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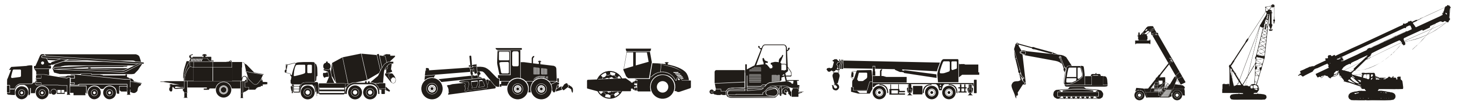


SANY

Quailty Changes the World

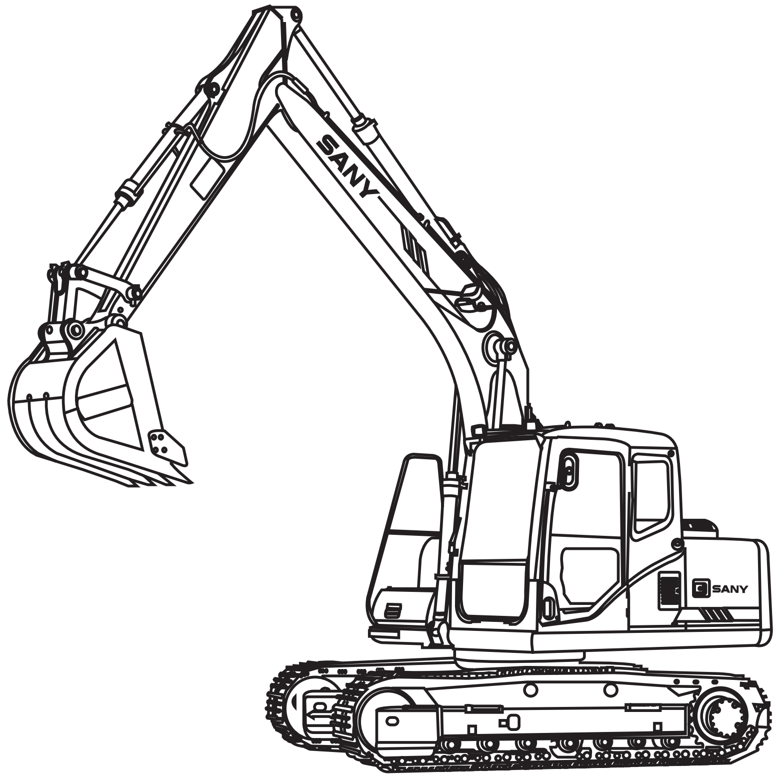
Crawler Hydraulic Excavator

SY195C9

SY205C9

SY215C9

SY225C9



Shop Manual

SANY

SY195/205/215/225C9

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.

⚠ WARNING

Read and follow the safety precautions and instructions in this manual and on the machine decals. Failure to do so may cause serious injury, death or property damage.

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Introduction

1 Introduction

⚠ WARNING

Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

1 INTRODUCTION

1.1 How to Read the Shop Manual

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.

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.

3. 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 { }.

4. 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.
kg	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.

1.2 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

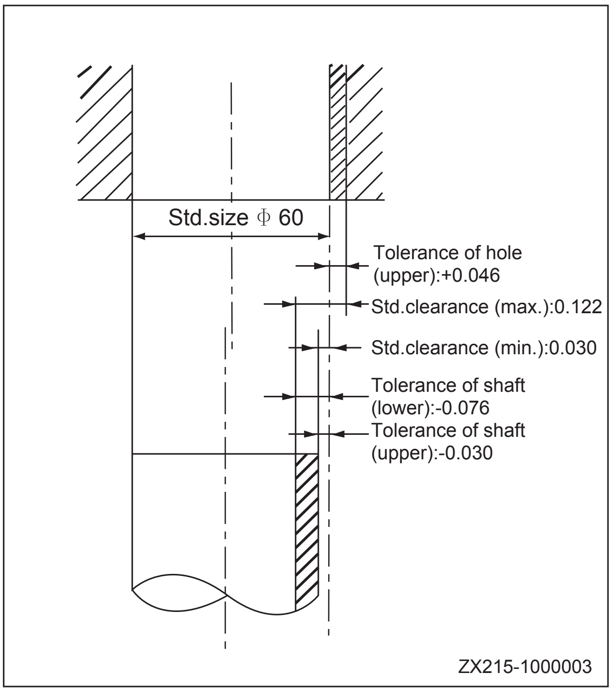
- To be accurate, the finishing size of parts is a little different from one to another.
- To specify a finishing size of a part, a temporary standard size is set and an allowable difference from that size is indicated.
- The above size set temporarily is called the "standard size" and the range of difference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

NOTE: 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.



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.

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.

1.3 Handling Electrical and Hydraulic Components

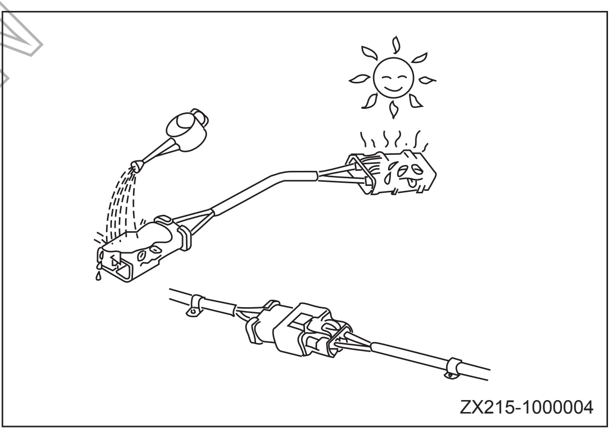
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct "operation", "maintenance and inspection", "troubleshooting", and "repairs" must be carried out. This section deals particularly with correct repair procedures for mechatronics 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).

1.3.1 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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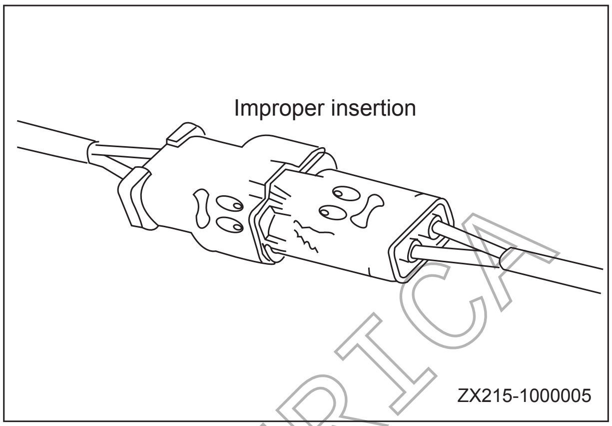
2. Main failures occurring in wiring harness

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.



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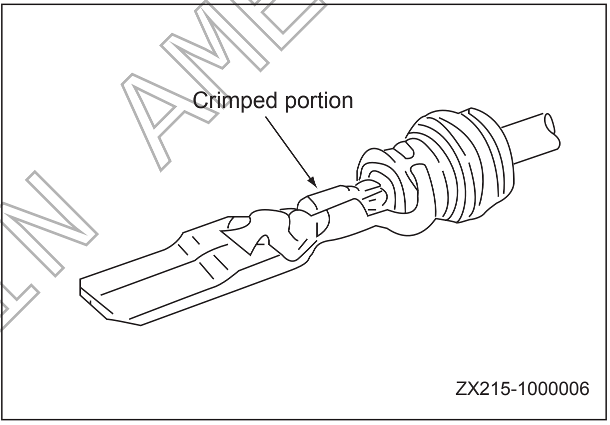
2) Defective crimping or soldering of connectors

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.



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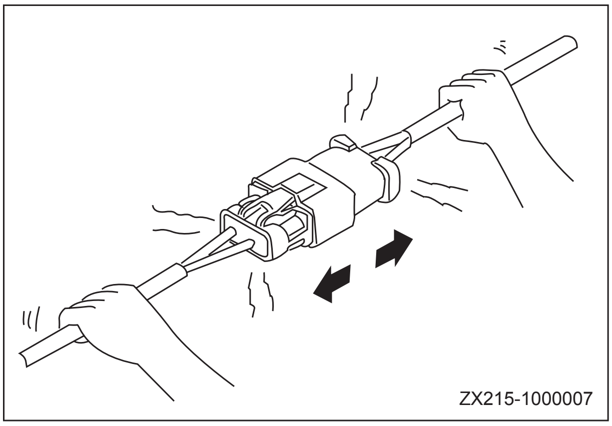
3) Disconnections in wiring

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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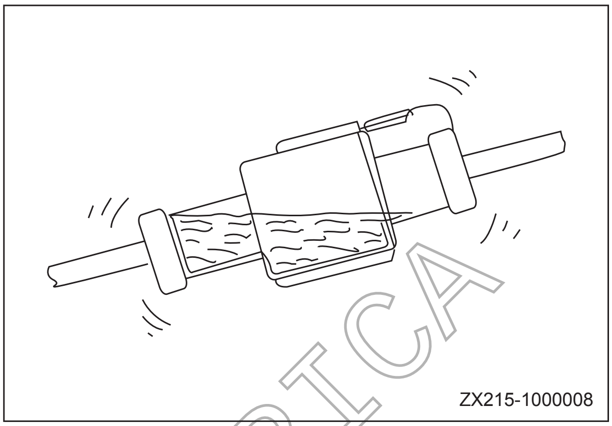
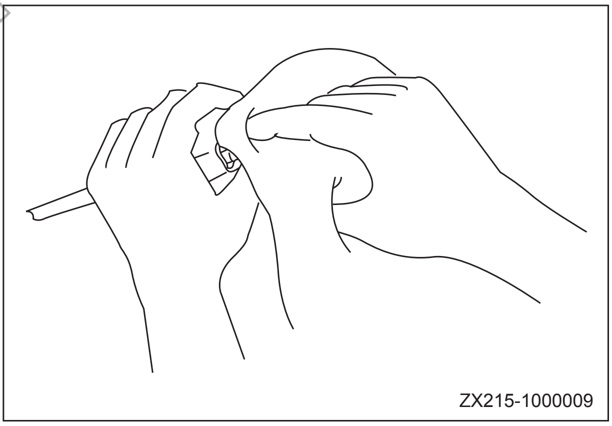
4) High-pressure water entering connector

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.



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.



NOTE:

- 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.

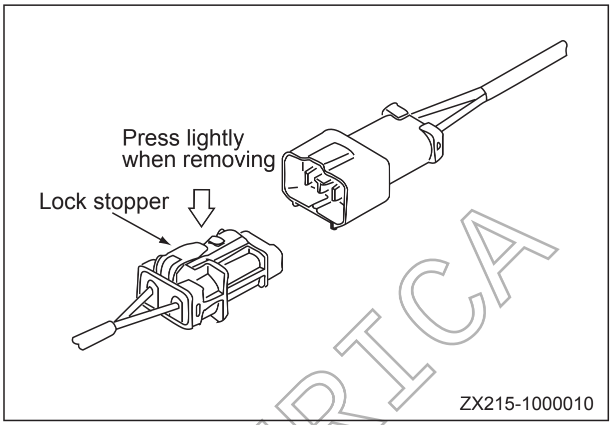
3. Removing, installing, and drying connectors and wiring harnesses

1) Disconnecting connectors

a. Hold the connectors when disconnecting.

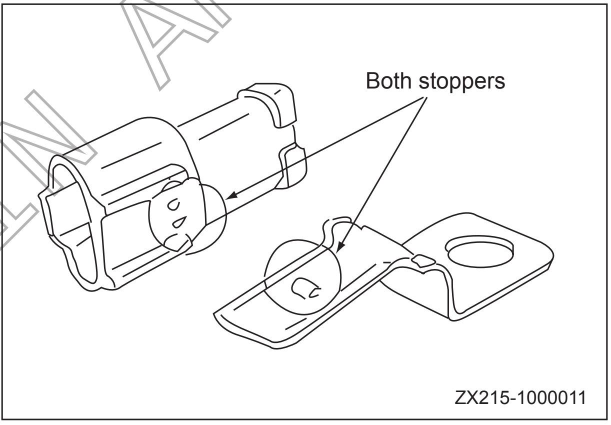
When disconnecting the connectors, hold the connectors. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.

NOTE: Never pull with one hand.

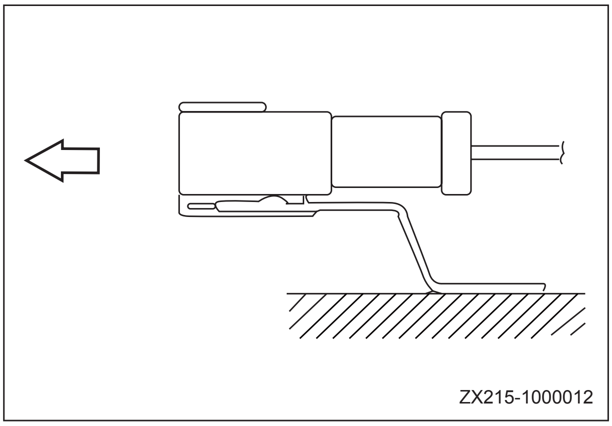


b. When removing from clips

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



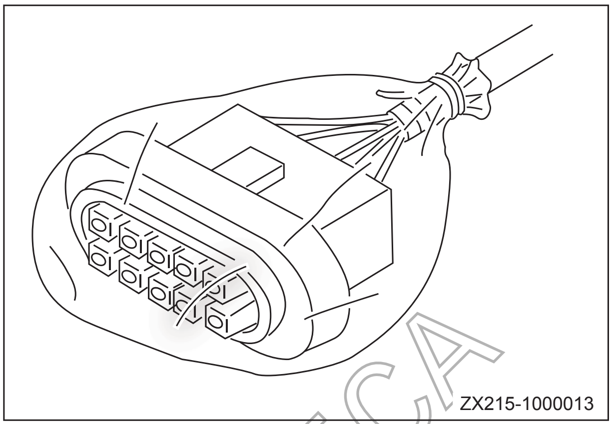
- When removing a connector from a clip, pull the connector in a parallel direction to the clip for removing stoppers.



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.

NOTE: 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

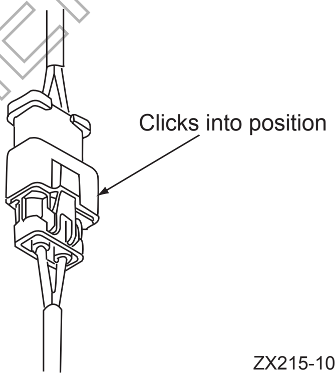
Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).

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.

NOTE: 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.

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



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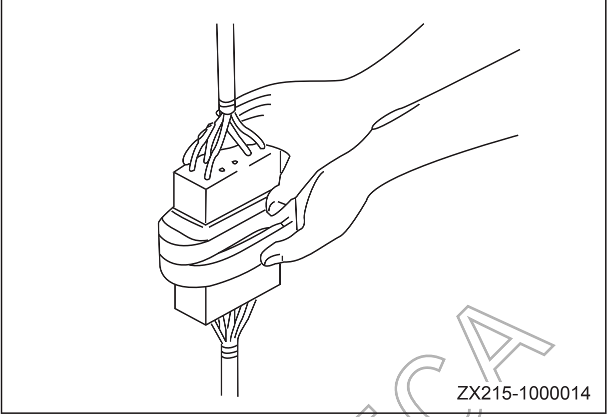
b. Fix the connector securely.

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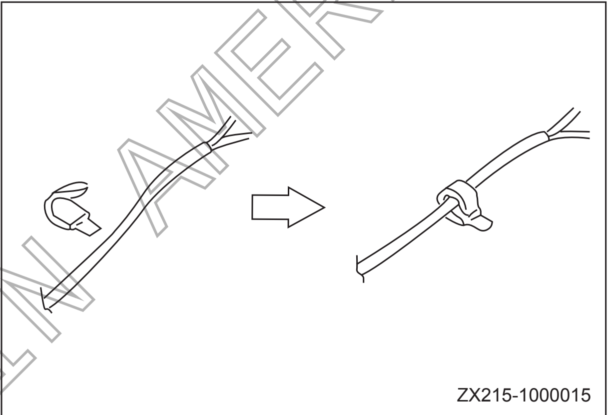
c. Correct any protrusion of the boot and any misalignment of the wiring harness.

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.

NOTE: 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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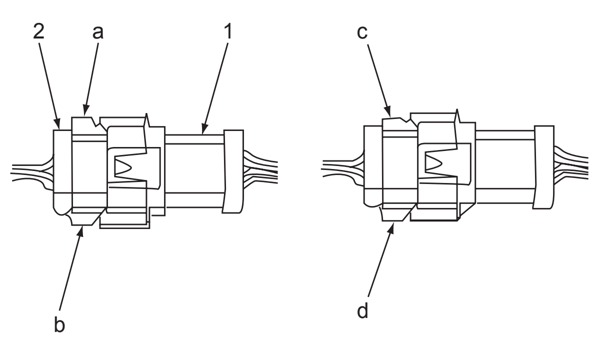
3) Connecting DT connectors

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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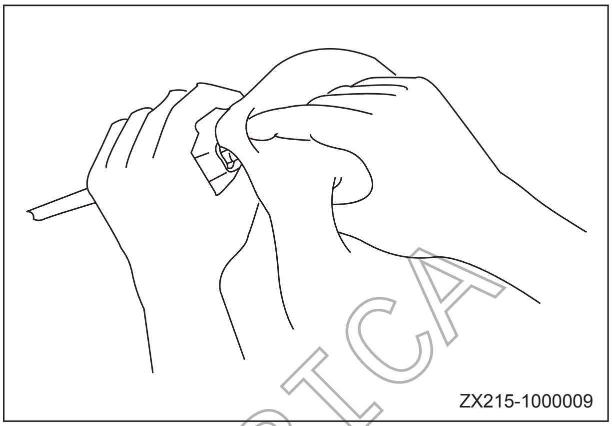
4) Drying wiring harness

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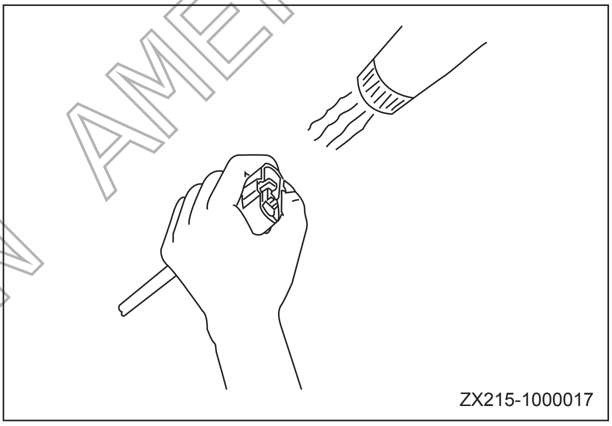
a. Disconnect the connector and wipe off the water with a dry cloth.

NOTE: 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.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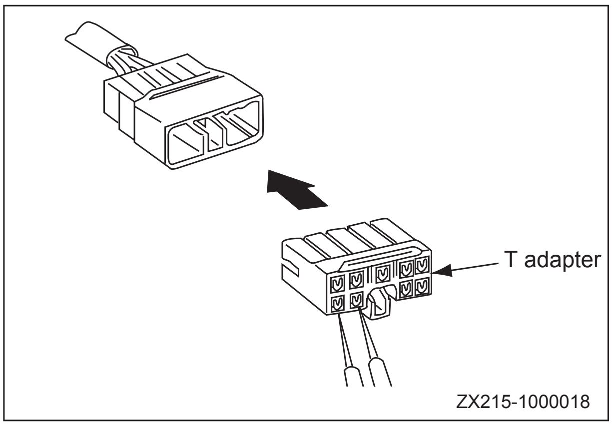
b. Dry the connector with a dryer.

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

NOTE: 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.



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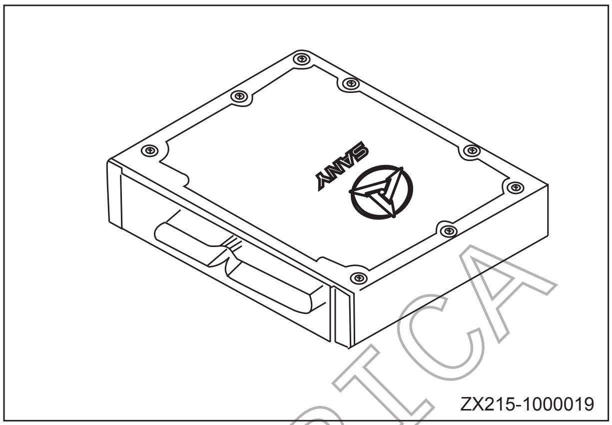
c. Carry out a continuity test on the connector.

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

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

4. Handling the integrated control monitor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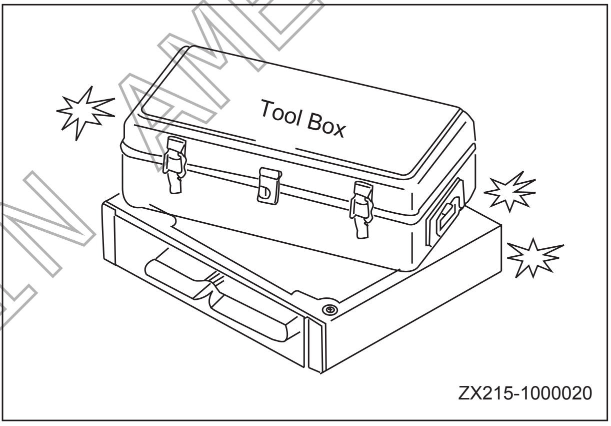
1) The controller contains a microcomputer and an electronic control circuits. They control all of the electronic circuits on the machine, so be extremely careful when handling the integrated control monitor.

2) Do not place objects on the controller.

3) Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts with your hand.



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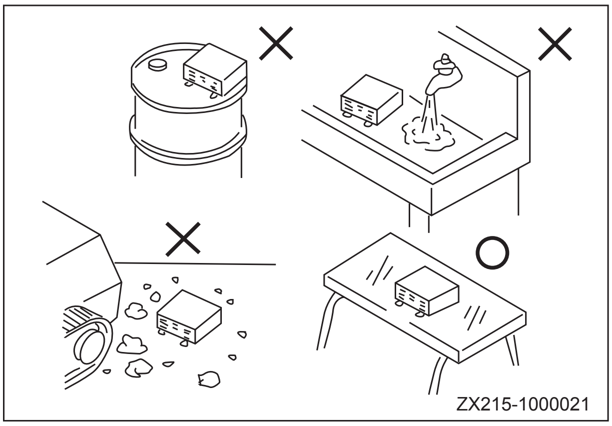
4) Do not leave it where it may be exposed to rain.

5) Do not place the controller 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.

   NOTE: Disconnect and connect the related connectors several times to check.

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

   NOTE: 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.

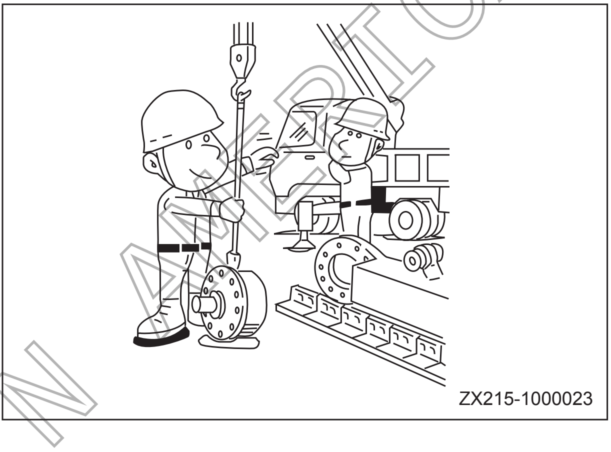
   NOTE: If there is any change, there is probably defective contact in that circuit.

1.3.2 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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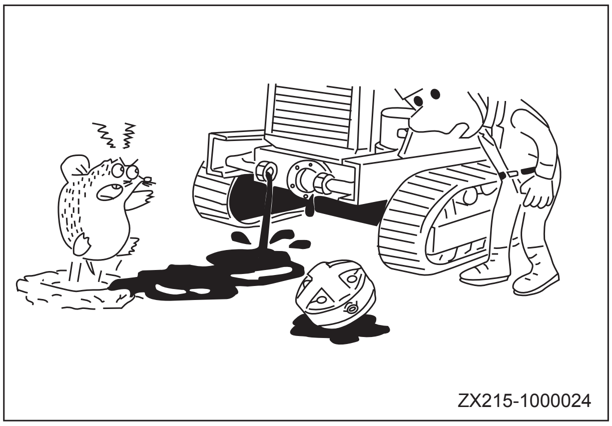
2. Disassembly and maintenance work in the field

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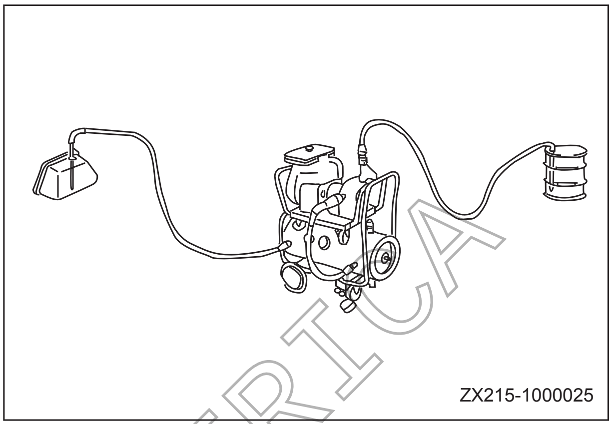
4. Do not let any dirt or dust get in during refilling operations

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.

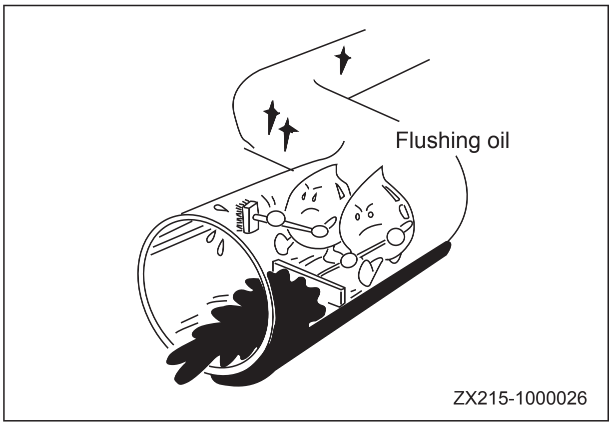


5. Change hydraulic oil when the temperature is high

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.

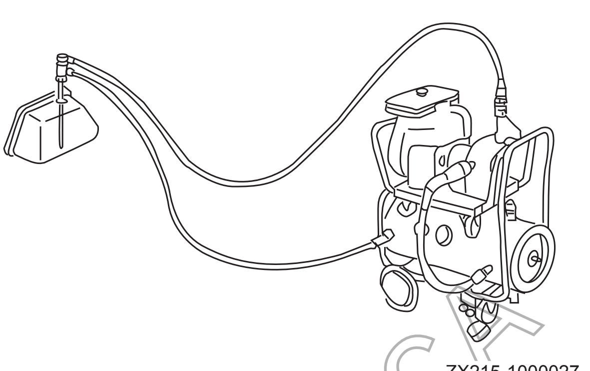
6. Flushing operations

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.



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.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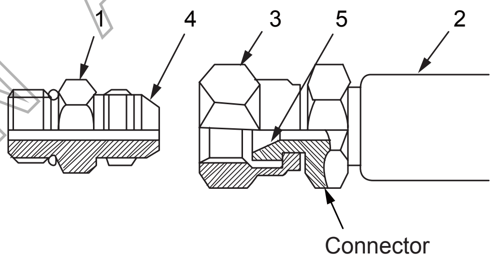
1.4 Hose Connector

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.



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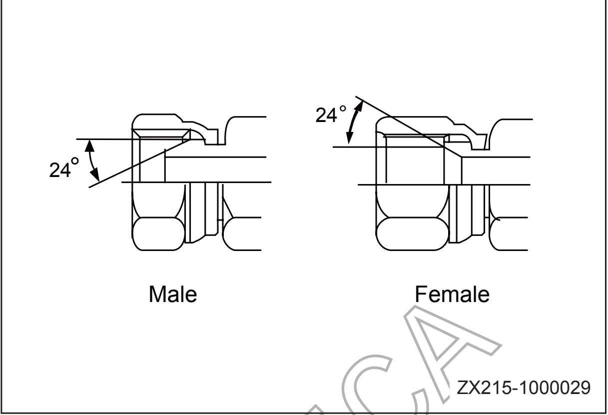
NOTICE

- **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.**

1.4.1 Type of hose connector



1.4.2 Hose connector tightening torque table

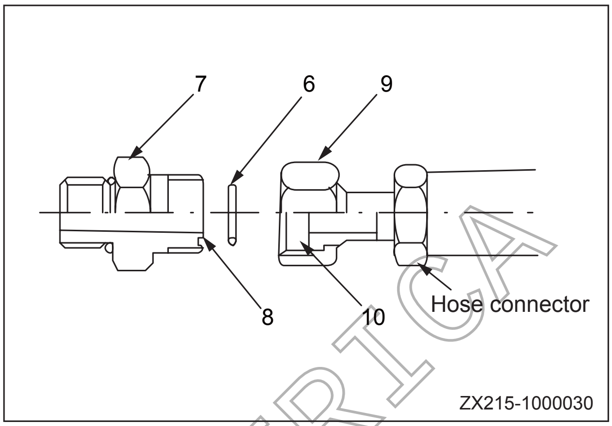
Type	Wrench size mm	Wrench size mm	Tightening torque
	Connecting nut	**Hose joint**	**N·m(kgf·m,lbf·ft)**
24° Male	19	19	59(6,44)
	22	22	98(10,72)
	27	27	118(12,87)
	36	36	235(24,173)
	41	41	295(30,218)
	50	50	490(50,361)
	60	60	670(68,494)
	70	70	980(100,723)
24° Female	19	17	44(4.5,32)
	22	19	59(6,44)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

1.4.3 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)

1.5 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

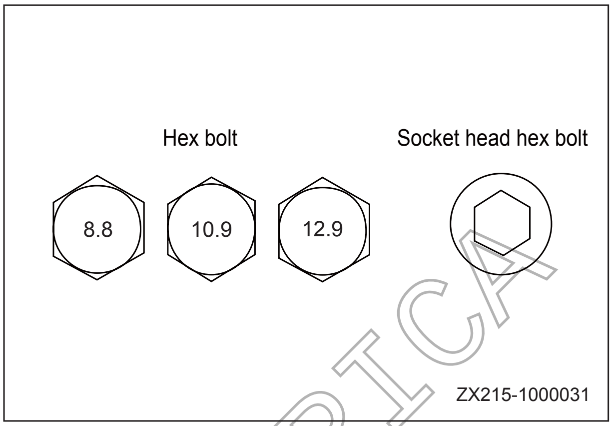
The following items apply to fine thread and coarse thread.

- **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.**

1.6 Type of Bolts

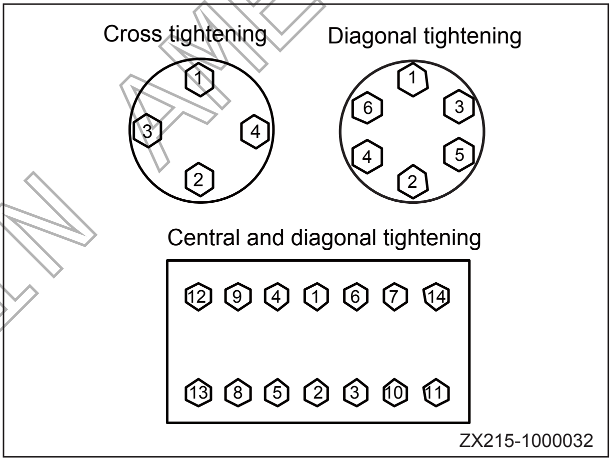
Tighten nuts and bolts properly to specified torque values. The type and grade of bolts are illustrated on the right.

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



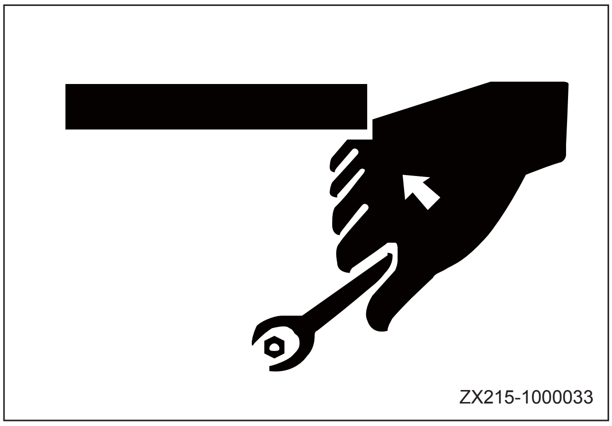
1.7 Tightening Sequence

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

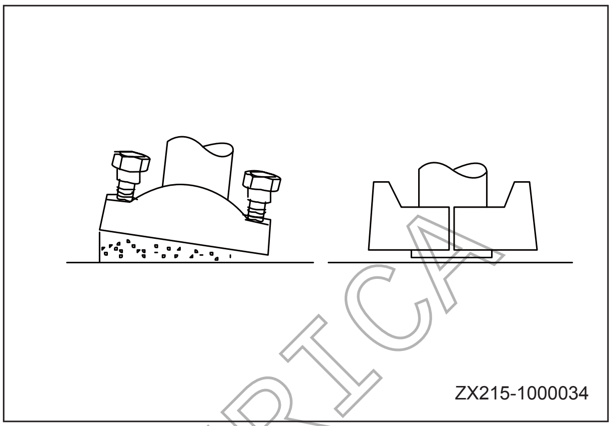


⚠ CAUTION

- **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.**

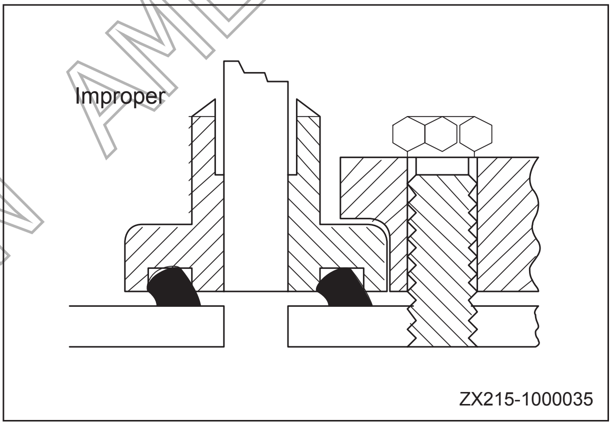


1.8 Maintenance of Half Flanges


ZX215-1000034

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.

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.



ZX215-1000035

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.

1.8.1 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

1.9 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.

Length

Millimeters to Inches

(B)

1mm=0.03937in

	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
						(C)				
(A) 50	1.969	2.008	2.047	2.087	2.126	$\boxed{2.165}$	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

Inches to Millimeters

in.			mm	in.			mm
		1/64	0.3969			33/64	13.0969
	1/32		0.7938		17/32		13.4938
		3/64	1.1906			35/64	13.8906
1/16			1.5875	9/16			14.2875
		5/64	1.9844			37/64	14.6844
	3/32		2.3813		19/32		15.0813
		7/64	2.7781			39/64	15.4781
1/8			3.1750	5/8			15.8750
		9/64	3.5719			41/64	16.2719
	5/32		3.9688		21/32		16.6688
		11/64	4.3656			43/64	17.0656
3/16			4.7625	11/16			17.4625
		13/64	5.1594			45/64	17.8594
	7/32		5.5563		23/32		18.2563
		15/64	5.9531			47/64	18.6531
1/4			6.3500	3/4			19.0500
		17/64	6.7469			49/64	19.4469
	9/32		7.1438		25/32		19.8438
		19/64	7.5406			51/64	20.2406
5/16			7.9375	13/16			20.6375
		21/64	8.3344			53/64	21.0344
	11/32		8.7313		27/32		21.4313
		23/64	9.1281			55/64	21.8281
3/8			9.5250	7/8			22.2250
		25/64	9.9219			57/64	22.6219
	13/32		10.3188		29/32		23.0188
		27/64	10.7156			59/64	23.4156
7/16			11.1125	15/16			23.8125
		29/64	11.5094			61/64	24.2094
	15/32		11.9063		31/32		24.6063
		31/64	12.3031			63/64	25.0031
1/2			12.7000	1			25.4000

Feet to Meters

ft.	0	1	2	3	4	5	6	7	8	9	ft.
	m	m	m	m	m	m	m	m	m	m	
-	-	0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	-
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223	100

Meters to Feet

m	0	1	2	3	4	5	6	7	8	9	m
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	
-	-	3.2808	6.5617	9.8425	13.1234	16.4042	19.6850	22.9659	26.2467	29.5276	-
10	32.8084	36.0892	39.3701	42.6509	45.9318	49.2126	52.4934	55.7743	59.0551	62.3360	10
20	65.6168	68.8976	72.1785	75.4593	78.7402	82.0210	85.3018	88.5827	91.8635	95.1444	20
30	98.4252	101.7060	104.9869	108.2677	111.5486	114.8294	118.1102	121.3911	124.6719	127.9528	30
40	131.2336	134.5144	137.7953	141.0761	144.3570	147.6378	150.9186	154.1995	157.4803	160.7612	40
50	164.0420	167.3228	170.6037	173.8845	177.1654	180.4462	183.7270	187.0079	190.2887	193.5696	50
60	196.8504	200.1312	203.4121	206.6929	209.9738	213.2546	216.5354	219.8163	223.0971	226.3780	60
70	229.6588	232.9396	236.2205	239.5013	242.7822	246.0630	249.3438	252.6247	255.9055	259.1864	70
80	262.4672	265.7480	269.0289	272.3097	275.5906	278.8714	282.1522	285.4331	288.7139	291.9948	80
90	295.2756	298.5564	301.8373	305.1181	308.3990	311.6798	314.9606	318.2415	321.5223	324.8032	90
100	328.0840	331.3648	334.6457	337.9265	341.2074	344.4882	347.7690	351.0499	354.3307	357.6116	100

Miles to Kilometers

miles	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**miles**
	km	km	km	km	km	km	km	km	km	km	
-	-	1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	-
10	16.093	17.703	19.312	20.921	22.531	24.140	25.749	27.359	28.968	30.577	10
20	32.187	33.796	35.405	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.764	30
40	64.374	65.983	67.592	69.202	70.811	72.420	74.030	75.639	77.248	78.858	40
50	80.467	82.077	83.686	85.295	86.904	88.514	90.123	91.732	93.342	94.951	50
60	96.561	98.170	99.779	101.388	102.998	104.607	106.216	107.826	109.435	111.044	60
70	112.654	114.263	115.872	117.482	119.091	120.701	122.310	123.919	125.529	127.138	70
80	128.748	130.357	131.966	133.575	135.185	136.794	138.403	140.013	141.622	143.231	80
90	144.841	146.450	148.059	149.669	151.278	152.887	154.497	156.106	157.715	159.325	90
100	160.934	162.543	164.153	165.762	167.371	168.981	170.590	172.199	173.809	175.418	100

Kilometers to Miles

km	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**km**
	miles	**miles**	**miles**	**miles**	**miles**	**miles**	**miles**	**miles**	**miles**	**miles**	
-	-	0.621	1.243	1.864	2.485	3.107	3.728	4.350	4.971	5.592	-
10	6.214	6.835	7.456	8.078	8.699	9.321	9.942	10.563	11.185	11.806	10
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.777	17.398	18.020	20
30	18.641	19.262	19.884	20.505	21.127	21.748	22.369	22.991	23.612	24.233	30
40	24.855	25.476	26.098	26.719	27.340	27.962	28.583	29.204	29.826	30.447	40
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.418	36.039	36.661	50
60	37.282	37.904	38.525	39.146	39.768	40.389	41.010	41.632	42.253	42.875	60
70	43.496	44.117	44.739	45.360	45.981	46.603	47.224	47.845	48.467	49.088	70
80	49.710	50.331	50.952	51.574	52.195	52.816	53.438	54.059	54.681	55.302	80
90	55.923	56.545	57.166	57.787	58.409	59.030	59.652	60.273	60.894	61.516	90
100	62.137	62.758	63.380	64.001	64.622	65.244	65.865	66.487	67.108	67.729	100

Area

Square inches to square centimeters

in^2	0	1	2	3	4	5	6	7	8	9	in^2
	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	
-	-	6.452	12.903	19.355	25.806	32.258	38.710	45.161	51.613	58.064	-
10	64.516	70.968	77.419	83.871	90.322	96.774	103.226	109.677	116.129	122.580	10
20	129.032	135.484	141.935	148.387	154.838	161.290	167.742	174.193	180.645	187.096	20
30	193.548	200.000	206.451	212.903	219.354	225.806	232.258	238.709	245.161	251.612	30
40	258.064	264.516	270.967	277.419	283.870	290.322	296.774	303.225	309.677	316.128	40
50	322.580	329.032	335.483	341.935	348.386	354.838	361.290	367.741	374.193	380.644	50
60	387.096	393.548	399.999	406.451	412.902	419.354	425.806	432.257	438.709	445.160	60
70	451.612	458.064	464.515	470.967	477.418	483.870	490.322	496.773	503.225	509.676	70
80	516.128	522.580	529.031	535.483	541.934	548.386	554.838	561.289	567.741	574.192	80
90	580.644	587.096	593.547	599.999	606.450	612.902	619.354	625.805	632.257	638.708	90
100	645.160	651.612	658.063	664.515	670.966	677.418	683.870	690.321	696.773	703.224	100

Square centimeters to square inches

cm^2	0	1	2	3	4	5	6	7	8	9	cm^2
	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	
-	-	0.155	0.310	0.465	0.620	0.775	0.930	1.085	1.240	1.395	-
10	1.550	1.705	1.860	2.015	2.170	2.325	2.480	2.635	2.790	2.945	10
20	3.100	3.255	3.410	3.565	3.720	3.875	4.030	4.185	4.340	4.495	20
30	4.650	4.805	4.960	5.115	5.270	5.425	5.580	5.735	5.890	6.045	30
40	6.200	6.355	6.510	6.665	6.820	6.975	7.130	7.285	7.440	7.595	40
50	7.750	7.905	8.060	8.215	8.370	8.525	8.680	8.835	8.990	9.145	50
60	9.300	9.455	9.610	9.765	9.920	10.075	10.230	10.385	10.540	10.695	60
70	10.850	11.005	11.160	11.315	11.470	11.625	11.780	11.935	12.090	12.245	70
80	12.400	12.555	12.710	12.865	13.020	13.175	13.330	13.485	13.640	13.795	80
90	13.950	14.105	14.260	14.415	14.570	14.725	14.880	15.035	15.190	15.345	90
100	15.500	15.655	15.810	15.965	16.120	16.275	16.430	16.585	16.740	16.895	100

Volume

Cubic inches to cubic centimeters

in^3	0	1	2	3	4	5	6	7	8	9	in^3
	cm^3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	cm3(cc)	
-	-	16.387	32.774	49.161	65.548	81.935	98.322	114.709	131.096	147.484	-
10	163.871	180.258	196.645	213.032	229.419	245.806	262.193	278.580	294.967	311.354	10
20	327.741	344.128	360.515	376.902	393.289	409.677	426.064	442.451	458.838	475.225	20
30	491.612	507.999	524.386	540.773	557.160	573.547	589.934	606.321	622.708	639.095	30
40	655.482	671.869	688.257	704.644	721.031	737.418	753.805	770.192	786.579	802.966	40
50	819.353	835.740	852.127	868.514	884.901	901.288	917.675	934.062	950.449	966.837	50
60	983.224	999.611	1015.998	1032.385	1048.772	1065.159	1081.546	1097.933	1114.320	1130.707	60
70	1147.094	1163.481	1179.868	1196.255	1212.642	1229.030	1245.417	1261.804	1278.191	1294.578	70
80	1310.965	1327.352	1343.739	1360.126	1376.513	1392.900	1409.287	1425.674	1442.061	1458.448	80
90	1474.835	1491.222	1507.610	1523.997	1540.384	1556.771	1573.158	1589.545	1605.932	1622.319	90
100	1638.706	1655.093	1671.480	1687.867	1704.254	1720.641	1737.028	1753.415	1769.802	1786.190	100

Cubic centimeters to cubic inches

cm^3 (cc)	0	1	2	3	4	5	6	7	8	9	cm^3 (cc)
	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	
-	-	0.0610	0.1220	0.1831	0.2441	0.3051	0.3661	0.4272	0.4882	0.5492	-
10	0.6102	0.6713	0.7323	0.7933	0.8543	0.9153	0.9764	1.0374	1.0984	1.1594	10
20	1.2205	1.2815	1.3425	1.4035	1.4646	1.5256	1.5866	1.6476	1.7086	1.7697	20
30	1.8307	1.8917	1.9527	2.0138	2.0748	2.1358	2.1968	2.2579	2.3189	2.3799	30
40	2.4409	2.5019	2.5630	2.6240	2.6850	2.7460	2.8071	2.8681	2.9291	2.9901	40
50	3.0512	3.1122	3.1732	3.2342	3.2952	3.3563	3.4173	3.4783	3.5393	3.6004	50
60	3.6614	3.7224	3.7834	3.8444	3.9055	3.9665	4.0275	4.0885	4.1496	4.2106	60
70	4.2716	4.3326	4.3937	4.4547	4.5157	4.5767	4.6377	4.6988	4.7598	4.8208	70
80	4.8818	4.9429	5.0039	5.0649	5.1259	5.1870	5.2480	5.3090	5.3700	5.4310	80
90	5.4921	5.5531	5.6141	5.6751	5.7362	5.7972	5.8582	5.9192	5.9803	6.0413	90
100	6.1023	6.1633	6.2243	6.2854	6.3464	6.4074	6.4684	6.5295	6.5905	6.6515	100

U.S. Gallons to liters

U.S. gal	0	1	2	3	4	5	6	7	8	9	U.S. gal
	liters	liters	liters	liters	liters	liters	liters	liters	liters	liters	
-	-	3.7854	7.5709	11.3563	15.1417	18.9271	22.7126	26.4980	30.2834	34.0688	-
10	37.8543	41.6397	45.4251	49.2106	52.9960	56.7814	60.5668	64.3523	68.1377	71.9231	10
20	75.7085	79.4940	83.2794	87.0648	90.8502	94.6357	98.4211	102.2065	105.9920	109.7774	20
30	113.5628	117.3482	121.1337	124.9191	128.7045	132.4899	136.2754	140.0608	143.8462	147.6317	30
40	151.4171	155.2025	158.9879	162.7734	166.5588	170.3442	174.1296	177.9151	181.7005	185.4859	40
50	189.2714	193.0568	196.8422	200.6276	204.4131	208.1985	211.9839	215.7693	219.5548	223.3402	50
60	227.1256	230.9110	234.6965	238.4819	242.2673	246.0528	249.8382	253.6236	257.4090	261.1945	60
70	264.9799	268.7653	272.5507	276.3362	280.1216	283.9070	287.6925	291.4779	295.2633	299.0487	70
80	302.8342	306.6196	310.4050	314.1904	317.9759	321.7613	325.5467	329.3321	333.1176	336.9030	80
90	340.6884	344.4739	348.2593	352.0447	355.8301	359.6156	363.4010	367.1864	370.9718	374.7573	90
100	378.5427	382.3281	386.1136	389.8990	393.6844	397.4698	401.2553	405.0407	408.8261	412.6115	100

Liters to U.S. Gallons

liters	0	1	2	3	4	5	6	7	8	9	liters
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
-	-	0.2642	0.5283	0.7925	1.0567	1.3209	1.5850	1.8492	2.1134	2.3775	-
10	2.6417	2.9059	3.1701	3.4342	3.6984	3.9626	4.2268	4.4909	4.7551	5.0193	10
20	5.2834	5.5476	5.8118	6.0760	6.3401	6.6043	6.8685	7.1326	7.3968	7.6610	20
30	7.9252	8.1893	8.4535	8.7177	8.9818	9.2460	9.5102	9.7744	10.0385	10.3027	30
40	10.5669	10.8311	11.0952	11.3594	11.6236	11.8877	12.1519	12.4161	12.6803	12.9444	40
50	13.2086	13.4728	13.7369	14.0011	14.2653	14.5295	14.7936	15.0578	15.3220	15.5861	50
60	15.8503	16.1145	16.3787	16.6428	16.9070	17.1712	17.4354	17.6995	17.9637	18.2279	60
70	18.4920	18.7562	19.0204	19.2846	19.5487	19.8129	20.0771	20.3412	20.6054	20.8696	70
80	21.1338	21.3979	21.6621	21.9263	22.1904	22.4546	22.7188	22.9830	23.2471	23.5113	80
90	23.7755	24.0397	24.3038	24.5680	24.8322	25.0963	25.3605	25.6247	25.8889	26.1530	90
100	26.4172	26.6814	26.9455	27.2097	27.4739	27.7381	28.0022	28.2664	28.5306	28.7947	100

U.K. Gallons to Liters

Imp gal	0	1	2	3	4	5	6	7	8	9	Imp gal
	liters	liters	liters	liters	liters	liters	liters	liters	liters	liters	
-	-	4.5459	9.0918	13.6377	18.1836	22.7295	27.2754	31.8213	36.3672	40.9131	-
10	45.4590	50.0049	54.5508	59.0967	63.6426	68.1885	72.7344	77.2803	81.8262	86.3721	10
20	90.9180	95.4639	100.0098	104.5557	109.1016	113.6475	118.1934	122.7393	127.2852	131.8311	20
30	136.3770	140.9229	145.4688	150.0147	154.5606	159.1065	163.6524	168.1983	172.7442	177.2901	30
40	181.8360	186.3819	190.9278	195.4737	200.0196	204.5655	209.1114	213.6573	218.2032	222.7491	40
50	227.2950	231.8409	236.3868	240.9327	245.4786	250.0245	254.5704	259.1163	263.6622	268.2081	50
60	272.7540	277.2999	281.8458	286.3917	290.9376	295.4835	300.0294	304.5753	309.1212	313.6671	60
70	318.2130	322.7589	327.3048	331.8507	336.3966	340.9425	345.4884	350.0343	354.5802	359.1261	70
80	363.6720	368.2179	372.7638	377.3097	381.8556	386.4015	390.9474	395.4933	400.0392	404.5851	80
90	409.1310	413.6769	418.2228	422.7687	427.3146	431.8605	436.4064	440.9523	445.4982	450.0441	90
100	454.5900	459.1359	463.6818	468.2277	472.7736	477.3195	481.8654	486.4113	490.9572	495.5031	100

Liters to U.K. Gallons

liters	0	1	2	3	4	5	6	7	8	9	liters
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
-	-	0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5399	1.7598	1.9798	-
10	2.1998	2.4198	2.6398	2.8597	3.0797	3.2997	3.5197	3.7397	3.9596	4.1796	10
20	4.3996	4.6196	4.8396	5.0595	5.2795	5.4995	5.7195	5.9395	6.1594	6.3794	20
30	6.5994	6.8194	7.0394	7.2593	7.4793	7.6993	7.9193	8.1393	8.3592	8.5792	30
40	8.7992	9.0192	9.2392	9.4591	9.6791	9.8991	10.1191	10.3391	10.5590	10.7790	40
50	10.9990	11.2190	11.4390	11.6589	11.8789	12.0989	12.3189	12.5389	12.7588	12.9788	50
60	13.1988	13.4188	13.6388	13.8587	14.0787	14.2987	14.5187	14.7387	14.9586	15.1786	60
70	15.3986	15.6186	15.8386	16.0585	16.2785	16.4985	16.7185	16.9385	17.1584	17.3784	70
80	17.5984	17.8184	18.0384	18.2583	18.4783	18.6983	18.9183	19.1383	19.3582	19.5782	80
90	19.7982	20.0182	20.2382	20.4581	20.6781	20.8981	21.1181	21.3381	21.5580	21.7780	90
100	21.9980	22.2180	22.4380	22.6579	22.8779	23.0979	23.3179	23.5379	23.7578	23.9778	100

Weight

Pound to Kilogram

lbs.	0	1	2	3	4	5	6	7	8	9	lbs.
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
-	-	0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	-
10	4.536	4.989	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.968	15.422	15.876	16.329	16.783	17.236	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.947	25.401	25.855	26.308	26.762	50
60	27.215	27.669	28.123	28.576	29.030	29.483	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.658	33.112	33.566	34.019	34.473	34.926	35.380	35.834	70
80	36.287	36.741	37.194	37.648	38.102	38.555	39.009	39.462	39.916	40.370	80
90	40.823	41.277	41.730	42.184	42.637	43.091	43.545	43.998	44.452	44.905	90
100	45.359	45.813	46.266	46.720	47.173	47.627	48.081	48.534	48.988	49.441	100

Kilogram to Pound

kg	0	1	2	3	4	5	6	7	8	9	kg
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
-	-	2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842	-
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888	10
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934	20
30	66.139	68.343	70.548	72.752	74.957	77.162	79.366	81.571	83.776	85.980	30
40	88.185	90.389	92.594	94.799	97.003	99.208	101.413	103.617	105.822	108.026	40
50	110.231	112.436	114.640	116.845	119.049	121.254	123.459	125.663	127.868	130.073	50
60	132.277	134.482	136.686	138.891	141.096	143.300	145.505	147.710	149.914	152.119	60
70	154.323	156.528	158.733	160.937	163.142	165.347	167.551	169.756	171.960	174.165	70
80	176.370	178.574	180.779	182.983	185.188	187.393	189.597	191.802	194.007	196.211	80
90	198.416	200.620	202.825	205.030	207.234	209.439	211.644	213.848	216.053	218.257	90
100	220.462	222.667	224.871	227.076	229.280	231.485	233.690	235.894	238.099	240.304	100

Newton to Kilogram

N	0	10	20	30	40	50	60	70	80	90	N
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
-	-	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	-
100	10.197	11.217	12.237	13.256	14.276	15.296	16.316	17.335	18.355	19.375	100
200	20.394	21.414	22.434	23.454	24.473	25.493	26.513	27.532	28.552	29.572	200
300	30.592	31.611	32.631	33.651	34.670	35.690	36.710	37.730	38.749	39.769	300
400	40.789	41.809	42.828	43.848	44.868	45.887	46.907	47.927	48.947	49.966	400
500	50.986	52.006	53.025	54.045	55.065	56.085	57.104	58.124	59.144	60.163	500
600	61.183	62.203	63.223	64.242	65.262	66.282	67.302	68.321	69.341	70.361	600
700	71.380	72.400	73.420	74.440	75.459	76.479	77.499	78.518	79.538	80.558	700
800	81.578	82.597	83.617	84.637	85.656	86.676	87.696	88.716	89.735	90.755	800
900	91.775	92.795	93.814	94.834	95.854	96.873	97.893	98.913	99.933	100.952	900
1000	101.972	102.992	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	1000

Kilogram to Newton

kg	0	1	2	3	4	5	6	7	8	9	kg
	N	N	N	N	N	N	N	N	N	N	
-	-	9.81	19.61	29.42	39.23	49.03	58.84	68.65	78.45	88.26	-
10	98.07	107.87	117.68	127.49	137.29	147.10	156.91	166.71	176.52	186.33	10
20	196.13	205.94	215.75	225.55	235.36	245.17	254.97	264.78	274.59	284.39	20
30	294.20	304.01	313.81	323.62	333.43	343.23	353.04	362.85	372.65	382.46	30
40	392.27	402.07	411.88	421.69	431.49	441.30	451.11	460.91	470.72	480.53	40
50	490.34	500.14	509.95	519.76	529.56	539.37	549.18	558.98	568.79	578.60	50
60	588.40	598.21	608.02	617.82	627.63	637.44	647.24	657.05	666.86	676.66	60
70	686.47	696.28	706.08	715.89	725.70	735.50	745.31	755.12	764.92	774.73	70
80	784.54	794.34	804.15	813.96	823.76	833.57	843.38	853.18	862.99	872.80	80
90	882.60	892.41	902.22	912.02	921.83	931.64	941.44	951.25	961.06	970.86	90
100	980.67	990.48	1000.28	1010.09	1019.90	1029.70	1039.51	1049.32	1059.12	1068.93	100

Pressure

Lb/in^2 to Kg/cm^2

lb/ in^2	0	1	2	3	4	5	6	7	8	9	lb/in^2
(psi)	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	(psi)
-	-	0.0703	0.1406	0.2109	0.2812	0.3515	0.4218	0.4921	0.5625	0.6328	-
10	0.7031	0.7734	0.8437	0.9140	0.9843	1.0546	1.1249	1.1952	1.2655	1.3358	10
20	1.4061	1.4764	1.5468	1.6171	1.6874	1.7577	1.8280	1.8983	1.9686	2.0389	20
30	2.1092	2.1795	2.2498	2.3201	2.3904	2.4607	2.5311	2.6014	2.6717	2.7420	30
40	2.8123	2.8826	2.9529	3.0232	3.0935	3.1638	3.2341	3.3044	3.3747	3.4450	40
50	3.5154	3.5857	3.6560	3.7263	3.7966	3.8669	3.9372	4.0075	4.0778	4.1481	50
60	4.2184	4.2887	4.3590	4.4293	4.4996	4.5700	4.6403	4.7106	4.7809	4.8512	60
70	4.9215	4.9918	5.0621	5.1324	5.2027	5.2730	5.3433	5.4136	5.4839	5.5543	70
80	5.6246	5.6949	5.7652	5.8355	5.9058	5.9761	6.0464	6.1167	6.1870	6.2573	80
90	6.3276	6.3979	6.4682	6.5386	6.6089	6.6792	6.7495	6.8198	6.8901	6.9604	90
100	7.0307	7.1010	7.1713	7.2416	7.3119	7.3822	7.4525	7.5228	7.5932	7.6635	100

Kg/cm^2 to Lb/in^2

kg/ cm^2	0	1	2	3	4	5	6	7	8	9	kg/cm^2
	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	lb/in^2 (psi)	
-	-	14.22	28.45	42.67	56.89	71.12	85.34	99.56	113.78	128.01	-
10	142.23	156.45	170.68	184.90	199.12	213.35	227.57	241.79	256.01	270.24	10
20	284.46	298.68	312.91	327.13	341.35	355.58	369.80	384.02	398.24	412.47	20
30	426.69	440.91	455.14	469.36	483.58	497.81	512.03	526.25	540.47	554.70	30
40	568.92	583.14	597.37	611.59	625.81	640.04	654.26	668.48	682.70	696.93	40
50	711.15	725.37	739.60	753.82	768.04	782.27	796.49	810.71	824.93	839.16	50
60	853.38	867.60	881.83	896.05	910.27	924.50	938.72	952.94	967.16	981.39	60
70	995.61	1009.83	1024.06	1038.28	1052.50	1066.73	1080.95	1095.17	1109.39	1123.62	70
80	1137.84	1152.06	1166.29	1180.51	1194.73	1208.96	1223.18	1237.40	1251.62	1265.85	80
90	1280.07	1294.29	1308.52	1322.74	1336.96	1351.19	1365.41	1379.63	1393.85	1408.08	90
100	1422.30	1436.52	1450.75	1464.97	1479.19	1493.42	1507.64	1521.86	1536.08	1550.31	100

Kg/cm^2 to Kpa

kg/ cm^2	0	1	2	3	4	5	6	7	8	9	kg/ cm^2
	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	Kpa	
-	-	98.1	196.1	294.2	392.3	490.3	588.4	686.5	784.5	882.6	-
10	980.7	1078.7	1176.8	1274.9	1372.9	1471.0	1569.1	1667.1	1765.2	1863.3	10
20	1961.3	2059.4	2157.5	2255.5	2353.6	2451.7	2549.7	2647.8	2745.9	2843.9	20
30	2942.0	3040.1	3138.1	3236.2	3334.3	3432.3	3530.4	3628.5	3726.5	3824.6	30
40	3922.7	4020.7	4118.8	4216.9	4314.9	4413.0	4511.1	4609.1	4707.2	4805.3	40
50	4903.4	5001.4	5099.5	5197.6	5295.6	5393.7	5491.8	5589.8	5687.9	5786.0	50
60	5884.0	5982.1	6080.2	6178.2	6276.3	6374.4	6472.4	6570.5	6668.6	6766.6	60
70	6864.7	6962.8	7060.8	7158.9	7257.0	7355.0	7453.1	7551.2	7649.2	7747.3	70
80	7845.4	7943.4	8041.5	8139.6	8237.6	8335.7	8433.8	8531.8	8629.9	8728.0	80
90	8826.0	8924.1	9022.2	9120.2	9218.3	9316.4	9414.4	9512.5	9610.6	9708.6	90
100	9806.7	9904.8	10002.8	10100.9	10199.0	10297.0	10395.1	10493.2	10591.2	10689.3	100

Kpa to Kg/cm^2

Kpa	0	100	200	300	400	500	600	700	800	900	Kpa
	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	
-	-	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	-
1000	10.197	11.217	12.237	13.256	14.276	15.296	16.316	17.335	18.355	19.375	1000
2000	20.394	21.414	22.434	23.454	24.473	25.493	26.513	27.532	28.552	29.572	2000
3000	30.592	31.611	32.631	33.651	34.670	35.690	36.710	37.730	38.749	39.769	3000
4000	40.789	41.809	42.828	43.848	44.868	45.887	46.907	47.927	48.947	49.966	4000
5000	50.986	52.006	53.025	54.045	55.065	56.085	57.104	58.124	59.144	60.163	5000
6000	61.183	62.203	63.223	64.242	65.262	66.282	67.302	68.321	69.341	70.361	6000
7000	71.380	72.400	73.420	74.440	75.459	76.479	77.499	78.518	79.538	80.558	7000
8000	81.578	82.597	83.617	84.637	85.656	86.676	87.696	88.716	89.735	90.755	8000
9000	91.775	92.795	93.814	94.834	95.854	96.873	97.893	98.913	99.933	100.952	9000
10000	101.972	102.992	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	10000

Torque

Ft·lbs to Kg·m

ft·lbs	0	1	2	3	4	5	6	7	8	9	ft·lbs
	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	
-	-	0.138	0.277	0.415	0.553	0.691	0.830	0.968	1.106	1.244	-
10	1.383	1.521	1.659	1.797	1.936	2.074	2.212	2.350	2.489	2.627	10
20	2.765	2.903	3.042	3.180	3.318	3.457	3.595	3.733	3.871	4.010	20
30	4.148	4.286	4.424	4.563	4.701	4.839	4.977	5.116	5.254	5.392	30
40	5.530	5.669	5.807	5.945	6.083	6.222	6.360	6.498	6.636	6.775	40
50	6.913	7.051	7.190	7.328	7.466	7.604	7.743	7.881	8.019	8.157	50
60	8.296	8.434	8.572	8.710	8.849	8.987	9.125	9.263	9.402	9.540	60
70	9.678	9.816	9.955	10.093	10.231	10.370	10.508	10.646	10.784	10.923	70
80	11.061	11.199	11.337	11.476	11.614	11.752	11.890	12.029	12.167	12.305	80
90	12.443	12.582	12.720	12.858	12.996	13.135	13.273	13.411	13.549	13.688	90
100	13.826	13.964	14.103	14.241	14.379	14.517	14.656	14.794	14.932	15.070	100

Kg·m to Ft·lbs

kg·m	0	1	2	3	4	5	6	7	8	9	kg·m
	ft·lbs	ft·lbs	ft·lbs	ft·lbs	ft·lbs	ft·lbs	ft·lbs	ft·lbs	ft·lbs	ft·lbs	
-	-	7.23	14.47	21.70	28.93	36.17	43.40	50.63	57.86	65.10	-
10	72.33	79.56	86.80	94.03	101.26	108.50	115.73	122.96	130.19	137.43	10
20	144.66	151.89	159.13	166.36	173.59	180.83	188.06	195.29	202.52	209.76	20
30	216.99	224.22	231.46	238.69	245.92	253.16	260.39	267.62	274.85	282.09	30
40	289.32	296.55	303.79	311.02	318.25	325.49	332.72	339.95	347.18	354.42	40
50	361.65	368.88	376.12	383.35	390.58	397.82	405.05	412.28	419.51	426.75	50
60	433.98	441.21	448.45	455.68	462.91	470.15	477.38	484.61	491.84	499.08	60
70	506.31	513.54	520.78	528.01	535.24	542.48	549.71	556.94	564.17	571.41	70
80	578.64	585.87	593.11	600.34	607.57	614.81	622.04	629.27	636.50	643.74	80
90	650.97	658.20	665.44	672.67	679.90	687.14	694.37	701.60	708.83	716.07	90
100	723.30	730.53	737.77	745.00	752.23	759.47	766.70	773.93	781.16	788.40	100

Kg·m to N·m

kg·m	0	1	2	3	4	5	6	7	8	9	kg·m
	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	
-	-	9.81	19.61	29.42	39.23	49.03	58.84	68.65	78.45	88.26	-
10	98.07	107.87	117.68	127.49	137.29	147.10	156.91	166.71	176.52	186.33	10
20	196.13	205.94	215.75	225.55	235.36	245.17	254.97	264.78	274.59	284.39	20
30	294.20	304.01	313.81	323.62	333.43	343.23	353.04	362.85	372.65	382.46	30
40	392.27	402.07	411.88	421.69	431.49	441.30	451.11	460.91	470.72	480.53	40
50	490.34	500.14	509.95	519.76	529.56	539.37	549.18	558.98	568.79	578.60	50
60	588.40	598.21	608.02	617.82	627.63	637.44	647.24	657.05	666.86	676.66	60
70	686.47	696.28	706.08	715.89	725.70	735.50	745.31	755.12	764.92	774.73	70
80	784.54	794.34	804.15	813.96	823.76	833.57	843.38	853.18	862.99	872.80	80
90	882.60	892.41	902.22	912.02	921.83	931.64	941.44	951.25	961.06	970.86	90
100	980.67	990.48	1000.28	1010.09	1019.90	1029.70	1039.51	1049.32	1059.12	1068.93	100

N·m to Kg·m

N·m	0	10	20	30	40	50	60	70	80	90	N·m
	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	kg·m	
-	-	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	-
100	10.197	11.217	12.237	13.256	14.276	15.296	16.316	17.335	18.355	19.375	10
200	20.394	21.414	22.434	23.454	24.473	25.493	26.513	27.532	28.552	29.572	20
300	30.592	31.611	32.631	33.651	34.670	35.690	36.710	37.730	38.749	39.769	30
400	40.789	41.809	42.828	43.848	44.868	45.887	46.907	47.927	48.947	49.966	40
500	50.986	52.006	53.025	54.045	55.065	56.085	57.104	58.124	59.144	60.163	50
600	61.183	62.203	63.223	64.242	65.262	66.282	67.302	68.321	69.341	70.361	60
700	71.380	72.400	73.420	74.440	75.459	76.479	77.499	78.518	79.538	80.558	70
800	81.578	82.597	83.617	84.637	85.656	86.676	87.696	88.716	89.735	90.755	80
900	91.775	92.795	93.814	94.834	95.854	96.873	97.893	98.913	99.933	100.952	90
1000	101.972	102.992	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	100

Temperature

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

To convert from Fahrenheit to Centigrade degrees, consider the center column as Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

To convert from Centigrade to Fahrenheit degrees, consider the center column as Centigrade values, and read the corresponding Fahrenheit temperature on the right.

1°C = 33.8°F

°C		°F
-40.0	**-40**	-40.0
-37.2	**-35**	-31.0
-34.4	**-30**	-22.0
-31.7	**-25**	-13.0
-28.9	**-20**	-4.0
-28.3	**-19**	-2.2
-27.8	**-18**	-0.4
-27.2	**-17**	1.4
-26.7	**-16**	3.2
-26.1	**-15**	5.0
-25.6	**-14**	6.8
-25.0	**-13**	8.6
-24.4	**-12**	10.4
-23.9	**-11**	12.2
-23.3	**-10**	14.0
-22.8	**-9**	15.8
-22.2	**-8**	17.6
-21.7	**-7**	19.4
-21.1	**-6**	21.2
-20.6	**-5**	23.0
-20.0	**-4**	24.8
-19.4	**-3**	26.6
-18.9	**-2**	28.4
-18.3	**-1**	30.2
-17.8	**0**	32.0
-17.2	**1**	33.8
-16.7	**2**	35.6
-16.1	**3**	37.4
-15.6	**4**	39.2
-15.0	**5**	41.0
-14.4	**6**	42.8
-13.9	**7**	44.6
-13.3	**8**	46.4
-12.8	**9**	48.2
-12.2	**10**	50.0

°C		°F
-11.7	**11**	51.8
-11.1	**12**	53.6
-10.6	**13**	55.4
-10.0	**14**	57.2
-9.4	**15**	59.0
-8.9	**16**	60.8
-8.3	**17**	62.6
-7.8	**18**	64.4
-7.2	**19**	66.2
-6.7	**20**	68.0
-6.1	**21**	69.8
-5.6	**22**	71.6
-5.0	**23**	73.4
-4.4	**24**	75.2
-3.9	**25**	77.0
-3.3	**26**	78.8
-2.8	**27**	80.6
-2.2	**28**	82.4
-1.7	**29**	84.2
-1.1	**30**	86.0
-0.6	**31**	87.8
0.0	**32**	89.6
0.6	**33**	91.4
1.1	**34**	93.2
1.7	**35**	95.0
2.2	**36**	96.8
2.8	**37**	98.6
3.3	**38**	100.4
3.9	**39**	102.2
4.4	**40**	104.0
5.0	**41**	105.8
5.6	**42**	107.6
6.1	**43**	109.4
6.7	**44**	111.2
7.2	**45**	113.0

°C		°F
7.8	**46**	114.8
8.3	**47**	116.6
8.9	**48**	118.4
9.4	**49**	120.2
10.0	**50**	122.0
10.6	**51**	123.8
11.1	**52**	125.6
11.7	**53**	127.4
12.2	**54**	129.2
12.8	**55**	131.0
13.3	**56**	132.8
13.9	**57**	134.6
14.4	**58**	136.4
15.0	**59**	138.2
15.6	**60**	140.0
16.1	**61**	141.8
16.7	**62**	143.6
17.2	**63**	145.4
17.8	**64**	147.2
18.3	**65**	149.0
18.9	**66**	150.8
19.4	**67**	152.6
20.0	**68**	154.4
20.6	**69**	156.2
21.1	**70**	158.0
21.7	**71**	159.8
22.2	**72**	161.6
22.8	**73**	163.4
23.3	**74**	165.2
23.9	**75**	167.0
24.4	**76**	168.8
25.0	**77**	170.6
25.6	**78**	172.4
26.1	**79**	174.2
26.7	**80**	176.0

°C		°F
27.2	**81**	177.8
27.8	**82**	179.6
28.3	**83**	181.4
28.9	**84**	183.2
29.4	**85**	185.0
30.0	**86**	186.8
30.6	**87**	188.6
31.1	**88**	190.4
31.7	**89**	192.2
32.2	**90**	194.0
32.8	**91**	195.8
33.3	**92**	197.6
33.9	**93**	199.4
34.4	**94**	201.2
35.0	**95**	203.0
35.6	**96**	204.8
36.1	**97**	206.6
36.7	**98**	208.4
37.2	**99**	210.2
37.8	**100**	212.0
40.6	**105**	221.0
43.3	**110**	230.0
46.1	**115**	239.0
48.9	**120**	248.0
51.7	**125**	257.0
54.4	**130**	266.0
57.2	**135**	275.0
60.0	**140**	284.0
62.8	**145**	293.0
65.6	**150**	302.0
68.3	**155**	311.0
71.1	**160**	320.0
73.9	**165**	329.0
76.7	**170**	338.0
79.4	**175**	347.0

SANY

Shop Safety

2 Shop Safety

⚠ WARNING

Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

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.

⚠ 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.

⚠ 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.**

2.2 General Shop Safety

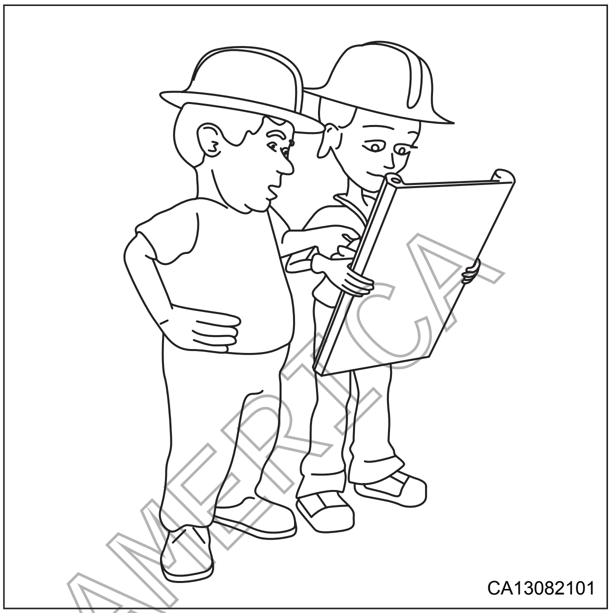
It's important to establish good shop safety rules for everyone who enters or uses the shop area. Implementing shop safety rules will keep employees safe and provide the most productive environment for working or learning. Post rules where they can clearly be viewed at all times. If necessary, provide 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.**

2.2.1 Rules and shop behavior


CA13082101

- 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


CA13082102

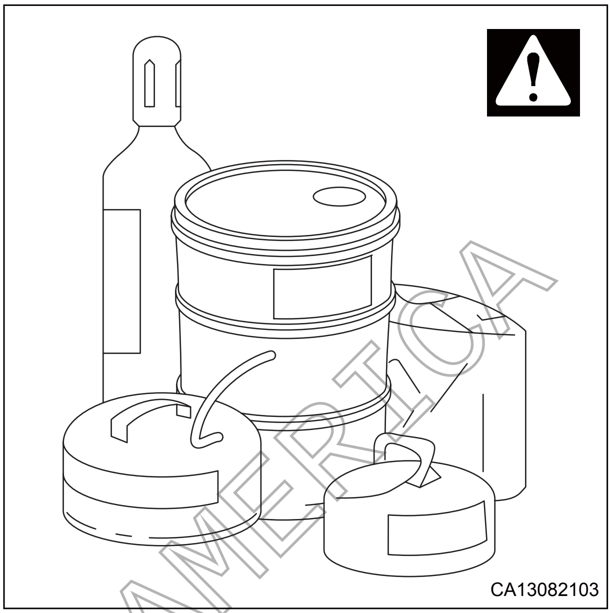
- Oils, grease, fuel, antifreeze or any fluid spills should be mopped up immediately. These items pose a serious slip hazard. Regardless of who was responsible for the spill, it is your job as a shop employee to secure and clean up the spill area.

- 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.

2.2.3 Shop Liquids Storage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- 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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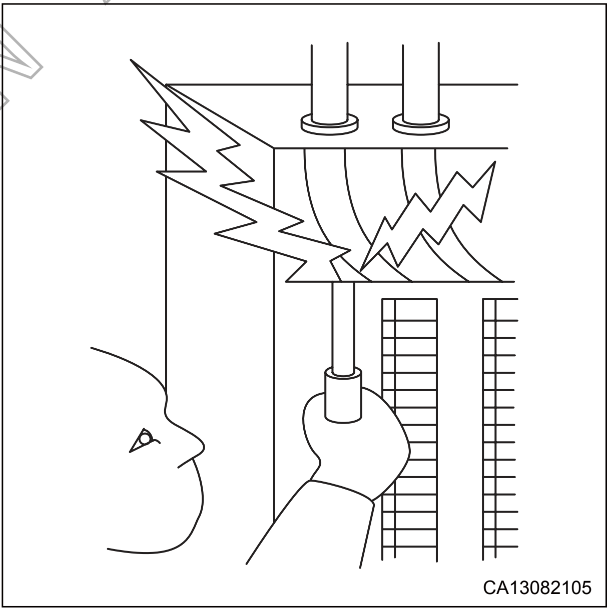
2.2.5 Jacking Up the Machine

- 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.

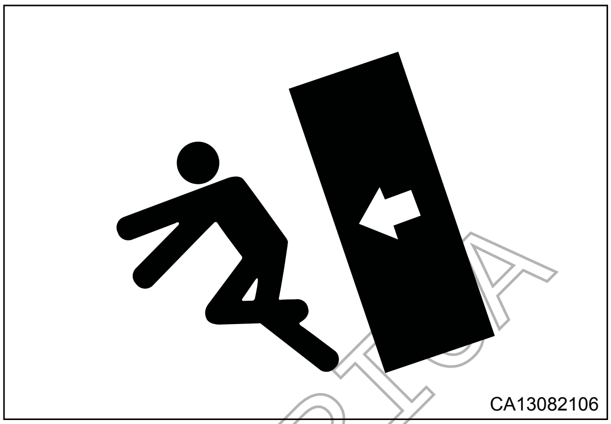
2.2.6 Electrical Dangers

- 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.



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.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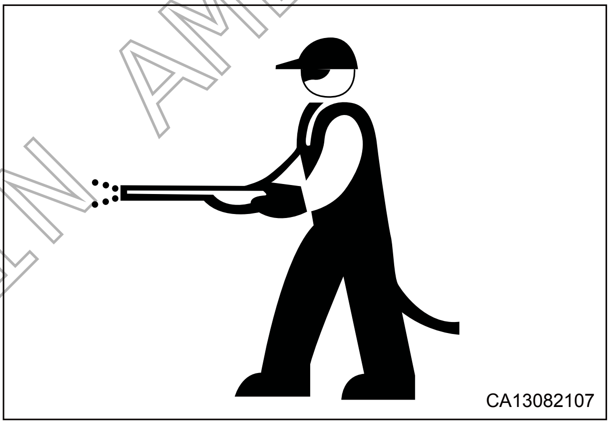
2.2.8 Cleaning the Machine

- 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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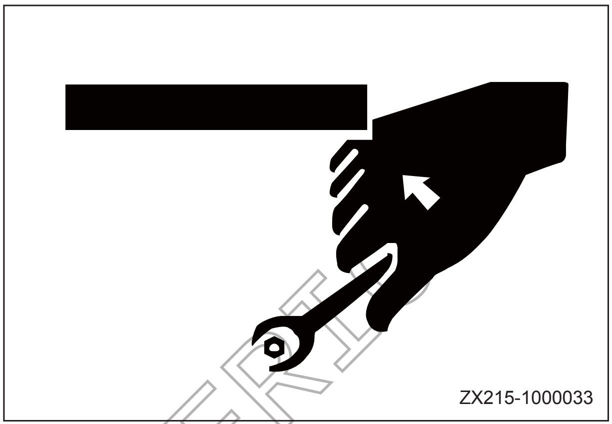
2.2.9 Using the Correct Tools

- 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.

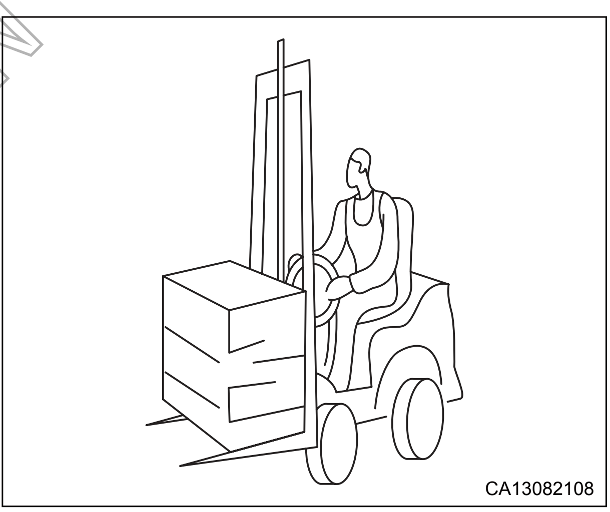
- Before starting the work, thoroughly check the tools, machine, forklift, crane, service car, etc.
- Keep your tools clean, and when the job is complete, take inventory of the tools you were using to be sure no tools were left in the machine.
- Always put shop tools back in there proper storage location when finished.
- If welding repairs are needed, always have a trained, experienced or certified welder carry out the work.


ZX215-1000033

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.

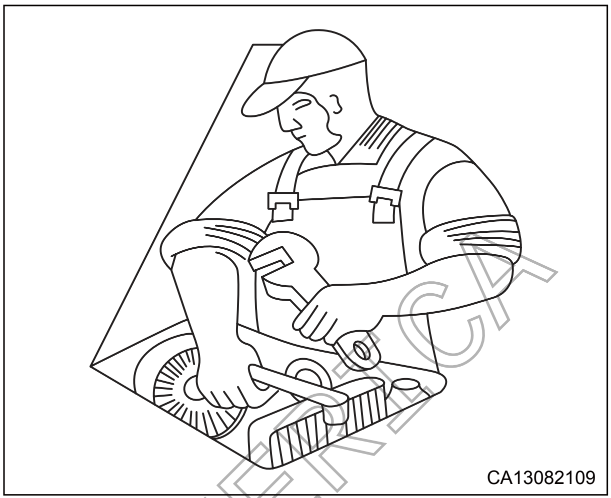
- Always use the appropriate lifting equipment such as hoist, crane, forklift etc. to handle a loads if possible.
- Be sure the lifting equipment is in good condition and rated for the load you are about to lift.
- If straps are to be used, ensure they are in good condition and rated for the load to 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.


CA13082108

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.

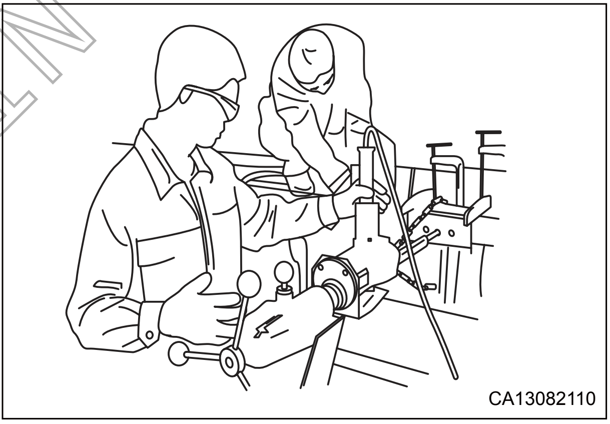


2.2.12 Safety Partners

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.



2.2.13 Two people when engine running

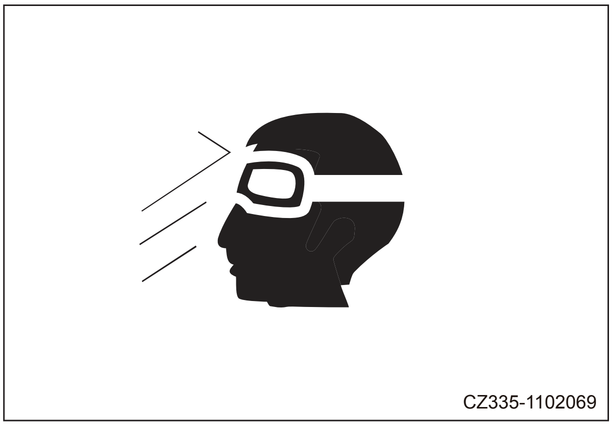
In order to prevent injury, do not perform the service while the engine is running. If the service must be performed while the engine is running, operate only when two people are on the spot and follow the regulations below:

- 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

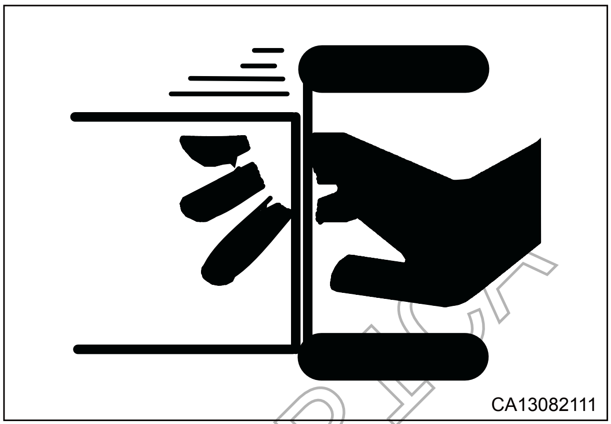
When using a hammer to drive pins, metal particles may fly off. This may lead to serious eye injuries. Always do the following:

- 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.



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.


CA13082111

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.

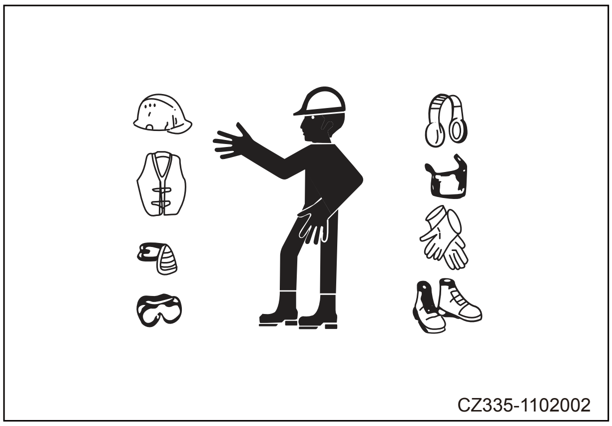

CA13082112

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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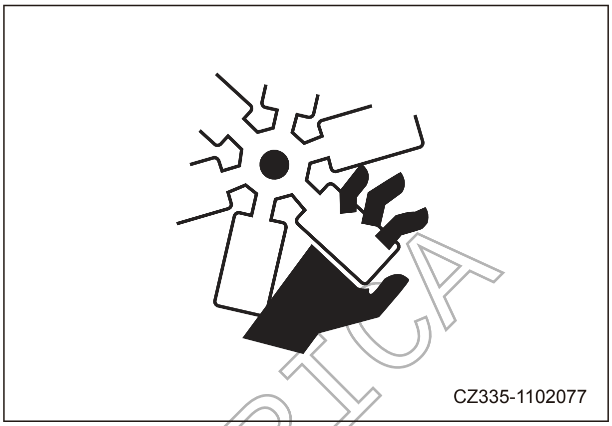
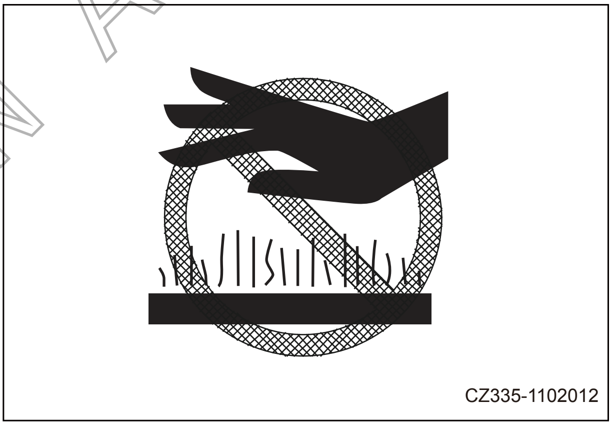
2.2.18 Running the Machine

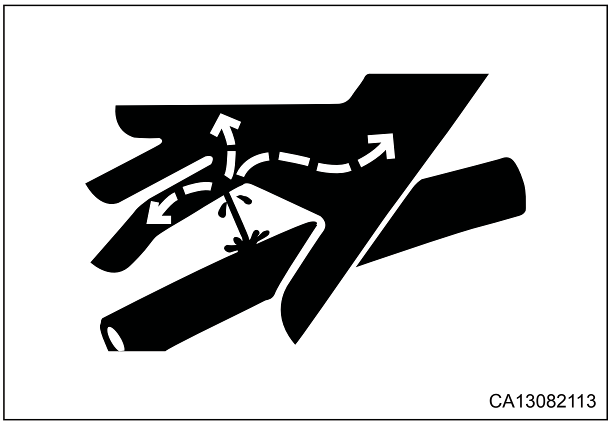
Run the machine during repair procedures ONLY if directed to do so in this shop manual. If the machine must be run when making repairs, it is important to follow some basic safety rules.


CZ335-1102077

- 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.


CZ335-1102012

- 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

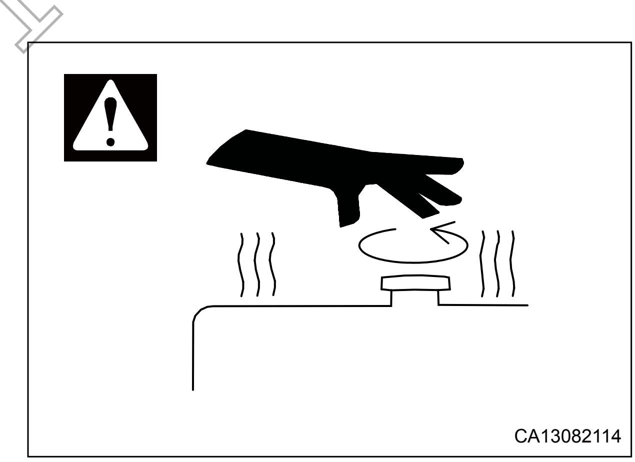
If the machine is equipped with an accumulator charged with high-pressure nitrogen gas, it is important to follow these basic precautions.

- 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.

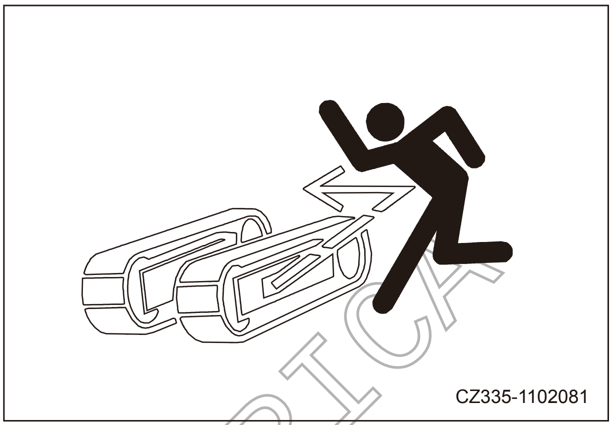


2.2.21 Track Recoil Springs

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 or death.

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.

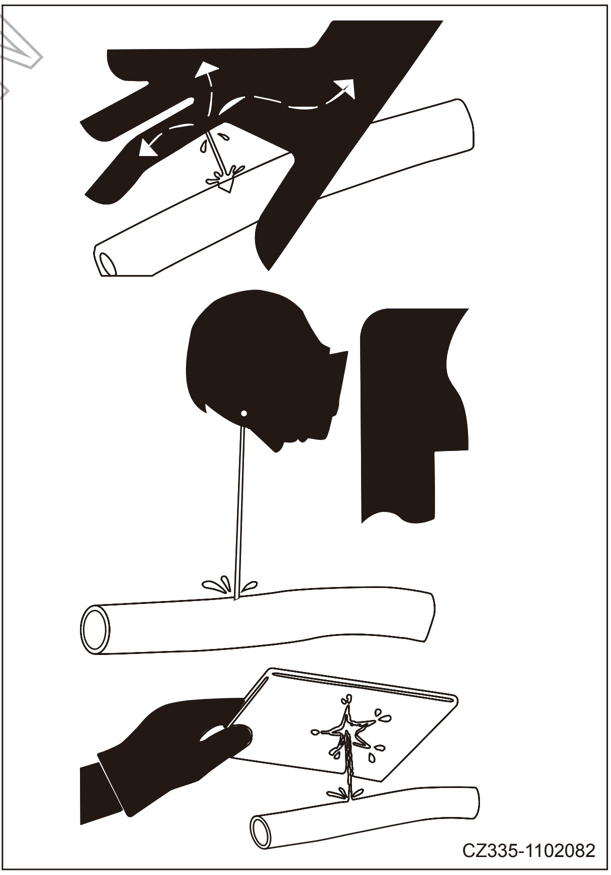
Always stand clear of the track travel path when separating the master link section of the track.


CZ335-1102081

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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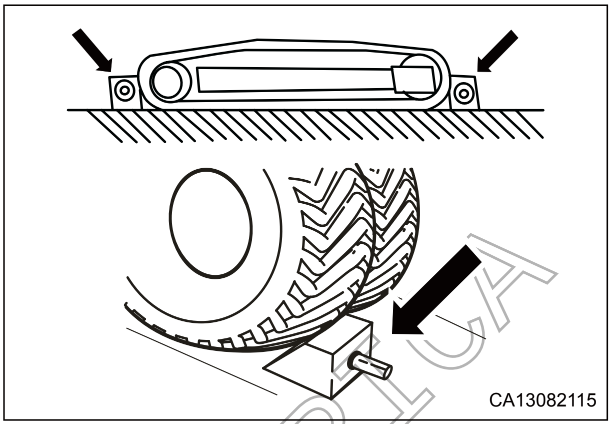
2.2.23 Safe Work Preparations



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.

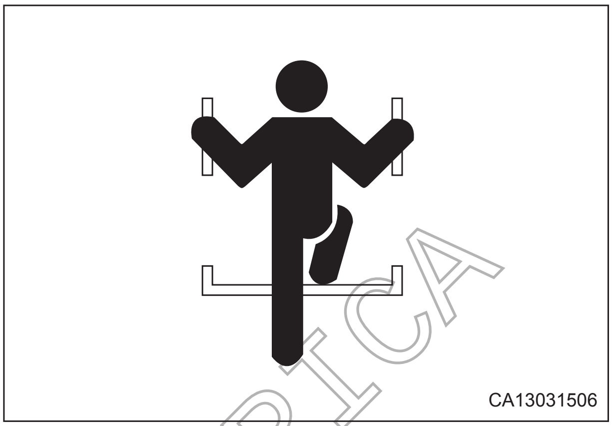
If equipped, set the hydraulic lock lever in the LOCKED position. If equipped, set the parking brake in the PARK position.

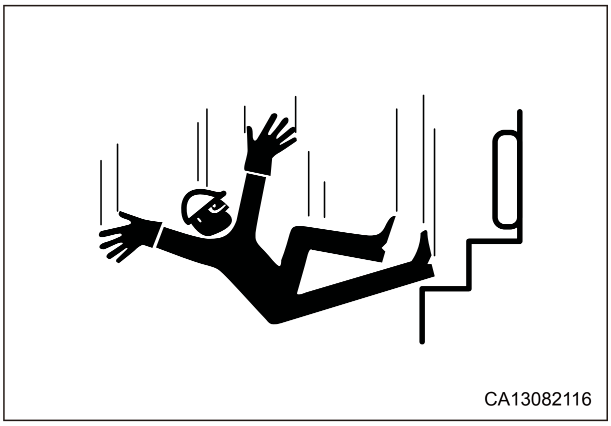
Be sure all personnel and equipment is clear of your work area and you can be seen by all working personnel especially if performing repairs in the field.

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.



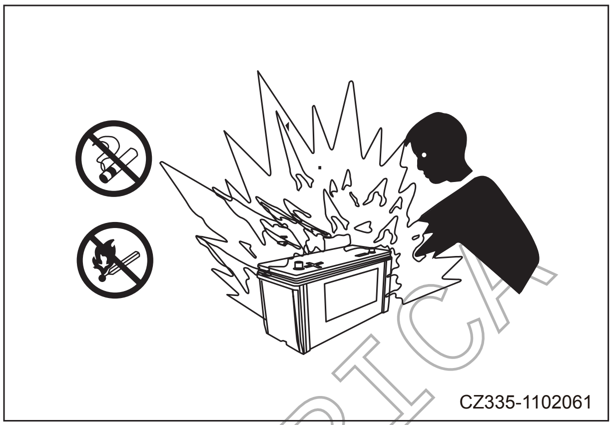


2.2.25 Battery Hazards

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.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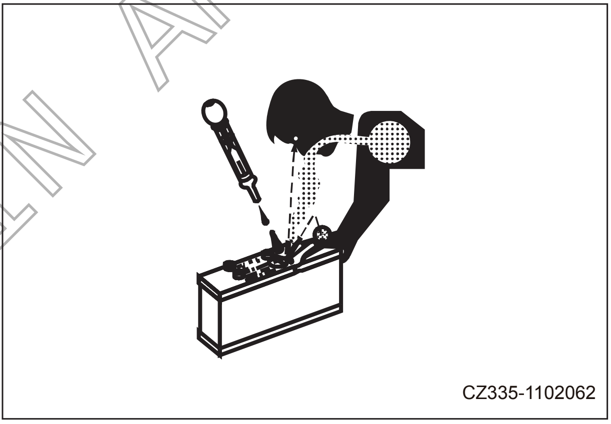
- When working with batteries, always work in a wellventilated area.
- If the battery is corroded, flush the area with a baking soda and warm water mix.


CZ335-1102062

- 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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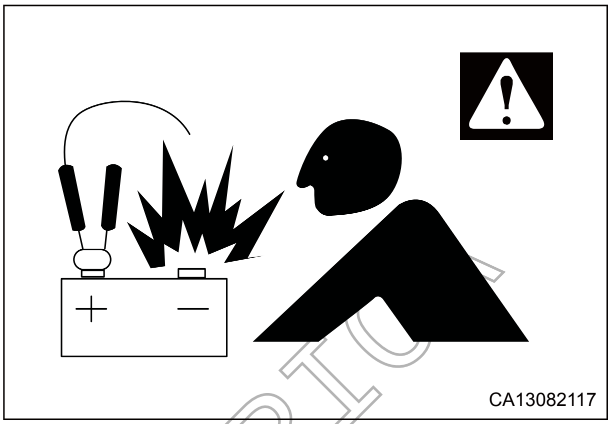
2.2.26 Jump-Start Safety

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.

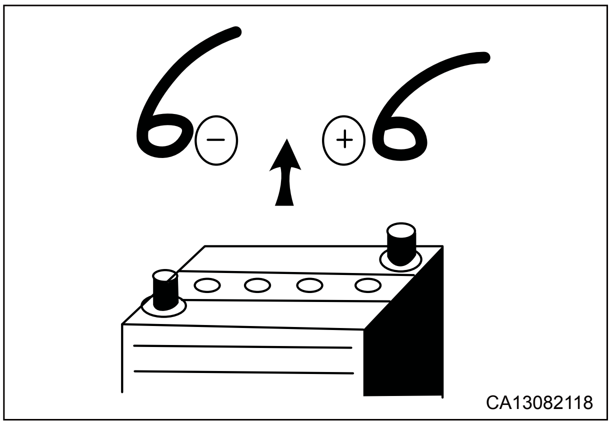
2.2.27 Disconnecting the System Power

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.



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.

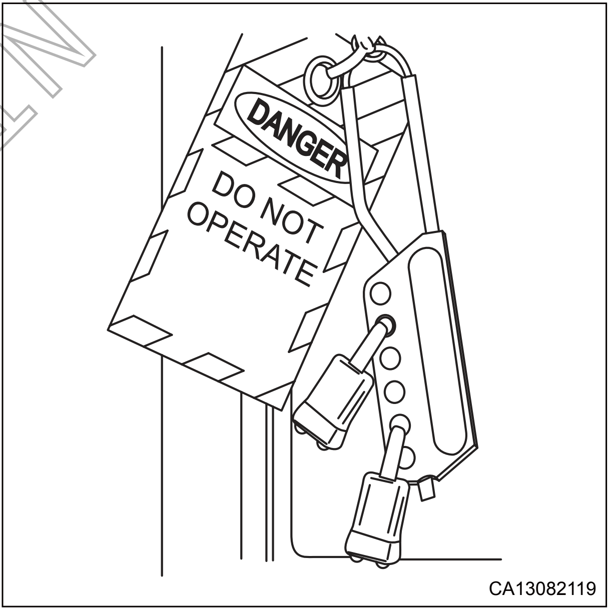
2.2.29 Sequence of Procedures

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.



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 startup.
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.

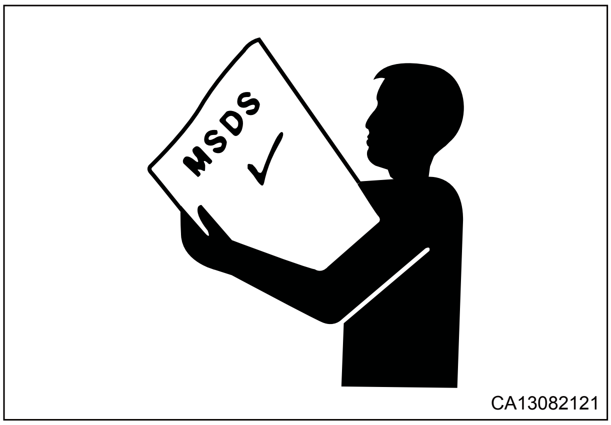
2.2.30 Chemical hazard

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.

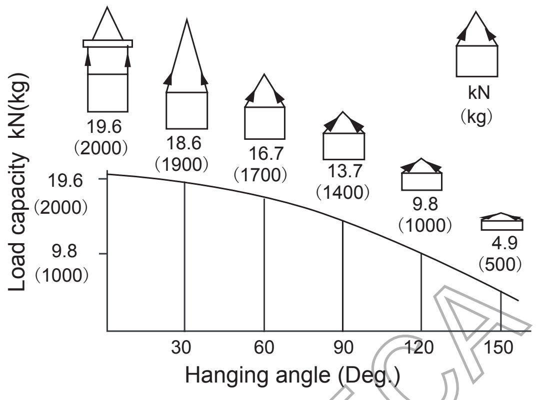
- MSDS data sheets provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. Information includes physical data, health effects, first aid, reactivity, storage, disposal and protective equipment required.
- Be sure all personnel involved 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.



2.3 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.
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}.



ZX215-1000001

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.

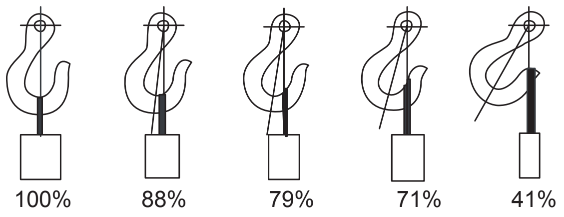
9. Use the specified eyebolts and fix wire ropes, chains, etc. to them with shackles, etc.

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.



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- 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 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 lowering a load, observe the following.

- When lowering 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.

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)

Nominal Diameter of Rope	Allowable Load	
mm	kN	Ton
10	9.8	1.0
11.5	13.7	1.4
12.5	15.7	1.6
14	21.6	2.2
16	27.5	2.8
18	35.5	3.6
20	43.1	4.4
22.4	54.9	5.6
30	98.1	10.0
40	176.5	18.0
50	274.6	28.0
60	392.2	40.0

⚠ CAUTION

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

Specifications

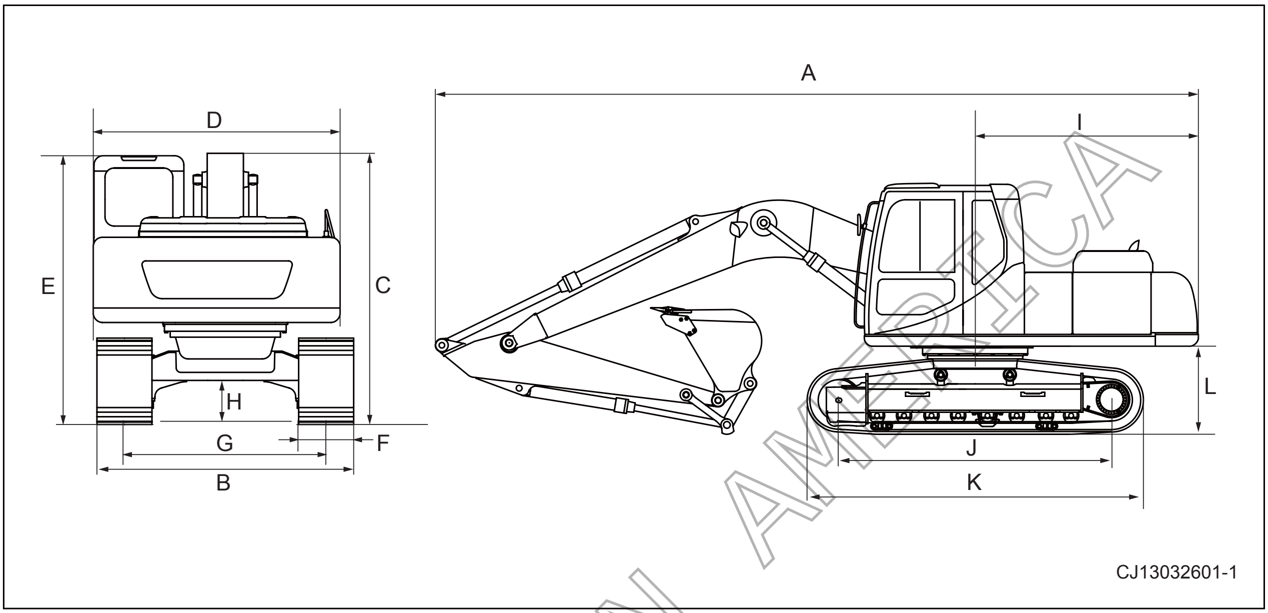
3 Specifications

⚠ WARNING

Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

3 SPECIFICATIONS

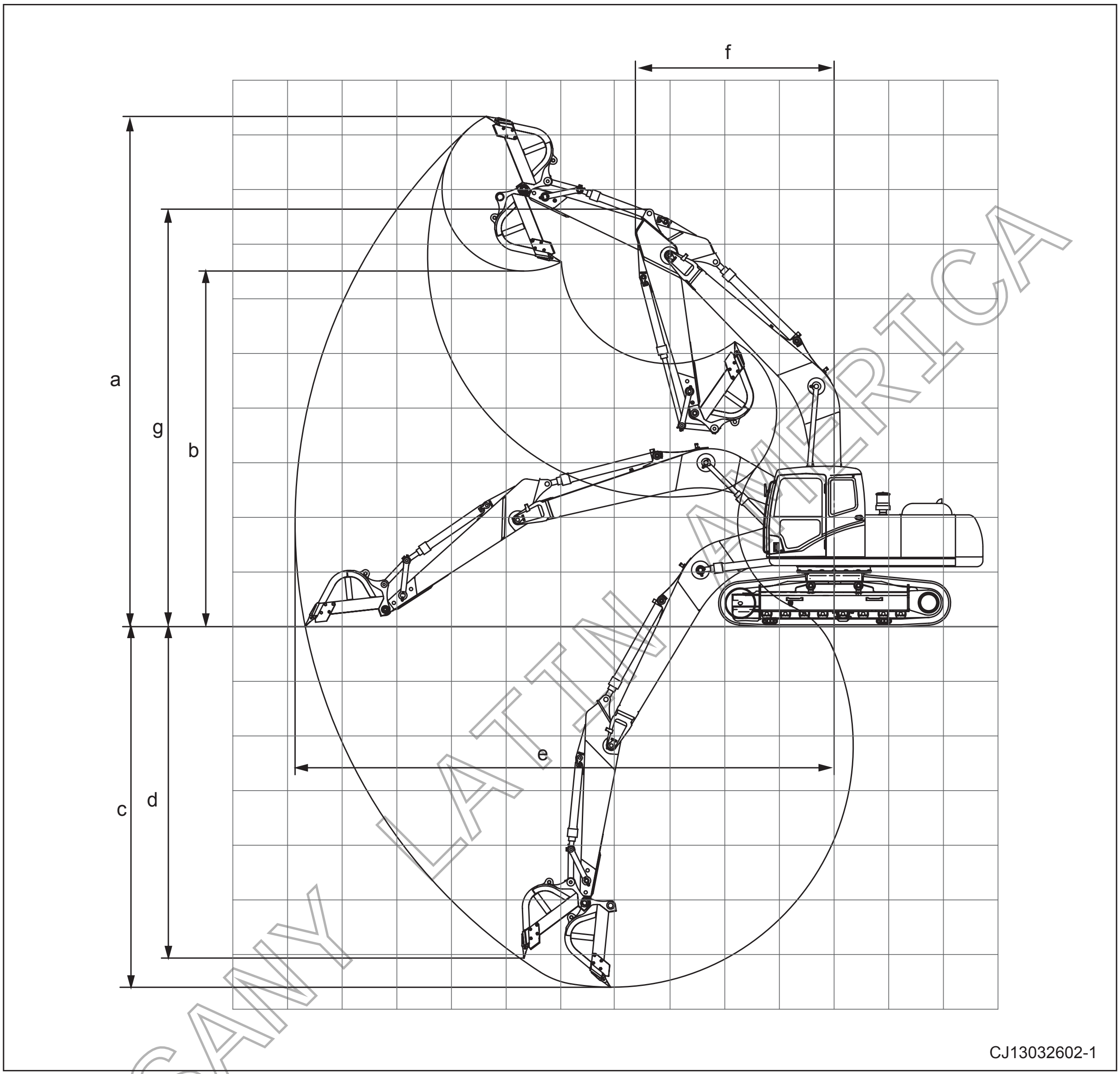
3.1 Dimensions



Unit: mm (ft, in)

Item		SY195C-9	SY205C-9	SY215C-9	SY225C-9
A	Overall length (shipping)	9560 {31'4"}	9680 {31'9"}	9680 {31'9"}	9680 {31'9"}
B	Overall width	2800 {9'2"}	2800 {9'2"}	2980 {9'9"}	2980 {9'9"}
C	Overall height (Shipping)	3250 {10'8"}	3440 {11'3"}	3440 {11'3"}	3440 {11'3"}
D	Width (top)	2710 {8'11"}	2710 {8'11"}	2710 {8'11"}	2710 {8'11"}
E	Overall height (to cab roof)	2990 {9'10"}	2990 {9'10"}	2990 {9'10"}	2990 {9'10"}
F	Std. track shoe width	600 {1'12"}	600 {1'12"}	600 {1'12"}	600 {1'12"}
G	Track gauge	2200 {7'3"}	2200 {7'3"}	2380 {7'10"}	2380 {7'10"}
H	Min. ground clearance	440 {1'5"}	440 {1'5"}	440 {1'5"}	440 {1'5"}
I	Tail swing radius	2890 {9'6"}	2890 {9'6"}	2890 {9'6"}	2890 {9'6"}
J	Length of track on ground	3260 {10'8"}	3355 {11'0"}	3445 {11'4"}	3640 {11'11"}
K	Track length	4060 {13'4"}	4160 {13'8"}	4250 {13'11"}	4445 {14'7"}

3.2 Working Ranges



Unit: mm (ft, in)

	Item	SY195C-9	SY205C-9	SY215C-9	SY225C-9
a	Max. cutting height	9410 {30'10"}	9570 {31'5"}	9570 {31'5"}	9570 {31'5"}
b	Max. dumping height	6490 {21'4"}	6700 {21'12"}	6700 {21'12"}	6700 {21'12"}
c	Max. digging depth	6410 {21'0"}	6600 {21'8"}	6600 {21'8"}	6600 {21'8"}
d	Max. vertical digging depth	5790 {18'12"}	5800 {19'0"}	5800 {19'0"}	5800 {19'0"}
e	Max. digging reach	9740 {31'11"}	9950 {32'8"}	9950 {32'8"}	9950 {32'8"}
f	Min. swing radius	3755 {12'4"}	3595 {12'12"}	3595 {12'12"}	3595 {12'12"}
g	Max. height at min. swing radius	7700 {25'3"}	7665 {25'2"}	7665 {25'2"}	7665 {25'2"}

3.3 Technical Specifications

Machine model				SY195C-9	SY205C-9	SY215C-9	SY225C-9
Bucket capacity			m³	0.8	0.8	0.9	1.0
Operating weight			kg	21000	21200	21800	22600
Performance		Max. bucket digging force	kN	135	138	138	138
		Max. arm digging force	kN	109	103	103	103
		Swing speed	rpm	11	11	11	11
		Travel speed (Hi/Lo)	km/h	5.4/3.3	5.4/3.3	5.4/3.3	5.4/3.3
		Gradeability	Deg.	35	35	35	35
		Ground pressure	kPa	47	46	47	46
Engine		Model		MITSUBISHI 6D34-TL			
		Type		6-cylinder, 4-cycle, water-cooled, in-line, direct injection			
		No. of cylinders-bore x stroke	mm	6-Φ104mm×115mm			
		Piston displacement	L	5.86			
		Rated power	KW/rpm	114 / 2050			
		Max. torque	N·m/rpm	590 / 1400			
		Max. speed at no load	rpm	2200±50			
		Min. speed at no load	rpm	1000±10			
		Min. fuel consumption	g/KWh	210			
		Starting motor		24V/5.0 KW			
		Alternator		24V/50A			
Undercarriage		Carrier roller (each side)		2	2	2	2
		Track roller (each side)		7	7	8	9
		Track shoe (each side)		45	46	47	49
Hydraulic system	Hydraulic pump	Type		KAWASAKI (Variable displacement piston type)			
		Max. delivery	L/min	2×210			
		Safety valve pressure	Mpa	34.3			
	Control valve	Type x No.		KMX15RB/B45201B ×1			
		Control method		Hydraulic			
	Hydraulic motor	Travel motor		2 x KYB variable displacement piston type (with brake valve and parking brake)			
		Swing motor		1 x KAWASAKI angle type, piston type (swing brake controller)			
	Hydraulic cylinder	Type		Double acting piston			
		Bore		120 (Boom), 135 (Arm), 115 (Bucket)			
		Rod diameter		85 (Boom), 95 (Arm), 80 (Bucket)			
		Stroke		1285 (Boom), 1490 (Arm), 1120 (Bucket)			
		Hydraulic tank		Closed type			
		Hydraulic oil filter element		Tank return side			
		Hydraulic oil cooler		Air-cooling type			

Engine

Item		Specification
Engine model		6D34TLE2A
Type		In-line 6-cylinder; water-cooled, 4-cycle diesel engine
Combustion chamber type		Direct injection
Valve mechanism		OHV
Max. output power	kW{PS}/rpm	114{155}/2050
Max. torque	N·m{kgf·m}/rpm	590{60}/1400
Bore×Stroke	mm	φ104×115
Total displacement	cm³{L}	5860{5.860}
Compression ratio		18.2

Swing motor

Producer		KAWASAKI
Model		M5×180CHB-12A-51A/260
Type		angle type, piston type (swing brake controller)
Theoretical displacement	cm³/rev	129.2
Safety valve set pressure	MPa {Kg/cm³}	25.5 {260}
Rated engine speed	rpm	2050
Brake release pressure	MPa {Kg/cm³}	3.4 {34}

Control valve

Item		Specification
Model		KMX15RB
Standard flow rate (equivalent to one pump)		300 L/min
Maximum pressure	When main relief valve is normal	34.3 MPa
	When main relief valve is boosting	37.3 MPa
Maximum pressure	When port relief valve is normal	39.2 MPa
Working oil temperature		-20~90°C
Drained oil maximum pressure		0.3 MPa

Travel motor

Maker				KYB
Model				MAG-170VP-3400E
Type				Variable displacement piston type (w/ brake valve and parking brake)
Weight			kg	275
Equivalent displacement			cm^3/rev	q x i
Motor displacement q	Large displacement q1		cm^3/rev	130.4
	Small displacement q2		cm^3/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)

3.4 Weight Table

Unit: kg

Machine Model	SY195C-9	SY205C-9	SY215C-9	SY225C-9
Engine	520	520	520	520
Radiator assembly	80	80	80	80
Hydraulic tank assembly (w/o hydraulic oil)	148	148	148	148
Fuel tank assembly (w/o fuel)	126	126	126	126
Revolving frame	1770	1770	1770	1770
Operator cab	360	360	360	360
Operator seat & control console	75	75	75	75
Counterweight	3900	3900	3900	3900
Hydraulic pump	120	120	120	120
Control valve	185	185	185	185
Swing reducer assembly	200	200	200	200
Final drive assembly	300×2	300×2	300×2	300×2
Center swivel joint	56	56	56	56
Track frame	2280	2432	2746	2746
Swing bearing	286	286	286	286
Idler	116×2	116×2	116×2	116×2
Tensioning device	135×2	135×2	135×2	135×2
Carrier roller	25.5×4	25.5×4	25.5×4	25.5×4
Track roller	40×14	40×14	40×16	40×18
Boom assembly	1568	1568	1590	1590
Arm assembly	706	709	709	709
Bucket assembly	769	769	781	781
Boom cylinder assembly	206×2	206×2	206×2	206×2
Arm cylinder assembly	262	262	262	262
Bucket cylinder assembly	188	188	188	188
Linkage	68	68	68	68
Rocker	22×2	22×2	22×2	22×2

3.5 Recommended Oil, 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 30	SAE 30	SAE 30	SAE 30	
			SAE 10W	SAE 10W	SAE 10W	SAE 10W				
			SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	
				SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40
Swing machinery case Idler Track roller Carrier roller			SAE 30	SAE 30	SAE 30	SAE 30	SAE 30	SAE 30	SAE 30	
Hydraulic system			SAE 10W	SAE 10W	SAE 10W	SAE 10W	SAE 10W	SAE 10W	SAE 10W	
			SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	SAE 10W-30	
			SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40	SAE 15W-40	
	Hydraulic oil	L-HV32 Low-temp, wear-resistant hydraulic oil	L-HV32 Low-temp, wear-resistant hydraulic oil	L-HV32 Low-temp, wear-resistant hydraulic oil	L-HV32 Low-temp, wear-resistant hydraulic oil	L-HV32 Low-temp, wear-resistant hydraulic oil				
				L-HM46 Wear-resistant hydraulic oil	L-HM46 Wear-resistant hydraulic oil	L-HM46 Wear-resistant hydraulic oil	L-HM46 Wear-resistant hydraulic oil	L-HM46 Wear-resistant hydraulic oil	L-HM46 Wear-resistant hydraulic oil	L-HM46 Wear-resistant hydraulic oil
						L-HM68 Wear-resistant hydra. oil	L-HM68 Wear-resistant hydra. oil	L-HM68 Wear-resistant hydra. oil	L-HM68 Wear-resistant hydra. oil	L-HM68 Wear-resistant hydra. oil
Fuel tank	Diesel fuel			ASTM D 975 No.2	ASTM D 975 No.2	ASTM D 975 No.2	ASTM D 975 No.2	ASTM D 975 No.2	ASTM D 975 No.2	ASTM D 975 No.2
				GB252 Super-20 Diesel fuel	GB252 Super-20 Diesel fuel	GB252 Super-20 Diesel fuel	GB252 Super-20 Diesel fuel	GB252 Super-20 Diesel fuel	GB252 Super-20 Diesel fuel	
		GB252 Super-35 Diesel fuel	GB252 Super-35 Diesel fuel	GB252 Super-35 Diesel fuel	GB252 Super-35 Diesel fuel	GB252 Super-35 Diesel fuel	GB252 Super-35 Diesel fuel	GB252 Super-35 Diesel fuel		
Grease fitting	Grease		NLGI No.2	NLGI No.2	NLGI No.2	NLGI No.2	NLGI No.2	NLGI No.2	NLGI No.2	NLGI No.2
Cooling system	Coolant	TEEC L35	TEEC L35	TEEC L35	TEEC L35	TEEC L35	TEEC L35	TEEC L35	TEEC L35	TEEC L35

- 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.

3.6 Capacity Table

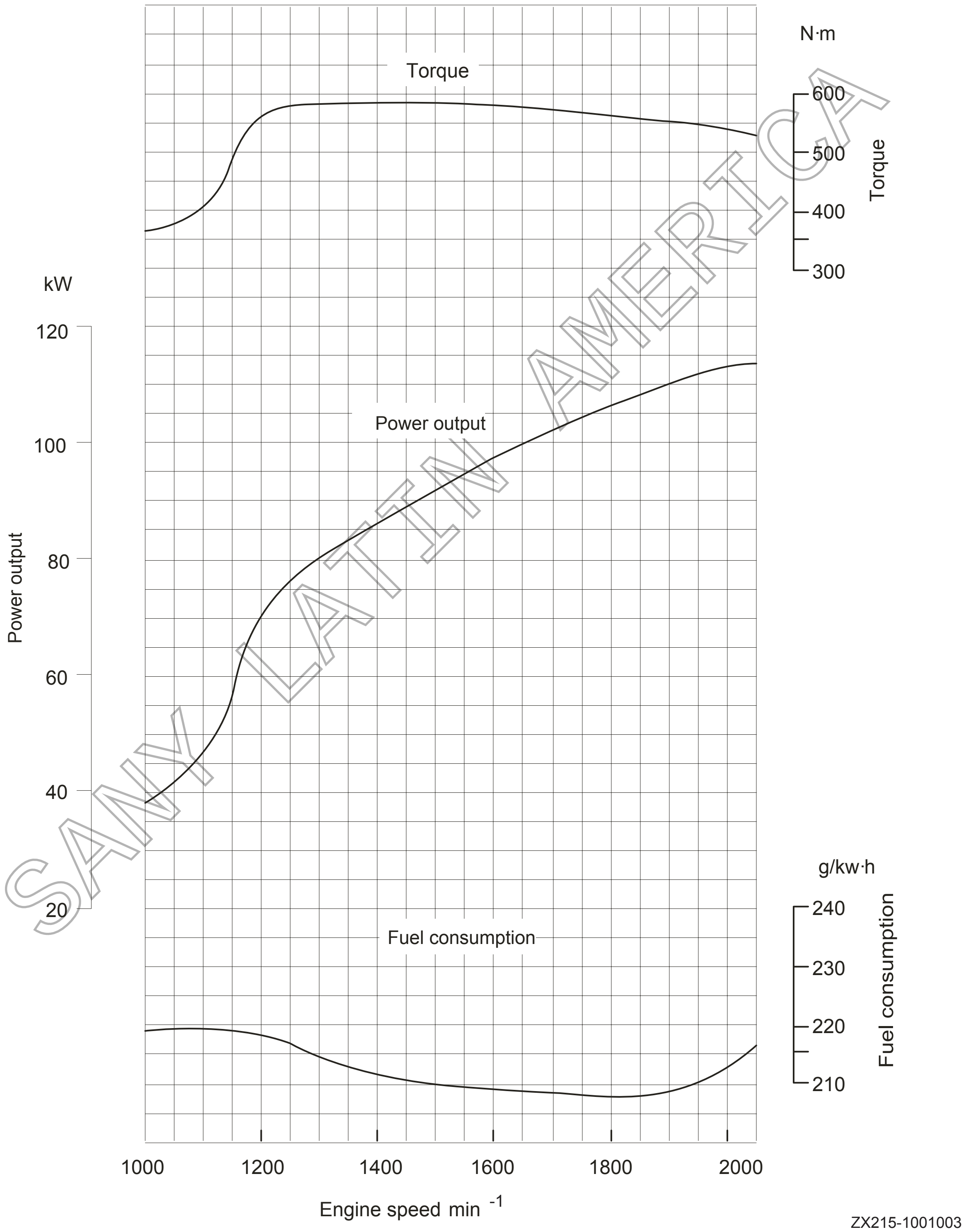
Unit: L {US Gal}

Engine oil pan	Swing mechanism casing	Final drive casing	Hydraulic system	Cooling system	Fuel tank
22 {5.81}	4.0 {1.06}	5.5 {1.45}	239 {63.14}	22.5 {5.94}	340 {89.82}

3.7 Engine Performance Curve

Testing condition:

1) Temperature: 298K, one standard atmospheric pressure. 2) No fan.



SANY

Structure and Function

4 Structure and Function

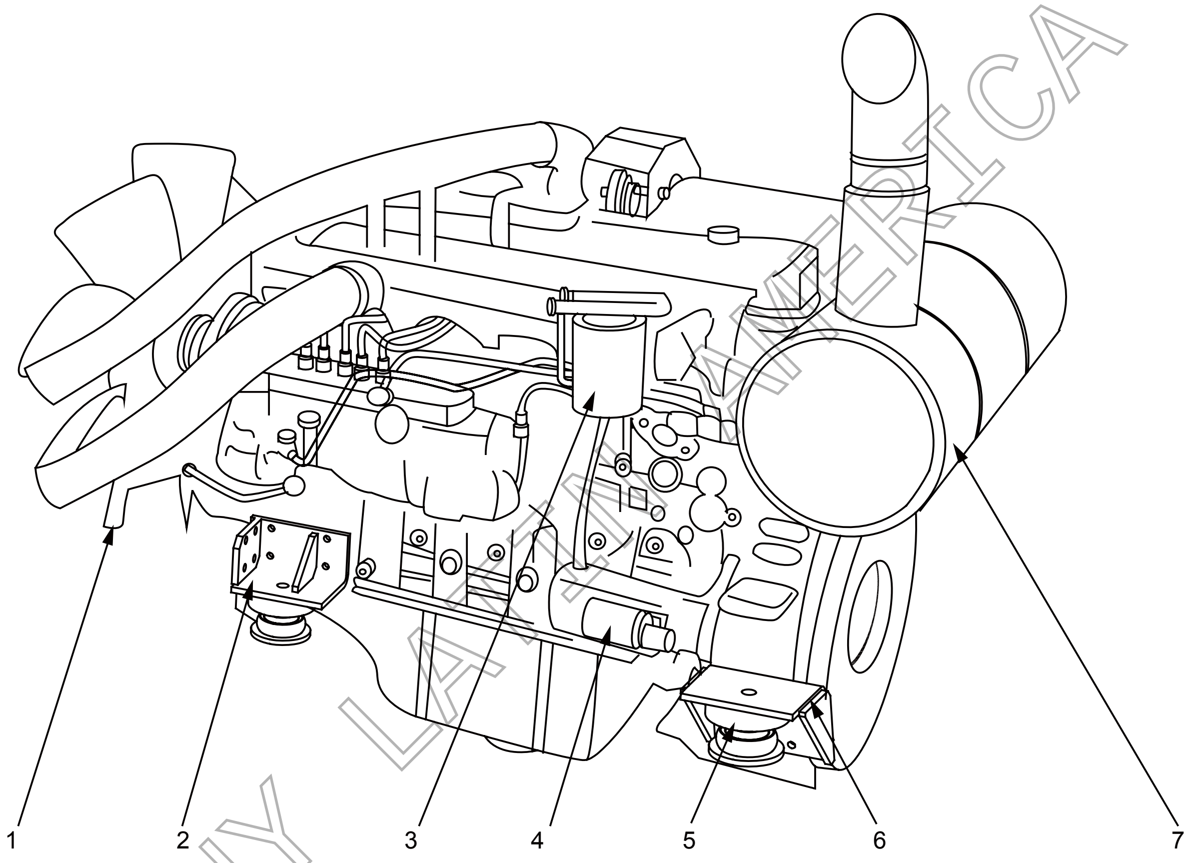
⚠ WARNING

Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

4 STRUCTURE AND FUNCTION

4.1 Engine and Cooling System

4.1.1 Engine-related parts



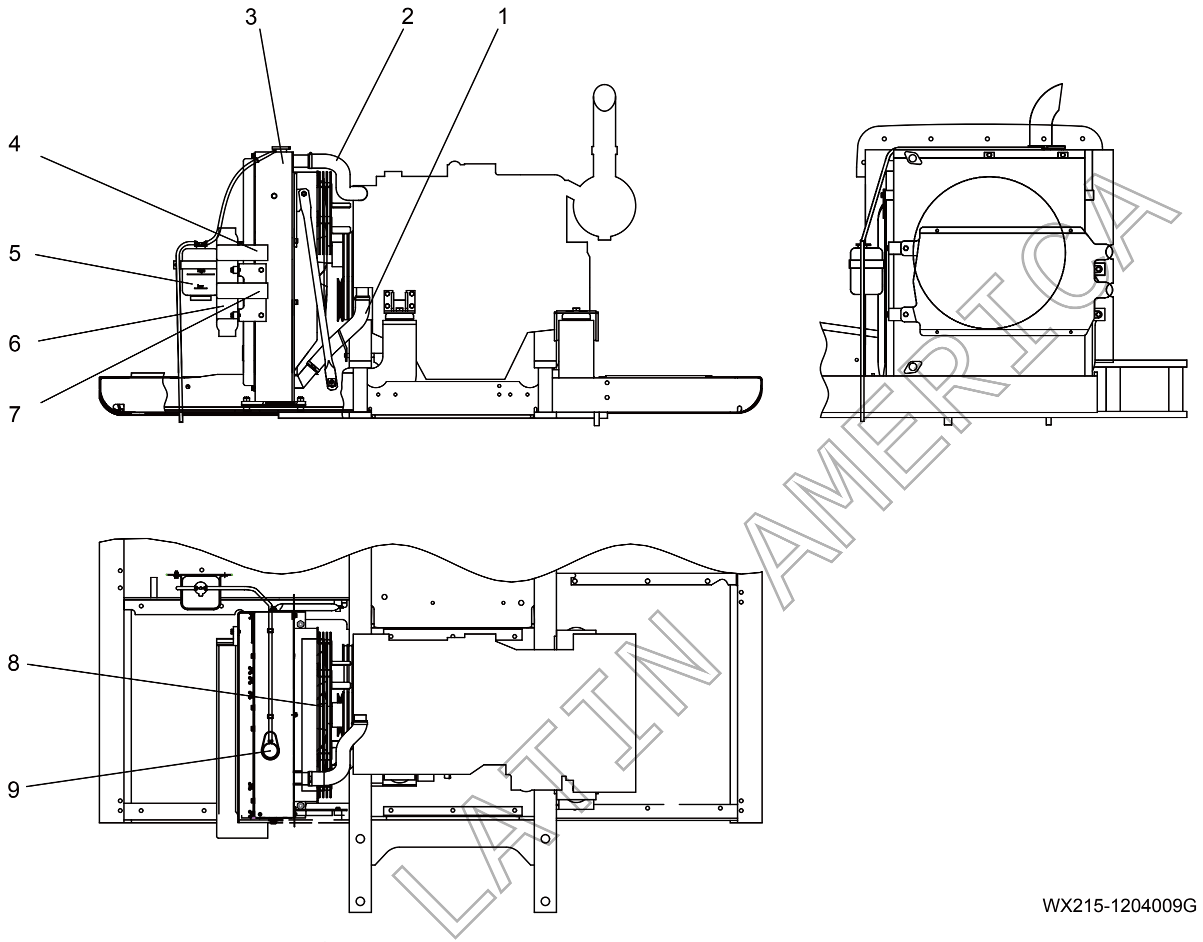
ZX215-1002001

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

4.1.2 Radiator and intercooler



1) Radiator outlet hose
2) Radiator inlet hose
3) Radiator
4) Intercooler air intake
5) Reserve tank
6) Intercooler
7) Intercooler air outlet
8) Fan guard
9) Radiator cap

Specifications

Radiator assembly:

ZH860×385×1050-S70Y75Z20Q/SY015

Aluminum pipe, belt-type radiator

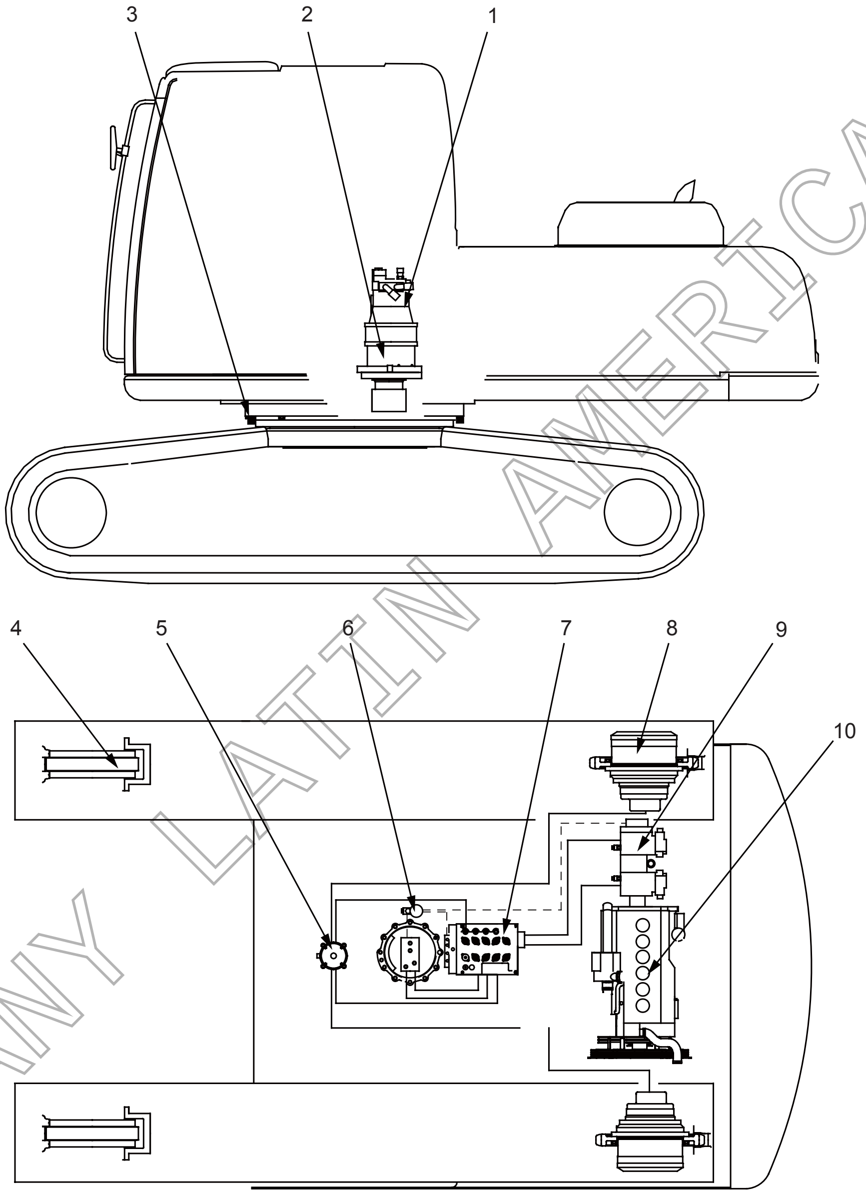
Radiator and oil cooler in parallel connection; intercooler in series connection with radiator and oil cooler.

Reservoir capacity: 8.9 L (2.35 US gal)

Engine coolant capacity: 9.5L (2.51 US gal)

4.2 Power Train

4.2.1 Power transmission system

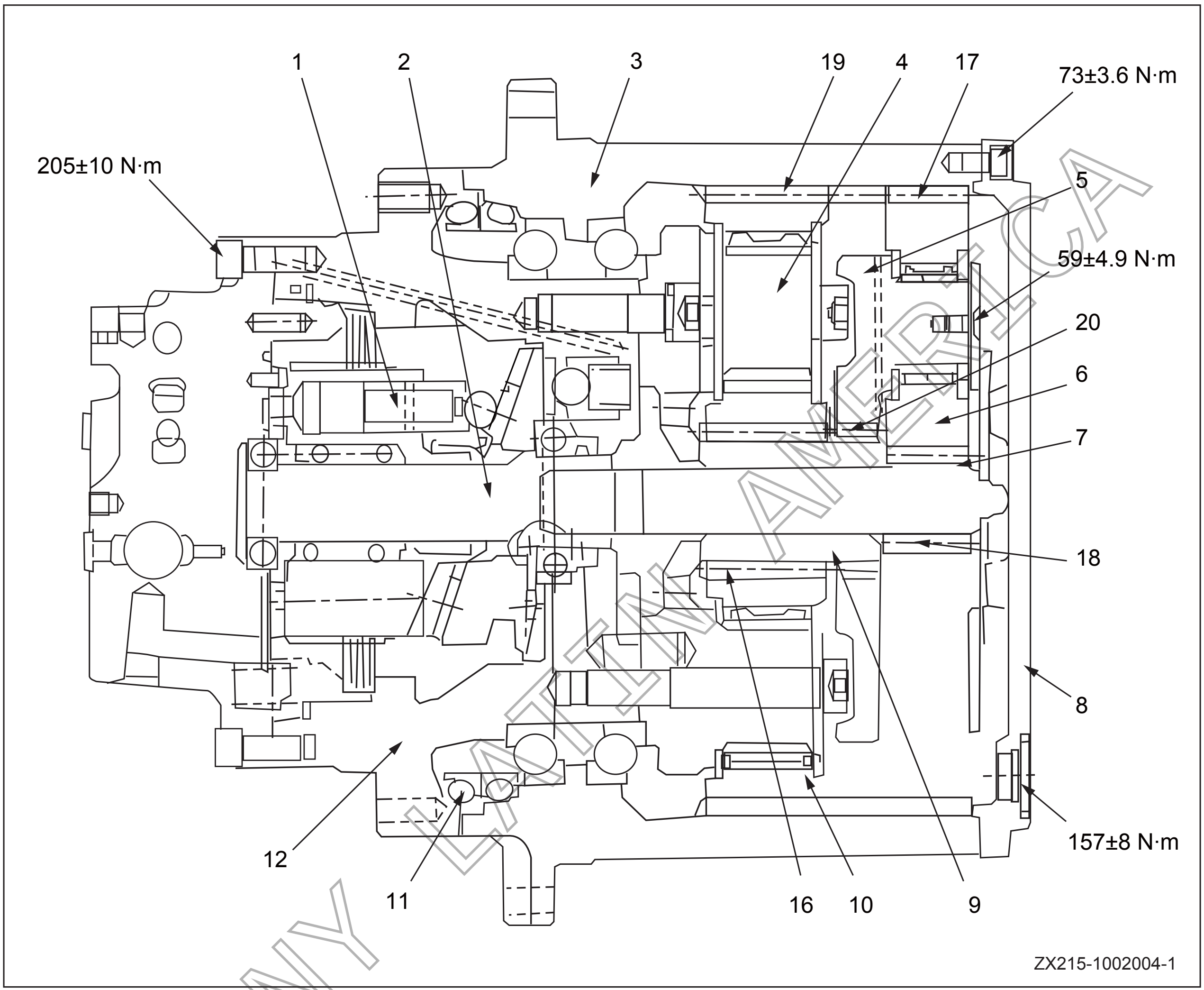


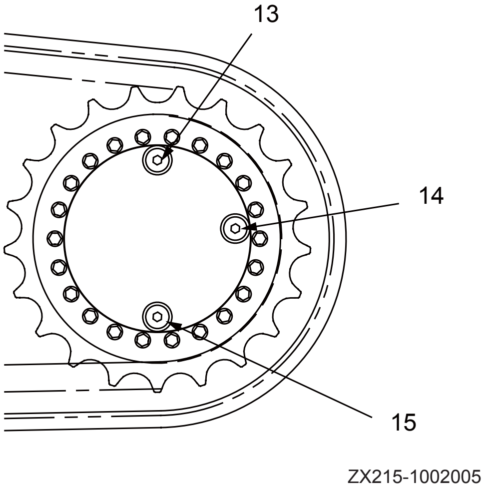
ZX215-1002003

1) Swing motor	6) Accumulator
2) Swing reducer	7) Control valve
3) Swing bearing	8) Final drive AS
4) Idler	9) Hydraulic pump
5) Central swivel joint	10) Engine

4.2.2 Final drive assembly

Final drive AS (KYB)





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

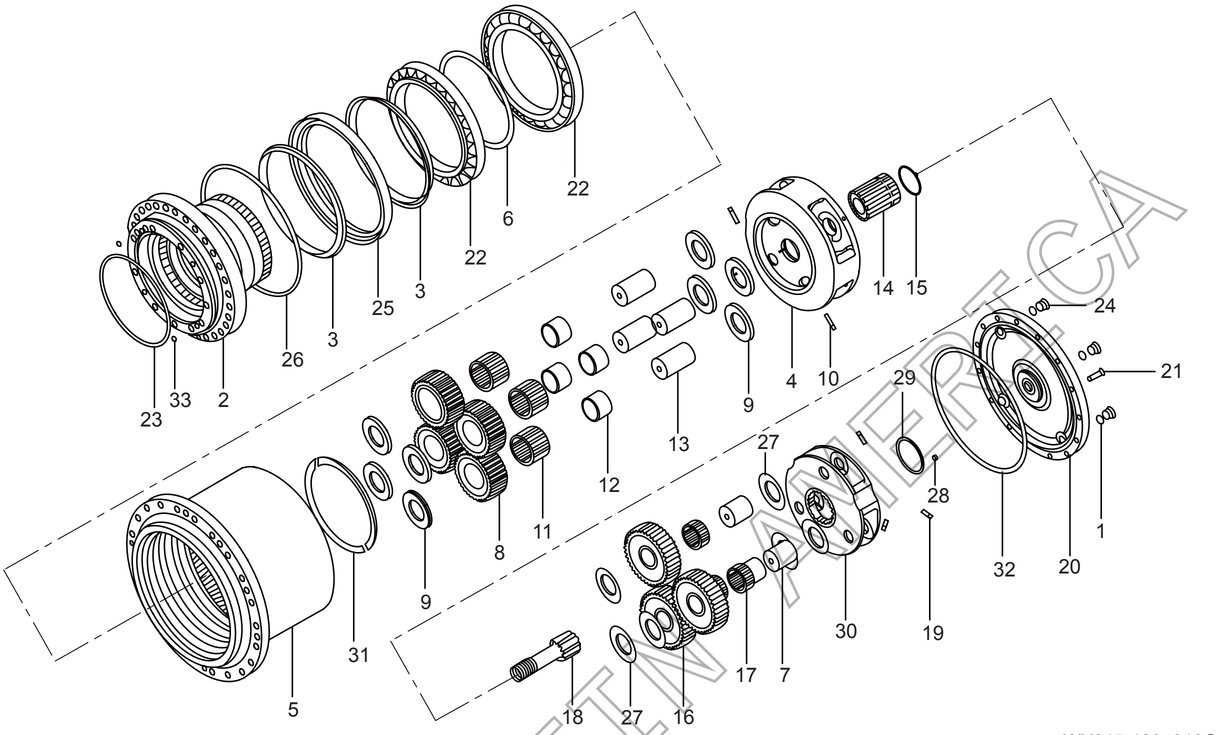
Specifications

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	

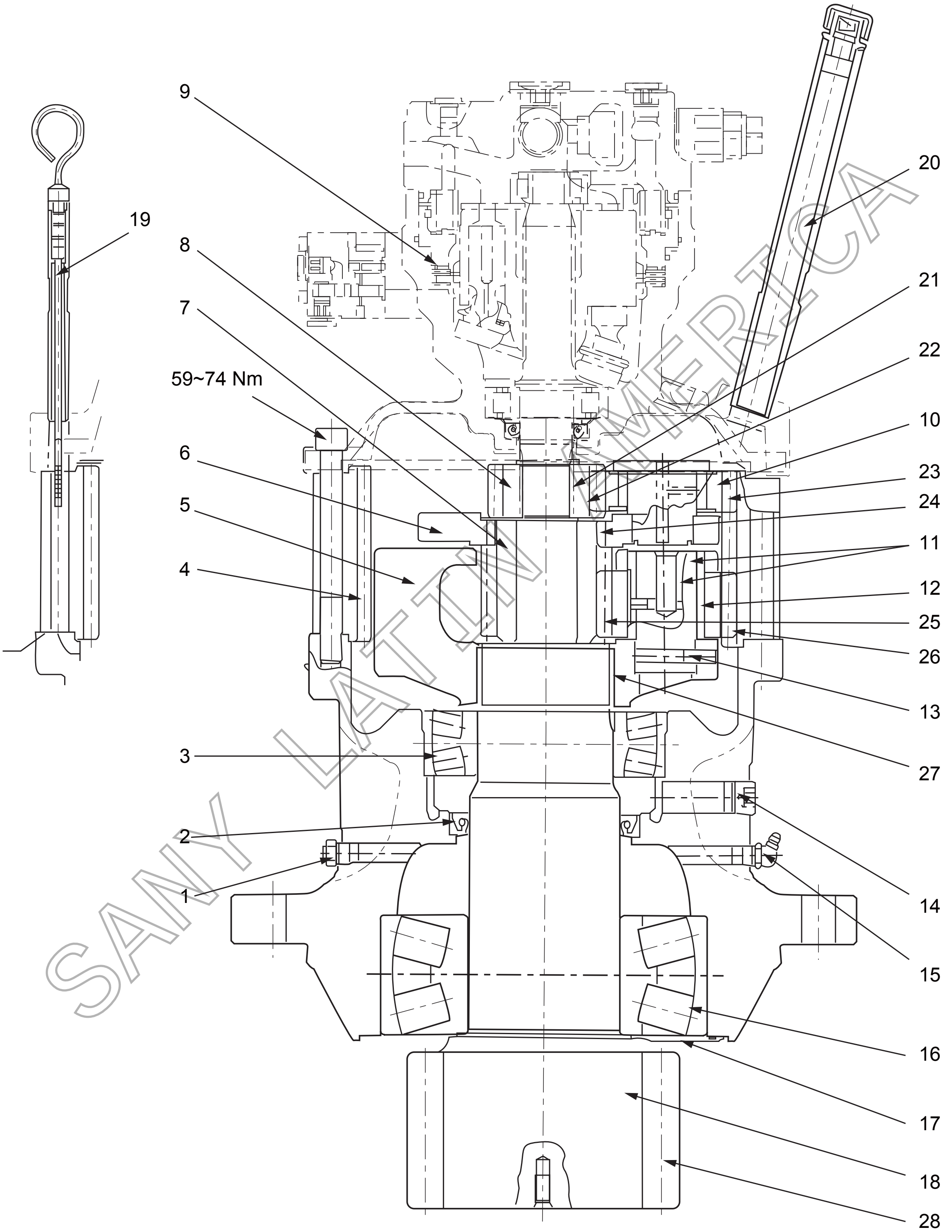
Final drive AS (Daewoo)



WX215-1204010G

1) O-ring
2) Mandrel
3) Float seal
4) Gear carrier
5) Hub
6) Spacer
7) Planetary gear shaft
8) Planetary gear
9) Thrust washer
10) Spring pin
11) Needle bearing
12) Floating bush
13) Planetary gear shaft
14) Sun gear
15) Snap ring
16) Planetary gear
17) Needle bearing
18) Drive gear
19) Spring pin
20) End cover
21) Socket head bolt
22) Radial thrust ball bearing
23) O-ring
24) Plug
25) Seal ring
26) O-ring
27) Thrust washer
28) Thrust washer
29) Thrust plate
30) Gear carrier
31) Gasket
32) O-ring
33) O-ring
34) Fill port
35) Level port
36) Drain port

4.2.3 Swing machinery



ZX215-1002007

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

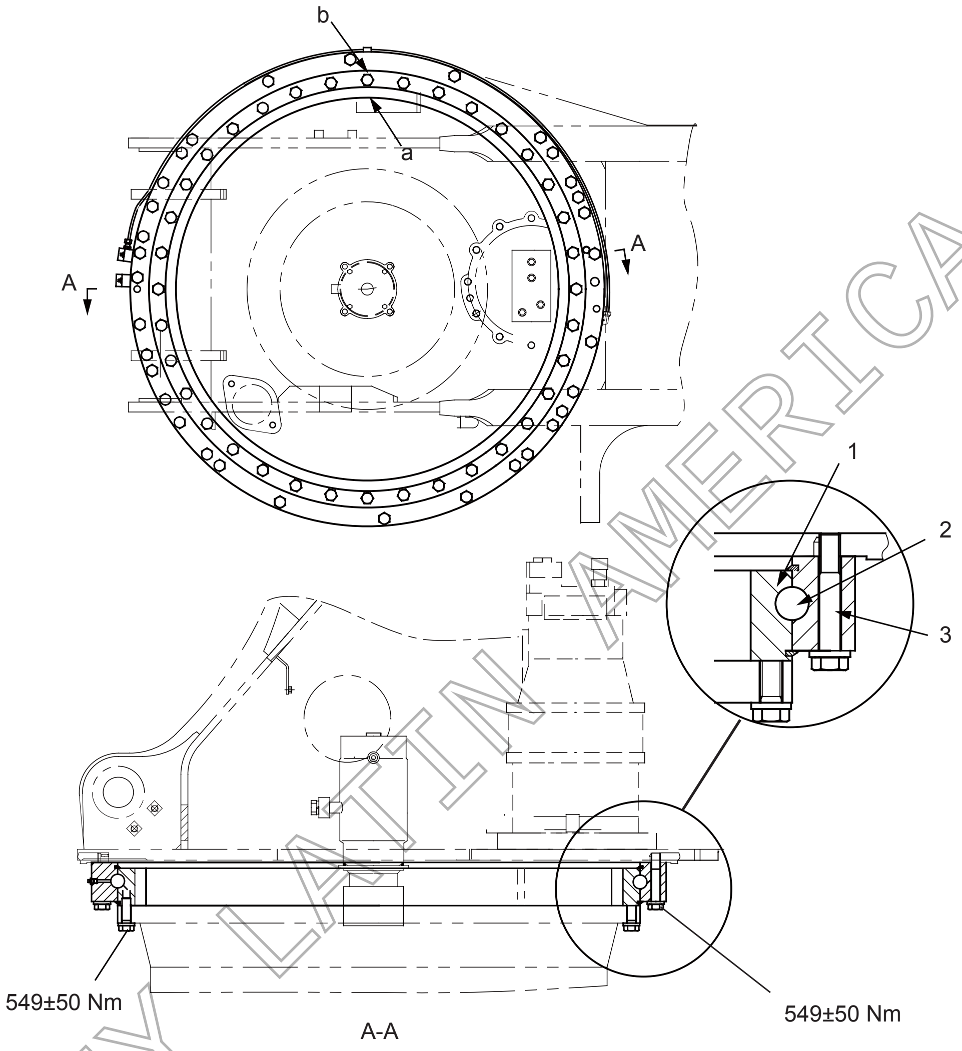
Reduction ratio:

(14+25) /14× (16+25) /14= 20.04

Unit: mm

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	

4.2.4 Swing bearing



ZX215-1002008

1) Swing bearing inner race (Teeth: 91)
2) Ball
3) Swing bearing outer race

Specifications

Reduction ratio: 91/13= 7

Amount of filled grease: 13±1 Kg

a. Inner race soft zone S position

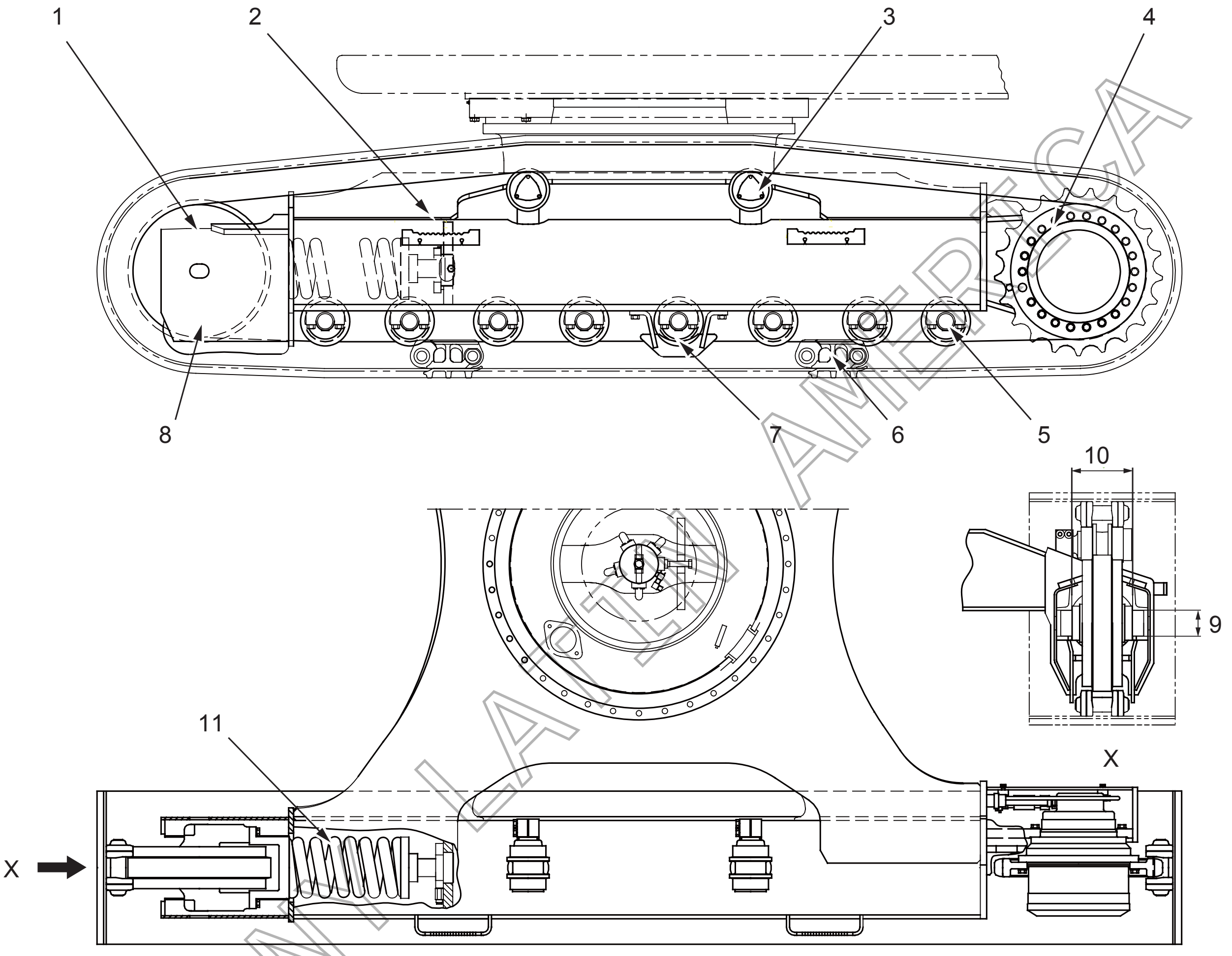
b. Outer race soft zone S position

Unit: mm

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

4.3 Undercarriage and Frame

4.3.1 Track frame and recoil spring



ZX215-1002009

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.

