www.sm-sany.ru

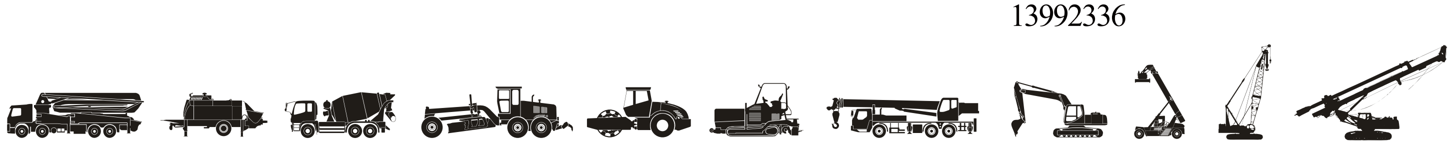
SANY HEAVY MACHINERY LIMITED

125466, Москва, ул. Соколово-Мещерская, д.25, офис 304А/Б

Tel: +7 (800) 600-29-61
E-mail: sany@stmachinery.ru

Documentation No.: B06T03ENAO1-SY50U

13992336



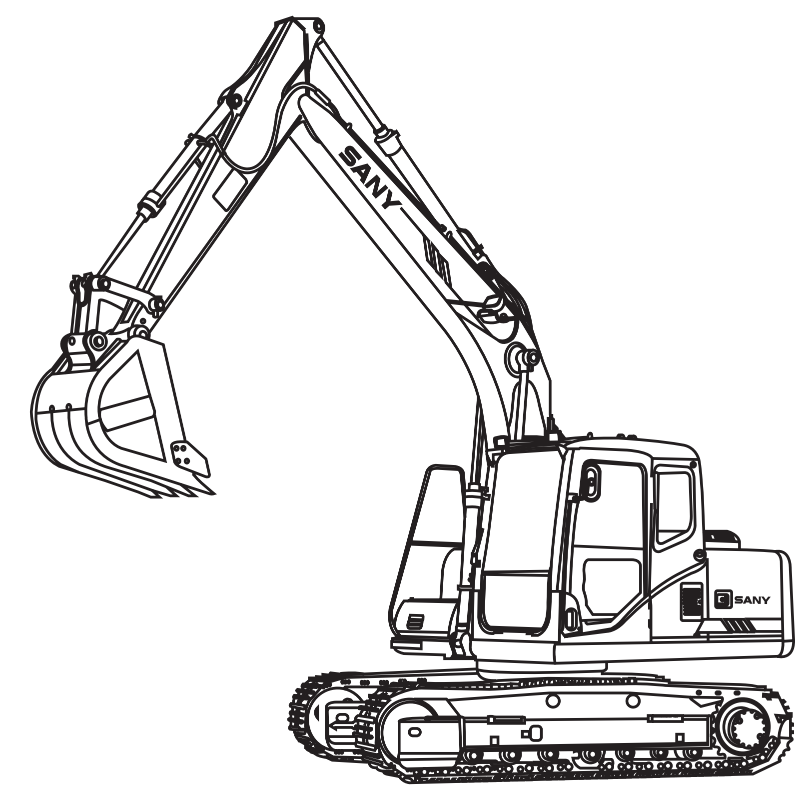
Руководство по ремонту гусеничного гидравлического экскаватора SY50U

SANY

Quality Changes the World

Гусеничный гидравлический экскаватор

SY50U



Shop Manual

SANY

SY50U

Гусеничный гидравлический экскаватор

Руководство по ремонту

WARNING

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

SANY RUSSIA

http://www.sm-sany.ru

125466, Москва, ул. Соколово-Мещерская, д.25,

офис 304А/Б Tel: +7 (800) 600-29-61

E-mail: sany@stmachinery.ru

Table of Contents

1 Introduction

2 Shop Safety

3 Specif cations

4 Structure and Functions

5 Standard Values

6 Testing and Adjusting

7 Troubleshooting

8 Disassembly and Assembly

9 Maintenance Standard

10 System Schematics

SANY

Introduction

1 Introduction

1 INTRODUCTION

1.1 How to Read the Manual

- Some attachments and optional parts presented in this shop manual may not be delivered to certain areas. Consult your Sany distributor if any of them is required.
- Materials and specif cations are subject to change without notice.

1.1.1 Shop manual organization

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.

Specif cations

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

Structure and functions

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.

Maintenance standard

This section provides inspection criteria for parts after disassembly.

System Schematics

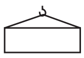
This section provides hydraulic circuit diagrams and electrical circuit diagrams.

1.1.2 Revision and distribution

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

1.1.3 Symbols

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

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

1.1.4 Units

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

1.2 Technical Terms

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

1.2.1 Standard size and tolerance

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

Example

Standard size	Tolerance
120	–0.022 –0.126

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

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

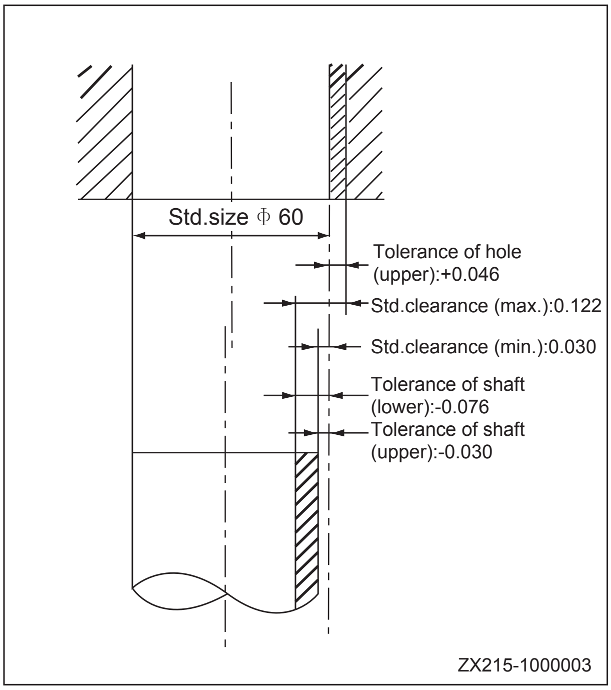


Fig. 1-1

Example

Standard size	Tolerance	
	Shaft	Hole
ϕ 60	-0.030 -0.076	+0.046 0

1.2.2 Standard clearance and 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.

1.2.3 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.

1.2.4 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.

1.2.5 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.

1.2.6 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

1.3.1.1 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 f tted 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.

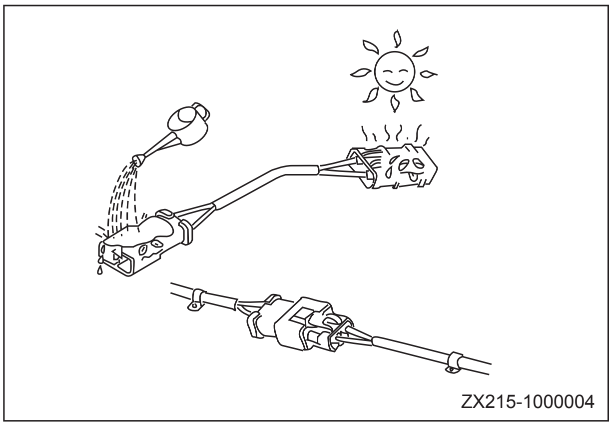


Fig. 1-2

1.3.1.2 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.

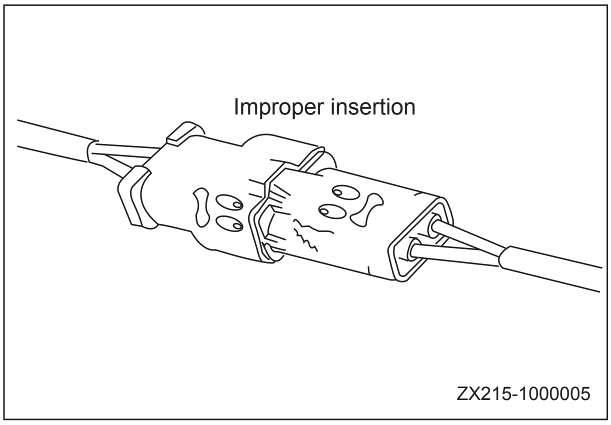


Fig. 1-3

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.

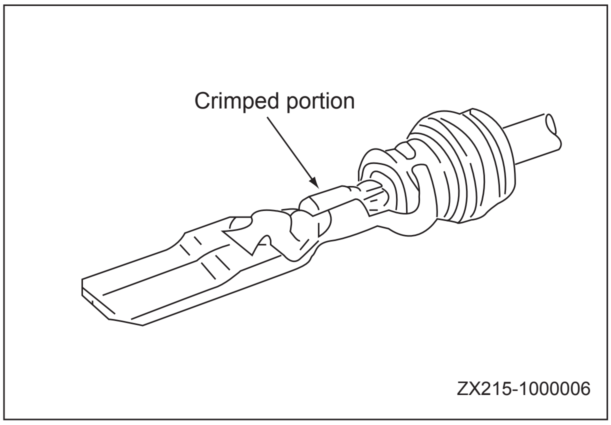


Fig. 1-4

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.

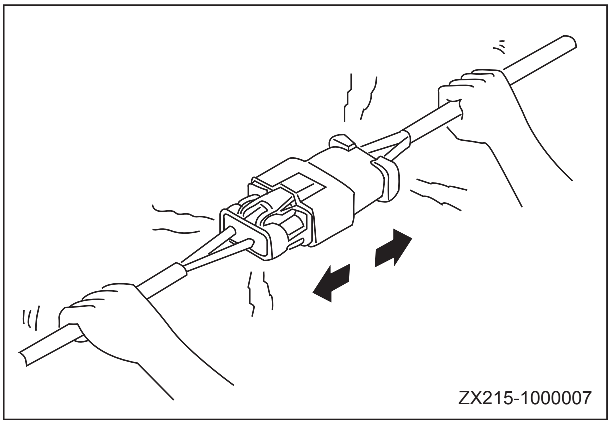


Fig. 1-5

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 diff cult 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.

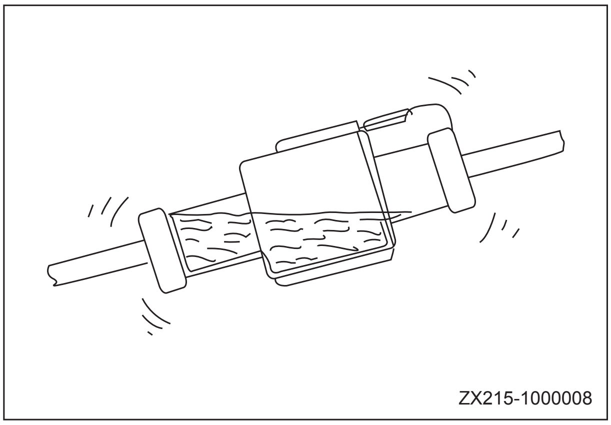


Fig. 1-6

5. Oil or dirt stuck to connector

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

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

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

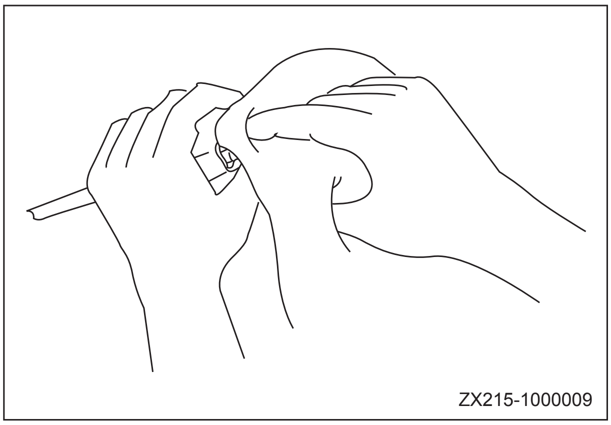


Fig. 1-7

1.3.1.3 Removing, installing, and drying connectors and wiring harnesses

1. Disconnecting connectors

   A. Hold the connectors when disconnecting.

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

   ★ Never pull with one hand.

   B. When removing from clips

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

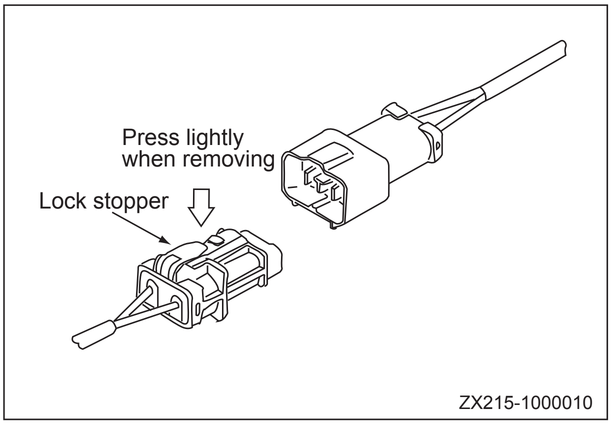


Fig. 1-8

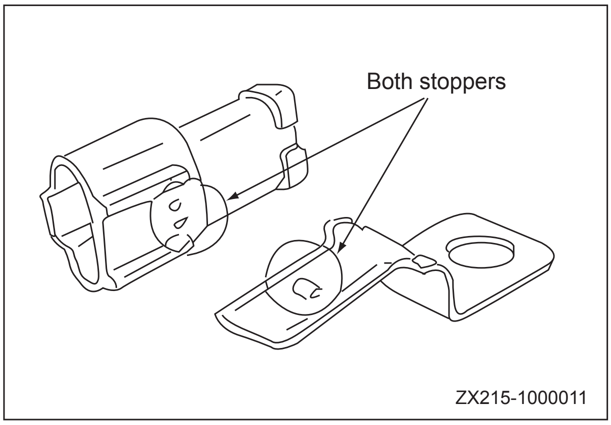


Fig. 1-9

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

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

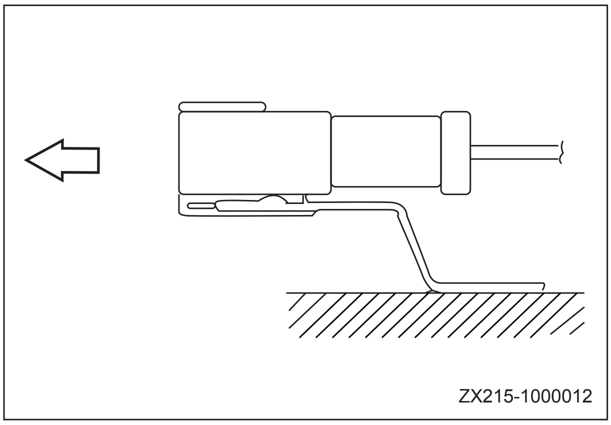


Fig. 1-10

C. Action to take after removing connectors

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

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

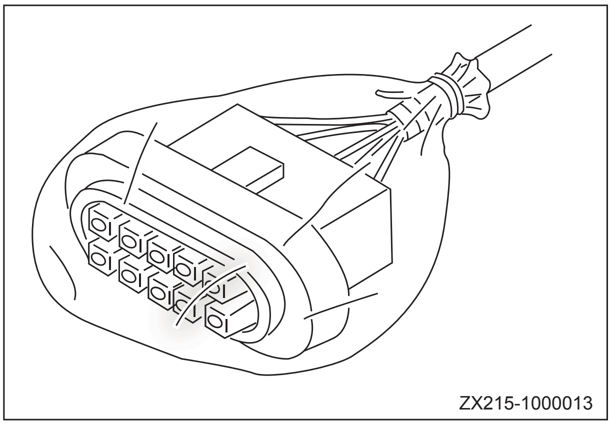


Fig. 1-11

2. Connecting connectors

A. Check the connector visually

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

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

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

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

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

B. Fix the connector securely.

Align the position of the connector cor-

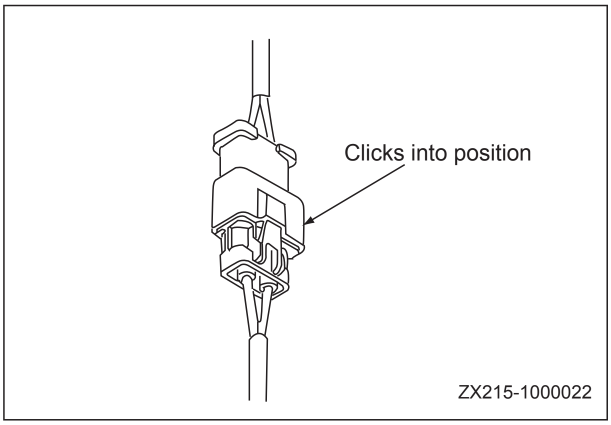


Fig. 1-12

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

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

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

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

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

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

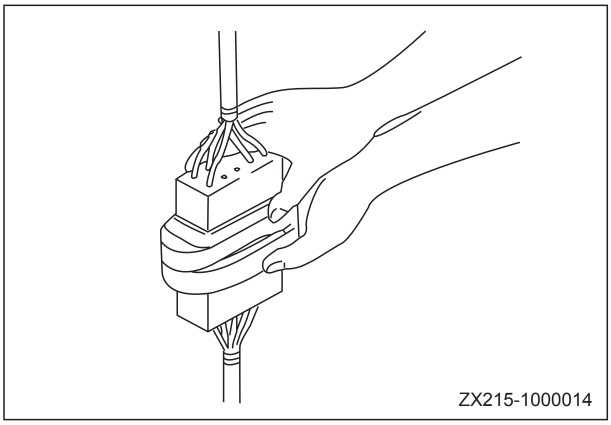


Fig. 1-13

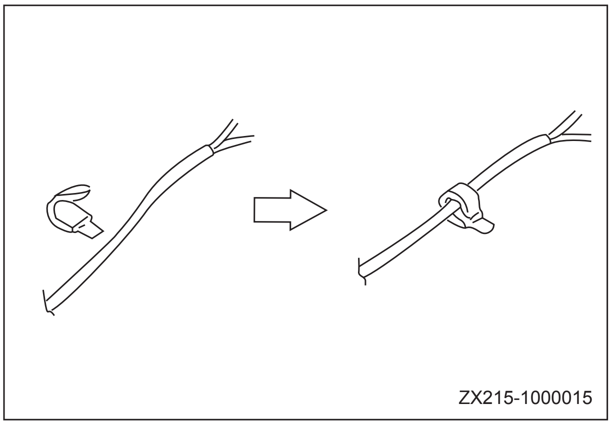


Fig. 1-14

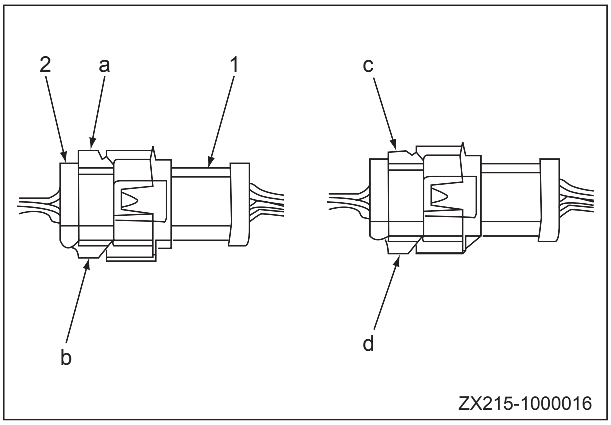


Fig. 1-15

4. Drying wiring harness

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

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

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

B. Dry the connector with a dryer.

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

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

C. Carry out a continuity test on the connector.

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

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

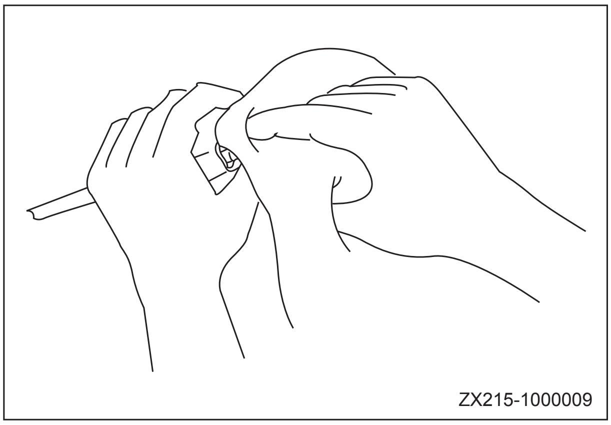


Fig. 1-16

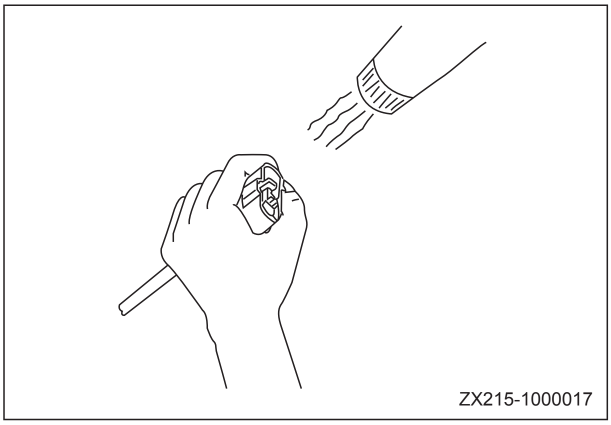


Fig. 1-17

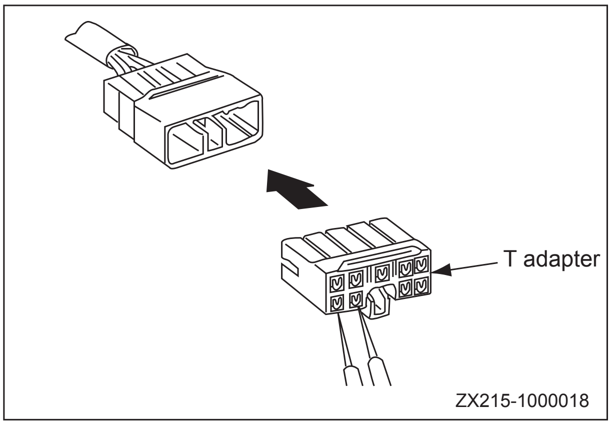


Fig. 1-18

1.3.1.4 Handling the integrated control monitor

1. The integrated control monitor contains a microcomputer, an electronic control circuits, an LCD monitor and GPS positioning circuit. They control all of the electronic circuits on the machine, so be extremely careful when handling the integrated control monitor.
2. Do not place objects on the integrated control monitor.
3. Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts with your hand.
4. Do not leave it where it may be exposed to rain.
5. Do not place the integrated control monitor on oil, water, or soil, or in any hot place, even for a short time.
6. Precautions for arc welding

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

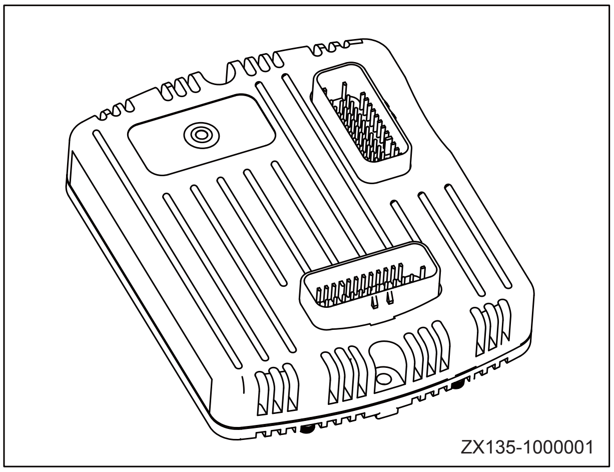


Fig. 1-19

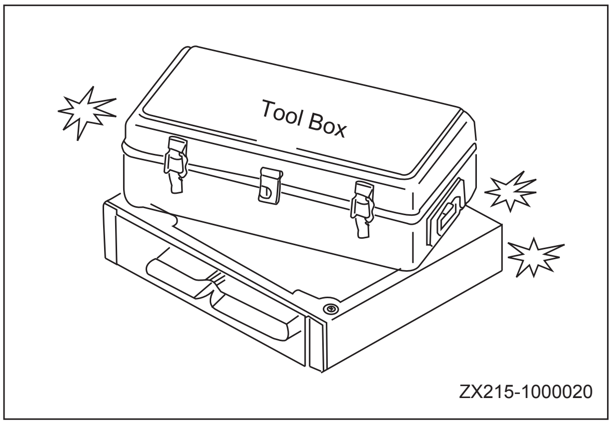


Fig. 1-20

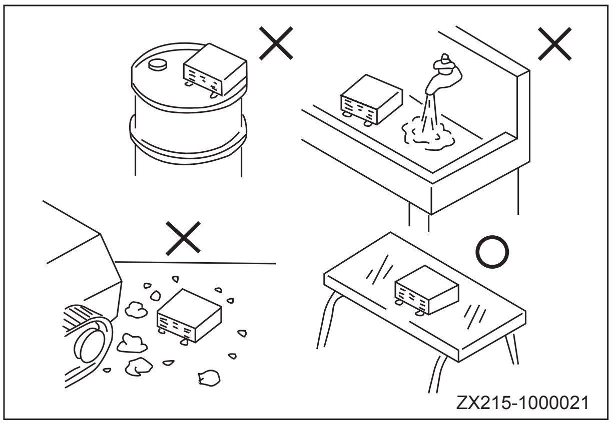


Fig. 1-21

1.3.1.5 Electric circuits troubleshooting precautions

1. Always turn the power OFF before disconnecting or connecting connectors.
2. Before carrying out troubleshooting, check that all the related connectors are properly inserted.

   ★ Disconnect and connect the related connectors several times to check.
3. Always connect any disconnected connectors before going on to the next step.

   ★ If the power is turned ON with the connectors still disconnected, unnecessary abnormality displays will be generated.
4. When carrying out troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), move the related wiring and connectors several times and check that there is no change in the reading of the tester.

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

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.

1.3.2.1 Be careful of the operating environment

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

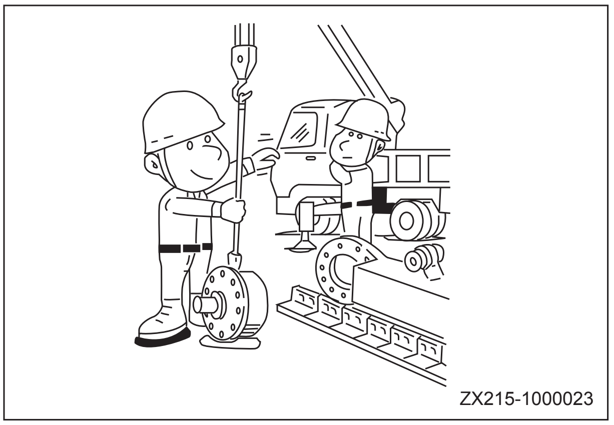


Fig. 1-22

1.3.2.2 Disassembly and maintenance work in the f eld

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.

1.3.2.3 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.

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.

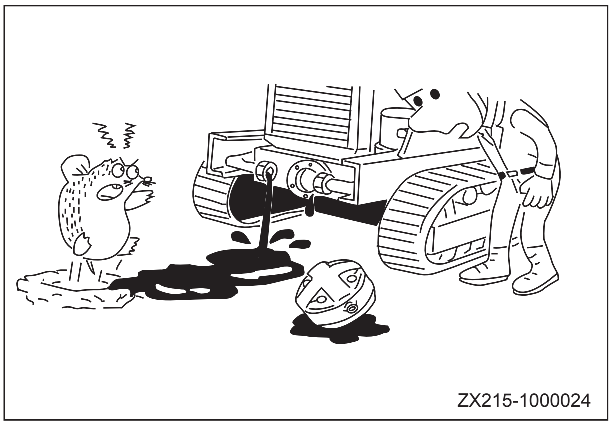


Fig. 1-23

1.3.2.4 Do not let any dirt or dust get in during ref lling 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 f lter out the dirt that has collected during storage, so this is an even more effective method.

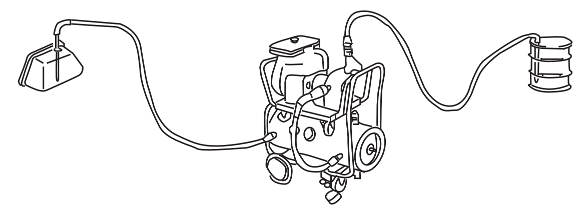


Fig. 1-24

1.3.2.5 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 f lter 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.

1.3.2.6 Flushing operations

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

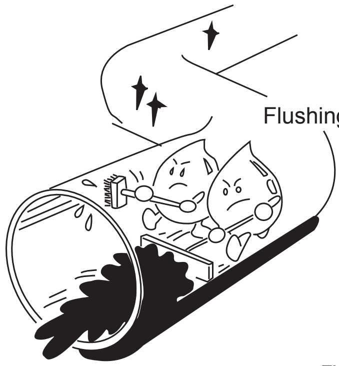


Fig. 1-25

1.3.2.7 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 f ne (about 3 μ) particles that the f lter built in the hydraulic equipment cannot remove, so it is an extremely effective device.

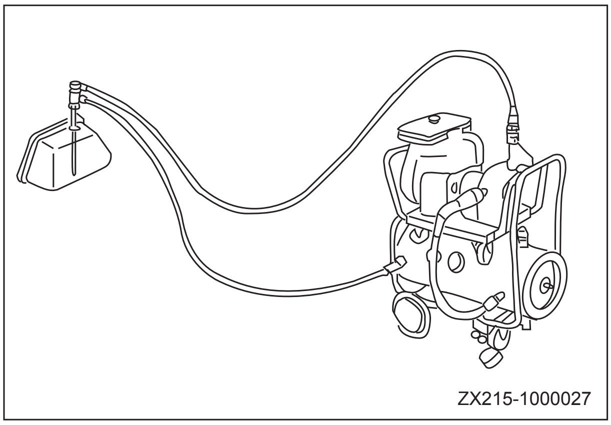


Fig. 1-26

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.

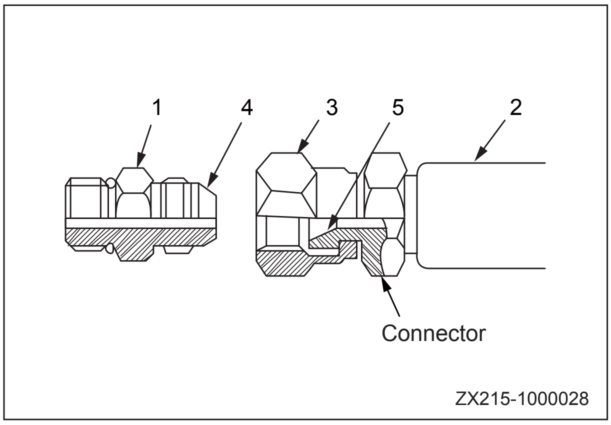


Fig. 1-27

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 specif cations.**
- **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

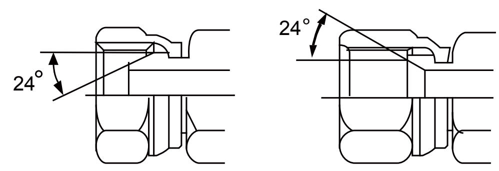


Fig. 1-28

1.4.2 Hose connector tightening torque table

Type	Wrench size mm Connecting nut	Wrench size mm Hose joint	Tightening torque 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 specif ed 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.

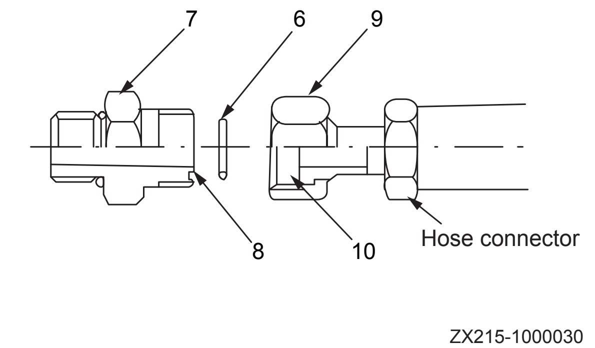


Fig. 1-29

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,Ibf·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 specif ed 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	206	21	152	206	21	152
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
M24	10.9	36	22	1050	107.14	775	1050	107.14	775

NOTICE

The following items apply to f ne thread and coarse thread.

- **Apply grease (zinc white B dissolved in spindle oil) onto the nuts and bolts to reduce the friction coeff cient. 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 insuff cient fastening.**
- **The torque values listed in the table are intended for general application. If different torque values are specif ed 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.

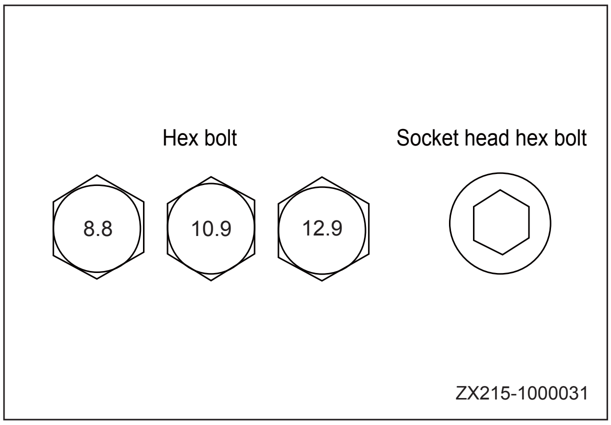


Fig. 1-30

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.**

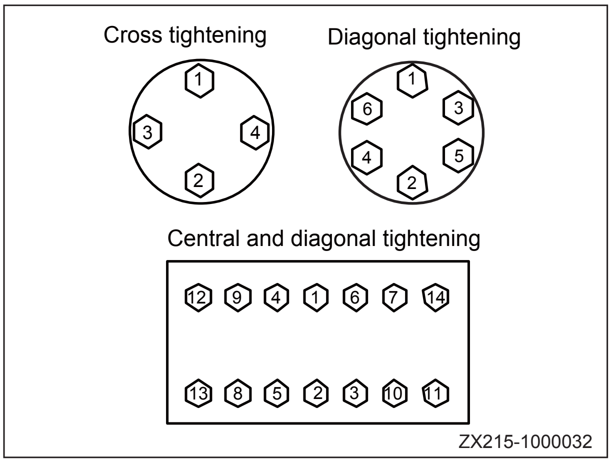


Fig. 1-31

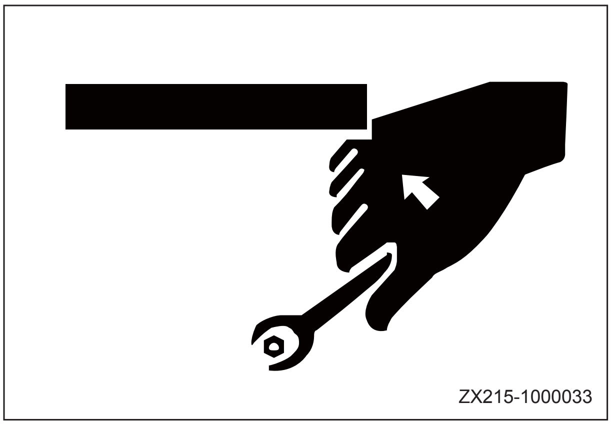


Fig. 1-32

1.8 Maintenance of Half Flanges

1. Clean the sealing surface of the f ange 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.

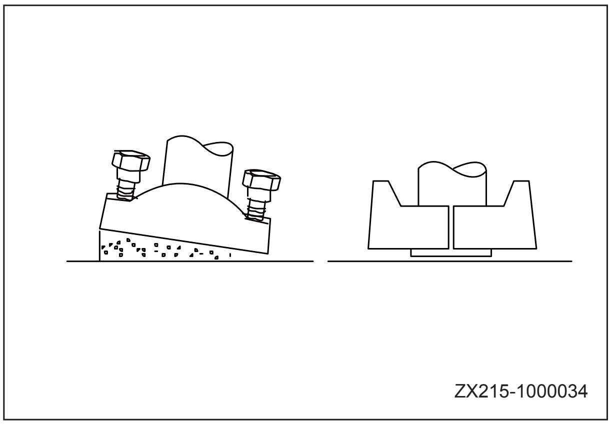


Fig. 1-33

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

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

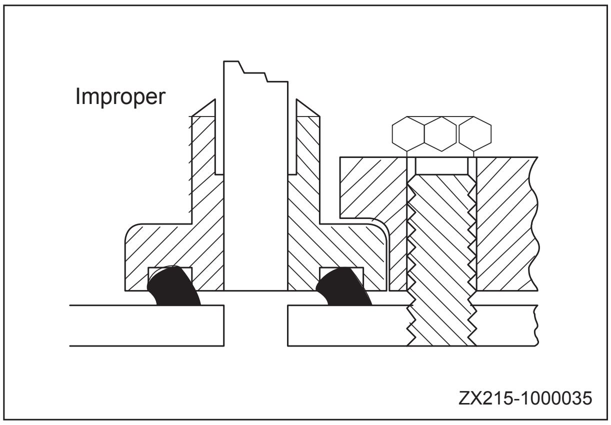


Fig. 1-34

1.8.1 Table of tightening torques for half f ange bolts

★ Unless specif ed otherwise, tighten the half f ange bolts to the torques below.

Thread diameter of bolt	Width across f ats	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

Conversion Table

Method of using conversion table

The conversion table in this section is provided to enable simple conversion of f gures. 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

Convert 55 mm into inches

Locate the number 50 in the vertical column at the left side, take this as (A), and then draw a horizontal line from (A).

Locate the number 5 in the row across the top, take this as (B), then draw a perpendicular line down from (B).

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.

Convert 550 mm into inches

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.

Carry out the same procedure as above to convert 55 mm to 2.165 inches.

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.

Millimeters to Inches

1mm=0.03937in

(B)

		0	1	2	3	4	5	6	7	8	9
	0	0.000	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
	10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
	20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
	30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.535
	40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
	50	1.969	2.008	2.047	2.087	2.126	(C) 2.165	2.205	2.244	2.283	2.323
(A)	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

Kilogram to Pound

1kg=2.2046 lb

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

Liters to U.S. Gallons

1 L=0.2642 U.S.Gal

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

Liters to U.K. Gallons

1 L=0.21997 U.K.Gal

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

kgm to ft.lb

1 kgm=7.233 ft.lb

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

kg/cm^2 to lb/in^2

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

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

1.8.2 Temperature

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

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

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

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

SANY

Shop Safety

2 Shop Safety

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.

Besides the above signals words, the following words are also used to remind you of rules to be followed or to provide you with very useful information.

Note: It is followed by measures that must be taken to prevent reduction of machine service life.

Remark: It is followed by very useful information.

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 specif cally 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 specif cations 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

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 disregarding 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

- 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 f oor or work area.

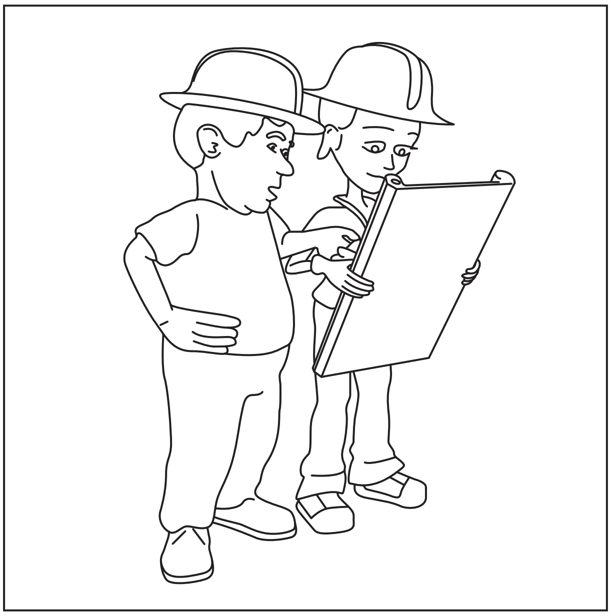


Fig. 2-2

2.2.2 Housekeeping

- Oils, grease, fuel, antifreeze or any fluid spills should be mopped up immediately. These items pose a serious slip hazard. Regardless of who was responsible for the spill, it is your job as a shop employee to secure and clean up the spill area.
- Keep the shop clean. Scrap or old parts should be disposed of properly. Never allow them to remain on the bench or shop f oor.
- 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.

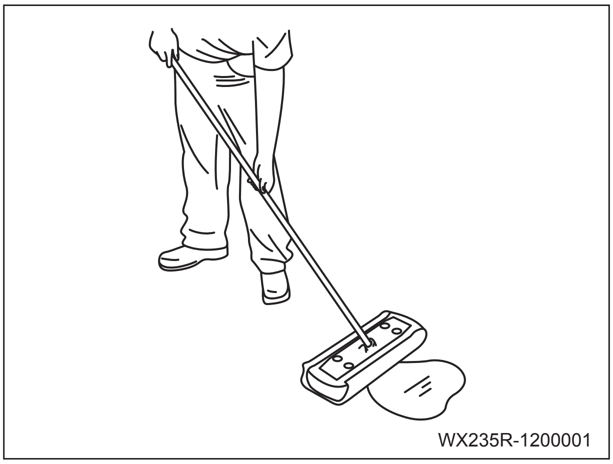


Fig. 2-1

2.2.3 Shop Liquids Storage

- Liquids, cleaning solvents or machine fluids should be properly stored in an area away from work locations. These storage areas should be ventilated to an outdoor location to avoid any vapor accumulation in a conf ned shop area. Follow all OSHA regulations regarding f uid storage.
- Never leave open containers of liquids sitting around. These could spill or catch f re. 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, f re or an unexpected explosion.
- Never smoke or bring open f ames around liquids, doing so could result in an unexpected f re or explosion.
- Never handle liquids without using personal protective equipment. Treat all liquids with caution.

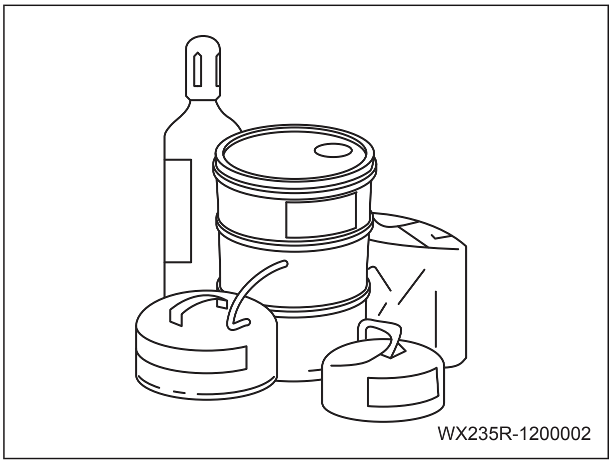


Fig. 2-3

2.2.4 Cleaning the Parts

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

Fig. 2-4

2.2.5 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 f ood the inside of an operator cab. This will damage sensitive electrical components.

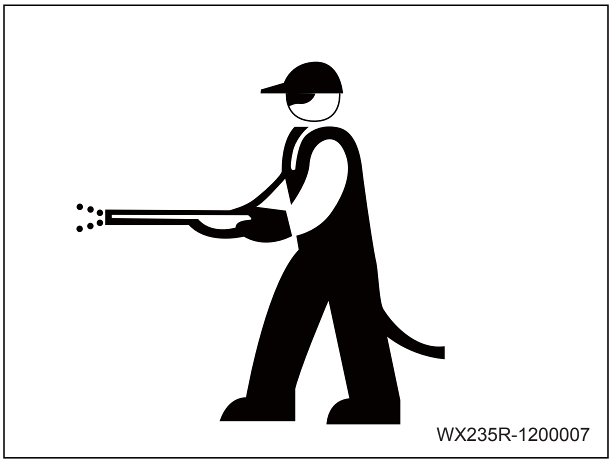


Fig. 2-5

2.2.6 Appropriate Working Apparel

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

Fig. 2-6

2.2.7 Personal Protective Equipment

If your shop specif es 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.

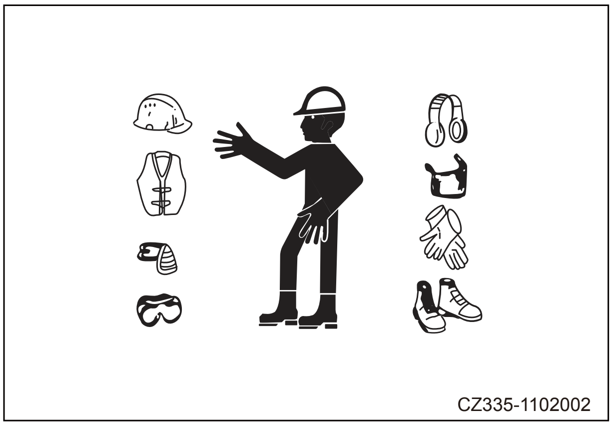


Fig. 2-7

2.2.8 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 f nished.
- If welding repairs are needed, always have a trained, experienced or certified welder carry out the work.

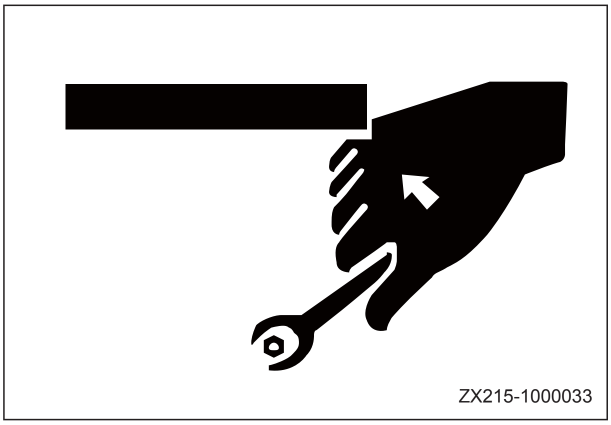


Fig. 2-8

2.2.9 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 f re equipment are located. If you are performing repairs in the f eld, always have a f re extinguisher handy and within reach.
- If you do not know how to use a f re extinguisher contact someone who can instruct you in the proper use of this equipment.

Fig. 2-9

2.2.10 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 f re.
- 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 f ammable liquids or explosive systems, use only approved anti-explosion proof work lamps. Non-approved work lamps can cause an explosion or f re.

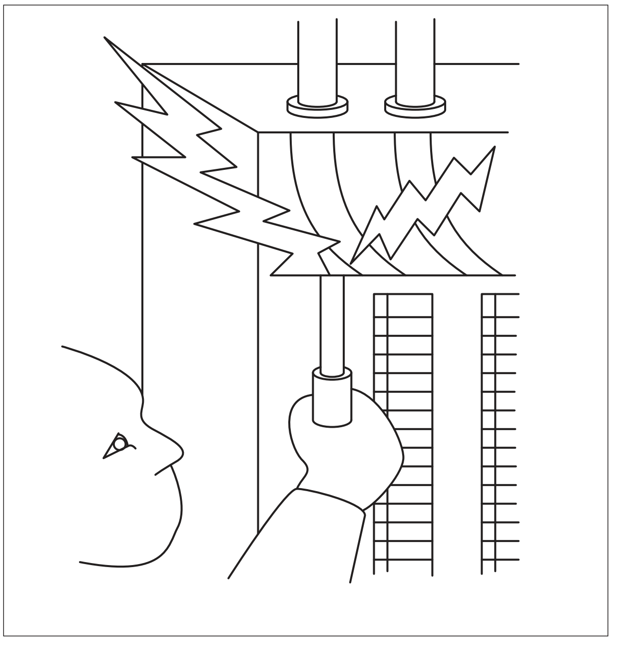


Fig. 2-10

2.2.11 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.

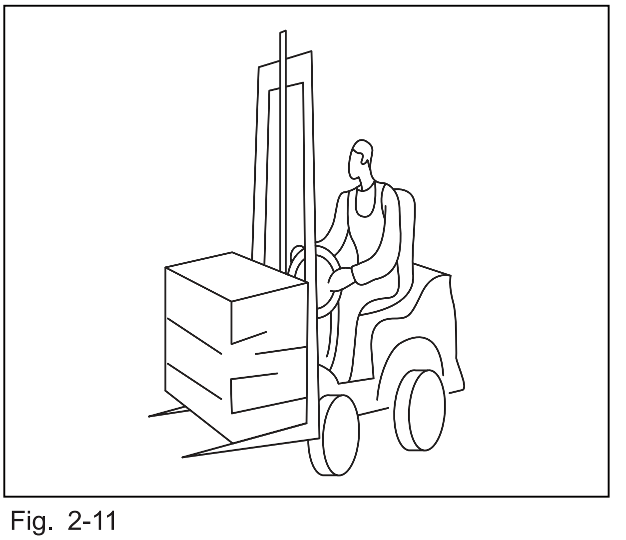


Fig. 2-11

2.3 Before Repair

2.3.1 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 f eld.

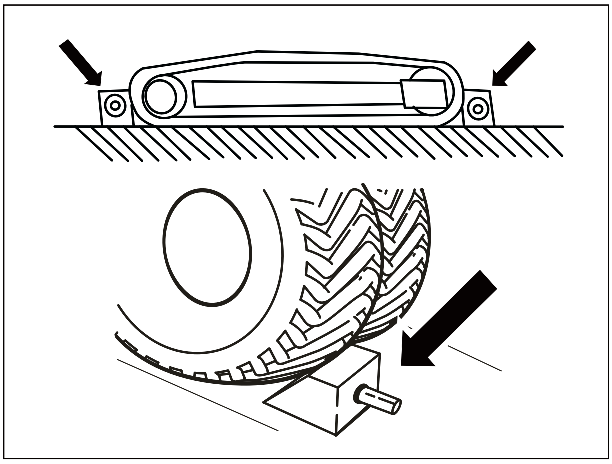


Fig. 2-12

2.3.2 Preparing yourself

Only approved personnel can maintain or repair the machine. An observer may be assigned if necessary.

- Wear protective clothing and shoes necessary for the job.
- Wear rubber apron and rubber gloves when handling corrosive materials. Wear heavy gloves when handling wooden materials, wire ropes or sharp-edged metals.
- Wear a face shield when removing spring or elastic parts, or adding acid to battery. Wear safety hat and goggles when you weld or cut with a torch.
- Never carry out grinding, flame cutting or welding without an aspirator and ventilation equipment. If you have to weld on the machine, refer to related instructions and understand the correct operating procedure.

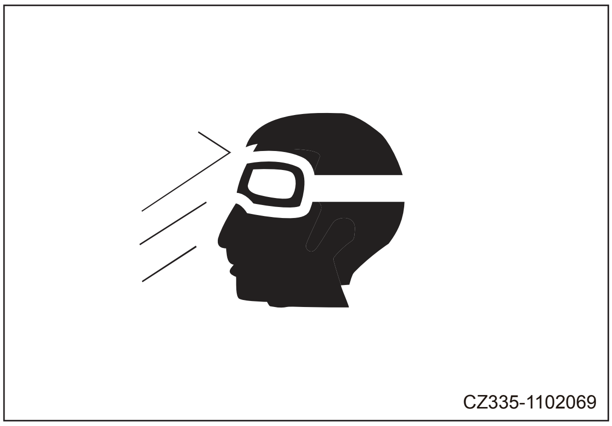


Fig. 2-13

Fig. 2-14

2.3.3 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.

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.

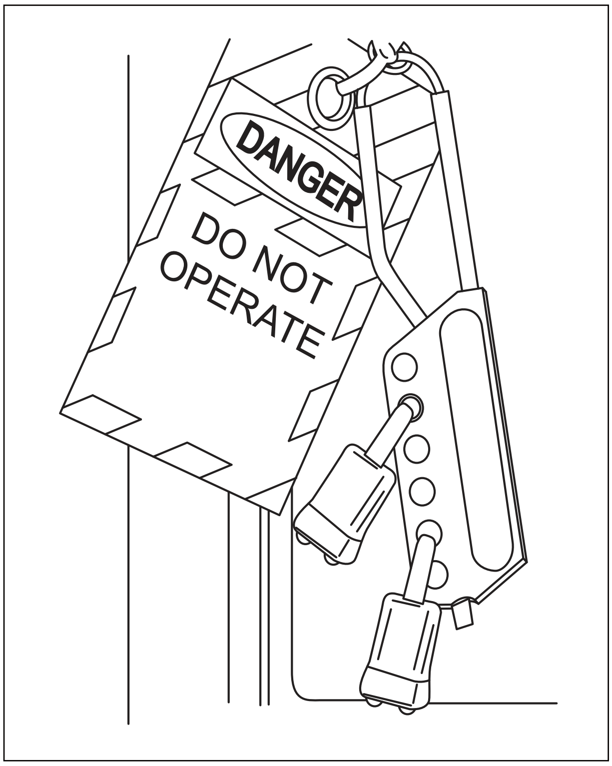


Fig. 2-15

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.

Fig. 2-16

Returning to service

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

2.3.4 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.

2.3.5 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.

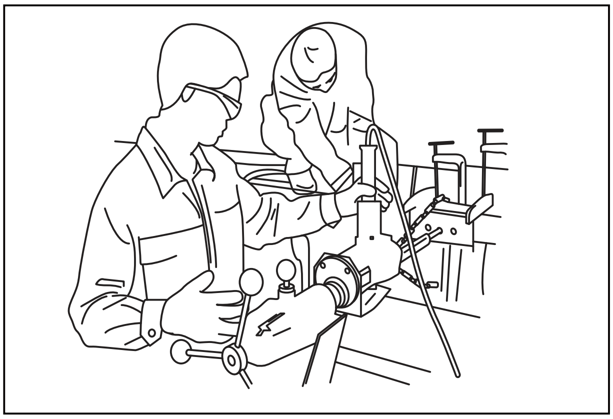


Fig. 2-17

2.4 Repair Precautions

2.4.1 Running the Machine

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

- Always be aware of rotating components.
- During repair operations while the engine is running, one worker must remain in the operator seat of the machine with clear contact between the person performing the repairs on the machine at all times.
- If equipped, all lock levers must be in the LOCK position or the parking brake must be in the PARK position.
- The person in the cab must never touch any controls. If a control lever must be operated, always maintain a clear view to the person doing the repair and signal them when you are about to move the control lever.
- Be aware of hot surfaces. During running operations, most surfaces will be hot, and some surfaces will be extremely hot. If necessary, use personnel protective equipment when working around high temperature surfaces.
- Keep in mind that during running operations, hydraulic systems, cooling systems and fuel systems will be under extremely high pressure and at high temperatures.
- Always use caution when working on or near these systems.

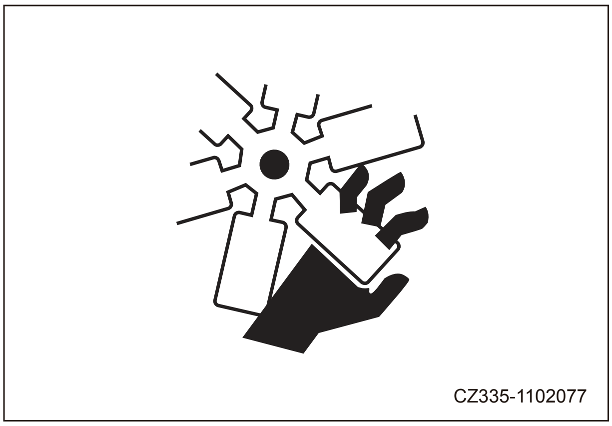


Fig. 2-18

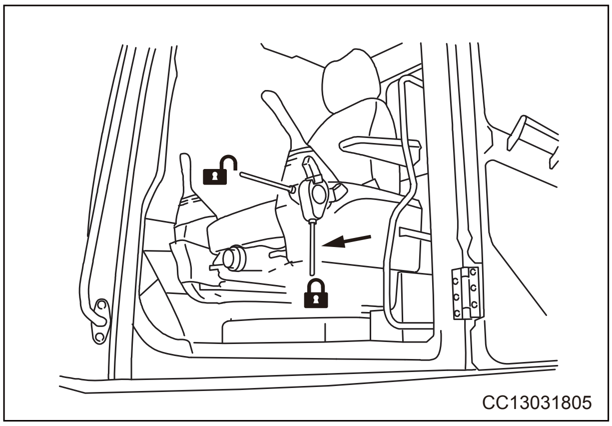


Fig. 2-19

Fig. 2-20

2.4.2 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-specif ed points on the equipment to get on or off the machine.
- Use all hand-holds when on the machine.

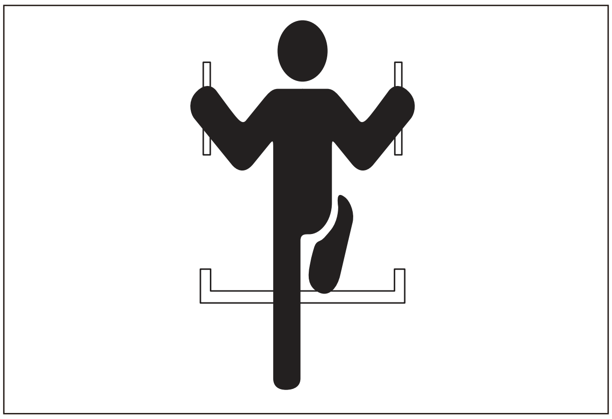


Fig. 2-21

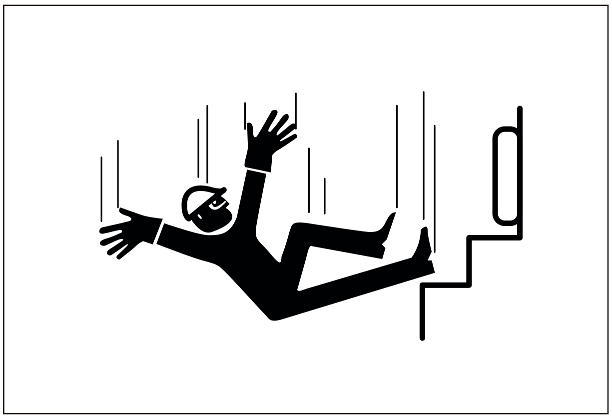


Fig. 2-22

2.4.3 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 f re exits.

Fig. 2-23

2.4.4 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.

Fig. 2-24

2.4.5 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 f uid.

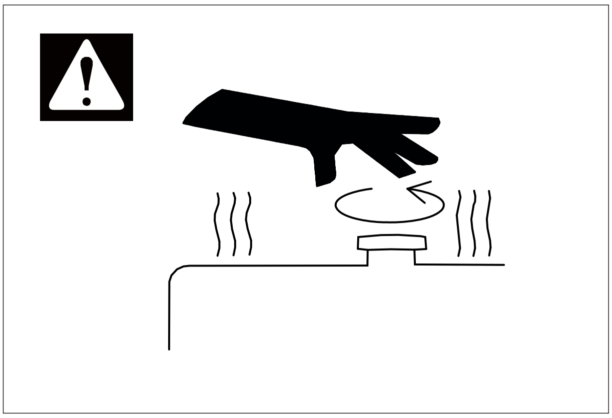


Fig. 2-25

2.4.6 Aligning Parts or Components

- Be careful when installing or aligning parts or components.
- Avoid using your f ngers 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 f nger or hand injuries.

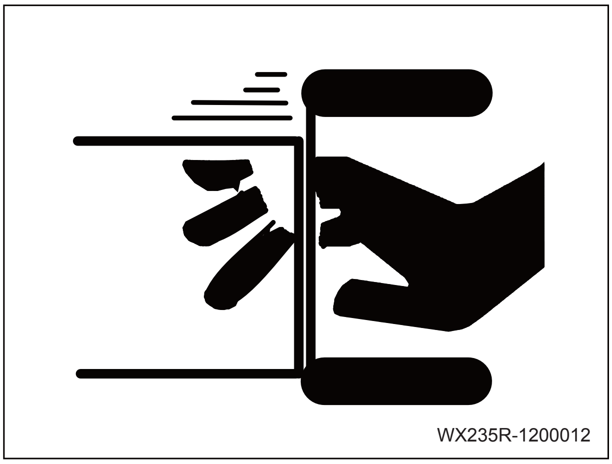


Fig. 2-26

2.4.7 Driving Pins

When using a hammer to drive pins, metal particles may f y 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.

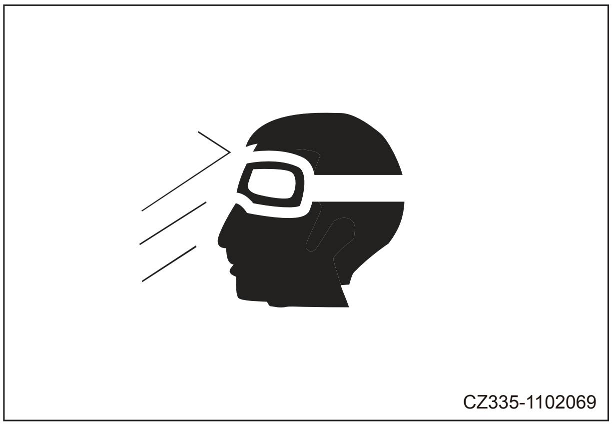


Fig. 2-27

2.4.8 When compressed air is used

When compressed air is used for cleaning, f ying particles may cause personal injury. In this case, wear goggles, dust-preventive mask, gloves and other protective gear.

2.4.9 Welding operation

There is possibility of f re or electrocution during welding. Therefore, welding must be performed by qualified personnel with suitable equipment. Never allow other people to do the welding.

Fig. 2-28

2.4.10 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 fy out and cause serious injury.

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

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

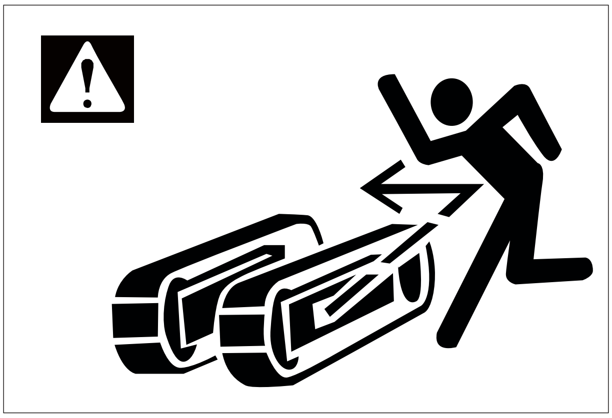


Fig. 2-29

2.4.11 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.

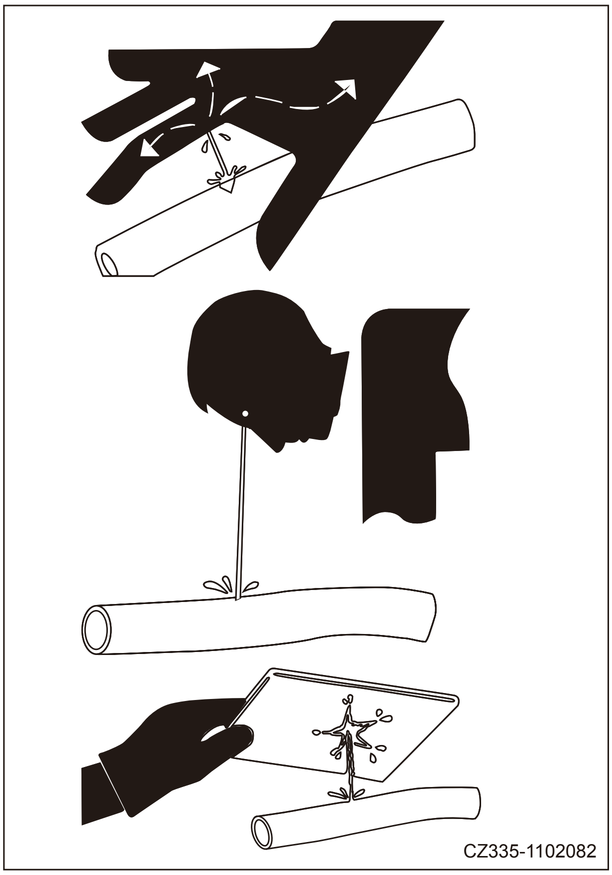


Fig. 2-30

2.4.12 Air-conditioning system maintenance

WARNING

- **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.**

- Keep f re source away when servicing air-conditioning system.
- In maintenance of air-conditioning system, observe the instruction on the refrigerant cylinder and use it correctly. The type of refrigerant is R134a. Use of other refrigerants may damage the air-conditioning system.
- Obey local material disposal regulations. Never discharge refrigerant directly into the air.

Fig. 2-31

2.4.13 High voltage precautions

You must understand the elements before testing electric circuit. High voltage or current could lead to machine damage, spark, explosion or f re.

You must know the voltage before repairing or testing electrical system. Always check the circuit and make sure it is disconnected before doing repair job.

Only explosion-proof light can be used when you work near flammable fluids or explosive system. Unapproved illumination equipment could lead to explosion or f re.

Fig. 2-32

2.4.14 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.

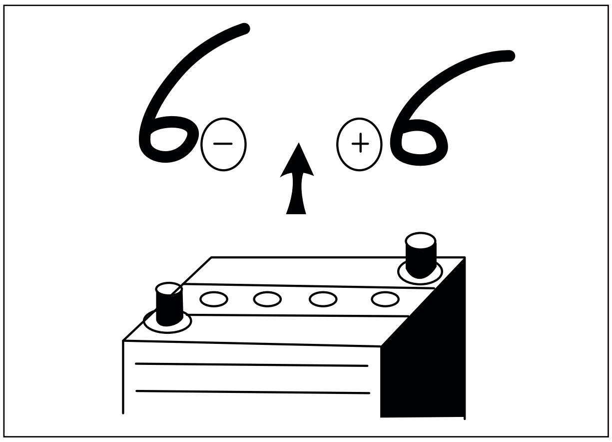


Fig. 2-33

2.4.15 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 f ames.
- 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.

Fig. 2-34

2.4.17 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.

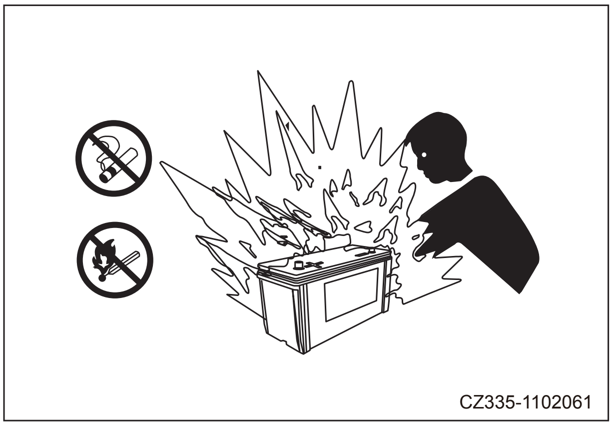


Fig. 2-35

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

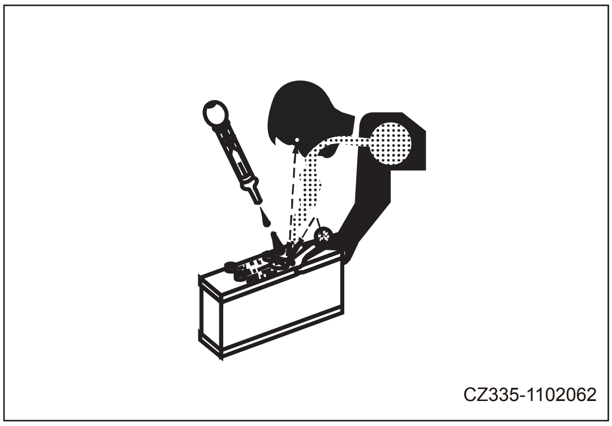


Fig. 2-36

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

Fig. 2-37

2.4.18 Jump-Start Safety

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.**

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.

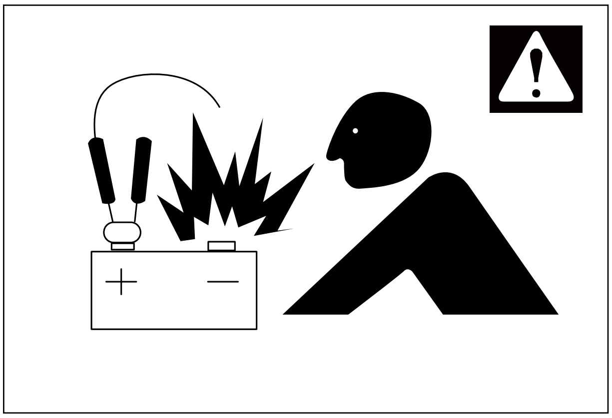


Fig. 2-38

2.4.19 Avoiding f re and explosion

WARNING

- **Never smoke when handling the fuel or maintaining the fuel system. The gases in empty fuel tank can cause explosion easily. Never carry out f ame-cutting or welding operation on fuel pipe, fuel tank or fuel vessels, which can lead to fire, explosion, injury or death.**

- Then engine must be shut down and electrical equipment must be switched off when refueling the tank. Be extremely careful when adding fuel to a hot engine. No sparks shall occur around the grounding nozzle.
- Handle all solvents and dry chemicals in a place with good ventilation according to the steps indicated on vessel.
- Clean the machine of all dust and residuals. Never place greasy rag or other f ammable materials on machine.
- When cleaning the parts and components, use nonf ammable solvents instead of gasoline, diesel oil or other f ammable f uids.
- Store flammable liquids and materials in suitable vessels as required by safety laws and regulations.
- Check fire extinguishers, fire-fighting system and fire detectors (if equipment) and make sure they are ready for use.

Fig. 2-39

2.4.20 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.

2.4.21 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.

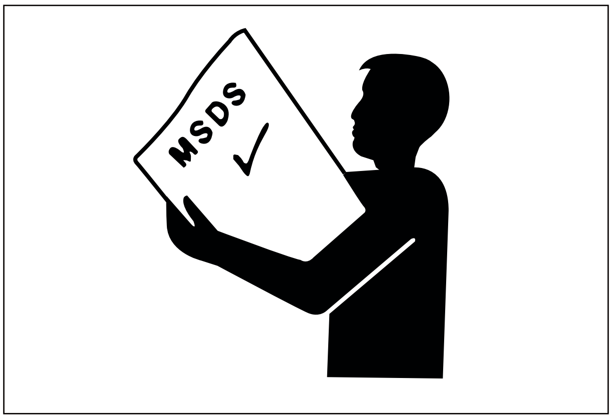


Fig. 2-40

2.4.22 Proper disposal of wastes

Improper disposal of wastes harms the environment and ecology. Consult local environmental protection department or Sany distributors for methods of recycling and waste disposal.

- Potential harmful substances used in Sany products include hydraulic oil, fuel, cooling liquid, refrigerant, f lter and batteries etc..
- Use leak-proof vessels to hold discharged f uids. Never use food or beverage containers.
- Never dump waste fluids directly to the ground, sewage or water source.
- Leaking of refrigerant from air conditioner can spoil the atmosphere of the globe. Related laws and regulations must be followed to recover or regenerate the refrigerant.

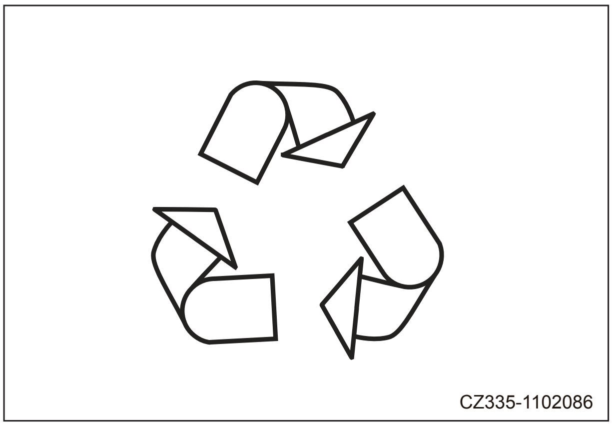


Fig. 2-41

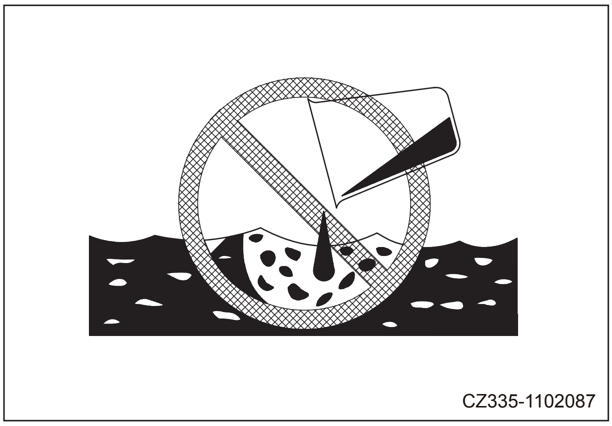


Fig. 2-42

2.5 Other Precautions

2.5.1 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 60º, 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

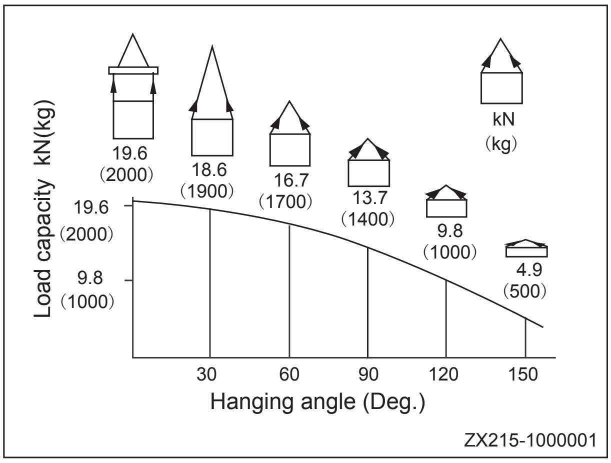


Fig. 2-43

at a lifting angle of 150 ° , each of them is subjected to a force as large as 39.2 kN {4,000 kg}.

8. When installing wire ropes to an angular load, apply softeners to protect the wire ropes. If the load is slippery, apply proper material to prevent the wire rope from slipping.
9. Use the specified eyebolts and fix wire ropes, chains, etc. to them with shackles, etc.
10. Apply wire ropes to the middle portion of the hook.
    - Slinging near the tip of the hook may cause the rope to slip off the hook during hoisting. The hook has the maximum strength at the middle portion.
11. Do not use twisted or kinked wire ropes.
12. When lifting up a load, observe the following.
    - Wind in the crane slowly until wire ropes are stretched. When settling the wire ropes with the hand, do not grasp them but press them from above. If you grasp them, your fingers may be caught.
    - After the wire ropes are stretched, stop the crane and check the condition of the slung load, wire ropes, and softener.
    - If the load is unstable or the wire rope or chains are twisted, lower the load and lift it up again.
    - Do not lift up the load slantingly.
13. When lifting down a load, observe the following.
    - When lifting down a load, stop it temporarily at 30 cm above the f oor, and then lower it slowly.
    - Check that the load is stable, and then remove the sling.

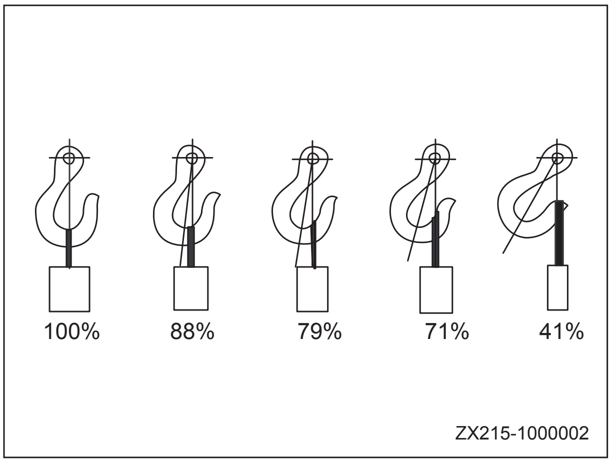


Fig. 2-44

- Remove kinks and dirt from the wire ropes and chains used for the sling work, and put them in the specified place.

2.5.2 Using mobile crane

⚠ CAUTION

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

2.5.3 Using overhead hoist crane

1. Before starting work, inspect the wire ropes, brake, clutch, controller, rails, over wind stop device, electric shock prevention earth leakage breaker, crane collision prevention device, and power application warning lamp, and check safety.
2. Observe the signals for sling work.
3. Operate the hoist at a safe place.
4. Check the direction indicator plates (east, west, south, and north) and the directions of the control buttons without fail
5. Do not sling a load slantingly. Do not move the crane while the slung load is swinging.
6. Do not raise or lower a load while the crane is moving longitudinally or laterally.
7. Do not drag a sling.
8. When lifting up a load, stop it just after it leaves the ground and check safety, and then lift it up.
9. Consider the travel route in advance and lift up a load to a safe height.
10. Place the control switch on a position where it will not be an obstacle to work and passage.

11. After operating the hoist, do not swing the control switch.
12. Remember the position of the main switch so that you can turn off the power immediately in an emergency.
13. If the hoist stops because of a power failure, turn the power switch OFF. When turning on a switch which was turned OFF by the electric shock prevention earth leakage breaker, check that the devices related to that switch are not in operation state.
14. If you find an obstacle around the hoist, stop the operation.
15. After finishing the work, stop the hoist at the specif ed position and raise the hook to at least 2 m above the f oor. Do not leave the sling installed to the hook.

2.5.4 Selecting wire ropes

Select adequate ropes according to the weight of parts to be hoisted. See the table below.

Wire Rope (Standard Z or S type of strand, ungalvanized)		
Nominal Diameter	Allowable Load	
mm	kN	t
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 coeff cient: 6).**

BLANK PAGE

SANY

Specif cations

3 Specif cations

3 SPECIFICATIONS

3.1 Dimension Drawing

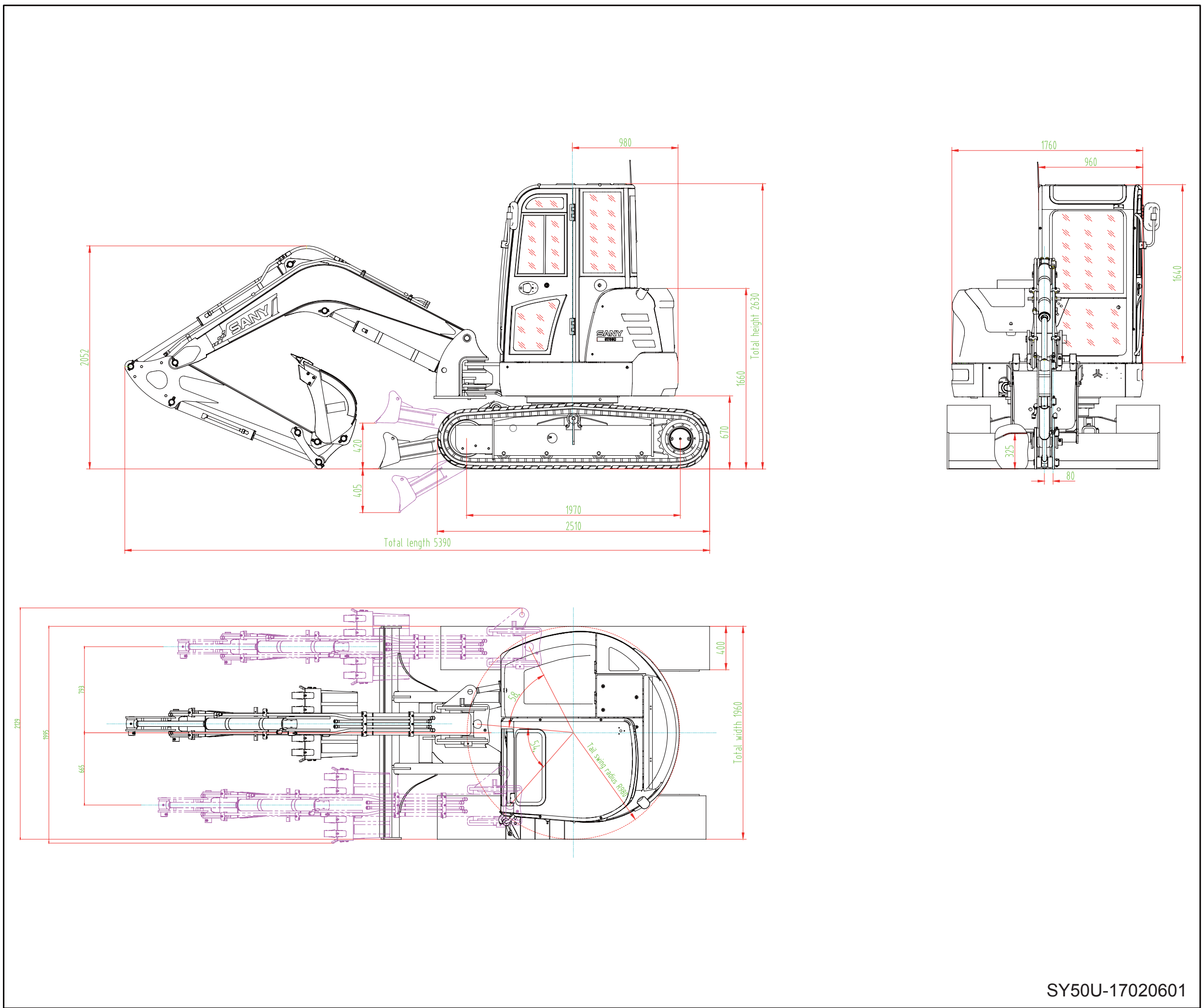


Fig. 3-1

3.2 Working Ranges

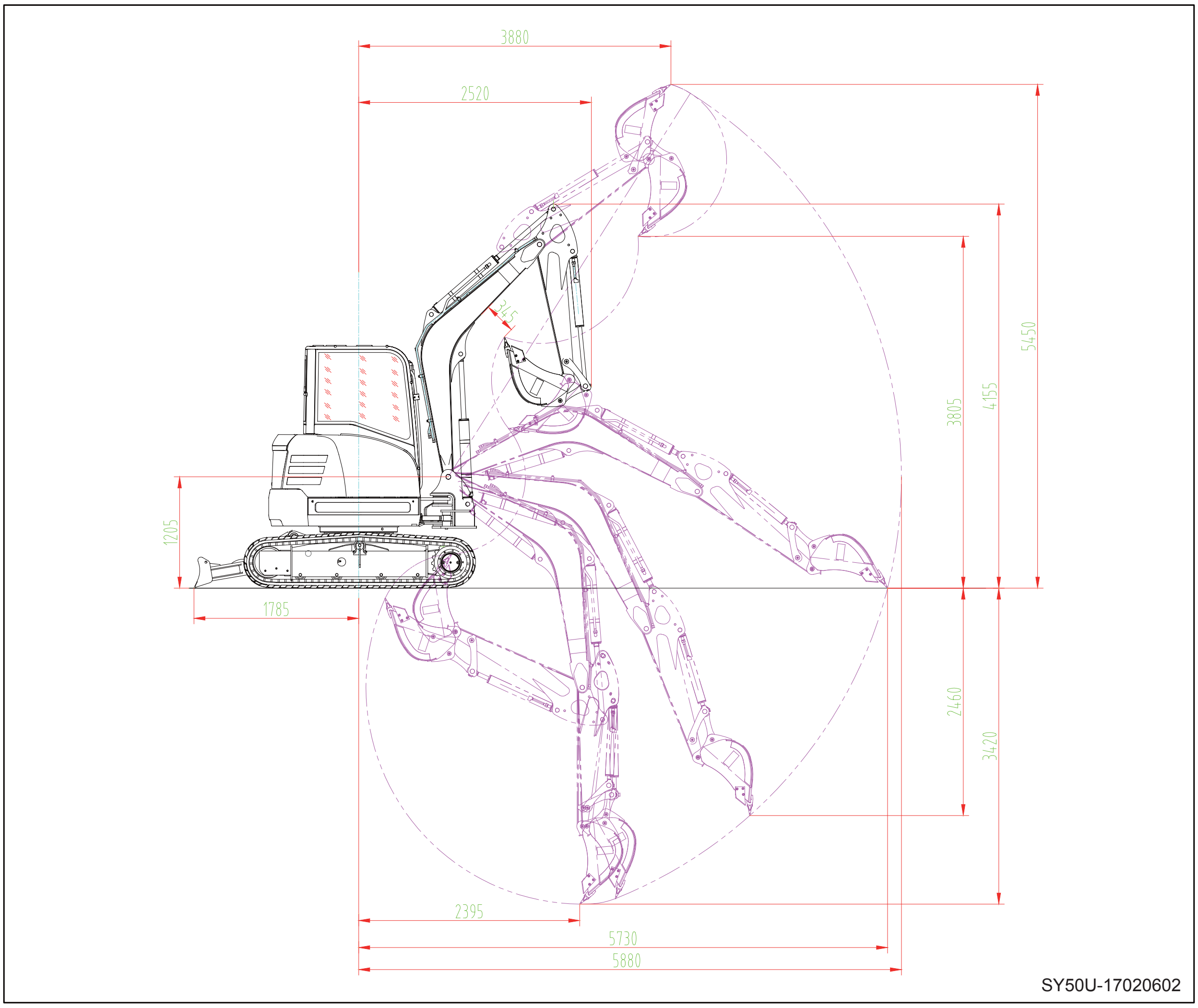


Fig. 3-2

3.3 Technical Specif cations

Machine Model				SY50U
Bucket capacity			m3	0.10-0.19(0.18)
Operating weight			kg	5300
Performance	Working ranges	Max digging depth	mm	3420
		Max vertical digging depth	mm	2460
		Max horizontal reach	mm	5880
		Max ground-level reach	mm	5730
		Max cutting height	mm	5450
		Max dumping height	mm	3805
		Blade max lifting height	mm	420
		Blade max cutting depth	mm	405
	Max digging force		kN	32.5
	Swing speed		rpm	10
	Max swing angle on an incline		Degree	-
	Travel speed		km/h	4.1/2.4
	Gradeability		Degree	30
	Specif cgroundpressure (Standard track shoe width: 400 mm)		kPa {kg/cm^2}	31.6
Dimensions	Shipping length		mm	5390
	Overall width		mm	1960
	Track width		mm	400
	Shipping height		mm	2630
	Body height (to cab top)		mm	2630
	Upper structure groudn clearance		mm	670
	Min ground clearance		mm	325
	Tail swing radius		mm	980
	Work equipment min swing radius		mm	2520
	Work equipment height at min swing radius		mm	4155
	Track length on ground		mm	1970
	Track gauge		mm	1560
	Cab height		mm	1640
	Blade width × height		mm	1960×340

Machine Model				SY50U
Engine		Model Type Number of cylinders - cyl bore × stroke Piston displacement	mm L {cc}	4TNV88-PSY 4 cylinders, 4 cycles, wa-ter cooling, direct injec-tion and natural breathing 4-88×90 2.190
Engine	Performance	Flywheel HP Max torque Max unloaded speed Min unloaded speed Min fuel consumption	kW/rpm {HP/rpm} Nm/rpm {kgm/rpm} rpm rpm g/kWh {g/HPh}	29.1/2400{39.0/2400} 133.3~144.9/1560 ±100{13.6~14.8/1560±100} 2550 1000 239{320.3}
Engine		Start motor Alternator Battery	–	12V，2.3kw 12V，80 A 12V，80 Ah
Engine		Radiator core model	–	–
Under-carriage		Carrier roller (each side) Track roller (each side) Track shoe（each side）	–	1 4 39 or Rubber track
Hydraulic system	Hyd pump	Type × quantity Oil delivery Set pressure	l/min MPa {kg/cm2}	Variable plunger pump ×1 110 24.5
Hydraulic system	Control valve	Type × quantity Control method	–	10 spool type×1 Auxiliary hydraulic plus mechanical
Hydraulic system	Hydraulic motor	Travel motor Swing motor	–	Variable plunger ×2 Quantative plunger type
Hydraulic system		Hydraulic cylinder Hydraulic tank Hydraulic oil f lter Hydraulic oil cooler	–	Bidirectional piston Closed tank Tank oil suction side/return side Air cooling

3.4 Weight Table

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

Unit: kg

Machine Model	SY50U
Engine AS excluding coolant and oil	205
PTO (coupling) AS	15
Radiator & oil cooler AS	34
Slewing platform	528
Cab	190
Operator seat with console	63
Fuel tank (empty)	47
Hydraulic tank (empty)	68
Counterweight	358
Hydraulic pump AS	22
Control valve	24
Swing bearing AS	99
Swing reducer AS	37
Swivel joint	23
Track frame AS	
Track frame	652
Idler with tensioning device	94
Track roller	8.7
Travel motor	57
Sprocket	17
Track AS	300
Steel track	190
Boom AS	106
Arm AS	75
Earthmoving blade AS	230
Def ector joint AS	150
Bucket AS	132
Boom cylinder AS	48
Arm cylinder AS	47
Bucket cylinder AS	29
Earthmoving blade cylinder AS	33
Def ector cylinder AS	31

3.5 Capacity Table

	Fuel tank	Hydraulic tank	Engine lubricant oil	Cooling system	Travel reducer lubricant oil
Capacity（L）	78	52	7.4	7.2	0.8

3.6 Fuel and Coolant Capacities

Reservoir	Fluid type	Select according to ambient temperature.	Capacity（L）	
		-30 -20 -10 0 10 20 30 40 50℃	Spe-cif c	Re-f ll
Engine oil pan	Engine oil	SAE 10W SAE 20W SAE 10W-30 SAE 15W-40 SAE 20 SAE30 SAE40 SAE 20W-50	7.4	7
Final drive tank (L &R)	Gear oil	SAE30	7.4	7
Idler (L &R)			0.08	0.08
Track roller			0.08	0.08
Carrier roller			0.08	0.08
Hydraulic system	Hydraulic oil	L-HV30 low-temp, wear-resistant hyd oil	40	-
		L-HV46 low-temp, wear-resistant hyd oil L-HV68 low-temp, wear-resist hyd oil	-	-
Fuel tank	Diesel oil	ASTM D 975 No.2 GB252 Super-20 diesel oil GB252 Super-35 diesel oil	78	-
Cooling system	Coolant	加入三一纯正超级冷却液（AF-NAC）	7.2	7.2

Fuel & Engine oil

As described above, fuel and engine oil shall be selected according to ambient temperature.

- The specif c quantity means total amount of oil contained in lines of a component. Ref lling quantity is the amount of oil to be changed during inspection and maintenance.
- Always use SAE 10W or SAE 10W-30 oil when starting the engine below 0ºC, or even the temperature rises to 10ºC during daytime. A quality grade of CI-4 or CF-4 is recommended.

Antifreeze

- Never use tap water as coolant.

