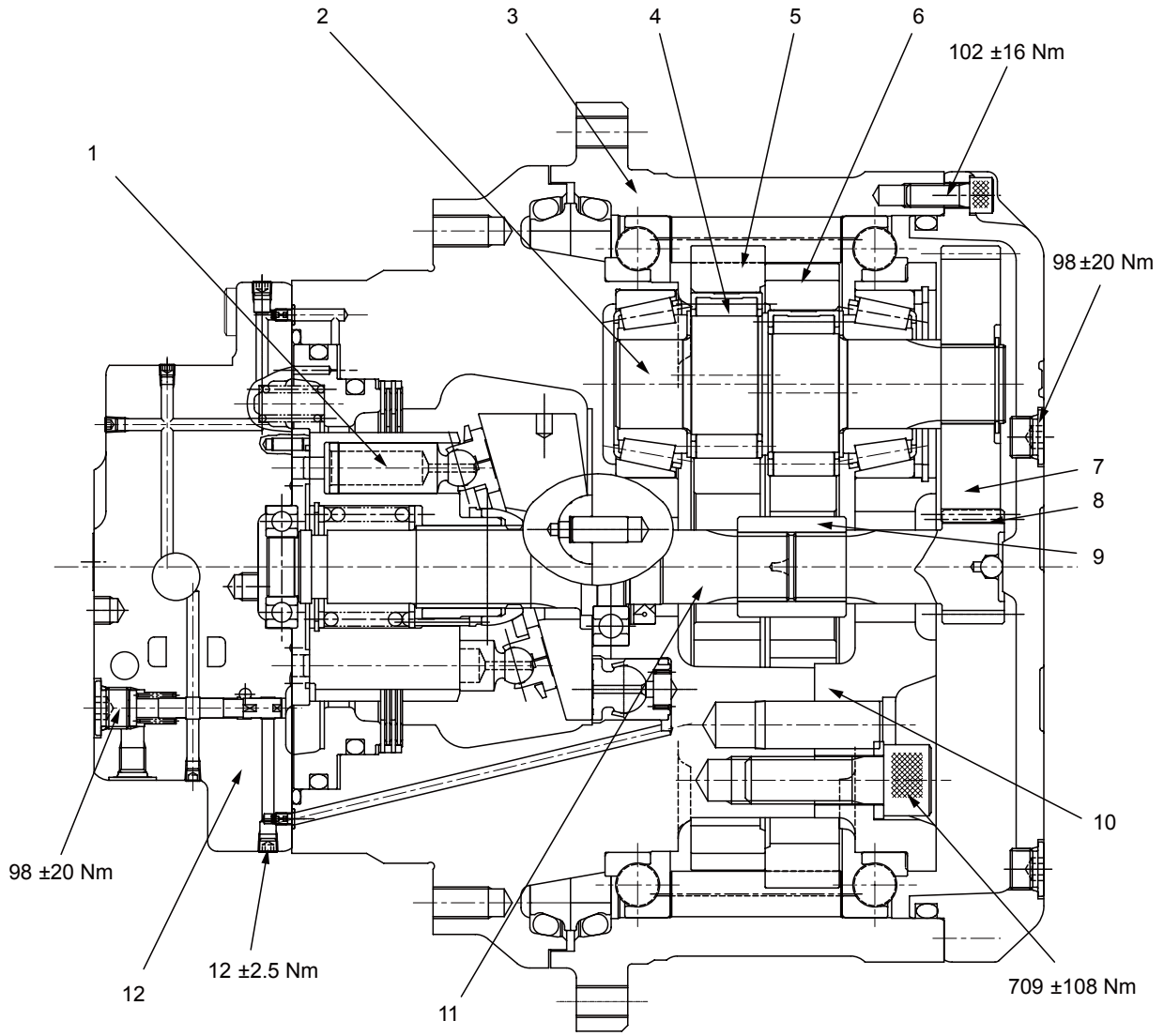
Reduction ratio:

((12+85) /12) × ((19+85) /19)) -1= 43.246

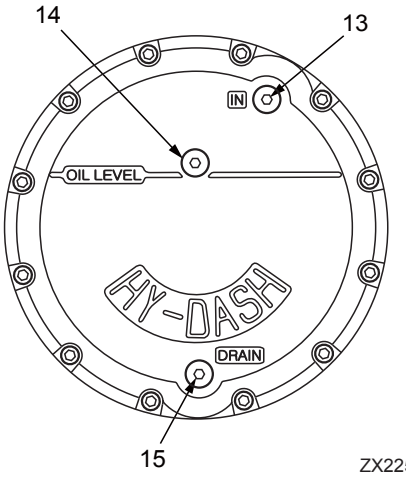
No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
16	Backlash between No. 2 sun gear and No.2 planetary gear	0.13 – 0.47	1.00	Replace
17	Backlash between No. 1 planetary gear and gear hub	0.17 – 0.57	1.10	Replace
18	Backlash between No. 1 sun gear and No.1 planetary gear	0.14 – 0.46	1.00	
19	Backlash between No. 2 planetary gear and gear hub	0.16 – 0.56	1.10	
20	Backlash between No. 1 planetary carrier and No. 2 sun gear	0.38 – 0.66	1.00	

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4.2.3 Final drive AS (Nabtesco)



ZX215-1002006



ZX225-1102047

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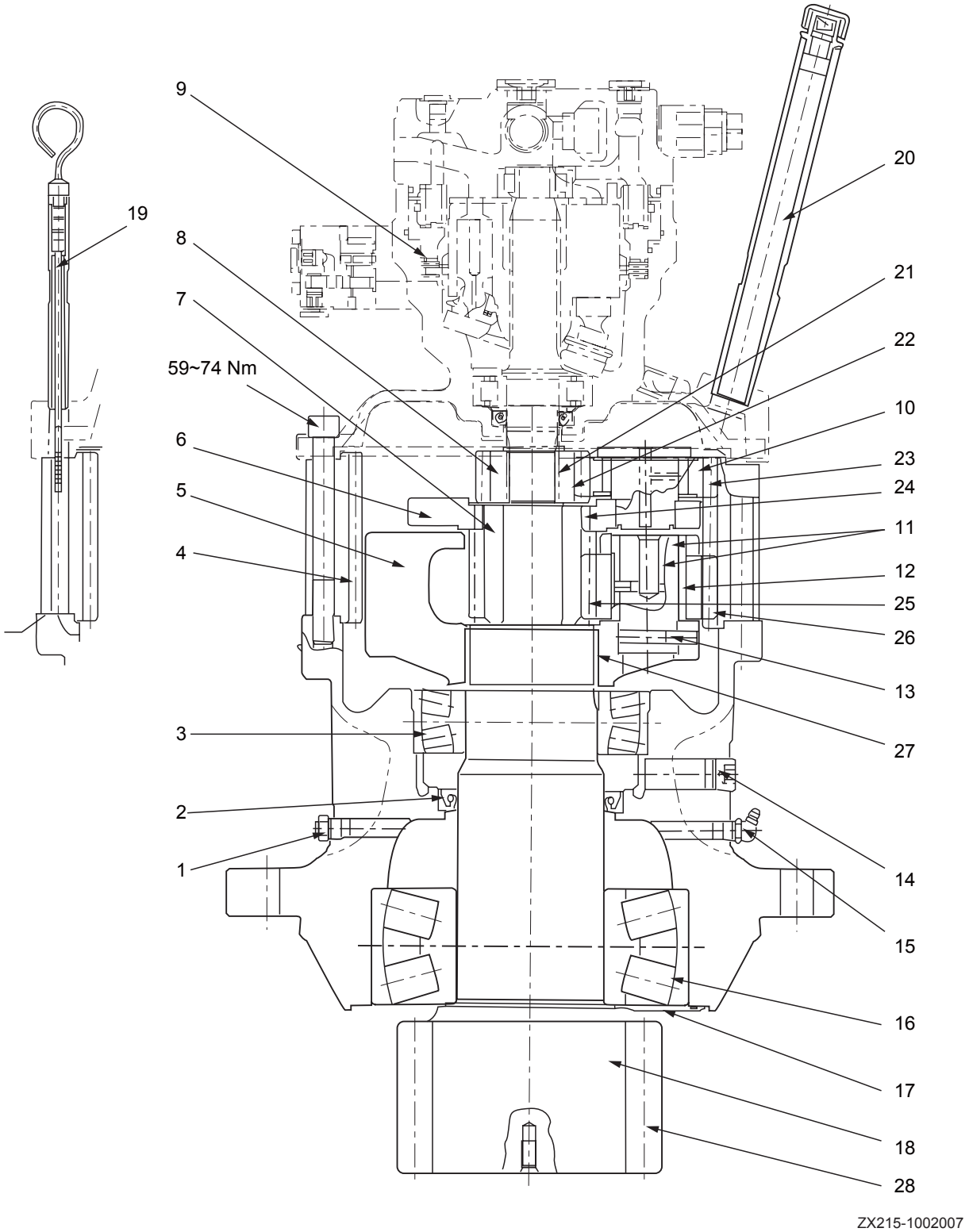
1- Plunger GP
2- Crankshaft
3- Gear hub
4- Roller bearing
5- RV drive gear A
6- RV drive gear B
7- No. 1 planetary gear (42)
8- No. 1 sun gear (18)
9- Shaft coupling
10- Retainer
11- Motor output shaft
12- Travel motor
13- Fill port
14- Level port
15- Drain port

Specifications

Reduction ratio: 60

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4.2.4 Swing machinery



ZX215-1002007

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1- Plug
2- Oil seal
3- Self-aligning bearing
4- Ring gear (No. of teeth:52)
5- No. 2 planetary carrier
6- No. 1 planetary carrier
7- No. 2 sun gear (No. of teeth: 16)
8- No. 1 sun gear (No. of teeth:14)
9- Swing motor
10- No. 1 planetary gear (No. of teeth:18)
11- No. 2 planetary gear GP
12- No. 2 planetary gear (No. of teeth:17)
13- Spring pin
14- Swing reducer screw plug
15- Grease fitting
16- Self-aligning bearing
17- Bearing sealing
18- Swing pinion
19- Dipstick
20- Oil filling pipe

Specifications

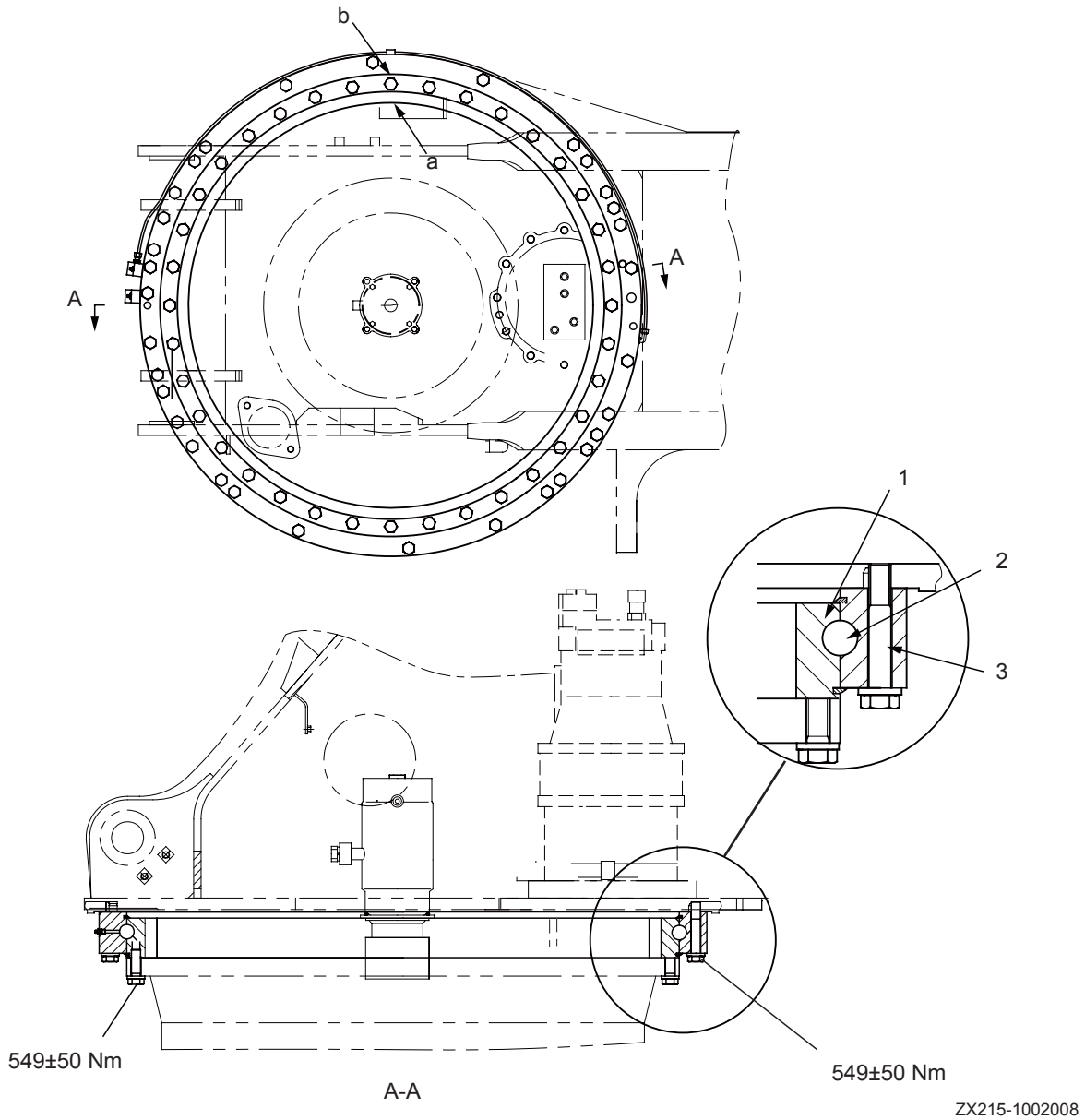
Reduction ratio:

(14+25) /14× (16+25) /14= 20.04

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
21	Backlash between swing motor shaft and No. 1 sun gear	0.18 – 0.28	—	Replace
22	Backlash between No. 1 sun gear and No.1 planetary gear	0.16 – 0.50	1.00	Replace
23	Backlash between No. 1 planetary gear and ring gear	0.18 – 0.59	1.10	
24	Backlash between No. 1 planetary carrier and No. 2 sun gear	0.39 – 0.71	1.20	
25	Backlash between No. 2 sun gear and No.2 planetary gear	0.16 – 0.50	0.90	
26	Backlash between No. 2 planetary gear and ring gear	0.18 – 0.59	1.00	
27	Backlash between No. 2 planetary carrier and swing pinion	0.07 – 0.23	—	
28	Backlash between swing pinion and swing bearing	0.22 – 1.32	2.00	

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4.2.5 Swing bearing



1- Swing bearing inner race (No. of teeth: 91)

2- Ball

3- Swing bearing outer race

a. Inner race soft zone S position

b. Outer race soft zone S position

Specifications

Reduction ratio: 91/13= 7

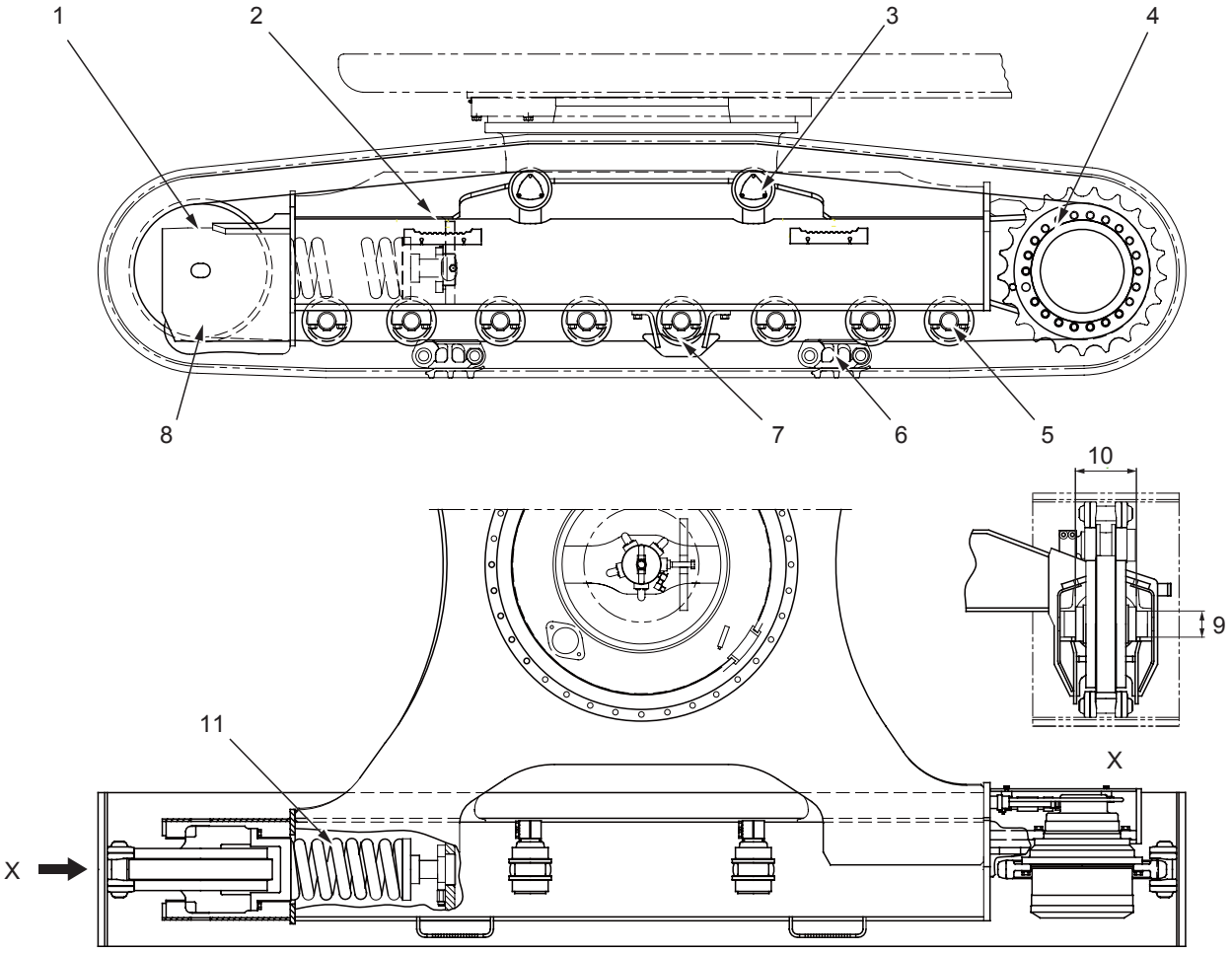
Amount of filled grease: 13±1 Kg

Check item	Criteria		Remedy
Axial clearance of bearing (when mounted on chassis)	Standard clearance	Clearance limit	Replace
	0.5~1.6	3.2	

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4.3 Undercarriage and Frame

4.3.1 Track frame and recoil spring



ZX215-1002009

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1- Idler
2- Track frame
3- Carrier roller
4- Sprocket
5- Track roller
6- Track shoe
7- Center guard
8- Front guard

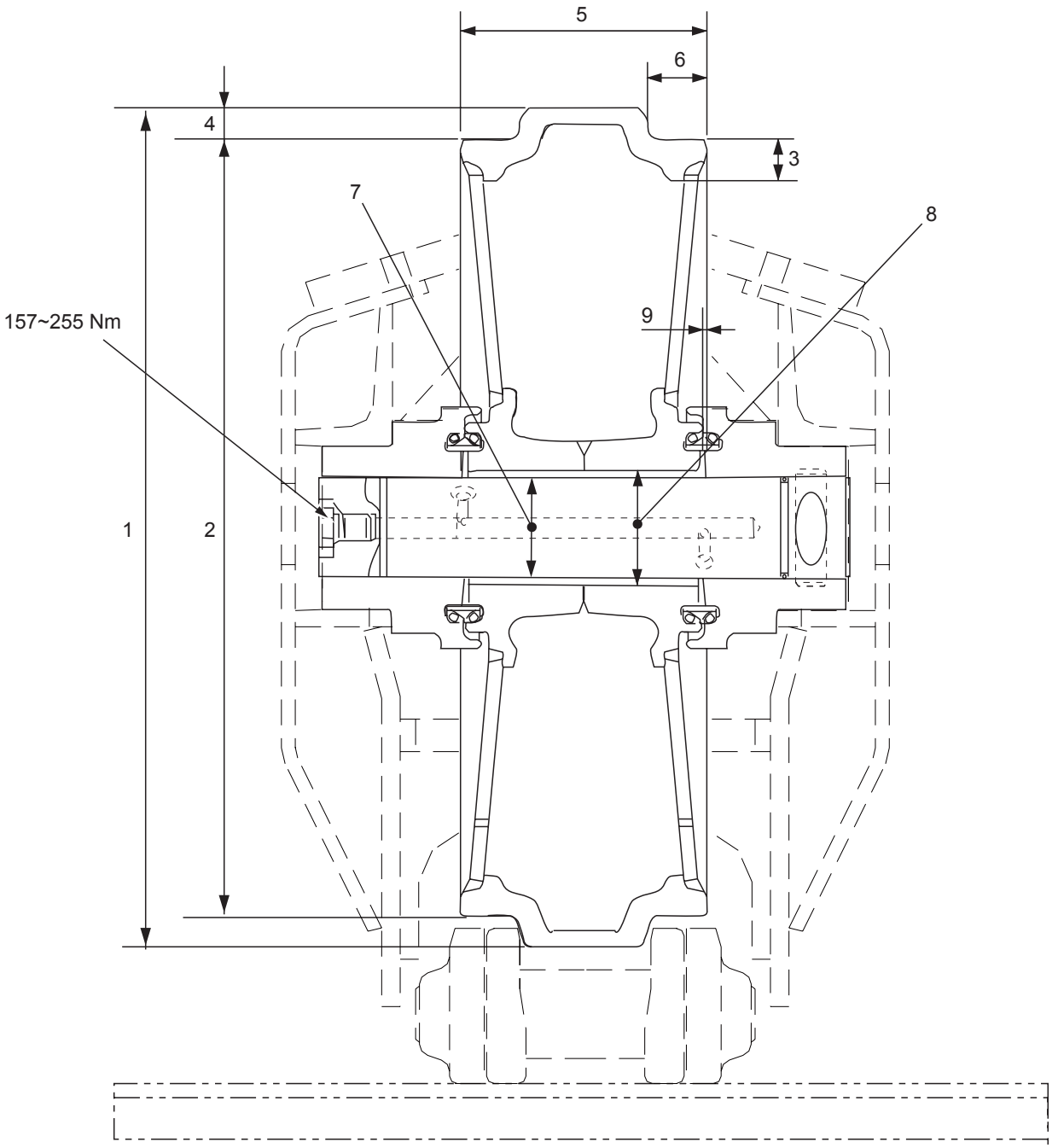
- Dimension and number of track rollers may vary depending on the machine model, but the basic structure is the same.
- Number of track rollers: 9 each side

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="5">9</td><td rowspan="5">Vertical width of idler guide</td><td colspan="2"></td><td>Standard size</td><td>Tolerance</td><td>Repair limit</td><td rowspan="5">Build-up welding or replace</td></tr>
<tr><td colspan="2">Track frame</td><td>107</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">Idler support</td><td>105</td><td>—</td><td>—</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Horizontal width of idler guide</td><td colspan="2">Track frame</td><td>250</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">Idler support</td><td>248</td><td>—</td><td>—</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length x Outside diameter</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>572 x 235</td><td>466</td><td>157.9 kN {16112 kg}</td><td>545</td><td>133.9 kN</td></tr>
</table>

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4.3.2 Idler



ZX215-1002010

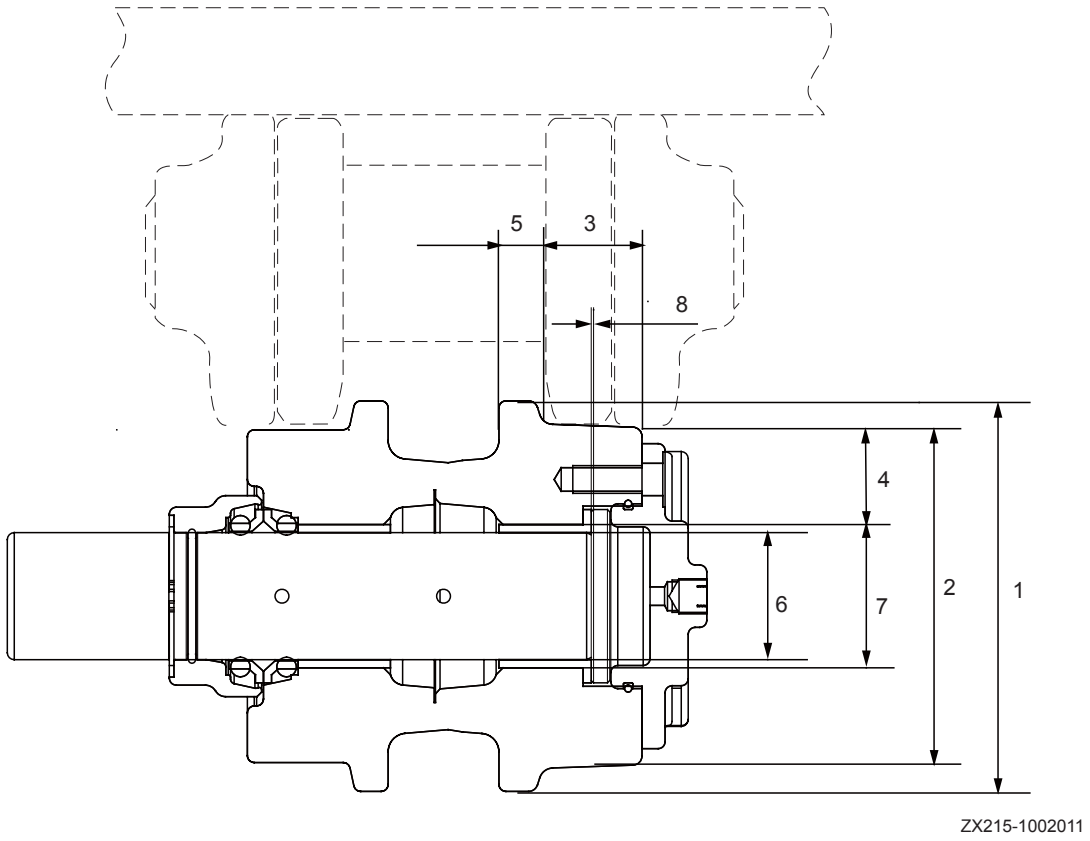
https://truckmanualshub.com/

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">Outside diameter of protrusion</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="7">Build-up welding or replace</td></tr>
<tr><td colspan="2">560</td><td colspan="2">—</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">520</td><td colspan="2">508</td></tr>
<tr><td>3</td><td>Thickness of tread</td><td colspan="2">30</td><td colspan="2">24</td></tr>
<tr><td>4</td><td>Difference of tread</td><td colspan="2">20</td><td colspan="2">26</td></tr>
<tr><td>5</td><td>Total width</td><td colspan="2">164</td><td colspan="2">—</td></tr>
<tr><td>6</td><td>Width of tread</td><td colspan="2">39.5</td><td colspan="2">—</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="6">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>65</td><td>– 0.250
– 0.350</td><td>+0.164
– 0.074</td><td>0.176 – 0.514</td><td>—</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Interference between idler and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="2">Interference limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>72</td><td>+0.108
+0.008</td><td>-0.032
-0.062</td><td>0.040 – 0.170</td><td>—</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Clearance between bushing and support (Sum of clearance at both sides)</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td></tr>
<tr><td colspan="3">0.5~1.0</td><td colspan="2">—</td></tr>
</table>

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4.3.3 Carrier roller



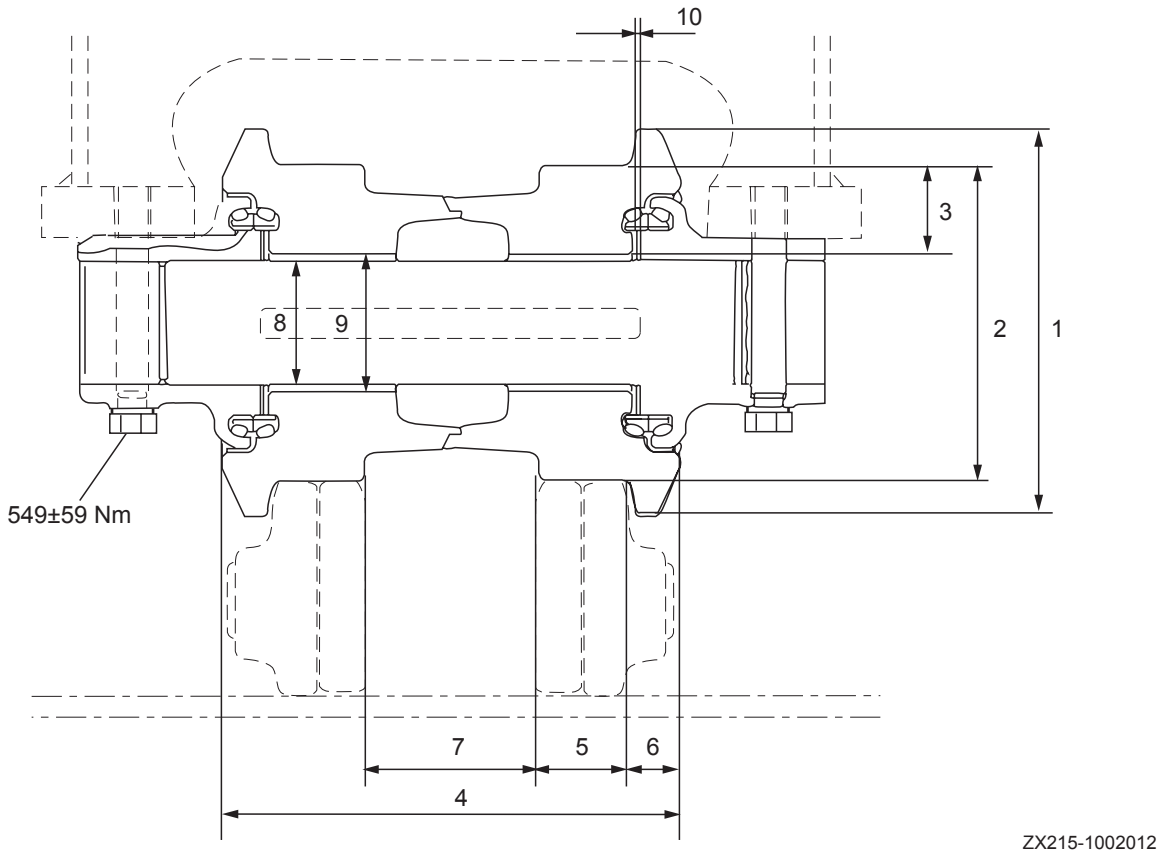
ZX215-1002011

Unit: mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Replace
		169		—		
2	Outside diameter of tread	144		130		
3	Width of tread	43		—		
4	Thickness of tread	34		27		
5	Width of flange	17		—		
6	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit
			Shaft	Hole		
		40	– 0.05 – 0.10	+0.10 0	0.05 – 0.20	—
7	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interfer-ence limit
			Shaft	Hole		
		47	+0.16 +0.12	0 -0.08	0.12 – 0.24	—
8	Axial clearance of roller	Standard clearance			Clearance limit	
		0.44 – 0.76			—	

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4.3.4 Track roller



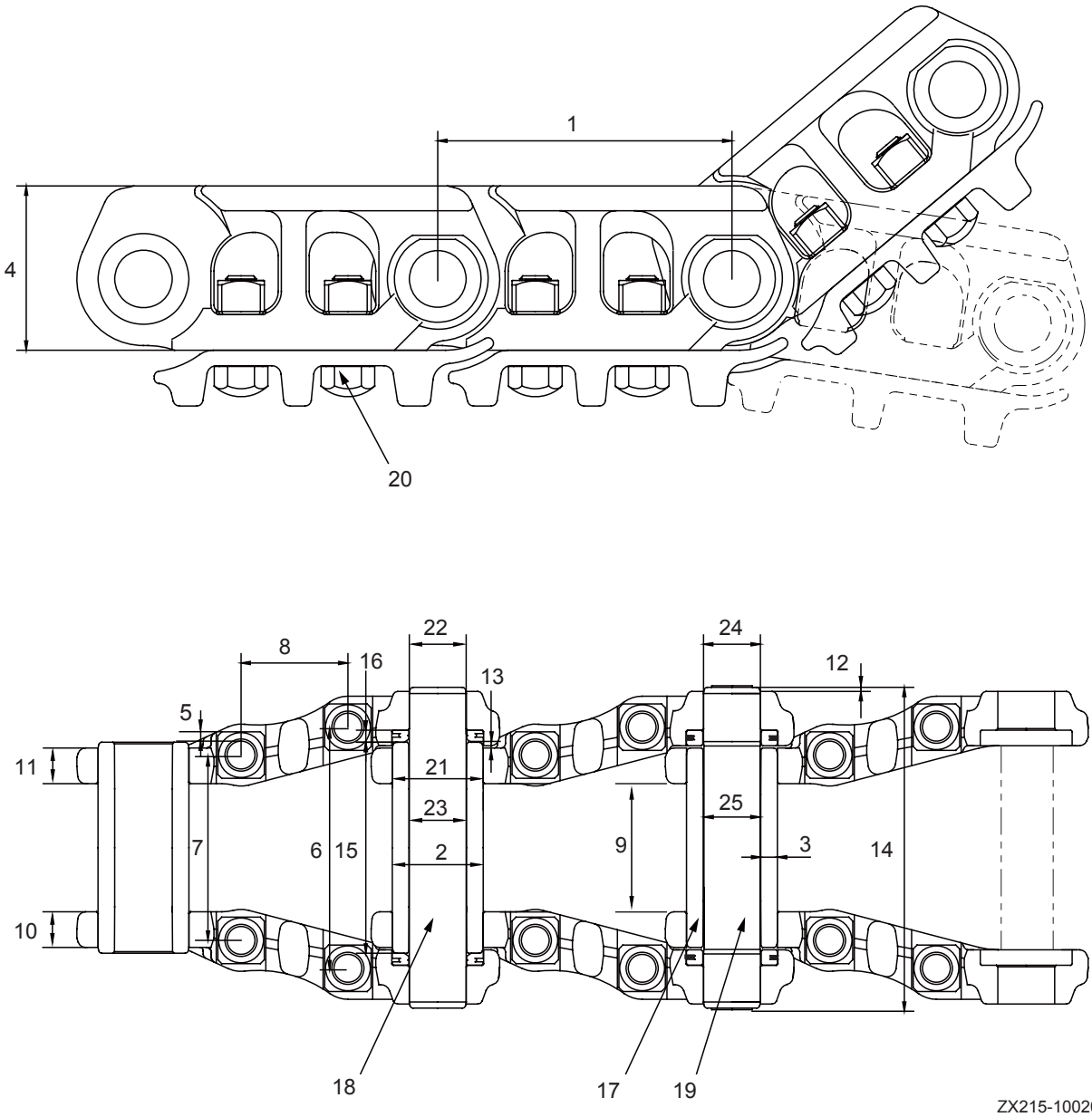
https://truckmanualshub.com/

Unit: mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard clearance		Repair limit		Build-up welding or replace
		193		—		
2	Outside diameter of tread	160		148		
3	Thickness of tread	46.5		40.5		
4	Total width	237		—		
5	Width of tread	46.5		—		
6	Width of flange	32		—		
7	Inside width	80				
8	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole		
		60	– 0.15 – 0.17	0 -0.08	0.07 – 0.17	—
9	Interference between roller and bushing	Standard size	Tolerance		Standard interference	Interfer-ence limit	
			Shaft	Hole		
		67	+0.16 +0.12	0 -0.08	0.12 – 0.24	—
10	Clearance between bush-ing and collar (Sum of clearance at both sides)	Standard clearance		Clearance limit		Replace
		0.5 – 1.0		—		

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4.3.5 Track shoe



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Unit: mm

No.	Check item		Criteria		Remedy
1	Link pitch		Standard size	Repair limit	Reverse or replace
			190	193	
2	Outside diameter of bushing		Standard size	Repair limit	
			58.7	53.7	
3	Thickness of bushing metal		10.75	5.75	Repair or replace
4	Link height		Standard size	Repair limit	
			106	98	
5	Thickness of link metal (bushing press-fitting portion)		30.65	22.5	
6	Shoe bolt pitch		155.57		Adjust or replace
7			119.57		
8			62		
9	Link	Inside width	82.69		
10		Overall width	40		
11		Tread width	38		
12	Protrusion of pin	Regular	2.65		
		Master	2.65		
13	Protrusion of bushing	Regular	3.7		
		Master	0.0		
14	Overall length of pin	Regular	207		
		Master	209		
15	Overall length of bushing	Regular	136.1		
		Master	128.7		
16	Thickness of spacer		—		
17	Press-fitting force	Bushing	88.2 – 245 kN {9 – 25 ton}		—
18		Regular pin	127.4 – 274.4 kN {13 – 28 ton}		
19		Master pin	78.4 – 147 kN {8 – 15 ton}		

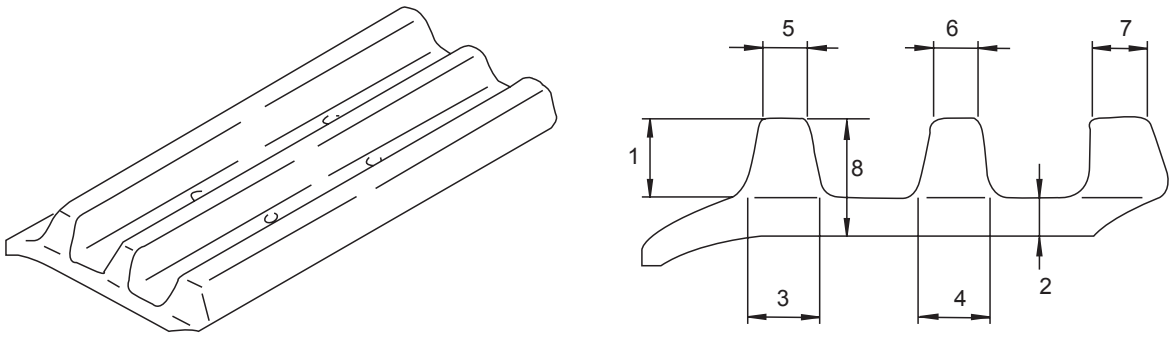
https://truckmanualshub.com/

Unit: mm

<table>
<tr><th>No.</th><th colspan="2">Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="4">20</td><td rowspan="4">Shoe bolt</td><td rowspan="2">a. Regular link</td><td colspan="2">Tightening torque (Nm {kgm})</td><td colspan="2">Retightening angle (°)</td><td rowspan="4">Retighten</td></tr>
<tr><td>Triple grouser shoe</td><td>750±22.5 {62.5±2.3}</td><td colspan="2">120±10</td></tr>
<tr><td rowspan="2">b. Master link</td><td>Tightening torque (Nm {kgm})</td><td colspan="2">Retightening angle (°)</td><td>Lower limit torque (Nm {kgm})</td></tr>
<tr><td>—</td><td colspan="2">—</td><td>—</td></tr>
<tr><td colspan="2">No. of shoes (each side)</td><td colspan="4">49</td><td>—</td></tr>
<tr><td rowspan="2">21</td><td rowspan="2">Interference between bushing and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="14">Adjust or replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>58.7</td><td>0
-0.05</td><td>-0.25
-0.32</td><td>0.20 – 0.32</td></tr>
<tr><td>22</td><td>Interference between regular pin and link</td><td>36.7</td><td>0
-0.04</td><td>–0.23
–0.29</td><td>0.19 – 0.29</td></tr>
<tr><td rowspan="2">23</td><td rowspan="2">Clearance between regular pin and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>36.7</td><td>0
-0.04</td><td>0.8
0.5</td><td>0.50 – 0.84</td></tr>
<tr><td rowspan="2">24</td><td rowspan="2">Interference between master pin and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>36.7</td><td>-0.08
-0.11</td><td>-0.23
-0.29</td><td>0.12 – 0.21</td></tr>
<tr><td rowspan="2">25</td><td rowspan="2">Clearance between master pin and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>36.7</td><td>-0.5
-0.7</td><td>1
0.5</td><td>1 – 1.7</td></tr>
</table>

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4.3.6 Triple grouser shoe



ZX215-1002014

Standard track shoe

Model / Item	SY215C9LC
Shoe width(mm)	800
Link pitch(mm)	190
Q'ty (One side)	49

Unit: mm

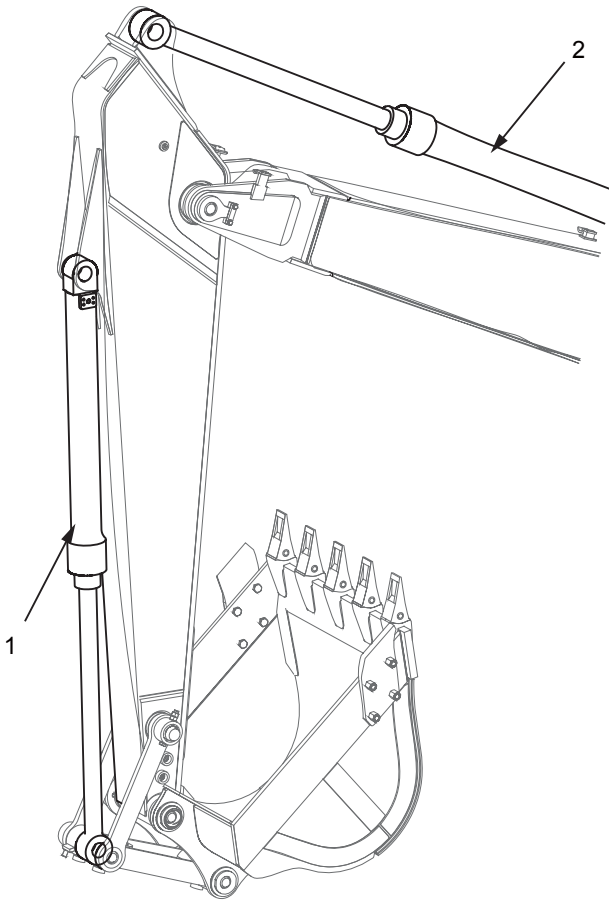
No.	Check item	Criteria		Remedy
1	Height	Standard size	Repair limit	Build-up welding or replace
		26	16	
2	Thickness	10		
3	Length of base	29.5		
4		22		
5	Length at tip	20.5		
6		17		
7		18		
8	Thickness	Standard size	Repair limit	
		36	26	

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4.4 Hydraulic System, Part 1

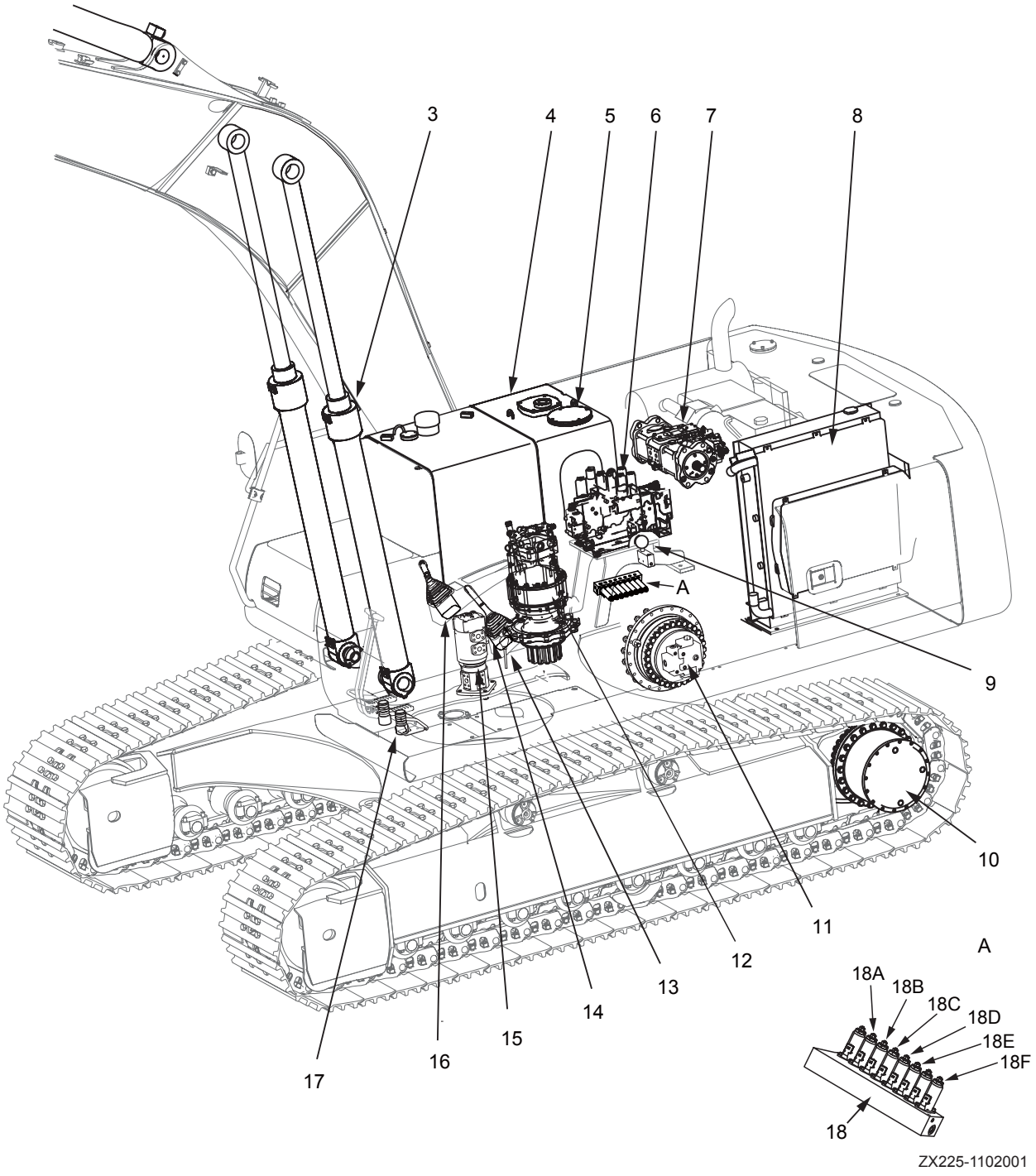
4.4.1 Hydraulic equipment layout drawing

1- Bucket cylinder
2- Arm cylinder
3- Boom cylinder
4- Hydraulic tank
5- Hydraulic oil filter
6- Control valve
7- Hydraulic pump
8- Radiator
9- Accumulator
10- Left travel motor
11- Right travel motor
12- Swing motor
13- Lockout lever
14- Left pilot valve
15- Center swivel joint
16- Right pilot valve
17- Travel pilot valve
18- Solenoid valve assembly
    18A. Pilot lockout solenoid valve
    18B. Boom priority solenoid valve
    18C. Bucket confluence solenoid valve
    18D. Swing priority solenoid valve
    18E. Hi/Lo travel speed solenoid valve
    18F. Secondary boosting solenoid valve



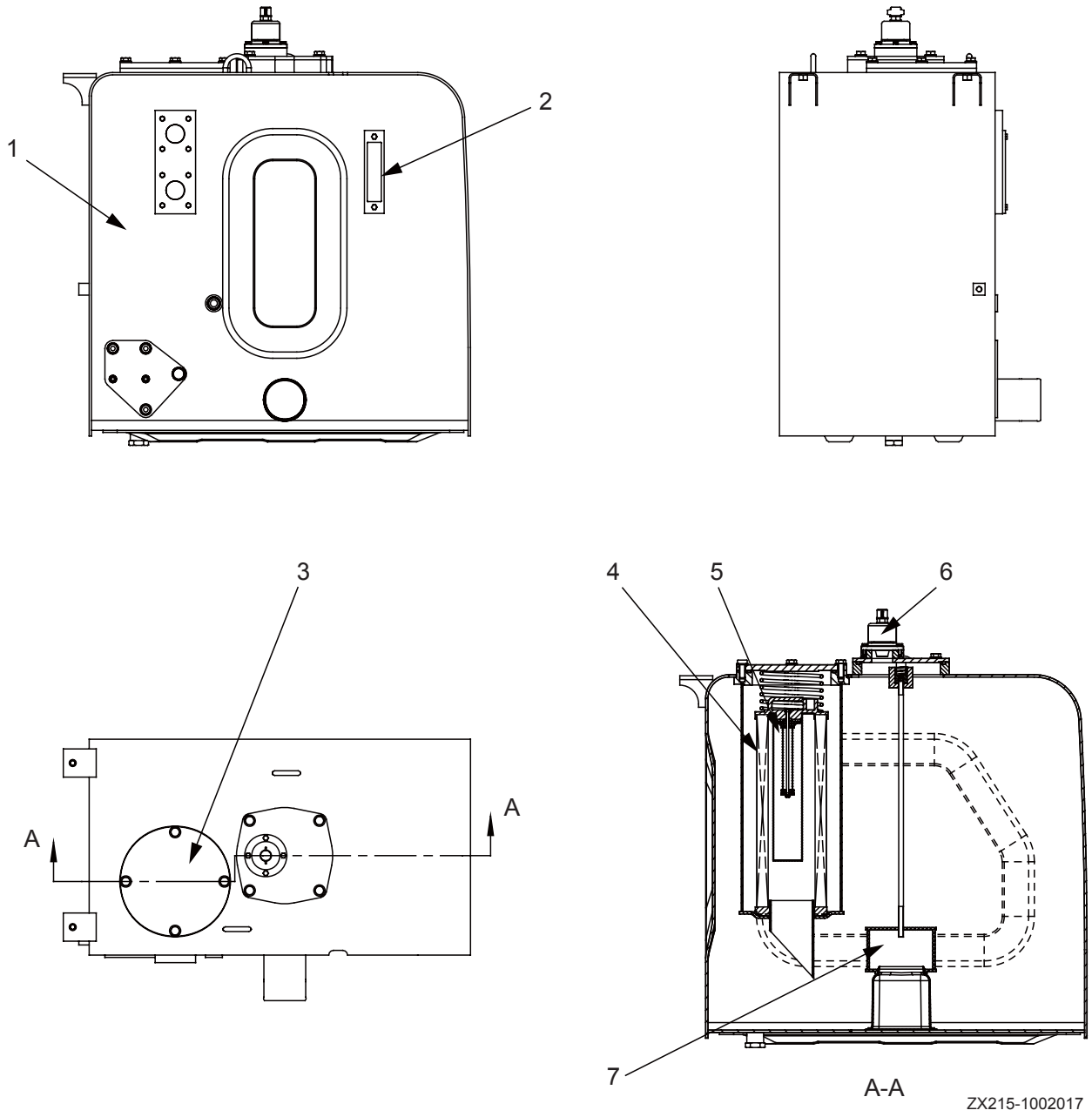
ZX215-1002015

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4.4.2 Hydraulic tank and filter



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1- Hydraulic tank
2- Level gauge
3- Oil filler cap
4- Return oil filter element
5- Bypass valve
6- Breather valve
7- Oil-suction filter element

Specifications

Tank capacity: 239 L

Amount of oil inside tank: 172 L

Breather valve

Filter fineness: 10μm

Ambient temperature: -30~100°C

Set pressure:

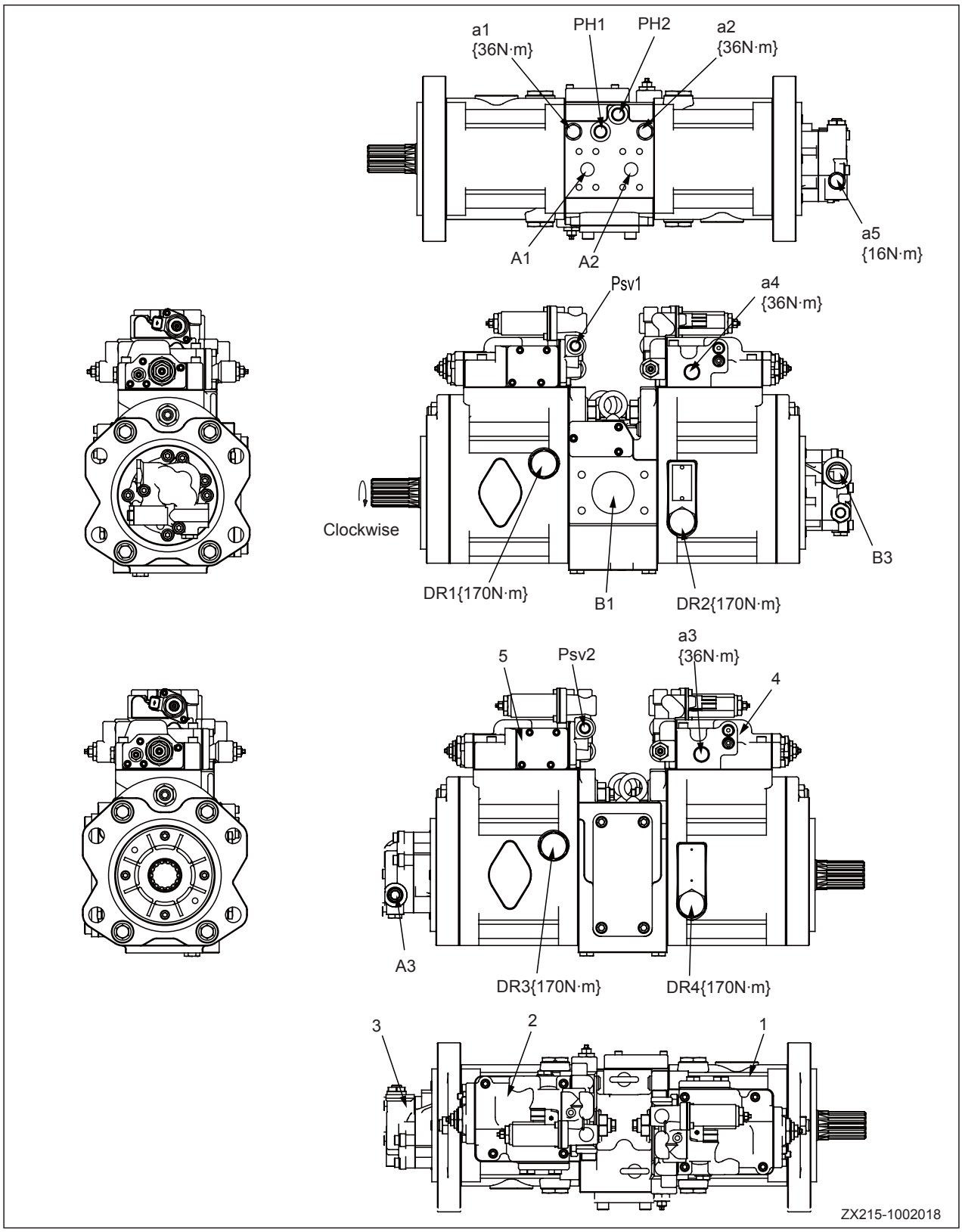
Air inlet side → 0.004MPa (at 1Lmin)

Air outlet side → 0.017MPa (at 1L/min)

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4.4.3 Hydraulic pump

Type: K3V112DTP1N9R



https://truckmanualshub.com/

Outline

- This pump consists of 2 variable capacity swash plate plunger pumps, 2 regulators, and 1 pilot gear pump.

a1: F. pump main pressure detection port

a2: R. pump main pressure detection port

a3: F. pump regulator pressure detection port

a4: Adjustor control pressure detection port

a5: Pilot gear pump output pressure detection port

PH1: F. pump pressure sensor assembly port

PH2: R. pump pressure sensor assembly port

A1: F. pump delivery port

A2: R. pump delivery port

A3: Pilot gear pump delivery port

Psv1: F. pump regulator control port

Psv2: R. pump regulator control port

Dr1: F. pump drain plug

Dr2: R. pump drain plug

Dr3: Air bleeder

Dr4: Drain plug

B1: Pump suction port

B3: Pilot gear pump oil suction port

1: Front pump

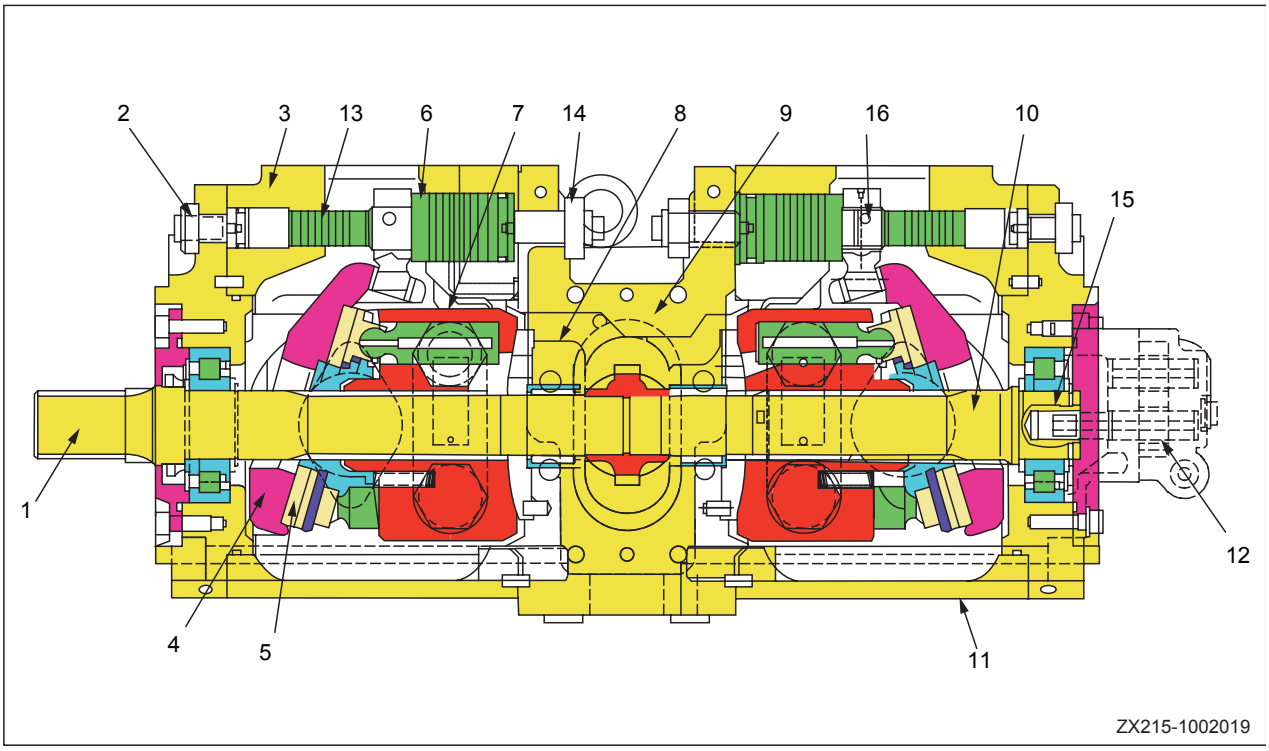
2: Rear pump

3: Pilot gear pump

4: Front pump regulator

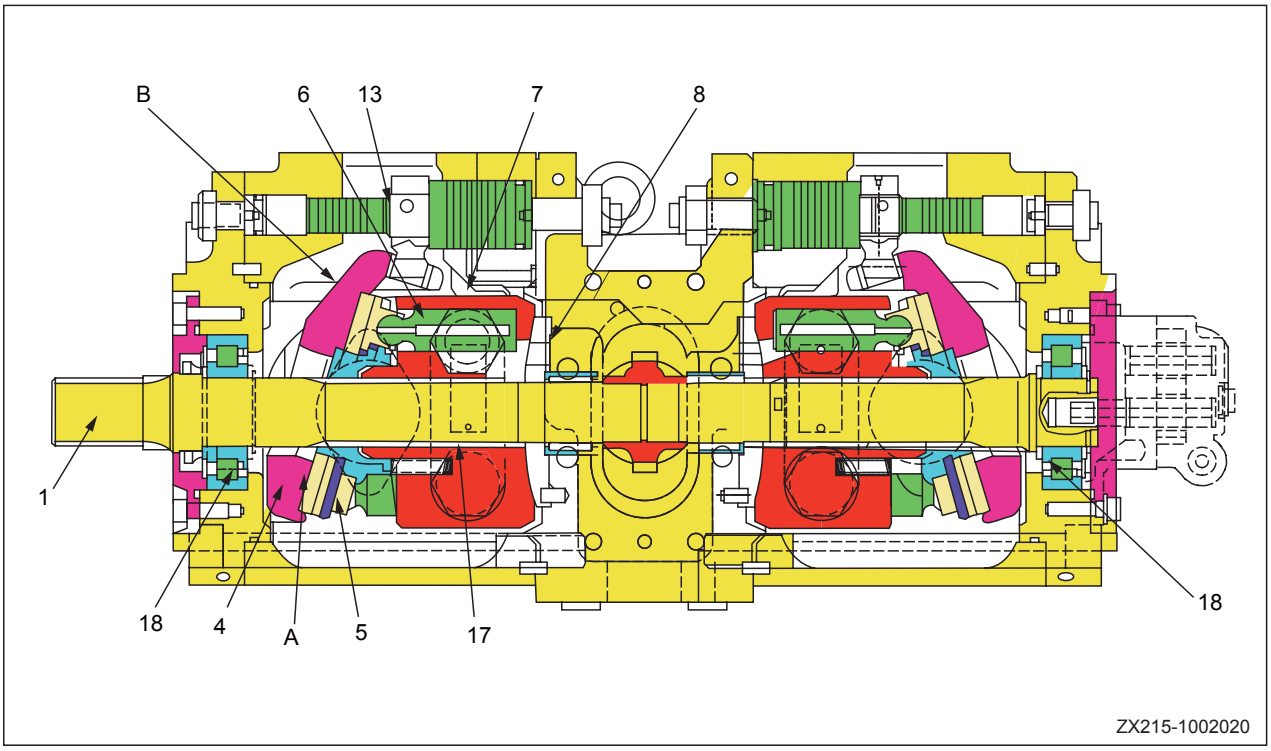
5: Rear pump regulator

https://truckmanualshub.com/



1- Front shaft
2- Min. delivery adjusting screw
3- Front casing
4- Swash plate
5- Slipper
6- Plunger
7- Cylinder block
8- Valve plate
9- End cover
10- Rear shaft
11- Rear casing
12- Gear pump
13- Piston
14- Max. delivery adjusting screw
15- Gear shaft
16- Driving pin

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Function

- The torque of the engine is transmitted to the pump shaft (1), and drives cylinder block (7) to rotate. At the same time, nine plungers (6) slide along the thrust plate (8). Plunger (6) moves back and forth inside cylinder block (7) and pressurized oil is sucked and discharged alternatively.
- It is possible to change the discharge amount by changing the swash plate angle.

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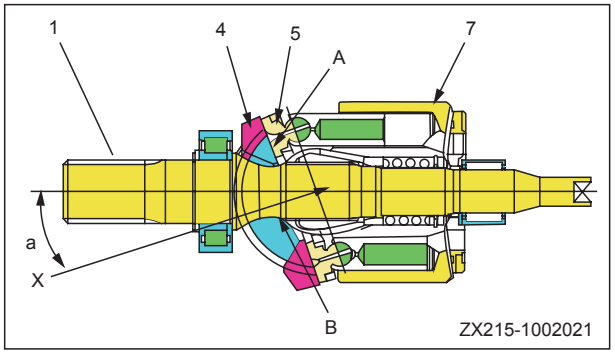
Structure

- Cylinder block (7) is supported to shaft (1) by spline (17).
- Shaft (1) is supported by front and rear bearings (18).
- Tip of plunger (6) is shaped as a concave ball and slipper (5) is caulked to it to form one unit.
- Plunger (6) and slipper (5) constitute the spherical bearing.
- Swash plate (4) has flat surface (A), and slipper (5) is always pressed against this surface while sliding in a circular movement.
- Swash plate (4) conducts high pressure oil to cylinder surface (B), and forms a static pressure bearing when it slides.
- Plunger (6) carries out relative movement in the axial direction inside each cylinder chamber of cylinder block (7).
- Cylinder block (7) seals the pressurized oil to thrust plate (8) and carries out relative rotation.
- This surface is designed so that the oil pressure balance is maintained at a suitable level.
- The oil inside the respective cylinder chambers of cylinder block (7) is sucked in and discharged through thrust plate (8).

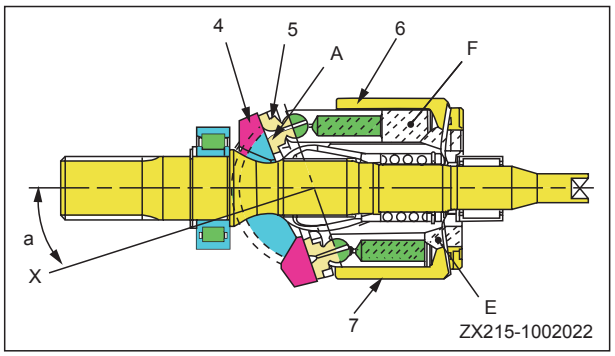
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Operation of pump

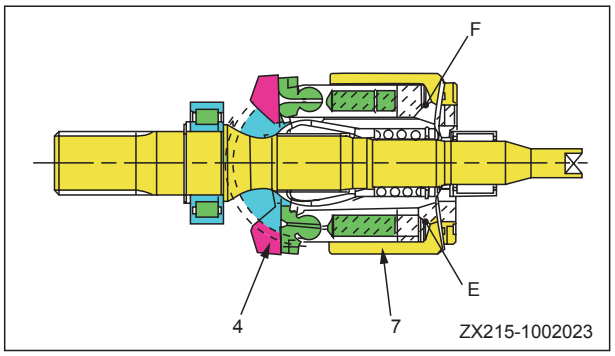
- Cylinder block (7) rotates together with shaft (1), and slipper (5) slides on flat surface (A).
- When this happens, swash plate (4) moves along cylindrical surface (B), so angle (a) between central line (X) of swash plate (4) and the axial direction of cylinder block (7) changes.
- (a) is named the swash plate angle.



- With central line (X) of swash plate (4) at a swash plate angle (a) in relation to the axial direction of cylinder block (7), flat surface (A) acts as a cam in relation to slipper (5).
- In this way, plunger (6) slides on the inside of cylinder block (7), so a difference between volumes (E) and (F) is created inside cylinder block (7).
- A single plunger sucks and discharges the oil by the amount (F) – (E).
- As cylinder block (7) rotates and the volume of chamber (E) becomes smaller, the pressurized oil is discharged.
- On the other hand, the volume of chamber (F) grows larger and, in this process, the oil is sucked.



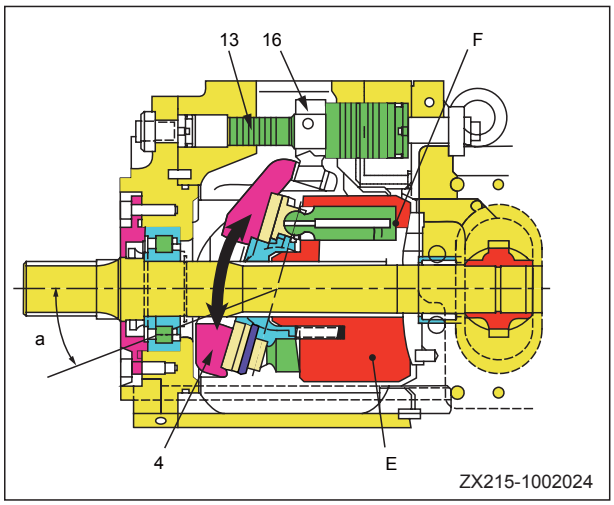
- As central line (X) of swash plate (4) overlaps the axial direction of cylinder block (7) (swash plate angle (a) = 0), the difference between volumes (E) and (F) inside cylinder block (7)becomes 0.
- Suction and discharging of pressurized oil is not carried out in this state. Namely pumping action is not performed. (In reality, however, the swash plate angle is not set to 0)



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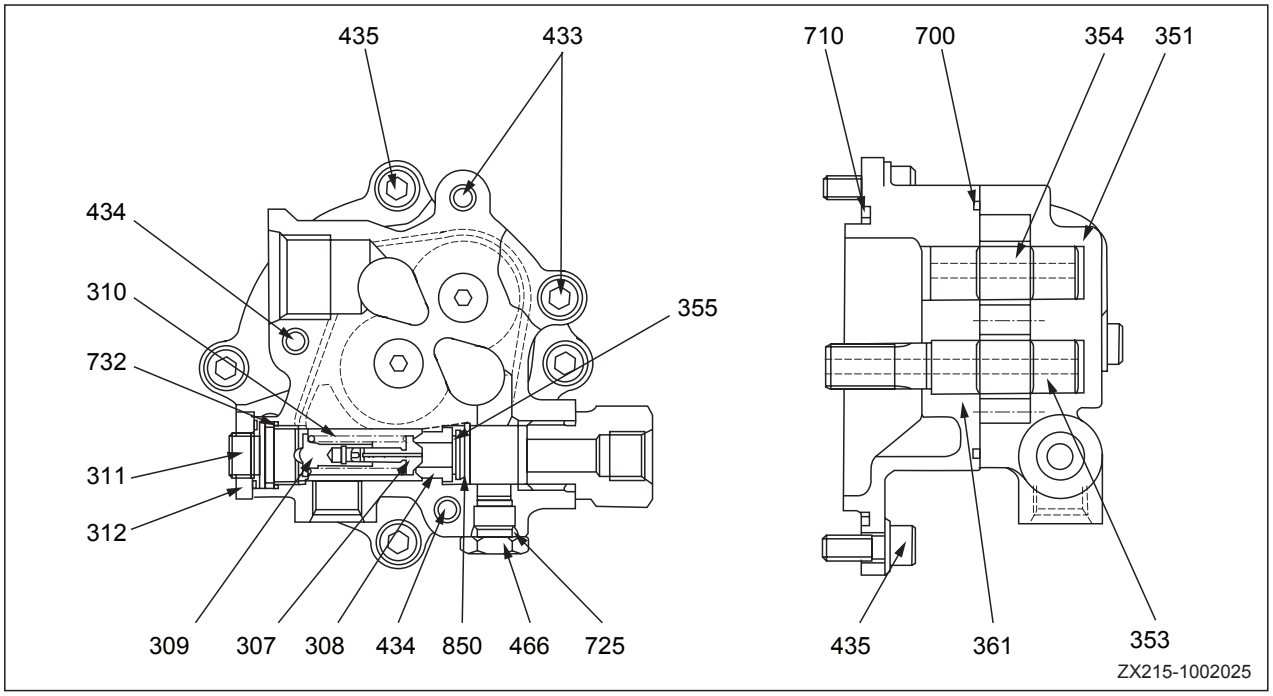
Control of delivery

- If swash plate angle (a) becomes larger, the difference between volumes (E) and (F) becomes larger and pump delivery (Q) increases.
- Piston (13) is used for changing swash plate angle (a).
- Piston (13) carries out linear alternating motion under the control of the adjustor.
- This linear motion is transmitted to swash plate (4) via drive pin (16). The sliding of the swash plate changes the swash plate angle and changes the discharge amount of the main pump.



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4.4.4 Pilot pump



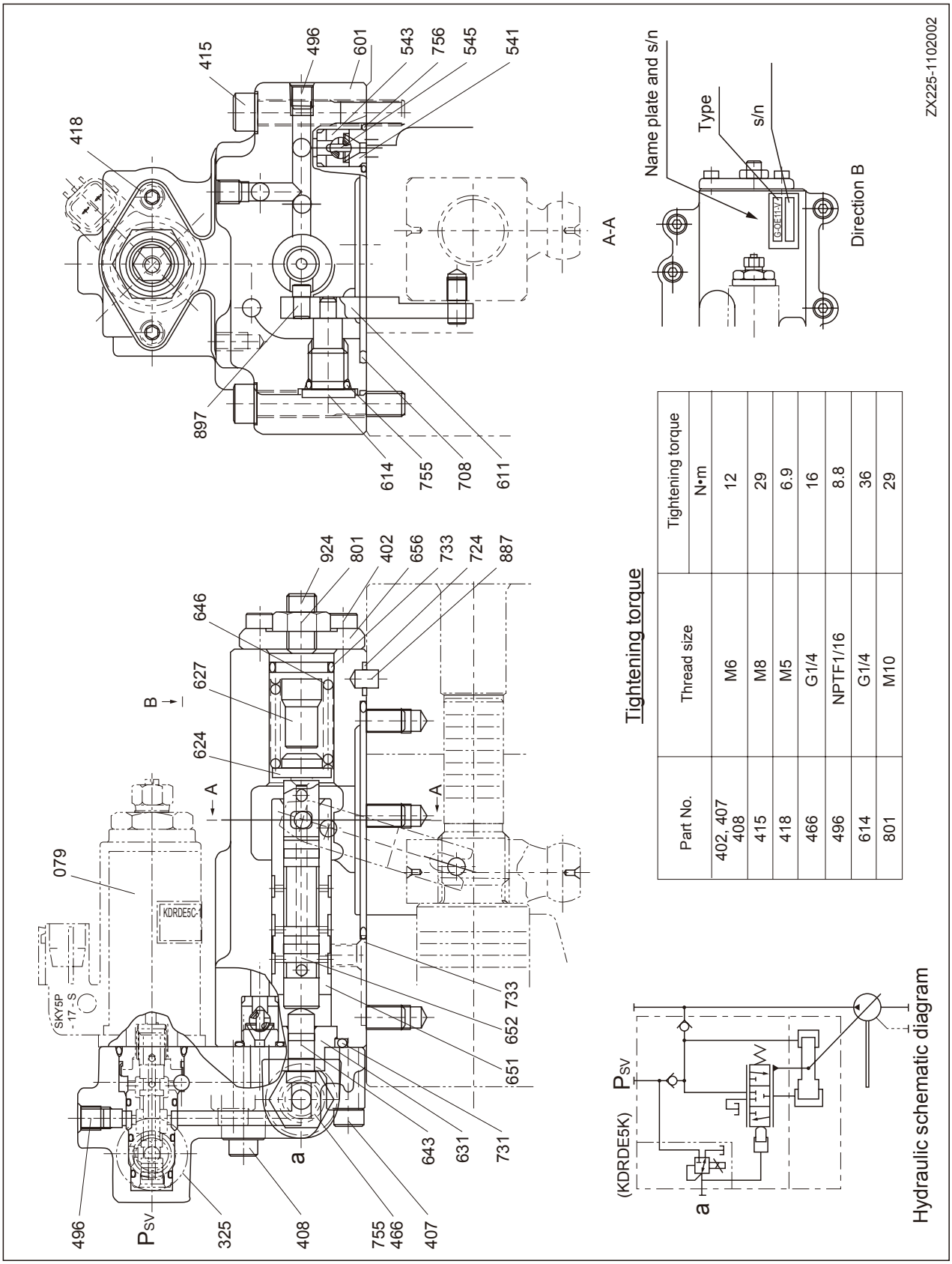
307: Valve stem
308: Valve base
309: Retainer
310: Spring
311: Adjusting screw
312: Nut
351: Body
353: Gear shaft
354: Gear shaft
355: Filter element
361: Body
433: Screw
434: Screw
435: screw
466: Plug
700: Washer
710: O-ring
725: O-ring
732: O-ring
850: Washer

Function

- The engine actuates the main pump and the drive shaft of the pilot pump through the transmission case, and drives the pilot pump through gear engagement.

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4.4.5 Regulator (KR3G-0E11-AV)



Tightening torque

Part No.	Thread size	Tightening torque N•m
402, 407 408	M6	12
415	M8	29
418	M5	6.9
466	G1/4	16
496	NPTF1/16	8.8
614	G1/4	36
801	M10	29

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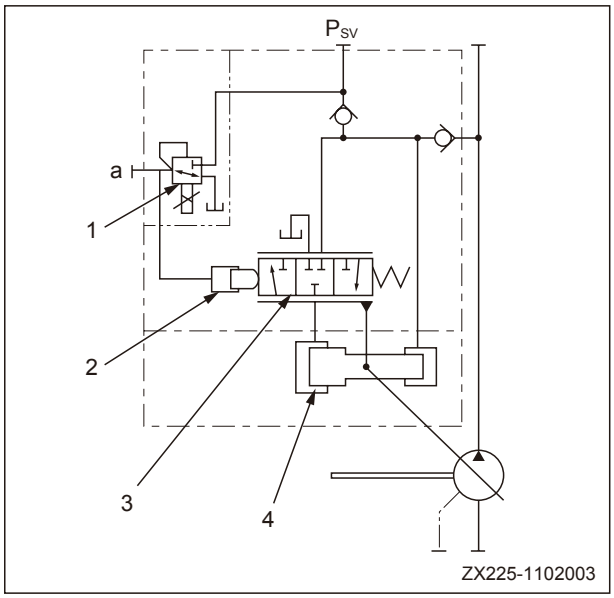
Category	Part No.	Part name	Q'ty	Remark
C	924	Hexagon socket head locating screw	1	
/	897	Pin	1	
/	887	Pin	1	
D	801	Hexagon nut	1	JIS B 1181 N-M10
D	756	O-ring	2	
D	755	O-ring	2	
D	733	O-ring	2	
D	731	O-ring	1	
D	724	O-ring	5	
D	708	O-ring	1	
/	656	Cover plate	1	
/	652	Spool valve	1	
/	651	Sleeve	1	
/	646	Guide spring	1	
/	643	Pilot plunger	1	
/	631	Pf pilot sleeve	1	
/	627	Adjusting wheel	1	
/	624	Spring seat	1	
/	614	Plug	1	
/	611	Feedback lever	1	
/	601	Casing	1	
/	545	Ball	2	
/	543	Stopper	2	
/	541	Valve seat	2	
C	496	Embedded plug	9	
C	466	VIP plug	1	
D	418	Hex socket head bolt	2	JIS B 1176 M5-12
D	415	Hex socket head bolt	6	JIS B 1176 M8-50
D	408	Hex socket head bolt	1	JIS B 1176 M6-40
D	407	Hex socket head bolt	4	JIS B 1176 M6-30
D	402	Hex socket head bolt	4	JIS B 1176 M6-16
/	325	Valve body	1	
B	079	Sol proportional reducing valve	1	
B	—	Regulator assembly	1	

B: Assembly obtainable at the dealers (individual parts not purchasable)
/: Individual components included in assemblies of category B
C: Parts obtainable at the dealers
D: Parts obtainable on the market

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Function

- The regulator controls the pump discharge amount according to the command signal pressure, keeping the driving power of the pump lower than the engine output.
- Pumps 1 and 2 are both equipped with a regulator. Key components of the regulator include a solenoid proportional pressure reducing valve (1), a positive flow regulator (2), a servo reversing valve (3) and a servo piston (4). The regulator opens and shuts the oil circuit of the servo piston (3) and changes the tilting angle of the hydraulic tank according to various command signal pressure so as to control the pump discharge amount.



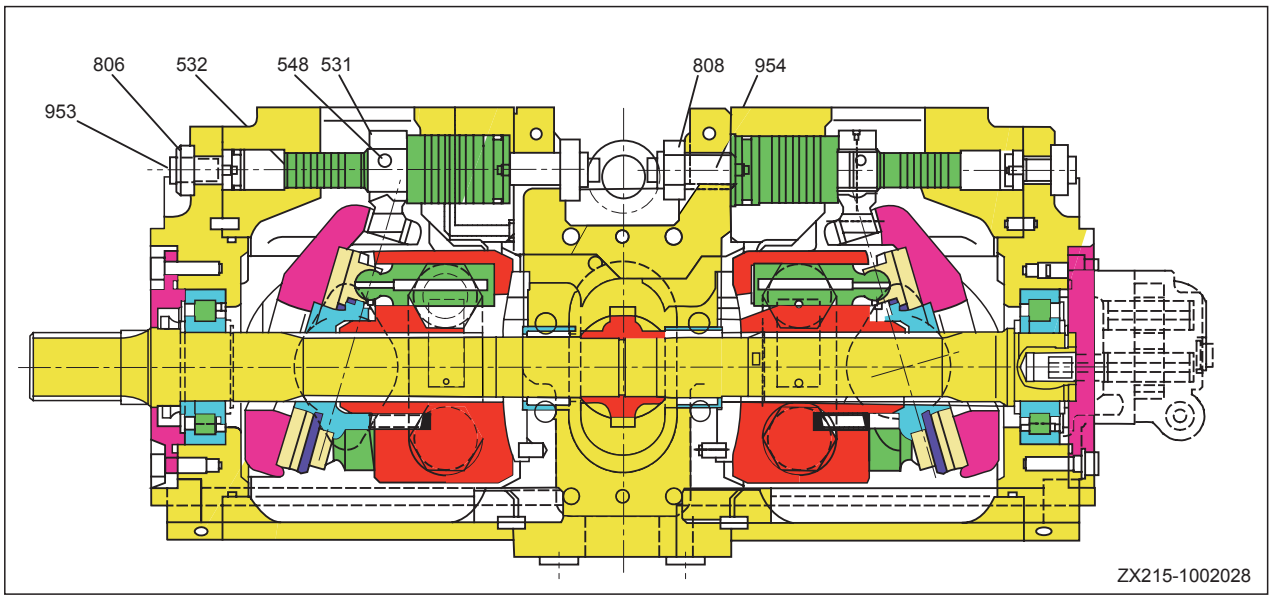
4.4.5.1 Control mechanism makeup

Current control

- The inclination (output delivery amount) of the pump can be controlled freely by changing of the command current I flowing into the solenoid proportional pressure reducing valve. This regulator applies positive flow control (positive control), through which output delivery amount Q changes according to the increase of command current. Necessary current for corresponding operation can be input through this control mechanism. The pump only delivers necessary oil amount and wastes no useless power.

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4.4.5.2 Adjustment of the regulator



531: Inclination pin

532: Servo piston

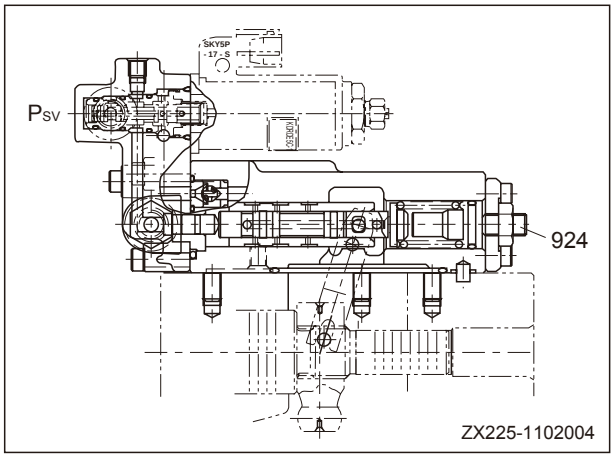
548: Feedback pin

806: Retaining nut

808: Retaining nut

953: Adjusting screw

954: Adjusting screw

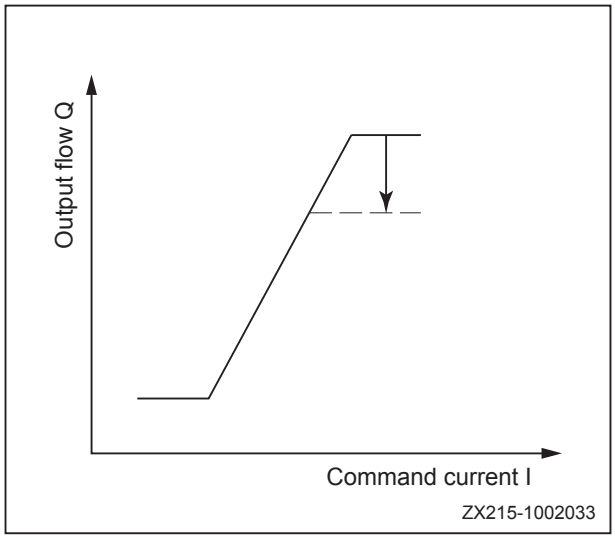


- It is possible to adjust the maximum and minimum flow by the adjusting screws (953, 954) in the pump block side. Flow control features can be adjusted with the hexagon socket head locating screw (924) on the regulator.

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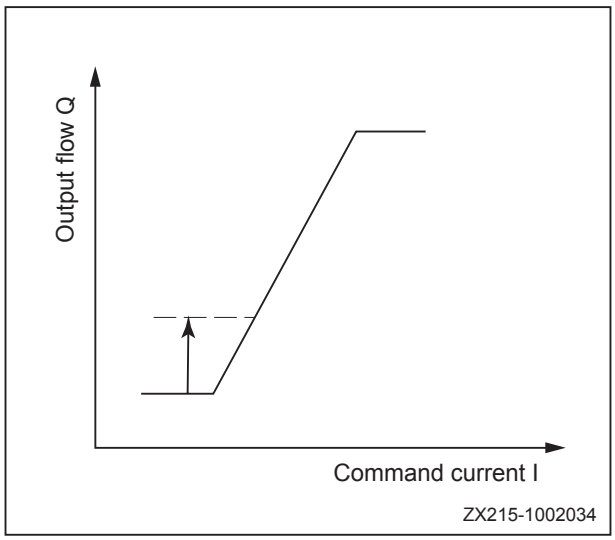
Maximum flow adjustment (pump block side)

- Loosen the hexagon nut (808), and tighten (or loosen) hexagon socket head locating screw (954). No control features except the maximum flow changes.



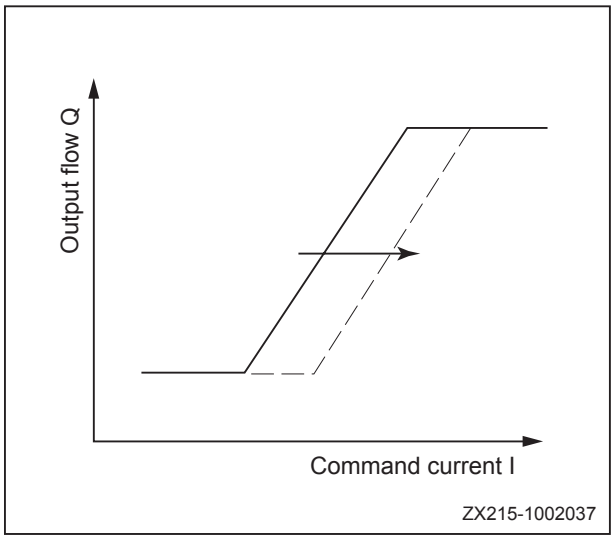
Minimum flow adjustment (pump block side)

- Loosen the hexagon nut (806), and tighten (or loosen) the hexagon socket head locating screw (953). Though this action is the same as the adjustment of maximum flow and all the other control features do not change, power required under maximum output pressure (overflow) is likely to increase if over-tightened. Be careful in this case.



Flow control feature adjustment

- After hexagon nut (810) is loosened, tighten (or loosen) the hexagon socket head locating screw (924) to carry out adjustment. When the hexagon socket head locating screw (924) is being tightened, the control diagram (as shown) will move to the right.

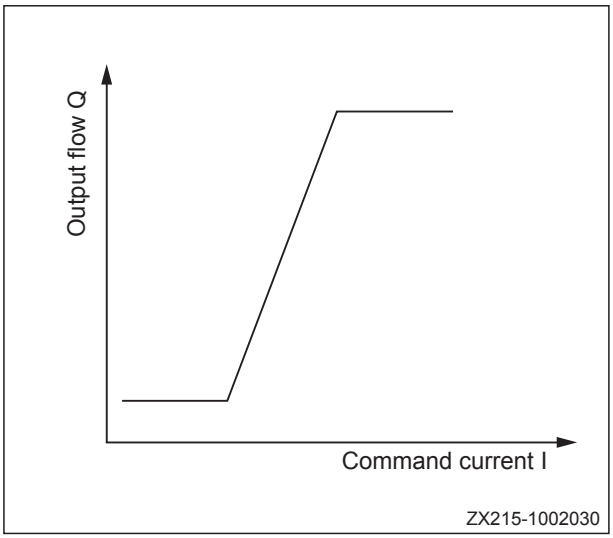


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4.4.5.3 Operation

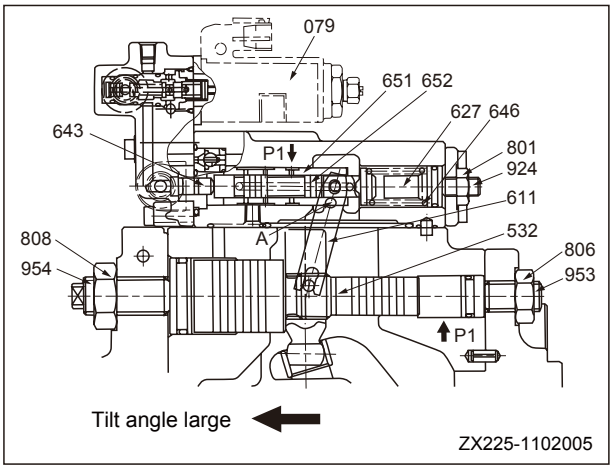
Flow control

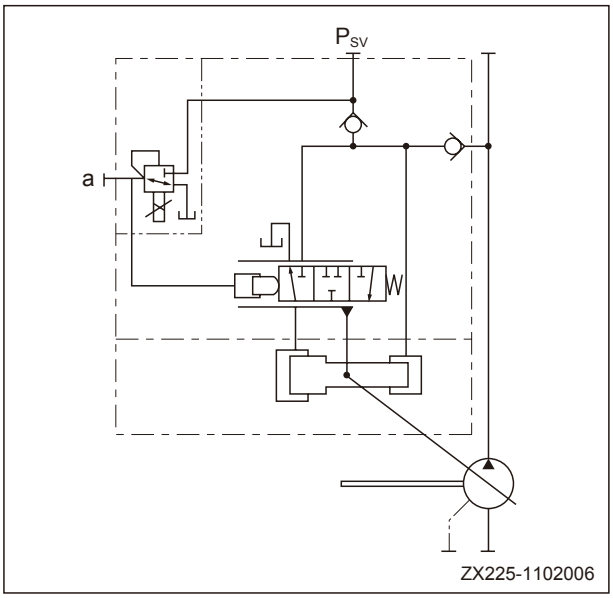
- The output flow of the pump can be controlled by the command current I, as shown.



Action of increasing flow rate

- When command current I increases, the solenoid proportional pressure reducing valve secondary pressure P2 will increase, and the spool valve (652) will move the right with the help of the guide piston (643). When a relative balance between the rightward hydraulic force and the spring force of guide spring (646) is achieved, spool valve (652) stops moving.
- As spool valve (652) moves to the right, because port cl and tank port are interconnected, pressure of the large diameter portion of the servo piston is released and servo piston (532) moves to the left via the output pressure P1 in the shall diameter portion. The inclination becomes larger.
- Since feedback lever (611) is integrated with the servo piston and valve sleeve (651), if servo piston (632) moves to the left, feedback lever swings with point A as the pivot. In this way, valve sleeve moves to the right.
- Through this movement, the opening portion between the spool and the valve block is closed slowly. The servo piston stops moving when the opening portion is completely closed.

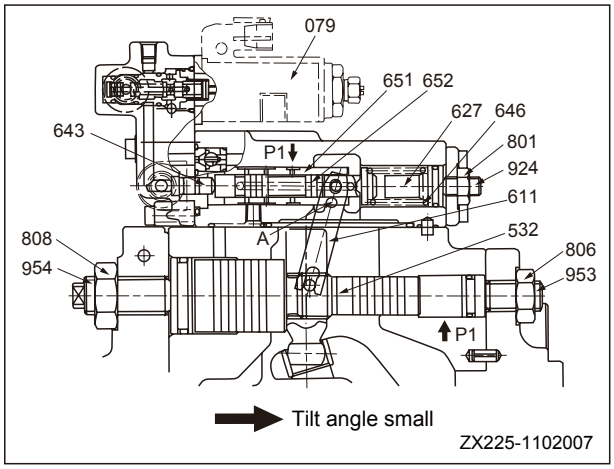


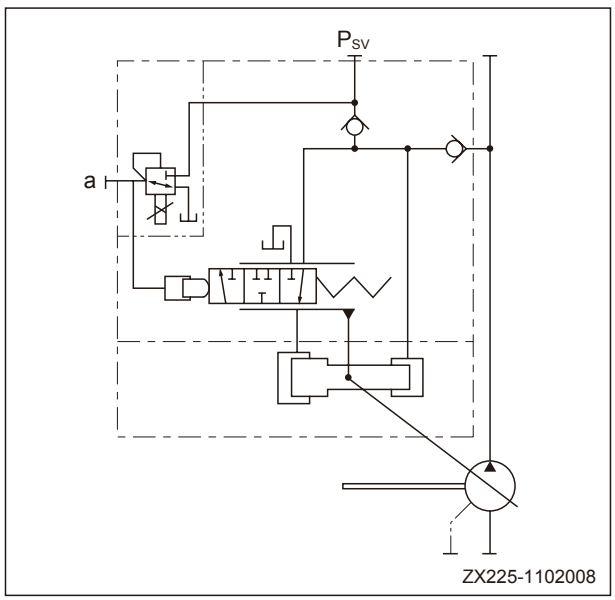


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Action of reducing flow rate

- When command current I decreases, the solenoid proportional pressure reducing valve secondary pressure P2 will decrease, and guide piston (643) will move to the left. However, as spool valve (652) moves, output pressure P1 is introduced into the large diameter chamber of the servo piston via the port cl. On the other hand, output pressure P1 is introduced into the small diameter chamber of the servo piston and servo piston moves to the right via are difference. The inclination becomes smaller.
- As servo piston (532) moves to the right, the feedback lever swings with point A as the pivot and the valve sleeve moves to the left. Through this movement, the opening portion between the spool and the valve block is slowly closed. The servo piston stops moving when the opening portion is completely closed.





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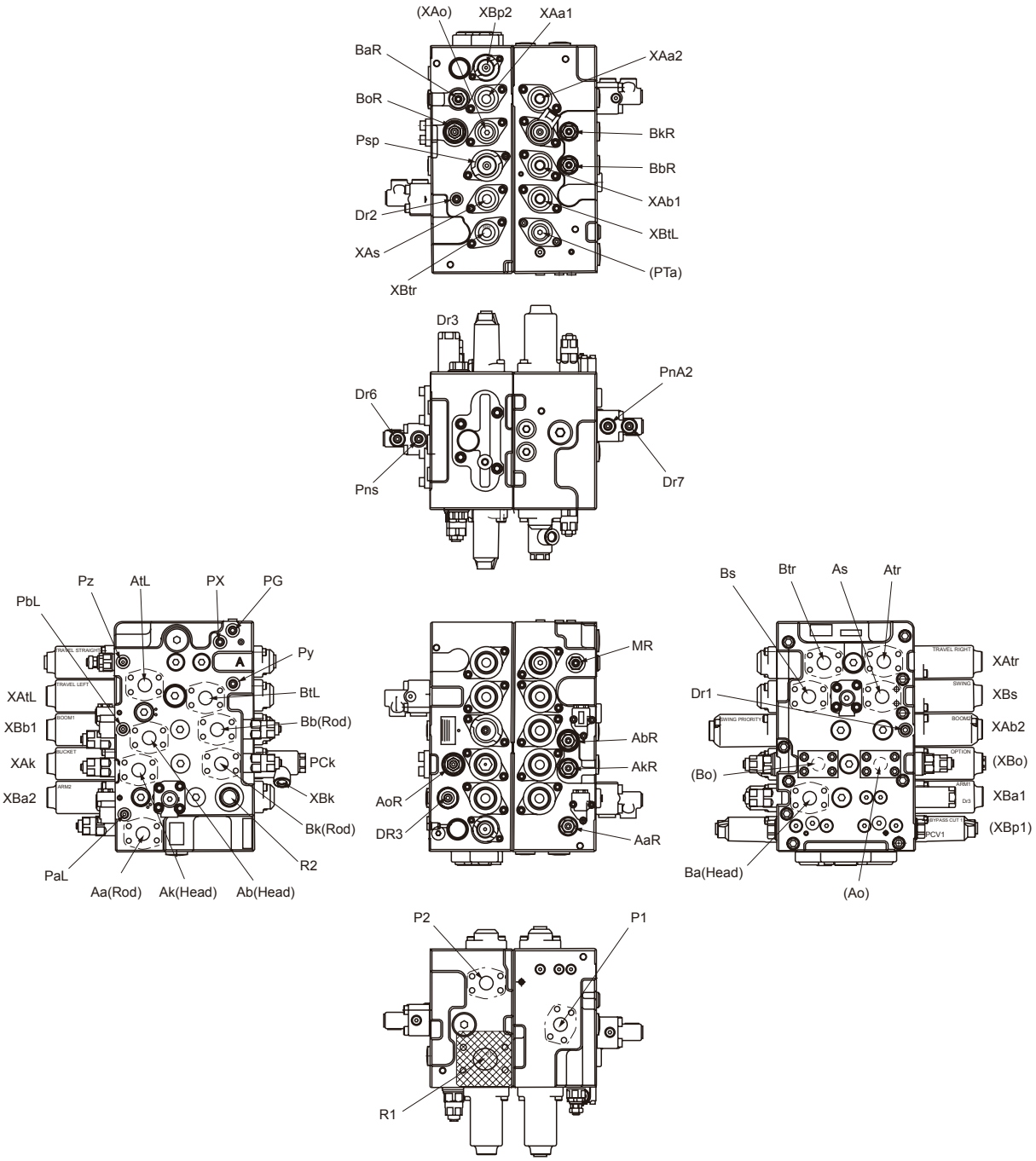
Adjustment value of the regulator

Type of regulator		KR3G-0E11-AV
Rotating speed (min^{-1})		2050
Adjustment of max. flow	Adjusting screw (954) screw-in (rotation)	+1/4
	Flow rate change (L/min^{-1})	-5.9
Adjustment of min. flow	Adjusting screw (953) screw-in (rotation)	+1/4
	Flow rate change (L/min^{-1})	+4.7

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4.5 Hydraulic System, Part 2

4.5.1 Control valve



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XAtr : R. travel (reverse) pilot port
XBtr : R. travel (forward) pilot port
(XAo) : (Option pilot port)
(XBo) : (Option pilot port)
XAk : Bucket (DIG) pilot port
XBk : Bucket (DUMP) pilot port
XAb1 : Boom 1 (UP) pilot port
XBb1 : Boom 2 (DOWN) pilot port
XAa2 : Arm 2 (OUT) pilot port
XBa2 : Arm 2 (IN) pilot port
XAtL : L. travel (reverse) pilot port
XBtL : L. travel (forward) pilot port
XAs : Swing (left) pilot port
XBs : Swing (right) pilot port
XAa1 : Arm 1 (OUT) pilot port
XBa1 : Arm 1 (IN) pilot port
Dr1 : Drain port
Px : Work equipment signal port
Py : Travel signal port
Pz : Main relief valve boosting pressure
PG : Pilot pressure resource port
Pns : Swing logic control valve pilot port
PCK : Bucket (DIG) stroke limit pilot port
PnA2 : Arm 2 logic control valve pilot port
Dr2 : Drain port
Dr3 : Drain port
Dr6 : Drain port
Dr7 : Drain port
Pal : Lock valve pilot port (arm rod end)
PbL : Lock valve pilot port (boom head end)
(XBp1) : Bypass cut spool pilot port (P1 side)
XBp2 : Bypass cut spool pilot port (P2 side)
XAb2 : Boom confluence (UP) pilot port pressure
Psp : Swing priority pilot port
R1 : Return port
R2 : Oil feed port
Atr : R. travel motor port (reverse)
Btr : R. travel motor port (forward)
(Ao) : Option
(Bo) : Option
Ak : Bucket cylinder head end port (DIG)
Bk : Bucket cylinder rod end port (DUMP)
Ab : Boom cylinder head end port (UP)
Bb : Boom cylinder rod end port (DOWN)
AtL : L. travel motor port (reverse)
BtL : L. travel motor port (forward)
As : Swing motor port (left swing)
Bs : Swing motor port (right swing)
Aa : Arm cylinder rod end port (OUT)
Ba : Arm cylinder head end port (IN)
P1 : Pump port (P1 side)
P2 : Pump port (P2 side)
MR : Main relief valve
AR : Arm regeneration check valve
AbR : Port relief valve
BbR : Port relief valve
AkR : Port relief valve
BkR : Port relief valve
AoR : Port relief valve
BoR : Port relief valve
AaR : Port relief valve
BaR : Port relief valve

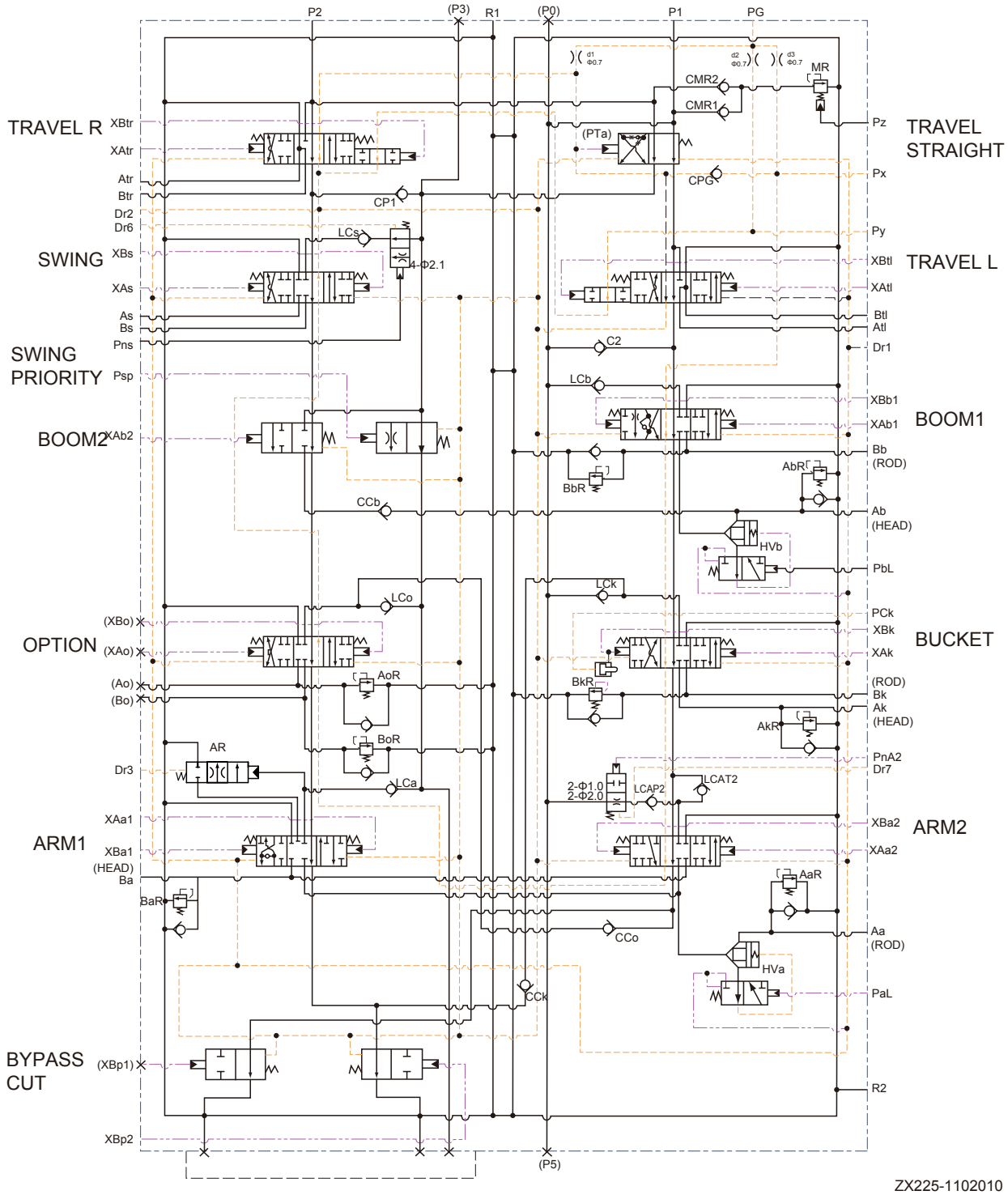
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Specifications

Item		Specification
Model		KMX15RB
Standard flow rate (equivalent to one pump)		220L/min
Maximum pressure	When main relief valve is normal	34.3MPa
	When main relief valve is boosting	37.3MPa
Maximum pressure	When port relief valve is normal	39.2MPa
Working oil temperature		-20~90°C
Drained oil maximum pressure		0.3MPa

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4.5.2 Hydraulic circuit diagram (with bucket confluence function)



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4.5.3 Operating principle

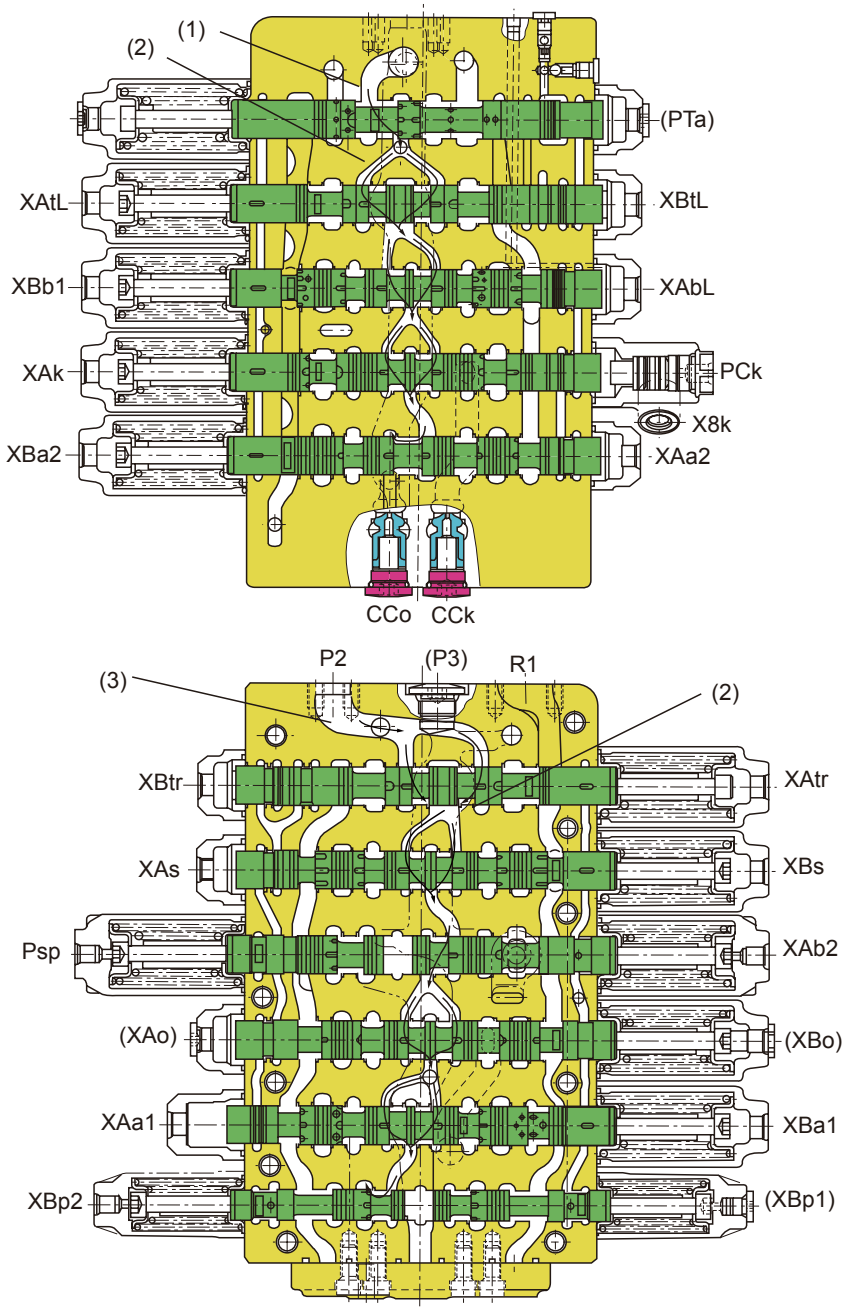
4.5.3.1 When spool is in neutral position

[Main circuit]

When all the spools are in neutral position, working oil supplied from the hydraulic pump (Front) flows in through pump port P1 and is introduced into the main passage (1). It passes the neutral bypass (2) (neutral M-shaped spool mechanism) of the spools of straight travel (308), L. travel (301), boom 1 (303), bucket (304) and arm 2 (306), and flows back into the working oil tank via return port (R1).

Working oil supplied from the hydraulic pump (Rear) flows in through pump port P2 and is introduced into the main passage (3). It passes the neutral bypass (2) (neutral M-shaped spool mechanism) of the spools of R travel (301), swing (305), boom confluence (boom 2: 307), option (309), arm 1 (302), and flows back into the working oil tank via return port (R1).

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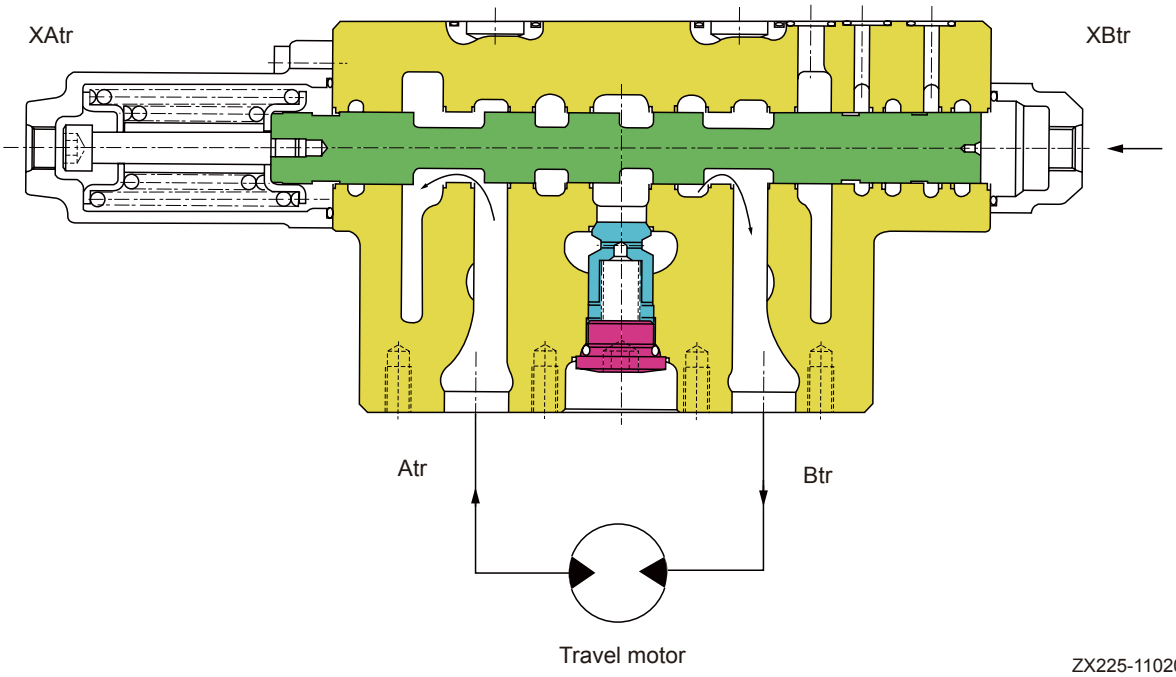
4.5.3.2 Travel

[Pilot circuit]

- When the left or right travel spool is switched, the side bypass circuit is closed and pressure at port Py (travel signal port) rises.

[Main circuit]

- When pressure at pilot port XBtL for left travel spool (301) rises, neutral bypass (2) at boom 1 side is closed, and working oil supplied from the hydraulic pump (front) is introduced into the left travel motor via port Btl.
- Likewise, when pressure at port XBtr for the right travel spool (301) rises, neutral bypass (2) at arm 1 side is closed, and working oil supplied from the hydraulic pump (rear) is introduced into the right travel motor via port Btr.
- On the other hand, return oil from the left and right travel motor passes the left (right) travel spool via port Atl (Atr), and returns to working oil tank via return port (R1).
- The principle is the same when travel on the opposite side is operated (when pressure at pilot port XAtr and XAtl rises).



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4.5.3.3 Arm

(1) Arm OUT

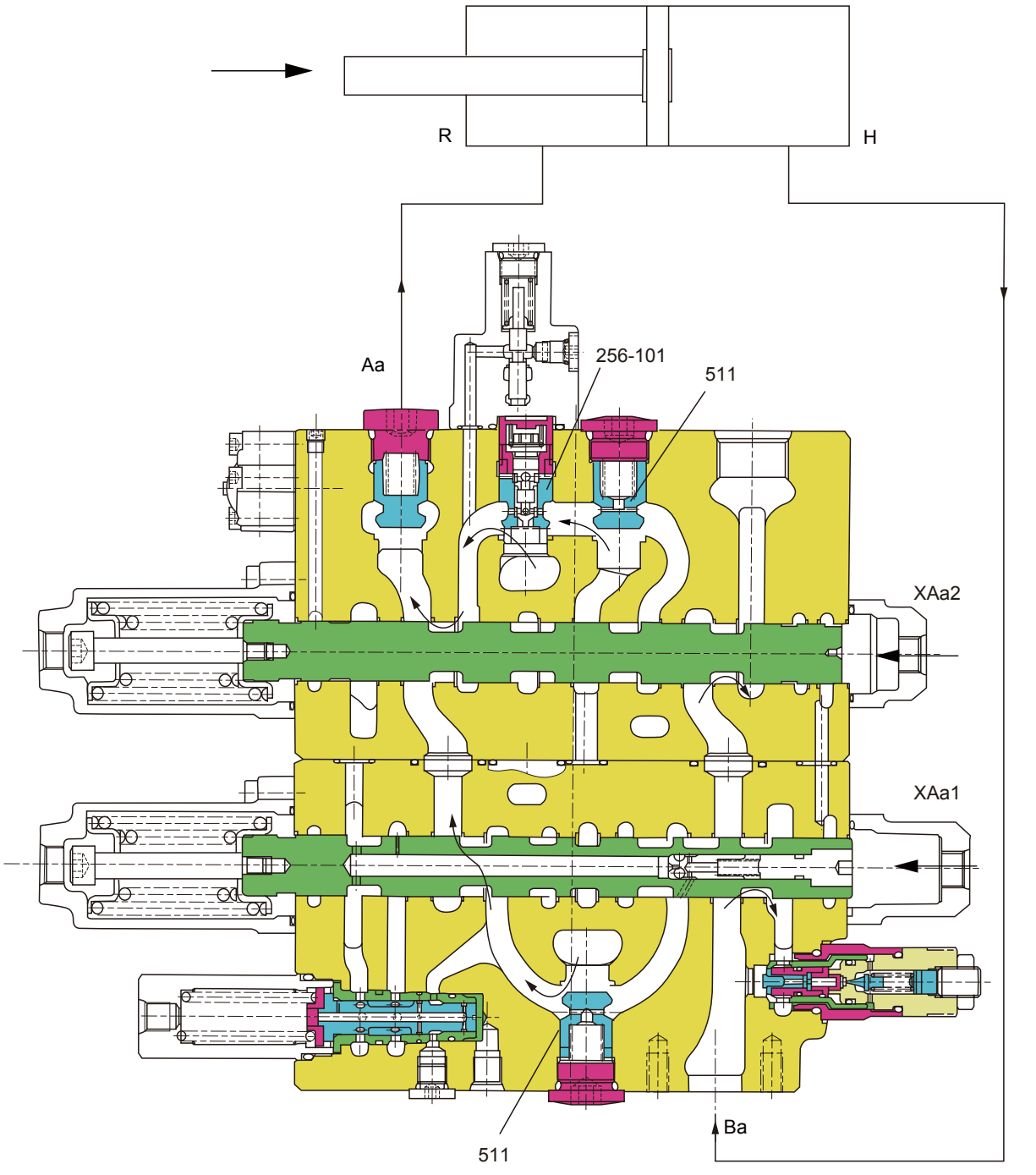
[Pilot circuit]

- When the arm 2 spool (306) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises.

[Main circuit]

- When arm OUT is operated, pilot pressure oil is supplied into port XAa1 and port XAa2. When pilot pressure oil is applied at the two sides of port XAa1 and port XAa2, arm 1 spool and arm 2 spool are switched to the left as shown in the illustration. As a result, working oil from P2 is introduced into neutral bypass (2) via main passage (3). Neutral bypass is cut off by switching arm 1 spool (302). Therefore, working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows into the arm 1 spool (302) via the U passage. Then, it flows into the periphery of arm 1 spool (302) and arm 2 spool (306) and is supplied into the arm cylinder rod end (R) via port As.
- On the other hand, working oil from port P1 is introduced into neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching the arm 2 spool (306). Therefore, working oil in the parallel passage pushes open the logic cone valve (256-101) of the arm 2 logic valve GP, and working oil from neutral bypass pushes open the cone valve (511) of the check valve and flows into the arm 2 spool (306) via the U passage. Then, it merges with port As via the inner passage of arm 2 spool (306) and is supplied into the arm cylinder rod end (R).
- Return oil from the arm cylinder head end (H) via port Ba flows into the tank circuit of arm 1 and arm 2, and returns to working oil tank via tank port (R1).

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(2) Arm IN

[Pilot circuit]

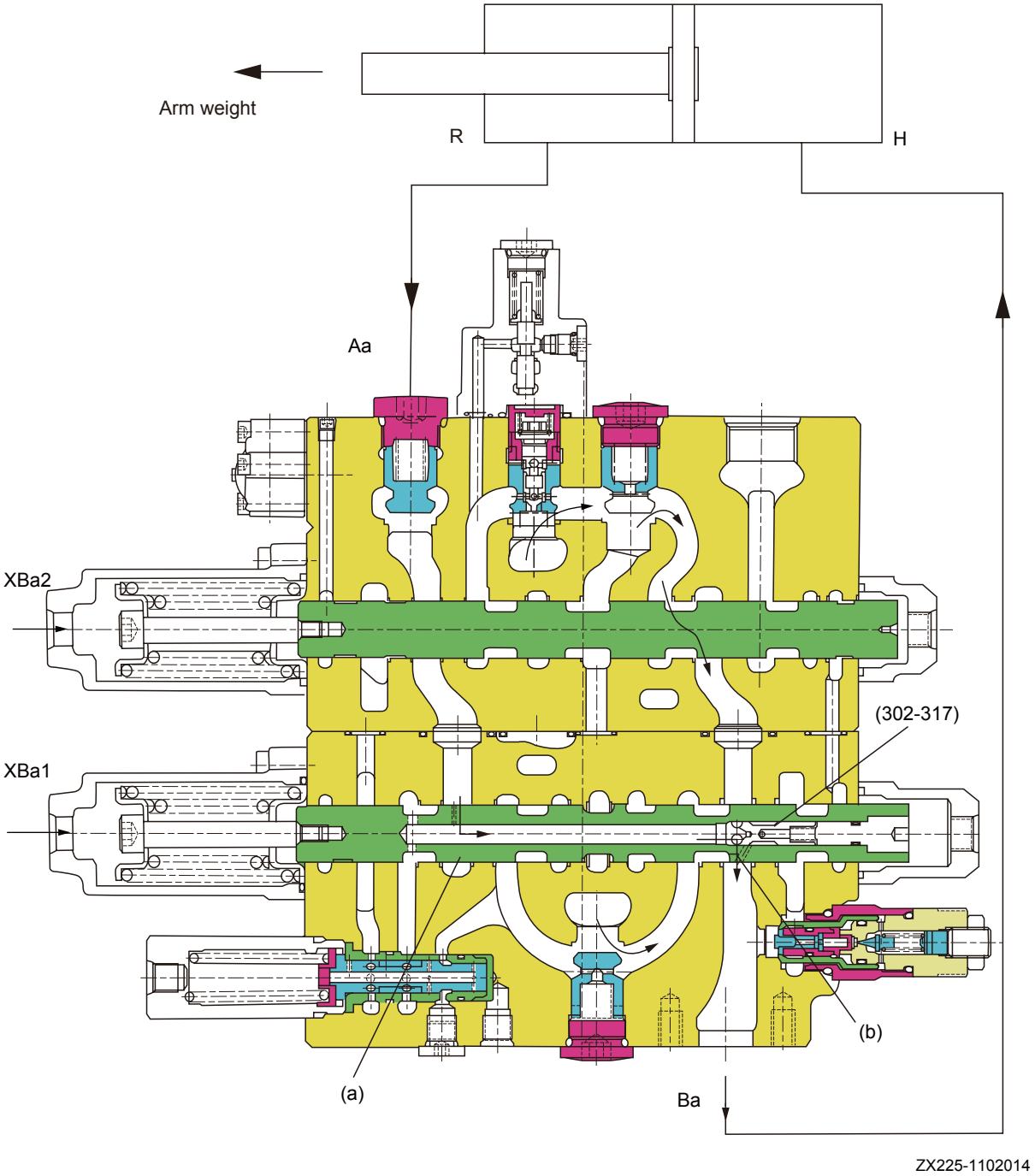
- When the arm 2 spool (306) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises. At the same time, pressure oil is supplied to port PaL and the release signal of lock valve option set (252) is sent out.

[Main circuit]

- When arm In is operated, pilot pressure oil is supplied to port XBa1 and port XBa2. When pilot pressure oil is applied at the two sides of port XBa1 and port XBa2, arm 1 spool and arm 2 spool is switched to the left. As a result, working oil from P2 is introduced into the neutral bypass (2) via main passage (3). Neutral bypass is cut off by switching arm 1 spool (302). Therefore, working oil flown into the parallel passage pushes open the cone valve (511) of the check valve and flows into the arm 1 spool (302) via the U passage. Then, it flows into the periphery of arm 1 spool (302) and is supplied into the arm cylinder head end (H) via port Ba.
- On the one hand, working oil from port P1 is introduced into neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching the arm 2 spool (306). Therefore, working oil in the parallel passage pushes open the logic cone valve (256-101) of the arm 2 logic valve GP, and working oil from neutral bypass pushes open the cone valve (511) of the check valve and flows into the arm 2 spool (306) via the U passage. Then, it merges with port Ba via the inner passage of arm 2 spool (306) and is supplied into the arm cylinder head end (H).
- On the other hand, pressure of the return oil from the arm cylinder rod end (R) rises under the weight the arm, and the return oil returns to port Aa. Working oil that returns to port Aa flows into the inside of the valve spool via the holes on the periphery of the arm 1 spool (302), and pushes open the cone valve (302-317) in the spool only under light load. It merges with port Ba through the holes on the spool. This is called the regeneration function of the arm.
- If the pressure at the arm cylinder head end and in the U passage rises, arm regeneration check valve spool (257-211) switches to the left. And, at the same time, the back pressure of the cone valve (302-317) in the spool is closed. Therefore, arm regeneration function is released and return oil from the arm cylinder rod end (R) flows into the spool via the hole (a) on the periphery of arm 1 spool (302). Then, it flows into arm regeneration check valve set (257) via hole (c) on the periphery of arm 1 spool (302), and returns to the working oil tank via tank port R1.

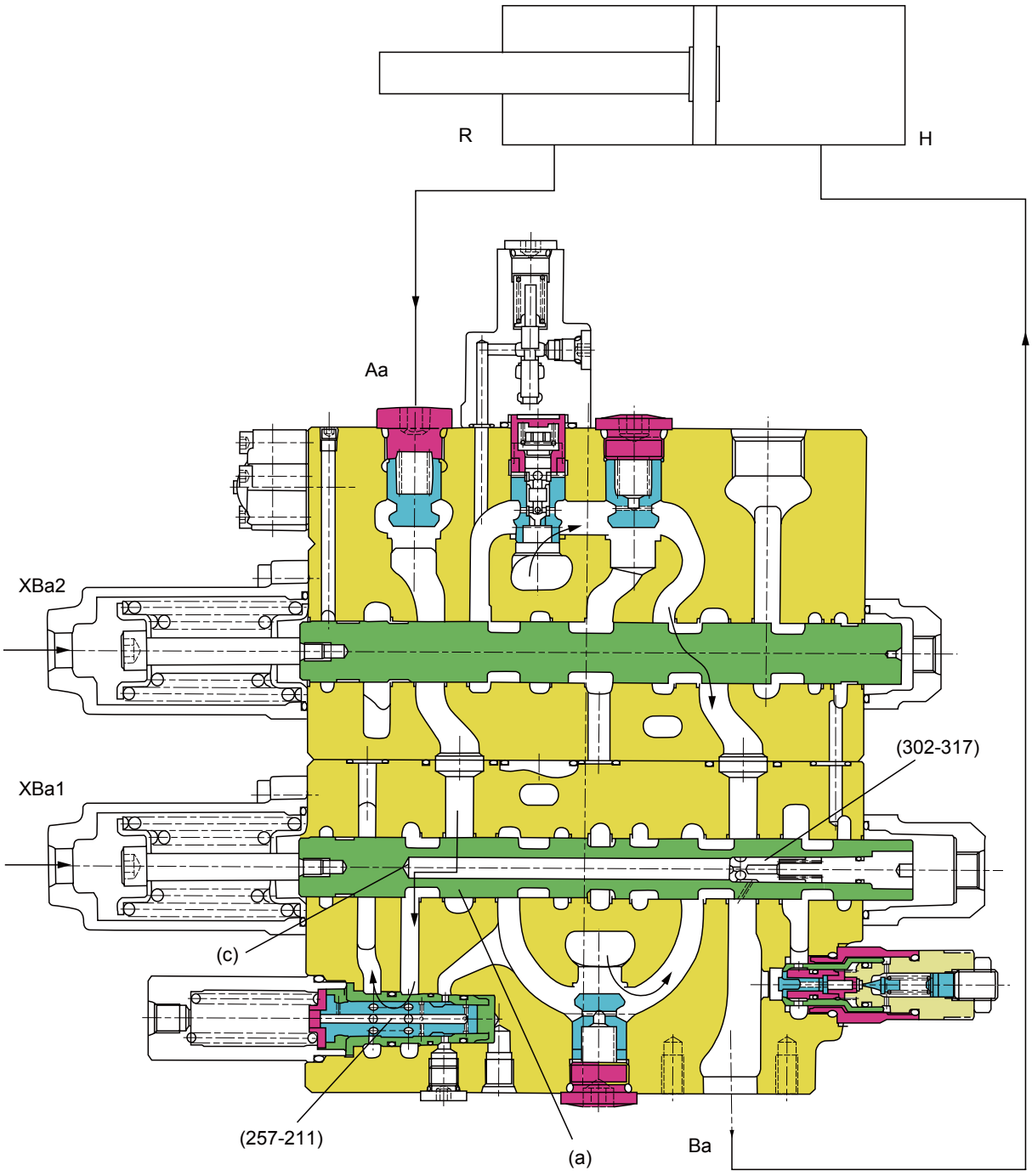
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- **Light load**



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- **When pressure at arm cylinder head end (H) rises**



ZX225-1102015

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4.5.3.4 Boom

(1) Boom UP

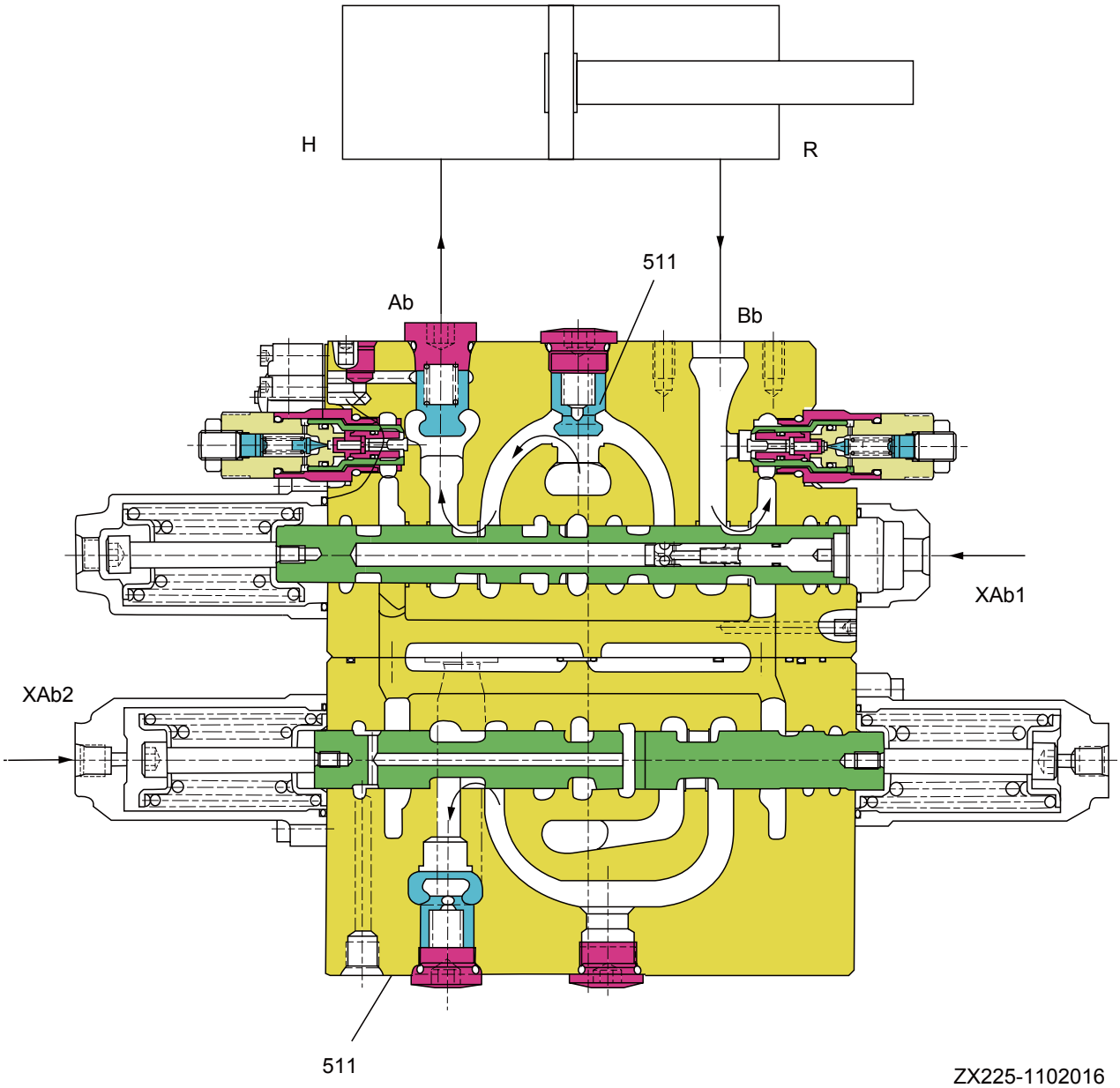
[Pilot circuit]

- When the boom 1 spool (303) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises.

[Main circuit]

- When boom UP is operated, pilot pressure oil is supplied into port XAb1 and boom 1 spool (303) moves to the left. Working oil from port P1 is introduced into neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching boom 1 spool (303). Therefore, working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows into the boom 1 spool (303) via the U passage. Then, it flows into the periphery of boom 1 spool (303) and is supplied into the boom cylinder head end (H) via port Ab.
- At the same time, pilot pressure oil is also supplied to port XAb2 and boom 2 spool (307) moves to the right. Working oil from port P2 is introduced into neutral bypass. Neutral bypass is cut off by switching the boom 2 spool (307). Therefore, working oil in the parallel passage flows into boom 2 spool (307) via the U passage. Then, it pushes open the cone valve (511) of the check valve and merges with port Ab and is supplied into the boom cylinder head end (H). This is called the boom confluence function.
- On the other hand, return oil from the boom cylinder rod end (H) via port Bb flows into the periphery of boom 1 spool (303) and returns to the working oil tank via tank port (R1).

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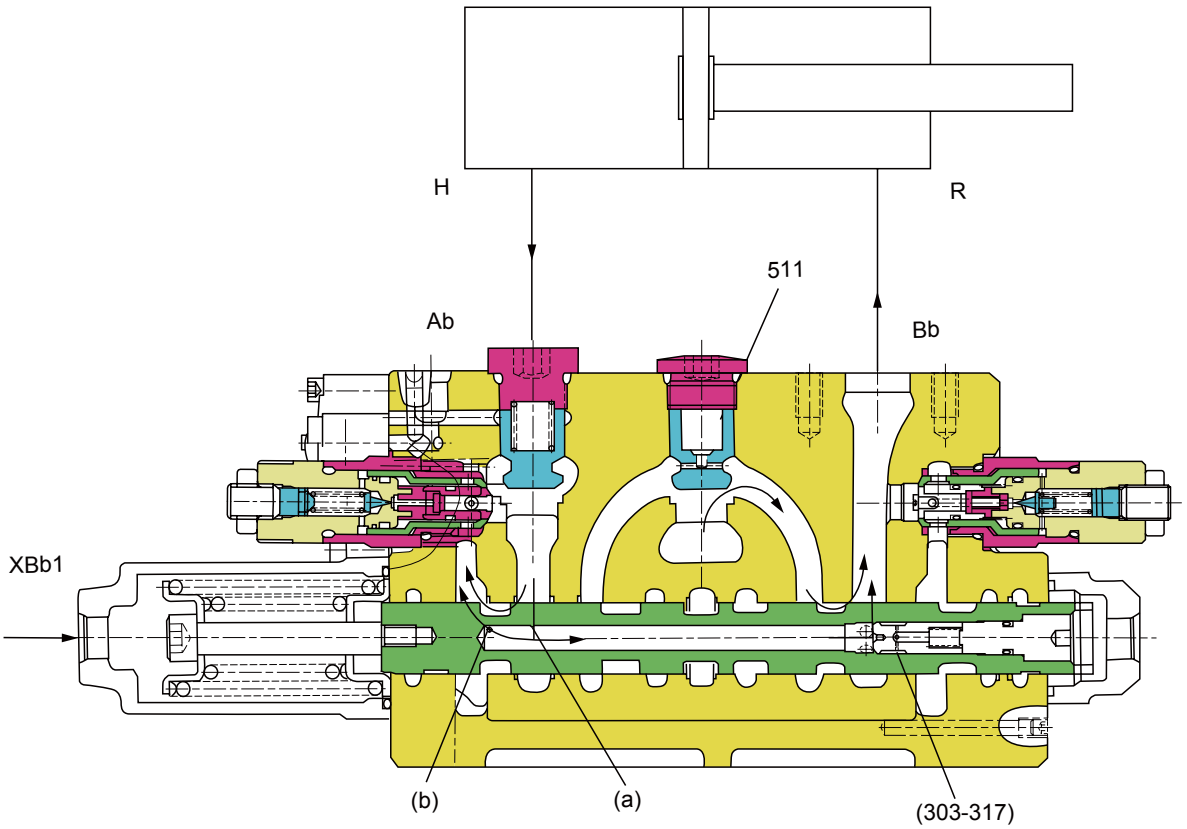
(2) Boom DOWN

[Pilot circuit]

- When the boom 1 spool (303) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises. At the same time, pressure oil is supplied to port PbL and the release signal of lock valve option set (252) is sent out.

[Main circuit]

- When boom DOWN is operated, pilot pressure oil is supplied to port XBb1. Boom 1 spool (303) moves to the right. As a result, working oil from P1 is introduced into the neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching boom 1 spool (303). Therefore, working oil flown into the parallel passage pushes open the cone valve (511) of the check valve and flows into the boom 1 spool (303) via the U passage. Then, it flows into the periphery of boom 1 spool (303) and is supplied into the boom cylinder rod end (R) via port Bb.
- On the other hand, return oil from the boom cylinder head end (H) passes the hole (a) and the periphery of boom 1 spool (303).
- Return oil pressure rises due to the self weight of the boom. Cone valve (303-317) in the spool is pushed to the right. Return oil flows to the outside of spool. The pressure oil is supplied into the boom cylinder rod end (R) as the working oil for boom DOWN operation. This is called the boom regeneration function. Part of the oil that flows into the inside passage of the spool via hole (a) returns to the working oil tank via hole (b).



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4.5.3.5 Bucket

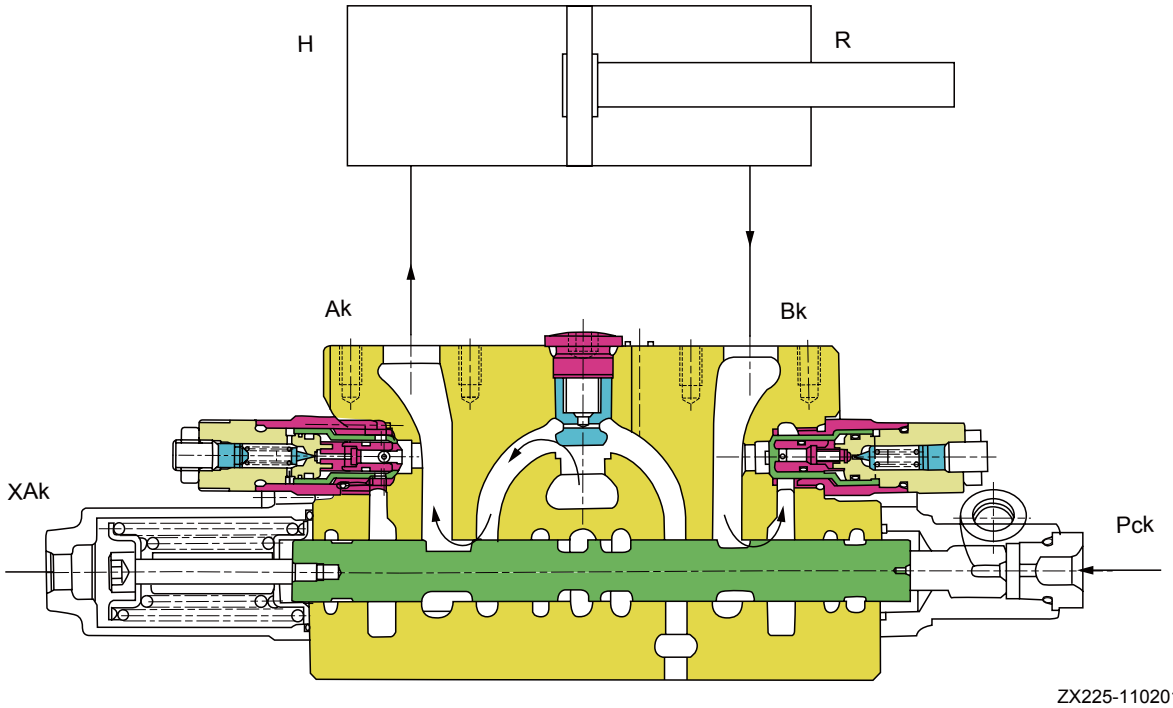
(1) Bucket DIG

[Pilot circuit]

- When the bucket spool (304) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises. At the same time, pressure oil is supplied at port XBp2.

[Main circuit]

- When bucket DIG is operated, pilot pressure oil is supplied into port XAk and bucket spool (304) moves to the right. Working oil from port P1 is introduced into neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching bucket spool (304). Therefore, working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows into the bucket spool (304) via the U passage. Then, it flows into the periphery of bucket spool (304) and is supplied into the bucket cylinder head end (H) via port Ak.
- On the other hand, return oil from the bucket cylinder rod end (R) flows in via port Bk. Then, it flows to oil tank port (R1) via the spool periphery and returns to working oil tank.
- When boom UP and bucket DIG are operated simultaneously, pilot pressure oil is supplied to port Pck. Therefore, the stroke of bucket spool is not limited at stroke end, but on any position halfway. As a result, bucket cylinder passage is throttled and working oil flows into boom 1 spool (303) via bucket spool (304). In this way, boom UP operation takes precedence.



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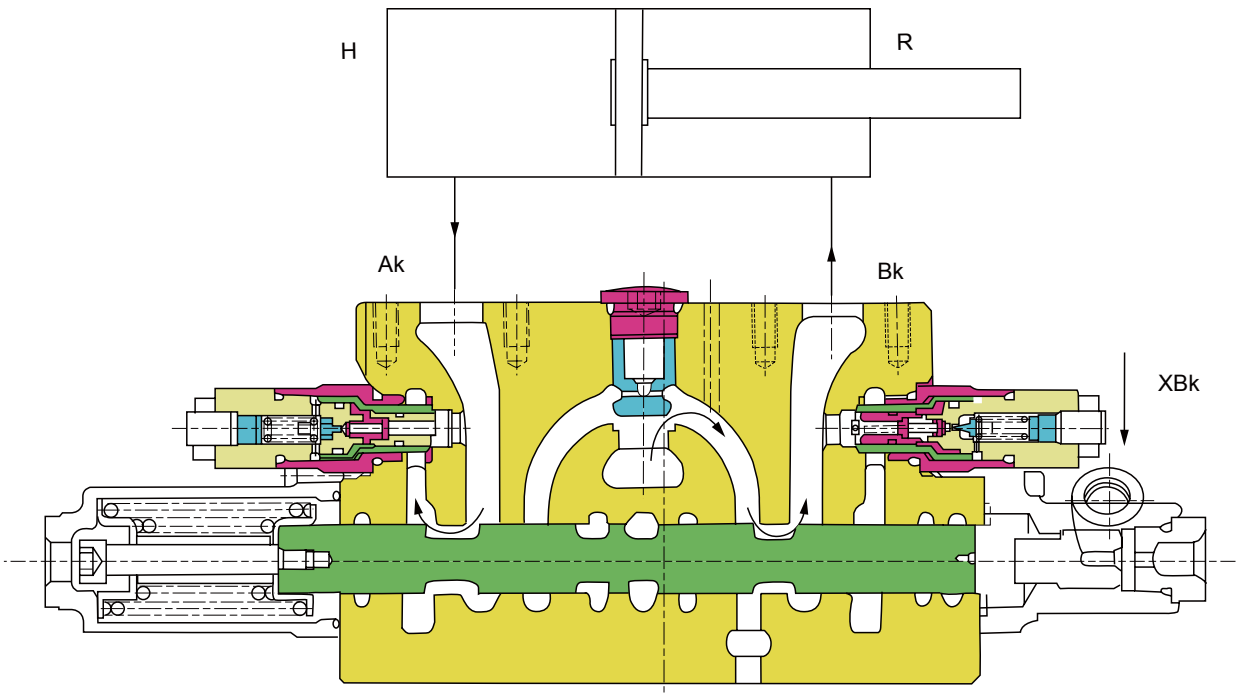
(2) Bucket DUMP

[Pilot circuit]

- When the bucket spool (304) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises. At the same time, pressure oil is supplied at port XBp2.

[Main circuit]

- When bucket DUMP is operated, pilot pressure oil is supplied into port XBk and bucket spool (304) moves to the left. Working oil from port P1 is introduced into neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching bucket spool (304). Therefore, working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows into the bucket spool (304) via the U passage. Then, it flows into the periphery of bucket spool (304) and is supplied into the bucket cylinder rod end (R) via port Bk.
- On the other hand, return oil from the bucket cylinder head end (H) flows in via port Ak. Then, it flows to oil tank port (R1) via the spool periphery and returns to working oil tank.



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(3) Bucket confluence

- When bucket DIG is operated, pilot pressure oil is supplied into port XBp2 and the neutral bypass cutoff valve spool (310) is switched. Working oil from port P2 is introduced into neutral bypass (2) via main passage (3). Neutral bypass is cut off by switching neutral bypass valve spool (310). Therefore, working oil pushes open the check valve, and interconnects with the U passage via the inside path, and converges with bucket spool (304).

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4.5.3.6 Swing

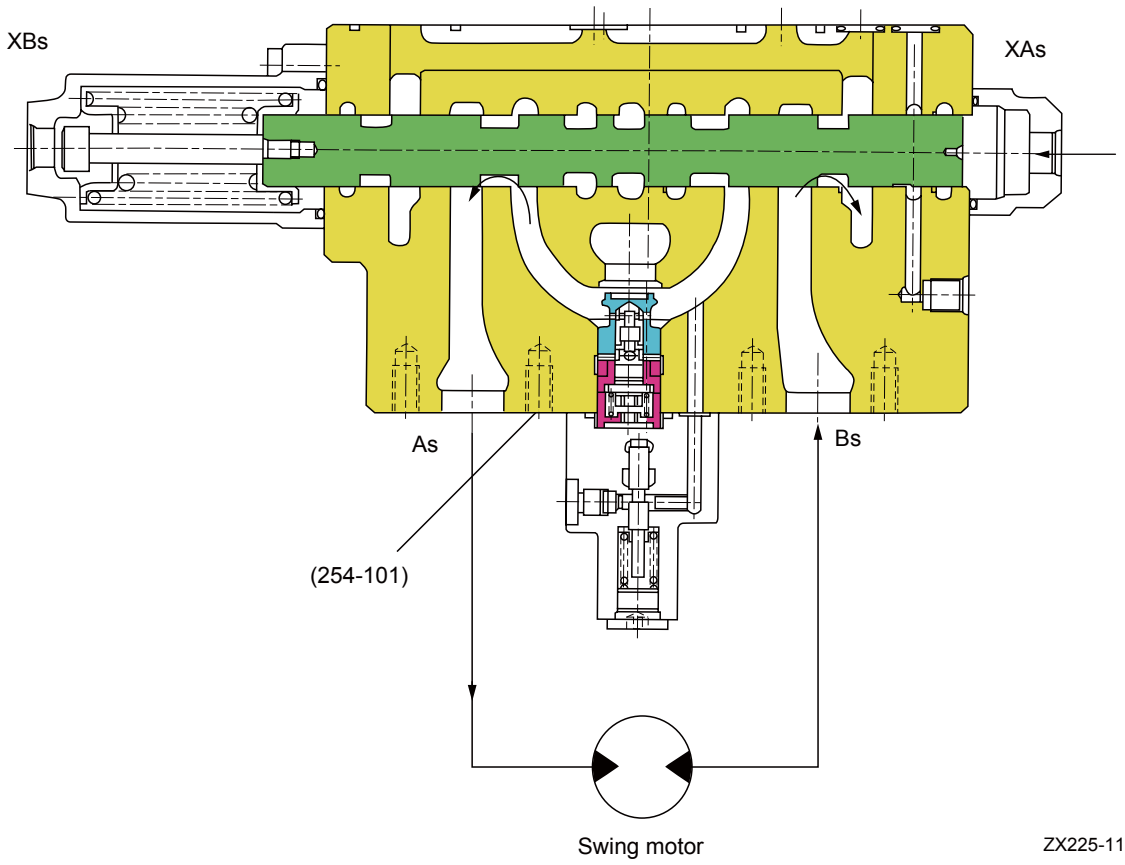
(1) Swing operation

[Pilot circuit]

- When the swing spool (305) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises.

[Main circuit]

- When swing is operated, pilot pressure oil is supplied into port XAs (or XBs) and swing spool (305) is switched. Working oil from port P2 is introduced into neutral bypass (2) via main passage (3). Neutral bypass is cut off by switching swing spool (305). Therefore, working oil in the parallel passage pushes open the logic cone valve (2540-101) of the swing logic valve GP, and flows into the swing spool (305) via the U passage. Then, it flows into the periphery of swing spool (305) and is supplied into the swing motor via port As (or Bs).
- On the other hand, return oil from the swing motor flows in via port Bs (or port As). Then, it flows into tank port (R1) via the spool periphery and returns to the working oil tank.



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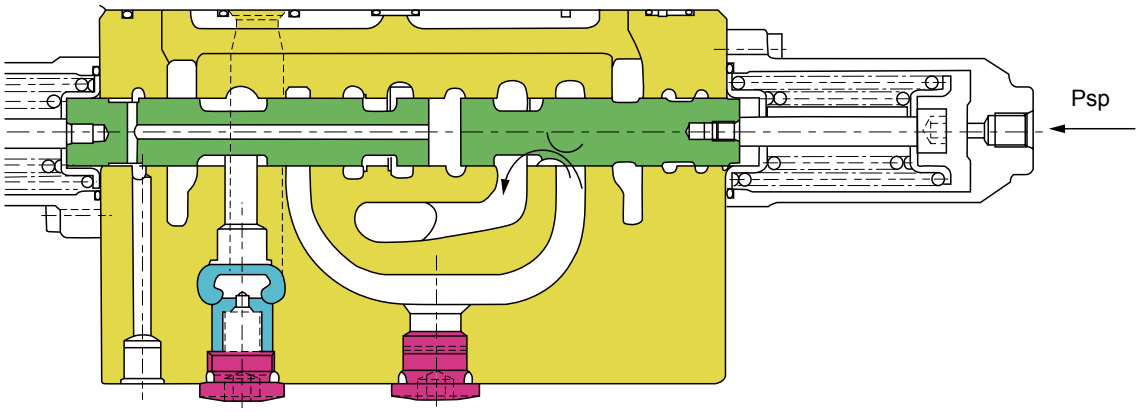
(2) Swing priority function

[Pilot circuit]

- Pilot pressure oil is supplied to port Psp and swing priority spool (311) is switch.

[Main circuit]

- Switch swing priority spool (311). The opening area of the swing priority reduces. As a result, working oil from arm 1 spool (302) flows into swing spool (305) and swing operation takes precedence.



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4.5.3.7 Option

Option spool is used to control optional equipment.

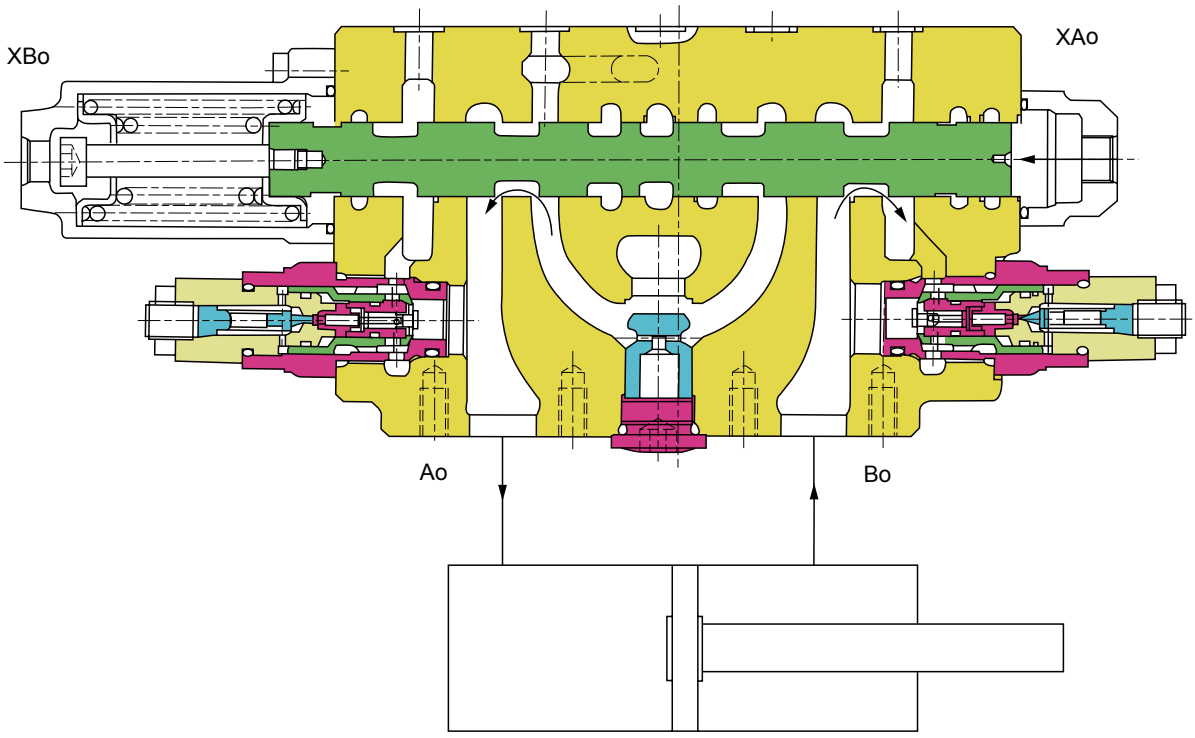
(1) Option operation

[Pilot circuit]

- When the option spool (309) is switched, the side path is closed and pressure at port Px (work equipment signal port) rises.

[Main circuit]

- When option is operated, pilot pressure oil is supplied into port XAo (or XBo) and option spool (309) is switched. Working oil from port P2 is introduced into neutral bypass (2) via main passage (3). Neutral bypass is cut off by switching option spool (309). Therefore, working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows into the option spool (309) via the U passage. Then, it flows into the periphery of option spool (309) and is supplied into the optional equipment via port Ao (or Bo).
- On the other hand, return oil from the optional equipment flows in via port Bo (or port Ao). Then, it flows into tank port (R1) via the spool periphery and returns to the working oil tank.



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(2) Option confluence

- To achieve option confluence, pilot pressure oil is supplied into port XBp1 and the bypass cutoff valve spool (310) is switched. Working oil from port P1 is introduced into neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching bypass valve spool (310). Therefore, working oil pushes open the cone valve (514) of check valve, and converges with option spool (309) via the inside path and the U passage.

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4.5.3.8 Travel straight

When travel spool (301) and other spool are operated simultaneously.

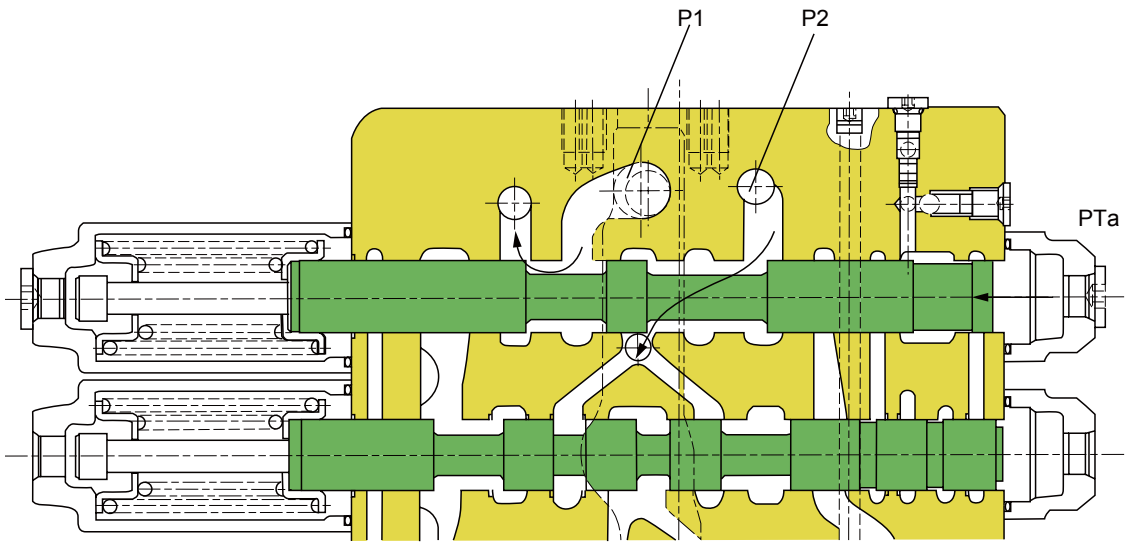
The following case shows when travel spool (301) and swing spool (305) are operated simultaneously. (When pilot pressure oil is supplied to port XAtL, port XAtr and port Xas)

[Pilot circuit]

- The side path of right/left travel spool (301) and the side path of the swing spool (305) at the downflow side are closed.
- Pilot oil from port PG is supplied to port PTa and straight travel spool (308) is switched.

[Main circuit]

- When straight travel spool (308) is switched, the right/left travel spool (301) are interconnected with port P2. The parallel passage of swing/boom 2/option/arm 1 circuit and boom 1/bucket/arm 2 circuit are interconnected with port P1. Therefore, working oil supplied from port P2 flows into port Atl and port Atr, and is supplied to the two travel motors equally.
- On the other hand, working oil from port P1 is supplied to the swing motor via port As.
- When oil pressure at port P2 is lower than that at port P1, part of the working oil form port P1 is supplied to port P2. In this way, sharp decrease of travel speed is averted.



ZX225-1102023

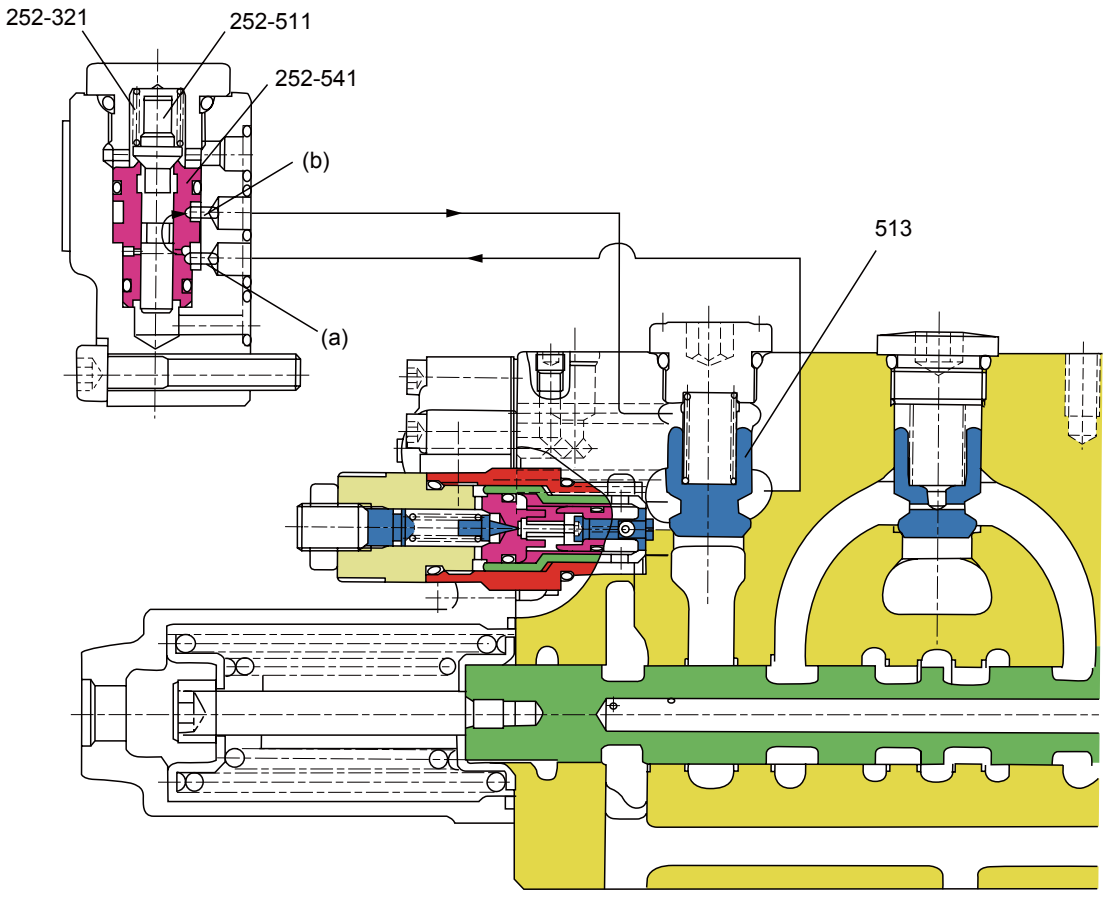
https://truckmanualshub.com/

4.5.3.9 Lock valve function

- The lock valve option set (252) is installed between the arm cylinder rod end (R) and arm 2 spool (302) and arm 2 spool (306). It is used to reduce the internal leakage of the spool due to cylinder pressure.
- Likewise, lockout option set (252) is also installed between boom cylinder head end (H) and boom 2 spool (303) to reduce the internal leakage of he spool due to cylinder pressure.

(1) Spool in neutral position

- The following shows when boom 1 spool (303) is in neutral position. (The same is with arm 2 spool (306))
- When boom 1 spool (303) is in neutral position, spool (252-511) in the lock valve option set is pressed against the valve seat of the valve sleeve (252-541) inside the lock valve option set, as shown in the illustration, via the spring force of spring (252-321).
- At this position, working oil at the boom cylinder head end (H) flows in via hole (a) and flows out from hole (b) through the periphery of the lock valve option set spool (252-511), pressing the cone valve (513) against the valve seat of the valve block via hole (b). By this means, oil leakage is reduced.