Model	Q'ty (One side)
SY195C9	7
SY205C9	7
SY215C9	8
SY225C9	9

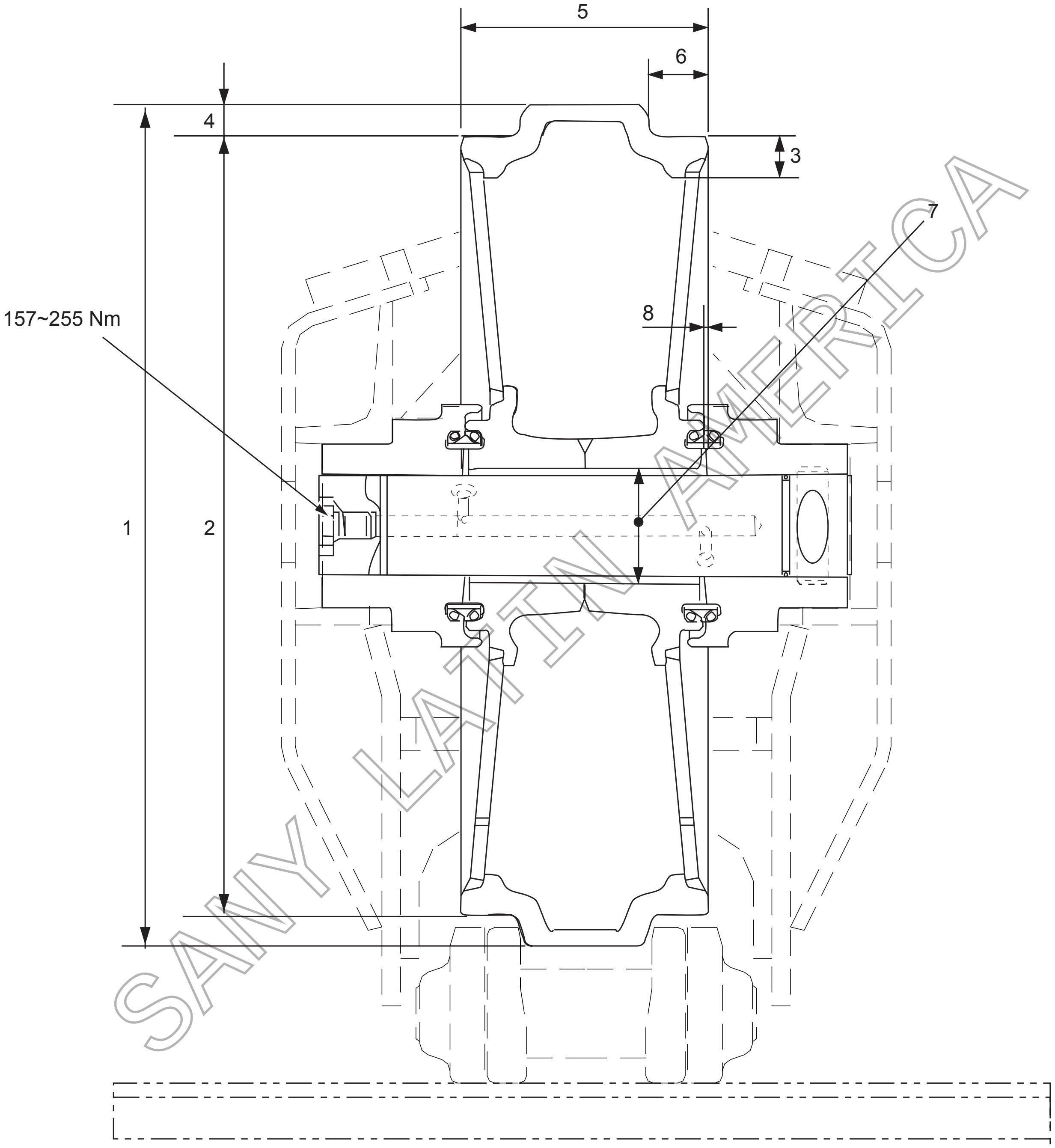
Standard track shoe

Model / Item	SY195C9	SY205C9	SY215C9	SY225C9
Shoe width(mm)	600	600	600	600
Link pitch(mm)	190	190	190	190
Q'ty (One side)	45	46	47	49

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">9</td><td rowspan="3">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>247</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>598 x 247</td><td>466</td><td>157.9 kN
{16112 kg}</td><td>545</td><td>133.9 kN</td></tr>
</table>

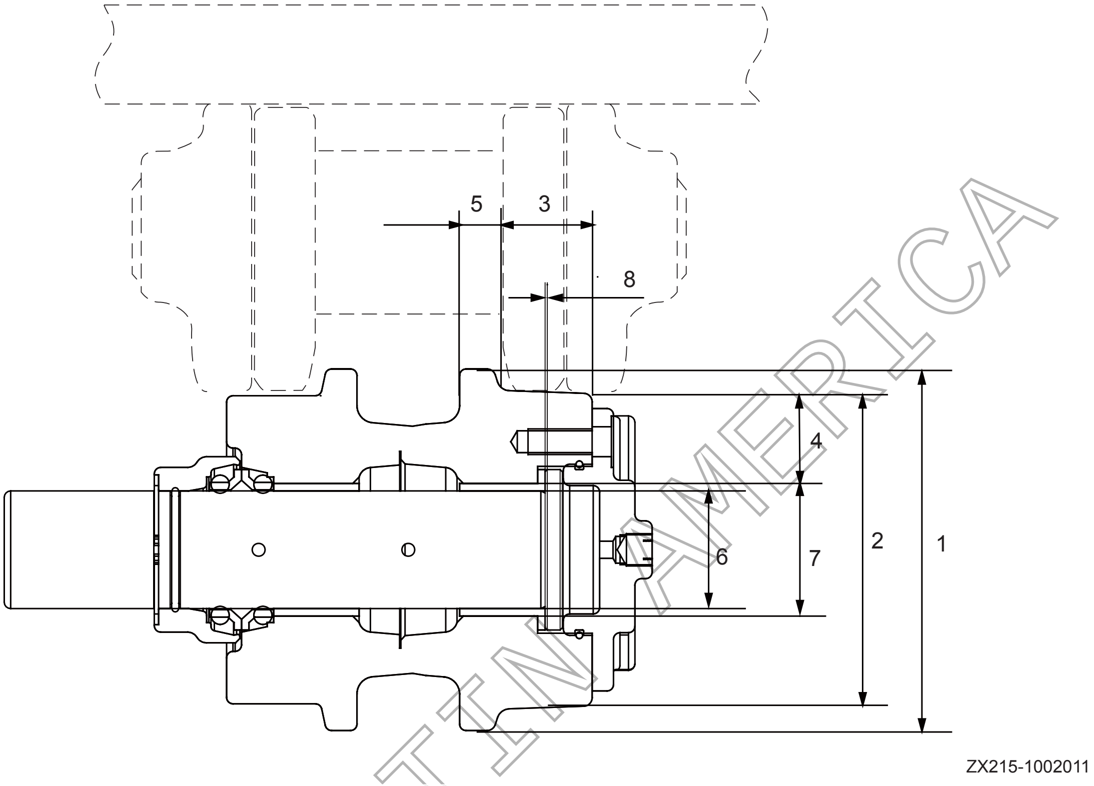
4.3.2 Idler



Unit: mm

No.	Check item	Criteria		Remedy
1	Outside diameter of protrusion	Standard size	Repair limit	Build-up welding or replace
		560	—	
2	Outside diameter of tread	520	508	
3	Thickness of tread	30	24	
4	Difference of tread	20	26	
5	Total width	164	—	
6	Width of tread	39.5	—	
7	Diameter of shaft	65	—	Replace
8	Clearance between bushing and support (Sum of clearance at both sides)	Standard clearance	Clearance limit	
		0.5~1.0	—	

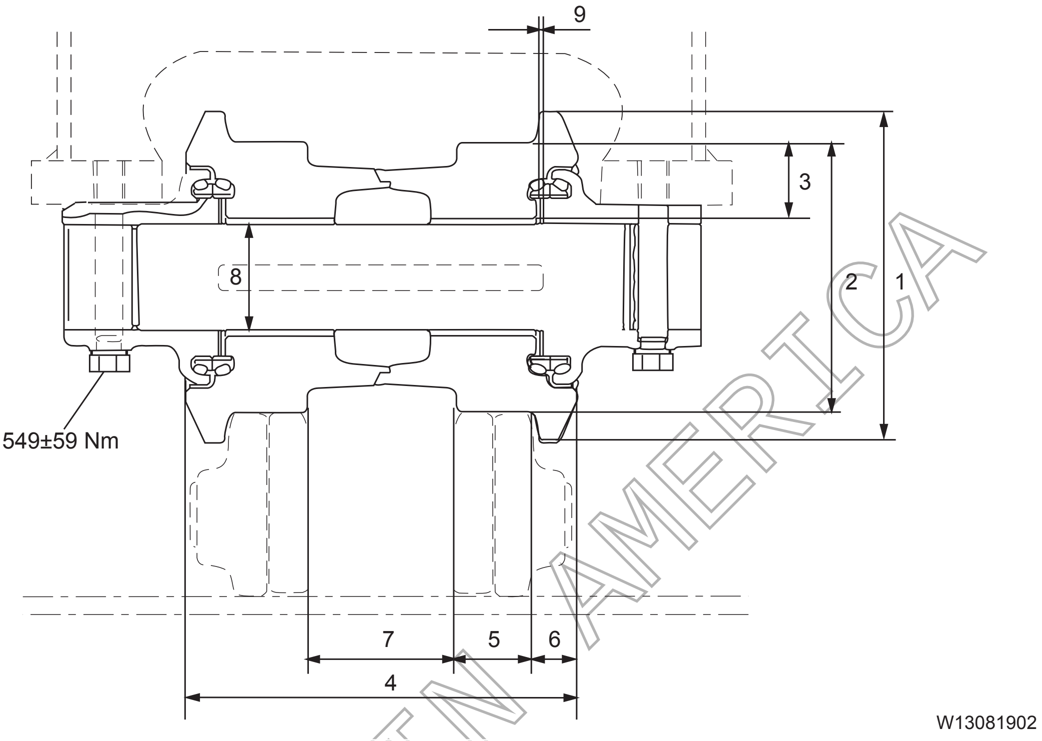
4.3.3 Carrier roller



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 flange</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="16">Replace</td></tr>
<tr><td colspan="2">165</td><td colspan="3">—</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">140</td><td colspan="3">130</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">44</td><td colspan="3">—</td></tr>
<tr><td>4</td><td>Thickness of tread</td><td colspan="2">41.5</td><td colspan="3">34</td></tr>
<tr><td>5</td><td>Width of flange</td><td colspan="2">18</td><td colspan="3">—</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">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></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>50</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Interference between roller 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>57</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Axial clearance of roller</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td></tr>
<tr><td colspan="3">0.44 – 0.76</td><td colspan="2">—</td></tr>
</table>

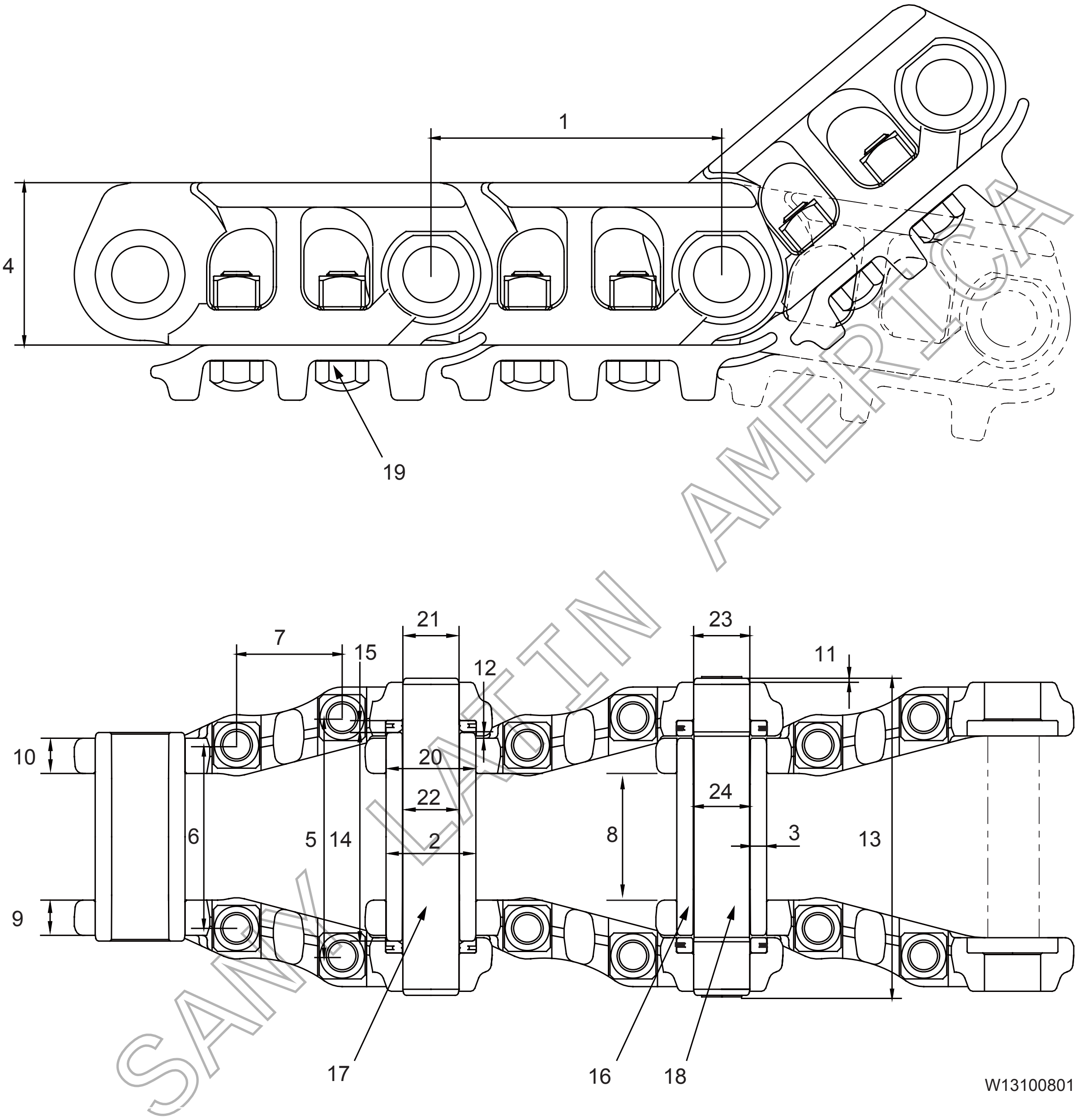
4.3.4 Track roller



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	Diameter of shaft	65	—	Replace
9	Clearance between bushing and collar	Standard clearance	Clearance limit	
		0.5 – 1.0	—	

4.3.5 Track shoe



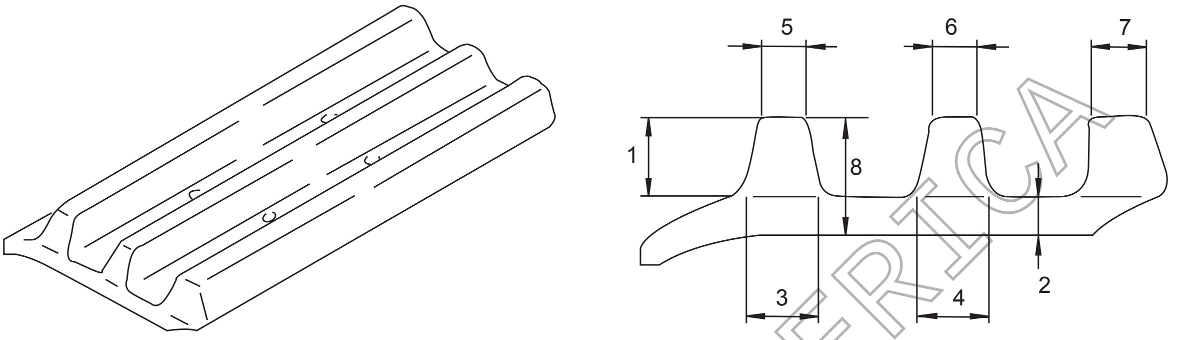
Unit: mm

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	
			59.45	53.7	
3	Thickness of bushing metal		10.75	5.75	Repair or replace
4	Link height		Standard size	Repair limit	
			105	98	
5	Shoe bolt pitch		155.57		Adjust or replace
6			119.57		
7			69		
8	Link	Inside width	82.57		
9		Overall width	40		
10		Tread width	38		
11	Protrusion of pin	Regular	2.7		
		Master	2.7		
12	Protrusion of bushing	Regular	3.7		
		Master	0.0		
13	Overall length of pin	Regular	207		
		Master	209		
14	Overall length of bushing	Regular	136		
		Master	128.5		
15	Thickness of spacer		—		
16	Press-fitting force	Bushing	88.2 – 245 kN {9 – 25 ton}		—
17		Regular pin	127.4 – 274.4 kN {13 – 28 ton}		
18		Master pin	78.4 – 147 kN {8 – 15 ton}		

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">19</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 rowspan="3">20</td><td colspan="2" rowspan="3">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="13">Adjust or replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>59.45</td><td>0
-0.05</td><td>-0.25
-0.32</td><td>0.20 – 0.32</td></tr>
<tr><td>21</td><td colspan="2">Interference between regular pin and link</td><td>38.25</td><td>0
-0.04</td><td>–0.23
–0.29</td><td>0.19 – 0.29</td></tr>
<tr><td rowspan="3">22</td><td colspan="2" rowspan="3">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>38.25</td><td>0
-0.04</td><td>0.8
0.5</td><td>0.50 – 0.84</td></tr>
<tr><td rowspan="3">23</td><td colspan="2" rowspan="3">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>38.25</td><td>-0.08
-0.11</td><td>-0.23
-0.29</td><td>0.12 – 0.21</td></tr>
<tr><td rowspan="3">24</td><td colspan="2" rowspan="3">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>38.25</td><td>-0.5
-0.7</td><td>1
0.5</td><td>1 – 1.7</td></tr>
</table>

4.3.6 Triple grouser shoe

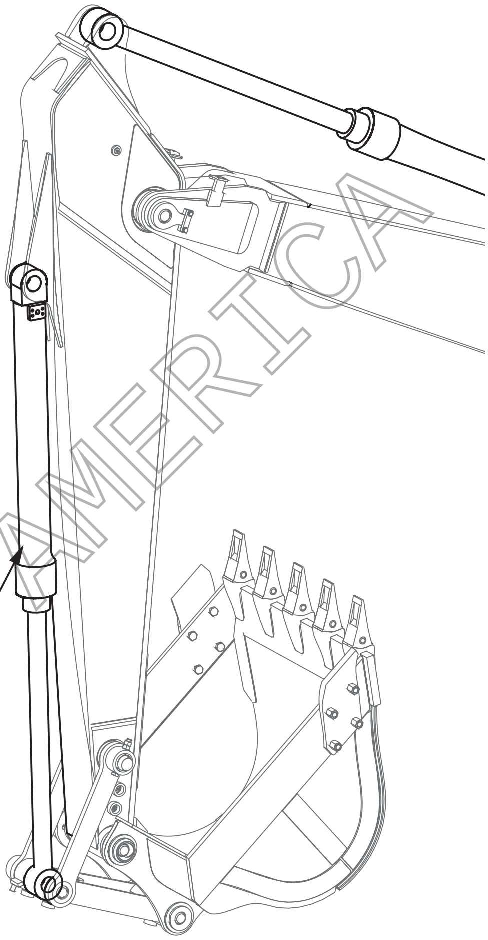


Unit: mm

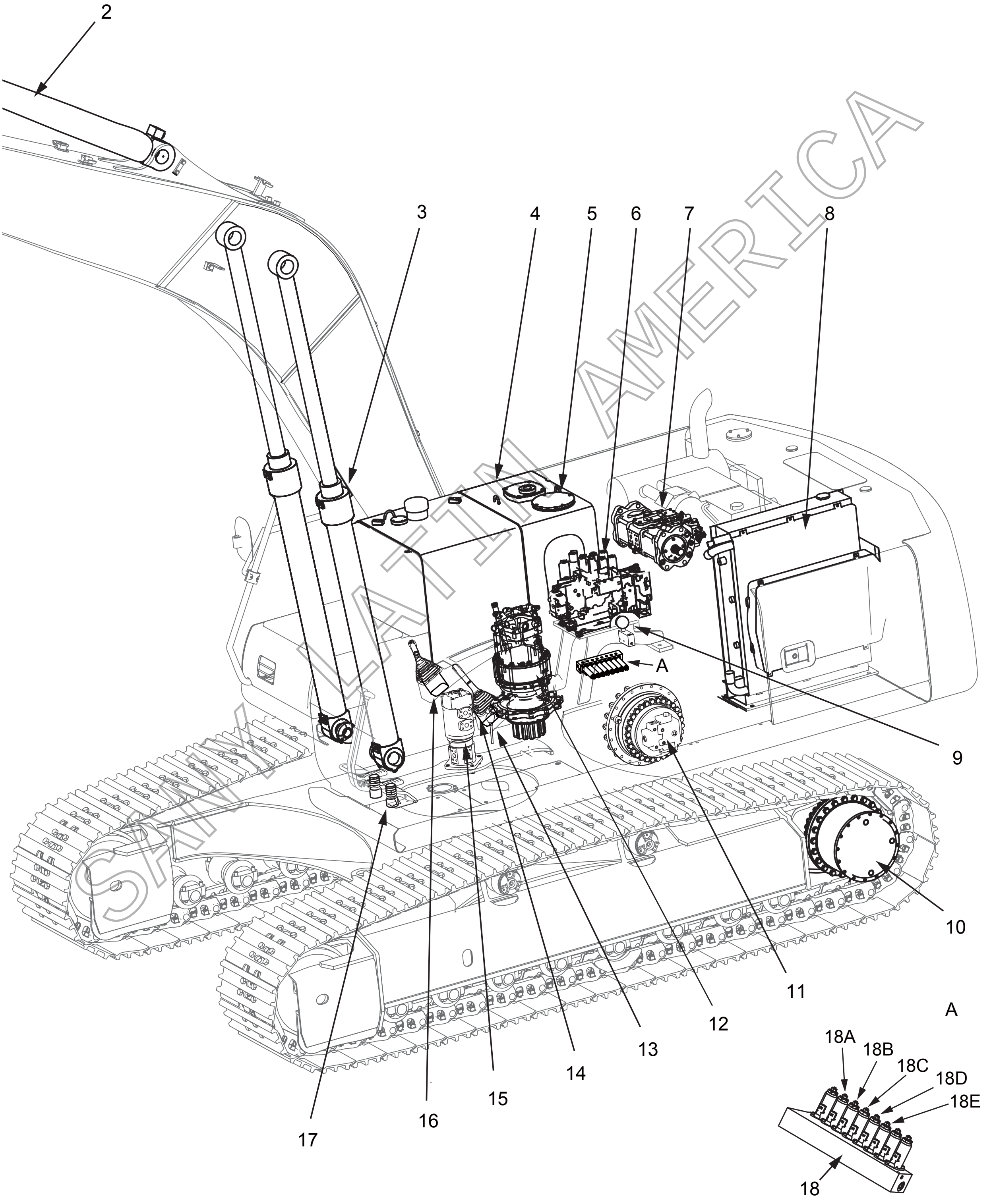
No.	Check item	Criteria		Remedy
1	Height	Standard size	Repair limit	Build-up welding or replace
		26	16	
2	Thickness	10		
3	Length of base	29.5		
4		22		
5	Length at tip	20.5		
6		17		
7		18		
8	Thickness	Standard size	Repair limit	
		36	26	

4.4 Hydraulic System, Part 1

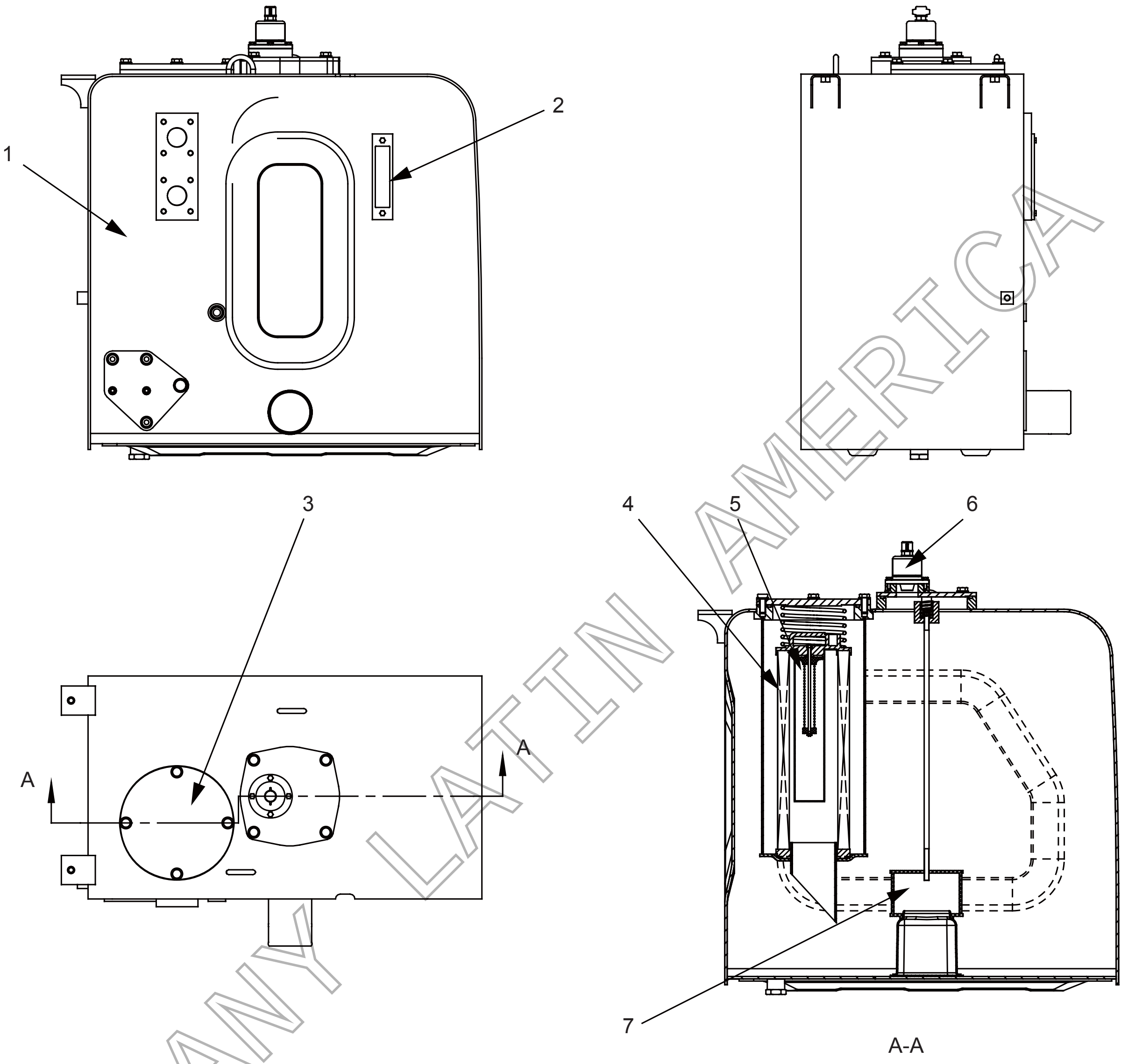
4.4.1 Hydraulic equipment layout



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


2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
A
A
18A
18B
18C
18D
18E
18
W13081903

4.4.2 Hydraulic tank and filter



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 (63 US gal)
Available capacity: 172 L (45.5 US gal)

Breather valve

Filter fineness: 10μm

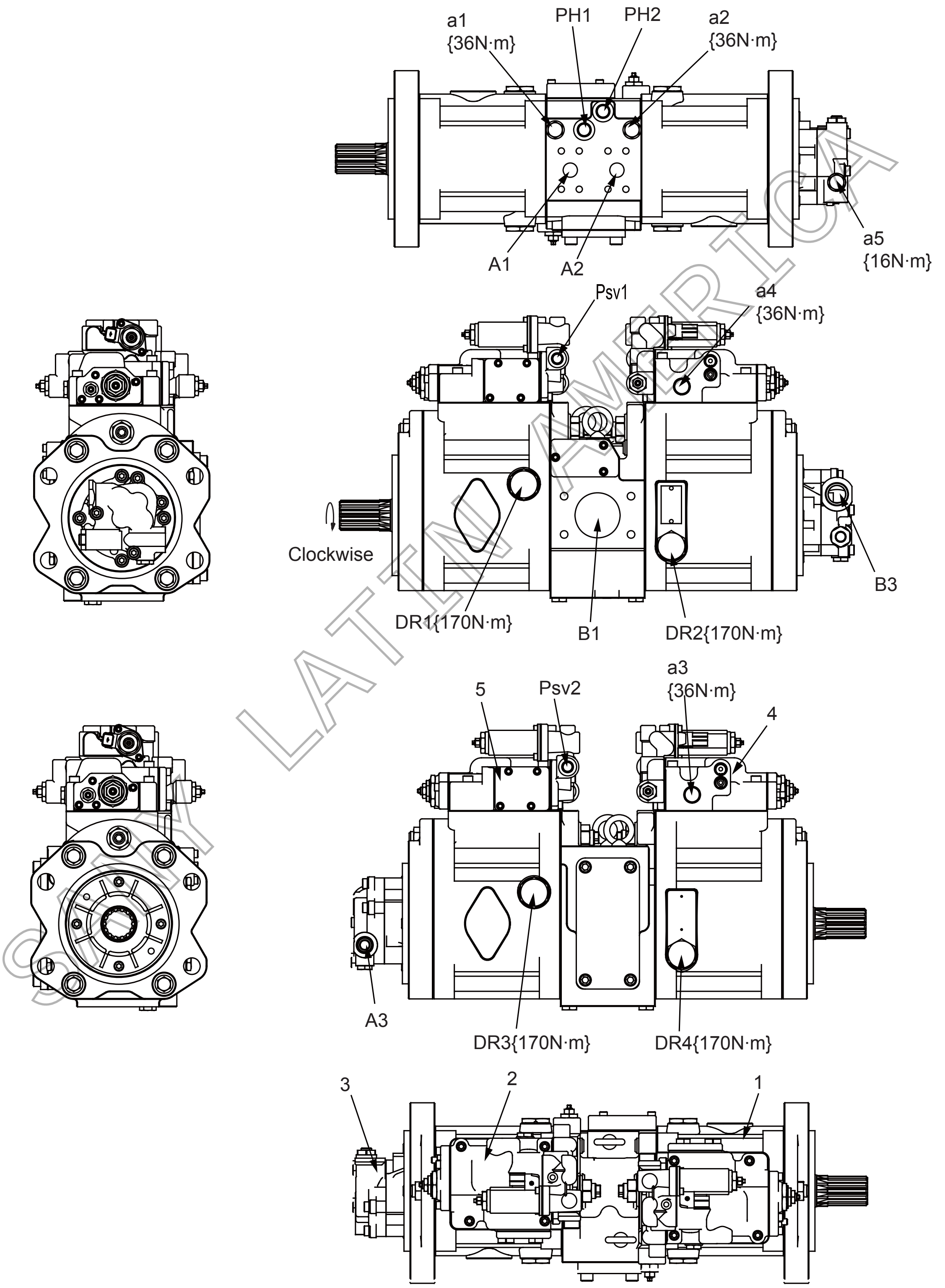
Ambient temperature: -20~100°C

Set pressure:

Air inlet side: 0.005MPa
Air outlet side: 0.05MPa

4.4.3 Hydraulic pump

Type: K3V112DTP1N9R



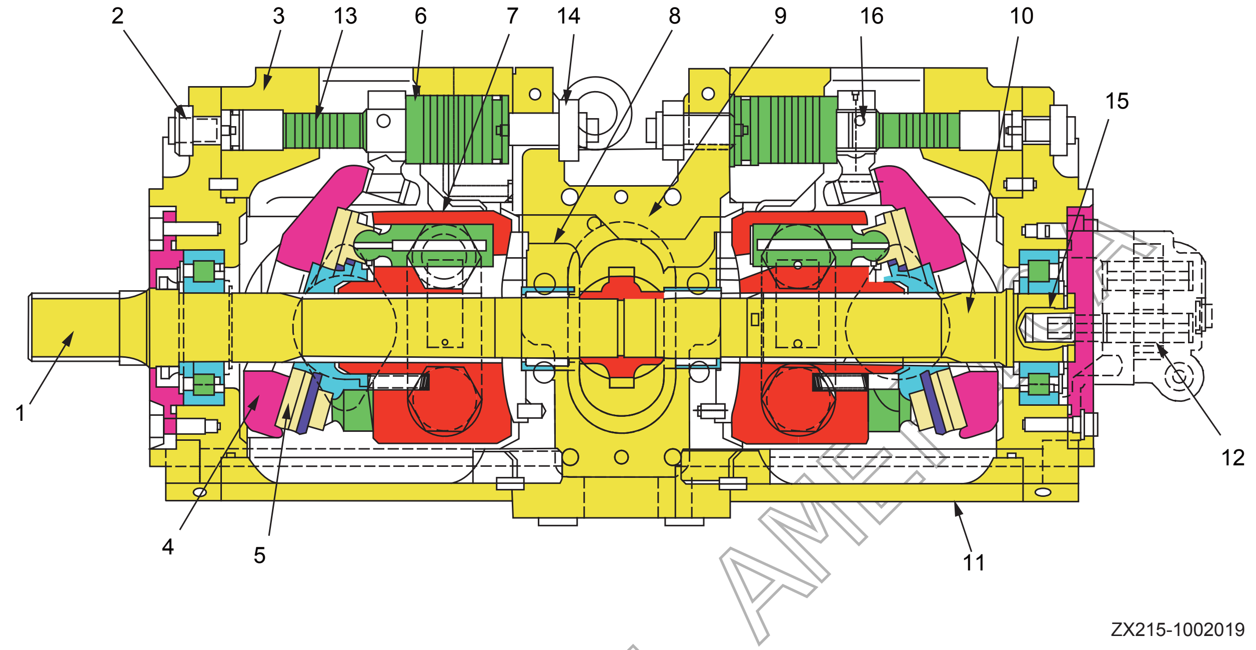
Outline

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

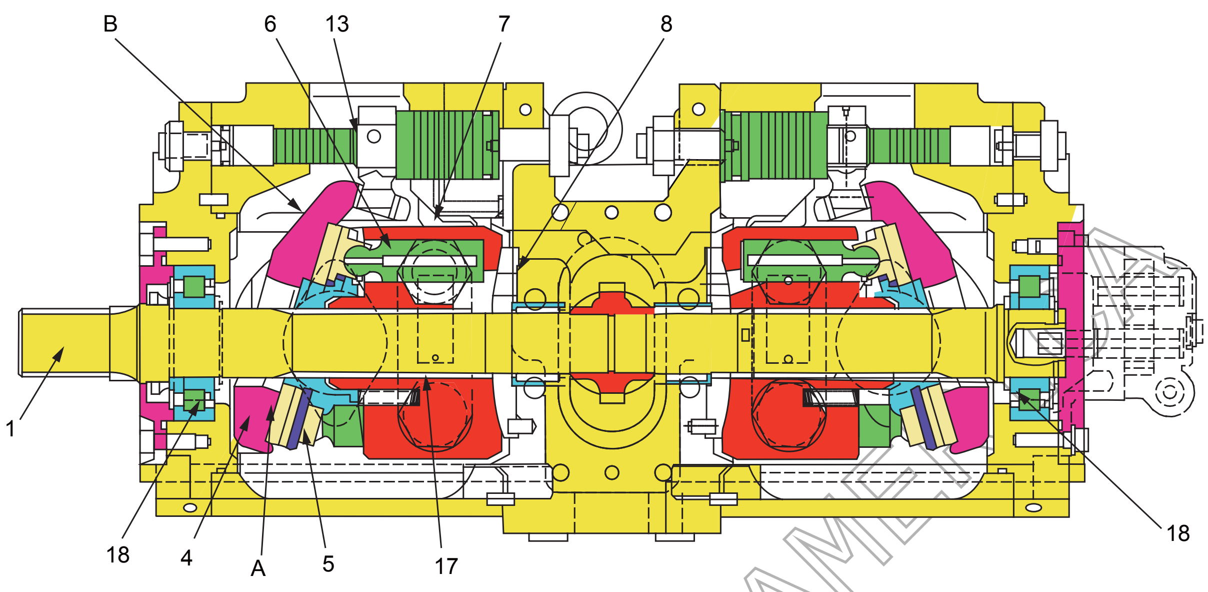
NOTE: For the location of the hydraulic pump on the machine, see “Hydraulic equipment layout” on page 4-24.

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



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



ZX215-1002020

Function

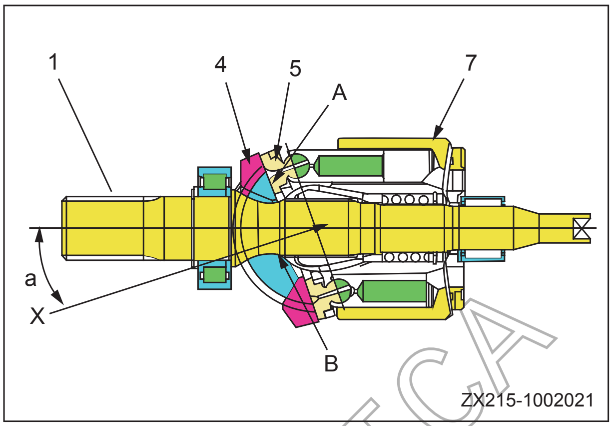
- The torque of the engine is transmitted to the pump shaft (1), and drives cylinder block (7) to rotate. At the same time, nine plungers (6) slide along the thrust plate (8). Plunger (6) moves back and forth inside cylinder block (7) and pressurized oil is sucked and discharged alternatively.
- It is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

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).

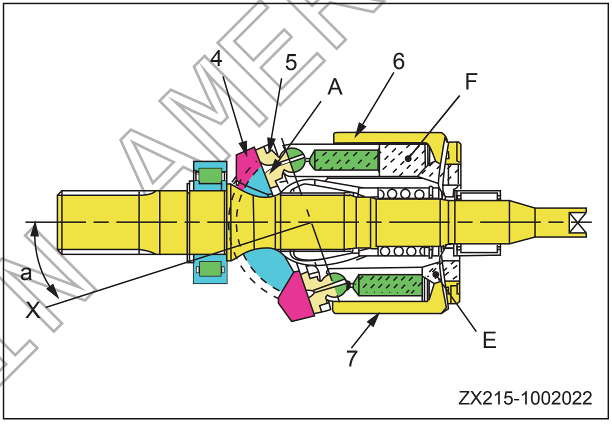
Operation of pump

- 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.



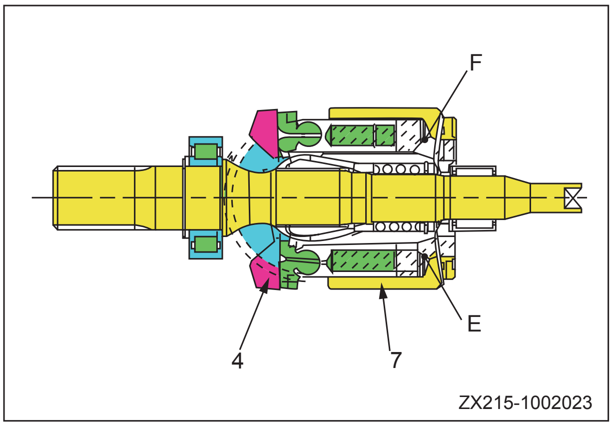
ZX215-1002021

- 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.



ZX215-1002022

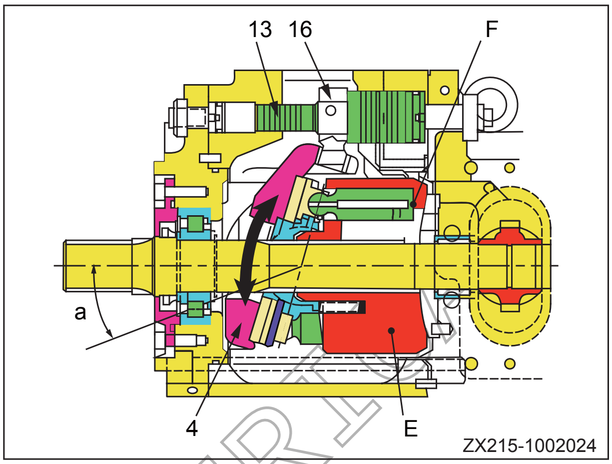
- As central line (X) of swash plate (4) overlaps the axial direction of cylinder block (7) (swash plate angle (a) = 0), the difference between volumes (E) and (F) inside cylinder block (7)becomes 0.
- Suction and discharging of pressurized oil is not carried out in this state. Namely pumping action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



ZX215-1002023

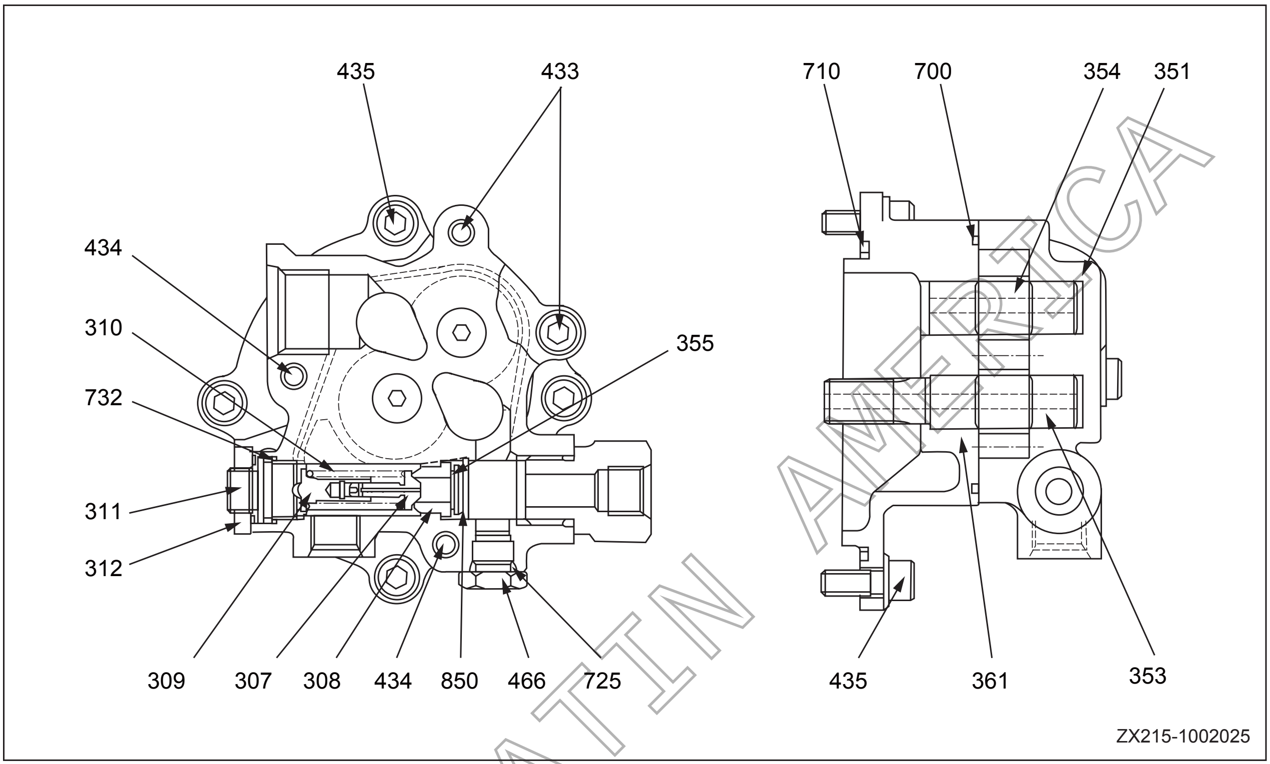
Control of delivery

- 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.



4.4.4 Pilot pump

NOTE: For the location of the pilot pump on the machine, see “Hydraulic equipment layout” on page 4-24.



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

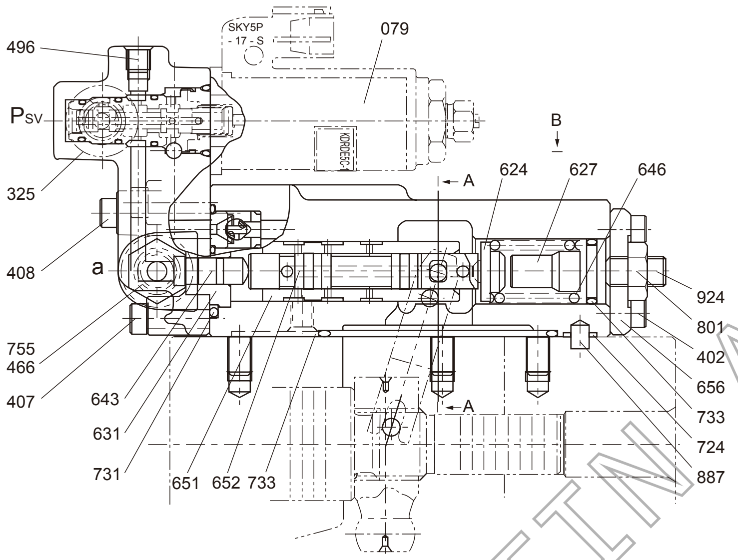
Function

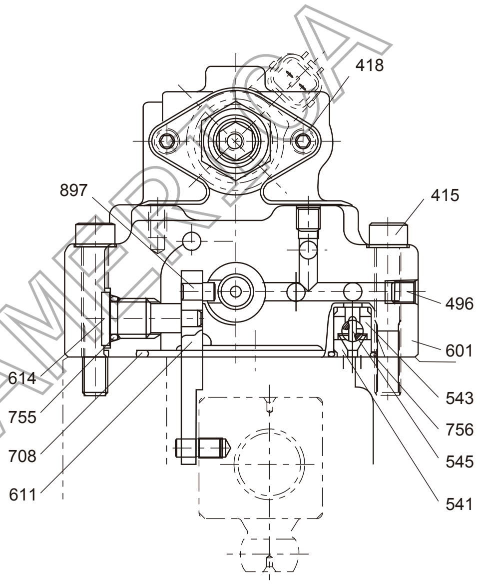
- The engine actuates the main pump and the drive shaft of the pilot pump through the transmission case, and drives the pilot pump through gear engagement.

4.4.5 Regulator

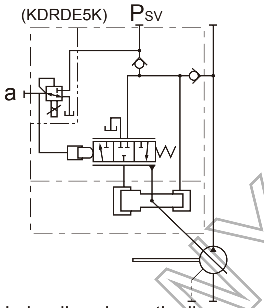
(KR3G-0E11-AV)

NOTE: Both the front pump and the rear pump are equipped with a regulator. For the location of the hydraulic pump, see “Hydraulic equipment layout” on page 4-24.





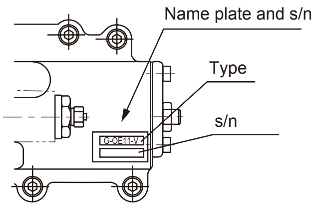
A-A



Hydraulic schematic diagram

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



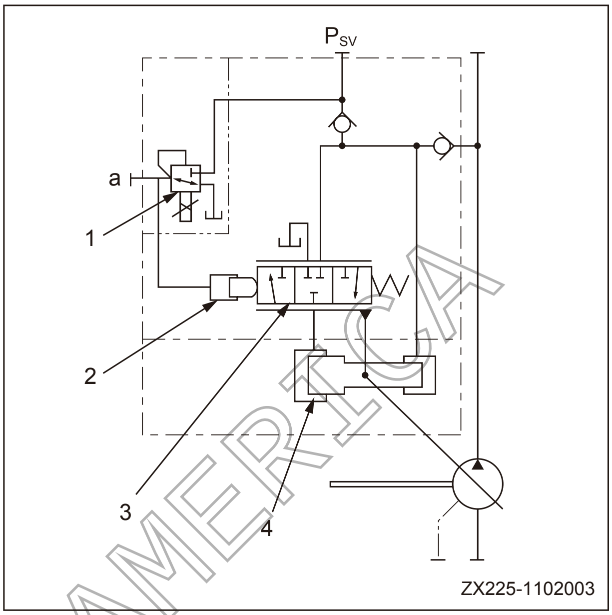
Direction B

ZX225-1102002

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 roller	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

Function



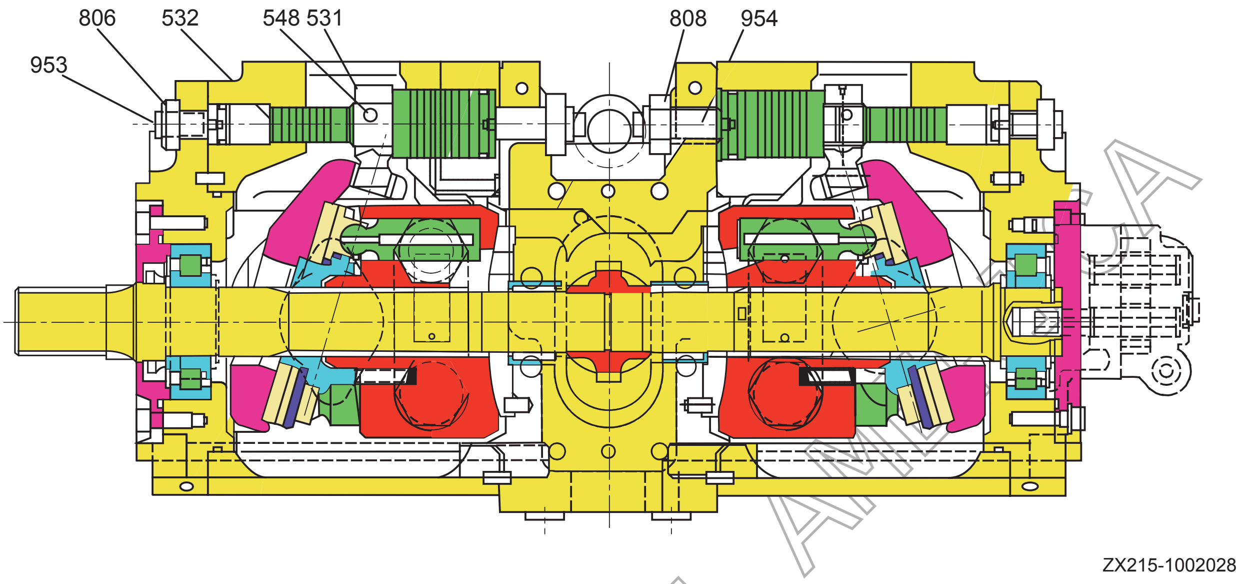
- The regulator controls the pump discharge amount according to the command signal pressure, keeping the driving power of the pump lower than the engine output.
- Pumps 1 and 2 are both equipped with a regulator. Key components of the regulator include a solenoid proportional pressure reducing valve (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.

4.4.5.2 Adjustment of the regulator



531: Inclination pin

532: Servo piston

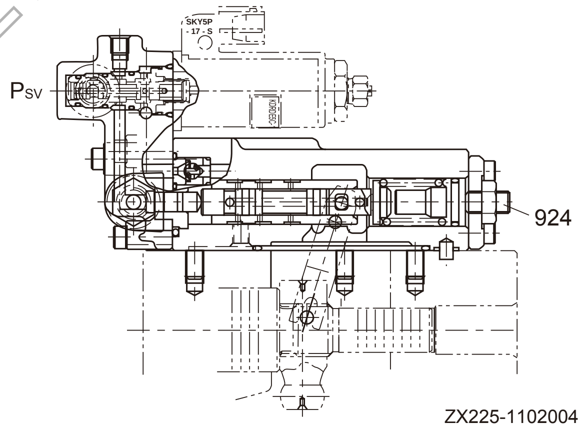
548: Feedback pin

806: Retaining nut

808: Retaining nut

953: Adjusting screw

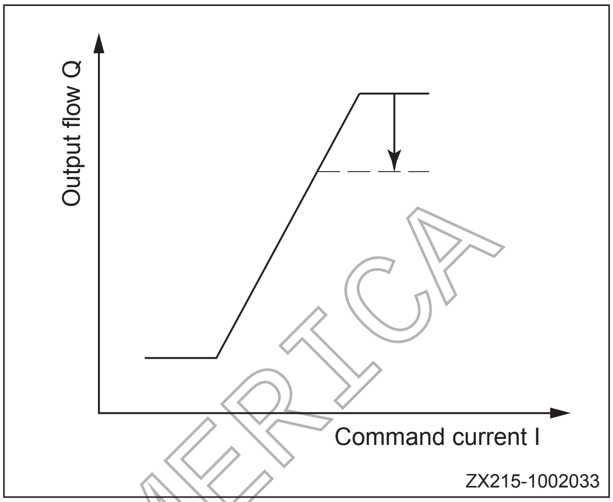
954: Adjusting screw



- 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.

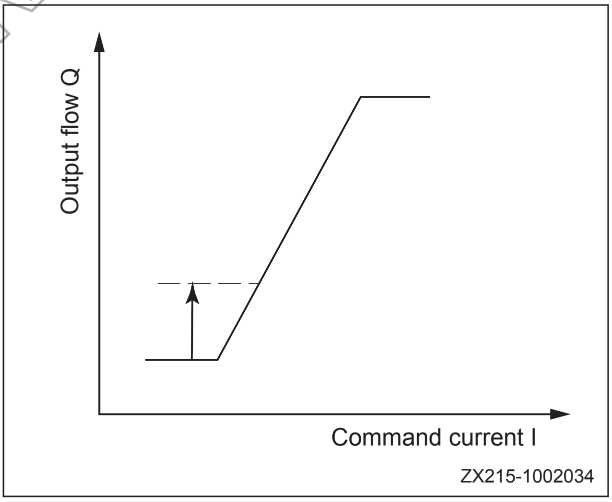
Maximum flow adjustment (pump block side)

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



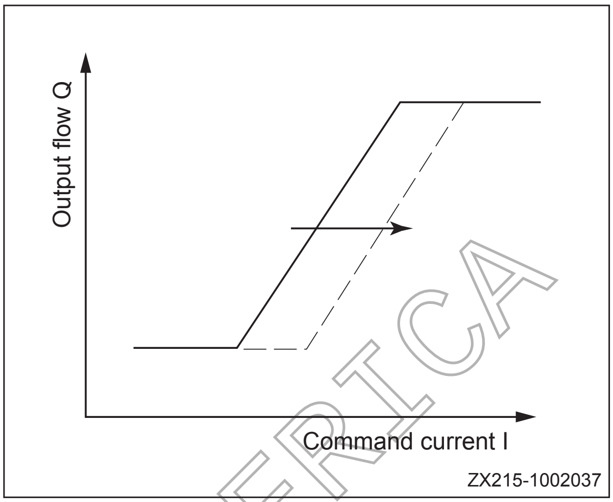
Minimum flow adjustment (pump block side)

- 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

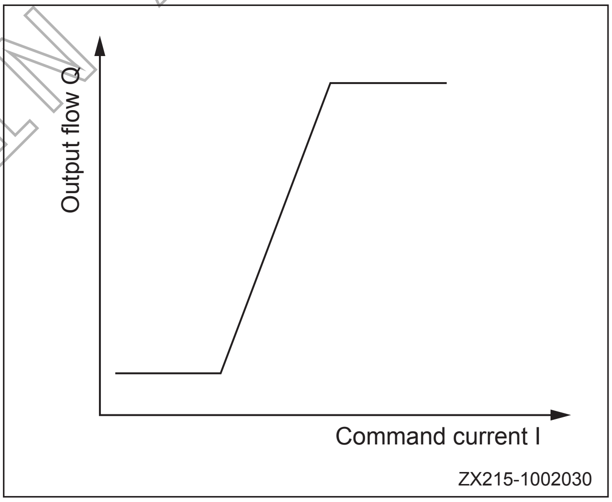
- After hexagon nut (810) is loosened, tighten (or loosen) the hexagon socket head locating screw (924) to carry out adjustment. When the hexagon socket head locating screw (924) is being tightened, the control diagram (as shown) will move to the right.



4.4.5.3 Operation

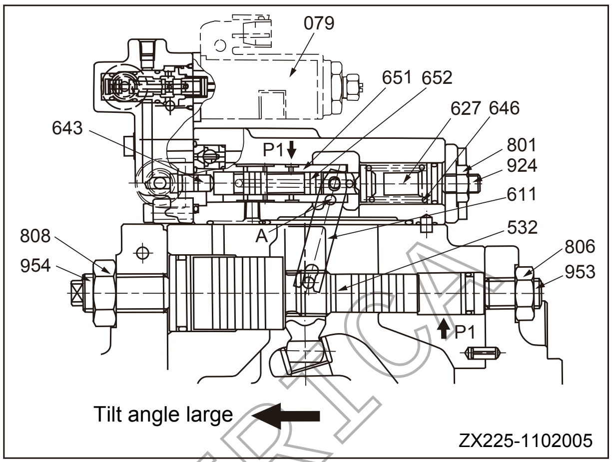
Flow control

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

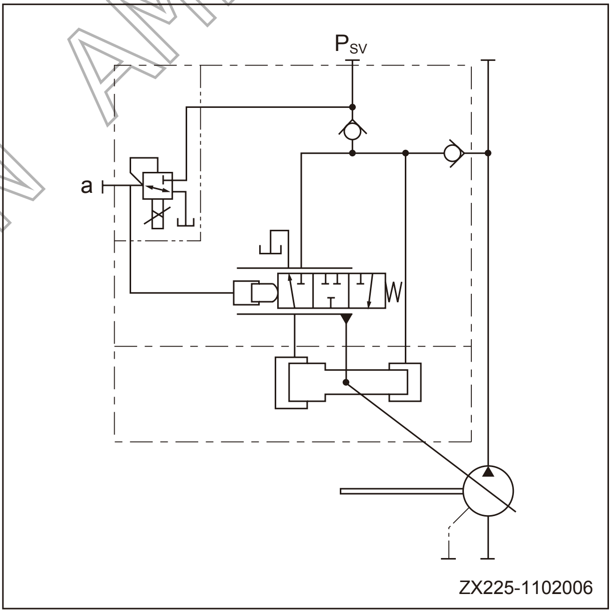


Action of increasing flow rate

- 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.



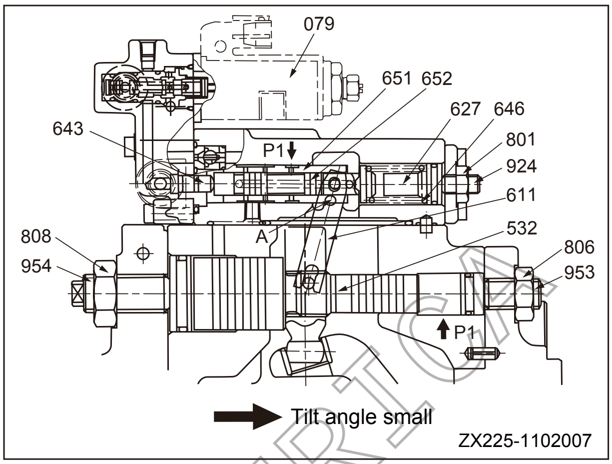
ZX225-1102005



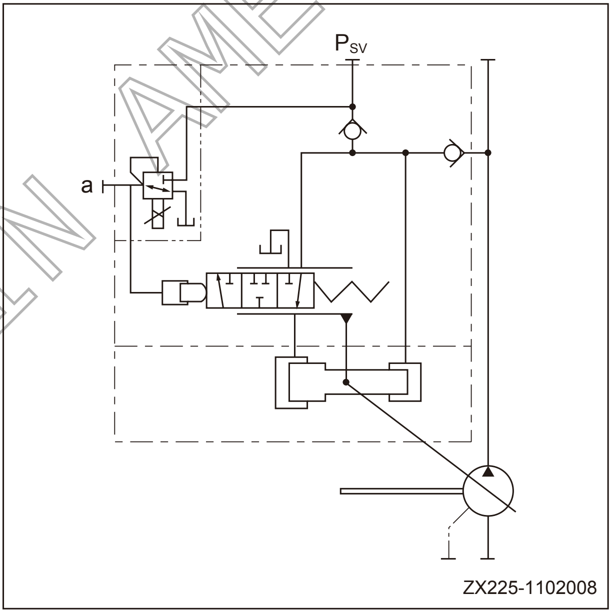
ZX225-1102006

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.



ZX225-1102007



ZX225-1102008

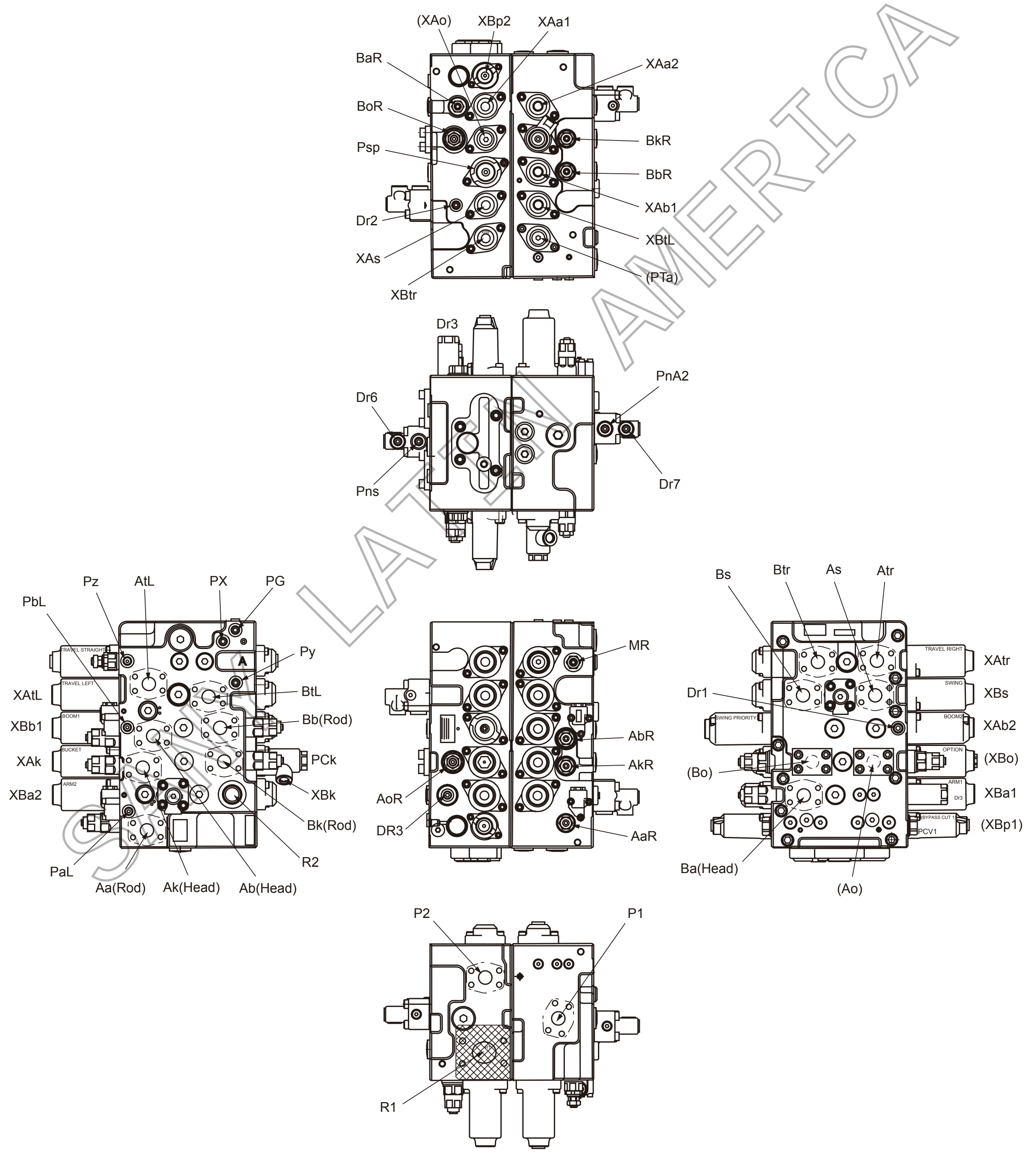
Adjustment value of the regulator

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)	-5.9
Adjustment of min. flow	Adjusting screw (953) screw-in (rotation)	+1/4
	Flow rate change (L/min)	+4.7

4.5 Hydraulic System, Part 2

4.5.1 Control valve

NOTE: For the location of the control valve on the machine, see “Hydraulic equipment layout” on page 4-24.

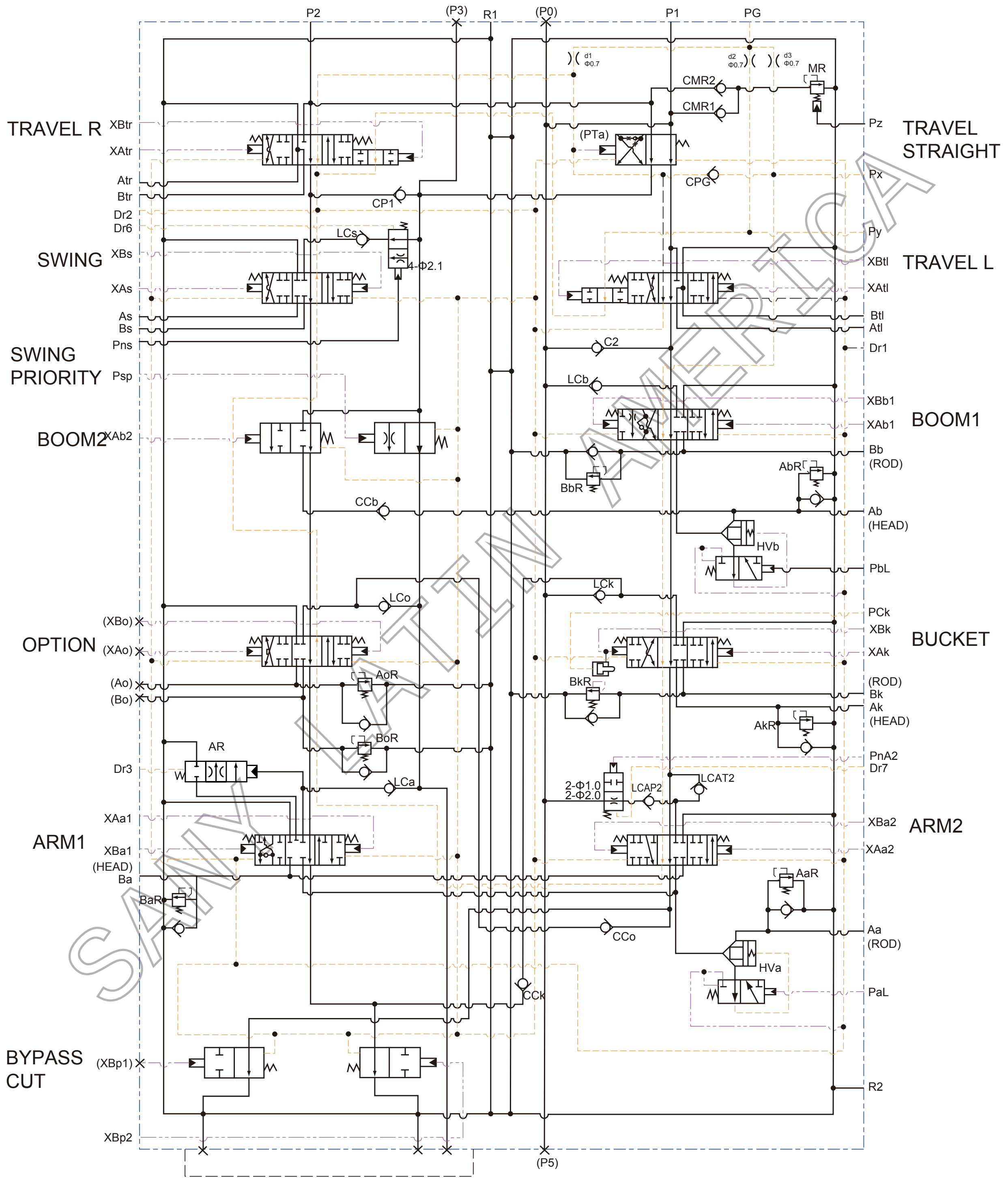


ZX225-1102009

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
XBa: 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 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

NOTE: For more technical information about the control valve, see “Control valve” on page 3-6.

Hydraulic circuit diagram (with bucket confluence function)



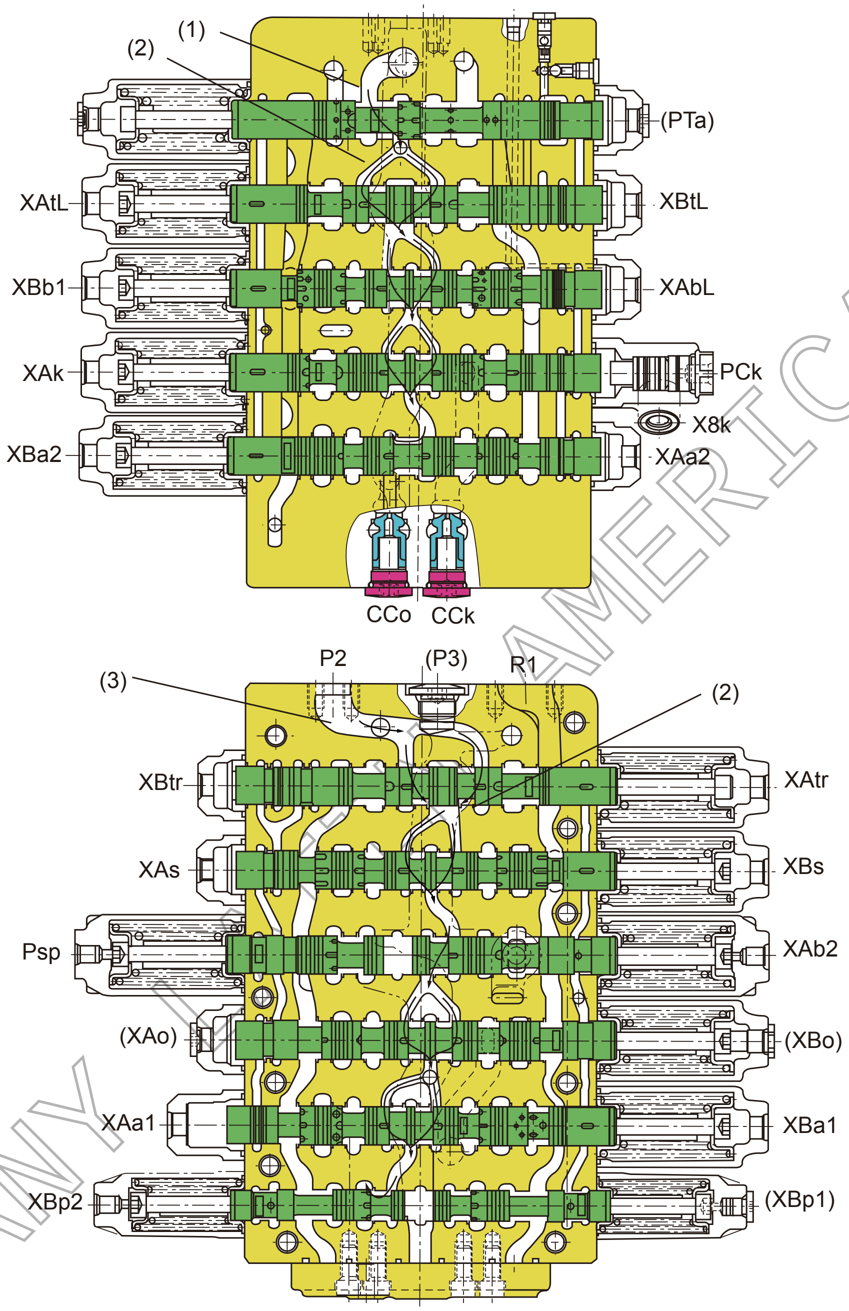
ZX225-1102010

4.5.2 Operating principle

4.5.2.1 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).



ZX225-1102011

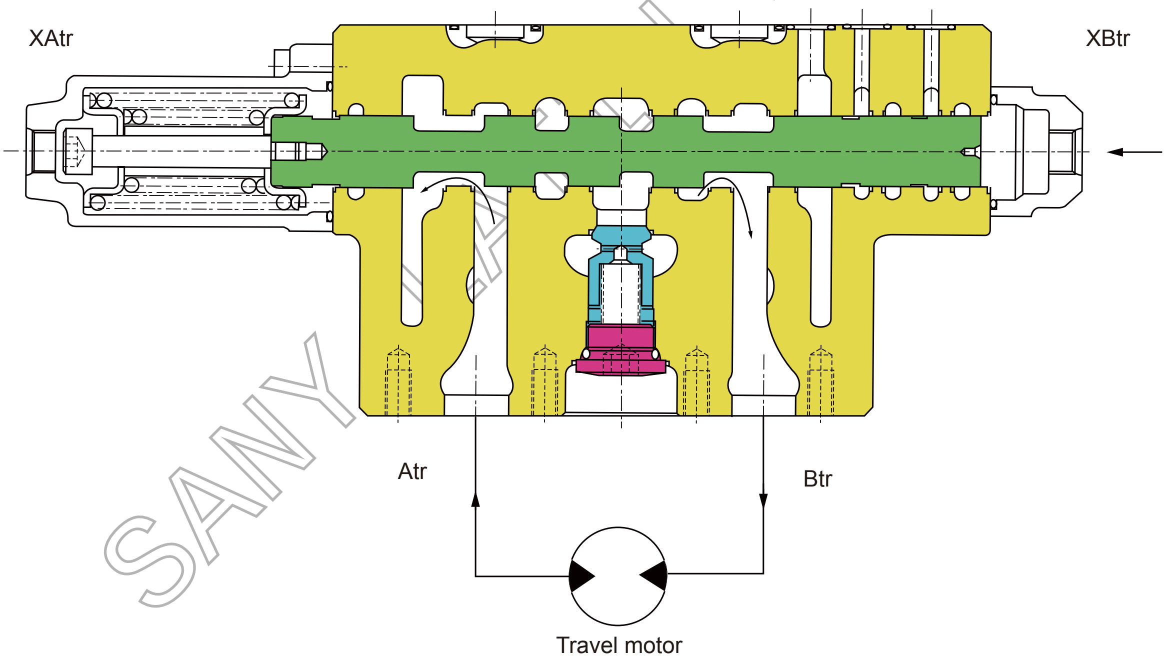
4.5.2.2 Travel

[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).



ZX225-1102012

4.5.2.3 Arm

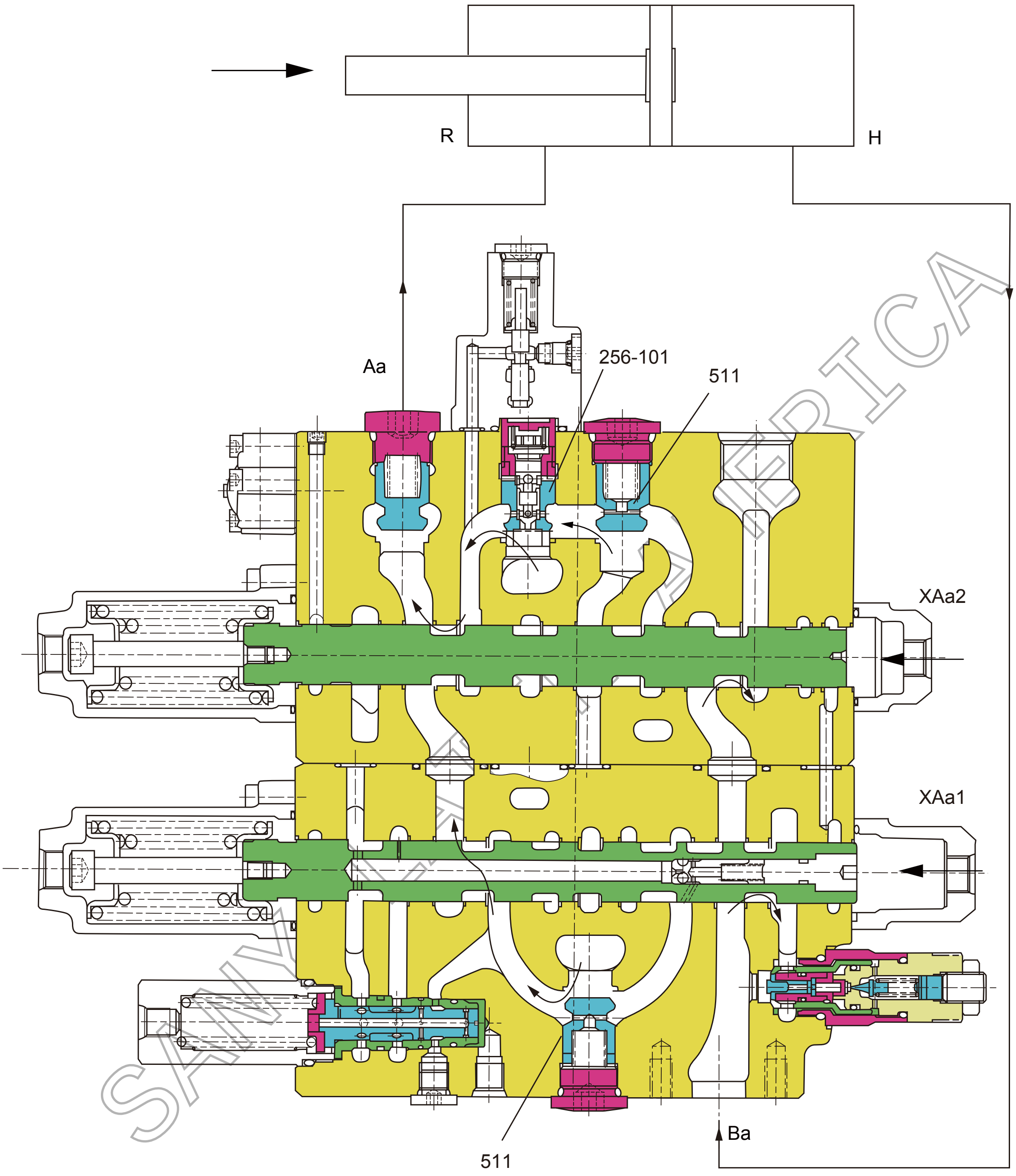
(1) Arm OUT

[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).



ZX225-1102013

(2) Arm IN

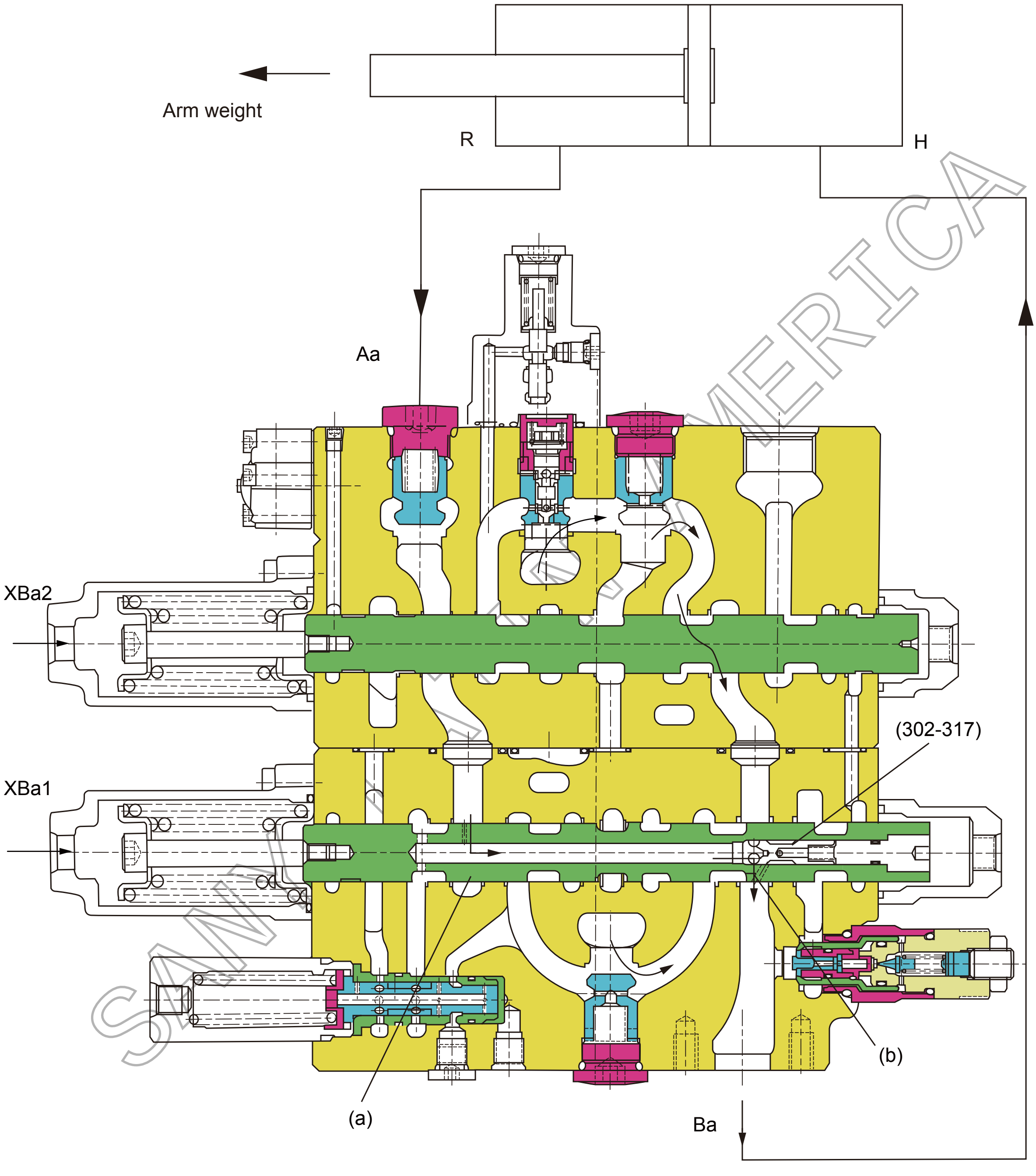
[Pilot circuit]

- 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]

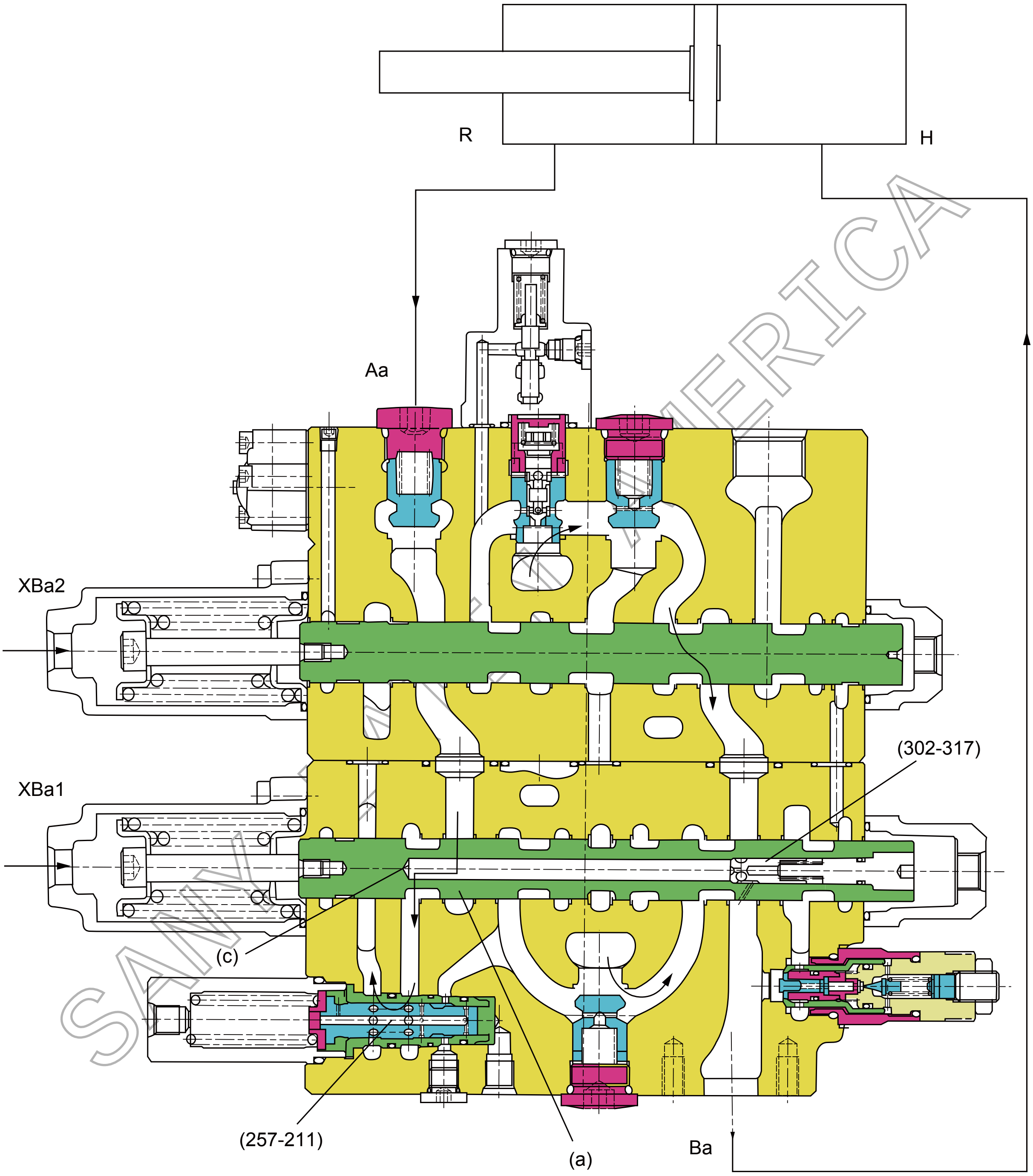
- When arm In is operated, pilot pressure oil is supplied to port XBa1 and port XBa2. When pilot pressure oil is applied at the two sides of port XBa1 and port XBa2, arm 1 spool and arm 2 spool is switched to the left. As a result, working oil from P2 is introduced into the neutral bypass (2) via main 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.

- **Light load**



ZX225-1102014

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



ZX225-1102015

4.5.2.4 Boom

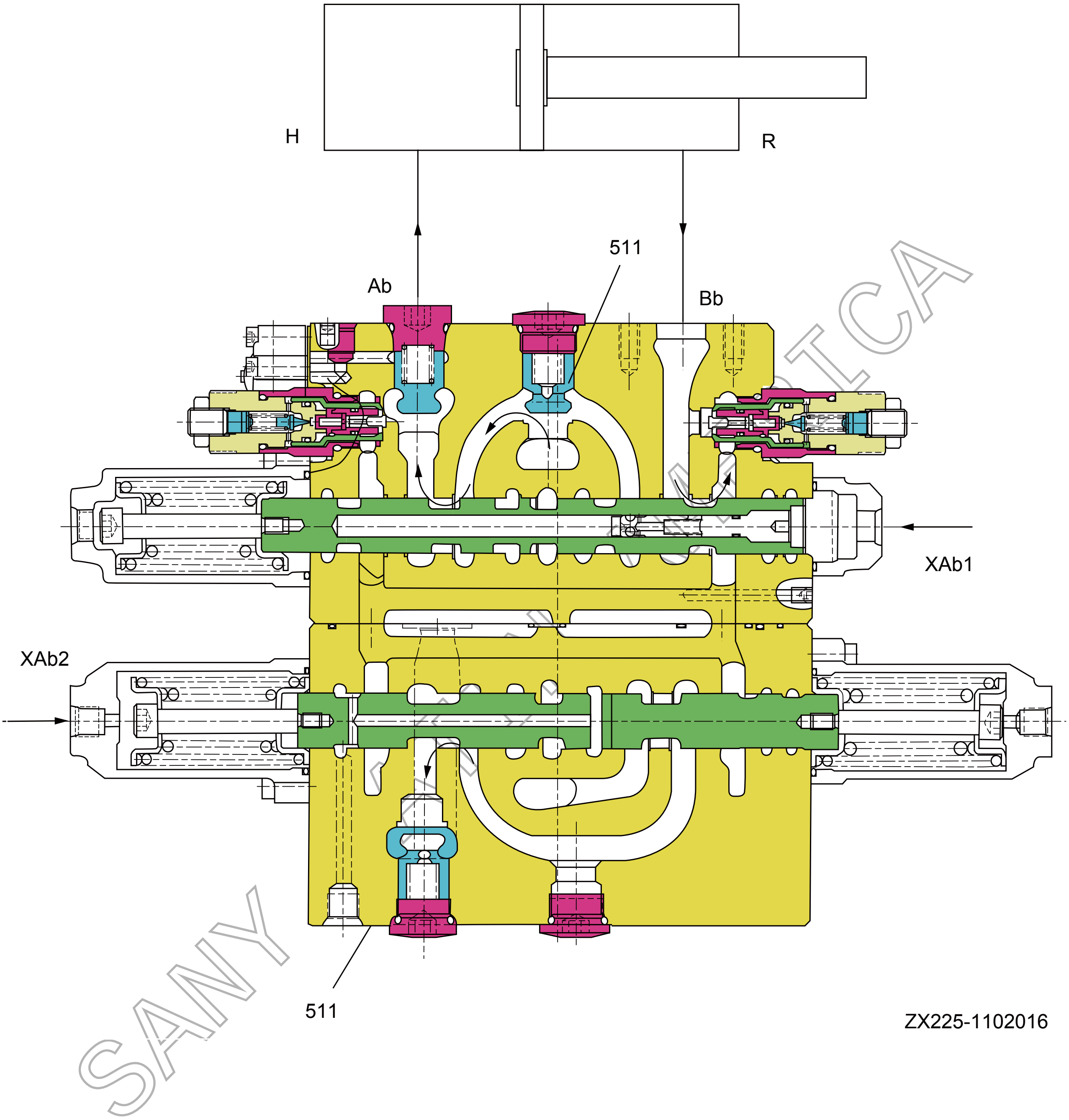
(1) Boom UP

[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).



ZX225-1102016

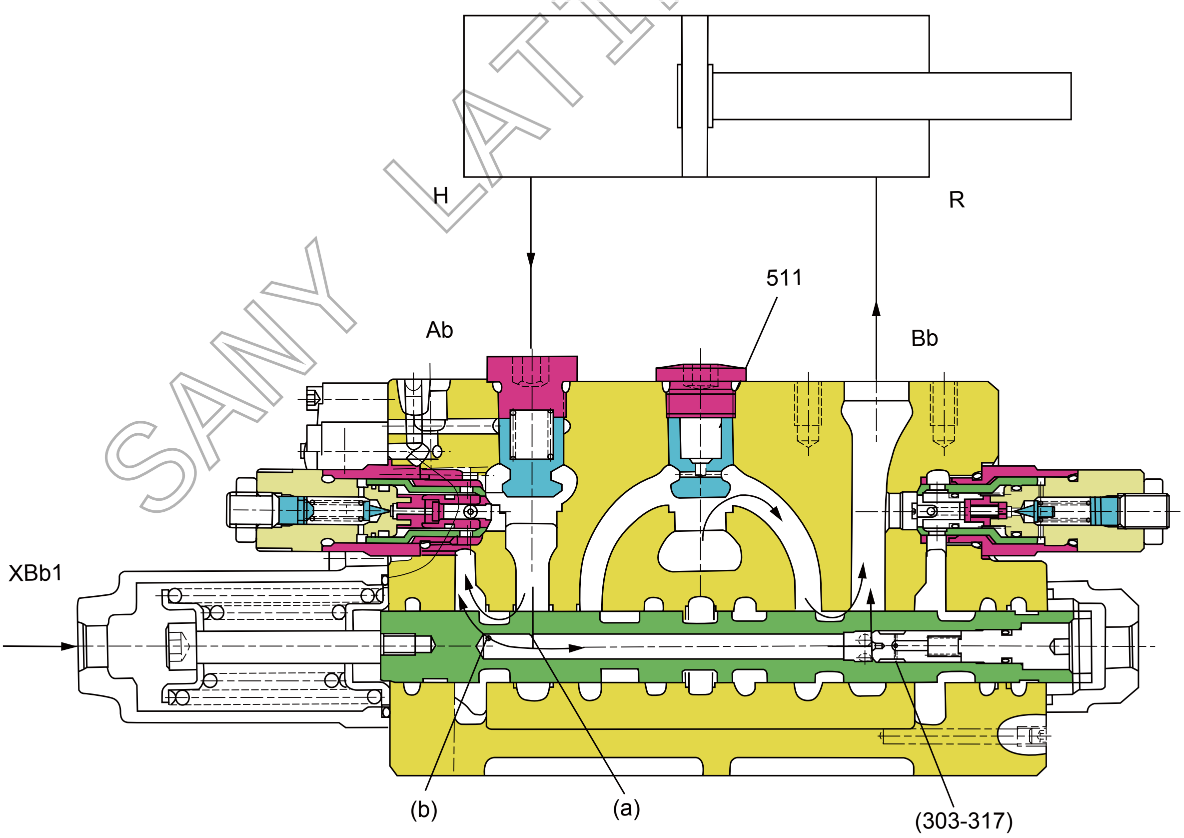
(2) Boom DOWN

[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).



ZX225-1102017

4.5.2.5 Bucket

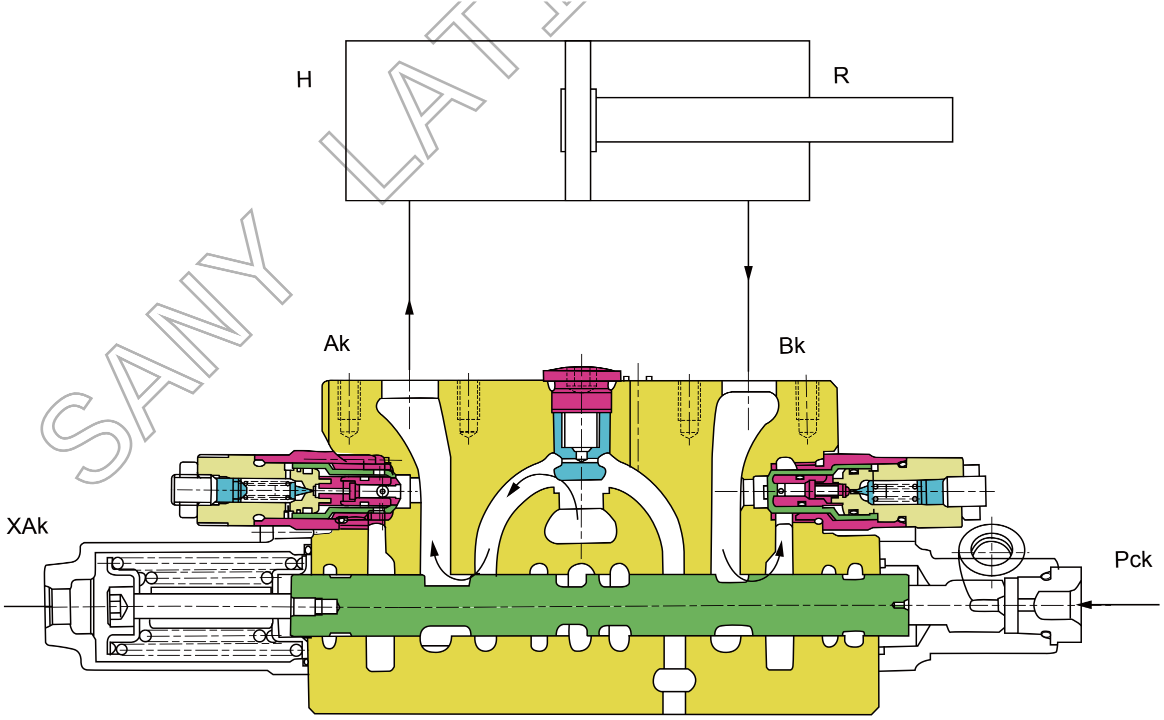
(1) Bucket DIG

[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.



ZX225-1102018

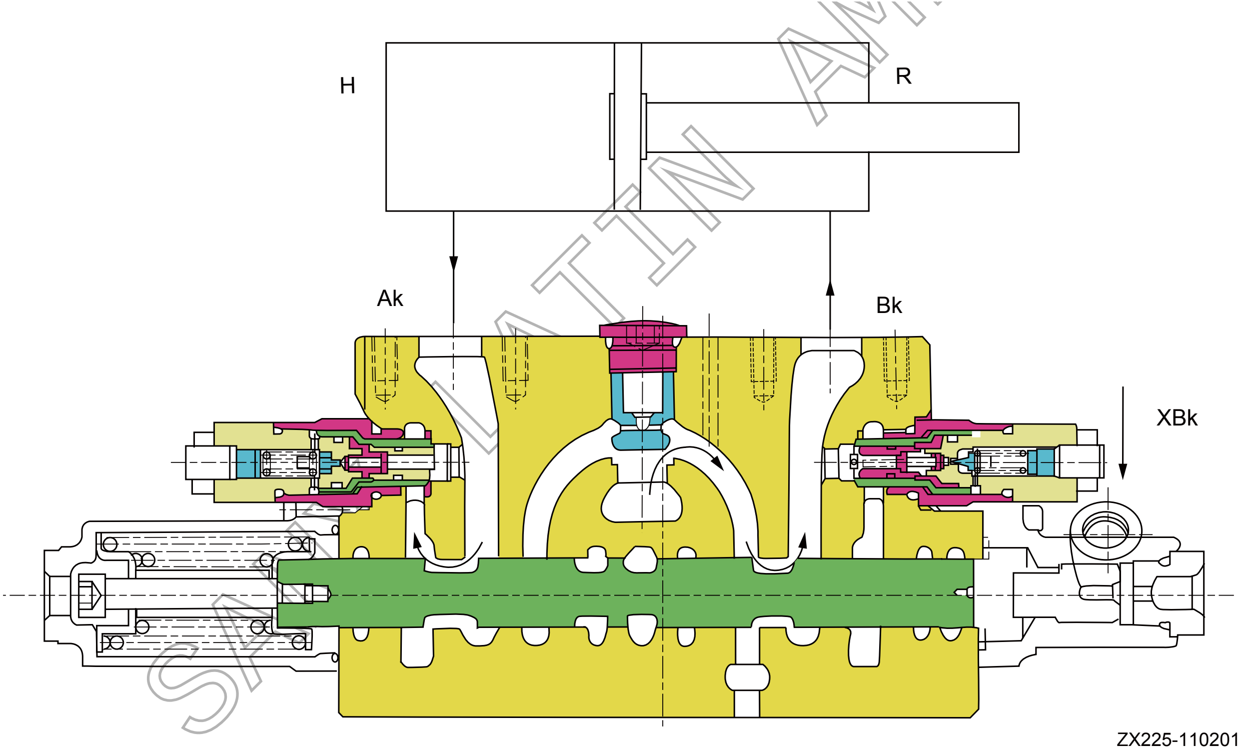
(2) Bucket DUMP

[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.



ZX225-1102019

(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).

4.5.2.6 Swing

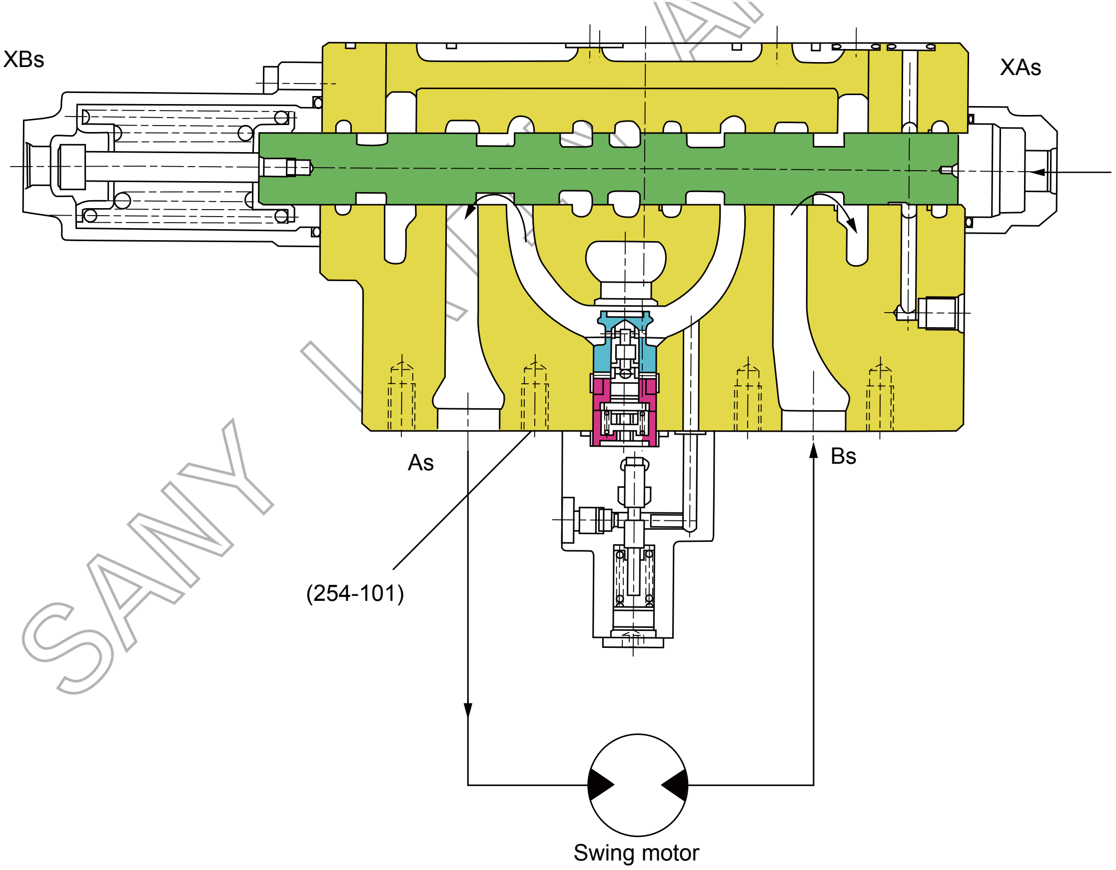
(1) Swing operation

[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.



ZX225-1102020

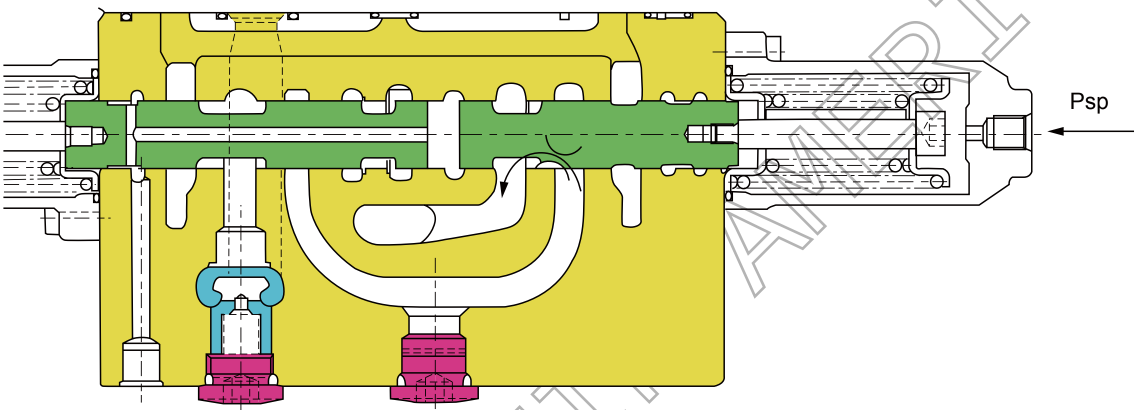
(2) Swing priority function

[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.



ZX225-1102021

4.5.2.7 Option

Option spool is used to control optional work equipment attachment.

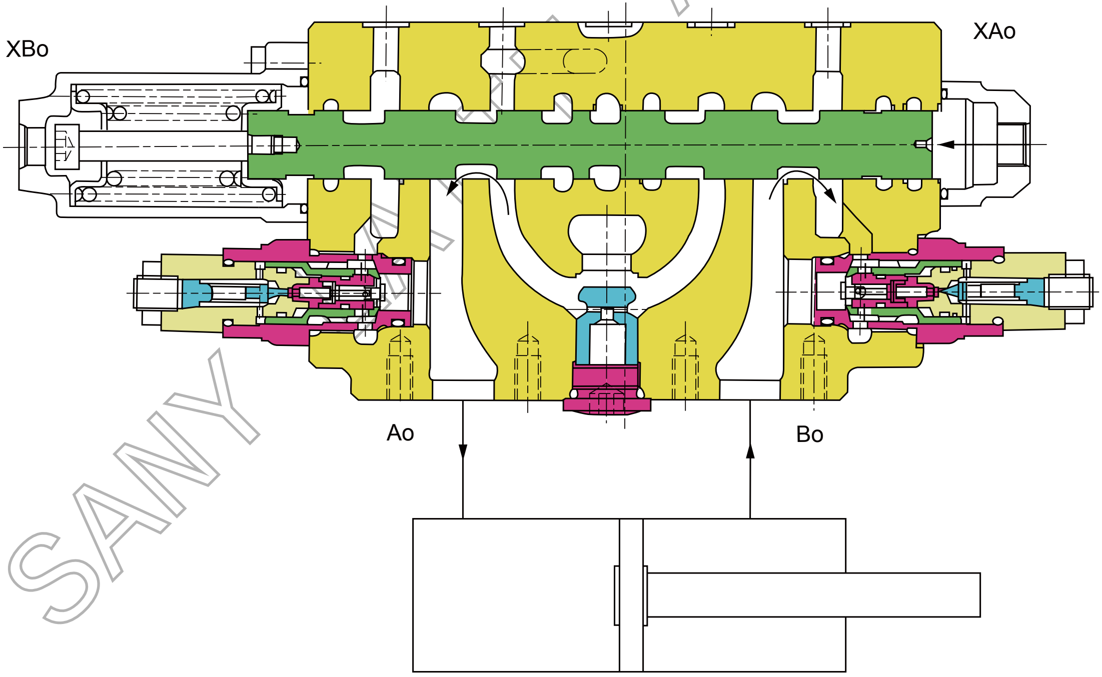
(1) Operation

[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.



ZX225-1102022

(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.

4.5.2.8 *Travel straight*

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

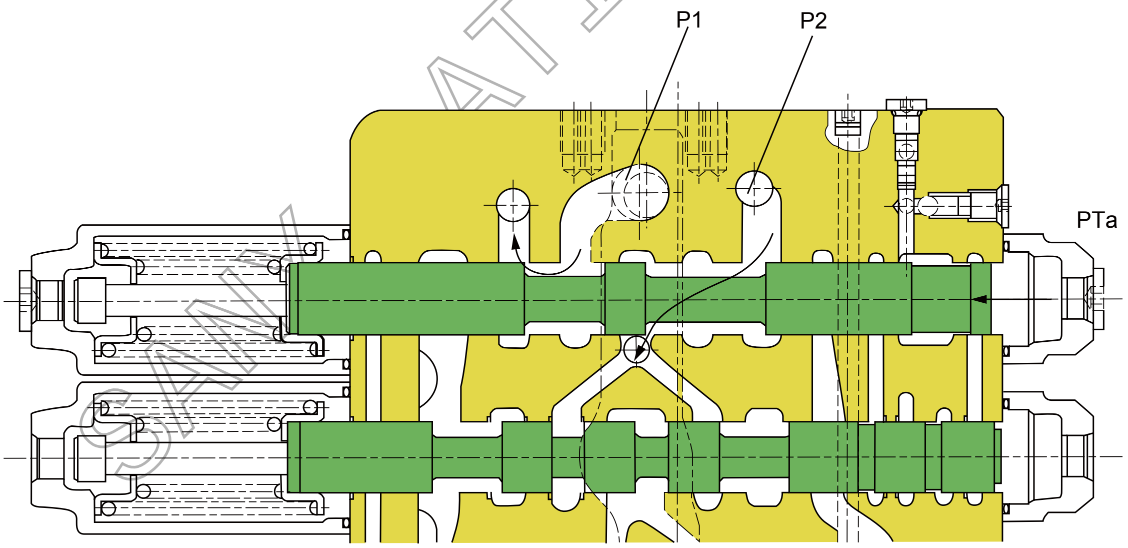
The following case shows when travel spool (301) and swing spool (305) are operated simultaneously. (When pilot pressure oil is supplied to port XAtL, port XAtr and port Xas)

[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.



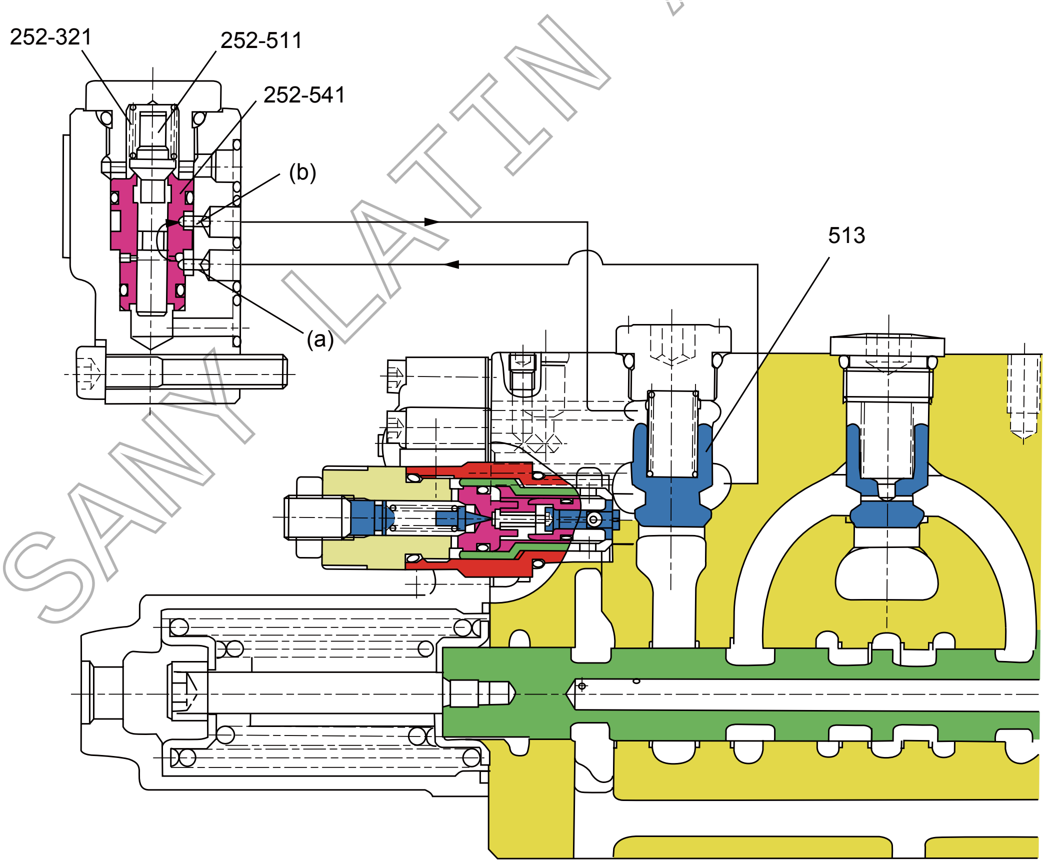
ZX225-1102023

4.5.2.9 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

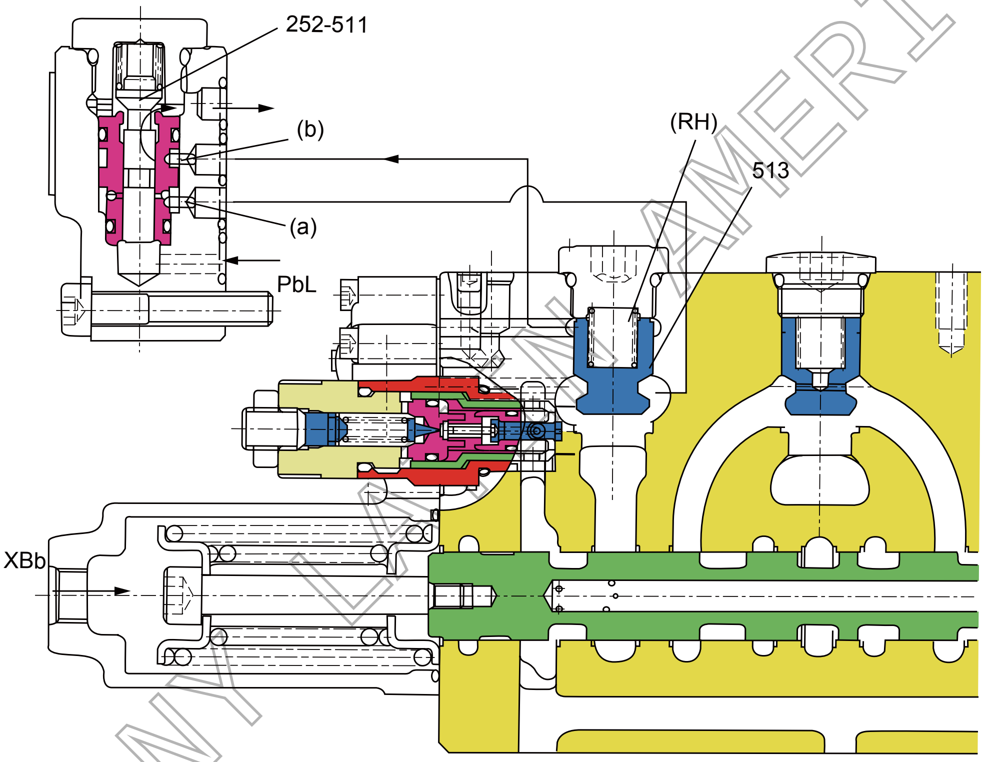
- The following shows when boom 1 spool (303) is in neutral position. (The same is with arm 2 spool (306))
- When boom 1 spool (303) is in neutral position, spool (252-511) in the lock valve option set is pressed against the valve seat of the valve sleeve (252-541) inside the lock valve option set, as 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.



ZX225-1102024

(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.



ZX225-1102025

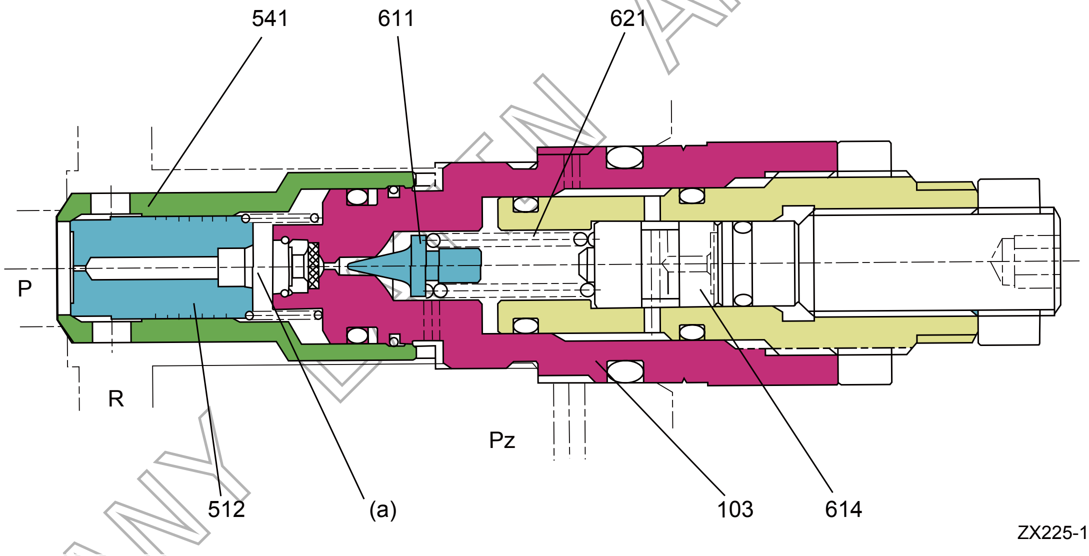
(2) Boom UP operation

- 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.

4.5.2.10 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.



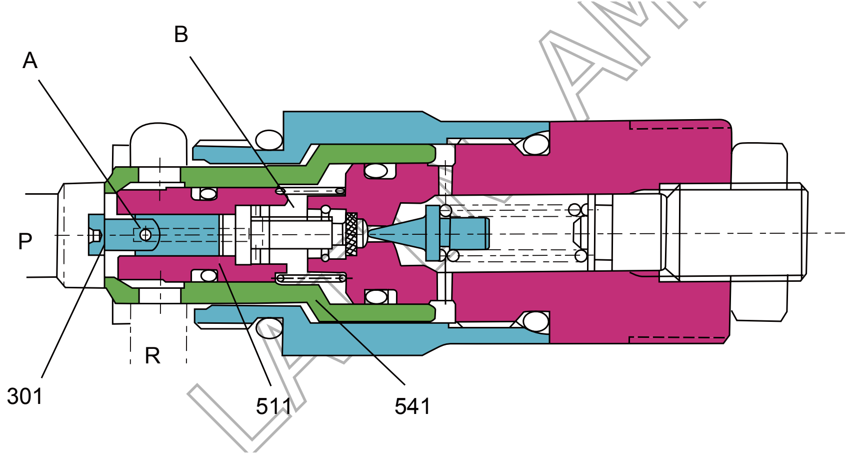
ZX225-1102026

4.5.2.11 Port relief valve function

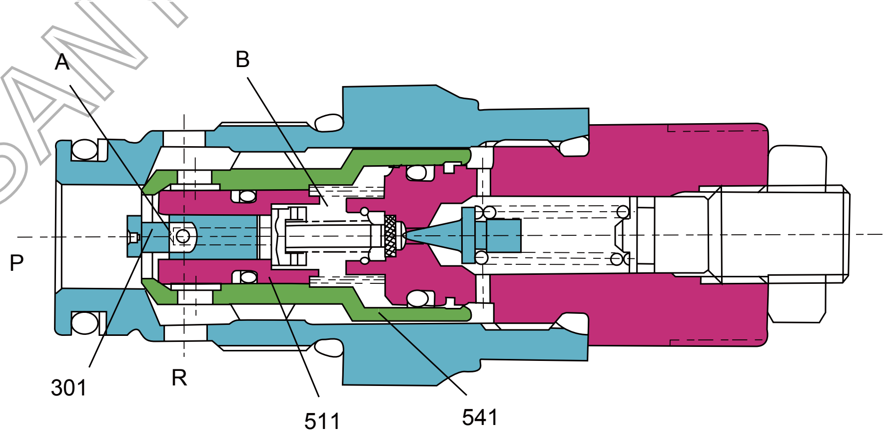
The port relief valve is installed between the tank port and low-pressure path. In addition to the function as relief valve, it has also the function of anti-cavitation oil complement check valve. Its function is described below:

(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.

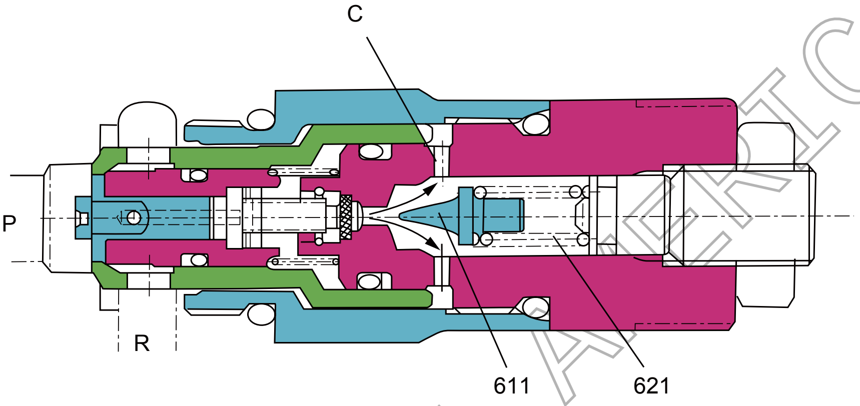


ZX225-1102027

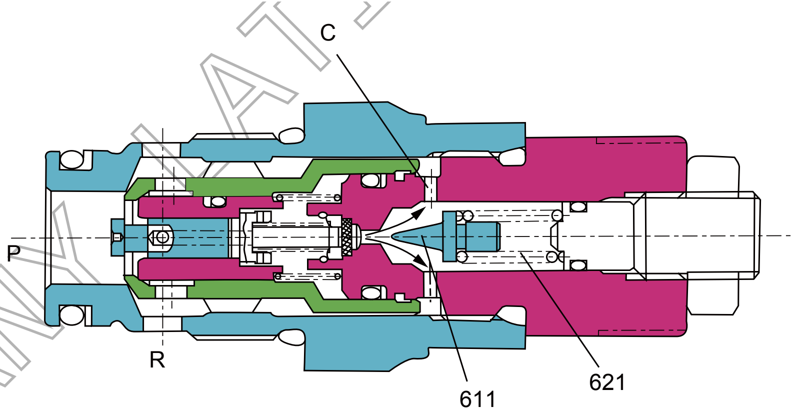


ZX225-1102028

- 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).

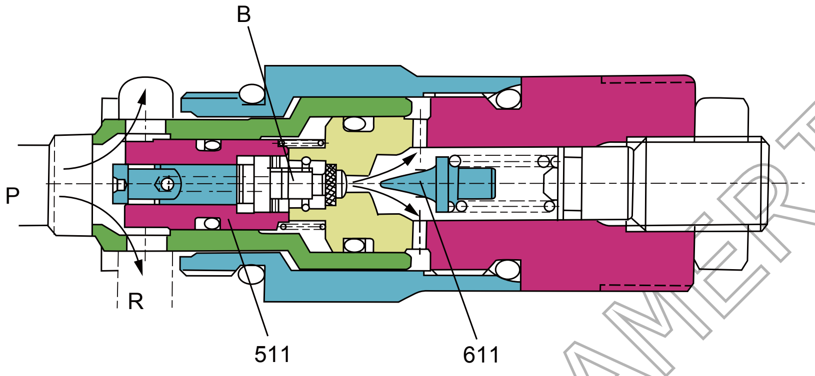


ZX225-1102029

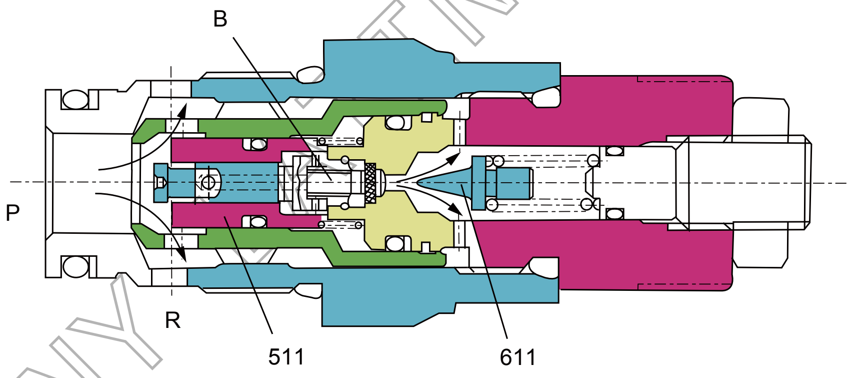


ZX225-1102030

- 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.



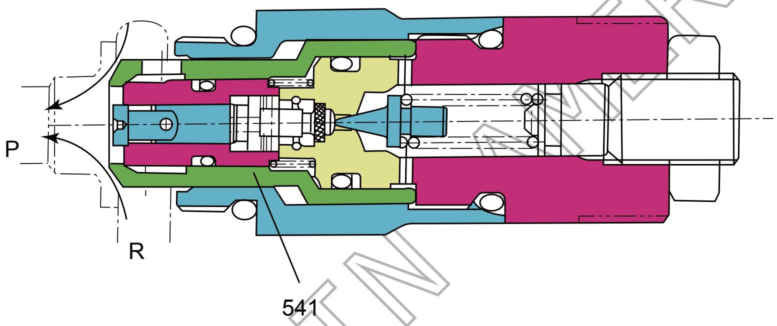
ZX225-1102031



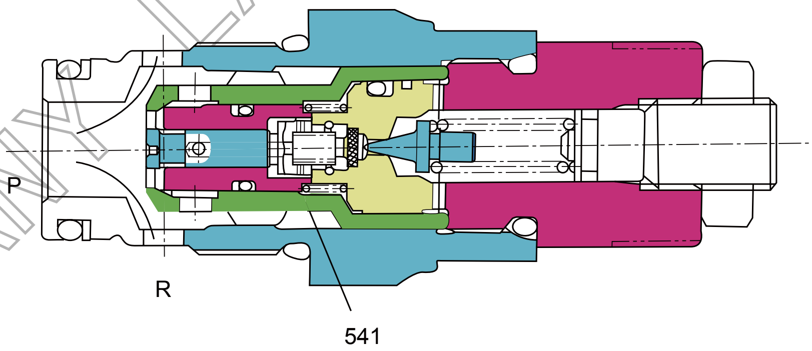
ZX225-1102032

(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.

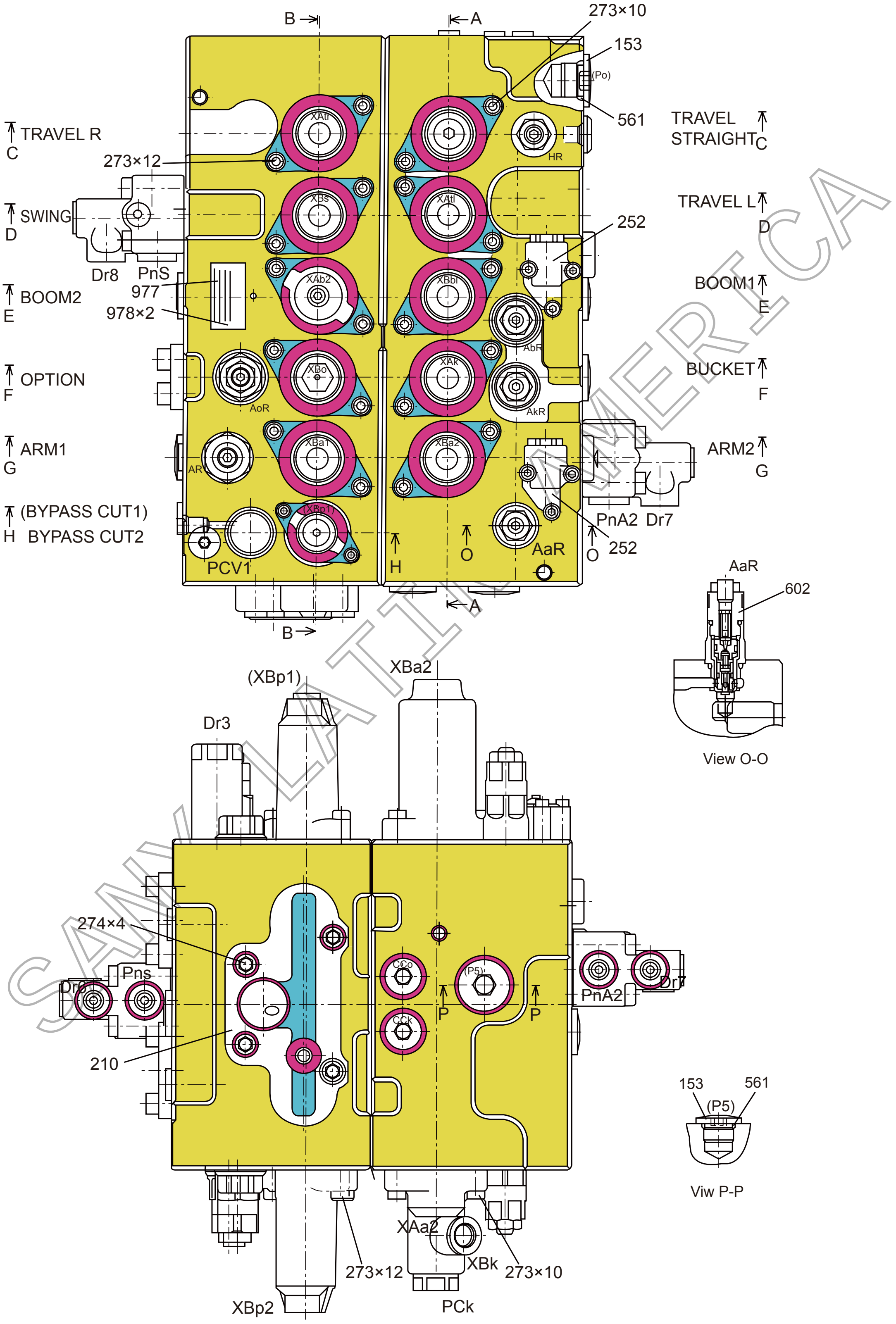


ZX225-1102033

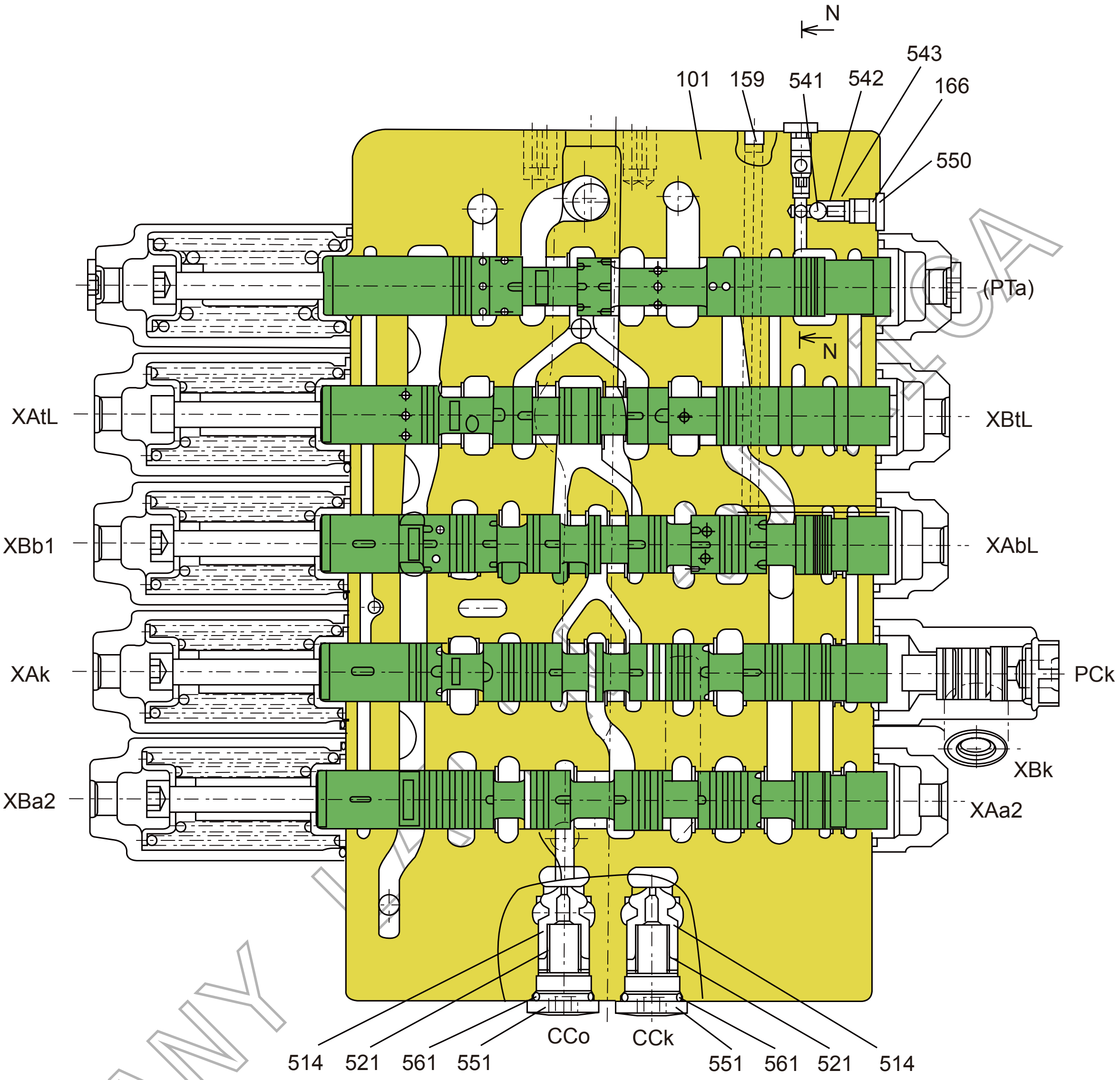


ZX225-1102034

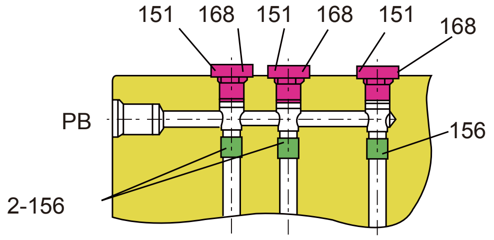
4.5.3 Section view



Section A-A, N-N



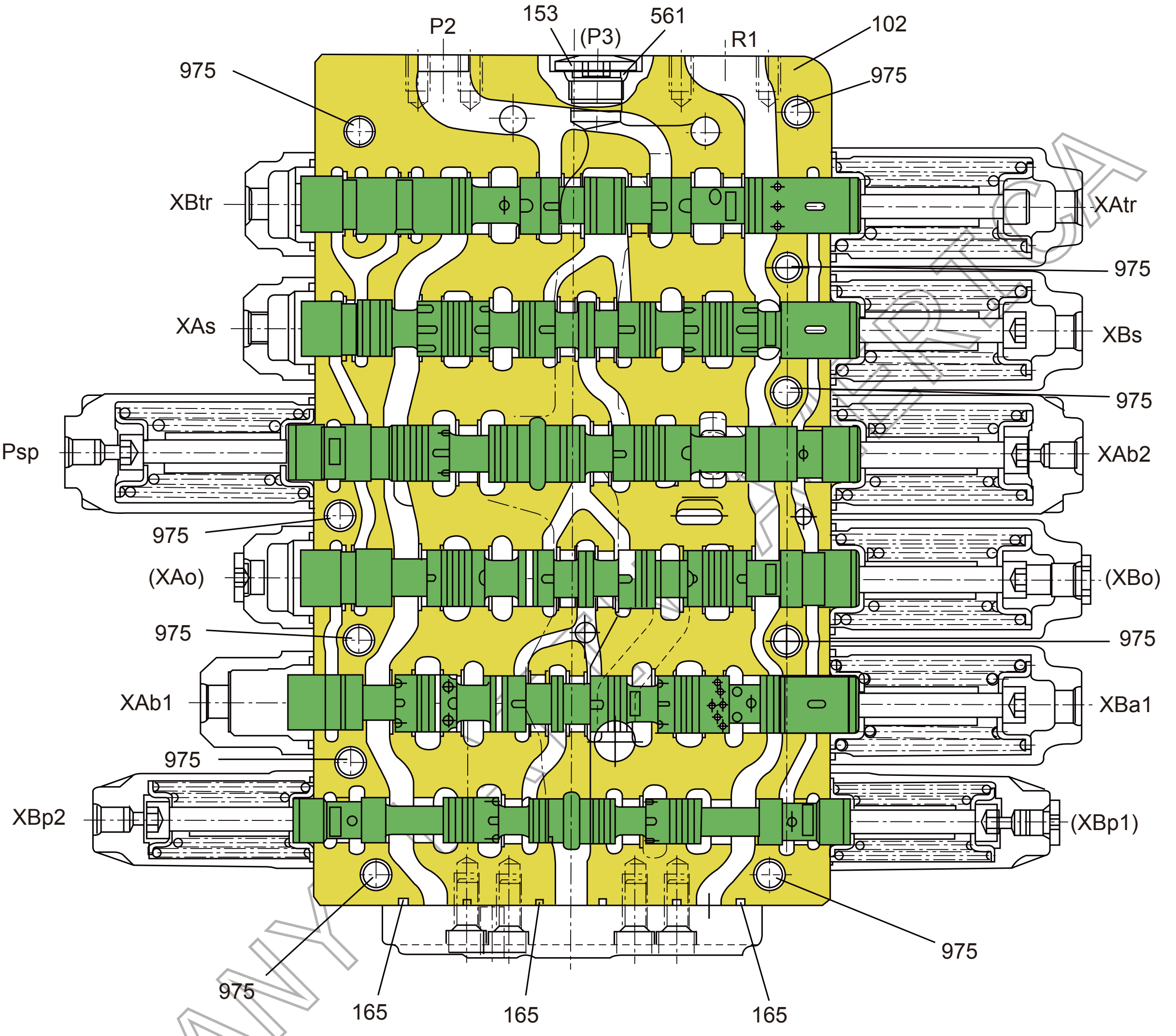
View A-A



View N-N

ZX225-1102036

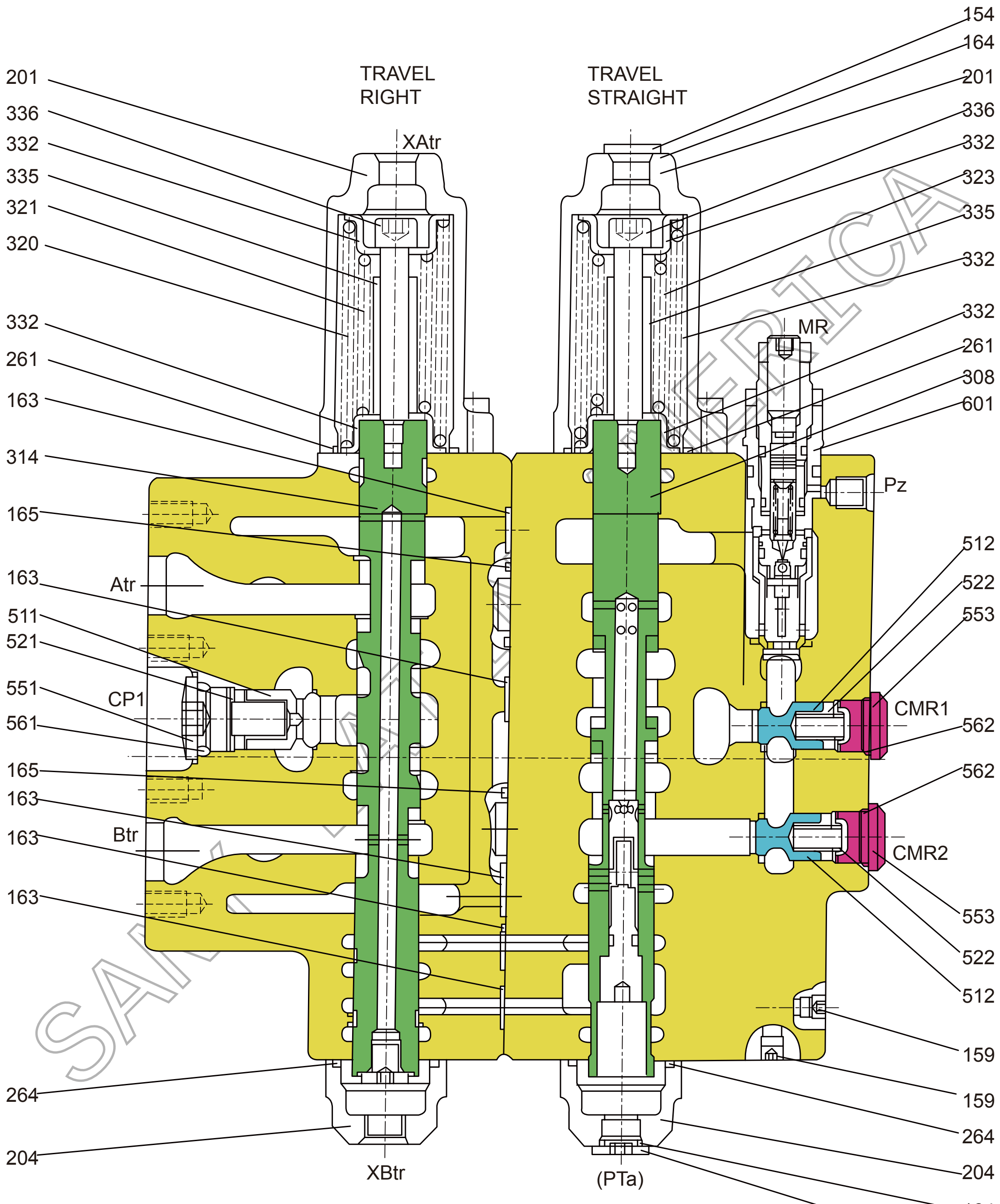
Section B-B



View B-B

ZX225-1102037

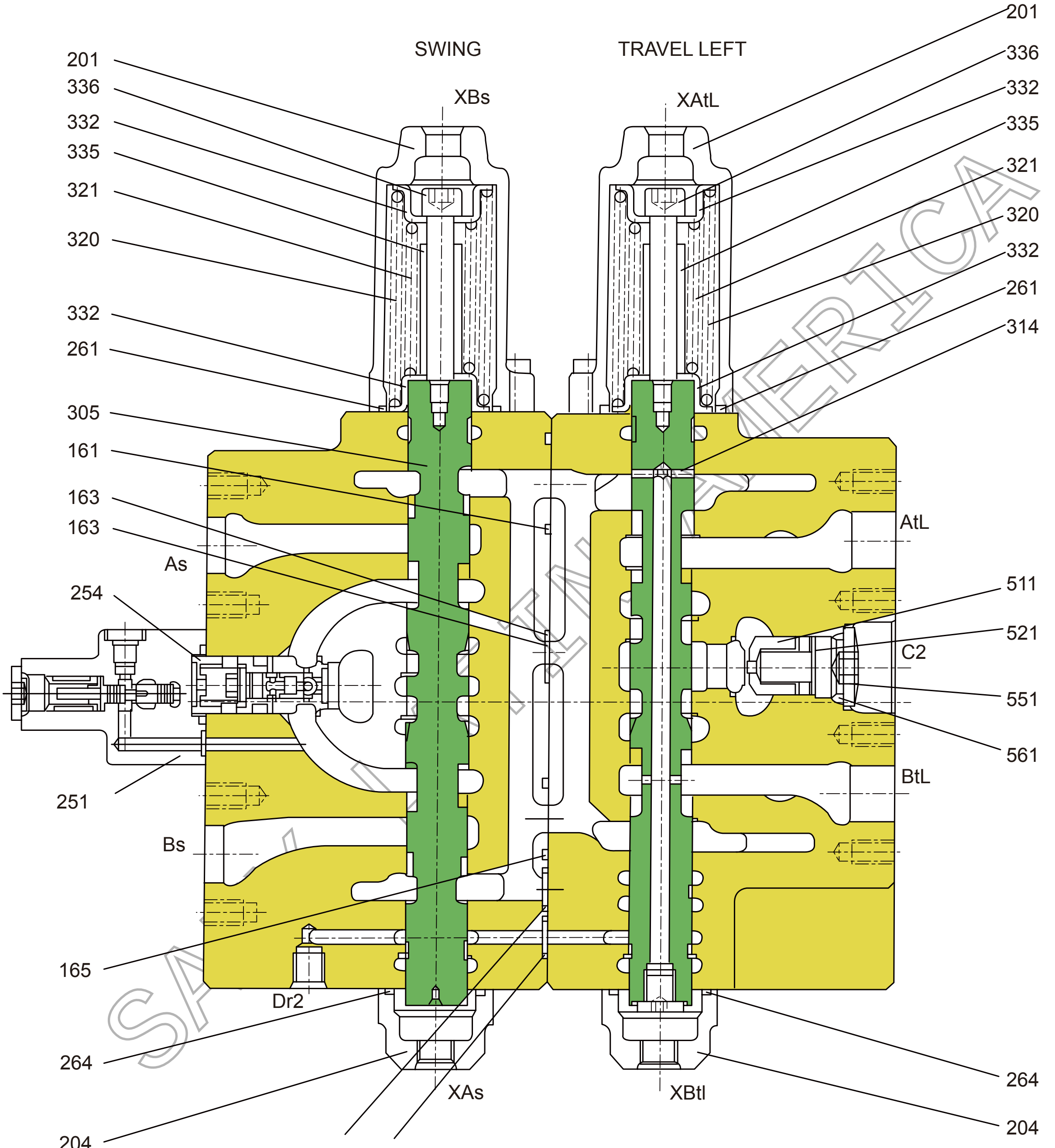
Section C-C (Travel right, travel straight)



View C-C

ZX225-1102038

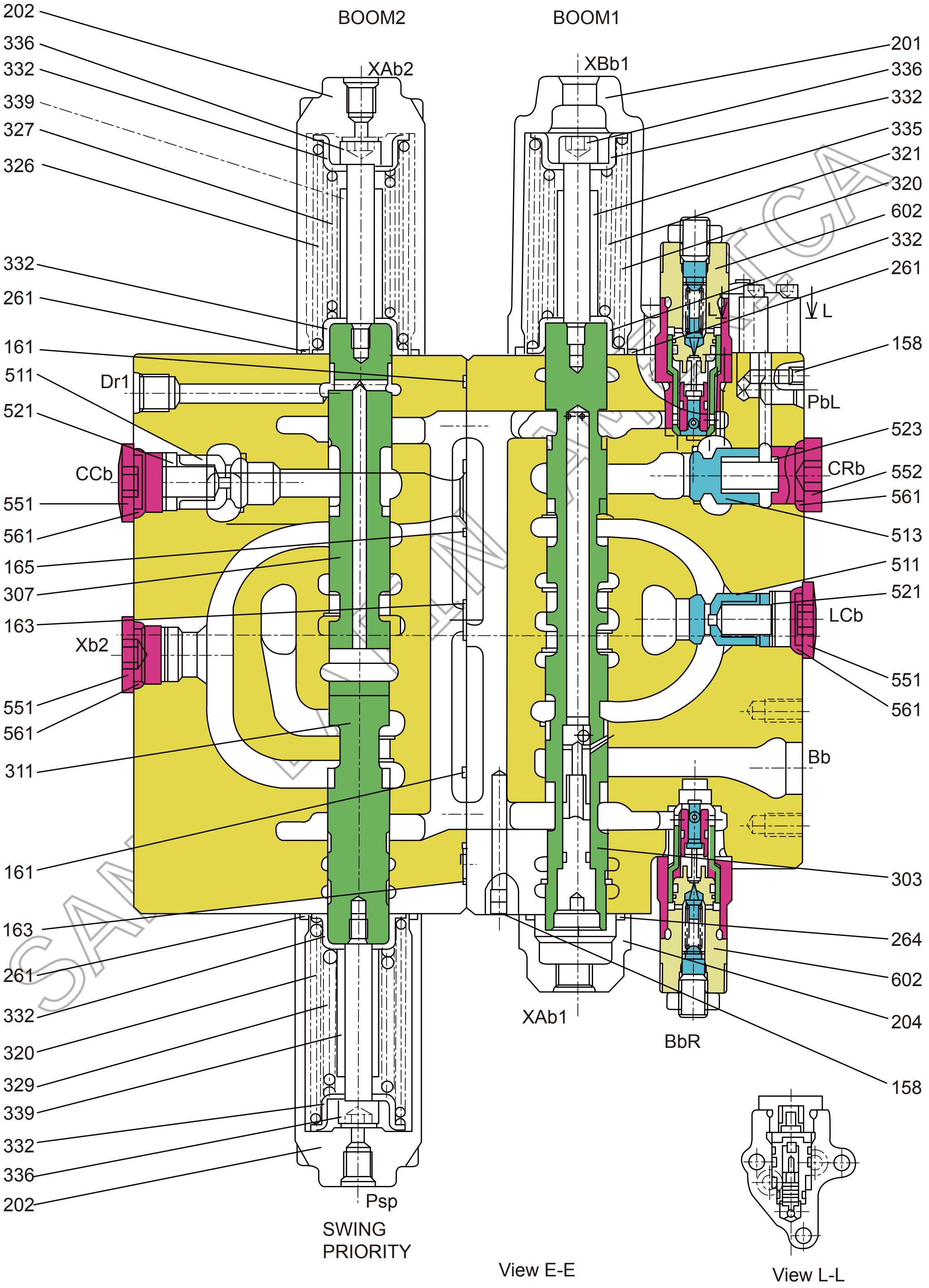
Section D-D (Swing, travel left)



View D-D

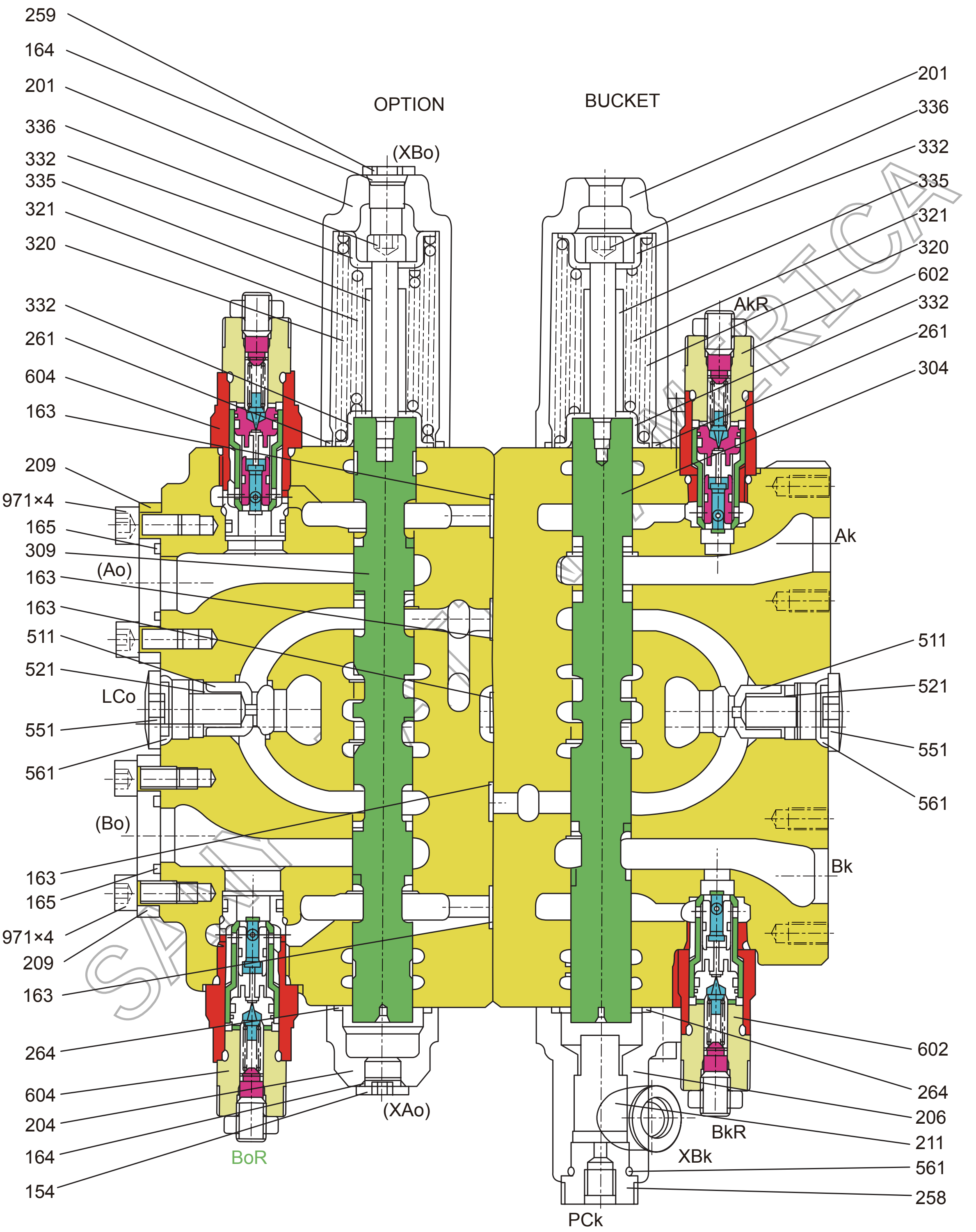
ZX225-1102039

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



ZX225-1102040

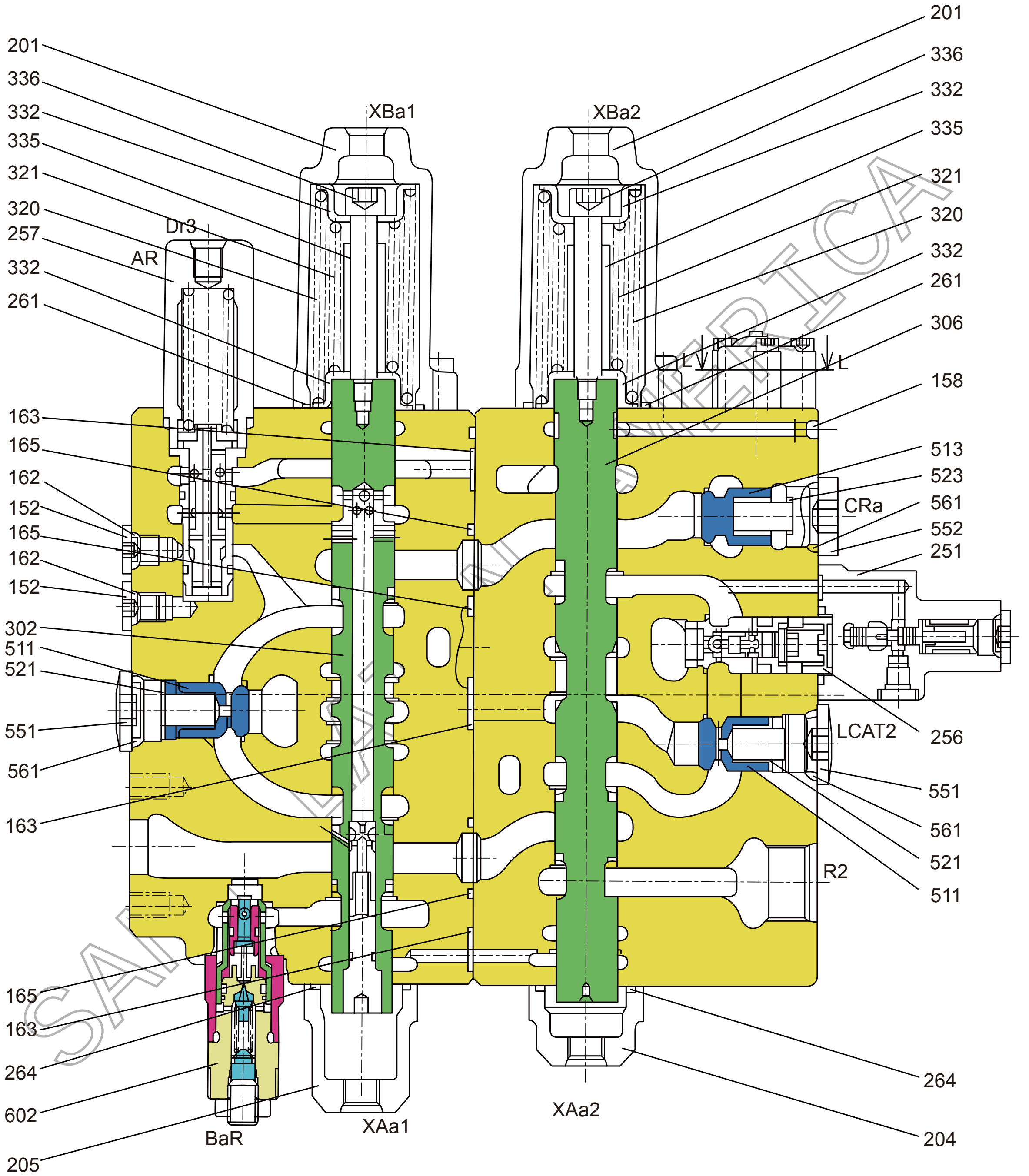
Section F-F (Option, bucket)



View F-F

ZX225-1102041

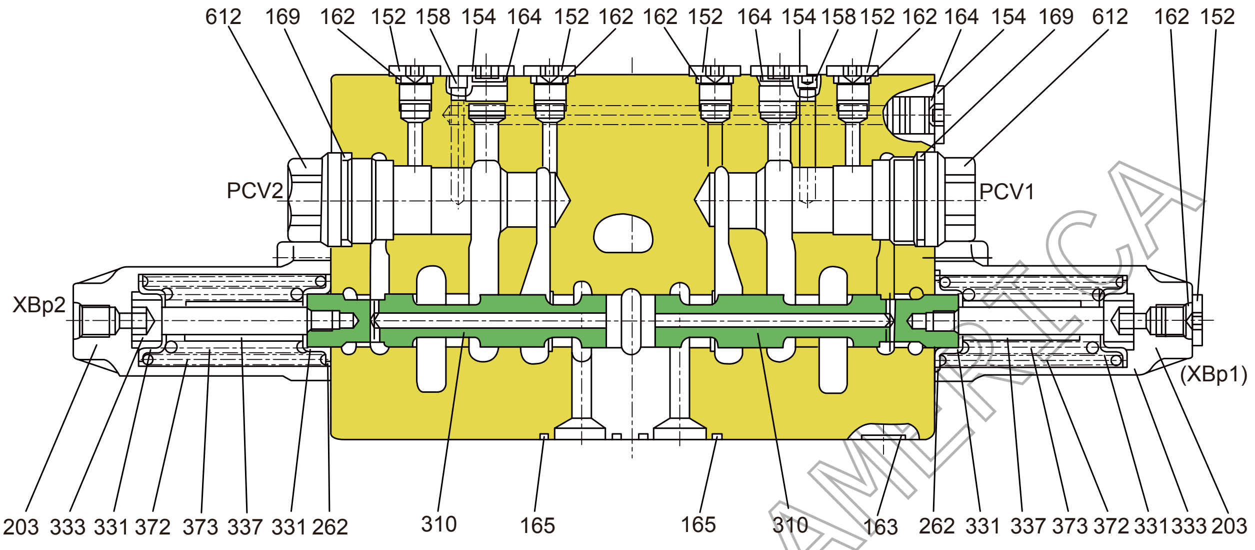
Section G-G (Arm 1, arm 2)



View G-G

ZX225-1102042

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



View H-H

ZX225-1102043

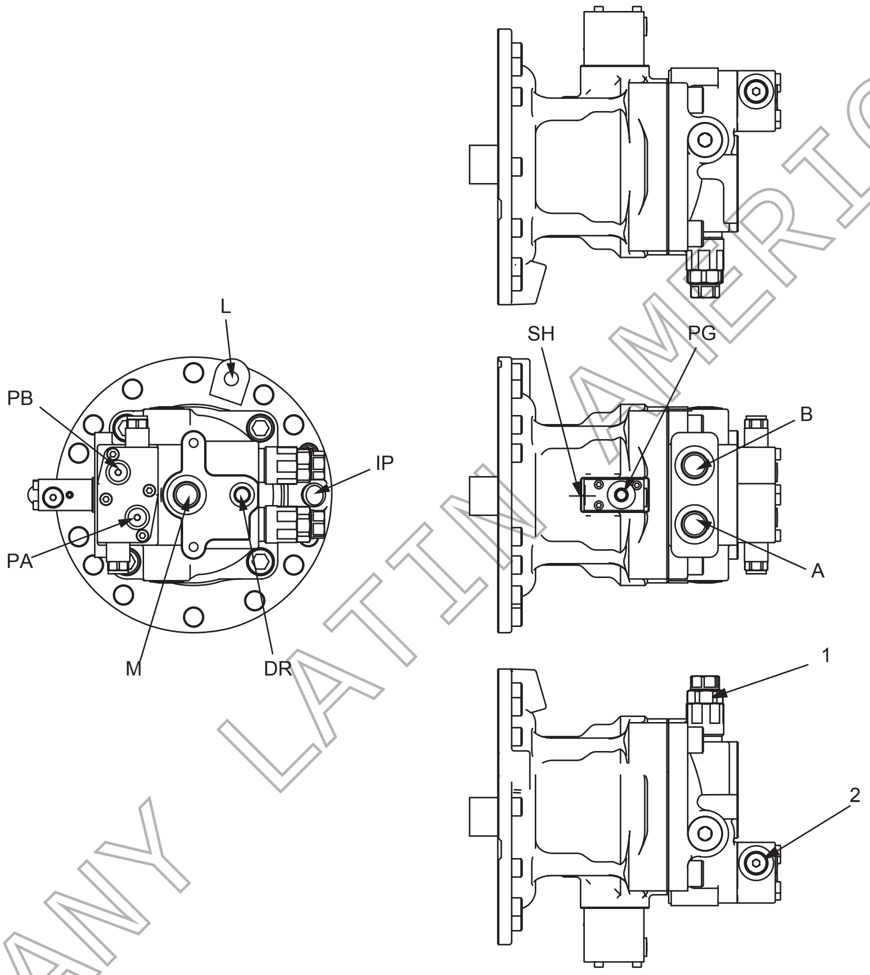
Mounting torque (N·m)	NO.	Part name	Q'ty	Mounting torque (N·m)	NO.	Part name	Q'ty
	101	BLOCK, valve A	1		308	SPOOL ASS'Y, travel straight	1
	102	BLOCK, valve B	1		309	SPOOL, option	1
13~17	151	PLUG	3		310	SPOOL, bypass cut	2
34~39	152	PLUG	7		311	SPOOL, swing priority	1
220~250	153	PLUG	3		320	SPRING	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

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				

4.6 Hydraulic System, Part 3

4.6.1 Swing motor

NOTE: For the location of the swing motor on the machine, see “Hydraulic equipment layout” on page 4-24.

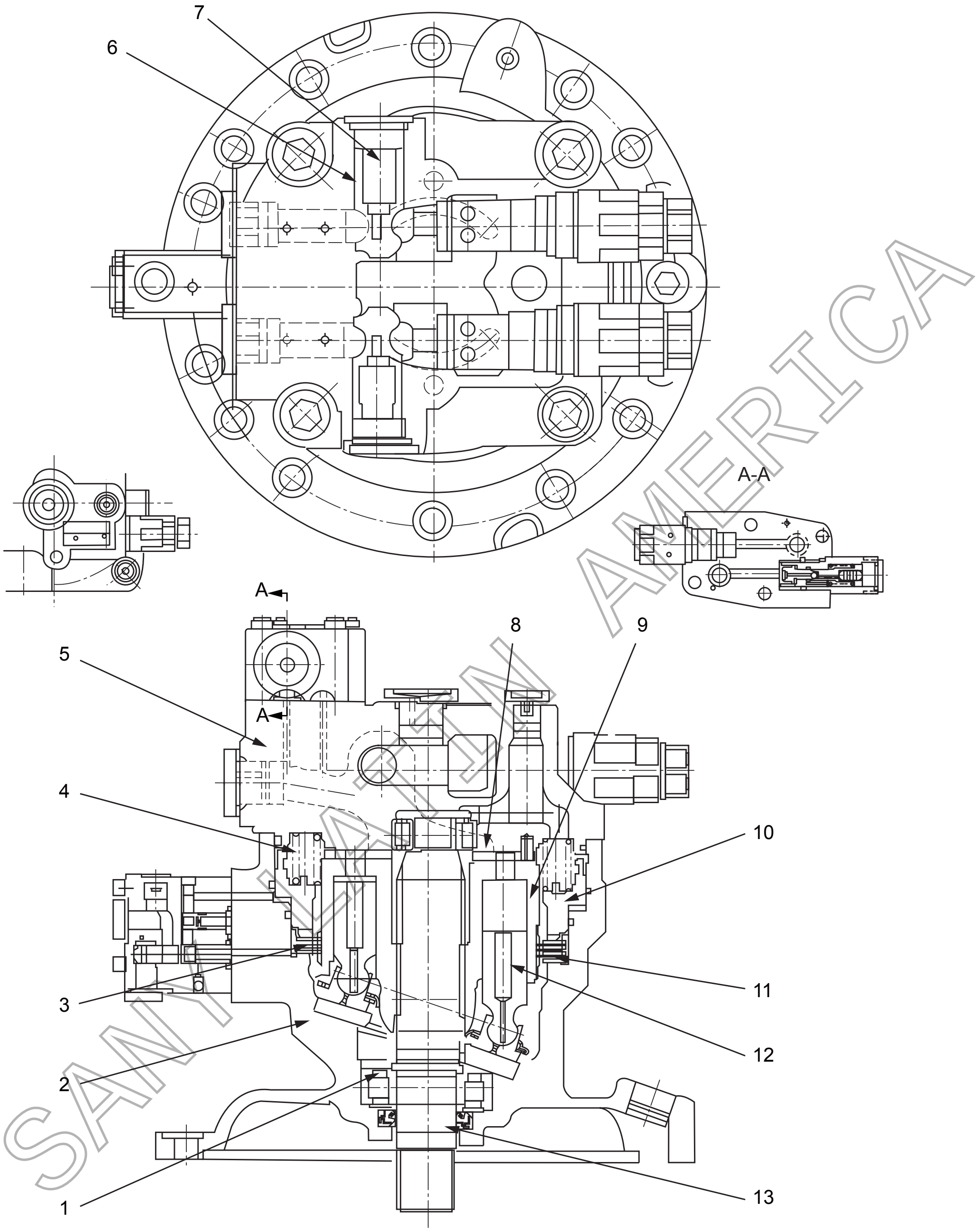


ZX215-1002081

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. Relief valve
2. Reverse prevention valve

For more technical information about the swing motor, see “Swing motor” on page 3-6.

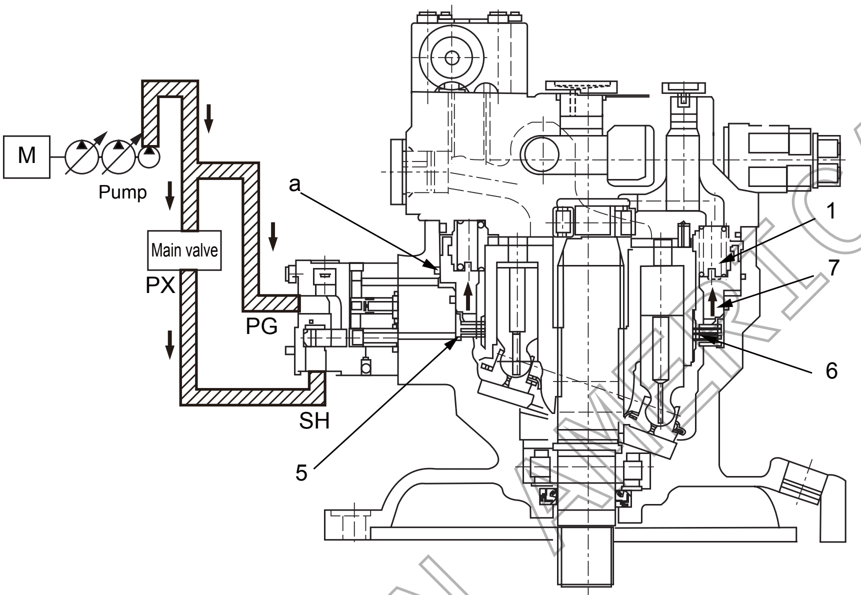


ZX215-1002082

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

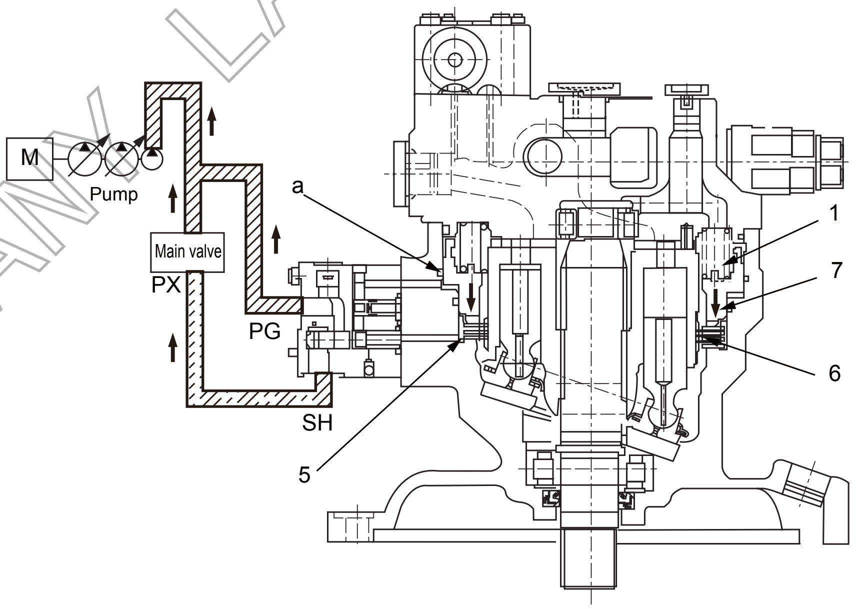
4.6.2 Swing holding brake

- 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.



ZX215-1002084

- 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.

4.6.3 Relief valve portion

NOTE: For the location of the relief valve on the swing motor, see “Swing motor” on page 4-81.

Structure

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

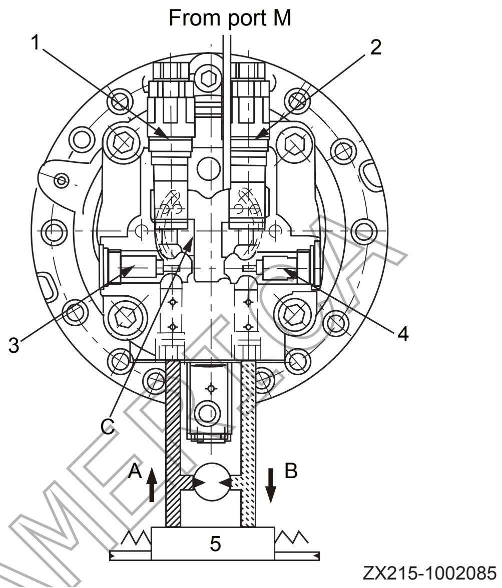
Function

- 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.

Operation

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

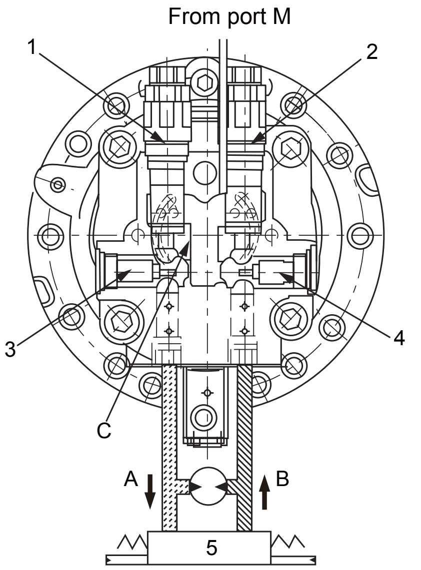
- When the swing control lever is operated for right swing, pressurized oil from the pump is supplied to port (A) via control valve (5).
- The pressure on port (A) rises, the starting torque is generated in the motor, and the motor is activated.
- The pressurized oil from the outlet port of the motor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



ZX215-1002085

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).