3.7 Engine Performance Curve

SY50U:

Yanmar 4TNV88-PSY engine

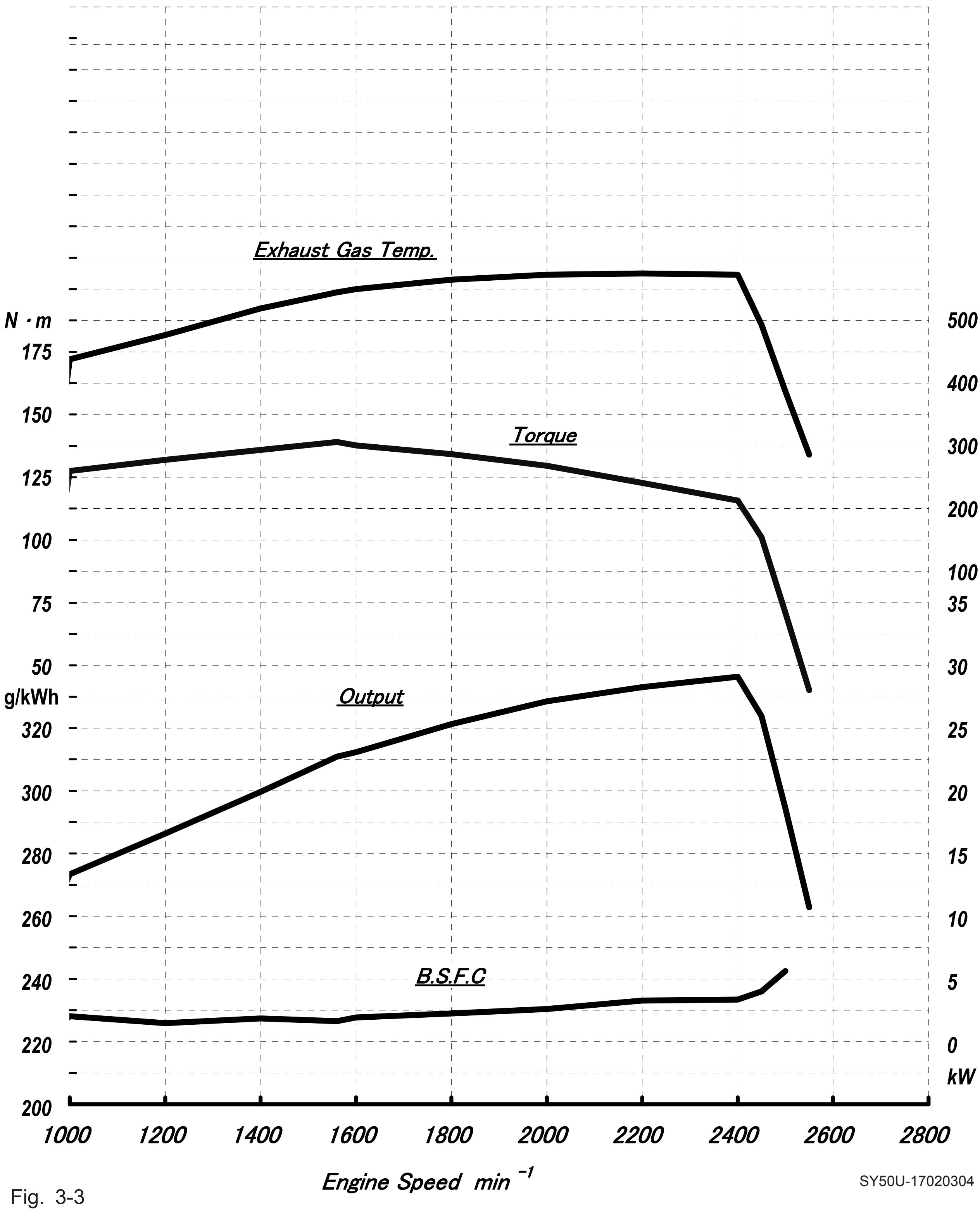


Fig. 3-3

SANY

Structure and Functions

4 Structure and Functions

4 STRUCTURE AND FUNCTIONS

4.1 Engine and Cooling System

4.1.1 Water cooler and oil cooler

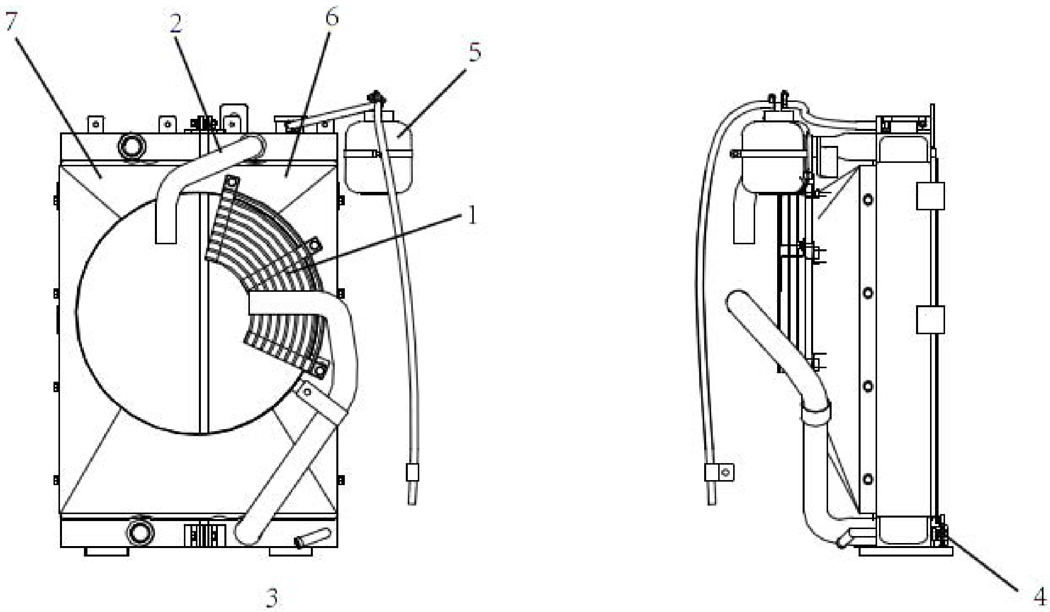


Fig. 4-1

(1) Fan guard
(2) Upper coolant pipe
(3) Lower coolant pipe
(4) Drain valve
(5) Reservoir
(6) Water cooler
(7) Oil cooler

Specifications water cooler

adiating area: 15 m2

oolant capacity: 4.2L

Oil cooler

Ratiating area: 14 m2

Oil capacity: 5.3 L

PTO (coupling)

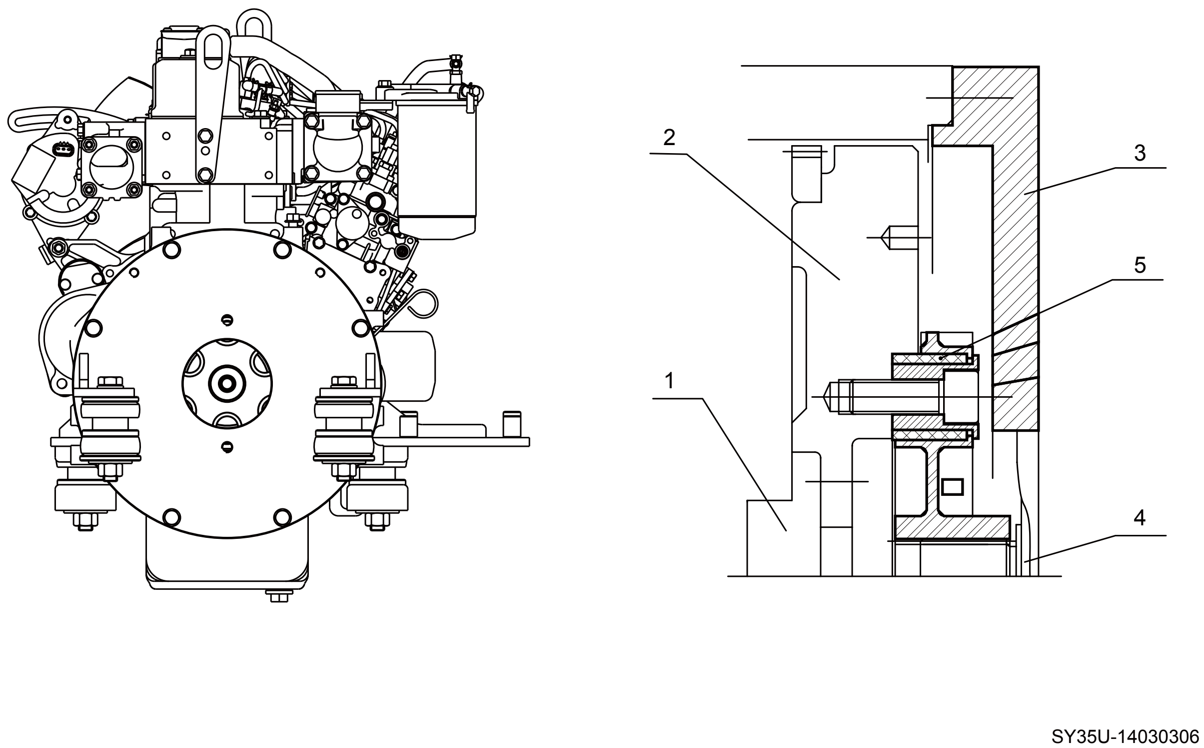


Fig. 4-2

(1) Engine crankshaft
(2) Flywheel
(3) Plate
(4) Main pump
(5) Coupling

4.1.2 Engine control device

SY50U

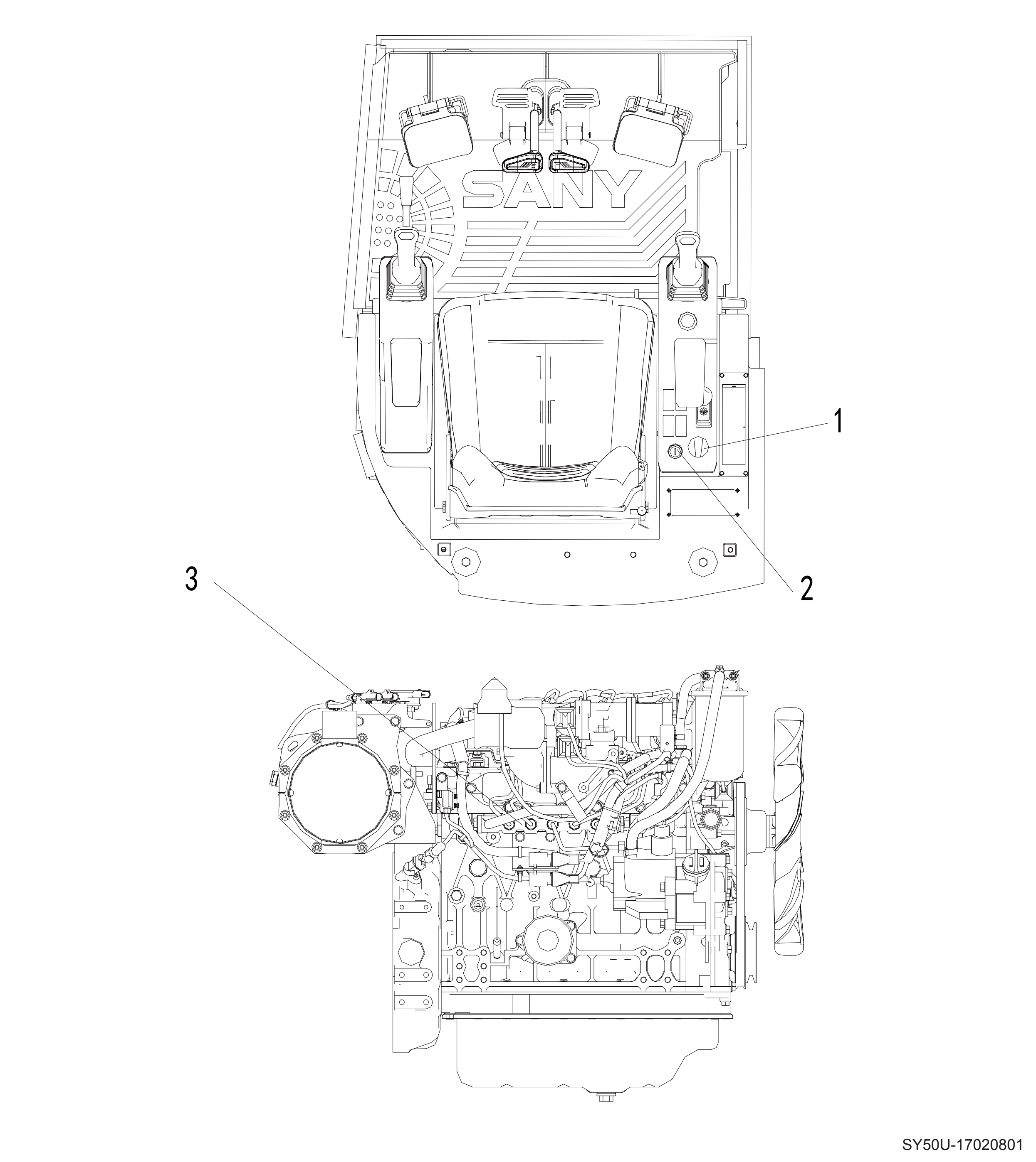


Fig. 4-3

(1) Fuel control dial
(2) Start switch
(3) Injection pump

SY50U:

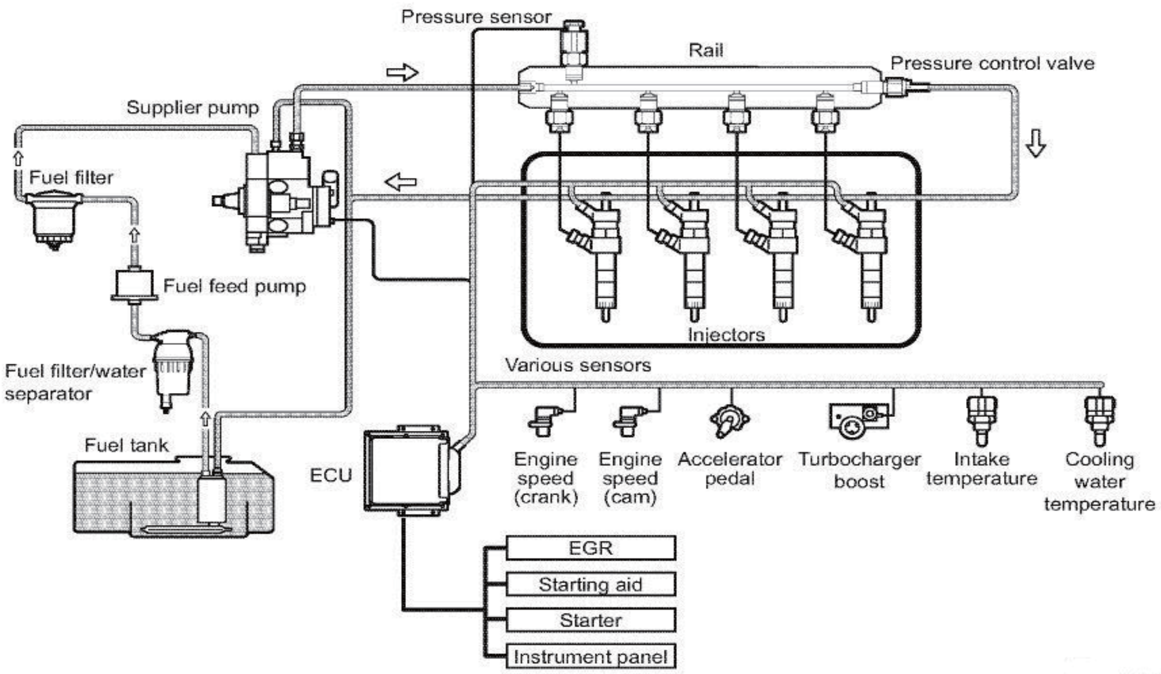

Pressure sensor
Rail
Pressure control valve
Supplier pump
Fuel filter
Fuel feed pump
Injectors
Fuel filter/water separator
Various sensors
Fuel tank
ECU
Engine speed (crank)
Engine speed (cam)
Accelerator pedal
Turbocharger boost
Intake temperature
Cooling water temperature
EGR
Starting aid
Starter
Instrument panel

Fig. 4-4

4.2 Power Train

4.2.1 Power transmission system

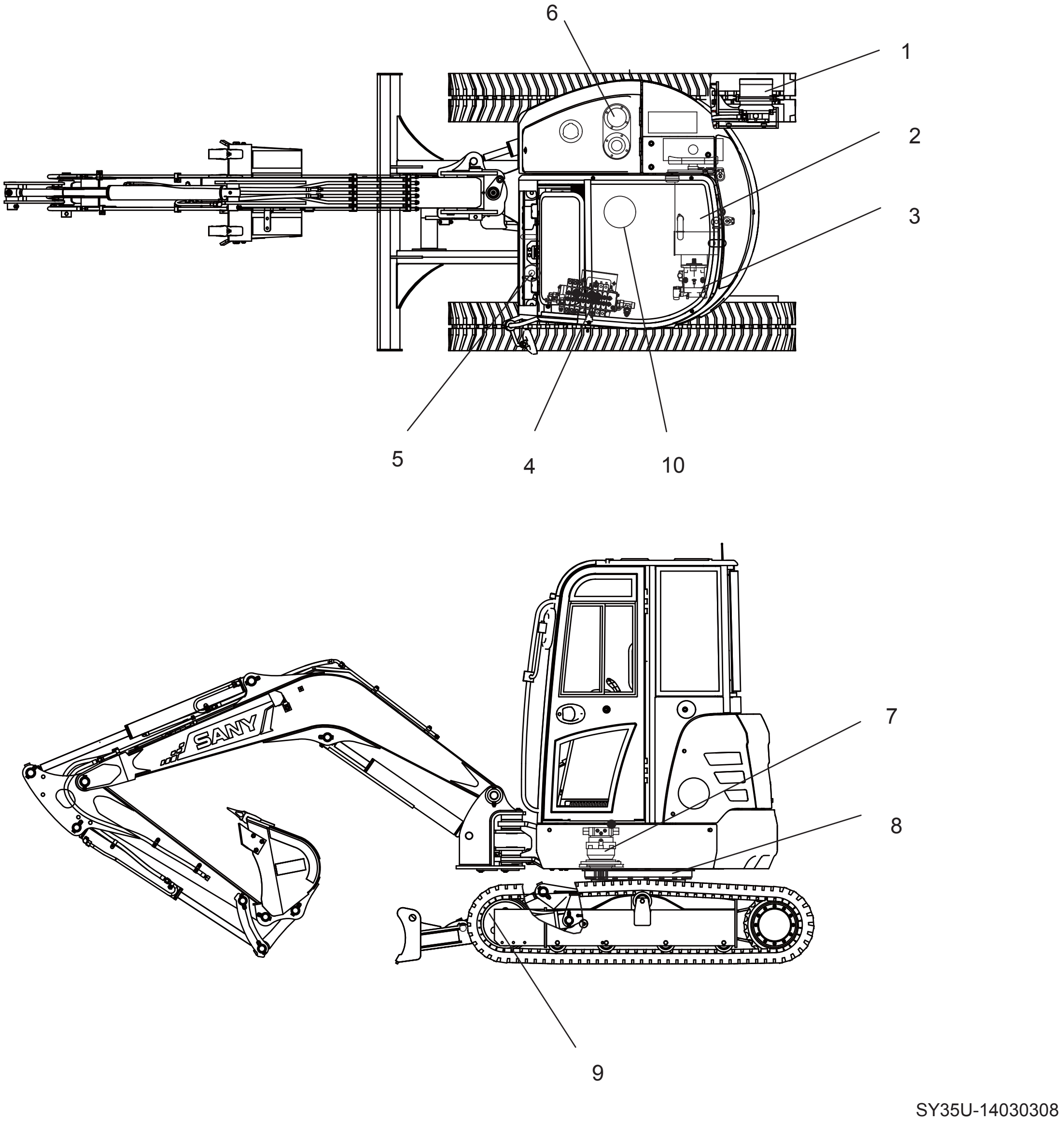


Fig. 4-5

(1) Travel motor
(2) Engine
(3) Main pump
(4) Main valve
(5) Oil source control valve
(6) Hydraulic tank
(7) Swing motor
(8) Swing bearing
(9) Idler
(10) Central swivel joint

4.2.2 Swing bearing

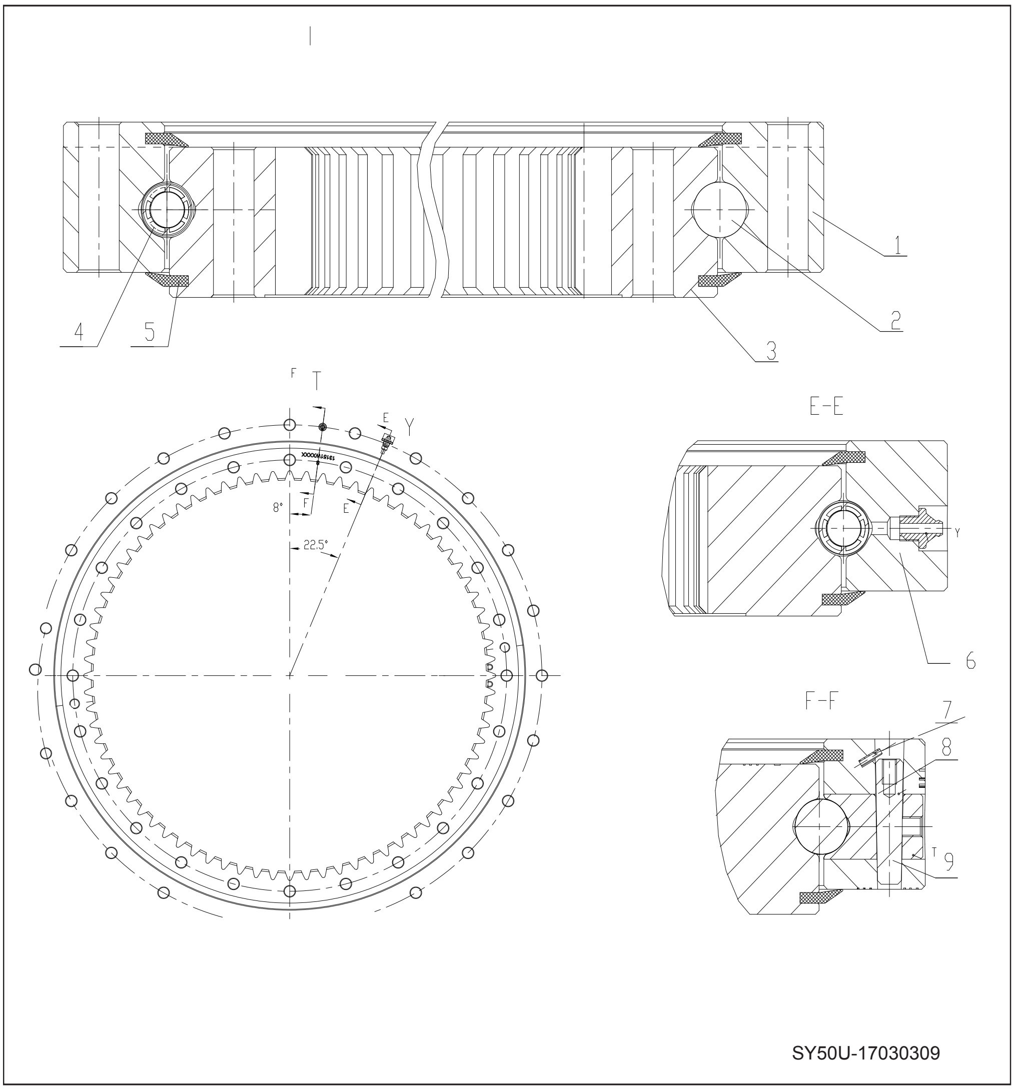


Fig. 4-6

(1) Outer race
(2) Steel ball
(3) Inner race
(4) Spacer
(5) Rubber
T: Plug
Y: Grease f tting

(6) Oil cup
(7) Pin
(8) Pin
(9) piug

Specif cations

Reduction ratio: 91/14=6.5

4.2.3 Swing motor

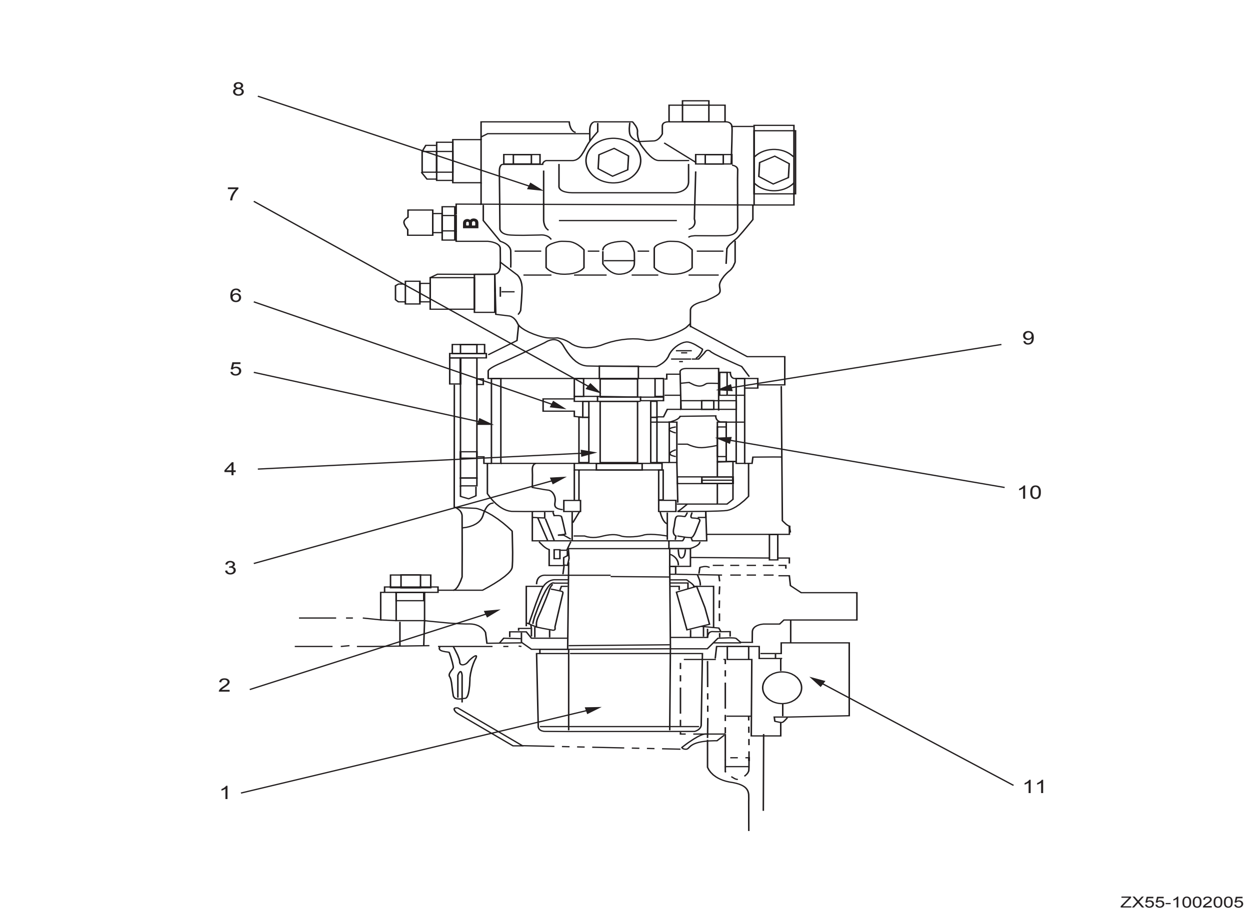


Fig. 4-7

(1) Pinion gear
(2) Housing
(3) No.2 planetary carrier
(4) No.2 sun gear
(5) Gear ring
(6) No.1 planetary carrier
(7) No.1 sun gear
(8) Swing motor
(9) No.1 planetary gear
(10) No.2 planetary gear
(11) Swing bearing

Specif cations

Reduction ratio: 23.2

4.3 Undercarriage

4.3.1 Track frame

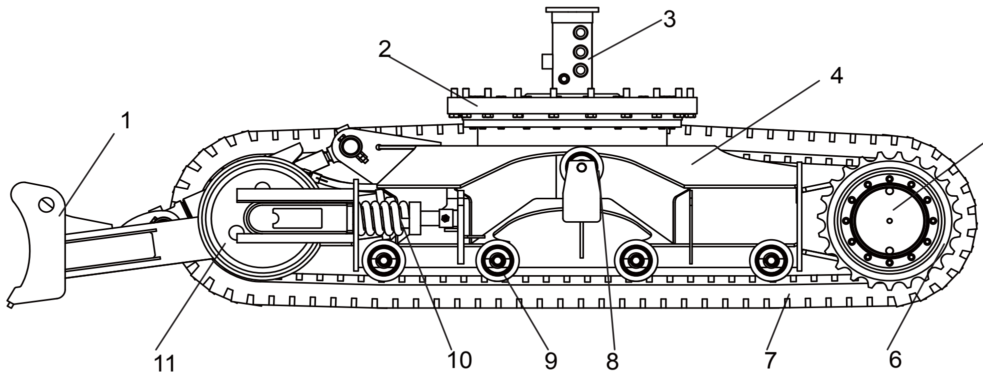


Fig. 4-8

(1) Dozer blade
(2) Swing bearing
(3) Central swivel joint
(4) Track frame
(5) Travel motor
(6) Sprocket
(7) Track
(8) Carrier roller
(9) Track roller
(10) Tensioning device
(11) Idler

4.3.2 Tensioning device

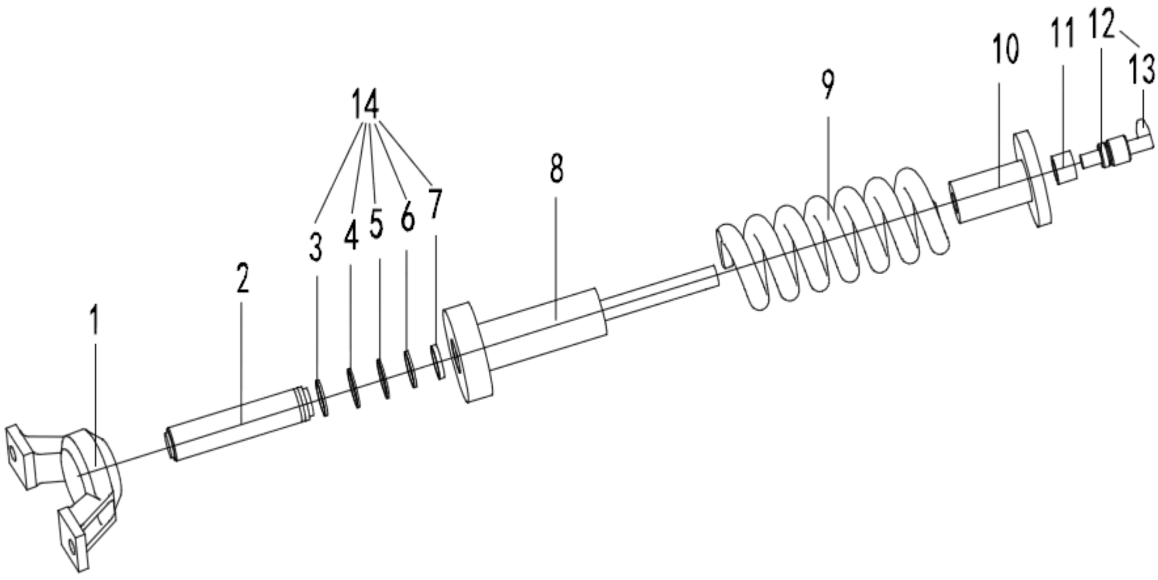


Fig. 4-9

(1) Bearing
(2) Plunger
(3) Anti-abrasion ring(45×50×10)
(4) Dust ring(50×58×6.5)
(5) Retaining ring(50×60×3)
(6) Sealing ring(50×60×6)
(7) Wear ring(50×55×6)
(8) Cylinder barrel
(9) Tensioning spring
(10) Spring seat
(11) Nut
(12) Tensioning equipment check valve
(13) Grease fitting
(14) Tensioning equipment repairing bag

4.3.3 Tensioning device

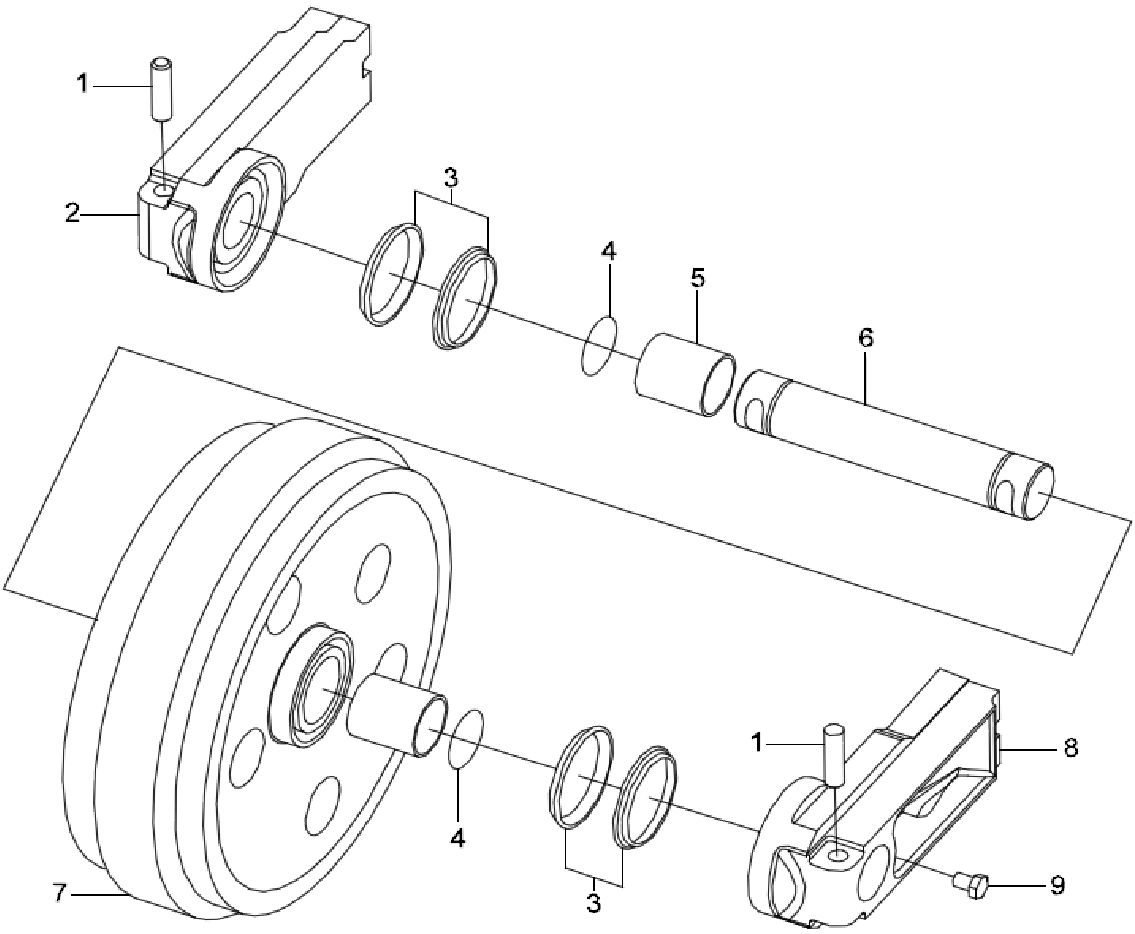


Fig. 4-10

项目号 物料英文名
(1) Pin
(2) Right-support abutment
(3) Floating seal(70×90×29)
(4) O-ring
(5) Sleeve(51×45×38)
(6) Spindle
(7) Idler body
(8) Left-support abutment
(9) Plug

4.4 Hydraulic System

4.4.1 Hydraulic lines

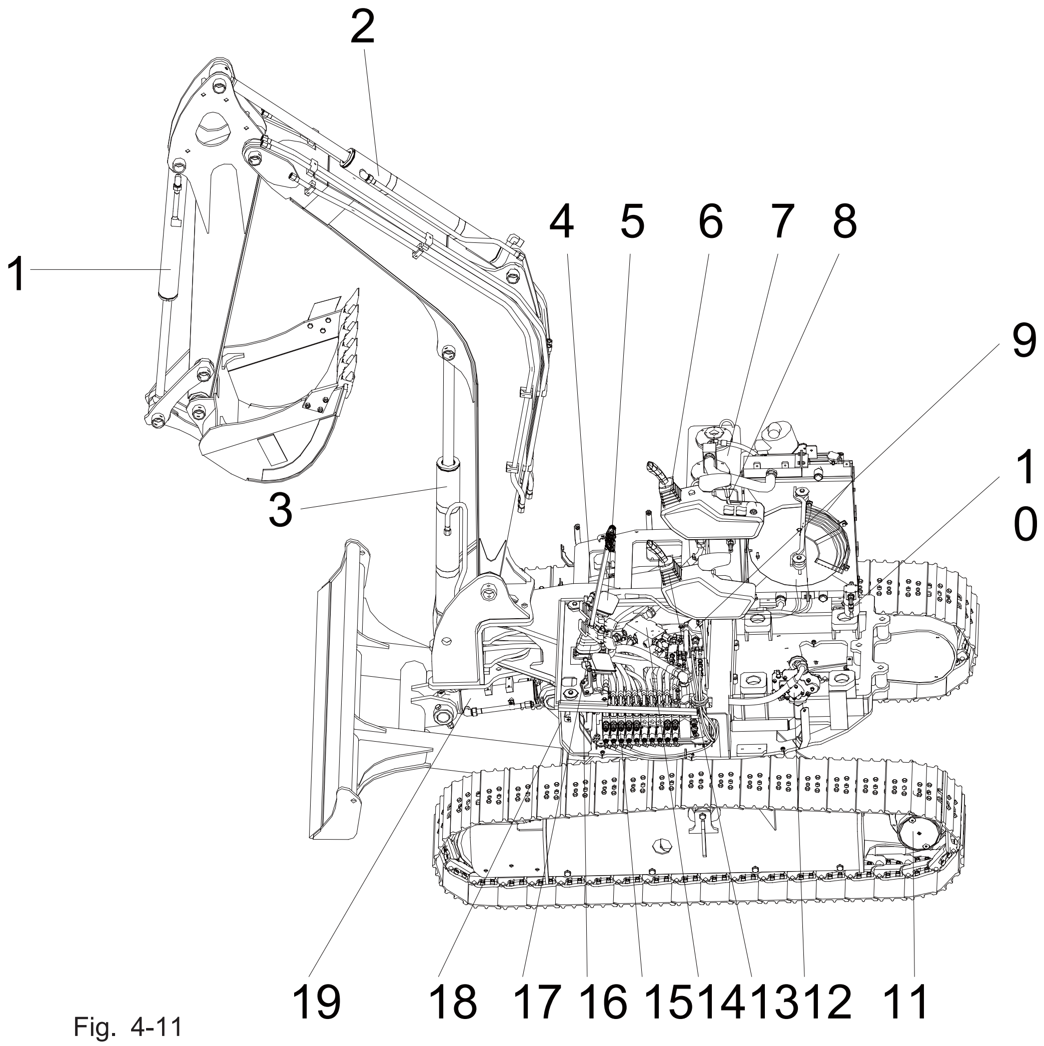


Fig. 4-11

(1) Bucket cylinder
(2) Arm cylinder
(3) Boom cylinder
(4) Boom swing cylinder
(5) Boom swing pilot valve
(6) Right pilot valve
(7) Hydraulic tank
(8) Dozer pilot valve
(9) Central swivel joint
(10) Pilot filter
(11) Travel motor
(12) Main pump
(13) Left pilot valve
(14) Slew motor
(15) Main valve
(16) Oil source valve
(17) Travel pedal valve
(18) Proportional electromagnetic valve
(19) Dozer cylinder

4.4.2 Hydraulic tank

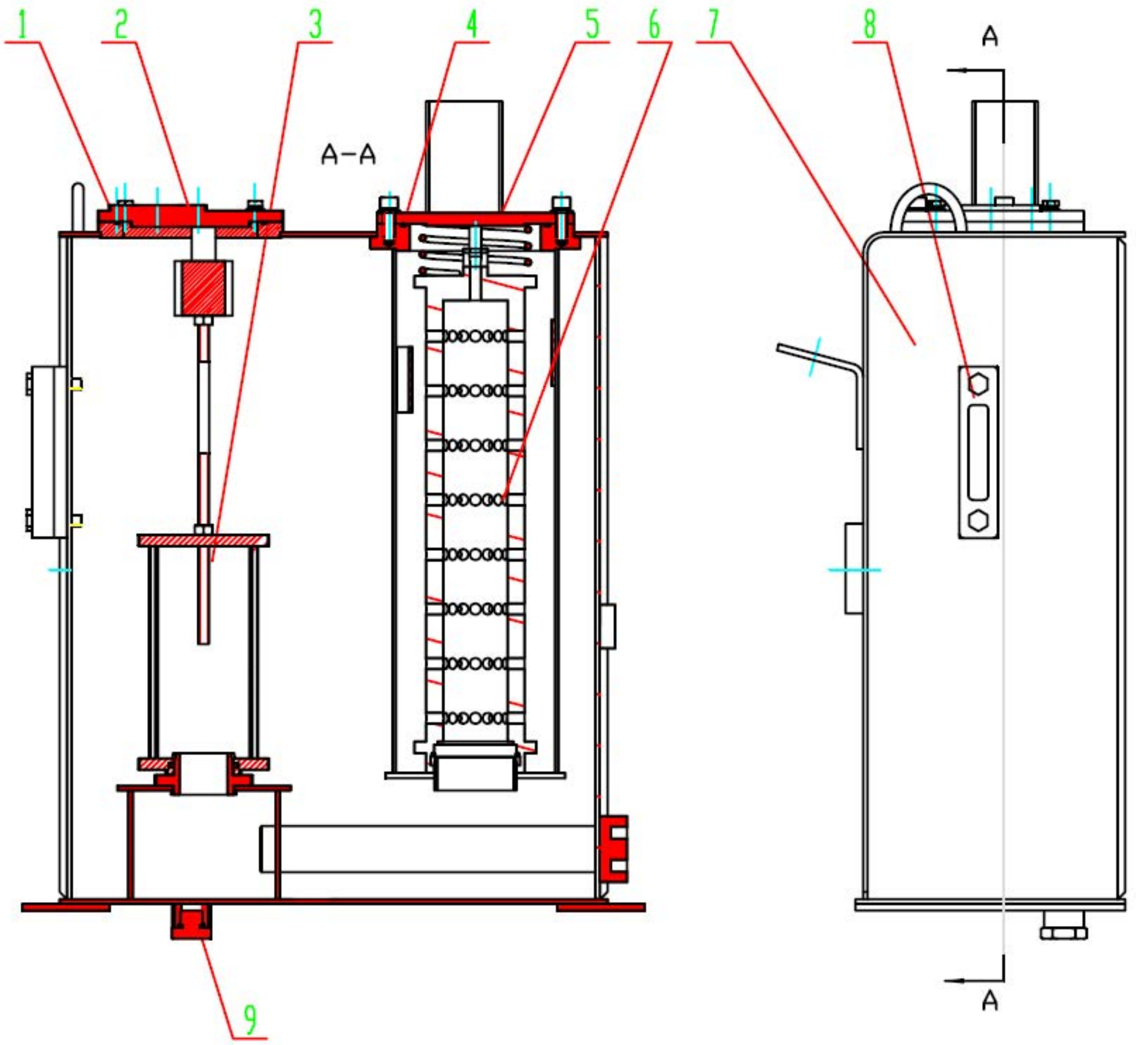


Fig. 4-12

(1) O-ring seal
(2) Cap,oil suction
(3) Filter element,oil suction
(4) O-ring seal
(5) Cap,oil return
(6) Filter element,oil return
(7) Tank body
(8) Level gauge
(9) Drain plug

4.4.3 Hydraulic pump

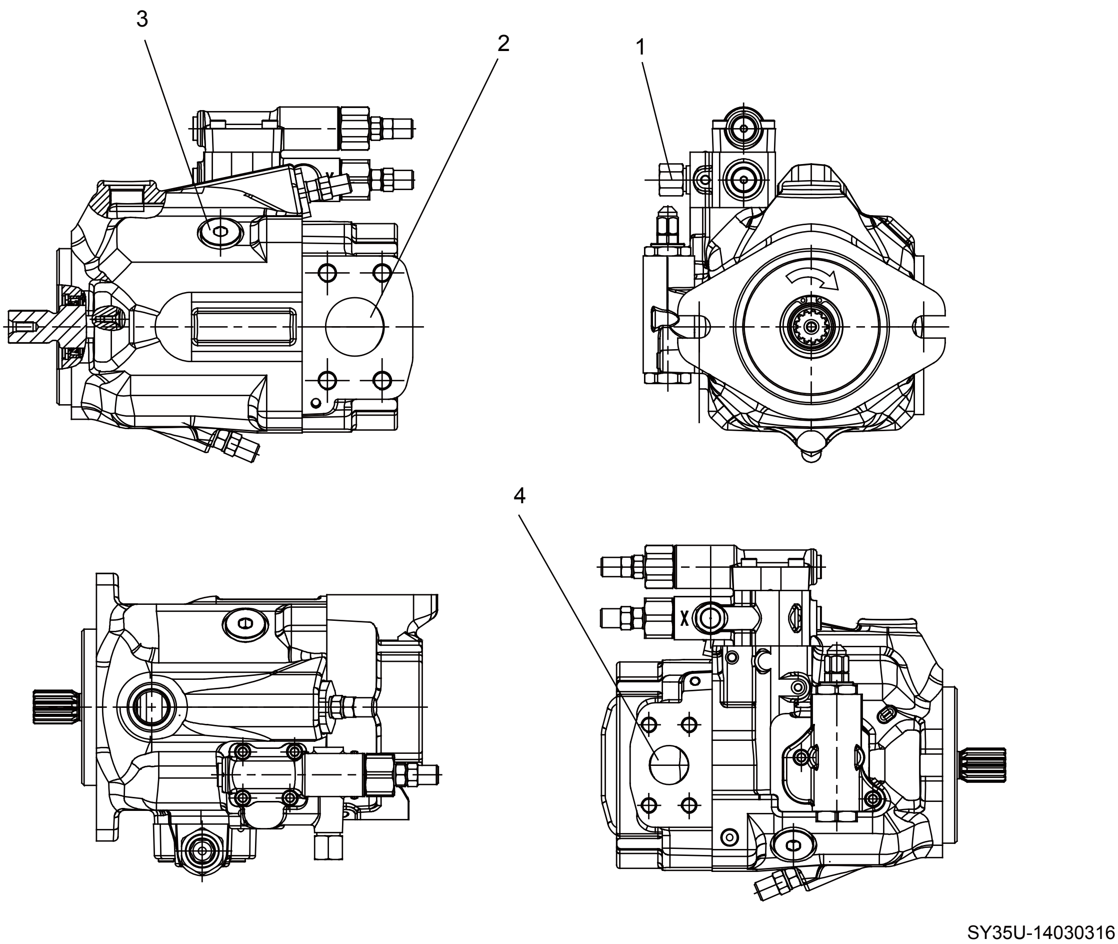
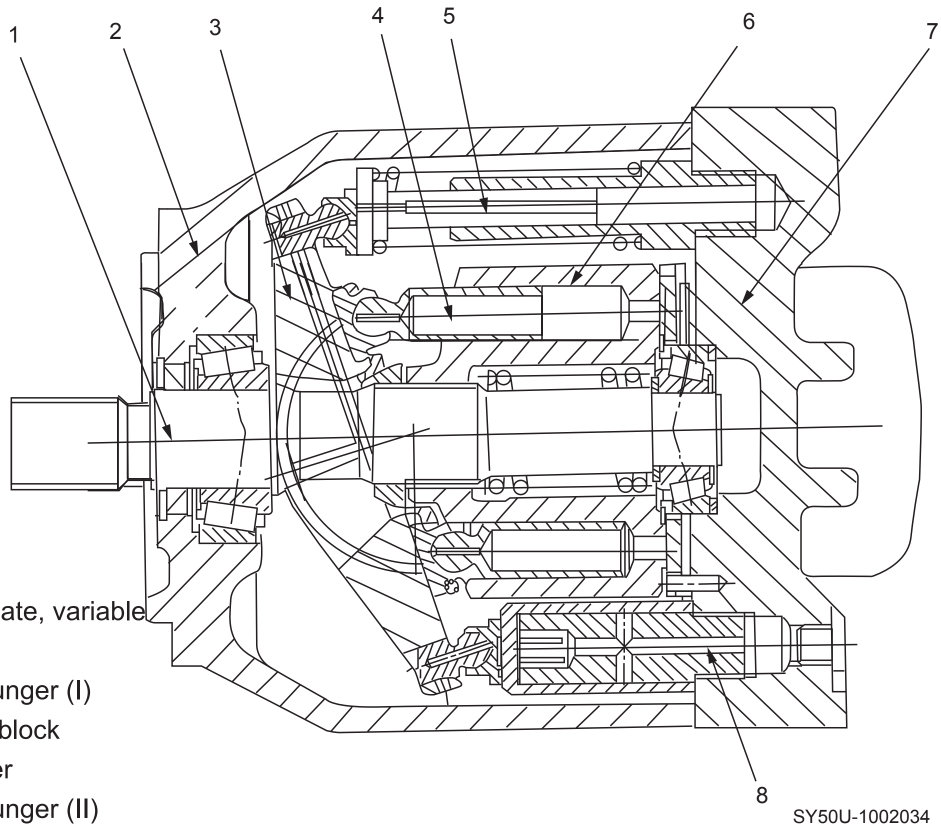


Fig. 4-13

(1) LS pressure port
(2) Oil suction port
(3) Oil drain port
(4) Pressure delivery port

Function

- Engine rotation and torque transmitted to pump shaft are transformed into hydraulic power, which delivers oil according to the amount of load.
- It is possible to change the amount of oil delivery by changing the angle of swash plate.



(1) Shaft
(2) Housing
(3) Swash plate, variable
(4) Plunger
(5) Servo plunger (I)
(6) Cylinder block
(7) End cover
(8) Servo plunger (II)

Fig. 4-14

Structure

- Cylinder block (6) is secured to shaft (1) with spline. Shaft (1) is supported by front and rear bearings.
- End of plunger (4) is spherical and it is integrally imbedded in the slipper. Plunger (4) and the slipper form a spherical bearing.
- The slipper is in close contact with swash plate (3) when it slides along the circumference.
- Plunger (4) moves axially in each cavity of cylinder block (6).
- Cylinder block (6) seals the pressure oil f owing toward the thrust plate and rotates relatively. This surface is designed to keep oil pressure balanced at a suitable level.

  Oil in each cavity of cylinder block (6) is drawn in and expelled via the thrust plate.

4.4.4 Control valve

Sany uses standard 10-spool control valve

Fig. 4-24 2017051808

List of oil ports:

P	From main pump
T	To oil return block
A1	To dozer cylinder left port
A2	To right travel A port
A3	To left travel B port
A4	To Slew motor B port
A5	To boom swing cylinder rod end
A6	To backup 2 steel tube left
A7	To backup 1 steel tube left
A8	To arm cylinder head end
A9	To bucket cylinder head end
A10	To boom cylinder head end
B1	To dozer cylinder right port
B2	To right travel B port
B3	To left travel A port
B4	To Slew motor A port
B5	To boom swing cylinder head end
B6	To backup 2 steel tube right
B7	To ball valve
B8	To arm cylinder rod end
B9	To bucket cylinder rod end
B10	To boom cylinder rod end

10-spool valvep)

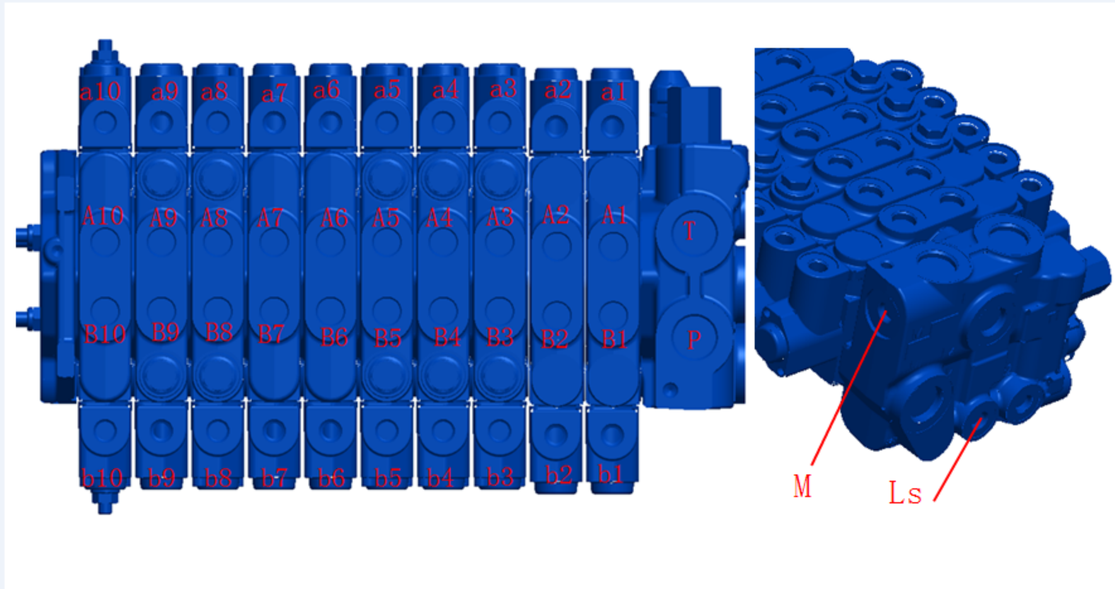


Fig. 4-25 2017051809

M	To oil source control valve
Ls	To main pump Ls port
a1	From dozer down pilot valve
a2	From right travel forward pilot valve
a3	From left travel forward pilot valve
a4	From left slew pilot valve
a5	From Boom swing left pilot valve
a6	From proportional electromagnetic valve(underside) A2 port
a7	From proportional electromagnetic valve(upside) A2 port
a8	From Arm-out pilot valve
a9	From bucket-out pilot valve
a10	From boom-down pilot valve
b1	From dozer up pilot valve
b2	From right travel backward pilot valve
b3	From left travel backward pilot valve
b4	From right slew pilot valve
b5	From Boom swing right pilot valve
b6	From proportional electromagnetic valve(underside) A1 port
b7	From proportional electromagnetic valve(upside) A1 port
b8	From Arm-in pilot valve
b9	From bucket-in pilot valve
b10	From boom-up pilot valve

BLANK PAGE

4.4.5 Swing motor

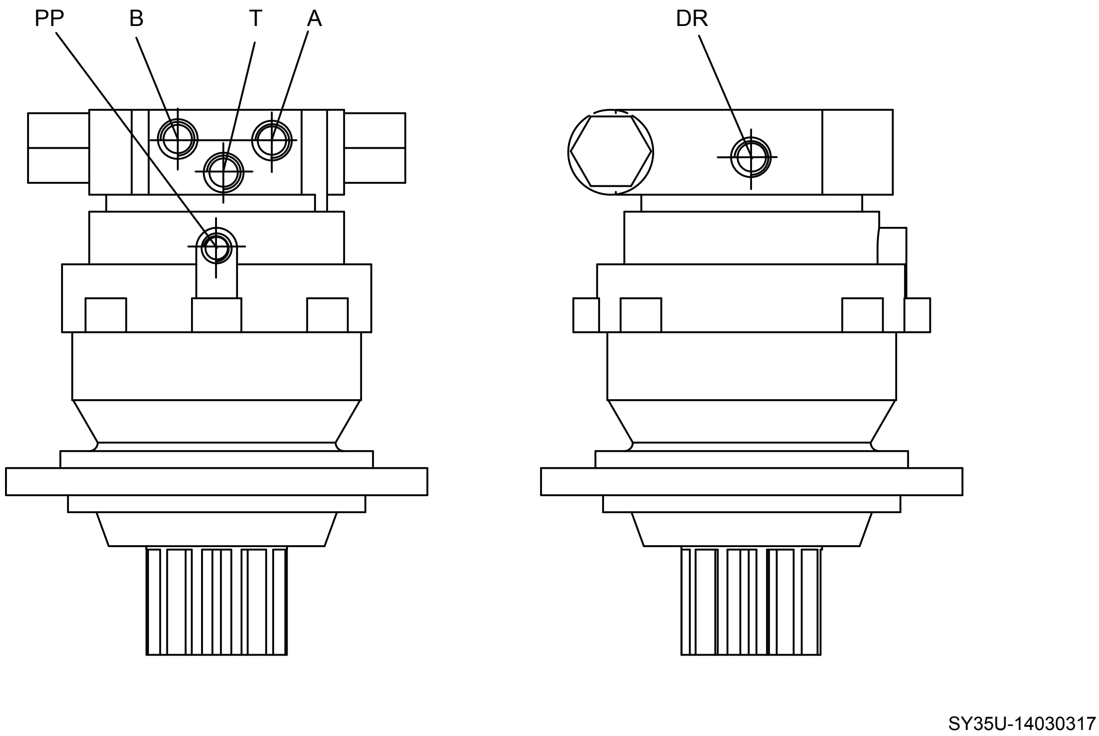


Fig. 4-43

A: From main valve port B4
B: From main valve port A4
DR:To hydraulic tank
T: From oil return block
pp:From oil source valve

Technical Specif cations:

	SY50U
Model	PCR-4B-20A-P-9217
Motor Displacement	28.0 cm³/rev
Rate Pressure	19.1 MPa

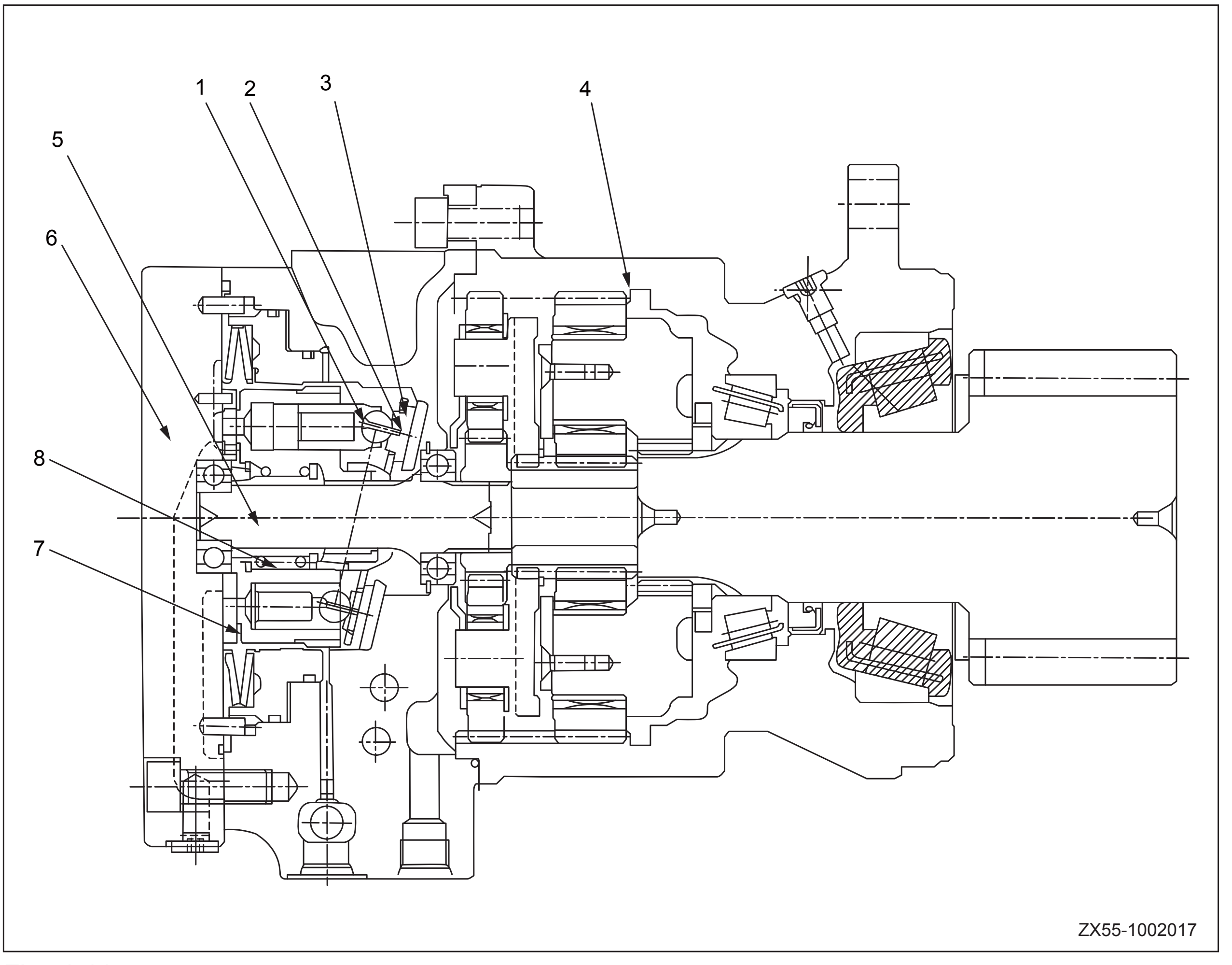


Fig. 4-44

(1) Plunger
(2) Boot
(3) Thrust plate
(4) Motor housing
(5) Output shaft
(6) End cover
(7) Thrust plate
(8) Central spring

Makeup oil check valve and safety relief valve

Function

- When swing stops, the motor outlet circuit is shut off by the control valve but the motor keeps rotating under the inertial force of machine swing. As a result, pressure at motor outlet becomes abnormally high, which may result in motor damage.
- The relief valve is designed to avoid this problem. It relieves abnormally high pressure to port S from the motor outlet. It also has a swing brake function.
- The makeup oil check valve provides oil equivalent to the oil that is relieved by the relief valve. It feeds the oil to the motor inlet via port S to prevent formation of cavitation.

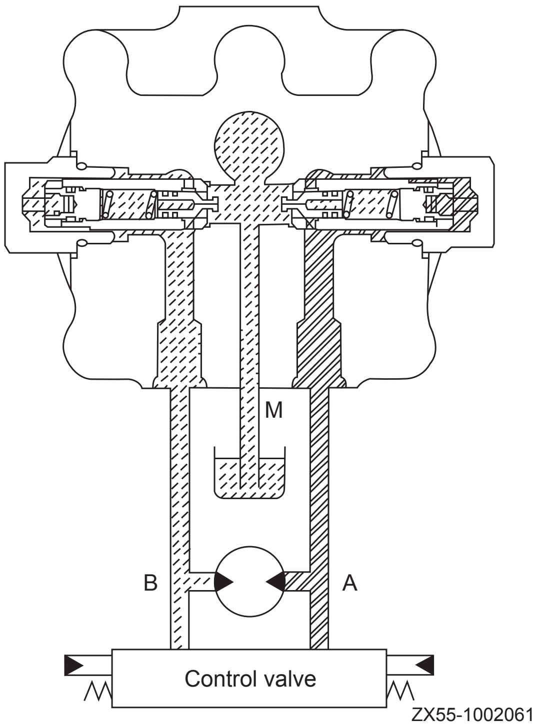


Fig. 4-45

Operation

1. When swing starts

- When swing control lever is operated for left swing, pressurized oil from the pump f ows through the control valve and enters port B.
- When this happens, pressure at port B rises and power is generated in the motor. The motor starts rotating.

  Oil from the motor outlet passes the control valve from port A and returns to the tank.

2. When swing is stopped

- When the swing control lever is neutralized, no pressurized oil is fed to port B from the pump.

  At the same time, oil from the motor outlet returns to the tank from the control valve and the circuit is shut off.
- Pressure at port A rises and a resistance is generated by the motor and the brake is actuated.

  When pressure at port A rises to the set pressure of relief valve (1), the relief valve (1) opens and release the pressurized oil between port A and port M.
- No pressurized oil is fed to port B, but swing continues. Negative pressure is generated.

  When the negative pressure drops to the set pressure of the makeup check valve (2), suction valve (2) opens and oil is provided from port M to prevent formation of cavitation.

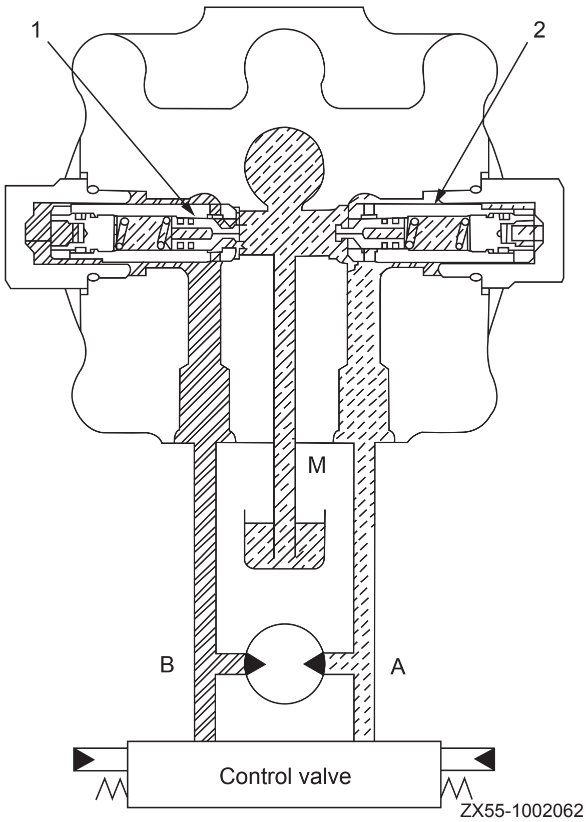


Fig. 4-46

4.4.6 Safety valve

Outline

The safety valve consists of a makeup oil check vale and a relief valve.

Function

When swing stops, the motor outlet circuit is shut off by the control valve but the motor keeps rotating under inertial force. As a result, pressure at motor outlet side becomes abnormally high which may result in motor damage. To avoid this, the oil that causes excessively high hydraulic pressure is allowed to be relieved to port M from motor outlet port (high pressure side) in order to avoid motor damage.

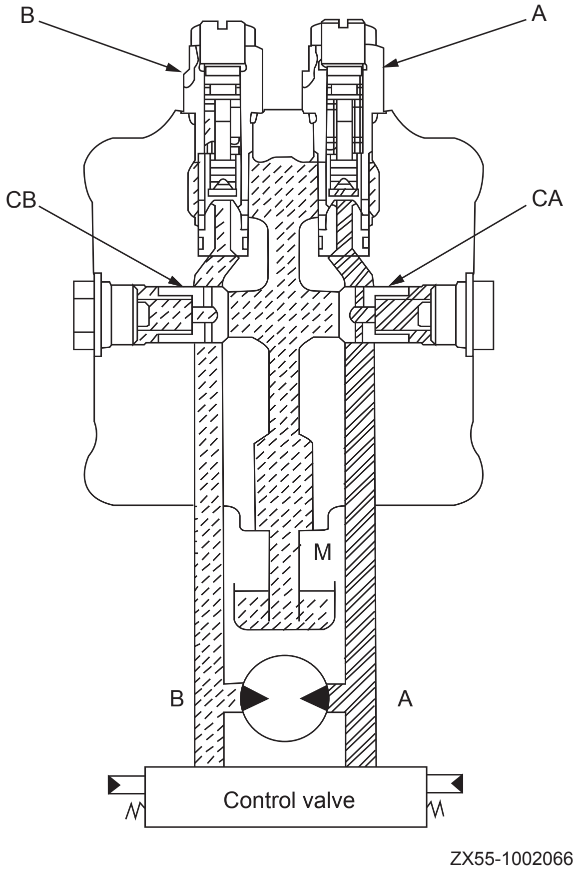


Fig. 4-47

Operation

1. When swing starts

- When the swing control lever is set to the left-swing, pressurized oil from the pump is supplied to port B via control valve. The pressure at port B rises, starting torque is generated in the motor, and the motor starts to rotate.

  The pressurized oil from the outlet port of the motor passes from port A through the control valve and returns to the tank.

2. When swing is stopped

- When the swing control lever is returned to neutral position, supply of pressurized oil from the pump to port B is stopped.

  Return oil circuit to the tank is shut off by the control valve and oil pressure from motor outlet port rises at port A. Motor rotation resistance increases and the brake is actuated.

- When pressure at port A rises to above the set pressure of relief valve B, a higher braking torque works on the motor causing it to stop.

- When relief valve B is acting, oil relieved from it and oil from port S flows to port B via check valve CA. In this way, cavitation at port B is avoided.

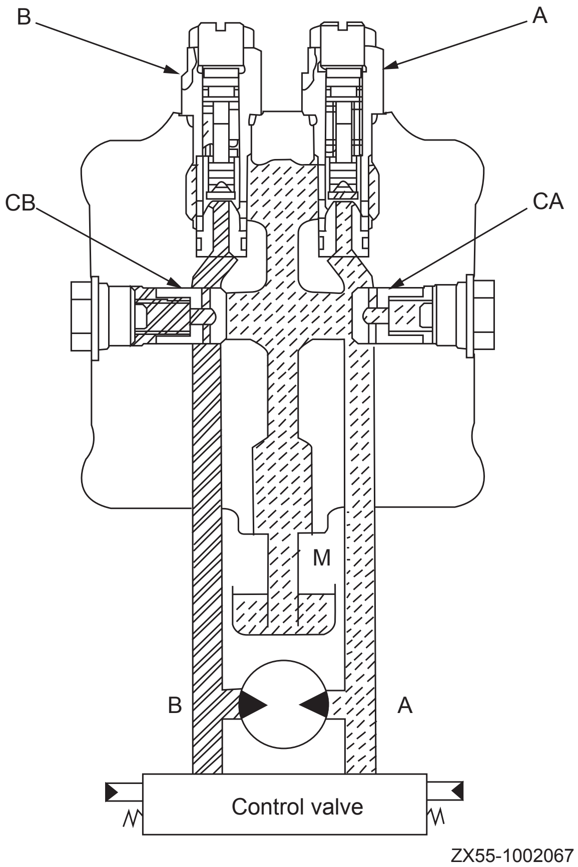


Fig. 4-48

4.4.7 Central swivel joint

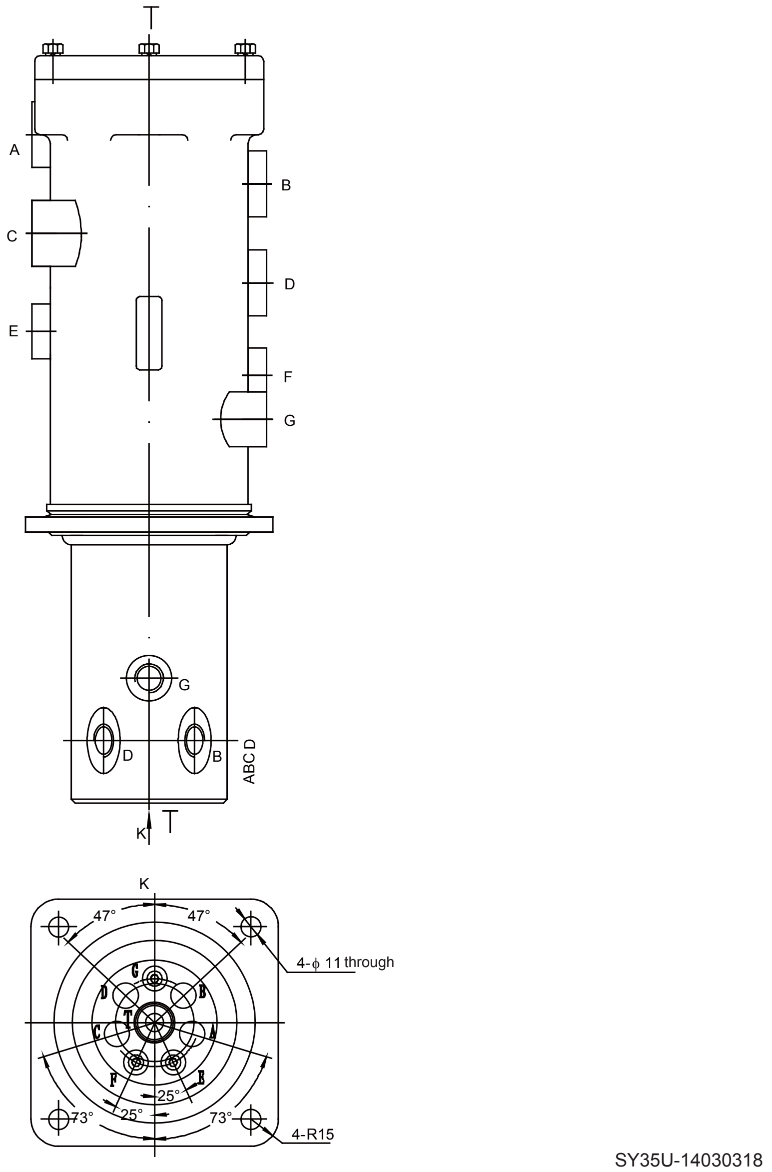


Fig. 4-49

Upper f gure：

A：To main valve port A2
B：To main valve port B2
C：To main valve port A3
D：To main valve port B3
E：To main valve port B1
F：To main valve port A1
G：To oil source valve port Pr
T：To slew motor port DR

Lower f gure：

A：To right travel motor port A
B：To right travel motor port B
C：To left travel motor port B
D：To left travel motor port A
E：To dozer cylinder right port
F：To dozer cylinder left port
G：To travel motor port pp
T：To travel motor port DR；

4.4.8 Travel motor

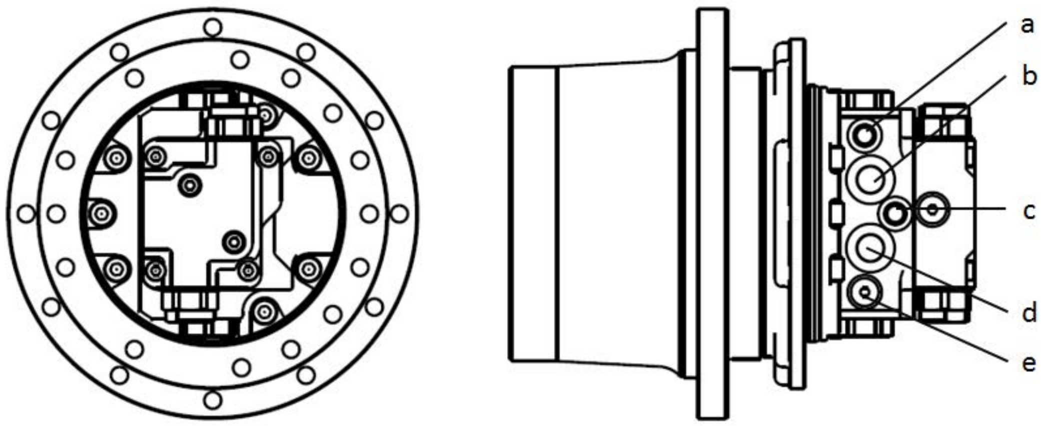


Fig. 4-50 ZX55-1002022

a. Port DR1 (to tank)

b. Port B (From control valve)

c. Port PP (Hi/Lo speed solenoid valve)

d. Port A (from control valve)

e. Port DR2 (to tank)

Specif cations

Model: PHV-4B-70D-PST-9793Z

Hydraulic motor

Motor capacity: Low 28.6 cm^3/rev

High 17.4 cm^3/rev

Max speed: 3391 rpm

Final drive

Output speed: 35.3 rpm (low) / 58.1 rpm (high)

Motor operating process

1. At low speed (swash plate at max. angle)

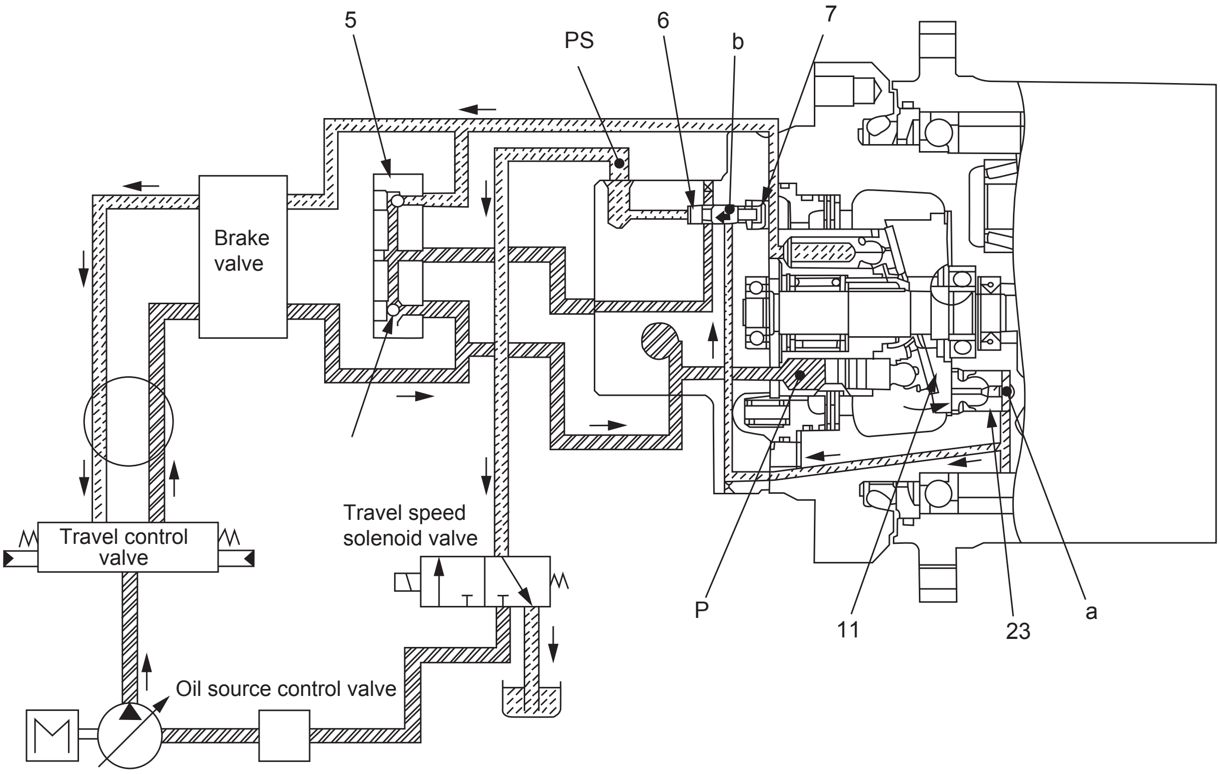


Fig. 4-51

- Hi/Lo travel speed solenoid valve is closed and pressurized oil from self-reducing valve does not f ow into port PS.
- As a result, regulating valve (6) is pushed to the left (←) by spring (7).
- As a result, it pushes check valve (32) and pressurized oil between control valve and end cover (5) is cut off by the regulating valve (6).
- At the same time, pressurized oil at chamber (a) of regulating plunger (23) is drained to the motor casing via passage (b) of the regulating valve (6).
- As a result, swash plate (11) is pushed to the max. angle direction by the main pressure in cylinder chamber P. Motor capacity becomes the maximum and the system is set in low speed.

2. At high speed (swash plate at minimum angle)

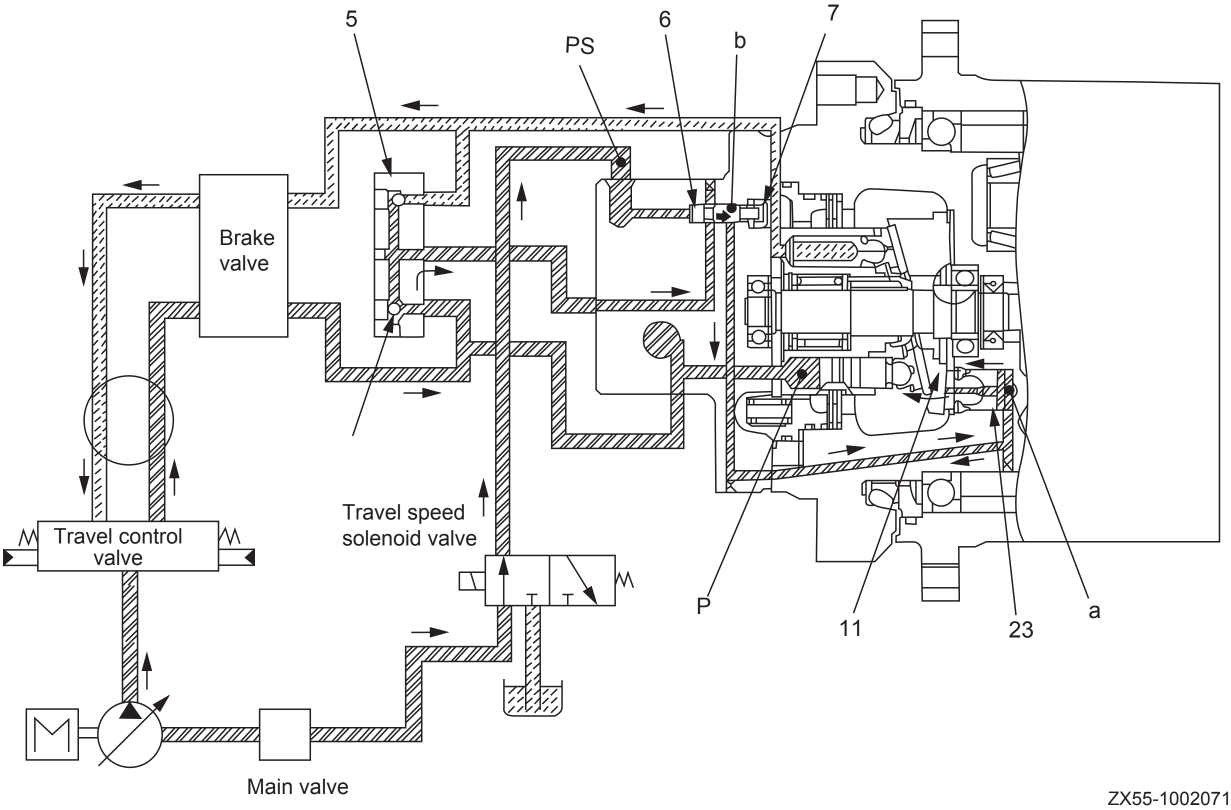


Fig. 4-52

- When the travel speed solenoid valve is excited, pilot oil from the self-reducing valve f ows to port Ps and pushes the regulating valve (6) to the right (→).
- As a result, main pressurized oil from the control valve enters the regulating plunger (6) at the bottom via passage (b) of regulating valve (6) and pushes the regulating plunger (23) to the left (←).
- As a result, swash plate (11) is pushed to the minimum angle direction. Motor capacity becomes the minimum and the system is set at high speed.

4.4.8.1 Working process of parking brake

1. When travel starts

- As the travel lever is operated, pressurized oil from the pump activates counterbalance valve spool (3), opens the circuit to the parking brake, pushes check valve (31) open and flows to chamber (a) of brake piston (8)..
- Pressurized oil overcomes the force of spring (28) and pushes piston (8) to the left (←).
- Since the force that pushes plate (26) and disc (27) together disappears, plate (26) is separated from disc (27) and the brake is released.

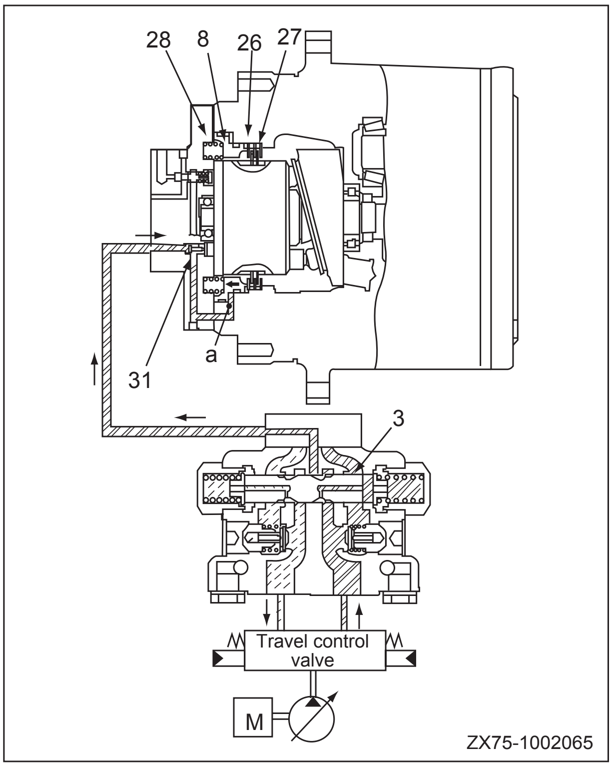


Fig. 4-53

2. When travel is stopped

- As the travel lever is placed in neutral position, counterbalance valve spool (3) returns to the neutral position and circuit to the parking brake is closed.
- The pressurized oil in chamber (a) of brake piston (8) is drained to the casing via the orif ce of the check valve. Brake piston (8) is pushed to the right (→) by spring (28).
- The plate (26) and disc (27) are pushed together, and the brake is applied.

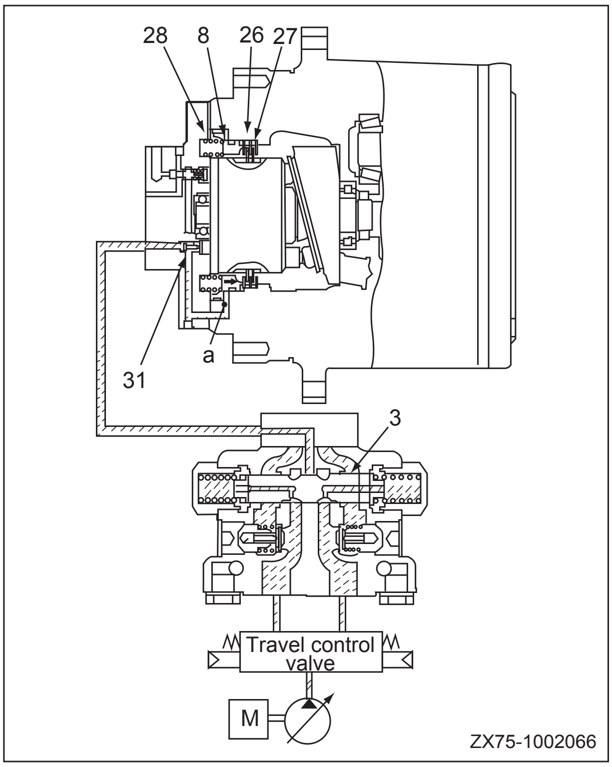


Fig. 4-54

4.4.8.2 Working process of brake valve

Function

- When traveling 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).

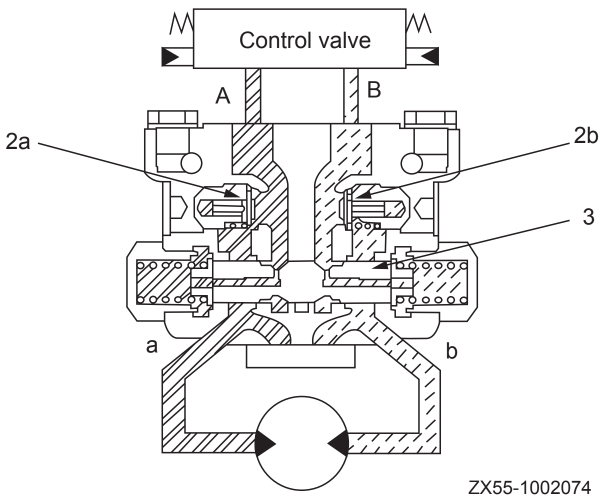


Fig. 4-55

Operation when pressurized oil is supplied

- When the travel levers are being operated, pressurized oil from the control valve is fed to port A. The pressurized oil opens check valve (2a) and then flows to motor outlet port (b) via motor inlet port (a).
- However, the motor outlet is closed by check valve (2b) and spool (3), so the pressure at the supply side rises.
- Pressurized oil on the supply side f ows to chamber (S1) via orif ce (E1) of the spool (3). As the pressure in chamber (S1) goes above the spool switching pressure, spool (3) is pushed toward the right (→).
- Port (b) and port (B) are connected, the motor outlet port side opens, and the motor starts rotating.

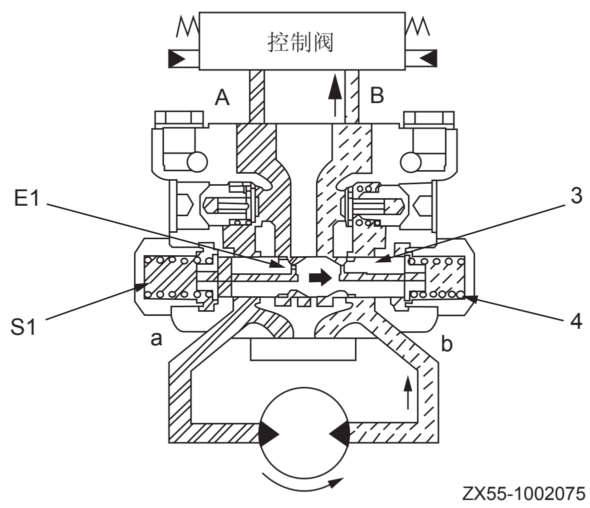


Fig. 4-56

Operation of brake when travelling downhill

- If the machine goes out of control while travelling downhill, the motor will rotate at zero load to decrease the inlet side oil pressure. Pressure in chamber (S1) will also drop via orif ces (E1).
- As the pressure in chamber (S1) goes below the spool switching pressure, spool (3) is returned to the left (←) via spring (4) and outlet port (b) is throttled.
- The pressure at the outlet port side rises, generating rotation resistance on the motor to prevent the machine from losing control.

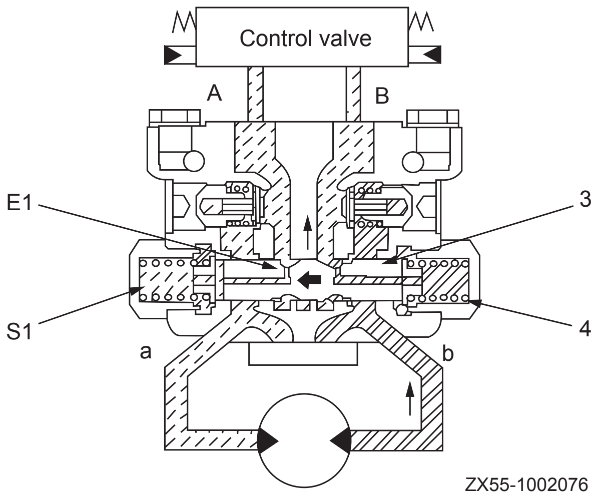


Fig. 4-57

4.4.9 Control system

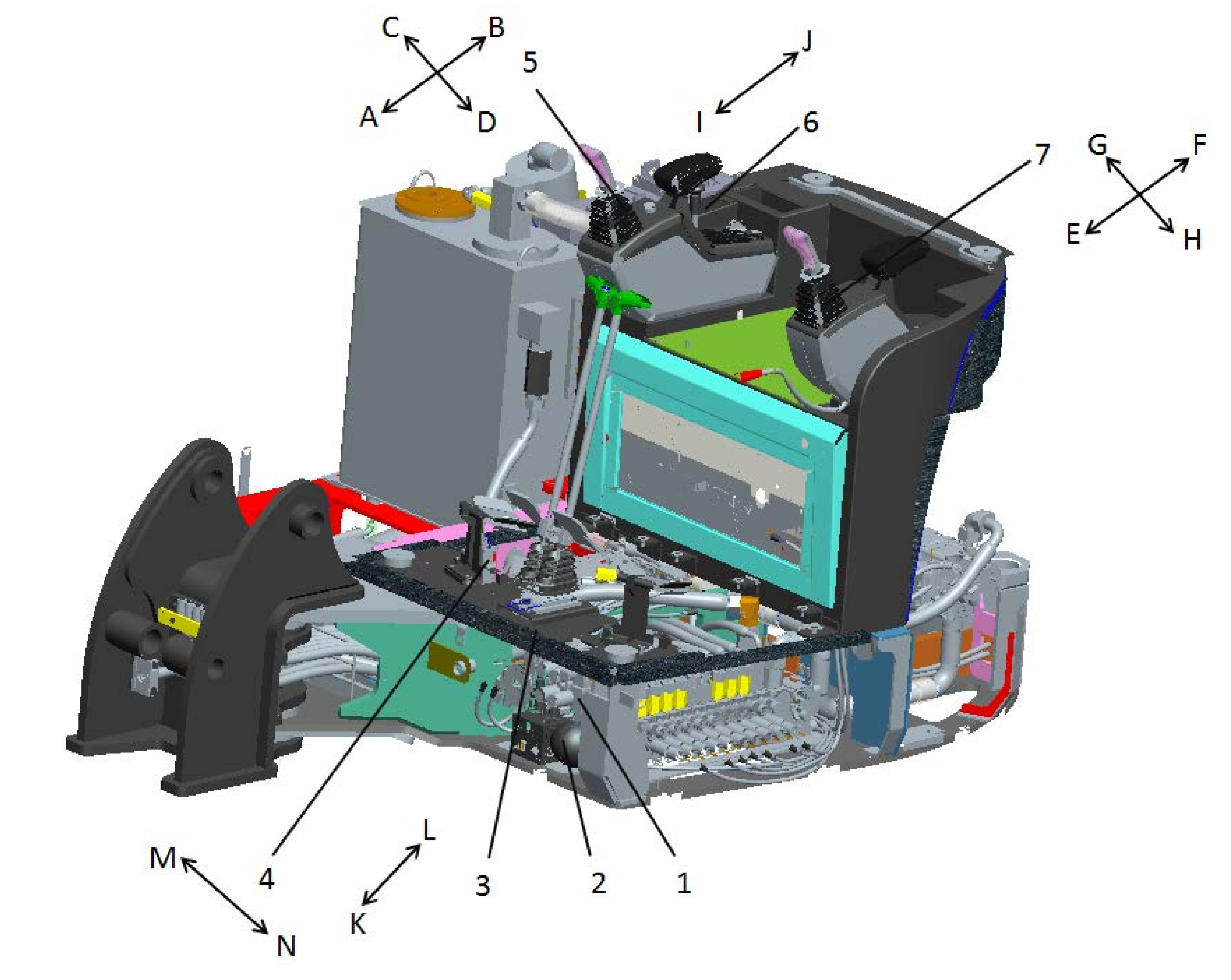
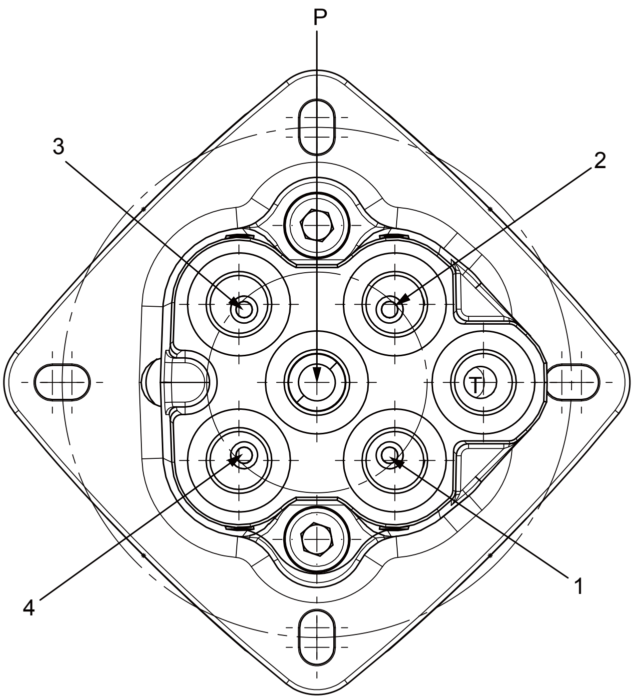


Fig. 4-58 SY35U-14030319

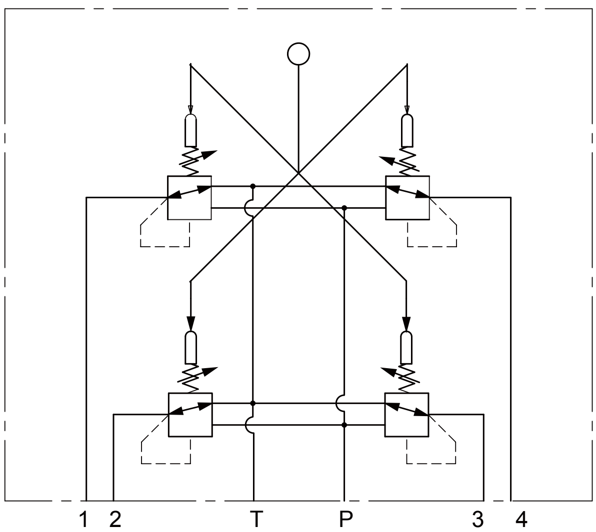
(1) Proportional electromagnetic valve
(2) Oil source valve
(3) Travel pilot valve
(4) Boom swing pilot valve
(5) Right pilot valve
(6) Dozer pilot valve
(7) Left pilot valve

(A) Boom down
(B) Boom up
(C) Bucket dump
(D) Bucket dig
(E) Arm open
(F) Arm in
(G) Slew right
(H) Slew left
(I) Dozer down
(J) Dozer up
(K) Forward travel
(L) Backward travel
(M) Boom swing right
(N) Boom swing left

4.4.10 Pilot valve



Schematic Diagram of Pilot Valve



ZX16-1203020

Fig. 4-59

a. Port P (from oil source control valve)

b. Port T (to oil tank)

c. Port 1 (left: arm out / right: boom up)

d. Port 2 (left: left swing / right: bucket dump)

e. Port 3 (left: arm in / right: boom down)

f. Port 2 (left: right swing / right: bucket dig)

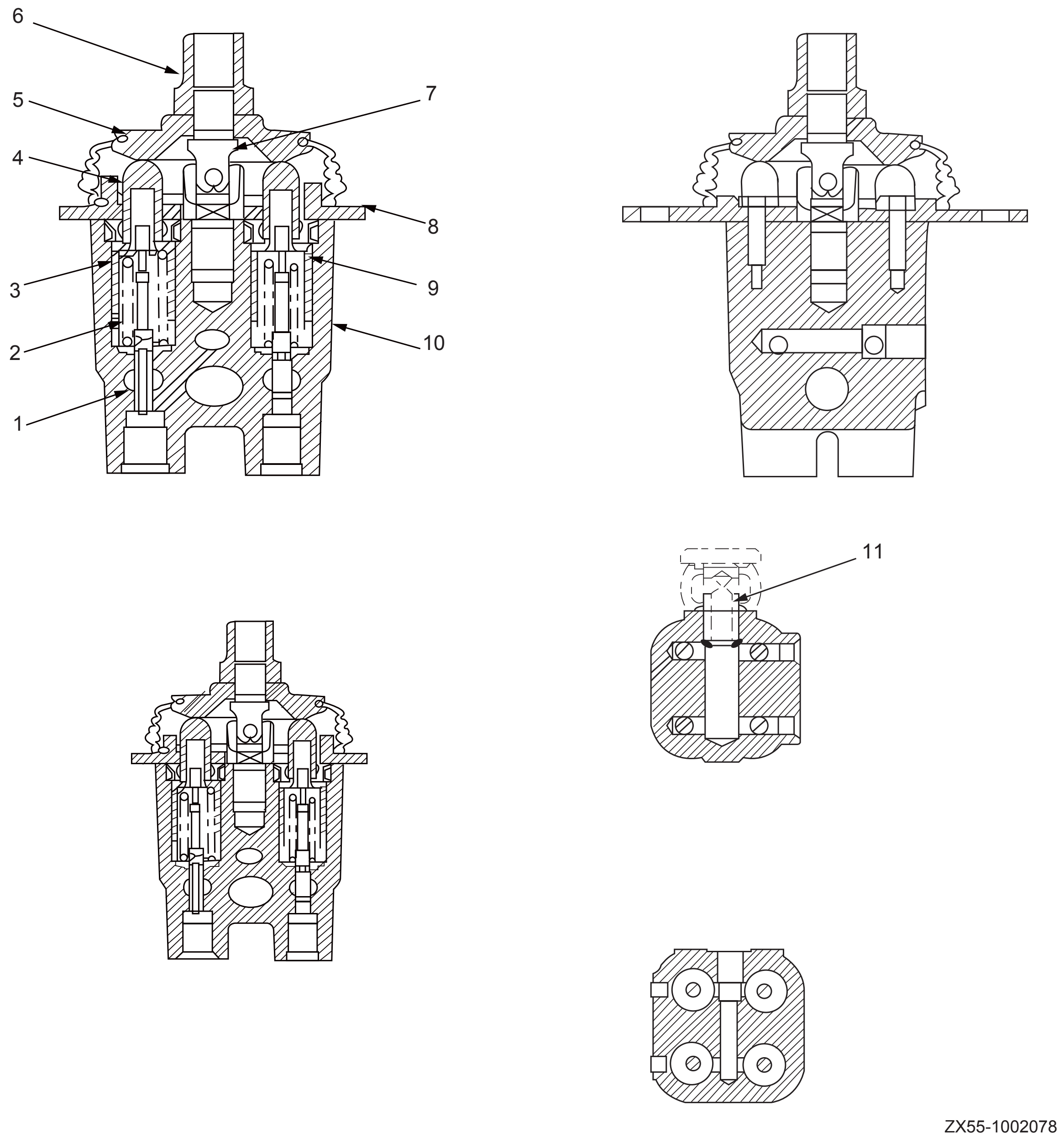


Fig. 4-60

(1) Valve spool
(2) Metering spring
(3) Center spring
(4) Plunger
(5) Disc
(6) Nut (for lever connection)
(7) Connector
(8) Plate
(9) Retainer
(10) Valve body
(11) Filter element

Working process

1. When in neutral position

   Ports (A) and (B) of the control valve and ports (P1) and (P2) of the pilot valve are connected to drain chamber (D) via fine control orif ce (f) of valve spool (1).

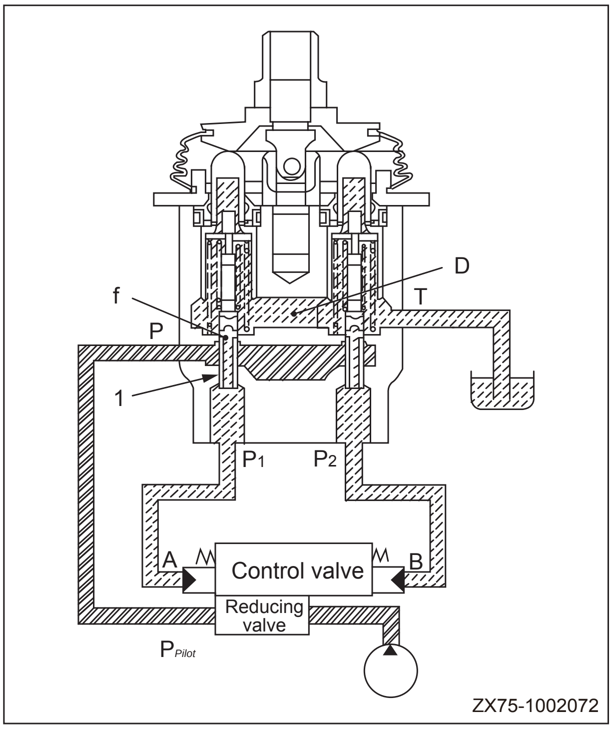


Fig. 4-61

2. During f ne control (Neutral → f ne control)

   When plunger (4) is pushed by disc (5), retainer (9) is also pushed down, valve spool (1) is also pushed by metering spring (2), and moves downward.

   At this time, fine control orifice (f) is shut off from drain chamber (D). At almost the same time, it is interconnected to pump pressure chamber (PP). Pilot pressure from port (P_{pilot}) of main valve passes f ne control orif ce (f) and f ows to port (A) via port (P1).

   When pressure at port (P1) rises, valve spool (1) is pushed back and fine control 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, valve spool (1) moves up and down so that the force of metering spring (2) is balanced with the pressure at port (P1).

   The position relationship between valve spool (1) and valve body (10) (f ne control orif ce (f) is at a certain point between drain chamber (D) and pump pressure chamber PP) does not change until retainer (9) contacts valve spool (1).

   Metering spring (2) contracts in proportion to control lever stroke. Pressure at port (P1) also rises in proportion to lever stroke.

   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.

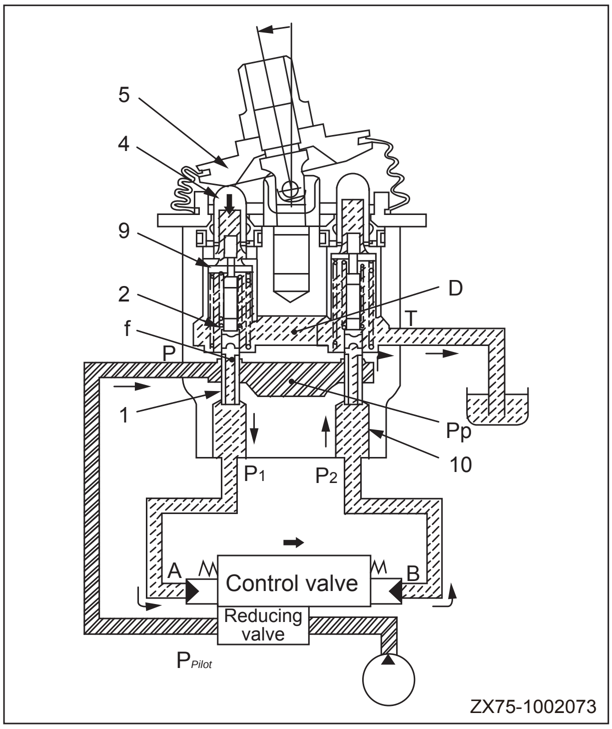


Fig. 4-62

3. During fine control (when control lever returns)

   When disc (5) starts to return, valve spool (1) is pushed up by the force of center spring (3) and the pressure at port (P1).

   As a result, fine control 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, valve spool (1) will be pushed down by metering spring (2) and f ne control orifice (f) will be shut off from drain chamber (D). At almost the same time, f ne control orif ce is interconnected with 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 control valve returns, oil in the drain chamber (D) f ows in drain chamber (D) via the fine control orifice (f’) at the unmoving side. The oil enters and fulfil chamber (B) via port (P2).

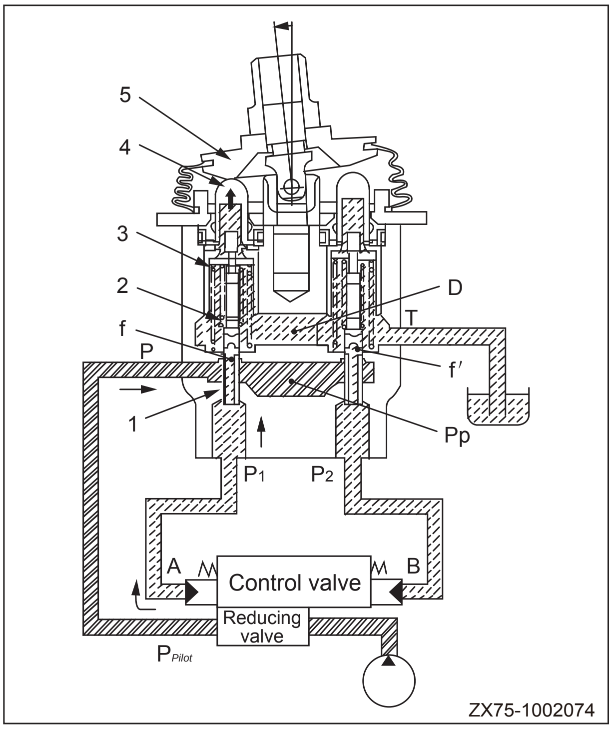


Fig. 4-63

4. At full stroke

When disc (5) pushes plunger (4) downward, retainer (9) pushes valve spool (1) downward, and f ne control orif ce (f) is shut off from drain chamber (D) and interconnected with pump pressure chamber (PP). Therefore, pressurized oil from main valve port (P_{pilot}) passes f ne control orif ce (f) and flows into chamber (A) via port (P1) and moves the control valve spool. Return oil in chamber (B) passes orif ce P2 and f ows into drain chamber (D) via f ne control orif ce (f’).

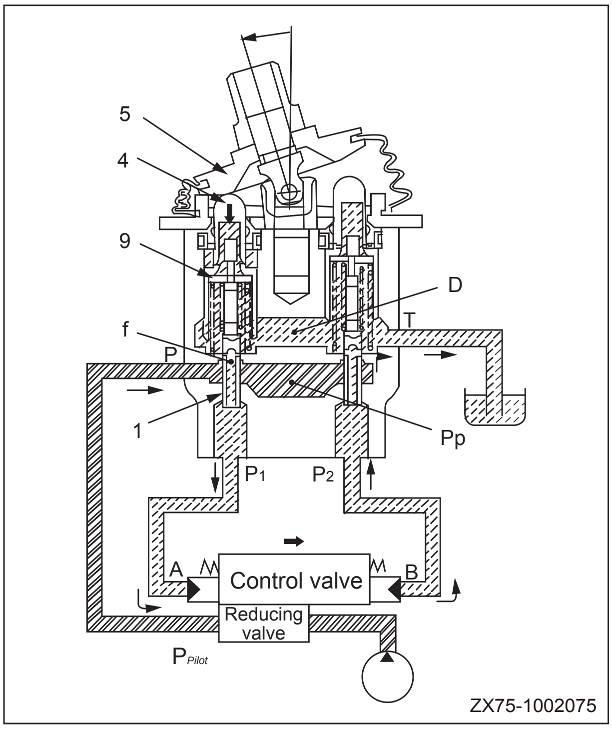


Fig. 4-64

4.4.11 Travel pilot valve

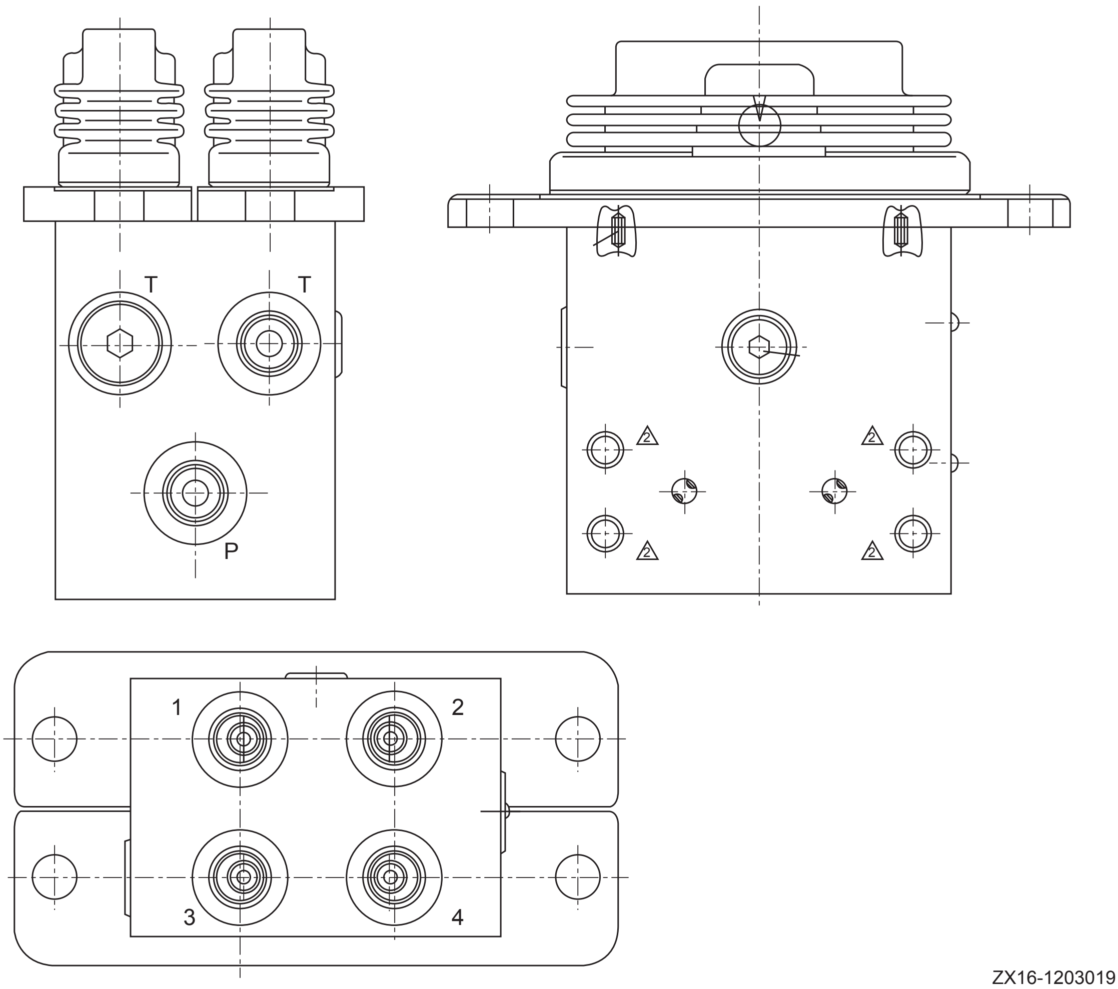


Fig. 4-65

Port T - To oil tank
Port P - From oil source control valve
Port 1 - Left forward
Port 2 - Left backward
Port 3 - Right forward
Port 4 - Right backward

Working process

1. When in neutral position

   Ports (A) and (B) of the control valve and ports (P1) and (P2) of the pilot valve are connected to drain chamber (D) via fine control orif ce (f) of valve spool (1).

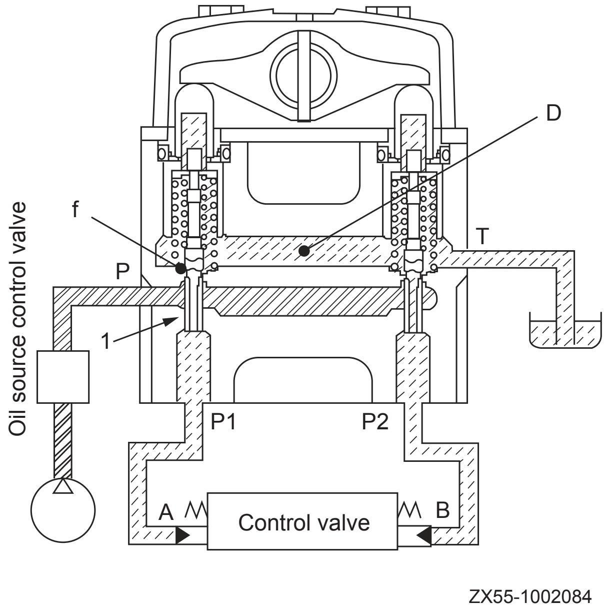


Fig. 4-66

2. During f ne control (neutral → f ne control)

When plunger (4) is pushed by disc (5), retainer (9) is also pushed down, valve spool (1) is also pushed by metering spring (2), and moves downward.

At this time, fine control orifice (f) is shut off from drain chamber (D). At almost the same time, it is interconnected to pump pressure chamber (PP). Pilot pressure from the oil source control valve passes f ne control orif ce (f) and f ows to port (A) via port (P1).

When pressure at port (P1) rises, valve spool (1) is pushed back and fine control 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, valve spool (1) moves up and down so that the force of metering spring (2) is balanced with the pressure at port (P1).

The position relationship between valve spool (1) and valve body (10) (f ne control orif ce f is at a certain point between drain chamber (D) and pump pressure chamber PP) does not change until retainer (9) contacts valve spool (1).

Metering spring (2) contracts in proportion to control lever stroke. Pressure at port (P1) also rises in proportion to lever stroke.

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.

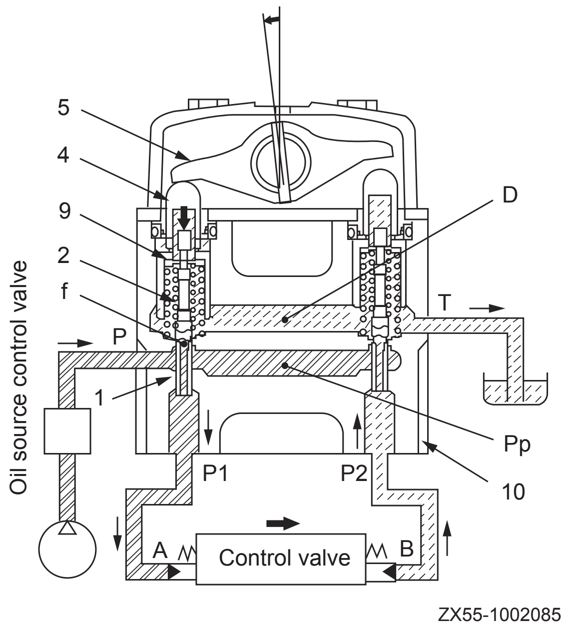


Fig. 4-67

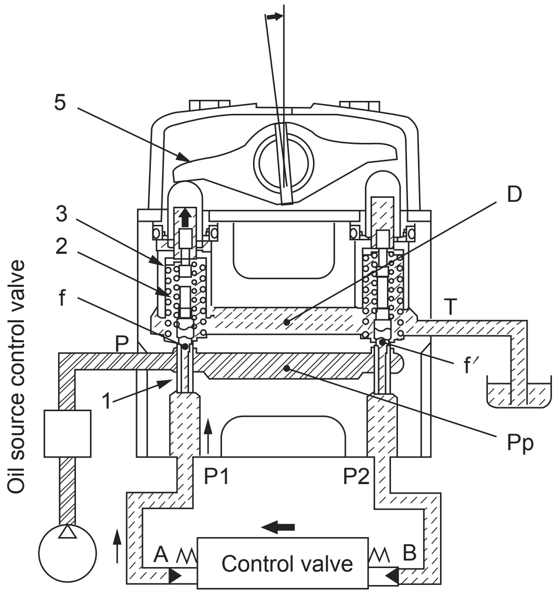
4. During fine control (When control lever returns)

   When disc (5) starts to return, valve spool (1) is pushed up by the force of center spring (3) and the pressure at port (P1).