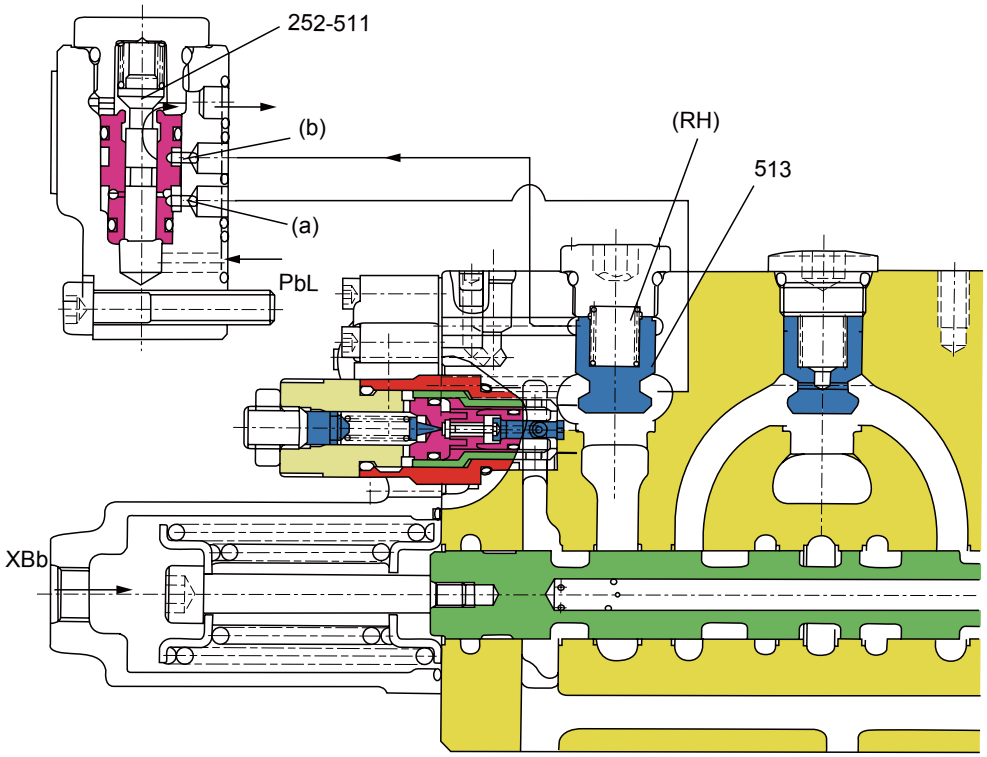


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(2) Boom DOWN operation

- When boom DOWN is operated, pilot pressure oil is supplied to port PbL and port XBb1. Spool (252-511) inside the lock valve option set moves to the top by via pilot pressure oil. Through the movement of spool (252-511) inside the lock valve option set, hole (a) is cutoff and working oil from boom cylinder head end (H) does not flow into spring chamber (RH). In addition, oil in the spring chamber (RH) flows into drain circuit via hole (b). In this way, the cone valve (513) is pushed up by the pressure at boom cylinder head end (H) and the function of the lock valve option set (252) is released.



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(2) Boom UP operation

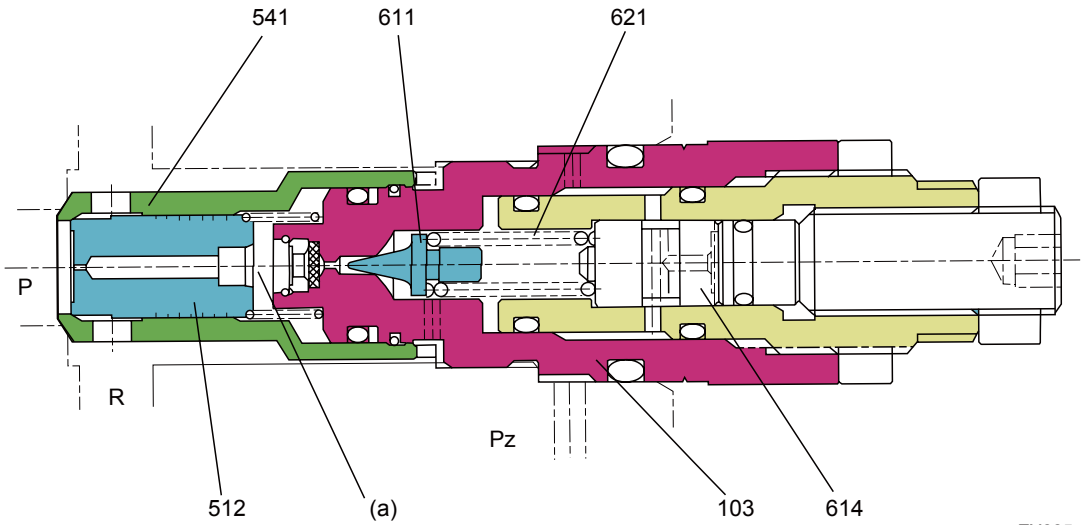
- When boom DOWN is operated, pilot pressure oil is supplied to port XAb1. The cone valve (513) is pushed ope by the oil from boom 1 spool (303) and working oil flows into port Ab.

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4.5.3.10 Main relief valve function

The main relief valve is installed on the valve block A (101). Its function is described below:

- Working oil flows into chamber (a) from passage (P) via the hole of valve seat (541) and hole on valve rod (512). Valve rod (512) is pressed against valve seat (541), forming a tight seal.
- When pressure in passage (P) exceeds the elastic force of spring (621), cone valve (611) is pushed open. Therefore, working oil flows through the hole on valve sleeve (103) via the periphery of cone valve (611) and enters low-pressure path (R).
- Opening of cone valve (611) causes pressure in chamber (a) to drop and valve rod (512) is open. In this way, working oil in passage (P) flows into low-pressure path (R) directly.
- When pressure oil high than 3MPa is supplied to port Pz, this pressure oil pushes plunger (614) to the left. The set load of spring (621) is changed and pressure of the main relief valve rises.



ZX225-1102026

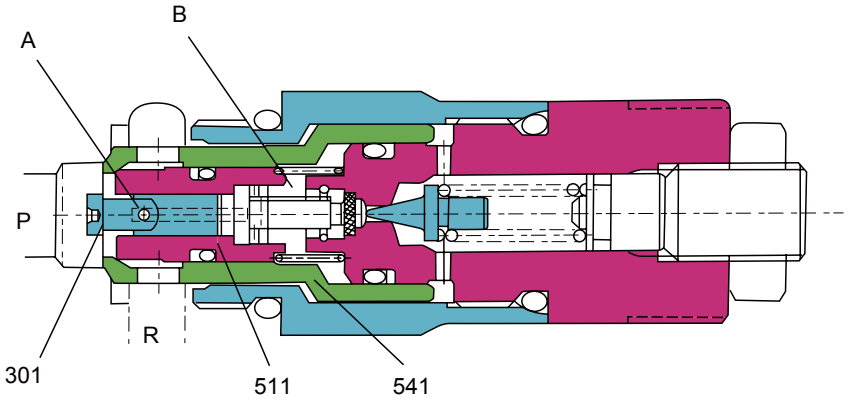
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4.5.3.11 Port relief valve function

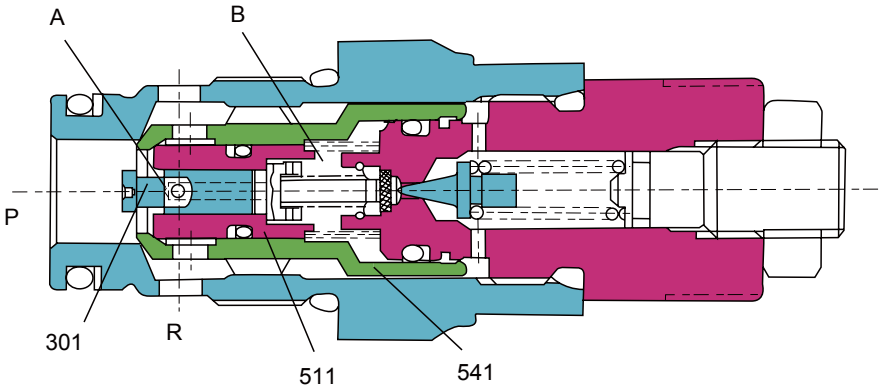
The port relief valve is installed between the tank port and low-pressure path. In addition to the function as relief valve, it has also the function of anti-cavitation oil complement check valve. Its function is described below:

(1) Relief valve function

- Working oil flows into chamber (B) via the hole (A) on plunger (301). Valve rod (511) is pressed against valve seat (541), and valve seat (541) is pressed onto the valve seat of the valve block, forming a tight seal.



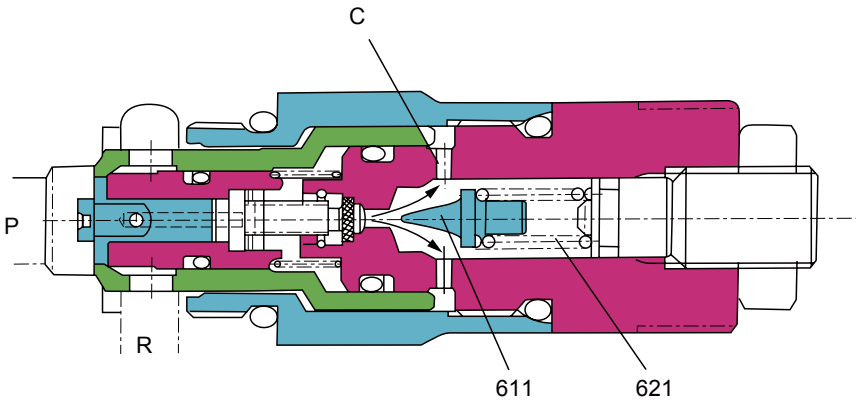
ZX225-1102027



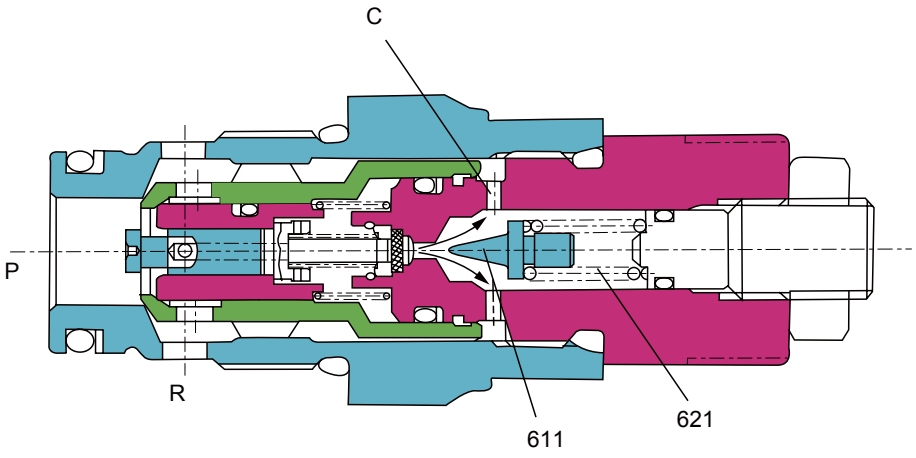
ZX225-1102028

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- When pressure in passage (P) exceeds the elastic force of spring (621), cone valve (611) is pushed open. Therefore, working oil flows through hole (C) via the periphery of cone valve (611) and enters low-pressure path (R).



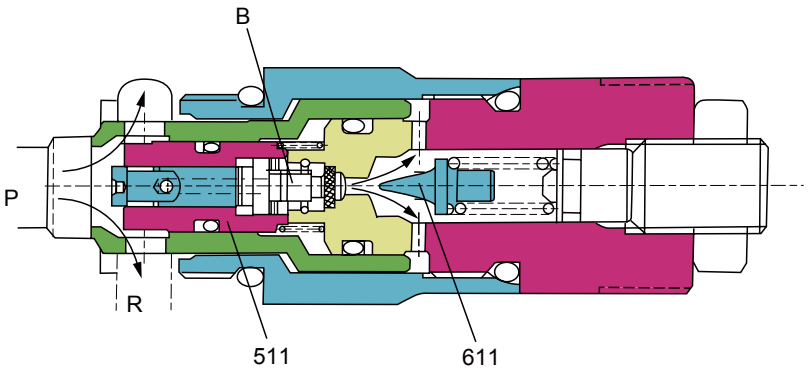
ZX225-1102029



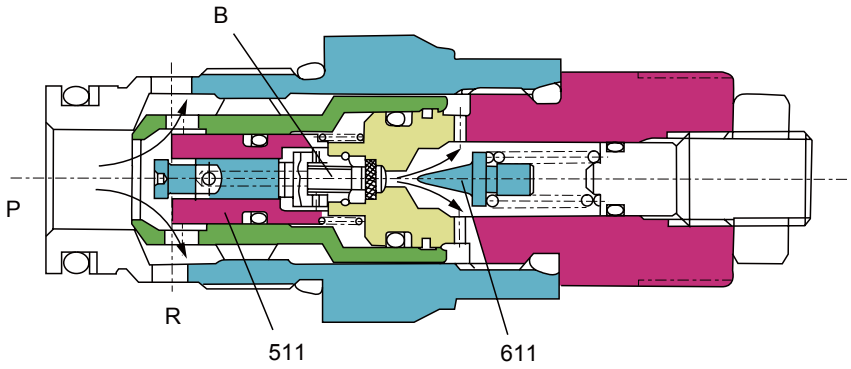
ZX225-1102030

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- Opening of cone valve (611) causes pressure in chamber (B) to drop and valve rod (511) is open. In this way, working oil in passage (P) flows into low-pressure path (R) directly.



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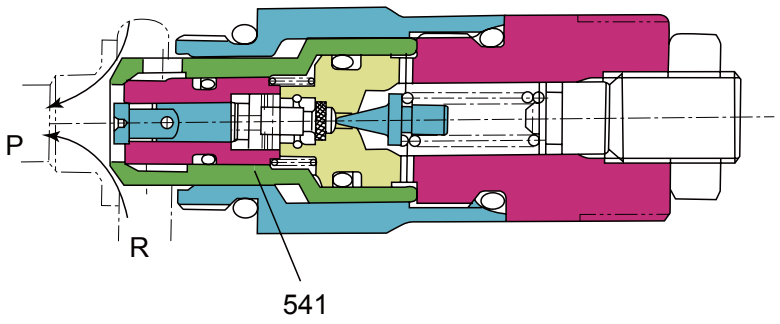


ZX225-1102032

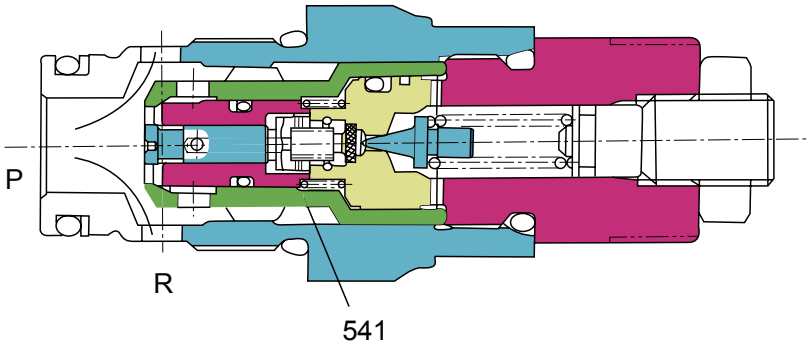
https://truckmanualshub.com/

(2) Anti-cavitation oil complement check valve

- When negative pressure is formed in path (P), working oil is supplied from path (R). When pressure in path (R) gets higher than pressure in path (P), valve seat (541) moves to the right direction. Therefore, working oil is supplied from path (R) to path (P) via the periphery of valve seat (541) in order to prevent cavitation.



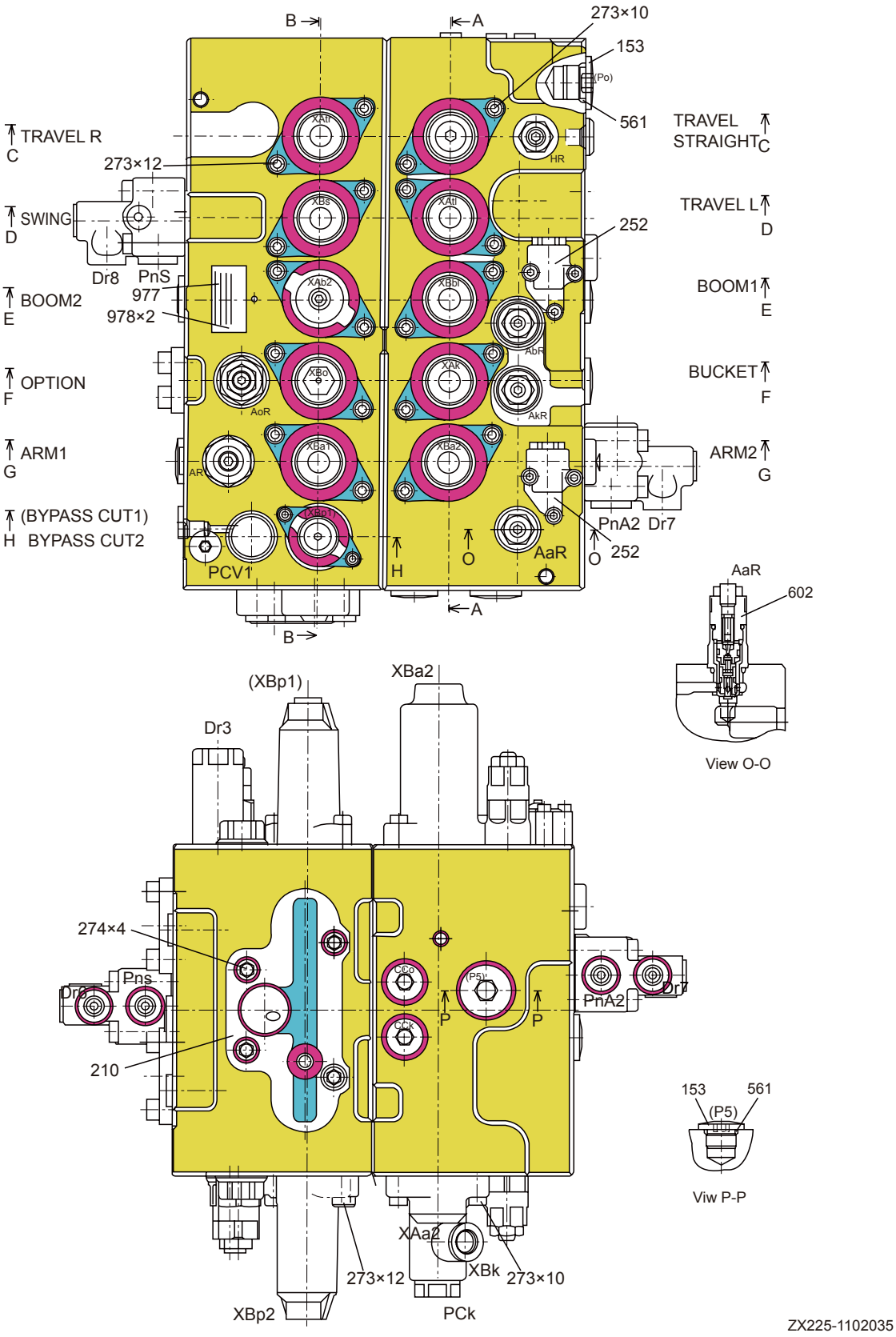
ZX225-1102033



ZX225-1102034

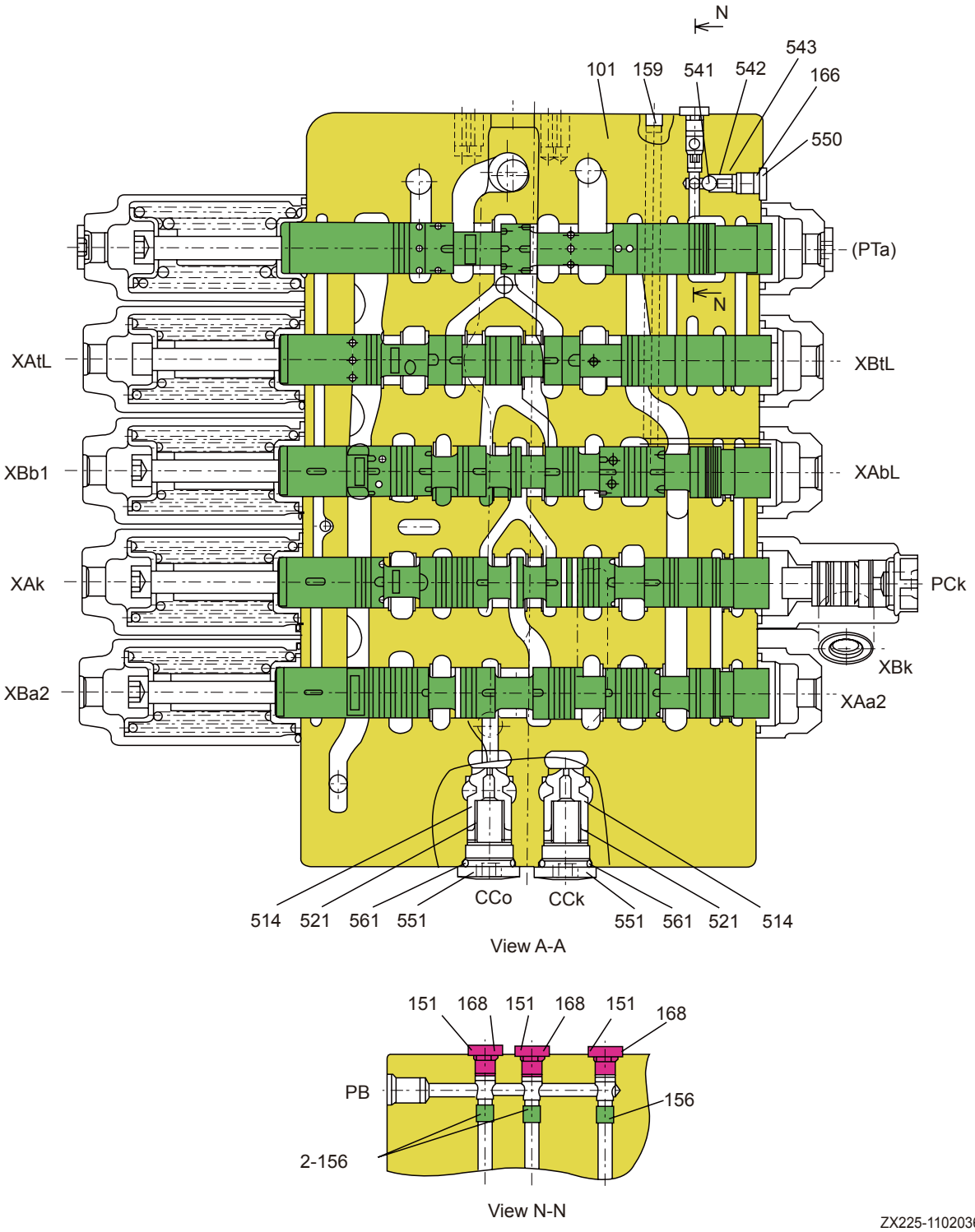
https://truckmanualshub.com/

4.5.4 Section view



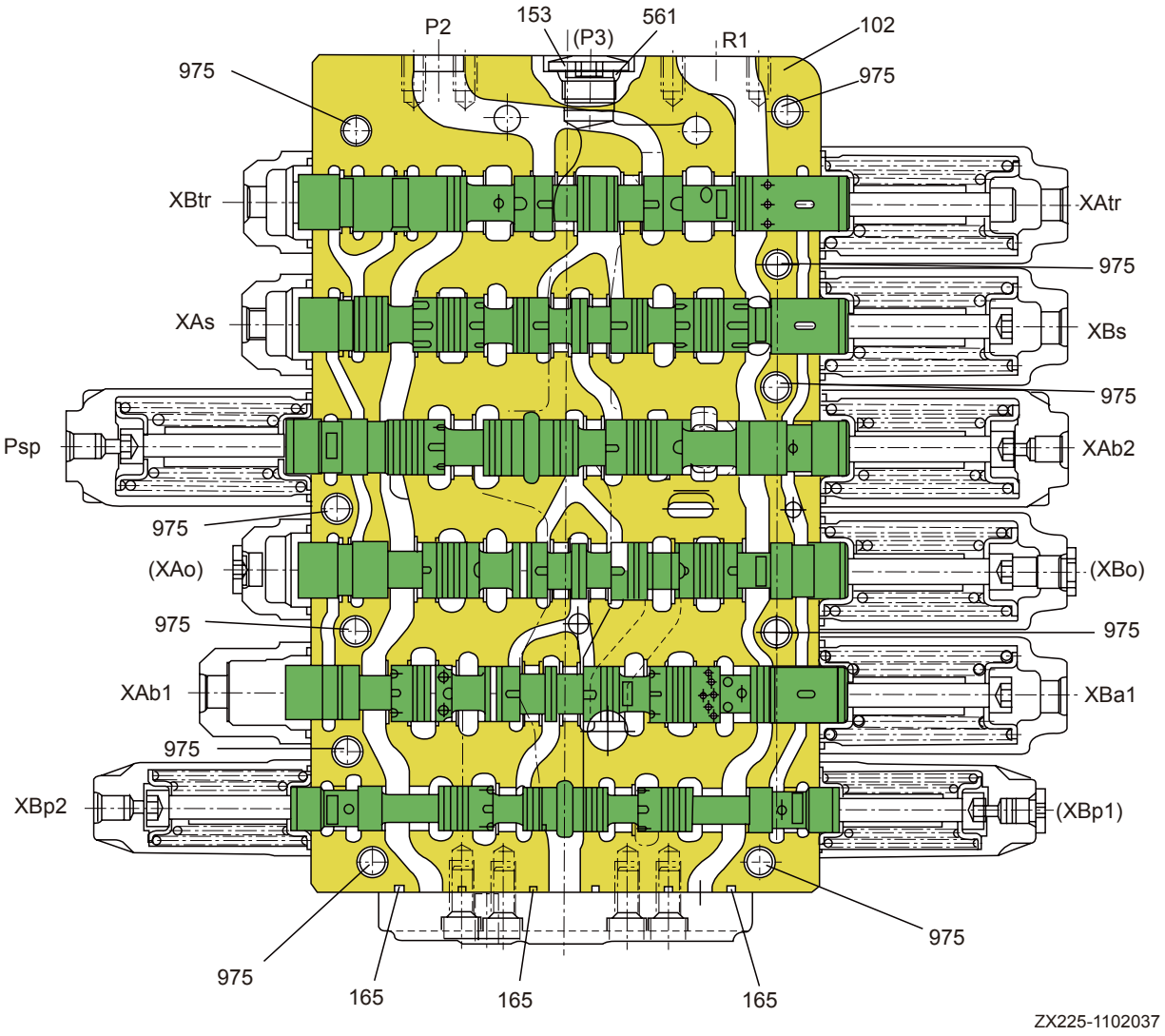
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Section A-A, N-N



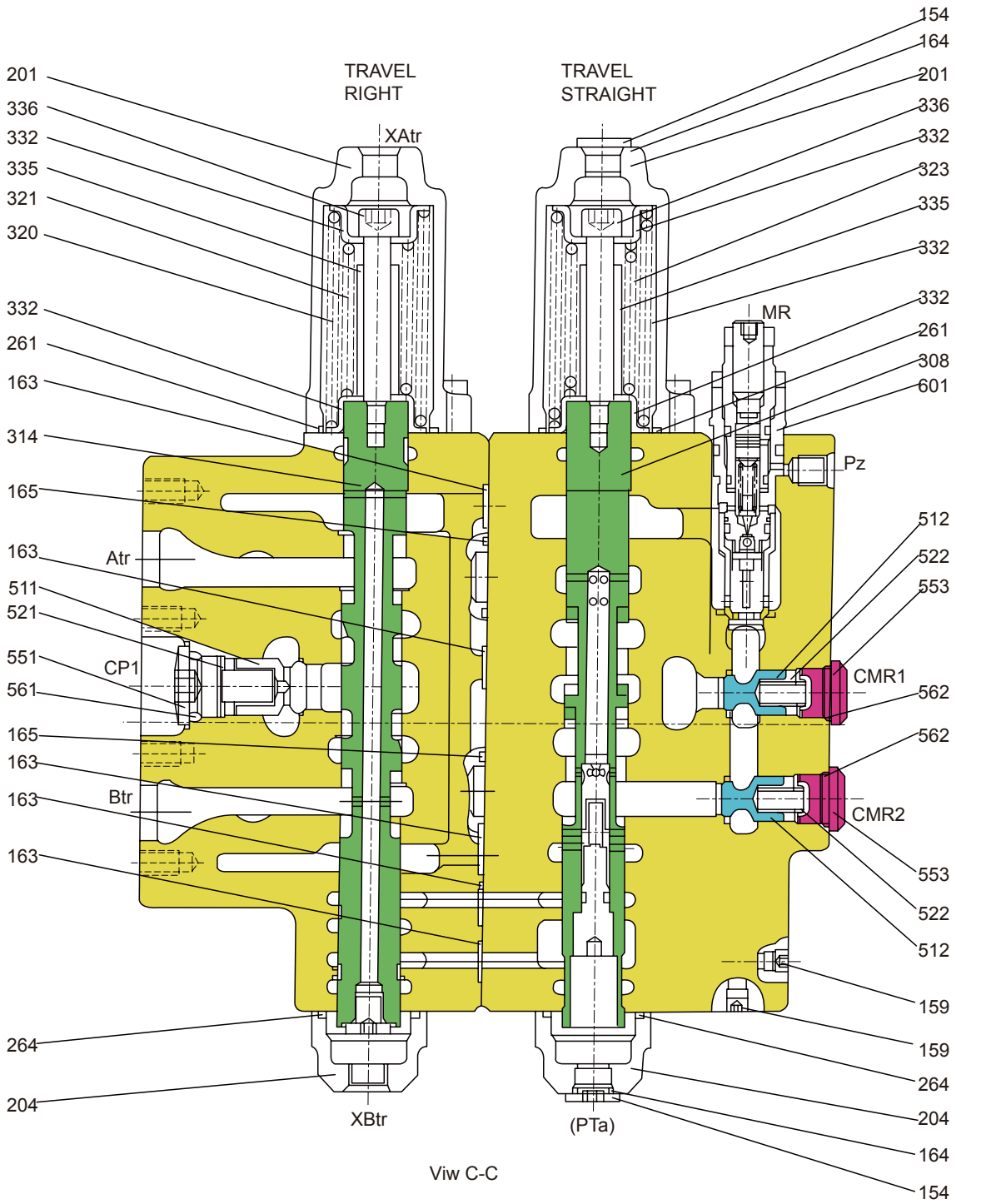
https://truckmanualshub.com/

Section B-B



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Section C-C (Travel right, travel straight)

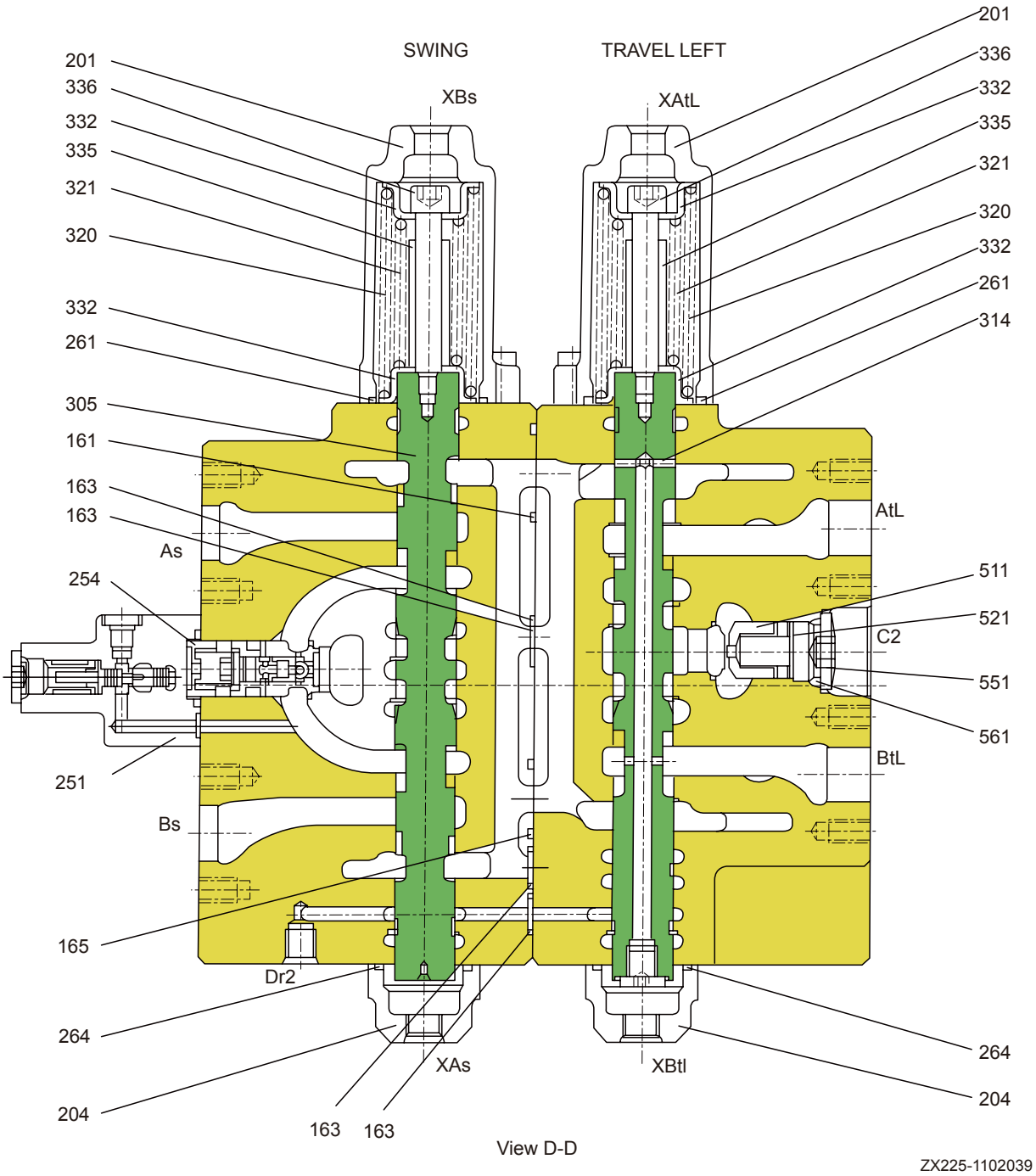


Viw C-C

ZX225-1102038

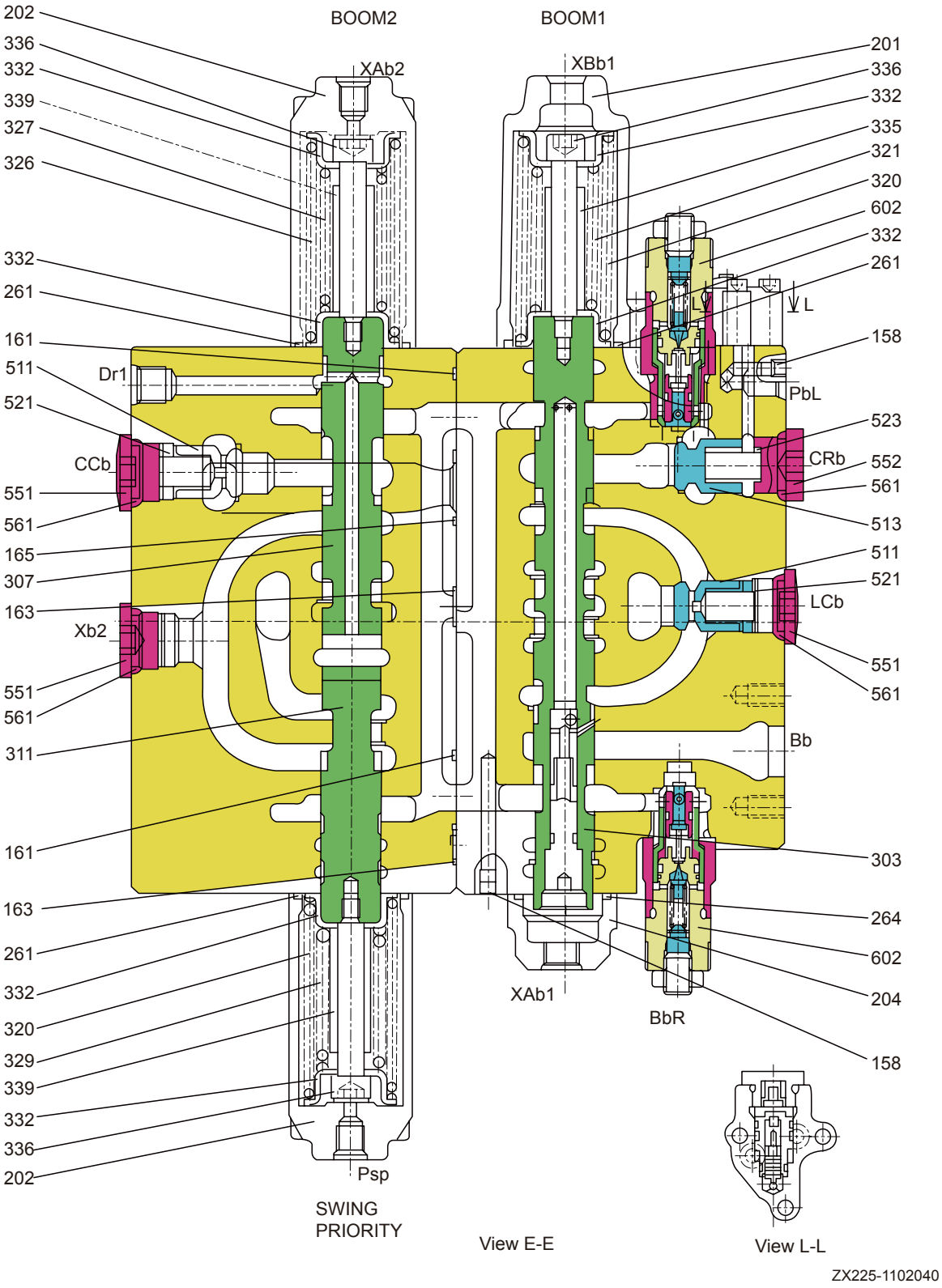
https://truckmanualshub.com/

Section D-D (Swing, travel left)



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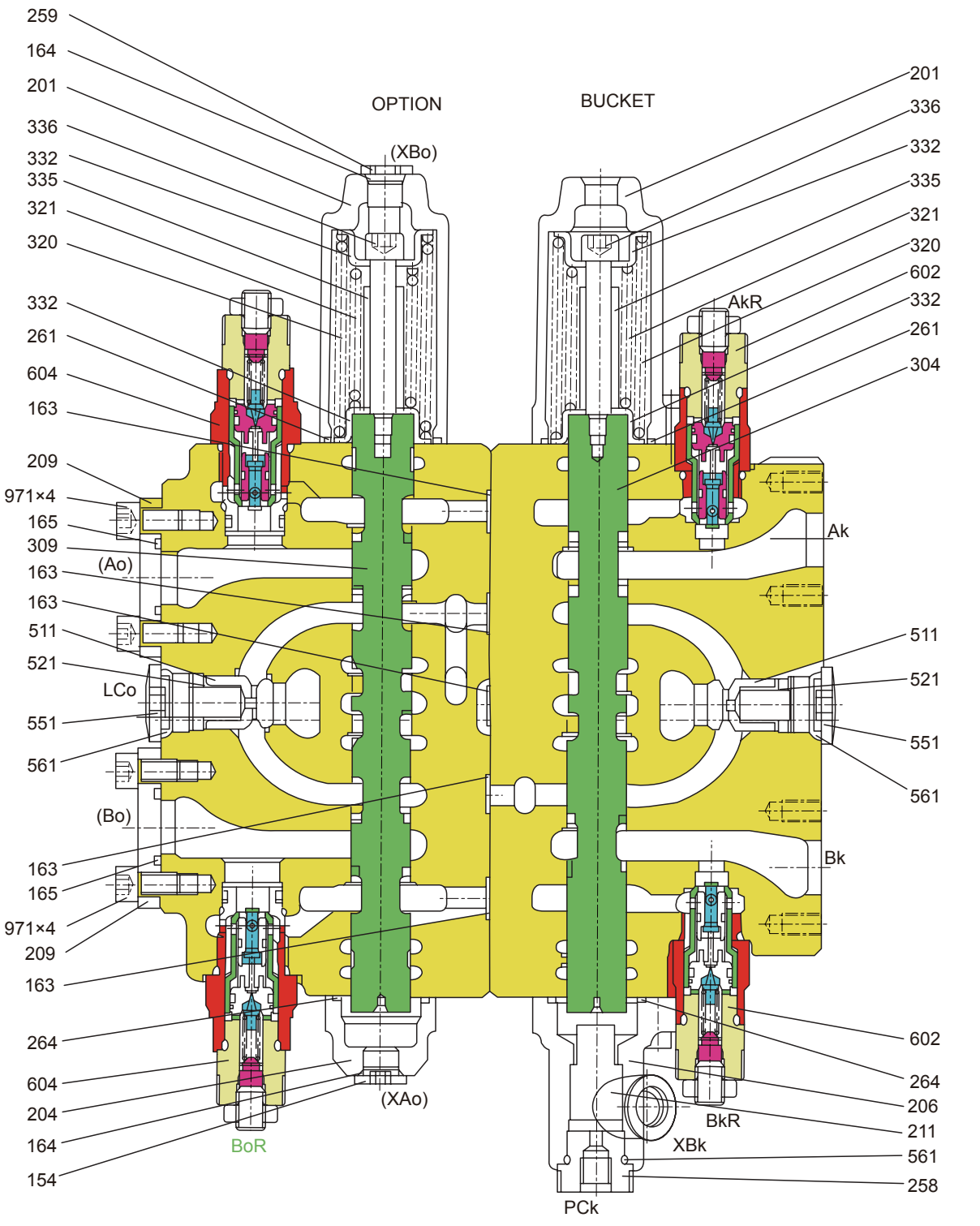
Section E-E, L-L (Boom 1, boom 2)



ZX225-1102040

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Section F-F (Option, bucket)

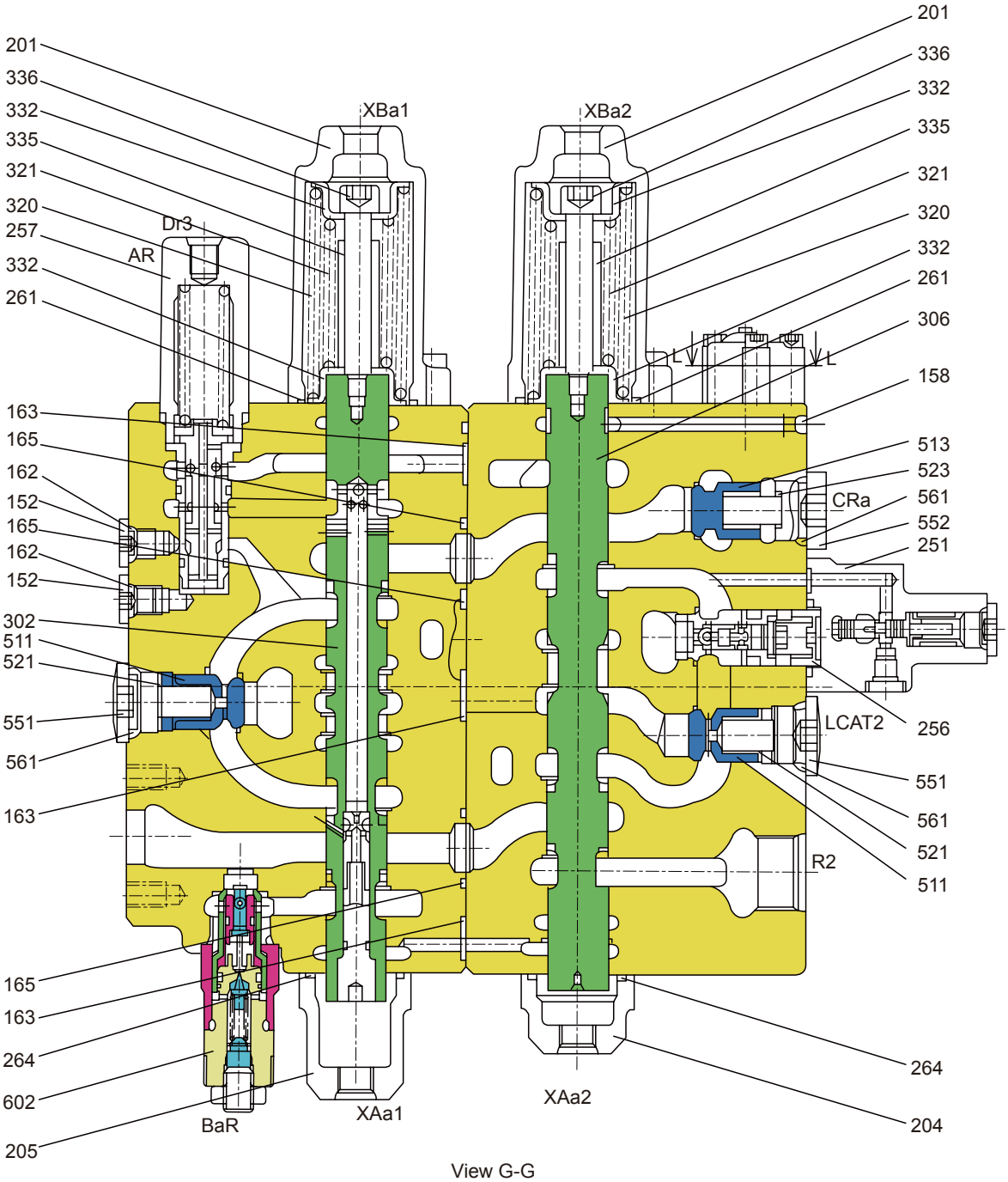


View F-F

ZX225-1102041

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Section G-G (Arm 1, arm 2)

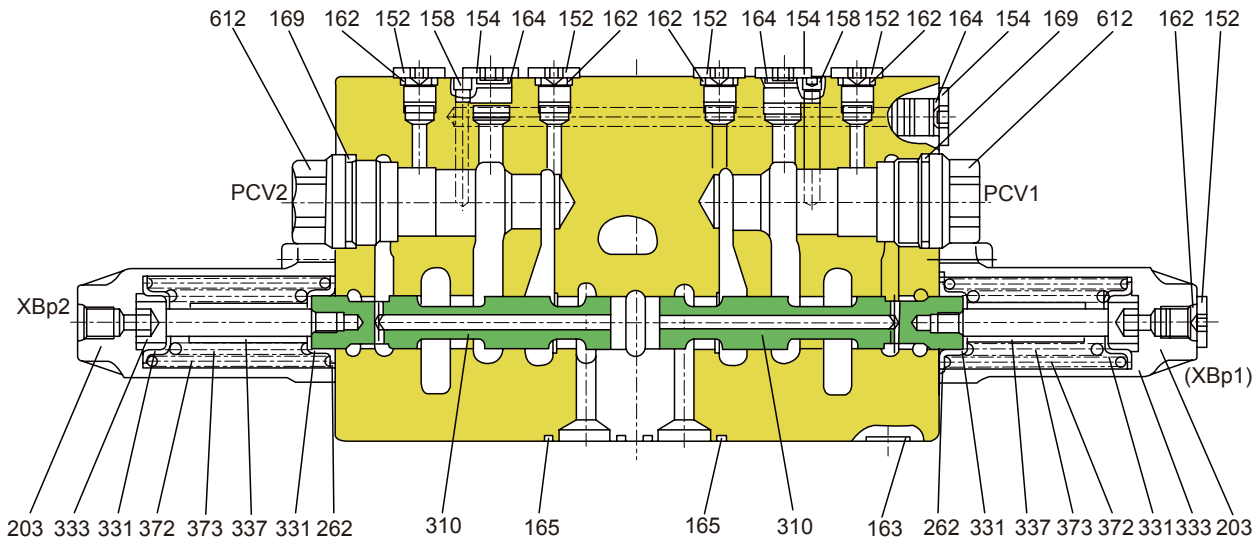


View G-G

ZX225-1102042

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Section H-H (Bypass cut 1, bypass cut 2)



View H-H

ZX225-1102043

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Mounting torque (N·m)	NO.	Part name	Q'ty	Mounting torque (N·m)	NO.	Part name	Q'ty
	101	BLOCK, valve A	1		308	SPOOL ASS'Y, travel straight	1
	102	BLOCK, valve B	1		309	SPOOL, option	1
13~17	151	PLUG	3		310	SPOOL, bypass cut	2
34~39	152	PLUG	7		311	SPOOL, swing priority	1
220~250	153	PLUG	3		320	SPRING	9
69~78	154	PLUG	6		321	SPRING	8
7.4~9.8	156	PLUG, orifice	3		322	SPRING	1
7.5~10	158	PLUG	5		323	SPRING	1
10~14	159	PLUG	3		326	SPRING	1
	161	O-RING	3		327	SPRING	1
	162	O-RING	7		329	SPRING	1
	163	O-RING	21		331	SPRING SEAT	4
	164	O-RING	7		332	SPRING SEAT	22
	165	O-RING	14	16~18	333	FLANGE SOCKET	2
	166	O-RING	1		335	STOPPER	9
	168	O-RING	3	16~18	336	FLANGE SOCKET	11
	169	O-RING	2		337	STOPPER	2
	201	COVER, spring	9		339	STOPPER	2
	202	COVER, spring	2		372	SPRING	2
	203	COVER, spring	2		373	SPRING	2
	204	COVER, spool	7		511	VALVE, cone	8
	205	COVER, spool	1		512	VALVE, cone	2
	206	COVER, spool	1		513	VALVE, cone	2
	209	FLANGE	2		514	VALVE, cone	2
	210	PLATE	1		521	SPRING	10
	211	PISTON	1		522	SPRING	2
49~65	251	VALVE, logic control	2		523	SPRING	2
9.8~14	252	OPTION ASS'Y, lock valve	2		541	BALL	1
	254	VALVE GP, swing logic	1		542	SPRING SEAT	1
	256	VALVE GP, arm 2 logic	1		543	SPRING	1
69~78	257	CHECK VALVE ASS'Y, arm regeneration	1	25~29	550	PLUG	1
	258	PLUG	1	230~260	551	PLUG	11
	259	PLUG	1	230~260	552	PLUG	2
	261	O-RING	11	130~150	553	PLUG	2

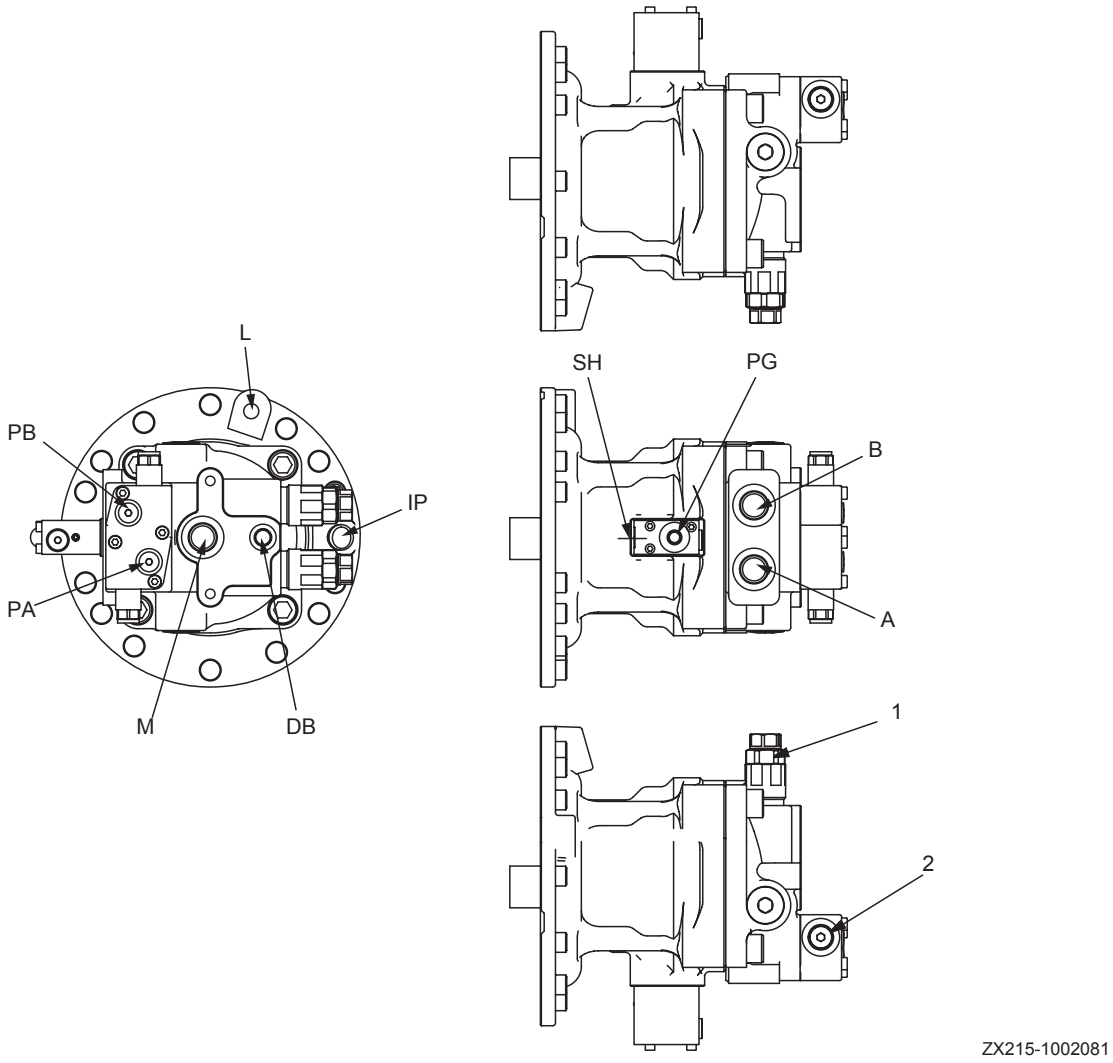
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Mounting torque (N·m)	NO.	Part name	Q'ty	Mounting torque (N·m)	NO.	Part name	Q'ty
	262	O-RING	2		561	O-RING	17
	264	O-RING	9		562	O-RING	2
25~34	273	SCREW, hex, S,H,C	44	69~78	601	VALVE, main relief	1
98~120	274	SCREW, hex, S,H,C	4	69~78	602	VALVE, port relief	6
	301	SPOOL, travel	2	120~140	604	VALVE, port relief	2
	302	SPOOL ASS'Y, arm 1	1	69~78	612	PLUG	2
	303	SPOOL ASS'Y, boom 1	1	49~65	971	SCREW, hex, S,H,C	8
	304	SPOOL, bucket	1	140~180	975	SCREW, hex, S,H,C	10
	305	SPOOL, swing	1		977	PLATE name	1
	306	SPOOL, arm 2	1		978	PIN	2
	307	SPOOL, boom 2	1				

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4.6 Hydraulic System, Part 3

4.6.1 Swing motor



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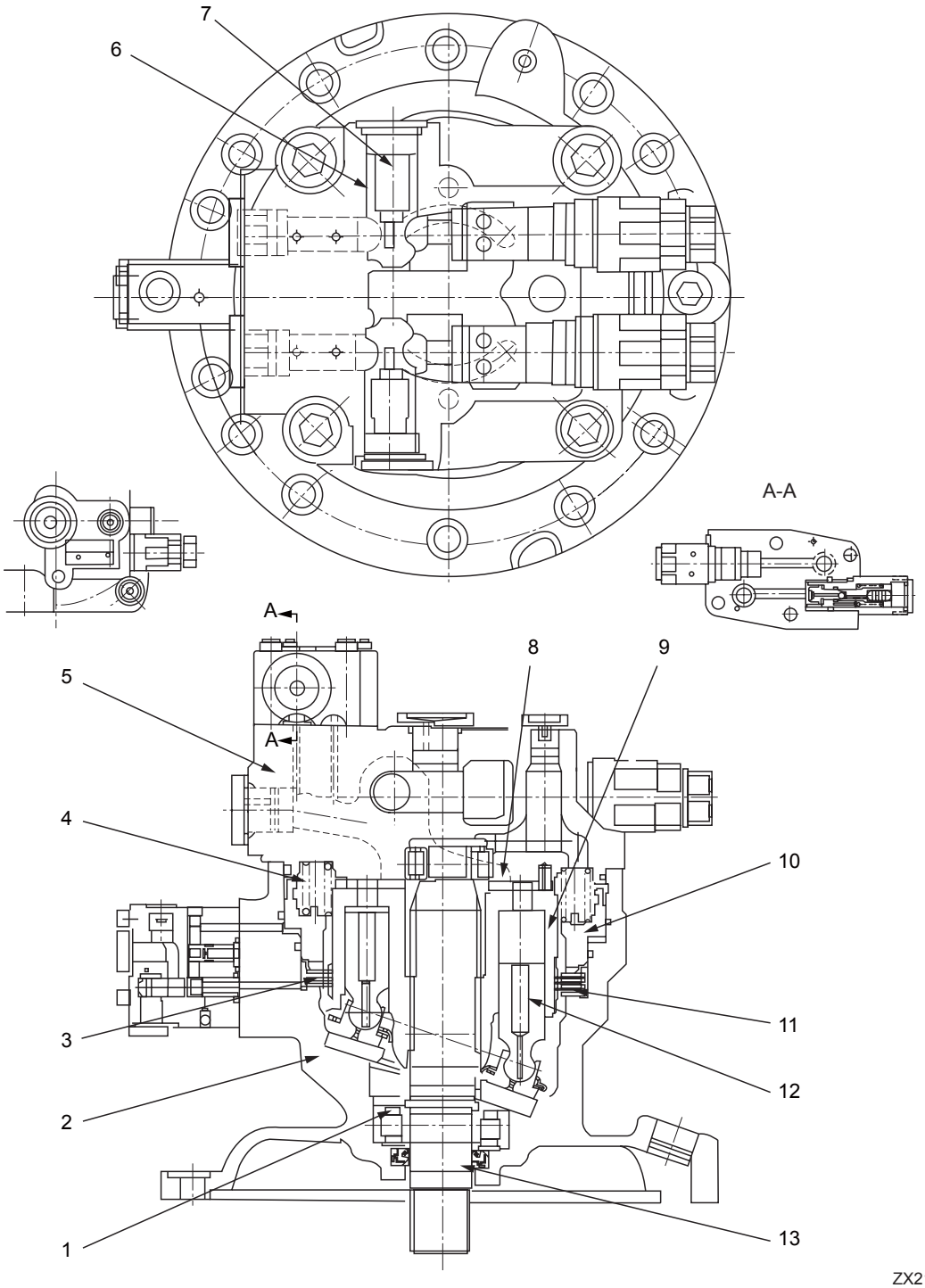
A: Main oil port
B: Main oil port
M: Oil complement port
PA: Pressure detection port
PB: Pressure detection port
DB: Lubricating port
PG: Brake release port
SH: Brake direction port
L: Oil level stick
IP: Gear oil feed port

1. Safety valve
2. Reverse prevention valve

Specifications

Type	M5×180CHB-12A-51A/260
Theoretical displacement	169.4 cm³/rev
Safety valve set pressure	25.5 MPa {255 Kg/cm³}
Rated engine speed	2000 rpm
Brake release pressure	2.7 MPa {27 Kg/cm³}

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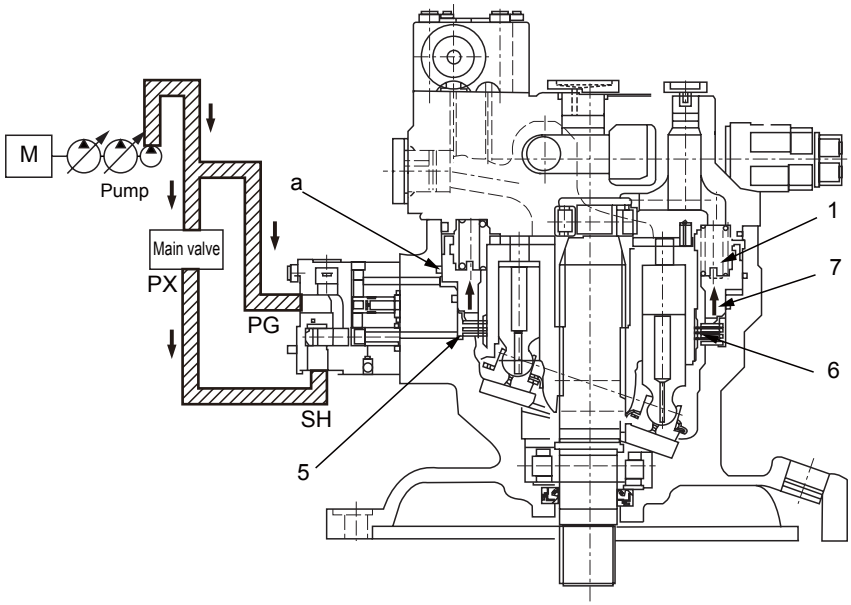
ZX215-1002082

1- Spacer
2- Casing
3- Disc
4- Brake spring
5- Shell
6- Check valve spring
7- Check valve
8- Oil distribution plate
9- Cylinder
10- Brake piston
11- Plate
12- Piston
13- Drive shaft

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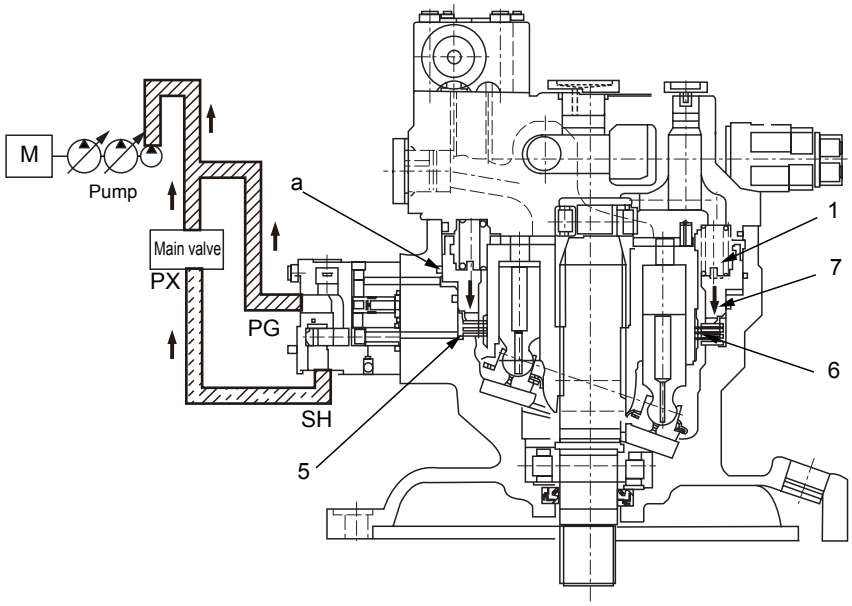
4.6.2 Swing holding brake

- Port PG is connected with the pilot gear pump directly, and a pressure of 3.9MPa is maintained.



ZX215-1002083

- Port SH is connected with port PX of the main valve. Once any movement other than travel is applied on the main valve, pressure will be generated at port PX, and port PG is interconnected with chamber a beneath piston 7. The pressurized oil compresses brake spring (1) and pushes the brake piston up. Disc (5) is separated from plate (6), releasing the brake.



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- Otherwise, no pressure is generated at port PX, and port PG is shut off from chamber a beneath piston (7). Brake piston (7) is pushed down by brake spring (1). Disc (5) and plate (6) are pushed together, and the brake is applied.

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4.6.3 Relief valve portion

Structure

- The relief valve portion consists of relief valves (1) and (2), check valves (3) and (4).

Function

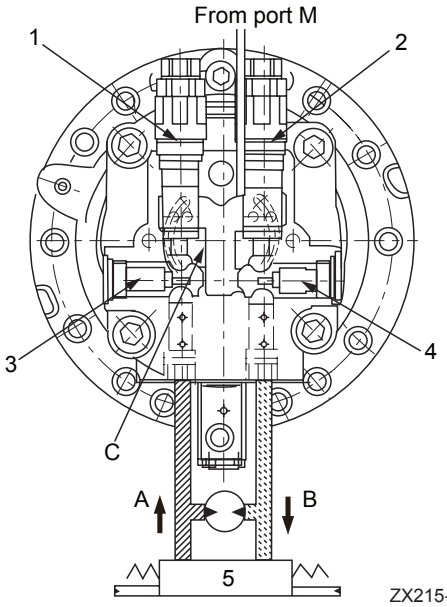
- When the machine is in the swing holding mode, control valve (5) closes the motor outlet circuit, but the motor rotation continues due to inertial force. The motor output, therefore, is abnormally increased, resulting in motor damage.
- In order to avoid the motor damage, the relief valve relieves the abnormally high pressure to port (M) from the motor outlet side (high-pressure side) of the motor.

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Operation

1. When swing begins (suppose pressurized oil enters Port A)

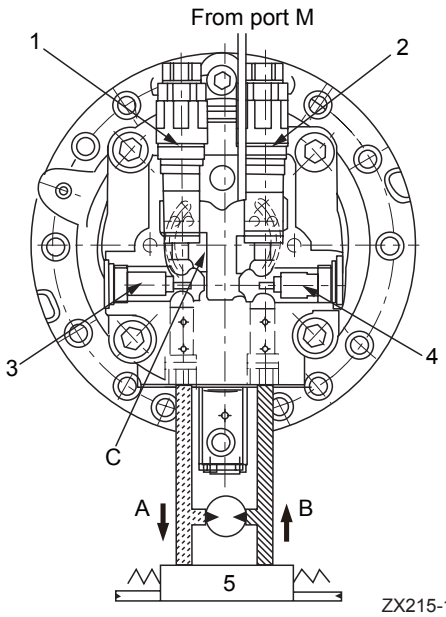
- When the swing control lever is operated for right swing, pressurized oil from the pump is supplied to port (A) via control valve (5).
- The pressure on port (A) rises, the starting torque is generated in the motor, and the motor is activated.
- The pressurized oil from the outlet port of the motor passes from port (B) through the control valve (5) and returns to the tank.



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2. When swing stops

- When the swing control lever is neutralized, the supply of pressurized oil from the pump to port (A) is cut off.
- The pressurized oil from the motor outlet can't return to the tank since the return circuit to the tank is closed from control valve (5). Thus, pressure at port (B) rises.
- Swing resistance is generated on the motor and hence the brake starts working.
- Pressurized oil will be relieved when the pressure on port (B) rises to the set pressure of relief valve (2).
- A high braking torque is applied on the motor, thereby stopping the motor.
- When relief valve (2) is being actuated, the relieved pressurized oil and the pressurized oil from port (M) are fed to port (B) via check valve (4).
- Above prevents cavitation on port (B).

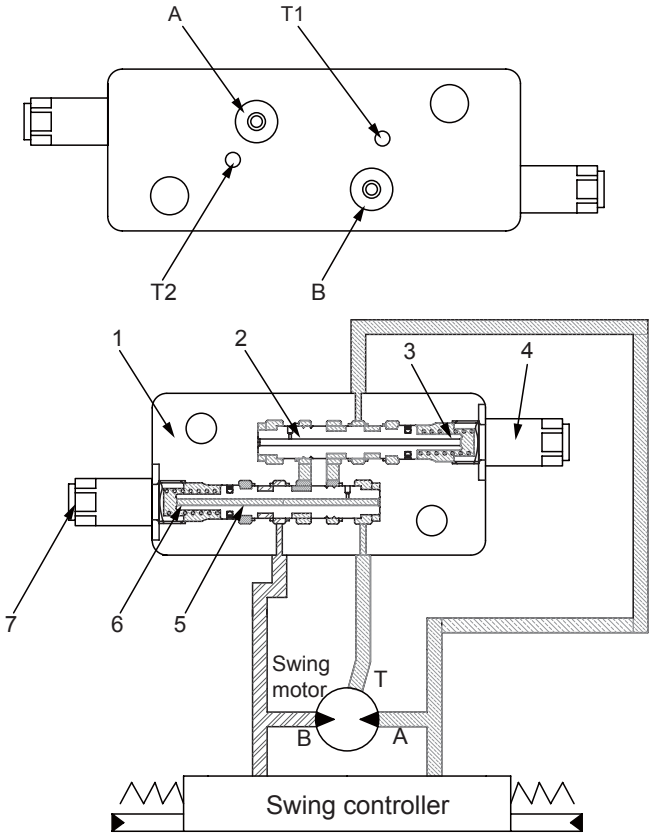


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4.6.4 Reverse prevention valve

4.6.4.1 Operation drawing

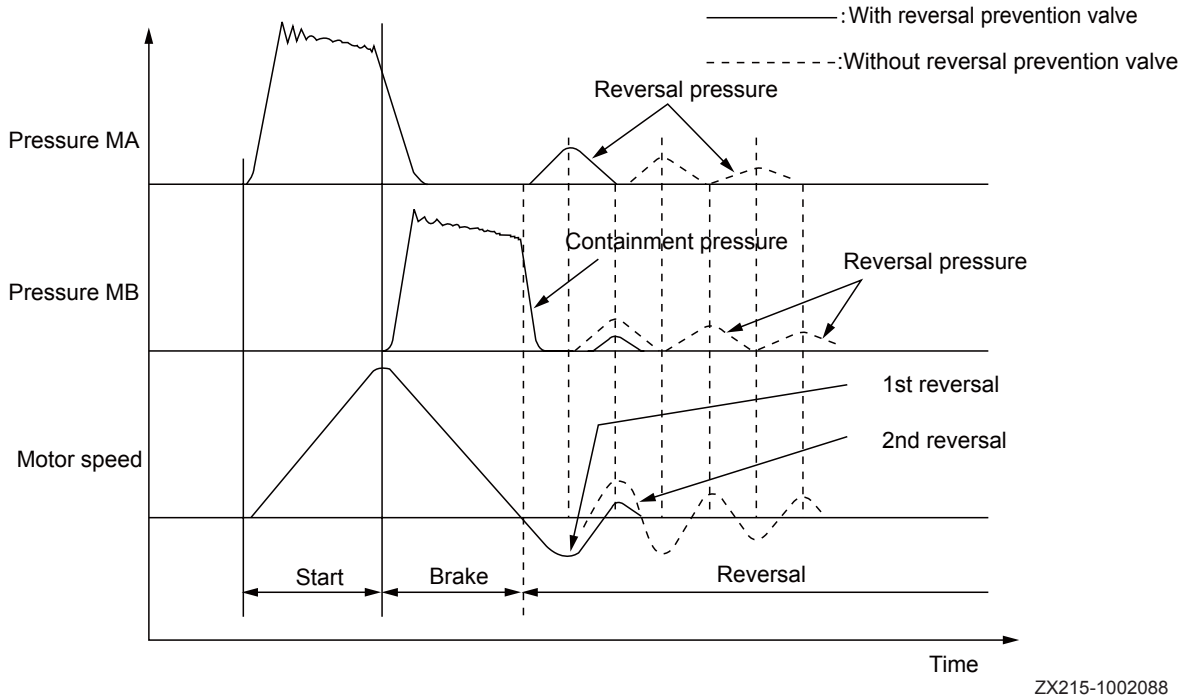


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1- Valve body
2- Spool (A side)
3- Spring (A side)
4- Plug
5- Spool (B side)
6- Spring (B side)
7- Plug

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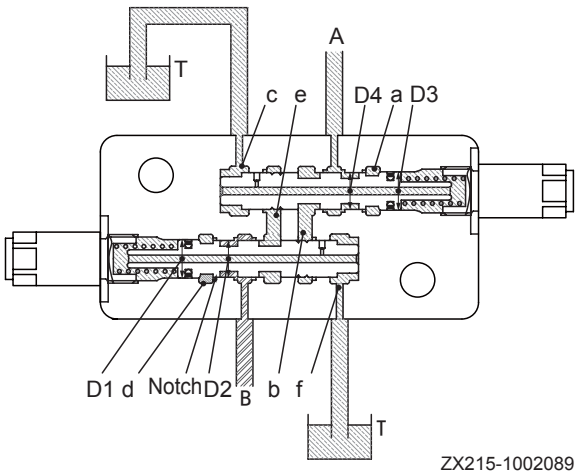
4.6.4.2 Explanatory drawing of effects



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Outline

- Inertia of the swing body, the backlash and rigidity of the machinery system, and the compression of the hydraulic oil all may cause the machine to shake during swing operation. The reverse prevention valve is designed to reduce this effect. The valve contributes in preventing collapsing of load when the swing is stopped and also contributes in reducing cycle time (enhances the positioning performance, enabling you to proceed to the next work quicker than ever).



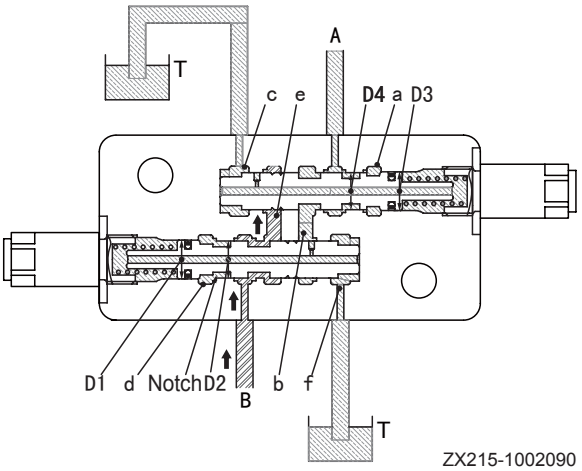
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Operation

3. When port (B) brake pressure is generated

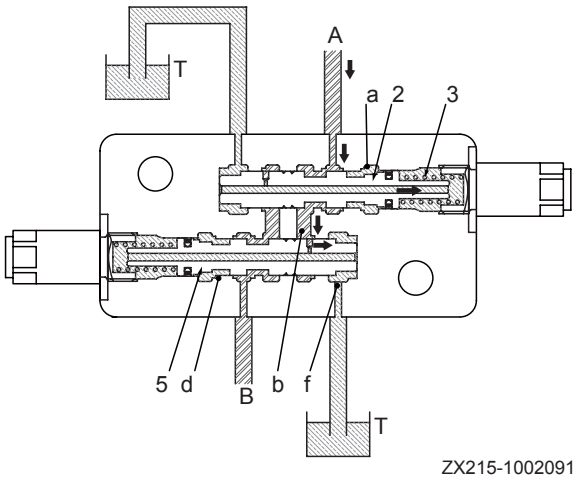
- Pressure (MB) is conducted to chamber (d) via the notch. The pressure compresses spring (6) by use of the difference in areas of circles (D1 > D2) of spool (5) and moves spring (6) to the left side. Port (B) and chamber (e) will be interconnected. Since pressure (A) is lower than the set pressure of spring (3), spool (2) does not move and the pressurized oil is stopped by spool (2). Thus the braking force is ensured.



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4. When motor is stopped

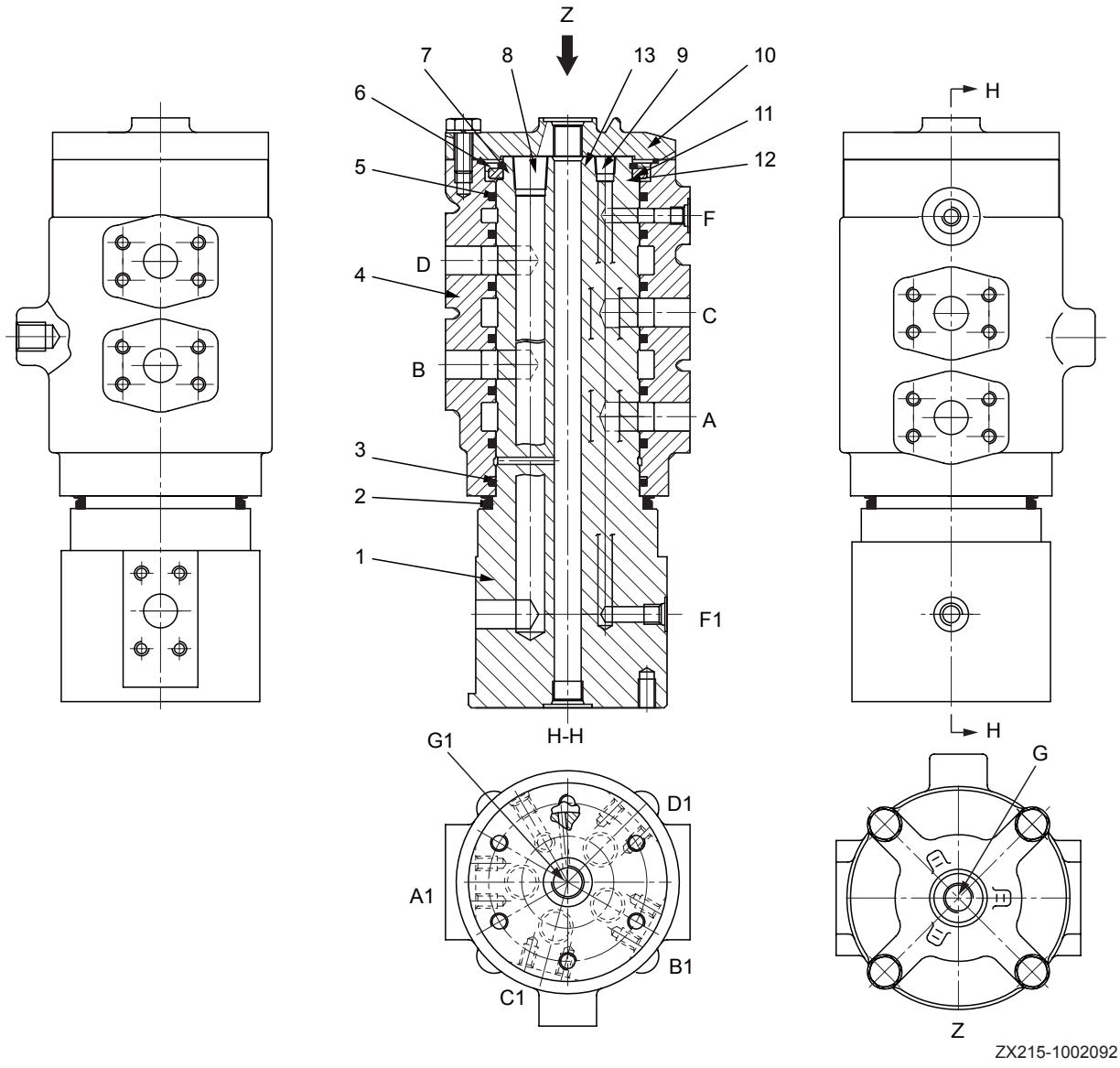
- The motor rotation is reversed by the closing pressure generated at port (B). (1st time: reverse rotation) Reversing pressure is generated on port (A). Pressure (A) is conducted to chamber (a), and spool (2) moves spring (3) to the right side, and A and B is interconnected. At this time, b is interconnected with f via the orifice on spool (5), and reversing pressure on port A is bypassed to port T, preventing the second reverse rotation.



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4.6.5 Center swivel joint



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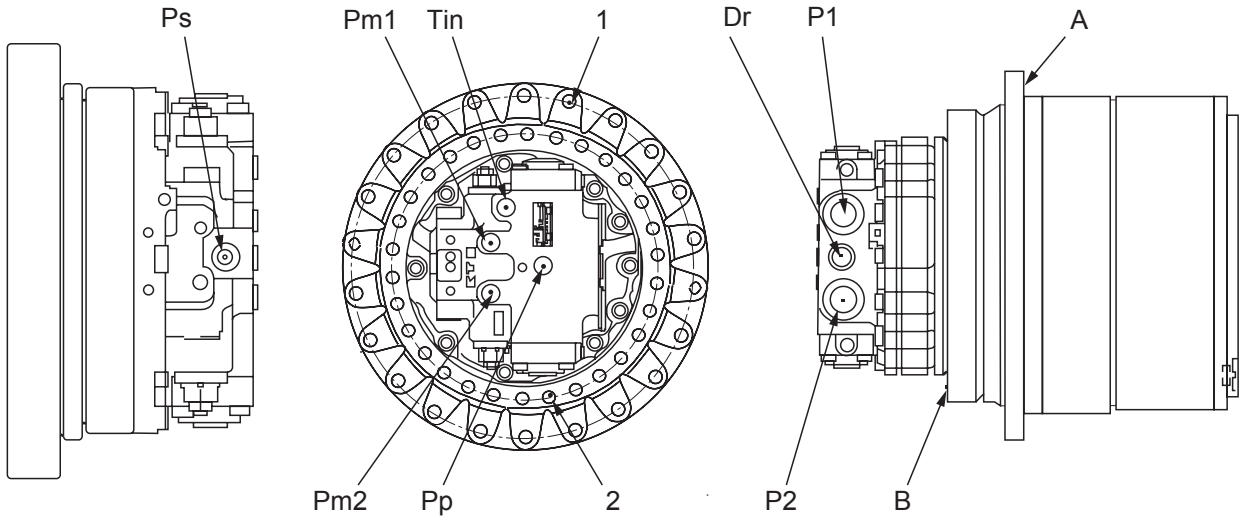
1- Swing shaft
2- Dust seal
3- O-ring
4- Swing body
5- Rotating seal φ100x5
6- Gasket
7- Retainer ringφ 90
8- Plug (ZG3/4)
9- Plug (ZG1/4)
10- Cover
11- Spacer
12- Gasket
13- Gasket

A: From main valve BTL
B: From main valve BTR
C: From main valve ATL
D: From main valve ATR
A1: To L. travel motor port (P1)
B2: To R. travel motor port (P2)
C3: To L. travel motor port (P2)
D4: To R. travel motor port (P1)
G: To swing motor port DB
G1: From travel motor final drive assembly oil drain port (D1,D2)
F: From solenoid valve port A2
F1: To travel motor reducer Hi/Lo speed switching port (P)

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4.6.6 Travel motor

Type: MAG-170VP-3400E



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Ps: Duo speed pilot hose port

Pm1: Pressure detection port

Pm2: Pressure detection port

Tin: Motor case inner oil port

Pp: Brake release port

Dr: Oil drain port

P1: Main oil port

P2: Main oil port

A. Mounting surface with sprocket

B. Mounting surface with undercarriage

1. Mounting hole with sprocket

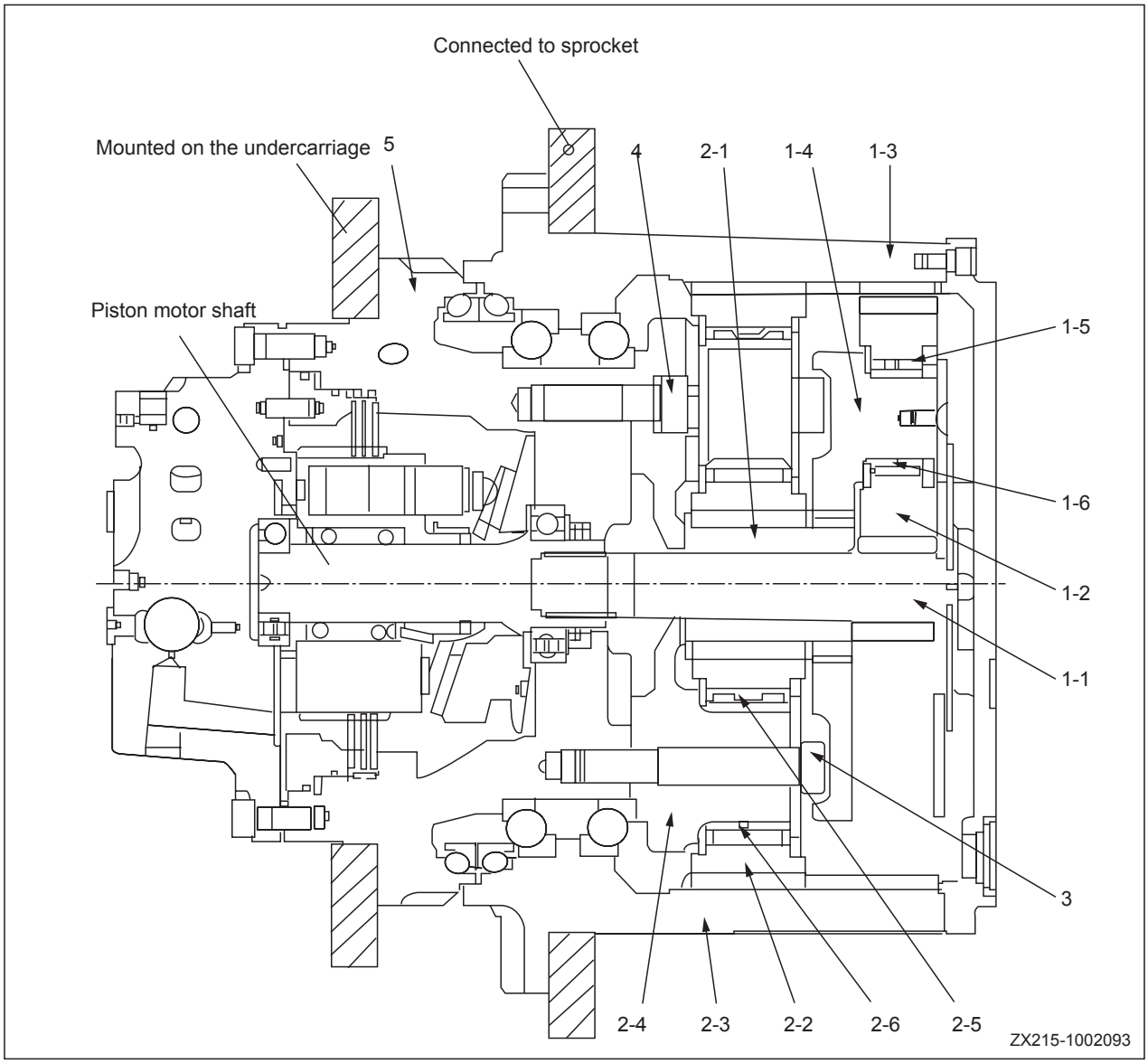
2. Mounting hole with undercarriage

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Table 1. Motor specifications

Equivalent displacement			cm³/rev	q x i
Motor displacement q	Large displacement q1		cm³/rev	130.4
	Small displacement q2		cm³/rev	74.9
Speed reduction rate i				60
2-speed switching Pilot pressure	Lo-Hi		Mpa	> 6.86
	Hi-Lo		Mpa	> 1.96
Braking torque			N·m	398
Operating displacement			L/min	228
Operating pressure			Mpa	33.34
Peak pressure			Mpa	within 44.1
Acting times (above 34.3Mpa and below 44.1Mpa)			times	< 1,200,000
Swing speed	Motor shaft	Large flow	rpm	1679
		Small flow	rpm	2861
	Reducer	Large flow	rpm	28
		Small flow	rpm	47.7
Output torque			KN·m	within 37
Input power	Normal		PS	
	Maximum		PS	within 210 (within 30 consecutive sec.)
Drain pressure	Normal		Mpa	within 0.2
	Momentary maximum		Mpa	within 0.5 (below 0.3 MHz)
Weight			kg	275

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4.6.6.1 Operation of components

Counterbalance valve

Function

- When external load makes the rotating speed of the piston motor faster than the rated rotating speed of supplied delivery, this valve controls the speed of the motor and prevent over-speed of the motor in relation with the supplied delivery.
- The counterbalance valve and the relief valve constitute the braking circuit. The braking circuit applies braking force onto the rotating motor and stops the motor gradually.
- This valve can serve as a shuttle valve for high pressure selection to release the brake under its own pressure.
- The structure of a standard counterbalance valve is shown as below. The following information describes the operating principle of a standard counterbalance valve.

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A. Stopped state (Fig. 1)

- When the main valve is neutralized (motor stopped), port M1 and port M2 are shut off by spool (1) and check valve (2) since no pressure is generated at port P1 and port P2. The motor is not rotating.

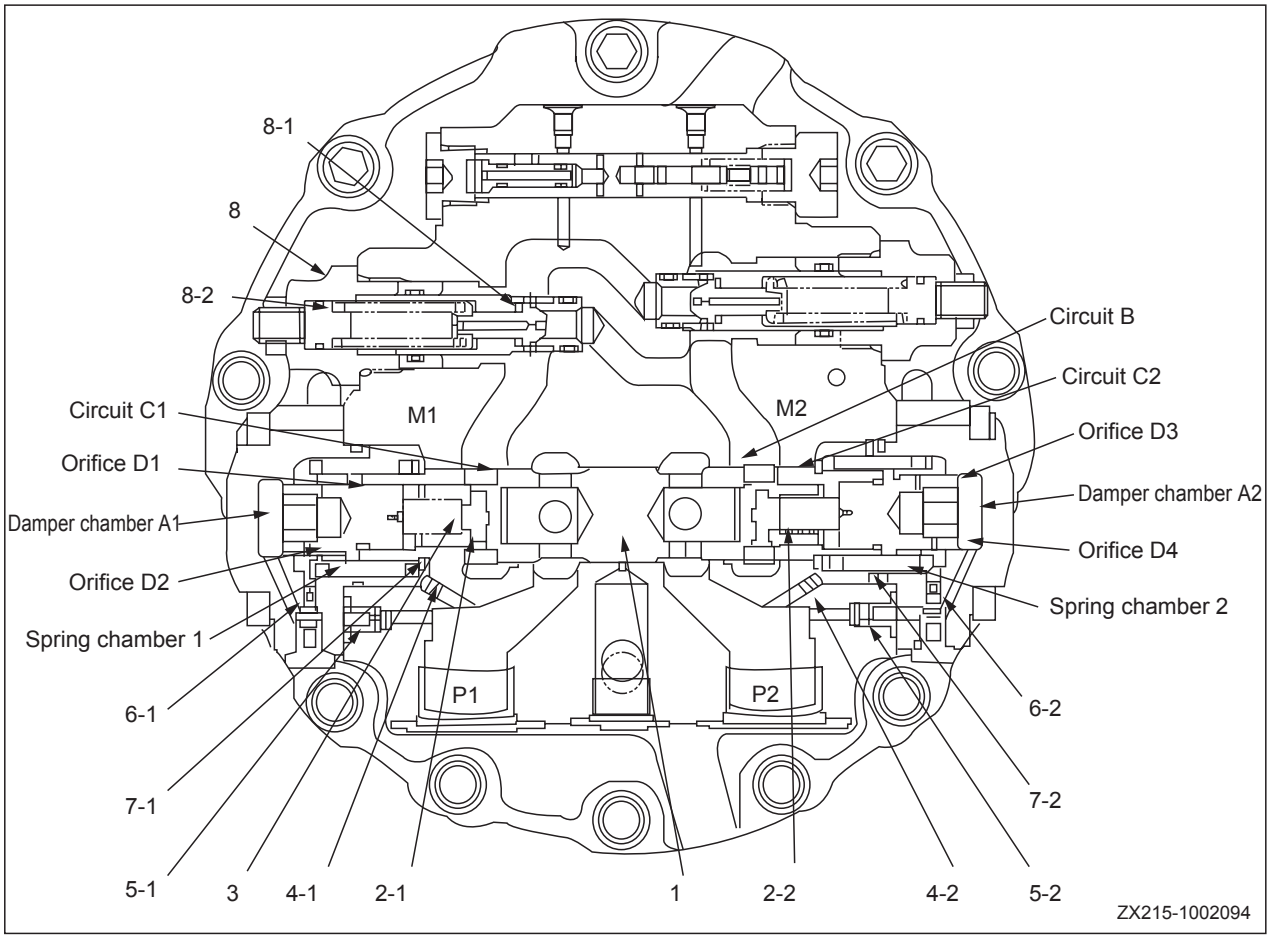


Fig. 1 Counterbalance valve layout (stopped)

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B. When the motor is activated (Fig. 2)

- When hydraulic oil from the main pump enters port P1 of the counterbalance valve, spring (3) is pushed to the left by check valve (2-1), opening circuit C1. The hydraulic oil enters the piston motor via port M, trying to make the motor rotating. At the same time, return oil from the piston motor enters the counterbalance via port M2, but it is stopped by check valve (2-2). The output pressure of the main pump increases as a result, and the hydraulic oil works on the inside of spring chamber (1) and damper chamber (A1) via orifice (4-1) and check valve (5-1). The force generated in this way pushes spring (7-2) on the other side and moves piston (1) to the right. At this time, return oil from port M2 passes through circuit of the notch on the periphery of piston (1), and through port P2 when pressure is generated at port M2, and enters the tank via the main valve finally. The motor is activated at this time.

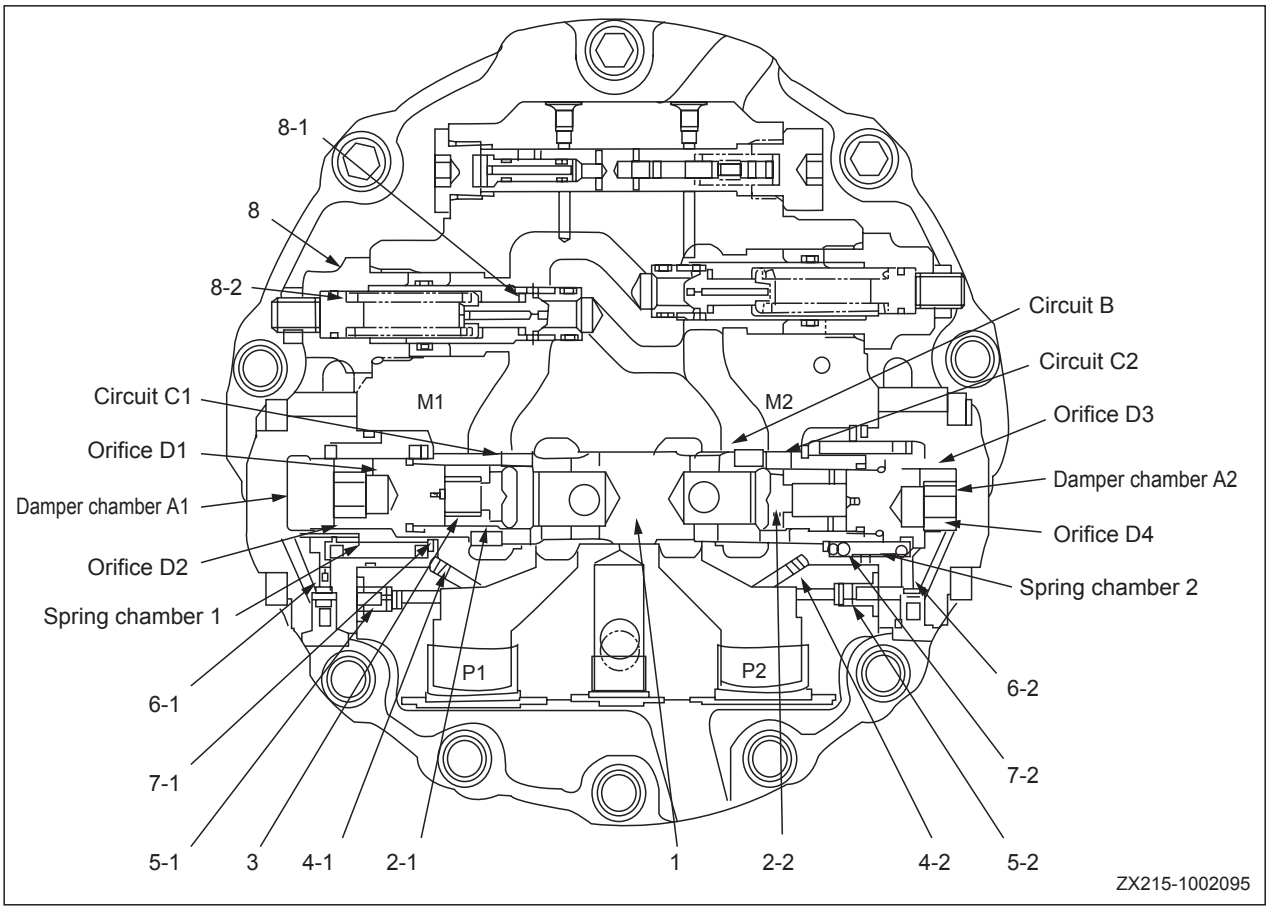


Fig. 2 Counterbalance valve when the motor is rotating

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C. Counterbalance function (Fig. 2)

- When the engine runs at an excessively high speed because of external force applied on it, the motor may lose control. At this time, port P1 serves as the inlet side, and the pressure drops. Pressure in spring chamber 1 and damper chamber A1 also drop. As a result, pison (1) moves to the left under the force of spring (7-2), closing circuit B. Circuit at the suction side is also closed at the same time when the circuit at return side is closed. When circuit B is closed, pressure at port P1 rises due to hydraulic oil from the main pump, moving piston (10 to the right again. In this way, when external load generates pump effect, slight movement of piston (1) keep circuit B open. The rotation speed of the motor keeps in line with fuel supply of the main pump, and the motor will not lose control because of the vacuum in the hydraulic system.

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D. Braking of motor (Fig. 3)

- The counterbalance valve and the relief valve forms the braking circuit. When the main valve is neutralized position, hydraulic oil from the main pump is cut off, and pressure at port P1 and P2 is the same. As a result, piston (1) moves to the neutral position, and the opening area of circuit B decreases. At the same time, because of the inertia of external force, the motor does not stop rotating (pump effect), and pressure at port M2 rises and serves as the braking force of motor rotation. When the pressure at port M2 reaches the set pressure of relief valve (8), cone valve (8-1) at port M1 overcomes the force of spring (8-2) and moves to the left, and hydraulic oil flows the port M1. In this way, the impacting force due to inertia at port M2 is under control, and vacuum at port M1 is avoided.

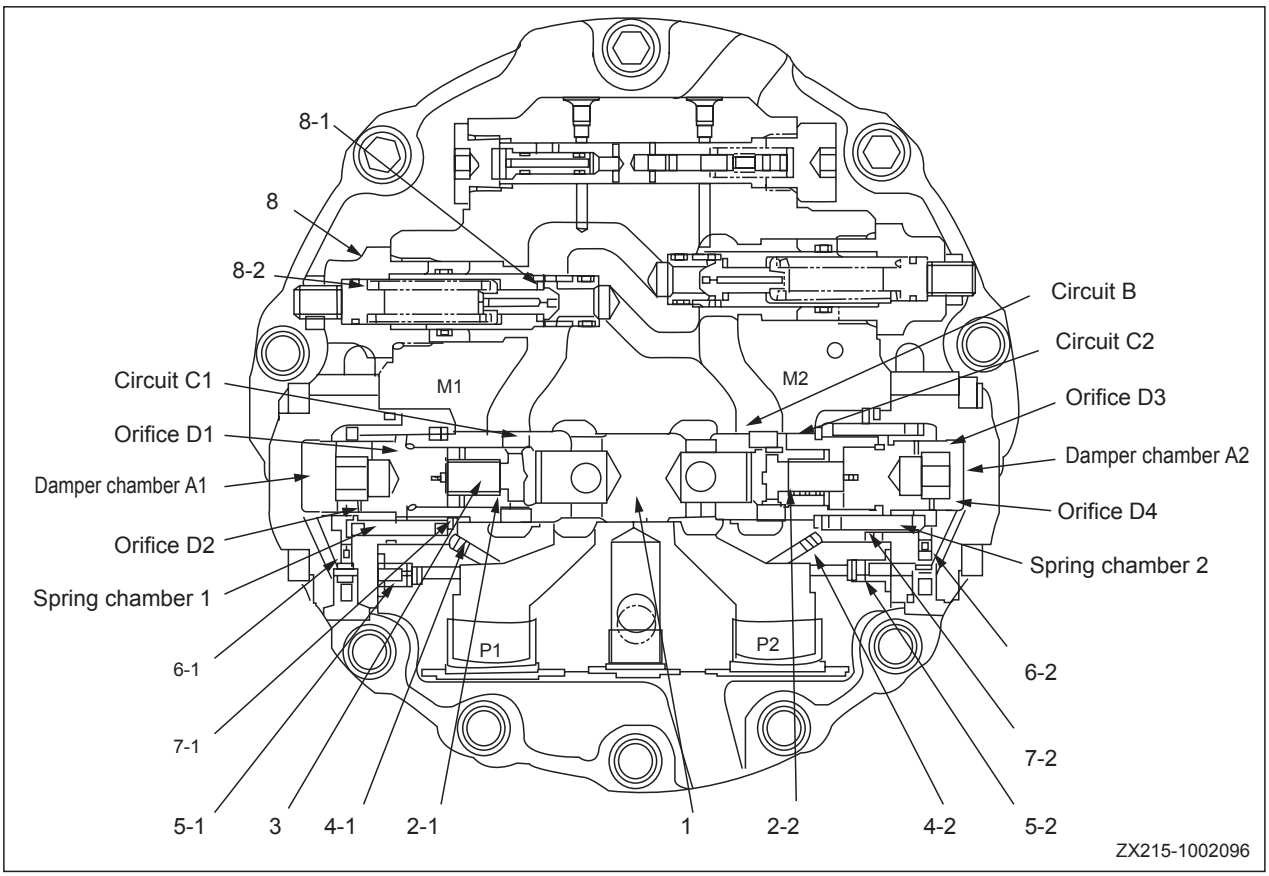


Fig. 3 Counterbalance valve and relief valve when the motor is braking

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E. Shuttle valve function for high pressure selection (Fig. 4 and 5)

- The counterbalance valve can function as a shuttle valve to release travel brake. When hydraulic oil is fed to port P1, piston (1) moves to the right, as shown in fig. 4. At this time, drain circuit F of motor body is cut off, and circuit D leading to cylinder chamber E for travel braking is connected. Hydraulic oil flows to circuit G via the orifice, and enters travel brake cylinder chamber E to release travel brake. In addition, piston (1) moves to neutral position, as shown in fig 5 when motor stops. Circuit D is closed and drain circuit F of motor body is connected. Hydraulic oil in travel braking cylinder chamber E is conducted to the drain circuit of motor body, and travel brake is applied.

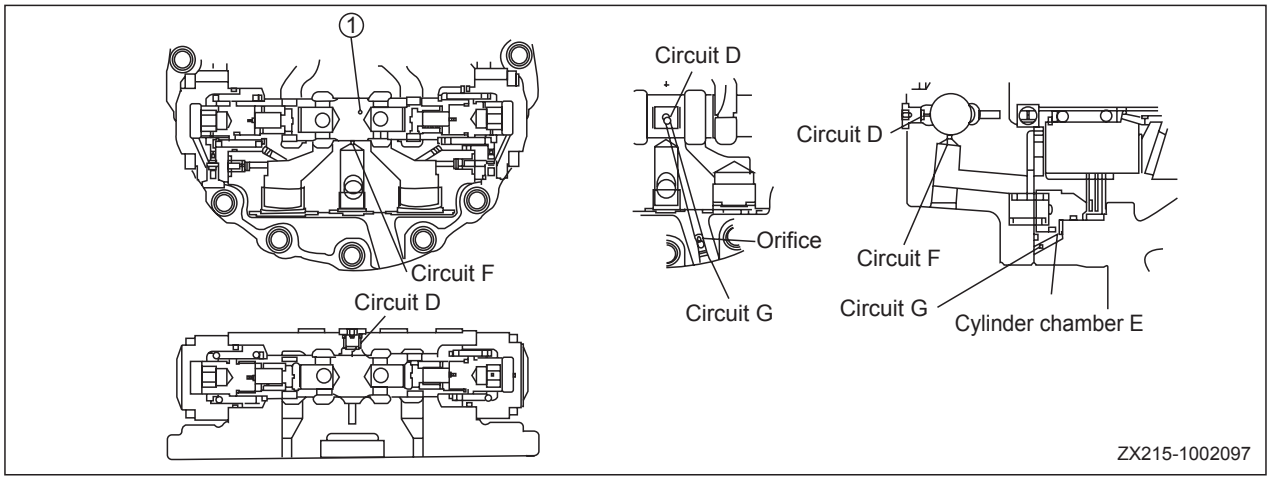


Fig. 4 High pressure selection function selection of high pressure

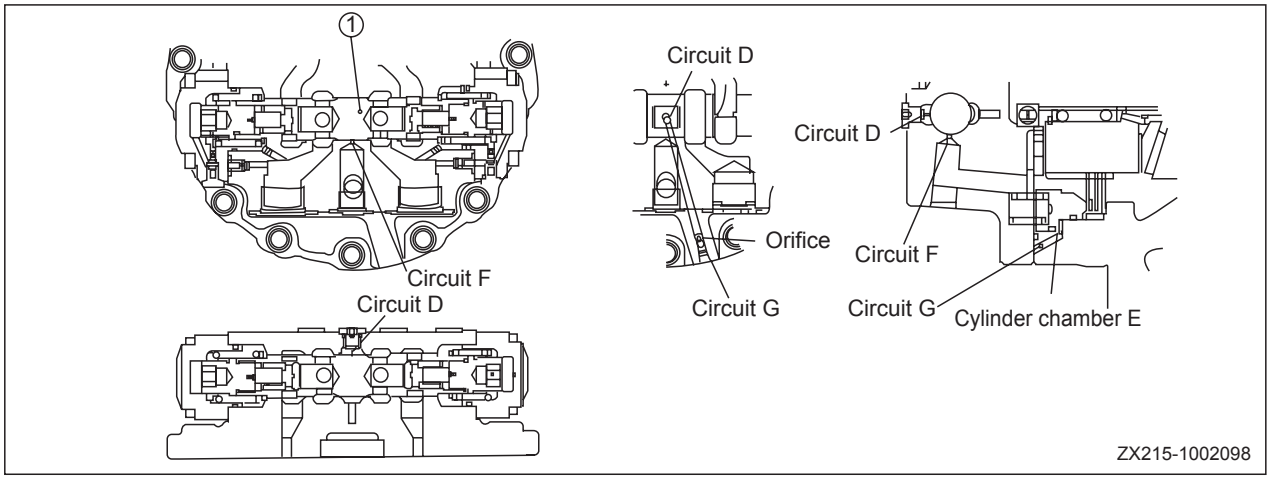


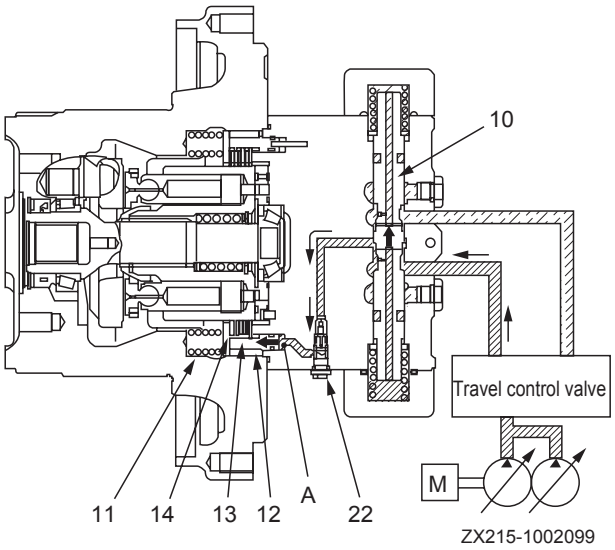
Fig. 5 High pressure selection function opening of oil drain to motor housing

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4.6.6.2 Operation of parking brake

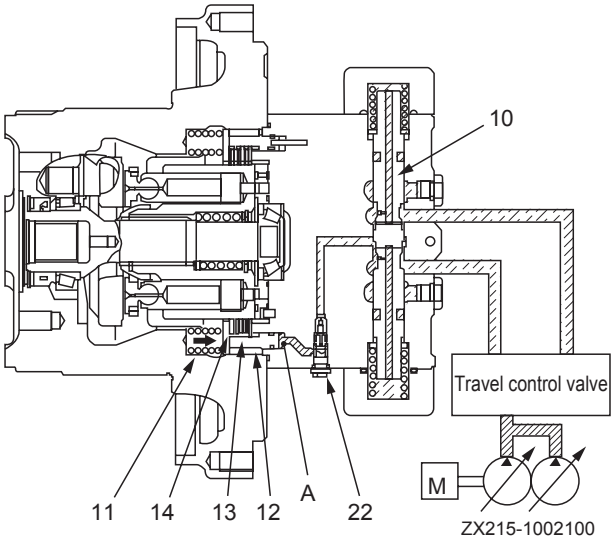
1) When travel begins

- As the travel lever is operated, pressurized oil from the pump activates counterbalance valve spool (10), opens the parking brake circuit, and flows to chamber A of brake piston (12). Pressurized oil overcomes the force of spring (11) and pushes piston (12) toward the left.
- Since the pushing force to plate (13) and disc (14) disappears, plate (13) is separated from disc (14) and the brake is released.



2) When travel stops

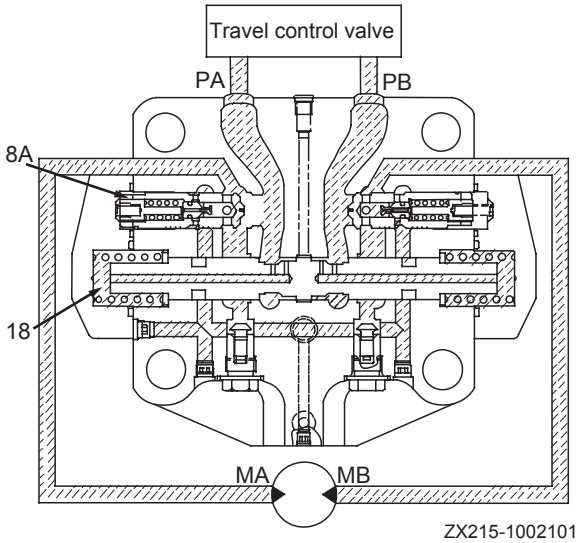
- As the travel lever is placed in neutral, counterbalance valve spool (10) returns to the neutral position and closes the parking brake circuit. The pressurized oil in chamber (A) of brake piston (12) passes through the orifice of the brake piston and is drained to the motor case. Brake piston (12) is pushed to the right by spring (12). Plate (13) and disc (14) are pushed together, and the brake is applied. As brake piston (12) returns, flow of pressurized oil is reduced with slow return valve (22). The time delay will be set to activate the brake only after the machine has stopped.



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4.6.6.3 Brake valve operation

- The brake valve consists of suction safety valve (8A) and counterbalance valve (18). Functions and operations of respective components are described below.

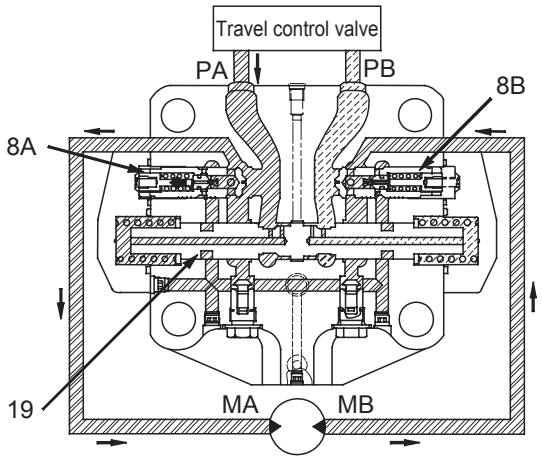


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1) Counterbalance valve and check valve

Function

- When the machine is travels downhill, the weight of the machine tends to make the travel speed faster than the motor speed. If the machine travels with the engine at low speed, the motor may rotate at zero load, resulting in run away and inviting a very dangerous situation. These valves are used to avoid such a situation by controlling the machine to travel as per the engine speed (pump delivery).



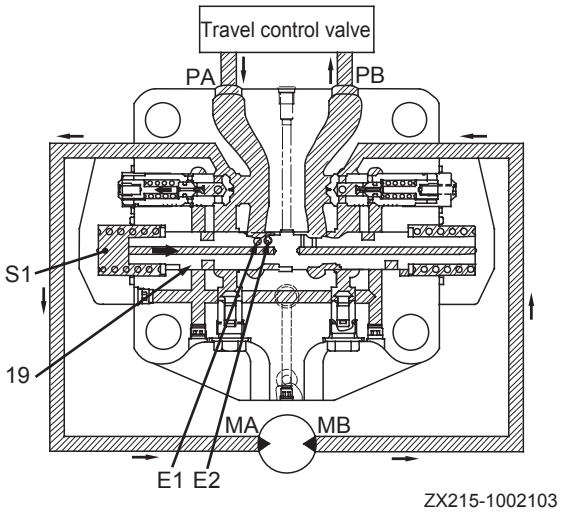
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Operation when pressurized oil is supplied

- Operating the travel lever conducts the pressurized oil from the control valve to port (PA). The pressurized oil opens suction safety valve (8A) and then flows to motor outlet port (MB) via motor inlet port (MA). The motor outlet side is closed by suction safety valve (8B) and spool (19), so the pressure at the supply side rises.

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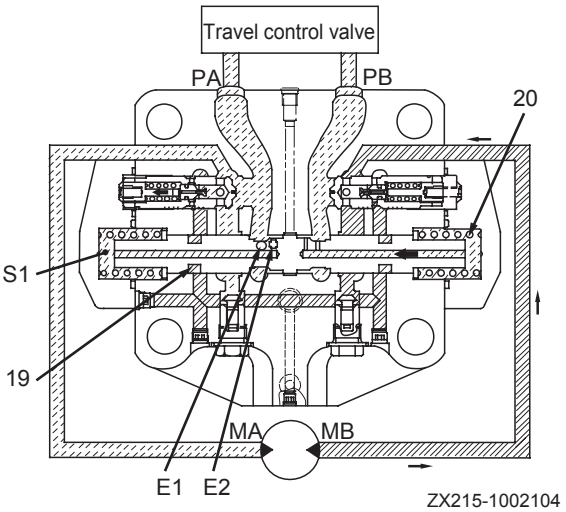
- The pressurized oil on the supply side flows to chamber (S1) via orifice (E1) and orifice (E2) of the spool (19). As the pressure in chamber (S1) goes above the spool selector pressure, spool (19) is pushed toward the right. Port (MB) and port (PB) are connected, the motor outlet port side opens and the motor starts rotating.



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Operation of brake during downhill travel

- If the machine goes out of control while travelling downhill, the motor will be caused to rotate without load to decrease the inlet side oil pressure. Pressure in chamber (S1) is released via orifices (E1) and (E2). As the pressure in chamber (S1) goes below the spool selector pressure, spool (19) is returned to the left by spring (20) and outlet port (MB) is throttled. The pressure at the outlet port side rises, generating rotation resistance on the motor to prevent the machine from losing control. On the other hand, the spool moves to a position where the pressure on outlet port (MB) can be balanced against the machine's own weight and the inlet port pressure. Oil flow from the outlet circuit is reduced to ensure the travel speed corresponded to the pump delivery.



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2) Safety valve

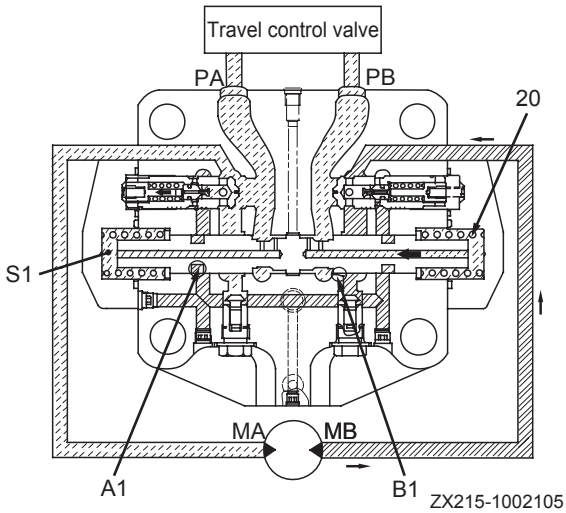
Function

- When the machine travel is stopped (or it is travelling downhill), the counterbalance valve closes the inlet and outlet circuits of the motor. Since the motor is rotated by inertial force, pressure in the motor outlet port side is abnormally increased, potentially resulting in damages on the motor and piping. The safety valve releases this abnormal pressure to the inlet port side of the motor in order to prevent damages to the equipment.

Operation

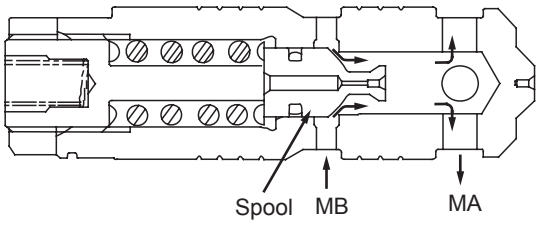
1. When travel is stopped (or when travelling downhill) (Right swing)

- Reduction of the pressure at motor inlet (PA) decreases the pressure in chamber (S1). When it drops beyond the spool switching pressure, the spool is returned to the left by spring (20), reducing the pressure at outlet passage (B1). At this time, the motor continues rotating due to its inertial force, thus pressure on the outlet port (MB) is increased.



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- When the pressure rises above the set pressure of the suction safety valve (8A), the poppet opens. The pressurized oil passes through notch (A1) of spool (19) into chamber (MA) of the circuit at the opposite side.

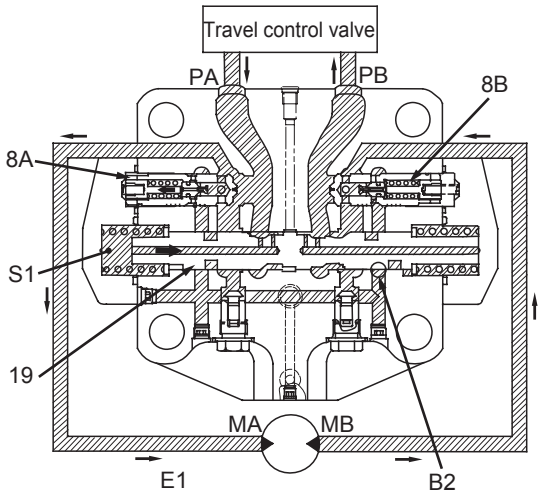


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2. When starting travel (or when traveling at a constant speed)

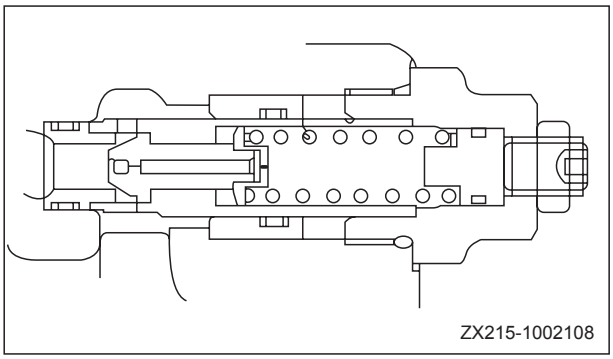
- As the travel lever is operated, the pressurized oil from the pump moves spool (19) toward right. The passage to the suction safety valve functions as a circuit which passes through notch (B2) of spool (19), producing large differential pressure. The pump pressure rises, providing a large tractional force to the valve.



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3) Relief valve

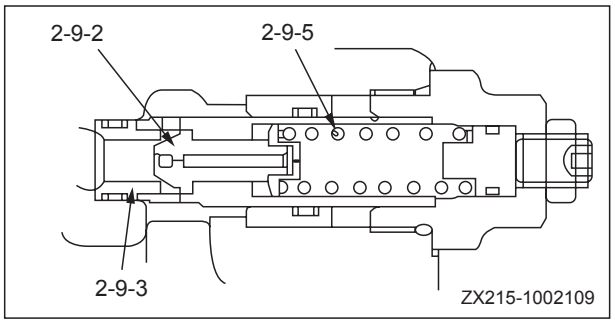
- The structure of the relief valve is shown in the right figure. This valve is area difference and direct flow type. It has impact damping function during starting and braking.


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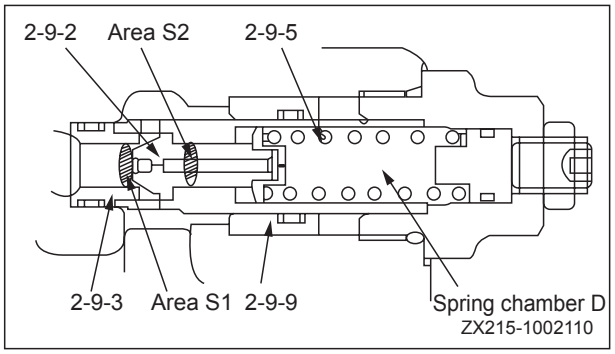
A. Operation principle and function

- When the main valve makes the motor to start or brake, front pressure of cone valve (2-9-2) rises above the set pressure and the force of spring (2-9-5), and moves cone valve (2-9-2) to the right and off the valve seat. Pressurized oil in the front of cone valve (2-9-2) is bypassed to the low pressure side. The impact due to inertia energy at the high pressure side is put under control and vacuum is prevented from occurring at the low pressure side through bypassing pressurized oil to the low pressure side.

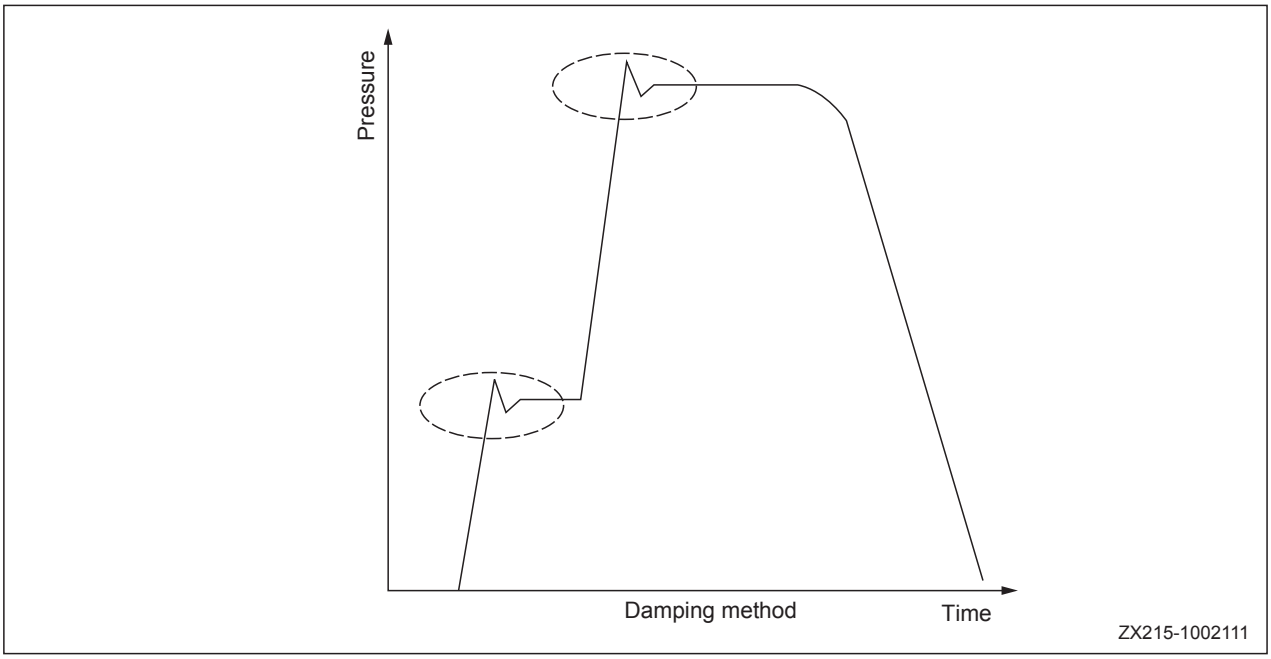


B. Damping function

- When the relief valve begins to function, damping piston (2-9-9) moves to the left. As a result, low pressure is maintained in spring chamber D. At this time, the loaded area of cone valve (2-9-2) is S1, and it is much larger than the normal set loaded area S1-S2 of the relief valve. So, when damping piston (2-9-9) is moving, the functional pressure of relief valve is maintained at 1/3 of normal set pressure in order to absorb the impact at the high pressure circuit side due to inertia energy. When the movement of damping piston stops, pressure in spring chamber D rises. Pressure at both side of cone valve (2-9-2) is the same, and the relief valve is working at normal set pressure. In this way, the relief valve reduces the impact during motor start and brake by a two-stage action to provide excellent performance.



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Table 2 Repair standard of motor components

Components	Check item	Allowable limit	Remedy
1-4-2 Plunger assembly	1. Sliding surface of the sliding shoe	Roughness 0.8a or surface roughness, scratch >0.02mm	Grind sliding surface; replace 4 cylinder block assembly parts if unrepairable
	2. Outside diameter of plunger	Roughness 1.2a or surface roughness, scratch >0.02mm	Replace 4 cylinder block assemblies
	3. Plunger outside diameter, and 4-1 cylinder bore	Clearance 0.060.	
	4. Sliding shoe ball end clearance	Clearance 0.4.	
1-4-1 Cylinder block	1. Valve leaf and sliding surface	Roughness 0.8a or surface roughness, scratch >0.02mm.	Grind sliding surface; replace 4 cylinder block assembly parts if unrepairable
	2. Shaft hole inner diameter	Roughness 1.6a or surface roughness, scratch >0.02mm	Replace 4 cylinder block assembly
	3. Shaft hole inner diameter, 4-2 piston assembly outer diameter	Clearance 0.060	
	4. Spline at shaft joint	Roller distance below 38.749 (measuring pin diameter φ3.333(V1=2.80)); or damaged	
1-21 Oil distributing plate	1. Sliding surface	Roughness 0.8a, scratch >0.02mm on sliding surface or burned sign	32 Grind sliding surface or replace 22 valve sheet if unrepairable
1-4-3 Retainer 1-4-4 Retaining assembly	1. Sliding surface	Roughness 0.8a, scratch >0.02mm on sliding surface or sign of burning	Replace retaining plate or retaining assembly.
1-5 Swash plate	1. Sliding surface	Roughness 0.8a, abrasion on sling surface or scratch >0.02mm	1-4-1 grind sliding surface or replace 22 valve sheet if unrepairable
	2. Ball hole on assembly steel ball portion	Roughness 1.6a.	Replace swash plate
		Scratch on spherical surface >0.02mm or surface roughness	
	3. Ball hole on assembly steel ball portion	Ball depth 14.5	

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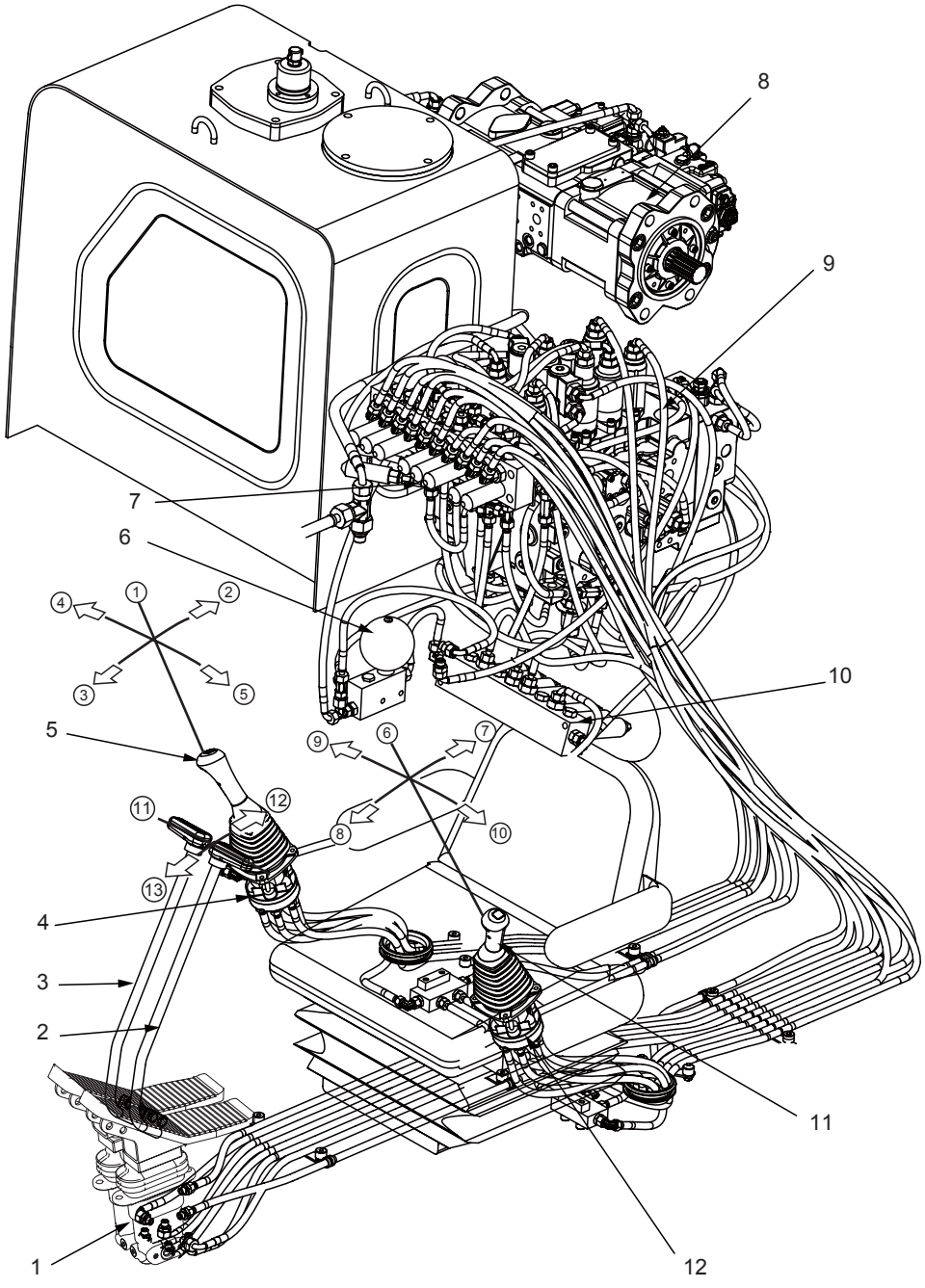
Components	Check item	Allowable limit	Remedy
1-3 Shaft	1. Sliding port of oil seal outer diameter	Roughness 1.6a oil seal lip sliding sign. Scratch >0.02mm or surface roughness	Replace swash plate
	2. Spline of cylinder block	Roller distance below 47.380(measuring pin diameter φ3.00); or damaged	Replace shaft
	3. Drive gear connection	Roller distance below 30.498 (measuring pin diameter φ3.33); or damage	
1-15 Brake piston	1. Dimension	Height 38.2	Replace brake piston
	2. Sliding surface	Roughness 2.5a	
	3. Appearance	Scratch 0.02mm+ or surface roughness	
1-13 Disc plate	1. Dimension	Thickness 3.2	Replace disc plate
	2. Appearance	Deep scratch on sliding surface or friction material peeling	
1-8 Ball bearing 1-9 Ball bearing	1. Rolling surface	Peeling or fracture	Replace ball bearing
	2. Action	Abnormal rotation (noise/uneven rotation)	
1-7 Piston assembly	1. Sliding shoe sliding surface	Roughness 1.6a, surface roughness, scratch >0.02mm	Grind sliding surface; replace flange plate parts if unrepairable
	2. Piston outer diameter	Roughness 1.2a, surface roughness, scratch >0.02mm	Replace flange plate parts
	3. Piston outer diameter and 1-1 flange plate part inner diameter	Roughness 0.8 a, scratch >0.02mm or surface roughness 0.040.	
	4. Ball end clearance of sliding shoe	Roughness 0.8 a, scratch >0.02mm or surface roughness 1.0.	
1-2-2 Piston assembly	1. Piston outer diameter	Roughness 0.8 a, scratch >0.02mm or surface roughness.	Replace valve sheet
	2. Piston outer diameter and valve sheet inner diameter	Roughness 0.8 a, scratch >0.02mm or surface roughness 0.060.	

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Components	Check item	Allowable limit	Remedy
1-2-1 Valve sheet	1. Assembly 2-2 piston assembly hole	Roughness 0.8 a, scratch >0.02mm or surface roughness	Replace valve sheet and parts
	2. Valve sheet inner diameter and piston outer diameter	Roughness 0.8 a, scratch >0.02mm or surface roughness 0.060	
	3. Assembly 2-11 sliding valve spool assembly hole	Roughness 0.8 a, scratch >0.02mm or surface roughness	
	4. Sliding valve sheet inner diameter and valve spool outer diameter	Roughness 0.8 a, scratch >0.02mm or surface roughness 0.060.	
	5. Relief valve assembly sliding piston and valve seat	Scratch >0.02mm or surface roughness	
1-2-9 Spool assembly	1. Valve spool out diameter	Roughness 0.8 a, scratch >0.02mm or surface roughness	Replace valve sheet and parts
	2. Slide valve spool outer diameter and valve sheet inner diameter	Roughness 0.8 a, scratch >0.02mm or surface roughness 0.060.	
1-2-7-9 Movable piston	1. Sliding portion of valve sheet and valve seat	Scratch >0.02mm or surface roughness	Replace relief valve assembly
1-2-7-1 Case	1. Sling portion of the movable piston (outer diameter)	Scratch >0.02mm or surface roughness	
1-4-7 Spring	1. Dimension	Free length 61.0	
	2. Appearance	Deformation and surface damage	
1-18 Spring	1. Dimension	Free length 39.0	
	2. Appearance	Deformation and surface damage	
1-20 Spring	1. Dimension	Free length 41.5	
	2. Appearance	Deformation and surface damage	
1-2-4 Spring	1. Dimension	Free length 48.5	
	2. Appearance	Deformation and surface damage	
1-2-10 Spring	1. Dimension	Free length 28.3	
	2. Appearance	Deformation and surface damage	
O-ring and oil seal		When being removed	Replace o-ring and oil seal

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4.6.7 Valve control system



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1- Travel PPC valve
2- L. travel control lever
3- R. travel control lever
4- Right PPC valve
5- Right joystick
6- Accumulator
7- Transition block
8- Hydraulic pump
9- Main control valve
10- Solenoid valve
11- Left joystick
12- Relay

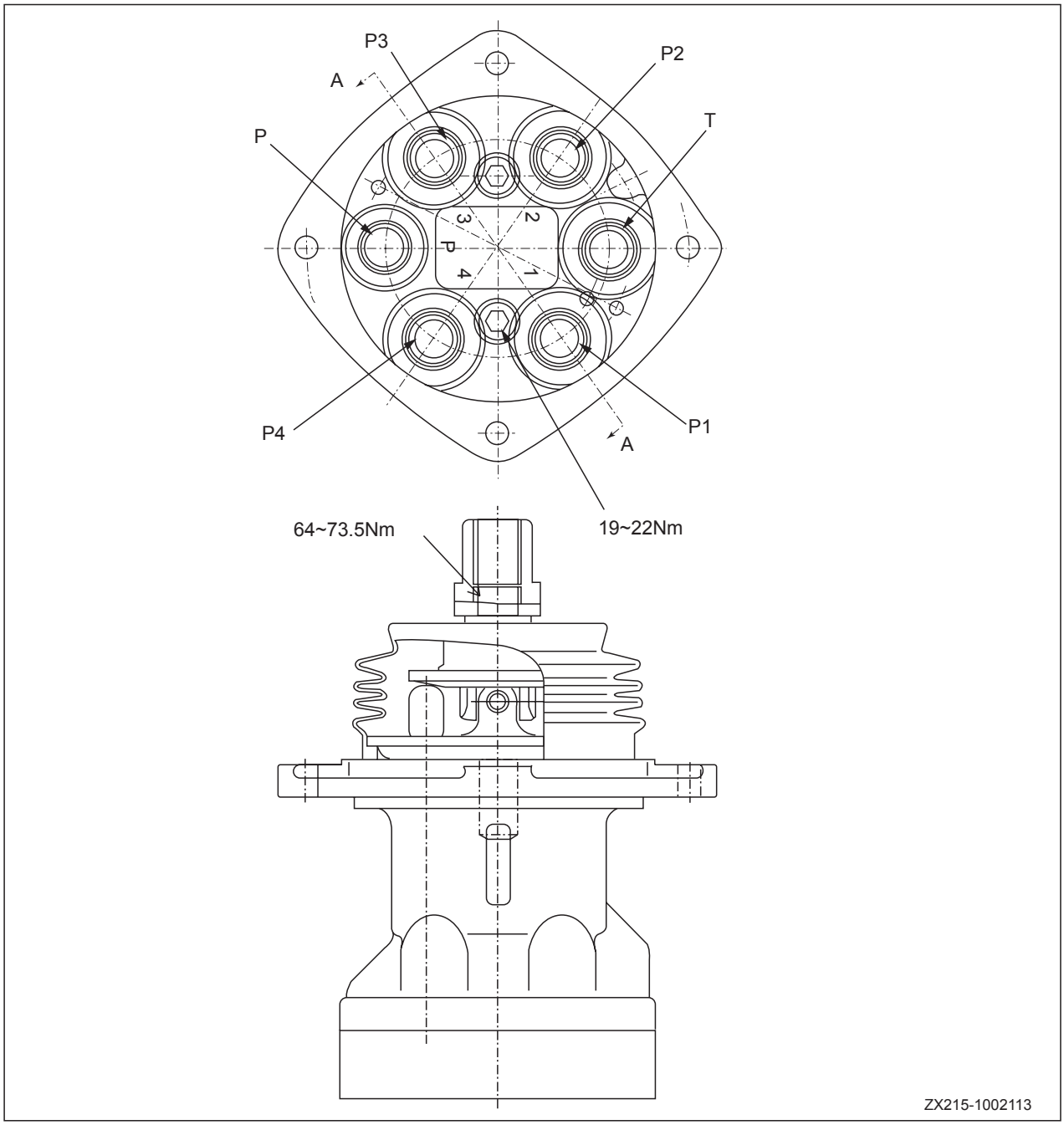
Control lever position

(1) HOLD
(2) Boom UP
(3) Boom DOWN
(4) Bucket DUMP
(5) Bucket DIG
(6) HOLD
(7) Arm IN
(8) Arm OUT
(9) Right swing
(10) Left swing
(11) Neutral
(12) Forward travel
(13) Backward travel

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4.6.8 Pilot valve

4.6.8.1 Work equipment and swing pilot valve

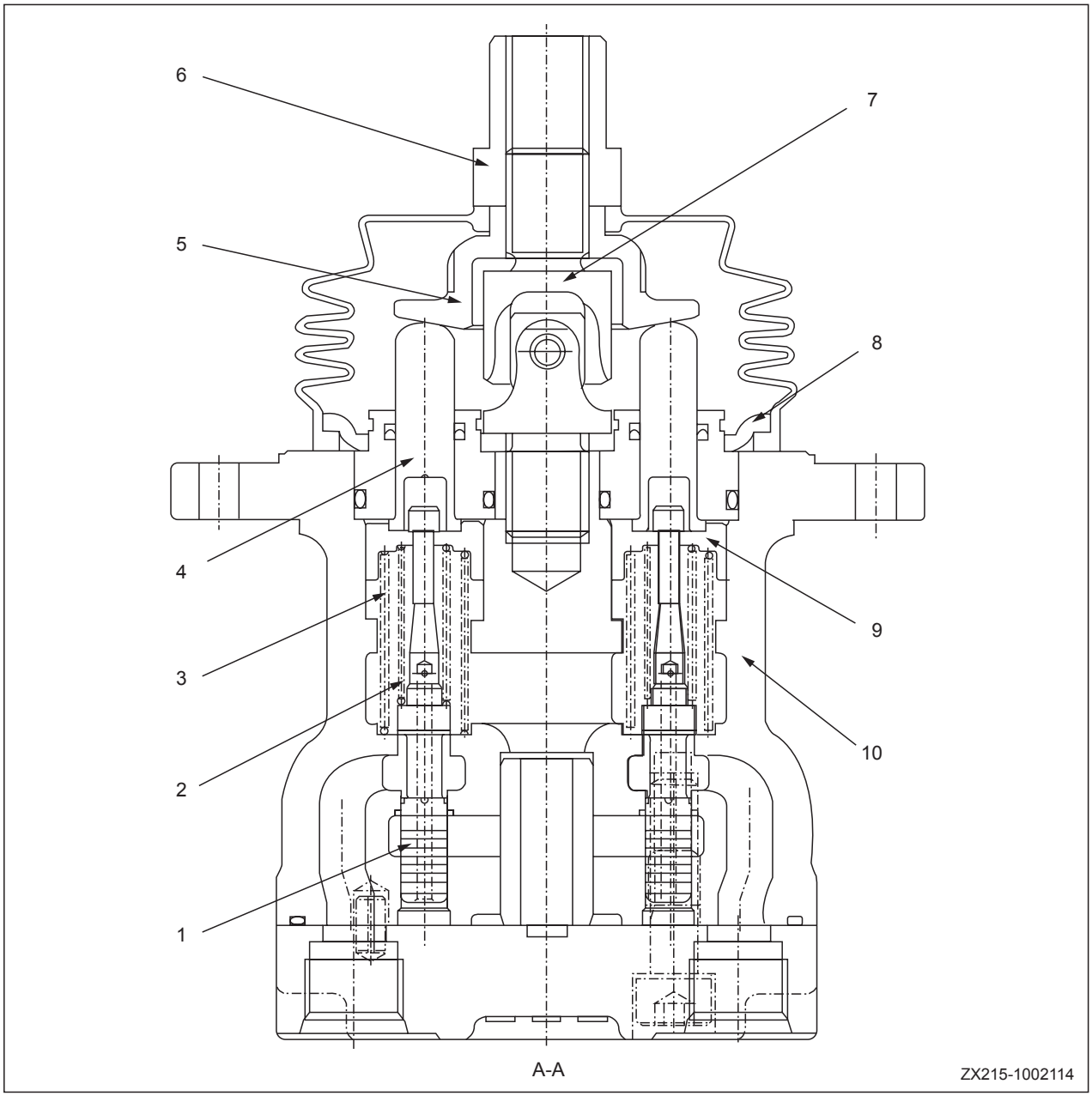


P: From pilot pump relief valve

P1: L.H. Pilot valve: Arm OUT	R.H. Pilot valve: Boom DOWN
P2: L.H. Pilot valve: Arm IN	R.H. Pilot valve: Boom UP
P3: L.H. Pilot valve: Swing LEFT	R.H Pilot valve: Bucket DIG
P4: L.H. Pilot valve: Swing RIGHT	R.H. Pilot valve: Bucket DUMP

T: To tank

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1- Plunger
2- Metering spring
3- Centering spring
4- Piston
5- Disc
6- Nut (for lever connection)
7- Joint
8- Plate
9- Retainer
10- Valve body

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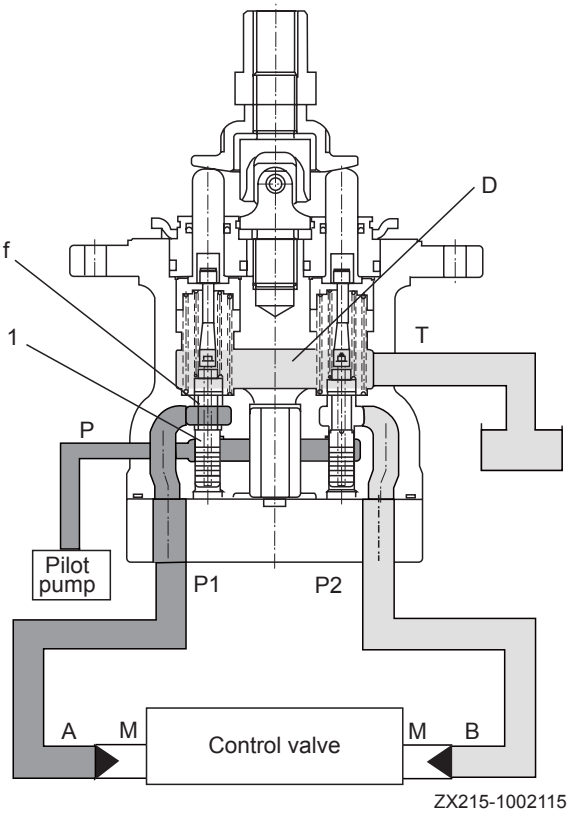
Operation

1. When in neutral

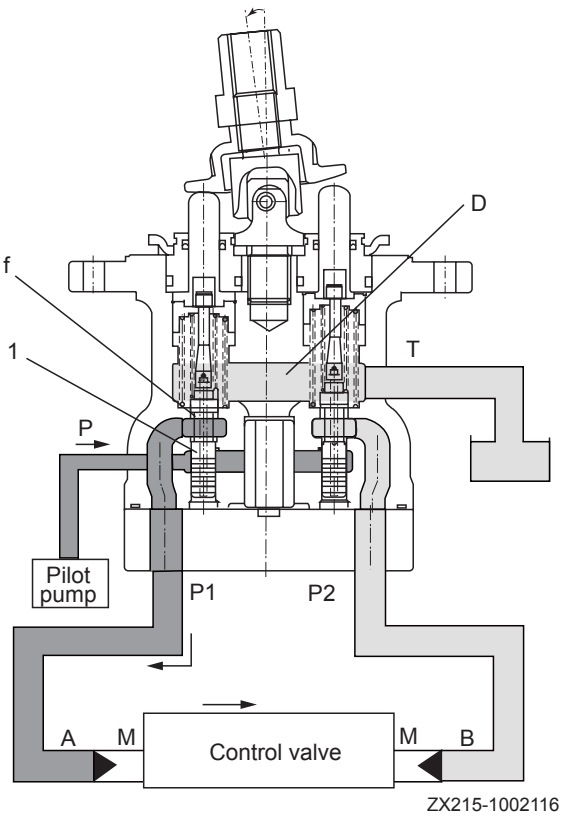
- Ports (A) and (B) of the control valve and ports (P1) and (P2) of the pilot valve are connected to drain chamber (D) via orifice (f) in plunger (1).

2. Fine control (Neutral to fine control)

- When piston (4) is pushed by disc (5), retainer (9) is pushed, plunger (1) is also pushed by metering spring (2), and moves down.
- When orifice (f) is shut off from drain chamber (D), it is almost simultaneously interconnected to pump pressure chamber (PP). Pilot pressurized oil of the control pump is led to port (A) from port (P1) via orifice (f). When the pressure at port (P1) becomes higher, plunger (1) is pushed back and orifice (f) is shut off from pump pressure chamber (PP). At almost the same time, it is connected to drain chamber (D) to release the pressure at port (P1). As a result, plunger (1) moves up and down until the force of metering spring (2) is balanced with the pressure at port (P1).
- The relationship of the position of plunger (1) and body (10) [orifice (f) is in the middle between drain chamber (D) and pump pressure chamber (PP)] does not change until retainer (9) contacts plunger (1). Metering spring (2) contracts in proportion to the stroke of the control lever. Pressure at port (P1) also rises in proportion to the stroke of the control lever. In this way, the control valve spool moves to a position where the pressure of chamber (A) (same as pressure at port (P1)) and the force of the return spring of the control valve spool are balanced.



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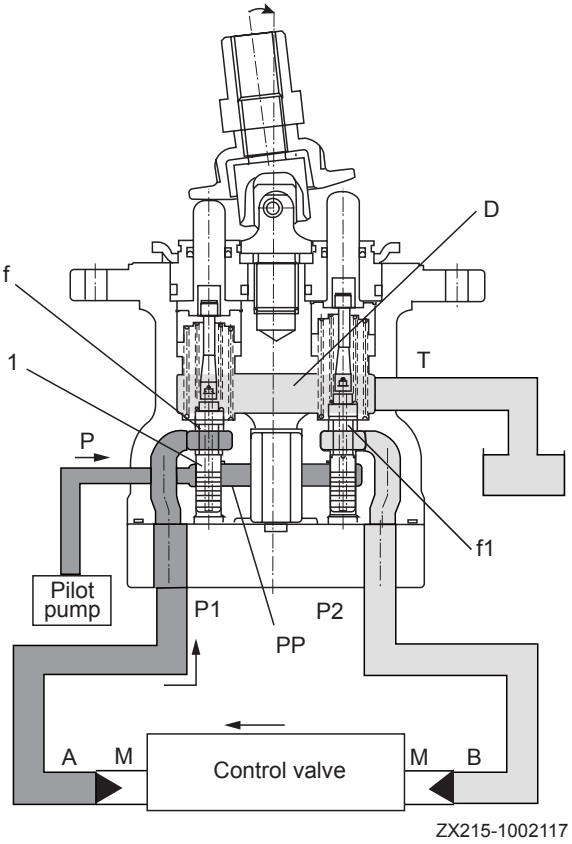


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3. During fine control (When control lever is returned)

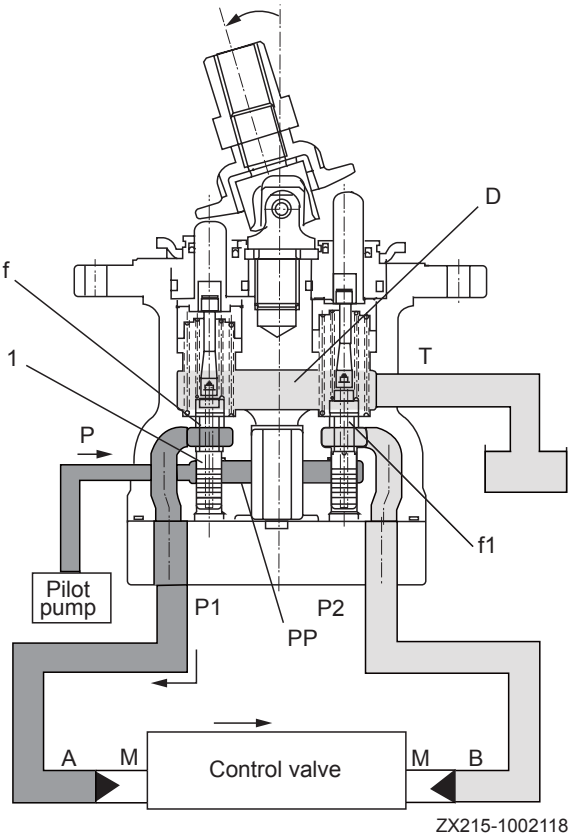
- When disc (5) starts to return, plunger (1) is pushed up by the force of centering spring (3) and the pressure at port (P1).
- Because of this, orifice (f) is connected to drain chamber (D), and the pressurized oil at port (P1) is released.
- If the pressure of port (P1) is lowered excessively, plunger (1) is pushed down by metering spring (2).
- Orifice (f) is shut off from drain chamber (D), and it is almost simultaneously interconnected to pump pressure chamber (PP). Pump pressure is supplied until the pressure at port (P1) recovers to the level equivalent to the lever position.
- When the spool of the control valve returns, the oil in drain chamber (D) flows in from orifice (f) in the valve on the side that is not working. The oil passes through port (P2) and enters chamber (B) to replenish the chamber with pressurized oil.



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4. At full stroke

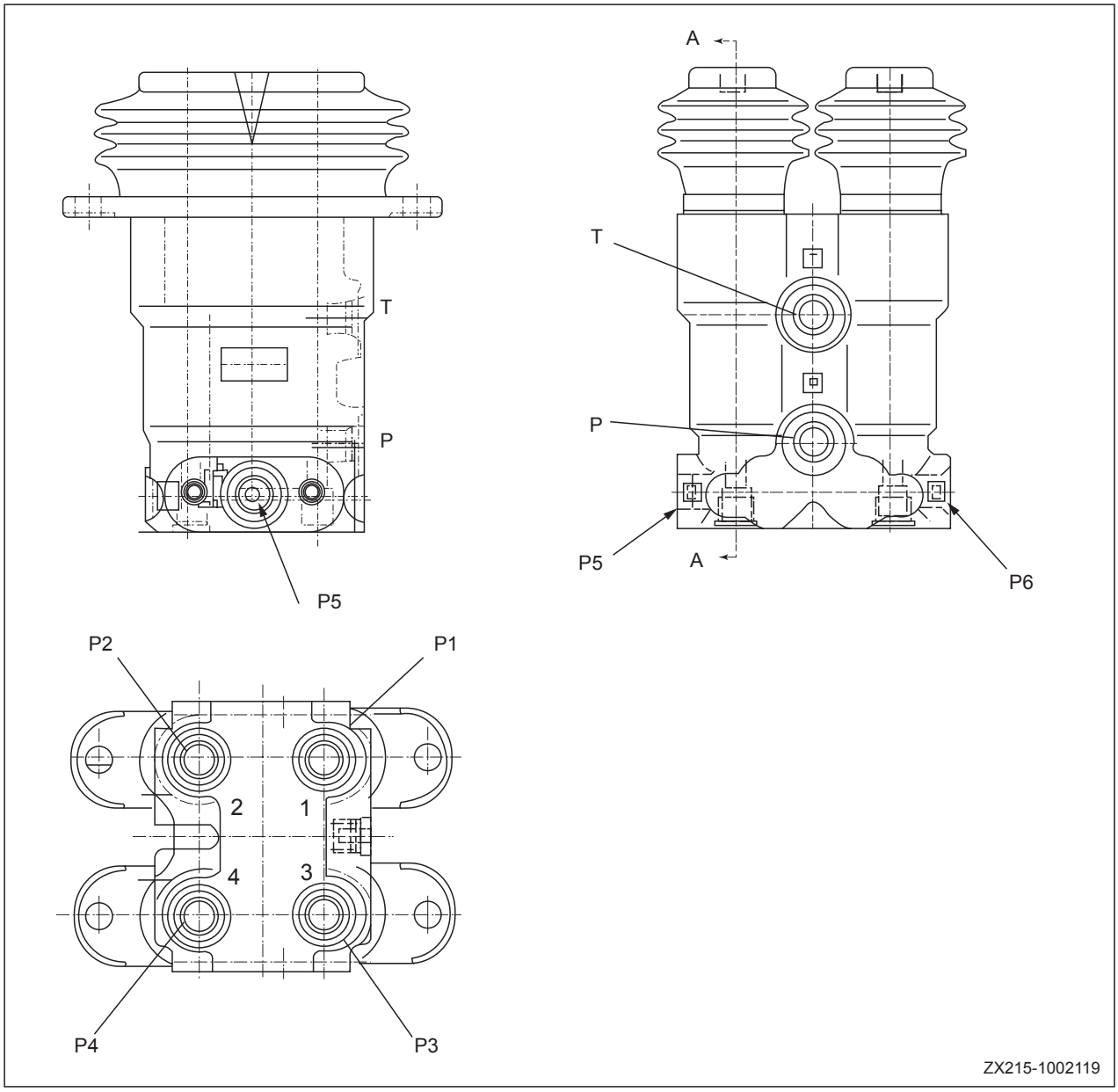
- Disc (5) pushes down piston (4), and retainer (9) pushes down plunger (1).
- Orifice (f) is shut off from drain chamber (D), and is interconnected to pump pressure chamber (PP).
- Therefore, the pilot pressure oil from the self pressure reducing valve passes through orifice (f) and flows to chamber (A) from port (P1) to push the control valve spool.
- The oil returning from chamber (B) passes from port (P2) through orifice (f) and flows to drain chamber (D).



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4.6.8.2 Travel PPC valve



P: From pilot pump

P1: L.H. reverse

P2: L.H. forward

P3: R.H. reverse

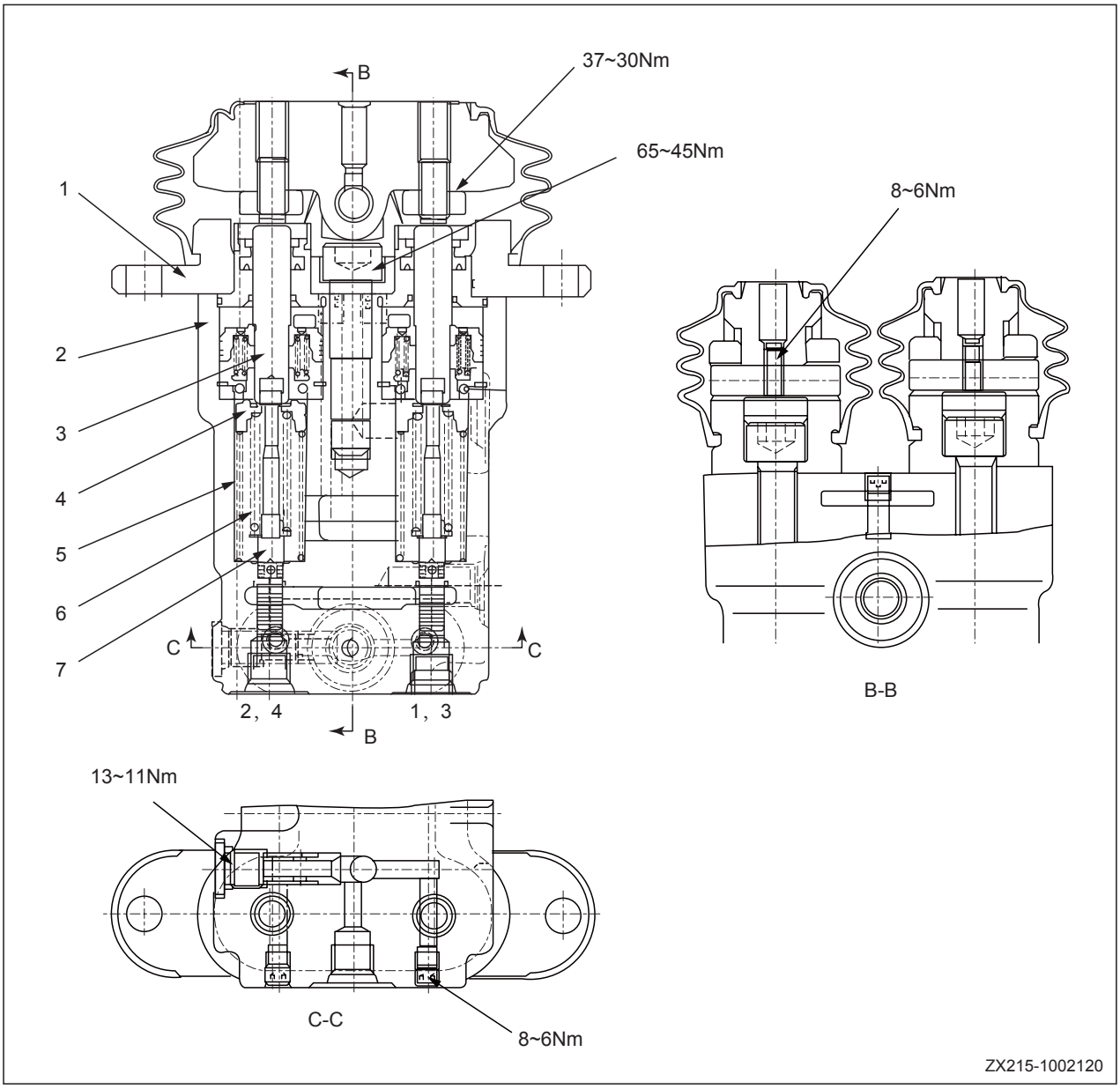
P4: R.H. forward

P5: Travel signal

P6: Travel signal

T: To tank

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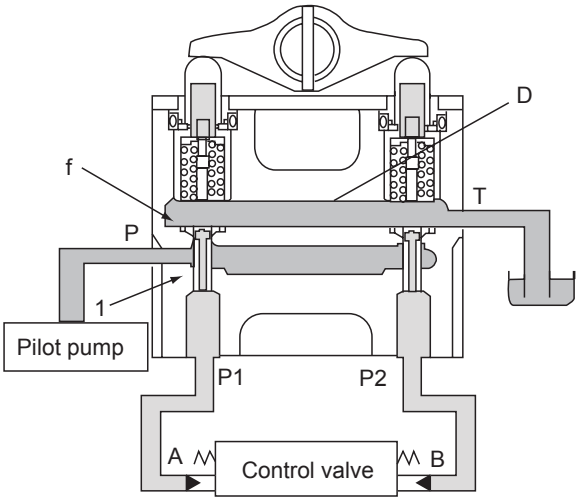
1- Plate
2- Body
3- Piston
4- Collar
5- Centering spring
6- Metering spring
7- Valve

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Operation

1. When in neutral

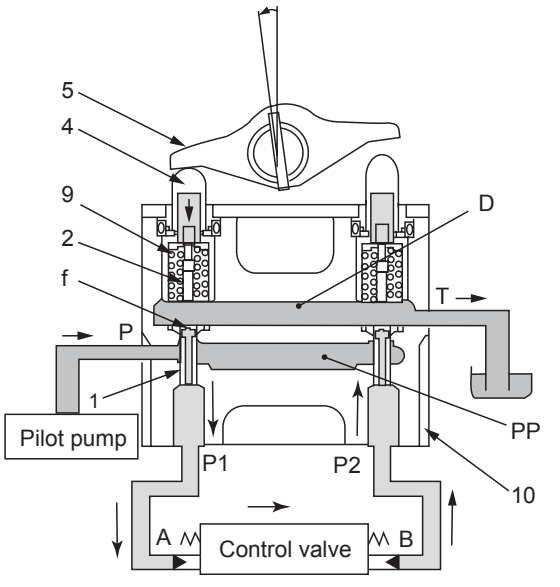
- Ports (A) and (B) of the control valve and ports (P1) and (P2) of the Pilot valve are connected to drain chamber (D) via orifice (f) in plunger (1).



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2. Fine control (Neutral to fine control)

- When piston (4) is pushed by lever (5), retainer (9) is pushed, plunger (1) is also pushed by metering spring (2), and moves down. When orifice (f) is shut off from drain chamber (D), it is almost simultaneously interconnected to pump pressure chamber (PP).
- Pilot pressurized oil of the control pump is led to port (A) from port (P1) via orifice (f).
- When the pressure at port (P1) becomes higher, plunger (1) is pushed back and orifice (f) is shut off from pump pressure chamber (PP). At almost the same time, it is connected to drain chamber (D) to release the pressure at port (P1).
- As a result, plunger (1) moves up and down until the force of metering spring (2) is balanced with the pressure at port (P1).
- The relationship of the position of plunger (1) and body (10) [orifice (f) is in the middle between drain chamber (D) and pump pressure chamber (PP)] does not change until retainer (9) contacts plunger (1).
- Metering spring (2) contracts in proportion to the stroke of the control lever.
- Pressure at port (P1) also rises in proportion to the stroke of the control lever.
- In this way, the control valve spool moves to a position where the pressure of chamber (A) (same as pressure at port (P1)) and the force of the return spring of the control valve spool are balanced.