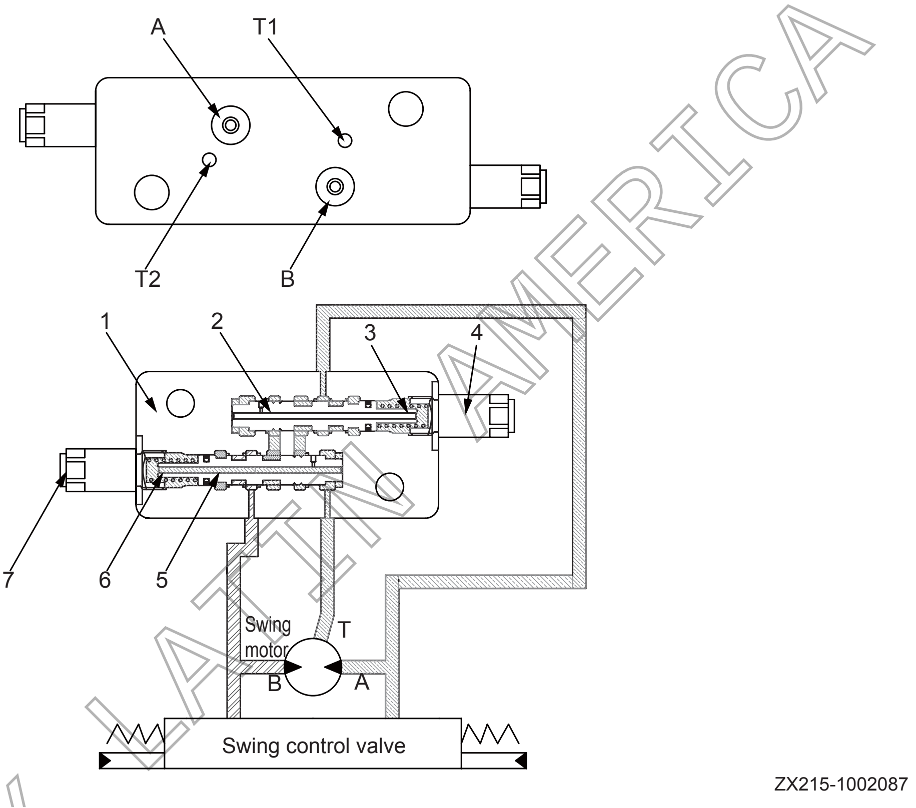


ZX215-1002086

4.6.4 Reverse prevention valve

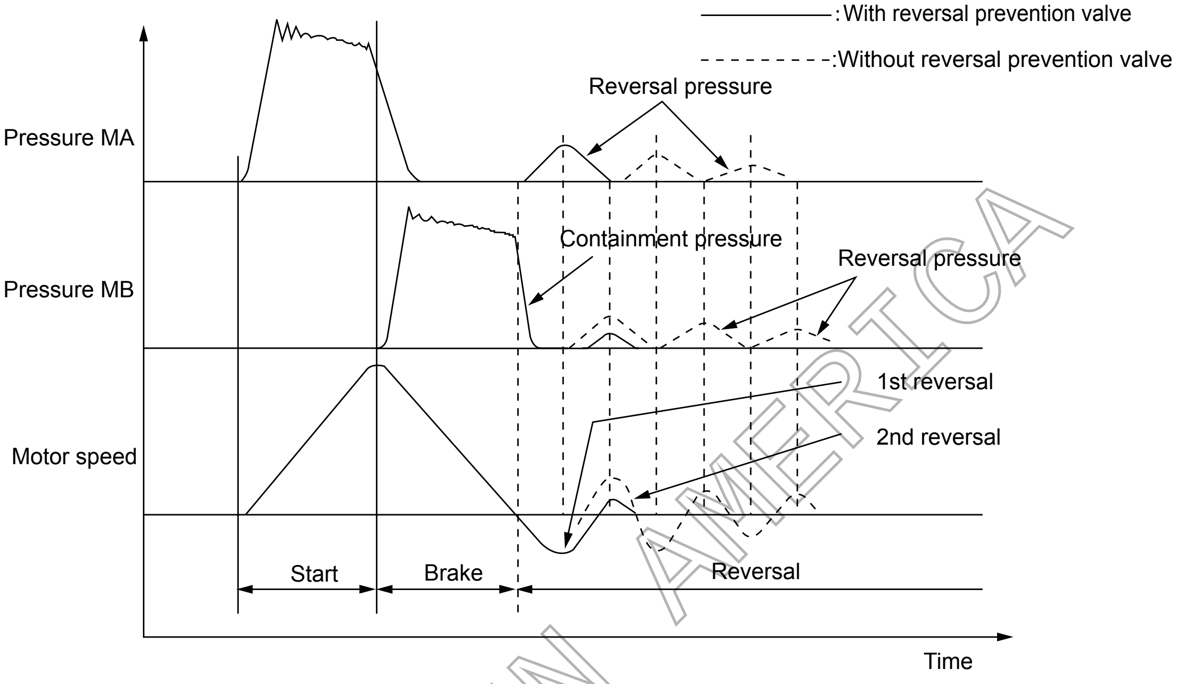
4.6.4.1 Operation drawing

NOTE: For the location of the reverse prevention valve on the swing motor, see “Swing motor” on page 4-81.



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

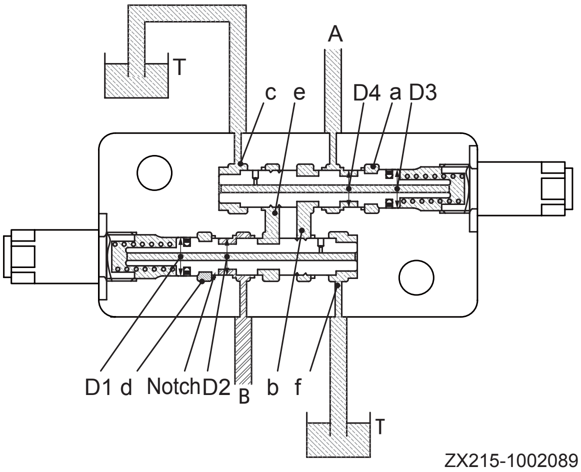
4.6.4.2 Explanatory drawing of effects



ZX215-1002088

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).

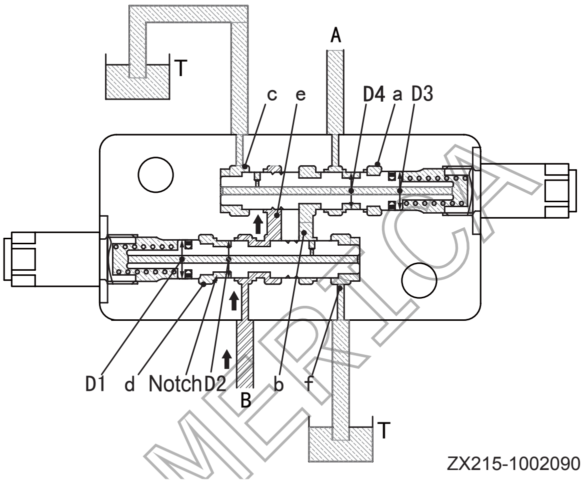


ZX215-1002089

Operation

1. When port (B) brake pressure is generated

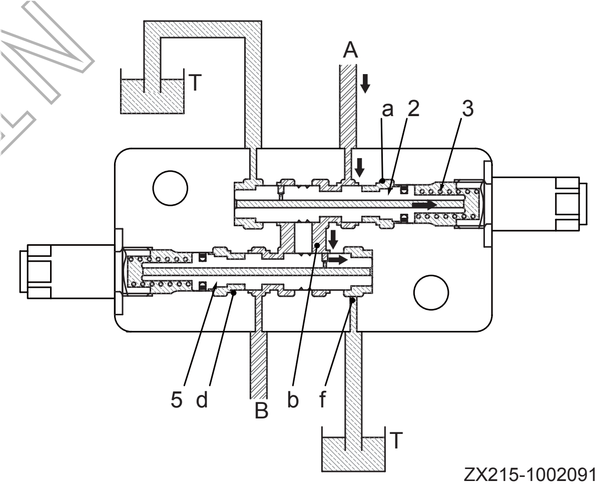
- Pressure (MB) is conducted to chamber (d) via the notch. The pressure compresses spring (6) by use of the difference in areas of circles (D1 > D2) of spool (5) and moves spring (6) to the left side. Port (B) and chamber (e) will be interconnected. Since pressure (A) is lower than the set pressure of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



ZX215-1002090

2. When motor is stopped

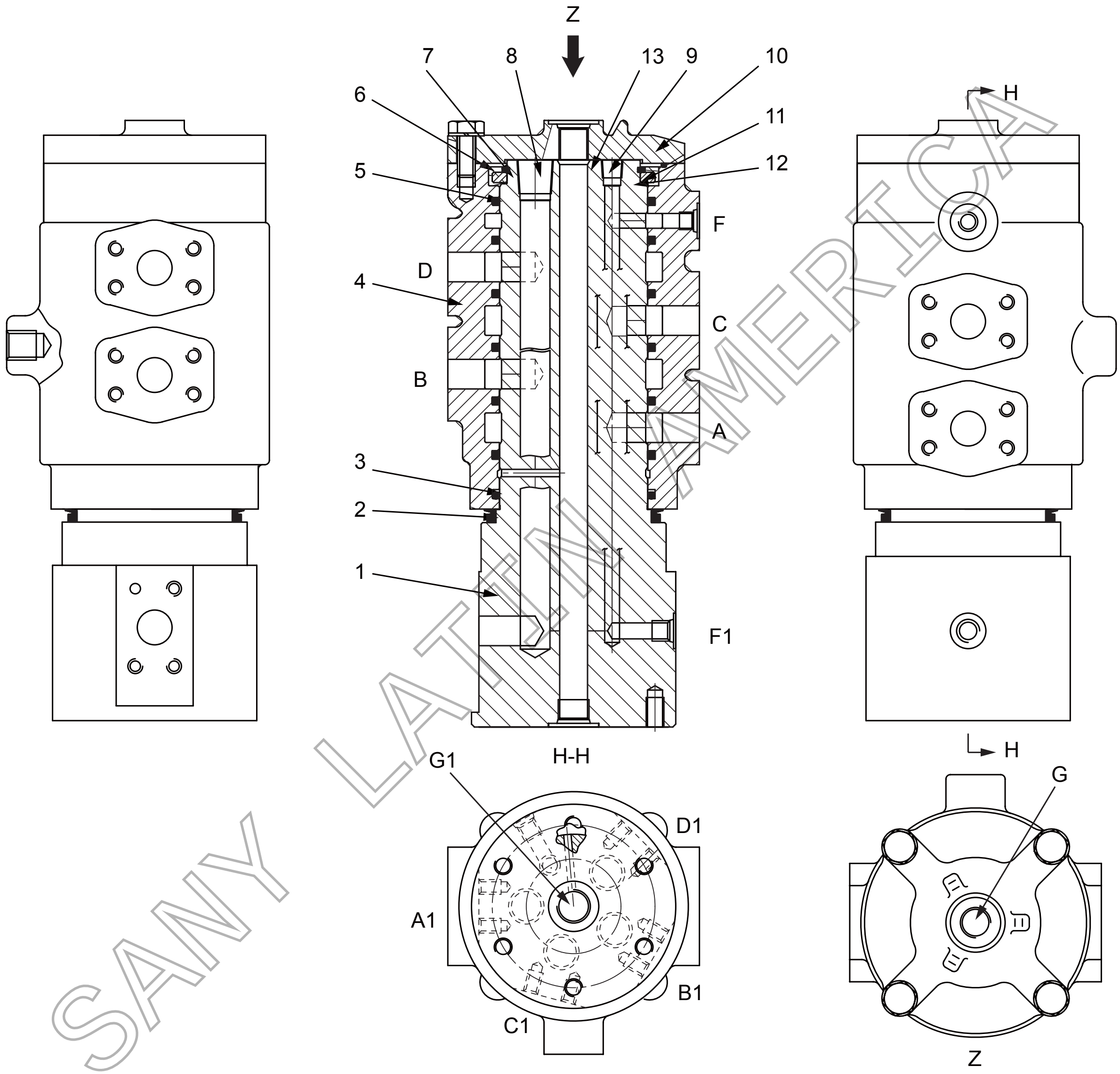
- The motor rotation is reversed by the closing pressure generated at port (B). (1st time: reverse rotation) Reversing pressure is generated on port (A). Pressure (A) is conducted to chamber (a), and spool (2) moves spring (3) to the right side, and A and B is interconnected. At this time, b is interconnected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



ZX215-1002091

4.6.5 Center swivel joint

NOTE: For the location of the central swivel joint on the machine, see “Hydraulic equipment layout” on page 4-24.



ZX215-1002092

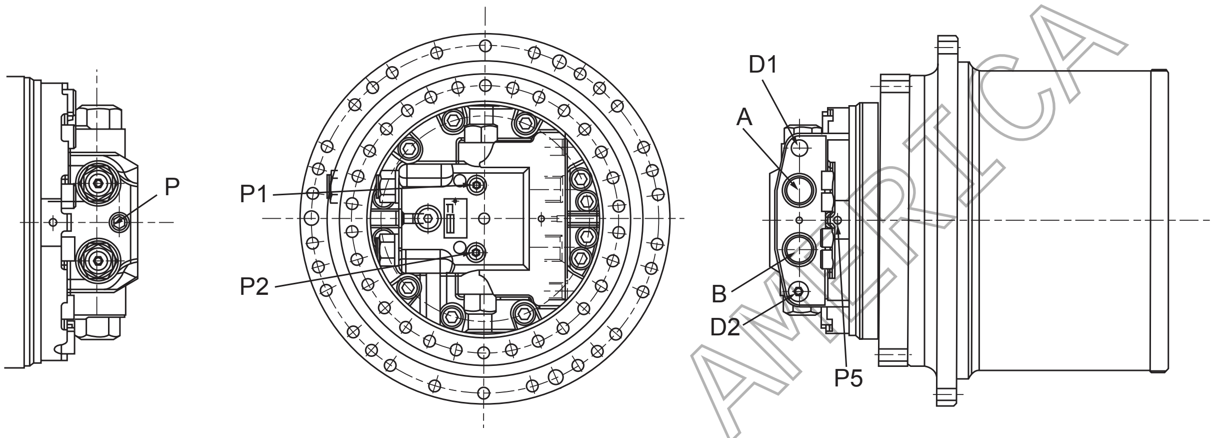
1) Swing shaft
2) Dust seal
3) O-ring
4) Swing body
5) Rotating seal φ100x5
6) Gasket
7) Retaining ring φ 90
8) Plug (ZG3/4)
9) Plug (ZG1/4)
10) Cover
11) Spacer
12) Gasket
13) Gasket

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)

4.6.6 Travel motor

Model: TM40VD-A-99/163-1

NOTE: For the location of the travel motor on the machine, see “Hydraulic equipment layout” on page 4-24.

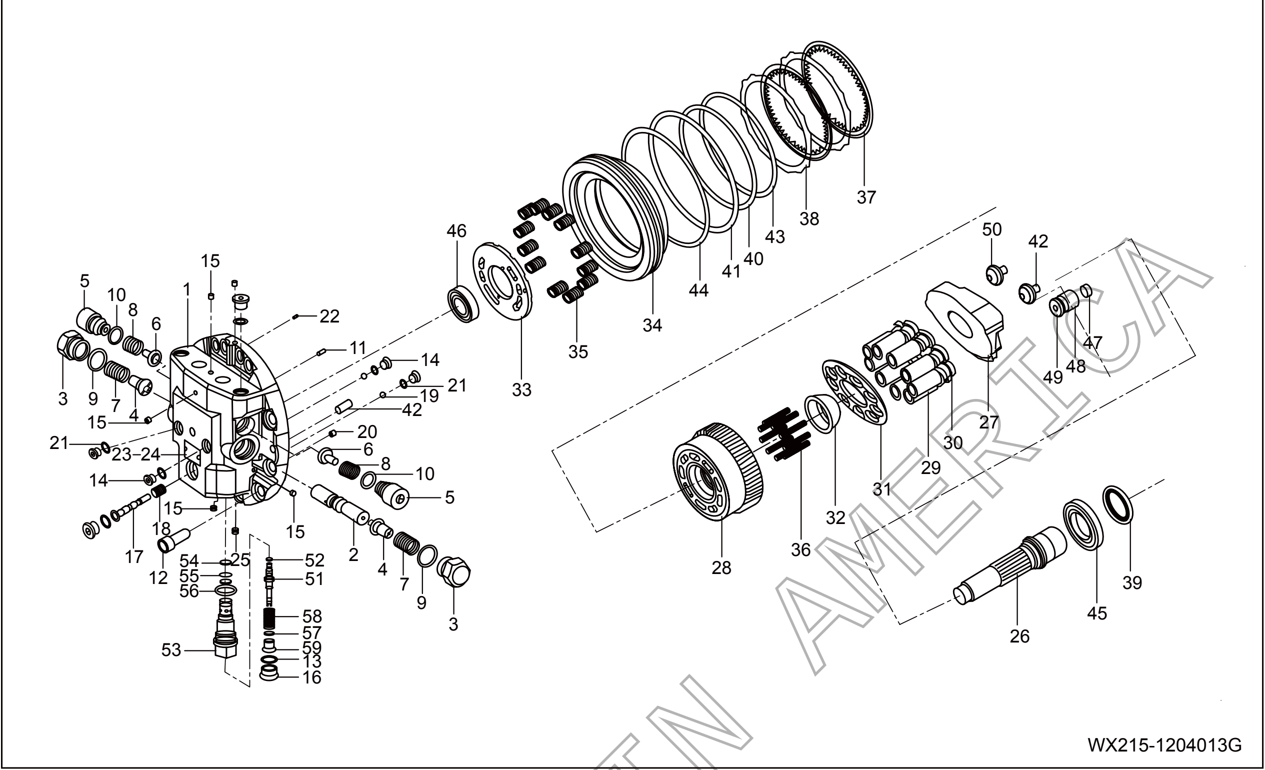


WX215-1204014G

Ps: Duo speed pilot hose port
P1: Pressure detection port
P2: Pressure detection port
P5: Parking brake release port
D1: Drain port
D2: Plug
A: Main oil port
B: Main oil port

				Working condition	
				Speed 1	Speed 2
Reduction gear	Gear ratio		49.95	←	
	Theoretical output torque	(kgf.m)	Max. 4650	4535	2767
	Theoretical output speed	(r.p.m)	Max. 60	28	45.9
Hydraulic motor	Displacement	(cc/rev)	Max. 174.7	162.9	99.4
	Continuous pressure	(kgf/cm2)	Max. 350	350	
	Theoretical speed	(r.p.m)	Max. 2800	1400	2294
	Flow	(l/min)	250	228	
	Duo speed control pressure	(kgf/cm2)	20~70	←	
	Braking torque	(kgf.m)	Min. 50	←	
	Brake release pressure	(kgf/cm2)	8.2	←	
Relief valve activation pressure			1~3L/min (above 365) 15L/min (above 420)		

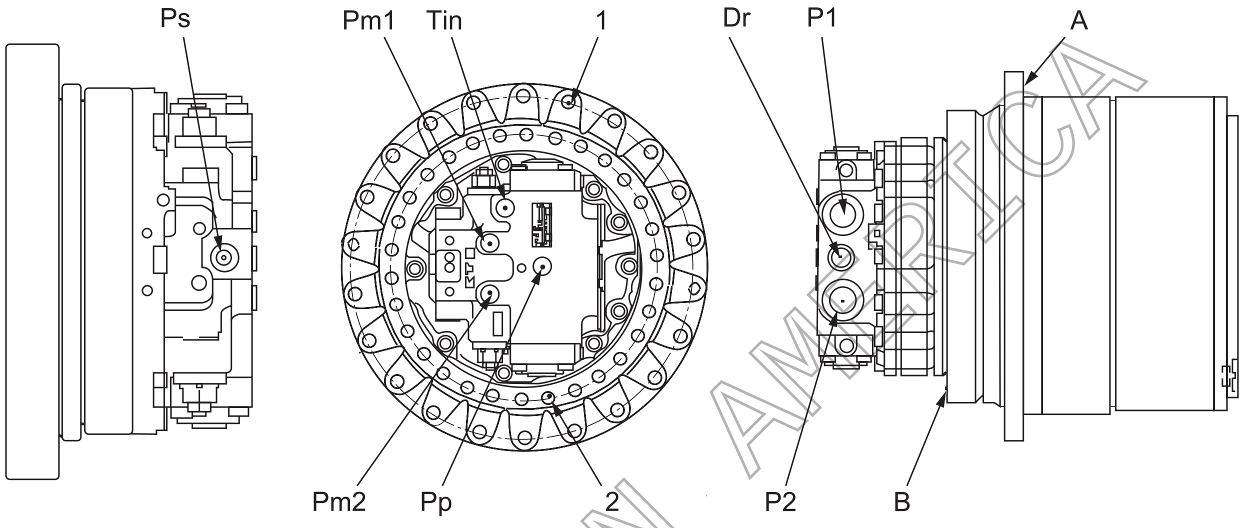
Explosive view



1) Flange, rear
2) H5 balance valve spool
3) Plug
4) D type block
5) Check plug
6) Check valve
7) Spring
8) Stop spring
9) O-ring
10) O-ring
11) Parallel pin
12) Socket head bolt
13) O-ring
14) Plug
15) Plug
16) Plug
17) Spool
18) Spring
19) Ball
20) Orifice
21) O-ring
22) Filter
23) Name plate
24) Rivet
25) Plug
26) Drive shaft
27) P-type swash plate
28) Cylinder block
29) Piston
30) Stopper
31) Baffle
32) Spheric bush
33) Timing plate
34) Parking piston
35) Spring
36) Cylinder block spring
37) Friction plate
38) Spacer
39) Oil seal
40) O-ring
41) O-ring
42) Parallel pin
43) Washer
44) Washer
45) Ball bearing
46) Ball bearing
47) Spring
48) Piston
49) Stopper
50) Pivot
51) Plunger
52) Piston seal
53) Valve body
54) Washer
55) O-ring
56) O-ring
57) Shim
58) Spring
59) Piston rod

Model: MAG-170VP-3400E

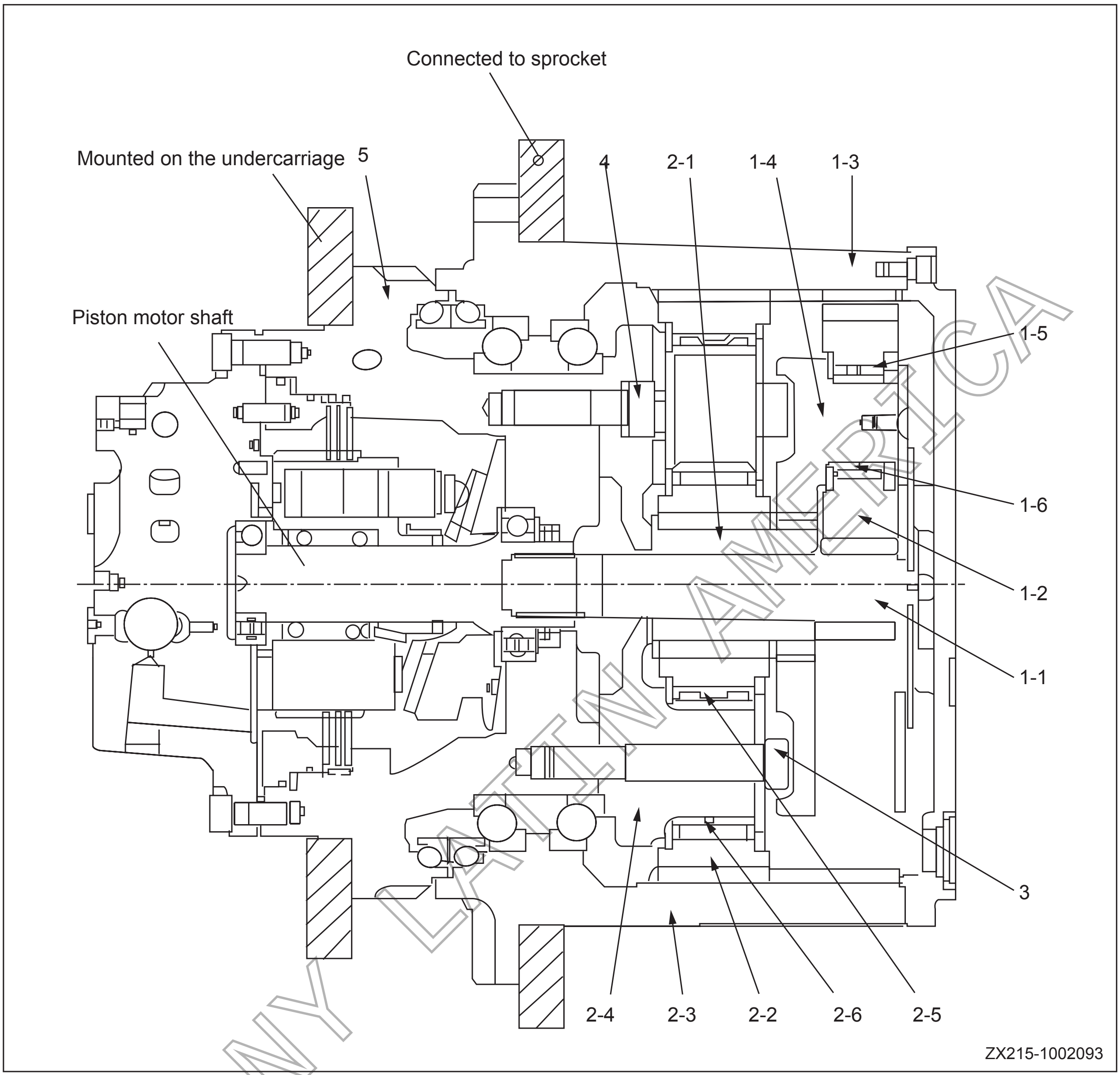
NOTE: For the location of the travel motor on the machine, see “Hydraulic equipment layout” on page 4-24.



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

NOTE: For more technical information about the travel motor, see “Travel motor” on page 3-7.


Connected to sprocket
Mounted on the undercarriage
5
4
2-1
1-4
1-3
Piston motor shaft
1-5
1-6
1-2
1-1
3
2-4
2-3
2-2
2-6
2-5
ZX215-1002093

4.6.6.1 Operation of components

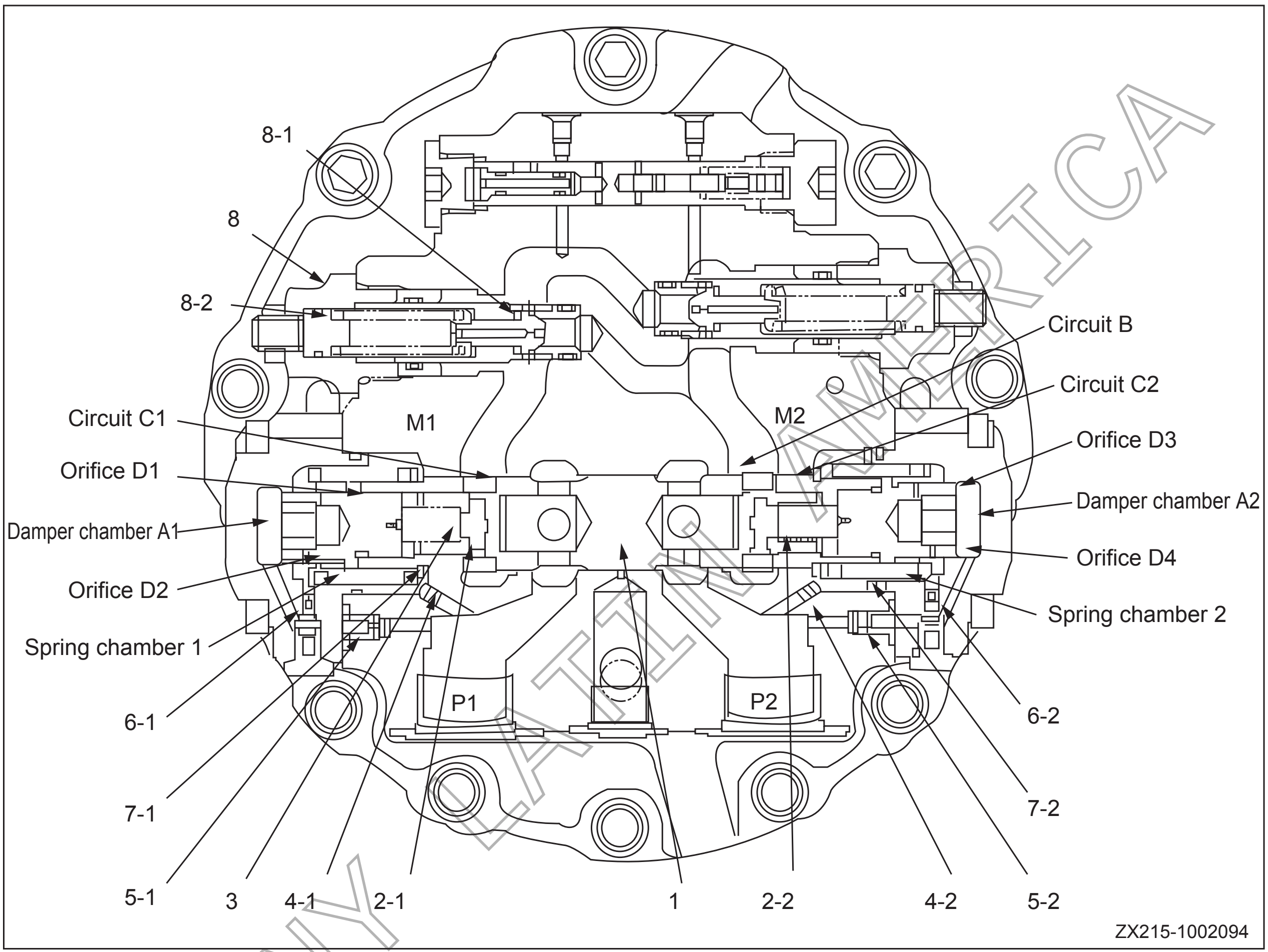
Counterbalance valve

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.

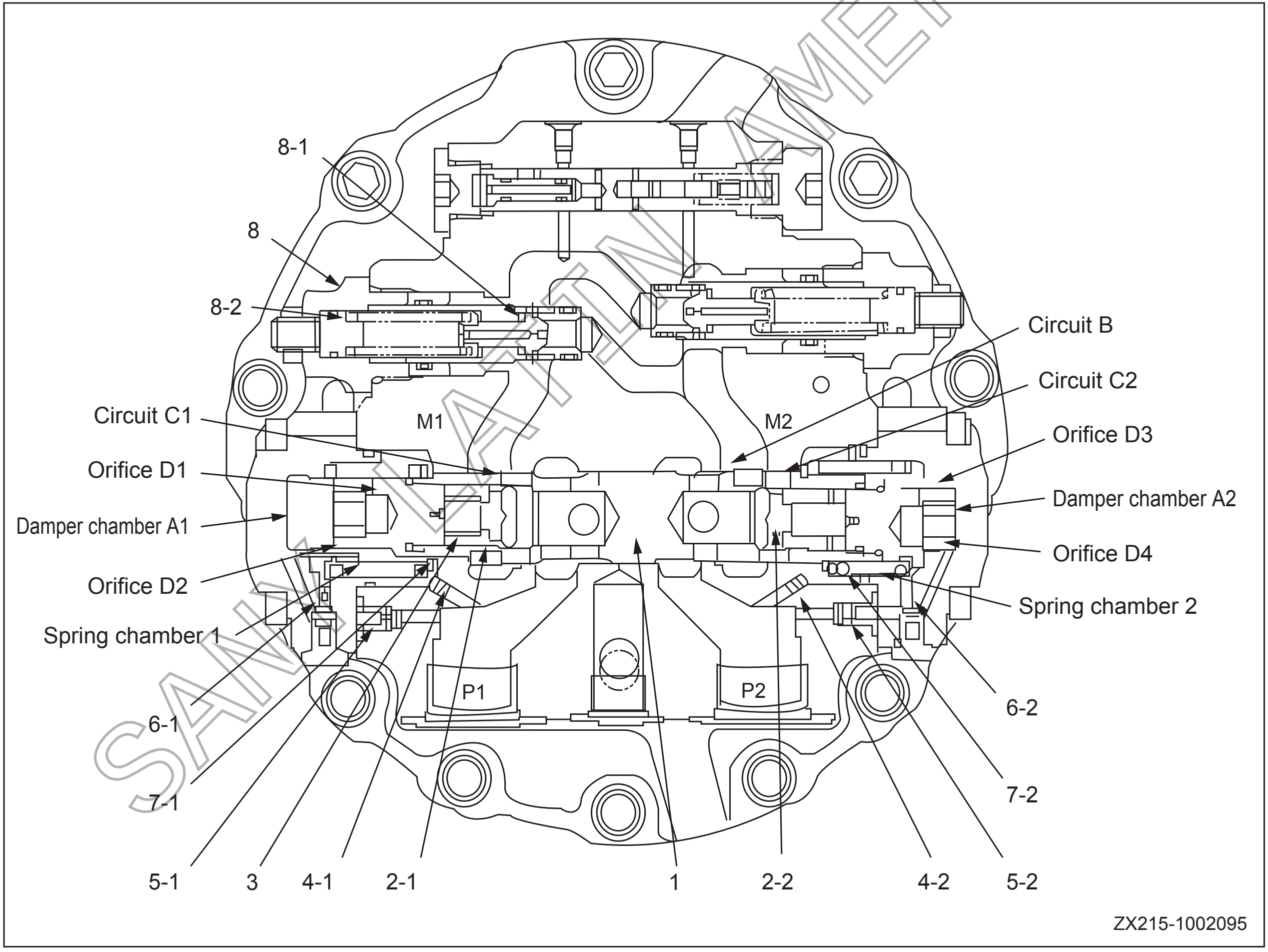
A. Stopped state

- 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.



B. When the motor is activated

- 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.

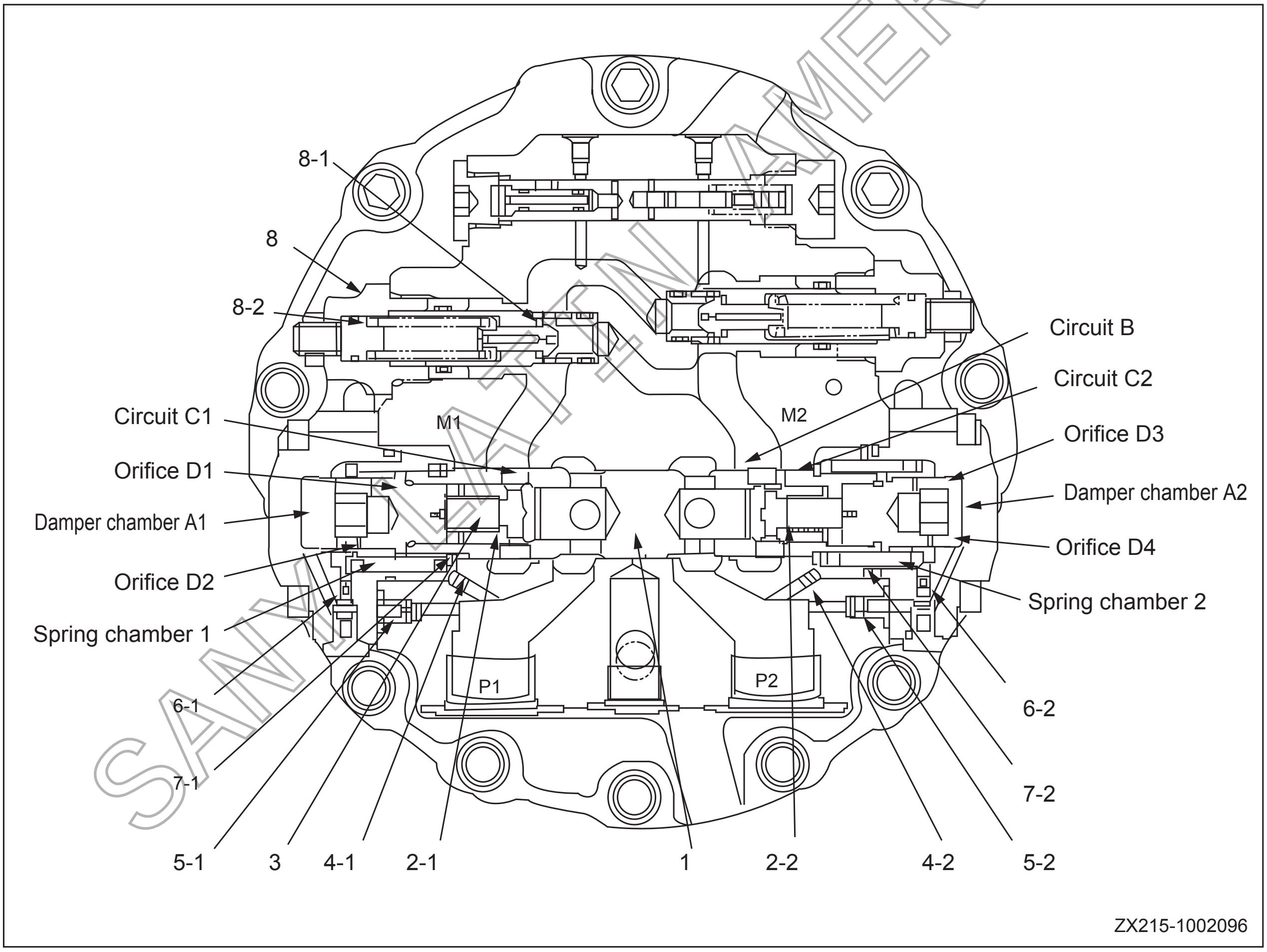


C. Counterbalance function

- 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.

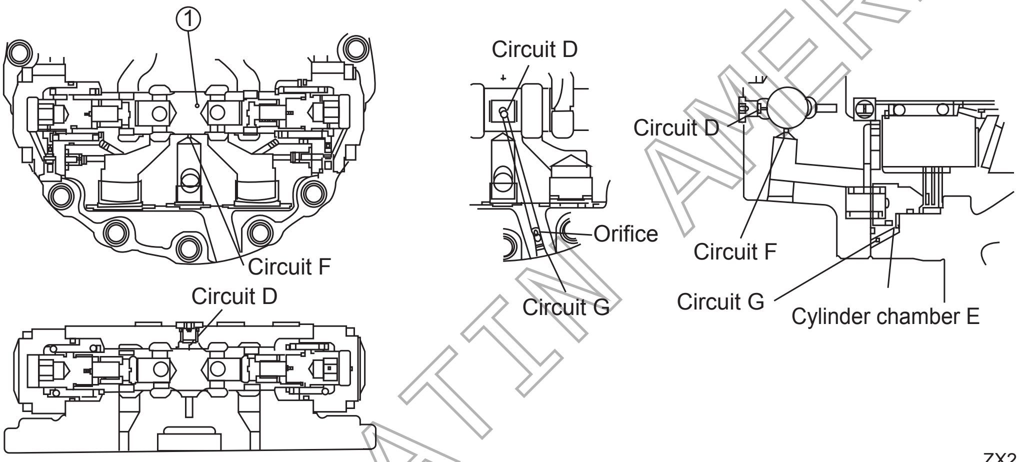
D. Braking of motor

- 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.



E. Shuttle valve function for high pressure selection

- 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.



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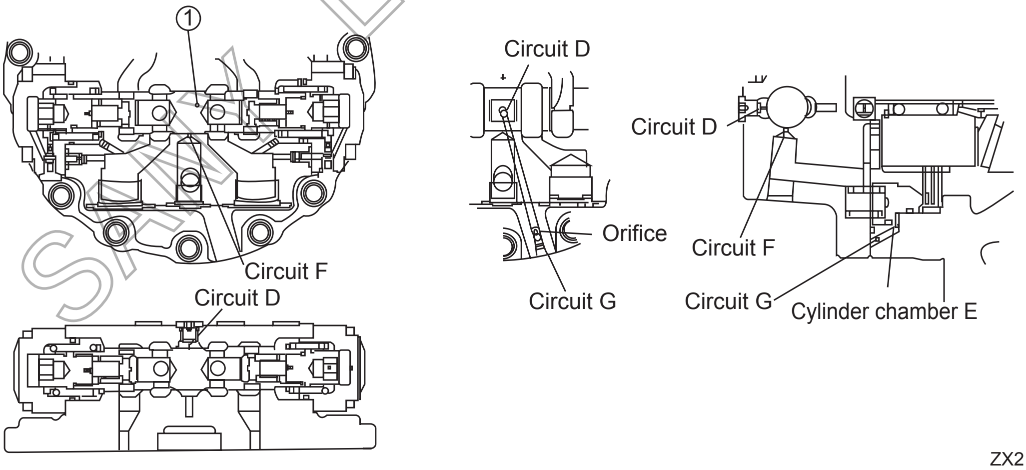
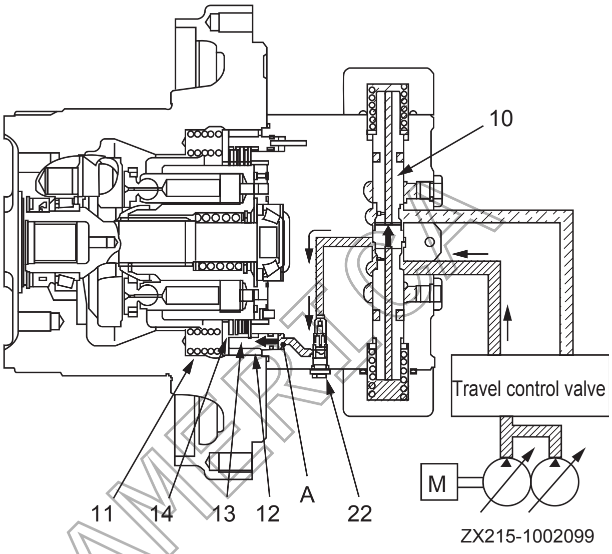


ZX215-1002098

Operation of parking brake

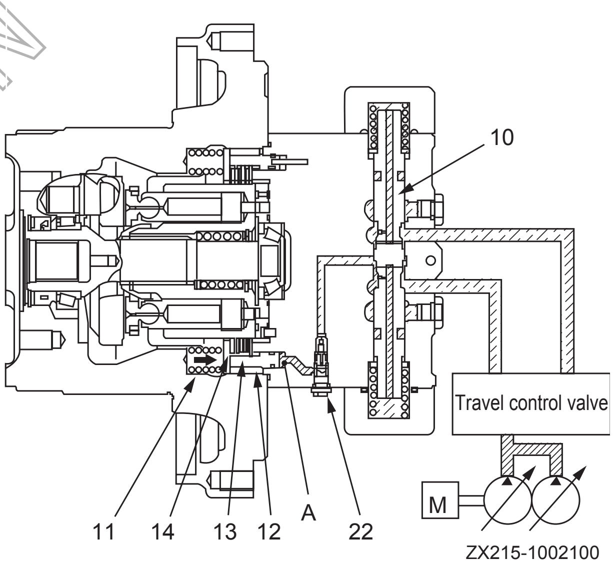
1) When travel begins



ZX215-1002099

- 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

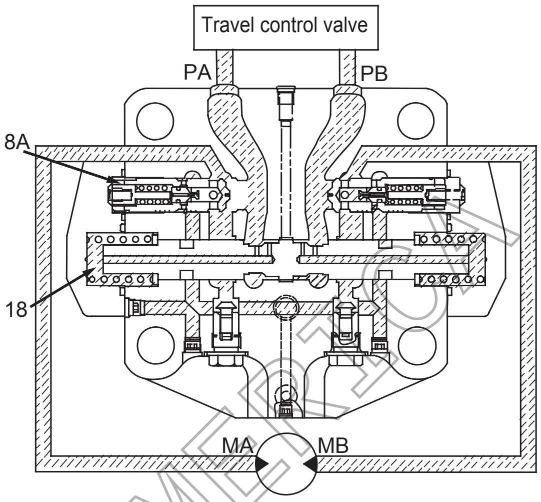


ZX215-1002100

- 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.

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.

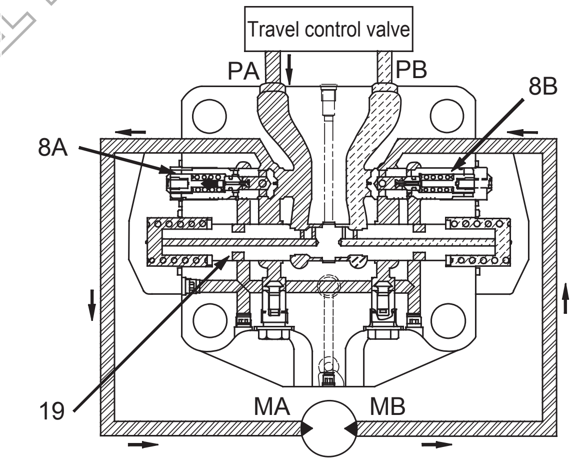


ZX215-1002101

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).

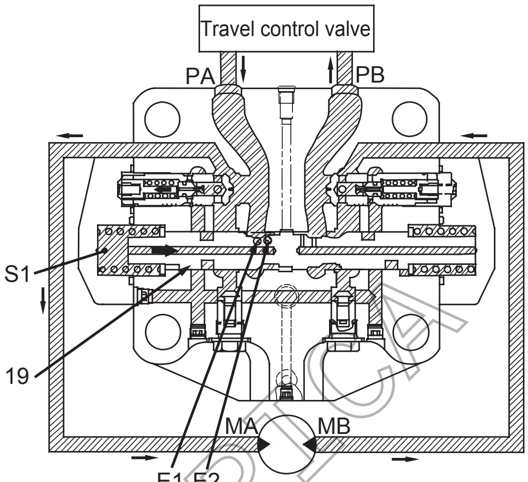


ZX215-1002102

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.

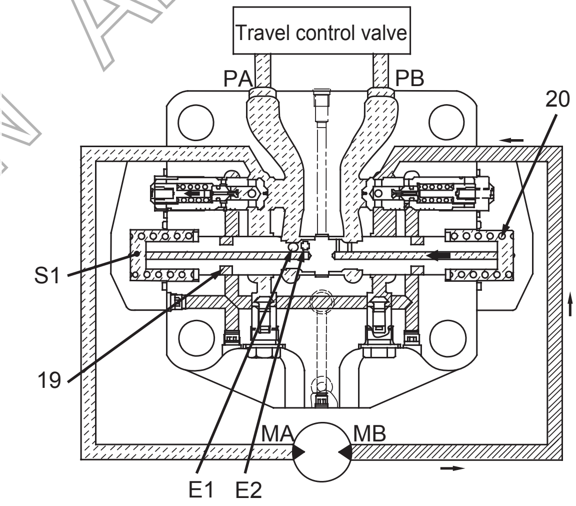
- The pressurized oil on the supply side flows to chamber (S1) via orifice (E1) and orifice (E2) of the spool (19). As the pressure in chamber (S1) goes above the spool selector pressure, spool (19) is pushed toward the right. Port (MB) and port (PB) are connected, the motor outlet port side opens and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



ZX215-1002103

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.



ZX215-1002104

2) Safety valve

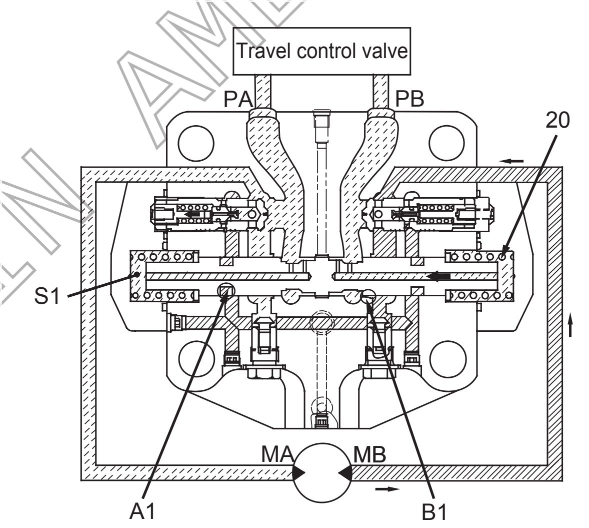
Function

- 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

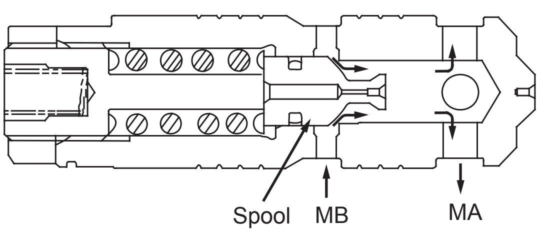
1. When travel is stopped (or when travelling downhill) (Right swing)

- 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.



ZX215-1002105

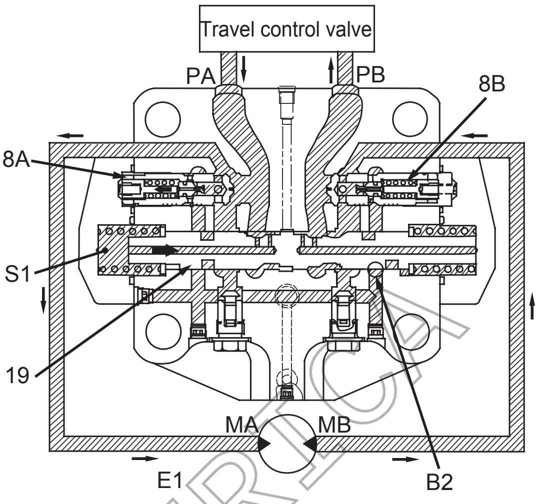
- When the pressure rises above the set pressure of the suction safety valve (8A), the poppet opens. The pressurized oil passes through notch (A1) of spool (19) into chamber (MA) of the circuit at the opposite side.



ZX215-1002107

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

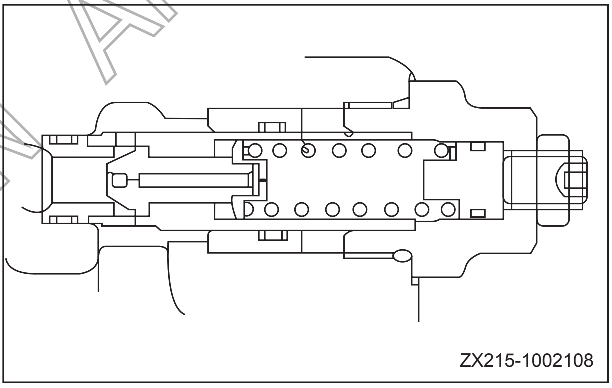
- As the travel lever is operated, the pressurized oil from the pump moves spool (19) toward right. The passage to the suction safety valve functions as a circuit which passes through notch (B2) of spool (19), producing large differential pressure. The pump pressure rises, providing a large tractional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



ZX215-1002106

3) Relief valve

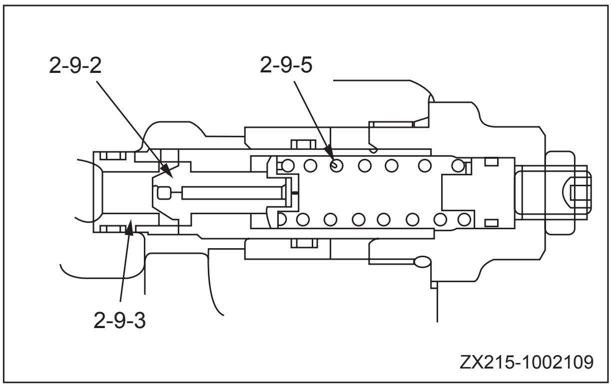
- The structure of the relief valve is shown in the right figure. This valve is area difference and direct flow type. It has impact damping function during starting and braking.



ZX215-1002108

A. Operation principle and function

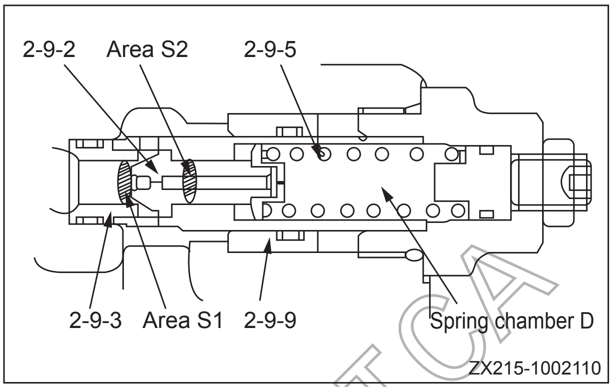
- When the main valve makes the motor to start or brake, front pressure of cone valve (2-9-2) rises above the set pressure and the force of spring (2-9-5), and moves cone valve (2-9-2) to the right and off the valve seat. Pressurized oil in the front of cone valve (2-9-2) is bypassed to the low pressure 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.



ZX215-1002109

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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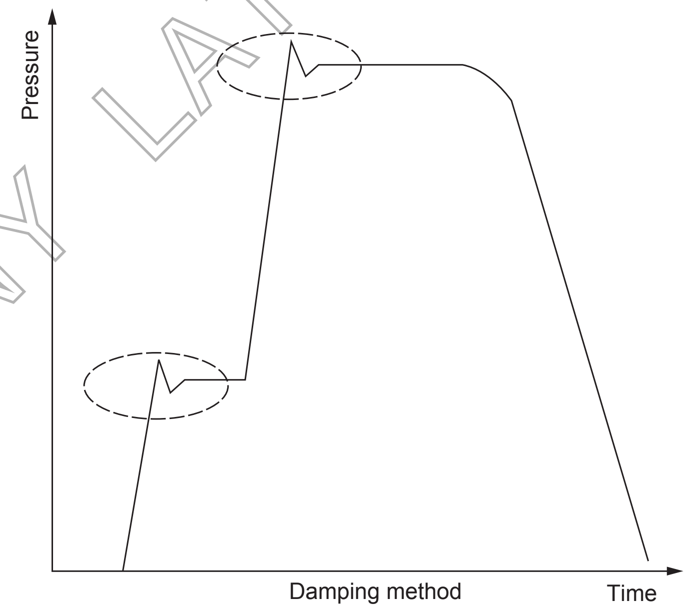

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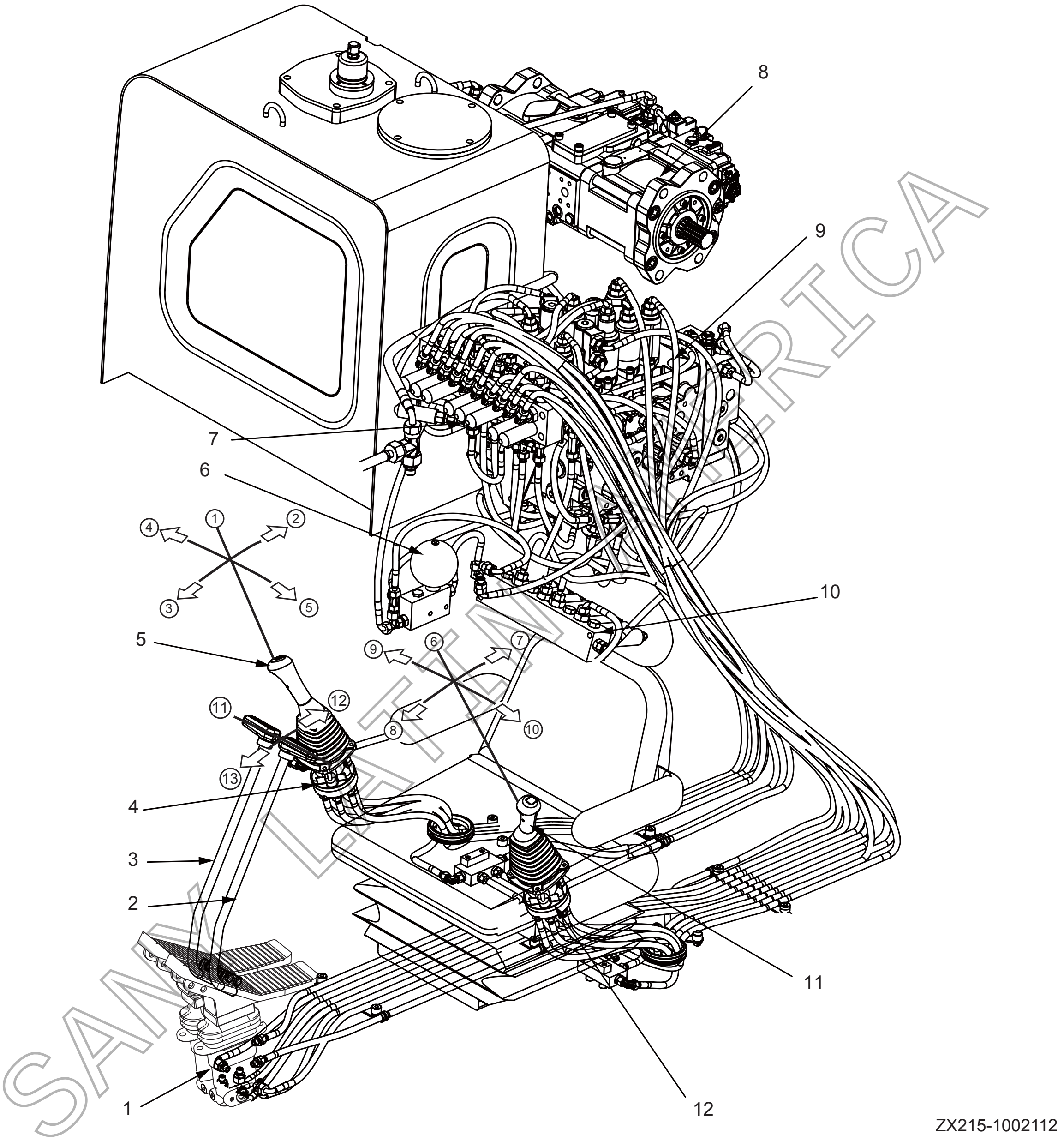
4.6.7 Valve control system



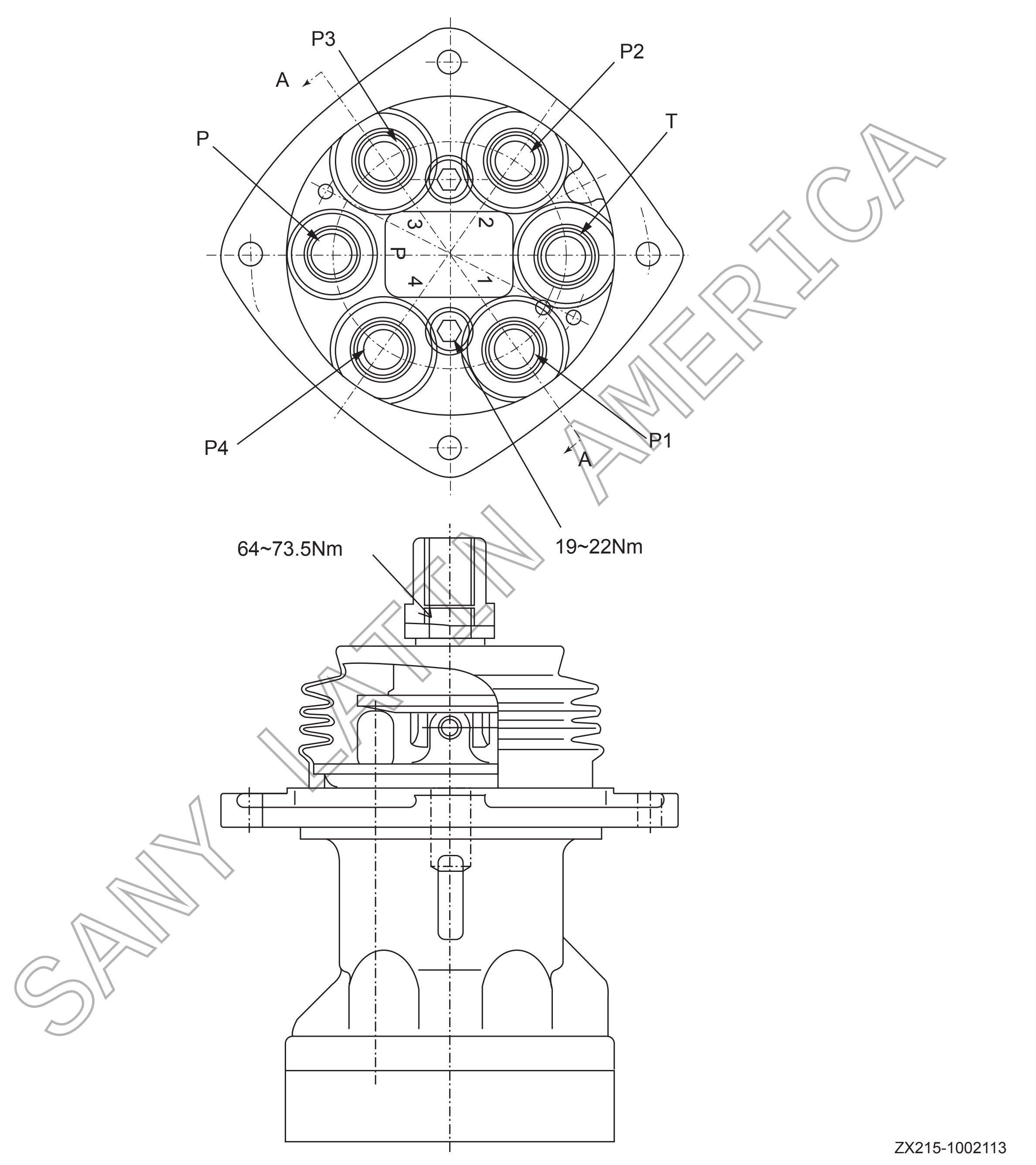
1. Travel PPC valve
2. L. travel control lever
3. R. travel control lever
4. Right PPC valve
5. Right joystick
6. Accumulator
7. Transition block
8. Hydraulic pump
9. Main control valve
10. Solenoid valve
11. Left joystick
12. Left PPC valve

Control lever position

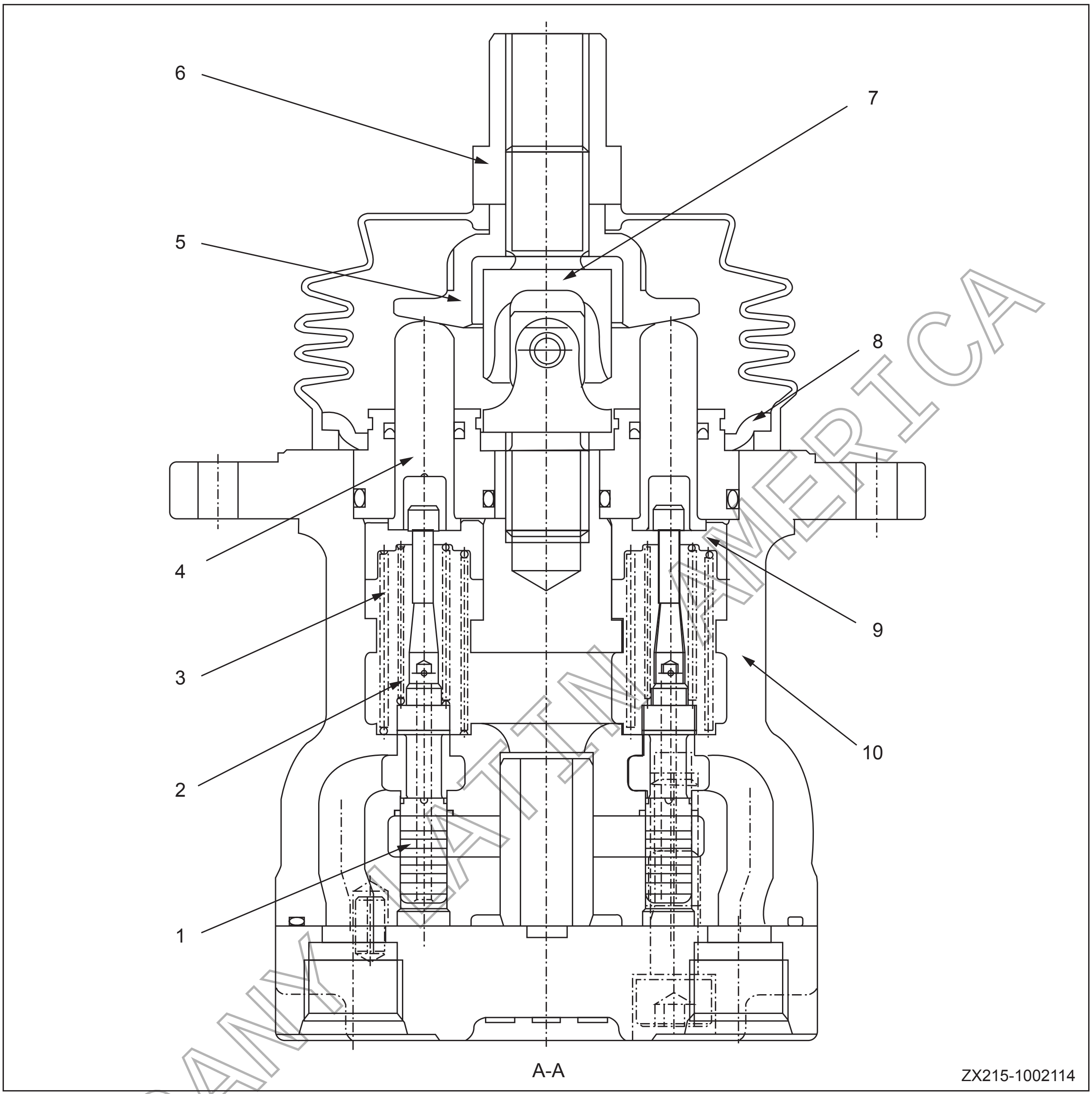
(1) HOLD
(2) Boom UP
(3) Boom DOWN
(4) Bucket DUMP
(5) Bucket DIG
(6) HOLD
(7) Arm IN
(8) Arm OUT
(9) Right swing
(10) Left swing
(11) Neutral
(12) Reverse travel
(13) Forward travel

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	



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

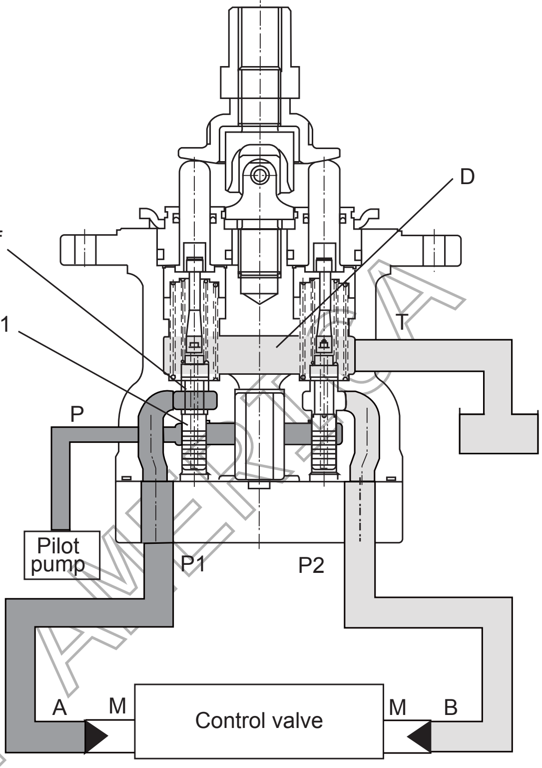
Operation

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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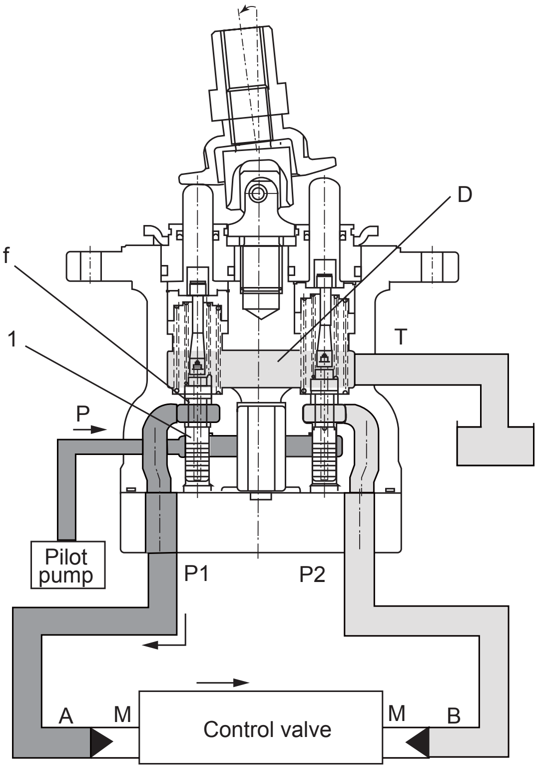
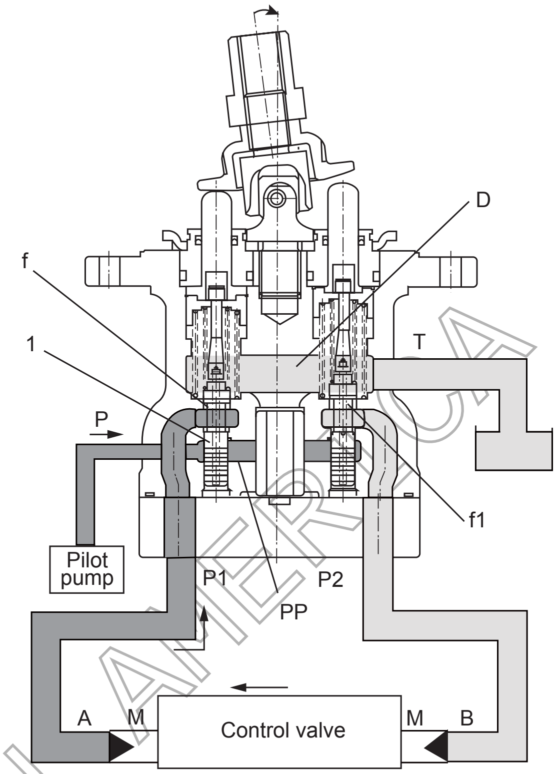


ZX215-1002116

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

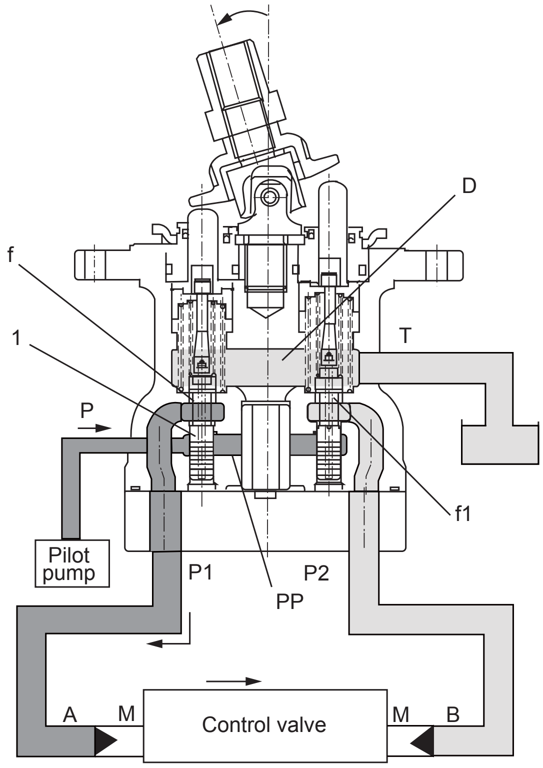
- When disc (5) starts to return, plunger (1) is pushed up by the force of centering spring (3) and the pressure at port (P1).
- Because of this, orifice (f) is connected to drain chamber (D), and the pressurized oil at port (P1) is released.
- If the pressure of port (P1) is lowered excessively, plunger (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.



ZX215-1002117

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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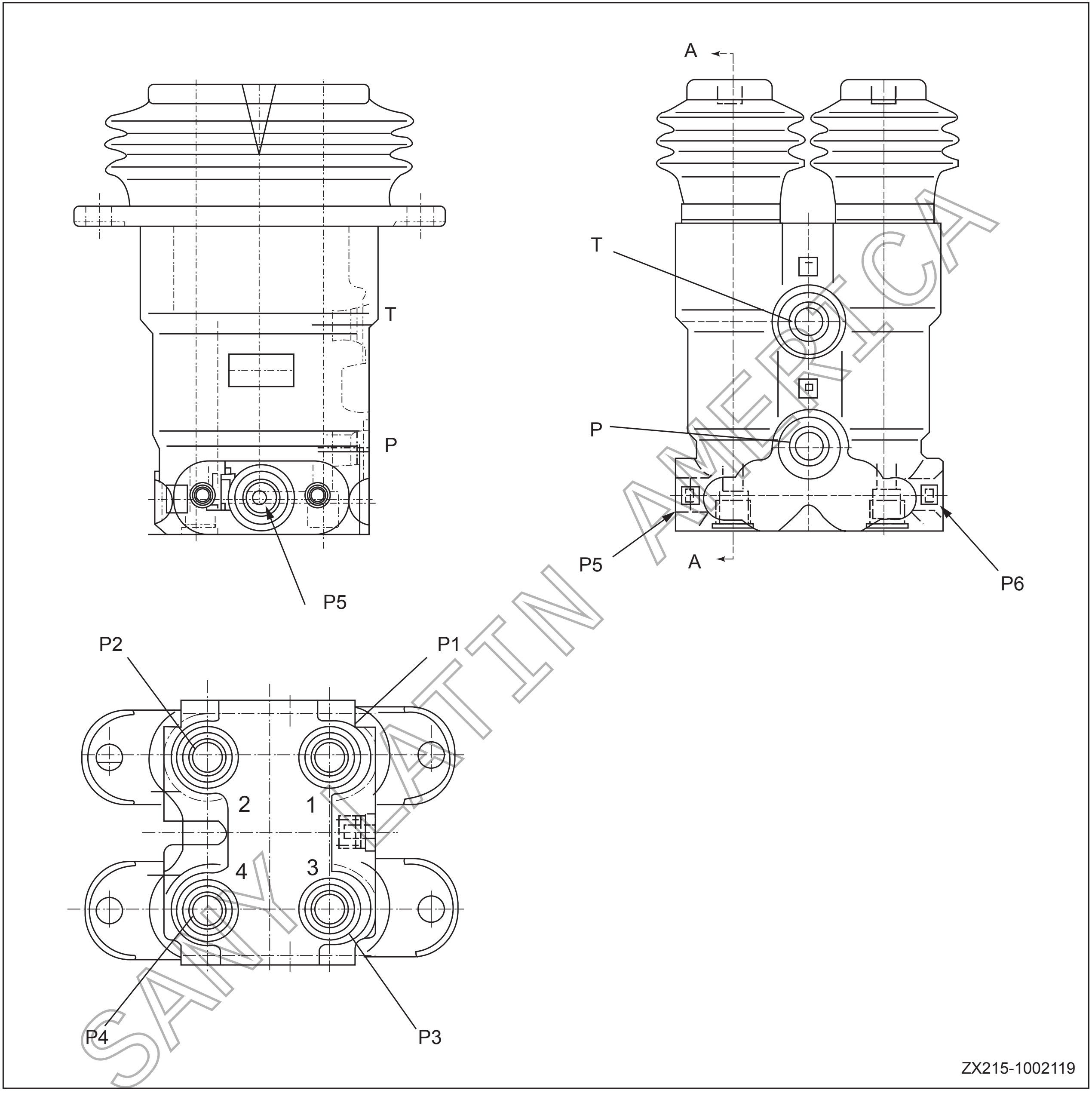
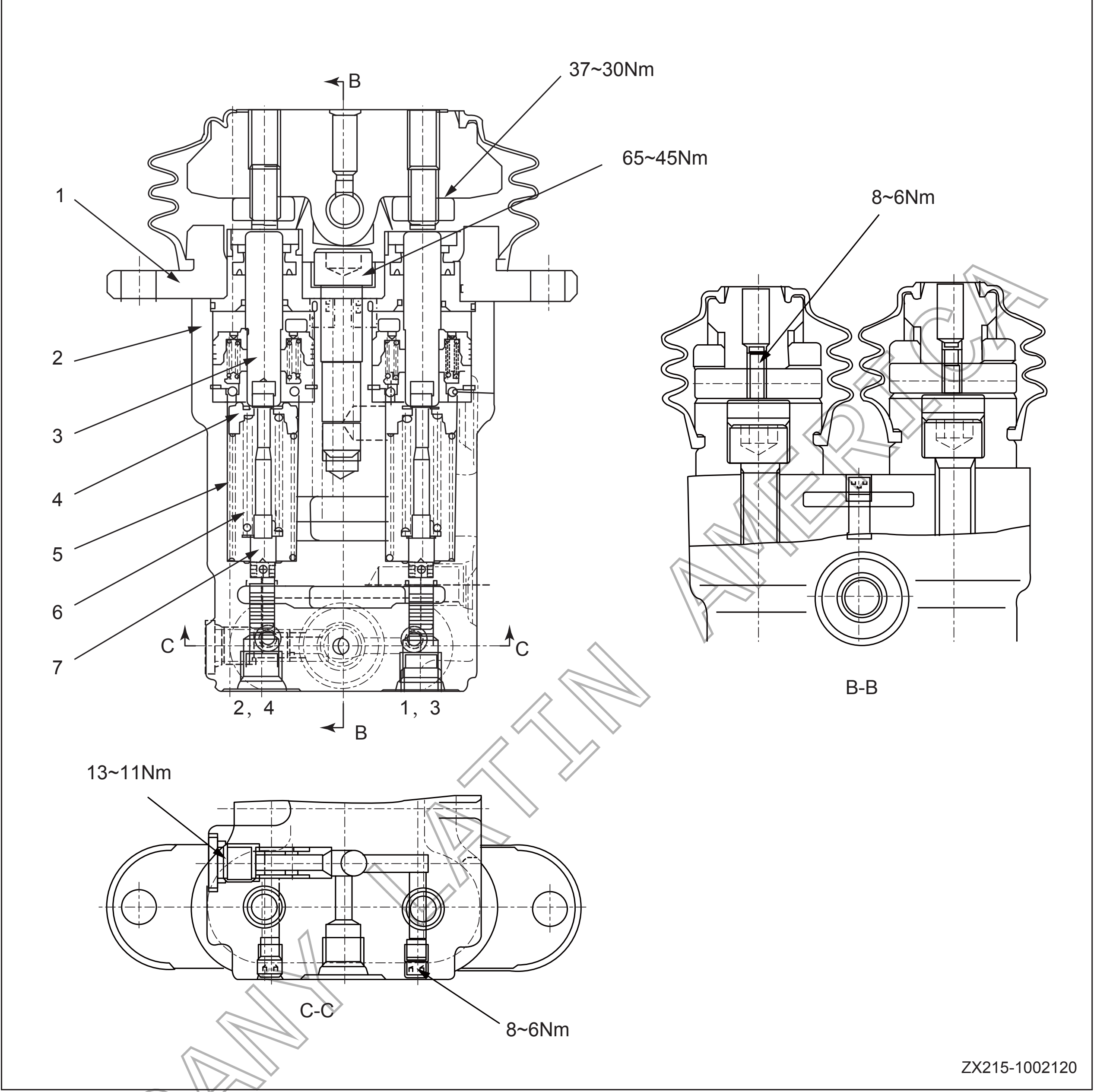
4.6.8.2 Travel PPC valve



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

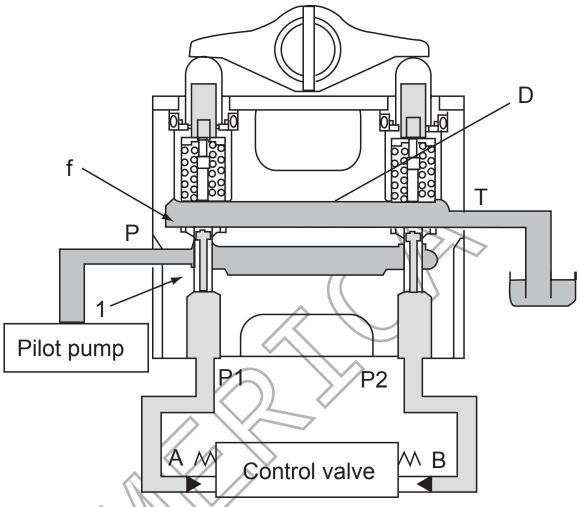


1)	Plate	5)	Centering spring
2)	Body	6)	Metering spring
3)	Piston	7)	Valve
4)	Collar		

Operation

1. When in neutral

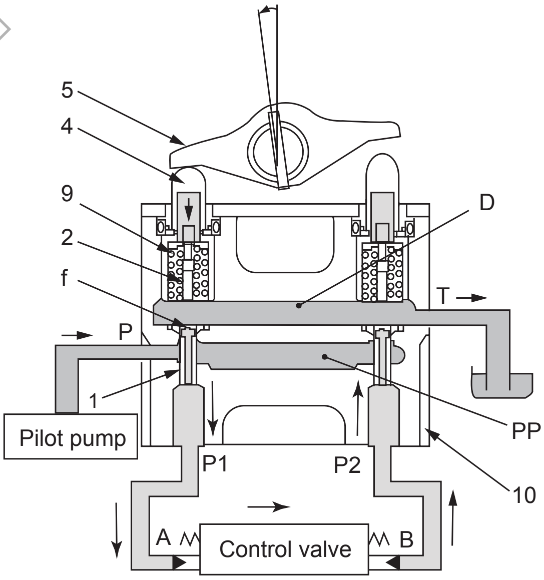
- Ports (A) and (B) of the control valve and ports (P1) and (P2) of the Pilot valve are connected to drain chamber (D) via orifice (f) in plunger (1).



ZX215-1002121

2. Fine control (Neutral to fine control)

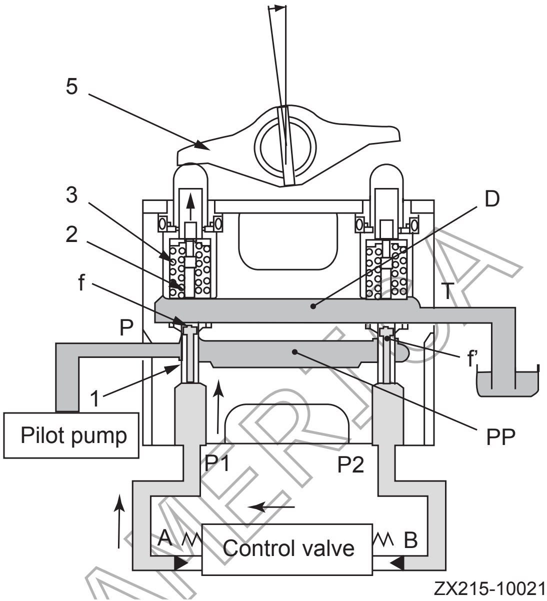
- When piston (4) is pushed by lever (5), retainer (9) is pushed, plunger (1) is also pushed by metering spring (2), and moves down. When orifice (f) is shut off from drain chamber (D), it is almost simultaneously interconnected to pump pressure chamber (PP).
- Pilot pressurized oil of the control pump 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.



ZX215-1002122

3. Fine control (When control lever is returned)

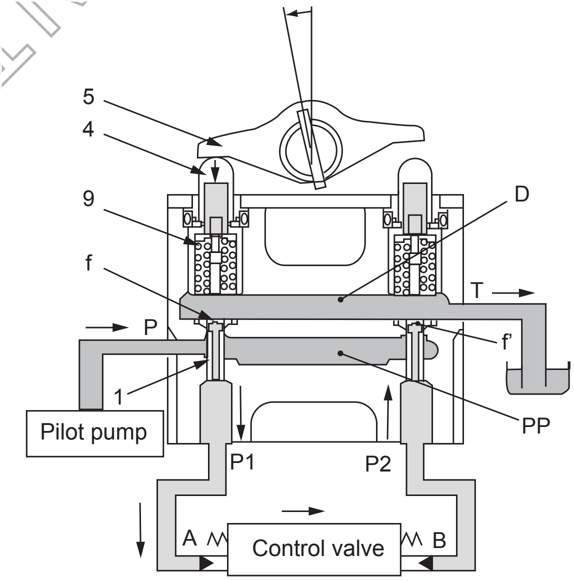
- When lever (5) starts to return, plunger (1) is pushed up by the force of centering spring (3) and pressure at port (P1).
- Because of this, orifice (f) is connected to drain chamber (D), and the pressurized oil at port (P1) is released.
- If the pressure of port (P1) is lowered excessively, plunger (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.



ZX215-1002123

4. At full stroke

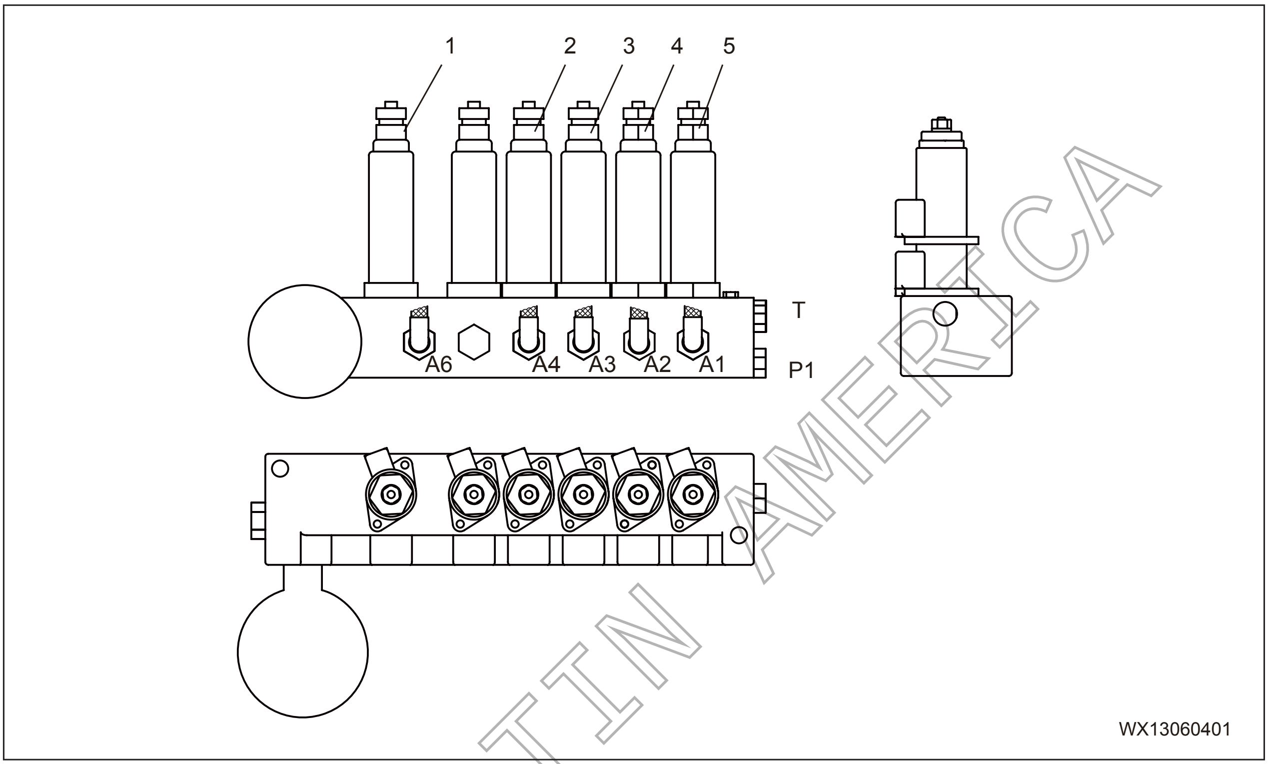
- Lever (5) pushes down piston (4), and retainer (9) pushes down plunger (1).
- Orifice (f) is shut off from drain chamber (D), and is interconnected to pump pressure chamber (PP).
- Therefore, the pilot pressure oil from the self pressure reducing valve passes through orifice (f) and flows to chamber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



ZX215-1002124

4.6.9 Solenoid valve

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

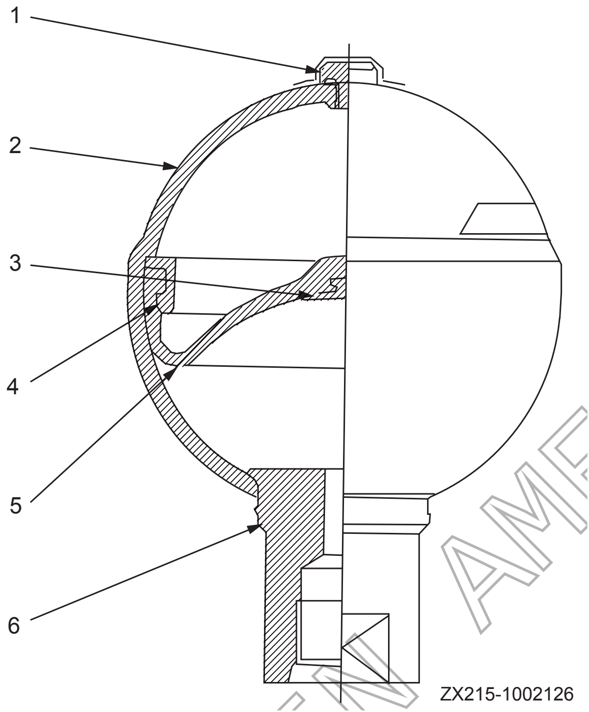


1) Travel hi/lo speed solenoid valve
2) Swing priority solenoid valve
3) Bucket confluence solenoid valve
4) Boom to arm priority solenoid valve
5) Pilot lockout solenoid valve

T:	To oil tank
P:	From accumulator and pilot pump
A1	To center swivel joint port
A2	To main valve port PsP
A3	To main valve port Xbp2
A4	To main valve port PnA2
A6	To pilot valve block P

NOTE: For the location of the solenoid valve on the machine, see “Hydraulic equipment layout” on page 4-24.

4.6.10 Accumulator

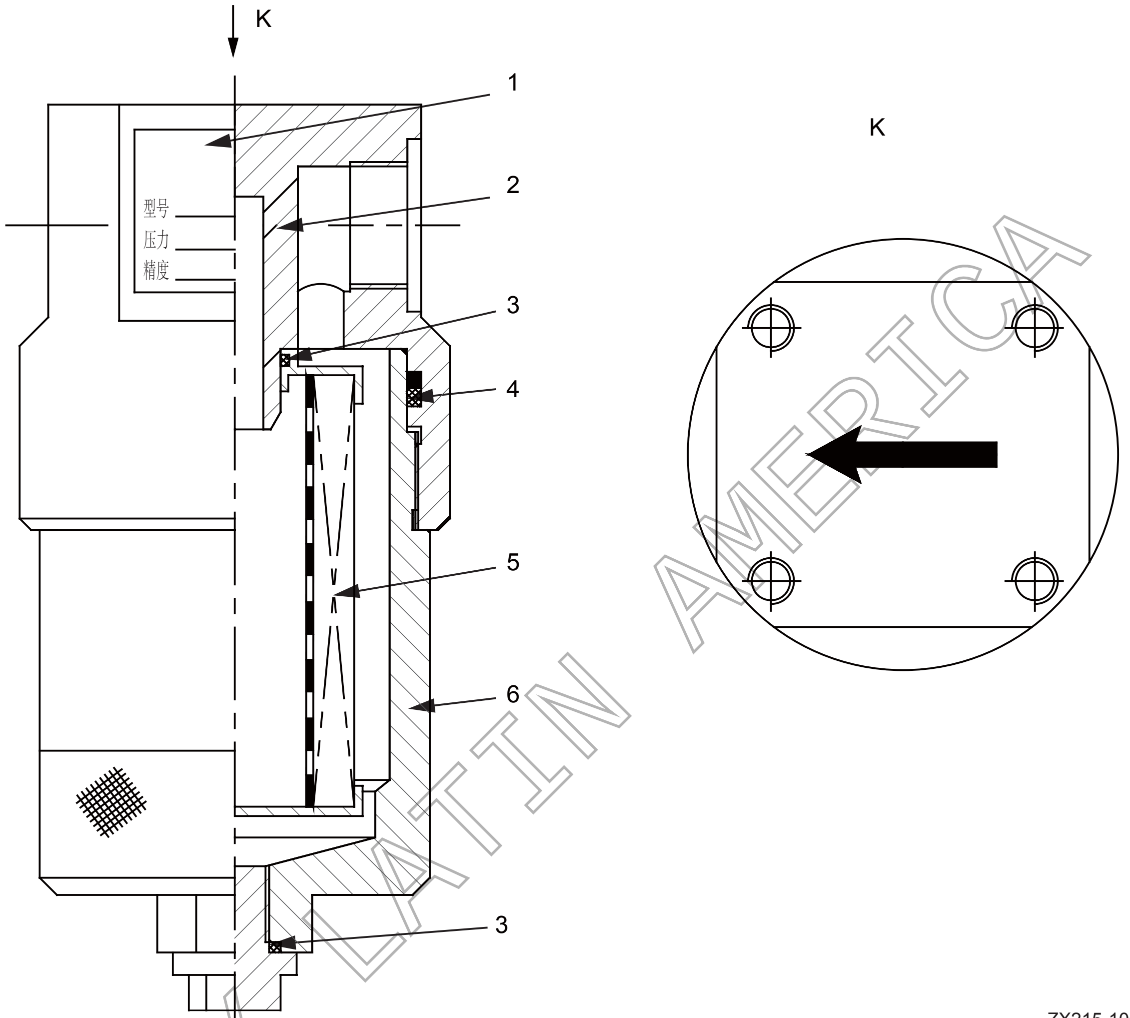


1) Gas plug
2) Shell
3) Poppet
4) Holder
5) Bladder
6) Oil port

Specifications

Gas capacity: 300 cm³

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

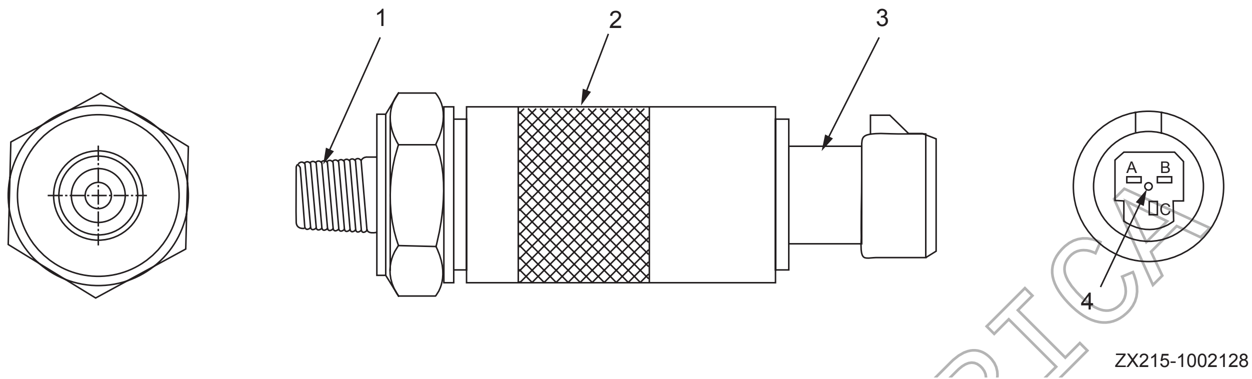
Max. operating pressure: 40 Mpa

Pressure loss: 0.05 Mpa

Max. allowable pressure difference: 1 Mpa

Specification of inlet/outlet port o-ring: 30×3.1

4.6.12 Pump oil pressure sensor



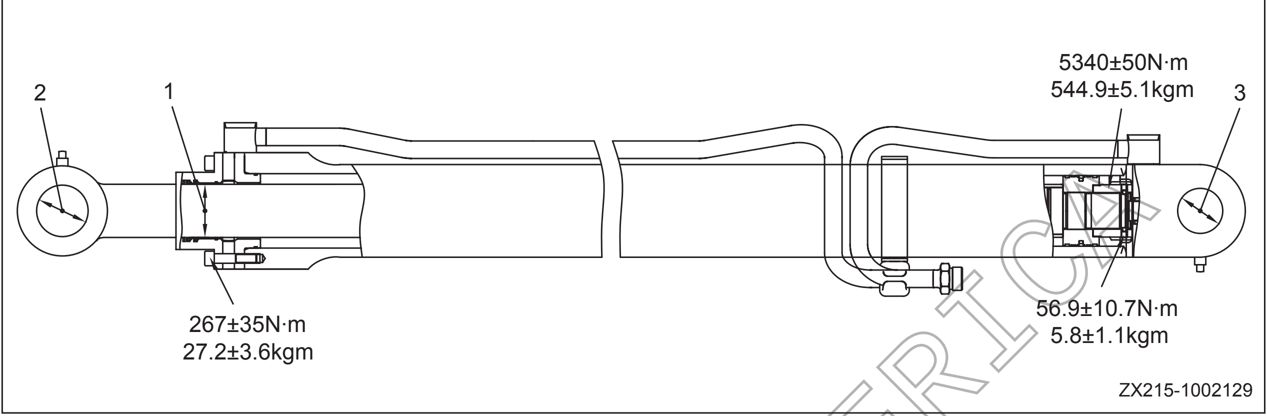
1) Pressure connector
2) Name plate
3) Connector
4) Vent hole

Function

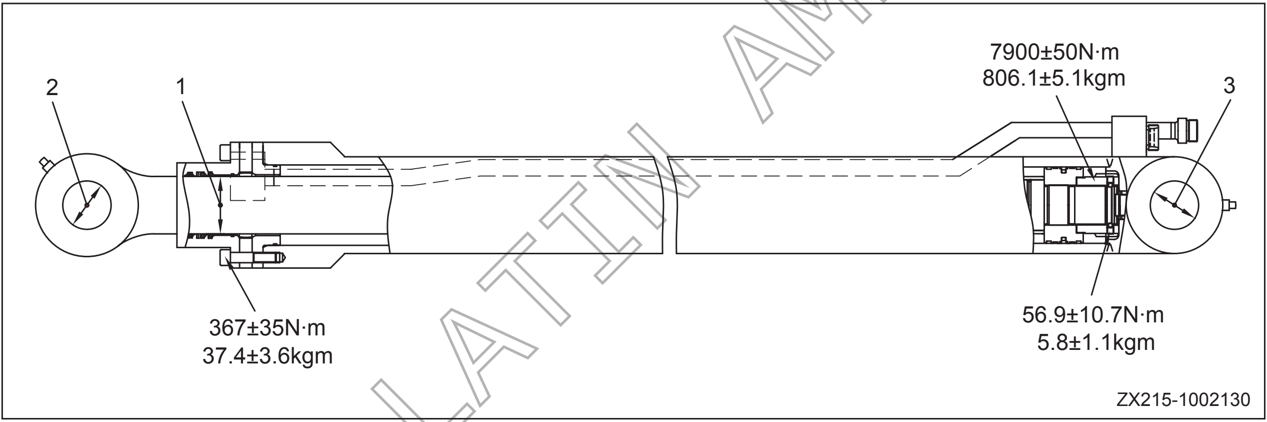
- This sensor measures pump oil pressure and uses it to control various machine operations. When oil pressure compresses the diaphragm, it deforms and this is detected in the form of electric signals.

4.6.13 Hydraulic cylinder

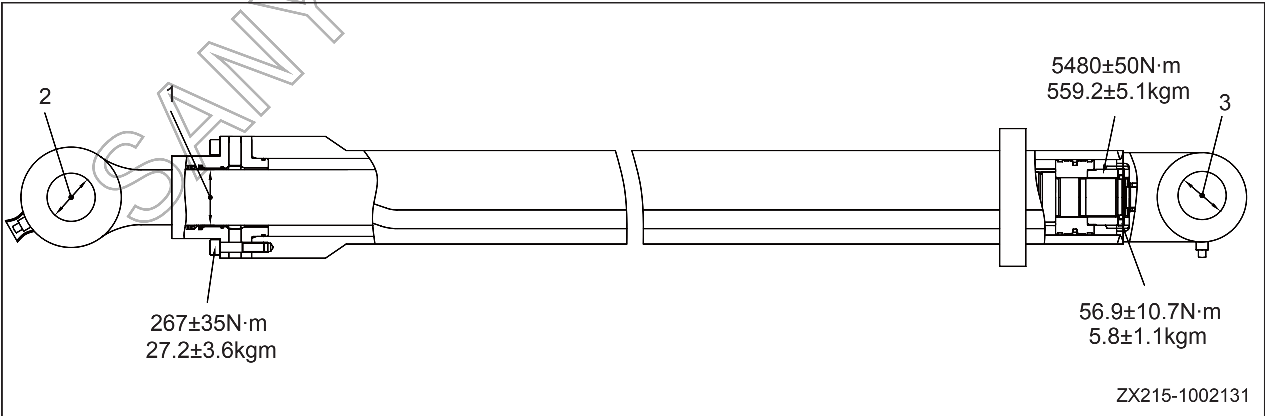
Boom cylinder



Arm cylinder



Bucket cylinder



100 hours greasing

Unit: mm

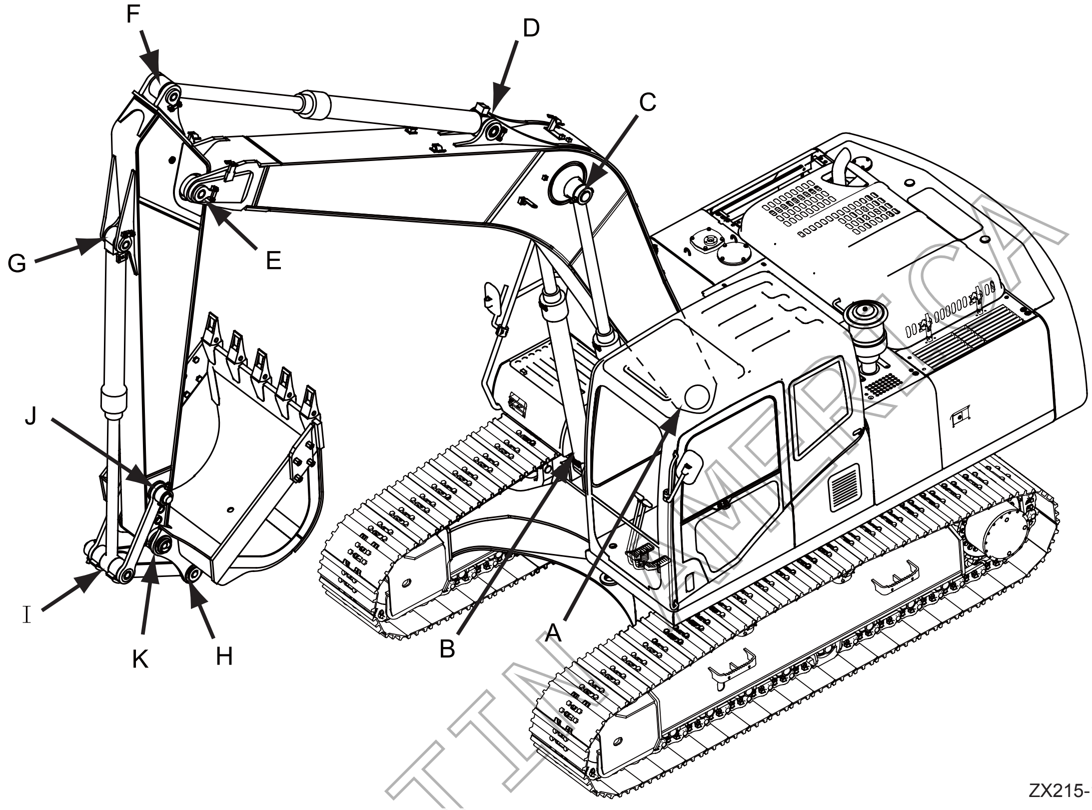
No.	Check item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	85	-0.036 -0.090	+0.222 +0.047	0.083 – 0.312	0.412	Replace bushing
		Arm	95	-0.036 -0.090	+0.222 +0.047	0.083 – 0.312	0.412	
		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

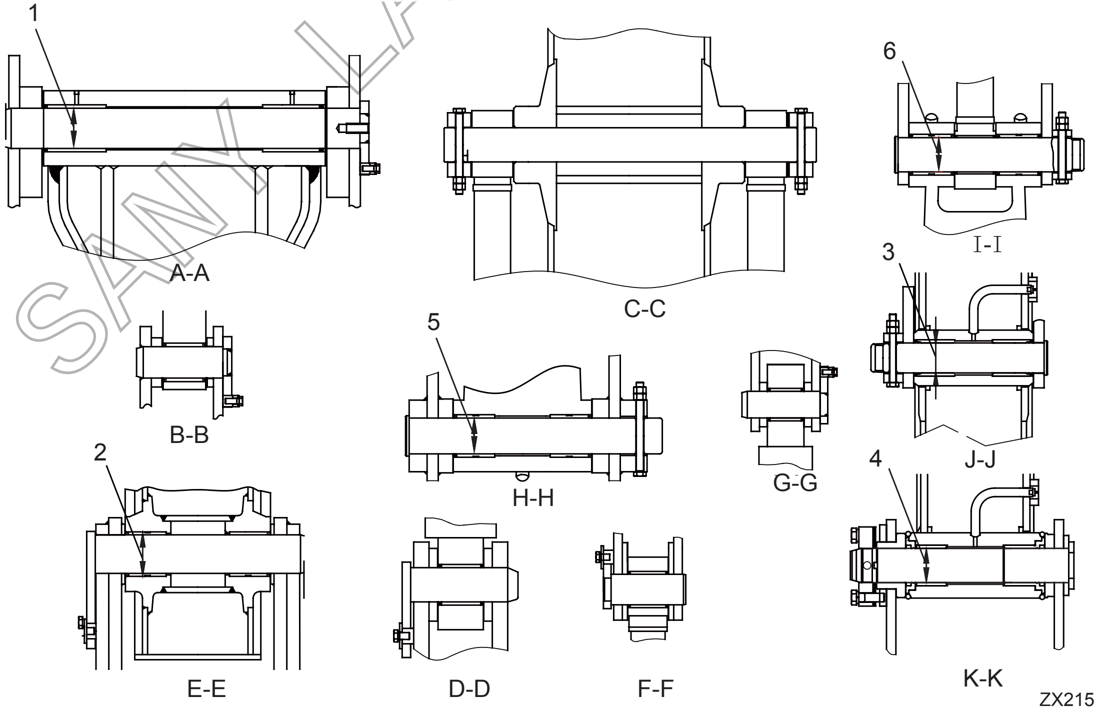
Unit: mm

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	

4.6.14 Work equipment



ZX215-1002133



ZX215-1002134

100 hour greasing

Unit: mm

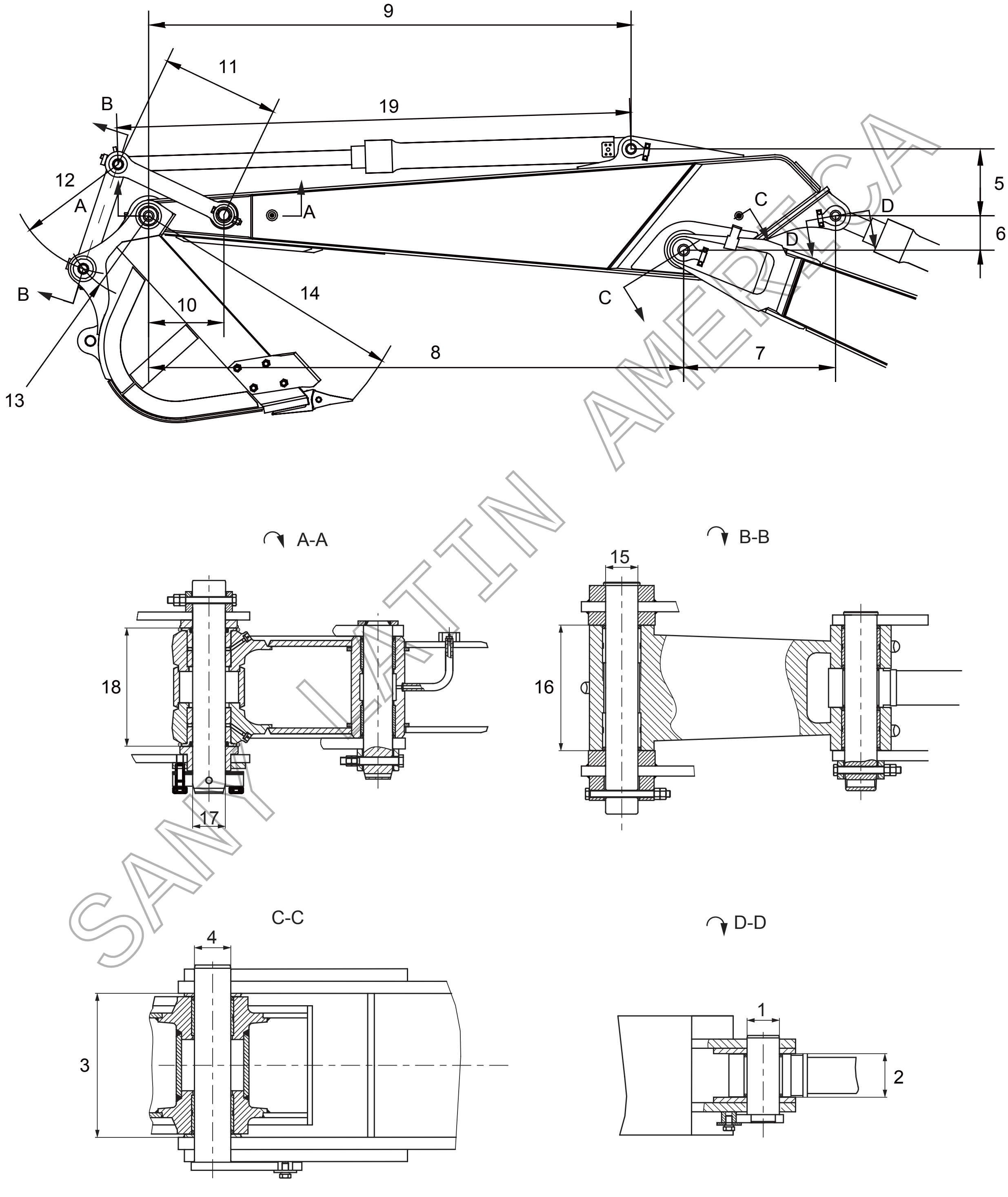
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pin connecting boom and revolving frame and bushing	90	–0.036 –0.071	+0.140 +0.105	0.141 ~ 0.211	1.0	Replace
2	Clearance between pin connecting boom and arm and bushing	90	–0.036 –0.071	+0.174 +0.104	0.140 ~ 0.345	1.0	
3	Clearance between pin connecting arm and rocker and bushing	70	–0.030 –0.060	+0.335 +0.275	0.305 ~ 0.395	1.0	
4	Clearance between pin connecting arm and bucket and bushing	80	–0.030 –0.060	+0.324 +0.270	0.300 ~ 0.384	1.0	
5	Clearance between pin connecting linkage and bucket and bushing	80	–0.030 –0.060	+0.373 +0.273	0.303 ~ 0.433	1.0	
6	Clearance between pin connecting linkages and bushing	70	–0.030 –0.060	+0.335 +0.275	0.305 ~ 0.395	1.0	

500 hour greasing

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pin connecting boom and revolving frame and bushing	90	–0.036 –0.071	+0.131 +0.074	0.110 ~ 0.202	1.0	Replace
2	Clearance between pin connecting boom and arm and bushing	90	–0.036 –0.071	+0.166 +0.074	0.110 ~ 0.237	1.0	
3	Clearance between pin connecting arm and rocker and bushing	70	–0.030 –0.060	+0.158 +0.078	0.108 ~ 0.218	1.0	
4	Clearance between pin connecting arm and bucket and bushing	80	–0.030 –0.060	+0.137 +0.074	0.104 ~ 0.197	1.0	
5	Clearance between pin connecting linkage and bucket and bushing	80	–0.030 –0.060	+0.166 +0.086	0.116 ~ 0.226	1.0	
6	Clearance between pin connecting linkages and bushing	70	–0.030 –0.060	+0.154 +0.074	0.104 ~ 0.214	1.0	

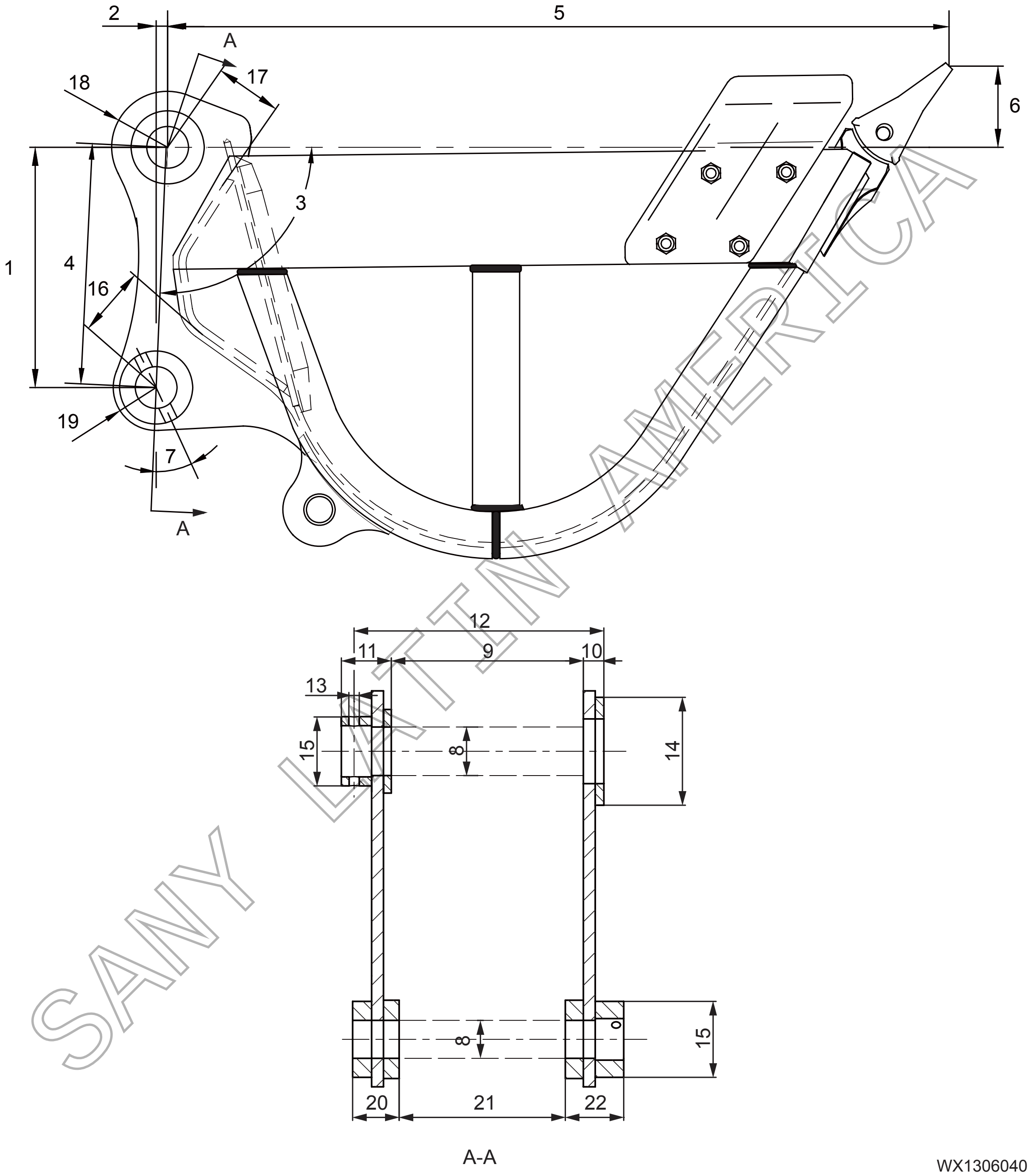
Arm dimension



Unit: mm

No.		SY195/205/215C-9		SY225C-9	
		Standard size	Tolerance	Standard size	Tolerance
1		φ80	+0.1 0	φ80	+0.1 0
2		107	±0.5 0	107	±0.5 0
3		310	-0.3 -0.8	310	-0.3 -0.8
4		φ90	-0.036 -0.071	φ90	-0.036 -0.071
5		549	±1	549	±1
6		158	±0.8	158	±0.8
7		835	±1	835	±1
8		2,911	±2	2,911	±2
9		2,643	±2	2,643	±2
10		411	±0.8	411	±0.8
11		640	0 -0.5	640	0 -0.5
12		600	—	600	—
13		458	—	458	—
14		1,483	—	1,495	—
15		φ80	—	φ80	—
16		326.5	—	326.5	—
17		φ80	+0.2 0	φ80	+0.2 0
18	Arm itself	311	—	311	—
	When press fitting bushing	325	—	325	—
19	Min.	1,680	—	1,680	—
	Max.	2,800	—	2,800	—

Bucket dimension

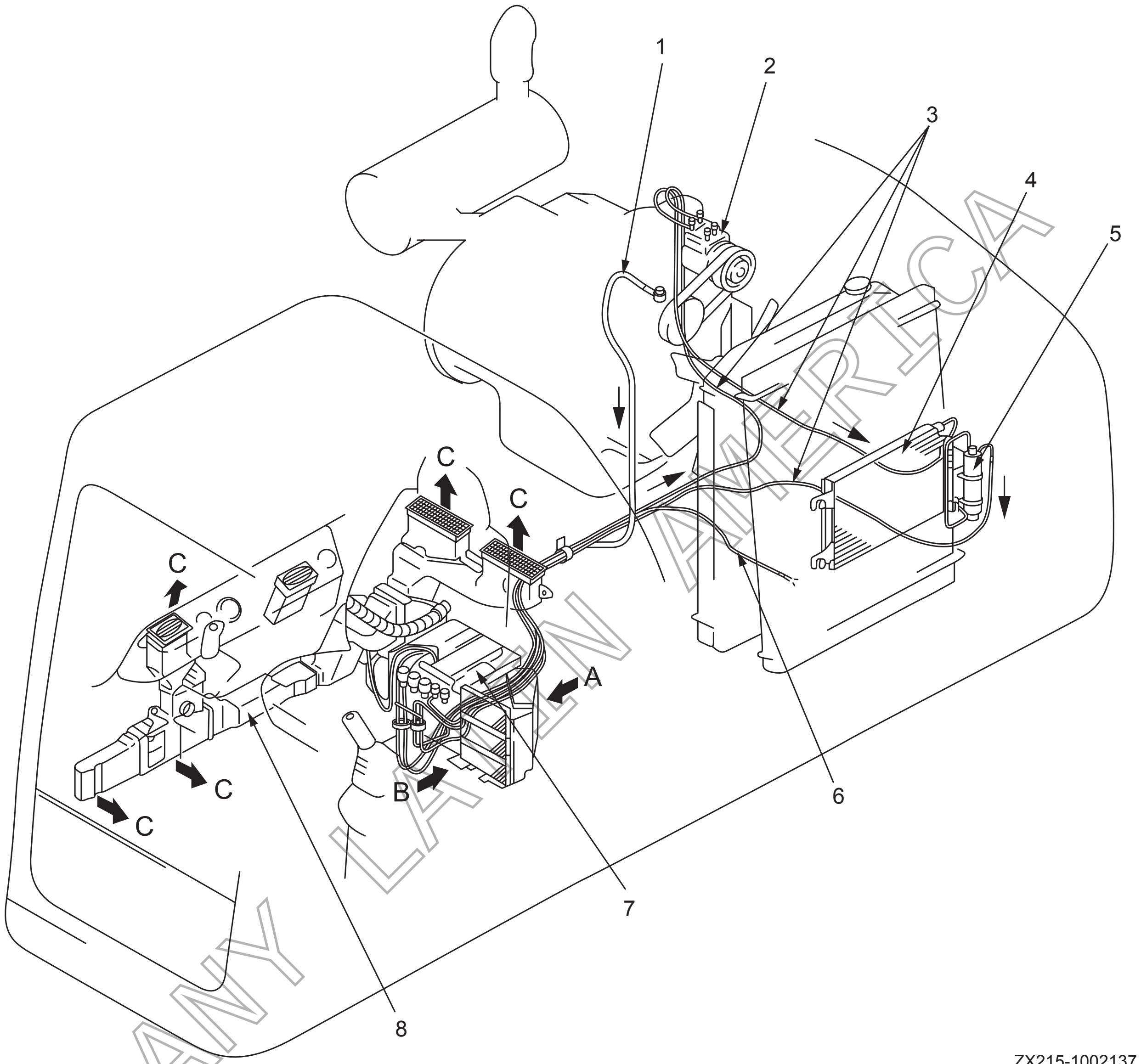


WX13060403

Unit: mm

No.	SY195/205/215C-9		SY225C-9	
	Standard size	Tolerance	Standard size	Tolerance
1	457.5	±0.5	457.5	±0.5
2	22	±0.5	22	±0.5
3	91.8°	—	91.8°	—
4	458	—	458	—
5	1,483	—	1,483	—
6	177	—	177	—
7	45°	—	45°	—
8	φ80	+0.2 0	φ80	+0.2 0
9	348.5	+0.2 0	348.5	+0.2 0
10	37	—	37	—
11	107	—	107	—
12	473.5	—	473.5	—
13	φ23.5	—	φ23.5	—
14	φ190	—	φ190	—
15	φ136	—	φ136	—
16	131	—	131	—
17	125	—	125	—
18	R180	—	R180	—
19	R140	—	R140	—
20	57	—	57	—
21	326.5	±0.5	326.5	±0.5

4.7 Air Conditioning System



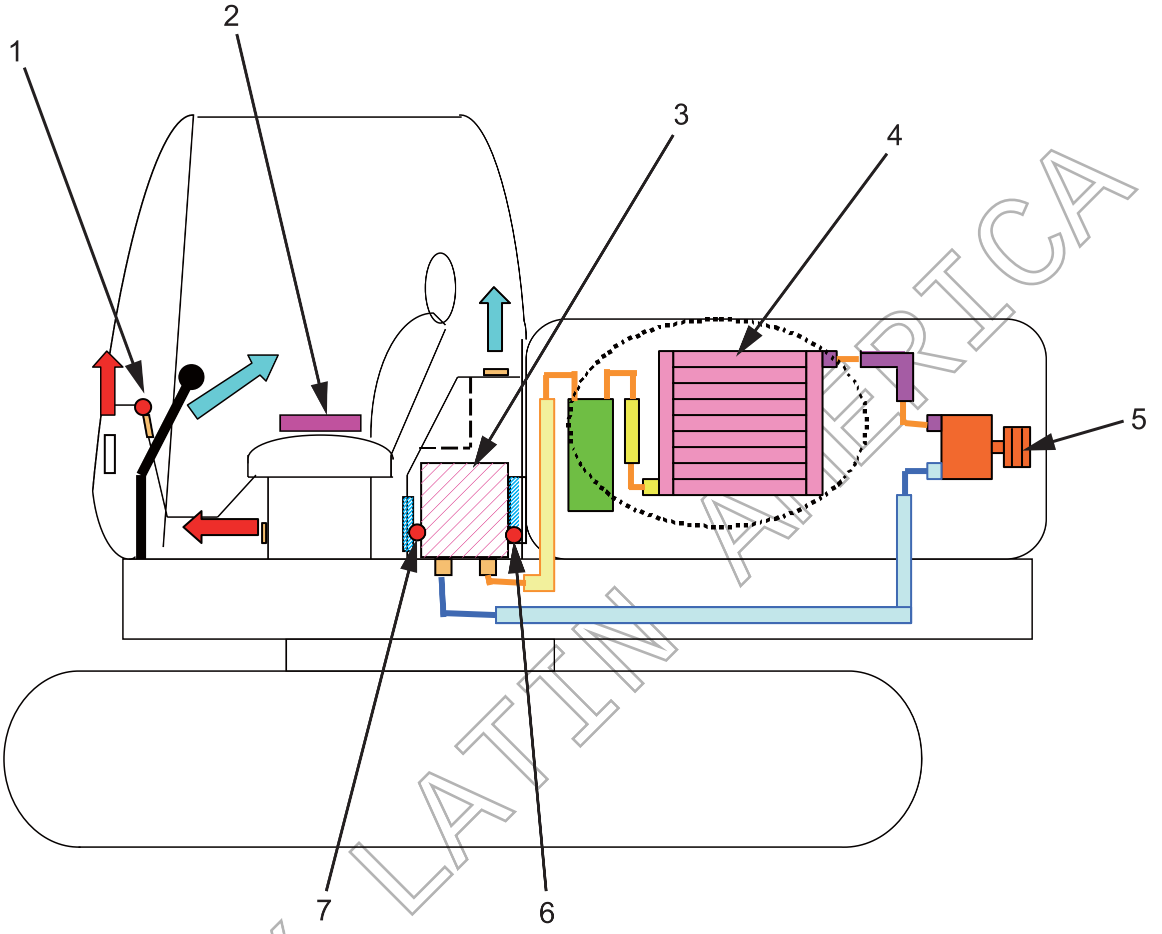
1) Hot water piping
2) A/C compressor (DENSO.2)
3) Refrigeration piping
4) Condenser (SG447750-A040)
5) Receiver tank (DENSO.4)
6) Hot water return piping
7) A/C unit assembly (SG443180-9320)
8) Air duct

A. Fresh air

B. Recirculated air

C. Warm air/cool air

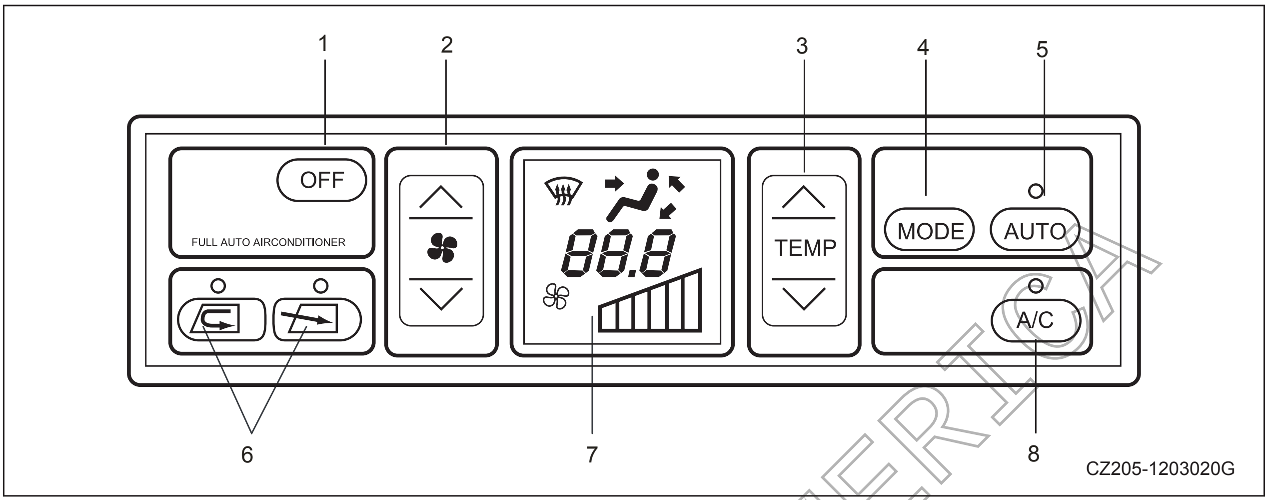
4.7.1 A/C components layout drawing



ZX215-1002138

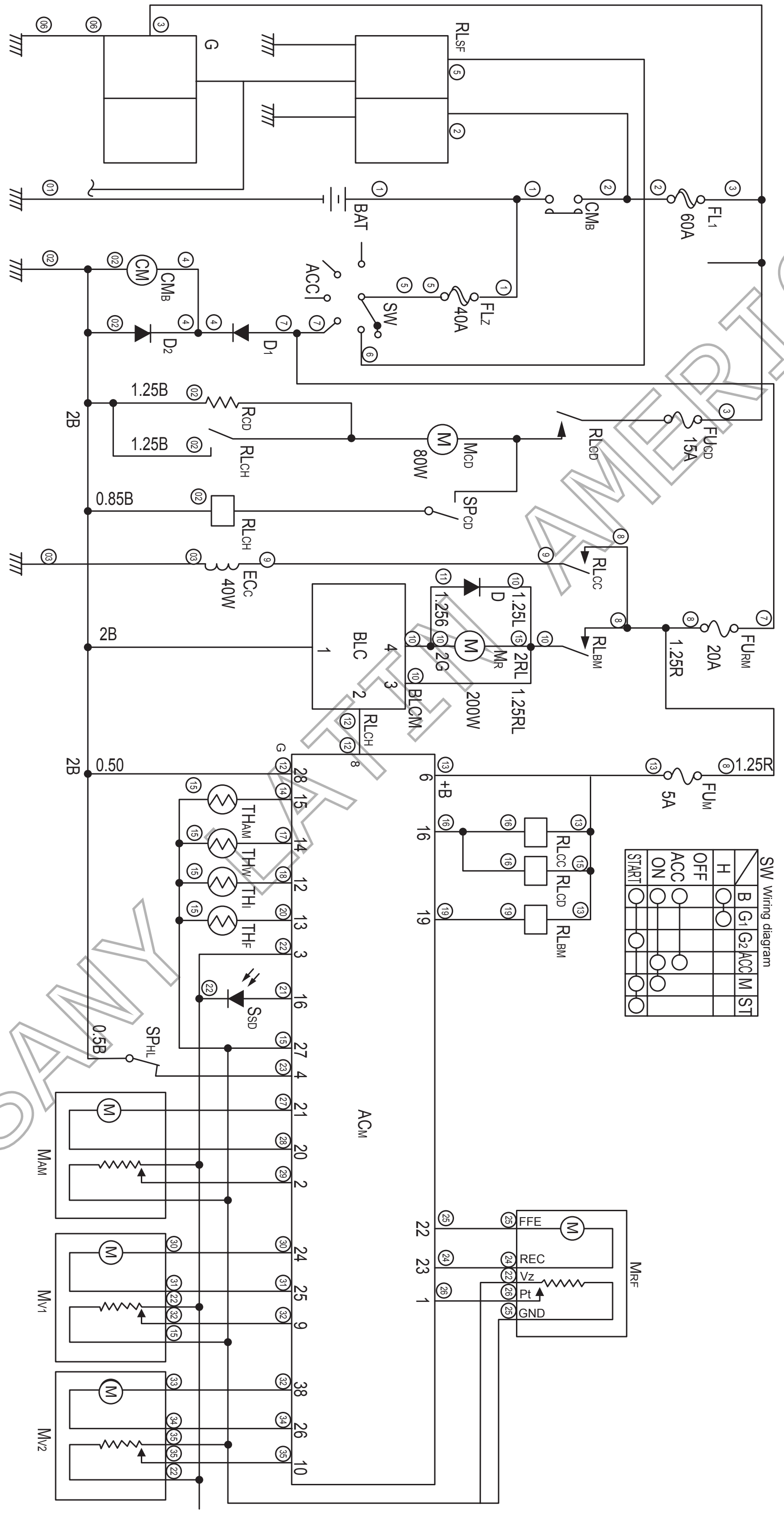
1)	Sunlight sensor	5)	Compressor
2)	Control panel	6)	Fresh air sensor
3)	Air conditioning unit	7)	Recirculated air sensor
4)	Condenser		

4.7.2 Control panel



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

4.7.3 Circuit diagram

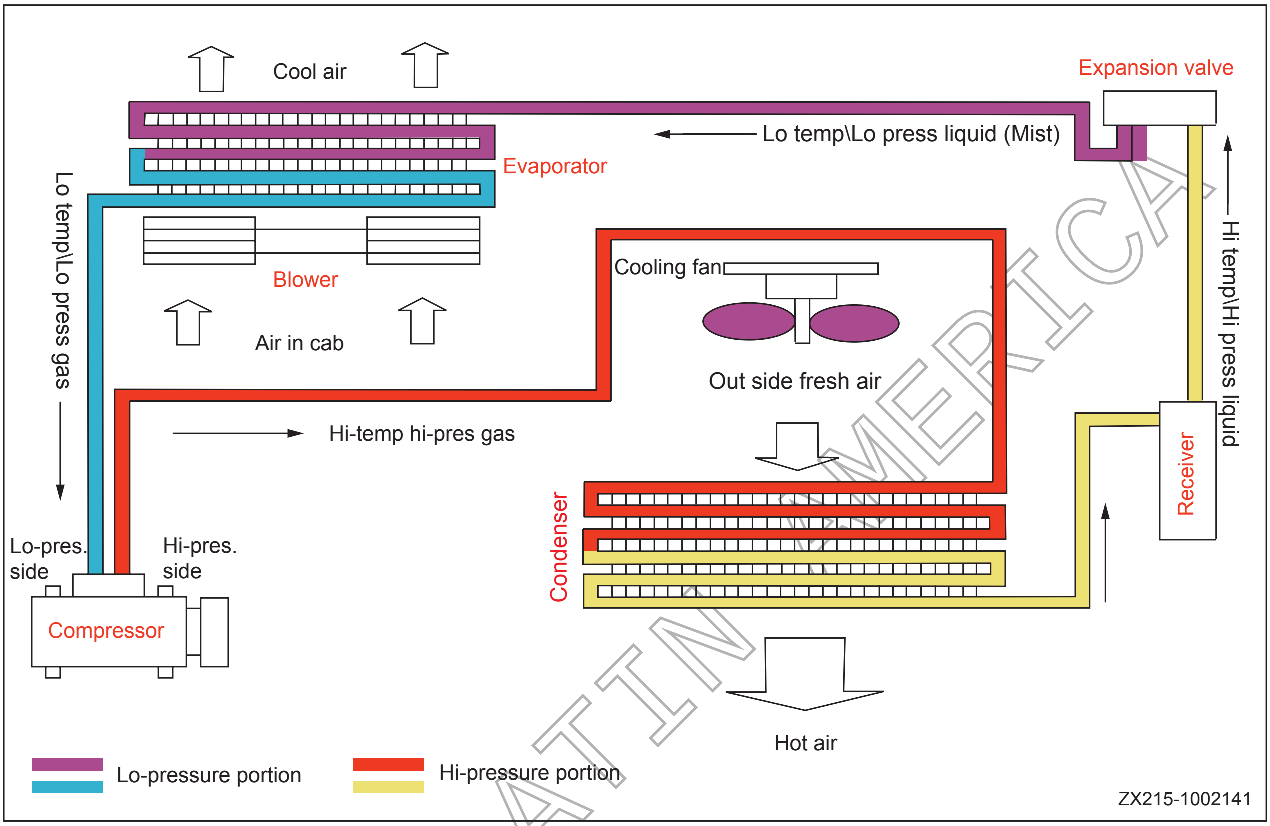


Wire No.	Diameter/Color code	Wire color	Wire No.	Diameter/Color code	Wire color
(02)	B	Black	㉔	0.5VW	Violet+white
⑧	Br(R)	Brown	㉕	0.5YB	Yellow+black
⑨	0.85W	White	㉖	0.5WO	White+orange
⑩	RL	Red+blue	㉗	0.5PB	Pink+black
⑪	G	Green	㉘	0.5VR	Violet+red
⑫	0.5BL	Black+blue	㉙	0.5BG	Black+green
⑬	0.5R	Red+blue	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			

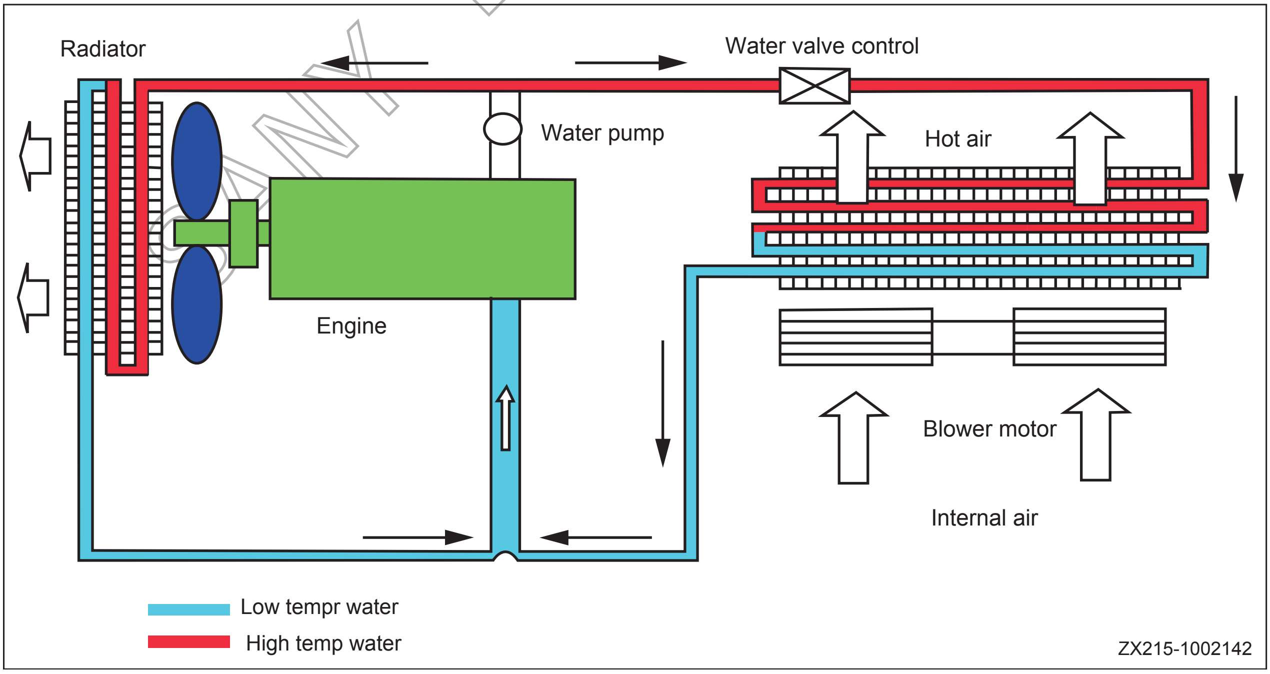
Code	Name	Code	Name	Code	Name
AC_{M}	A/C amplifier	FU_{CD}	Condenser fuse	RL_{CH}	Condenser high speed relay
BAT	Battery	FU_{M}	A/C main fuse	RL_{SF}	Protective relay
BLC	Speed regulating resistor	G	Alternator	S_{SD}	Sunlight sensor
CM_{B}	Battery relay	M_{AM}	A/M servo motor	SP_{CD}	Condenser pressure 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		

4.7.4 Refrigeration principle

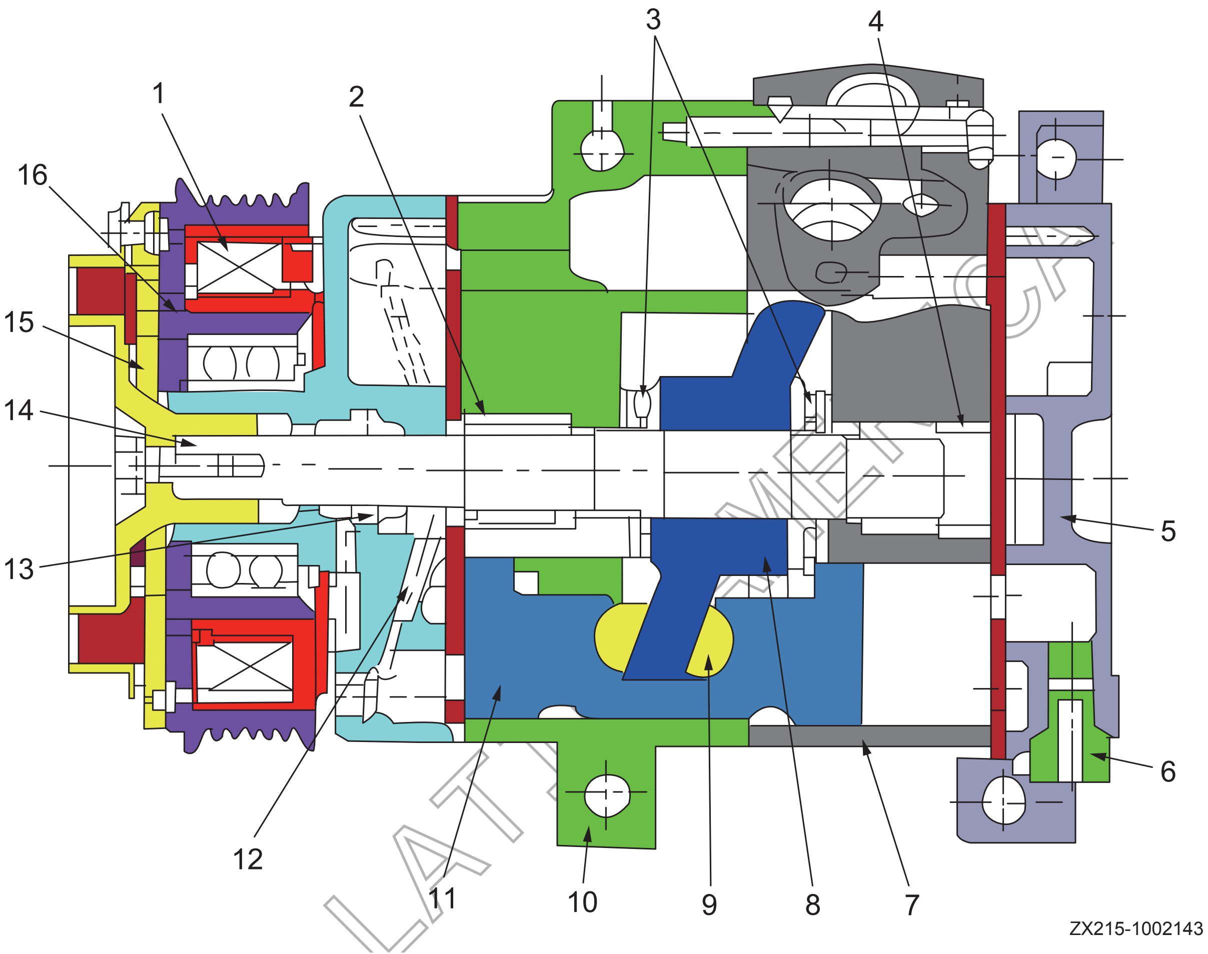
4.7.4.1 Refrigeration cycle diagram



4.7.4.2 Heating cycle diagram



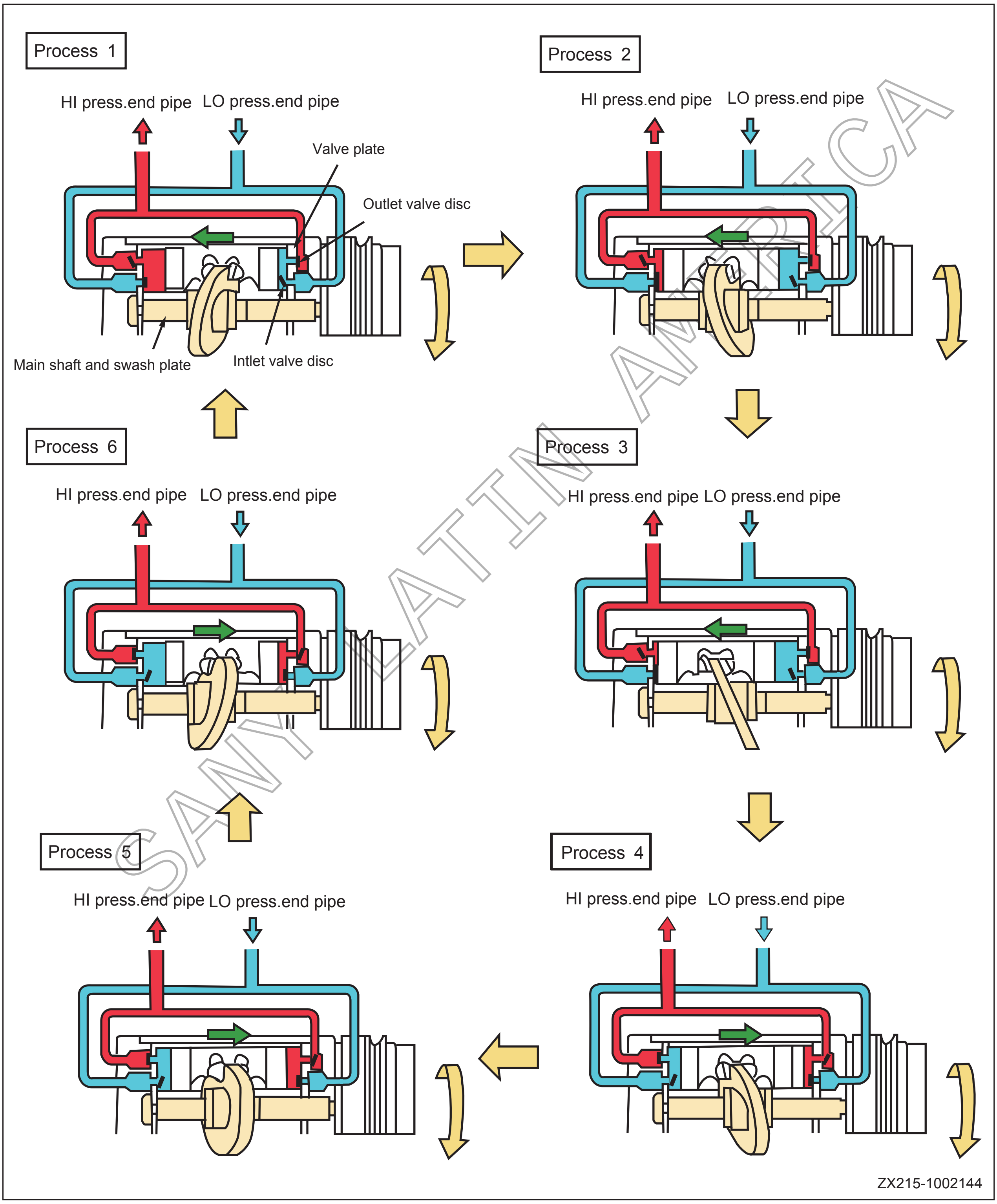
4.7.5 Compressor



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

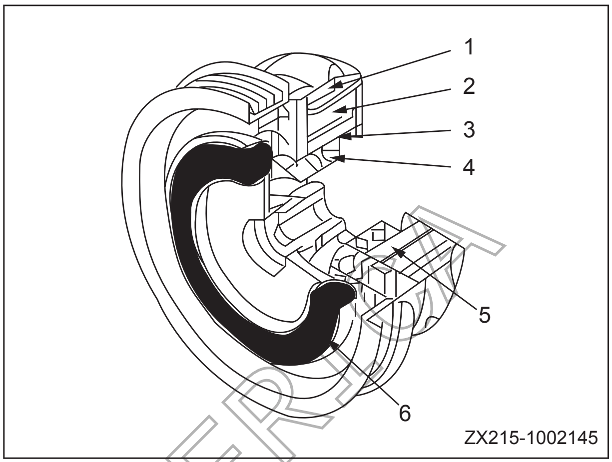
Operating principle

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.



4.7.6 Clutch

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

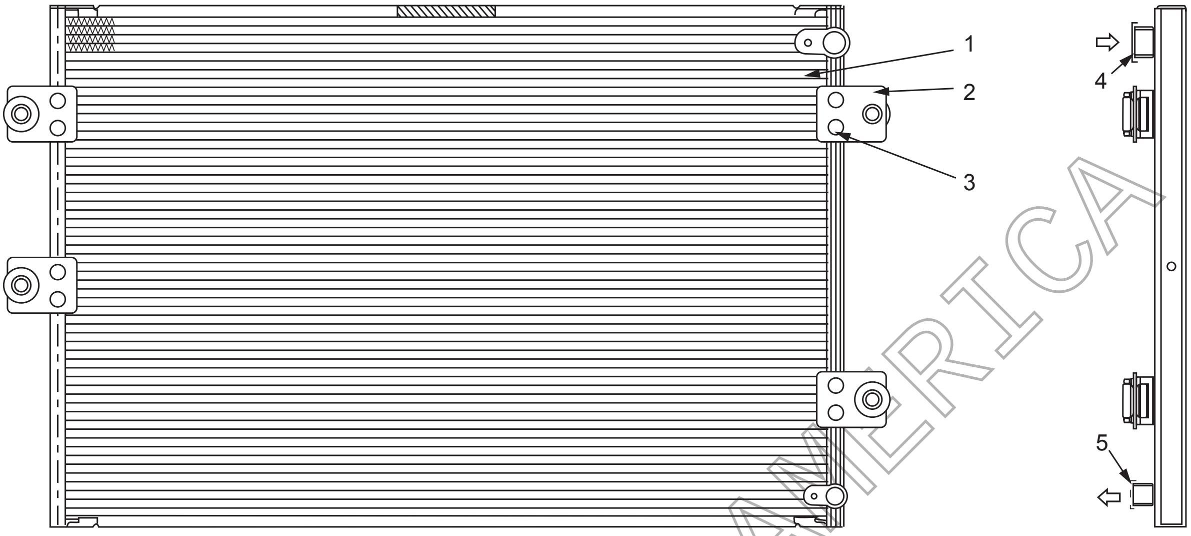


- The electromagnetic clutch is used to transmit moment of torsion. When the engine is operating, the compressor may not be working. The clutch controls the operation of the compressor only when the air conditioner is under refrigerating mode.

- **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.

4.7.8 Condenser



ZX215-1002146

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

Function

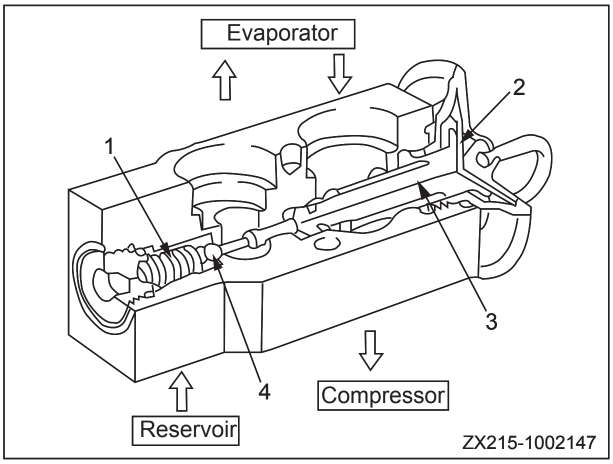
- The condenser converts high-temperature, high-pressure gas refrigerant (16Kg/cm², about 80°C) to high-temperature and high-pressure liquid refrigerant (16Kg/cm², below 60°C) through radiating.

4.7.7 Expansion valve

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

Operating principle

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



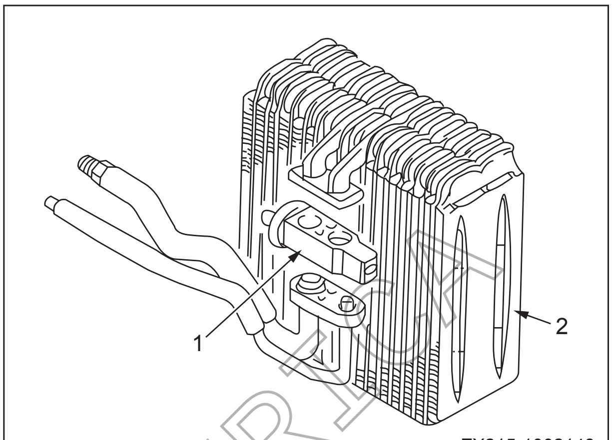
ZX215-1002147

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.



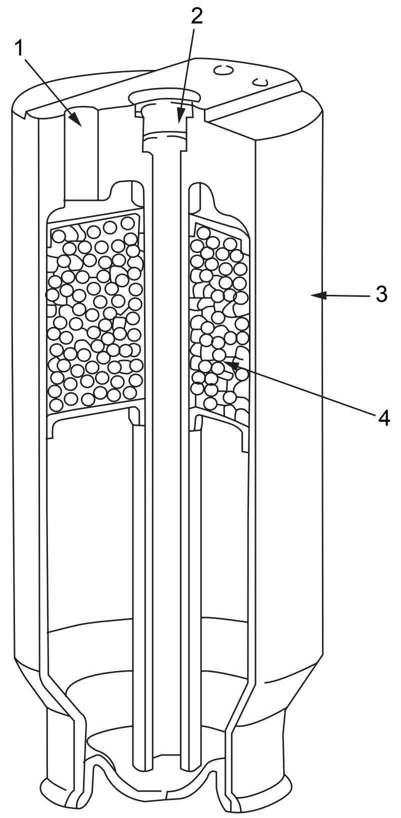
ZX215-1002148

4.7.10 Receiver tank

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

Function

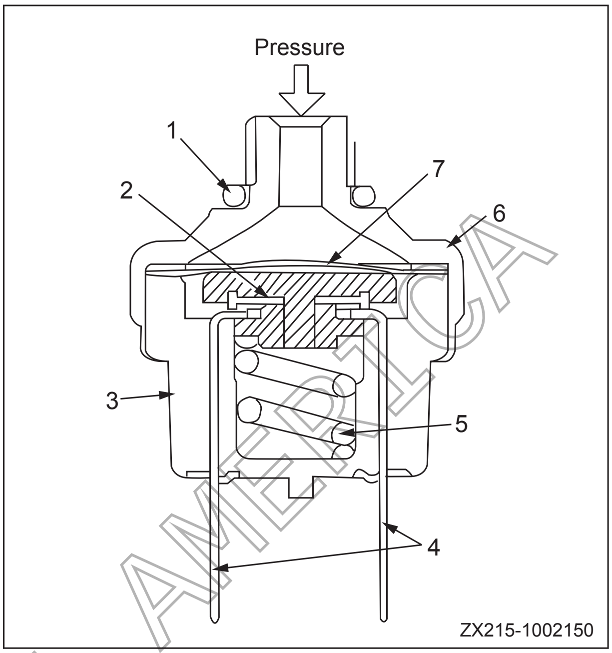
- Temporary storage of refrigerant
- Dehydration of refrigerant
- Dust removal from refrigerant
- Measure the volume of refrigerant



ZX215-1002149

4.7.11 Pressure switch

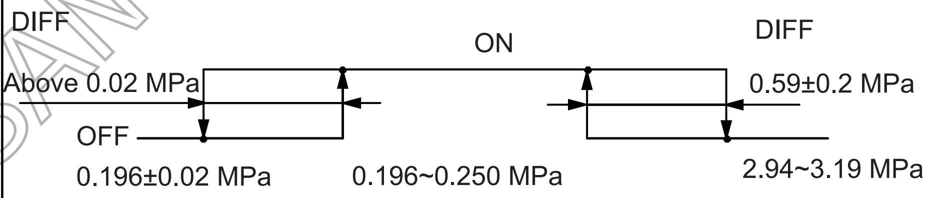
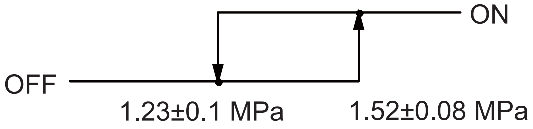
1) O-ring
2) Mobile contact point
3) Hood
4) Plug and fixed contact
5) Spring
6) Chamber
7) Diaphragm



Function

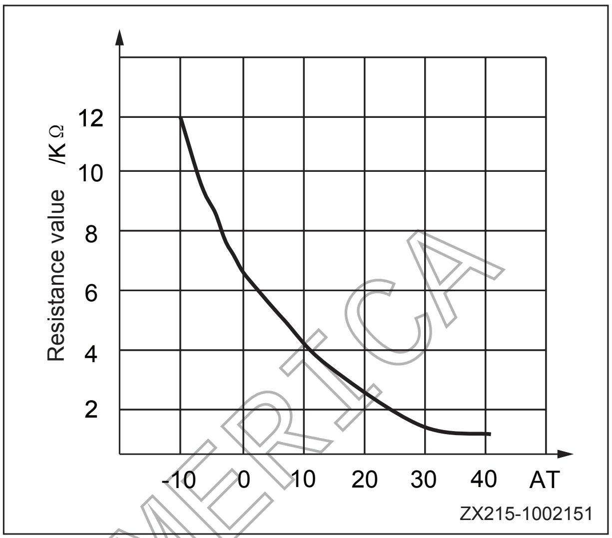
- The pressure switch is installed between the receiver tank and the expansion valve (hi-pressure pipe). It is a combination switch (Hi-Lo pressure combination switch).
- When pressure is excessively high, the compressor stops.
- When pressure and temperature is very low, the compressor stops.

Operating features

	Feature
HI pressure operating value LO pressure operating value	
MID pressure operating value	

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)

4.7.13 Refrigerant

WARNING

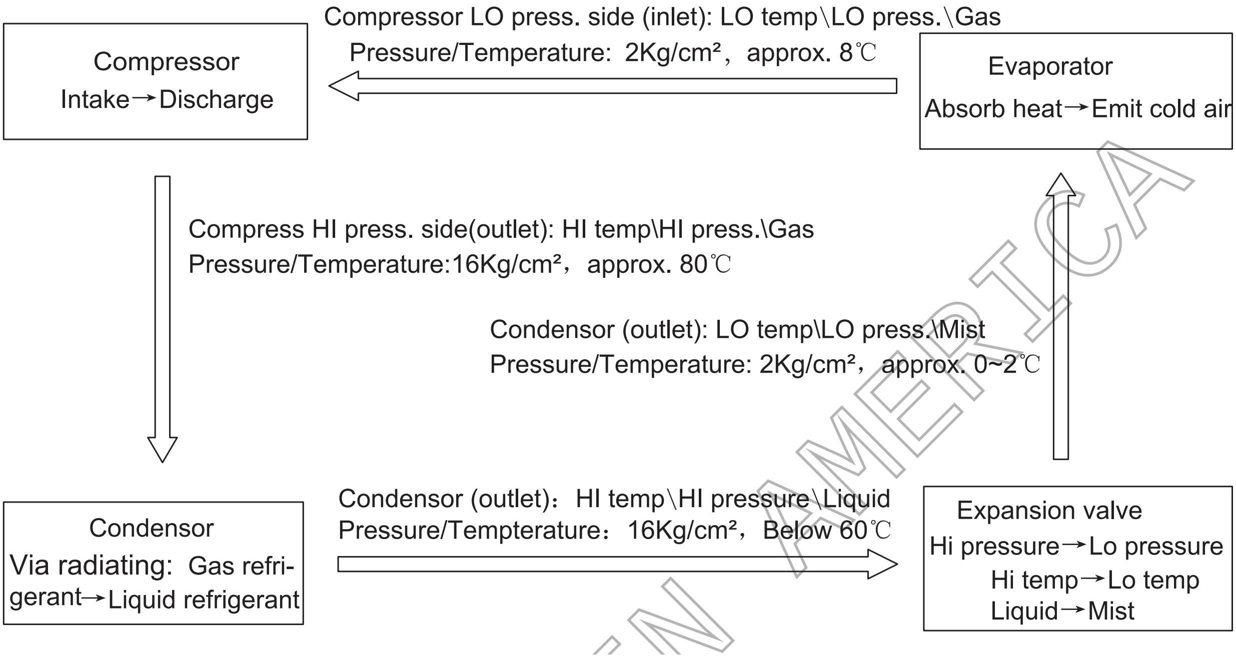
- **Obey local material disposal regulations. Never discharge refrigerant directly into the air.**
- **Refrigerant R134 a is a harmless gas under room temperature. It will change into highly toxic gas when burning.**
- **Refrigerant getting into eyes may cause blindness. It may cause frostbite if splashed on your skin.**

1. General property

- 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.



Compressor

Intake→Discharge

Compressor LO press. side (inlet): LO temp\LO press.\Gas

Pressure/Temperature: 2Kg/cm², approx. 8℃

Evaporator

Absorb heat→Emit cold air

Compress HI press. side(outlet): HI temp\HI press.\Gas

Pressure/Temperature:16Kg/cm², approx. 80℃

Condensor (outlet): LO temp\LO press.\Mist

Pressure/Temperature: 2Kg/cm², approx. 0~2℃

Condensor

Via radiating: Gas refrigerant→Liquid refrigerant

Condensor (outlet): HI temp\HI pressure\Liquid

Pressure/Tempterature: 16Kg/cm², Below 60℃

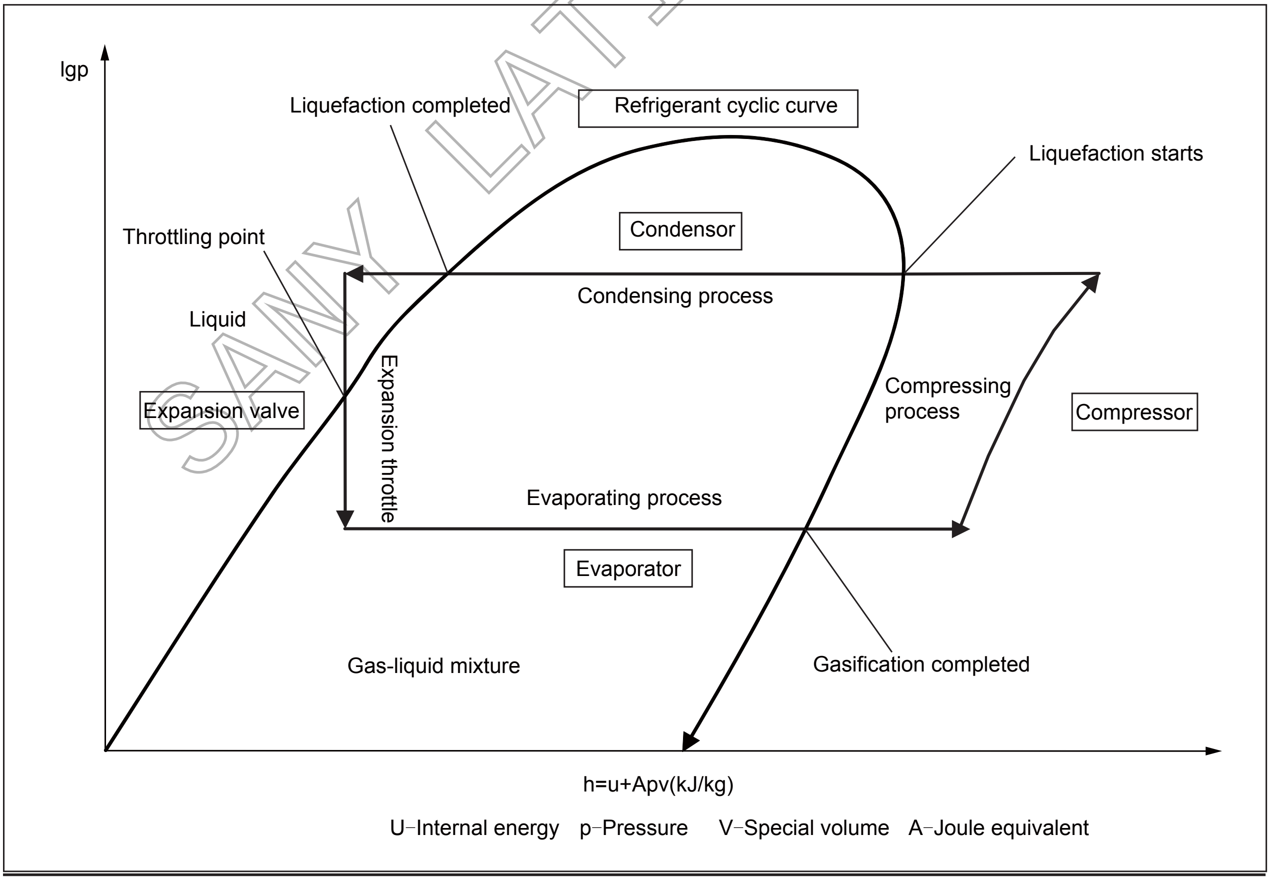
Expansion valve

Hi pressure→Lo pressure

Hi temp→Lo temp

Liquid→Mist

- Refrigerant cycle principle (pressure - enthalpy diagram)



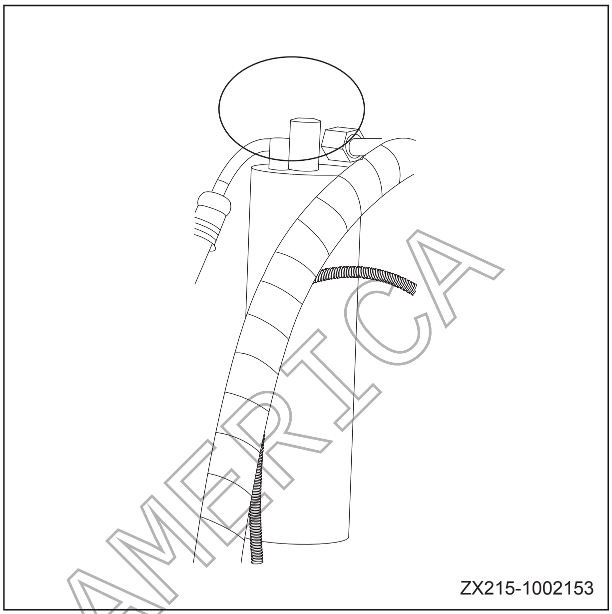
3. Feeding of refrigerant

- Filling method and volume:

1) Refrigerant: HFC-134a

2) Feeding volume: 850±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 refeeding.