   As a result, fine control 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, valve spool (1) will be pushed down by metering spring (2) and f ne control orifice (f) will be shut off from drain chamber (D). At almost the same time, f ne control orif ce is interconnected with 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 control valve returns, oil in the drain chamber (D) flows in drain chamber (D) via the fine control orifice (f’) at the unmoving side and then f ows into chamber (B) via port P2 and f ll this chamber.



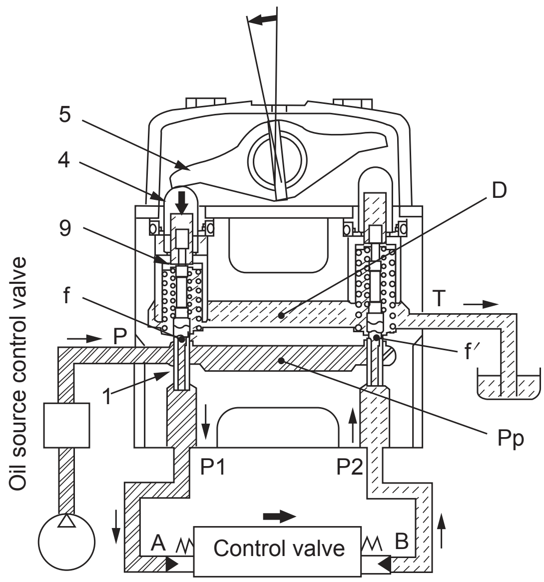
ZX55-1002086

Fig. 4-68

3. At full stroke

   When disc (5) pushes plunger (4) downward, retainer (9) pushes valve spool (1) downward, and fine control orifice (f) is shut off from drain chamber (D) and interconnected with pump pressure chamber (PP). Therefore, pressurized oil from the oil source control valve passes f ne control orif ce (f) and f ows into chamber (A) via port P1 and moves the control valve spool.

   Return oil in chamber (B) passes orif ce P2 and flows into drain chamber (D) via fine control orif ce (f’).



ZX55-1002087

Fig. 4-69

4.4.12 Oil source control valve

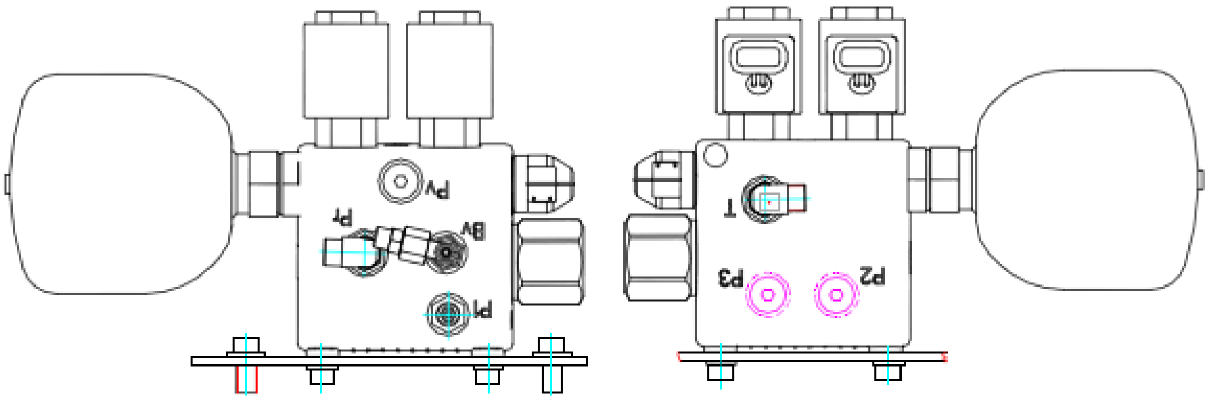


Fig. 4-70

T: To hydraulic tank
P1: From main valve M port
Pr: To high/low speed port of central swivel joint
BV:pilot filter and slew motor Pp port

4.4.13 Dozer/Boom swing pilot valve

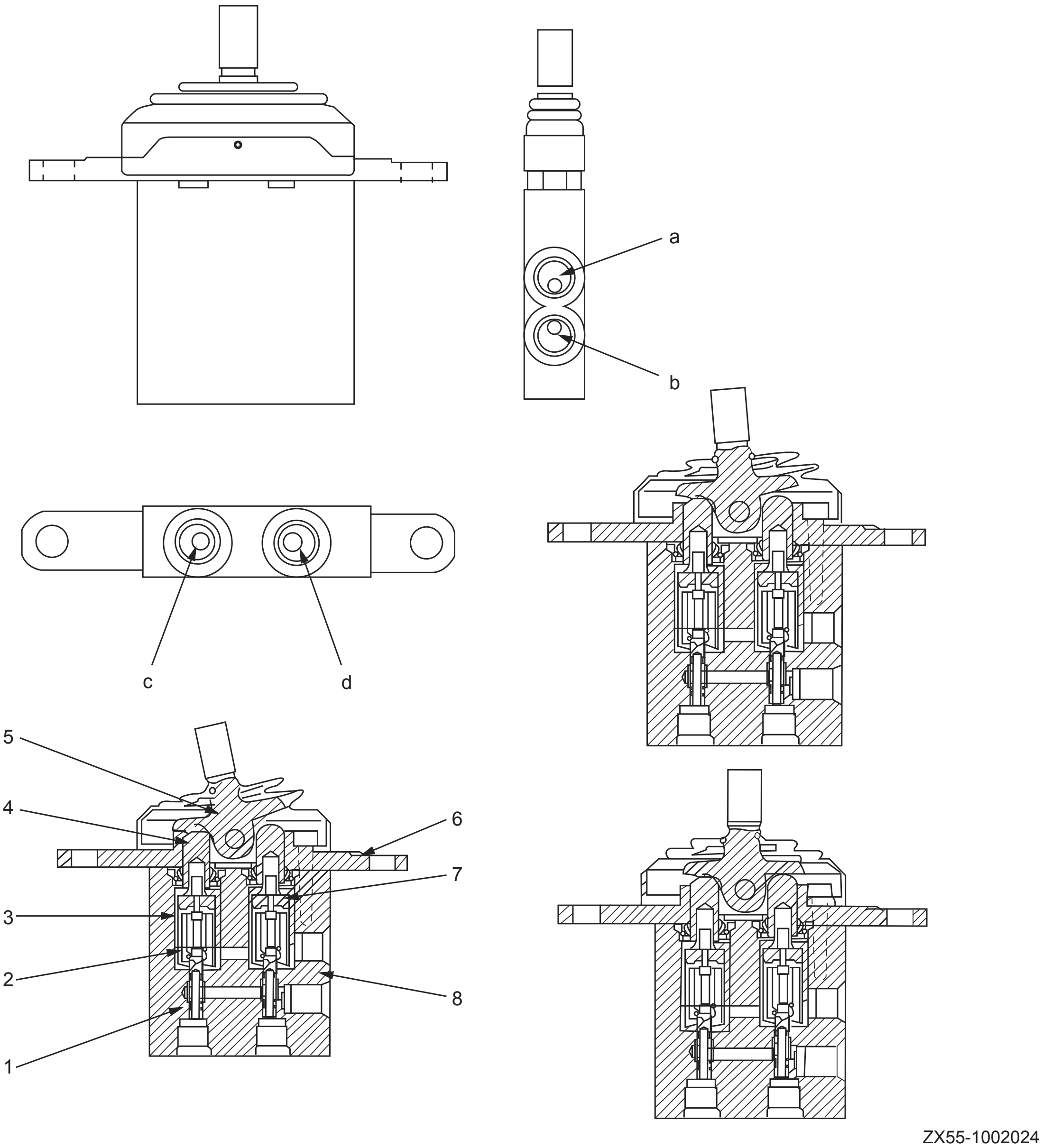


Fig. 4-71

a. Port T (to oil tank)
b. Port P (from oil source control valve)
c. Port P1
d. Port P2

(1) Valve spool
(2) Metering spring
(3) Center spring
(4) Plunger
(5) Lever
(6) Plate
(7) Retainer
(8) Valve body

Working process

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 fine control orif ce (f) of valve spool (1).

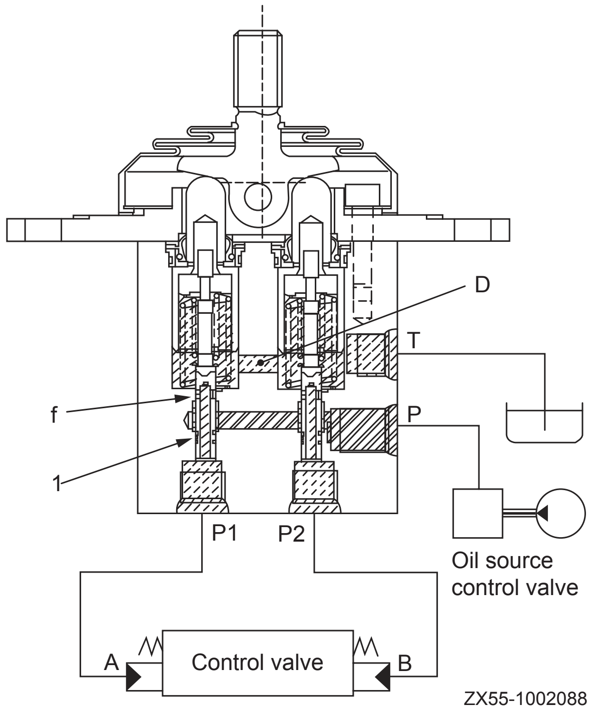


Fig. 4-72

2. During f ne control (Neutral → f ne control)

   When plunger (4) is pushed by lever (5), retainer (7) is also pushed down, valve spool (1) is also pushed by metering spring (2), and moves downward.

   At this time, fine control orifice (f) is shut off from drain chamber (D). At almost the same time, it is interconnected to pump pressure chamber (PP). Pilot pressure from the oil source control valve passes f ne control orif ce (f) and f ows to port (A) via port (P1).

   When pressure at port (P1) rises, valve spool (1) is pushed back and fine control 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, valve spool (1) moves up and down so that the force of metering spring (2) is balanced with the pressure at port (P1).

   The position relationship between valve spool (1) and valve body (8) (fine control orif ce f is at a certain point between drain chamber (D) and pump pressure chamber PP) does not change until retainer (7) contacts valve spool (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.

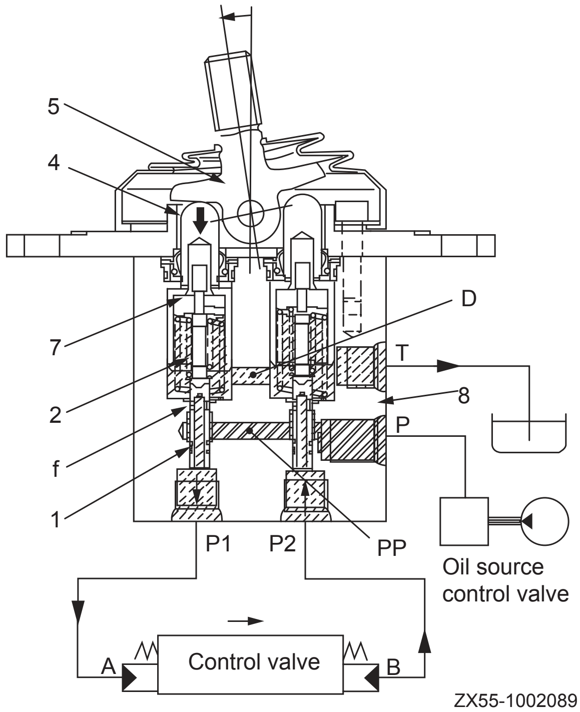


Fig. 4-73

3. During fine control (When control lever returns)

   When lever (5) starts to return, valve spool (1) is pushed up by the force of center spring (3) and the pressure at port (P1).

   As a result, fine control 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, valve spool (1) will be pushed down by metering spring (2) and f ne control orifice (f) will be shut off from drain chamber (D). At almost the same time, f ne control orif ce is interconnected with 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 control valve returns, oil in the drain chamber (D) f ows in drain chamber (D) via the fine control orifice (f’) at the unmoving side and then flows into chamber (B) via port P2 and f ll this chamber.

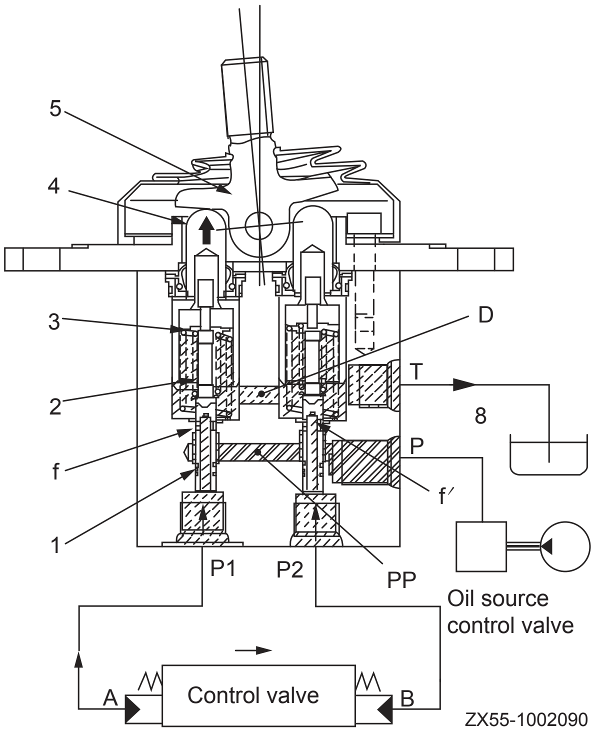


Fig. 4-74

4. At full stroke

   When lever (5) pushes plunger (4) downward, retainer (7) pushes valve spool (1) downward, and fine control orifice (f) is shut off from drain chamber (D) and interconnected with pump pressure chamber (PP). Therefore, pressurized oil from the oil source control valve passes f ne control orif ce (f) and f ows into chamber (A) via port P1 and moves the control valve spool.

   Return oil in chamber (B) passes orif ce P2 and flows into drain chamber (D) via fine control orif ce (f’).

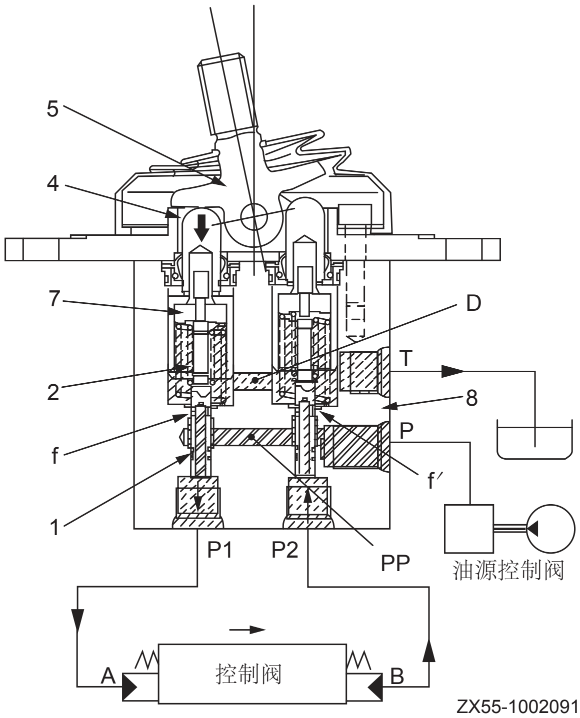


Fig. 4-75

4.4.14 Hydraulic cylinders

Arm cylinder

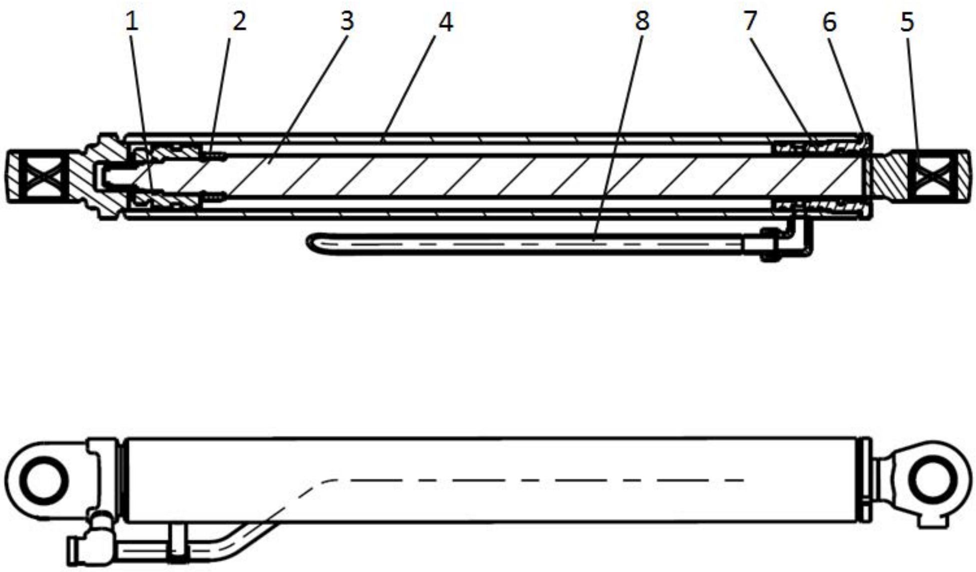


Fig. 4-76 SY50U-1702032

(1) Piston
(2) Buffer sleeve
(3) Piston rod
(4) Cylinder liner
(5) Bushing
(6) Dust ring
(7) Guide bush
(8) Pipe assembly

Technical Specif cations

Unit：mm

Cylinder / Item	Boom	Arm	Bucket	Def ection	Dozer Blade
Cylinder bore	90	80	70	85	85
Piston rod outer dia.	50	50	40	45	55
Stroke	640	690	590	400	180
Min. locating distance	985	1055	875	695	520

4.5 Air Conditioner System

4.5.1 Electric circuit

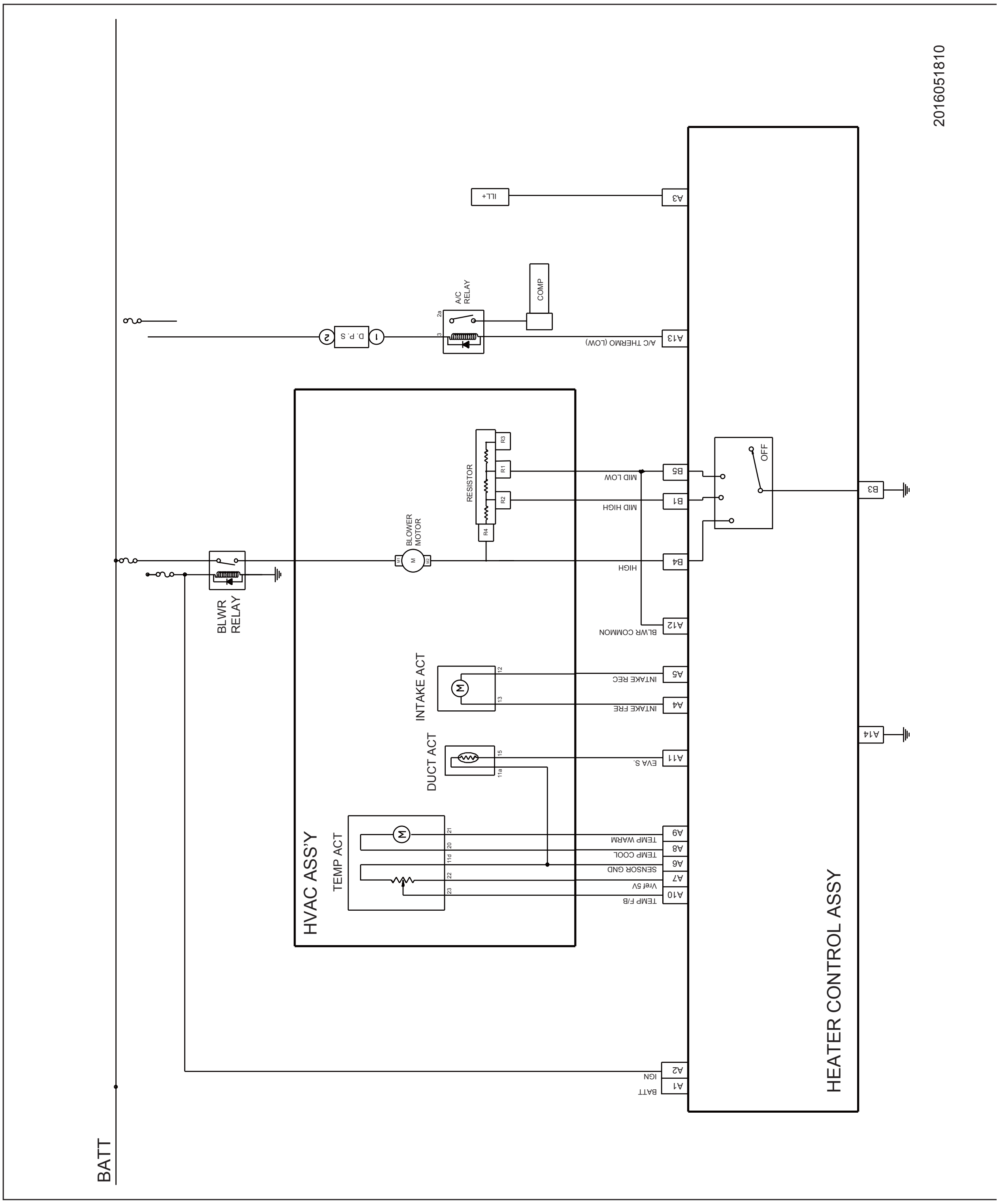


Fig. 4-77

4.5.2 Component locations

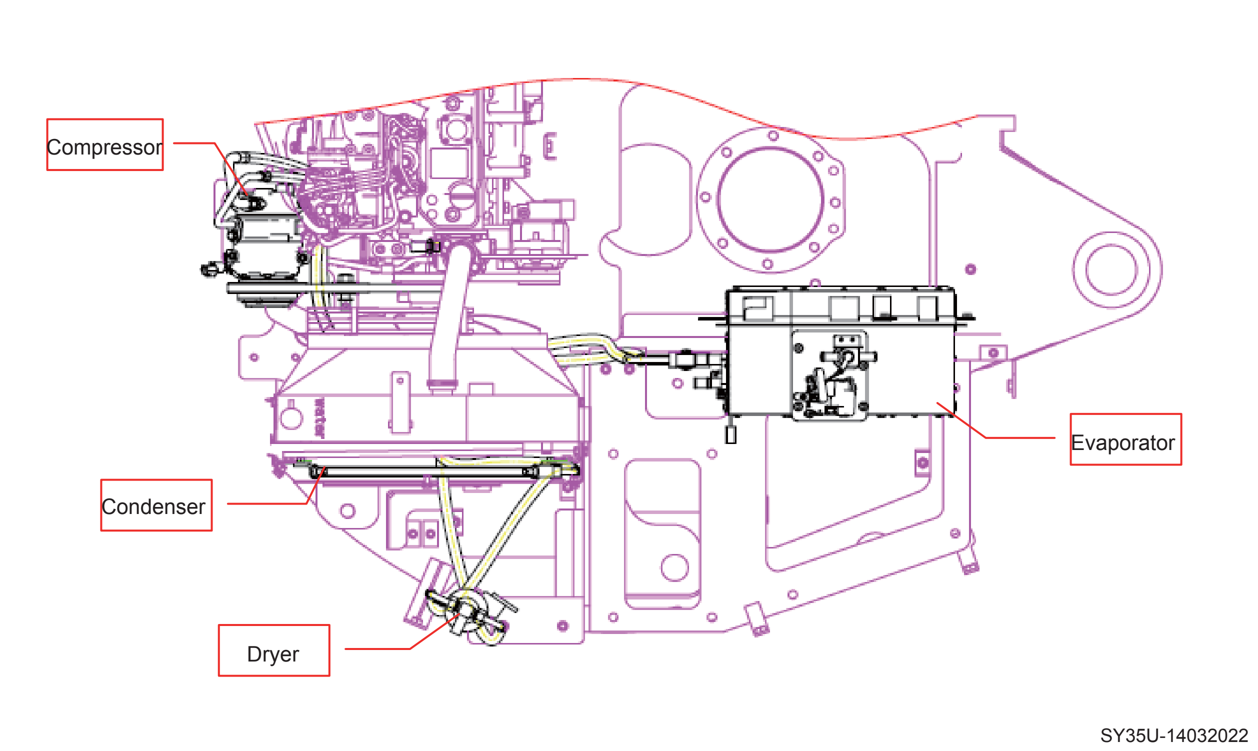


Fig. 4-78

Filling refrigerant oil

The air conditioner system needs refrigerant oil for lubrication. All refrigerant oil required by the whole system is f lled into the compressor. Refrigerant oil is soluble to coolant and it circulates through the whole system. When the air conditioner is turned off, refrigerant oil stays in all components of the system. Therefore, when a major component has been replaced, a suitable amount of refrigerant oil should be replenished. The amount of oil to be ref lled is shown in the table below:

	Component replaced				
	Condenser	Evaporator	Dryer	Each pipeline	Compressor
Refrigerant oil to be replenished（ml）	40	40	15	See ①	See ②

① Changing a pipeline

There are four cooling medium pipes in the air conditioner system: compressor → condenser, condenser → dryer, dryer → evaporator, evaporator → compressor. See the table below when you are changing a pipeline.

	Component replaced				
	Compressor → Condenser	Condenser → Dryer	Dryer → Evaporator	Evaporator → Compressor	Compressor
Refrigerant oil to be replenished （ml）	10	10	15	15	See ②

② Changing compressor

As a new compressor contains refrigerant oil required by the whole air conditioner system, you must be sure that the new compressor carries the same amount of oil as the old one and extra oil must be drained when you are replacing the compressor. You can work out the extra oil to be drained by deducting the amount of oil in old compressor from that in the new one. The detailed method is shown by the right f gure.

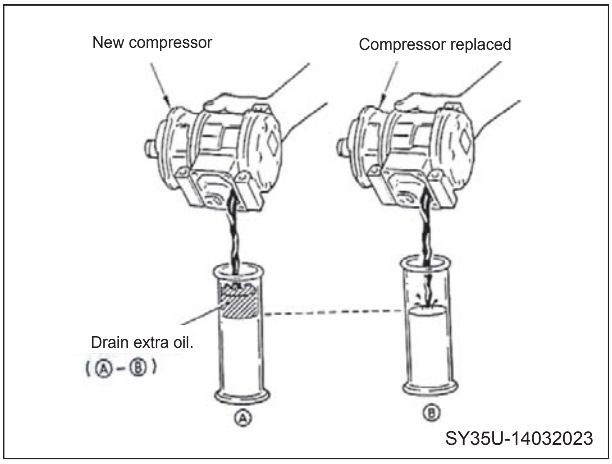


Fig. 4-79

① Compressor installation method

The compressor is mounted on auxiliary bracket of the engine and it is hold by four bolts tightened to a torque of 24.5~29.4N.

② V-belt parallelism

The parallel error between engine belt pulley and clutch belt pulley must be within ±1.0mm.

③ V-belt tension

Checking by hand：Press the middle part of belt between the drive pulley and compressor pulley with your fingers with a force around 6Kg (58.5N). Normally the belt will deform by 5-8.

Checking with a tension gauge：Check the tension of belt with a tension gauge.

New belt	Used belt
637±108N	441±88.2N

4.5.3 Checking condenser f ns

Check the condenser fins for dirt, dust, tree leaves and other debris after operating the machine for a period of time. Sweep the fins with compressed air, steam or water if any.

Note:

1. Never expose your body to direct impact of compressed air, steam or water. Always wear goggles, face shield and safety shoes.
2. To prevent ruining the fins, keep the air nozzle a safe distance from the fins. Damaged fins can cause leak or overheat. In a dusty work site, check the fins everyday regardless of the specified maintenance intervals.

Fig. 4-80 SY50U-17022024

4.5.4 Refrigerant-filling operation

1. Why to evacuate?

It is very important to know that the air conditioner shall contain no water when you install it. The refrigerant (R134a) used by air conditioner is soluble to water. Even a tiny amount of water residual in the unit can cause icing in the small hole of expansion valve or rusting of compressor valve. It is therefore to purge water in the cooling system before you add refrigerant. To minimize water residual in the cooling system, evacuation method is used to vaporize water in the unit and let it go. There is no other way better than this.

2. Filling the refrigerant

   A. Close the manual valve after evacuation. When no leak is found after inspection, connect the middle hose to the refrigerant cylinder. (Note that the valve on refrigerant cylinder should be open at the moment and air in the hose will be released via gauge connection.)

   B. Filling from the high-pressure side: Open the high-pressure manual valve and refrigerant enters the system from the high-pressure side. Now the pressure indicated by the gauge at the low-pressure side rises slowly until the specified amount of refrigerant is filled.

      Note: The refrigerant cylinder can be laid down at the moment to charge liquid refrigerant. But the engine must not be started to prevent liquid impact.

   C. Filling from the low-pressure side: When refrigerant cannot be filled any more from the high-pressure side but the specified filling amount is not met yet, close the high-pressure manual valve, erect the refrigerant cylinder (to prevent liquid refrigerant from entering the compressor and generate liquid impact to ruin the compressor when the engine is started), start the engine and turn on the air conditioner cooling system, increase air volume to the maximum, turn on the cooling switch, run the engine at a speed around 1000 rpm, and open the low-pressure manual valve to allow liquid refrigerant to enter the system until the specified level is reached.

   D. After filling the refrigerant close the low-pressure manual valve and the refrigerant cylinder and remove the filling hose. Note that the hose must be removed quickly to prevent flooding of refrigerant. Replace the plastic cap to filler opening of the compressor.

      Note: When you are adding refrigerant to the system, different length of pipe may lead to variation of refrigerant capacity. In this case, pay close attention to the sight glass of reservoir until no foam is seen.

   E. When an automatic filler is used to fill refrigerant, the method of filler should be referred to.

4.5.5 Troubleshooting with a manifold pressure gauge

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

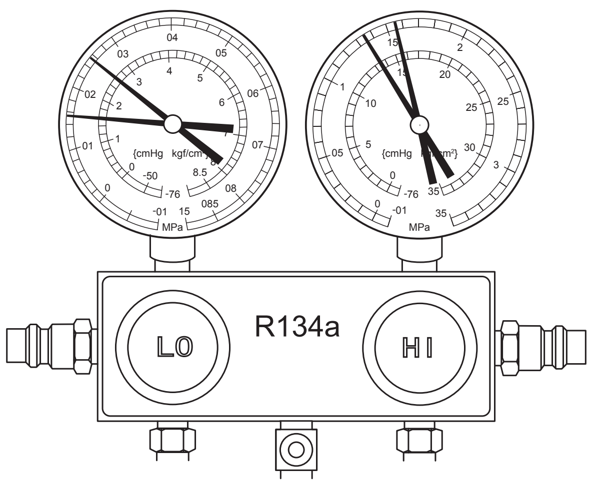
- Temperature at air inlet: 30 – 35° C
- Engine speed: 1500 rpm
- Fan speed: High
- Temperature control: Minimum.
- Air circulation mode: Recirculation

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

Fig. 4-81

Moisture in the refrigerating system

Symptom: Intermittent refrigeration to non-refrigeration

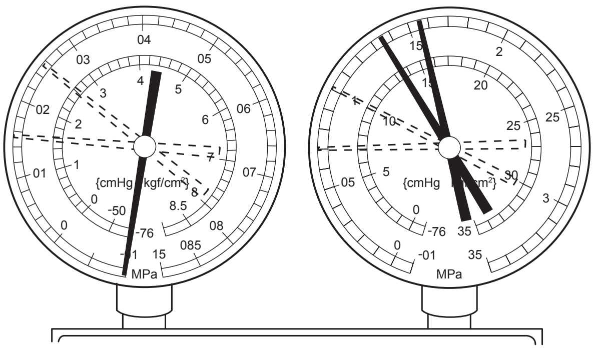
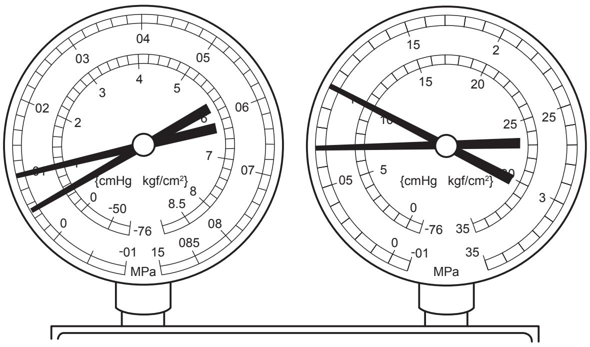


Fig. 4-82

Symptom	Possible cause	Diagnostic	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.

Insuff cient refrigeration

Symptom: Insuff cient refrigeration



ZX215-1002169

Fig. 4-83

Symptom	Possible cause	Diagnostic	Remedy
• Pressure at both Hi- and Ho-pressure ends very low • Foam is continuously observed via the sight glass • Insuff cient refrigera-tion.	• Air leaks some-where in the re-frigerating system	• Insuff cient refriger-ant in the system • Leak of refrigerant	• Check for air leakage with a leak detector. Make necessary re-pairs. • Add proper amount of refrigerant. • When connected with the gauge, if the reading is near zero, set the system under vacuum state

Defective refrigerant circulation

Symptom: insuff cient refrigeration

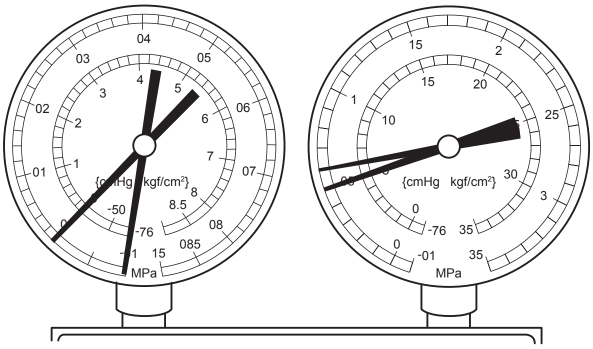


Fig. 4-84

Symptom	Possible cause	Diagnostic	Remedy
• Pressure at both high and low pressure sides very low • Frosting on the piping between parts and reservoir	• Contaminant in the reservoir hinders the f ow of refrigerant.	• Blocked reservoir	• Replace reservoir

Refrigerant not circulating

Symptom: Non-refrigeration (intermittent refrigeration)

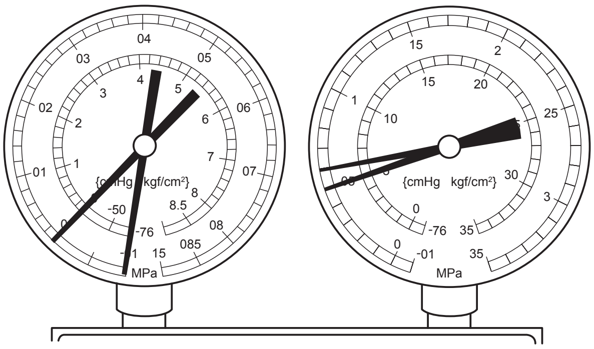
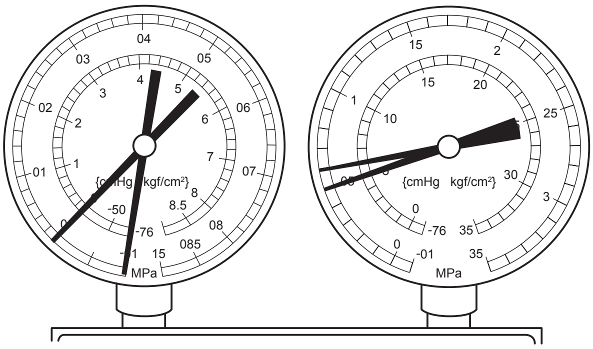


Fig. 4-85

Symptom	Possible cause	Diagnostic	Remedy
• Vacuum at low-pressure side; pressure at high-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 f ow of refrigerant\\ • Air leak at the thermal pipe of the expansion valve hinders the f ow 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 insuff cient refrigeration of condenser

Symptom: Insuff cient refrigeration



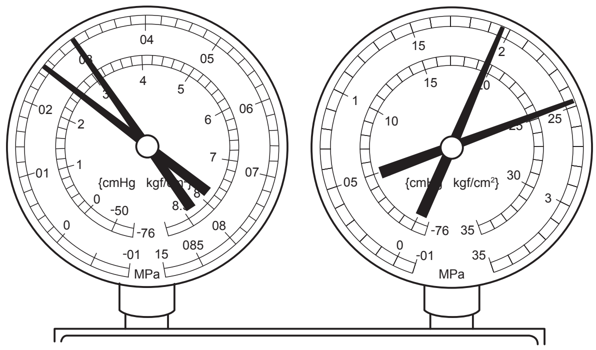
ZX215-1002171

Fig. 4-86

Symptom	Possible cause	Diagnostic	Remedy
• Pressure at both High and low pressure sides very high • No foam can be observed via the sight glass even when engine speed drops.	• Over-f lling of refrigerant in the system. Refrigerating performance inadequate. • Insuff cient refrigeration of condenser	• Over-f lling of refrigerant • Condenser f ns 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



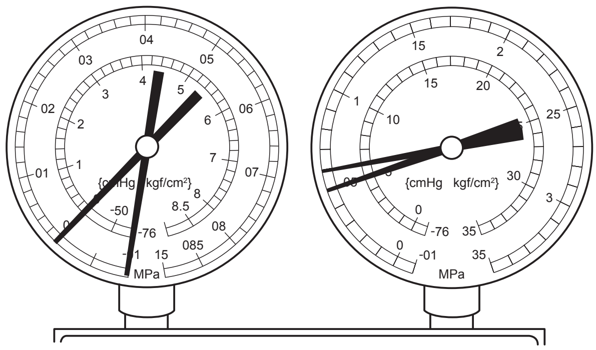
ZX215-1002173

Fig. 4-87

Symptom	Possible cause	Diagnostic	Remedy
• Pressure at both High and low pressure sides very high • Low pressure piping feeling hot • Foam is observed through sight glass	• Air enters the refrigerating system	• Air enters the refrigerant system • Insuff cient evacuation	• Check if compressor oil is contaminated or inadequate. • Evacuate and add new refrigerant.

Improper installation of expansion valve

Symptom: Insuff cient refrigeration



ZX215-1002171

Fig. 4-88

Symptom	Possible cause	Diagnostic	Remedy
● Pressure at both High and low pressure sides very high ● Frosting or condensation on low pressure piping	● Expansion valve defect or improper installation of thermal pipe	● Over-f lling of refrigerant in low 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

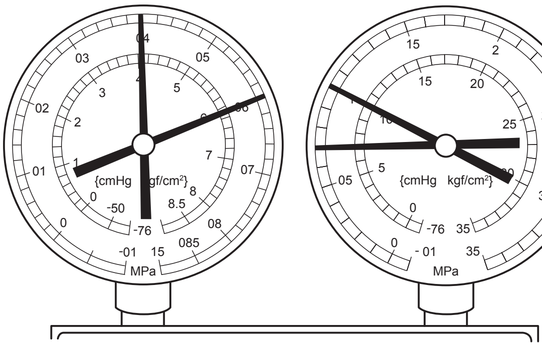


Fig. 4-89

Symptom	Possible cause	Diagnostic	Remedy
● Pressure at low pressure side very high ● Pressure at high pressure side very low	● Compressor internal leakage	● Compressing fault; ● Leaking or damaged valve, loosened parts	● Repair or replace compressor

4.6 Electrical System

Electrical system layout Tier3

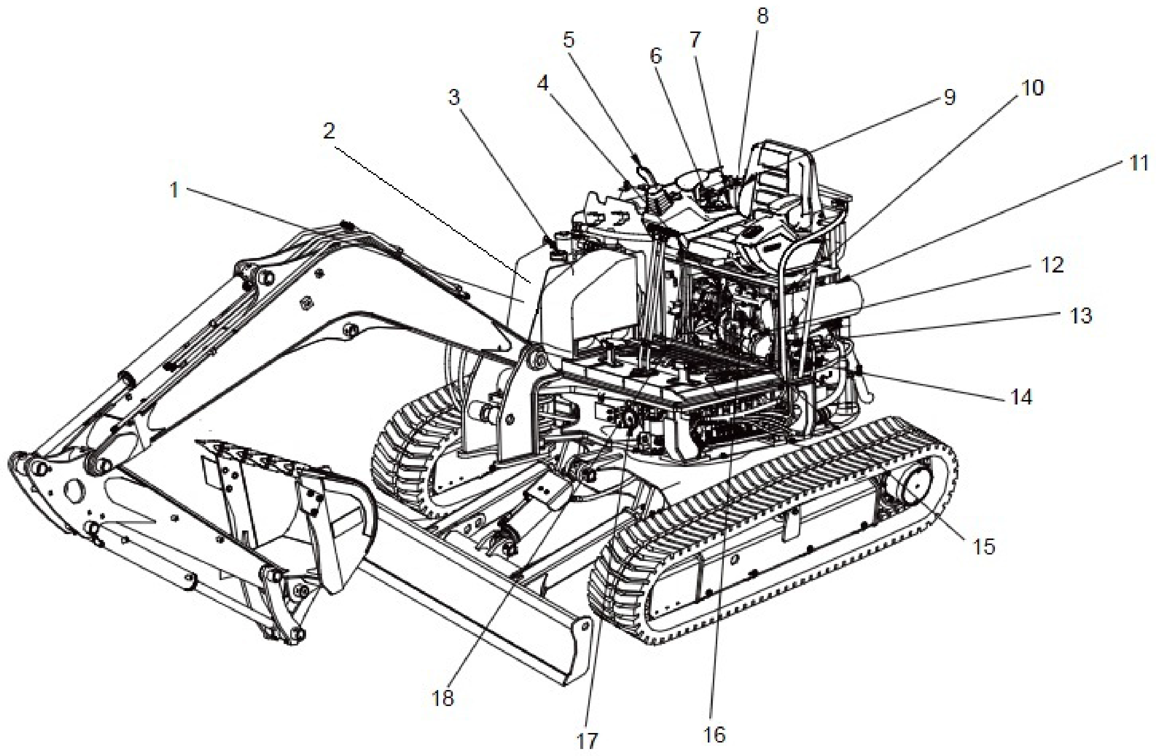


Fig. 4-91

(1) Battery
(2) Switch of power supply
(3) Fuel level sensor
(4) Emergency stop
(5) Horn button
(6) Fuel control dial
(7) Rocker switch
(8) Start switch
(9) RadioAir f lter sensor
(10) Hydraulic lockout control
(11) Engine oil pressure sensor
(12) Start motor
(13) Throttle motor
(14) Electronic fuel transfer pump
(15) Alternator
(16) Safety relay
(17) Electric horn
(18) Integrated box

4.6.1 Electrical circuit diagram

For the model powered by a Tier III engine

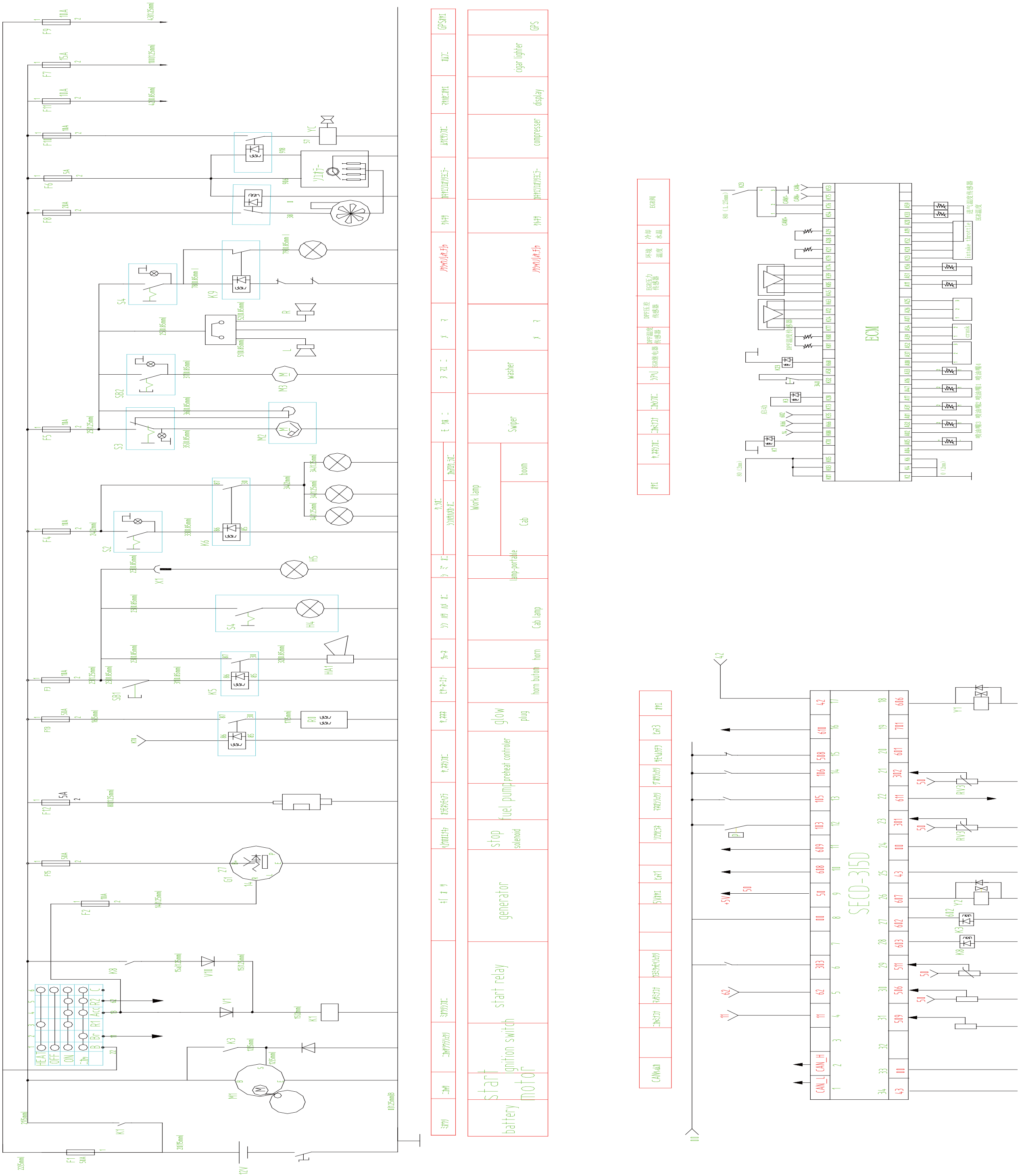


Fig. 4-92

4.7 Electronic Control System

4.7.1 General view

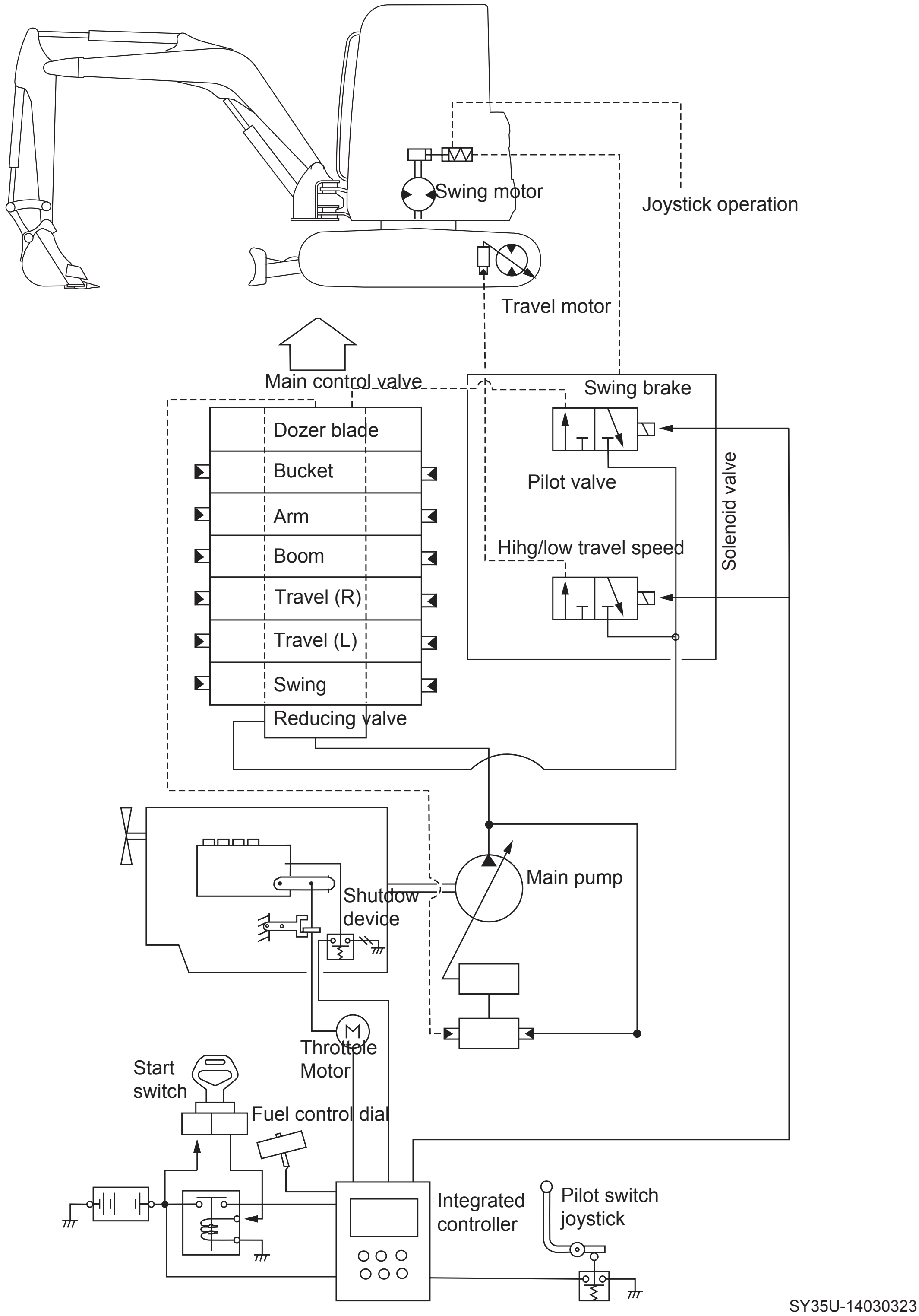
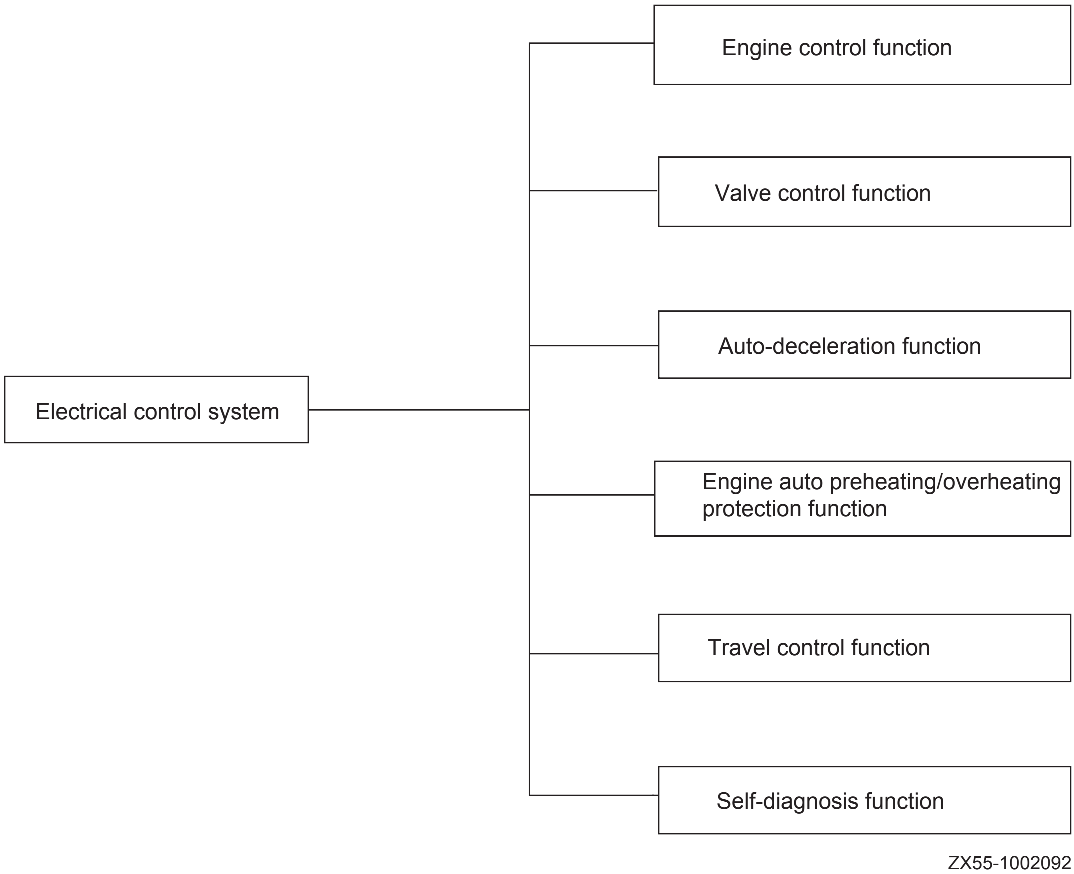


Fig. 4-94

4.7.2 Functional overview of electrical control system



Tier IV engine

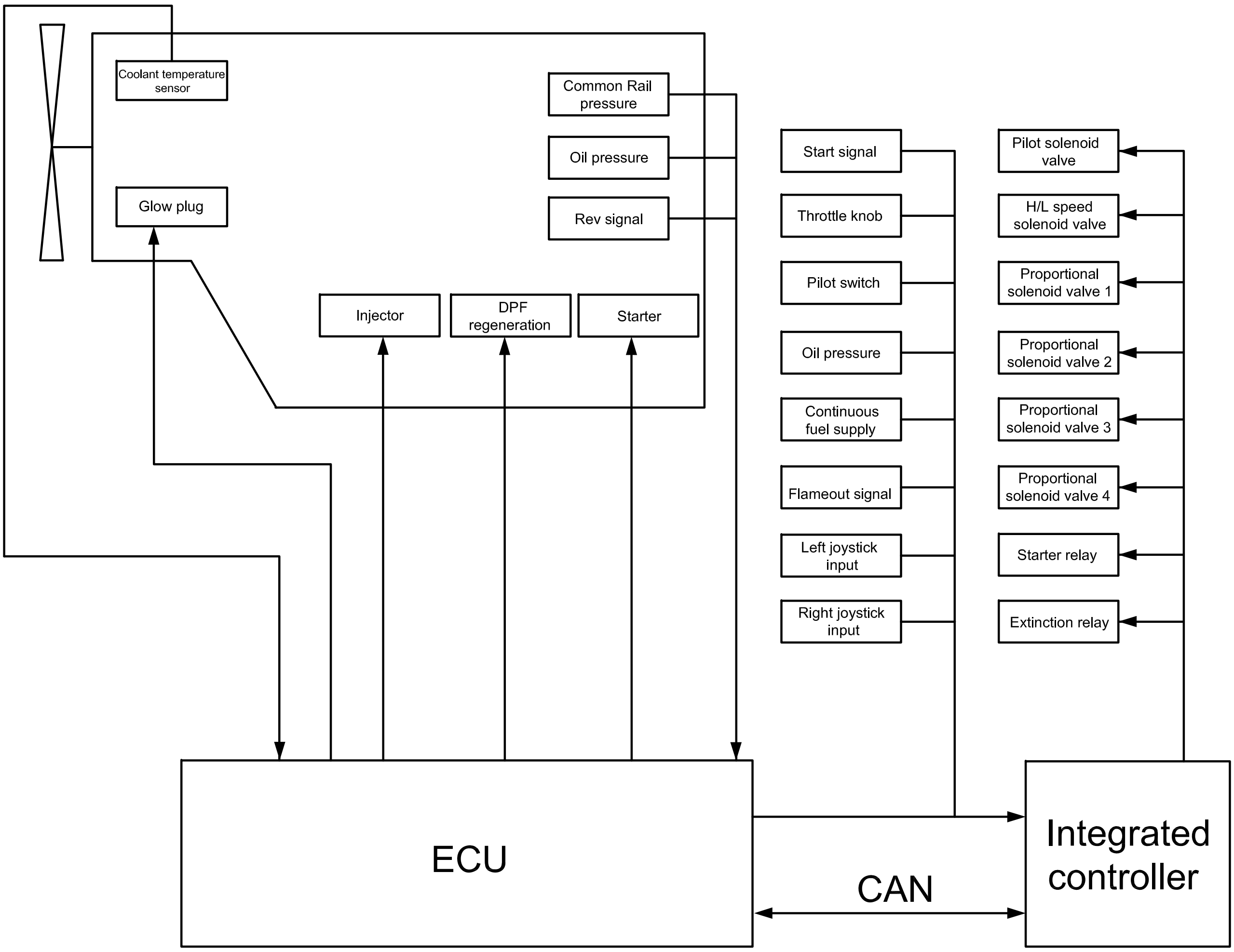


Fig. 4-96

Function

- The operator can adjust the working mode switch on the monitor panel to S or B mode.
- Speed governor detects the speed of the engine fuel control device set by the fuel control dial and the real engine speed.

Tier 4

Engine Speed \ Mode	S	B
MAX.RPM	2200	1800
MIN.RPM	1200	1400

4.7.3 Valve control function

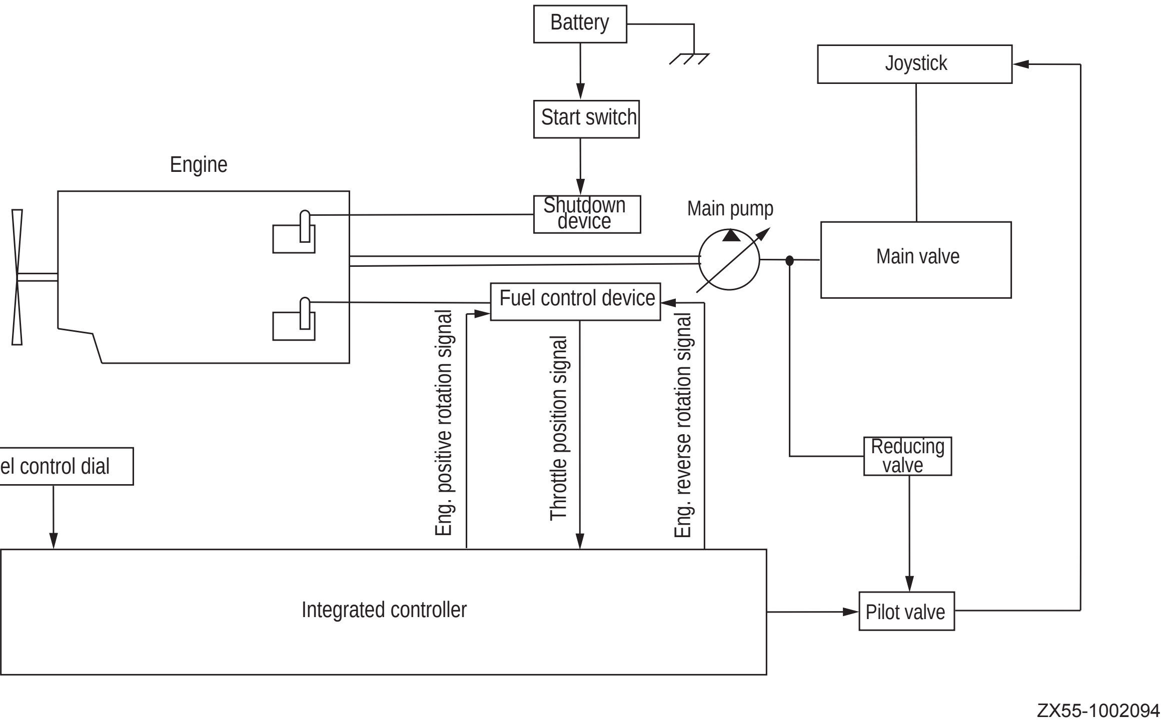


Fig. 4-97

Tier IV engine

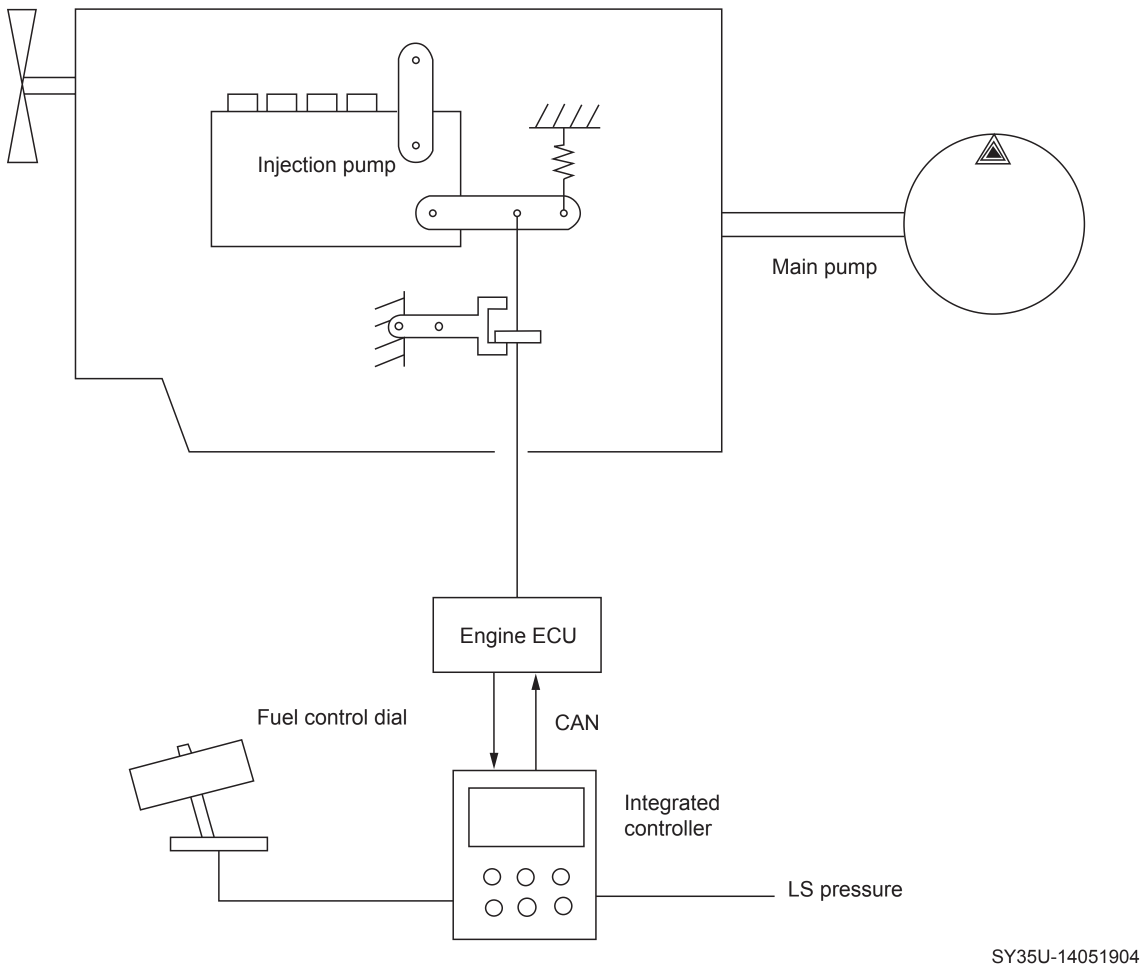


Fig. 4-99

Function

- Select auto deceleration mode on machine monitor and, If the machine is not operated for a few minutes, engine speed drops to idling speed automatically in order to reduce fuel consumption and noise.
- Once a control lever is operated or fuel control dial is adjusted, engine speed rises to the preset speed immediately.

4.7.4 preheating and overheating protection function

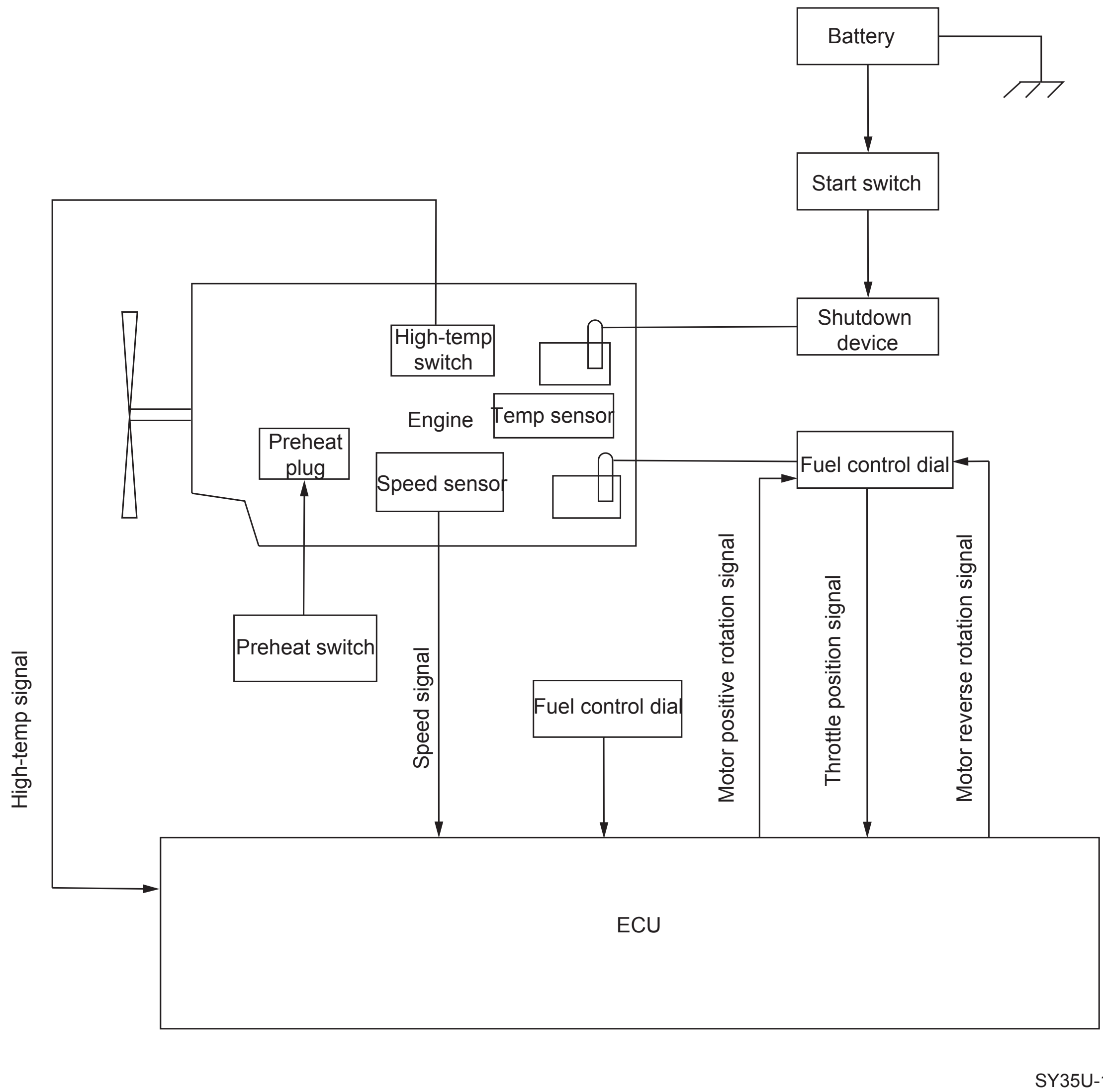


Fig. 4-100

Function

- Automatic preheating:According to ambient temperature, ECU adjusts the preheating time automatically.
- If coolant temperature is higher than the preset value after the engine has been started, high temperature switch will be turned on. The controller reduces engine speed to set speed in order to protect the engine.

4.7.5 Travel speed selection

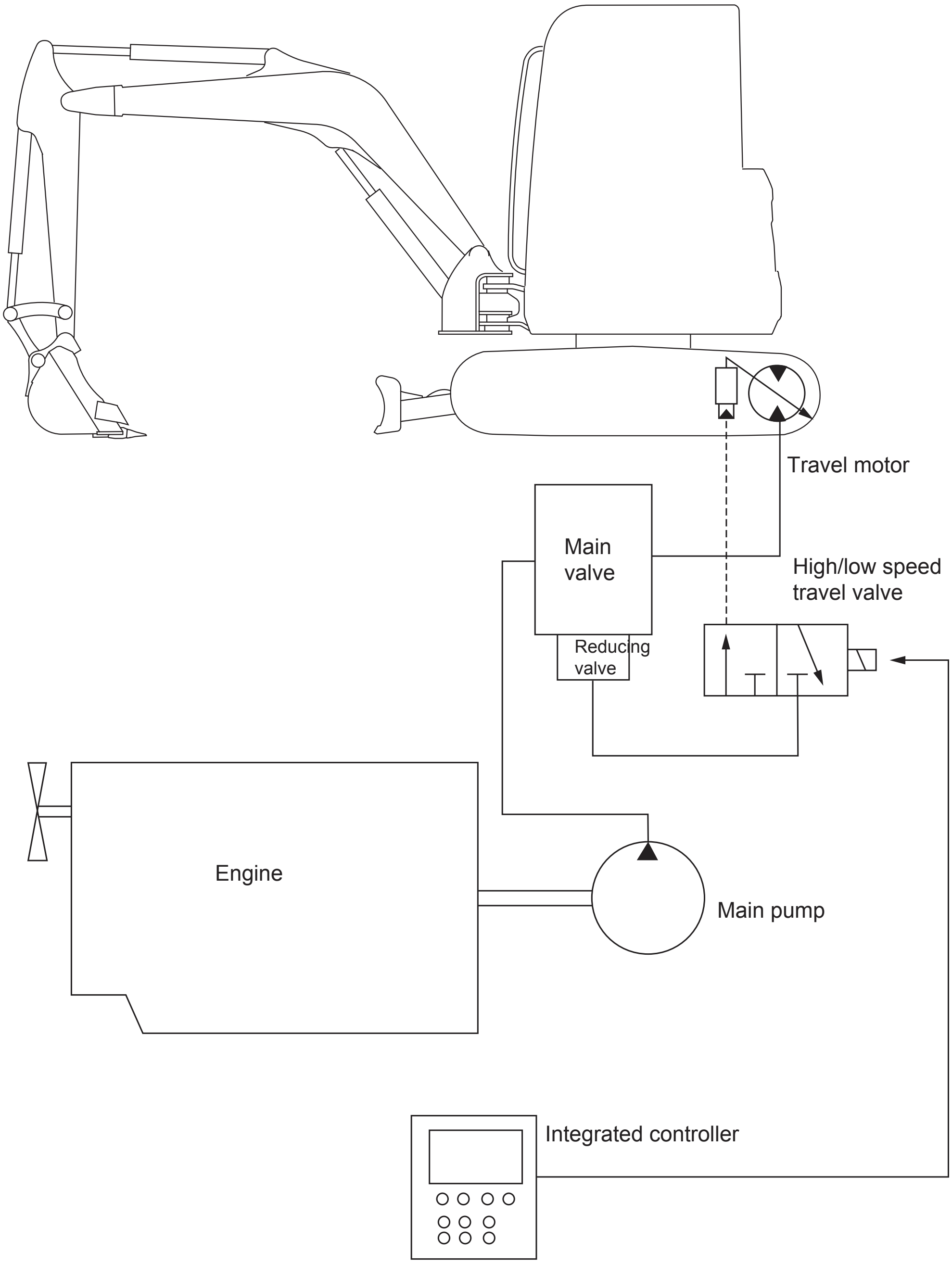


Fig. 4-101

Function

- This machine has travel speed selection function.
- Selection of travel speed can be performed on the machine monitor.

4.7.6 Machine monitoring system

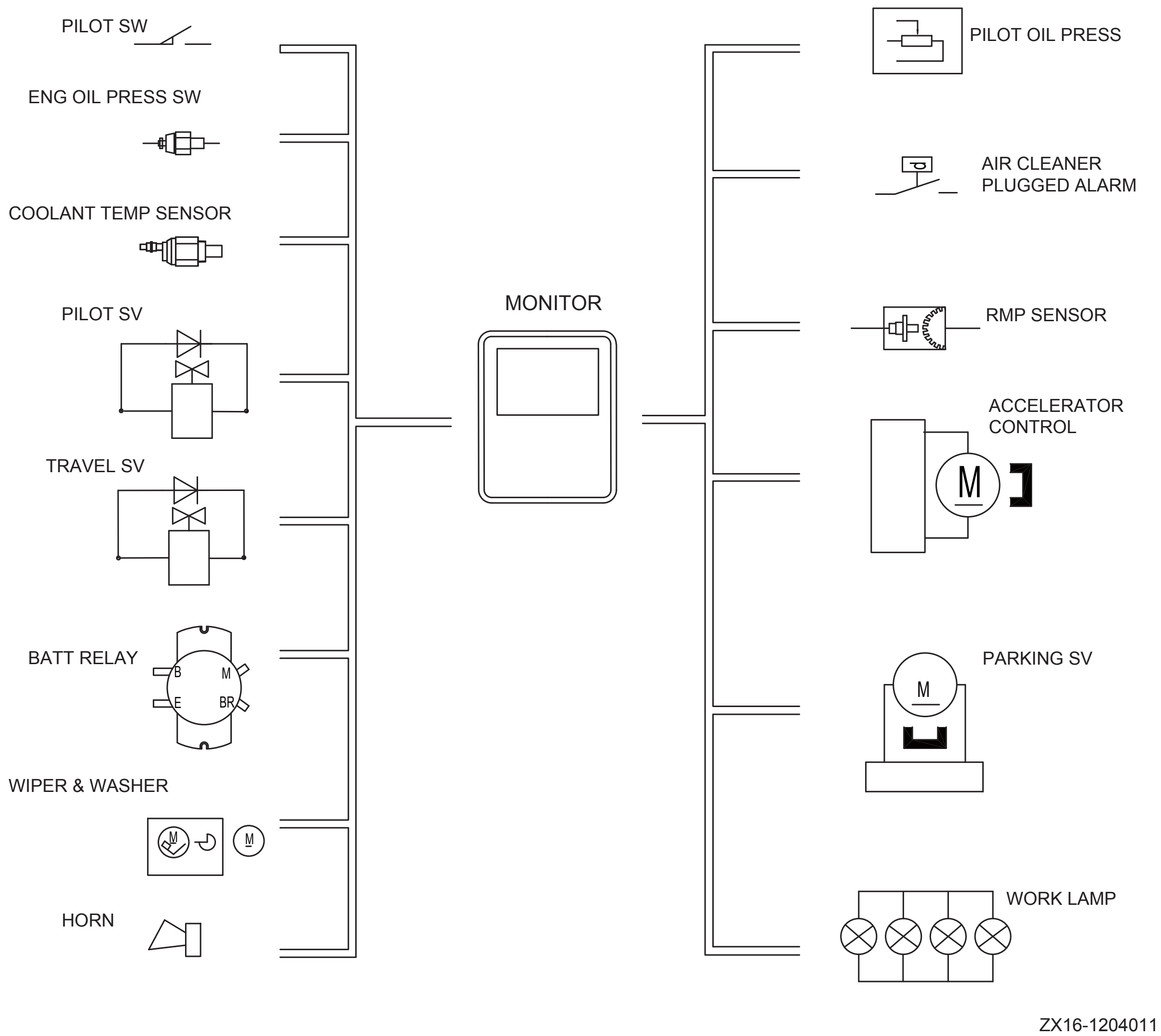


Fig. 4-102

The table blow lists the display method and signal collection of all the functions of the monitoring and alarming system.

Real-time monitoring	Fuel level gauge	Fuel level sensor	Analog quantity
	Engine coolant temperature gauge	Coolant temperature sensor	Analog quantity
	Oil pressure	Oil pressure sensor	Analog quantity
	Fuel control dial	Fuel control dial	Analog quantity
	Engine rpm	Engine speed sensor	High frequency pulse
	Switching value collected by controller		Switching value
Alarm information	Low oil pressure	Oil pressure sensor	Switching value
	Engine coolant temperature very high	Coolant temperature sensor	Analog quantity
	Air f lter clogged	Pressure sensor	Switching value

4.8 Integrated-controlled Monitor System

4.8.1 Monitor

The monitor control panel is used to display machine information and change system parameters.

It contains the following pages. The keys and pages will be explained in the following pages.

The default page is the page that is displayed during normal operation of the excavator. It includes working mode, local date, gear position, warning prompt, coolant temperature, fuel level, manual idling prompt, alert prompt, maintenance prompt.

(1) System time and date
(2) Operating mode
(3) Fuel level
(4) Severe failure alarm
(5) Failure information
(6) Maintenance prompt
(7) AUX circuit configuration
(8) Switch to full/idling speed
(9) Switch to high/low speed
(10) Enter main menu
(11) Coolant temperature
(12) Operating hours
(13) Gear position
(14) Battery charge symbol
(15) Preheat symbol

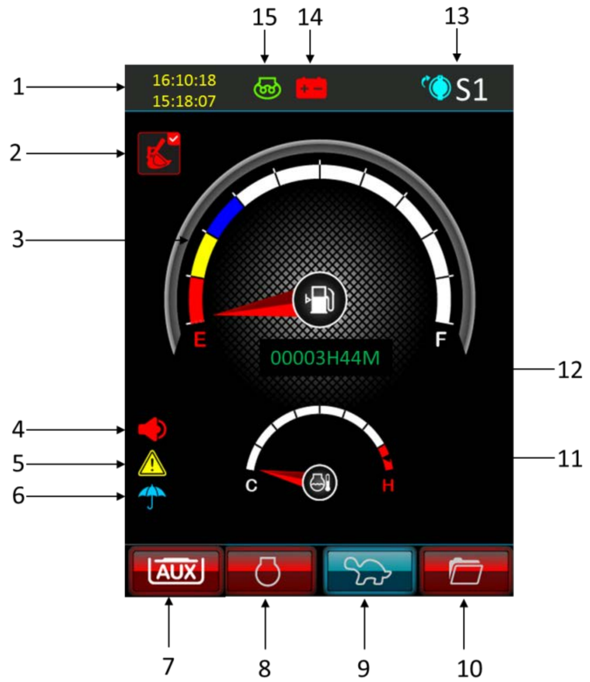


Fig. 4-103

Input and output signals

Pin number	Signal name	I/O
1	CAN+	Output
2	CAN-	Output
3	Reserved, undefined	Input
4	Start switch	Input
5	Shutdown switch	Input
6	One way hold	Input
7	RS	—
8	Ground	Input
9	Sensor power supply	Output
10	Auxiliary port valve 1	Output
11	Auxiliary port valve 2	Output
12	Air-cleaner Plugged Switch	Input
13	Pilot switch	Input
14	Reserved, undefined	Input
15	Engine oil pressure	Input
16	Auxiliary port valve 3	Input
17	+12V Input	Input
18	Hydraulic pilot valve drive	Output
19	Reserved, undefined	Output
20	Reserved, undefined	Output
21	Proportional Joystick L	Input
22	Auxiliary port valve 4	Output
23	Proportional Joystick R	Input
24	Ground	Input
25	+12V permanent power source	Input
26	High-speed travel valve drive	Output
27	Start relay drive	Output
28	Safety relay drive	Output
29	LS oil pressure signal	Input
30	Fuel control dial position	Input
31	Fuel level	Input
32	Reserved, undefined	Input
33	Ground	Input
34	+12V permanent power source	Input

4.8.2 Page introduction and operation

4.8.2.1 **Auxiliary function**

The auxiliary port is used for hydraulic implements, such as a breaker. You can set the operating modes and also set the flow rate prior to operating auxiliary port.

Operating modes

You can select the following symbols:

1. Common Bucket (default)
2. Breaker
3. Dipper bucket
4. Tilt bucket
5. Brush cutter
6. Grapple
7. Rotary grapple
8. Auger

The auxiliary function is not activated by default. Whenever you select one of the symbols above except the common bucket and press the button 3 to complete the operating mode setting, the auxiliary port is activated.

When an operating mode has been selected, you can set the flow rate accordingly by pressing button 2. Refer to the section for the flow rate information (***Flow rate setting***) for details.

Fig. 4-105

Fig. 4-104

4.8.2 Page introduction and operation

4.8.2.1 Auxiliary function

The auxiliary port is used for hydraulic implements, such as a breaker. You can set the operating modes and also set the flow rate prior to operating auxiliary port.

Operating modes

You can select the following symbols:

1. Common Bucket (default)
2. Breaker
3. Dipper bucket
4. Tilt bucket
5. Brush cutter
6. Grapple
7. Rotary grapple
8. Auger

The auxiliary function is not activated by default. Whenever you select one of the symbols above except the common bucket and press the button 3 to complete the operating mode setting, the auxiliary port is activated.

When an operating mode has been selected, you can set the flow rate accordingly by pressing button 2. Refer to the section for the flow rate information (***Flow rate setting***) for details.

Fig. 4-105

Flow rate setting

Suppose the same implement has to be attached to a different excavator. Even when using identical flow rate settings for the other excavator, the working speed may differ. For each excavator, you need to individually adjust the flow rate settings. Upon changing the implement, you need to determine and adjust the optimum flow rates for the new implement.

In page of *Flow Rate information*, you can see the auxiliary port flow rate information of the operating mode that you selected in last page.

- Press button 1 to select the bar graph index.
- Press button 2 to enter the flow rate setting.
- Press button 4 to return.

In page of *Flow Rate Setting,* you can set the flow rate of the bar graph index selected in last page:

- Press button 1 or button 2 to set the length of the bar graph.
- Press button 3 to confirm and complete the settings.
- Press button 4 to return.

When the bar graph has been set to the longest level, the flow rate is at its maximum.
When the bar graph has been set to its shortest level (no bar is visible), the flow is blocked and no oil will flow.

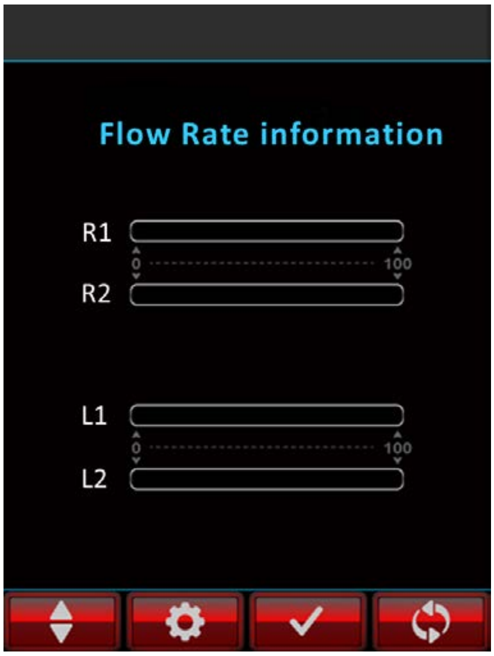


Fig. 4-106

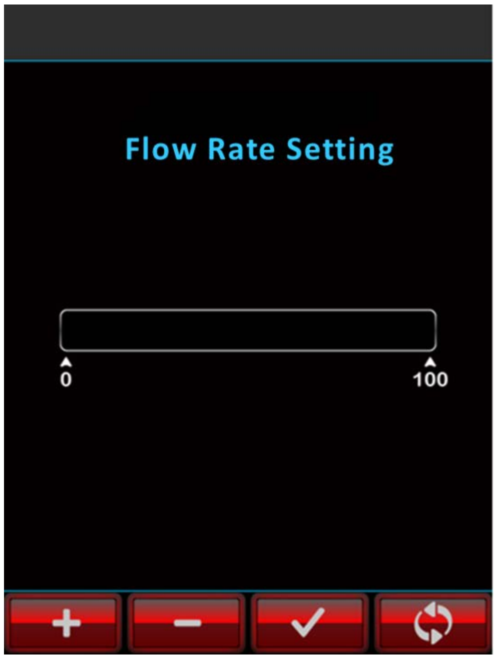


Fig. 4-107

One way hold operation

Activate the operation setting for the "one way flow".

Switching on:

- Push the rocker switch on the right joystick to the appropriate location, and press the one way hold switch on the left joystick at the same time.

Switching off:

- Briefly press the one way hold switch to switch off the oil flow, or
- Push the rocker switch on the right handle briefly to the up or down to stop oil flow.

4.8.2.2 **Maintenance Information**

When the Maintenance prompt present to the Default page, the Maintenance Information page will continue to display maintenance information automatically. This page displays information from 50 to 4000 service hours according to the work hours.

Operation

- Press button 2 to pause or continue to display maintenance information.
- Press button 3 to confirm that you have completed the maintenance of this stage. At this time, you should enter the correct maintenance password.
- Press button 4 to enter the default page.

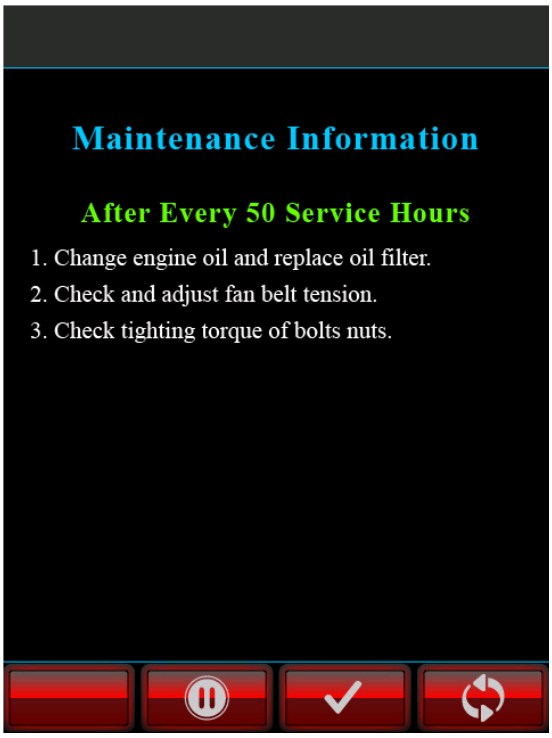


Fig. 4-108

4.8.2.2 **Maintenance Information** When the Maintenance prompt present to the Default page, the Maintenance Information page will continue to display maintenance information automatically. This page displays information from 50 to 4000 service hours according to the work hours.

Operation

● Press button 2 to pause or continue to display maintenance information.

● Press button 3 to confirm that you have completed the maintenance of this stage. At this time, you should enter the correct maintenance password.

● Press button 4 to enter the default page.

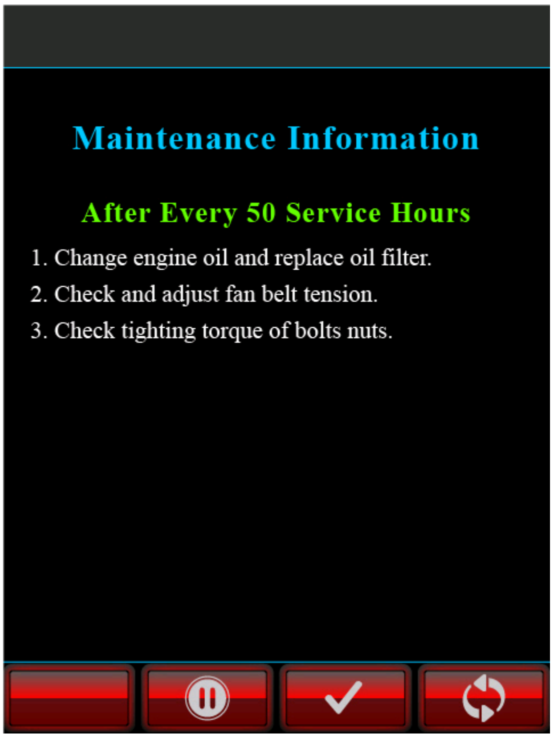


Fig. 4-108

4.8.2.3 **Main Menu**

Press on the default page to enter Main menu. This page displays the main signals to/from the system controller, for example, running information in real time, configure about the machine, detailed information of failures or changing language. **Operation**

● Press button 1 to select the function symbol that you want.

● Press button 3 to confirm and enter the specific page.

● Press button 4 to return the default page.

NOTE: Before this, you should enter the correct password.

Fig. 4-109

4.8.2.4 **Running Information**

This page displays in real time the engine signals collected by the controller, the switch signals, and proportional signals of the auxiliary ports.

Operation

● Press button 1 to change the page to Switch Signals and Proportional Joystick.

● Press button 2 to enter DPF Regeneration. Refer to the section ***3.3.3.3 DPF*** for details.

● Press button 4 to return the Main menu page.

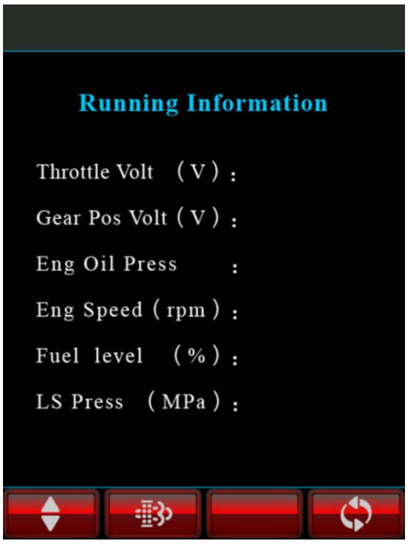


Fig. 4-110

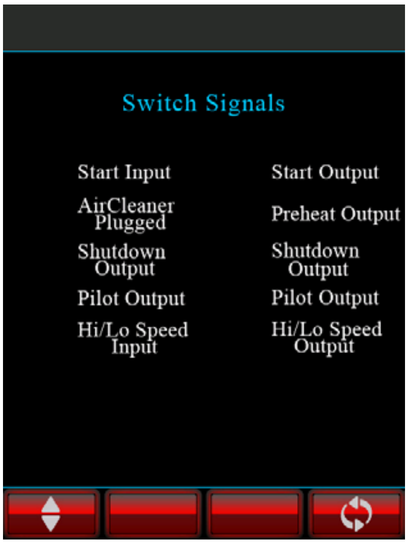


Fig. 4-111

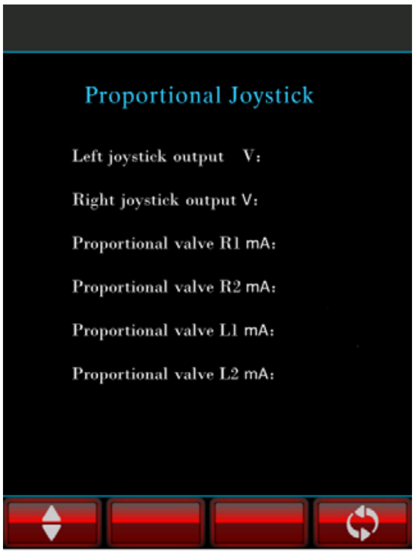


Fig. 4-112

4.8.2.5 **DPF**

Detection of certain PM deposit amount or more causes DPF to transfer to the stationary regeneration standby. System will prompt operators to start regeneration. Make sure to refer to “DPF Notice” and confirm the operation procedures and precautions before starting stationary regeneration.

1. When performing DPF stationary regeneration, follow the precautions listed below:

- Start it after the engine is warmed up. It has been running for more than 15 minutes or the coolant temperature is over 65 degree.
- Move to a safe location that is well-ventilated.
- Shut off hydraulic pilot, and run the engine at idle speed.
- Make sure DPF regeneration inhibit SW is in "Re-generation permitted".

2. Then press button 1 to transfer to the page “DPF Regeneration”.

3. If above conditions are all permitted,

press button 1 to start the stationary regeneration.

- When the stationary regeneration starts, the engine speed will gradually increase to high idle speed.
- When the stationary regeneration starts, the Failure lamp or Amber warning lamp turn off, the DPF Regen Ack lamp changes from flashing to constant illumination, and the EGT lamp illuminates.
- The stationary regeneration will be finished after approx. 25 to 30 minutes.
- To abort the stationary regeneration, set the button 2 to “Regeneration inhibited” state, or turn the key switch to OFF.

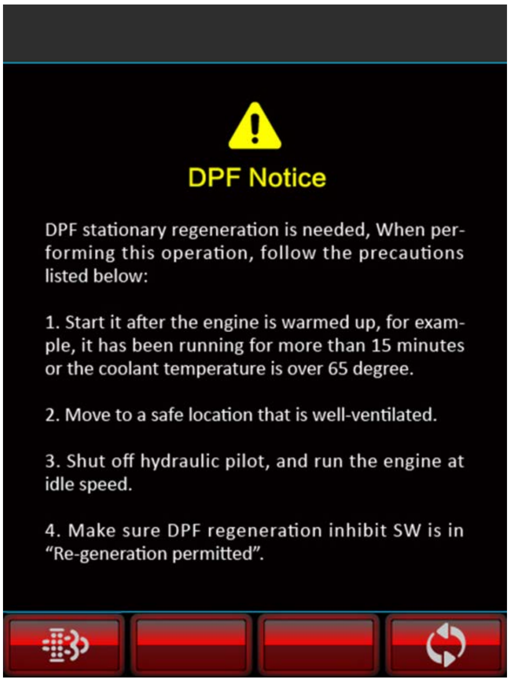


Fig. 4-113

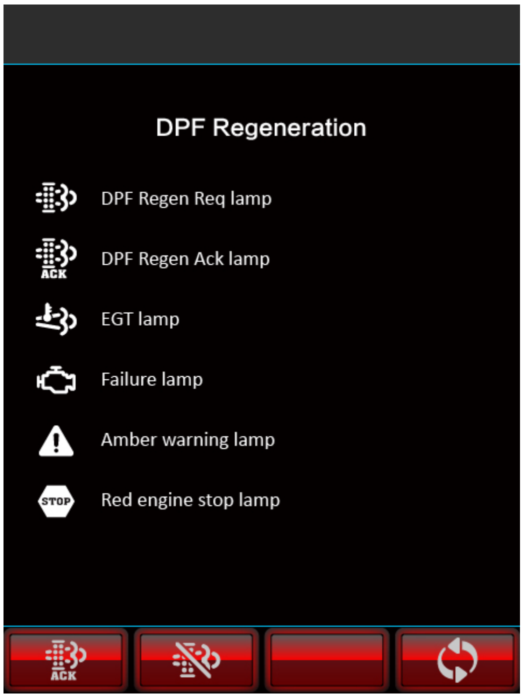


Fig. 4-114

4.8.2.6 **Machine Configuration**

When Machine Configuration icon is selected on the Main menu page, press √ to enter Machine Configuration page. This page displays basic information of software and hardware of the excavator system.

Operation

- Press button 4 to enter Main menu page.

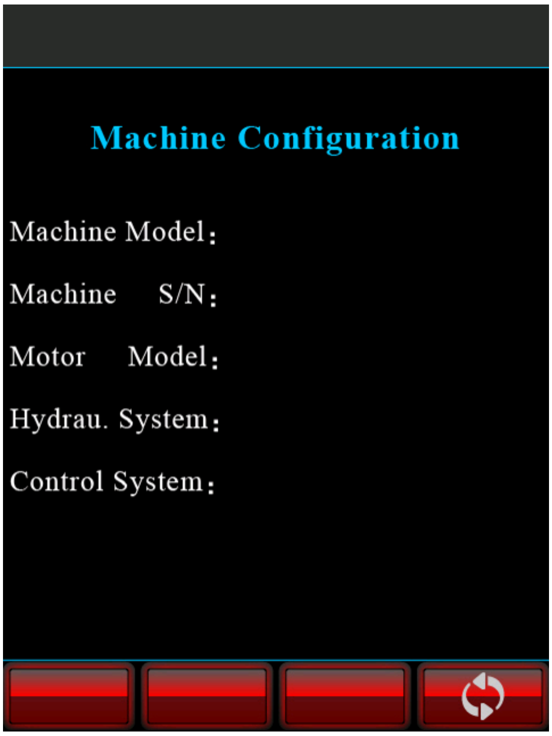


Fig. 4-115

4.8.2.7 **Failure Information**

When failure information icon is selected on the Main menu page, press √ to enter failure information page This page displays the detailed failures that has just occurred to the machine. There are current failure code and the number of total failures in the upper section of the page.

Operation

- Press button 1 to enter another page of failure codes.
- Press button 4 to enter Main menu page.
- SPN and FMI codes are engine internal diagnostic failure codes.

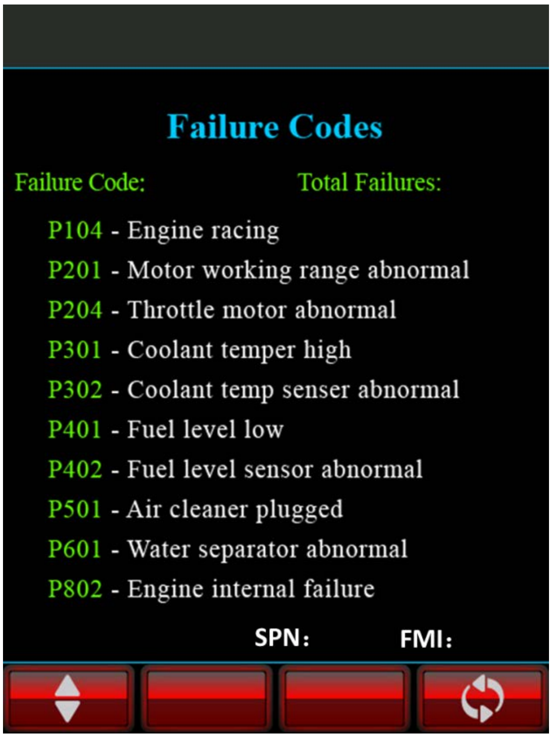


Fig. 4-116

4.8.2.8 **Language Selection**

When Language Selection icon is selected on the Main menu page, press √ to enter Language Selection page. You can choose the language that you needed in this page.

Operation

- Press button 1 to choose system language(Chinese or English).
- Press button 3 to confirm.
- Press button 4 to enter Main menu page.