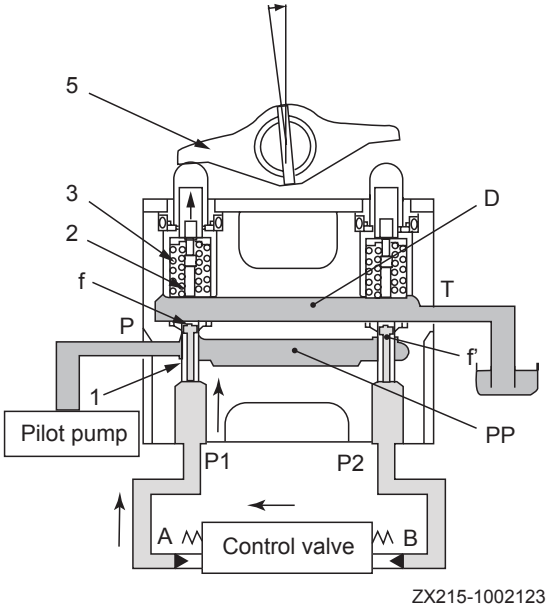


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3. Fine control (When control lever is returned)

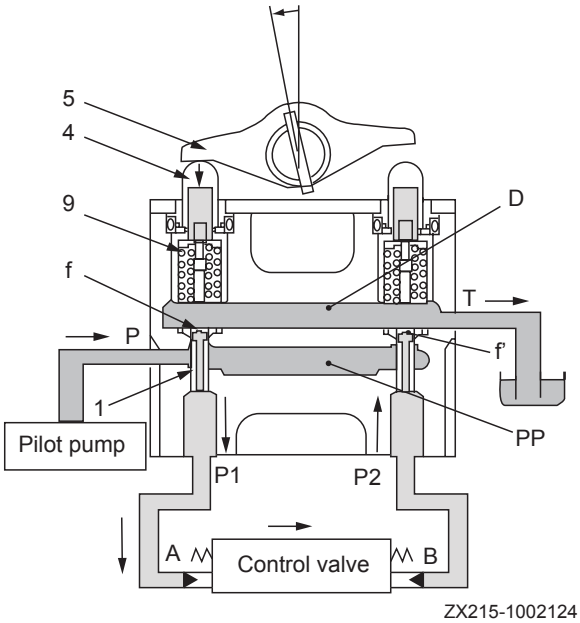
- When lever (5) starts to return, plunger (1) is pushed up by the force of centering spring (3) and pressure at port (P1).
- Because of this, orifice (f) is connected to drain chamber (D), and the pressurized oil at port (P1) is released.
- If the pressure of port (P1) is lowered excessively, plunger (1) is pushed down by metering spring (2).
- Orifice (f) is shut off from drain chamber (D), and it is almost simultaneously interconnected to pump pressure chamber (PP).
- Pump pressure is supplied until the pressure at port (P1) recovers to the level equivalent to the lever position.
- When the spool of the control valve returns, the oil in drain chamber (D) flows in from orifice (f) in the valve on the side that is not working. The oil passes through port (P2) and enters chamber (B) to replenish the chamber with pressurized oil.



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4. At full stroke

- Lever (5) pushes down piston (4), and retainer (9) pushes down plunger (1).
- Orifice (f) is shut off from drain chamber (D), and is interconnected to pump pressure chamber (PP).
- Therefore, the pilot pressure oil from the self pressure reducing valve passes through orifice (f) and flows to chamber (A) from port (P1) to push the control valve spool.
- The oil returning from chamber (B) passes from port (P2) through orifice (f) and flows to drain chamber (D).

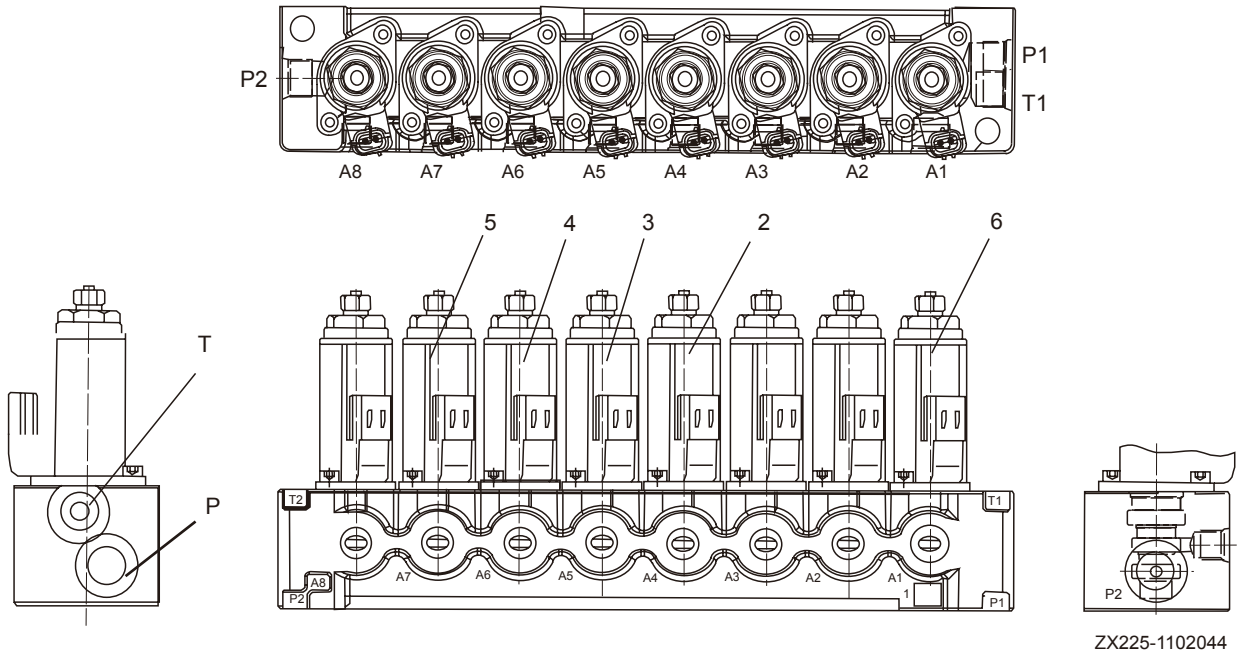


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4.6.9 Solenoid valve

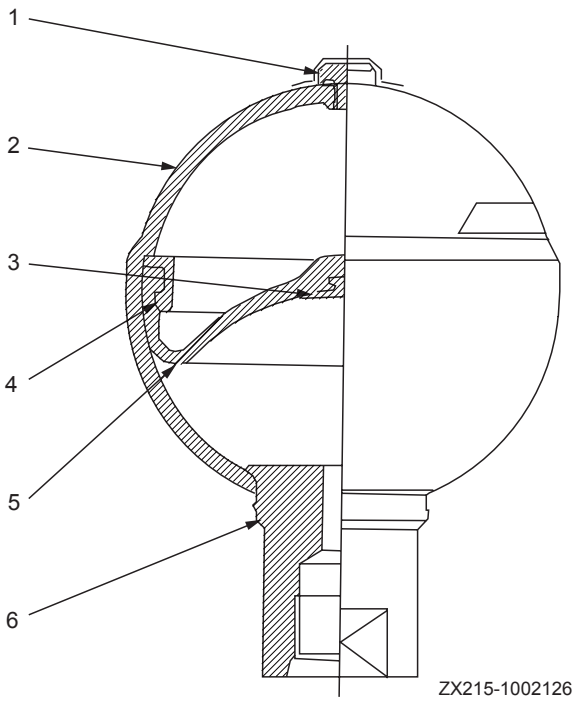
Pilot valve lock, travel speed, bucket confluence, swing priority



1- Travel hi/lo speed solenoid valve
2- Swing priority solenoid valve
3- Bucket confluence solenoid valve
4- Boom to arm priority solenoid valve
5- Pilot lockout solenoid valve
6- Secondary boosting solenoid valve
T: To oil tank
P: From accumulator and pilot pump
A3 To center swivel joint port
A4 To main valve port PsP
A5 To main valve port Xbp2
A6 To main valve port PnA2
A7 To pilot valve block P

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4.6.10 Accumulator



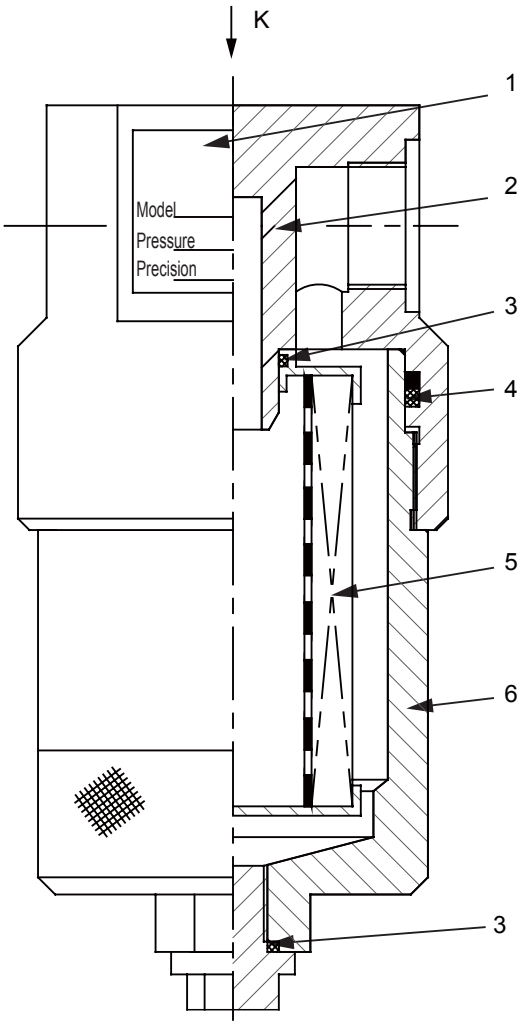
1- Gas plug
2- Shell
3- Poppet
4- Holder
5- Bladder
6- Oil port

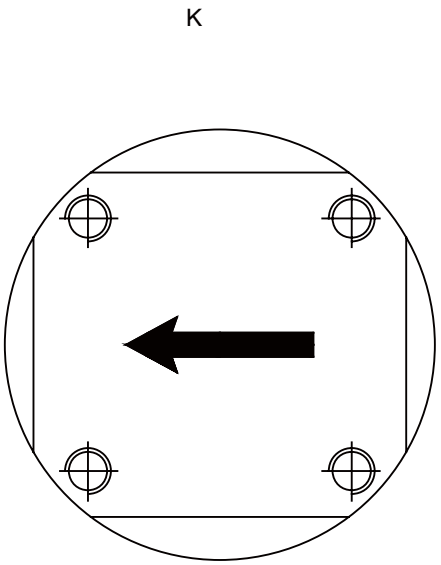
Specifications

Gas capacity: 300 cc (for Pilot)

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4.6.11 Pilot oil filter





ZX215-1002127

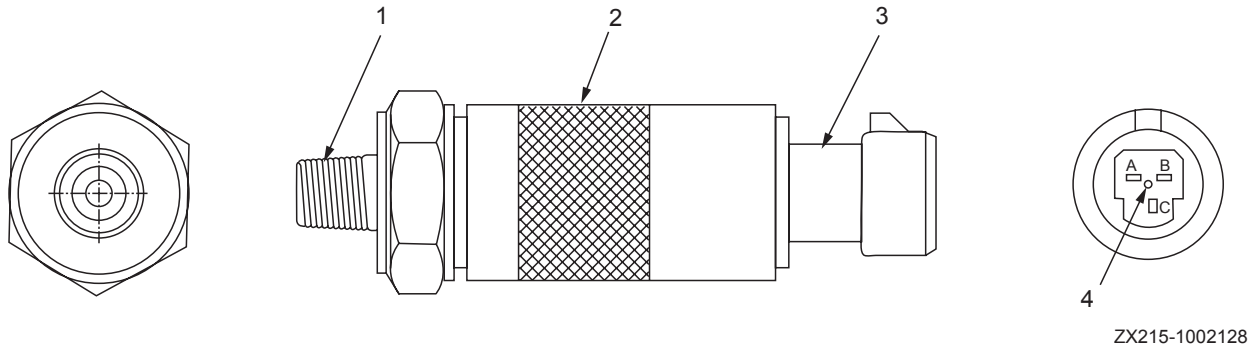
1- Name plate
2- Head cover
3- O-ring
4- Seal
5- Filter
6- Case

Specifications

Max. delivery: 40 L/min
Filter fineness: 10 μm
Operating pressure: 20 Mpa
Max. operating pressure: 40 Mpa
Pressure loss: 0.05 Mpa
Max. allowable pressure difference: 1 Mpa
Specification of inlet/outlet port o-ring: 30×3.1

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4.6.12 Pump oil pressure sensor



ZX215-1002128

1- 1/8NPT Pressure connector
2- Name plate
3- Connector
4- Vent hole

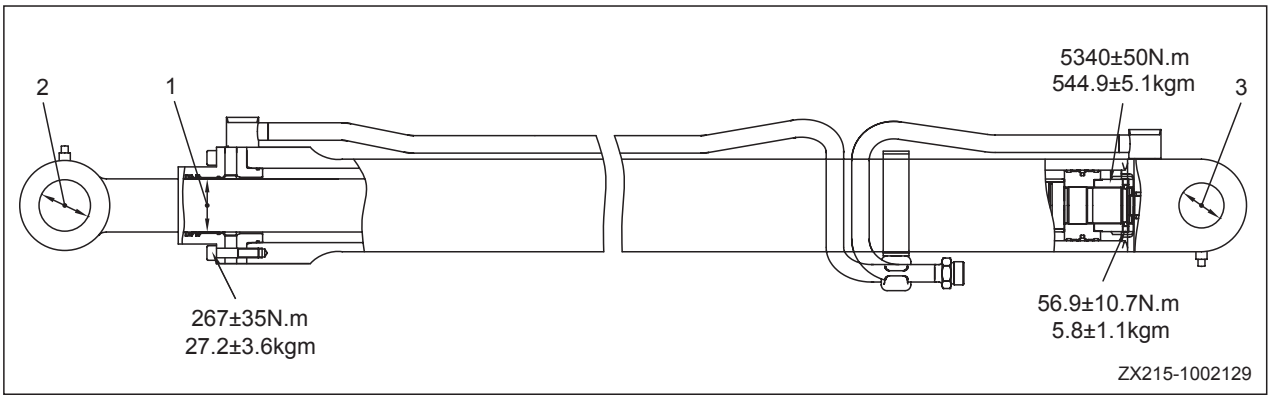
Function

- This sensor measures pump oil pressure and uses it to control various machine operations. When oil pressure compresses the diaphragm, it deforms and this is detected in the form of electric signals.

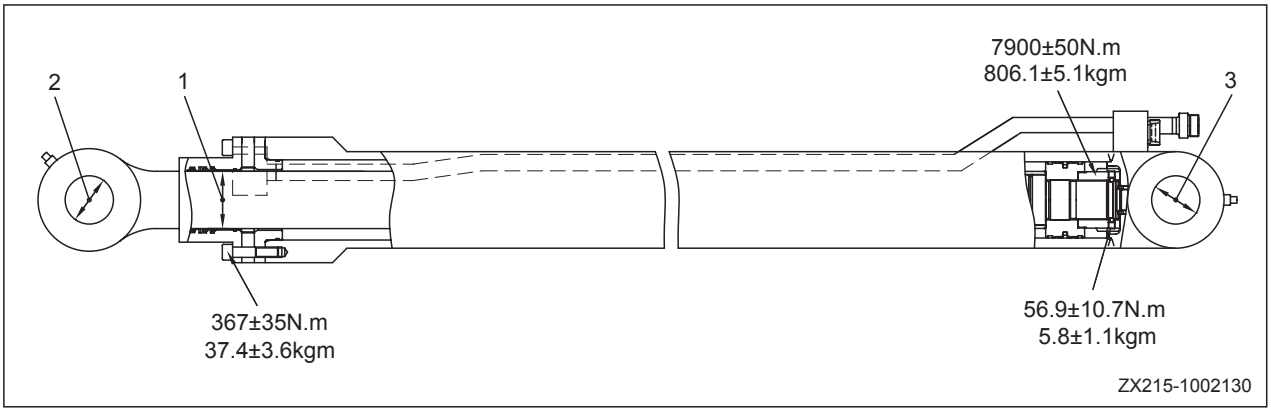
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4.6.13 Hydraulic cylinder

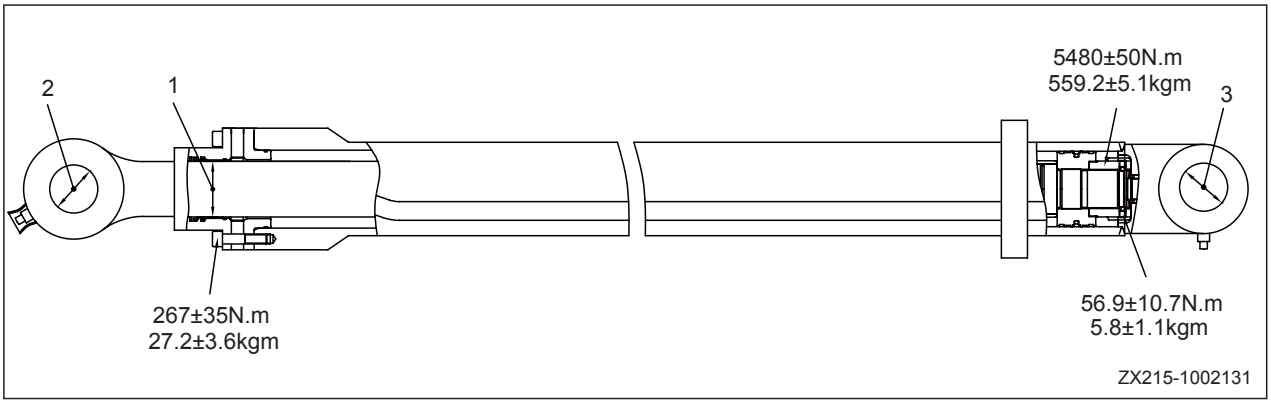
Boom cylinder



Arm cylinder



Bucket cylinder



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100 hours greasing

Unit: mm

No.	Check item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	85	-0.036 -0.090	+0.222 +0.047	0.083 – 0.312	0.412	Replace bushing
		Arm	95	-0.036 -0.090	+0.222 +0.047	0.083 – 0.312	0.412	
		Bucket	80	-0.030 -0.076	+0.258 +0.048	0.078 – 0.334	0.434	
2	Clearance between piston rod support pin and bushing	Boom	80	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	Replace pin or bushing
		Arm	80	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
		Bucket	70	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
3	Clearance between cylinder bottom support pin and bushing	Boom	70	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
		Arm	80	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
		Bucket	70	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	

500 hours greasing

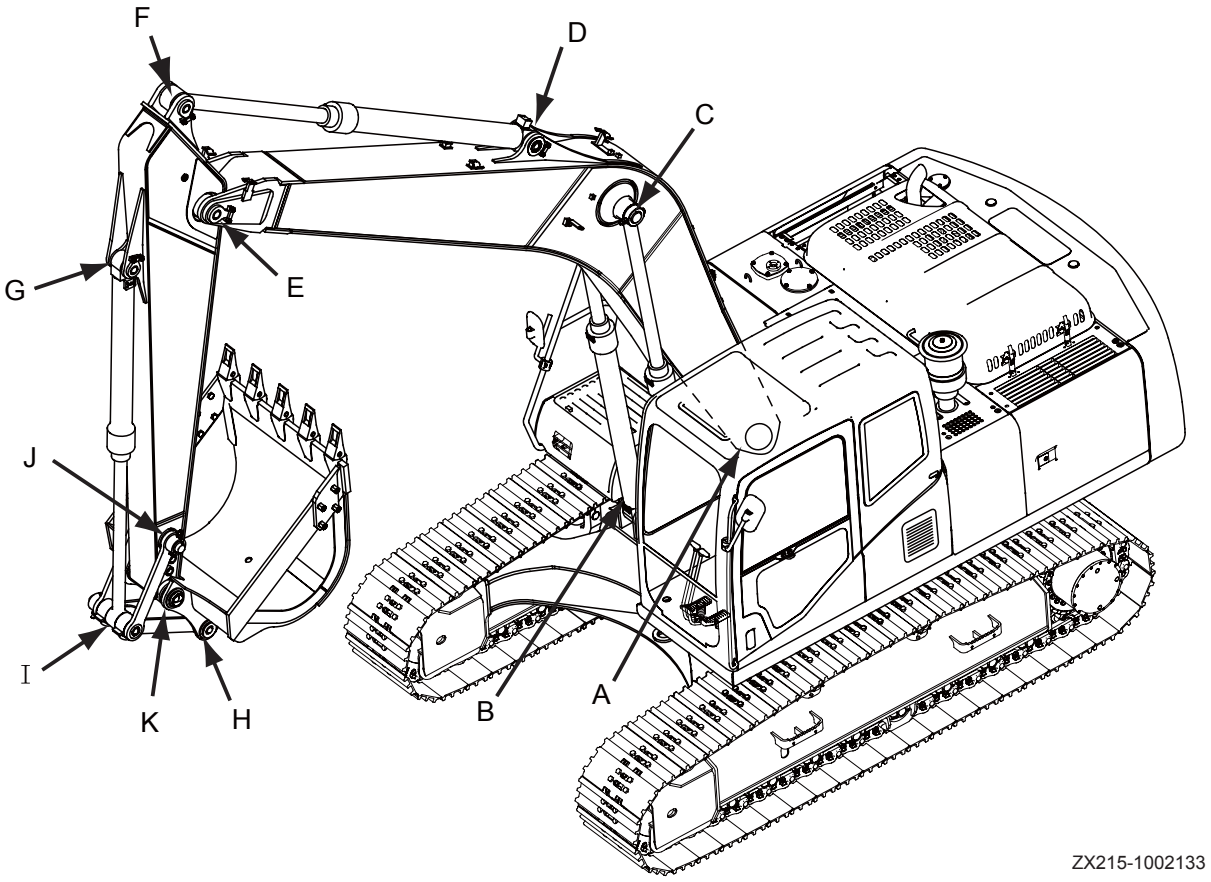
Unit: mm

No.	Check item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	85	-0.036 -0.090	+0.222 +0.047	0.083 – 0.312	0.412	Replace bushing
		Arm	95	-0.036 -0.090	+0.222 +0.047	0.083 – 0.312	0.412	
		Bucket	80	-0.030 -0.076	+0.258 +0.048	0.078 – 0.334	0.434	
2	Clearance between piston rod support pin and bushing	Boom	80	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	Replace pin or bushing
		Arm	80	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
		Bucket	70	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
3	Clearance between cylinder bottom support pin and bushing	Boom	70	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
		Arm	80	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	
		Bucket	70	-0.030 -0.076	+0.246 +0.200	0.230 – 0.322	1.0	

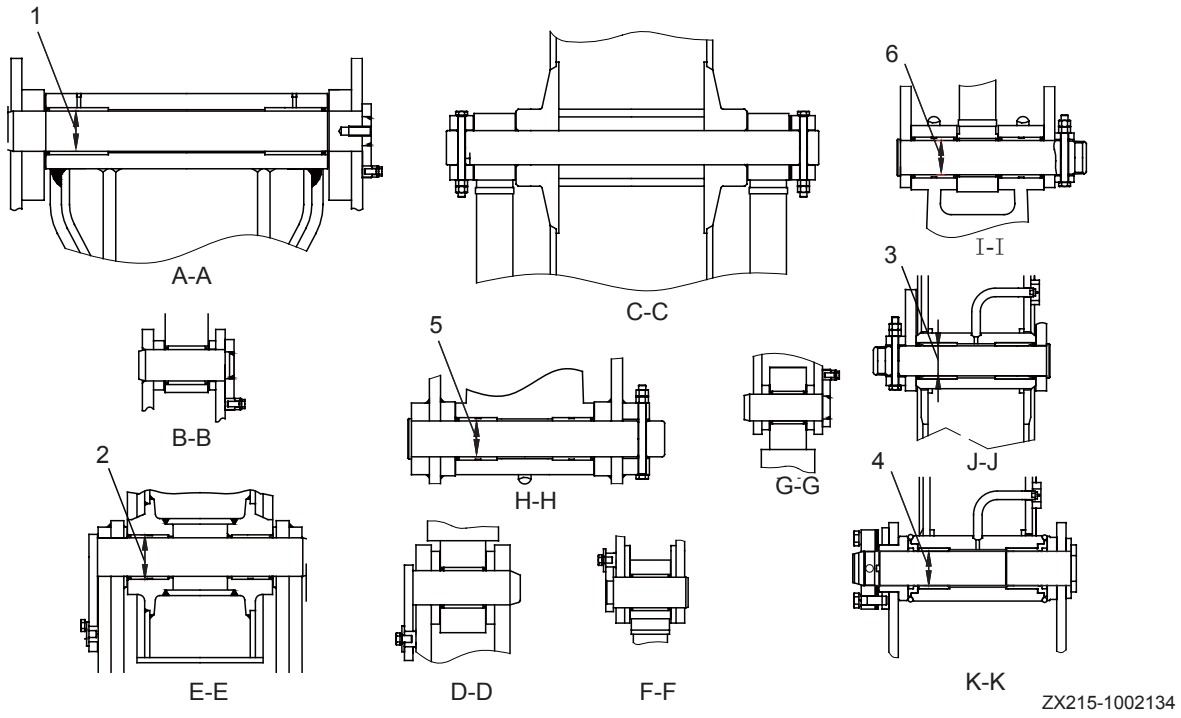
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4.6.14 Work equipment

Dimensions



ZX215-1002133



ZX215-1002134

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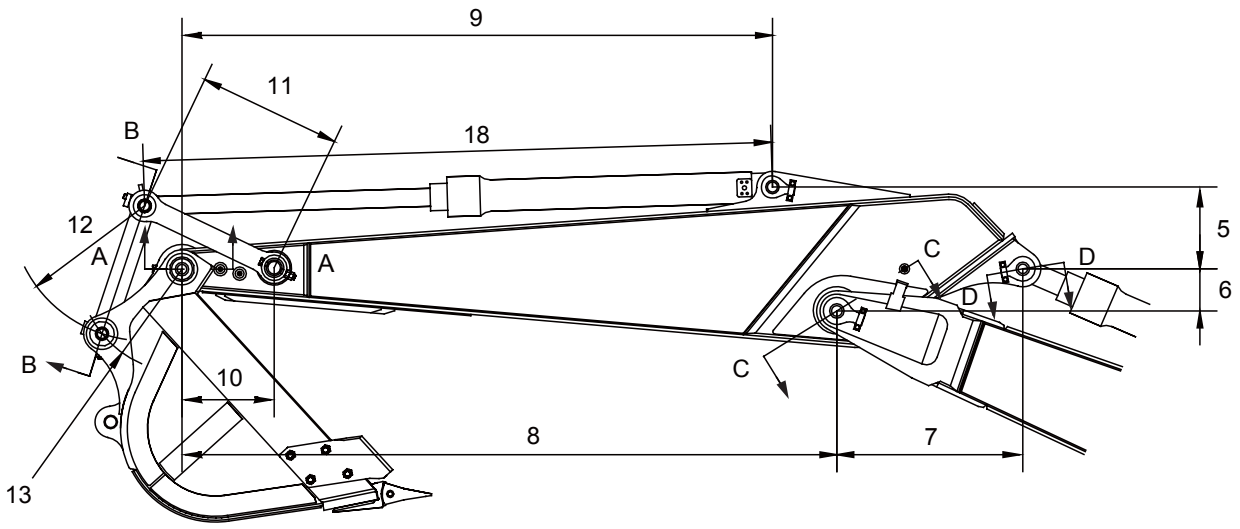
Greasing

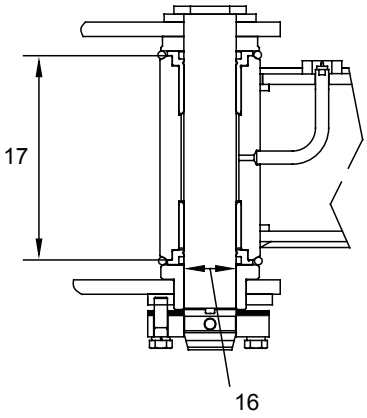
Unit: mm

No.	Check item	Bush material	Greasing interval	Criteria					Remedy
				Standard size	Tolerance		Standard clearance	Clearance limit	
					Shaft	Hole			
1	Clearance between pin connecting boom and revolving frame and bushing	Alloy	500 h	Φ 100	–0.036 –0.071	+0.171 +0.084	0.120 ~ 0.242	1.0	Replace
2	Clearance between pin connecting boom and arm and bushing	Steel	100 h	Φ 100	–0.036 –0.071	+0.282 +0.240	0.276 ~ 0.353	1.0	
3	Clearance between pin connecting arm and rocker and bushing	Steel	100 h	Φ 90	–0.036 –0.071	+0.338 +0.272	0.308 ~ 0.409	1.0	
4	Clearance between pin connecting arm and bucket and bushing	Steel	100 h	Φ 90	–0.036 –0.071	+0.336 +0.275	0.311 ~ 0.407	1.0	
5	Clearance between pin connecting linkage and bucket and bushing	Steel	100 h	Φ 90	–0.036 –0.071	+0.338 +0.272	0.308 ~ 0.409	1.0	
6	Clearance between pin connecting linkages and bushing	Steel	100 h	Φ 90	–0.036 –0.071	+0.338 +0.272	0.308 ~ 0.409	1.0	

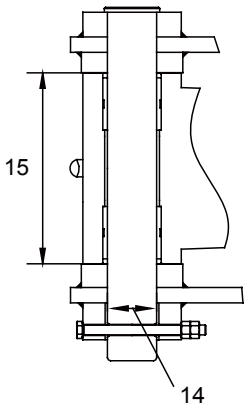
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Arm dimension

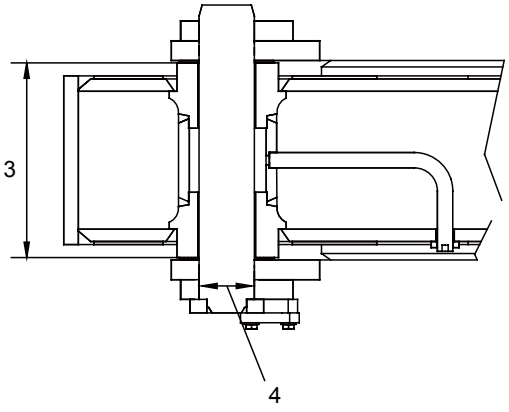




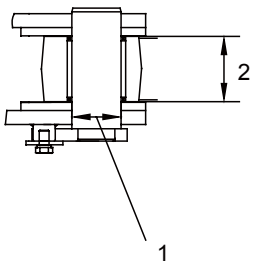
A-A



B-B



C-C



D-D

ZX215-1002135

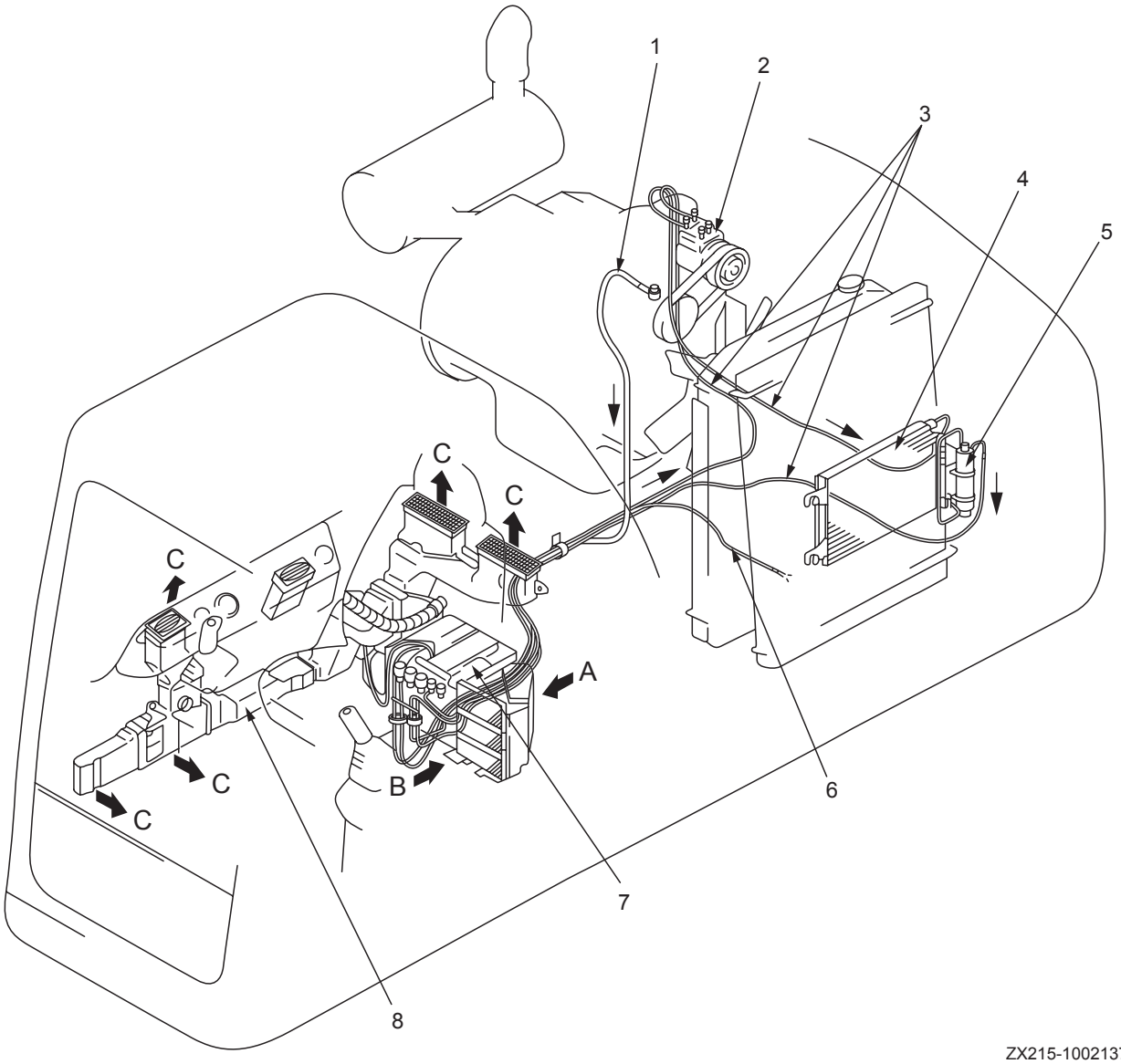
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Unit: mm

No.		Standard size	Tolerance
1		φ80	+0.1 0
2		107	+1.5 0
3		310	-0.3 -0.8
4		φ90	+0.174 +0.104
5		365.6	±1
6		187.2	±0.5
7		829.1	±1
8		2,919	—
9		2,631.3	±1
10		411	—
11		640	±0.2
12		600	±0.5
13		458	—
14		φ80	+0.373 +0.273
15		325	0 -0.5
16		φ80	+0.1 0
17	Arm itself	311	0 -0.5
	When press fitting bushing	325	—
18	Min.	1,680	—
	Max.	2,800	—

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4.7 Air Conditioning System

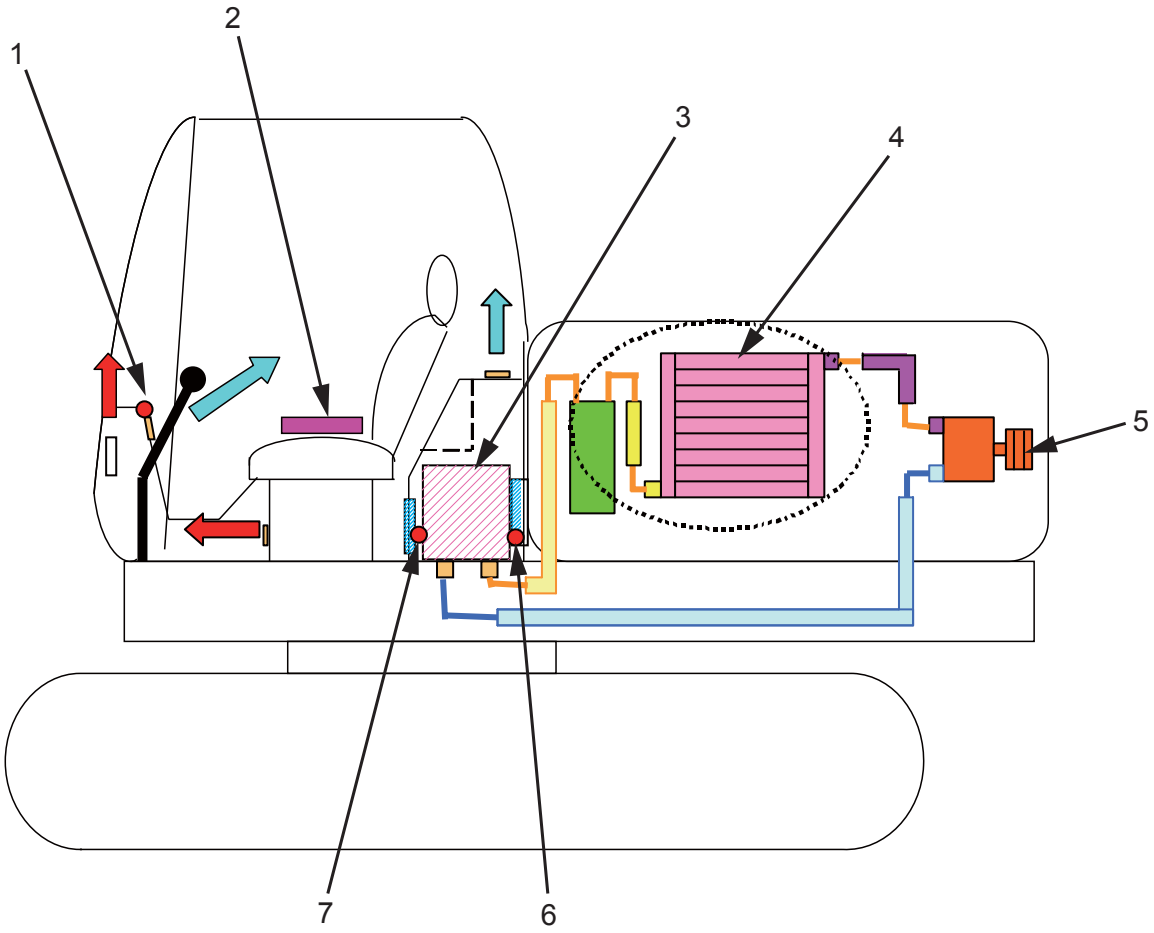


ZX215-1002137

1- Hot water piping
2- A/C compressor (DENSO.2)
3- Refrigeration piping
4- Condenser (SG447750-A040)
5- Reservoir (DENSO.4)
6- Hot water return piping
7- Refrigeration unit
8- Air duct
A. Fresh air
B. Recirculated air
C. Warm air/cool air

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4.7.1 A/C components layout drawing

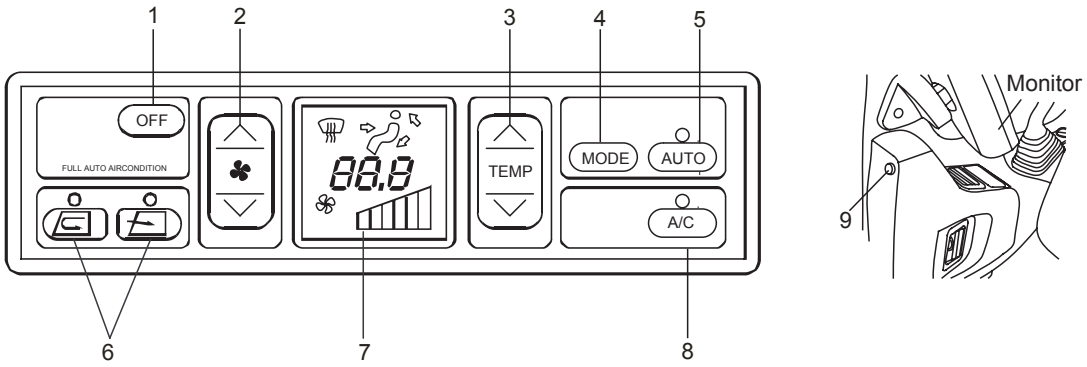


ZX215-1002138

1- Sunlight sensor
2- Control panel
3- Air conditioning unit
4- Condenser
5- Compressor
6- Fresh air sensor
7- Recirculated air sensor

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4.7.2 Control panel



ZX215-1002139

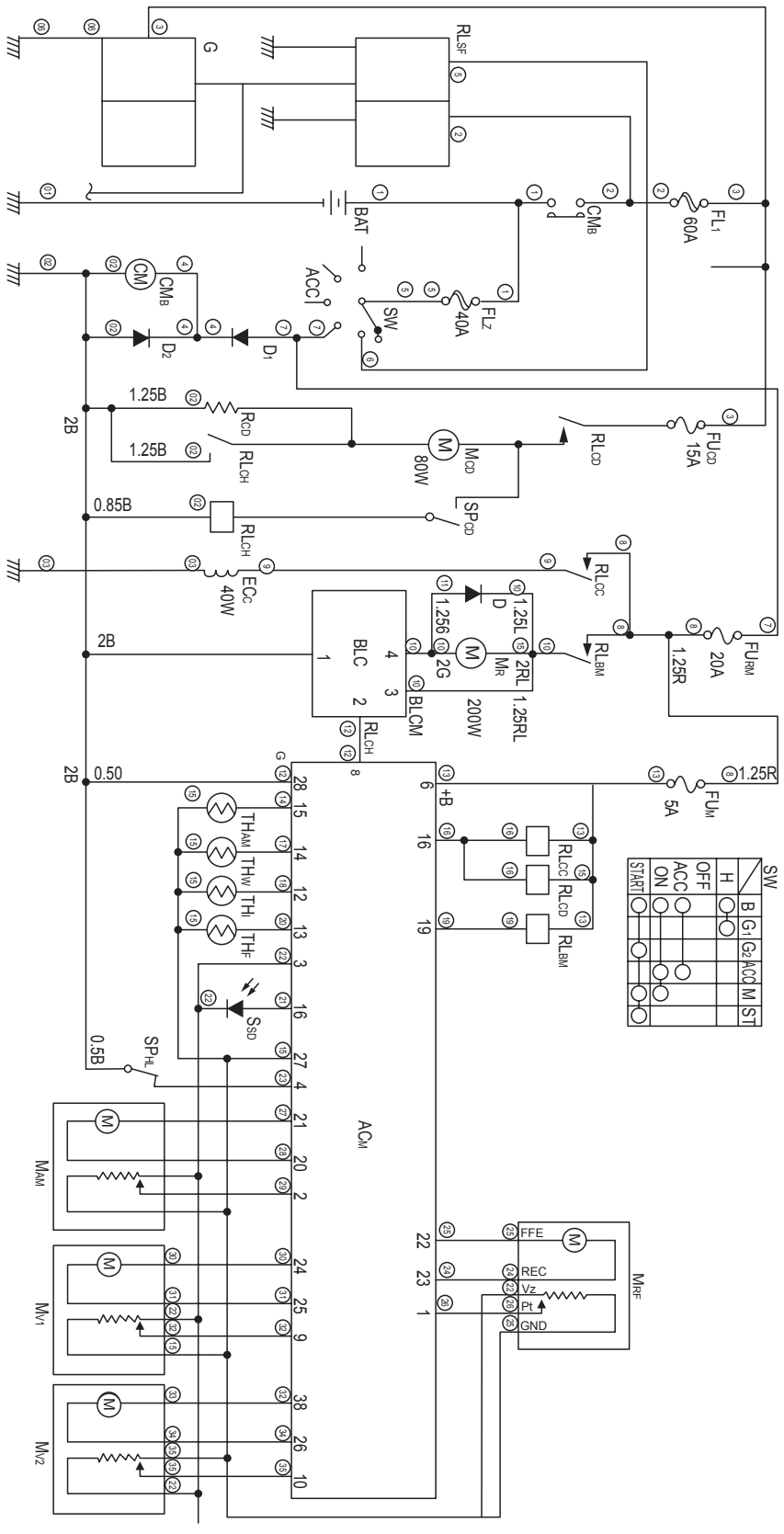
1- OFF switch
2- Fan speed control switch
3- Temperature control switch
4- Air outlet mode switch
5- Auto mode switch
6- Air circulation control switch
7- LCD display
8- A/C switch
9- Sunlight sensor

Remark:

When Auto mode switch (5), Air circulation control switch (6) and A/C switch (8) are turned on, indicator lights above these switches will light up.

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4.7.3 Circuit diagram



ZX215-1002140

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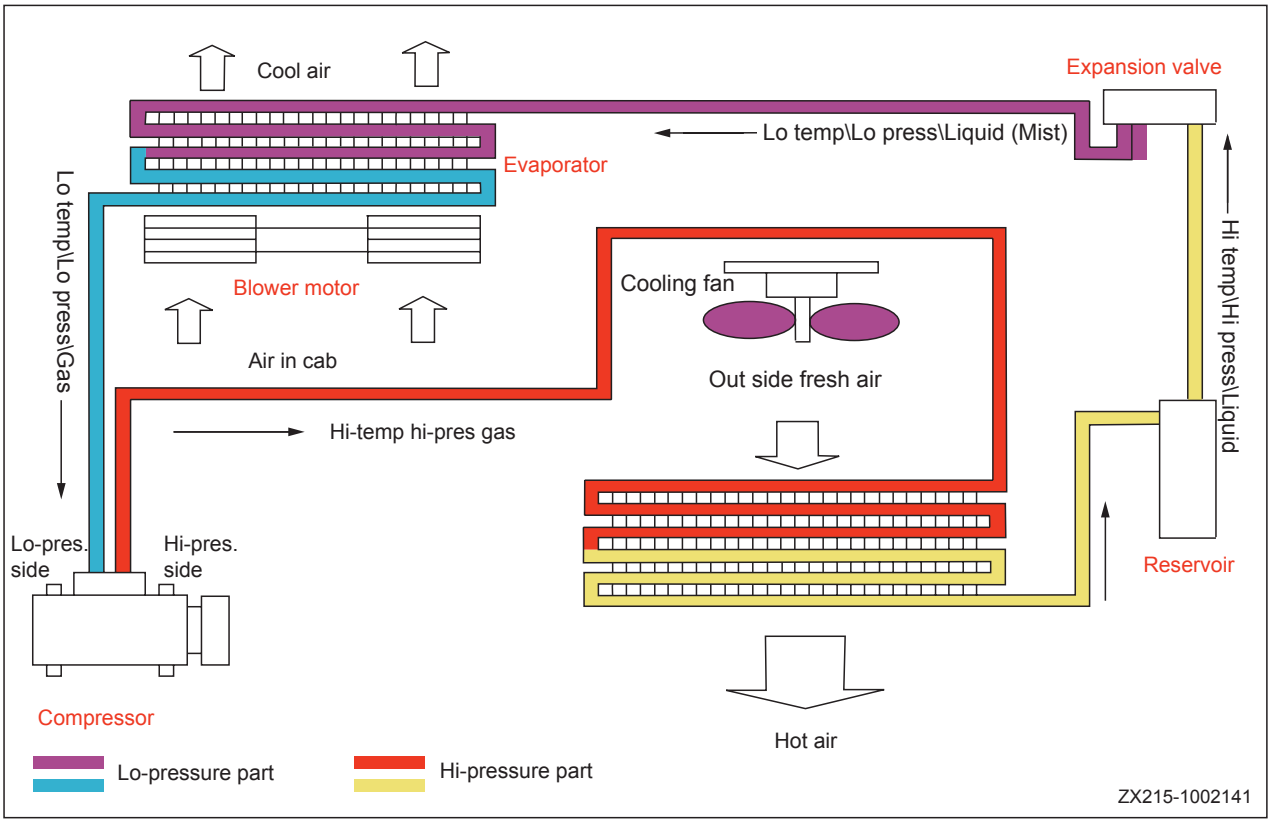
Wire No.	Diameter/Color code	Wire color	Wire No.	Diameter/Color code	Wire color
⑫	B	Black	㉔	0.5VW	Violet+white
⑧	Br(R)	Brown	㉕	0.5YB	Yellow+black
⑨	0.85W	White	㉖	0.5WO	White+orange
⑩	RL	Red+blue	㉗	0.5PB	Pink+black
⑪	G	Green	㉘	0.5VR	Violet+red
⑫	0.5BL	Black+blue	㉙	0.5BG	Black+green
⑬	0.5R	Red+blue	㉚	0.5WY	White+yellow
⑭	0.5Y	Yellow	㉛	0.5WR	White+red
⑮	0.5BR	Black+red	㉜	0.5BrW	Brown+white
⑯	0.5BrY	Brown+yellow	㉝	0.5GO	Green+orange
⑰	0.5BY	Black+yellow	㉞	0.5Sb	Sky blue
⑱	0.5GW	Green+white	㉟	0.5OW	Orange+white
⑲	0.5LO	Blue+orange	㊱	1.25V	Violet
⑳	0.5PG	Pink+green	㊲	1.25RG	Red+green
㉑	0.5RY	Red+yellow	㊳	1.25RW	Red+orange
㉒	0.5BW	Black+white	㊴	0.85GL	Green+Blue
㉓	0.5LgR	Light green+red			

Code	Name	Code	Name	Code	Name
AC_M	A/C amplifier	FU_{CD}	Condenser fuse	RL_{CH}	Condenser high speed relay
BAT	Battery	FU_M	A/C main fuse	RL_{SF}	Protective relay
BLC	Speed regulating resistor	G	Alternator	S_{SD}	Sunlight sensor
CM_B	Battery relay	M_{AM}	A/M servo motor	SP_{CD}	Condenser pressure switch
D	Diode	M_B	Blower motor	SP_{HL}	HI/LO pressure switch
D_1	Diode 1	M_{CD}	Condenser motor	SW	Switcher
D_2	Diode 2	M_{RF}	Internal/External air servo motor	TH_{AM}	External air thermistor
EC_C	Compressor clutch	M_{V1}	Air outlet servo motor	TH_F	Anti-frosting thermistor
FL_1	Fuse	M_{V2}	FRONT outlet servo motor	TH_I	Internal air thermistor
FL_2	Fuse	R_{CD}	Condenser resistor	TH_W	Water temp. thermistor
FU_{BM}	Blower fuse	RL_{BM}	Blower main relay		
RL_{CC}	Compressor relay	RL_{CD}	Condenser relay		

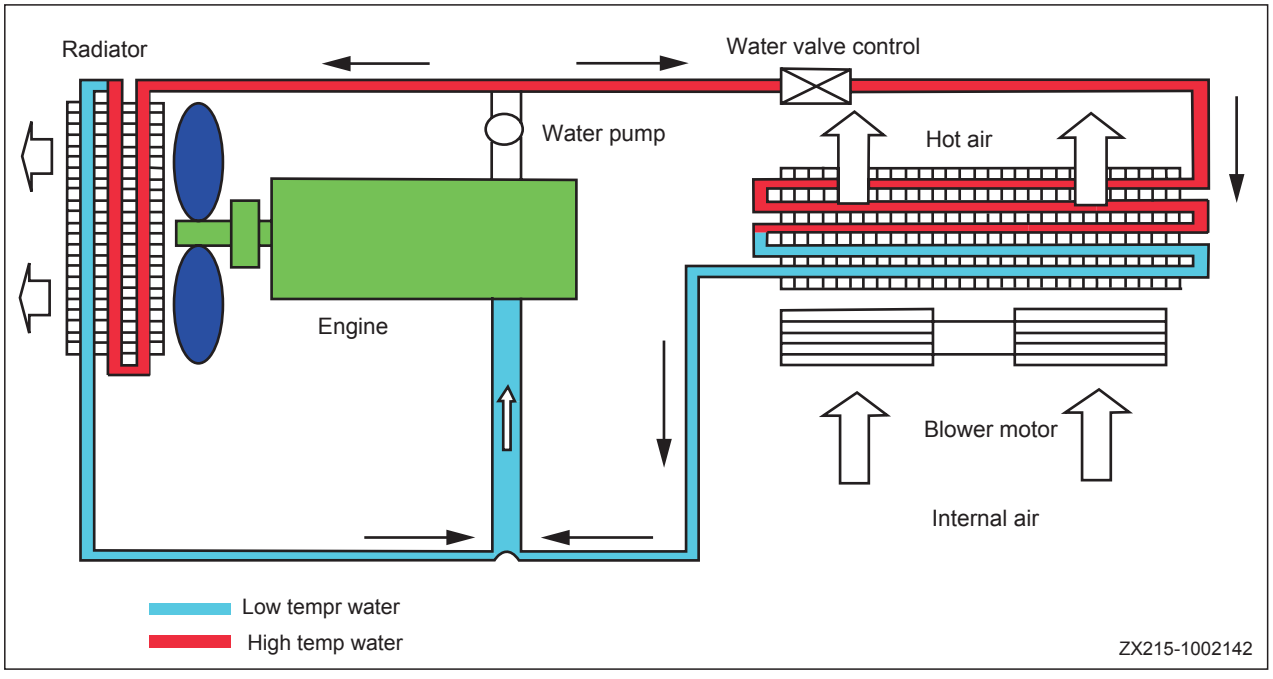
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4.7.4 Refrigeration principle

4.7.4.1 Refrigeration cycle diagram

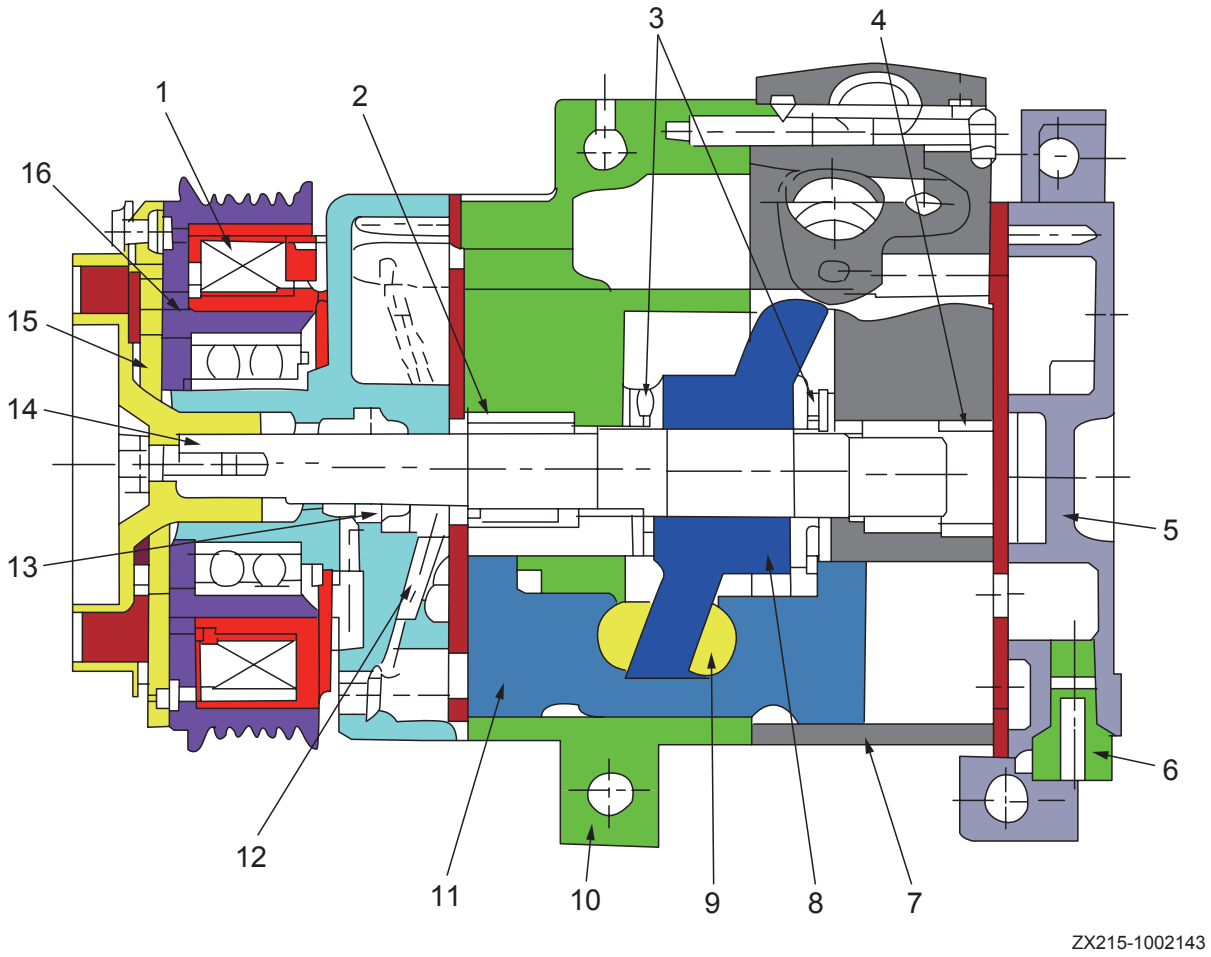


4.7.4.2 Heating cycle diagram



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4.7.5 Compressor

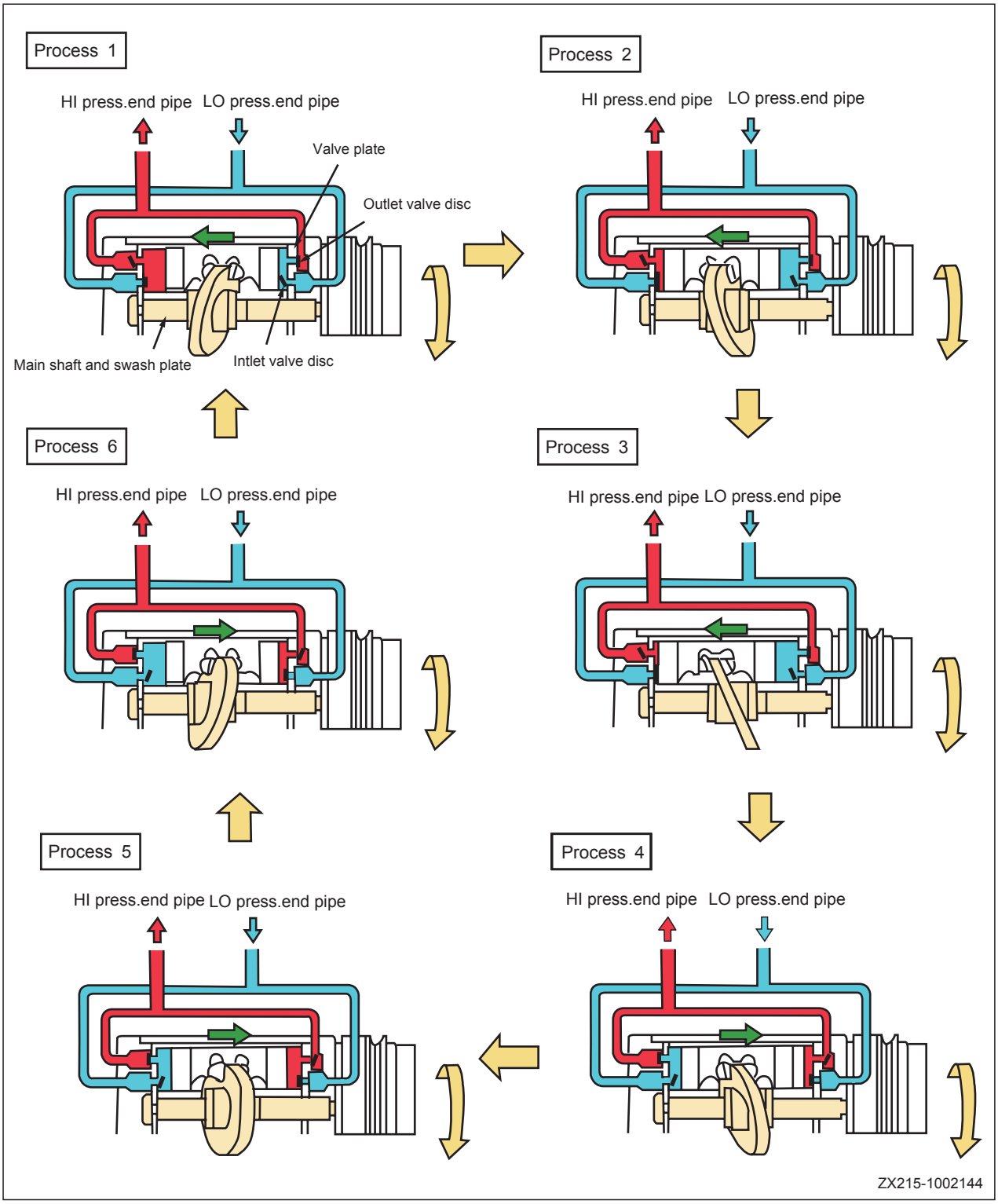


1- Stator
2- Front radial bearing
3- Thrust bearing
4- Front radial bearing
5- Rear cylinder head
6- Safety valve
7- Rear cylinder block
8- Swash plate
9- Slipper
10- Front cylinder block
11- Piston
12- Front cylinder head
13- Shaft seal
14- Main shaft
15- Hub
16- Rotor

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Operating principle

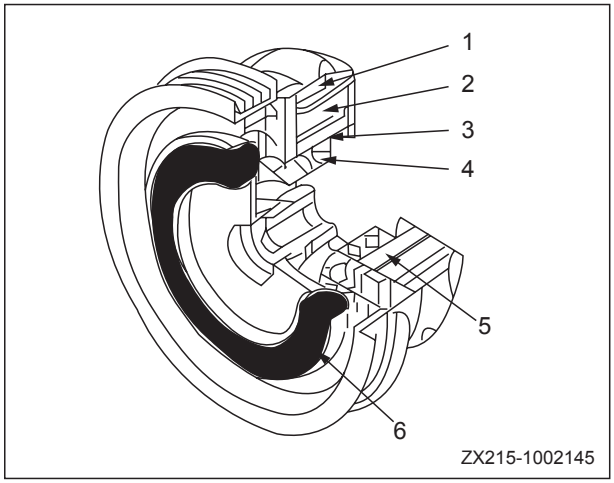
Compressor type: 10S15C. This compressor has 5 plungers in total with a piston on both sides of each plunger. The rotation of the swash plate drives the pistons to move back and forth and transforms the refrigerant sucked from the evaporator from low temperature and low pressure gas state to high temperature and high pressure state.



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4.7.6 Clutch

1- Rotor
2- Stator coil
3- Snap ring
4- Ball bearing
5- Stator
6- Center piece

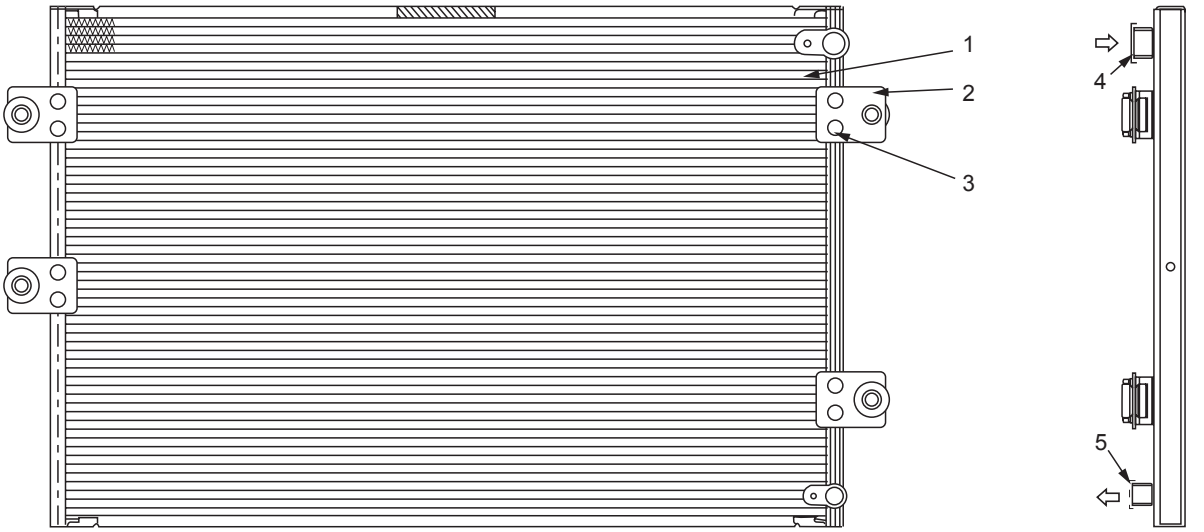


- The electromagnetic clutch is used to transmit moment of torsion. When the engine is operating, the compressor may not be working. The clutch controls the operation of the compressor only when the air conditioner is under refrigerating mode.
- **Operating principle**

  When the A/C switch is turned on, the clutch coil with an electromagnet generates a magnetic field and attracts the metal piece. The stator and rotor of the clutch are engaged and drives the main shaft of the compressor into rotation.

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4.7.7 Condenser



ZX215-1002146

1- Condenser core
2- Bracket
3- Bolt with gasket
4- Refrigerant inlet
5- Refrigerant outlet

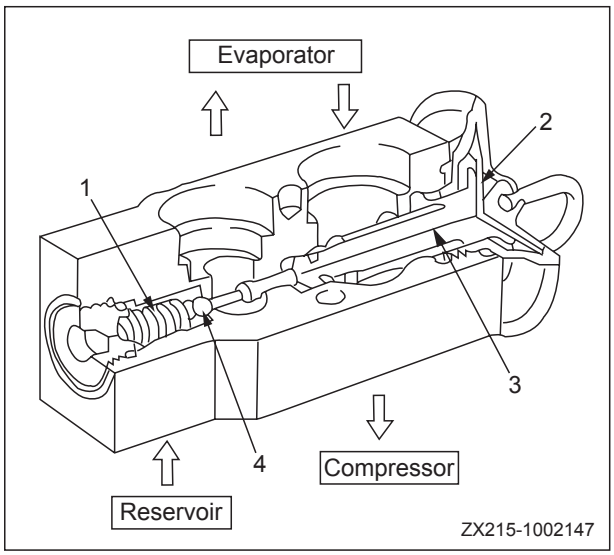
Function

- The condenser changes high-temperature, high-pressure gas refrigerant (16Kg/cm², approx. 80°C) to high-temperature and high-pressure liquid refrigerant (16Kg/cm², below approx. 60°C) through radiating.

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4.7.8 Expansion valve

1- Spring
2- Diaphragm
3- Probe
4- Needle valve

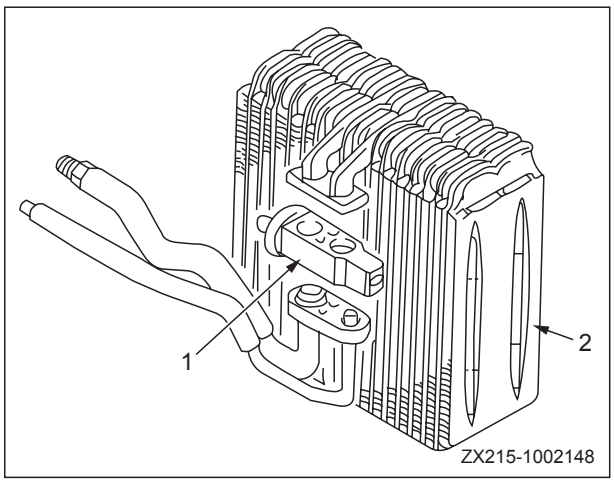


Operating principle

- Refrigerant from the reservoir spurts out via the orifice, turns into low-temperature, low-pressure liquid (mist) after expanding, and enters the evaporator.

4.7.9 Evaporator

1- Expansion valve
2- Evaporator



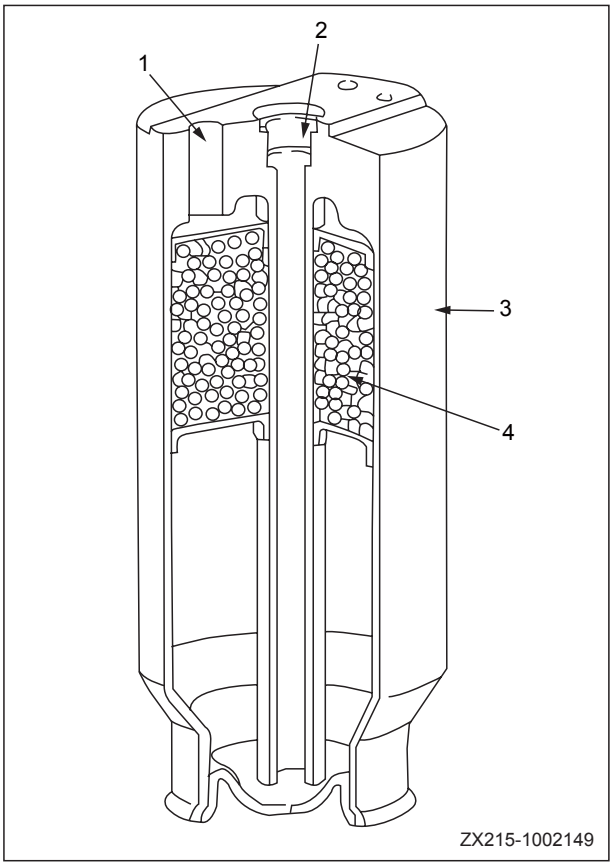
Operating principle

- The evaporator is a kind of heat exchanger that looks like a condenser. Hot air in the cab is conducted into the evaporator via the blower motor and undergoes heat exchange with the surface of the evaporator. Heat is absorbed and hot air turns into cold air, which flows into the cab through the air ducts. Evaporator surface absorbs heat→Refrigerant in the evaporator absorbs heat → Refrigerant evaporates . Evaporated refrigerant (gas) is absorbed by the compressor.

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4.7.10 Dehydrator

1- Inlet
2- Outlet
3- Receiver/dehydrator
4- Desiccant



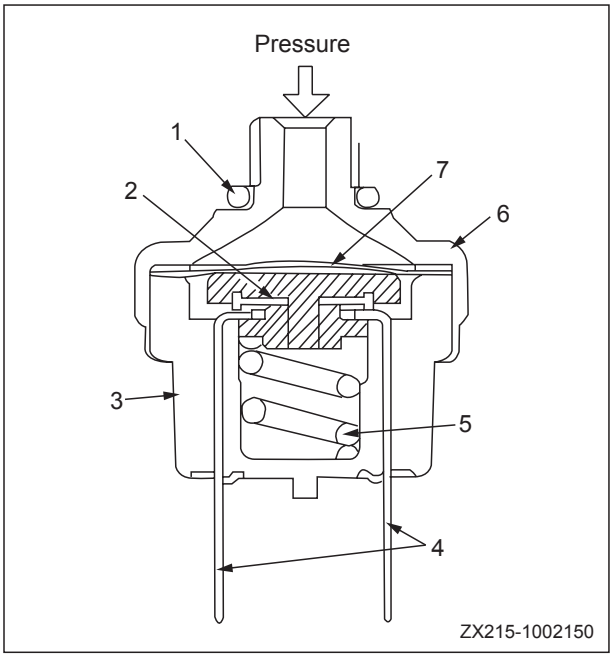
Function

- Temporary storage of refrigerant
- Dehydration of refrigerant
- Dust removal from refrigerant
- Measure the volume of refrigerant

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4.7.11 Pressure switch

1- O-ring
2- Mobile contact point
3- Hood
4- Plug and fixed contact
5- Spring
6- Chamber
7- Diaphragm



Function

- The pressure switch is installed between the reservoir and the expansion valve (hi-pressure pipe). It is a combination switch (Hi-Lo pressure combination switch).
- When pressure is excessively high, the compressor stops.
- When pressure and temperature is very low, the compressor stops.

Operating features

	Feature
HI pressure operating value LO pressure operating value	DIFF ON DIFF Above 0.02 MPa 0.59±0.2 MPa OFF 2.94~3.19 MPa 0.196±0.02 MPa 0.196~0.250 MPa
MID pressure operating value	ON OFF 1.23±0.1 MPa 1.52±0.08 MPa

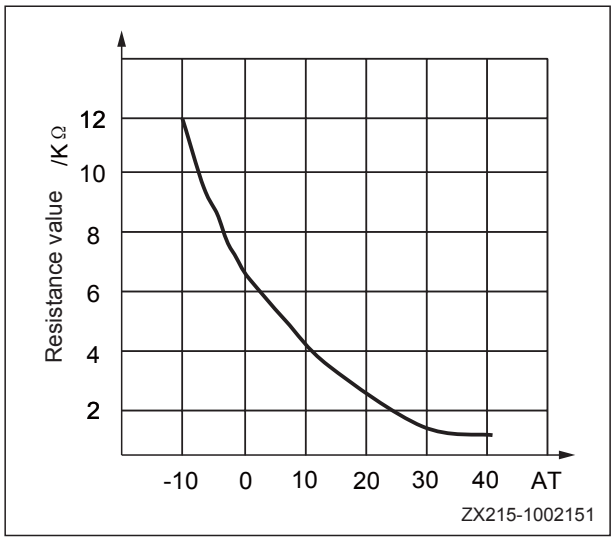
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4.7.12 Fresh air sensor

The fresh air sensor is installed beside the condenser or around the fresh air inlet. It measures the temperature of outside air and it is composed of thermistors.

Technical specifications

Item	Specification
Service voltage range	4.4~5.6 V
Service temp range	-30~60 °C
Storage temp range	-40~90 °C
Resistance value	1700±85Ω
B constant	3900±195 K
Allowable operating current	1.6 mA (MAX)



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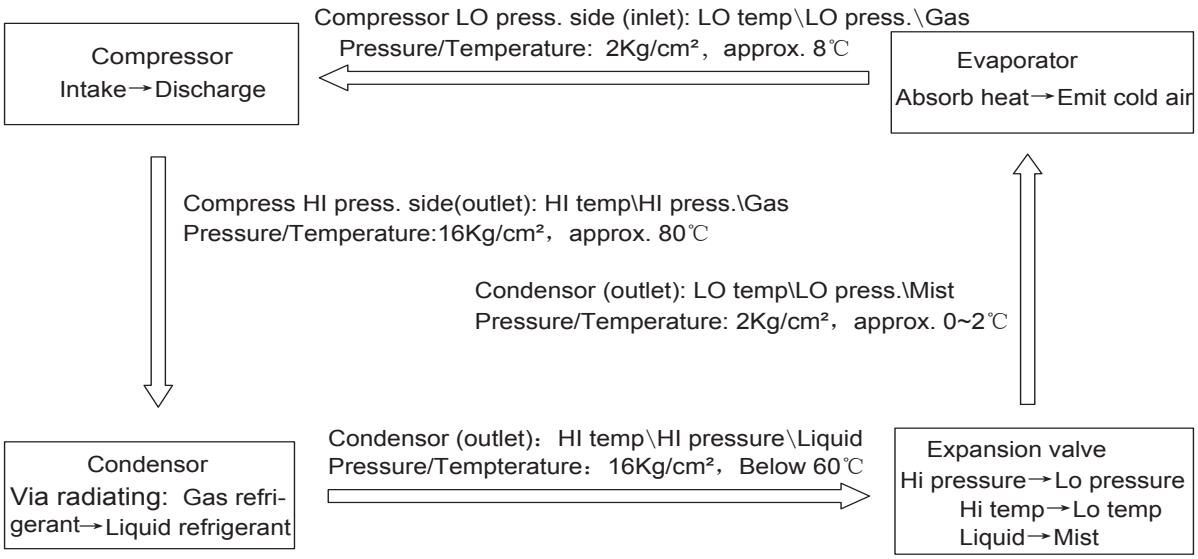
4.7.13 Refrigerant

1. General property of refrigerant

- High heat absorption and easy liquefaction
- Non-flammable, nonexplosive
- Stable chemical composition
- Non-toxic
- Non-corrosive
- No hazard to clothing

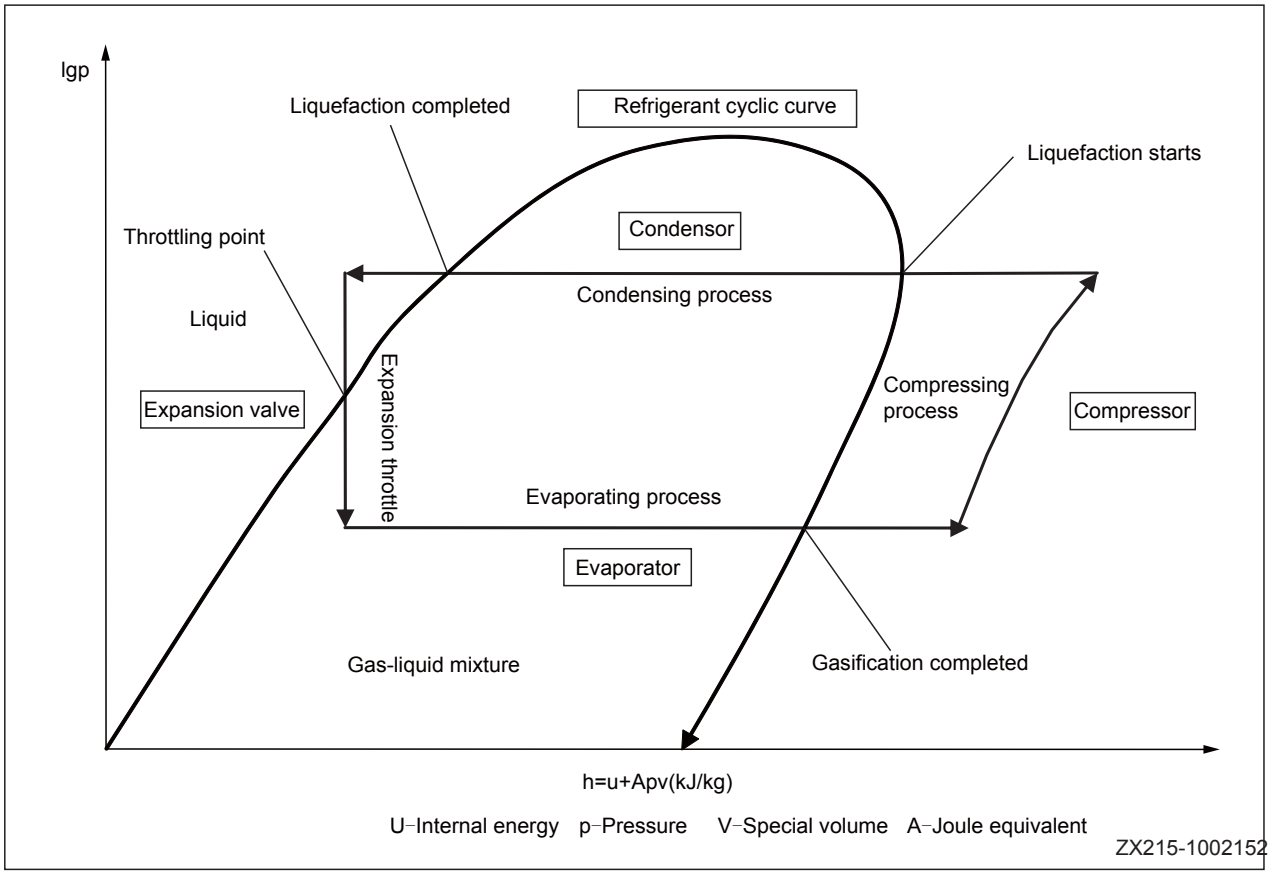
2. Refrigerant cycle

- After evaporation in the evaporator, refrigerant turns from gas into liquid via the compressor and the condenser, which finishes a refrigerant cycle.



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- Refrigerant cycle principle (pressure - enthalpy diagram)

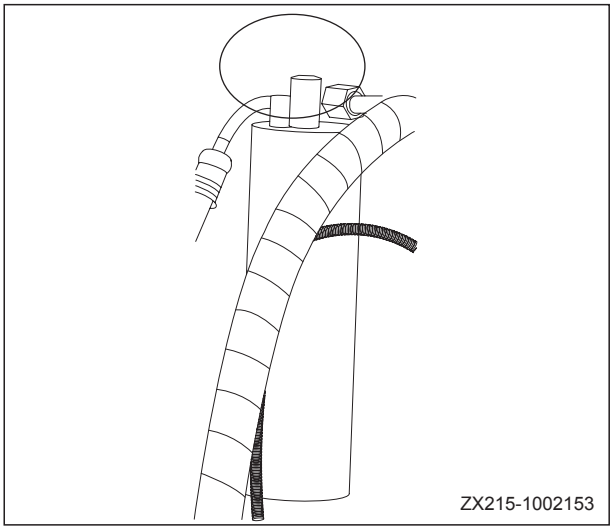


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3. Feeding of refrigerant

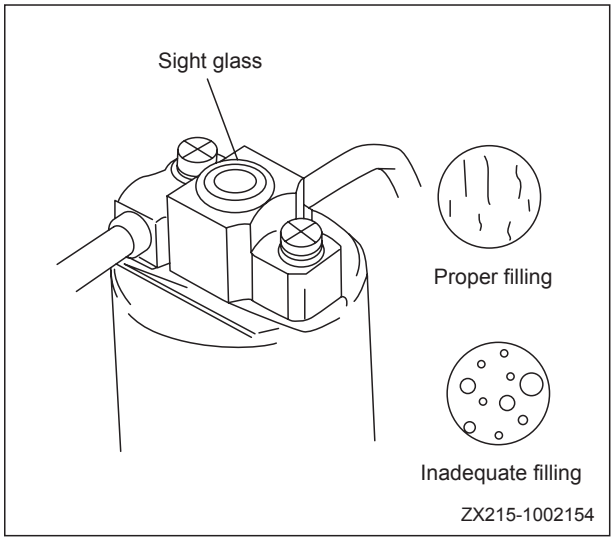
- Filling method and volume:

1) Refrigerant: HFC-134a
2) Feeding volume: 900±50 g (for reference)
3) Feeding method: Feeding of liquid refrigerant from the low-pressure end is not allowed. If feeding operation fails, discharge the refrigerant that has been fed before re-feeding.


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- Inspect the state of the refrigerant in the A/C circulation system through the sight glass:

1) Correct feeding: Foam is hardly observed when the refrigerant is flowing. When engine speed increases from idling to 1500 rpm, foam disappears and the refrigerant turns clear.
2) Over-feeding: No foam can be observed when refrigerant is flowing.
3) Under-feeding: Foam is always observed when refrigerant is flowing.



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4. Evacuation

- Reason for evacuation

  No moisture shall be mixed inside the air conditioning unit. Refrigerant (R134a) is soluble in water. Very small amount of moisture in the unit can cause the orifice of the expansion valve to ice up, or cause the valve of the compressor to rust. To avoid such problems, moisture in the system shall be removed before refrigerant is fed. To reduce the residual moisture in the system to the minimum, moisture in the system can evaporate through evacuating. No better means is available so far.

- Evacuating steps

1) Connection of manifold pressure gauge:

   i) Close the high-pressure valve (HI) and low-pressure valve (LO) of the manifold pressure gauge.

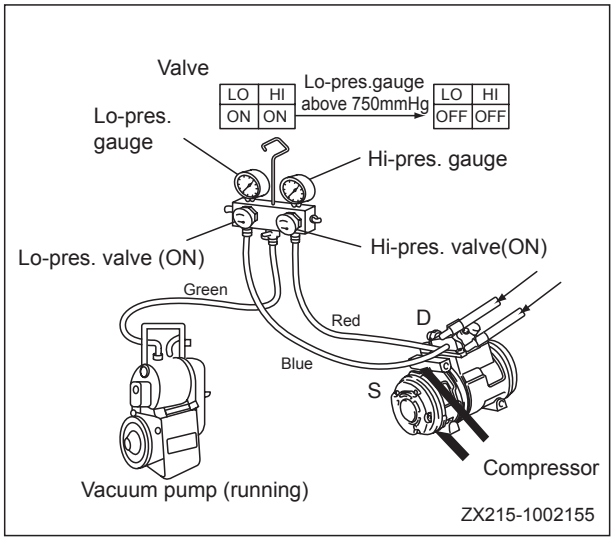
   ii) Connect the hoses (red, blue) to the auxiliary valve of the compressor.

   Red hose – High pressure side (Mark D)

   Blue hose – Low pressure side (Mark S)

   ★ Connect the end of the hose with a L to the auxiliary valve of the compressor. If connected inversely, the valve will not open. Besides, do not inversely connect the high-pressure end and the low-pressure end.

   iii) Connect the green hose to the vacuum pump.



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2) Evacuating

i) Open the high-pressure valve (HI) and low-pressure valve (LO) on the manifold pressure gauge.

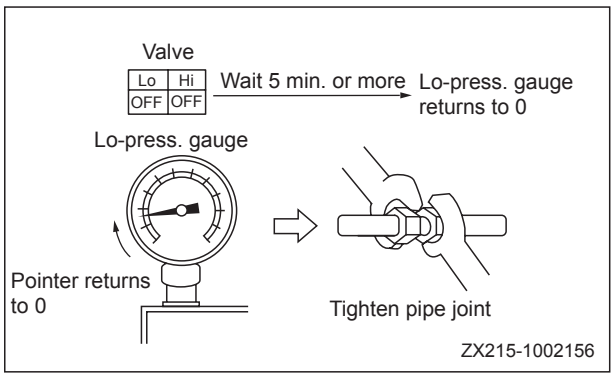
ii) Turn on the vacuum pump and evacuate for about 15 minutes.

iii) When negative pressure reading on the gauge (degree of vacuum) reaches above 750 mmHg, turn off the vacuum pump and close the Hi-pressure valve and the Lo-pressure valve on the gauge.

3) Air - proof check

i) Keep the Hi- and Lo-pressure valve of the manifold pressure gauge under closed state for more than 5 minutes, and make sure the pointer on the gauge does not return to zero.

ii) If the pointer returns to near zero, a leakage is available somewhere. Check and adjust the pipe joint. Tighten the joint and conduct another evacuating operation until no leakage is detected.

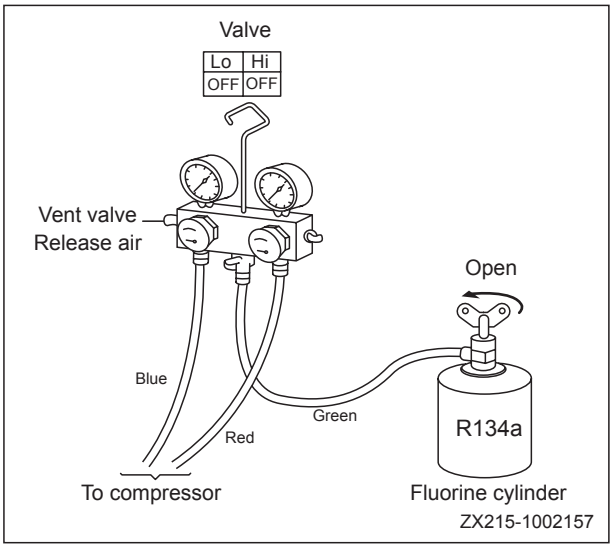


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4) Leak check

i) Connect the green hose that is previously connected to the vacuum pump to the fluorine cylinder.

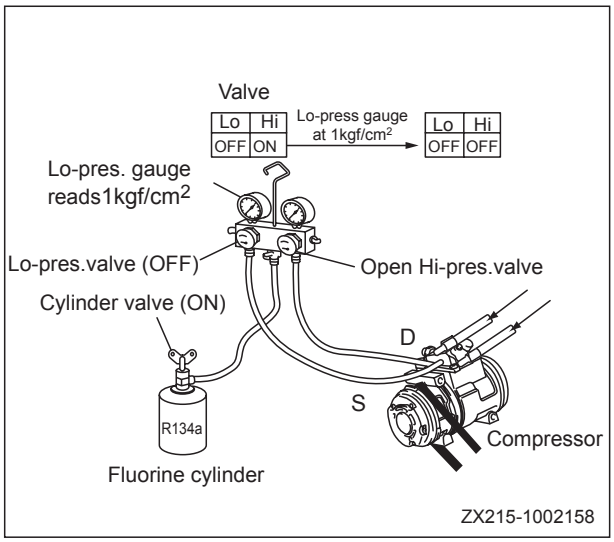
ii) Connect the other end of the green hose to the pressure gauge. Open the valve of the cylinder and press the vent valve of the pressure gauge. (Do not press the valve with naked hand to avoid frostbite caused by refrigerant). Release the air in the hose with the pressure of the refrigerant. (Release the vent valve when you hear a squeezing sound).



iii) Add refrigerant until pressure reading on the Lo-pressure gauge is 1kgf/cm2 . Hi-pressure valve of the gauge is open at this time. Close the Hi-pressure valve when feeding is finished.

iv) Use a leak detector to check if leakage is available in the cooling system.

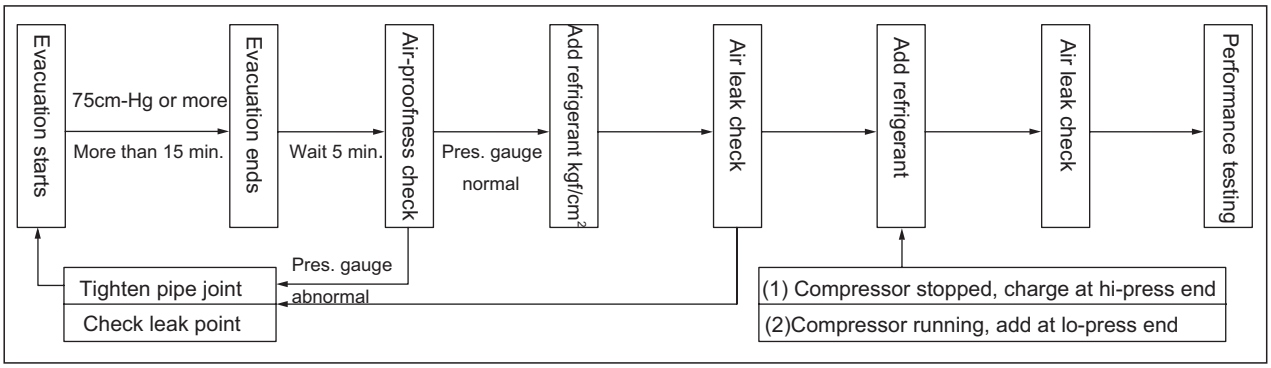
v) Make necessary repairs (tightening) if leakage is observed.



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5. Refrigerant charging operation

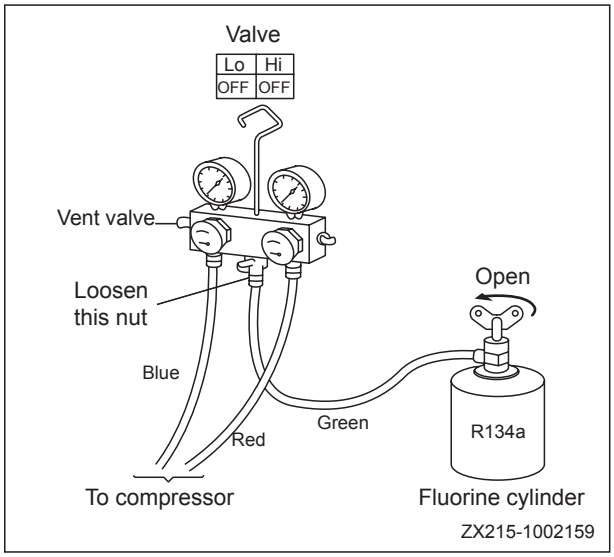
- When evacuation is finished, add refrigerant into the cooling system as per the following instruction:



- Charge at hi-pressure side

1) Remove the air green hose of the manifold pressure gauge from the vacuum pump and connect it to the fluorine cylinder.
2) Open the valve of the cylinder and press the vent valve on the pressure gauge. Use the pressure of the refrigerant to release the air in the hose.

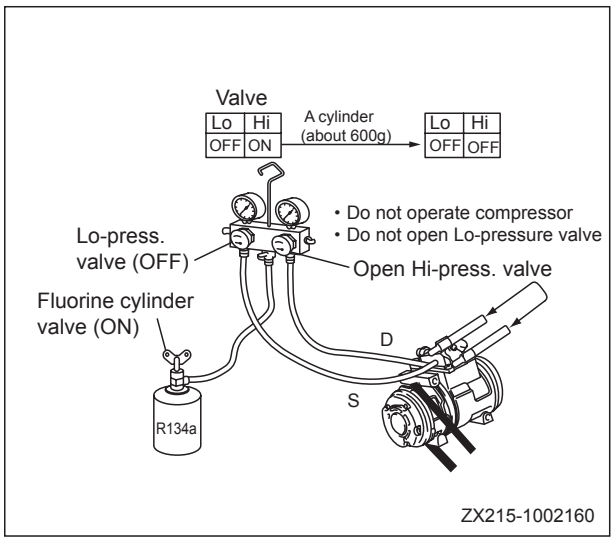
⚠ Release the vent valve when you hear a hissing sound. Do not press the vent valve with naked hand to avoid frostbite.



3) Open the hi-pressure valve of the manifold pressure gauge and the valve of the cylinder and fill the cylinder with refrigerant (approx.600 g)

⚠ At this time, do not operate the compressor when refrigerant charging is in progress. Otherwise, refrigerant will counterflow and cause the cylinder and hoses to explode.

⚠ Do not operate the compressor when there is no refrigerant. Otherwise, it will be damaged.



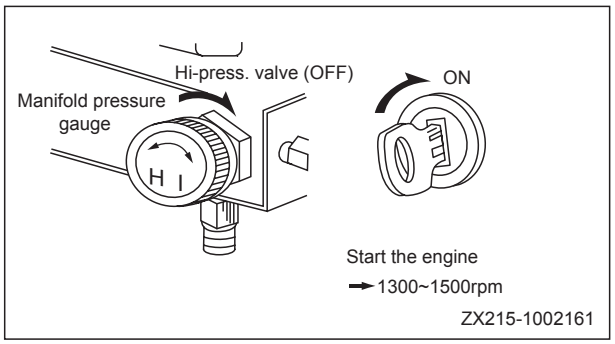
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⚠ Do not open the lo-pressure valve of the manifold pressure gauge; otherwise, the compressor will be damaged.

4) Close the hi-pressure valve of the pressure gauge and the valve of the fluorine cylinder.

- Charge at lo-pressure side (additional)

1) Confirm the hi-pressure valve of the manifold pressure gauge is closed.
2) Start the engine and open the cab door.
3) Turn on the air conditioner, and set Temperature control switch to minimum.
4) Adjust engine speed to 1300 – 1500 rpm.
5) Open the Lo-pressure valve of the manifold pressure gauge and the valve of the fluorine cylinder, and add refrigerant into the reservoir until no foam is observed.



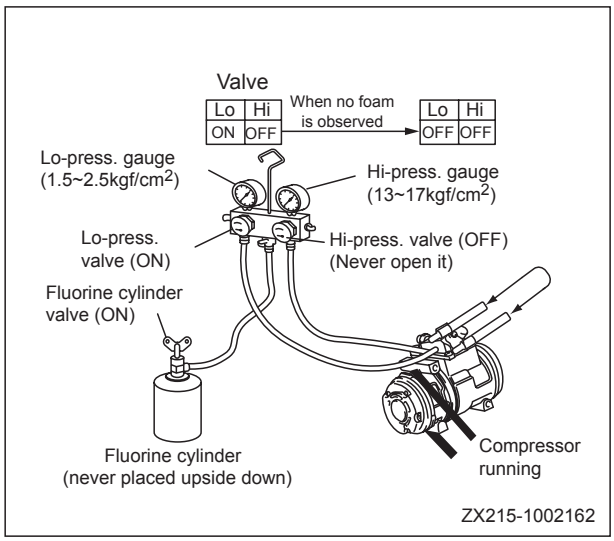
Remark:

Manifold pressure gauge reading (for reference):

High pressure 13~17kgf/cm² (outside temperature 30°C)

Low pressure 1.5~2kgf/cm² (outside temperature 30°C).

6) When refrigerant charging is finished, close the Lo-pressure valve of the manifold pressure gauge and the valve of the fluorine cylinder.
7) Check carefully for air leaks with a leak detector.



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⚠ Never open the Hi-pressure valve of the manifold pressure gauge. If it is opened, high-pressure gas will counterflow and cause the air hoses and the fluorine cylinder to explode.

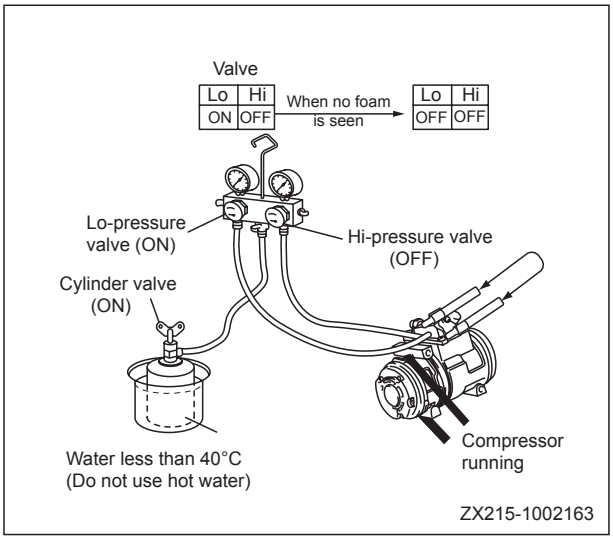
⚠ Do not position the fluorine cylinder upside down (when engine is operating and charging in progress). Otherwise, liquid refrigerant will be sucked directly into the compressor and cause liquid compression, resulting in damage to the compressor valve and the gaskets. Place the cylinder vertically and charge gas refrigerant.

8) When outside temperature is low

When refrigerant charging can not be performed due to low outside temperature, place the cylinder in water of less than 40C to increase the pressure of the refrigerant inside the cylinder.

9) When outside temperature is high

When outside temperature is very high, cool the compressor with an electrical fan.



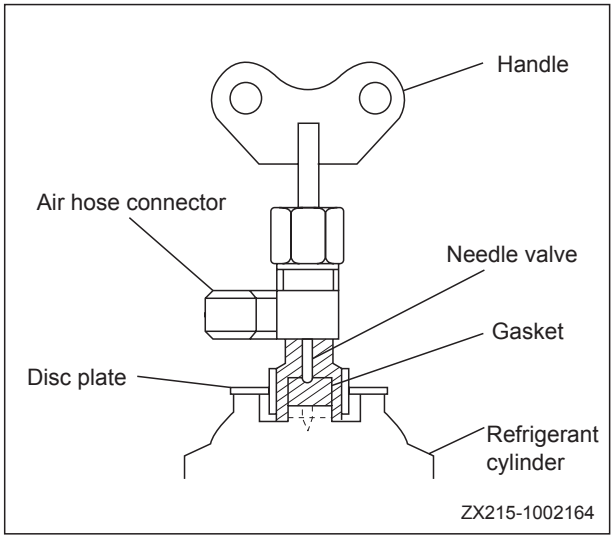
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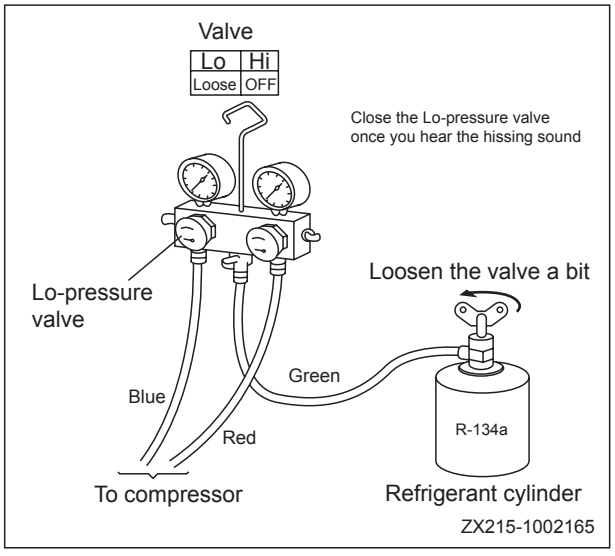
- Replace the fluorine cylinder

  When the refrigerant in a cylinder is used up, replace the cylinder as per the following instruction:

1) Close the Hi- and Lo-pressure valves of the manifold pressure gauge.
2) Raise the needle and disc plate of the cylinder and remove the empty cylinder.
3) Install a new cylinder onto the cylinder valve.
4) Release the air in the hose as per the following instruction:
   - i) Tighten the valve of the fluorine cylinder, and then, loosen it a bit.
   - ii) Open the Lo-pressure valve of the manifold pressure gauge a bit.
   - iii) Press the vent valve and allow a little refrigerant to come out. Immediately close the valve of the cylinder and the Lo-pressure valve of the manifold pressure gauge.

   ★ Do not press the vent valve with naked hand to avoid frostbite by refrigerant.
5) Turn the handle of the cylinder valve to pierce the cylinder and continue charging operation.





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6. Fault testing with manifold pressure gauge

After the engine has been preheated, read the pressure value on the gauge under the following conditions:

1) Temperature at air inlet: 30 – 35°C
2) Engine speed: 1500 rpm
3) Fan speed: High
4) Temperature control: Minimum.
5) Air circulation mode: Recirculation

- Refrigerating system under normal condition

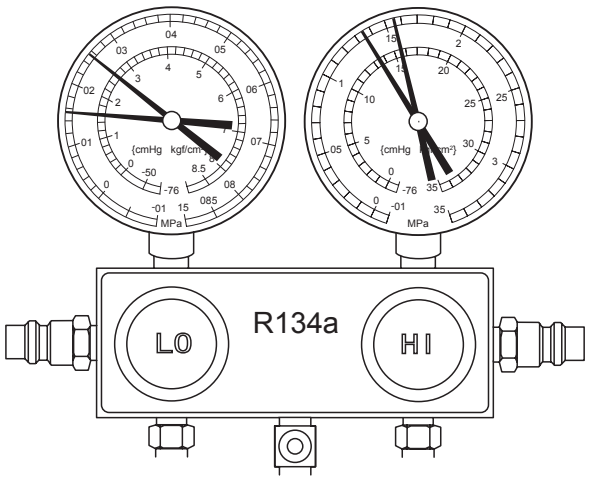
Gauge reading:

Lo-pressure end:

0.15~0.25 Mpa (1.5~2.5 Kgf/cm²)

Hi-pressure end:

1.37~1.57 Mpa (14~16 Kgf/cm²)

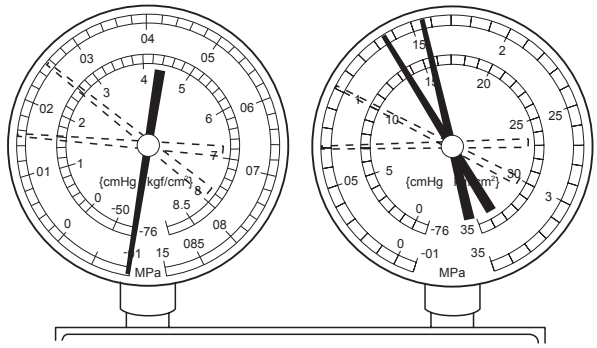


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- Moisture in the refrigerating system

Symptom: Intermittent refrigeration to non-refrigeration



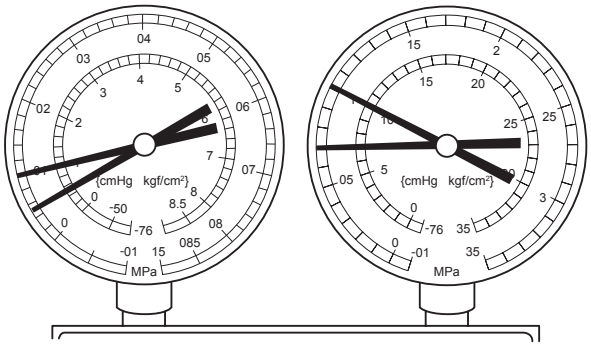
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Symptom	Cause	Analysis	Remedy
● When the system is operating, pressure at the Lo-pressure end unstable (sometimes vacuum, sometimes normal)	● Moisture in the system ices up at the expansion valve causing circular temporary stop. When ice melts, the system becomes normal again.	● Over-saturation of dehydrator. ● Moisture in the system ices up at the expansion valve and hinders the circulation of the refrigerating system.	● Replace receiver/ dehydrator ● Remove the moisture in the system through constant pumping. ● Add proper volume of new refrigerant.

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- Insufficient refrigeration

Symptom: Insufficient refrigeration



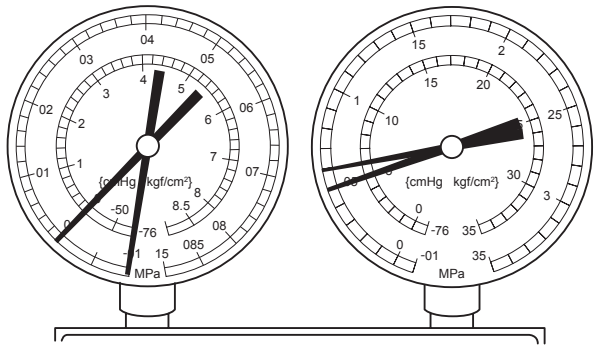
ZX215-1002169

Symptom	Cause	Analysis	Remedy
• Pressure at both Hi- and Ho-pressure ends very low • Foam is continuously observed via the sight glass • Insufficient refrigeration.	• Air leaks somewhere in the refrigerating system	• Insufficient refrigerant in the system • Leak of refrigerant	• Check for air leakage with a leak detector. Make necessary repairs. • Add proper amount of refrigerant. • When connected with the gauge, if the reading is near zero, set the system under vacuum state after inspection and repair.

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- Defective refrigerant circulation

Symptom: insufficient refrigeration



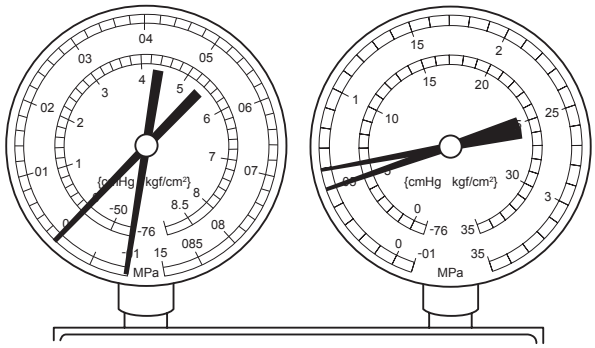
ZX215-1002170

Symptom	Cause	Analysis	Remedy
● Pressure at both Hi- and Lo-pressure sides very low ● Frosting on the piping between parts and reservoir	● Contaminant in the reservoir hinders the flow of refrigerant.	● Blocked reservoir	● Replace reservoir

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- Refrigerant not circulating

Symptom: Non-refrigeration (intermittent refrigeration)



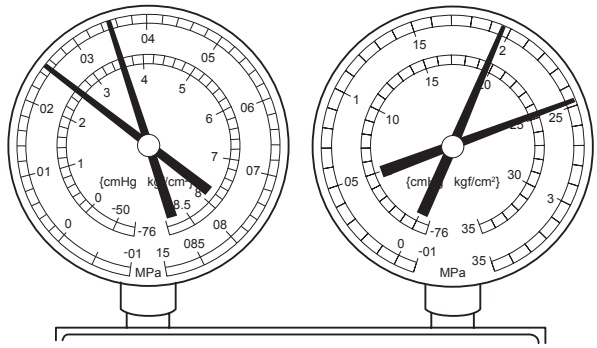
ZX215-1002171

Symptom	Cause	Analysis	Remedy
● Vacuum at Lo-pressure side; pressure at Hi-pressure side extremely low ● Frosting or condensation on the pipes around the expansion valve or receiver/dehydrator	● Moisture or contaminant in the refrigerant hinders the flow of refrigerant. ● Air leak at the thermal pipe of the expansion valve hinders the flow of refrigerant.	● Refrigerant not circulating	● Check the expansion valve and ERP. ● Blow the contaminant in the expansion valve or replace the expansion valve if necessary. ● Replace the receiver ● Release internal air and add refrigerant. If air leaks from thermal pipe, replace expansion valve.

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- Over-charging of refrigerant or insufficient refrigeration of condenser

Symptom: Insufficient refrigeration



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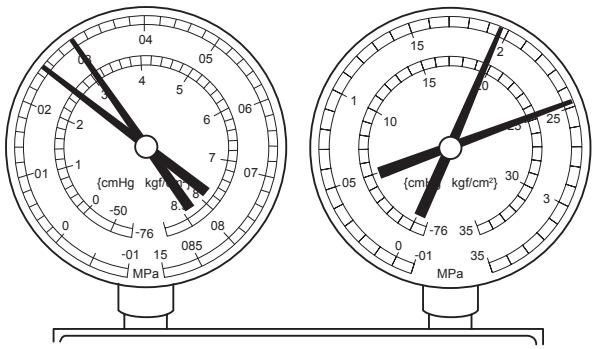
Symptom	Cause	Analysis	Remedy
● Pressure at both Hi- and Lo-pressure sides very high ● No foam can be observed via the sight glass even when engine speed drops.	● Over-filling of refrigerant in the system. Refrigerating performance inadequate. ● Insufficient refrigeration of condenser	● Over-filling of refrigerant ● Condenser fins clogged or fan motor error.	● Clean the condenser ● Check the working condition of fan motor ● If the two above items are normal, check the volume of refrigerant. Add refrigerant.

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- Air is observed in the refrigerating system

Symptom: Poor refrigeration

If refrigerant is added with no evacuation operation performed, the following gauge reading will appear:



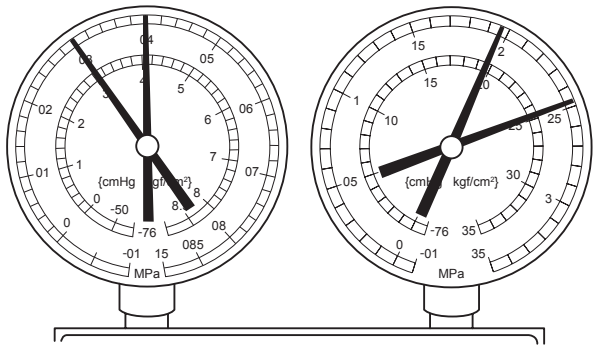
ZX215-1002173

Symptom	Cause	Analysis	Remedy
● Pressure at both Hi- and Lo-pressure ends very high ● Lo-pressure piping feeling hot ● Foam is observed through the sight glass	● Air enters the refrigerating system	● Air enters the refrigerant system ● Insufficient evacuation	● Check if compressor oil is contaminated or inadequate. ● Evacuate and add new refrigerant.

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- Improper installation of expansion valve/thermal pipe defect (wide opening)

Symptom: insufficient refrigeration



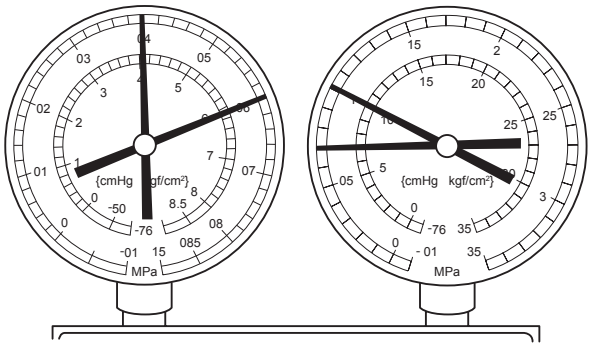
ZX215-1002174

Symptom	Cause	Analysis	Remedy
• Pressure at both Hi- and Lo-pressure ends very high • Frosting or condensation on Lo-pressure piping	• Expansion valve defect, or improper installation of thermal pipe	• Over-filling of refrigerant in Lo-pressure piping • Expansion valve opening very wide	• Check the installation of thermal piping • If thermal piping is normal, check the expansion valve. Replace defective expansion valve if observed.

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- Compressing error

Symptom: No refrigeration



ZX215-1002175

Symptom	Cause	Analysis	Remedy
• Pressure at Lo-pressure side very high • Pressure at Hi-pressure side very low	• Compressor internal leakage	• Compressing fault; • Leaking or damaged valve, loosened parts	• Repair or replace compressor

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4.7.14 Compressor oil

Oil shall be added into the A/C system for lubrication. Compressor oil is solved in the refrigerant and circulates in the system. When the air conditioning system is shut down, compressor oil will stay inside the components. If no compressor oil is added into the system when replacing components, inadequate lubrication will result. Add compressor oil according to the chart below:

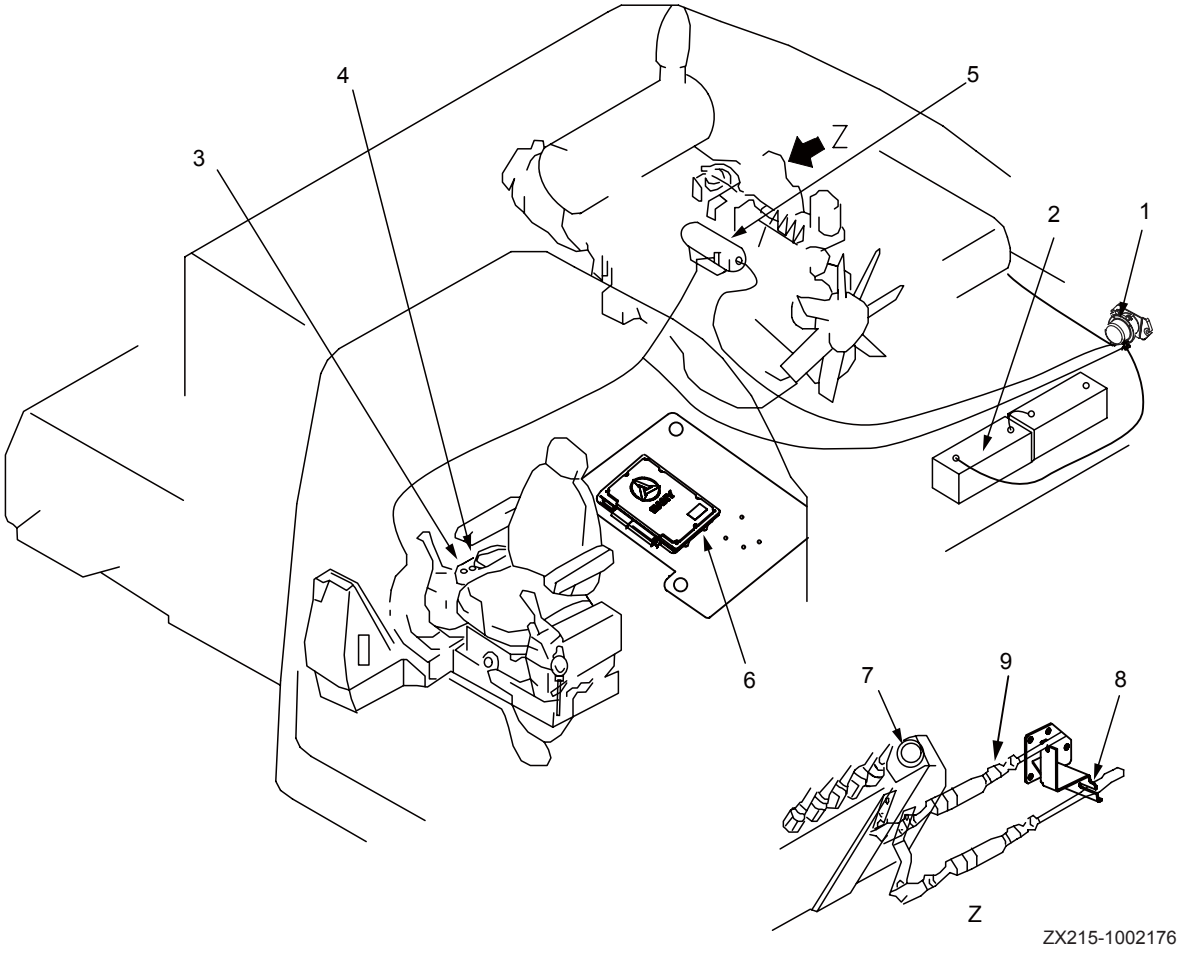
	Replaced component		
	Compressor	Condenser	Evaporator
Volume(CC)	See "CAUTION" below	40	40
Compressor oil grade	ND8# (10P, 10PA, 10S series compressor)		
	ND9#(TV series compressor)		

⚠ CAUTION

- **Add oil into a new compressor according to the required volume of the system. When the compressor is to be replaced, discharge the surplus oil in it.**
- **Over-filling of compressor oil will reduce the refrigerating capacity. Short of compressor oil in the system will cause compressor abnormality.**
- **Protect pipe joints and O-rings from contamination when disassembling the compressor.**

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4.8 Engine Control



1- Battery relay
2- Battery
3- Engine start switch
4- Fuel control dial
5- Start motor
6- Engine controller
7- Fuel injection pump
8- Throttle motor
9- Shutdown device

Outline

- Start and stop the engine only with the engine start switch (3).
- The controller (6) receives the signal from the fuel control dial (4) and transmits the drive signal to the throttle motor (8) to control the governor lever angle of fuel injection pump (7) and control the engine speed.
- When engine start switch (3) is turned to the OFF position, the shutdown device (9) closes the injection nozzle of the fuel injection pump and cuts the engine fuel supply. Then, the engine stops.

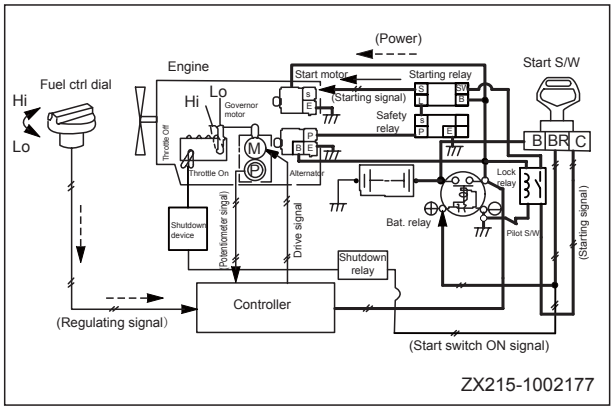
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4.8.1 System operation

4.8.1.1 Engine startup

- When the start switch is turned to the START position, the starting signal is transmitted to the start motor. Then, the start motor rotates to start the engine.

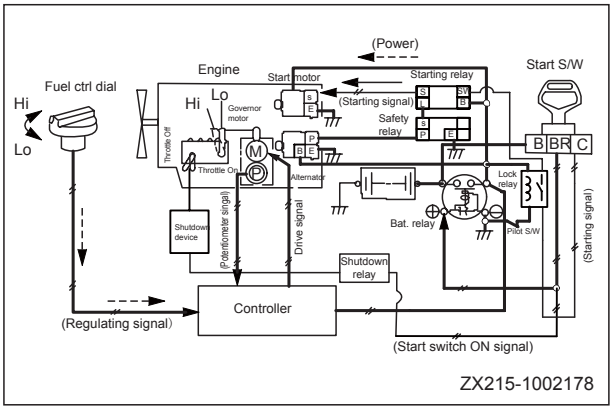
  When it happens, the engine controller checks the signal voltage from the fuel control dial and sets the engine speed to the speed set by the fuel control dial.



4.8.1.2 Engine speed control

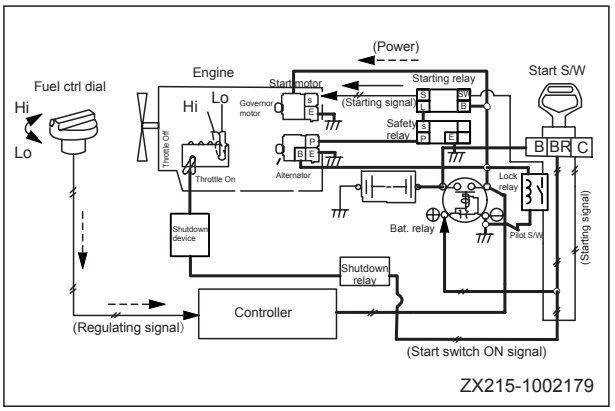
- The fuel control dial sends a signal voltage corresponding to the rotation angle to the engine controller.

  The engine controller sends a driving signal to the throttle motor according to the signal voltage to control the fuel injection pump, and eventually controls the engine speed.



4.8.1.3 Engine shutdown

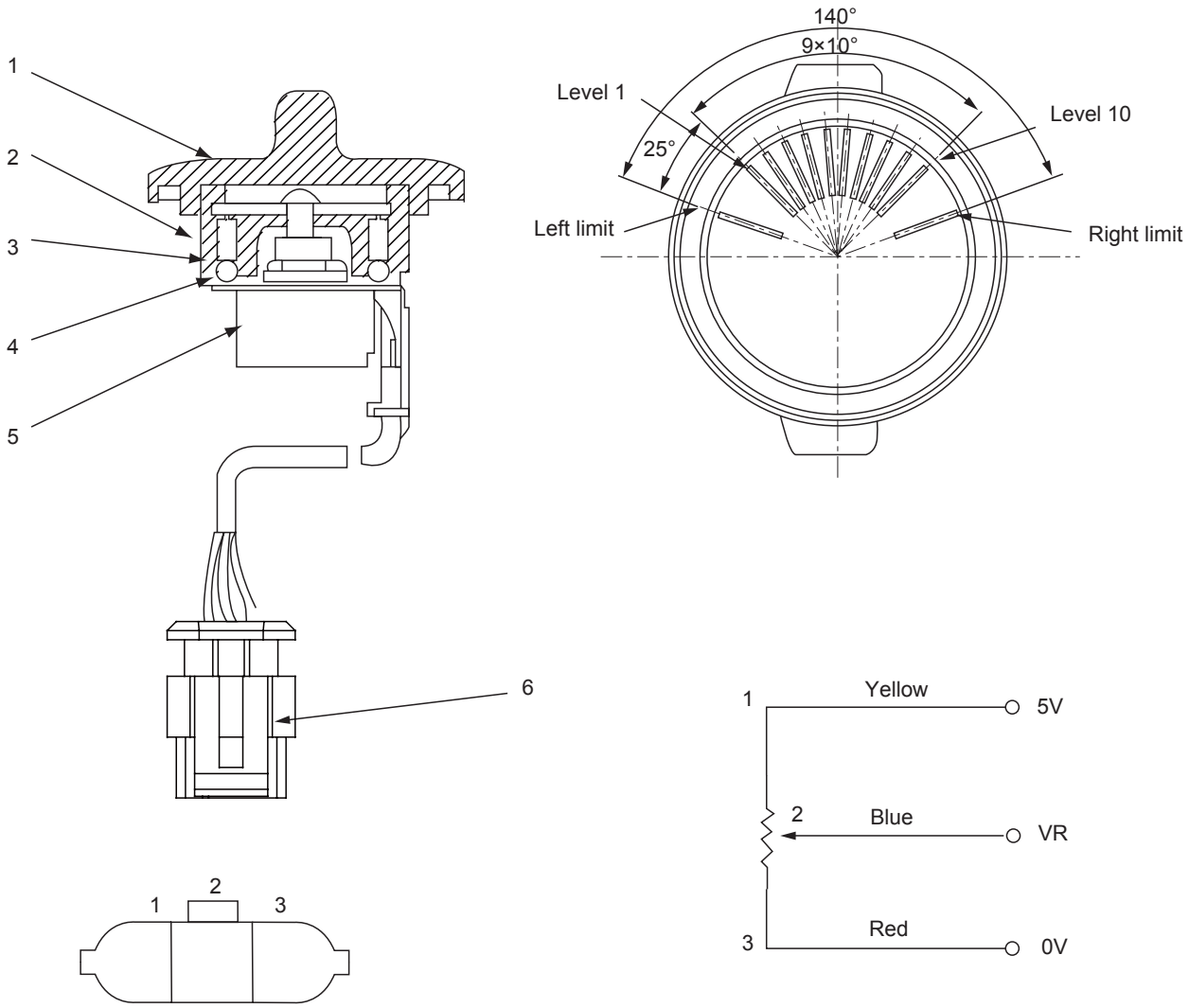
- When the start switch is turned to the OFF position, the controller activates the shutdown device to cut off the fuel supply and stops the engine.



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4.8.2 Components

4.8.2.1 Fuel control dial



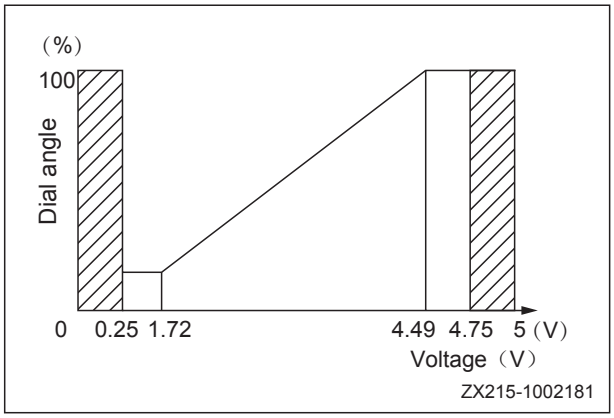
ZX215-1002180

1- Knob
2- Dial
3- Spring
4- Ball
5- Potentiometer
6- Connector

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Function

- Turning of the fuel control dial changes the resistance of the sliding rheostat inside the dial and the voltage signal collected by the controller. The controller calculates the collected signals and drives the throttle motor via signal output and controls the volume of the injection pump so that the engine can run at an optimal speed.
- When throttle voltage is beyond the area, the controller sends out alarm code and the engine runs at low idle. The area under the sloping line is the abnormality detection area.

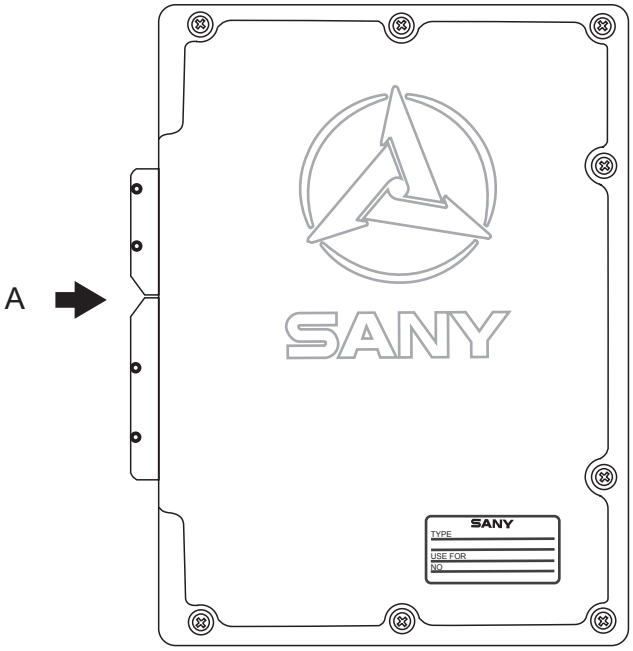


Remark:

The left limit is 0%; and the right limit is 100%.

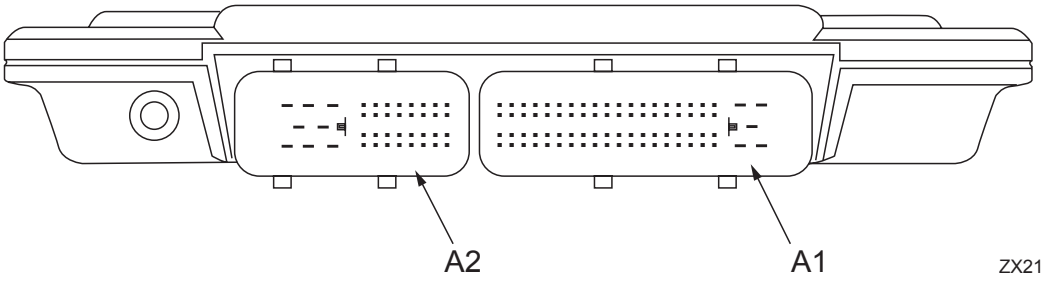
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4.8.2.2 Controller



ZX215-1002182

Controller port layout



ZX215-1002183

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Input and output signals

A1

Pin No.	Signal name	Input/ output
1	Power ground	
2	Power ground	
3	Power ground	
4	Power supply(24V constant)	Input
5	Power supply(24V constant)	Input
11	Fuel level sensor	Input
15	Throttle position signal	Input
19	Engine speed signal	Input
22	RS232 ground	
23	RS232 receive	
24	Enable	
30	Coolant temperature sensor signal	Input
31	Oil temperature sensor signal	Input
33	Backup pilot pressure signal	Input
34	Fuel dial signal	Input
38	Engine speed signal ground	
41	RS232 send	
42	CPU mode	
43	Enable	
48	Engine oil pressure switch	Input
49	L. travel pressure sensor	Input
50	Bucket DUMP pressure sensor	Input
51	Boom LOWER pressure sensor	Input
52	Arm OUT pressure sensor	Input

A2

Pin No.	Signal name	Input/ output
82	Travel speed switching solenoid	
88	Front pump solenoid valve	
89	Rear pump solenoid valve	
97	Swing priority solenoid valve	
98	Bucket confluence solenoid valve	
99	Boom priority 1	
100	Boom priority 2	
104	Motor drive signal +	
113	Motor drive signal -	
114	Power ground	
115	Power ground	
116	Power ground	
117	Power ground	
118	Power supply(24V constant)	
119	Power supply(24V constant)	
120	Power supply(24V constant)	
121	Power supply(24V constant)	

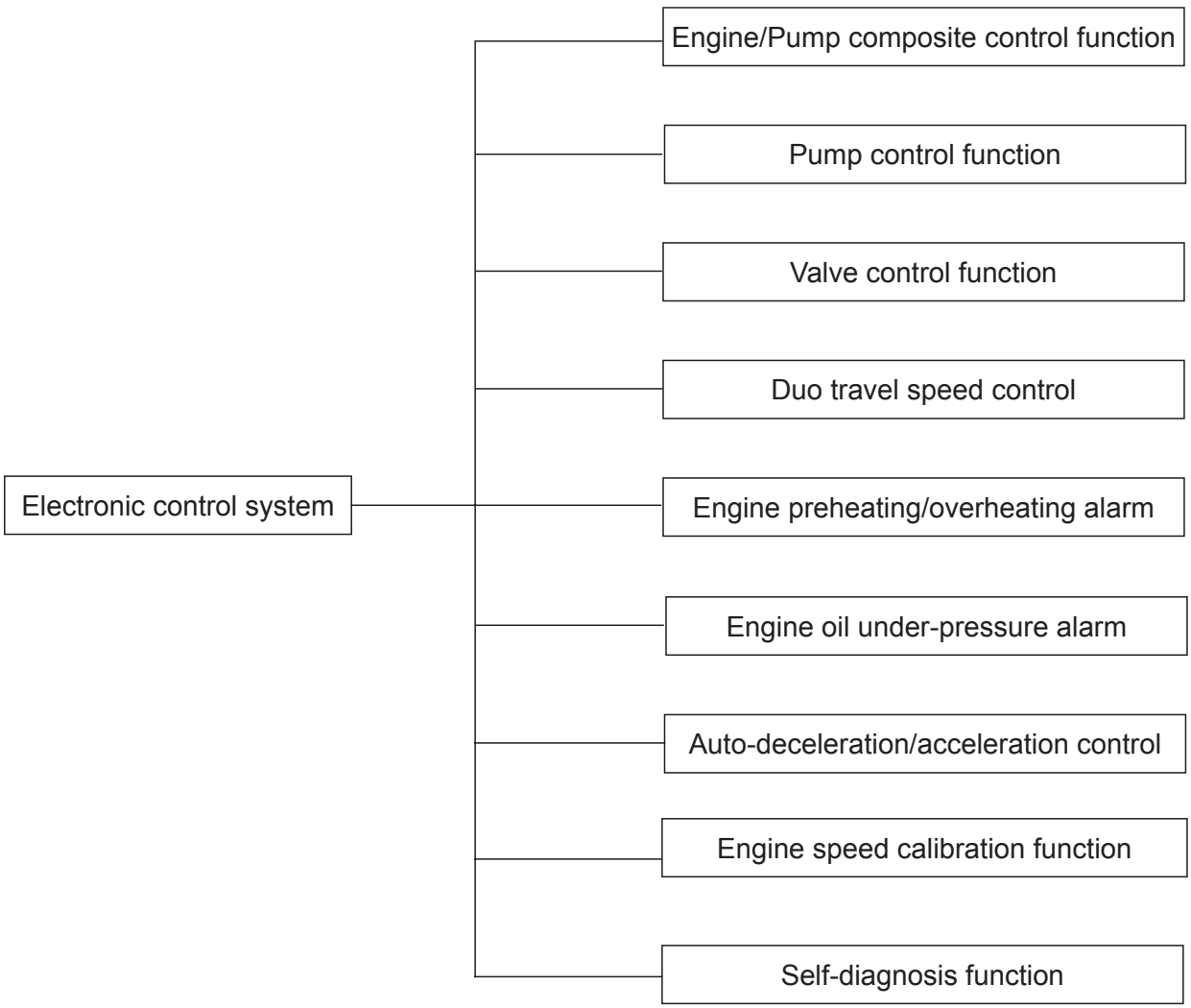
A1

Pin No.	Signal name	Input/ output
53	Rear pump pressure sensor	Input
54	Sensor power ground	Input
55	Sensor power ground	Input
56	Sensor power	Output
60	Monitor CAN Low	
61	Calibrator CAN High	
62	Calibrator CAN Low	
66	Coolant temp very high	Input
67	R. travel pressure sensor	Input
68	Swing pressure sensor	Input
69	Bucket CURL pressure sensor	Input
70	Boom RAISE pressure sensor	Input
71	Arm IN pressure sensor	Input
72	Front pump pressure sensor	Input
73	Sensor PWR ground	
74	Sensor PWR	Output
75	Sensor PWR	Output
76	State indicator	
77	Monitor CAN High	
78	Monitor CAN Low	
79	Setting tool CAN Low	
80	Setting tool CAN shield wire	
81	Setting tool CAN High	

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4.9 Electrical Control System

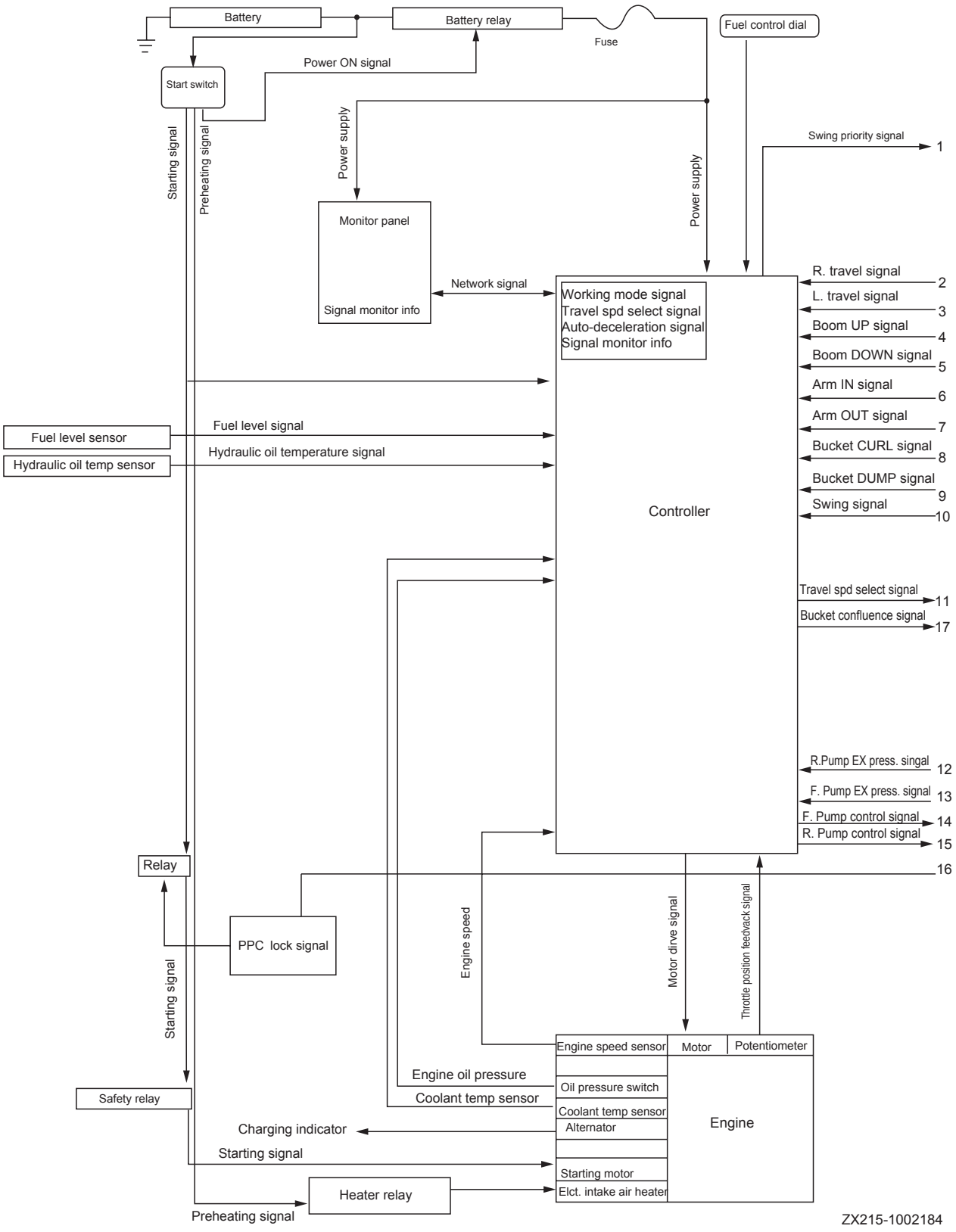
4.9.1 Control function



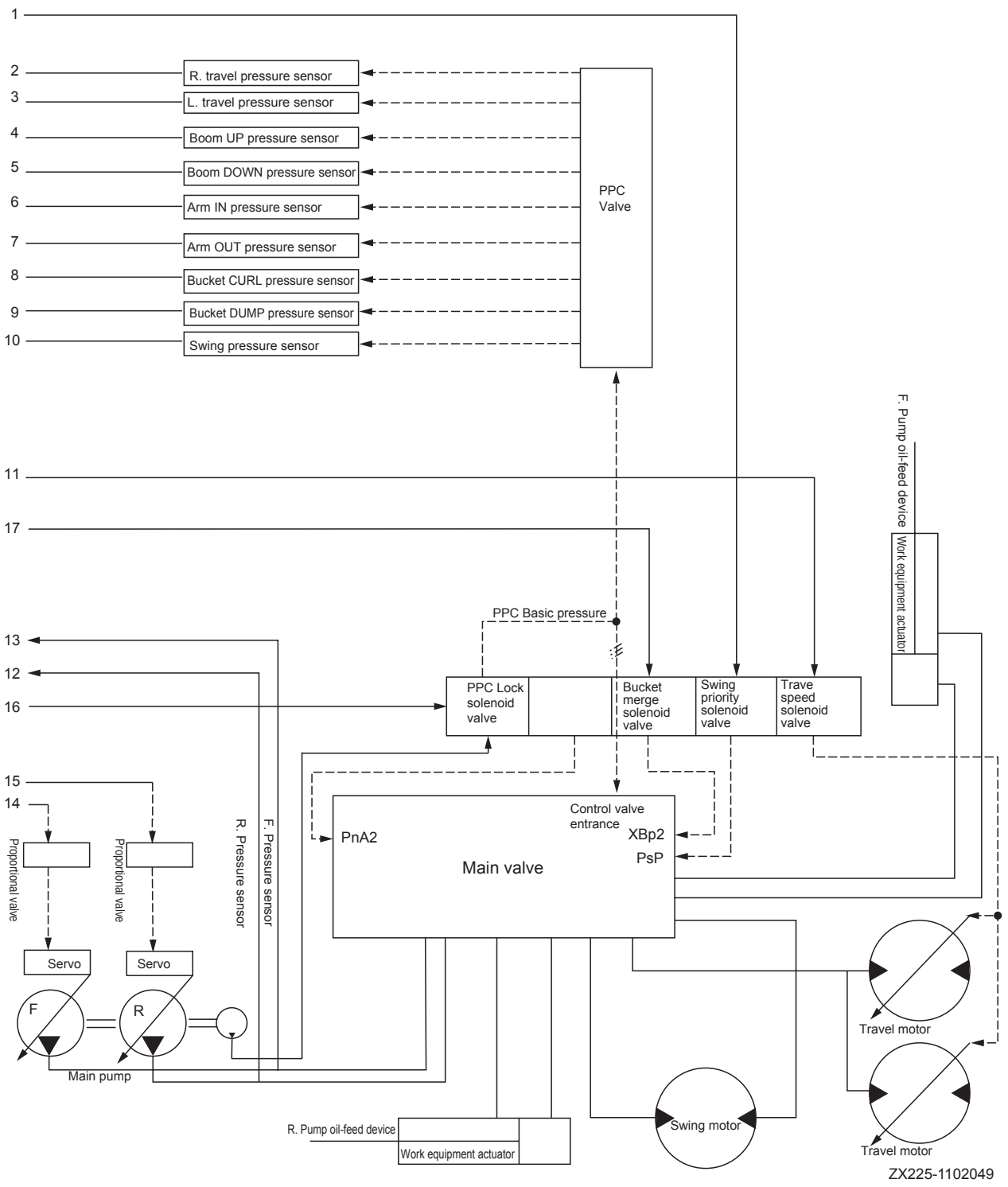
★ For detailed information about self-diagnosis function, see "Troubleshooting"

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4.9.2 Machine control system diagram



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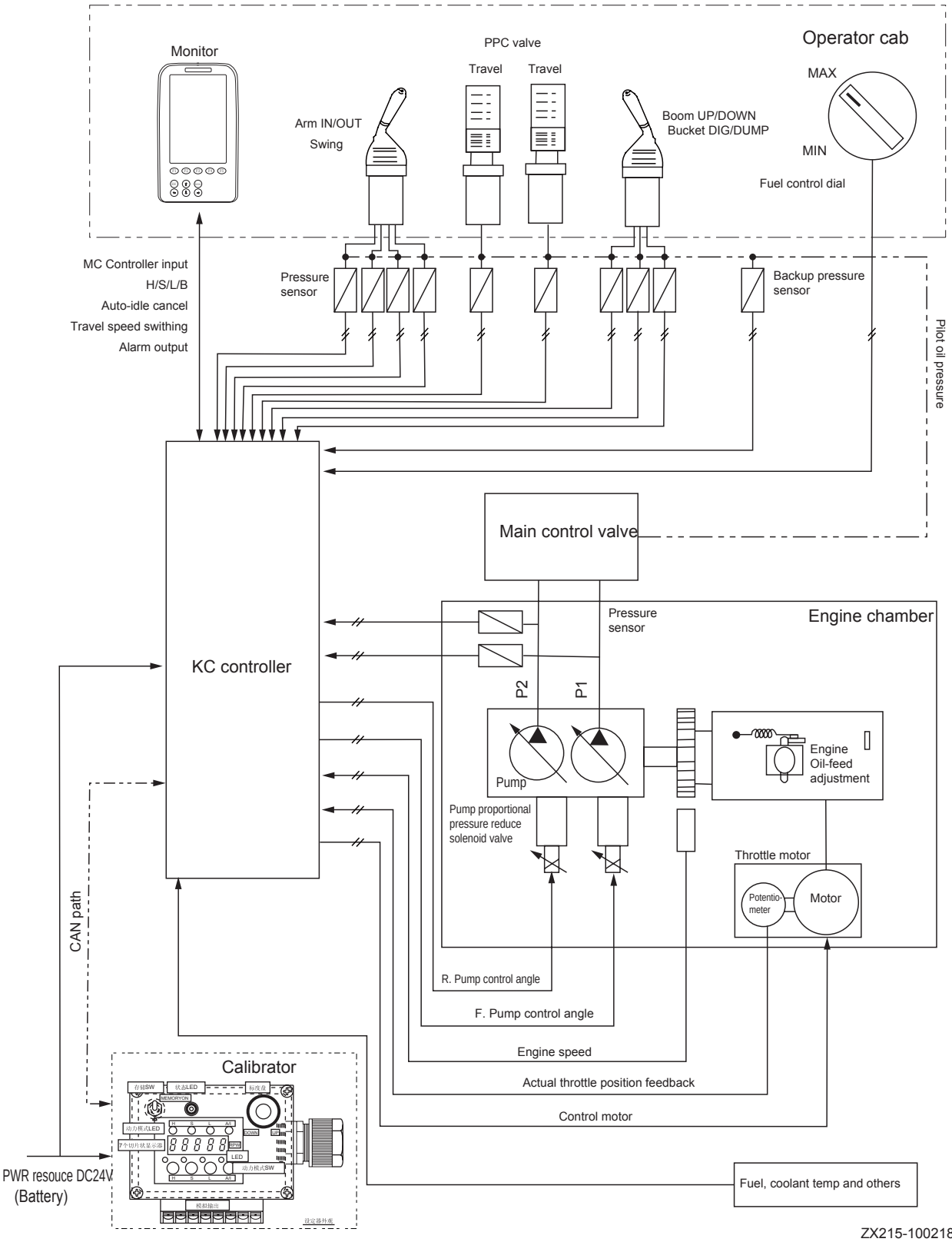


Remark:

The diagram above illustrates the electrical control system. For hydraulic circuit diagram, see Hydraulic System section.

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4.9.3 Engine and pump composite control function

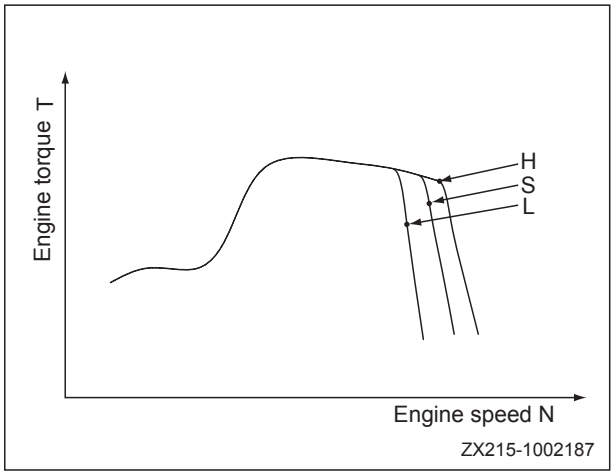


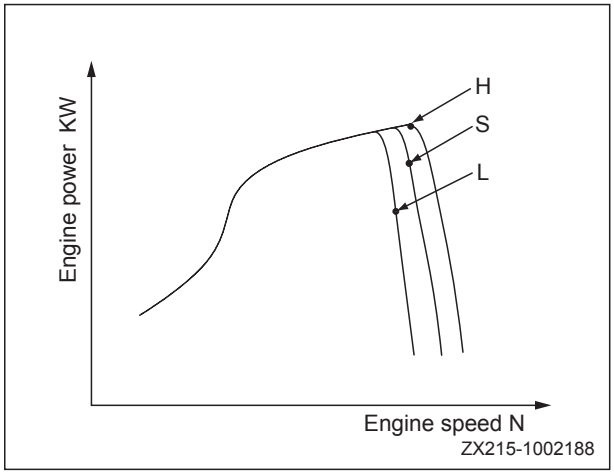
ZX215-1002186

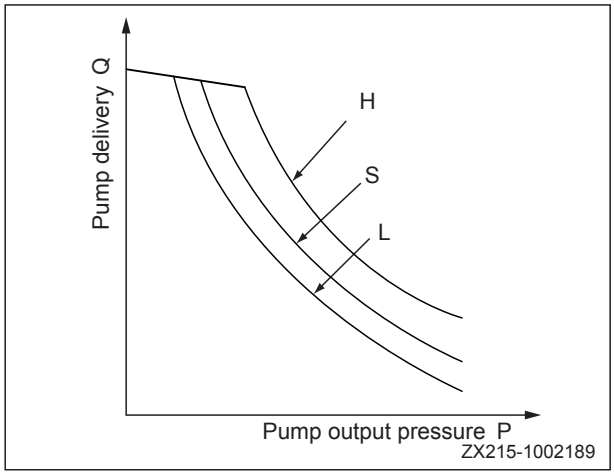
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Function

- This function allows the operator to select a working mode according to the job to be performed and change engine power output. Four different working modes are available: H, S, L and B. To select a working mode, use the working mode selector switch on the machine monitor.
- The main controller controls the pump so that it can absorb all the torque at the output points of the engine depending on the pump absorption torque specified for each mode, rotation set by the fuel control dial, and actual engine speed.







Specifications

H mode

Speed(Rpm)	~1600	1600~1800	1800~2000
Power (KW)	102	110	116

S mode

Speed(Rpm)	~1600	1600~2000
Power (KW)	102	104

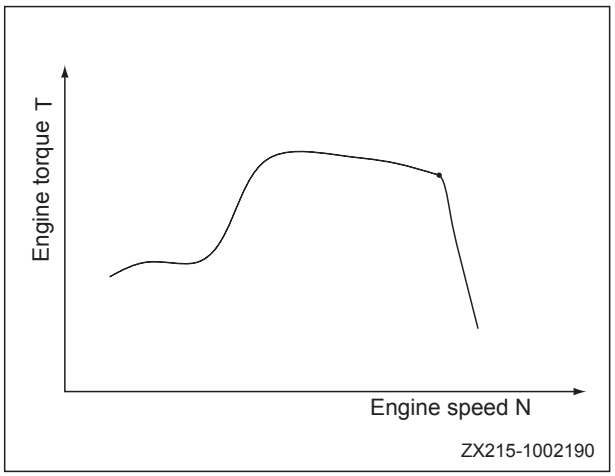
L mode

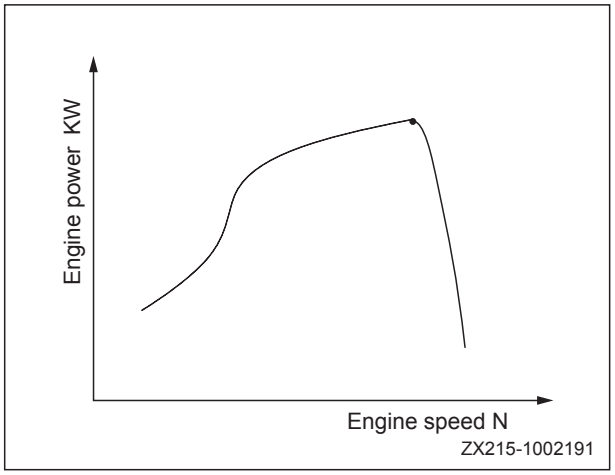
Speed (Rpm)	~2000
Power (KW)	92

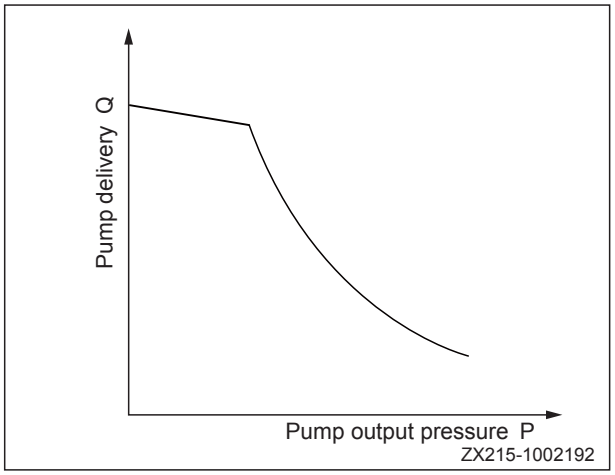
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Control method of each working mode

- H mode
- The matching point of H mode: rated speed 116kW/2000rpm
- If pump load increases and pump pressure rises, engine speed drops. In this case, engine speed will rise to near the matching point, allowing the pump controller to reduce pump discharge. On the contrary, if pump load decreases and pump pressure drops, pump controller will continue to increase pump discharge until engine speed reaches the matching point.







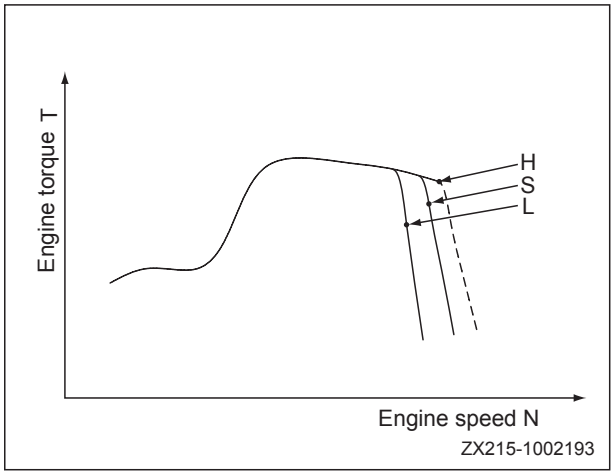
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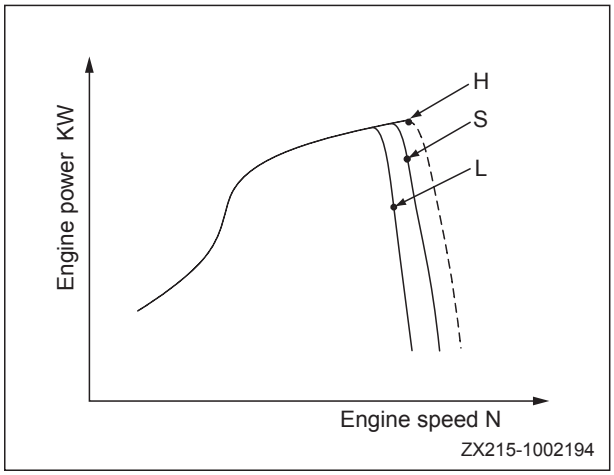
- S mode/B mode/L mode

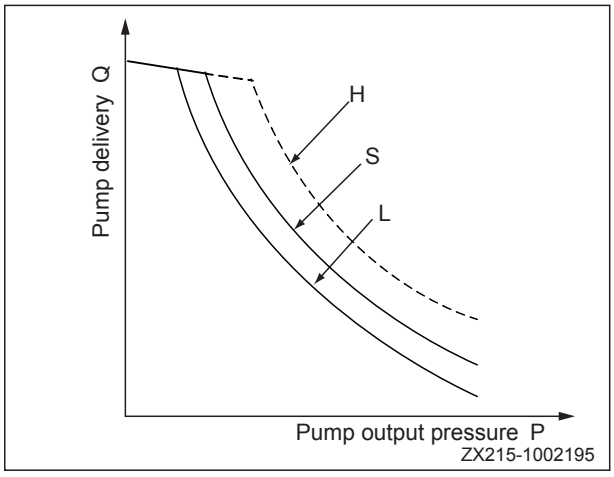
Power output of each working mode

Mode	S	L	B
Power output rate	90%	80%	70%

- At this time, the controller keeps the pump oil-suction torque in line with the stabling motor curve, and controls engine speed through combined control of the engine and pump.

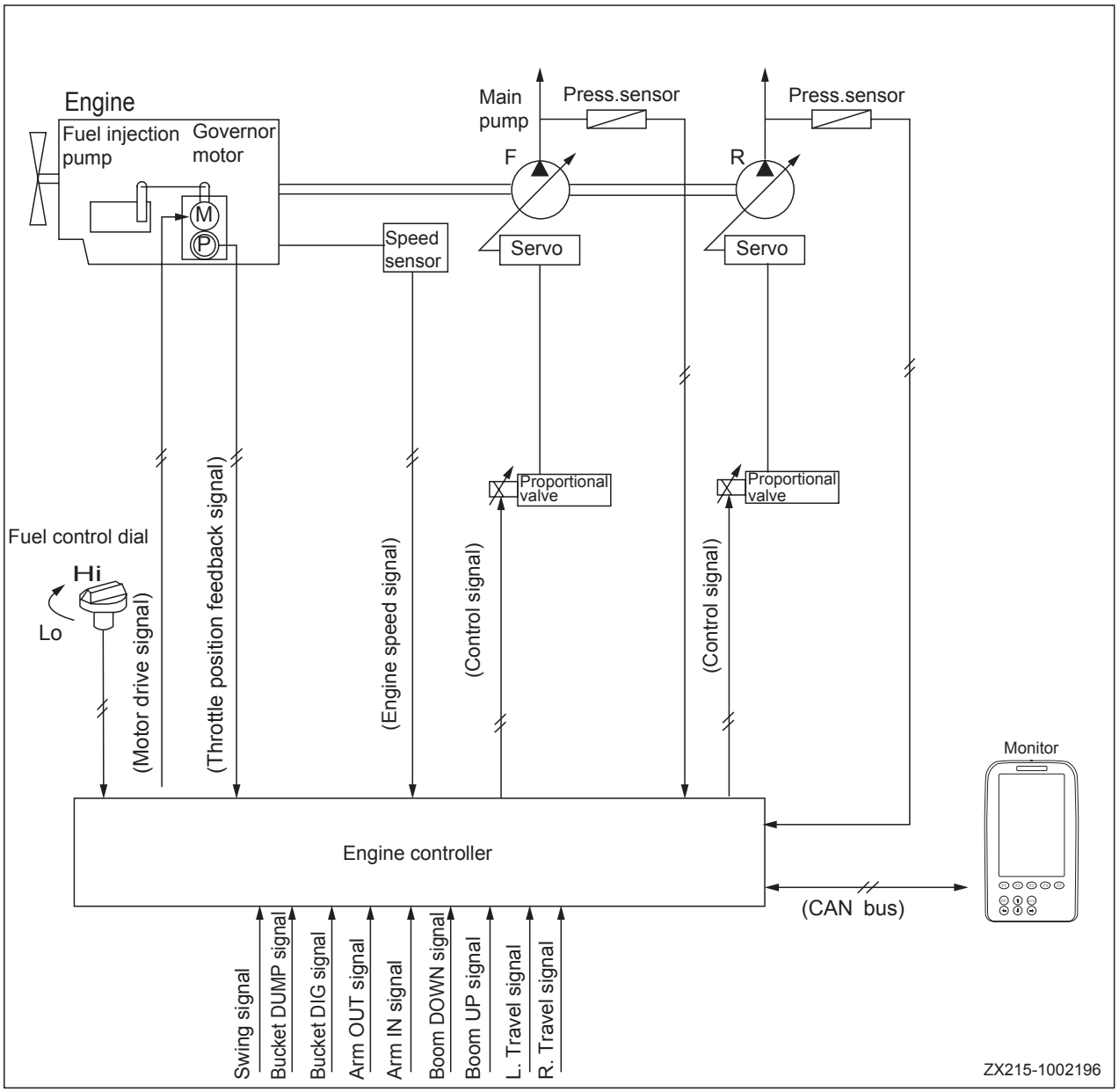






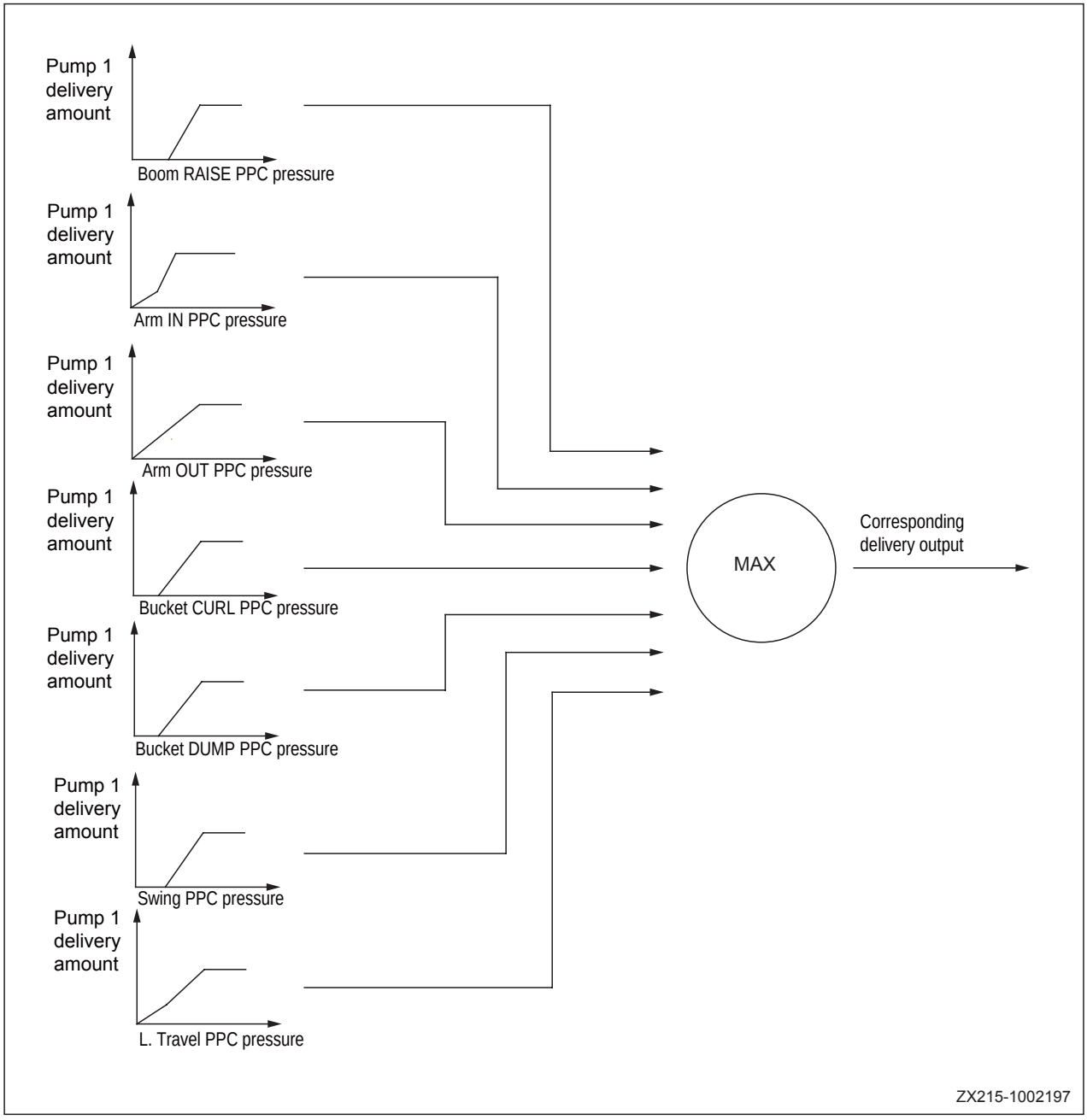
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4.9.4 Pump control function

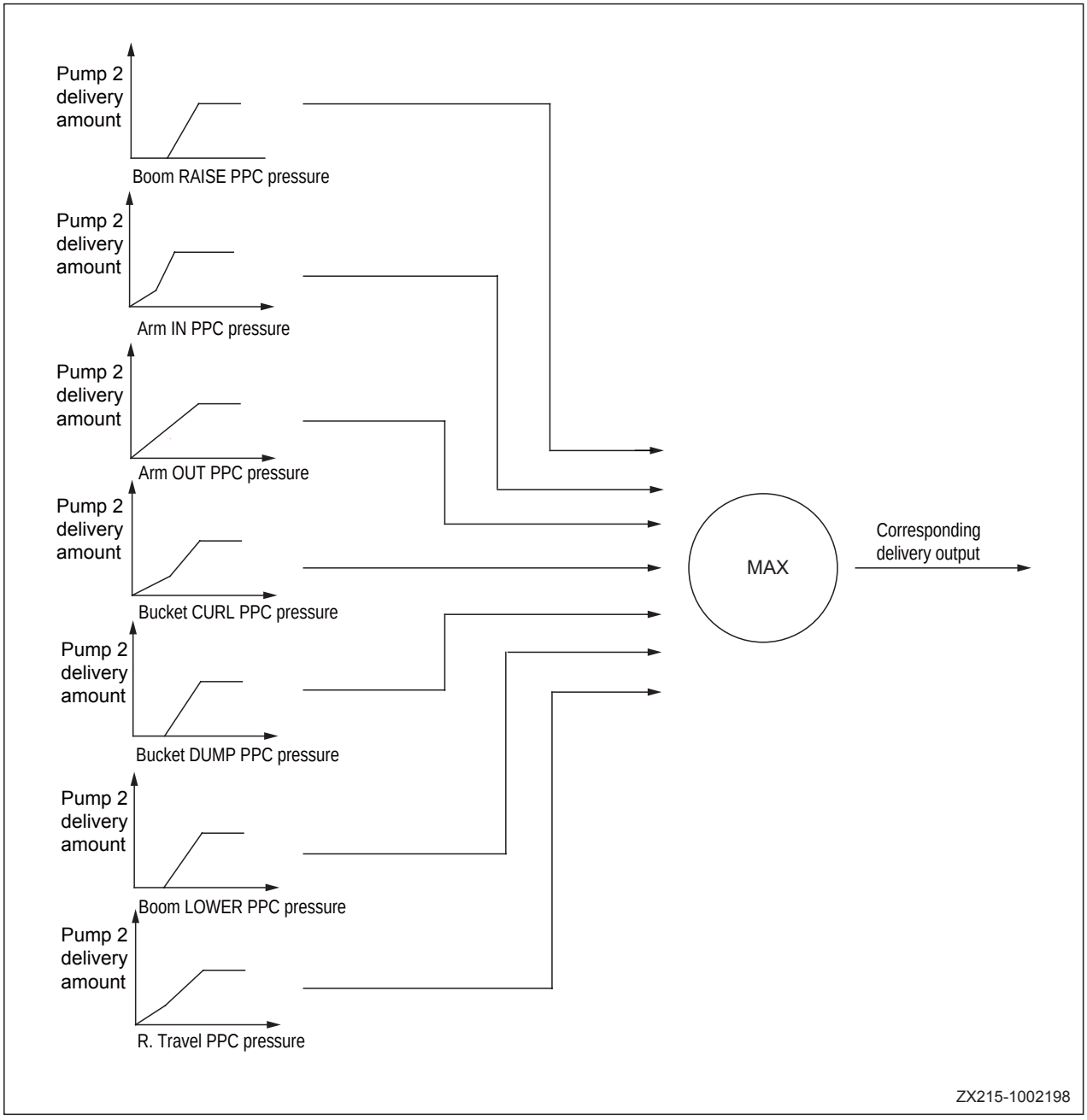


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4.9.4.1 Electrical positive flow control



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Function

- Use the work equipment and swing pilot pressure signal directly as the hydraulic pump discharge control signal. Pilot pressure is applied on the valve stem and, on the other hand, is collected by the controller. The controller keeps the discharge amount of the hydraulic pump at the specified value of the corresponding pilot pressure according to the functional relation between the set hydraulic pump discharge amount and pilot pressure. During combined operation, the set discharge amount of each operation shall be added.