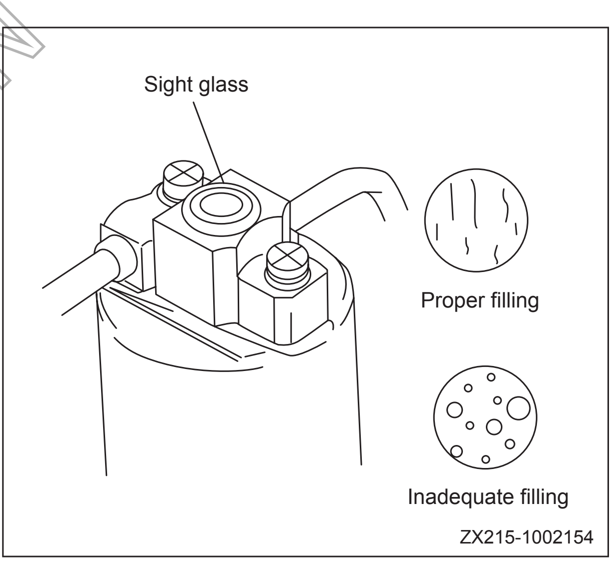

ZX215-1002153

- 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

- No moisture shall exit in 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 compressor valve to rust. To avoid such problems, moisture in the system shall be removed before refrigerant is added. To minimize the residual moisture in the system, moisture in the system can evaporate through evacuating.

Evacuating steps

Step 1: Connect the manifold pressure gauge

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

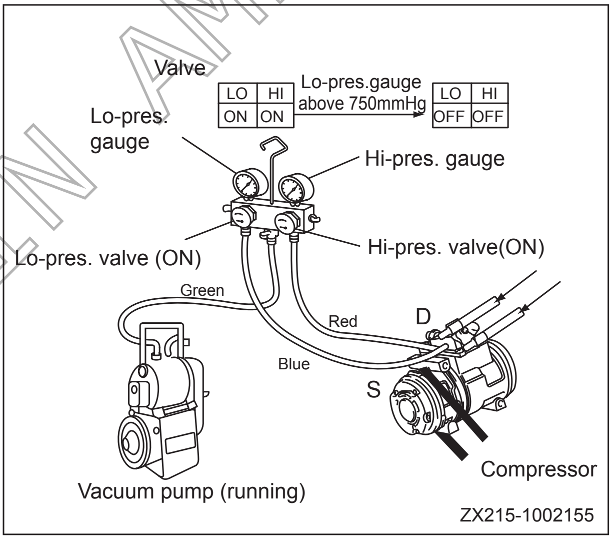
2) Connect the hoses (red, blue) to the auxiliary valve of the compressor.

   Red hose – High pressure side (Mark D)

   Blue hose – Low pressure side (Mark S)

   NOTE: 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.

3) Connect the green hose to the vacuum pump.



Step 2: Evacuation

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

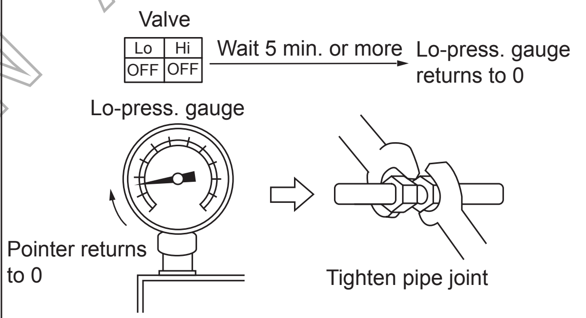
2) Turn on the vacuum pump and evacuate for about 15 minutes.

3) 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.

Step 3: Air - proof check

1) 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.

2) 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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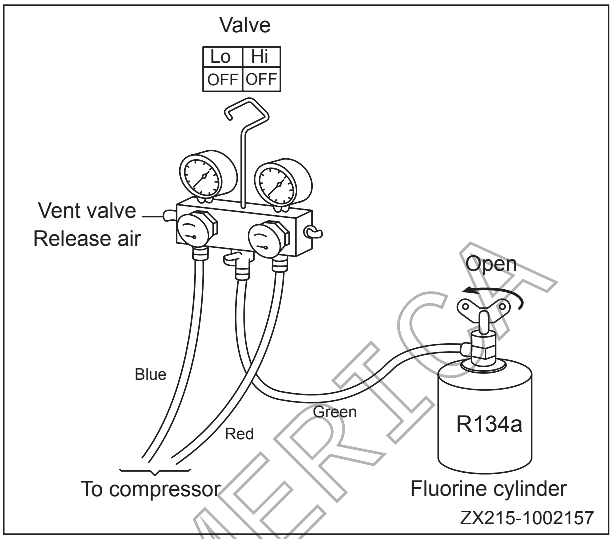
Step 4: Leak check

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

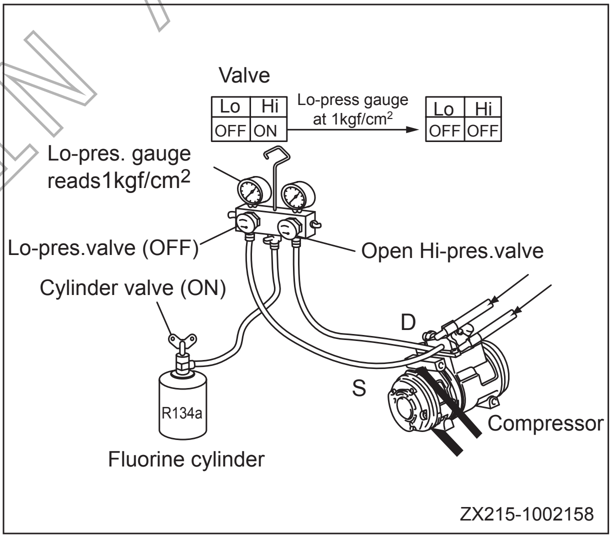
2) Connect the other end of the green hose to the pressure gauge. Open the valve of the cylinder and press the vent valve of the pressure gauge. (Do not press the valve with naked hand to avoid frostbite caused by refrigerant). Release the air in the hose with the pressure of the refrigerant. (Release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



3) 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.

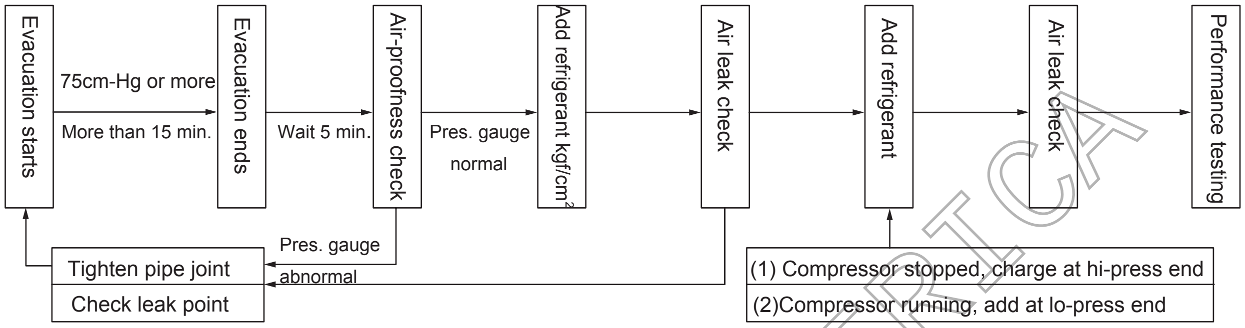
4) Use a leak detector to check if leakage is available in the cooling system.

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

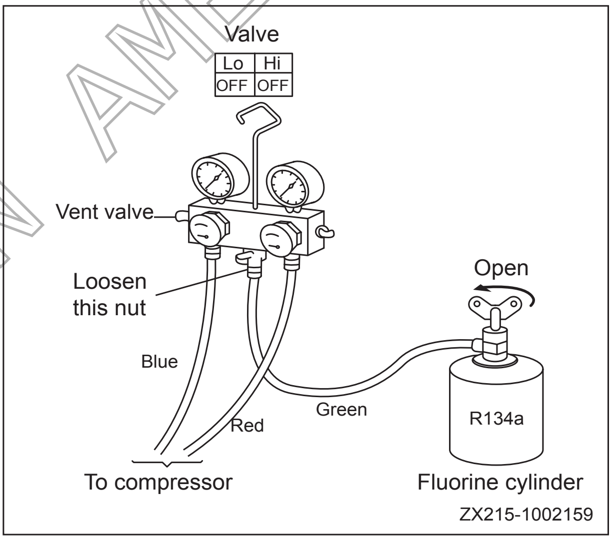


5. Refrigerant charging operation

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



Charge at the hi-pressure side



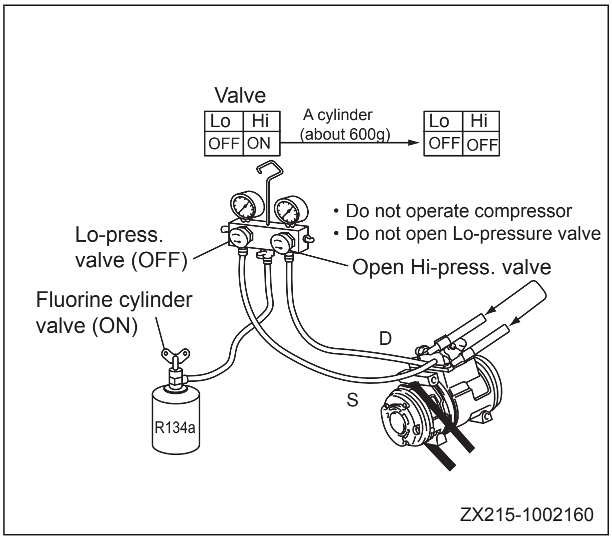
1. Remove the green hose of the manifold pressure gauge from the vacuum pump and connect it to the fluorine cylinder.
2. Loosen the cylinder valve and press the vent valve on the gauge. Use the pressure of the refrigerant to release the air in the hose.

   NOTE: Release the vent valve when you hear a hissing sound.

CAUTION

- **Do not press the valve with naked hand to avoid frostbite.**

3. Open the hi-pressure valve of the manifold pressure gauge and the cylinder valve with the engine stopped. Fill about 600g of refrigerant.
4. Close the hi-pressure valve of the pressure gauge and shut the cylinder valve.

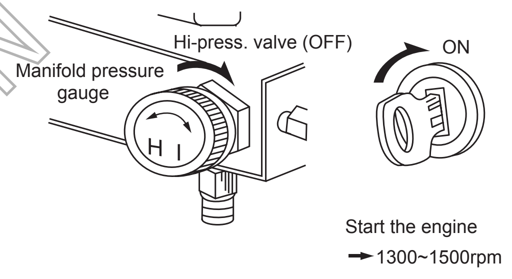


⚠ CAUTION

- **Do not operate the compressor when refrigerant charging is in progress. Otherwise, refrigerant will counterflow and cause the cylinder and hoses to explode.**
- **Operating the compressor with no refrigerant in the system will cause damage to the compressor.**
- **Do not open the lo-pressure valve of the manifold pressure gauge; otherwise, the compressor will be damaged.**

Charge at the lo-pressure side (refill)

1. Check that the hi-pressure valve of the manifold pressure gauge is closed.
2. Start the engine.
3. Turn on the A/C unit. Adjust 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 cylinder valve. Add refrigerant until no foam is observed through the sight glass.



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Remark:

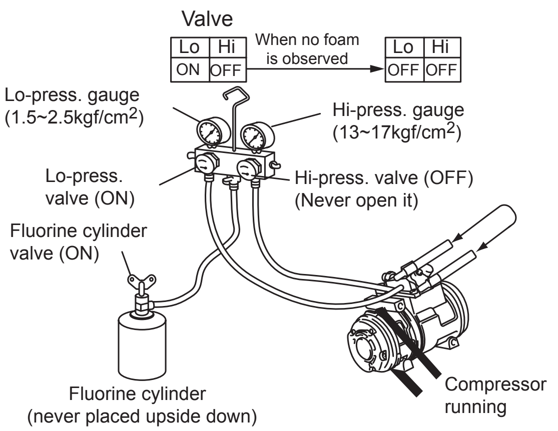
Manifold pressure gauge reading (for reference):

HIGH pressure:

13~17kgf/cm² (when ambient temperature is 30°C)

LOW pressure:

1.5~2kgf/cm² (when ambient temperature is 30°C).



ZX215-1002162

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.

⚠ CAUTION

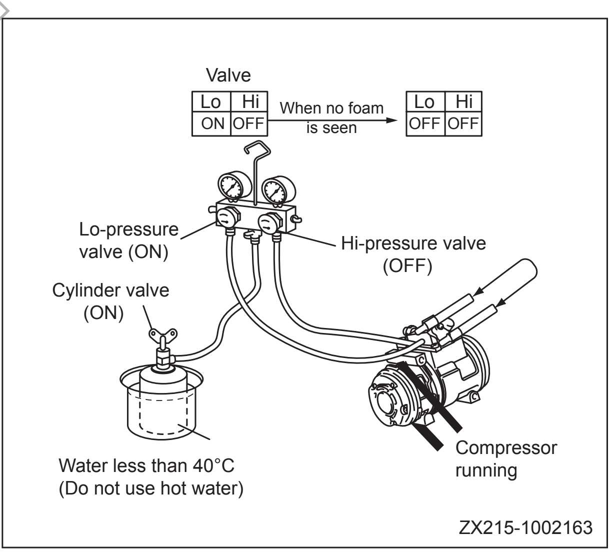
- **Opening the Hi-pressure valve of the pressure gauge will cause pressurized gas to counterflow and cause the hoses and the fluorine cylinder to explode, resulting in serious damage.**
- **When engine is running and charging in progress, placing the fluorine cylinder upside down will cause liquid refrigerant to be sucked directly into the compressor and cause liquid compression, resulting in equipment damage.**

8. When ambient temperature is low

   When refrigerant charging gets difficult due to low temperature, put the cylinder in warm water (max. 40°C).

9. When ambient temperature is high

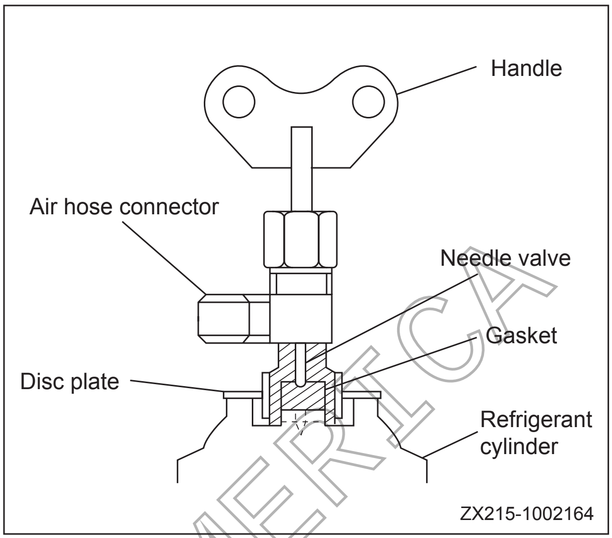
   When ambient temperature is very high, cool the compressor with an electrical fan.



Replace the fluorine cylinder

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

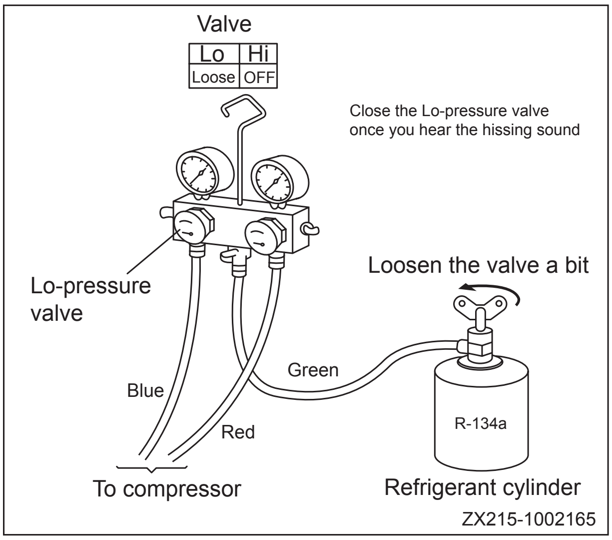
1. Close the Hi- and Lo-pressure valves of the manifold pressure gauge.
2. Raise the needle and disc plate of the cylinder and remove the empty cylinder.
3. Install a new cylinder onto the cylinder valve.
4. Release the air in the hose as per the following instruction:
   1) Tighten the valve of the fluorine cylinder, and then, loosen it a bit.
   2) Open the Lo-pressure valve of the manifold pressure gauge a bit.
   3) 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.



CAUTION

- **Do not press the valve with naked hand to avoid frostbite.**

5. Turn the handle of the cylinder valve to pierce the cylinder and continue charging operation.



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.

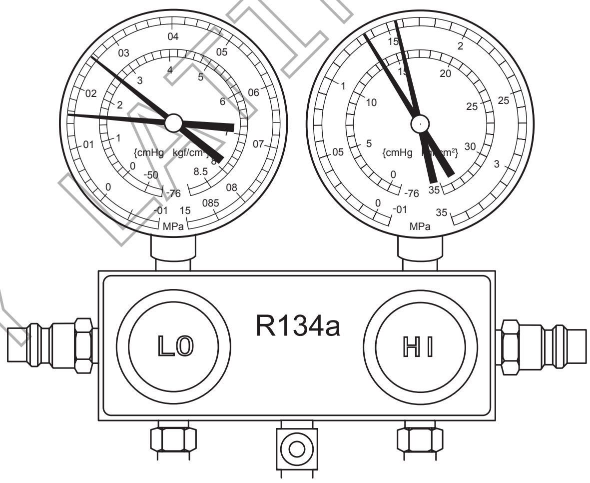
5) Air circulation mode: Recirculation

- Cooling system under normal condition

Gauge reading:

Lo-pressure end: 0.15~0.25 Mpa (1.5~2.5 Kgf/cm²)

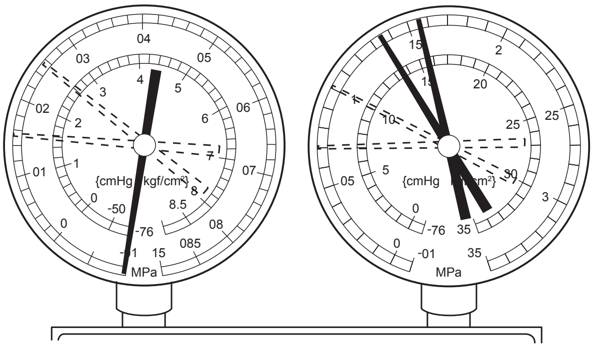
Hi-pressure end: 1.37~1.57 Mpa (14~16 Kgf/cm²)



ZX215-1002167

- Moisture in the refrigerating system

Symptom: Intermittent refrigeration to non-refrigeration

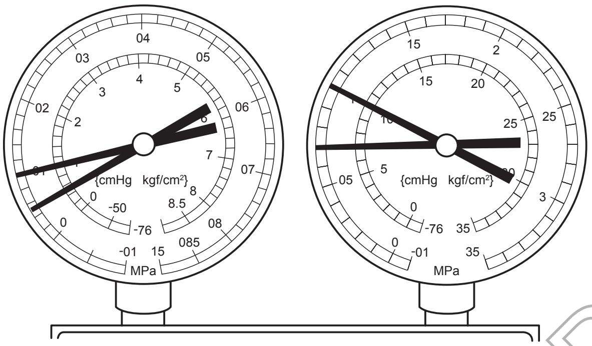


ZX215-1002168

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.

- Insufficient refrigeration

Symptom: Insufficient refrigeration

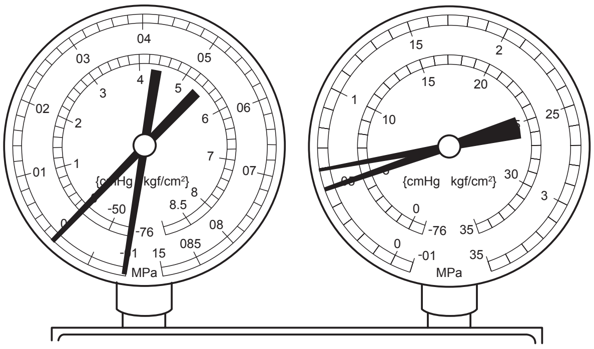


ZX215-1002169

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

- Defective refrigerant circulation

Symptom: insufficient refrigeration

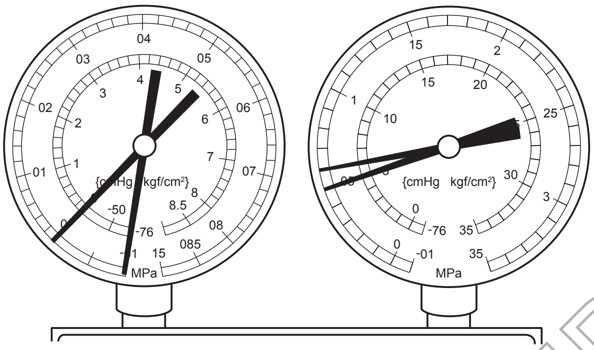


ZX215-1002170

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

- Refrigerant not circulating

Symptom: Non-refrigeration (intermittent refrigeration)

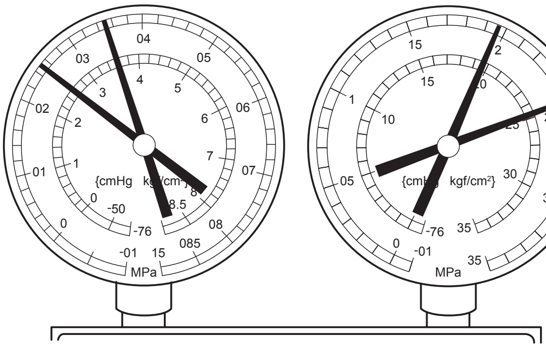


ZX215-1002171

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.

- Over-charging of refrigerant or insufficient refrigeration of condenser

Symptom: Insufficient refrigeration



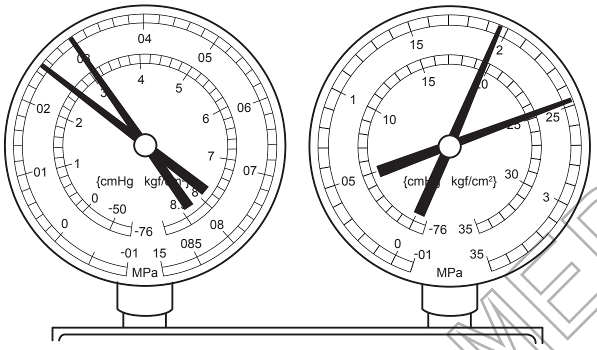
ZX215-1002172

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.

- Air is observed in the refrigerating system

Symptom: Poor refrigeration

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

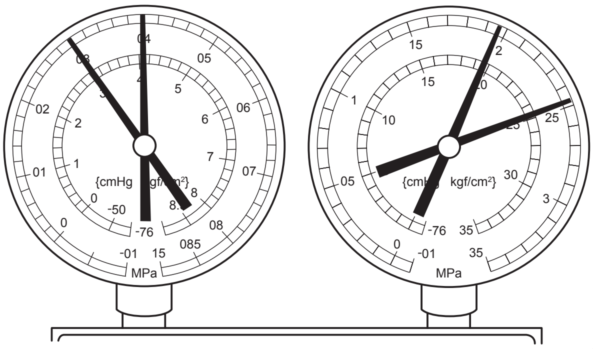


ZX215-1002173

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.

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

Symptom: insufficient refrigeration

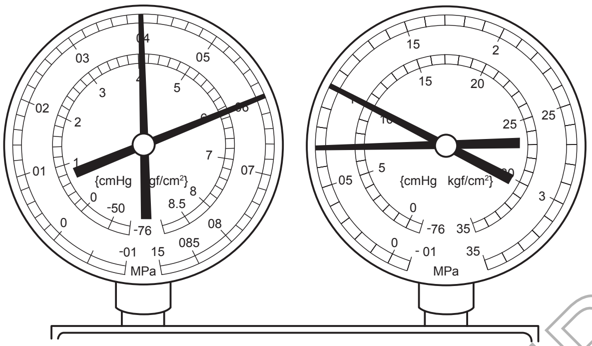


ZX215-1002174

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.

- 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

4.7.14 Compressor oil

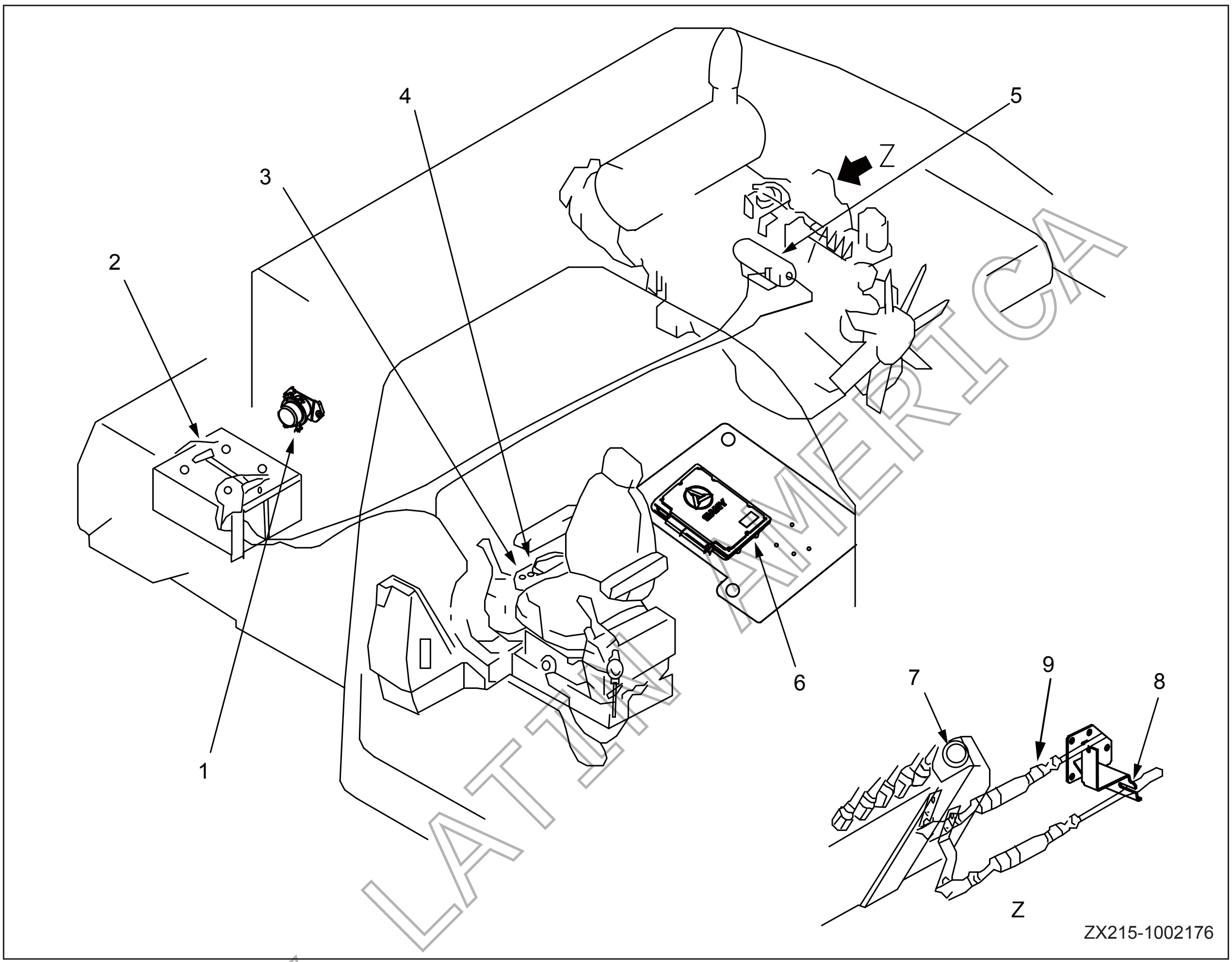
Oil shall be added into the A/C system for lubrication. Compressor oil is solved in the refrigerant and circulates in the system. When the air conditioning system is shut down, compressor oil will stay inside the components. If no compressor oil is added into the system when replacing components, inadequate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

	Replaced component		
	Compressor	**Condenser**	**Evaporator**
Volume (ml)	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.**

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

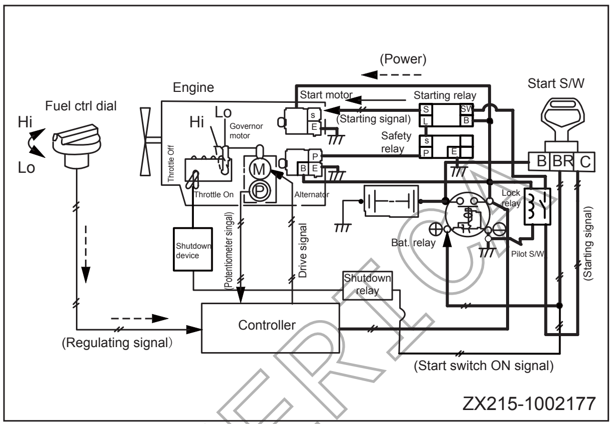
- Start and stop the engine only with the engine start switch (3).
- The controller (6) receives the signal from the fuel control dial (4) and transmits the drive signal to the throttle motor (8) to control the governor lever angle of fuel injection pump (7) and control the engine speed.
- When engine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

4.8.1 System operation

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



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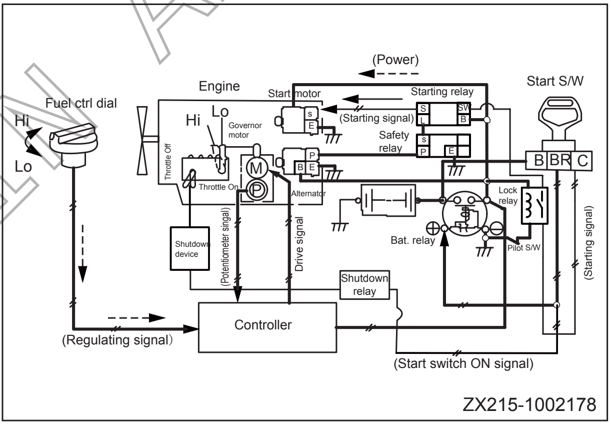
Engine speed control

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

  The 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.



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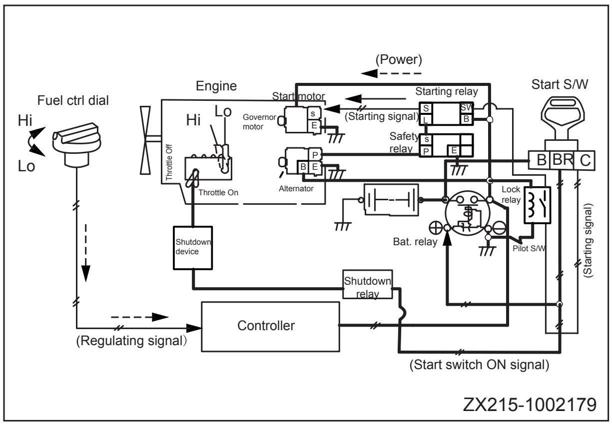
Engine shutdown

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



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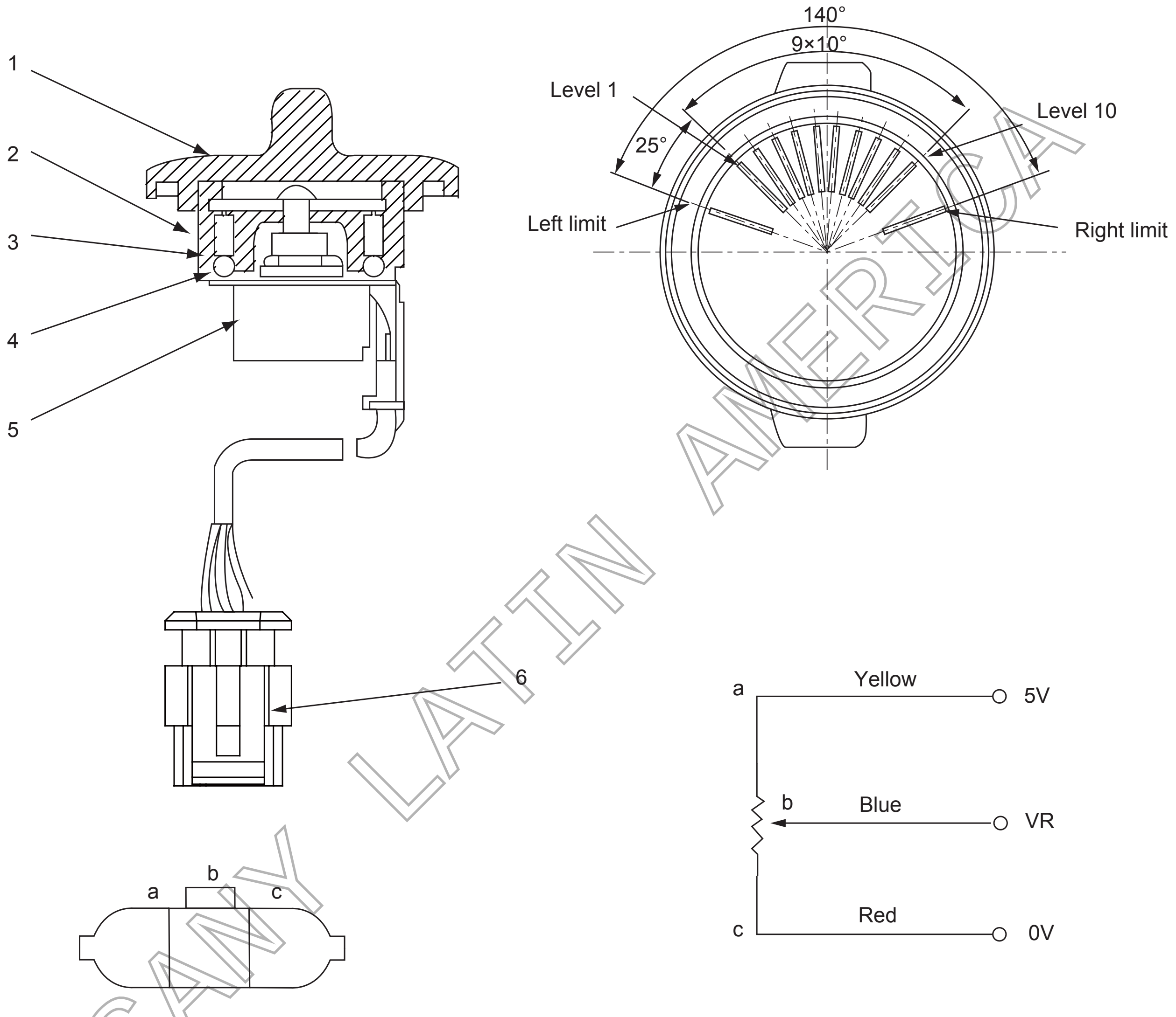
4.8.2 Components

4.8.2.1 Fuel control dial

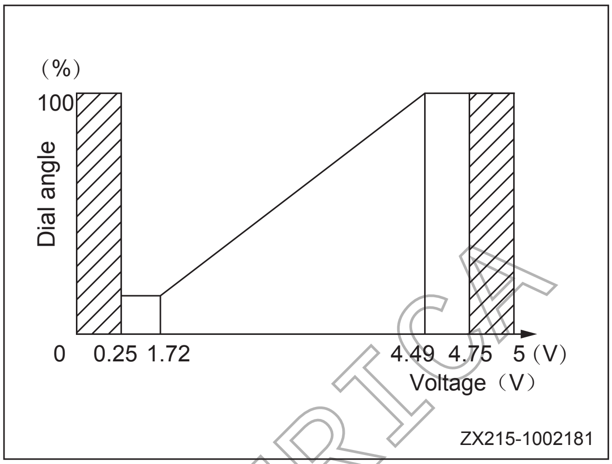


ZX215-1002180

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

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.

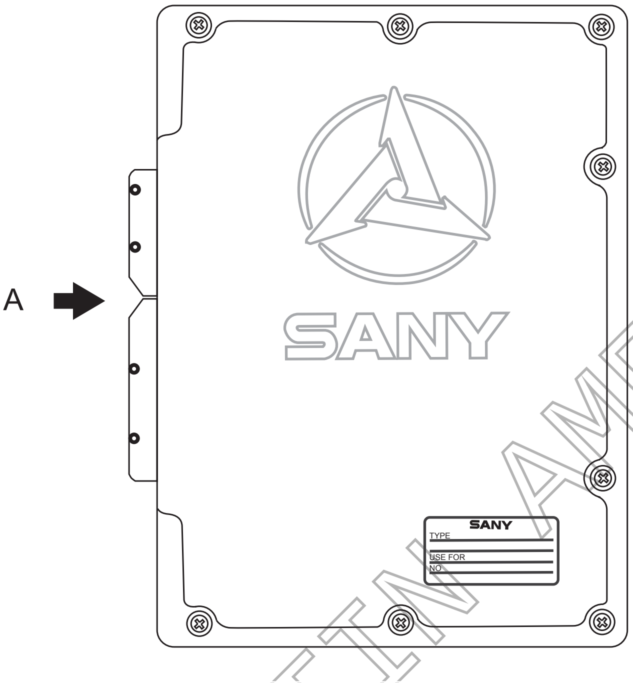


Remark:

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

4.8.2.2 Controller

Controller



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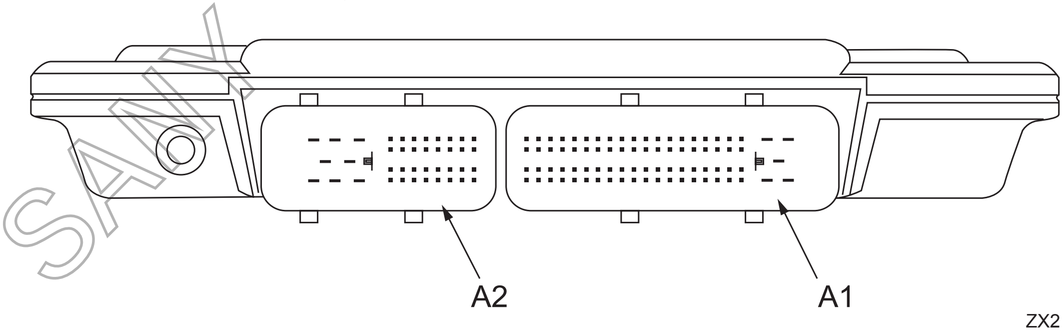
Controller port layout



ZX215-1002183

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

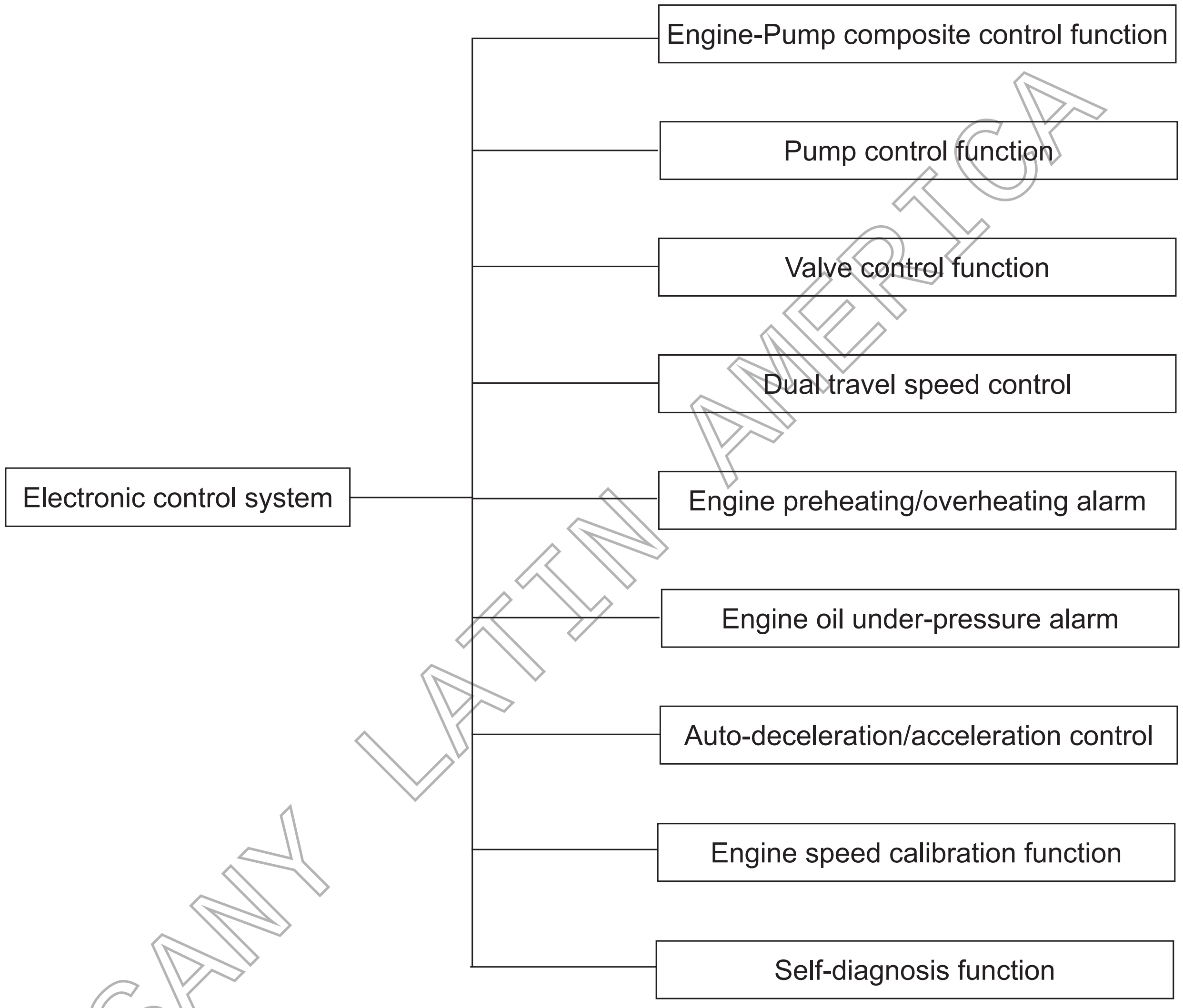
Pin No.	Signal name	Input/ output
82	Travel speed switching solenoid	
88	Front pump solenoid valve	
89	Rear pump solenoid valve	
97	Swing priority solenoid valve	
98	Bucket confluence solenoid valve	
99	Boom priority 1	
100	Boom priority 2	
104	Motor drive signal +	
113	Motor drive signal -	
114	Power 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	Calibrator CAN Low	
80	Calibrator CAN shield wire	
81	Calibrator CAN High	

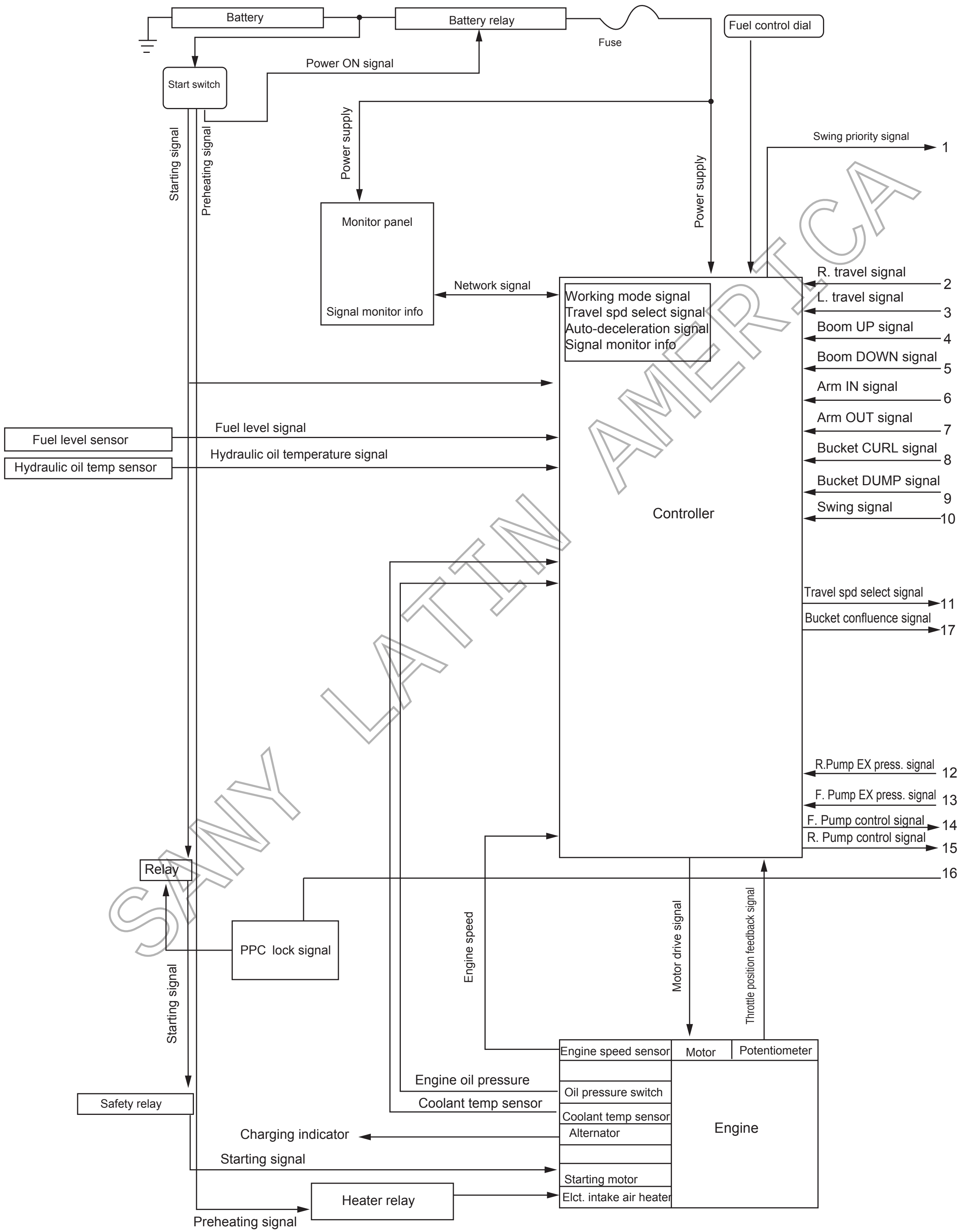
4.9 Electrical Control System

4.9.1 Control function

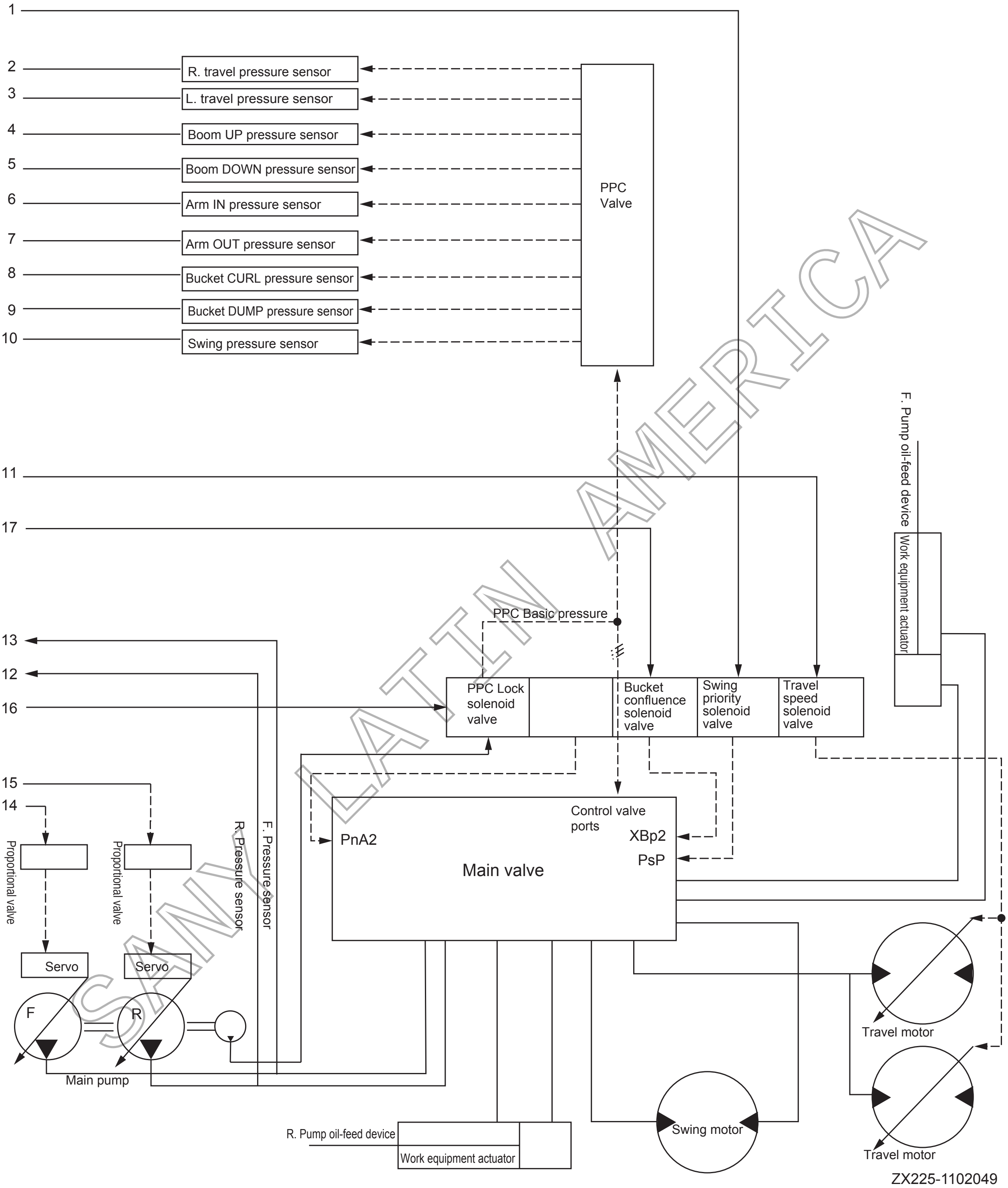


NOTE: For detailed information about self-diagnosis function, see "Troubleshooting"

4.9.2 Machine control system diagram



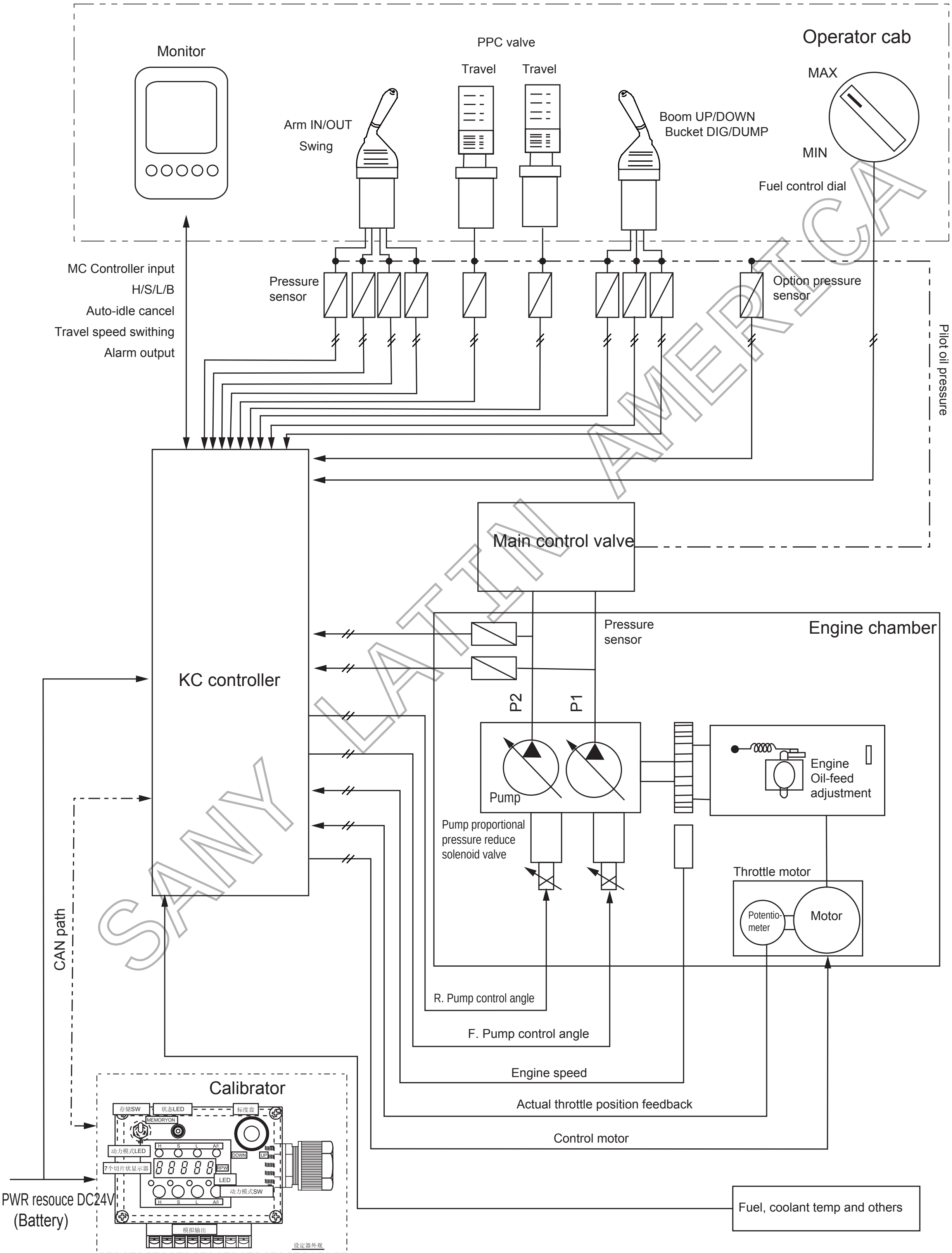
ZX215-1002184



Remark:

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

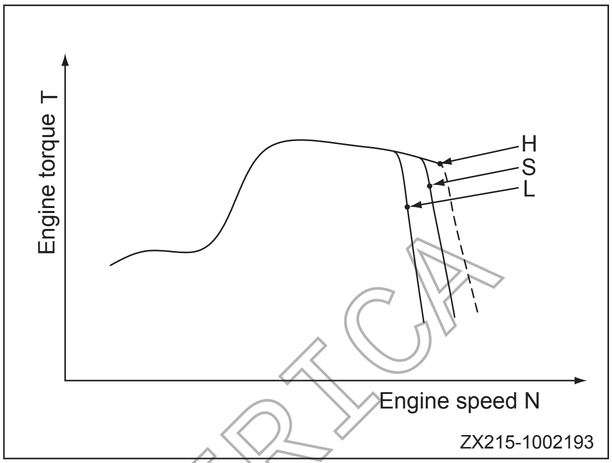
4.9.3 Engine and pump composite control function

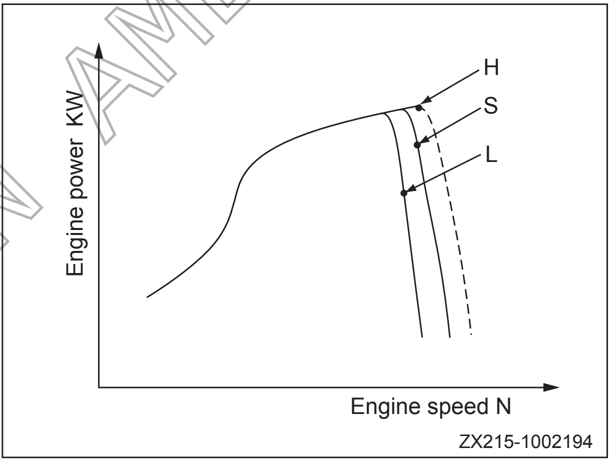


ZX215-1002186

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

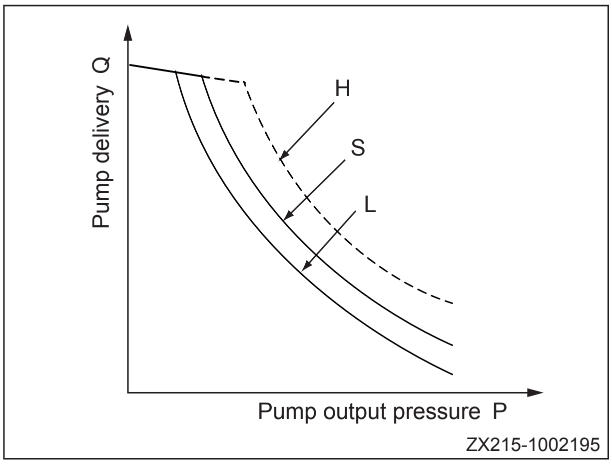
Engine speed	~1600	1600~1800	1800~2250
Power (KW)	60	84	115

S mode

Engine speed	~1600	1600~2250
Power (KW)	60	84

L mode

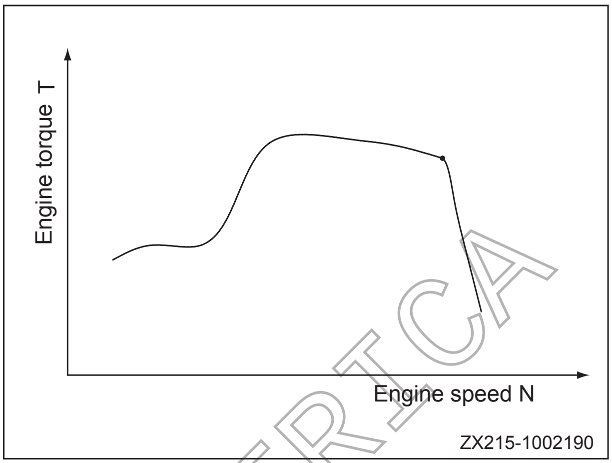
Engine speed	~2250
Power (KW)	60

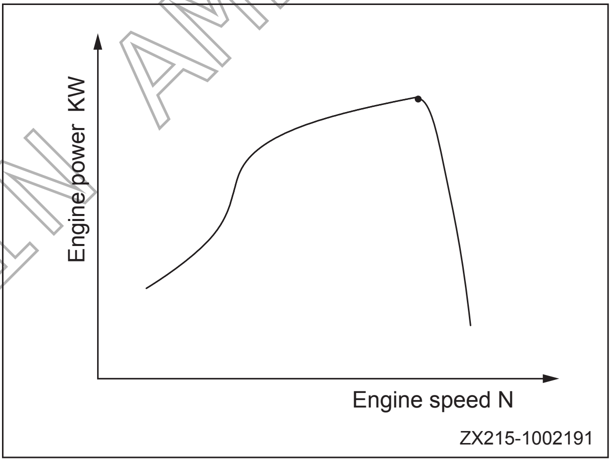


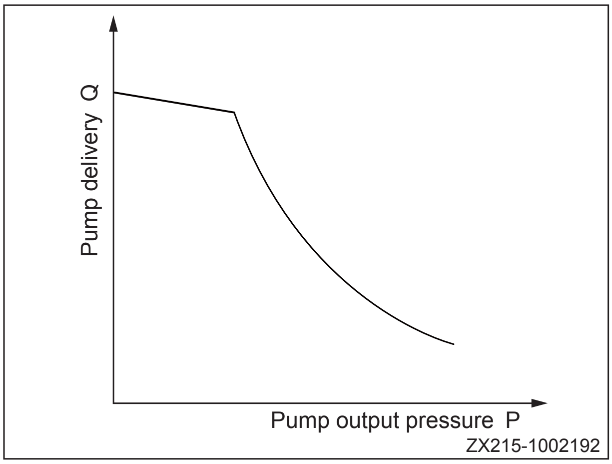
Control method of each working mode

H mode

- The matching point of H mode: rated speed 114kW/2050rpm
- 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.





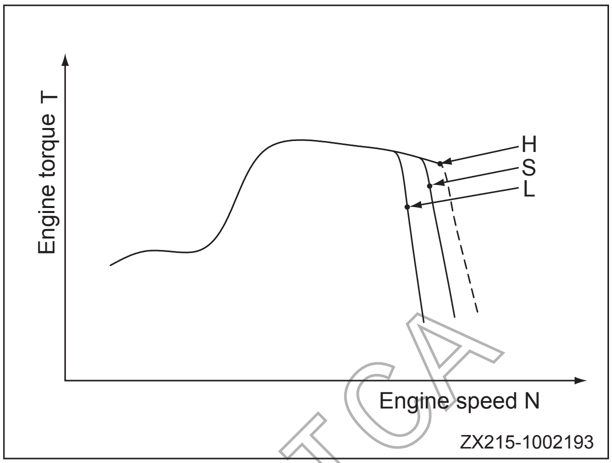


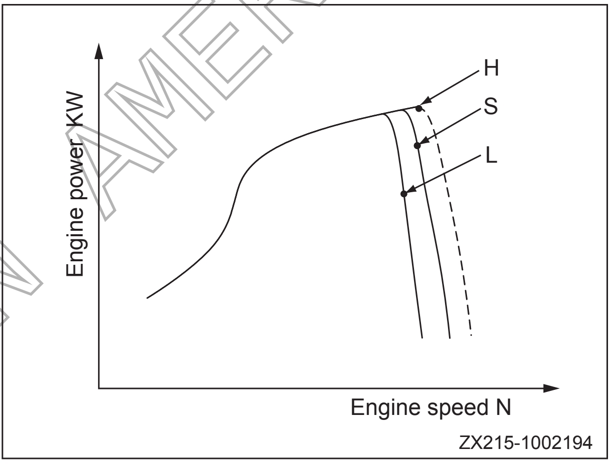
S mode/B mode/L mode

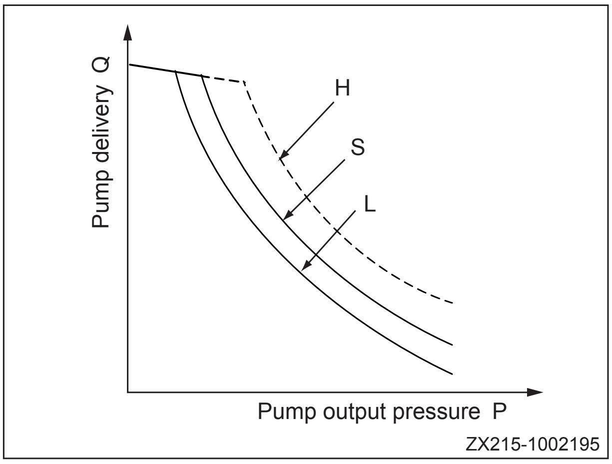
Power output rate of at each working mode

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

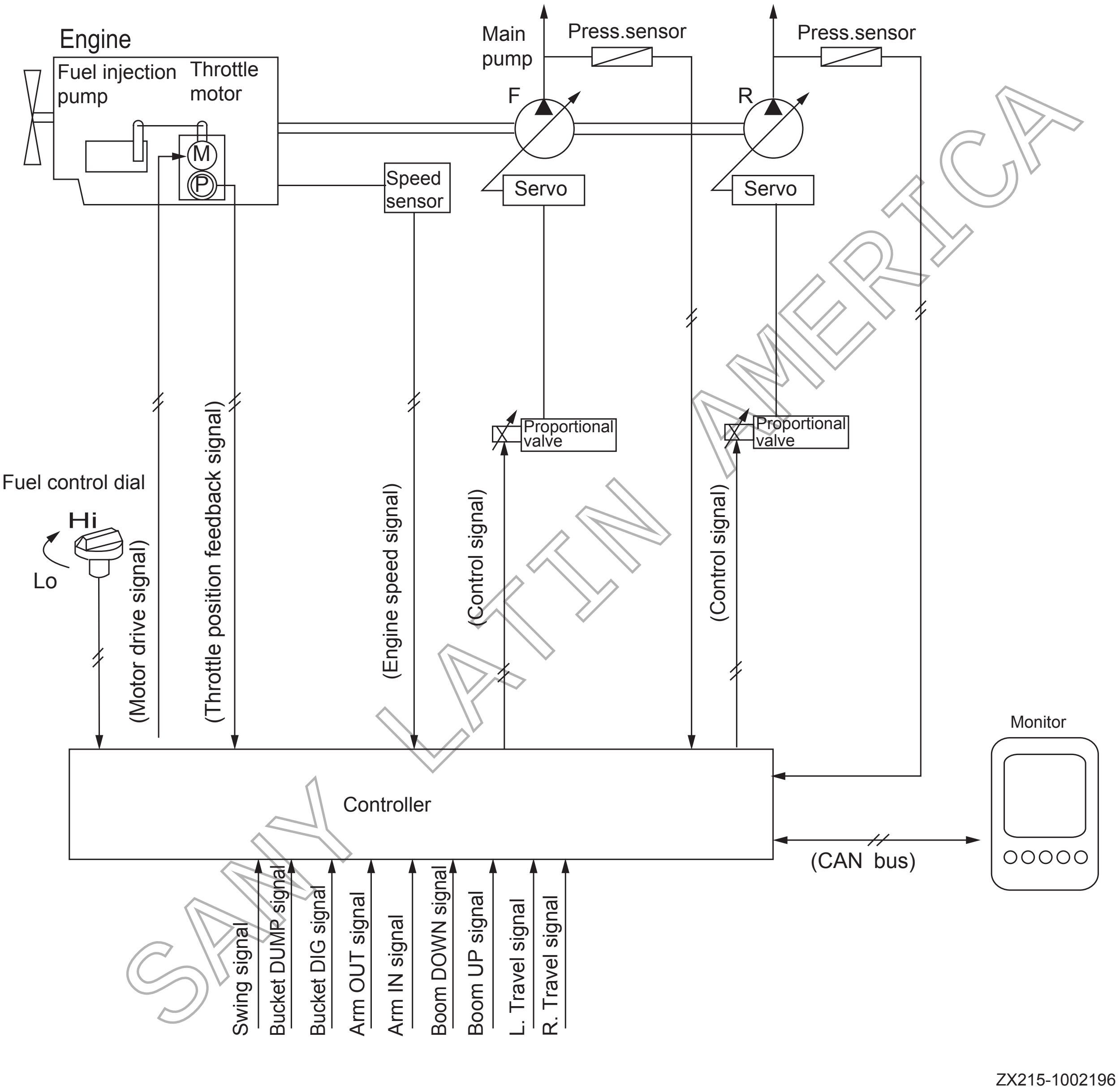
- At this time, the controller keeps the pump oil-suction torque in line with the stabling motor curve, and controls engine speed through combined control of the engine and pump.



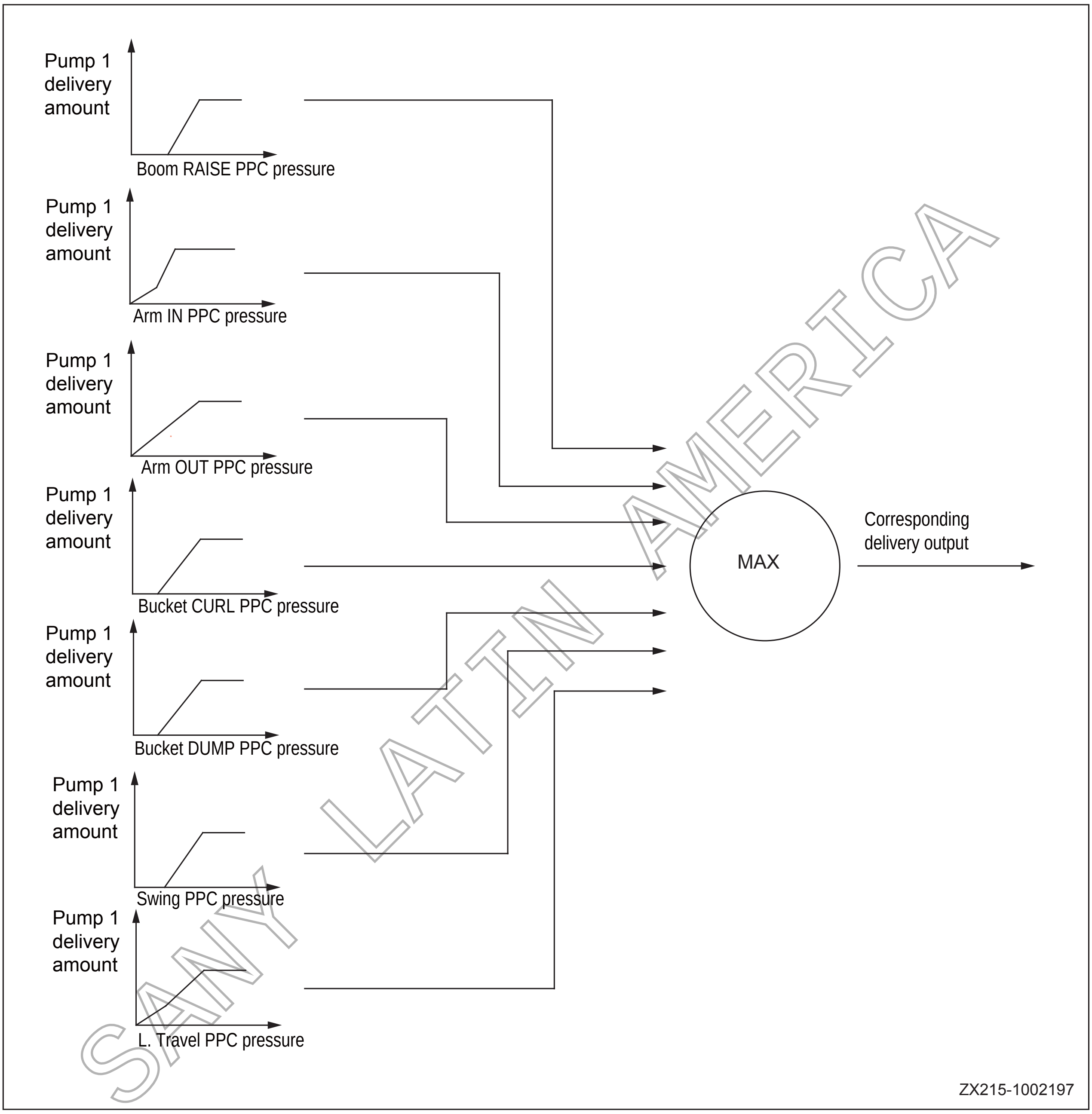


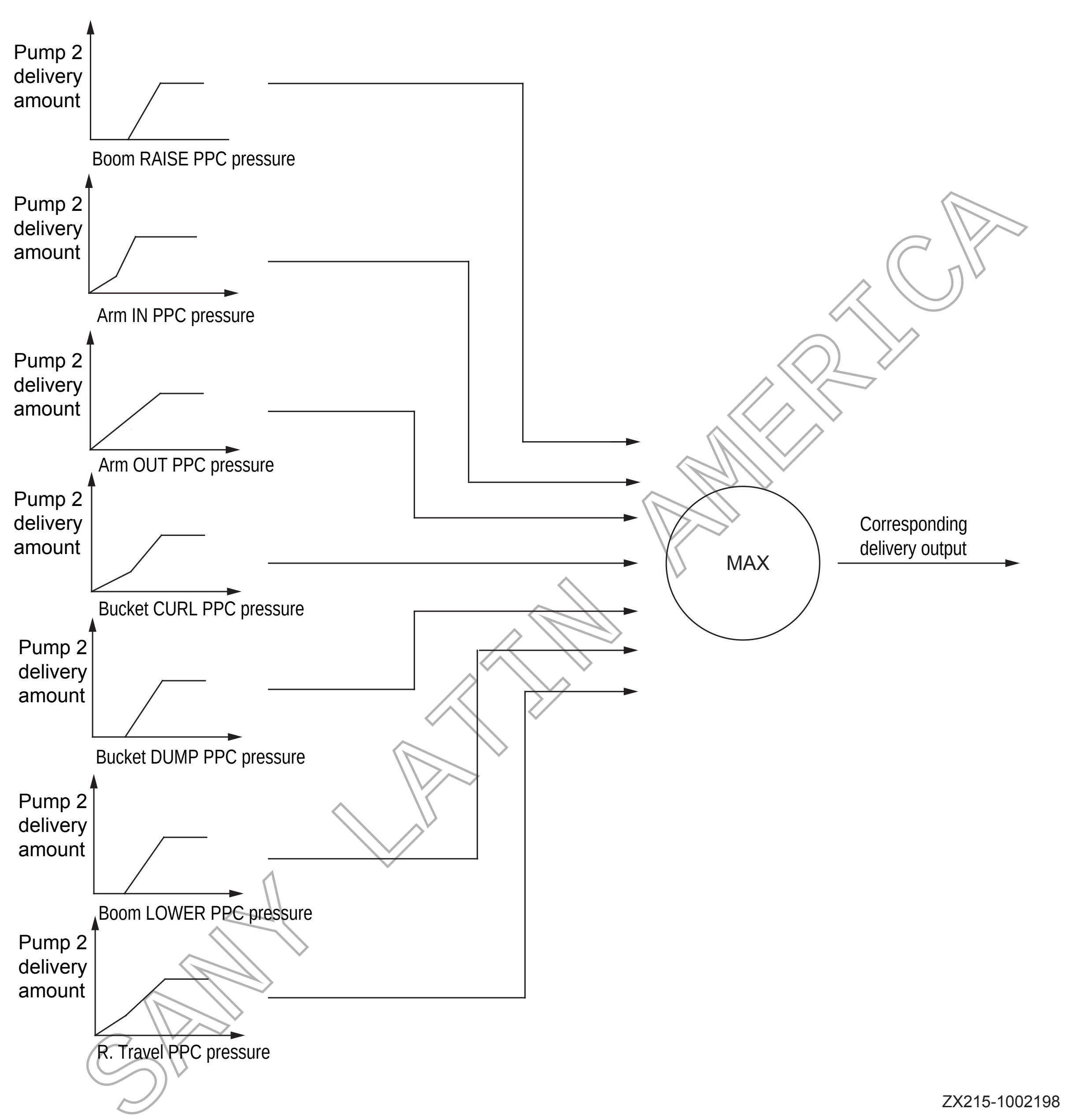


4.9.4 Pump control function



4.9.4.1 Electrical positive flow control




Pump 2 delivery amount
Boom RAISE PPC pressure
Pump 2 delivery amount
Arm IN PPC pressure
Pump 2 delivery amount
Arm OUT PPC pressure
Pump 2 delivery amount
Bucket CURL PPC pressure
Pump 2 delivery amount
Bucket DUMP PPC pressure
Pump 2 delivery amount
Boom LOWER PPC pressure
Pump 2 delivery amount
R. Travel PPC pressure
MAX
Corresponding delivery output
ZX215-1002198

Function

- Use the joystick 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.

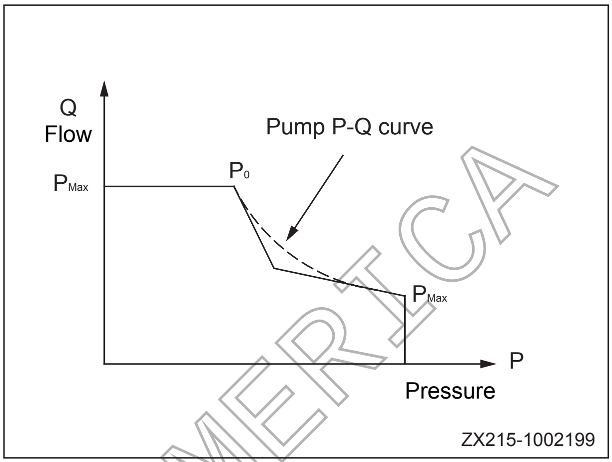
Operation

- 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.

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 $2P_0 \leq P_{\Sigma} \leq 2P_{Max}$ 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 working, the controller collects the throttle gear signal,, a constant current value is provided and pump power control is achieved.

ESS control

Function

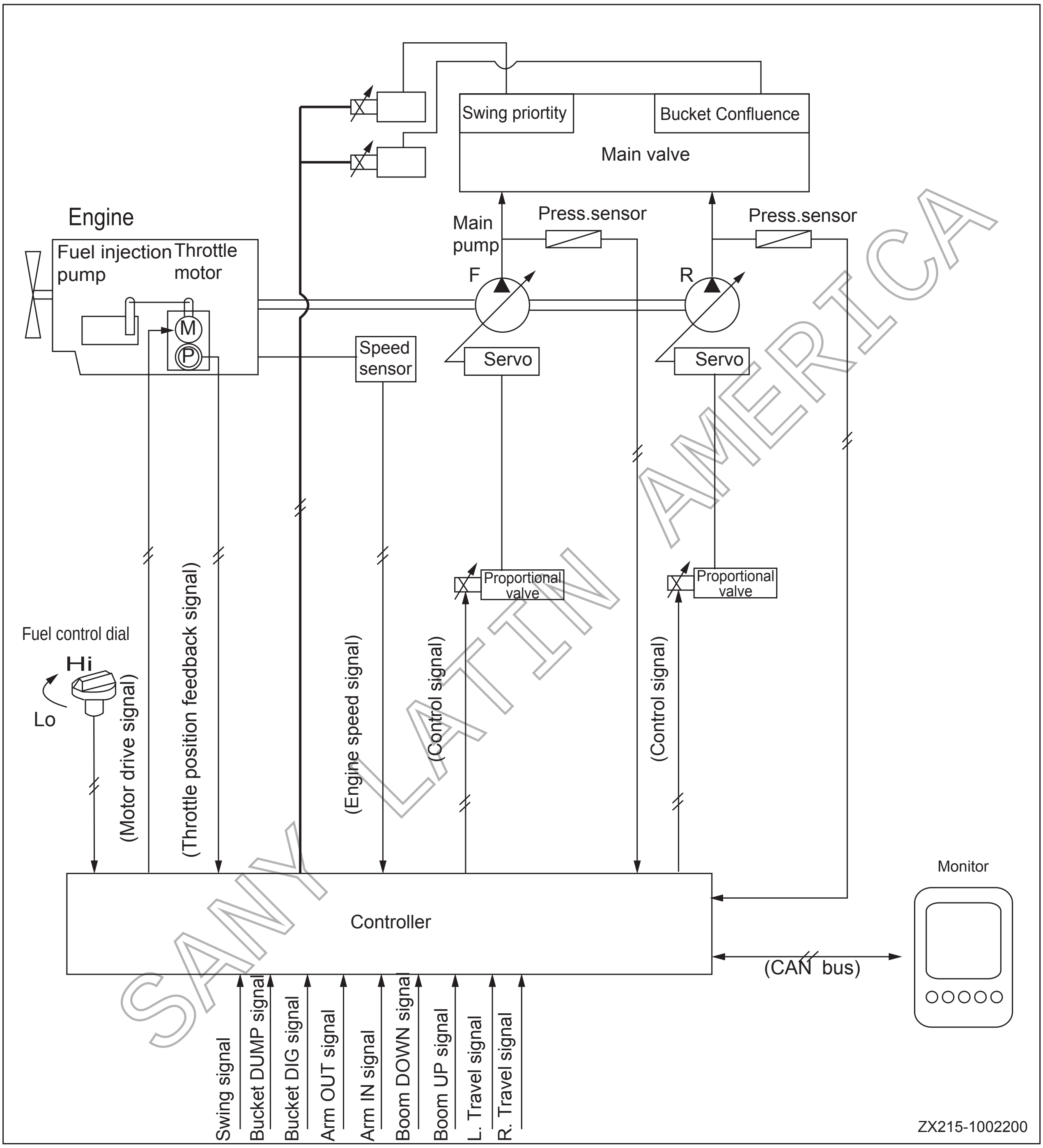
- Changing of the engine speed due to load change controls the pump power, and engine output can be used more efficiently. (This function can also prevent the engine from losing control when the machine is operating under harsh conditions (eg. high - altitude area).

Operation

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

- The engine controller collects the actual speed signal from the ECM, 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.

4.9.5 Valve control function



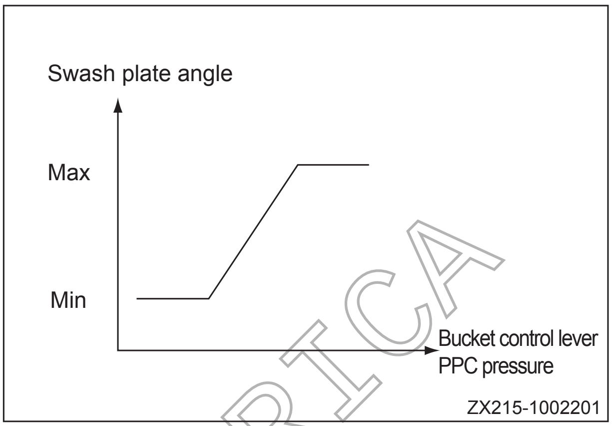
Valve control function

- Bucket flow control
- Swing priority control

4.9.5.1 Bucket flow control

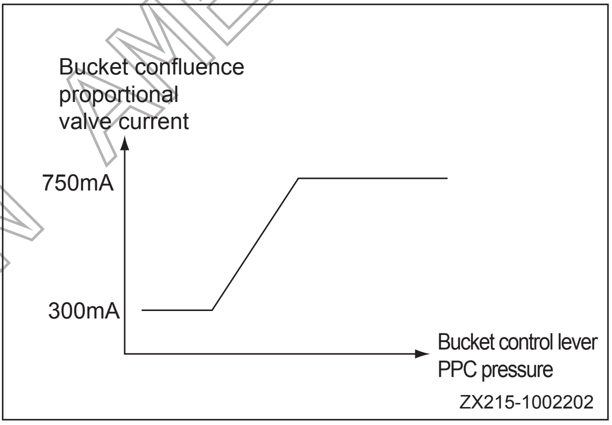
Function

- 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.



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.

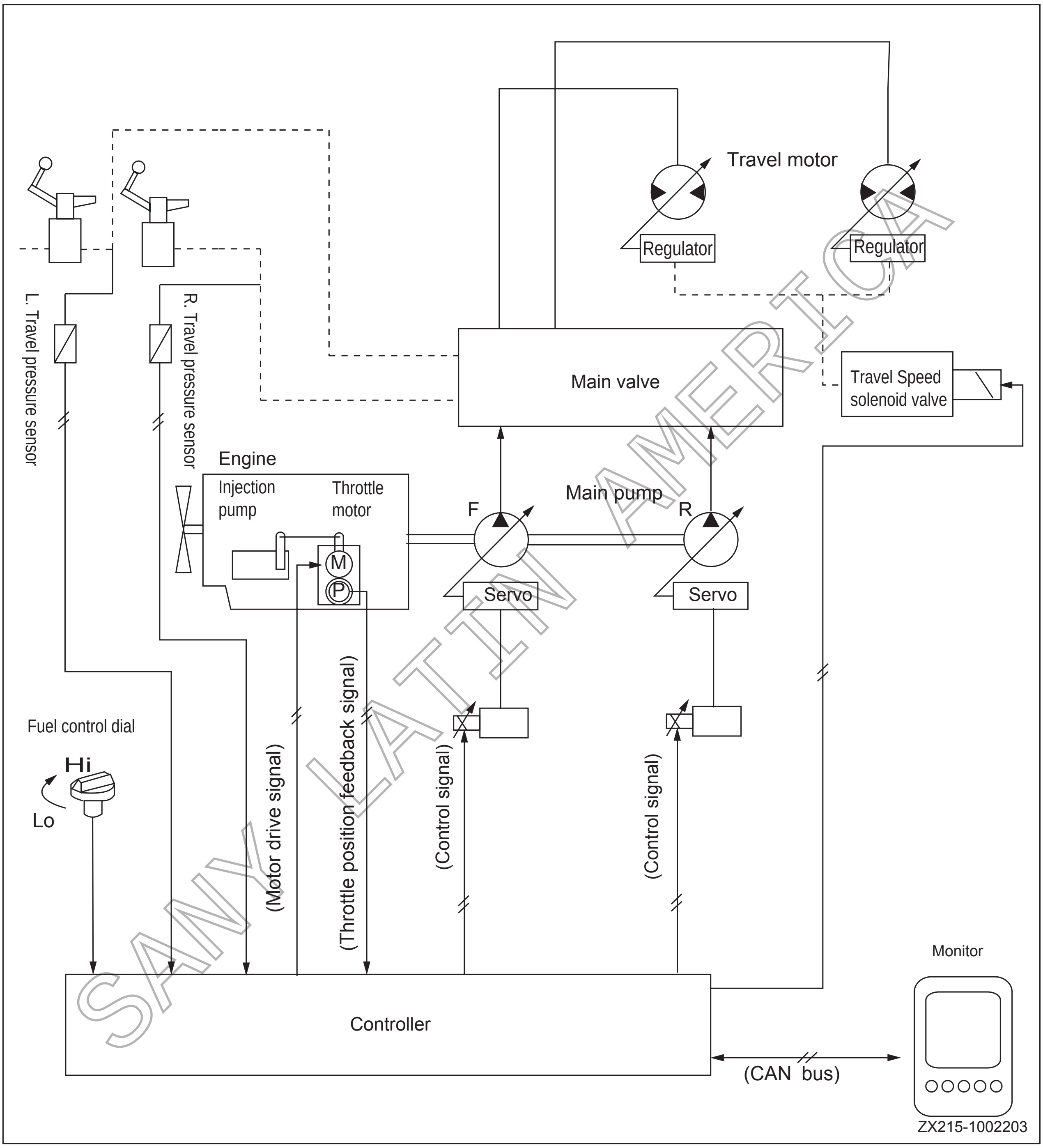
Operation

- 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

4.9.6 Duo travel speed control



Function

- Control travel mode.

Operating condition

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

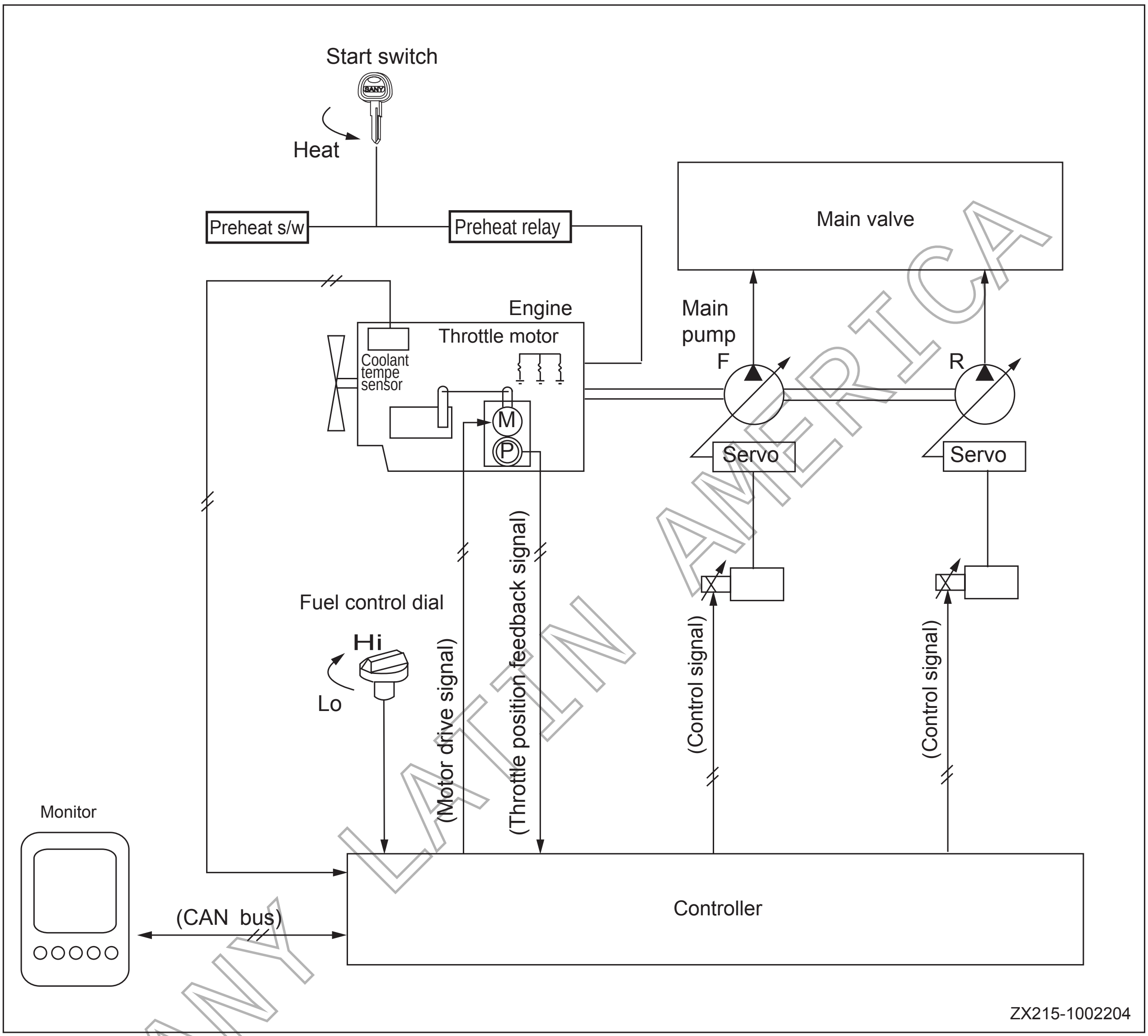
Operation

- 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.

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.

4.9.7 Engine preheating/overheating alarm



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

4.9.7.2 Engine overheating alarm

Function

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

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.

Operating condition

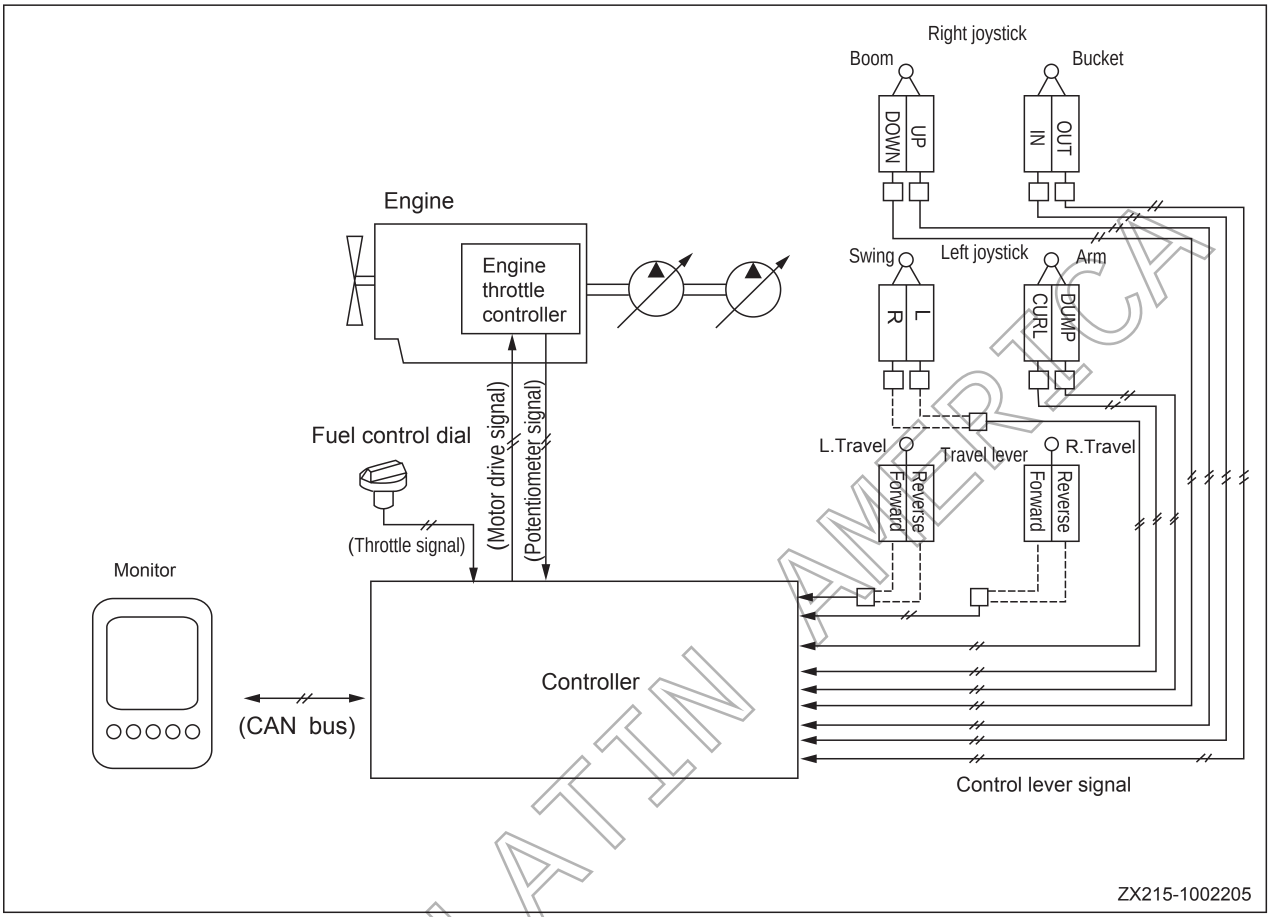
- Power ON.
- Coolant temperature above 110°C.

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.

4.9.9 Auto deceleration/acceleration control

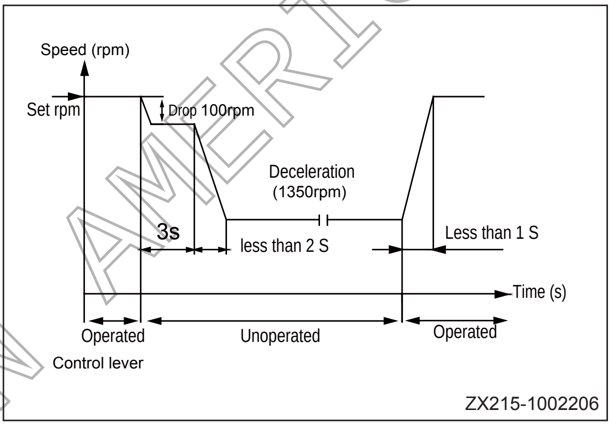


Function

- 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.

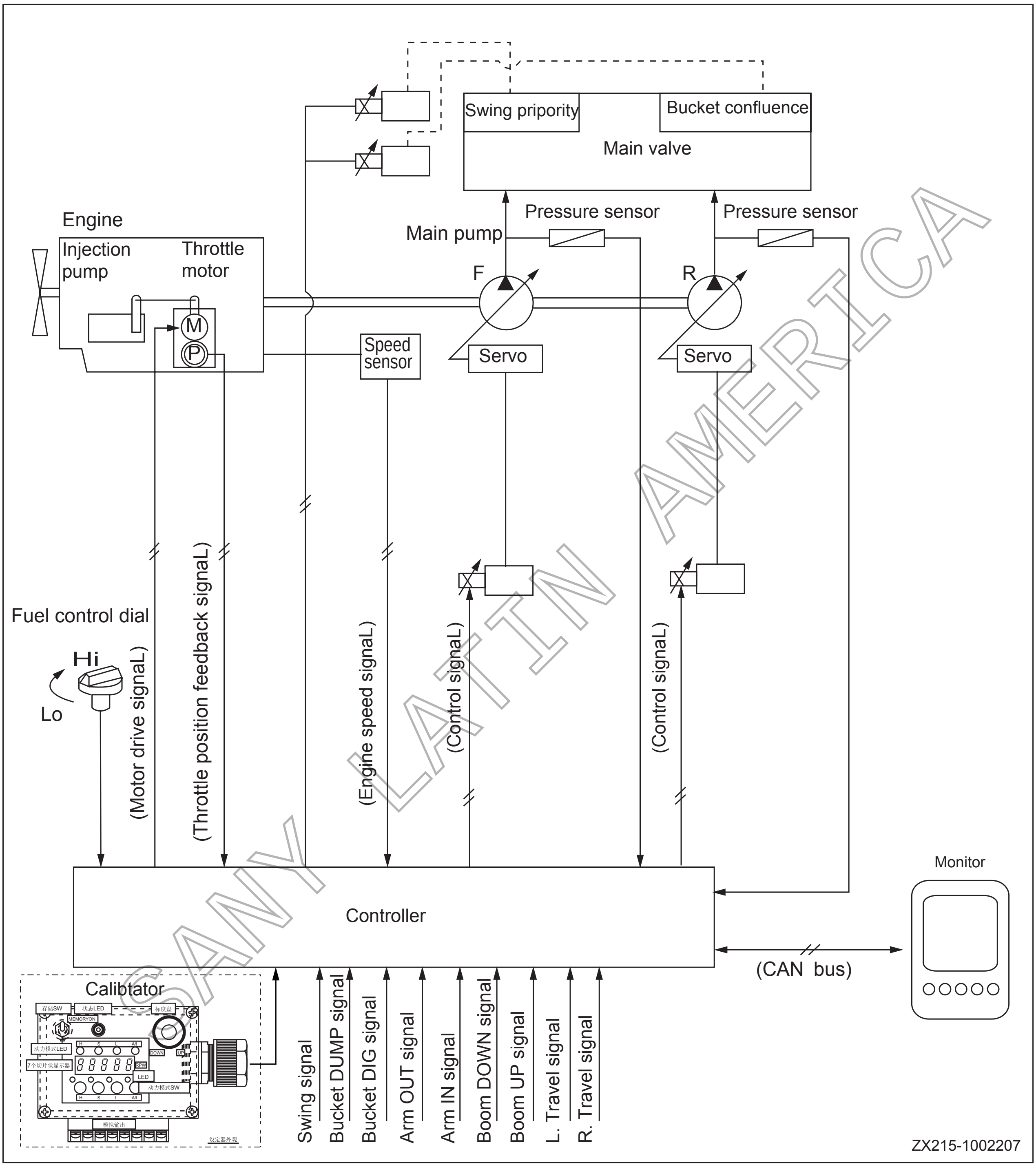
Operation

- About 3 second 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 (1400 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.



ZX215-1002206

4.9.10 Engine speed calibration function



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) Selection of fixing point of throttle motor soft shaft
2) H, S, L maximum speed calibration, and A/I speed calibration.
3) Turn the dial on the calibrator counterclockwise to the end
4) Power OFF
5) Set the calibrator to "Monitor mode", power on and check the result.

Remark:

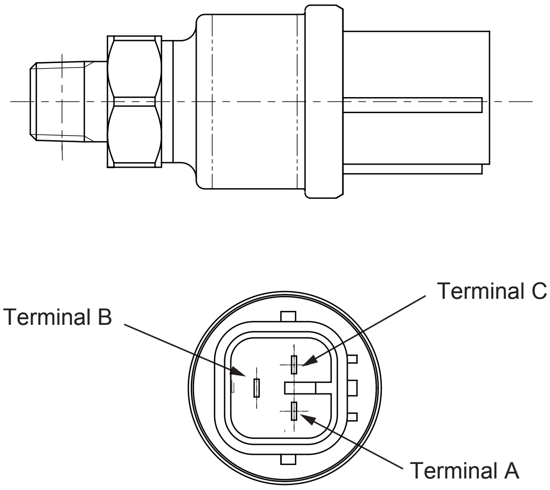
Memory SW up: Calibration mode;

Memory SW down: Monitor mode

For more information, see “Engine Speed - Test and Calibrate” on page 6-3.

4.9.11 Electrical Components

4.9.11.1 Pump pressure sensor



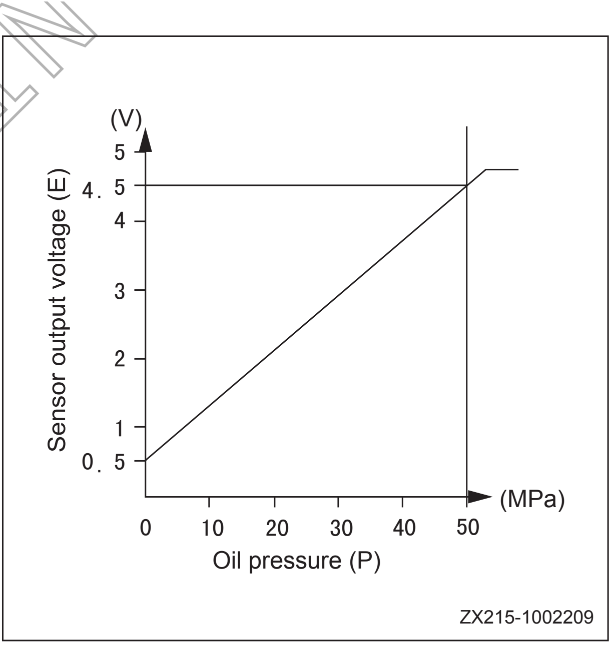
Connection diagram

No.	Signal name
A	PWR +5V
B	Output
C	

ZX305-1002066

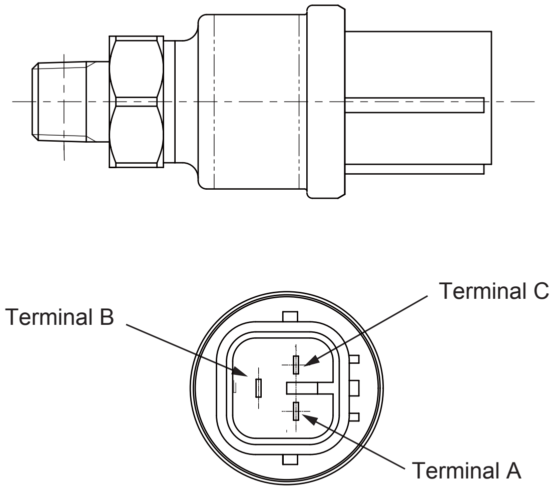
Operation

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



ZX215-1002209

4.9.11.2 Pilot pressure sensor



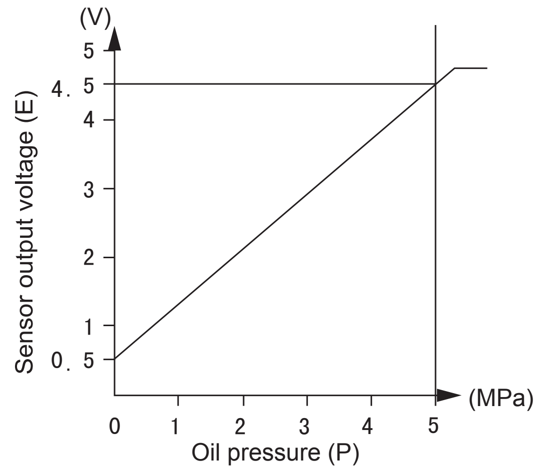
Connection diagram

No.	Signal name
A	PWR +5V
B	Output
C	

ZX305-1002066

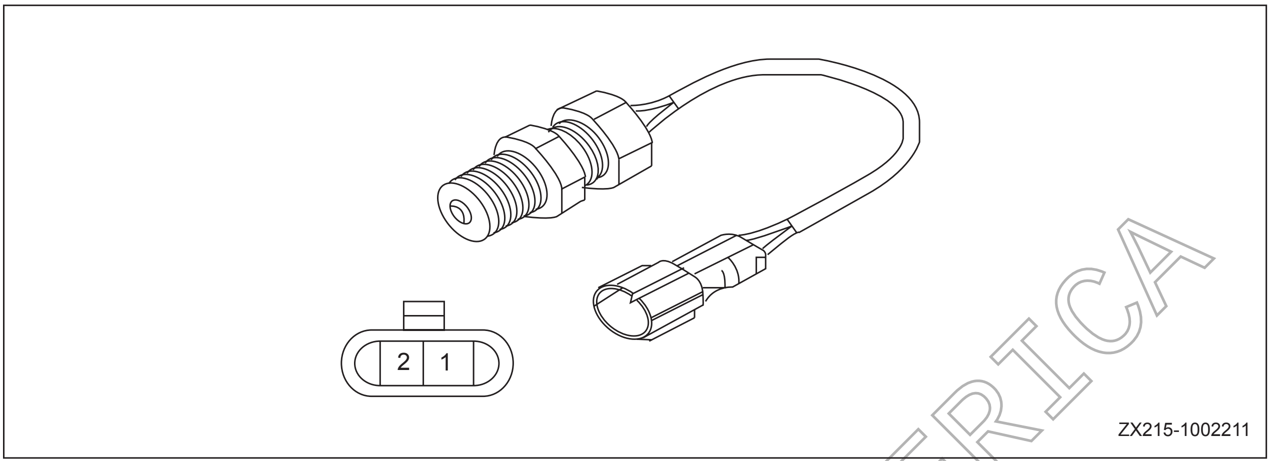
Operation

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



ZX215-1002210

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.

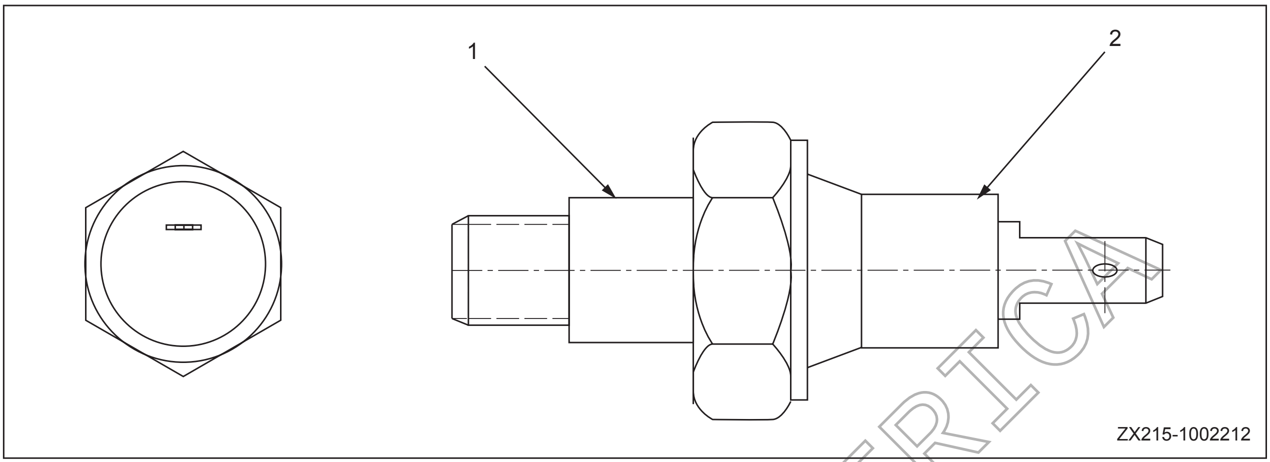
Standard value (@25°C)	2.3±0.2 kΩ

- 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.**

4.9.11.4 Coolant temperature sensor



1) Sensor
2) Connector

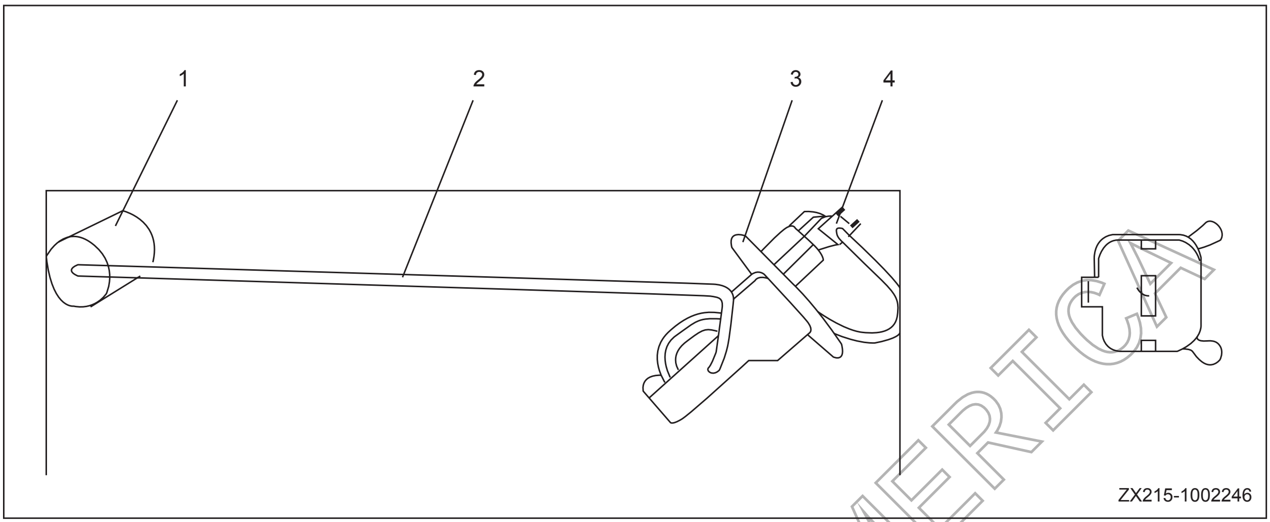
Function

- 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

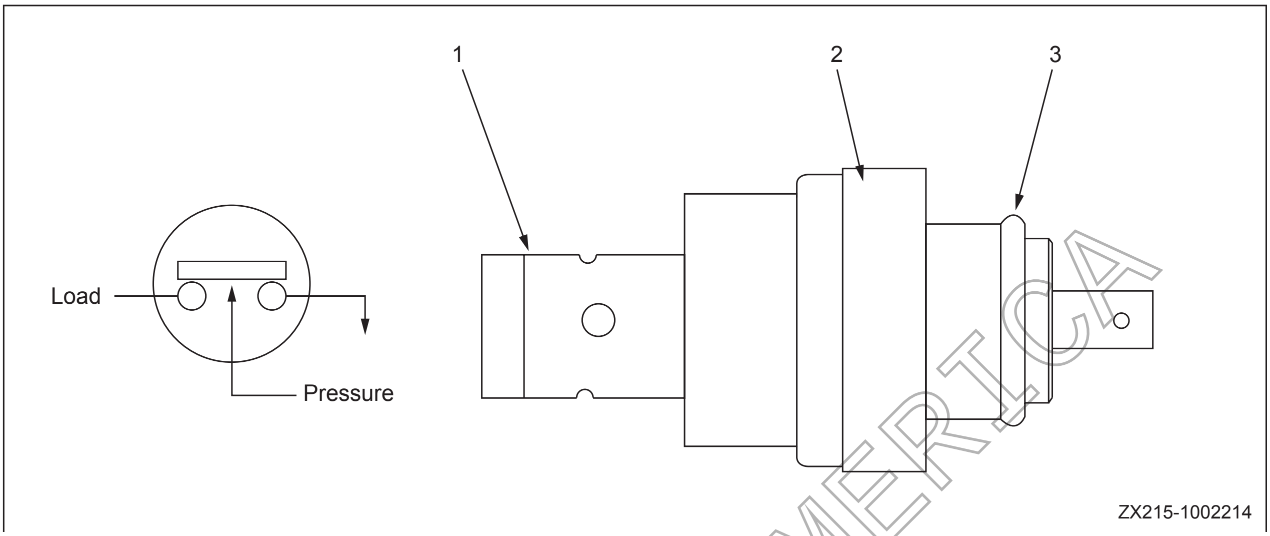
Standard value	50°C	80Ω (Ref.)
	60°C	56.3Ω
	80°C	29.5±10Ω
	100°C	16.5Ω
	106°C	14.3±0.5Ω
	120°C	10Ω(Ref.)

4.9.11.5 Fuel level sensor



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

4.9.11.6 Oil pressure switch



1) O-ring
2) Sensor
3) Connector

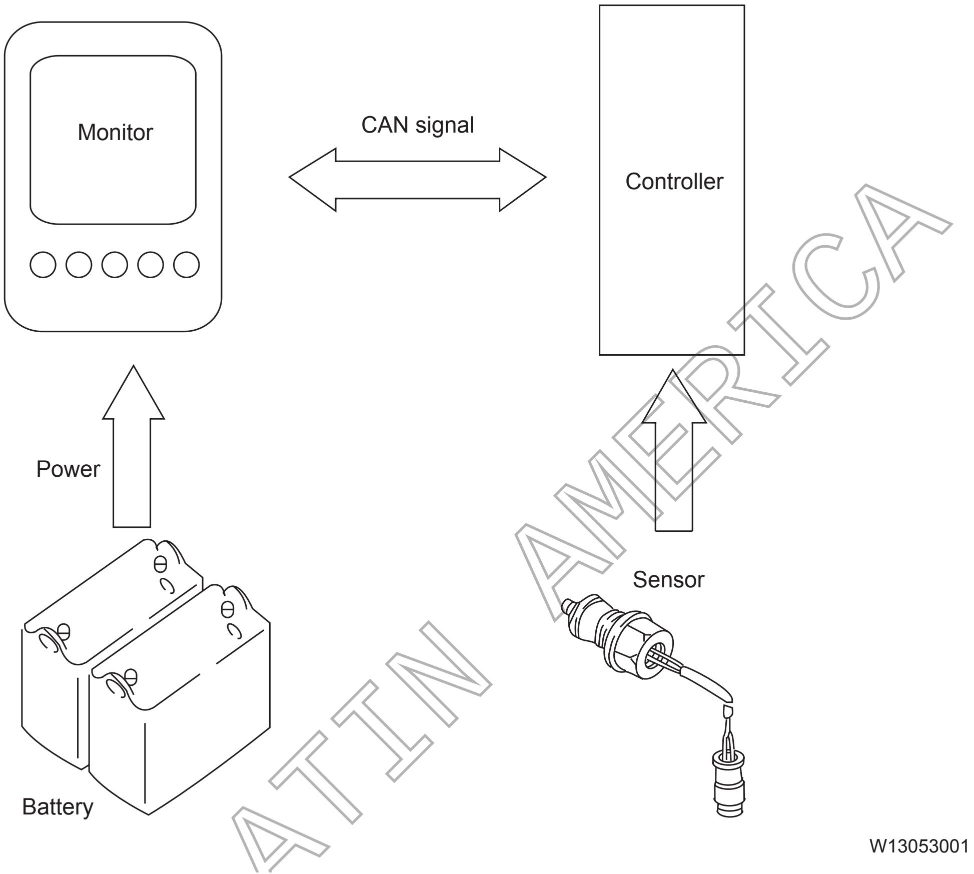
Function

- 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 type
- Operating pressure: 1.9kg

4.10 Monitoring System

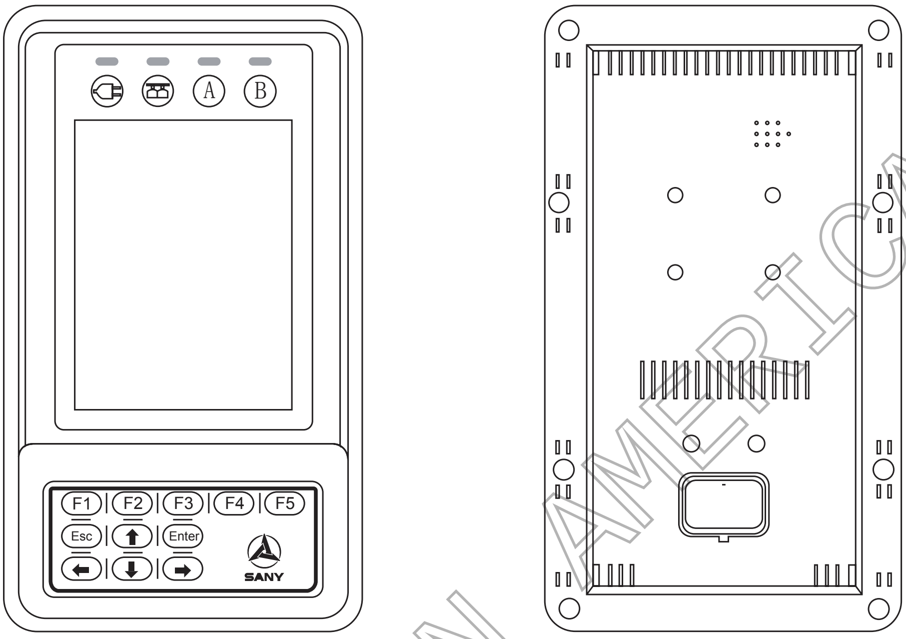


- The state of the machine is monitored by the sensors mounted on the machine components. The controller processes the signals and transmits the signals to the monitor display, informing the operator of the machine condition.
- Information on the monitor display includes primarily:

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.

4.10.1 Machine monitor



WX215-1204002H

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.

NOTE:

- 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.

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	

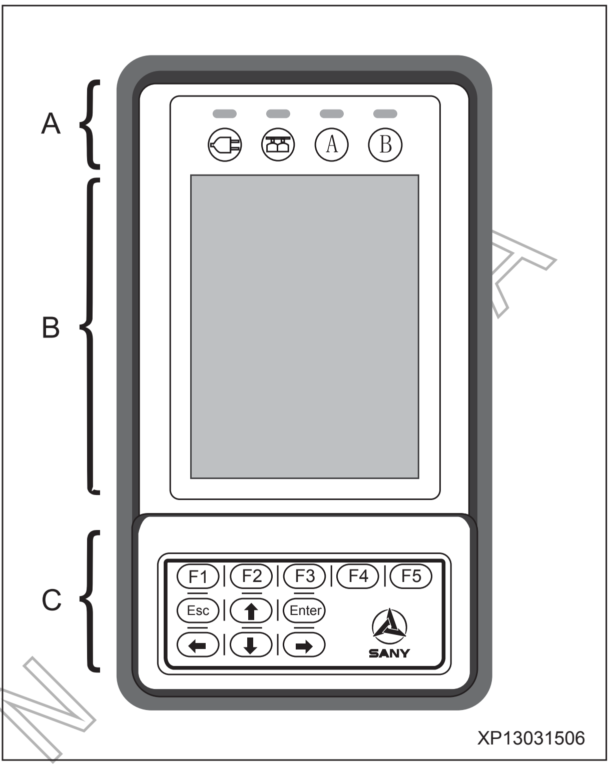
4.10.2 Monitor functions

The front side of the machine monitor is made up of three sections:

A. Warning and signal indicators

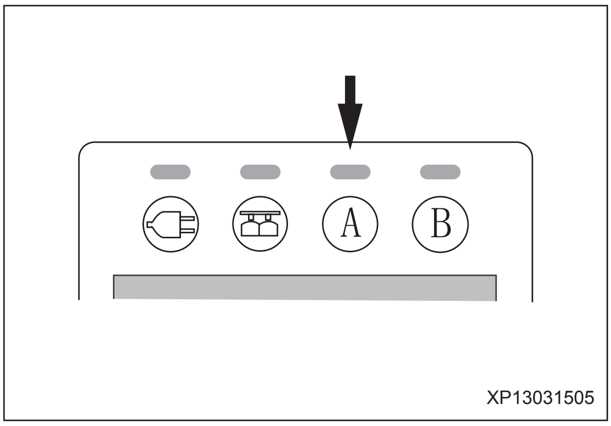
B. Display screen

C. Key pad



Warning and signal indicators

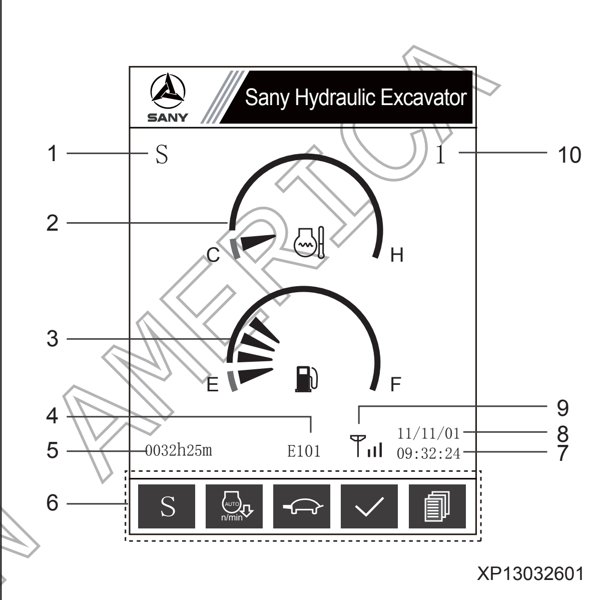
- When a machine fault occurs, the warning indicator lights up, reminding the user to check and address the fault.



Screen display

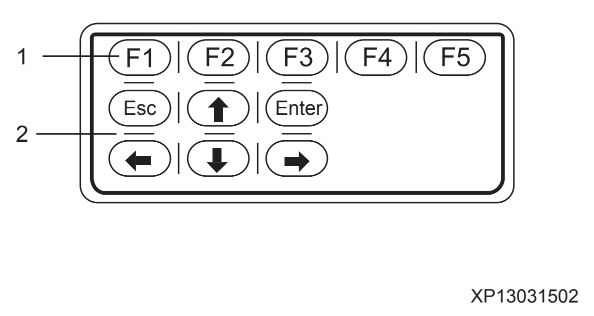
The LCD display is where monitor items are shown. This display is also the interface where most monitor operations are performed. Items on a normal operation display include:

1. Working mode indicator
2. Coolant temperature gage
3. Fuel level gage
4. Failure code
5. Total service hours
6. Function icons
7. System time (Hr: Min: Sec)
8. Date (YY:MM:DD)
9. GPS signal
10. Engine speed level (1 to 11)



Key pad

The key pad is composed of 5 function keys and six navigation keys.



1. Function keys

Functions of the five keys (F1, F2, F3, F4, F5) are indicated by the function icons above them on the screen.

Function keys and icons

Function key	Icon	Function	Operation interface
F1	S, H L, B	Working mode selection	Home page
	⇕	Select the next item; Go to the next page; Increase password value	Information Menu page Engine and Throttle Signal page, etc. Password Entry page
	✓	Save	System Time Calibration page, etc.
	▼	Lower monitor brightness	Brightness Adjustment page
F2	AUTO n/min or n/min	Switch between Auto idle and Non auto idle	Home page
	⇔	Move the cursor to the right	Password Entry page
	✓	Enter a selected entry	Information Menu page, etc.
	▲	Increase monitor brightness	Brightness Adjustment page
F3	🐢 or ■	Switch between High and Low travel speed	Home page
	🔑	Password validation	Password Entry page
	✓	Confirm the validity of a password and, if it's correct, enter the desired page. Save monitor brightness	Password Entry page Brightness Adjustment page
F4	✓	Go to "Fault Information" page Enter/Confirm	Home page Same as Enter
	☼	Go to Brightness Adjustment page	Password Entry page
	🛠	Go to System Setup page	Information Menu page
F5	🗐	Go to Information Menu	Home page
	↺	Return to Home page, Information Menu or System Setup page	Password Entry page, etc.
	✓	Save	Machine Configuration Calibration page
	🔑	Go to System Unlock page	Lockout Information page

NOTE: When no icon is displayed above a function key, this key is disabled.

2. Navigation keys

Navigation keys	Function
Enter	Enter/Confirm
ESC	Return
⬆	Select the item above (returns to the bottom item after the top item); or increase the value where the cursor blinks.
⬇	Select the item below (returns to the top item after the bottom item); or decrease the value where the cursor blinks.
⬅	Move the cursor to the left (returns to the right end digit after the left end digit).
➡	Move the cursor to the right (returns to the left end digit after the right end digit).

4.10.3 Monitor operation

1. Home page

The Home page is the normal operation display of the monitor. Items on this page include: truck load counter, working mode, speed level, coolant temperature, fuel level, service hours, clock, fault code, etc..

Operation

Working mode selection (1)

- Press F1 switch between S, H. L and B mode.

  NOTE: S mode is the default working mode.

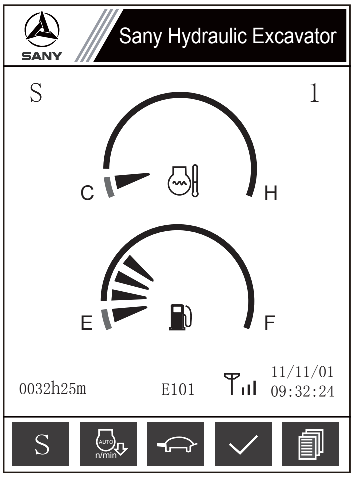
Auto-idle and Non auto-idle mode (2)

- Press F2 to switch between auto-idle and Non auto-idle mode.

  Auto-idle mode is indicated by ▭.

  Non auto-idle mode is indicated by ▭.

  NOTE: Auto-idle mode is the default mode.



XP13032602

When neither of the joysticks are operated for 5 seconds, the engine enters the idling state automatically in order to save fuel and reduce noise.

High and low travel speed (3)

- Press F3 to switch between high and low travel speed.

  High travel speed is indicated by 🐇.

  Low travel speed is indicated by 🐢.

  NOTE: Default travel speed is Low.

Fault Information (4)

- Press F4 to go to “Fault Information” when a fault occurs.

  NOTE: When the ECU detects an error in the machine, a fault code will appear on the monitor display. The tick icon on the bottom will turn red.

Information Menu (5)

- Press F5 to go to the Password Entry page before accessing the “Information Menu” page.

2. Information Menu password entry

A 5-digit password is required to access the “Information Menu”. You can ask your local dealer to obtain this password.

Operation

1. Press F1 to change the number where the cursor blinks in an ascending order. You can also use ⬆ or ⬇ to increase or decrease the number.
2. Press F2 to move the cursor to the right. You can also use ⬅ or ➡ to move the cursor to the left or to the right.

   NOTE: The cursor moves back to the left end side after the right end side.
3. When all the five digits of the password have been entered, press F3 or Enter. If the password is correct, the display moves to the “Information Menu” page; if not, please try again.
4. Press F5 or ESC to return to the Home page.
5. Press F4 on this page to go to Brightness Adjustment page.

Information Menu

Please enter the password

* * * * *

XP13031501

3. Information Menu

The information menu is a list of system functions. On this page, you can select and access any of the items on the list.

Operation

- Press F1 to select the item below the highlighted one. The highlighter returns to the top after the bottom item. You can also use ⬆ and ⬇ to move the highlighter up and down.
- Press F2 or Enter to access the selected entry.
- Press F5 or ESC to return to the Home page.
- Press F4 on this page to go to the Password Entry page before accessing the System Setup page.

XP1251203007

NOTE: Once an entry on the list is highlighted, an introductory hint will appear on the bottom of the display giving a short description of the selected entry. These hints include:

- Running parameters of the engine, main pup and main valve
- Fault code and description
- Throttle installation assistance
- System language selection
- System time setup
- GPS monitoring information

4. Engine & Throttle Signal

Select “Running Parameter” on the Information Menu page and press F2 or Enter, and the display moves to Engine & Throttle Signal page. This page is a real-time display of the running parameter of the engine and throttle.

Engine & Throttle Signal

Coolant temp °C:
Fuel level %:
Oil press kPa:
Throttle gear:
Eng speed rpm:
Gear position V:
Throt position V:

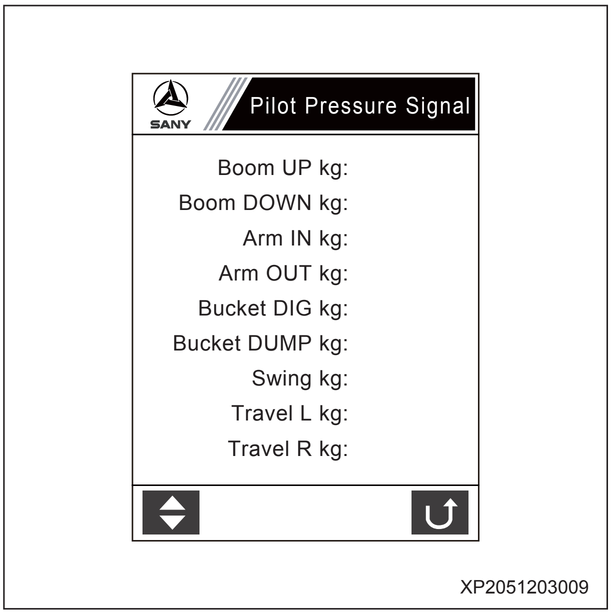
XP1251203008

Operation

- Press F1 to go to “Pilot Pressure Signal” page.
- Press F5 or ESC to return to the “Information Menu”.

5. Pilot Pressure Signal

This page is a real-time display of the pilot pressure signal of the hydraulic system.



Pilot Pressure Signal

Boom UP kg:
Boom DOWN kg:
Arm IN kg:
Arm OUT kg:
Bucket DIG kg:
Bucket DUMP kg:
Swing kg:
Travel L kg:
Travel R kg:

XP2051203009

Operation

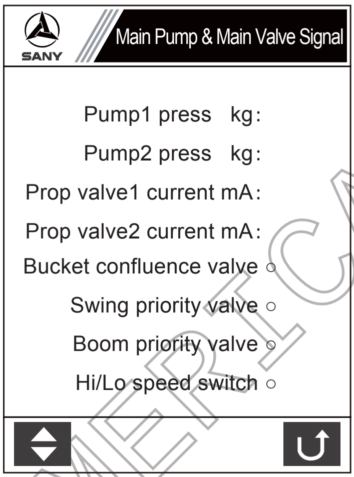
- Press F1 to go to “Main Pump and Main Valve Signal” page.
- Press F5 or ESC to return to the “Information Menu”.

6. Main Pump & Main Valve Signal

This page is a real-time display of the main pump and main valve signals of the hydraulic system.

Operation

- Press F1 to go to "Engine & Throttle Signal" page.
- Press F5 or ESC to return to the "Information Menu".



Pump1 press kg:
Pump2 press kg:
Prop valve1 current mA:
Prop valve2 current mA:
Bucket confluence valve ○
Swing priority valve ○
Boom priority valve ○
Hi/Lo speed switch ○

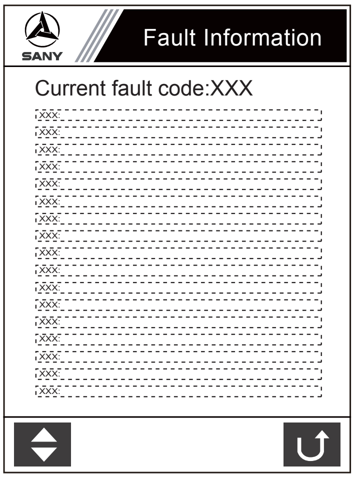
XP2051203010

7. Fault Information

Select "Fault Information" on the Information Menu page and press F2 or Enter, and the display moves to Fault Information page. This page lists important machine fault information.

Operation

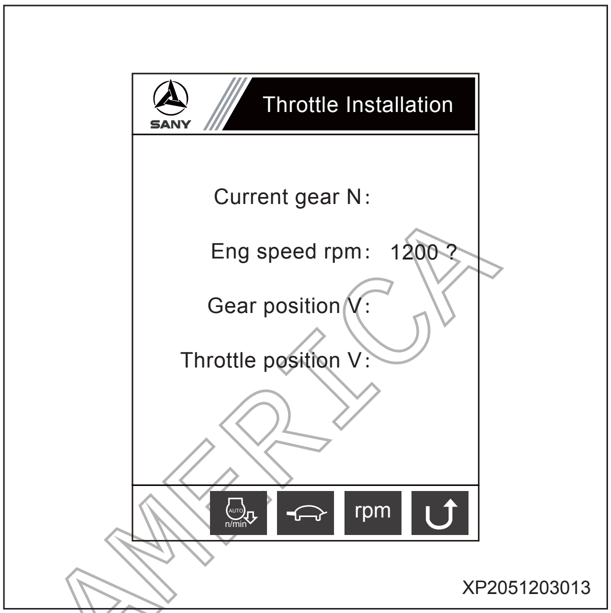
- Press F1 to go to the next page.
- Press F5 or ESC to return to the "Information Menu".



Current fault code:XXX
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:
XXX:

XP13041501

8. Throttle Installation


Throttle Installation

Current gear N:

Eng speed rpm: 1200 ?

Gear position V:

Throttle position V:

XP2051203013

Select “Throttle Installation” on the Information Menu page and press F2 or Enter, and the display moves to Throttle Installation page. This page displays throttle installation assistance function.

Operation

- Press F2 to switch between auto-idle and full speed.
- Press F3 to select high or low travel speed.
- For machines equipped with SYFCS controllers, press F4 to switch between rpm (blue) and rpm (red).
- Press F5 or ESC to return to the “Information Menu”.

NOTE: For machines equipped with SYFCS controllers, when engine speed calibration is not successful, a question mark will appear.

9. System Language


System Language

中文系统

English Systems

XP2051203014

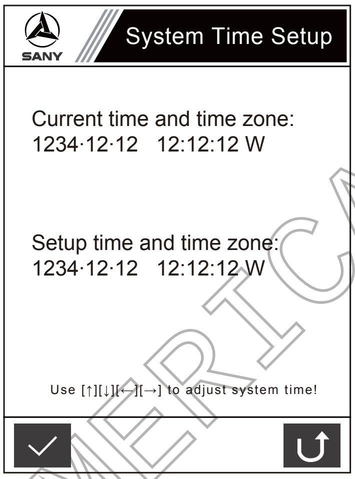
Select “System Language” on the Information Menu page and press F2 or Enter, and the display moves to this page.

Operation

- Press F2 to select 中文.
- Press F3 to select English.
- You can also use ⬆ or ⬇ to select a system language on the list.
- Press F5 or ESC to return to the “Information Menu”.

10. System Time Setup

Select “System Time Setup” on the Information Menu page and press F2 or Enter, and the display moves to this page. You can set system time on this page.



Current time and time zone:
1234·12·12 12:12:12 W

Setup time and time zone:
1234·12·12 12:12:12 W

Use [↑][↓][←][→] to adjust system time!

XP2051203015

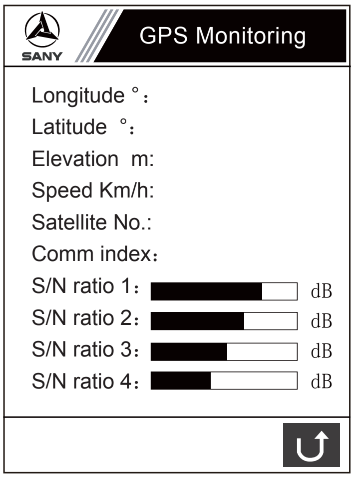
Operation

- Use ↑ and ↓ to change the number where the cursor blinks.
- Use ← and → to move the cursor.
- Press F1 or Enter to save adjusted time.
- Press F5 or ESC to return to the “Information Menu”.

NOTE: When F1 or Enter is pressed, the screen displays “Setup Finished” on the bottom. If system time has been adjusted, it cannot be adjusted again until the system is re-energized.

11. GPS Monitoring

Select “GPS Monitoring” on the Information Menu and press F2 or Enter to view this page.



Longitude °:
Latitude °:
Elevation m:
Speed Km/h:
Satellite No.:
Comm index:
S/N ratio 1: dB
S/N ratio 2: dB
S/N ratio 3: dB
S/N ratio 4: dB

XP130426011

Operation

- Press F5 or ESC to return to the “Information Menu”.

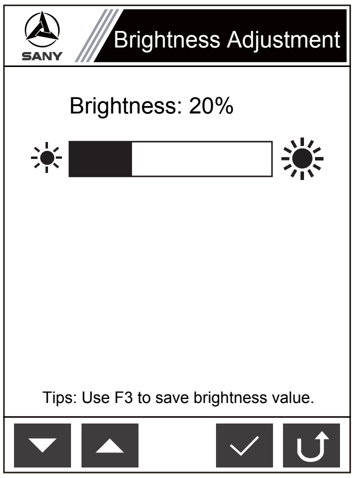
Remark:

- Longitude: “E” stands for “East”, while “W” for “West”.
- Latitude: “N” stands for “North”, while “S” for “South”.
- Altitude: “P” means “Above Sea Level”, while “N” means “Below Sea Level”.

- The blue-white bars show signal-to-Noise ratio ranges from 0 to 99.
- When the altitude is nonzero and the longitude and latitude is zero, it means that the system is receiving GPS data, yet still in the process of precise positioning.
- GPS is normal when the signal indicator shows 1023, otherwise it is abnormal when the signal indicator shows 615.
- When the signal indication changes to 0 from 7, a connection failure occurs either in the SIM card or in the antenna.
- When the signal indication changes to 0 from 15, it is either because the GPS service is not available, or the SIM card charge is overdue, or the GPS network is abnormal.
- When the signal indication changes to 0 from 31, it is because the monitoring center suspends.

12. Brightness Adjustment

Press F4 on the Information Menu Password Entry page to go to Bright Adjustment page. This page is used to adjust monitor screen brightness.



Brightness: 20%

Tips: Use F3 to save brightness value.

XP2051203029

Operation

- Press F1 to decrease brightness level. The progress bar moves to the left side. Minimum brightness is 10%.
- Press F2 to increase brightness level. The progress bar moves to the right side. Maximum brightness is 100%.
- Press F3 to save brightness adjustment.
- Press F5 to return to the “Information Menu”.

13. System Setup password entry

Press F4 on the Information Menu page to enter the Password Entry page before accessing the System Setup page.

Please enter the password

* * * * *

XP130426012

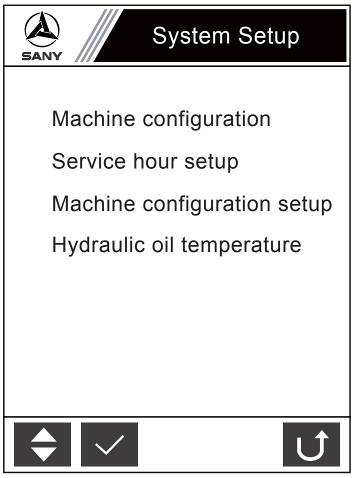
Operation

1. For password entry method, see Information Menu Password Entry page.
2. When all the five digits of the password have been entered, press F3 or Enter. If the password is correct, the display moves to the “System Setup” page; if not, please try again.
3. Press F5 or ESC to return to the Home page.

NOTE: Contact your local dealer to obtain this password.

14. System Setup

This page is used to set up machine configuration.



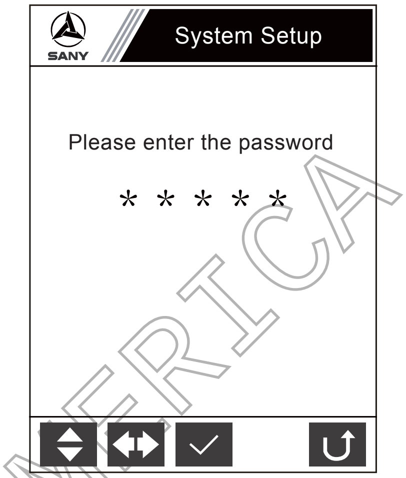
XP2051203016

Operation

- Press F1 to select the item below the highlighted one. The highlighter returns to the top after the bottom item. You can also use ⬆ and ⬇ to move the highlighter up and down.
- Press F2 or Enter to access the selected entry.
- Press F5 or ESC to return to the Home page.

15. Machine Configuration password entry

Select Machine Configuration on the System Setup list and press F2 or Enter, and the display moves to the Password entry page before accessing the Machine Configuration page.


System Setup

Please enter the password

* * * * *

XP13060801

Operation

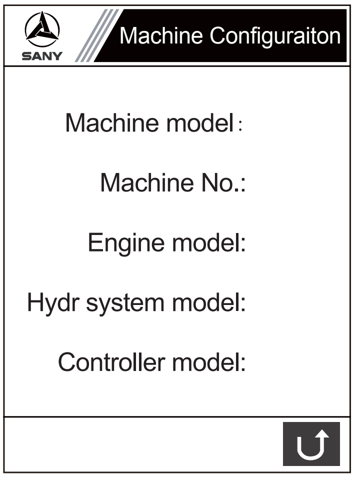
1. For password entry method, see Information Menu Password Entry page.
2. When all the five digits of the password have been entered, press F3 or Enter. If the password is correct, the display moves to the "Machine Configuration" page; if not, please try again.
3. Press F5 or ESC to return to the "System Setup" page.

16. Machine Configuration

You can view machine configuration information on this page.

Operation

- Press F5 or ESC to return to the "System Setup" page.


Machine Configuraiton

Machine model：

Machine No.:

Engine model:

Hydr system model:

Controller model:

XP13041502

17. Service Hour Setup password entry

Select “Service Hour Setup” on the System Setup list and press [F2] or [Enter], and the display moves to the Password entry page before accessing the Service Hour Setup page.

Operation

1. For password entry method, see Information Menu Password Entry page.
2. When all the five digits of the password have been entered, press [F3] or [Enter]. If the password is correct, the display moves to the “Service Hour Setup” page; if not, please try again.
3. Press [F5] or [ESC] to return to the “System Setup” page.

Please enter the password

* * * * *

XP13060802

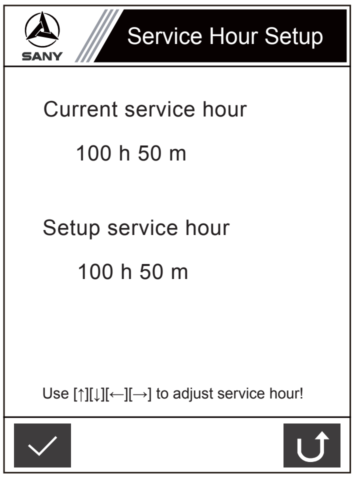
18. Service Hour Setup

This page is used to set up machine service hours.

Operation

- Use [↑] and [↓] to change the number where the cursor blinks.
- Use [←] and [→] to move the cursor.
- Press [F1] or [Enter] to save adjusted time.
- Press [F5] or [ESC] to return to the “System Setup” page.

NOTE: When [F1] or ENTER is pressed, the screen displays “Setup Finished” on the bottom. If system time has been adjusted, it cannot be adjusted again until the system is reenergized.



Current service hour

100 h 50 m

Setup service hour

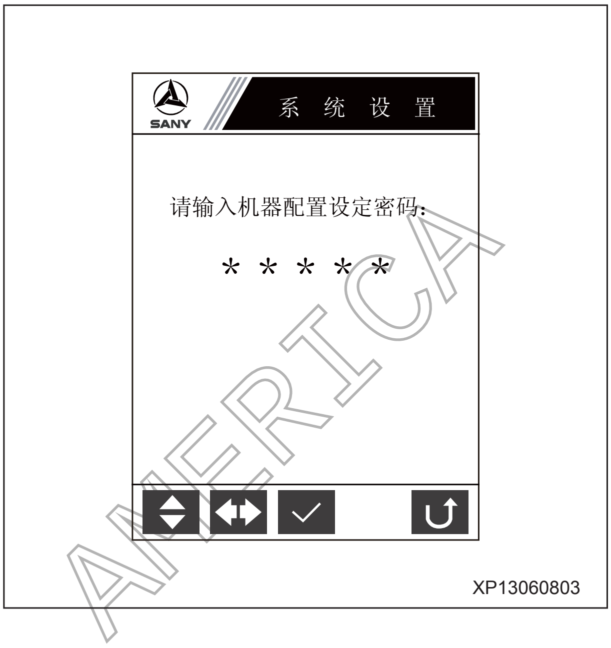
100 h 50 m

Use [↑][↓][←][→] to adjust service hour!

XP2051203021

19. Machine Configuration Setup password entry

Select “Machine Configuration Setup” on the System Setup list and press F2 or Enter, and the display moves to this Password entry page.



请输入机器配置设定密码:

* * * * *

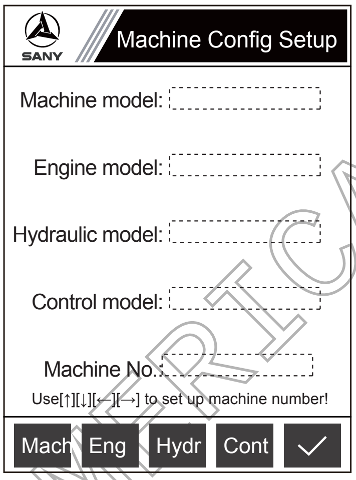
XP13060803

Operation

1. For password entry method, see Information Menu Password Entry page.
2. When all the five digits of the password have been entered, press F3 or Enter. If the password is correct, the display moves to the “Machine Configuration Setup” page; if not, please try again.
3. Press F5 or ESC to return to the “System Setup” page.

20. Machine Configuration Setup

This page is used to set up machine configuration after installation of the monitor.



Machine model:

Engine model:

Hydraulic model:

Control model:

Machine No.:

Use[↑][↓][←][→] to set up machine number!

XP13041503

Operation

- Press F1 to change machine model.
- Press F2 to change engine model.
- Press F3 to change hydraulic system model.
- Press F4 to change controller model.
- Press F5 to save machine configuration. The screen displays “Setup finished. Please re-energize the system.”
- Press Enter to move the cursor between different parts in the machine number.
- Use ↑ and ↓ to increase and decrease the selected machine number by 100 each time.
- Use ← and → to increase and decrease the selected machine number. One quick pressing increase or decrease the number by 1. Long pressing increase or decrease the number in a quicker pace.
- Press ESC to return to the “System Setup” page.

Remark:

The machine serial number is composed of 4 parts: 1) Production year, 2) Product code, 3) Tonnage code, 4) Alteration code, 5) Serial number, and 6) Tail number “8”.

1) Press Enter to move the cursor to different part (Production year, Product code and Serial number) in the machine number.

2) When the cursor moves to Production year and Alteration code, press ← and → to increase or decrease Production year and Alteration code by 1 each time.

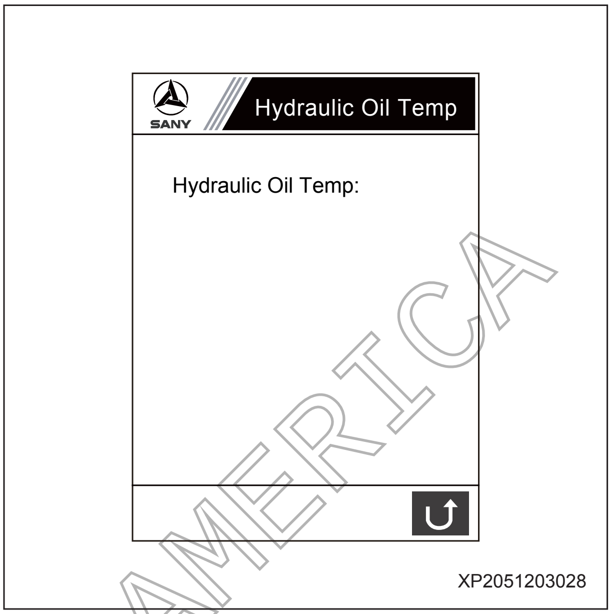
3) When the cursor moves to Tonnage code, press ← and → to increase or decrease tonnage code by 1 each time; or press ↑ and ↓ to increase or decrease tonnage code by 100 each time.

4) When the cursor moves to Serial number, press ← and → to increase or decrease this number by 1 each time. Long pressing to change the number in a quick pace. Press ↑ and ↓ to increase or decrease this number by 100 each time.

5) The machine number has 4 adjustable digits. Use ← and → to switch between the four digits, and use ↑ and ↓ to change the value on a digit. The value of the first digit from the left could be any numbers from 0 to 9 and any letters from A to Z; the value of the rest three digits could only be any number from 0 to 9. When the number exceed 9999, capital letter from A to Z will have to be used. A, B, C, D, E ... means respectively 10000, 11000, 12000, 13000, 14000, 15000 .... For example: 10000 will be written as A000; 11020 as B020, 12999 as C999.

21. Hydraulic Oil Temperature

Select “Hydraulic Oil Temperature” on the System Setup list and press F2 or Enter, and the display moves to this page.



Hydraulic Oil Temp:

XP2051203028

Operation

- Press F5 or ESC to return to the “System Setup” page.

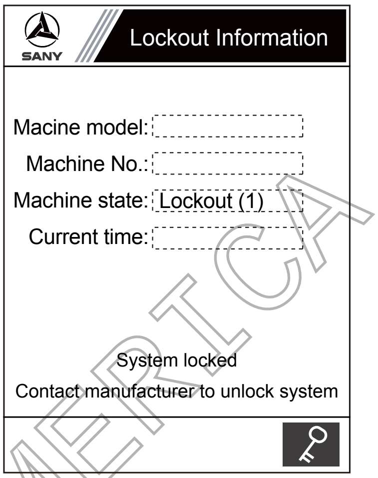
22. Lockout Information (Level 1)

This display indicates that the machine has entered lockout state (level 1).

Operation

- Press F5 to enter “System Unlock” page.

NOTE: Contact your local dealer to unlock the machine when the system is locked.



Lockout Information

Macine model:

Machine No.:

Machine state: Lockout (1)

Current time:

System locked

Contact manufacturer to unlock system

XP13041504

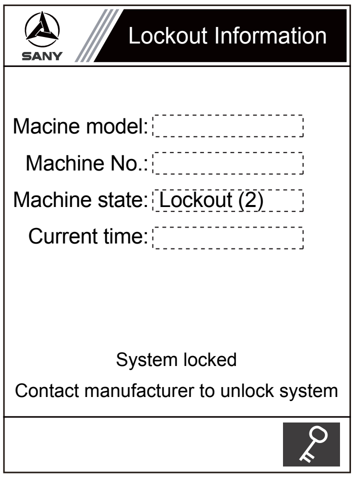
30. Lockout Information (Level 2)

This display indicates that the machine has entered lockout state (level 2).

Operation

- Press F5 to enter “System Unlock” page.

NOTE: Contact your local dealer to unlock the machine when the system is locked.



Lockout Information

Macine model:

Machine No.:

Machine state: Lockout (2)

Current time:

System locked

Contact manufacturer to unlock system

XP13041505

Standard Values

5 Standard Values

⚠ WARNING

Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

5 STANDARD VALUES

5.1 Standard Values of Engine - related Parts

Item	Measurement condition	Unit	Std. value for new machine	Permissible value
Engine Speed	High Idling	rpm	2,060 ± 70	2,060 ± 70
	Low Idling	rpm	1,050 ± 50	1,050 ± 50
	Rated Speed	rpm	2,000	2,000
Intake Pressure (Negative Pressure)	● Air Cleaner Outlet Location ● Arm-In Overflow+Max. rpm	kPa {mmH$_2$O}	Min. 133 {Min. 1,000}	Min. 133 {Min. 1,000}
Exhaust Color	At Sudden Acceleration	Bosch Index	Max.25	35
	At High Idling		—	—
Valve Clearance	Intake Valve	mm	0.25	0.152 ~ 0.381
	Exhaust Valve	mm	0.51	0.381 ~0.762
Compression Pressure	● Oil Temp: 40~60°C ● Engine Speed 250 rpm	Mpa {kg/cm^2}	Min. 2.41 {Min. 24.6}	1.69 {17.2}
Blow-by Pressure	● Coolant Temp: Working Range ● Arm-In Overflow: Max. rpm	kPa {mmH$_2$O}	Max. 0.98 {Max. 100}	1.96 {200}
Oil Pressure	High Idling	MPa {kg/cm^2}	Min. 0.29 {Min. 3.0}	0.25 {2.5}
	Low Idling	MPa {kg/cm^2}	Min. 0.10 {Min. 1.0}	0.07 {0.7}
Oil Temp.	● Full Speed Range (In Oil Pan)	°C	80 ~ 110	120
Fan Belt Tension	● Between fan belt pulley and alternator belt pulley ● Deflection when pressed with finger force of 58.8 N {6 kg}	mm	8.0	Min. 6, Max. 10
A/C Compressor Belt Tension	● Between fan belt pulley and compressor belt pulley ● Deflection when pressed with finger force of 58.8 N {6 kg}	mm	5 ~ 8	5 ~8

5.2 Standard Values of 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	2,030 ± 50	2,030 ± 50
	Speed when auto deceleration is operated	● Engine running at high idle ● Auto idling switch on ● All control levers neutral		rpm	1,400 ± 50	1,400 ± 100
Spool Stroke	Boom control valve	● Engine stopped ● See Control valve.	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 at stroke end (except lever play in NEUTRAL position)		mm	85 ± 10	85 ± 10
	Arm control lever			mm	85 ± 10	85 ± 10
	Bucket control lever			mm	85 ± 10	85 ± 10
	Swing control lever			mm	85 ± 10	85 ± 10
	Travel control lever			mm	115 ± 12	115 ± 12
	Play of control lever	● Engine stopped ● Slightly push the control lever. Stop pushing when resistance is felt. ● Max. reading at stroke end.	Work Equipment	mm	Max. 15	Max. 20
			Stroke	mm	Max. 20	Max. 25

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 {kgf}	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. 107.8 {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 {0~10}	0~2.0 {0~20}
	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}

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.		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.	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.		sec.	27 ± 3.5	Max. 30
	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. ● 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 (unloaded)	● 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.	Lo	sec.	51.3 ± 5.1	46.2 - 60.4
			Hi		28.0 ± 1.4	26.6 - 31.4

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.	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.		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.		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 min. by measuring the falling every 5 min. 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.
					mm	Max. 600	Max. 900

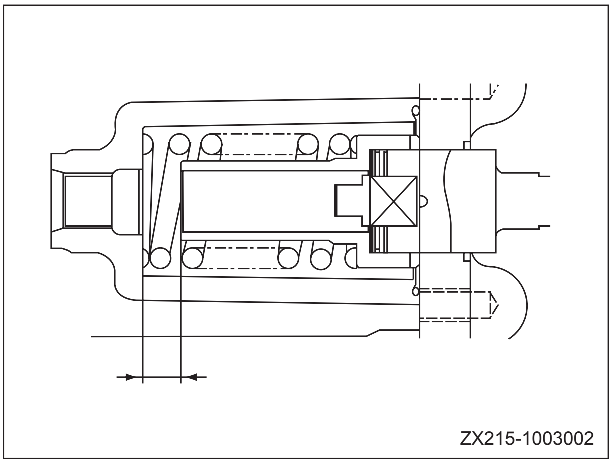
		Boom cylinder			mm	Max. 20	Max. 27
		Arm cylinder			mm	Max. 20	Max. 20
		Bucket cylinder			mm	Max. 45	Max. 45

Categ.	Item		Measurement condition		Unit	Std. value for new machine	Permissible 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.	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.	IN	sec.	2.8 ± 0.4	Max. 4.5
				OUT	sec.	2.3± 0.3	Max. 3.5
		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.	DIG	sec.	2.3 ± 0.4	Max. 3.4
				DUMP	sec.	1.6 ± 0.3	Max. 2.3

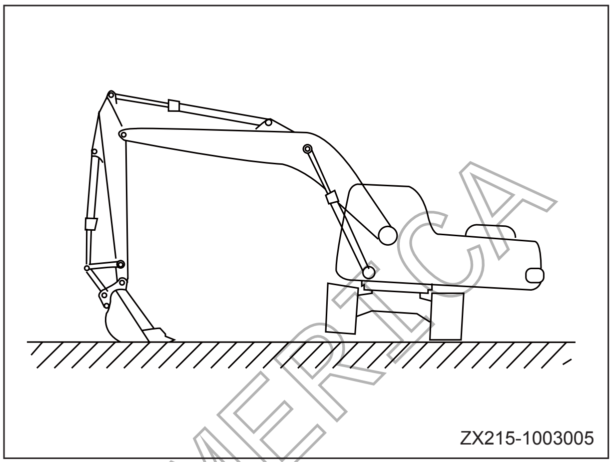
Cat.	Item		Measurement condition	Unit	Std. value for new machine	Judgement criteria
Work Equipment	Time Delay	Boom	● Hydraulic oil temp: Within operational range ● Engine running at low idle ● Working mode: H ● Time required from maneuvering the joystick to the moment that the bucket reaches the ground and begins to push the machine upward, within 50mm off the ground ● For measuring posture see Work Equipment 5.	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.	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.	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.	mm	Max. 200	Max. 220

Machine postures for measuring (For all models)

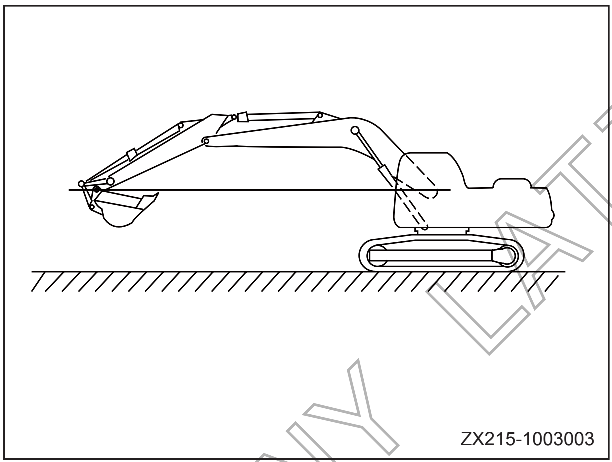
Control value: Spool stroke



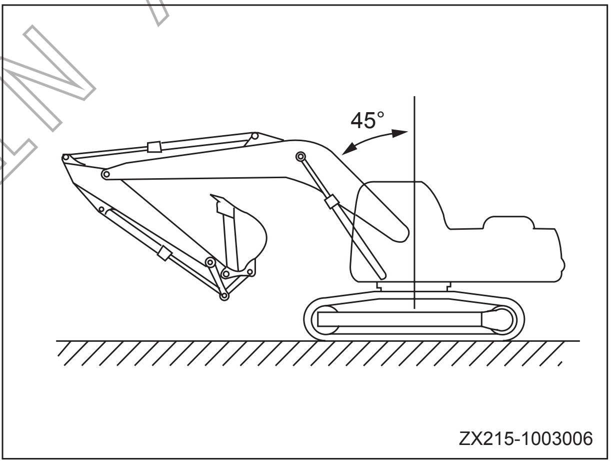
Travel 1: Travel speed (without load)



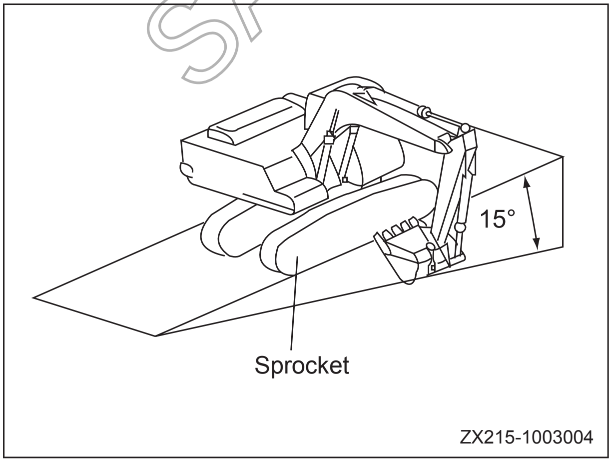
Swing 1: Swing brake angle, time taken to start swing, time taken to swing



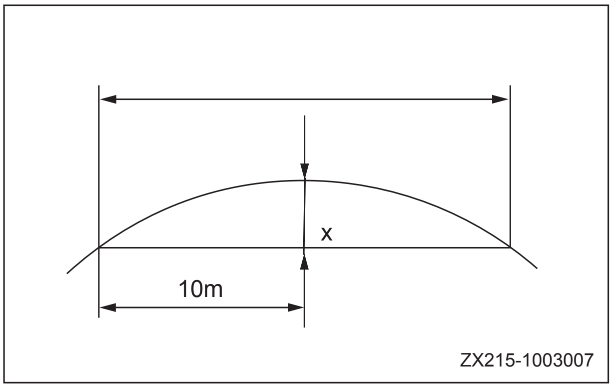
Travel 2: Travel speed (actual run), Travel deviation



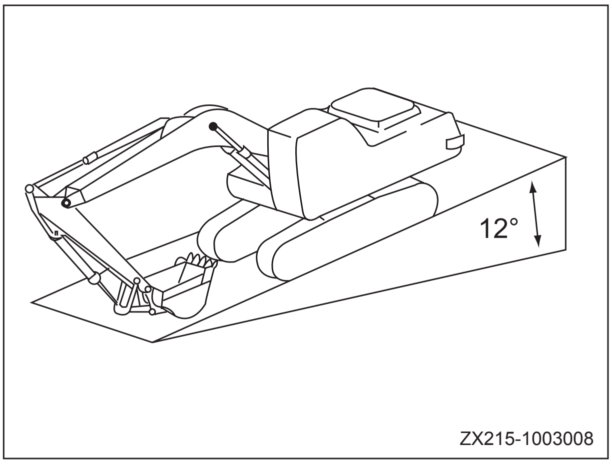
Swing 2: Hydraulic drift of swing



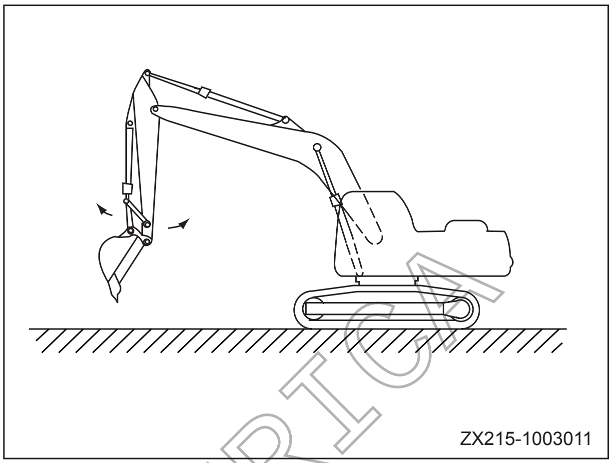
Travel 3: Travel deviation



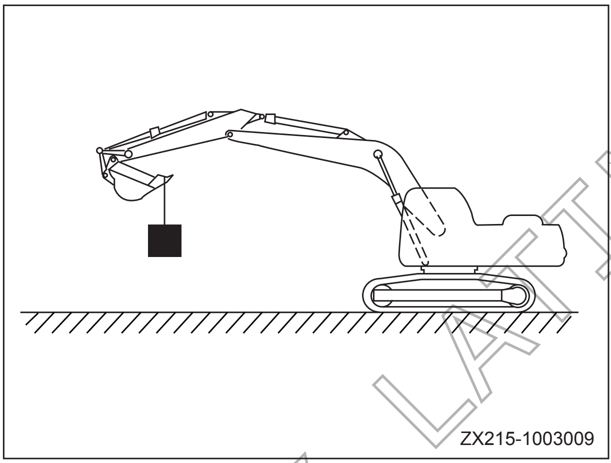
Travel 4: Hydraulic drift of Travel



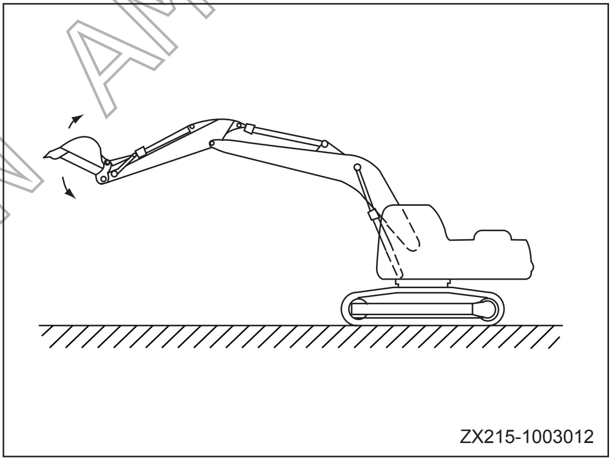
Work equipment 3: Arm speed



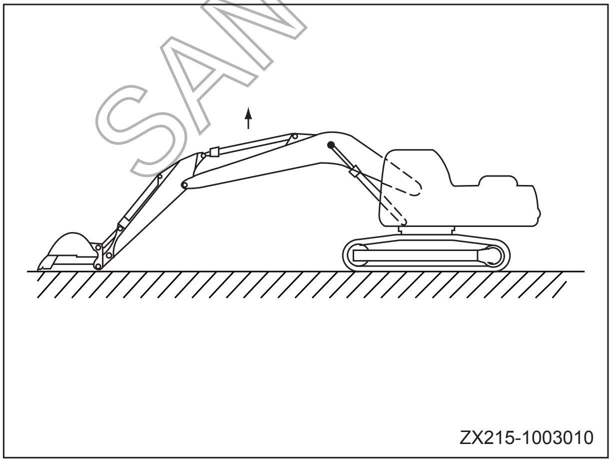
Work equipment 1: Hydraulic drift of work equipment



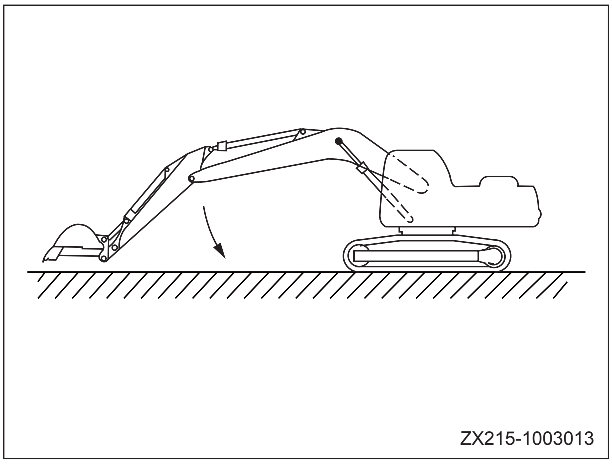
Work equipment 4: Bucket speed



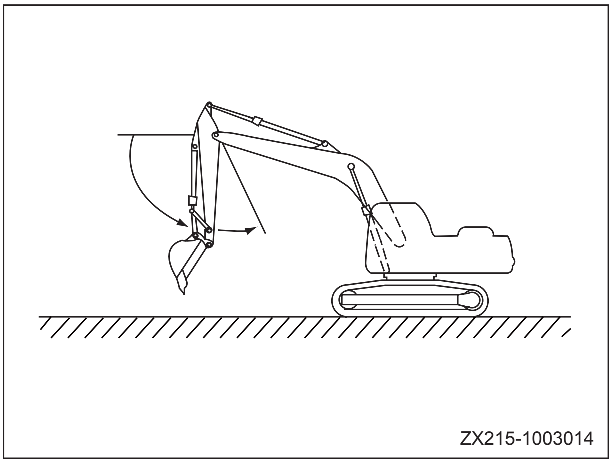
Work equipment 2: Boom speed



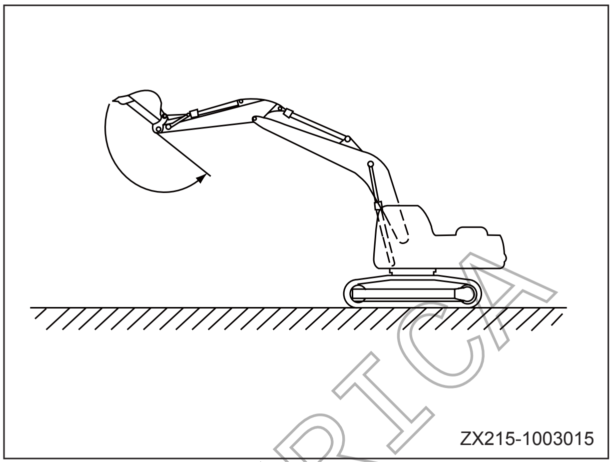
Work equipment 5: Boom delay



Work equipment 6: Arm delay



Work equipment 7: Bucket delay



SANY

Testing and Adjusting

6 Testing and Adjusting

⚠ WARNING

Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

6 TESTING AND ADJUSTING

6.1 Engine Speed - Test and Calibrate

Engine speed calibrator

ID	Part Number	Part Name
1	B249900001206	Engine Speed Calibrator

6.1.1 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.