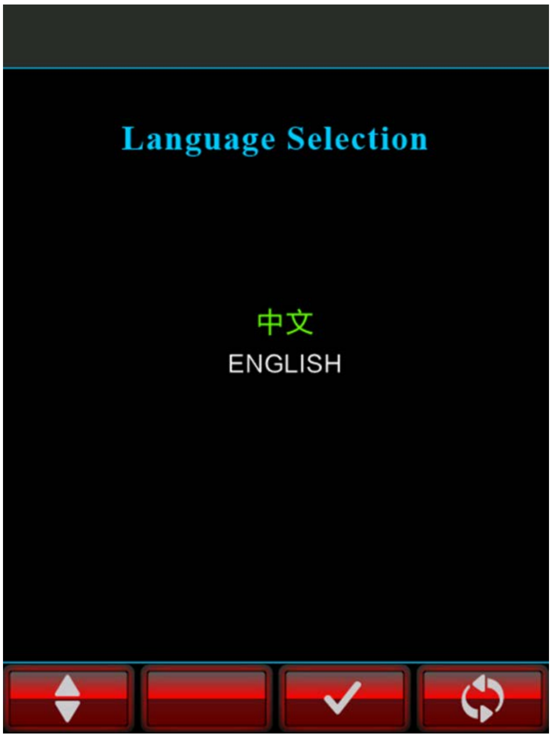


Fig. 4-117

BLANK PAGE

BLANK PAGE

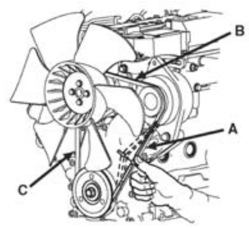
SANY

Standard Values

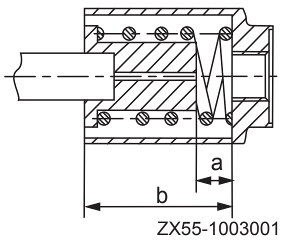
5 Standard Values

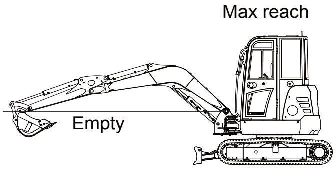
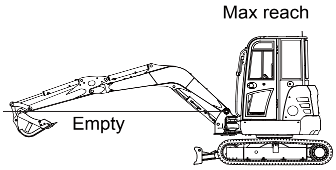
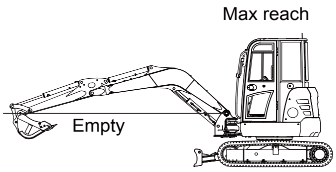
5 STANDARD VALUES

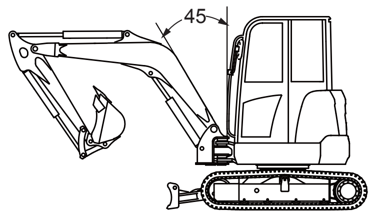
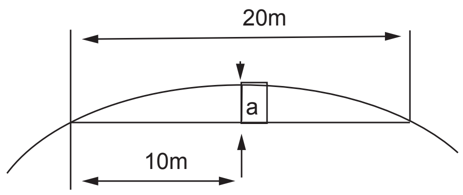
5.1 Standard Values for Engine-Related Parts

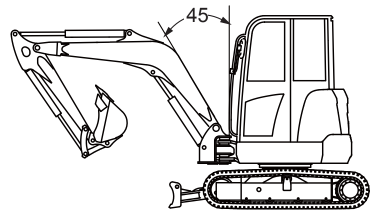
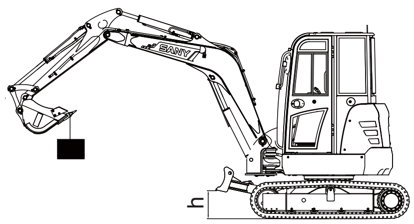
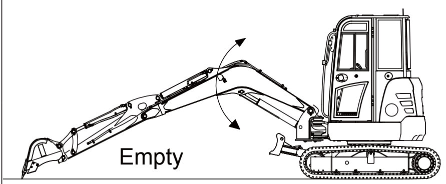
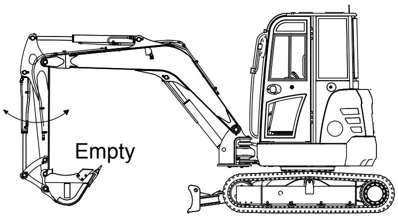
Item	Measuring Condition	Unit	Standard Value	Permissible Value
Engine speed	High idle Low idle Rated rpm	rpm	2550 1000 2400	- - -
Exhaust gas color	Sudden acceleration High idle	Bosh	-	3
Valve clearance	Intake valve Exhaust valve (normal temp)	mm	0.3-0.5	0.8
Compression pressure	Engine oil temp: 40-60ºC (Engine rpm: 250 rpm) (SAE 15W – 40 engine oil)	MPa	3.33-3.53	2.65-2.85
Blow-by pressure (oil port dia. mm)	(Coolant temp: within operational range) At rated output (oil SAE 15W – 40)	Pa	-	1.96
Engine oil pressure	Pressure tolerance (alert pressure)	kPa	0.39-0.54	49.0±9.8
	Rated output	MPa	0.39	-
	Low idling	MPa	0.06	-
Engine oil temp	Full speed range (engine oil pan)	ºC	120	120
Belt Tension (air compressor)	Def ection under f nger pressure of 98 N {10 kg}	mm	 Tension of used belt A: 3/8-1/2 ft (10-14 mm) B: 1/4-3/8 ft (7-10 mm) C: 5/16-1/2 ft (9-13 mm)	
Initial injection pressure		MPa	19.6-20.6	19.6-20.6
Thermostat	Opening temp (normal atmosphere) Valve opening more than 8mm	ºC	71±1.5 85	71±1.5 85
Starter	Mitsubishi	-	12V-2.3kw	-
Alternator	Mitsubishi	-	12V-80A	-

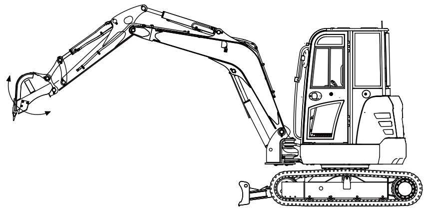
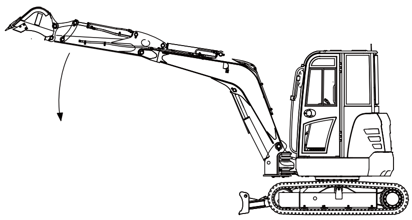
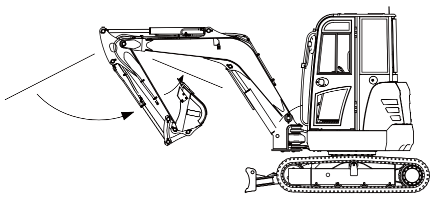
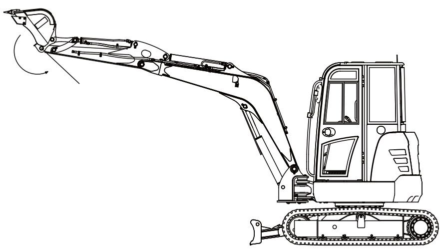
5.2 Standard Values for Chassis-Related Parts

Type	Item	Measuring Condition	Unit	Standard Value	Permissible Value
Engine rpm	Pump 1 overf ow (LS overf ow)	• Hydraulic oil temp: 45 – 55° C • Coolant temp: within operational range • Pump 1 relief: arm relief	rpm	Min. 2,000	Min. 2,000
Valve spool stroke	Boom ctrl valve		mm	7±0.1 | 40±0.1	7±0.1 | 40±0.1
	Arm ctrl valve				
	Bucket ctrl valve				
	Swing ctrl valve				
	Travel ctrl valve				
	Dozer ctrl valve				
Control lever stroke	Boom control	• Center of joystick • Max value to stoke end • Engine shut down • Divided by play in neutral position	mm	82 ± 10	82 ± 10
	Arm control			78 ± 10	78 ± 10
	Bucket control			65 ± 10	65 ± 10
	Swing control			85 ± 10	85 ± 10
	Travel control			145 ± 15	145 ± 15
	Dozer control			-	-
	Control lever play	Boom, bucket, arm, swing and dozer blade		Max. 5	Max. 5
		Travel control lever		Max. 10	Max. 10
Control Lever Operating Force	Boom control	• Engine at full speed • Hydraulic oil temp: 45 - 55° C • Measure by mounting a push-pull type scale onto the joystick. • Measure the max value to stoke end.	N	4.0-5.7	4.0-5.7
	Arm control			3.5-6.3	3.5-6.3
	Bucket control			4.5-6.5	4.5-6.5
	Swing control			4.0-5.5	4.0-5.5
	Travel control			5.0-9.2	5.0-9.2
	Dozer control			-	-
Hydraulic Pressure	Boom	Hydraulic oil temp: 45 ～ 55 ° C • Engine releases pressure at high idle (in only the circuit to be tested).	MPa	24.5	24.5±0.5
	Arm				
	Bucket				
	Dzoer				
	Travel	Relief pressure at one side		24.5	24.5±0.5
	Slew	• Engine running at high idle • Hydraulic oil temp: 45-55 ° C		20.6	20.6.±0.5
	Pilot pressure setting			3-3.5	3-3.5

Type	Item	Measuring Condition		Unit	Standard Value	Permissible Value
Swing	Overspeed when swing stops	Work equipment attitude  ● Engine runs at high idle ● Hydraulic oil temp: 45 ～ 55 °C ● Stop swing after one trun and measure swing distance ● ( ): Swing bearing outer ring moving distance		Deg. (mm)	Max. 25 Max. 185	30 225
	Time to start swing	Work equipment attitude  ● Engine runs at high idle ● Hydraulic oil temp: 45 ～ 55 °C ● Time to swing by 90 ° and 180 ° from	**90°**	**s**	**2.5**±0.3	**3.5**
			180°		**4.0**±0.3	**4.5**
	Combined operation of swivel and boom	● Under S mode, the arm cylinder/ bucket cylinder retracts; the boom lowers until work equipment reaches the ground; swing at full speed; raise the boom; stop swinging at 90 °. Note down the height of bucket tip and the swinging time.	Boom height	mm	>4800 mm	
			Time needed to swing 90°	s	2.5±0.4 s	
	Swinging time	Work equipment attitude  ● Engine running at high speed ● G mode ● Hydraulic oil temp: 45 ～ 55ºC ● Measure the time necessary for making five swinging turns after the initial one turn.		s	29	29±2

Type	Item	Measuring Condition	Unit	Standard Value	Permissible Value
Travel	Travel def ection	 ● Engine running at high idle ● Hydraulic oil temp: 45 ~ 55ºC ● Measure the defection for a travel distance of 20 m after traveling 10 m on a fat ground. ★ Choose a hard, level surface  ★ Measure the dimension l	mm	Max. 200	Max. 220

<table>
<tr><th>Type</th><th colspan="2">Item</th><th>Measuring Condition</th><th></th><th>Unit</th><th>Standard Value</th><th>Permissible Value</th></tr>
<tr><td rowspan="2">Travel</td><td colspan="2" rowspan="2">Travel speed</td><td rowspan="2">
● Engine running at high idle
● Hydraulic oil temp: 45 ～ 55° C
● Measure the time necessary for a travel distance of 20 m after traveling 10 m on a fat ground.</td><td>Low</td><td rowspan="2">s</td><td>27</td><td>27±3</td></tr>
<tr><td>High</td><td>18</td><td>18±3</td></tr>
<tr><td rowspan="8">Work Equipment</td><td rowspan="4">Hydraulic Drift of Work Equipment</td><td>Work equipment as a whole (Hydraulic drift of bucket tips)</td><td colspan="2" rowspan="4">Measuring attitude

The bucket lowers freely 5 min. after engine shutdown. Check the functions with the bucket 150 cm above ground. Retract arm cylinder. Extend bucket cylinder to its maximum limit. Measure the dropping amount of bucket tips.</td><td rowspan="4">mm/15 min.</td><td><95</td><td>143</td></tr>
<tr><td>Boom cylinder (Cylinder retraction)</td><td><7</td><td>11</td></tr>
<tr><td>Arm cylinder (Cylinder extension)</td><td><10</td><td>11</td></tr>
<tr><td>Bucket cylinder (Cylinder retraction)</td><td><10</td><td>15</td></tr>
<tr><td rowspan="4">Work Equipment</td><td rowspan="2">Boom
Bucket tips reach the ground.
↕
Cylinder fully extended</td><td rowspan="2">
● Engine running at high idle
● Hydraulic oil temp: 45 - 55° C</td><td>Raise</td><td>S</td><td>2.3</td><td>2.3±0.3</td></tr>
<tr><td>Lower</td><td>S</td><td>1.9</td><td>1.9±0.2</td></tr>
<tr><td rowspan="2">Arm
Cylinder fully retracted
↕
Fully extended</td><td rowspan="2">
● Engine running at high idle
● Hydraulic oil temp: 45 - 55° C</td><td>In</td><td>S</td><td>2.1</td><td>2.1±0.3</td></tr>
<tr><td>Out</td><td>S</td><td>2.0</td><td>2.0±0.3</td></tr>
</table>

Type	Item		Measuring Condition		Unit	Standard Value	Permissible Value
Work Equipment	Work Equipment	Bucket Cylinder fully retracted ↕ Fully extended	 ● Engine running at high idle ● Hydraulic oil temp: 45 - 55° C	CURL	s	2.0	2.0±0.3
				DUMP		1.9	1.9±0.3
Work Equipment	Time delay	Boom	 ● Engine running at low idle ● Hydraulic oil temp: 45 - 55° C		s	0	1.0
		Arm	 ● Stop the arm suddenly and measure the time necessary for the arm to stop. ● Engine running at low idle ● Hydraulic oil temp: 45 - 55° C			0	1.0
		Bucket	 ● Stop the bucket and measure the time necessary for the bucket to move again after its stoppage at bottom. ● Engine running at low idle ● Hydraulic oil temp: 45 - 55° C			0	1.0

Type	Item		Measuring Condition		Unit	Standard Value	Permissible Value
Work Equipment	Internal leakage	Cylinder	• Hydraulic oil temp: 45 ～ 55°C • Engine running at high idle • Oil relief circuit to be tested	Boom	cc/min	Max. 2.3	15
				Arm		Max. 2.2	
				Bucket		Max. 2.0	
		Swivel joint				Max. 10	50
Hydraulic Pump Performance	Hydraulic pump delivery	Main pump	·Engine running at high idle ·Hydraulic oil temp:45～55℃ ·run boom、arm、bucket action at one time.		l/min	138	138± 10

5.3 Standard Values for Electrical Parts

System	Component	Connector No.	Check	Judgement Table	Measuring Condition
Monitoring system	Oil pressure sensor	T-119	Conductivity	Oil pressure normal: conductivity not detected Oil pressure abnormal: conductitivy detected	Start switch in OFF position
	Alternator	CN-800M	Voltage	About 28V when the engine is running	Start the engine.
	Coolant temp sensor	T-510	Resistance	105° 54.5Ω	Start switch in OFF position
	Fuel level sensor	CN-101F	Voltage	Full: 4Ω Empty: 85Ω	Start switch in OFF position
	Light switch	CN-502F	Conductivity	Switch OFF: conductivity not detected Switch On: conductivity detected	Start switch in ON position
	Pilot lockout switch	CN-205F	Conductivity	Switch OFF: conductivity not detected Switch On: conductivity detected	Start switch in OFF position

SANY

Testing and Adjusting

6 Testing and Adjusting

6 TESTING AND ADJUSTING

Observe the following points when you make a judgement according to standard values provided for testing, adjusting and troubleshooting:

- The standard values given in table are just for your reference as they are the values of new machine delivered from manufactory. These values will be used to determine the wearing degree of machine after operation and as reference values when you repair the machine.
- The troubleshooting determination reference values given in table are estimated values concluded from various tests of the machine before delivery. They can be referred to along with machine repair and operation history in order to determine the causes of machine failure.
- These values shall never be used as evidence for a claim.

WARNING

- **Before you test, adjust or troubleshoot your machine, park it on a level ground, use the safety pins and chock your machine to prevent it from moving.**
- **When the job is to be performed by more than one person, use agreed signals and keep irrelevant people away from the machine.**
- **If you want to check the radiator coolant level, wait until the cool is cool enough. If you remove the radiator cap when the coolant is still hot, the coolant would squirt out and cause burns.**
- **Take care not to be seized by the fan, belt or other rotating parts.**

6.1 Engine Speed - Test

CAUTION

- **Be careful not to touch any hot part when installing or removing a testing equipment.**

Test the engine speed under the following conditions:

- Coolant temperature: within operational range
- Hydraulic oil temp: 45-55° C

1. Remove engine oil f ller cap (1).
2. Install tachometer sensor to the f ller opening.
3. Start the engine. Set engine speed to testing condition and test the speed.

Note: Do not touch the tachometer cable of fan.

A. Testing the speed at low idle and high idle:

Set the fuel control dial to low idle and high idle respectively. Test the engine speed.

B. Testing the speed at pump relief:

Switch on the air conditioner. Test the engine speed at full power during relief of each pump.

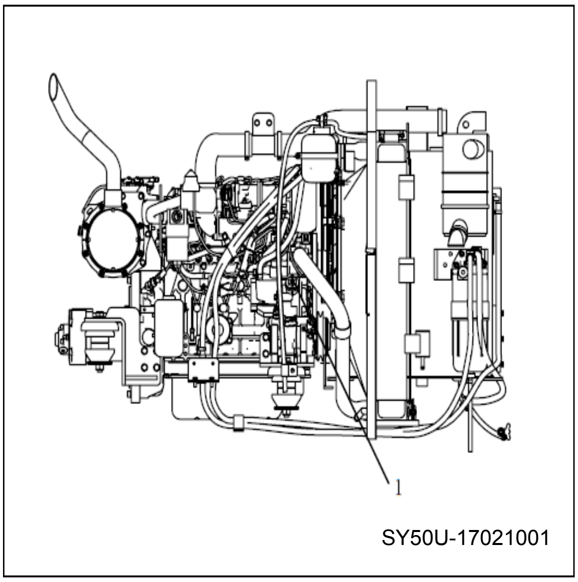


Fig. 6-1

6.2 Exhaust Gas Color - Test

A smoke tester is used to test exhaust gas color where compressed air or power source is not present. A smokemeter is used to record actual data.

Heat up the coolant to a temperature within the working range before the test is performed.

CAUTION

- **Be careful not to touch any hot part when installing or removing a testing equipment.**

6.2.1 Using a hand tester

A. Place a f lter paper in the tester.

B. Insert the probe of the tester into the exhaust pipe. Increase the engine speed suddenly and operate the portable smoke tester in order to let exhaust gas penetrate the f lter paper.

C. Remove the filter paper and compare it with the provided scale in order to make a judgement.

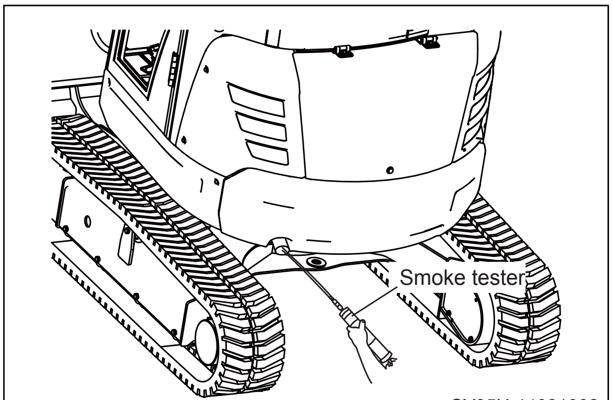


Fig. 6-2

6.2.2 Using an instrument

A. Insert the probe in the exhaust pipe and secure it with clips.

B. Connect the probe hose, accelerator switch plug and air hose to smokemeter.

Pressure of feeding air shall not be greater than 1.5 MPa {15kg/cm^2}.

C. Connect a power line to the A00V outlet.

Before connecting the power line to the outlet, check whether power switch of the smokemeter is in the OFF position.

D. Loosen the nut on the cover of the suction pump. Load the f lter paper.

Load the f lter paper properly in order to prevent gas leakage.

E. Turn the power switch of smokemeter to the ON position.

F. Switch on the air conditioner. Increase engine speed suddenly. Accumulate pressure in boom and bucket. Move the arm back and forth. Push down the acceleration pedal at the same time in order to discharge exhaust gas onto the f lter paper.

G. Remove the f lter paper and place it on new f lter papers (at least 10 pieces) in the box and read its value.

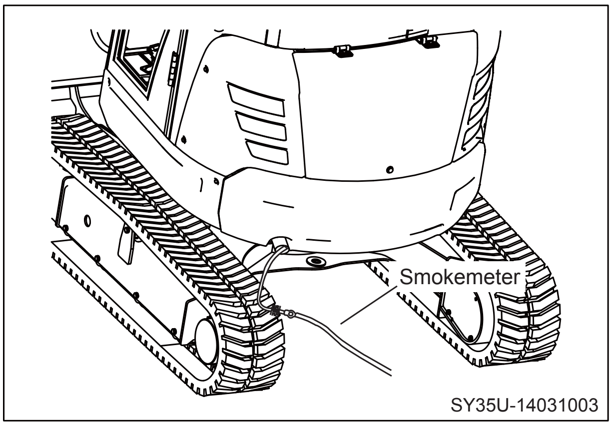


Fig. 6-3

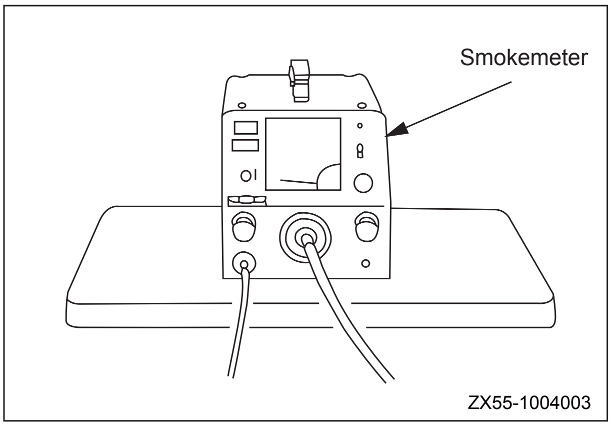


Fig. 6-4

6.3 Valve Clearance - Adjust

Remark: Check and adjust valve clearance when the engine is cool.

1. Remove cylinder head cover and heat plug.
2. Align the mark 1TC (1) on flywheel with the mark (2) on gear in order to make No.1 piston reach compression top dead center (TDC).
3. Use feeler gauge to check valve clearance marked with ☆ .
4. If the clearance is not in line with the specified value, use the screw to adjust clearance.
5. Turn flywheel 6.28 rad (360º). Align the mark 1TC (1) on f ywheel with the mark (2) on end plate in order to make No.1 piston reach the overlap.
6. Use feeler gauge to check valve clearance marked with ☆ .
7. If the clearance is not in line with the specified value, use the screw to adjust clearance.

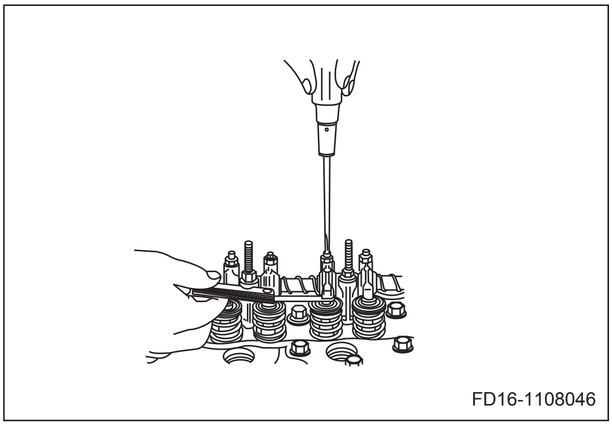


Fig. 6-5

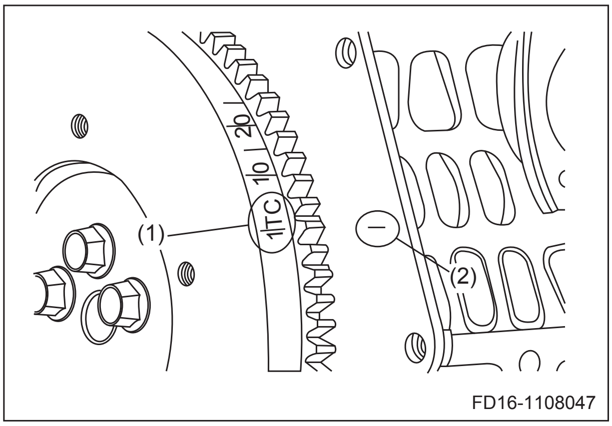


Fig. 6-6

Number of cylinder	1		2		3		4	
Valve	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
NO. 1 cylinder at compression TDC	★	★	★			★		
NO. 2 cylinder at exhaust TDC				★	★		★	★

Valve clearance	Factory specif cations	0.15-0.25 mm 0.006-0.010 in.

Remark:

- The cylinders are numbered 1-2-3 in turn as viewed from the f ywheel side. The three cylinders are ignited in a sequence of 1-3-2.
- Lock the screw with locknut after adjusting the clearance.

6.4 Compression Pressure - Test

1. Start the engine to warm it up a few minutes.
2. Stop the engine and fuel supply.
3. Remove all preheat plugs.
4. Install pressure gauge and its connector to the socket of No.1 cylinder preheat plug.
5. Rotate the engine with the start motor and take down engine reading.

   Compression pressure at 200 rpm:

MPa (kgf/cm^2/psi)

Standard	Limit
3.04 (31/441)	2.2 (22/313)

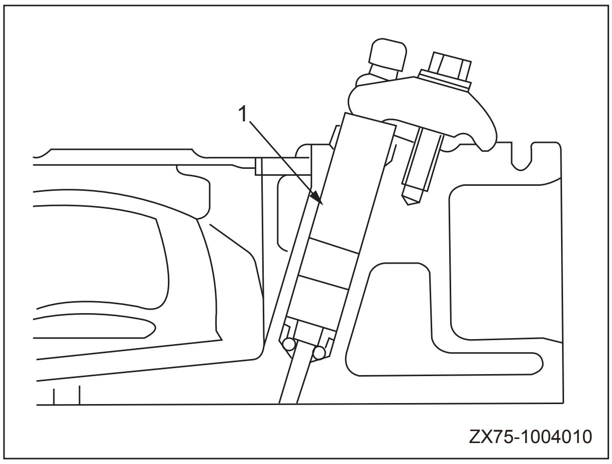


Fig. 6-7

6.5 Injection Timing – Test and Adjust

6.5.1 Checking injection timing

Note: Some oil may leak from the injection pump during this process. Collect oil leakage with a container.

1. Open the switches of oil delivery pipe and return pipe.
2. Pinch the return pipe (1) to prevent oil from getting into the diesel f lter.

- Clean the top of injection pump to prevent invasion of contaminants during plunger movement.

3. Remove the plunger (2) on top of injection pump.
4. Install the dial indicator adaptor and clamp it to the plunger hole.

Note: TNV82-88 injection pump uses M14 adaptor (Yanmar code: 158090-51831); MP4 injection uses M16 adaptor (Yanmar code: 158090-51841); Plunger adaptor clamp (3) is coded as 23000-013000).

5. Install dial indicator. The adaptor clamp (3) is positioned roughly on the middle point of plunger stroke.

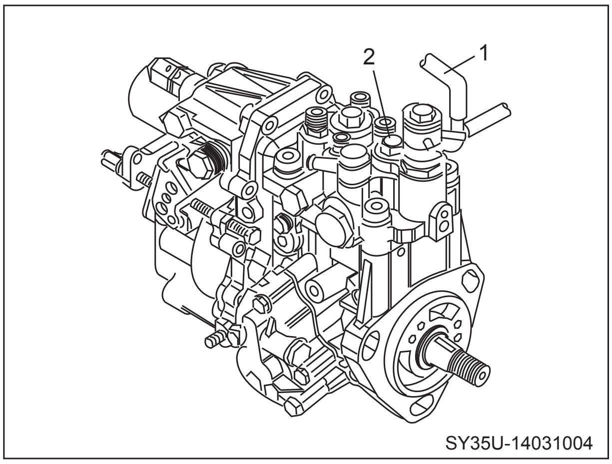


Fig. 6-8

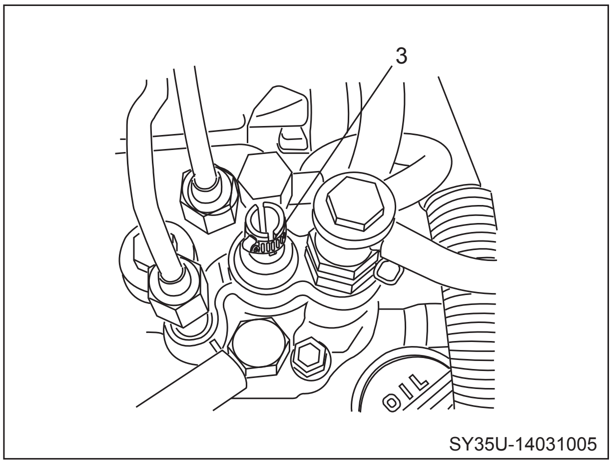


Fig. 6-9

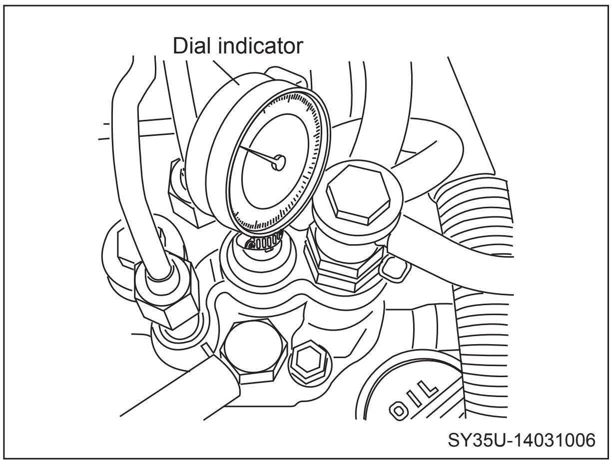


Fig. 6-10

Note: The following direction is the direction facing the coolant pump on the end of engine. Adjustment is made by turning the pull wheel.

6. Hold the bolt on crankshaft pull wheel with a wrench and turn the crankshaft clockwise until you see the f ywheel porthole (5). By turning the crankshaft you see the number of injection timing.

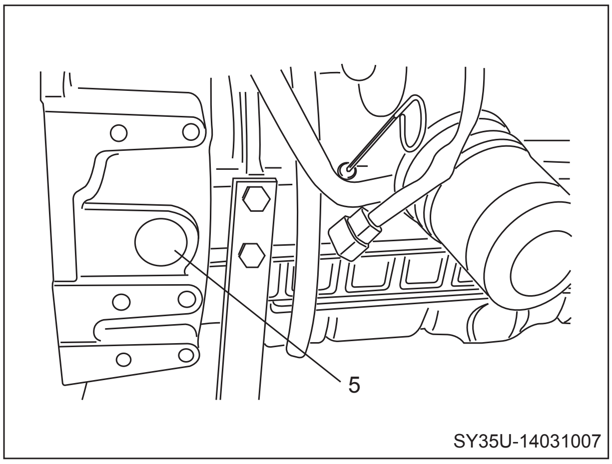


Fig. 6-11

7. A standard flywheel mark is shown in the right f gure.

Note: As the number of cylinders in an engine is different, a standard f ywheel can have several different timing scales. Any scale can be used to test the timing of injection pump.

The right figure shows a flywheel used on a direct injection engine of standard Yanmar parameters.

TDC (top dead center) can be identified by TDC mark printed near f ywheel.

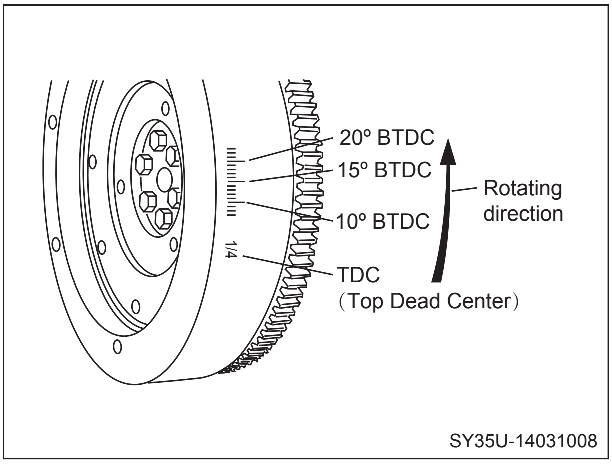


Fig. 6-12

If you are not sure how to identify the timing scale on f ywheel timing mark, you can calculate it by measuring the scales.

First measure the distance between the two longer lines on the timing mark. And then measure the distance from the TDC mark to the f rst longer line. Dividing by the distance between the two longer lines, the result is degrees between the TDC mark and the f rst longer line.

For instance, if the distance between the two longer lines is 2.0 cm, the distance from TDC mark to the line is 4.0 cm, and the divisor is 2, it indicates that from the TDC mark to the f rst longer line on the timing mark would be 10º (2×5º), i.e. the f rst longer line on the TDC mark is 10ºBTDC, the second 15ºBTDC . If the divisor is 3, the degrees would be 15 (3×15º). So the f rst longer line is 15ºBTDC, the second 20ºBTDC and the relative third 25ºBTDC.

8. Make a timing reference mark on f ywheel chamber or engine rear cover. Make a TDC (top dead center) mark on the f ywheel.
9. Make target timing mark calculated on f y-wheel.
10. Turn the crankshaft counterclockwise until the dial indicator shows that the pump plunger is in stroke end. Turn the crankshaft back and forth to make sure the dial indicator reads no moving point. Reset the dial indicator to zero.
11. Slowly turn the crankshaft clockwise until the dial indicator shows that the plunger moves up by 2.5mm (0.098in).
12. Check the flywheel target timing mark made before and related reference mark made on f ywheel chamber or rear cover of engine. If the two marks are in the same line, the injection timing is good. If they are not in the same line, the injection timing needs to be readjusted.
13. If the injection timing is correct, remove the dial indicator and adaptor. Replace the plunger and washer and tighten the bolts to specified values. Replace the cocver of f ywheel porthole. Open the oil delivery valve and remove the clamps on deilvery pipe and return pipe.
14. Pump fuel to the fuel system. Run the engine and check for oil leak.

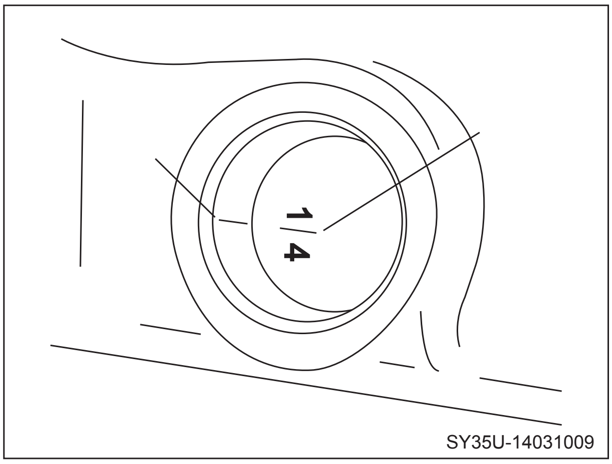


Fig. 6-13

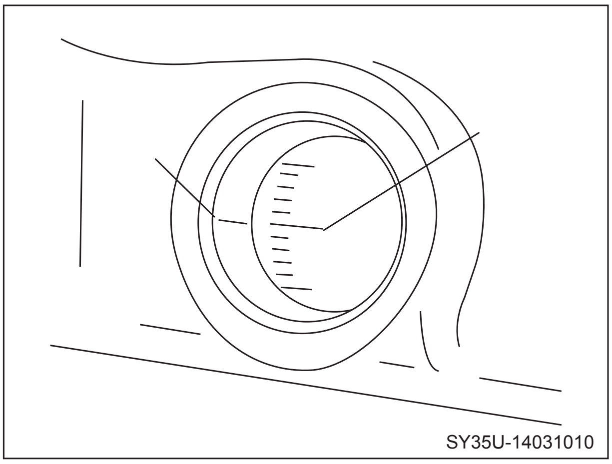


Fig. 6-14

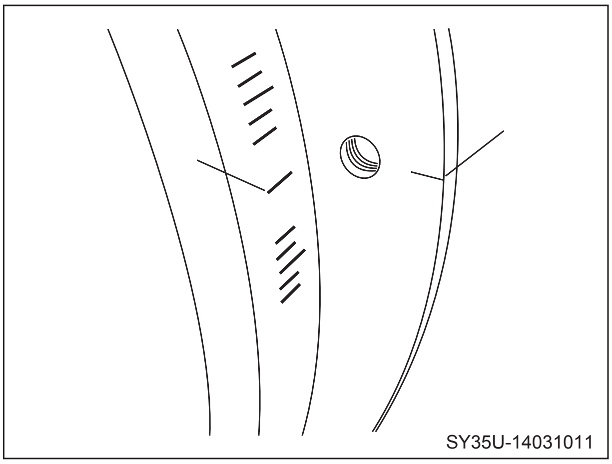


Fig. 6-15

6.5.2 Adjusting the injection timing

If the timing marks are not in the same line, re-adjust the timing. The following steps must be followed when you correct the engine.

1. Do not remove the dial indicator mounted on injection pump. Do not interfere the degrees indicated on the dial indicator.
2. Turn the flywheel until the target timing mark is aligned with the reference timing mark on f ywheel chamber or rear cover of engine.

Note: Do not turn the crankshaft when you proceed other steps of the procedure.

3. Notice the reading on dial indicator. If it is less than 2.5 mm (0.098 in), the timing is delayed; if it is greater than 2.5 mm (0.098 in), the timing is advanced.

Note: Some engines require removing intake manifold and oil pump heat insulator but keeping the nuts fastening the pump.

4. Loosen the nuts that hold oil pump to gearbox or front cover. Loosen the rear bracket of injection pump.

Note: Loosening the nut of high pressure oil pipe on the oil pump allows you to turn the pump easily.

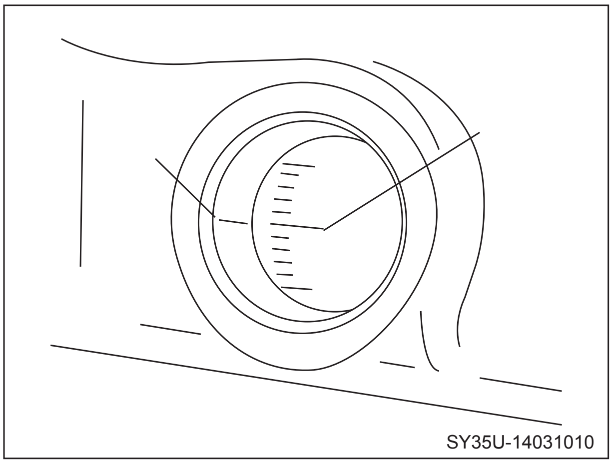


Fig. 6-16

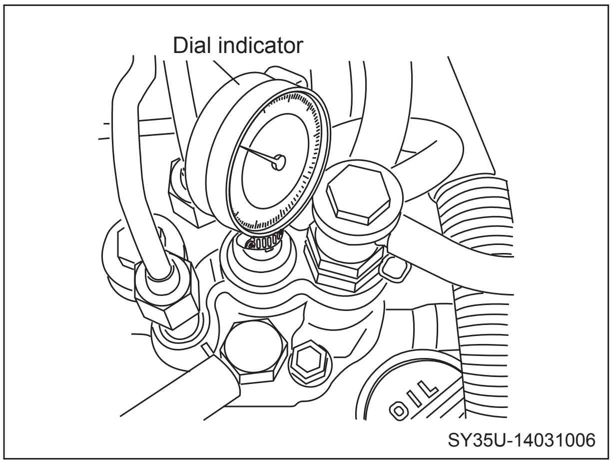


Fig. 6-17

5. Turn the oil pump until the dial indicator reads 2.5 mm (0.098 in).
6. To advance the injection timing, turn the top of injection pump away from the engine.
7. To delay the injection timing, turn the top of injection pump toward the engine.
8. When the dial indicator reads 2.5 mm (0.098 in), the plunger lifts, and the target mark on f ywheel and the mark on f ywheel chamber or engine rear cover are in the same line, the injection timing is good.
9. Tighten the injection pump assembling nuts and rear bracket.
10. Remove the dial indicator and adaptor. Replace the plug to plunger hole and tighten it to specif ed torque. Reinstall the intake manifold and oil pump heat insulator. Tighten the nut of injection tube to specif ed torque. Open the oil delivery switch, remove clamps from oil return pipe, and pump fuel to the fuel system. Run the engine and check for leak.

6.6 Engine Oil Pressure - Test

Test oil pressure under the following condition:

- Coolant temperature: within working range

1. Remove oil pressure sensor (1) and install the connector of the pressure gauge kit (stud threads PT 1/8) and the oil pressure gauge (0.5 MPa {10 kg/cm^2}).
2. Start the engine. Test oil pressure while the engine is running at idle and at high speed.

   Low idle: 0.6 kgf/cm²

   High idle: 4 kgf/cm²

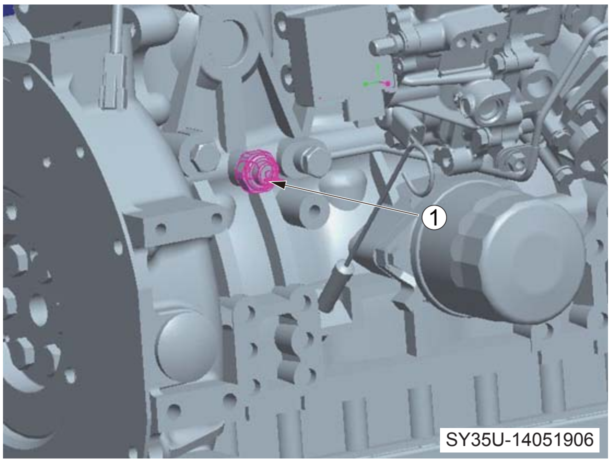


Fig. 6-18

6.7 Alternator Belt Tension - Test and Adjust

Testing

Press the middle of the belt between the alternator and the fan with a pressure of 98 N{10 kg} in order to check whether the belt def ection is within the range of 8-12 mm.

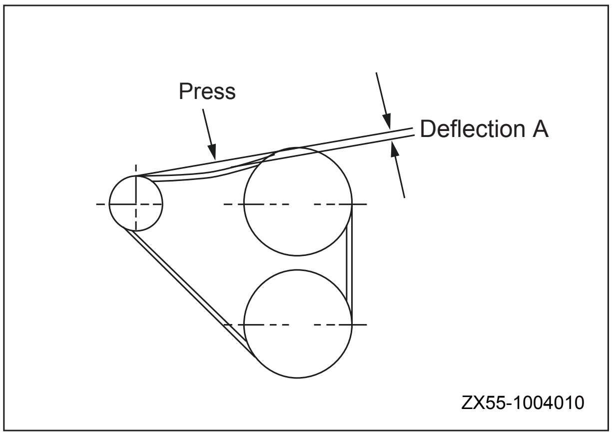


Fig. 6-19

Adjusting

1. Remove the cover at the alternator side.
2. Loosen the belt tension adjusting bolt (1) and the alternator mounting nut (2).
3. Move the alternator (3) toward body of machine. Tighten the belt tension adjusting bolt (1).
4. Tighten the mounting nut (2).

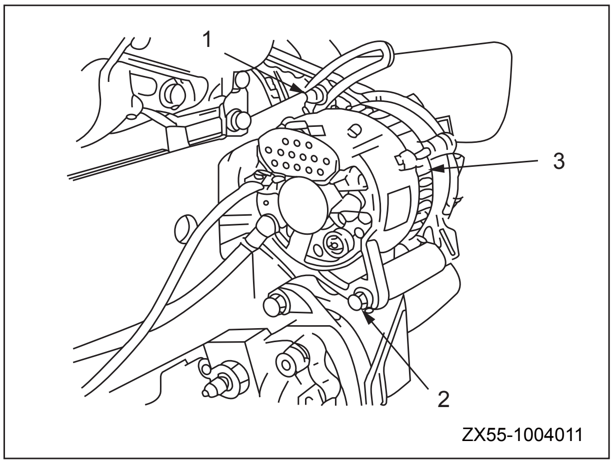


Fig. 6-20

6.8 Hydraulic Pressure in Oil Circuits – Test and Adjust

Testing

- Hydraulic oil pressure at testing: 45-55° C
- Lower the work equipment to the ground and turn off the engine.

  Loose the hose joint（1） and connect oil pressure gauge C1（60 MPa）,and then tighten the hose joint.

- **Measuring relief pressure**

  Measure hydraulic oil pressure with the engine running at full speed and all control levers neutralized.

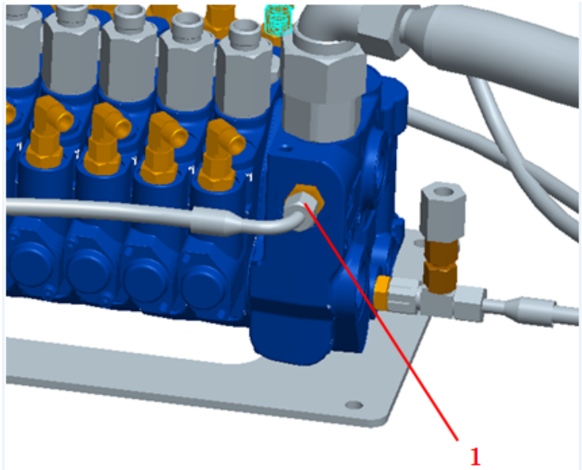


Fig. 6-21 SY50U-1701868

Adjusting the pressure of main relief valve

Loosen the locknut (1) and turn the adjusting screw (2) in order to make adjustment.

- Turn the adjusting screw:

  Turn it clockwise to increase the pressure;

  Turn it counterclockwise to decrease the pressure.

  Locknut: 20±2N·m

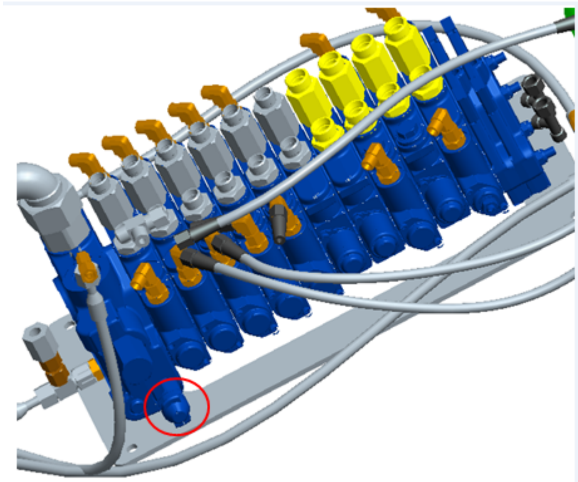


Fig. 6-22

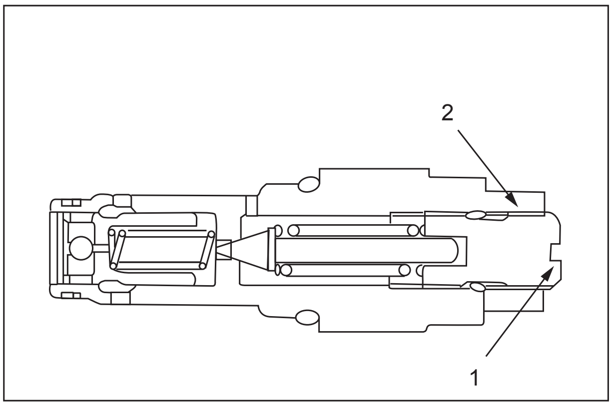


Fig. 6-23 ZX55-1004012

6.9 Pilot Valve Output Pressure - Test

Hydraulic oil Temp for testing: 45-55 ºC

1. Disconnect the hose (1) from the oil circuit to be tested.
2. Install a connector between the hose and the elbow.
3. Install oil pressure gauge (5.9MPa) onto the Tee connector.
4. Run the engine at high idle, operate the control lever of the oil circuit to be tested, and check the oil pressure.

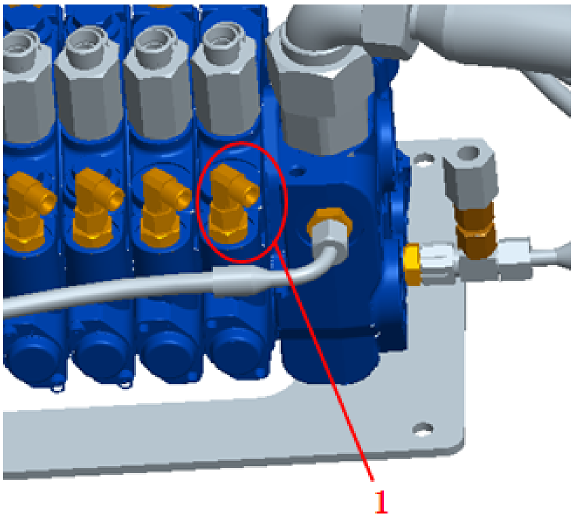


Fig. 6-29 SY50U-021872

6.10Work Equipment and Swing Pilot Valve - Adjust

CAUTION

- **Lower the work equipment to the ground and turn off the engine. Slowly loosen the filler cap of the hydraulic tank in order to release the tank pressure.**

If the work equipment control lever or the swing control lever has excessive play, it should be adjusted through the following procedure:

1. Pull up the rubber sleeve on the lever.
2. Remove the cover (1).
3. Loosen the locknut (2). Adjust the play of control lever by repositioning the disc (3).

- Play of control lever: 0.5 - 3 mm

  (In a distance of 200 mm from the control lever revolving center)

- The play of control lever reduces when the locknut (2) is tightened. Therefore, the adjustment is to be made according to the amount to be reduced.

4. Fix the disc (3) and tighten the locknut (2) to the specif ed torque.

   Locknut: 112.7±14.7 N·m

Fig. 6-30

6.11 Travel Deviation - Test

1. Adjust the excavator to the attitude of travel.

- In the attitude of travel, fully extend the bucket cylinder rod and the arm cylinder rod. Hold the boom at an angle of 45° .

2. Travel 10m, and then travel 20m to check the amount of deviation.

- Check the amount of deviation when the engine is running at high idle.
- Install the hydraulic pressure gauge and measure the pump output pressure.

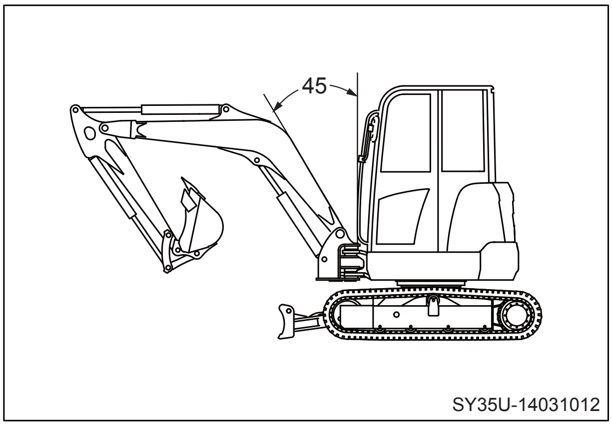


Fig. 6-31

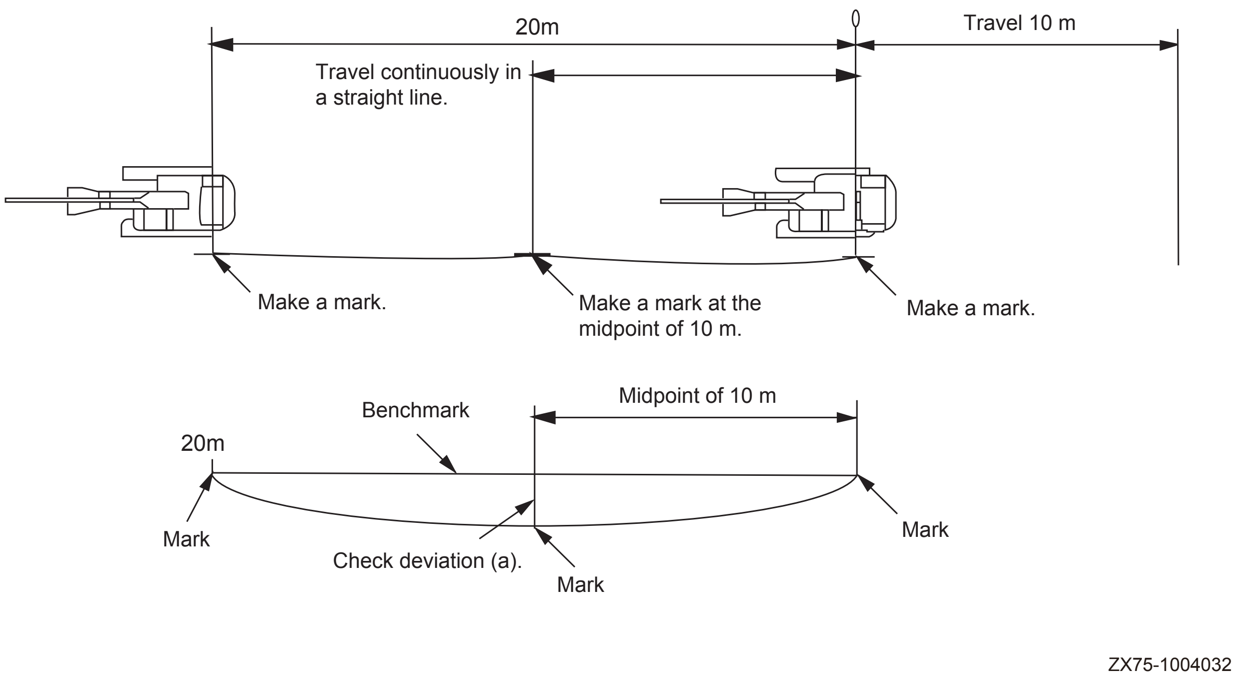


Fig. 6-32

6.12 Oil Leakage - Test

Hydraulic oil temp for testing: 45-55° C

6.12.1 Work equipment cylinder

If the hydraulic drift of work equipment is out of the standard range, the amount of oil leakage in the cylinder is to be tested according to the following procedure. It is also necessary to judge whether the hydraulic drift is caused by internal failure of the cylinder or the failure of control valve.

- If the amount of leakage is within the standard range, it is the fault of control valve.
- If the amount of leakage is greater than the standard value, it is the internal failure of the cylinder.

1. Fully extend the rod of the cylinder to be tested and then turn off the engine.
2. Disconnect the hose from the end of cylinder and then plug the line to the chassis.

   Be careful not to disconnect the circuit at the boom side.
3. Leave it for 10-15 minutes and then check the hydraulic drift of the cylinder immediately.

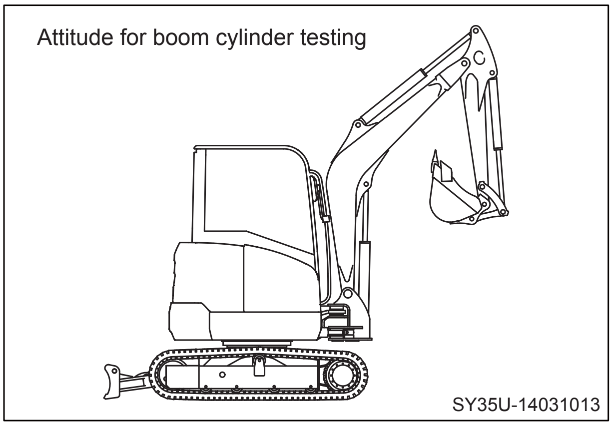


Fig. 6-33

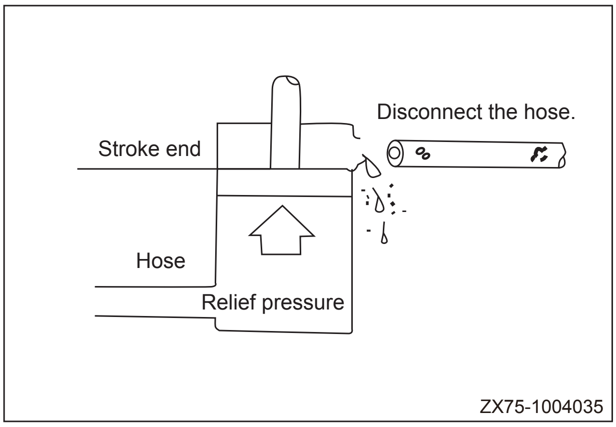


Fig. 6-34

6.12.2 Swing motor

1. Disconnect the drain hose (1) of the swing motor and travel motor (2). Then plug the hose.
2. Connect a drain hose to the swing motor side. Contain the oil leakage with a measuring cup.
3. Turn start switch to the ON position.
4. Start the engine. Operate the swing relief with the engine running at high speed.
5. Maintain this state for 30 seconds and then check the amount of leakage.

   After the first measurement, swing by 180° and measure the amount of leakage again.

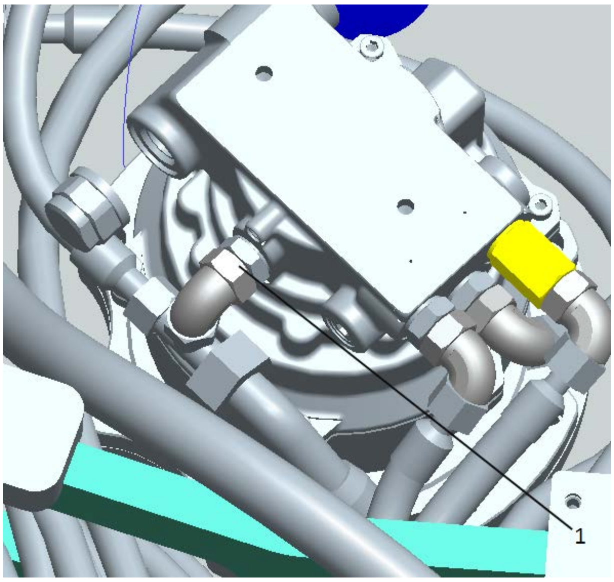


Fig. 6-39 2016052001

6.12.3 Travel motor

1. Disconnect the drain hose (3) of the travel motor and plug the hose end.
2. Connect a polyethylene hose to the elbow and contain the leaked oil with a measuring cup.
3. Place block ①（Fig.6-41） under the grouser of track shoe. Place block ② between carrier roller and the track frame in order to lock the track shoe.
4. Start the engine. Operate the travel relief when the engine is running at high idle.

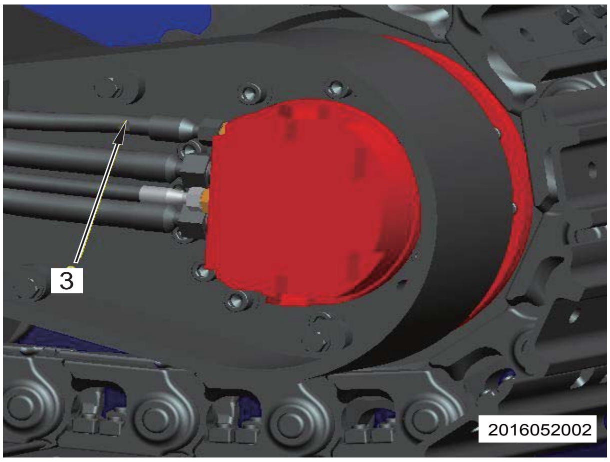


Fig. 6-40

⚠ WARNING

- **Misoperation of the control levers is very likely to cause accidents. So, always operate properly and make sure of the signals.**

5. Maintain this state for 30 seconds and then check the amount of oil leakage.

- The test should be repeated several times with the motor running under light load. (Change the relative position between oil distributor and oil cylinder and between piston and oil cylinder.)

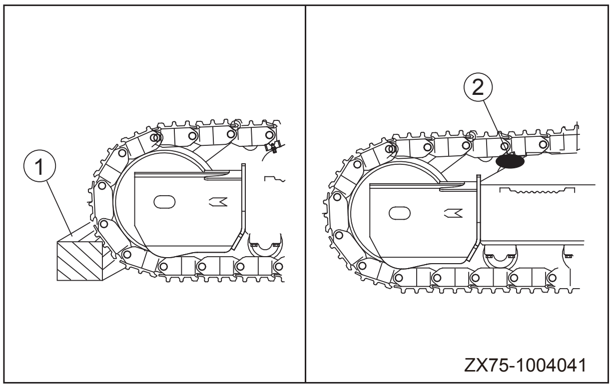


Fig. 6-41

6.13 Residual Pressure in Hydraulic Circuit - Release

1. Turn the fuel control dial (2) to MIN position and stop the engine.
2. Switch on power supply and operate all pilot valves to relieve pressure. (Keep the lockout control lever at FREE position.)
3. Switch off power supply and move the lockout control lever to the LOCKED position.

Fig. 6-42

6.14 Track Tension - Check and Adjust

6.14.1 Checking track tension

1. Drive the excavator straight forward on a hard, level ground for a distance not less than 3 meters.
2. Use the bucket as the support on one side in order to raise the track of the side off the ground.
3. Place a straight edge between the middle track roller (1) and the track (2).
4. Measure the deflection between the track roller tread and the track link surface.

- If the deflection (a) is within the following range, the track tension is normal.

Model	Std. sag (a)
SY50U	15-25mm(Steel track) 10-20mm(Rubber track)

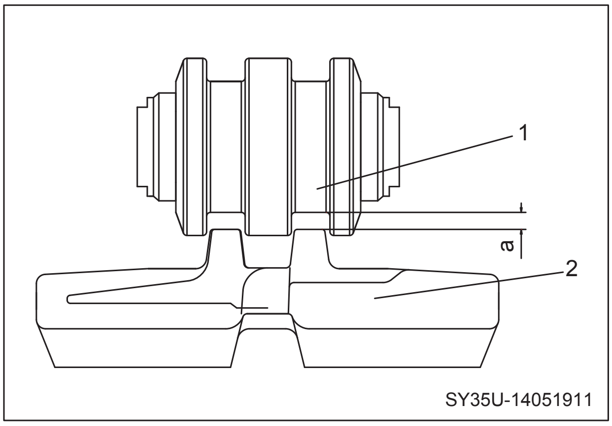


Fig. 6-43

6.14.2 Adjusting track tension

If the standard track tension is inappropriate, make adjustment as per the following procedure:

6.14.2.1 When the tension is high

1. Loosen valve (1) to slowly discharge the grease.

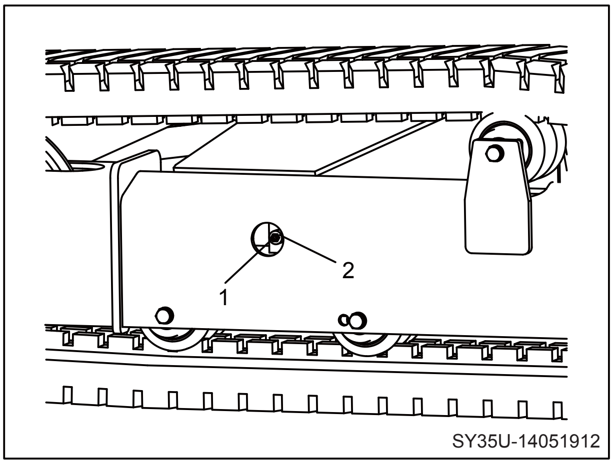


Fig. 6-44

⚠ WARNING

- **Do not loosen the valve by over one turn. Otherwise, the grease may squirt out due to high internal pressure.**

- If the grease is not discharged completely, slowly move the machine back and forth.

2. Before checking the track tension, it is necessary to run the engine at idle speed, move the machine forward to a distance equal to the grounding length of track, and slowly park the machine.

3. Recheck the track tension and, if incorrect, adjust it again by following the above procedure.

6.16.2.2 When the tension is low

1. Add grease through grease f tting (2).

- If normal track tension cannot be ensured during filling of grease, it is necessary to slowly move the machine back and forth.

  Grease f tting: Grease (G2-LI)

2. Before checking the track tension, it is necessary to run the engine at idle speed, move the machine forward to a distance equal to the grounding length of track, and slowly park the machine.

3. Recheck the track tension and, if incorrect, adjust it again by following the above procedure.

6.15 Air Purging

Item	Air Removal Steps					
	1	2	3	4	5	6
Description	**Hyd pump**	**Engine starting**	**Oil cylin-der**	**Swing motor**	**Travel motor**	**Operate**
Change hydraulic oil Clean f lter element	○ →	○ →	○ →	○ (Note) →	○ (Note) →	○
Replace return oil f lter element		○ →				○
Repair or replace hydraulic pump Remove oil suction pipe	○ →	○ →	○ →			○
Repair or replace control valve		○ →	○ →			○
Replace cylinder Disconnect cylinder lines		○ →	○ →			○
Replace swing motor Disconnect swing motor lines		○ →		○ →		○
Replace travel motor Disconnect travel motor lines		○ →			○ →	○

Note: Air is only removed through swing motor and travel motor while oil is being drained from the housing.

6.15.1 Purging air from hydraulic pump

1. For new pumps or pumps that have been repaired, this procedure is necessary. Add oil through (1) until oil leaks from it.
2. When oil is well added, connect oil drain hose to (1) and tight it specif ed torque (80 – 90 N·m).

- Precautions for engine starting

  After the operation of air purging, run the engine at low idle for 10 minutes before operating the machine.

Fig. 6-45

6.15.2 Purging air from hydraulic cylinder

1. Start the engine and run the engine at low idle for f ve (5) minutes
2. Raise and lower the boom 4-5 times while the engine is running at low idle.
- Be careful not to apply relief pressure. Stop the piston rod at about 100 mm to the stroke end.
3. Repeat step 2) while the engine is running at high idle.
4. Apply relief pressure by extending the piston rod to its stroke end while the engine is running at low idle.
5. Perform the step 2) through step 4) to eliminate air from the arm cylinder and the bucket cylinder.
- When a new cylinder is to be installed, purge the air from the cylinder before installation. Especially the boom cylinder, which would not extend to the stroke end of the BOOM LOWER side after installation, must be purged of air prior to installation.

6.15.3 Purging air from swing motor

1. Start the engine and run the engine at low idle.
2. Purge the air from the motor by slowly turning the upper structure.

6.15.4 Purging air from travel motor

1. Start the engine and run the engine at low idle.
2. Loosen the hose (2) and make sure that oil leaks from it.
3. Tighten the hose (2) if oil leakage is conf rmed.

   Air vent plug: 27.5-35.3 N·m

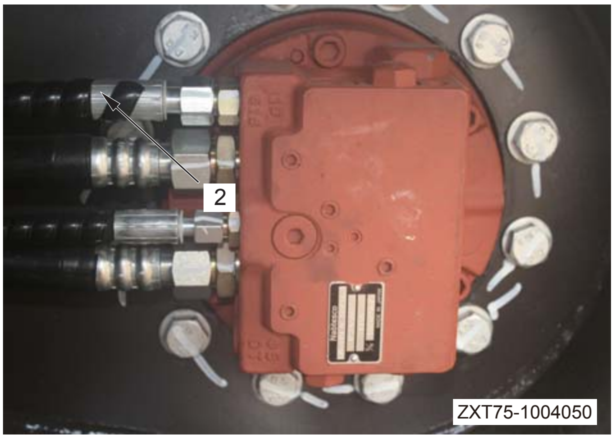


Fig. 6-46

BLANK PAGE

SANY

Troubleshooting

7 Troubleshooting

7 TROUBLESHOOTING

7.1 Troubleshooting Precautions

WARNING

- Park the machine on a level ground. Make sure that the safety pins, blocks and parking brake are active.
- The hand signals must be agreed during coordinated operation. Irrelevant personnel must be cleared of the working range.
- If the radiator cap is removed when the engine is still hot, the hot coolant may squirt out and cause burns. Wait for the engine to cool down before performing any maintenance job.
- Be extremely careful not to touch any hot part or hold any rotating part.
- The negative (-) post of battery must be disconnected before disconnecting any lead.
- Internal pressure must be released before removing the plug or cap under oil pressure, water pressure or air pressure. Correct connection must be ensured when installing a testing equipment.

The purpose of troubleshooting is to f nd out the root cause of failure, correct the fault in time and prevent it from occurring again.

It is important to know the structures and functions before troubleshooting is performed.

However, in order to perform troubleshooting eff ciently, asking the operator for possible causes of failure is a shortcut for troubleshooting.

1. Do not rush to disassemble the part during troubleshooting.

   Immediate disassembly of a part may lead to:

   - That the disassembled part is irrelevant to the failure or that the disassembly of part is unnecessary.
   - No result.

   Waste of manpower, parts, oil or grease, and that the user or operator looses faith in the product.

   Therefore, perform investigation f rst and carry out troubleshooting according to the specif c procedure.

2. Ask the user or operator the following questions:

   A. Is there any other problem you missed?

   B. Did the machine show abnormality before the failure occurred?

   C. Did the failure occur unexpectedly or the machine was abnormal prior to occurrence of the failure?

   D. When did the failure occur?

   E. Did you make any repair before the failure occurred? When was the repair performed?

   F. Was there any similar failure before?

3. Check the following items:

   A. Check the engine oil level.

   B. Check for oil leakage from the pipes or hydraulic equipment.

   C. Check the travel distance of control levers.

   D. Check the stroke of control valve spool.

   E. As other daily service items can be checked visually, you may check only those necessary.

4. Conf rm a failure.

   - Conf rm the failure by yourself and judge whether it is a true failure or whether it is the problem of application or operation.

   - When the failure reoccurs during operation, do not perform any check or test that would make the problem worse.

5. Perform troubleshooting.

   - Focus on the causes of failure according to the checking and testing results drawn from step 2 through step 4.

   - The primary troubleshooting procedure is shown below:

     A. Begin with simple causes;

     B. Focus on the most possible causes;

     C. Check other related items.

6. How to eliminate the root cause of failure.

   - Even if the fault is corrected, the failure may reoccur if the root cause still exists.

     Therefore, the root cause must be found out and eliminated.

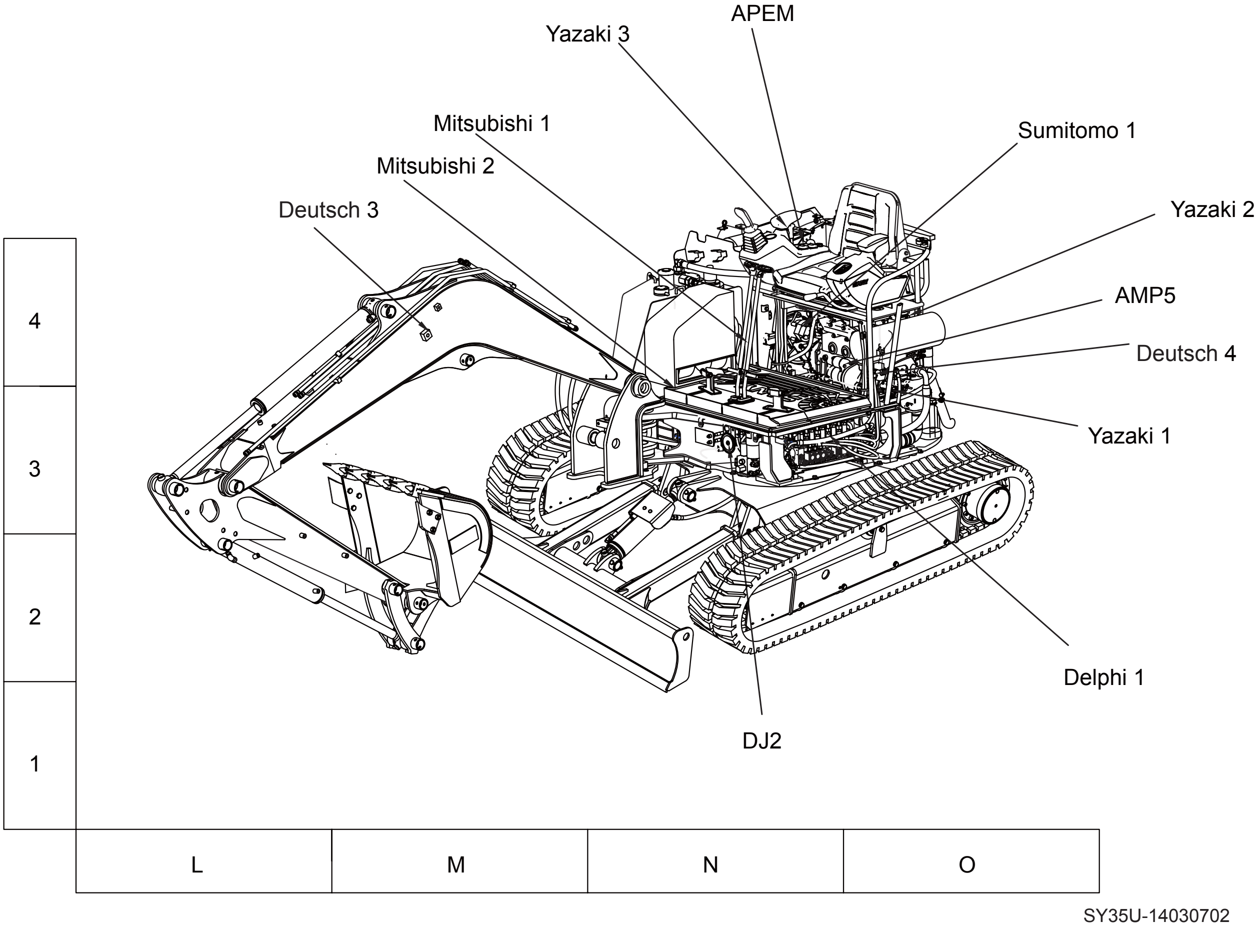
7.2 Checks Before Troubleshooting

	Item	Criterion	Remedy
Lube oil, coolant	1. Check fuel level.	—	Add fuel
	2. Check for water or impurities in fuel.	—	Clean, drain
	3. Check hydraulic oil level.	—	Add oil
	4. Check hydraulic oil strainer.	—	Clean, drain
	5. Check engine oil level (in oil pan).	—	Add oil
	6. Check coolant level.	—	Add water
	7. Check dust indicator for clogging.	—	Clean or replace
	8. Check hydraulic oil f lter.	—	
Electrical devices	1. Check battery for loose or eroded terminals.	—	Tighten or replace
	2. Check alternator for loose or eroded terminals.	—	Tighten or replace
	3. Check start motor for loose or eroded terminals.	—	Tighten or replace
Hydraulic, mechanical devices	1. Check for abnormal noise and odd smell	—	Repair
	2. Check for oil leakage	—	Repair
	3. Bleed the air.	—	Bleed air
Electrical components	1. Check battery voltage (with engine stopped).	10-15 V	Replace
	2. Check electrolyte level of battery.	—	Change or ref ll
	3. Check for discolored, burnt or exposed electric wires.	—	Replace
	4. Check for missing wire clamps or dangling electric wires.	—	Repair
	5. Check for wet wires (esp. wet connectors and terminals).	—	Remove connector and blow it dry.
	6. Check for blown or corroded fuses.	—	Replace
	7. Check alternator voltage (with engine speed at middle or higher).	After running for several minutes: 13-15 V	Replace
	8. Check operating sound of battery relay (when start switch is turned ON or OFF).	—	Replace

7.3 Connector Locations and System Diagrams

★ The location code given in the table below corresponds to the location of connector (in 3D drawing).

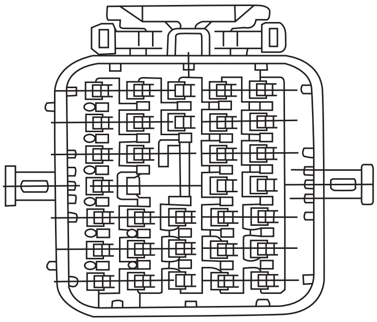
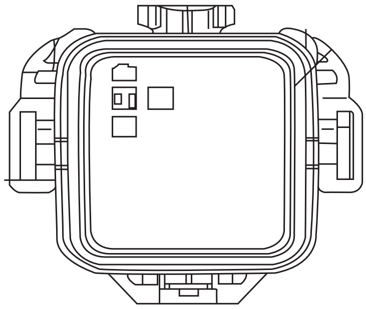
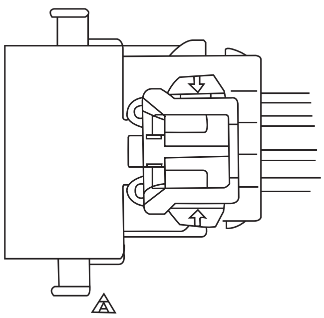
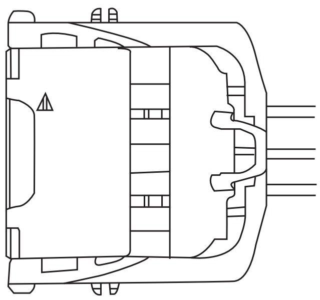
Connector Code	Type	Pins	Location	Location Code
AMP1	AMP:282080-1	2	Horn button	M2
AMP2	AMP:282105-1	3	Fuel control dial	H3
AMP3	AMP:282104-1	2	Pilot joystick	I2
Deutsch 3	DT06-25	2	Boom	M4
AMP5	AMP:735075-0	1	Start motor	O4
DJ2	DJ70214y-2.2-20	1	Horn	N3
Deutsch 5	Deutsch DT06-6S	6	Start switch	H3
Sumitomo 1	6189-0442,0443	2	Alternator	N4
Yazaki 2	7123-6234-40	2	Solenoid valve	O4
Deutsch 4	DT04-4P	6	Throttle motor	O3
Mitsubishi 1	PK461-32120-C01A	37	Cab harness	N4
Mitsubishi 2	PK465-32127-C01B	37	Chassis harness	N4
Delphi 1	12078090	3	Main valve	O3
Yazaki 3	7119-3070	8	Radio	N4
Deutsch 1	DT06-8S	12	Cab harness	I2
Deutsch 2	DT06-12S	12	Cab harness	I2
APEM	U2292	8	Lamp switch	N4
Yazaki 1	7223-6423	2	Electronic fuel transfer pup	O3

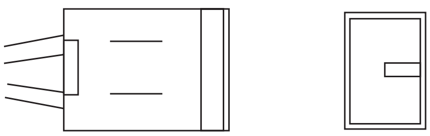
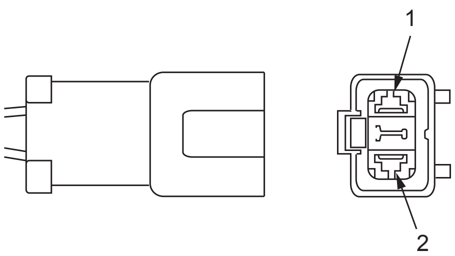
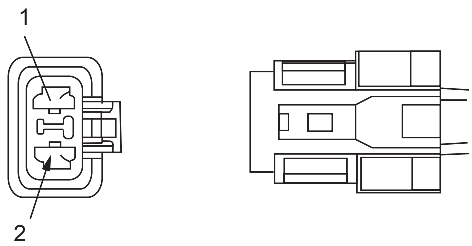
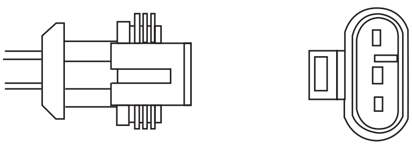
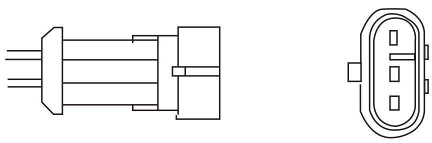


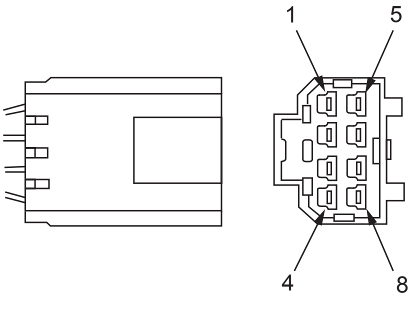
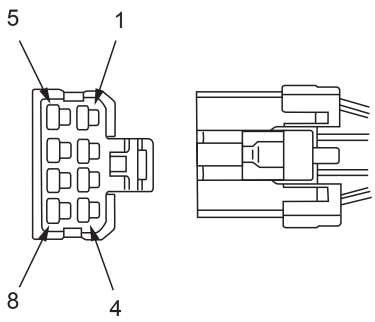
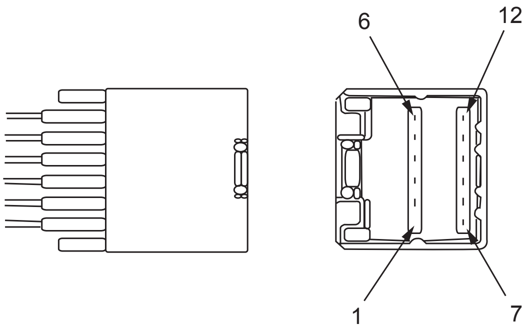
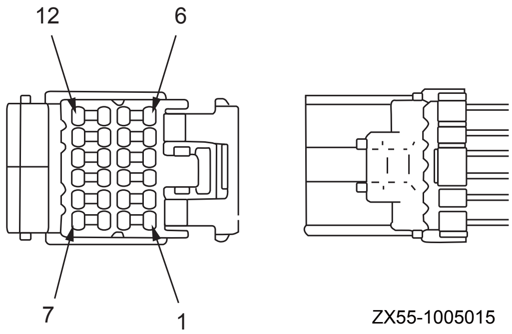
APEM
Yazaki 3
Mitsubishi 1
Sumitomo 1
Mitsubishi 2
Yazaki 2
Deutsch 3
AMP5
Deutsch 4
Yazaki 1
Delphi 1
DJ2
4
3
2
1
L
M
N
O
SY35U-14030702

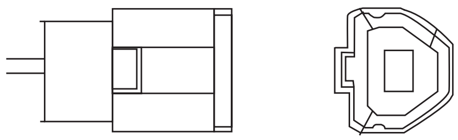
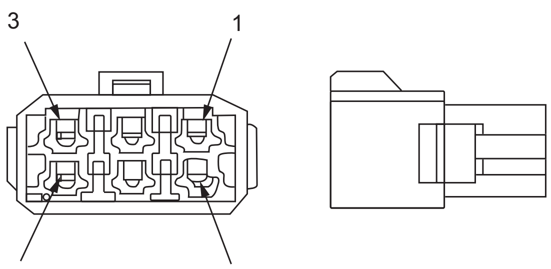
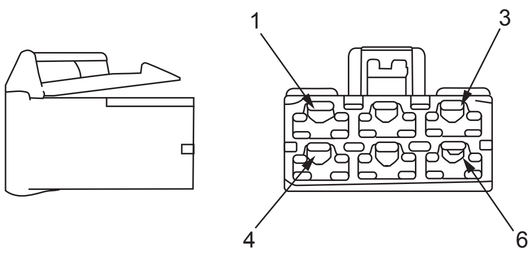
Fig. 7-2

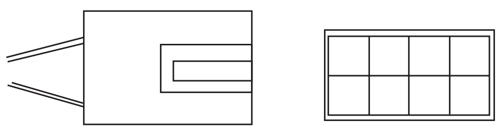
7.4 Number of Pins Required for Connection

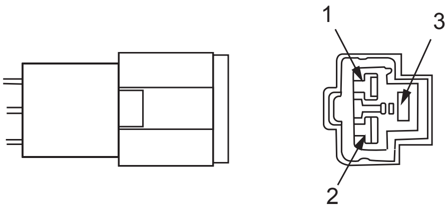
Pin(s)	Mitsubishi	
	Plug	Socket
37	PK461-32120-C01A  ZX55-1005003	PK465-32127-C01B  ZX55-1005004
	 ZX55-1005005	 ZX55-1005006

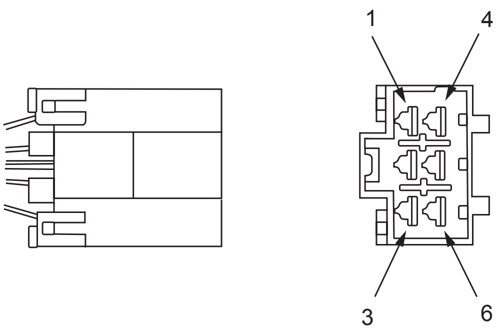
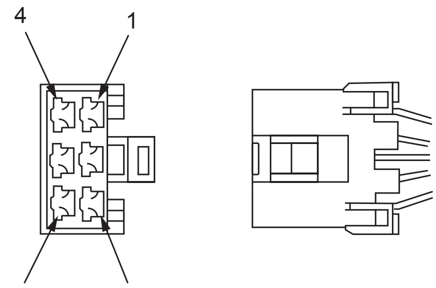
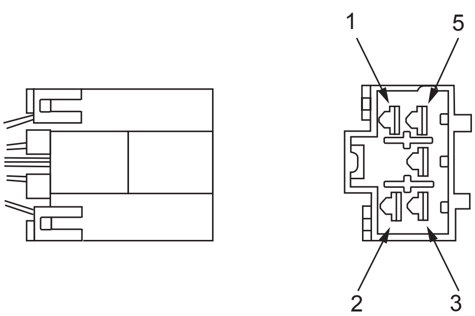
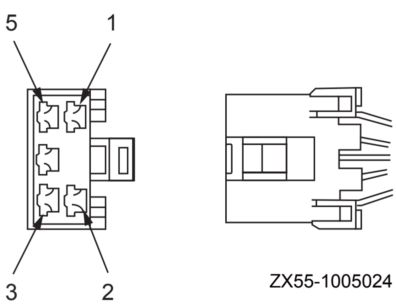
Pin(s)	AMP	
	Plug	Socket
1	735075-0  ZX55-1005007	–
2	282080-1  ZX55-1005008	282104-1  ZX55-1005009
3	AMP:282105-1  ZX55-1005010	 ZX55-1005011

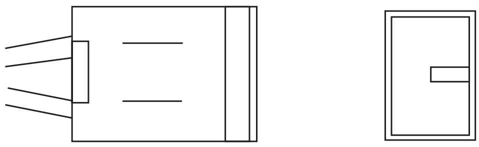
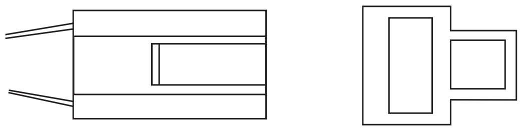
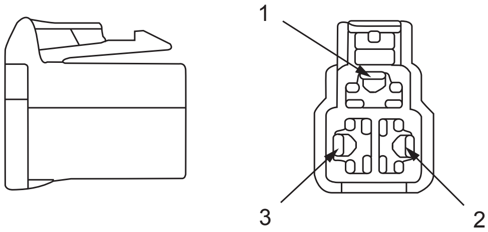
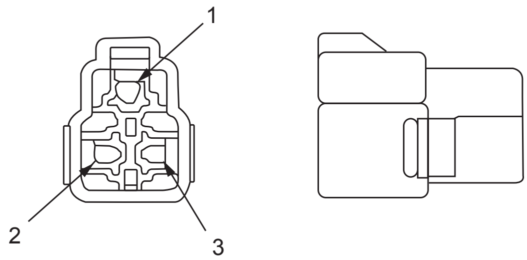
Pin(s)	Deutsch	
	Plug	Socket
8	DT04-8P  ZX55-1005012	DT06-8S  ZX55-1005013
12	DT04-12P  ZX55-1005014	DT06-12S  ZX55-1005015

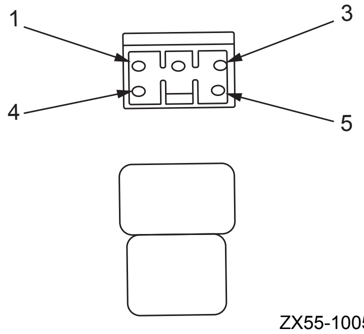
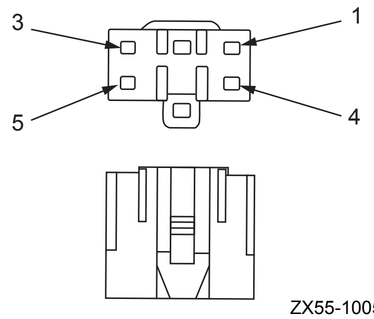
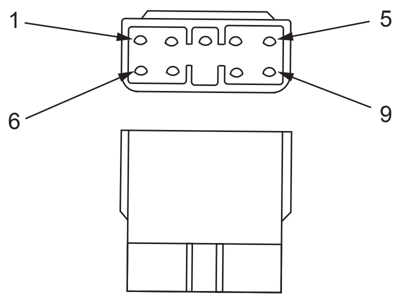
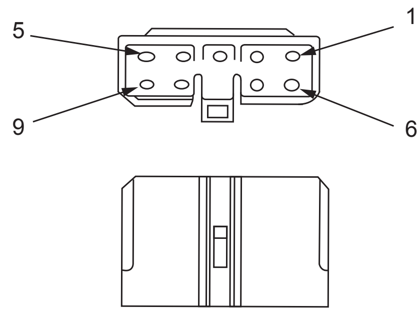
Pin(s)	Yazaki	
	Plug	Socket
1	X01FGY-M/C  ZX55-1005016	–
6	7123 — 7464 — 40  ZX55-1005017	7123-7464-30  ZX55-1005018

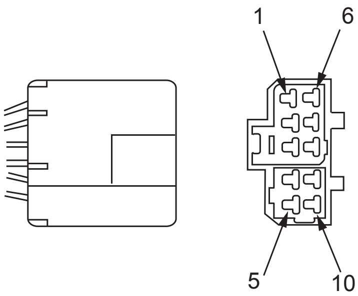
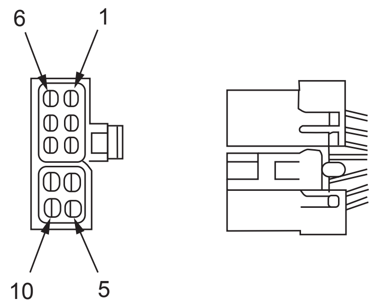
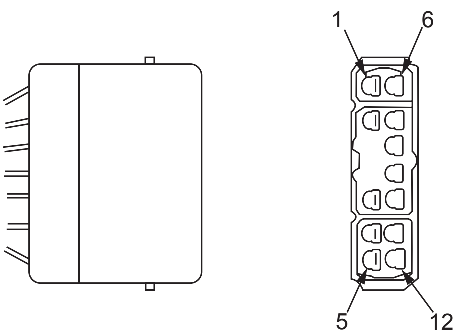
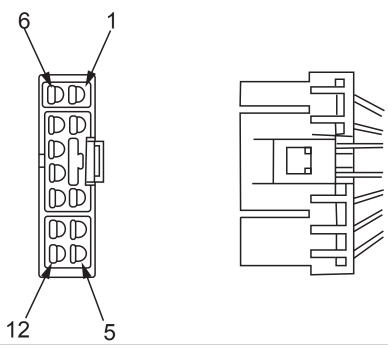
Pin(s)	**Hella**
8	H8JA713631  ZX55-1005019

Pin(s)	Delphi	
	Plug	Socket
3	12078090  ZX55-1005020	–

Pin(s)	DJ	
	Plug	Socket
6	7061Y-2.3-1.0  ZX55-1005021	 ZX55-1005022
5	7072-3-21  ZX55-1005023	 ZX55-1005024

Pin(s)	HSG	
	Plug	Socket
1	HSG 7122-3012  ZX55-1005025	–
2	7123-2128  ZX55-1005026	–
3	HSG 7123-2830  ZX55-1005027	 ZX55-1005028

Pin(s)	MIC	
	Plug	**Socket**
5	 ZX55-1005029	 ZX55-1005030
9		

Pin(s)	S type connector	
	Plug	**Socket**
5		
9		

7.5 Electric Wire Specif cations

In the electric circuit diagram, the material, thickness, and color of each electric wire are indicated by symbols. The electric wire code is helpful in understanding the electric circuit diagram.

e.g. AVX 1.25 B

- B — Color code indicating color of wire
- 1.25 — Nominal No. indicating size of wire (See table 2 for details)
- AVX — Wire symbol indicating type of wire (See table 1 for details)

Type, Symbol and Material

AVS, AVX and AEX are similar in thickness and outside diameter. AEX is different from AVX and AVS in material of the cover.

Type	Symbol	Material		Application temp. range (℃)	Example
Thin-cover, low-voltage wire for automobile	AVS	Conductor	Annealed copper for electric appliance	-30 ～ +80	General wiring (Nominal No. 3 and below)
		Insulator	Soft polyvinyl chloride		
Heat-resistant, low-voltage wire for automobile	AVX	Conductor	Annealed copper for electric appliance	-45 ～ +100	General wiring in cold areas, wiring in hot areas
		Insulator	Heat-resistant, cross-linked polyvinyl chloride		
Heat-resistant, low-voltage wire for automobile	AEX	Conductor	Annealed copper for electric appliance	-45 ～ +120	General wiring in extremely cold areas, wiring in hot areas
		Insulator	Heat-resistant, cross-linked polyvinyl chloride		

Dimensions

Nominal No.	Conductor			Cover		
	No. of strands/Dia. of strand (mm)	Sectional area (mm^2)	O.D. (mm)	AVS Std. O.D. (mm)	AVX Std. O.D. (mm)	AEX Std. O.D. (mm)
0.75f	30/0.18	0.76	1.2	2.2	2.2	2.2
-0.85	11/0.32	0.88				
1.25f	50/0.18	1.27	1.5	2.5	2.7	2.7
-1.25	16/0.32	1.29				
2f	37/0.26	1.96	1.9	2.9	3	3
-2	26/0.32	2.09	1.9	2.9	3.1	3.1
3f	58/0.26	3.08	2.3	3.5	-	-
-3	65/0.32	5.23	2.4	3.6	3.8	3.8
5	84/0.45	13.36				
15	41/0.8	20.61	9.8	-	7	7
20	169/0.8	84.96	4.8	-	8.2	8.2

7.6 How to Use the Judgement Chart

The judgement chart is a tool to determine whether a fault is caused by abnormality of the electrical system, the hydraulic system or the mechanical system. The abnormality indication (warning) displayed on the monitor panel is directly referred to the troubleshooting of Monitoring System. (See Troubleshooting of the Monitoring System)

Troubleshooting of travel system, work equipment and swing system

(Pilot hydraulic lockout, swing brake, power mode and travel speed)

Failure mode and judgement chart

Failure Symptom / Part(s) Causing the Failure		Pump						Control Valve											
		PC valve	LS valve	Servo plunger	Pump body	Filter screen	PTO spline shaft	Spool	Unload valve	Main relief valve	Pressure compensation valve	LS selector valve	LS oil circuit throttle valve	Safety and oil suction valve	Oil suction valve	Dozer blade valve	PPC valve	PPC shuttle valve	Central swivel joint
Travel, Swing and Work Equipment	All moving devices are slow or weak.	○	○		○				○	○									
	Engine speed drops considerably or engine stalls.	○		○															
	All work equipment and travel and slewing devices do not work.			○	○	○													
	Abnormal sound (around pump)			○															
	Precise control fails.		○										○						
Work Equipment	Boom moves slowly or is powerless.							○			○			○	○		○		
	Arm moves slowly or is powerless.							○			○			○	○		○		
	Bucket moves slowly or is powerless.							○			○			○	○		○		
	Boom fails to move.							○									○		
	Arm fails to move.							○									○		
	Bucket fails to move.							○									○		
	Hydraulic drift is too much.							○			○			○	○				
	Time delay is too much.										○			○					
Combined Operations	In work equipment operation the side with greater load moves slowly.										○								
	In swing and boom operation the boom-up speed is slow.											○							
	In swing and travel operation the travel speed drops too much.										○								
	In travel and work equipment operation (boom up) the travel speed drops too much.										○								
Travel System	Travel deviates: in the same forward and backward directions.							○			○						○		○
	Travel deviates: in different forward and backward directions.							○											○
	Bigger curve at the beginning							○											○
	Travel speed is low or powerless.								○	○									
	Steering operation is difficult.										○				○				○
	Unable to select travel speed.																		
	Travel fails (at only one side).														○				
Swing System	Unable to swing: in both directions																		
	Unable to swing: In one direction							○									○		
	Swing acceleration is poor.: in both directions										○								
	Swing acceleration is poor.: In one direction							○									○	○	
	Too much override upon swing stoppage.: in both directions																		
	Too much override upon swing stoppage.: In one direction							○									○		
	Too much shock (in one direction) upon swing stoppage							○									○		
	Too much noise upon swing stoppage																		
	Hydraulic drift of swing is too much.: Brake ON																		
	Hydraulic drift of swing is too much.: Brake OFF							○											
	Swing speed is more than the specified.		○																
Dozer Blade	Dozer blade moves slowly or is powerless.															○			
	Dozer blade fails to move.															○			
	Hydraulic drift of dozer blade is too much.															○			
	Electrical system troubleshooting mode																		

Solenoid Valve				Swing Motor				Travel Motor									
Swing Brake Solenoid	Travel Speed Selector Solenoid	PPC Hydraulic Pressure Lockout Solenoid	Mode Select Solenoid	Brake	Safety valve	Oil suction valve	In-sheel leak or crack	Balance valve	Check valve	Travel speed selector follow-up device	In-sheel leak or crack	Swing mechanism	Final drive	Hydraulic cylinder	Back pressure valve	Engine system	Hydraulic system troubleshooting mode
1) Connect T-connector to swing brake solenoid V4. 2) Operate swing lockout switch when start switch is ON. 3) Does the voltage between (1) and (2) of V4 meet the voltage given below?	1) Connect T-connector to travel speed selector solenoid V5. 2) Operate travel speed selector switch when start switch is ON. 3) Does the voltage between (1) and (2) of V5 meet the voltage given below?	1) Connect T-connector to PPC hydraulic lockout solenoid V1. 2) Operate PPC hydraulic lockout control when start switch is ON. 3) Does the voltage between (1) and (2) of V1 meet the voltage given below?	1) Connect T-connector to mode select solenoid V3. 2) Operate fuel control lever when start switch is ON. 3) Does the voltage between (1) and (2) of V3 meet the voltage given below?														
(Normal) SWING LOCK SWITCH / VOLT CHECK OFF / 20-30V ON / 0V	(Normal) TRL SPEED SELECT SW / VOLT CHECK Lo / 0V Hi / 20-30V	(Normal) HYD LOCK CTRL LEVER / VOLT CHECK UNLOCKED / 20-30V LOCKED / 0V	(Normal) FUEL CTRL LEVER / VOLT CHECK FULL SPEED / 0V LOW SPEED / 20-30V														
			○														H-1
																○	H-2
		○															H-3
																	H-4
																	H-5
														○			H-6
														○			H-7
														○			H-8
																	H-9
														○			H-10
																	H-11
																	H-12
																	H-13
																	H-14
																	H-15
										○		○					H-16
								○									H-17
																○	H-18
									○	○							H-19
										○							H-20
								○			○		○				H-21
				○			○					○					H-22
					○												H-22
							○										H-23
					○	○											H-23
							○										H-24
					○												H-24
																	H-25
					○	○						○			○		H-26
				○													H-27
					○	○	○										H-27
																	H-28
														○			H-29
																	H-30
														○			H-31
E-3 E-4	E-5	E-1 E-2	E-6														

Step 1

Find failure mode.

Ask the operator and determine, if possible, the failure (the symptom of fault on the machine). Find out the corresponding failure mode in the Judgement Chart.

Step 2

Determine whether it is a fault of the electrical system, hydraulic system or mechanical system.

A. Connect a Tee connector or a socket between the wiring harness and the connector with solenoid indicated with an "O" mark. Follow the troubleshooting steps to check whether the voltage in each checking location is normal.

B. Is the voltage identical to that in the chart (when it is normal)?

   Voltage identical to that in the chart (when it is normal) → Proceed with troubleshooting on hydraulic or mechanical system.

   Voltage not identical to that in the cart (when it is normal) → Proceed with troubleshooting on electrical system.

Step 3

Perform necessary troubleshooting (YES/NO diagnosis).

7.7 How to Use a Schematic Diagram for Troubleshooting

1. Troubleshooting codes and problems

   The title of troubleshooting schematics contains troubleshooting code and failure mode (problem of machine)

2. Identif cation

   The same failure mode (problem) can have different troubleshooting methods according to model, part or problem. In this case, the failure mode (problem) is further divided into a number of parts indicated with lowercase letters (such as a). Perform troubleshooting in the corresponding part.

   If there is only one troubleshooting table, begin troubleshooting with the f rst checking item.

3. The way of following troubleshooting f ow chart

- Check or measure the items in ☐ YES NO and enter the next ☐ according to the answer or following the line indicated with “YES” or “NO” .

(Note: The upper right number of ☐ is an index, not a serial number.)

- According to checking or measuring result, the cause column will be reached f nally following the “YES” line or the “NO” line. Check the cause and do as told in the Remedy column.
- Under ☐ is the method or judgement value used for checking or measuring. If the value under ☐ is correct or the answer to the question inside ☐ is “YES” , continue troubleshooting by following the “YES” line. If the value is incorrect or the answer is “NO”, follow the “NO” line.
- Under ☐ is preparatory work and judgement value necessary for checking and measuring. If the preparatory work is neglected or the operation and handling method are performed in a wrong way, it could lead to wrong judgement or machine damage. Therefore, carefully read the description inside ☐ and start from item 1) before checking and measuring operation.

4. General precautions

   For troubleshooting of failure mode (problem), precautions (indicated with ★) applicable to all items are provided on top of each page.

   No precautions (indicated with ★) are provided in ☐ , but the indicated ones must be followed when checking the item described in ☐ .

5. Installation location and pin number

   Sketch or schematic drawing is presented to describe the connector type, installation location and pin numbers. When troubleshooting is performed, see the schematic drawing of connector pin numbers and location detail for each failure mode (problem) and for checking and testing the lead connector numbers indicated in the f ow chart.

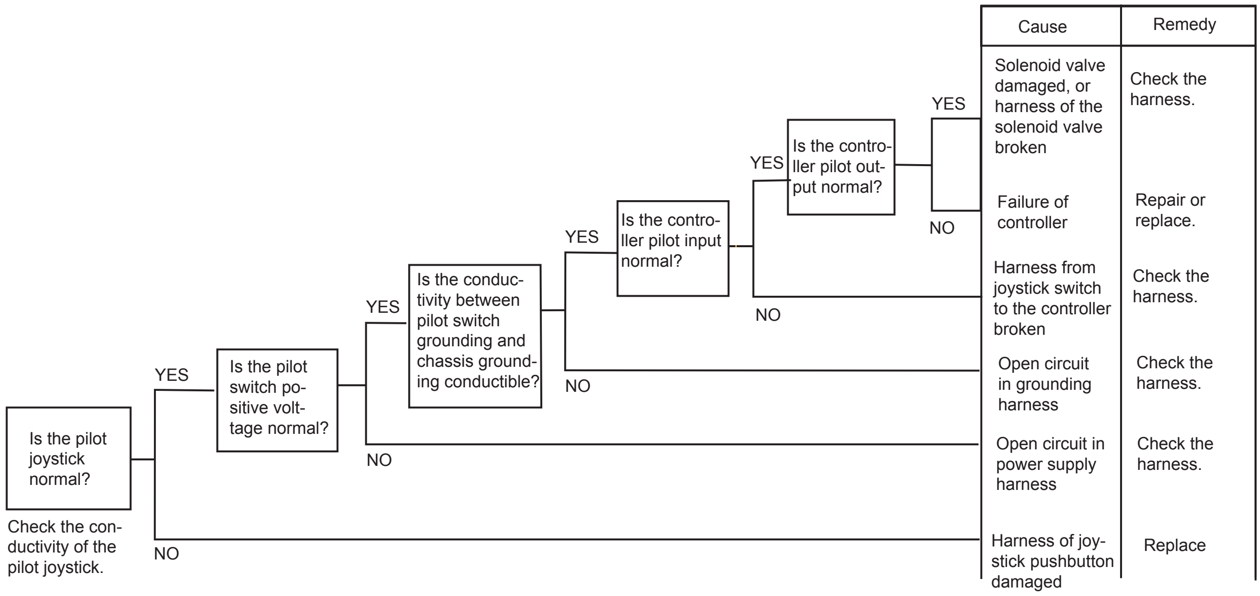
7.8 Troubleshooting the Electrical System

7.8.1 Troubleshooting the Electrical System

With the pilot joystick UNLOCKED, the machine does not move while operating the control levers.

★ Check related connectors for improper contact before carrying out troubleshooting.

★ Make sure that the disconnected connectors are restored before proceeding to the next step.



Related circuit diagram

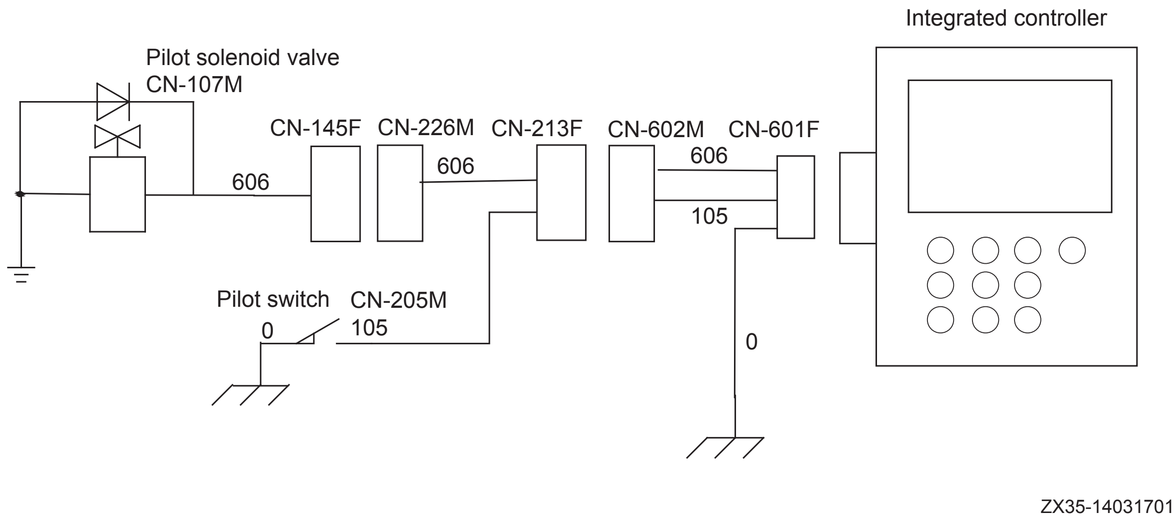
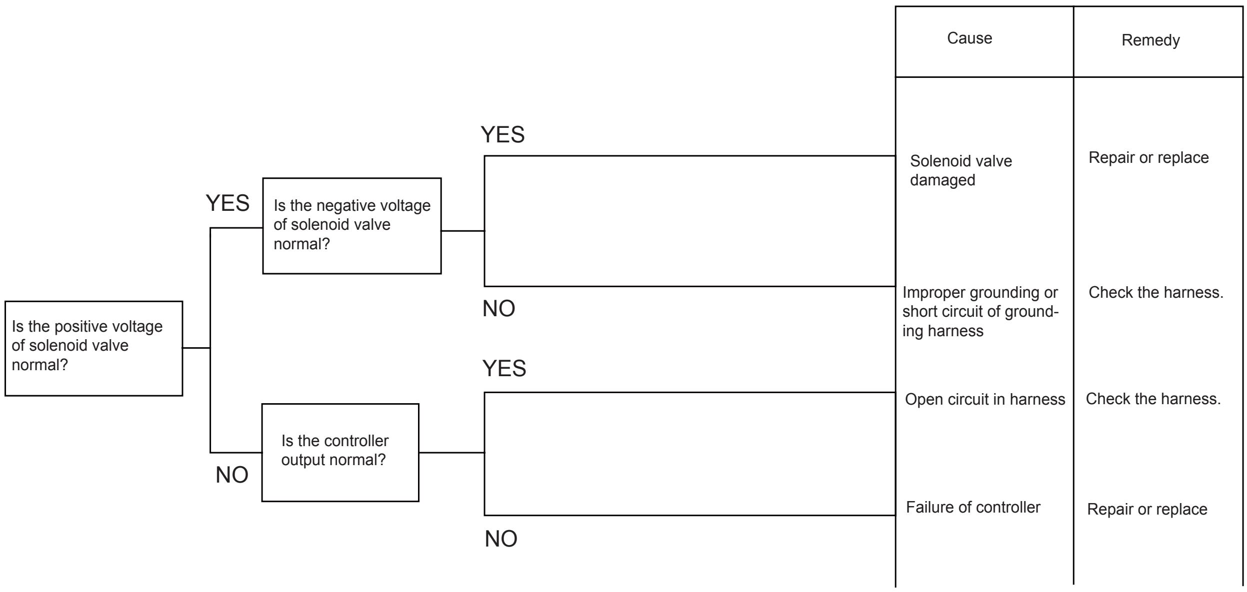


Fig. 7-3

7.8.2 Unable to shift travel speed

★ Check related connectors for improper contact before carrying out troubleshooting.

★ Make sure that the disconnected connectors are restored before proceeding to the next step.