Operation

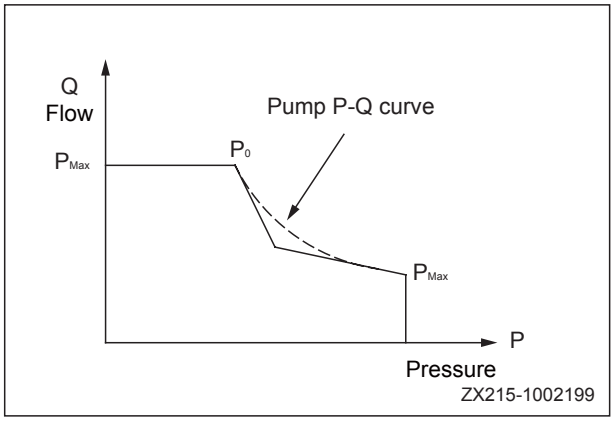
- When the work equipment is operating, the controller collects the signal of pilot pressure sensor, and determines the control discharge amount of pump 1 and pump 2 according to the pressure signal.

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4.9.4.2 Constant power control

Function

- Calculation of theoretical maximum discharge amount of the pump. The system applies constant power control. The two adjustor act together hydraulically, and keep two executing unit of the same specification and acting together in synchronization. The change of pump discharge is determined by the sum of operating pressure of the two hydraulic pumps P_{Σ}. When $2P_0 \le P_{\Sigma} \le 2P_{Max}$ is met, the sum of the power of the two hydraulic pumps remains constant below the power of the engine.



Operation

- When the work equipment is operating, the controller collects the pressure sensor signal of pump 1 and pump 2, and realize the pump constant power control according to the main pressure signal.

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4.9.4.3 ESS control

Function

- Changing of the engine speed due to load change controls the pump power, and engine output can be used more efficiently. (This function can also prevent the engine from losing control when the machine is operating under harsh conditions (eg. high - altitude area).

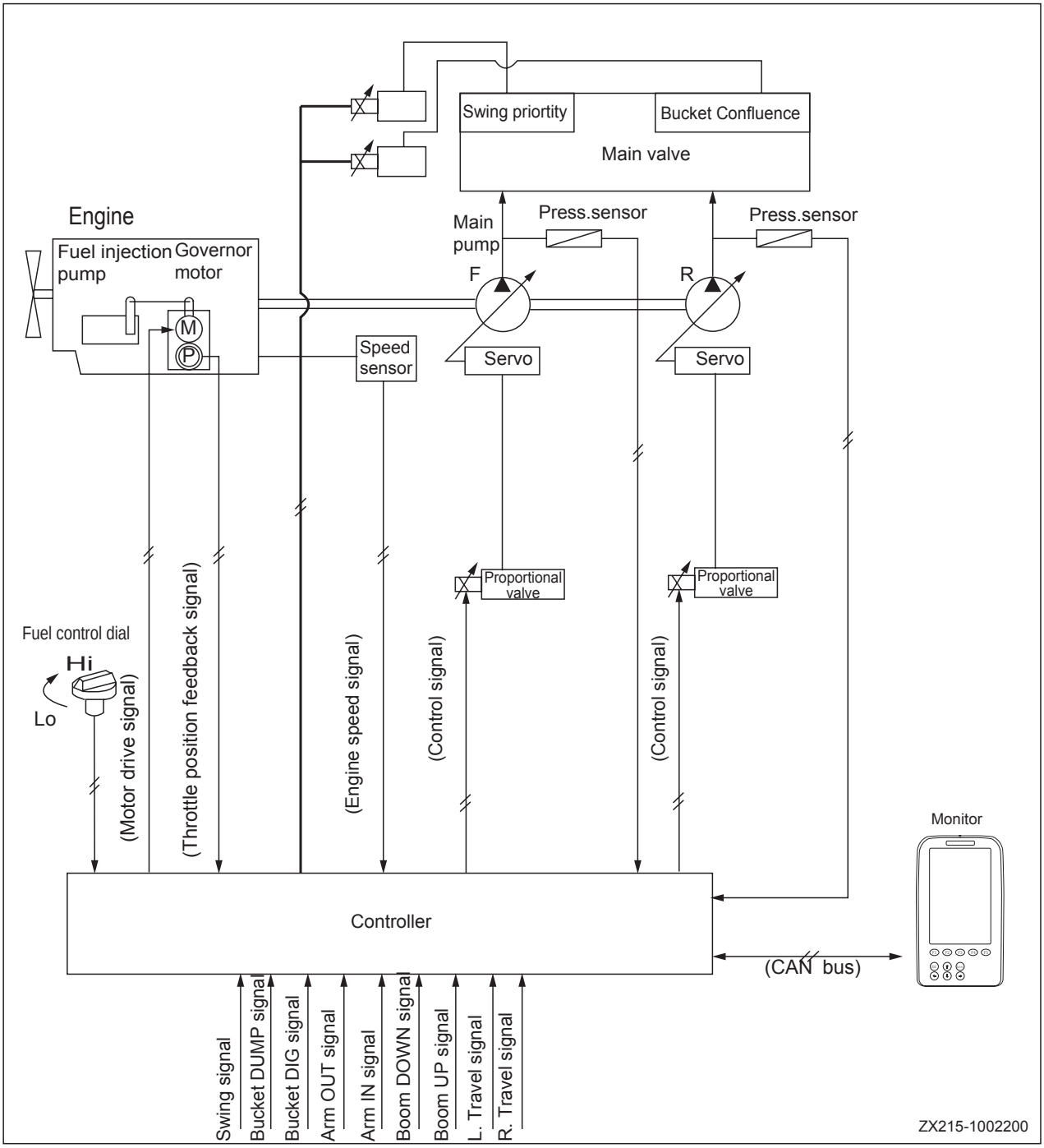
Operation

The engine control panel controls the target operating speed of the engine.

- The engine controller collects the actual speed signal from the speed sensor, and preforms a closed loop control with the target operating speed. Then, the controller involves the output of closed-loop control with the calculation of the solenoid valve control signal, and sends the final adjusting current signal to the pump proportional solenoid valve.
- The solenoid valve feeds pilot pressure oil to the pump adjustor according to the signal of the controller, and controls the pump discharge amount.

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4.9.5 Valve control function



Valve control function

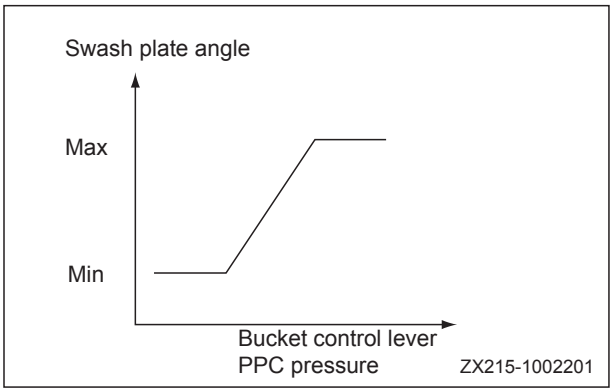
- Bucket flow control
- Swing priority control

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4.9.5.1 Bucket flow control

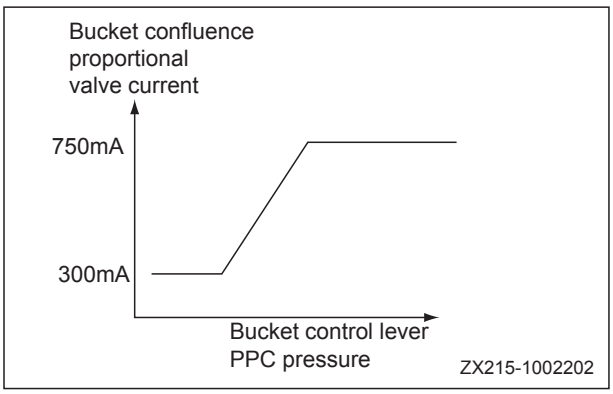
Function

- Control the pump swash plate angle according to the operation of bucket control lever.



Operation

- When the bucket control lever is operated, the controller collects the signal from the bucket DUMP pressure sensor and bucket CURL pressure sensor, and controls the bucket confluence proportional valve.



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4.9.5.2 Swing priority control

Function

- Pressurized oil from pump 1 bypasses bucket 1 valve spool, and flows first to swing motor valve spool to activate swing first.

Operation

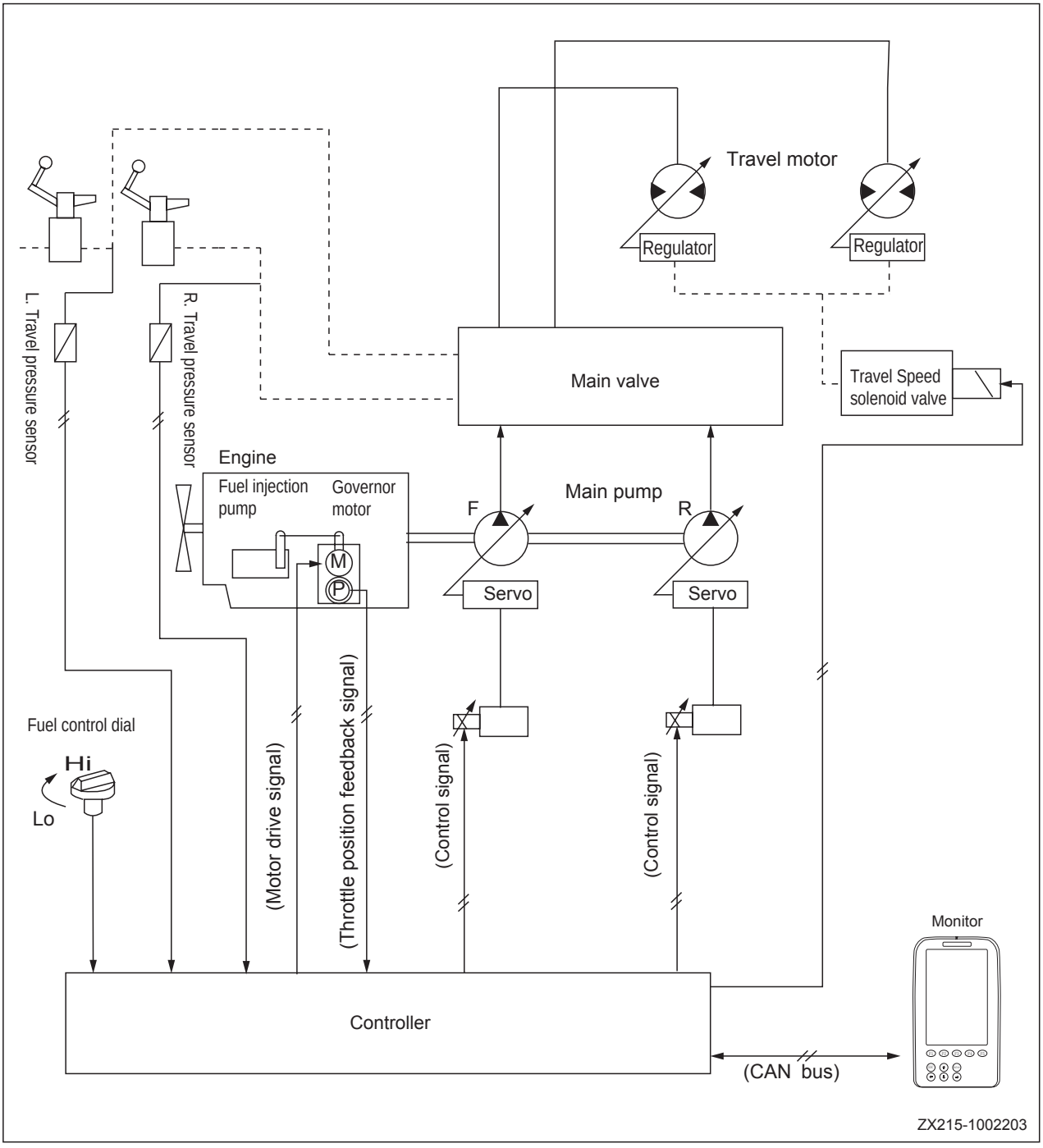
- When signals from pump 1 pressure sensor, arm pressure sensor and swing pressure sensor meet the following conditions, the controller activates the solenoid valve. The solenoid valve conducts pilot pressure oil to arm flow controller and limits the alternate circuit of arm 1 valve spool. Swing valve spool first ensures swing motor power, preventing the counter acting force when the arm is retracting from affecting the positioning of the upper swing structure.

Operating condition

- Swing pressure sensor: signal output available
- Arm pressure sensor: signal output available

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4.9.6 Duo travel speed control



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Function

- Control travel mode.

Operation

- When the travel mode is set at LO speed, the swash plate angle of the travel motor is the largest, and travel speed is low.
- When the controller receives the signal from the travel pressure sensor under the conditions below, it activates the solenoid valve. Then, the solenoid valve conducts pilot pressure oil to the swash plate angle control valve of the travel motor, and reduces the swash plate angle to increase travel speed.

Operating condition

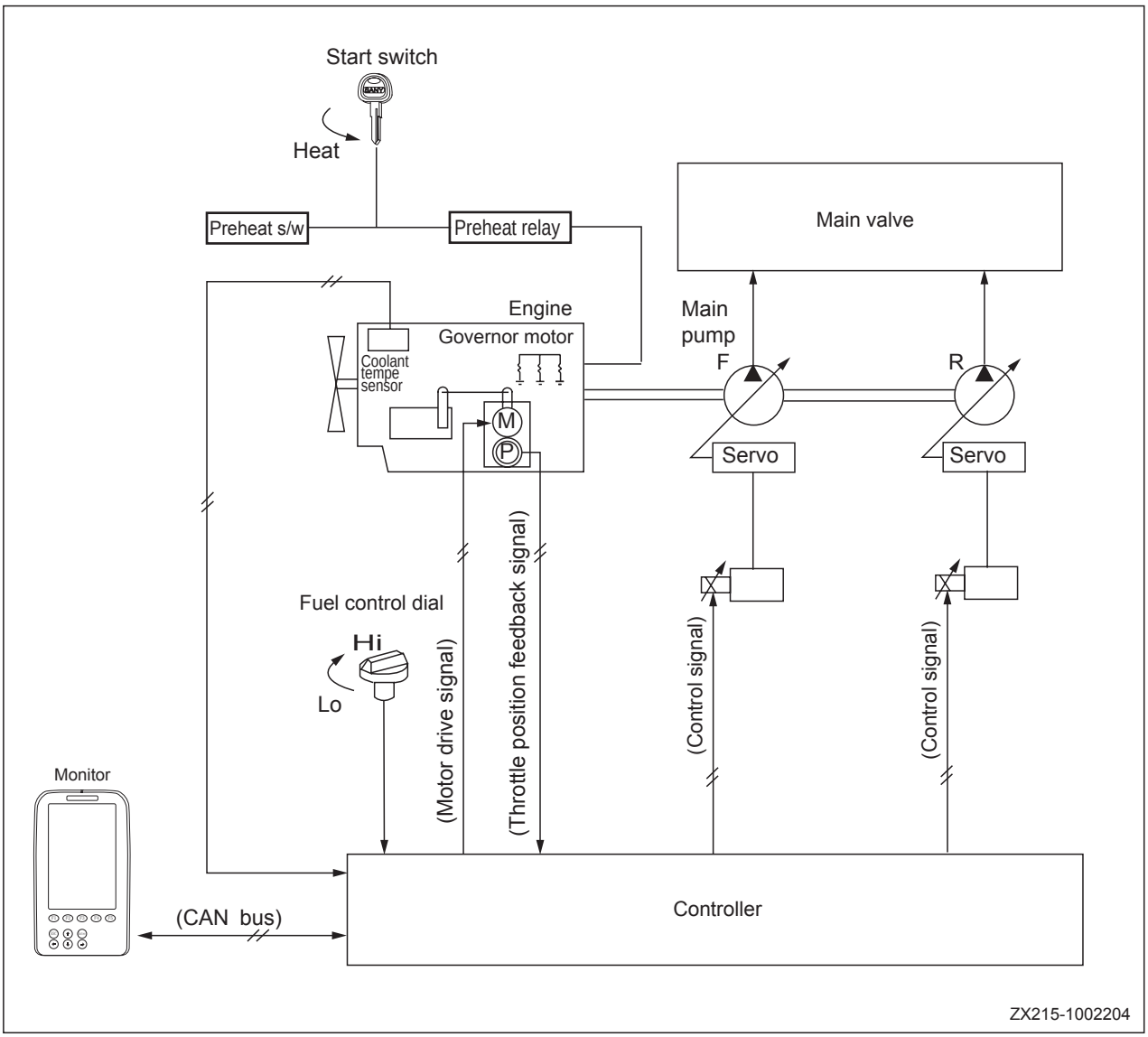
- When Hi speed travel mode on the monitor is enabled.

Remark:

When one side of the tracks is lifted off the ground by the work equipment and rotating, pressure at one side of the pump increases, which makes the lifted track rotate very fast. When the machine is traveling under Hi speed mode, even if work equipment is being operated (work equipment pressure sensor is switched ON), travel mode remains in Hi travel mode.

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4.9.7 Engine preheating/overheating alarm



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4.9.7.1 Engine preheating

Function

- Preheating control

Operation

- This function shall be used in combination with the preheating switch located on the right armrest. Turn the engine start key counterclockwise to the HEAT position and hold on, the engine will start preheating. When released, the key will return to the OFF position automatically and preheating stops.

Operating condition

- Power ON. Start key set at the HEAT position.
- Preheating switch: ON

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4.9.7.2 Engine overheating alarm

Function

- When engine coolant temperature becomes excessively high (above 110°C) during operation, overheating alarm on the monitor display will light up.

Operation

- The controller collects signal from the coolant temperature sensor. When coolant temperature rises too high, alarming information will be generated and transmitted to the machine monitor. The alarm lamp on the display lights up when the monitor receives the signal.

Operating condition

- Power ON.
- Coolant temperature above 110°C.

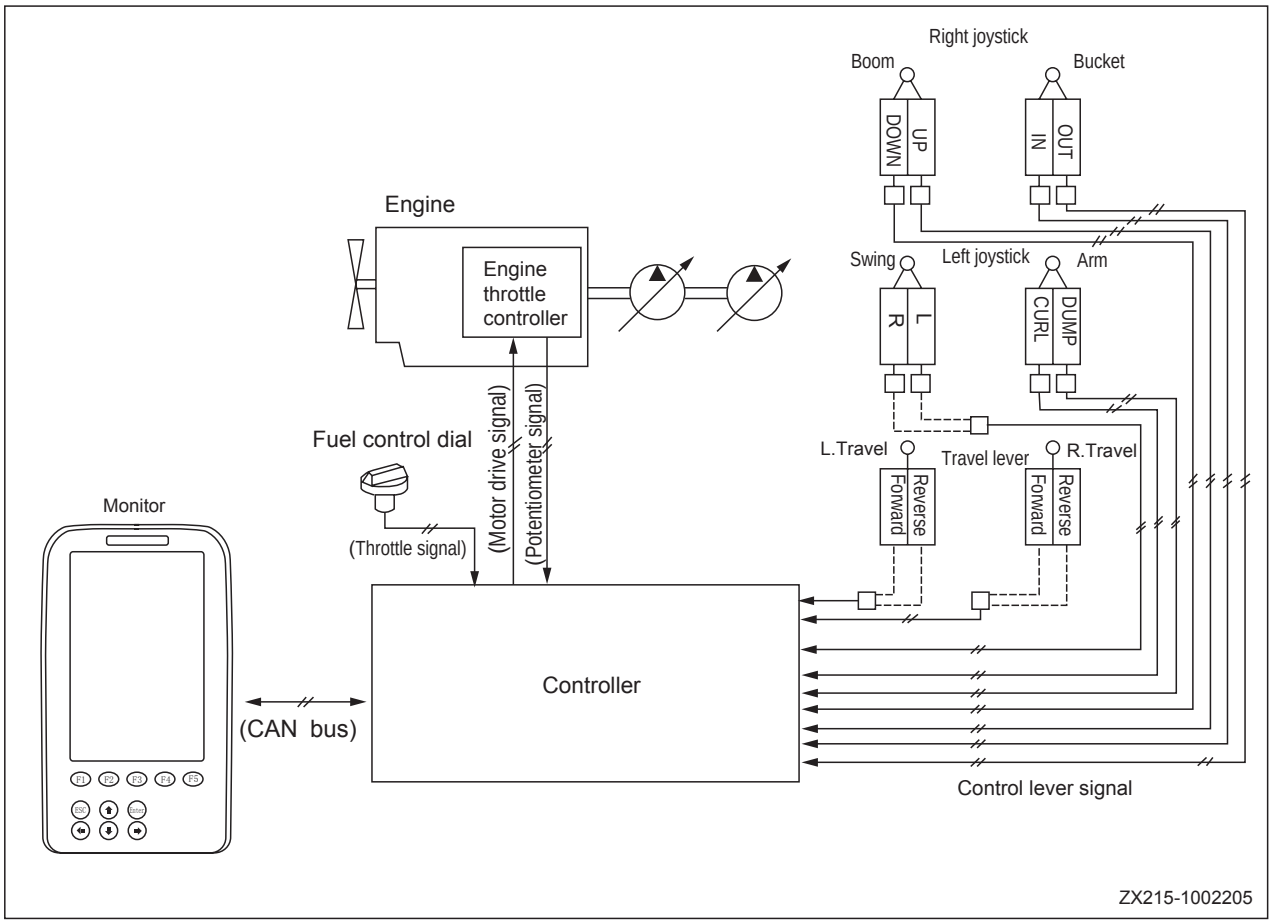
4.9.8 Engine oil under–pressure alarm

Function

- The engine controller collects signal from the engine oil pressure sensor. When engine speed exceeds 600 rpm, if oil pressure is too low, alarming information will be generated and transmitted to the machine monitor. The alarm indicator lights up when the monitor receives the signal.

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4.9.9 Auto deceleration/acceleration control



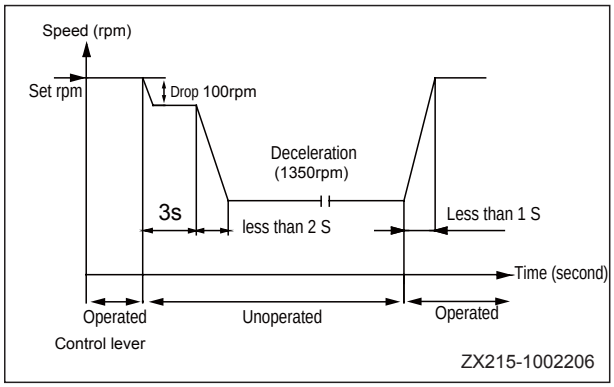
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Function

- If all the control levers are neutralized, engine speed will drop to the medium level automatically to reduce fuel consumption and noise.
- If any of the levers is operated, the engine speed rises to the set level instantly.

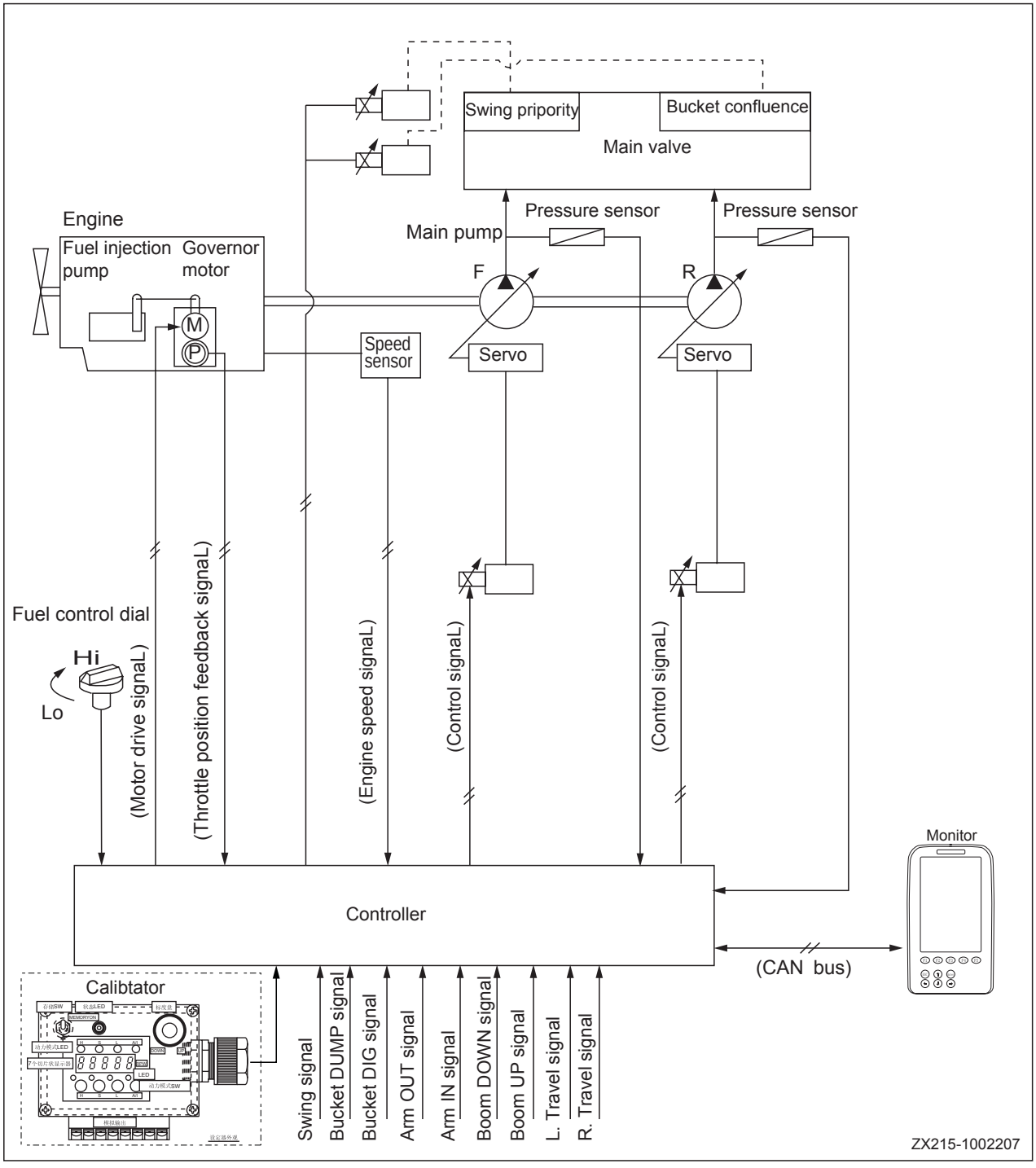
Operation

- Three seconds after all control levers are neutralized, engine speed will drop to the first deceleration level about 100 rpm lower than the set speed. After another 3 seconds engine speed enters low speed (1350 rpm) to reduce the loss of the hydraulic system and engine wear, and reduce fuel consumption and noise. When the control lever is operated again, the engine speed rises instantly to the previous level.
- If any control lever is operated while the engine speed is kept at decelerated level, engine speed will rise instantly to the level set by the fuel control dial.



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4.9.10 Engine speed calibration function



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Function

- Set the maximum engine speed under each working mode. This set speed is the standard to control engine speed.

Operation

- Calibrating procedure for positive flow excavators.

1) H, S, L maximum speed calibration, and A/I speed calibration.
2) Turn the dial on the calibrator counter-clockwise to the end
3) Power OFF
4) Set the calibrator to "Monitor mode", power on and check the result.

Remark:

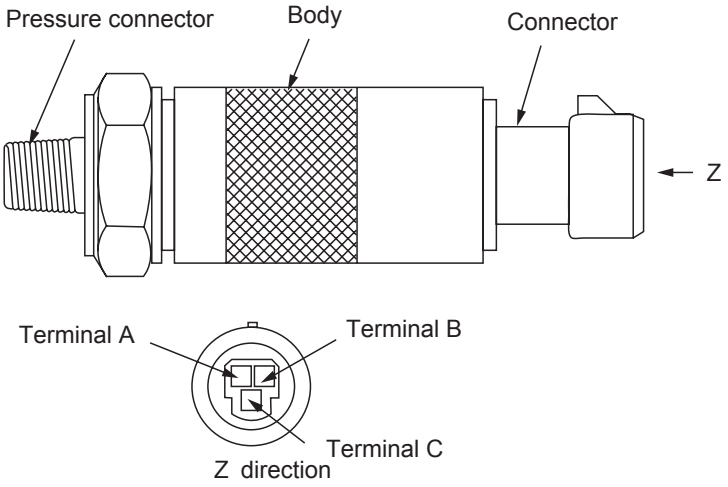
Memory SW up: Calibration mode;

Memory SW down: Monitor mode

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4.9.11 System Components

4.9.11.1 Pump pressure sensor



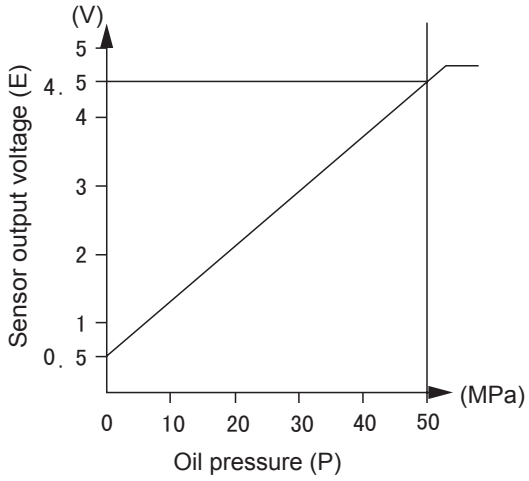
Connection diagram

No.	Signal name
A	
B	Grounding
C	Output

ZX215-1002208

Operation

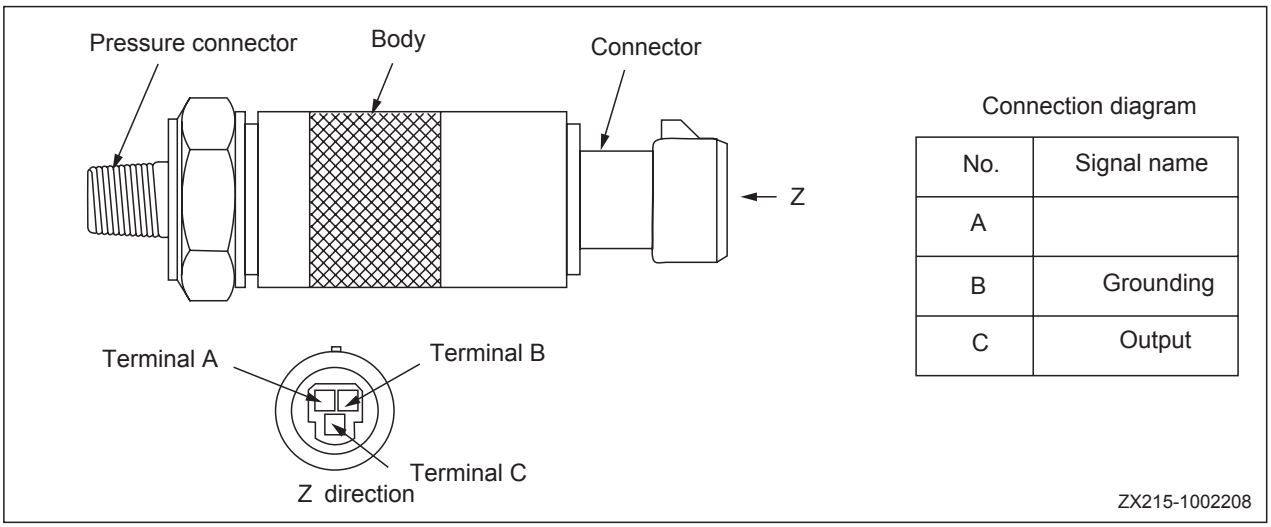
- The relationship between the pressure applied to sensors (P) and output voltage (E) is shown in the figure on the right.



ZX215-1002209

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4.9.11.2 Pilot pressure sensor



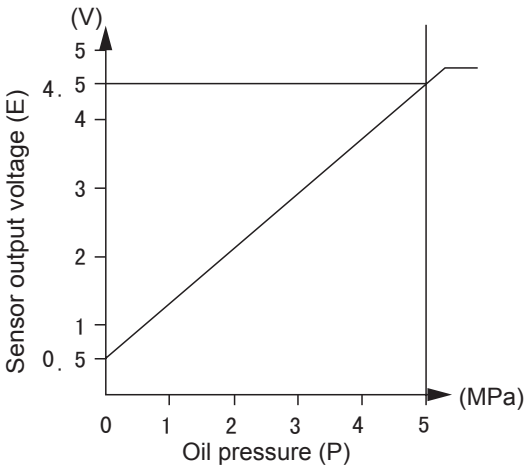
Connection diagram

No.	Signal name
A	
B	Grounding
C	Output

ZX215-1002208

Operation

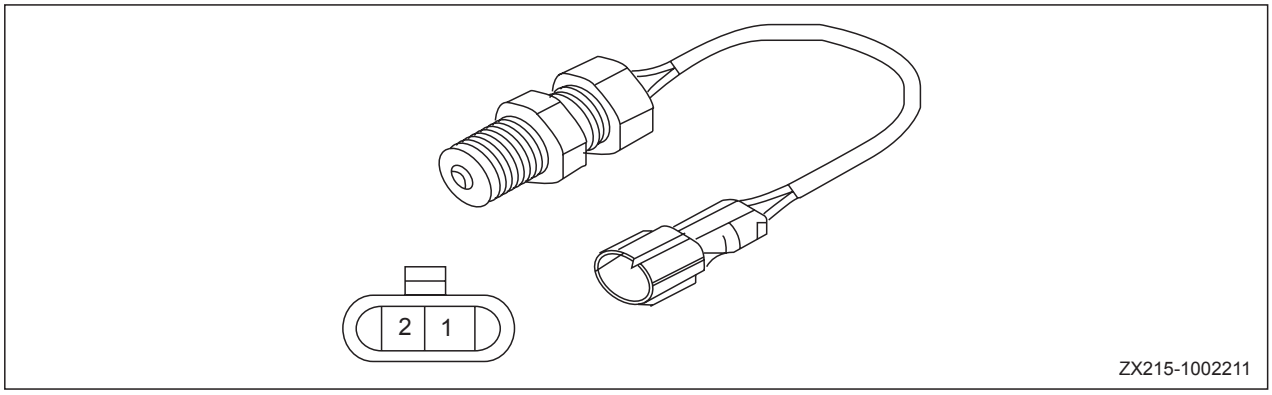
- The relationship between the pressure applied to sensors (P) and output voltage (E) is shown in the figure on the right.



ZX215-1002210

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4.9.11.3 Engine speed sensor



Function

- The engine revolution sensor is installed to the ring gear of the engine flywheel. It electrically calculates the number of the gear teeth which pass in front of it and transmits the result to the engine controller.

Operation

- Measure the resistance between terminal 1 and terminal 2 when it is in service.

Standard value (@25°C)	2.3±0.2 kΩ

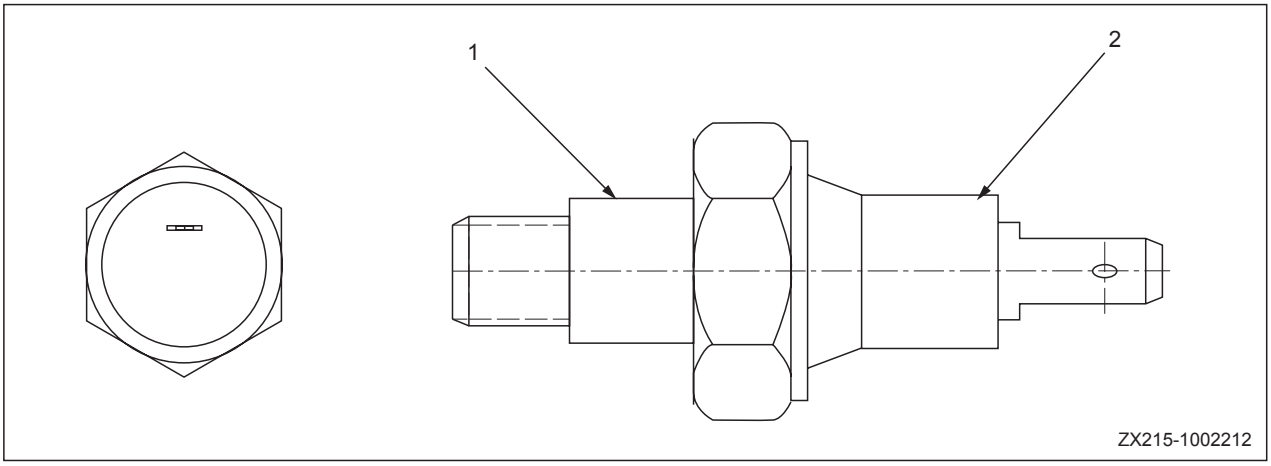
- If the measured value exceeds the standard value, replace the sensor.

⚠ CAUTION

- **If the engine speed sensor is not tightened to the specified torque, the sensor may send out no signals. Tighten the engine speed sensor to the specified torque.**

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4.9.11.4 Coolant temperature sensor



1- Sensor
2- Connector

Function

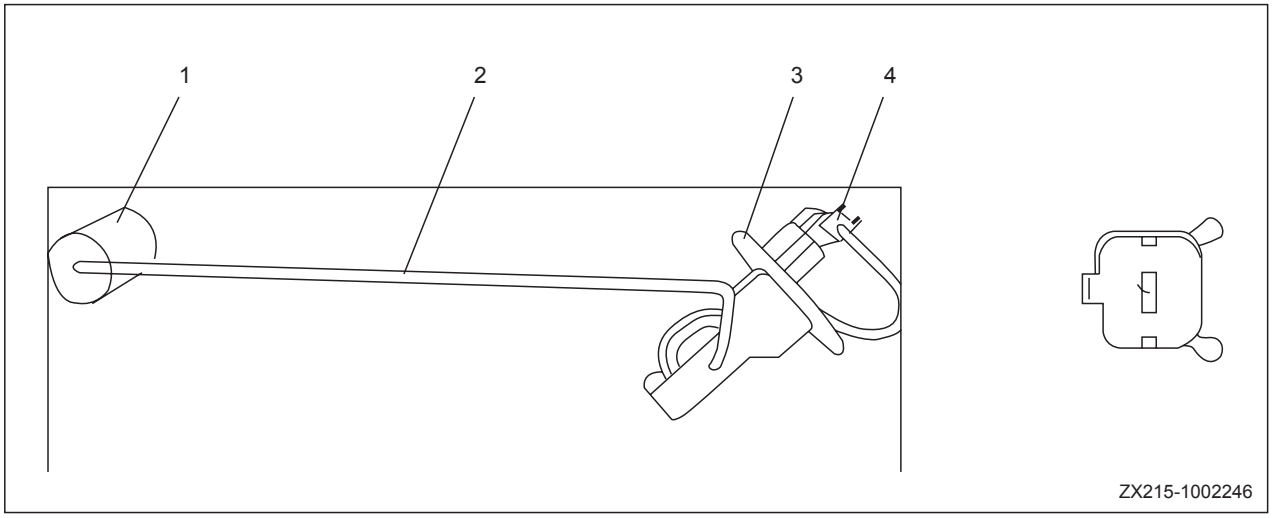
- The output resistance of the engine coolant temperature sensor changes with the coolant temperature. The controller collects and processes coolant temperature signals and works out the coolant temperature.

Specifications

Standard value	50°C	80Ω (Ref.)
	60°C	56.3Ω
	80°C	29.5±10Ω
	100°C	16.5Ω
	106°C	14.3±0.5Ω
	120°C	10Ω(Ref.)

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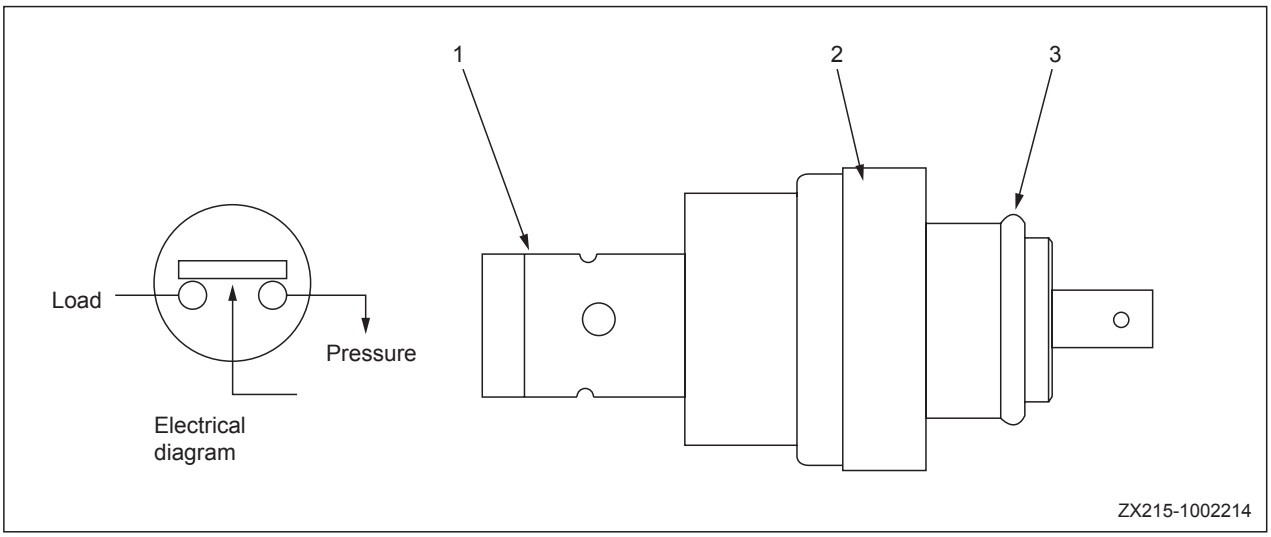
4.9.11.5 Fuel sensor



1- Float
2- Lever
3- Casing
4- Coupler

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4.9.11.6 Oil pressure switch



1- O-ring
2- Sensor
3- Connector

Function

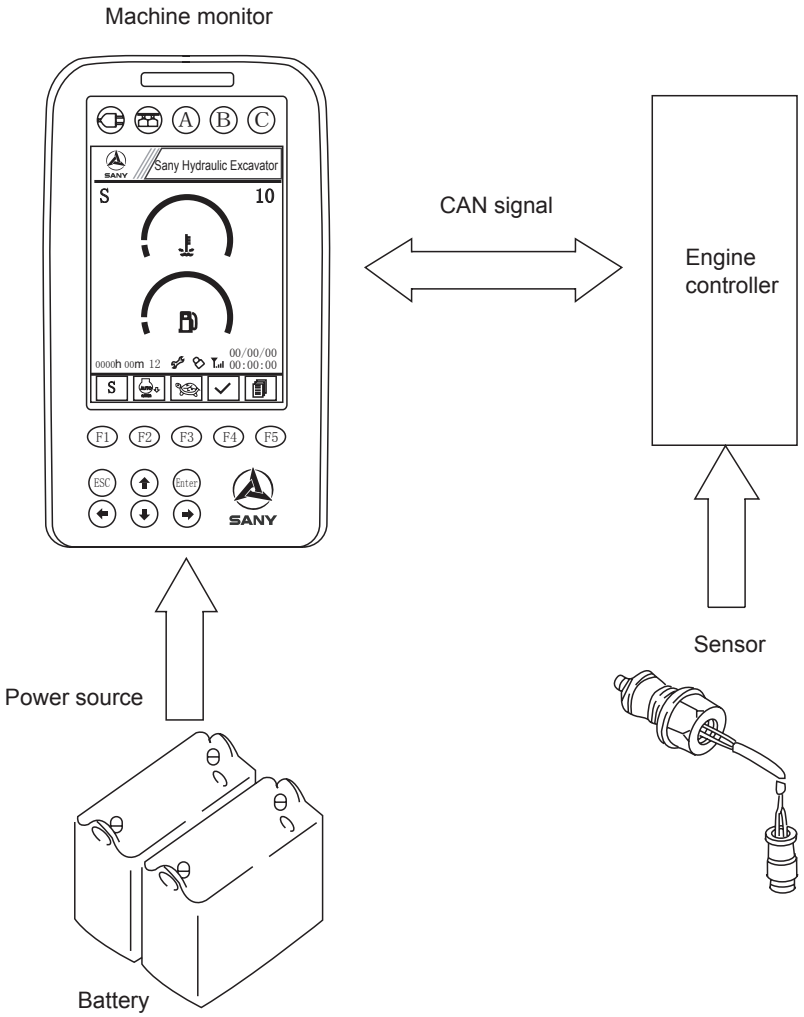
- The oil pressure switch is installed on the outlet circuit of the oil filter. It detects oil pressure and transmits warning signals to the controller.

Specifications

- Type of contact: Normally closed
- Operating pressure: 1.9kg

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4.10 Monitoring System



ZX215-1002215

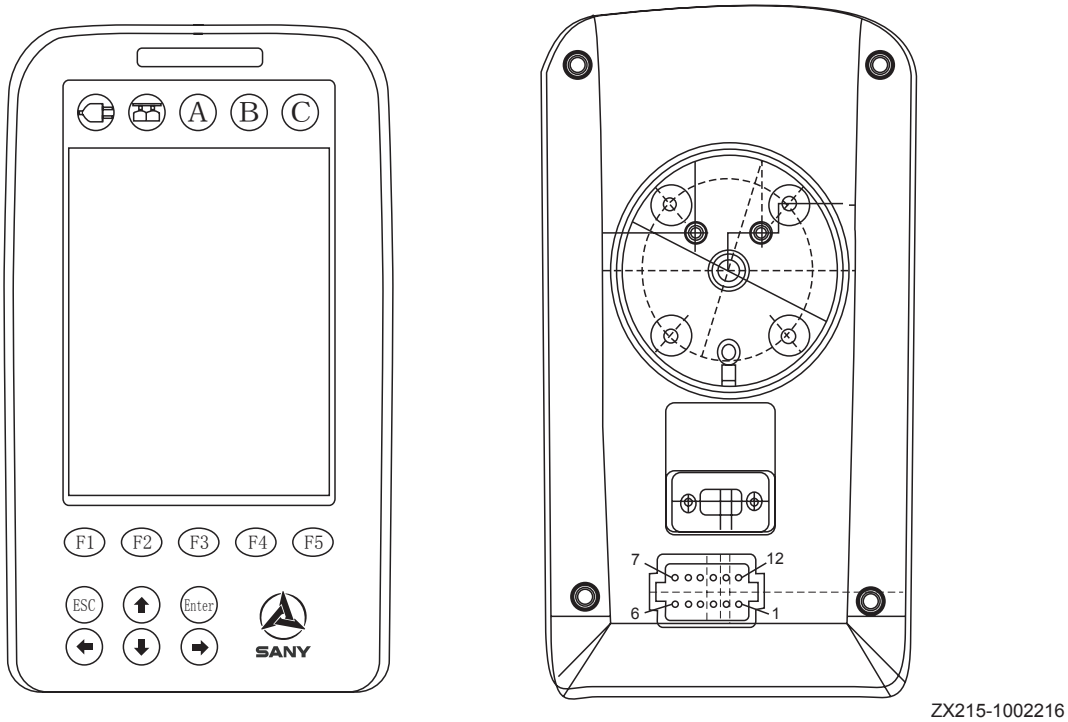
- The state of the machine is monitored by the sensors mounted on the machine components. The controller processes the signals and transmits the signals to the monitor display, informing the operator of the machine condition.
- Information on the monitor display includes primarily:

1. Alert information when a machine fault is detected.
2. Operating condition (coolant temperature, fuel level, etc.)

- The machine control system can be operated using the switches and keys on the monitor panel.

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4.10.1 Machine monitor



ZX215-1002216

Outline

- The monitor displays various kinds of items and is used by the operator to select a working mode.
- The monitor has a CPU which processes, displays, and outputs information.
- The monitor has an LCD (Liquid Crystal Display) screen.

Input and output signals

No.	Signal name	Input/output
1	Digital input A	Input
3	CAN high	
4	CAN low	
7	Digital input B	
8	Trigger power source (24V)	
9	Power source (24V)	
10	Grounding	
11	Digital input C	
12	Grounding	

NOTICE

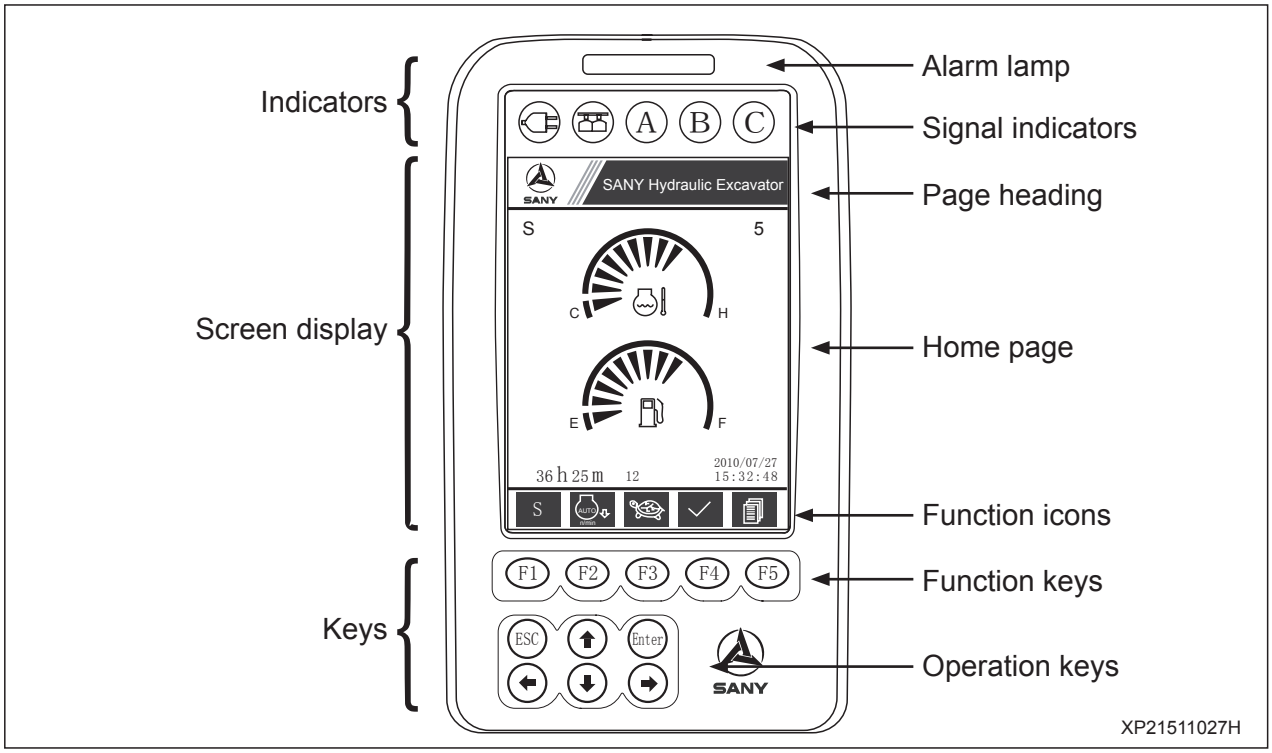
- **The LCD may have black spots (which do not light up) or bright spots (which stay on). Products having 10 or less black or bright spots conform to the product specification; such condition is quite normal.**
- **Continuous operation of the monitor may cause the LCD to display bright blue spots on a black background; it is quite normal.**
- **When the monitor is turned on, blinking strips may appear on the LCD screen. This is normal.**

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4.10.2 Monitor functions

When the engine start switch is turned to ON position, the monitoring system is energized.

The monitor screen displays the home page.



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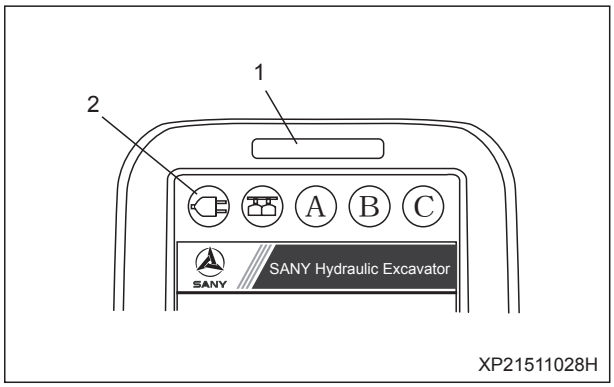
Indicators

1. Alarm lamp

- When a fault occurs on the machine and is detected by the monitor, the alarm lamp lights up, informing the operator to take trouble shooting measures.

2. Signal indicators

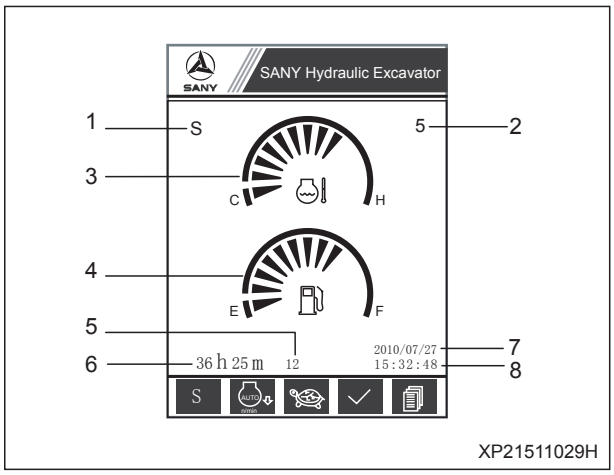
- The signal indicators include power indicator, CAN indicator and backup indicators for the user to define.



Screen display

All screen pages are displayed on the LCD. Different page heading, page content, parameters, time, and function icons are displayed on the screen according to different selected entries. The user is allowed to switch between different entries, and adjust data and parameters.

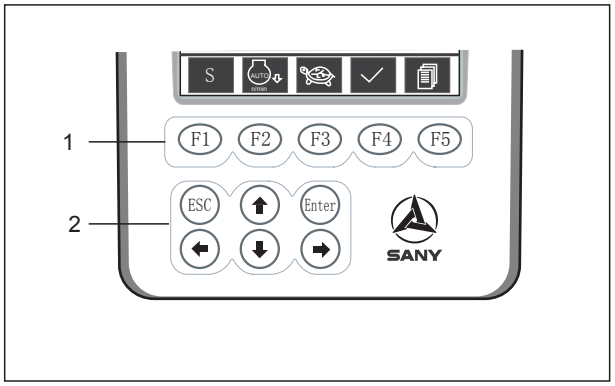
1. Working mode (H, S, L and B)
2. Engine speed level (1~11)
3. Coolant temperature (°C)
4. Fuel level (%)
5. Failure code (Refreshed every 2 seconds)
6. Total service hours (××h××m)
7. Date (Y/M/D)
8. System clock (H:M:S)



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Monitor keys

Keys on the monitor include function keys and operation keys.



Function keys

- Functions of keys F1 to F5 are indicated respectively by the icons above them on the screen display.
- When the icon above a certain function key changes, the function of this key will change accordingly.
- When there is no icon above a function key, this key is disabled.

Function keys	Icon	Function	Monitor display
F1	S	Working mode selection	H→S→L→B
F2		Auto idle mode switch	
F3		High/Low travel speed switch	
F4		Enter a selected item/Set up an item	Same as Enter
F5		Enter information menu	------
		Return to previous page	Same as ESC

Each time the machine is energized, default display on the monitor screen is as follows:

- Working mode: H
- Auto idle switch: Auto idle
- Travel speed switch: Low speed

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Auto deceleration switch

- Auto idle mode is the default mode. When the engine is under auto idle mode, it will enter idling state automatically if no control levers are operated for 5 consecutive seconds to save fuel and reduce noise. Engine speed is regulated by the controller.
- When the engine is idling, engine speed returns automatically to previous level set by the fuel control dial once the controller detects the action from any control lever or the adjustment of fuel control dial.
- Auto idle mode is disabled when the machine is working under L mode.

Operation keys

Operation keys	Function
Enter	Enter/Confirm
ESC	Return to previous page
⬆	Select item on upper side (Selects bottom item after top item)
⬇	Select item on lower side (Selects top item after bottom item)
⬅	Select item on left side (Selects right end item after left end item)
➡	Select item on right side (Selects left end item after right end item)

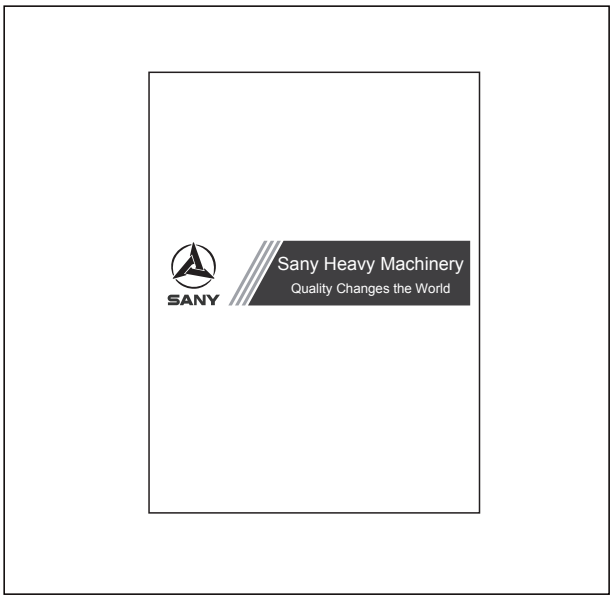
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4.10.3 Screen display and operation

4.10.3.1 Initializing page

When the start switch is turned to the ON position, the initializing page will be displayed on the monitor screen.

When initializing process is over after about 2 seconds, the screen displays the Home page.

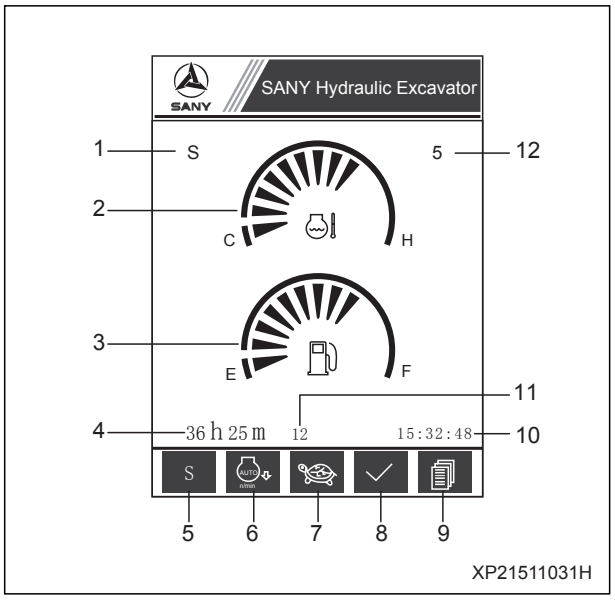


4.10.3.2 Home page

Function

This is the normal operation display. Items displayed on the home page include, working mode, engine gear level, coolant temperature, total service hours, system time and alarm indicator. Working conditions of the machine can be set up on this page.

Screen display



1. Working mode indicator (H, S, L and B)
2. Coolant temperature (°C)
3. Fuel level (%)
4. Total service hours (h/m)
5. Working mode selection button.
6. Switch on/off auto idle: → → ……
7. Travel speed: → → ……
8. Go to Failure codes.
9. Main menu icon.
10. System time (h:m:s)
11. Failure code. Refreshed every 2 seconds.
12. Engine speed level (1~11)

Keypad input

- Press F1 to switch between four working modes (H, S, L and B).

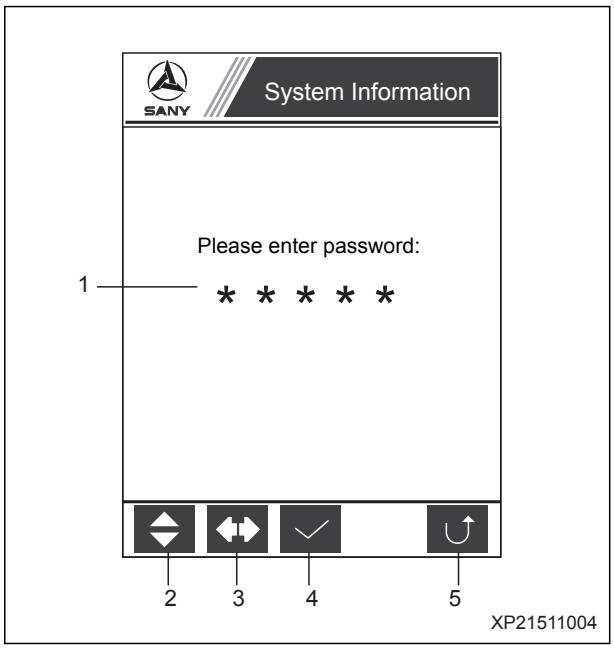
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- Press F2 to select auto idle or full speed.
- Press F3 to select high or low travel speed.
- When a failure alarm occurs, press F4 to go to Failure Codes.
- Press F5 to go to System Information.

4.10.3.3 System Information

Function

Enter the password before accessing the system information page.



Screen display

1. A 5-digit password. Each digit is indicated by an asterisk (*) standing for a value from 0 to 9. A numeral appears at the digit where the cursor is located while the other four digits are in asterisk.
2. Change the value of the digit where the cursor is located.
3. Move the cursor.
4. Check the password and go to Main Menu if the password is correct, or tell the user to enter the correct password, if the password is wrong.
5. Return to the home page.

Keypad input

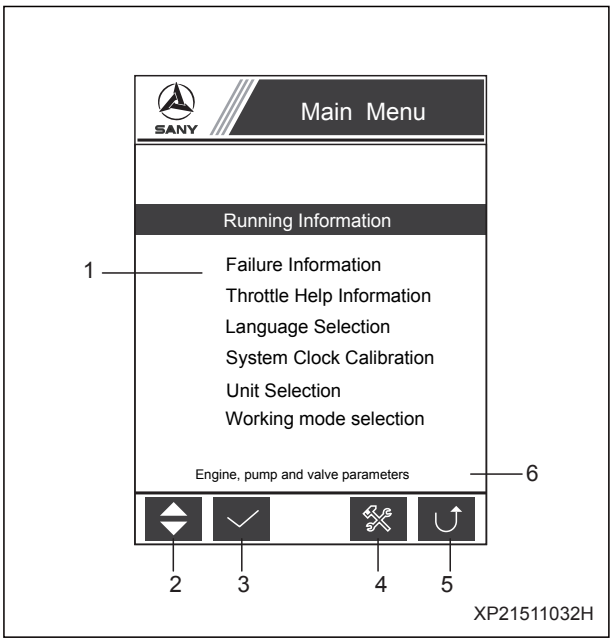
- Press F1 or [↑] and [↓] to change the value of the digit where the cursor is located.
- Press F2 or [←] and [→] to move the cursor.
- Press F3 or [Enter] to check the validity of the password and go to Main Menu if it is correct.
- Press F5 or [ESC] to return to the home page.

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4.10.3.4 Main Menu

Function

A list of system functions that can be selected to access different options.



Screen display

1. System information menu.
2. Scroll up and down to select an entry on the menu.
3. Access the selected entry.
4. Go to System Setup password entry page.
5. Return to the home page.
6. Brief description of the selected entry.
   - Operating parameters of the engine, main pump and main valve.
   - Failure codes.
   - Throttle help information.
   - System language selection.
   - System clock adjustment
   - Unit display setting.

Keypad input

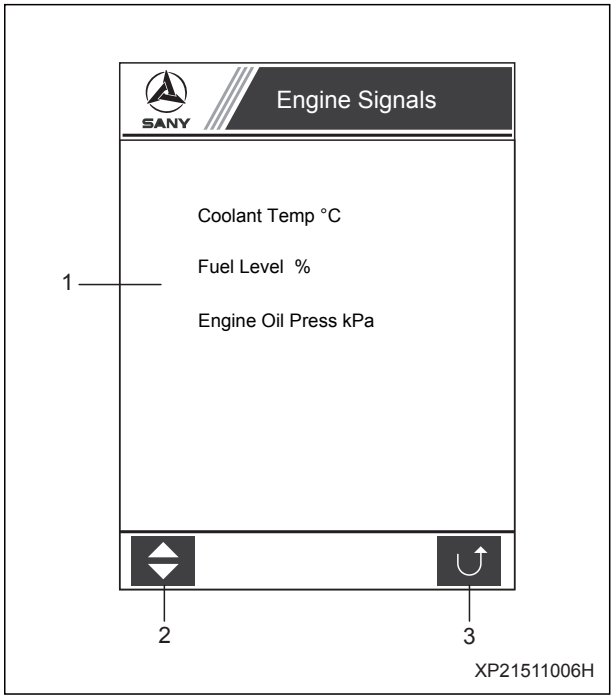
- Press F1 or ⬆ and ⬇ to scroll up and down and select an entry in the list.
- Press F2 or Enter to access the selected entry.
- Press F4 to go to System Setup password entry page.
- Press F5 or ESC to return to the home page.

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4.10.3.5 Engine Signals

Function

Display the operating parameter of the engine.



Screen display

1. Real-time display of engine signal collected by the controller.
2. Move to the next page Throttle Signals.
3. Return to Main Menu.

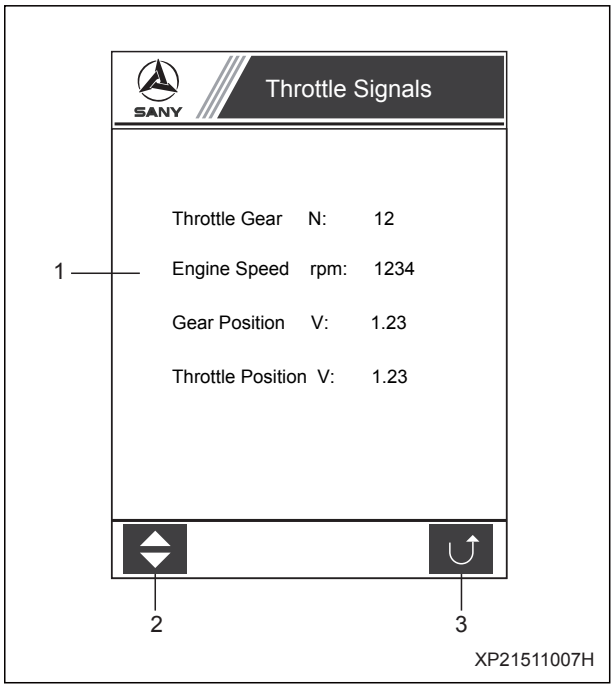
Keypad input

- Press F1 to go to Throttle Signals.
- Press F5 or ESC to return to Main Menu.
- Press ↑ to go to Main Valve Signals.
- Press ↓ to go to Throttle Signals.

4.10.3.6 Throttle Signals

Function

Display engine throttle signal information.



Screen display

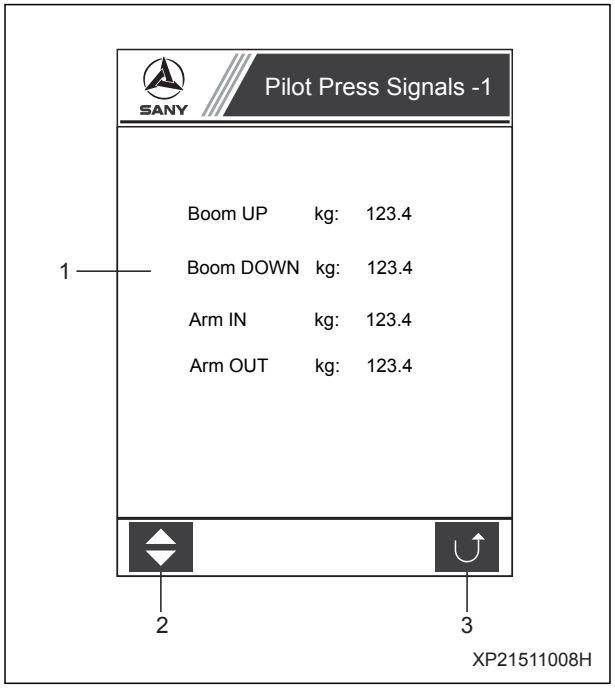
1. Real-time display of engine throttle signal collected by the controller.
2. Move to the next page Pilot Pressure Signals - 1.
3. Return to Main Menu.

Keypad input

- Press F1 to go to Pilot Pressure Signals - 1.
- Press F5 or ESC to return to Main Menu.
- Press ↑ to go to Engine Signals.
- Press ↓ to go to Pilot Pressure Signals - 1.

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4.10.3.7 Pilot Pressure Signal - 1



Function

Display hydraulic system pilot pressure signals

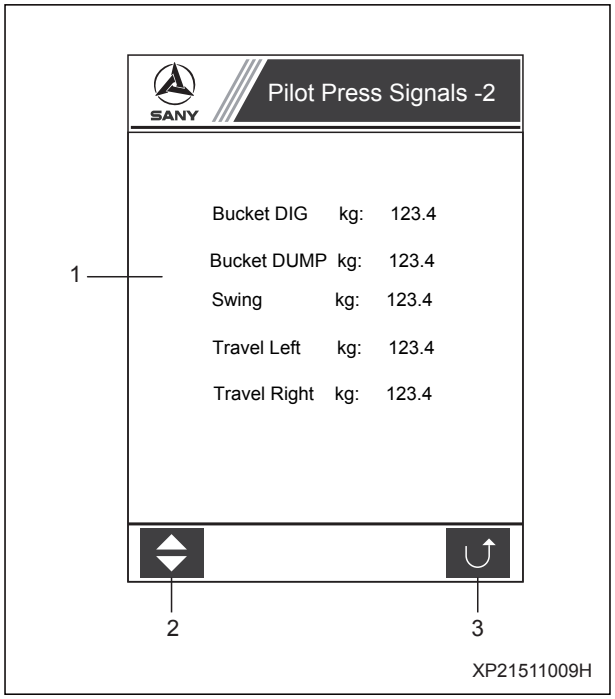
Screen display

1. Real-time display of pilot pressure signal collected by the controller.
2. Move to the next page Pilot Pressure Signals - 2.
3. Return to Main Menu.

Keypad input

- Press F1 to go to Pilot Pressure Signals - 2.
- Press F5 or ESC to return to Main Menu.
- Press ↑ to go to Throttle Signals.
- Press ↓ to go to Pilot Pressure Signals - 2.

4.10.3.8 Pilot Pressure Signal - 2



Function

Display hydraulic system pilot pressure signals

Screen display

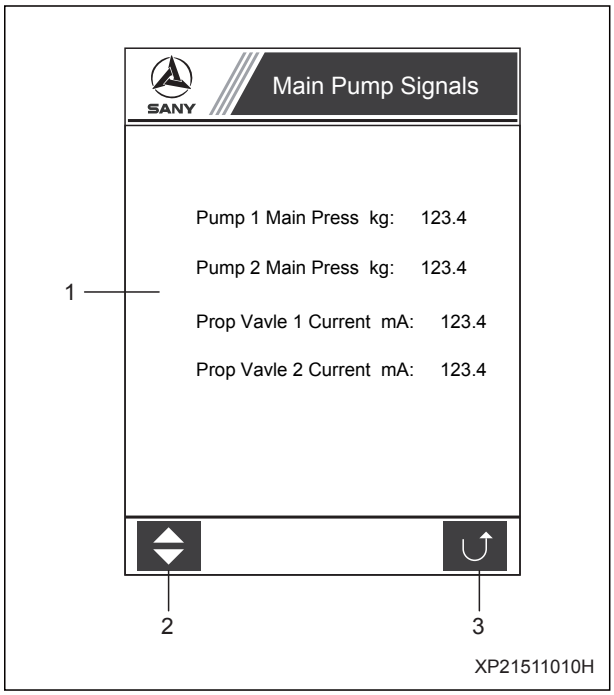
1. Real-time display of pilot pressure signal collected by the controller.
2. Move to the next page Main Pump Signals.
3. Return to Main Menu.

Keypad input

- Press F1 to go to Main Pump Signals.
- Press F5 or ESC to return to Main Menu.
- Press ↑ to go to Pilot Pressure Signals - 2.
- Press ↓ to go to Main Pump Signals.

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4.10.3.9 Main Pump Signals



Function

Display main pump signal of the hydraulic system.

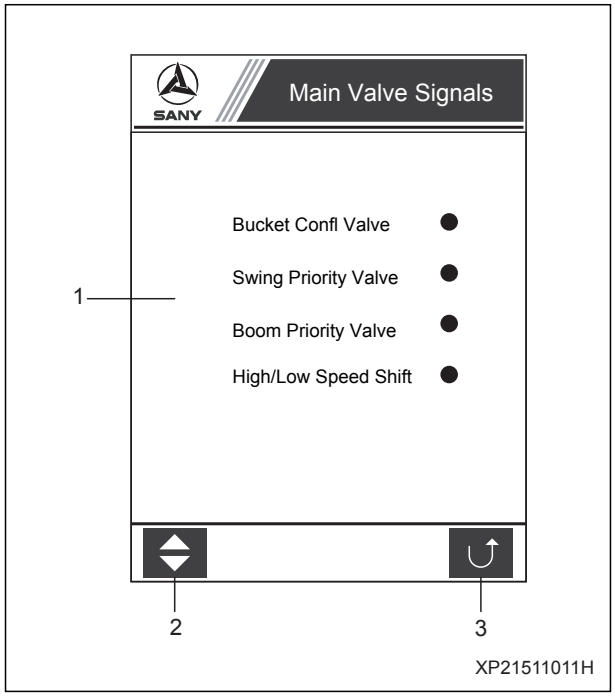
Screen display

1. Real-time display of main pump signal collected by the controller.
2. Move to the next page Main Valve Signals.
3. Return to Main Menu.

Keypad input

- Press F1 to go to Main Valve Signals.
- Press F5 or ESC to return to Main Menu.
- Press ↑ to go to Pilot Pressure Signals - 2.
- Press ↓ to go to Main Valve Signals.

4.10.3.10 Main Valve Signals



Function

Display main valve signal information.

Screen display

1. Real-time display of main valve signal. When the output switches are ON, the indicator turns green.
2. Move to the next page Engine Signals.
3. Return to Main Menu.

Keypad input

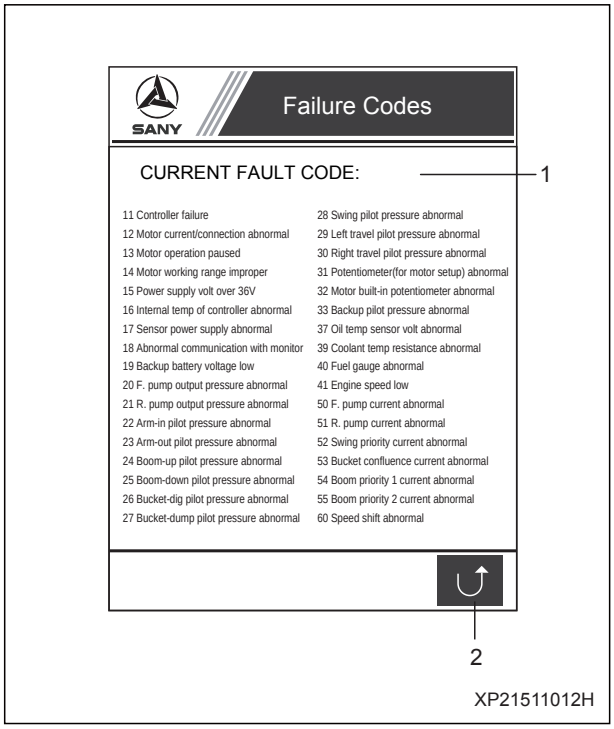
- Press F1 to go to Engine Signals.
- Press F5 or ESC to return to Main Menu
- Press ↑ to go to Main Pump Signals.
- Press ↓ to go to Engine Signals.

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4.10.3.11 Fault Information

Function

Display fault code and fault information.



Screen display

1. Fault code.
2. Return to Main Menu.

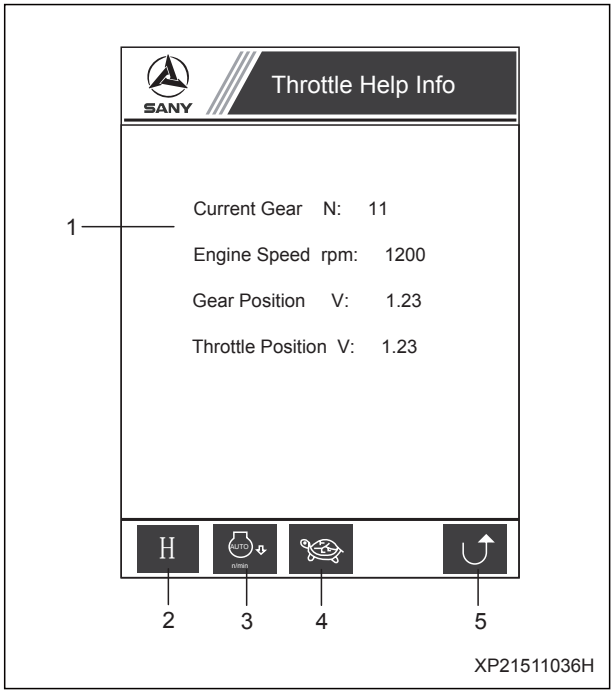
Keypad input

- Press F5 or ESC to return to Main Menu.

4.10.3.12 Throttle Help Information

Function

Throttle installation assistance.



Screen display

1. Real-time display of detected value.
2. Working mode.
3. Auto-idle and full speed.
4. High and low travel speed.
5. Return to Main Menu.

Keypad input

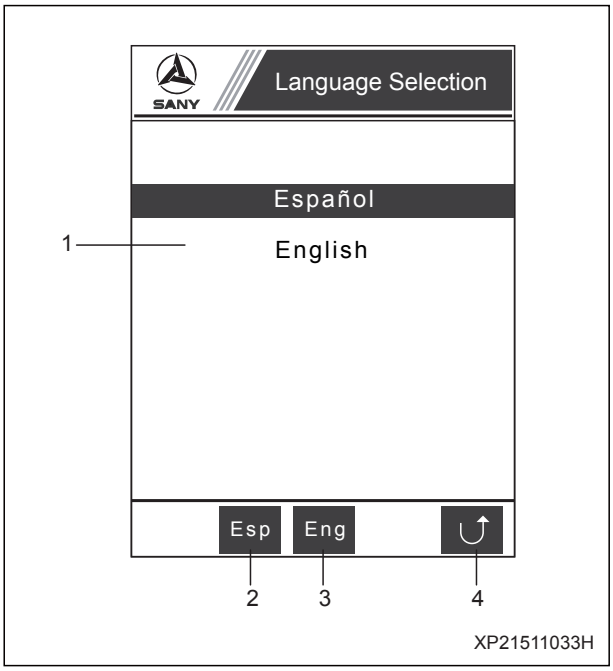
- Press F1 to switch between H, S, L and B mode.
- Press F2 to switch between auto-idle mode and full speed.
- Press F3 to switch between high and low travel speed.
- Press F5 or ESC to return to Main Menu.

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4.10.3.13 Language Selection

Function

Select system language.



Screen display

1. List of system languages.
2. Español
3. English
4. Return to Main Menu.

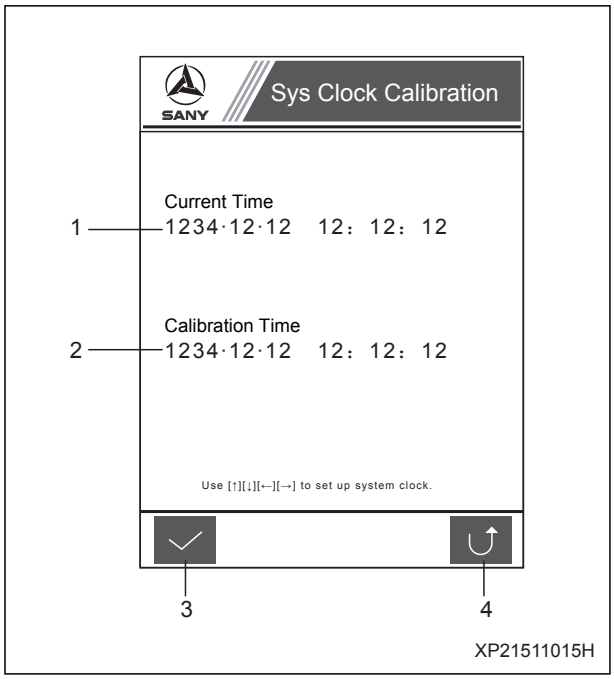
Keypad input

- Press F2 to select Español.
- Press F3 to select English.
- Press F5 or ESC to return to Main Menu.

4.10.3.14 System Clock Calibration

Function

Adjust system time.



Screen display

1. Current time.
2. Adjusted time.
3. Save adjusted time.
4. Return to Main Menu.

Keypad input

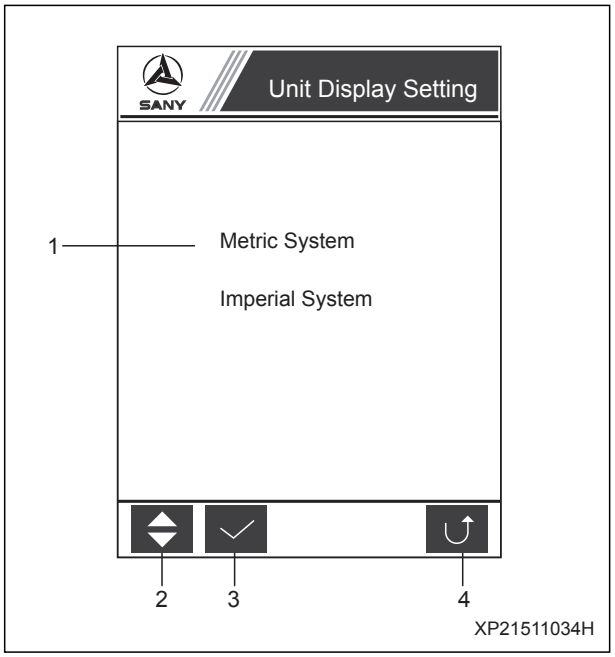
- Press F1 or Enter to confirm and save adjusted time.
- Press F5 or ESC to return to Main Menu.

Remark:

- When F1 or Enter is pressed, “Adjustment finished” is displayed on the bottom.
- System time can not be adjusted once again until the system is re-energized.

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4.10.3.15 Unit Display Setup



Function

Set up system unit display.

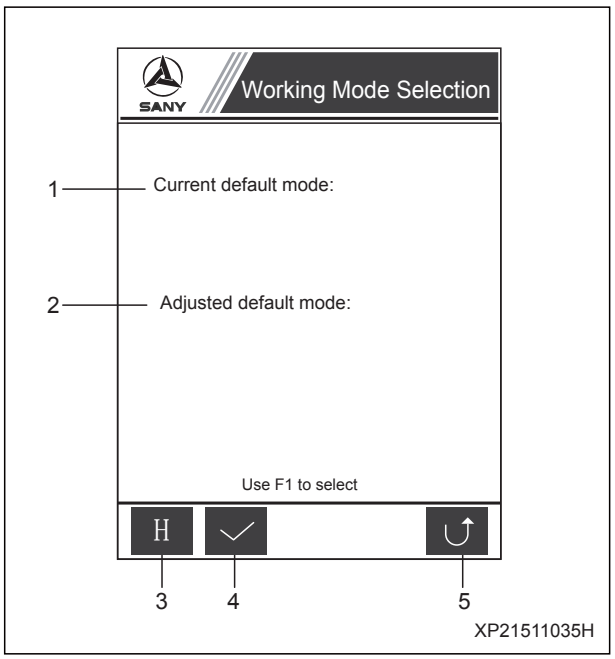
Screen display

1. Metric and Imperial unit.
2. Switch between Metric and English unit.
3. Confirm unit selection.
4. Return to Main Menu

Keypad input

- Press F1 to switch between Metric and Imperial unit system.
- Press F2 or Enter to confirm unit selection.
- Press F5 or ESC to return to Main Menu.

4.10.3.16 Working Mode Selection



Function

Set default working mode to H, S or L.

Screen display

1. Current default working mode.
2. Adjusted default working mode.
3. Switch between H, S, L and B mode.
4. Confirm default working mode selection.
5. Return to System Setup

Keypad input

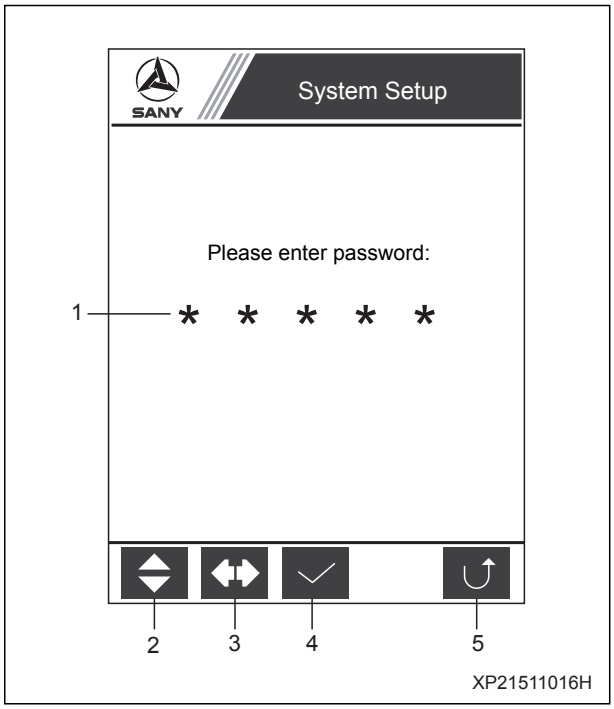
- Press F1 to switch between H, S, L and H.
- Press F2 or Enter to confirm default working mode adjustment.
- Press F5 or ESC to return to System Setup.

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4.10.3.17 System Setup Password Entry

Function

Enter the password before accessing the system setup page.



Screen display

1. A 5-digit password. Each digit is indicated by an asterisk (*) standing for a value from 0 to 9. A numeral appears at the digit where the cursor is located while the other four digits are in asterisk.
2. Change the value of the digit where the cursor is located.
3. Move the cursor.
4. Check the password and go to System Setup if the password is correct, or tell the user to enter the correct password, if the password is wrong.
5. Return to Main Menu.

Keypad input

- Press F1 or [↑] and [↓] to change the value of the digit where the cursor is located.
- Press F2 or [←] and [→] to move the cursor.
- Press F3 or [Enter] to check the validity of the password and go to System Setup if it is correct.
- Press F5 or [ESC] to return to Main Menu.

Remark:

- Password of this page is only authorized to service workers.

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4.10.3.18 System Setup Menu

Function

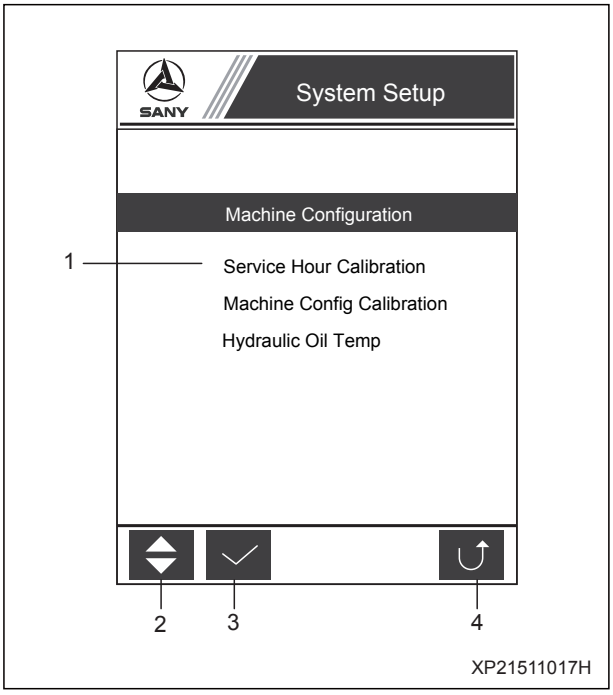
Set up machine configuration.

Screen display

1. System setup menu.
2. Scroll up and down to select an entry on the menu.
3. Access the selected entry.
4. Return to System Setup.

Keypad input

- Press F1 or ⬆ and ⬇ to scroll up and down and select an entry in the list.
- Press F2 or Enter to access the selected entry.
- Press F5 or ESC to return to Main Menu.

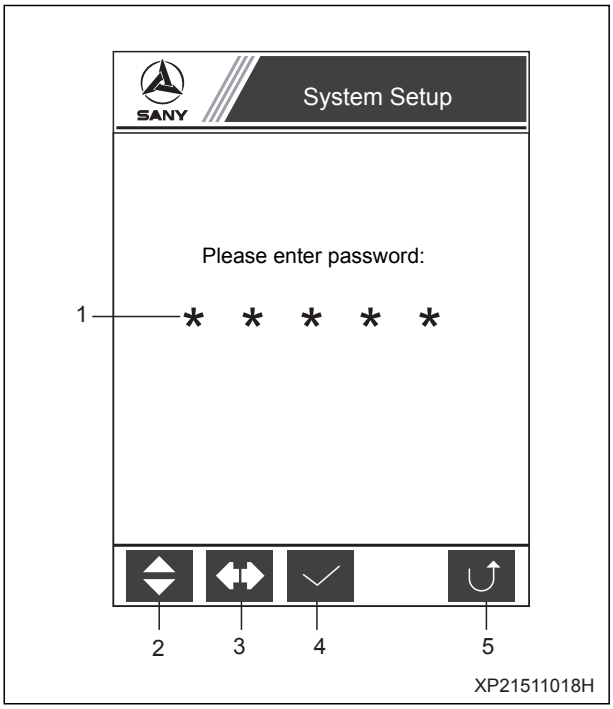


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4.10.3.19 Machine Configuration Password

Function

Enter the password before accessing the system configuration page.



Screen display

1. A 5-digit password. Each digit is indicated by an asterisk (*) standing for a value from 0 to 9. A numeral appears at the digit where the cursor is located while the other four digits are in asterisk.
2. Change the value of the digit where the cursor is located.
3. Move the cursor.
4. Check the password and go to Machine Configuration if the password is correct, or tell the user to enter the correct password, if the password is wrong.
5. Return to System Setup.

Keypad input

- Press F1 or [↑] and [↓] to change the value of the digit where the cursor is located.
- Press F2 or [←] and [→] to move the cursor.
- Press F3 or [Enter] to check the validity of the password and go to Machine Configuration if it is correct.
- Press F5 or [ESC] to return to System Setup.

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4.10.3.20 Machine Configuration

Function

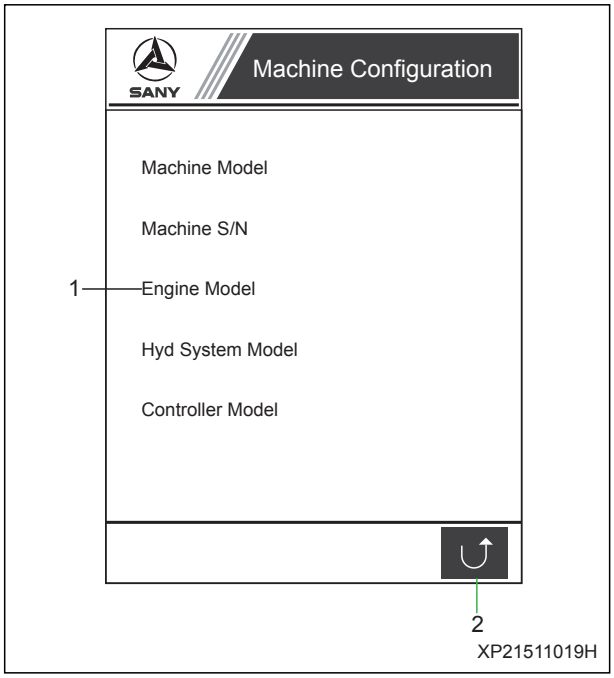
Machine configuration information.

Screen display

1. List of machine configuration information.
2. Return to System Setup.

Keypad input

- Press F5 or ESC to return to System Set-up.



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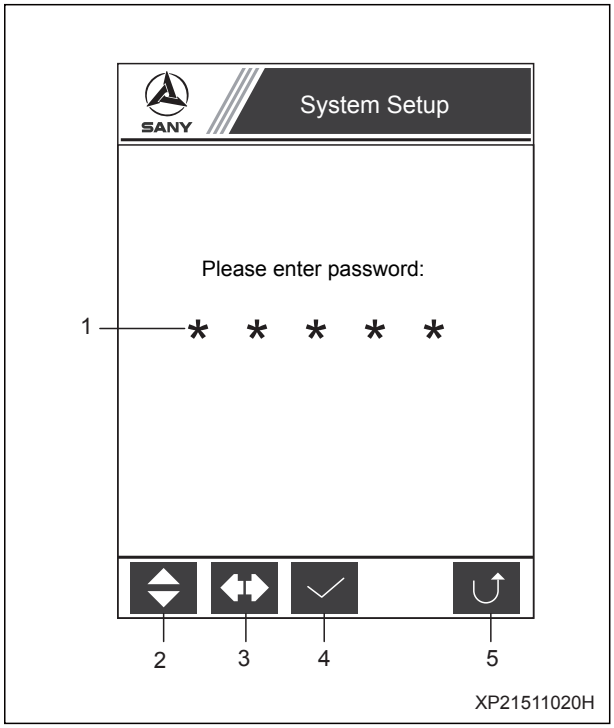
4.10.3.21 Service Hour Calibration Password

Function

Enter the password before accessing the service hour adjustment page.

Screen display

1. A 5-digit password. Each digit is indicated by an asterisk (*) standing for a value from 0 to 9. A numeral appears at the digit where the cursor is located while the other four digits are in asterisk.
2. Change the value of the digit where the cursor is located.
3. Move the cursor.
4. Check the password and go to Service Hour Calibration if the password is correct, or tell the user to enter the correct password, if the password is wrong.
5. Return to System Setup.



Keypad input

- Press F1 or ↑ and ↓ to change the value of the digit where the cursor is located.
- Press F2 or ← and → to move the cursor.
- Press F3 or Enter to check the validity of the password and go to Service Hour calibration if it is correct.
- Press F5 or ESC to return to System Setup.

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4.10.3.22 Service Hour Calibration

Function

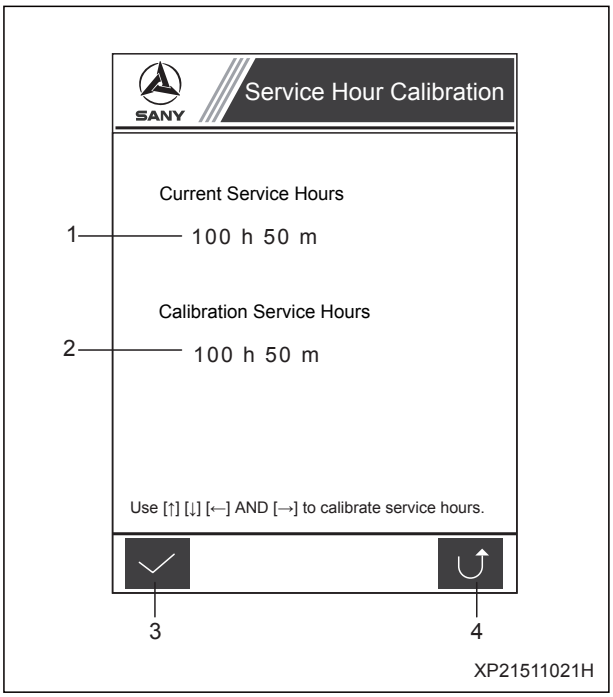
Adjust total service hours.

Screen display

1. Current total service hour reading in the controller.
2. Adjusted service hour.
3. Update the current total service hour reading with the adjusted service hour.
4. Return to System Setup.

Keypad input

- Press F1 or Enter to confirm and update service hour reading. “Adjustment finished. Re-energize the system” is displayed on the bottom.
- Press F5 or ESC to return to System Setup.



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4.10.3.23 Machine Configuration Calibration Password

Function

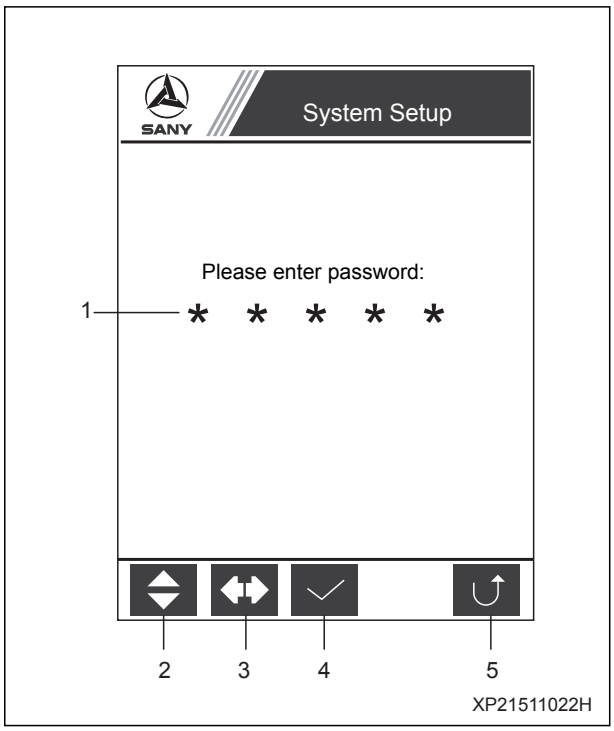
Enter the password before accessing the machine configuration calibration page.

Screen display

1. A 5-digit password. Each digit is indicated by an asterisk (*) standing for a value from 0 to 9. A numeral appears at the digit where the cursor is located while the other four digits are in asterisk.
2. Change the value of the digit where the cursor is located.
3. Move the cursor.
4. Check the password and go to Machine Configuration Calibration if the password is correct, or tell the user to enter the correct password, if the password is wrong.
5. Return to System Setup.

Keypad input

- Press F1 or [↑] and [↓] to change the value of the digit where the cursor is located.
- Press F2 or [←] and [→] to move the cursor.
- Press F3 or [Enter] to check the validity of the password and go to Machine Configuration Calibration if it is correct.
- Press F5 or [ESC] to return to System Setup.

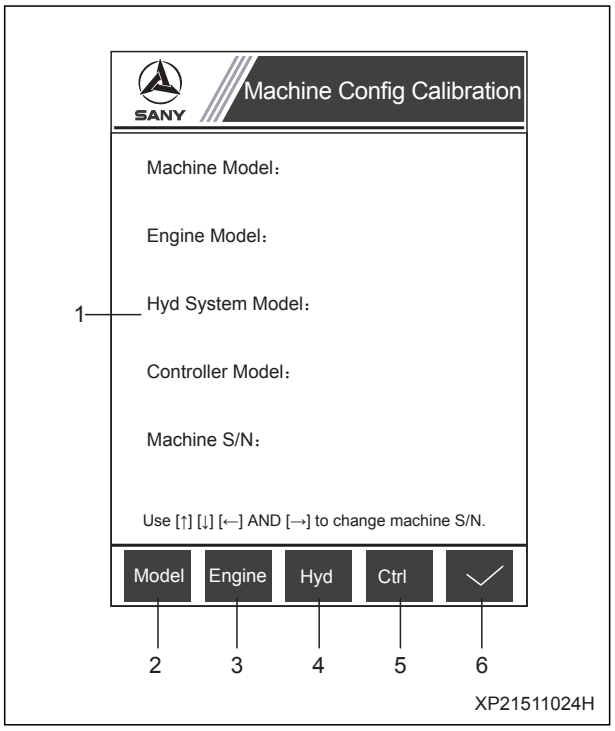


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4.10.3.24 Machine Configuration Calibration

Function

Adjust machine configuration when the monitor is installed.



Screen display

1. Machine configuration information.
2. Adjust machine model.
3. Adjust engine model.
4. Adjust hydraulic system model.
5. Adjust controller model.
6. Save machine configuration adjustment.

Keypad input

- Press F1 to alter machine model.
- Press F2 to alter engine model
- Press F3 to alter hydraulic system model.
- Press F4 to alter controller model.
- Press F5 to save machine configuration adjustment. “Adjustment finished. Re-energize the system” is displayed on the bottom.
- Press [↑] or [↓] to increase or decrease machine number by 100.
- Press [←] or [→] to increase or decrease machine number by 1. Keep them pressed to quicken the increase or decrease.
- Press [ESC] to return to System Setup.
- Press [Enter] to move the cursor between different blocks in the machine number.

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Remark:

Machine number is composed of four parts: Year of production, Machine code, Tonnage code, Alteration code, Serial number and Tail number “8”.

1. Press Enter to switch between Year of production, Machine code and Serial number. The selected block keeps blinking.
2. When Year of production or Alteration code is selected, press ⬅ or ➡ to increase or decrease the number by 1.
3. When Tonnage code is selected, press ⬅ or ➡ to increase or decrease the number by 1, or press ⬆ or ⬇ to increase or decrease the number by 100.
4. When Tonnage code is selected, press ⬅ or ➡ to increase or decrease the number by 1, or press ⬆ or ⬇ to increase or decrease the number by 100.
5. The machine number can be reduced to four digits. Press ⬅ or ➡ to switch between different parts. Press ⬆ or ⬇ to increase or decrease the numbers. The first digit from the left can be adjusted from 0 to 9 and from A to Z. The last three digits can be adjusted from 0 to 9. When the number exceeds 9999, letters A, B, C, D, E to Z are used to stand for 10 thousand, 11 thousand, 12 thousand, 13 thousand, 14 thousand, 15 thousand and so on. e.g. 10,000 is indicated by A000, 11,020 is indicated by B020, 12,999 is indicated by C999.

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4.10.3.25 Hydraulic Oil Temperature

Function

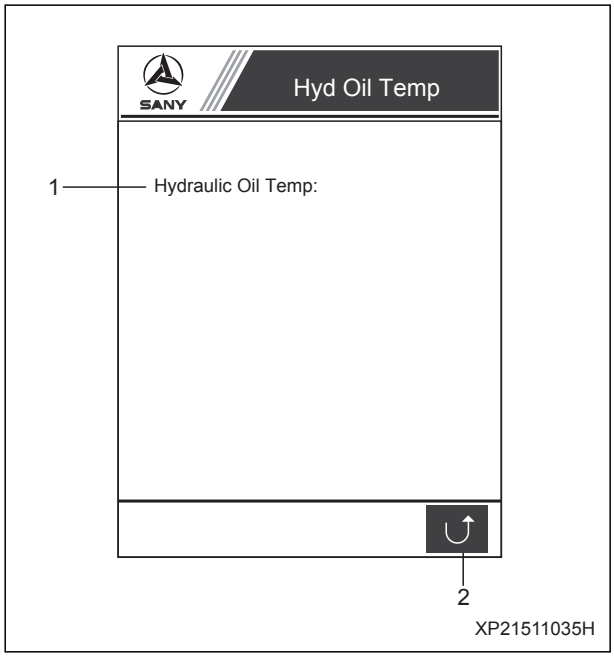
Display hydraulic oil temperature.

Screen display

1. Hydraulic oil temperature.
2. Return to System Setup.

Keypad input

- Press F5 or ESC to return to System Set-up.



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4.10.3.26 System Lockout Level 1

Function

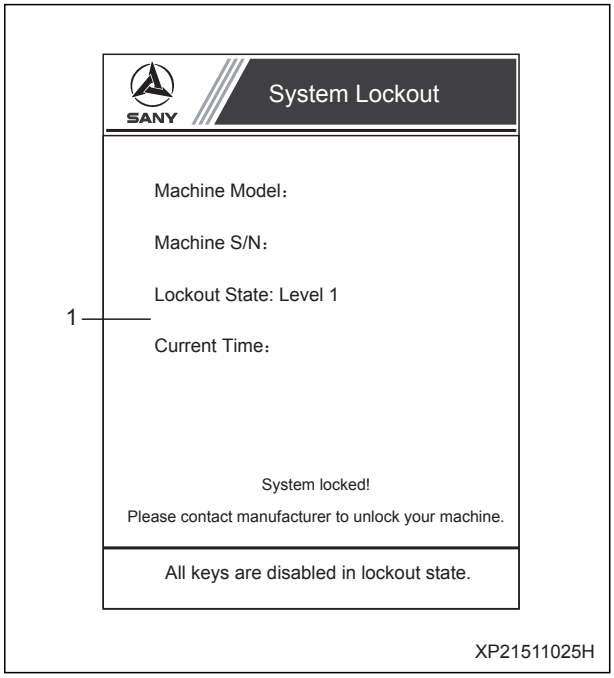
The machine is under level 1 lockout state. All keys are disabled.

Screen display

1. Machine configuration information, lockout level and current time.

Remark

- After 5 seconds, the screen displays lockout level: Lockout Level 1, Lockout Level 2 or Unlocked.



4.10.3.27 System Lockout Level 2

Function

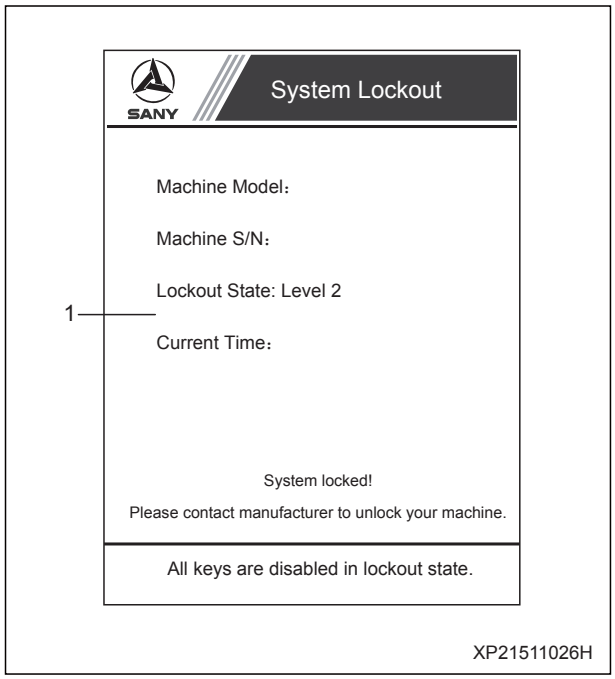
The machine is under level 2 lockout state. All keys are disabled.

Screen display

1. Machine configuration information, lockout level and current time.

Remark

- After 5 seconds, the screen displays lockout level: Lockout Level 1, Lockout Level 2 or Unlocked.



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Standard Values

5 Standard Values

5.1 Standard Values for Chassis-related Parts 5-3

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⚠ WARNING

Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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5 STANDARD VALUES

5.1 Standard Values for Chassis-related Parts

Categ.	Item	Measurement condition		Unit	Std. value for new machine	Permissible value
Engine Speed	2 pumps at relief	• Engine coolant temperature: Within operational range • Hydraulic oil temperature: Within operational range • Engine running at high idle • Heavy-load operating mode (H) • Arm-in relief condition		rpm	2,000±50	2,000±50
	Speed when auto deceleration is operated	• Engine running at high idle • Auto idling switch on • All control levers neutral		rpm	1,200±50	1,200±50
Spool Stroke	Boom control valve	• Engine stopped • See Control valve on pg 4-9.	UP	mm	11.5±0.5	11.5±0.5
			DOWN	mm	9.5±0.5	9.5±0.5
	Arm control valve		IN	mm	11.5±0.5	11.5±0.5
			OUT	mm	9.5±0.5	9.5±0.5
	Bucket control valve		DIG/DUMP	mm	9.5±0.5	9.5±0.5
	Swing control valve		Travel (L&R)	mm	9.5±0.5	9.5±0.5
	Travel control valve		Forward & Reverse	mm	9.5±0.5	9.5±0.5
Control Lever stroke	Boom control lever	• Engine stopped • Control lever grip at center • Max. reading up to stroke end (except lever play in NEUTRAL position)		mm	80±10	80±10
	Arm control lever			mm	80±10	80±10
	Bucket control lever			mm	80±10	80±10
	Swing control lever			mm	80±10	80±10
	Travel control lever			mm	115±12	115±12
	Play of control lever	• Engine stopped • Slightly push the control lever with your hand. Stop pushing when you feel clear resistance • Max. reading up to stroke end	Work Equipment	mm	Max.15	Max.20
			Stroke	mm	Max.20	Max.25

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Categ.	Item	Measurement condition	Unit	Std. value for new machine	Permissible value
Operating Force of Control Lever/ Pedal	Boom control lever	• Hydraulic oil temp: Within operational range • Engine running at high idle • Control lever grip at center • Pedal at tip • Max. reading at stroke end	N {kg}	Max.19.6 {Max.2.0}	Max.24.5 {Max.2.5}
	Arm control lever			Max.19.6 {Max.2.0}	Max.24.5 {Max.2.5}
	Bucket control lever			Max.15.6 {Max.1.6}	Max.21.6 {Max.2.2}
	Swing control lever			Max.15.6 {Max.1.6}	Max.21.6 {Max.2.2}
	Travel control lever			Max.30.4 {Max.3.1}	Max.39.2 {Max.4.0}
	Travel control pedal			Max.93.1 {Max.9.5}	Max.107.6 {Max.11}
Hydraulic Pressure	Unloaded pressure	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • All control levers in neutral position • Hydraulic pump output pressure	MPa {kg/cm²}	0 – 1.0	0 – 2.0
	Boom relief	• Hydraulic oil temp: Within operational range • Operate corresponding control lever after engine runs at high idling speed. • Working mode: H • Hydraulic pump output pressure with all measurement circuits relieved		34.3 ± 1.0 {350 ± 10}	33.3 – 35.3 {340 – 360}
	Arm relief			34.8 ± 1.0 {355 ± 10}	33.3 – 36.8 {340 – 375}
	Bucket relief			34.8 ± 1.0 {355 ± 10}	33.3 – 36.8 {340 – 375}
	Swing relief	• Hydraulic oil temp: Within operational range • Operate corresponding control lever after the engine runs at high idling speed. • Working mode: H • Hydraulic pump output pressure with all measurement circuits relieved		25.5 ± 1.0 {261 ± 10}	24.5 – 27.5 {250 – 280}
	Travel relief			33.4 ± 1.0 {342±10}	32.4 – 34.4 {330 – 351}
	Control circuit source pressure	• Hydraulic oil temp: Within operational range • Engine running at high idle • Self pressure reducing valve output pressure with all control levers in NEUTRAL position		3.9±0.2 {40±2}	3.7 – 4.1 {37 – 41}

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Categ.	Item	Measurement condition		Unit	Std. value for new machine	Permis-sible value
Swing	Swing brake angle	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Swing circle misalignment amount when stopping after one turn • For measuring posture see Swing 1 on Pg. 4-10.		Deg. mm	Max.100 (—)	Max. 130 (—)
	Time taken to start swing	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Time required for passing points 90°and 180° from starting point • For measuring posture see Swing 1 on Pg. 4-10.	90°	sec.	3.1 ± 0.3	Max.3.7
			180°	sec.	4.4 ± 0.4	Max.5.5
	Time taken to swing	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Time required for 5 turns after making initial 1 turn • For measuring posture see Swing 1 on Pg. 4-10.		sec.	28 ± 3.5	Max.34
	Hydraulic drift	• Hydraulic oil temp: Within operational range • Engine stopped • Keeping the upper structure transverse on a grade of 15°. For more information see Swing 2 on Pg. 4-11. • Notching a mating mark on inner and outer races of the swing circle • Mating mark misalignment amount during 5 min.		mm	0	0
	Motor leakage	• Hydraulic oil temp: Within operational range • Engine running at high idle • Swing lockout switch: ON • Leakage amount for 1 minute during swing relief		ml/ min	Max.5	Max.10
Travel	Travel speed (unload-ed)	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Time required for track shoes to make 5 turns after making one initial idle turn • For more information on measuring posture see Travel 1 on Pg. 4-9.	Lo	sec.	51.3 ± 5.1	46.2 - 60.4
			Hi		28.0 ± 1.4	26.6 - 31.4

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Cat.	Item		Measurement Condition		Unit	Std. value for new machine	Permissible value
Travel	Travel speed (Actual run)		• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Level ground • Time required for traveling 10m after 10m trial run • For measuring posture see Swing 2 on Pg. 4-11.	Lo	sec.	20 ± 2.5	17.5~22.5
				Hi		13 ± 2.5	11.5~15.5
	Deviation		• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Travel Speed: Low • Hard level ground • Amount of deviation (χ) while traveling 20m after initial 10m trial run • For measuring posture see Travel 2/3 on Pg. 4-9/10.		mm	Max.800	Max.900
	Hydraulic drift		• Hydraulic oil temp: Within operational range • Engine stopped • Park the machine on a grade of 12°, with the sprocket in the downhill direction • Measure the sliding distance for 5 minutes • For measuring posture see Travel 4 on Pg. 4-10.		mm	0	0
	Leakage of travel motor		• Hydraulic oil temp: Within operational range • Engine running at high idle • Traveling with the sprocket locked • Oil leakage amount for one minute with traveling in relief condition		mm	13.6	27.2
Work Equipment	Hydraulic drift	Bucket tips	• Hydraulic oil temp: Within operational range • Flat and level ground • Bucket full of earth or with rated load (0.8m³: 1,440 kg) • Boom horizontal, arm fully retracted and bucket cylinder fully extended • Engine stopped • Work equipment control lever in neutral position • Measure total amount of falling for 15 minutes by measuring the falling every 5 minutes immediately after initial setting ★ Bucket tip lower distance ★ Boom cylinder: Cylinder retracting distance ★ Arm cylinder: cylinder extending distance ★ Bucket cylinder: cylinder retracting distance • For measuring posture see Work Equipment 1 on Pg. 4-11.		mm	Max.600	Max.900
		Boom cylinder			mm	Max.20	Max.27
		Arm cylinder			mm	Max.20	Max.20
		Bucket cylinder			mm	Max.35	Max.40

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Categ.	Item		Measurement condition		Unit	Std. value for new machine	Permis-sible value
Work Equipment	Work Equipment Speed	Boom	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Time required for the bucket to raise from the ground to its stroke end • For measuring posture see Work Equipment 2 on Pg. 4-11.	UP	sec.	3.4 ± 0.4	Max. 4.8
		Arm	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Time required from dumping stroke end to digging stroke end • For measuring posture see Work Equipment 3 on Pg. 4-12.	IN	sec.	2.6 ± 0.4	Max. 3.3
				OUT	sec.	2.3± 0.3	Max. 2.8
		Bucket	• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Time required from dumping stroke end to digging stroke end • For measuring posture see Work Equipment 4 on Pg. 4-12.	DIG	sec.	2.3 ± 0.4	Max. 2.8
				DUMP	sec.	1.6 ± 0.3	Max. 1.9

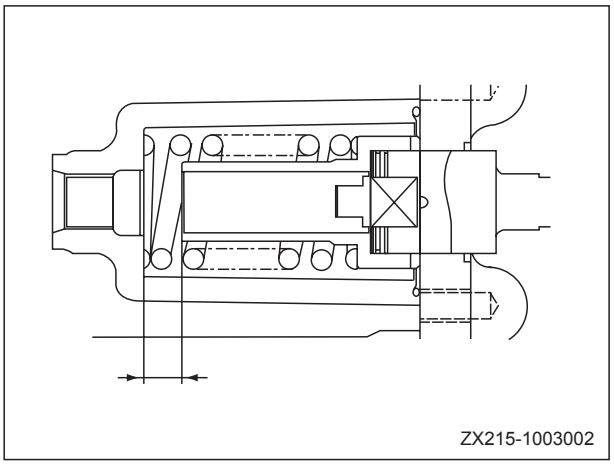
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Cat.	Item		Measurement condition	Unit	Std. value for new machine	Judgement criteria
Work Equipment	Time Delay	Boom	• Hydraulic oil temp: Within operational range • Engine running at low idle • Working mode: H • Time required from maneuvering the joystick to the moment that the bucket reaches the ground and begins to push the machine upward, within 50mm off the ground • For measuring posture see Work Equipment 5 on Pg. 4-12.	sec.	Max. 1.0	Max.1.2
		Arm	• Hydraulic oil temp: Within operational range • Engine running at low idle • Working mode: H • Average time required for operating the control lever back and forth till the arm starts to move • For measuring posture see Work Equipment 6 on Pg. 4-13.	sec.	Max. 2.0	Max.2.8
		Bucket	• Hydraulic oil temp: Within operational range • Engine running at low idle • Working mode: H • Average time required for operating the control lever back and forth till the arm starts to move • For measuring posture see Work Equipment 7 on Pg. 4-13.	sec.	Max. 1.0	Max.3.6
	Internal Leakage	Cylinders	• Hydraulic oil temp: Within operational range • Engine running at high idle • Leakage amount for one minute with cylinder or travel measured at relief condition	ml/min	5	20
		Central Swivel Joint			10	50
Performance in Combined Operations	Amount of deviation in simultaneous operation of work equipment and travel		• Hydraulic oil temp: Within operational range • Engine running at high idle • Working mode: H • Travel Speed: Low • Amount of deviation measured for 20 m after traveling about 10 m on a hard level ground • For measuring posture see Travel 2 on Pg. 4-9.	mm	Max.200	Max.220

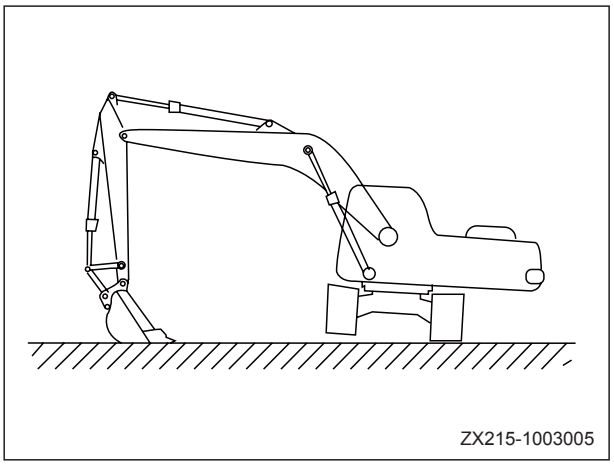
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Machine postures for measuring (For all models)

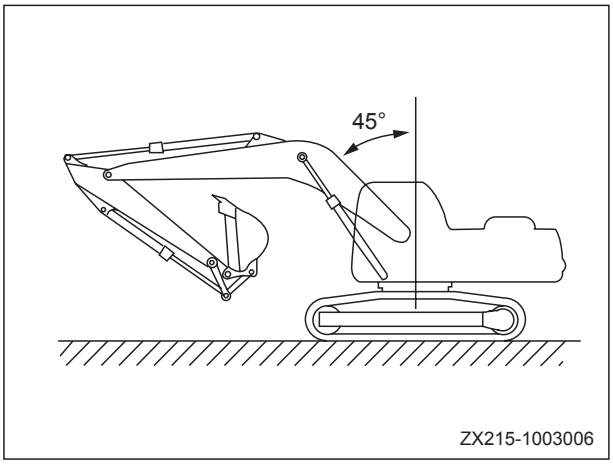
Control value: Spool stroke



Travel 1: Travel speed (without load)

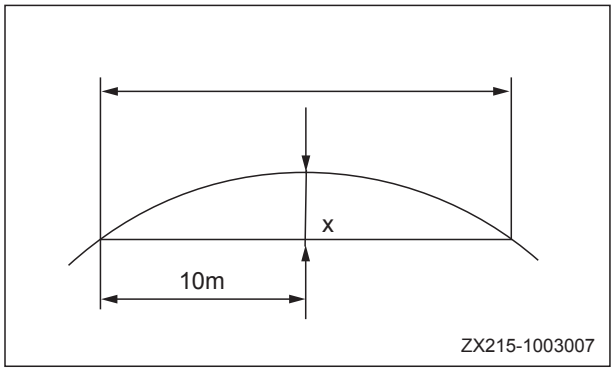


Travel 2: Travel speed (actual run), Travel deviation

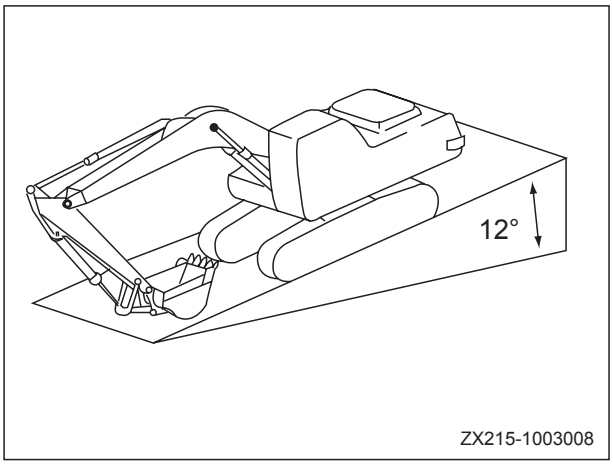


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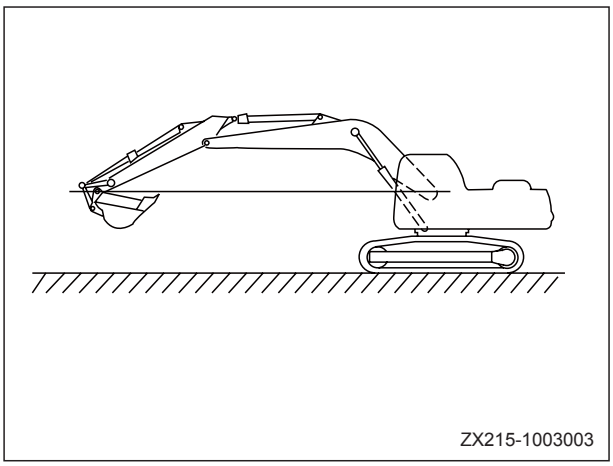
Travel 3: Travel deviation



Travel 4: Hydraulic drift of Travel

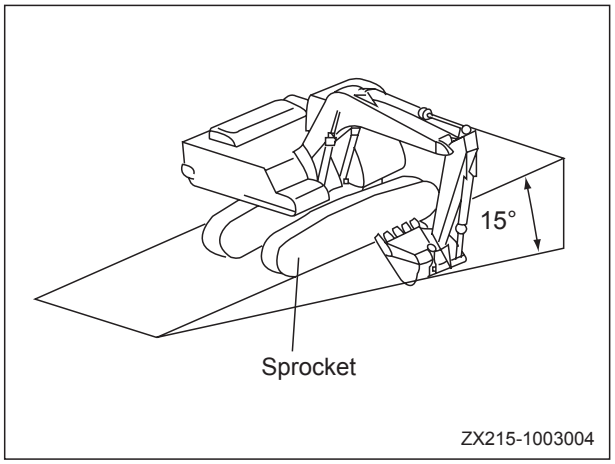


Swing 1: Swing brake angle, time taken to start swing, time taken to swing

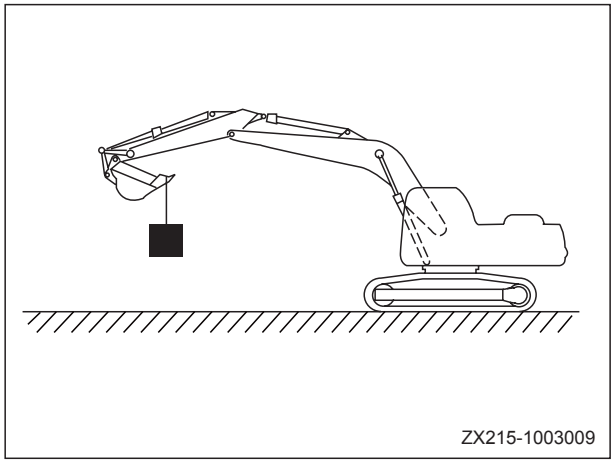


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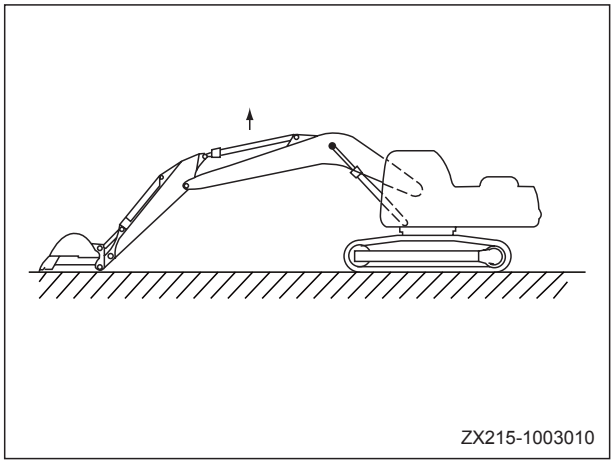
Swing 2: Hydraulic drift of swing



Work equipment 1: Hydraulic drift of work equipment

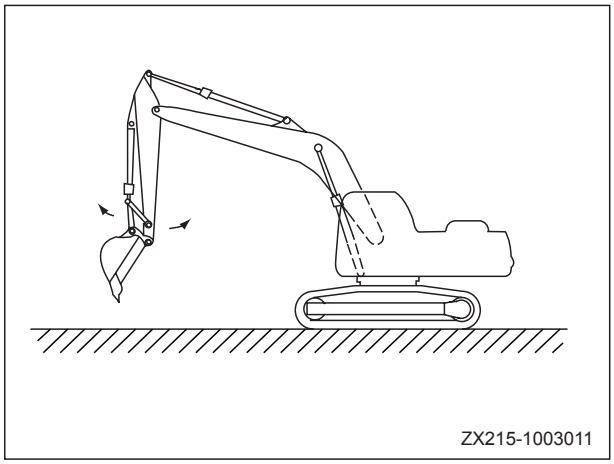


Work equipment 2: Boom speed

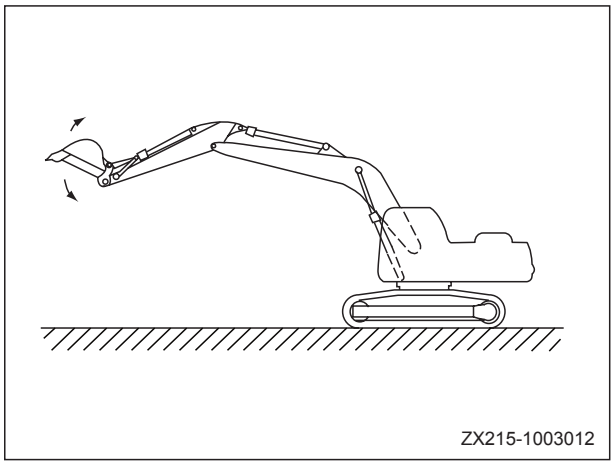


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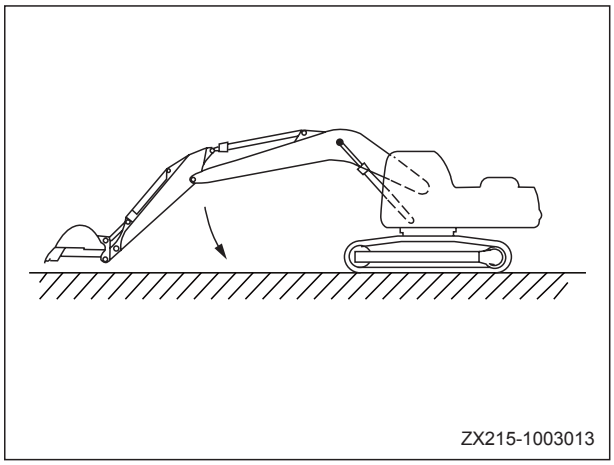
Work equipment 3: Arm speed



Work equipment 4: Bucket speed

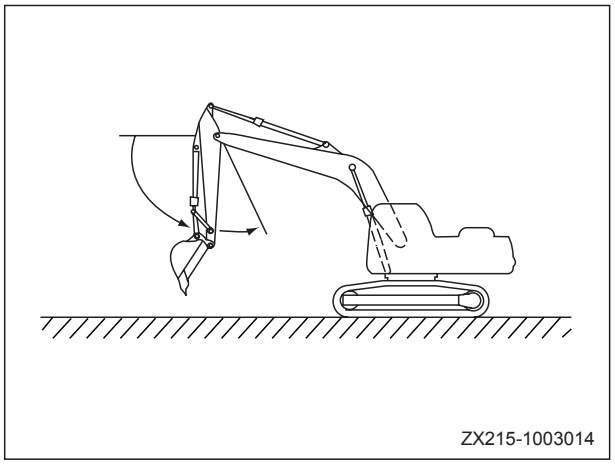


Work equipment 5: Boom delay

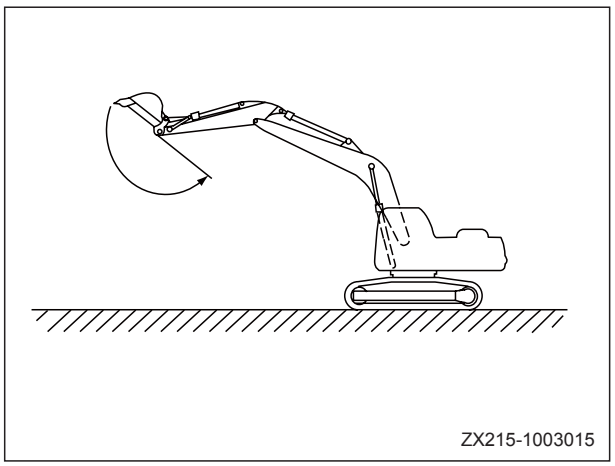


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Work equipment 6: Arm delay



Work equipment 7: Bucket delay



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Testing and Adjusting

6 Testing and Adjusting

6.1 Engine Speed - Test and Calibrate 6-3
6.2 Exhaust Gas Color - Test 6-5
6.3 Engine Speed Sensor - Adjust 6-7
6.4 A/C Compressor Belt Tension - Test and Adjust 6-8
6.5 Swing Bearing Clearance - Measure 6-10
6.6 Track Tension - Test and Adjust 6-12
6.7 Hydraulic Pressure in Hydraulic Circuits - Test and Adjust 6-14
6.8 Control Circuit Oil Pressure - Test and Adjust 6-19
6.9 Solenoid Valve Output Pressure - Measure 6-21
6.10 Pilot Valve Output Pressure - Measure 6-23
6.11 Pilot Valves (Work Equipment and Swing) - Adjust 6-25
6.12 Work Equipment Hydraulic Drift - Test 6-26
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⚠ WARNING

Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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6 TESTING AND ADJUSTING

6.1 Engine Speed - Test and Calibrate

★ Engine speed calibrator

ID	Part Number	Part Name
1	B249900001206	Engine Speed Calibrator

6.1.2 Testing

Start the engine and keep the engine running until engine coolant temperature rises within the operational range. Key in the code on the monitor and check if the engine speed is normal in each throttle position.

Testing Items:

1. Engine speed at low idle
2. Engine speed at fuel control dial position 11 (H and S modes)
3. Engine speed at relief, with fuel control dial placed at position 11 (H and S modes)
4. Engine speed at auto idle

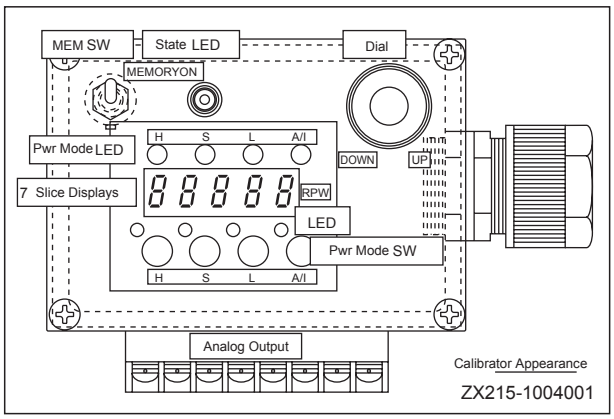
6.1.1 Adjusting

Speed calibration steps:

1. Plug the calibrator and chassis harness;
2. Set the calibrator to "Calibrate" mode and turn the calibrator dial counterclockwise to its end;
3. Start the engine;
4. Adjust the calibrator dial to the max. speed under H mode;

   Note: Memory SW UP: Calibrating mode

   Memory SW DOWN: monitoring mode



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5. Press the button under H. The corresponding power mode LED flashes, indicating the controller is storing data. No operation should be performed during the moment. The storing process will finish in about 5 seconds. Current data is regard as the max. engine speed under this mode.
6. Increase the engine speed to the max. speed under S mode. Press the button under S. The corresponding power mode LED flashes, indicating the controller is storing data. No operation should be performed during the moment. The storing process will finish in about 5 seconds. Current data is regard as the max. engine speed under this mode.
7. Calibrate the engine speed for the L mode and for auto idle following the description in step 5 and step 6.
8. Lower the engine speed to the minimum.
9. Turn off the engine.

   Set the calibrator to "Monitoring" mode. Power on and start the engine. Make sure that the max. engine speed calibration is correct under each mode.
10. If engine speed calibration fails, repeat step 1 through step 9.

Remark:

When the control levers are neutralized, engine speed will drop automatically to about 1350 rpm after 3 seconds. This not only reduces loss of the hydraulic system and engine wear, but also cuts fuel consumption and reduces noise. When any of the control lever is moved, the engine resumes its original speed.

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6.2 Exhaust Gas Color - Test

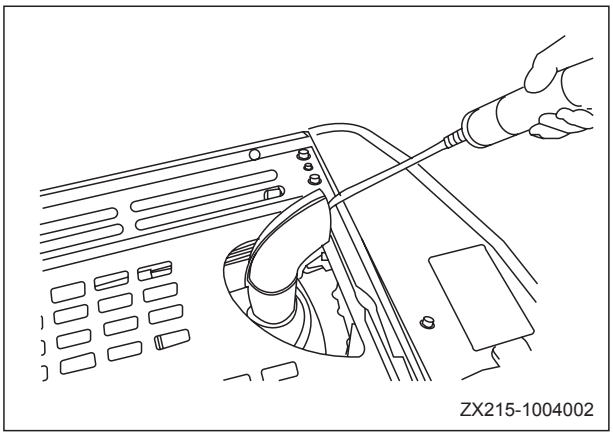
★ Testing tools

ID	Model	Part Name
1	YDJ-2006	Smoke meter
2	SV-2TY	Opacimeter

⚠ Do not touch any hot parts when mounting or dismounting the testing tools.

1. Measure with a smoke meter

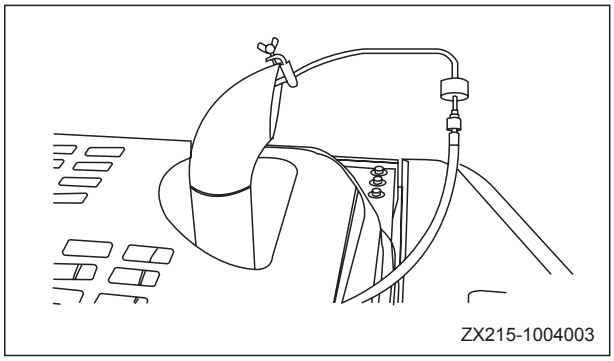
1) Put the filter paper into the smoke meter.
2) Insert the waste gas intake pipe into the exhaust pipe.
3) Start the engine and keep the engine running until engine coolant temperature is within the operational range.
4) When engine speed increases suddenly or is kept at high idle, direct exhaust gas through smoke meter to the filter paper.
5) Remove the filter paper from the smoke meter. Read the smoke value through the apparatus provided.
6) Remove the testing tools after measuring. Make sure the machine goes back to its normal state.


ZX215-1004002

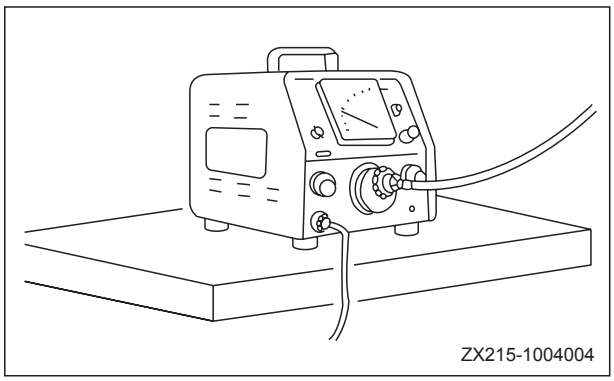
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2. Measure with an opacimeter

1) Mount the opacimeter onto the exhaust pipe by clamping it to the pipe outlet.


ZX215-1004003

2) Open the opacimeter and preheat it for about 15 minutes.


ZX215-1004004

3) Start the engine and keep the engine running until engine coolant temperature is within the operational range.
4) When engine speed increases suddenly or is kept at high idle, use the opacimeter to read the smoke value of exhaust gas.
5) Remove the testing tools after measuring. Make sure the machine goes back to its normal state.

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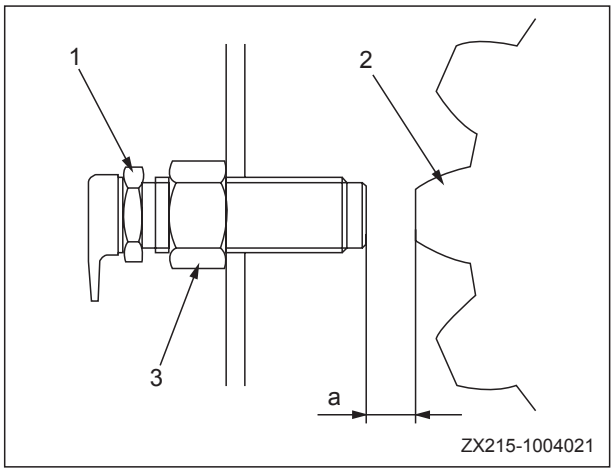
6.3 Engine Speed Sensor - Adjust

★ Remove the engine speed sensor (1) before adjusting. Check for presence of metal chips and for damaged sensor top. Restore the sensor.



1. Screw on the sensor (1) until its end contacts with ring gear tip (2) of the flywheel.
2. Unscrew the sensor some degrees.
   - ★ Degrees: 1.2~1.4 turns
   - ★ Adjust the clearance (a) between the sensor end and the flywheel edge to 2±0.2 mm.
3. Tighten the sensor (1) with the nut (3).

   Nut: 49.0~68.6 N·m {5~7kg·m}
4. Make sure that the engine speed is displayed properly on the control panel after adjustment.

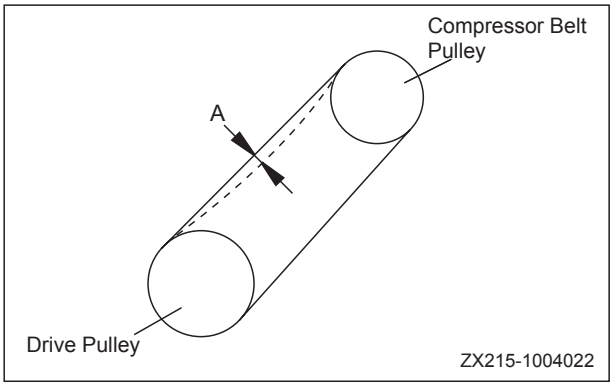


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6.4 A/C Compressor Belt Tension - Test and Adjust

6.4.1 Testing

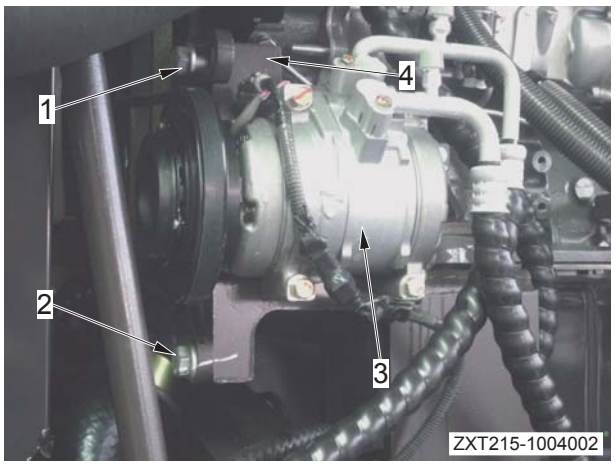
Press the intermediate point of the belt between the drive pulley and the compressor pulley with a finger force of about 58.8 N（6kgf）, and measure deflection (A) of the belt, which shall be 5~8 mm (0.20 in~0.31in).



6.4.2 Adjusting

★ If the belt deflection is abnormal, adjust it according to the following procedure.

1. Loosen the bolts (1) and (2).
2. Move the compressor (3) and the bracket (4) together to adjust belt tension.
3. After positioning the compressor (3), tighten the bolts (1) and (2).
4. Check belt tension again after adjustment.



Reference

Use a tensiometer to check the compressor belt tension.

New Belt	Used Belt
637±108 N {65±11 kgf}	441±88.2 N {45±9 kgf}

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Note:

- Check each belt for damage. Check the V - groove and the V - belt for wear. In addition, it is especially important to keep the V - belt free from friction with bottom of the V - groove.
- Contact local Sany dealer and replace the belt in case of the following conditions.
  - The fan belt has been stretched and little margin is left for adjustment.
  - Cuts or cracks are found in the belt.
  - Abnormal sliding or noise.
- When a new belt is mounted, readjust the belt tension after one hour operation.

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6.5 Swing Bearing Clearance - Measure

★ Measuring tool

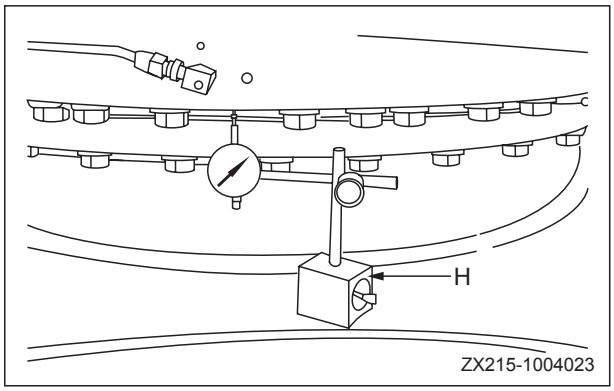
Symbol	Part Number	Part Name
H	60033930	Dial gauge

★ The following steps are to be followed when measuring the clearance of swing bearing.

⚠ Park your machine on a level ground. Lower your work equipment to the ground.

⚠ Do not put your hands or feet under the undercarriage during measurement.

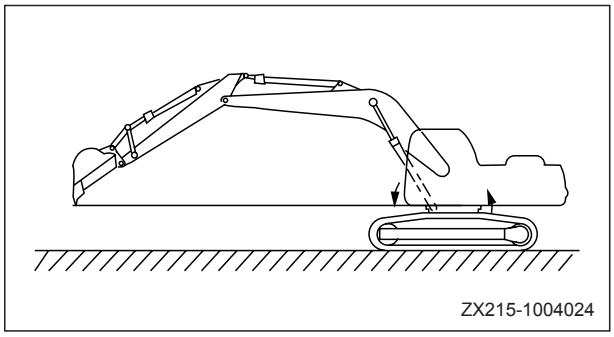
1. Fix the dial gauge (H) to the track frame and apply the probe to the lower end of the outer race.



2. Place the work equipment to the maximum reach position. Raise the bucket to a height that the bucket tips and the swivel table bottom are on the same level.

★ At the moment, the front of upper structure lowers while the rear rises.

3. Set the dial gauge (H) to zero.



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4. Set the arm almost perpendicular to the ground and lower the boom until the front track shoe floats.

★ At the moment, the front of upper structure rises while the rear lowers.

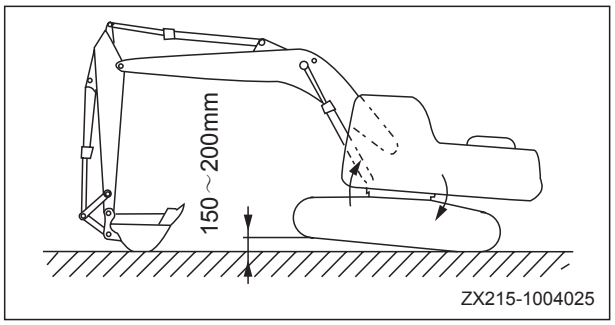
5. Read the dial gauge (H).

★ The value indicated by the dial gauge (H) is the clearance of the bearing.

★ For more information, see “Swing bearing” on page 4-12.

6. Restore the machine to the condition of step 2. Check the dial gauge (H) to see if it reads zero.

★ Repeat step 3 through step 5 if the dial gauge (H) reads a value other than zero.



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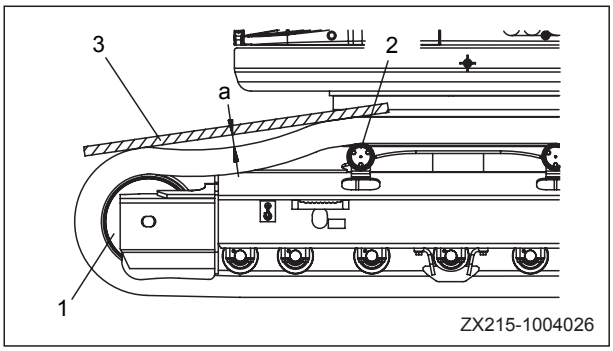
6.6 Track Tension - Test and Adjust

6.6.1 Testing

1. Move your machine forward for a distance that is equal to the length of track on the ground. Keep running the engine at low idle. Park your machine slowly.
2. Place a straight bar on the track over idler (1) and carrier roller (2).

★ A straight angle steel bar is recommended for this purpose as it has good resistance to bending strain.

3. Measure the maximum clearance (a) between the upper surface of track and the lower edge of the straight bar.
   - Max. clearance (a): 10~30 mm (0.4~1.2 in)



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6.6.2 Adjusting

★ If track tension is incorrect, make adjustment as per the following instruction.

1. Reduce track tension

   1) Loosen the valve (1) to discharge grease. Tighten the valve after discharging.

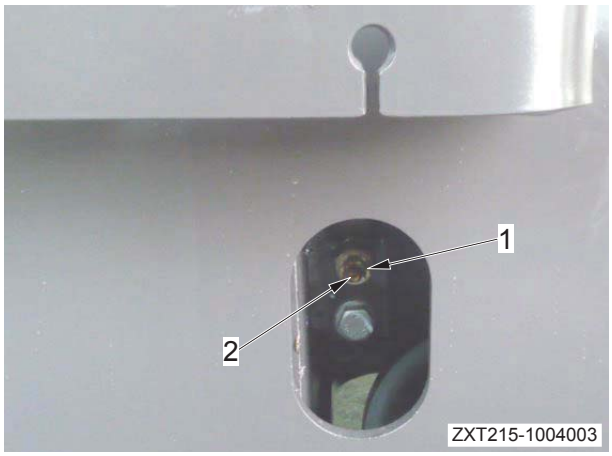
   ⚠ Do not loosen the valve over one turn. If the valve is loosened too much, the grease under high pressure may cause the valve to shoot.

   2) Check the track tension again as per the above method after adjustment.

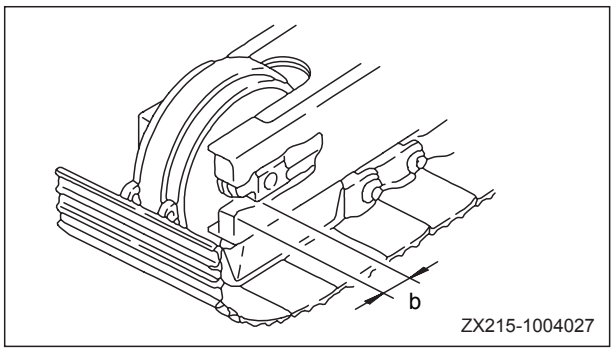
2. Increase track tension

   1) Add grease through the grease fitting (2) with a grease gun.

   2) Check the track tension again as per the above method after adjustment.



★ Add grease until the gap (b) between the idler guide and the track frame end becomes zero. If the tension is till low, it indicates that the pins and bushings are seriously worn. Replace the pins and bushings, or remove a piece of track shoe.



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6.7 Hydraulic Pressure in Hydraulic Circuits - Test and Adjust

★ Testing and adjusting tools

ID	Part Number	Part Name
—	60038932	Hydraulic Tester
	B210770000084	Adaptor

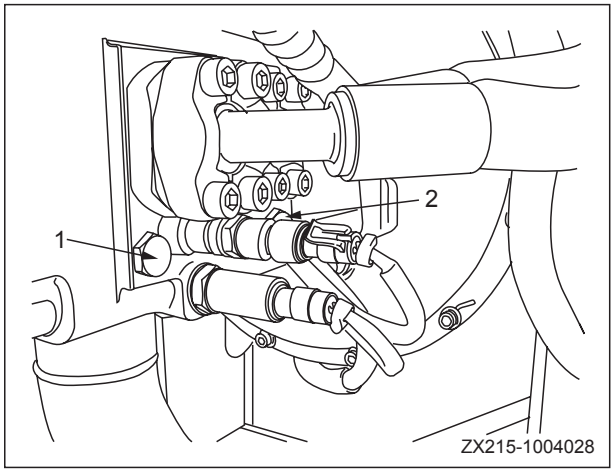
★ The hydraulic pressure in work equipment, swing and travel (hydraulic pump output) circuits can be viewed on the monitor.

6.7.1 Measuring

1. Preparatory work

⚠ Lower the work equipment to the ground and stop the engine. After the engine is stopped, operate the control levers for several times in order to release the residual pressure in hydraulic circuits. Open the butterfly nut on the breather valve. Press the relief button to release pressure in the hydraulic tank.

1) Remove the plug (1) and plug (2) for hydraulic pressure measurement.
   - Plug (1): For rear pump oil circuit
   - Plug (2): For front pump oil circuit
2) Install the priming adaptor and connect it to the hydraulic tester.
   ★ Use an oil pressure gauge with a capacity of 40 MPa {408 kgf/cm²}.
3) Start the engine and keep it running until the hydraulic pressure rises to a point within the operational range.



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2. Measurement of unloading pressure

1) Start the engine.
2) Measure the hydraulic pressure when the engine is running at high idle and all control levers are in a neutral position.

★ The hydraulic pressure indicated is the pressure when the unloading valve unloads.

3. Measurement of work equipment pressure at relief

1) Start the engine and move the cylinder to be measured to its stroke end.
2) Measure the hydraulic pressure when the engine is running at high idle and the cylinder is in relief condition.

★ The hydraulic pressure indicated is the pressure when the main relief valve is in relief condition.

4. Measurement of swing pressure at relief

1) Start the engine. Reach out the work equipment as far as possible. Lower the work equipment on the ground in order to restrict swinging.
2) Measure the hydraulic pressure when the engine is running at high idle and the swing circuit is in relief condition.

★ The hydraulic pressure indicated is the pressure when the swing motor relief valve is in relief condition.

★ The relief pressure of swing motor is lower than the main relief pressure.

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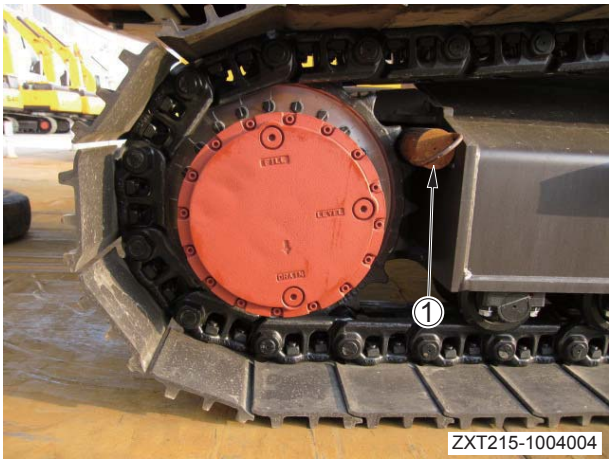
5. Measurement of travel pressure at relief

1) Start the engine and lock the travel mechanism.

⚠ Place the pin (1) between the sprocket and the track frame in order to lock the travel mechanism.

2) Measure the hydraulic pressure when the engine is running at high idle and the travel circuit is in relief condition.

★ The hydraulic pressure indicated is the pressure when the main relief valve is in relief condition. When the travel circuit is in relief condition, the pressure indicated is always the pressure at high relief.



6.7.2 Adjusting

★ Boom relief valve cannot be adjusted.

1. Main relief pressure adjustment

★ If the high relief pressure in work equipment and travel circuits is abnormal, adjust high pressure setting of the main relief valve (3) according to the following procedure.

1) Disconnect the pilot hose.

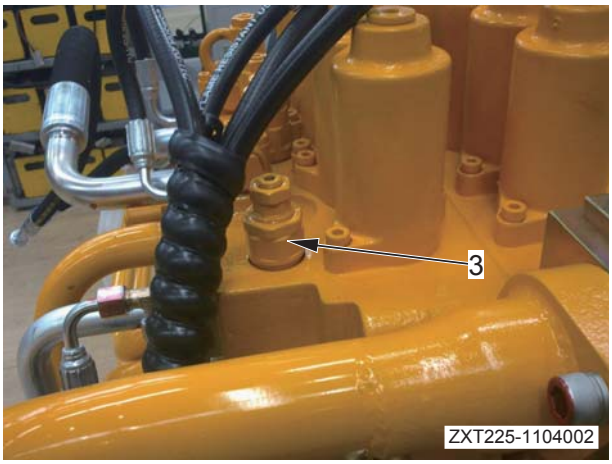
2) Loosen the locknut (4). Turn the adjustment screw (5) to adjust the pressure.

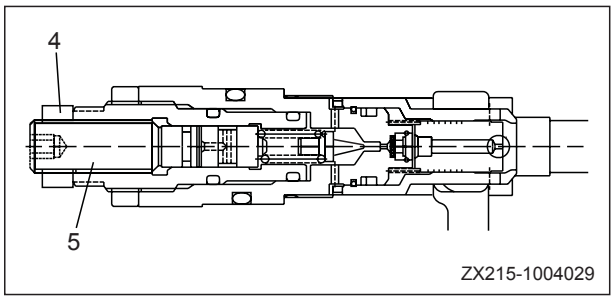
★ Pressure rises as the retainer turns right and pressure drops as the retainer turns left.

★ One full turn of the retainer is equivalent to about 12.5 MPa {128 kgf/cm²}

Locknut:

53.5±4.9 N·m {5.5±0.5 kgf·m}





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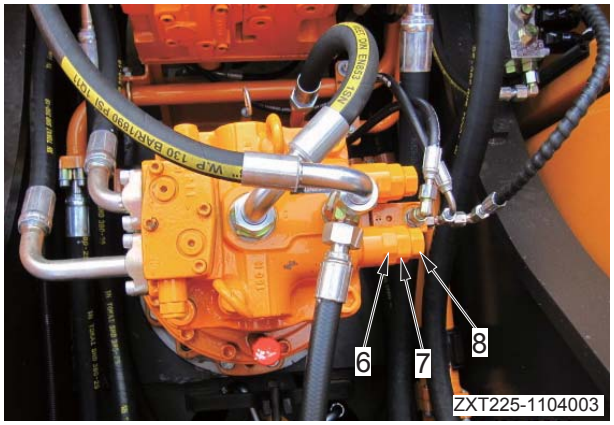
3) Check the pressure again after adjustment. Measure the pressure according to the procedure described above.

★ Connect the pilot hose before measuring the pressure.

★ Adjustment of the high pressure setting side will affect the low pressure setting side. The low pressure setting side is, therefore, to be adjusted too.

2. Swing relief pressure adjustment

★ If the swing relief pressure is abnormal, adjust the swing motor relief valve (6) according to the following procedure.



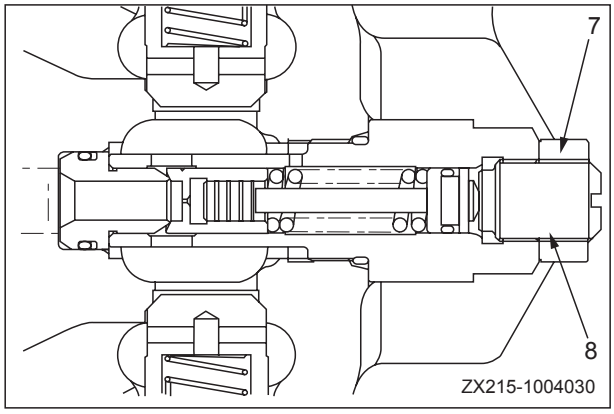
1) Loosen the locknut (7). Turn the adjustment screw (8) to adjust the pressure.

★ Pressure rises as the retainer turns right and pressure drops as the retainer turns left.

★ One full turn of the retainer is equivalent to about 6.71 MPa { 68.4 kgf/cm²}

Locknut:

78-103 N·m{8.0-10.5 kgf·m}



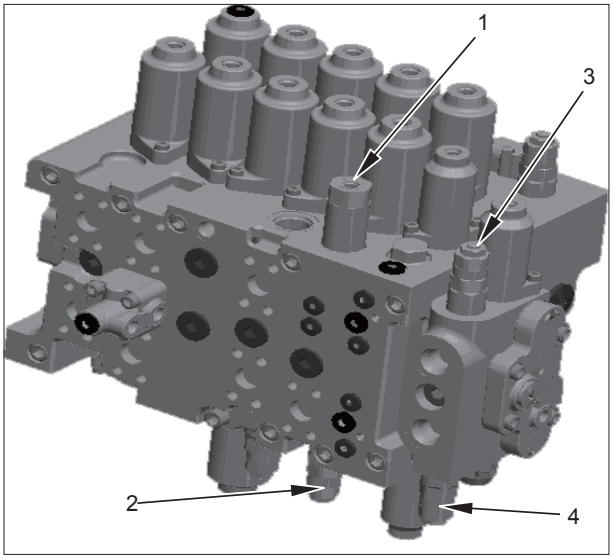
2) Check the pressure again after adjustment. Measure the pressure according to the procedure described above.