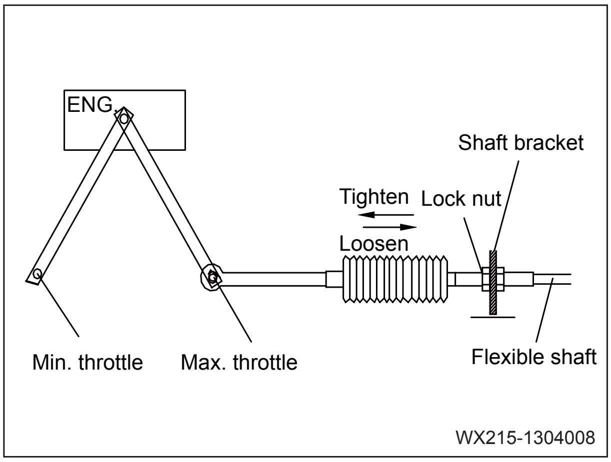
Testing Items:

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

6.1.2 Adjusting

Adjust the fixing point of the flexible shaft of the throttle motor.

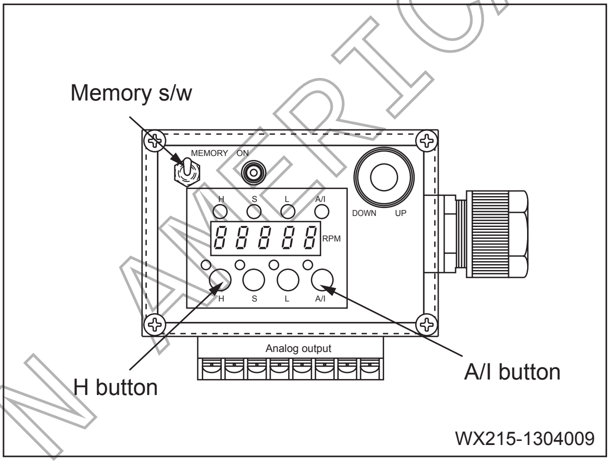
1. Connect the calibrator with the chassis harness.
2. Push the memory switch of the calibrator down to the OFF position.
3. Turn the start switch of the machine to the ON position.
4. Start the engine. Check if engine speed is within 1100±50 rpm range. (Throttle voltage at speed level 1 is 1.3±0.03V)



5. Tighten the fixing position of the flexible shaft when engine speed is lower than 1050 rpm; loosen the fixing position of the flexible shaft when engine speed is higher than 1150 rpm.
6. Shutdown the engine.

Speed calibration steps:

1. Connect the calibrator with the chassis harness.
2. Push the memory switch of the calibrator down to the OFF position. Turn the start switch of the machine to the ON position.
3. Start the engine. Engine speed “XXXX” will be displayed on the screen display of the calibrator. Press the H button and hold it, the screen will display “E. XXXX”.
4. When automatic speed calibration is completed, the screen display of the calibrator will change from “E. XXXX” to “XXXX”.
5. Shut off the engine.



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NOTE:

In order to make sure speed calibration is successful, deactivate auto-idle mode after the calibration process and check the idling speed at each speed level. If excessive variation is found between the real speed and the target speed, try automatic speed calibration once again.

Engine speed reference (SY215C9)

Level	Speed (rmp)	Level	Speed (rmp)
S1	1100	H1	1100
S2	1200	H2	1200
S3	1300	H3	1300
S4	1500	H4	1500
S5	1600	H5	1600
S6	1650	H6	1700
S7	1750	H7	1800
S8	1850	H8	1900
S9	1950	H9	2000
S10	2050	H10	2100
S11	2150	H11	2200

6.2 Exhaust Gas Color - Test

Testing tools

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

⚠ CAUTION

- **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.

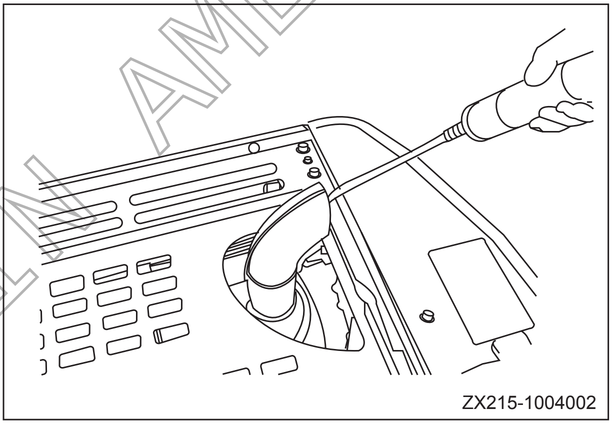
2) Insert the waste gas intake pipe into the exhaust pipe.

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.

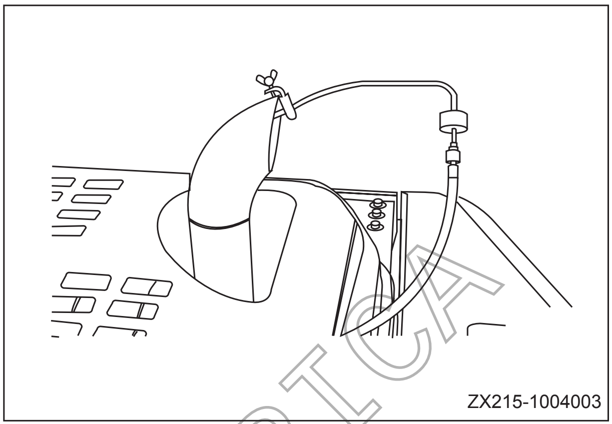
5) Remove the filter paper from the smoke meter. Read the smoke value through the apparatus provided.

6) Remove the testing tools after measuring. Make sure the machine goes back to its normal state.



2. Measure with an opacimeter

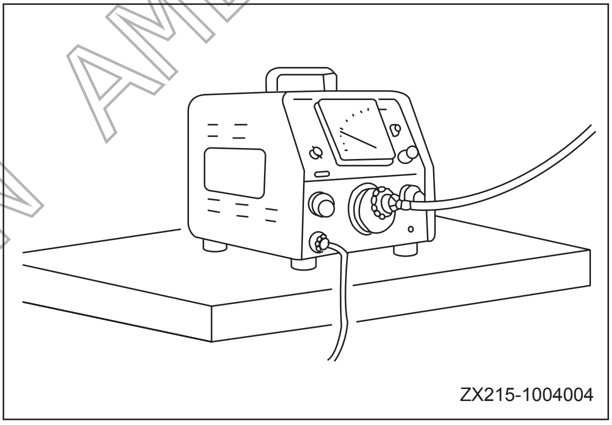
1) Mount the opacimeter onto the exhaust pipe by clamping it to the pipe outlet.



ZX215-1004003

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

3) Start the engine and keep the engine running until engine coolant temperature is within the operational range.



ZX215-1004004

4) When engine speed increases suddenly or is kept at high idle, use the opacimeter to read the smoke value of exhaust gas.

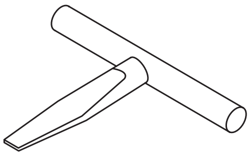
5) Remove the testing tools after measuring. Make sure the machine goes back to its normal state.

6.3 Valve Clearance - Adjust

Service Standard (Unit: mm)

Location	Service Item	Standard Value	Limits	Remedy
—	Valve clearance (engine cold)	0.4	—	Adjust

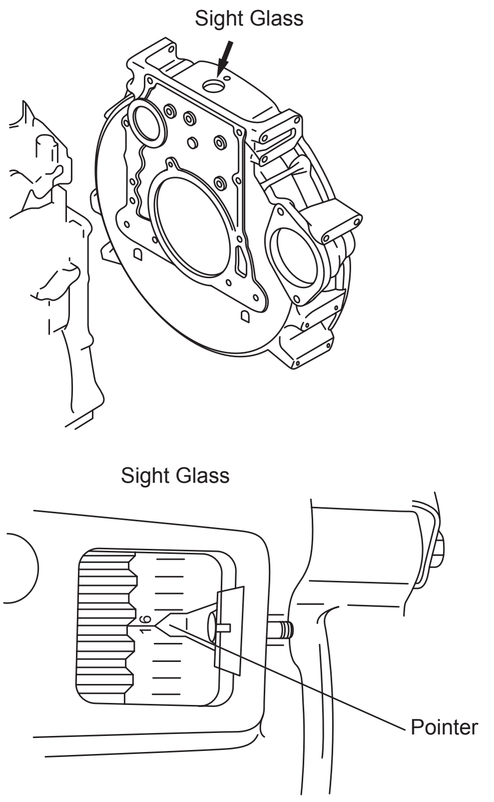
Special Tools

Symbol	Tool Name and Shape	Part Number	Application
a	Flat head screwdriver 	MH060008	Valve clearance adjustment (Carried on vehicle)

Check and adjust valve clearance in cold state as per the following procedure:

6.3.1 Testing

1. Remove the rocker arm cover.
2. Turn the No.1 piston or the No.6 piston to the top dead center of compression stroke by following the procedure below.
    - Turn the engine until the mark 16 on the flywheel aligns with the pointer on sight glass of the flywheel shell.
    - Turn the No.1 piston or the No.6 piston to the top dead center of compression stroke.



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NOTE:

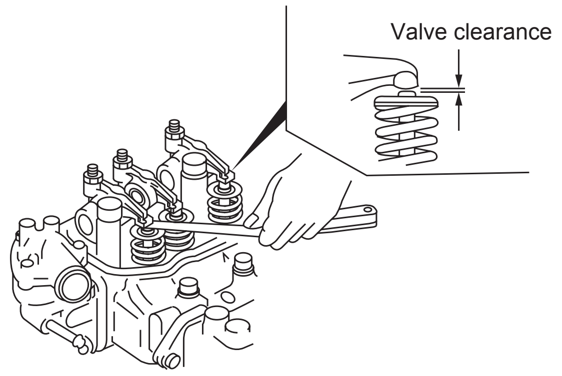
When the rocker arm at the intake side and rocker arm at the exhaust side cannot be turned with hands, it is indicated that the piston has reached the top dead center of compression stroke. Turning the engine by one more turn, the top dead center of compression stroke of No.1 piston and No.6 piston interchanges.

3. When the No.1 piston is at the top dead center, adjust the valve clearance in a sequence marked by the black dot.

Cylinder	1		2		3		4		5		6	
INT		●		○		●		○		●		○
EXH	●		●		○		●		○		○	

   1) When a feeler gauge is used for such measurement, resistance to a moving feeler gauge in the clearance should be felt.
   2) If the feeler gauge moves easily in the clearance, it is impossible to obtain accurate result.

4. If the measured value is out of specification, readjustment shall be performed according to the following method.



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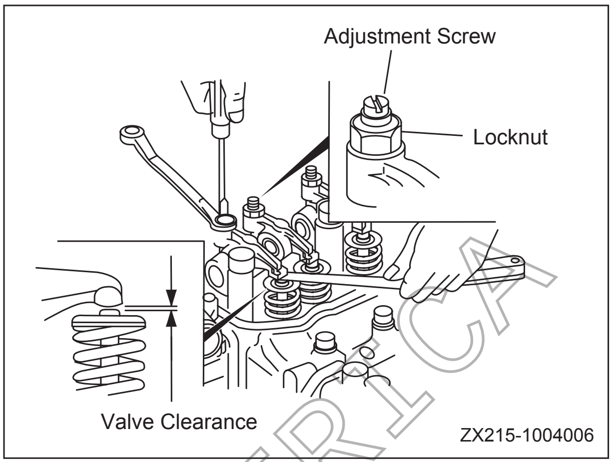
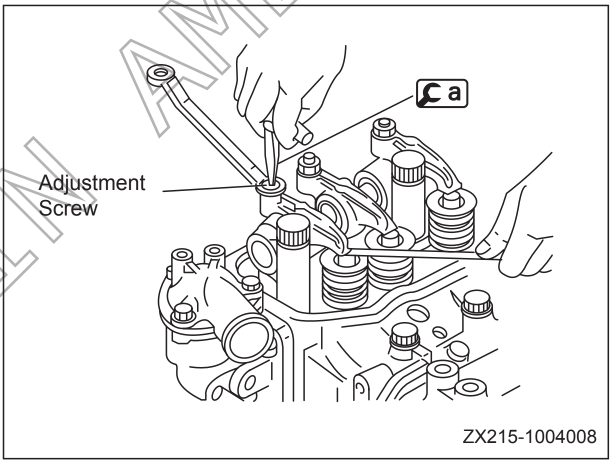
6.3.2 Adjusting





1. To adjust valve clearance, loosen the locknut before adjusting the adjustment screw. Standard clearance is achieved when resistance to the feeler gauge is felt when pulling it out from the clearance.
2. After adjustment, stop the turning motion of the adjustment screw with a screwdriver, and tighten the locknut.

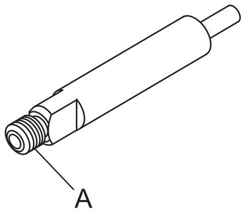
   Locknut: 16-24 N·m {1.7±2.5 kgf·m}
3. Go on with the next step until all valve clearances marked with a black dot have been adjusted.
4. Check the clearances again with the feeler gauge. Readjustment should be made if the value is out of specification.
5. When the engine is carried in vehicle, using a to turn the adjustment screw will make your work easy.

6.4 Compression Pressure - Measure

Service Standard

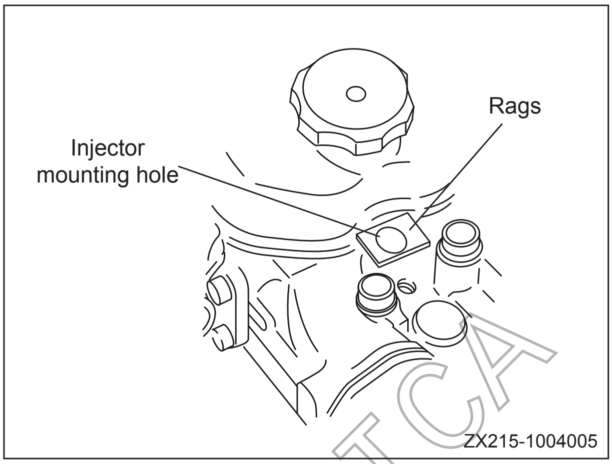
Location	Service Item		Standard Value	Limits	Remedy
—	Compression pressure	Each cylinder (at 200 rpm)	2550kPa {26kgf/cm²}	1960 kPa {20kgf/cm²}	Test
		Differential pressure between cylinders	—	Below 390 kPa {4kgf/cm²}	Test

Special Tool

Symbol	Tool Name and Shape	Part Number	Application
a	Compression pressure gauge connector A M14×1.5 	MH061460	Measuring compression pressure

1. Reduction of compression pressure can be an indication for engine overhaul.
2. Check the compression pressure regularly and pay attention to its variation from time to time. In addition, in a new vehicle or when new parts are installed for replacement, the pressure may be higher due to running-in of the piston ring, valve seat, etc. The pressure will become normal as the parts wear.
3. Before testing, make sure engine oil, start motor and battery are in normal condition.
4. Set the machine as per the following:
    1) Preheat the engine until engine coolant temperature reaches 75~85°C.
    2) Switch off all lamps and auxiliary devices.
    3) Place the gear lever in a neutral position.
5. Remove the entire fuel injector.

6. Cover the fuel injector mounting opening with cloth.
7. Activate the start motor in order to run the engine. Check if the cloth is stained by foreign substances.
8. Determine the problem with the engine according to the substances (engine oil and/or coolant) on the cloth.
   1) When engine oil is found, it might be improper sealing caused by piston ring. Check the piston ring.
   2) When engine oil and coolant are found, it might be cracking of cylinder. Replace the crankcase.
9. Mount the gasket and tool 🔧a to the fuel injector mounting hole and fix them with the injector cap. Install the compression pressure gauge.
10. Start the engine and measure the compression pressure of each cylinder. Calculate the differential pressure between the cylinders.
11. When the compression pressure and the differential pressure between cylinders deviate from their limits, inject a small amount of engine oil through the fuel injector mounting hole, and measure the compression pressure again.
    - If the compression pressure is higher, it is probably due to worn or damaged piston ring or cylinder inner surface.
    - If the compression pressure is still low, it is probably due to stuck valve or improper seating, or improperly mounted gasket of cylinder head.



⚠ CAUTION

When coolant and/or engine oil is found attached to the cloth, running the engine may cause the hot coolant and engine oil to squirt out through the mounting hole of the fuel injector. This is very dangerous. Never touch or look into the fuel injector mounting hole when the engine is running.

6.5 Fuel Injection Timing - Test and Adjust

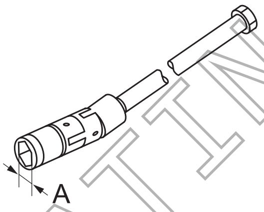
Service Standard

Location	Service Item	Standard Value	Limits	Remedy
—	Fuel injection timing (BTDC)	14°	—	Adjust

Tightening Torque (Unit: N·m)

Symbol	Parts Tightened	Tightening Torque	Remark
—	Union nut	24	—
—	Lock plate	3.4~4.9	—
—	Lock seat - delivery valve	39~44	—
—	Nut (used for mounting fuel injection pump)	29~39	—

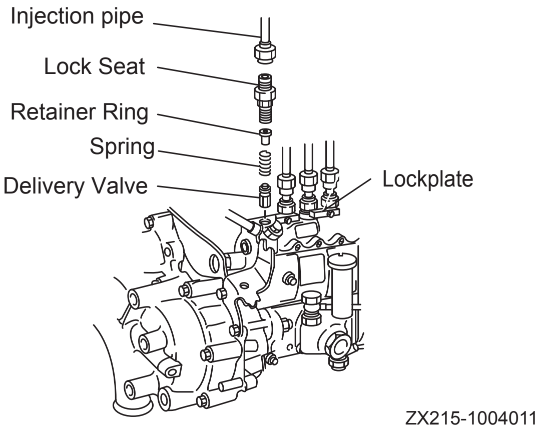
Special Tool

Symbol	Tool Name and Shape	Part Number	Application
a	Universal Extension Rod A 14 	MH061099	Testing and adjusting the fuel injection timing

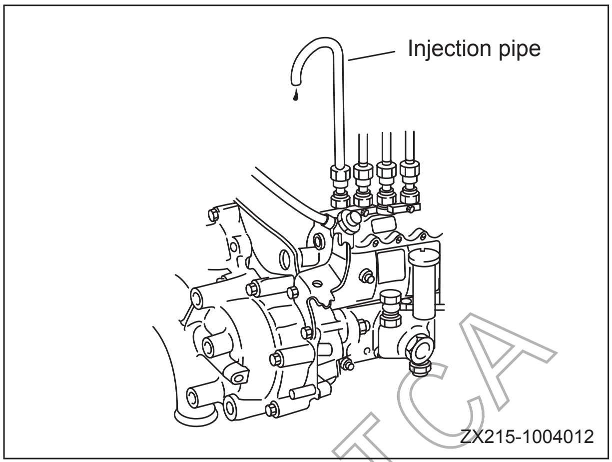
6.5.1 Testing

1. Remove the injection pipe, lock plate, lock seat, retainer ring and delivery valve from the No.1 cylinder of the fuel injection pump.
2. After removal of all the parts, install the lock seat.

   NOTE: The removed parts should be put into light oil in order to keep them free from dust.



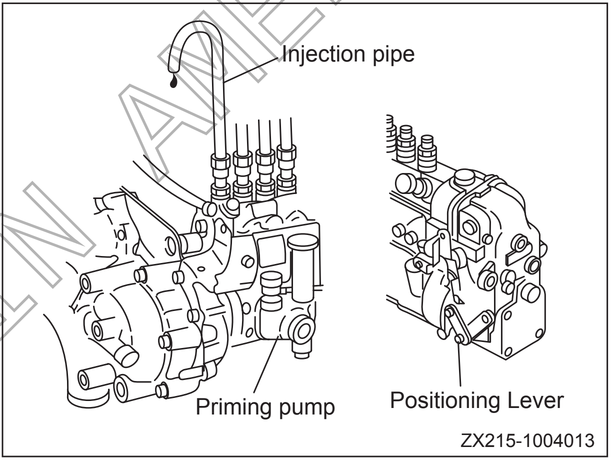
3. Install the prepared injection pipe onto No.1 cylinder. Keep the other end of the injection pipe downward so that fuel flowing out can be observed.
4. Turn the crankshaft manually over 180° in the forward direction to locate No.1 cylinder in a position that is about 30° from the top dead center of compression stroke.



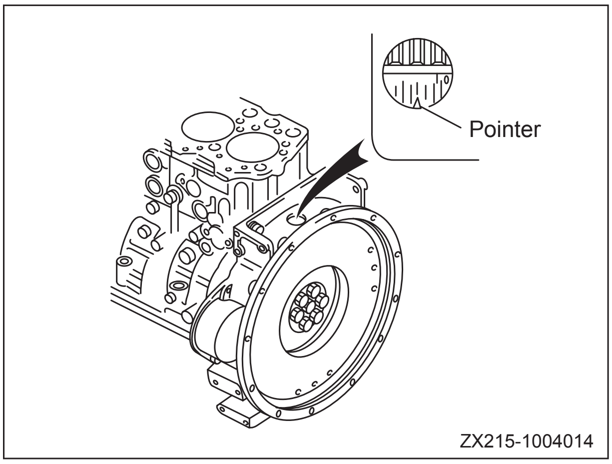
5. The main pump is used to transfer fuel. As the fuel flows out of the injection pipe, turn the engine manually in the forward direction.

   NOTE: The engine positioning lever on the governor must be placed in the starting position.

6. When the fuel coming out of the injection pipe is about to stop, continue to turn the engine slowly until the fuel stops coming out.



7. Make sure that the flywheel mark and pointer are one degree before the fuel injection timing.



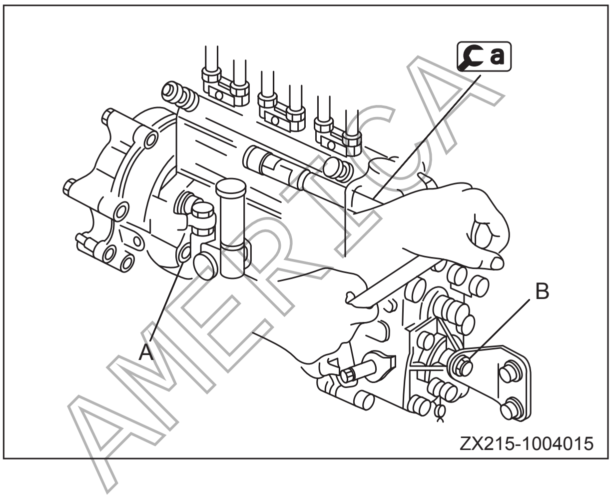
NOTE: When the fuel injection timing deviates from its standard value, the following steps must be followed for adjustment.

6.5.2 Adjusting

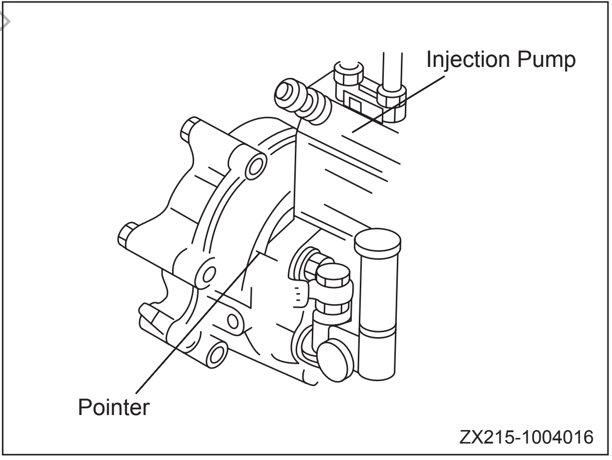
1. Loosen the mounting nuts of fuel injection pump.

   A: 4 nuts (on the flange)

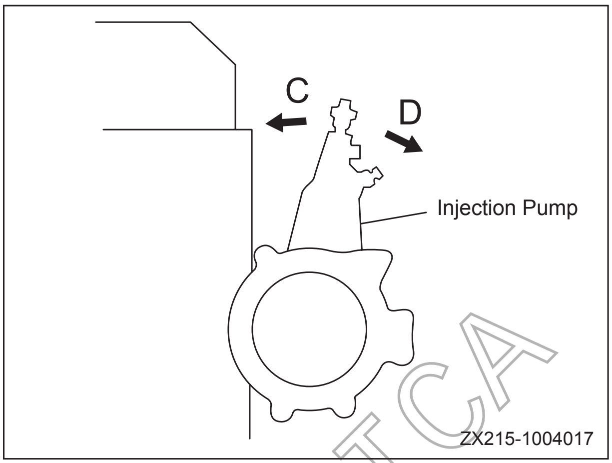
   B: 1 nut



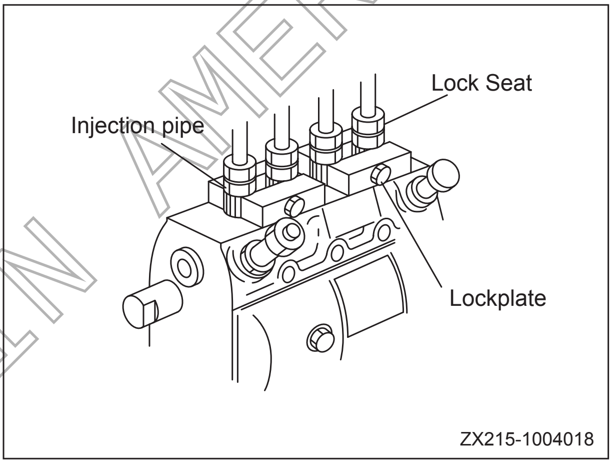
2. Targeted at the pointer, activate the injection pump in order to adjust injection timing.
3. Tighten the nuts to specific torque. Measure the injection timing again.



4. When the injection timing is slow, move the injection pump toward the crankcase (direction C).
5. When the injection timing is fast, move the injection pump away from the crankcase (direction D).



6. When injection timing meets the standard value, install the delivery valve, spring, retainer ring, lock seat, lock plate and injection pipe.
7. Tighten all the parts to specific torques.



6.6 Engine Oil Pressure - Measure

Service Standard

Location	Service Item		Standard Value	Limits
—	Engine oil pressure at 70~90°C	Min. speed, unloaded	145 KPa	49 KPa
—		Max. speed, unloaded	295 KPa~490 KPa	195 KPa

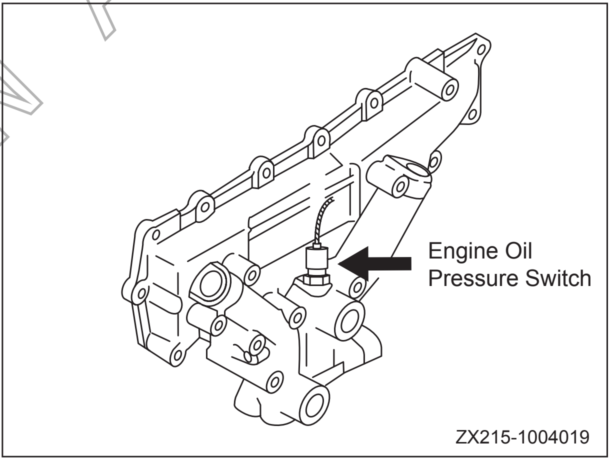
Tightening Torque (Unit: N·m)

Symbol	Part Tightened	Tightening Torque	Remark
—	Engine oil pressure switch	7.8~12	Engine cold

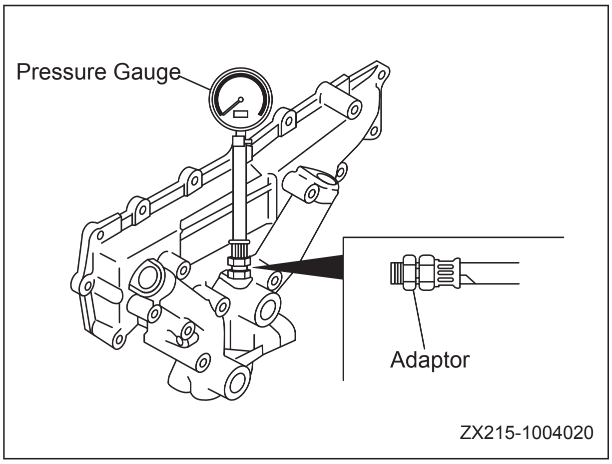
Lubricant/Sealant

Symbol	Location	Part Number	Amount
—	Threads of pressure switch	A420300000032	As necessary

1. Remove the engine oil pressure switch.



2. Mount the adaptor to where the engine oil pressure switch has been removed. Mount the engine oil pressure gauge to the adaptor.



3. Preheat the engine until engine oil temperature reaches 70-90°C.
4. Measure respectively the unloaded engine oil pressure at minimum speed and maximum speed.
5. If the measured value is lower than the specified standard value, check the entire lubrication system.
6. After measuring, apply sealant to the threads of pressure switch. Tighten the pressure switch to specific torque.

NOTICE

Then engine oil pressure switch must be installed when the engine is cold.

6.7 Engine Speed Sensor - Adjust

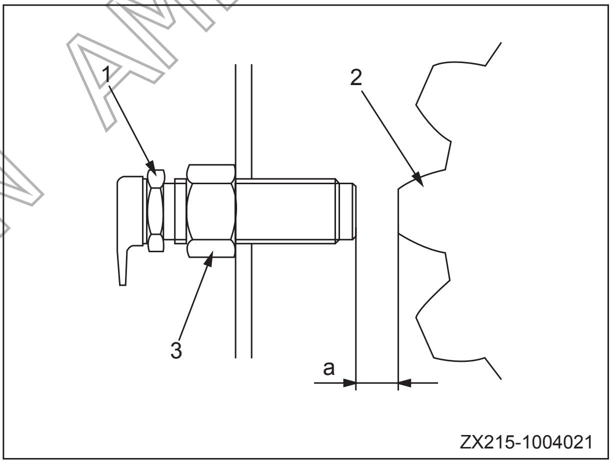
NOTE: Remove the engine speed sensor (1) before adjusting. Check for presence of metal chips and for damaged sensor top. Restore the sensor.

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).

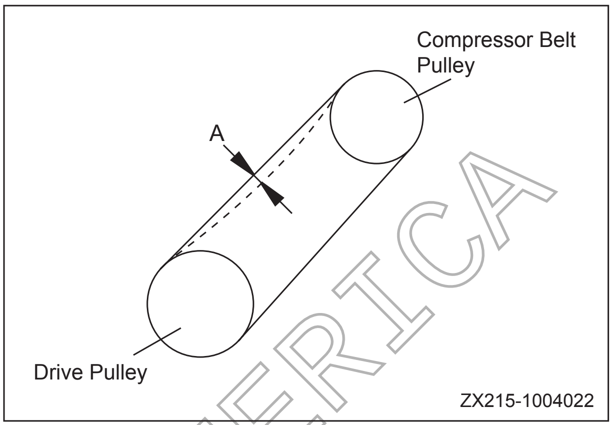
   Nut: 49.0~68.6 N·m {5~7kg·m}
4. Make sure that the engine speed is displayed properly on the control panel after adjustment.



6.8 A/C Compressor Belt Tension - Test and Adjust

6.8.1 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).



6.8.2 Adjusting

NOTE: 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}

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.

6.9 Swing Bearing Clearance - Measure

Measuring tool

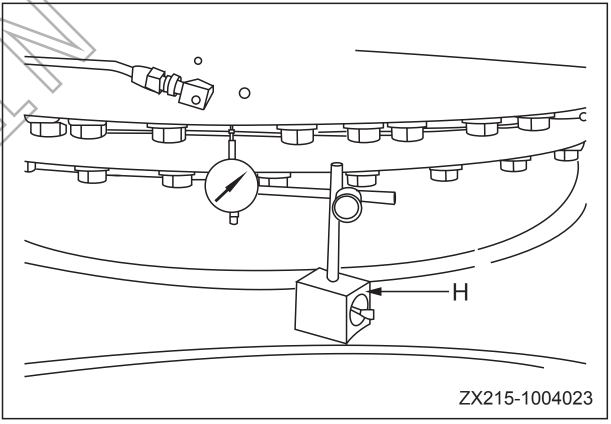
Symbol	Part Number	Part Name
H	60033930	Dial gauge

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

CAUTION

- **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.



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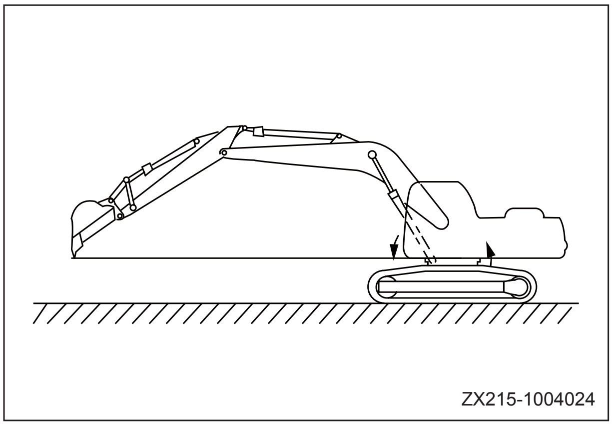
2. Place the work equipment to the maximum reach position. Raise the bucket to a height that the bucket tips and the swivel table bottom are on the same level.

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

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



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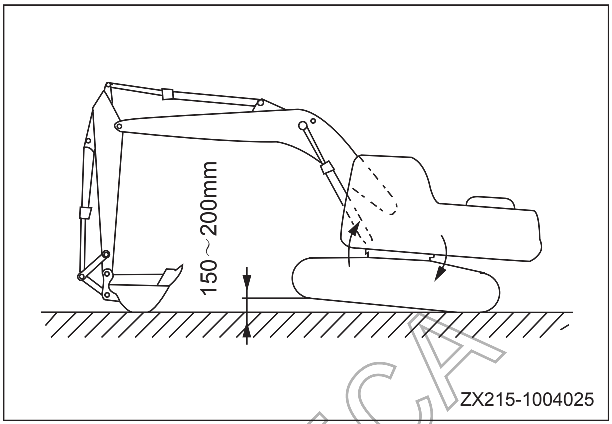
5. Read the dial gauge (H).
6. Restore the machine to the condition of

step 2. Check the dial gauge (H) to see if it reads zero.

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

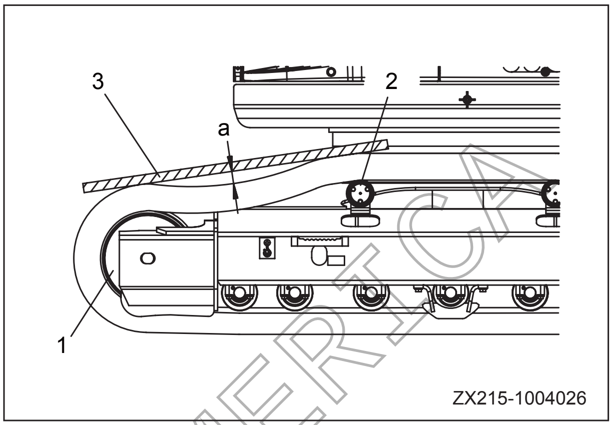
For more information, see “Swing bearing” on page 4-13.



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

6.10 Track Tension - Test and Adjust

6.10.1 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).

   NOTE: 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)

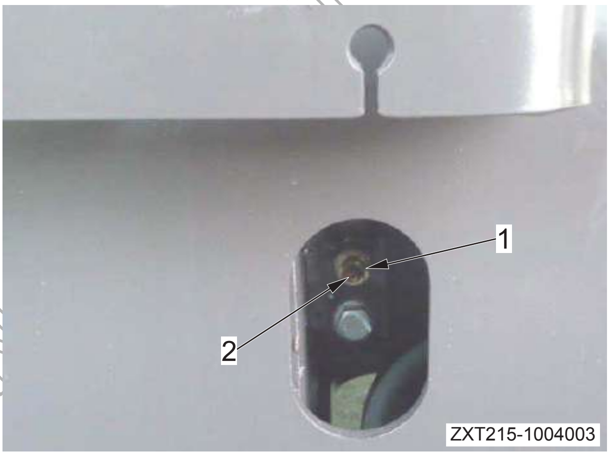
6.10.2 Adjusting

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

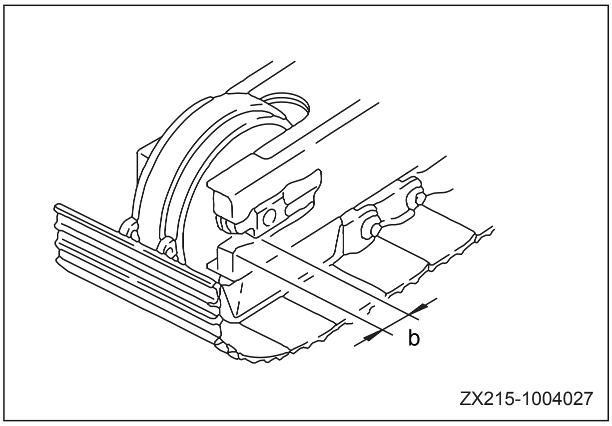
CAUTION

- **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 eject.**

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



NOTE: 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.



6.11 Hydraulic Pressure in Hydraulic Circuits - Test and Adjust

Testing and adjusting tools

ID	Part Number	Part Name
—	60038932	Hydraulic Tester
	B210770000084	Adaptor

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

6.11.1 Measuring

CAUTION

- **Lower the work equipment to the ground and stop the engine. Operate the control levers for several times to release the residual pressure in hydraulic circuits.**
- **Open the butterfly nut on the breather valve and press the relief button to release pressure in the hydraulic tank.**

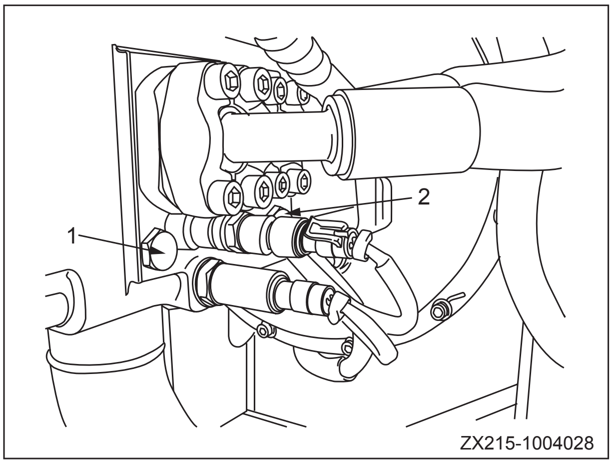
1. **Preparatory work before measuring**

   1) Remove the plug (1) and plug (2) for measuring the hydraulic pressure.

   - Plug (1): For oil circuit of rear pump
   - Plug (2): For oil circuit of front pump

   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.

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.

   NOTE: 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.

   NOTE: 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.

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

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

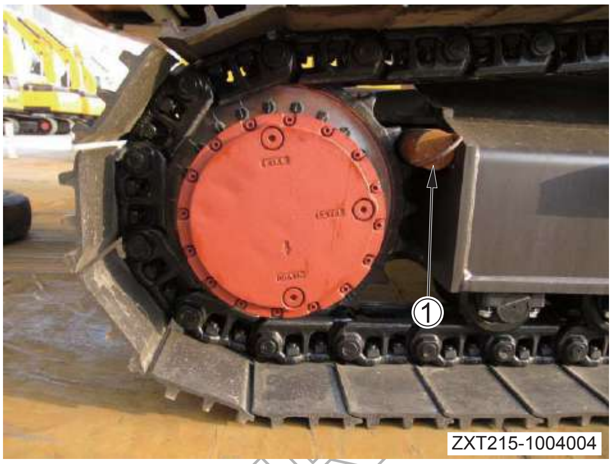
5. Measurement of travel pressure at relief

1) Start the engine and lock the travel mechanism.

NOTE: Place the pin (1) between the sprocket and the track frame 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.

NOTE: 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.



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6.11.2 Adjusting

NOTE: The boom relief valve cannot be adjusted.

1. Adjustment of main relief pressure

NOTE: If the high relief pressure is abnormal, adjust the high pressure setting of the main relief valve (3) as per the following.

1) Disconnect the pilot hose.

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

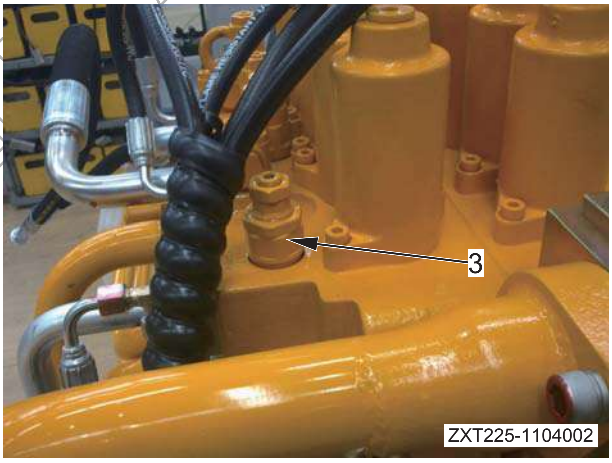
Pressure rises as the screw turns right.

Pressure drops as the screw turns left.

Each turn of the screw equals about: 12.5 MPa {128 kgf/cm²}

Locknut:

53.5±4.9 N·m {5.5±0.5 kgf·m}



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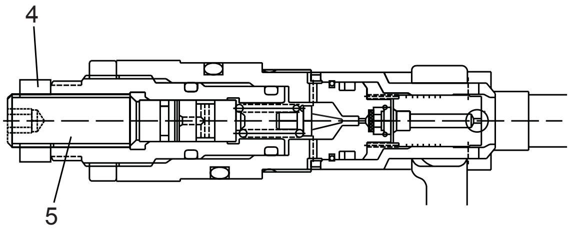

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3) Check the pressure again after adjustment. Measure the pressure according to the procedure described above.

- 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. Adjustment of swing relief pressure

NOTE: If the swing relief pressure is abnormal, adjust the swing motor relief valve (6) as per the following.

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

Pressure rises as the screw turns right.

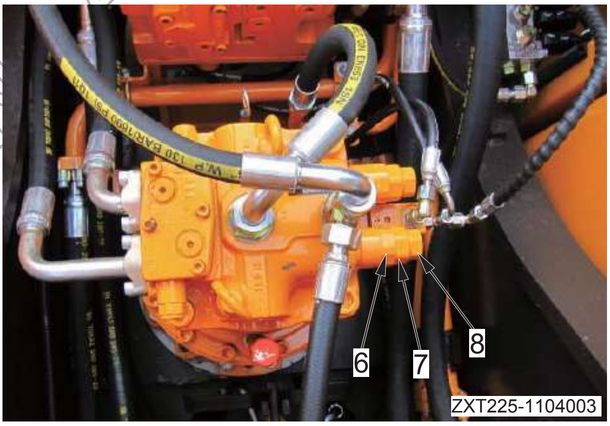
Pressure drops as the screw turns left.

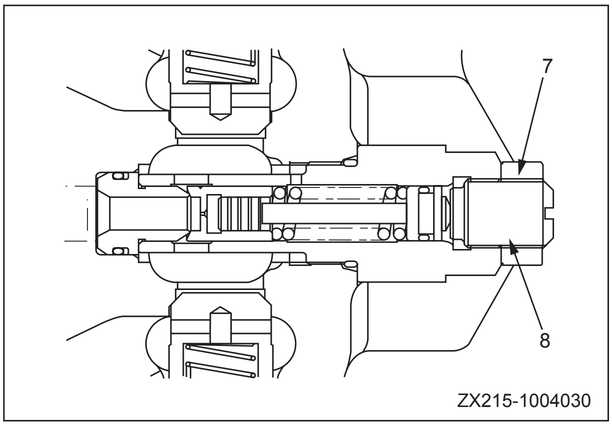
Each turn of the screw equals about: 6.71 MPa { 68.4 kgf/cm²}

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.





6.12 Control Circuit Oil Pressure - Test and Adjust

Testing and adjusting tools

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

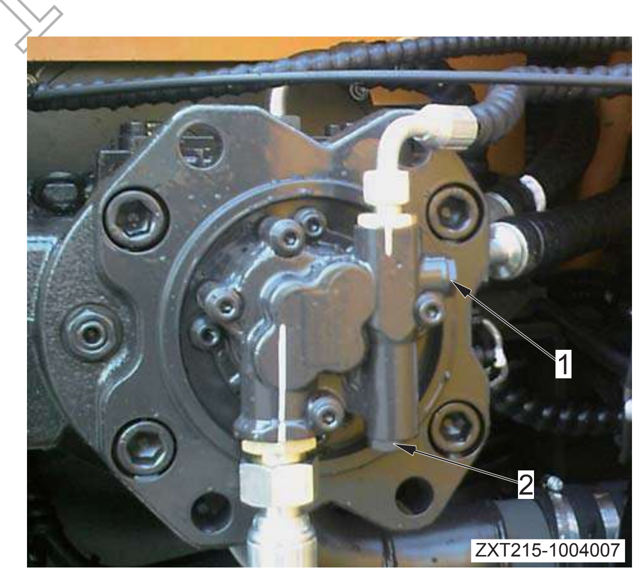
6.12.1 Testing

CAUTION

- **Lower the work equipment to the ground and stop the engine. Operate the control levers for several times to release the residual pressure in hydraulic circuits.**
- **Open the butterfly nut on the breather valve and press the relief button to release pressure in the hydraulic tank.**

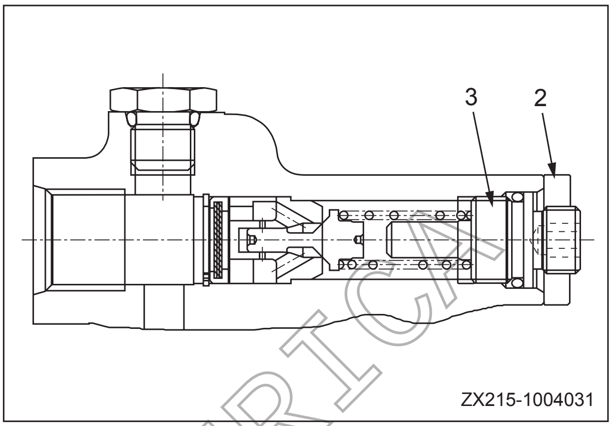
1. Remove the plug (1) for measuring the hydraulic pressure.
2. Install the priming adaptor and connect it to the hydraulic tester.

   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.



6.12.2 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.



6.13 Solenoid Valve Output Pressure - Measure

Measuring tools

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

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

CAUTION

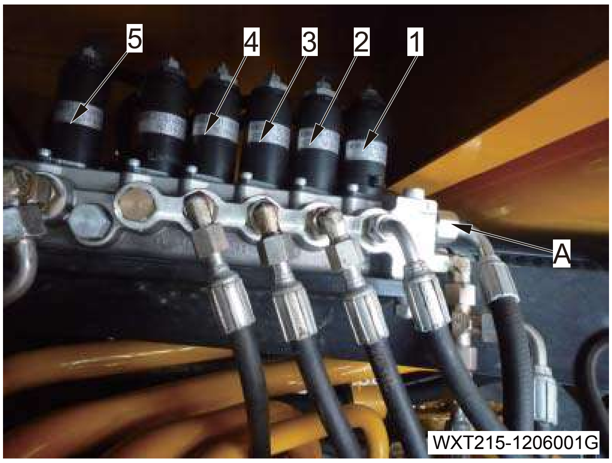
- **Lower the work equipment to the ground and stop the engine. Operate the control levers for several times to release the residual pressure in hydraulic circuits.**
- **Open the butterfly nut on the breather valve and press the relief button to release pressure in the hydraulic tank.**

1. Disconnect the hose of solenoid valve to measure the pressure at the outlet.

No.	Solenoid Valves to be Measured
1	Solenoid valve - high/low travel speed
2	Solenoid valve - swing priority
3	Solenoid valve - bucket confluence/diffluence
4	Solenoid valve - boom priority
5	Solenoid valve - pilot lockout

2. Install a tee to location (A) on each solenoid valve and connect the hose.
3. 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} .



4. Start the engine and keep it running until the hydraulic oil temperature rises to a point within the operational range.
5. 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.

High speed travel

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

Swing priority

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

6. 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

6.14 Pilot Valve Output Pressure - Measure

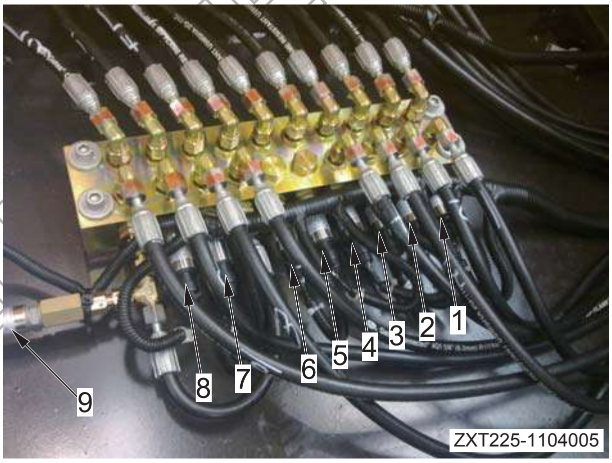
Measuring tools

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

NOTE: 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	Travel left	7	Bucket DUMP
2	Travel right	8	Arm IN
3	Arm OUT	9	Swing
4	Bucket DIG		
5	Boom DOWN		
6	Boom UP		



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.

NOTE: 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.

6.15 Pilot Valves (Work Equipment and Swing) - Adjust

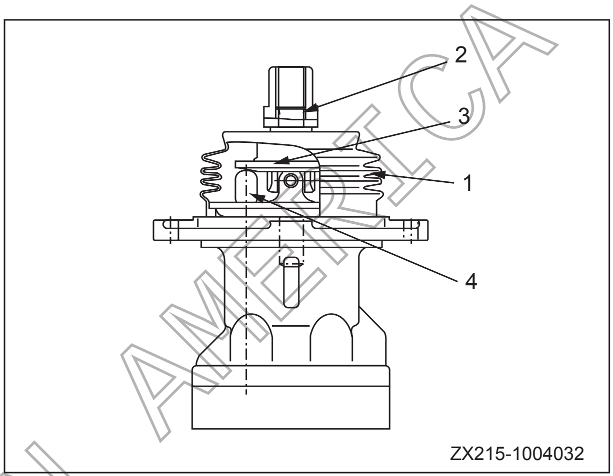
- If the play of work equipment or swing control lever is excessive, make adjustment as per the following procedure.

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).

   NOTE: 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.



6.16 Work Equipment Hydraulic Drift - Test

NOTE: 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.

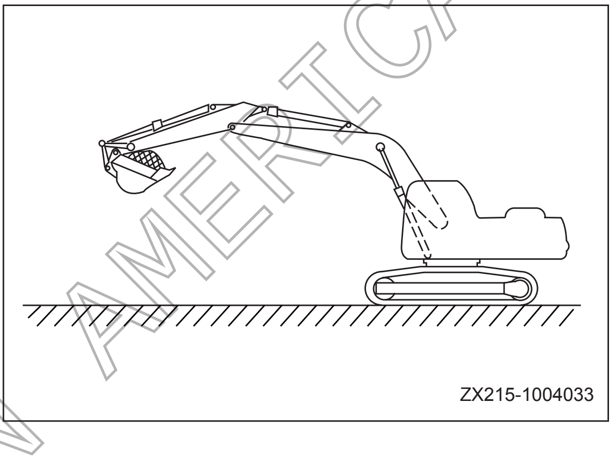
1. Boom and bucket cylinders

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

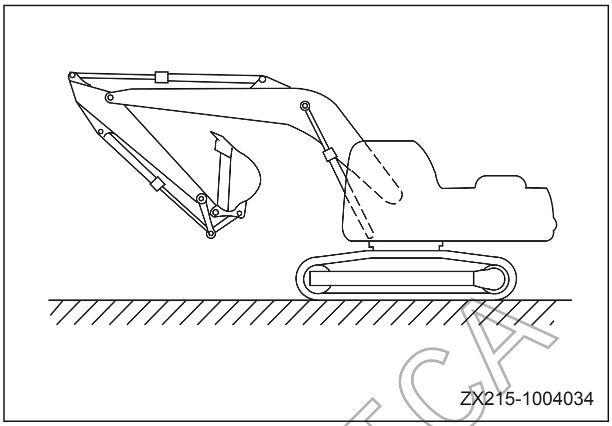
      NOTE: Load the bucket fully with earth or impose rated load on the bucket.

   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 rises, 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.



2. Arm cylinder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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.

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

- If the lowering speed rises, 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 hydraulic drift is caused by failure of the cylinder seal, the reason for lowering speed increase 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.

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.

6.17 Residual Pressure in Hydraulic Circuit - Release

⚠ CAUTION

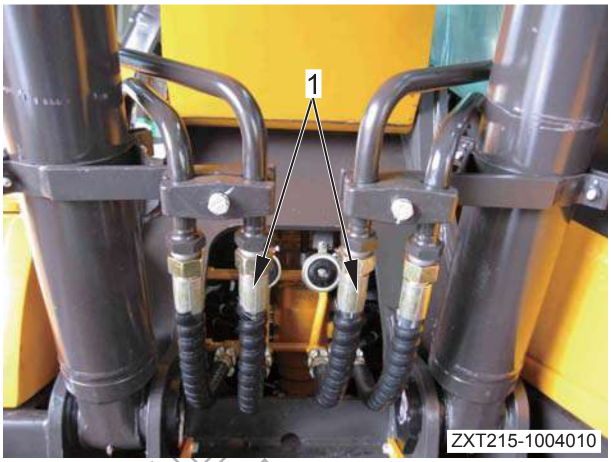
- **Release the residual pressure in the hydraulic circuit before disconnecting the lines between the hydraulic cylinders or between the hydraulic motor and the control valve.**

NOTE: 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.

6.18 Oil Leakage - Measure

1. Measure oil leakage from boom cylinder



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

   NOTE: Release the residual pressure in the circuits.

   See "Residual Pressure in Hydraulic Circuit - Release" on page 6-40.

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

   NOTE: 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.

2. Measure oil leakage from arm cylinder

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

   NOTE: Release the residual pressure in the circuits.

   See "Residual Pressure in Hydraulic Circuit - Release" on page 6-40.

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

   NOTE: 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.

3. Measure oil leakage from bucket cylinder

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

   NOTE: Release the residual pressure in the circuits.

   See "Residual Pressure in Hydraulic Circuit - Release" on page 6-40.

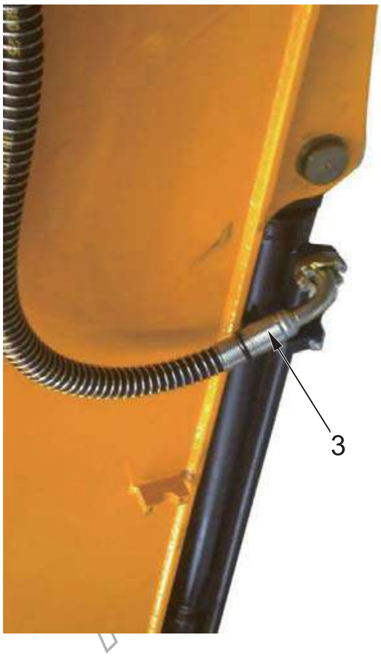
2) Disconnect the hose (3) on the cylinder head side and plug the hose end with a cap.

   NOTE: 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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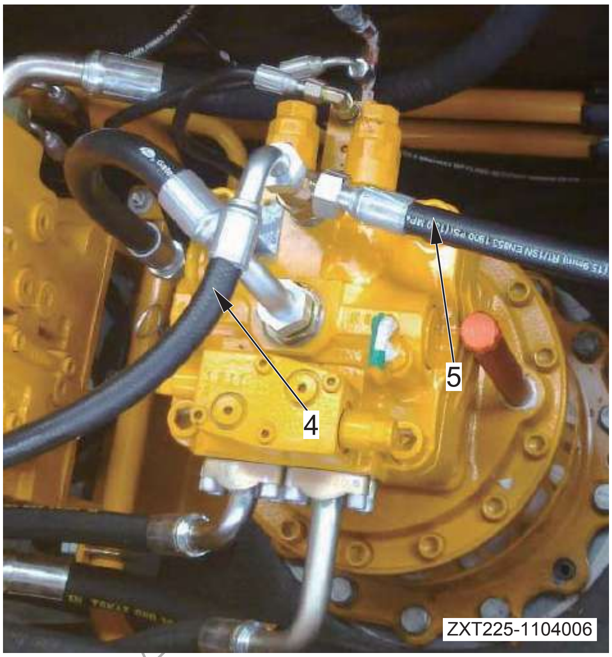
4. Measure oil leakage from swing motor



1) Fully extend the work equipment. Lower the bucket on the ground and raise the machine slightly. Secure machine from rotating clockwise or counter clockwise while testing. Stop the engine.

2) Disconnect the hose (4) and the hose (5). Plug the hose ends with caps.

3) Start the engine and apply relief pressure to the bottom side of the swing motor 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.

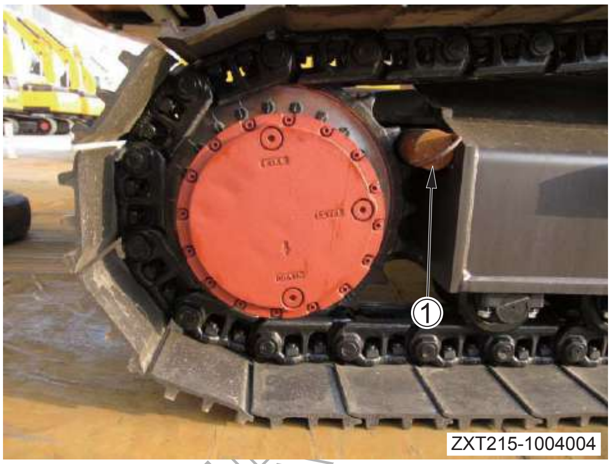
4) Make sure that the machine returns to its normal condition after measurement.

5. Measure oil leakage from travel motor

1) Remove the cover of the travel motor.

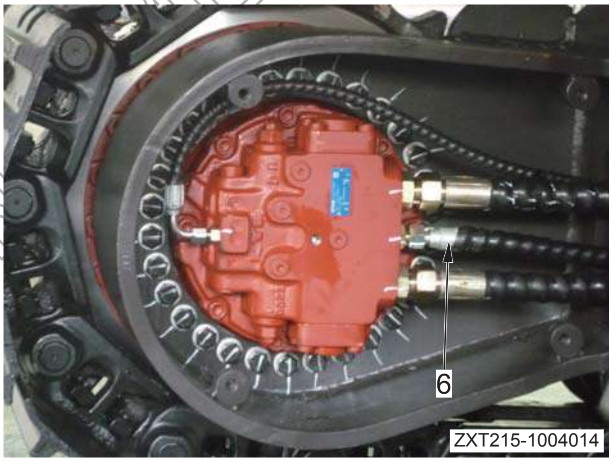
2) Start the engine and lock the travel mechanism.

   NOTE: 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. Plug the hose end with a cap.

4) Start the engine and apply relief pressure to the bottom side of the travel motor while the engine is running at high idle. Measure oil leakage under this condition.



WARNING

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

- 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 travel motor and of the cylinder and piston. Repeat the measurement several times.

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

6.19 Air in Each Component - Bleed

Air bleeding item / Contents of work	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

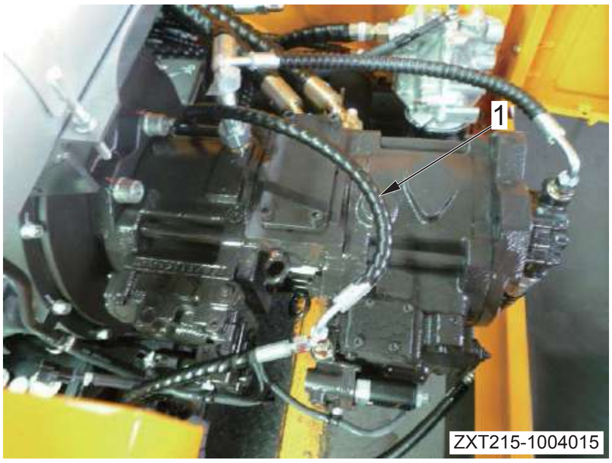
1) Loosen the air bleeder (1) and check that oil oozes out through the air bleeder.

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

Bleeder:

7.8~9.8 N·m{0.8~1.0 kgf·m}

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



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.

   NOTE: Be careful not to apply relief pressure. Stop the piston when the 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).

   NOTE: 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.

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}

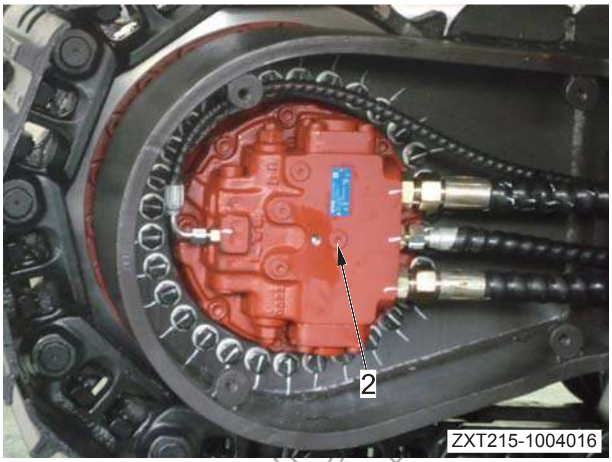


Table of monitored items

Monitored Item		Unit	Remark
Controller Mode Selection		Graph	
High/Low Travel Speed Selection		Graph	
Auto Idle Selection		Graph	
Engine Speed		r / min	
Pressure - Front pump		Kg	
Pressure - Rear pump		Kg	
Current - Proportional Valve (Solenoid, Front pump)		mA	
Current - Proportional Valve (Solenoid, Rear pump)		mA	
Pilot Pressure - Boom Raise		Kg	
Pilot Pressure - Boom Lower		Kg	
Pilot Pressure - Arm In		Kg	
Pilot Pressure - Arm Out		Kg	
Pilot Pressure - Bucket Curl		Kg	
Pilot Pressure - Bucket Dump		Kg	
Pilot Pressure - Swing		Kg	
Pilot Pressure - Travel Left		Kg	
Pilot Pressure - Travel Right		Kg	
Solenoid Valve 1	Bucket Confluence	ON / OFF	
	Swing Priority	ON / OFF	
	Hi/Lo Speed Switching	ON / OFF	
Voltage - Fuel Control Dial		V	
Voltage - Motor Position		V	
Temperature - Engine Coolant		°C	Gauge reading
Temperature - Hydraulic oil		°C	Gauge reading
Pressure - Engine Oil		KPa	

SANY

Troubleshooting

7 Troubleshooting

⚠ WARNING

Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

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.

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.

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.

  NOTE: 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.

7.2 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?

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 connector and dry
	6. Check for blown or corroded fuses		
	7. Check alternator voltage (with engine speed at middle or higher)	— After running for several minutes: 27.5~ 29.5V	Replace
	8. Check operating sound of battery relay (when start switch is turned ON or OFF)	—	Replace Replace

4. 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.

5. 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.

6. 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.

7.3 Connector Location and Electrical Circuit Diagram

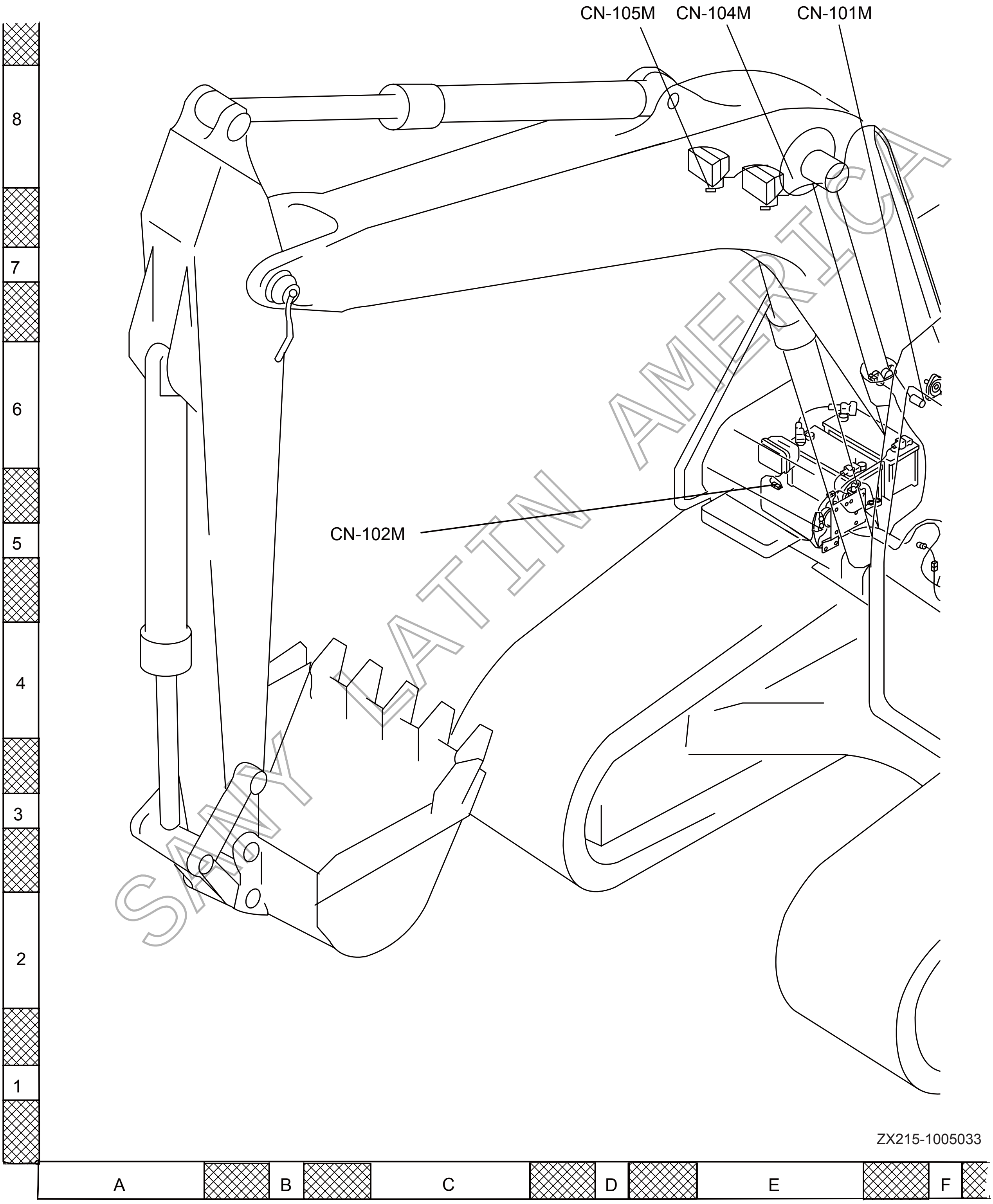
Connec-tor No.	Type	No. of pin	Name of device	Location			
				Layout	Cab circuit	Engine circuit	Sensor, solenoid circuit
T-101	Terminal	1	Battery relay coil (positive)	M-2		D-1	
T-102	Terminal	1	Battery relay coil (negative)	M-2		D-1	
T-103	Terminal	1	Battery relay contact (output)	M-2		D-1	
T-104	Terminal	1	Battery relay contact (input)	M-2		D-1	
T-106	Terminal	1	Starting motor (B terminal)	J-6		L-3	
T-107	Terminal	1	Alternator (B terminal)	K-6		L-5	
T-108	Terminal	1	Preheating fuse (21#)	M-2		G-9	
T-109	Terminal	1	Preheating fuse (17#)	M-2		G-9	
T-110	Terminal	1	Body grounding	M-1	B-1		
T-111	Terminal	1	Body grounding	K-6			
T-112	Terminal	1	Preheating resistance wire terminal	J-7		H-9	
T-115	Terminal	1	Starting motor grounding	J-6		L-3	
T-119	Terminal	1	Body grounding (at the sides of battery)	M-1		B-9	
T-201	Terminal	1	Body grounding	X-6			
T-202	Terminal	1	Body grounding	X-6			
K5	R	5	Horn relay	X-6	H-9		
K6	R	5	Lamp relay	X-6	I-9		
K8	R	5	Top lamp relay	X-6	J-9		
K7	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	
KH	—	5	Preheating relay	Y-6		G-9	
K10	R	5	Pilot valve relay	X-6		K-1	
CN-106F	A	2	Junction connector	W-6		J-2	
CN-142M	D	12	Intermediate connector	W-6	C-9		
CN-131M	D	12	Intermediate connector	R-5	C-9		
CN-302F	A	3	Intermediate connector	R-6	D-9		
CN-301M	S	6	Intermediate connector	R-6		F-9	
CN-132F	D	12	Intermediate connector	R-5	C-5		
CN-1-110	D	6	Intermediate connector	AB-4	K-5		
CN-121F	D	12	Intermediate connector	W-6	D-8		

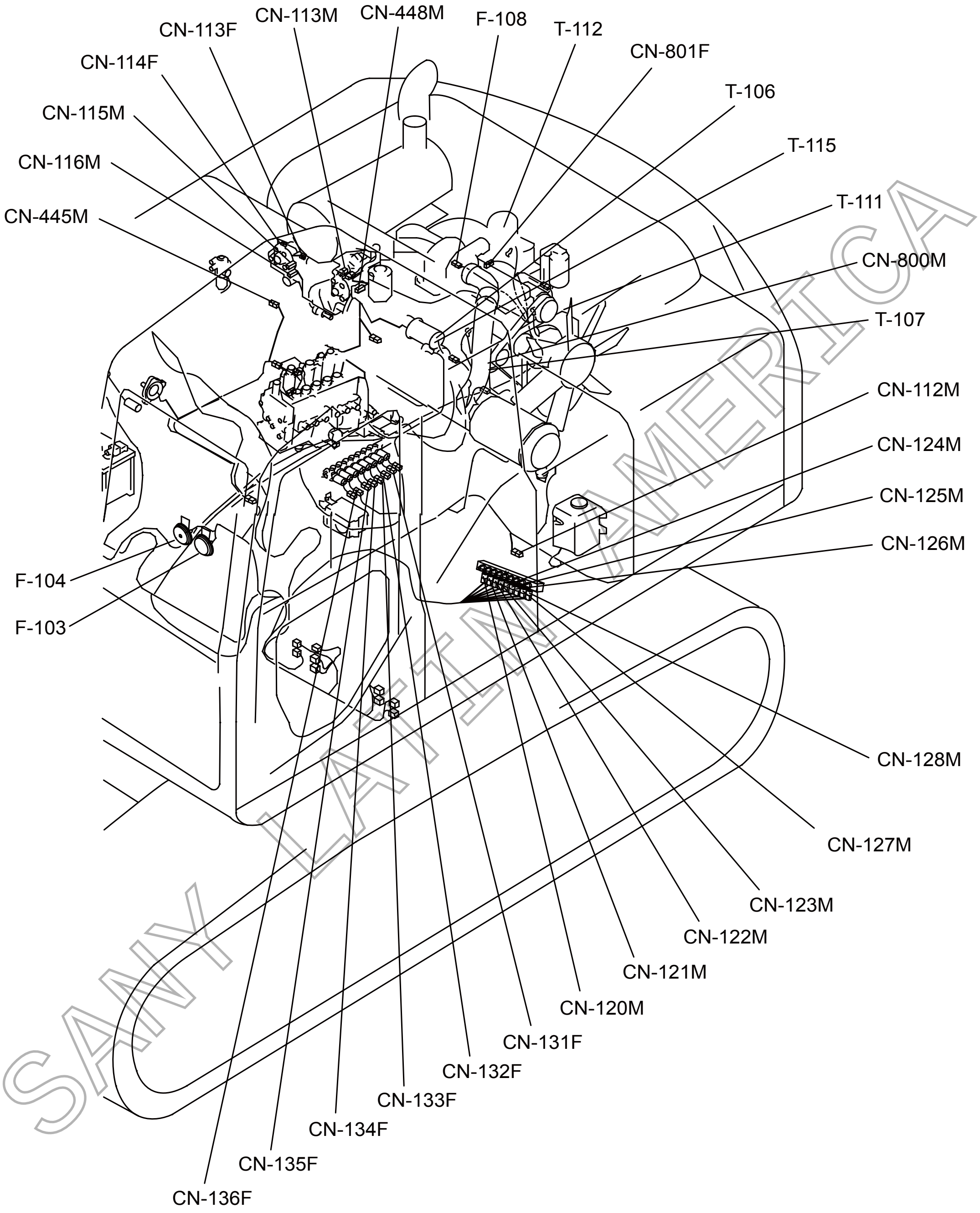
Connec-tor No.	Type	No. of pin	Name of device	Location			
				Layout	Cab circuit	Engine circuit	Sensor, solenoid circuit
CN-241M	D	12	Intermediate connector	W-6	F-8		
CN-1-112	3	3	Intermediate connector	W-6	C-9		
CN-1-111	D	8	Intermediate connector	W-6	C-9		
CN-7-705	D	12	Monitor panel	P-5	D-9		
CN-801F	H	6	Intermediate connector	J-7		K-8	
CN-445M	S	6	Intermediate connector	I-7		F-3	
CN-204F	A	2	Intermediate connector	X-6	C-8		
CN-412F	A	3	Intermediate connector	X-6	C-8		
CN-112M	A	2	Washing motor	K-5	K-4		
CN-102M	A	2	Platform lamp	E-5	K-2		
CN-104M	A	2	Boom lamp (left)	E-7	K-1		
CN-105M	A	2	Boom lamp (right)	E-7	K-2		
CN-113M	A	2	Hydraulic oil temperature sensor	I-7			F-9
CN-101M	S	1	Fuel level sensor	F-6			F-9
CN-152M	A	2	Intermediate connector	W-6			F-8
CN-613F	L	6	Safety relay	X-6		K-7	
CN-661F	S	16	Intermediate connector	W-6		I-8	
CN-161M	S	16	Intermediate connector	W-6			
CN-115M	DF	3	Main pressure sensor (front)	I-7			F-4
CN-116M	DF	3	Main pressure sensor (rear)	I-7			F-4
CN-128M	DF	3	Arm-in pilot sensor	I-6			F-5
CN-122M	DF	3	Arm out pilot sensor	I-6			F-4
CN-126M	DF	3	Boom-up pilot sensor	I-6			F-5
CN-125M	DF	3	Boom-down pilot sensor	I-6			F-6
CN-124M	DF	3	Bucket-curl pilot sensor	I-6			F-6
CN-127M	DF	3	Bucket-dump pilot sensor	I-6			F-6
CN-123M	DF	3	Swing pilot sensor	I-6			F-7
CN-120M	DF	3	Travel pilot sensor (left)	I-6			F-7
CN-121M	DF	3	Travel pilot sensor (right)	I-6			F-8
CN-448M	S	2	Speed sensor	I-7			F-9
CN-307M	H	8	Top lamp switch	R-5	C-3		
CN-303M	H	8	Work lamp switch	R-6	C-2		
CN-305M	H	8	Washer switch	R-6	C-2		

Connec-tor No.	Type	No. of pin	Name of device	Location			
				Layout	Cab circuit	Engine circuit	Sensor, solenoid circuit
CN-304M	H	8	Wiper switch	R-6	C-1		
CN-104M	A	2	Horn switch	R-6	E-3		
CN-306M	H	8	Preheating switch	R-5		F-1	
CN-207F	S	12	Air conditioner unit	W-6			
CN-113F	AMP	2	F. pump solenoid valve	I-7			F-2
CN-114F	AMP	2	R. pump solenoid valve	I-7			F-1
CN-135F	AMP	2	Boom priority solenoid valve 2	J-6			F-2
CN-134F	AMP	2	Bucket Confluence solenoid valve	J-6			F-3
CN-132F	AMP	2	Boom priority solenoid valve 1	J-6			F-3
CN-136F	AMP	2	Pilot solenoid valve	J-6		L-2	
CN-131F	AMP	2	Hi/Lo speed travel solenoid valve	J-6			F-1
CN-133F	AMP	2	Swing priority solenoid valve	J-6			F-4
F-108	W	1	Coolant temperature sensor	J-7			F-8
F-104	W	1	Horn (right)	I-5	K-2		
F-103	W	1	Horn (left)	I-5	K-2		
CN-616F	AMP	81	Controller	W-6	A-4		
CN-615F	AMP	40	Controller	W-6	A-9		
CN-800M	S	2	Alternator terminal L/R	K-6			
CN-7-707	AMP	2	Cigarette lighter	P-4			
CN-150M	D	8	Intermediate connector	AE-3			
CN-107M	HL	7	Radio	W-6			
PF021	-	-	Fuse box	X-4			
CN-1-001M	A	2	Speaker (left)	AE-6			
CN-1-002M	A	2	Speaker (right)	AD-7			
CN-1-103M	A	2	Front right lamp	AB-6			
CN-1-004M	A	2	Front left lamp	AC-5			
CN-1-005	H	1	Cab lamp	AE-7			

Connector code	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

7.3.1 Connector location layout





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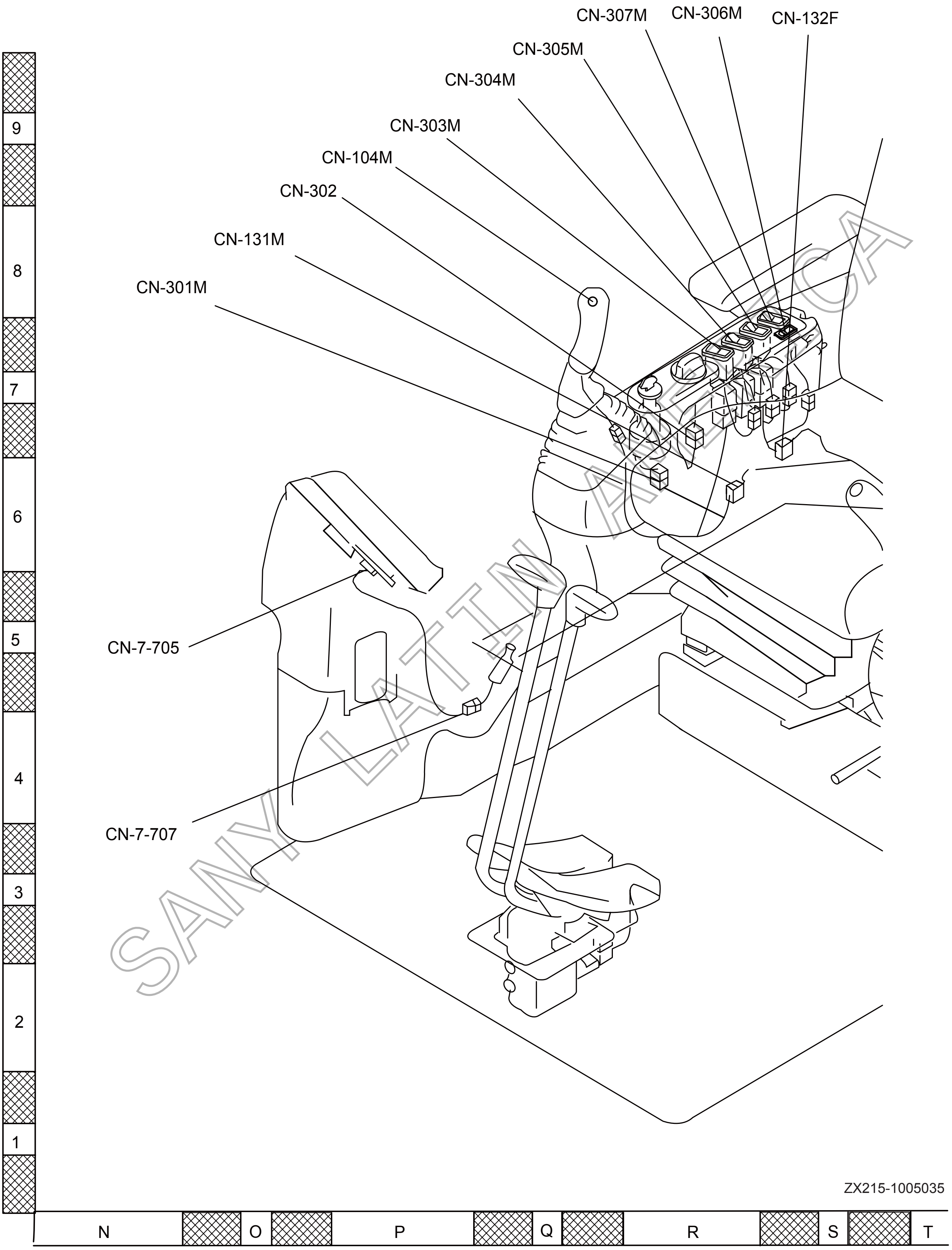
G		H		I		J		K		L		M	


CN-307M
CN-306M
CN-132F
CN-305M
CN-304M
CN-303M
CN-104M
CN-302
CN-131M
CN-301M
CN-7-705
CN-7-707
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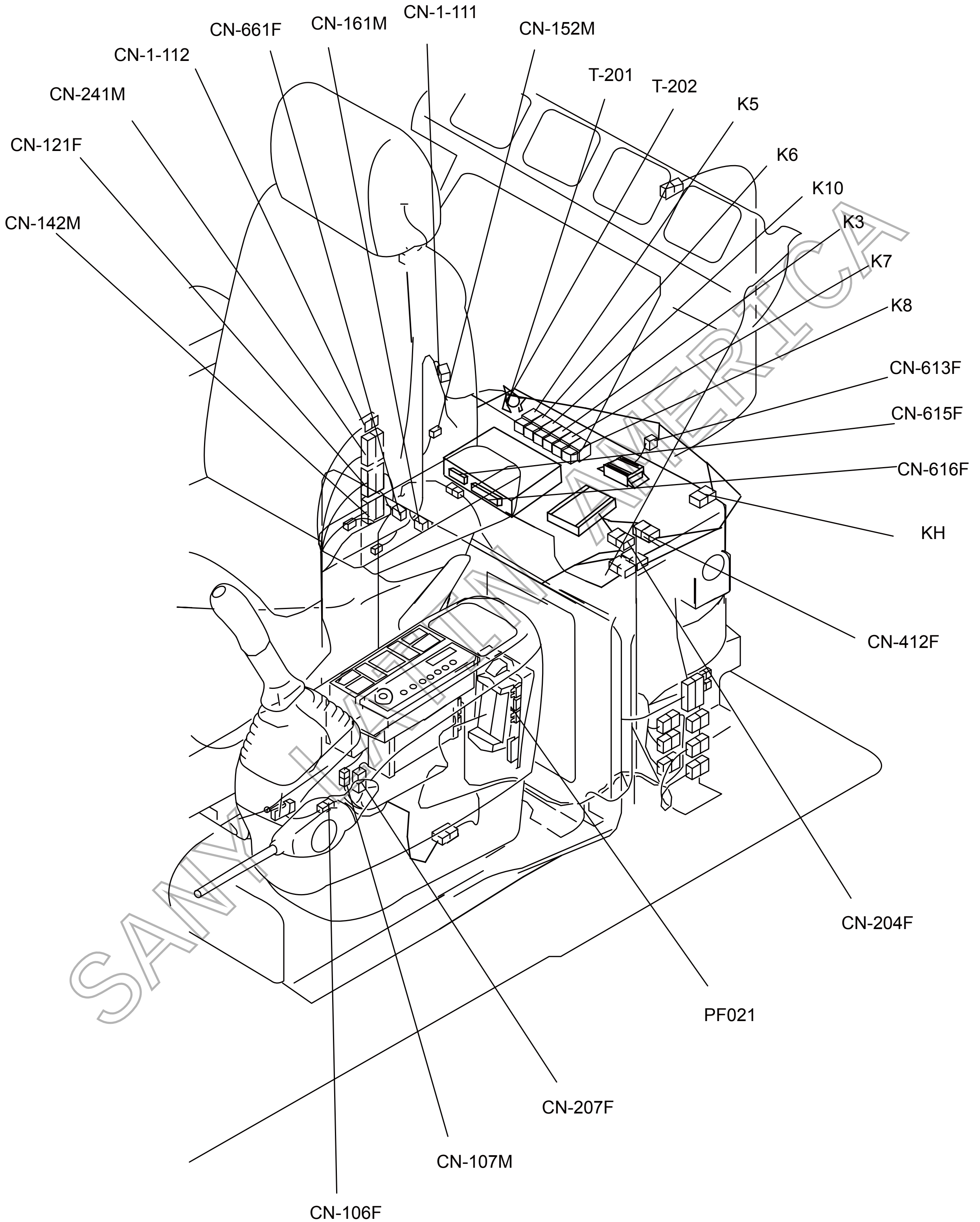
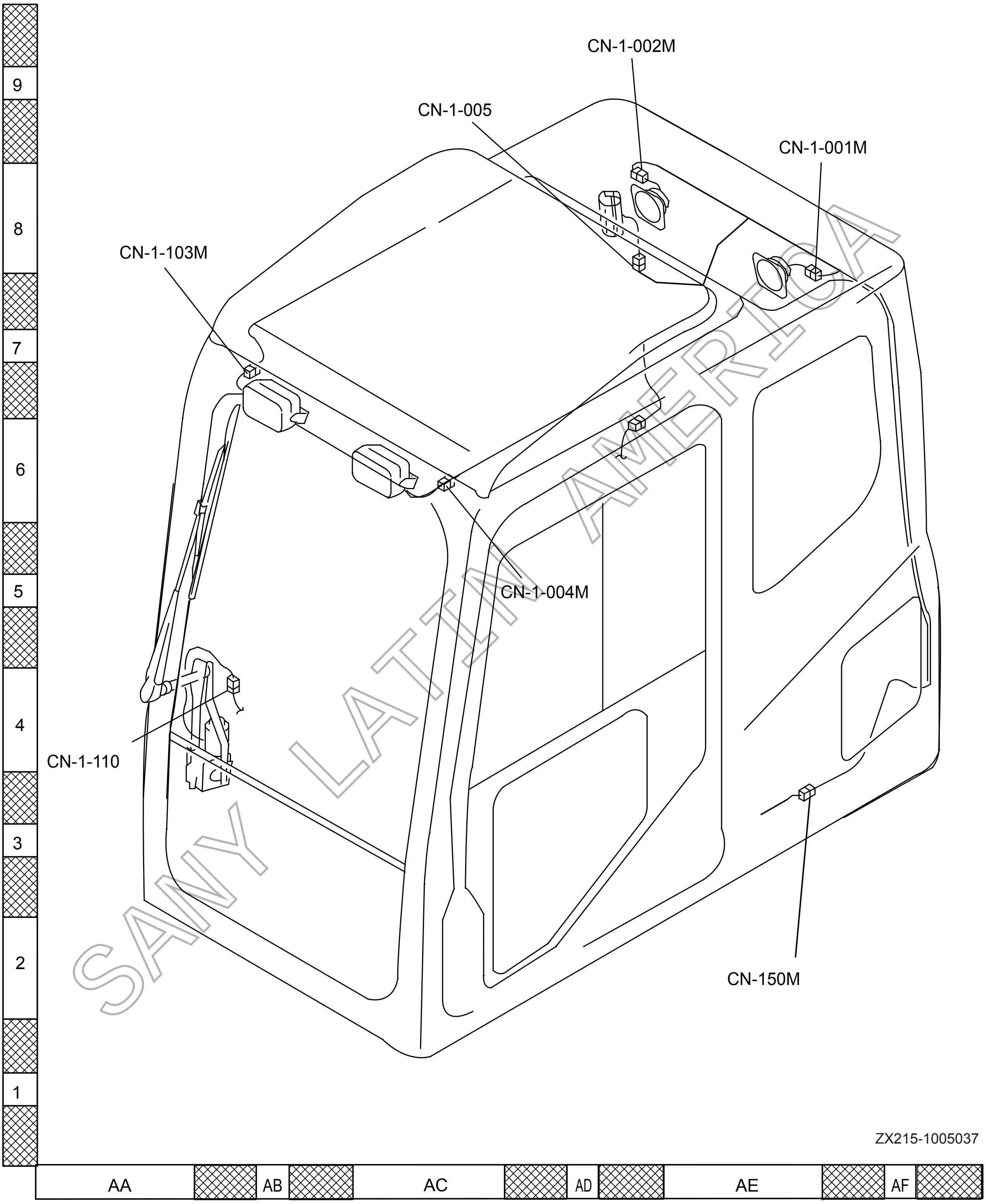
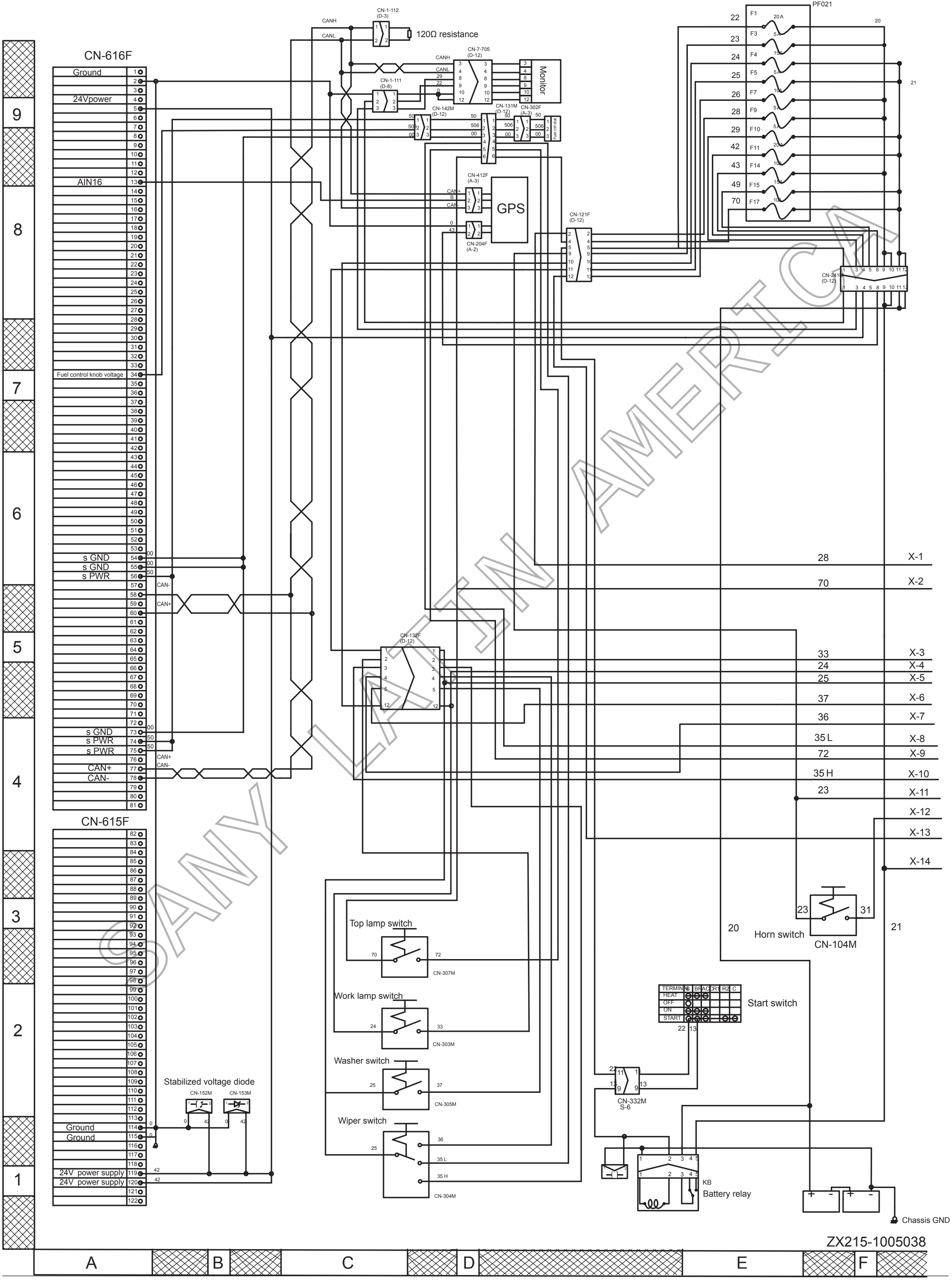
ZX215-1005035


CN-661F
CN-161M
CN-1-111
CN-152M
CN-1-112
T-201
T-202
CN-241M
K5
CN-121F
K6
K10
CN-142M
K3
K7
K8
CN-613F
CN-615F
CN-616F
KH
CN-412F
CN-204F
PF021
CN-207F
CN-107M
CN-106F
ZX215-1005036

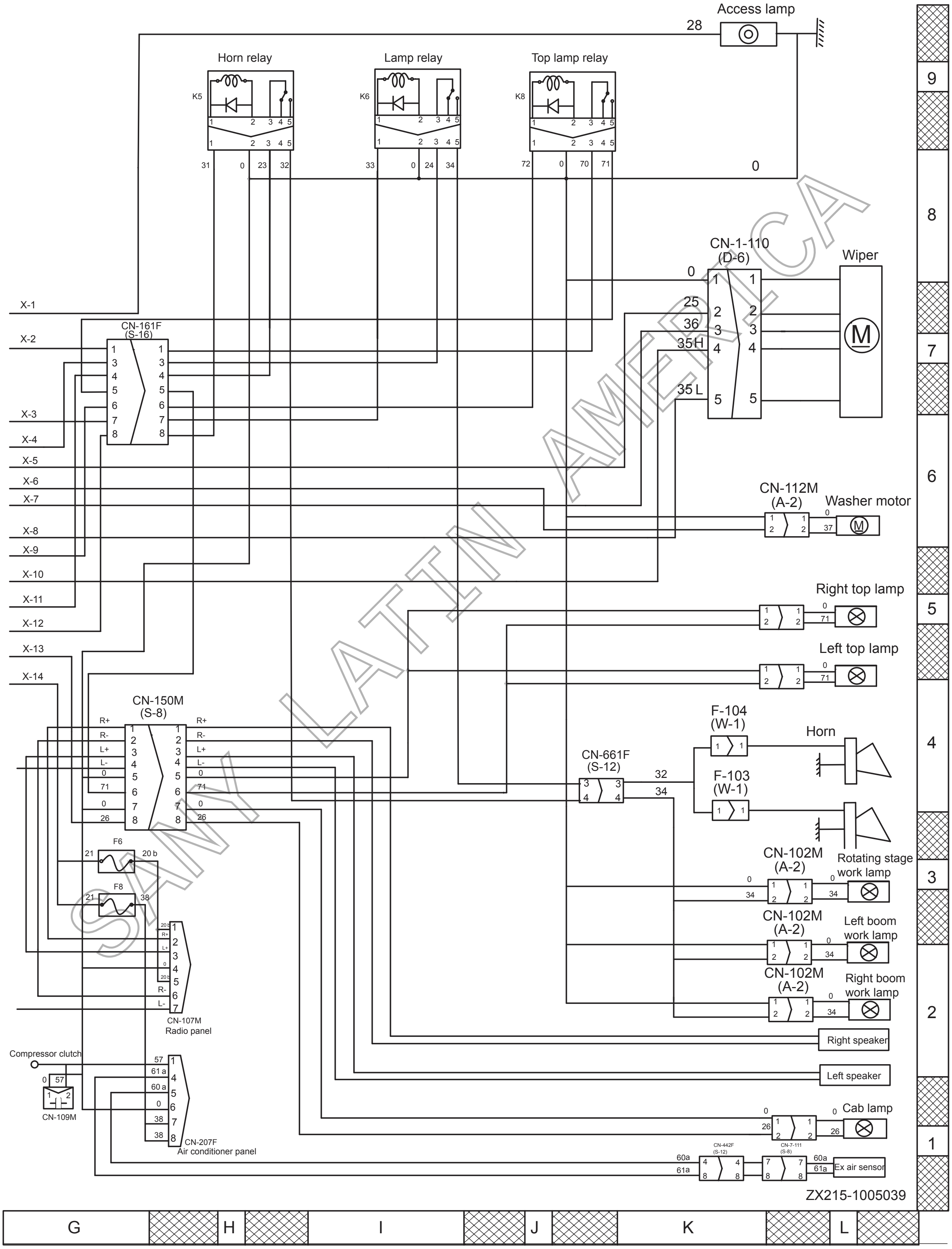
T	▨	U	▨	V	▨	W	▨	X	▨	Y	▨	Z	▨


CN-1-002M
CN-1-005
CN-1-001M
CN-1-103M
CN-1-004M
CN-1-110
CN-150M
ZX215-1005037
9
8
7
6
5
4
3
2
1
AA
AB
AC
AD
AE
AF

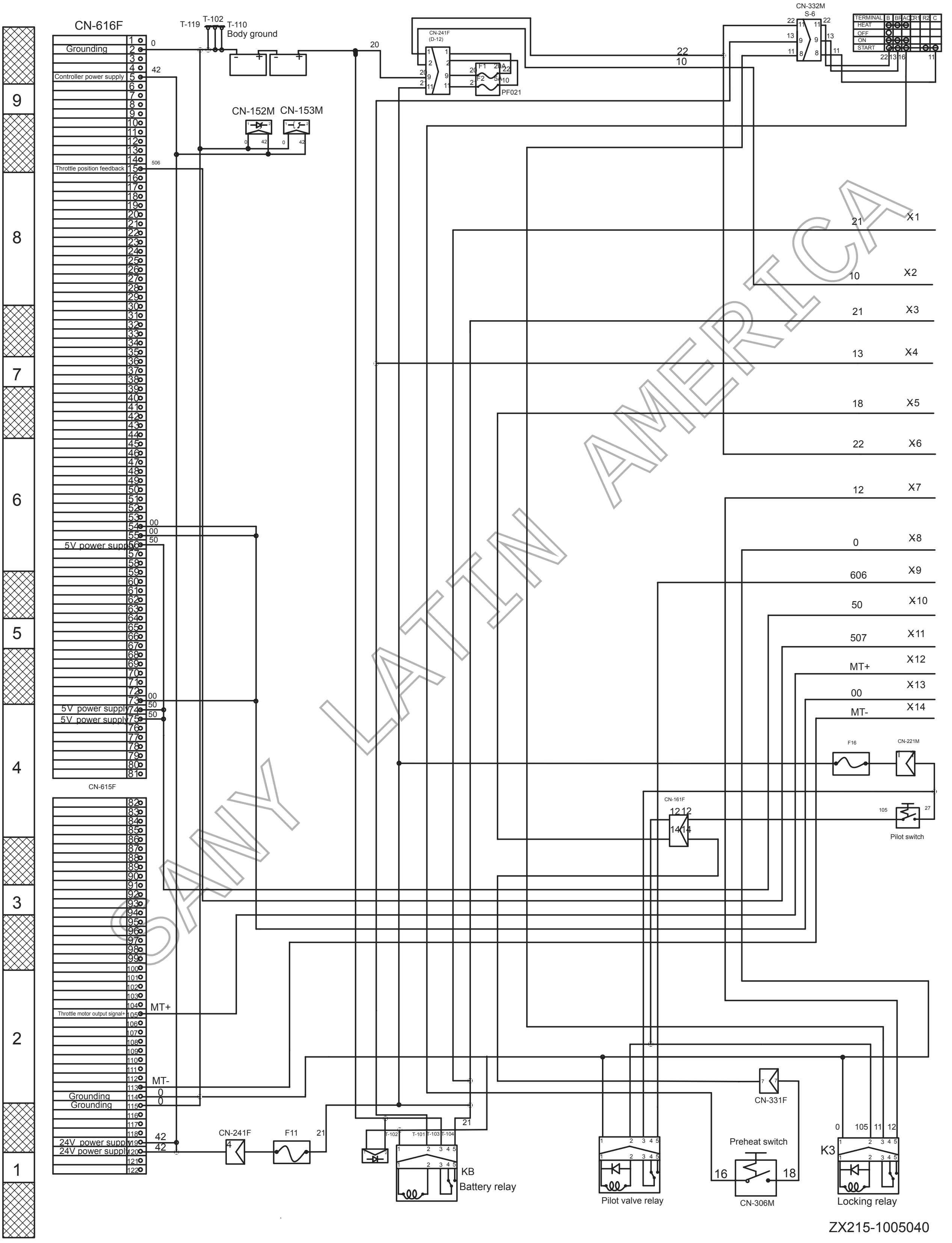
7.3.2 Electrical element circuit diagram (cab circuit)



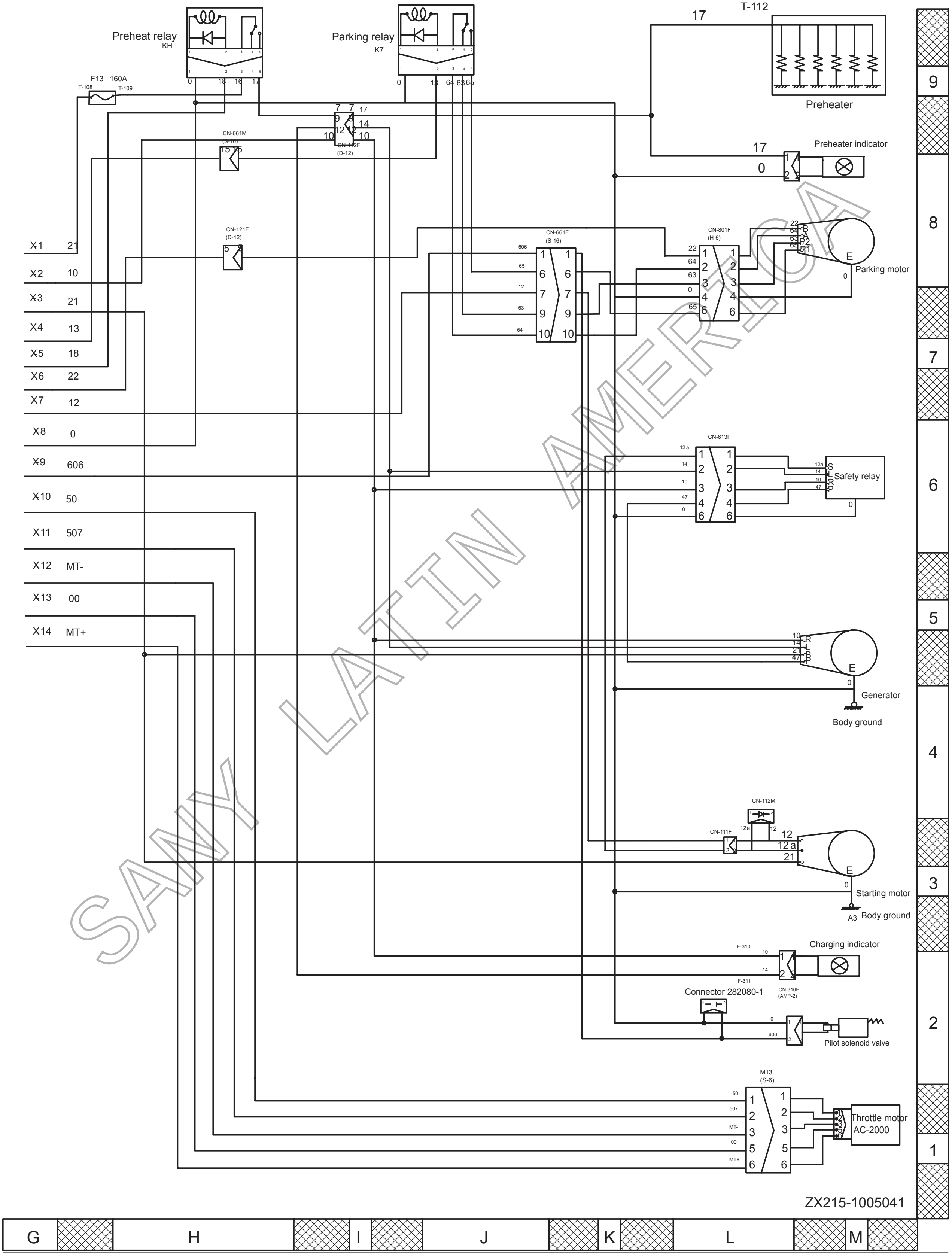
★ This circuit diagram has been compiled by extracting the wiper system and each switch control system from the overall electrical circuit diagram.



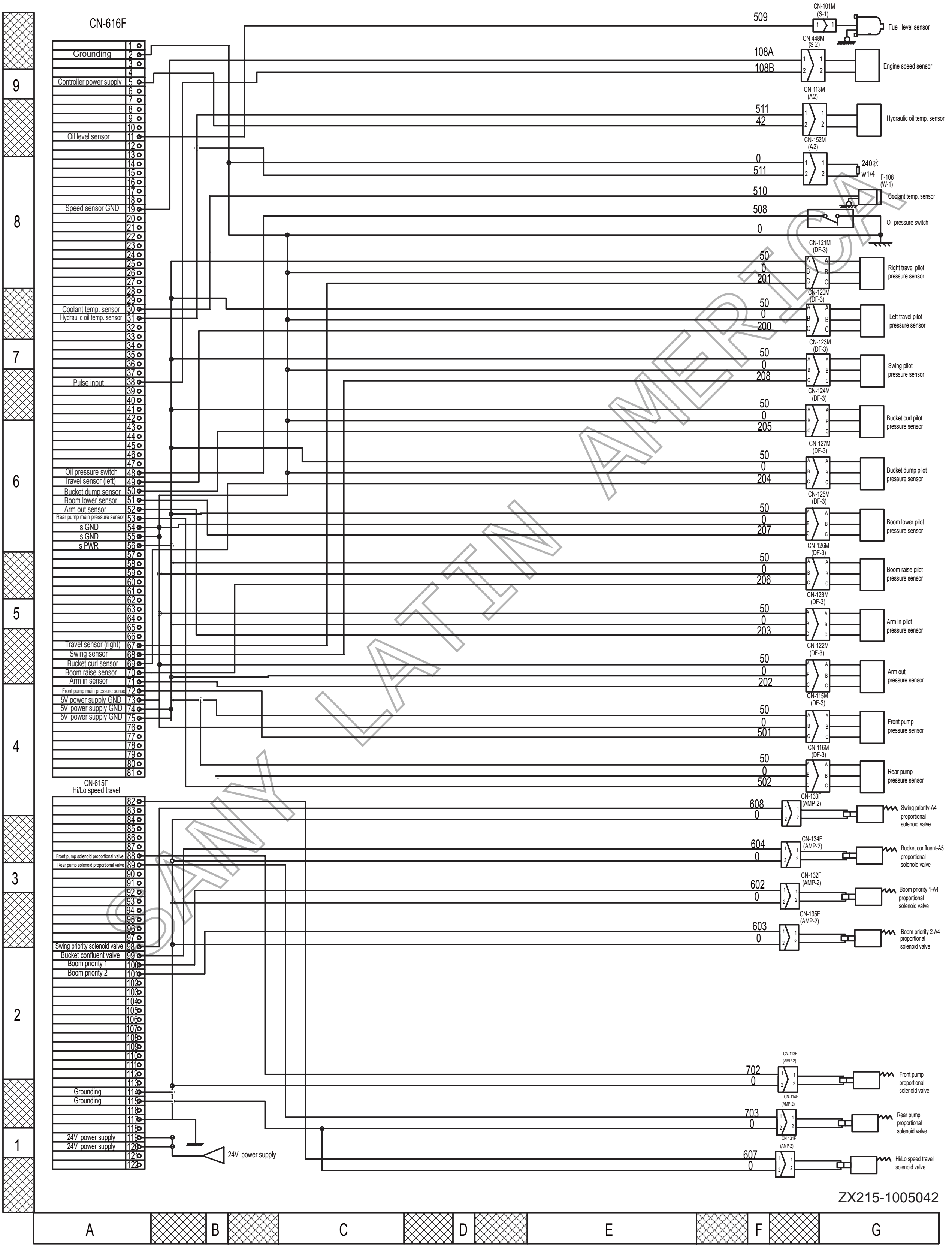
7.3.3 Electrical control circuit diagram (engine circuit)



★ This circuit diagram has been compiled by extracting the engine preheat system, startup system and governor system from the overall electrical circuit diagram.



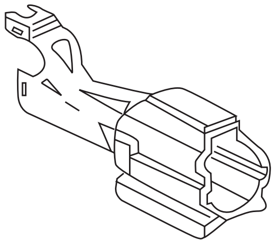
7.3.4 Electrical control circuit diagram (sensor and solenoid valve circuit)



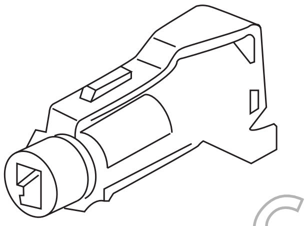
7.3.5 SWP type connector

Male (Plug)

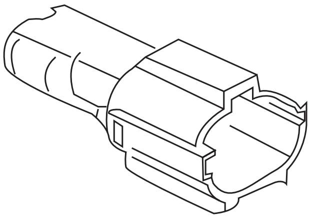
Female (Socket)



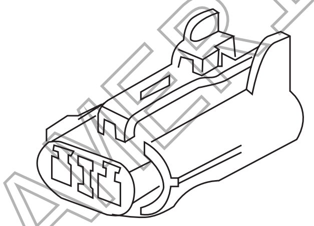
7222-7414-40



7123-7414-40 (No.of pin: 1)



7222-1424-40



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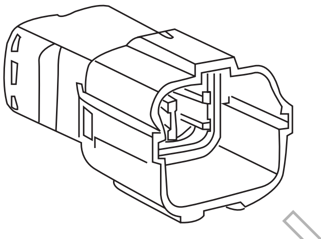
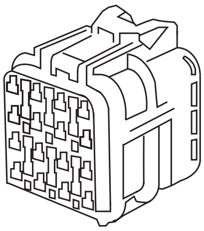


7222-7464-40



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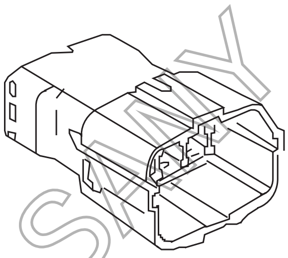
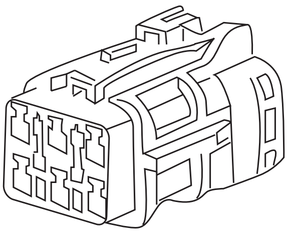


7222-7484-40



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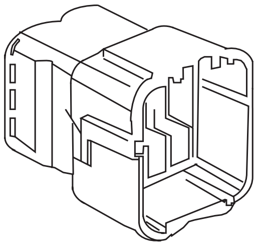

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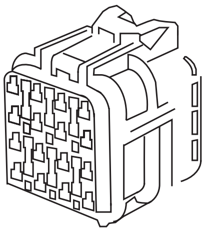
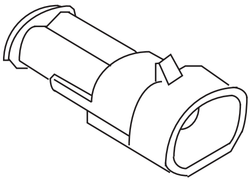


7123-7564-40 (No.of pin: 16)

7.3.6 A/AMP type connector

Male (Plug)

Female (Socket)



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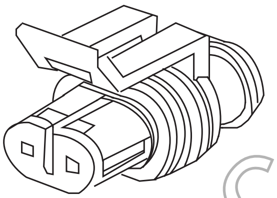
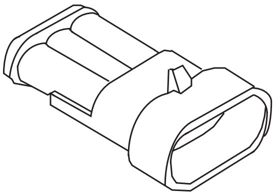
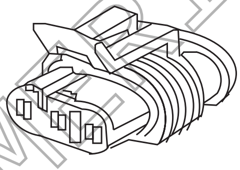


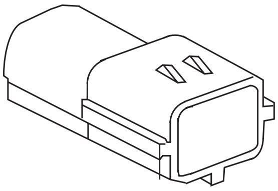
282080-1 (No.of pin: 2)



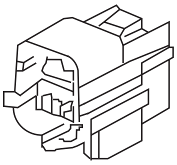
282105-1



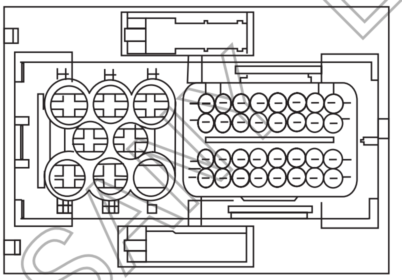
282087-1 (No.of pin: 3)



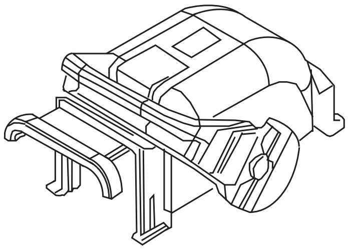
174354-2



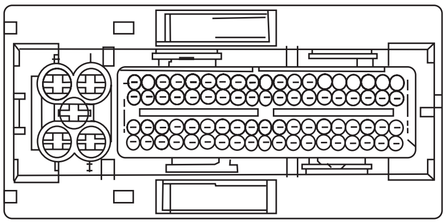
174352-2 (No.of pin: 2)



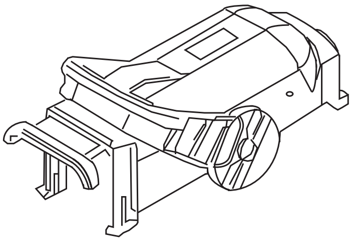
1473252-1



1473255-1 (No.of pin: 40)



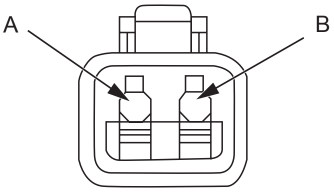
1473244-1



1473247-1 (No.of pin: 81)

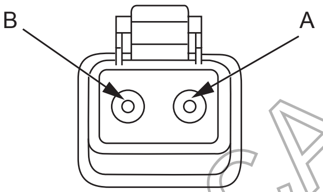
7.3.7 DT type connector

Shell (Plug)

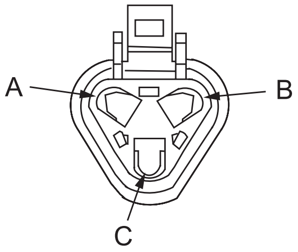


DT06-2S

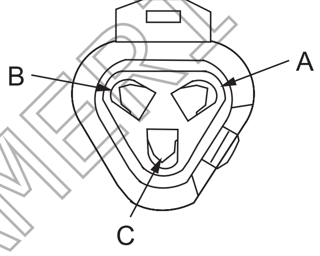
Shell (Socket)



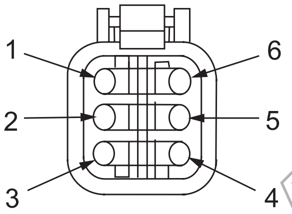
DT04-2P



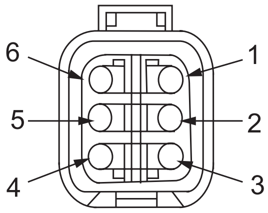
DT06-3S



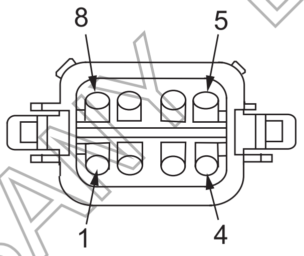
DT04-3P (No.of pin: 3)



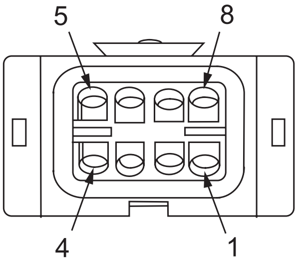
DT06-6S



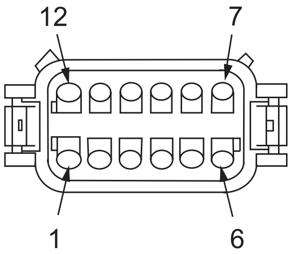
DT04-6P (No.of pin: 6)



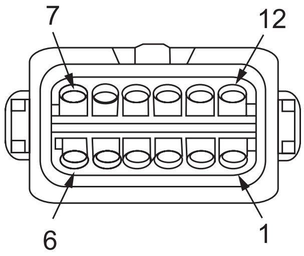
DT06-8S



DT04-8P (No.of pin: 8)



DT06-12S



DT04-12P (No.of pin: 12)

7.4 Failure Symptoms and Troubleshooting Codes

No.	Symptom	Troubleshooting			
		Code	E mode	H mode	(Engine)
Action to be taken concerning Service Code, User Code and Failure Code					
1	Display User Code in monitor panel	According to displayed code			
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)				S-1
5	Engine misfires.		E-1		S-2
6	Color of exhaust gas is too dark.(Incomplete combustion)				S-3
7	Engine pickup is poor.				S-4
8	Engine runs rough or is unstable.		E-2		S-5
9	Engine is short of output, or lacks power			H-2	S-6
10	Auto Idle fails.		E-4	H-5	
11	Excessive engine oil consumption, or color of exhaust gas is blue				S-7
12	Premature engine oil contamination				S-8
13	Excessive fuel consumption				S-9
14	Engine cooling water is mixed with engine oil, spurts out or decreases				S-10
15	Engine oil amount increases. (Water or fuel gets in)				S-11
16	Abnormal noises are heard				S-12
17	Excessive vibrations are caused				S-13
Failure related to work equipment, swing and travel					
18	Power supply of machine cannot be cut off.		E-3		
19	There are abnormal noises from around hydraulic pump			H-4	
20	All work equipment, travel and swing do not move			H-3	
21	Speeds of all work equipment, travel and swing are slow			H-1	S-6
22	When Machine Swings and Travels Simultaneously, Travel Speed Lowers Largely			H-13	
Work equipment-related failure					
23	All the equipment do not work		E-6		
24	Cylinder do not work singly			H-9	
25	Drift of cylinder is too large			H-10	
26	Work equipment time lag is too big			H-11	

No.	Symptom	Troubleshooting			
		Code	E mode	H mode	(Engine)
27	Other work equipment moves, when specific work equipment is relieved			H-12	
28	Boom-up 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 tends to swerve while in travel			H-14	
34	Machine is difficult to steer, or lacks power			H-16	
35	Travel speed cannot be shifted			H-17	
36	Track shoe does not move (only on one side)			H-18	
	Swing-related failure				
37	Machine does not swing			H-19	
38	Swing acceleration is poor, or swing speed is slow			H-20	
39	Upper structure overruns remarkably when stopping swinging			H-21	
40	Large shock is made when stopping swinging			H-22	
41	Large sound is made when stopping swinging			H-23	
42	Hydraulic drift of swing is large			H-24	
	Monitor panel-related failure				
43	Monitor display is blank.		E-11		
44	Monitor displays nothing.		E-12		
45	Engine coolant temperature reading is incorrect.		E-14		
46	Fuel level reading is incorrect.		E-15		
47	Arm-in pilot pressure reading is incorrect.		E-17		
48	Arm-out pilot pressure reading is incorrect.		E-18		
49	Boom-up pilot pressure reading is incorrect.		E-19		
50	Boom-down pilot pressure reading is incorrect.		E-20		
51	Bucket-close pilot pressure reading is incorrect.		E-21		
52	Bucket-open pilot pressure reading is incorrect.		E-22		
53	Swing pilot pressure reading is incorrect.		E-23		
54	Left travel pilot pressure reading is incorrect.		E-24		
55	Right travel pilot pressure reading is incorrect.		E-25		
	Other failure				
56	Preheating function fails.		E-5		
57	Wiper does not work.		E-16		

7.5 Troubleshooting with an Event Code

Information in troubleshooting table

User Code	Service Code	Trouble	Title of failure shown in failure history
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.		

	Cause		**Standard value in normal state and remarks on troubleshooting**
Possible causes and standard value in normal state	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.

E111 (controller memory failure (FROM))

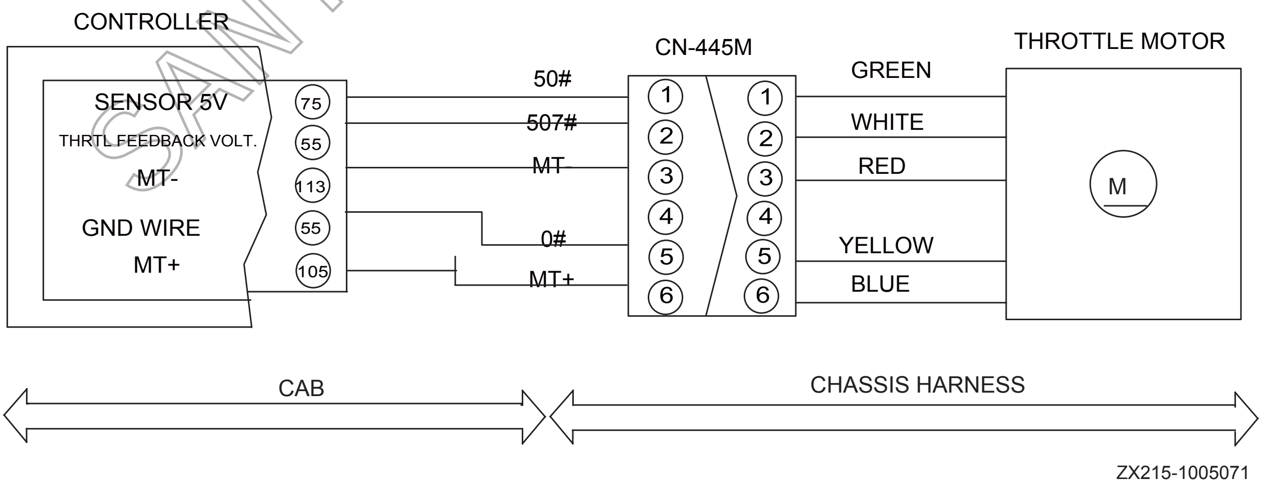
User Code	Service Code	Trouble	Controller memory fails and the system slows down.
11	E111		
Failure description	When the power is on, abnormality is detected by checking through FROM summation and RAM verification.		
Response from controller	Stop the operation of motor and solenoid coil.		
Symptom of 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				

E212 (throttle motor current & motor connection abnormal)

User Code	Service Code	Trouble	Throttle motor loading circuit is abnormal and the engine acceleration fails.
12	E212		
Failure description	When the power is on, magnitude of throttle motor coil current is out of the range of 0.1A~1.8A and lasts for 2 seconds.		
Response from controller	The controller stops the motor driving system when this failure is detected.		
Symptom of machine	Engine acceleration fails and the machine acts slowly.		

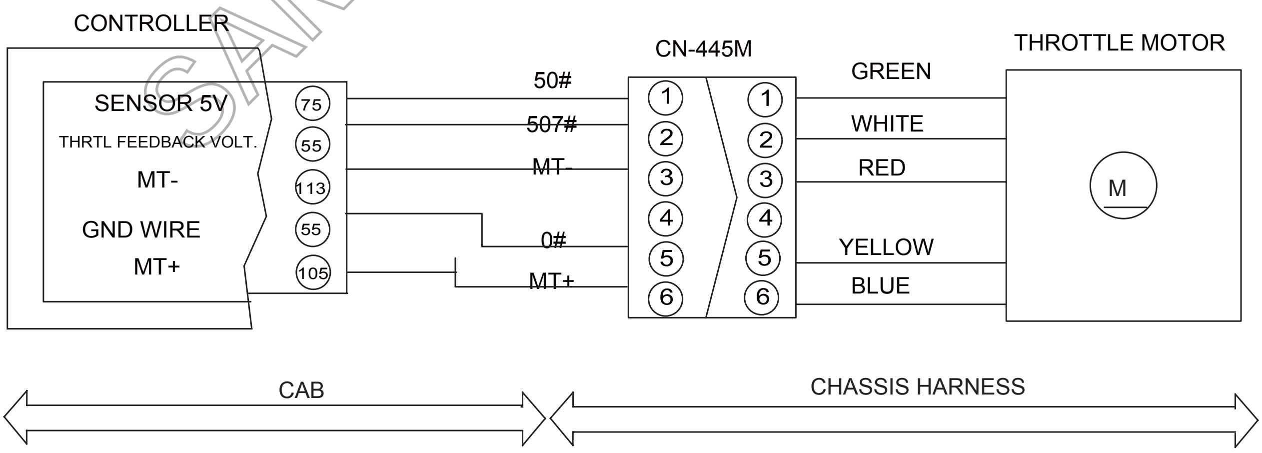
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of throttle motor coil	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-445M ③ and ⑥	Resistance	12.2 Ω
	2	Open 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 113 and pin 105.	Resistance	12.2 Ω
	3	Short circuit of harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-445M and measure the resistance between motor ③ (⑥) and the housing.	Resistance	≥2M Ω
	4	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.)		
	5				



E213 (throttle motor operation suspends)

User Code	Service Code	Trouble	Operation of throttle motor suspends and engine acceleration fails.
13	E213		
Failure description	The controller monitoring accuracy deviates by over 5%, which is normally between 0.8 - 4.2 Voltage, after the system is powered on for 30 seconds.		
Response from controller	The controller stops the motor driving system when this failure is detected.		
Symptom of machine	Engine acceleration fails and the machine acts slowly.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Failure of throttle motor coil	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-445M ③ and ⑥	Resistance	12.2 Ω
	2	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-445M ① and ⑤	Voltage	About 5V
	3	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 113 and pin 105.	Resistance	12.2 Ω
	4	Failure of throttle position sensor	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-445M ② and ground	Voltage	0.8V~3.5V
	5	Short circuit of harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-445M and measure the resistance between motor ③ (⑥) and the housing.	Resistance	≥2M Ω
	6	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.)		

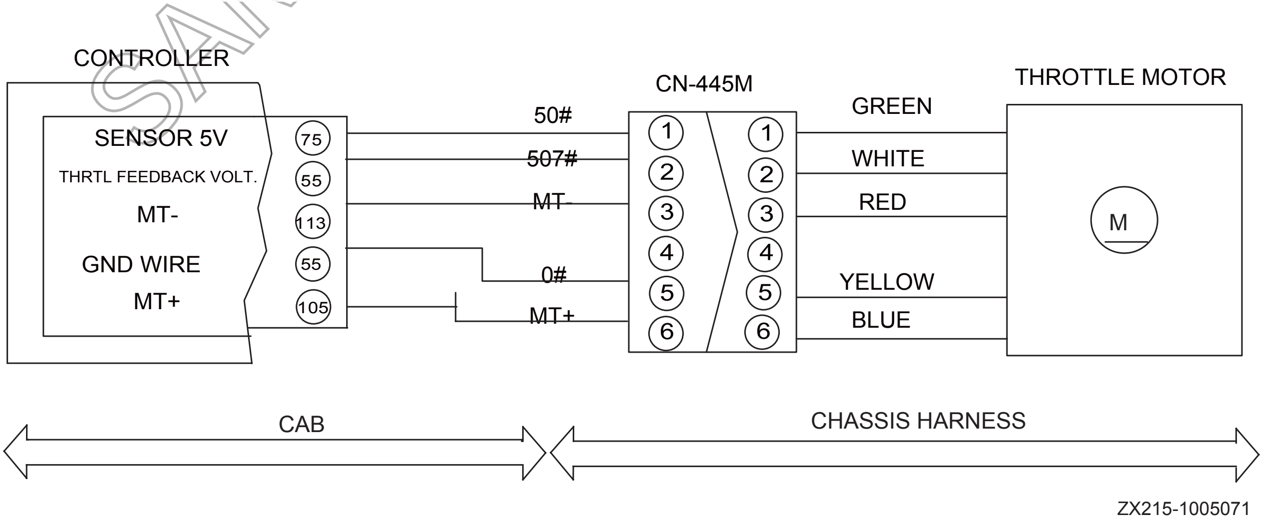


ZX215-1005071

E214 (throttle motor working range abnormal)

User Code	Service Code	Trouble	Throttle motor working range is abnormal and the engine returns to auto idle.
14	E214		
Failure description	The voltage is below 0.8V at the minimal stroke or above 4.2V at the maximal stroke, and it lasts for 100msec when the power is on.		
Response from controller	Turn the throttle to idle speed.		
Symptom of machine	Engine returns to auto idle.		

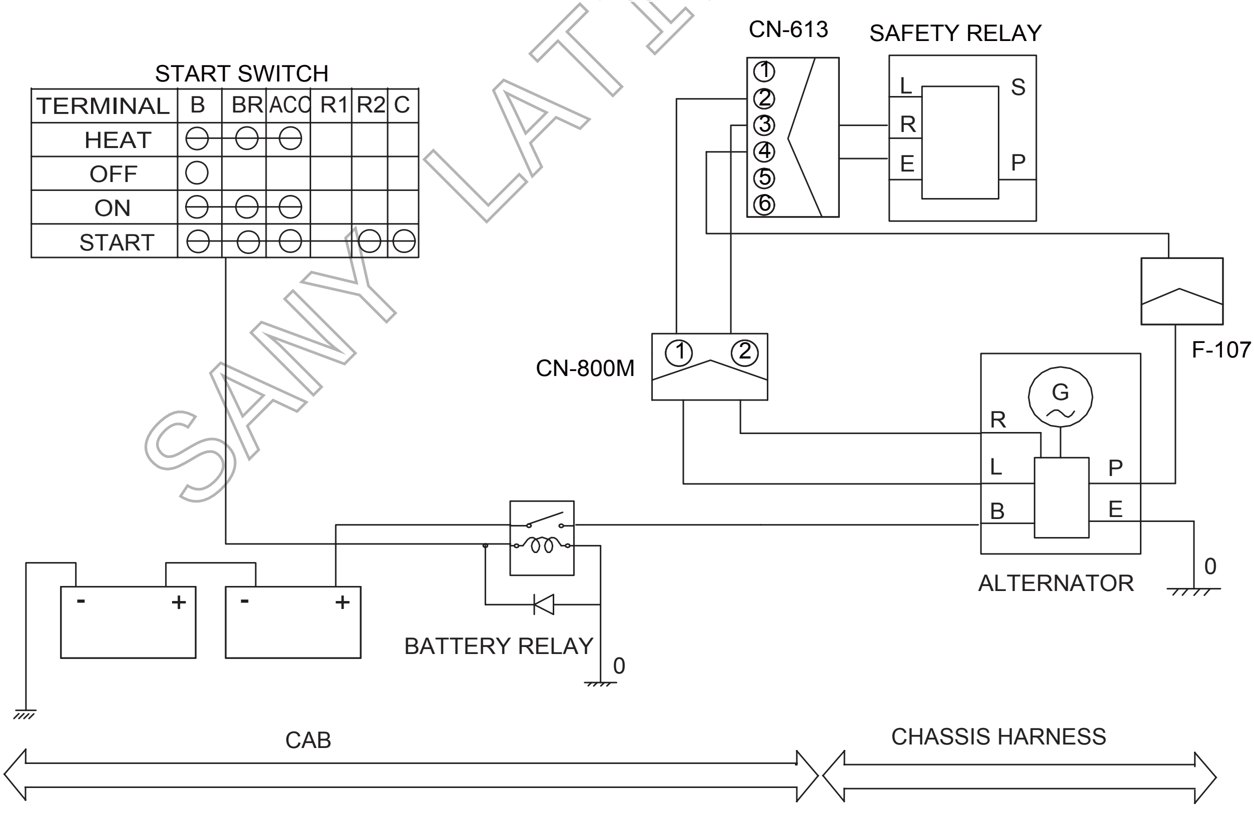
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of throttle motor coil	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-445M ③ and ⑥	Resistance	12.2 Ω
	2	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-445M ① and ⑤	Voltage	About 5V
	3	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 113 and pin 105.	Resistance	12.2 Ω
	4	Failure of throttle position sensor	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-445M ② and ground	Voltage	0.8V—3.5V
	5	Short circuit of harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-445M and measure the resistance between motor ③ (⑥) and the housing.	Resistance	≥2M Ω
	6	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.)		



E015 (power supply voltage abnormal)

User 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				



START SWITCH

TERMINAL	B	BR	ACC	R1	R2	C
HEAT	○	○	○			
OFF	○					
ON	○	○	○			
START	○	○	○		○	○

E116 (controller internal temperature abnormal)

User 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				

E017 (abnormal output of 5v power supply in sensor)

User 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	—		

	Cause		**Standard value in normal state/Remarks on troubleshooting**		
Possible causes and standard value in normal state	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	≥2M Ω
	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				

E118 (abnormal communication between controller and monitor)

<table>
<tr><td>User Code</td><td>Service Code</td><td rowspan="2">Trouble</td><td rowspan="2">Abnormal communication between controller and monitor</td></tr>
<tr><td>18</td><td>E118</td></tr>
<tr><td>Failure description</td><td colspan="3">Communication of monitor is interrupted for 5 consecutive times when the power is on.</td></tr>
<tr><td>Response from controller</td><td colspan="3">Only output alarm is enabled.</td></tr>
<tr><td>Symptom of machine</td><td colspan="3">—</td></tr>
</table>

<table>
<tr><td rowspan="13">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="2">1</td><td rowspan="2">Failure of CAN resistance</td><td colspan="3">● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.</td></tr>
<tr><td>Between CN-7-709 ① and ②</td><td>Resistance</td><td>60 Ω</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Open circuit of harness</td><td colspan="3">● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.</td></tr>
<tr><td>Unplug the controller and measure the resistance between pin 60 and CN-7-705 ③</td><td rowspan="2">Resistance</td><td>≤1 Ω</td></tr>
<tr><td>Unplug the controller and measure the resistance between pin 78 and CN-7-705 ④</td><td>≤1 Ω</td></tr>
<tr><td>3</td><td>Internal failure of controller</td><td colspan="3">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.)</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2"></td><td colspan="3"></td></tr>
<tr><td></td><td></td><td></td></tr>
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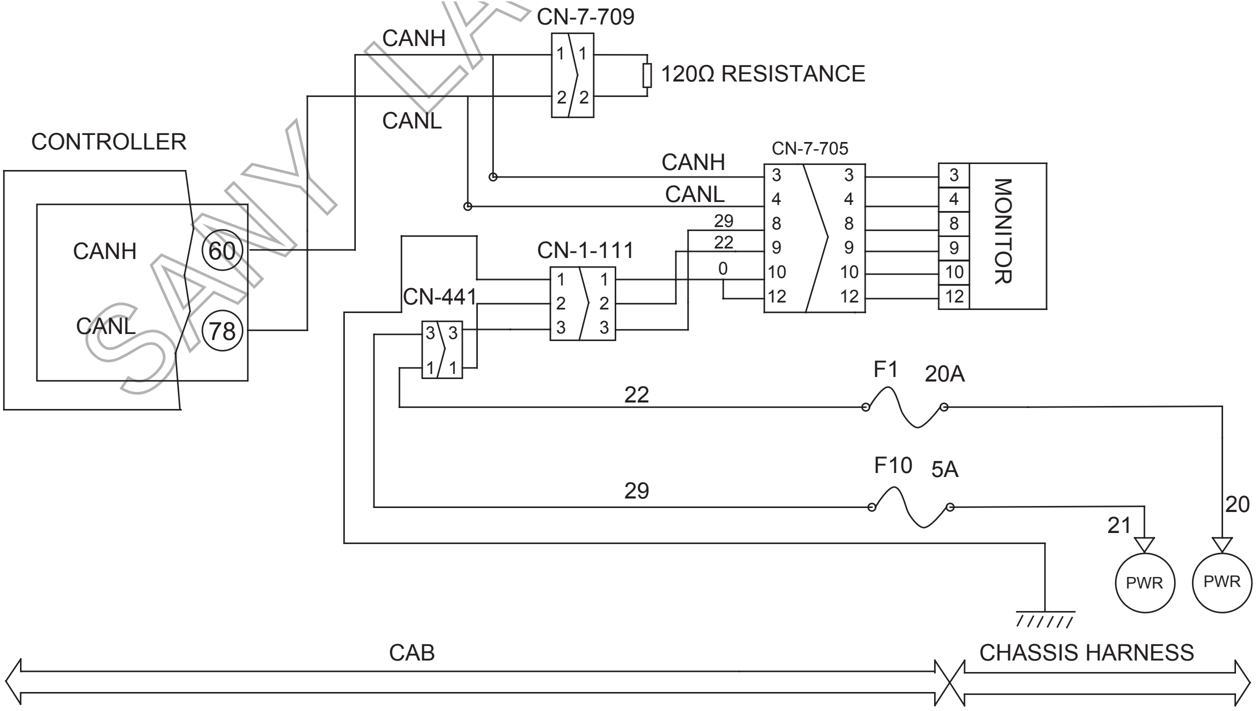
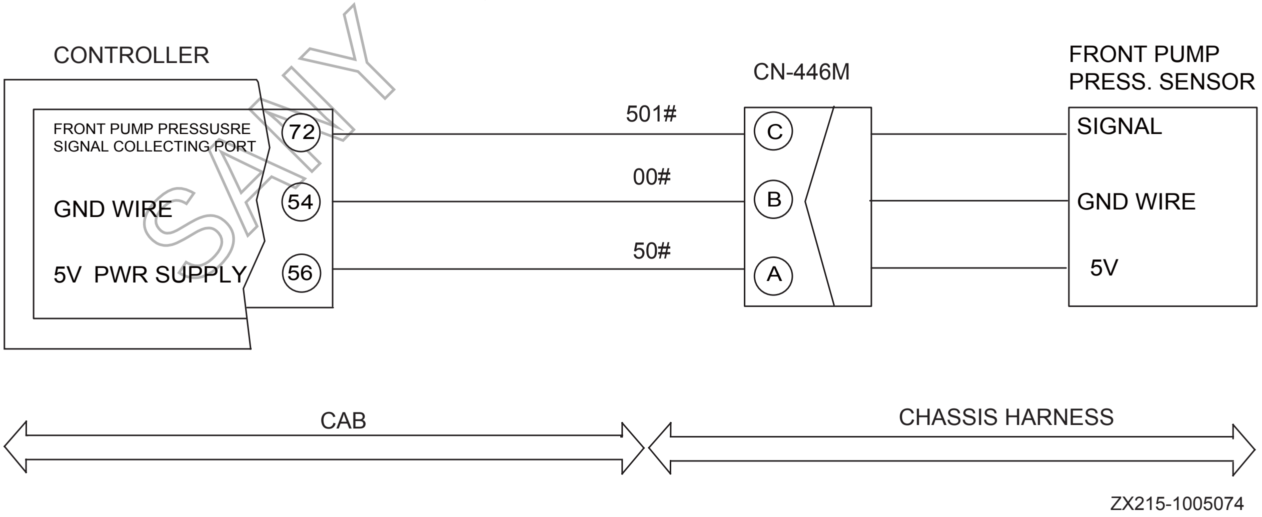


ZX215-1005073

E320 (abnormality in front pump output pressure)

User 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	—		

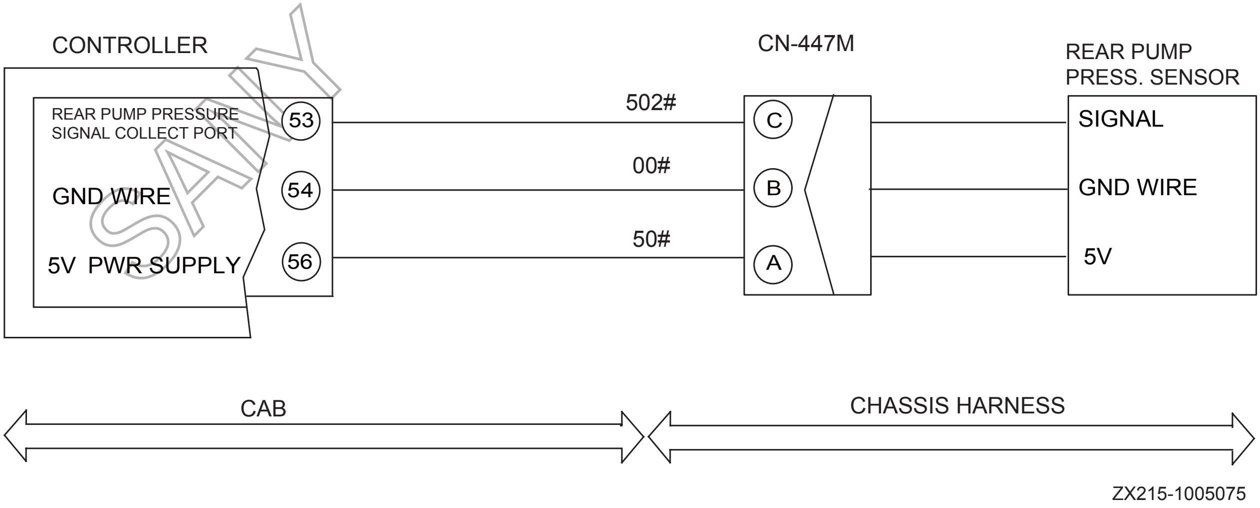
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-115M A and B	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-115M C and pin 72 of controller	Resistance	≤1 Ω
			Between CN-115M 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-115M 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-115M C and ground	Voltage	0.5±0.2V
	5				



E321 (abnormality in rear pump output pressure)

User 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	—		

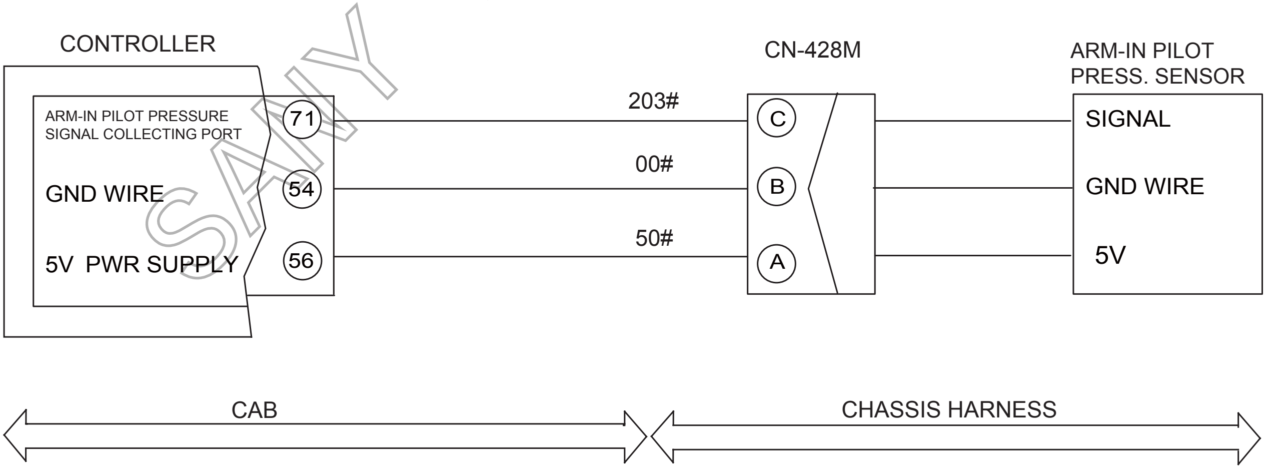
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-116M A and B	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-116M C and pin 53 of controller	Resistance	≤1 Ω
			Between CN-116M 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-116M 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-116M C and ground	Voltage	0.5±0.2V
	5				



E322 (abnormality in arm-in pilot pressure)

User 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-128M 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-128M C and pin 71 of controller	Resistance	≤1 Ω
			Between CN-128M 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-128M 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-128M C and ground	Voltage	0.5±0.2V
	5				

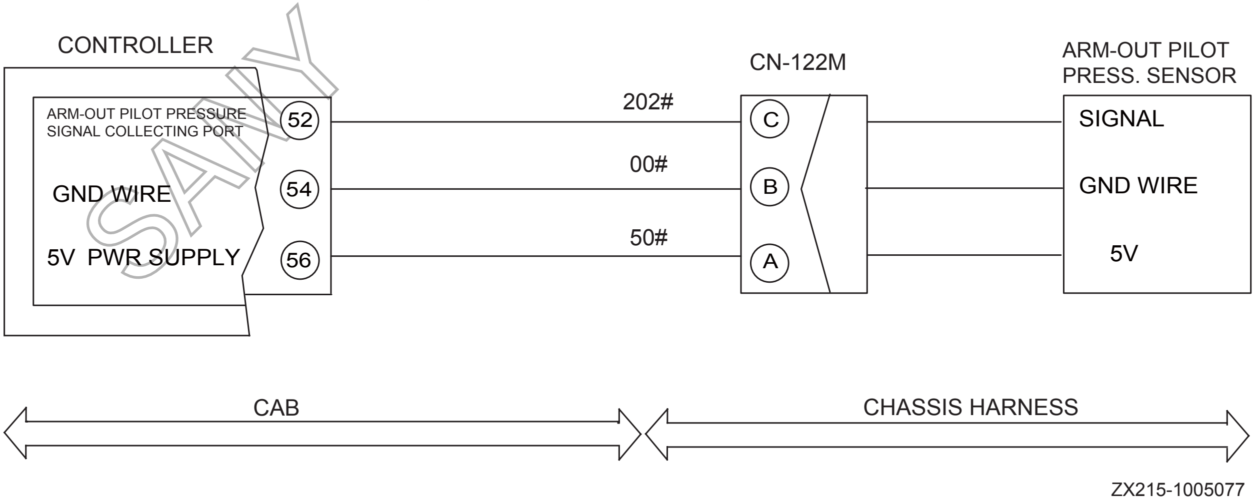


ZX215-1005076

E323 (abnormality in arm-out pilot pressure)

User 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.		

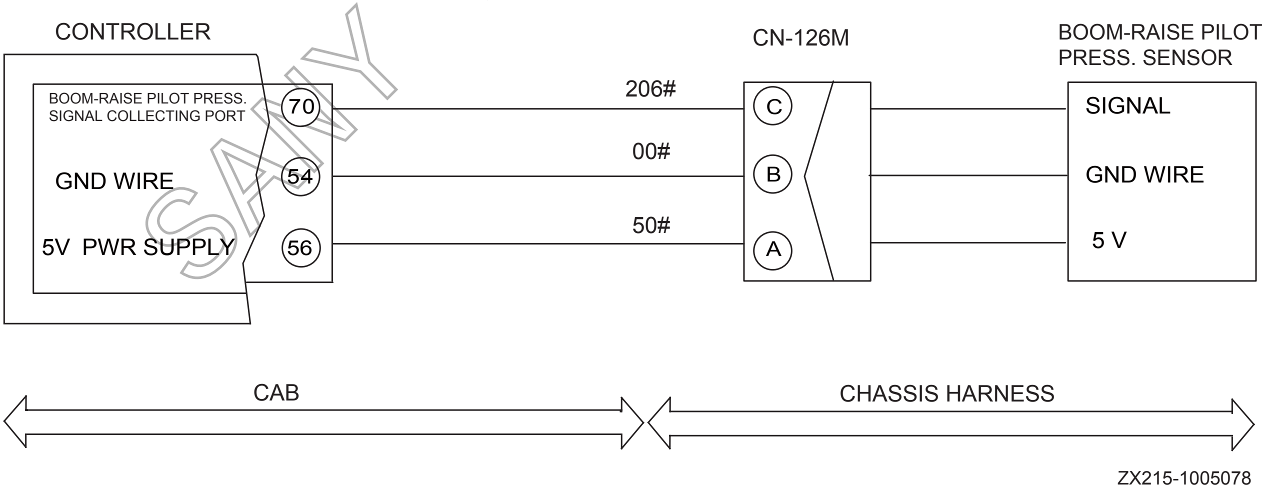
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-122M A and B	Voltage	About 5V
	2	Open 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	≤1 Ω
			Between CN-122M 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-122M 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-122M C and ground	Voltage	0.5±0.2V
	5				



E324 (abnormality in boom-raise pilot pressure)

User 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.		

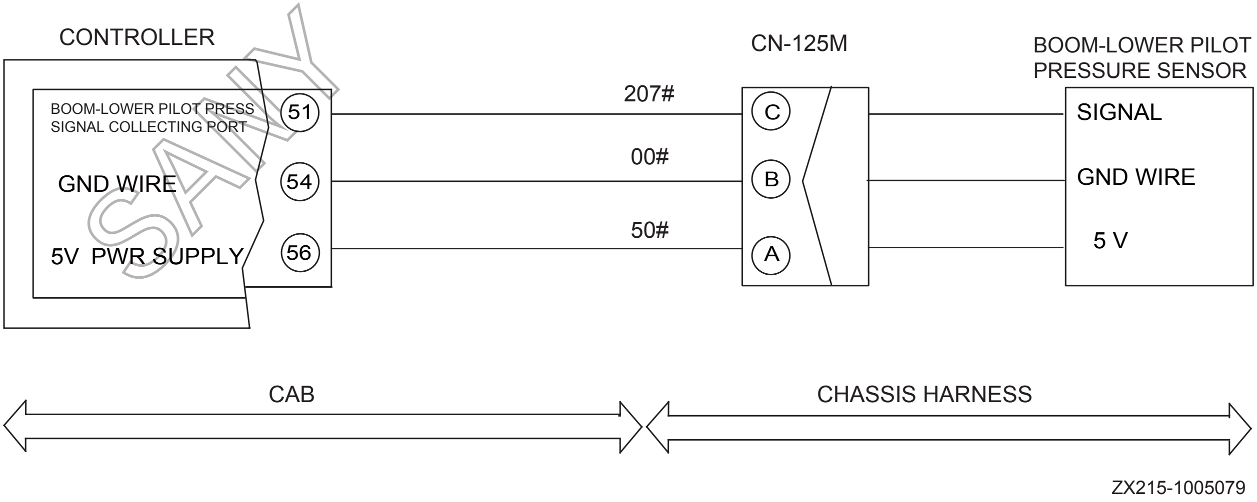
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-126M A and B	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-126M C and 70 pin of controller	Resistance	≤1 Ω
			Between CN-126M 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-126M 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-126M C and ground	Voltage	0.5±0.2V
	5				



E325 (abnormality in boom-lower pilot pressure)

User 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.		

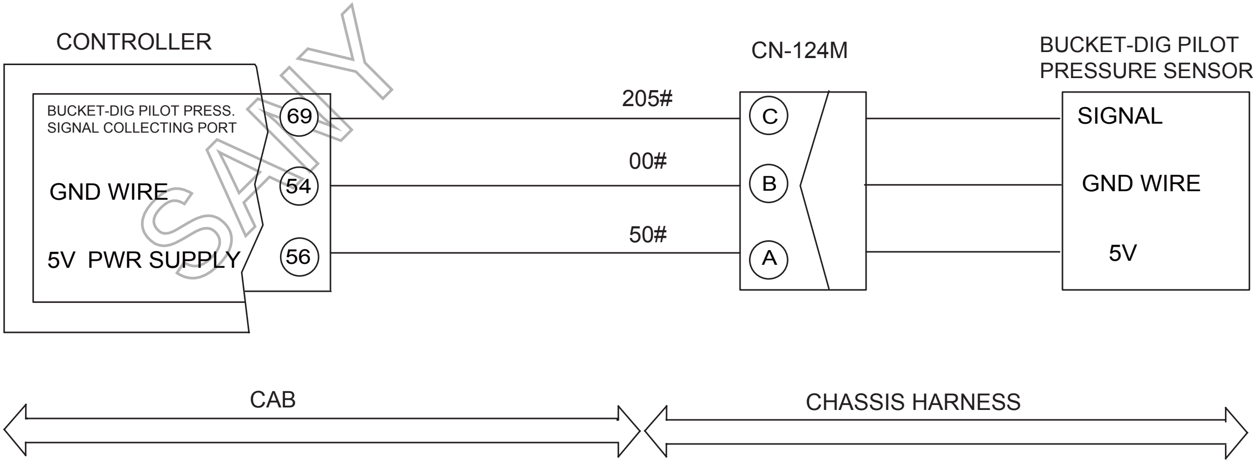
Possible causes and standard value in normal state	**Cause**		**Standard value in normal state/Remarks on troubleshooting**		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-125M A and B	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-125M C and pin 51 of controller	Resistance	≤1 Ω
			Between CN-125M 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-125M 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-125M C and ground	Voltage	0.5±0.2V
	5				



E326 (abnormality in bucket-curl pilot pressure)

User 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-124M 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-124M C and 69 pin of controller	Resistance	≤1 Ω
			Between CN-124M 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-124M 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-124M C and ground	Voltage	0.5±0.2V
	5				

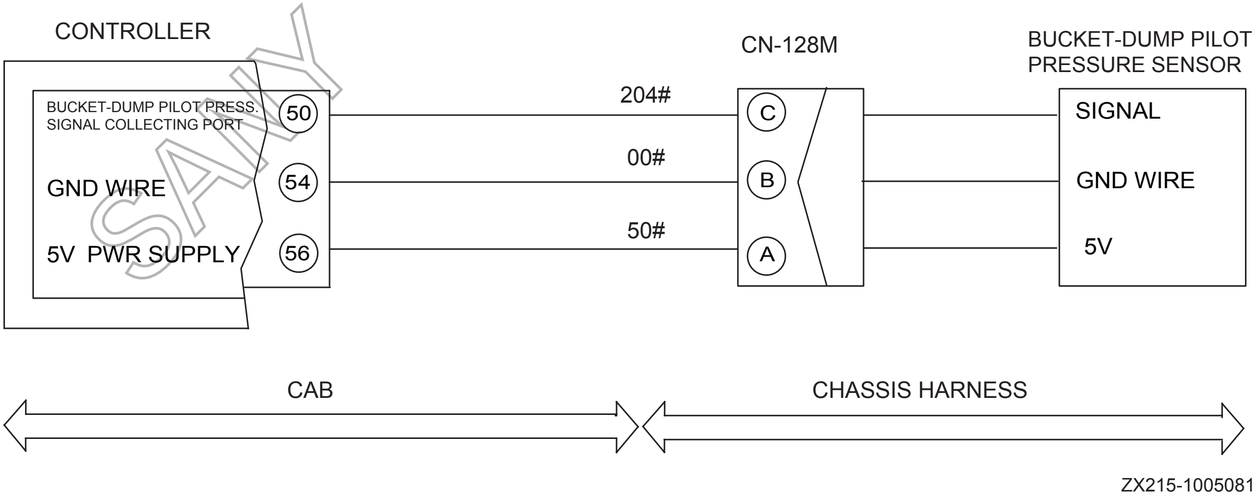


ZX215-1005080

E327 (abnormality in bucket-dump pilot pressure)

User 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		

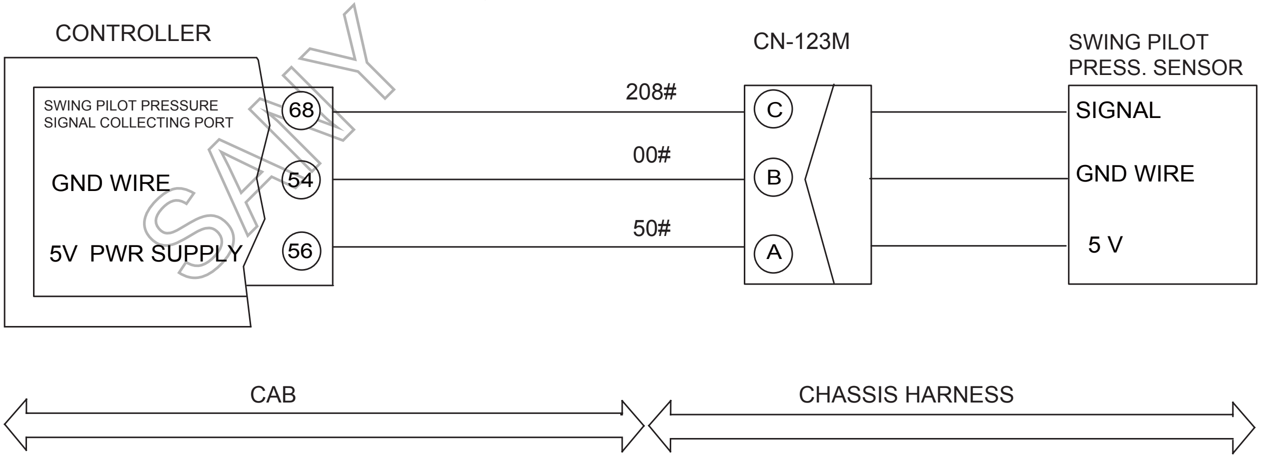
Possible causes and standard value in normal state		**Cause**	**Standard value in normal state/Remarks on troubleshooting**		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-128M A and B	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-128M C and pin 50 of controller	Resistance	≤1 Ω
			Between CN-128M 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-128M 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-128M C and ground	Voltage	0.5±0.2V
	5				



E328 (abnormality in swing pilot pressure

User 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-123M 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-123M C and pin 68 of controller	Resistance	≤1 Ω
			Between CN-123M 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-123M 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-123M C and ground	Voltage	0.5±0.2V
	5				

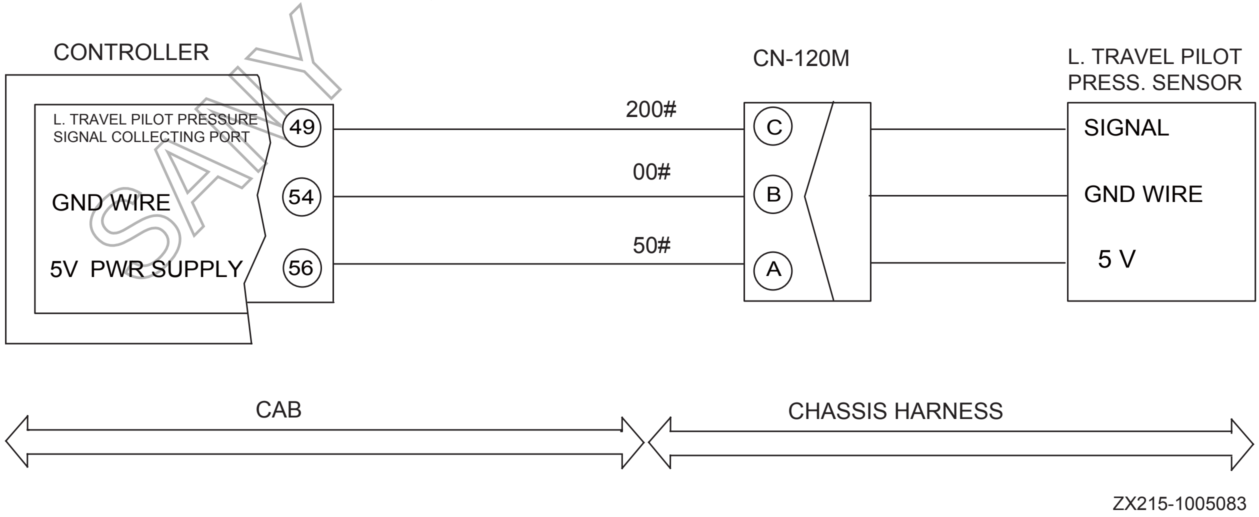


ZX215-1005082

E329 (abnormality in left travel pilot pressure)

User 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.		