Related circuit diagram

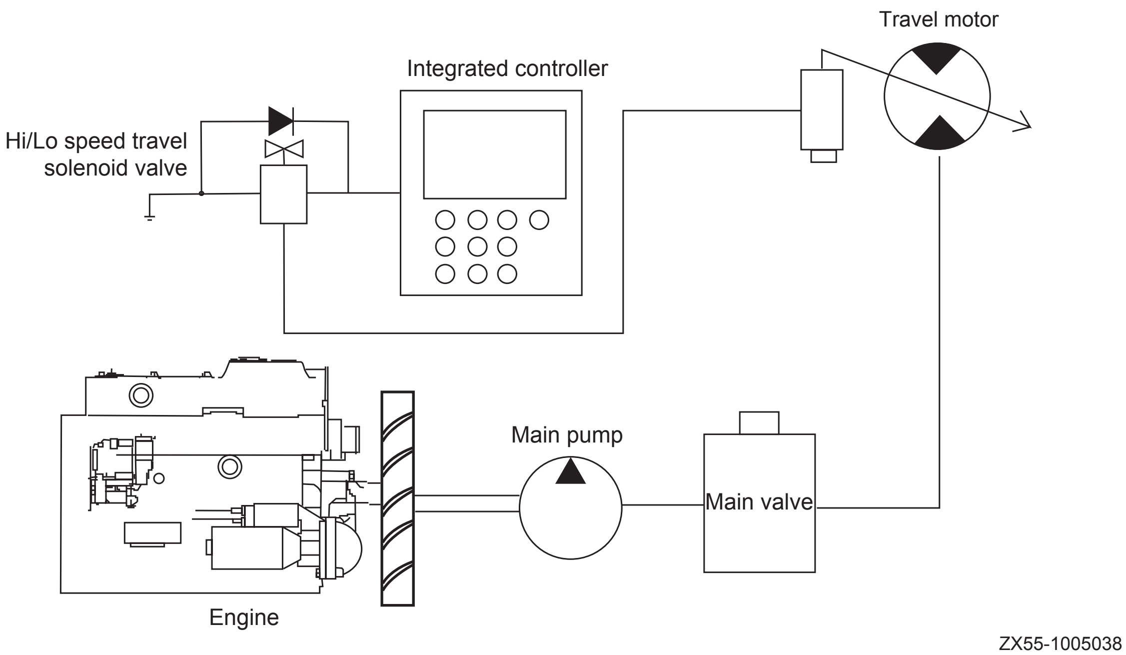
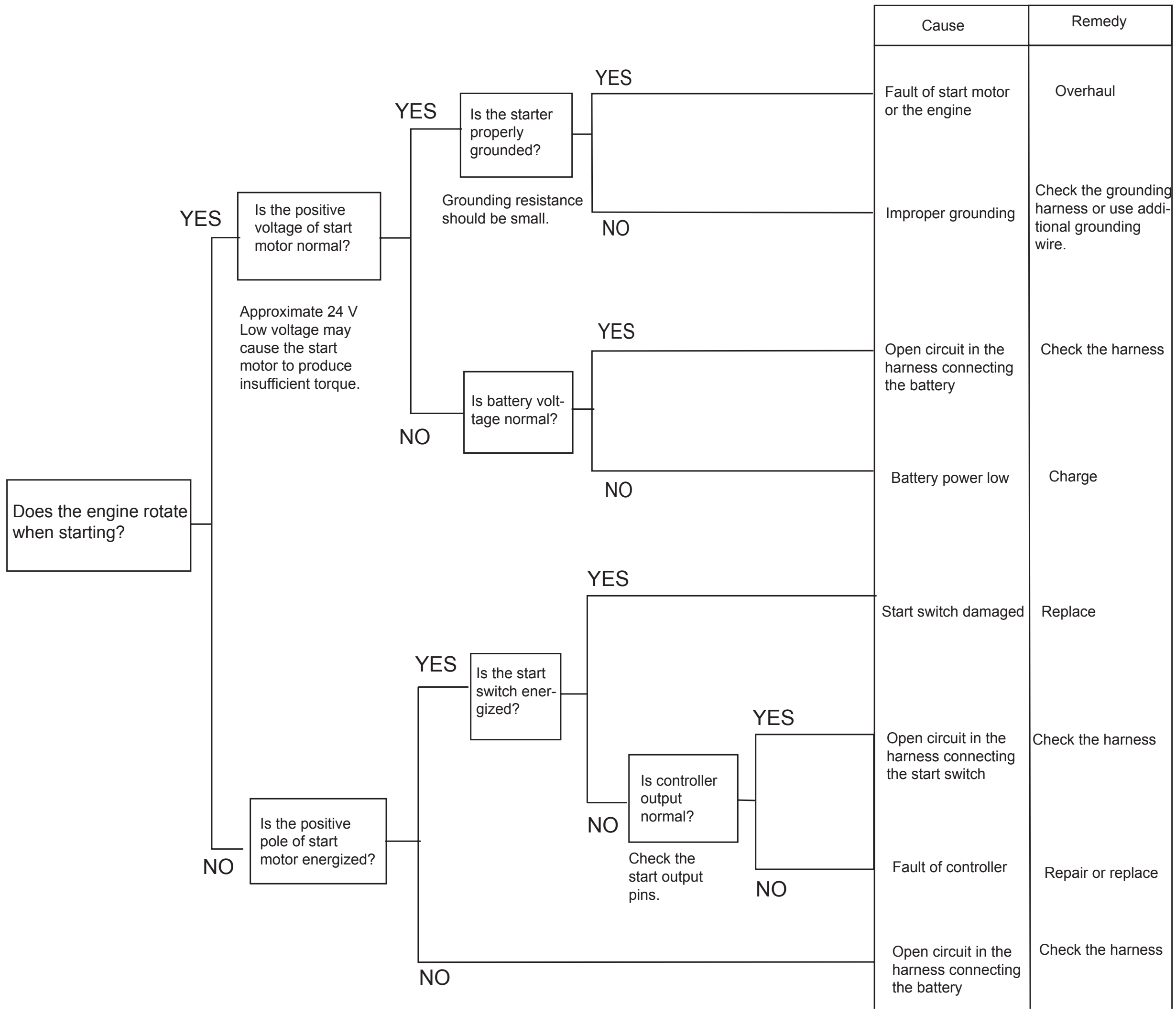


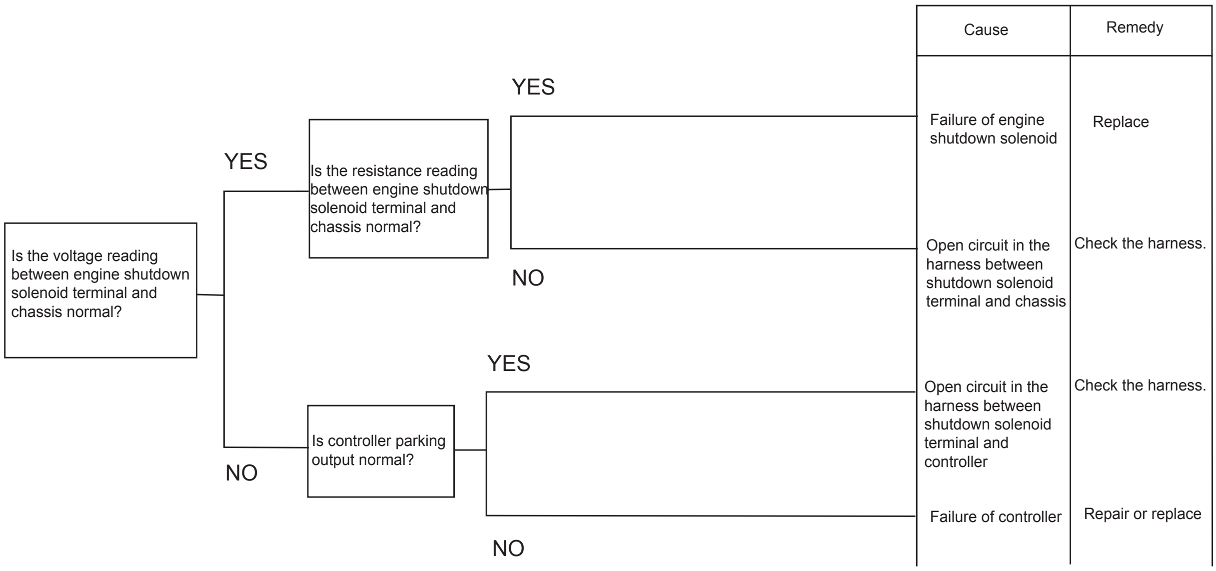
Fig. 7-4

7.8.3 Engine fails to start

- Check related connectors for improper contact before carrying out troubleshooting.
- Make sure that the disconnected connectors are restored before proceeding to the next step.



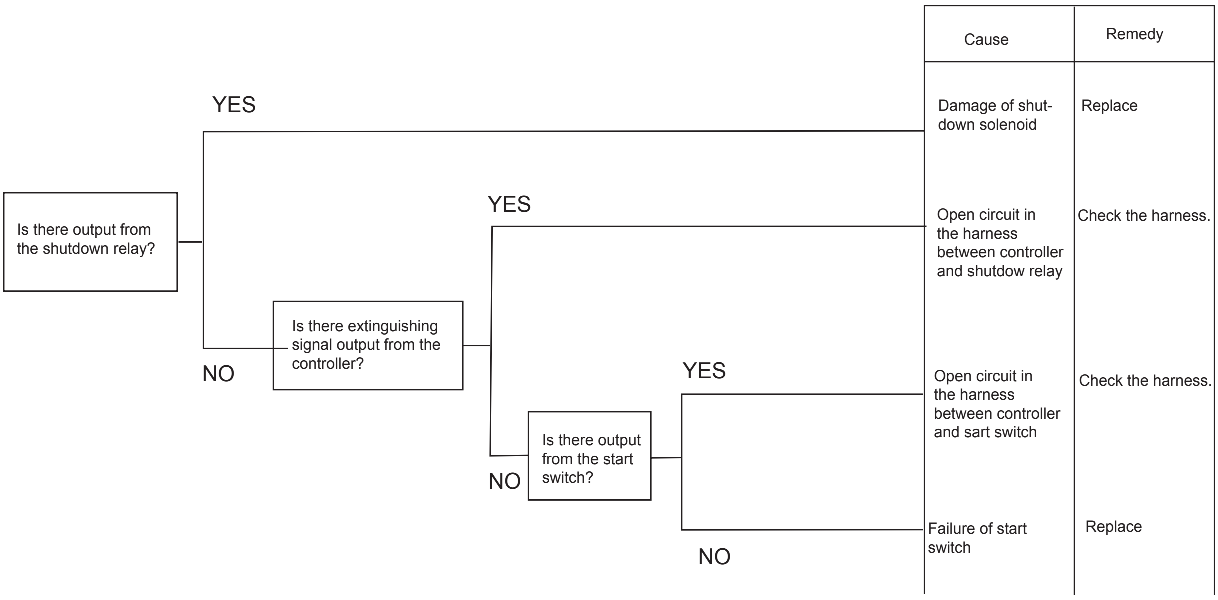
7.8.4 Engine parking solenoid fails



7.8.5 Unable to stop the engine

★ Check related connectors for improper contact before carrying out troubleshooting.

★ Make sure that the disconnected connectors are restored before proceeding to the next step.



Related circuit diagram

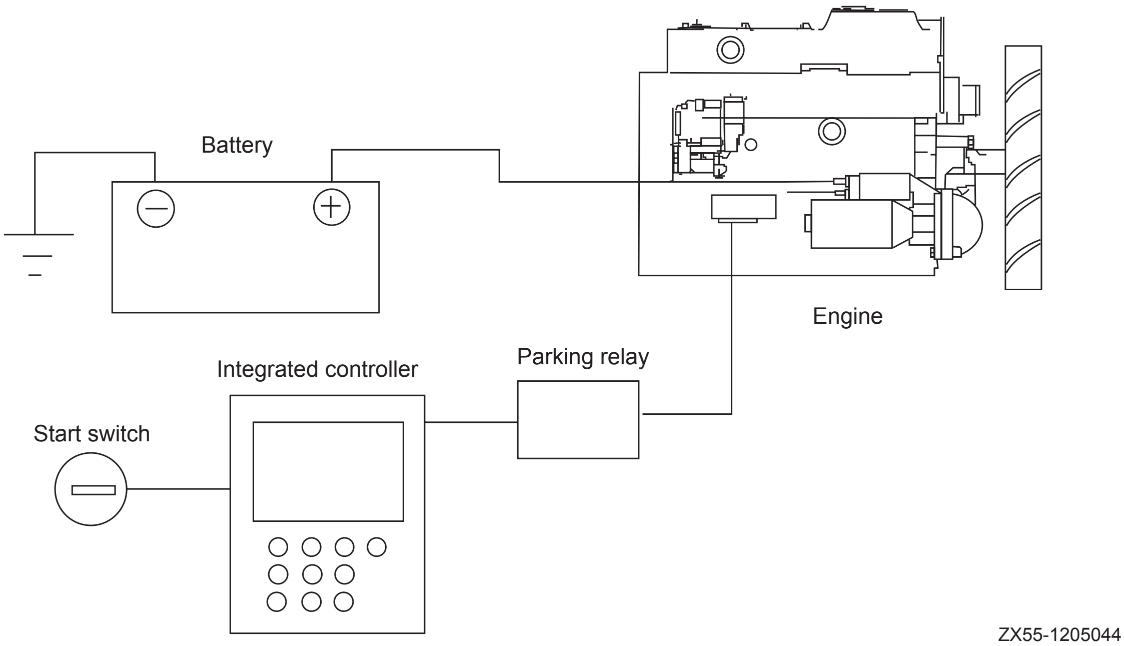
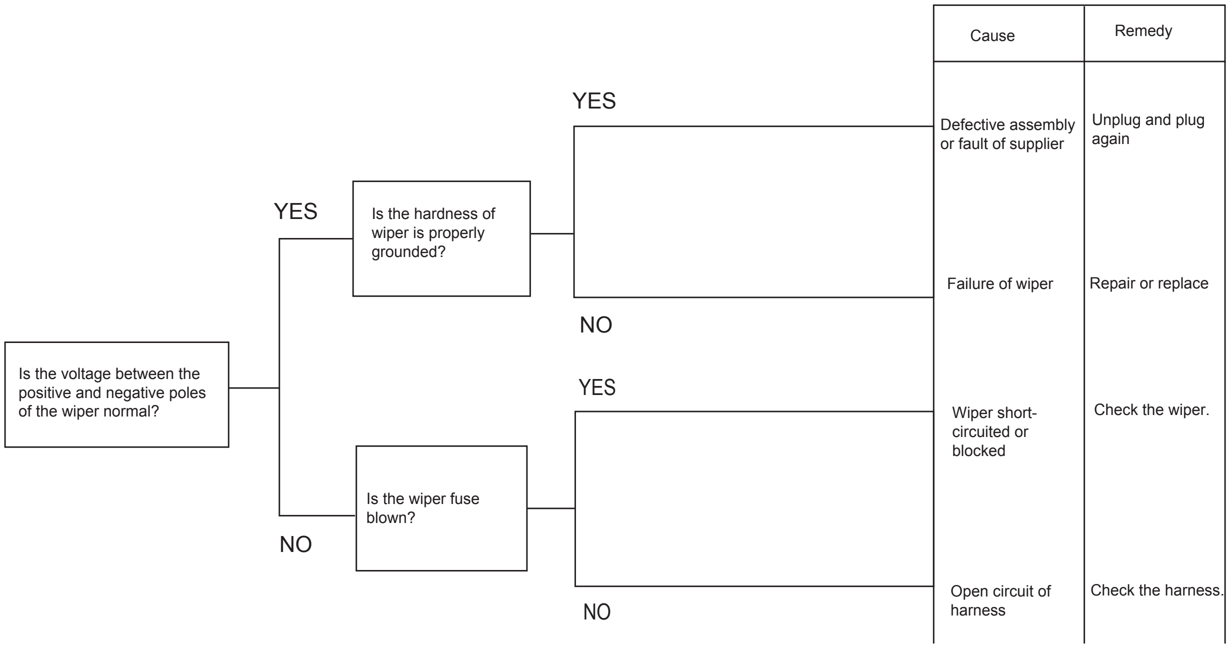


Fig. 7-5

7.8.6 Wiper fails

★ Check related connectors for improper contact before carrying out troubleshooting.

★ Make sure that the disconnected connectors are restored before proceeding to the next step.

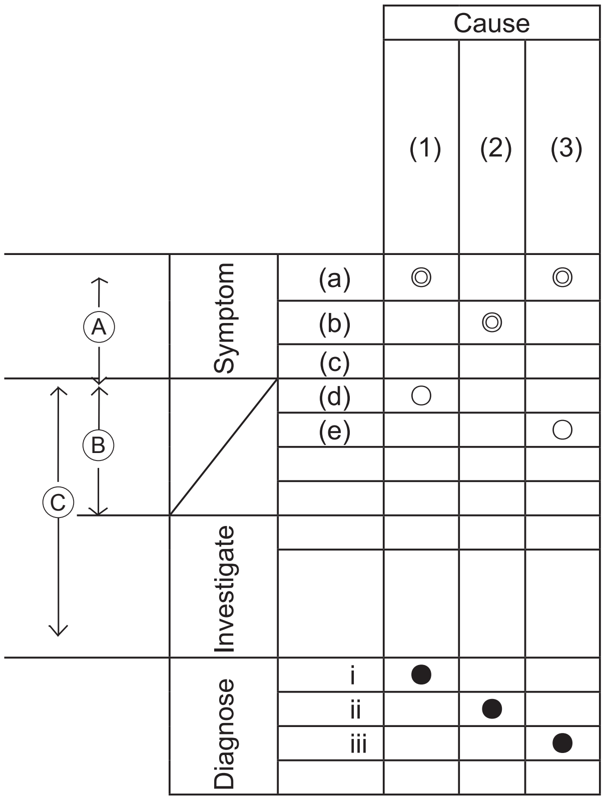


7.9 Troubleshooting the Engine

7.9.1 How to use the chart of troubleshooting

The Chart of Troubleshooting consists of three parts: Symptom, Investigate and Diagnose. “Symptom” and “Investigate” are used to point out the most possible causes through trouble symptoms or simple investigation without using any troubleshooting tools.

Troubleshooting tools or direct investigation are used to determine the most possible causes.



Symptom

Part Ⓐ + Ⓑ in the chart refers to information that can be provided by the user. Ⓑ refers to information that might be provided by users at different levels.

Investigate

Maintenance personnel shall carry out simple investigation in order to focus on the causes. Items below Ⓒ are corresponding checks.

The maintenance personnel shall focus on the possible causes according to information Ⓐ, which is drawn from the user and his own testing results.

Diagnose

“Diagnose” are performed in the possible sequence, starting from the most possible cause obtained from “Symptom” and “Investigate”.

The use of this Chart of Troubleshooting is described as the following:

In the chart, related items of “Symptom” and “Investigate” are marked with ○, while the most possible causes are marked with ◎.

Check each item of “Symptom” and “Investigate” and mark the corresponding problems with ○ or ◎. The “Cause” column with the most points shows the most possible cause. Therefore, the troubleshooting shall begin from the item that is decided as the f nal cause.

※1. “Records of recent repairs” under “Symptom” shall be obtained from the user and marked with △ as a reference for troubleshooting. However, this information shall not be counted when pinpointing the most possible causes.

※2. Causes marked with △ are used as reference. “Service hours (long-term operation)” under “Symptom” are also used as reference. Generally, This mark shall not be counted to determine the cause, but is can be counted when deciding on troubleshooting sequence.

			Air cleaner element plugged	Wear of piston ring and cylinder	Injection nozzle seized or blocked	Injection timing incorrect	Failure of injection pump (excessive injection)	
※1	Records of recent repairs							
※2	Service hours	Long-term operation	△	△	△			

- An example of troubleshooting black exhaust gas

  Suppose a clogged air cleaner is the cause for black exhaust gas. This trouble is shown by 3 symptoms: a) Exhaust gas becomes black gradually; b) Power is decreasing slowly; c) Air cleaner sensor alarm.

  Five causes can be found after an investigation. This example explains how to use the cause-effect relationship to f nd out the most possible causes.

7 Black exhaust gas (incomplete combustion)

General causes:

- Insuff cient air intake
- Improper injection condition
- Excessive injection

Symbols:
○ : Possible causes (judged by Symptom and Investigate).
◎ : Most possible causes (judged by Symptom and Investigate).
△ : Long service hours may be a possible cause.
● : Item that determines the Cause.

			Air cleaner element plugged	Wear of piston ring and cylinder	Injection nozzle blocked or seized	Injection timing incorrect	Failure of injection pump	Air valve clearance incorrect	Muff er squeezed or plugged	Improper contact of air valve	Failure of injection pump
Symptom	Records of recent repairs										
	Service hours	Long service hours	△	△	△					△	
	Exhaust gas color	Blacken suddenly									○
		Blacken gradually	◎		○						
		Blue under light load		◎							
	Engine oil must be added more often.			◎							
	Power loss	Suddenly			○				○		○
		Gradually	○	○						○	
	Unapproved fuel has been used all the time.				○						○
	Air cleaner sensor alarms.										
	Excessive blow-by		◎								
	Poor engine acceleration performance or nonuniform combustion										
Investigate				◎							
					◎			○	○		○
	Feel the exhaust manifold with hand immediately after the engine is started. Temperature of air cylinders is low.				◎						○
	The matching marks on the injection pump are not aligned.					◎					
	Seal of injection pump has detached.						◎				
	Clang is heard around the cylinder head.							◎			
	Abnormal noise of exhaust				○				◎		
	The muff er was squeezed.								◎		
	Air cleaner is blocked.		●								
	The compression force measured is too low.			●						●	
	The rpm of some cylinders does not change when pressure-reducing cylinder is operated.				●						
	Injection timing found wrong when checked with oil f ow method.					●					
	Injection pump testing suggests improper injection amount.						●				
	The air valve clearance is out of the standard range.							●			
	Exhaust gas color turns normal when muff er is removed.								●		
	The adjusting rack is heavy or does not return when pushed.										●
	Remedy		Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Replace	Replace

Five causes

Be clear of the relationship between the three symptom in the [symptom] and [investigate] and the f ve causes in the columns.

Three symptoms

Count the total number of ○ and ◎ at where the row of symptom meets the column of cause.

Air cleaner element is plugged: ◎○◎

Air leaks between turbocharger and cylinder head: ○○

Injection nozzle is blocked or seized: ○

Improper contact of air valve with its seat: ○

Wear of piston ring and cylinder: ○

Step 2 shows that it is more likely to be caused by the plugging of air cleaner. Go to the diagnostic area along this line and exclude the items marked with ● . The given method is [cleaning]. Cleaning should be able to restore the exhaust gas to its normal color.

7.9.2 Poor starting performance

It always takes extra time to start.

General causes for smoking but poor starting performance

- Failure of the electrical system
- Insuff cient fuel feed
- Low air intake
- Inappropriate fuel selection

(Diesel oil ASTM D975 #1 should be used at where the ambient temperature is -10ºC or below.)

Diesel type	10#	5#	0#	-10#	-20#	-35#	-50#
Minimum applicable temperature	Diesel engine equipped with a pre-heater	8℃	4℃	-5℃	-14℃	-29℃	-44℃

The above temperature is the lowest local temperature risking 10% in the month. Reference from GB 252-2000.

★ Battery charging rate

Ambient temp \ Charging rate	100%	90%	80%	75%	70%
20° C	1.28	1.26	1.24	1.23	1.22
0° C	1.29	1.27	1.25	1.24	1.23
-10° C	1.30	1.28	1.26	1.25	1.24

- The specif c gravity of battery shall be greater than the value corresponding to charging rate of 70%.
- In a cold area, the specif c gravity shall be greater than the value corresponding to the charging rate of 75%.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause															
			Wear of piston ring and cylinder	Improper contact of air valve with its seat	Air cleaner element plugged	Fuel filter or primary filter element plugged	Feeder pump screen plugged	Failure of intake air heater	Failure of alternator (with external regulator)	Failure of alternator (built-in regulator)	Failure or aging of battery	Failure of injection nozzle	Injection timing incorrect	Failure of injection pump (seized rack or plunger)	Leaking or blocking of fuel lines; air exists in fuel pipe	Plugging of fuel system breather	Failure of feeder pump	Boosting compensator cancelling function fails.
Symptom	Confirm records of recent repairs																	
Symptom	Service hours	Long service hours			△	△	△				△							
Symptom	Starting problems	Getting worse	◎	◎	○	○	○											
Symptom	Starting problems	Warm-up start						◎			◎							◎
Symptom	Preheat indicator does not light up.							◎										
Symptom	Consumption of engine oil increases.		◎															
Symptom	Filter element was not replaced as per Operation and Maintenance Manual.				◎	◎	◎											
Symptom	Unapproved fuel has been used all the time.					○	○											
Symptom	The dust indicator light is ON.				◎													
	The battery charging indicator light is ON.											○		○				
	The start motor runs slowly.																	
	Feel the exhaust manifold with hand after the engine is started. Temperature of some cylinders is low.								◎	◎								
Investigate	Engine acceleration is not stable and combustion not uniform.		○	○							◎							
Investigate	Excessive blow-by		◎									◎						
Investigate	The matching marks on the injection pump are not aligned.											◎						
Investigate	Dirt covers the fuel tank cap breather														○			
Investigate	When the start motor is used to start the engine, 1)Only a small amount of fuel is seen coming out even if injection pump connecting nuts are loosened.												◎					
Investigate	2)Only a small amount of fuel is seen coming out even if fuel filter bleeding plug is loosened.					◎	◎						◎			◎		
Investigate	Leaking in the fuel lines													◎				
Investigate	Engine vibrates (or rotates unstably).					○	○							◎	○			
Diagnose	The compression force measured is too low.		●	●														
Diagnose	The filter element of air cleaner is blocked.				●													
Diagnose	The element of fuel filter or primary filter is blocked.					●									●			
Diagnose	The primary filter element of feeder pump is blocked						●											
Diagnose	The heater does not heat up.							●										
Diagnose	Is the voltage between the alternator terminals B and E 13-15V while the engine is running at low idle?	Yes							●									
Diagnose	Is the voltage between the alternator terminals B and E 13-15V while the engine is running at low idle?	No								●								
Diagnose	Either low specific gravity of the electrolyte or low voltage of the battery										●							
Diagnose	The speed does not change while operation of some cylinders is stopped.											●						
Diagnose	The control rack is felt resistant or does not return when pushed. (By removing the sealing cap on the back of the pump, you may find that the sleeve of the plunger control valve does not move.)													●				
Diagnose	The fuel tank cap breather is blocked.															●		
		Remedy	Replace	Repair	Clean	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Repair	Clean	Replace	Replace

7.9.3 Engine fails to start

Engine fails to rotate

General causes:

- Seizure of internal engine parts

★ If any internal part of the engine is seized, perform troubleshooting on "engine failure during operation."

- Failure of electrical system
- Failure of power train

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause								
			Failure of the line of the starting circuit	Failure or aging of battery	Failure of start motor	Cracking of gear ring	Failure of safety relay or safety switch	Failure of battery relay	Battery terminal connection error	Failure of fuel cutoff solenoid	Failure of start switch
Symptom	Conf rm records of recent repairs										
Symptom	Service hours	Long service hours		△		△					
Symptom	Horn condition when start switch is turned to ON.	Dead horn	◎						○		○
Symptom		Horn volume low		◎							
	When the start switch is turned to the START position and the pinion gear moves outward,	The rotating speed decreases.		◎							
		Harsh sound is produced.			◎	◎					
		It is disengaged immediately.					◎				
		It clicks but does not rotate.		○	○		○				
Investigate	When the start switch is turned to the START position and the pinion gear does not engage		◎	○							
Investigate	There is no click when the start switch is turned to the ON position.		Perform diagnosis on the faulty line of the starting circuit.	○				◎			
Investigate	Loose battery terminal								◎		
Investigate	When start switch is turned to the ON position and the linkage does not move,									◎	
Investigate	Battery electrolyte level is low.			◎							
Diagnose	The specif c gravity of electrolyte is small and the battery voltage is low.			●							
Diagnose	Under the conditions from 1) to 5), turn OFF the start switch, connect the wires and carry out troubleshooting: 1)The engine starts when the start switch terminals B and C are connected.				●						●
Diagnose	2)The engine starts when the start motor terminals B and C are connected.						●				
Diagnose	3)The engine starts when the safety relay terminals B and C are connected.						●				
Diagnose	4)The engine starts when the safety switch terminal and the start motor terminal B are connected.							●			
Diagnose	5)The voltage between battery relay terminal b and terminal E is not 24V.					●					
Diagnose	Cracks are found on the surface of gear ring.										
Diagnose	No movement is seen even if the fuel cutoff solenoid link is disconnected.									●	
		Remedy		Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

The engine rotates but produce smoke

With no fuel injection

General causes:

- No fuel feeding.
- Fuel feed is too small.
- Inappropriate fuel selection (esp. in winter)

★ Applicable fuel standard

Fuel Type	Ambient Temperature						
	-4	14	32	50	68	86°	F
	-20	-10	0	10	20	30°	C
Diesel	ASTM D975 No.2						
	GB252 QUALITY-20 DIESEL OIL						
	GB252 QUALITY-35 DIESEL OIL						

Symbols:

○ : Possible causes (judged by Symptom and Investigate).
◎ : Most possible causes (judged by Symptom and Investigate).
△ : Long service hours may be a possible cause.
● : Item that determines the Cause.

			Crack of drive shaft and key of injection pump	Injection pump error (seized rack and plunger)	Feeder pump plunger is seized or cracks.	Fuel f lter or primary f lter element plugged	Feeder pump screen plugged	Insuff cient fuel in the rack	Fuel line is blocked or leaks.	Fuel tank breather is blocked.	Failure of fuel cutoff solenoid	Failure of engine shutdown motor	Incorrect fuel
Symptom	Conf rm records of recent repairs												
Symptom	Service hours	Long service hours				△	△			△			
Symptom	Smoke disappears suddenly when restarted.		◎	◎	◎								
Symptom	Filter element not replaced as per Operation and Maintenance Manual.					◎	◎						
Symptom	Fuel tank is empty.							◎					
Symptom	Fuel line leaks.								◎				
Symptom	Dirt covers the fuel tank cap breather.									◎			
	Linkage does not move when start switch is turned to ON position.										◎	◎	
	No fuel is seen f owing out when the fuel f lter element is drained.												◎
Investigate	When the start motor is used to start the engine, 1)The coupling of injection pump does not rotate.		◎										
Investigate	2)No fuel f ows out when air vent plug of f lter element is loosened.		◎			○	○						○
Investigate	3)No fuel squirts out when injection pump connecting nuts are loosened.		◎	◎	◎								
Investigate	Rust and water are found in the fuel drained.					○	○						
Diagnose	Check the injection pump directly.		●										
Diagnose	The control rack is felt resistant or does not return when pushed.			●									
Diagnose	Check the feeder pump directly. Check the feeder pump directly.				●								
Diagnose	The fuel f lter element and the primary f lter are plugged.					●							●
Diagnose	The screen of feeder pump is plugged.						●						
Diagnose	The fuel tank cap breather is blocked.									●			
Diagnose	No movement is seen even if the fuel cutoff solenoid link is disconnected.										●		
Diagnose	No movement is seen when engine shutdown motor link is disconnected.											●	
		Remedy	Replace	Replace	Replace	Clean	Clean	Add	Repair	Repair	Replace	Replace	Replace

Fume is seen but the engine does not start

With fuel injection

General causes:

- Rotating power looses due to failure of the electrical system.
- Insuff cient fuel feeding
- Insuff cient air intake
- Inappropriate selection of fuel and oil

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

		Cause											
		Valve system (valve or rocker arm) fails or cracks .	Failure of injection pump (seized rack and plunger)	Wear of piston ring and cylinder sleeve	Fuel f lter or primary f lter element plugged	Feeder pump screen plugged	Air cleaner element plugged	Failure of intaken air heater	Failure or aging of battery	The fuel system leaks or is blocked.	Injection nozzle is blocked and the injection fails.	The fuel tank breather is blocked.	Use of inappropriate fuel
Symptom	Conf rm records of recent repairs												
Symptom	Service hours — Long service hours			△	△	△					△		
Symptom	Engine starting fails suddenly.	◎	◎										
Symptom	When the engine is started, abnormal noise is heard around the cylinder head.	◎											
Symptom	Engine oil must be added more frequently.			◎									
Symptom	Unapproved fuel was used.		○								○		
Symptom	Filter element was not replaced as per Operation and Maintenance Manual.				◎	◎	◎						
Symptom	Rust and water are found in the fuel drained.				◎	◎							
Symptom	Air cleaner sensor alarms.						◎						
	The indicator fails to light up.							◎					
	The start motor starts the engine slowly.								◎				
	Dirt covers the fuel tank cap breather											○	
	The stopper is not reached when fuel control lever is placed at FULL position.		○										
Investigate	When the start motor is used to start the engine, 1)Only a small amount of fuel is seen f owing out even if the injection pump connecting nuts are loosened.		◎										
Investigate	2)No fuel f ows out when air vent plug of f lter element is loosened.				◎	◎							○
Investigate	Fuel line leaks.									◎			
Investigate	Feel the exhaust manifold with hand immediately after the engine is started. Temperature of cylinder is low.										◎		
Investigate	No fuel is seen f owing out when the fuel f lter element is drained.												◎
Diagnose	Check it directly by removing the cover of cylinder head.	●											
Diagnose	The control rack is felt resistant or does not return when pushed.		●										
Diagnose	The compression force is found low.			●									
Diagnose	The elements of fuel f lter and primary f lter are blocked.				●								●
Diagnose	The feeder pump screen is plugged.					●							
Diagnose	The air cleaner element is plugged.						●						
Diagnose	The heater does not heat up.							●					
Diagnose	Small specif c gravity of electrolyte or low battery voltage								●				
Diagnose	The resistance is little or too much when operating the feeder pump.									●			
Diagnose	The speed does not change when operation of some cylinders are stopped.										●		
Diagnose	The fuel tank cap breather is blocked.											●	
	Remedy	Replace	Replace	Replace	Replace	Clean	Clean	Clean	Repair	Replace	Repair	Clean	Clean

7.9.4 Engine acceleration is unstable

Poor follow-up performance

General causes:

- Insuff cient air intake
- Insuff cient fuel feeding
- Inappropriate injection condition
- Use of incorrect fuel

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause: Air cleaner element plugged	Fuel f lter or primary f lter element plugged	Feeder pump screen plugged	Injection failure due to clogged injection nozzle	Plunger of injection pump is seized.	Wear of piston ring and cylinder sleeve	Turbocharger seized or interfering	Air valve clearance is incorrect.	The fuel tank breather is blocked.	Fuel line is blocked or leaks.	Improper contact of air valve with its seat
Symptom	Conf rm records of recent repairs												
Symptom	Service hours	Long service hours	△	△	△			△					△
Symptom	Filter element was not replaced as per Operation and Maintenance Manual.		◎	◎	◎								
Symptom	Unapproved fuel has been used all the time.			◎	◎	◎	◎						
Symptom	Engine oil must be added more often.							◎					
Symptom	Rust and water are found in the fuel drained.			◎	◎								
Symptom	Air cleaner sensor alarms.		◎										
Symptom	Interference noise around turbocharger								◎				
	Engine acceleration becomes worse suddenly.					○			◎		○	○	
	Color of exhaust gas	Blue under light load				○		◎					
	Color of exhaust gas	Black	◎			◎			◎				○
Investigate	Clangs are heard around the cylinder head.									◎			
Investigate	Dirt covers the fuel tank cap breather										◎		
Investigate	Fuel line leaks.											◎	
Investigate	Engine speed is normal at unloaded high idle but drops suddenly when loaded.			◎	◎						○		
Investigate	Engine vibrates (rotates unstably).			○	◎	○					○		
Investigate	Feel the exhaust manifold immediately after the engine is started. Temperature of cylinder is low.					◎	○						
Investigate	Excessive blow-by							◎					
Diagnose	The air cleaner element is blocked.		●										
Diagnose	The fuel f lter element and the primary f lter element are blocked.			●									
Diagnose	The feeder pump screen is plugged.				●								
Diagnose	The speed does not change when operation of some cylinders is stopped.					●							
Diagnose	The control rack is felt resistant or does not return when pushed.						●						
Diagnose	Compression force is low.							●					●
Diagnose	Great resistance is felt when you turn the turbocharger with hand.								●				
Diagnose	The air valve clearance is out of standard range.									●			
Diagnose	The fuel tank cap breather is blocked.										●		
Diagnose	The feeder pump operates too easy or too diff cult.											●	
		Remedy	Clean	Clean	Clean	Repair	Replace	Replace	Replace	Adjust	Clean	Repair	Replace

7.9.5 Engine stops during operation

General causes:

- Internal part of engine is seized.
- Insuff cient fuel feeding
- Overheating

★ When overheated with engine stoppage, perform diagnostic analysis on overheating.

- Failure of power train

★ If the engine stops due to failure of the power train, perform diagnostic analysis on the chassis.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause: Piston or lever breaks or is seized.	Crankshaft bearing breaks or is seized.	Valve system breaks (valve and rocker arm)	The gear breaks or is seized.	The auxiliary equipment of pump breaks.	The injection pup drive shaft or key breaks	Fuel insuff ciency	Fuel f lter or primary f lter element plugged	Primary f lter element of feeder pump clogged.	Feeder pump plunger is broken or seized.	Fuel line is blocked or leaks.	Fuel tank breather is blocked.	Injection pump error (seized rack or plunger)	Failure of power train
Symptom	Conf rm records of recent repairs															
Symptom	Service hours	Long service hours								△	△					
Symptom	Conditions when engine stops	Engine stops suddenly at abnormal sound.	◎	◎	◎	◎	◎	◎				○			○	◎
Symptom	Conditions when engine stops	Engine is overheated and stops.	◎	○			○									
Symptom	Conditions when engine stops	Engine stops gradually.							◎	○	○					
Symptom	Conditions when engine stops	Engine stops due to vibration.							◎	○	○			○		
Symptom	Fuel level indicator light comes on.								◎							
Symptom	Fuel tank is empty.								◎							
	Filter element not replaced as per Operation and Maintenance Manual.									◎	◎					
	Unapproved fuel has been used all the time.									○	○	○			○	
	The feeder pump fails or operates sluggishly.									○	○		◎			
Investigate	Dirt covers the fuel tank cap breather.													◎		
Investigate	The engine is running but stops when the power train is operated.															◎
Investigate	Test run manually with barring gear.	No rotation	◎	◎												
Investigate	Test run manually with barring gear.	Rotate in the opposite direction.			◎											
Investigate	Test run manually with barring gear.	Moving distance is equivalent to back clearance.				◎	◎									
Investigate	Test run manually with barring gear.	The shaft does not rotate.						◎								
Investigate	Rust and water are found in the fuel drained.									◎	◎					
Investigate	Metallic chips are found in the oil drained.		◎	◎						○	○					
Diagnose	Remove and check the engine oil pan.		●	●												Chassis Diagnose
Diagnose	Remove and check the cylinder head cover.				●											
Diagnose	The gear does not rotate when the gear system is checked.					●										
Diagnose	The pump runs after the pump’s auxiliary device is removed.						●									
Diagnose	The fuel f lter element and the primary f lter element are blocked.									●						
Diagnose	The feeder pump screen is plugged.										●					
Diagnose	Check the feeder pump directly.											●				
Diagnose	The control rack is felt resistant or does not return when pushed.														●	
		Remedy	Replace	Replace	Replace	Replace	Replace	Replace	Add	Clean	Clean	Replace	Repair	Clean	Replace	

7.9.6 Engine rotates unstably (vibrates)

General causes:

- Air present in the fuel system
- Failure of speed governor
- Failure of electronic speed governor (if equipped)

★ If the vibration stops when the electronic governor rod disengages, perform diagnostic analysis on the chassis.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause: Failure in operation of governor	Error of governor adjustment	Failure in operation of control rack	Low idle is too low.	Insuff cient fuel	Feeder pump screen plugged	Fuel f lter or primary f lter element plugged	Oil circuit between fuel tank and feeder pump is blocked; air exists in the circuit	Oil circuit between feeder pump and injection nozzle is blocked; qir exists in the circuit.	The fuel tank breather is blocked.
Symptom	Conf rm records of recent repairs											
Symptom	Service hours	Long service hours						△	△			
Symptom	Conditions for vibration	Within certain speed range	◎	◎	◎							
Symptom	Conditions for vibration	At low idle	○			◎		○	○	○	○	
Symptom	Conditions for vibration	Even if the speed increases	○	○	○							○
Symptom	Conditions for vibration	On a slope					◎					
Symptom	Fuel tank is empty						◎					
Symptom	Filter element was not replaced as per Operation and Maintenance Manual.							◎	◎			
	Rust and water are found in the fuel drained.							○	○			
	Fuel line leaks.									◎	◎	
	When the feeder pump is operated,									◎		
Investigate	1)No response, too light, quick return									◎		
Investigate	2) No response, too light, normal return											
Investigate	Engine speed sometimes increases too fast.			◎	◎							
Investigate	Sometimes it is diff cult to stop the engine.			◎		◎						
Investigate	Seal of injection pump detaches.				◎		◎					
Diagnose	It is diff cult to move the shift lever.		●		●							
Diagnose	Adjustment of governor is found inappropriate when checking injection pump.			●								
Diagnose	The control rack is felt resistant or does not return when moved.				●							
Diagnose	The fuel tank cap breather is blocked.					●						●
Diagnose	The primary f lter of feeder pump is blocked.							●				
Diagnose	The fuel f lter element and the primary f lter are blocked.								●			
		Remedy	Adjust	Adjust	Adjust	Adjust	Add	Clean	Clean	Repair	Repair	Clean

7.9.7 Low power output (lack of power)

General causes:

- Insuff cient air intake and fuel feeding
- Inappropriate injection condition
- Use of incorrect fuel

(Power output may drop if unapproved fuel is used.)

- Lower power output caused by overheating.

★ If the engine is overheated or lacks power output, perform diagnostic analysis on overheating.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause											
			Air cleaner element plugged	Wear of piston ring and cylinder	Fuel f lter or primary f lter element clogged	Feeder pump screen plugged	Nozzle plugged or injection error	Plunger of injection pump is seized.	Air valve clearance is incorrect.	Improper contact of air valve with its seat	Bent fuel control lever or mis-adjustment	Fuel line is blocked or leaks.	The fuel tank breather is blocked.	Failure of boosting compensator diaphragm
Symptom	Conf rm records of recent repairs													
	Service hours	Long service hours	△	△	△	△				△				
	Power loss	Suddenly												◎
		Gradually	○	○	○	○	○			○				
	Engine oil must be added more often.			◎										
	Filter element not replaced as per Operation and Maintenance Manual.		◎		◎	◎								
	Unapproved fuel has been used all the time.				◎	◎	◎	◎						
	Air cleaner sensor alarms.		◎											
	Color of exhaust gas	Black	◎											
		Blue under light load		◎										
Investigate	Excessive blowby			◎										○
	Poor engine acceleration and incomplete combustion						○					○	○	
	Engine speed is normal at unloaded high idle but drops suddenly when loaded.				◎	◎							○	
	Feel the exhaust manifold immediately after the engine is started. Temperature of cylinder is low.						◎	○						
	Engine vibrates (rotates unstably).				○	○						○	○	
	Clangs are heard around cylinder head.								◎					
	Engine speed is low at high idle.							○			◎			
	Fuel line leaks.											◎		
Diagnose	The air cleaner element is blocked.		●											
	Compression force is low.			●						●				
	The fuel f lter element and the primary f lter element are blocked.				●									
	The feeder pump screen is plugged.					●								
	The speed does not change when operation of some cylinders is stopped.						●							
	The control rack is felt resistant or does not return when pushed.							●						
	Air valve clearance is out of the standard range.								●					
	Control lever cannot reach the stopper when moved to the FULL position.										●			
	The feeder pump operates too easy or too diff cult.											●		
	The fuel tank cap breather is blocked.												●	
		Remedy	Clean	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Adjust	Repair	Clean	Replace

7.9.8 Black exhaust gas (incomplete combustion)

General causes:

- Insuff cient air intake
- Inappropriate injection condition
- Excessive injection

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Air cleaner element plugged	Wear of piston ring and cylinder	Failure of injection due to blocked nozzle	Injection timing is incorrect.	Failure of injection pump (excessive injection)	Air valve clearance is incorrect.	Muff er is squeezed and blocked.	Improper contact of air valve with its seat	Failure of injection pump (seized rack and plunger)
Symptom	Conf rm records of recent repairs										
Symptom	Service hours	Long service hours	△	△	△					△	
Symptom	Color of exhaust gas	Blacken suddenly			○						○
Symptom	Color of exhaust gas	Blacken gradually	◎		○						
Symptom	Color of exhaust gas	Blue under light load		◎							
Symptom	Engine oil must be added more often.			◎							
Symptom	Power loss	Suddenly			○				○		○
Symptom	Power loss	Gradually	○	○						○	
	Unapproved fuel has been used all the time.				○						○
	Dust indicator lights up.		◎								
Investigate	Excessive blowby			◎							
Investigate	Poor engine acceleration performance or nonuniform combustion				◎			○	○		○
Investigate	Feel the exhaust manifold with hand immediately after the engine is started. Temperature of air cylinders is low.				◎						○
Investigate	The matching marks on the injection pump are not aligned.					◎					
Investigate	Seal of injection pump has detached.						◎				
Investigate	Clangs are heard around the cylinder head.							◎			
Investigate	Abnormal noise of exhaust				○				◎		
Investigate	The muff er was squeezed.								◎		
	Air cleaner is blocked.		●								
	Compression force is low.			●						●	
	The speed does not change when operation of some cylinders is stopped.				●						
	Injection timing is found incorrect when checking it with oil outlet method.					●					
	Injection amount is inappropriate according to the testing of injection pump.						●				
	The air valve clearance is out of the standard range.							●			
	The color of exhaust gas goes back to normal when the muffler has been removed.								●		
	The control rack is felt resistant or does not return when pushed.										●
		Remedy	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Replace	Replace

7.9.9 Engine oil consumed excessively or exhaust gas turned blue

★ Do not idle the engine continuously for more than 20 minutes. (Either low idle or high idle.)

General causes:

- Engine oil burns.
- Engine oil leaks.
- Wear of lubrication system.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause									
			Piston ring breaks.	Wear of piston ring and cylinder sleeve	Breather or breather hose is blocked.	Engine oil pipe leaks.	Engine oil drain plug leaks.	Engine oil pan or cylinder head leaks.	Oil cooler breaks.	Wear or damage of rear oil seal and sealing surface	Dust taken in from the air intake system	Wear of valve (stem and guide) and damage of seal
Symptom	Conf rm records of recent repairs											
Symptom	Service hours	Long service hours		△								
Symptom	Engine oil consumption increases suddenly.		◎						○			
Symptom	Engine oil must be added more often.			◎					○			
Symptom	Engine oil becomes dirty soon.		○	◎	○							
Symptom / Investigate	Blue smoke under light load		◎	◎								
Symptom / Investigate	Blowby amount	Abnormally high	◎	◎								○
Symptom / Investigate	Blowby amount	None			◎							
Symptom / Investigate	Dirty engine oil is found around the engine.					◎	◎	◎				
Symptom / Investigate	Oil is found in engine cooling water.								◎			
Investigate	Dirty oil is found in the exhaust pipe disassembled.											○
Investigate	Dirty oil found at end cover of engine f ywheel									◎		
Investigate	The clamps of air intake system are loose.										◎	
Diagnose	Compression force is low.		●	●								
Diagnose	The breather element is full of dirty oil.				●							
Diagnose	Engine oil leaks.					●	●	●				
Diagnose	The airtight test on oil cooler indicates the presence of leakage.								●			
Diagnose	Check the rear oil seal directly.									●		
Diagnose	Dust is found in the air intake manifold removed.										●	
Diagnose	Dirty oil is found in the air intake manifold removed.											●
		Remedy	Replace	Replace	Clean	Repair	Repair	Repair	Replace	Repair	Repair	Repair

7.9.10 Engine oil is contaminated quickly

General causes:

- Exhaust gas is taken in due to internal wear.
- Lubrication channel is blocked.
- Use of inappropriate fuel
- Use of inappropriate engine oil
- Overloaded running

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause: Wear of piston ring and cylinder sleeve	Breather or breather tube is blocked.	Oil f lter element is plugged.	Wear of air valve and its guide tube	Oil cooler is blocked.	Turbocharger oil drain tube plugged	Turbine end seal broken	Black exhaust gas
Symptom	Conf rm records of recent repairs									
Symptom	Service hours	Long service hours	△			△			△	
Symptom	Engine oil must be added more often.		◎							
Symptom	Unapproved engine oil has been used all the time.				○					
	Color of exhaust gas	Blue under light load	◎							
	Color of exhaust gas	Black								◎
	Blowby amount	Abnormally high	◎			○		○	○	Perform troubleshooting to “Black Exhaust Gas”.
	Blowby amount	None		◎						
Investigate	Metal chips are found in oil f lter element.		○		◎	○				
Investigate	Dirty oil is found in the exhaust pipe disassembled.					◎				
Investigate	Engine oil temperature rises quickly.						◎			
Diagnose	Compression force is low.		●			●				
Diagnose	The breather element is full of dirty oil or its hose is broken.			●						
Diagnose	Engine oil f lter element is plugged.				●					
Diagnose	Engine oil cooler is blocked.						●			
Diagnose	Turbocharger water drain pipe blocked							●		
Diagnose	Turbocharger axial clearance too big								●	
Diagnose	The spring of safety valve is seized or broken.									
		Remedy	Replace	Clean	Replace	Replace	Clean	Clean	Replace	

7.9.11 Fuel consumption is excessive

General causes:

- Fuel leaking
- Inappropriate injection condition
- Excessive injection of fuel

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause							
			Failure of injection pump (excessive injection)	Damage of injection nozzle seat	Failure of injection pump plunger	Injection timing is incorrect.	Fuel pipe or fuel f lter element leaks.	Fuel leaks inside cylinder head.	Damage of oil seal in feeder pump (plunger)	Improper adjustment of fuel control lever
Symptom	Conf rm records of recent repairs									
Symptom	Service hours	Long service hours		△	△				△	
Symptom	Fuel consumption	Is more than other machines of the same type	◎			○				
Symptom	Fuel consumption	Increases gradually		○	○					
Symptom	Fuel consumption	Increases suddenly					○	○		
Symptom	Color of exhaust gas	Black	◎	○		○				○
Symptom	Color of exhaust gas	White						○		
	Seal of injection pump has detached.		◎							
	Non-uniform combustion			◎						
	Cylinder temp is low when feeling exhaust manifold immediately after engine startup			◎	○					
Investigate	The matching marks on the injection pump are not aligned.					◎				
Investigate	Fuel leaks from the engine.						◎			
Investigate	Level of engine oil rises and the odor of diesel fuel can be smelt.		○					◎	◎	
Investigate	Engine speed is high at low idle.		○							◎
Diagnose	The test of injection pump shows excessiveness of fuel injection.		●							
Diagnose	The speed does not change when operation of some cylinders is stopped.			●						
Diagnose	The control rack is felt resistant or does not return when pushed.				●					
Diagnose	Injection timing is incorrect when tested with outlet valve method.					●				
Diagnose	Remove the cylinder head and check for fuel leakage.							●		
Diagnose	Remove the feeder pump and check for damage of fuel seal.								●	
Diagnose	The engine speed is high at low idle.									●
		Remedy	Adjust	Replace	Replace	Adjust	Repair	Repair	Repair	Adjust

7.9.12 Coolant contains engine oil, water sprays back or water level drops

General causes:

- Internal leakage of lubrication system
- Internal leakage of cooling system

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause: Damage of oil cooler core and O-ring	Cause: Damage of cylinder head and cylinder gasket	Cause: Oil cooler of power train is damaged.	Cause: Pitting develops into depression	Cause: Interior cracking of cylinder block
Symptom	Conf rm records of recent repairs						
Symptom	Service hours	Long service hours	△		△		
Symptom	Oil level	Rises suddenly	○	○	○		
Symptom	Oil level	Rises gradually				○	○
	Use of hard water as coolant		○			○	
	Engine oil level is already high and engine oil shows turbid white.		◎			○	○
Investigate	There are excessive bubbles in the radiator and the spray comes back.			◎			
Investigate	Hydraulic oil and oil in the hydrodynamic transmission are turbid white.				◎		
Investigate	Water is found in drained hydraulic oil and oil drain from hydrodynamic transmission.				◎		
Diagnose	The airtight test of oil cooler shows the presence of leakage.		●		●		
Diagnose	The airtight test of cylinder head shows the presence of leakage.			●			
Diagnose	Remove the engine oil pan and check it directly.					●	●
		Remedy	Replace	Replace	Replace	Replace	Replace

7.9.13 Engine oil pressure alert indicator lights up

Oil pressure drops.

General causes:

- **Leakage, blocking or wear of lubrication system**
- Improper control of oil pressure
- Use of wrong engine oil (inappropriate viscosity)
- Deterioration of engine oil due to overheating

★ Engine oil selection standard

Oil type	Select as per ambient temperature
	-30 -20 -10 0 10 20 30 40° C
Engine oil	SAE 30 CD
	SAE10WCD
	SAE10W-30 CD
	SAE10W-30 CD

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Plugging of oil f lter element	Wear of bearing or journal	Plugging of primary f lter in oil pan	Blocking or breaking of oil pipe in oil pan	Breaking of suction pipe braze	Failure of oil pump	Insuff cient oil in engine oil pan	Failure of regulator valve	Failure of relief valve	Hydraulic line leaks or is crushed.	Failure of oil level sensor	Failure of oil pressure sensor	Oil contaminated by water and/or fuel
Symptom	Conf rm records of recent repairs														
Symptom	Service hours	Long service hours	△	△				△							
Symptom	Filter element was not replaced as per Operation and Maintenance Manual.		◎												
Symptom	Alert indicator lights up.		◎								○				
Symptom	Unapproved engine oil has been used all the time.		○	○											
Symptom	Conditions for oil pressure indicator lighting up	Low idle		◎							○				
Symptom	Conditions for oil pressure indicator lighting up	Low idle or high idle			◎	◎	◎	◎	○	○	○				
Symptom / Investigate	Conditions for oil pressure indicator lighting up	Traveling uphill							◎						
Symptom / Investigate	Conditions for oil pressure indicator lighting up	Sometimes								◎	◎		○	○	
Investigate	Hydraulic line is blocked or leaks (externally).											◎			
Investigate	Engine oil level sensor indicator lights up.								◎				◎		
Investigate	Oil level in engine oil pan is low.								◎						
Investigate	Metal chips are found in engine oil drained.			◎											
Investigate	Metal chips are found attaching to the element of engine oil f lter.			◎				○							
Investigate	Engine oil looks turbid white or gives the smell of diesel fuel.														◎
Diagnose	The engine oil f lter element is plugged.		●	●											Proceed with S-13
Diagnose	Remove the engine oil pan and check it directly.				●	●	●								
Diagnose	Oil pump rotates heavily; excessive play.							●							
Diagnose	Relief valve or regulator valve seized. Spring/valve stem broken.									●	●				
Diagnose	Oil level sensor indicator goes off when replacing oil level sensor.												●		
Diagnose	The oil pressure measured is out of the standard range.													●	
		Remedy	Clean	Clean	Clean	Clean	Repair	Replace	Add	Adjust	Adjust	Repair	Replace	Replace	—

7.9.14 Higher oil level

Engine oil is contaminated by water and/or fuel.

★ If the coolant is contaminated by engine oil, proceed with S-11.

General causes:

- Engine oil is contaminated by water (looks turbid white)
- Engine oil is contaminated by fuel (diluted, giving out the smell of diesel fuel).
- Oil f ows in from other components.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause..

			Cause									
			Damage of oil cooler core and O-ring	Failure of nozzle seat jacket	Cylinder head/gasket damage (pre-combustion chamber)	Surface wear or damage of rear oil seal.	Seal of pump auxiliary device is damaged.	Fuel leaks in the pipe inside cylinder head.	Part in injection pump is damaged.	Failure of thermostat	Depression caused by pitting	Internal cracks in cylinder block
Symptom	Conf rm records of recent repairs											
Symptom	Service hours	Long service hours		△		△	△				△	
Symptom	Radiator coolant contaminated by engine oil		◎	○	○						○	○
	White exhaust gas			◎				○		○		
	Water drips from muff er when the engine is started.			◎								
	Open the radiator cap. When the engine runs at idle speed, abnormal amount of bubbles appear or water sprays back.				◎						○	
	The breather hole of water pump is blocked by sludge.											
Investigate	Water comes out of the breather hole of water pump when cleaned.											
Investigate	Oil level in the clutch, hydrodynamic box or buffer cavity drops.					◎						
Investigate	Oil level in hydraulic tank drops.						◎					
Investigate	Engine oil give out the smell of diesel fuel.							◎	◎	◎		
Investigate	Fuel must be often added.							◎	◎	◎		
Investigate	Low water temperature									◎		
Diagnose	The airtight test of engine oil cooler shows a leakage.		●									
Diagnose	The airtight test of cylinder head show a leakage.			●								
Diagnose	Compression force is low.				●							
Diagnose	Remove the rear seal and check it directly.					●						
Diagnose	Seal of the pump auxiliary device is damaged.						●					
Diagnose	Remove the cylinder head cover and check it directly.							●				
Diagnose	Remove the injection pump and check it directly.								●			
Diagnose	Improper contact of thermostat sealing valve									●		
Diagnose	Remove and check the engine oil pan.										●	●
		Remedy	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace	Replace

7.9.15 Higher coolant temperature (overheated)

General causes:

- Lack of cool air (deformation or damage of fan)
- Eff ciency of heat dissipation drops.
- Failure of cooling system
- Oil temperature of power train rises too high.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Water pump is damaged.	Plugged or crushed f ns of radiator	Plugging of radiator core	Thermostat error (Actuation failure).	Failure of coolant thermometer	Coolant is insuff cient.	Fan belt skids or wears.	Blocking or breaking of oil cooler	Failure of pressure valve	Damage of cylinder head and gasket	Depression caused pitting	Oil temp. of torque converter over-rises .
Symptom	Conf rm records of recent repairs													
Symptom	Service hours	Long service hours		△	△							△	△	
Symptom	Overheating conditions	Sudden overheating	◎					○	○					
Symptom	Overheating conditions	Overheating tendency		◎	◎	○			○					
Symptom	Water thermometer	Temperature rises quickly.				◎								
Symptom	Water thermometer	Stay in the red range.					◎							
Symptom	Water level sensor of radiator lights up.							◎						
	The lower fan belt produces noise when loaded suddenly.								◎					
	Turbid white oil f oats on the coolant.									◎				
	Coolant f ows out of the overf ow hose.										◎			
Investigate	There are excessive bubbles in the radiator. Water sprays back.											◎		
Investigate	Engine oil level is high. The oil looks turbid white.									○			◎	
Investigate	There is play while the fan belt pulley is rotating.		◎											
Investigate	Debris or sludge is full under radiator cover and lower guard.			◎					◎					
Investigate	When the radiator is illuminated with a bulb behind it, there is no light coming through it.			◎										
Investigate	Water leaks due to cracking hose or loose clips.							◎						
Investigate	The belt is found slack when belt tension is checked.								◎					
Investigate	Oil temperature of the power train enters the red range faster than engine coolant temperature.													◎
Diagnose	Temp difference between top and bottom of reservoir is large.		●											Perform diagnose on the chassis.
Diagnose	Temp difference between top and bottom of reservoir is small.			●										
Diagnose	The core is found blocked when checking the f ller of water.				●									
Diagnose	The thermostat is not activated at the activating temperature during testing.					●								
Diagnose	The temperature of water is normal during testing.						●							
Diagnose	The oil cooler is blocked.									●				
Diagnose	The set pressure is low when checked with the radiator cap tester.										●			
Diagnose	Compression force is low.											●		
Diagnose	Remove the oil pan and check it directly.												●	
		Remedy	Replace	Repair	Repair	Replace	Replace	Add Water	Repair	Replace	Replace	Replace	Replace	

7.9.16 Abnormal noise

★ Internal noise or external noise is to be determined.

General causes:

- Abnormal noise caused by damage of part
- Irregular combustion
- Air intake system is abnormal.

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

			Cause: Wear of piston ring and cylinder sleeve	Turbocharger seized or interfering	Sleeve is missing or seized.	Injection nozzle is blocked or seized.	Injection pump failure (seized rack and plunger)	Failure of injection pump (excessive injection)	Deformation of fan or interference of fan belt	Improper adjustment of air valve clearance.	Valve gear breaks (air valve, rocker arm, etc.)	Back clearance of gear drive system is incorrect.	Air leaks between turbocharger and cylinder head	Internal failure of muff er (Screen deviates).
Symptom	Conf rm records of recent repairs													
Symptom	Service hours	Long service hours	△											
Symptom	Conditions for abnormal noise	Gradual occurrence	○						○					
Symptom	Conditions for abnormal noise	Sudden occurrence		○	○						○			
Symptom	Unapproved fuel has been used all the time.					○	○							
Symptom	Engine oil must be added more often.		◎											
Symptom	Color of exhaust gas	Blue under light load	◎											
Symptom	Color of exhaust gas	Black		◎						○			○	
	Metal chips are found in engine oil f lter element.		◎		◎									
	Excessive blowby		◎											
	Engine acceleration is poor and combustion is abnormal.			◎		◎								
	Cylinder temp is low when feeling exhaust manifold immediately after the engine is started.					◎	○							
	Seal of injection pump has detached.							◎						
	The engine gives high abnormal noise when accelerated.					○	○	○	○	○		○		
	Clangs are heard around the cylinder.									◎	◎			
	Air leaks between turbocharger and cylinder head, or clamp loose												◎	
	Noise of vibration is heard around the muff er.													◎
Diagnose	Compression force is low.		●											
Diagnose	Great resistance is felt when you turn turbocharger with hands.			●										
Diagnose	Remove the gear chamber cover and check it directly.				●							●		
Diagnose	Speed does not change when operation of some cylinders stops.					●								
Diagnose	The control rack is found resistant or hard to return while pushed.						●							
Diagnose	Injection amount is found incorrect when testing injection pump.							●						
Diagnose	The fan deforms and/or the belt is loose.								●					
Diagnose	The air valve clearance is out of standard range.									●				
Diagnose	Remove the cylinder head and check it directly.										●			
	Abnormal noise disappears after the muff er is removed.													●
		Remedy	Replace	Replace	Replace	Replace	Replace	Adjust	Repair	Adjust	Replace	Repair	Repair	Replace

7.9.17 Violent vibration

★ If abnormal noise is also heard along with vibration, Perform troubleshooting to “Abnormal noise”.

General causes:

- Damage (abnormal wear or breaking) of part
- Misalignment
- Irregular combustion

Symbols:

○ : Possible causes (judged by Symptom and Investigate).

◎ : Most possible causes (judged by Symptom and Investigate).

△ : Long service hours may be a possible cause.

● : Item that determines the Cause.

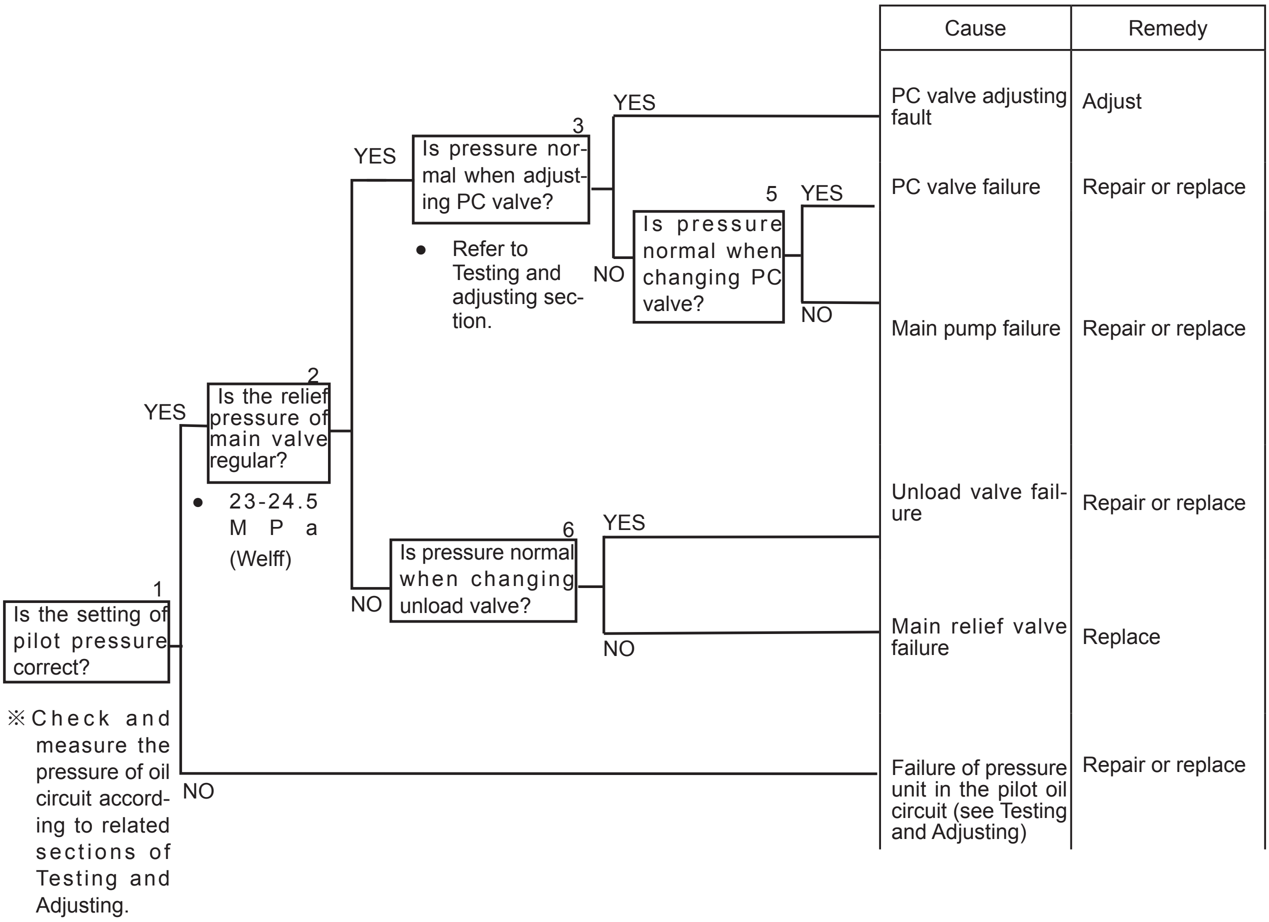
			Cause: The rod and main bearing are worn.	Cause: The cam bushing is worn.	Cause: Engine mounting bolts are loose. Cushion is damage.	Cause: The part (damper) of output shaft is broken.	Cause: Engine and power train not aligned by centerline.	Cause: The back clearance of gear drive system is incorrect.	Cause: Valve gear (air valve, rocker arm and so on) is seized.	Cause: Failure of injection pump (excessive injection)
Symptom	Conf rm records of recent repairs									
Symptom	Service hours	Long service hours	△	△	△					
Symptom	Conditions for vibration	Sudden increase				○			○	
Symptom	Conditions for vibration	Gradual increase	○	○	○					
Symptom	Unapproved engine oil has been used all the time.		○	○						
	Metal chips are found in engine oil f lter element.		◎	◎						
	Metal chips are found in engine oil drained.		◎	◎						
	Oil pressure is low at low idle.		○	○						
Investigate	Vibration occurs in the range of moderate speed.				○	○				
Investigate	Vibration changes with engine speed.				○	○	○	○		
Investigate	Exhaust gas becomes black.								◎	○
Investigate	Seal of injection pump has detached.									◎
Diagnose	Remove the oil pan and check it directly.		●							
Diagnose	Remove the side cover and check it directly.			●						
Diagnose	Check wether the engine mounting bolts are loose and whether the cushion is damaged.				●					
Diagnose	Check directly the interior of output shaft (damper).					●				
Diagnose	The results of radial runout test and end face runout test are out of the standard ranges.						●			
Diagnose	Remove the front cover and check it directly.							●		
Diagnose	Remove the cylinder head cover and check it directly.								●	
Diagnose	The amount of injection is incorrect when testing the injection pump.									●
	Remedy		Replace	Replace	Replace	Replace	Repair	Repair	Replace	Adjust

7.10 Troubleshooting the Hydraulic and Mechanical System

7.10.1 Work equipment, swing drive and f nal drive move slowly or is weak

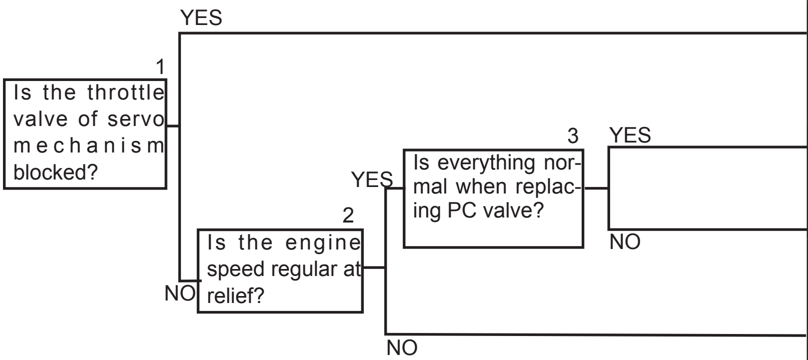
- Make sure that the main pump produces no abnormal noise before troubleshooting.

  (Perform troubleshooting described 10.7.4 in case of abnormal noise.)



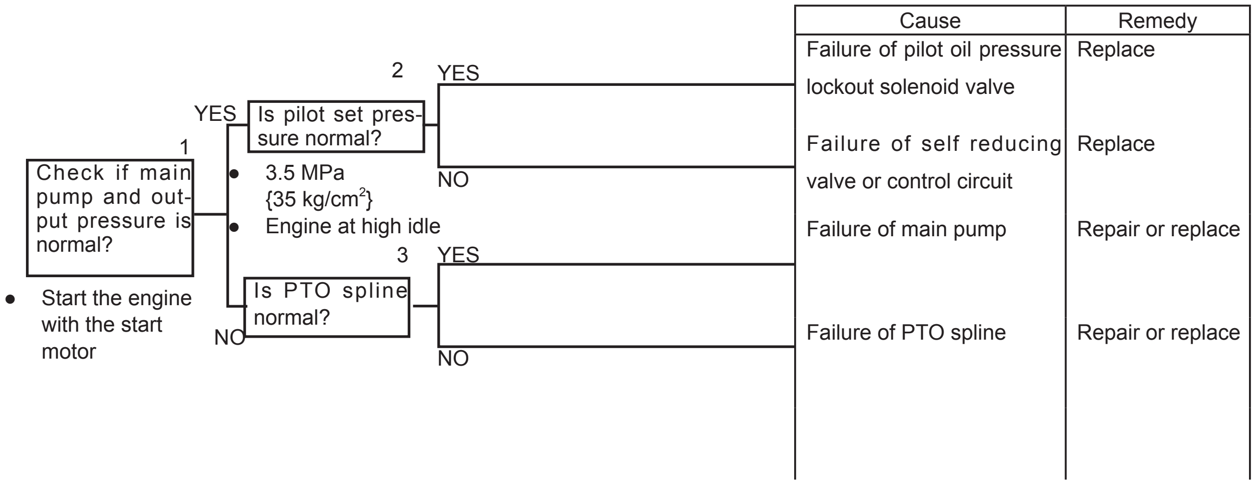
7.10.2 Engine speed drops sharply or engine stalls

★ Make sure that the main relief pressure is regular.

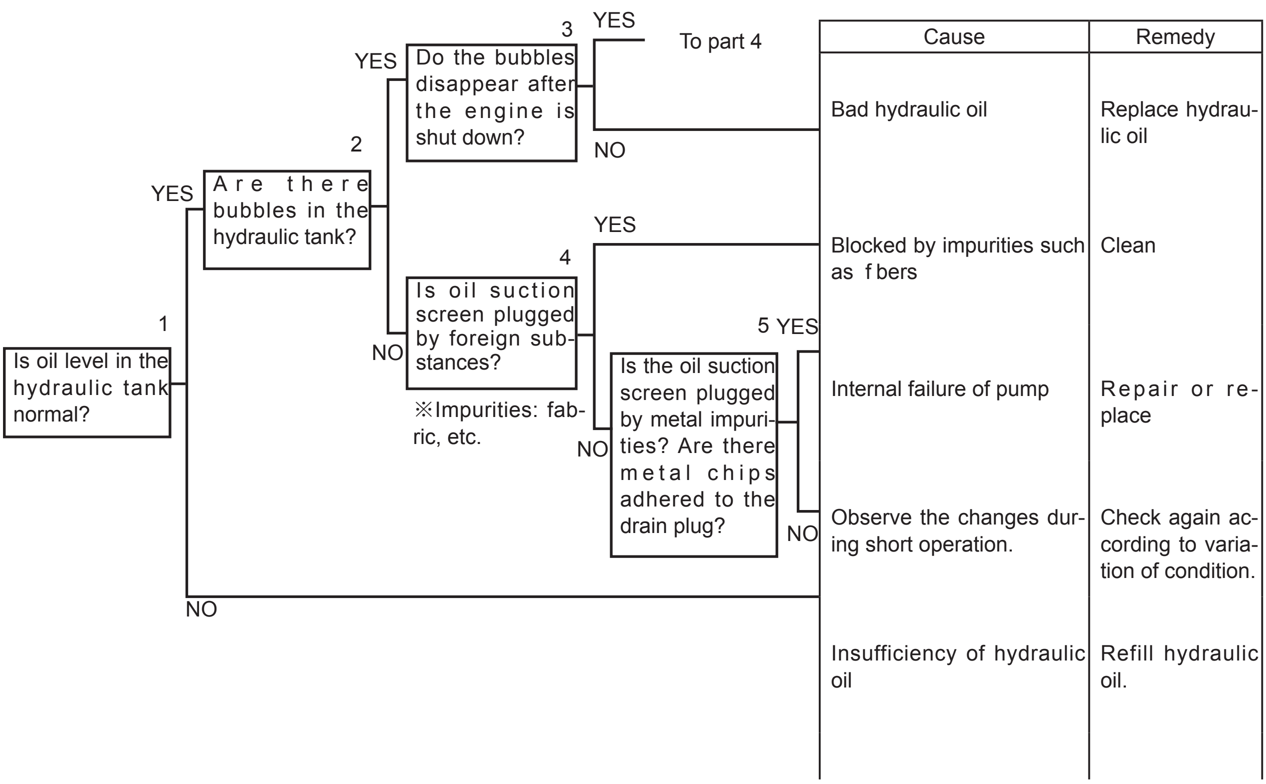


Cause	Remedy
Throttle valve in servo machanism blocked	Clean
PC valve failure or PC valve adjusting failure	Adjust or replace PC valve
Servo piston fault	Replace (main pump assembly)
Refer to troubleshooting of engine (S).	—

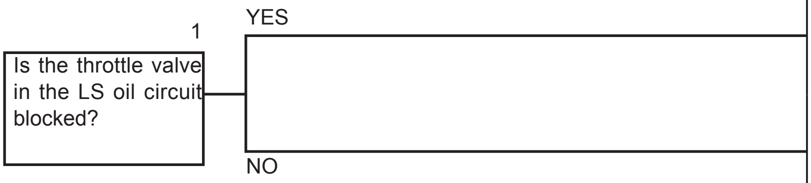
7.10.3 Work equipment, f nal drive and swing drive do not work



7.10.4 Abnormal noise occurs (around the pump)



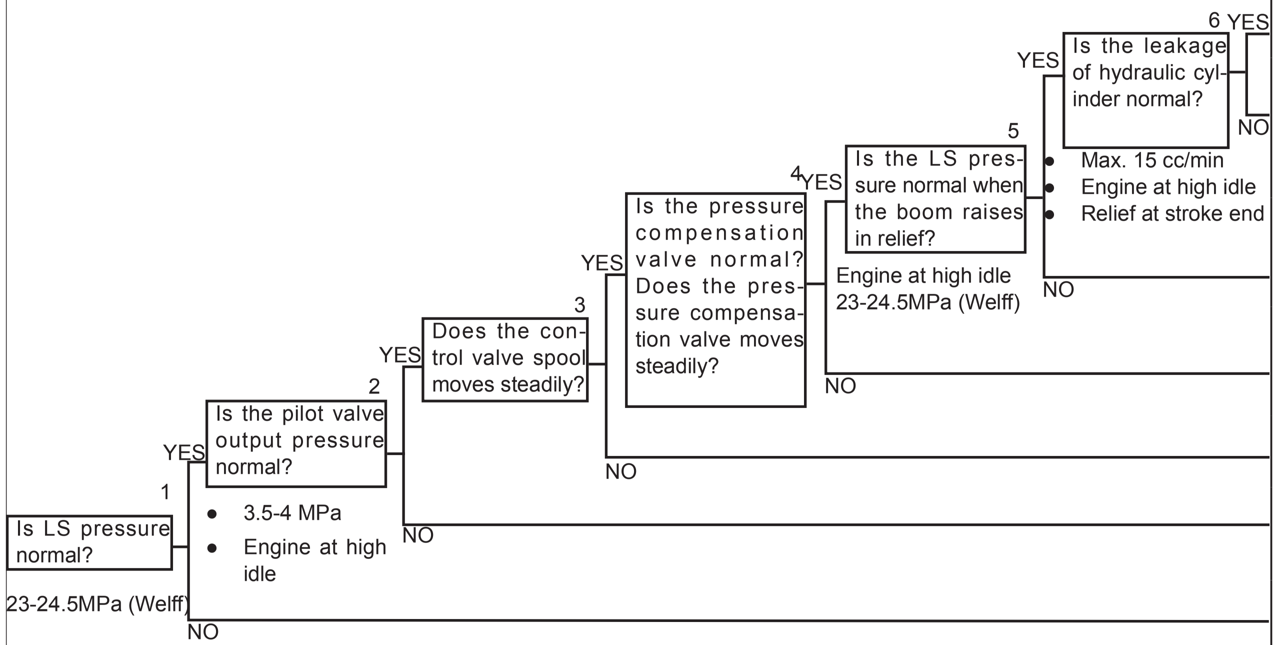
7.10.5 Poor precise control performance or bad sensitivity



Cause	Remedy
Throttle valve in LS oil circuit is blocked.	Clean
Failure of flow control valve or servo plunger	Replace

7.10.6 Boom moves slowly or power is weak

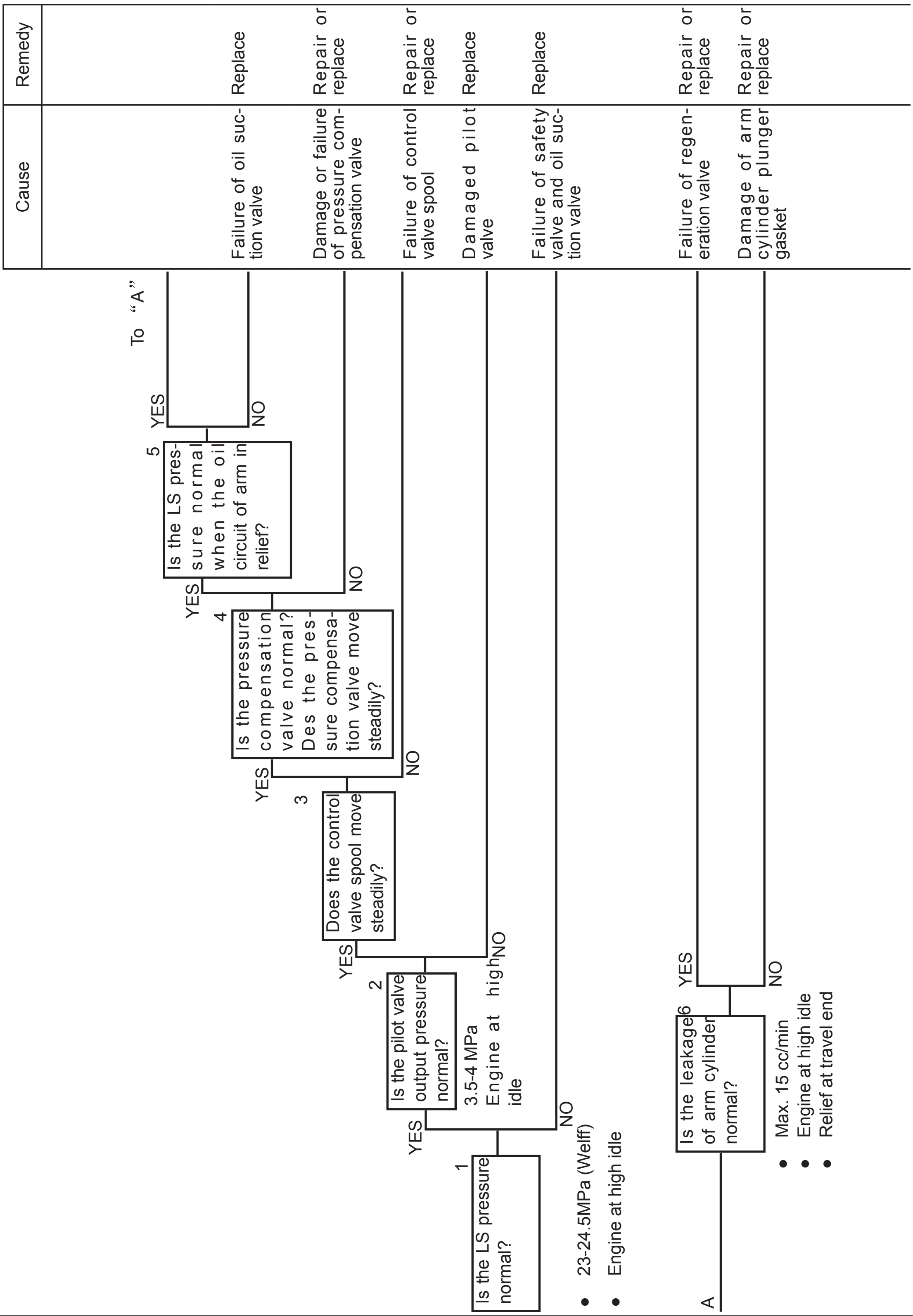
★ When travel speed and swing speed are normal



Cause	Remedy
Failure of regeneration valve	Replace
Damage of hydraulic cylinder gasket	Repair or replace
Failure of oil suction valve	Replace
Damage or failure of pressure compensation valve	Repair or replace
Failure of control valve spool	Repair or replace
Damage of PPC valve	Replace
Failure of safety valve and oil suction valve	Replace

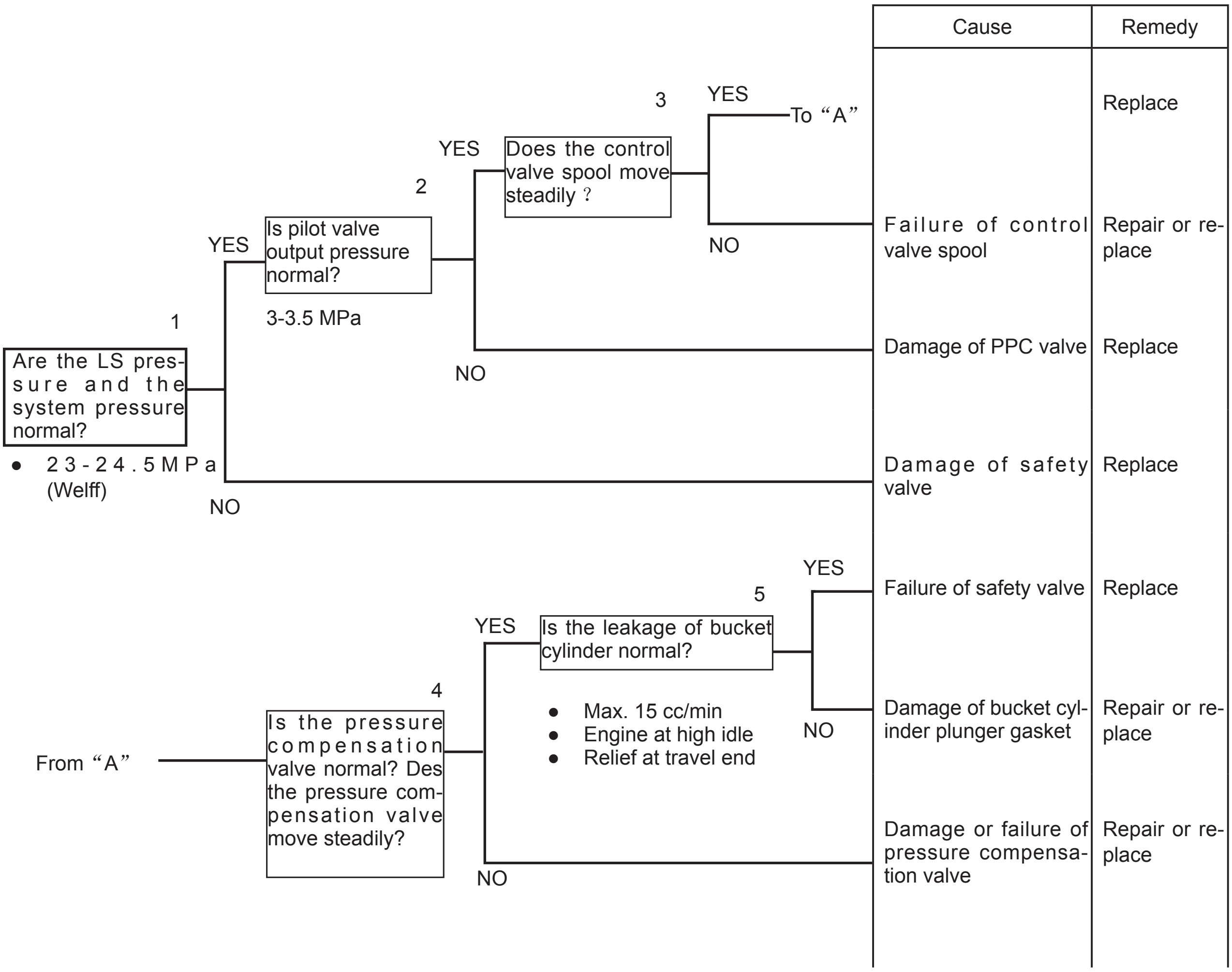
7.10.7 Arm moves slowly or power is weak

★ When travel speed and swing speed are normal



7.10.8 Bucket moves slowly or power is weak

★ When travel speed and swing speed are normal



7.10.9 Work equipment does not work (but travel and swing are normal)

★ When the boom, arm or bucket is operated separately

Is the pilot valve output pressure normal?

3-3.5 MPa
Engine at high idle

- YES → Damage of control valve spool — Repair or replace
- NO → Damage of pilot valve — Replace

Cause	Remedy
Damage of control valve spool	Repair or replace
Damage of pilot valve	Replace

7.10.10 Excessive hydraulic drift (of boom, arm and bucket)

Is the leakage of hydraulic cylinder normal?

- See Testing and Adjusting.
- Engine at high idle
- Relief at strokel end

- Is the leakage of hydraulic cylinder normal? YES → Is everything normal after the oil suction valve has been replaced.
  - YES → Failure of safety valve — Replace
  - NO → Damage of oil seal of control valve spool — Replace
- Is the leakage of hydraulic cylinder normal? NO → Damage of hydraulic cylinder plunger gasket — Replace

Cause	Remedy
Failure of safety valve	Replace
Damage of oil seal of control valve spool	Replace
Damage of hydraulic cylinder plunger gasket	Replace

7.10.11 Work equipment with greater load moves slowly in combined operation

★ When engine runs at full speed

Cause	Remedy
Failure of pressure compensation valve	Replace (the pressure compensation valve with less load)

(※Replace the valve group assembly)

	Combined operations	Side with greater load
1	Boom RAISE + Arm IN	Boom RAISE
2	Boom RAISE + Arm OUT	Arm OUT
3	Boom RAISE + Bucket CURL	Boom RAISE
4	Arm OUT + Bucket DUMP	Arm OUT
5	Boom LOWER + Arm OUT	Arm OUT

7.10.12 Boom raises slowly during swing + boom UP operation

★ When machine works normally and Swing and Boom RAISE are operated separately

Cause	Remedy
Failure of swing pressure compensation valve	Repair or replace

7.10.13 Travel speed drops considerably during travel + swing operation

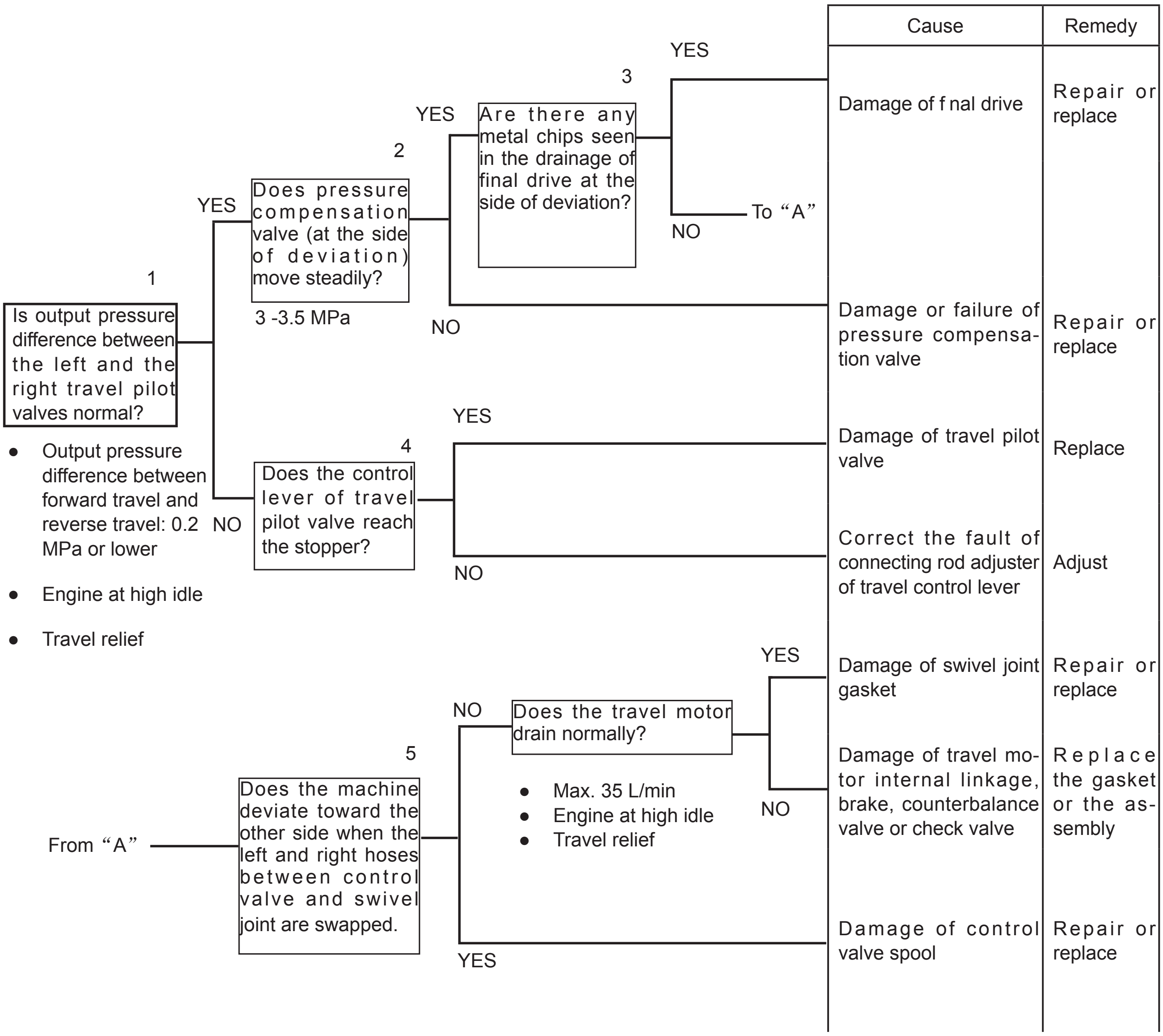
★ When machine works normally and Swing and Travel are operated separately

Cause	Remedy
Failure of pressure compensation valve and LS check valve (The pressure compensation valve is used for travel.)	Repair or replace

7.10.14 Machine cannot make a straight travel

★ When work equipment speed and swing speeds are normal

a) Machine deviates at one side during forward travel and reverse travel.

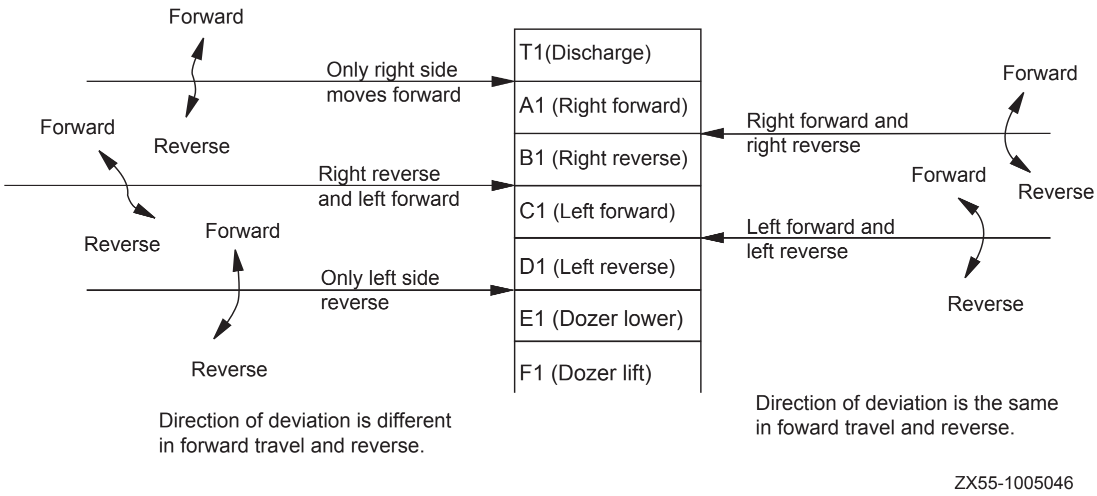


b) The side of deviation is different during forward travel and reverse travel.

1 Does the control lever of travel pilot valve reach the stopper?

Answer	Cause	Remedy
YES	Damage of swivel joint gasket	Repair or replace
NO	Failure of control valve spool	Repair or replace

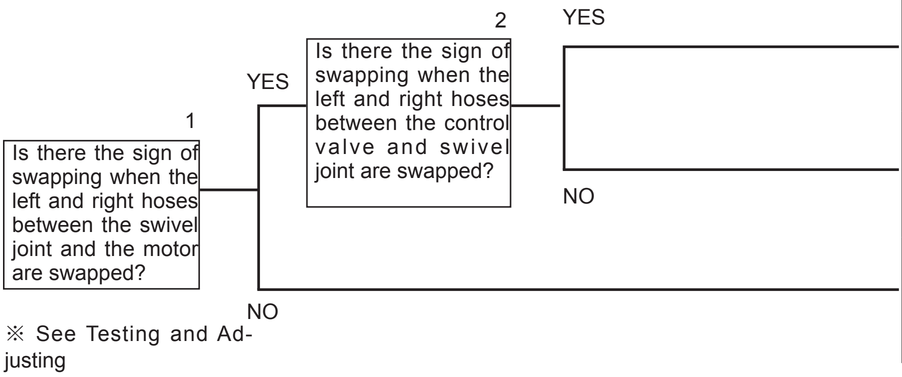
Figure 1 Position of damaged swivel joint seal and direction of travel deviation



7.10.15 Travel deviation is big at beginning

★ When travel speed is normal

★ (However, deviation can also occur during normal travel. Perform troubleshooting according 15 "Machine Cannot Make a Straight Travel" .

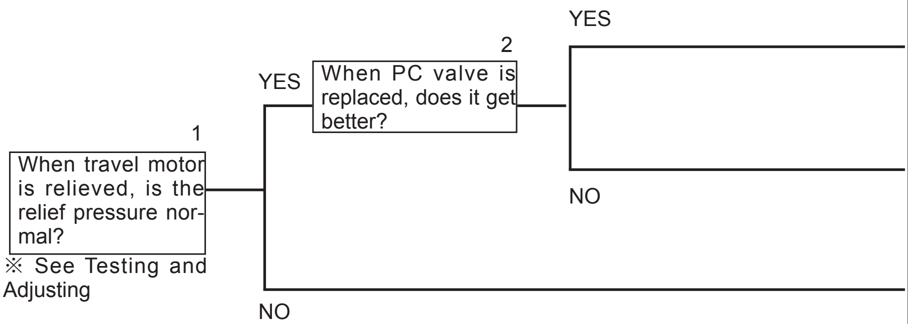


Cause	Remedy
Failure of control valve spool	Replace the control valve assembly.
Damage of swivel joint gasket	Replace the gasket or the assembly
Damage of travel motor (failure of travel counterbalance valve)	Replace the motor assembly.

7.10.16 Travel speed is low or power is weak

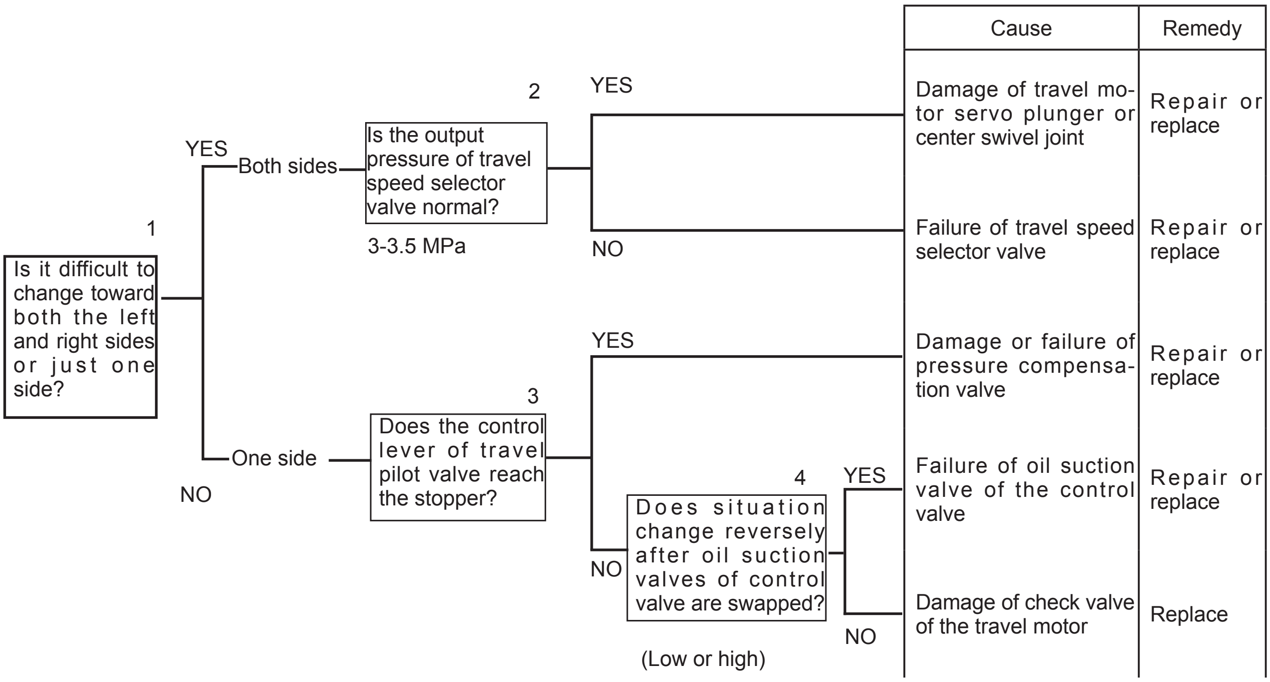
★ When no deviation occurs during travel (In case of travel deviation, f rst perform troubleshooting as per 15 "Machine Cannot Make a Straight Travel.")

★ When work equipment operates at normal speed



Cause	Remedy
Damage of PC valve	Replace
Refer to troubleshooting of engine (S)	—
Damage or inappropriate adjustment of main relief valve	Adjust or replace

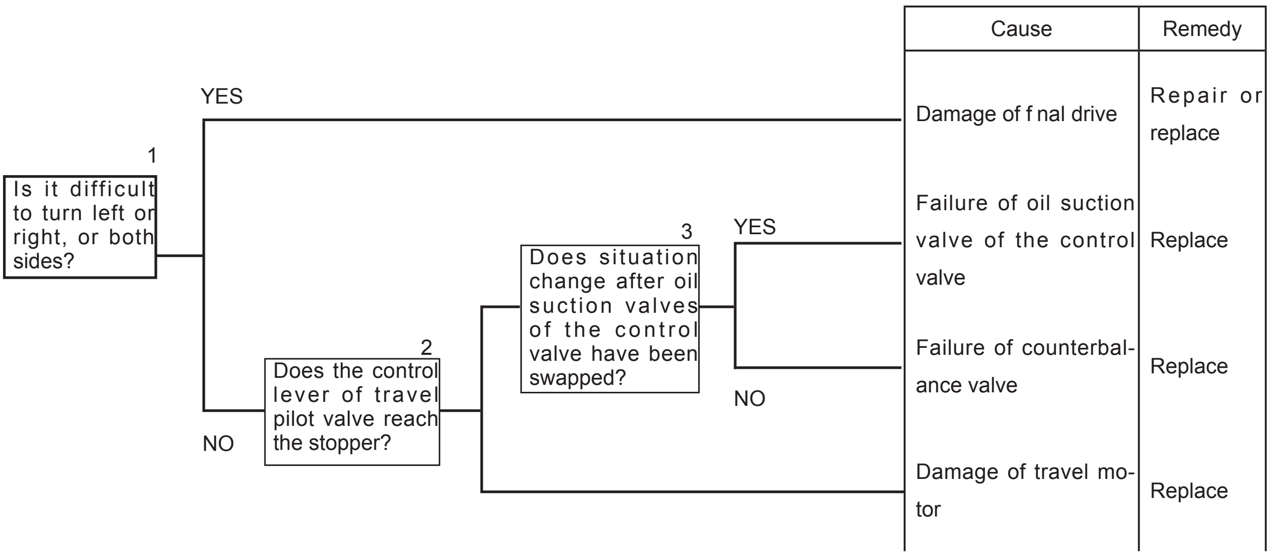
7.10.17 It Is diff cult to change direction



7.10.18 Travel speed cannot be changed

- 3-3.5 MPa
- Travel speed selector at Hi position (high speed)
- Travel switch ON
- Engine at high idle

7.10.19 Travel system fails (only at one side)



7.10.20 Swing operation fails

2 In output pressure of pilot valve normal?

- 3-3.5 MPa
- Operate the swing control lever
- Turn the swing lockout switch to the ON (locked) position.
- Engine at high idle

YES → 3 Does the control valve spool moves smoothly?