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3. Option valve relief pressure adjustment

★ Optional equipment such as breaker and shears can be installed on the machine. Set pressure of different breakers or shears may vary depending on the manufactures. Set pressure as per the specifications of the attachment manufacturer.

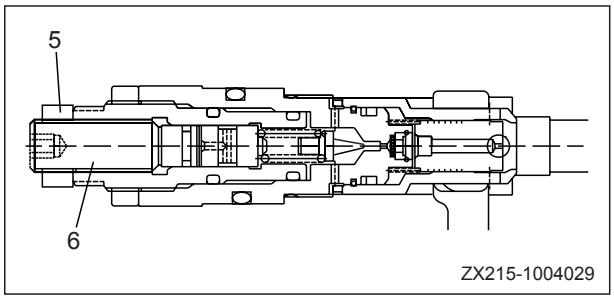
★ Adjust relief pressure of valve [1] and [2] to adjust shear split/close pressure and breaker pressure. Adjust relief pressure of valve [3] and [4] to adjust shear swing pressure.



Adjusting procedures

1) Disconnect the pilot hose.
2) Loosen the locknut [5]. Turn the adjustment screw [6] to adjust the pressure.

★ Pressure rises as the retainer turns right and pressure drops as the retainer turns left.



3) Check the pressure again after adjustment. Measure the pressure according to the procedure described above.

★ Connect the pilot hose before measuring the pressure.

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6.8 Control Circuit Oil Pressure - Test and Adjust

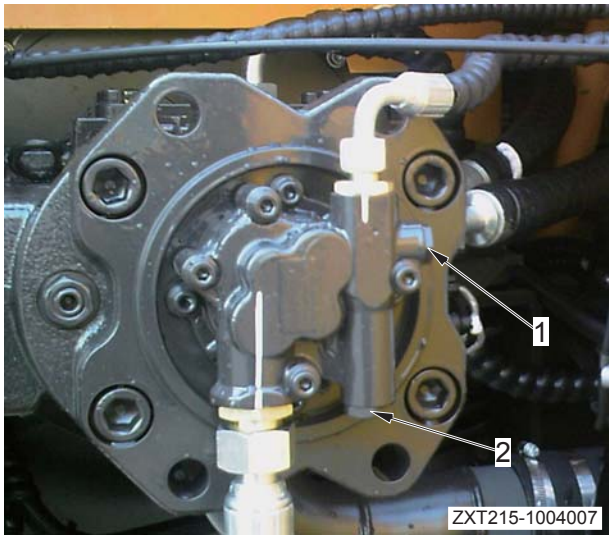
★ Testing and adjusting tools

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

6.8.1 Testing

⚠ Lower the work equipment to the ground and stop the engine. After the engine is stopped, operate the control levers for several times in order to release the residual pressure in hydraulic circuits. Open the butterfly nut on the breather valve. Press the relief button to release pressure in the hydraulic tank.

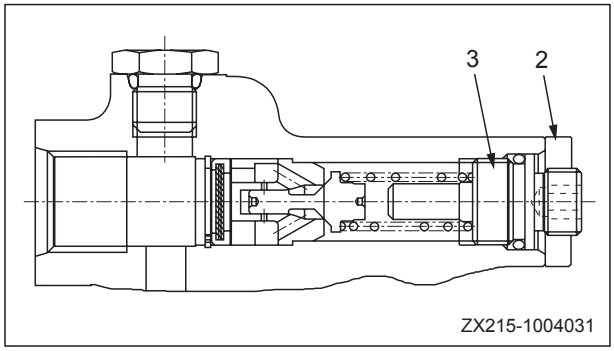
1. Remove the plug (1) for measuring the hydraulic pressure.
2. Install the priming adaptor and connect it to the hydraulic tester.
   ★ Use an oil pressure gauge with a capacity of 6 MPa{61 kgf/cm²}
3. Start the engine and keep it running until the hydraulic pressure rises to a point within the operational range.
4. Measure oil pressure when the engine is running at high idle and all control levers are in a neutral position.



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6.8.2 Adjusting

1. If the measurement is less than 3.5 kgf/cm², loosen the retaining nut (2) and screw in adjusting stud (3). Watch the change of readings on the pressure gauge at the same time. Tighten the retaining nut (2) when proper pressure value is achieved.
2. Remove all the tools after measurement and make sure the machine returns to its normal condition.



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6.9 Solenoid Valve Output Pressure - Measure

★ Measuring tools

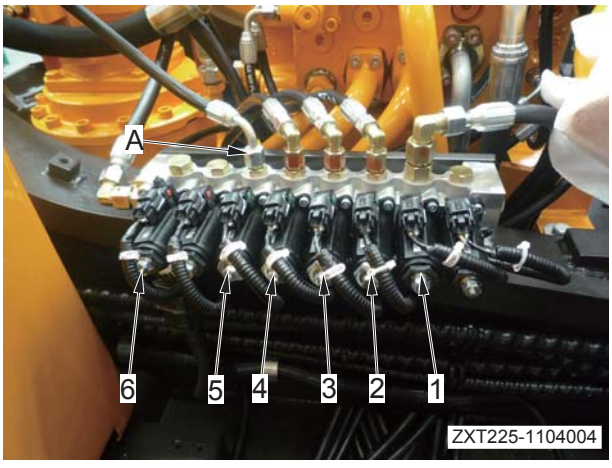
ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

★ Make sure that the initial pressure of control oil circuit is normal before measuring the output pressure of solenoid valve.

⚠ Lower the work equipment to the ground and stop the engine. After the engine is stopped, operate the control levers for several times in order to release the residual pressure in hydraulic circuits. Open the butterfly nut on the breather valve. Press the relief button to release pressure in the hydraulic tank.

3. Disconnect the hose of solenoid valve in order to measure the pressure at the outlet.

No.	Solenoid Valves to be Measured
1	Solenoid valve - pilot lock
2	Solenoid valve - boom priority
3	Solenoid valve - bucket confluence/diffluence
4	Solenoid valve - swing priority
5	Solenoid valve - Hi/Lo travel speed
6	Solenoid valve - secondary boosting



4. Install a tee to location (A) on each solenoid valve and connect the hose.
5. Mount the adaptor onto the tee and connect it to the hydraulic tester.

★ Use a hydraulic tester with a capacity of 6 MPa{61 kgf/cm²} .

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6. Start the engine and keep it running until the hydraulic oil temperature rises to a point within the operational range.
7. Run the engine at full speed. Operate the control levers to open or close each solenoid valve, and measure the pressure.
   ★ The function of each solenoid valve can be checked through the monitor's monitoring function. (This is a special function of the monitor.)
   ★ When each output pressure reads the following values, the solenoid valve is normal.

Tab. 1: High speed travel

Solenoid Valve	Output Pressure
OFF (de-energize)	0 {0}
ON (energize)	3.9~4.1 MPa{39~41 kgf/cm²}

Tab. 2: Swing priority

Solenoid Valve	Output Pressure
OFF (de-energize)	0 {0}
ON (energize)	3.0~3.9 MPa{30~39 kgf/cm²}

8. Remove all measuring tools after measurement. Make sure that the machine returns to its normal condition.

Table of functioning state - pilot lock solenoid valve

Functioning State		Function
Lockout control	Lock	OFF
	Free	ON

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6.10 Pilot Valve Output Pressure - Measure

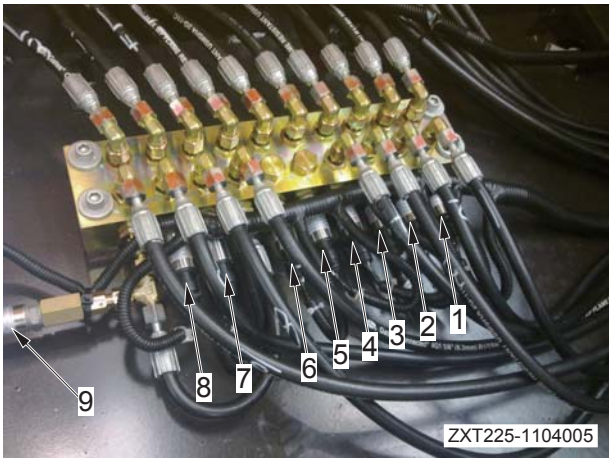
★ Measuring tools

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

★ Make sure that the initial pressure of control oil circuit is normal before measuring the output pressure of pilot valve.

1. Remove the pilot pressure switch.

No.	Oil Circuit Measured	No.	Oil Circuit Measured
1	Boom DOWN	7	Arm IN
2	Bucket DUMP	8	Arm OUT
3	Bucket DIG	9	Swing
4	Boom UP		
5	Travel left		
6	Travel right		



2. Install the adaptor and connect it to the hydraulic tester.
   ★ Use a hydraulic tester with a capacity of 6 MPa {61kgf/cm²}
3. Start the engine and keep it running until the hydraulic oil temperature rises to a point within the operational range.
4. Measure the output pressure when the engine is running at high idle and all control levers of the tested circuit are in neutral position or at full stroke.

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★ When the measured output pressure reads the following values, the pilot valve is normal.

Control Lever	Hydraulic Pressure
Neutral	0{0}
Full stroke	Close to the average initial pressure of oil control circuit (See Table of Standard Values)

5. Remove all measuring tools after measurement. Make sure that the machine returns to its normal condition.

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6.11 Pilot Valves (Work Equipment and Swing) - Adjust

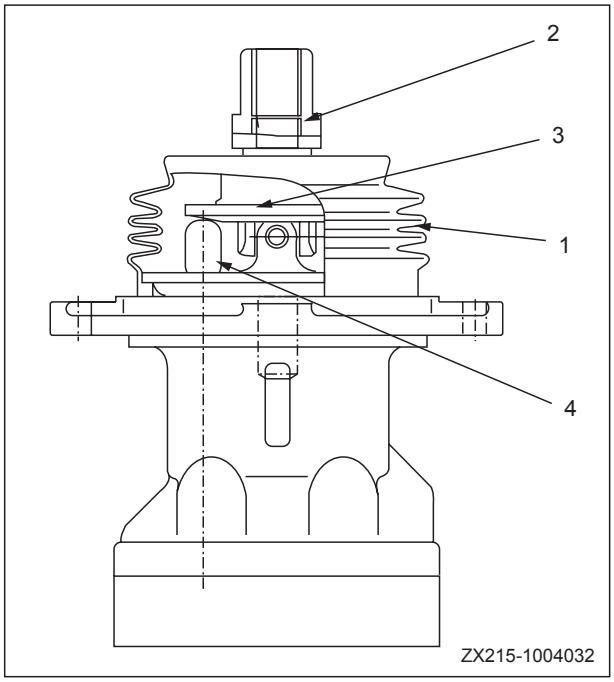
★ If the play of work equipment or swing control lever is excessive, make adjustment as per the following procedure.

1. Remove the work equipment and swing pilot valve assembly.
2. Remove the rubber sleeve (1).
3. Loosen the locknut (2). Screw on the disc (3) until it contacts with the four heads of plunger (4).

   ★ Do not move the plunger.
4. When the disc (3) is fixed, tighten the locknut (2) to specified torque.

   Locknut:

   98~127 N·m {10~13 kgf·m}
5. Install the rubber sleeve (1).
6. Install the work equipment and swing pilot valve assembly.



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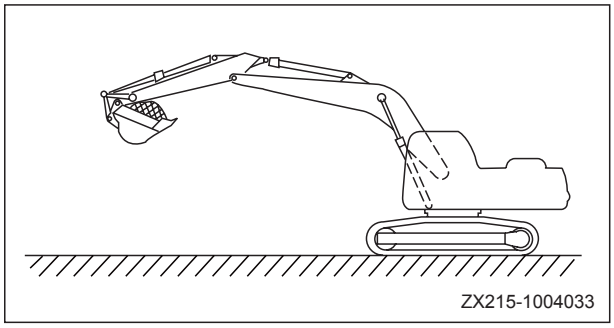
6.12 Work Equipment Hydraulic Drift - Test

★ If hydraulic drift exists in the work equipment cylinder, check it according to the following procedure and determine whether the failure lies in the cylinder seal or in the control valve.

1. Boom and bucket cylinders

1) Park your machine in an attitude as shown and stop the engine.

★ Load the bucket fully with earth or impose rated load on the bucket.



2) Operate the control levers so that the boom is in the raising position and the bucket in the digging position.

- If the lowering speed increases, the problem lies in the cylinder seal.
- If nothing changes, the problem lies in the control valve.

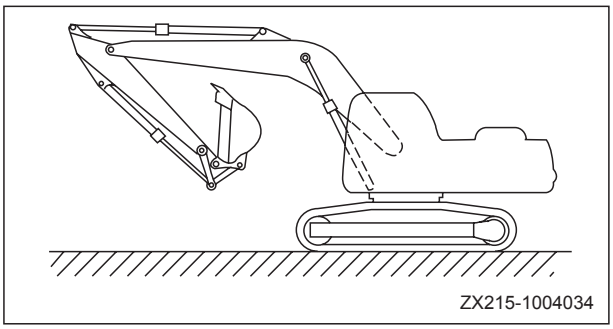
★ Operate the control levers with engine start switch in the ON position.

★ If the pressure in accumulator drops, charge the accumulator again by running the engine for about 10 seconds.

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2. Arm cylinder

1) Park your machine in an attitude as shown. The distance between the arm cylinder and the digging stroke end is 100 mm. Stop the engine.


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2) Operate the control levers in order to place the arm in the digging position.

- If the lowering speed increases, it is failure of the cylinder seal.
- If nothing changes, it is failure of the control valve.

★ Operate the control levers with engine start switch in the ON position.

★ If the pressure in accumulator drops, charge the accumulator again by running the engine for about 10 seconds.

[Reference]

If the hydraulic drift is caused by failure of the cylinder seal, the reason for increase of lowering speed during the above operation is described below:

1) If the machine is set in the above position (where the holding pressure is applied to the bottom side), the oil leaks from the bottom side to the head side. The pressure in the head side is increased.

2) As the pressure in the head side decreases, the pressure in the bottom side increases in order to keep it balanced. This process is repeated until balance is reached at a certain level depending on the amount of leakage.

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3) When the pressure is balanced, the lowering speed decreases. If the control levers are operated according to the above procedure, the oil circuit in the head side opens to the drain circuit (while the bottom side is closed by a check valve), and the oil flows to the drain circuit from the head side. As a result, the lowering speed increases.

3. Checking the pilot valve

While the pressure in the accumulator is high, set the hydraulic lockout control in the LOCKED/FREE position and measure the hydraulic drift respectively.

★ Operate the control levers with engine start switch in the ON position.

★ If the pressure in accumulator drops, charge the accumulator again by running the engine for about 10 seconds.

★ If there is a difference in hydraulic drift between the LOCKED position and the FREE position, it the failure (internal fault) of the pilot valve.

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6.13 Residual Pressure in Hydraulic Circuit - Release

⚠ Before disconnecting the lines between the hydraulic cylinders or between the hydraulic motor and the control valve, perform the following steps in order to release the residual pressure from the hydraulic circuit.

★ Even if the swing motor circuit and the travel motor circuit are free from residual pressure, they will be influenced by the internal pressure of hydraulic tank. The breather valve must therefore be opened to release pressure prior to such operation.

1. Stop the engine, loosen the butterfly nut on the breather valve, and press the release button to release the pressure in hydraulic tank.
2. Turn the engine start switch to the ON position and operate the control levers for several times.
   - ★ The pilot lock valve must be energized. Operate the control levers with the engine start switch in the ON position.
   - ★ The pressure in accumulator will be released after the control levers have been operated 2 or 3 times.
3. Start the engine and keep the engine running at low idle for about 10 seconds in order to increase the pressure in accumulator. Stop the engine.
4. Repeat the above step 2 through step 3 several times.

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6.14 Oil Leakage - Measure

1. Measure oil leakage from boom cylinder

1) Start the engine and keep the engine running until the hydraulic oil temperature reaches a point within the operational range. Fully extend the boom cylinder.

   ⚠ Release the residual pressure in the circuits. See “Residual Pressure in Hydraulic Circuit - Release” on page 6-29.

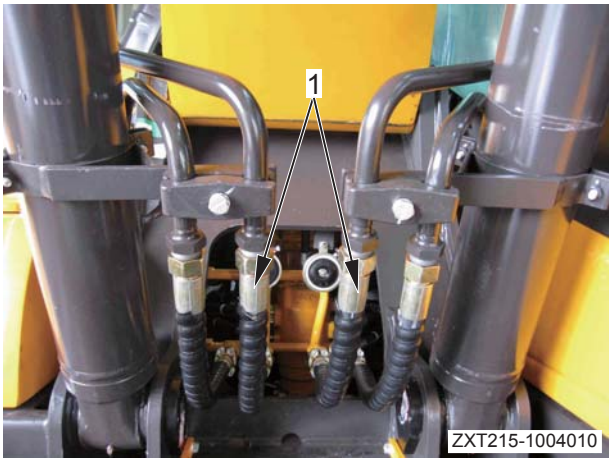
2) Disconnect the hose (1) on the cylinder head side and blind the hose end with a cap.

   ⚠ Be careful not to disconnect the hose on the cylinder bottom side.

3) Start the engine and apply relief pressure to the bottom side of the cylinder while the engine is running at high idle.

4) Hold this condition for 30 seconds. Measure oil leakage for one minute.

5) Make sure that the machine returns to its normal condition after measurement.



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2. Measure oil leakage from arm cylinder

1) Start the engine and keep the engine running until the hydraulic oil temperature reaches a point within the operational range. Fully extend the arm cylinder.

   ⚠ Release the residual pressure in the circuits. See “Residual Pressure in Hydraulic Circuit - Release” on page 6-29.

2) Disconnect the hose (2) on the cylinder head side and blind the hose end with a cap.

   ⚠ Be careful not to disconnect the hose on the cylinder bottom side.

3) Start the engine and apply relief pressure to the bottom side of the cylinder while the engine is running at high idle.

4) Hold this condition for 30 seconds. Measure oil leakage for one minute.

5) Make sure that the machine returns to its normal condition after measurement.



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3. Measure oil leakage from bucket cylinder

1) Start the engine and keep the engine running until the hydraulic oil temperature reaches a point within the operational range. Fully extend the bucket cylinder.

   ⚠ Release the residual pressure in the circuits. See “Residual Pressure in Hydraulic Circuit - Release” on page 6-29.

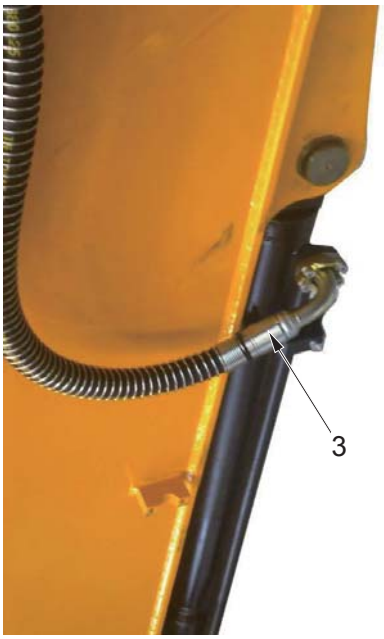
2) Disconnect the hose (3) on the cylinder head side and blind the hose end with a cap.

   ⚠ Be careful not to disconnect the hose on the cylinder bottom side.

3) Start the engine and apply relief pressure to the bottom side of the cylinder while the engine is running at high idle.

4) Hold this condition for 30 seconds. Measure oil leakage for one minute.

5) Make sure that the machine returns to its normal condition after measurement.



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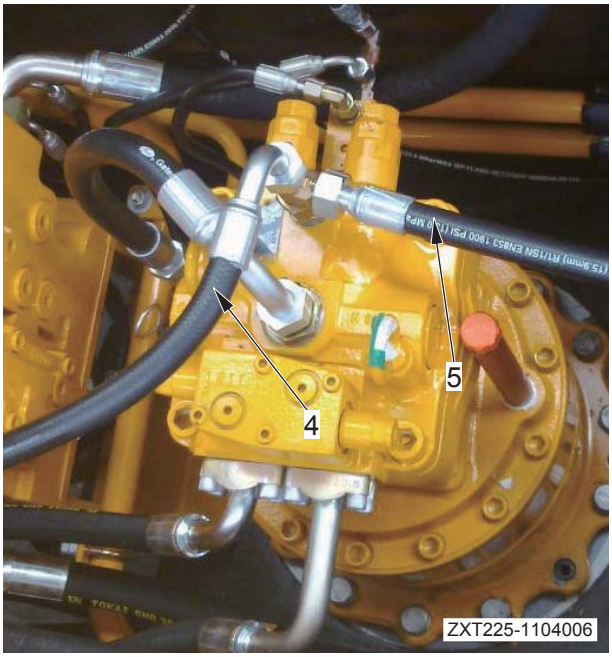
4. Measure oil leakage from swing motor

1) Fully extend the work equipment. Lower the bucket on the ground and raise the machine slightly. Stop the engine.
2) Disconnect the hose (4) and the hose (5). Blind the hose ends with caps.
3) Start the engine and apply relief pressure to the bottom side of the cylinder while the engine is running at high idle. Measure oil leakage under this condition.

★ Hold the condition described in step 3) for 30 seconds. Measure oil leakage for one minute.

★ After the first measurement, turn the upper structure 180°and measure the leakage again in the same way.

4) Make sure that the machine returns to its normal condition after measurement.

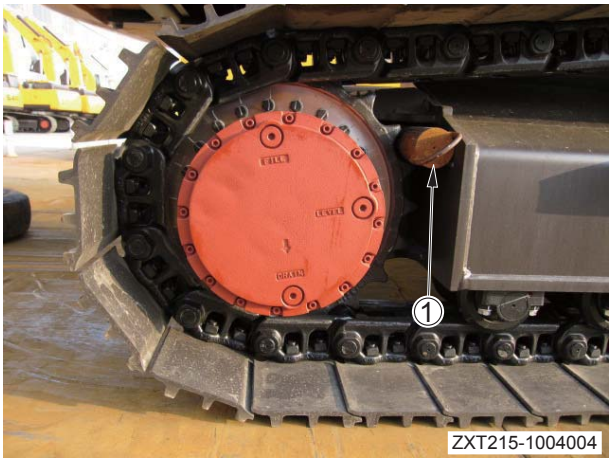


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5. Measure oil leakage from travel motor

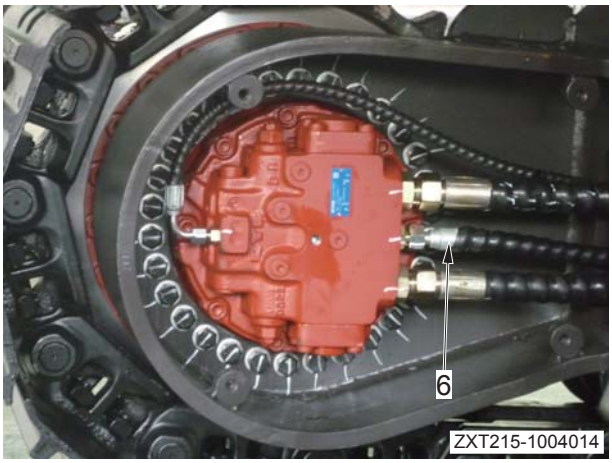
1) Remove the cover of the travel motor.
2) Start the engine and lock the travel mechanism.

⚠ Insert pin (1) between the sprocket and the track frame to lock the travel mechanism.



3) Disconnect the drain hose (6) of the travel motor. Blind the hose end with a cap.
4) Start the engine and apply relief pressure to the bottom side of the cylinder while the engine is running at high idle. Measure oil leakage under this condition.

⚠ During measurement, mis-operation of the control levers can cause serious accidents. Make sure that all signals are correct.



★ Hold the condition described in step 4) for 30 seconds. Measure oil leakage for one minute.

★ Rotate the motor slightly. Change the positions of the valve plate and the cylinder and of the cylinder and piston. Repeat the measurement several times.

5) Make sure that the machine returns to its normal condition after measurement.

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6.15 Air in Each Component - Bleed

Contents of work \ Air bleeding item	Air bleeding procedures					
	1	2	3	4	5	6
	Bleed air from hydraulic pump	Starting engine	Bleed air from cylinder	Bleed air from swing motor	Bleed air form travel motor	Starting operation
• Replacing hydraulic oil • Cleaning filter element	○ →	○ →	○ →	○ (Note) →	○ (Note) →	○
• Replacing return filter element		○ →	→	→	→	○
• Repairing/replacing hydraulic pump • Removing suction piping	○ →	○ →	○ →	→	→	○
• Repairing/replacing control valve		○ →	○ →	→	→	○
• Replacing cylinder • Removing cylinder piping		○ →	○ →	→	→	○
• Replacing swing motor • Removing swing motor piping		○ →	→	○ →	→	○
• Replacing travel motor • Removing travel motor piping		○ →	→	→	○ →	○

Note:

Bleed air from the swing motor and travel motor only when the oil in the motor cases is drained.

1. Bleed air from hydraulic pump

1) Loosen the air bleeder (1) and check that oil oozes out through the air bleeder.

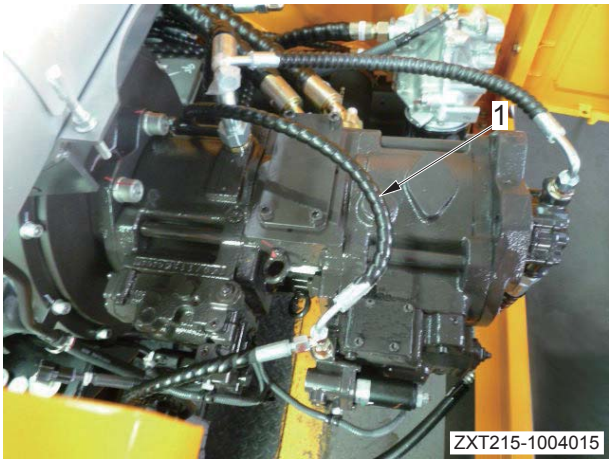
2) Tighten the air bleeder (1) if oil is seen.

Bleeder:

7.8~9.8 N·m{0.8~1.0 kgf·m}

★ Engine starting precautions

Run the engine at low idle for 10 minutes after bleeding the air according to the above procedure.



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2. Bleed air from hydraulic cylinder

1) Start the engine and keep the engine running at low idle for 5 minutes.
2) Raise or lower the boom 4 or 5 times with the engine running at low idle.

★ Be careful not to apply relief pressure. Stop the piston when the piston rod is about 100 mm before stroke end.

3) Repeat step 2) with the engine running at high idle.
4) While running the engine at low idle, move the piston rod to the stroke end and apply relief pressure.
5) Bleed air from arm cylinder and bucket cylinder by performing step 2) through step 4).

★ When a new cylinder is installed for replacement, bleed the air from the new cylinder before mounting it to the work equipment. Especially the boom cylinder, once mounted to the work equipment, its piston rod is unable to reach its stroke end in lowering operation. Therefore, the air must be bled from the boom cylinder before it is mounted to the work equipment.

3. Bleed air from swing motor

1) Start the engine and run the engine at low idle.
2) Bleed air from the swing motor by turning the upper structure slowly.

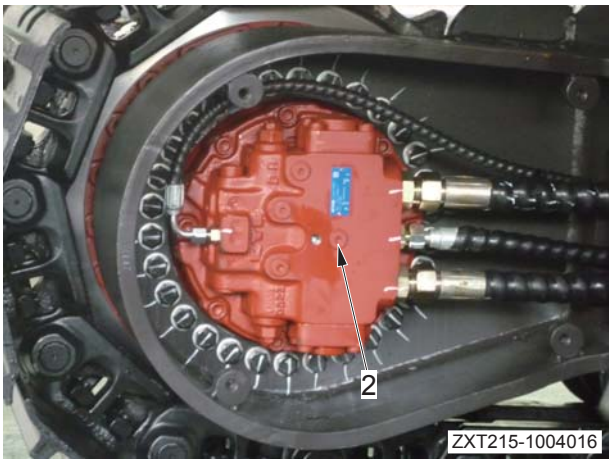
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4. Bleed air from travel motor

1) Start the engine and run the engine at low idle.
2) Loosen the bleeder (2) and check that oil oozes out through the air bleeder.
3) Tighten the air bleeder (2) if oil is seen.

Bleeder:

27.5~35.3 N·m{2.8~3.6 kgf·m}



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Troubleshooting

7 Troubleshooting

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7.2 Sequence of Events in Troubleshooting 7-6
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⚠ WARNING

Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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7 TROUBLESHOOTING

7.1 Points to Remember When Troubleshooting

⚠ Stop the machine in a level ground, and check that lock pins, blocks, and parking brake are securely fitted.

⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.

⚠ If the radiator cap is removed when the engine is hot. Hot coolant may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.

⚠ Be extremely careful not to touch any hot parts or to get caught in any rotating parts.

⚠ When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.

⚠ When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.

When carrying out troubleshooting, important point is to understand the structure and function.

However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

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1. When carrying out troubleshooting, do not hurry to disassemble the components.

   If components are disassembled immediately any failure occurs:

   - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   - It will become impossible to find the cause of the failure.

   It will also cause a waste of man-hours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.

   For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.

2. Points to ask user or operator:

   1) Have any other problems occurred apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure? When were these repairs carried out?
   6) Has the same kind of failure occurred before?

3. Check before troubleshooting

   1) Check the oil level.
   2) Check for any external leakage of oil from the piping or hydraulic equipment.

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3) Check the travel of the control levers.

4) Check the stroke of the control valve spool.

5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.

4. Confirming failure

- Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.

  ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.

5. Troubleshooting

- Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.

  ★ The basic procedure for troubleshooting is as follows.

1) Start from the simple points.

2) Start from the most likely points.

3) Investigate other related parts or information.

6. Measures to remove root cause of failure

- Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again. To prevent this, always investigate why the problem occurred. Then, remove the root cause.

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7.2 Sequence of Events in Troubleshooting

Office

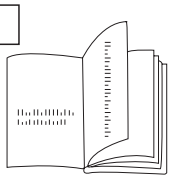
Step 1
Examination & confirmation of symptoms

1) When a request of repairs is received, first ask the following points:
- Name of customer
- Type, serial number of machine
- Details of jobsite, etc.



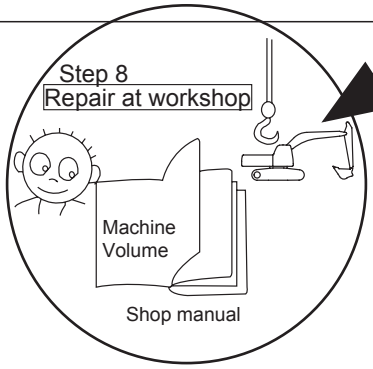
2) Ask questions to gain an outline of the problem
- Condition of failure
- Work being carried out when the failure occurs
- Operating environment
- Past history, details of maintenance,etc.

Step 2
Pinpoint the cause of the failure



1) Refer to "Troubleshooting" on this manual to find out the locations of possible causes.

Step 8
Repair at workshop

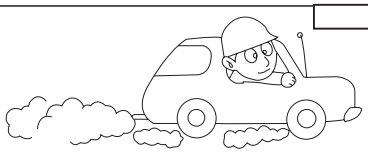


Step 3
Preparation of troubleshooting tools

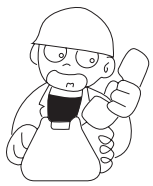
1) Look at the table of troubleshooting tools in the shop manual and prepare the necessary tools.
- T-adapter
- Hydraulic pressure gauge etc.
- Look in the parts book and prepare necessary replacement parts.

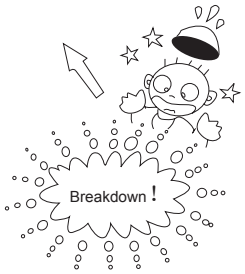


Step 4
Go to jobsite



Jobsite

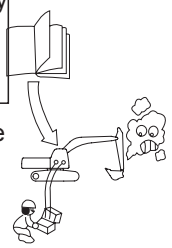




Step 8
Repair at jobsite



Step 7
- Pinpoint locations of failure (carry out troubleshooting)
- Decide actions to take

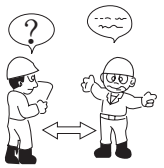


1) Before starting troubleshooting, locate and repair simple failures.
- Checks before starting
- Other check items.

2) See the troubleshooting section in the shop manual, select a troubleshooting flowchart that matches the symptoms, and carry out troubleshooting.

Step 6
Re-enacting the failure
- Start and operate the machine to confirm the conditions and judge if there is really a failure.

Step 5
Ask operator questions to confirm details of failure



- Was there anything strange about the machine before the failure occurs?
- Did the failure occur suddenly?
- Have any repairs been carried out before the failure occurs?

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7.3 Troubleshooting Procedures

If some phenomenon occurs on a machine that looks like a failure, identify the corresponding troubleshooting No. and proceed to the explanations for diagnosis.

Follow six steps listed below to diagnose and analyze for troubleshooting, and find the causes and work out the corresponding methods.

1. **Read related technical manuals in detail. Have a knowledge of related system, principle of operation, and structure, function and technical specification of parts.**

2. **Ask operator**

   Before checking, ask related person, i.e. the operator for all information about the failure.

   a. Current working condition of machine (Whether machine is operated properly).

   b. When troubles are found and what kind of operation does machine perform at that time?

   c. Development of troubles (Whether troubles are becoming severer or occur for the first time.)

   d. What kind of trouble did machine have before?

      For example: Which parts have been repaired or replaced?

   e. What has been done after troubles take place and how about the reaction?

   f. Will the trouble reoccur? Does the trouble occur regularly?

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3. Check before starting

Before starting troubleshooting, check the operator's records on operation, maintenance and service of the machine. Understand whether related personnel has done wrong in operation, maintenance and service. Check for wrong operation and maintenance at the same time.

	Item	Criterion	Remedy
Lubricating oil, coolant	1. Check fuel level and type of fuel	—	Add fuel
	2. Check for impurities in fuel	—	Clean, drain
	3. Check hydraulic oil level	—	Add oil
	4. Check hydraulic oil strainer	—	Clean, drain
	5. Check swing drive oil level	—	Add oil
	6. Check engine oil level (in oil pan)	—	Add oil
	7. Check coolant level	—	Add water
	8. Check dust indicator for clogging	—	Clean or replace
	9. Check hydraulic filter	—	Replace
	10. Check final drive oil level	—	Add oil
Electrical equipment	1. Check for looseness, corrosion of battery terminal and wiring	—	Tighten or replace
	2. Check for looseness, corrosion of alternator terminal and wiring	—	Tighten or replace
	3. Check for looseness, corrosion of start motor terminal and wiring	—	Tighten or replace
Hydraulic, mechanical equipment	1. Check for abnormal noise and smell	—	Repair
	2. Check for oil leakage	—	Repair
	3. Bleeding air	—	Bleed air
Electrics, electrical equipment	1. Check battery voltage (with engine stopped)	20-30V	Replace
	2. Check electrolyte level	—	Add or replace
	3. Check for discolored, burnt, exposed wiring	—	Replace
	4. Check for missing wiring clips and hanging wiring	—	Repair
	5. Check for wet wires (esp. wet connectors or terminals)	—	Disconnect con-
	6. Check for blown or corroded fuses		nector and dry
	7. Check alternator voltage (with engine speed at middle	—	
	or higher)	After running for	Replace
	8. Check operating sound of battery relay (when start	several minutes:	Replace
	switch is turned ON or OFF)	27.5~ 29.5V	Replace
		—	

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6. Operate machine by yourself (trial run)

Confirming that the third item above is normal, run startup check on the machine to determine the cause of failure. If the failure cannot be determined, turn off the engine and get more information from the operator.

4. Perform troubleshooting

Conduct deep analysis and determine the cause of trouble according to the symptoms of the machine and the information displayed on the monitor.

Remark:

- Never disconnect harness and hydraulic lines when the engine is running. Oil and water under high pressure and high temperature may squirt and cause personal injuries. Shut off then engine when disconnecting the harness and hydraulic lines.
- Failure codes may not indicate machine trouble. Temporary electrical failure can occur in controller memory, such as low battery output voltage, or open circuit in switch or sensor. Therefore, make repeated trials to erase the accumulated failure codes from the controller memory and confirm whether the failure codes are displayed after repeated trials. That is to say, "reoccurrence" of this trouble is possible.

5. Find out possible causes

Before making a conclusion, check the most possible causes again and try to determine the root causes of troubles. Make a feasible repair scheme according to your conclusion.

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7.4 Connectors

7.4.1 Table of connectors

No.	Type	Pin No.	Name of device	Location reference			
				Layout drawing	Cab circuit	Engine circuit	Sensor, solenoid circuit
T-401	Terminal	1	Battery relay coil (positive)	M-2		D-1	
T-402	Terminal	1	Battery relay coil (negative)	M-2		D-1	
T-403	Terminal	1	Battery relay contact (output)	M-2		D-1	
T-404	Terminal	1	Battery relay contact (input)	M-2		D-1	
T-417	Terminal	1	Starting motor (B terminal)	J-6		L-3	
T-419	Terminal	1	Alternator (B terminal)	K-6		L-5	
T-406	Terminal	1	Preheating fuse (21#)	M-2		G-9	
T-405	Terminal	1	Preheating fuse (16#)	M-2		G-9	
T-408	Terminal	1	Body grounding	M-1	B-1		
T-418	Terminal	1	Body grounding	K-6			
T-412	Terminal	1	Preheating resistance wire terminal	J-7		H-9	
T-416	Terminal	1	Starting motor grounding	J-6		L-3	
T-407	Terminal	1	Body grounding (battery side)	M-1		B-9	
CN-104M	Terminal	1	Body grounding	X-6			
T-102	Terminal	1	Body grounding	X-6			
K5	R	5	Horn relay	X-6	H-9		
K4	R	5	Lamp relay	X-6	I-9		
K9	R	5	Top lamp relay	X-6	J-9		
	R	5	Parking relay	X-6		J-8	
KB	—	5	Battery relay	M-2		D-1	
K3	R	5	Starting relay	X-6		L-4	
K7	—	5	Preheating relay	Y-6		G-9	
K10	R	5	Pilot valve relay	X-6		E-1	
CN-101F	A	2	Junction connector	W-6			
	D	12	Intermediate connector	W-6	C-9		
CN-314M	D	12	Intermediate connector	R-5	C-9		
CN-300F	A	3	Intermediate connector	R-6	D-9		
CN-308M	S	6	Intermediate connector	R-6		F-9	
CN-133F	D	12	Intermediate connector	R-5	C-5		
CN-302M	D	8	Intermediate connector	AB-4	K-7		
CN-214F	D	12	Intermediate connector	W-6	D-8		

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No.	Type	Pin No.	Name of device	Location reference			
				Layout drawing	Cab circuit	Engine circuit	Sensor, solenoid circuit
CN-219M	D	12	Intermediate connector	W-6	F-8		
CN-1-112	D	3	Intermediate connector	W-6	C-9		
CN-1-111	D	8	Intermediate connector	W-6	C-9		
CN-7-705	D	12	Monitor panel	P-5	D-9		
	H	6	Intermediate connector	J-7		K-8	
	S	6	Intermediate connector	I-7		F-3	
CN-489F	A	2	Intermediate connector	X-6	C-8		
CN-490F	A	3	Intermediate connector	X-6	C-8		
CN-118M	A	2	Washing motor	K-5	K-4		
CN-404M	A	2	Platform lamp	E-5	K-2		
CN-412M	A	2	Boom lamp (left)	E-7	K-1		
CN-411M	A	2	Boom lamp (right)	E-7	K-2		
CN-440M	A	2	Hydraulic oil temp sensor	I-7			F-9
CN-405F	S	1	Fuel level sensor	F-6			F-9
	A	2	Intermediate connector	W-6			F-8
	L	6	Safety relay	X-6		K-7	
	S	16	Intermediate connector	W-6		I-8	
	S	16	Intermediate connector	W-6			
CN-4465M	DF	3	Main pressure sensor (front)	I-7			F-4
CN-447M	DF	3	Main pressure sensor (rear)	I-7			F-4
CN-428M	DF	3	Arm-in pilot sensor	I-6			F-5
CN-422M	DF	3	Arm out pilot sensor	I-6			F-4
CN-426M	DF	3	Boom-up pilot sensor	I-6			F-5
CN-425M	DF	3	Boom-down pilot sensor	I-6			F-6
CN-424M	DF	3	Bucket-curl pilot sensor	I-6			F-6
CN-427M	DF	3	Bucket-dump pilot sensor	I-6			F-6
CN-423M	DF	3	Swing pilot sensor	I-6			F-7
CN-420M	DF	3	Travel pilot sensor (left)	I-6			F-7
CN-421M	DF	3	Travel pilot sensor (right)	I-6			F-8
CN-448M	S	2	Speed sensor	I-7			F-9
CN-304M	H	8	Top lamp switch	R-5	C-3		
CN-301M	H	8	Work lamp switch	R-6	C-2		
CN-303M	H	8	Washer switch	R-6	C-2		
CN-302M	H	8	Wiper switch	R-6	C-1		

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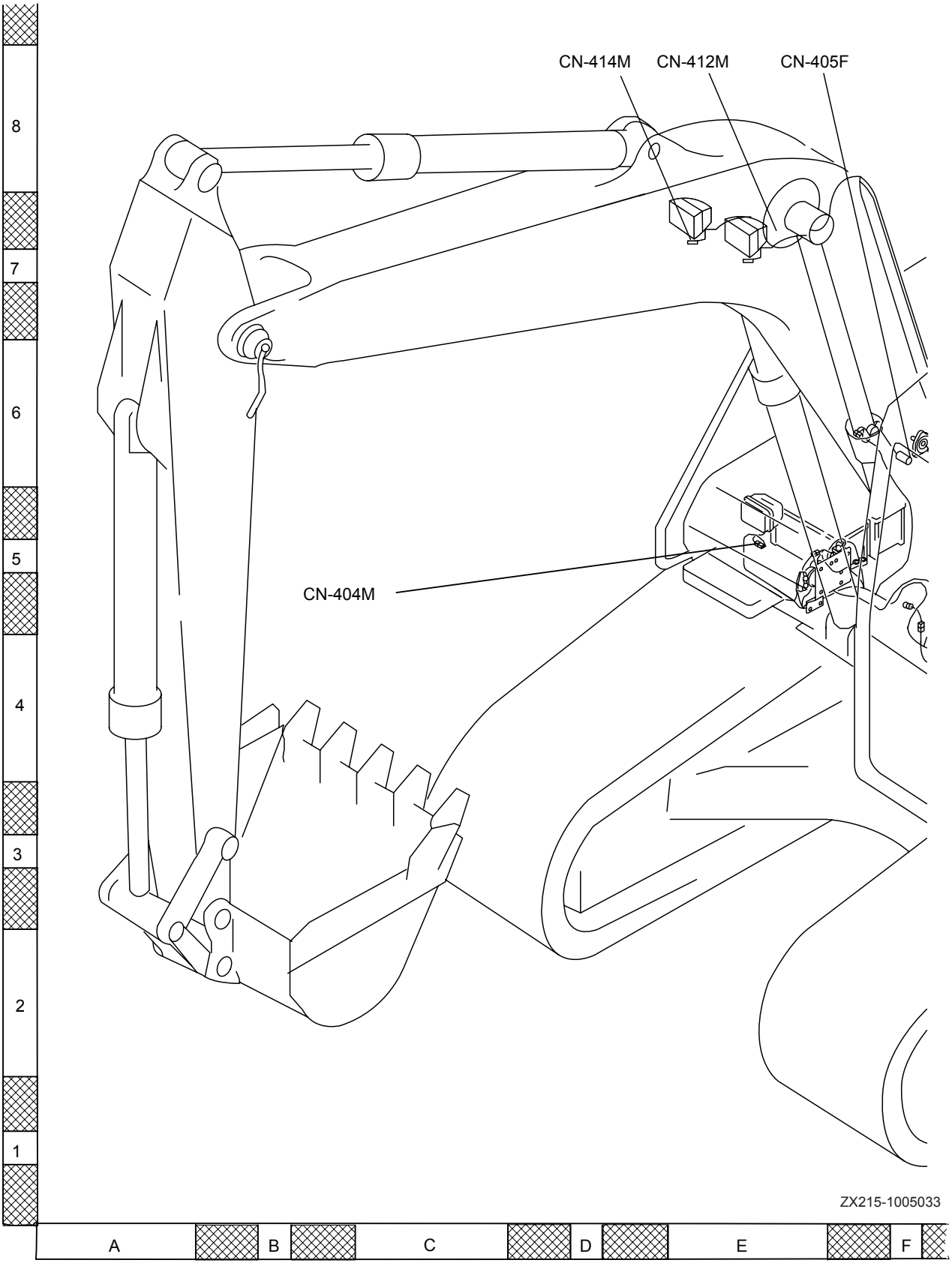
No.	Type	Pin No.	Name of device	Location reference			
				Layout drawing	Cab circuit	Engine circuit	Sensor, solenoid circuit
CN-134M	D	6	Horn switch	R-6	E-3		
	H	8	Preheating switch	R-5		F-1	
CN-116F	S	12	Air conditioner unit	W-6			
CN-445F	AMP	2	F. pump solenoid valve	I-7			F-2
CN-444F	AMP	2	R. pump solenoid valve	I-7			F-1
CN-435F	AMP	2	Boom priority solenoid valve 2	J-6			F-2
CN-434F	AMP	2	Bucket Confluence solenoid valve	J-6			F-3
CN-432F	AMP	2	Boom priority solenoid valve 1	J-6			F-3
CN-436F	AMP	2	Pilot solenoid valve	J-6		L-2	
CN-431F	AMP	2	Hi/Lo speed travel solenoid valve	J-6			F-1
CN-433F	AMP	2	Swing priority solenoid valve	J-6			F-4
	W	1	Coolant temperature sensor	J-7			F-8
F-402	W	1	Horn (right)	I-5	K-2		
F-401	W	1	Horn (left)	I-5	K-2		
CN-448F	AMP	81	Controller	W-6	A-4		
CN-487F	AMP	40	Controller	W-6	A-9		
CN-460F	S	2	Alternator terminal L/R	K-6			
CN-486M	DT	8	Cigarette lighter	P-4			
CN-150M	D	8	Intermediate connector	AE-3			
CN-102M	HL	7	Radio	W-6			
PF021	-	-	Fuse box	X-4			
CN-102M	HL	7	Speaker (left)	AE-6			
CN-102M	HL	7	Speaker (right)	AD-7			
CN-1-150F	DT	8	Front right lamp	AB-6			
CN-1-150F	DT	8	Front left lamp	AC-5			
CN-1-150F	DT	8	Cab lamp	AE-7			

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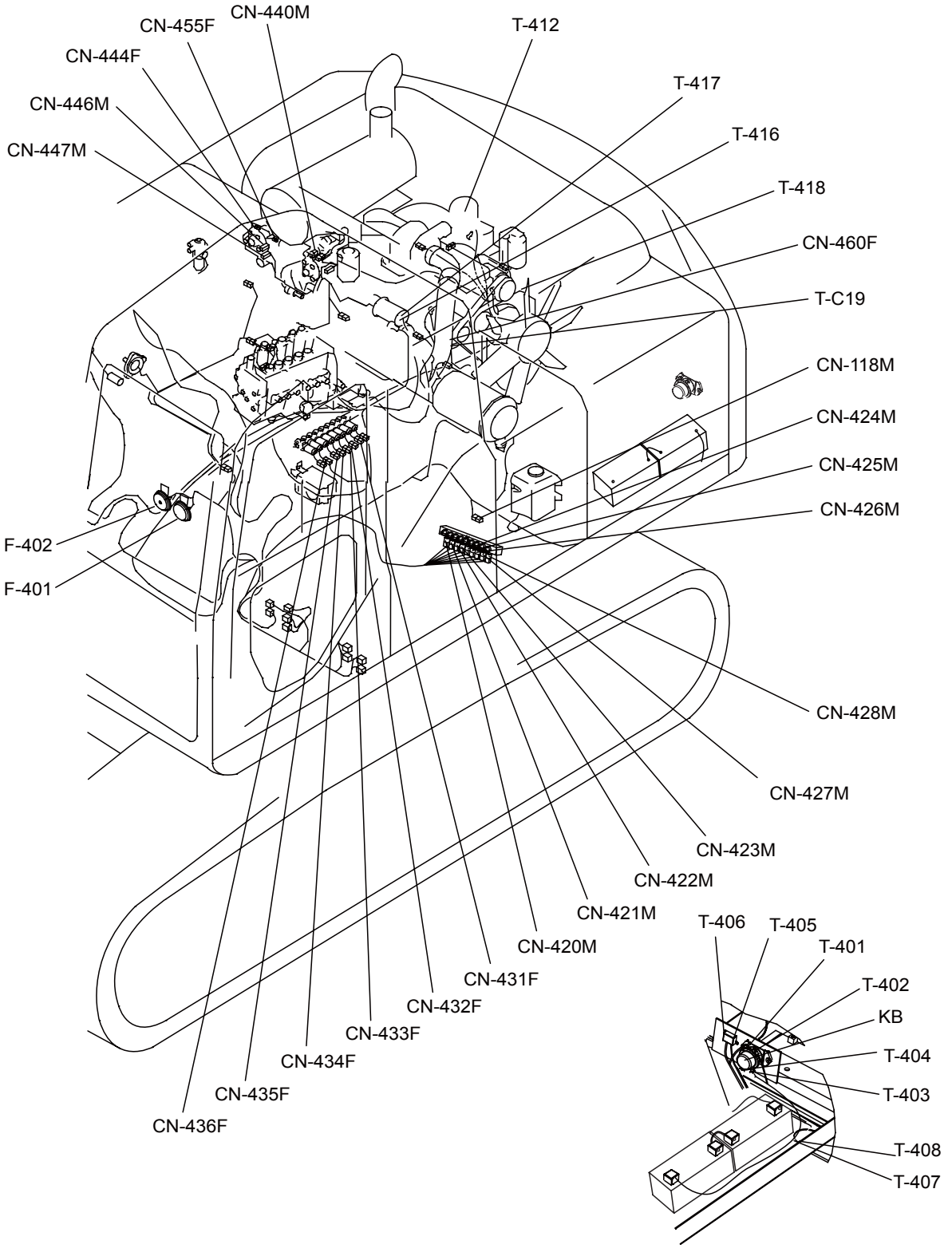
Connector type	Description
S	SWP type, Yazaki
A/AMP	AMP, Japan
D	DT type, Japan
H	Hebi
HL	Hulane Connectors
L	Ling Xing Electronic Equipment
DF	Delphi, U.S.
W	AMP, Japan
Terminal	Round terminal

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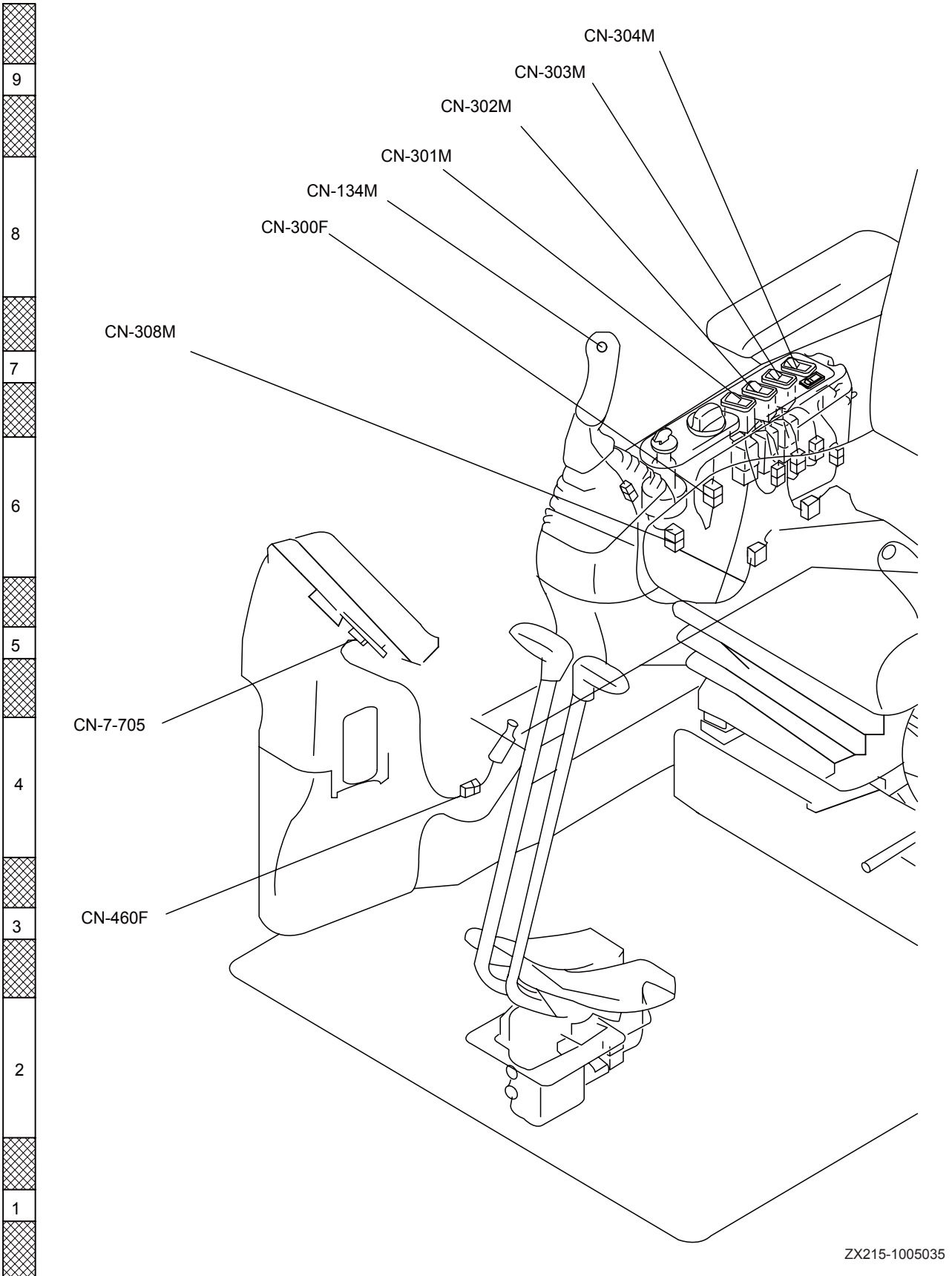
7.4.2 Connector layout



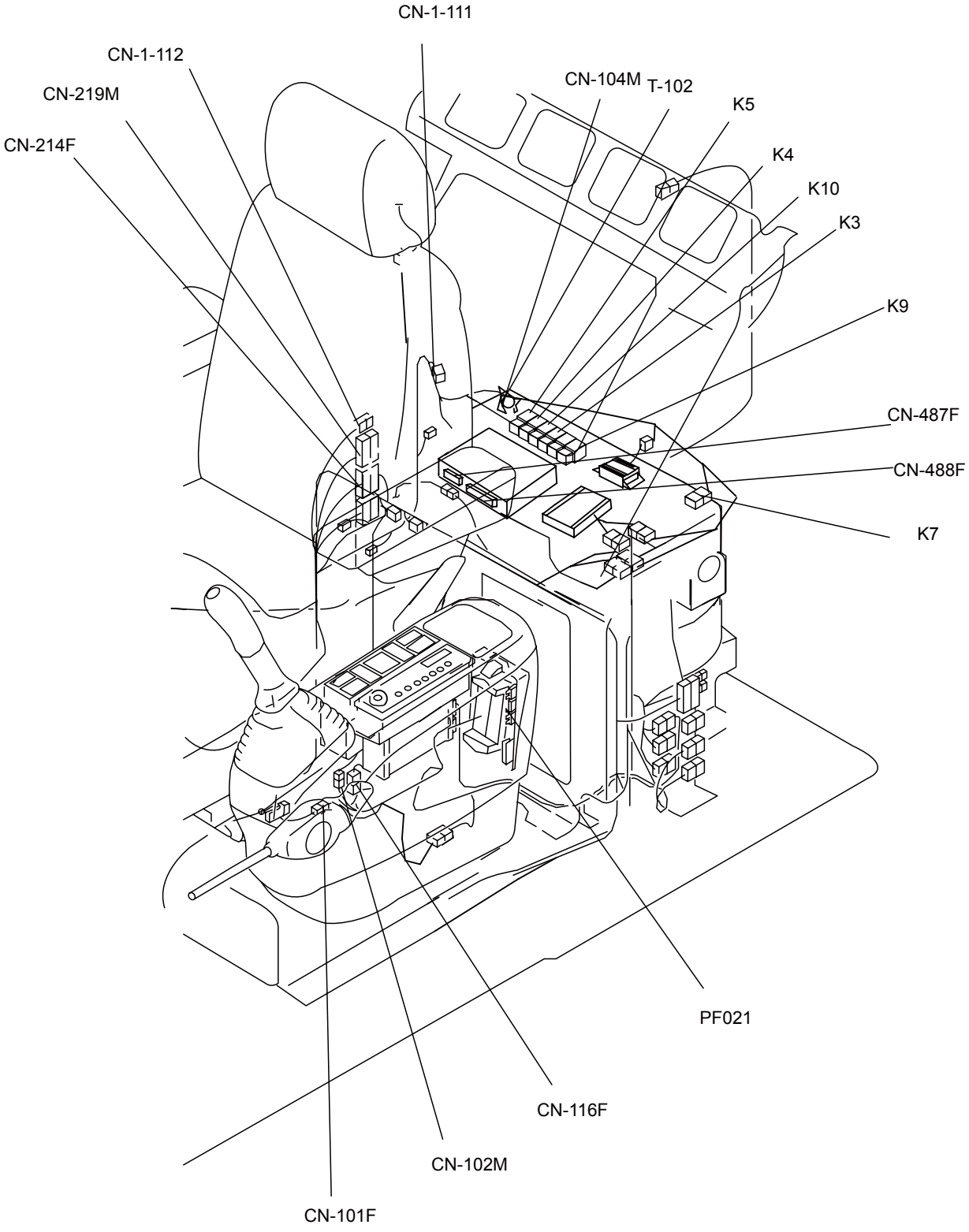
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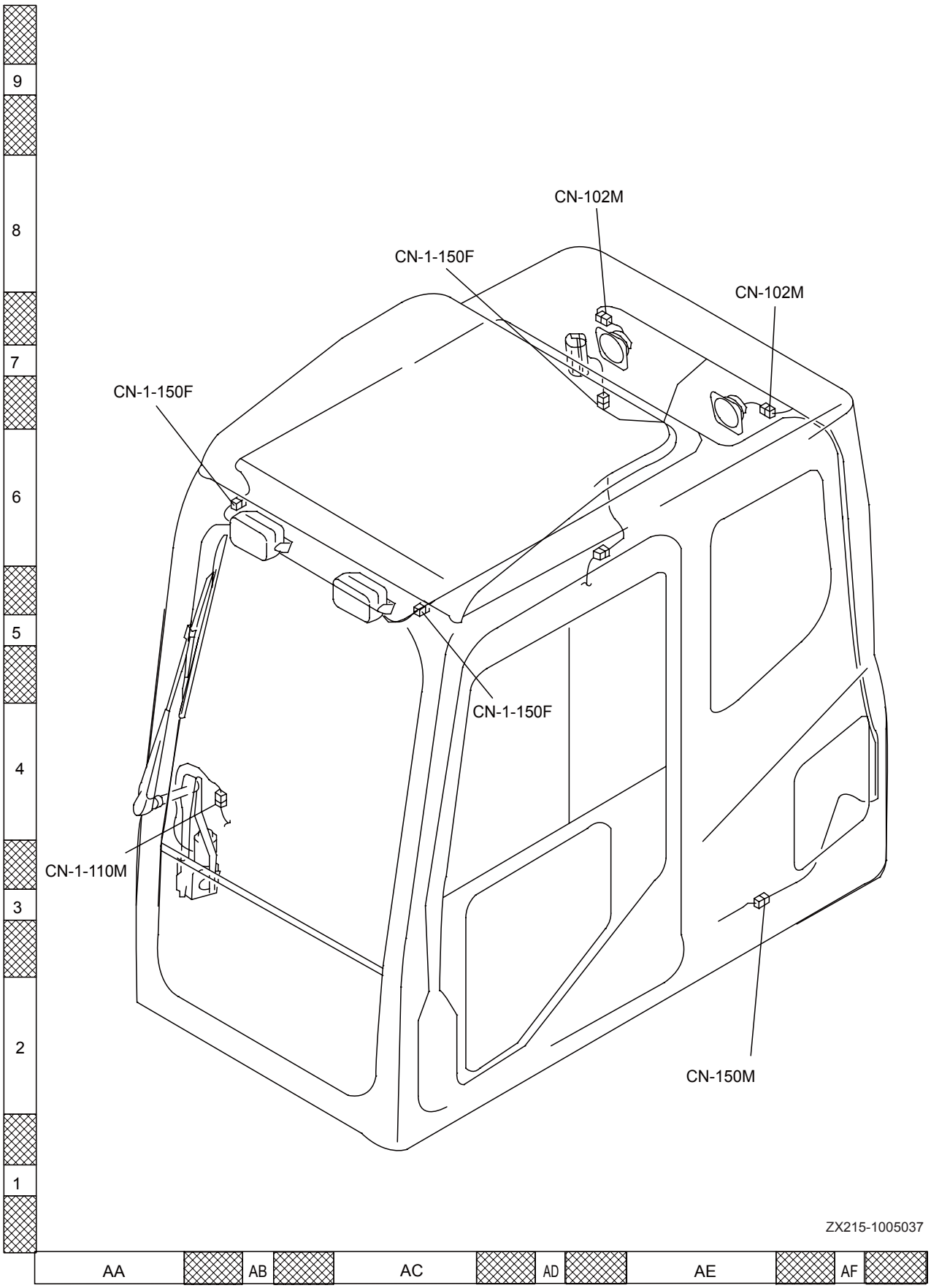


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ZX215-1005036

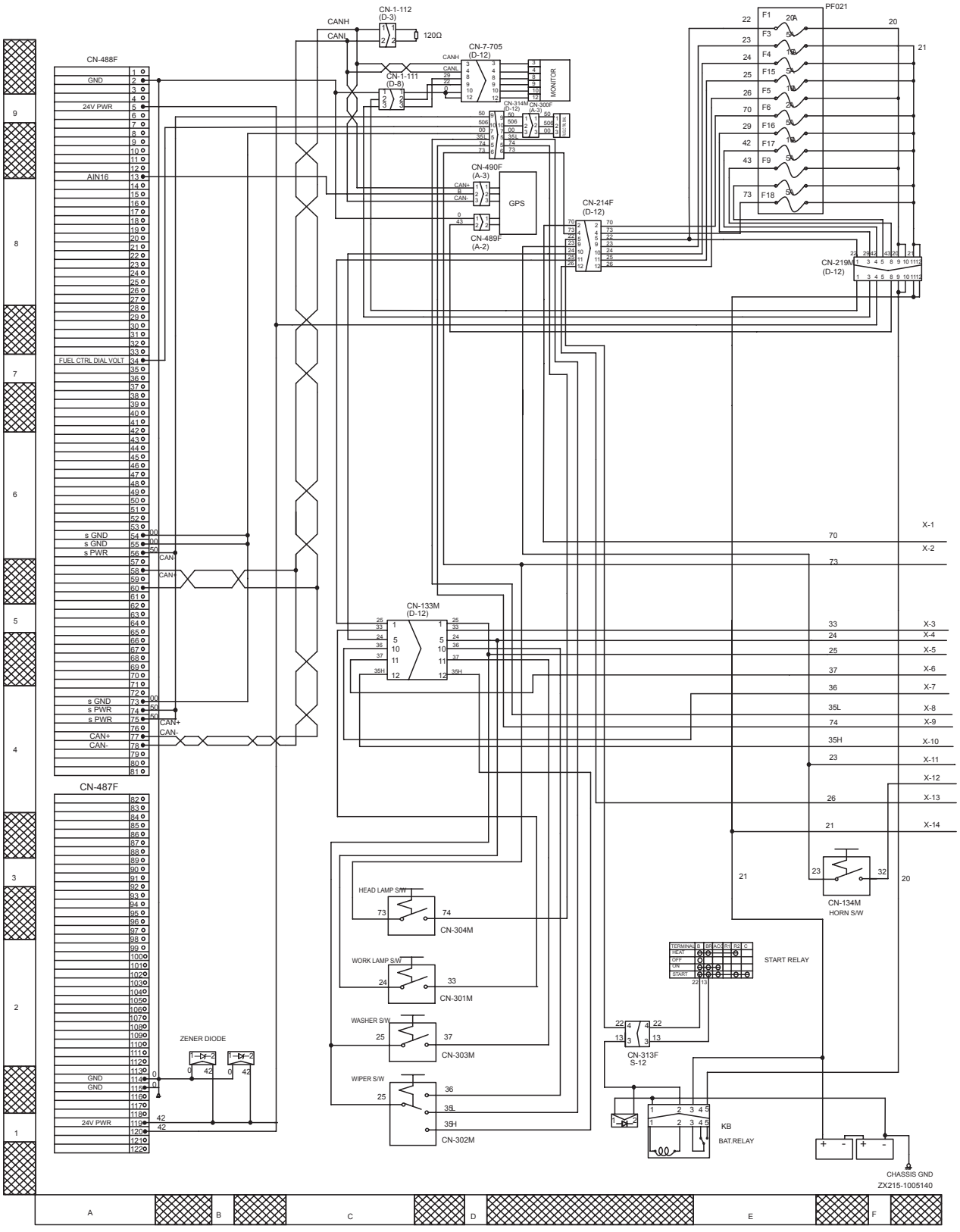
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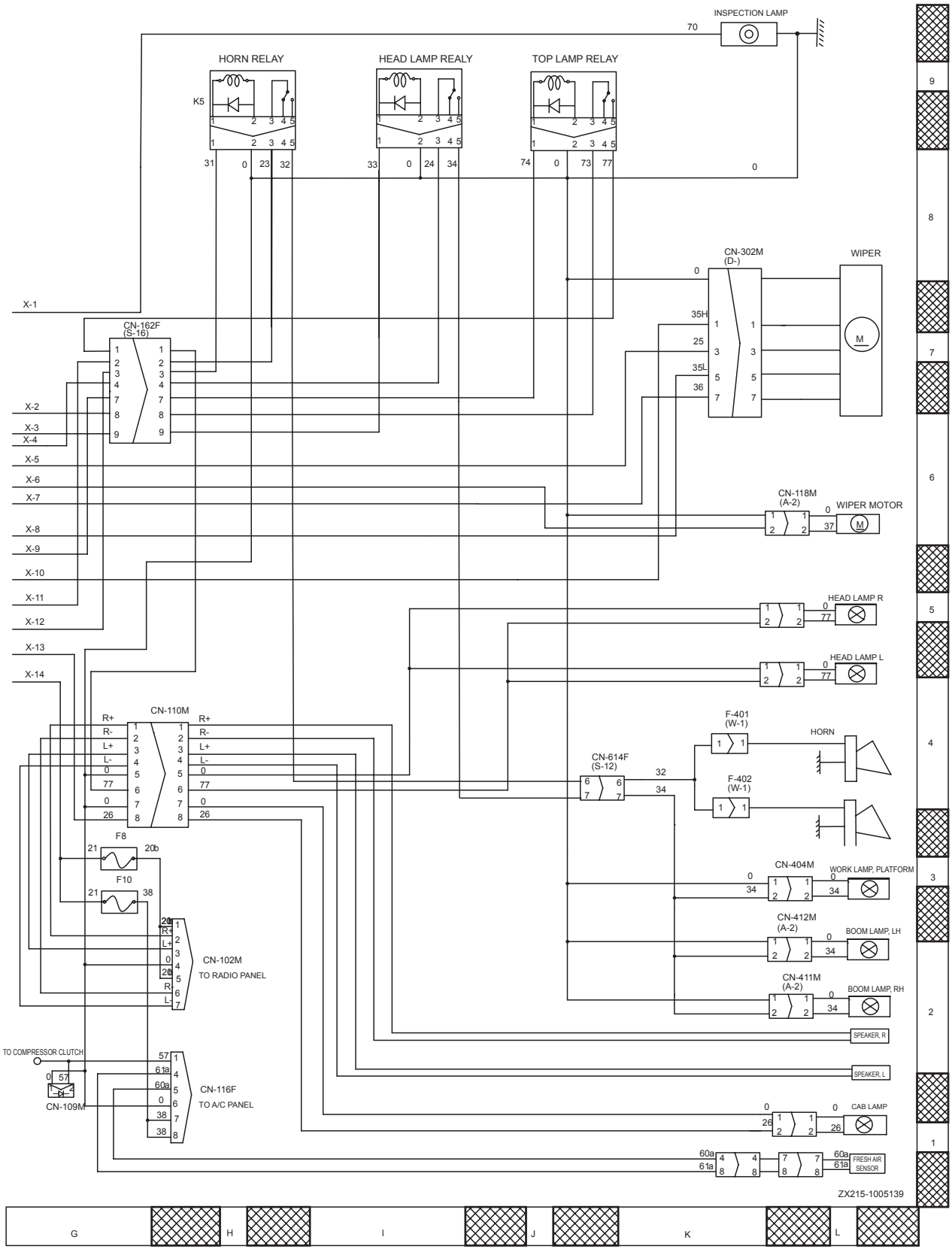
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7.4.3 Electrical element circuit diagram (cab circuit)



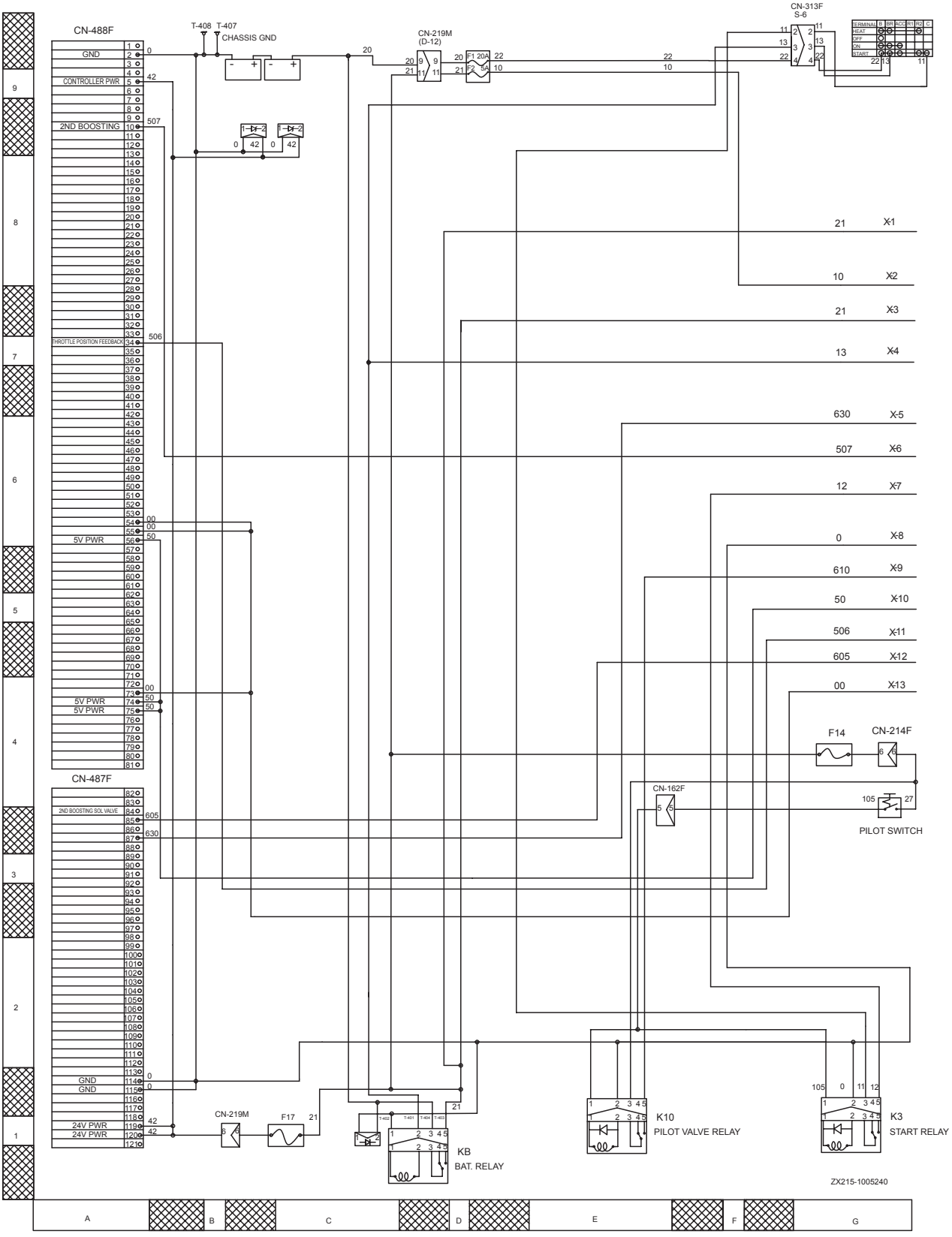
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★ This circuit diagram has been compiled by extracting the wiper system and each switch control system from the overall electrical circuit diagram.



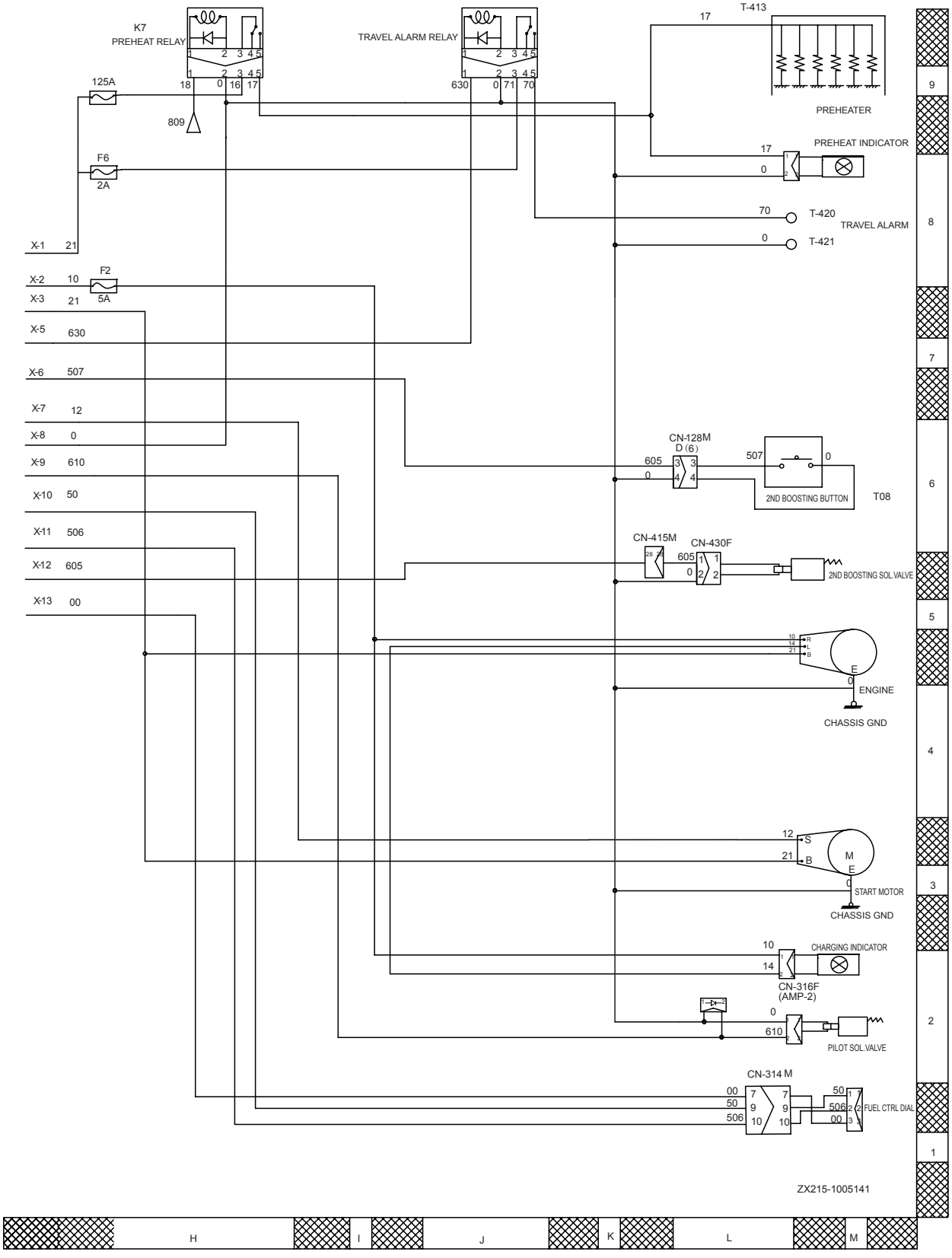
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7.4.4 Electrical control circuit diagram (engine circuit)



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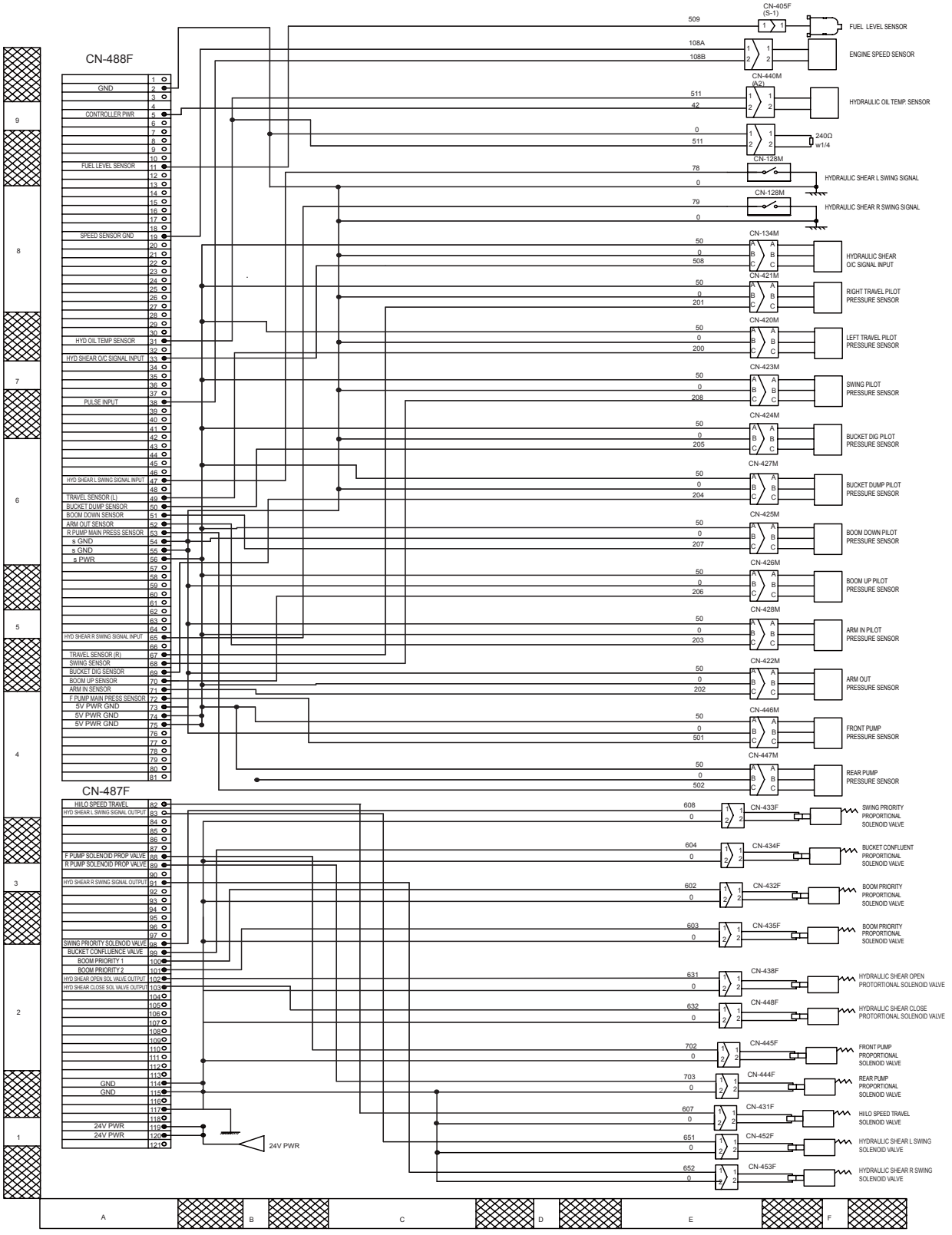
★ This circuit diagram has been compiled by extracting the engine preheat system, startup system and governor system from the overall electrical circuit diagram.



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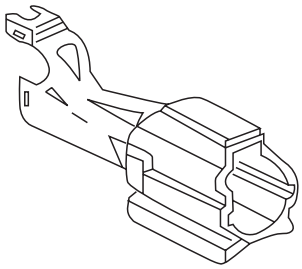
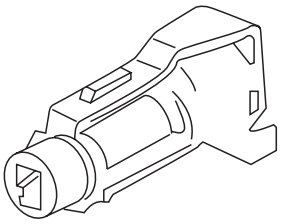
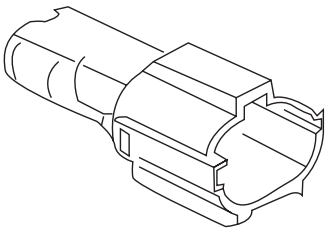
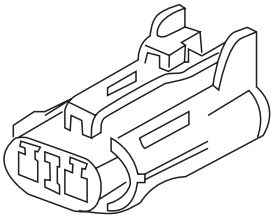
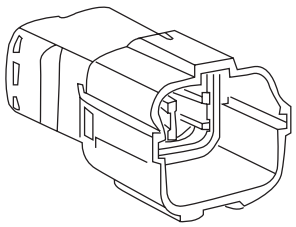
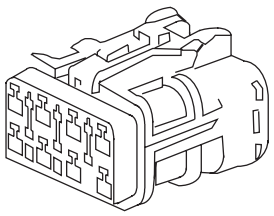
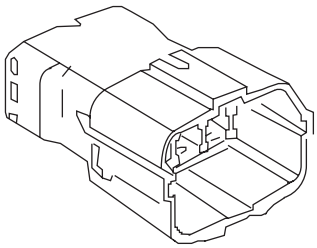
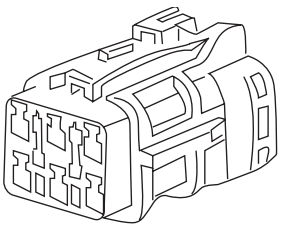
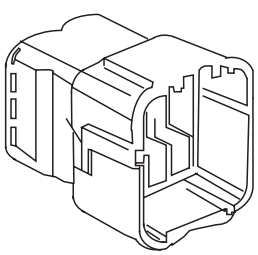
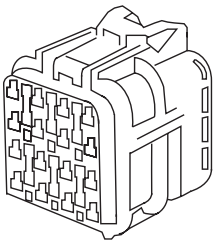
7.4.5 Electrical control circuit diagram (sensor and solenoid valve circuit)

★ This circuit diagram has been compiled by extracting the pressure sensor system and the solenoid valve control system from the overall electrical circuit diagram.



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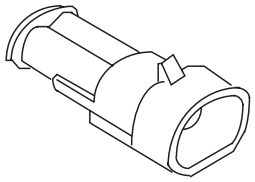
7.4.6 SWP type connector

Male (Plug)	Female (socket)
	
7222-7414-40	7123-7414-40 (No. of pin: 1)
	
7222-1424-40	7123-1424-40 (No. of pin: 2)
	
7222-7464-40	7123-7464-40 (No. of pin: 6)
	
7222-7484-40	7123-7484-40 (No. of pin: 8)
	
7222-7564-40	7123-7564-40 (No. of pin: 16)

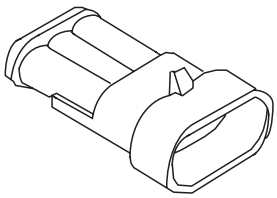
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7.4.7 A/AMP type connector

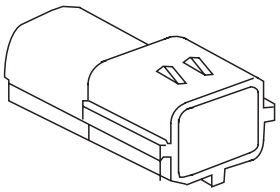
Male (Plug)



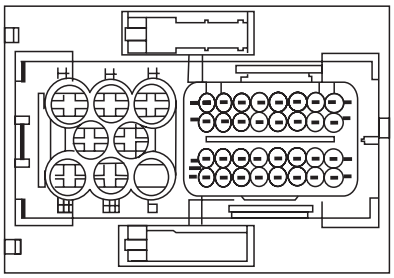
Part No.: 282104-1



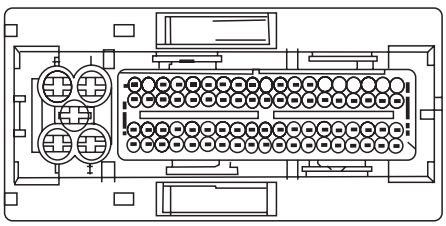
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174354-2

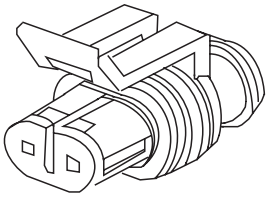


1473252-1

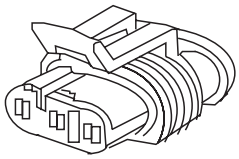


1473244-1

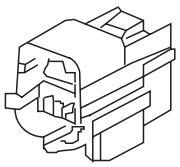
Female (socket)



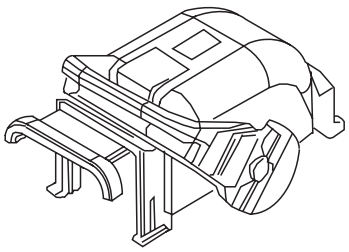
Part No.: 282080-1 (No. of pin: 2)



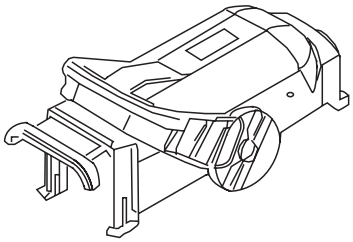
282087-1 (No. of pin: 3)



174352-2 (No. of pin: 2)



1473255-1 (No. of pin: 40)

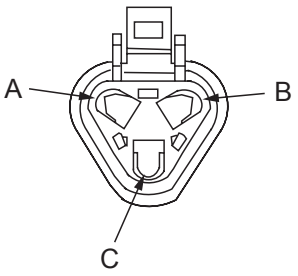


1473247-1 (No. of pin: 81)

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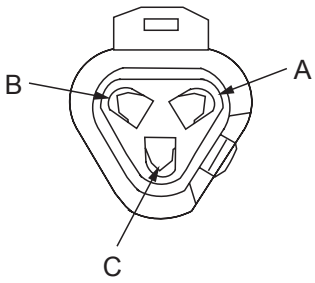
7.4.8 DT type connector

Housing (Plug)

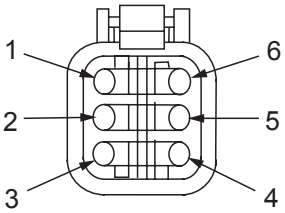


DT06-3S

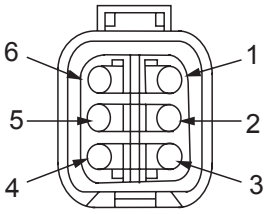
Housing (socket)



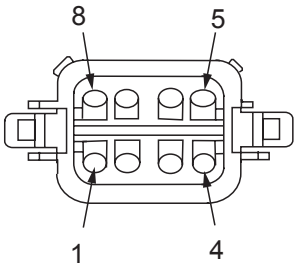
DT04-3P (No. of pin: 3)



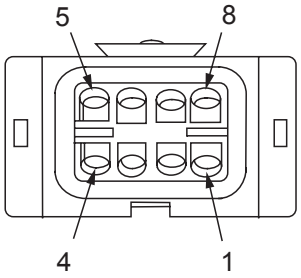
DT06-6S



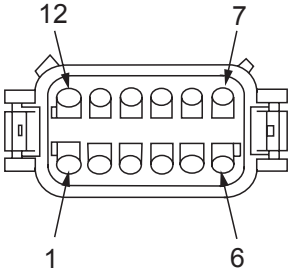
DT04-6P (No. of pin: 6)



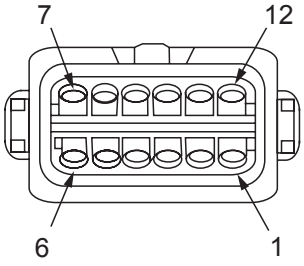
DT06-8S



DT04-8P (No. of pin: 8)



DT06-12S



DT04-12P (No. of pin: 12)

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7.5 Failure Symptoms and Service Codes

Service code	Description
E-	Troubleshooting of electrical system
H-	Troubleshooting of hydraulic and mechanical systems

No.	Symptom	Service code	
	Action to be taken concerning Service Code, User Code and Failure Code		
1	Display User Code in monitor panel		
2	Display Service Code in electrical system after checking failure history		
3	Display Failure Code in mechanical system after checking failure history		
	Engine-related failure		
4	Engine does not start up easily. (It always takes some time to start up the engine)		
5	Engine does not start	E-1	
6	Color of exhaust gas is too dark.(Incomplete combustion)		
7	Engine pickup is poor.		
8	Engine runs rough or is unstable	E-2	
9	Engine speed drops sharply or engine stalls		H-2
10	Auto idle not functioning	E-4	H-5
11	Excessive engine oil consumption, or color of exhaust gas is blue		
12	Premature engine oil contamination		
13	Excessive fuel consumption		
14	Engine cooling water is mixed with engine oil, spurts out or decreases		
15	Engine oil amount increases. (Water or fuel gets in)		
16	Abnormal noises are heard		
17	Excessive vibrations are caused		
	Failure related to work equipment, swing and travel		
18	Power supply of machine cannot be cut off	E-3	
19	Abnormal noise in hydraulic pump		H-4
20	Work equipment, swing, and travel systems do not work		H-3
21	Work equipment speed slow, or swing and travel speeds slow		H-1
22	Travel speed drops considerably while swinging and travelling		H-13
	Work equipment-related failure		
23	Work equipment does not work	E-6	
24	Work equipment cylinders no response in separate operation		H-9
25	Work equipment drifts excessively		H-10
26	Work equipment moves sluggishly		H-11
27	Other work equipment moves while single oil circuit is relieved		H-12

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No.	Symptom	Service code	
28	Boom-raise speed or power is low	E-7	H-6
29	Arm speed or power is low	E-8	H-7
30	Bucket speed or power is low	E-9	H-8
	Travel-related failure		
31	Travel speed or power is low	E-10	H-15
32	Dual speed travel not functioning	E-13	
33	Machine deviates during travel		H-14
34	Machine is not steered well or steering power is low		H-16
35	Travel speed cannot be changed		H-17
36	Travel system fails (only at one side)		H-18
	Swing-related failure		
37	Swing operation fails		H-19
38	Swing acceleration poor or swing speed low		H-20
39	Upper structure overruns remarkably when it stops swinging		H-21
40	Large shock is produced when upper structure stops swinging		H-22
41	High noise is produced when upper structure stops swinging		H-23
42	Swing drift excessive		H-24
	Monitor panel-related failure		
43	Blank monitor display	E-11	
44	Monitor displays nothing	E-12	
45	Incorrect engine coolant reading	E-14	
46	Incorrect fuel level reading	E-15	
47	Incorrect arm-in pilot pressure reading	E-17	
48	Incorrect arm-out pilot pressure reading	E-18	
49	Incorrect boom-raise pilot pressure reading	E-19	
50	Incorrect boom-lower pilot pressure reading	E-20	
51	Incorrect bucket-curl pilot pressure reading	E-21	
52	Incorrect bucket-dump pilot pressure reading	E-22	
53	Incorrect swing pilot pressure reading	E-23	
54	Incorrect left travel pilot pressure reading	E-24	
55	Incorrect right travel pilot pressure reading	E-25	
	Other failure		
56	Preheating function fails	E-5	
57	Wiper does not work	E-16	

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7.5.1 Troubleshooting with an failure code

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E325 Boom-down pilot pressure abnormal 7-42
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E327 Bucket-dump pilot pressure abnormal 7-44
E328 Swing pilot pressure abnormal 7-45
E329 Left travel pilot pressure abnormal 7-46
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E231 Fuel control dial set voltage abnormal 7-48
E237 Hydraulic oil temperature abnormal 7-49
E450 Front pump proportional solenoid coil current abnormal A 7-50
E450 Front pump proportional solenoid coil current abnormal B 7-51
E451 Rear pump proportional solenoid coil current abnormal A 7-52
E451 Rear pump proportional solenoid coil current abnormal B 7-53
E452 Swing priority proportional solenoid coil current abnormal A 7-54
E452 Swing priority proportional solenoid coil current abnormal B 7-55
E453 Bucket confluence proportional solenoid coil current abnormal A 7-56
E453 Bucket confluence proportional solenoid coil current abnormal B 7-57
E455 Boom priority 2 proportional solenoid coil current abnormal A 7-58
E455 Boom priority 2 proportional solenoid coil current abnormal B 7-59
E460 Dual speed travel solenoid valve abnormal 7-60

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Information in troubleshooting table

Failure Code	Service Code	Trouble	Trouble description
Display on monitor	—		
Failure description	Failure is described on the monitor display.		
Response from controller	When failure is detected, the controller has taken action to protect the affected system or equipment.		
Symptom of machine	Symptom that is shown on the machine due to action of controller.		

Possible causes and standard value in normal state	Cause		Standard value in normal state and remarks on troubleshooting
	1	Possible causes of trouble (Given numbers are reference numbers, which do not indicate priority)	<Inclusion> ● Standard value under normal condition can be used to judge possible causes ● Reference for passing the above "Good" or "No Good" judgement <Symptom of Wiring Harness Failure> ● Open circuit Faulty contact with connector or open circuit in wiring harness ● Faulty grounding An ungrounded wiring is grounded. ● Short circuit A wiring has mistaken contact with a 24 V electric circuit.
	2		
	3		
	4		
	5		

Related circuit diagram

This is part of the circuit diagram which shows the portion where the failure occurred.

- Connector No.: A connector number Indicates a connector.
- Arrow: An arrow roughly indicates the installing location.

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E111 Controller memory error (FROM)

Failure Code	Service Code	Trouble	Controller memory fails and the system slows down.
11	E111		
Failure description	When the power is on, abnormality is detected by checking through FROM summation and RAM verification.		
Response from controller	Stop the operation of motor and solenoid coil.		
Symptom of machine	Engine acceleration fails and the machine acts slowly. .		

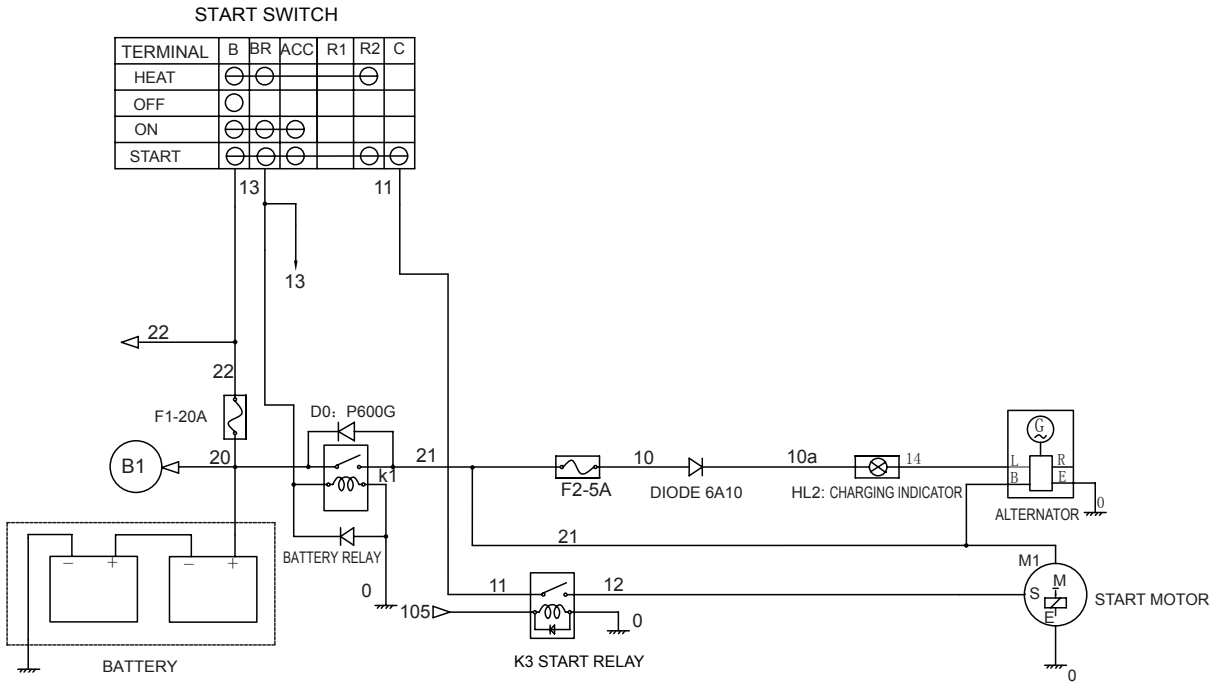
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Internal failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (If this failure occurs, replace the controller.)		
	2				
	3				
	4				
	5				

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E015 Power supply voltage abnormal

Failure Code	Service Code	Trouble	Power supply voltage is abnormal.
15	E015		
Failure description	Voltage of power supply is above 36V when the machine is running.		
Response from controller	The system stops the motor and solenoid valve automatically.		
Symptom of machine	Engine acceleration fails and the machine acts slowly.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of power supply	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Measure battery voltage	Voltage	≤25V
	2	Alternator abnormal	★ Turn engine start switch to OFF position. And Then, keep the engine running to perform troubleshooting.		
			Measure the voltage between the alternator terminal B and ground.	Voltage	About 28V
	3				
	4				
	5				



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E116 Controller internal temperature abnormal

Failure Code	Service Code	Trouble	Internal temperature of controller is abnormal. Engine acceleration fails and the machine acts slowly.
16	E116		
Failure description	Internal temperature of controller keeps above 80°C or below -30°C for 10 seconds when the power is on.		
Response from controller	The controller stops the motor and the solenoid coil.		
Symptom of machine	Engine acceleration fails and the machine acts slowly.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Internal failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (If this failure occurs, replace the controller.)		
	2				
	3				
	4				
	5				

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E017 Sensor 5V power output abnormal

Failure Code	Service Code	Trouble	Abnormal output of power supply in sensor
17	E017		
Failure description	The controller detects out over current or short circuit of sensor power source output when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	—		

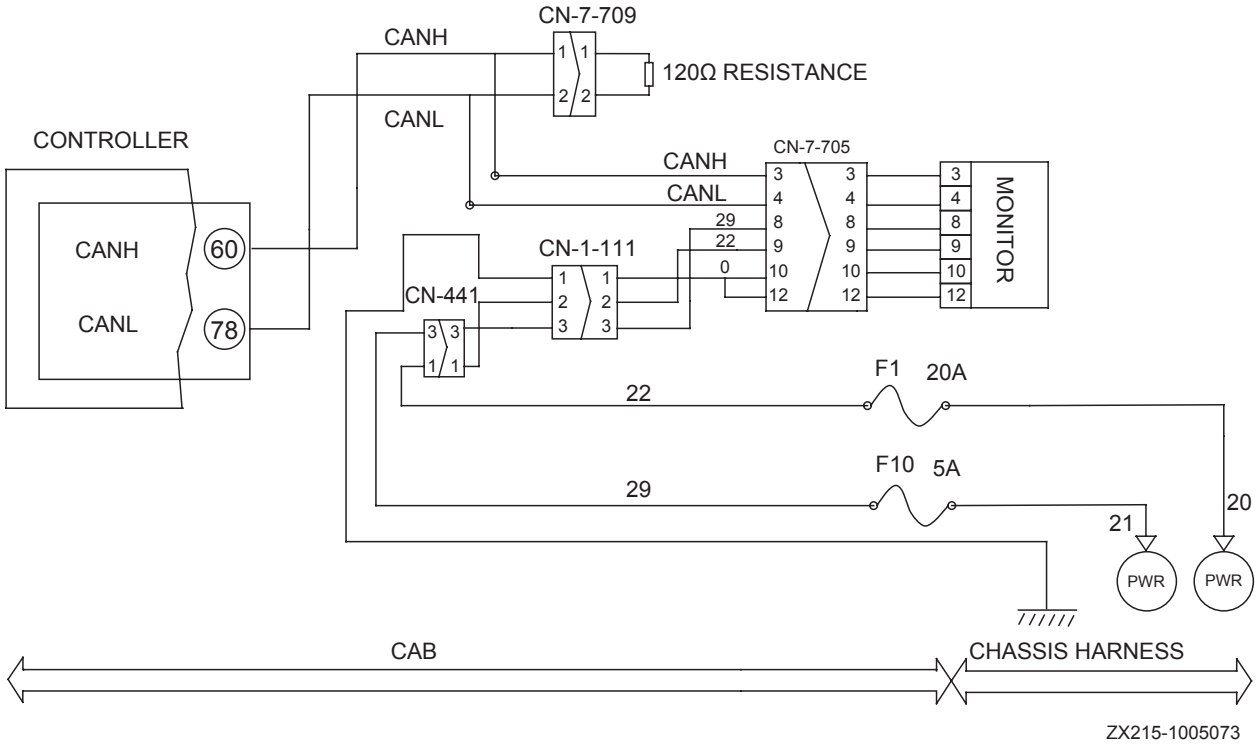
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Short circuit in harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Measure the resistance between pin 56, pin 75, pin 74 of controller KC-MB and the ground.	Resistance	≥2MΩ
	2	Internal failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of failure.)		
	3				
	4				
	5				

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E118 Communication abnormal between controller and monitor

Failure Code	Service Code	Trouble	Abnormal communication between controller and monitor
18	E118		
Failure description	Communication of monitor is interrupted for 5 consecutive times when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of CAN resistance	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-7-709 ① and ②	Resistance	60Ω
	2	Open circuit of harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the controller and measure the resistance between pin 60 and CN-7-705 ③	Resistance	≤1Ω
			Unplug the controller and measure the resistance between pin 78 and CN-7-705 ④		≤1Ω
	3	Internal failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of failure.)		
	4				
	5				



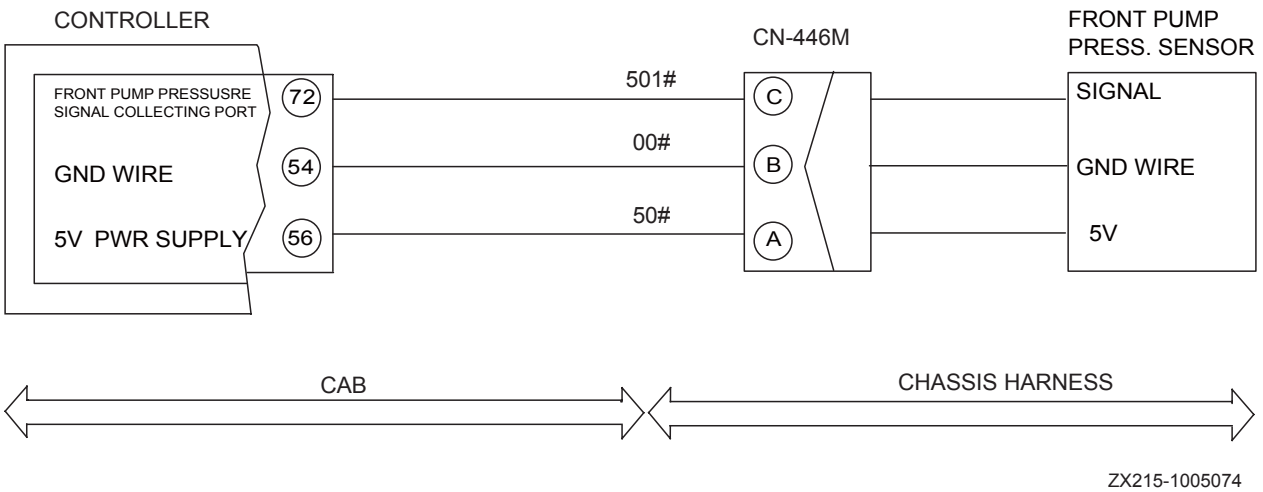
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E320 Front pump output pressure abnormal

Failure Code	Service Code	Trouble	Front pump output pressure is abnormal. Only output alarm is enabled. .
20	E320		
Failure description	A pressure feedback voltage other than 0.25~4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-446M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-446M C and pin 72 of controller	Resistance	≤1Ω
			Between CN-446M B and ground		≤1Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-446M C and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-446M C and ground	Voltage	0.5±0.2V
	5				



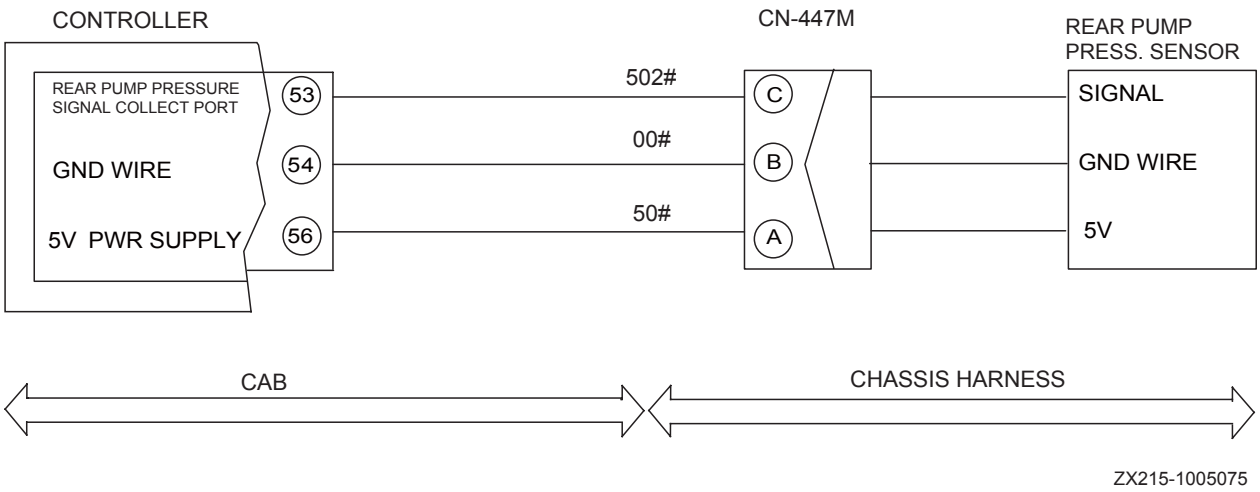
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E321 Rear pump output pressure abnormal

Failure Code	Service Code	Trouble	Reading of rear pump output pressure is abnormal. Only output alarm is enabled. .
21	E321		
Failure description	A pressure feedback voltage other than 0.25~4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-447M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-447M C and pin 53 of controller	Resistance	≤1 Ω
			Between CN-447M B and ground		≤1 Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-447M C and ground	Resistance	≥2M Ω
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at OFF position to perform troubleshooting.		
			Between CN-447M C and ground	Voltage	0.5±0.2V
	5				



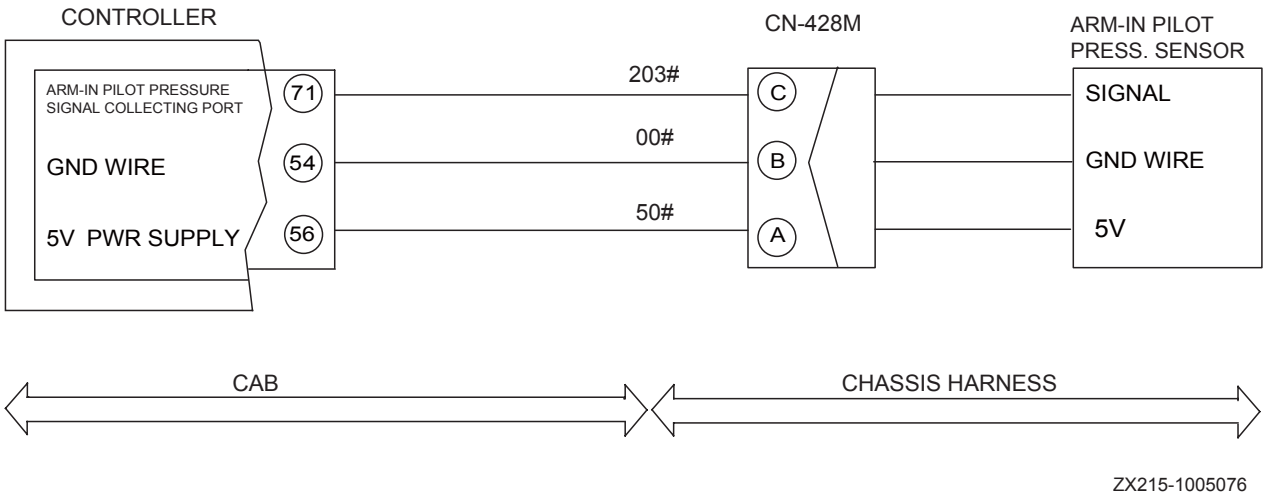
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E322 Arm-in pilot pressure abnormal

Failure Code	Service Code	Trouble	Arm-in pilot pressure is abnormal. Only output alarm is enabled. .
22	E322		
Failure description	A pressure feedback voltage other than 0.25~4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	The arm in motion is slow.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-428M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-428M C and pin 71 of controller	Resistance	≤1 Ω
			Between CN-428M B and ground		≤1 Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-428M C and ground	Resistance	≥2M Ω
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-428M C and ground	Voltage	0.5±0.2V
	5				



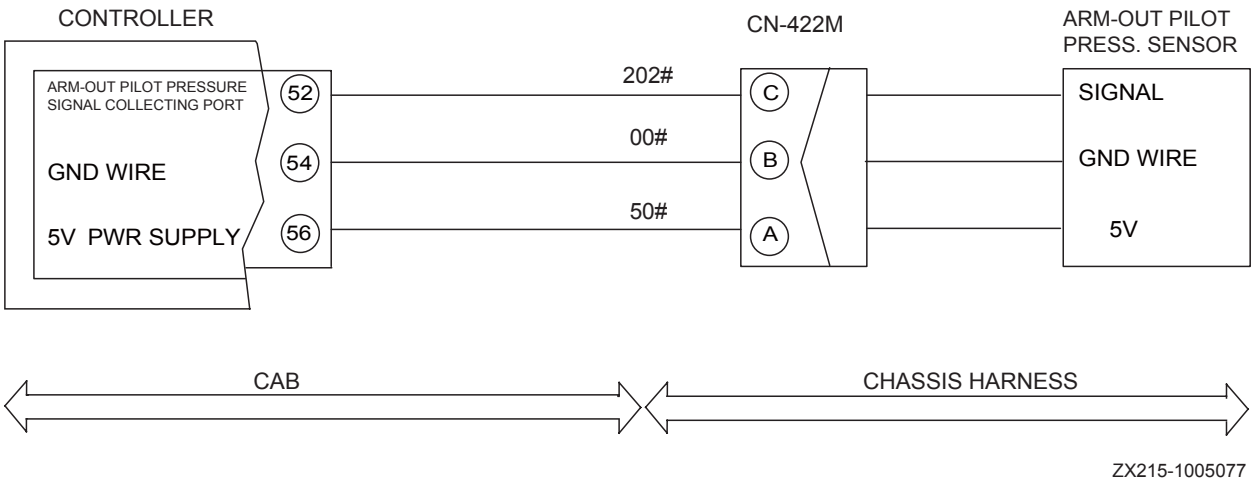
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E323 Arm-out pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of arm-out pilot pressure is abnormal. Only output alarm is enabled.
23	E323		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Arm-out motion is slow.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-422M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-122M C and pin 52 of controller	Resistance	≤1Ω
			Between CN-422M B and ground		≤1Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-422M C and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-422M C and ground	Voltage	0.5±0.2V
	5				



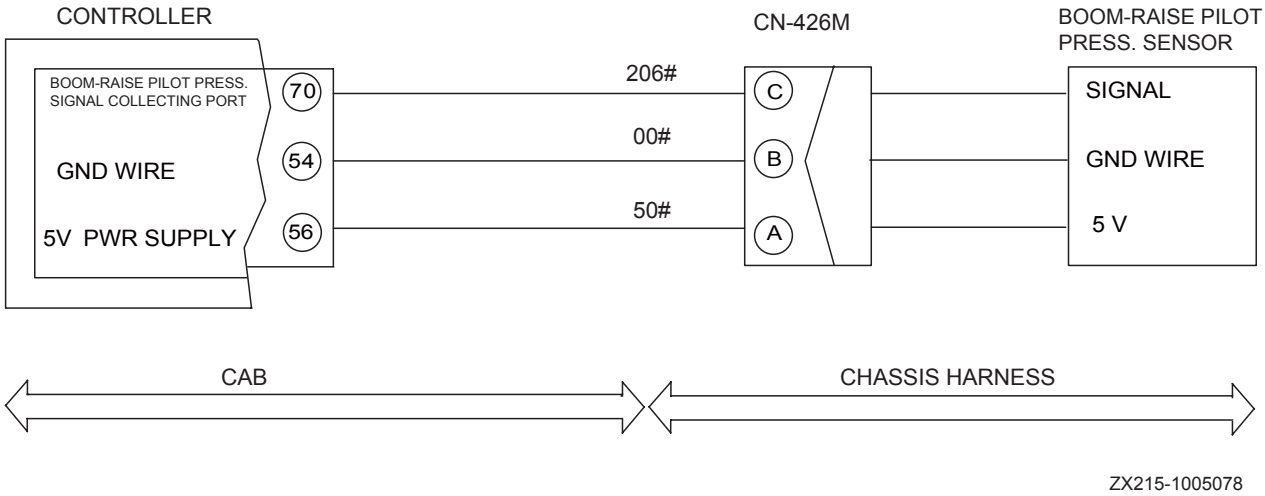
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E324 Boom-up pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of boom-raise pilot pressure is abnormal. Only output alarm is enabled. .
24	E324		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Boom-raise motion is slow.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-426M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-426M C and 70 pin of controller	Resistance	≤1Ω
			Between CN-426M B and ground		≤1Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-426M C and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-426M C and ground	Voltage	0.5±0.2V
	5				



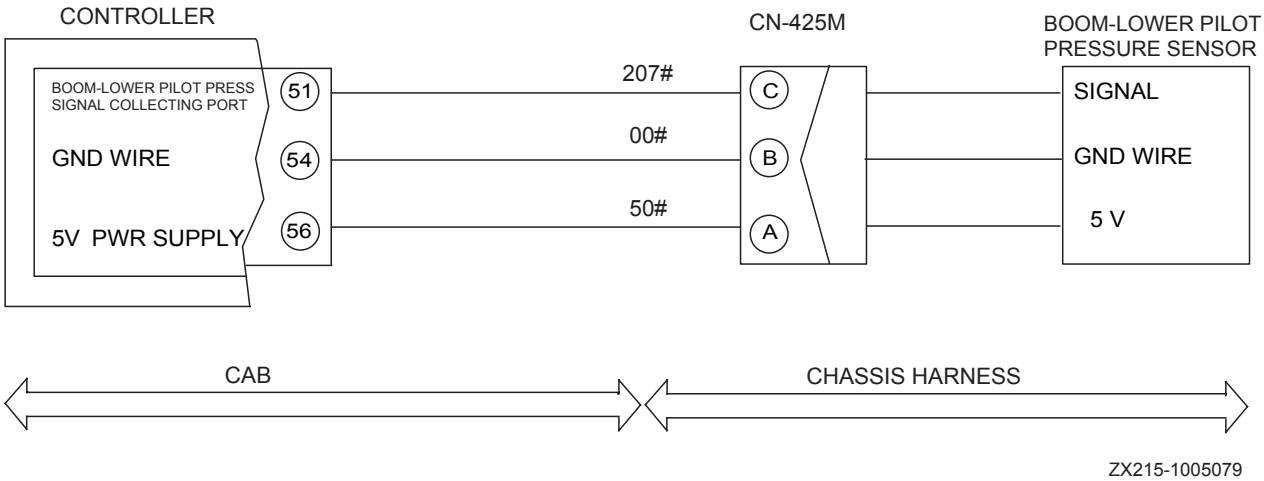
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E325 Boom-down pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of boom-lower pilot pressure is abnormal. Only output alarm is enabled. .
25	E325		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Boom-lower motion is slow.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-425M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-425M C and pin 51 of controller	Resistance	≤1 Ω
			Between CN-425M B and ground		≤1 Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-425M C and ground	Resistance	≥2M Ω
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-425M C and ground	Voltage	0.5±0.2V
	5				



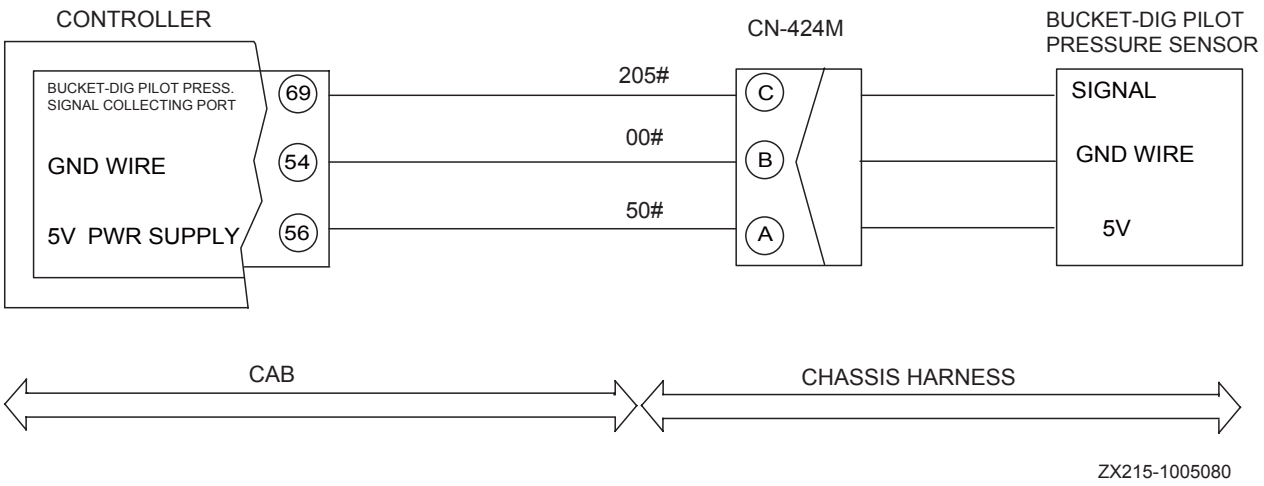
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E326 Bucket-dig pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of bucket-curl pilot pressure is abnormal. Only output alarm is enabled. .
26	E326		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Bucket-curl motion is low.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-424M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-424M C and 69 pin of controller	Resistance	≤1Ω
			Between CN-424M B and ground		≤1Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-424M C and ground	Resistance	≥2MΩ
	4	Failure of sen-sor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-424M C and ground	Voltage	0.5±0.2V
	5				



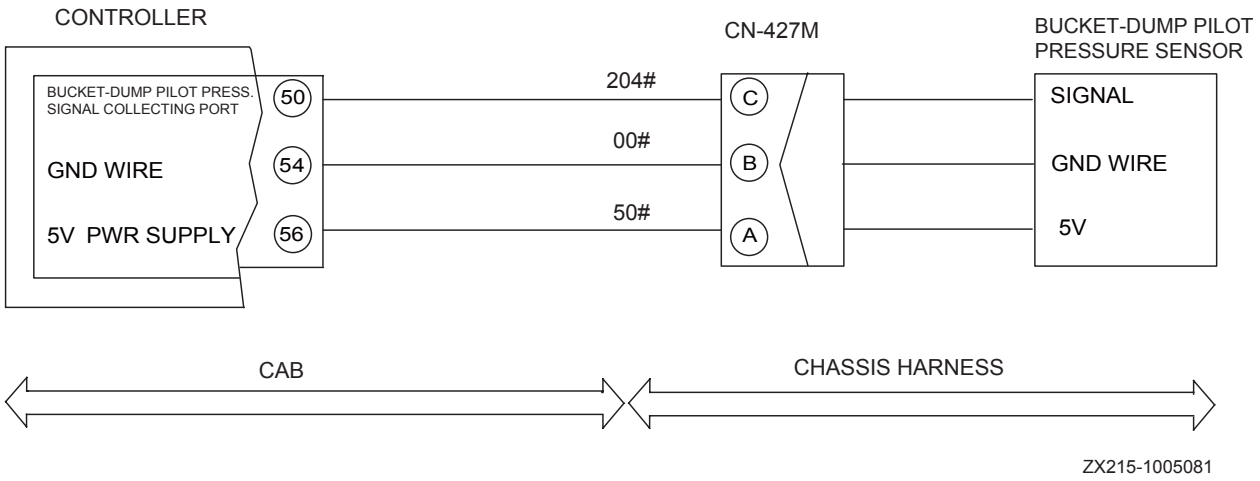
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E327 Bucket-dump pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of Bucket-dump pilot pressure is abnormal. Only output alarm is enabled. .
27	E327		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Bucket-dump motion is low		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-427M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-427M C and pin 50 of controller	Resistance	≤1Ω
			Between CN-427M B and ground		≤1Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-427M C and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-427M C and ground	Voltage	0.5±0.2V
	5				



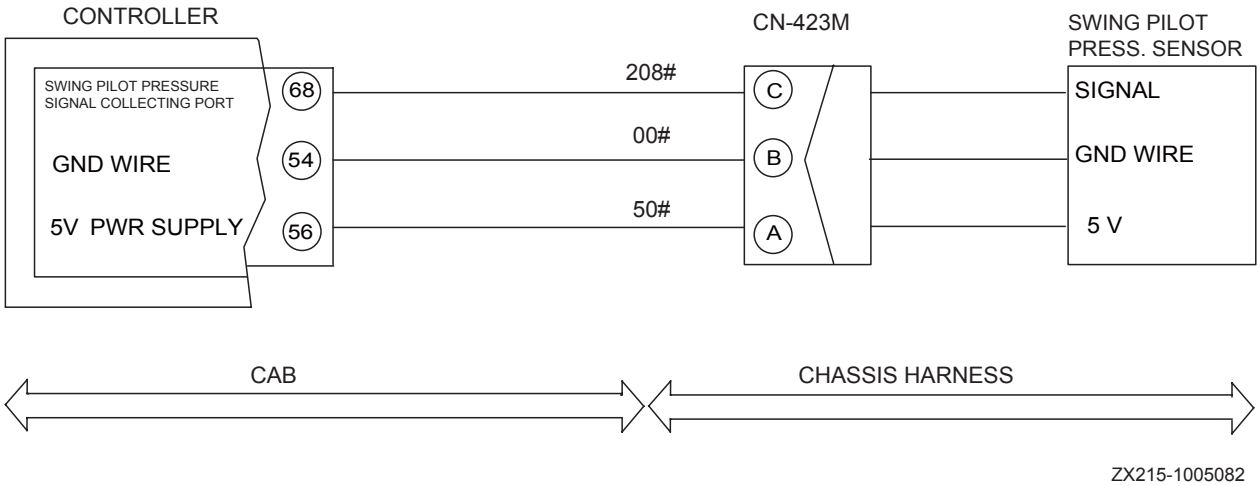
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E328 Swing pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of swing pilot pressure is abnormal. Only output alarm is enabled. .
28	E328		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Swinging motion is slow.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-423M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-423M C and pin 68 of controller	Resistance	≤1Ω
			Between CN-423M B and ground		≤1Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-423M C and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at OFF position to perform troubleshooting.		
			Between CN-423M C and ground	Voltage	0.5±0.2V
	5				



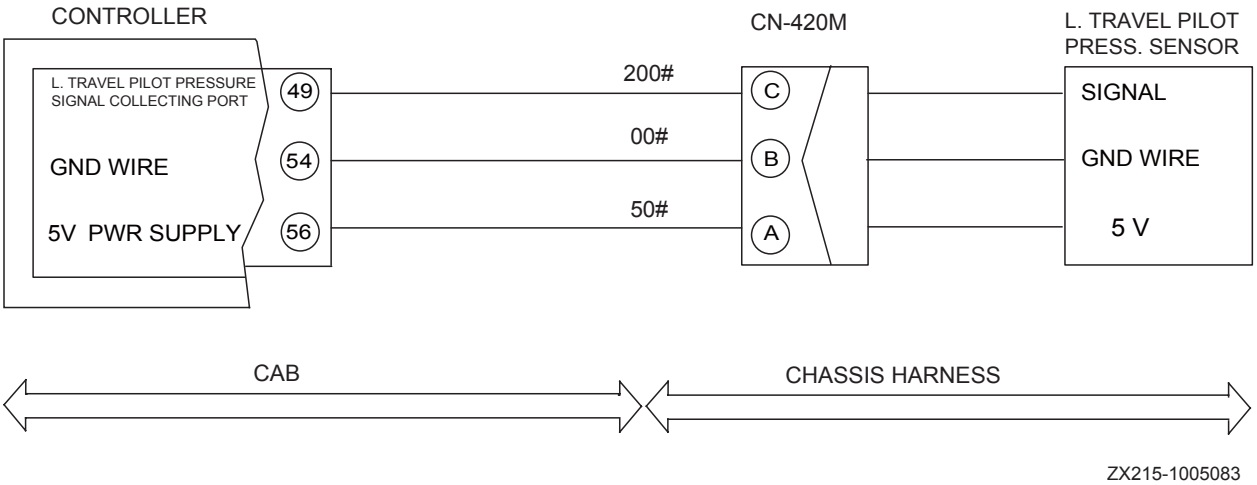
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E329 Left travel pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of left travel pilot pressure is abnormal. Only output alarm is enabled. .
29	E329		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Left travel speed is low. Travel deviates.		

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-420M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-420M C and pin 49 of controller	Resistance	≤1 Ω
			Between CN-420M B and ground		≤1 Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-420M C and ground	Resistance	≥2M Ω
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at OFF position to perform troubleshooting.		
			Between CN-420M C and ground	Voltage	0.5±0.2V
	5				



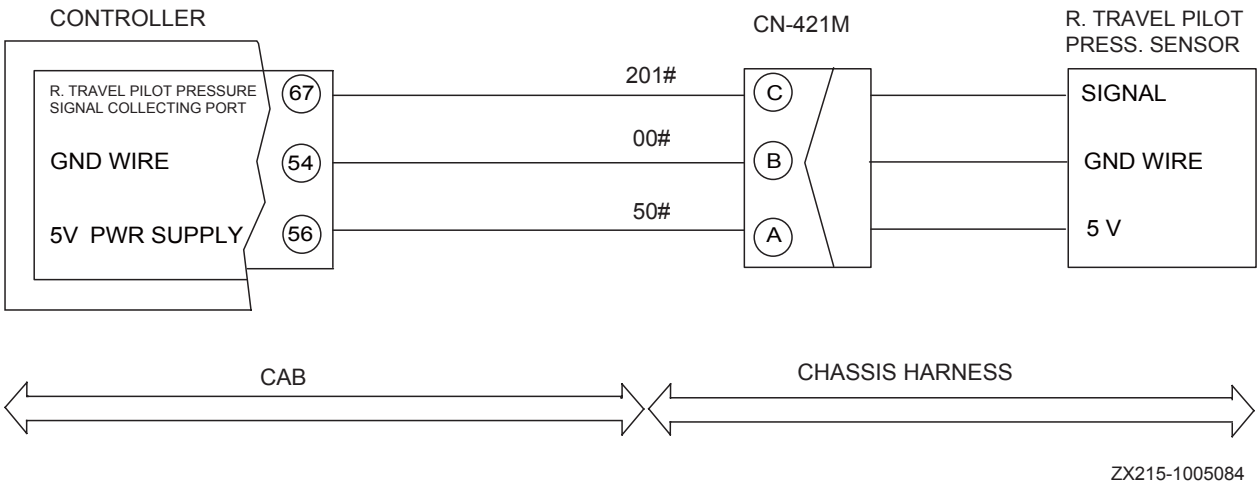
ZX215-1005083

https://truckmanualshub.com/

E330 Right travel pilot pressure abnormal

Failure Code	Service Code	Trouble	Reading of right travel pilot pressure is abnormal. Only output alarm is enabled. .
30	E330		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	Right travel speed is low. Travel deviates.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-421M A and B	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-421M C and pin 67 of controller	Resistance	≤1 Ω
			Between CN-421M B and ground		≤1 Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-421M C and ground	Resistance	≥2M Ω
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-421M C and ground	Voltage	0.5±0.2V
	5				



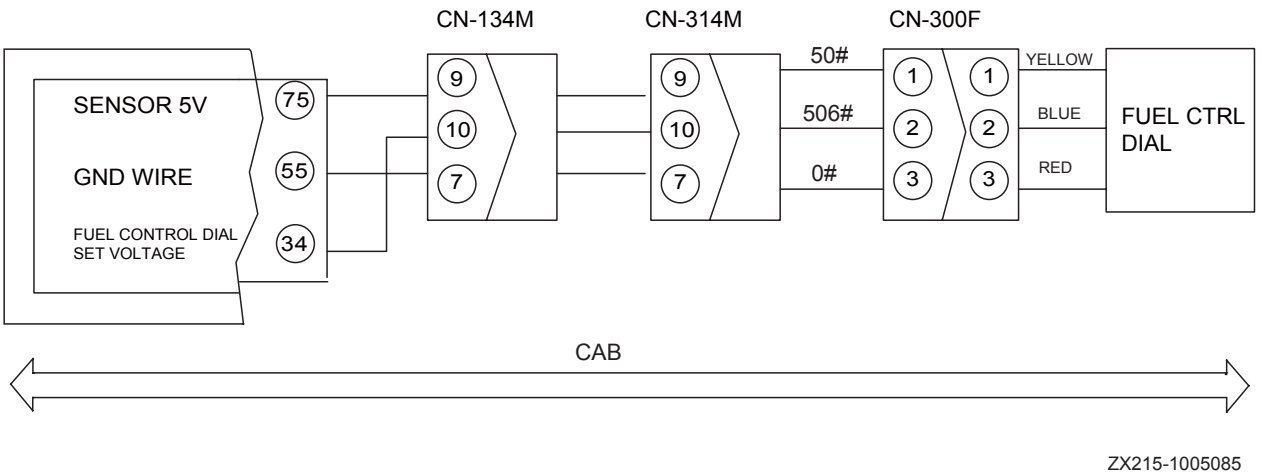
ZX215-1005084

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E231 Fuel control dial set voltage abnormal

Failure Code	Service Code	Trouble	Voltage setting of fuel control dial is abnormal. Engine returns to auto idle.
31	E231		
Failure description	The voltage of fuel control dial other than 0.25 – 4.75V keeps more than 200msec when the power is on.		
Response from controller	The throttle is switched to idle position.		
Symptom of machine	Engine returns to auto idle speed.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-300F ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-300F ② and pin 34 of controller	Resistance	≤1Ω
	3	Short circuit of signal wire (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-300F ② and ground	Resistance	≥2MΩ
	4	Short circuit of signal wire (contact with power supply)	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-300F ② and ground	Voltage	≤5V
	5	Defective knob	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-300F, and measure the resistance between dial ① and ③	Resistance	5K±15%Ω



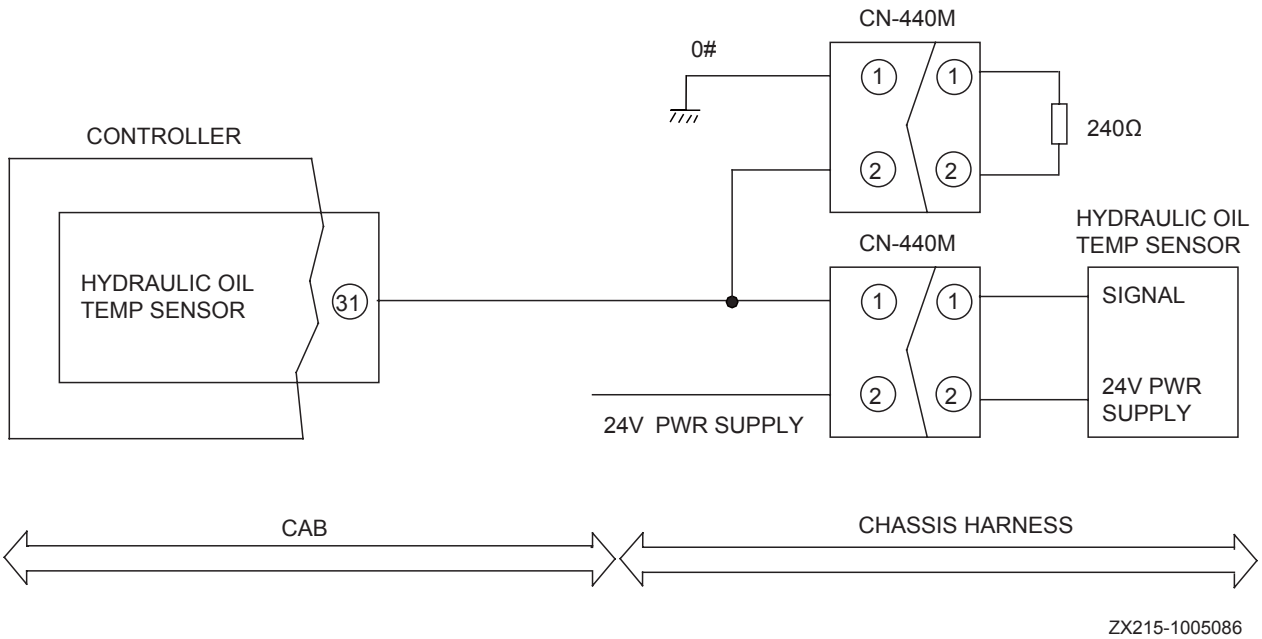
ZX215-1005085

https://truckmanualshub.com/

E237 Hydraulic oil temperature abnormal

Failure Code	Service Code	Trouble	Hydraulic oil temperature is abnormal. Only output alarm is enabled.
37	E237		
Failure description	A voltage other than 0.2 – 4.75V, transformed from hydraulic oil temperature that is detected by controller, keeps more than 200msec.		
Response from controller	Only output alarm is enabled. The alarm resets automatically when conditions become normal.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at OFF position to perform troubleshooting.		
			Between CN-440M ① and ground	Voltage	0.2~4.75V
	2	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-440M ① and pin 31 of controller	Resistance	≤1Ω
	3	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-440M ① and ground	Resistance	≥1MΩ
	4	Failure of 24V power supply	★ Turn engine start switch to OFF position. Keep it at ON position to perform troubleshooting.		
			Between CN-440M ② and ground	Voltage	About 24V
	5				



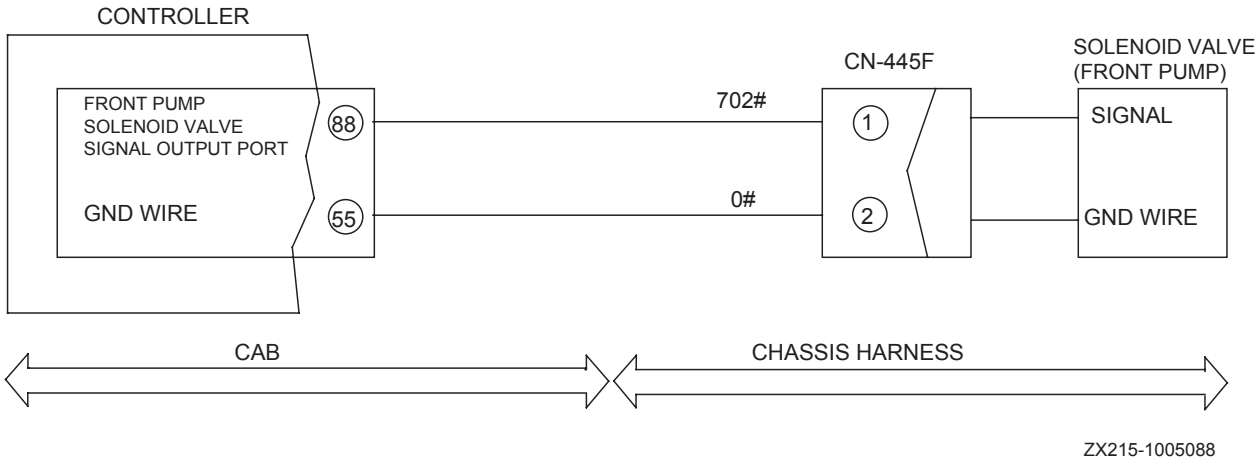
ZX215-1005086

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E450 Front pump proportional solenoid coil current abnormal A

Failure Code	Service Code	Trouble	Front pump proportional solenoid coil current is abnormal. The system operates slowly.
50	E450		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 1.8A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Stop the solenoid coil when failure is detected. Power supply must be restored.		
Symptom of machine	System operates slowly.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-445F ① and pin 88 of controller	Resistance	≤1Ω
			Between CN-445F ② and ground		≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-445F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-445F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



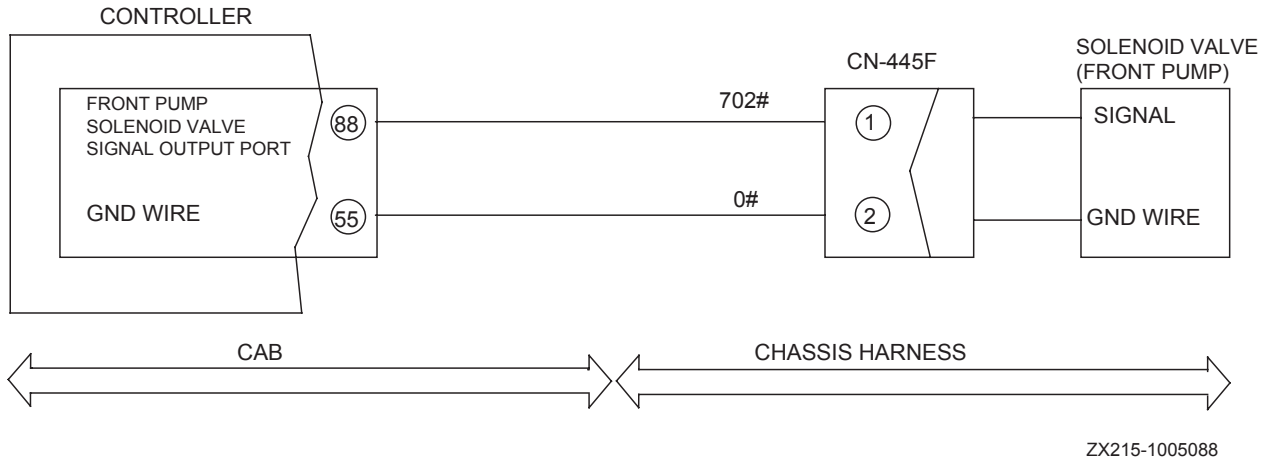
ZX215-1005088

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E450 Front pump proportional solenoid coil current abnormal B

Failure Code	Service Code	Trouble	Front pump proportional solenoid coil current is abnormal. The system operates slowly.
50	E450		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 0.1 A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Stop the solenoid coil when failure is detected. Power supply must be restored.		
Symptom of machine	System operates slowly.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-445F ① and pin 88 of controller	Resistance	≤1Ω
			Between CN-445F ② and ground		≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-445F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-445F, and measure the resistance between solenoid valve's ① and ② .	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



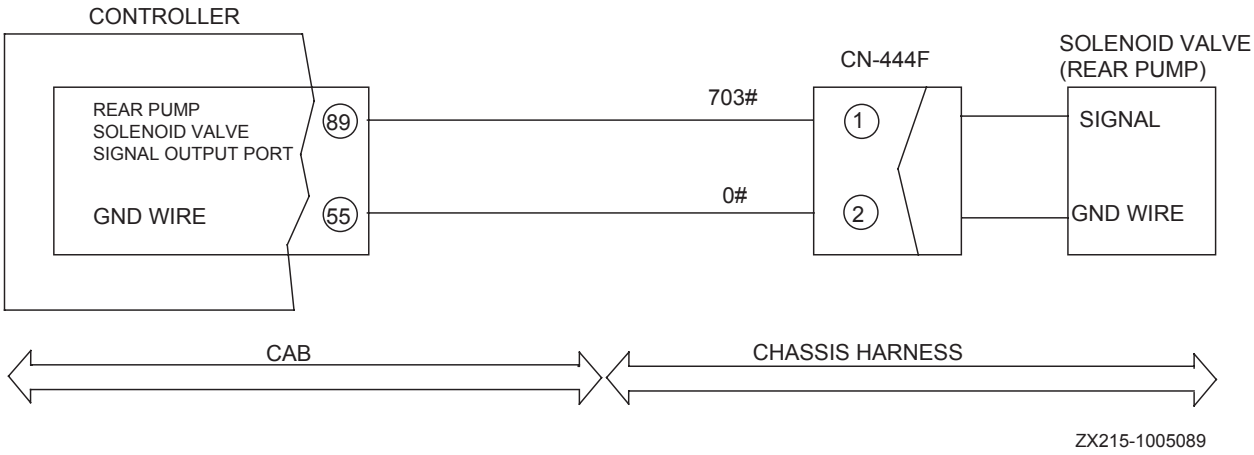
ZX215-1005088

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E451 Rear pump proportional solenoid coil current abnormal A

Failure Code	Service Code	Trouble	Rear pump proportional solenoid coil current is abnormal. The system operates slowly.
51	E451		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 1.8 A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Stop the solenoid coil when failure is detected. Power supply must be restored.		
Symptom of machine	System operates slowly.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-444F ① and pin 89 of controller	Resistance	≤1Ω
			Between CN-444F ② and ground		≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-444F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-444F, and measure the resistance between solenoid valve's ① and ② .	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				

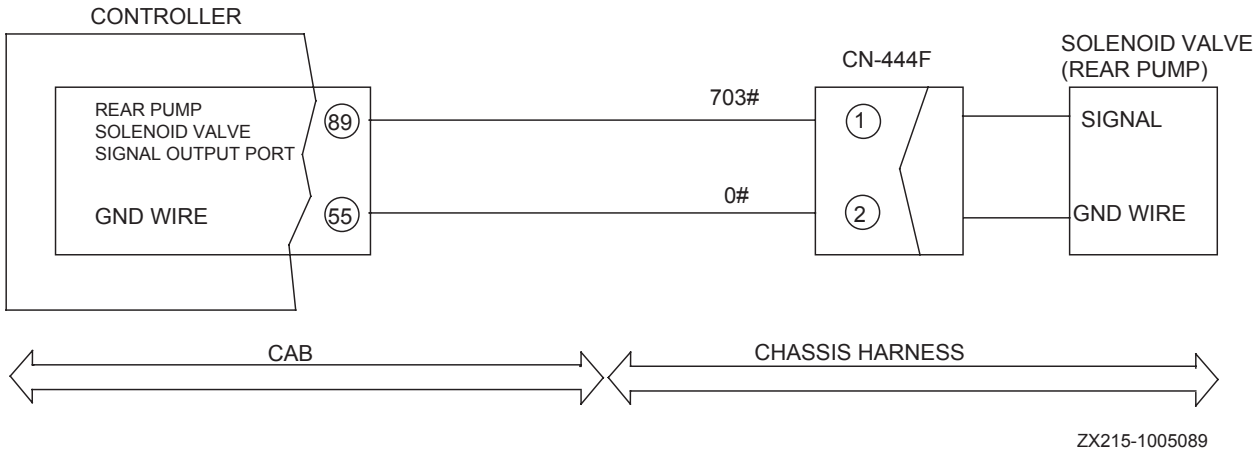


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E451 Rear pump proportional solenoid coil current abnormal B

Failure Code	Service Code	Trouble	Rear pump proportional solenoid coil current is abnormal. The system operates slowly.
51	E451		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 0.1 A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Stop the solenoid coil when failure is detected. Power supply must be restored.		
Symptom of machine	System operates slowly.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-444F ① and pin 89 of controller	Resistance	≤1Ω
			Between CN-444F ② and ground	Resistance	≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-444F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-444F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



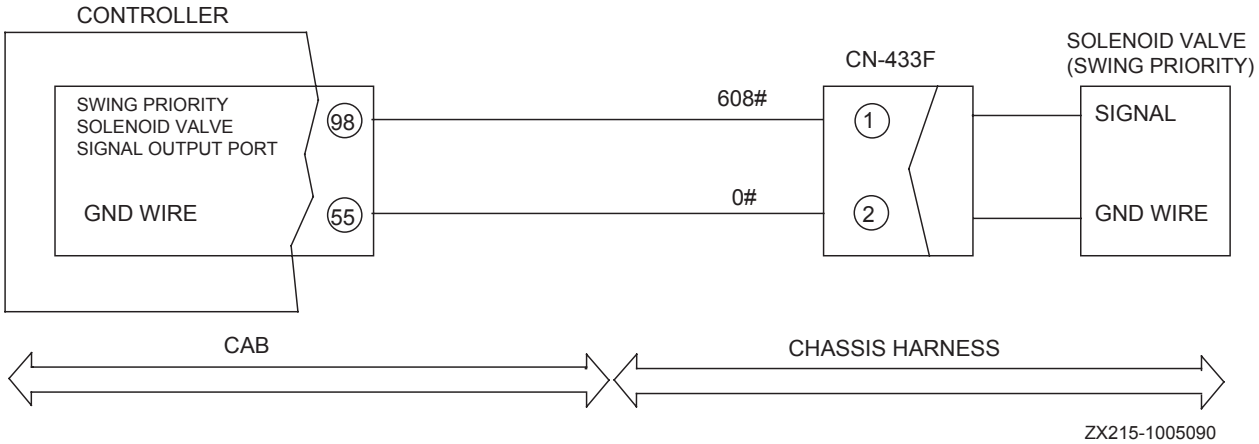
ZX215-1005089

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E452 Swing priority proportional solenoid coil current abnormal A

Failure Code	Service Code	Trouble	Current through the proportional solenoid coil for swing priority is abnormal.
52	E452		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 1.8A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Operation of solenoid coil is stopped when failure is detected. Power supply must be restored.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-433F ① and pin 98 of controller	Resistance	≤1Ω
			Between CN-433F ② and ground	Resistance	≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-433F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-433F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				

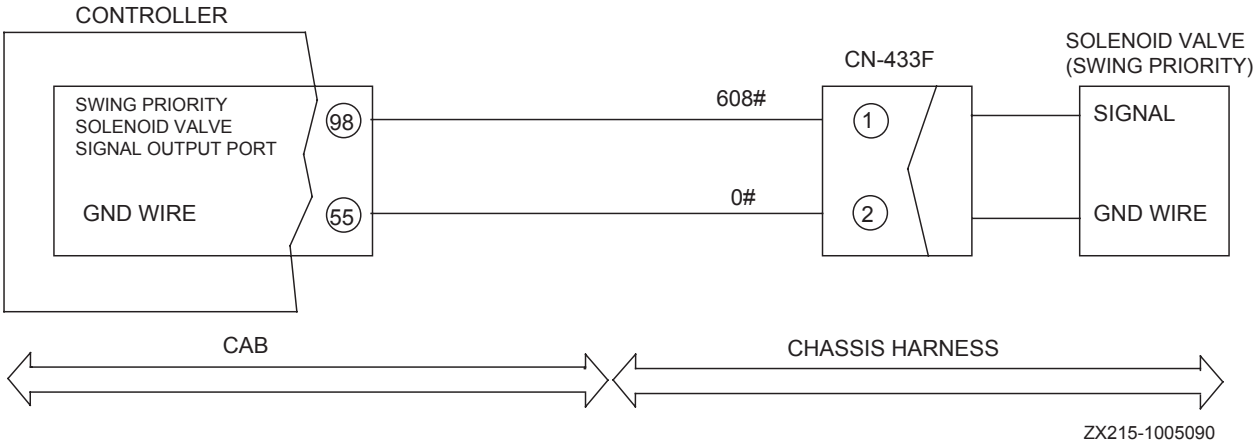


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E452 Swing priority proportional solenoid coil current abnormal B

Failure Code	Service Code	Trouble	Current through the proportional solenoid coil for swing priority is abnormal.
52	E452		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 0.1A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Operation of solenoid coil is stopped when failure is detected. Power supply must be restored.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-433F ① and pin 98 of controller	Resistance	≤1Ω
			Between CN-433F ② and ground	Resistance	≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-433F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-4133F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				

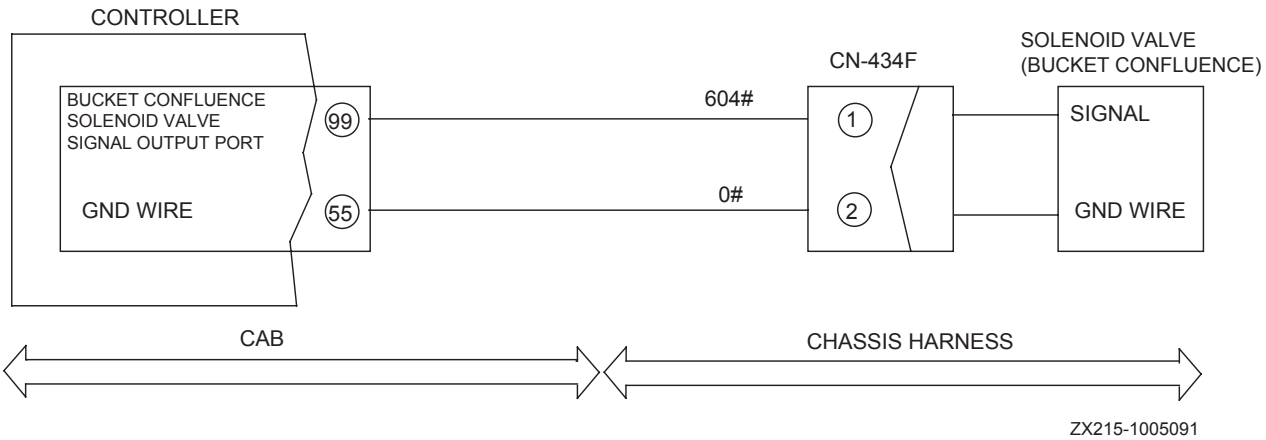


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E453 Bucket confluence proportional solenoid coil current abnormal A

Failure Code	Service Code	Trouble	Current through the proportional solenoid coil for bucket confluence is abnormal. Motion of bucket is slow.
53	E453		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 1.8 A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Operation of solenoid coil is stopped when failure is detected. Power supply must be restored.		
Symptom of machine	Motion of bucket is slow.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-434F ① and 99 pin of controller	Resistance	≤1Ω
			Between CN-434F ② and ground	Resistance	≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-434F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-434F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				

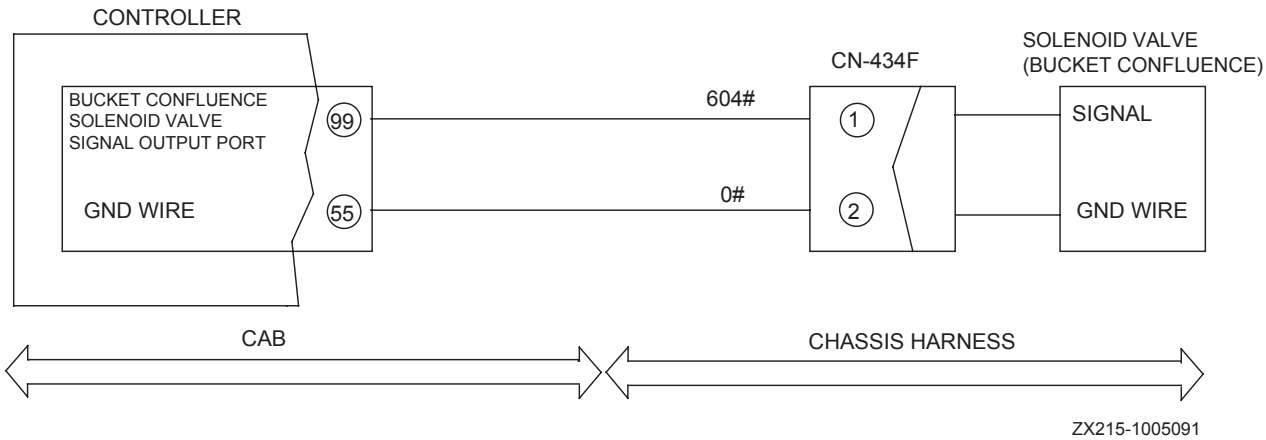


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E453 Bucket confluence proportional solenoid coil current abnormal B

Failure Code	Service Code	Trouble	Current through the proportional solenoid coil for bucket confluence is abnormal. Motion of bucket is slow.
53	E453		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 0.1A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Operation of solenoid coil is stopped when failure is detected. Power supply must be restored.		
Symptom of machine	Motion of bucket is slow.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-434F ① and pin 99 of controller	Resistance	≤1Ω
			Between CN-434F ② and ground		≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-434F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-434F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



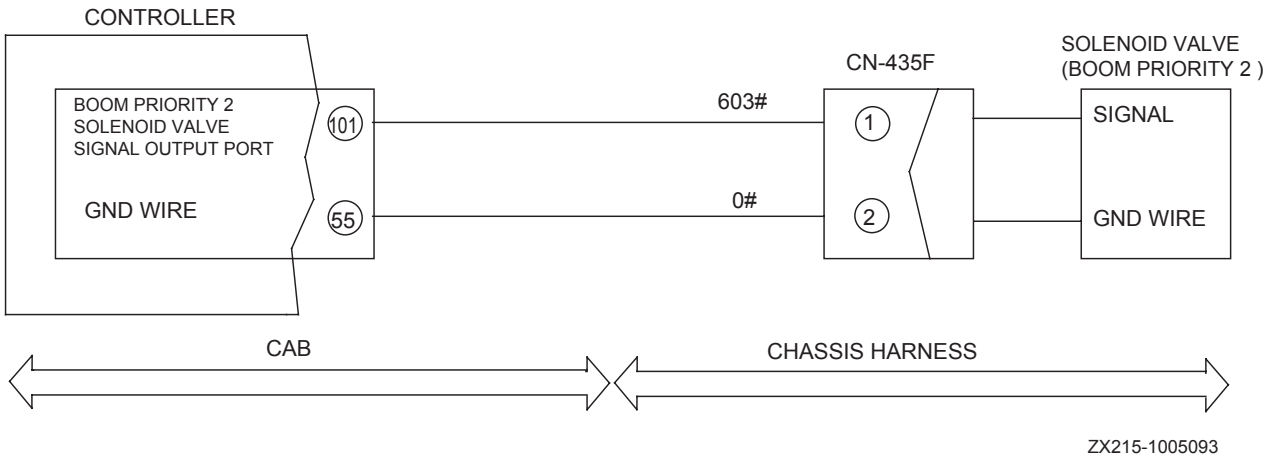
ZX215-1005091

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E455 Boom priority 2 proportional solenoid coil current abnormal A

Failure Code	Service Code	Trouble	Current through the proportional solenoid coil for boom priority is abnormal.
55	E455		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 1.8 A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Operation of solenoid coil is stopped when failure is detected. Power supply must be restored.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-435F ① and pin 101 of controller	Resistance	≤1Ω
			Between CN-435F ② and ground	Resistance	≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-435F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-435F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



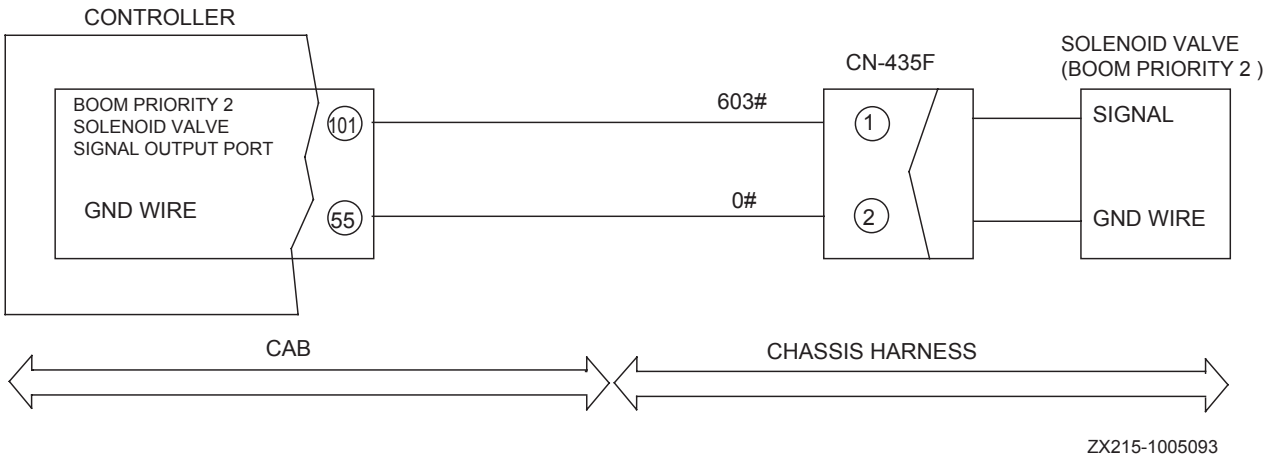
ZX215-1005093

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E455 Boom priority 2 proportional solenoid coil current abnormal B

Failure Code	Service Code	Trouble	Current through the proportional solenoid coil for boom priority is abnormal.
55	E455		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid coil. Current above 0.1A lasts for 1 second. Differential current occurs in drive protection loop.		
Response from controller	Operation of solenoid coil is stopped when failure is detected. Power supply must be restored.		
Symptom of machine	—		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-435F ① and pin 101 of controller	Resistance	≤1Ω
			Between CN-435F ② and ground	Resistance	≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-435F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-435F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



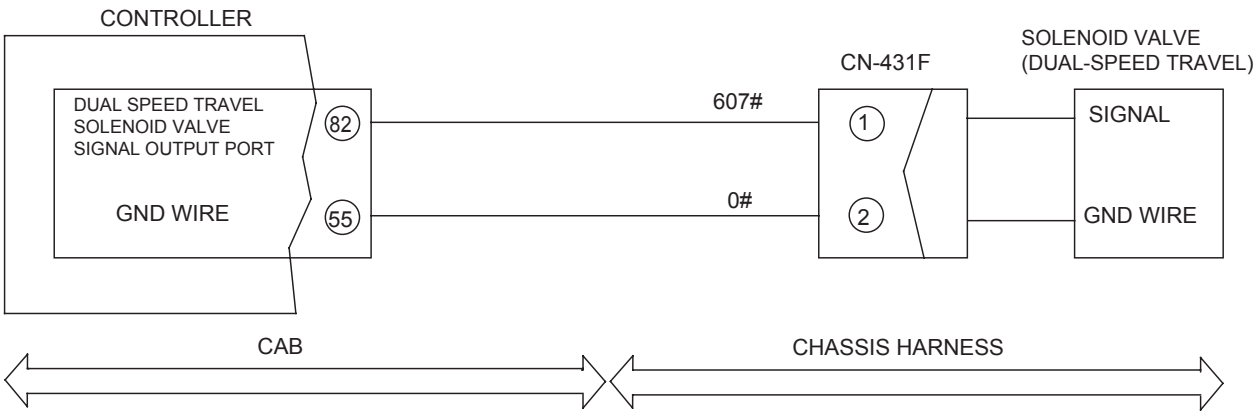
ZX215-1005093

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E460 Dual speed travel solenoid valve abnormal

Failure Code	Service Code	Trouble	Connection of the solenoid coil for dual speed travel is abnormal. High speed travel is not functioning.
60	E460		
Failure description	Abnormality, open circuit or short circuit occurs in the proportional solenoid coil.		
Response from controller	Only output alarm is enabled.		
Symptom of machine	High speed travel is not functioning.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-431F ① and pin 100 of controller	Resistance	≤1Ω
			Between CN-431F ② and ground		≤1Ω
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-431F ① and wire 0#	Resistance	≥1MΩ
	3	Failure of proportional valve coil	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-431F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



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7.5.2 Troubleshooting of Electrical System (E - Code)

Information in troubleshooting table 7-62
E-1 Engine does not start 7-63
E-2 Engine runs rough or is unstable 7-65
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Information in troubleshooting table

★ The following information is contained in the troubleshooting table and related electric circuit diagrams. Fully understand these information before carrying out troubleshooting.

Trouble	Trouble which occurs on the machine
Related information	Information related to detected trouble or troubleshooting

Possible causes and standard value in normal state	Cause		Standard value in normal state and remarks on troubleshooting
	1	Possible causes of trouble (Given numbers are reference numbers, which do not indicate priority)	< Description > ● Standard value in normal state, which is used to judge possible causes that might be OK or N/G. ● A reference value is used to determine OK or N/G.
	2		
	3		
	4		
	5		

Related circuit diagram

This is part of the circuit diagram which shows the portion where the failure occurred.

- Connector No.: A connector number Indicates a connector.
- Arrow: An arrow roughly indicates the installing location.