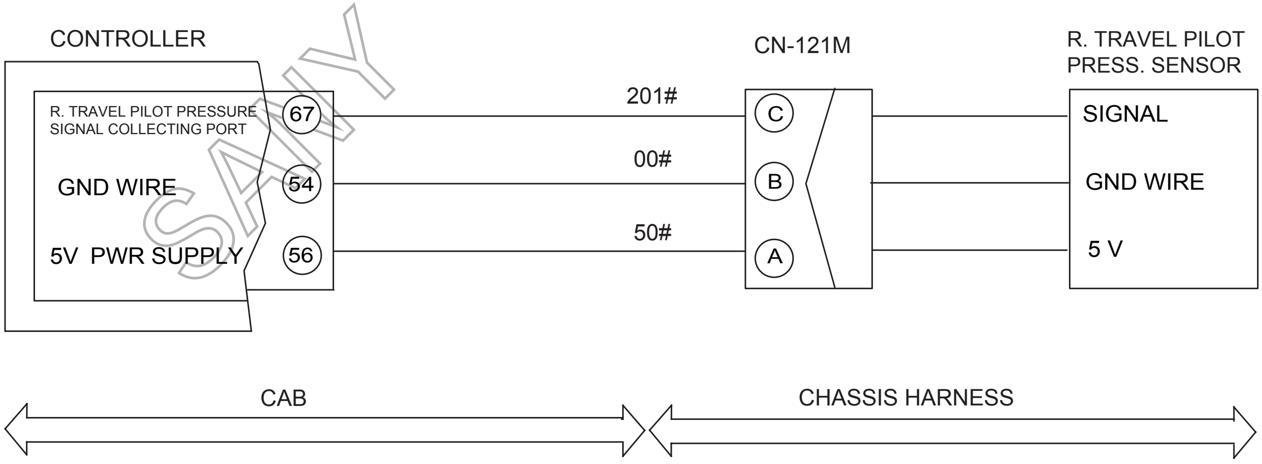
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-120M A and B	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-120M C and pin 49 of controller	Resistance	≤1 Ω
			Between CN-120M 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-120M 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-120M C and ground	Voltage	0.5±0.2V
	5				



E330 (abnormality in right travel pilot pressure)

User 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-121M 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-121M C and pin 67 of controller	Resistance	≤1 Ω
			Between CN-121M 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-121M 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-121M C and ground	Voltage	0.5±0.2V
	5				

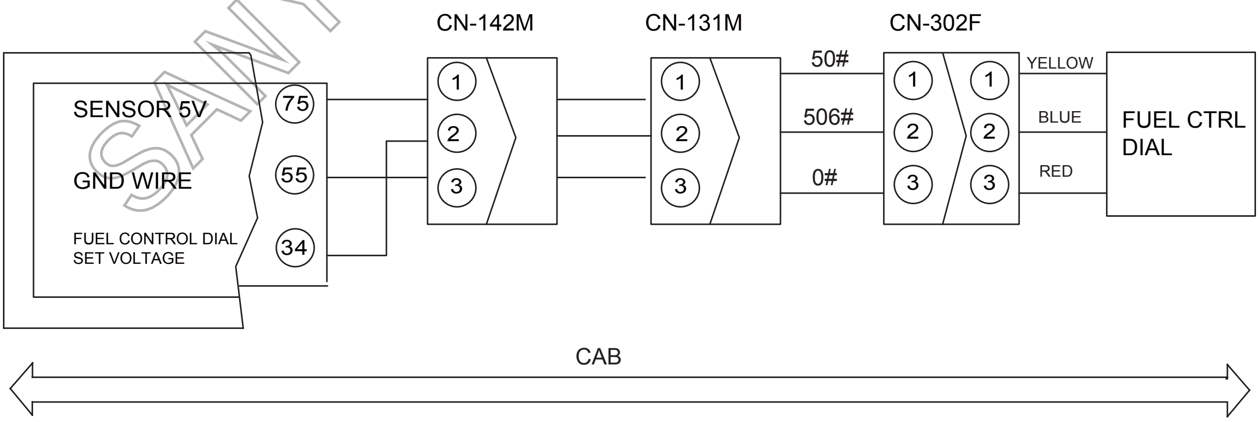


ZX215-1005084

E231 (abnormality in fuel control dial set voltage)

User 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-302F 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-302F ② and pin 34 of controller	Resistance	≤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-302F ② and ground	Resistance	≥2M Ω
	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-302F 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-302F, and measure the resistance between dial ① and ③	Resistance	5K±15% Ω

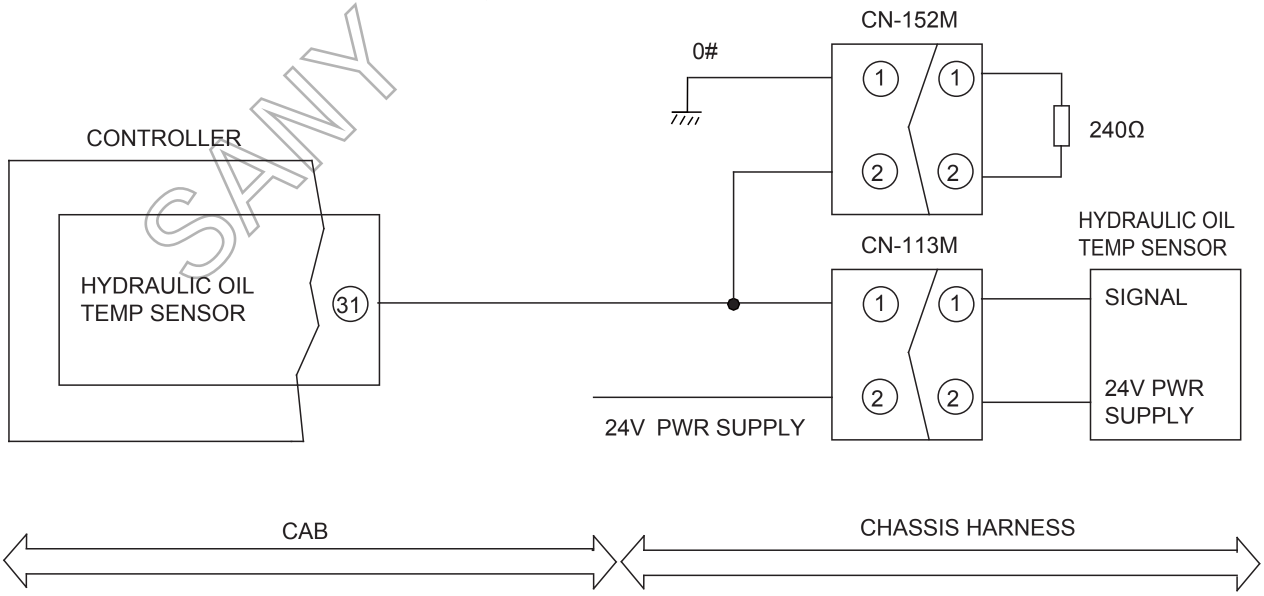


ZX215-1005085

E237 (abnormality in hydraulic oil temperature)

User 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-113M 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-113M ① and pin 31 of controller	Resistance	≤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 CN-113M ① and ground	Resistance	≥1M Ω
	4	Failure of 24V power supply	• Turn engine start switch to OFF position. Keep it at ON position to perform troubleshooting.		
			Between CN-113M ② and ground	Voltage	About 24V
	5				

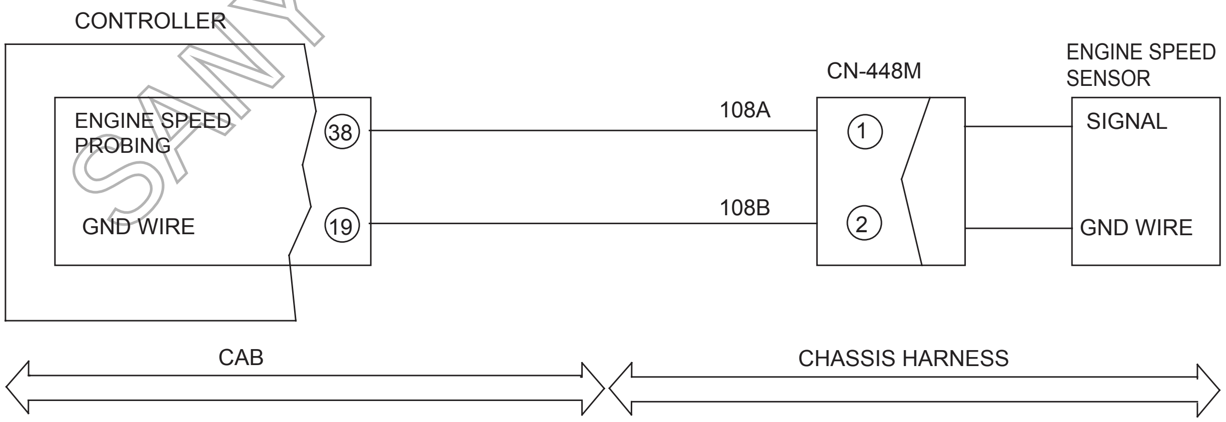


ZX215-1005086

E541 (abnormality in engine speed)

User Code	Service Code	Trouble	Engine speed is abnormal. Only output alarm is enabled.
41	E541		
Failure description	CPU detects out that engine speed is too low (below 100 rpm).		
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	Normal condition	● Code 41 will be displayed on the monitor when engine start switch is turned from the OFF position to the ON position. This is normal as the engine is not started.		
	2	Open circuit of wire harness	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-448M ① and pin 38 of controller	Resistance	≤1 Ω
			Between CN-448M ② and pin 19 of controller		≤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 CN-448M ① and ground	Resistance	≥1M Ω
	4	Failure of sensor	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector CN-448M, and measure the resistance between the speed sensors's ① and ② .	Resistance	2.3±0.2k Ω
	5				

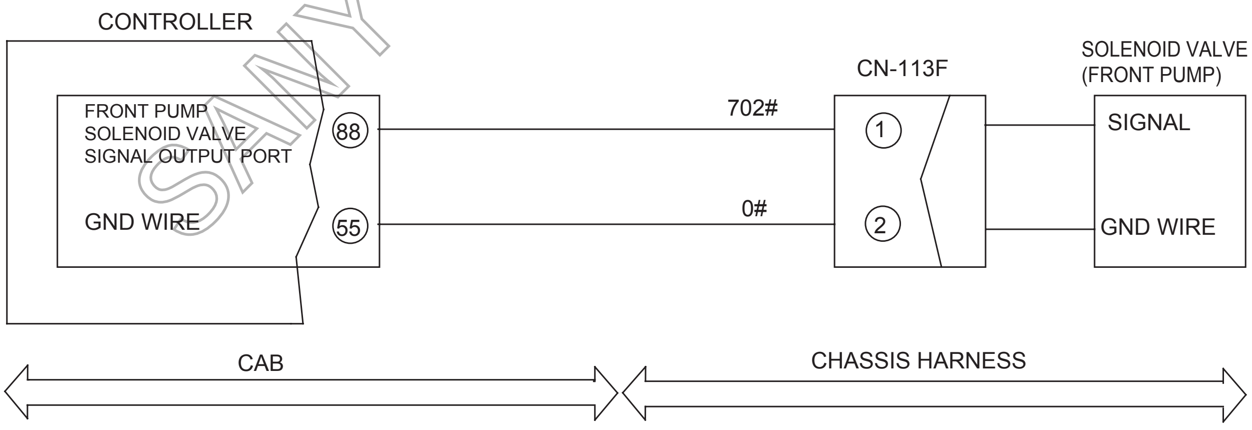


ZX215-1005087

E450 (abnormality (a) in front pump proportional solenoid coil current)

User 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-113F ① and pin 88 of controller	Resistance	≤1 Ω
			Between CN-113F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-113F ① and wire 0#	Resistance	≥1M Ω
	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-113F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

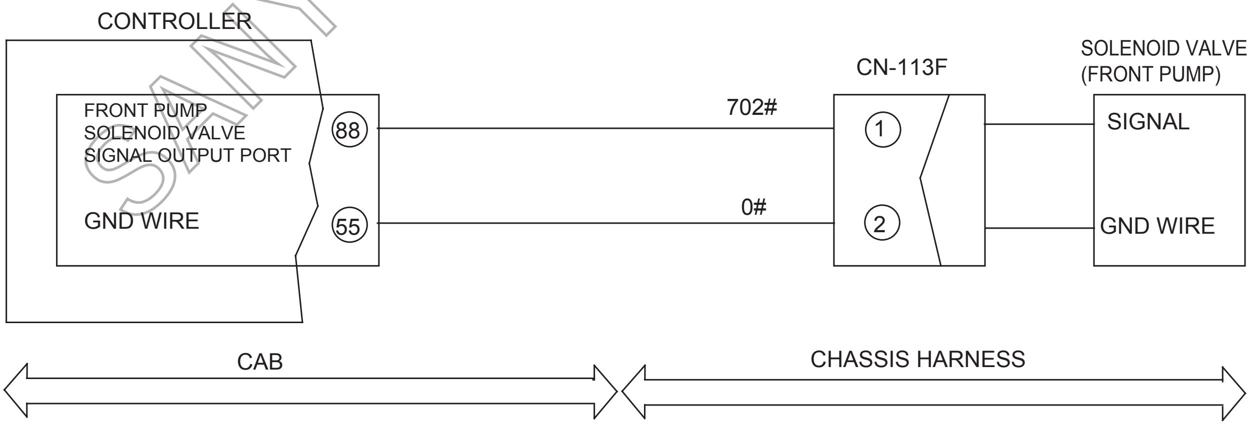


ZX215-1005088

E450 (abnormality (b) in front pump proportional solenoid coil current)

User 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-113F ① and pin 88 of controller	Resistance	≤1 Ω
			Between CN-113F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-113F ① and wire 0#	Resistance	≥1M Ω
	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-113F, and measure the resistance between solenoid valve's ① and ② .	Resistance	17.5 Ω
	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				

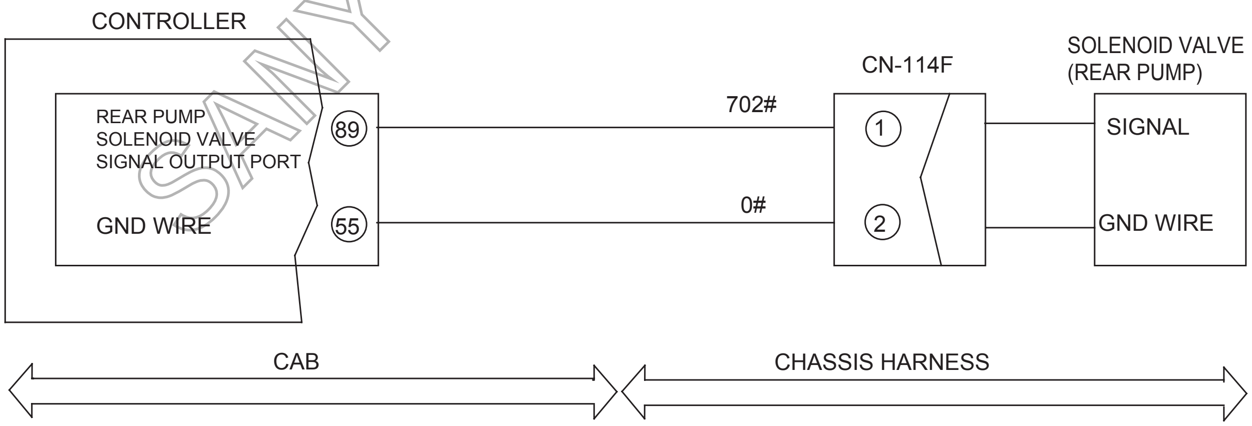


ZX215-1005088

E451 (abnormality (a) in rear pump proportional solenoid coil current)

User 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.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Open circuit of wire harness	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-114F ① and pin 89 of controller	Resistance	≤1 Ω
			Between CN-114F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-114F ① and wire 0#	Resistance	≥1M Ω
	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-114F, and measure the resistance between solenoid valve's ① and ② .	Resistance	17.5 Ω
	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				

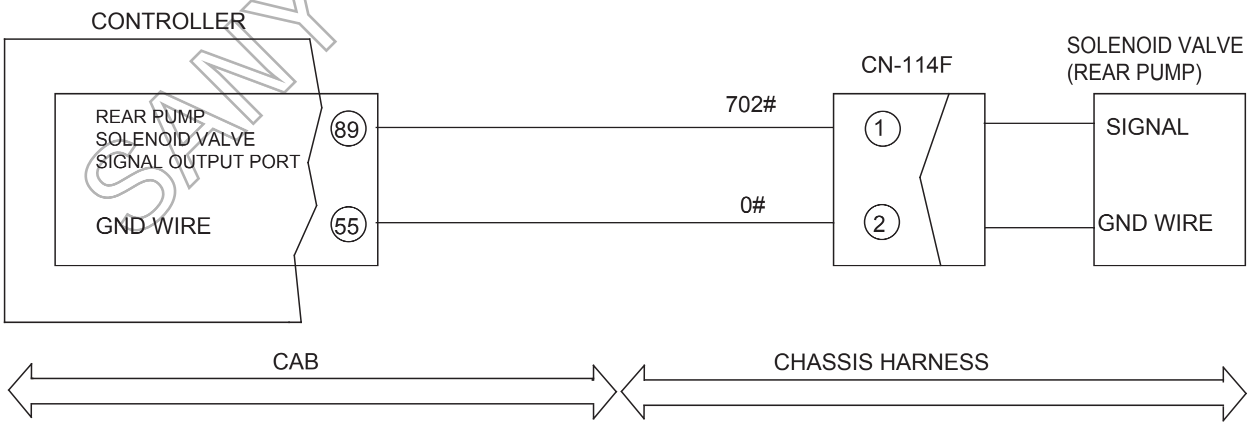


ZX215-1005089

E451 (abnormality (B) in rear pump proportional solenoid coil current)

User 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-114F ① and pin 89 of controller	Resistance	≤1 Ω
			Between CN-114F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-114F ① and wire 0#	Resistance	≥1M Ω
	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-114F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

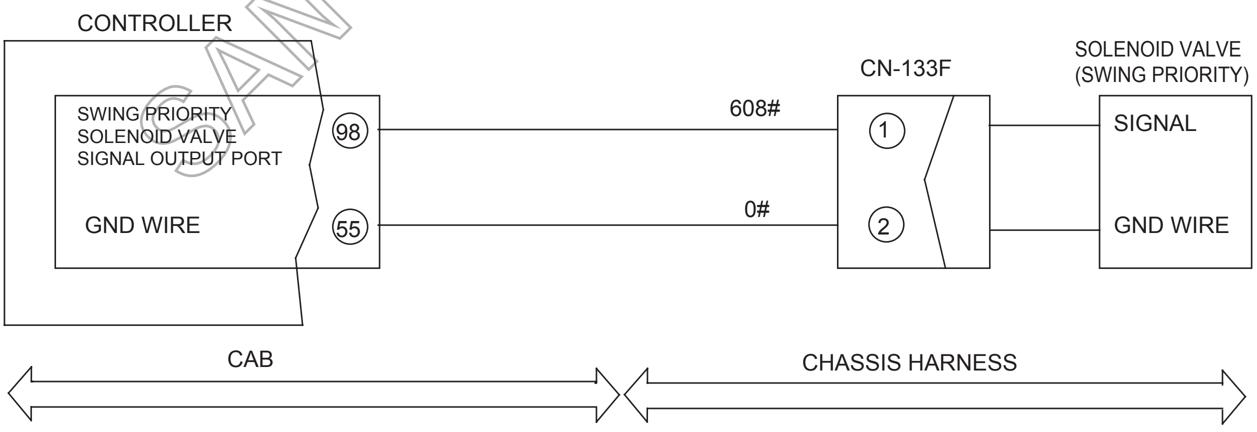


ZX215-1005089

E452 (abnormality (A) in swing priority proportional solenoid coil current)

User 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-133F ① and pin 98 of controller	Resistance	≤1 Ω
			Between CN-133F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-133F ① and wire 0#	Resistance	≥1M Ω
	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-133F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

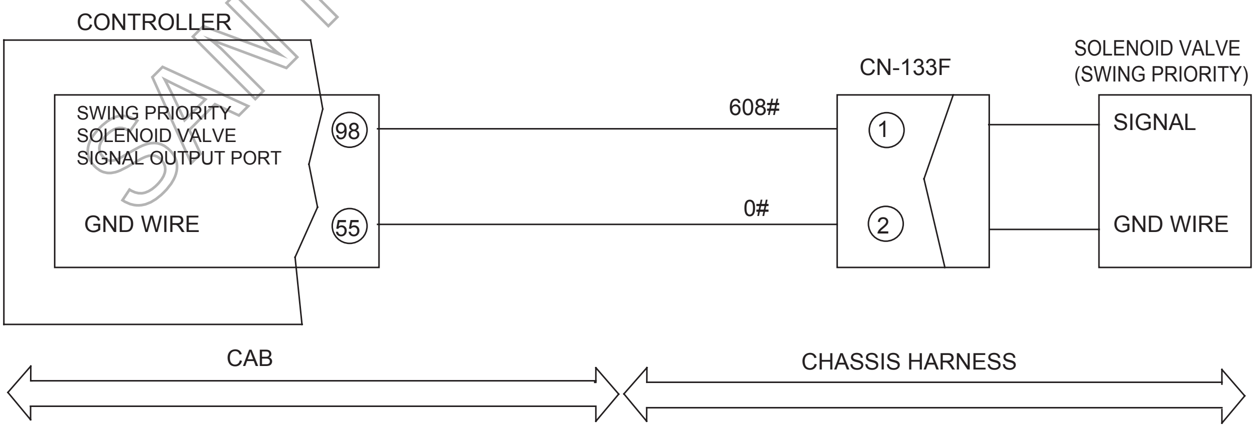


ZX215-1005090

E452 (abnormality (B) in swing priority proportional solenoid coil current)

User 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-133F ① and pin 98 of controller	Resistance	≤1 Ω
			Between CN-133F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-133F ① and wire 0#	Resistance	≥1M Ω
	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-133F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

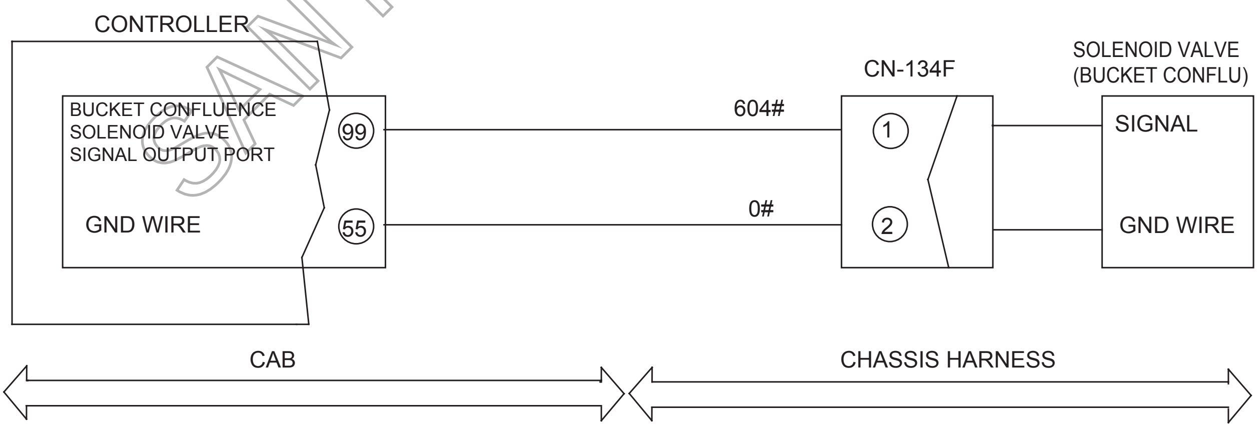


ZX215-1005090

E453 (abnormality (A) in bucket confluence proportional solenoid coil current)

User 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-134F ① and 99 pin of controller	Resistance	≤1 Ω
			Between CN-134F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-134F ① and wire 0#	Resistance	≥1M Ω
	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-134F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

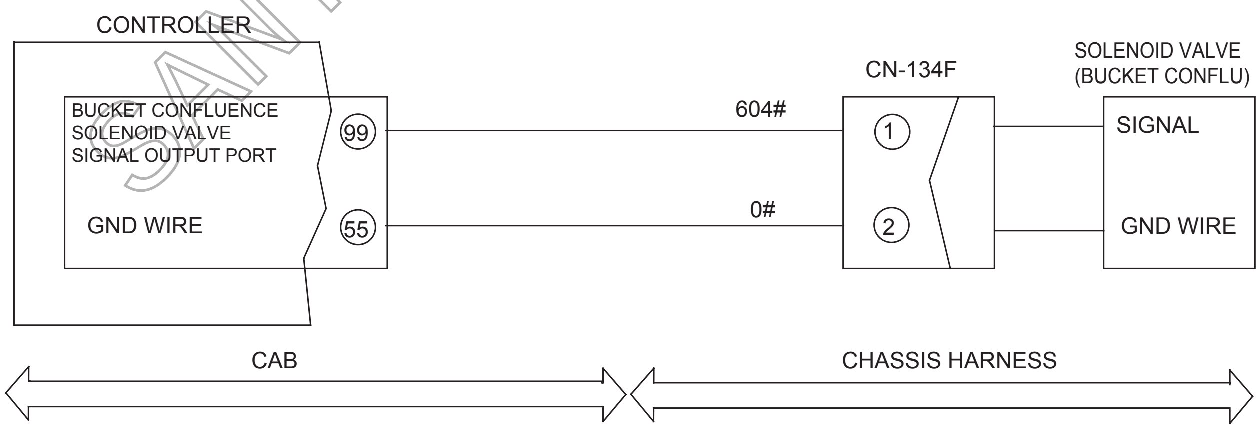


ZX215-1005091

E453 (abnormality (B) in bucket confluence proportional solenoid coil current)

User 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-134F ① and pin 99 of controller	Resistance	≤1 Ω
			Between CN-134F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-134F ① and wire 0#	Resistance	≥1M Ω
	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-134F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

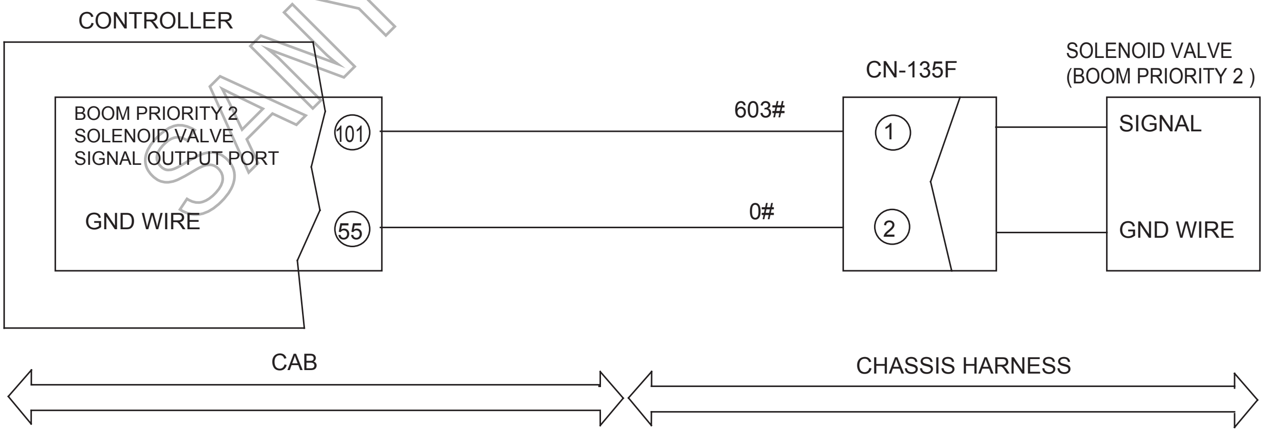


ZX215-1005091

E455 (abnormality (A) in boom priority 2 proportional solenoid coil current)

User 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-135F ① and pin 101 of controller	Resistance	≤1 Ω
			Between CN-135F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-135F ① and wire 0#	Resistance	≥1M Ω
	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-135F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

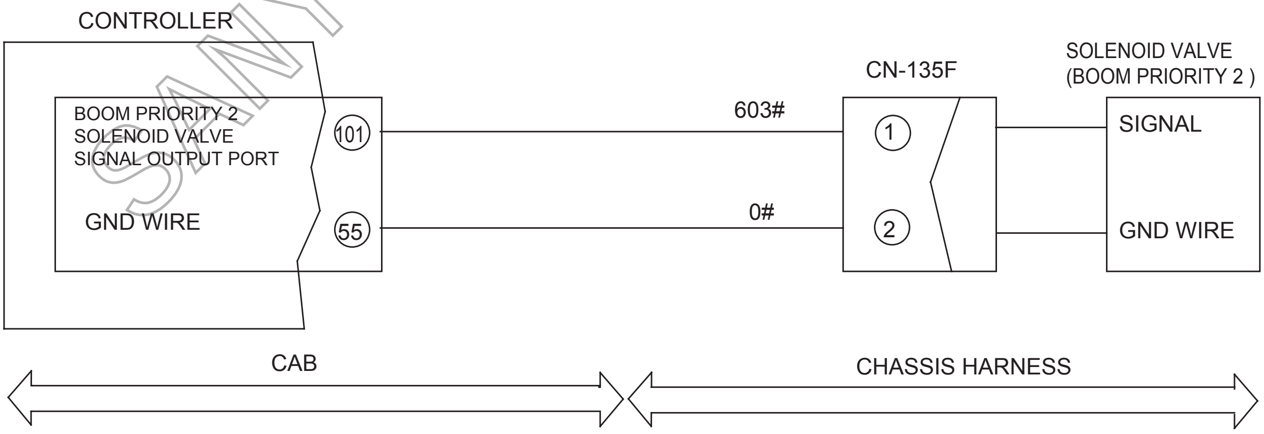


ZX215-1005093

E455 (abnormality (B) in boom priority 2 proportional solenoid coil current)

User 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-135F ① and pin 101 of controller	Resistance	≤1 Ω
			Between CN-135F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-135F ① and wire 0#	Resistance	≥1M Ω
	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-135F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				

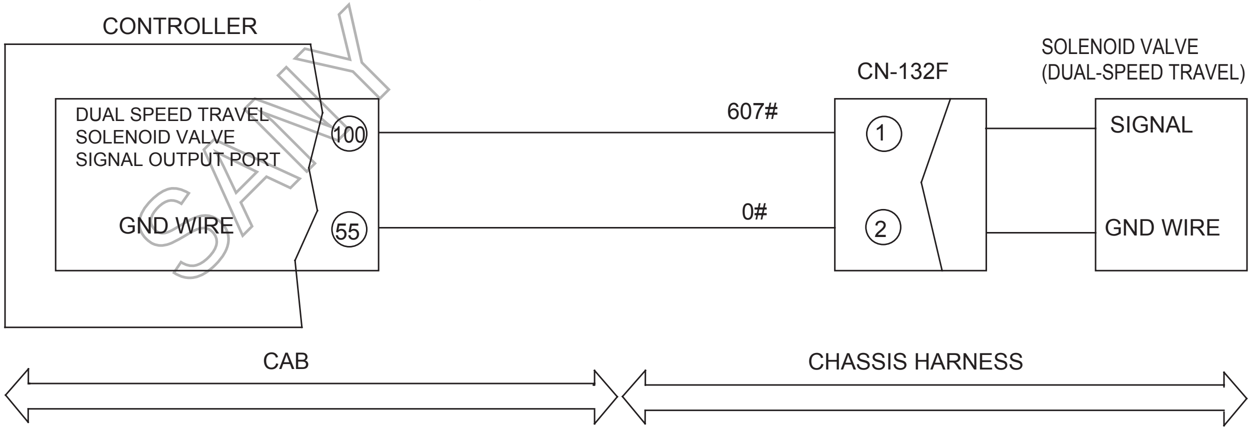


ZX215-1005093

E460 (abnormality in dual speed travel solenoid valve)

User 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-132F ① and pin 100 of controller	Resistance	≤1 Ω
			Between CN-132F ② and ground		≤1 Ω
	2	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-132F ① and wire 0#	Resistance	≥1M Ω
	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-132F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5 Ω
	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				



ZX215-1005094

7.6 Troubleshooting of Electrical System (E - Mode)

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

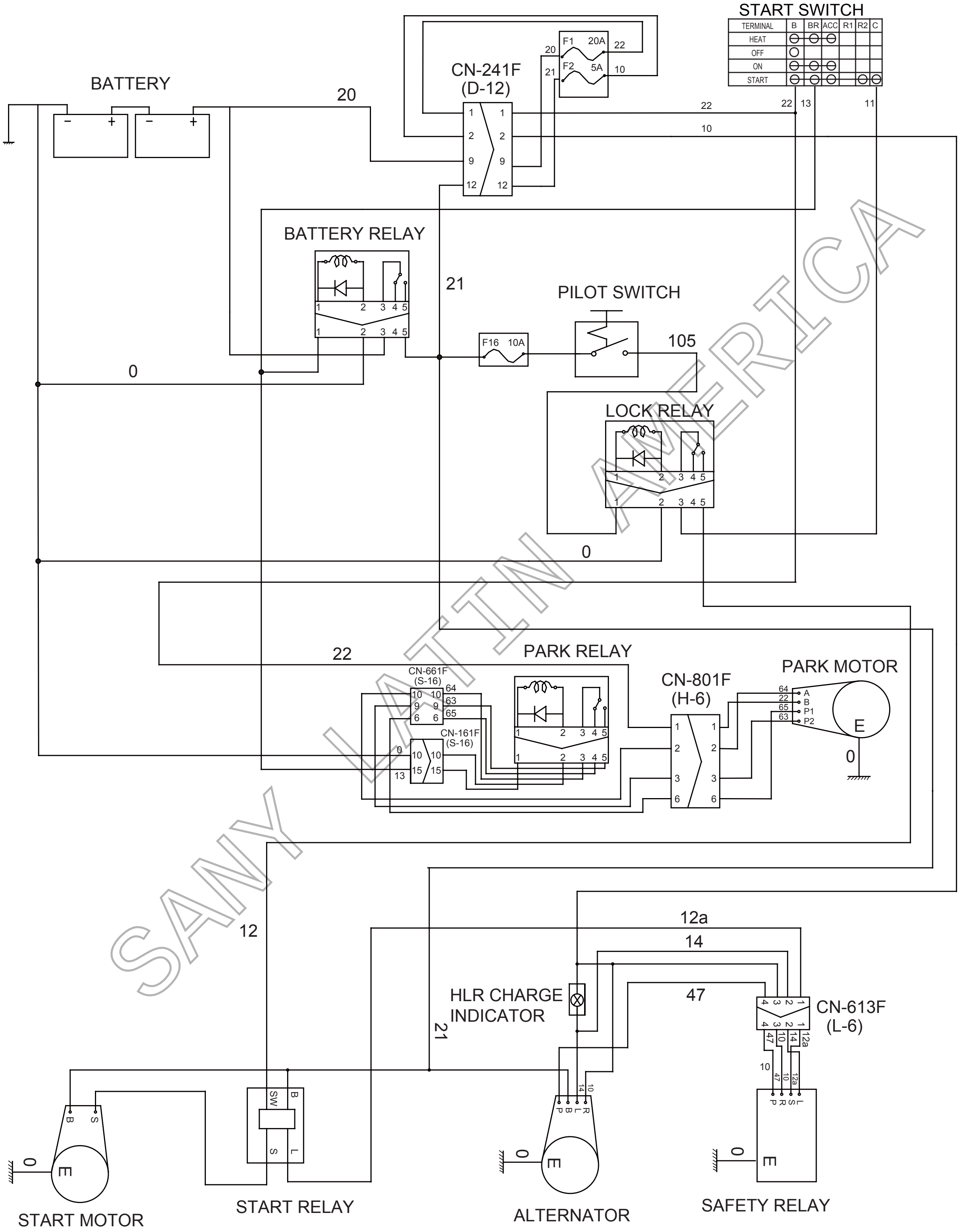
This is part of the circuit diagram which shows the portion where the failure occurred.

- Connector No.: A connector number Indicates a connector.
- Arrow: An arrow roughly indicates the installing location.

E-1 Engine does not start

Trouble	Engine cannot be started.
Related information	

	Cause		**Standard value in normal state/Remarks on troubleshooting**		
Possible causes and standard value in normal state	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	≥1M Ω
	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	≤1 Ω
			Lockout lever LOCKED position: between wire 105# and 27#		≥1 M Ω
	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	≤1 Ω
			Wire 12# and start relay terminal SW		≤1 Ω
			Start relay terminal L and safety relay terminal S		≤1 Ω
	6	Failure of fuse F1	Battery terminal "+" (wire 20#) and control dial wire 22#	Resistance	≤1 Ω
	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 M Ω
			Engine input terminal S and ground		≥1 M Ω
	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
	10	Failure of parking unit	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-801F 2 and 3	Resistance	≤1 Ω
			Unplug connector CN-801F; measure resistance of motor coil.		App 63 Ω

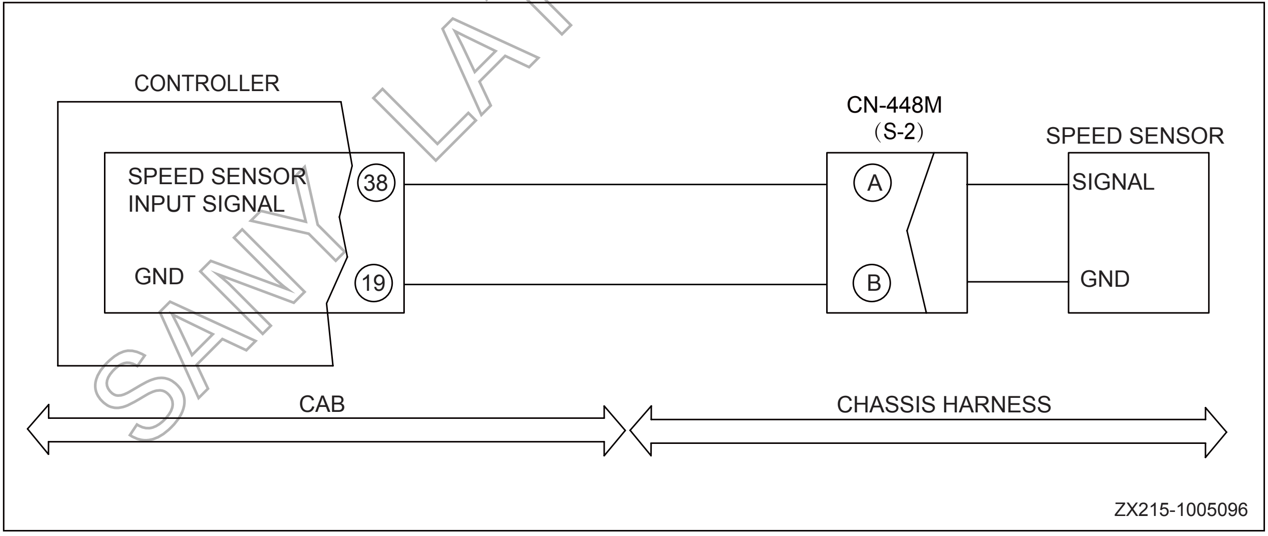


ZX215-1005095

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.

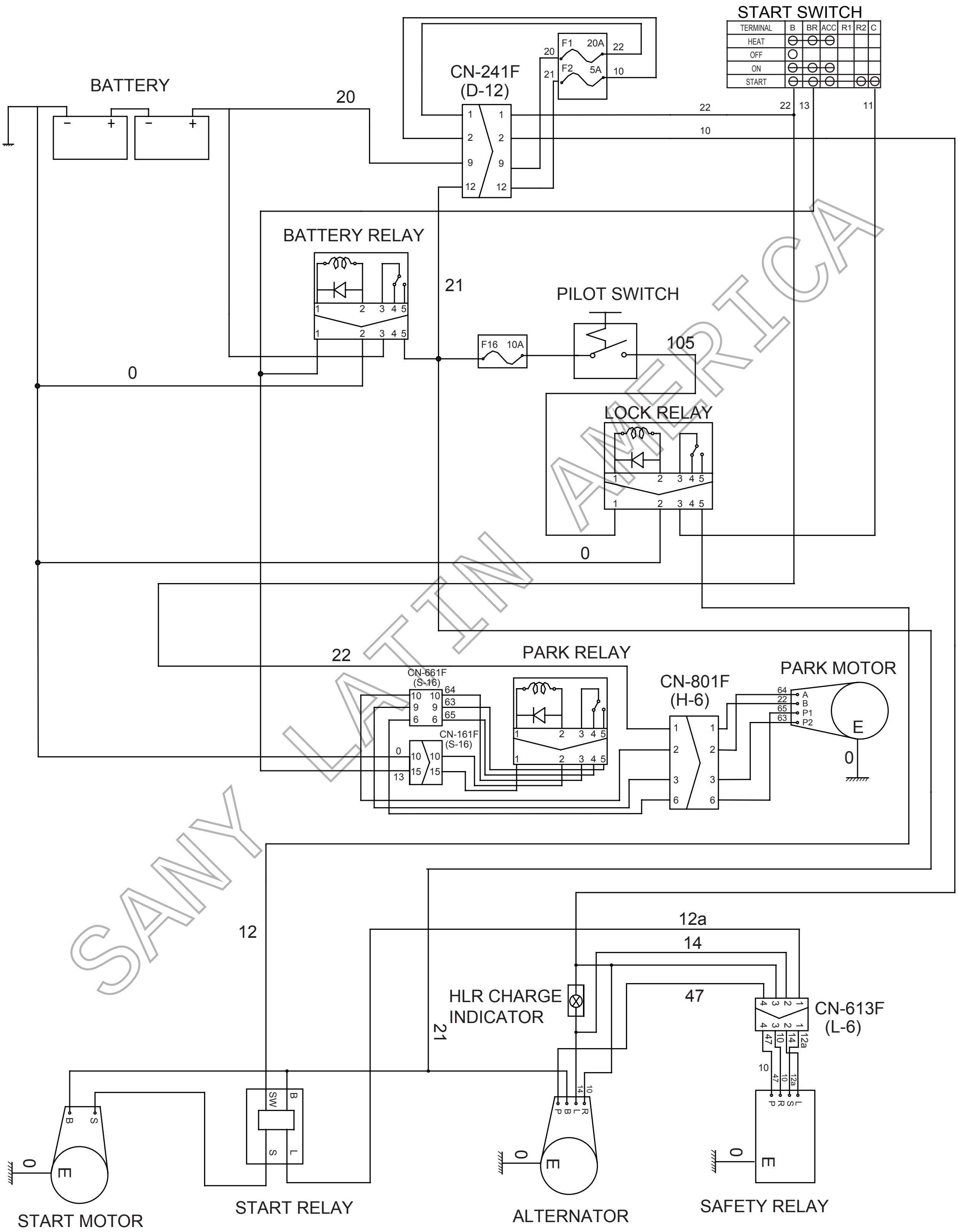
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Open circuit of wire harness	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Unplug the connector controller, and measure the resistance between pin 19 and pin 38.	Resistance	2.3±0.2 K Ω
	2	Internal failure in sensor	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-448M A and B	Resistance	2.3±0.2 K Ω
	3	Short circuit of wire harness (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-448M B and ground	Resistance	≥1M Ω
	4	Internal failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		
	5				



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.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	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	≥1M Ω
	3				
	4				
	5				



ZX215-1005095

E-4 Auto idle not functioning

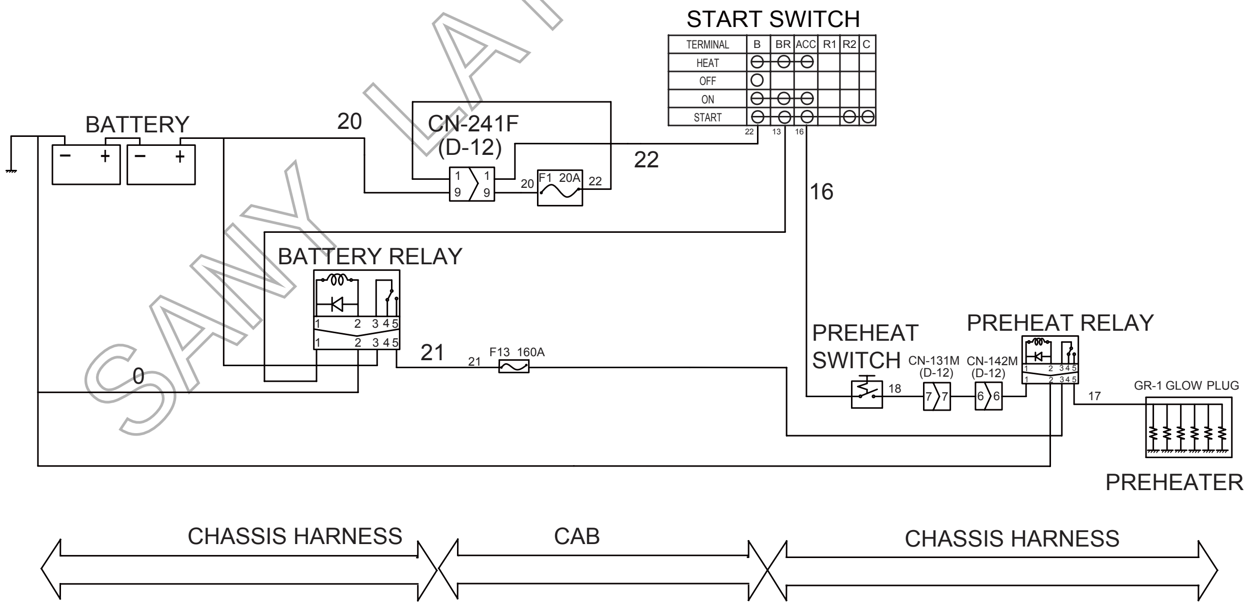
Trouble	Auto idle speed do not work
Related information	Engine speed do not decrease wen the mode is auto idle speed and grip keeps still in "NEUTRAL" position

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	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 attachment 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 controller	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.)		

E-5 Preheating function fails

Trouble	Engine does not preheat.
Related information	

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	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 3# (contact)	Resistance	≤1 Ω
	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 16# and wire 18#.	Resistance	≥1M Ω
			Turn on the preheat switch and measure the resistance between wire 16# and wire 18#		≤1 Ω
	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	≥1M Ω
	5				



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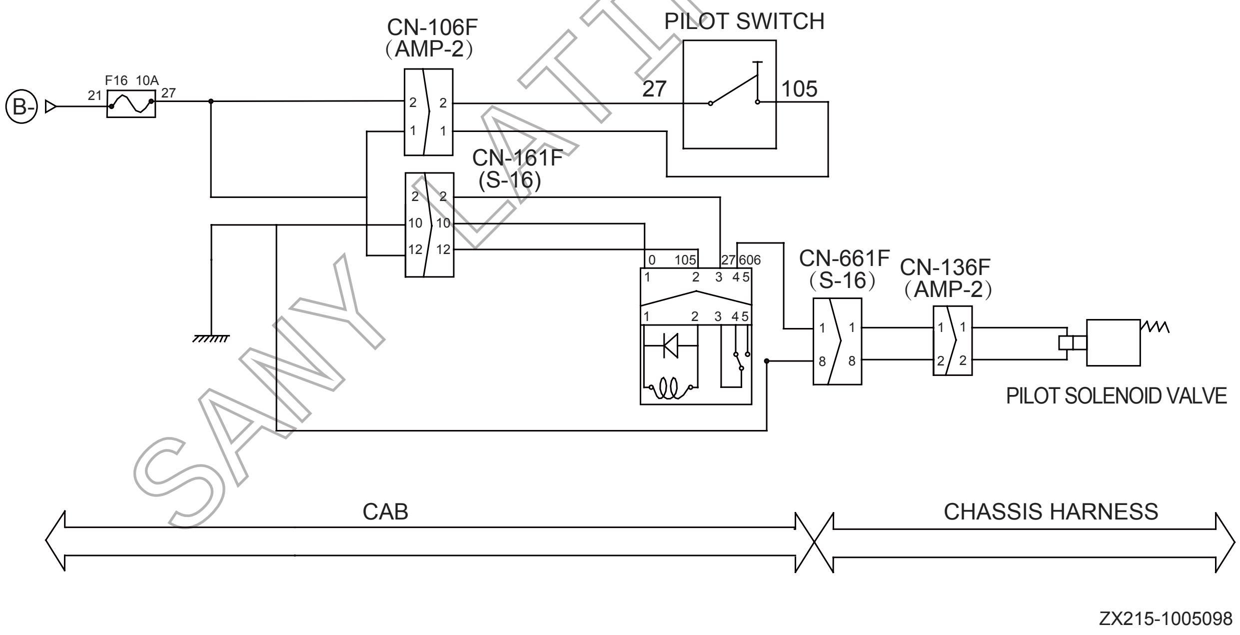
E-6 Work equipment does not work

Trouble	The machine is motionless while operated after starting.
Related information	

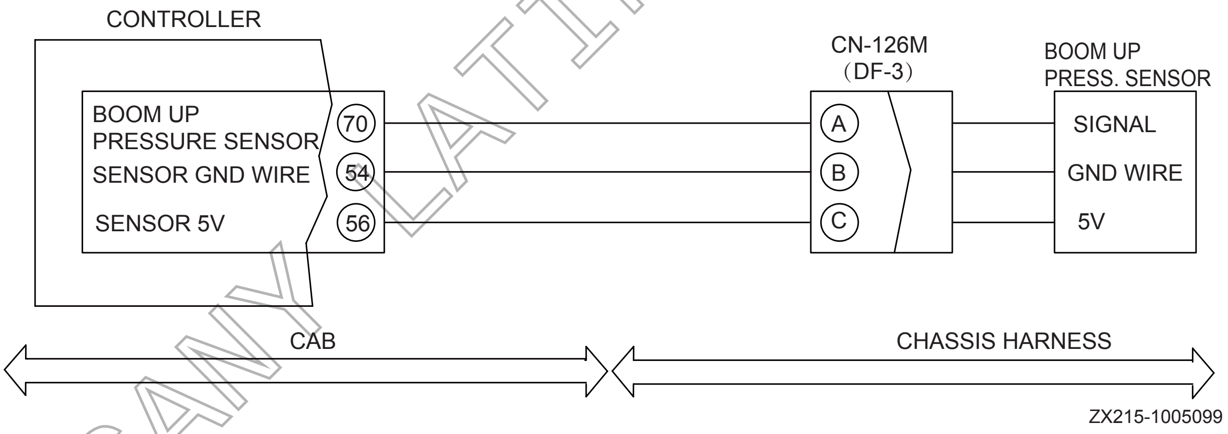
Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Failure of lockout switch	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Item	Lockout control lever	Resistance
			Between wire 105# and wire 27#	LOCK	≤1 Ω
				FREE	≥1M Ω
	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	≥1M Ω
	3	Failure of coil inside lockout solenoid valve	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-136F 1 and 2	Resistance	About 34 Ω
	4				



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.

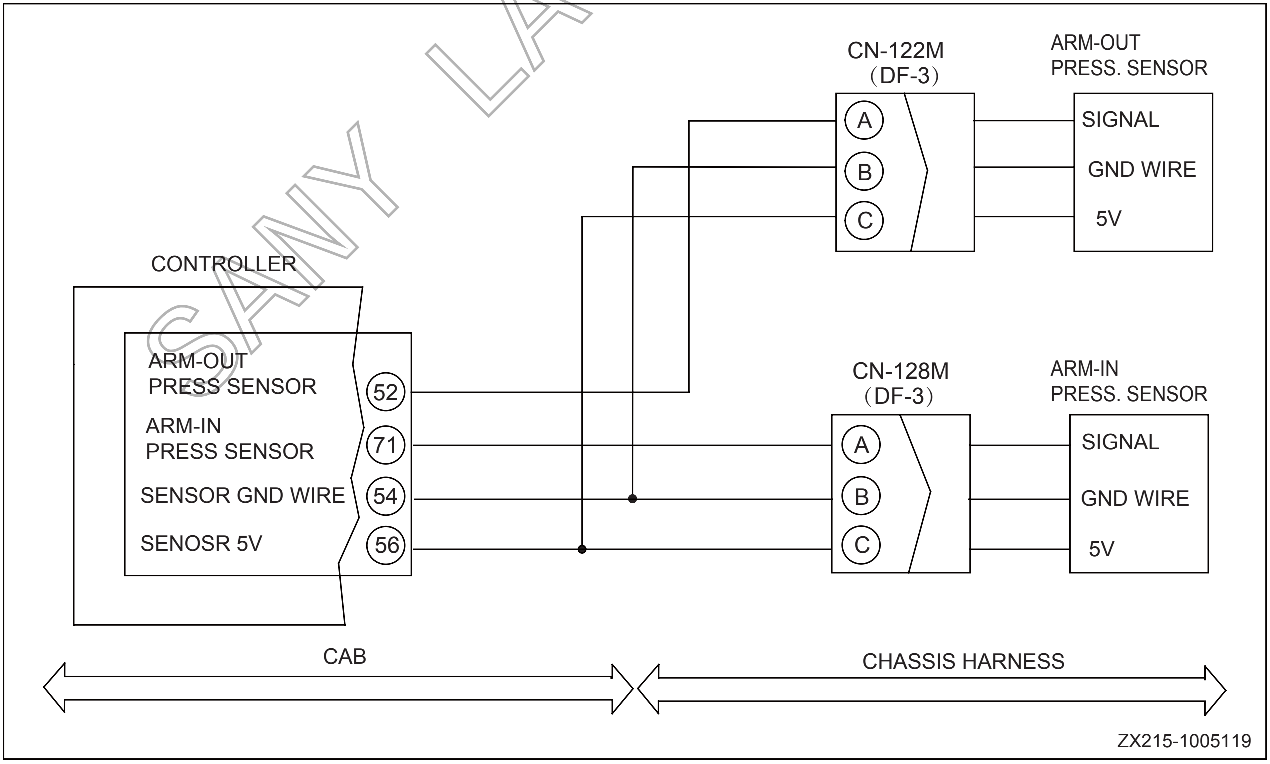
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Failure of sensor	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, boom-raise pressure signal	Pressure	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-126M A) and ground	Resistance	≥1M Ω
	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-126M B	Resistance	≤1 Ω
	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)		



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.

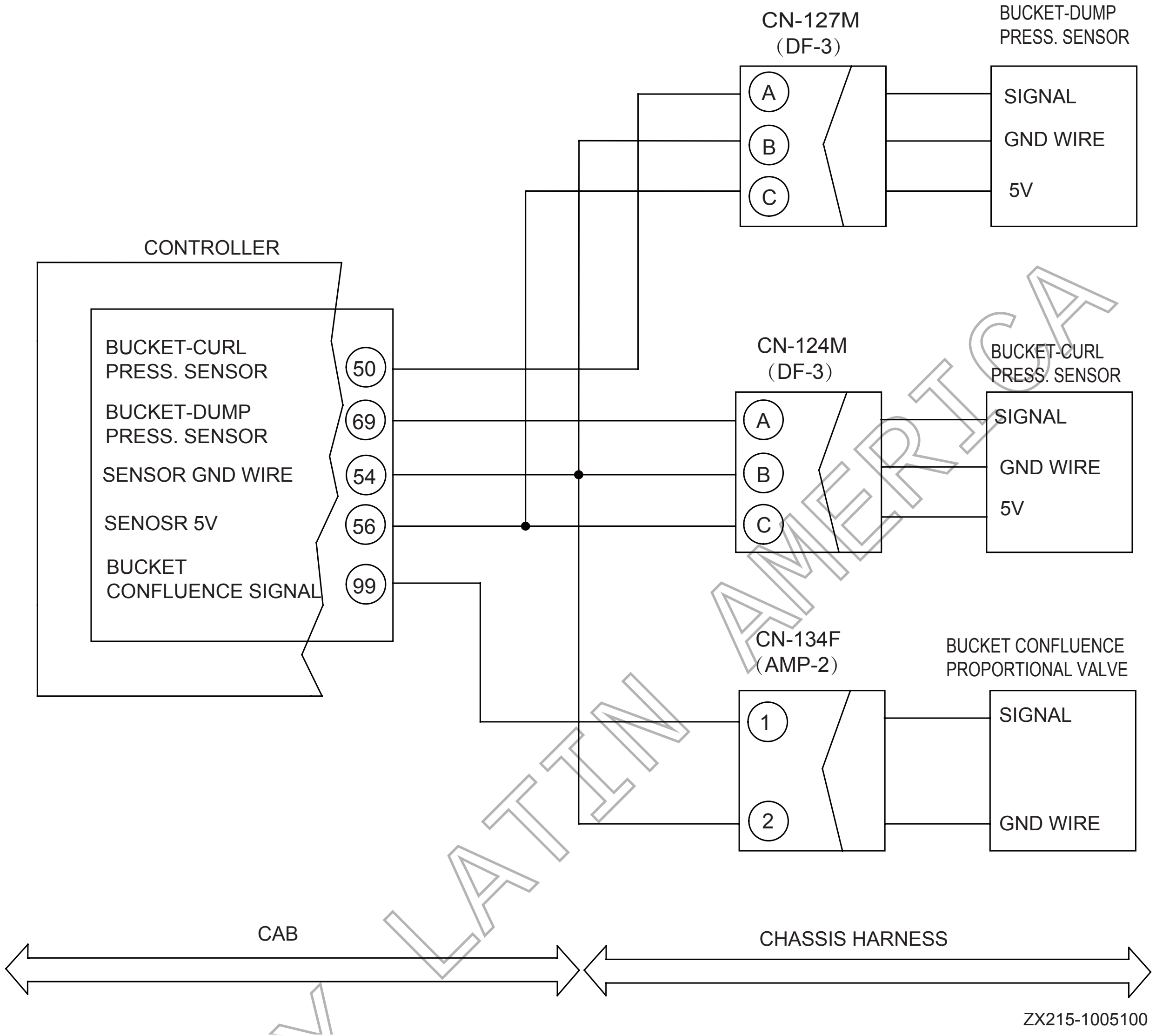
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Failure of sensor	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, arm-in and arm-out pressure signals	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-128M A) and ground Between harness (from controller pin 52 to CN-122M A) and ground	Resistance	≥1M Ω
	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-128M B Between controller pin 54 and CN-122M B	Resistance	≤1 Ω
	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)		



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.

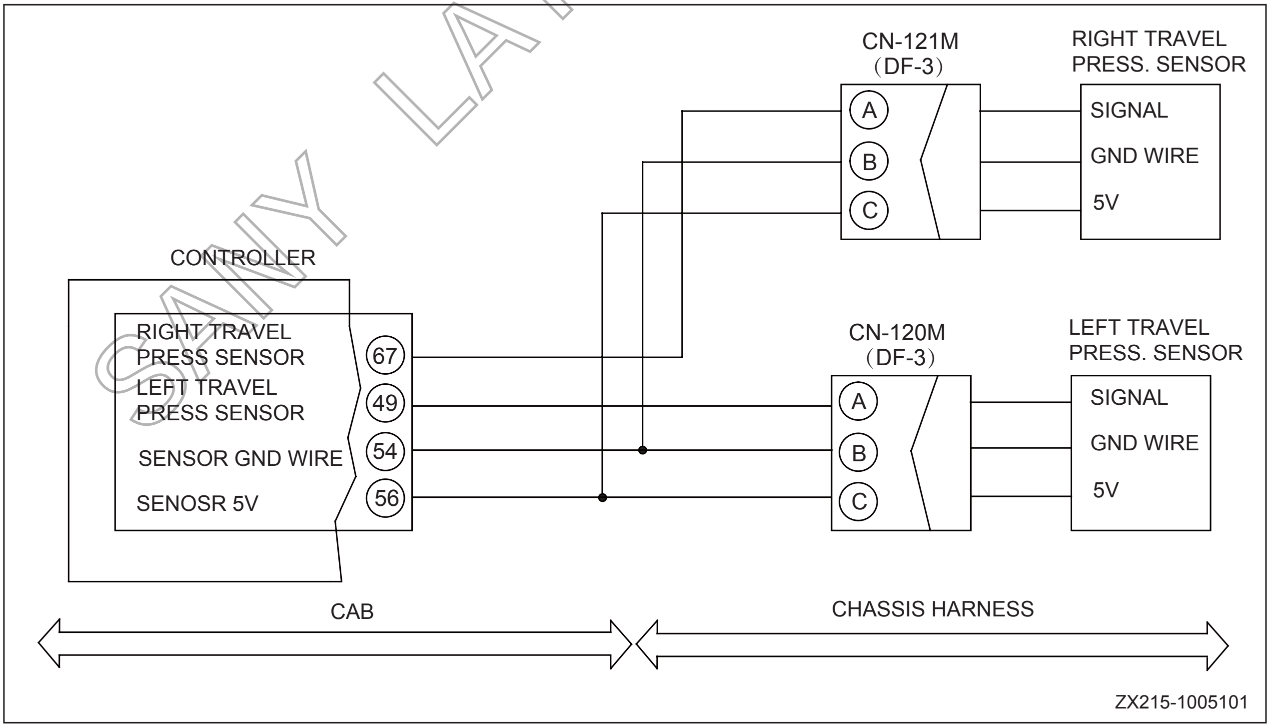
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Failure of sensor	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, bucket-curl/dump pressure signals	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-124M A) and ground Between harness (from controller pin 50 to CN-127M A) and ground	Resistance	≥1M Ω
	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-124M B Between controller pin 54 and CN-127M B	Resistance	≤1 Ω
	4	Defective bucket confluence solenoid valve	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-134F 1 and 2	Resistance	About 17.5 Ω
	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)		


CN-127M
（DF-3）
BUCKET-DUMP
PRESS. SENSOR
A
B
C
SIGNAL
GND WIRE
5V
CONTROLLER
BUCKET-CURL
PRESS. SENSOR
BUCKET-DUMP
PRESS. SENSOR
SENSOR GND WIRE
SENOSR 5V
BUCKET
CONFLUENCE SIGNAL
50
69
54
56
99
CN-124M
（DF-3）
BUCKET-CURL
PRESS. SENSOR
A
B
C
SIGNAL
GND WIRE
5V
CN-134F
（AMP-2）
BUCKET CONFLUENCE
PROPORTIONAL VALVE
1
2
SIGNAL
GND WIRE
CAB
CHASSIS HARNESS
ZX215-1005100

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.

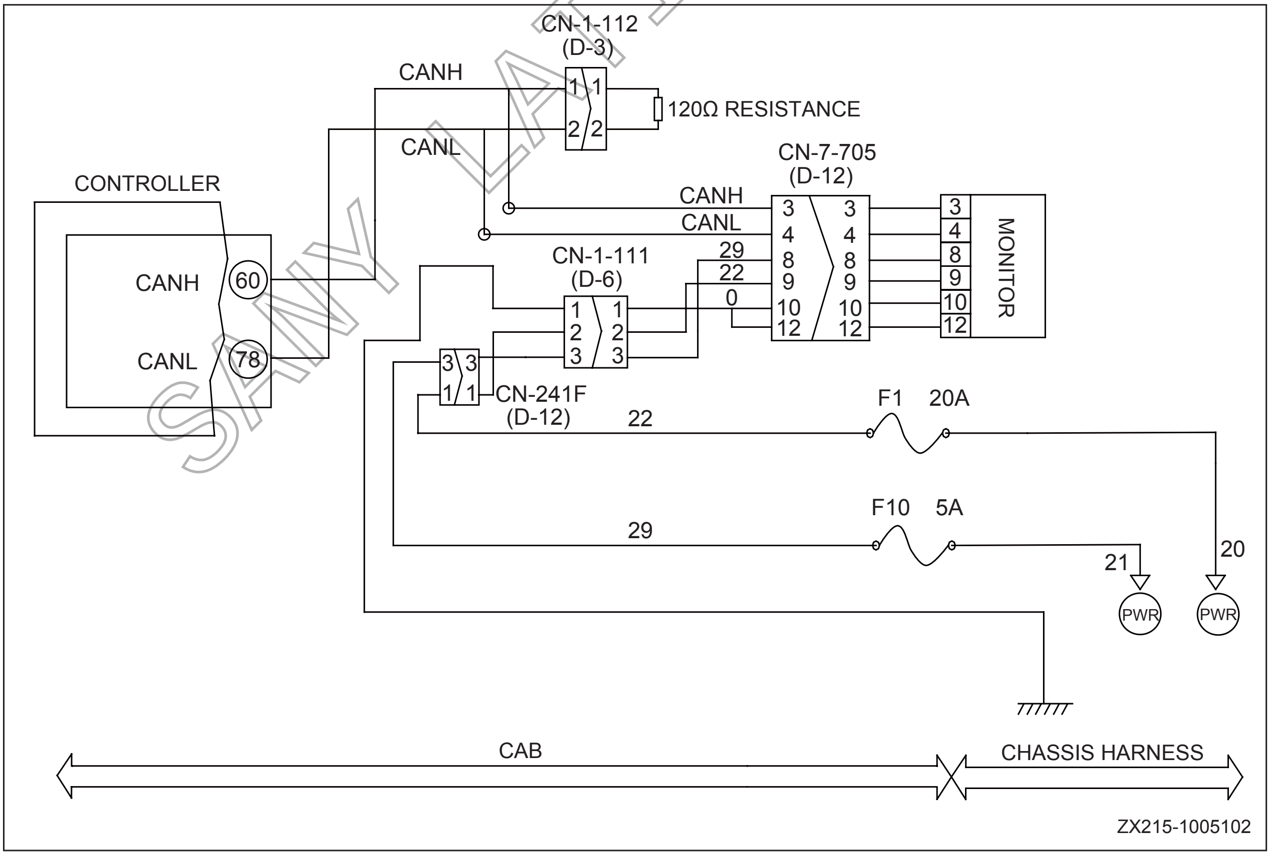
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of sensor	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, left and right travel pressure 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-120M A) and ground Between harness (from controller pin 67 to CN-121M A) and ground	Resistance	≥1M Ω
	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-120M B Between controller pin 54 and CN-121M B	Resistance	≤1 Ω
	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)		



E-11 Blank monitor display

Trouble	Monitor display is blank after the machine is powered on.
Related information	

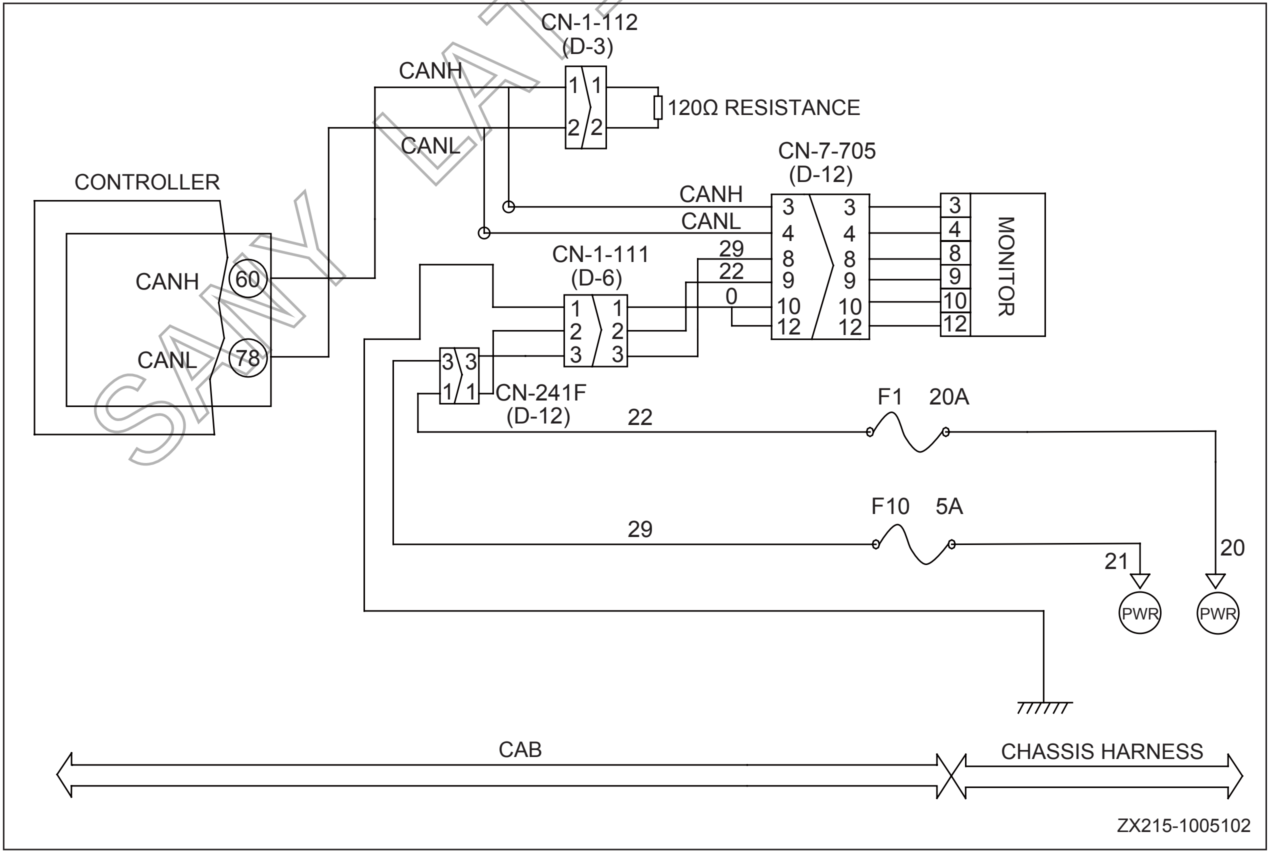
		Cause	Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Failure of fuse	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between wire 22# and ground	Voltage	About 24V
			Between wire 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	≤1 Ω
			Between CN-7-705 pin 9 and CN-241 pin 1		≤1 Ω
			Between CN-7-705 pin 10# and ground		≤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 8 to CN-241 pin 3) and ground	Resistance	≥1M Ω
			Between harness (from CN-7-705 pin 9 to CN-241 pin 1) and ground		≥1M Ω
	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.)		



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	

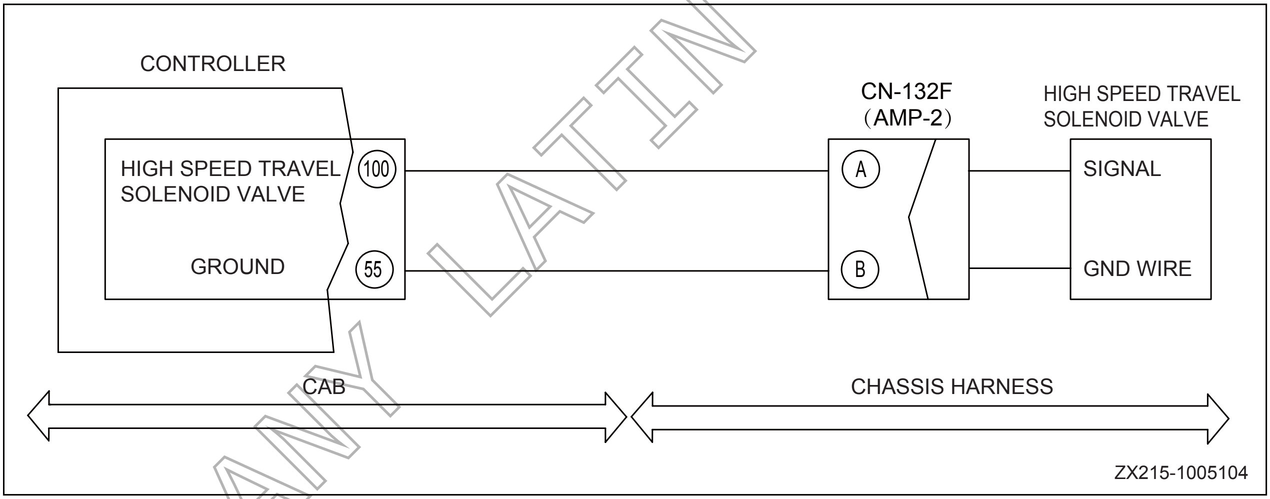
Possible causes and standard value in normal state	**Cause**		**Standard value in normal state/Remarks on troubleshooting**		
	1	Failure of resistance	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-1-112 1 and 2	Resistance	120 Ω
	2	Open 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.)		



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.

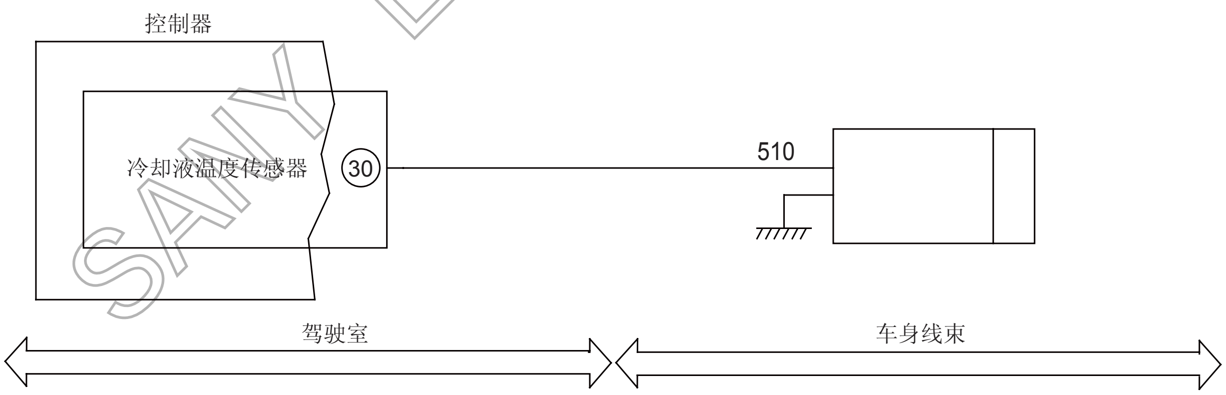
Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Failure of dual speed travel solenoid valve	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-131F A and B	Resistance	About 17.5 Ω
	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	≤1 Ω
			Between CN-132F pin B and controller pin 55		≤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-132F pin A to controller pin (100) and ground	Resistance	≥1M Ω
	4				



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	Open circuit of lead	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between wire 510# and controller pin 30	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 510# and ground	Resistance	≥1M Ω
	4	Lead short to 24V circuit	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Wire 510# to ground	Voltage	≤1V



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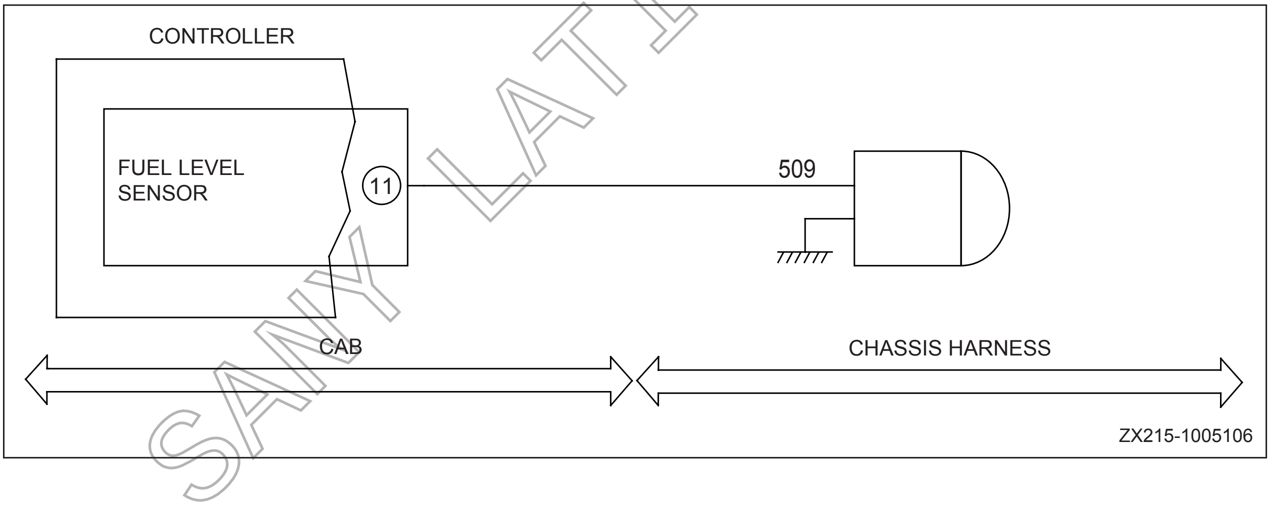
E-15 Incorrect fuel level reading

Trouble	Engine fuel level sensor cannot correctly reflect current fuel level.
Related information	Fuel level can be checked on the monitor.

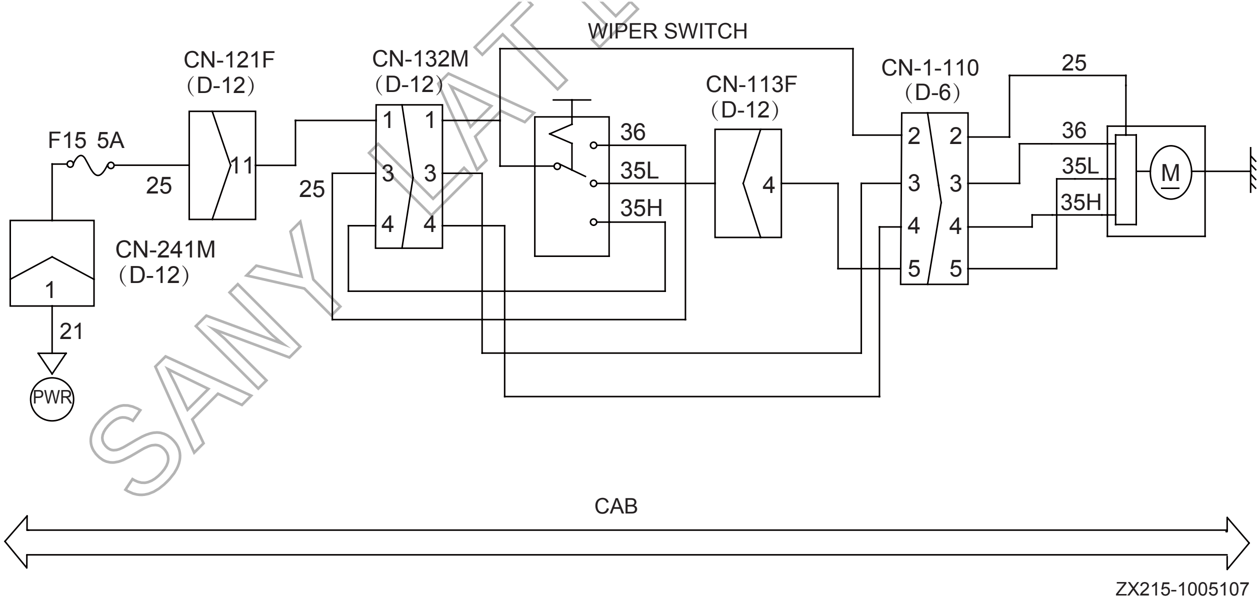
Possible causes and standard value in normal state	**Cause**		**Standard value in normal state/Remarks on troubleshooting**		
	1	Fuel level sensor error	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Pin	Fuel level	Resistance
			Between wire 509# 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



E-16 Wiper does not work

Trouble	Wiper does not work
Related information	

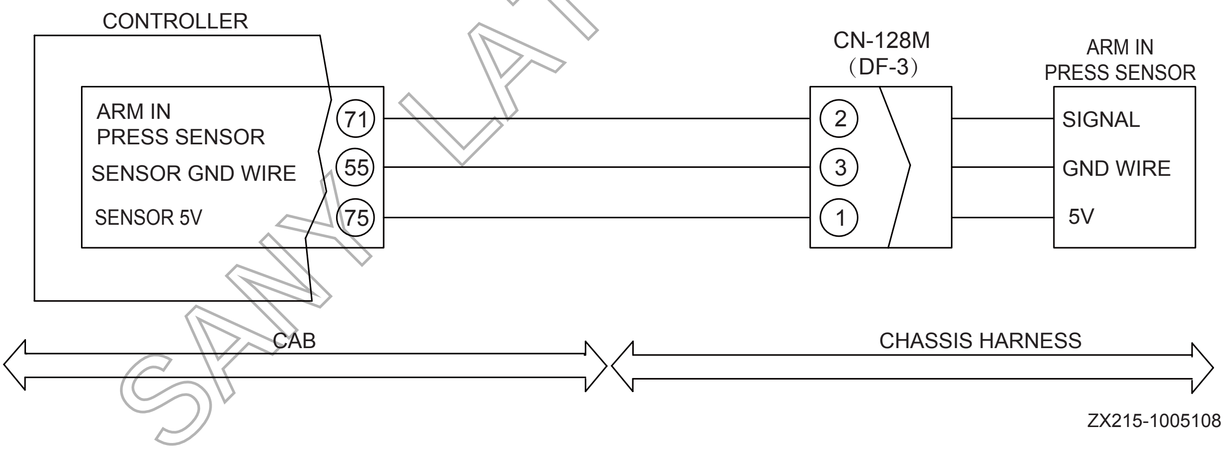
Possible causes and standard value in normal state		**Cause**	**Standard value in normal state/Remarks on troubleshooting**		
	1	Internal Failure of wiper motor	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between wiper wire 25# and ground	Resistance	>10 Ω
	2	Open circuit of lead	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-241F 1 and CN-1-110 (2)	Resistance	≤1 Ω
			Between wiper switch wire 35L# and CN-1-110 (5)		≤1 Ω
			Between wiper switch wire 35L# and CN-1-110 (4)		≤1 Ω
	3	Short circuit of lead (grounded)	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Harness from CN-241F 1 to CN-1-110 2 short to ground	Resistance	≥1M Ω
	4				



E-17 Incorrect arm-in pilot pressure reading

Trouble	Reading of arm-in pilot pressure is incorrect.
Related information	

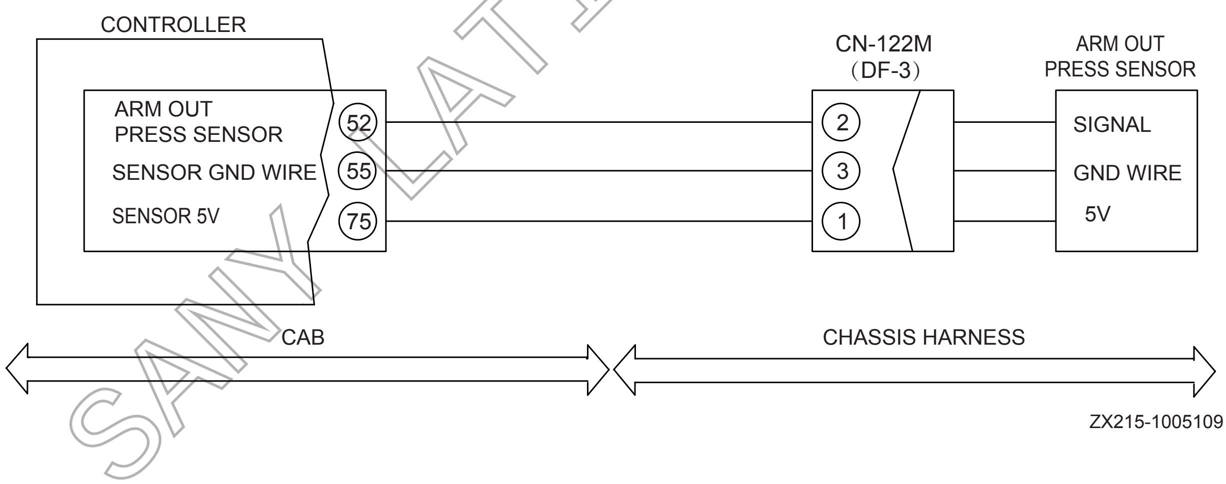
Possible causes and standard value in normal state	**Cause**		**Standard value in normal state/Remarks on troubleshooting**		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-128M ① and ③	Voltage	Approx. 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-128M ② and controller pin 71	Resistance	≤ Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-128M ② 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-128M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-18 Incorrect arm-out pilot pressure reading

Trouble	Reading of arm-out pilot pressure is incorrect.
Related information	

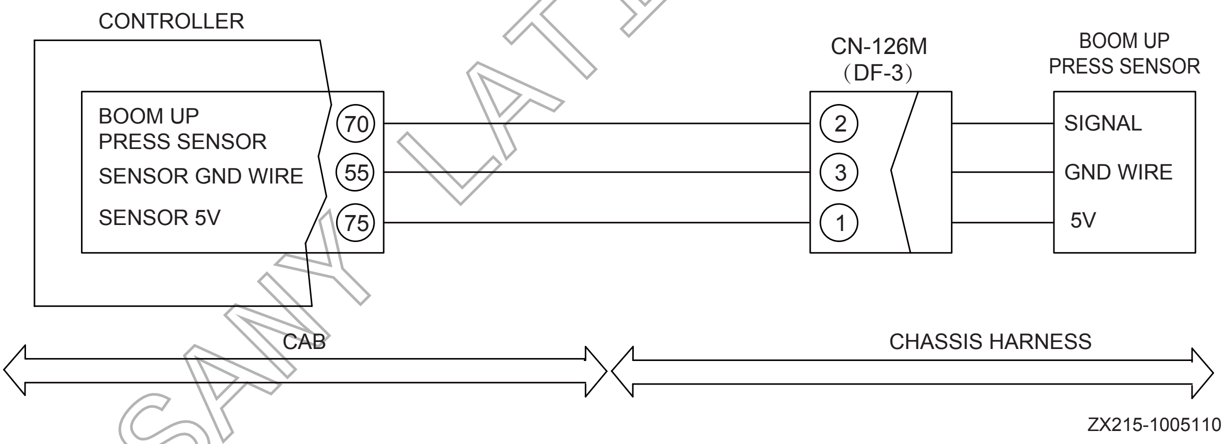
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-122M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-122M ② and controller pin 52	Resistance	≤1 Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-122M ② 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-122M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-19 Incorrect boom-raise pilot pressure reading

Trouble	Incorrect Boom-Raise Pilot Pressure Reading
Related information	

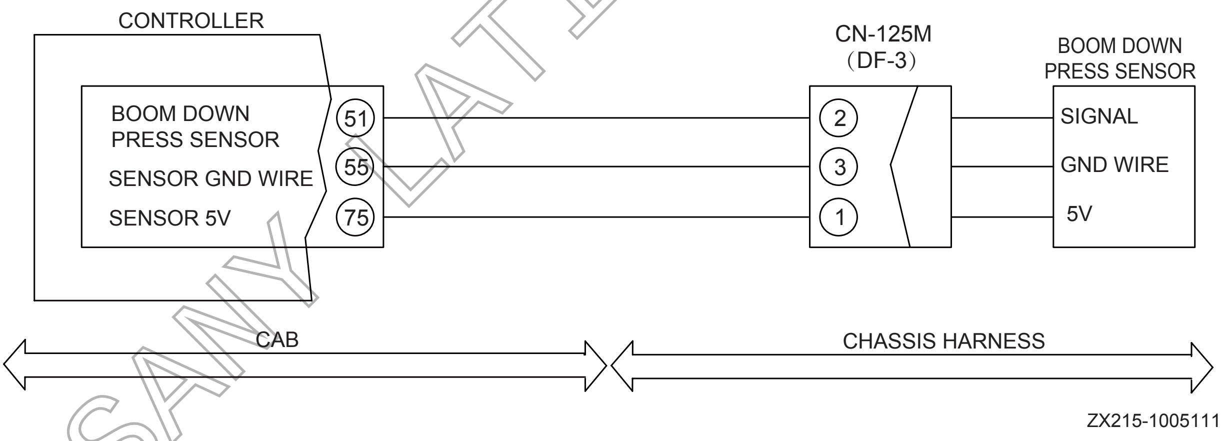
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-126M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-126M ② and controller pin 70	Resistance	≤1 Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-126M ② 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-126M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-20 Incorrect boom-lower pilot pressure reading

Trouble	Boom-Lower pilot pressure reading is incorrect.
Related information	

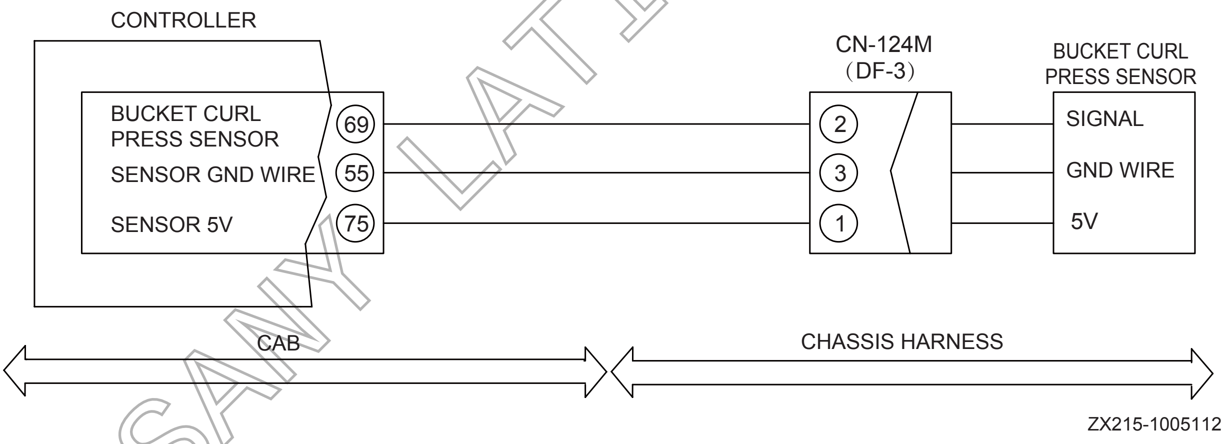
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-125M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-125M ② and controller pin 51	Resistance	≤1 Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-125M ② 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-125M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-21 Incorrect bucket-curl pilot pressure reading

Trouble	Bucket-curl pilot pressure reading is incorrect.
Related information	

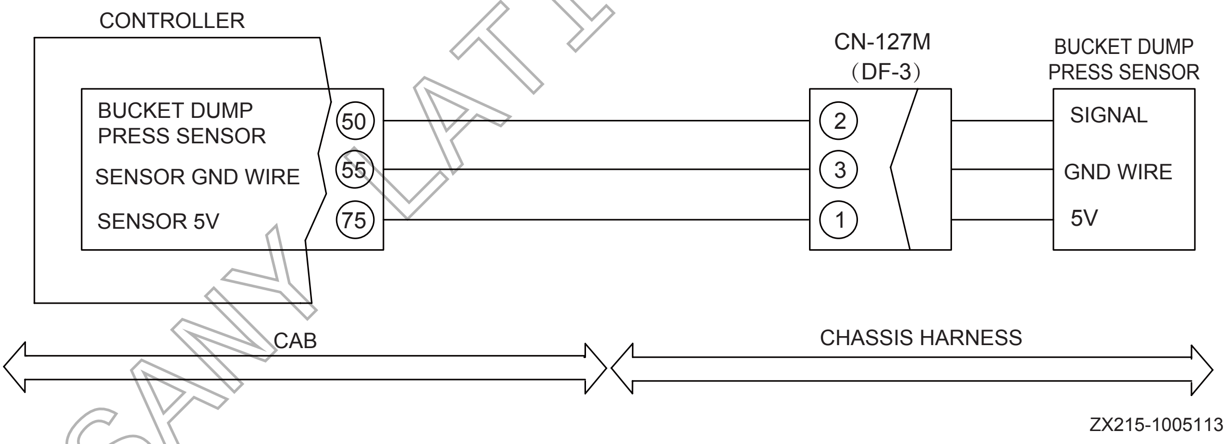
Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-124M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-124M ② and controller pin 69	Resistance	≤1 Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-124M ② 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-124M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-22 Incorrect bucket-dump pilot pressure reading

Trouble	Bucket-dump pilot pressure reading is incorrect.
Related information	

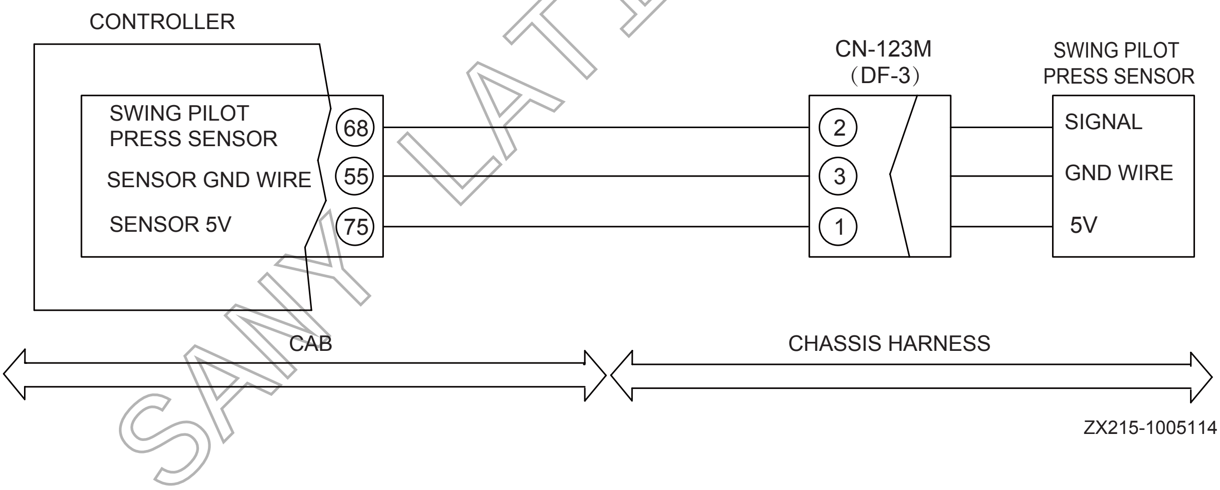
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-127M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-127M ② and controller pin 50	Resistance	≤1 Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-127M ② 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-127M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-23 Incorrect swing pilot pressure reading

Trouble	Swing pilot pressure reading is incorrect.
Related information	

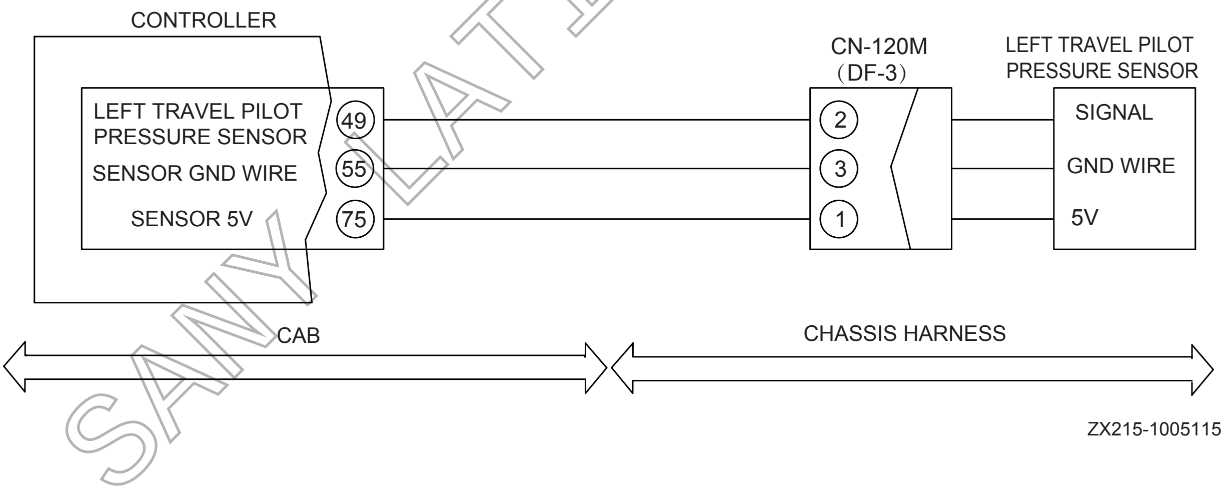
Possible causes and standard value in normal state	**Cause**		**Standard value in normal state/Remarks on troubleshooting**		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-123M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-123M ② and controller pin 68	Resistance	≤1 Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-123M ② 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-123M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-24 Incorrect left travel pilot pressure reading

Trouble	Left Travel Pilot Pressure Reading is incorrect.
Related information	

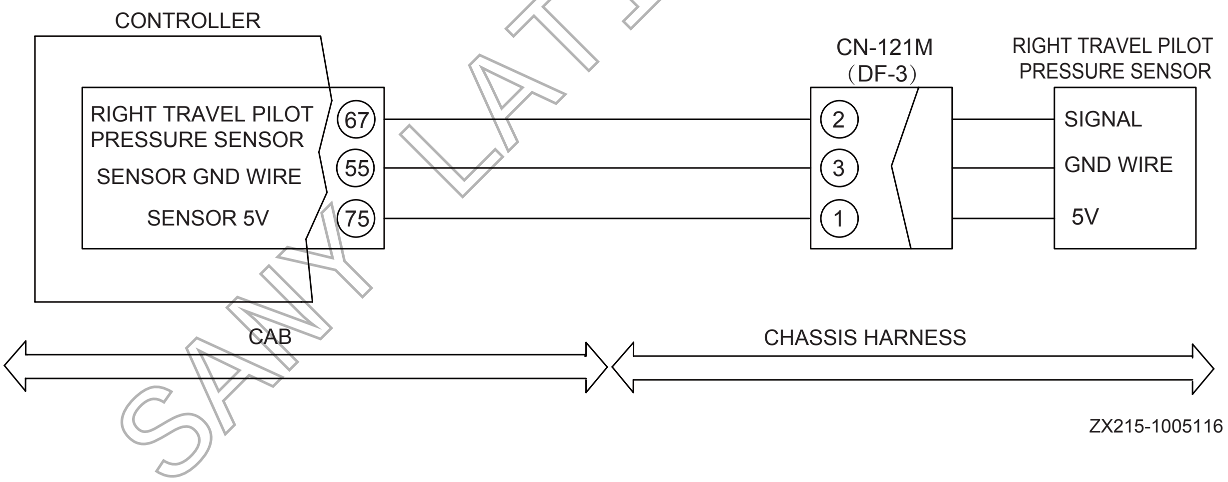
Possible causes and standard value in normal state	**Cause**		**Standard value in normal state/Remarks on troubleshooting**		
	1	Failure of 5V power supply	● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.		
			Between CN-120M ① and ③	Voltage	About 5V
	2	Open circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-120M ② and controller pin 49	Resistance	≤1 Ω
	3	Short circuit of signal wire	● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.		
			Between CN-120M ② 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-120M ② and ground	Voltage	0.5V~ 4.5V
	5				



E-25 Incorrect right travel pilot pressure reading

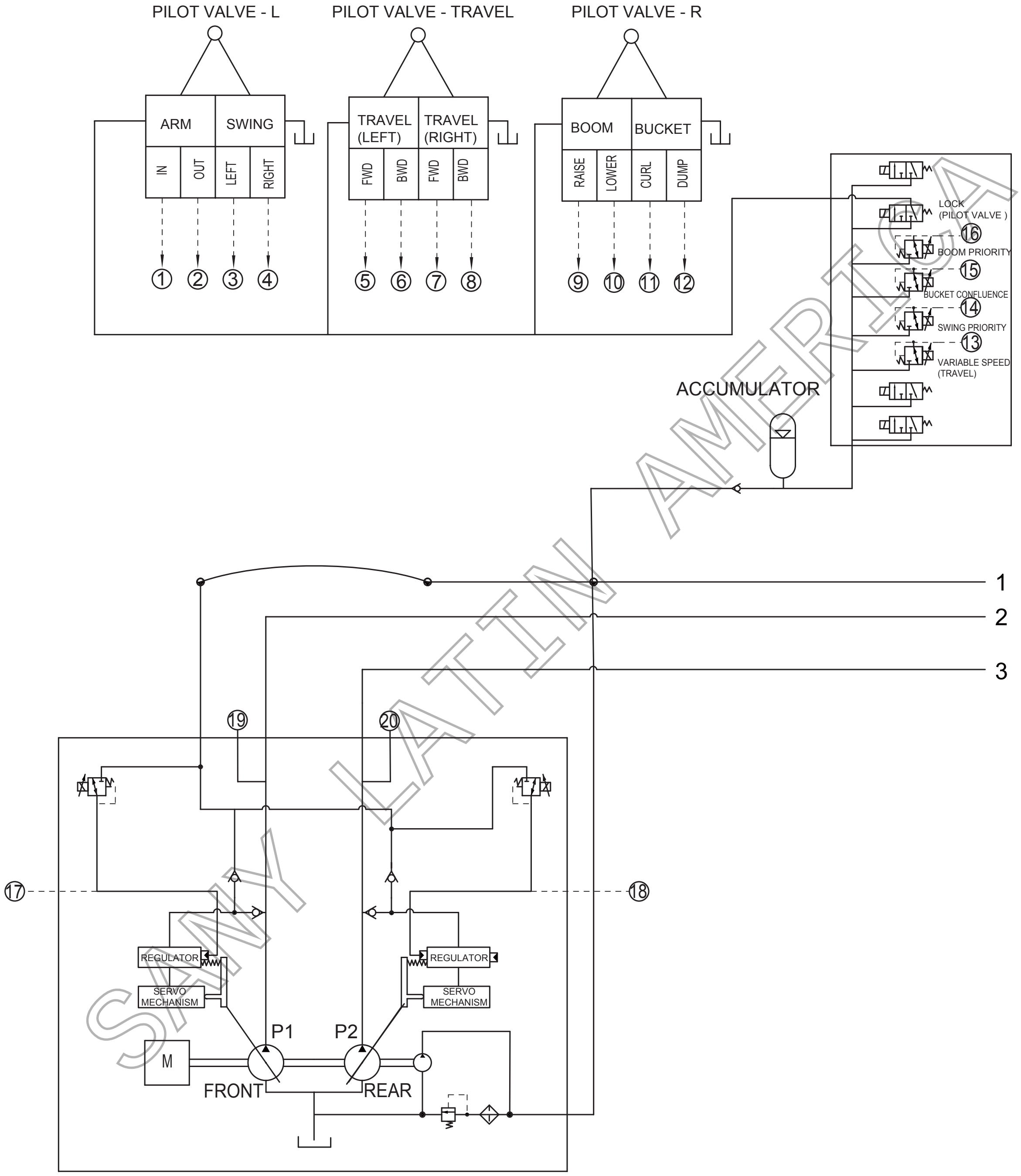
Trouble	Right travel pilot pressure reading is incorrect.
Related information	

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><th colspan="2">Cause</th><th colspan="3">Standard value in normal state/Remarks on troubleshooting</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Failure of 5V power supply</td><td colspan="3">● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.</td></tr>
<tr><td>Between CN-121M ① and ③</td><td>Voltage</td><td>About 5V</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Open circuit of signal wire</td><td colspan="3">● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.</td></tr>
<tr><td>Between CN-121M ② and controller pin 67</td><td>Resistance</td><td>≤1 Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Short circuit of signal wire</td><td colspan="3">● Turn engine start switch to OFF position. Keep it at OFF position to perform troubleshooting.</td></tr>
<tr><td>Between CN-121M ② and ground</td><td>Resistance</td><td>≥2M Ω</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Failure of sensor</td><td colspan="3">● Turn engine start switch to OFF position. Then, keep it at ON position to perform troubleshooting.</td></tr>
<tr><td>Between CN-121M ② and ground</td><td>Voltage</td><td>0.5V~ 4.5V</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2"></td><td colspan="3"></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>



7.7 Troubleshooting of Hydraulic and Mechanical Systems (H - Mode)

A Schematic of hydraulic system and mechanical system



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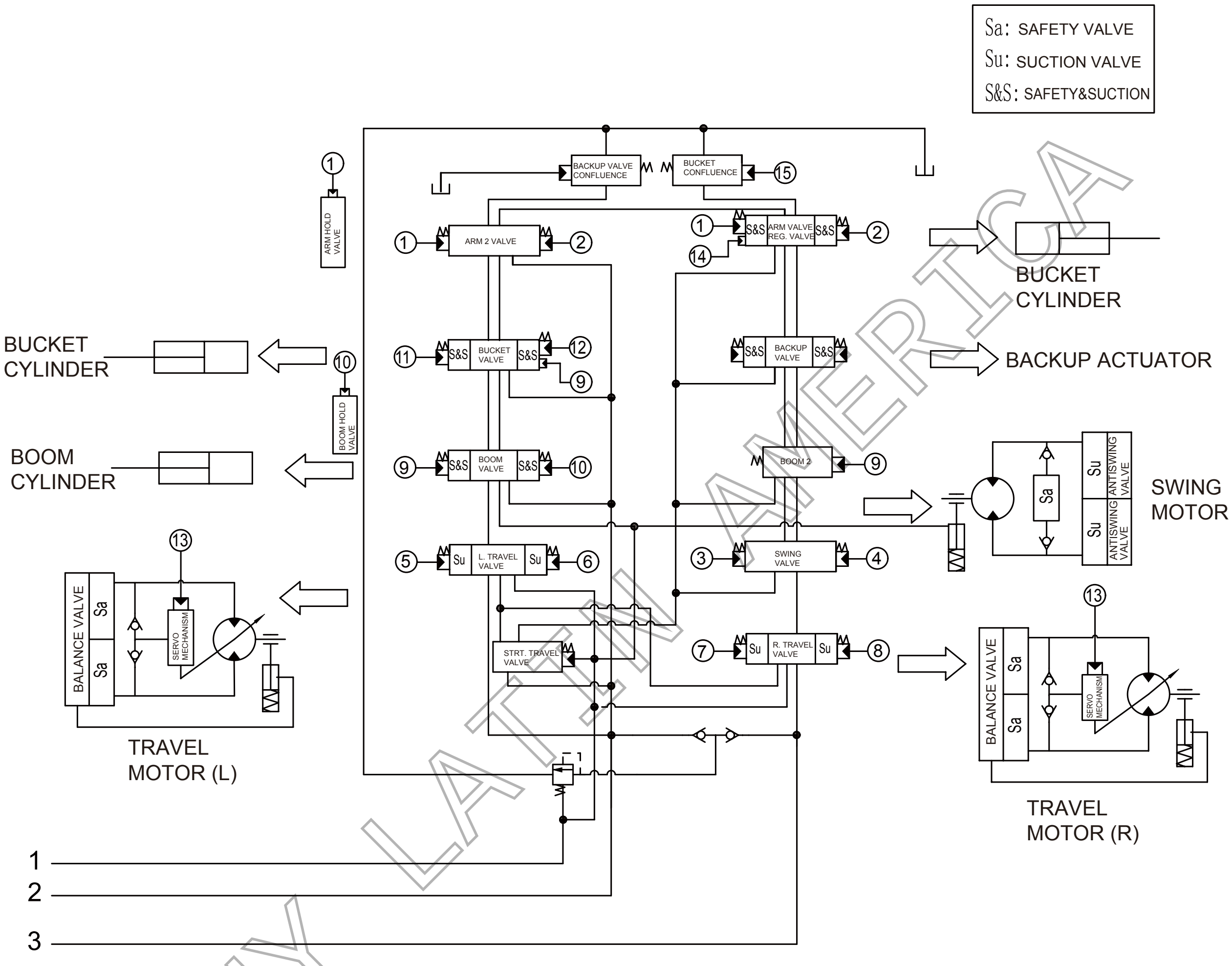
- The system schematic is a simplified hydraulic circuit schematic, which can be used as a reference to the hydraulic system and the mechanical system.



ZX225-1105040

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		

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><td rowspan="11">Possible causes and standard value in normal state</td><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/cm^2}</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="3">2</td><td rowspan="3">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/cm^2}</td></tr>
<tr><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>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>

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.

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="10">Possible causes and standard value in normal state</td><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 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/cm^2}</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/cm^2}</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>

H-4 Abnormal noise in hydraulic pump

Trouble	● Abnormal noise is produced from the hydraulic pump
Related information	—

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	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.

H-5 Auto deceleration 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="10">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/cm^2}</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/cm^2}</td></tr>
<tr><td>3</td><td>Failure of controller</td><td colspan="2">Controller may be defective. Check it directly.</td></tr>
</table>

H-6 Boom speed slow

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="12">Possible causes and standard value in normal state</td><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 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 (retaining 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 defective 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 malfunction 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 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 refer to "Testing and Adjusting", "Hydraulic Drift (Work Equipment) - Test".</td></tr>
</table>

H-7 Arm speed slow

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="12">Possible causes and standard value in normal state</td><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 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/cm^2}</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 refer to "Testing and Adjusting", "Hydraulic Drift (Work Equipment) - Test".</td></tr>
</table>

H-8 Bucket speed slow

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><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 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/cm^2}</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 refer to "Testing and Adjusting", "Hydraulic Drift (Work Equipment) - Test".</td></tr>
</table>

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.

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.	
			Work equipment control lever	Pilot valve output pressure
			"NEUTRAL"	0 {0}
			DIG or DUMP	≥3.5MPa {36 kg/cm^2}
	2	Failure of pressure sensor	● Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Check the pressure sensor by replacing it with a new one.	
	3	Malfunction of control valve (spool)	Spool of control valve may have malfunction. Check it directly.	

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.

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state			● 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 refer to "Testing and Adjusting", "Hydraulic Drift (Work Equipment) - Test".
	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.

Trouble (2)	● The arm drifts excessively.
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	Failure of arm cylinder	● Stop the engine. Perform troubleshooting while the engine is running at high idle.
			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 refer to "Testing and Adjusting", "Hydraulic Drift (Work Equipment) - Test".
	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.

	Cause		**Standard value in normal state/Remarks on troubleshooting**	
Possible causes and standard value in normal state	1	Failure of bucket cylinder	● Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			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.	

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.

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.

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.

<table>
<tr><td rowspan="23">Possible causes and standard value in normal state</td><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>Forward
Reverse</td><td>3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td>Difference occurs between left and right output</td><td>0.4 MPa {4 kg/cm^2}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">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 lever</td><td>Control circuit source pressure</td></tr>
<tr><td>All levers in "NEUTRAL"</td><td>3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td>3</td><td>Failure of regulator</td><td colspan="2">Check the regulator by swapping the front and back regulators.</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Sluggishness of proportional solenoid 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>Proportional valve output pressure</td></tr>
<tr><td>Operate both control levers</td><td>≤0.1 MPa</td></tr>
<tr><td>5</td><td>Sluggishness of travel control valve (spool)</td><td colspan="2">Check the valve spool to see whether it works well.</td></tr>
<tr><td>6</td><td>Internal leakage of central swivel joint</td><td colspan="2">Check it by swapping the lines.</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Malfunction of travel motor</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>Leakage of travel motor</td></tr>
<tr><td>Travel relief</td><td>27.2 ml/min</td></tr>
<tr><td>8</td><td>Failure of final drive</td><td colspan="2">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>
<tr><td rowspan="5">9</td><td rowspan="5">Failure 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>Pilot valve output pressure</td></tr>
<tr><td>Forward
Reverse</td><td>3.5~3.9MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td>Difference occurs between left and right output</td><td>0.4 MPa {4 kg/cm^2}</td></tr>
<tr><td colspan="2">Check the sensor by swapping it with another one.</td></tr>
</table>

H-15 Travel speed 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="19">Possible causes and standard value in normal state</td><th colspan="2">Cause</th><th colspan="6">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="6">● Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="3">Travel control lever</td><td colspan="3">Pilot valve output pressure</td></tr>
<tr><td colspan="3">Forward
Reverse</td><td colspan="3">3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td colspan="3">Difference occurs between left and right output</td><td colspan="3">≤0.4 MPa
≤{4 kg/cm^2}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Malfunction of pilot relief valve</td><td colspan="6">● Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="3">Control lever</td><td colspan="3">Control circuit source pressure</td></tr>
<tr><td colspan="3">All levers in "NEUTRAL"</td><td colspan="3">3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">Failure of sensor</td><td colspan="6">● Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Travel speed</td><td colspan="2">Travel control lever</td><td colspan="2">Reading on monitor</td></tr>
<tr><td colspan="2">Lo</td><td colspan="2">Operated</td><td colspan="2">3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td colspan="2">Hi</td><td colspan="2">Operated</td><td colspan="2">3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td colspan="6">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="6">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="6">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="6">Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="3">Travel control lever</td><td colspan="3">Oil leakage of travel motor</td></tr>
<tr><td colspan="3">Travel relief</td><td colspan="3">27.2 ml/min</td></tr>
<tr><td>7</td><td>Failure of final drive</td><td colspan="6">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>

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.

		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
			Both sides in "NEUTRAL"	0 {0}
			Either side operated	3.5~3.9 MPa { 36~40 kg/cm^2}
	2	Malfunction of travel pilot pressure sensor	● Stop the engine. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Solenoid valve output pressure
			Both sides operated	3.5~3.9 MPa { 36~40 kg/cm^2}
			Either side operated	3.5~3.9 MPa { 36~40 kg/cm^2}
	3	Malfunction of travel control valve (spool)	Spool of travel control valve may have malfunction. Check it directly.	
	4	Malfunction of travel control valve (makeup valve)	The makeup valve in travel control valve may have malfunction. Check it directly.	
	5	Failure of travel motor (relief valve)	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.	
	6	Failure of travel motor (check valve)	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.	

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.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Malfunction of travel speed shifting solenoid valve	● Stop the engine. Perform troubleshooting while the engine is running at high idle.		
			Travel speed	Travel control lever	Solenoid valve output pressure
			Lo	Operated	0 {0}
			Hi	Operated	3.5~3.9 MPa { 36~40 kg/cm^2}
	2	Failure of travel motor (in speed change)	Speed shifting assembly of travel motor may have malfunction. Check it directly.		

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.

<table>
<tr><td rowspan="13">Possible causes and standard value in normal state</td><th colspan="2">Cause</th><th colspan="2">Standard value in normal state/Remarks on troubleshooting</th></tr>
<tr><td>1</td><td>Defective seat of travel control valve (makeup valve)</td><td colspan="2">Seat of makeup valve in travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>2</td><td>Defective seat of travel motor (relief valve)</td><td colspan="2">Seat of relief valve in travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>3</td><td>Defective seat of travel motor valve (makeup valve)</td><td colspan="2">Seat of check valve in travel motor valve may have malfunction. Check it directly.</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Speed of travel motor drops.</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>Leakage from travel motor</td></tr>
<tr><td>Travel relief</td><td>27.2 ml/min</td></tr>
<tr><td>5</td><td>Failure of final drive</td><td colspan="2">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.</td></tr>
<tr><td rowspan="5">6</td><td rowspan="5">Defective 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>Pilot valve output pressure</td></tr>
<tr><td>Forward
Reverse</td><td>3.5~3.9MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td>Difference occurs between left and right output</td><td>0.4 MPa {4 kg/cm^2}</td></tr>
<tr><td colspan="2">Check it with swapping method.</td></tr>
</table>

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.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
	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 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.	
	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	Failure of swing mechanism	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.	

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.

<table>
<tr><td rowspan="7">Possible causes and standard value in normal state</td><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 pilot valve</td><td colspan="2">● Stop the engine. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Left control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>"NEUTRAL"</td><td>0 {0}</td></tr>
<tr><td>Swing</td><td>≥3.5MPa {≥36 kg/cm^2}</td></tr>
<tr><td>2</td><td>Malfunction of swing control valve (spool)</td><td colspan="2">Spool of swing control valve 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.
● Failure of the seal can be determined by swapping the right and left makeup valves and check for any changes.</td></tr>
</table>

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.

<table>
<tr><td rowspan="12">Possible causes and standard value in normal state</td><th colspan="2">Cause</th><th colspan="2">Standard value in normal state/Remarks on troubleshooting</th></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 valve</td></tr>
<tr><td>Swing relief</td><td>25.5~28.5 MPa
{260~291 kg/cm^2}</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>Clogging of brake control lines</td><td colspan="2">Disassemble, clean and check.</td></tr>
</table>

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="13">Possible causes and standard value in normal state</td><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 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/cm^2}</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/cm^2}</td></tr>
</table>

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/cm^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.	
	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/cm^2}
	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.	

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.

<table>
<tr><th rowspan="7">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 swing 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 reverse prevention valve</td><td colspan="2">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.</td></tr>
<tr><td>3</td><td>Malfunction of swing relief valve</td><td colspan="2">Swing relief valve may be worn or sluggish.</td></tr>
</table>

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.

<table>
<tr><th rowspan="5">Possible causes and standard value in normal state</th><th colspan="2">Cause</th><th>Standard value in normal state/Remarks on troubleshooting</th></tr>
<tr><td>1</td><td>Malfunction of back pressure valve</td><td>Back pressure valve may have malfunction. Check it directly.</td></tr>
<tr><td>2</td><td>Malfunction of swing motor (relief valve)</td><td>Relief valve of swing motor may have malfunction. Check it directly.</td></tr>
<tr><td>3</td><td>Malfunction of swing motor (makeup valve)</td><td>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.</td></tr>
<tr><td>4</td><td>Failure of swing mechanism</td><td>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.</td></tr>
</table>

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.

SANY

Disassembly and Assembly

8 Disassembly and Assembly

8 DISASSEMBLY AND ASSEMBLY

8.1 How to Read This Manual

8.1.1 Removing and Installing an Assembly

Removal

- The "Removal" section contains procedure, precautions and the amount of oil or water to be discharged.

Installation

- Unless specified otherwise, installation of a part is a reverse procedure of removing the part.

8.1.2 Disassembling and assembling an assembly

Disassembly

- The "Disassembly" section contains procedure, precautions and the amount of oil or water to be discharged.

Assembly

- The "Assembly " section contains operating procedure, precautions, technical specification and the amount of oil or water to be added.

8.1.3 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.

8.1.4 The symbols used in this section

This section uses some symbols and icons that are not used elsewhere in this manual. They include:

This symbol indicates the amount of oil or water to be discharged.

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.

This symbols indicates the weight of a component or an assembly.

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 antifreeze 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. 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.

- **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

2. Precautions 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.

NOTE: 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 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.

NOTE: 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.

  For more information, see “Air in Each Component - Bleed” on page 6-46.
- Add the specified amount of grease (molybdenum disulphide) to the work equipment related parts.

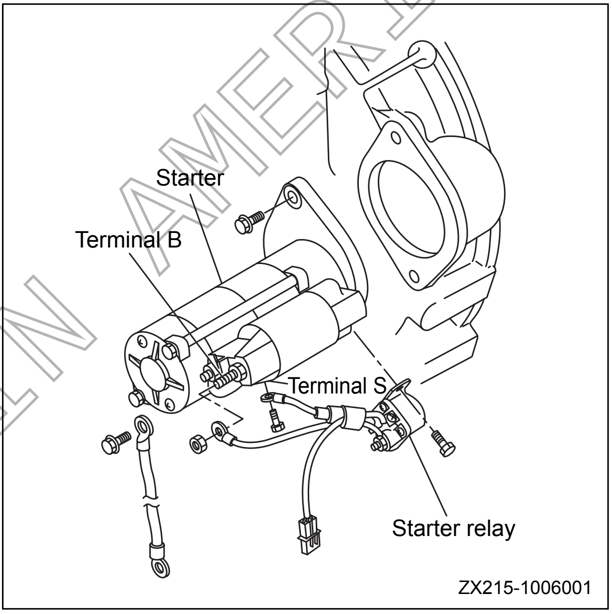
8.3 Start Motor AS - Remove and Install

8.3.1 Removal

CAUTION

- **Before removing the start motor assembly, disconnect the cable from the negative (-) post of the battery, and insulate between the cable and the negative post with insulation tape.**

1. Open the engine hood.
2. Disconnect the cables (1), (2), (3), (4) and (5).
3. Unscrew the bolts (6) and (7) used to fix the start motor. Remove the start motor assembly.



8.3.2 Installation

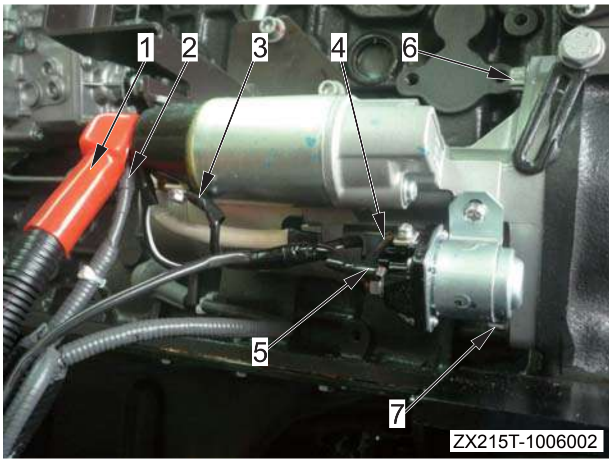
- Installation is to be performed in the reverse order of removal.

  Terminal B locknut (start motor):

  18 ~ 25 N·m {1.8 ~ 2.6 kgf·m}

  Fixing bolts (start motor):

  43±6 N·m {4.4±0.6 kgf·m}



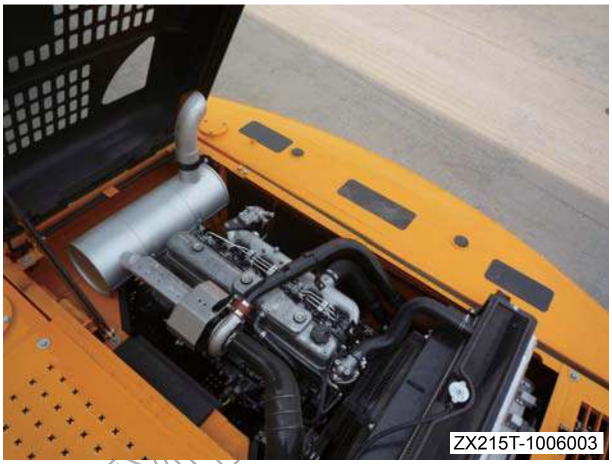
8.4 Injection Pump AS - Remove and Install

8.4.1 Removal

CAUTION

- **Disconnect the negative (-) post of the battery.**

1. Open the engine hood.


ZX215T-1006003

2. Disconnect the air intake hose (1).

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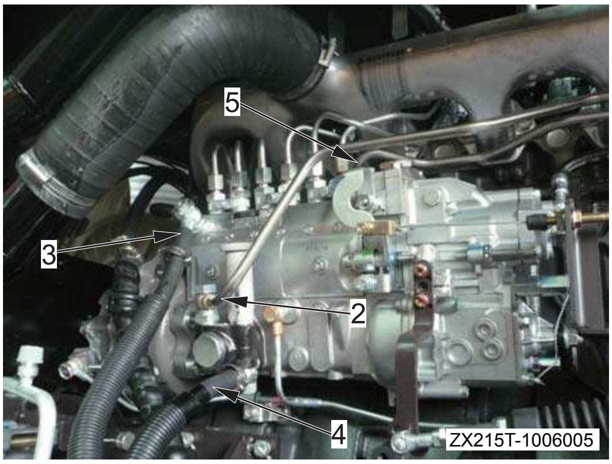
3. Disconnect fuel supply tube (2), fuel delivery hose (4), fuel return hose (3) and fuel supply tube (5).
    - Block the hose with a cork in order to prevent flow of fuel from the hose.



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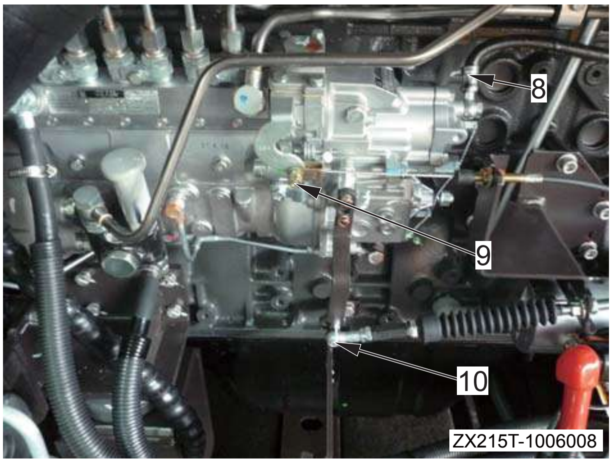
4. Disconnect the lubrication tube (6).

5. Disconnect six fuel delivery tubes (7).

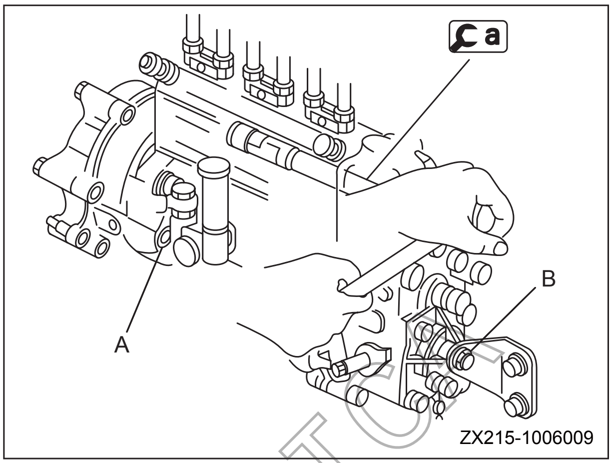
6. Disconnect the air hose (8).
7. Remove the bolt (9) fixing the electronic choke. Disconnect the bolt (10) fixing the governor motor.



8. Adjust the injection timing of the timing gear. For more information, see “Fuel Injection Timing - Test and Adjust” on page 6-13.
9. Remove the injection pump mounting nuts in order to disassemble the injection pump assembly.

   A: 4 nuts on the flange

   B: 1 nut



8.4.2 Installation

- Installation is to be performed in the reverse order of removal.

  Bolts for installation of fuel supply tube:

  20~29 N·m {2.1~3.0 kgf·m}

  Relief valve:

  20~29 N·m {2.1~3.0 kgf·m}

  Bolts for installation of engine oil line:

  10~13 N·m {1.0~1.3 kgf·m}

  Fuel injection tube:

  24 N·m {2.5 kgf·m}

  Bolts for installation air hose:

  12~15 N·m {1.2~1.5 kgf·m}

- Adjust the engine speed. For more information, see “Engine Speed - Test and Calibrate” on page 6-3.

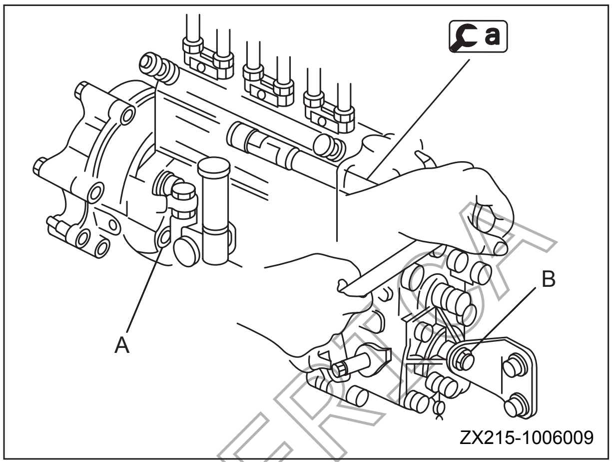
- Installation of the fuel injection pump is to be performed as the following:

1) Check the fuel injection timing to see if it has been adjusted properly.
    - For more information, see “Fuel Injection Timing - Test and Adjust” on page 6-13.
2) Assemble the fuel injection pump assembly and tighten the 4 nuts at position A and 1 nut at position B.

   Nut: 9.8±2 N·m {10±0.2 kgf·m}

- Air bleeding

  Bleed the air from the fuel injection system.



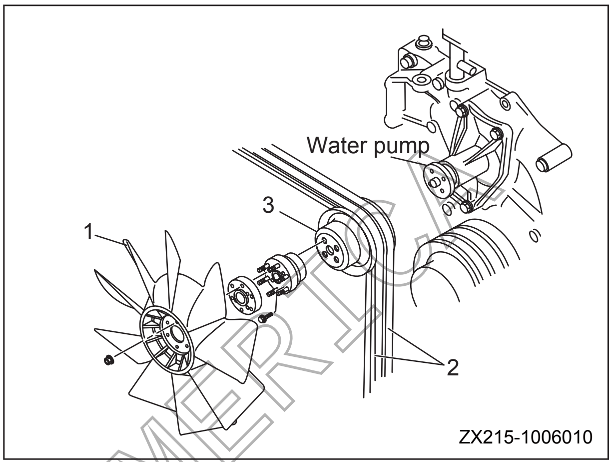
8.5 Engine Front Seal - Remove and Install

8.5.1 Removal

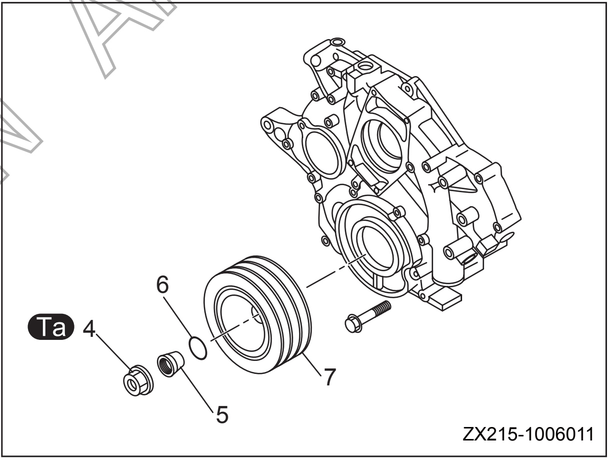
1. Remove the radiator assembly.

   For more information, see “Radiator AS - Remove and Install” on page 8-24.

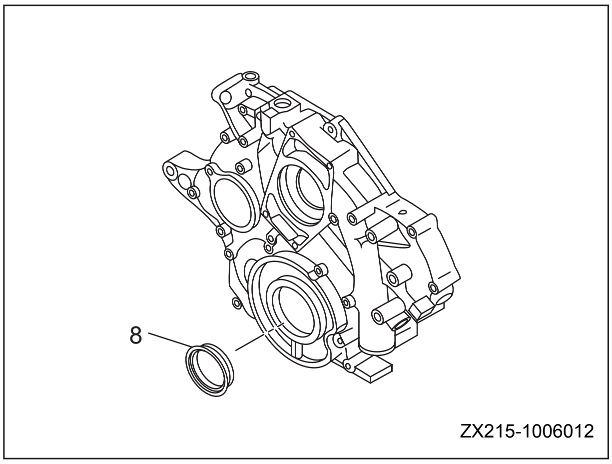
2. Remove the engine fan (1), the belt (2) and the pulley (3).



3. Remove the mounting nut (4) and replace the cone (5) and the O-ring (6). Remove the crankshaft belt pulley (7).



4. Disassemble the front oil seal (8).



8.5.2 Installation

- Installation is to be performed in the reverse order of removal.

  Ta Nut: 490 N·m {50 kgf·m}

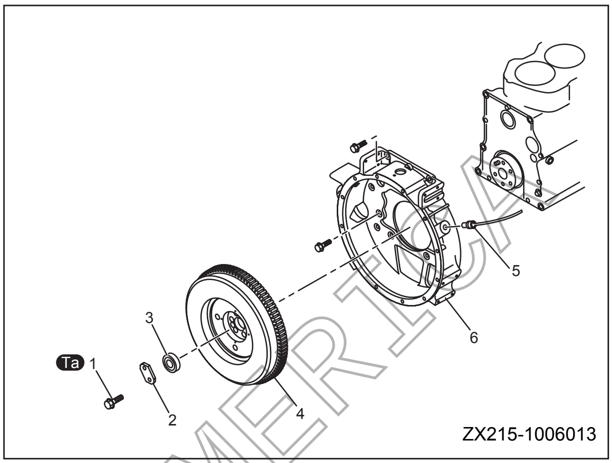
8.6 Engine Rear Seal - Remove and Install

8.6.1 Removal

1. Remove the hydraulic pump assembly.

   For more information, see “Hydraulic Pump AS - Remove and Install” on page 8-85.

2. Remove the bolt (1), the latch piece (2) and the bearing (3).
3. Remove the flywheel (4).
4. Remove the engine speed sensor (5) and the flywheel shell (6).



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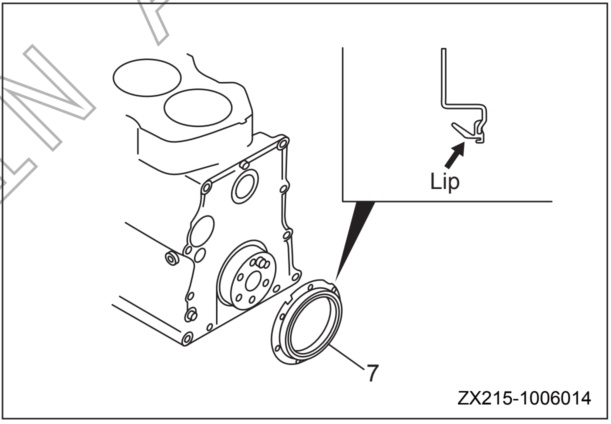
5. Remove the rear seal (7).



ZX215-1006014

8.6.2 Installation

- The installation is to be performed in the reverse order of removal.

  Ta Bolt:

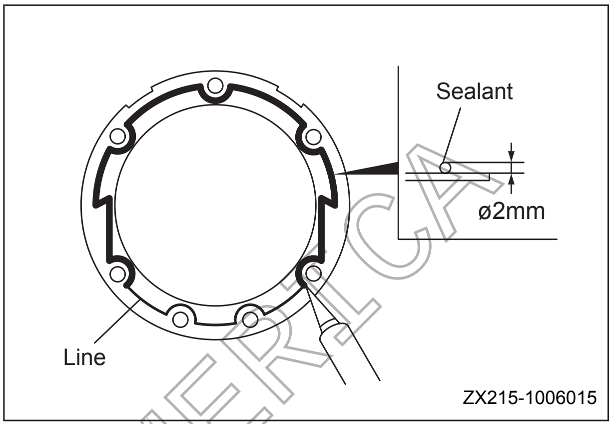
  39 N·m {4.0 kgf·m} + 47°

- The rear oil seal is to be installed according to the following procedure:

1. Apply engine oil to the lips of the rear seal.
2. Clean the oil-sealing surface.
3. Apply the sealant evenly and continuously align the line of the rear seal.

   Sealant (Tonsun 1596)

4. The installation is to be performed 3 minutes after application of the sealant. Be careful not to deviate the line while applying the sealant.



8.7 Cylinder Head AS - Remove and Install

8.7.1 Removal

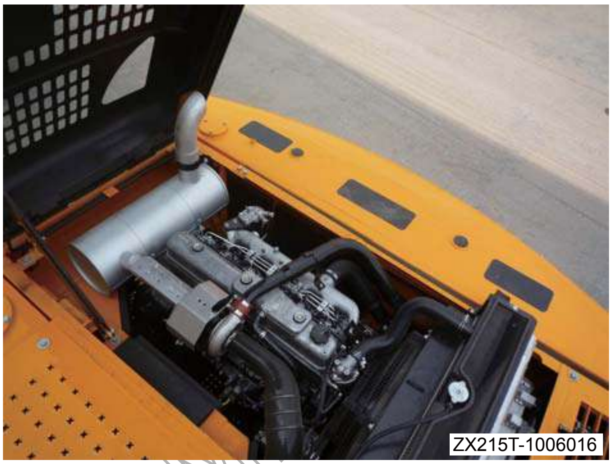
⚠ CAUTION

- **Disconnect the negative (-) post of the battery.**

1. Drain the engine of coolant.

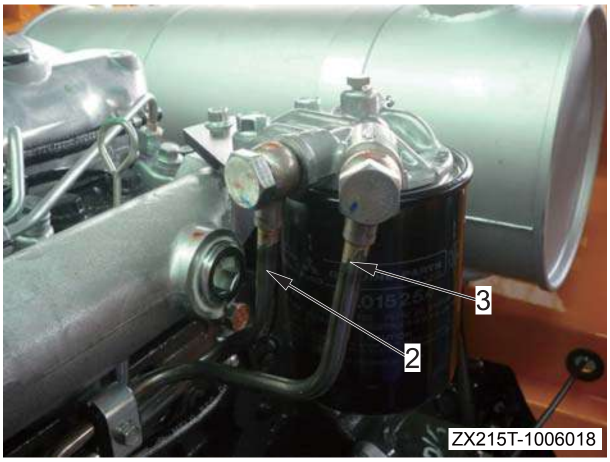
   Coolant: 18 L

2. Open the engine hood.

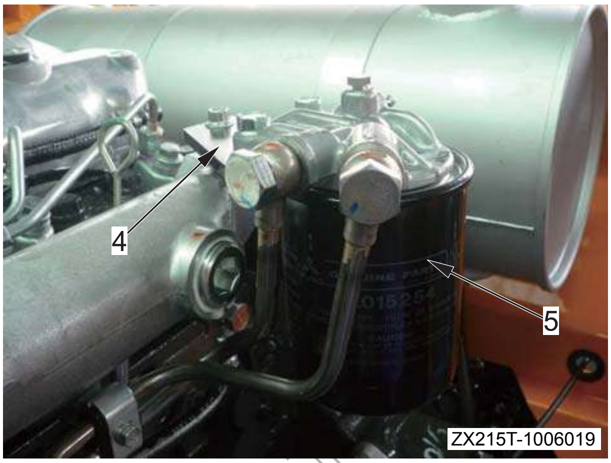


3. Disconnect the air intake hose (1).

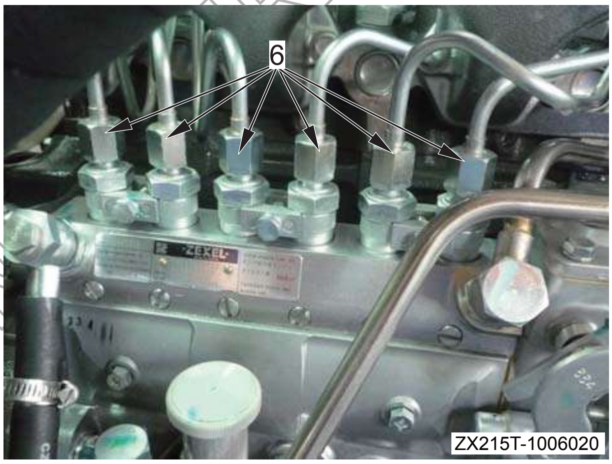
4. Remove piping (2) and piping (3) between the fuel filter and the injection pump.



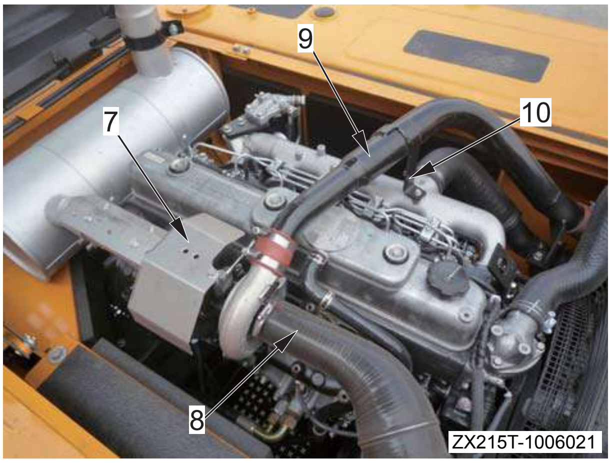
5. Remove the fuel filter bracket (4) and the fuel filter assembly (5).
6. Remove the six delivery hoses (6).



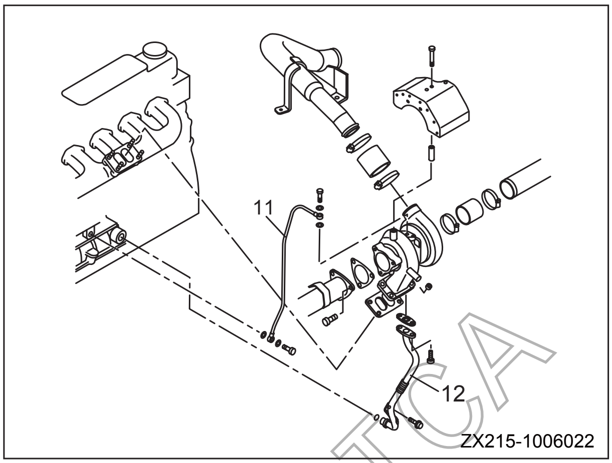
7. Remove the exhaust muffler connector cover (7).



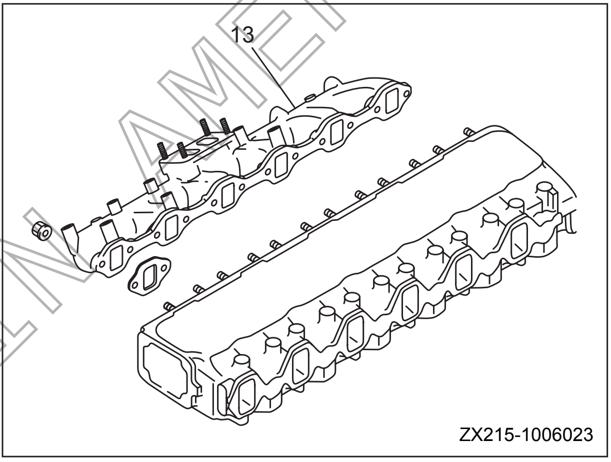
8. Remove the air cleaner suction hose (8).
9. Remove the air intake tube (9) and its clamps (10) between the turbocharger and the intercooler.
10. Remove the engine oil delivery tube (11) and the oil return tube (12).



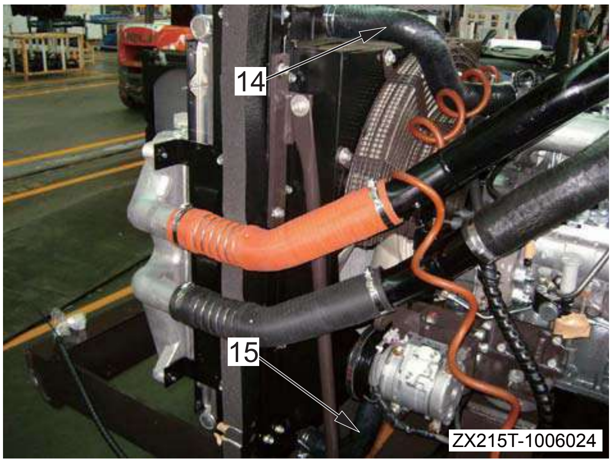
11. Remove the turbocharger assembly.



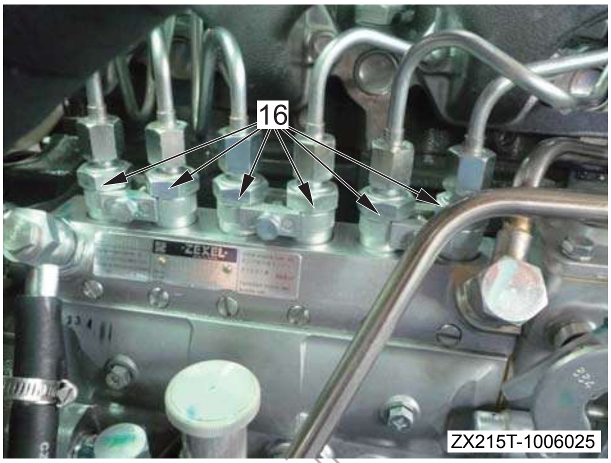
12. Remove the exhaust manifold (13).



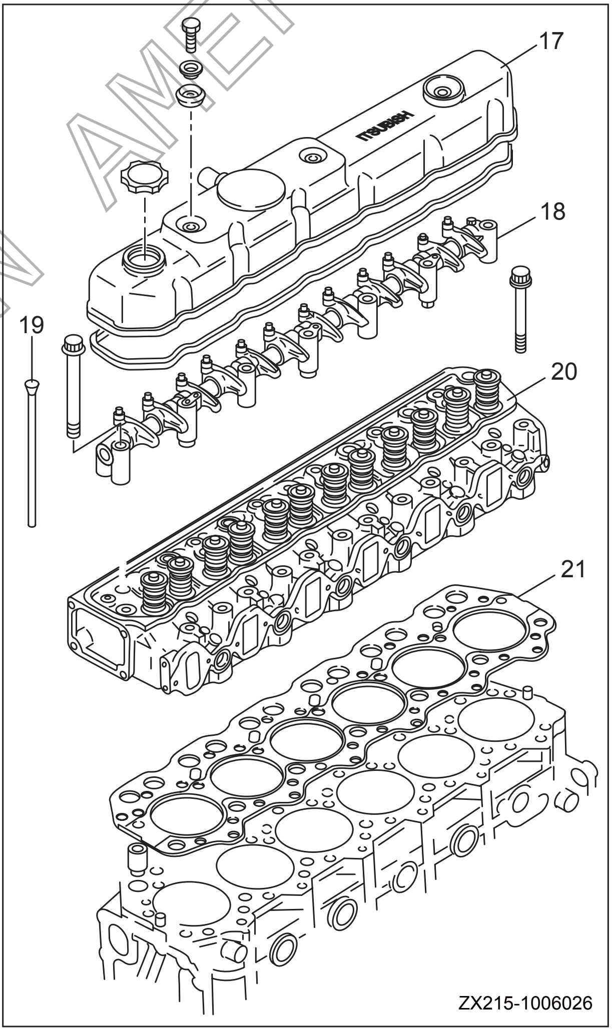
13. Remove the radiator inlet hose (14) and outlet hose (15).



14. Remove the six nozzle seats (16).



15. Remove the rocker arm housing (17).
16. Remove the rocker arm assembly (18).
17. Remove the pushrod (19).
18. Remove the 25 mounting bolts from the cylinder head assembly. Lift the cylinder head assembly in order to disassemble it.
19. Remove the cylinder head gasket (21).



8.7.2 Installation

- The installation is to be performed in the reverse order of removal.

Installation of cylinder head gasket

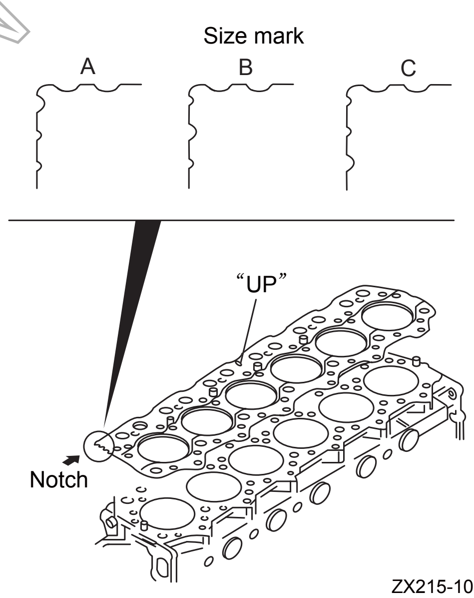
Choose a cylinder head gasket as per the following.

1. Measure the amount of piston projection of each cylinder.
2. Select from the following table a gasket with a thickness suitable for the maximum piston projection after measurement. In addition, even if one cylinder's piston projection is 0.05 mm greater than the average, the gasket with a thickness one grader higher (A→B, B→C) is to be used.

Unit: mm

Piston Projection	Cylinder Head Gasket	
Average	Size	Thickness Tightened
0.546~0.610	A	1.3
0.610~0.674	B	1.35
0.674~0.738	C	1.4

3. The size of cylinder head gasket is determined according the notch.
4. Install the cylinder head gasket to the crankshaft case as indicated by the arrow.



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NOTICE

The amount of piston projection must be measured as the amount of piston projection may vary when replacing a piston or connecting rod.

Bolt (rocker cover installation):

4.9~6.9 N·m {0.5~0.7 kgf·m}

Bolt (cylinder head):

147 N·m {15 kgf·m}+90°

Bolt threads (cylinder head):

Engine oil

Tappet circumference:

Engine oil

Tappet ends:

Engine oil

- Adjustment of valve clearance

  For more information, see “Valve Clearance - Adjust” on page 6-8.

- Adding coolant

  Add engine coolant to the specified level. Start the engine to circulate the coolant in order to release all foams. Check the coolant level again.

8.8 Radiator AS - Remove and Install

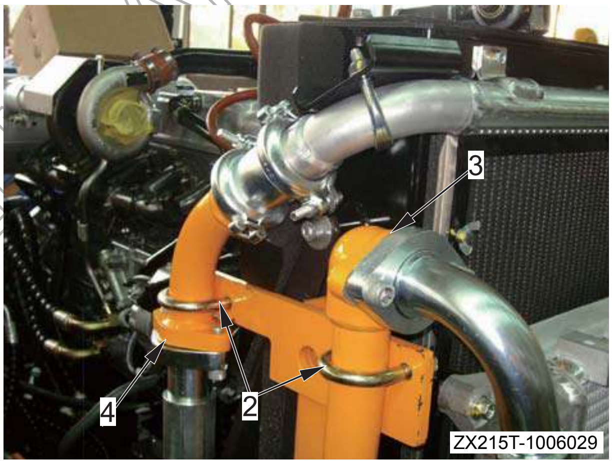
8.8.1 Removal

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. 18 L
3. Remove the coverplate.

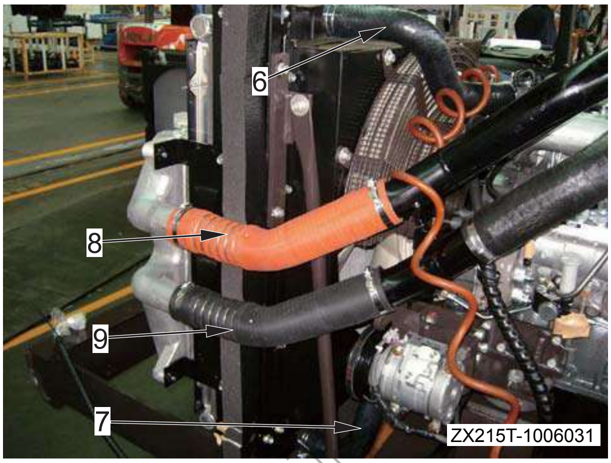
4. Remove the two U-bolts (2).
5. Disconnect the hydraulic oil cooler inlet connector (3) and outlet connector (4). Block the openings to prevent leakage of hydraulic oil.
6. Discharge hydraulic oil from the hydraulic cooler.

   Hydraulic oil radiator: approx. 5.6 L
7. Disconnect the coolant tank hose (5).

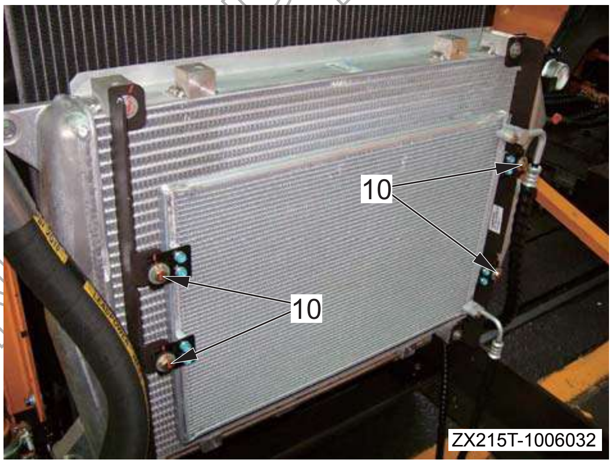


8. Disconnect the cooler inlet hose (6) and outlet hose (7).

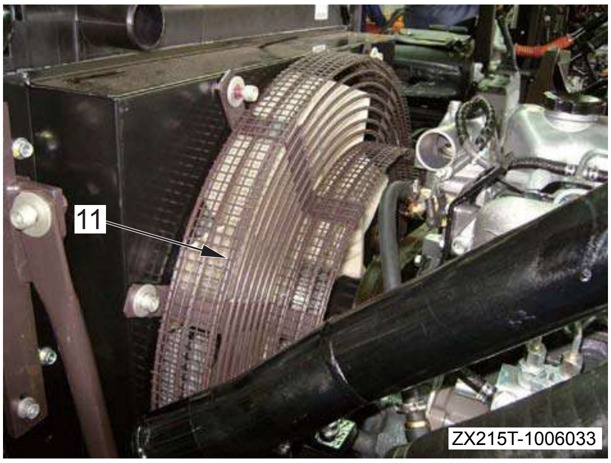
9. Disconnect the intercooler air inlet tube (8) and outlet tube (9).



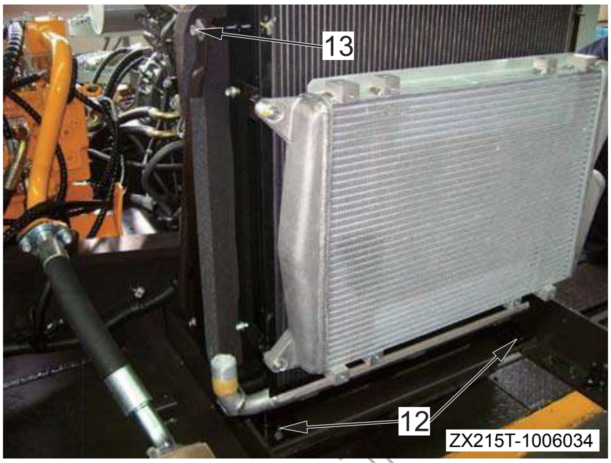
10. Remove the four bolts (10) from the air conditioner radiator. Remove the air conditioner radiator and store it properly.



11. Remove the radiator fan guard (11).

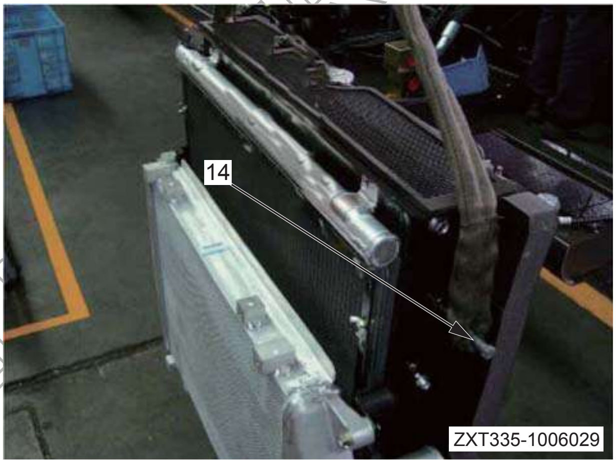


12. Remove the four mounting bolts (12) from the radiator bottom and the two mounting bolts (13) from the left and right brackets.



13. Mount the hoisting bolts (14) to both sides of the radiator in order to hoist the radiator assembly.

    NOTE: Before the radiator assembly is hoisted, move the radiator assembly axially until the fan avoids its guard.



8.8.2 Installation

- Installation is to be performed in the reverse order of removal.

NOTE:

- 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. 18 L

    Hydraulic oil radiator: approx. 12 L

8.9 Engine and Hydraulic Pump AS - Remove and Install

8.9.1 Removal

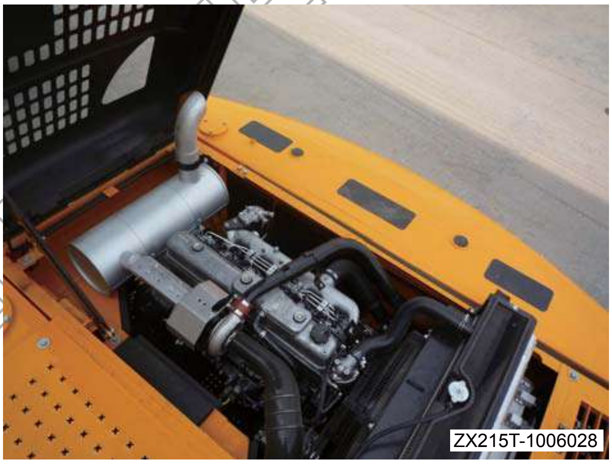
CAUTION

- **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.**

NOTE: 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. 18 L
3. Open the engine hood.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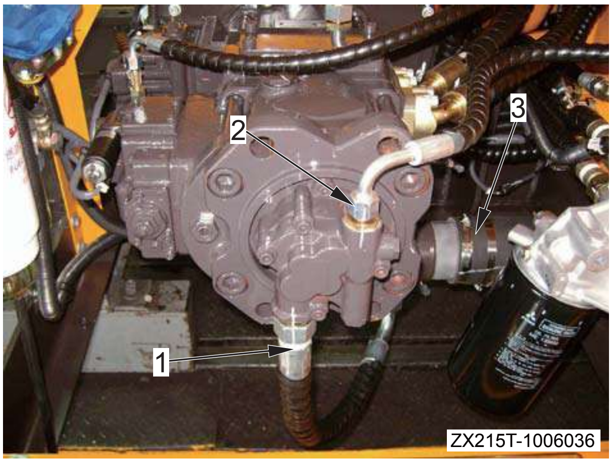
4. Disconnect piping (1), (2) and (3).



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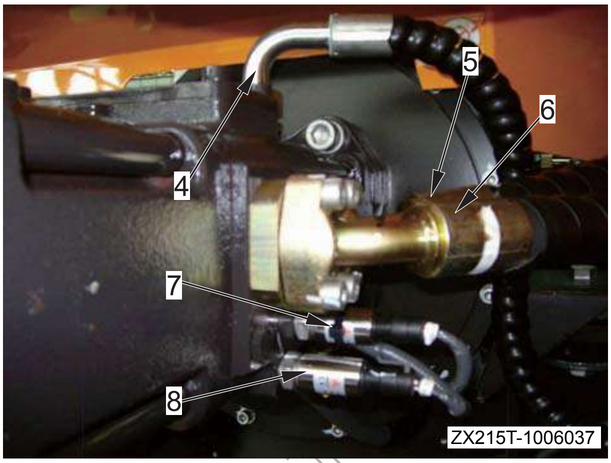
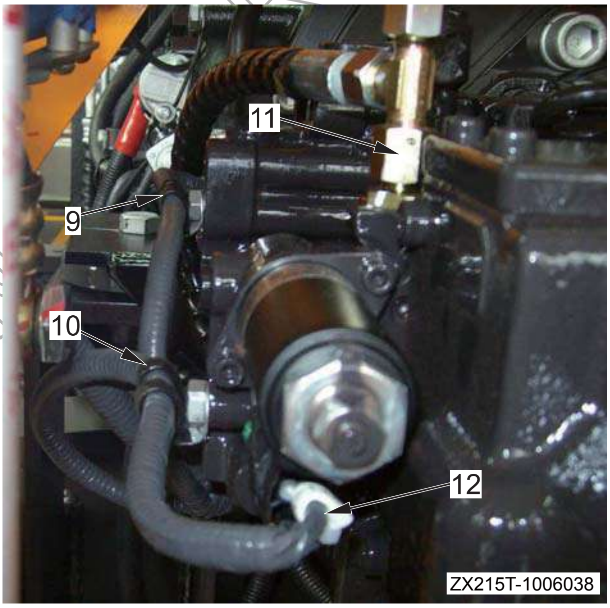
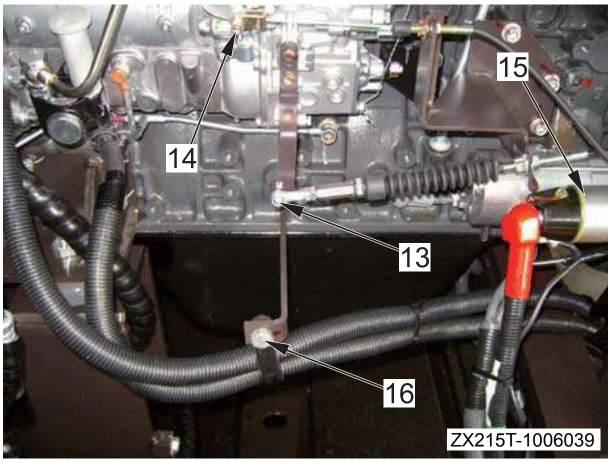
5. Disconnect piping (4), (5) and (6).
6. Remove the sensors (7) and (8).



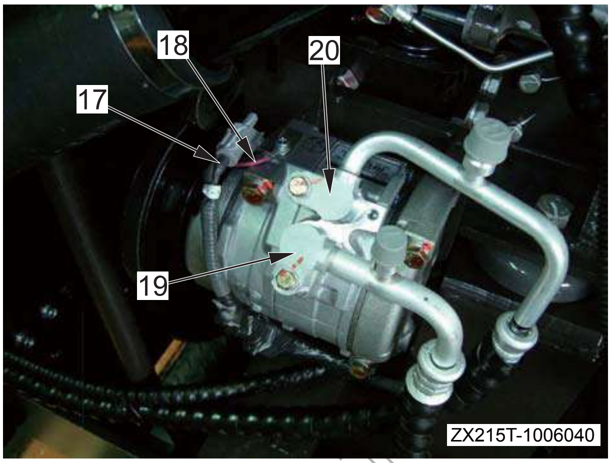
7. Remove the clamps (9) and (10). Remove the line (11) and the cable (12).