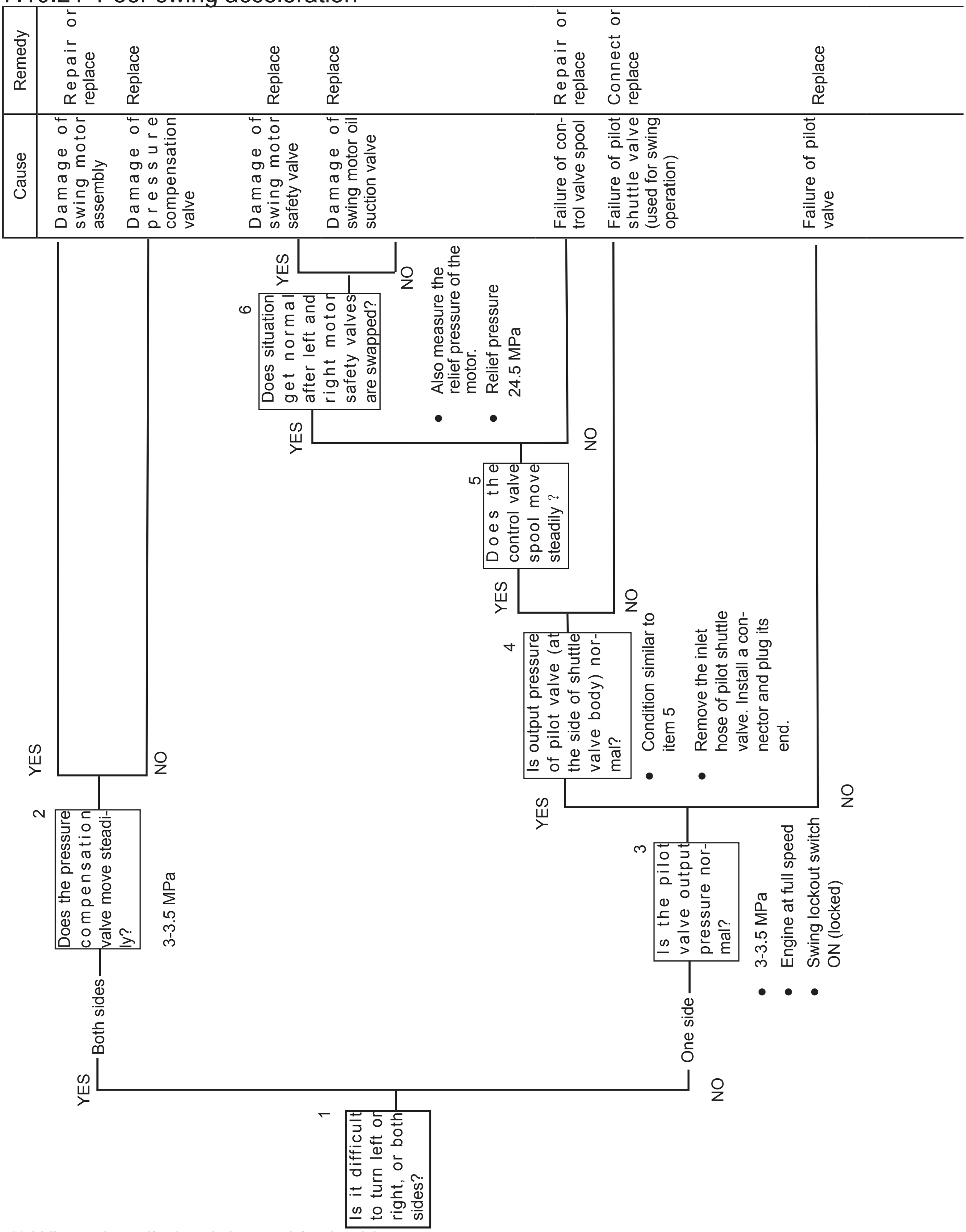
YES → Damage of swing motor safety valve — Replace

NO → Damage of control valve spool — Repair or replace

NO → Damage of pilot valve — Replace

Cause	Remedy
Damage of swing motor safety valve	Replace
Damage of control valve spool	Repair or replace
Damage of pilot valve	Replace

7.10.21 Poor swing acceleration

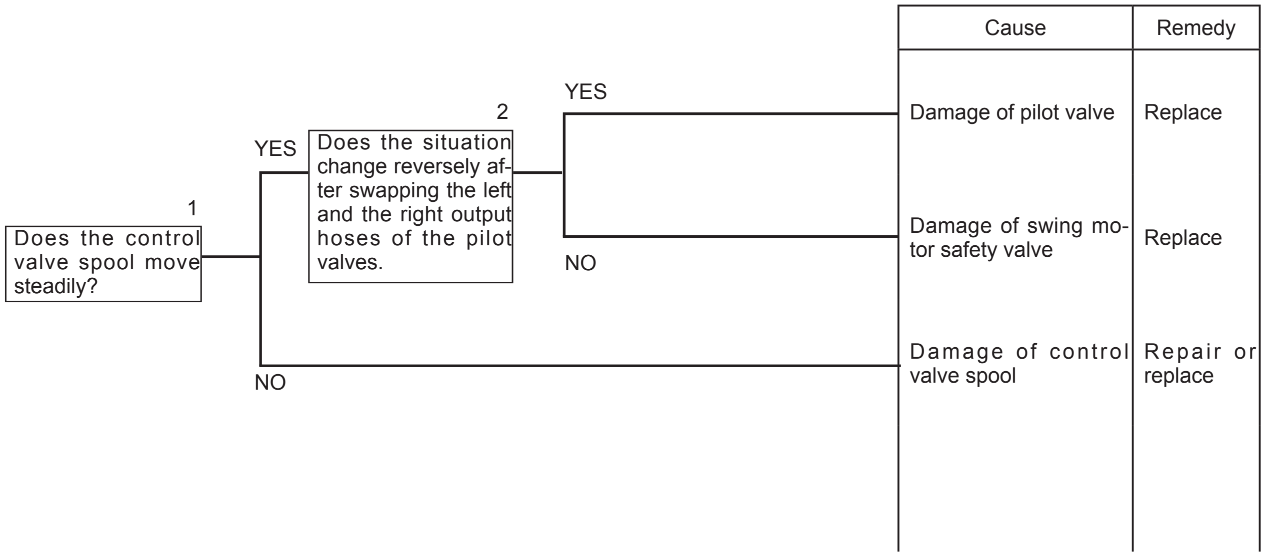


※ When the oil circuit is not blocked by a connector.

Hoses of the pilot valve can replace the swing hose with the arm (IN and OUT) hose or the boom (RAISE) hose, and then reverse the operation.

7.10.22 Excessive overrunning upon swing stoppage

a) Only one side

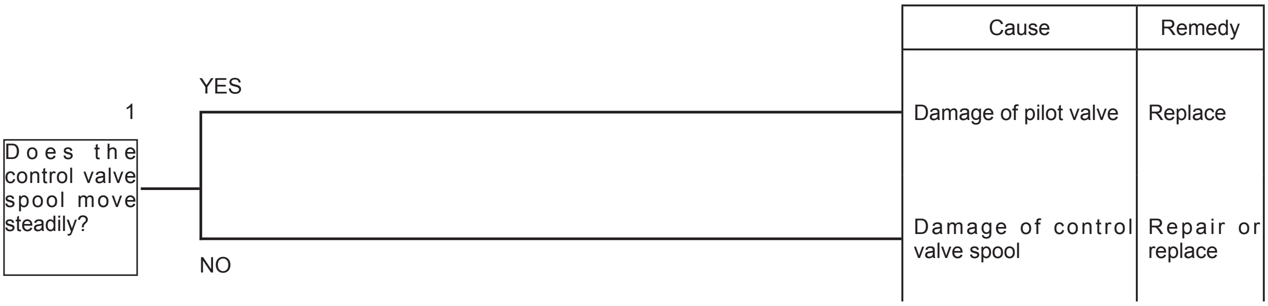


b) Both sides

Cause	Remedy
Damage of swing motor	Repair or replace

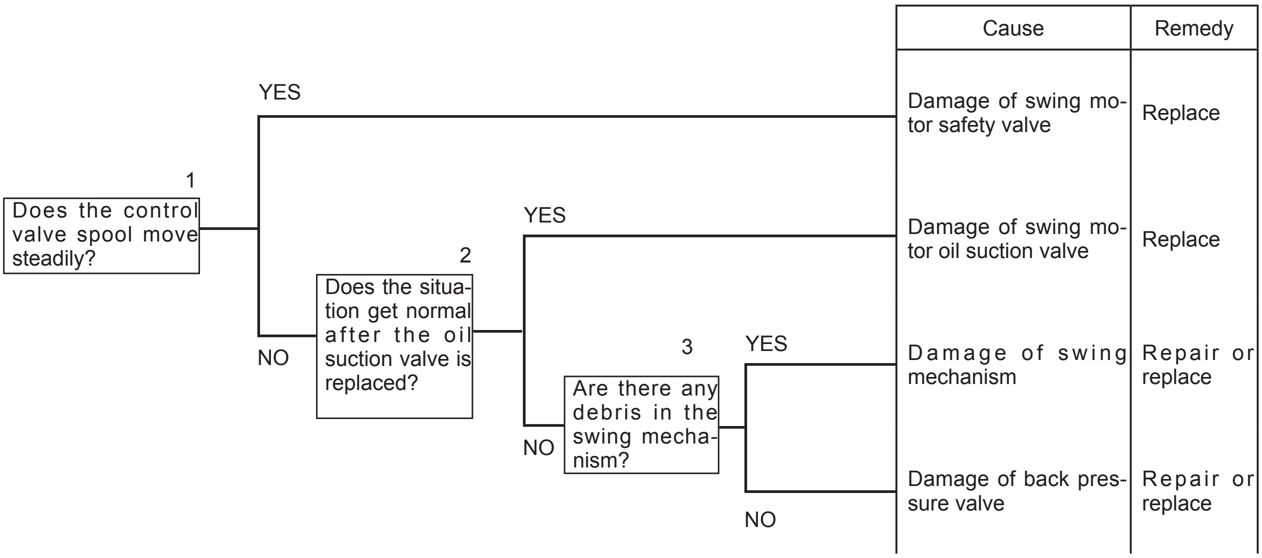
7.10.23 Considerable shaking resulted from swing stoppage

In only one direction



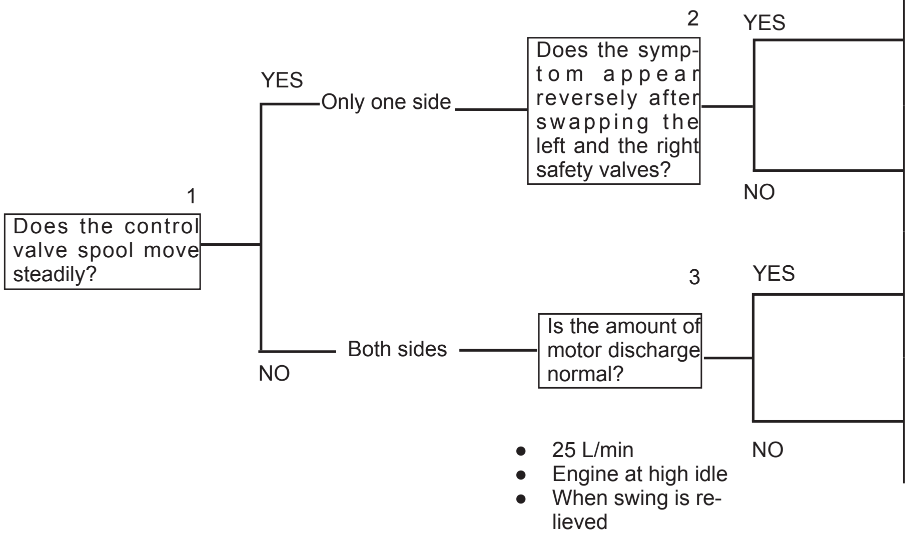
7.10.24 Abnormally high noise resulted from swing stoppage

In only one direction



7.10.25 Excessive hydraulic drift of swing

When swing brake is released



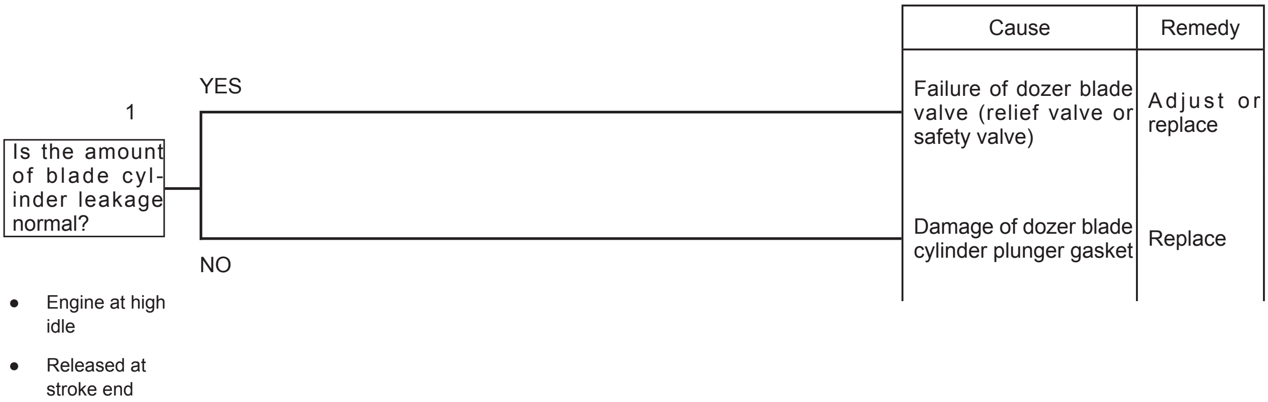
Cause	Remedy
Damage of swing motor safety valve	Replace
Damage of swing motor oil suction valve	Repair or replace
Damage of oil seal of control valve spool	Replace
Damage of swing motor	Repair or replace

7.10.26 Swing speed is faster than specif ed

Cause	Remedy
Failure of LS valve	Replace

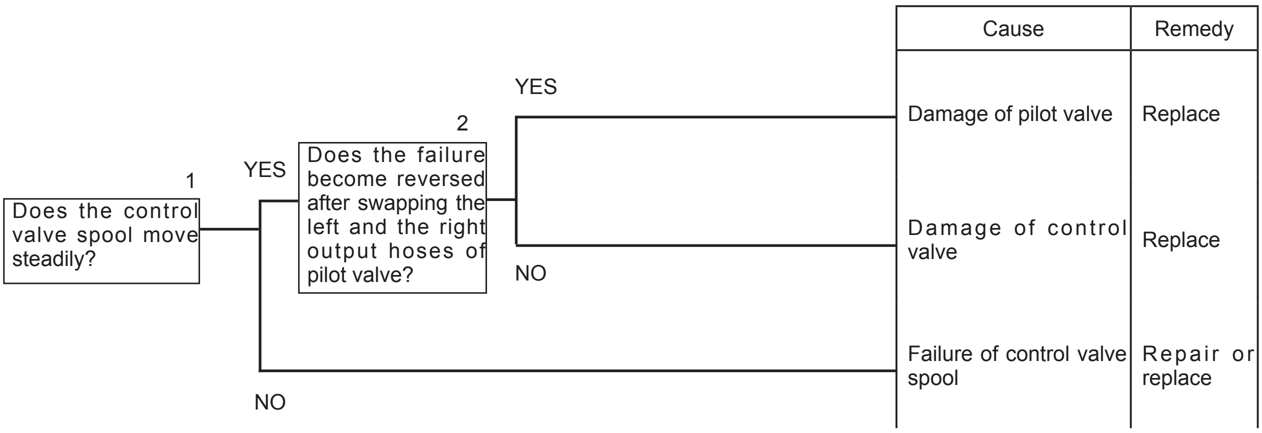
7.10.27 Dozer blade moves slowly or power is weak

★ When work equipment speed, travel speed and swing speed are normal



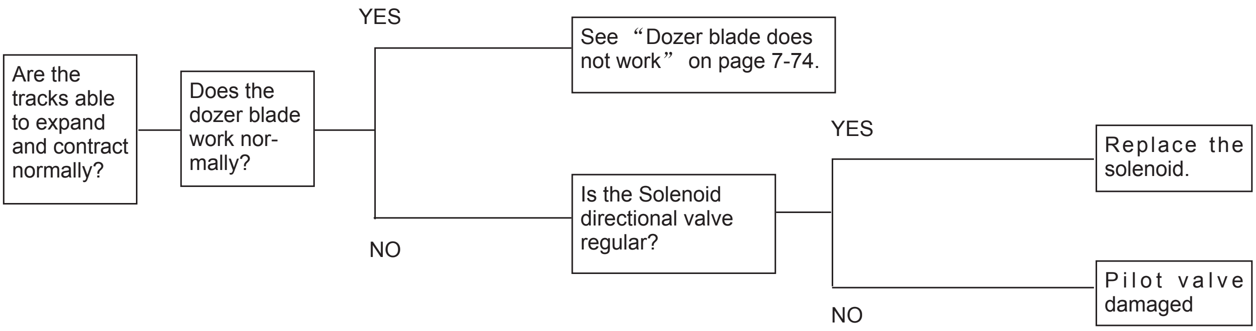
7.10.28 Dozer blade does not work

★ When the Dozer blade is operated separately



7.10.29 Excessive hydraulic drift of dozer blade

7.10.30 Unable to expand and contract rubber tracks



Tier IV engine

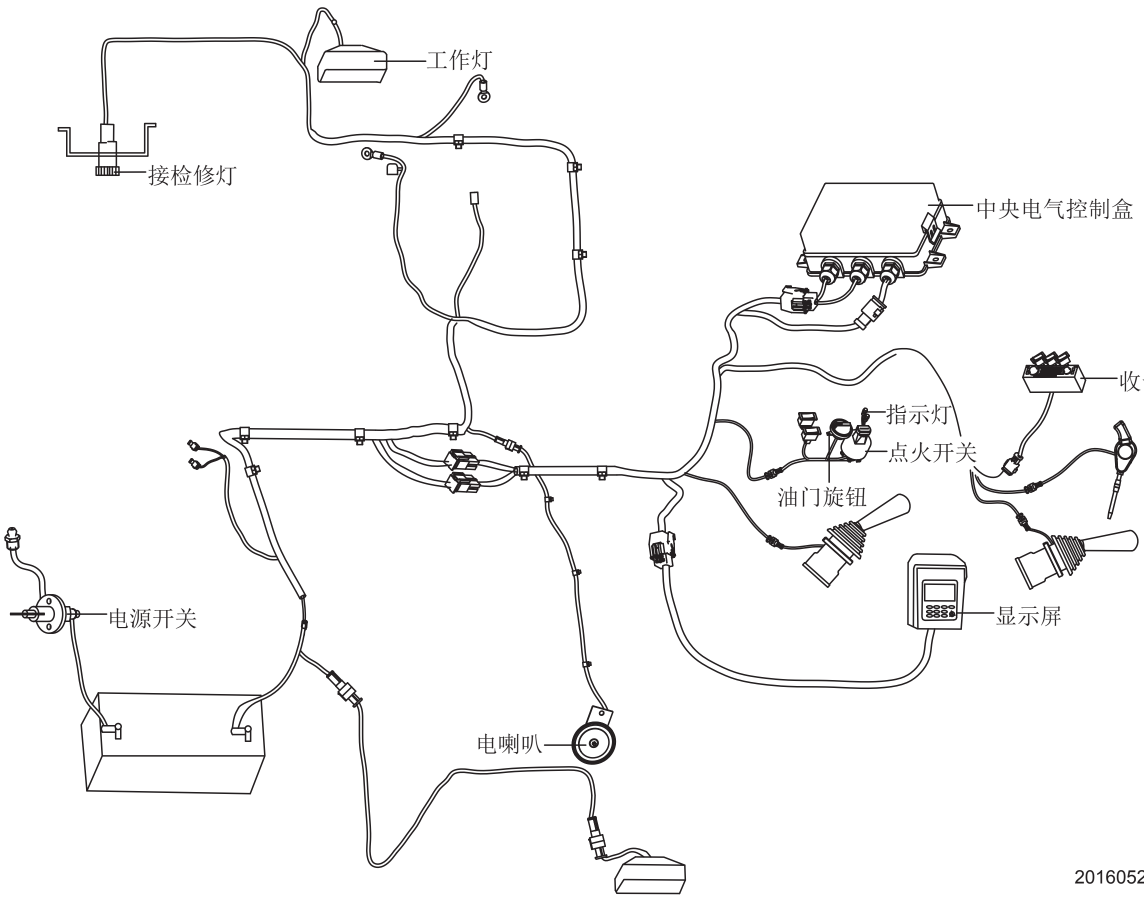
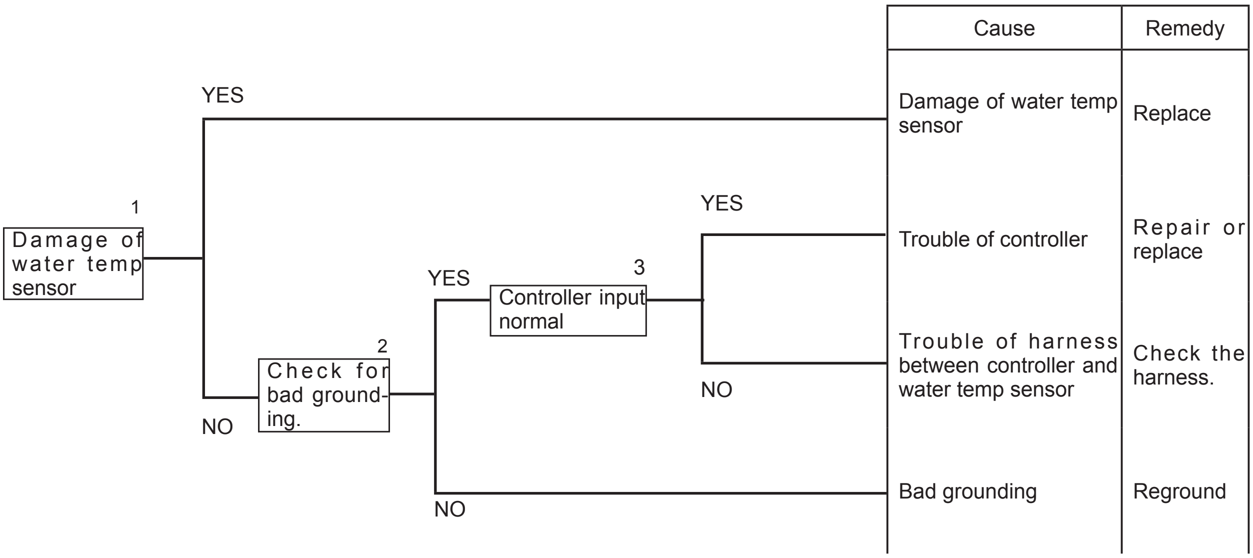


Fig. 7-7

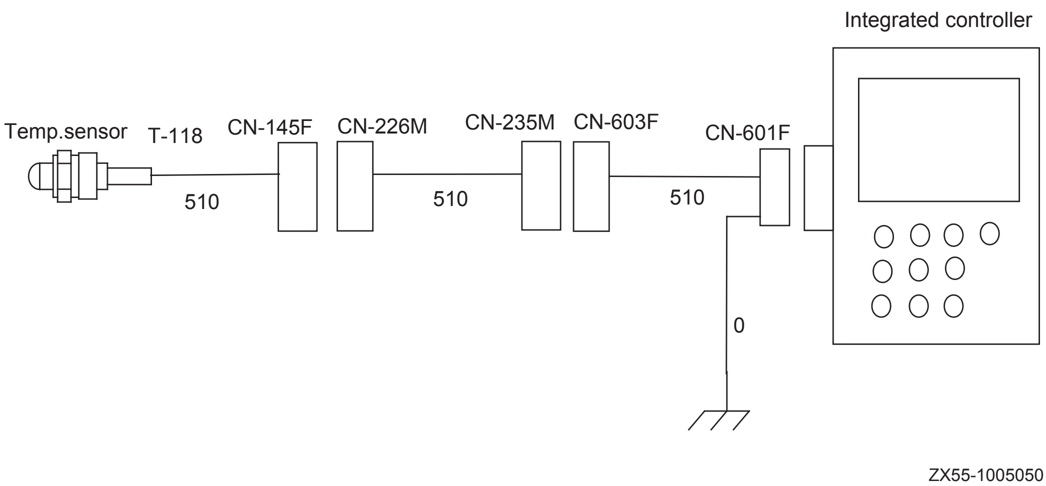
7.10.35 Engine coolant temperature reading is abnormal

★ Check related connectors for contact problem before troubleshooting.

★ Make sure that the connectors removed are restored before carrying out next step.



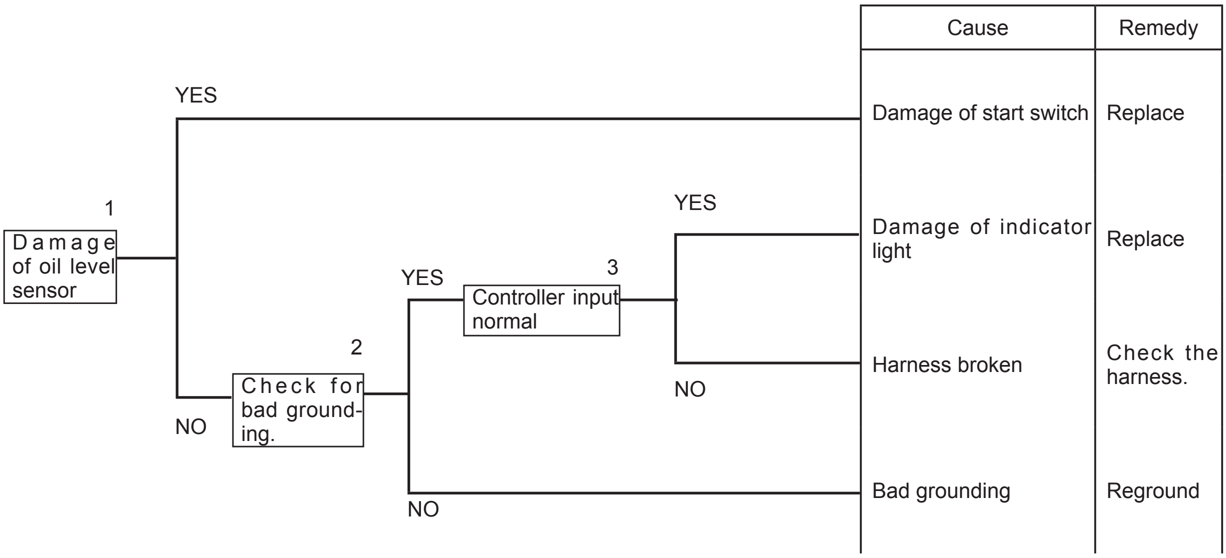
Related diagram



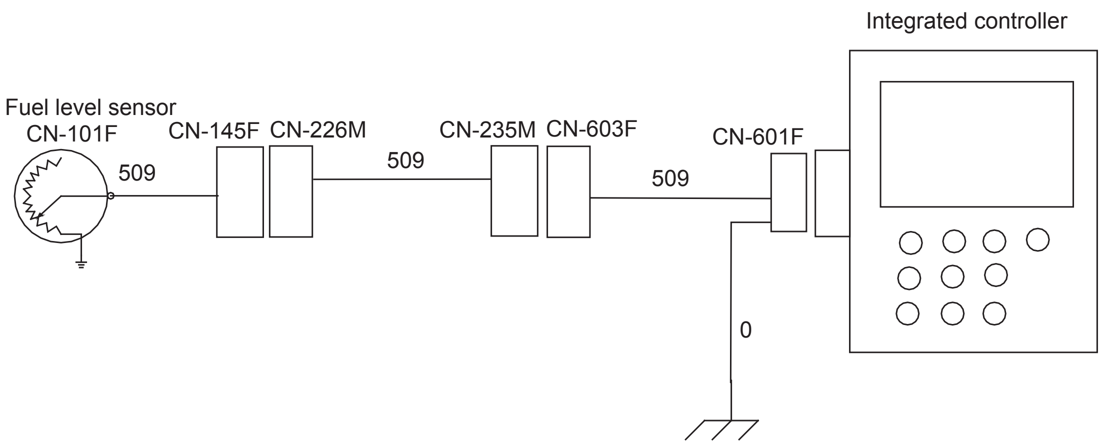
7.10.36 Engine oil level indication is abnormal

★ Check related connectors for contact problem before troubleshooting.

★ Make sure that the connectors removed are restored before carrying out next step.



Related diagram

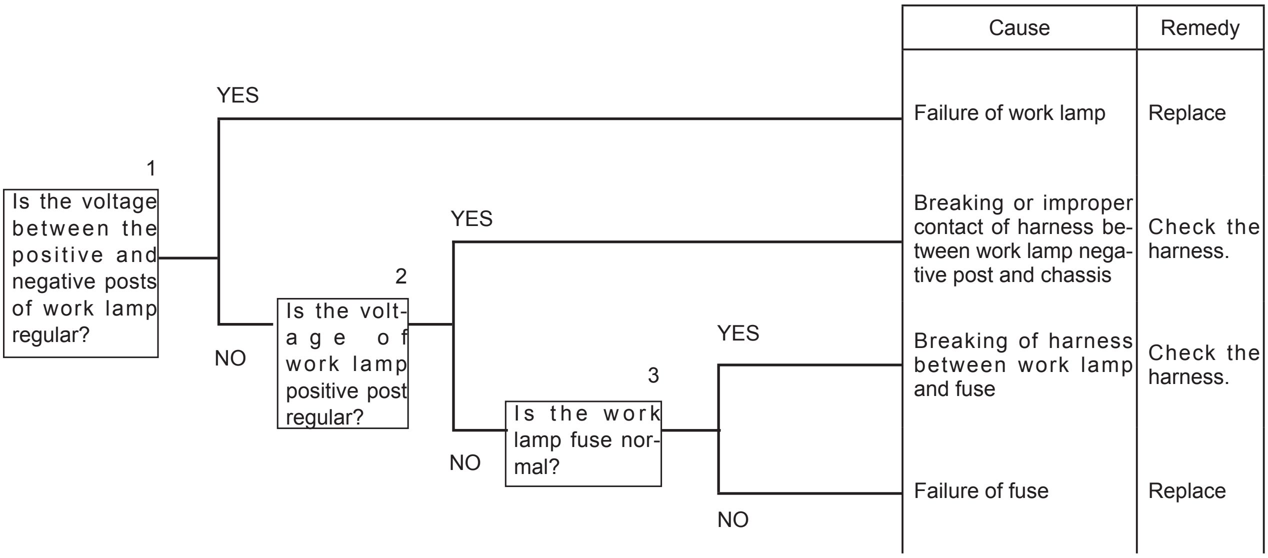


ZX55-1005051

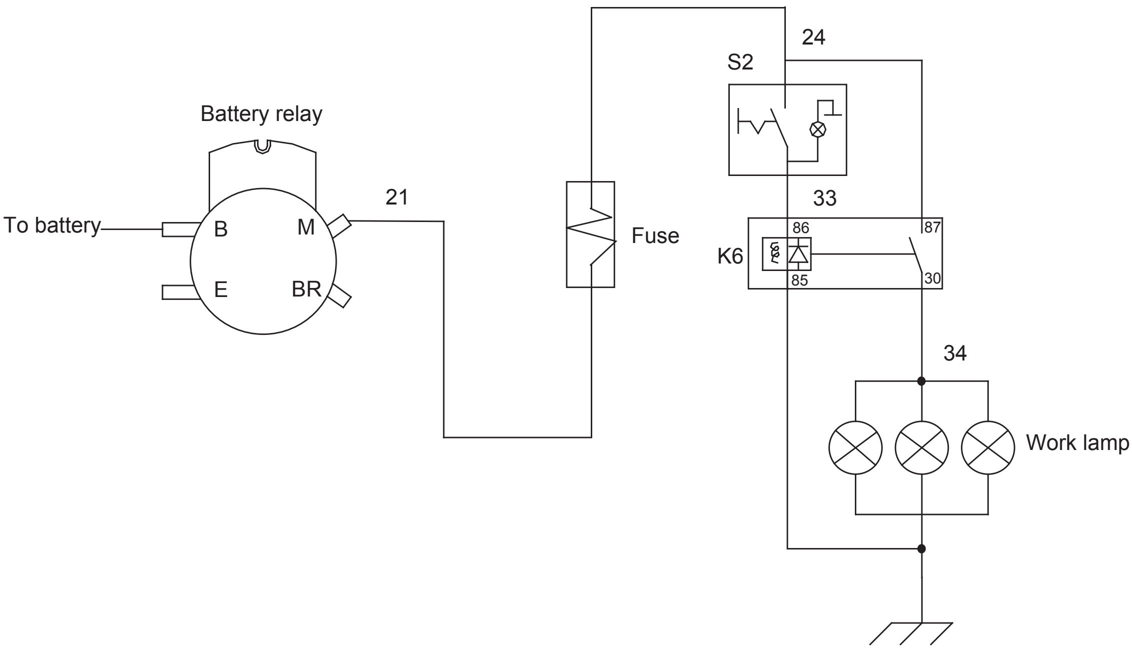
7.10.37 Work lamps do not light up

★ Check related connectors for contact problem before troubleshooting.

★ Make sure that the connectors removed are restored before carrying out next step.



Related diagram

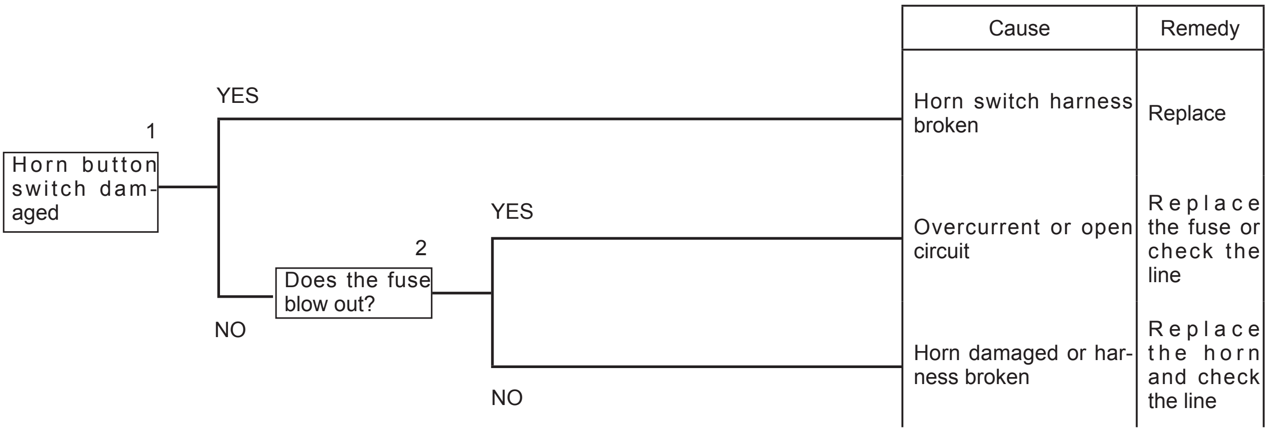


ZX55-1005052

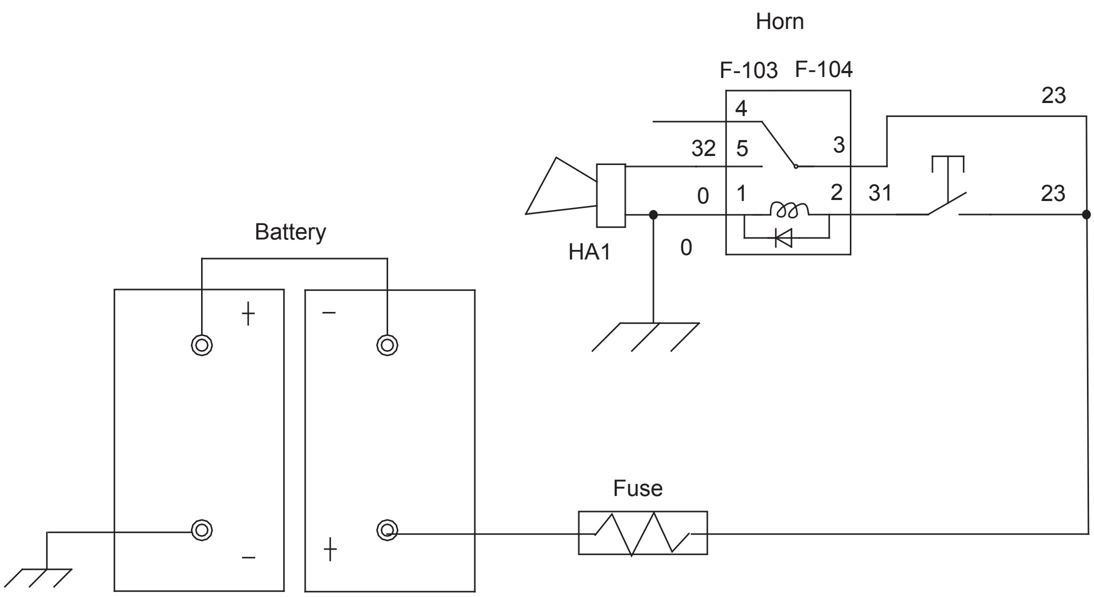
7.10.38 Horn does not sound

★ Check related connectors for contact problem before troubleshooting.

★ Make sure that the connectors removed are restored before carrying out next step.



Related diagram



ZX55-1005053

BLANK PAGE

SANY

Disassembly and Assembly

8 Disassembly and Assembly

8 DISASSEMBLY AND ASSEMBLY

8.1 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 its contact. To avoid excessive force imposing on the wire, hold the connector when disconnecting a wire.
   - Tag the wires and the hoses in order to ensure their connecting positions. By doing so, mistakes can be avoided during reinstallation.
   - Count and check the number and thickness of the shims, and keep them in a safe place.
   - When raising or lifting components, be sure to use proper lifting equipment of ample strength and safety.
   - When forcing screws are used to remove any components, tighten the screws evenly in turn.
   - The surrounding area must be cleaned before removing a unit. Cover the unit after removal in order to prevent invasion of dirt or dust.

   ★ 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 to be observed prior to installation operation
   - Tighten all the screws and nuts (sleeve nuts) to specif ed 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 f ange, tighten it evenly in turn in order to prevent over tighten-

ing on one side.

★ After reassembling the hydraulic cylinder, main pump or other hydraulic equipment that has been disassembled and repaired, it is necessary to bleed the air from the hydraulic cylinder prior to initial operation of the cylinder. The purging procedure is performed as the following:

A. Start the engine and run the engine at low idle.

B. 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.

C. Go on operating the hydraulic cylinder 3 or 4 times to its stroke end.

D. You can run the engine at normal speed after this operation.

★ This procedure is to be performed before using your machine for the f rst 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 specif ed level after disassembly and reinstallation of a hydraulic unit. Run the engine to circulate the hydraulic oil through the system. Check the oil level again.
- Bleed the air from the system after removing and repairing the lines or hydraulic unit and reassembling the parts.

  ★ Bleed the air. Refer to related section in "Testing and Adjusting".
- Add the specif ed amount of grease (molybdenum disulphide) to the work equipment related parts.

8.2 Engine and Main Pump AS

8.2.1 Removal

⚠ WARNING

- **Lower the work equipment to ground and stop the engine. Disengage the hydraulic lockout control and operate both joysticks for one or two minutes. After the pressure in hydraulic circuit has been completely relieved, slowly loosen the filler cap to release internal pressure of the hydraulic tank.**
- **Loosen the butterfly nut of breather valve and press the air release button to relieve internal pressure.**
- **Disconnect the cable from negative (-) post of the battery.**

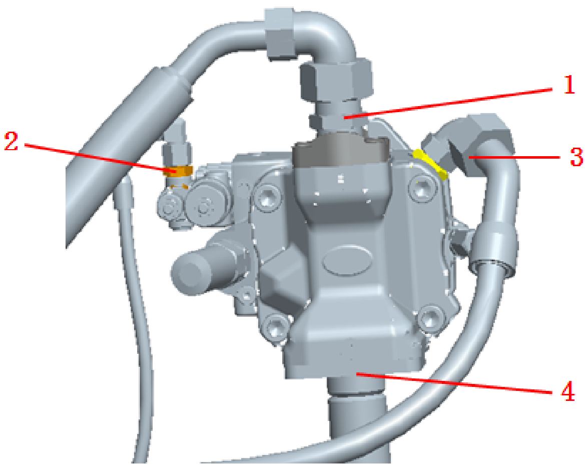


Fig. 8-1

1. Remove the f lter screen of hydraulic tank and plug the opening with the tool.

Note: When the tool is not used, remove the drain plug to drain oil from the hydraulic tank and the lines.

Hydraulic tank: approximate 52 L

2. Disconnect the following hoses from the main pump.

- P1 port (1)
- LS port (2)
- DR port (3)
- Suction Port(4)

Note: If oil is blocked by the tool, oil will come out. A plug must be ready in this case.

3. Disconnect the two wires from alternator (5).

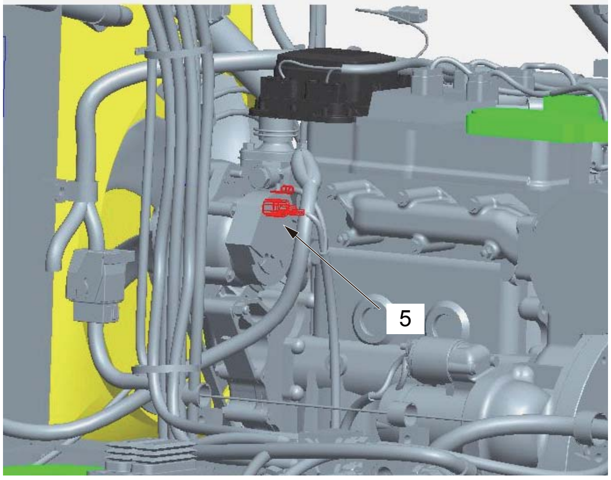


Fig. 8-2

4. Disconnect the wire (6) of oil pressure switch.

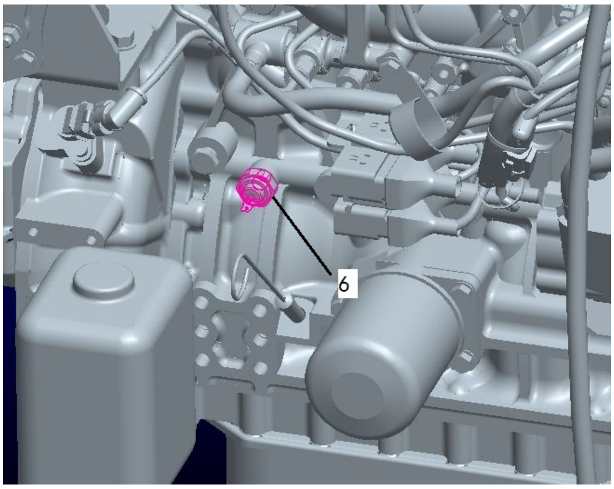


Fig. 8-3

5. Disconnect the preheat plug wire connector (E12) (7).

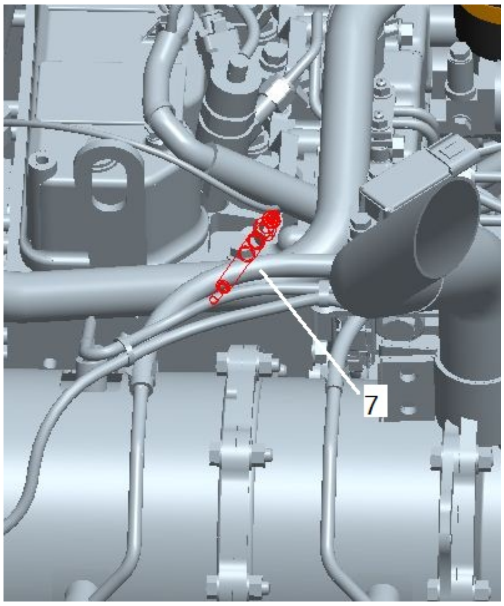


Fig. 8-4

6. Disconnect the air compressor wire connector (M34) (8).

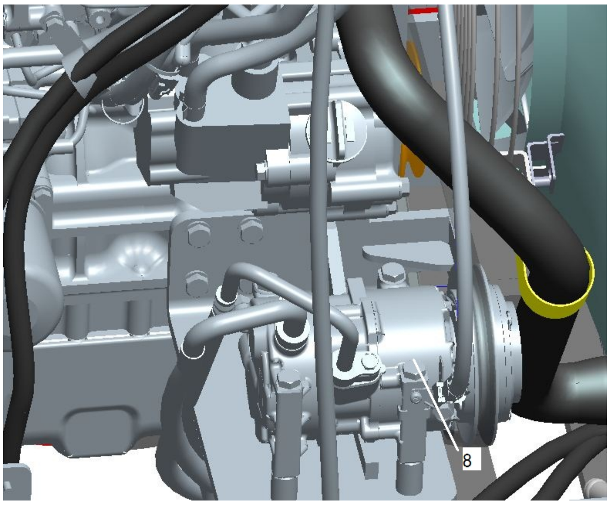


Fig. 8-5

7. Disconnect the water temperature sensor wire connector (P7) (9).

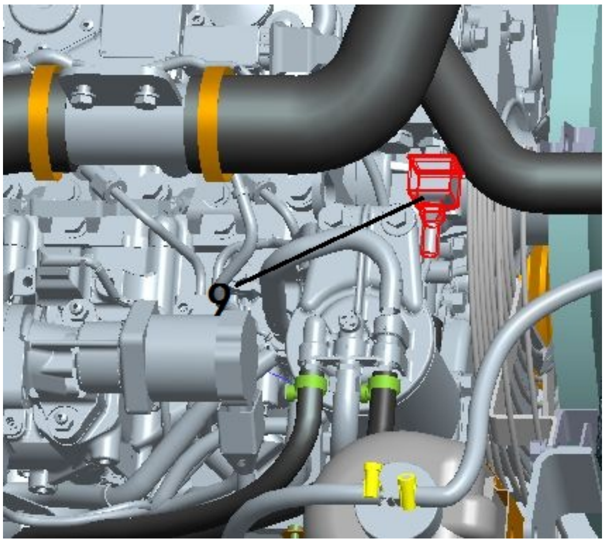


Fig. 8-6

8. Disconnect the start motor wire (11).

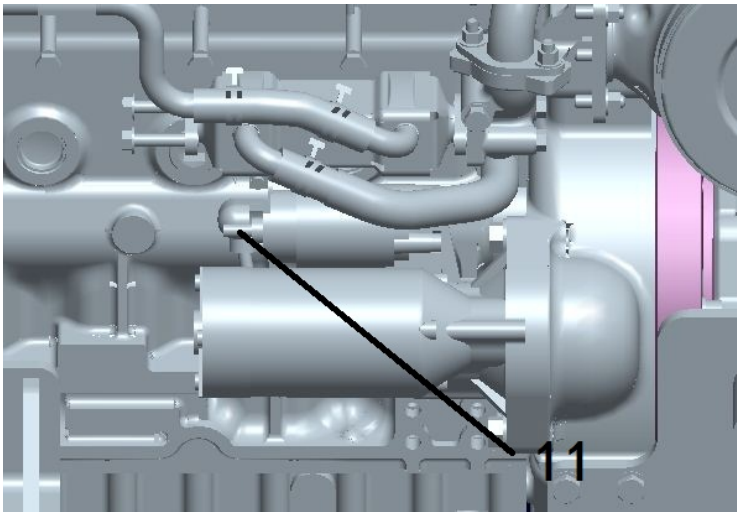


Fig. 8-8

9. Disconnect the radiator lower water pipe (12) and upper water pipe (13).

10. Remove the fan guard (14).

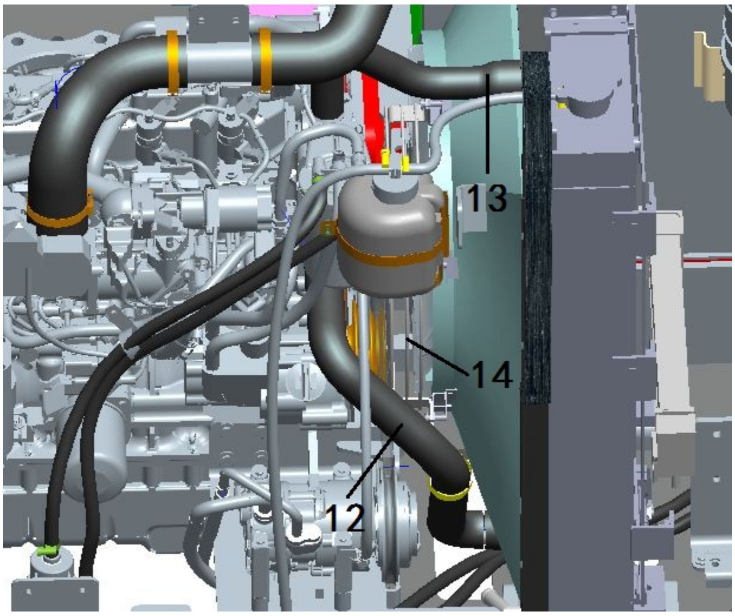


Fig. 8-9

12. Remove the air conditioner compressor assembly (optional) from the engine through the following steps.

- When the compressor assembly is being removed after discharge of refrigerant (R134a):
  A. Drain refrigerant (R134a) completely.
  B. Disconnect the two tubes (16) from the air compressor assembly (15).
- When the compressor assembly is being removed without discharging the refrigerant (R134a):
  A. Loosen the air compressor tensioning pulley (17) and mounting bolts in order to remove the belt of air compressor.
  B. Remove the air compressor assembly (15) together with the pipes and hold them to the engine with a rope.

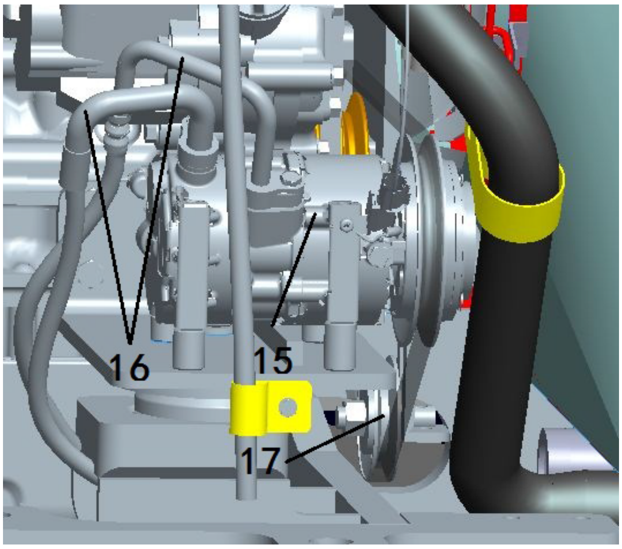


Fig. 8-10

13. Hoist up the engine and main pump assembly temporarily. Remove the four mounting bolts (18).
14. Move the engine and main pump assembly aside.

- Check if all wires and lines are disconnected and if the assembly interferes with the body and the radiator.

Engine and main pump AS: 180 kg

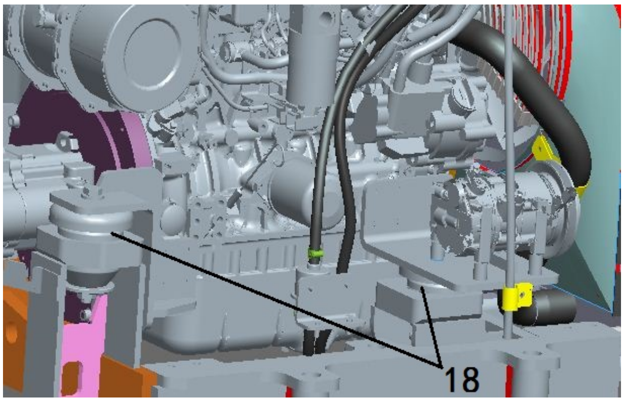


Fig. 8-11

8.2.2 Installation

- Adding water

  Add water through water filler to the spe-cif clevel.

  Run the engine to circulate water in the system, and then check the water level again.

- Adding oil (to hydraulic tank)
  Add oil through oil f ller to the specif c level. Run the engine to circulate oil in the sys-tem, and then check the oil level again.

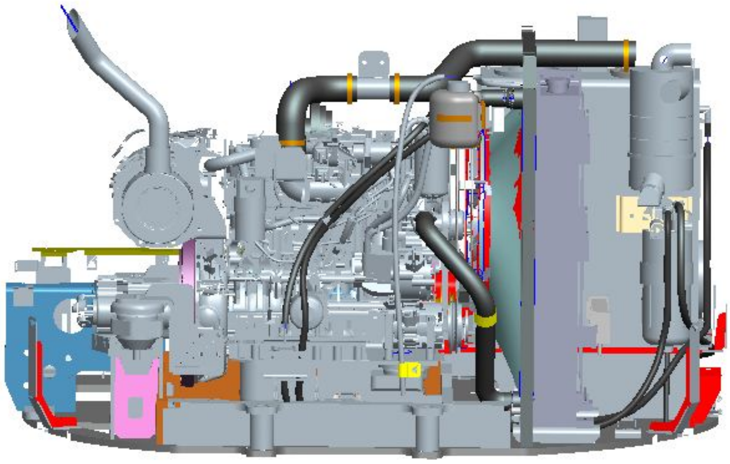


Fig. 8-12

- Adding refrigerant to air conditioner
  Add refrigerant (R134a) to air conditioner lines with a Freon f ller.

8.3 Central Swivel Joint AS

8.3.1 Removal

⚠ WARNING

- **Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release internal pressure in the hydraulic tank.**

Note: All pipes should be tagged in order to prevent wrong installation.

1. Disconnect the two oil drain hoses (1) of the travel motor.
2. Remove elbow (2).
3. Disconnect four inlet and outlet hoses (3) of both left and right travel motors.
4. Disconnect the two dozer blade hoses (4).
5. Disconnect the two speed selector hoses (5) of travel motor.
6. Disconnect oil drain hose (6) on top of swivel joint.
7. Disconnect hose (7) between control valve and swivel joint.
8. Remove swivel joint stopper bracket (8).
9. Remove the swivel joint mounting bolts (bottom) and lift the swivel joint assembly and move it aside.

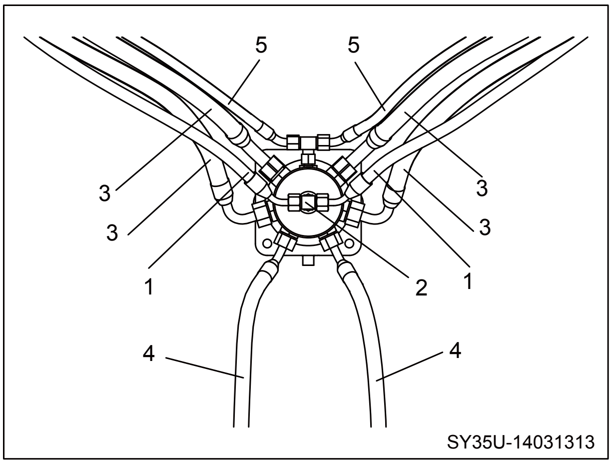


Fig. 8-13

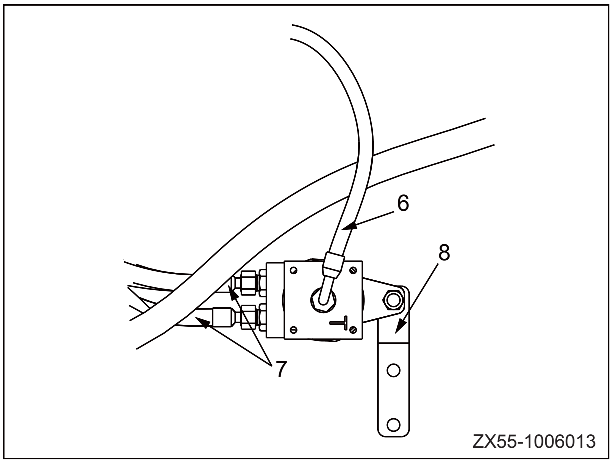


Fig. 8-14

8.3.2 Installation

- Installation is to be performed in reverse procedure of removal.

Swivel joint mounting bolt thread:

Thread adhesive: (1277)

Mounting bolt: 78±10 N·m

- Adding oil (to hydraulic tank)

  Add oil through oil f ller to the specif c level. Run the engine to circulate oil in the system, and then check the oil level again.

- Purging the air

  Purge the air inside travel motor.

  For detailed information on air purging see **"Air Purging"**

8.3.3 Disassembly

1. Unscrew bolt (13) to remove end cover (12).
2. Remove O-ring (11)， bolt(10) and retainer rings (9).
3. Use tool ② to pull out housing (8) from rotor (3).
4. Remove oil seal (7), O-ring seal (6) and water seal (4) from the rotor (3).

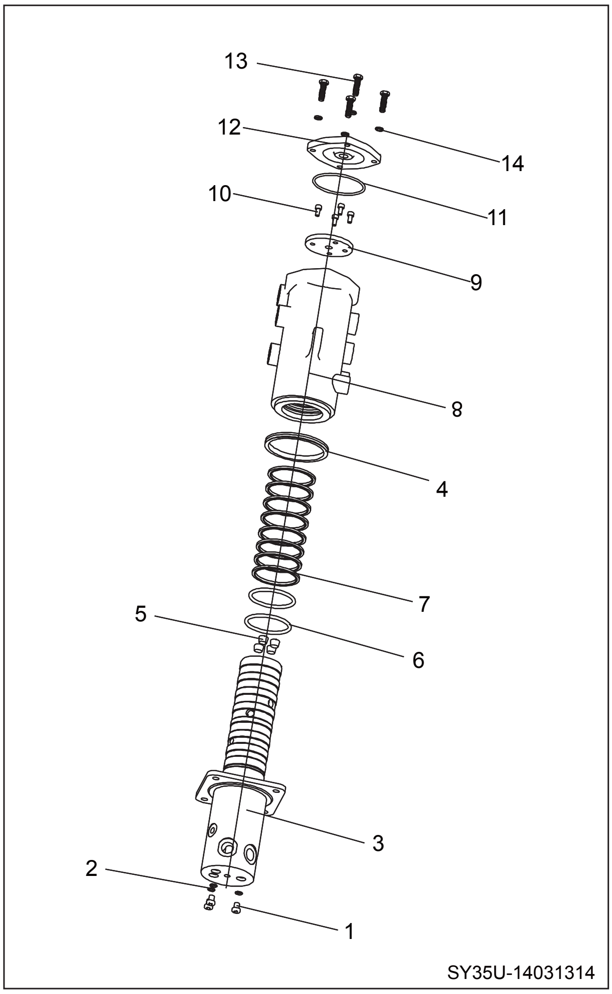


Fig. 8-15

8.3.4 Assembly

- Installation is to be performed in reverse procedure of removal.

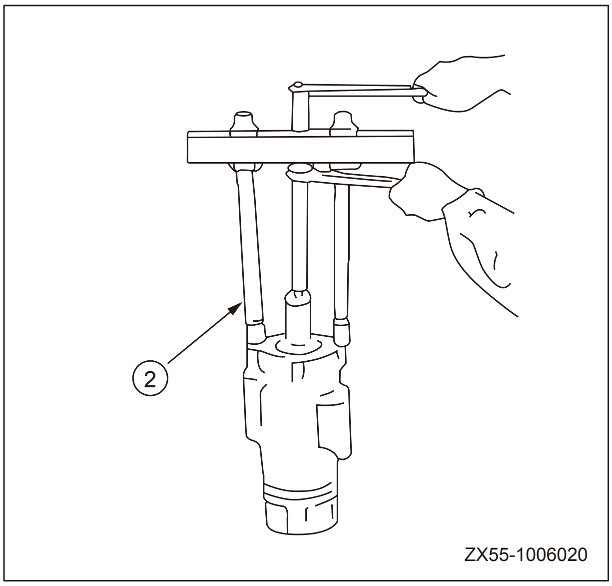


Fig. 8-16

8.4 Sprocket

8.4.1 Removal

1. Remove the track.
   For detailed information see **"Track AS"**
2. Swing the work equipment by 90º and tilt the machine with force of work equipment. Place a block ① between track frame and track.
3. Remove the mounting bolts and slightly pull out the sprocket (2).
4. Install eyebolt and nut. Hoist the sprocket (2) and move it aside.

Sprocket: 18Kg

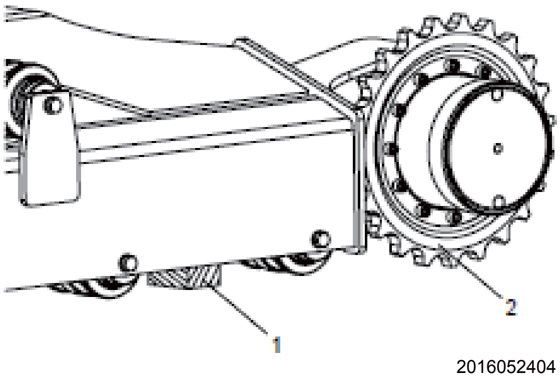


Fig. 8-17

8.4.2 Installation

- Installation is to be performed in reverse procedure of removal.

Sprocket mounting bolt thread:

Thread adhesive: (1277)

Mounting bolt: 113±10 N·m

8.5 Travel Motor AS

8.5.1 Removal

WARNING

- **Lower the work equipment fully on ground and stop the engine. Disengage the hydraulic lockout control and maneuver both left and right joysticks for 10-20 seconds to release system pressure.**

1. Remove the sprocket.
   For detailed information see **"Sprocket"** on.

2. Remove cover (1).

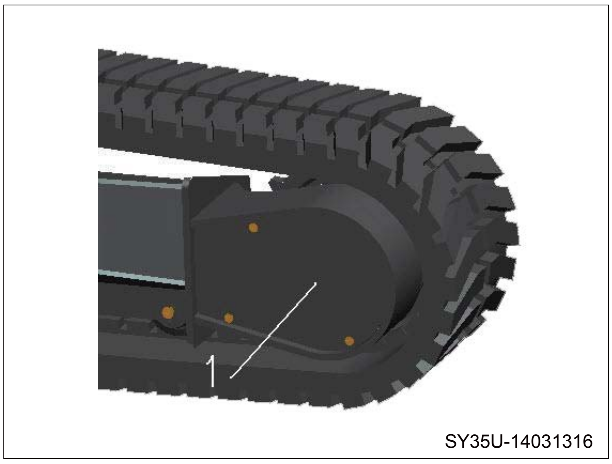


Fig. 8-18

3. Remove the four hoses (2) of travel motor. Remove the four hose connectors (3).
4. Remove the mounting bolts (4) of the travel motor and hoist the motor assembly (5) away.

- Plug the disconnected hoses.
- Take care not to damage the connector seals.

Travel motor assembly: 43.5 kg

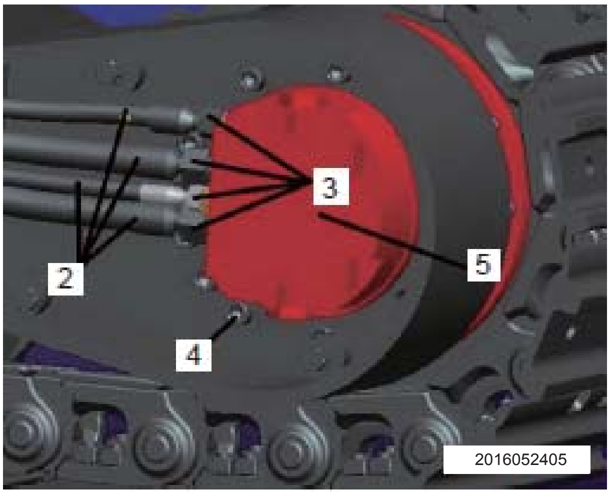


Fig. 8-19

8.5.2 Installation

- Installation is to be performed in reverse procedure of removal.

Cover bolt thread:

Thread adhesive: (1277)

Cover bolt: 66N·m±7.0N·m

Travel motor mounting bolt thread:

Thread adhesive: (1277)

Travel motor mounting bolt:

113N·m±19N·m

- Purge air from the hydraulic motor (hydraulic tank).

  For detailed information on air purging see **"Air Purging"**.

- Adding oil (to hydraulic tank)

  Add oil through oil f ller to the specif c level. Run the engine to circulate oil in the system, and then check the oil level again.

8.5.3 Disassembly

8.5.3.1 Preparatory work

- Prepare the following items before disassembling the travel motor.

1. Workbench
   - Prepare a workbench used for disassembling the travel motor.
   - The workbench must be strong enough for disassembling and assembling the internal parts of travel motor. The workbench must have a surface large enough for placing the parts in proper arrangement while the parts would not be moved or fall.
   - Cover the workbench with a rubber sheet or ethylene sheet.
2. Tools and materials

   Prepare the tools and materials mentioned above.

8.5.3.2 General precautions for disassembling

★ The internal parts disassembled are slippery due to application of hydraulic oil. Take care not to let them fall in order to avoid injury.

★ When f ammable liquid (such as kerosene) is used to clean the parts, it is easy to cause f re or burns. Be especially careful while doing this job.

1. It is necessary to consider the checking items and the conf rmed trouble characteristics before disassembling the travel motor. And then perform the job as per the disassembling steps provided.
2. Be careful when handling the parts as they are very precise. Take care not to let them collide each other or fall.
3. A securely-installed part may have burrs or be broken if it is hammered or pried for removal or installation.
4. If the travel motor disassembled partially or completely is left as it is, the parts may rust due to moisture and dust. Therefore, if the job has to be suspended, measures should be taken to prevent rusting or dust invasion.
5. Make a mark on mating surface of the parts during disassembly.
6. Store the disassembled parts properly in order to avoid damage or missing.
7. As a rule, all seals must be replaced once the travel motor has been disassembled. Therefore, prepare all kinds of seals for replacement prior to disassembly.

8.5.3.3 Disassembling procedure

1. Fix the motor on a bench clamp. Remove bolt (50-8) and then remove valve assembly (50).

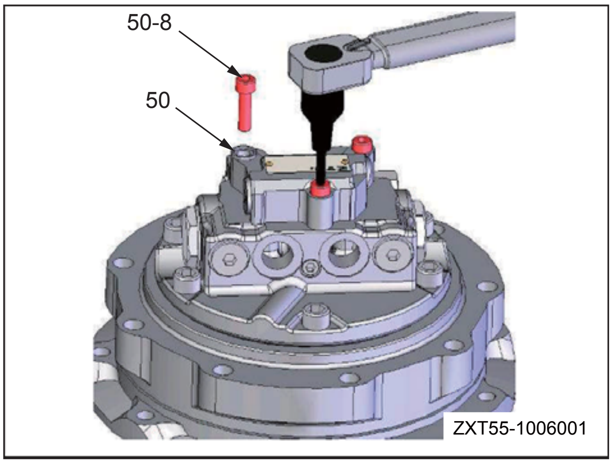


Fig. 8-23

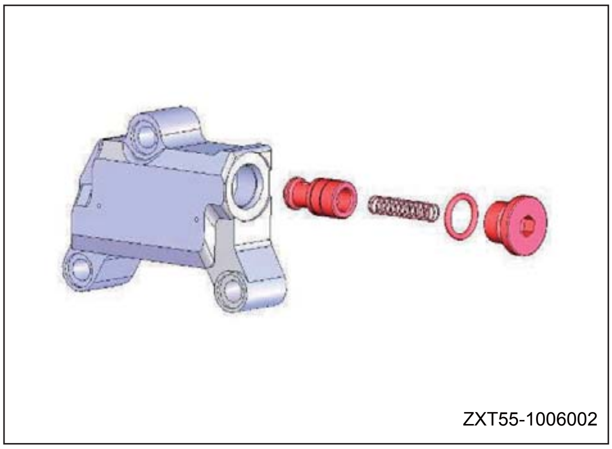


Fig. 8-24

2. If valve assembly is normal, there is not need to remove it. Fix valve body (50-1) on a bench clamp and remove screw plug (50-5), spring (50-3), valve spool (50-2) and spring seat (50-4).

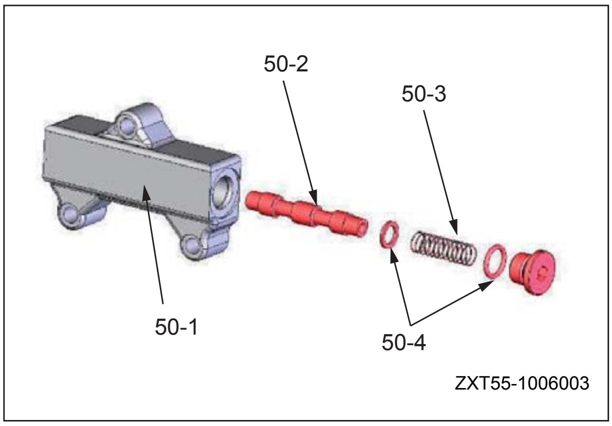


Fig. 8-25

3. Remove cap (38).

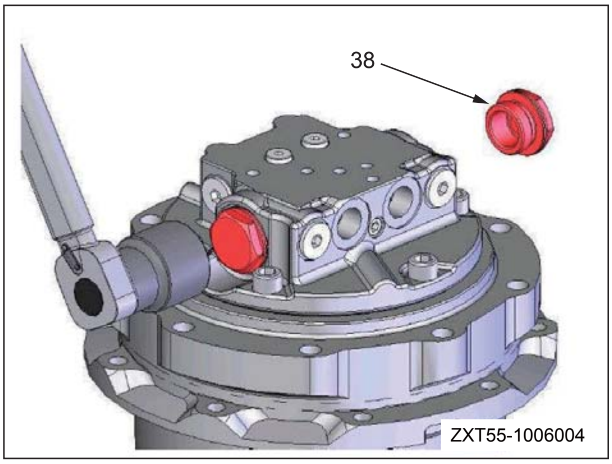


Fig. 8-26

4. Remove spring (37) and spring seat (36).

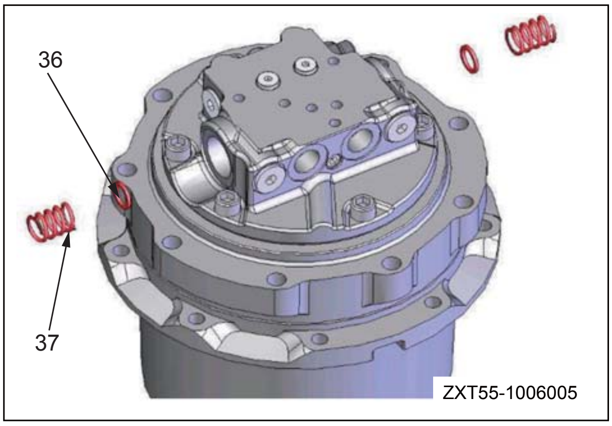


Fig. 8-27

5. Turn parts of the plunger assembly (31) slowly and remove it. Be careful not to damage the plunger.

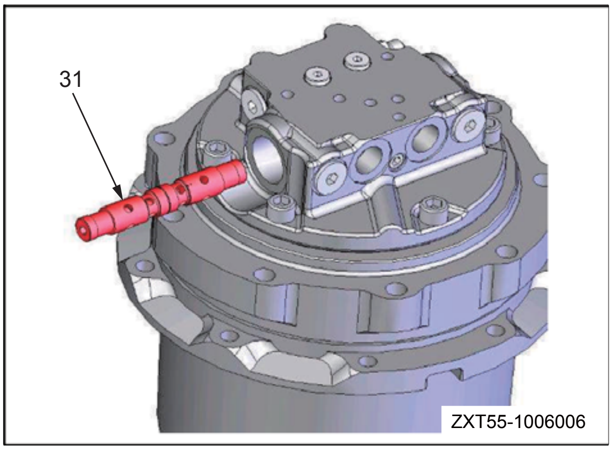


Fig. 8-28

6. If the parts of the plunger is found normal, there is no need to remove it.

   Insert a pin (Φ5x30) into the through hole (Φ6) on the part of plunger and f x it with a bench clamp. Remove it with by turning the plug (31-4).

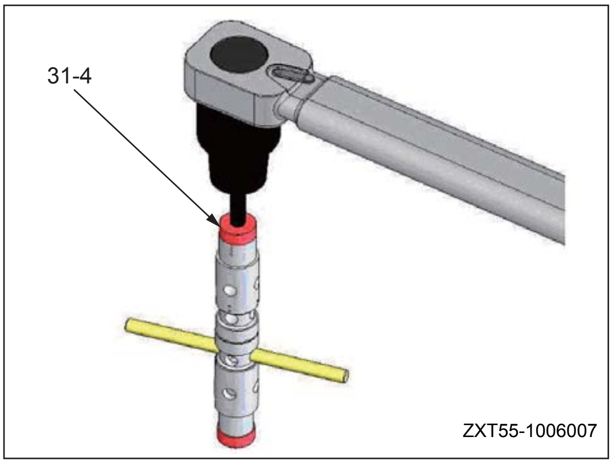


Fig. 8-29

7. Remove spring (31-3) and check valve (31-2).

   Pay attention to the check valve assembly opposite the plunger. Store the parts in the removing order to facilitate future installation.

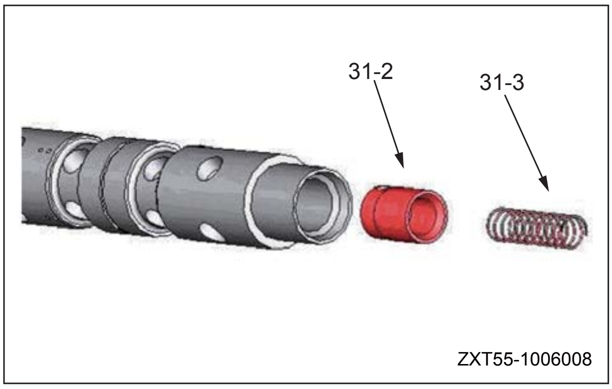


Fig. 8-30

8. Remove screw plug (43) and (46).

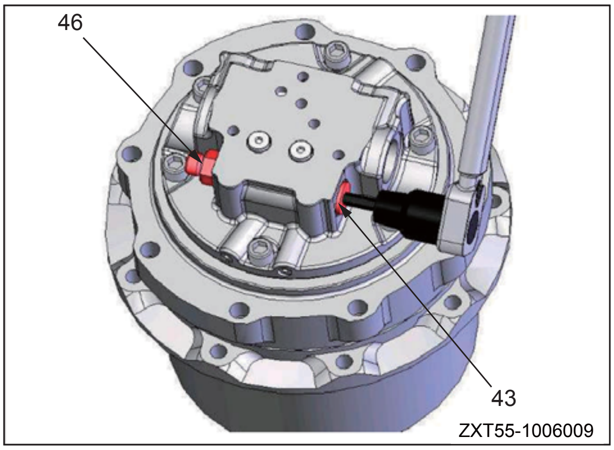


Fig. 8-31

9. Remove spring and valve assembly. Be careful not to damage the periphery of the valve spool.

   Remove the following parts: spring (42), valve spool A (41-1) and valve spool C (41-2).

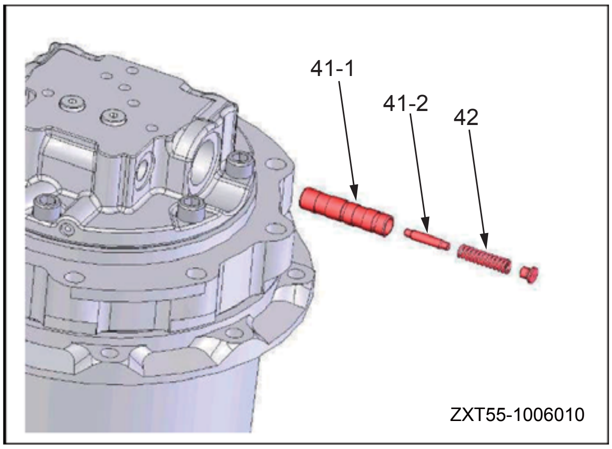


Fig. 8-32

10. Remove cover bolts (48).

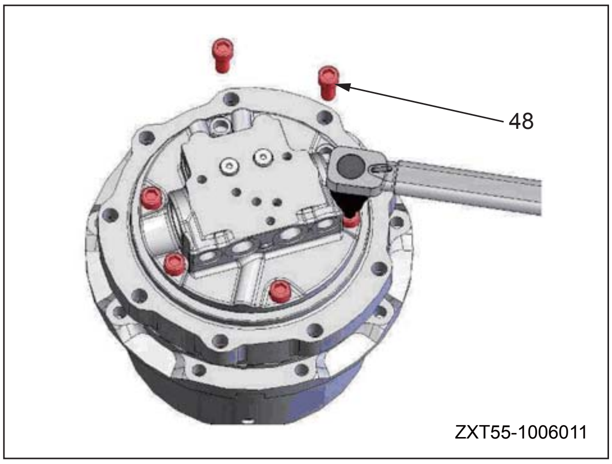


Fig. 8-33

11. Remove base plate (30). Be careful not to pull out cylinder block (7).

    If it is difficult to remove it, hit it with a plastic hammer. Otherwise, use a screw driver to pry and remove it.

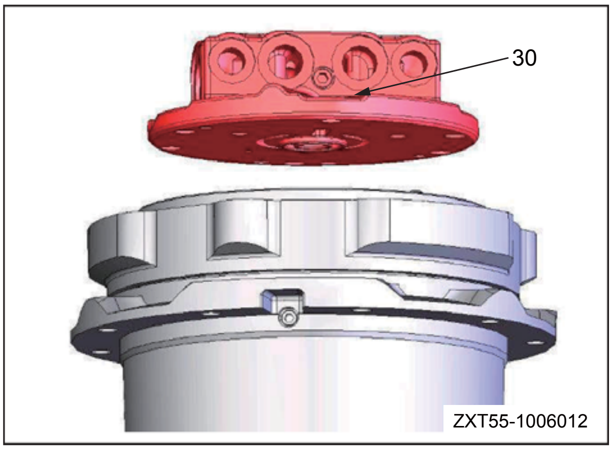


Fig. 8-34

12. Remove pin, valve plate and O-ring. Pin (26) and (49), valve plate (25), O-ring (28) and (29).

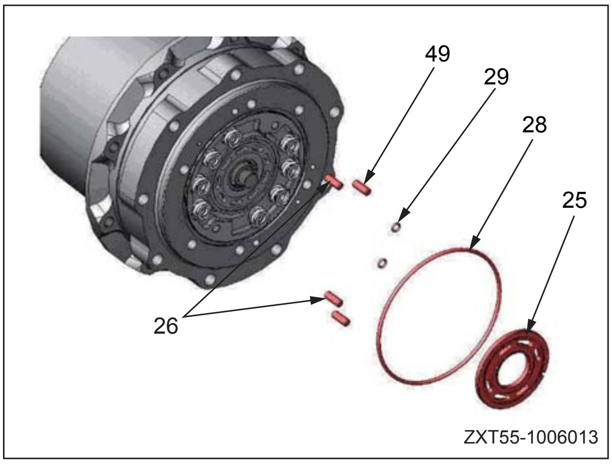


Fig. 8-35

13. Remove spring (62) and brake piston (60). Insert a pneumatic drill into the parking brake releasing hole of the mounting f ange (1-1) and remove it.

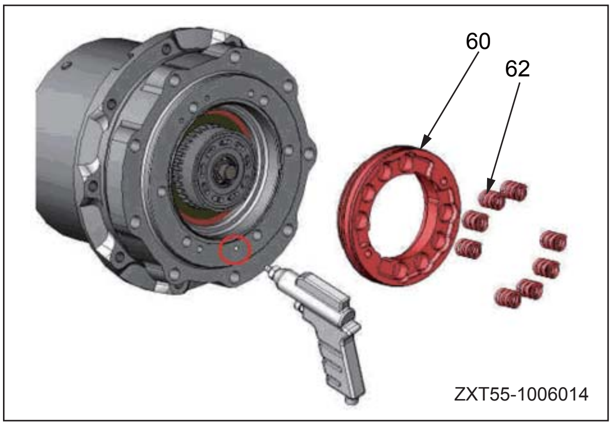


Fig. 8-36

14. Remove cylinder block (7), pin (12), guard bracket (13), guard plate (14), plunger parts (15) and disc (16).

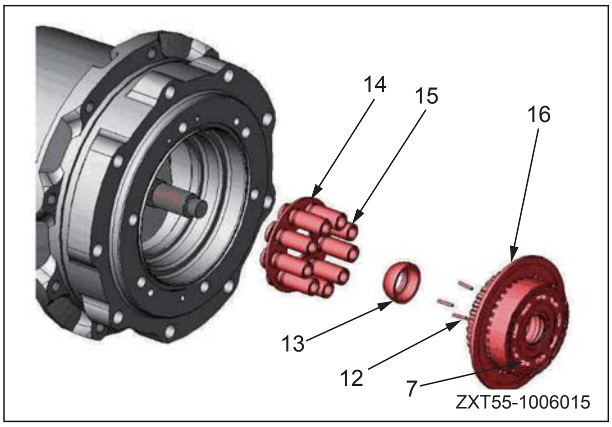


Fig. 8-37

15. Remove elastic stopper ring (11). Remove gasket (8), spring (9) and spring seat (10).

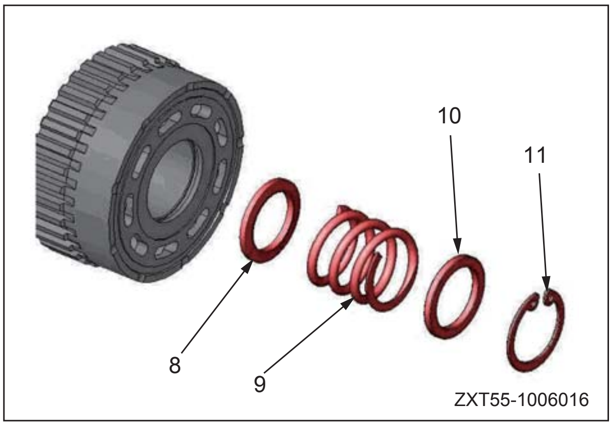


Fig. 8-38

16. Remove swash plate (5), ball (6), piston (19) and spring (20).

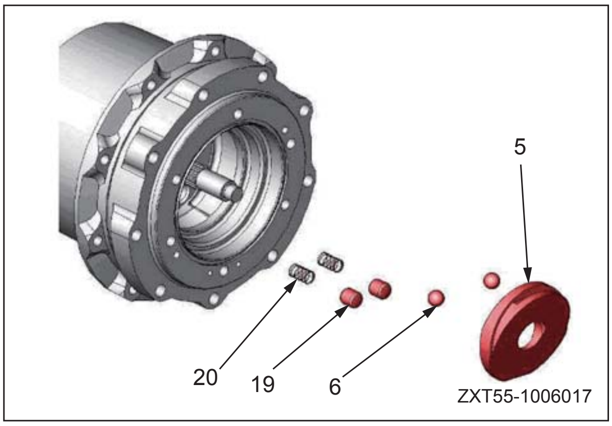


Fig. 8-39

17. Remove screw plug (1-27) and (1-8).

    Fix eye bolt (PF1/4) at screw plug hole (1-27) and put an iron bar through the eye bolt (about 1m). Turn cover (1-24) until steel wire (1-26) can be seen from screw plug hole (1-8). Take the steel wire at the hole with a screw driver and pull it out with pliers.

    Attach a hook on the eye bolt to remove the cover. Or remove it with the iron bar.

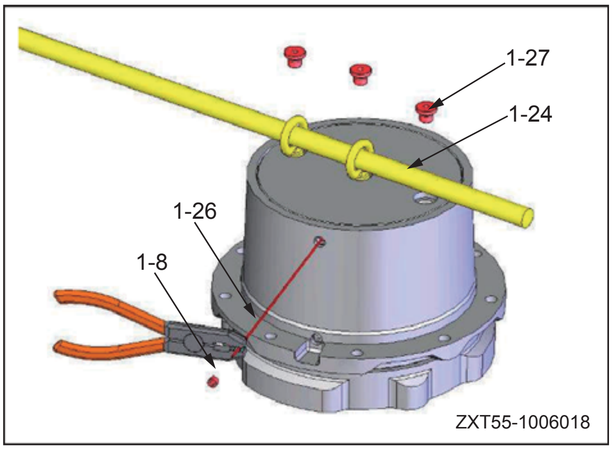


Fig. 8-40

Disassembly and Assembly

18. Remove sun gear (1-15), bracket (1-17), planetary gear A (1-18), needle bearing (1-19), inner ring (1-20), driving gear (1-22) and thrust plate (1-23).

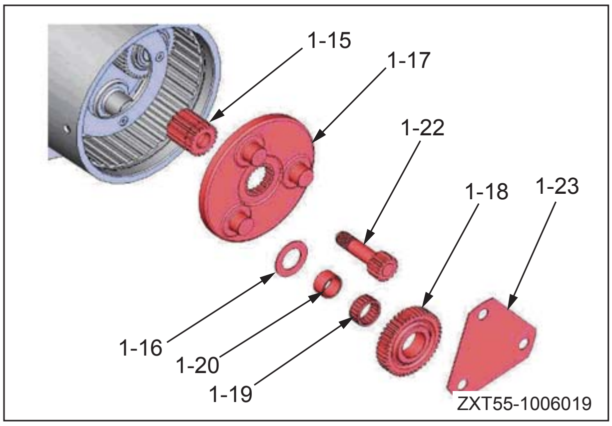


Fig. 8-41

19. Remove thrust plate (1-13) and screw (1-14).

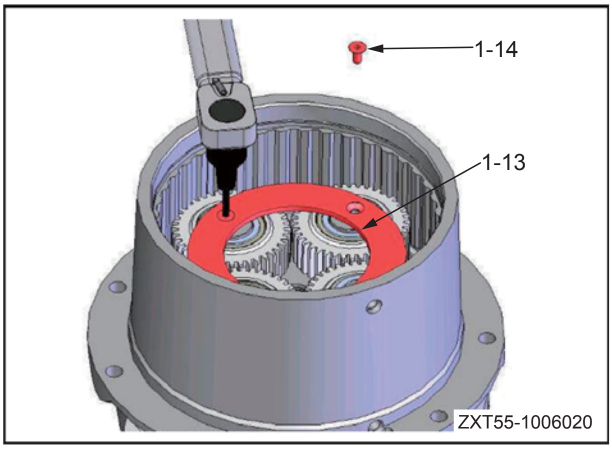


Fig. 8-42

20. Remove planetary gear B (1-9), needle bearing (1-10), inner ring (1-11) and thrust washer (1-12).

    Be careful not to damage the tooth face of the gear or the rotating portion of the shaft collar.

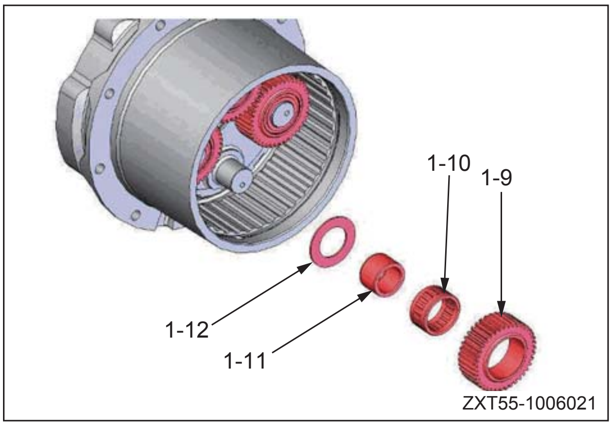


Fig. 8-43

22. Remove screw plug (1-8).

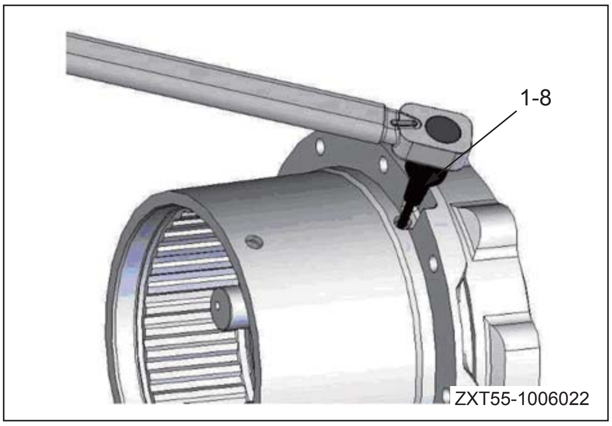


Fig. 8-44

21. Take ball (1-7) out of screw plug hole (1-8). Blow them out using compressed air after degreasing (dilluent and white gasoline). Insert a carbon steel wire into the hole to conf rm if all balls are taken out.

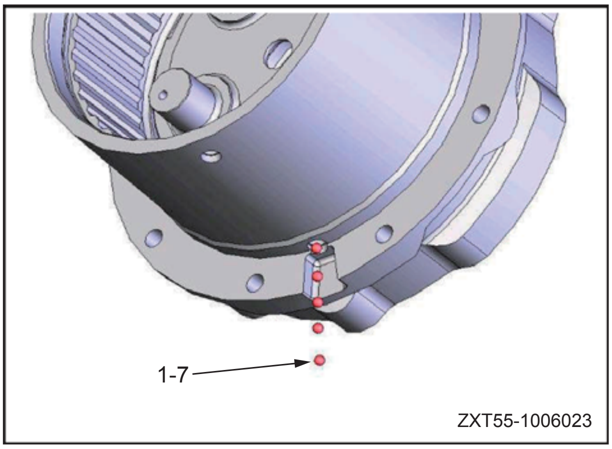


Fig. 8-45

23. Use a metal piece or clamp between flange (1-1) and casing (1-6). Tighten the bracket evenly with 3 bolts at the side of the casing.

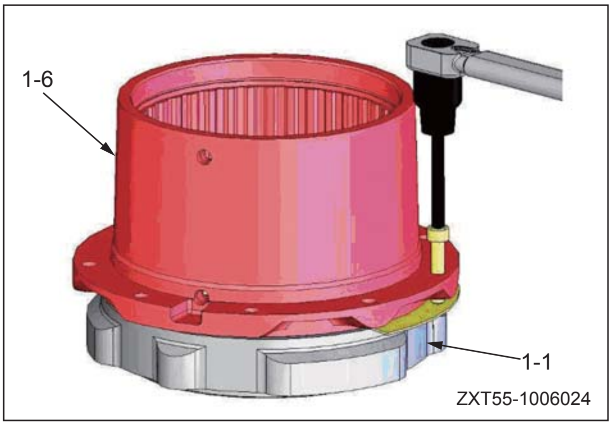


Fig. 8-46

24. Remove screw plug (1-5).

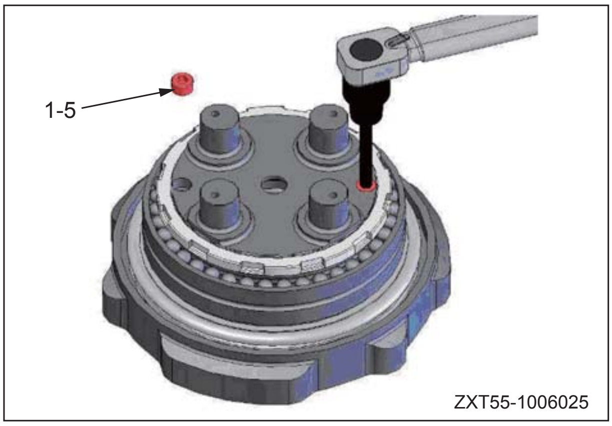


Fig. 8-47

25. Remove ring nut (1-4).

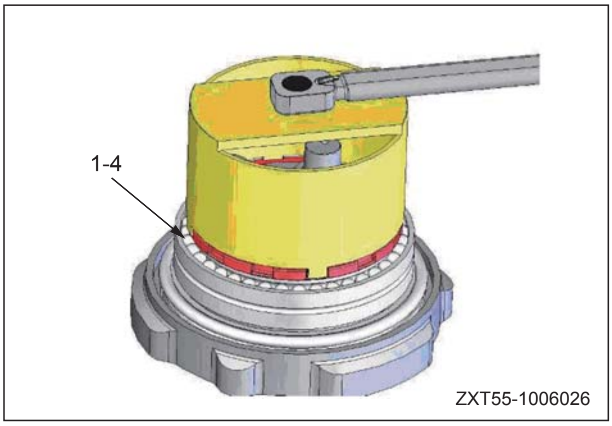


Fig. 8-48

26. Remove float seal (1-2) and angular contact bearing (1-30.

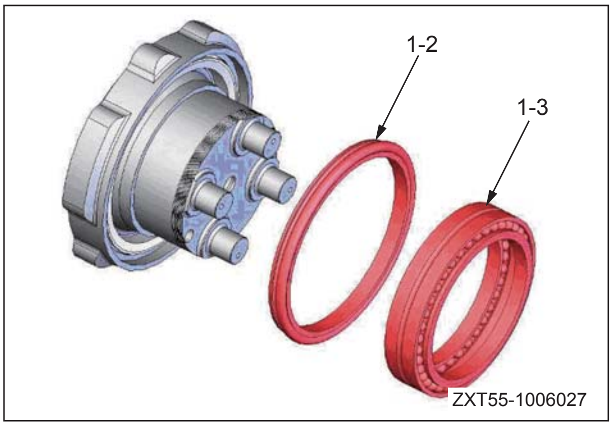


Fig. 8-49

27. Insert an iron bar into the shaft (2) inside spline hole and hammer it out.

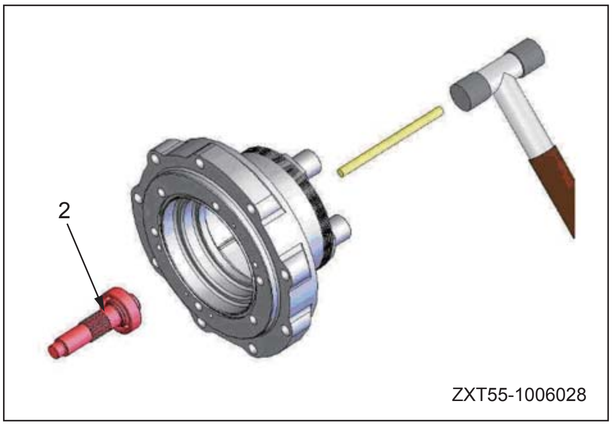


Fig. 8-50

28. Remove oil seal (4).

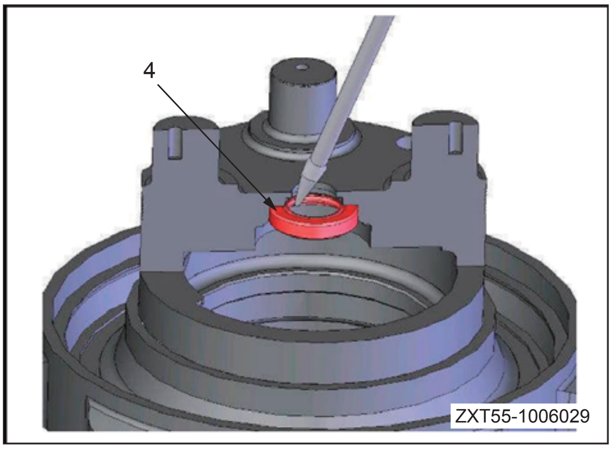


Fig. 8-51

29. Remove ball bearing (3) from shaft (2).

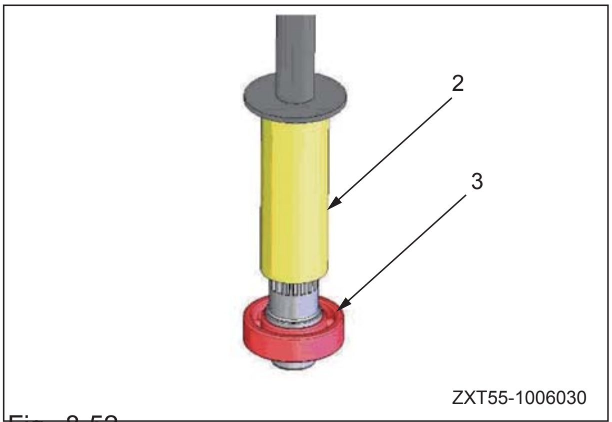


Fig. 8-52

8.5.4 Table of maintenance standard

Rinse all removed part with cleaning oil and dry them with compressed air. Inspect the parts as per the information in the table below. Make necessary replacement or repairs.

S/N	Part name (No.)	Check point	(Std.value) Replacement value recommended	Remedy
1	Float sel (1-2)	Sliding surface		Replace
2	Angular contact bearing (1-3)	Sliding surface	Abnormal damage, wear or scaling on ball groove	Replace
3	Casing (1-6)	Surface on gear tooth face	Abnormal damage, wear or scaling on tooth face (10% meshing cut on a tooth face)	Replace
4	Planetary gear A・B (1-9), (1-18)	Gear tooth surface Needle bearing moving surface	If working surface similar to No.3 has abnormal damage, wear or peeling.	Replace
5	Needle bearing (1-10), (1-19)	Needle bearing surface	If there is abnormal damage, wear or peeling.	Replace
6	Inner ring (1-11), (1-20)	Needle bearing surface	If there is abnormal damage, wear or peeling.	Replace
7	Thrust washer (1-12), (1-16)	Sliding surface	If there is abnormal damage, wear or scuff ng.	Replace
8	Thrust plate (1-13), (1-23)	Sliding surface	If there is abnormal damage, wear or peeling.	Replace
9	Sun gear (1-15)	Gear tooth surface	Same with No.3	Replace
10	Bracket (1-17)	Surface condition of planetary gear A and slide face	If there is abnormal damage, wear or peeling.	Replace planetary gear A and carrier
12	Driving gear (1-22)	Condition of gear tooth surface	Same with No.3	Replace
13	O-ring (1-25), (1-28), (28), (29), (31-5), (39), (44), (50-5), (50-6), (50-7), (57), (65), (66), (74)	Surface condition and harness	If there is damage, deformation or hardening.	Rubber seal will deteriorate as time goes by. Replace the seal after disassembly.
14	Shaft (2)	Surface condition of oil seal	If there is damage or extra wear	Replace
15	Ball bearing (3), (27)	Same with No.2	Same with No.2	Replace
16	Oil seal (4)	Surface condition and hardness of lip	If there is damage, deformation, extra wear or hardening.	Replace
17	Swash plate (5)	Surface roughness of plunger assembly and sliding surface	If there is extra damage (above 0.02mm), wear or scuff ng 0.4a (0.8a)	Grind rough part (#1000) or replace the part that cannot be repaired.

S/N	Part name (No.)	Check point	(Std.value) Replacement value recommended	Remedy
18	Cylinder block (7)	Clearance between parts of plunger;	0.02mm (0.04mm)	Replace cylinder block and parts of plunger together.
		Surfaces between valve plate and slide face;	If there is damage (above 0.02mm), wear, or scuff ng	Grind rough part of slide sur-face(#1000)
		Roughness	0.4a (0.8a)	For part that can-not be repaired, also replace cylinder block and parts of plunger together
19	Spring (9), (20), (37), (42), (31-3), (50-3), (62)	Deformation or large-area deformation		Replace
20	Plunger portion parts (15)	Clearance between cylinder blocks	Same with No.17	Same with No.17
		Surface condition of swash plate and slide surface	Same with No.16	Same with No.16
		Roughness	0.2a (0.8a)	
		Clearance between plunger and slipper	0.15mm (0.4mm)	Replace
21	Plunger (19)	Clearance between f ange carriers	Same with No.17	Same with No.17
		Surface condition and rough-ness of swash plate and slide surface	Same with No.16	Same with No.16
22	Valve plate (25)	Surface condition of cylinder block and slide surface Roughness Thickness 5mm	Same with No.17 0.2a (0.8a) 4.8mm	Same with No.17 Replace
23	Bottom plate (30)	Surface condition of plunger and slide surface	If there is damage, wear or scuff ng	Replace base plate and plunger together
		Surface condition of spool and slide surface	If there is damage, wear or scuff ng	Replace base plate and spool together

S/N	Part name (No.)	Check point	(Std.value) Replacement value recommended	Remedy
24	Plunger (31-1)	Surface condition of base plate and slide surface	If there is damage, wear or scuff ng	Replace base plate and plunger together
		Surface condition of check valve and slide surface	If there is damage, wear or scuff ng	Replace check valve and plunger together
25	Check valve (31-2)	Surface condition of plunger and slide surface	If there is damage, wear or scuff ng	Replace check valve and plunger together
		Surface condition of plunger and seat	If the seat is installed in place	Replace check valve and plunger together
26	Valve spool assem-bly (41)	Surface condition of base plate and slide surface	If there is damage, wear or scuff ng	Replace base plate and plunger together
27	Valve body (50-1)	Surface condition of spool and slide surface	If there is damage, wear or scuff ng	Also replace valve assembly
28	Valve spool • Check valve (50-2)	Surface condition of valve body and slide surface and seat	If there is abnormal damage, bruise, wear or scuff ng	Replace valve As

8.5.5 Assembly

As a rule, disassembling operation is performed in the reverse order of disassembling.

8.5.5.1 Preparatory work

Like the preparatory work for disassembling, prepare a workbench, tools and materials used for disassembling.

8.5.5.2 General precautions

1. Abide by the general precautions for disassembling.
2. Before assembling, it is necessary to remove all metal chips and impurities on the parts and check for burrs and bruises. Remove the burrs and bruises if any with a whetstone.
3. Replace the O-ring seals, oil seals and f oating seals.
4. As a rule, the hinge bolt should be replaced. The use of the old bolt requires removing any attached substance from the bolt. Remove any bruises with a whetstone on bolt seat. Remove the grease on the hinge bolts.
5. Be careful not to damage the O-ring seals, oil seals and f oating seals during assembling. (A small amount of greased can be applied to the parts in order to ease their installation.)
6. Clean hydraulic oil (NAS 9 or above) is to be applied to the hydraulic motor parts and the moving or sliding parts of valve during assembling.
7. Do not wear cotton gloves during assembling. (Fibers of cotton gloves can cause failure.)
8. Tighten all bolts and screw plugs to the table of tightening torques.
9. Plug all openings after assembling operation in order to prevent invasion of dust.

8.5.5.3 Assembly procedure

1. Apply grease on f oat seal (1-2) and install it onto mounting f ange (1-1).

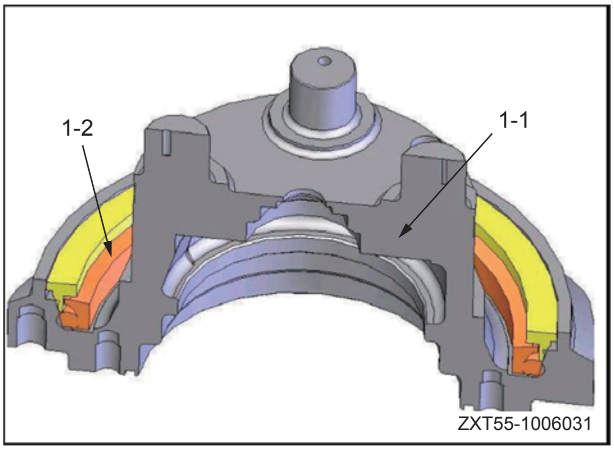


Fig. 8-53

2. Press angular contact bearing (1-3) into casing (1-6).

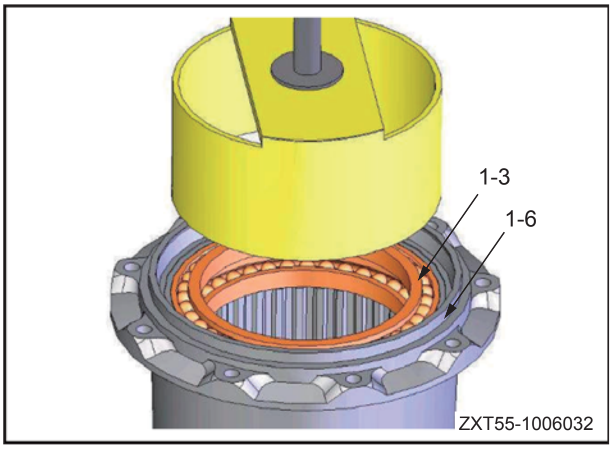


Fig. 8-54

3. Apply grease onto the float seal on the other side and install it on casing (1-6).

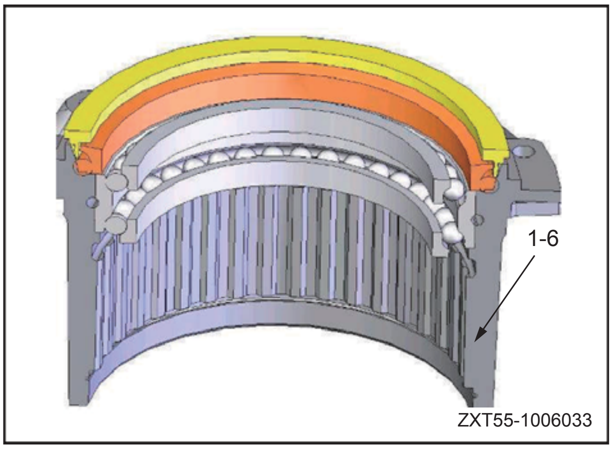


Fig. 8-55

4. Wipe the sliding surface of float seal (1-2) with clean waste cotton and spray gear oil on the sliding surface. Install mounting f ange (1-1) and casing (1-6).