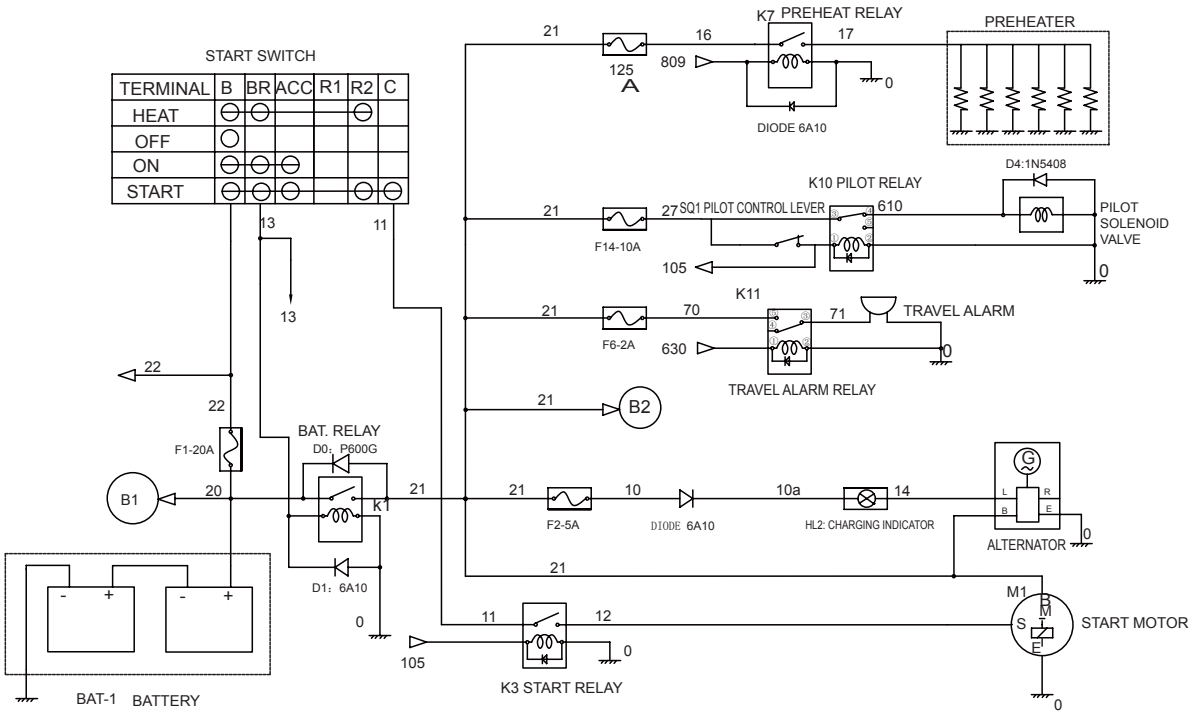
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E-1 Engine does not start

Trouble	Engine cannot be started.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Low battery capacity	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Battery voltage	Voltage	≥24V
	2	Internal failure of start switch	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			OFF position: between wire 22# and wire 11#	Resistance	≥1MΩ
	3	Failure of pilot switch	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Lockout lever FREE position: between 105 # and 27# wire	Resistance	≤1Ω
			Lockout lever LOCKED position: between wire 105# and 27#		≥1 MΩ
	4	Failure of start motor	★ Turn engine start switch to OFF position. Keep the engine running during troubleshooting. (When all power supplies, grounding, signal and engine inputs are normal except engine output, it is the failure of start motor)		
			Engine start motor	Start switch	Voltage
			Power supply: Terminal B and ground	Start	20~30V
			Between engine input terminal S and ground		20~30V
	5	Open circuit of wire harness	★ Turn engine start switch to OFF position. Then, keep it at OFF position to perform troubleshooting.		
			Wire 21# and start motor terminal B	Resistance	≤1Ω
			Wire 12# and start relay terminal SW		≤1Ω
			Start relay terminal L and safety relay terminal S		≤1Ω
	6	Failure of fuse F1	Battery terminal "+" (wire 20#) and control dial wire 22#	Resistance	≤1Ω
	7	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Start relay terminal SW and ground	Resistance	≥1 MΩ
			Engine input terminal S and ground		≥1 MΩ
	8	Internal failure of alternator	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Alternator terminal P and ground	Voltage	≤1V
	9	Start relay	★ Turn engine start switch to OFF position. Move it to START position when performing troubleshooting.		
			Terminal SW and ground	Voltage	App. 24V
			Terminal S and ground		App. 24V

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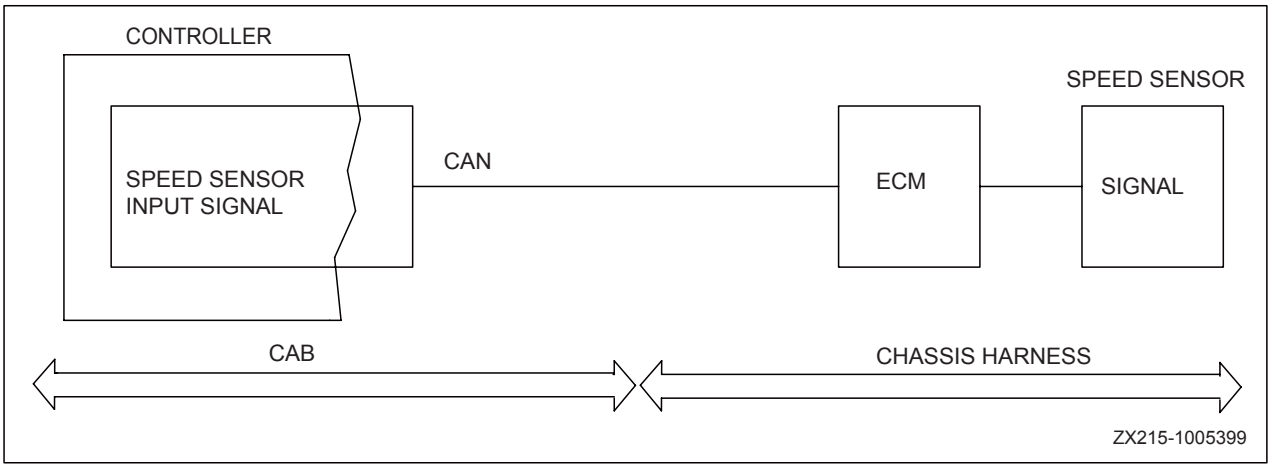
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E-2 Engine runs rough or is unstable

Trouble	Engine Runs Rough or Is Unstable
Related information	Engine speed can be read on the monitor.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector controller, and measure the resistance between pin 19 and pin 38.	Resistance	2.3±0.2 KΩ
	2				
	3				
	4				
	5				

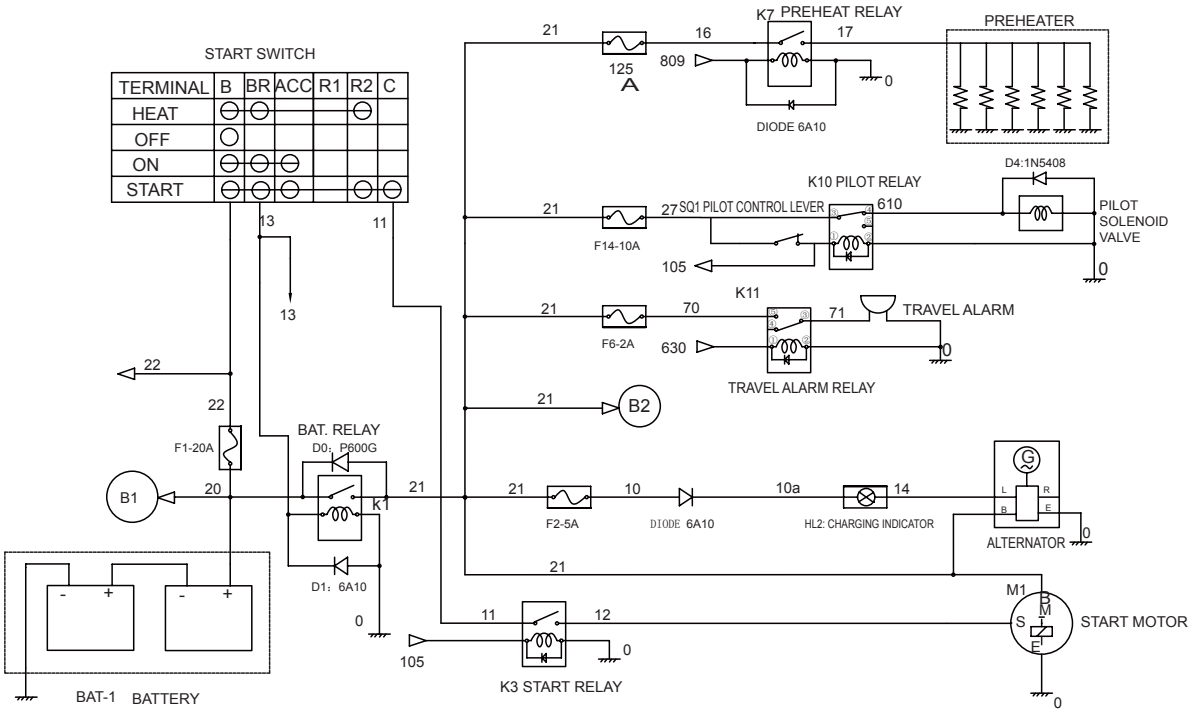


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E-3 Power supply of machine cannot be cut off

Trouble	Engine cannot be stopped.
Related information	Engine stalls when start switch it turned to OFF position. There is no time delay for power cutout.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of battery relay	When engine start switch is operated, if the operation of battery relay contact is heard, the battery is normal. Turn the start switch OFF→ON→OFF.		
	2	Breakdown of surge diode	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between battery relay wire 20# and wire 21#	Resistance	≥1MΩ
	3				
	4				



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E-4 Auto idle not functioning

Trouble	Auto idle speed do not work
Related information	Engine speed do not decrease wen the mode is auto idle speed and grip keeps still in "NEUTRAL" position

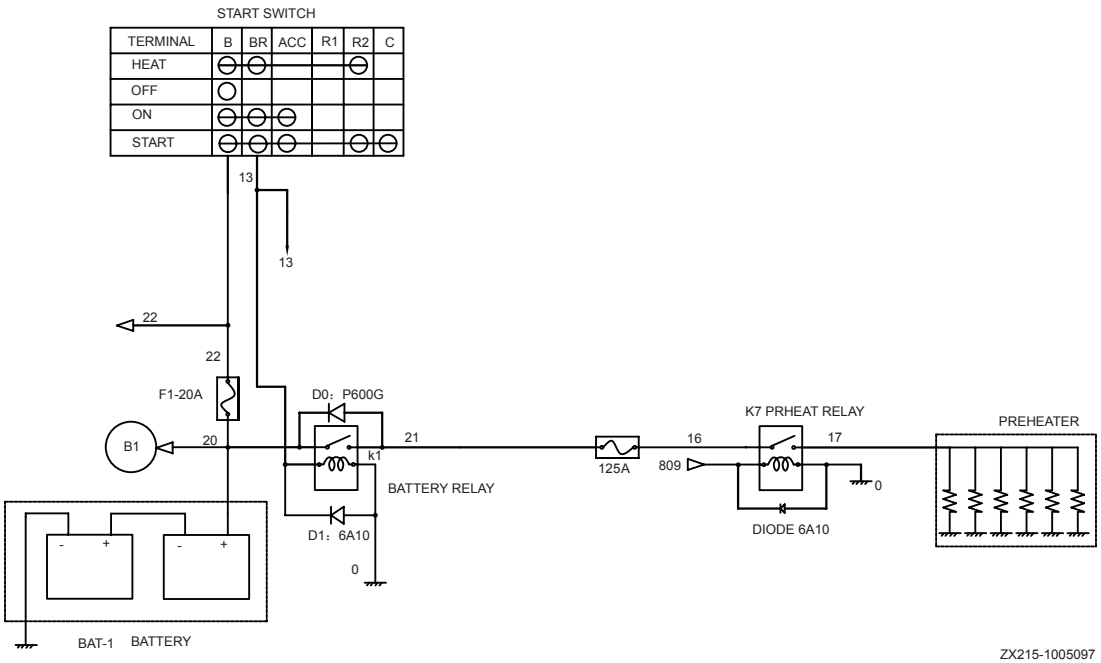
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Error of boom-raise signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	2	Error of boom-lower signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	3	Error of arm-in signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	4	Error of arm-out signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	5	Error of bucket-curl signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	6	Error of Bucket-dump signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	7	Error of swing signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	8	Error of travel signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	9	Error of attach-ment signal	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0~39 KG
	10	Failure of con-troller	No troubleshooting can be done for it is internal failure. (If it is not caused by one of the factors listed above, it should be the failure of controller.)		

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E-5 Preheating function fails

Trouble	Engine does not preheat.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of preheat fuse	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between wire 21# and preheat relay pin 16# (contact)	Resistance	≤1Ω
	2	Failure of preheat relay	When the preheating function is activated, if operation of the preheat relay contact is heard, the relay is normal. The preheat switch is to be switched OFF→ON→OFF.		
	3	Failure of preheat switch	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Turn off the preheat switch and measure the resistance between wire 809# and wire 0#.	Resistance	≥1MΩ
			Turn on the preheat switch and measure the resistance between wire 809# and wire 0#		≤1Ω
	4	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between preheat relay pin 3# (contact) and ground	Resistance	≥1MΩ
	5				

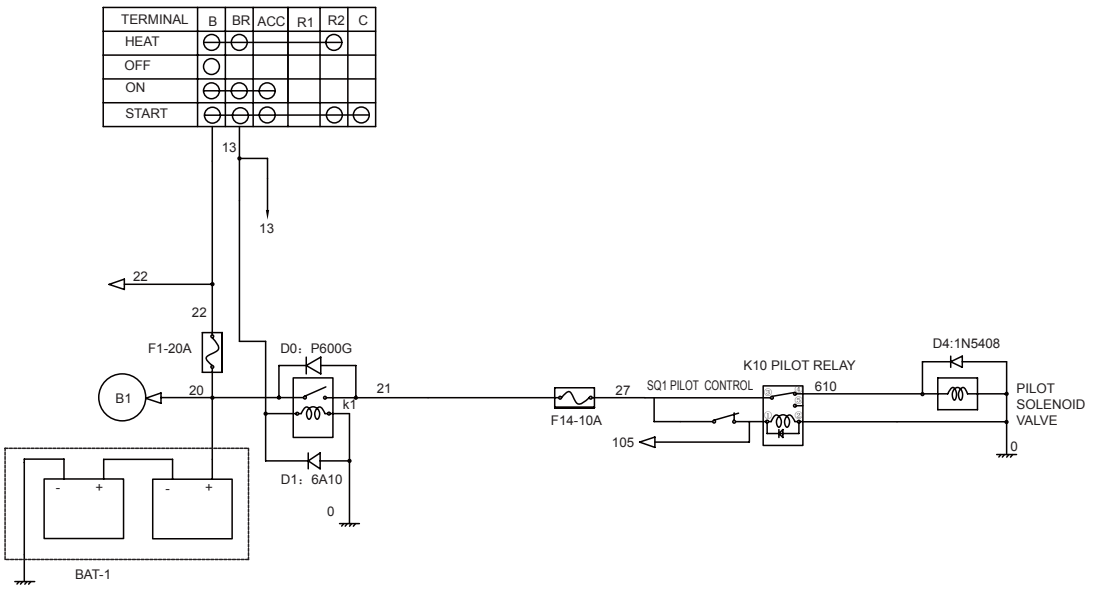


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E-6 Work equipment does not work

Trouble	The machine is motionless while operated after starting.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of lockout switch	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Item	Lockout control lever	Resistance
			Between wire 105# and wire 27#	LOCK	≤1Ω
				FREE	≥1MΩ
	2	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between 105# and ground	Resistance	≥1MΩ
	3				
	4				

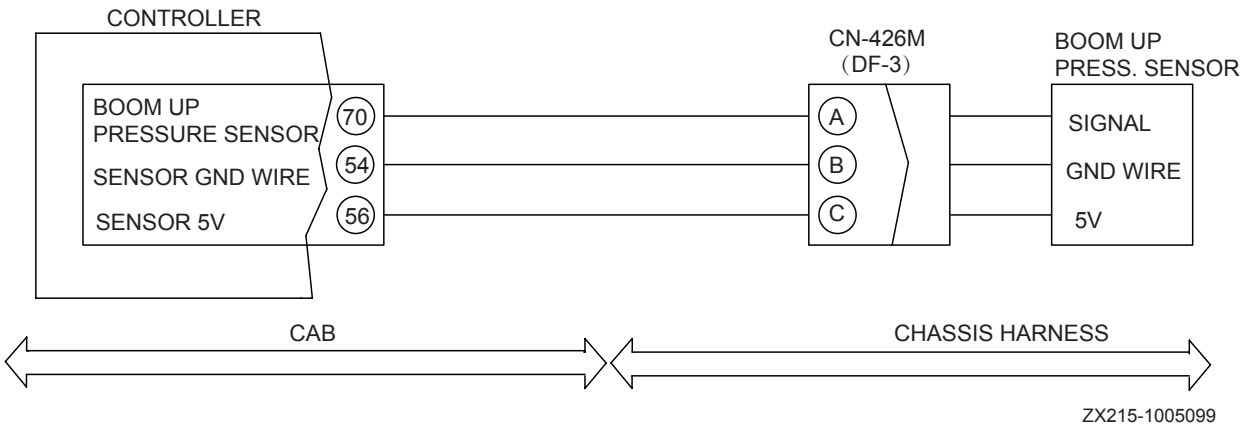


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E-7 Boom-raise speed or power is low

Trouble	Boom-raise speed or power is low.
Related information	Pilot pressure of the boom in operation can be checked on the monitor.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of sensor	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, boom-raise pressure signal	Pressure	0 KG
			Lever in operation, boom-raise pressure signal		0~39 KG
	2	Short circuit of harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between harness (from controller pin 70 to CN-426M A) and ground	Resistance	≥1MΩ
	3	Open circuit of harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between controller pin 54 and CN-426M B	Resistance	≤1Ω
	4	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		

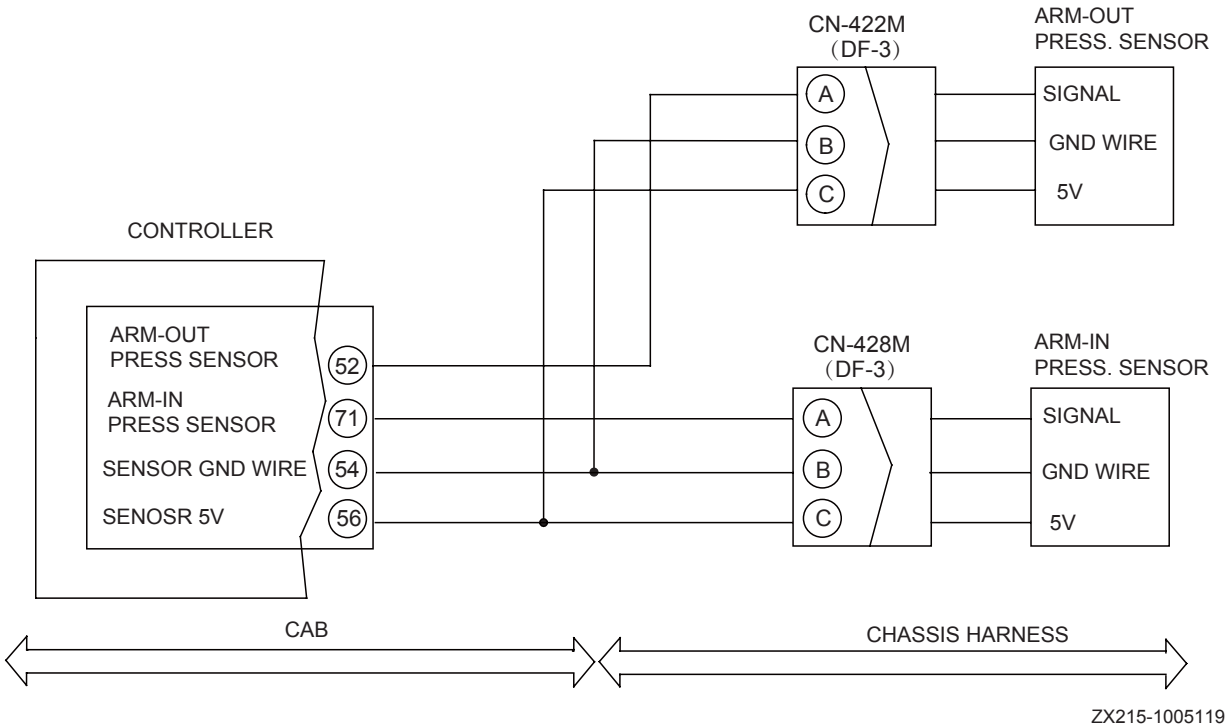


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E-8 Arm speed or power is low

Trouble	Arm speed or power is low during operation.
Related information	Pilot pressure of the arm in operation can be checked on the monitor.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of sensor	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, arm-in and arm-out pressure signals	Pressure	0 KG
			Levers in operation, arm-in and dump pressure signal		0~39 KG
	2	Short circuit of harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between harness (from controller pin 71 to CN-428M A) and ground Between harness (from controller pin 52 to CN-422M A) and ground	Resistance	≥1MΩ
	3	Open circuit of harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between controller pin 54 and CN-428M B Between controller pin 54 and CN-422M B	Resistance	≤1Ω
	4	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		



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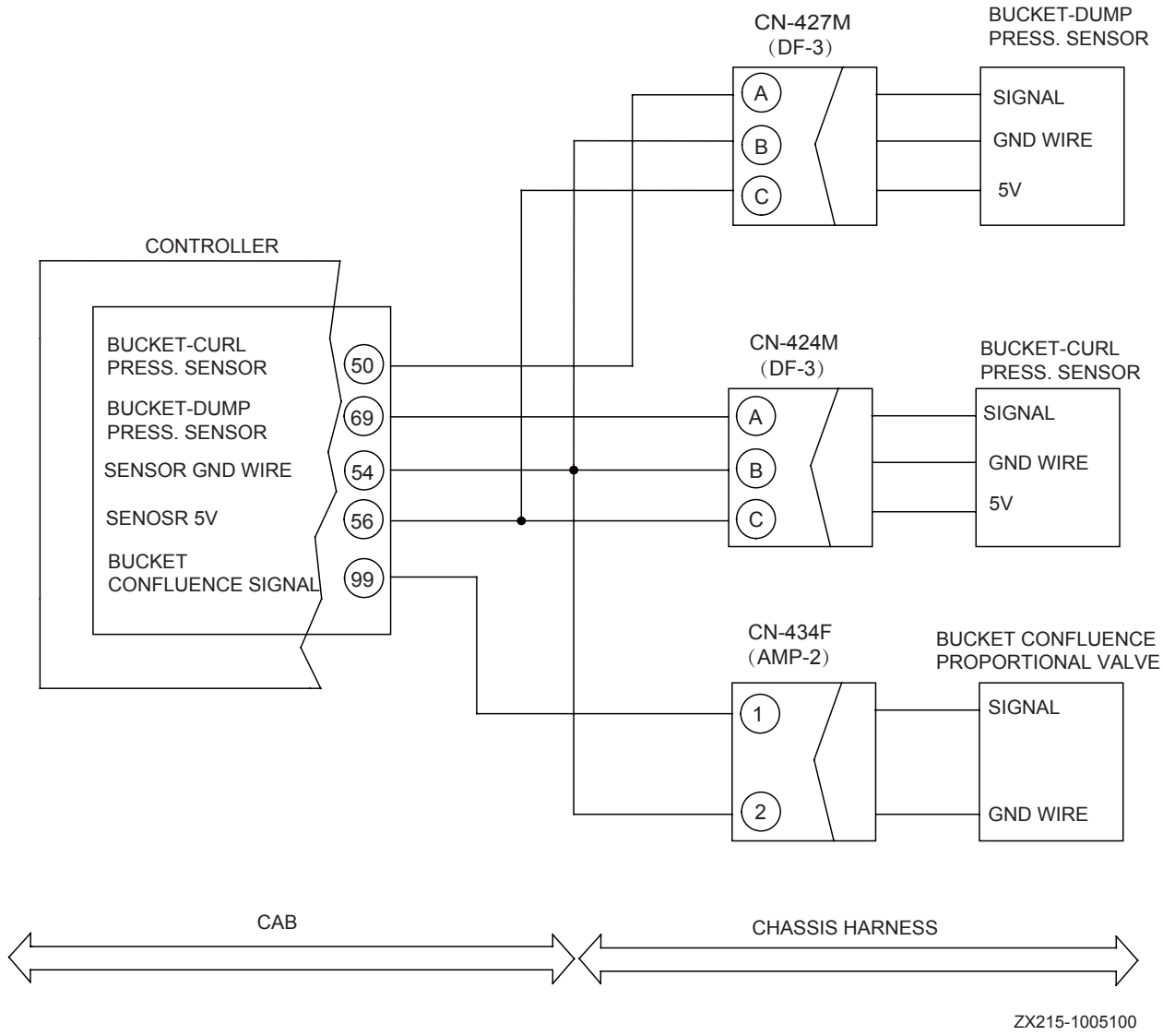
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E-9 Bucket speed or power is low

Trouble	Bucket speed or power is low during operation.
Related information	Pilot pressure of the bucket can be checked on the monitor.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of sensor	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, bucket-curl/dump pressure signals	Pressure	0 KG
			Levers in operation, bucket-curl/dump pressure signals		0~39 KG
	2	Short circuit of harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between harness (from controller pin 69 to CN-424M A) and ground Between harness (from controller pin 50 to CN-427M A) and ground	Resistance	≥1MΩ
	3	Open circuit of harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between controller pin 54 and CN-424M B Between controller pin 54 and CN-427M B	Resistance	≤1Ω
	4	Defective bucket confluence solenoid valve	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-434F 1 and 2	Resistance	About 17.5Ω
	5	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		

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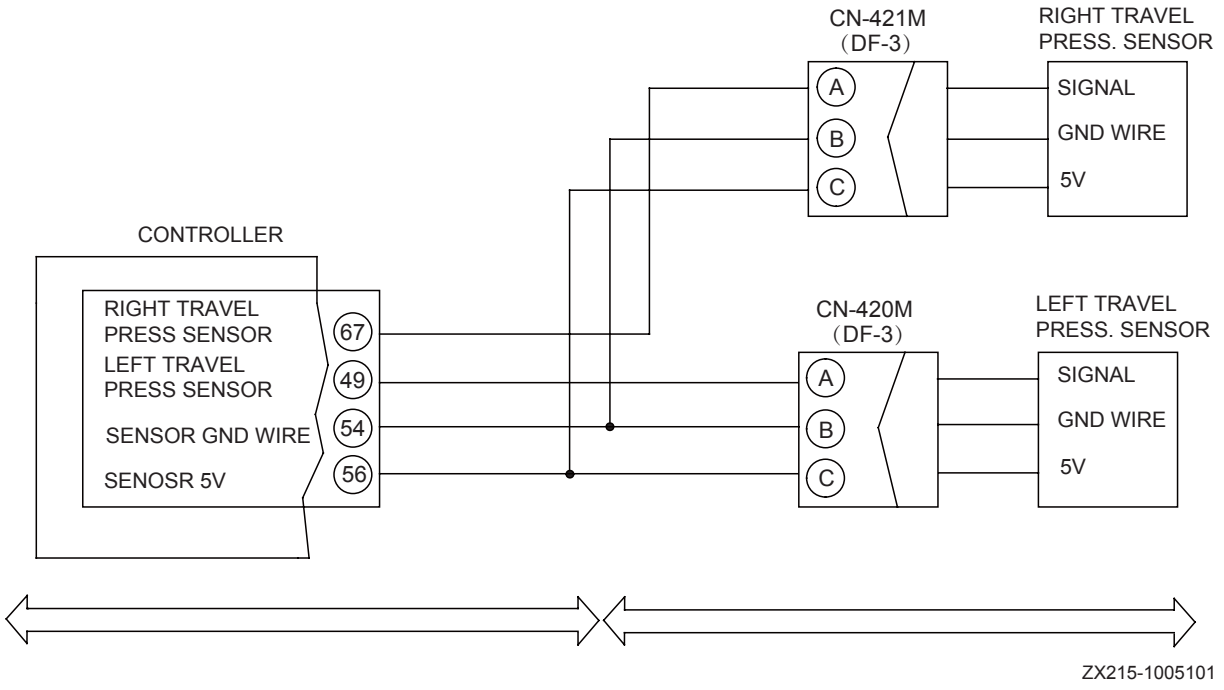
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E-10 Travel speed or power is low

Trouble	Travel speed or power is low during operation.
Related information	Pilot pressure of travel operation can be checked on the monitor.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of sensor	★ Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, left and right travel pressure signals	Pressure	0 KG
			Levers in operation, left and right travel pressure signals		0~39 KG
	2	Short circuit of harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between harness (from controller pin 49 to CN-420M A) and ground Between harness (from controller pin 67 to CN-421M A) and ground	Resistance	≥1MΩ
	3	Open circuit of harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between controller pin 54 and CN-420M B Between controller pin 54 and CN-421M B	Resistance	≤1Ω
	4	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		



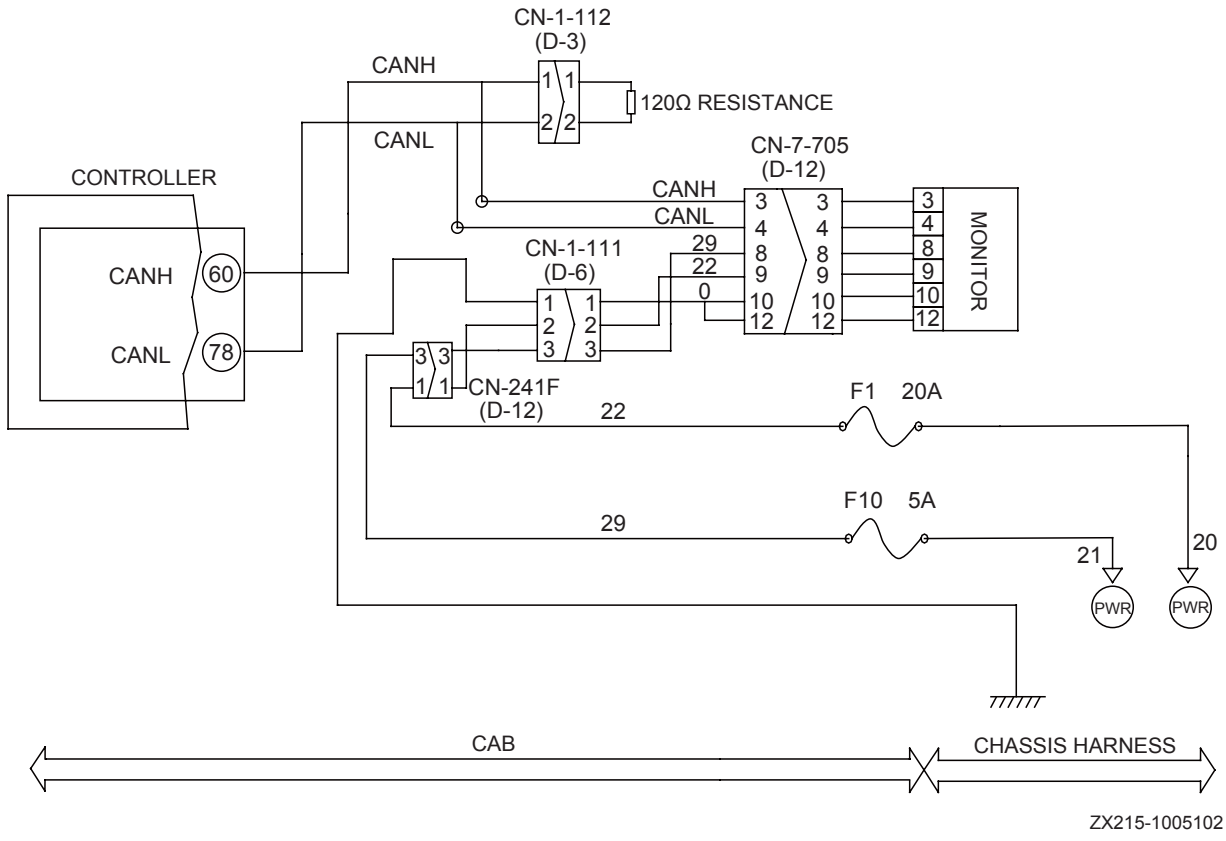
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E-11 Blank monitor display

Trouble	Monitor display is blank after the machine is powered on.
Related information	

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Failure of fuse	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between wire 22# and ground	Voltage	About 24V
			Between wire 29# and ground		About 24V
	2	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-7-705 pin 8 and CN-241F pin 3	Resistance	≤1Ω
			Between CN-7-705 pin 9 and CN-241 pin 1		≤1Ω
			Between CN-7-705 pin 10# and ground		≤1Ω
	3	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between harness (from CN-7-705 pin 8 to CN-241 pin 3) and ground	Resistance	≥1MΩ
			Between harness (from CN-7-705 pin 9 to CN-241 pin 1) and ground		≥1MΩ
	4	Failure of monitor	No troubleshooting can be done for it is internal failure. (If it is not caused by one of the factors listed above, it should be the failure of monitor.)		

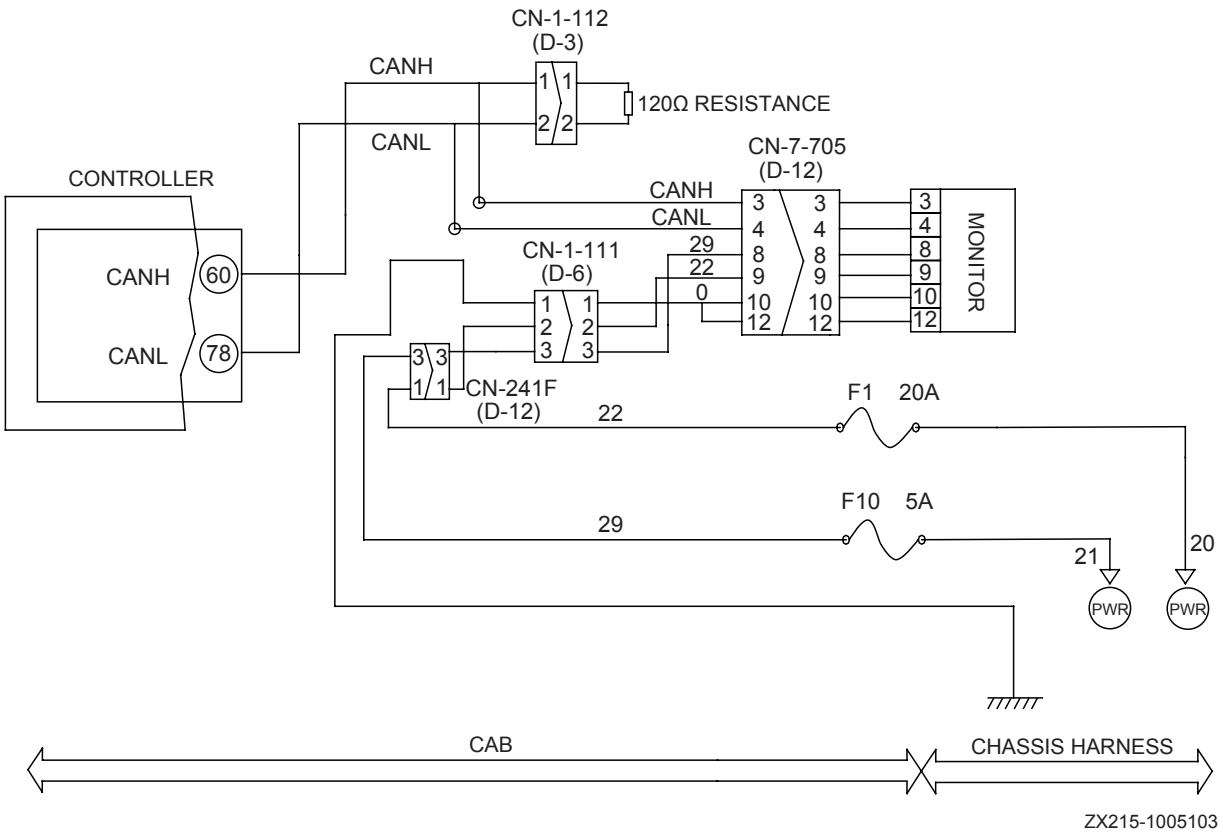


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E-12 Monitor displays nothing

Trouble	Display of monitor is illuminated but no information is shown on the screen after machine is powered on.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of resistance	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-1-112 1 and 2	Resistance	120 Ω
	2	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-7-705 pin 3 and controller pin 60	Resistance	≤1 Ω
			Between CN-7-705 pin 4 and controller pin 78		≤1 Ω
	3	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between harness (from CN-7-705 pin 3 to controller pin 60) and ground	Resistance	≥1M Ω
			Between harness (from CN-7-705 pin 4 to controller pin 78) and ground		≥1M Ω
	4	Failure of monitor or controller	No troubleshooting can be done for it is internal failure. (If it is not one of the failures stated above, it should be the failure of monitor or controller.)		



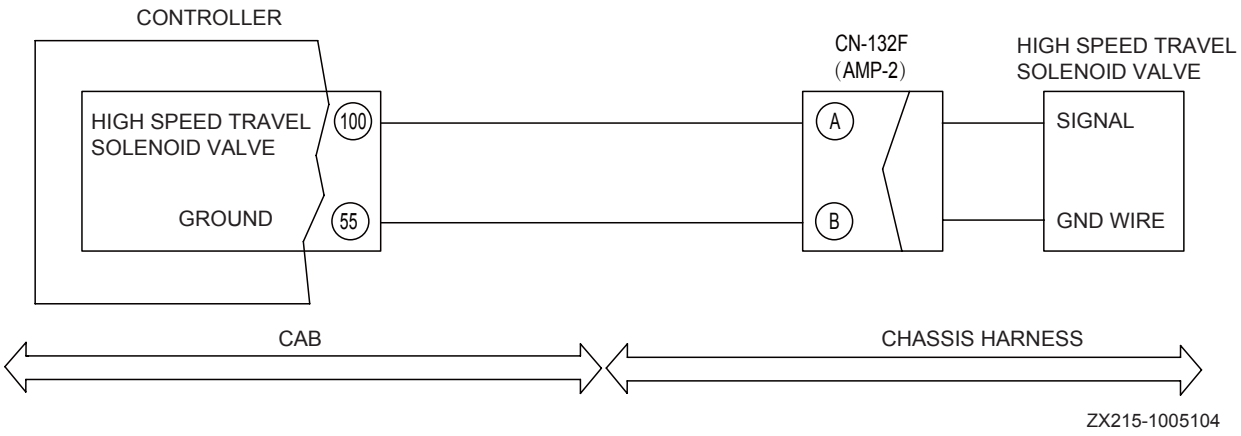
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E-13 Dual speed travel not functioning

Trouble	Only low speed travel is functioning during operation.
Related information	Press the Hi/Lo button on the monitor to change travel speed.

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Failure of dual speed travel solenoid valve	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-131F A and B	Resistance	About 17.5Ω
	2	Open circuit of wire harness	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-132F pin A and controller pin 100	Resistance	≤1Ω
			Between CN-132F pin B and controller pin 55		≤1Ω
	3	Short circuit of wire harness (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between harness (from CN-131F pin A to controller pin (100) and ground	Resistance	≥1MΩ
	4				

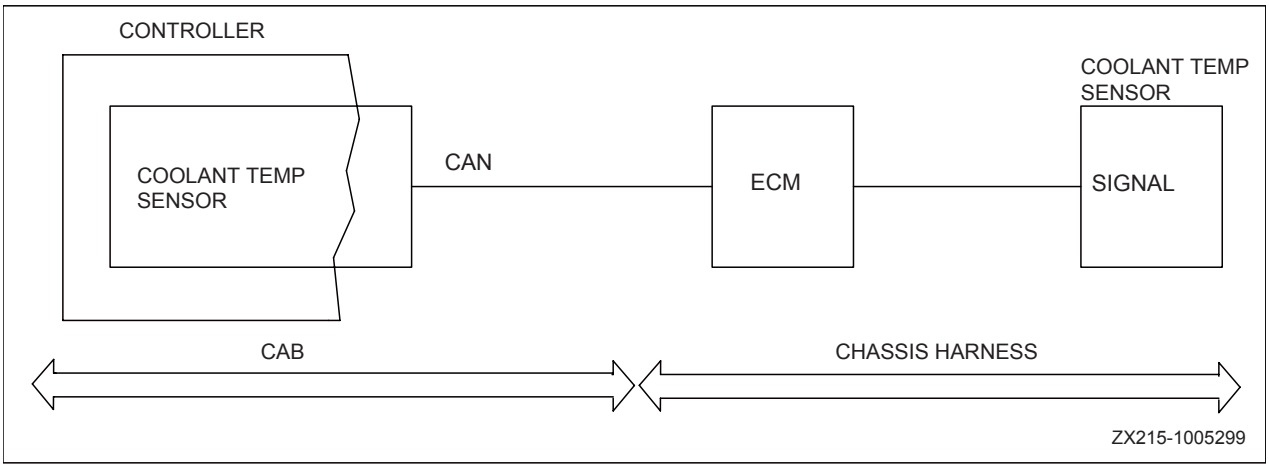


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E-14 Incorrect engine coolant reading

Trouble	Engine coolant temperature sensor cannot correctly reflect current coolant temperature.
Related information	Coolant temperature can be checked on the monitor.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of coolant temperature sensor	Standard values for engine coolant temperature sensor		
			50°C	80 Ω	
			60°C	56.3 Ω	
			80°C	29.5 Ω	
			100°C	16.5 Ω	
			106°C	14.3 Ω	
			120°C	10 Ω	
	2				
	3				
	4				

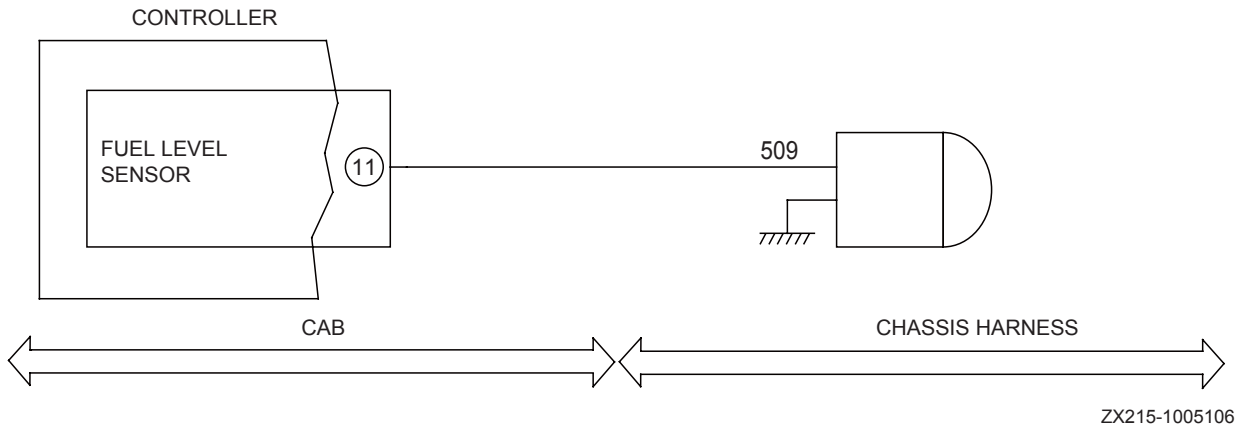


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E-15 Incorrect fuel level reading

Trouble	Engine fuel level sensor cannot correctly reflect current fuel level.
Related information	Fuel level can be checked on the monitor.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Fuel level sensor error	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Pin	Fuel level	Resistance
			Between wire 509# and ground	FULL (Upper limit)	Approx. 10 Ω
				EMPTY (Lower limit)	85-95 Ω
	2	Open circuit of lead	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between wire 509# and controller pin 11	Resistance	≤1 Ω
	3	Short circuit of lead (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between wire 509# and ground	Resistance	≥1M Ω
	4	Lead short to 24V	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Wire 509# grounded	Voltage	≤1V



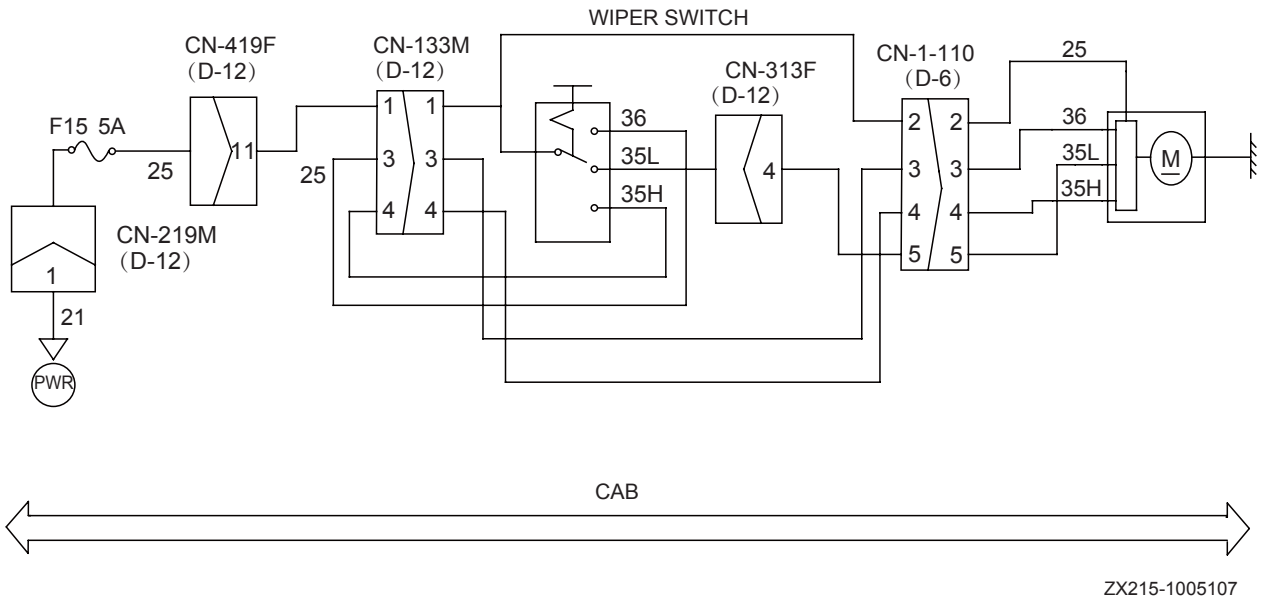
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E-16 Wiper does not work

Trouble	Wiper does not work
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Internal Failure of wiper motor	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between wiper wire 25# and ground	Resistance	>10Ω
	2	Open circuit of lead	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-219M 1 and CN-1-110 (2)	Resistance	≤1Ω
			Between wiper switch wire 35L# and CN-1-110 (5)		≤1Ω
			Between wiper switch wire 35L# and CN-1-110 (4)		≤1Ω
	3	Short circuit of lead (grounded)	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Harness from CN-219M 1 to CN-1-110 2 short to ground	Resistance	≥1MΩ
	4				



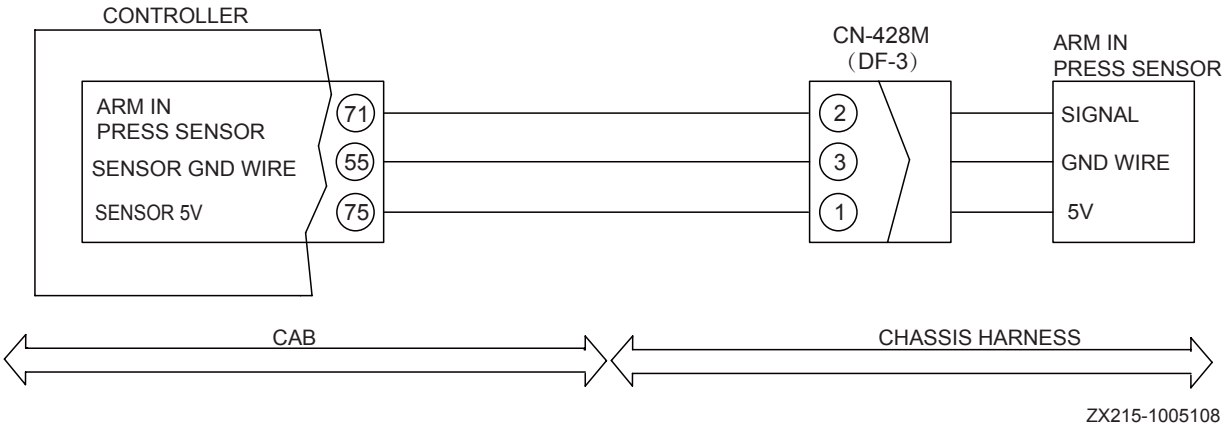
ZX215-1005107

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E-17 Incorrect arm-in pilot pressure reading

Trouble	Reading of arm-in pilot pressure is incorrect.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-428M ① and ③	Voltage	Approx. 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-428M ② and controller pin 71	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-428M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-428M ② and ground	Voltage	0.5V~ 4.5V
	5				



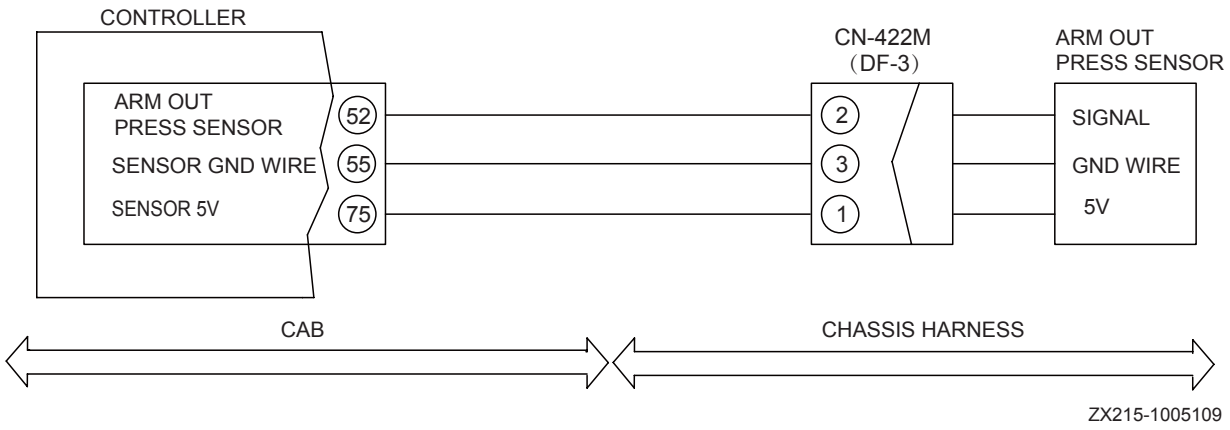
ZX215-1005108

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E-18 Incorrect arm-out pilot pressure reading

Trouble	Reading of arm-out pilot pressure is incorrect.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-422M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-422M ② and controller pin 52	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-422M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-422M ② and ground	Voltage	0.5V~ 4.5V
	5				

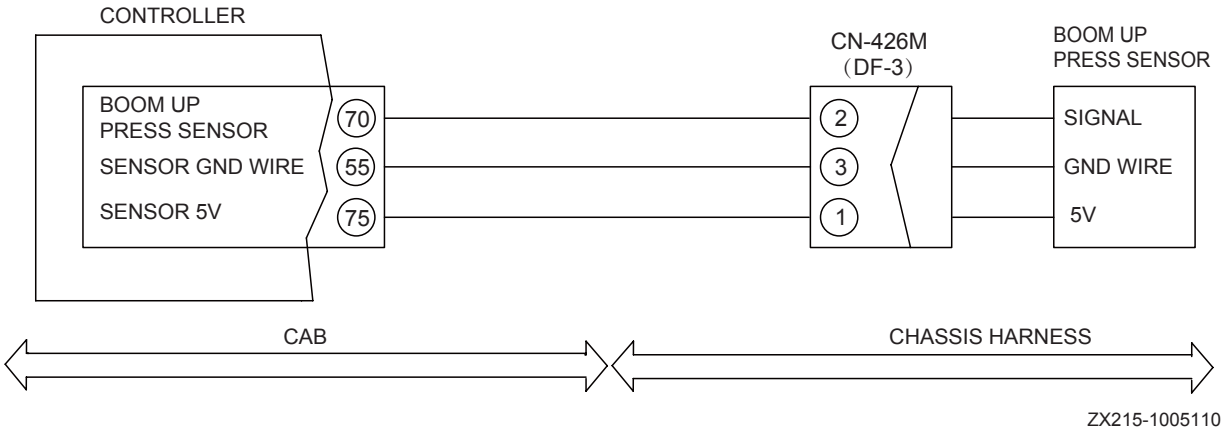


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E-19 Incorrect boom-raise pilot pressure reading

Trouble	Incorrect Boom-Raise Pilot Pressure Reading
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-426M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-426M ② and controller pin 70	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-426M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-426M ② and ground	Voltage	0.5V~ 4.5V
	5				

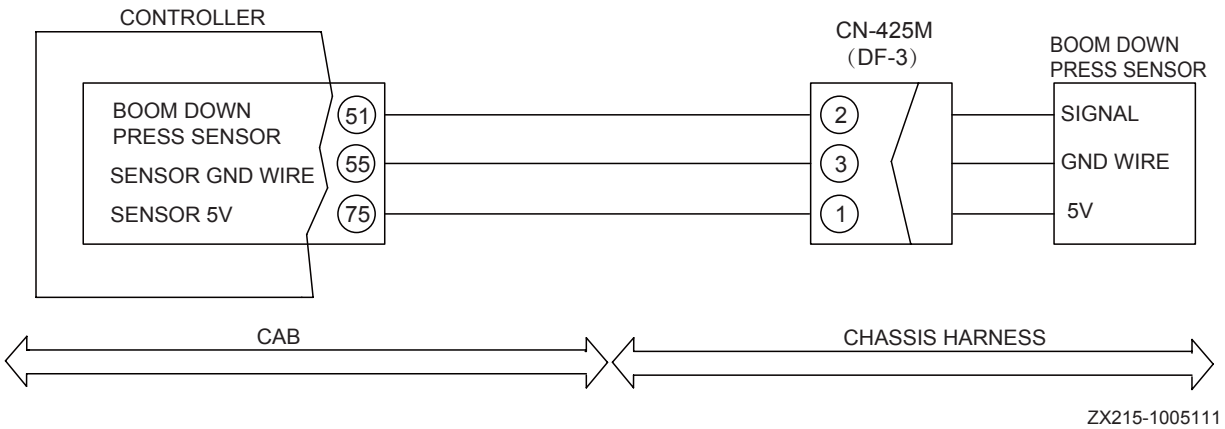


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E-20 Incorrect boom-lower pilot pressure reading

Trouble	Boom-Lower pilot pressure reading is incorrect.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-425M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-425M ② and controller pin 51	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-425M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-425M ② and ground	Voltage	0.5V~ 4.5V
	5				



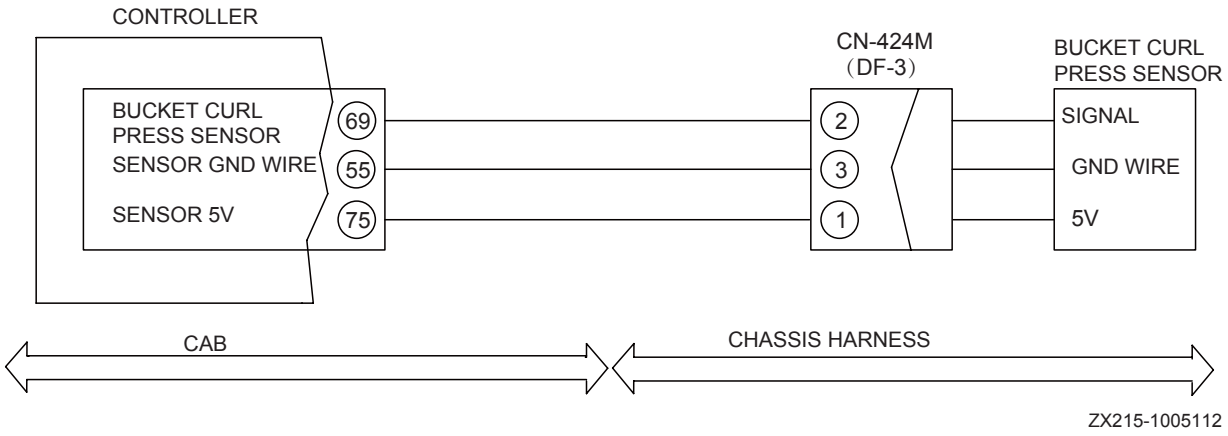
ZX215-1005111

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E-21 Incorrect bucket-curl pilot pressure reading

Trouble	Bucket-curl pilot pressure reading is incorrect.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-424M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-424M ② and controller pin 69	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-424M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-424M ② and ground	Voltage	0.5V~ 4.5V
	5				



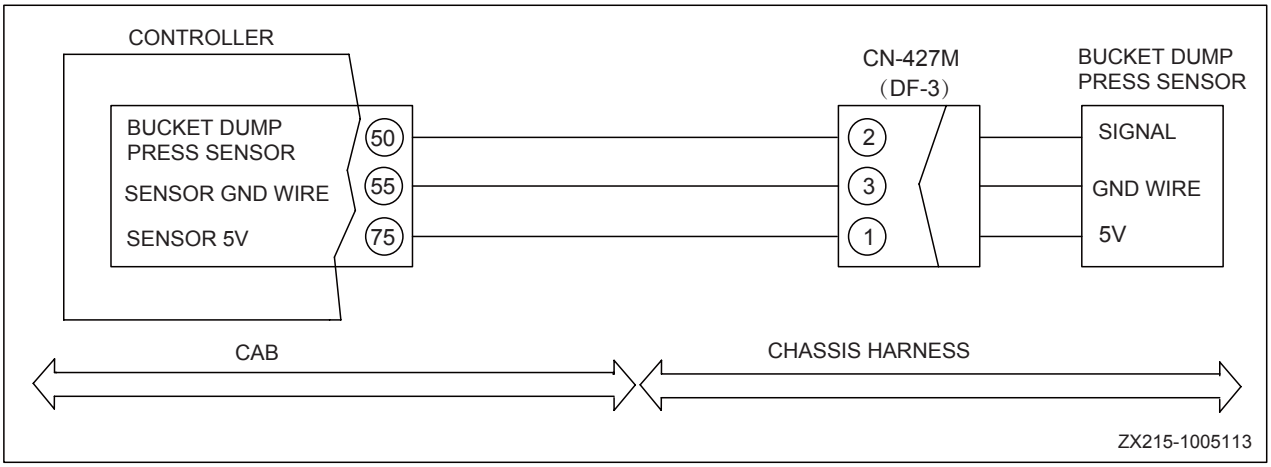
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E-22 Incorrect bucket-dump pilot pressure reading

Trouble	Bucket-dump pilot pressure reading is incorrect.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-427M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-427M ② and controller pin 50	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-427M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-427M ② and ground	Voltage	0.5V~ 4.5V
	5				

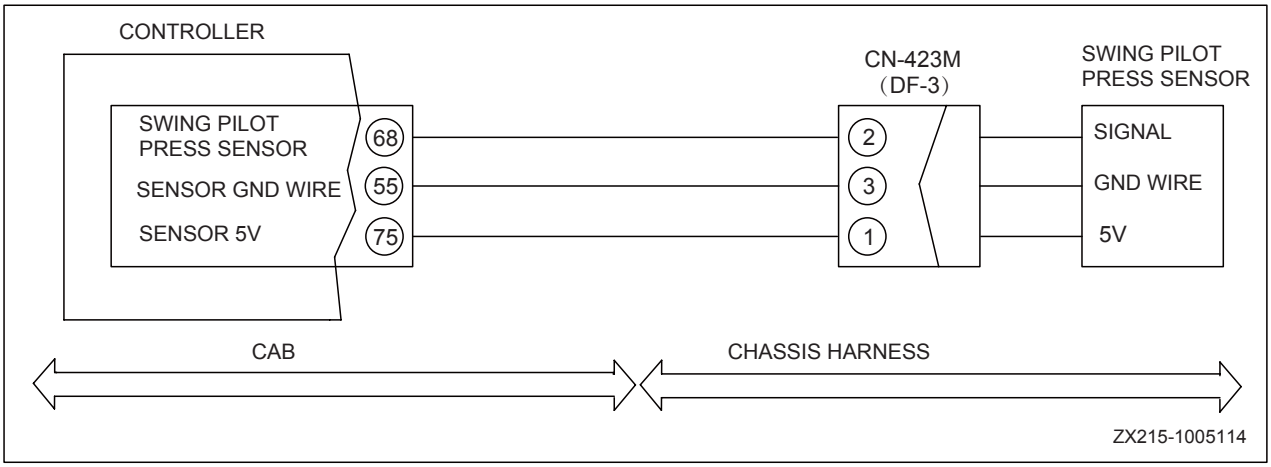


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E-23 Incorrect swing pilot pressure reading

Trouble	Swing pilot pressure reading is incorrect.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-423M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-423M ② and controller pin 68	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-423M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-423M ② and ground	Voltage	0.5V~ 4.5V
	5				

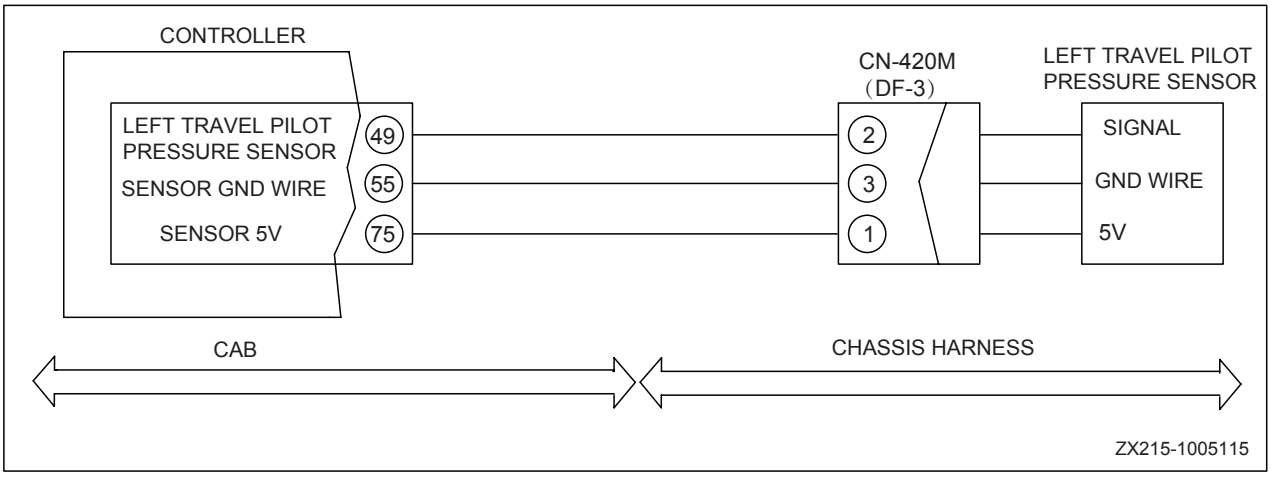


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E-24 Incorrect left travel pilot pressure reading

Trouble	Left Travel Pilot Pressure Reading is incorrect.
Related information	

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-420M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-420M ② and controller pin 49	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-420M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-420M ② and ground	Voltage	0.5V~ 4.5V
	5				

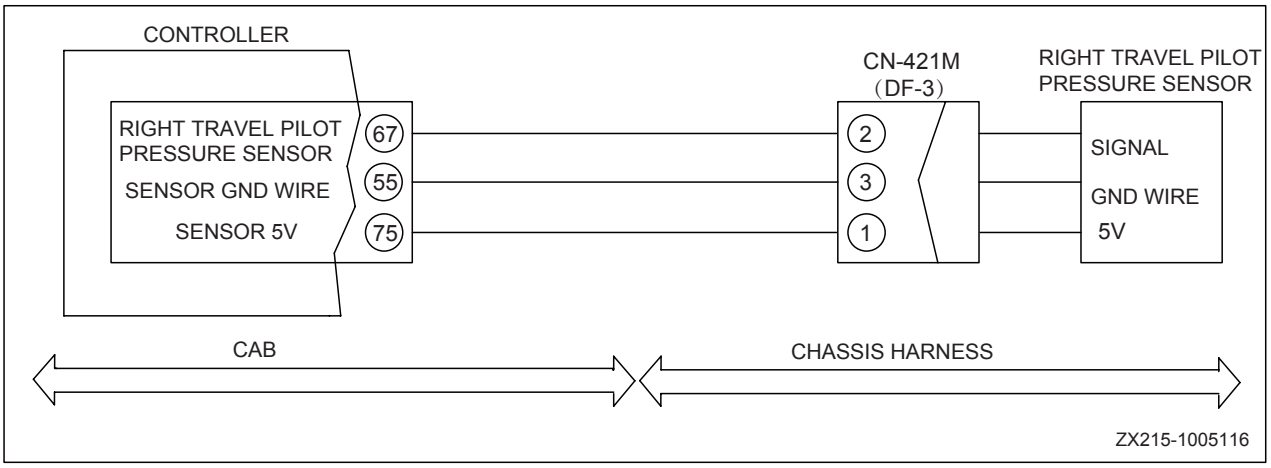


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E-25 Incorrect right travel pilot pressure reading

Trouble	Right travel pilot pressure reading is incorrect.
Related information	

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-421M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-421M ② and controller pin 67	Resistance	≤1Ω
	3	Short circuit of signal wire	★ Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-421M ② and ground	Resistance	≥2MΩ
	4	Failure of sensor	★ Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-421M ② and ground	Voltage	0.5V~ 4.5V
	5				



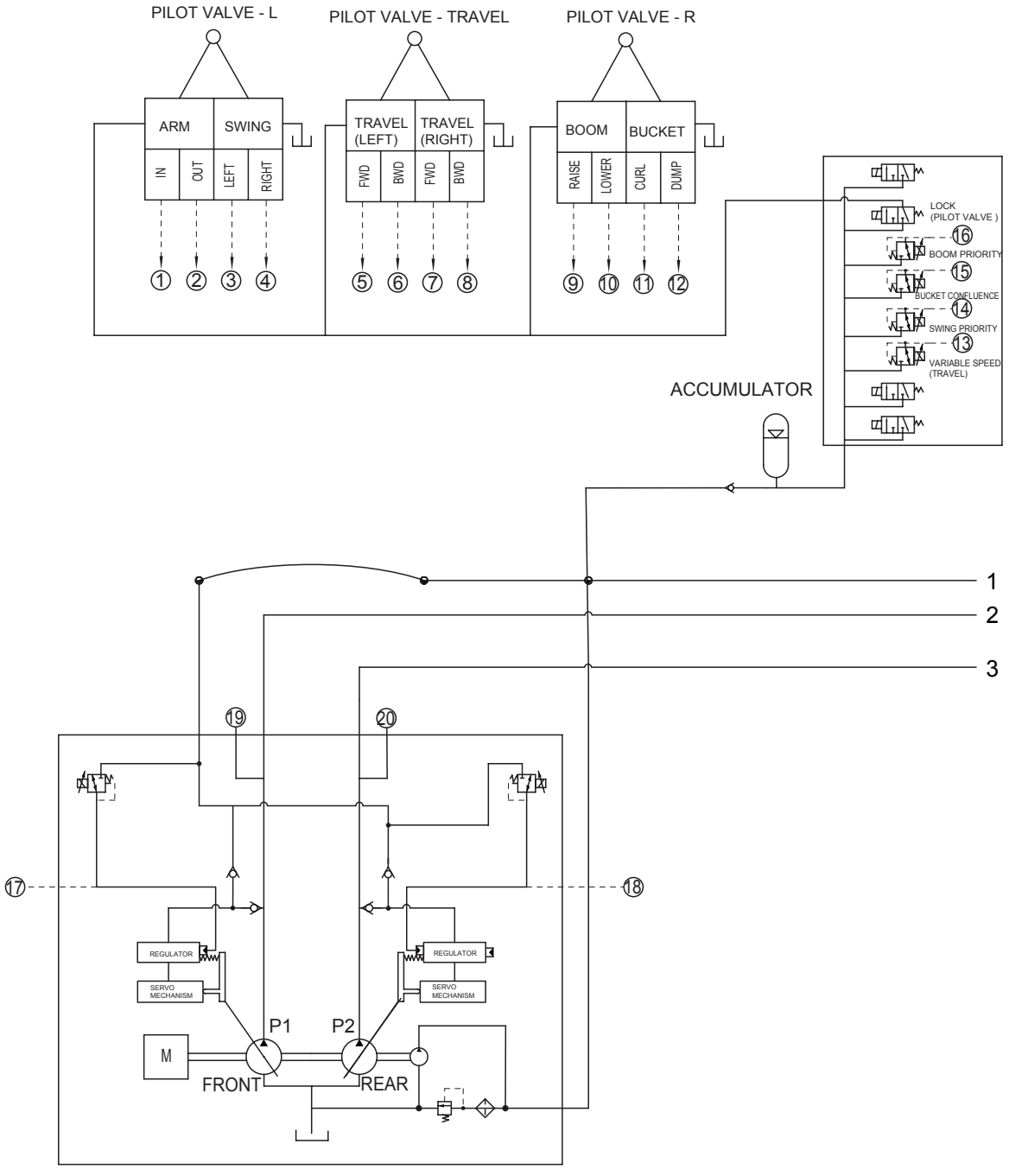
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7.5.3 Troubleshooting of Hydraulic and Mechanical Systems (H - Code)

A Schematic of hydraulic system and mechanical system 7-91
Information contained in troubleshooting table 7-93
H-1 Work equipment speed slow, or swing and travel speeds slow 7-94
H-2 Engine speed drops sharply or engine stalls 7-95
H-3 Work equipment, swing, and travel systems do not work 7-96
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H-5 Auto idle not functioning 7-98
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H-9 Work equipment cylinders no response in separate operation 7-102
H-10 Work equipment drifts excessively 7-103
H-11 Work equipment moves sluggishly 7-105
H-12 Other work equipment moves while single oil circuit is relieved 7-105
H-13 Travel speed drops considerably while swinging and travelling 7-106
H-14 Machine deviates during travel 7-107
H-15 Travel speed or power is low 7-108
H-16 Machine is not steered well or steering power is low 7-109
H-17 Travel speed cannot be changed 7-110
H-18 Travel system fails (only at one side) 7-111
H-19 Swing operation fails 7-112
H-20 Swing acceleration poor or swing speed low 7-114
H-21 Upper structure overruns remarkably when it stops swinging 7-116
H-22 Large shock is produced when upper structure stops swinging 7-117
H-23 High noise is produced when upper structure stops swinging 7-117
H-24 Swing drift excessive 7-118

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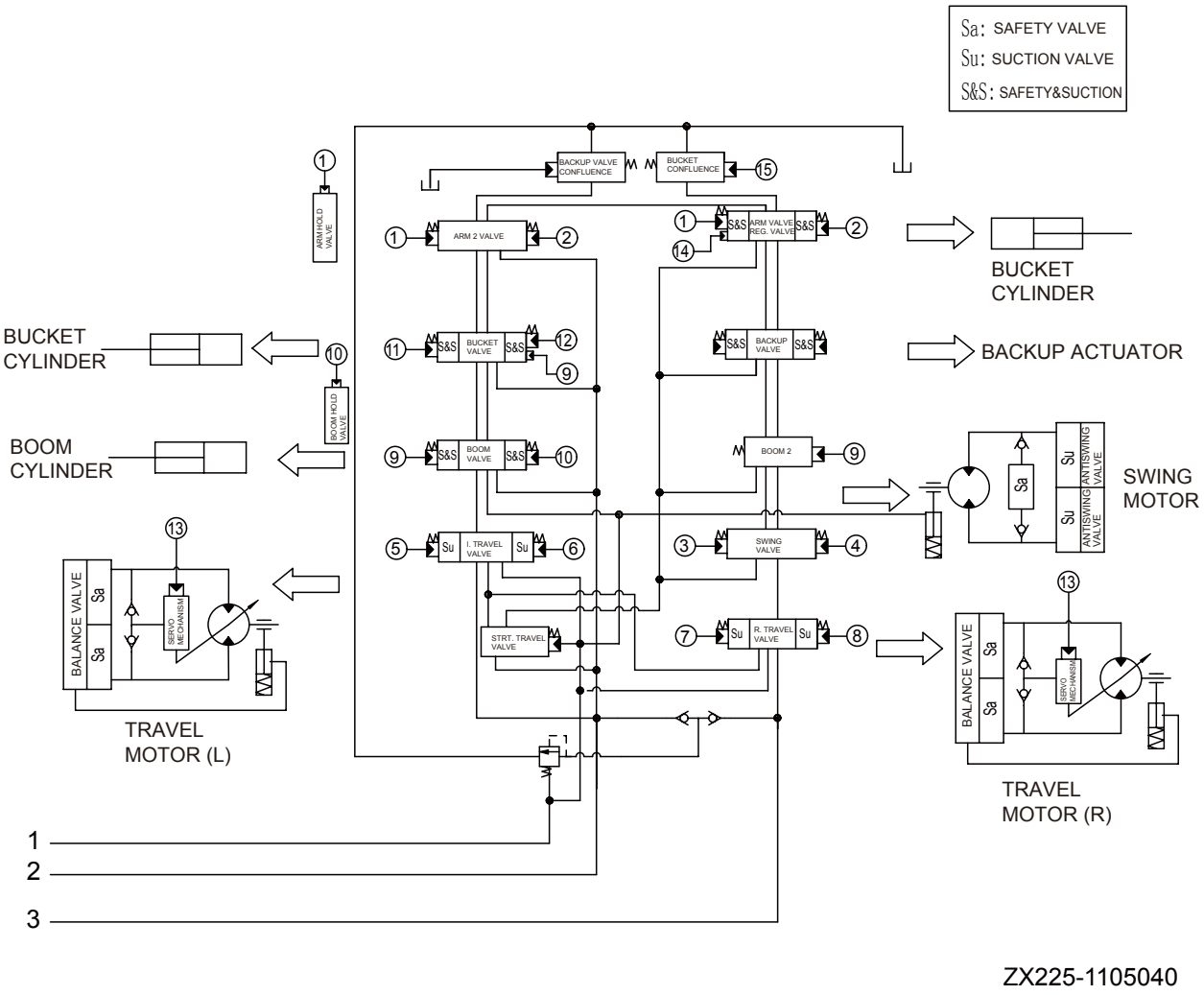
A Schematic of hydraulic system and mechanical system



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★ The system schematic is a simplified hydraulic circuit schematic, which can be used as a reference to the hydraulic system and the mechanical system.



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Information contained in troubleshooting table

★ The following information is contained in the troubleshooting table and related electric circuit diagrams. Fully understand these information before carrying out troubleshooting.

Trouble	Trouble which occurs on the machine
Related information	Information related to detected trouble or troubleshooting

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Possible causes of trouble (Given numbers are reference numbers, which do not indicate priority)	< Description > ● Standard value in normal state, which is used to judge possible causes that might be OK or N/G. ● A reference value is used to determine OK or N/G.
	2		
	3		
	4		
	5		

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H-1 Work equipment speed slow, or swing and travel speeds slow

Trouble	• Work equipment speed is slow or the travel and swing speeds are slow.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><th colspan="2" rowspan="2">Possible causes and standard value in normal state</th><th colspan="2">Cause</th><th colspan="2">Standard value in normal state/Remarks on troubleshooting</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective adjustment or malfunction of main relief valve</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control levers</td><td>Main relief pressure</td></tr>
<tr><td>Arm in</td><td>33~34.3 MPa
{337~350 kg/cm²}</td></tr>
<tr><td colspan="2">If normal pressure cannot be restored after adjustment, it is possible the failure of main relief valve or internal defect. Check the valve directly.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Malfunction of pilot relief valve</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control levers</td><td>Pilot control pressure</td></tr>
<tr><td>All levers in "NEUTRAL"</td><td>3.9~4.1 MPa
{40~42 kg/cm²}</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td></td><td>3</td><td>Malfunction of regulator</td><td colspan="2">The regulator possibly fails. Check the servo mechanism of the regulator.</td></tr>
<tr><td></td><td>4</td><td>Malfunction of main pump</td><td colspan="2">If the trouble is caused by other factors, it might be the main pump that has performance deterioration, malfunction or internal defect.</td></tr>
</table>

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H-2 Engine speed drops sharply or engine stalls

Trouble	● Engine speed drops sharply or engine stalls.
Related information	● Information concerned

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Failure of injection pump	Injection pump may be defective. Check it directly.
	2	Malfunction of regulator	Regulator may have malfunction. Check its servo mechanism.
	3	Clogging of oil filter element	Oil filter element may be clogged. Check the element directly.
	4	Carbon buildup at fuel injection nozzle	Carbon built up at fuel injection nozzle. Check it directly.
	5	Clogging of air cleaner	Air cleaner may be clogged. Check it directly.
	6	Abnormal wear of engine	Engine may be worn abnormally. Check it directly.
	7	Failure of oil pump	Oil pump may be defective. Check it directly.

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H-3 Work equipment, swing, and travel systems do not work

Trouble	● Whole work equipment, swing, and travel systems do not work.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of pilot relief solenoid valve</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Pilot lockout control lever</td><td>Pilot relief pressure</td></tr>
<tr><td>LOCKED</td><td>0 {0}</td></tr>
<tr><td>FREE</td><td>3.9~4.1 MPa
{40~42 kg/cm²}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Failure of relief valve (pilot pump)</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control lever</td><td>Pilot relief pressure</td></tr>
<tr><td>All levers in "NEUTRAL"</td><td>3.9~4.1 MPa
{40~42 kg/cm²}</td></tr>
<tr><td>3</td><td>Failure of hydraulic pump</td><td colspan="2">The main pump may have malfunction or internal defect. Check it by following method.
● Remove the oil pressure measurement plug and start the engine. If oil flows out of the opening, the piston pump is in good condition.</td></tr>
<tr><td>4</td><td>Failure of coupling</td><td colspan="2">Internal failure of the coupling can stop rotation of the pump shaft. Check the coupling.
● Loosen the oil delivery line of the pilot pump. If no oil is seen, it is probably the failure of coupling.</td></tr>
</table>

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H-4 Abnormal noise in hydraulic pump

Trouble	● Abnormal noise is produced from the hydraulic pump
Related information	—

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Low level of hydraulic oil	Make a visual check.
	2	Inferior hydraulic oil	Hydraulic oil probably contains air. Make a visual check.
	3	Clogging of vent on top of hydraulic tank	It is probably the clogging of the vent on top of the hydraulic tank that causes negative pressure in the hydraulic tank. Press the release button of the breather valve to eliminate air. Check again if the noise disappears.
	4	Clogging of hydraulic tank strainer	It is probably the clogging of hydraulic tank strainer that causes negative pressure in the oil suction line. Make a visual check.
	5	Failure of main pump	The main pump may have internal defect. Check the main pump.

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H-5 Auto idle not functioning

Trouble	● Auto-deceleration is not functioning.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of sensor</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control levers</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Operation</td><td>3.5~4.1MPa
{36~42 kg/cm²}</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Malfunction of pilot valve</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control levers</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Operation</td><td>3.5~4.1MPa
{36~42 kg/cm²}</td></tr>
<tr><td>3</td><td>Failure of controller</td><td colspan="2">Controller may be defective. Check it directly.</td></tr>
</table>

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H-6 Boom-raise speed or power is low

Trouble	• The boom moves slowly.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of right pilot valve (boom circuit)</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Boom control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Boom RAISE
Boom LOWER</td><td>≥3.5MPa
{36 kg/cm²}</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Failure of pressure sensor</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Check the pressure sensor by replacing it with a new one.</td></tr>
<tr><td>3</td><td>Malfunction of boom control valve (spool)</td><td colspan="2">Spool of boom control valve may have malfunction. Check it directly.</td></tr>
<tr><td>4</td><td>Malfunction of boom control valve (re-taining valve)</td><td colspan="2">Retaining valve of boom control valve may have malfunction. Check the valve directly.</td></tr>
<tr><td>5</td><td>Malfunction or de-fective seal of boom control valve (Relief valve and makeup valve)</td><td colspan="2">The relief valve and makeup valve in boom control valve may have mal-function or defective seal. Check the valves directly.</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Failure of boom cylinder</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Charge the bucket with a load of approximate 1260 kg. Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylin-der from the main valve. Measure the displacement of piston for 15 min-utes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure, see "Work Equipment Hydrau-lic Drift - Test" on page 6-26.</td></tr>
</table>

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H-7 Arm speed or power is low

Trouble	● The arm moves slowly.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of left pilot valve (arm circuit)</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Arm control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Arm IN or Arm OUT</td><td>≥3.5MPa
{36 kg/cm²}</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Failure of pressure sensor</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Check the pressure sensor by replacing it with a new one.</td></tr>
<tr><td>3</td><td>Malfunction of arm control valve (spool)</td><td colspan="2">Spool of arm control valve may have malfunction. Check it directly.</td></tr>
<tr><td>4</td><td>Malfunction of arm control valve (regeneration valve)</td><td colspan="2">Regeneration valve of arm control valve may have malfunction. Check it directly.</td></tr>
<tr><td>5</td><td>Malfunction or defective seal of arm control valve (Relief valve and makeup valve)</td><td colspan="2">The relief valve or makeup valve inside the arm control valve may have malfunction or defective seal. Check the valves directly.</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Failure of arm cylinder</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure, see "Work Equipment Hydraulic Drift - Test" on page 6-26.</td></tr>
</table>

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H-8 Bucket speed or power is low

Trouble	● The bucket moves slowly.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of right pilot valve (bucket circuit)</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Bucket control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Bucket CURL or Bucket DUMP</td><td>≥3.5MPa
{36 kg/cm²}</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Failure of pressure sensor</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Check the pressure sensor by replacing it with a new one.</td></tr>
<tr><td>3</td><td>Malfunction of bucket control valve (spool)</td><td colspan="2">Spool of bucket control valve may have malfunction. Check it directly.</td></tr>
<tr><td>4</td><td>Malfunction or defective seal of bucket control valve (relief valve and makeup valve)</td><td colspan="2">Relief valve and makeup valve in bucket control valve may have malfunction or defective seal. Check the valves directly.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Failure of bucket cylinder</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Charge the bucket with a load of approximate 1260 kg. Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure, see "Work Equipment Hydraulic Drift - Test" on page 6-26.</td></tr>
</table>

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H-9 Work equipment cylinders no response in separate operation

Trouble	● Boom cylinder gives no response in separate operation. ● Arm cylinder gives no response in separate operation. ● Bucket cylinder gives no response in separate operation.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="6">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Malfunction of pilot valve</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Work equipment control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>DIG or DUMP</td><td>≥3.5MPa
{36 kg/cm²}</td></tr>
<tr><td>2</td><td>Failure of pressure sensor</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.
Check the pressure sensor by replacing it with a new one.</td></tr>
<tr><td>3</td><td>Malfunction of control valve (spool)</td><td colspan="2">Spool of control valve may have malfunction. Check it directly.</td></tr>
</table>

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H-10 Work equipment drifts excessively

Trouble (1)	● The boom drifts at excessive speed.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
			★ Stop the engine. Perform troubleshooting while the engine is running at high idle.
	1	Failure of boom cylinder	Charge the bucket with a load of approximate 1260 kg. Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure, see "Work Equipment Hydraulic Drift - Test" on page 6-26.
	2	Failure of boom retaining valve	Boom retaining valve or pilot valve may be worn or sluggish. Check the valves.
	3	Malfunction or defective seal of boom control valve (relief valve and makeup valve)	The relief valve and the makeup valve in the boom control valve may have a defective seal. Check the seals.
	4	Failure of boom valve spool	Spool of boom valve may be worn excessively. Check the spool.

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Trouble (2)	• The arm drifts excessively.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
			★ Stop the engine. Perform troubleshooting while the engine is running at high idle.
	1	Failure of arm cylinder	Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure, see "Work Equipment Hydraulic Drift - Test" on page 6-26.
	2	Malfunction or defective seal of arm control valve (relief valve and makeup valve)	Relief valve or makeup valve of the arm control valve may be defective. Check the valves directly. ★ The performance of seal can be judged by replacing it with another relief valve or makeup valve. (Do not replace it with the boom-down relief valve or makeup valve as their pressures are set differently.)
	3	Failure of arm retaining valve	Arm retaining valve or pilot valve may be worn or sluggish. Check the valves.
	4	Failure of arm valve (spool)	Arm valve (spool) may be worn excessively. Check it directly.

Trouble (3)	• The bucket drifts excessively.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
			★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
	1	Failure of bucket cylinder	Bucket control lever	Leakage from bucket cylinder
			Bucket-in relief	20 ml/min
	2	Defective seal of bucket control valve (relief valve and makeup valve)	Seal of relief valve or makeup valve of bucket control valve may be defective. Check it directly. ★ The performance of seal can be judged by replacing it with another relief valve or makeup valve. (Do not replace it with the boom-down relief valve or makeup valve as their pressures are set differently.)	
	3	Defective seal of bucket control valve (spool)	Seal of bucket control valve spool may be defective. Check it directly.	

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H-11 Work equipment moves sluggishly

Trouble	● Work equipment moves sluggishly.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting
	1	Malfunction of arm regeneration valve	Regeneration valve of arm may have malfunction. Check it directly.
	2	Malfunction of control valve (relief valve and makeup valve)	Relief valve or makeup valve of control valve may have malfunction. Check it directly. ★ For arm and boom, whether a valve has malfunction can be judged by replacing it with another relief valve or makeup valve. (Do not replace it with the boom-lower relief valve or makeup valve as their pressures are set differently.)

H-12 Other work equipment moves while single oil circuit is relieved

Trouble	● Other work equipment moves while single oil circuit of certain work equipment is relieved.
Related information	● Set the working mode to (S) in order to perform troubleshooting.

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting
	1	Defective seal of control valve	Seal of control valve may be defective. Check it directly.

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H-13 Travel speed drops considerably while swinging and travelling

Trouble	● Travel speed drops considerably in swinging plus travelling operation.
Related information	● If the travel speed is low in only travelling operation, check first according to H-15.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Failure of straight travel valve	The straight travel valve gives no response. Check the spool and the logic oil circuit drain port.

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H-14 Machine deviates during travel

Trouble	• Machine deviates during travel.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Malfunction of travel pilot valve	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Pilot valve output pressure
			Forward Reverse	3.5~3.9 MPa { 36~40 kg/cm²}
			Difference occurs between left and right output	0.4 MPa {4 kg/cm²}
	2	Malfunction of pilot relief valve	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Control lever	Control circuit source pressure
			All levers in "NEUTRAL"	3.5~3.9 MPa { 36~40 kg/cm²}
	3	Failure of regulator	Check the regulator by swapping the front and back regulators.	
	4	Sluggishness of proportional solenoid valve	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Proportional valve output pressure
			Operate both control levers	≤0.1 MPa
	5	Sluggishness of travel control valve (spool)	Check the valve spool to see whether it works well.	
	6	Internal leakage of central swivel joint	Check it by swapping the lines.	
	7	Malfunction of travel motor	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Leakage of travel motor
			Travel relief	27.2 ml/min
	8	Failure of final drive	Final drive may have internal defect. Check it directly. ★ Internal defect of the final drive can be determined through abnormal noise, abnormal heat, and metal powder or debris contained in the oil drained.	
	9	Failure of travel pilot pressure sensor	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Pilot valve output pressure
			Forward Reverse	3.5~3.9MPa { 36~40 kg/cm²}
			Difference occurs between left and right output	0.4 MPa {4 kg/cm²}
			Check the sensor by swapping it with another one.	

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H-15 Travel speed or power is low

Trouble	● Machine travel speed is low.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="20">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of travel pilot valve</td><td colspan="3">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Travel control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td colspan="2">Forward
Reverse</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td colspan="2">Difference occurs between left and right output</td><td>≤0.4 MPa
≤{4 kg/cm²}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Malfunction of pilot relief valve</td><td colspan="3">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Control lever</td><td>Control circuit source pressure</td></tr>
<tr><td colspan="2">All levers in "NEUTRAL"</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">Failure of sensor</td><td colspan="3">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel speed</td><td>Travel control lever</td><td>Reading on monitor</td></tr>
<tr><td>Lo</td><td>Operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td>Hi</td><td>Operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td colspan="3">Check the sensor by replacing it with another one.</td></tr>
<tr><td>4</td><td>Malfunction of travel control valve (spool)</td><td colspan="3">Spool of travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>5</td><td>Malfunction of travel control valve (make-up valve)</td><td colspan="3">The makeup valve in travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Failure of travel motor</td><td colspan="3">Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Travel control lever</td><td>Oil leakage of travel motor</td></tr>
<tr><td colspan="2">Travel relief</td><td>27.2 ml/min</td></tr>
<tr><td>7</td><td>Failure of final drive</td><td colspan="3">Final drive may have internal defect. Check it directly.
★ Internal defect of the final drive can be determined through abnormal noise, abnormal heat, and metal powder or debris contained in the oil drained.</td></tr>
</table>

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H-16 Machine is not steered well or steering power is low

Trouble	● Machine is not steered well or steering power is low
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><th rowspan="11">Possible causes and standard value in normal state</th><th colspan="2">Cause</th><th colspan="2">Standard value in normal state/Remarks on troubleshooting</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of travel pilot valve</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>Both sides in "NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Either side operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Malfunction of travel pilot pressure sensor</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel control lever</td><td>Solenoid valve output pressure</td></tr>
<tr><td>Both sides operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td>Either side operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td>3</td><td>Malfunction of travel control valve (spool)</td><td colspan="2">Spool of travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>4</td><td>Malfunction of travel control valve (makeup valve)</td><td colspan="2">The makeup valve in travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>5</td><td>Failure of travel motor (relief valve)</td><td colspan="2">Seal of relief valve in travel motor may be defective. Check it directly.
★ The failure of seal can be determined by swapping the front and back motors or the left and right motors.</td></tr>
<tr><td>6</td><td>Failure of travel motor (check valve)</td><td colspan="2">Seal of check valve in travel motor may be defective. Check it directly.
★ The failure of seal can be determined by swapping the front and back motors or the left and right motors.</td></tr>
</table>

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H-17 Travel speed cannot be changed

Trouble	● Travel speed cannot be changed.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="5">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Malfunction of travel speed shifting solenoid valve</td><td colspan="3">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel speed</td><td>Travel control lever</td><td>Solenoid valve output pressure</td></tr>
<tr><td>Lo</td><td>Operated</td><td>0 {0}</td></tr>
<tr><td>2</td><td>Failure of travel motor (in speed change)</td><td>Hi</td><td>Operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm²}</td></tr>
<tr><td colspan="2">Speed shifting assembly of travel motor may have malfunction. Check it directly.</td><td colspan="3"></td></tr>
</table>

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H-18 Travel system fails (only at one side)

Trouble	● One side of the tracks cannot make a turn.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
	1	Defective seat of travel control valve (makeup valve)	Seat of makeup valve in travel control valve may have malfunction. Check it directly.	
	2	Defective seat of travel motor (relief valve)	Seat of relief valve in travel control valve may have malfunction. Check it directly.	
	3	Defective seat of travel motor valve (makeup valve)	Seat of check valve in travel motor valve may have malfunction. Check it directly.	
	4	Speed of travel motor drops.	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Leakage from travel motor
			Travel relief	27.2 ml/min
	5	Failure of final drive	Final drive may have internal defect. Check it directly. ★ Internal defect of final drive can be determined with abnormal noise, overheat, and metal powder or debris contained in the oil drained.	
	6	Defective pilot pressure sensor	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Pilot valve output pressure
			Forward Reverse	3.5~3.9MPa { 36~40 kg/cm²}
			Difference occurs between left and right output	0.4 MPa {4 kg/cm²}
			Check it with swapping method.	

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H-19 Swing operation fails

Trouble (1)	● Upper structure fails to swing in either direction.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="8">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Malfunction of swing motor (parking brake)</td><td colspan="2">Parking brake of swing motor may have malfunction. Check it directly.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Improper adjustment or malfunction of swing motor (relief valve)</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Swing relief pressure</td></tr>
<tr><td>Swing relief</td><td>25.5~28.5 MPa
{260~291 kg/cm²}</td></tr>
<tr><td colspan="2">If oil pressure does not become normal after adjustment, swing motor relief valve may have malfunction or internal defect. Check the relief valve directly.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Failure of swing motor</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Leakage from swing motor</td></tr>
<tr><td>Swing relief</td><td>≥10 ml/min</td></tr>
<tr><td>4</td><td>Failure of swing mechanism</td><td colspan="2">Swing mechanism may have internal defect. Check it directly.
★ Internal defect of swing mechanism can be determined with abnormal noise, overheat, and metal powder or debris contained in the oil drained.</td></tr>
</table>

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Trouble (2)	• Upper structure only fails to swing in one direction.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
	1	Malfunction of pilot valve	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Left control lever	Pilot valve output pressure
			"NEUTRAL"	0 {0}
			Swing	≥3.5MPa {≥36 kg/cm²}
	2	Malfunction of swing control valve (spool)	Spool of swing control valve may have malfunction. Check it directly.	
	3	Defective seal of swing motor (makeup valve)	Seal of makeup valve in swing motor may have defect. Check it directly. ★ Failure of the seal can be determined by swapping the right and left makeup valves and check for any changes.	

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H-20 Swing acceleration poor or swing speed low

Trouble (1)	● Swing acceleration is poor, or swing speed is low.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Malfunction of swing motor (parking brake)	Parking brake of swing motor may have malfunction. Check it directly.	
	2	Improper adjustment or malfunction of swing motor (relief valve)	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Swing control lever	Swing relief valve
			Swing relief	25.5~28.5 MPa {260~291 kg/cm²}
			If oil pressure does not become normal after adjustment, swing motor relief valve may have malfunction or internal defect. Check the relief valve directly.	
	3	Failure of swing motor	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Swing control lever	Leakage from swing motor
			Swing relief	≤10 ml/min
	4	Clogging of brake control lines	Disassemble, clean and check.	

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Trouble (2)	• Swing acceleration is only poor on one side, or swing speed is low.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

<table>
<tr><td rowspan="9">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of pilot valve</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Left swing
Right swing</td><td>≥3.5MPa {≥36 kg/cm²}</td></tr>
<tr><td>2</td><td>Malfunction of swing motor (pressure compensation valve)</td><td colspan="2">Pressure compensation valve of swing motor may have malfunction. Check it directly.</td></tr>
<tr><td>3</td><td>Defective seal of swing motor (makeup valve)</td><td colspan="2">Seal of makeup valve in swing motor may have defect. Check it directly.
★ Swap the left and right makeup valves and observe the result in order to determine whether the seal fails.</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">One-side leakage of swing pilot pressure sensor (shuttle valve)</td><td colspan="2">★ Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Left swing
Right swing</td><td>3.5~3.9MPa {36~40 kg/cm²}</td></tr>
</table>

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H-21 Upper structure overruns remarkably when it stops swinging

Trouble (1)	• Upper structure overruns remarkably when it stops swinging in both directions.
Related information	• Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
	1	Improper adjustment or malfunction of swing motor (relief valve)	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Swing control lever	Swing relief pressure
			Swing relief	25.5~28.5 MPa {260~291 kg/cm²}
			If oil pressure does not become normal after adjustment, swing motor relief valve may have malfunction or internal defect. Check the relief valve directly.	
	2	Failure of swing motor	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Control lever	Leakage from swing motor
			Swing relief	≤10 ml/min

Trouble (2)	• Swing acceleration is only poor on one side, or swing speed is low.
Related information	• Set the working mode at gear (10) of power mode (S) to perform troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
	1	Malfunction of pilot valve	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Swing control lever	Pilot valve output pressure
			"NEUTRAL"	0 {0}
			Left swing Right swing	≥3.5MPa {≥36 kg/cm²}
	2	Malfunction of swing control valve (spool)	Spool of swing control valve may have malfunction. Check it directly.	
	3	Malfunction or defective seal of swing motor (makeup valve)	Seal of makeup valve in swing motor may be defective. Check it directly. ★ Swap the left and right makeup valves and observe the result in order to determine whether the seal fails.	

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H-22 Large shock is produced when upper structure stops swinging

Trouble	● Large shock is produced when upper structure stops swinging.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
	1	Malfunction of swing pilot valve	★ Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Swing control lever	Pilot valve output pressure
			"NEUTRAL"	0 {0}
			Left swing Right swing	≥3.5MPa {≥36 kg/cm²}
	2	Malfunction of swing reverse prevention valve	Reverse prevention valve of swing motor may have malfunction. Check it directly. ★ Replace the valve with a new on in order to determine whether the valve fails.	
	3	Malfunction of swing relief valve	Swing relief valve may be worn or sluggish.	

H-23 High noise is produced when upper structure stops swinging

Trouble	● High noise is produced when upper structure stops swinging.
Related information	● Set working mode to (S) and fuel control dial at position (10) to carry out troubleshooting.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Malfunction of back pressure valve	Back pressure valve may have malfunction. Check it directly.
	2	Malfunction of swing motor (relief valve)	Relief valve of swing motor may have malfunction. Check it directly.
	3	Malfunction of swing motor (makeup valve)	Seal of makeup valve in swing motor may have malfunction. Check it directly. ★ Swap the left and right makeup valves and observe the result in order to determine whether the seal fails.
	4	Failure of swing mechanism	The swing mechanism is suspected of an internal failure. Check the inside of the machinery itself. ★ Internal defect of swing mechanism can be determined with abnormal noise, overheat, and metal powder or debris contained in the oil drained.

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H-24 Swing drift excessive

Trouble (1)	● Hydraulic drift of swing is large (when swing holding brake is applied).
Related information	● When swing lock switch is turned ON or when swing holding brake release switch is in normal position, swing holding brake operates and upper structure is fixed with disc brake.

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting
	1	Failure of swing holding brake control lines	Swing holding brake control lines and holding brake pilot valve may be defective. Check them directly.
	2	Malfunction of swing motor (parking brake)	Parking brake of swing motor may have malfunction. Check it directly.

Trouble (2)	● Hydraulic drift of swing is large (when swing holding brake is released).
Related information	● When swing holding brake release switch is in release position, swing holding brake is released and upper structure is secured by only hydraulic pressure.

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting
	1	Malfunction or defective seal of swing control valve (spool)	Swing control valve spool may have malfunction or defective seal. Check it directly.
	2	Failure of swing motor (relief valve)	Seal of relief valve in swing motor may be defective. Check it directly.
	3	Failure of swing motor (makeup valve)	Seal of makeup valve in swing motor may be defective. Check it directly.

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Disassembly and Assembly

8 Disassembly and Assembly

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⚠ WARNING

Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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8 DISASSEMBLY AND ASSEMBLY

8.1 Reading Guide

8.1.1 Removing and Installing an Assembly

8.1.1.1 Special tools

- Special tools for removal and installation of machine parts are listed.
- Necessary characteristics of the tools are noted in the list of special tools.

  ■: Special tools that cannot be replaced and must be used.

  ●: Very useful tools, which can be replaced with commercially available ones.

8.1.1.2 Removal

- The "Removal" section contains procedure, precautions and the amount of oil or water to be discharged.
- The symbols used the in the "Removal" section are described below:

  ⚠ This symbol indicates that safety-related precautions must be observed when doing the job.

  ★ This symbol is followed by instructions or precautions when performing a procedure.

  ※1 This symbol indicates related rules and precautions that must be obeyed when installing the pats.

  This symbol indicates the amount of oil or water to be discharged.

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8.1.1.3 Installation

- Unless specified otherwise, installation of a part is a reverse procedure of removing the part.
- The mark ※1 used in the "Installation" section indicates the rules and precautions related to parts installation.
- Symbols used in the "Installation" sections are shown below:


This symbol indicates that safety-related precautions must be observed when doing the job.

★ This symbol is followed by instructions or precautions when performing a procedure.


This symbol indicates that specific coating agent must be used.



This symbol indicates the lubricant required.


This symbol indicates a torque specified.


This symbol indicates the amount of oil or water to be added.

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8.1.2 Disassembling and assembling an assembly

8.1.2.1 Special tools

- Special tools for parts disassembly and assembly are listed.
- Necessary characteristics of the tools are noted in the list of special tools.

  ■: Special tools that cannot be replaced and must be used.

  ●: Very useful tools, which can be replaced with commercially available ones.

8.1.2.2 Disassembly

- The "Disassembly" section contains procedure, precautions and the amount of oil or water to be discharged.
- The symbols used the in the "Disassembly" section are described below:

  This symbol indicates that safety-related precautions must be observed when doing the job.

  ★ This symbol is followed by instructions or precautions when performing a procedure.

  ※1 This symbol indicates related rules and precautions that must be obeyed when installing the pats.

  This symbol indicates the amount of oil or water to be discharged.

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8.1.2.3 Assembly

- The "Assembly " section contains operating procedure, precautions, technical specification and the amount of oil or water to be added.
- The symbols used the in the "Assembly" section are described below:


This symbol indicates that safety-related precautions must be observed when doing the job.

★ This symbol is followed by instructions or precautions when performing a procedure.


This symbol indicates that specific coating agent must be used.



This symbol indicates the lubricant required.


This symbol indicates a torque specified.


This symbol indicates the amount of oil or water to be added.

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8.2 Operating Precautions

The following precautions must be observed before removing or installing (disassembling or assembling) a component.

1. Precautions to be observed prior to removal operation

- Dispose the engine coolant properly if anti-freeze is contained in the engine coolant.
- After disconnecting a hose or tube, cover or plug must be used to prevent invasion of dirt or dust.
- A suitable container must be prepared to collect oil when draining the oil.
- Matching mark must be made at where is necessary before removing in order to avoid mistake during reinstallation.
- Do not pull the wire and avoid the wire coming off its contact. To avoid excessive force imposing on the wire, hold the connector when disconnecting a wire.
- Tag the wires and the hoses in order to ensure their connecting positions. By doing so, mistakes can be avoided during reinstallation.
- Count and check the number and thickness of the shims, and keep them in a safe place.
- When raising or lifting components, be sure to use proper lifting equipment of ample strength and safety.
- When forcing screws are used to remove any components, tighten the screws evenly in turn.
- The surrounding area must be cleaned before removing a unit. Cover the unit after removal in order to prevent invasion of dirt or dust.

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★ Precautions to be observed when disassembling the lines

The lines disassembled must be blinded with plugs.

A: Thread-connected hoses

I.D. (mm)	Code	Description
Light Thread Connection		
6	B210780001189	Plug
8	B210780001190	Plug
10	B210780000077	Plug
12	B210780000078	Plug
15	B210780000883	Plug
20	B210780000079	Plug
22	60056667	Plug
Heavy Thread Connection		
12	B210780001142	Plug
16	60002397	Plug
20	B210780000080	Plug
25	B210780000081	Plug

B: Thread-connected adaptors (plug and nut used in combination)

I.D. (mm)	Code	Description	Code	Description
Light Thread Connection				
6	B210780000903	Taper bore plug	23002925	Nut
8	B210780001146	Plug	B210770000011	Nut
10	B210780000088	Plug	B210334000011	Nut
12	B210780000089	Plug	B210334000012	Nut
15	B210780000882	Plug	B210334000004	Nut
20	B210780000090	Plug	B210334000010	Nut
22	B210780000091	Plug	B210780000112	Nut
Heavy Thread Connection				
12	B210780001143	Plug	B210780000406	Nut
16	A820205001523	Plug	B210780000405	Nut
20	B210780000902	Plug	B210780000904	Nut
25	B210780001172	Plug	B210334000006	Nut

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2. Precautions to be observed prior to installation operation

- Tighten all the screws and nuts (sleeve nuts) to specified torques.
- Install the hoses without twisting or interference.
- Replace the gaskets, O-rings, cotter pins and lock plates with new parts.
- Bend the cotter pin or lock plate securely.
- Before applying the adhesive, clean the parts of oil and dust. Apply 2 or 3 drops of adhesive to the threaded portion.
- Before applying the sealant to the gasket, clean the gasket surface of oil and dust. Check the gasket for contamination or damage. Apply the gasket sealant evenly.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Apply engine oil to the moving parts.
- Before installing a snap ring, make sure that the snap ring is mounted properly in the circular groove.
- Before connecting the wiring connector, clean the wiring connector of oil, dirt or water. Make sure that the wiring connector is connected securely.
- Before using an eyebolt, check the eyebolt for deformation or deterioration. Screw on the eyebolt as far as possible and align it to the direction of the hook.
- Before tightening the split flange, tighten it evenly in turn in order to prevent over tightening on one side.

★ After reassembling the hydraulic cylinder, main pump or other hydraulic equipment that has been disassembled and repaired, it is necessary to bleed the air from the hydraulic cylinder prior to initial operation

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of the cylinder. The purging procedure is performed as the following:

1) Start the engine and run the engine at low idle.
2) Operate the work equipment control lever in order to cycle the movement of the hydraulic cylinder 4 or 5 times. Hold the cylinder at where it is 100 mm from its stroke end.
3) Go on operating the hydraulic cylinder 3 or 4 times to its stroke end.
4) You can run the engine at normal speed after this operation.

★ This procedure is to be performed before using your machine for the first time after repair or long storage.

3. Precautions to be observed upon completion of the operations

- Completely discharge the engine coolant, tighten the drain valve, and add coolant to the specified level. Run the engine to circulate the coolant through the system. Check the coolant level again.
- Add hydraulic oil to the specified level after disassembly and reinstallation of a hydraulic unit. Run the engine to circulate the hydraulic oil through the system. Check the oil level again.
- Bleed the air from the system after removing and repairing the lines or hydraulic unit and reassembling the parts.

★ Bleed the air. For more information, see “Air in Each Component - Bleed” on page 6-35.

- Add the specified amount of grease (molybdenum disulphide) to the work equipment related parts.

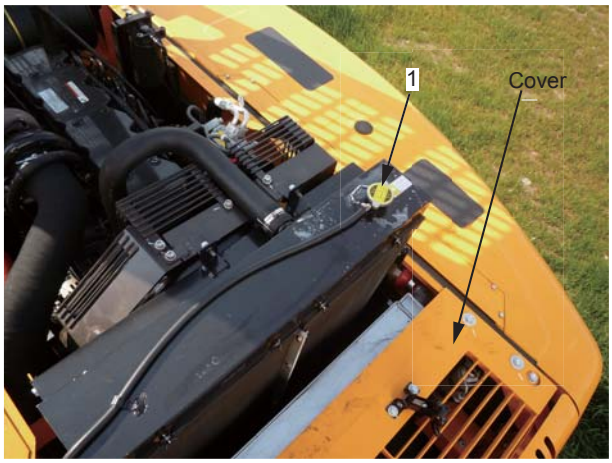
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8.3 Radiator AS - Remove and Install

8.3.1 Removal

1. Open the engine hood.
2. Open the pressure cap (1). Open the drain valve to discharge engine coolant from the coolant tank.

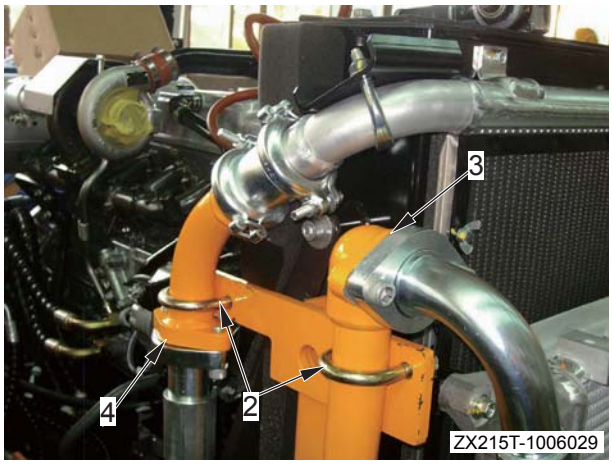
   Coolant: approx. 22.5 L
3. Remove the coverplate.



4. Remove the two U-bolts (2).
5. Disconnect the hydraulic oil cooler inlet connector (3) and outlet connector (4). Block the openings to prevent leakage of hydraulic oil.
6. Discharge hydraulic oil from the hydraulic cooler.

   Hydraulic oil radiator:

   approx. 5.6 L

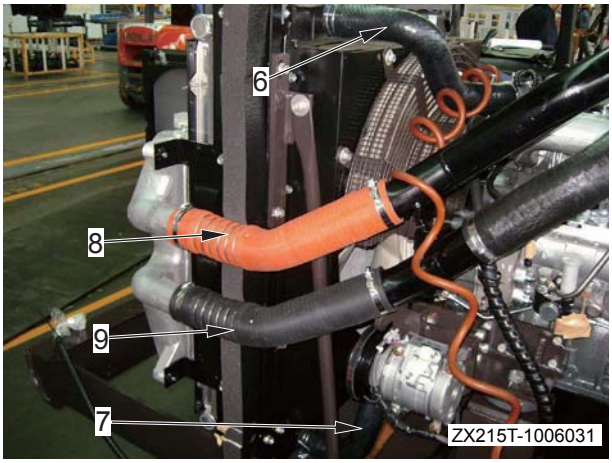


7. Disconnect the coolant tank hose (5).

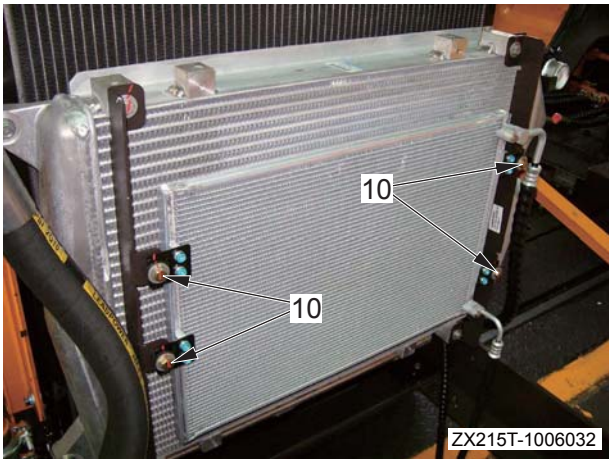


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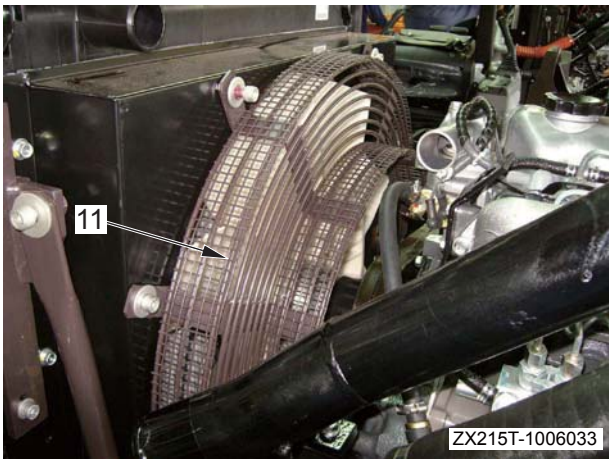
8. Disconnect the cooler inlet hose (6) and outlet hose (7).
9. Disconnect the intercooler air inlet tube (8) and outlet tube (9).



10. Remove the four bolts (10) from the air conditioner radiator. Remove the air conditioner radiator and store it properly.

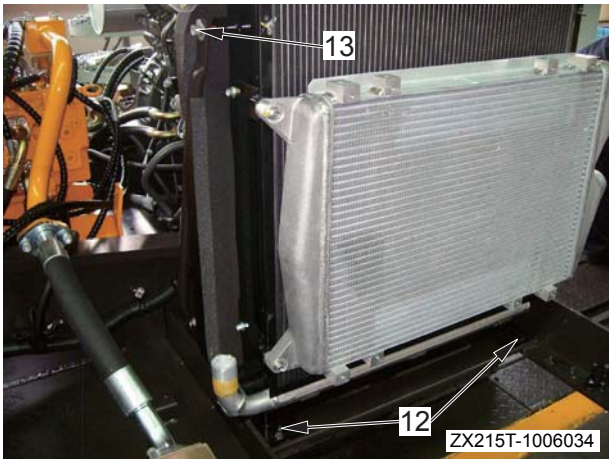


11. Remove the radiator fan guard (11).



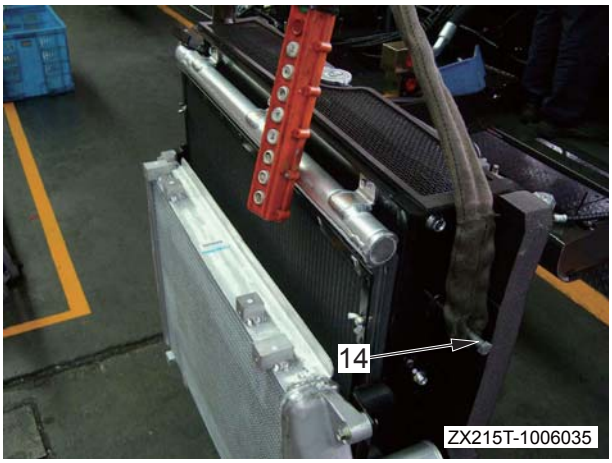
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12. Remove the four mounting bolts (12) from the radiator bottom and the two mounting bolts (13) from the left and right brackets.



13. Mount the hoisting bolts (14) to both sides of the radiator in order to hoist the radiator assembly.

★ Before the radiator assembly is hoisted, move the radiator assembly axially until the fan avoids its guard.



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8.3.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

★ Adjust the clearance (a) between the fan and the fan guard in order to have a uniform clearance surrounding the fan.

★ Check the values (a) at the four measuring points in the left, right, top and bottom directions, which should be as the following:

  - Standard clearance (a) in all directions: 15±1.5 mm
  - Fan diameter (b): ø620 mm
  - Fan guard inner diameter (c): ø650 mm

- Engine coolant and hydraulic oil adding

  Add a specific amount of coolant and hydraulic oil. Start the engine to circulate the coolant and hydraulic oil. Check the coolant level and the oil level.

  Engine coolant: approx. 22.5 L

  Hydraulic oil radiator: approx. 5.6 L

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8.4 Engine and Hydraulic Pump AS - Remove and Install

8.4.1 Removal

⚠ Lower the work equipment to the ground. Stop the engine. Disconnect the cable from the battery negative (-) post.

⚠ Loosen the butterfly nut on the breather valve and press the relief button to relieve internal pressure.

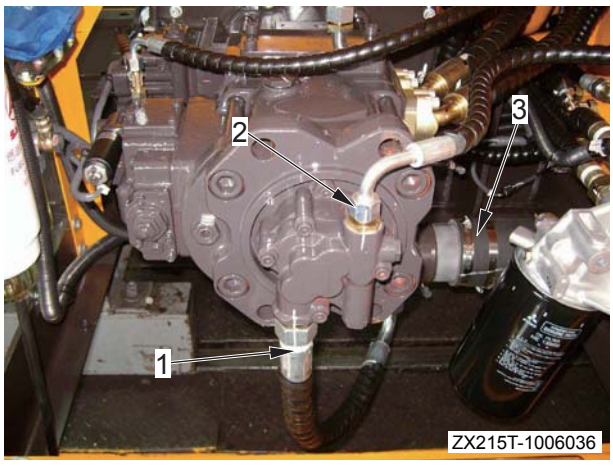
★ Mark the lines to avoid mistakes during reinstallation.

1. Remove the hydraulic tank suction filter element and block the opening.
2. Drain the engine of coolant.

   Coolant: approx. 22.5 L
3. Open the engine hood.

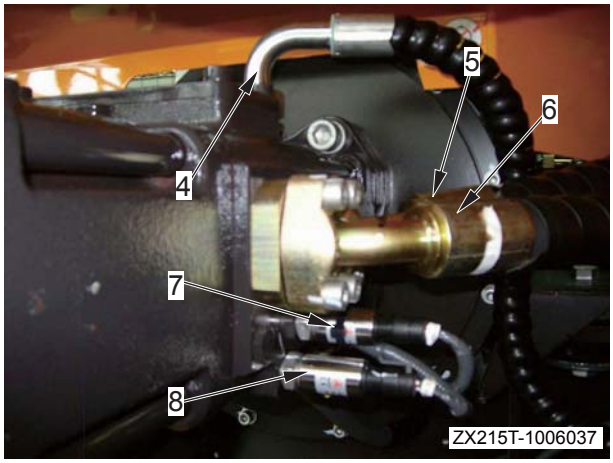


4. Disconnect piping (1), (2) and (3).

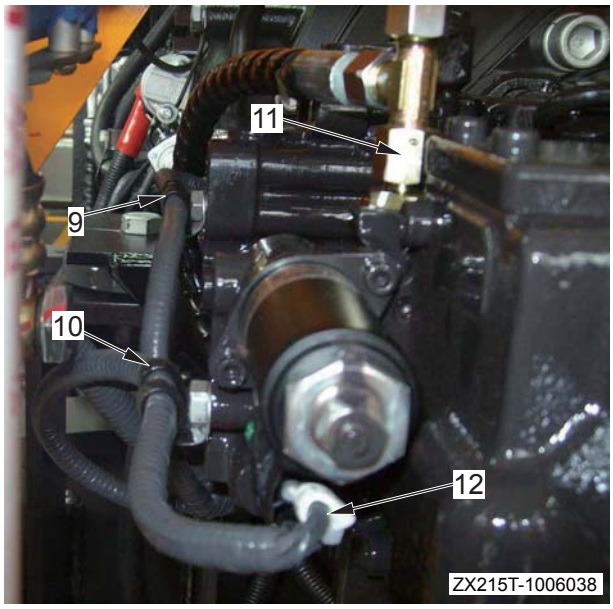


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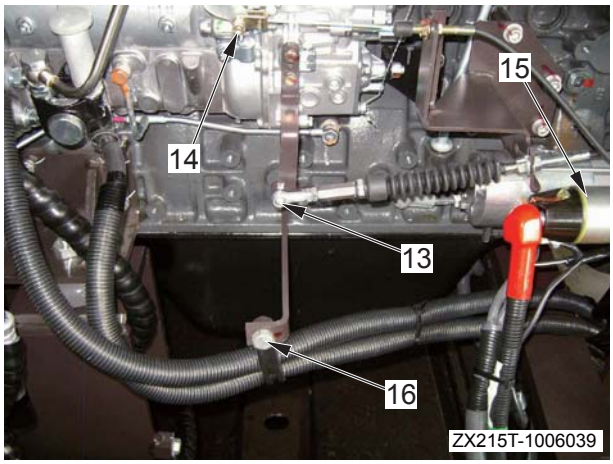
5. Disconnect piping (4), (5) and (6).
6. Remove the sensors (7) and (8).



7. Remove the clamps (9) and (10). Remove the line (11) and the cable (12).

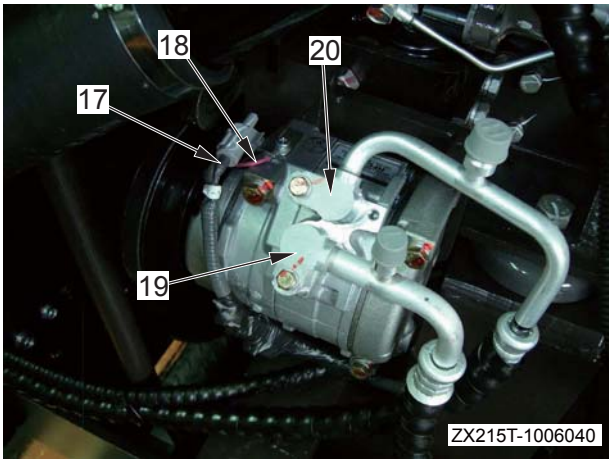


8. Unscrew the connection bolt (13) of the governor motor and the connection bolt (14) of the engine stopper.
9. Disconnect the external cable from the starter (15).
10. Remove the mounting bolt (16) from the hose clamp.

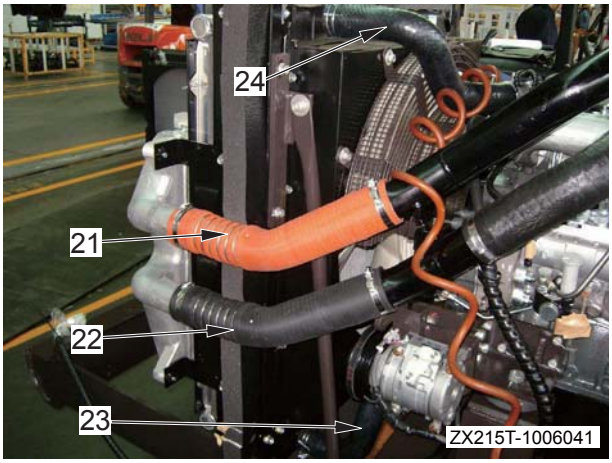


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11. Disconnect the cables (17) and (18) as well as the tubes (19) and (20) from the compressor.



12. Disconnect the hoses (21), (22), (23) and (24) between the engine and the radiator

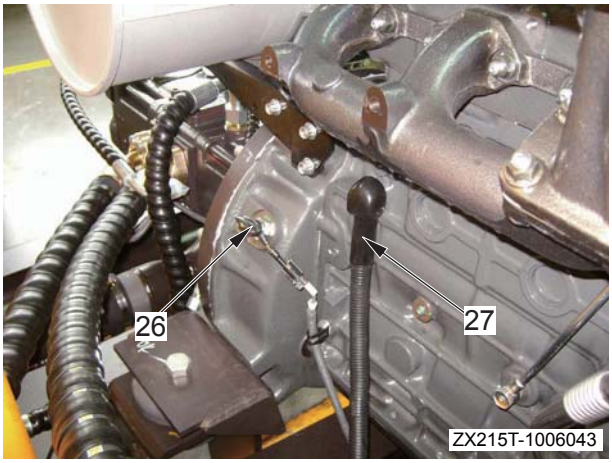


13. Disconnect the air intake hose (25).

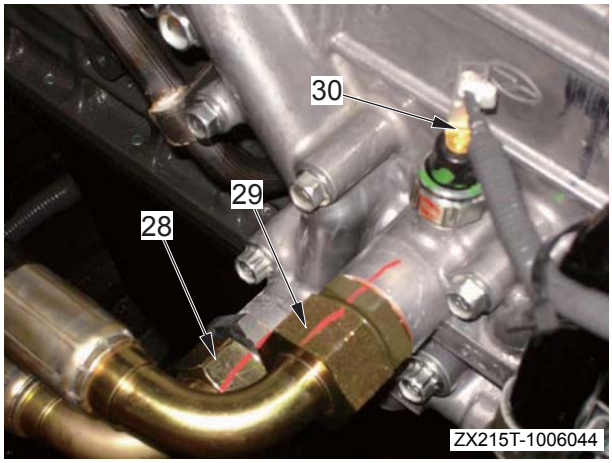


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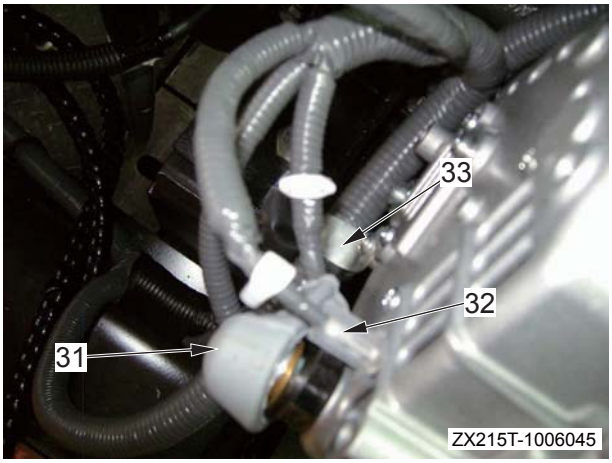
14. Disconnect the external cable (26) of the rpm sensor.
15. Disconnect the external cable (27) of engine oil pressure sensor.



16. Disconnect the engine oil inlet tube (28) and outlet tube (29).
17. Disconnect the wiring (30) of the engine oil pressure switch.



18. Disconnect the cables (31) and (32), and remove the hose clamp (33).

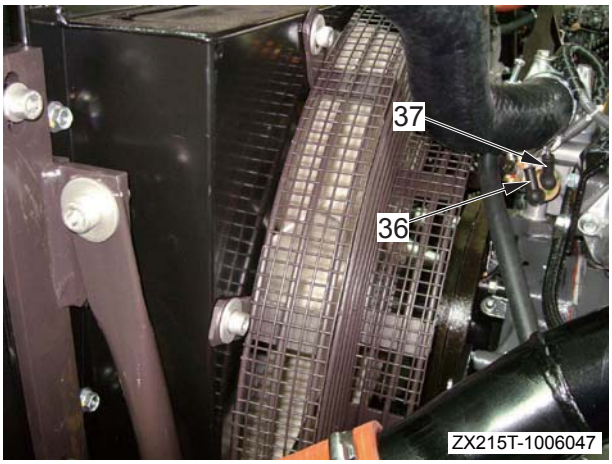


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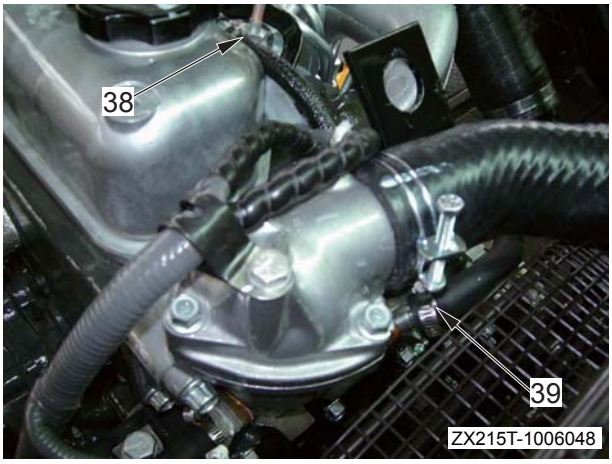
19. Remove the hose clamp (35).
20. Disconnect the wiring (34) of the water temperature sensor.



21. Disconnect the cables (36) and (37) of the water temperature switch.

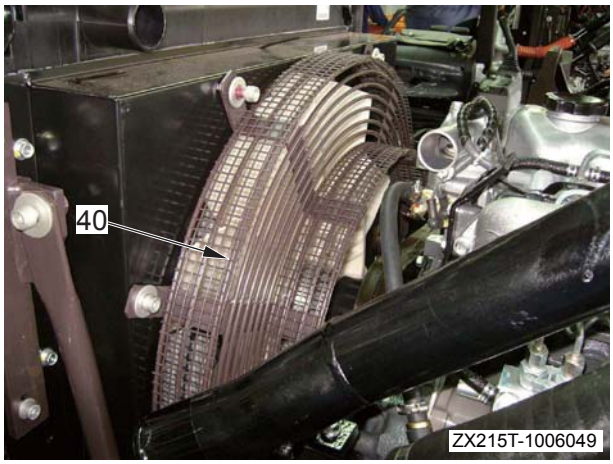


22. Disconnect the oil return hose (38).
23. Disconnect the A/C water pipe (39).



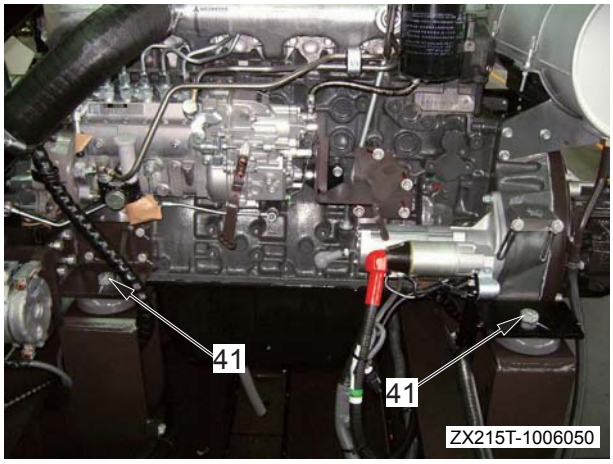
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24. Disconnect the radiator fan guard (40).



25. Remove the fixing bolt (41) on each of the four mounting plates of the damper. Lift the engine and main pump assembly.

Engine and hydraulic pump AS: 640 kg



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8.4.2 Installation

- Installation is to be performed in the reverse order of removal.
- Open the radiator tank cover to add coolant. Also add coolant to the coolant reservoir.

   Engine coolant:

  approx. 22.5 L.
- Refill the hydraulic tank with hydraulic oil.

   Hydraulic tank:

  approx. 225 L

★ Start the engine to circulate the coolant in order release the foams, and check the coolant level again.

★ Start the engine to circulate the hydraulic oil in the hydraulic system, and check the oil level again.

- Air bleeding

  For more information, see “Air in Each Component - Bleed” on page 6-35.

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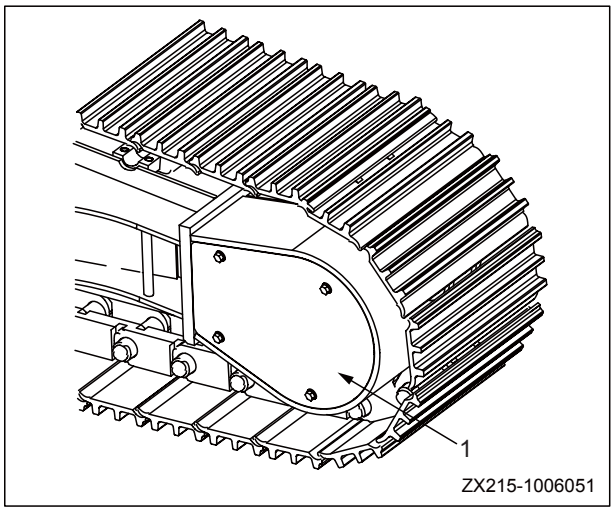
8.5 Final Drive AS - Remove and Install

8.5.1 Removal

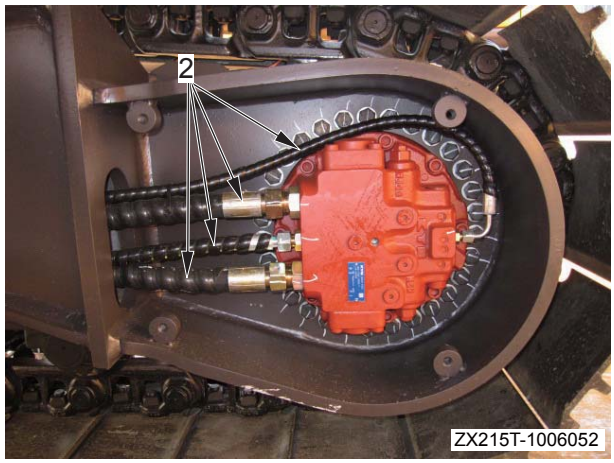
1. Remove the sprocket. Refer to “Sprocket - Remove and Install” on page 8-49.

⚠ Lower the work equipment to the ground. Stop the engine. Operate the breather valve to release internal pressure.

2. Remove the motor cover plate (1).



3. Disconnect the four hoses (2) of the travel motor and the corresponding hose connectors.



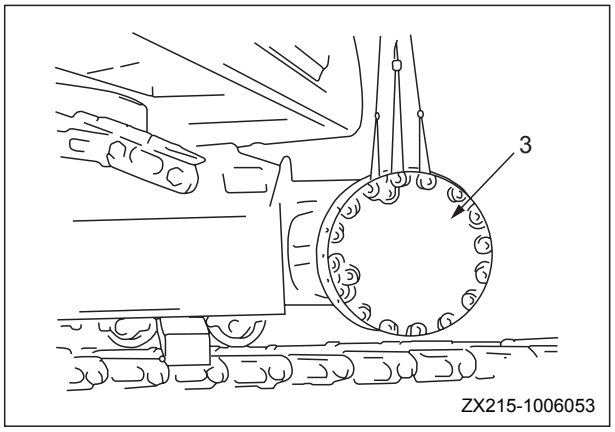
https://truckmanualshub.com/

4. Remove the 30 mounting bolts from the final drive assembly (3), and lift the assembly for disassembling.

   ★ Be careful not to damage the surface of mounting seal installed on the hose base.

   ★ Never use the threaded holes to lift the cover when lifting the final drive.

   Final Drive Assembly: 250 kg



8.5.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

Mounting bolts (final drive assembly):

245~309 N·m {25~31 kgf·m}

- Hydraulic oil adding

  Add hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Air bleeding

  For more information, see “Air in Each Component - Bleed” on page 6-35.

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8.6 Final Drive AS - Disassemble and Assemble

8.6.1 Disassembly

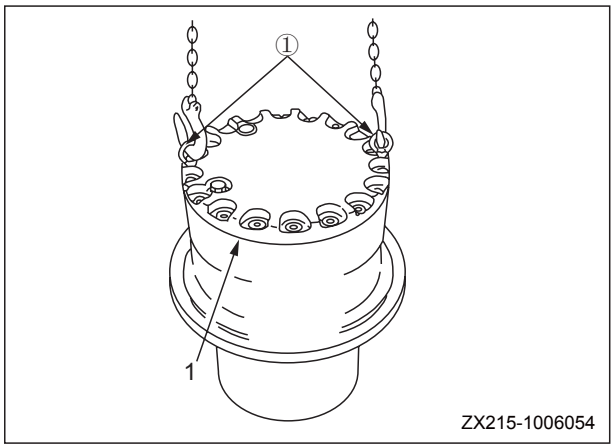
1. Oil draining

Open the drain plug to drain the oil from the final drive tank.

Final drive tank: approx. 4.7 L

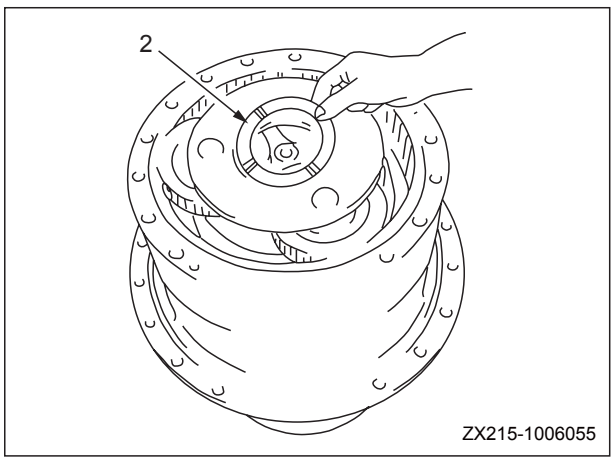
2. Cover

Remove the bolts. Use eyebolts ① to the cover (1).



3. Spacer

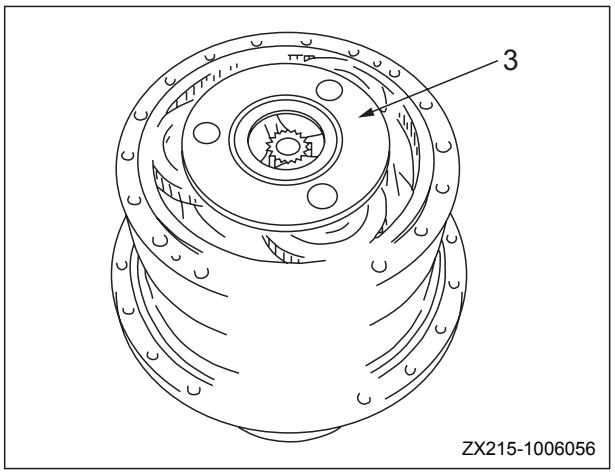
Remove the spacer (2).



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4. No. 1 planetary carrier assembly

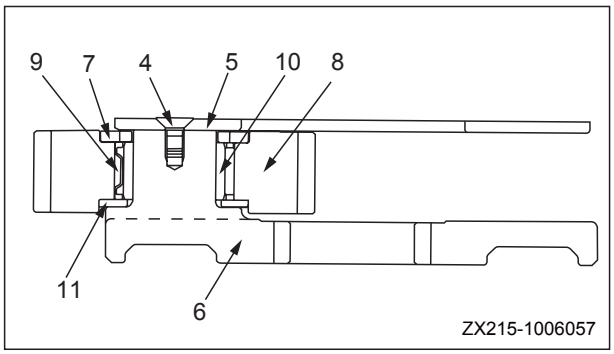
1) Remove the No.1 planetary carrier assembly (3).



2) Disassembly of No.1 planetary carrier assembly.

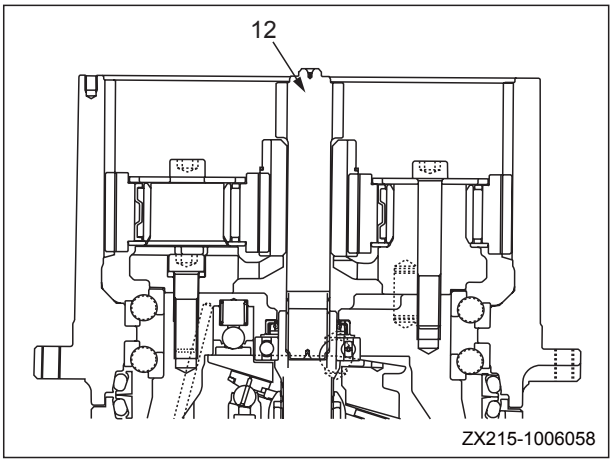
i) Remove the screws (4). Remove the coverplate (5) from the planetary carrier assembly (6).

ii) Remove the thrust washer (7), gear (8), bearing (9), bearing inner race (10) and a second thrust washer (11).



5. No.1 sun gear shaft

Remove No.1 sun gear shaft (12).



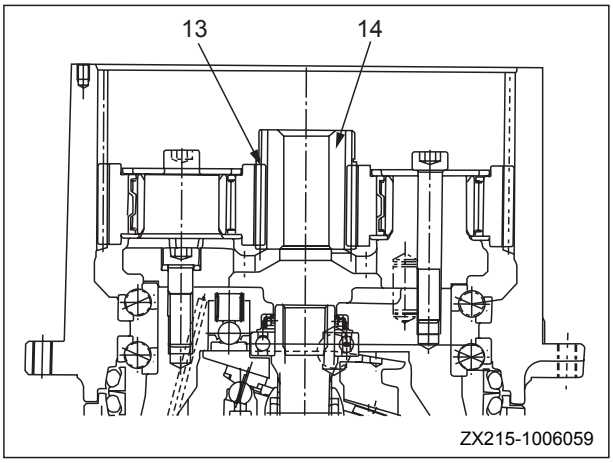
https://truckmanualshub.com/

6. Thrust washer

Remove the thrust washer (13).

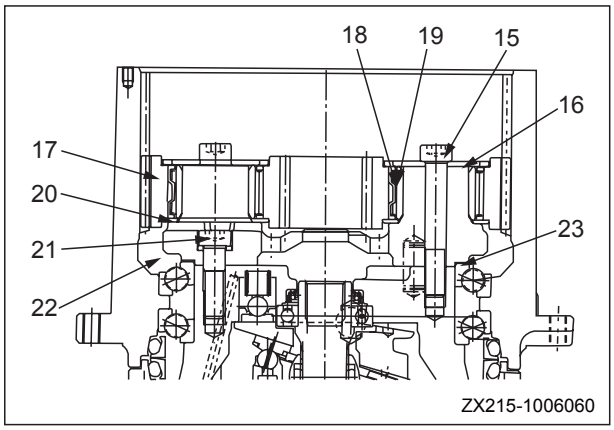
7. No.2 sun gear

Remove No.2 sun gear (14).



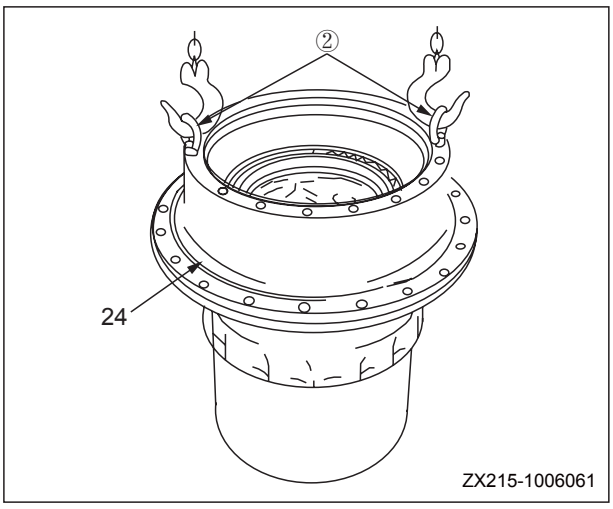
8. Disassembly of No.2 planetary carrier assembly

1) Remove the screws (15). Remove the plate (16) and the planetary gear (17) from the carrier assembly (22).
2) Remove the bearing inner race (19) and outer race (18). Remove the plate (20).
3) Remove the screw (21) to take the planetary carrier assembly (22) and the shim (23) from the body.



9. Hub assembly

1) Use eyebolts ② to remove the hub assembly (24) from the travel motor.



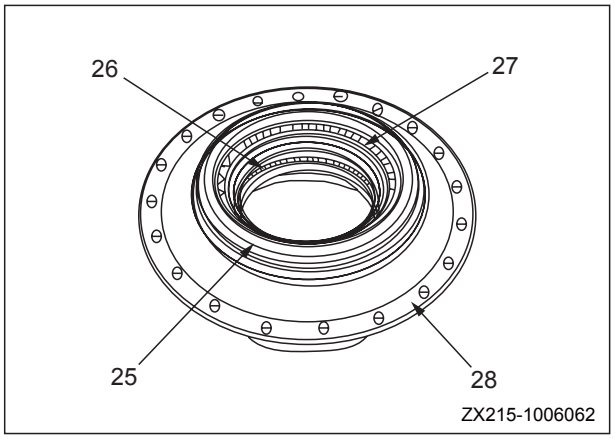
https://truckmanualshub.com/

2) Disassemble the hub assembly as the following.

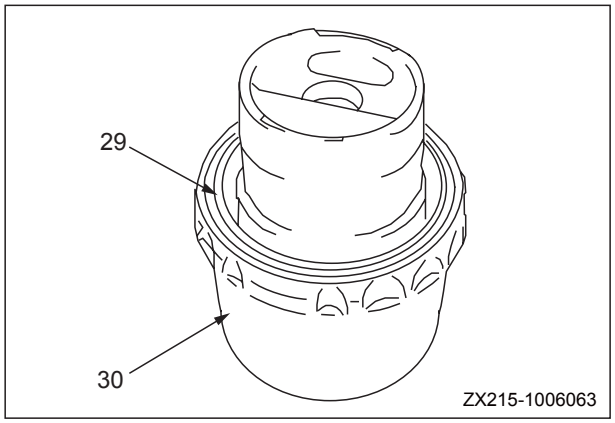
   i) Remove the float seal (25).

   ii) Remove the bearing (26) and bearing (27) from the hub (28).

   ★ Do not damage the bearing retainer when removing the bearing (26).



3) Remove the float seal (29) from the travel motor.



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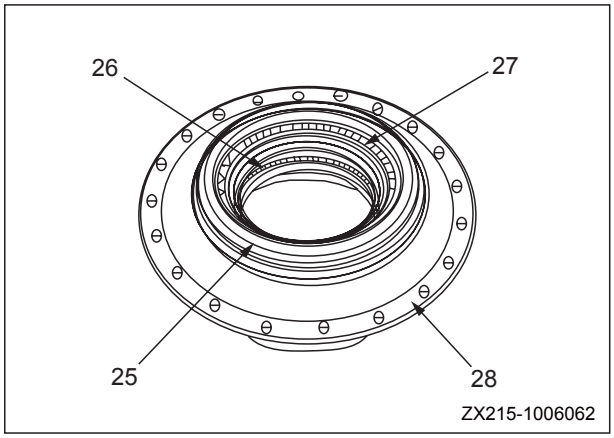
8.6.2 Assembly

★ Clean all the parts. Check that these parts are free from any contamination or damage. Apply some engine oil to the sliding surface prior to installation.

1. Hub assembly

1) Install the bearing 26 and bearing (27) by pressing them onto the hub (28).

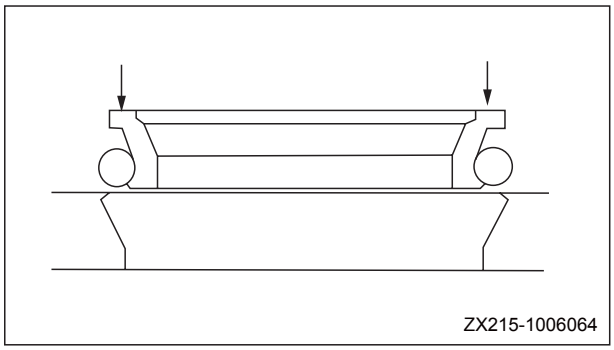
2) Install the float seal (25).



★ Remove any oil or dust from the O-ring or O-ring contact surface. Dry the parts before installing the float seal.

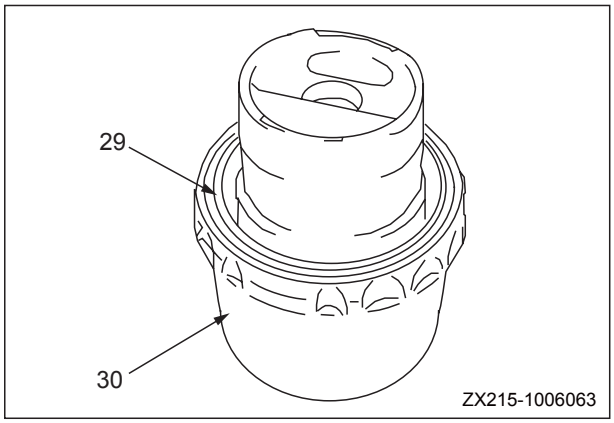
★ After installing the float seal, check that the angle of the floating seal is within 1 mm.

★ Apply a thin layer of engine oil to the sliding surface after the float seal has been installed.



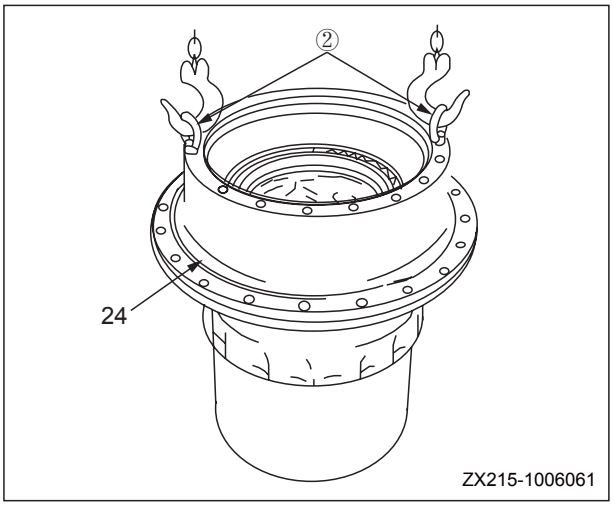
3) Install the float seal (29) to the travel motor (30).

★ See the above step 2 for the installation procedure.



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4) Use eyebolts ② to carefully place the hub assembly (24) onto the travel motor. Tap to press fit the bearing.



2. Calculation of shim thickness

1) Measure the thickness (H) of the raised part of No.2 carrier assembly (22).

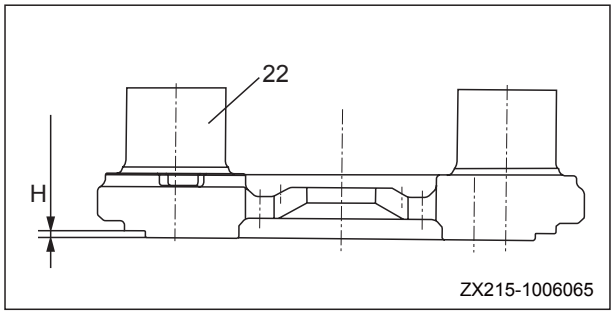
2) Measurement of raised thickness
Apply 3000 Kg load to the bearing and measure the value (H) of the raised part of the bearing.

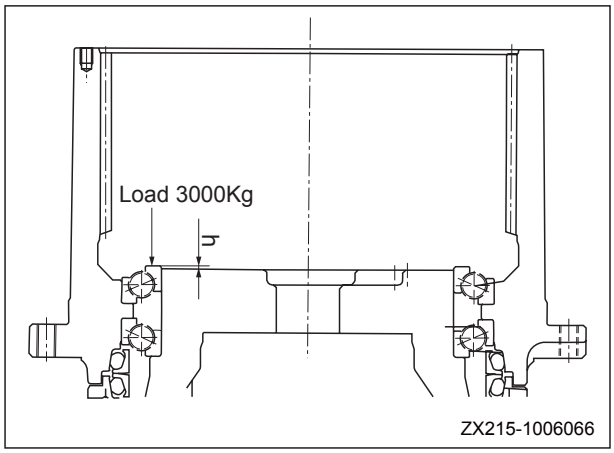
★ Turn the hub 2-3 times before applying a pushing force.

★ Do not use a spray gun to cushion the bearing.

★ Do not push or strike the resin retainer.

3) Shim thickness calculation: C=H-h.





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4) Place the shims on the body and insert the dowel pin. Press the carrier assembly onto the dowel pin and tighten it with screw (21). Apply locking adhesive to the threads.

Screw-locking adhesive:

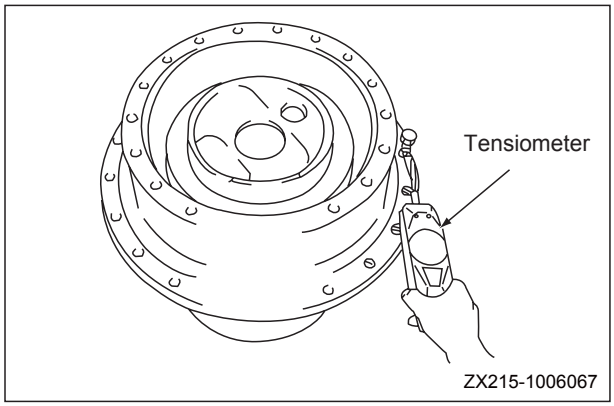
(Kesaixin 1277)

Screw (21):

539±28 N·m {55±2.9 kgf·m}

★ Use a tensiometer to measure the tangential force of hub to motor rotation.

- Tangential force: Max.294 N {30 kg}
- Maximum tangential force occurs when the rotating direction begins to change.



3. Assembly of No.2 planetary carrier assembly

1) Assemble the No.2 planetary carrier assembly according to the following procedure.

★ Replace the plates (20) and (16) with new parts.

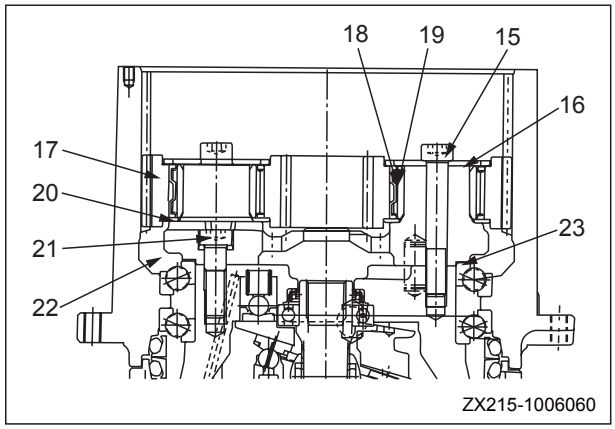
i) Assemble the bearing (18) and bearing (19) to the gear (17). Assemble the top and bottom plates (16) and (20), and place the gear assembly into the carrier assembly (22).

ii) Tighten the screw (15).

Screw (15):

539±28 N·m {55±2.9 kgf·m}

★ Check the flexibility of gear (17) after assembling the planetary carrier assembly.



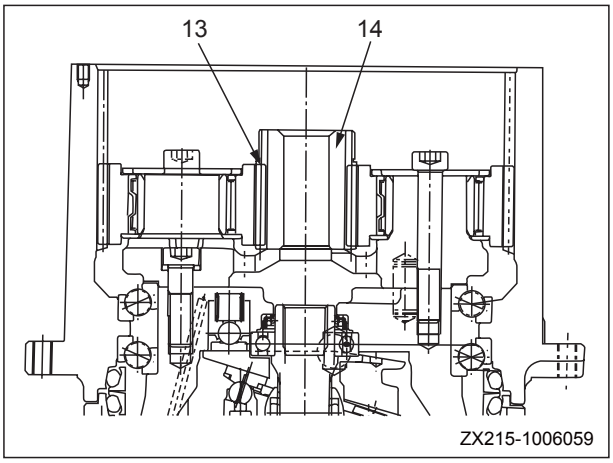
https://truckmanualshub.com/

4. Thrust washer

Install the thrust washer (13).

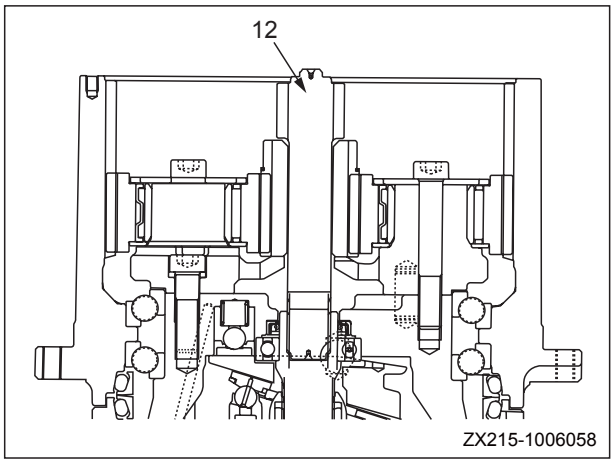
5. No.2 sun gear

Install No.2 sun gear (14).



6. No. 1 sun gear shaft

Install No.1 sun gear shaft (12).



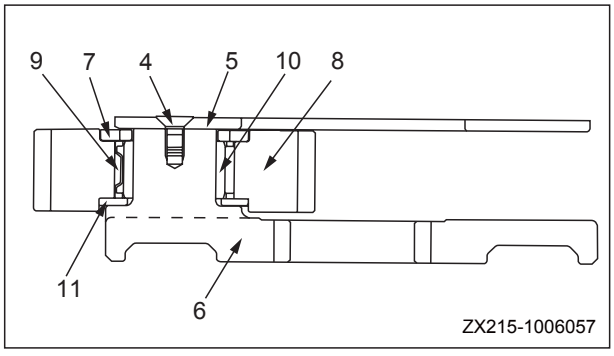
7. No.1 planetary carrier assembly

1) No. 1 planetary carrier assembly is assembled as the following.

★ Replace the thrust washers (7) and (11) with new parts.

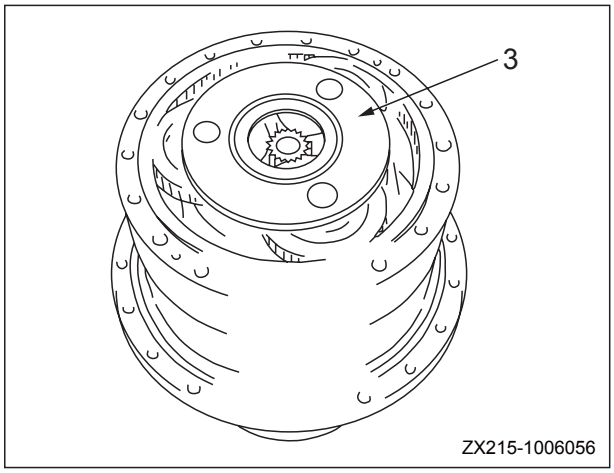
i) Assemble the bearings (9) and (10) onto the gear (8). Assemble the top and bottom thrust washers (7) and (11). Place the gear assembly into the carrier assembly (6).

ii) Fix the coverplate (5) to the carrier assembly (6) with screw (4).



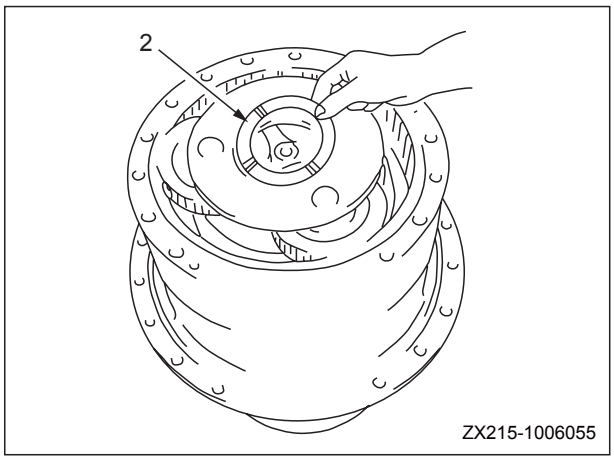
https://truckmanualshub.com/

2) Install No.1 planetary carrier assembly (3).



8. Spacer

Install the spacer (2).



9. Cover

Use eyebolts ① to assemble the cover (1). Use a torque spanner to tighten the bolts.

Bolts:

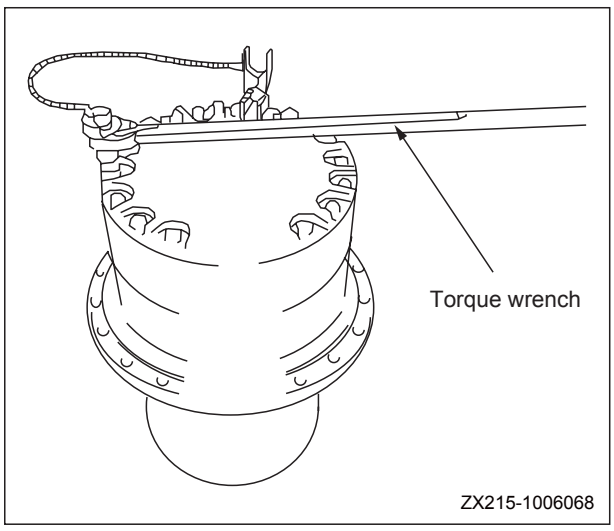
73.4±3.63 N·m {7.5±0.4 kgf·m}

10. Oil adding

Tighten the drain plug and add engine oil through the filler.

Final drive case: approx. 4.7 L

★ Check the oil level after the final drive has been successfully installed to the chassis.



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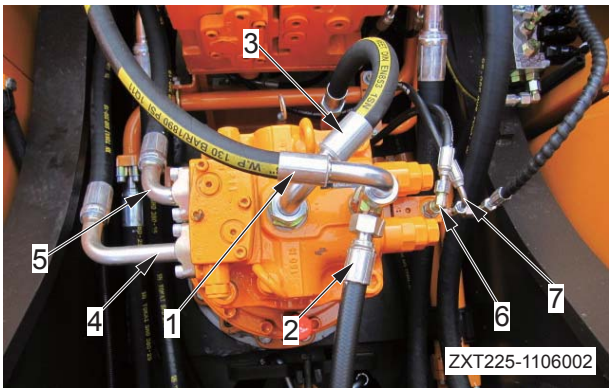
8.7 Swing Motor and Swing Drive AS - Remove and Install

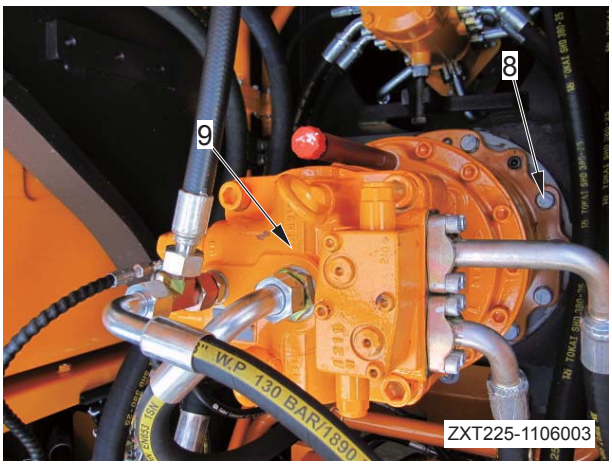
8.7.1 Removal

⚠ Release the residual pressure in the hydraulic circuit. Refer to “Residual Pressure in Hydraulic Circuit - Release” on page 6-29.

⚠ Lower the work equipment to the ground. Stop the engine. Press the release button of the breather valve to release residual pressure in the hydraulic tank. Place the hydraulic lockout control in the LOCK position.

1. Disconnect the hoses (1) to (7).
   1) Between hydraulic tank and swing motor (port DR)
   2) Between central swivel joint and swing motor (port DR)
   3) Between swing motor and main valve (port M)
   4) Between swing motor and main valve (port HA)
   5) Between swing motor and main valve (port HB)
   6) Between swing motor and main valve Px port (port SH)
   7) Between swing motor and solenoid valve block (port PG)
2. Remove the 11 fixing bolts (8).
3. Lift the swing motor and swing drive assembly (9) for disassembling.
   ★ Slowly lift the swing motor and swing drive assembly in order to avoid damaging the hoses and other parts.
   Swing motor and swing drive assembly: 260 kg





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8.7.2 Installation

- Installation is performed in the reverse order of removal.

※1

Mounting bolts (swing motor and swing drive assembly):

490~608 N·m {50~62 kgf·m}

- Hydraulic oil adding

  Add hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Air bleeding

  For more information, see “Air in Each Component - Bleed” on page 6-35.

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8.8 Swing Motor and Swing Drive AS - Disassemble and Assemble

8.8.1 Disassembly

1. Draining of oil

Open the drain plug to drain the oil from the swing drive.