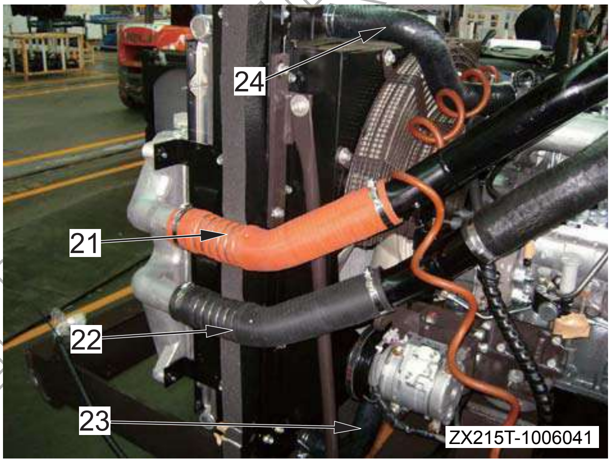
8. Unscrew the connection bolt (13) of the governor motor and the connection bolt (14) of the engine stopper.
9. Disconnect the external cable from the starter (15).
10. Remove the mounting bolt (16) from the hose clamp.



11. Disconnect the cables (17) and (18) as well as the tubes (19) and (20) from the compressor.

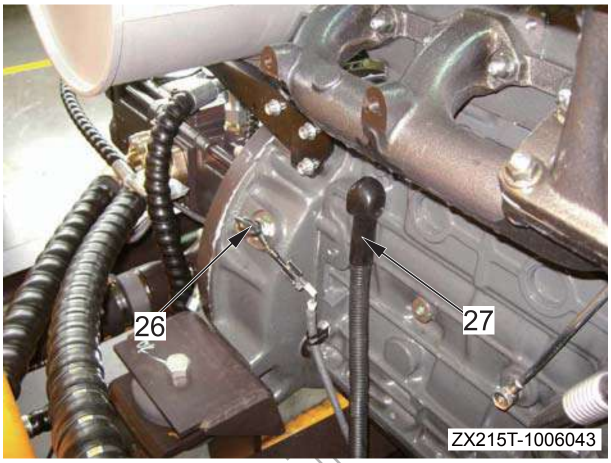


12. Disconnect the hoses (21), (22), (23) and (24) between the engine and the radiator

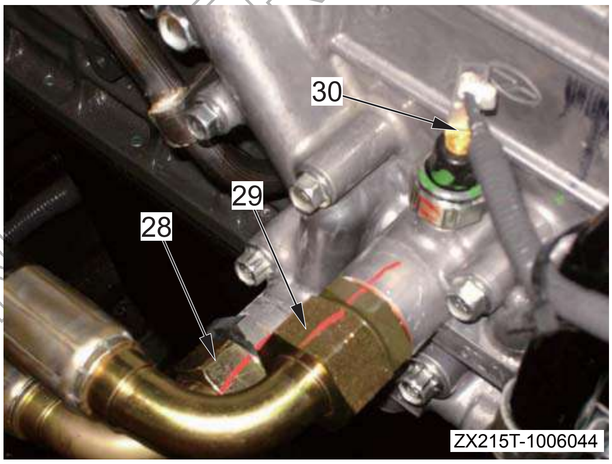


13. Disconnect the air intake hose (25).

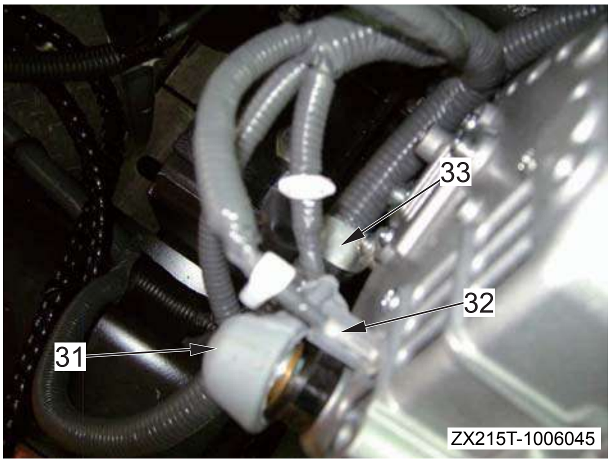
14. Disconnect the external cable (26) of the rpm sensor.
15. Disconnect the external cable (27) of engine oil pressure sensor.



16. Disconnect the engine oil inlet tube (28) and outlet tube (29).
17. Disconnect the wiring (30) of the engine oil pressure switch.

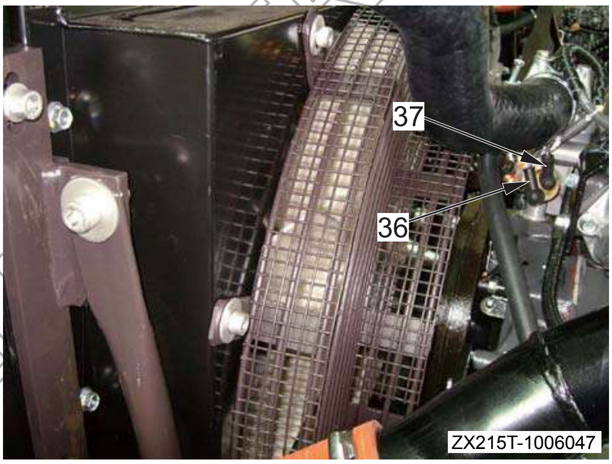


18. Disconnect the cables (31) and (32), and remove the hose clamp (33).

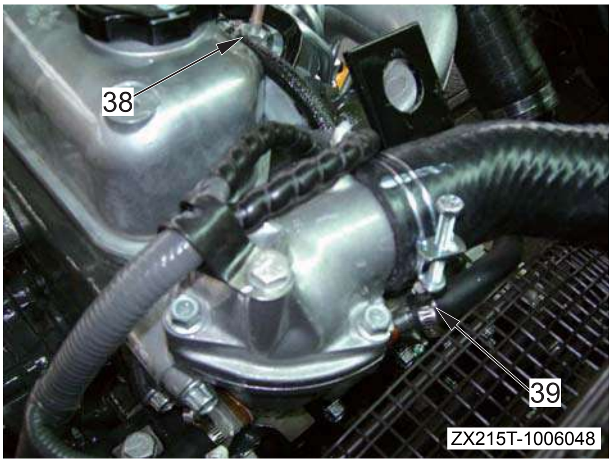


19. Remove the hose clamp (35).
20. Disconnect the wiring (34) of the water temperature sensor.

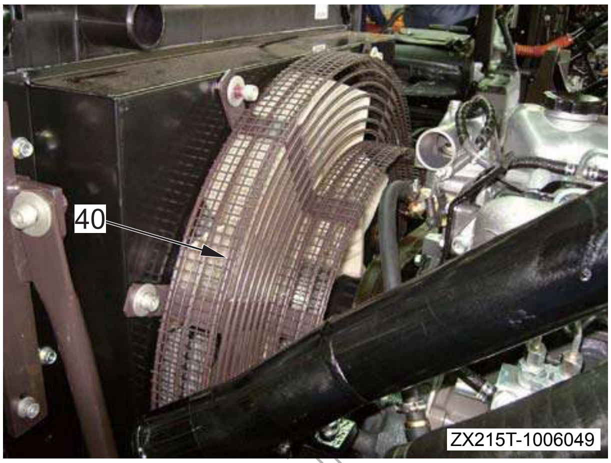
21. Disconnect the cables (36) and (37) of the water temperature switch.



22. Disconnect the oil return hose (38).
23. Disconnect the A/C water pipe (39).



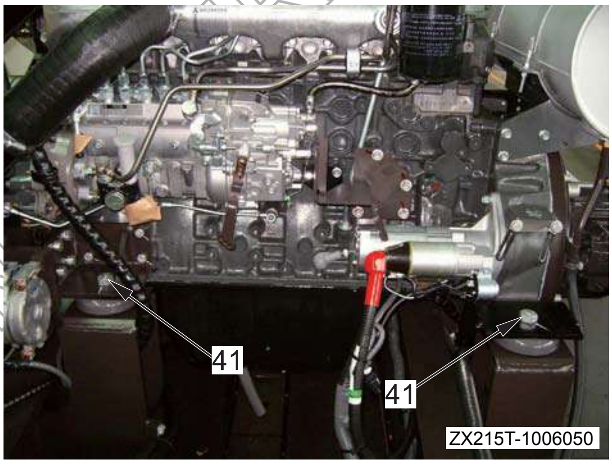
24. Disconnect the radiator fan guard (40).



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



8.9.2 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 6-46.

8.10 Final Drive AS - Remove and Install

8.10.1 Removal

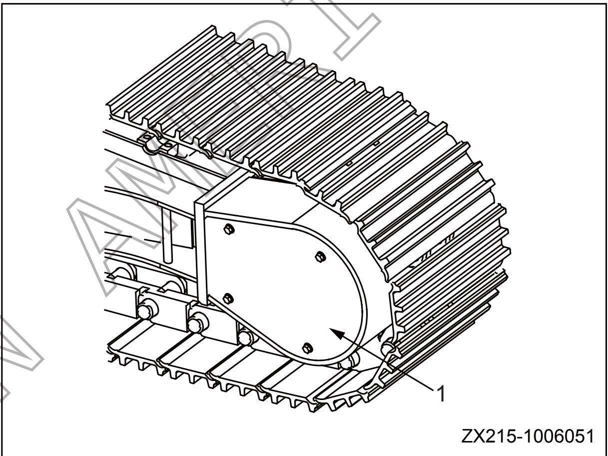
⚠ CAUTION

- **Lower the work equipment to the ground. Stop the engine. Operate the breather valve to release internal pressure.**

1. Remove the sprocket.

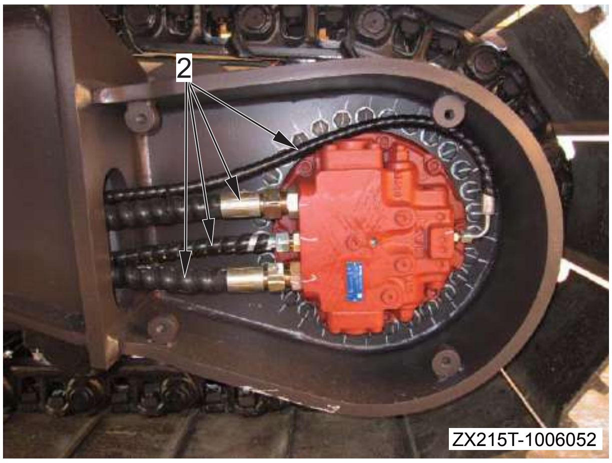
   For more information, see “Sprocket - Remove and Install” on page 8-62.

2. Remove the motor cover plate (1).



ZX215-1006051

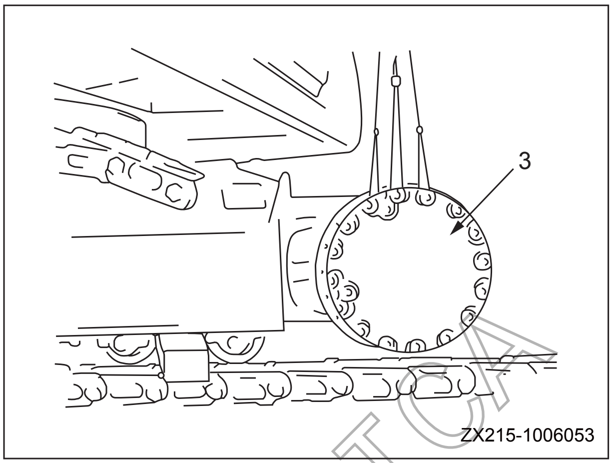
3. Disconnect the four hoses (2) of the travel motor and the corresponding hose connectors.



ZX215T-1006052

4. Remove the 30 mounting bolts from the final drive assembly (3), and lift the assembly for disassembling.

   Final Drive Assembly: 250 kg



NOTICE

- **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.**

8.10.2 Installation

- Installation is to be performed in the reverse order of removal.

  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 6-46.

8.11 Final Drive AS - Disassemble and Assemble

8.11.1 Disassembly

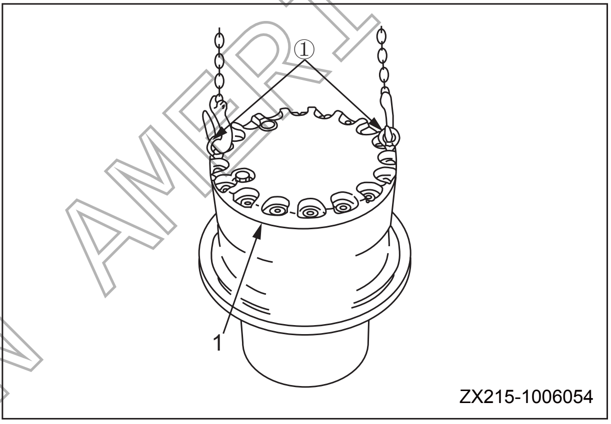
1. Oil draining

Open the drain plug to drain the oil from the final drive tank.

Final drive tank: approx. 4.7 L

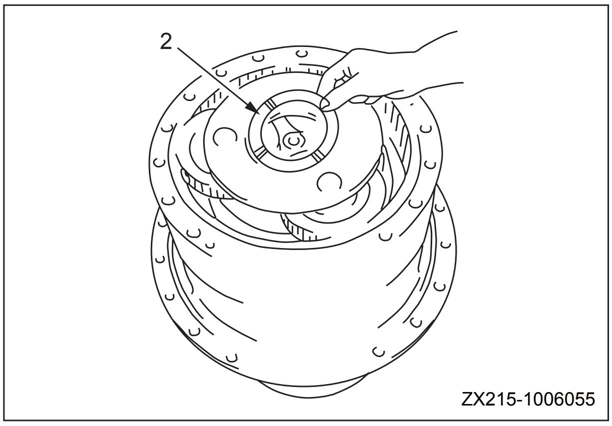
2. Cover

Remove the bolts. Use eyebolts □ to the cover (1).



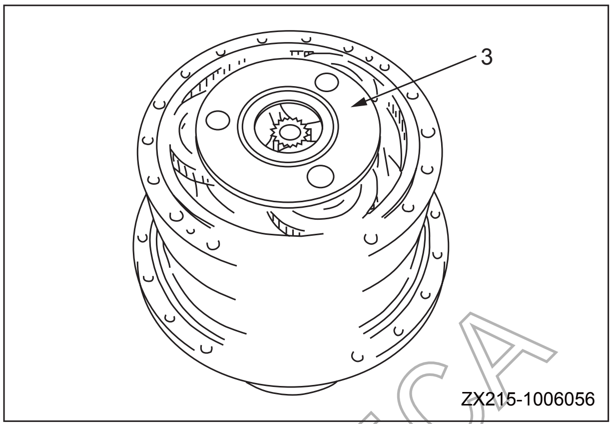
3. Spacer

Remove the spacer (2).



4. No. 1 planetary carrier assembly

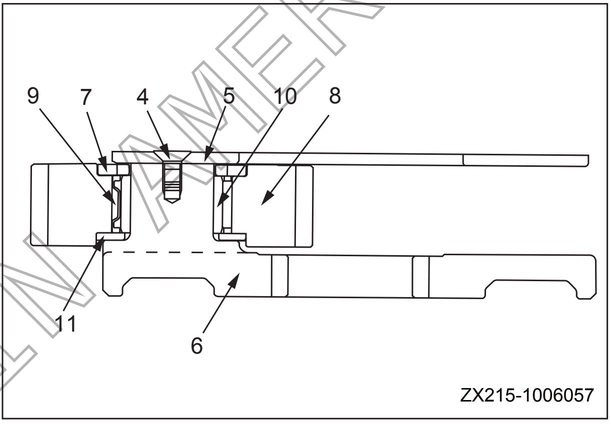
1) Remove the No.1 planetary carrier assembly (3).



2) Disassembly of No.1 planetary carrier assembly.

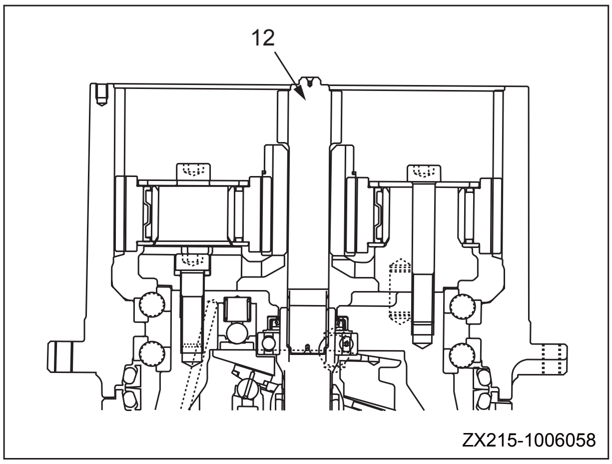
3) Remove the screws (4). Remove the coverplate (5) from the planetary carrier assembly (6).

4) 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).

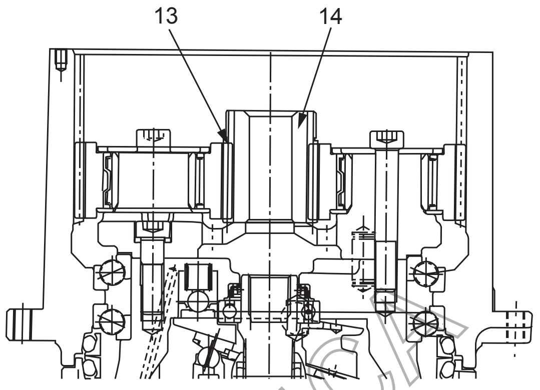


6. Thrust washer

Remove the thrust washer (13).

7. No.2 sun gear

Remove No.2 sun gear (14).



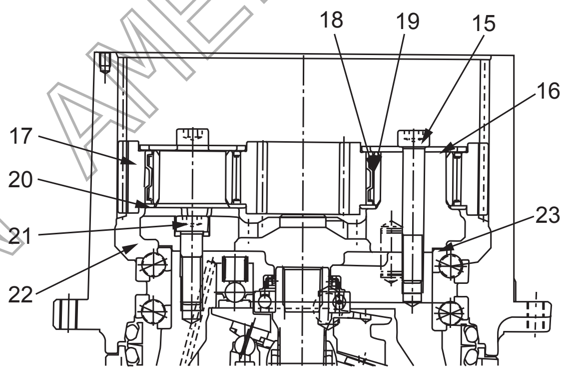
ZX215-1006059

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).

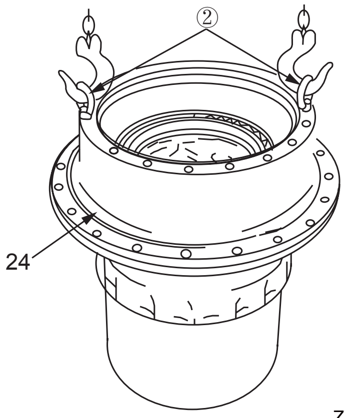
3) Remove the screw (21) to take the planetary carrier assembly (22) and the shim (23) from the body.



ZX215-1006060

9. Hub assembly

1) Use eyebolts ② to remove the hub assembly (24) from the travel motor.



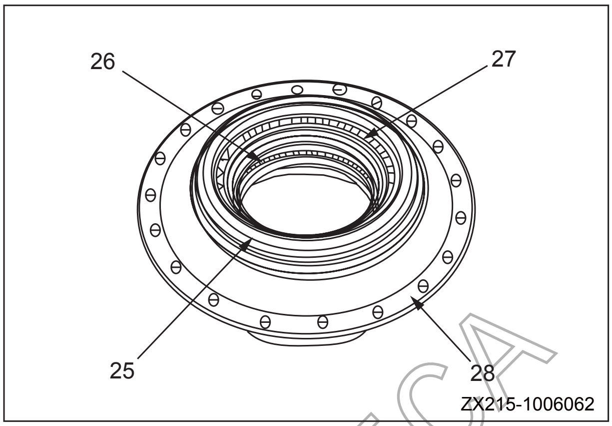
ZX215-1006061

2) Disassemble the hub assembly as the following.

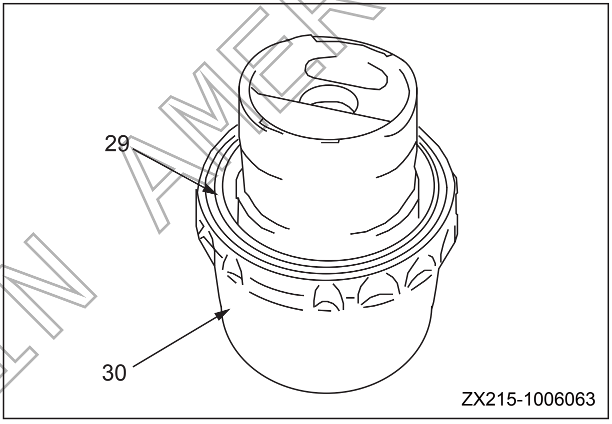
3) Remove the float seal (25).

4) Remove the bearing (26) and bearing (27) from the hub (28).

NOTE: Do not damage the bearing retainer when removing the bearing (26).



5) Remove the float seal (29) from the travel motor.



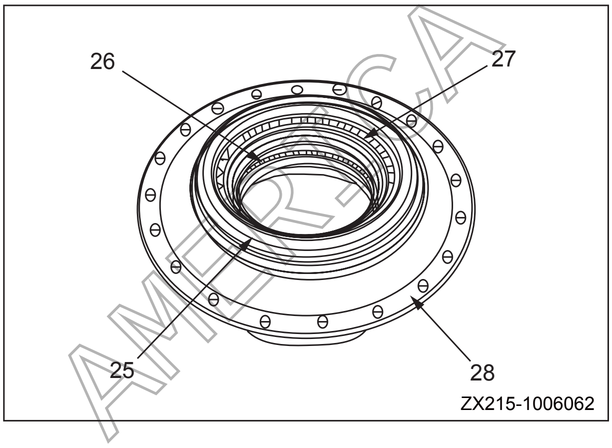
8.11.2 Assembly

NOTE: 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**

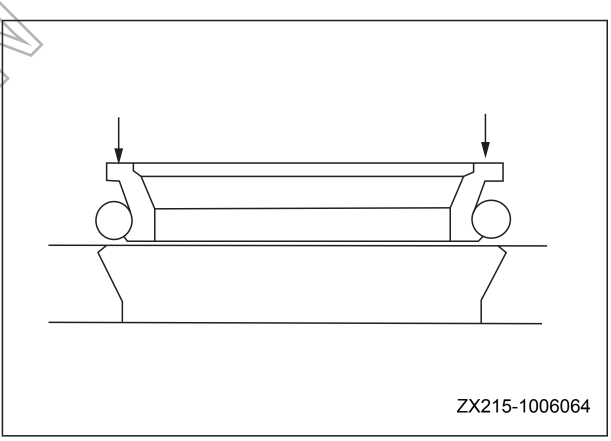
   1) Install the bearing 26 and bearing (27) by pressing them onto the hub (28).

   2) Install the float seal (25).



ZX215-1006062

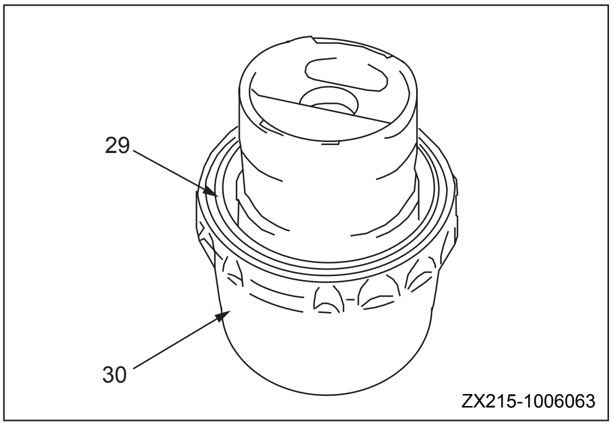
- Remove any oil or dust from the O-ring or O-ring contact surface. Dry the parts before installing the float seal.
- After installing the float seal, check that the angle of the floating seal is within 1 mm.
- Apply a thin layer of engine oil to the sliding surface after the float seal has been installed.



ZX215-1006064

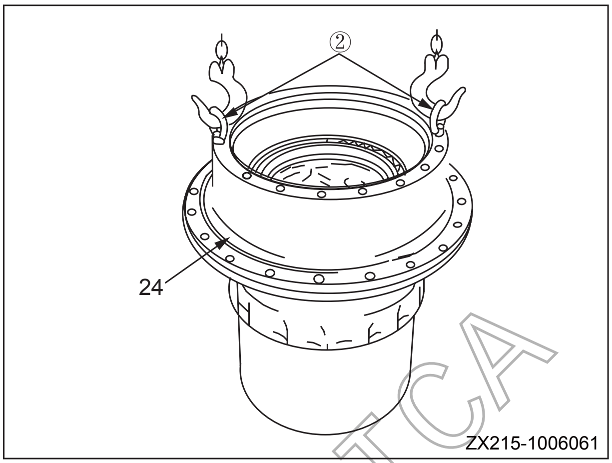
   3) Install the float seal (29) to the travel motor (30).

- See the above step 2 for the installation procedure.



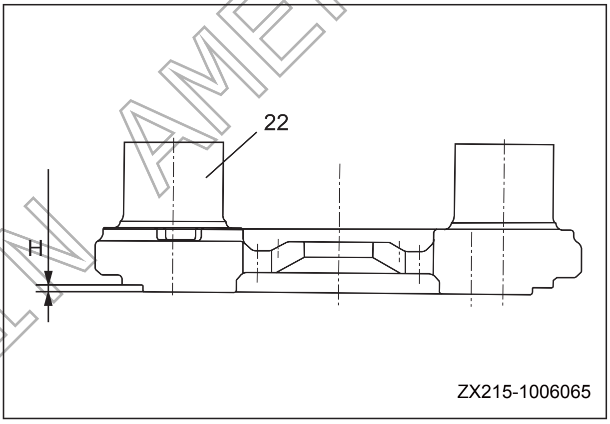
ZX215-1006063

4) Use eyebolts □ to carefully place the hub assembly (24) onto the travel motor. Tap to press fit the bearing.



2. Calculation of shim thickness

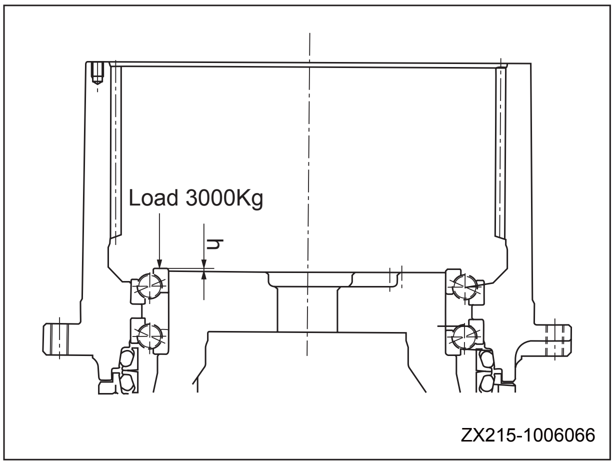
1) Measure the thickness (H) of the raised part of No.2 carrier assembly (22).



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.



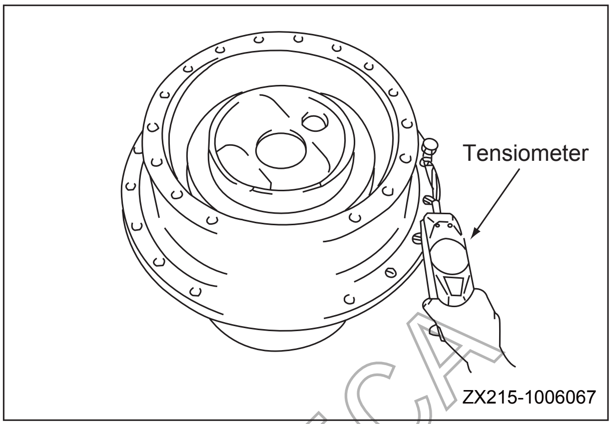
4) Place the shims on the body and insert the dowel pin. Press the carrier assembly onto the dowel pin and tighten it with screw (21). Apply locking adhesive to the threads.

Screw-locking adhesive:

(Tonsan 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.

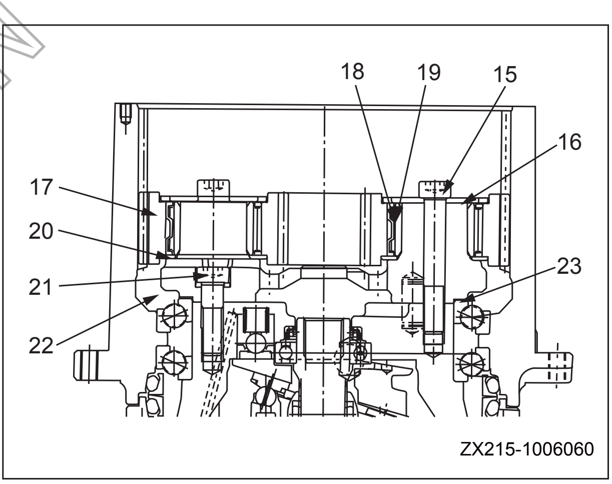
   NOTE: Replace the plates (20) and (16) with new parts.

2) 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).

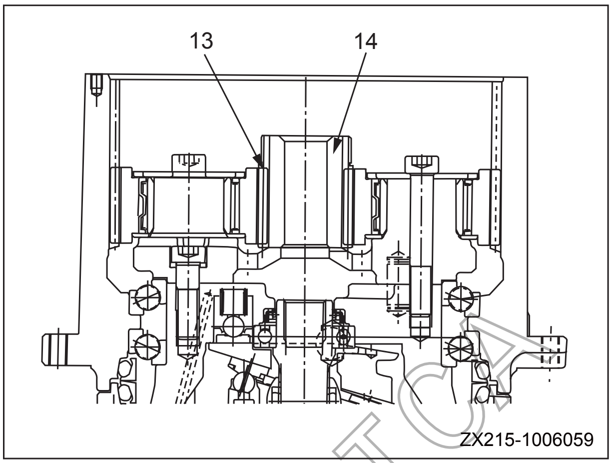
3) Tighten the screw (15).

   Screw (15):

   539±28 N·m {55±2.9 kgf·m}



- Check the flexibility of gear (17) after assembling the planetary carrier assembly.



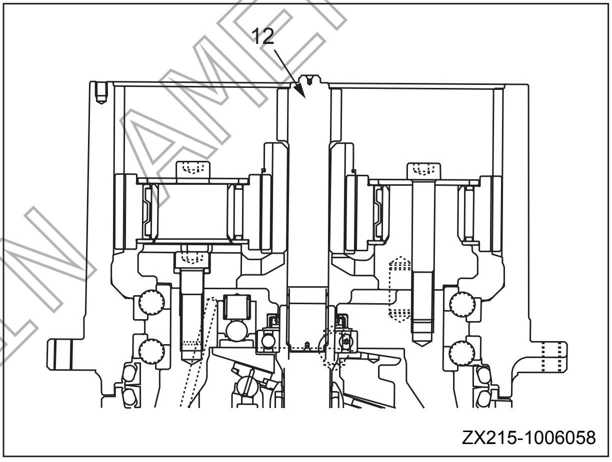
ZX215-1006059

4. Thrust washer

Install the thrust washer (13).

5. No.2 sun gear

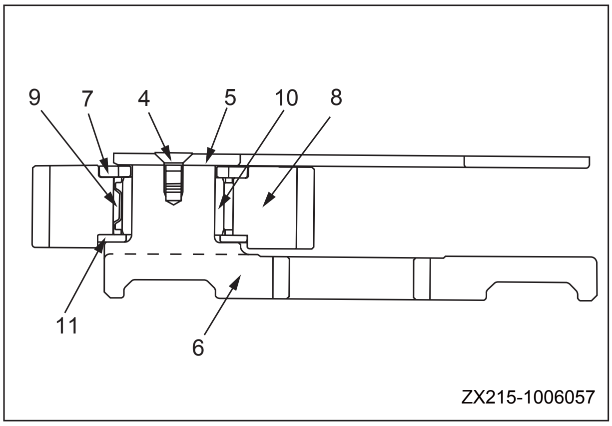
Install No.2 sun gear (14).



ZX215-1006058

6. No. 1 sun gear shaft

Install No.1 sun gear shaft (12).



ZX215-1006057

7. No.1 planetary carrier assembly

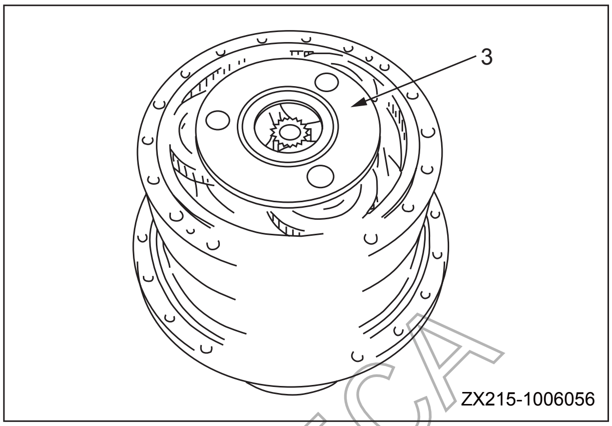
1) No. 1 planetary carrier assembly is assembled as the following.

   NOTE: Replace the thrust washers (7) and (11) with new parts.

2) 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).

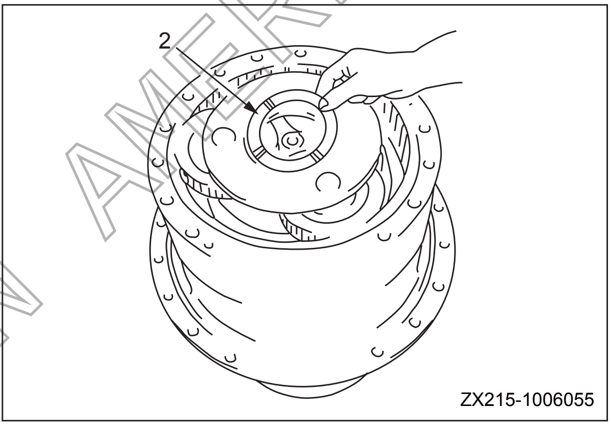
3) Fix the coverplate (5) to the carrier assembly (6) with screw (4).

4) Install No.1 planetary carrier assembly (3).



8. Spacer

Install the spacer (2).

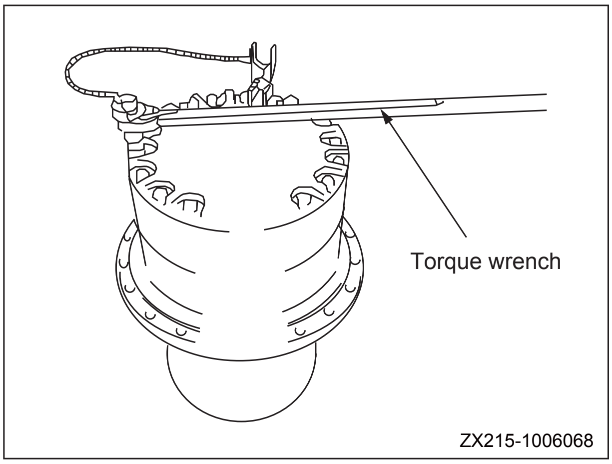


9. Cover

Use eyebolts □ 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.

8.12 Swing Motor and Swing Drive AS - Remove and Install

8.12.1 Removal

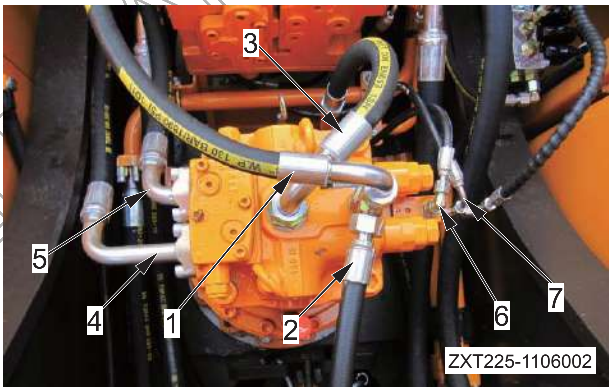
CAUTION

- **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.**

Release the residual pressure in the hydraulic circuit. Refer to “Residual Pressure in Hydraulic Circuit - Release” on page 6-40.

1. Disconnect the hoses (1) to (7).

- Between hydraulic tank and swing motor (port DR)
- Between central swivel joint and swing motor (port DR)
- Between swing motor and main valve (port M)
- Between swing motor and main valve (port HA)
- Between swing motor and main valve (port HB)
- Between swing motor and main valve Px port (port SH)
- Between swing motor and solenoid valve block (port PG)

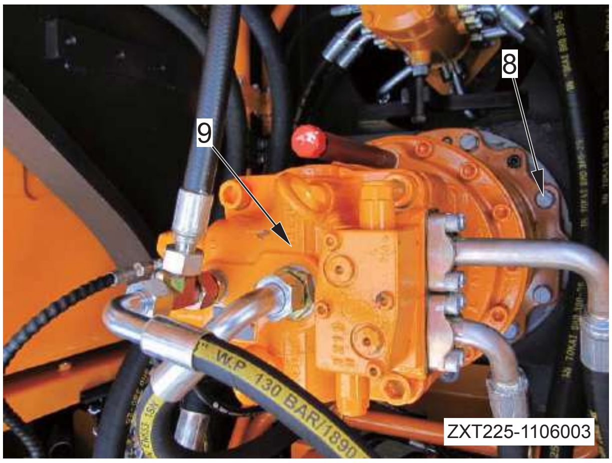


2. Remove the 11 fixing bolts (8).

3. Lift the swing motor and swing drive assembly (9) for disassembling.

NOTE: 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



8.12.2 Installation

- Installation is performed in the reverse order of removal.

  🔧 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 6-46.

8.13 Swing Motor and Swing Drive AS - Disassemble and Assemble

8.13.1 Disassembly

1. Draining of oil

Open the drain plug to drain the oil from the swing drive.

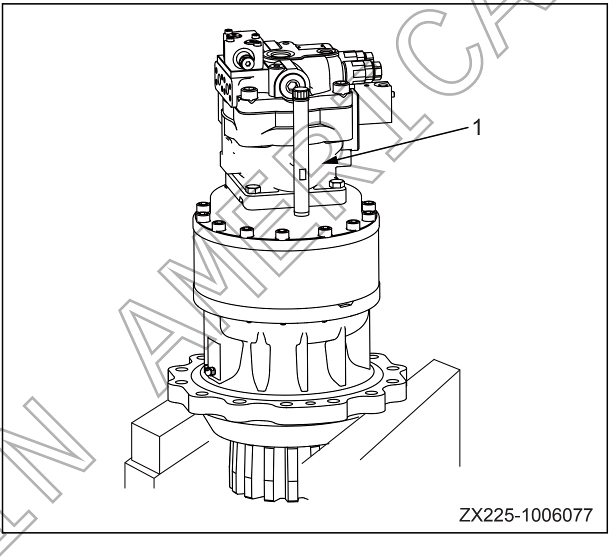
Swing drive: approx. 4.4 L

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.

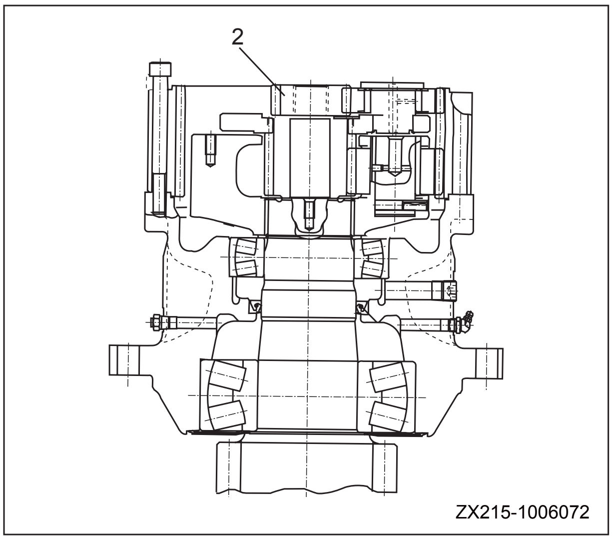
2) Unscrew the 14 bolts in order to remove the swing motor assembly (1).

Swing motor assembly: 70 kg



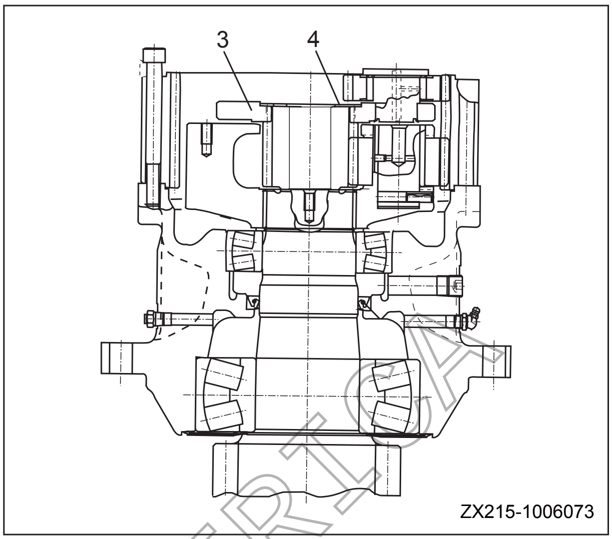
3. No.1 sun gear

1) Remove No.1 sun gear (2).



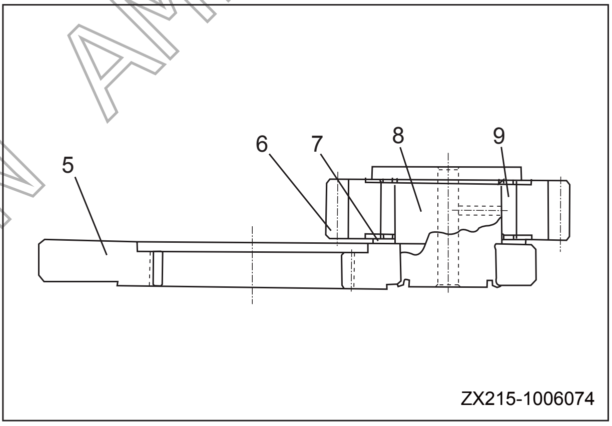
4. No.1 planetary carrier assembly

1) Remove No.1 carrier assembly (3) and the plate (4).



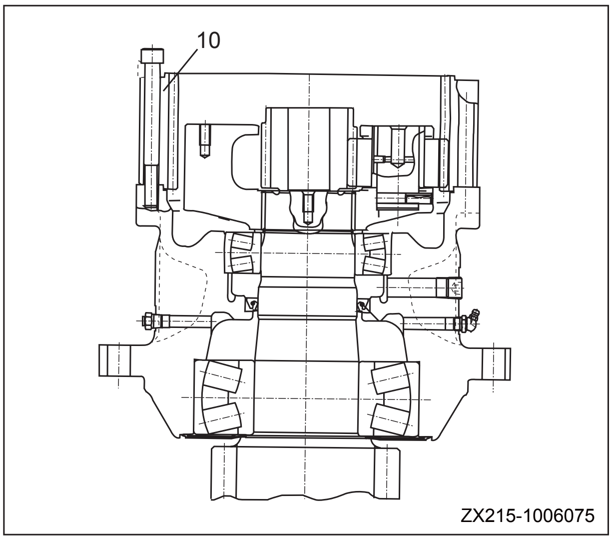
2) Disassemble the carrier assembly.

Cut the rivets on the shaft (8) to remove the shaft (8), and remove in turn the gear (6), bearing (9) and plate (7).



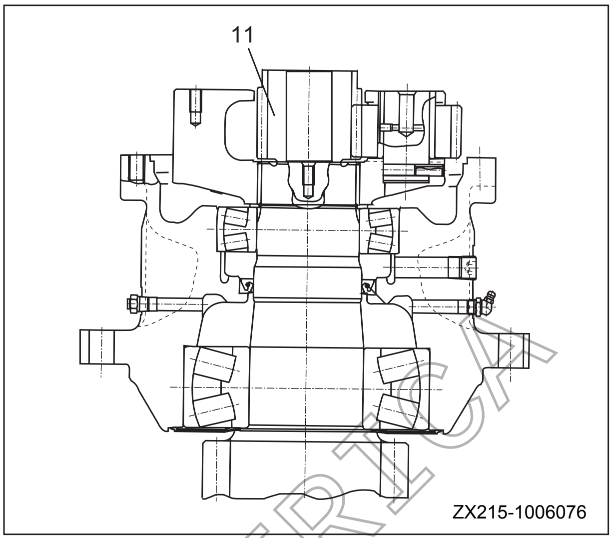
5. Ring gear

Unscrew the mounting bolts to remove the ring gear (10).



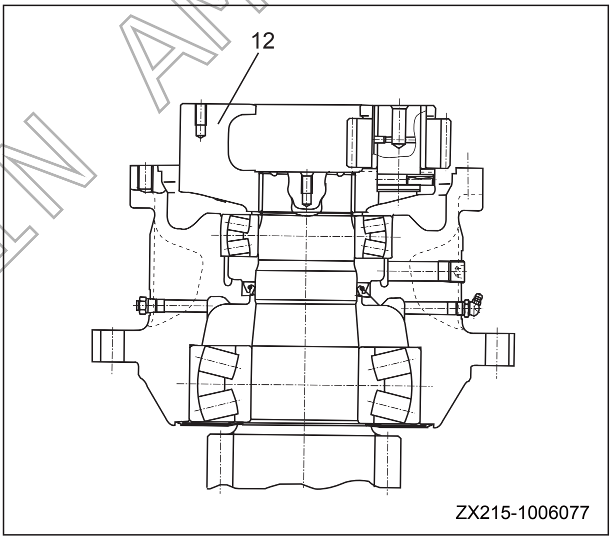
6. No. 2 sun gear

Remove No. 2 sun gear (11).



7. No.2 planetary carrier assembly

1) Remove No.2 carrier assembly (12).
2) Disassemble No. 2 carrier assembly as per the following procedure.

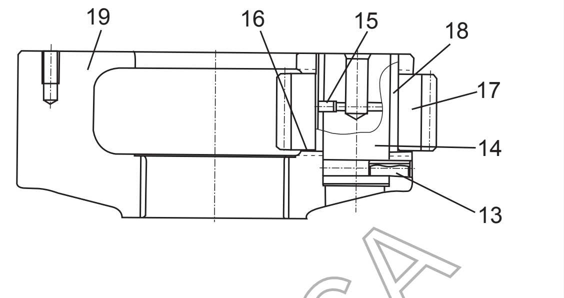


3) Insert pin (13) and push the shaft (14) out of the carrier assembly (19).

   NOTE: Pull out the pin (13) after removal of the shaft.

4) Remove the thrust washer (16), gear (17) and a second thrust washer (19).

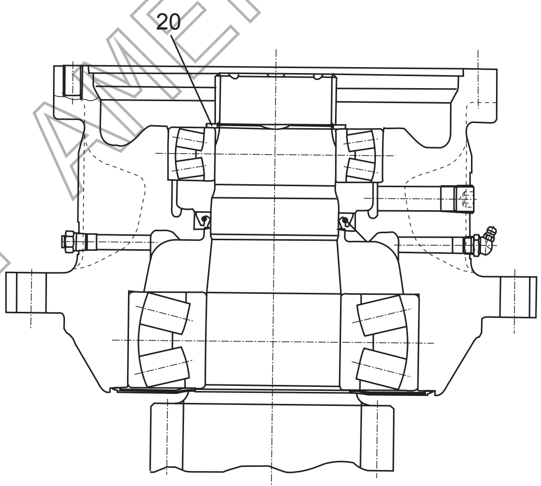
5) Insert the pin (15) to remove the bearing (18) from the shaft. Remove the pin (15).



ZX215-1006078

8. Snap ring

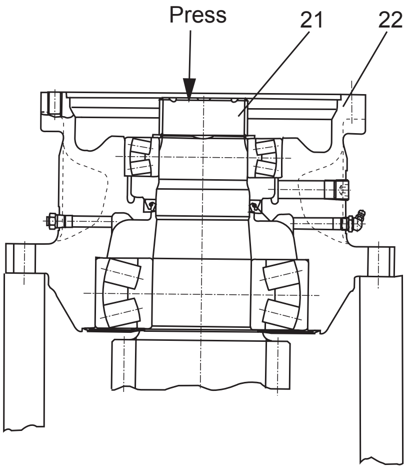
Remove the snap ring (20).



ZX215-1006079

9. Disassembly of main shaft

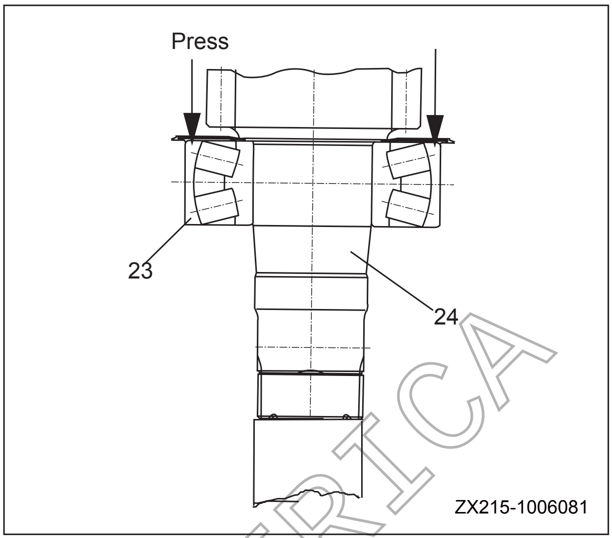
1) Place the shaft housing assembly on a press and push the shaft assembly (21) out of the shaft housing assembly (22).



ZX215-1006080

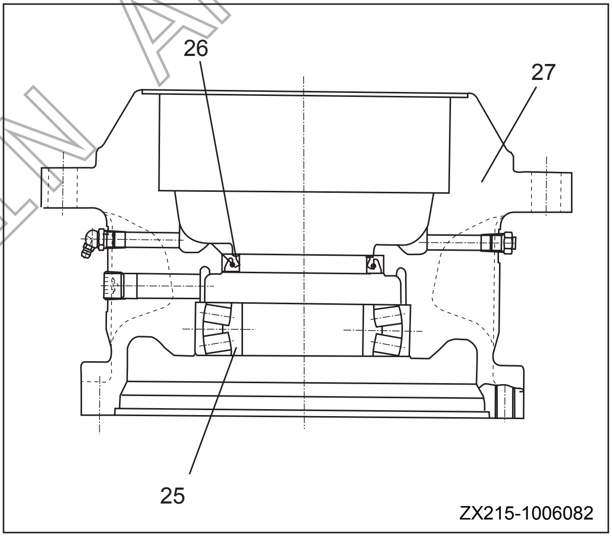
2) Disassemble the shaft assembly in the following procedure.

   Remove the bearing (23) from the shaft (24).



10. Bearing

Remove the bearing (25) and the oil seal (26) from the housing (27).

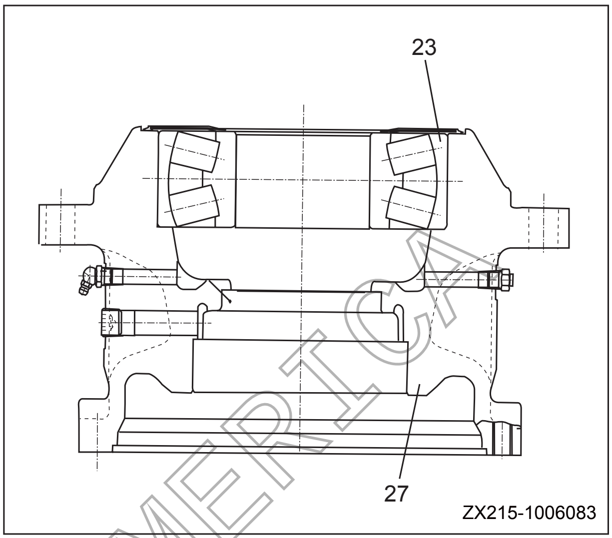


8.13.2 Assembly

NOTE: 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).

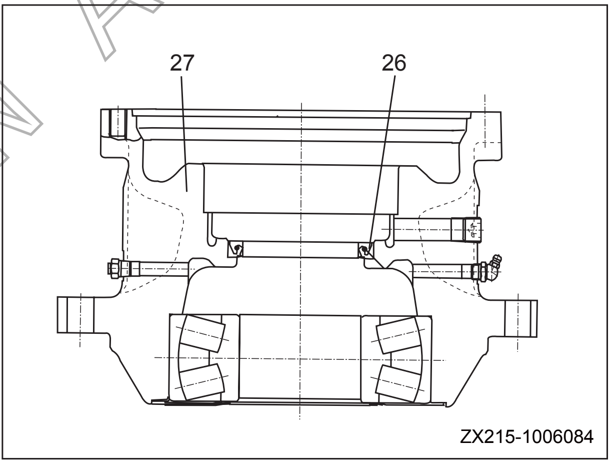


2. Oil seal

Press the oil seal (26) into the housing (27).

Oil seal installation surface:

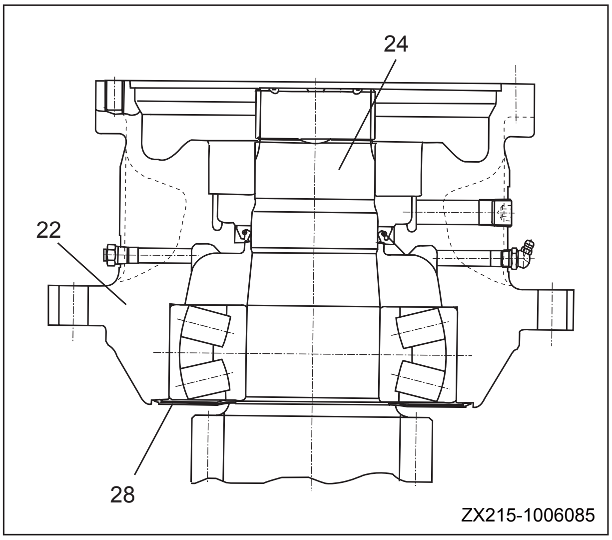
Gasket sealant (Loctite 515)



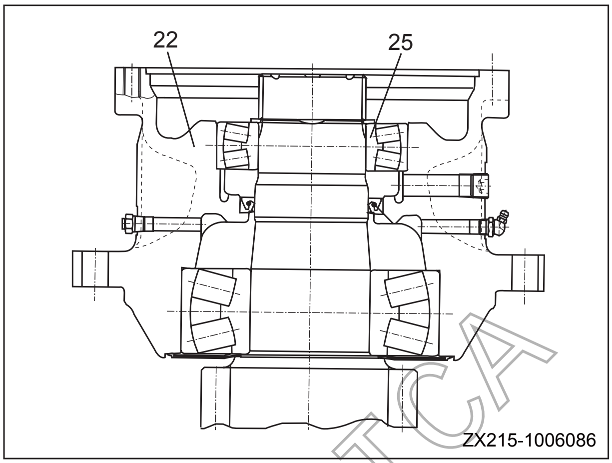
3. Housing assembly

1) Position the plate (28) on the shaft (24).

2) Position the housing assembly (22) on the shaft (24). Press in the bearing.



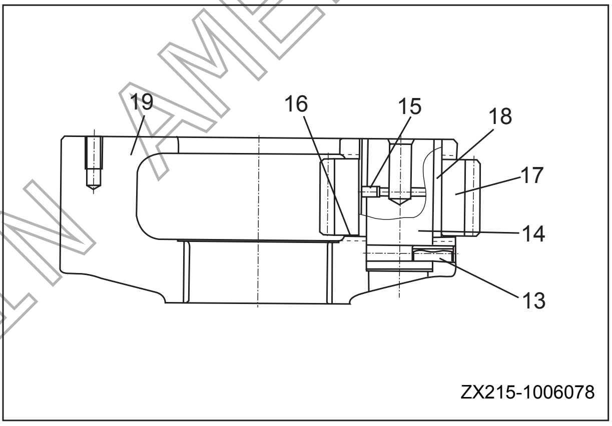
4. Bearing



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.

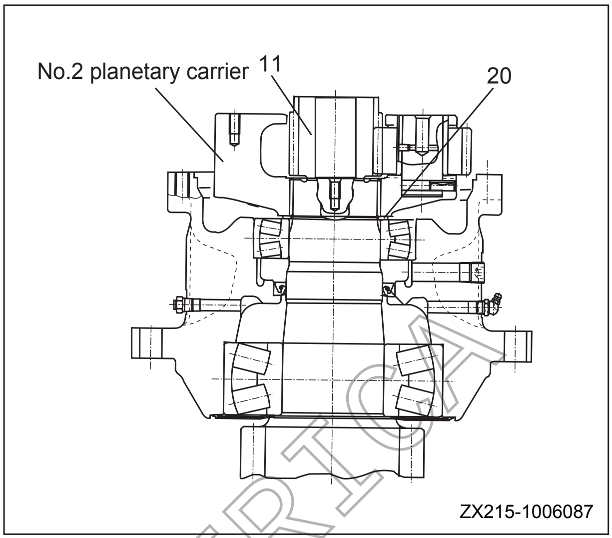
5. No. 2 Planetary carrier assembly



1) Reassemble No. 2 carrier assembly according to the following procedure.
2) Assemble the plate (16) in the carrier assembly (19).
3) 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).
4) 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.

NOTE: Installation of the shaft requires rotating the planetary gear. Be careful not to damage the thrust washer.

6. **Assemble in turn the snap ring (20), No.2 carrier assembly and No.2 sun gear (11).**

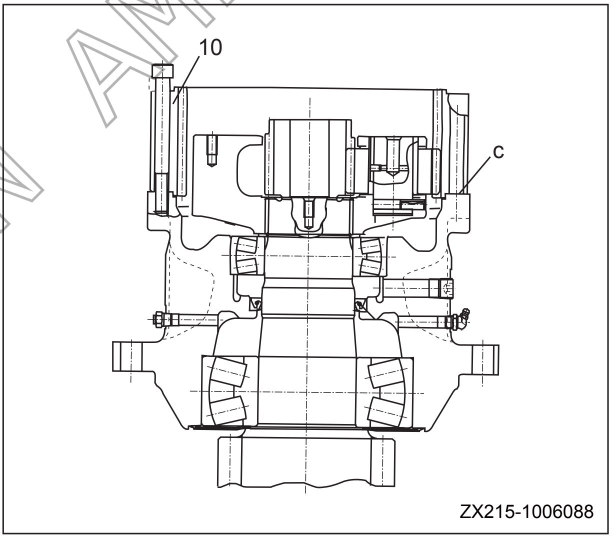


7. Installation of ring gear

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

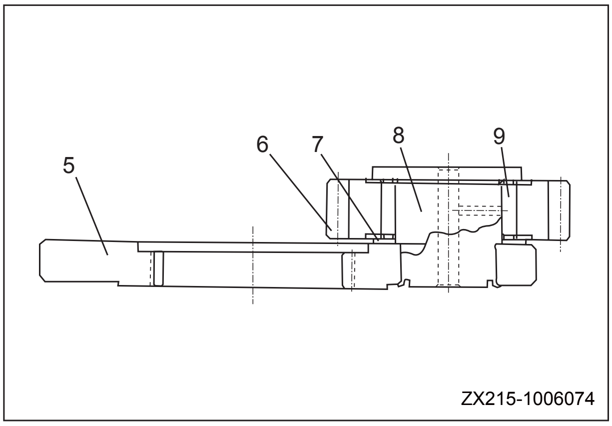
1) No. 1 carrier assembly is assembled as per the following procedure.

2) Install the plate (7) into the carrier assembly (5).

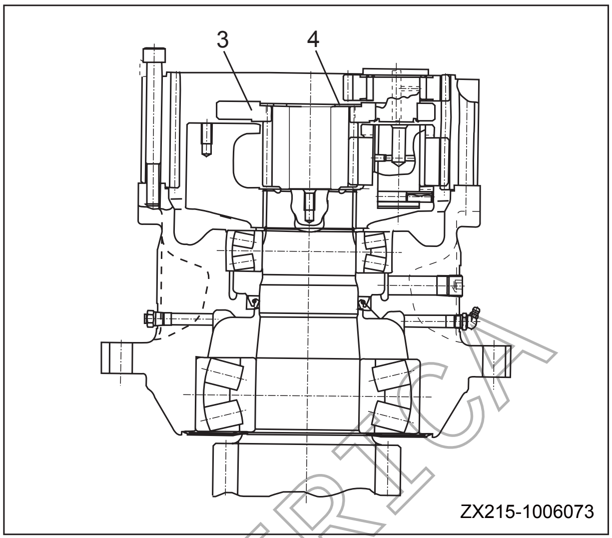
3) Install the gear (6) onto the plate after installing the bearing (9) into the gear.

4) 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.

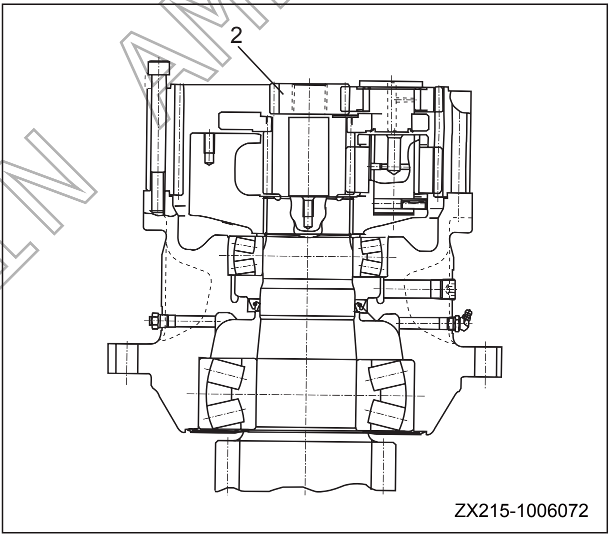


5) Install No. 1 carrier assembly (3) and the plate (4).



9. No. 1 sun gear assembly

Install No. 1 sun gear (2).



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:

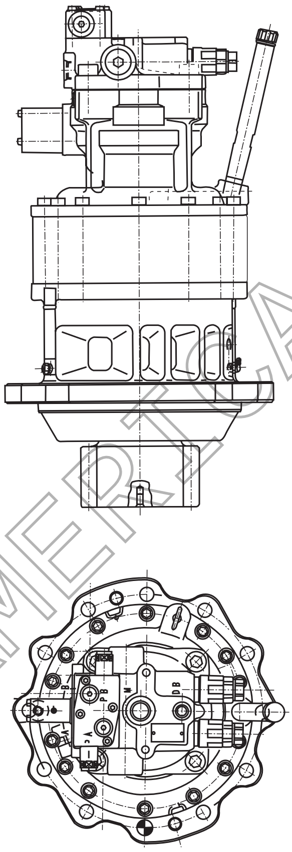
Sealant (Loctite 515)

Swing motor assembly: 55 kg

Mounting bolts (swing motor):

156±5 N·m {16±0.5 kg}

NOTE: 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.



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11. Lubricant adding

Screw on the drain plug and add lubricant through the filler to the specified level (the upper mark of oil stick).

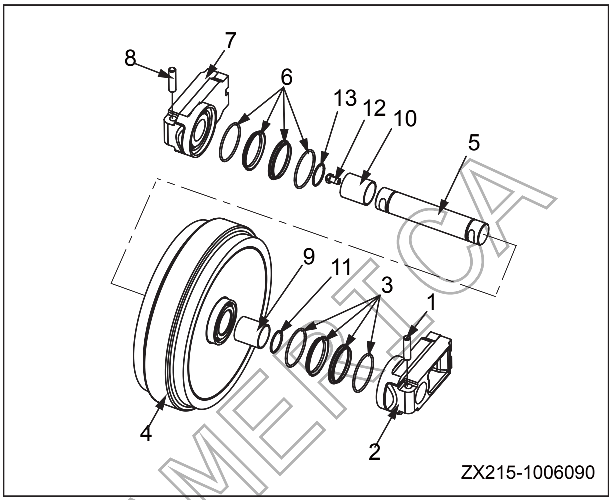
Swing drive: approx. 4 L

8.14 Idler AS - Disassemble and Assemble

8.14.1 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).

   NOTE: 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.



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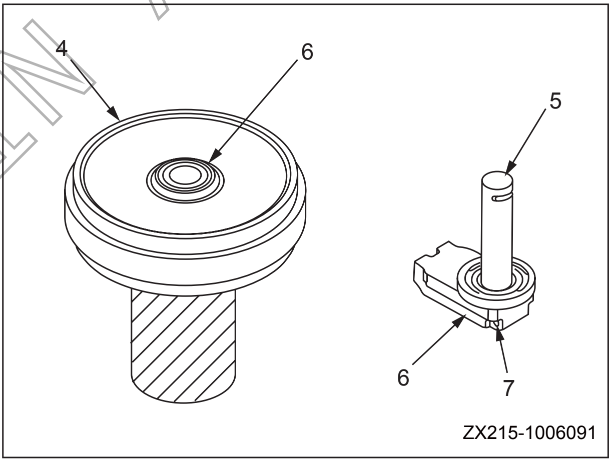
4. Remove the float seals (6) on the other side from the idler (4), shaft (5) and support assembly (7).



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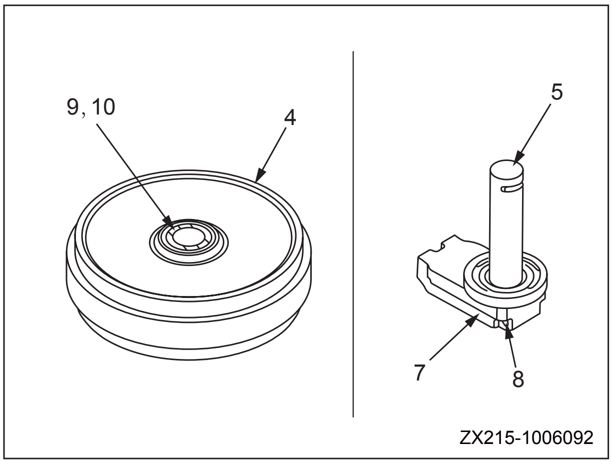
5. Remove the dowel pin (8) in order to remove the support (7) from the shaft (5).
6. Remove the bushings (9) and (10) from the idler (4).



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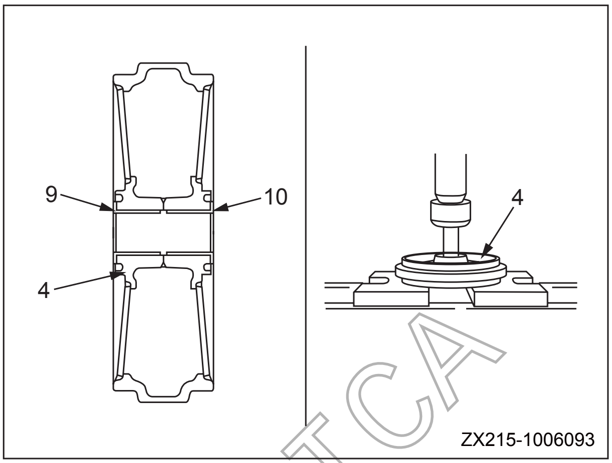
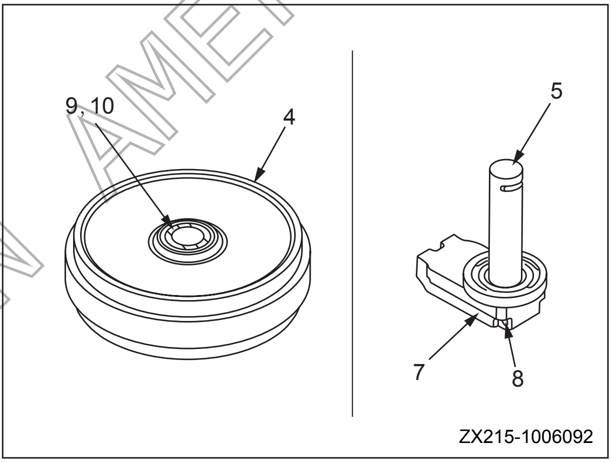
8.14.2 Assembly

1. Install the bushings (9) and (10) in the idler (4).



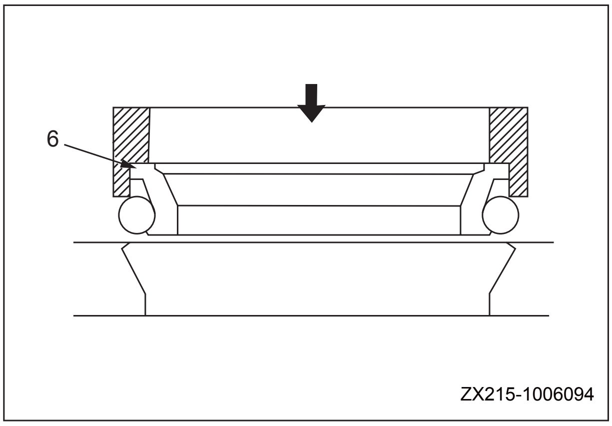
2. Assemble the O-ring. Install the support (7) to the shaft (5) with the dowel pin (8).



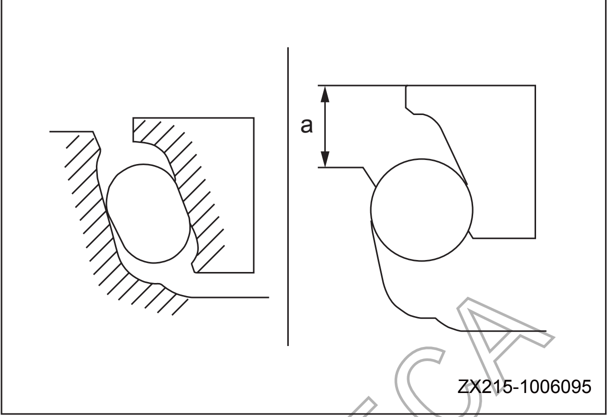
3. Install the float seals (6) to the idler (4), shaft (5) and support (7) assembly.

   - Float seals

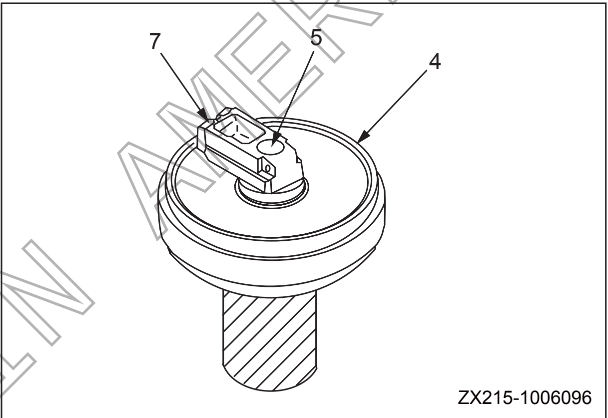
     Completely remove the grease from the contact surfaces (hatched area in the illustration on the right) of O-ring and float seal before installing the float seal. In addition, care must be taken to keep the contact surface of float seal free from dust.



- 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.



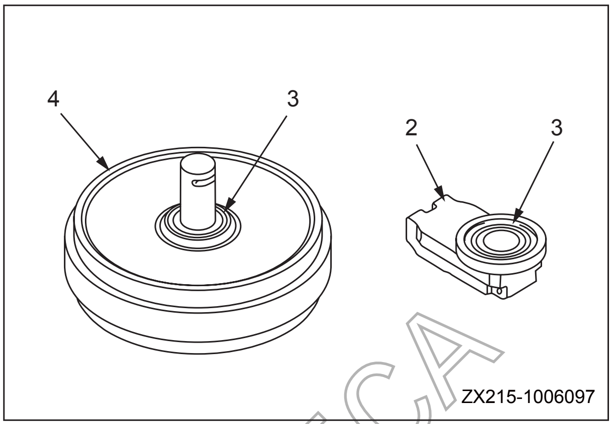
4. Install the shaft (5) and support (7) assembly to the idler (4).

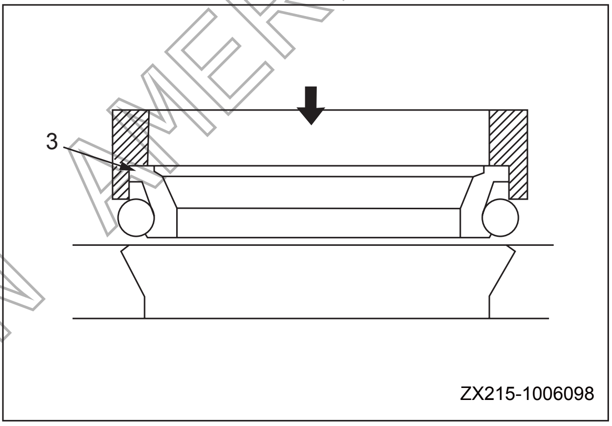


5. Install the float seal (3) to the idler (4) and support (2).

   NOTE: Apply oil to the sliding surface of float seal. Care must be taken to keep the sliding surface from any contaminants or dust.

   NOTE: Remove the oil and dust from the contact surfaces of the O-ring and float seal.





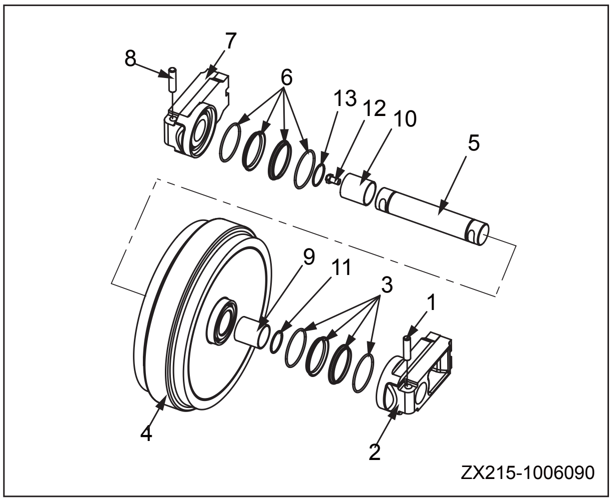
6. Install the O-ring. Install the support (2) with the dowel pin (1).
7. Add oil and screw on the plug.

Oil: approx.

80 ml (No.18 hyperbola gear oil)

Plug:

205.8±49 N·m {21±5 kgf·m}



8.15 Sprocket - Remove and Install

8.15.1 Removal

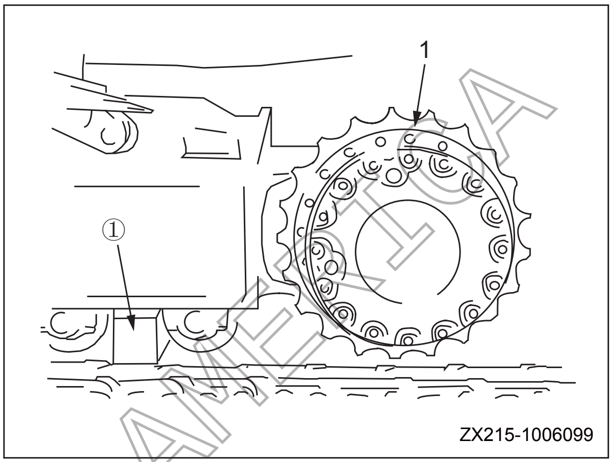
1. Remove the track assembly.

   Refer to “Track AS - Remove and Install” on page 8-63.

2. Swing the work equipment 90°and lift the chassis with the work equipment. Place a block □ between the track frame and the track shoe.

3. Remove the sprocket (1).

   Sprocket: 58 kg



8.15.2 Installation

- Installation is to be performed in the reverse order of removal.

  Threads (bolt - sprocket):

  Thread sealant (Tonsan 1277)

  Bolts (sprocket):

  339±20 N·m {35±2 kgf·m}

8.16 Track AS - Remove and Install

Special tools

Mark	Part Name	Necessity	Qty
M	Manual/electric hydraulic track removing/installing machine	●	1

8.16.1 Removal

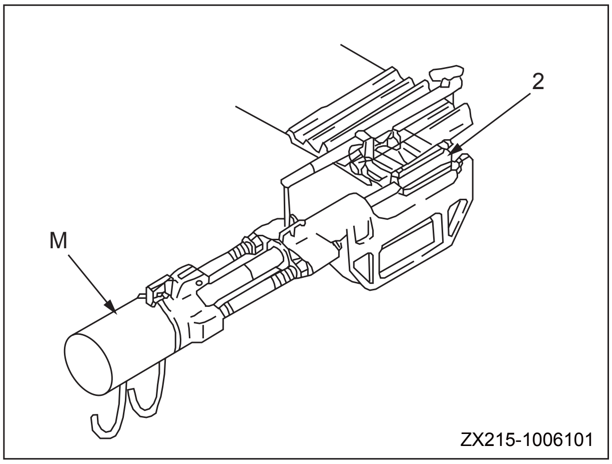
1. Choose a place that has enough space to spread the track. Park the machine when the master pin is between the idler and the carrier roller.

2. Lower the work equipment. Loosen the grease fitting (1) and release the track tension.

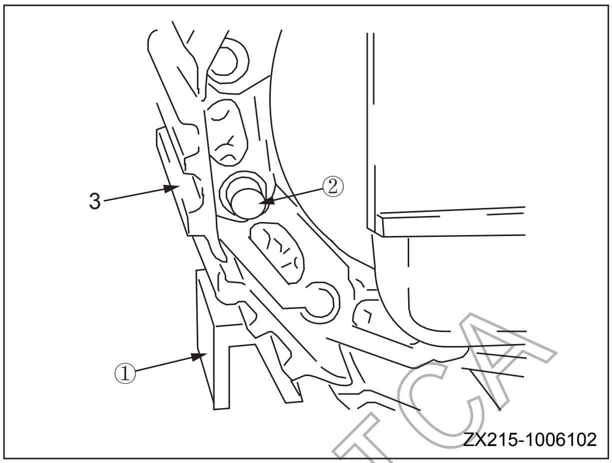
⚠ WARNING

- **The adjustment cylinder is under extremely high pressure. Never loosen the grease fitting by more than one turn.**

3. Pull out the master pin (2) with the tool (M).



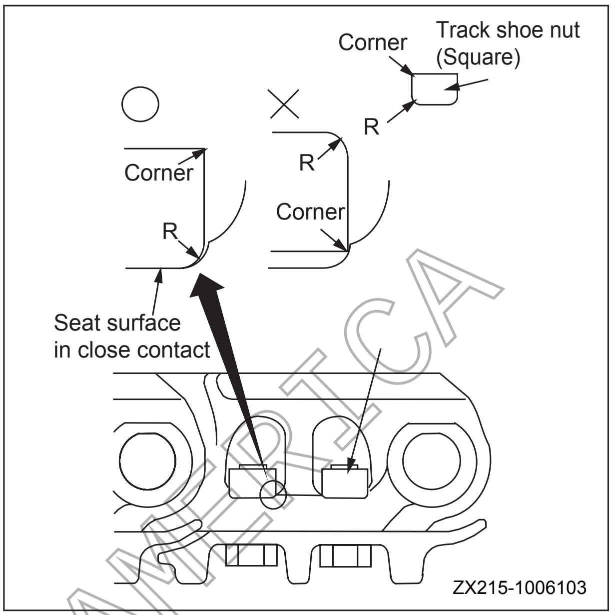
4. Remove the tool (M). Move the machine forward so that the temporary pin □ is in front of the idler. Place the block □.
5. Remove the temporary pin□ and the dust seal. Move the machine backward to spread the track (3).



8.16.2 Installation

- Installation is to be performed in the reverse order of removal.

  For more information, see “Track Tension - Test and Adjust” on page 6-24.



- 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.

   NOTE: 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.

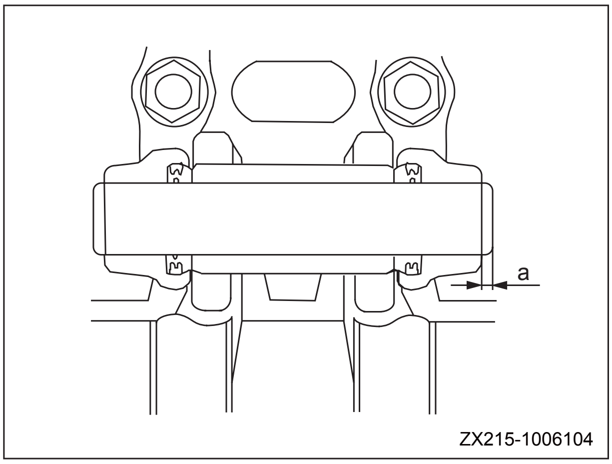
2. Tighten the bolts of track shoe to the torque below.

   Track shoe bolts:

   750±30 N·m {77±3 kgf·m}

- 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



- Before installing the dust seal, apply grease (No.2 lithium base) to its contact surface with the bushing.

8.17 Swing Bearing AS - Remove and Install

8.17.1 Removal

1. Remove the swing platform assembly.

   For more information, see “Swing Platform AS - Remove and Install” on page 8-68.

2. Dismount the 36 bolts (1) to remove the swing bearing assembly.

3. Hoist the swing bearing assembly (2).

   Swing bearing assembly: 314 kg

8.17.2 Installation

- Installation is to be performed in the reverse order of removal.

  Threads (bolt - swing bearing):

  Thread adhesive (Tonsun 1277)

  Mounting bolts (swing bearing):

  Step 1:

  Use a pneumatic spanner to tighten the bolts.

  Step 2:

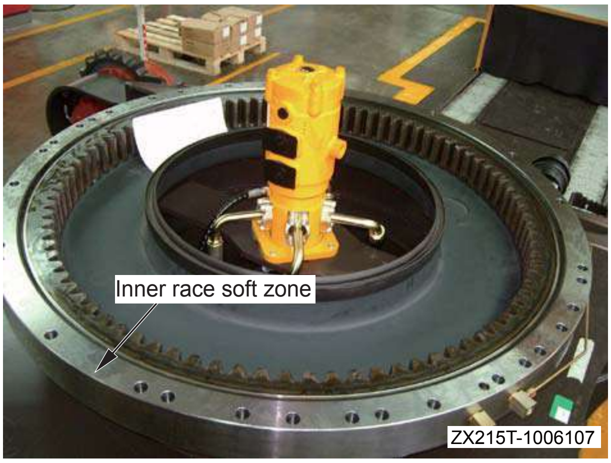
  Torque to: 549±59 N·m {56±6kgf·m}

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.
   - 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.

     NOTE: All gear teeth must be covered by grease .

     Swing bearing:

     Grease(supramoly lithium base):15 L



8.18 Swing Platform AS - Remove and Install

8.18.1 Removal

CAUTION

- **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.

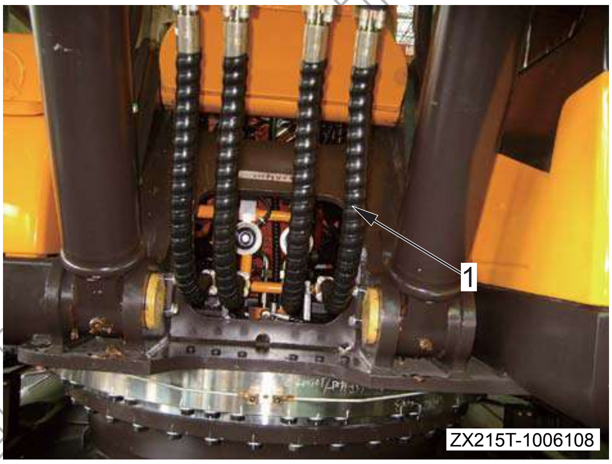
   For more information, see “Work Equipment AS - Remove and Install” on page 8-105.

2. Remove the counterweight assembly.

   For more information, see “Counterweight AS - Remove and Install” on page 8-113.

3. Remove the four hoses (1) of boom cylinder.

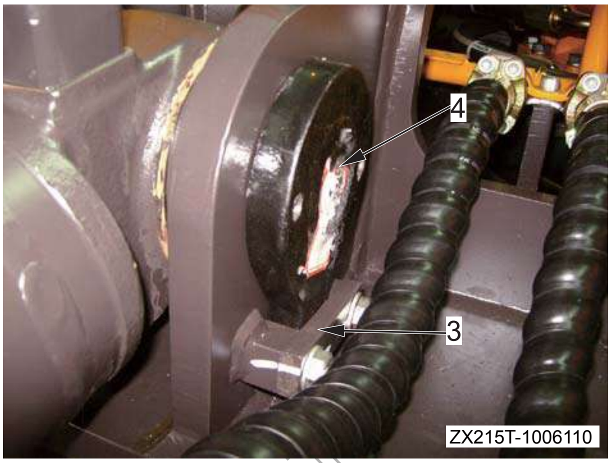
   NOTE: Plug the hoses to prevent flow of oil.



4. Lift the boom cylinder assembly (2).

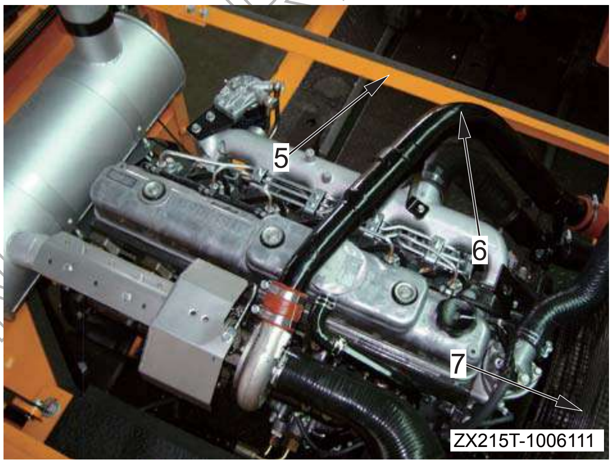
5. Remove the plate (3) and the pin (4). Lift the boom cylinder assembly (2) in order to remove it.
    - Remove the boom cylinder assembly on the other side in the same way.

      Boom cylinder AS: 230 kg

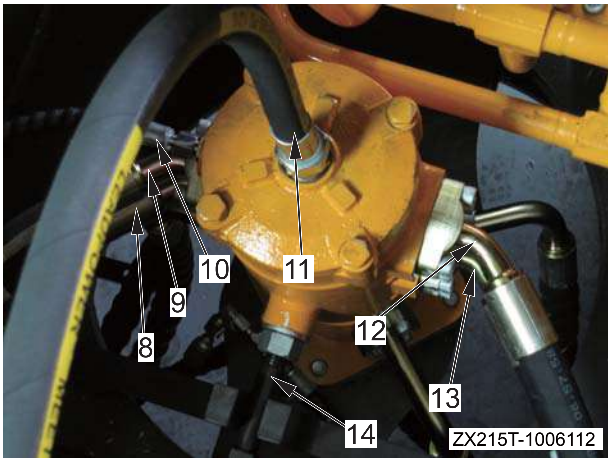


6. Remove the plate (5), air intake hose (6) and fan guard (7).

   NOTE: Removal of the swing platform requires removing other parts that interfere with the lifting of swing platform.



7. Disconnect the six hoses above the swivel joint assembly.
    - Central swivel joint (port A) - Left travel control valve (port BTL)
    - Central swivel joint (port C) - Left travel control valve (port ATL)
    - Central swivel joint (port F) - Solenoid valve
    - Central swivel joint (port G) - Swing motor (port T)
    - Central swivel joint (port D) - Right travel control valve (port ATR)
    - 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.

   NOTE: 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.

NOTICE

- **Be careful not to impact the central swivel joint while removing the swing platform assembly.**

Swing platform assembly:

Assembly	Swing Platform Only (Ref.)
8,427 kg	1,689 kg

8.18.2 Installation

- Installation is to be performed in the reverse order of removal.

  Clamping screws (air intake hose):

  5.4~6.4 N·m {0.55~0.65 kgf·m}

  Mating surface (swing bearing):

  Flat surface sealant (Tonsun 1596)

  Threads (bolt - swing platform):

  Thread adhesive: (Tonsun 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 6-46.

8.19 Swivel Joint AS - Remove and Install

8.19.1 Removal

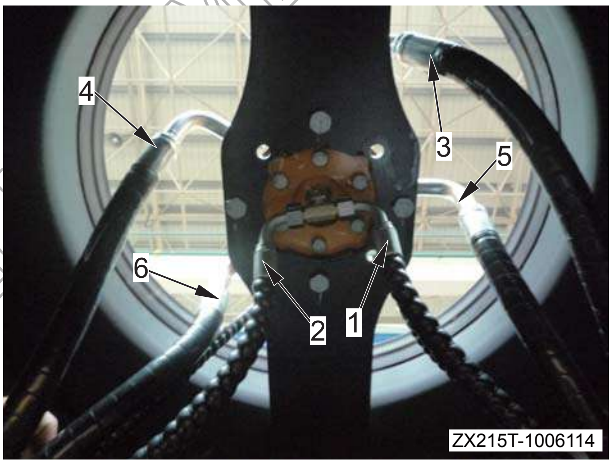
WARNING

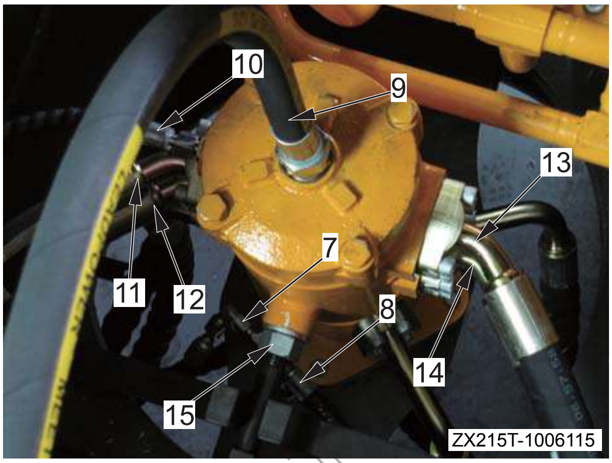
- **Release residual pressure in the hydraulic circuit before disconnecting the hydraulic hoses.**

Refer to “Residual Pressure in Hydraulic Circuit - Release” on page 6-40.

NOTE: 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)

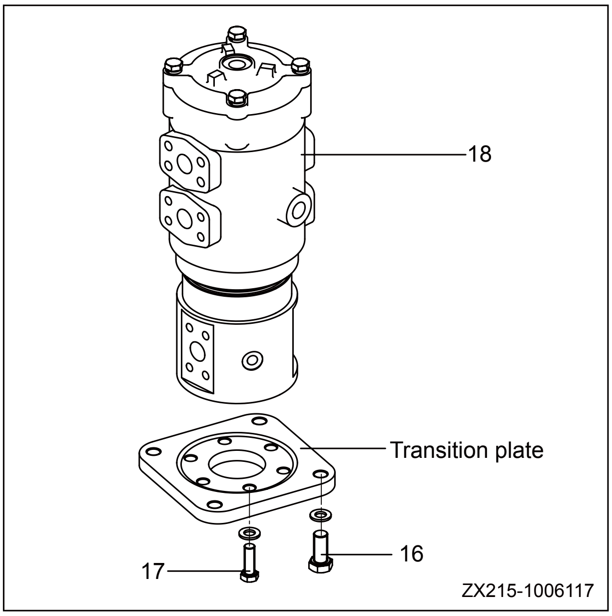




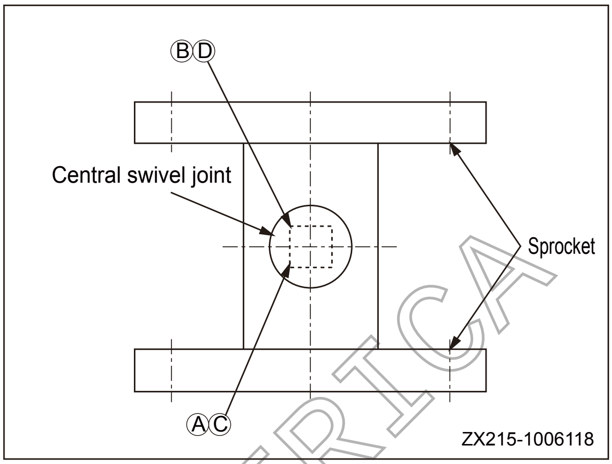
2. Disconnect the eight hoses from (7) to (14).
   7) Central swivel joint (port F) - Left travel motor (port P)
   8) Central swivel joint (port F) - Right travel motor (port P)
   9) Central swivel joint (port G) - Swing motor (port T)
   10) Central swivel joint (port F) - Solenoid valve
   11) Central 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).

Central swivel joint: 56 kg



8.19.2 Installation



- Installation is to be performed in the reverse order of removal.

  NOTE: Install the central swivel joint facing the direction indicated in the illustration.

- 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.

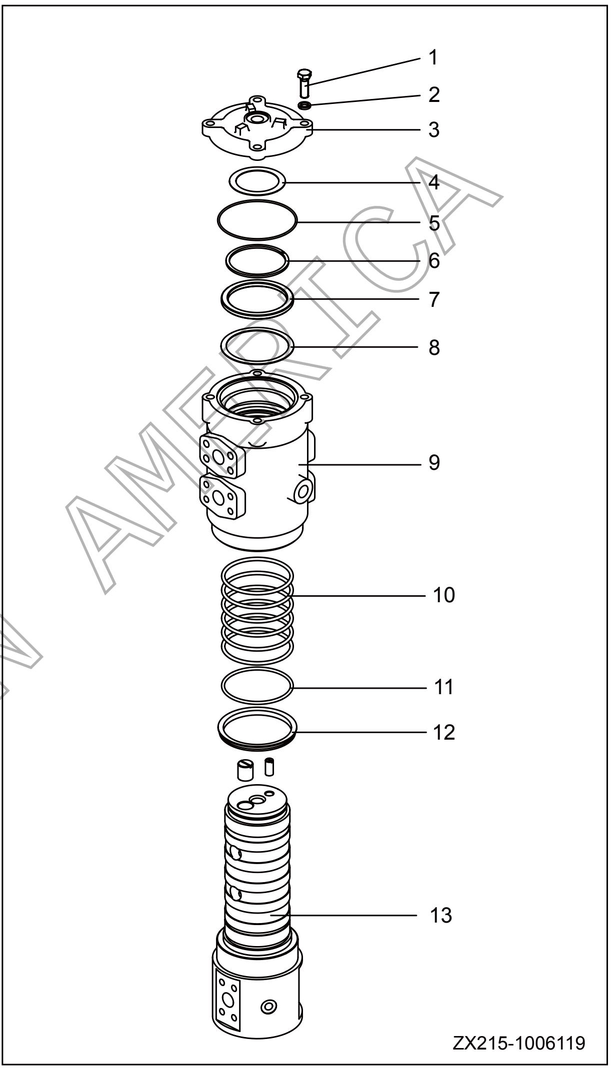
  For more information, see “Air in Each Component - Bleed” on page 6-46.

8.20 Swivel Joint AS - Disassemble and Assemble

8.20.1 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).

   NOTE: 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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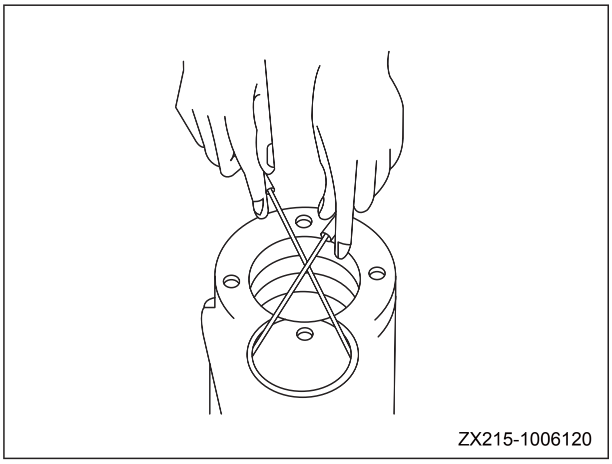

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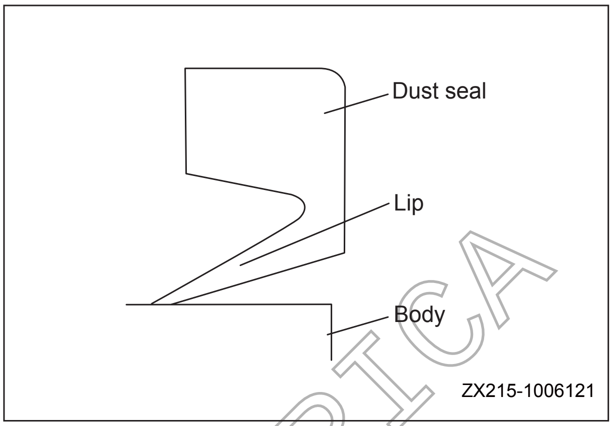
8.20.2 Assembly



1. Install the dust seal (12) on the rotor (13).

   NOTE: 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).

   NOTE: 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).

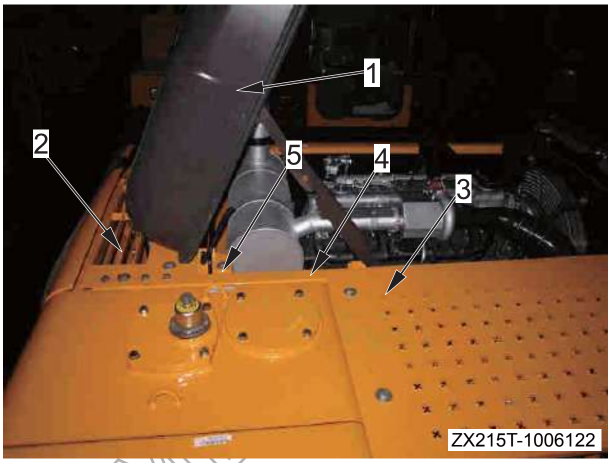
   Fixing bolts: 49 N·m{5 kgf·m}

8.21 Hydraulic Tank AS - Remove and Install

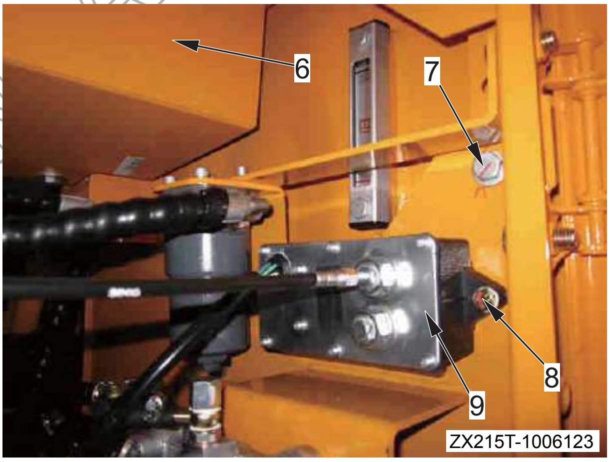
8.21.1 Removal

1. Drain the hydraulic oil into a suitable container for storage or disposal.

   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).

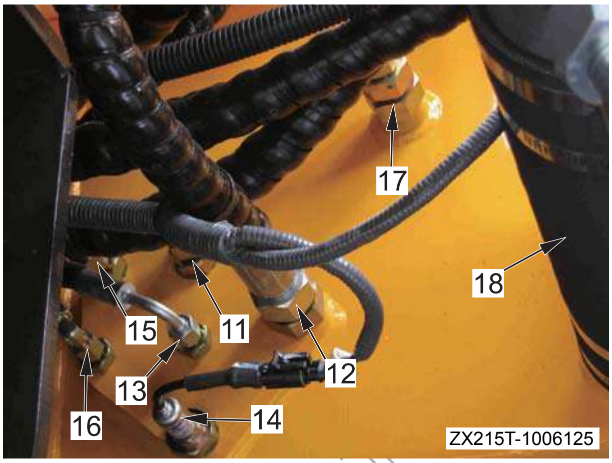


5. Remove the screen (6) and the partition frame mounting bolt (7) on the hydraulic tank side.
6. Remove the screw (8) and the fuel control motor (9).



7. Remove the two oil return hoses (10) from the hydraulic tank.

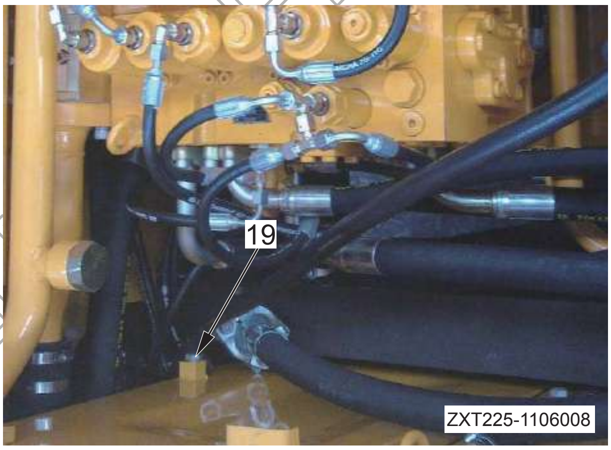
8. Disconnect the seven hoses.
    - (11): Oil return - pilot T block
    - (12): Oil return - main pump
    - (13): Oil return D2 - main valve
    - (14): Sensor - temperature
    - (15): Oil return - solenoid valve
    - (16): Oil return D1/D3 - main valve
    - (17): Oil return - swing motor



NOTE:

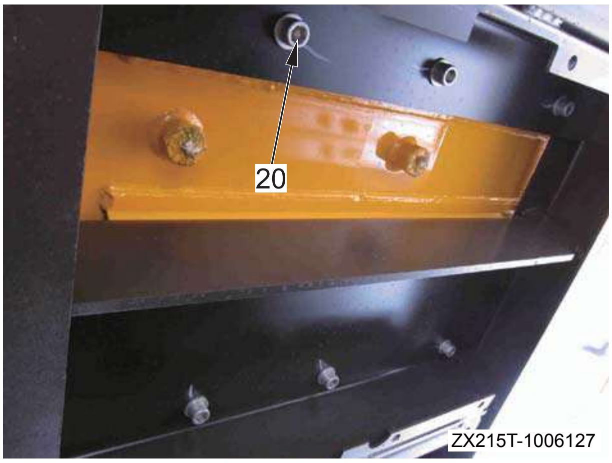
- Disconnect the oil inlet hose (18) from the hydraulic tank after disconnection of the oil inlet tube from the pump.
- Attach each hose with an identification tag.
- Use a sleeve nut to prevent the fitting and the cone seal from damage.

9. Remove the hose clamp (19).



10. Lift the hydraulic tank assembly and remove the six bolts (20).
11. Lift off the hydraulic tank assembly for disassembling.

Hydraulic tank assembly: 130 kg



8.21.2 Installation

- Installation is to be performed in the reverse order of removal.

  Drain plug (hydraulic tank):

  58.8~78.5 N·m {6.0~8.0 kgf·m}

  NOTE: After tightening the hose clamping screw, check that the screw should be in the range indicated in the illustration.

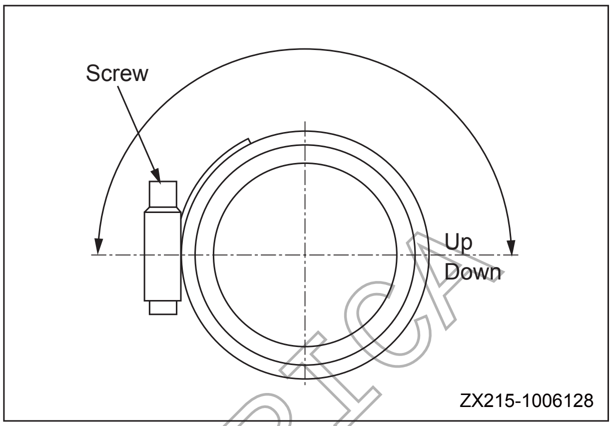
  Screw (hose clamp):

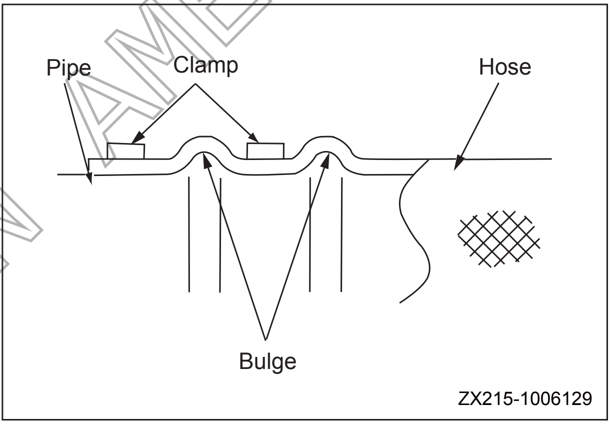
  8.8±0.5 N·m {0.9±0.05 kgf·m}

  - Install the hose clamp and tighten the screw according to the illustration on the right.

  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 6-46.

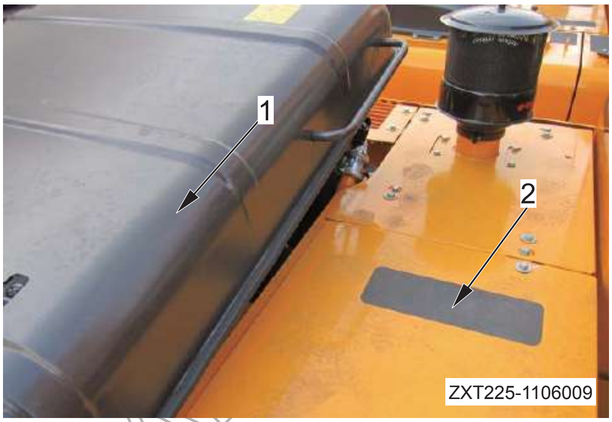
8.22 Control Valve AS - Remove and Install

8.22.1 Removal

WARNING

- **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.**

NOTE: Tag each line so as to ensure correction installation.



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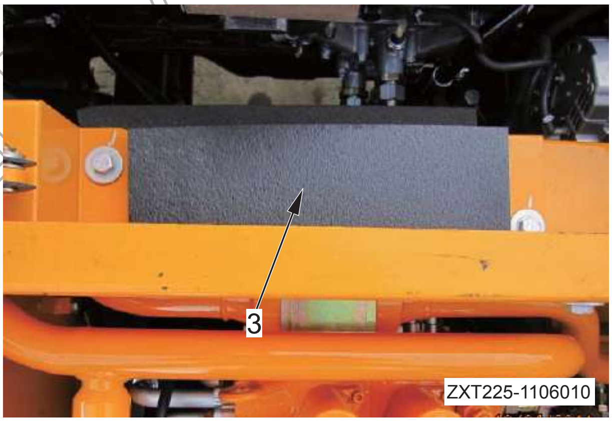
1. Lift the hood (1).
2. Remove the cover (2) above the control valve.
3. Remove the engine silencing hood (3).



ZXT225-1106010

4. Remove the baffle (4) to (9) of the pressure transducer and tag them.

   (4): XAK Bucket DIG

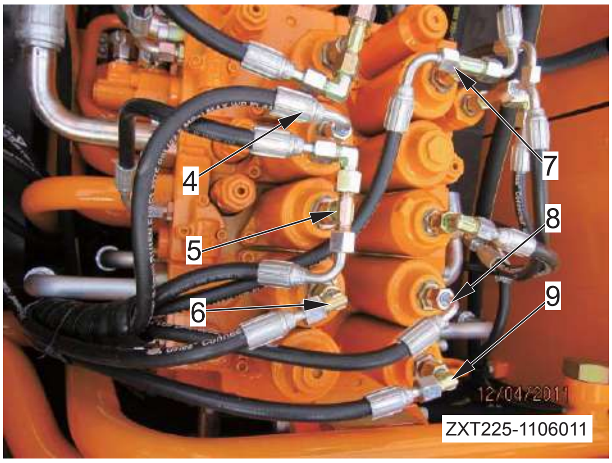
   (5): XBb1 Boom DOWN

   (6): XAtL Travel LEFT

   (7): XBa1 Arm IN

   (8): XBs Swing RIGHT

   (9): XAtr Travel RIGHT



ZXT225-1106011

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

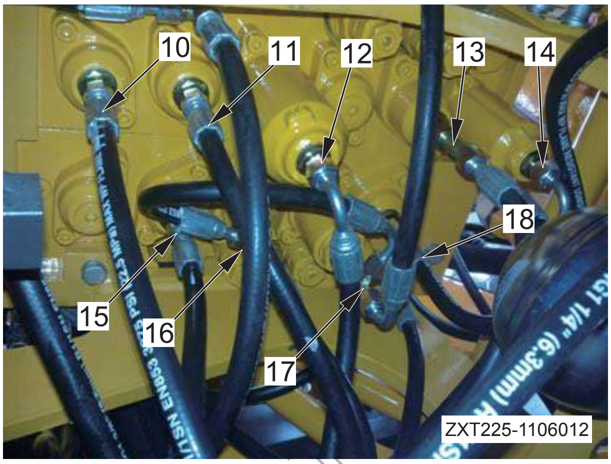
   (14): XBp2 Bucket confluence

   (15): XBtL Travel LEFT

   (16): XAb1 Boom UP

   (17): XBK Bucket DIG

   (18): XAa2 Arm OUT

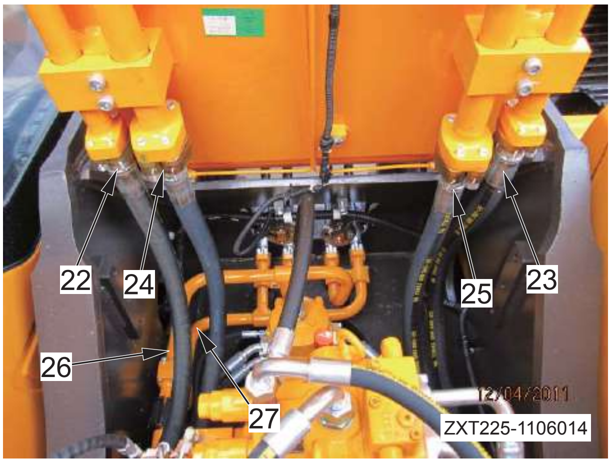


6. Remove the port (19) (accumulator to solenoid valve), port (10) (pilot filter to accumulator). Remove hose clip (21) of the central swivel joint.

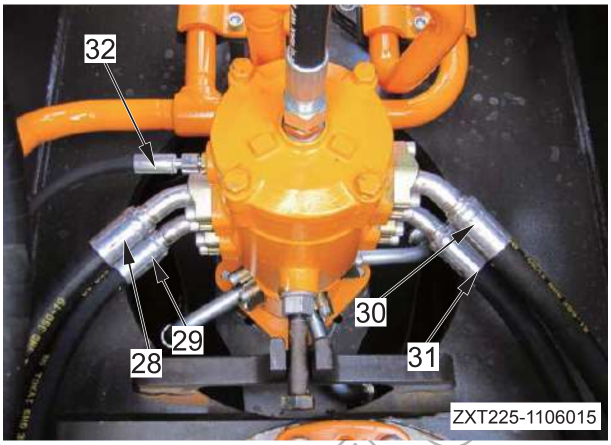
7. Remove bucket hoses (22) and (23) and seal the ports.

8. Remove arm hoses (24) and (25) and seal the ports.

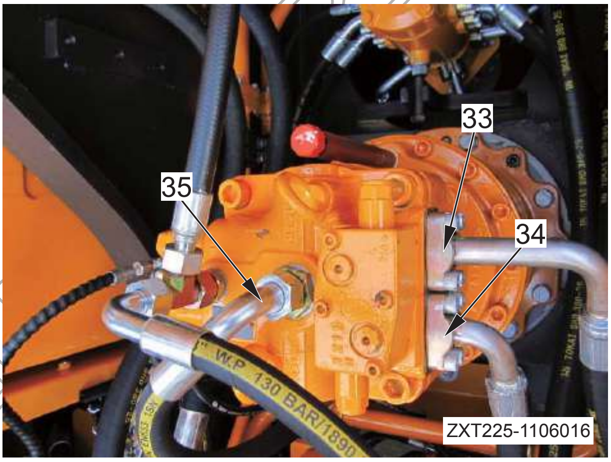
9. Remove boom hoses (26) and (27) and seal the ports.



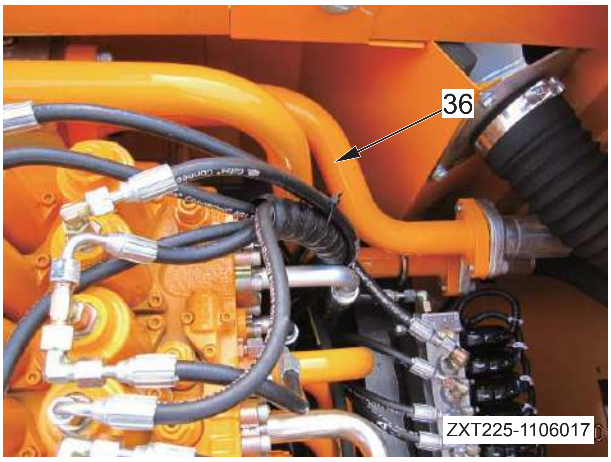
10. Remove central swivel joint hoses (28), (29), (30) and (31). Remove travel speed switching hose (32) and seal the ports.



11. Remove swing motor hoses (33) and (34). Remove swing motor oil complement hose (35). Seal the ports properly.

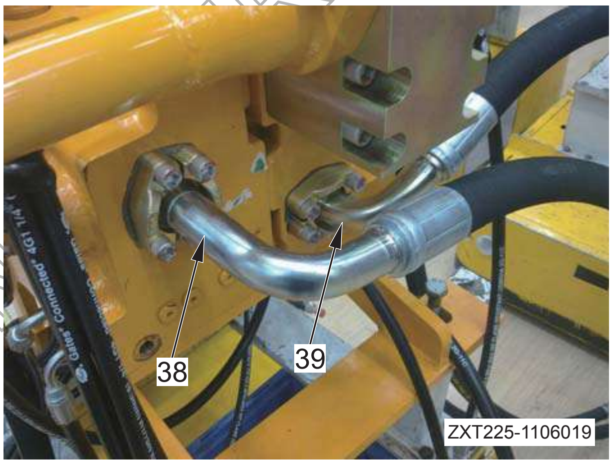


12. Remove pipe (36) (main valve to radiator).



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

16. Remove the fixing bolts (45). Lift the control valve assembly (46) for disassembling.

Control valve assembly: 220 kg

8.22.2 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 6-46.

8.23 Hydraulic Pump AS - Remove and Install

8.23.1 Removal

⚠ WARNING

- **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.**

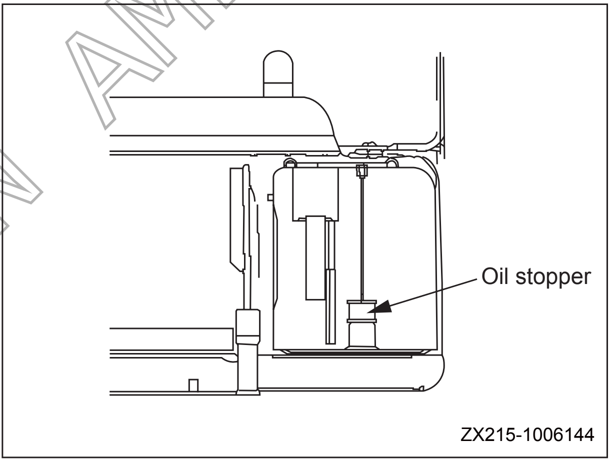
NOTE: Tag each line so as to ensure correction installation.

1. Remove the oil inlet filter element from the hydraulic tank and stop oil outflow with an oil stopper.

   NOTE: 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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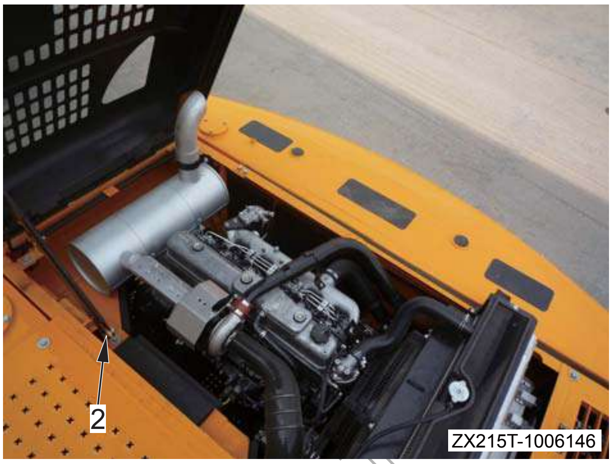
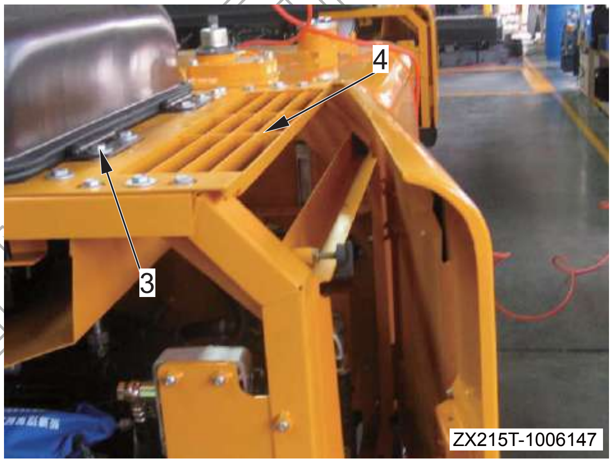
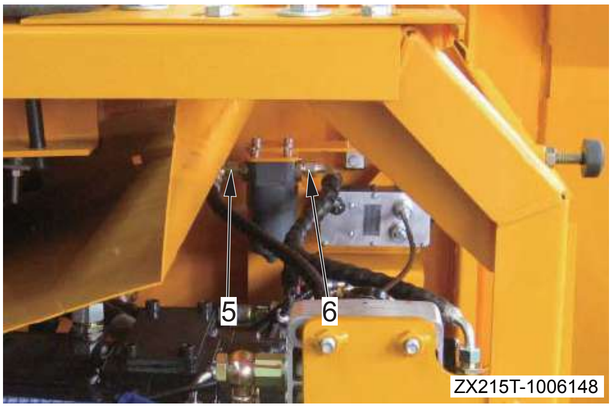
3. Remove the pin (2) and the bolts (3). Lift the engine hood in order to remove it.



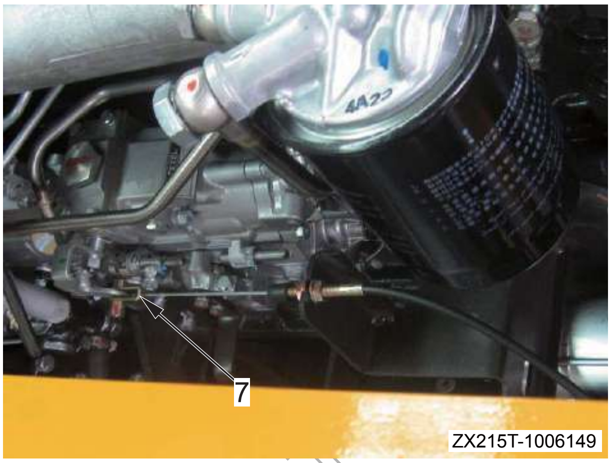
4. Remove the right upper cover (4).



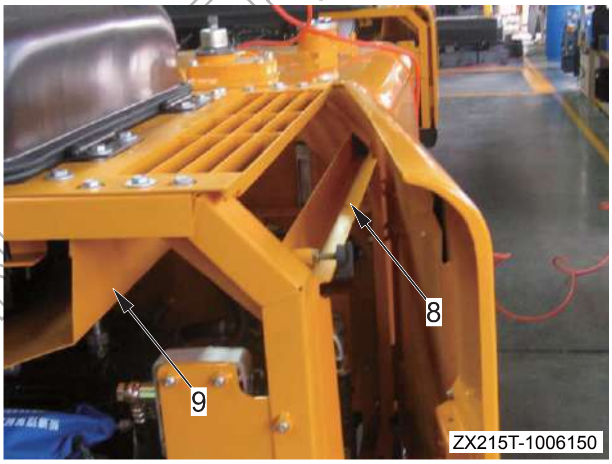
5. Disconnect the hose (5) supplying oil to the lower proportional valve and the hose (6) delivering oil from the pilot pump.



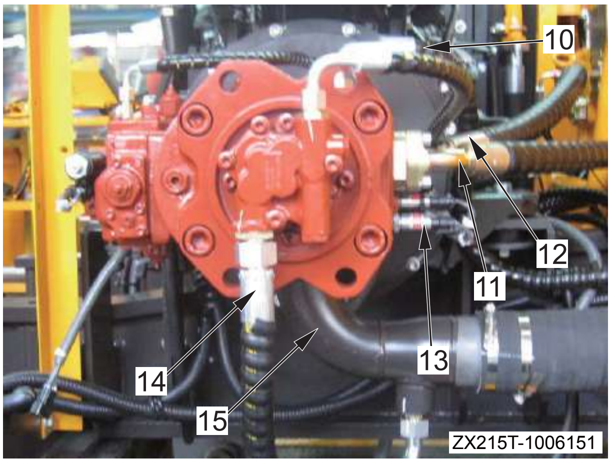
6. Disconnect the shutdown wire (7).



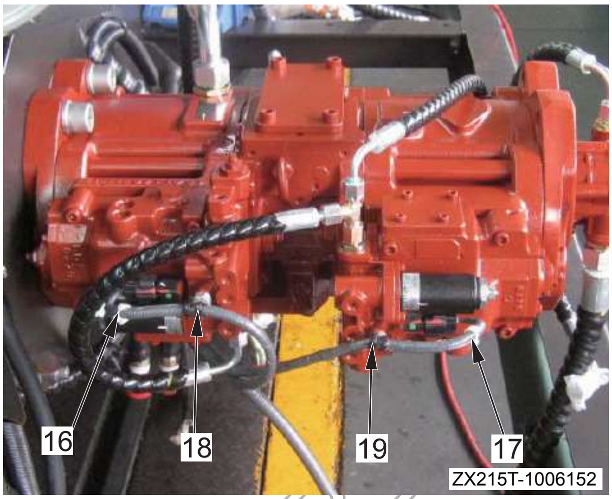
7. Remove the right door (8).
8. Remove the hydraulic pump cover (9).



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.

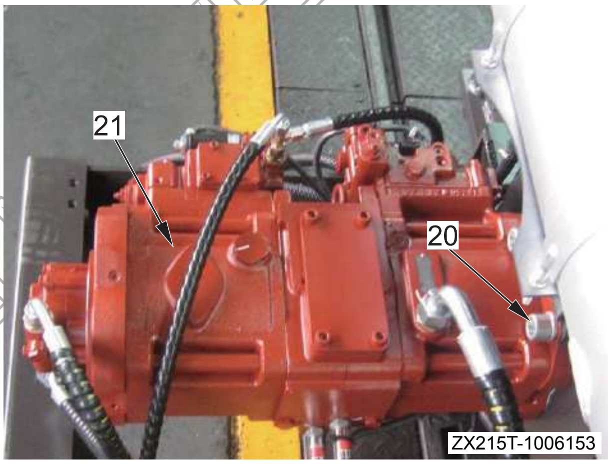


14. Disconnect the solenoid valve harnesses (16) and (17). Remove the cable straps (18) and (19).



15. Remove the four bolts (20) of the hydraulic pump. Lift the hydraulic pump assembly (21) to remove it.

   Hydraulic pump assembly: 112 kg



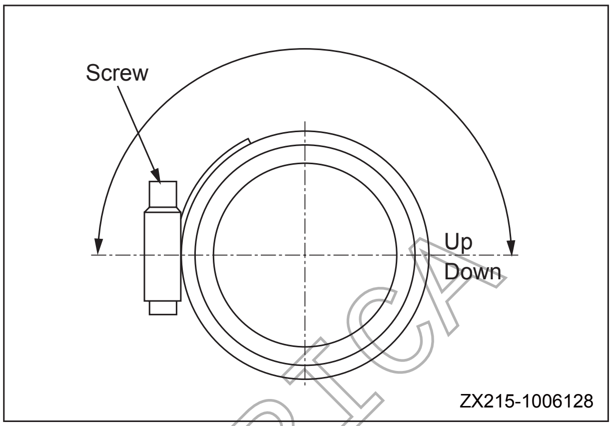
8.23.2 Installation

- Installation is to be performed in the reverse order of removal.

  NOTE: After tightening the hose clamping screw, check that the screw should be in the range indicated in the illustration.

  Screw (hose clamp):

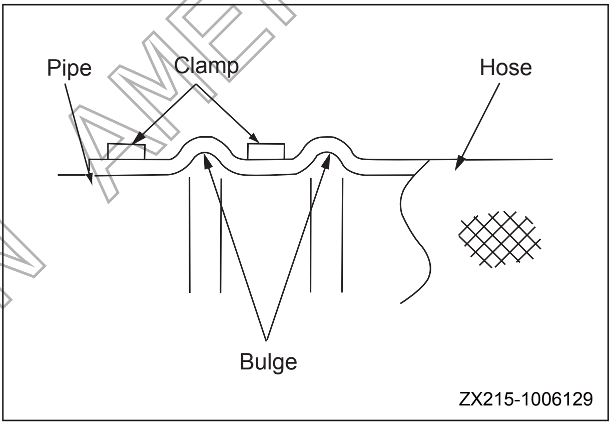
  8.8±0.5 N·m {0.9±0.05 kgf·m}



- Install the hose clamp and tighten the screw according to the illustration on the right.

  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 6-46.

8.24 Middle Oil Seal (Hydraulic Pump Input Shaft)- Remove and Install

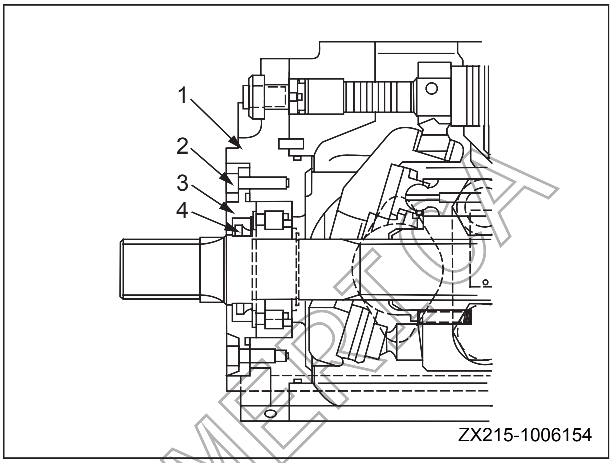
8.24.1 Removal

1. Remove the hydraulic pump assembly (1).

   For more information, see "Hydraulic Pump AS - Remove and Install" on page 8-85.

2. Remove the screw (2). Remove the bearing cover (3).
3. Pry the oil seal (4) out with a screwdriver.

   NOTE: Be careful not to damage the shaft while prying the oil seal.



8.24.2 Installation

- Installation is to be performed in the reverse order of removal.

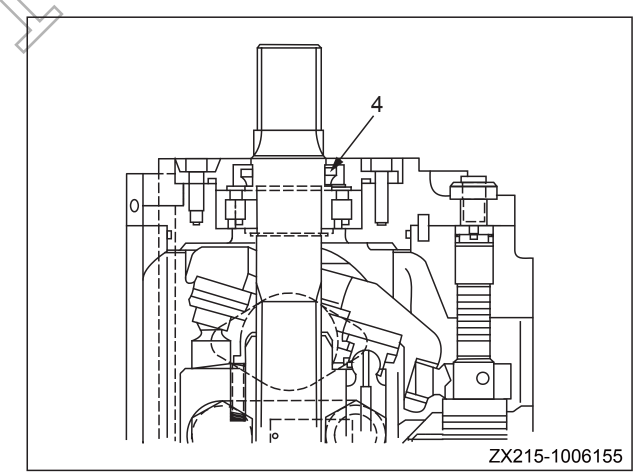
  Seal lip:

  Grease (No.1 Calcium base grease)

  Seal circumference:

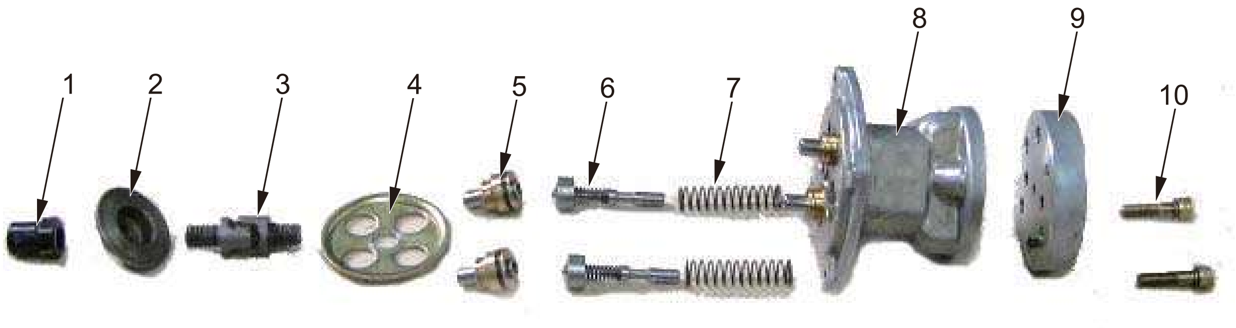
  Grease (No.1 Calcium base grease)

  - Apply a thin layer of grease to the oil seal circumference.



8.25 Pilot Valve AS (Work Equipment) - Disassemble and Assemble

NOTE: This section discusses only the precautions when reassembling the work equipment pilot valve assembly.



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8.25.1 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 plunger (5) on the spool. Push the plug (5) to the spool hole.

3. Install the plate (4) on the plunger (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}

   NOTE: Location of each oil port is stamped on the bottom of valve body.

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 (Tonsun 1277)

- Apply the thread adhesive (Tonsun 1277) to two points on the inner threads. The amount of application is approximately 0.02 g.

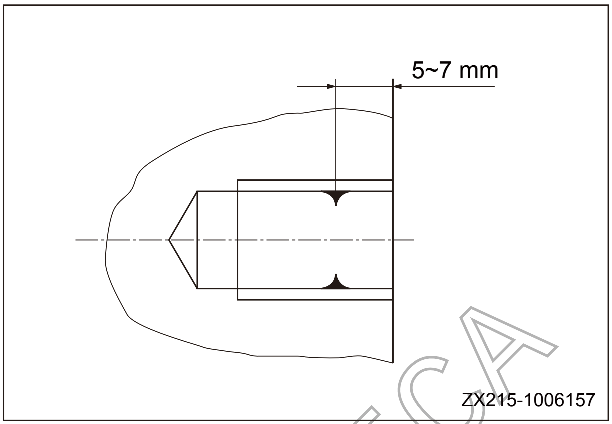
🔧 U-joint (3):

98~133 N·m {10~13.5 kgf·m}

NOTE: Tightening is to be made to the specified torque.

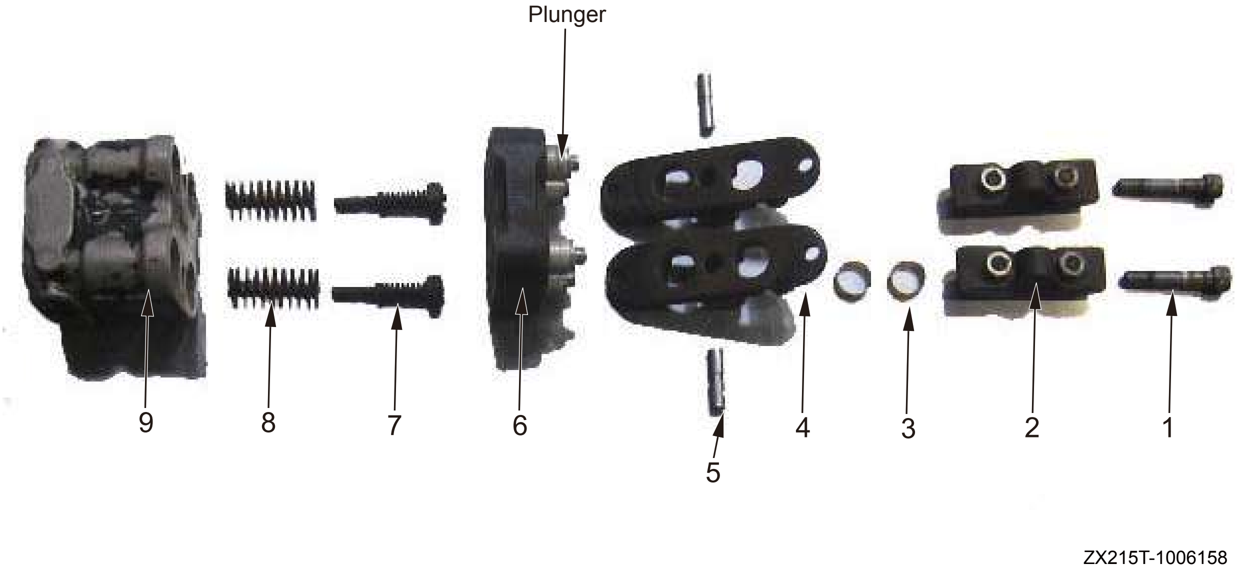
Contact surface between plunger (5) and plate (2):

Grease 0.3~0.8 ml (No.1 Calcium base grease)



8.26 Pilot Valve AS (Travel) - Disassemble and Assemble

NOTE: This section discusses only the precautions when reassembling the travel pilot valve assembly.



8.26.1 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}

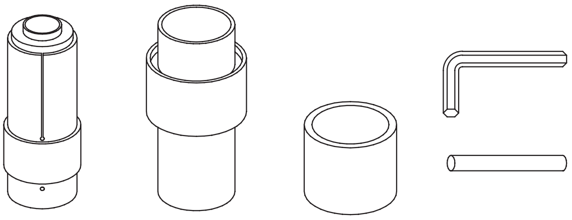
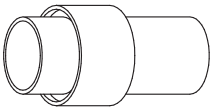
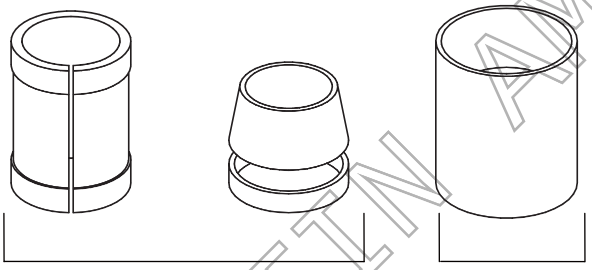
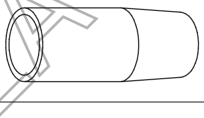
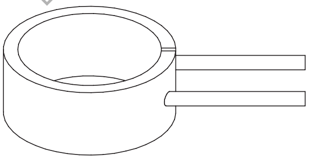
3. Install the dust ring (3) on the plunger. Install the cover (2) and fix the cover (2) with the camshaft (5).

   Contact surface between plunger and dust ring (5):

   Grease (No.1 Calcium base grease)

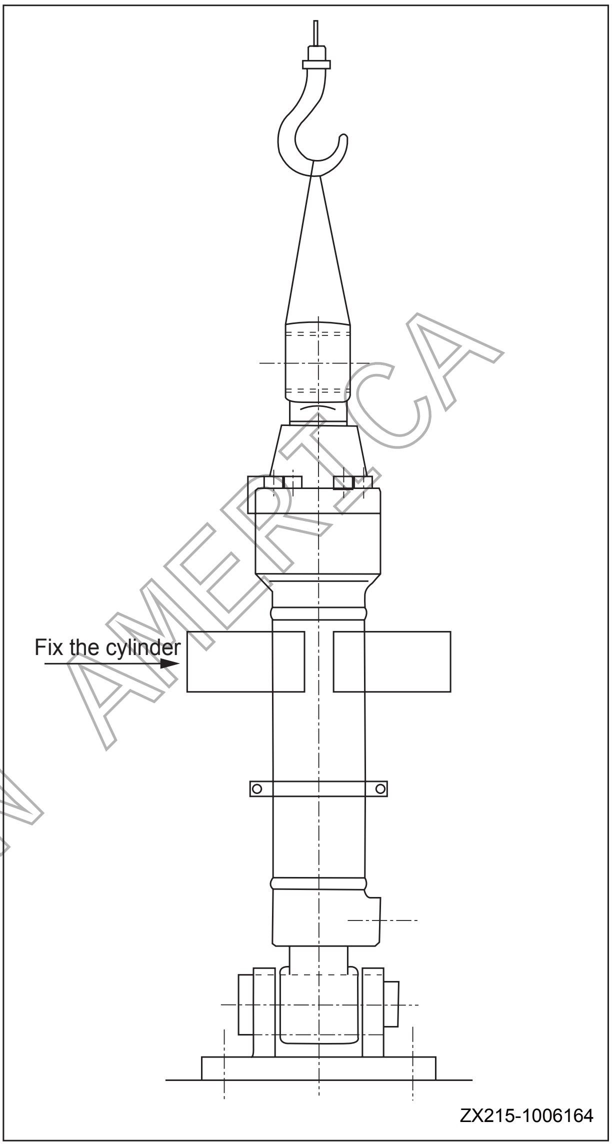
8.27 Hydraulic Cylinder AS - Disassemble and Assemble

Special tools

Application	Tool Shape	Necessity	Quantity
Pulling out/pushing in the bushing		■	1
Press fitting the dust ring		■	1
O-ring seal correction		■	1
Inserting the cylinder head		■	1
Inserting the piston		■	1

8.27.1 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.



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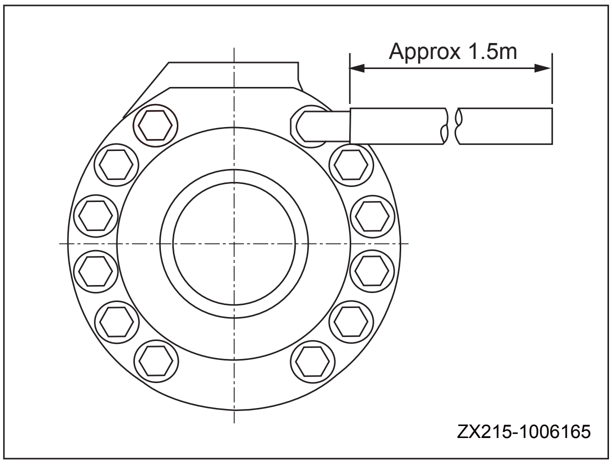
3. Removal of cylinder head
    - Unscrew the bolts with Allen Wrench.
    - Using an extension rod, as shown in the illustration on the right, will make the work easy.



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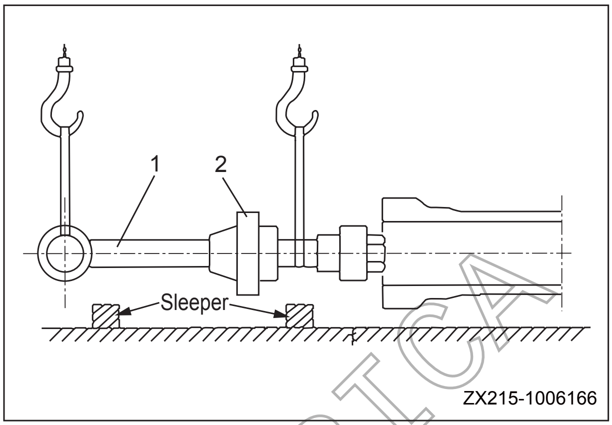
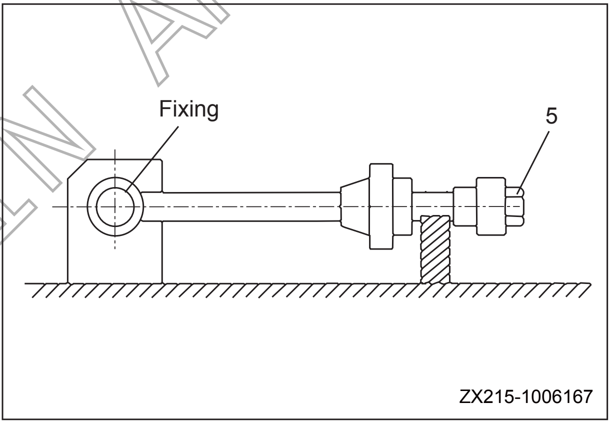
4. Pulling out the piston rod



   - 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.

6. Remove of the piston nut (5)

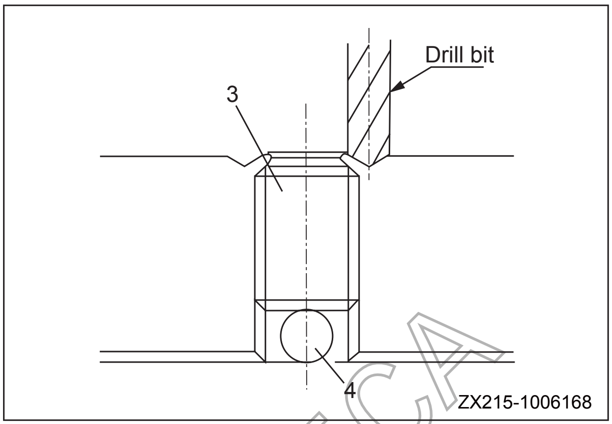
   1) Remove the fixing screw (3) from the piston nut (5).

      NOTE: 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).

      NOTE: 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.



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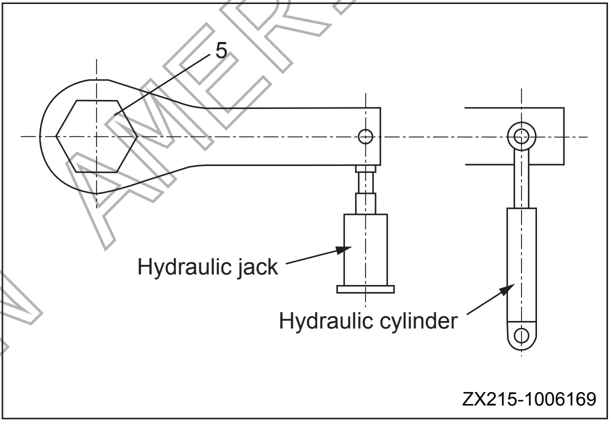

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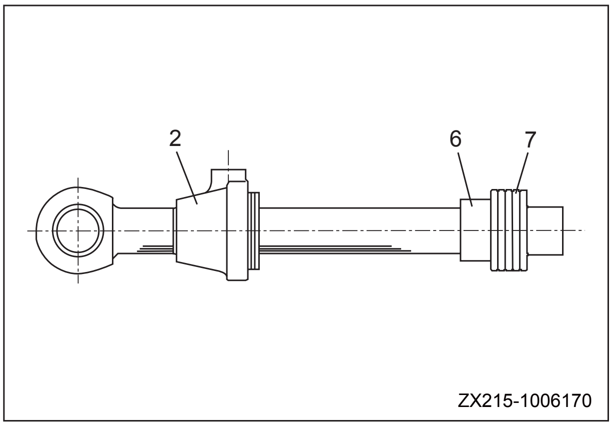
7. Removal of piston assembly

   - Remove in turn the piston (7), buffer sleeve (6) and cylinder head (2).



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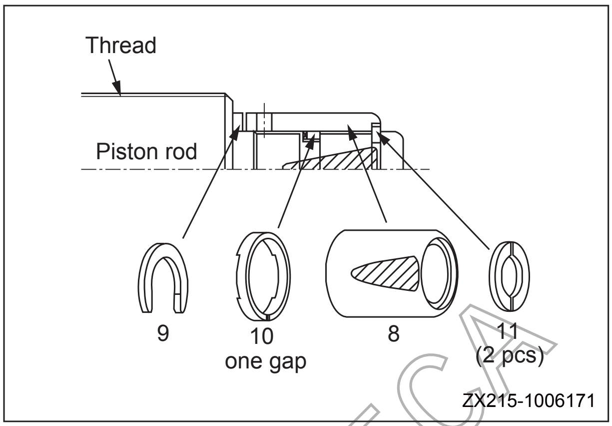
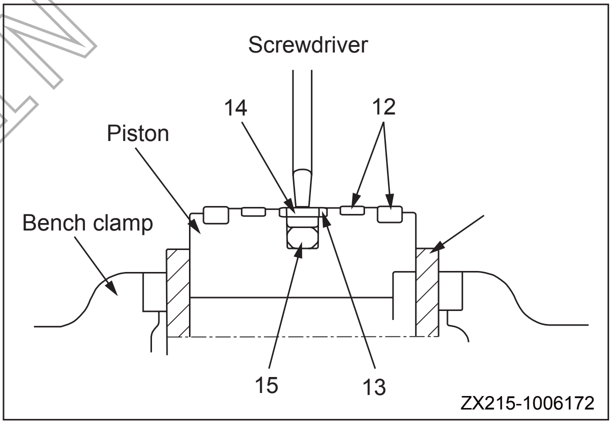
8. Removal of the buffer sleeve (8) on the bottom end
    1) Remove first the piston nut (5).
    2) Use a tool like rubber hammer to tap the piston nut (5) slightly for removal while keeping the piston rod and the buffer sleeve (8) intact. Remove the elastic ring (9).
    3) Slide the buffer sleeve (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).



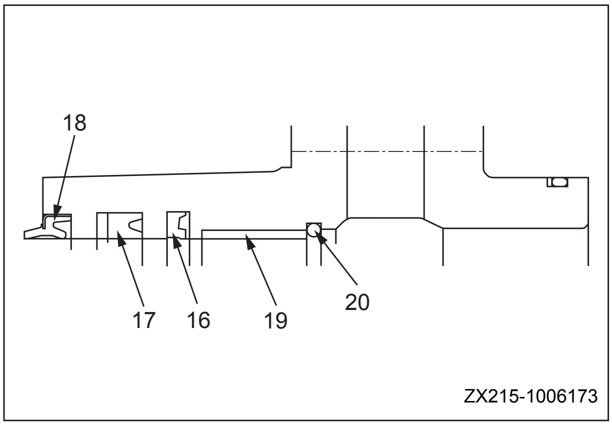
9. Removal of piston seal
    1) The slide ring (12) and the guard ring (13) can be simply removed with hands.
    2) The seal (14) can be removed with a hammer and a flat-head screwdriver.
    3) Remove the O-ring seal (15) with a pry bar.

    NOTE: The removed seals should not be reused.



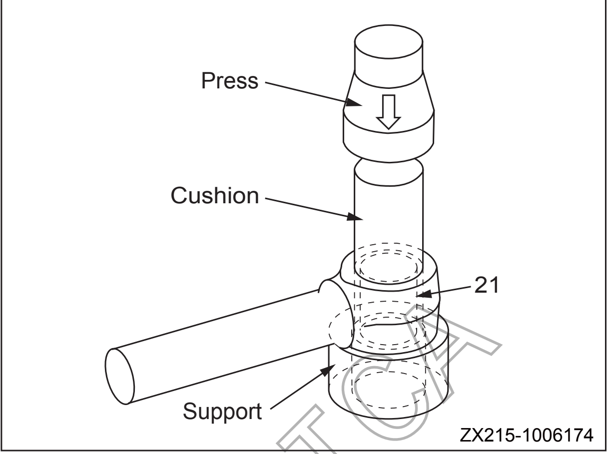
10. Removal of buffer ring (16)

    NOTE: 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.



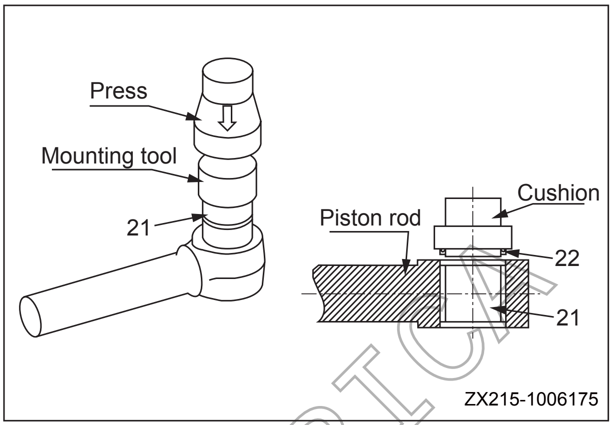
11. Removal of the U-ring (17) and the dust ring (18)
    1) Remove the U-ring (17) with a tool such as screwdriver.
    2) Pierce a tool (such as a screwdriver) into the dust ring (18) and hammer the screwdriver to remove the dust ring (18).

       NOTE: 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.



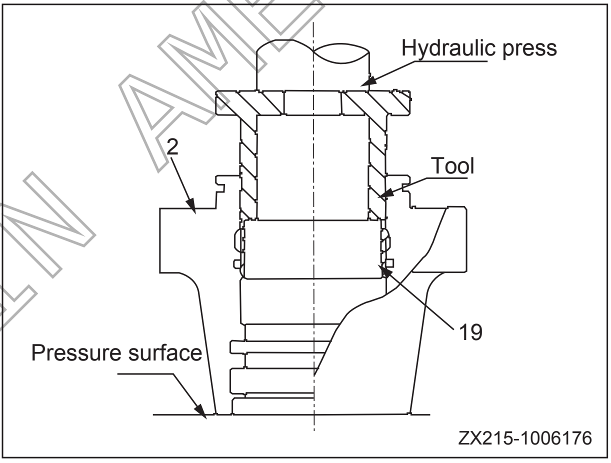
8.27.2 Assembly

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).

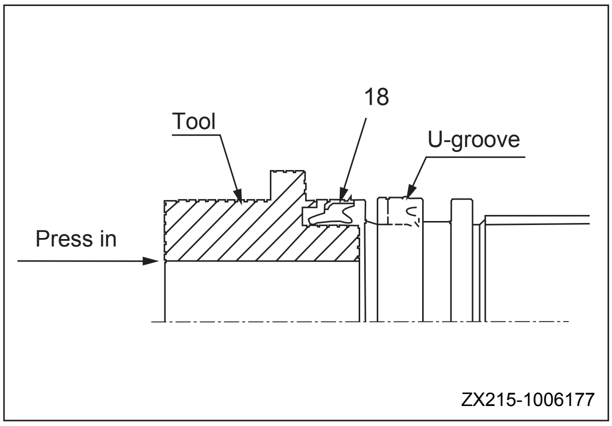
      NOTE: Apply hydraulic oil to the inside of cylinder head in advance. Make sure that the bushing (19) pushed in is free from a raised shoulder.
   2) Use the press to push in dust ring (18).



   3) Install the guard ring and the U-ring (17) sequentially in the U-groove.

   NOTE:

   - 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.

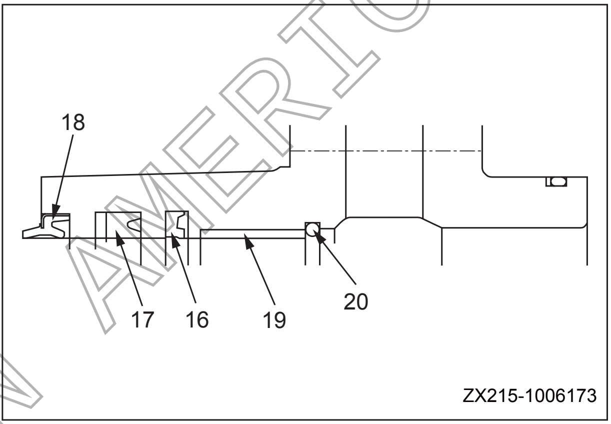


4) Installation of buffer ring (16)

NOTE: 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).

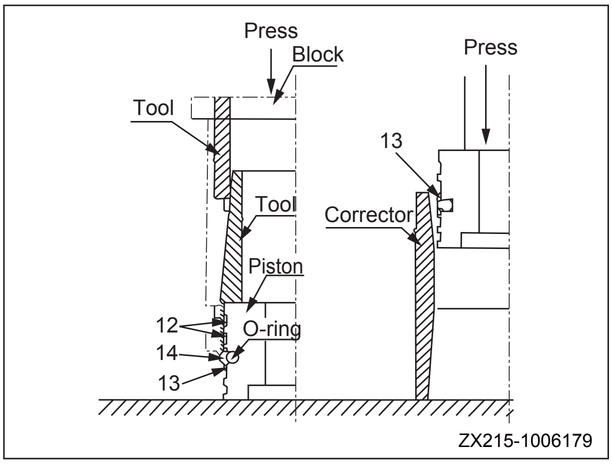
3. Assembling the piston assembly



1) Installation of seal (14).

NOTE: 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)



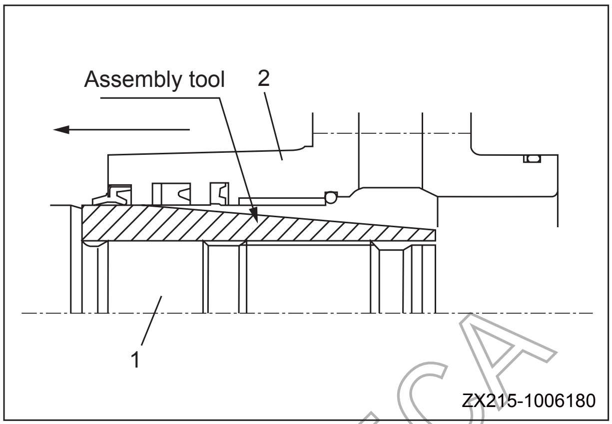
NOTE: Install the seal (14) and the guard ring (13) on the other side. In order to prevent the expansion of the seal (14), a corrector must be used to correct the seal (14) which has been stretched during installation. The piston rod may not be able to go in the cylinder barrel if the seal (14) is not corrected timely.

3) Installation of slide ring (12)

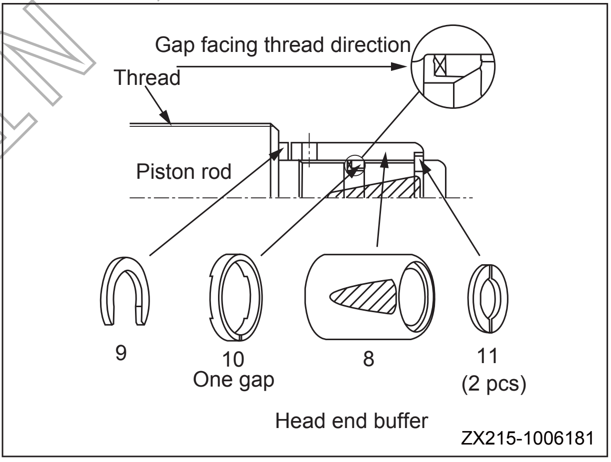
NOTE: Slightly open the slide ring (12) and install it axially. Excessive opening of the slide ring (12) can fail installation.

4. Assembling the piston rod assembly
   1) Fix the piston rod (1).
   2) Install the cylinder (2) on the piston rod.

      NOTE: 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.
   4) Let the notched side of the buffer seal (10) face the piston while installing the buffer seal (10) in the groove.
   5) Install the buffer sleeve (8) according to the indication in the illustration on the right.
   6) 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.
   7) If the head side of cylinder contains a buffer, install the buffer sleeve (6) and the buffer seal (23) according to the following order.
   8) The piston nut must be installed after installation of the buffer bearing.
   9) The buffer seal (23) must be installed in the groove, with its notches facing the piston.



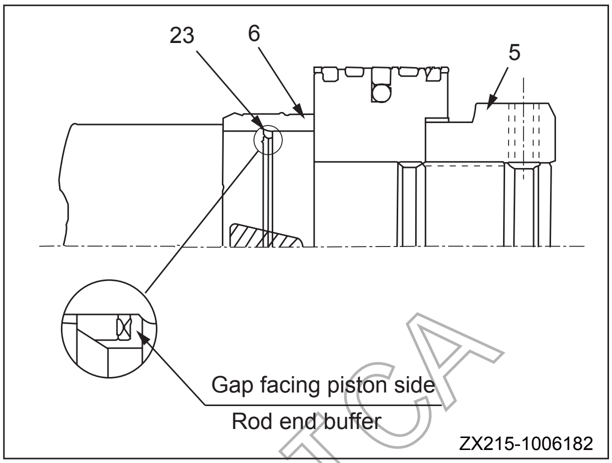
ZX215-1006180



Head end buffer

ZX215-1006181

10) The buffer sleeve (6) must be installed according to the illustration on the right.



11) 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}

NOTE:

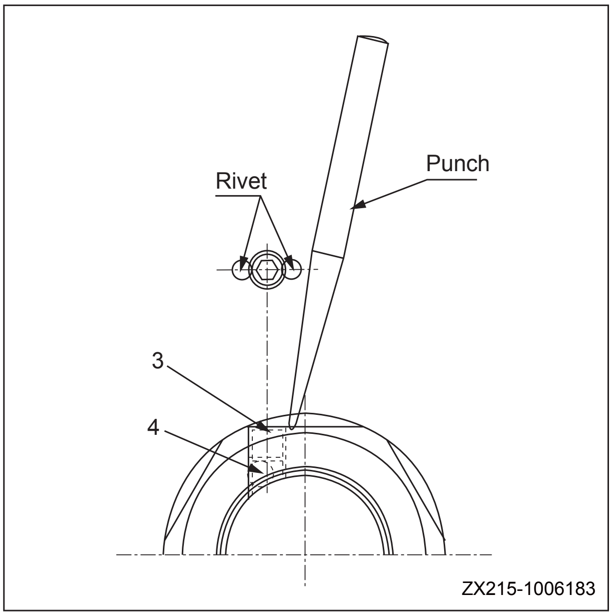
- Insufficient tightening can cause oil leakage, loose nut and thread breakage. In addition, excessive tightening can cause expansion of the buffer shaft on the extending side or deformation of piston on the contact side.
- Thoroughly clean and grease (with banana oil) the threaded portions of the piston, nuts and piston rod before tightening the nuts.

12) Treatment of the piston against loosening

NOTE: 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):

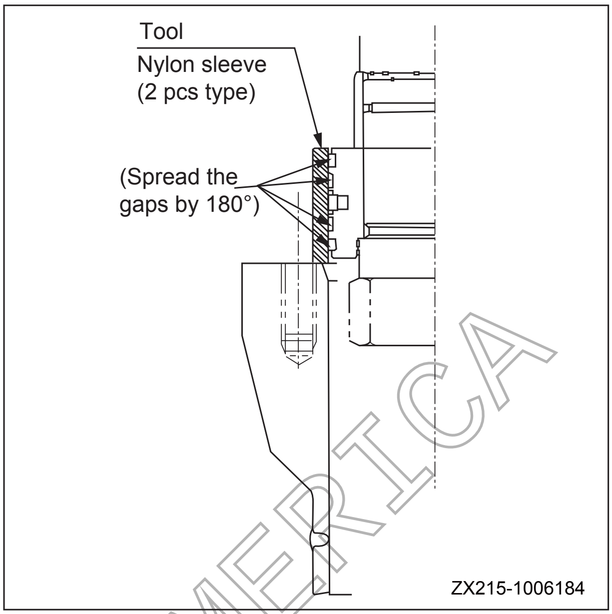
66.9 N·m {6.8 kgf·m}



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.

NOTE:

- 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.

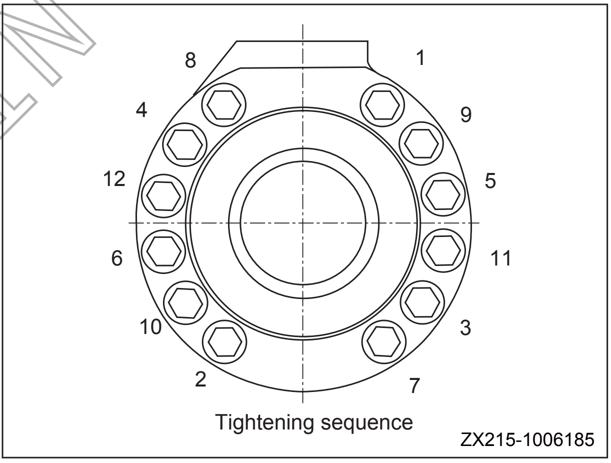


6. Tightening of cylinder head

Tighten the cylinder head according to the sequence shown in the illustration on the right.

🔧 Bolt: 267 N·m {27.2 kgf·m}

7. Install the tubing.



Tightening sequence

8.28 Work Equipment AS - Remove and Install

8.28.1 Removal

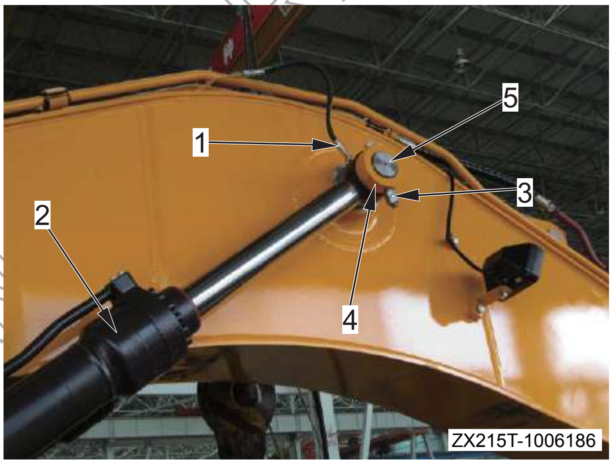
⚠ WARNING

- **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 6-40.

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).

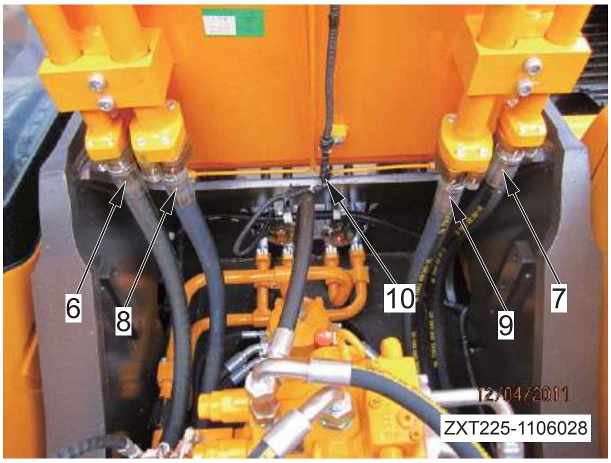
   NOTE: There are shims installed. Count the shims and check the thickness. Place the shims in a safe place.



4. Start the engine and retract the piston rod.

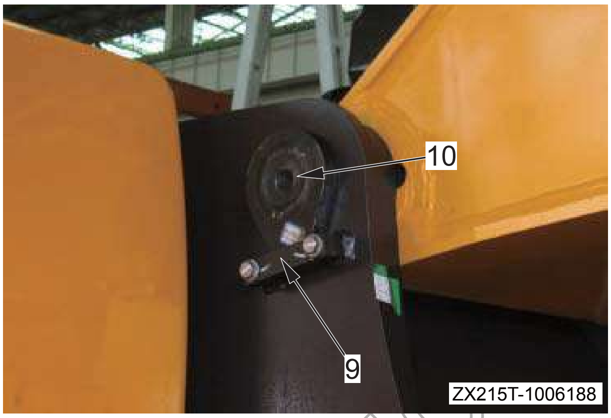
   NOTE: Secure the piston rod with a wire rope in order to prevent the piston from slipping out. Put the cylinder on a bench or support. Remove the grease fitting on the bottom side in the later case. Remove the other boom cylinder in the same way.
5. Remove the two hoses (6) of bucket cylinder and the those (7) of the arm cylinder.