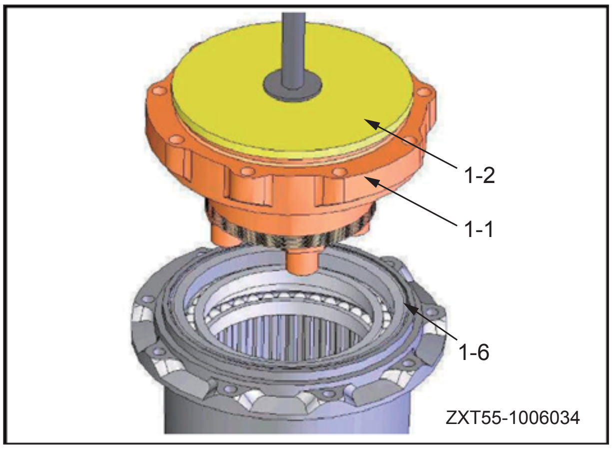


Fig. 8-56

5. Tighten angular contact bearing (1-3) with ring nut (1-4).

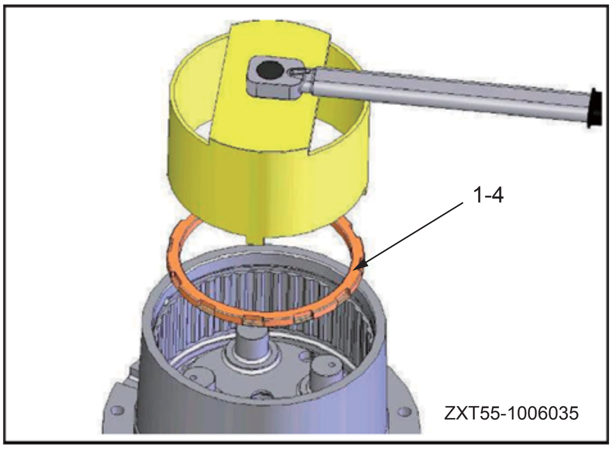


Fig. 8-57

6. Tighten screw plug (1-5).

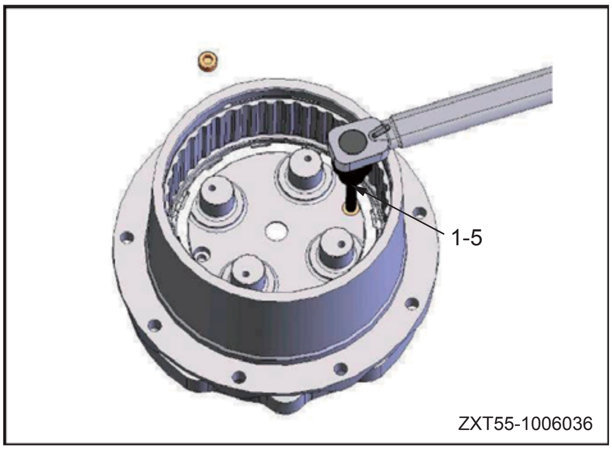


Fig. 8-58

7. When screw plug (1-5) is tightened, rivet at two points with a perforator so that it will not come loose.

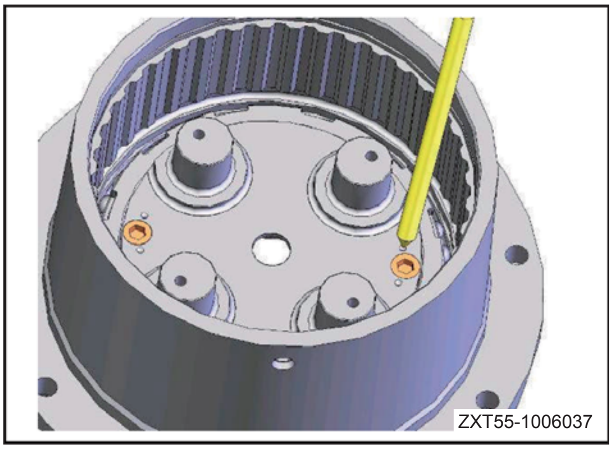


Fig. 8-59

8. Insert necessary numbers of steel balls (1-7).

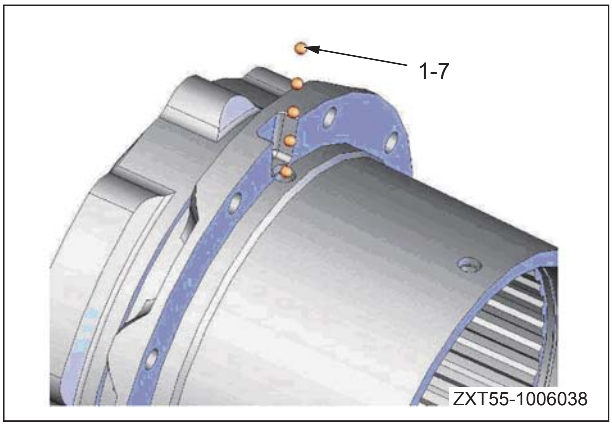


Fig. 8-60

9. Coil sealing bands on screw plug (1-8) and tighten it.

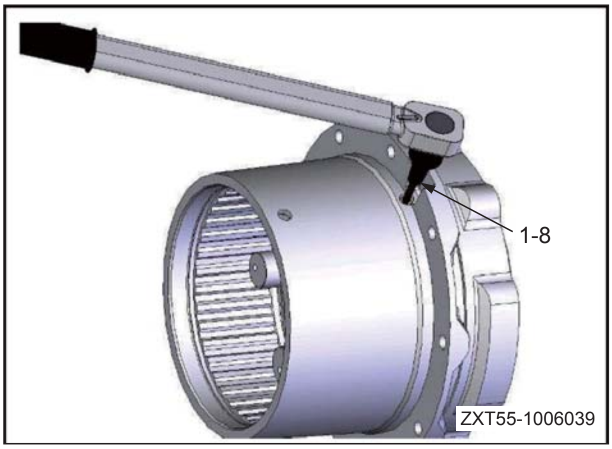


Fig. 8-61

10. Install planetary gear B (1-9), needle bearing (1-10), inner ring (1-11), thrust washer (1-12).

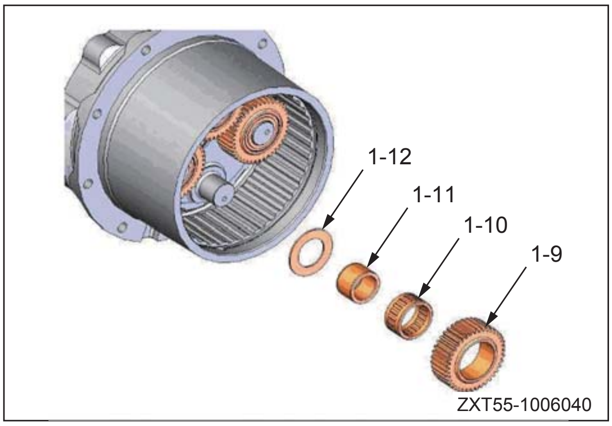


Fig. 8-62

12. Set thrust plate (1-13) on the journal of mounting f ange. Apply adhesive (Henkem Loctite #262) on screw (1-14) and tighten it.

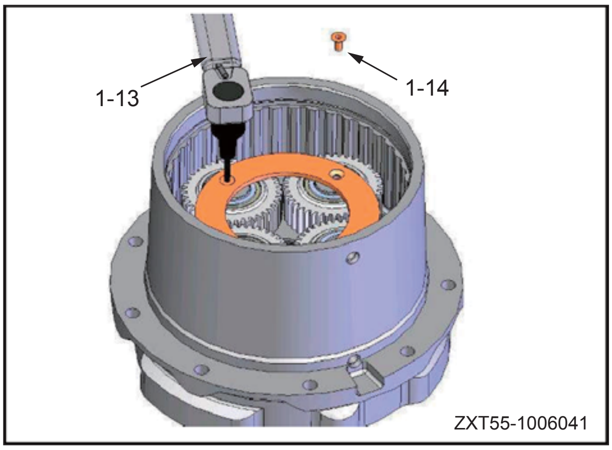


Fig. 8-63

11. Install elastic stopper ring (1-30). Then, install sun gear (1-15), inner ring (1-20), bracket (1-17), planetary gear (1-18), needle bearing (1-19) and driving gear (1-22).

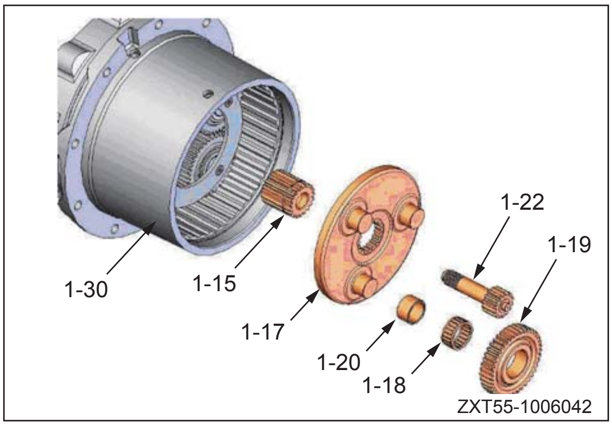


Fig. 8-64

13. Install thrust plate (1-23).

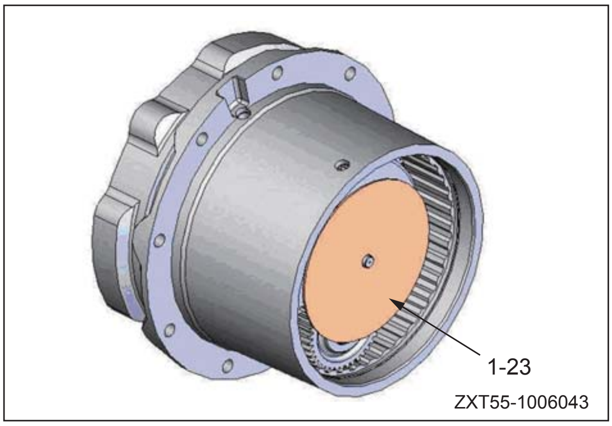


Fig. 8-65

14. Apply grease on O-ring (1-25) and install it to cover (1-24). Align the screw hole of screw plug (1-8) of casing (1-6) with the notch on cover (1-24) and install them.

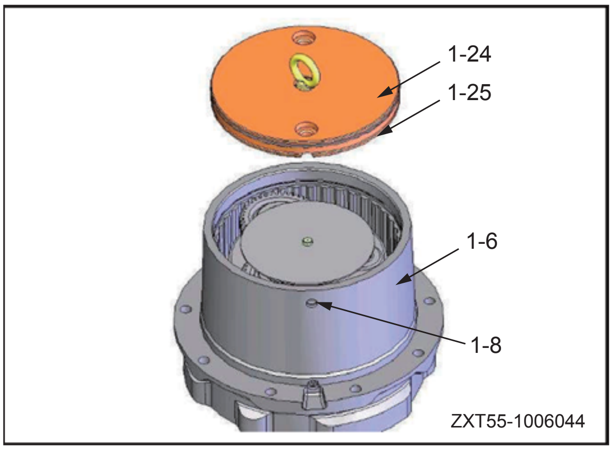


Fig. 8-66

15. There is an elbow (6mm, 90º)at the end of the steel wire (1-26). There is a small hook on the tip of the elbow. Insert the elbow into the screw hole of the casing inside the notch of cover (1-24).

    Turn the cover and coil the steel wire inside at the same time. Cut off surplus wire with pliers after one coil. Coil sealing band on screw plug (1-8).

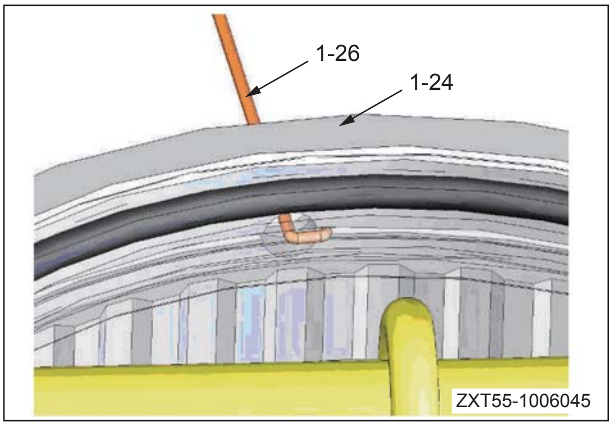


Fig. 8-67

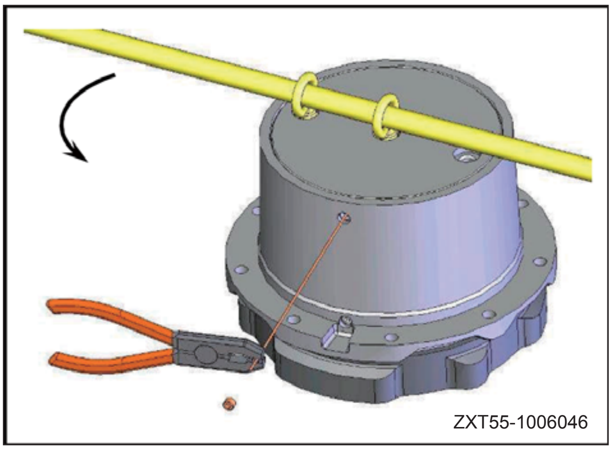


Fig. 8-68

16. Apply grease on the inner and outer edge of oil seal (4) and on the mounting f ange. Press in the oil seal.

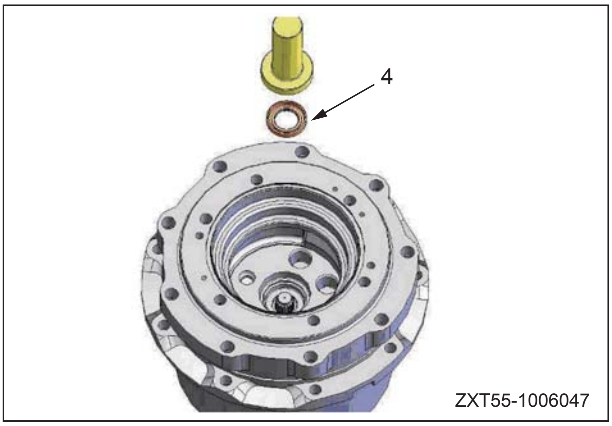


Fig. 8-69

19. Press ball bearing (3) onto shaft (2).

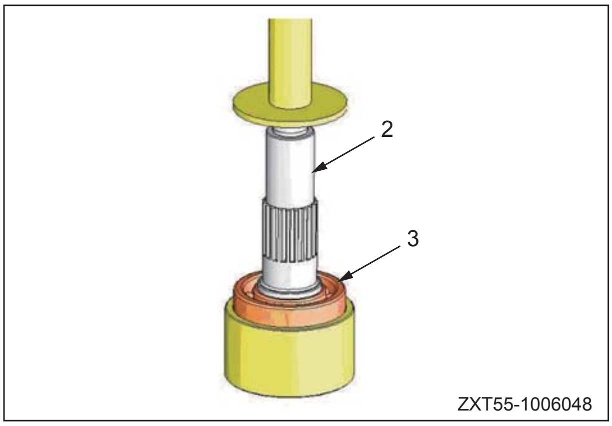


Fig. 8-70

17. Apply grease onto the oil seal sliding section on shaft assembly parts and on the edge of the oil seal. Press shaft parts into mounting f ange (1-1).

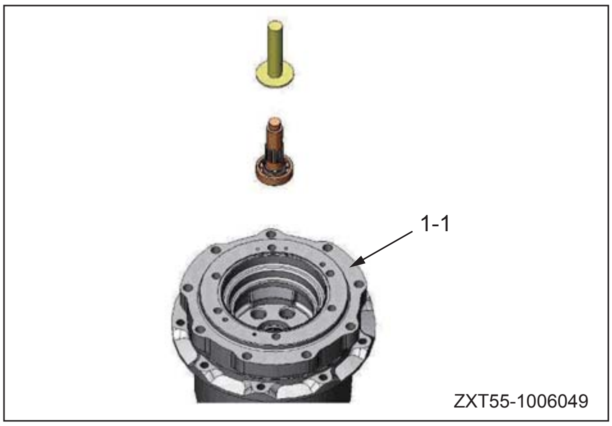


Fig. 8-71

18. Install ball (6), plunger (19), spring (20), swash plate (5) onto mounting f ange (1-1). Apply grease on spring (20) and assemble it with plunger (19).

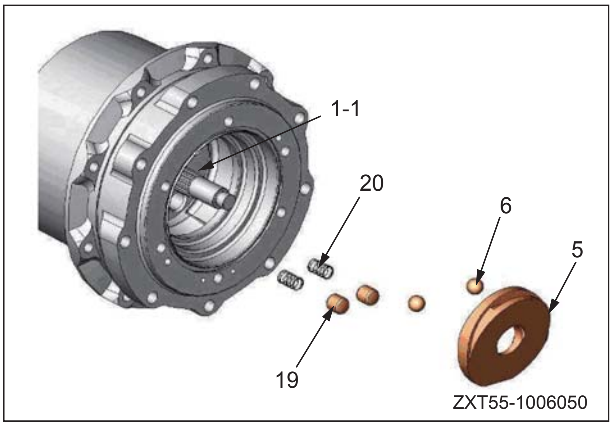


Fig. 8-72

22. Install shaft collar (8), spring (9), washer (10) and elastic stopper ring (11) onto cylinder block (7).

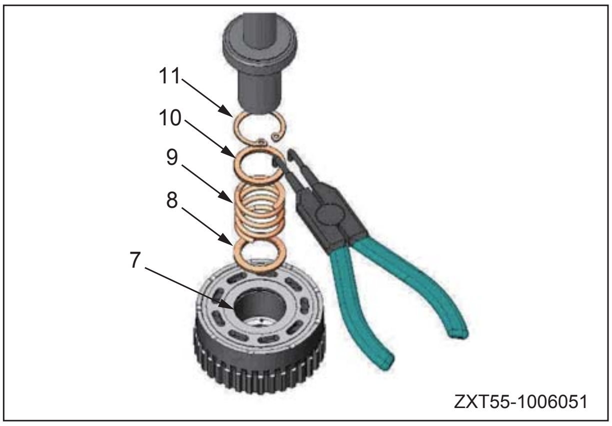


Fig. 8-73

20. Apply grease on pins (12) and insert them into the 3 holes on cylinder block.

Fig. 8-74

21. Assemble guard bracket (13), guard plate (14) and plunger assembly (15).

    Apply oil inside the 9 holes on cylinder block.

    Install disc (61).

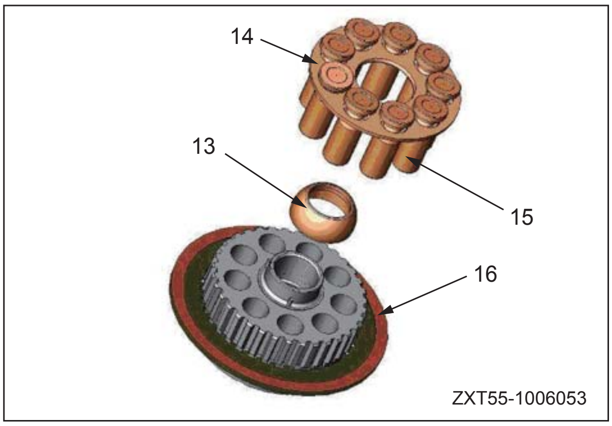


Fig. 8-75

25. Place the motor on its side and install cylinder block parts using shaft spline as the guide.

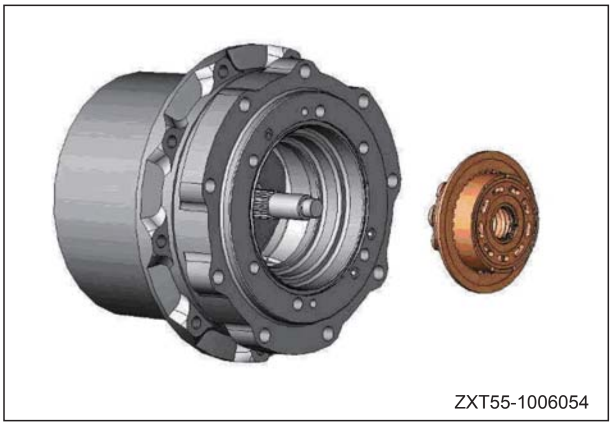


Fig. 8-76

23. Check if springs are well placed by pressing the cylinder block. Apply grease on the sliding portion of the cylinder block.

Fig. 8-77

24. Install pin(49), O-ring (28) and O-ring (29) onto the groove of the mounting f ange.

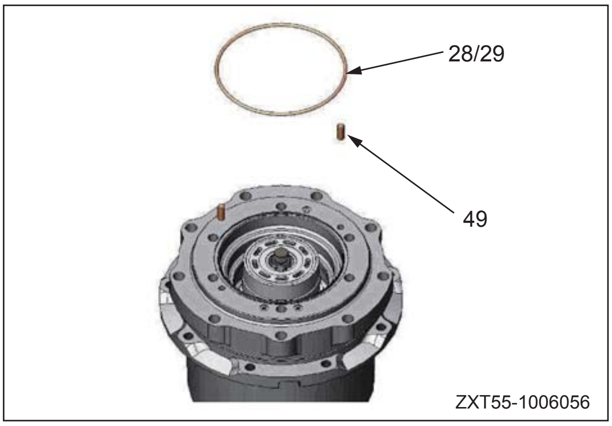


Fig. 8-78

26. Press ball bearing (27) into base plate (30).

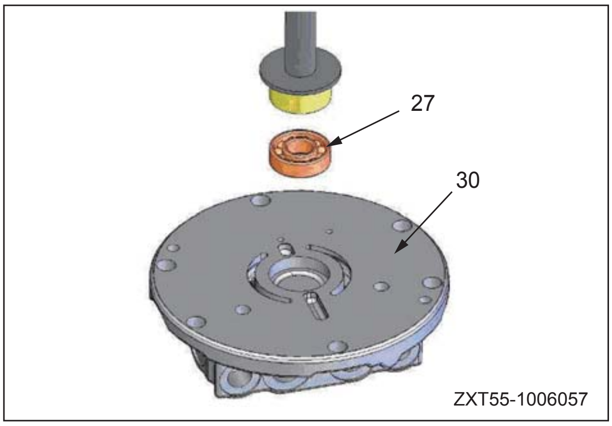


Fig. 8-79

27. Install pin (26). Rivet at one place in the direction of the periphery.

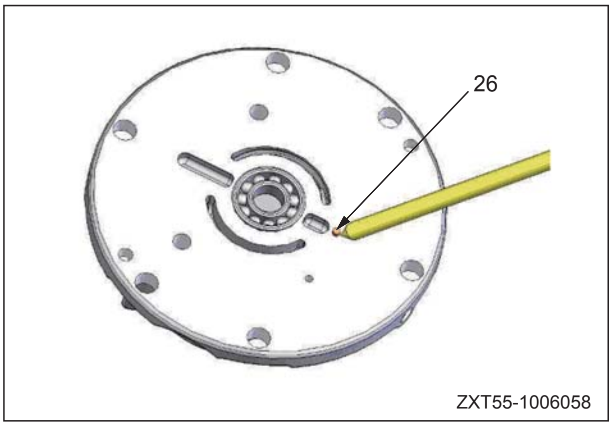


Fig. 8-80

28. Apply grease on the back of valve plate (25) and install it onto base plate (30).

    Install pin (61) onto bottom plate.

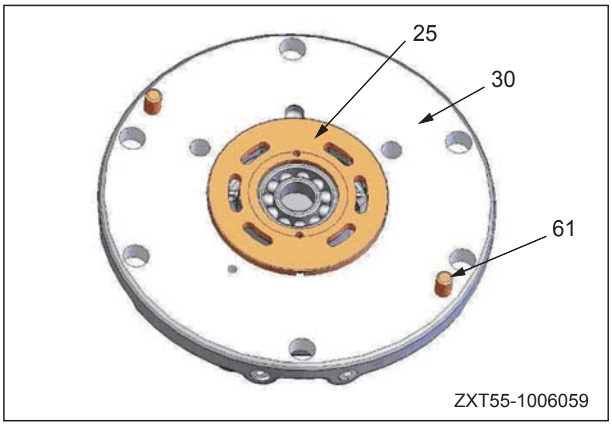


Fig. 8-81

29. Apply a little grease on O-ring (65), O-ring (66), guard ring (68) and guard ring (69) install them onto brake piston (60). Match pin (49) that has been assembled in step 28 with the pin hole of brake piston (60) and install them on mounting f ange (1-1).

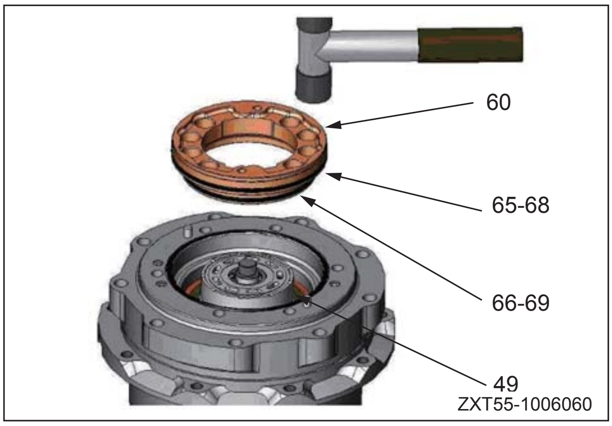


Fig. 8-82

30. Install spring (32) and (62), O-ring (28) and base plate (30).

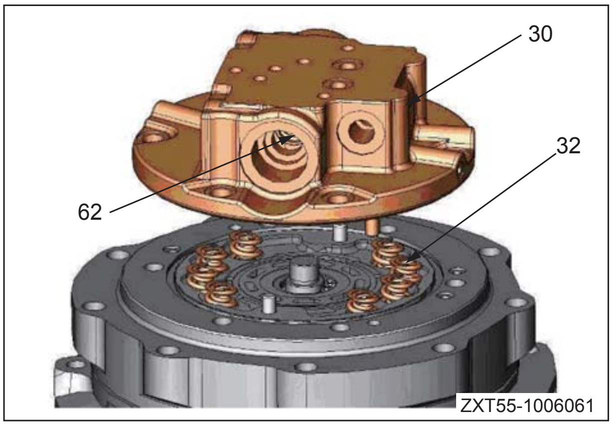


Fig. 8-83

31. Tighten the six cover bolts (48).

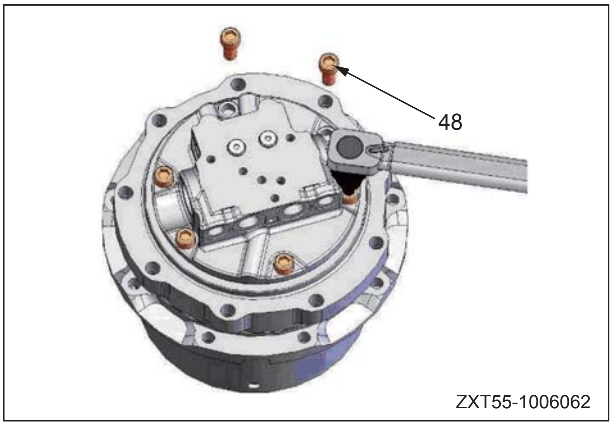


Fig. 8-84

32. Install valve spool and spring. Turn the valve spool while installing it. Apply oil on valve spool before installation.

    Spring (42), valve spool A (41-1), valve spool C (41-2).

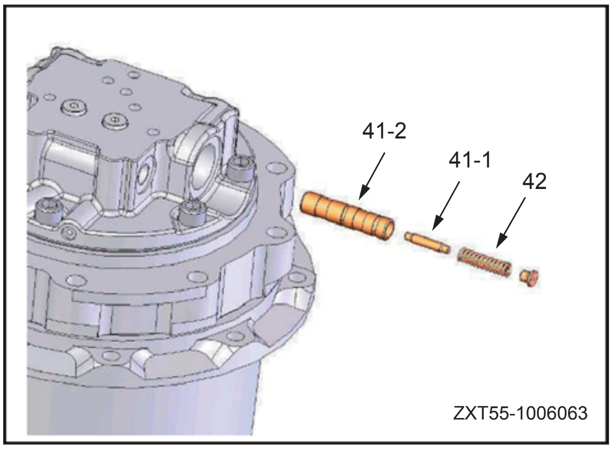


Fig. 8-85

33. Tighten screw plug (43) and (46) with O-ring (44) attached.

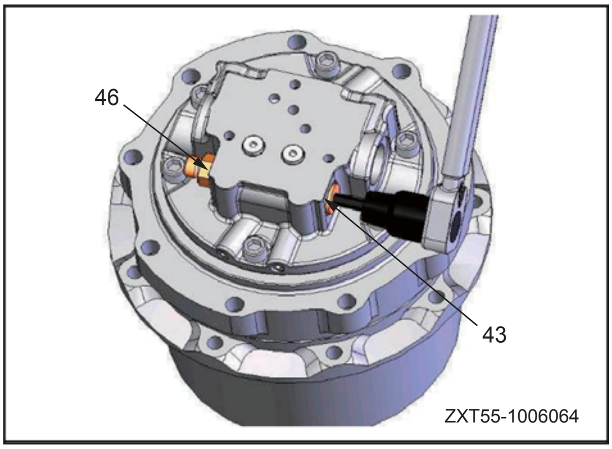


Fig. 8-86

34. Install check valve (31-2), spring (31-3), O-ring (31-5) on valve spool (31-1), and tighten screw plug (31-4).

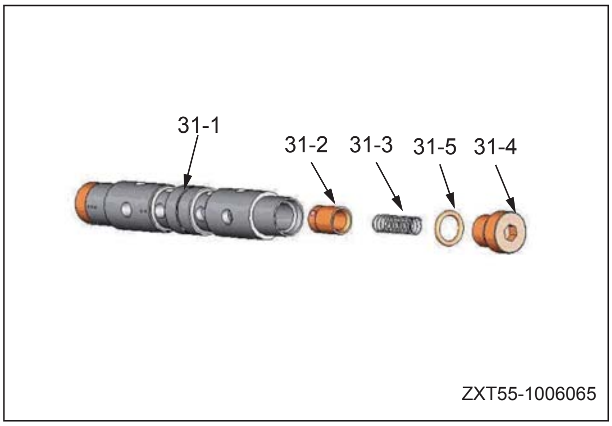


Fig. 8-87

35. Install valve spool assembly (31) on bottom plate. Keep turning it during installation. Be careful not to get it stuck.

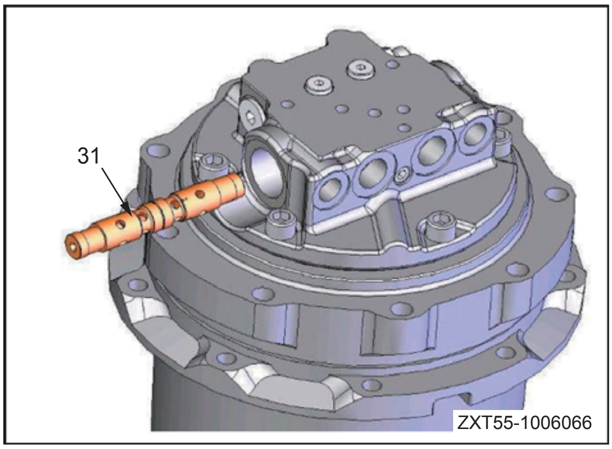


Fig. 8-88

36. Install spring (37) and spring seat (36).

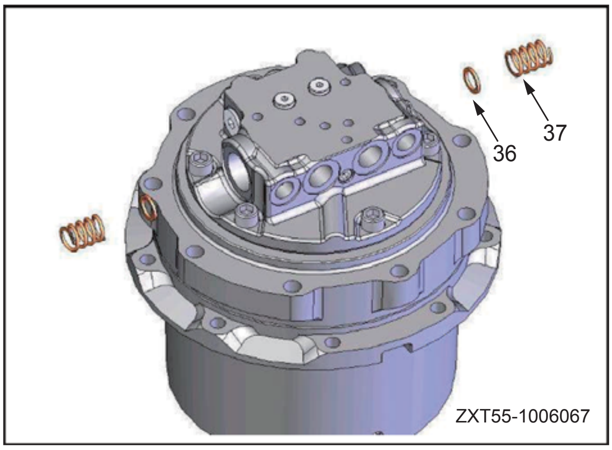


Fig. 8-89

37. Tighten bolt cap (38) with O-ring (39) mounted. Apply a little grease on the O-ring.

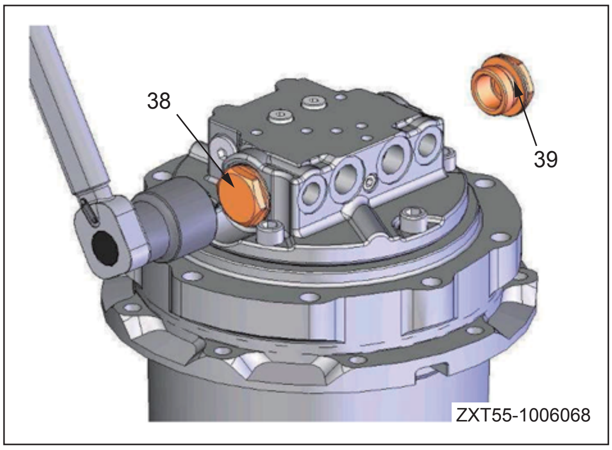


Fig. 8-90

38. Install O-ring (44), tighten screw plug (43) and install dust plug (53).

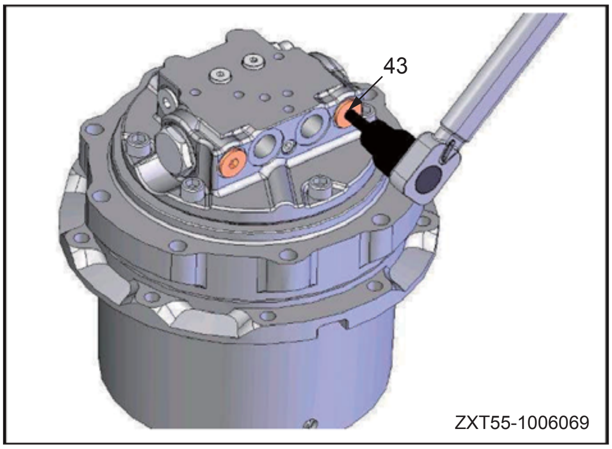


Fig. 8-91

39. Install valve spool (50-2), spring (50-3) and spring seat (50-4) on valve body (50-1) and tighten screw plug (50-5).

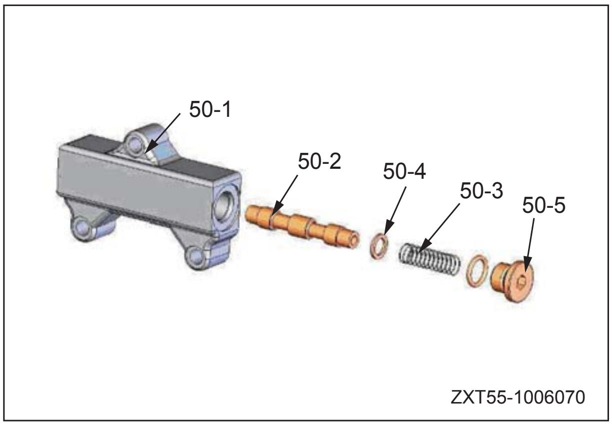


Fig. 8-92

40. Install O-ring (50-7) and (50-8) on valve body and install valve assembly (50) onto bottom plate (30). Then, tighten cover bolt (50-9).

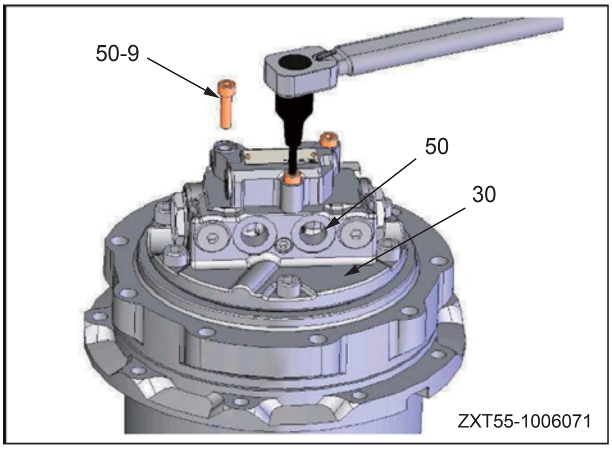


Fig. 8-93

41. Apply appropriate amount of gear oil into the screw hole of screw plug (1-27). Tighten screw plug (1-27) with O-ring (1-28) mounted.

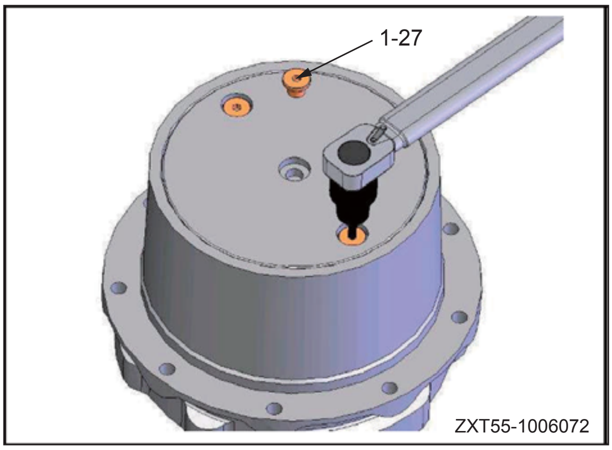


Fig. 8-94

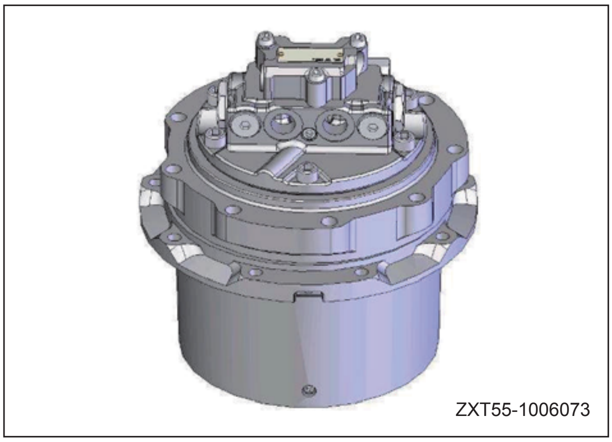


Fig. 8-95

8.5.5.4 Performance test

1. Reducer leak test

   Remove one screw plug (1-27) from the reducer. Apply compressed air (0.03MPa) through the screw hole with it submerged in water for two minutes. Check that no bubbles are observed.

2. Motor leak test

   Leave one piping hole on the motor open and seal the rest with screw plugs. Apply compressed air (0.03MPa) through the hole that is left open for 2 minutes in water. Check that no bubbles are observed.

3. After procedure (1) and (2) add working oil into the cover of the motor. Add working oil to 20L/min and start a 2-minute test run in both directions. Check that no abnormal heating, vibration or noise can be observed.

8.6 Swing Motor and Swing Mechanism AS

8.6.1 Removal

WARNING

- **Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release internal pressure in the hydraulic tank.**

Note: Since an accumulator is equipped, release residual pressure in oil circuit before removing it. For more information see **"Residual Pressure in Hydraulic Circuit - Release"**

1. Disconnect swing motor oil suction hose (1).
2. Disconnect the two main port hoses (2) of swing motor.
3. Disconnect swing motor brake pressure releasing hose (3).
4. Disconnect motor oil return hose (4) and central swivel joint hose (5).
5. Remove the mounting bolts (6), and hoist up the swing mechanism and swing motor assembly (7).

Note: When removing the swing mechanism and swing motor assembly, lift it away slowly and be careful not to damage the leads or pipelines.

Swing mechanism and swing motor as-sembly: 53 kg

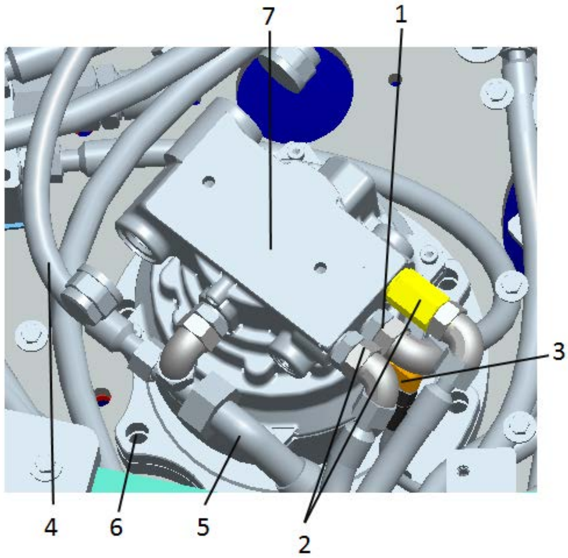


Fig. 8-96

8.6.2 Installation

Installation is to be performed in reverse procedure of removal. .

Mating surface of swing mechanism box: Gasket sealant (LG-4)

Mounting bolt of swing mechanism and swing motor assembly: 113±10 N·m

- Adding oil (to hydraulic tank).

  Refilling the tank to the specified level through the f ller opening. Start the engine to circulate the oil in the system. And then check oil level.

- Purging the air

  Purge the air from the swing motor.

  For detailed information on air purging see **"Air Purging"** .

8.7 Swing Motor AS

8.7.1 Disassembly

8.7.1.1 Separation of motor from reducer

Clamp the motor with a bench vice and remove six socket head bolts (1).

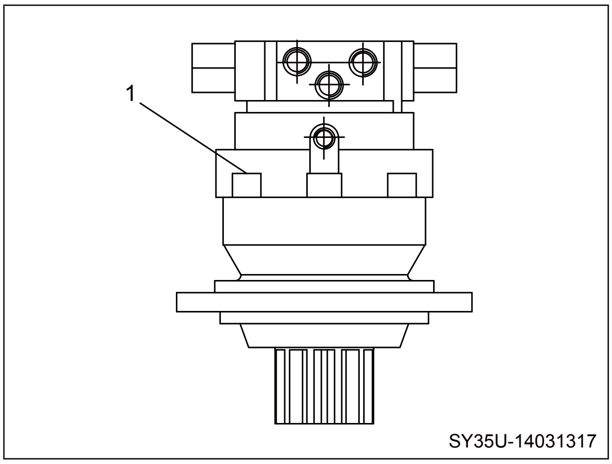


Fig. 8-97

8.7.1.2 Motor disassembly

1. Fix the motor on a bench vice.

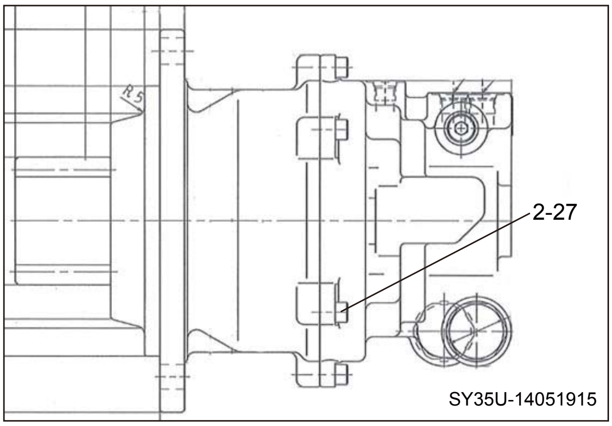


Fig. 8-98

Remove socket head bolt (2-27) and remove top cover (2-21).

Note: Be careful not to drop valve plate (2-24) when removing top cover (2-21).

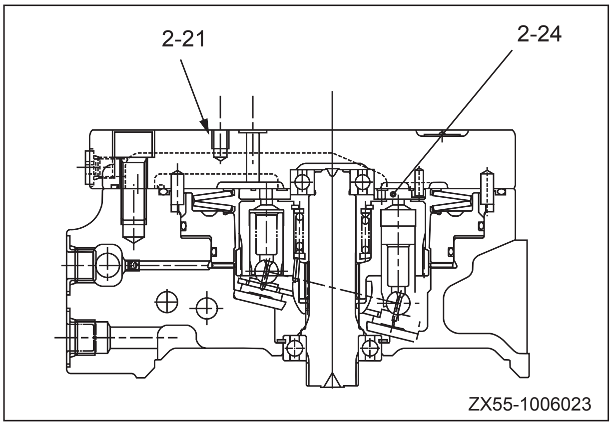


Fig. 8-99

2. Remove valve plate (2-24) and pin (2-23).

   Valve plate (2-24) may be left at the motor side.

3. Take out bearing (2-22).

   Remove O-ring (2-26).

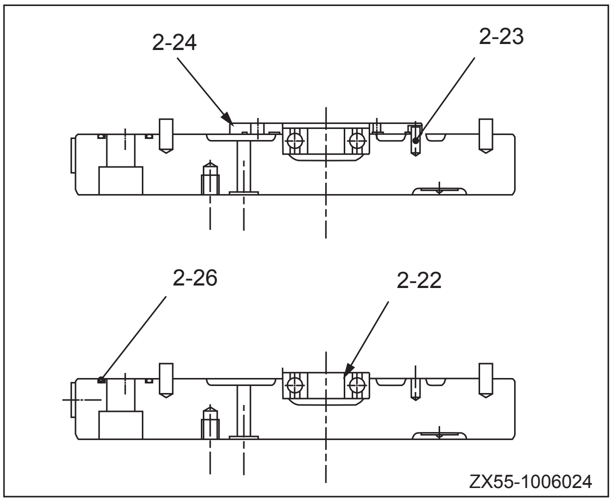


Fig. 8-100

4. Remove check valve.

   Loosen and remove screw plug (2-41).

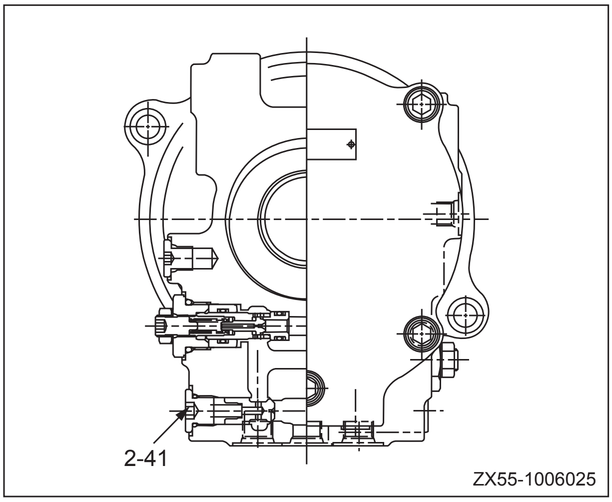


Fig. 8-101

Remove spring (2-40) and check valve (2-39).

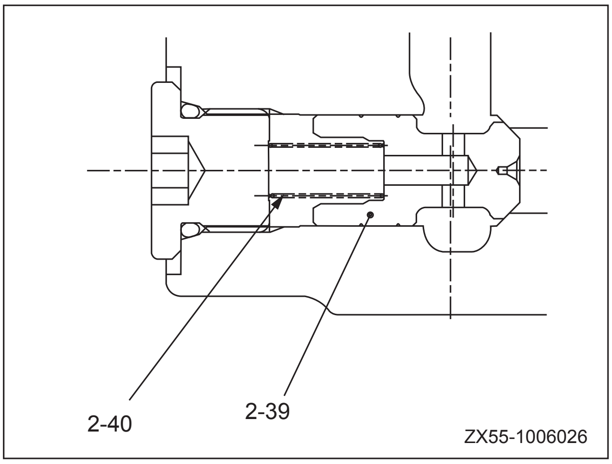


Fig. 8-102

5. Remove relief valve

   Loosen screw plug (2-38-6) and remove relief valve assembly (2-38).

   - Do not turn the adjustment screw (2-38-7). Otherwise, set pressure of the relief valve will be changed.
   - Since the relief valve is a functional component, do not disassemble the relief valve assembly (2-38).

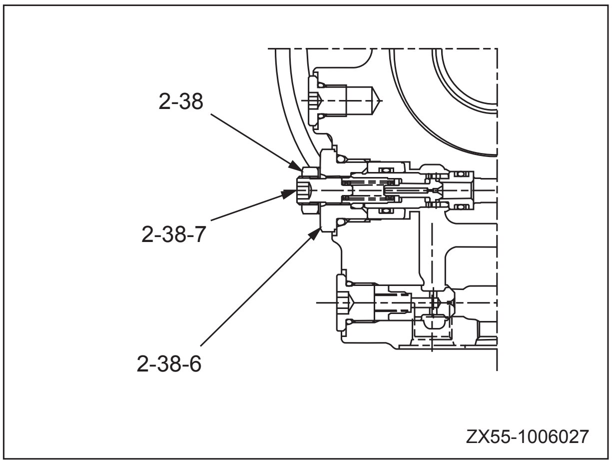


Fig. 8-103

6. Remove valve plate (2-24), pin (2-25) and O-ring (2-20).

   - Valve plate (2-24) may be left at the top cover side.

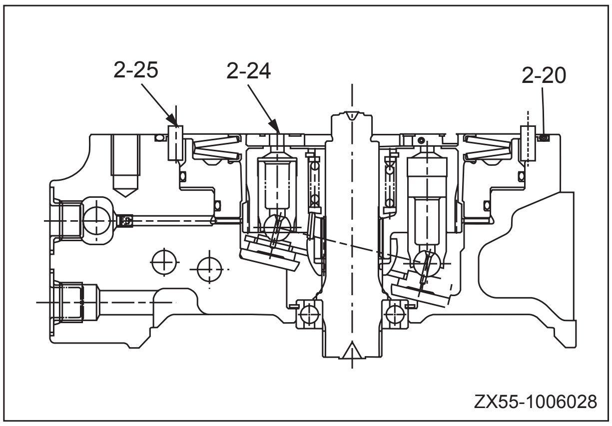


Fig. 8-104

7. (Note:, Applicable only to motors with brake function) Remove brake disc spring assembly (2-19) and spring seat (2-18). Apply compressed air at pressure detection port (2-1) of the casing and knock out the brake piston (2-15). (The pressure detection port is installed with a screw plug.)
   - Be careful when during this operation because the piston may shoot out under high pressure. Low pressure is recommended at the beginning and adjust pressure while keeping an eye on piston movement.

   Remove brake delayer after brake piston has been removed. (Otherwise, the piston may become very diff cult to be removed.)

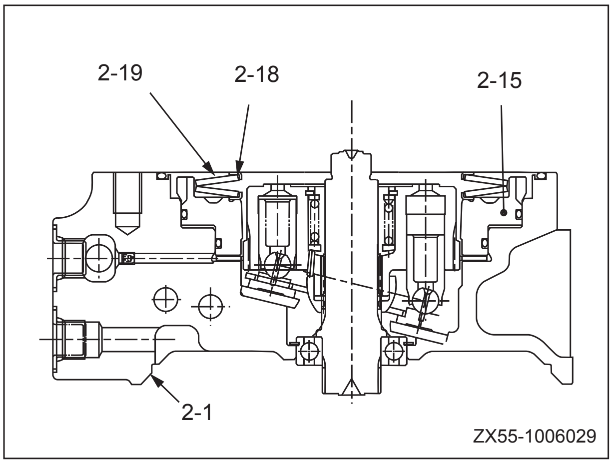


Fig. 8-105

8. Remove cylinder block etc.

   (2-5) Cylinder block

   (2-6) Shaft collar

   (2-7) Spring

   (2-8) Gasket

   (2-9) Snap ring

   (2-10) Pin

   (2-11) Stop bracket

   (2-12) Stop plate

   (2-13) Piston assembly

   (2-14) Brake disc (※2, applicable only to motors with brake function)

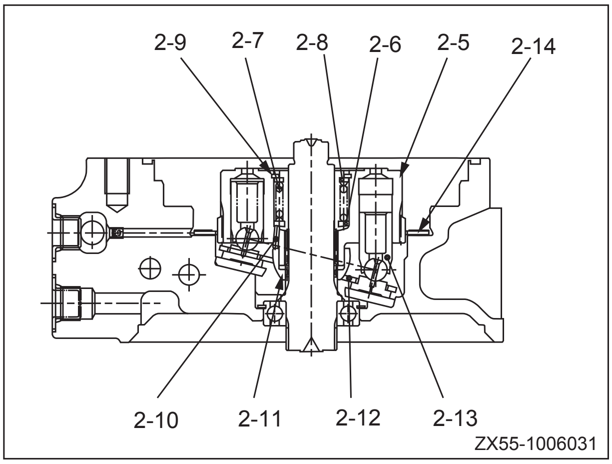


Fig. 8-106

9. Remove stop plate (2-12) and piston assembly (2-13).

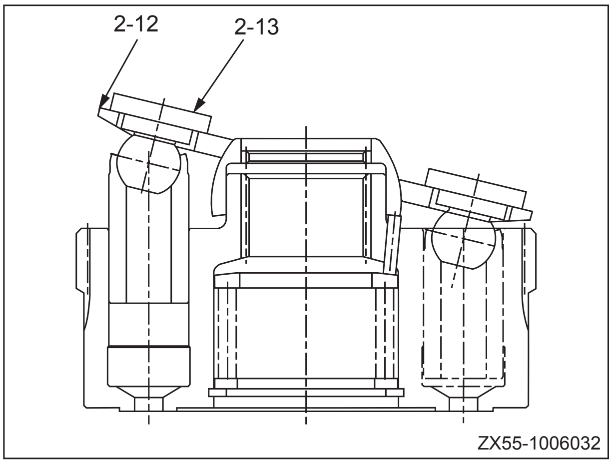


Fig. 8-107

10. Remove pin (2-10) and stop bracket (2-11).

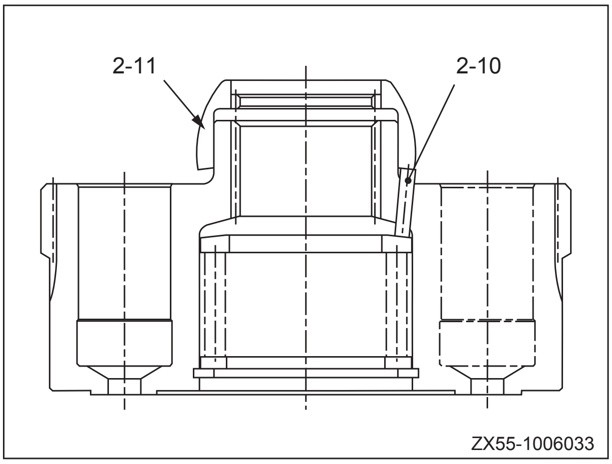


Fig. 8-108

11. Depress gasket (2-8) and remove snap ring (2-9).

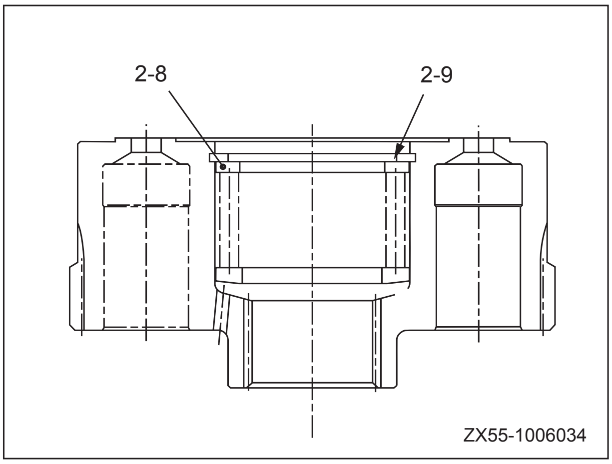


Fig. 8-109

12. Remove shaft collar (2-6), spring (2-7) and gasket (2-8).

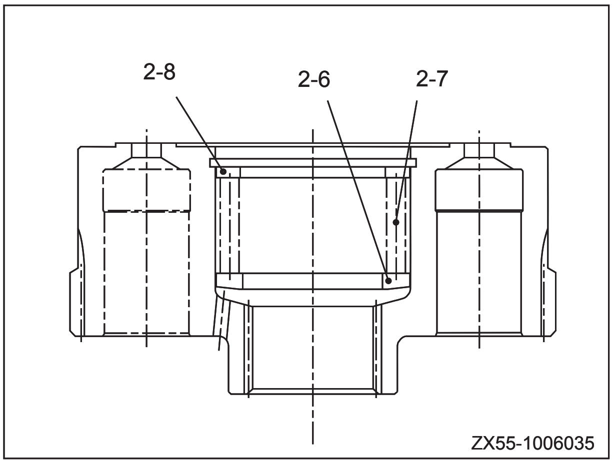


Fig. 8-110

13. Remove thrust plate (2-4).

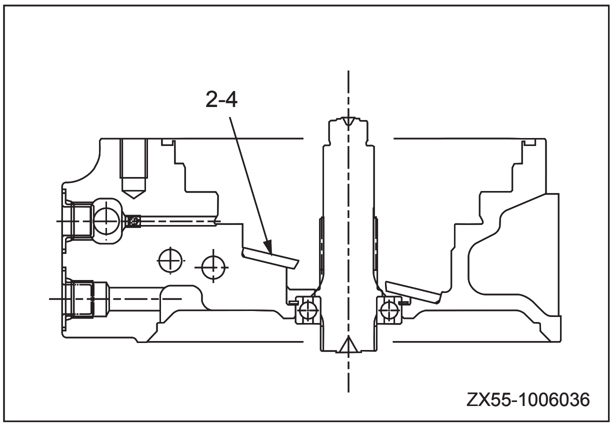


Fig. 8-111

14. Hit the top of shaft (2-3) with a plastic hammer and remove the shaft.

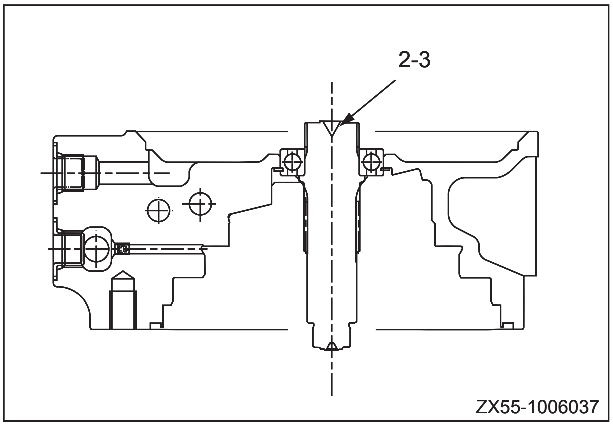


Fig. 8-112

15. Remove bearing (2-2) and ball bearing (2-3).

    ★ Do not re-use the removed bearing.

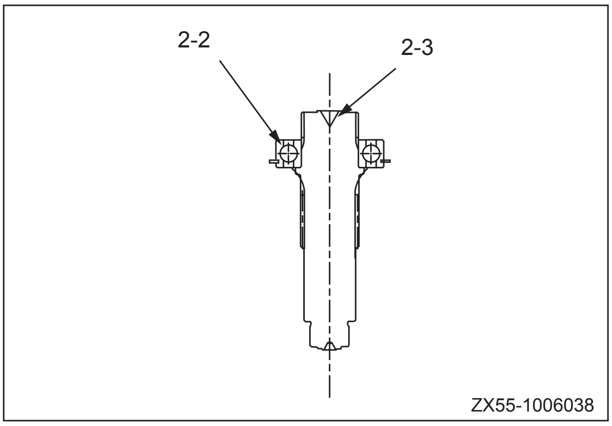


Fig. 8-113

8.7.1.3 Disassembling the reducer

1. Remove the following parts:

   (1-18) Cage

   (1-19) Thrust gasket

   (1-20) Inner ring

   (1-21) Needle bearing

   (1-22) Planetary gear

   (1-23) Thrust plate

   (1-24) Driving gear

   (1-37) O-ring

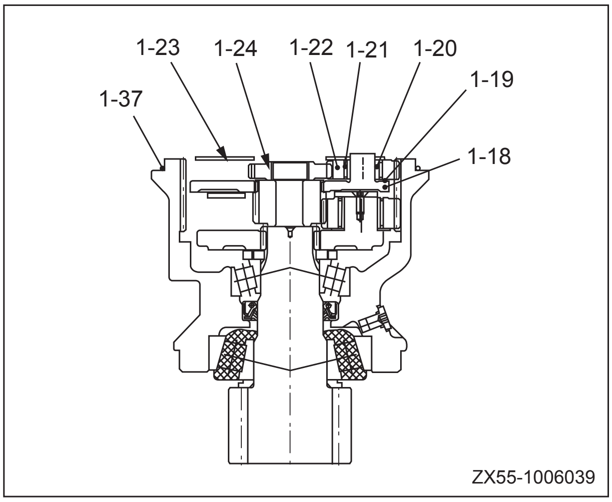


Fig. 8-114

2. Remove sun gear (1-17).

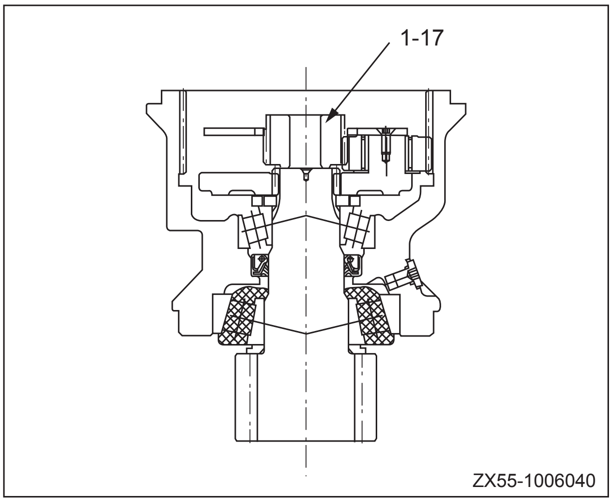


Fig. 8-115

3. Remove cage (1-10) and other elated parts.

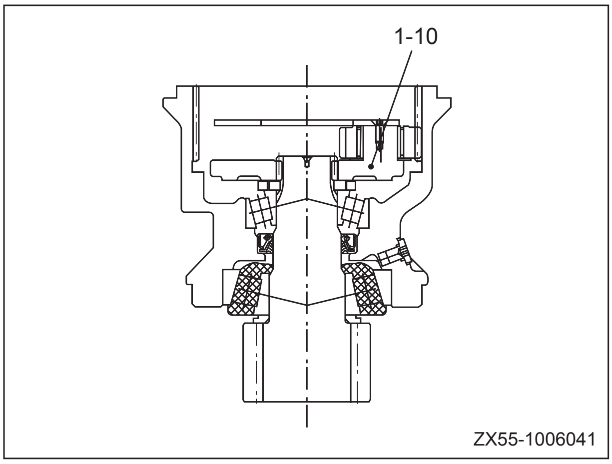


Fig. 8-116

4. Fix the cage (1-10) on a bench vice, loosen screw (1-16) and remove thrust plate (1-15).

   Since adhesive is applied for installation, screw may be diff cult to be removed. Use a blower to heat the adjacent area around the screw in this case.

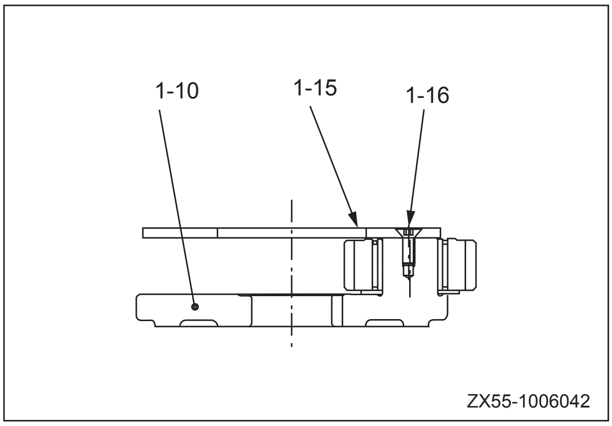


Fig. 8-117

5. Remove the following parts:

   (1-12) Inner ring

   (1-13) Needle bearing

   (1-14) Planetary gear

   Replace the whole assembly when replacing tapered ball bearing (1-5) and (1-7) and shaft collar (1-4).

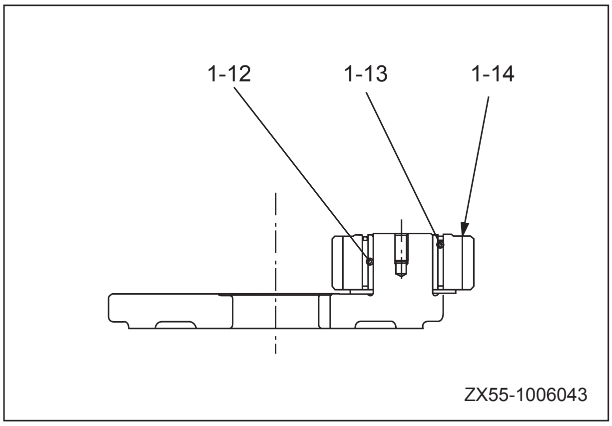


Fig. 8-118

6. Remove the following parts:

   (1-8) Base plate

   (1-9) Shaft collar

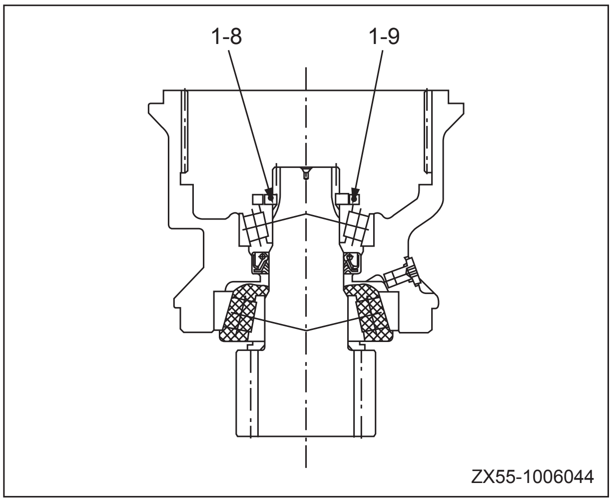


Fig. 8-119

7. Remove pinion shaft (1-2)

   ★ Be careful not to drop the pinion. Hit it with a plastic hammer when removal gets diff cult.

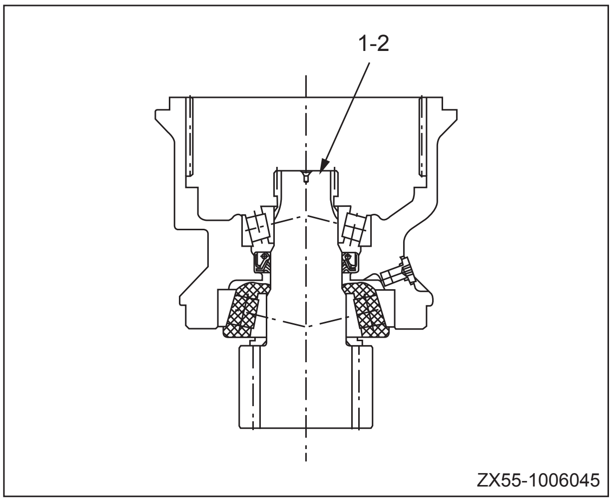


Fig. 8-120

8. Remove the inner ring of tapered ball bearing (1-8).

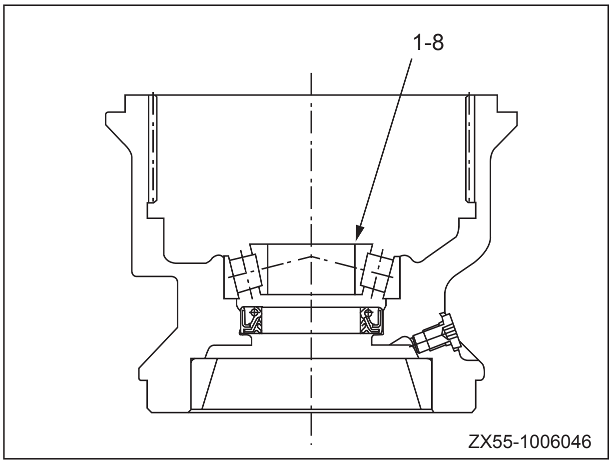


Fig. 8-121

9. Break oil seal (1-7) and take it out.

- Removed oil seal shall not be used again.
- Do not damage the outer ring of tapered ball bearing (1-7), (1-5) when removing the oil seal.

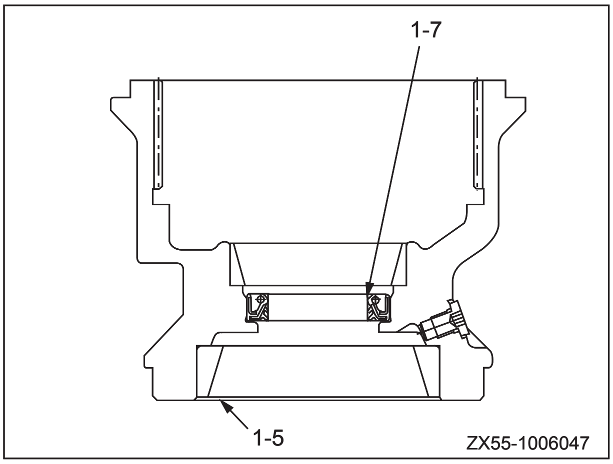


Fig. 8-122

10. Remove the outer ring of taper ball bearing (1-7) and screw plug (1-35).

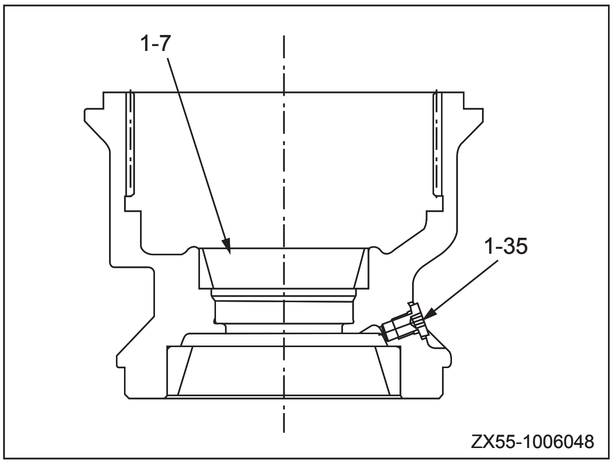


Fig. 8-123

8.7.1.4 Assembling the motor

1. Install relief valve assembly (2-38).

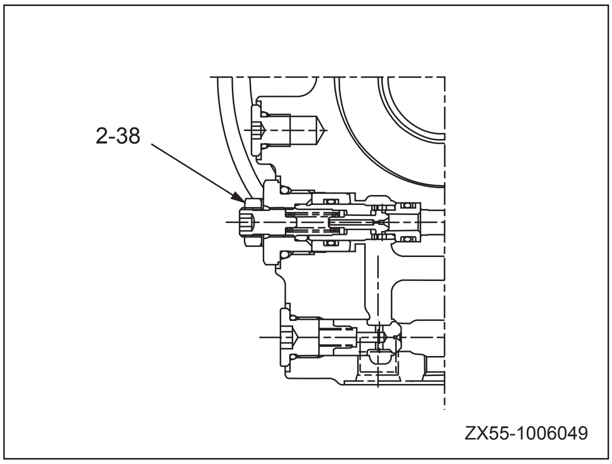


Fig. 8-124

2. Install check valve (2-39) and spring (2-40).

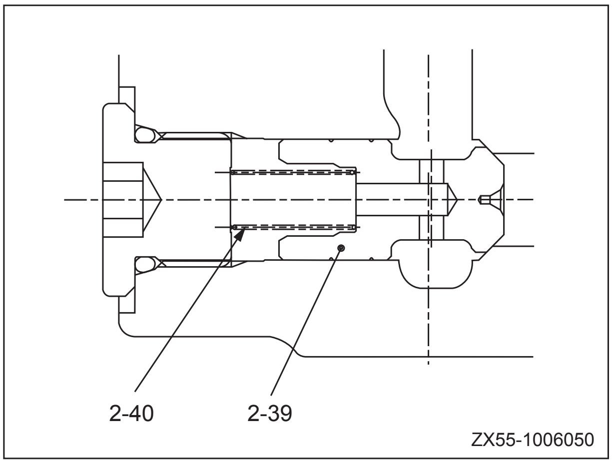


Fig. 8-125

3. Install screw plug (2-41).

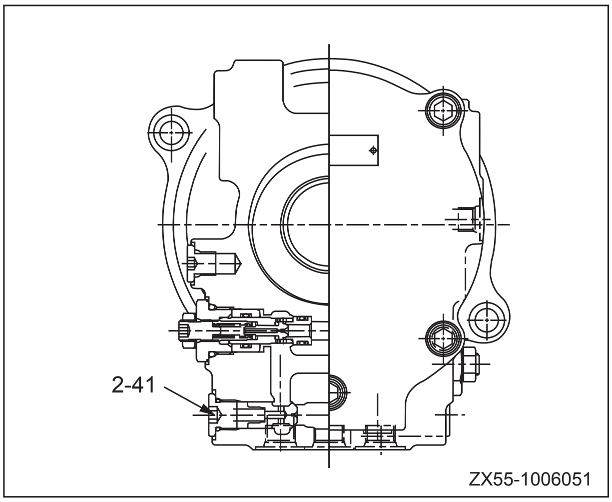


Fig. 8-126

4. Install shaft collar (2-6), spring (2-7) and gasket (2-8) into cylinder block (2-5).

   Pay attention to the installation direction of shaft collar (2-6).

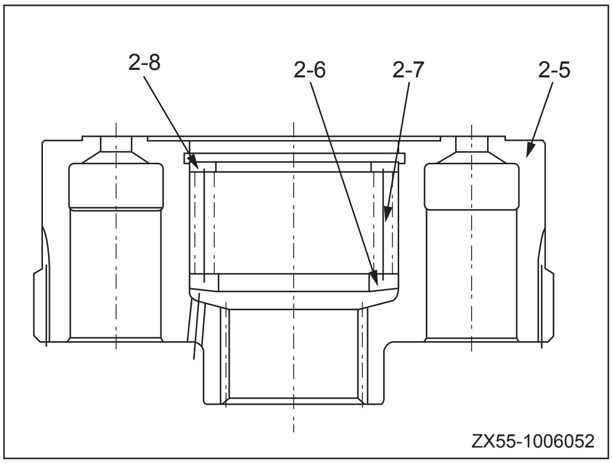


Fig. 8-127

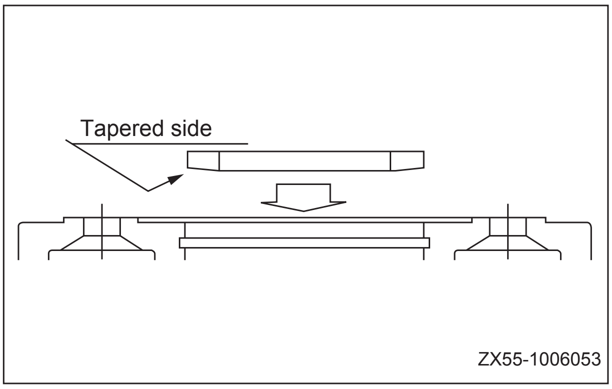


Fig. 8-128

5. Depress gasket (2-8) and put snap ring (2-9) in place.

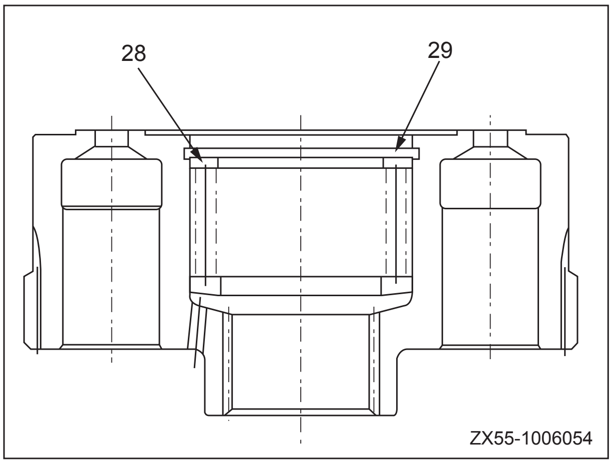


Fig. 8-129

6. Apply grease on pin (2-10) and install it in cylinder block (2-5).
7. Install stop bracket (2-11).

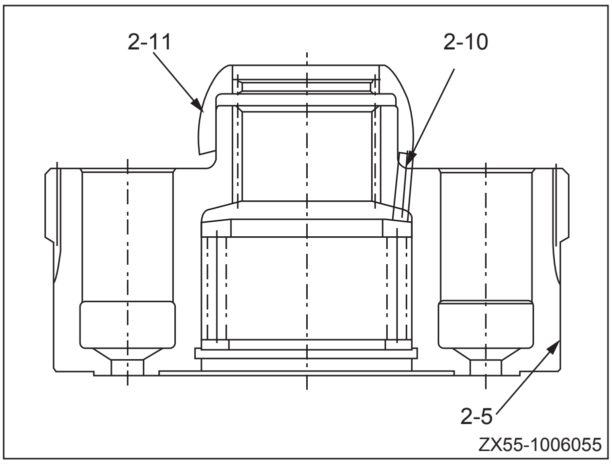


Fig. 8-130

8. Install plunger assembly (2-13) onto stop plate (2-12). Then, install it into cylinder block (2-5).

   Apply enough hydraulic oil onto the sliding portion before installation.

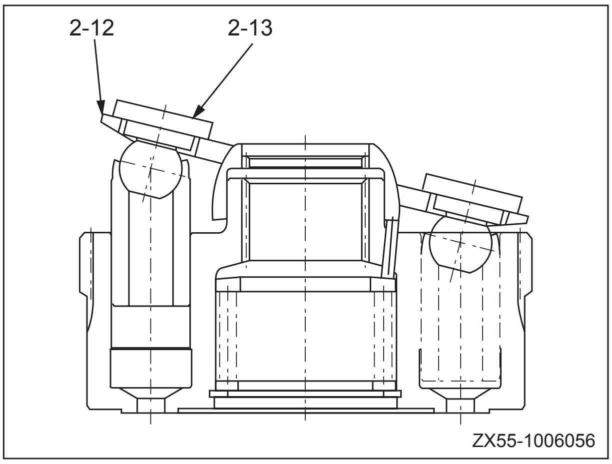


Fig. 8-131

9. Press ball bearing (2-2) onto shaft (2-3).

   Install the ball bearing (2-2) with its attached snap ring in the illustrated direction.

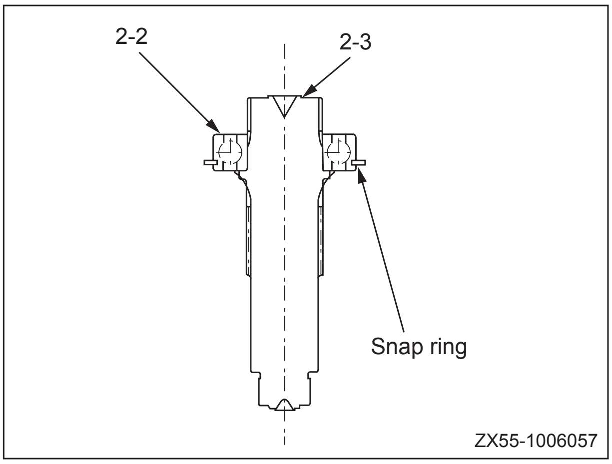


Fig. 8-132

10. Press shaft (2-3) and ball bearing (2-2) into casing (2-1).

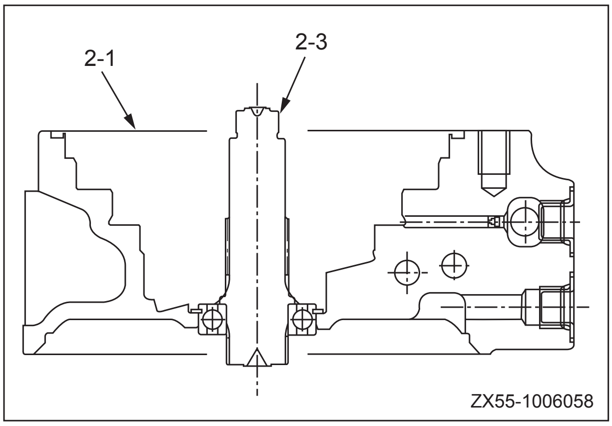


Fig. 8-133

11. Apply grease on the back of thrust plate (2-4) before installing it.

    Direction of the thrust plate is shown in the illustration.

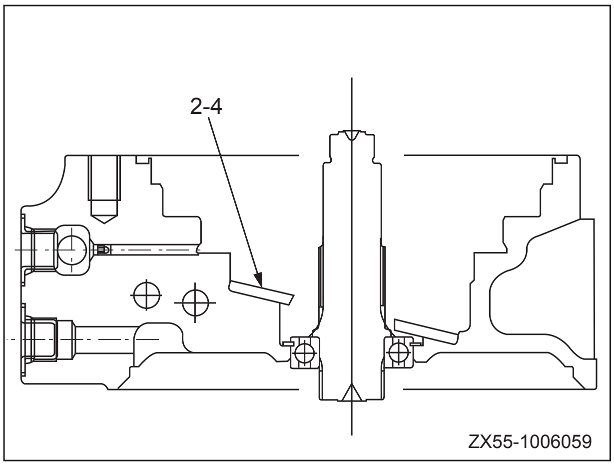


Fig. 8-134

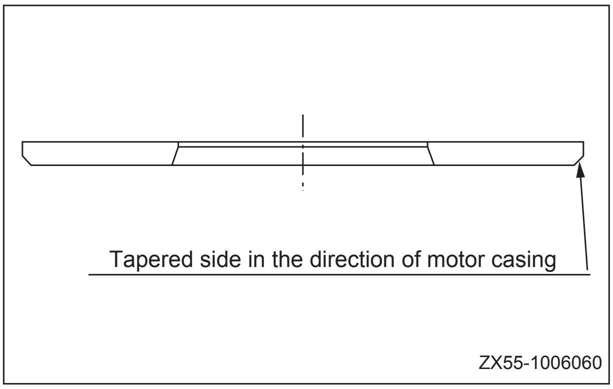


Fig. 8-135

12. Assemble cylinder block (2-5) and other related parts.

    Be careful not to drop pin (2-10) during installation.

    Note: Installation of brake disc (2-14) only applies to motors with brake function.

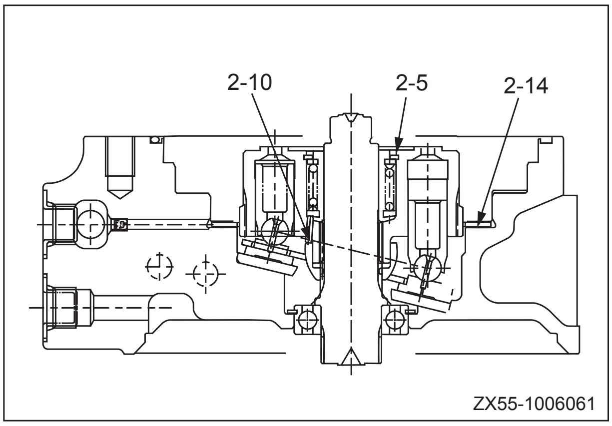


Fig. 8-136

13. (**Note**: Only applicable to motors with brake function).

    Apply grease onto O-ring (2-16) and (2-17) and install them onto brake piston (2-15).

14. (**Note**: Only applicable to motors with brake function).

    Install brake piston (2-15) into casing (2-1). Note the position of pin (2-25) during installation.

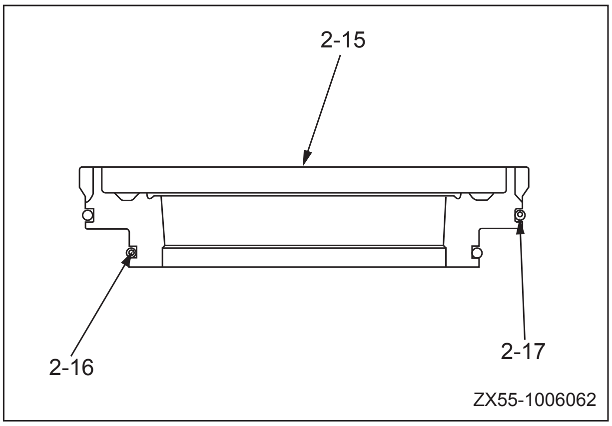


Fig. 8-137

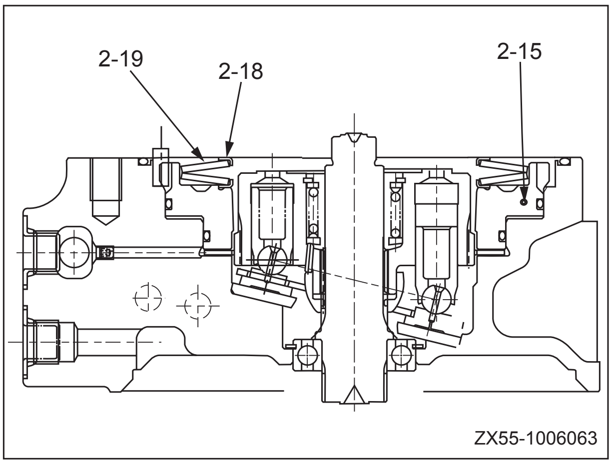


Fig. 8-138

15. (**Note**: Only applicable to motors with brake function).

    Install spring seat (2-19) and piston spring (2-18). Pay attention to mounting direction.

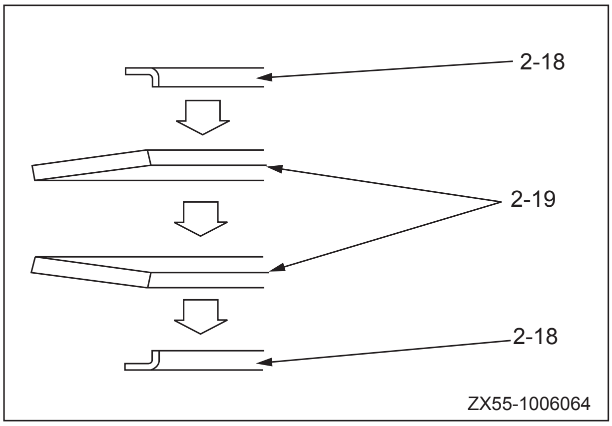


Fig. 8-139

16. Apply grease onto O-ring (2-20) and install it inside the casing (2-1).

    - If pin (2-25) can not be installed inside the hole of brake piston and the casing, take out the brake piston (2-15), align and then reinstall it. (※2, Applicable only to motor with brake function).
    - Install pin (2-25) into top cover before assembling.

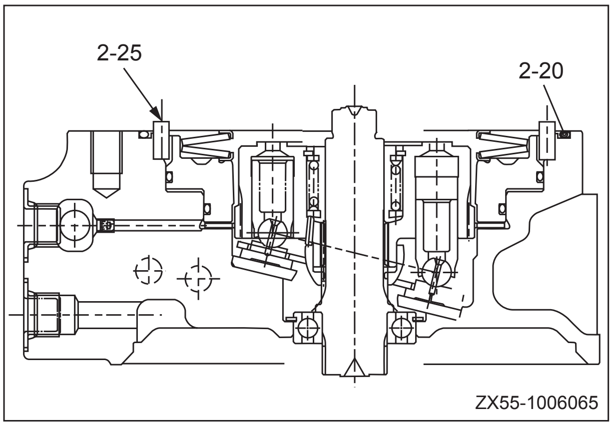


Fig. 8-140

17. Apply grease onto O-ring (2-26), pin (2-25) and install them into top cover (2-21). Then, press them into ball bearing (2-22).

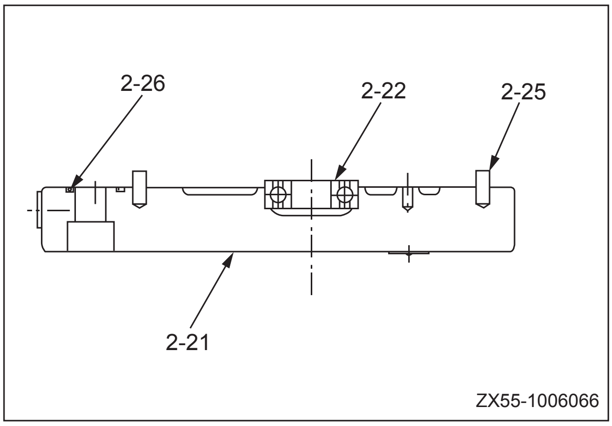


Fig. 8-141

18. Install pin (2-23) and then valve plate (2-24).

    Apply grease on the back to avoid dropping.

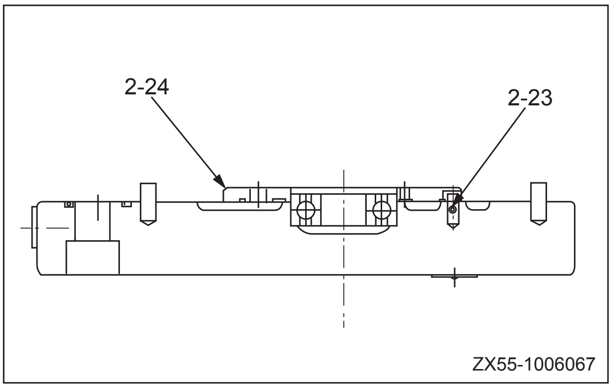


Fig. 8-142

19. Install top cover (2-21) onto the casing (2-1).

    - Pay attention to the position of pin (2-25).
    - Be careful not to drop pin (2-25) and valve plate (2-24).

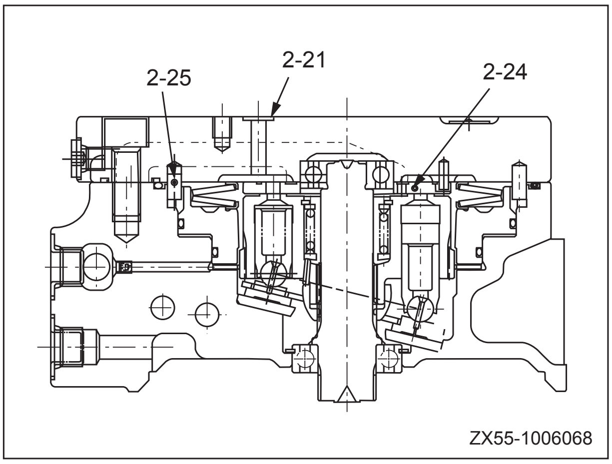


Fig. 8-143

20. Mount socket heat bolt (2-27) and tighten them to specified torque with a torque wrench.

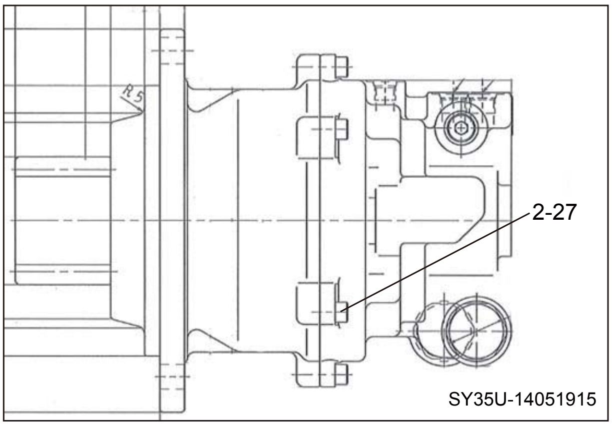


Fig. 8-144

8.7.1.5 Assemble the reducer

1. Press the oil seal (1-7) into place.

   Grease the portion of the casing where oil seal is to be mounted and the oil seal before pressing it into place.

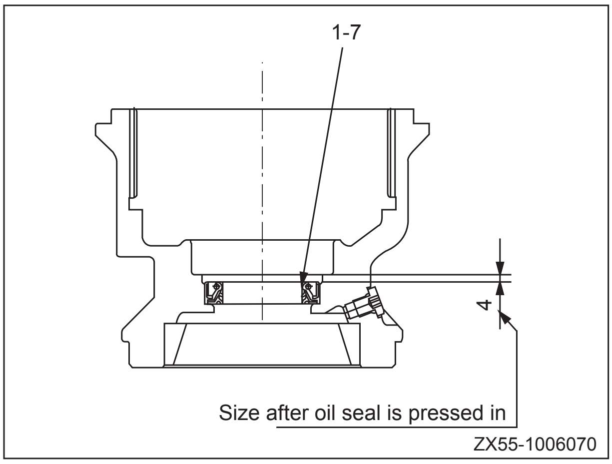


Fig. 8-145

2. Press tapered ball bearing (1-8) into place. Then mount screw plug (1-35).

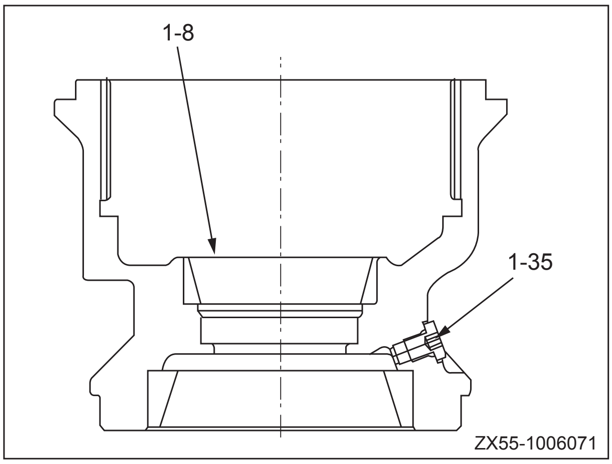


Fig. 8-146

3. Apply grease onto the inner ring (1-5) of the tapered ball bearing that is mounted on the pinion shaft (1-2).

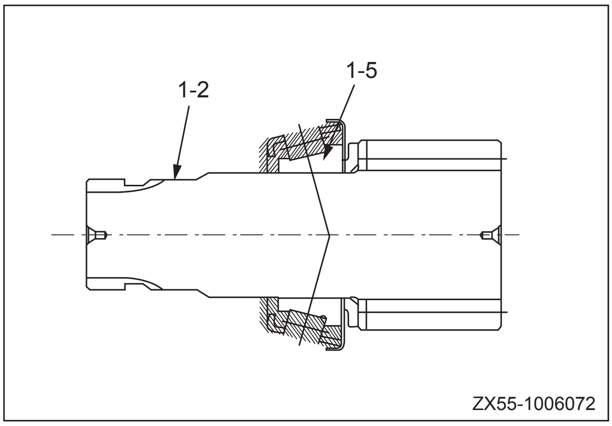


Fig. 8-147

4. Install the pinion shaft (1-2) and other related parts. Install the inner ring (1-8) of the ball bearing.

   Grease the lip of the oil seal (1-7) before installing pinion shaft (1-2).

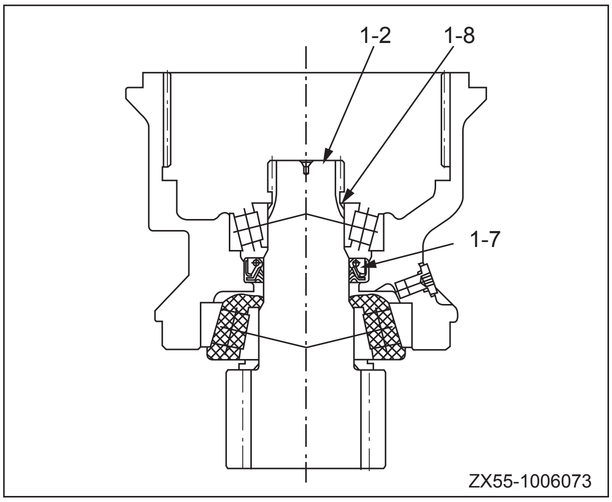


Fig. 8-148

6. Install shaft collar (1-9) and base plate (1-8).

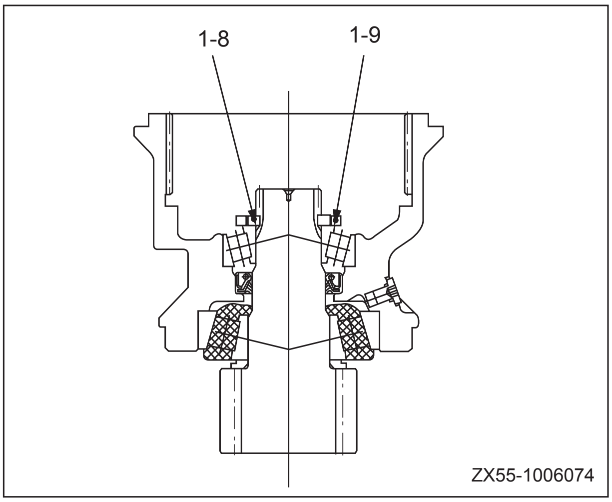


Fig. 8-149

5. Install the following parts onto cage (1-10):

   (1-11) Thrust gasket

   (1-12) Inner ring

   (1-13) Needle bearing

   (1-14) Planetary gear

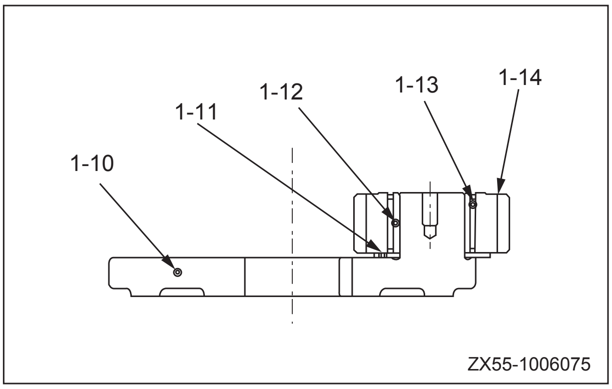


Fig. 8-150

7. Install the following parts onto cage (1-10):

   (1-15) Thrust plate

   (1-16) Screw

   Coat screw with loctite 242 before tightening it.

   Tightening torque: 3.92 ±0.49 Nm

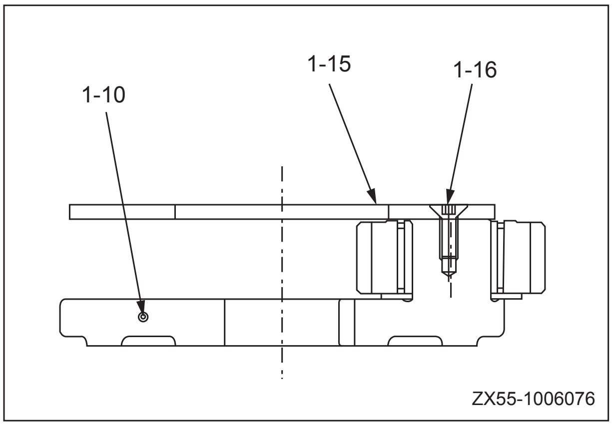


Fig. 8-151

8. Install cage (1-10) and related parts.

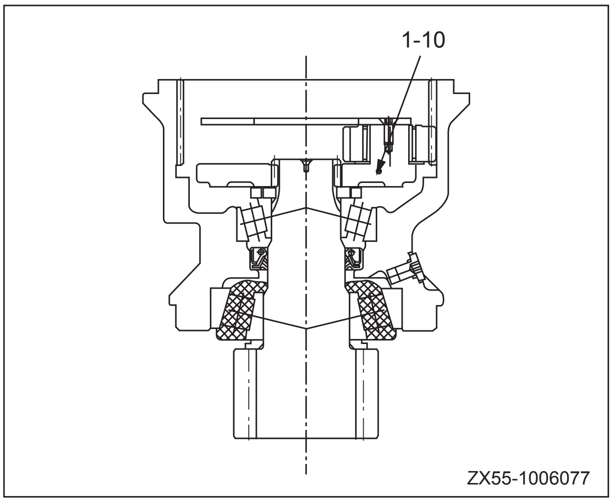


Fig. 8-152

9. Install sun gear (1-17).

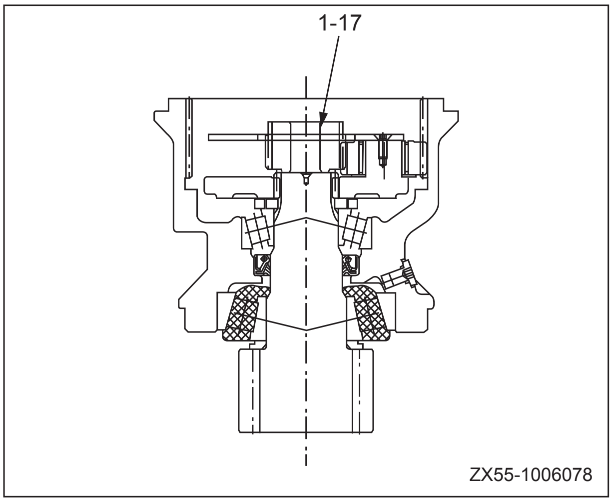


Fig. 8-153

10. Install cage (1-19).

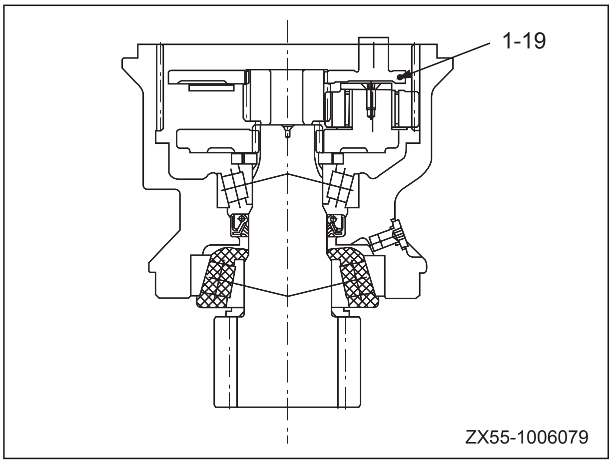


Fig. 8-154

11. Install the following parts:

    (1-20) Thrust gasket

    (1-21) Inner ring

    (1-22) Needle bearing

    (1-23) Planetary gear

    (1-24) Thrust plate

    (1-25) Driving gear

    (1-37) O-ring

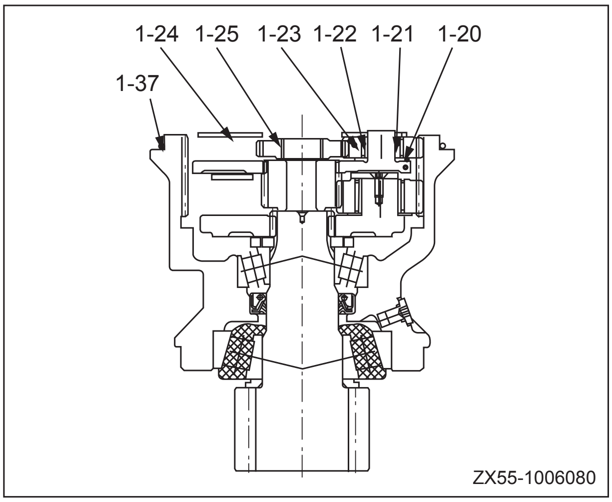


Fig. 8-155

8.7.1.6 Assembling the swing motor assembly

Place the motor assembly onto the reducer assembly and mount the socket head bolts (3). Then, tighten the bolts to specif ed torque.

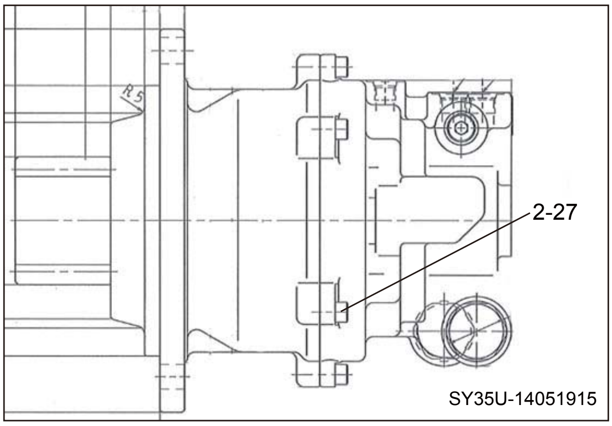


Fig. 8-156

8.8 Swing Mechanism AS

8.8.1 Disassembly

1. Swing motor assembly

   Remove the swing motor assembly (1).