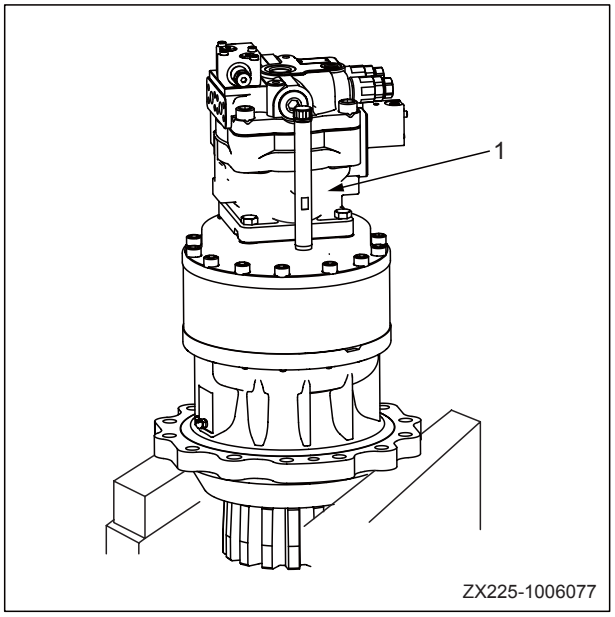
Swing drive: approx. 4.4 L

2. Swing motor assembly

1) Place the swing motor and swing drive assembly on a suitable cribbing. Be careful not to damage the drive gear or let it contact the ground.

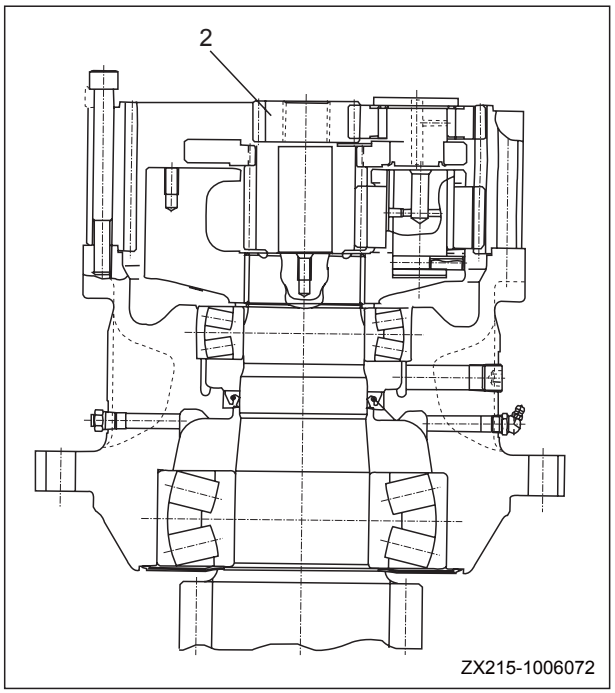
2) Unscrew the 14 bolts in order to remove the swing motor assembly (1).

Swing motor assembly: 62 kg



3. No.1 sun gear

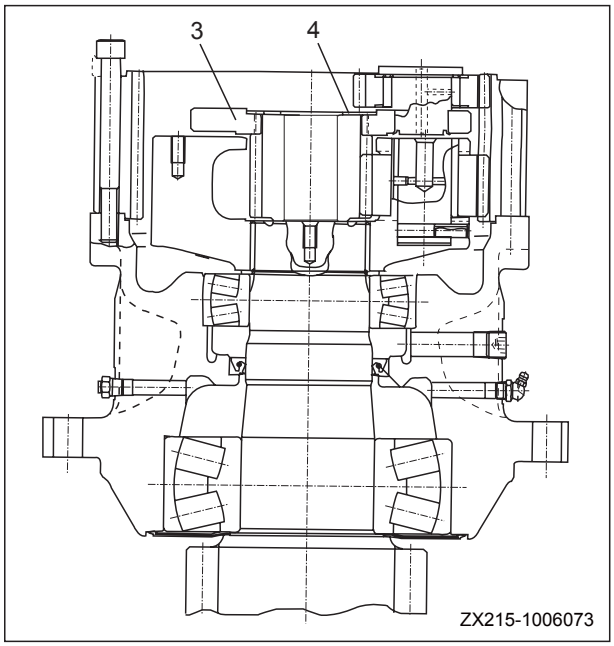
1) Remove No.1 sun gear (2).



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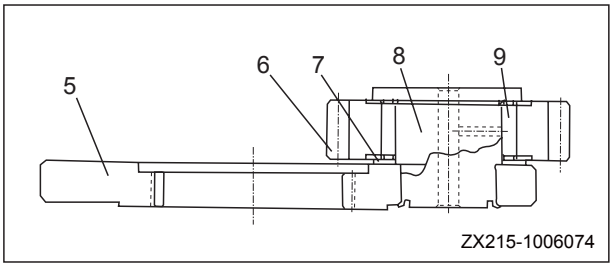
4. No.1 planetary carrier assembly

1) Remove No.1 carrier assembly (3) and the plate (4).



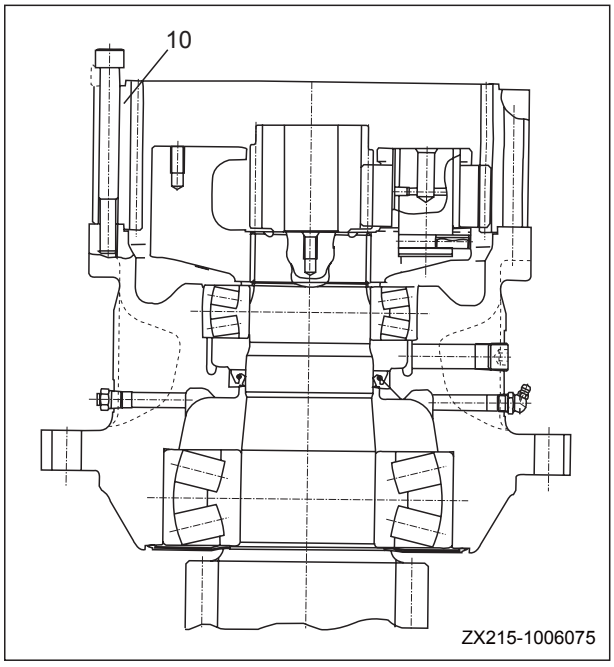
2) Disassemble the carrier assembly.

Cut the rivets on the shaft (8) to remove the shaft (8), and remove in turn the gear (6), bearing (9) and plate (7).



5. Ring gear

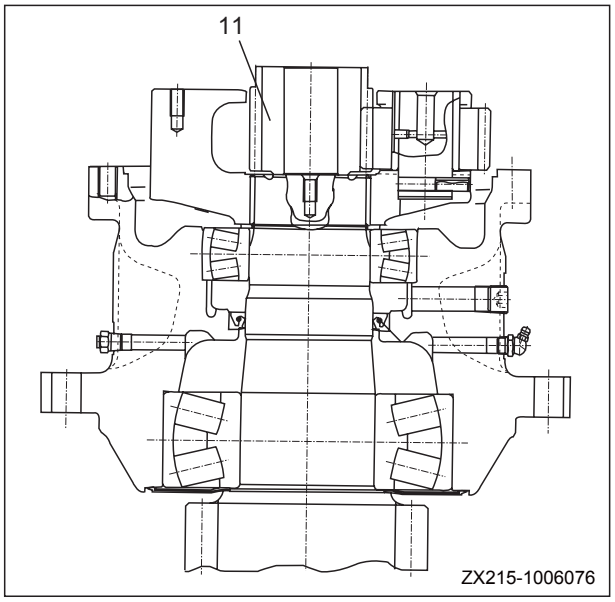
Unscrew the mounting bolts to remove the ring gear (10).



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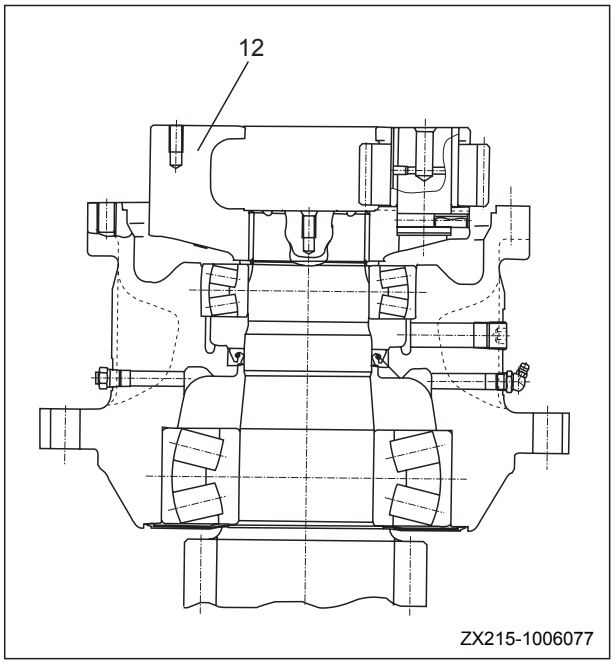
6. No. 2 sun gear

Remove No. 2 sun gear (11).



7. No.2 planetary carrier assembly

1) Remove No.2 carrier assembly (12).



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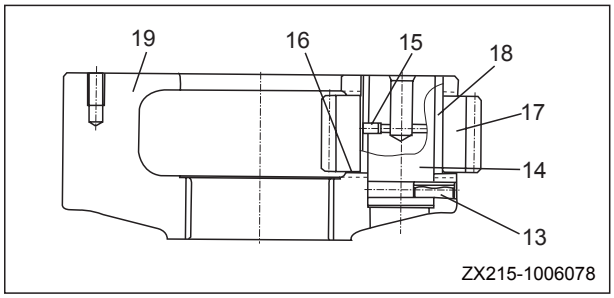
2) Disassemble No. 2 carrier assembly as per the following procedure.

i) Insert pin (13) and push the shaft (14) out of the carrier assembly (19).

★ Pull out the pin (13) after removal of the shaft.

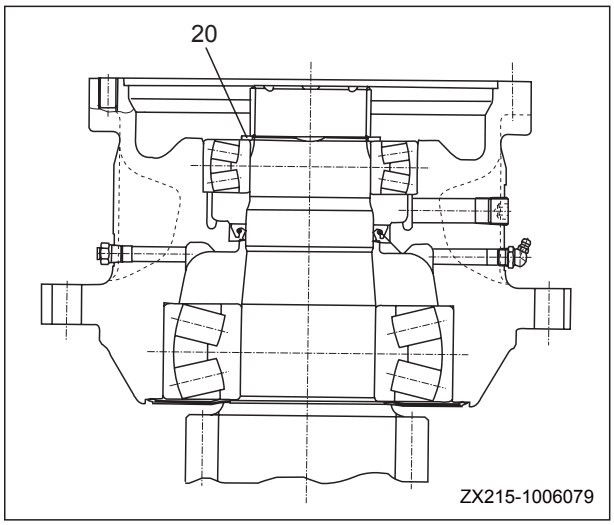
ii) Remove the thrust washer (16), gear (17) and a second thrust washer (19).

iii) Insert the pin (15) to remove the bearing (18) from the shaft. Remove the pin (15).



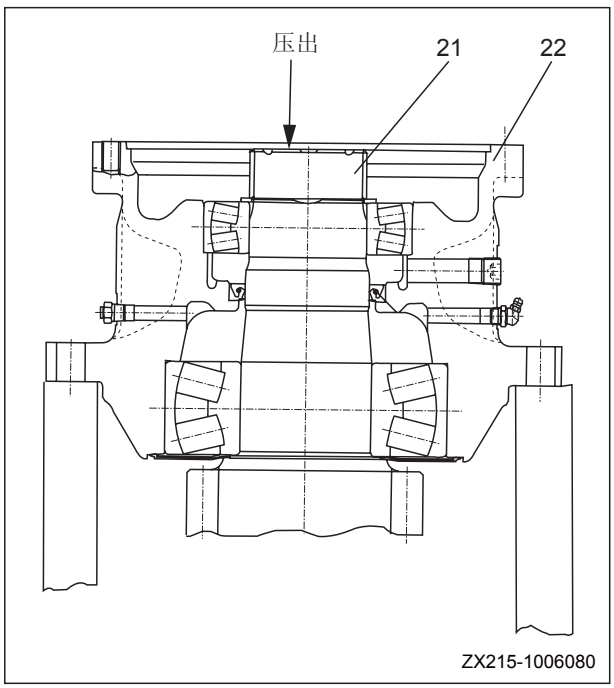
8. Snap ring

Remove the snap ring (20).



9. Disassembly of main shaft

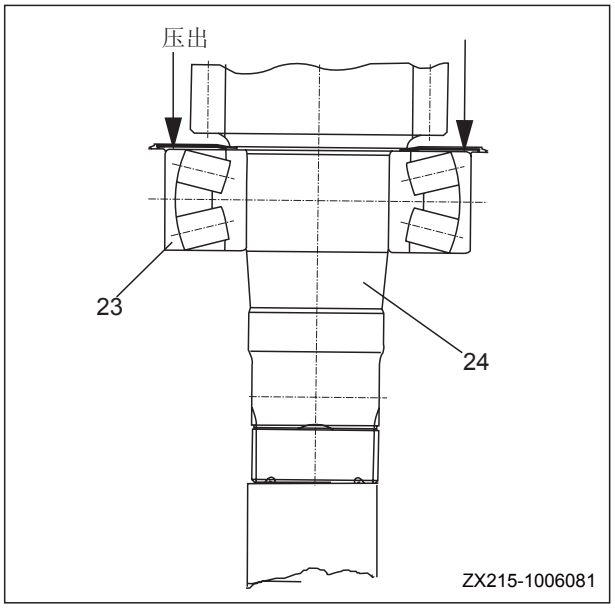
1) Place the shaft housing assembly on a press and push the shaft assembly (21) out of the shaft housing assembly (22).



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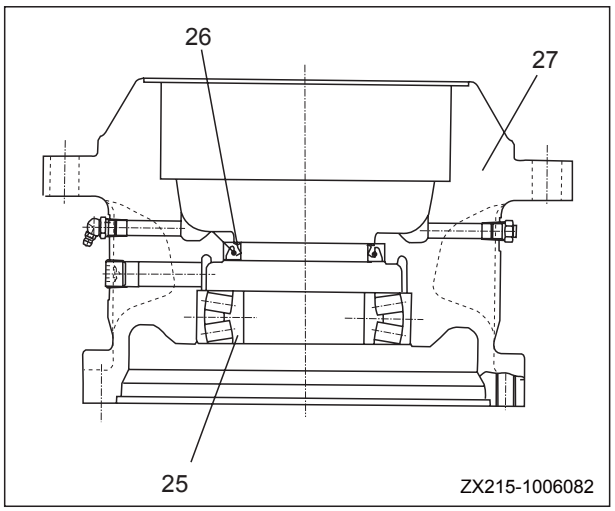
2) Disassemble the shaft assembly in the following procedure.

   Remove the bearing (23) from the shaft (24).



10. Bearing

Remove the bearing (25) and the oil seal (26) from the housing (27).



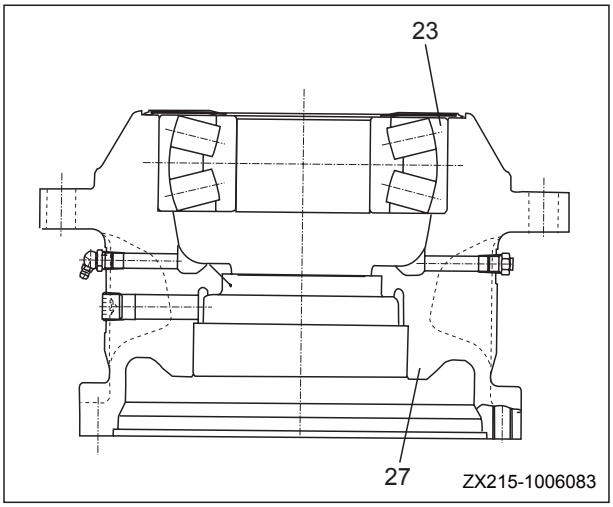
https://truckmanualshub.com/

8.8.2 Assembly

★ Clean all the parts and check for any contamination or damage. Apply engine oil to the sliding surface of the parts.

1. Bearing

Press the bearing (23) into the housing (27).

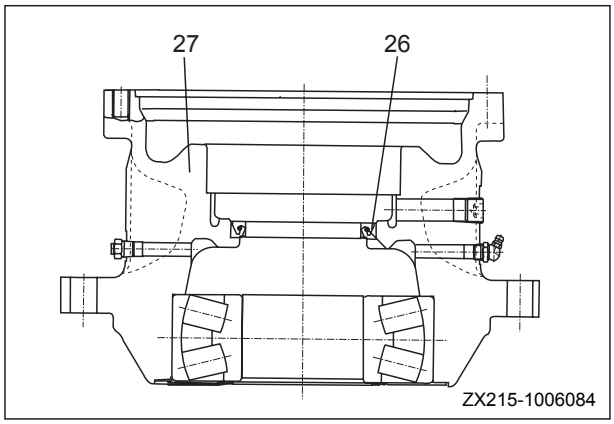


2. Oil seal

Press the oil seal (26) into the housing (27).

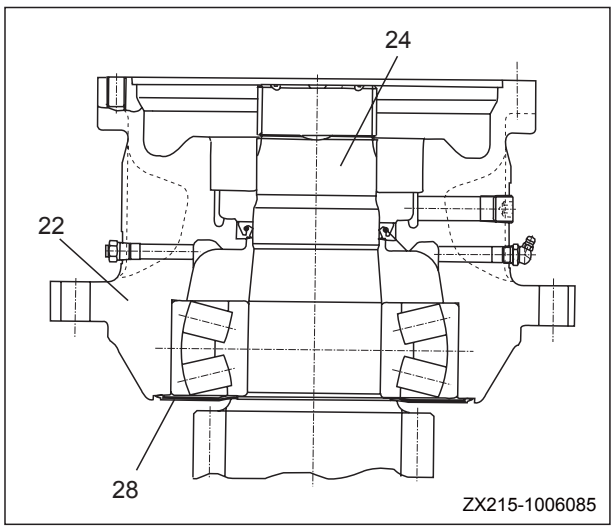
Oil seal installation surface:

Gasket sealant (Loctite 515)



3. Housing assembly

1) Position the plate (28) on the shaft (24).
2) Position the housing assembly (22) on the shaft (24). Press in the bearing.



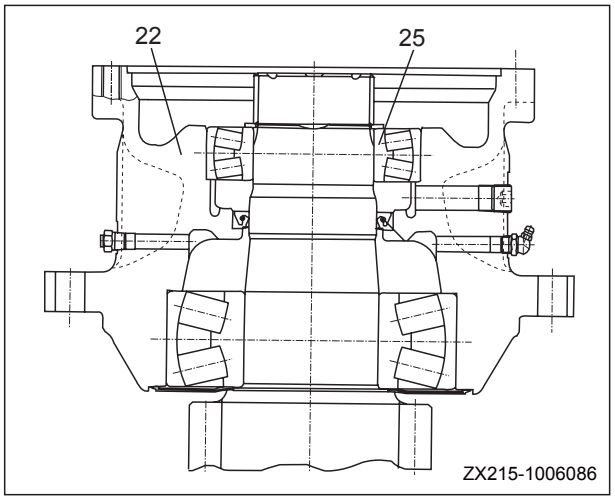
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4. Bearing

Press in the bearing (25).

★ When press fitting the bearing, press the bearing inner race and outer race simultaneously. Never press only the inner race.

★ After assembling the bearing, check if the housing rotates freely.



5. No. 2 Planetary carrier assembly

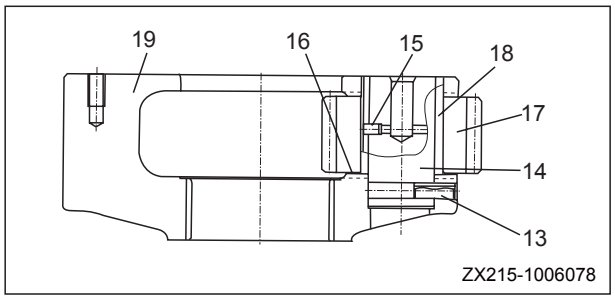
1) Reassemble No. 2 carrier assembly according to the following procedure.

i) Assemble the plate (16) in the carrier assembly (19).

ii) Assemble the gear (17) in the carrier assembly (19). Put the bearing (18) on the shaft (14). Slightly tap the pin (15) into the bore after alignment. Use a rubber hammer to tap the pin. Make sure that the pin (15) must not higher than the bearing (18).

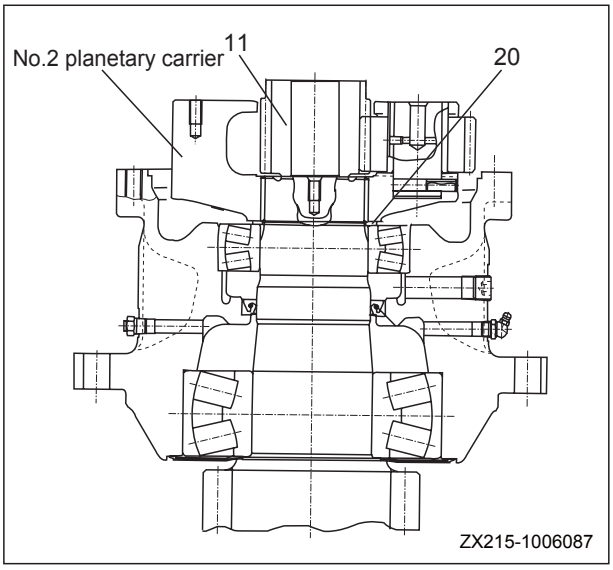
iii) Push the shaft assembly into the carrier assembly (19). Be careful not to damage the gear and the plate. Align the pin bore of the shaft with that of the carrier assembly, and install the pin (13). Carefully tap the pin with a rubber hammer during installation.

★ Installation of the shaft requires rotating the planetary gear. Be careful not to damage the thrust washer.



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6. Assemble in turn the snap ring (20), No.2 carrier assembly and No.2 sun gear (11).

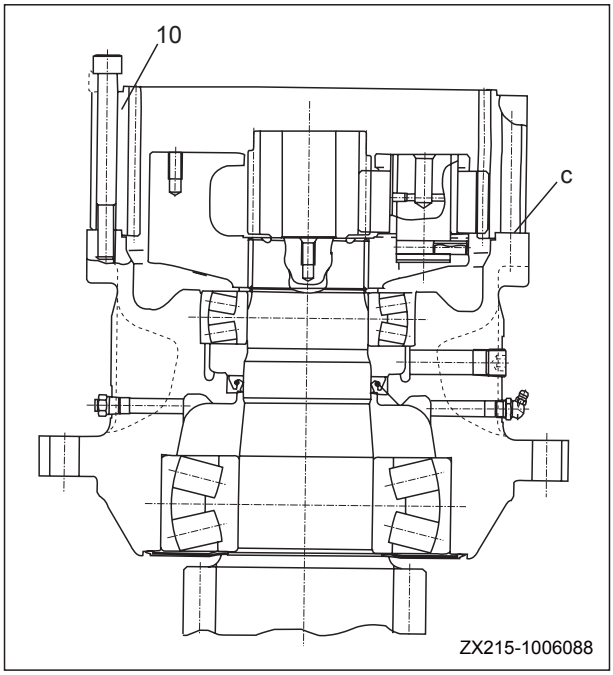


7. Installation of ring gear

Apply sealant on the mating surface indicated by (C) and tighten it with screws. Never get the sealant onto the ring gear (10).

Mating surface:

Sealant (Loctite 515)



8. No. 1 planetary carrier assembly

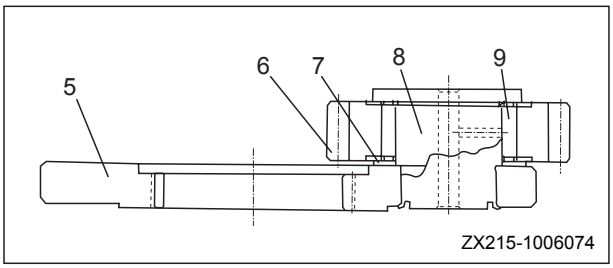
1) No. 1 carrier assembly is assembled as per the following procedure.

   i) Install the plate (7) into the carrier assembly (5).

   ii) Install the gear (6) onto the plate after installing the bearing (9) into the gear.

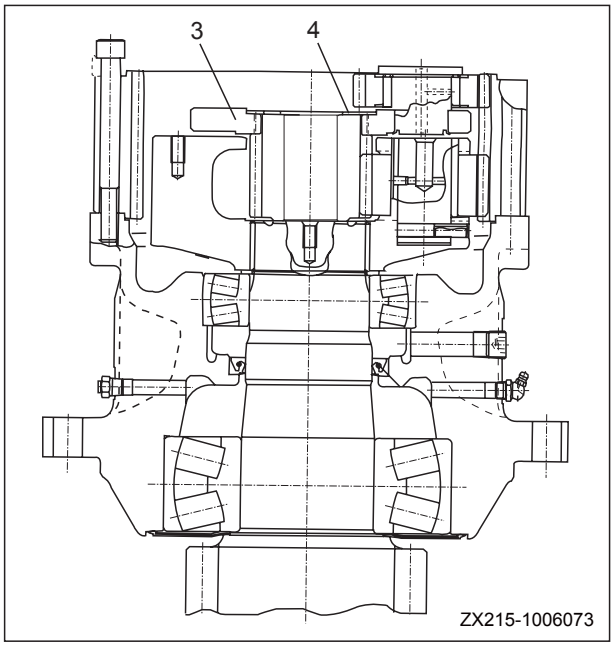
   iii) Press the shaft (8) into the gear (6) and the carrier assembly (5). Rivet one end of the shaft.

   ★ Check if the gear rotates freely.



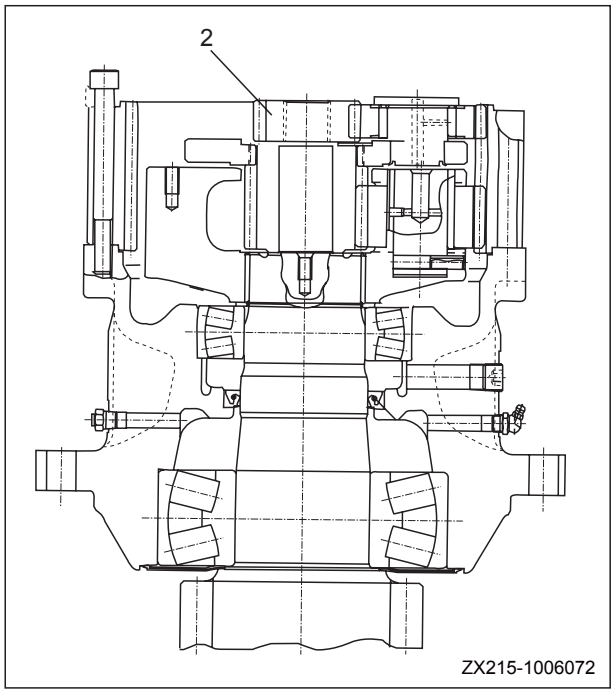
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2) Install No. 1 carrier assembly (3) and the plate (4).



9. No. 1 sun gear assembly

Install No. 1 sun gear (2).



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10. Installation of swing motor assembly

Apply sealant to the contact surfaces of the ring gear and the motor cover, and install the swing motor assembly.

Contact surface:

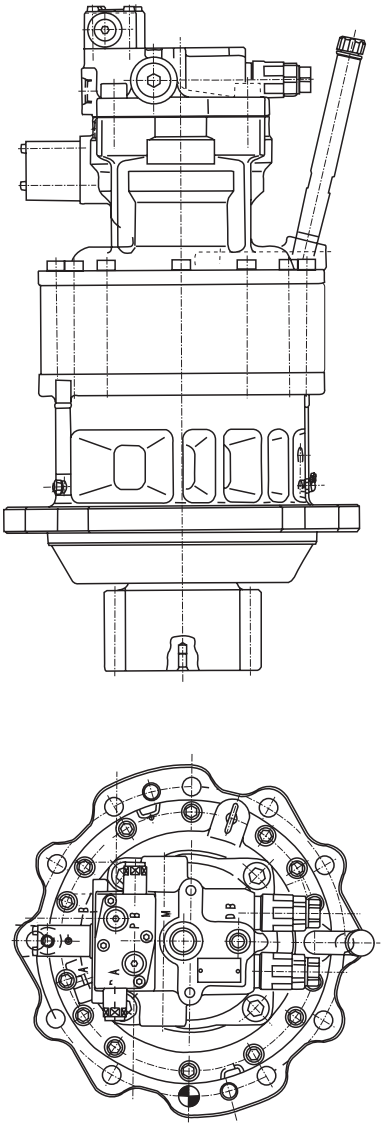
Sealant (Loctite 515)

Swing motor assembly: 62 kg

Mounting bolts (swing motor):

156±5 N·m {16±0.5 kg}

★ The 14 bolt holes of the swing motor and swing drive assembly are distributed nonuniformly. The mating direction of each hole is fixed, as shown in the illustration on the right. The installation of swing motor requires proper alignment of the bolt holes in order to ensure the installation orientation.



ZX215-1006089

11. Lubricant adding

Screw on the drain plug and add lubricant through the filler to the specified level (the upper mark of oil stick).

Swing drive: approx. 4 L

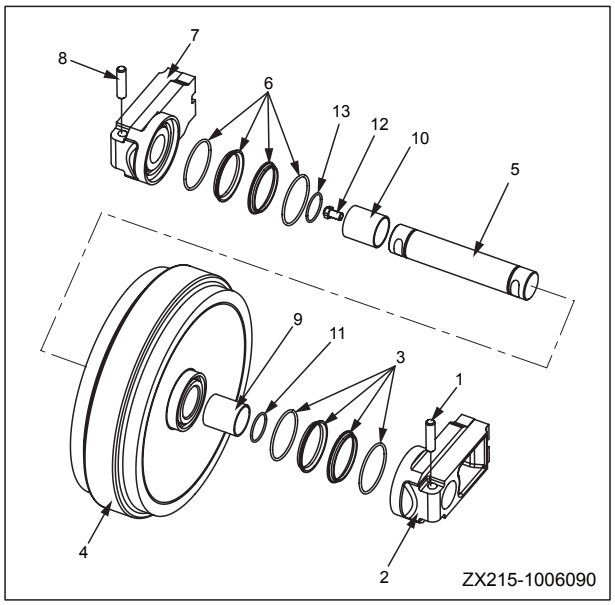
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8.9 Idler AS - Disassemble and Assemble

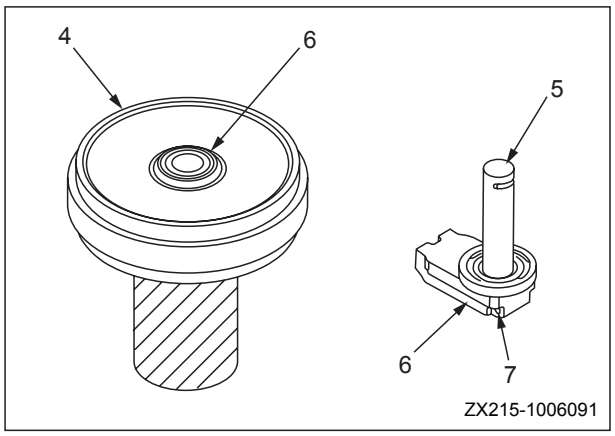
8.9.1 Disassembly

1. Remove the dowel pin (1) and the support (2).
2. Remove the float seals (3) from the support (2) and the idler (4).
3. Remove the O-ring (11). Remove the idler (4) from the shaft (5) and the support assembly (7).

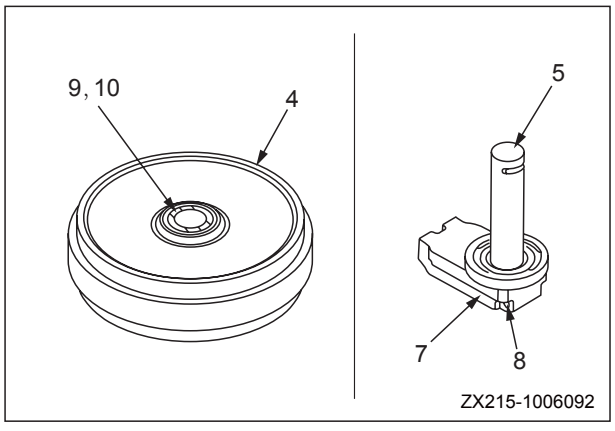
   ★ The idler contains 80 ml oil, which should be drained completely before disassembling. Spread a cloth on the floor to prevent smearing the floor with oil.



4. Remove the float seals (6) on the other side from the idler (4), shaft (5) and support assembly (7).



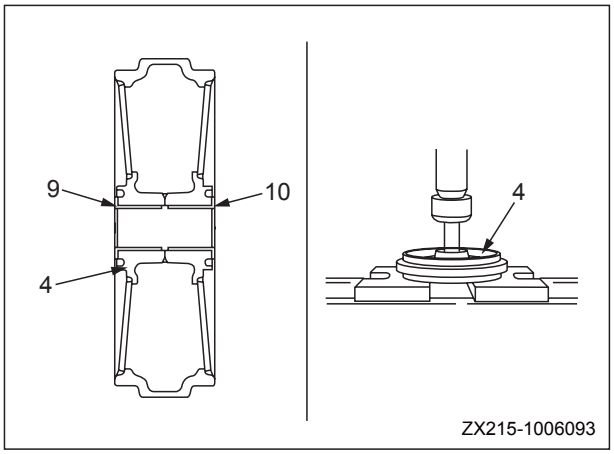
5. Remove the dowel pin (8) in order to remove the support (7) from the shaft (5).
6. Remove the bushings (9) and (10) from the idler (4).



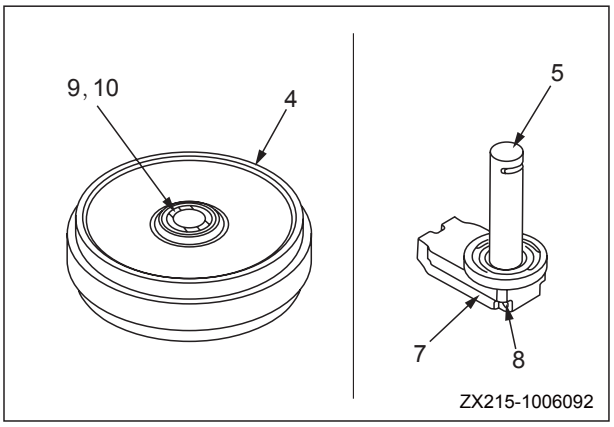
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8.9.2 Assembly

1. Install the bushings (9) and (10) in the idler (4).



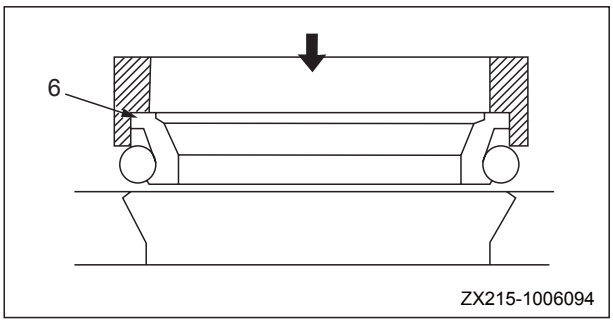
2. Assemble the O-ring. Install the support (7) to the shaft (5) with the dowel pin (8).



3. Install the float seals (6) to the idler (4), shaft (5) and support (7) assembly.

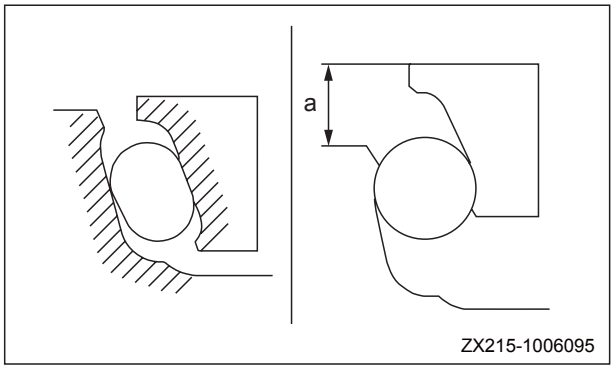
   ★ Float seals

   Completely remove the grease from the contact surfaces (hatched area in the illustration on the right) of O-ring and float seal before installing the float seal. In addition, care must be taken to keep the contact surface of float seal free from dust.

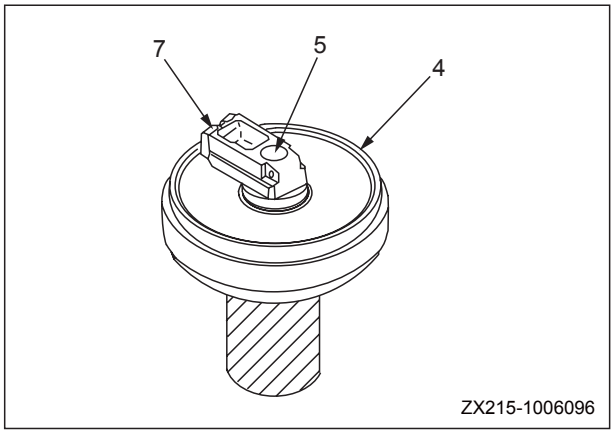


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★ After installation of the float seals, check that the sealing inclination should be less than 1 mm and the seal protrusion between 5 and 7 mm.



4. Install the shaft (5) and support (7) assembly to the idler (4).

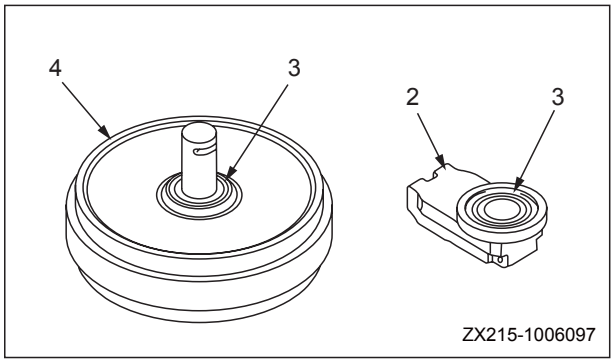


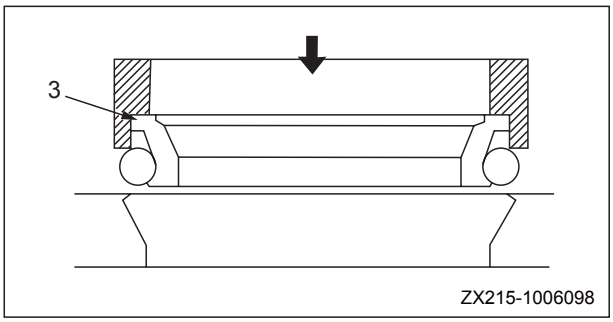
https://truckmanualshub.com/

5. Install the float seal (3) to the idler (4) and support (2).

   ★ Apply oil to the sliding surface of float seal. Care must be taken to keep the sliding surface from any contaminants or dust.

   ★ Remove the oil and dust from the contact surfaces of the O-ring and float seal.

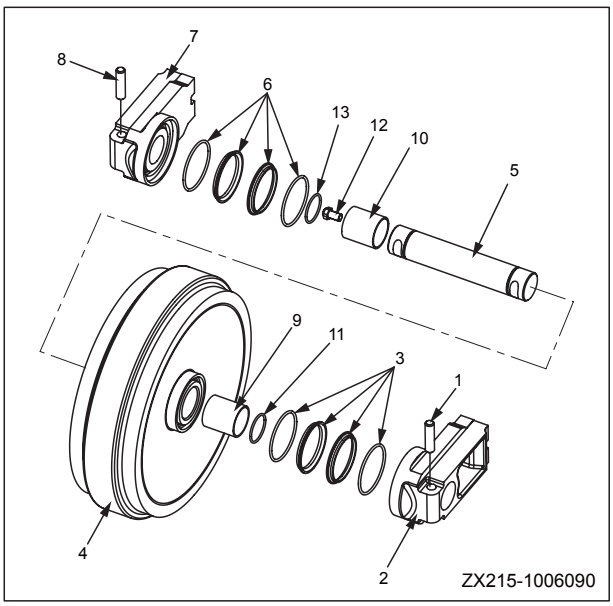




6. Install the O-ring. Install the support (2) with the dowel pin (1).
7. Add oil and screw on the plug.

   Oil: approx.
   80 ml (No.18 hyperbola gear oil)

   Plug:
   205.8±49 N·m {21±5 kgf·m}



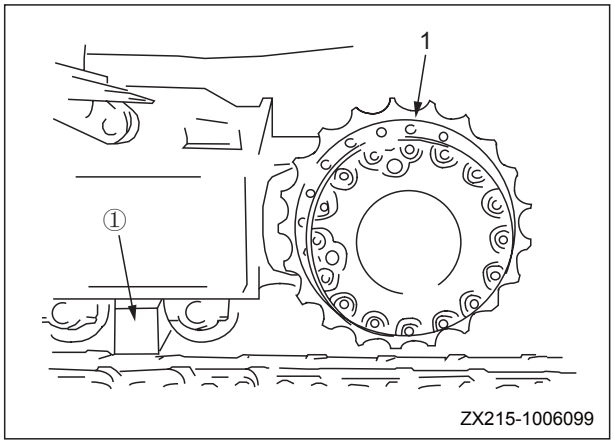
https://truckmanualshub.com/

8.10 Sprocket - Remove and Install

8.10.1 Removal

1. Remove the track assembly. Refer to “Track AS - Remove and Install” on page 8-50.
2. Swing the work equipment 90°and lift the chassis with the work equipment. Place a block ① between the track frame and the track shoe.
3. Remove the sprocket (1).

Sprocket: 58 kg



8.10.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

Threads (bolt - sprocket):

Thread sealant (Kesaixin 1277)

Bolts (sprocket):

339±20 N·m {35±2 kgf·m}

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8.11 Track AS - Remove and Install

Special tools

Mark	Part Name	Necessity	Qty
M	Manual/electric hydraulic track removing/installing machine	•	1

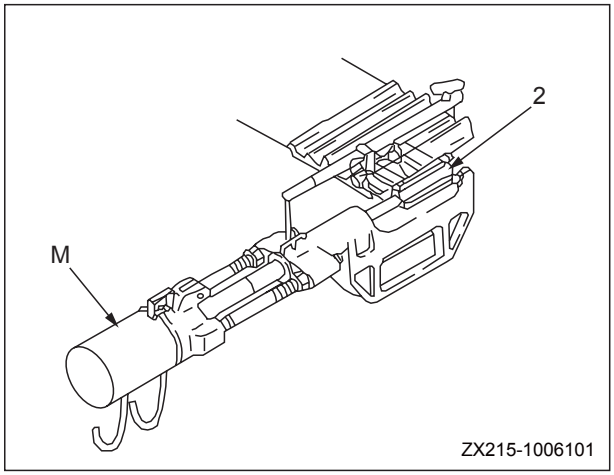
8.11.1 Removal

1. Choose a place that has enough space to spread the track. Park the machine when the master pin is between the idler and the carrier roller.
2. Lower the work equipment. Loosen the grease fitting (1) and release the track tension.

   The adjustment cylinder is under extremely high pressure. Never loosen the grease fitting by more than one turn. Move the machine back and forth if no grease is seen.

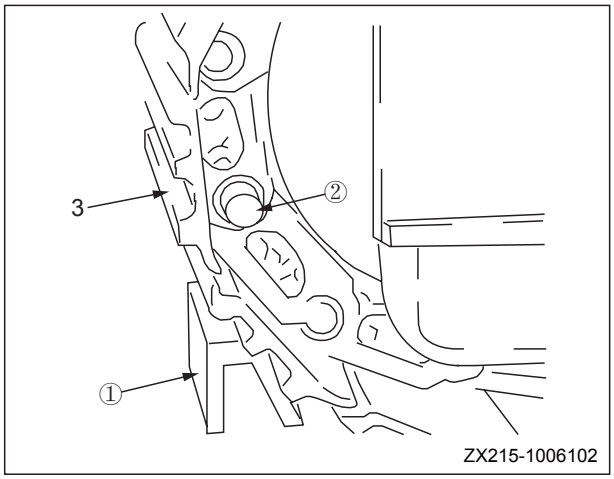


3. Pull out the master pin (2) with the tool (M).



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4. Remove the tool (M). Move the machine forward so that the temporary pin ② is in front of the idler. Place the block ①.
5. Remove the temporary pin ② and the dust seal. Move the machine backward to spread the track (3).



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8.11.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

★ Refer to "Testing and Adjusting", "Track Shoe Tension - Test and Adjust".

- Installation procedure of track shoe bolts and nuts

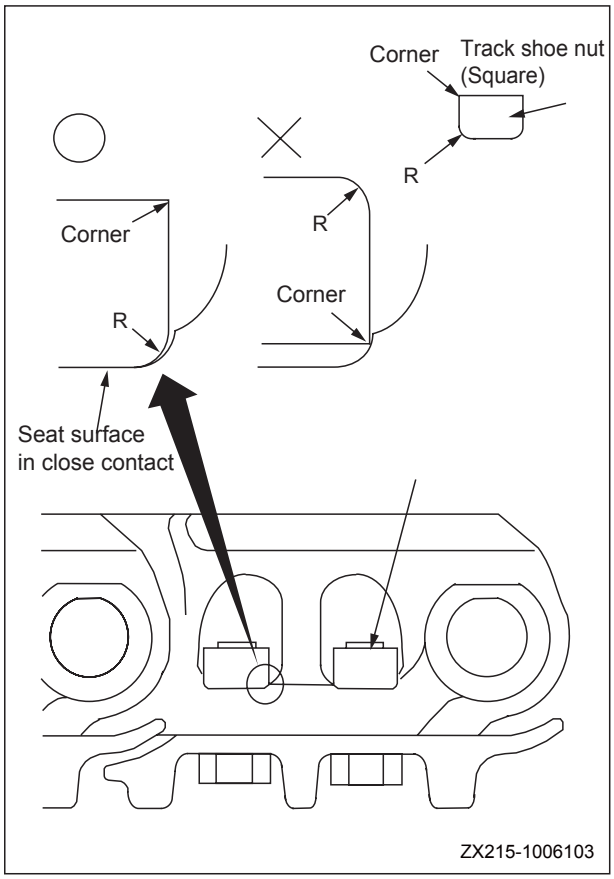
  1) Bring the R side of the track shoe nut (1) to the link seat surface. Both seat surfaces should be in close contact when assembling the track shoe.

  ★ If the track shoe bolts are installed from the other side, the corner of nut will interfere with the link seat surface, causing the nut to raise and the bolt to loosen.

  2) Tighten the bolts of track shoe to the torque below.

  Track shoe bolts:

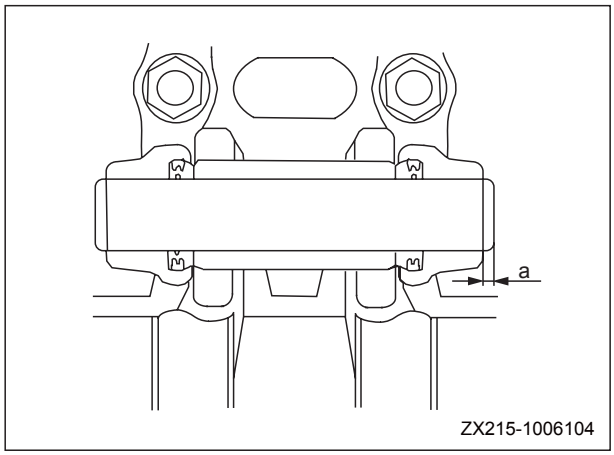
  750±30 N·m {77±3 kgf·m}



※2

★ Use the tool (M) to press the master pin. Make sure that the protrusion of master pin meets the size (a).

Master pin protrusion (a): 2.5±1 mm



※3

★ Before installing the dust seal, apply grease (No.2 lithium base) to its contact surface with the bushing.

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8.12 Swing Bearing AS - Remove and Install

8.12.1 Removal

1. Remove the swing platform assembly. Refer to “Swing Platform AS - Remove and Install” on page 8-55.
2. Dismount the 36 bolts (1) to remove the swing bearing assembly.

※1



3. Hoist the swing bearing assembly (2).

※2

Swing bearing assembly: 314 kg



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8.12.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

Threads (bolt - swing bearing):

Thread adhesive (Tonson 1277)

Mounting bolts (swing bearing):

Step 1:

Use a pneumatic spanner to tighten the bolts.

Step 2:

Torque to: 549±59 N·m {56±6kgf·m}

1) When a torque spanner is used to tighten the bolts, tighten first the four corners and mark them.
2) Other bolts will be tightened clockwise or counterclockwise. After one bolt is tightened, tighten the next one on the diagonal position and make a mark.
3) Tighten the rest bolts in this way.

※2

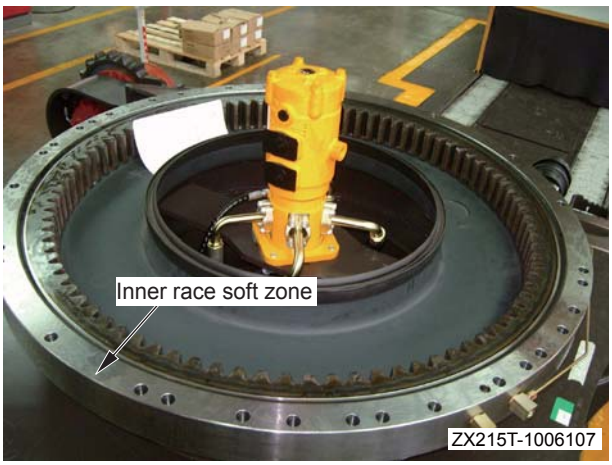
★ Let the S mark in the soft zone of the inner race of the inner ring face the right side, as shown in the photo, and install the swing bearing to the track frame.

★ Apply grease to the inside of the gear ring of the swing bearing.

- All gear teeth must be covered by grease .

Swing bearing:

Grease(supramoly lithium base):15 L



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8.13 Swing Platform AS - Remove and Install

8.13.1 Removal

⚠ Fully extend the arm and the bucket. Lower the work equipment to the ground and move the hydraulic lockout control lever to the LOCK position.

1. Disassemble the work equipment assembly. Refer to “Work Equipment AS - Remove and Install” on page 8-94.
2. Remove the counterweight assembly. Refer to “Counterweight AS - Remove and Install” on page 8-101.
3. Remove the four hoses (1) of boom cylinder.

   ★ Cork the hoses to prevent flow of oil.



4. Lift the boom cylinder assembly (2).

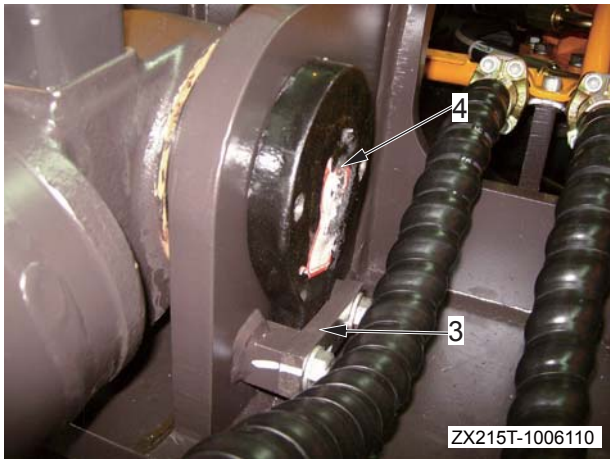


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5. Remove the plate (3) and the pin (4). Lift the boom cylinder assembly (2) in order to remove it.

   ★ Remove the boom cylinder assembly on the other side in the same way.

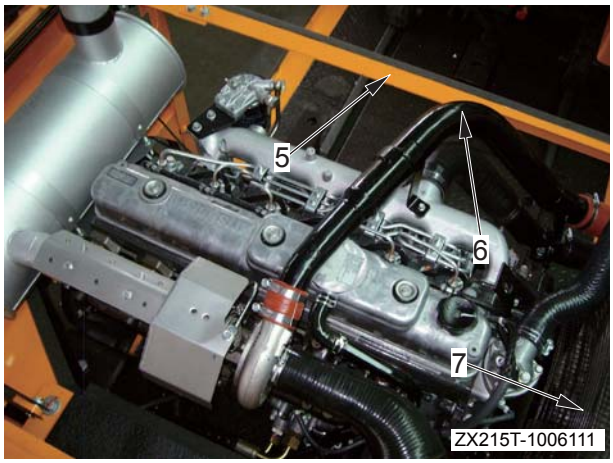
   Boom cylinder AS: 230 kg



6. Remove the plate (5), air intake hose (6) and fan guard (7).

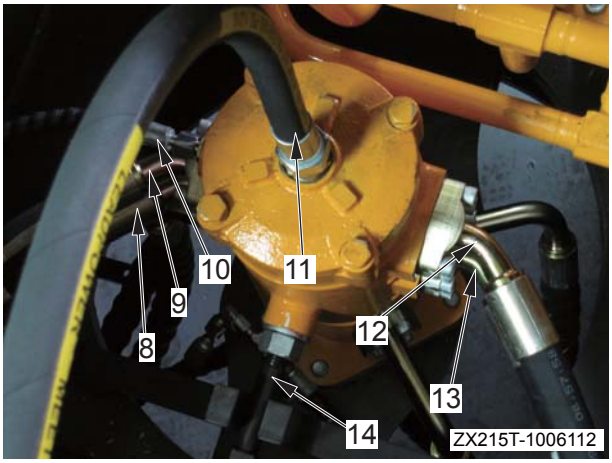
   ※1

   ★ Removal of the swing platform requires removing other parts that interfere with the lifting of swing platform.



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7. Disconnect the six hoses above the swivel joint assembly.
   8) Central swivel joint (port A)-
      Left travel control valve (port BTL)
   9) Central swivel joint (port C)-
      Left travel control valve (port ATL)
   10) Central swivel joint (port F)-
      Solenoid valve
   11) Central swivel joint (port G)-
      Swing motor (port T)
   12) Central swivel joint (port D)-
      Right travel control valve (port ATR)
   13) Central swivel joint (port B)-
      Right travel control valve (port BTR)
8. Remove the bolt (14).
9. Unscrew the 32 swing platform mounting bolts in order to remove the swing platform assembly (15). Lift the swing platform assembly off the machine.
   ★ Remove the front and rear mounting bolts of the platform. Use a lever block to adjust the swing platform so that the platform can reach a balance both longitudinally and laterally. Remove the last two bolts finally.
   ⚠ Be careful not to impact the central swivel joint while removing the swing platform assembly.
   Swing platform assembly:





	Assembly	Swing Platform Only (Ref.)
SY215C$_{LC}$	8,427 kg	1,689 kg

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8.13.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

Clamping screws (air intake hose):

5.4~6.4 N·m {0.55~0.65 kgf·m}

※2

Mating surface (swing bearing):

Flat surface sealant (Tonson 1596)

Threads (bolt - swing platform):

Thread adhesive: (Tonson 1277)

Mounting bolts (swing platform):

Step 1: Tighten the bolts with a pneumatic spanner.

Step 2: tighten them again.

490~608 N·m {50~62 kgf·m}

- Hydraulic oil adding

  Add through the filler opening the hydraulic oil to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Air bleeding

  Bleed the air from the travel motor.

  For more information, see “Air in Each Component - Bleed” on page 6-35.

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8.14 Swivel Joint AS - Remove and Install

8.14.1 Removal

⚠ Release residual pressure in the hydraulic circuit. Refer to “Residual Pressure in Hydraulic Circuit - Release” on page 6-29.

★ Tag each line so as to ensure correction installation.

1. Disconnect the six hoses from (1) to (6) on the central swivel joint of the travel motor.

   (1): Central swivel joint (port T)-
   Left travel motor (port T)

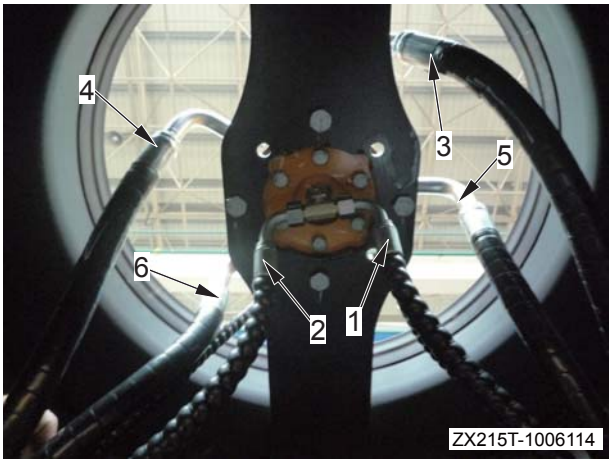
   (2): Central swivel joint (port T)-
   Right travel motor (port T)

   (3): Central swivel joint (port B)-
   Left travel motor (port PA)

   (4): Central swivel joint (port D)-
   Right travel motor (port PB)

   (5): Central swivel joint (port A)-
   Left travel motor (port PB)

   (6): Central swivel joint (port C)-
   Right travel motor (port PA)



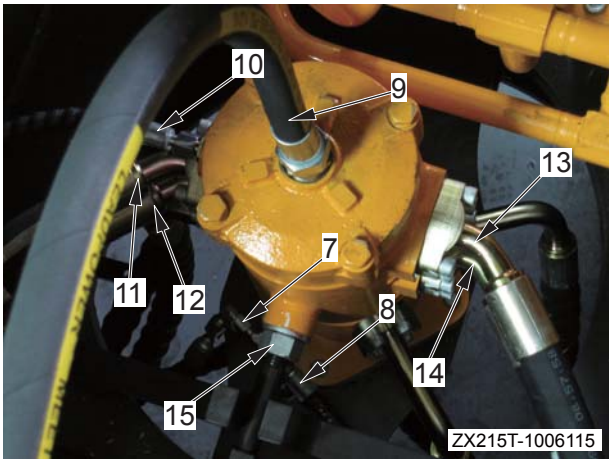
2. Disconnect the eight hoses from (7) to (14).

   (7): Central swivel joint (port F)-
   Left travel motor (port P)

   (8): Central swivel joint (port F)-
   Right travel motor (port P)

   (9): Central swivel joint (port G)-
   Swing motor (port T)

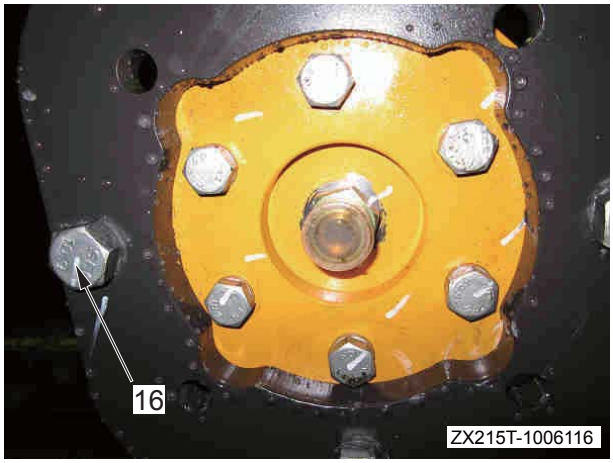
   (10): Central swivel joint (port F)-
   Solenoid valve



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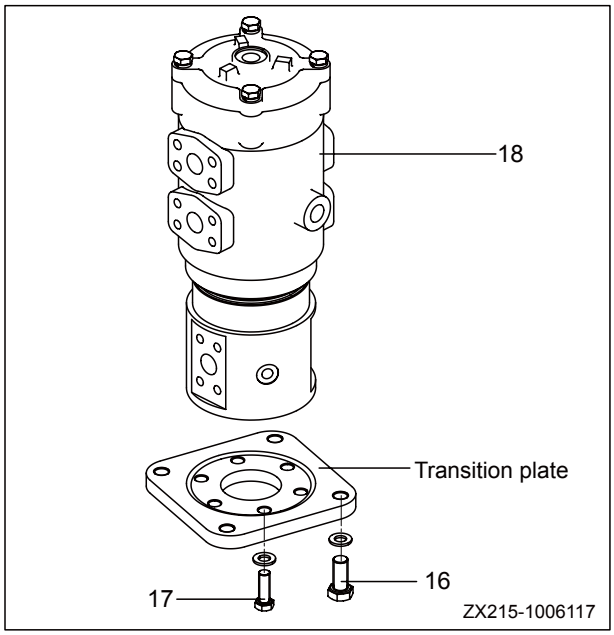
(11): Central swivel joint (port C)-
Left travel control valve (port ATL)
(12): Central swivel joint (port A)-
Left travel control valve (port BTL)
(13): Central swivel joint (port D)-
Right travel control valve (port ATR)
(14): Central swivel joint (port B)-
Right travel control valve (port BTR)

3. Remove the fixing bolt (15).
4. Remove the four mounting bolts (16).



5. Remove the six mounting bolts (17) from the transition plate. Remove the swivel joint assembly (18). ※1

Central swivel joint: 56 kg



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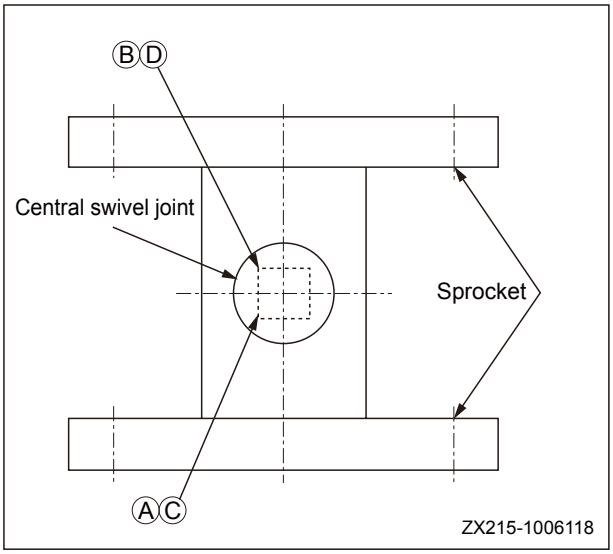
8.14.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

Install the central swivel joint facing the direction indicated in the illustration.

(In the illustration, the machine is seen from the above.)



- Oil adding (hydraulic tank)

  Add through the filler opening the hydraulic oil to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Air bleeding

  Bleed the air from the travel motor.

  For more information, see “Air in Each Component - Bleed” on page 6-35.

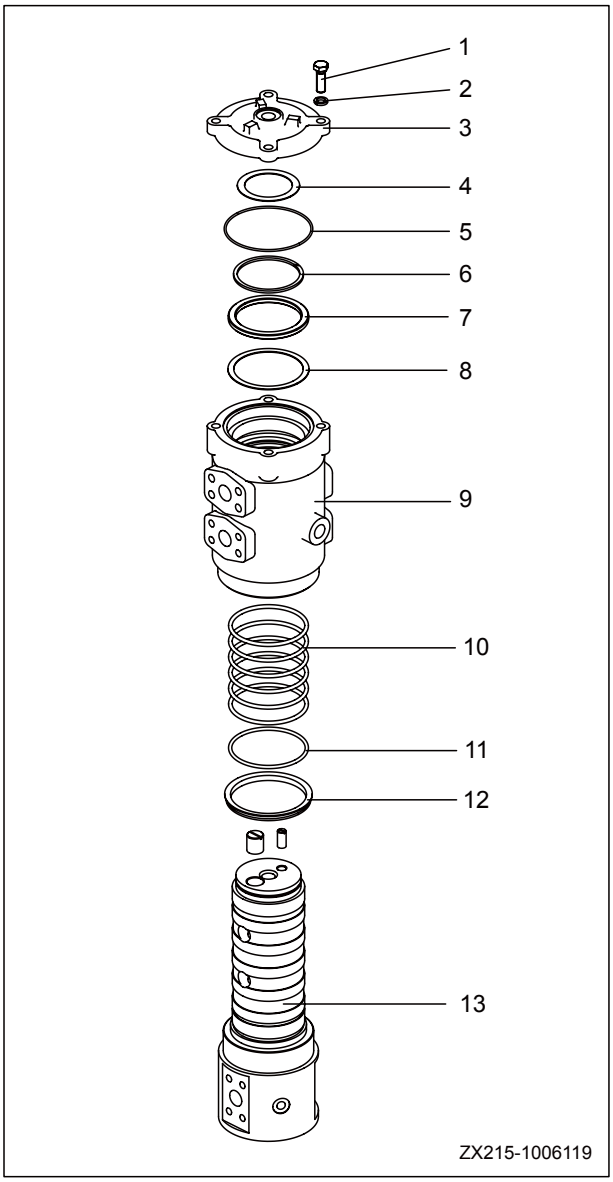
https://truckmanualshub.com/

8.15 Swivel Joint AS - Disassemble and Assemble

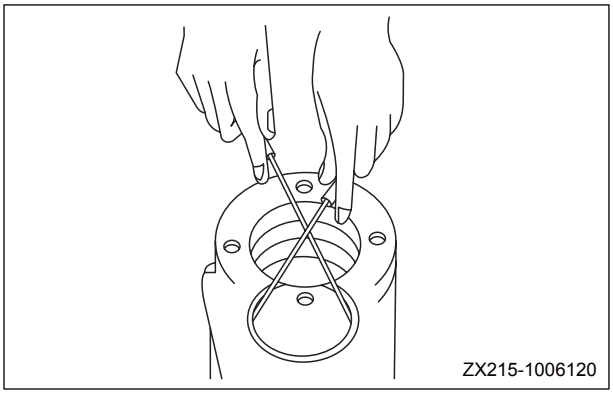
8.15.1 Disassembly

1. Remove the bolt (1) and the spring washer (2).
2. Remove the cover (3).
3. Remove the gasket (4), O-ring (5) and snap ring (6).
4. Remove the rotor (13) from the housing (9).

   ★ Be careful not to damage the sliding surface of the seal of the rotor (13).
5. Remove the spacer (7) and the gasket (8) from the housing (9).
6. Remove the dust seal (12) from the swing shaft (13).



7. Remove the O-ring seal (11) and the seals (10) from the housing (9).

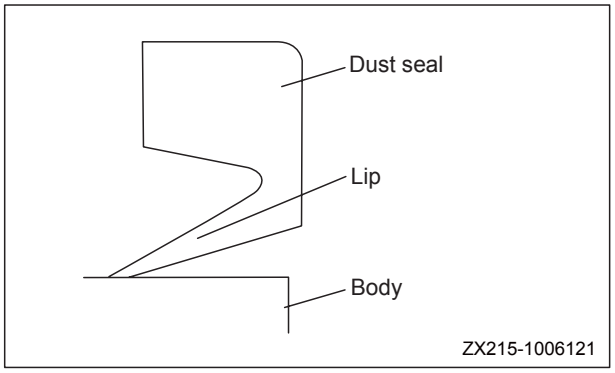


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8.15.2 Assembly

1. Install the dust seal (12) on the rotor (13).
   ★ Let the lip face the housing while installing the dust seal.
2. Install the six seals (10) in the housing (9).
3. Fix the rotor (13) on a work bench. Install the housing (9) on the rotor (13).
   ★ Since the clearance between the housing (9) and the rotor (13) is approximately 0.1 mm, install the housing (9) on the rotor (13) slowly and vertically. Be careful not to damage the seals (10) and the O-ring seal (11).
4. Use a rubber hammer to tap the housing (9) in order to match the rotor (13) properly.
5. Install the spacer (7) and gasket (8) in the housing (9).
6. Install the gasket (4), O-ring seal (5) and snap ring (6) on the rotor (13).
7. Install the cover (3). Tighten the bolts (1) and the spring washer (2).

   Fixing bolts: 49 N·m{5 kgf·m}



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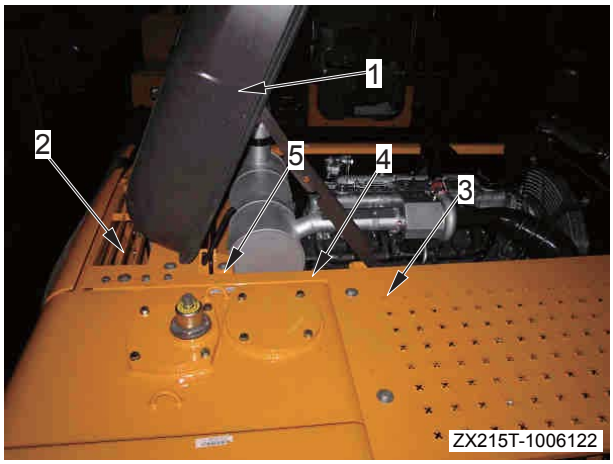
8.16 Hydraulic Tank AS - Remove and Install

8.16.1 Removal

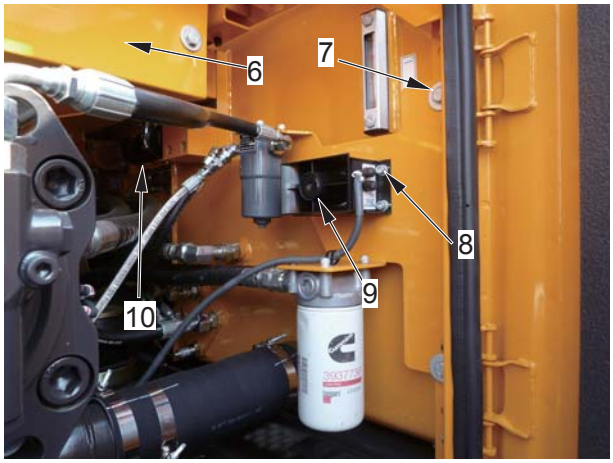
1. Drain the hydraulic oil into a suitable container for storage or disposal.

   ※1

   Hydraulic oil: approx. 225 L
2. Open the engine hood.
3. Remove the engine hood (1), cover (2) and control valve cover (3).
4. Remove the cover mounting frame (4) and the screen (5).



5. Remove the screen (6) and the partition frame mounting bolt (7) on the hydraulic tank side.
6. Remove the screen (8) and the travel alarm (9).
7. Remove the two oil return hoses (10) from the hydraulic tank.



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8. Disconnect the seven hoses.

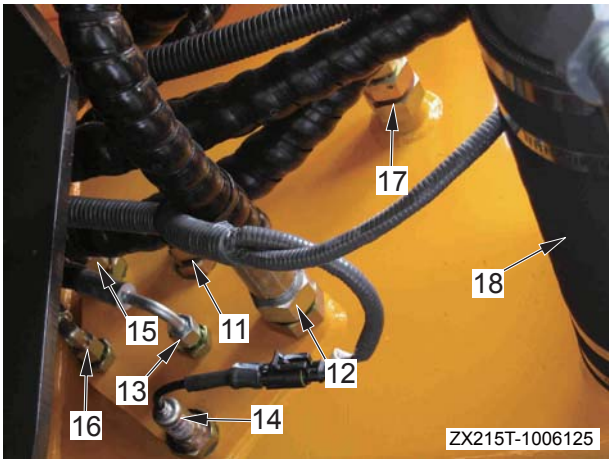
※2

- (11): Oil return - pilot T block
- (12): Oil return - main pump
- (13): Oil return D2 - main valve
- (14): Sensor - temperature
- (15): Oil return - solenoid valve
- (16): Oil return D1/D3 - main valve
- (17): Oil return - swing motor

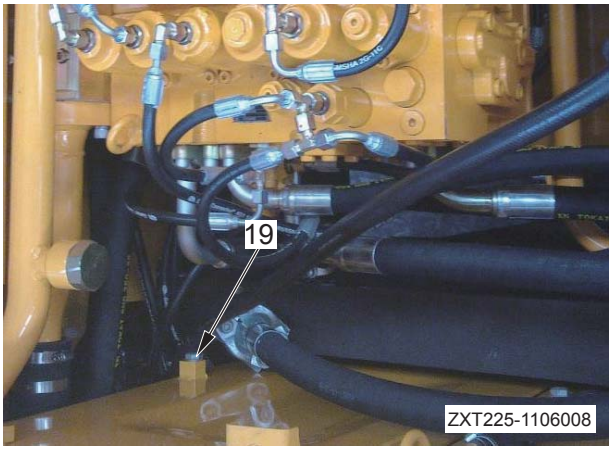
★ Disconnect the oil inlet hose (18) from the hydraulic tank after disconnection of the oil inlet tube from the pump.

★ Attach each hose with an identification tag.

★ Use a sleeve nut to prevent the fitting and the cone seal from damage.



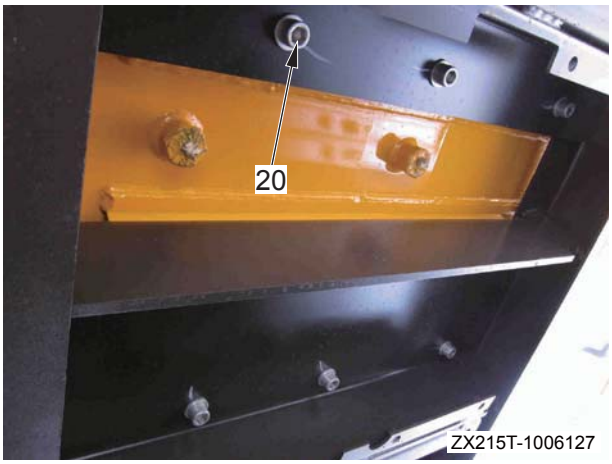
9. Remove the hose clamp (19).



10. Lift the hydraulic tank assembly and remove the six bolts (20). ※3

11. Lift off the hydraulic tank assembly for disassembling.

Hydraulic tank assembly: 130 kg



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8.16.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

Drain plug (hydraulic tank):

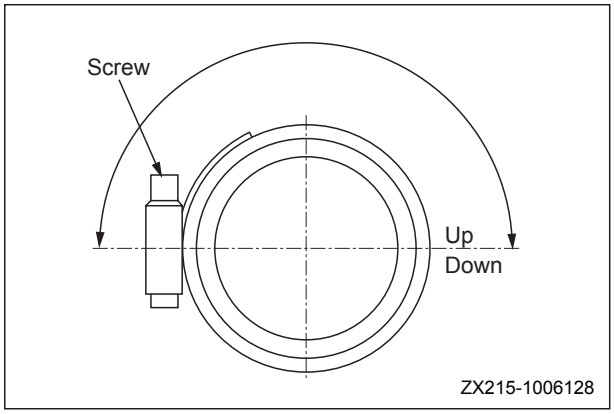
58.8~78.5 N·m {6.0~8.0 kgf·m}

※2

★ After tightening the hose clamping screw, check that the screw should be in the range indicated in the illustration.

Screw (hose clamp):

8.8±0.5 N·m {0.9±0.05 kgf·m}

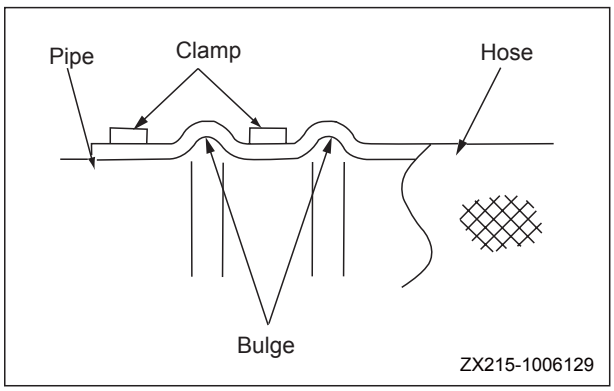


★ Install the hose clamp and tighten the screw according to the illustration on the right.

※3

Bolt:

245.2~308.9 N·m {25~31.5 kgf·m}



- Oil adding (hydraulic tank)

  Add hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Air bleeding

  For more information, see “Air in Each Component - Bleed” on page 6-35.

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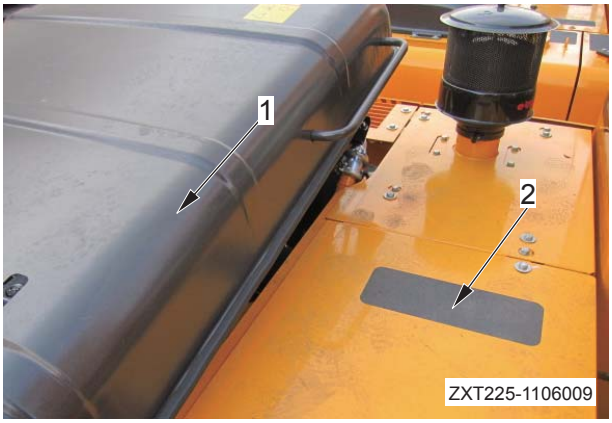
8.17 Control Valve AS - Remove and Install

8.17.1 Removal

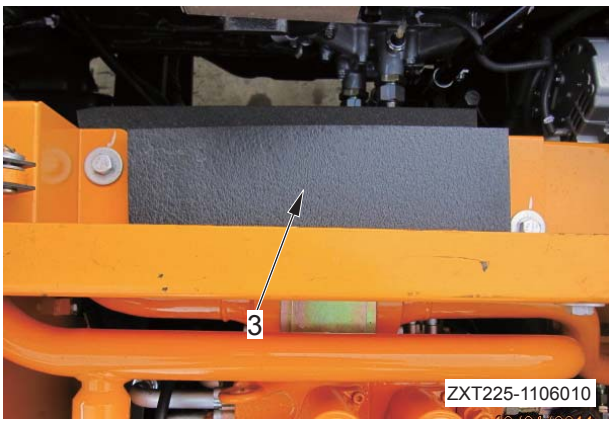
⚠ Lower the work equipment to the ground. Stop the engine. Press the release button of the breather valve to release residual pressure in the hydraulic tank. Place the hydraulic lockout control in the LOCK position.

★ Tag each line so as to ensure correction installation.

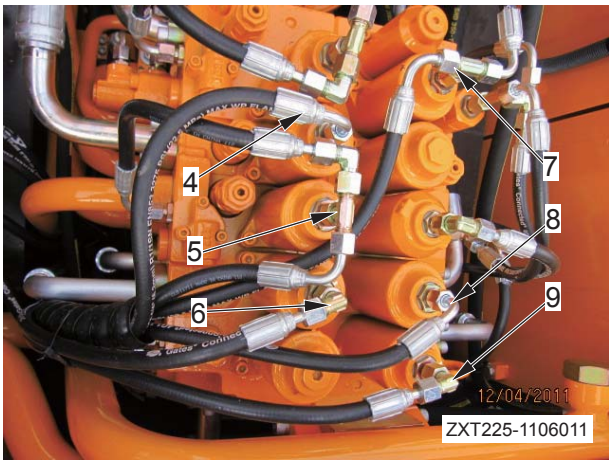
1. Lift the hood (1).
2. Remove the cover (2) above the control valve.



3. Remove the engine silencing hood (3).



4. Remove the baffle (4) to (9) of the pressure transducer and tag them.
   (4): XAK Bucket DIG
   (5): XBb1 Boom DOWN
   (6): XAtL Travel LEFT
   (7): XBa1 Arm IN
   (8): XBs Swing RIGHT
   (9): XAtr Travel RIGHT



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5. Disconnect the pilot hoses (10) to (18) and tag them properly.

   (10): XBtr Travel RIGHT

   (11): XAs Swing LEFT

   (12): PSP Swing priority

   (13): XAa1 Arm OUT

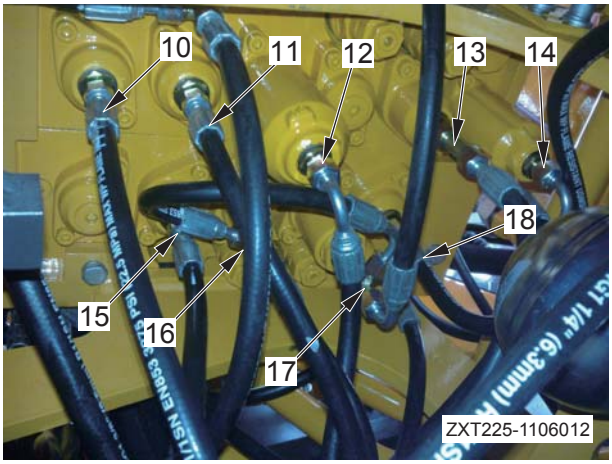
   (14): XBp2 Bucket confluence

   (15): XBtL Travel LEFT

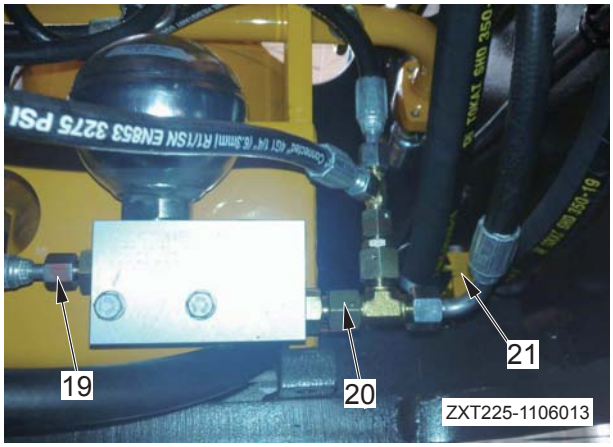
   (16): XAb1 Boom UP

   (17): XBK Bucket DIG

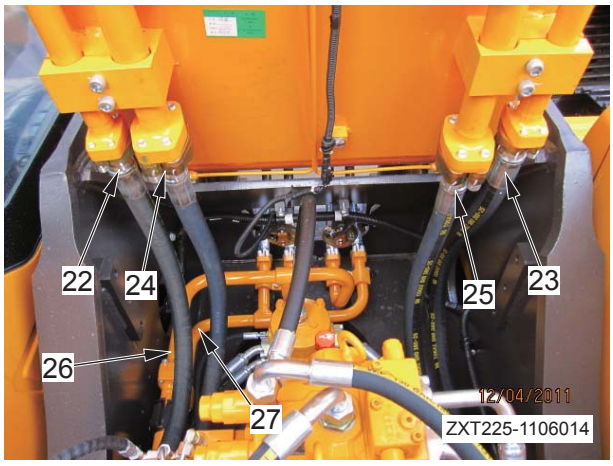
   (18): XAa2 Arm OUT



6. Remove the port (19) (accumulator to solenoid valve), port (10) (pilot filter to accumulator). Remove hose clip (21) of the central swivel joint.

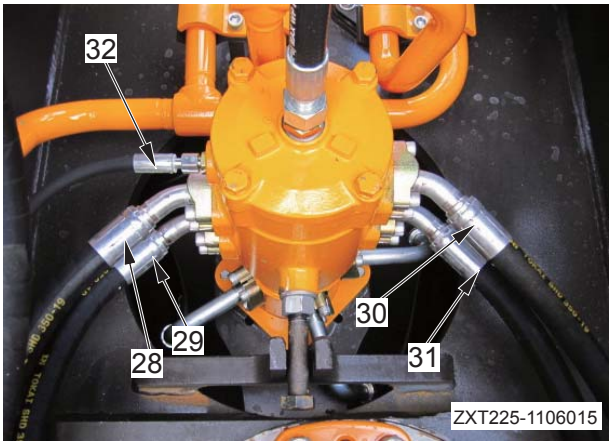


7. Remove bucket hoses (22) and (23) and seal the ports.
8. Remove arm hoses (24) and (25) and seal the ports.
9. Remove boom hoses (26) and (27) and seal the ports.

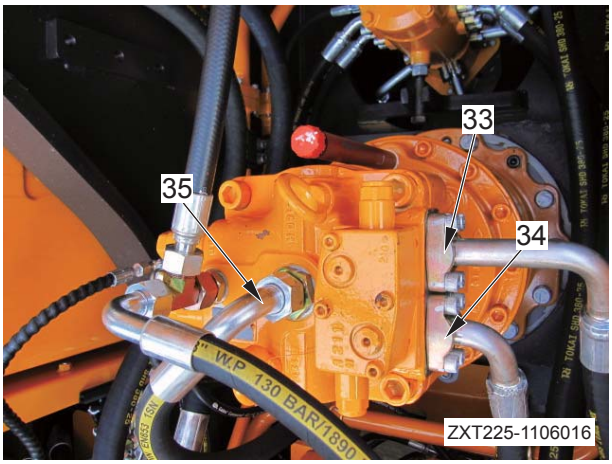


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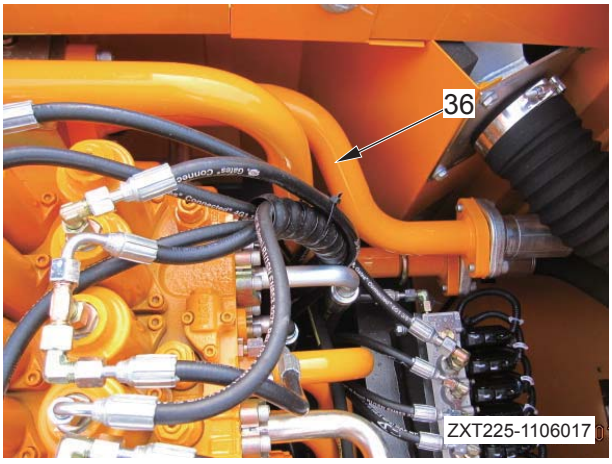
10. Remove central swivel joint hoses (28), (29), (30) and (31). Remove travel speed switching hose (32) and seal the ports.



11. Remove swing motor hoses (33) and (34). Remove swing motor oil complement hose (35). Seal the ports properly.

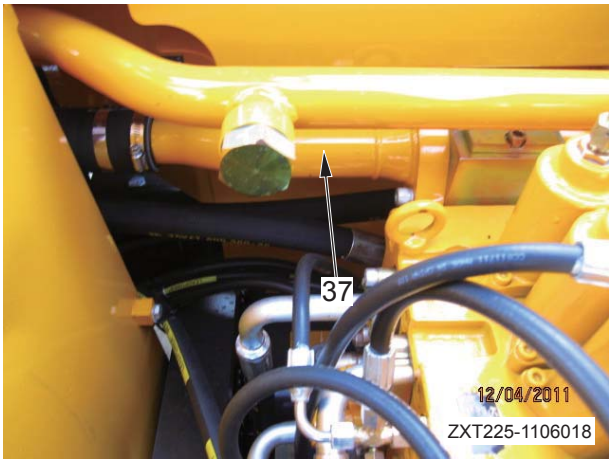


12. Remove pipe (36) (main valve to radiator).

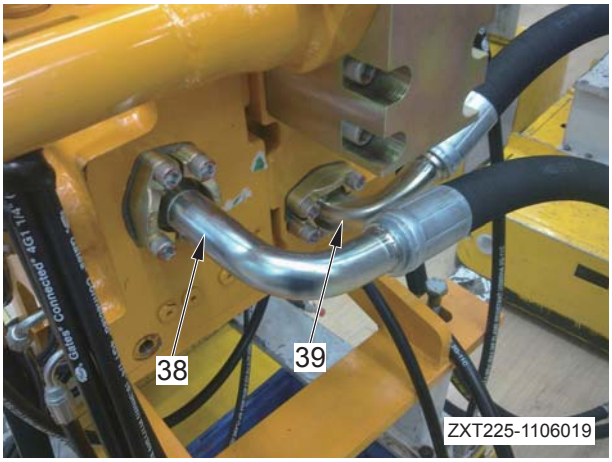


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13. Remove pipe (37) (main valve to return oil tank). Seal the ports properly.



14. Remove hydraulic pump hoses (38) and (39).



15. Remove hoses (40) to (44) on the solenoid valve and tag them properly.

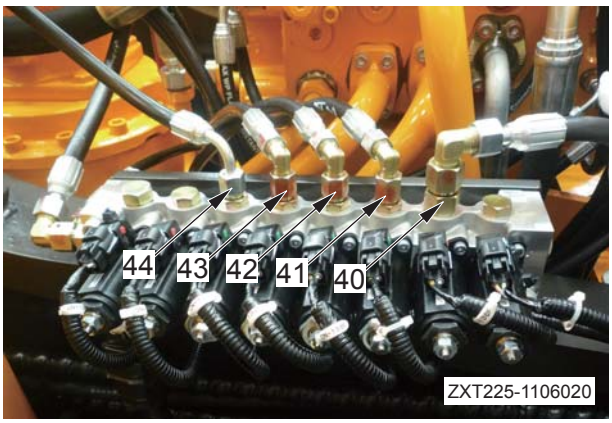
    (40): PPC lockout valve

    (41): Main valve PnA2

    (42): Main valve XBP2

    (43): Main valve PSP

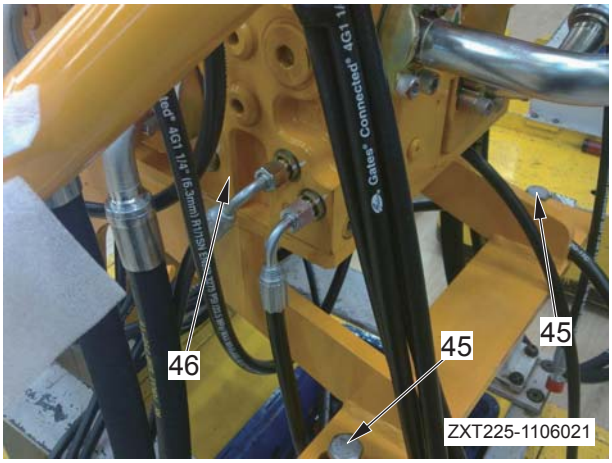
    (44): Travel PT port



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16. Remove the fixing bolts (45). Lift the control valve assembly (46) for disassembling.

    Control valve assembly: 220 kg



8.17.2 Installation

- Installation is to be performed in the reverse order of removal.
- Oil adding (hydraulic tank)

  Add hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.
- Air bleeding

  Bleed the air from the circuit between the valve and the hydraulic cylinder. For more information, see “Air in Each Component - Bleed” on page 6-35.

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8.18 Hydraulic Pump AS - Remove and Install

8.18.1 Removal

⚠ Lower the work equipment to the ground and stop the engine. Press the release button of the breather valve to release residual pressure in the hydraulic tank.

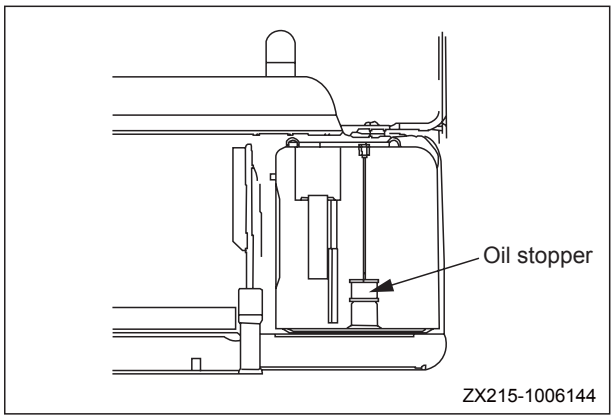
⚠ Disconnect the cable from the negative (-) post of the battery before performing the job.

★ Tag each line so as to ensure correction installation.

1. Remove the oil inlet filter element from the hydraulic tank and stop oil outflow with an oil stopper.

   ★ If no oil stopper is used, remove the drain plug and drain the oil from the hydraulic tank and from circuits.

   Hydraulic tank: Approx. 225 L

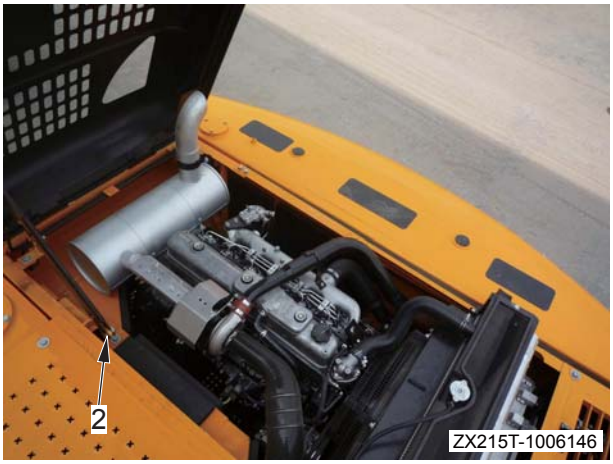


2. Lift the hood (1).

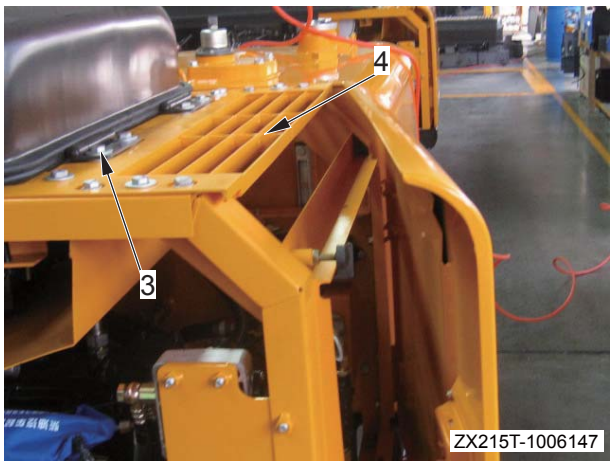


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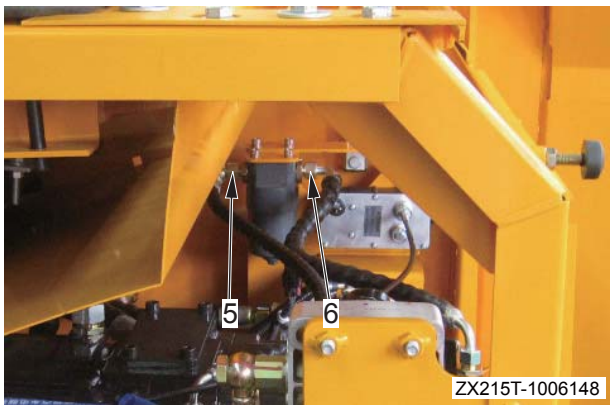
3. Remove the pin (2) and the bolts (3). Lift the engine hood in order to remove it.



4. Remove the right upper cover (4).

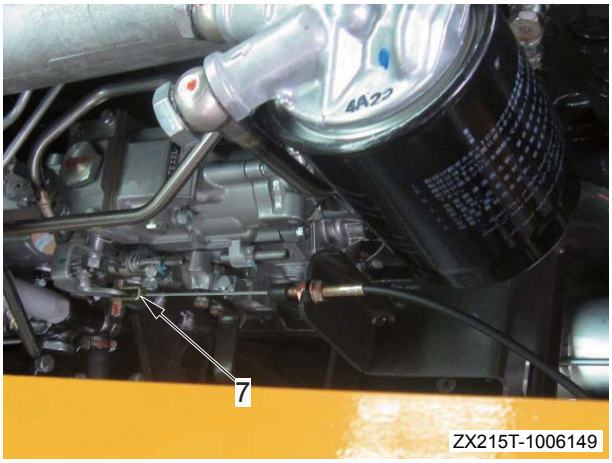


5. Disconnect the hose (5) supplying oil to the lower proportional valve and the hose (6) delivering oil from the pilot pump.

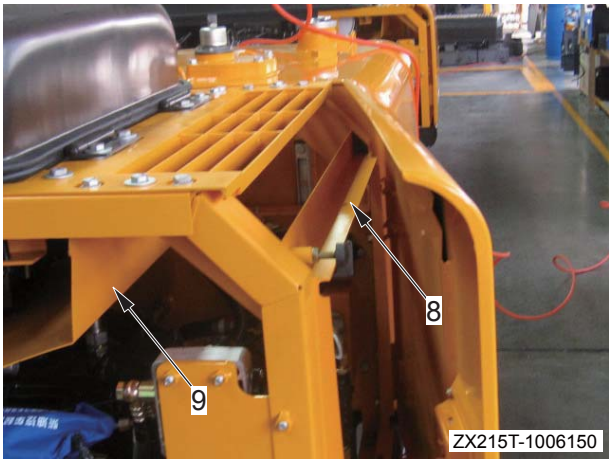


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6. Disconnect the shutdown wire (7).

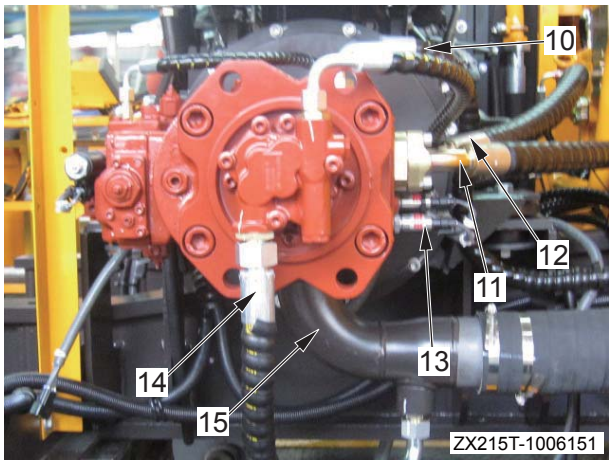


7. Remove the right door (8).
8. Remove the hydraulic pump cover (9).



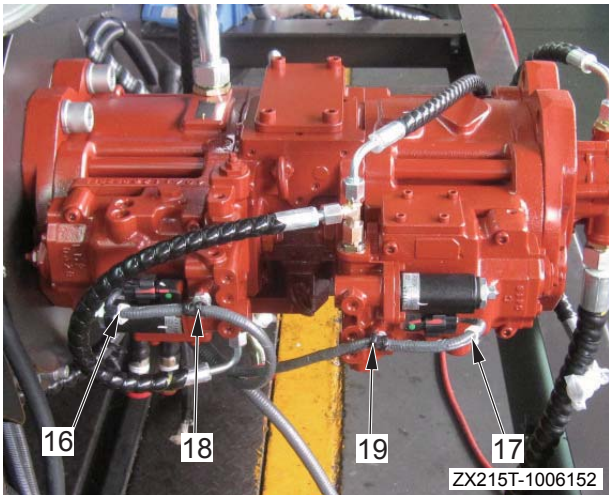
9. Disconnect the oil drain hose (10) and seal the openings properly.
10. Disconnect the high-pressure hoses (11) and (12) connecting to the control valve, and seal the openings properly.
11. Disconnect the harness (13) of the pressure transducer.
12. Disconnect the pilot pump oil inlet hose (14) and seal the openings properly.
13. Disconnect the pilot pump oil inlet tube (15) and seal the openings properly.

※1



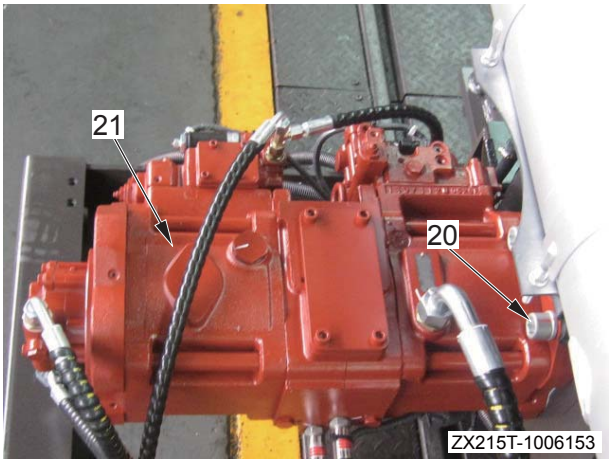
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14. Disconnect the solenoid valve harnesses (16) and (17). Remove the cable straps (18) and (19).



15. Remove the four bolts (20) of the hydraulic pump. Lift the hydraulic pump assembly (21) to remove it. ※2

Hydraulic pump assembly: 112 kg



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8.18.2 Installation

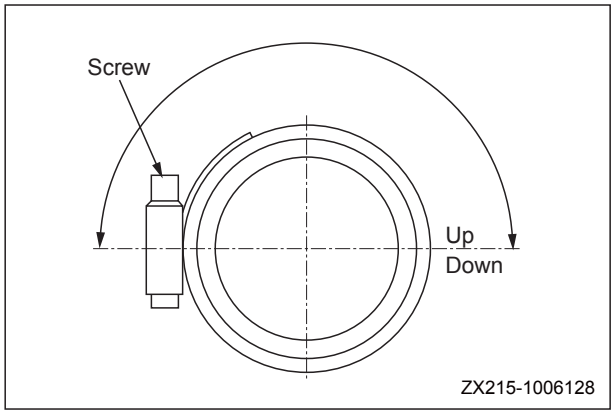
- Installation is to be performed in the reverse order of removal.

※1

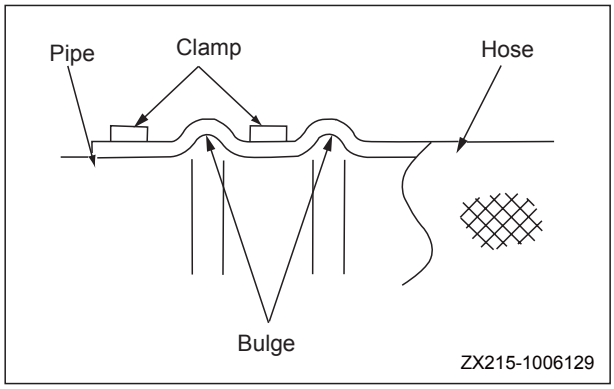
★ After tightening the hose clamping screw, check that the screw should be in the range indicated in the illustration.

Screw (hose clamp):

8.8±0.5 N·m {0.9±0.05 kgf·m}



★ Install the hose clamp and tighten the screw according to the illustration on the right.



※2

Mating surface (hydraulic pump housing):

Gasket sealant: (Loctite 515)

- Oil adding (hydraulic tank)

  Add hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

  Hydraulic tank: approx. 225 L

- Air bleeding

  For more information, see “Air in Each Component - Bleed” on page 6-35.

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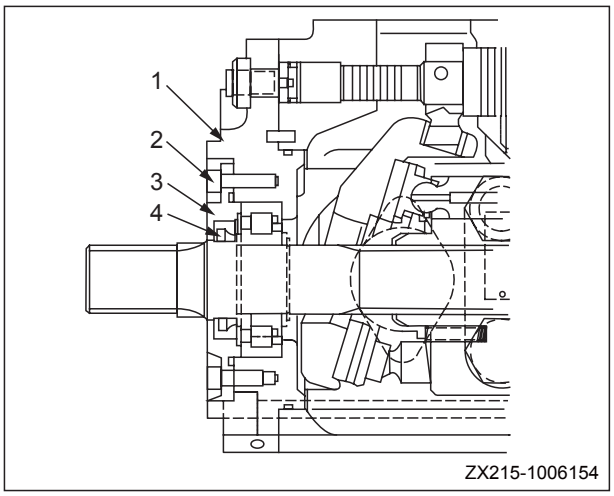
8.19 Middle Oil Seal (Hydraulic Pump Input Shaft)- Remove and Install

8.19.1 Removal

1. Remove the hydraulic pump assembly (1). Refer to “Hydraulic Pump AS - Remove and Install” on page 8-72.
2. Remove the screw (2). Remove the bearing cover (3).
3. Pry the oil seal (4) out with a screwdriver.

※2

★ Be careful not to damage the shaft while prying the oil seal.



8.19.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

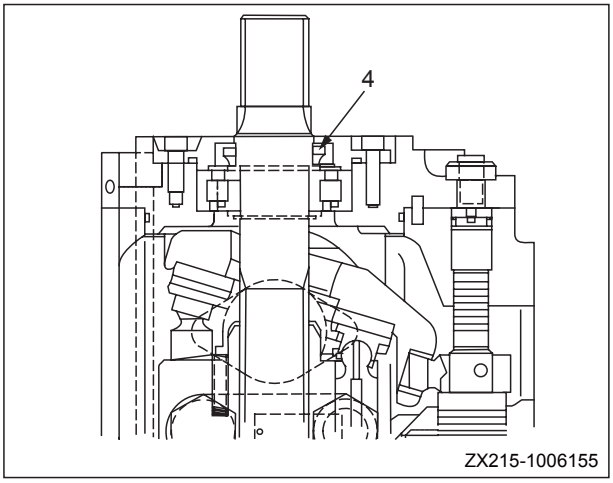
Seal lip:

grease (No.1 Calcium base grease)

Seal circumference:

grease (No.1 Calcium base grease)

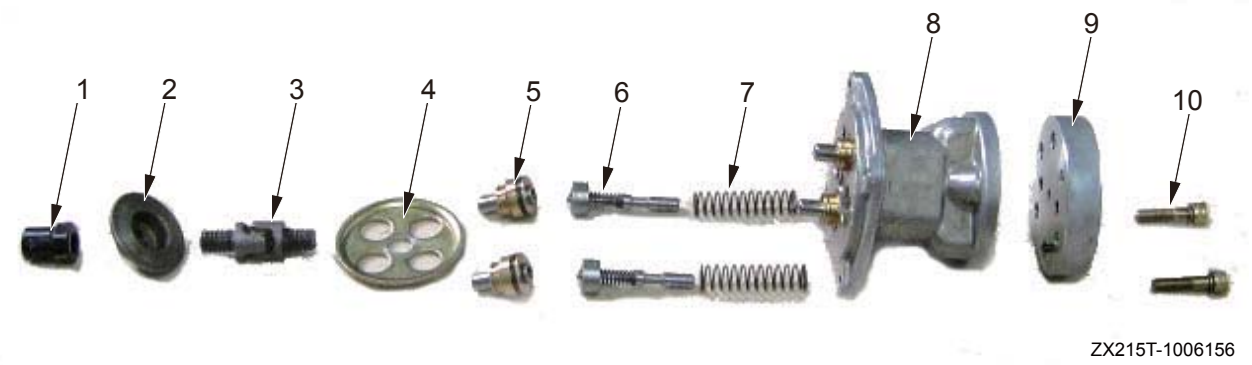
★ Apply a thin layer of grease to the oil seal circumference.



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8.20 Pilot Valve AS (Work Equipment) - Disassemble and Assemble

★ This section discusses only the precautions when reassembling the work equipment pilot valve assembly.



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8.20.1 Assembly

- Reassembly of the work equipment pilot valve assembly

1. Install the plate (9) in the valve body (8) with O-ring seal. Tighten the socket bolt (10).

   Socket bolt:

   25~33 N·m {2.55~3.36 kgf·m}

2. Insert the spring (7) into the spool hole in the valve body (8). Put the spool (6) in the spring. Install the plug (5) on the spool. Push the plug (5) to the spool hole.
3. Install the plate (4) on the plug (5). Tighten the U-joint (3).
4. Install the plate (2). Align the position of the plate (2) and tighten the nut (1).

   Nut:

   98~133 N·m {10~13.5 kgf·m}

   ★ Location of each oil port is stamped on the bottom of valve body.

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Plug (5) circumference:

Grease (No.1 Calcium base grease)

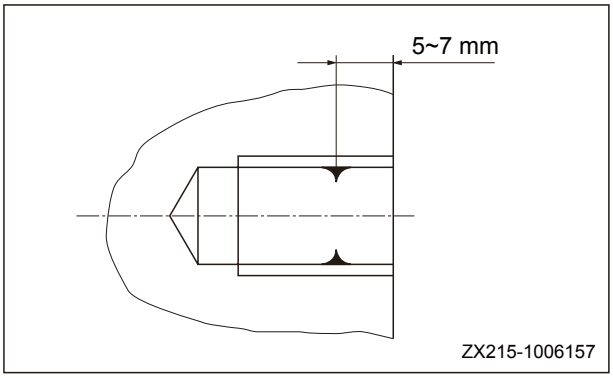
U-joint moving surface:

Grease (No.1 Calcium base grease)

Threads in valve body:

Thread adhesive (Tonson 1277)

★ Apply the thread adhesive (Tonson 1277) to two points on the inner threads, as indicated in the illustration below. The amount of application is approximately 0.02 g.



U-joint (3):

98~133 N·m {10~13.5 kgf·m}

★ Tightening is to be made to the specified torque.

Contact surface between plug (5) and plate (2):

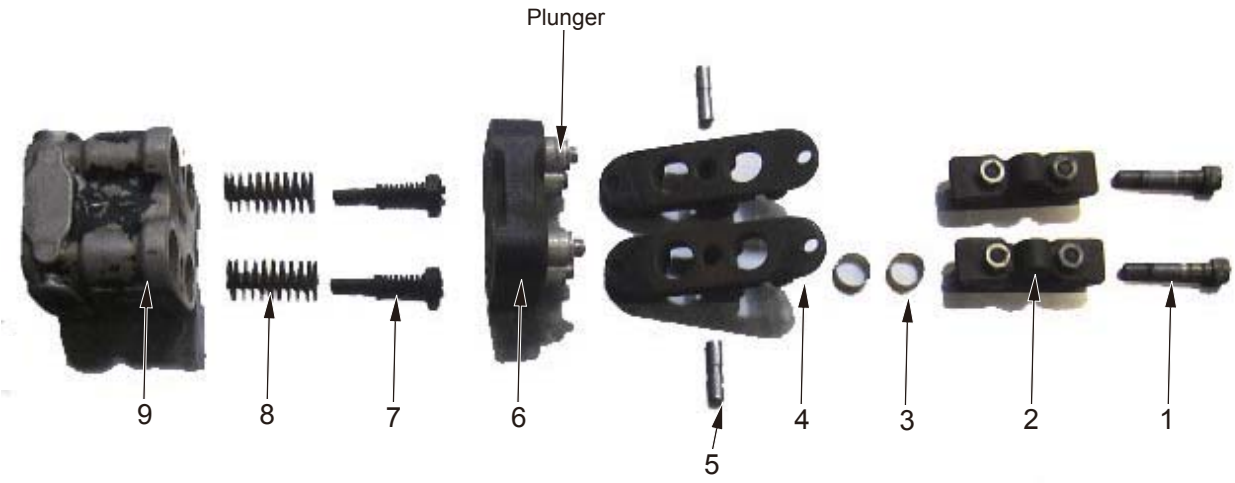
Grease 0.3~0.8cc (No.1 Calcium base grease)

★ See also “Pilot Valves (Work Equipment and Swing) - Adjust” on page 6-25.

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8.21 Pilot Valve AS (Travel) - Disassemble and Assemble

★ This section discusses only the precautions when reassembling the travel pilot valve assembly.



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8.21.1 Assembly

- Reassembly of the pedal pilot valve assembly

1. Install the spring (8) into the spool installation hole in the body assembly (9). Install the spool (7). Place the cover assembly (6) on the spool and press the cover assembly (6) with a hand.
2. Install the cover (4) after aligning the holes. Tighten the socket bolts (1).

   Bolt (socket):

   98~114 N·m {10~11.6 kgf·m}
3. Install the dust ring (3) on the plug. Install the cover (2) and fix the cover (2) with the camshaft (5).

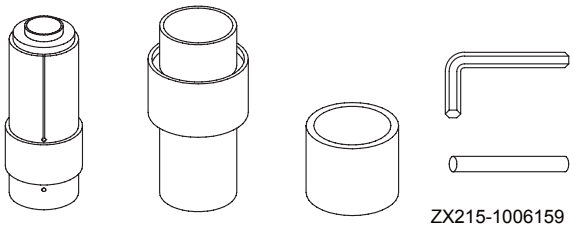
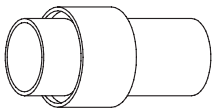
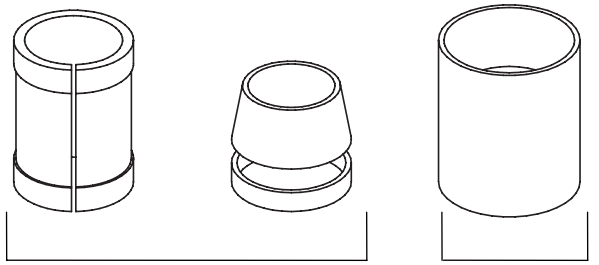
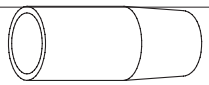
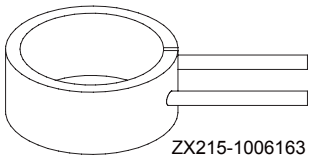
   Contact surface between the plug and the dust ring (5):

   Grease (No.1 Calcium base grease)

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8.22 Hydraulic Cylinder AS - Disassemble and Assemble

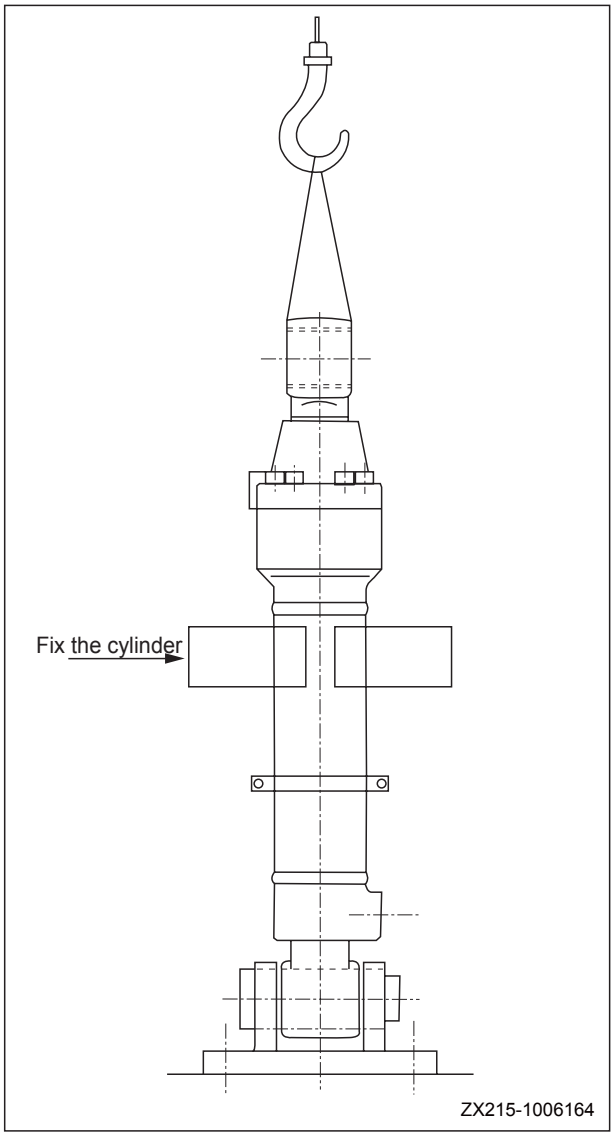
Special tools

Application	Tool Shape	Necessity	Quantity
Pulling out/pushing in the bushing	 ZX215-1006159	■	1
Press fitting the dust ring	 ZX215-1006160	■	1
O-ring seal correction	 Inserting tool Correcting tool ZX215-1006161	■	1
Inserting the cylinder head	 ZX215-1006162	■	1
Inserting the piston	 ZX215-1006163	■	1

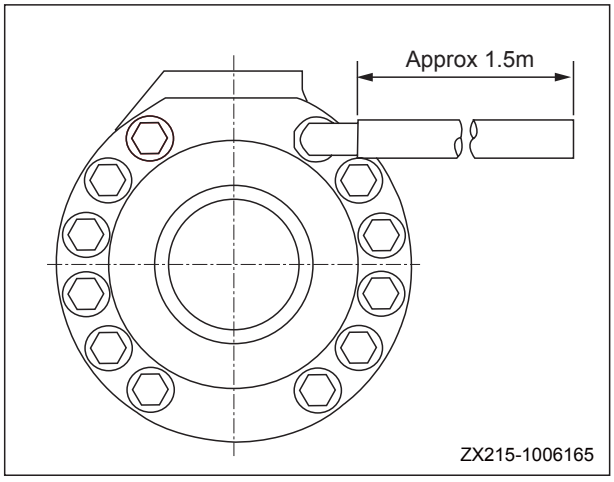
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8.22.1 Disassembly

1. Drain the oil and remove the tubing.
2. Fix the cylinder.
   - ★ Fix the cylinder in a vertical or level manner. A vertically fixed cylinder can be disassembled and assembled easily.
   - ★ The pin bore in the head end can be used for fixing of the cylinder. The pin roll can prevent the cylinder from turning.
   - ★ Remove the tubing in case of tubing interference while fixing the cylinder.



3. Removal of cylinder head
   - ★ Unscrew the bolts with Allen Wrench.
   - ★ Using an extension rod, as shown in the illustration on the right, will make the work easy.



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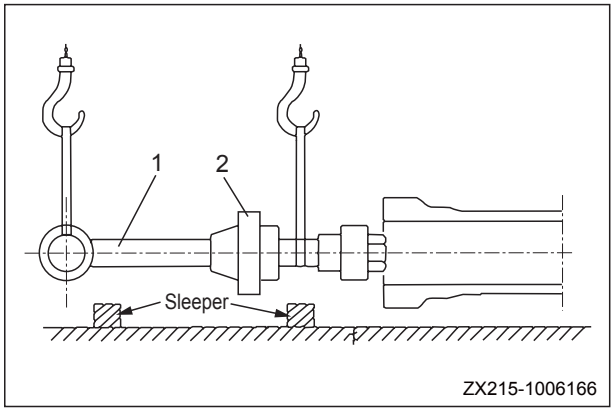
4. Pulling out the piston rod

★ Be sure to have removed the tubing cover.

★ Prepare a suitable container to collect oil coming out of the oil port.

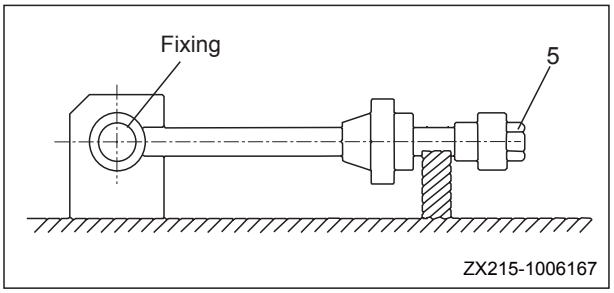
★ After pulling out the piston rod to its limit, slowly loosen the cylinder head and pull it out.

★ Remove the piston rod (1) with the cylinder head (2) and place them on a wooden sleeper.



5. Fixing the piston rod

★ Use pin bore on the rod end or the flat part of the ear to prevent turning of the piston rod.



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6. Remove of the piston nut (5)

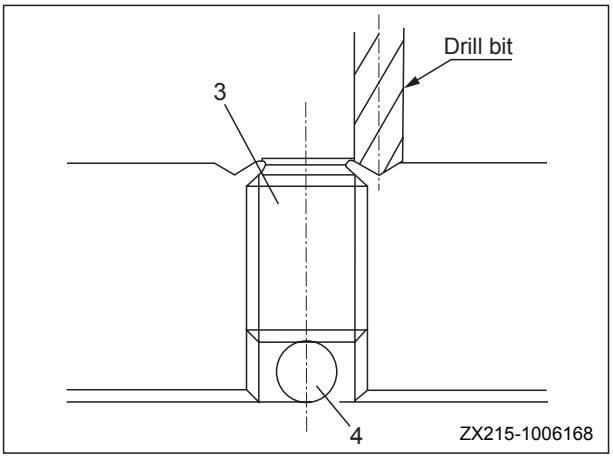
1) Remove the fixing screw (3) from the piston nut (5).

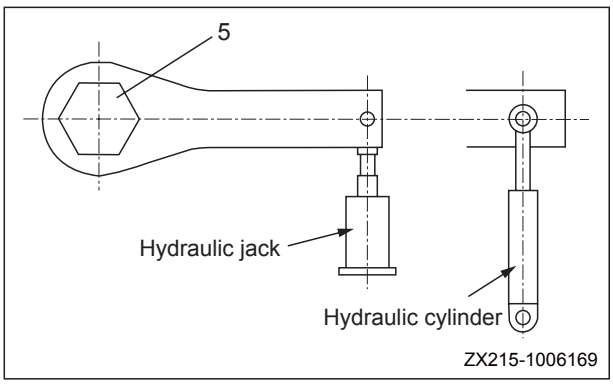
★ Around the fixing screw there are two points that have been punched against loosening. After removing the riveted part with a hand drill, loosen and remove the fixing screw (3).

2) Remove the steel ball (4).

3) Remove the piston nut (5).

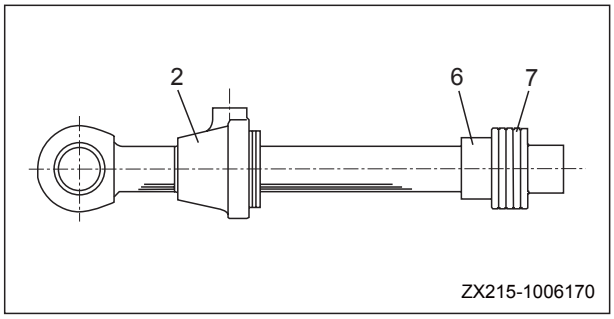
★ The piston nut (5) is very tight. To loosen the piston nut (5), prepare a hydraulic jack or a spanner powered by hydraulic cylinder. An extension rod should be ready when removing the piston nut (5) manually.





7. Removal of piston assembly

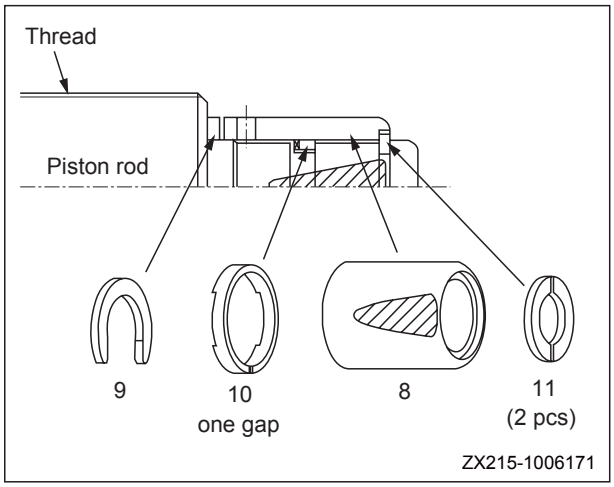
Remove in turn the piston (7), buffer sleeve (6) and cylinder head (2).



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8. Removal of the buffer sleeve (8) on the bottom end

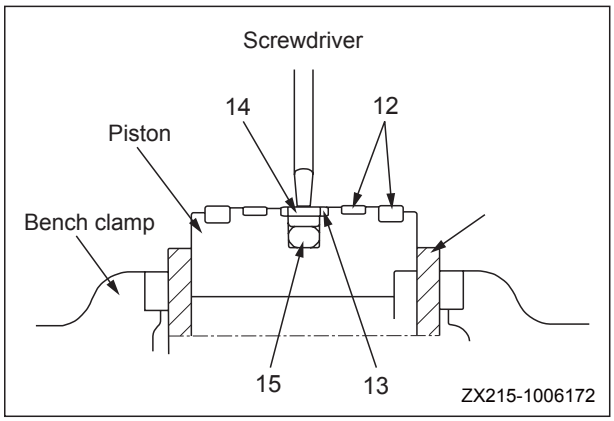
   1) Remove first the piston nut (5).
   2) Use a tool like rubber hammer to tap the piston nut (5) slightly for removal while keeping the piston rod and the buffer sleeve (8) intact. Remove the elastic ring (9).
   3) Slide the buffer sleeve (8) toward the piston threads in order to remove the two-piece stopper ring.
   4) Remove the buffer sleeve (8).
   5) There is an opening in the buffer seal (10). Take advantage of this opening to remove the buffer seal (10).



9. Removal of piston seal

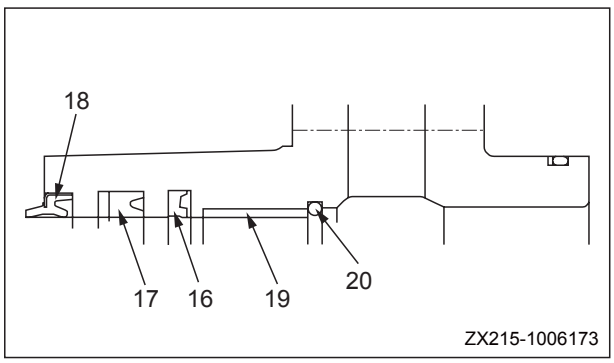
   1) The slide ring (12) and the guard ring (13) can be simply removed with hands.
   2) The seal (14) can be removed with a hammer and a flat-head screwdriver.
   3) Remove the O-ring seal (15) with a pry bar.

   ★ The removed seals should not be reused.



10. Removal of buffer ring (16)

   ★ The buffer ring (16) is installed in the inner groove in the cylinder head. Use a tool with sharp end to pry it out and remove it with a scraper.



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11. Removal of the U-ring (17) and the dust ring (18)

    1) Remove the U-ring (17) with a tool such as screwdriver.

    2) Pierce a tool (such as a screwdriver) into the dust ring (18) and hammer the screwdriver to remove the dust ring (18).

    ★ The removed seals should not be reused.

12. Removal of bushing (19)

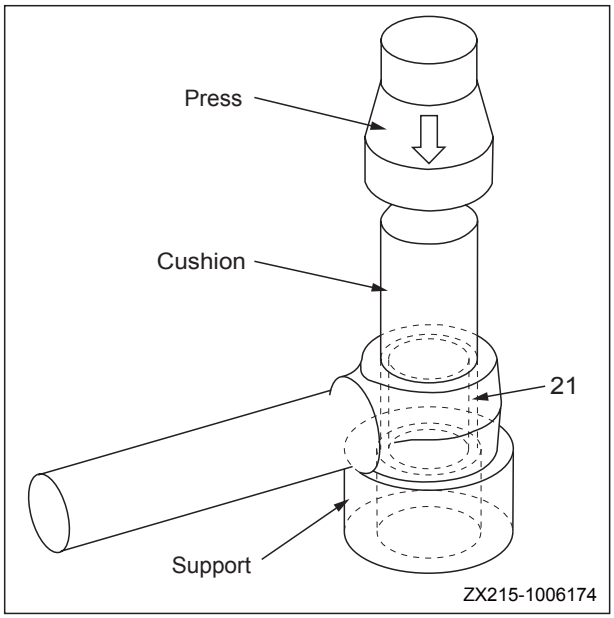
    1) Remove the elastic ring (20) from the cylinder head (2) with a screwdriver.

    2) Push the bushing (19) out with the help of clamps and press.

13. Removal of bushing (21)

    1) Remove the dust ring (22) on the side of cylinder barrel and piston rod with a tool such as screwdriver.

    2) Remove the bushing (21) with the help of a suitable cushion block.



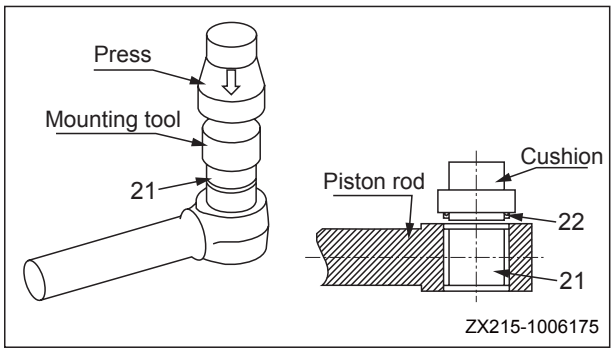
https://truckmanualshub.com/

8.22.2 Assembly

1. Installation of bushing (21)

   1) Use a mounting tool to press the bushing (21) into the bushing (lubricated with hydraulic oil) on the side of piston rod and cylinder barrel.

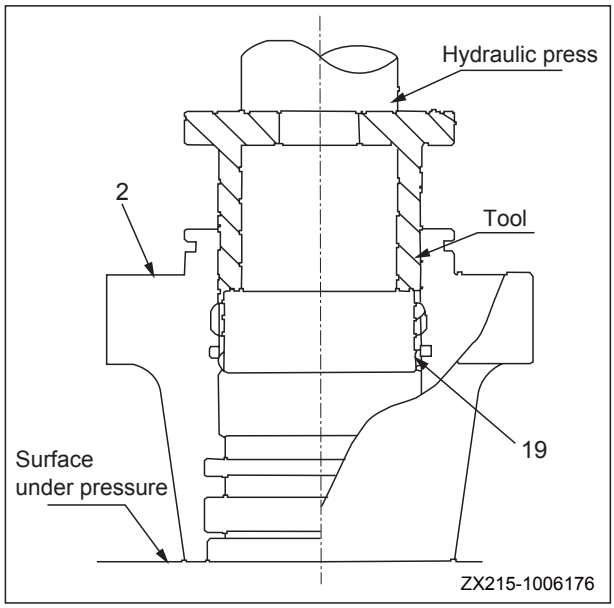
   2) Install the dust ring (22) with the help of a suitable cushion block.



2. Assembly of cylinder head (2)

   1) Use the press to push in the bushing (19).

   ★ Apply hydraulic oil to the inside of cylinder head in advance. Make sure that the bushing (19) pushed in is free from a raised shoulder.



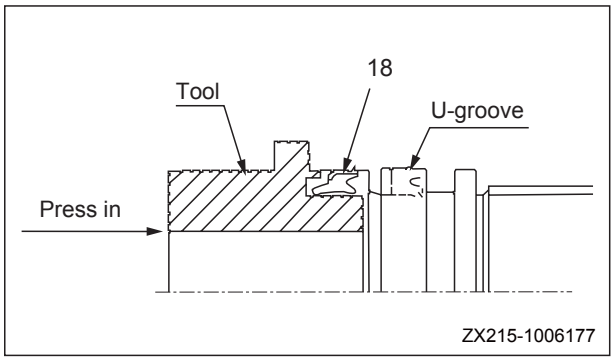
   2) Use the press to push in dust ring (18).

   3) Install the guard ring and the U-ring (17) sequentially in the U-groove.

   ★ Install the U-ring (17) in correct direction. Make sure that the U-ring is intact before installation.

   ★ Inverse installation will cause leak of oil.

   ★ Make sure that the U-ring is free from any corrugation or permanent deformation after installation.

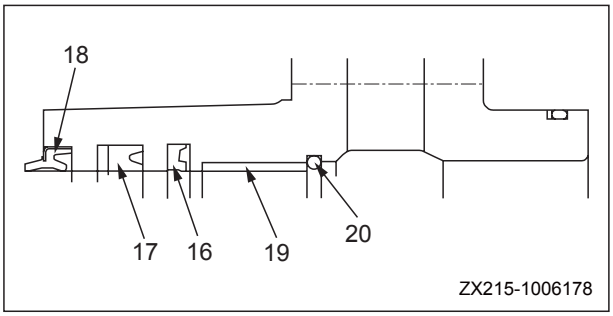


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4) Installation of buffer ring (16)

★ Make sure that the seal is installed in correct direction. Inverse installation can cause high pressure between the buffer ring (16) and the U-ring (17), which may lead to deformation or breakage of oil cylinder.

5) Install the elastic ring (20) to prevent the fall of the bushing (19).



3. Assembling the piston assembly

1) Installation of seal (14).

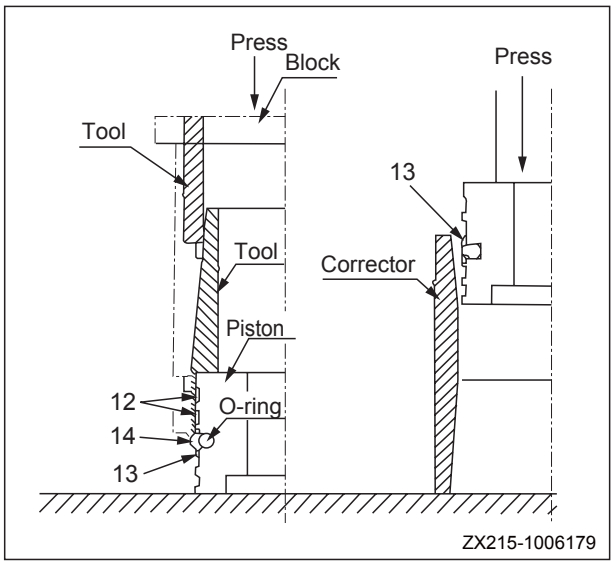
★ Install first the O-ring seal and the one-side guard ring (13) on the piston. Place the piston on the press. As shown in the illustration on the right, the seal (14) is installed with the tools indicated.

2) Correction of seal (14)

★ Install the seal (14) and the guard ring (13) on the other side. In order to prevent the expansion of the seal (14), a corrector must be used to correct the seal (14) which has been stretched during installation. The piston rod may not be able to go in the cylinder barrel if the seal (14) is not corrected timely.

3) Installation of slide ring (12)

★ Slightly open the slide ring (12) and install it axially. Excessive opening of the slide ring (12) can fail installation.



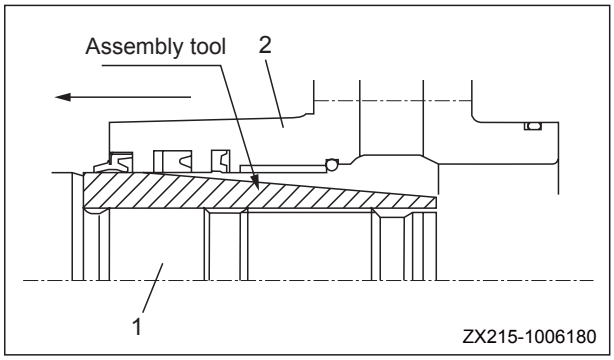
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4. Assembling the piston rod assembly

1) Fix the piston rod (1).

2) Install the cylinder (2) on the piston rod.

★ Make sure that the dust ring lip or the U-ring lip is not stopped by the shoulder of any part. Install the cylinder head and the piston rod with the tools.

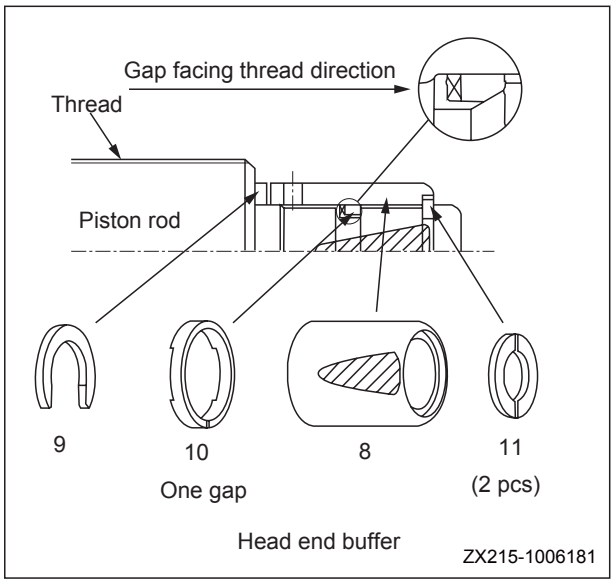


3) If the bottom side of cylinder contains a buffer (not for bucket cylinder), install the buffer bearing and the buffer seal in the following order.

i) Let the notched side of the buffer seal (10) face the piston while installing the buffer seal (10) in the groove.

ii) Install the buffer sleeve (8) according to the indication in the illustration on the right.

iii) Install the stopper ring in the groove. Install the elastic ring after the buffer sleeve (8) is pushed to the bottom. A rubber hammer should be used for the tapping job in order to avoid damaging the piston rod and the buffer bearing.



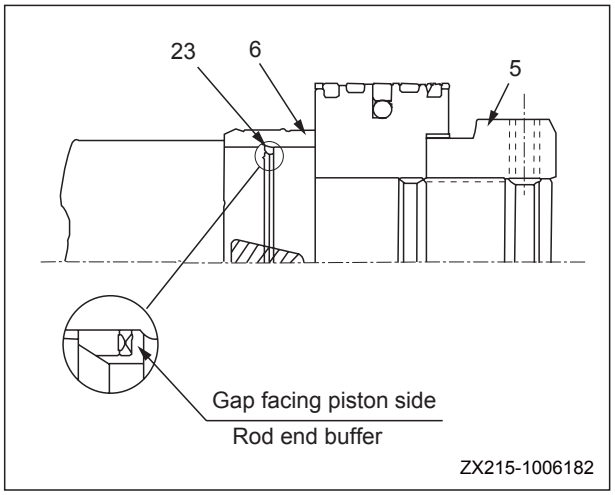
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4) If the head side of cylinder contains a buffer, install the buffer sleeve (6) and the buffer seal (23) according to the following order.

   i) The piston nut must be installed after installation of the buffer bearing.

   ii) The buffer seal (23) must be installed in the groove, with its notches facing the piston.

   iii) The buffer sleeve (6) must be installed according to the illustration on the right.



5) Tighten the piston nut (5).

   Piston nut (arm):

   9600 N·m {979.6 kgf·m}

   Piston nut (boom and bucket):

   6200 N·m {632.6 kgf·m}

★ Insufficient tightening can cause oil leakage, loose nut and thread breakage. In addition, excessive tightening can cause expansion of the buffer shaft on the extending side or deformation of piston on the contact side.

★ Thoroughly clean and grease (with banana oil) the threaded portions of the piston, nuts and piston rod before tightening the nuts.

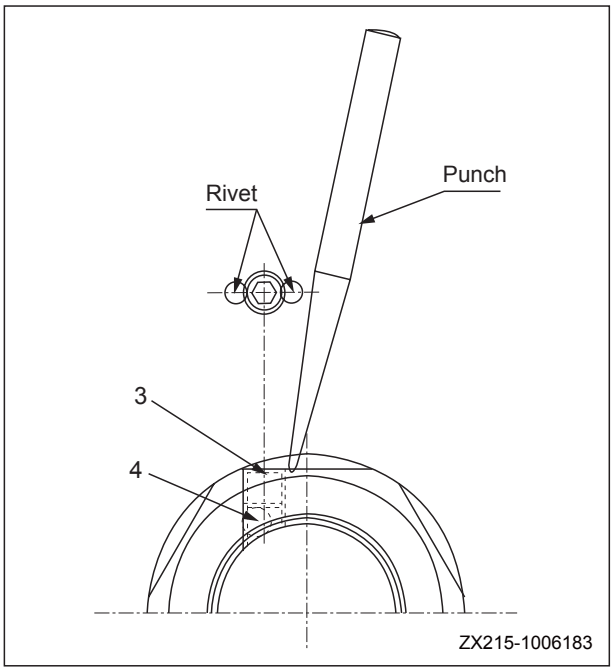
6) Treatment of the piston against loosening

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★ After the piston nut (5) is tightened, put in the steel ball (4), tighten the setscrew (3) and punch to rivet the two peripheral points.

Setscrew (3):

66.9 N·m {6.8 kgf·m}



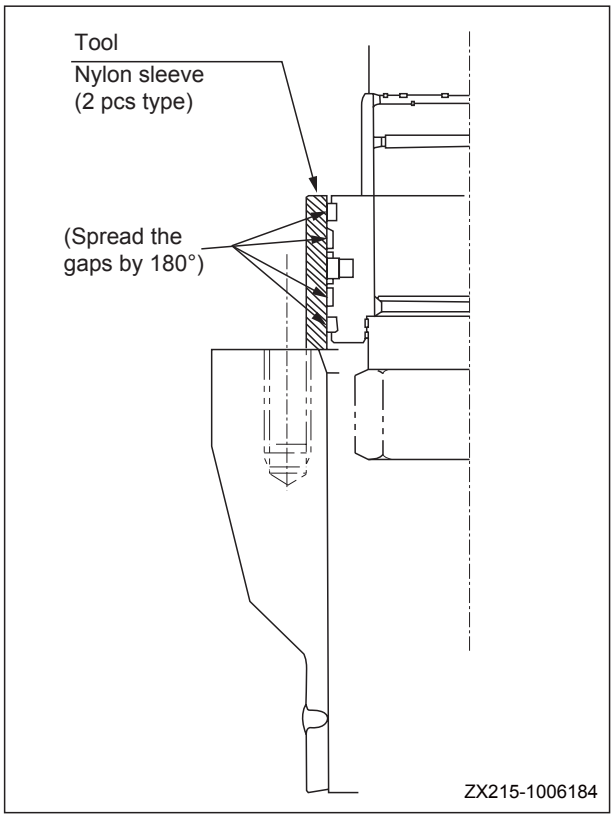
5. Install the piston into the cylinder barrel

1) Fix the barrel in a vertical or level manner.

2) Install the piston rod into the cylinder barrel.

★ If fixed in a vertical manner, the piston rod falls into the barrel under its gravity.

★ Make sure that the slide ring does not fall while the piston is inserted into the barrel.



6. Tightening of cylinder head

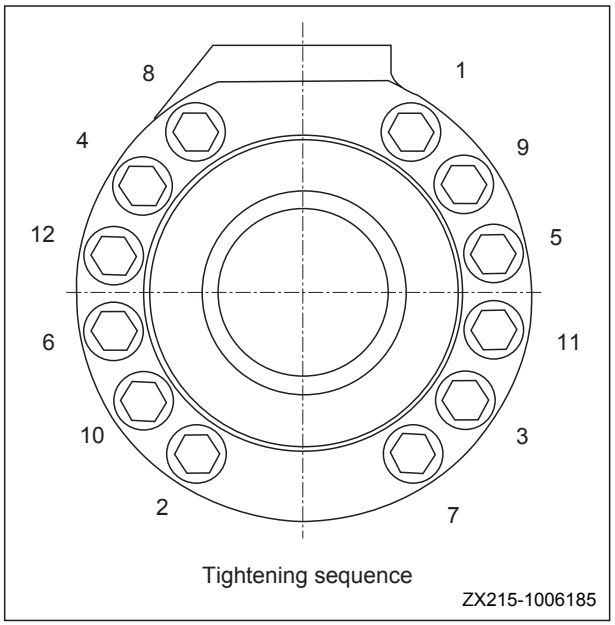
Tighten the cylinder head according to the

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sequence shown in the illustration on the right.

Bolt: 267 N·m {27.2 kgf·m}

7. Install the tubing.



Tightening sequence

ZX215-1006185

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8.23 Work Equipment AS - Remove and Install

8.23.1 Removal

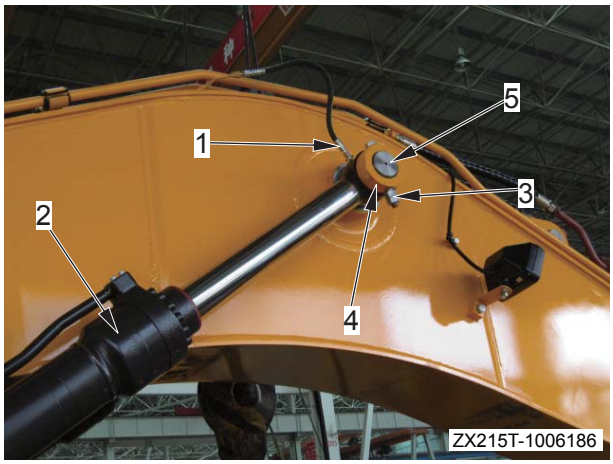
⚠ Fully extend the arm and the bucket. Lower the work equipment to the ground. Move the hydraulic lockout control to the LOCK position.

⚠ Release residual pressure in the hydraulic circuit. See “Residual Pressure in Hydraulic Circuit - Release” on page 6-29.

1. Disconnect the grease hose (1).
2. Lift the boom cylinder assembly (2). Remove the lock bolt (3).
3. Remove the plate (4) and then the pin (5).

※1

★ There are shims installed. Count the shims and check the thickness. Place the shims in a safe place.



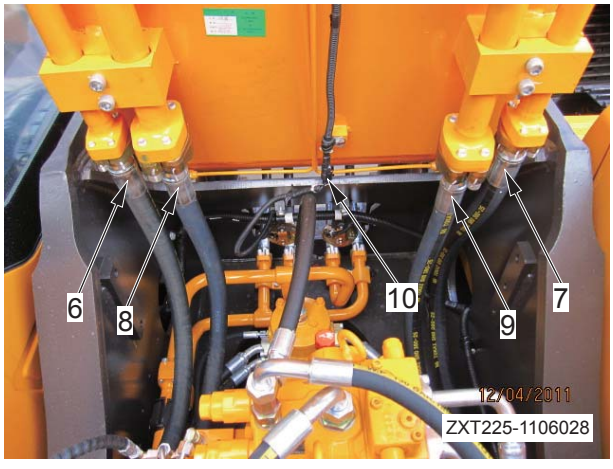
4. Start the engine and retract the piston rod.

★ Secure the piston rod with a wire rope in order to prevent the piston from slipping out. Place the cylinder on a bench or support. The grease fitting on the bottom side must be removed in the later case.

★ Remove the other boom cylinder in the same way.

5. Remove the two hoses (6) of bucket cylinder and the two hoses (7) of the arm cylinder.

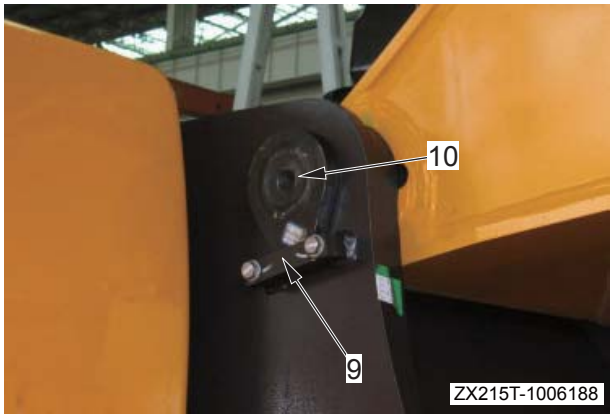
★ Cork the hoses to prevent outflow of oil. Secure the hoses to the side of valve.



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6. Remove the inter-connector (8) used for work lamp.
7. Lift the work equipment and remove the plate (9). Remove the pin (10) from the bottom.

※2



★ There are shims installed. Count the shims and mark their locations.

8. Lift and disassemble the work equipment assembly.

Work equipment assembly:

3578 kg



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8.23.2 Installation

- Installation is to be performed in the reverse order of removal.

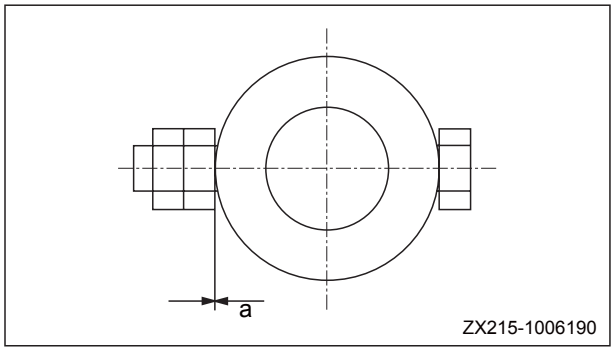
※1

★ A clearance (a: 0.5 - 1.5 mm) should be left between the plate and the nut when tightening the locknut.

Greasing after assembling the pin:

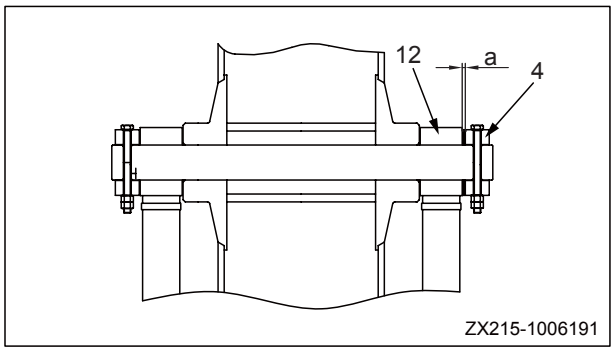
Grease (supramoly lithium base)

Do not put your finger in the pin bore while aligning the pin bore.



★ Adjust the shim thickness in order to have a desired clearance (a: 0.5<a<1 mm) between the piston end (12) and the plate (4).

★ Standard shim thickness: 1.0 mm and 2.0 mm.



※2

Greasing after assembling the pin:

Grease (supramoly lithium base)

Do not put your finger in the pin bore while aligning the pin bore.

- Hydraulic oil adding

  Add hydraulic oil to the specified level. Start the engine to circulate the oil in the hydraulic system, and check the oil level again. Add more hydraulic oil if necessary.

- Air bleeding

  Bleed the air from travel motor.

  For more information, see “Air in Each Component - Bleed” on page 6-35.

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8.24 Air Conditioner AS - Remove and Install

Special tools

ID	Part Name	Model	Necessity	Qty
S	Refrigerant charger	Robinair 34711-2K	•	1
	Refrigerant charger	Inoue Qing-Hua	•	1

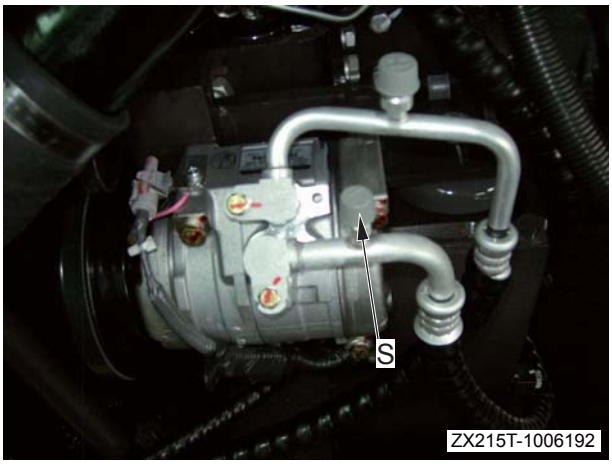
8.24.1 Removal

Disconnect the cable from the negative (-) post of the battery.

1. Drain the coolant.

   Coolant: approx. 22.5 L

2. Recover refrigerant from the air-conditioning system with the tool (S).

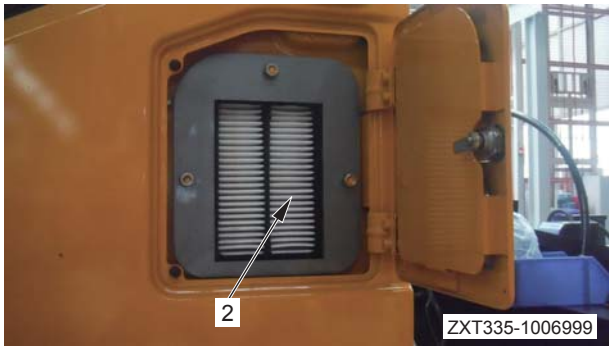


3. Remove the pad (1) on the cab floor.

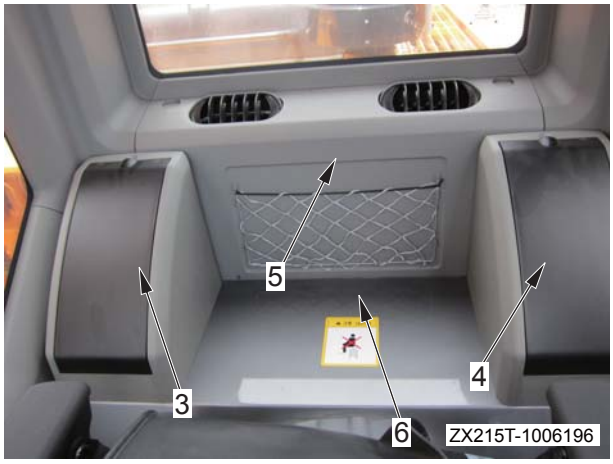


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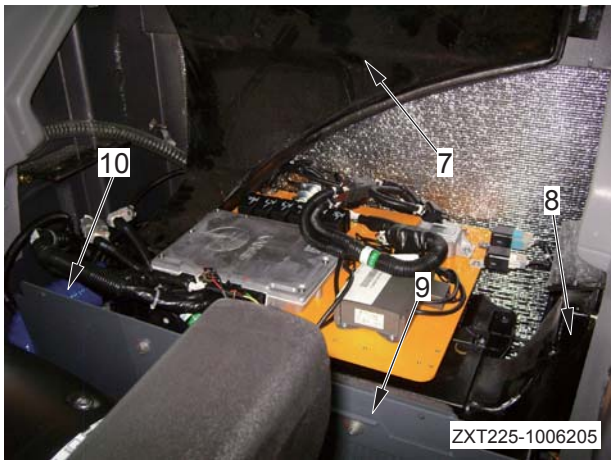
4. Open the left rear cover of the cab with the ignition key. Remove the outer filter element (2).



5. Remove the fuse box (3) and storage box (4).
6. Remove outer covering (5).
7. Remove the air conditioner cover (6).

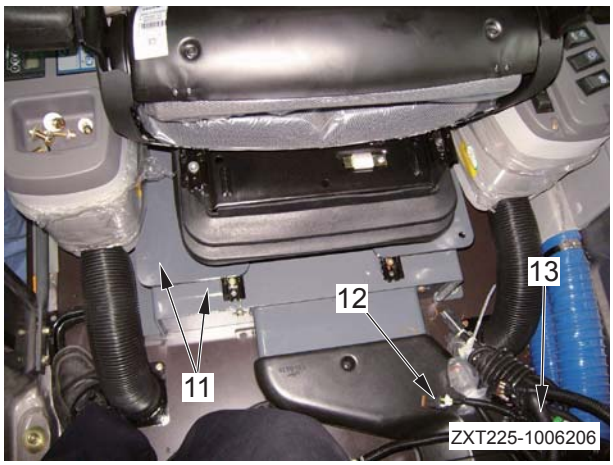


8. Remove the back air duct (7).
9. Remove the left air duct (8).
10. Remove the baffle (9).
11. Remove the right air duct (10).

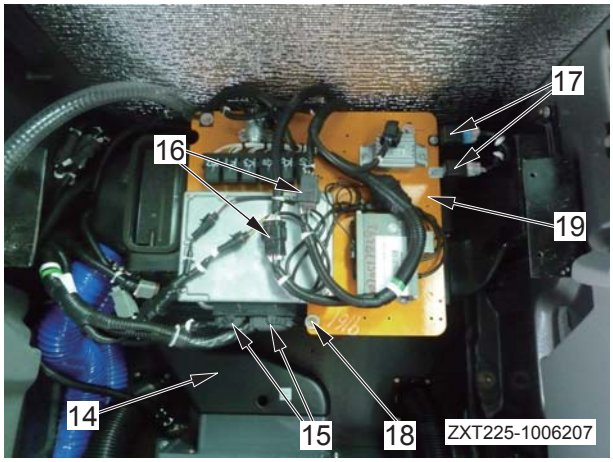


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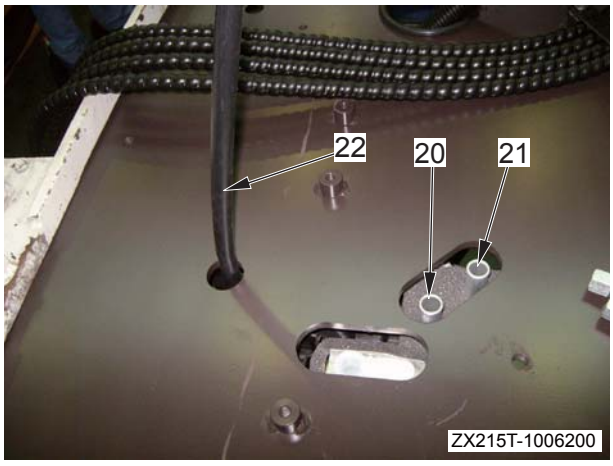
12. Remove the cover (11).
13. Remove the cab's center connector (12).
14. Remove the radio antenna(13).



15. Remove the air duct (14), connector (15) and air conditioner wiring connection (16). Remove the two air conditioner relays (17), three mounting bolts (18). Remove the electrical mounting plate (19).



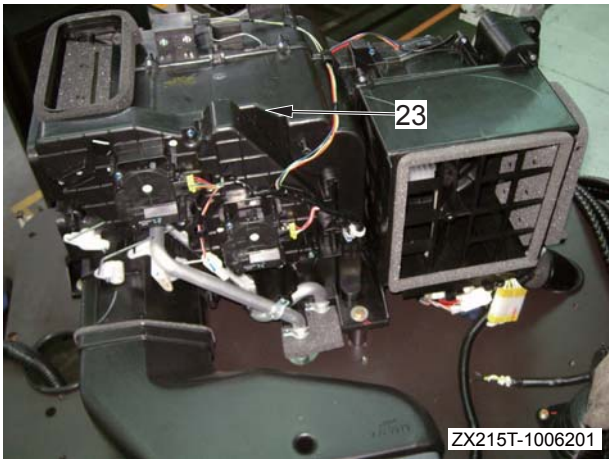
16. Remove the air conditioner water pipes (20) and (21) as well as the dripping tube (22).



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17. Remove the air conditioner unit (23).

    ★ Also disconnect the two hoses connecting to the bottom of the air conditioner when removing the air conditioner unit.



8.24.2 Installation

- Installation is to be performed in the reverse order of removal.

★ Keep the hoses free from contamination by dirt, dust or water while installing the return hose of the air conditioner.

★ Make sure that the O-ring seal is present in the connection before connecting a hose of the air conditioner.

★ Make sure that the O-ring seals are free from any damage or deformation.

※1

★ Apply compressor oil (ND8#) to the threads of the parts connected with the refrigerant lines. Tighten the line connections with a double-end spanner.

Screw (hose clamp):
8.83~14.7 N·m {0.9~1.5 kgf·m}

Bolt (pressure plate):
13.5±1.2 N·m {1.38±0.12 kgf·m}

- Refrigerant charging

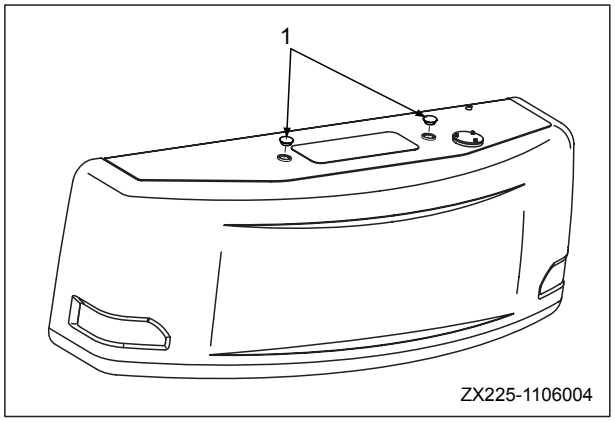
  Charge refrigerant (HFC-134a) into the air condition return lines with tool (S).

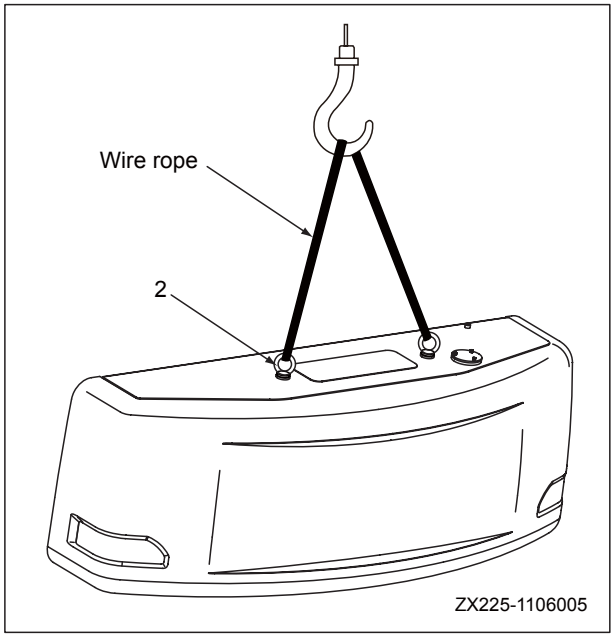
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8.25 Counterweight AS - Remove and Install

8.25.1 Removal

1. Remove the cover (1) from the counterweight. Install eyebolts to the counterweight. Hold the counterweight.





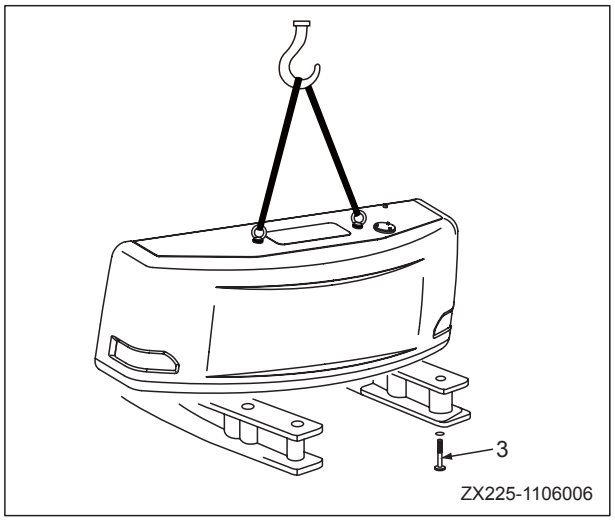
2. Remove the four bolts (2). ※1
3. Lift the counterweight levelly with wire rope or chain hoist.

※2

★ Be careful not to damage the engine, radiator or cooler.

Counterweight assembly:

3901 kg



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8.25.2 Installation

- Installation is to be performed in the reverse order of removal.

※1

Threads (mounting bolt - counterweight):

Thread adhesive (Tonson 1277)

Mounting bolt (counterweight):

1,180~1,470 N·m {120~150 kgf·m}

※2

★ Counterweight Installation and adjustment

1) Move the counterweight with a crane to a suitable position on the frame.
2) Push the counterweight and install the bolts. Adjustment is to be made according to the following specification.

- Clearance with swivel:

10±5 mm(L&R)

- Clearance with bodywork door:

10±5 mm(L&R)

- Step difference from swivel in left to right direction

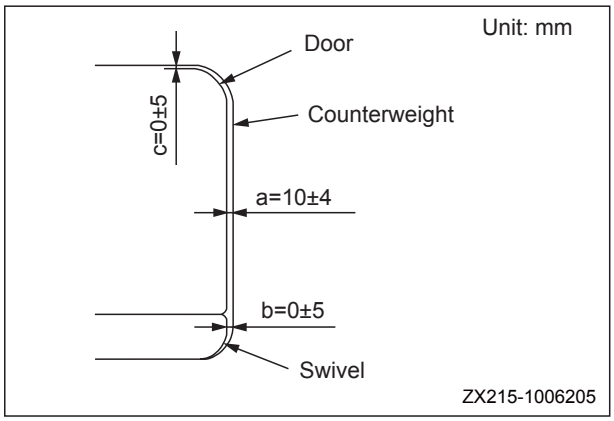
b: max. 5 mm

- Step difference from bodywork door in left to right direction

a: 10±4

- Step difference from bodywork top cover in upper to lower direction

c: max. 5 mm



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8.26 Cab AS - Remove and Install

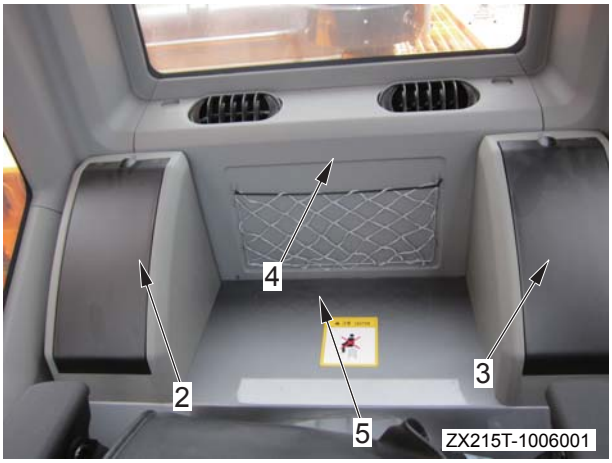
8.26.1 Removal

⚠ Disconnect first the cable connecting to the negative (-) post of the battery.