   NOTE: Cork the hoses to prevent outflow of oil. Secure the hoses to the valve side.
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.

   NOTE: There are shims installed. Count the shims and mark their locations.



8. Lift and disassemble the work equipment assembly.

   Work equipment assembly: 3451 kg

8.28.2 Installation

CAUTION

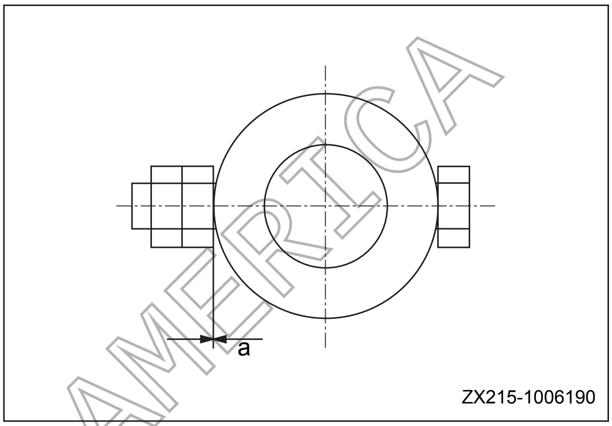
- **Do not put your finger in the pin bore while aligning the pin bore.**

- Installation is to be performed in the reverse order of removal.

  NOTE: A clearance (a: 0.5~1.5 mm) shall be left between the plate and the nut when tightening the locknut.

  Greasing after assembling the pin:

  Grease (supramoly lithium base)

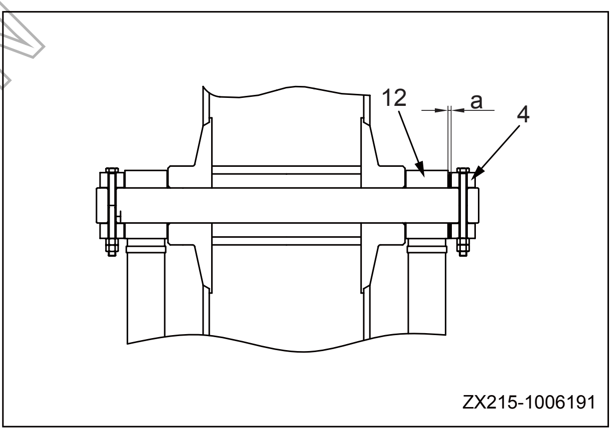


  NOTE: Adjust the shim thickness in order to have a desired clearance (a: 0.5<a<1 mm) between the piston end (12) and the plate (4).

  Standard shim thickness: 1.0 mm and 2.0 mm.

  Greasing after assembling the pin:

  Grease (supramoly lithium base)



- 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 6-46.

8.29 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

8.29.1 Removal

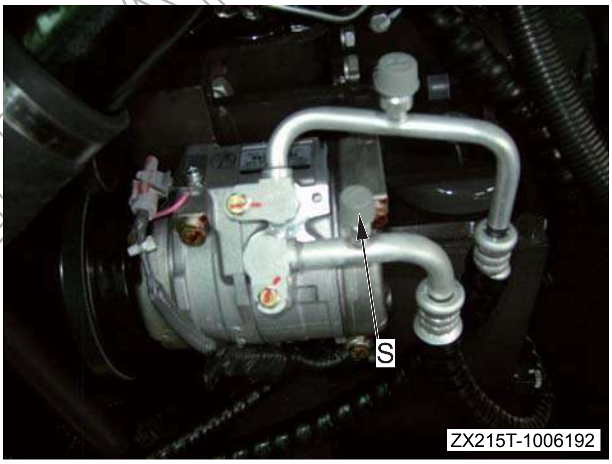
CAUTION

- **Disconnect the cable from the negative (-) post of the battery.**

1. Drain the coolant.

   Coolant: approx. 22.5 L

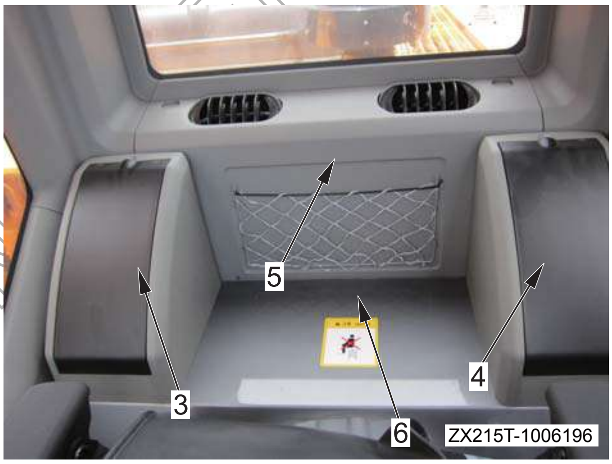
2. Recover refrigerant from the air-conditioning system with the tool (S).



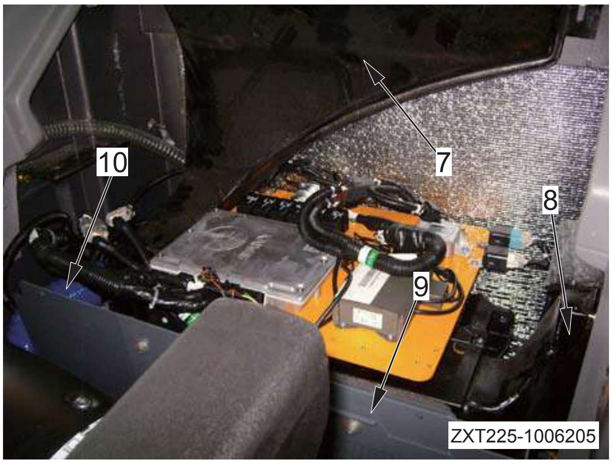
3. Remove the pad (1) on the cab floor.

4. Open the left rear cover of the cab with the ignition key. Remove the outer filter element (2).

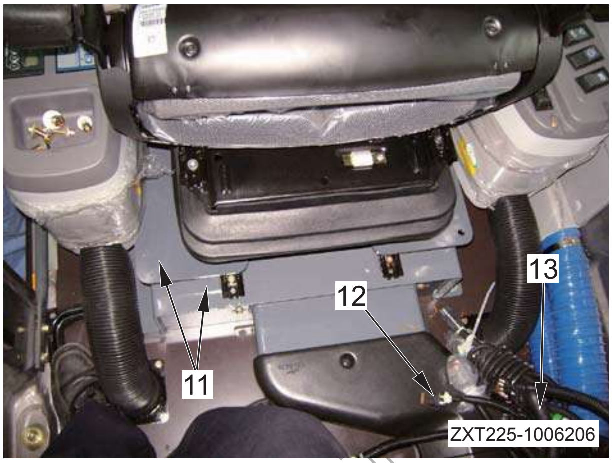
5. Remove the fuse box (3) and storage box (4).
6. Remove outer covering (5).
7. Remove the air conditioner cover (6).



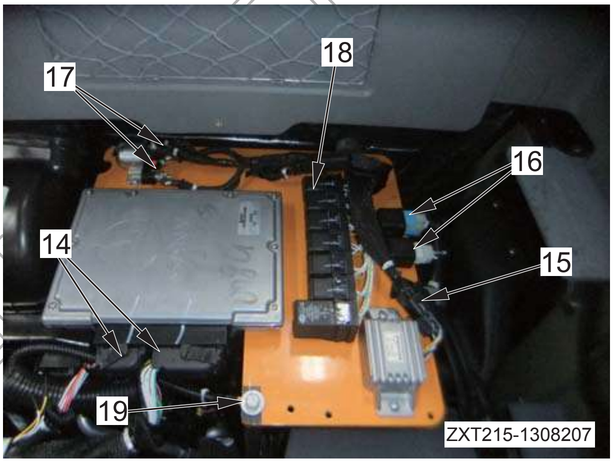
8. Remove the back air duct (7).
9. Remove the left air duct (8).
10. Remove the baffle (9).
11. Remove the right air duct (10).



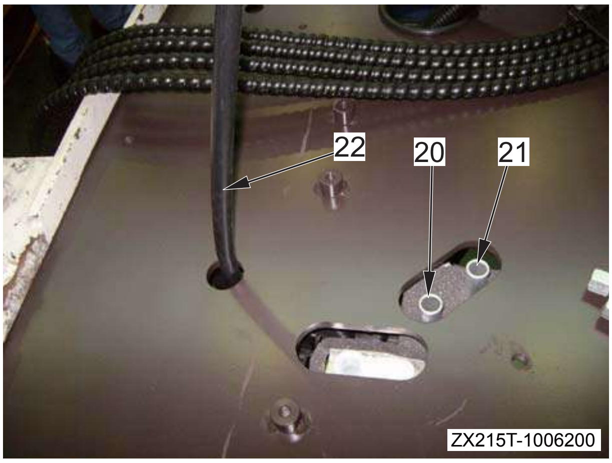
12. Remove the cover (11).
13. Remove the cab's center connector (12).
14. Remove the radio antenna(13).



15. Remove the connector (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).

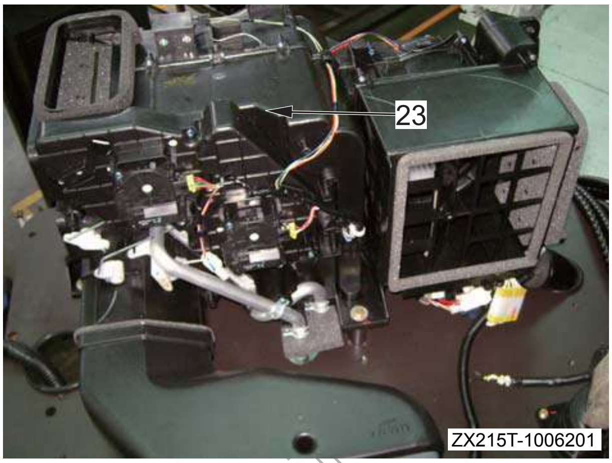


16. Remove the air conditioner water pipes (20) and (21) as well as the dripping tube (22).



17. Remove the air conditioner unit (23).

    NOTE: Also disconnect the two hoses connecting to the bottom of the air conditioner when removing the air conditioner unit.



8.29.2 Installation

- Installation is to be performed in the reverse order of removal.

NOTICE

- **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.**

NOTE: 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

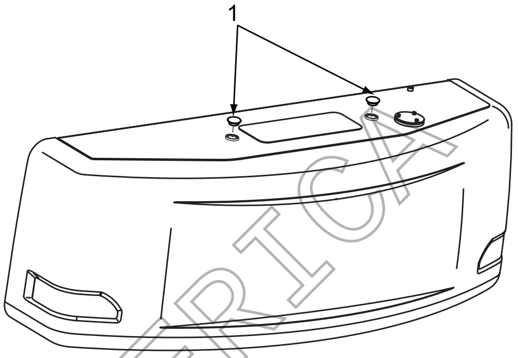
Charge refrigerant (HFC-134a) into the air condition return lines with tool (S).

For more information, see “Refrigerant” on page 4-141.

8.30 Counterweight AS - Remove and Install

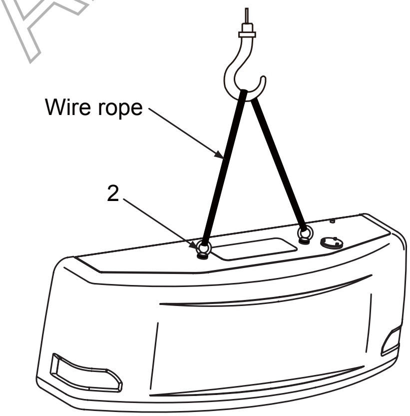
8.30.1 Removal

1. Remove the cover (1) from the counterweight. Install eyebolts to the counterweight. Hold the counterweight.



ZX225-1106004

2. Remove the four bolts (2).



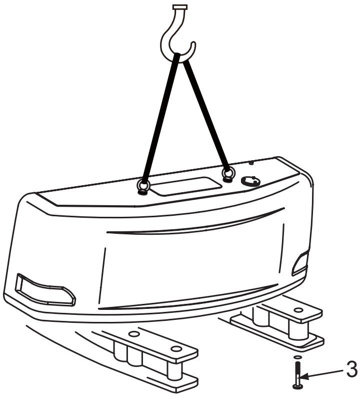
ZX225-1106005

3. Lift the counterweight levelly with wire rope or chain hoist.

   NOTE: Be careful not to damage the engine, radiator or cooler.

   Counterweight assembly:

   3901 kg



ZX225-1106006

8.30.2 Installation

- Installation is to be performed in the reverse order of removal.

  Threads (mounting bolt - counterweight):

  Thread adhesive (Tonsun 1277)

  Mounting bolt (counterweight):

  1,180~1,470 N·m {120~150 kgf·m}

Counterweight adjustment

1. Move the counterweight with a crane to a suitable position on the frame.
2. Push the counterweight and install the bolts. Adjust the position of the counterweight in such a manner that the following dimensions can be obtained.
   - Clearance with swivel:

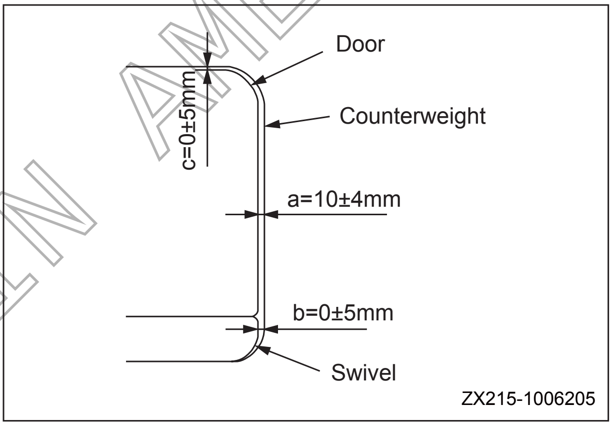
     10±5 mm(L&R)
   - Clearance with bodywork door:

     10±5 mm(L&R)
   - Step from swivel in left to right direction

     b: max. 5 mm
   - Step from bodywork door in left to right direction

     a: 10±4
   - Step from bodywork top cover in upper to lower direction

     c: max. 5 mm



8.31 Cab AS - Remove and Install

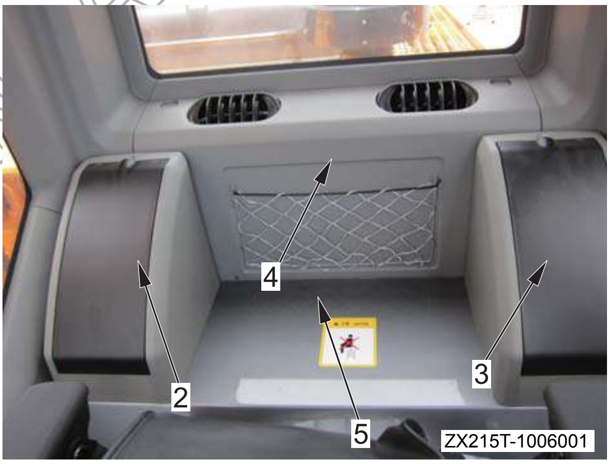
8.31.1 Removal

CAUTION

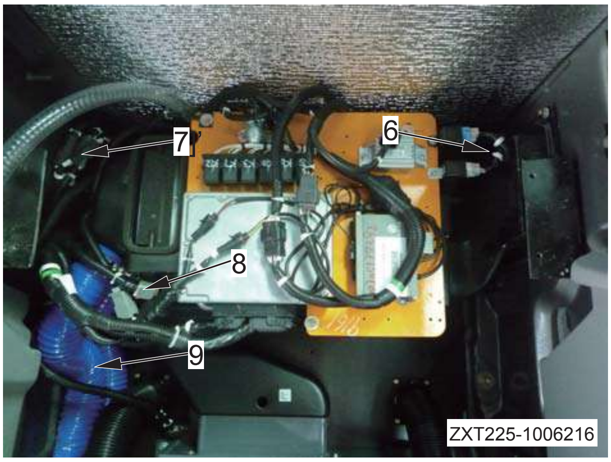
- **Disconnect first the cable connecting to the negative (-) post of the battery.**

1. Remove the floor mat (1).

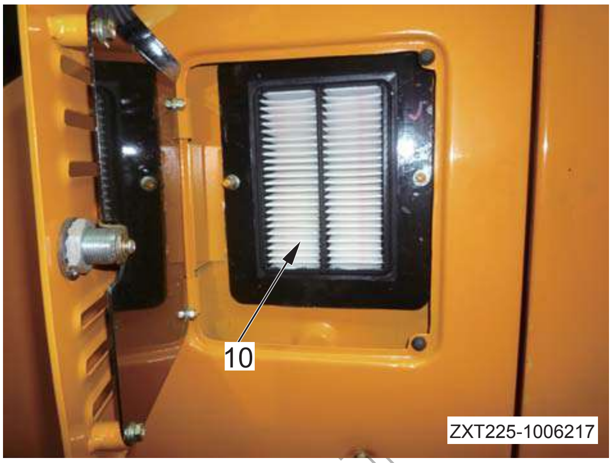
2. Remove the fuse box (2) and storage box (3).
3. Remove outer covering (4).
4. Remove the air conditioner cover (5).



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).

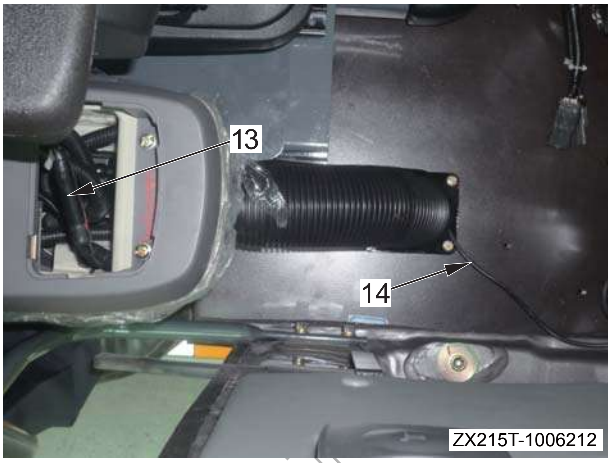


8. Disconnect the external air duct (11).

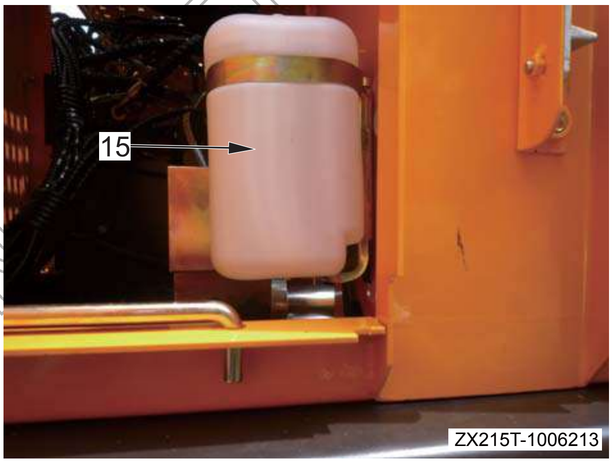
9. Remove the storage box on the armrest (12).

10. Remove the radio connector (13).

11. Remove the radio wire harness (14).



12. Remove the window washer reservoir (15).



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).

16. Lift the cab assembly (20) for removal.

Cab assembly: 450 kg

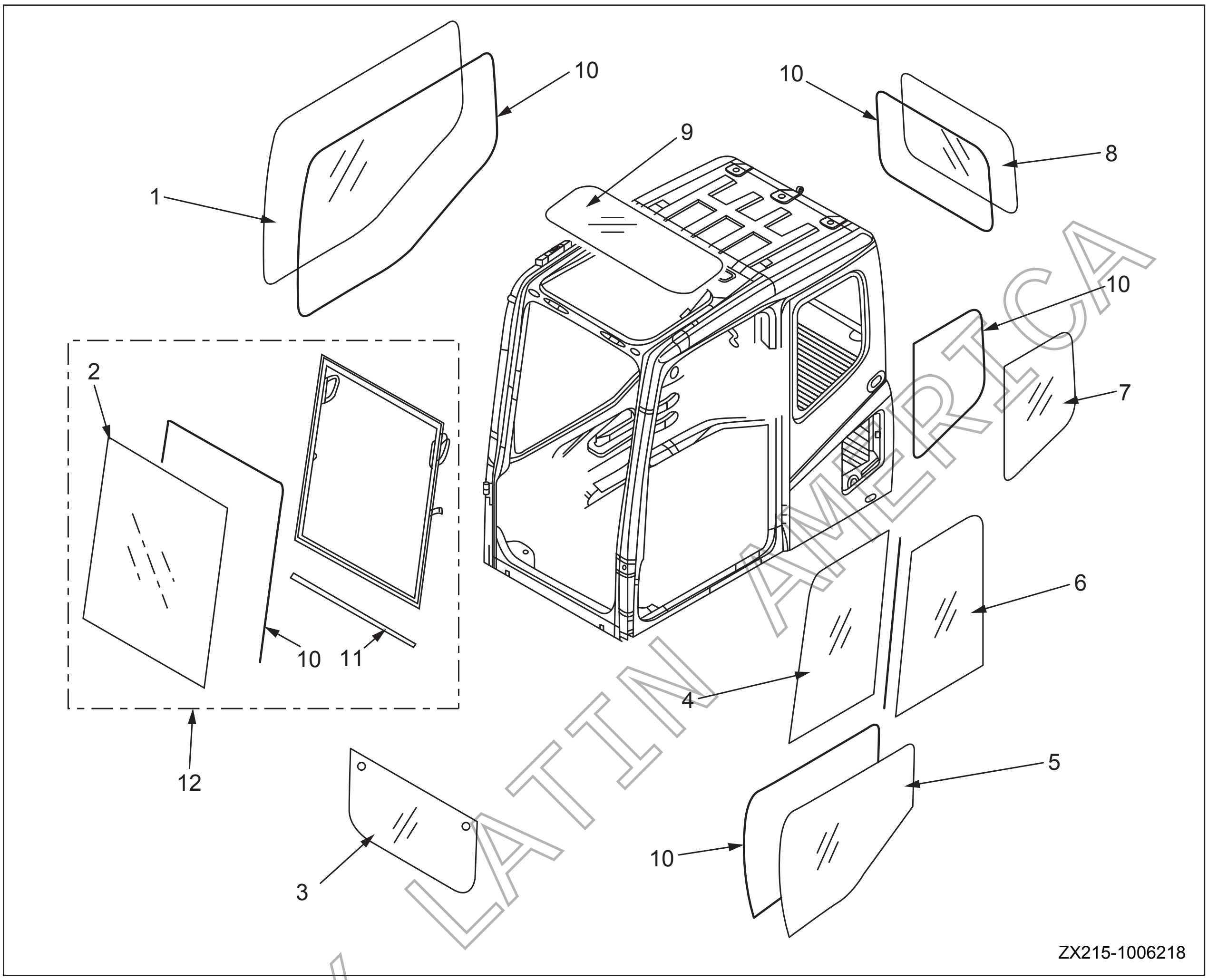
8.31.2 Installation

- Installation is to be performed in the reverse order of removal.

  🔧 Bolt: 200 N·m {20.4 kgf·m}

  🔧 Nut: 210 N·m {21.4 kgf·m}

8.32 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 AS (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 more information about front window replacement, see “Front Window AS - Disassemble and Assemble” on page 8-134.

8.32.1 Removal

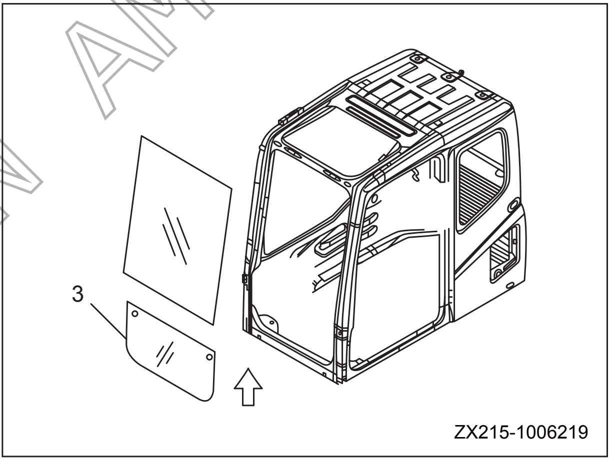
⚠ CAUTION

- **Removing shattered or cracked window glass may cause finger cuts.**
- **Wear proper PPEs when removing shattered cab window glasses.**

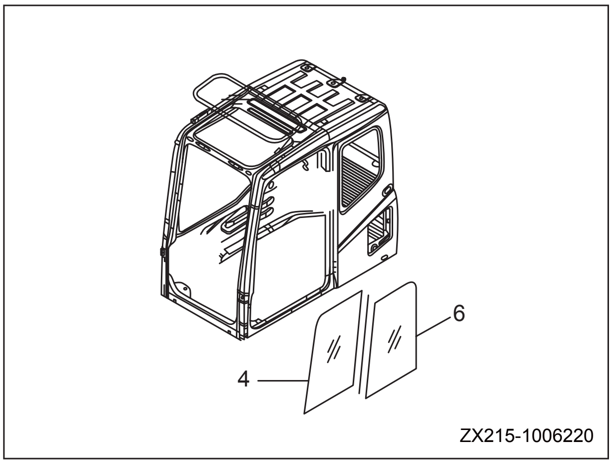
NOTE: To avoid finger cut during when removing a shattered or cracked glass, cover it with a piece of adhesive film or tapes.

1. Removal of glass (3)

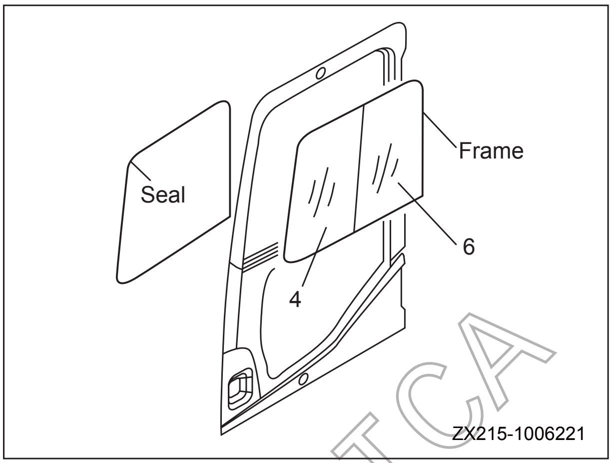
   Glass (3) is hold in place by sealing strips. Pull it upward carefully to remove it.



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.

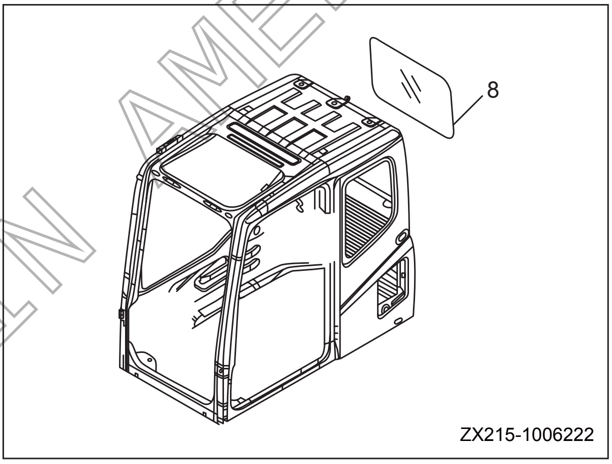


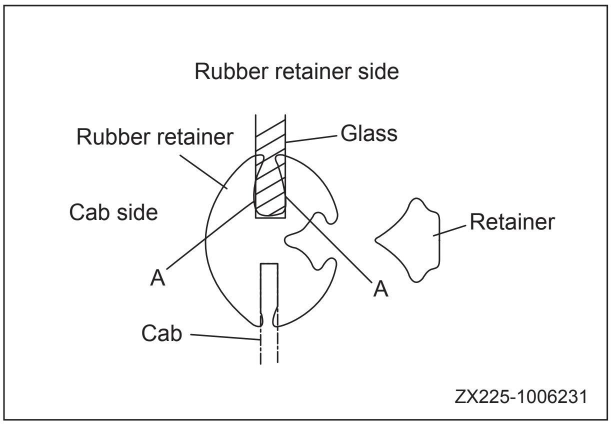
3. Removal of glass (8)

1) Remove the retainer from the groove on the rubber with an ordinary screw driver.

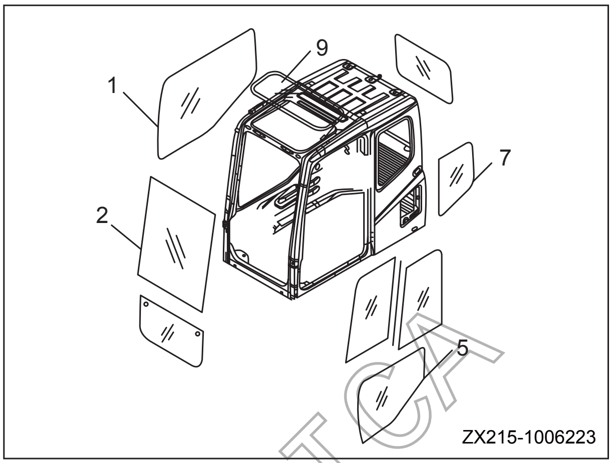
2) Put a thin bamboo chip inside part A of the retaining rubber and detach the retainer along the edge.

3) Pat the glass from inside of the cab and remove it. This job may require two people.

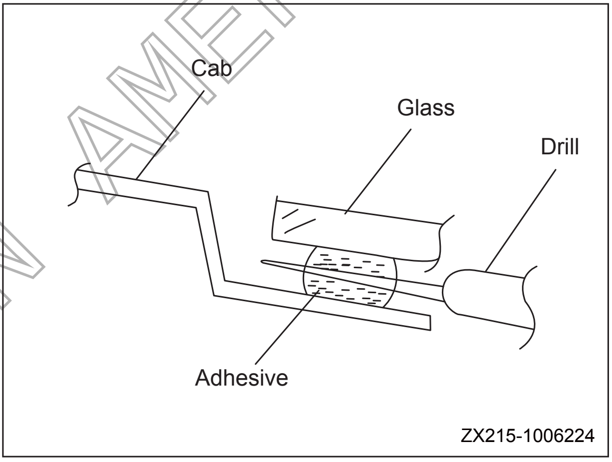




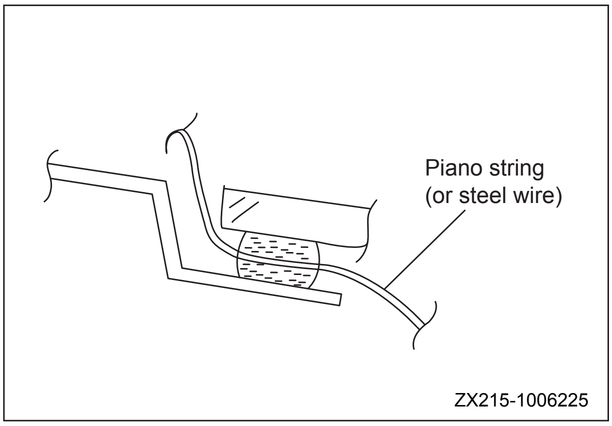
4. Removal of glass (1), (2), (5), (7) and (9).



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.

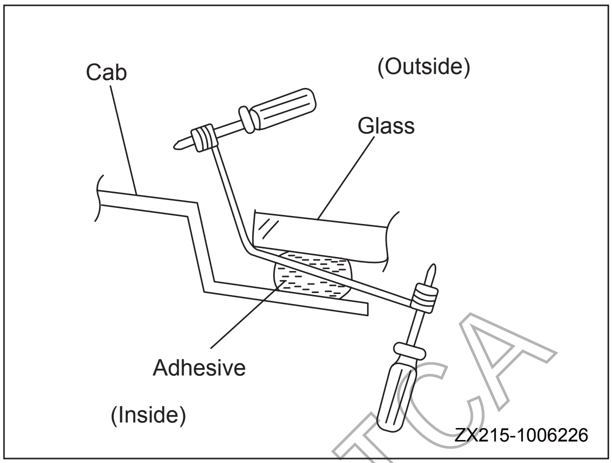


3) Pull a piece of piano string (or steel wire) through the hole as illustrated.



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.



8.32.2 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.

3. Priming coat (10)

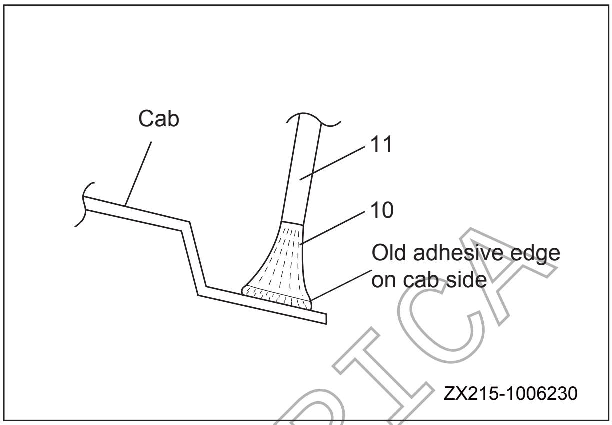
- Priming paint expires 4 months after production. Do not use expired paint.
- Use the paint within 2 hours after it is unsealed.
- Use the paint within 24 hours even if it is sealed again immediately after unsealing. (Dispose the paint 24 hours after it is unsealed)

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.

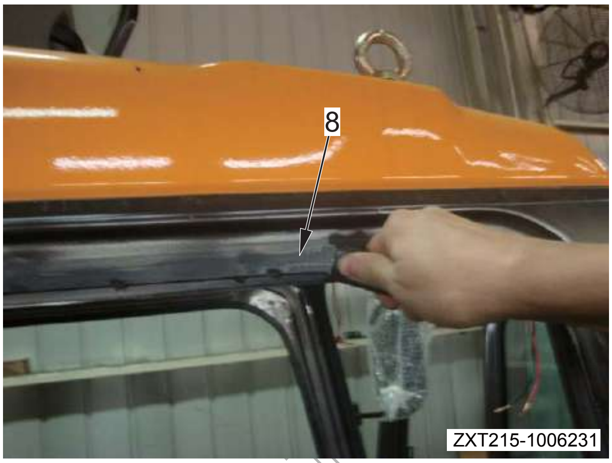
- Check the brush for contaminants after it has been washed.
- Prepare two brushes for priming paint, one for painted surface and the other for glass surface.



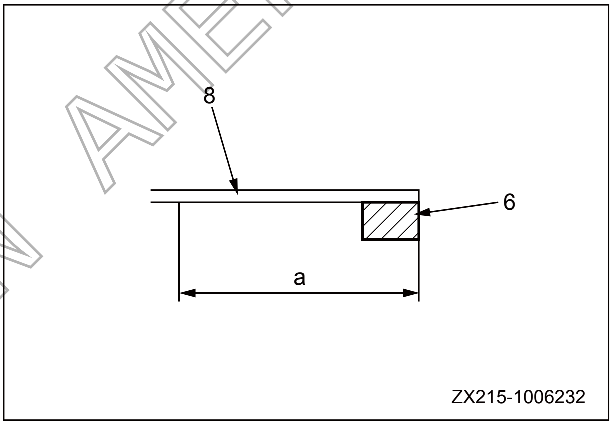
3) Apply priming paint (for painted surface) evenly onto the surface where sealing rubber is to be adhered and where adhesive agent is to be applied (on the cab (8)).

Priming paint (for painted surface): Sunrise MSI Primer 24

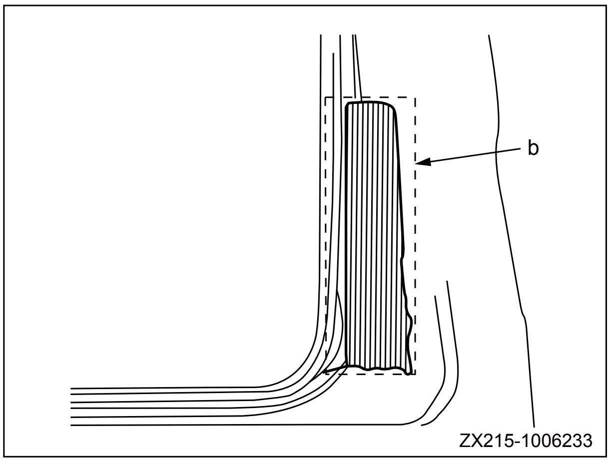
- Do not apply primer more than twice; otherwise, the performance of the primer will be reduced.



- Applying location: Cover the whole area of (a). Dimension of (a): 25mm

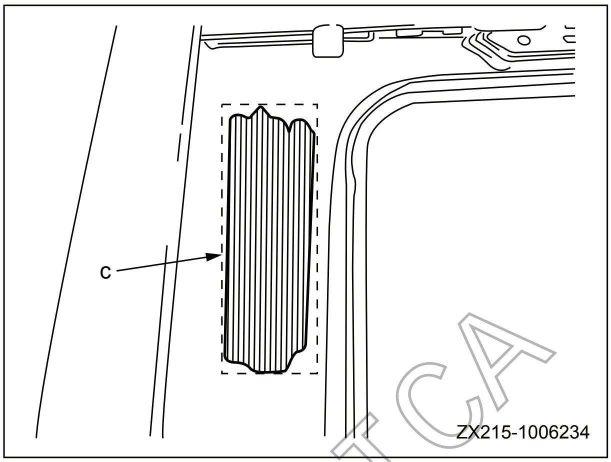


- Besides the above locations, apply primer also onto the right window glass and the cab door lower window glass.
  - Additional priming area on the right window glass: (b)
  - Additional priming area on the cab door lower window glass: (c)



- 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.

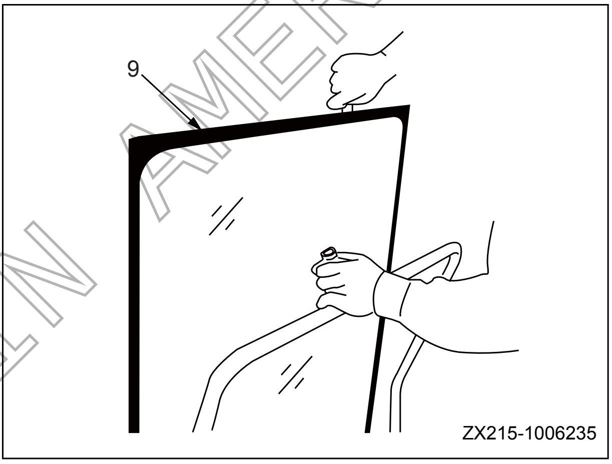


4) Apply priming paint (for glass surface) onto the contact surface of window glass (9).

   Glass primer:

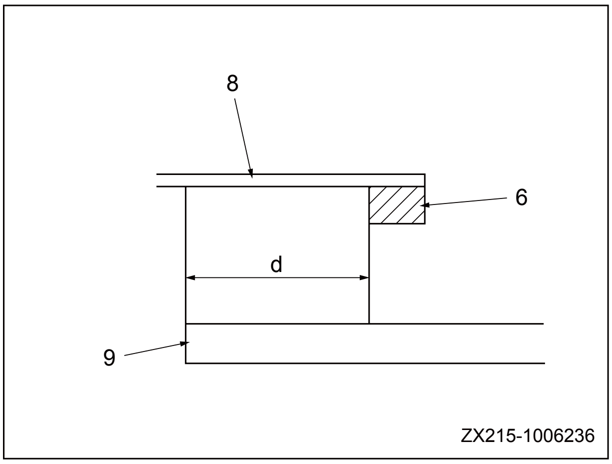
   Sunrise MSI Primer 35

- 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).
- 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.

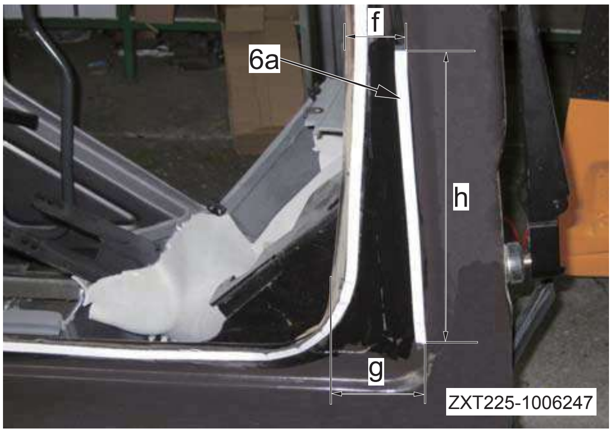
- Adhere additional rubber seal (6a) onto the right cab window

  Position of the additional rubber seal:

  (f): 50 mm

  (g): 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.

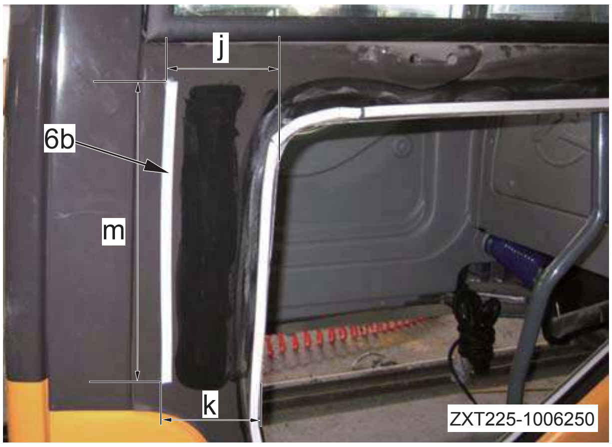
- Adhere additional rubber seal (6b) onto the lower cab door window frame as illustrated.

  Position of additional rubber seal:

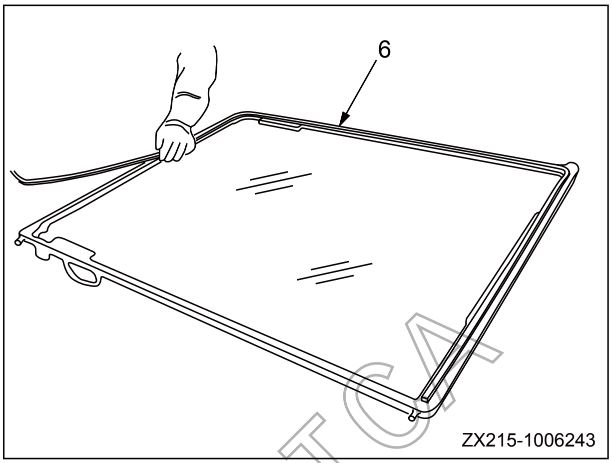
  (j): 110 mm

  (k): 90 mm

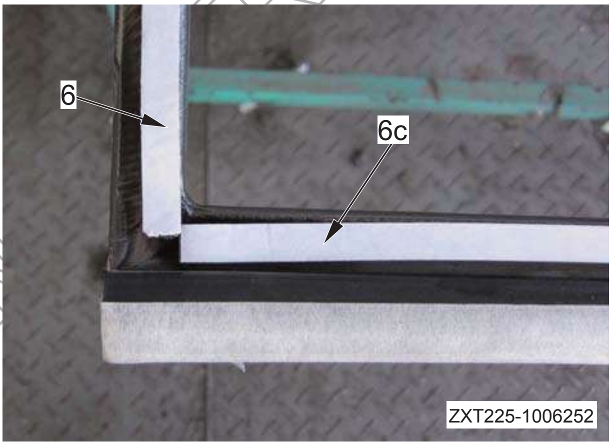
  (m): 200 mm



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.)



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.

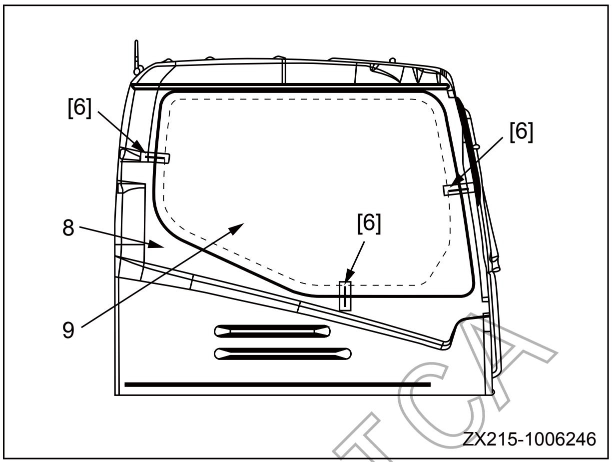
- Adhere tape [6] at 3 points as illustrated for precise alignment of right window glass, left rear window glass and cab door lower window glass.

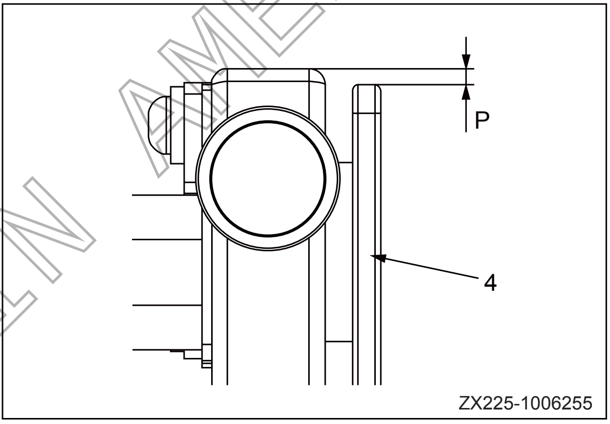
3) Cut the tapes across the glass (9) and the cab (8) and remove the glass.

- 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.

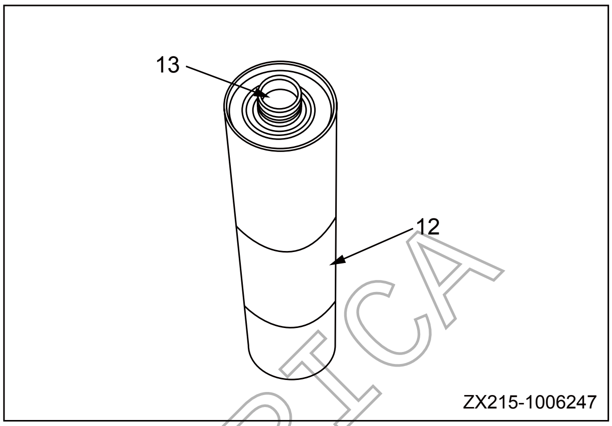
  Set the clearance (p) between the top edge of the glass and the upper frame at 3 mm when positioning it in the vertical direction.





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 (14).

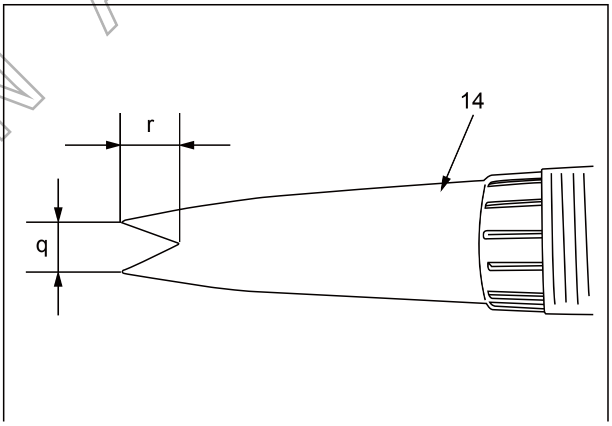
Adhesive:

Sunrise MSI SR sealant U90 4463876

2) Cut the tip of nozzle (14) as illustrated. Dimension of the cut:

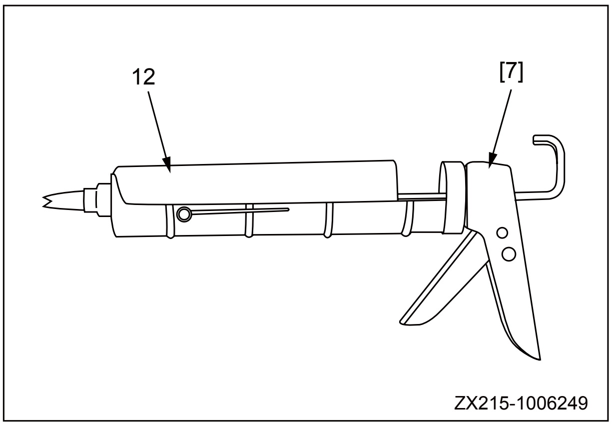
(q): 10 mm

(r): 5 mm



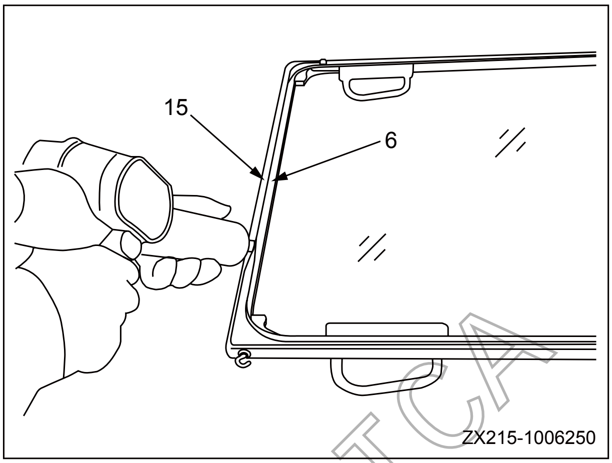
3) Set the cylinder (12) in the gun [7].

- An electrical caulking gun is more efficient.



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).

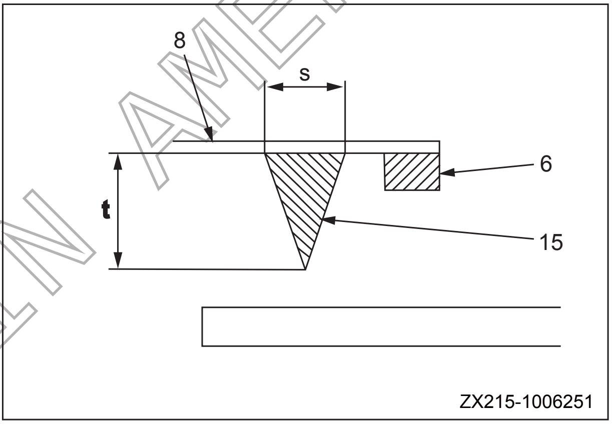


- Adhesive (15) for rubber seal (6) on cab (8) shall be applied as illustrated:

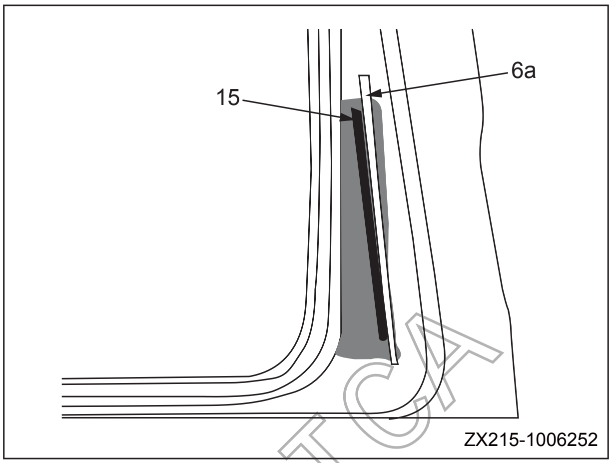
  Dimension of (s): 10 mm

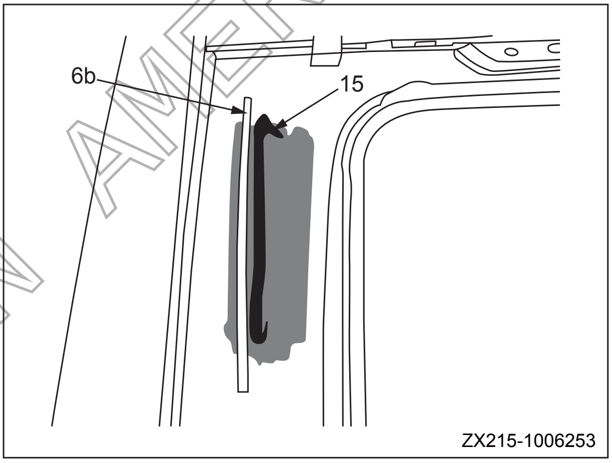
  Dimension of (t): 15 mm

- Adhesive (15) shall be thicker that the rubber seal (6).
- Apply adhesive of the same thickness evenly.



- 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.

- 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

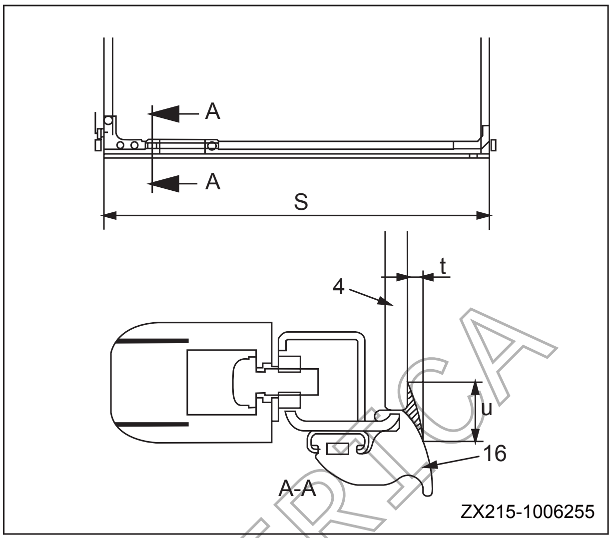
- Use a rubber spatula to cover the edge of the glass and trim the adhesive.
- Remove surplus adhesive.

  Glass primer:

  Sunrise MSI Primer 35

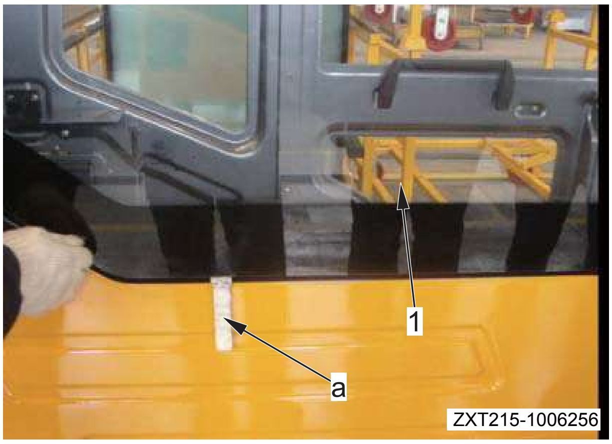
  Adhesive:

  Sunrise MSI SR Sealant U90 4463876

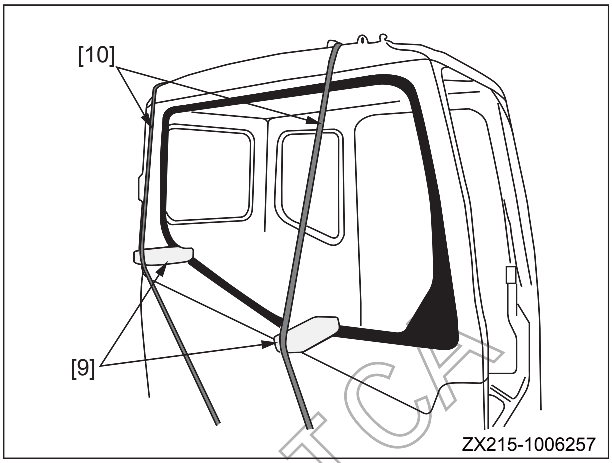


8. Fix the glass

   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.

8.33 Front Window AS - Disassemble and Assemble

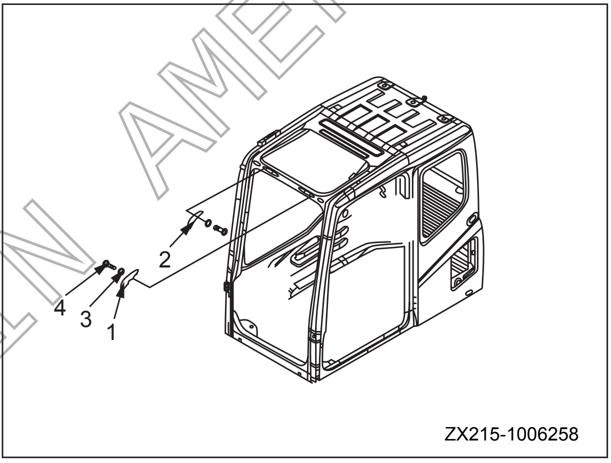
NOTICE

- **Before removing the front window assembly, 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.

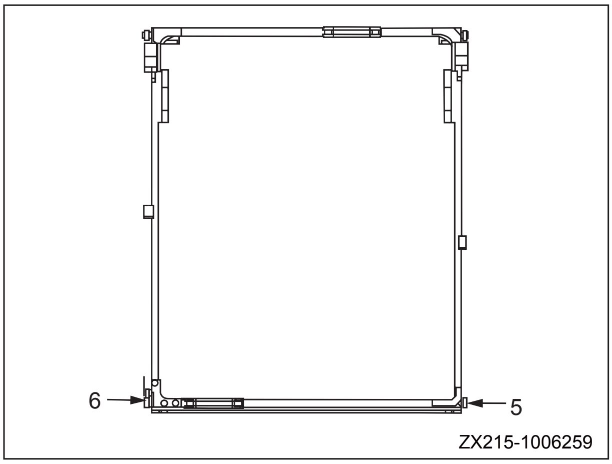
8.33.1 Disassemble

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).
    - Mounting bolt (4) and washer (3) of the left corner plate will be used in Step 6 to hang the pull rod.



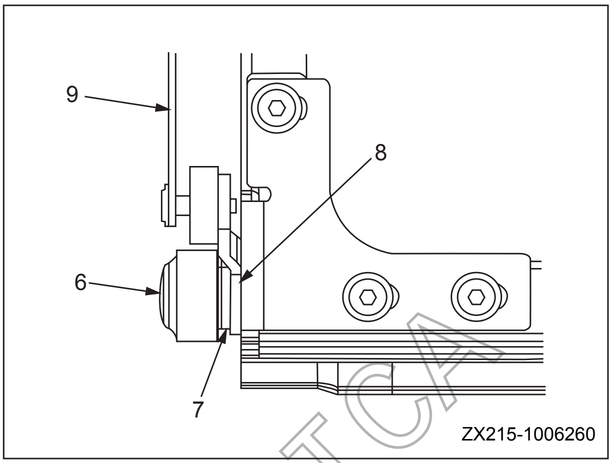
ZX215-1006258

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.



ZX215-1006259

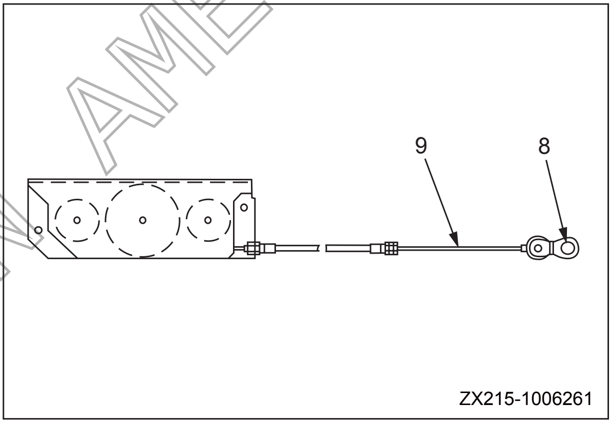
6. Remove pin (7) at the lower left side.
   - Plate (8) at the end of the pull rod (9) will come out by removing of pin (7).
   - Hang plate (8) onto the mounting bolt of left corner plate (using the washer) and fix it.



ZX215-1006260

NOTICE

- **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).**



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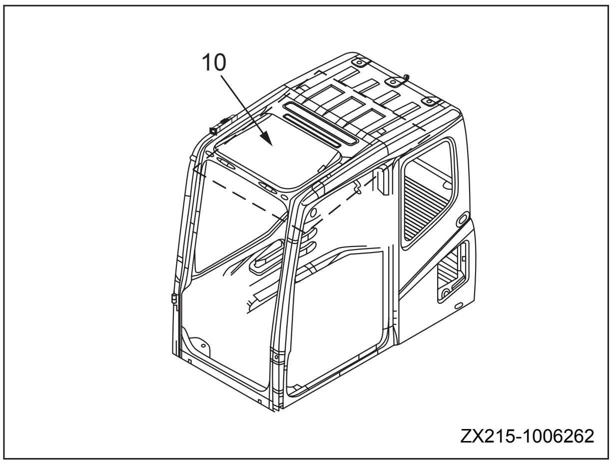
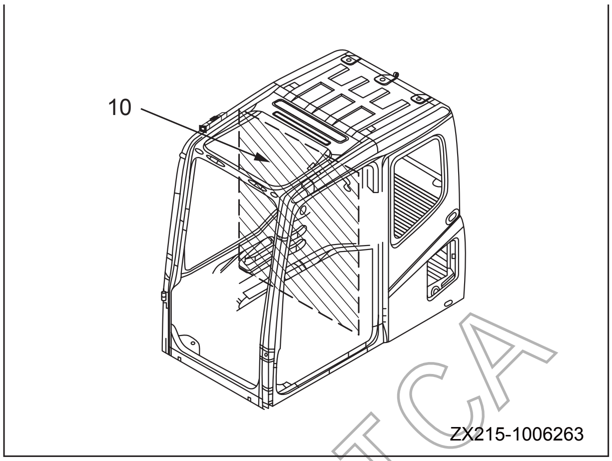
7. Pull out the front window assembly (10) from the opened part of the guide rail and lower the assembly gradually.

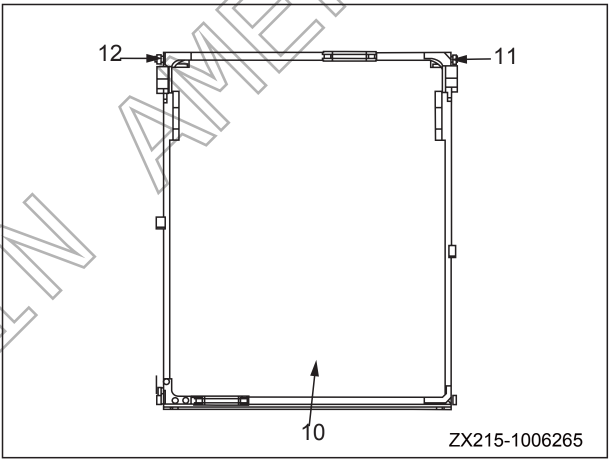


ZX215-1006262

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).



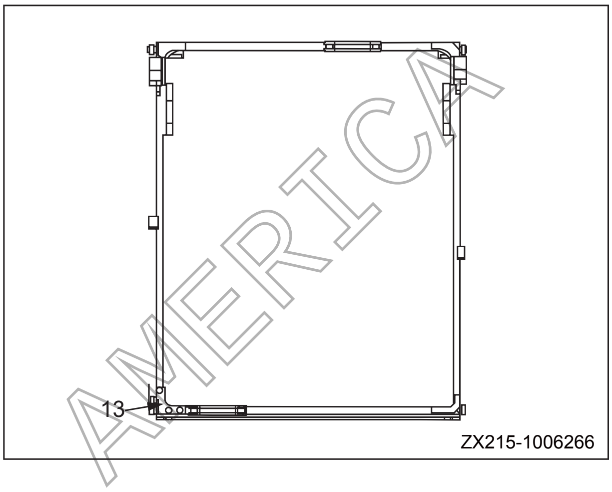
8.33.2 Assemble

- Reverse the disassembling sequence.
- 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.

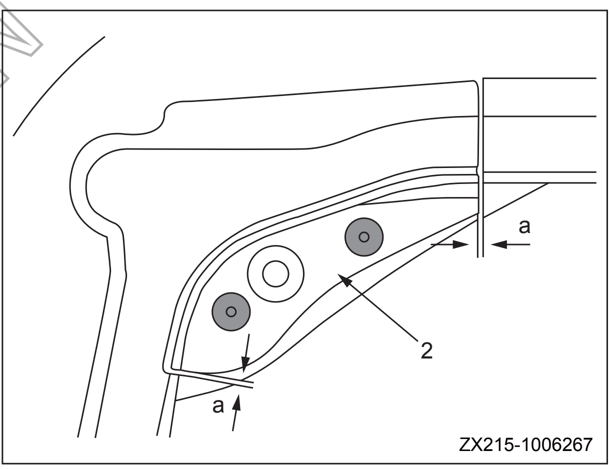
   🔧 Mounting bolt:

   34.3 N·m {3.5 kgf·m}



ZX215-1006266

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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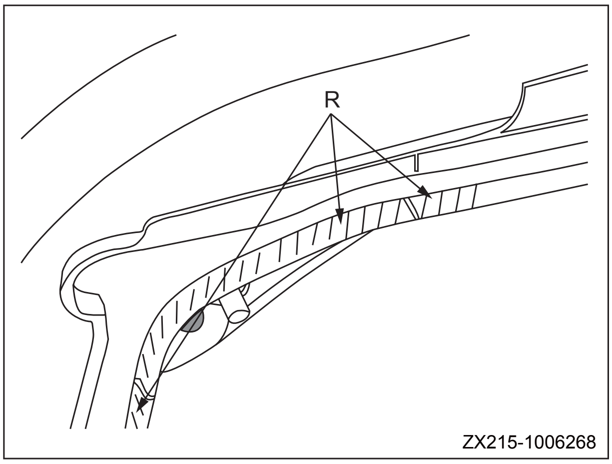
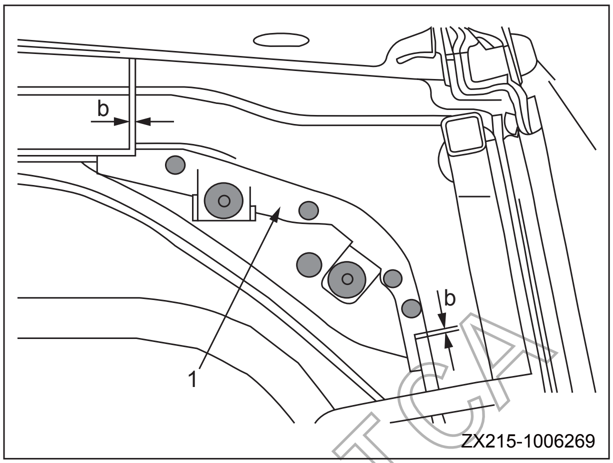


ZX215-1006268

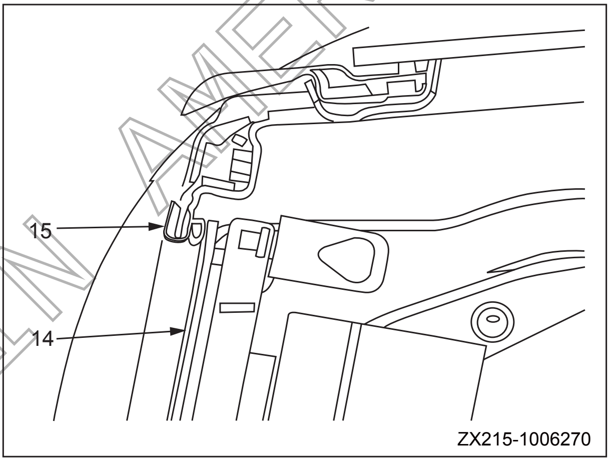
5. Install left corner plate (1)

   - 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 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 (15) on the cab.

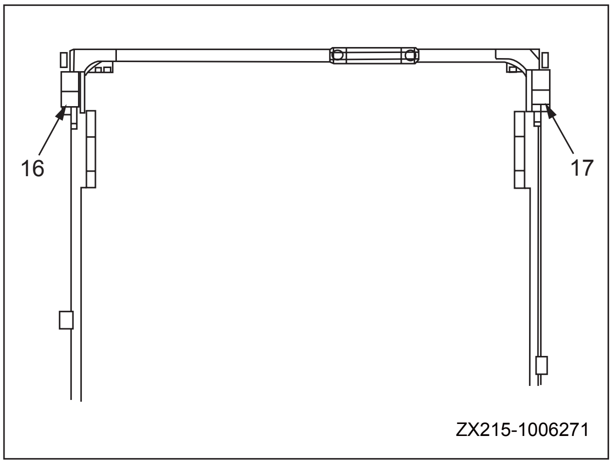


   2) Open and close the front window assembly and check the working condition of left lock (16) and right lock (17).

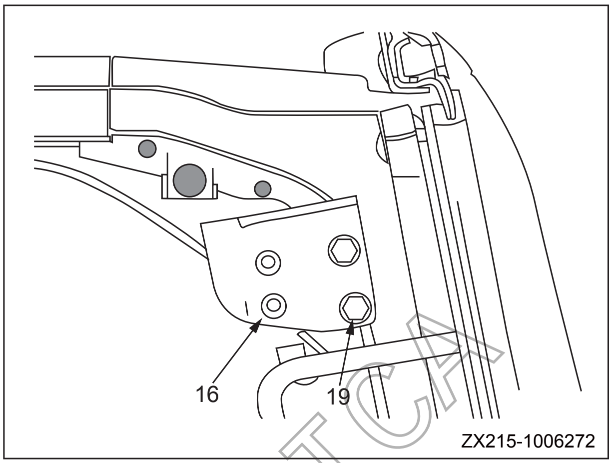
   - If left lock (16) and right lock (17) do not work properly, Loosen the mounting bolt (19) of the lock and move the lock (16) forward. Tighten the bolt after that.
   - Adjust the right lock with the same method.

   3) Check again the adaptability between the front window assembly (14) and the adjusting seal (15) on the cab. (Checked in Step 1)

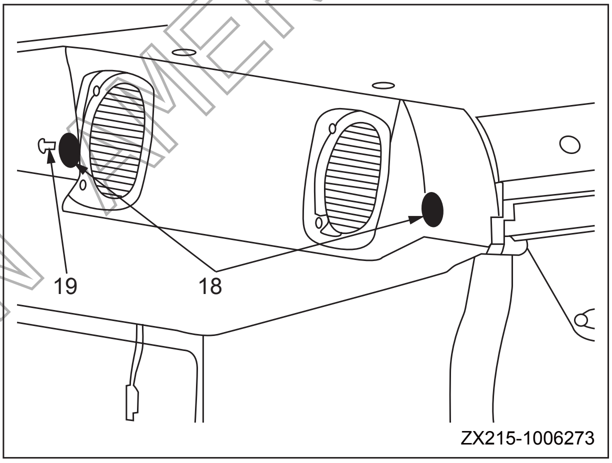
   - Tighten the mounting bolts of the left and right corner plates when the left and right locks (16, 17) are properly in place.

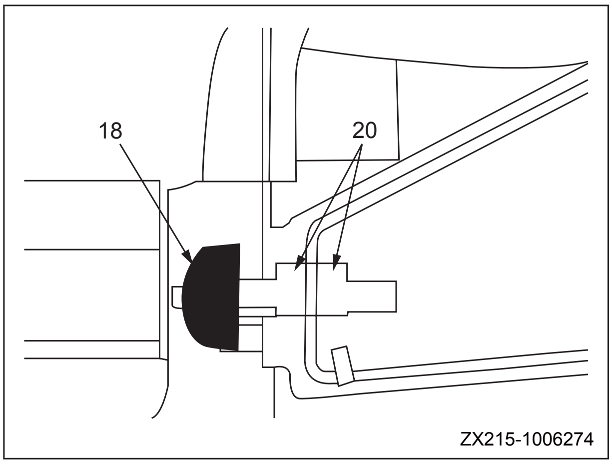


7. After adjustment is finished, flush the front window glass and check if any water leaks into the cab.



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 1.5 – 3.0 mm.
   - The front window assembly shall push the limit switch 4 – 7mm backward.



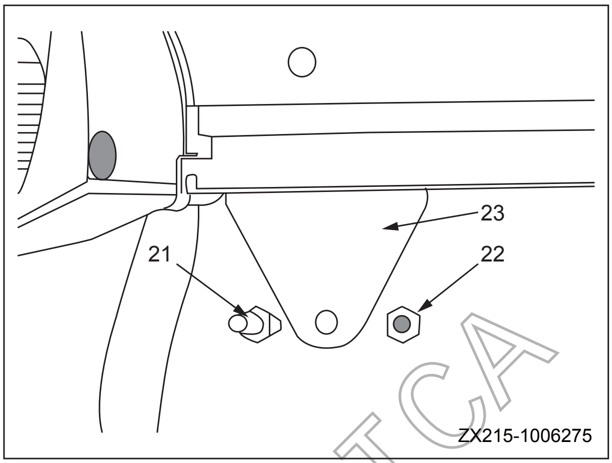


3) Close the front window assembly (10).

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).

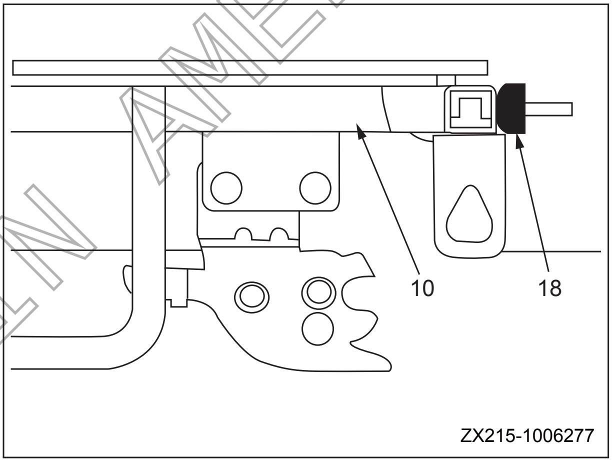
- Latch bolt(21): M10, Inner diameter of plate (23): ø14.5 mm



6) Adjustment of left and right rubber stopper (18)

- Allow front window assembly (10) to contact the left and right rubber stopper (18). (when the lock is "unlocked")

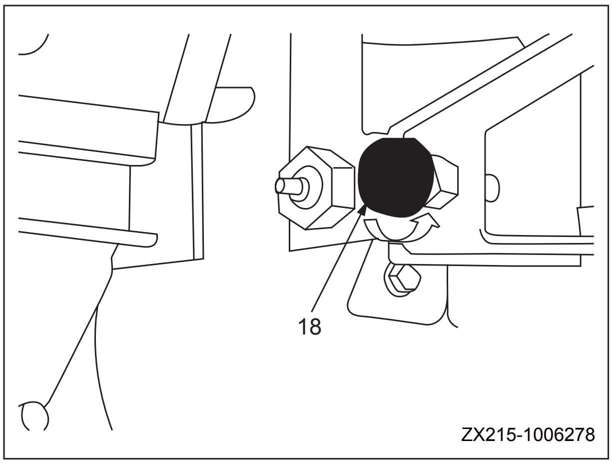
7) Lock front window assembly (10).



8) Turn the left/right rubber stopper (18) to the left by one and a half round.

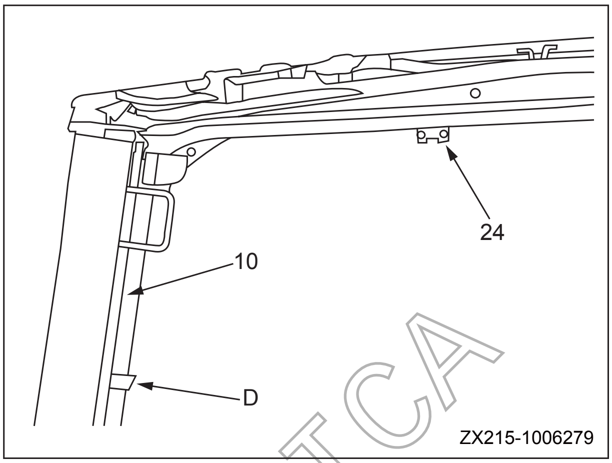
- Turning the rubber stopper (18) leftward for one round is equivalent to pressing it by 1.5 mm.
- When front window assembly is "unlocked", it must move the left/right rubber stopper (18) by 1.5 – 3.0 mm.

9) Tighten the retaining nuts (20) at both sides of the rubber stopper (18).



9. Adjust the front window assembly retainer (24).

   - 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.

    - After the adjustment from Step 6 to Step 9 is finished, check the locking force of left lock (16) and right lock (17).

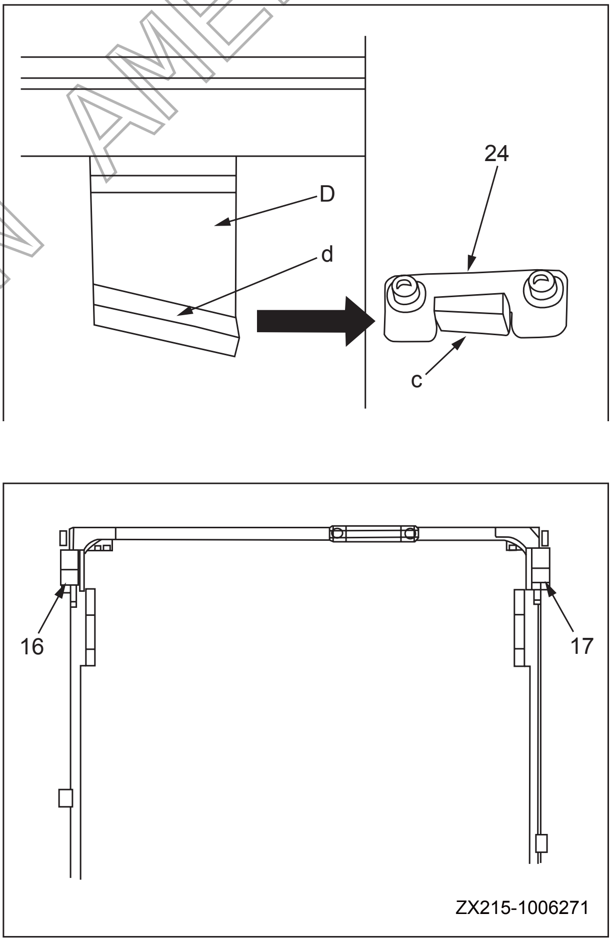
    - Check the locking force at the "locked" side (front of cab) and the "unlocked" side (rear of cab).

      Left lower pin:

      27 – 34 N·m {2.75 – 3.47 kgf·m}

      Mounting bolt:

      Adhesive(LT-2)



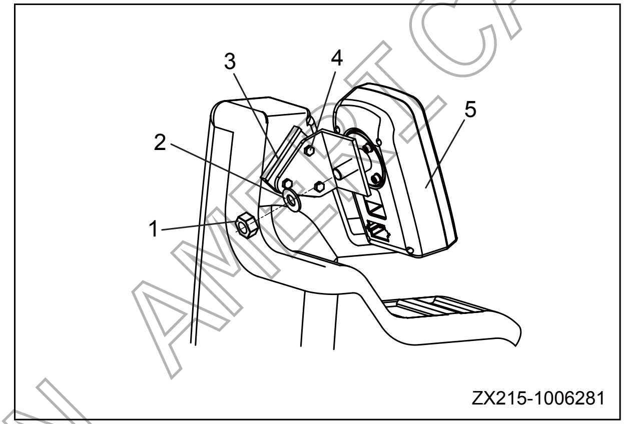
8.34 Monitor - Remove and Install

8.34.1 Removal

CAUTION

- **Disconnect first the cable connecting to 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.



8.34.2 Installation

- Installation is to be performed in the reverse order of removal.

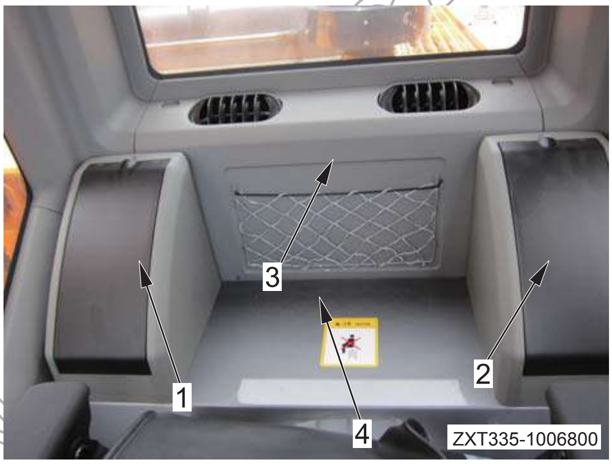
8.35 Controller AS - Remove and Install

8.35.1 Removal

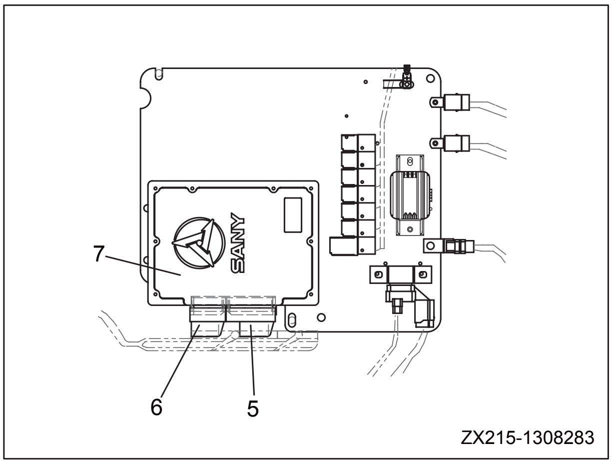
⚠ CAUTION

- **Disconnect first the cable connecting to 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).



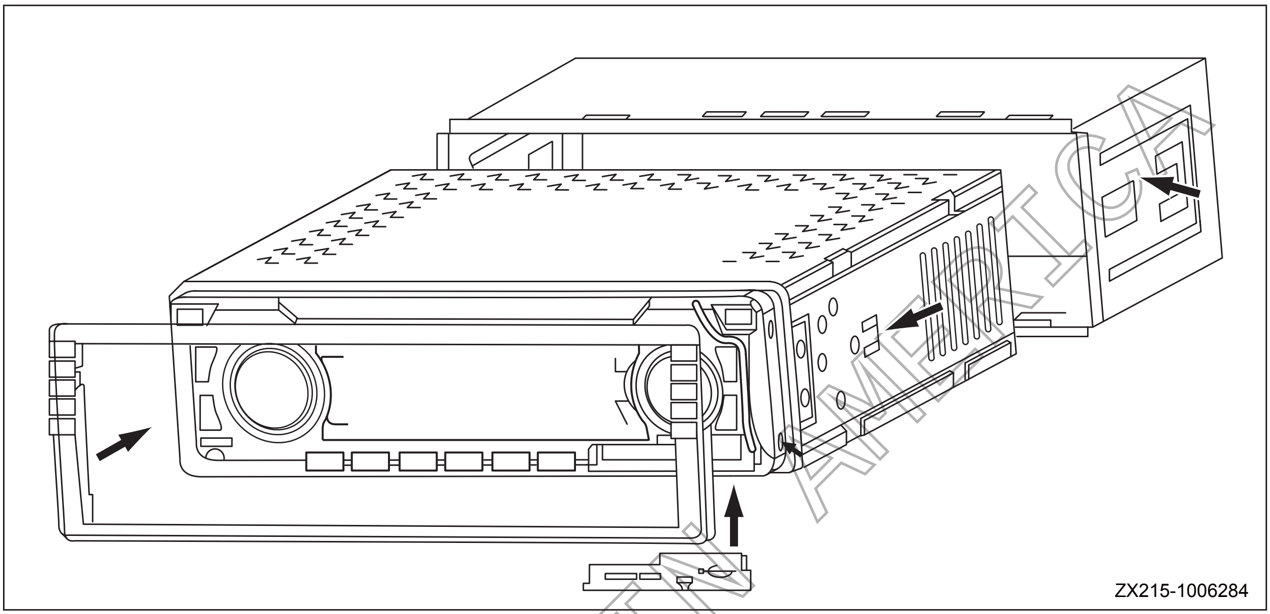
8.35.2 Installation

- Installation is to be performed in the reverse order of removal.

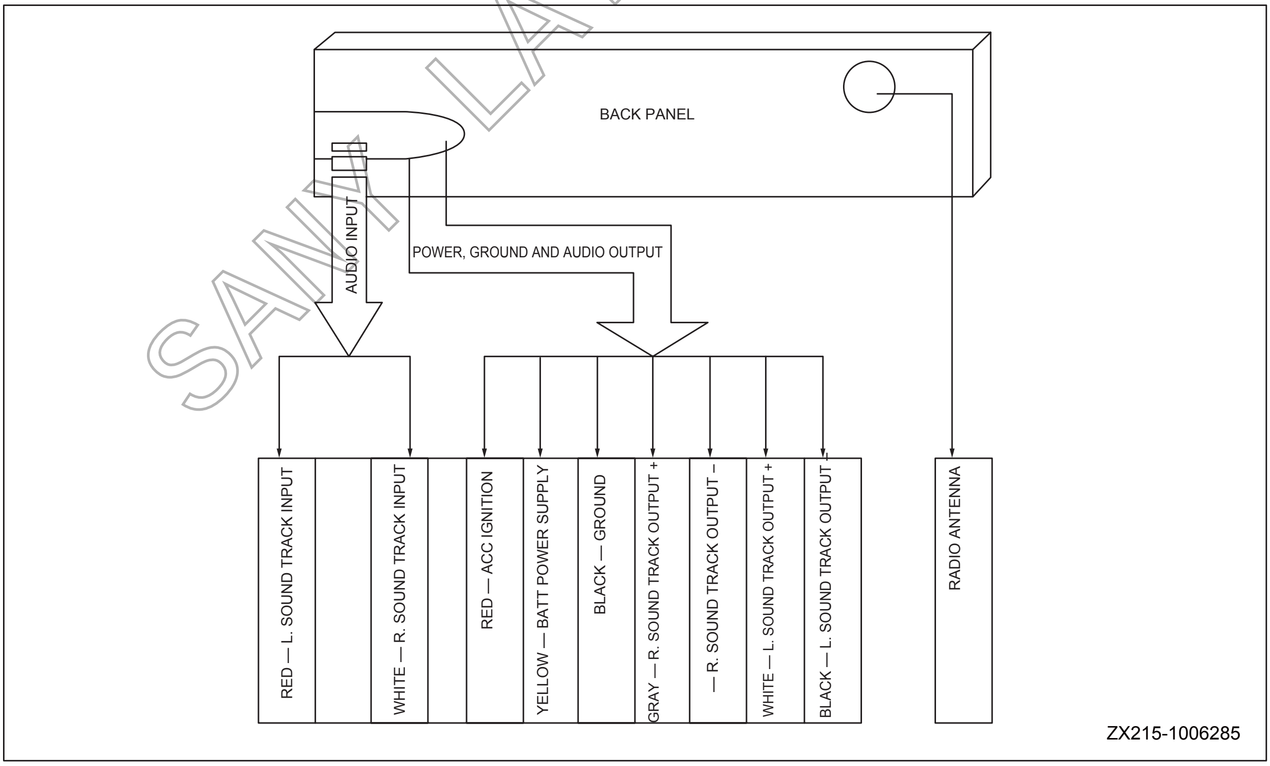
8.36 Radio

8.36.1 Structure

1. Main structure


ZX215-1006284

2. Wiring



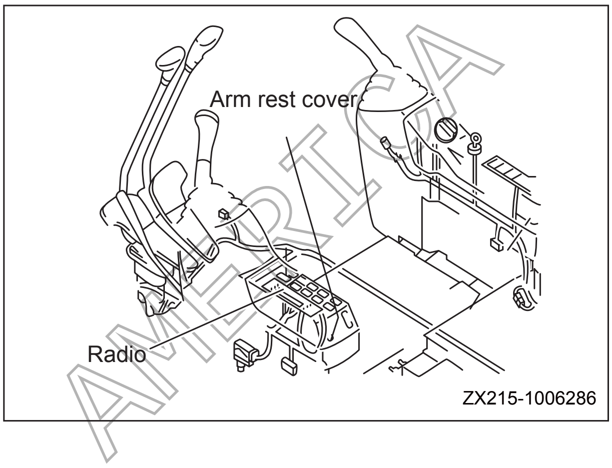
ZX215-1006285

8.36.2 Removal

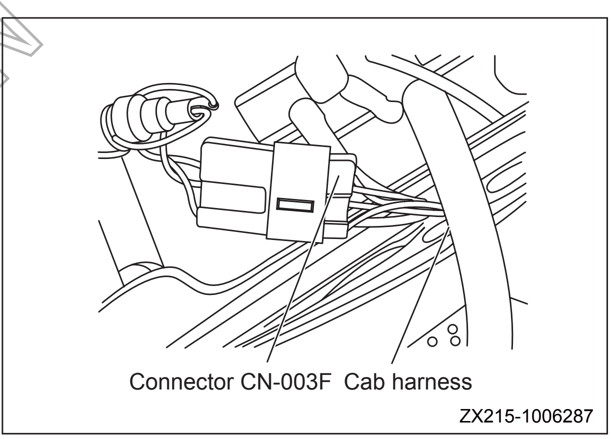
NOTICE

- **Disconnect the power supply prior to removal.**

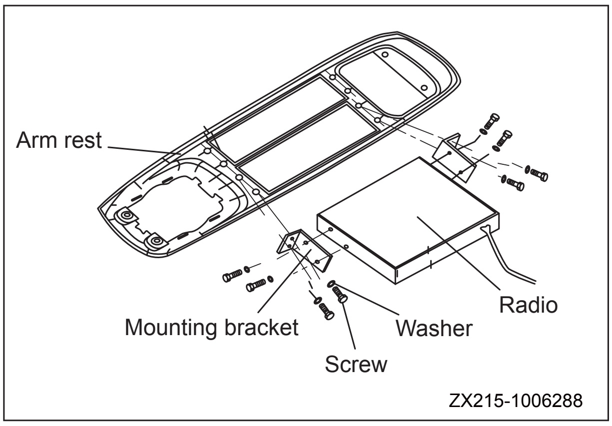
1. Remove the console cover.



2. Remove the radio connector CN-003F.



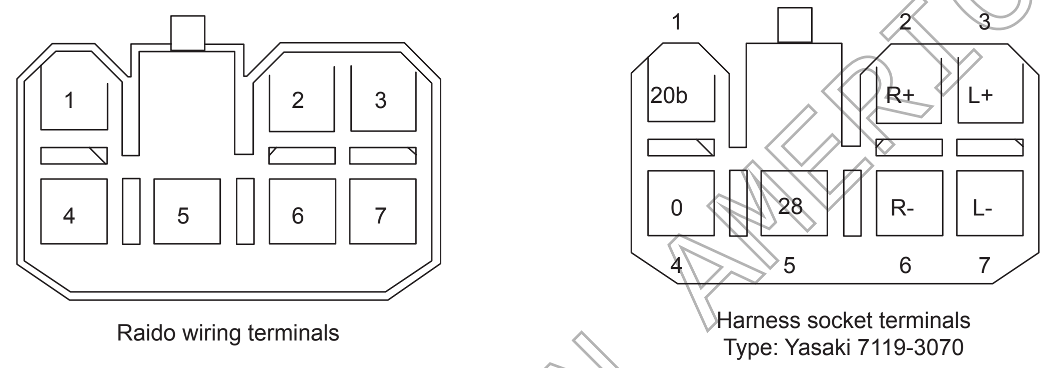
3. Remove the four screws and the washers in order to remove the radio and the radio mounting brackets from the console cover.
4. Remove the four screws and the washers in order to remove the radio from the radio mounting brackets.



8.36.3 Installation

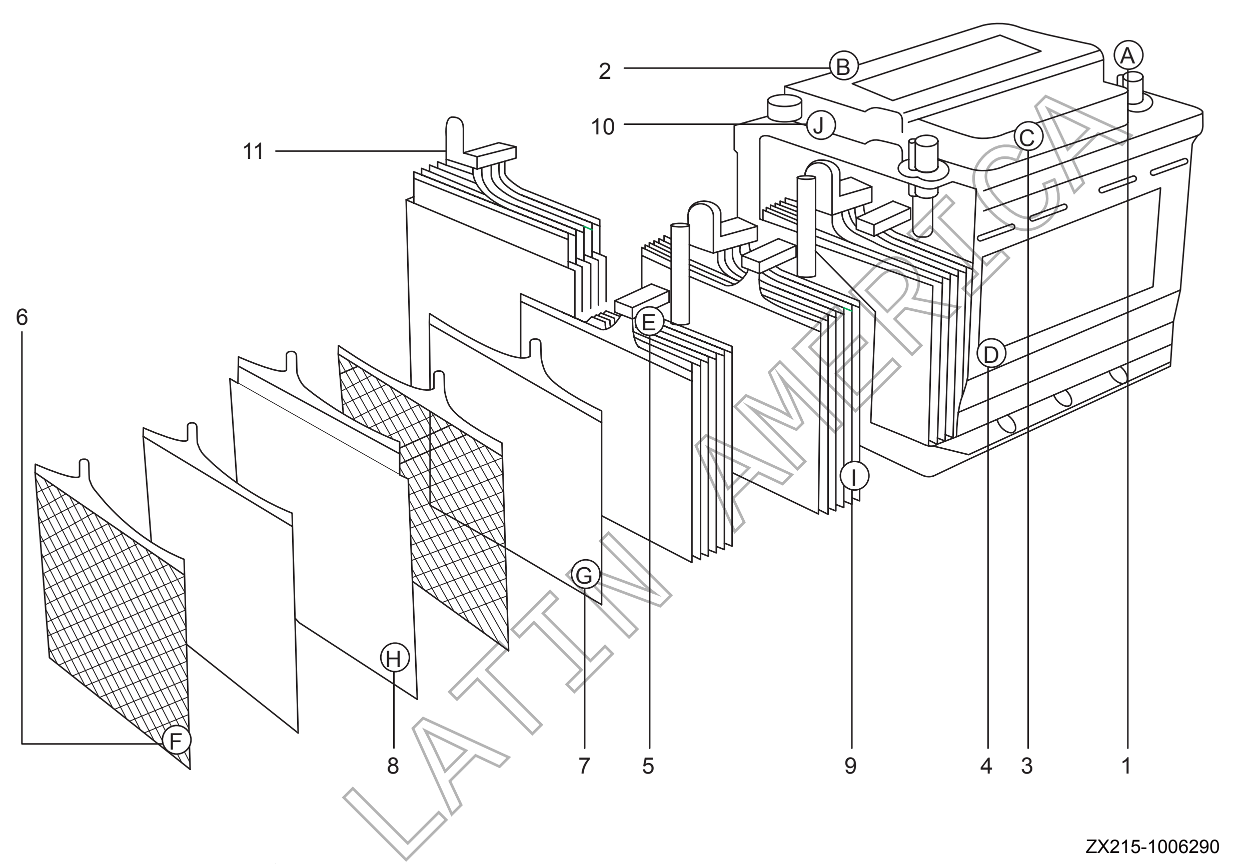
- Installation is to be performed in the reverse order of removal.

8.36.4 Connector model and wiring



8.37 Battery

8.37.1 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

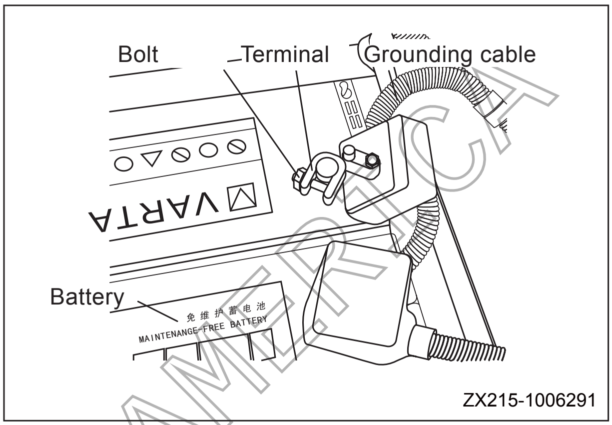
8.37.2 Removal

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.**

1. Removal of battery grounding wire

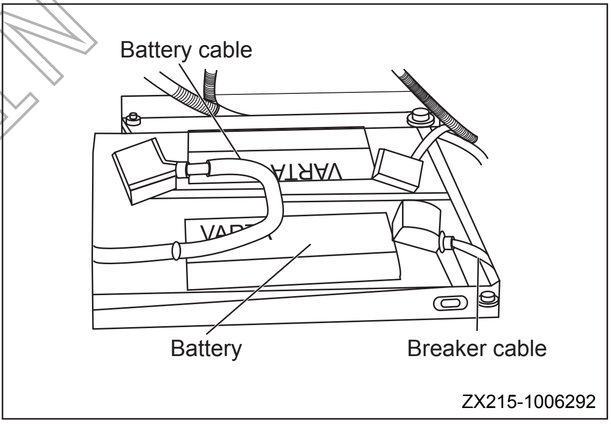
- Open the tarpaulin, unscrew the bolt, and remove the terminal from the battery wiring post.



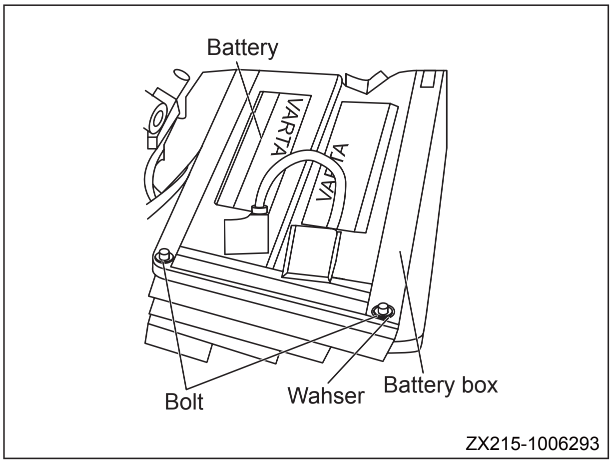
CAUTION

- **Battery gas can cause explosion. No sparks or flames are allowed near the battery.**

2. Disconnect the battery wiring cable and the battery breaker cable.



3. Remove the four bolts and washers. Remove the battery assembly from the bottom plate. Remove the battery.



8.37.3 Installation

- Installation is to be performed in the reverse order of removal.

8.37.4 Replacement

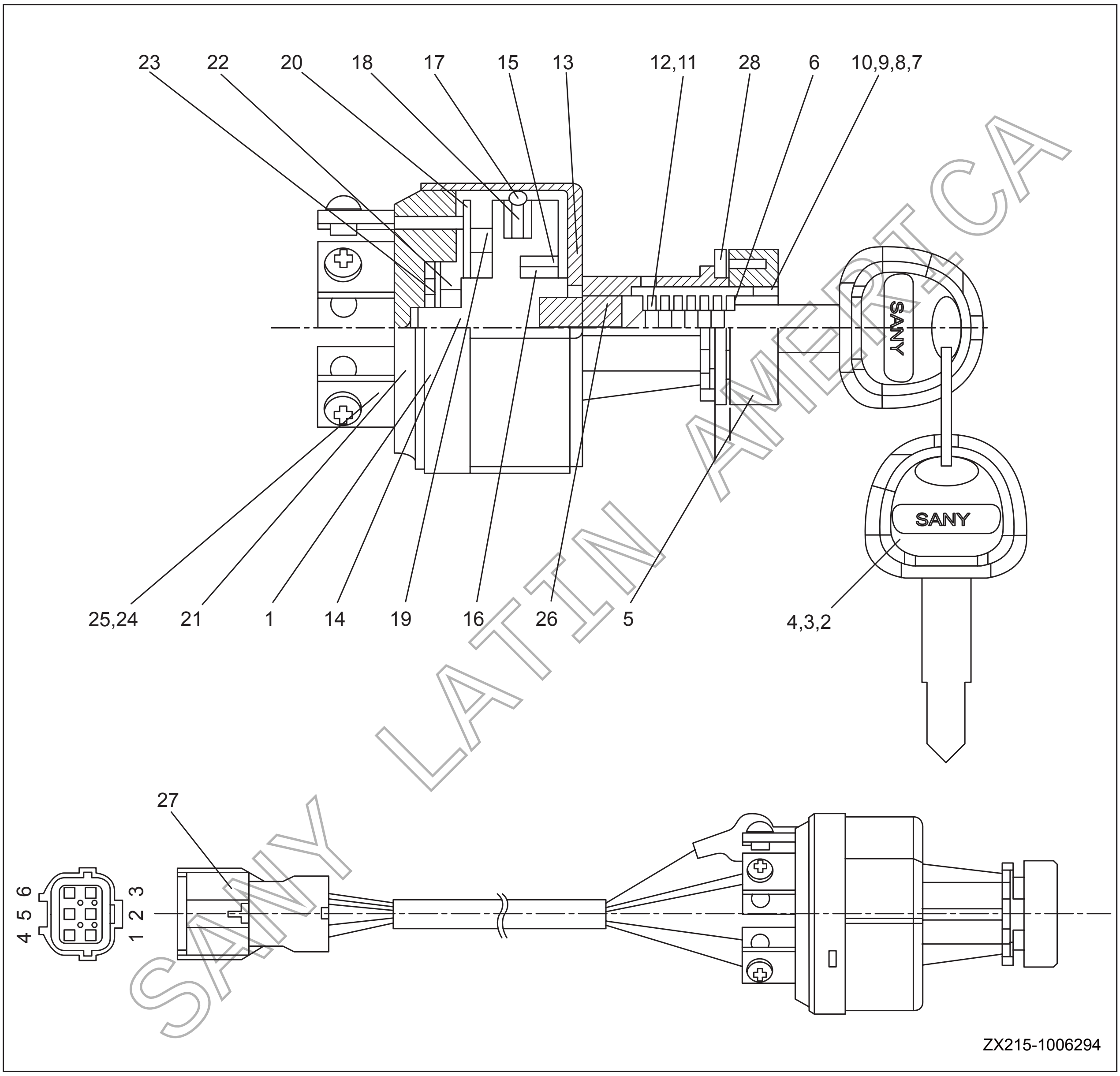
There are two 12V batteries with grounding negative (-) posts in the machine. If one battery fails in the 24V system, it must be replaced with one of the same type. Batteries of different types are probably charged at different speeds, which may cause one of them to fail due to overloading.

NOTICE

- **During installation, apply vaseline to battery terminals in order to prevent corrosion.**

8.38 Start Switch

8.38.1 Structure



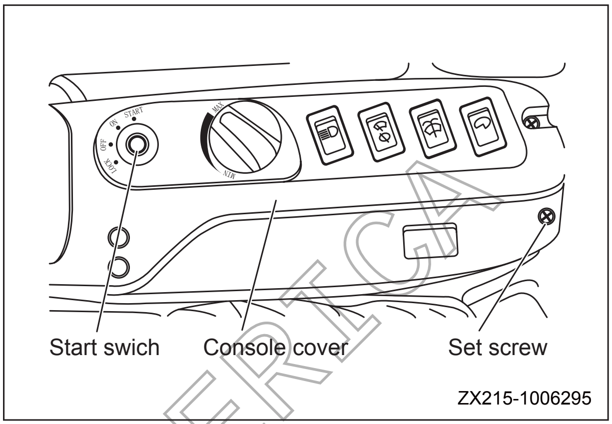
1) Housing
2) Key
3) Ring
4) Knob
5) Nut
6) Cylinder
7) Cap
8) Shield
9) Pin
10) Spring
11) Disc
12) Spring
13) Plug
14) Rotor
15) Cover
16) Spring
17) Ball
18) Spring
19) Contact SPR-B
20) Contact A
21) Seat
22) Contact SPR-A
23) Contact B
24) Terminal
25) Bolt
26) O-ring seal
27) Harness AS
28) Washer

8.38.2 Removal

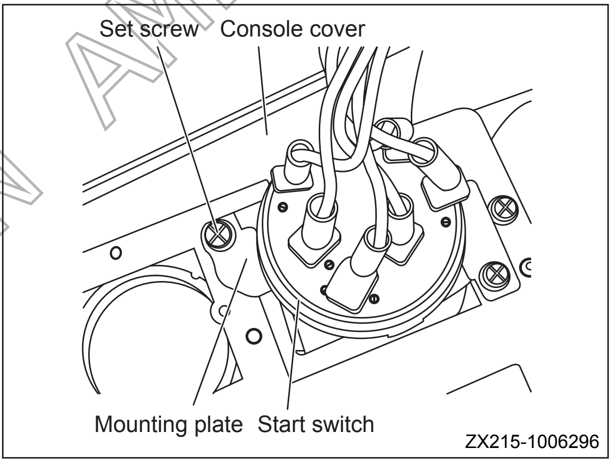
NOTICE

- **Disconnect the power supply of the start switch before removal.**

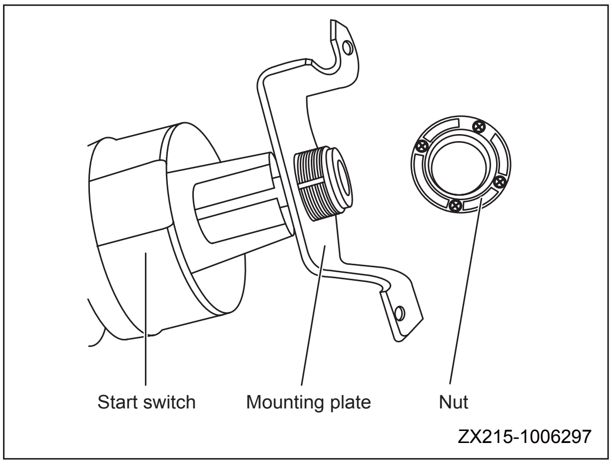
1. Remove the setscrew to remove the console cover.



2. Remove both setscrews in order to remove the mounting plate and the start switch from the console cover.



3. Remove the nut so as to remove the start switch from its mounting plate.

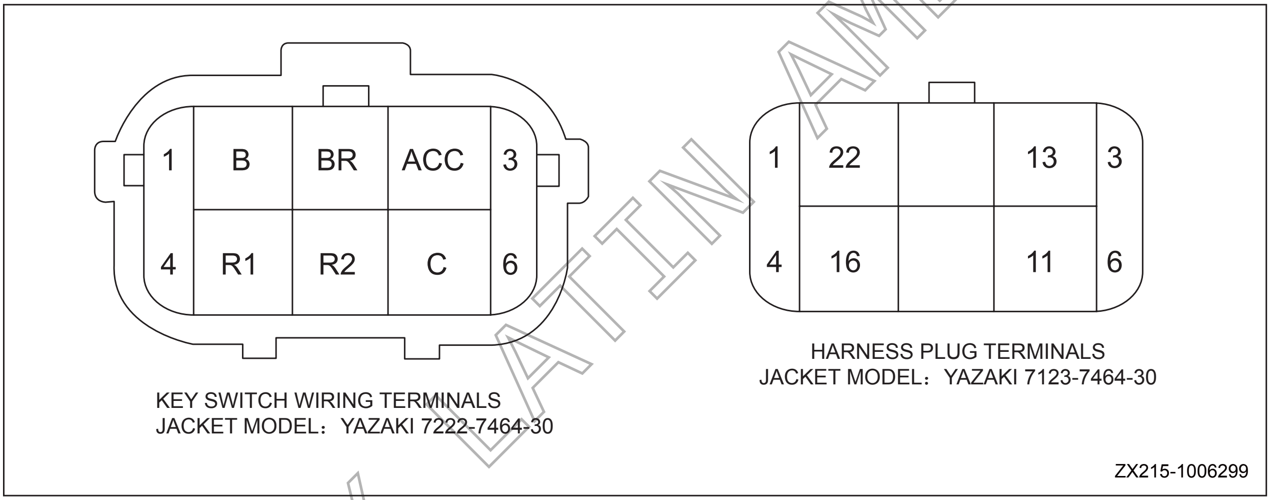


Working principle and wiring of start switch

1. Working principle

Key Position	ON/OFF					
	Battery (B)	Battery Relay (BR)	Accessory	Preheat Plug		Start Relay (C)
				(R1)	(R2)	
HEAT	○ ———	○ ———	○			
OFF	○					
ON	○ ———	○ ———	○			
START	○ ———	○ ———	○ ———	———	○ ———	○

2. Wiring



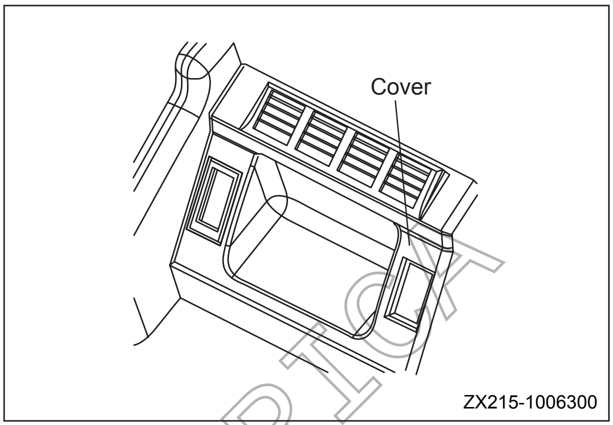
KEY SWITCH WIRING TERMINALS
JACKET MODEL：YAZAKI 7222-7464-30

HARNESS PLUG TERMINALS
JACKET MODEL：YAZAKI 7123-7464-30

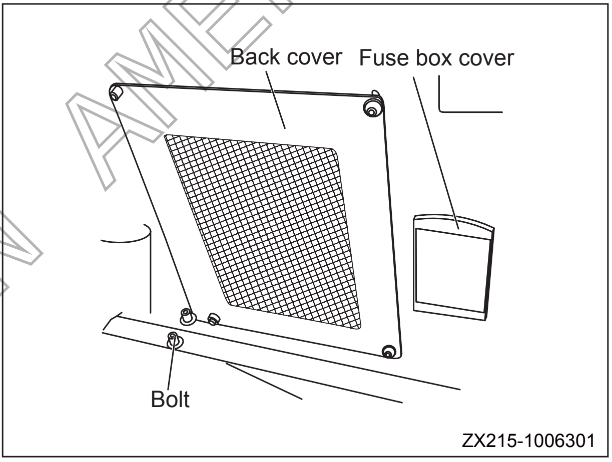
8.39 Fuse Box

8.39.1 Removal

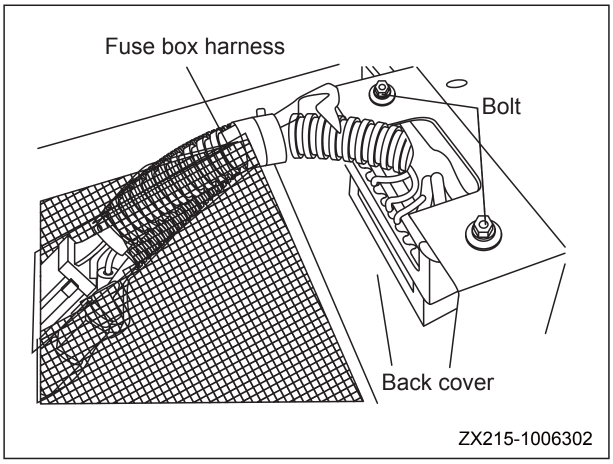
1. Remove the cover.



2. Remove the bolts and take off the back cover along with the fuse box.

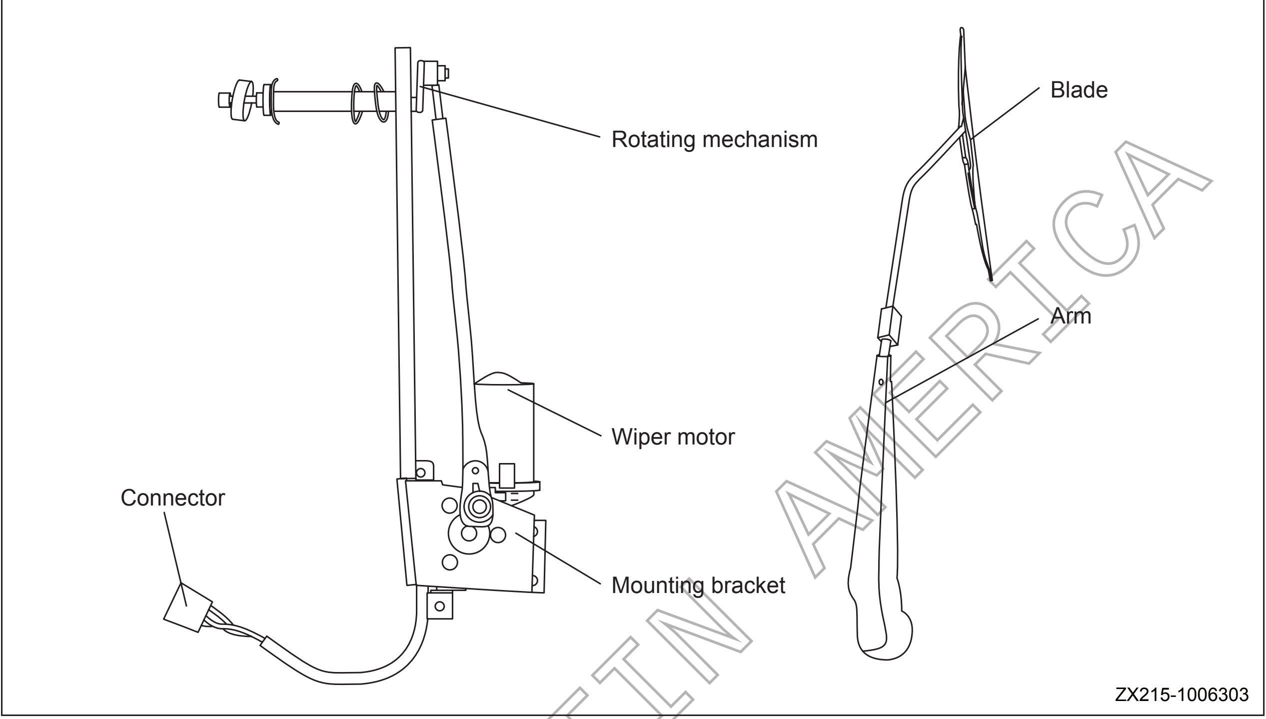


3. Remove the bolts so as to separate the fuse box and harness assembly from the back cover.

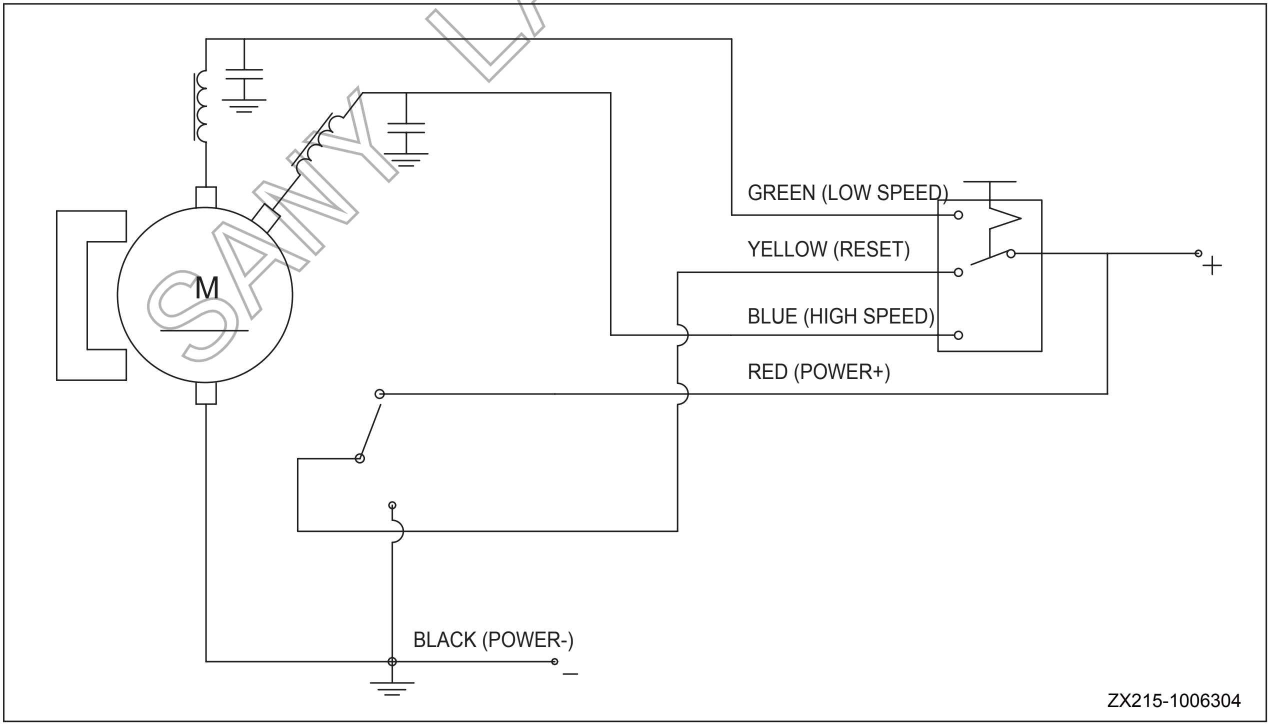


8.40 Wiper

8.40.1 Structure

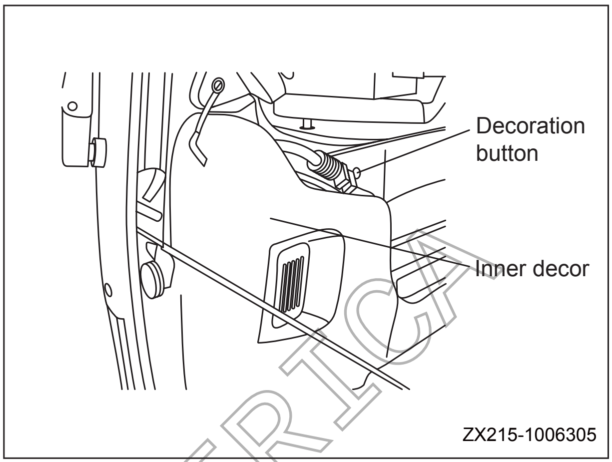


8.40.2 Working principle

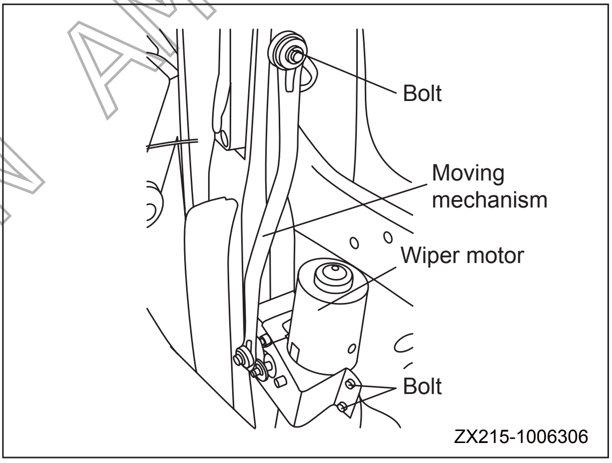


8.40.3 Removal

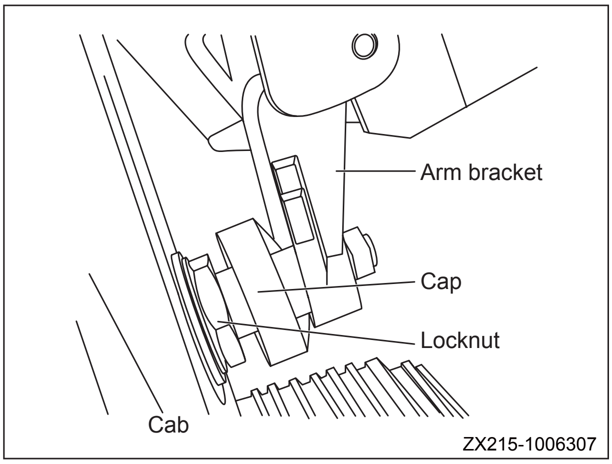
1. Remove the decorative button in order to remove the interior decoration.



2. Remove the moving mechanism and the motor.
   - Unscrew the bolts to remove the wiper motor and moving mechanism from the cab.



3. Remove the arm and the blade.
   - Unscrew the nut to remove the wiper arm and blade from the cab.

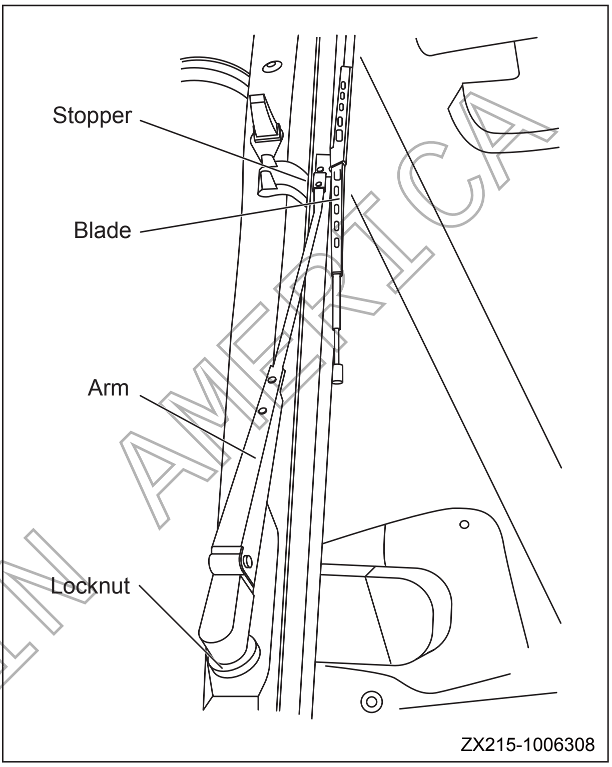


8.40.5 Installation

- Installation is to be performed in the reverse order of removal.

8.40.4 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.

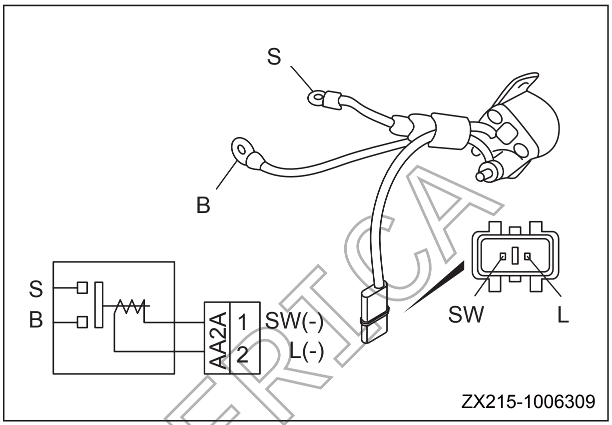


8.41 Relay

8.41.1 Engine relays

1. Starter relay - check

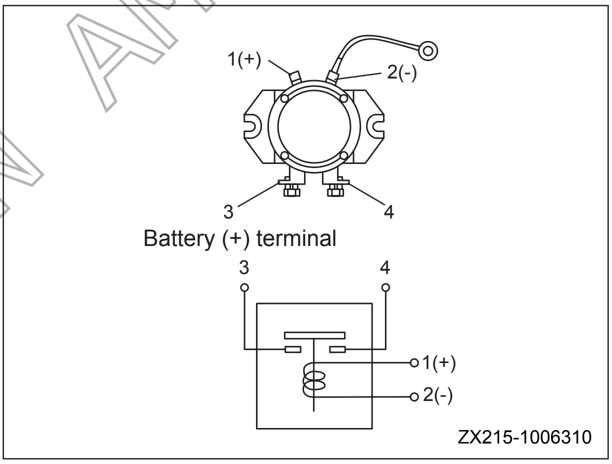
- Check the conduction and action. Replace the relay in case of any failure.



ZX215-1006309

2. Mains relay - check

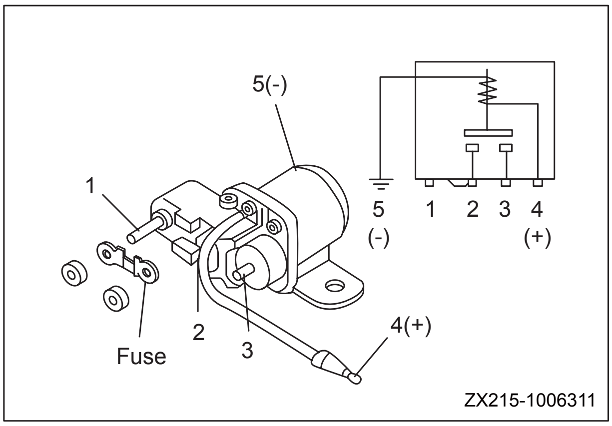
- Check the conduction and action. Replace the relay in case of any failure.



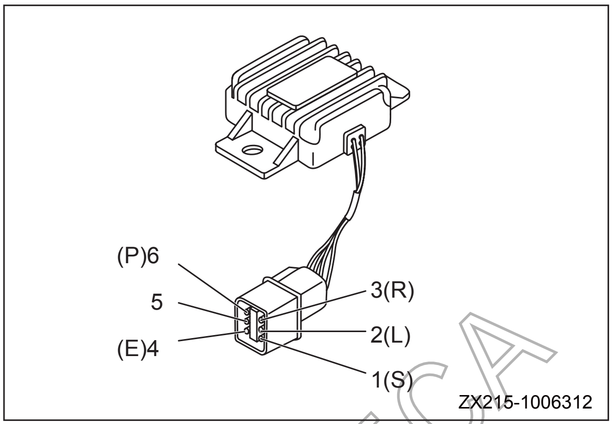
ZX215-1006310

3. Heater relay

- Check the conduction and action. Replace the relay in case of any failure.



ZX215-1006311



4. Safety relay

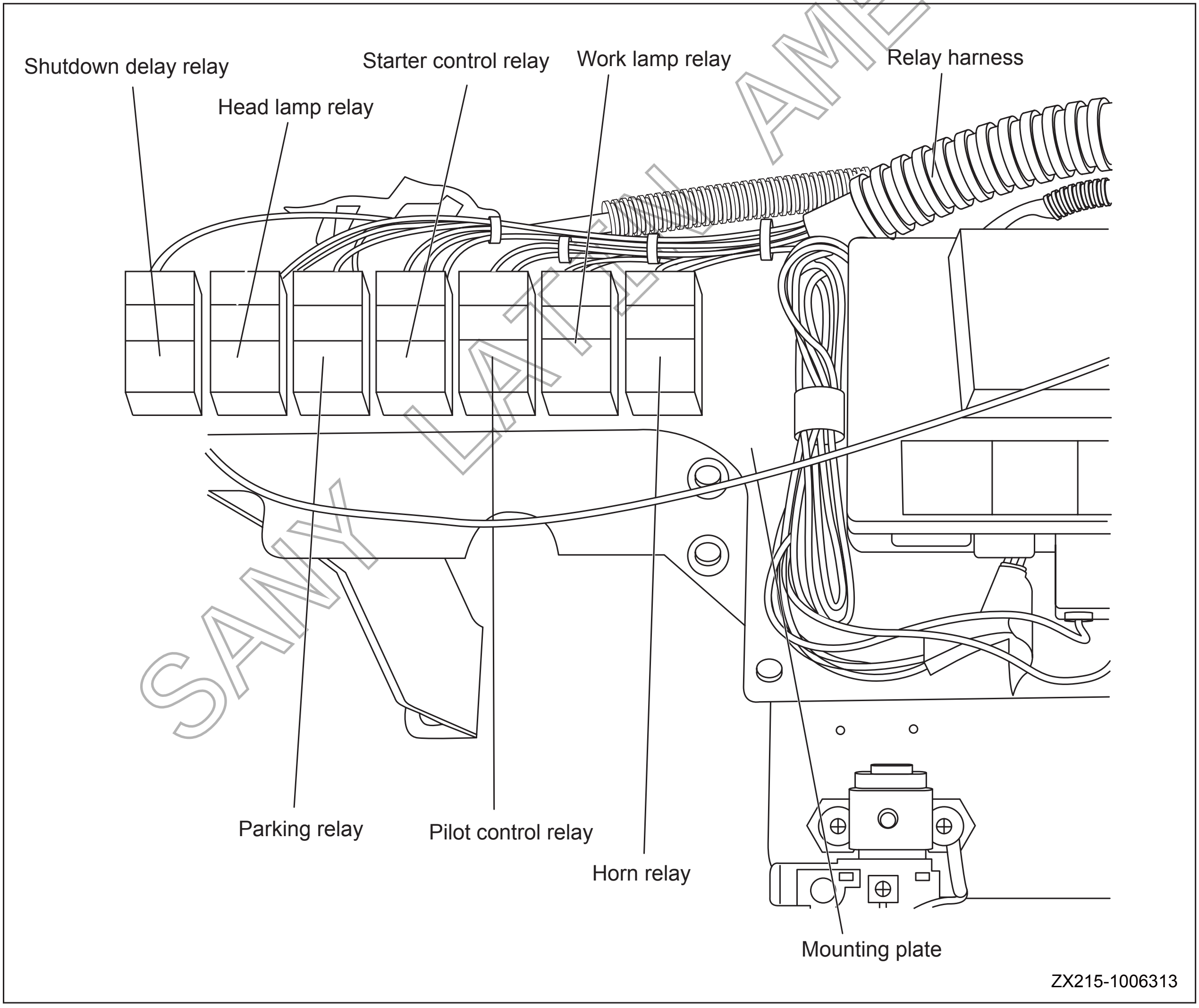
Measure the resistance between terminal 2 and terminal 3.

Standard Value	Approx. 200Ω

- Check the conduction and action. Replace the relay in case of any failure.

8.41.2 Other relays

1. Function and location

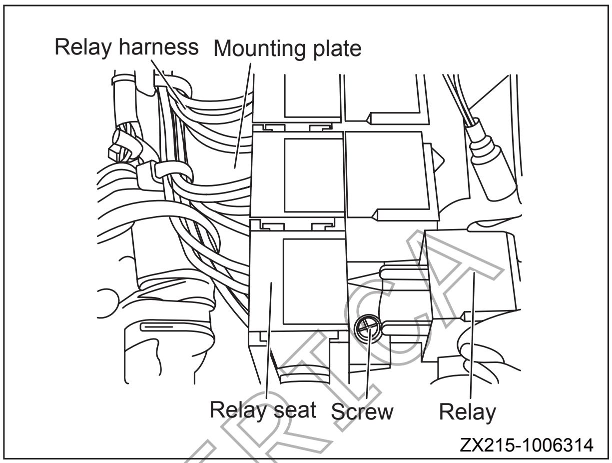


2. Removal

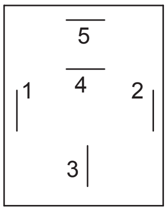
1) Remove relay from its seat.
2) Remove the screw in order to remove the relay seat and harness from the mounting plate.

3. Installation

- Installation is to be performed in the reverse order of removal.

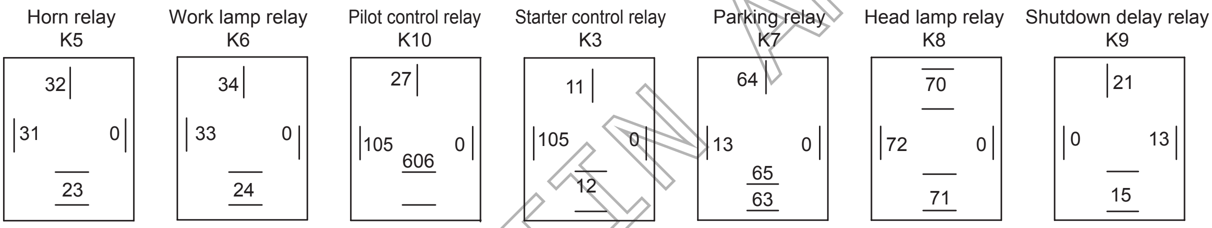


4. Relay connector and wiring



Relay wiring terminals

Relay model: HELLA 4RD 007 903-027



Harness socket terminals

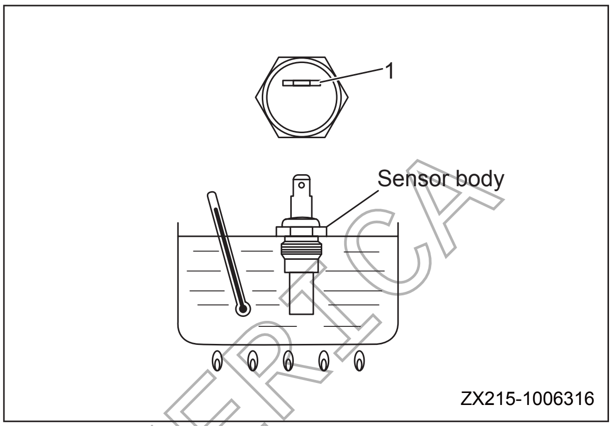
Socket model: Jacket 8JA003526-00

ZX215-1006315

8.42 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.

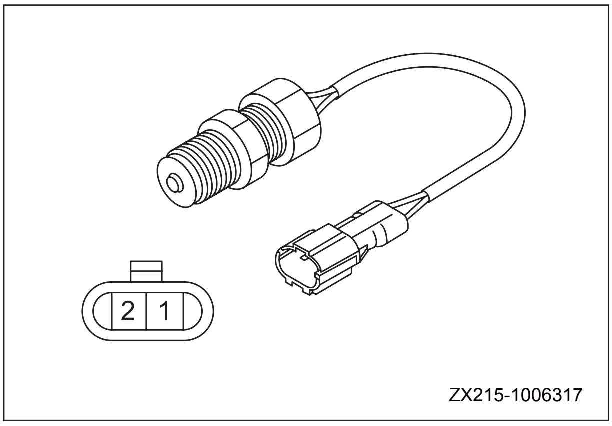


Standard Value	50±0.2°C	80±10Ω
	60°C	56.3Ω(ref.)
	80°C	29.5Ω(ref.)
	100°C	16.5Ω(ref.)
	106±0.3°C	14.3±1.0Ω
	120°C	10Ω(ref.)

- 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

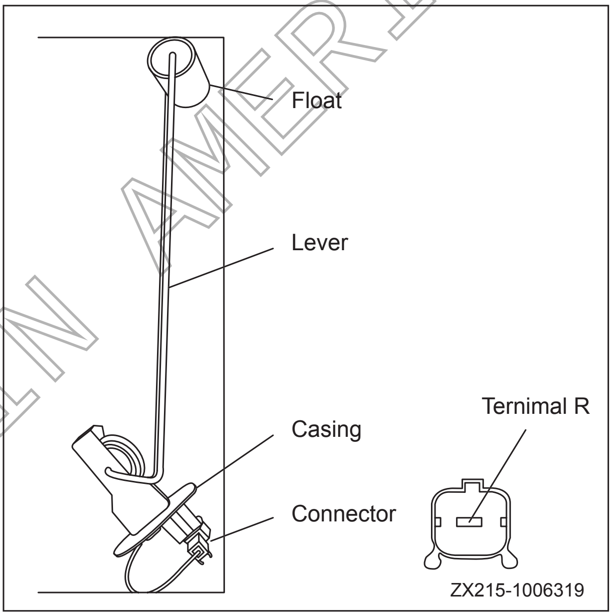
- **Insufficient tightening of the engine speed sensor may cause signal output failure. Tighten the sensor to specified torque.**

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

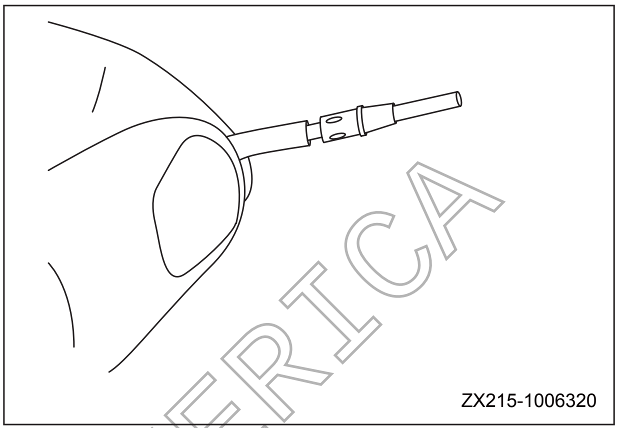
- Swing the float up and down in order to measure the effective angle of radial swing, i.e. the line through the float and the turning point will swing 105°.
- Swing the float up and down. The vertical distance between the upper limit and the lower limit of the float should be 500 mm.
- Move the float 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.



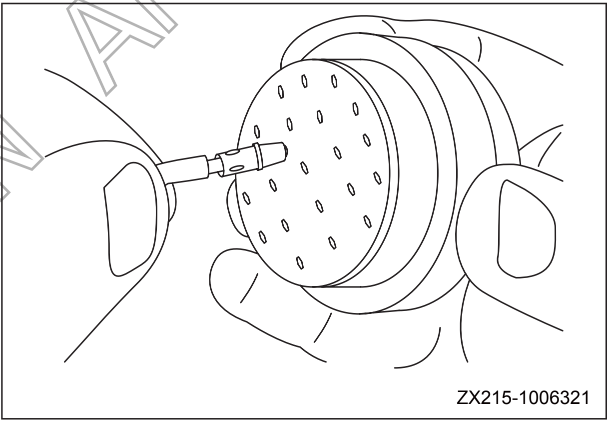
8.43 Connector Terminals - Insert and Remove

8.43.1 Insertion

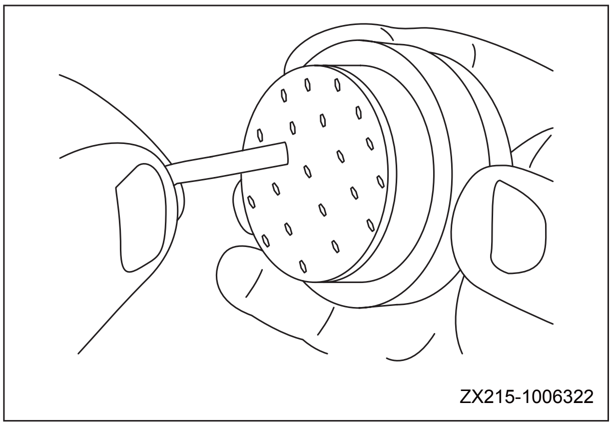
1. Hold tightly a wire terminal at a distance of about 25 mm from its end.



2. Hold the connector. Let the rear seal face you.

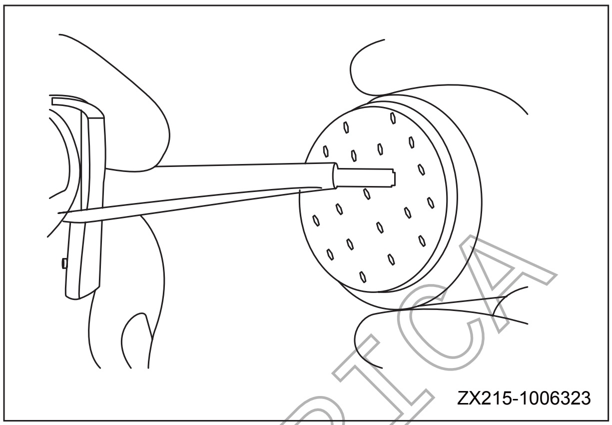


3. Align the terminal with a hole on the seal and push it perpendicularly to the bottom. Slightly pull back the wire in order to ensure that the terminal is locked in place.

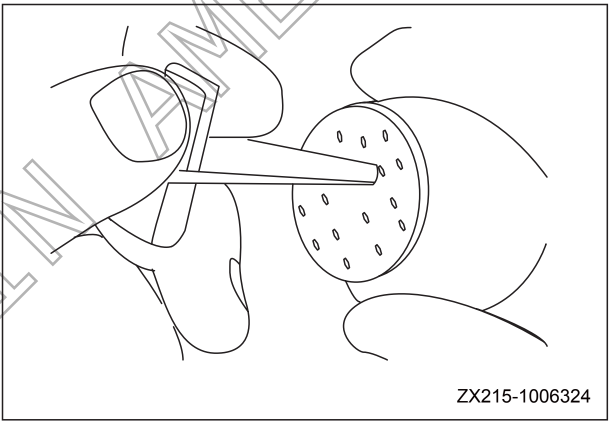


8.43.2 Removal

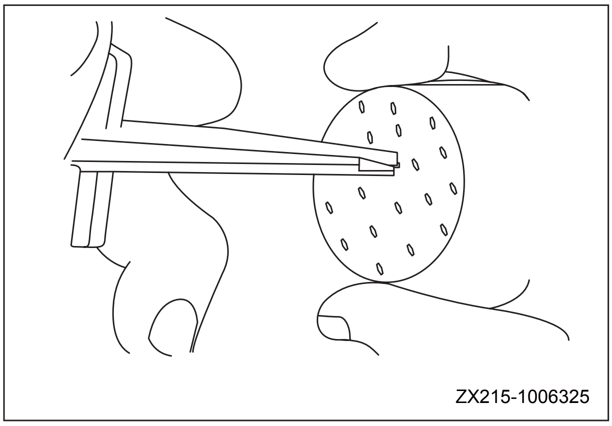
1. Hold the connector, with its back end facing you. Select a suitable tool and clip on the wire.



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.



3. Pull out the tool to remove the wire with terminal.



SANY

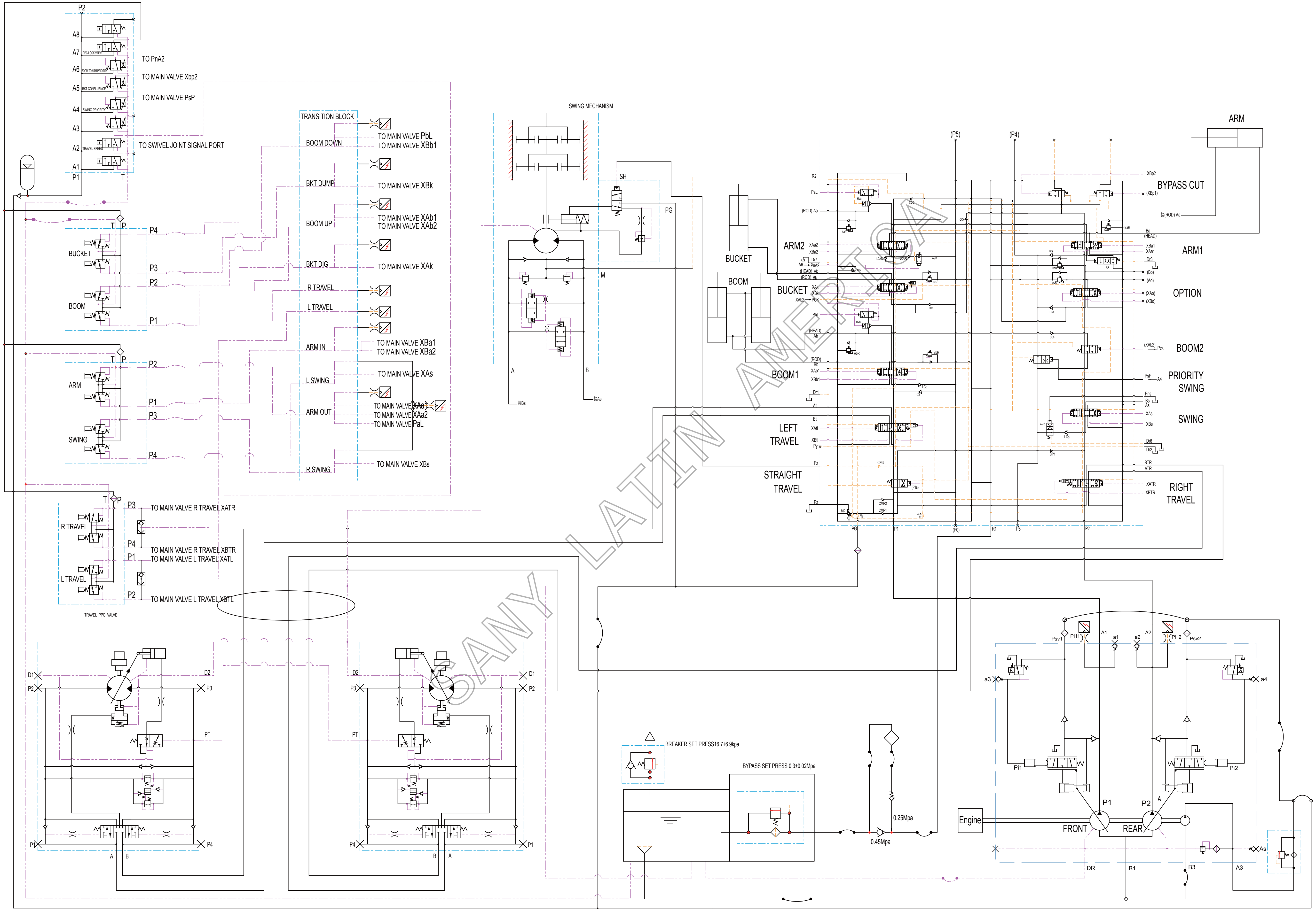
System Schematics

9 System Schematics

⚠ WARNING

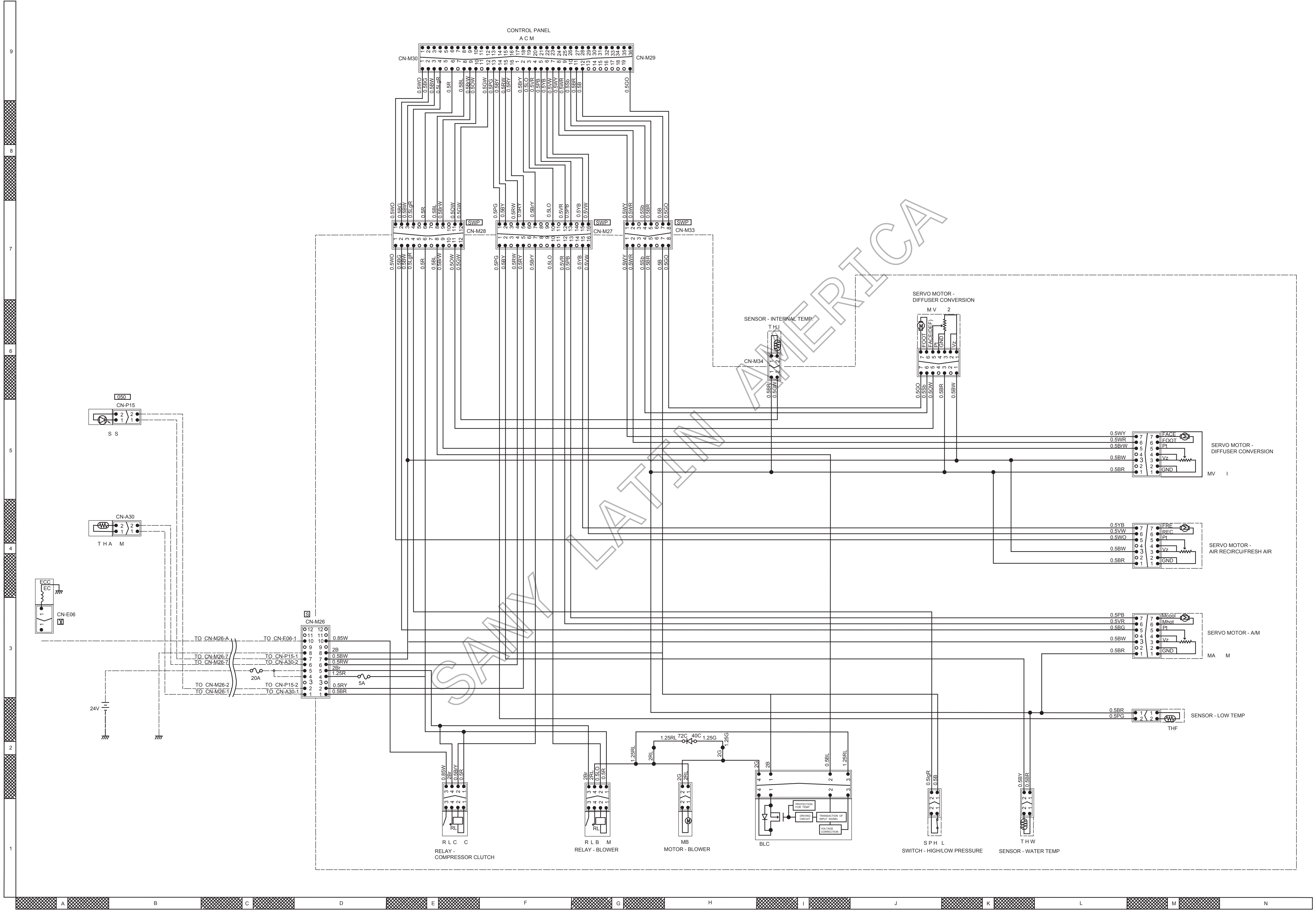
Read and understand all safety precautions and instructions in this manual before reading any other manuals provided with this machine and before operating or servicing the machine. Also read the safety information on machine decals before performing any operations. Failure to do so can cause machine damage, personal injury or death.

9.1 Hydraulic System Diagram

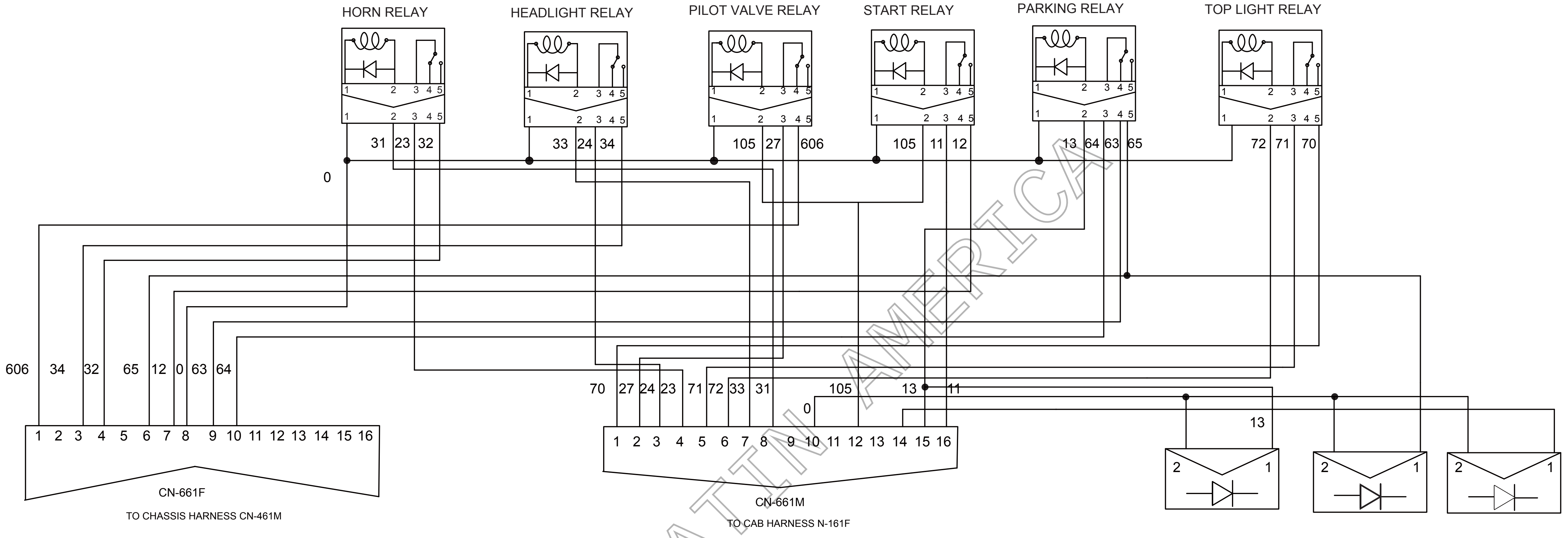


ZX225-1108005

9.2 Air-Conditioning Electrical Circuit Diagram

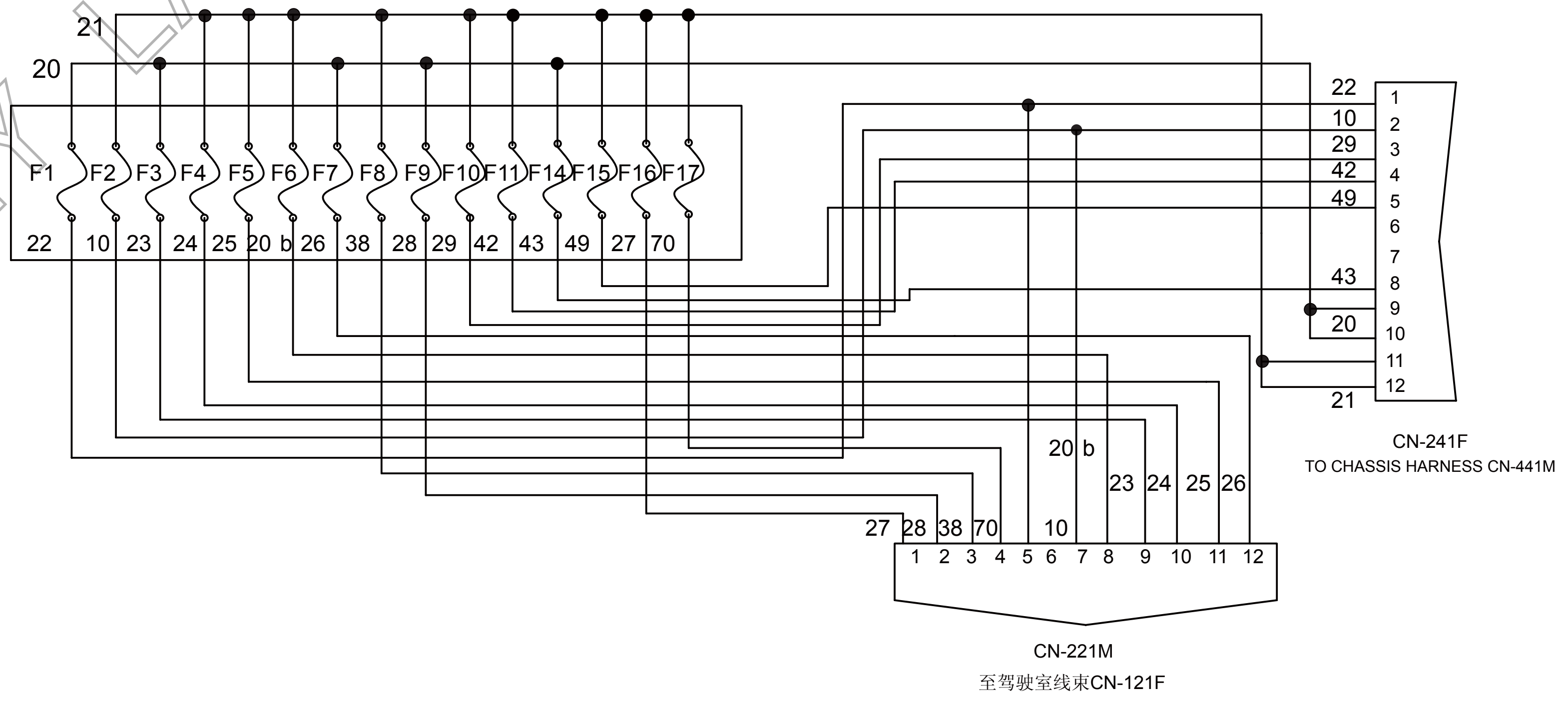


9.3 Fuse Box Relay

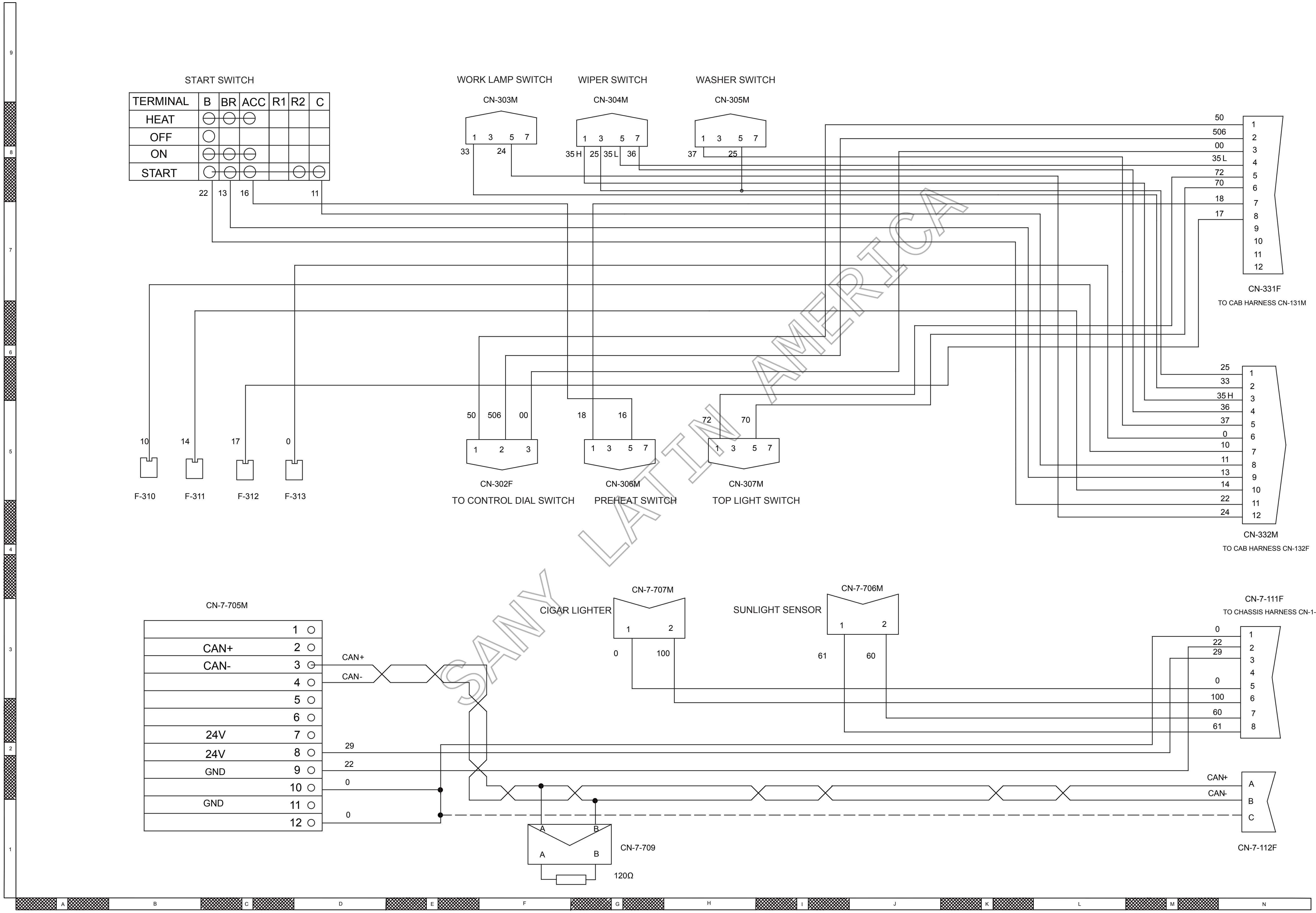


Fuse Box Harness

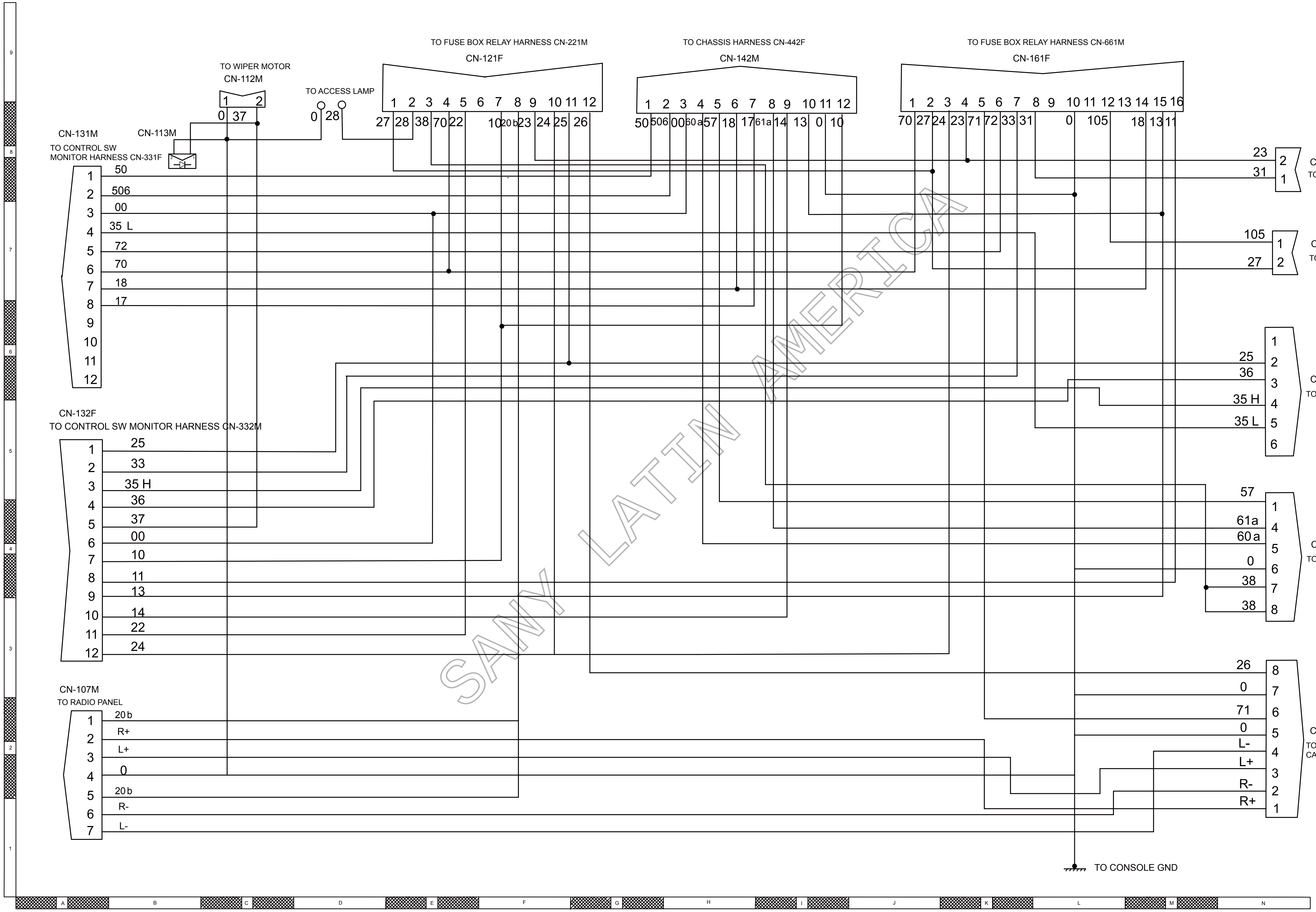
Fuse	Rated Value	System
F1	20A	Start Circuit
F2	10A	Charging Indication
F3	5A	Horn Circuit
F4	15A	Work Lamp
F5	5A	Wiper & Washer
F6	10A	Speaker
F7	10A	Cab Light
F8	20A	Air Conditioner
F9	5A	Access Lamp
F10	5A	Monitor
F11	20A	Controller
F14	10A	Aux. Controller
F15	15A	Cigar Lighter
F16	10A	Solenoid Valve GP
F17	10A	Top Light



9.4 Control Switches and Monitor Electrical Diagram



9.5 Operator Cab Electrical Circuit Diagram



9.6 Chassis Electrical Circuit Diagram