1. Remove the floor mat (1).

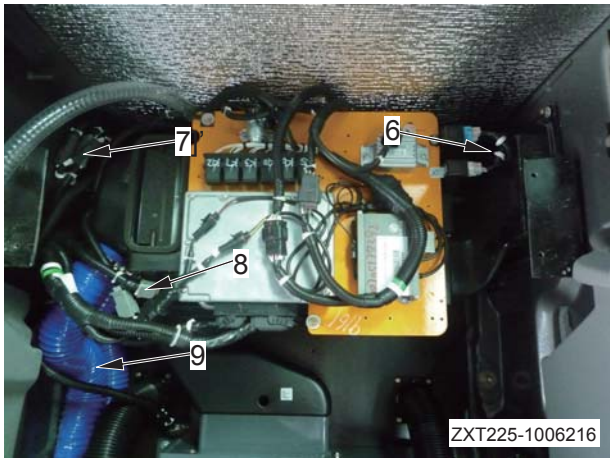


2. Remove the fuse box (2) and storage box (3).
3. Remove outer covering (4).
4. Remove the air conditioner cover (5).

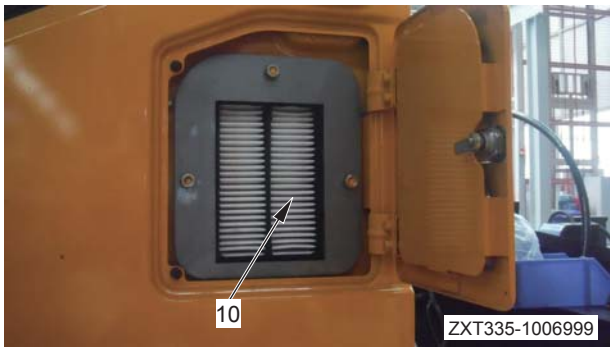


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5. Disconnect the left wire harness (6), monitor harness connector (7) and window washer harness (8).
6. Remove the right side air duct (9).



7. Remove external air filter (10).



8. Disconnect the external air duct (11).

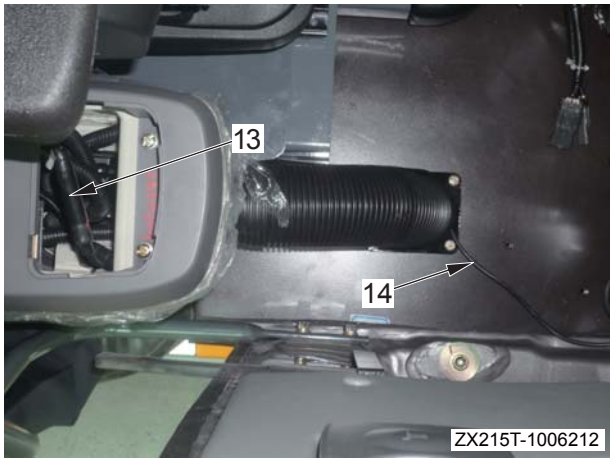


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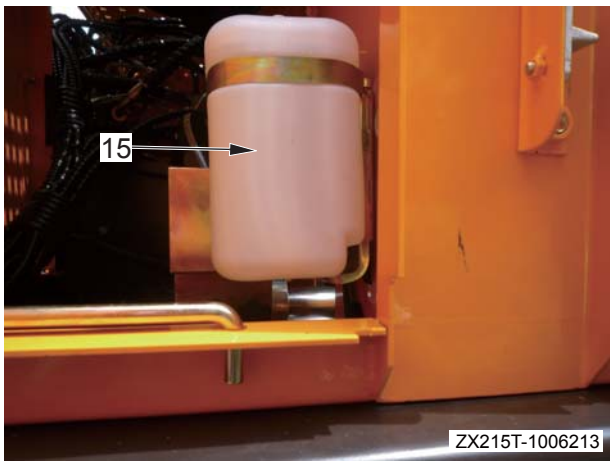
9. Remove the storage box on the armrest (12).



10. Remove the radio connector (13).
11. Remove the radio wire harness (14).

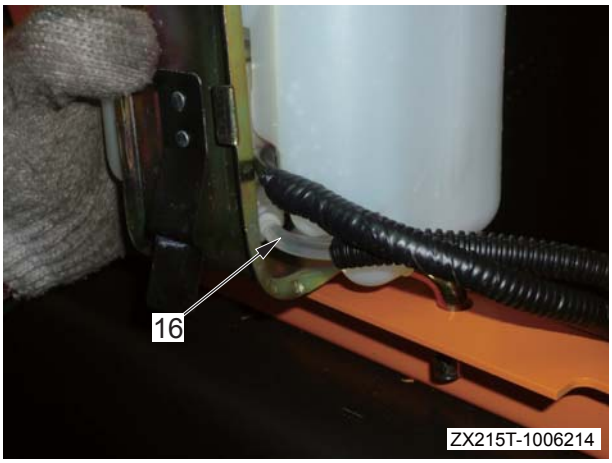


12. Remove the window washer reservoir (15).



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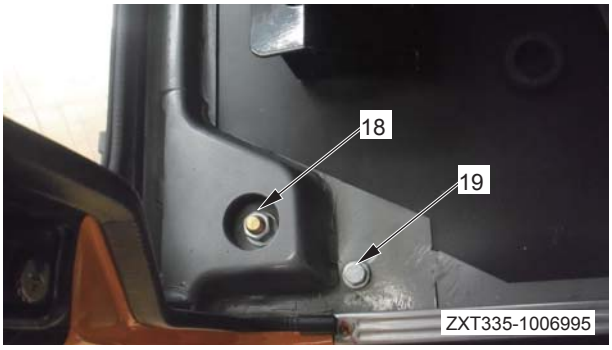
13. Remove the window washer pipe (16).



14. Remove the decor cover (17).



15. Remove the four mounting nuts (18) and the five mounting bolts (19).



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16. Lift the cab assembly (20) for removal.

Cab assembly: 633 kg



8.26.2 Installation

- Installation is to be performed in the reverse order of removal.

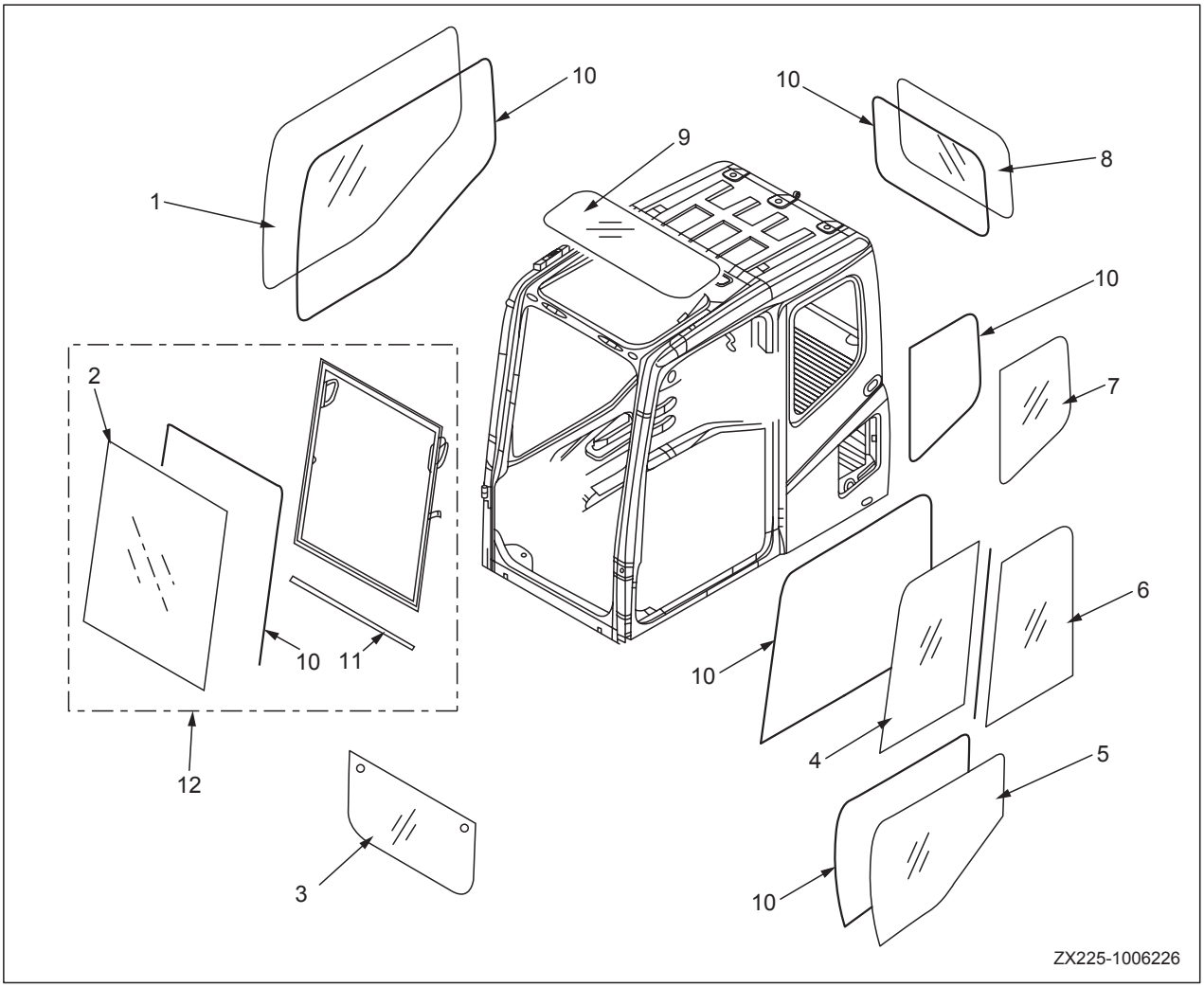
※1

Bolt: 200 N·m {20.4 kgf·m}

Nut: 210 N·m {21.4 kgf·m}

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8.27 Cab Window Glass – Disassemble and Assemble



1- Right window glass
2- Front window glass
3- Lower front glass
4- Cab door window glass (upper)
5- Cab door window glass (lower)
6- Cab door window glass (upper)
7- Left side rear window glass
8- Rear window glass
9- Roof window glass
10- Rubber sealing strip
11- Center adjusting seal
12- Front window assembly (Glass and frame)

★ Cab window glasses (1), (2), (5), (7) and (9) are adhered to the window frame.

★ When replacing front window glass (2), disassemble front window assembly (12). (If the cab is install with a front window assembly, do not only replace the front window glass.)

★ For detailed information, see “Front Window Assembly - Disassembly and Assembly”.

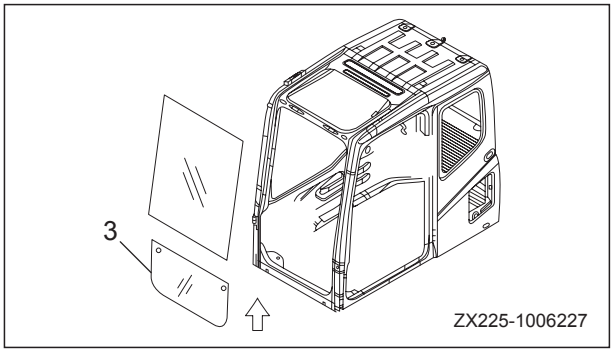
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8.27.1 Removal

⚠ Be careful with sharp edges that may cut your fingers when handling broken or cracked window glasses. Put a piece of adhesive film (or adhesive tapes) onto the broken or cracked window glass to prevent possible personal injury before you proceed. Remove all glass fragments.

1. Removal of glass (3)

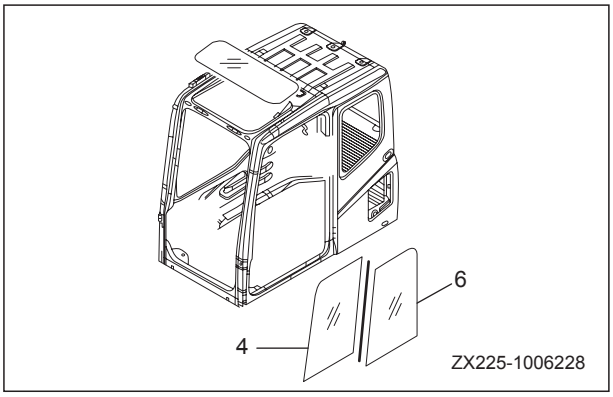
   Glass (3) is hold in place by sealing strips. Pull it upward carefully to remove it.



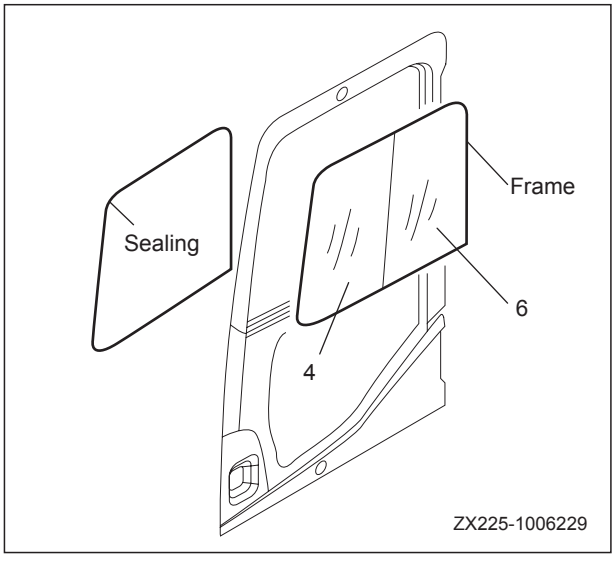
2. Removal of glass (4) and (6)

   1) Remove the sealing strip from the frame of the cab door.

   2) Push the glass outward carefully from inside of the cab and remove glass (4) and (6) together with the frame.



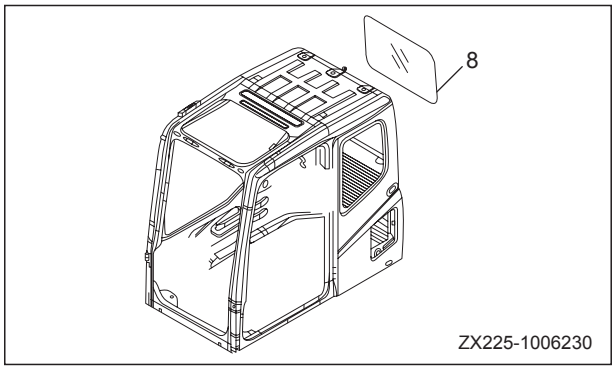
   3) Remove glass (4) and (6) from the frame with a screw driver.

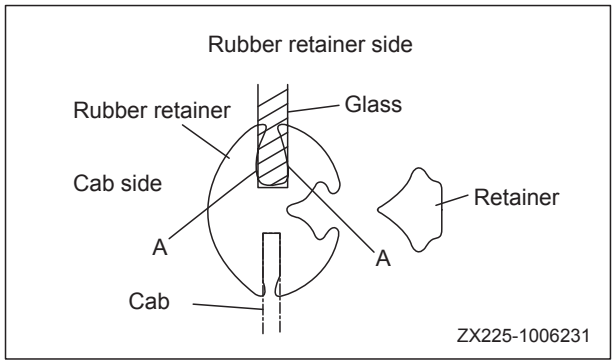


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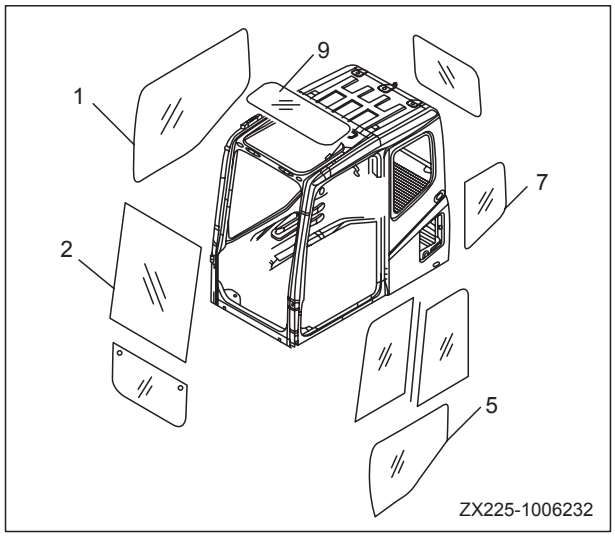
3. Removal of glass (8)

1) Remove the retainer from the groove on the rubber with an ordinary screw driver.
2) Put a thin bamboo chip inside part A of the retaining rubber and detach the retainer along the edge.
3) Pat the glass from inside of the cab and remove it. This job may require two people.



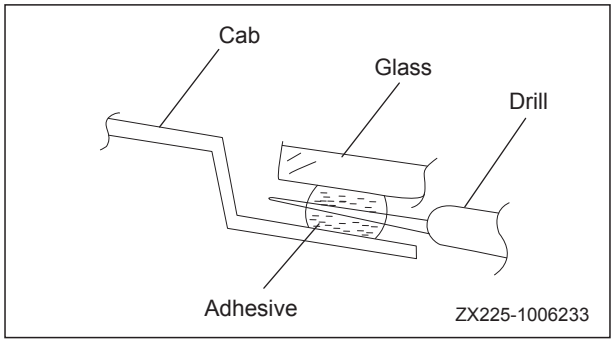


4. Removal of glass (1), (2), (5), (7) and (9).

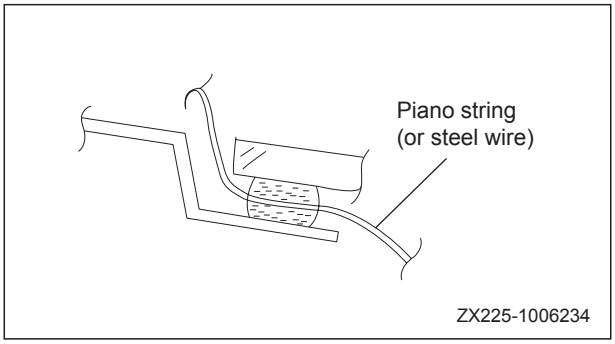


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1) Remove the resin board, decor strip and retainer along the edge of the glass.
2) Punch a hole through the adhesive with a drill (or a cutter) as illustrated.

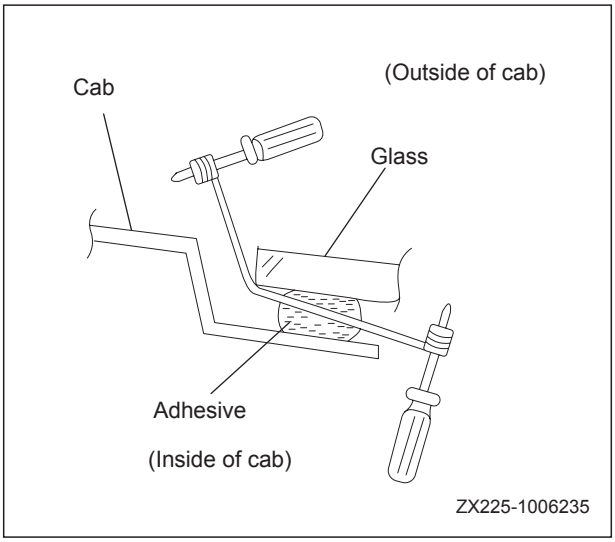


3) Pull a piece of piano string (or steel wire) through the hole as illustrated.



4) Fix both ends of the piano string onto two screw drivers. Pull the wire back and forth in order to cut the adhesive and detach the glass from the cab. This job may require 2-3 people.

- Run the string along the center of the adhesive. The string may break when it becomes very hot. Use different sections of the string while cutting the adhesive.



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8.27.2 Installation

- Reverse the disassembling sequence when installing glasses (3), (4), (6) and (8). Follow the procedures below to install glasses (1), (2), (5), (7) and (9).

1. Clean the remaining adhesive and rubber on cab frame (contact surface) with a knife or scraper (5).

   ★ Remove the remaining adhesive and rubber so that they will not affect the application of new adhesive. Do not scrape the original paint on the surface. (Scraping of paint reduces the performance of the adhesive.)



2. Clean the grease, dust and dirt on the cab (8) and the glass (9) with unleaded gasoline.

   ★ Contaminant on the contact surface reduces the performance of adhesive.

   ★ Clean the black part on the back of the glass.

   ★ After cleaning, dry the glass for at least 5 minutes.





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3. Priming coat (10)

★ Priming paint expires 4 months after production. Do not use expired paint.

★ Use the paint within 2 hours after it is unsealed.

★ Use the paint within 24 hours even if it is sealed again immediately after unsealing. (Dispose the paint 24 hours after it is unsealed)

1) Make sure the adhesive paint and glass priming paint are well agitated before application.

★ If the priming paint is stored in a refrigerator, keep it under ambient temperature for at least half a day before agitation.

(If the paint is unsealed immediately after it is taken out of a refrigerator, water will condense on it.)

2) Always wash a used brush (11) with unleaded gasoline before using it.

★ Check the brush for contaminants after it has been washed.

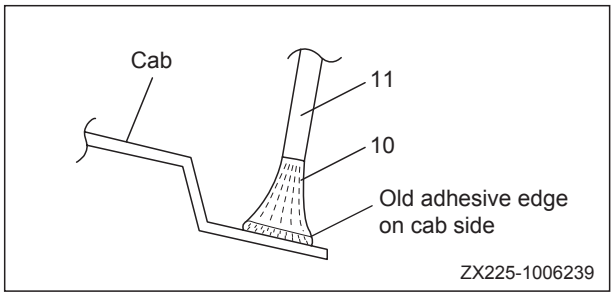
★ Prepare two brushes for priming paint, one for painted surface and the other for glass surface.

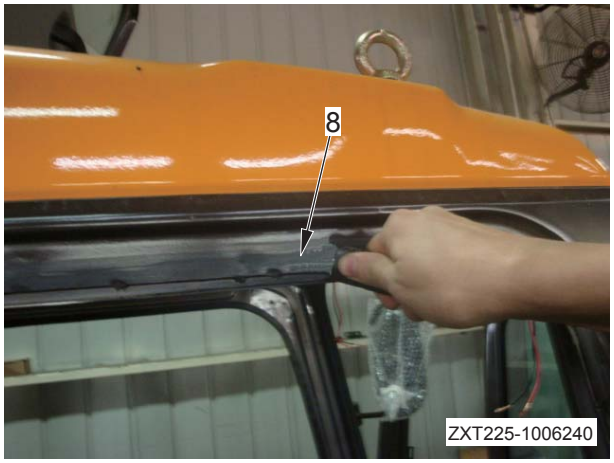
3) Apply priming paint (for painted surface) evenly onto the surface where sealing rubber is to be adhered and where adhesive agent is to be applied (on the cab (8)).

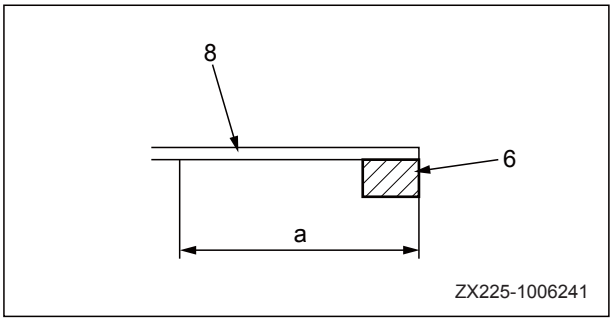
Priming paint (for painted surface): Sunrise MSI Primer 24

★ Do not apply primer more than twice; otherwise, the performance of the primer will be reduced.

★ Applying location: Cover the whole area of (a). Dimension of (a): 25mm







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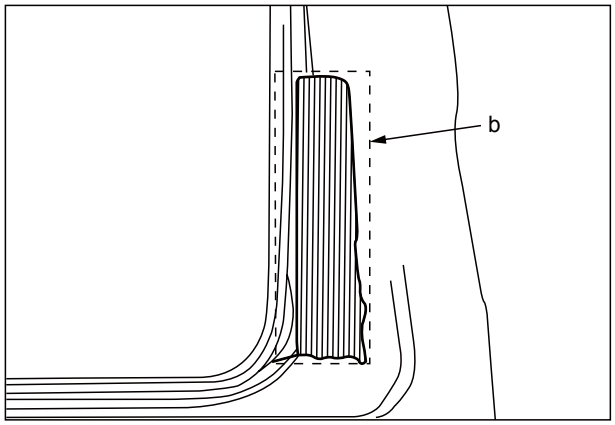
★ Besides the above locations, apply primer also onto the right window glass and the cab door lower window glass.

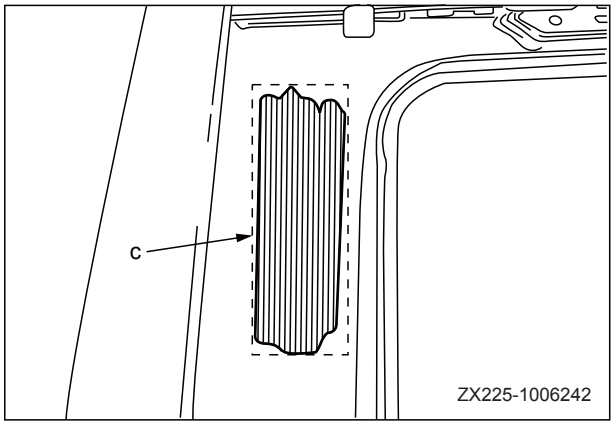
- Additional priming area on the right window glass: (b)
- Additional priming area on the cab door lower window glass: (c)

★ Dry the primer for at least 5 minutes (within 8 hours).

★ Do not use wrong priming paint.

If, for example, glass primer is mistakenly used, wash it with unleaded gasoline.





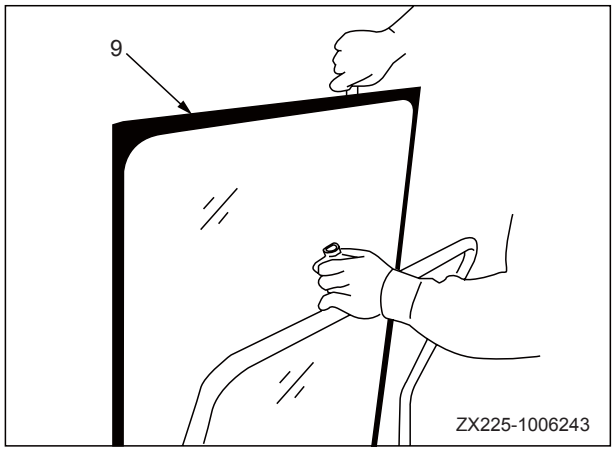
4) Apply priming paint (for glass surface) onto the contact surface of window glass (9).

Glass primer:

Sunrise MSI Primer 35

★ Do not apply the primer more than twice; otherwise, the performance of the primer will be reduced.

★ Priming area: Apply the priming paint on the contact surface of glass (9) (rubber seal (6)adhering location) and along cab frame (8).



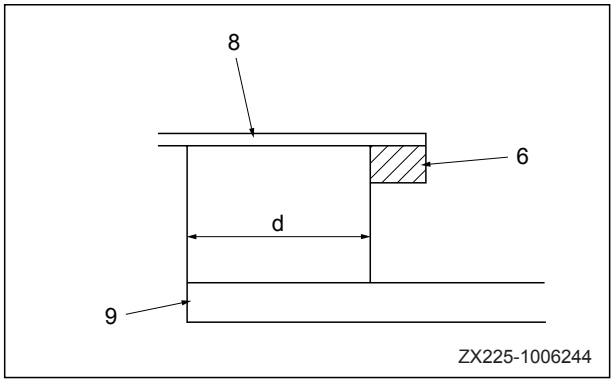
https://truckmanualshub.com/

★ Leave a 5 mm margin uncoated along the black strip adjacent to the clear area of the glass.

★ When priming paint has been coated, dry it for at least 5 minutes (within 8 hours).

★ Do not use wrong primer.

If wrong glass primer is used, wash it with unleaded gasoline.



4. Adhere rubber seal (6) (with adhesive tape on both sides) along the inner edge of the contact surface of the glass.

★ Do not detach the waxed paper on the rubber seal before the window glass is installed.

★ Do not touch the cleaned area on the glass before rubber seal is adhered.

★ Be careful not to allow the rubber seal on the corners to peel off.



★ When sticking rubber seal (6) along the window frame, do not overlap the two ends of the seal. A 5 mm gap between the two ends of the seal is recommended.

1) Stick rubber seal (6) onto the right cab window frame as illustrated.



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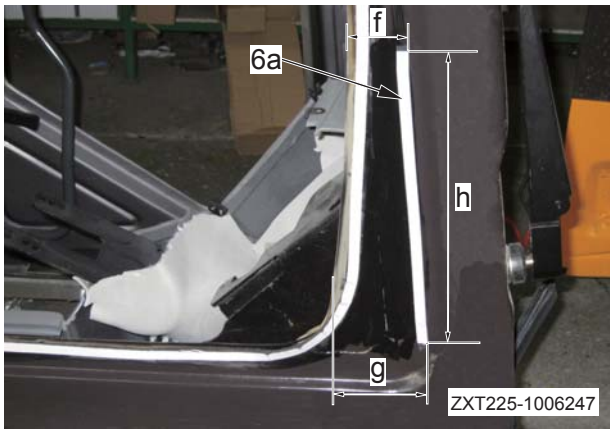
★ Adhere additional rubber seal (6a) onto the right cab window

- Position of the additional rubber seal:

  (f): 50 mm

  (f): 90 mm

  (h): 250 mm



2) Adhere rubber seal (6) on the left cab window as illustrated.



3) Adhere rubber seal (6) onto the lower cab door window as illustrated.



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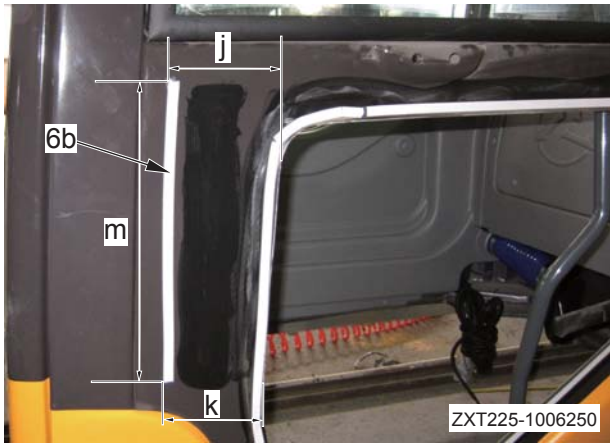
★ Adhere additional rubber seal (6b) onto the lower cab door window frame as illustrated.

- Position of additional rubber seal:

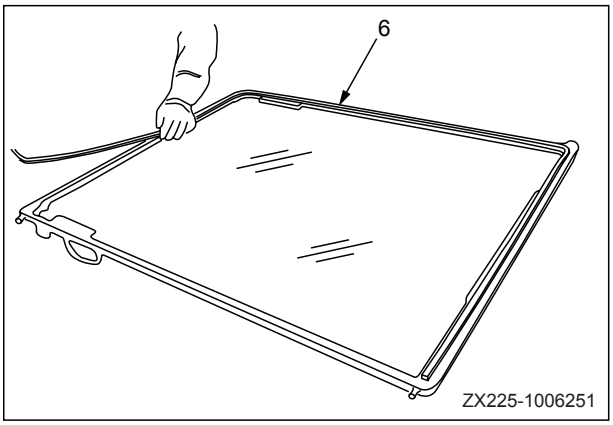
  (j): 110 mm

  (k): 90 mm

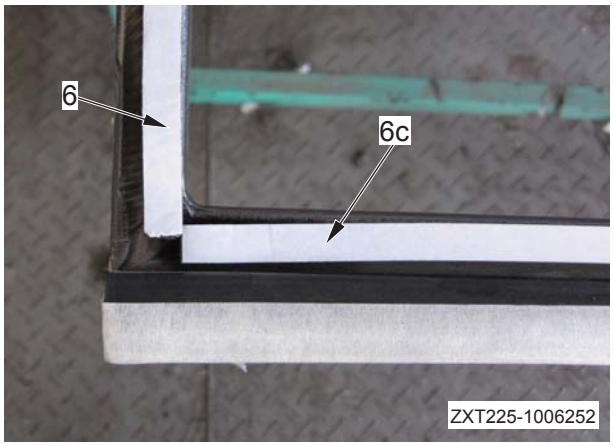
  (m): 200 mm



4) Adhere rubber seal (6) onto the front window glass as illustrated.



★ Different from the rubber seal (6) on other window, rubber seal (6c) on the bottom of the front window shall be adhered onto the external edge of the lower part of the front window frame. (If it is adhered along the inner edge, the rubber seal will be seen through the clear part of the glass.)



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5. Positioning of new window glass

1) Check the clearance between the edge of glass and the cab in 4 directions, and position the glass. Make sure the clearance is even.

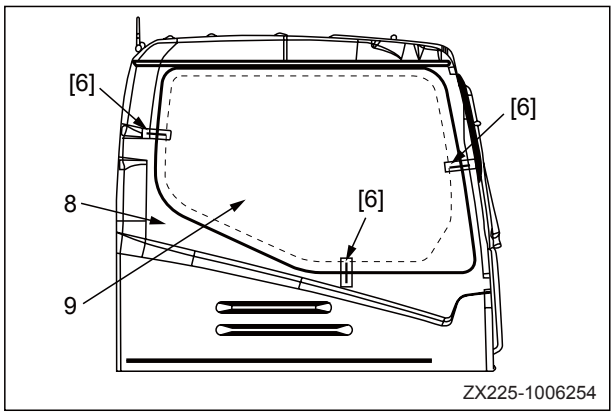
2) Put a tape [6] across the glass (9) and cab (8) and draw a line (n) on it for alignment.

★ Adhere tape [6] at 3 points as illustrated for precise alignment of right window glass, left rear window glass and cab door lower window glass.

3) Cut the tapes across the glass (9) and the cab (8) and remove the glass.

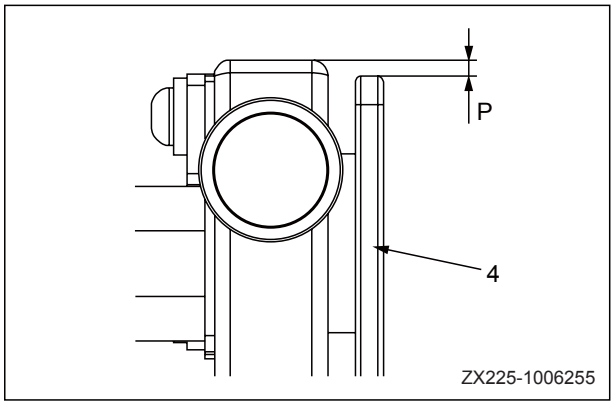
★ Do not remove the tape on the left side of the glass until the glass is installed.





★ When positioning front window glass (4), cover it across the width of the window frame in the horizontal direction.

Set the clearance (p) between the top edge of the glass and the upper frame at 3 mm when positioning it in the vertical direction.



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6. Adhesive

★ Store adhesion agent in dark places where temperature is blow 25°C.

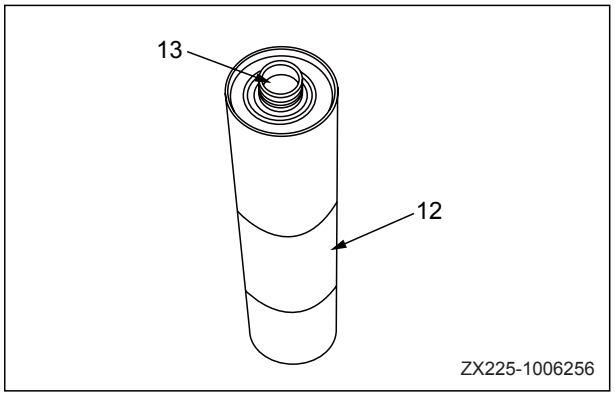
★ Do not heat the adhesive to above 30°C.

★ Before using adhesive that has been unsealed, remove the hardened part at the nozzle.

1) Open the aluminum seal (13) on the head of the cylinder (12) and install the nozzle.

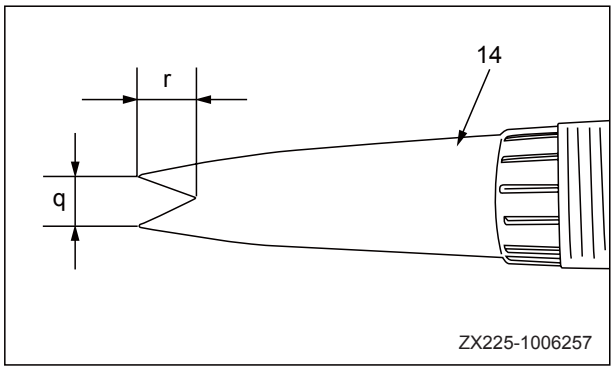
Adhesive:

Sunrise MSI SR sealant U90 4463876



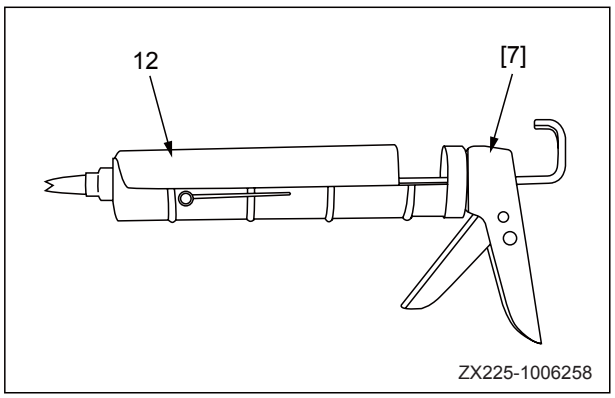
2) Cut the tip of nozzle as illustrated. Dimension of the cut:

- (q): 10 mm
- (r): 5 mm



3) Set the cylinder (12) in the gun [7].

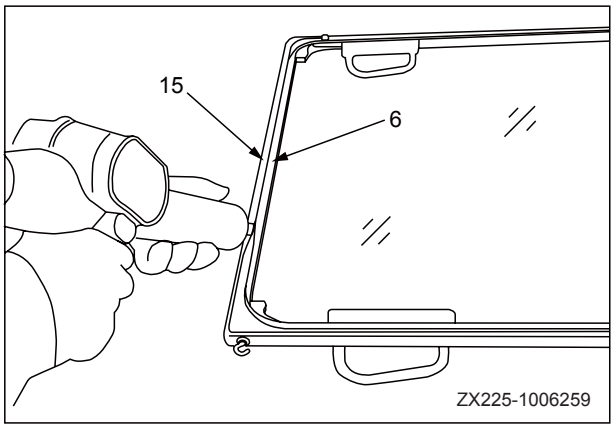
★ An electrical caulking gun is more efficient.



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4) Remove the waxed paper of the rubber seal on the surface where adhesive is to be applied.

5) Apply adhesive (15) along the external edge of the rubber seal (6).

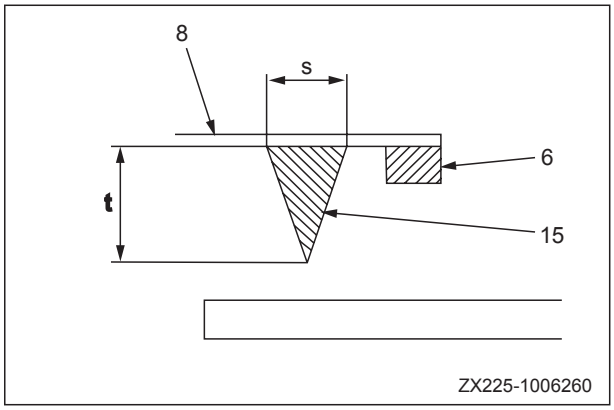


★ Adhesive (15) for rubber seal (6) on cab (8) shall be applied as illustrated:

- Dimension of (s): 10 mm
- Dimension of (t): 15 mm

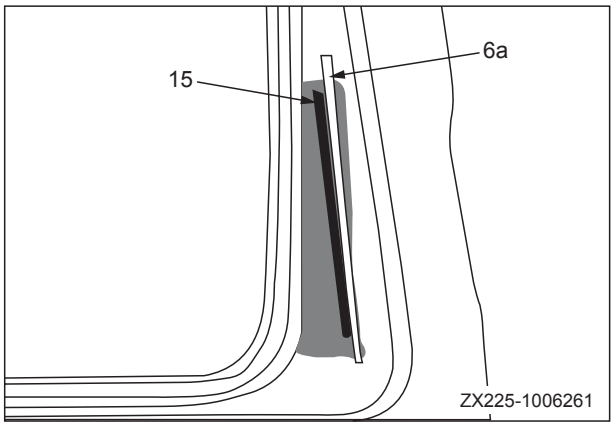
★ Adhesive (15) shall be thicker that the rubber seal (6).

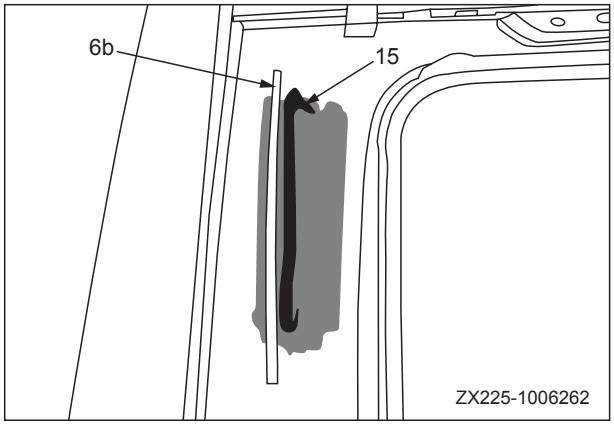
★ Apply adhesive of the same thickness evenly.



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★ Apply adhesive (15) onto the additional rubber seal of the right window (6a) and additional rubber seal of the cab door lower window (6b).





7. Install window glass

1) Install window glass (9) and align it with the mark on the cab. (See step 5)

★ Since the glass can not be remove once installed, be very careful when performing this task.

★ Install the glass properly within 5 minutes after adhesive has been applied.

2) Press the perimeter of the glass (9) after is has been put in place until it is securely stuck to the rubber seal.

★ Press the corners of the glass hard.



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★ After the front window glass has been installed, fill the clearance between the glass on area (s) and the center adjusting seal (16) to the dimension of (t) and (u). Coat primer onto glass (4) on section A-A and apply the adhesive as fillers.

- Dimension of (t): 2 mm
- Dimension of (u): 5 mm

★ Use a rubber spatula to cover the edge of the glass and trim the adhesive.

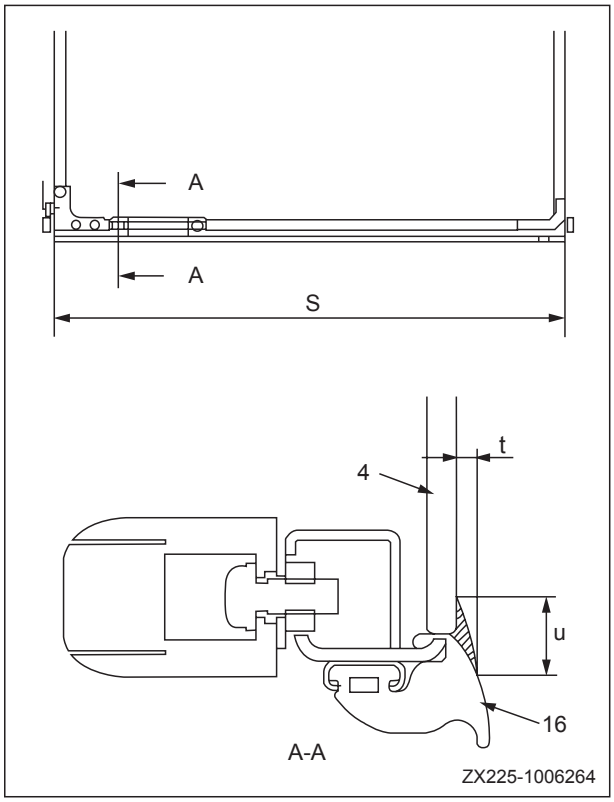
★ Remove surplus adhesive.

Glass primer:

Sunrise MSI Primer 35

Adhesive:

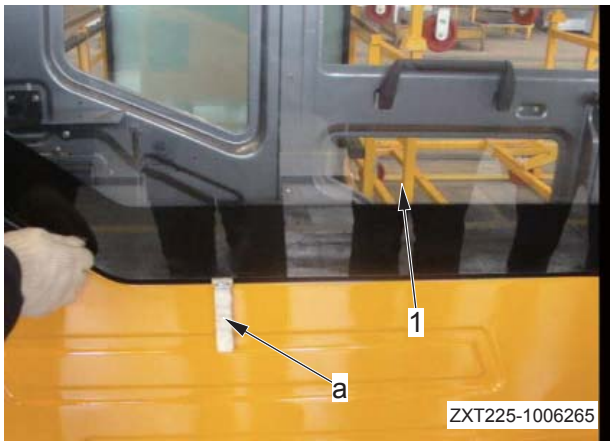
Sunrise MSI SR Sealant U90
4463876



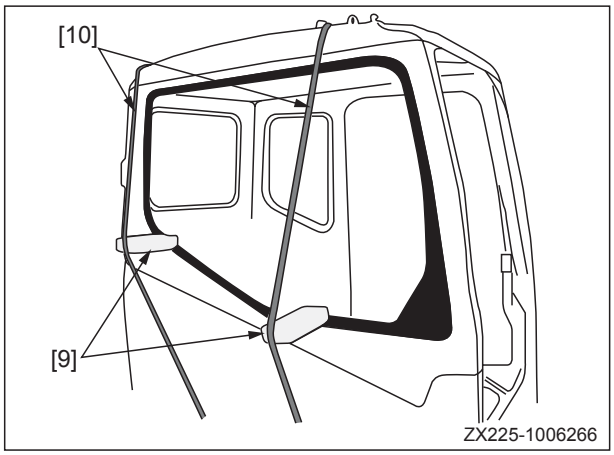
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8. Fix the glass

   1) After the right window glass (1) has been adhered to the cab, put positioning chips a (1 or 2 pcs) beneath the glass in order to fix it.



   2) Use foam polystyrene blocks [9] and rubber band [10] to fix the glass and the rubber seal as illustrated.



9. After the glass has been fixed, remove all the remaining primer and adhesive on the cab and on the glass.

   ★ Clean the adhesive with unleaded gasoline before it is hardened.

   ★ Do not apply impacting force onto the glass when cleaning it.

10. Protection of fixed window glass

   1) Remove the positioning chips, foam polystyrene blocks and the rubber band after 10 hours.

      (Condition: Temperature: 20; humidity: 60%)

   2) Wait for another 14 hours after the removal of positioning chips, foam polystyrene blocks and rubber band before operating the machine.

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8.28 Front Window AS - Disassemble and Assemble

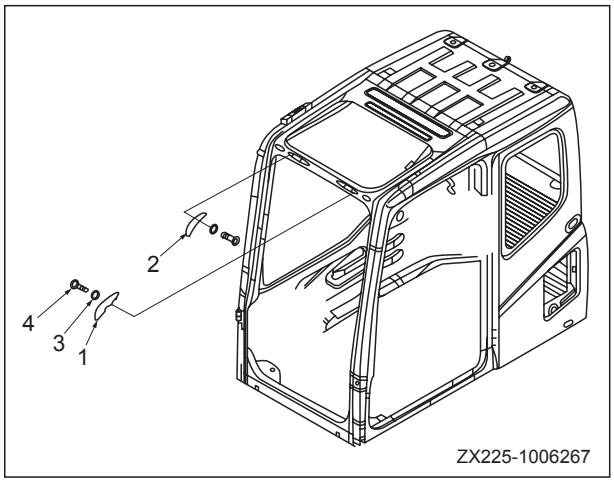
Lower the work equipment onto the ground and shut down the engine.

★ The front window assembly must be removed from the cab in order to replace the front window glass. Disassembling and assembling method of front window assembly (frame and glass) is illustrated in the following part.

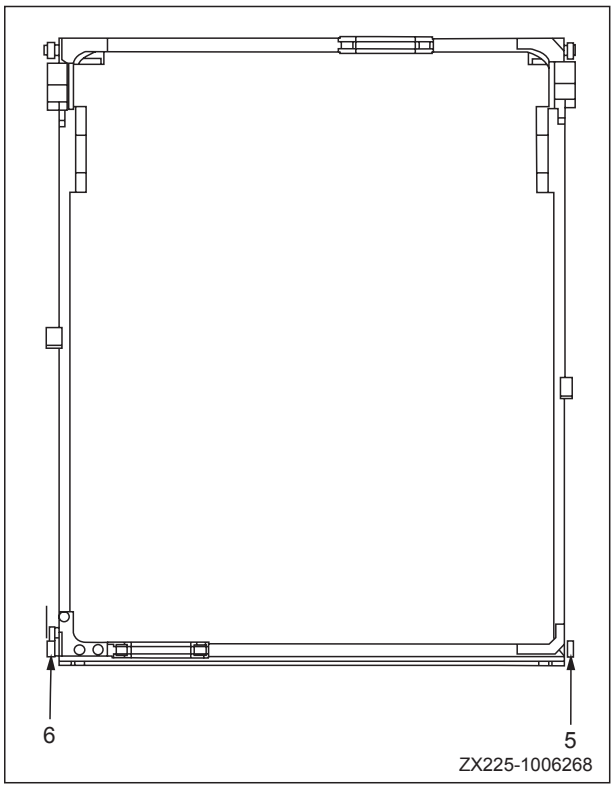
8.28.1 Disassemble

1. Raise the front window assembly to the roof and secure it with the rear locks (at both sides).
2. Remove left corner plate (1) and right corner plate (2). ※1

   ★ Mounting bolt (4) and washer (3) of the left corner plate will be used in Step 6 to hang the pull rod.



3. Release the rear lock of the cab.
4. Lower the front window assembly carefully a bit. Take out and hold the rollers (5) and (6) at the bottom of the front window from the removed parts in Step 2.
5. Remove roller (5) and (6) from both sides of the bottom of the front window.



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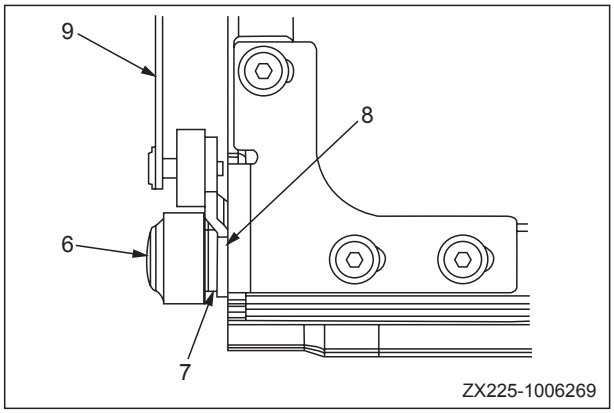
6. Remove pin (7) at the lower left side.

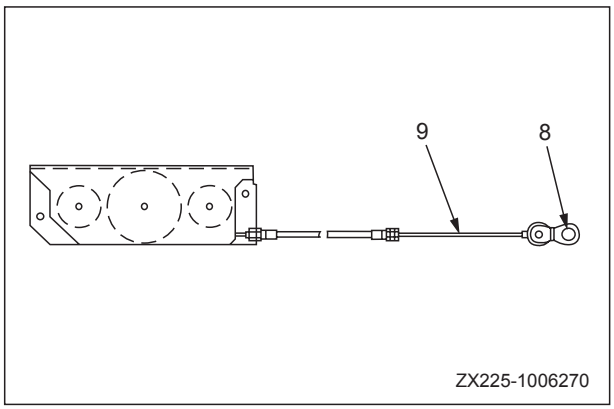
※2

★ Plate (8) at the end of the pull rod (9) will come out by removing of pin (7).

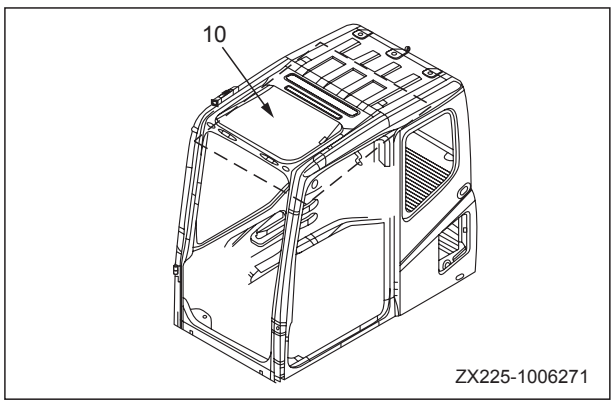
★ Hang plate (8) onto the mounting bolt of left corner plate (using the washer) and fix it.

⚠ **A return load of 58.8 N {6 kg}is applied onto the rear of the cab. Be very careful when removing pin (7) to disconnect pull rod (9).**





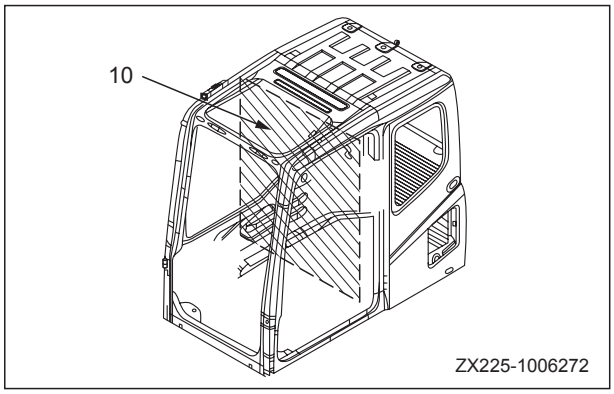
7. Pull out the front window assembly (10) from the opened part of the guide rail and lower the assembly gradually.



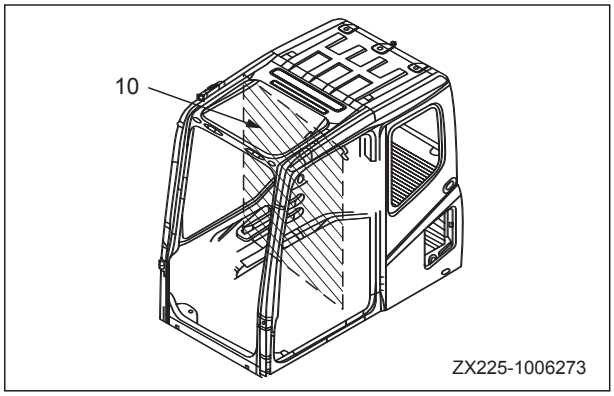
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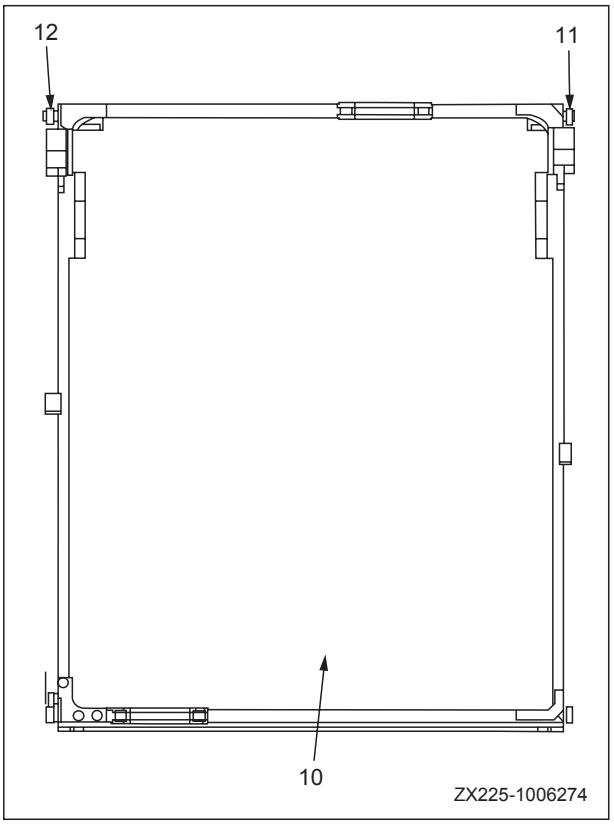
8. Lower the front window assembly (10) completely.

   ★ Be careful not to allow the front window assembly to damage the machine monitor.



9. Move the front window assembly (10) to the right and the left and remove the two upper rollers (11) and (12) from the guide rail. Then, remove the front window assembly (10).





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8.28.2 Assemble

- Reverse the disassembling sequence.

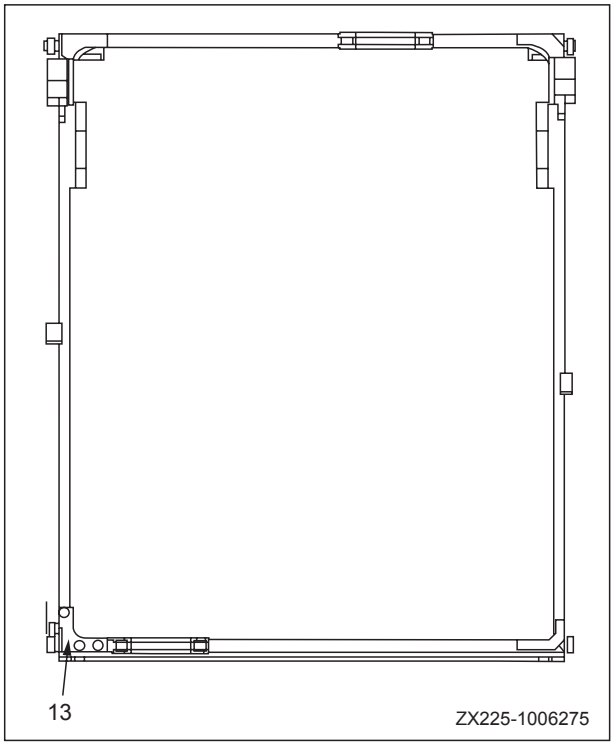
※1

- Adjust the opening and closing of the front window assembly as per the following instruction.

1. Open and close the front window assembly and check if it interferes with the guide rail. Check if the roller is jammed.
2. If the front window can not be opened or closed properly, loosen the mounting bolt of the roller adjusting bracket (13) and adjust the condition of the front window. Tighten the mounting bolt after adjusting.

   ★ Make sure bracket (13) is installed without an angle.

   Mounting bolt: 34.3 N·m {3.5 kgf·m}



3. Raise the front window assemble and fix it with rear locks (at both sides).

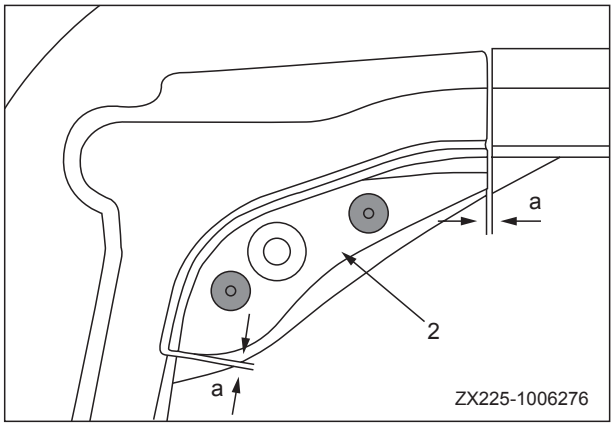
   ★ Check if the locks at the rear of the cab are securely fixed.

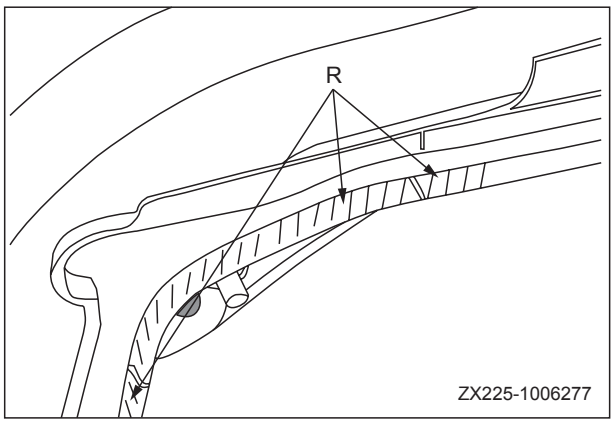
4. Install the right corner plate (2).

   ★ After the "locked" position is adjusted in Step 6, tighten the corner plate.

   ★ Install the right corner plate. Clearance (a) between the guide rail and the right corner plate (2) is 0 – 2.0 mm.

   ★ Install the right corner plate. Keep the surface (R) of the roller without a level error.





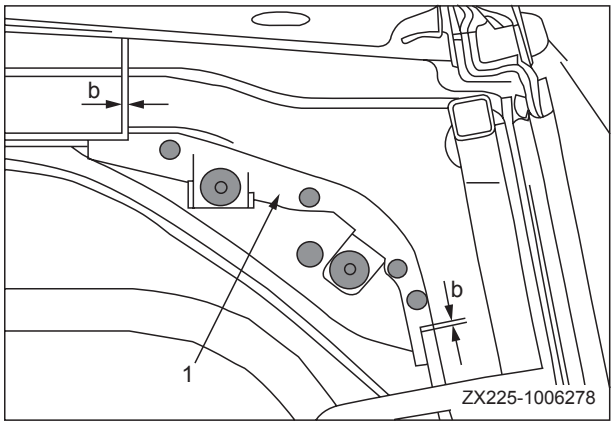
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5. Install left corner plate (1)

   ★ After the "locked" position is adjusted in Step 6, tighten the corner plate.

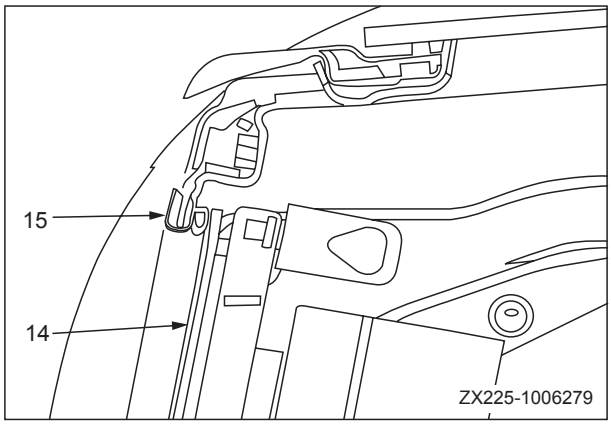
   ★ Install left corner plate. Clearance (b) between the guide rail and the left corner plate (1) is 0 – 2.0 mm.

   ★ Install left corner plate and keep the surface (R) of the roller without a level error. (See the previous illustration).



6. Adjust the "locked" position of the lock of front window assembly as per the following instruction.

   1) Tighten the left corner plate (1) and the right corner plate (2) in a nearly correct position so that front window glass (14) is pressed closely against the adjusting seal (19) on the cab.



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2) Open and close the front window assembly and check the working condition of left lock (16) and right lock (17).

- If left lock (16) and right lock (17) do not work properly,

i) Loosen the mounting bolt (19) of the lock and move the lock (16) forward. Tighten the bolt after that.

★ Adjust the right lock with the same method.

ii) Check again the adaptability between the front window assembly (14) and the adjusting seal (15) on the cab. (Checked in Step 1)

- Repeat Step i) and Step ii) until the condition of front window glass and lock (16) and (17) is satisfactory. Tighten the mounting bolts of the left and right corner plates.

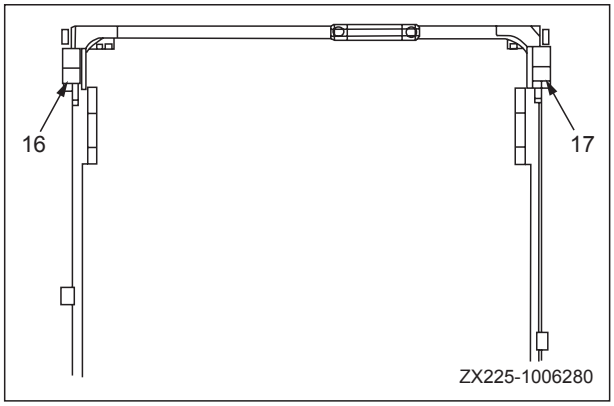
7. After adjustment is finished, flush the front window glass and check if any water leaks into the cab.

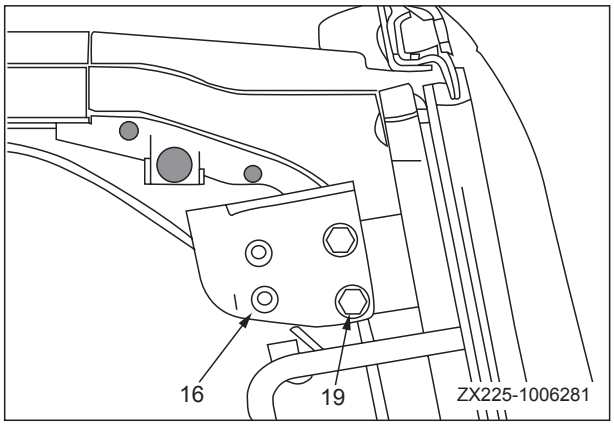
8. Adjust the "locked" position of the lock of front window assembly

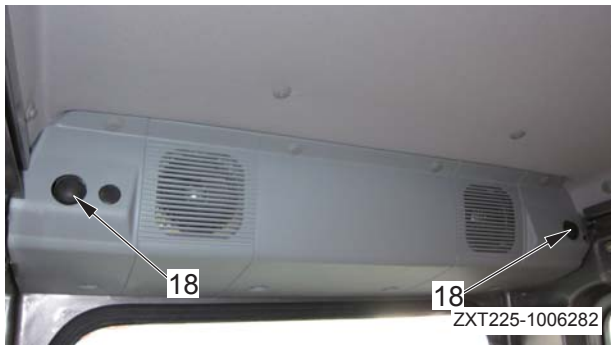
1) After the "locked" position of the lock of front window assembly is adjusted in Step 6 and Step 7, raise the assembly to the roof.

2) Set the locks of the front window assembly at the rear of the cab at the "locked" position, and check the following items:

- Check the conditions of left lock (16) and right lock (17).
- The front window assembly must contact the left and right rubber stopper (18), and the rubber stoppers must be pushed backward by







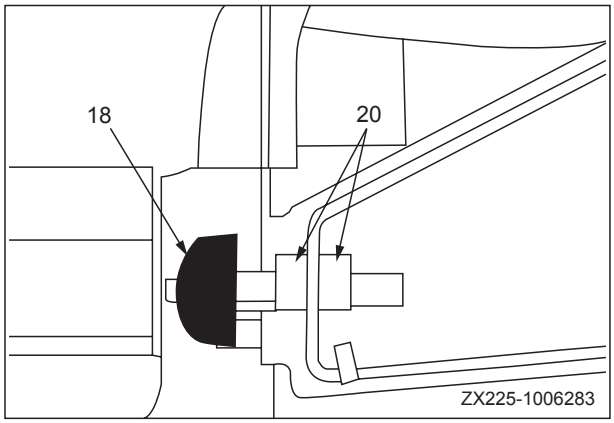
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1.5 – 3.0 mm.

- The front window assembly shall push the limit switch 4 – 7mm backward.

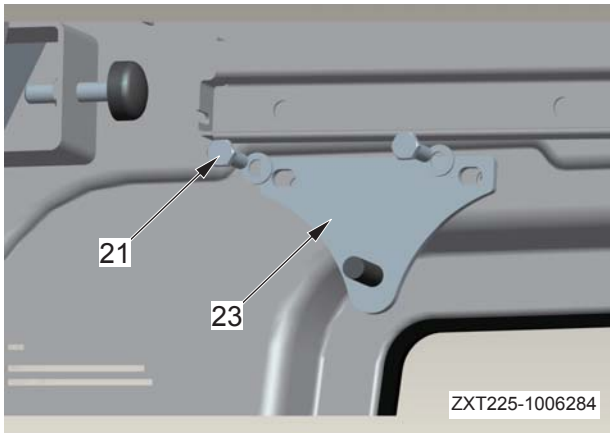
3) Close the front window assembly (10).

4) Loosen the retaining nut (20) at the left and right side of rubber stopper (18), and pull the two rubber stoppers (18) inward so that they can not contact the "unlocked" front window assembly.



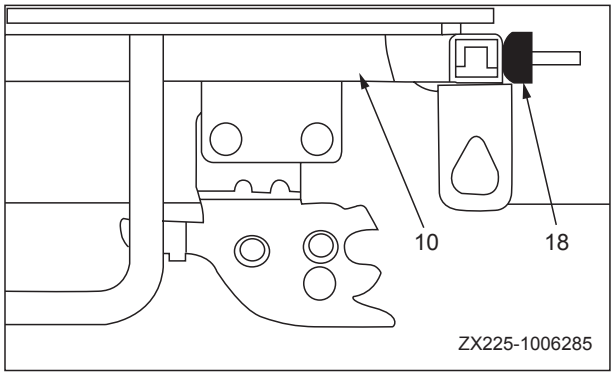
5) Adjust the position of latch bolt (21).

★ Latch bolt(21): M10, Inner diameter of plate (23): ø14.5 mm



6) Adjustment of left and right rubber stopper (18)

i) Allow front window assembly (10) to contact the left and right rubber stopper (18). (when the lock is "unlocked")



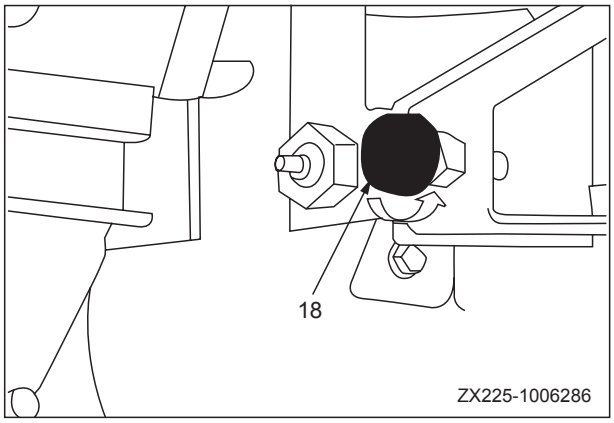
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ii) Lock front window assembly (10).

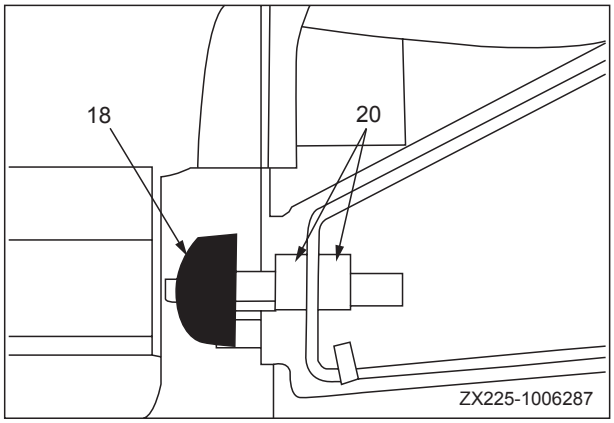
iii) Turn the left/right rubber stopper (18) to the left by one and a half round.

★ Turning the rubber stopper (18) leftward for one round is equivalent to pressing it by 1.5 mm.

★ When front window assembly is "unlocked", it must move the left/right rubber stopper (18) by 1.5 – 3.0 mm.

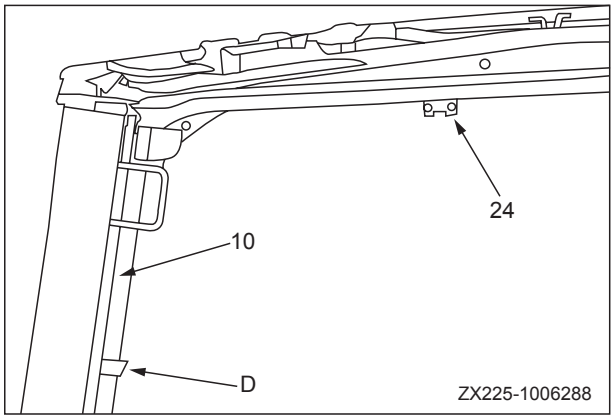


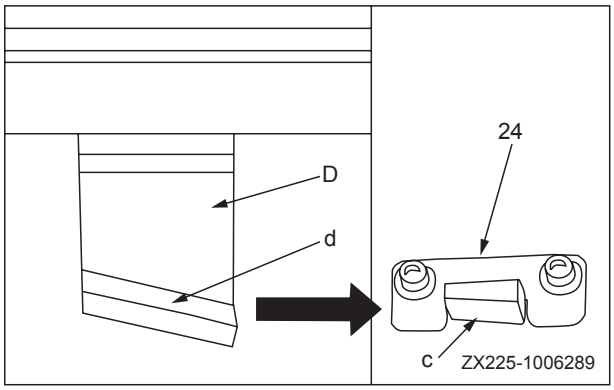
iv) Tighten the retaining nuts (20) at both sides of the rubber stopper (18).



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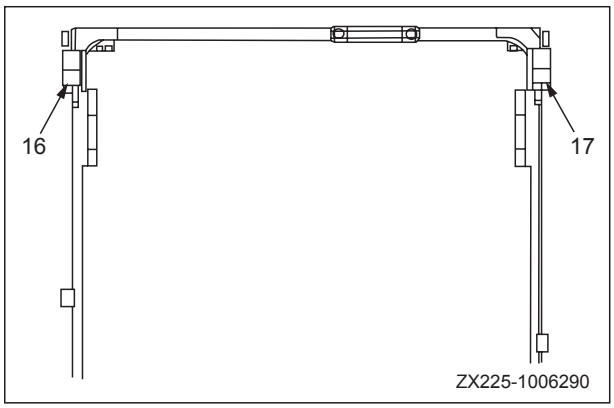
9. Adjust the front window assembly retainer (24).
   1) Adjust and lock both sides of the retainer (24) so that surface (d) of stopper (D) of front window assembly contacts surface (c) of retainer (24) when front window assembly is raised.





10. Check the locking ability of front window assembly.
   1) After the adjustment from Step 6 to Step 9 is finished, check the locking force of left lock (16) and right lock (17).

      ★ Check the locking force at the "locked" side (front of cab) and the "unlocked" side (rear of cab).



※2

Left lower pin:

27 – 34 N·m {2.75 – 3.47 kgf·m}

Mounting bolt:

adhesive(LT-2)

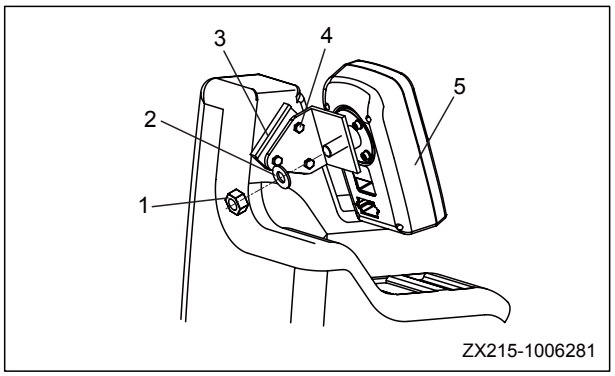
https://truckmanualshub.com/

8.29 Monitor - Remove and Install

8.29.1 Removal

⚠ Disconnect first the cable from the negative (-) post of the battery.

1. Unscrew the three bolts (4). Remove the mounting plate and the monitor assembly from the bracket (3).
2. Remove the nut (1) and the gasket (2) to separate the monitor (5) from the mounting plate.



8.29.2 Installation

- Installation is to be performed in the reverse order of removal.

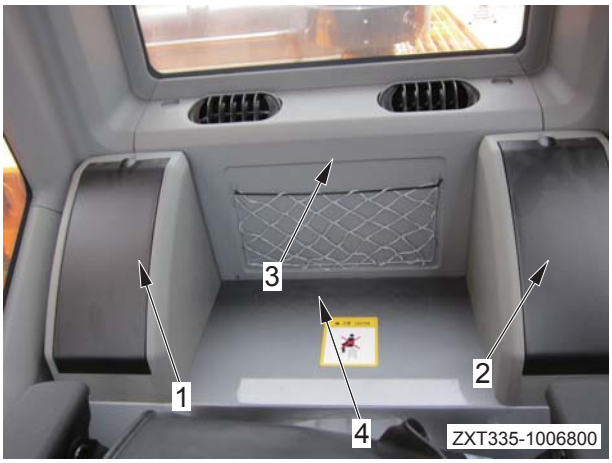
https://truckmanualshub.com/

8.30 Controller AS - Remove and Install

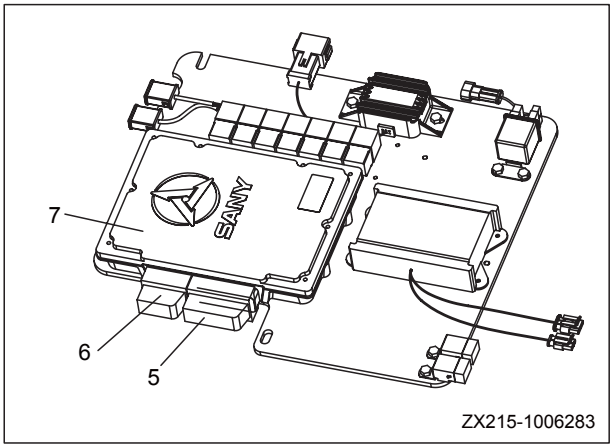
8.30.1 Removal

⚠ Disconnect first the cable from the negative (-) post of the battery.

1. Remove the fuse box (1) and storage box (2).
2. Remove rear covering (3).
3. Remove air conditioner cover (4).



4. Remove the controller wiring connectors A1(5) and A2(6).
5. Remove the four bolts. Remove the controller assembly (7).



8.30.2 Installation

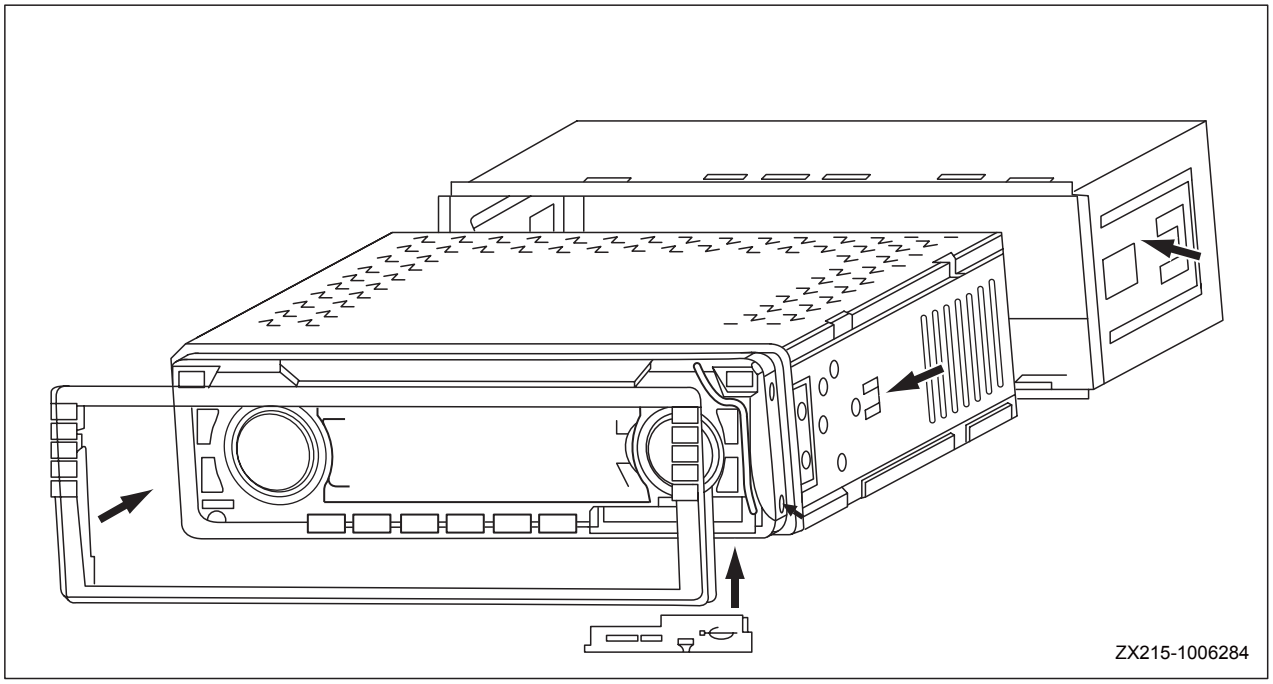
- Installation is to be performed in the reverse order of removal.

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8.31 Radio

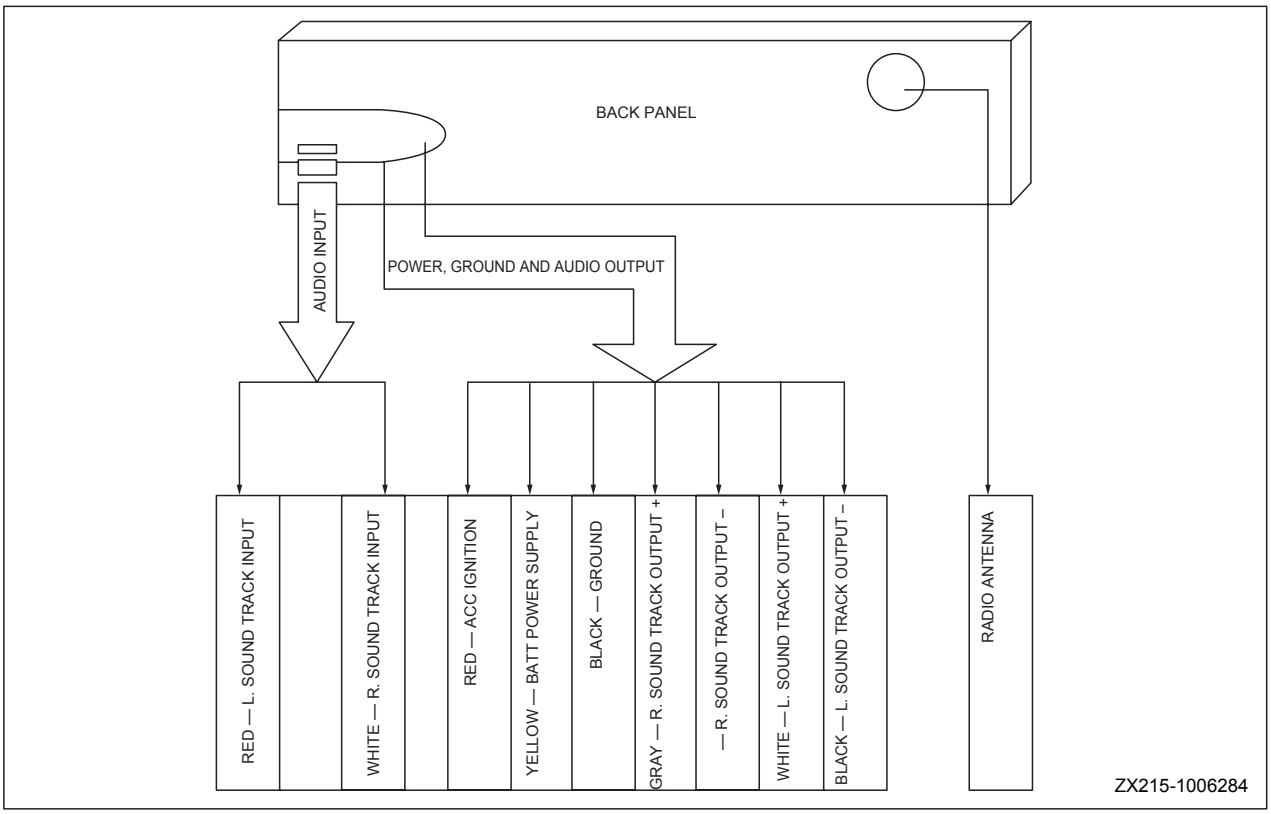
8.31.1 Structure

1) Main structure



https://truckmanualshub.com/

2) Wiring



https://truckmanualshub.com/

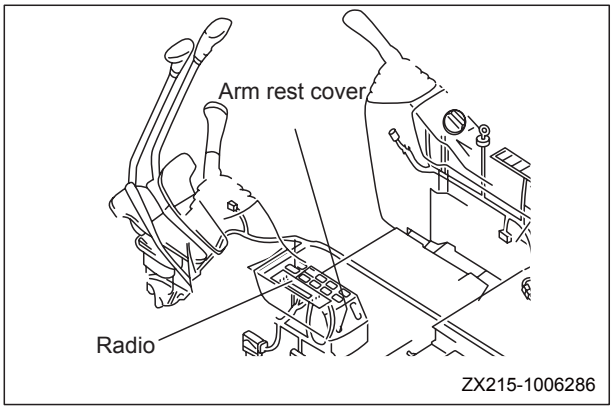
8.31.2 Removal and installation

8.31.2.1 Removal

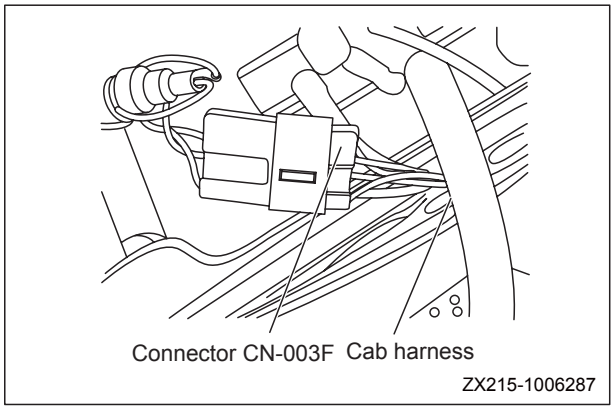
1. Remove the console cover.

NOTICE

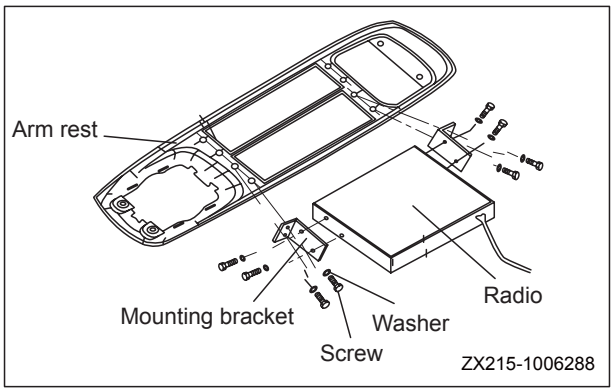
- **Disconnect the power supply prior to removal.**



2. Remove the radio connector CN-003F.



3. Remove the four screws and the washers in order to remove the radio and the radio mounting brackets from the console cover.
4. Remove the four screws and the washers in order to remove the radio from the radio mounting brackets.

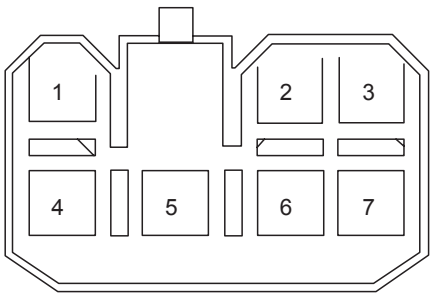


8.31.2.2 Installation

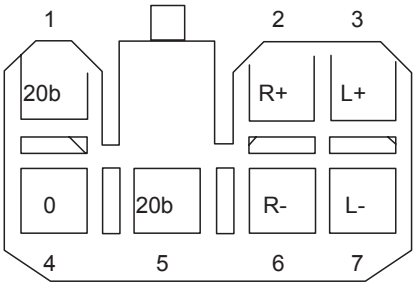
- Installation is to be performed in the reverse order of removal.

https://truckmanualshub.com/

8.31.3 Connector model and wiring



Raido wiring terminals



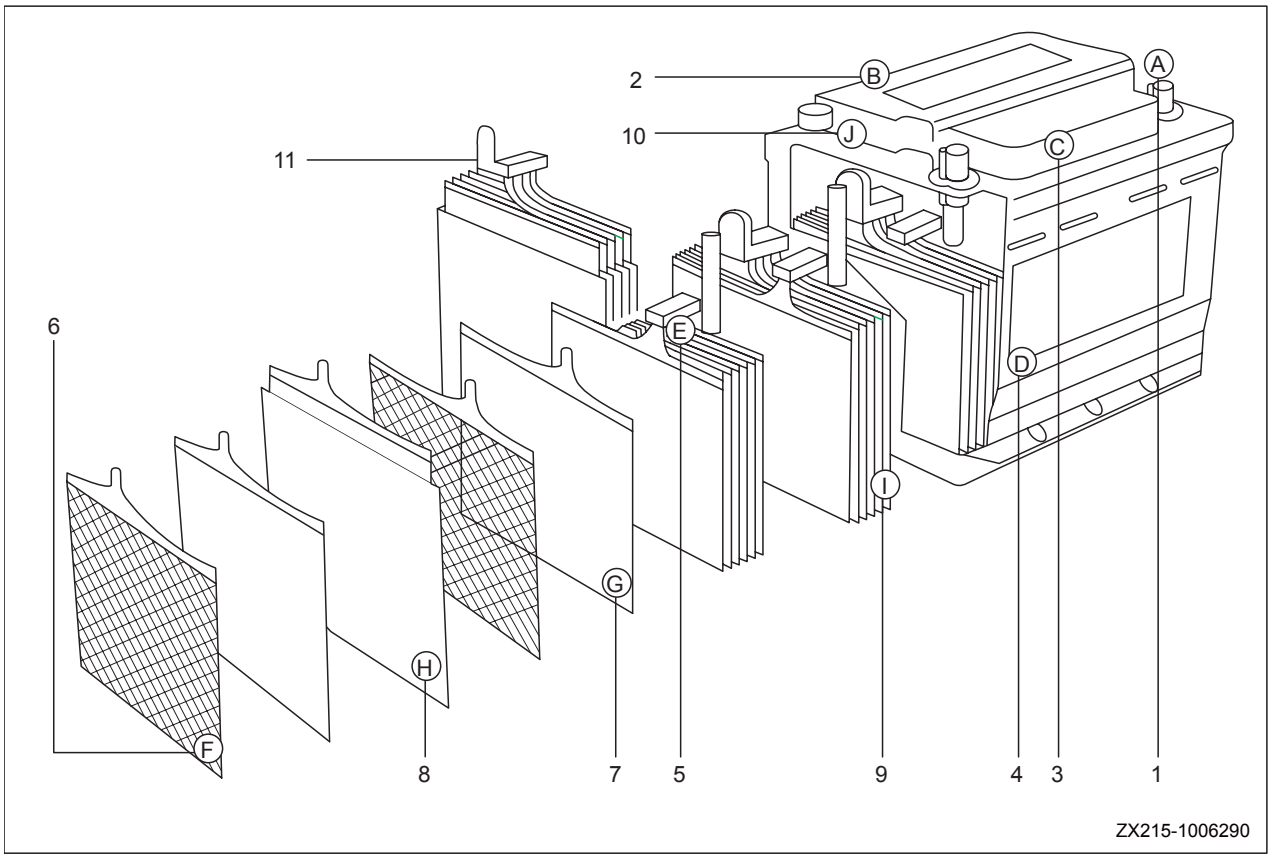
Harness socket terminals
Type: Deutsch DJ7072-3-21

ZX215-1006289

https://truckmanualshub.com/

8.32 Battery

8.32.1 Structure



1- Spinning post
2- Charge densiometer
3- Heat-sealing cover
4- PP casing
5- Central polar ear
6- Forged grid
7- Paste (active material)
8- "Bag-type" screen
9- Polar group
10- Liquid-gas separator
11- Central busbar

https://truckmanualshub.com/

8.32.2 Removal and installation

NOTICE

- **Turn the start switch to the OFF position before removal.**
- **Do not remove the charge densimeter. Tighten the densimeter clockwise, if it is loosened, with a suitable tool.**

⚠ CAUTION

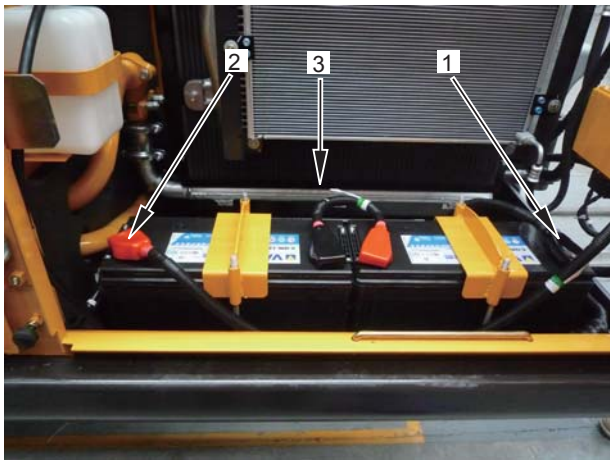
- **Battery gas can cause explosion. No sparks or flames are allowed near the battery.**

8.32.2.1 Removal

1. Remove the four bolts on the battery cover and then remove the battery cover.



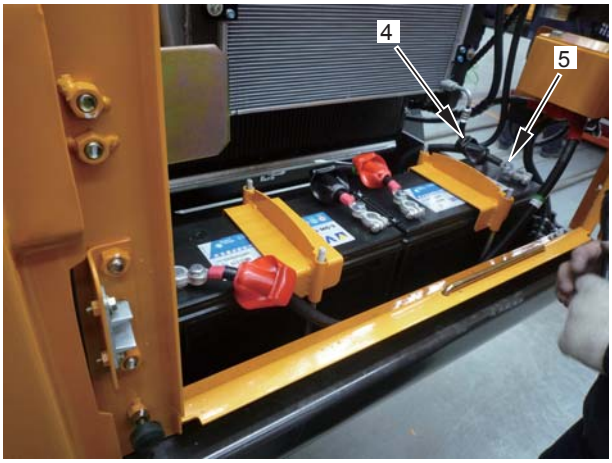
2. Disconnect the negative lead cable (1) of the battery.



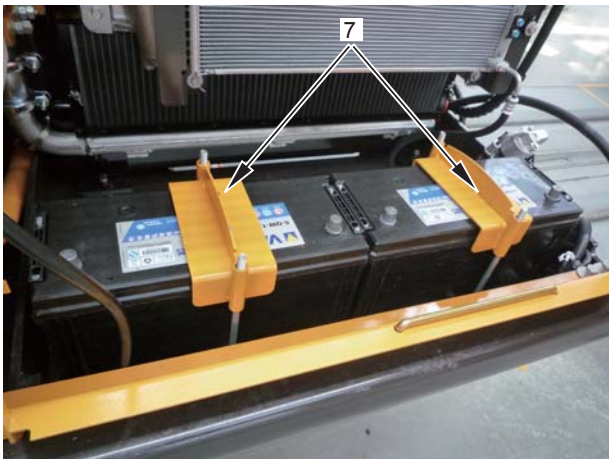
https://truckmanualshub.com/

- Pull up the terminal cover (4), unscrew the bolt (5), and remove the lead wire from the battery post.

3. Disconnect the positive lead cable (2) and the battery connection cable (3) in the same manner.



4. Remove plate (7) and take the battery out of the compartment.



8.32.2.2 Installation

- Installation is to be performed in the reverse order of removal.

8.32.3 Replacement

There are two 12V batteries with grounding negative (-) posts in the machine. If one battery fails in the 24V system, it must be replaced with one of the same type. Batteries of different types are probably charged at different speeds, which may cause one of them to fail due to overloading.

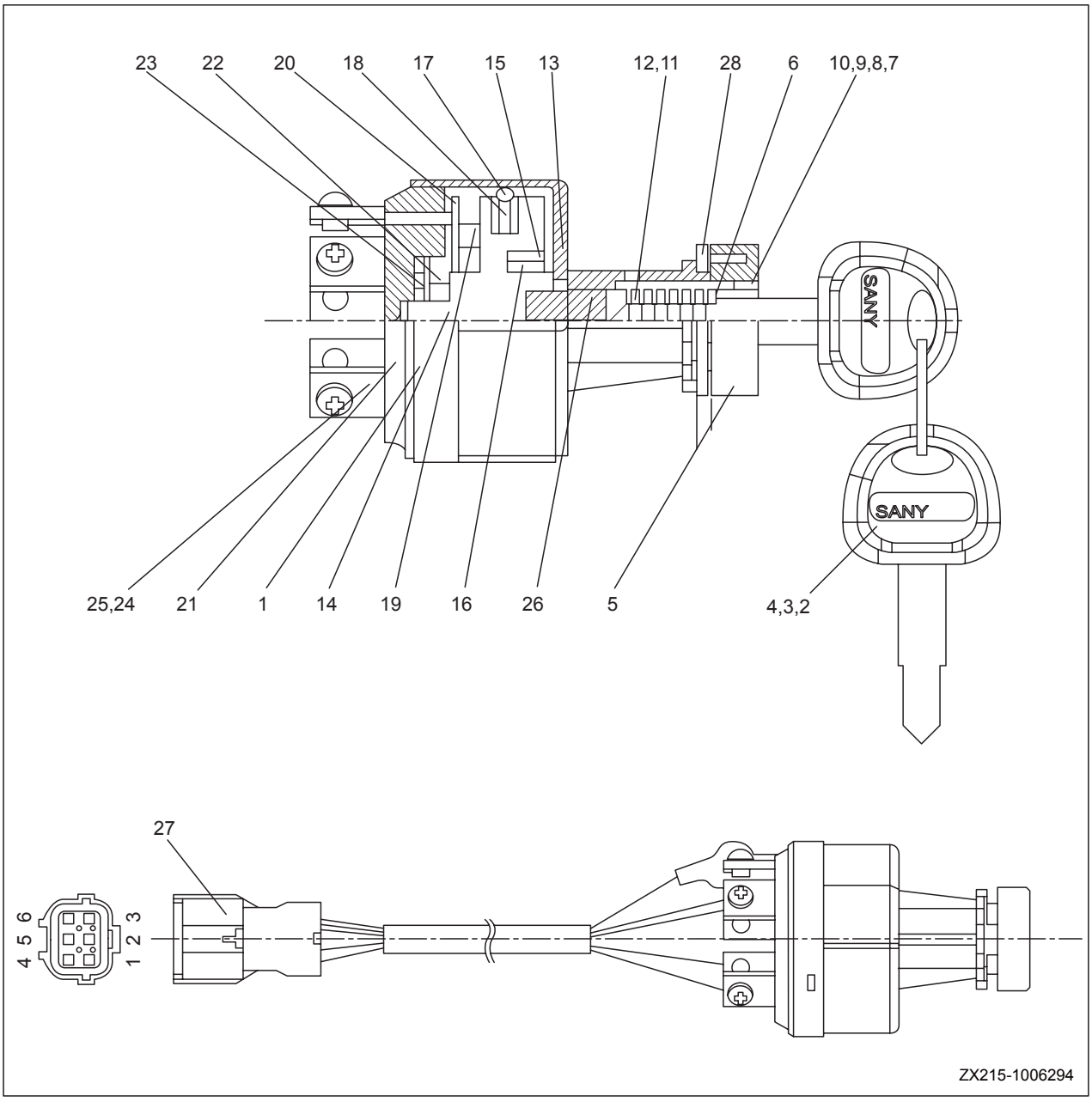
NOTICE

- **During installation, apply vaseline to battery terminals in order to prevent corrosion.**

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8.33 Start Switch

8.33.1 Structure



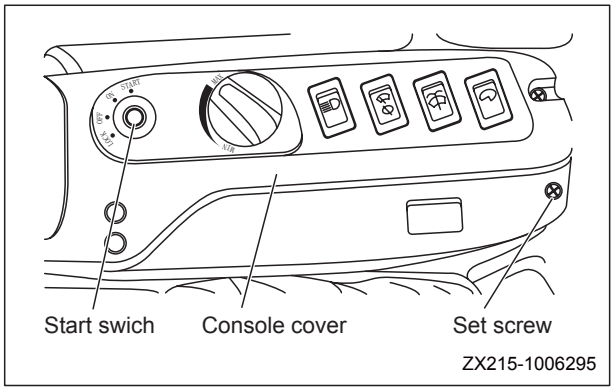
1- Housing	2- Key	3- Ring	4- Knob	5- Nut
6- Cylinder	7- Cap	8- Shield	9- Pin	10- Spring
11- Disc	12- Spring	13- Plug	14- Rotor	15- Cover
16- Spring	17- Ball	18- Spring	19- Contact SPR-B	20- Contact A
21- Seat	22- Contact SPR-A	23- Contact B	24- Terminal	25- Bolt
26- O-ring seal	27- Harness AS	28- Washer		

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8.33.2 Removal and installation

8.33.2.1 Removal

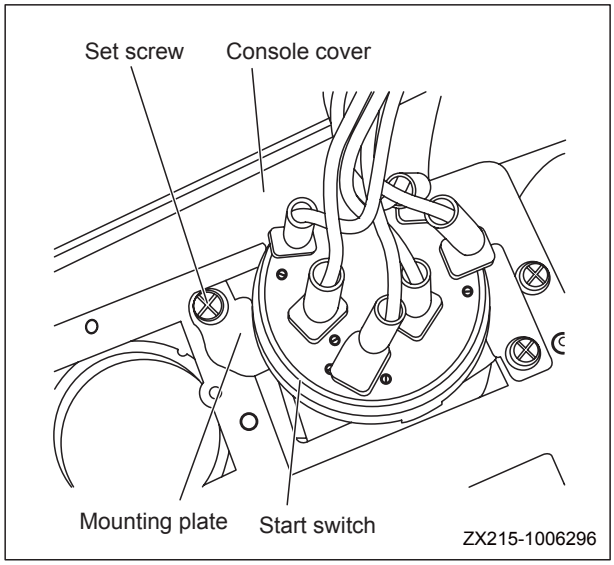
1. Remove the setscrew to remove the console cover.



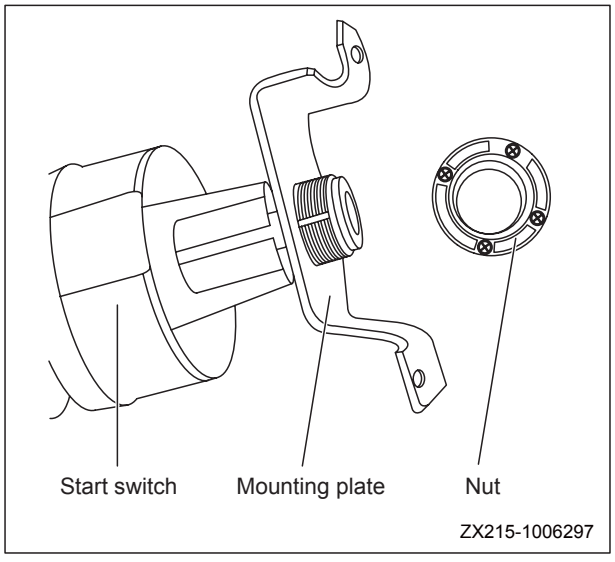
2. Remove both setscrews in order to remove the mounting plate and the start switch from the console cover.

NOTICE

- **Disconnect the power supply of the start switch before removal.**



3. Remove the nut so as to remove the start switch from its mounting plate.



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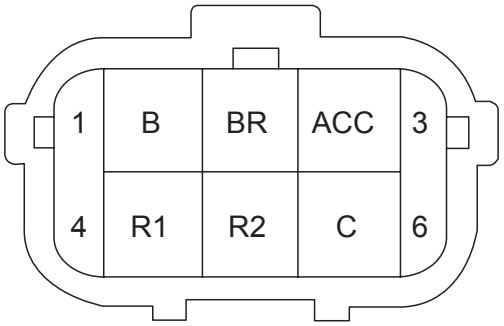
8.33.3 Working principle and wiring of start switch

Working principle

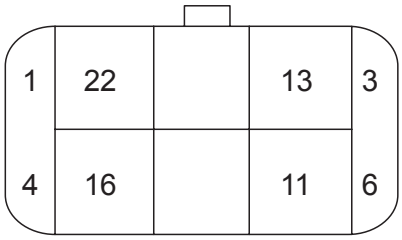
Accelerator Position	ON/OFF					
	Battery (B)	Battery Relay (BR)	Accessories (ACC)	Preheat Plug		Start Relay (C)
				(R1)	(R2)	
HEAT	○	○	○			
OFF	○					
ON	○	○	○			
START	○	○	○		○	○

ZX215-1006298

Wiring



KEY SWITCH WIRING TERMINALS
JACKET MODEL：YAZAKI 7222-7464-30



HARNESS PLUG TERMINALS
JACKET MODEL：YAZAKI 7123-7464-30

ZX215-1006299

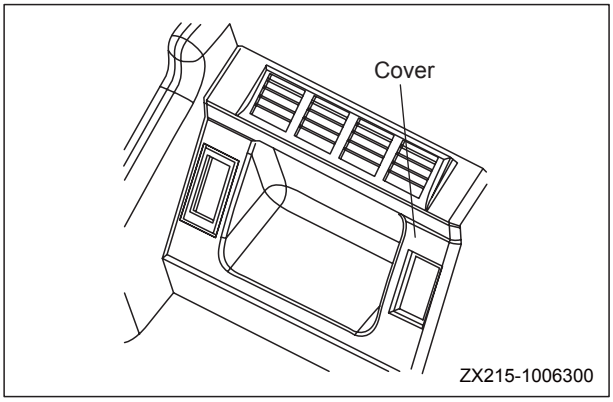
https://truckmanualshub.com/

8.34 Fuse Box

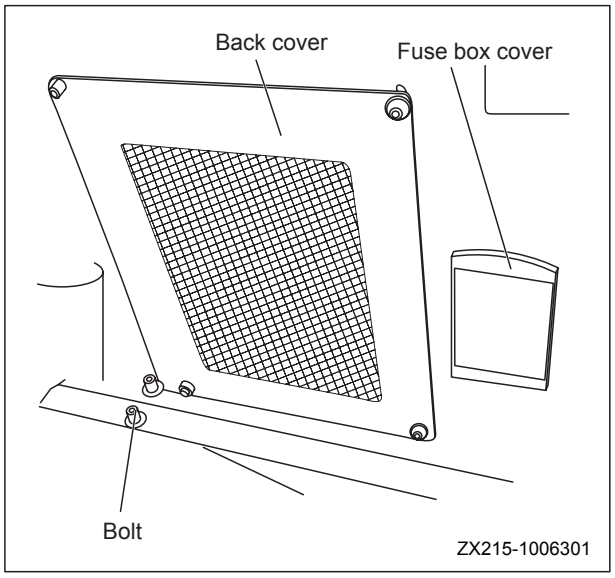
8.34.1 Removal and installation

Removal

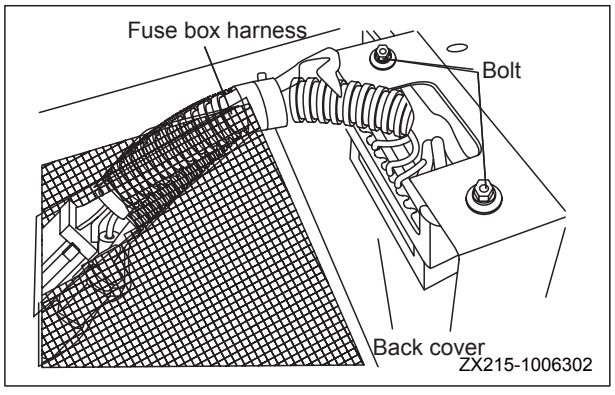
1. Remove the cover.



2. Remove the bolts and take off the back cover along with the fuse box.



3. Remove the bolts so as to separate the fuse box and harness assembly from the back cover.

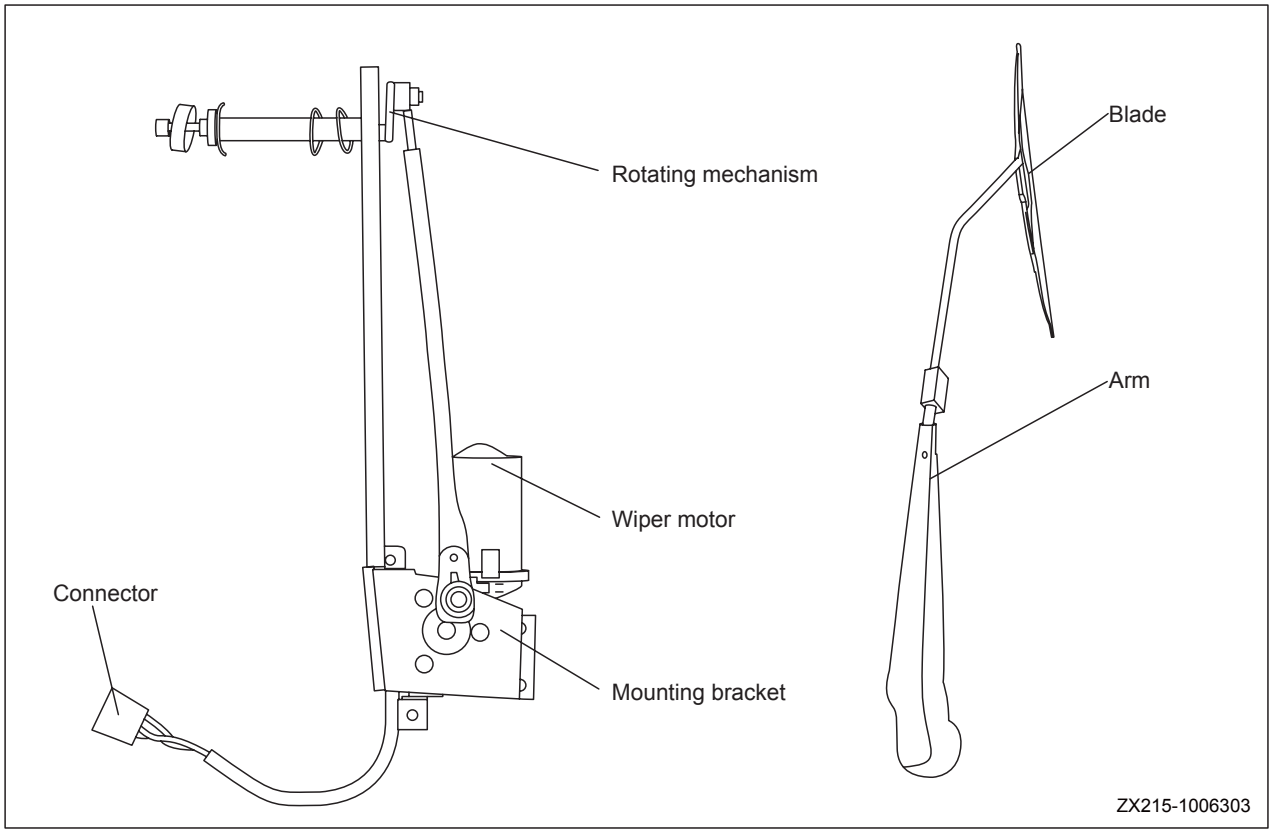


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8.35 Wiper

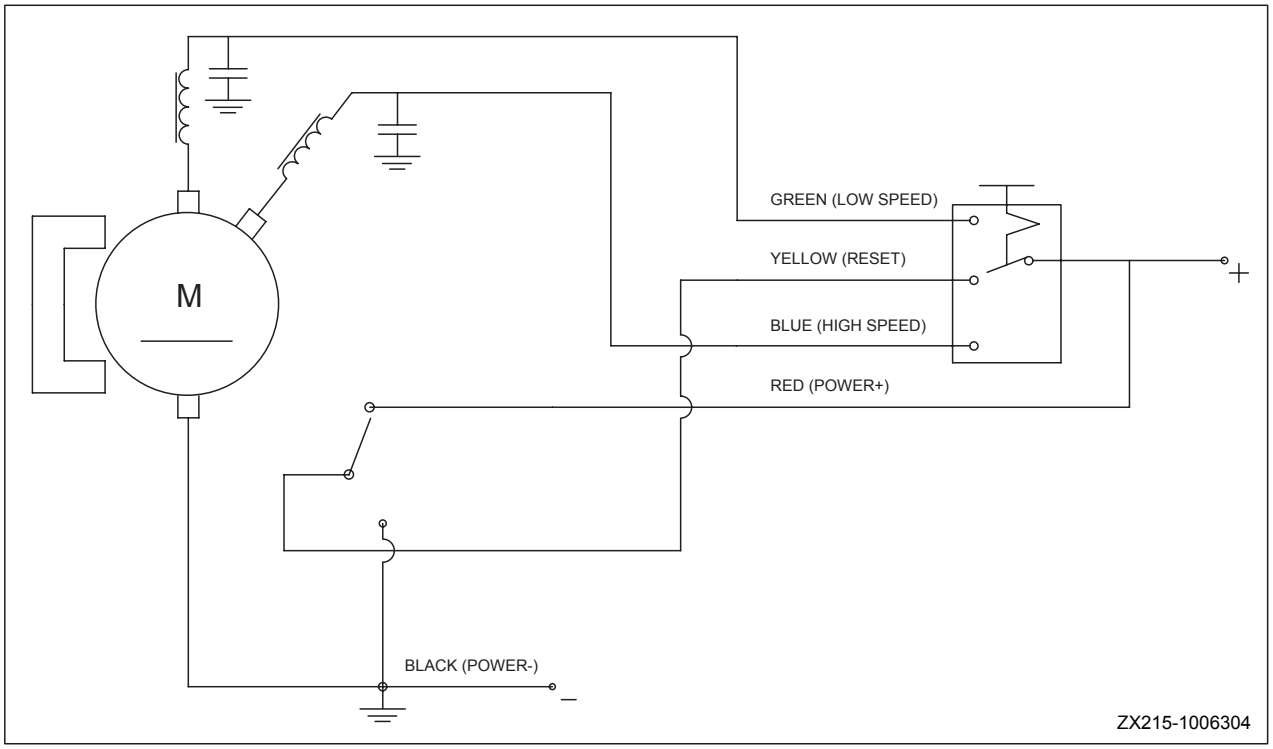
8.35.1 Structure and working principle

Structure



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Working principle

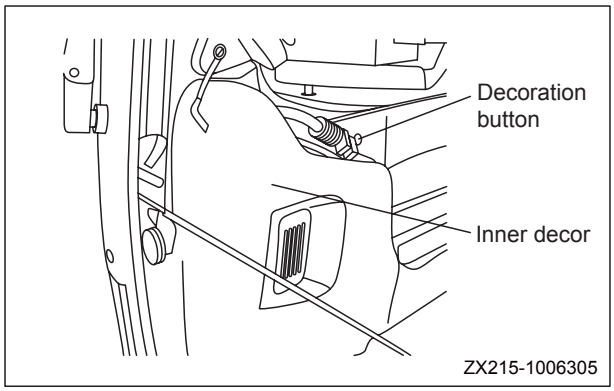


https://truckmanualshub.com/

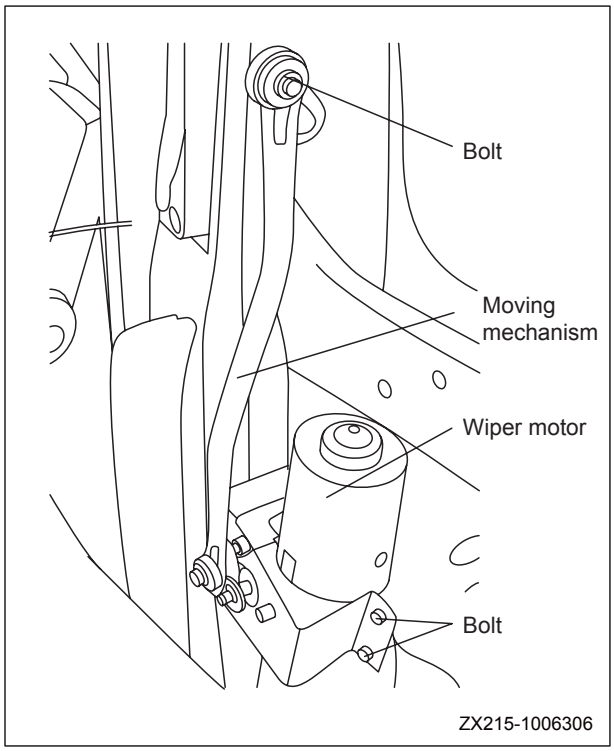
8.35.2 Removal and Installation

Removal

1. Remove the decorative button in order to remove the interior decoration.

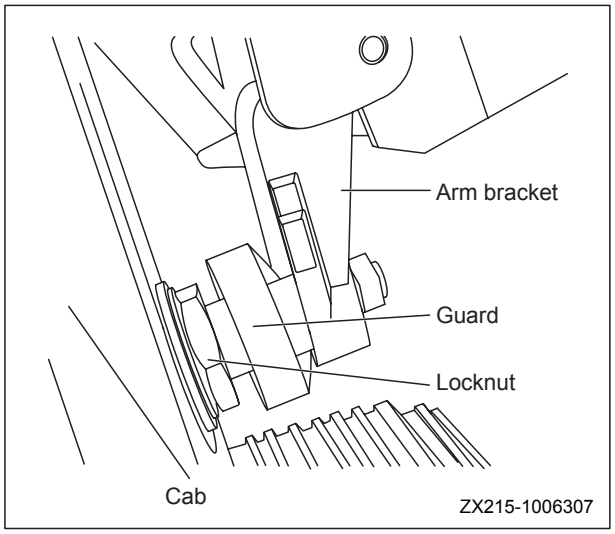


2. Remove the moving mechanism and the motor.
   - Unscrew the bolts to remove the wiper motor and moving mechanism from the cab.



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3. Remove the arm and the blade.
   - Unscrew the nut to remove the wiper arm and blade from the cab.



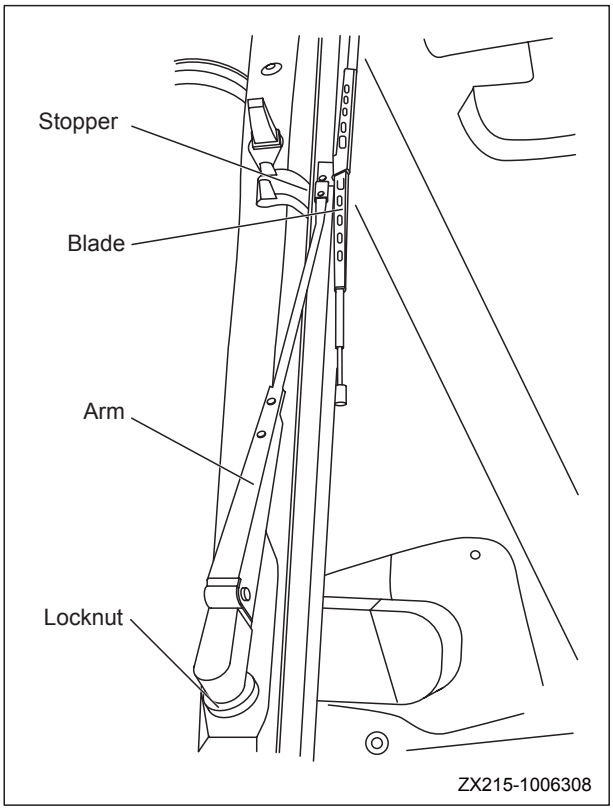
Installation

- Installation is to be performed in the reverse order of removal.

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8.35.3 Angle adjustment of wiper arm

- The arm should stops moving when the blade reaches the stopper.
- If the arm is still working when the blade reaches the stopper or the arm already stops working before the blade reaches the stopper, the moving angle of wiper should be adjusted to prevent breakdown of the wiper.
- Adjust the wiper in such a way. Loosen the locknut; adjust the arm working angle according to actual condition. Make sure that the wiper motor stops working at the moment that the blade reaches the mechanical stopper.



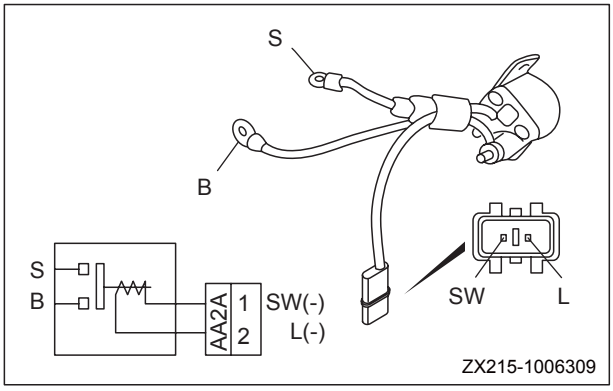
https://truckmanualshub.com/

8.36 Relay

8.36.1 Engine relays

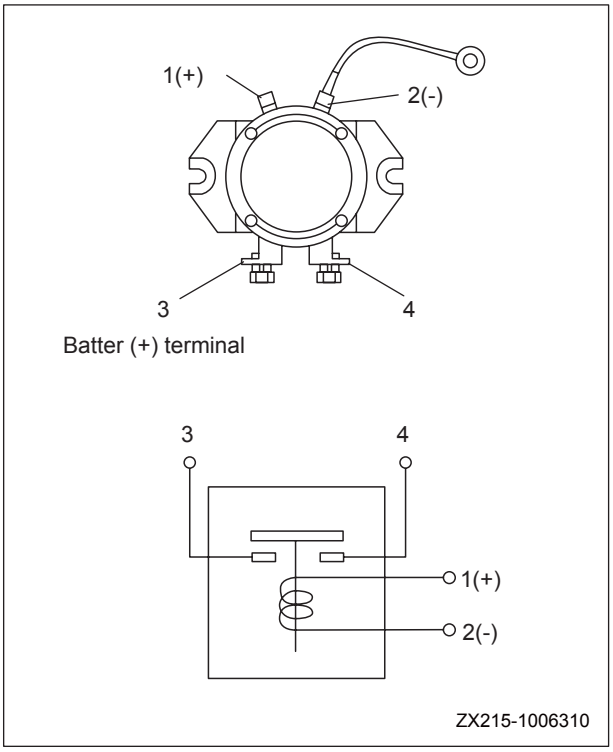
1. Starter relay - check

- Check the conduction and action. Replace the relay in case of any failure.



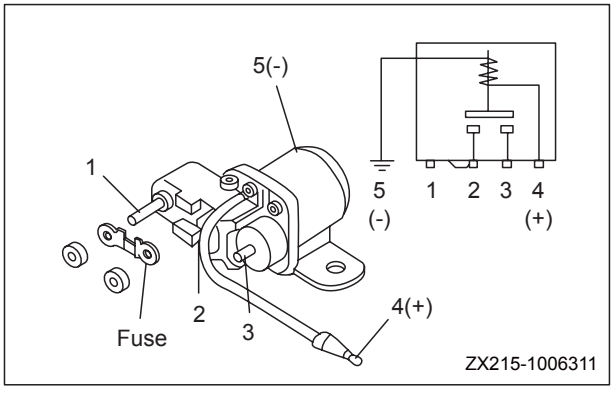
2. Mains relay - check

- Check the conduction and action. Replace the relay in case of any failure.



3. Heater relay

- Check the conduction and action. Replace the relay in case of any failure.



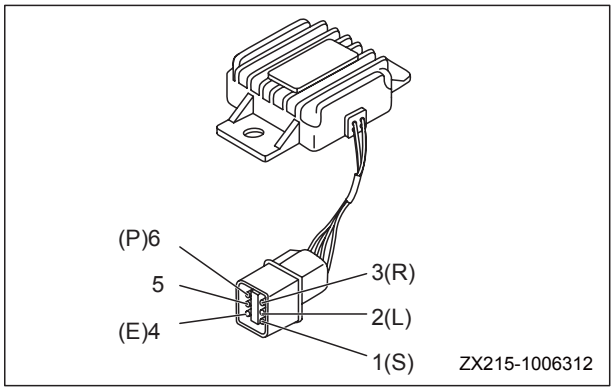
https://truckmanualshub.com/

4. Safety relay

Measure the resistance between terminal 2 and terminal 3.

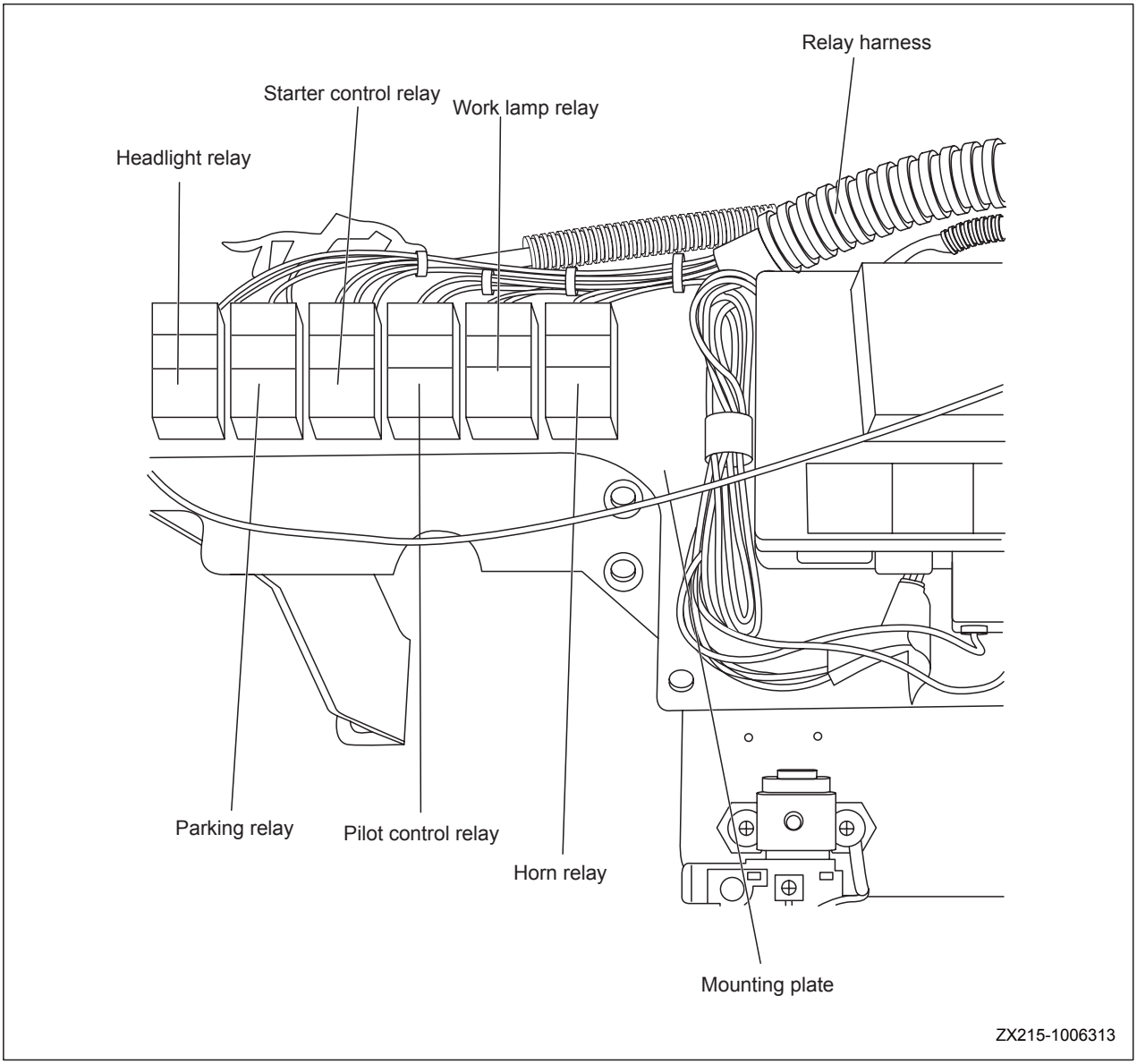
Standard Value	Approx. 200W

- Check the conduction and action. Replace the relay in case of any failure.



8.36.2 Other relays

8.36.2.1 Function and location



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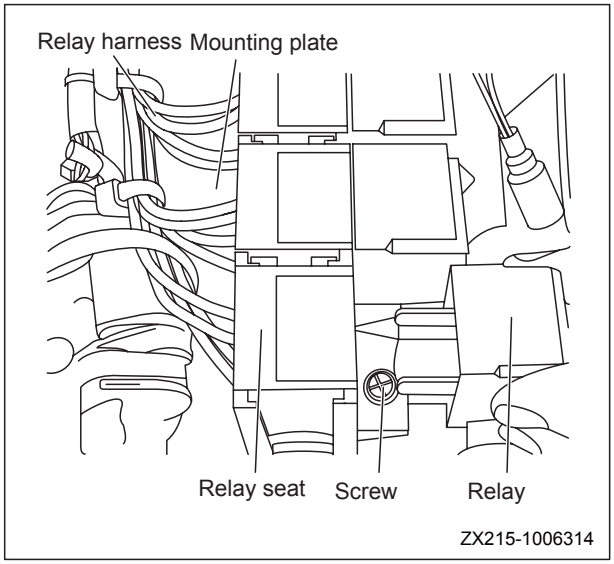
8.36.2.2 Removal and Installation

Removal

1. Remove relay from its seat.
2. Remove the screw in order to remove the relay seat and harness from the mounting plate.

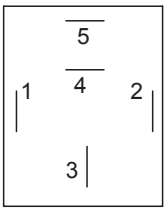
Installation

- Installation is to be performed in the reverse order of removal.



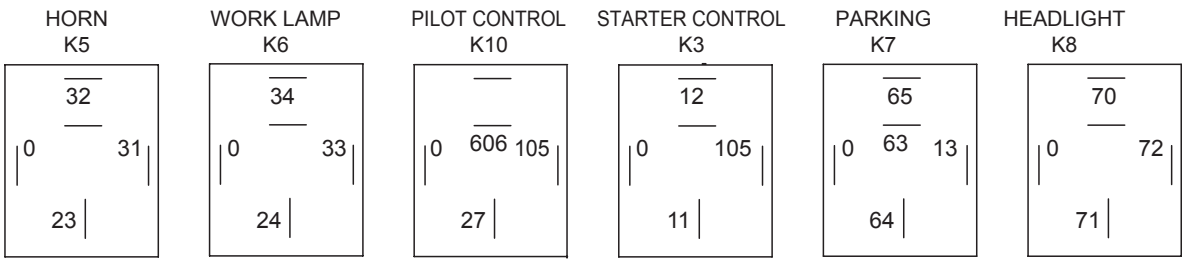
https://truckmanualshub.com/

8.36.2.3 Relay connector and wiring



RELAY WIRING TERMINALS

RELAY MODEL:HELLA 4RD 007 903-027



HARNESS SOCKET TERMINAL

SOCKET MODEL: JACKET 8JA003526-00

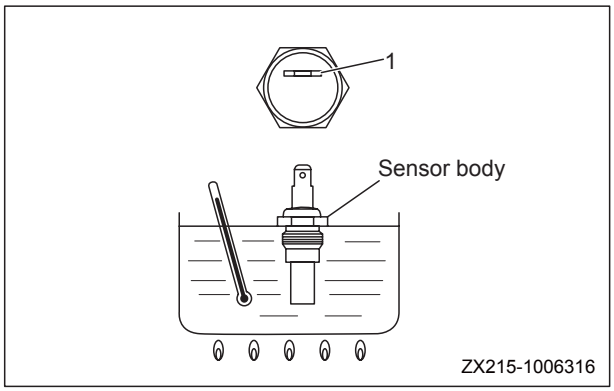
ZX215-1006315

https://truckmanualshub.com/

8.37 Sensor

1. Water temperature sensor - check

- Put the sensor into a vessel containing engine oil.
- Heat the oil to the specified temperature. Stir the oil at the same time.
- Measure the resistance value between the terminal 1 and the sensor body at different temperatures.



Standard Value	50±0.2°C	80±10Ω
	60°C	56.3Ω(ref.)
	80°C	29.5Ω(ref.)
	100°C	16.5Ω(ref.)
	106±0.3°C	14.3±1.0Ω
	120°C	10Ω(ref.)

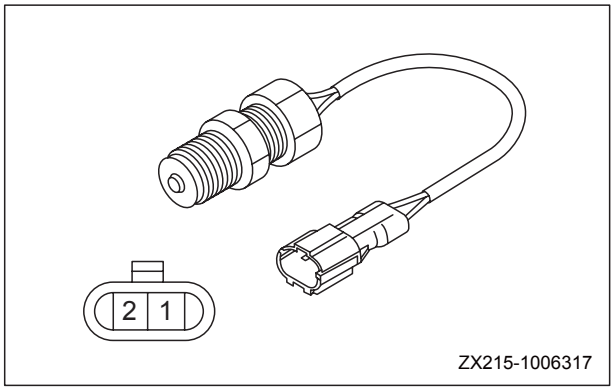
- Replace the sensor if the measured value exceeds the standard one.

2. Engine speed sensor - check

- Measure the resistance between terminal 1 and terminal 2.

Std. Value(25°C)	2.3±0.2kΩ

- Replace the sensor if the measured value exceeds the standard one.



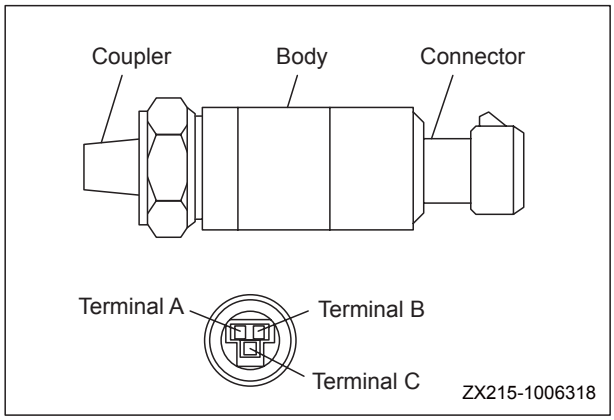
NOTICE

- **Insufficient tightening of the engine speed sensor may cause signal output failure. Tighten the sensor to specified torque.**

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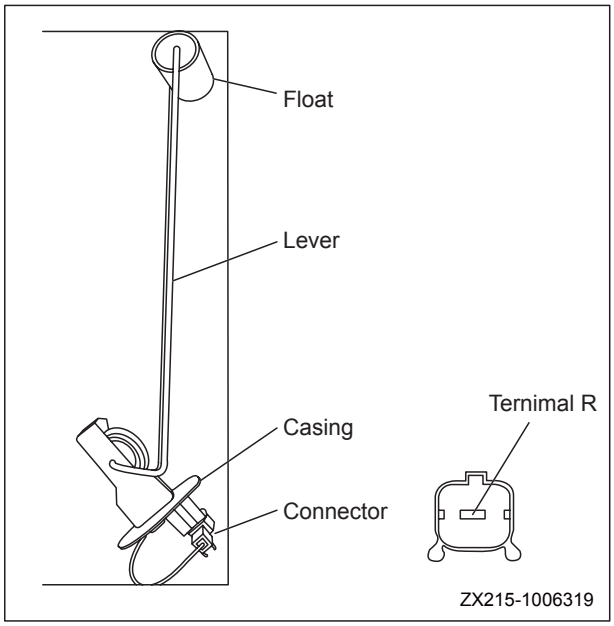
3. Pressure sensor - check

- Input volt: 4.75~5.25VDC
- Output volt: 0.5~4.5V
- Pressure range: 0~50BAR



4. Fuel level sensor - check

- Swing the float up and down in order to measure the effective angle of radial swing, i.e. the line through the float and the turning point will swing 105°.
- Swing the float up and down. The vertical distance between the upper limit and the lower limit of the float should be 500 mm.
- Move the float to its upper limit. Measure the resistance between the sensor terminal R and ground with a multimeter. The measured resistance should be Ru ≦ 9.6Ω.
- Move the float to its lower limit. Measure the resistance between the sensor terminal R and ground with a multimeter. The measured resistance should be Rd ≧ 86Ω.

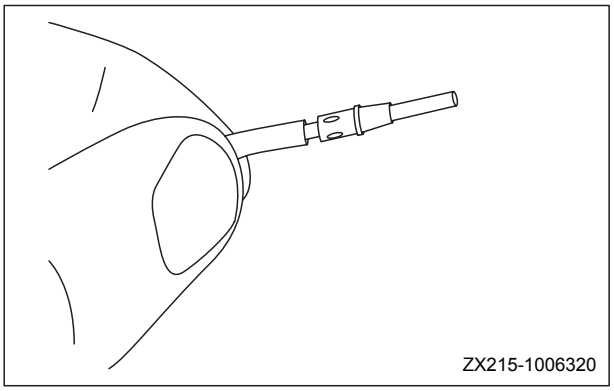


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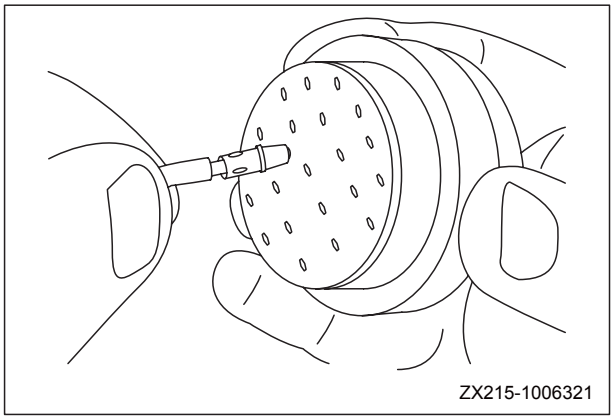
8.38 Connector Terminals - Insert and Remove

8.38.1 Insertion

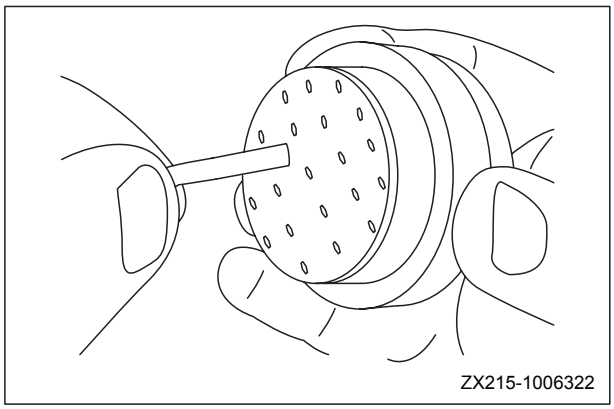
1. Hold tightly a wire terminal at a distance of about 25 mm from its end.



2. Hold the connector. Let the rear seal face you.



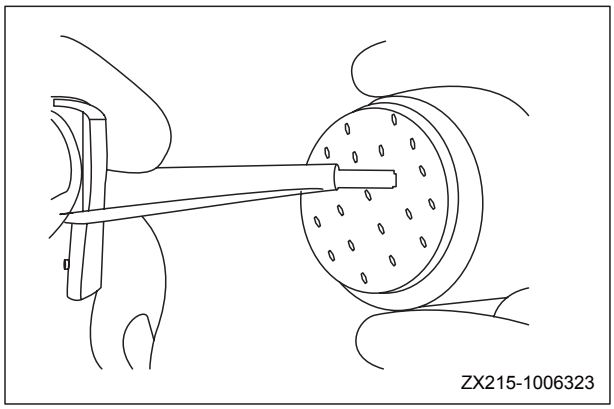
3. Align the terminal with a hole on the seal and push it perpendicularly to the bottom. Slightly pull back the wire in order to ensure that the terminal is locked in place.



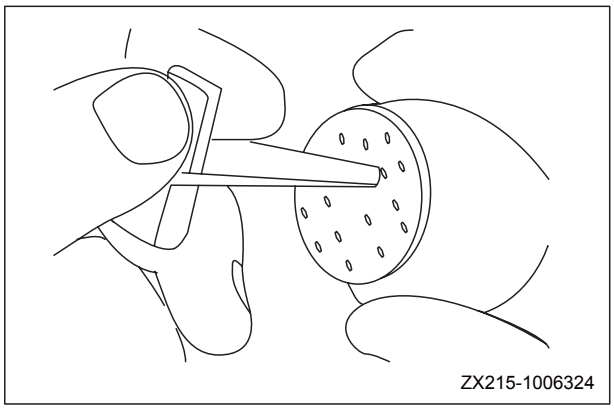
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8.38.2 Removal

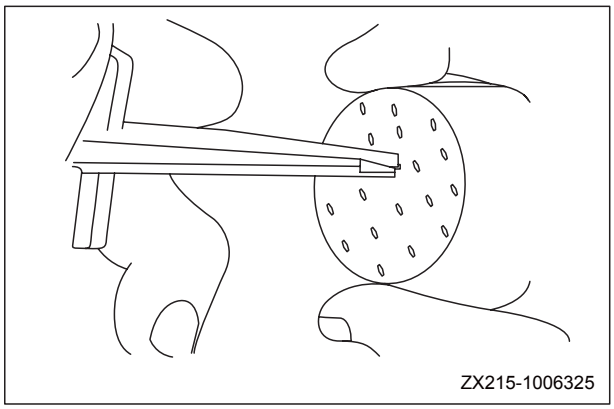
1. Hold the connector, with its back end facing you. Select a suitable tool and clip on the wire.


ZX215-1006323

2. Push the tool along the wire into the connector so that the tool can expand the terminal lock shoulder and reach its flanged part.


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3. Pull out the tool to remove the wire with terminal.


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System Schematics

9 System Schematics

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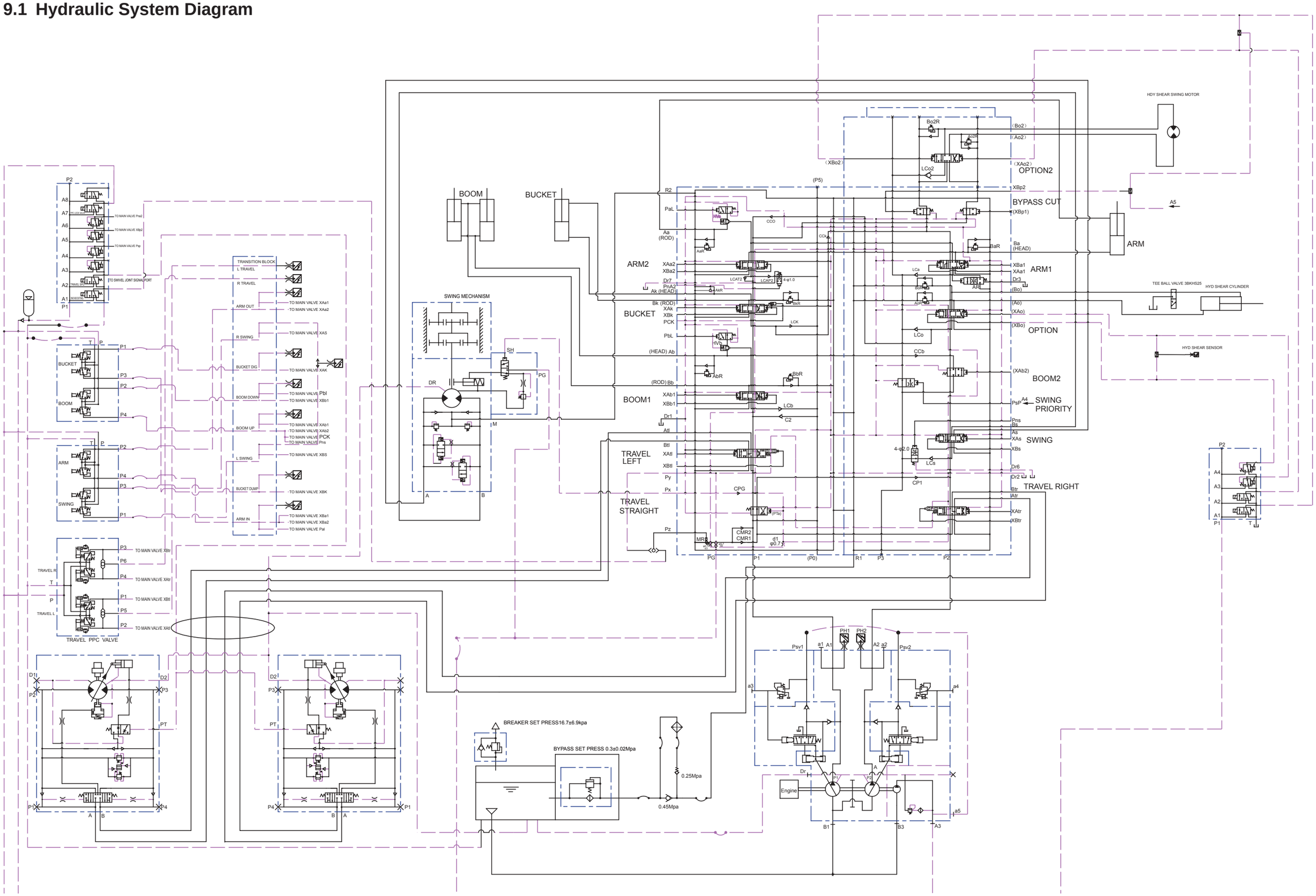
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⚠ WARNING

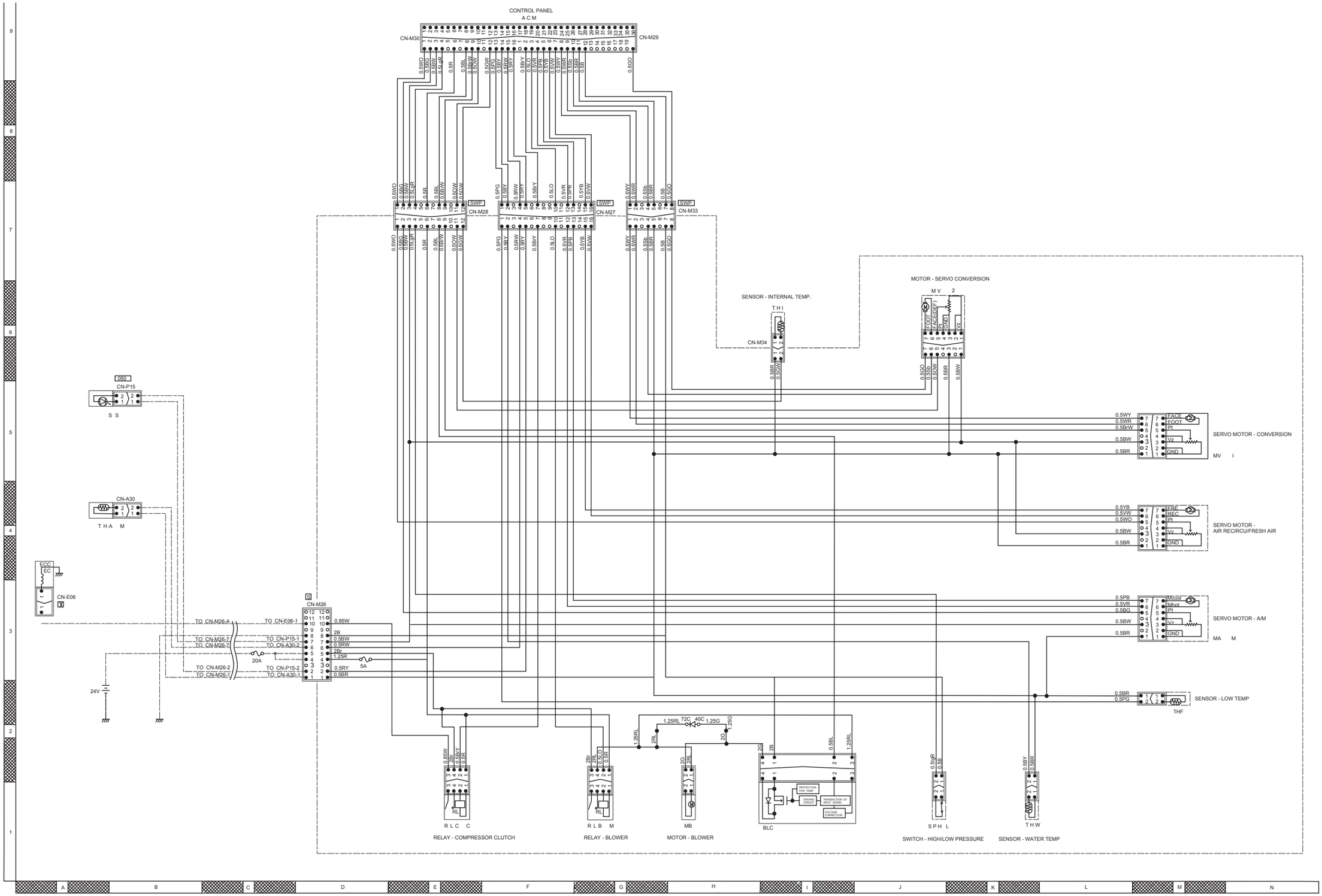
Always read the Safety section of this manual before attempting to operate or service this equipment. Failure to do so could result in machine damage, personnel injury or death.

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9.1 Hydraulic System Diagram

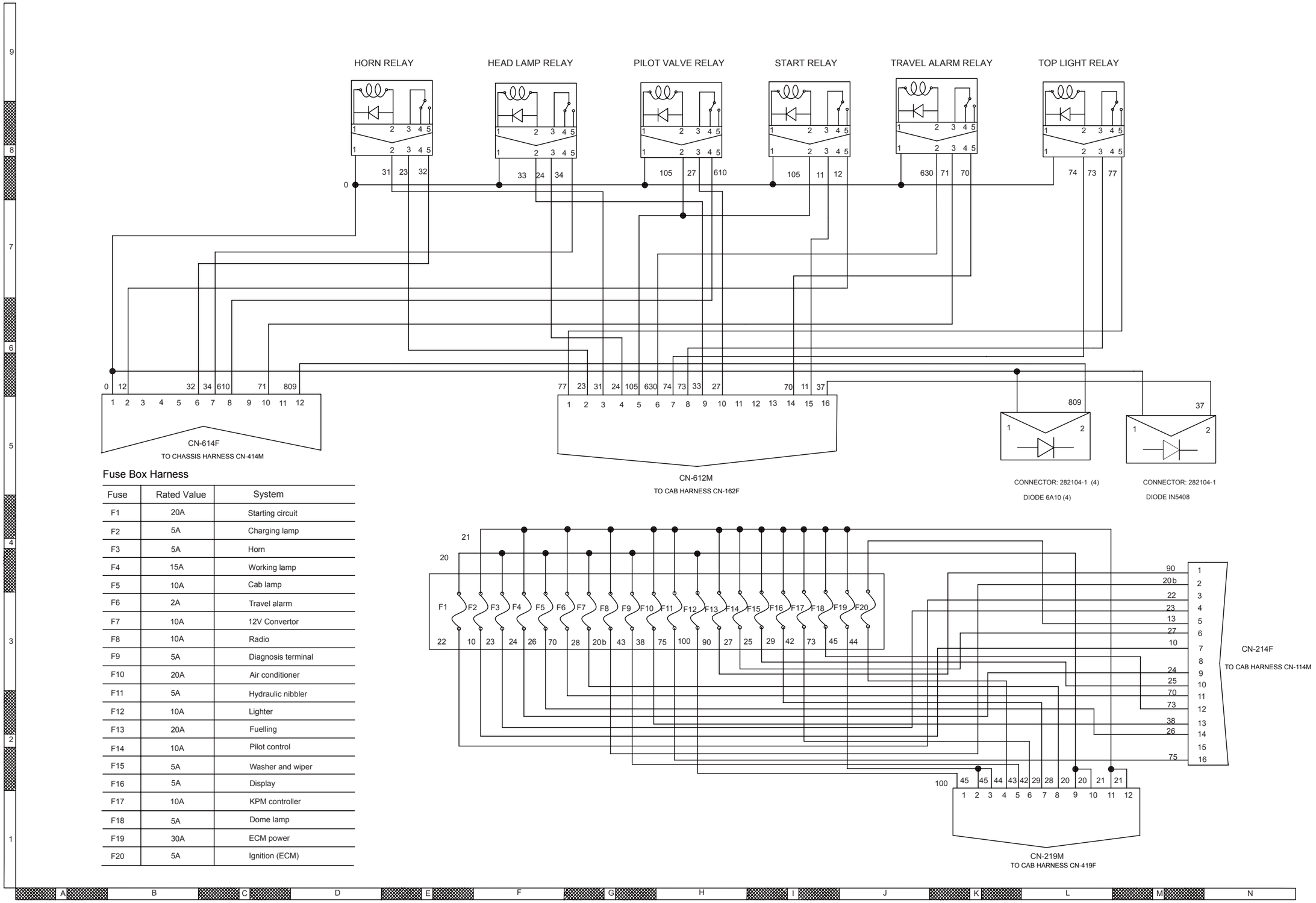


9.2 Air-Conditioning Electrical Diagram



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9.3 Fuse Box Relay

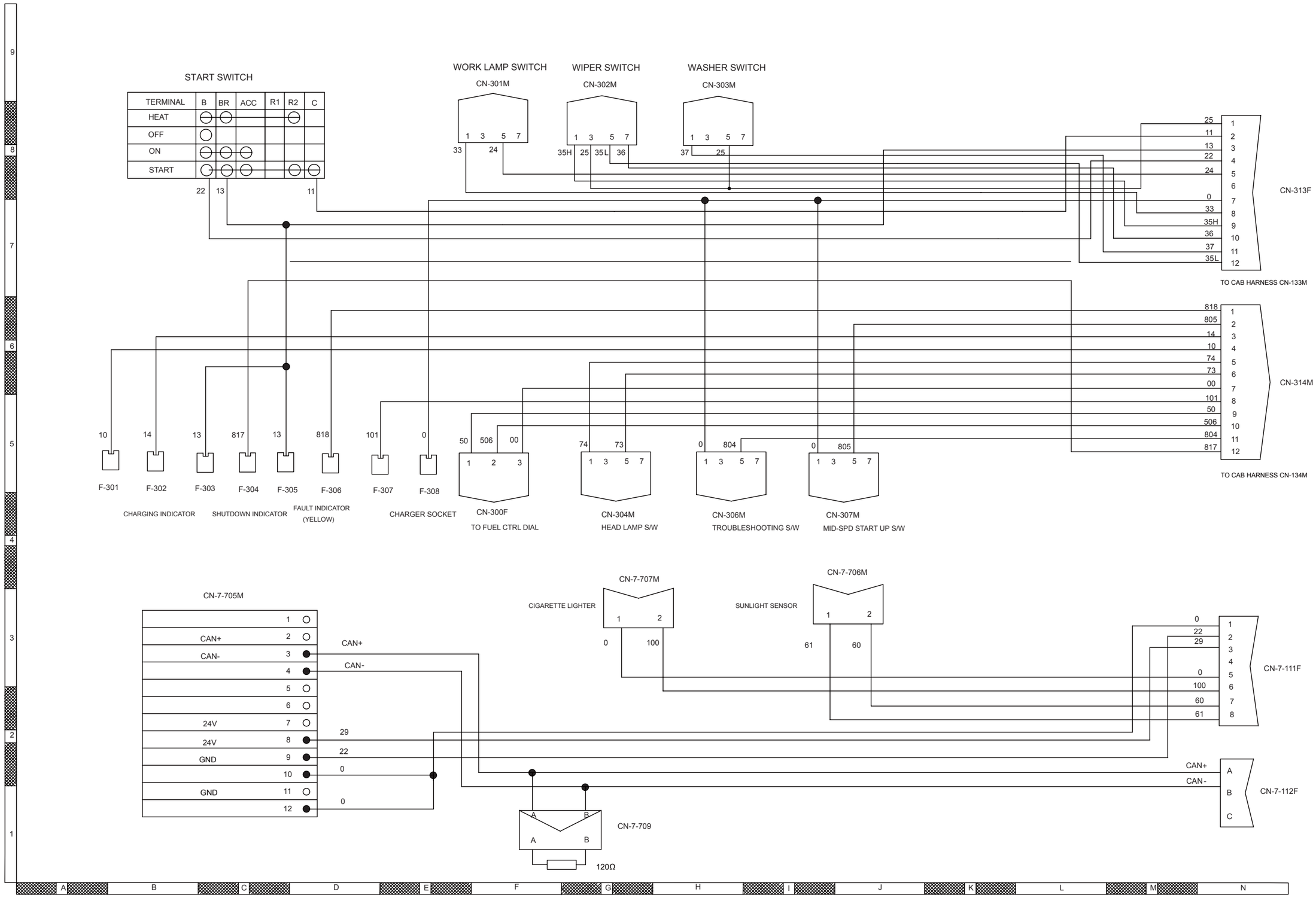


Fuse Box Harness

Fuse	Rated Value	System
F1	20A	Starting circuit
F2	5A	Charging lamp
F3	5A	Horn
F4	15A	Working lamp
F5	10A	Cab lamp
F6	2A	Travel alarm
F7	10A	12V Convertor
F8	10A	Radio
F9	5A	Diagnosis terminal
F10	20A	Air conditioner
F11	5A	Hydraulic nibbler
F12	10A	Lighter
F13	20A	Fuelling
F14	10A	Pilot control
F15	5A	Washer and wiper
F16	5A	Display
F17	10A	KPM controller
F18	5A	Dome lamp
F19	30A	ECM power
F20	5A	Ignition (ECM)

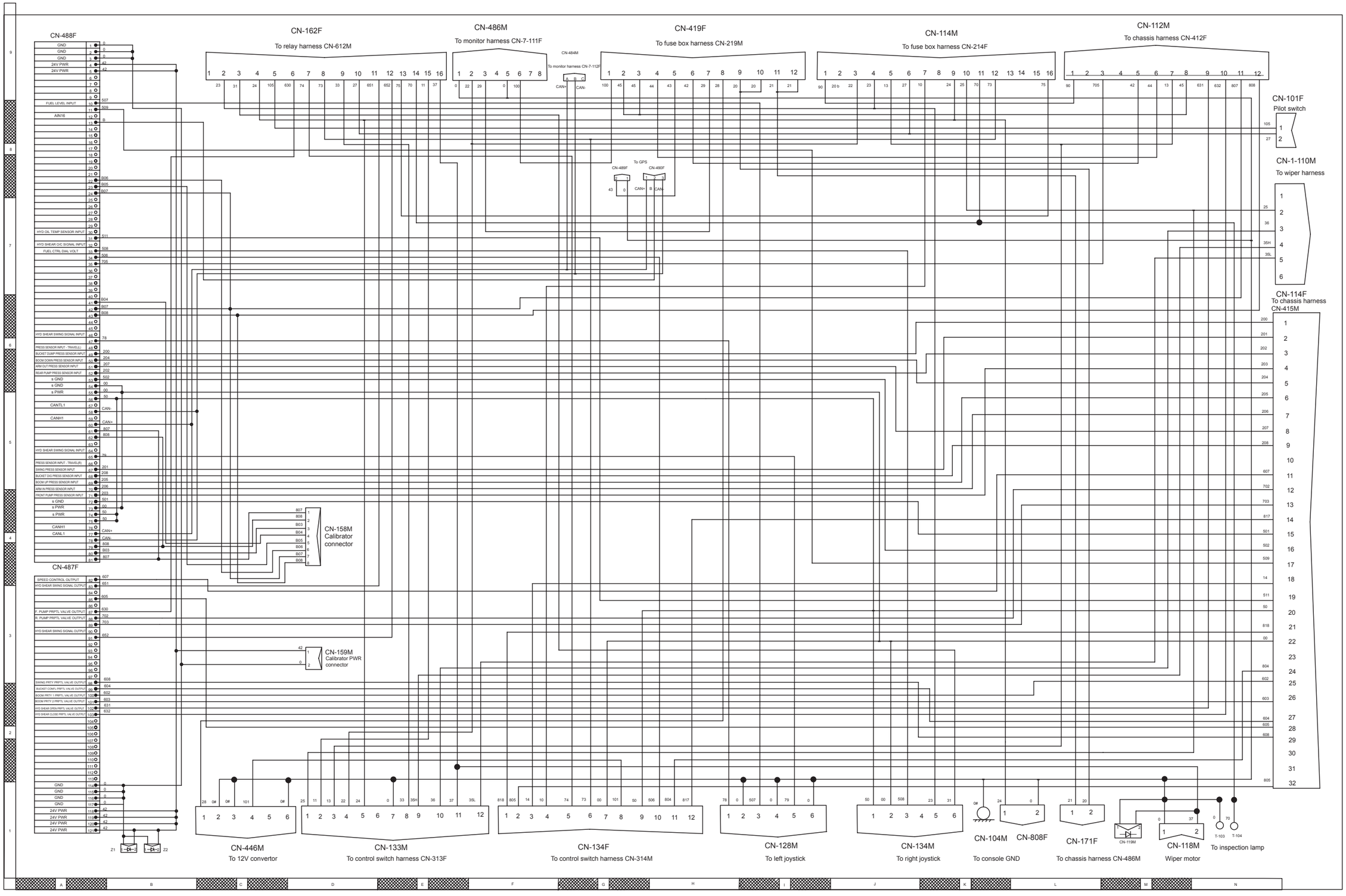
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9.4 Control Switches and Monitor Electrical Diagram



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9.5 Operator Cab Electrical Diagram



9.6 Chassis Electrical Diagram