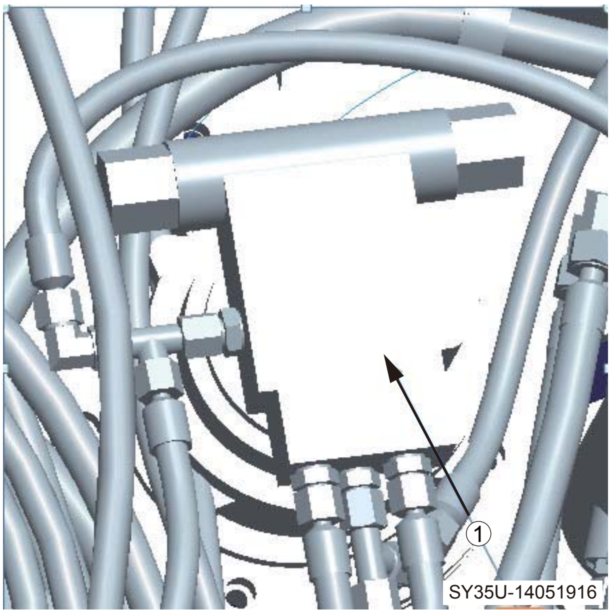


Fig. 8-157

2. No.1 sun gear and No.1 planetary carrier.

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

   B. Remove No.1 planetary carrier (3).

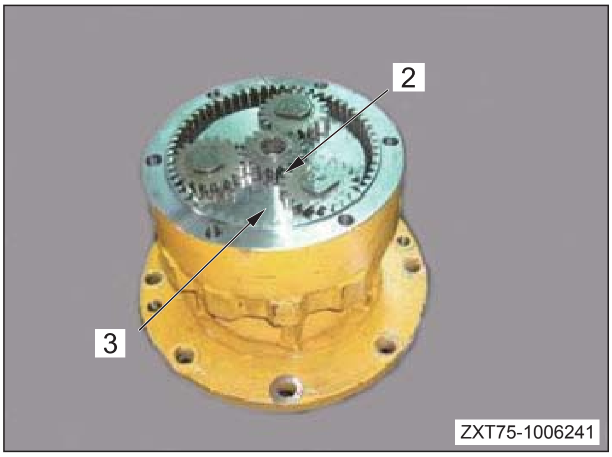


Fig. 8-158

   C. Disassemble No.1 planetary carrier as per the following method.

      a. Remove the snap ring (4), followed by removal of the thrust washer (5), gear (6), bearing (7) and thrust washer (8).

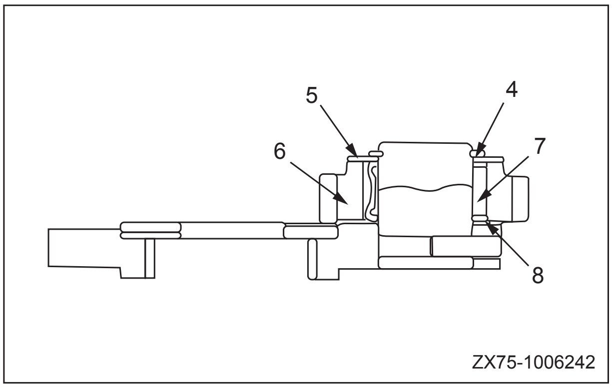


Fig. 8-159

b. Hammer in the pin (9) and hammer out the shaft (10).

- Remove the pin (9) after removal of the shaft.

c. Remove the thrust washer (11) from the planetary carrier (12).

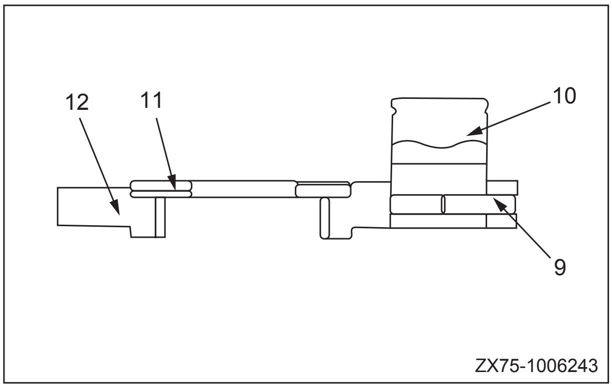


Fig. 8-160

3. No.2 sun gear

   Remove No.2 sun gear (13).

4. Ring gear

   Remove ring gear (14).

5. No.2 planetary carrier

   A. Remove No.2 planetary carrier assembly (15).

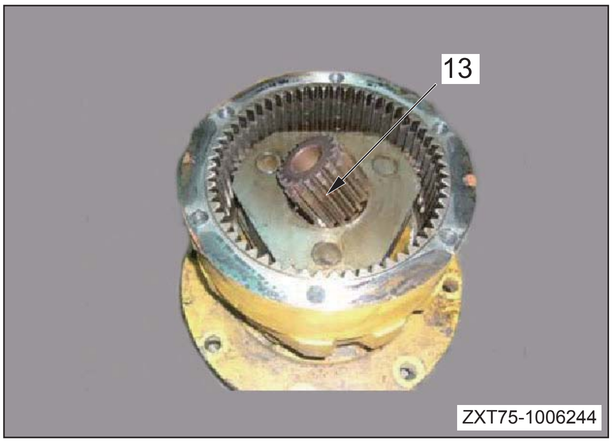


Fig. 8-161

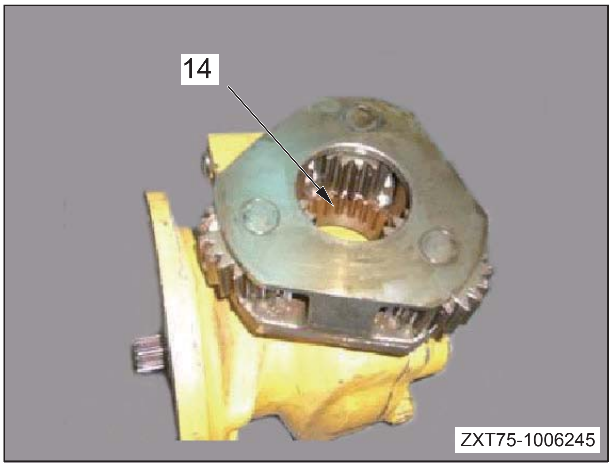


Fig. 8-162

B. Disassemble No.2 planetary carrier assembly as per the following method.

   a. Remove snap ring (16). Then, remove thrust washer (17), gear (18), bearing (19) and thrust washer (20).

   b. Hammer in pin (21) and hammer out shaft (22).

      Remove pin (21) after removal of shaft.

   c. Remove thrust washer (23) from planetary carrier (24).

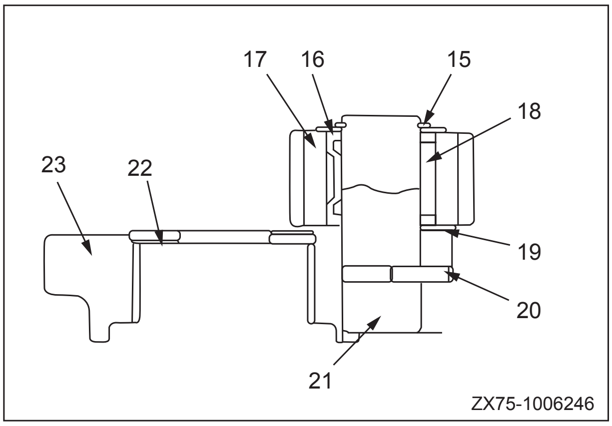


Fig. 8-163

6. Retainer

   A. Place the shaft and the casing onto a press. Push bearing (25) with pusher A.

      ★ Slowly operate the press till the bearing is pressed to a position that the open retainer can be removed.

   B. Remove the open retainer (26).

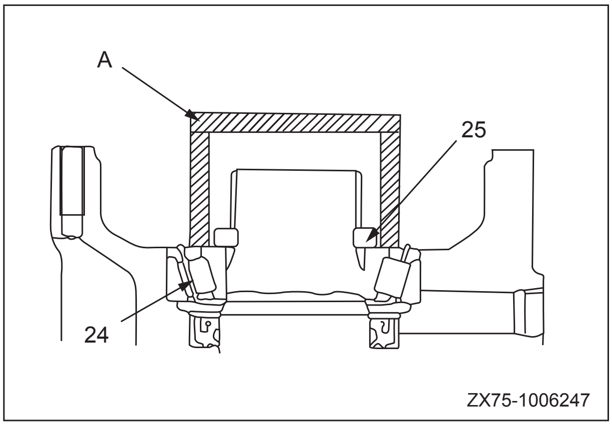


Fig. 8-164

8.8.2 Assembly

Clean all the parts. Check the parts for contamination or damage.

1. Oil seal

   Press the oil seal (33) to f t the casing (34) with the pusher ⑤ .

- A new oil seal should be used for replacement.

Lip of oil seal: grease (G2-LI)

2. Outer ring of bearing

   Press the bearing outer rings (35) and (36) to f t the casing (34) with the pusher.

3. Shaft assembly

   A. Install the retainer (30) on the shaft (31).

   B. Use the press to fit the bearing (29) with the pusher ⑥ .

   C. Place the casing assembly (37) on the shaft assembly (28).

   D. Operate the press to push the bearing (25) to a position that the open retainer can be inserted with the pusher ⑦ .

   - Pressing force: Max. 11.76 kN {1200 kg}
   - Slow press the bearing while turning the housing.

   E. Install the open retainer (26).

   F. Use the pusher ⑧ and the press to push the shaft (31) till the open retainer is f xed in place.

   G. Screw the bolts (10 mm, P=1.5 mm) into the casing. Measure the tangential force in the direction of rotation with a spring balance ⑨ .

   - Tangential force: Max. 147N {15 kg}
   - Tangential force is the maximum force at the beginning of rotation.

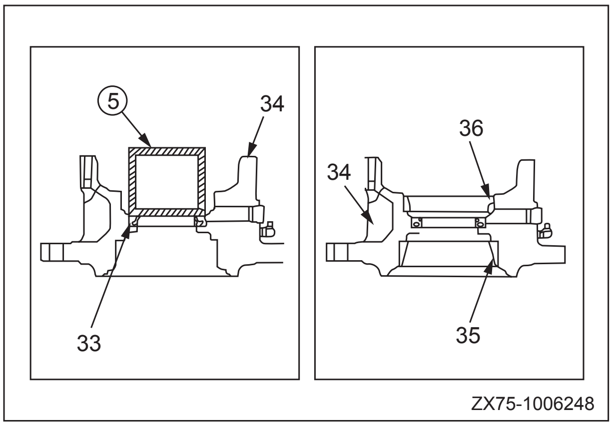


Fig. 8-165

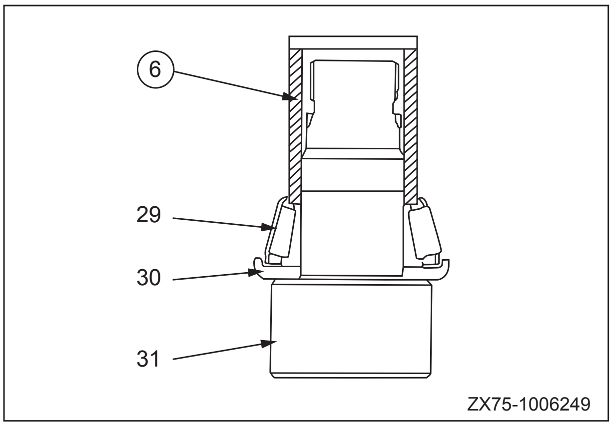


Fig. 8-166

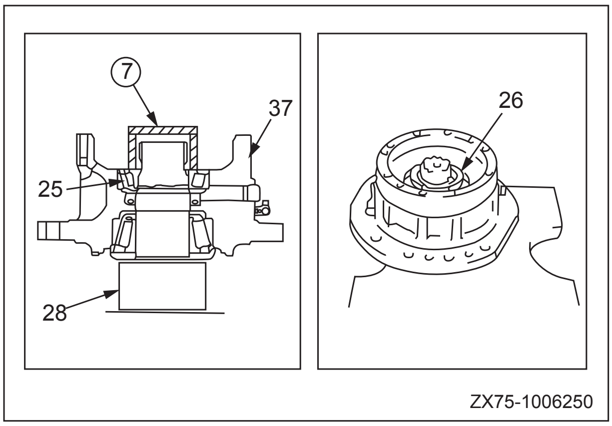


Fig. 8-167

4. Dust seal

   Press to fit the dust seal (32) with the pusher ⑩ .

   - A new dust seal is required.

5. No.2 planetary carrier assembly

   A. Assemble No.2 planetary carrier assembly as per the following method.

      a. Install the thrust washer (23) on the planetary carrier (24).

      b. Align the pin holes of the shaft and the carrier. Use a plastic hammer to install the shaft (22).

      c. Insert the pin (21).

      - Seal the gap at where the pin is inserted on the carrier.

      - Make sure that the step difference between the shaft and the planetary carrier is lower than 0.2 mm.

      d. Instal the thrust washer (20), bearing (19), gear (18) and thrust washer (17), followed by the snap ring (16).

   B. Install No.2 planetary carrier assembly (15) on the shaft and casing assembly.

6. Ring gear

   Install ring gear (14).

   Ring gear mating surface:

   Gasket sealant (LG-4 or LG-6)

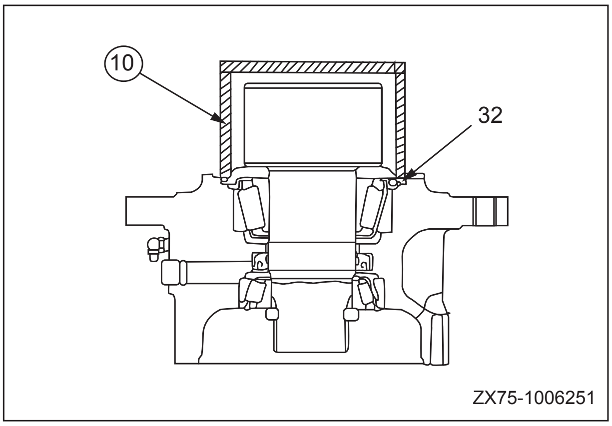


Fig. 8-168

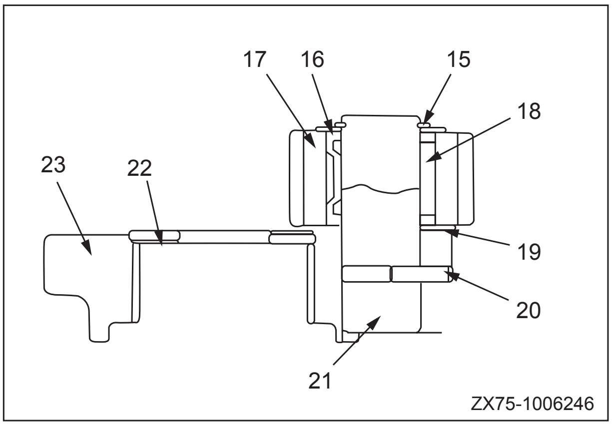


Fig. 8-169

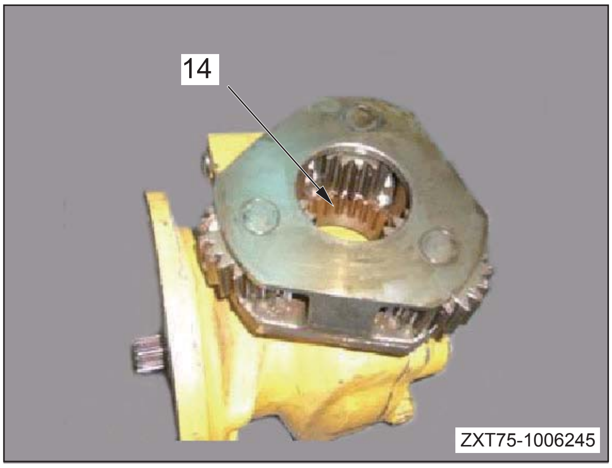


Fig. 8-170

7. No.2 sun gear

   Install No.2 sun gear (13).

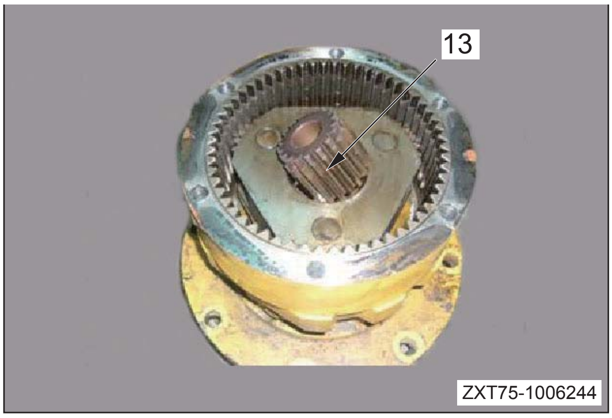


Fig. 8-171

8. No.1 planetary carrier assembly

   A. Install No.1 planetary carrier assembly as per the following method.

      a. Install the thrust washer (11) on the planetary carrier (12).

      b. Align the pin holes of the shaft and the carrier. Use a plastic hammer to install the shaft (10)..

      c. Insert the pin (9).

      - Seal the gap at where the pin is inserted on the carrier.

      - Make sure that the step difference between the shaft and the planetary carrier is lower than 0.2 mm.

      d. Install the thrust washer (8), shaft (7), gear (6) and thrust washer (5), followed by the snap ring (4).

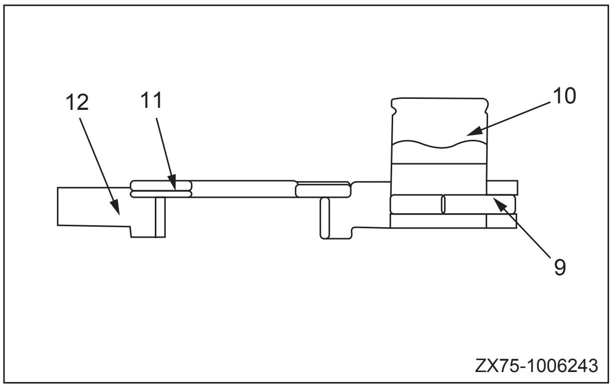


Fig. 8-172

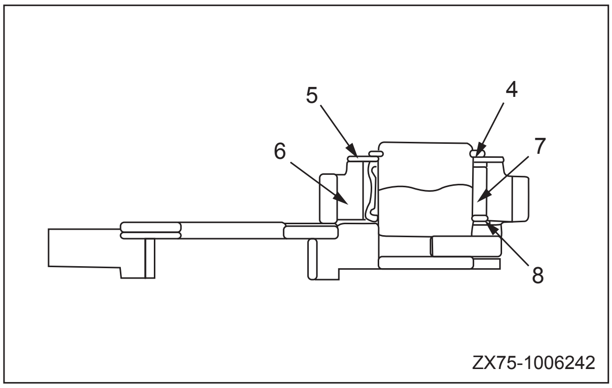


Fig. 8-173

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

C. Install No.1 sun gear (2).

9. Swing motor assembly

Install the swing motor assembly (1).

Mounting bolt: 279±30 N·m

Motor mating surface:

Gasket sealant (LG-4 or LG-6)

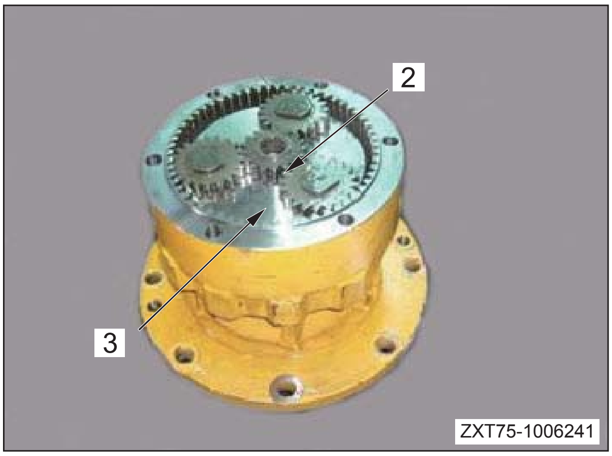


Fig. 8-174

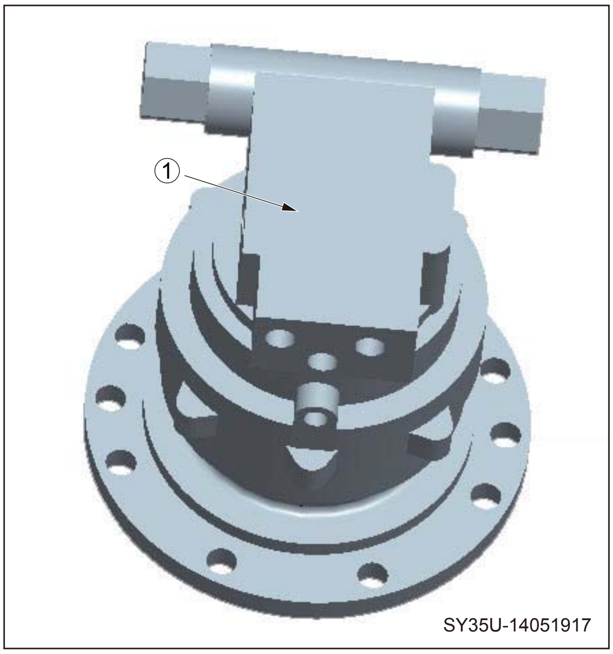


Fig. 8-175

8.9 Swing Platform AS

8.9.1 Removal

NOTICE

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

1. Remove the work equipment assembly. For detailed information see **"Work Equipment AS**.
2. Disconnect boom cylinder hose (1).
3. Hoist boom cylinder assembly (2). Remove bolt (4) and pin (3).
4. Remove boom cylinder assembly (2).

   Boom cylinder assembly: 34.8 kg

Fig. 8-176

5. Remove cab bottom plate (5).

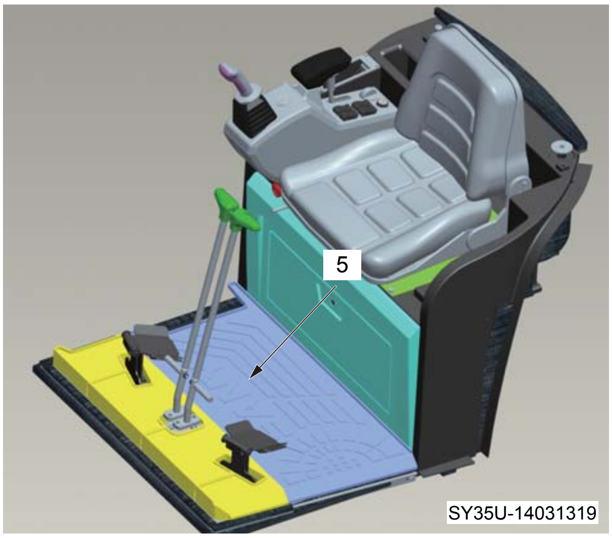


Fig. 8-177

6. Remove grease fitting and hose (6) from race of swing bearing race of swing bearing.

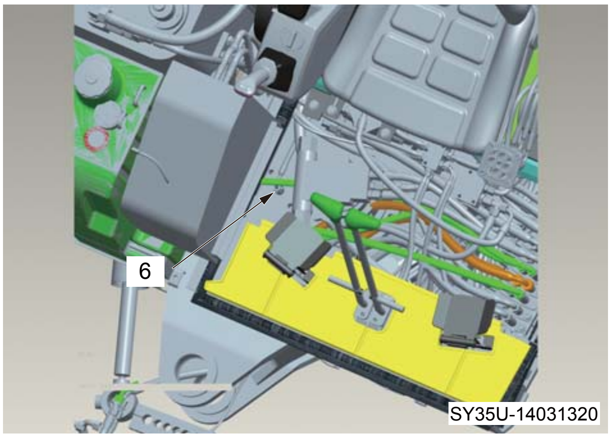


Fig. 8-178

7. Disconnect all hoses (7), (8) and (9) between control valve and swivel joint.

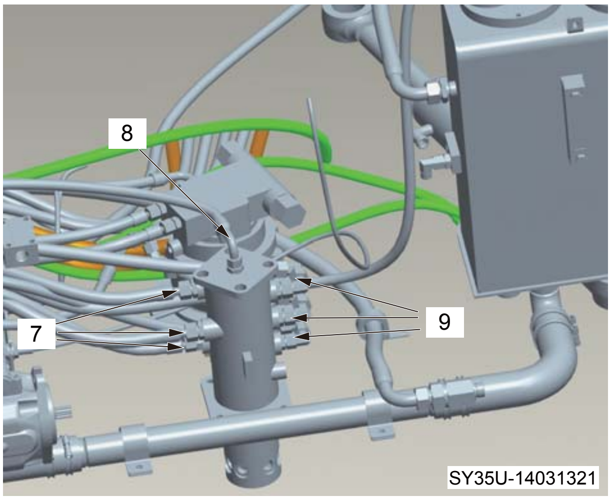


Fig. 8-179

8. Put a block between wire rope and machine frame. Hoist the swing platform. Be careful not to let the wire rope contact the engine.
9. Remove swing bearing outer race installation bolts (10). Hoist the platform assembly (11) and move it aside.

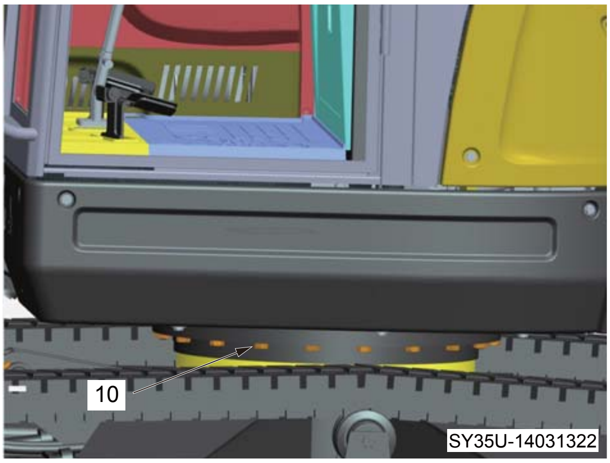


Fig. 8-180

Leave two bolts at both the front and the rear sides. Use adjusting blocks to adjust the balance of the swing platform in all directions. Remove the bolts left and hoist away the platform.

Do not damage the swivel joint while removing the swing platform.

Swing platform assembly: 1695 kg

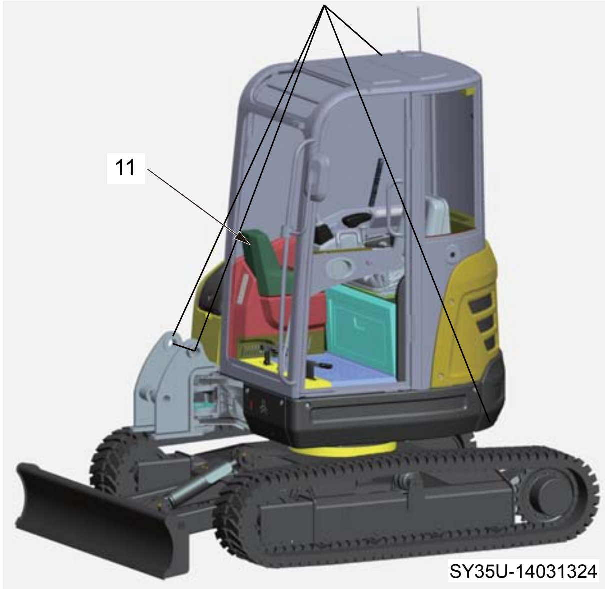


Fig. 8-181

8.9.2 Installation

- Installation is to be performed in reverse procedure of removal.

Swing bearing mating surface:

Gasket sealant (LG-1)

Threads of swing platform mounting bolt: Thread adhesive (1277)

Swing platform mounting bolt:

279±30 N·m

- Adding oil (to hydraulic tank)

  Add oil to the specific level through the f ller opening. Start the engine to circulate oil in the system. Check oil level again.

- Purging the air

  Purge the air from the swing motor.

  For detailed information on air purging see **"Air Purging"**.

8.10 Swing Bearing AS

8.10.1 Removal

1. Remove the swing platform assembly.

   For detailed information see “Swing Platform AS.

2. Remove the mounting bolts (1) of the swing bearing.
3. Hoist away the swing bearing assembly (2).

   Swing bearing assembly: 97 kg

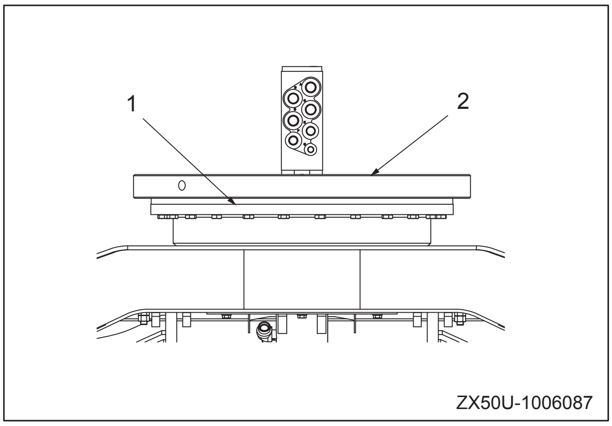


Fig. 8-182

8.10.2 Installation

- Installation is to be performed in reverse procedure of removal.

Inner ring gear surface: Grease (G2-LI)

Mounting bolt: Thread adhesive (1277)

Mounting bolt: 279N·m±30N·m

8.11 Idler and Tension Spring AS

8.11.1 Removal

1. Remove the track shoe assembly.

   For detailed information see “**Track AS**” .

2. Lift the idler and tensioning device assembly and pull it out from the front end.

   Idler and tensioning device AS: 94 kg

3. Remove bolt (1), tensioning device (2) from idler (3).

   Idler: 52 kg

   Tensioning device: 32 kg

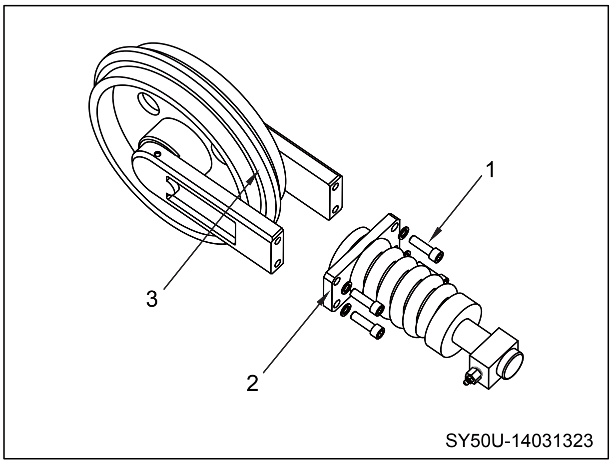


Fig. 8-183

8.11.2 Installation

- Installation is to be performed in reverse procedure of removal.

※1

Threads of tension spring assembly mounting bolt:

Thread adhesive: 1277

8.12 Tension Spring AS

8.12.1 Disassembly

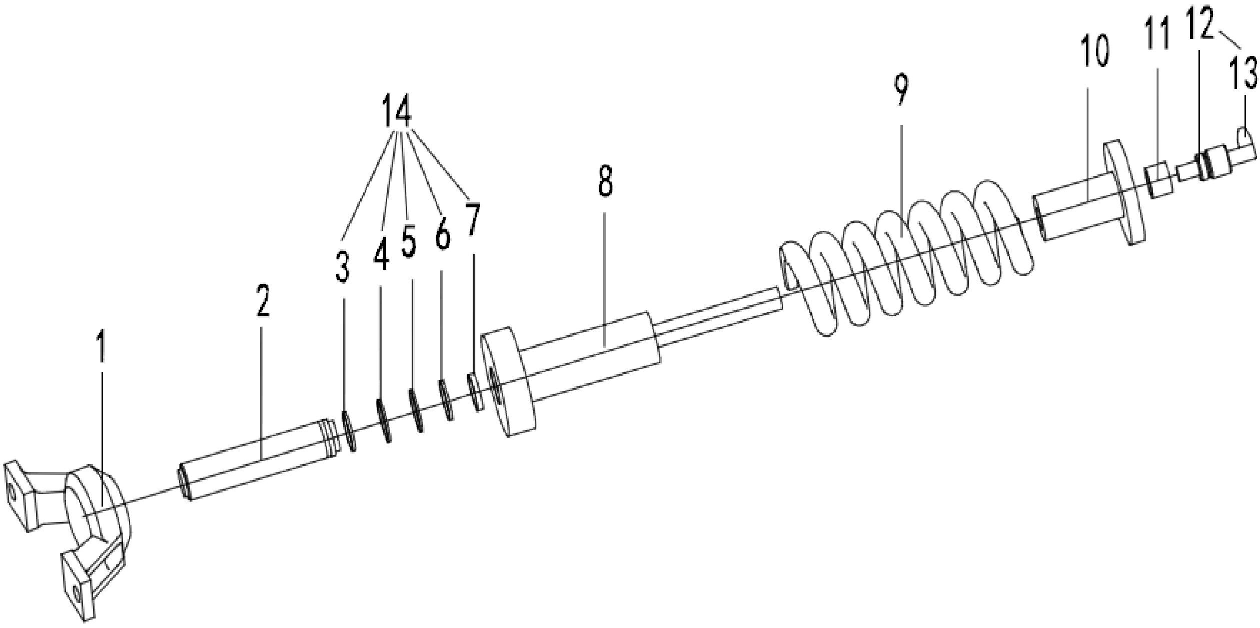


Fig. 8-184

SY50U-17020311

1. Remove check valve (12) and Bearing (1) and mandrel (2).
2. Disassemble tension spring assembly.

A. Place the tension spring assembly on a special tool.

The tool must be placed properly since the tension spring is under higher installation load.

Improper placement of the tool is dangerous.

B. Slowly apply hydraulic pressure to compress the spring. Remove the nut (11).

- Compress the spring until the nut become loose.
- Slowly release hydraulic pressure in order to cancel the tension of spring.
- Remove spring (1), body cylinder (8) and Spring seat (10).
- Remove dust ring (4), retaining (5) and seal (6) from body cylinder.

8.12.2 Assembly

1. Assemble tension spring assembly.
   A. Install anti-abrasion ring (3),dust ring (4), retaining ring (5), sealing ring (6) and wear ring (7) to cylinder barrel (8).
   B. Install cylinder barrel (8) and tensioning spring (9) on spring sea (10). Place it on the tool.
   C. Put hydraulic pressure to compress the spring slowly. Make sure the spring get a length of 349 mm and a preload of 37240 N.
   D. Remove the spring assembly from the tool.
2. Inject about 20cc grease into cylinder (inside cylinder block: G2-Li grease).
3. Install the plunger (2) to spring assembly.
4. Install the check valve (12).

- Let the grease fitting face outward during installation.
- When installation in completed, the check valve should be able to receive the grease in the front. No leak should occur in the opposite direction.

8.13 Idler AS

8.13.1 Disassembly

1. Remove pin (1) and seat sliding rail (8)
2. Remove float seal (3) from idler shaft.
3. Pull out idler body (7) from idler spindle(6)

and bracket (2).

The idler body contains approximate 70 ml oil. It is necessary to discharge oil or cover the work area with a piece of cloth to pre vent getting the area dirty.

4. Remove float seal (3) from idler body(7)

and bracket (2).

5. Remove bush (5) from idler body (7).

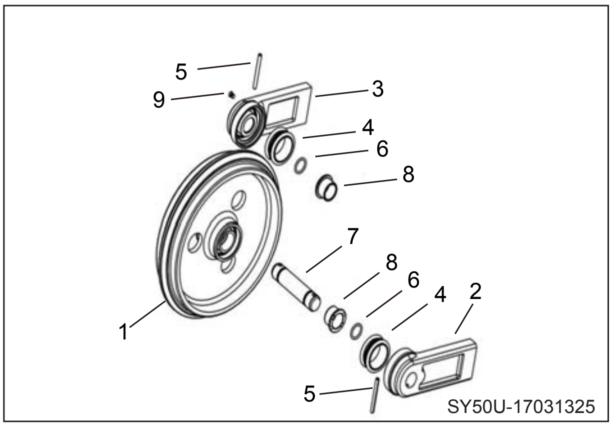


Fig. 8-185

8.13.2 Assembly

1. Install and press bush (5) onto idler body(7).

2. Install bracket (8) to spindle (6) with the pin(1).

3. Install float seal (3) to idler body (7) andbracket (2).

Apply oil to sliding surface of float seal (4).
Take care not to allow dirt or dust to con-
taminate the seal.

4. In tall spindle (6) and bracket (8) to idlerbody (7).

5. Add oil (SAE 15W-40) to idler body (7).

Oil capacity: 95 ml～105 ml

6. Install float seal (3) to the other side of idler
 body (7) and bracket (2) on the other side.
7. Install bracket (2) to the spindle assembly
6. Install f oat seal (4) to the other side of idler body (1) and bracket (3) on the other side.
7. Install bracket (3) to the spindle assembly with the pin (5).

   Make sure that the wheel rotates freely af- ter installation.

   with the pin (1).
   Make sure that the wheel rotates
   freely af- ter installation.

8.14 Track Roller AS

8.14.1 Removal

WARNING

- **The track tensioning cylinder is under extremely high pressure. Never loosen the grease fitting over one turn. If no grease is seen, move the machine back and forth.**

1. Lower the work equipment on the ground. Loosen check valve (1) of tensioning device. Loosen grease f tting (2) to release track tension.
2. Remove track roller mounting bolt (3). Turn work equipment by 90º. Use the force of work equipment to lift your machine and remove track roller assembly (4) that faces outward.

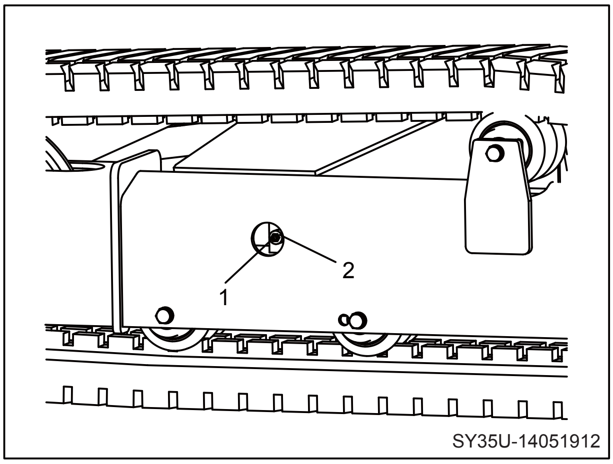


Fig. 8-186

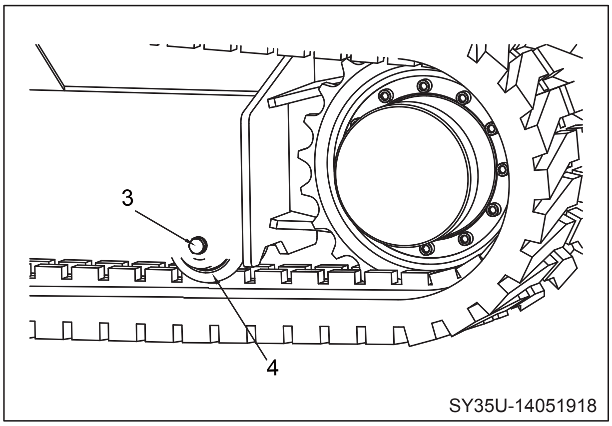


Fig. 8-187

8.14.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Threads of track roller AS mounting bolt:

  Thread adhesive (1277)

  - Place the screw on the outside of chassis. Install track roller assembly in place.
  - Slowly lower your machine. Tighten the mounting bolts partially.
  - Fully lower your machine to ground. Tighten the mounting bolts completely.

8.15 Track Roller AS

8.15.1 Disassembly

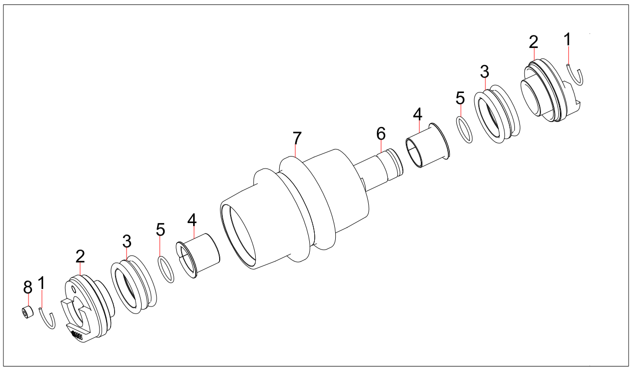


Fig. 8-188

1. Remove collar (1) on one side.
2. Remove end cover (2).
3. Remove float seals (3) on roller body (7) and end cover (2).

   The roller body contains approximate 70 ml oil. It is necessary to discharge oil or cover the work area with a piece of cloth to prevent getting the area dirty.
4. Pull off the roller body (7) from spindle (6).
5. Remove float seals (3) on roller body (7) and end cover (2) on the other side.
6. Remove bushing (4) from roller body (7).

8.15.2 Assembly

1. Press bushings (4) on both sides into the roller body (7).

   Clean each part before assembling.
2. Install roller body (7) to spindle (6).
3. Install f oat seals (3) to end cover (2) and roller body (7).

   When you are installing float seals (3) it is necessary to clean the O-ring and f oat seals in order to make sure the f oat seals are free from contaminants or dust.
4. Install collar (1).
5. Install f oat seals (3) to end cover (2) and roller body (7) on the other side.
6. Inject oil into roller body.

   Oil capacity: SAE 15W-40，85 ml～95 ml
7. Install collar (1).

   Make sure that the roller rotates freely after installation.

8.16 Carrier Roller AS

8.16.1 Removal

WARNING

- **The track tensioning cylinder is under high pressure, so do not loosen the grease f tting by more than one turn. If no grease is seen, move the machine back and forth.**

1. Lower the work equipment and loosen the valve (1). Loosen grease fitting (2) to release track tension.
2. Use a hydraulic jack (3) to push up the track to a position that allows you to remove the carrier roller assembly. Remove the carrier roller assembly (4).

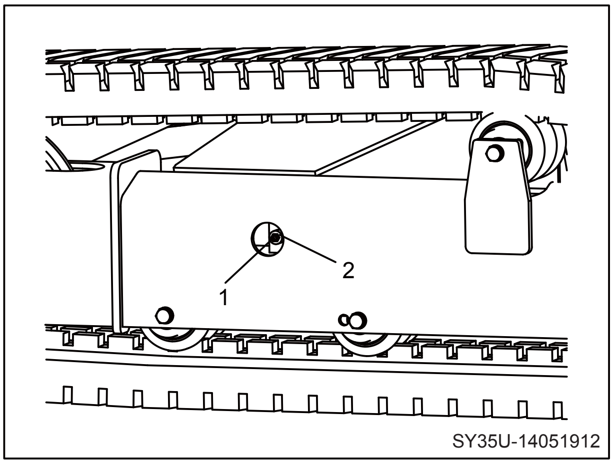


Fig. 8-189

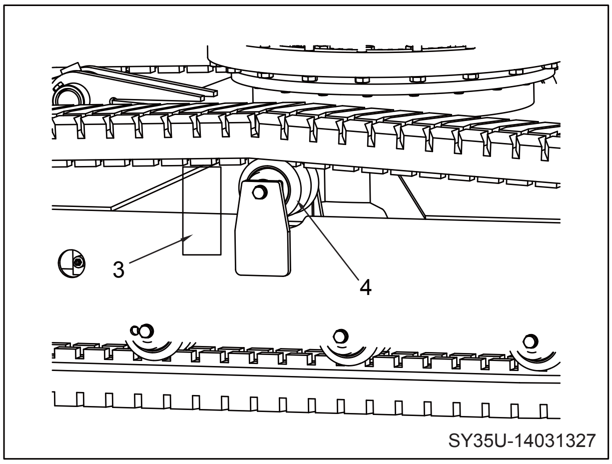


Fig. 8-190

8.16.2 Installation

- Installation is to be performed in reverse procedure of removal.
- Adjusting the track tension.

  For detailed information on track tension adjustment see **"Track Tension - Check and Adjust"**

  Threads of carrier roller AS mounting bolt: Thread adhesive (1277)

8.17 Track AS

8.17.1 Removal

1. Swing upper structure by 180º and raise the machine with the force of work equipment.
2. Loosen the check valve (1) to discharge grease. Relieve the tension of rubber track.

   ★ Never loosen valve (1) over one turn, or it could eject under high grease pressure.
3. If the assembly of steel track,find the main pin ,then remove it(the main pin and the chain link for the interference fit),if the assembly of rubber track,directly in step 4.
4. Lift track assembly and pull it out.

Rubber track：295 kg

Steel track: 310kg

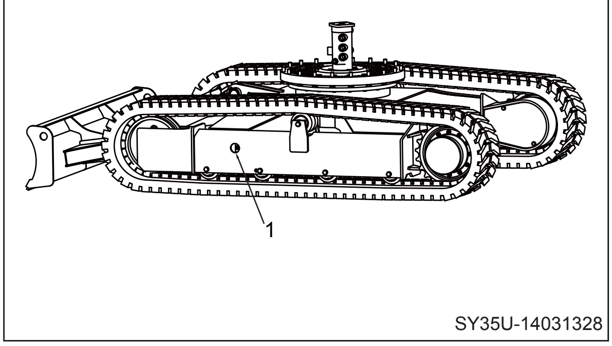


Fig. 8-191

8.17.2 Installation

- Installation is to be performed in reverse procedure of removal.
- Adjust track tension according to the amount of grease injected into the tensioning device. Make sure that the sag of track is within 10-20 mm（rubber track),or 15-25mm(Steel track).

8.18 Hydraulic Tank AS

8.18.1 Removal

WARNING

- **Lower work equipment to ground. Stop the engine. Slowly loose the f ller cap in order to release internal pressure of hydraulic tank.**

1. Drain oil from hydraulic tank.

   Tank capacity: Approx. 52 L

2. Remove cab and covering assembly.
3. Remove check valve (1), hoses (2) and (3).

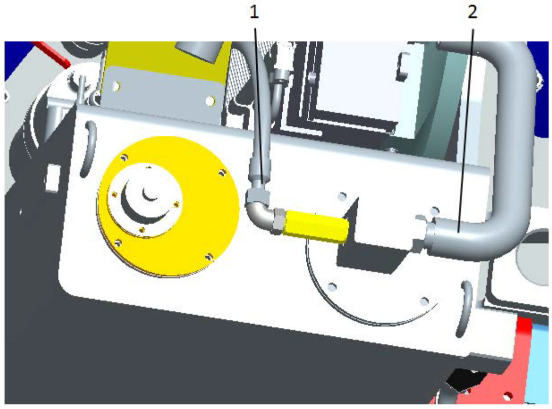


Fig. 8-192

4. Remove the screws of f ange (4).
5. Unscrew the mounting bolts to remove the hydraulic tank.

   Hydraulic tank assembly: 68.5kg.

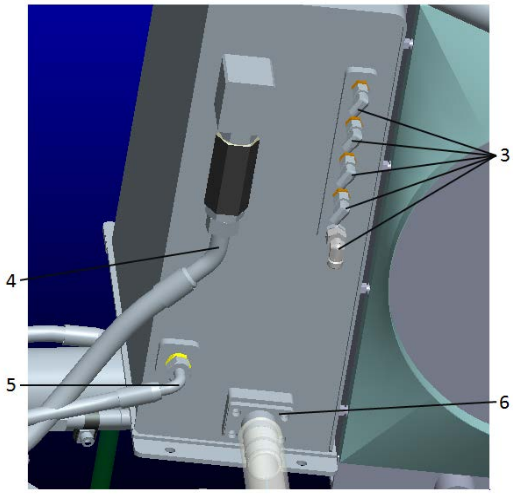


Fig. 8-192A

8.18.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Threads of hydraulic tank mounting bolt: Thread adhesive (LT-2)

  Hydraulic tank mounting bolt:

  113N·m±10N·m

- Ref lling the hydraulic tank

  Add oil to the specific level through the f ller opening. Start the engine to circulate oil in the system. Check the oil level again.

  Tank capacity: 40 L (SAE 10W CD)

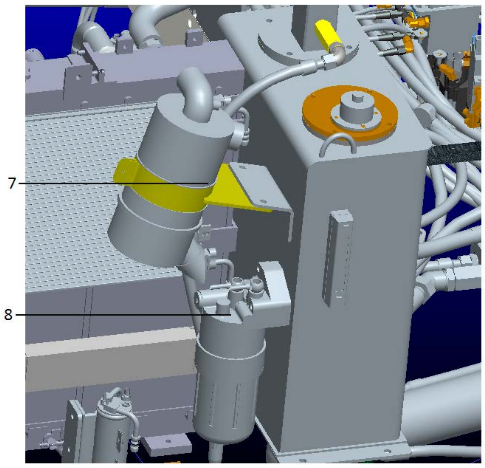


Fig. 8-193

8.19 Main Pump AS

8.19.1 Removal

Lower work equipment to ground and shut down the engine.

1. 1.Disconnect the main pump's delivery hose (1),Ls hose(2),Drain hose(3),Oil suction pipe(4).
2. Remove the f xing screws on f ywheel connection disc in order to take off the pump together with the disc.
3. Remove the coupling on pump input shaft.
4. Remove the pump from flywheel connection disc.

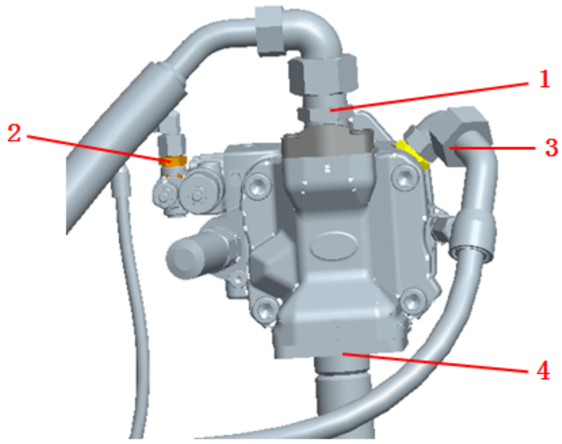


Fig. 8-194

8.19.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Pump housing mating surface:

  Gasket sealant (LG-6)

- Ref lling the PTO gear box

  Add oil to specif ed level via the f ller opening.

- Ref lling the hydraulic tank

  Add oil to the specif c level through the f ller opening. Purge air from the main pump. Run the engine to circulate oil in the system. Check the oil level again.

- Purging the air

  Purge air from the main pump.

  For detailed information on air purging see **"Air Purging"** .

8.20 Control Valve

AS 8.20.1 Removal

WARNING

- **Lower work equipment to ground and shut down the engine. Release system pressure.**

Note: Mark the hoses before disassembling.

1. Disconnect hoses (1), (2).
2. Disconnect hoses (3) — Corresponding to two pilot ports of all the functional valve plates, 20 in total.
3. Disconnect hose (6) — Corresponding to the main circuit of all functional valve plates, 20 in total.
4. Disconnect the LS hose(5).
5. 5.Disconnect the M port hose(4).
6. Remove four mounting screws on the main valve frame.
7. Lift the control valve assembly(7) with the frame,then disconnect the valve and the frame.

Control valve AS: Approx. 42kg

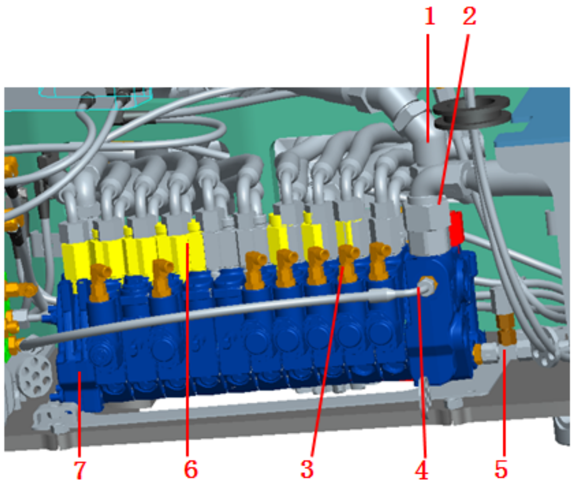


Fig. 8-196

8.20.2 Installation

- Installation is to be performed in reverse procedure of removal.
- Ref lling the hydraulic tank

  Add oil to the specific level through the f ller opening. Start the engine to circulate oil in the system. Check the oil level again.
- Purging the air

  Purge air between the valve and the hydraulic cylinder.

  For detailed information on air purging see **"Air Purging"** .

8.21 Oil Source Control Valve AS

8.21.1 Removal

NOTICE

- **Disconnect the terminals of the oil source control valve.**

1. Remove left side plate.
2. Disconnect five hoses (1).
Mark the connection location of each hose before disconnection.
3. Unscrew mounting bolts to remove oil source control valve assembly (2)with the frame.

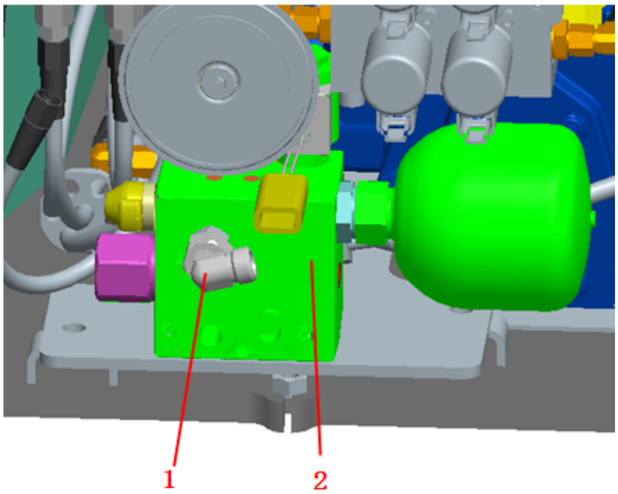


Fig. 8-197

8.21.2 Installation

- Installation is to be performed in reverse procedure of removal.

8.22 Left Pilot Valve AS (Arm and Swing Control)

WARNING

- **Lower work equipment to ground and shut down the engine. Release system pressure.**

8.22.1 Removal

1. Remove rubber jacket (2) from cover (1) and pull it upward.
2. Remove the mounting bolts of the pilot valve assembly. Lift up the pilot valve assembly and disconnect the six hoses (4).
3. Remove the pilot valve assembly (5).

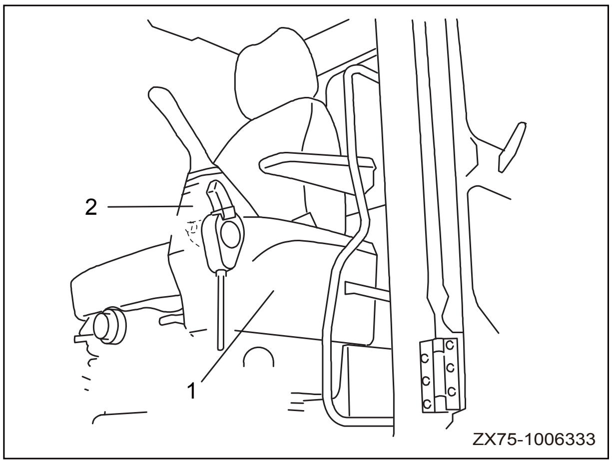


Fig. 8-198

8.22.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Hose connection bolt:

  39.2±4.9 N·m

  Adjust the pilot valve if the control lever plays too much. For detailed information see **"Work Equipment and Swing Pilot Valve - Adjust"**.

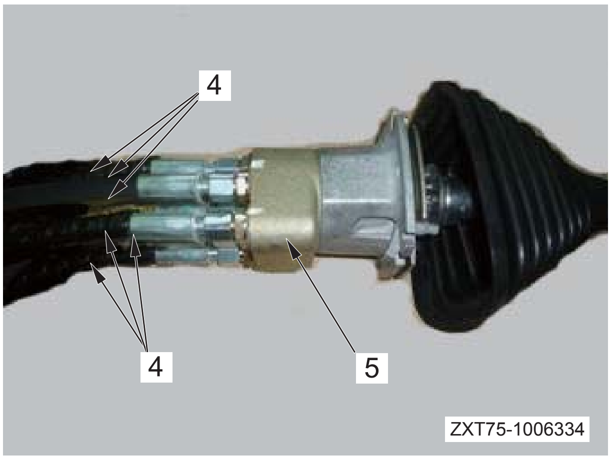


Fig. 8-199

8.23 Right Pilot Valve (Boom and Bucket Control)

WARNING

- **Lower work equipment to ground and shut down the engine. Release system pressure.**

8.23.1 Removal

1. Remove the rubber jacket (2) from the cover (1) and pull it up.
2. Remove the mounting bolts of the pilot valve assembly. Pull up the pilot valve assembly and disconnect the six hoses (4).
3. Remove the pilot valve assembly.

Fig. 8-200

8.23.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Hose connection bolt:

  39.2±4.9 N·m

- Adjust the pilot valve if the control lever plays too much. For detailed information see "**Work Equipment and Swing Pilot Valve - Adjust**".

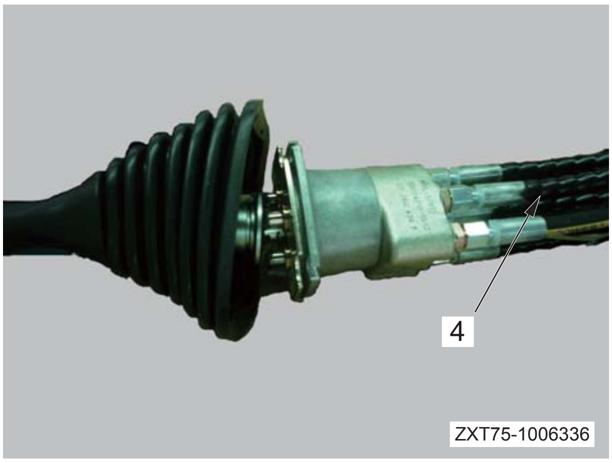


Fig. 8-201

8.24 Work Equipment Pilot Valve

AS 8.24.1 Disassembly

1. Remove the nut (1) and then the lower disc (2) and rubber jacket (3).
2. Remove the bolt and then the plate (5).

   Do not remove connector (4) unless it has to be replaced.
3. Remove the seal (6) and the retainer (7).
4. Pull out the plunger (8). Remove the positioner (9), springs (10) and (11), and gasket (12).

   Spring (10) consists of two kinds of springs with different installation loads. So check the installation position (oil port) and the tag to avoid making mistake during installation.
5. Pull out the valve (13) from valve body (14).

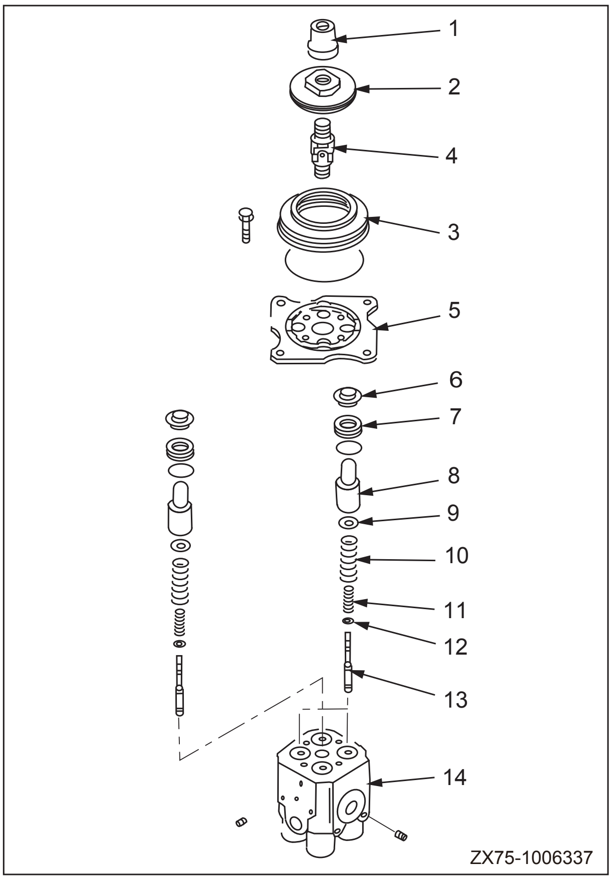


Fig. 8-202

8.24.2 Assembly

1. Install the valve (13) in valve body (14).
2. Install the gasket (12) and the spring (11) on the valve (13).

   When installing the spring (11), the end with small diameter (inner diameter) shall face the gasket (12).
3. Install the spring (10), positioner (9) and plunger (8).

   The number of coils of the spring (10) for each hydraulic oil port is different. Be aware of this during installation.

   The position of each port is marked on bottom of valve body.

   Plunger: grease (G2-LI)

   When installing the plunger (8), apply grease to the outer of plunger and to the bore of valve body.

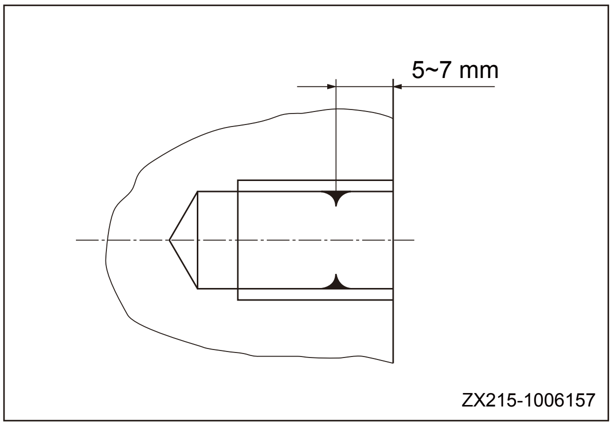


Fig. 8-203

Port Position	Free Length of Spring
P1, P2	44.4 mm
P3, P4	42.4 mm

4. Install the O-ring seal on the retainer (7), which will be installed on valve body (14). And then install the seal (6).
5. Install the plate (5).

   Mounting bolt: 13.23±1.47 N·m
6. Install the connector (4).

   Sliding part of connector: Grease (G2-LI)

   Threads inside valve body: Thread adhesive: (LT-2)

   Apply adhesive to two points on the inner threads, one drop of Loctite for each point.

   Connector: 44.1±4.9 N·m

   The tightening torque of connector should be ensured.
7. Install the jacket (3) and disc (2). Tighten the nut (1).

   Nut: 112.7±14.7 N·m

   The tightening torque of connector should be ensured.

8.25 Travel Pilot Valve

AS 8.25.1 Removal

WARNING

- **Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release internal pressure in the hydraulic tank.**

1. Remove the f oor mat.
2. Remove the bottom cover.
3. Remove the control lever (1).
4. Remove the bolts (2).
5. Disconnect the hoses (3) and three-way connector (4). Remove the travel pilot valve assembly.

Fig. 8-204

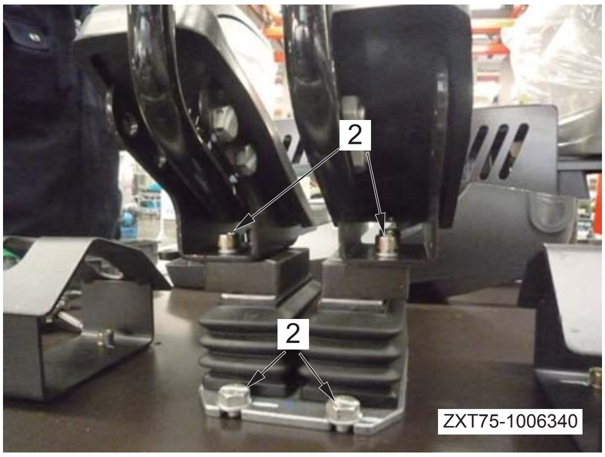


Fig. 8-205

8.25.2 Installation

- Installation is to be performed in reverse procedure of removal.
- Adjust the travel control lever.

  See “Testing and Adjusting” for more information on adjustment of travel control lever.

  Cover mounting bolt:

  19.6±1.96 N·m

  Hose connector mounting bolt (cross width : 30 mm):

  39.2±4.9 N·m

  Hose connector mounting bolt (cross width : 22 mm):

  29.4±4.9 N·m

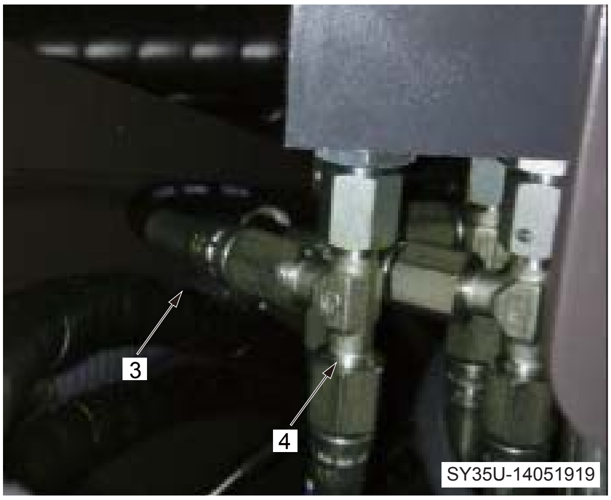


Fig. 8-206

8.26 Travel Pilot Valve AS

8.26.1 Disassembly

Note: The chapter only discusses the precautions to be observed when reassembling the travel pilot valve assembly.

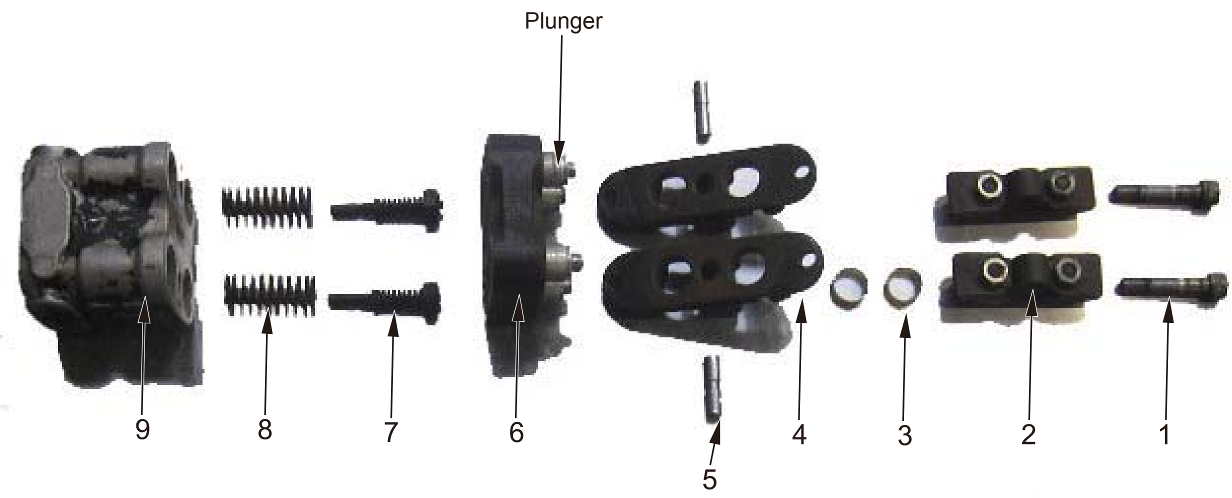


Fig. 8-207

8.26.2 Assembly

- Reassemble the travel pilot valve assembly.

1. Install the spring (8) in the spool bore of housing (9). Install the spool (7). Put the cover (6) on the spool and hold the cover (6) with a hand.
2. Align the bore and install the plate (4). Tighten the socket-headed screws (1).

   Socket head screw: 98-114 N·m
3. Install the dust ring (3) on the plunger. Install the cams(2). Fix the cam (2) with the camshaft (5).

   Interface between plunger and dust ring (3): grease (No.1 calcium base grease)

8.27 Boom CylinderAS

8.27.1 Removal

NOTICE

- **Fully extend the arm and bucket. Lower the work equipment completely on the ground. Place the hydraulic lockout control in the LOCKED position.**

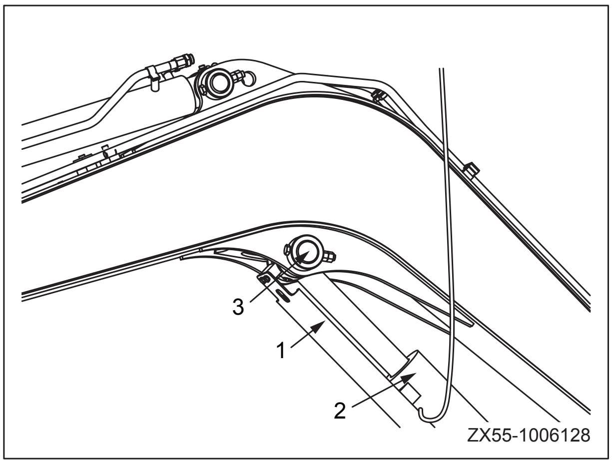


Fig. 8-208

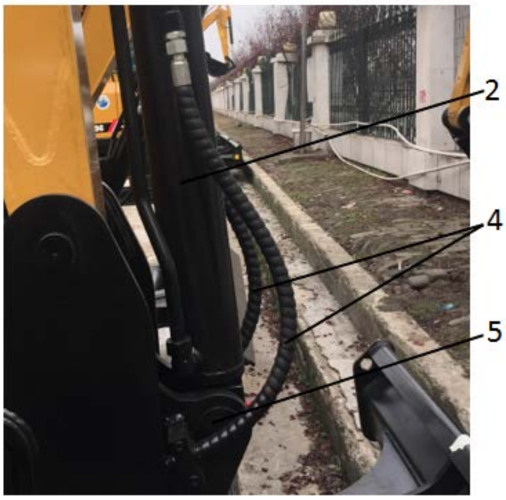


Fig. 8-209

1. Remove cylinder guard plate (1).

   Check the number and thickness of shims removed and store them in a safe place.

2. Lift the boom cylinder assembly (2). Remove the locknut and the pin (3).

   Check the number and thickness of shims removed and store them in a safe place.

3. Start the engine, retract the piston rod and tie rod with a string to prevent it from coming off.

   Place a support under the cylinder assembly. Adjust the position of the cylinder assembly hoisted.

4. Disconnect the left hose and the right hose (4).

5. Remove stop bolt and the bottom pin (5). Then remove boom cylinder assembly (2).

   Check the number and thickness of shims removed and store them in a safe place.

   Boom cylinder AS: 48.1kg

8.27.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Tighten the lock nut with clearance between stop collar and nut at 0.5 mm~1.0 mm.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your finger in the pinhole while aligning it.

  - Adjust shim thickness so that the clearance between piston rod (6) and plate (7) is less than 1 mm.
  - Standard shim thickness: 0.5 mm
  - Tighten the lock nut with clearance between stop collar and nut at 0.5 mm~1.0 mm.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your finger in the pinhole while aligning it.

  - Adjust shim thickness so that the clearance between cylinder bottom (8) and plate (9) is less than 1 mm.
  - Standard shim thickness: 0.5 mm

- Purging the air

  Purge the air from oil cylinder.

  For detailed information on air purging see **"Air Purging"**.

- Ref lling the hydraulic tank

  Add oil to the specific level through the f ller opening.

  Start the engine to circulate oil in the system and then check oil level again.

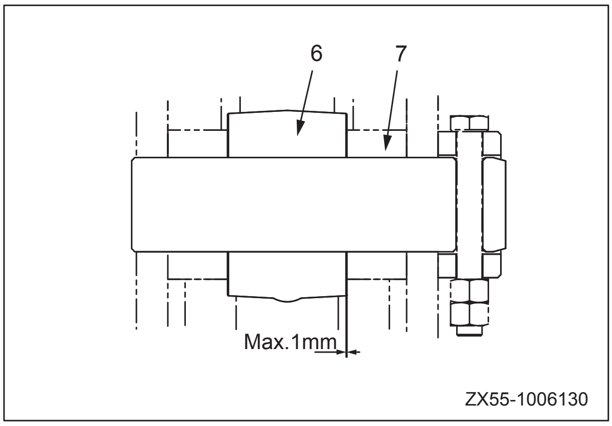


Fig. 8-210

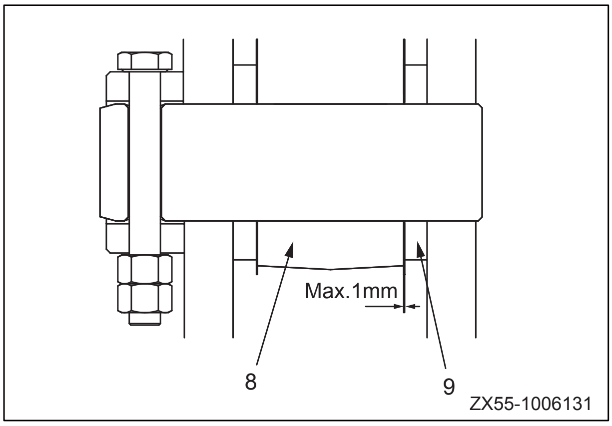


Fig. 8-211

8.28 Arm Cylinder

AS 8.28.1 Removal

NOTICE

- **Fully extend the arm and bucket. Completely lower the work equipment on ground. Place the hydraulic lockout control in the locked position.**

1. Hoist the cylinder assembly.
2. Remove the latch and the pin (1) on the end.

   Check the number and thickness of shims removed and store them in a safe place.
3. Start the engine and retract the piston rod. Tie the rod with a string to prevent it from coming off.
4. Disconnect both the left and right hoses (2).
5. Disconnect the lubrication line (5).
6. Lift the arm cylinder assembly. Remove the latch and then the bottom pin (3). Remove the arm cylinder assembly (4).

   Check the number and thickness of shims removed and store them in a safe place.

   Arm cylinder assembly:46.9 kg

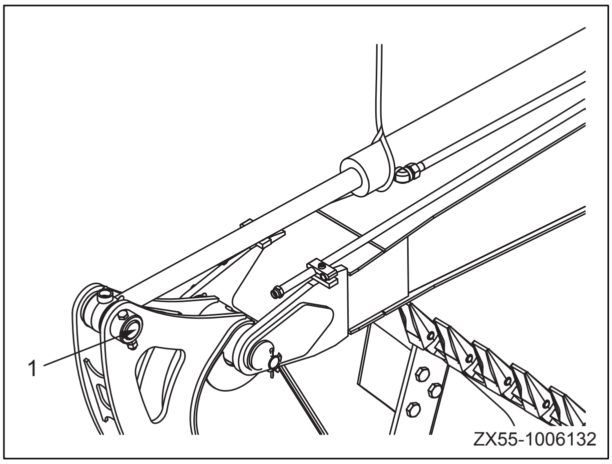


Fig. 8-212

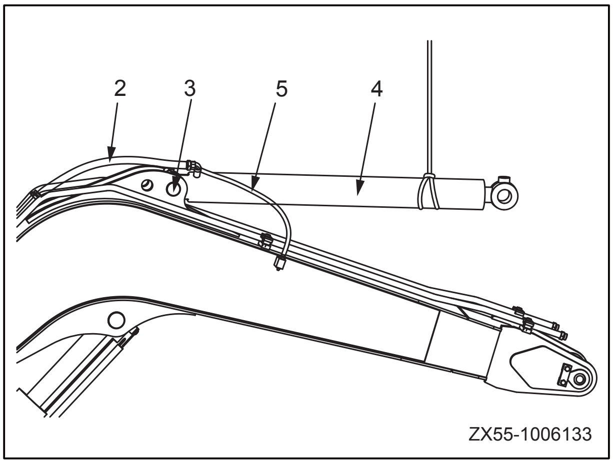


Fig. 8-213

8.28.2 Installation

- Installation is to be performed in reverse procedure of removal.

Note: Tighten the lock nut with clearance between stop collar and nut at 0.5 mm~1.0 mm.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your finger in the pinhole while aligning it.

- Adjust shim thickness so that the clearance between piston rod (5) and plate (6) is less than 1.0 mm.
- Standard shim thickness: 0.5 mm
- Tighten the lock nut with clearance between stop collar and nut at 0.5 mm~1.0 mm.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your finger in the pinhole while aligning it.

- Adjust shim thickness so that the clearance between cylinder bottom (7) and plate (8) is less than 1 mm .
- Standard shim thickness: 0.5 mm

- Purging the air

  Purge the air fro oil cylinder.

  For detailed information on air purging see **"Air Purging"** .

- Adding oil (to hydraulic tank)

  Add oil to the specific level through the f ller opening.

  Start the engine to circulate oil in the system and then check oil level again.

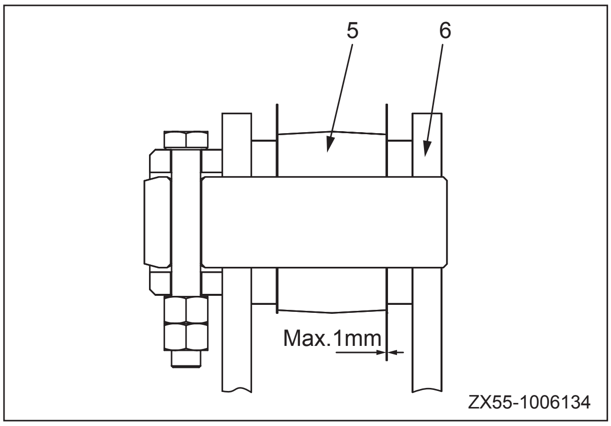


Fig. 8-214

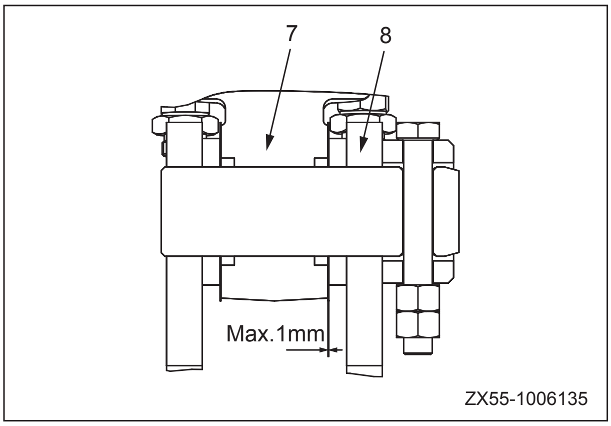


Fig. 8-215

8.29 Bucket CylinderAS

8.29.1 Removal

Extend piston rod of bucket cylinder by approximately 55 mm. Lower the work equipment fully on ground. Place the hydraulic lockout control in the locked position.

1. Place a block ① under the end of arm.
2. Place blocks ② and ③ between the linkage and the arm.
3. Lift the bucket cylinder assembly.
4. Remove stop nut (1) and then the pin (2). Tie the piston rod to prevent it from coming off.
    - If the pin (2) comes off, the linkage (4) would fall. So always keep the block ② in its position.
    - Check the number and thickness of shims removed and store them in a safe place.
5. Disconnect the left and right hoses (3).
6. Hoist up the bucket cylinder assembly. Remove the stop bolt and the bottom pin (5). Remove the bucket cylinder assembly (6).

    Check the number and thickness of shims removed and store them in a safe place.

    Bucket cylinder assembly:28.6 kg

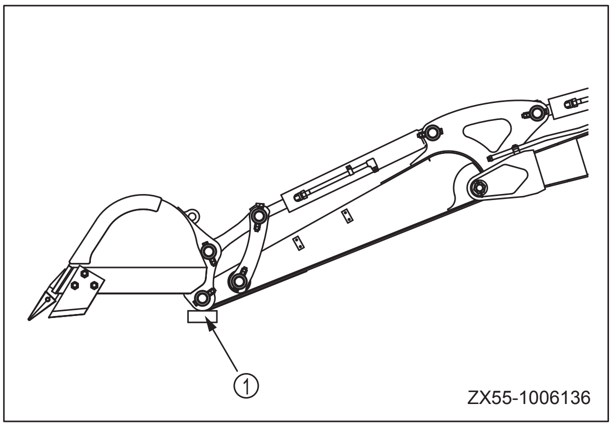


Fig. 8-216

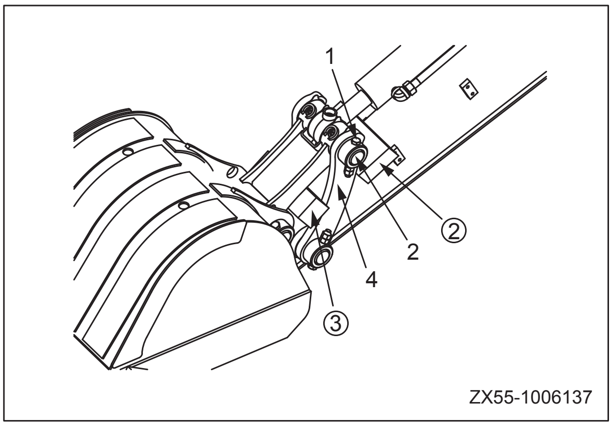


Fig. 8-217

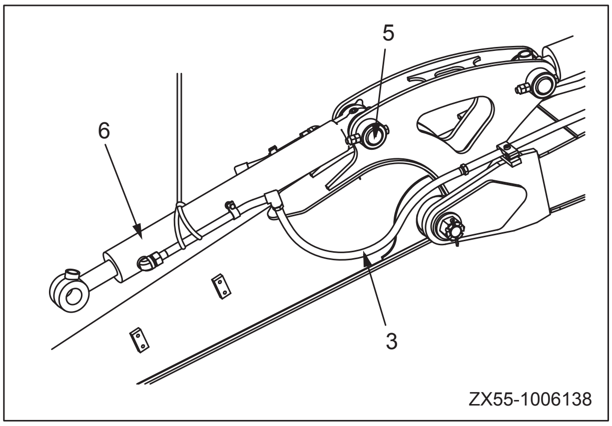


Fig. 8-218

8.29.2 Installation

- Installation is to be performed in reverse procedure of removal.

Note: When tightening the locknut, keep a clearance of 0.5-1.5 mm between the stop collar and the nut.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your finger in the pinhole while aligning it.

- Adjust the thickness of shims so that both clearance between rock bar (8) and linkage (4), and clearance between cylinder head (9) and linkage (4) are less than 1 mm .
- Standard shim thickness: 0.5 mm

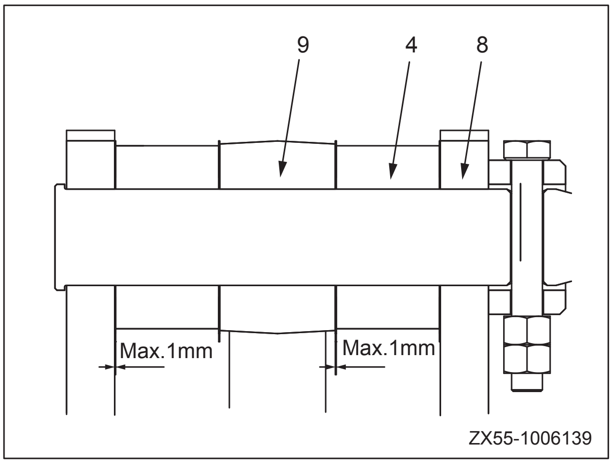


Fig. 8-219

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your finger in the pinhole while aligning it.

- Adjust the thickness of shims so that clearance between cylinder bottom (10) and bucket (11) is less than 1 mm .
- Standard shim thickness: 0.5 mm

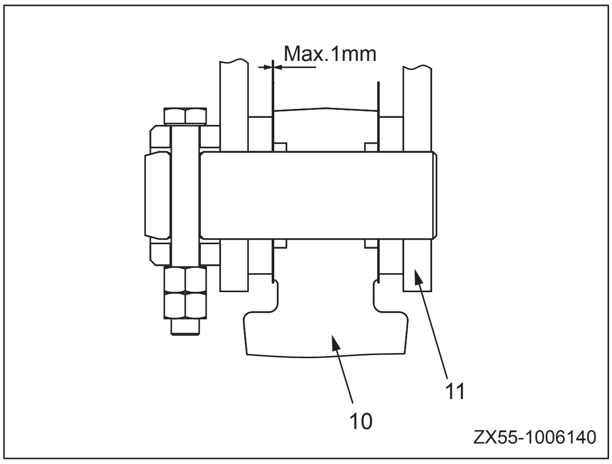


Fig. 8-220

- Purging the air

  Purge the air from oil cylinder.

  For detailed information on air purging see **“Air Purging”** .

- Ref lling the hydraulic tank

  Add oil to the specific level through the f ller opening.

  Start the engine to circulate oil in the system and then check oil level again.

8.30 Def ectionCylinder

AS 8.30.1 Removal

WARNING

- **Swing work equipment by 45º. Lower work equipment to ground and stop the engine. Operate the pedal valve 2-3 times to release residual pressure in hydraulic circuit. Engage the hydraulic lockout control.**

1. Remove right side plate.

   Check the quantity of bolts and shims removed and store them in a safe place.
2. Remove bottom holding pin (1).
3. Remove head holding pin (2).
4. Disconnect hoses (3) from head end and rod end.
5. Pull out the def ection cylinder (4) from the front side.
   Deflection cylinder assembly: 31.5kg

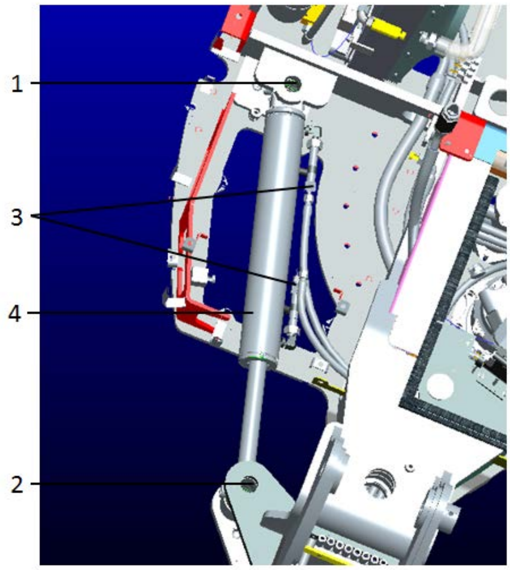


Fig. 8-221

8.30.2 Installation

- Installation is to be performed in reverse procedure **of removal.**

  Note: Do not put your f nger in the pinhole while aligning it.

  Install the shims securely in their original positions.
- Purging the air

  Purge the air from oil cylinder.

  For detailed information on air purging see **"Air Purging"**.
- Ref lling the hydraulic tank

  Add oil to the specific level through the f ller opening.

  Start the engine to circulate oil in the system and then check oil level again.

8.31 Dozer Blade Cylinder

AS 8.31.1 Removal

WARNING

- **Turn work equipment 45 degrees. Lower work equipment to ground. Lower dozer blade to ground and stop the engine. Cycle the blade control 2-3 times in order to release the residual pressure in hydraulic circuit.**
- **Slowly loosen the filler cap to release the internal pressure of hydraulic tank. Place the hydraulic lockout control in the locked position.**

1. Remove blade cylinder protection cover.

   Check the quantity of bolts and shims removed and store them in a safe place.
2. Lift blade cylinder (1). Remove the head installation pin (2).

   Check the quantity and thickness of shims removed and store them in a safe place.
3. Start the engine, retract the piston rod, and tie the rod to prevent it from coming off.
4. Disconnect hose (3).
5. Remove bottom pin (4). Hoist away the blade cylinder assembly (1).

   Check the quantity and thickness of shims removed and store them in a safe place.

   Blade cylinder assembly: 32.9 kg

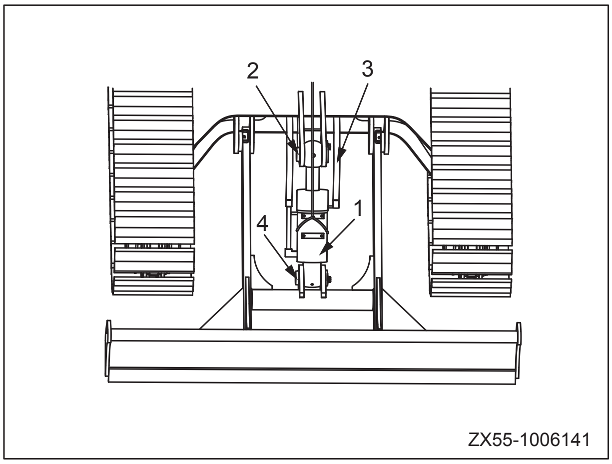


Fig. 8-222

8.31.2 Installation

- Installation is to be performed in reverse procedure **of removal.**

  Note: Do not put your f nger in the pinhole while aligning it.

  Install the shims securely in their original positions.

- Purging the air

  Purge the air from oil cylinder.

  For detailed information on air purging see “**Air Purging**”.

- Ref lling the hydraulic tank

  Add oil to the specific level through the f ller opening.

  Start the engine to circulate oil in the system and then check oil level again.

8.32 Hydraulic Cylinder

AS 8.32.1 Disassembly

1. Cylinder assembly
   A. Plate the cylinder assembly (1) on the tool E1.
   B. Using a hydraulic pump or a power wrench, loosen the cylinder head assembly (2) with the tool E2.
   C. Pull out the rod assembly (3).
      - Place a container under the cylinder to collect oil.

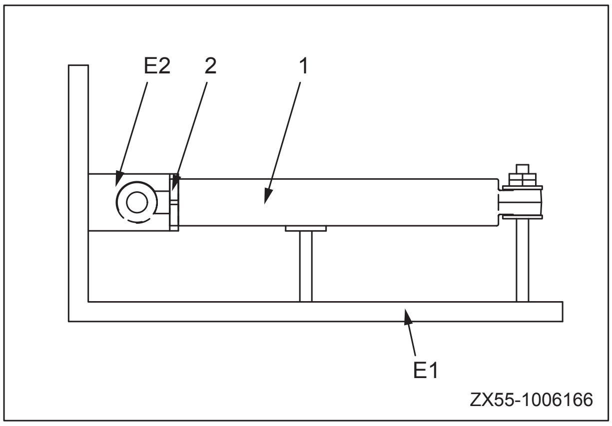


Fig. 8-223

2. Piston rod assembly
   A. Place the rod assembly (3) the on the tool E1.
   B. Loosen lock nut (4) with a tool.
      - For arm cylinders, remove the stop ring and the cushion collar at the end.

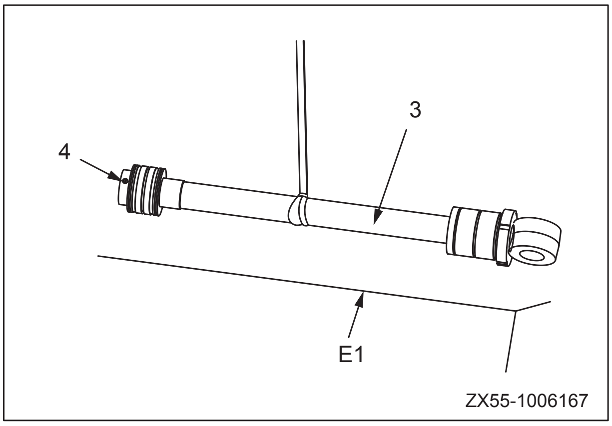


Fig. 8-224

C. Remove piston assemble (5) and cushion collar (6) with tool E3.

- Cushion collar (6) is only used for boom and arm cylinder.

D. Remove cylinder head assembly (2).

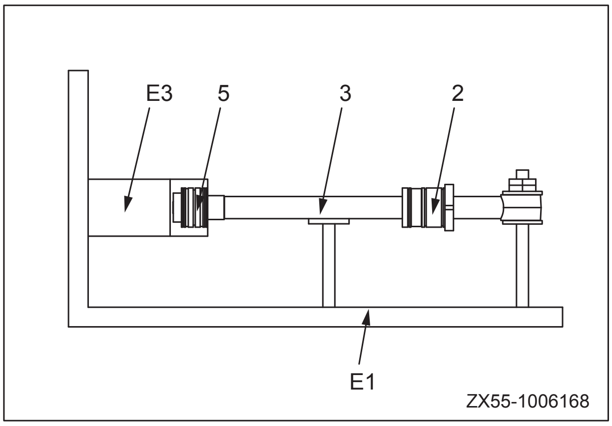


Fig. 8-225

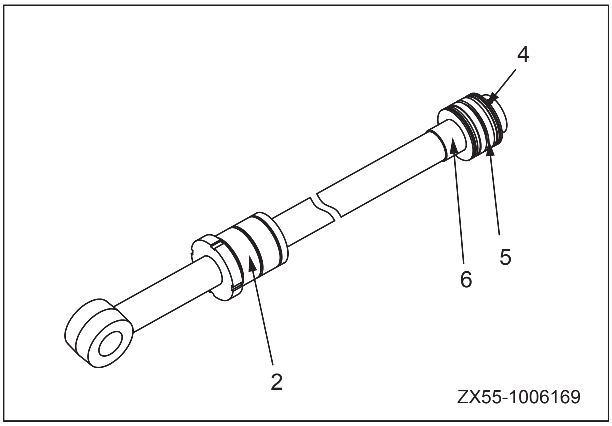


Fig. 8-226

3. Disassemble piston assemble

A. Remove dust ring (7).

B. Remove guide ring (8).

C. Remove seal ring (9).

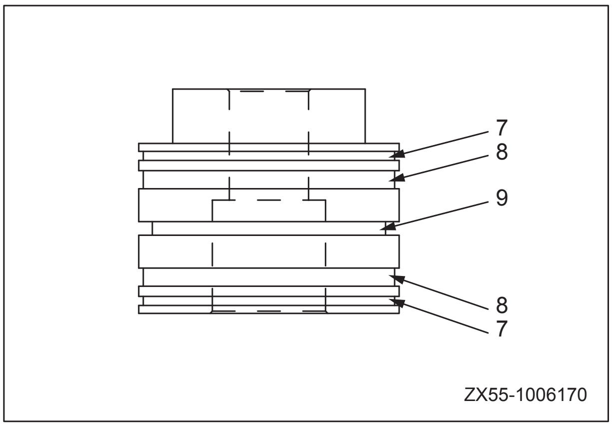


Fig. 8-227

4. Disassemble the cylinder head assembly
   A. Remove O-ring (10) and (11).
   B. Remove stop ring (12) and bushing (13).
   C. Remove buffer ring (14).
   D. Remove stop ring (17) and dust ring (16).
   E. Remove seal ring (15).

Boom, arm cylinder

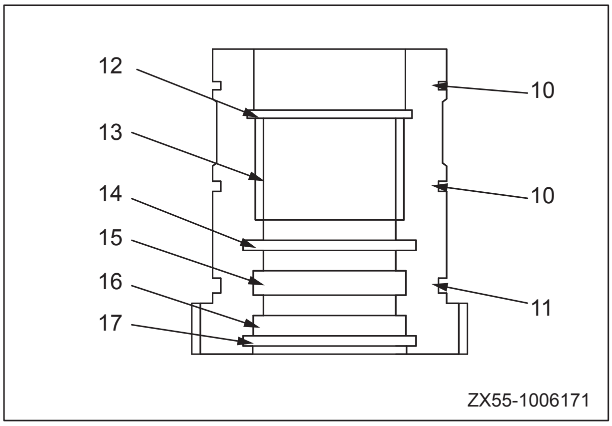


Fig. 8-228

Bucket, dozer blade cylinder

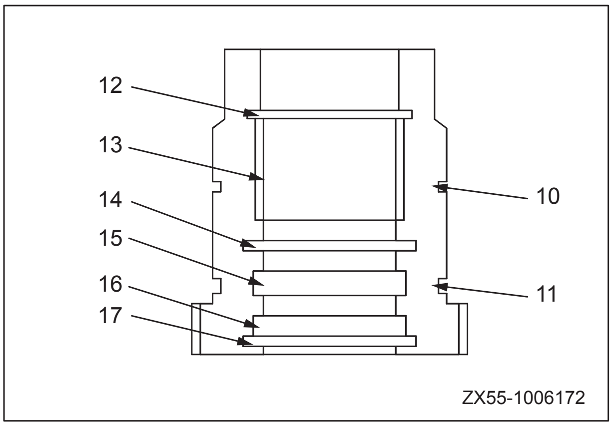


Fig. 8-229

8.32.2 Assembly

Note: Do not damage the seals, dust rings and O-ring seals.

1. Assembling the cylinder head assembly
   A. Press f t the bushing (13) with the tool E4.
   B. Install buffer ring (14).
   C. Install seal ring (15).
   D. Install dust ring (16) with tool E5 and secure it with stop ring (17).
   E. Install O-ring (10).
   F. Install O-ring (11).

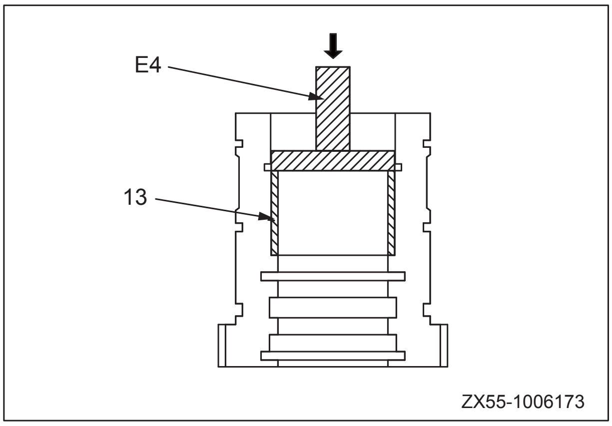


Fig. 8-230

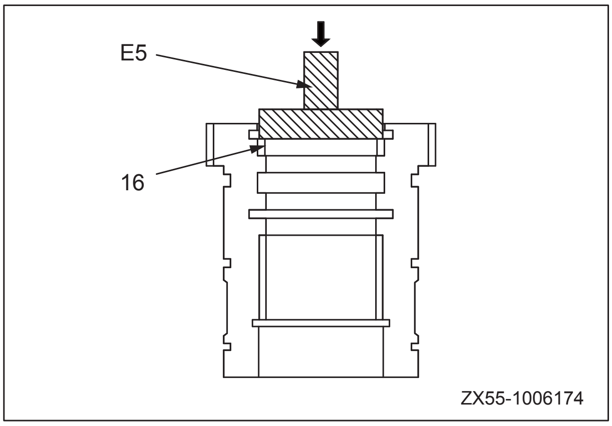


Fig. 8-231

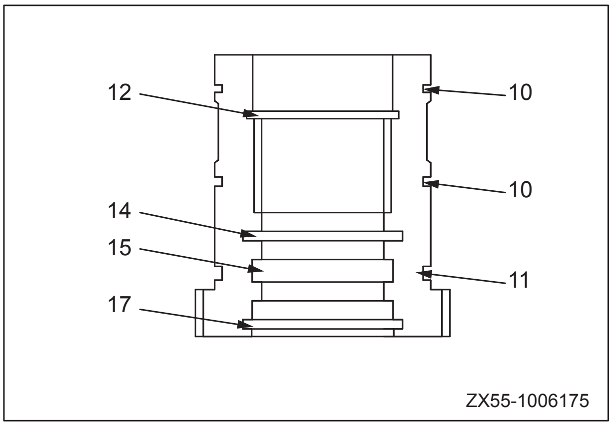


Fig. 8-232

2. Assembling the piston assembly
   A. Install seal ring (9).
   B. Install guide ring (8).
   C. Install dust ring (7).

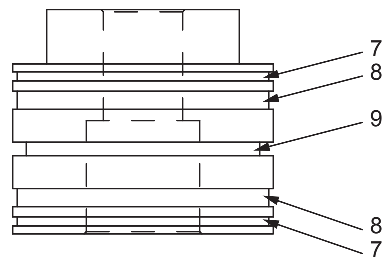


Fig. 8-233

3. Piston rod assembly
   A. Mount cylinder (2).
   B. Install cushion collar (6) and install piston assembly (5) with tool E3.
      - Cushion collar (6) is only used for boom and arm cylinders.
      - Piston assembly tightening torque:

Cylinder	Tightening torque
Boom	1200±120N·m
Arm	1200±120N·m
Bucket	700±70N·m
Dozer blade	11000±100N·m
Def ector	900±90N·m

   C. Tighten lock screw (4) with a tool.
      - Tightening torque: 31.5±5.9 Nm
      - End cushion collar and stop ring are needed for installation of arm cylinder.

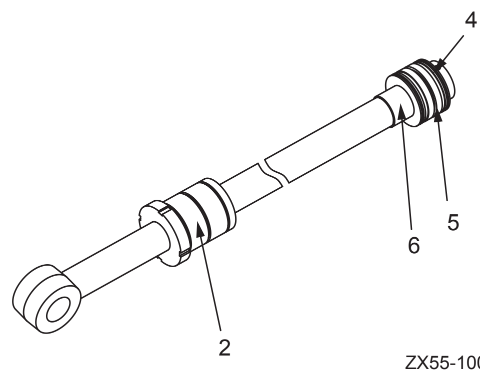


Fig. 8-234

4. Cylinder assembly
   A. Place cylinder on tool E1.
   B. Install piston rod assembly (3).
      Push piston rod inside completely.

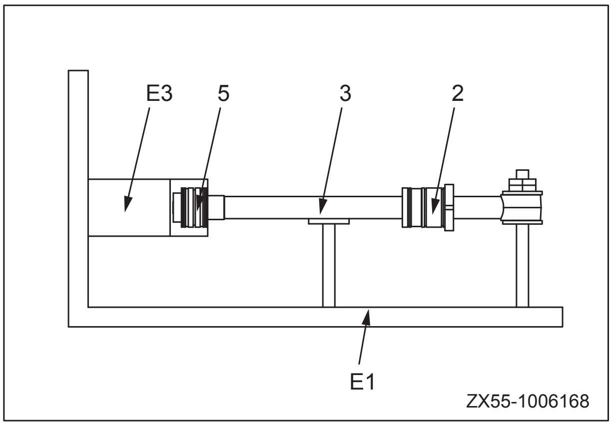


Fig. 8-235

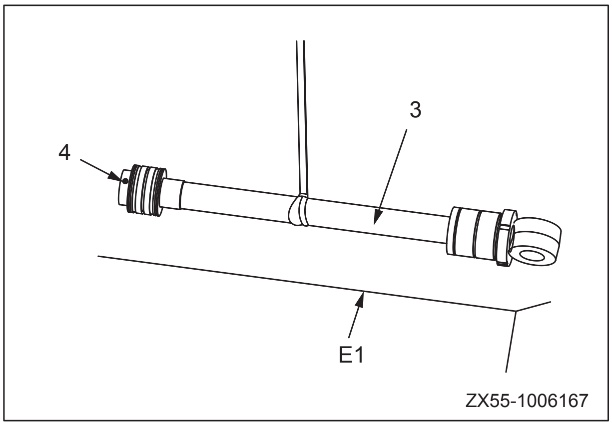


Fig. 8-236

   C. Using a hydraulic pump or a power wrench, tighten the cylinder head assembly (2) with the tool E2.

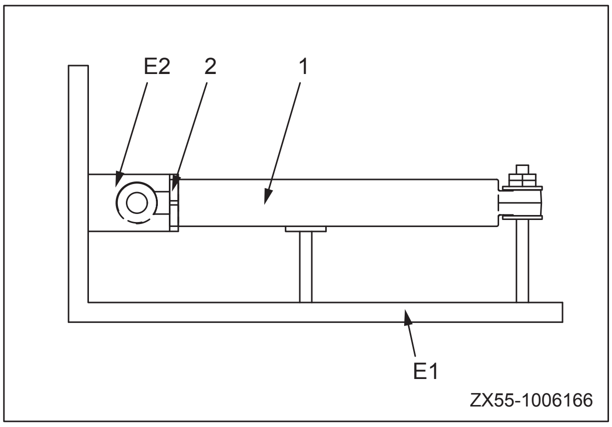


Fig. 8-237

Cylinder head assembly:

Cylinder	Tightening torque
Boom	650±65N·m
Arm	600±60N·m
Bucket	550±55N·m
Dozer blade	650±65N·m
Def ector	65±65N·m

8.33 Work Equipment

AS 8.33.1 Removal

NOTICE

- **Fully extend the arm and bucket. Lower the work equipment completely on the ground. Place the hydraulic lockout control in the locked position.**

1. Remove boom cylinder guard plate.
2. Hoist the boom cylinder assembly (1), remove pin locknut and dismount cylinder head pin (2).

   Check the number and thickness of shims removed and store them in a safe place.
3. Lower the boom cylinder assembly on a stand.

   Since no accumulator is installed, loosen the connection nuts of the hoses slowly before removal and check for oil spurting out.
4. Disconnect the hoses (3) and (4), and tie them to the valve.

   Plug the disconnected hoses.
5. Disconnect the wiring connector of the work lamps.
6. Hoist the work equipment assembly and remove the shims. Remove the root pin (5). Remove the work equipment assembly (6).

   Check the number and thickness of shims removed and store them in a safe place.

   Work equipment AS: 410 kg

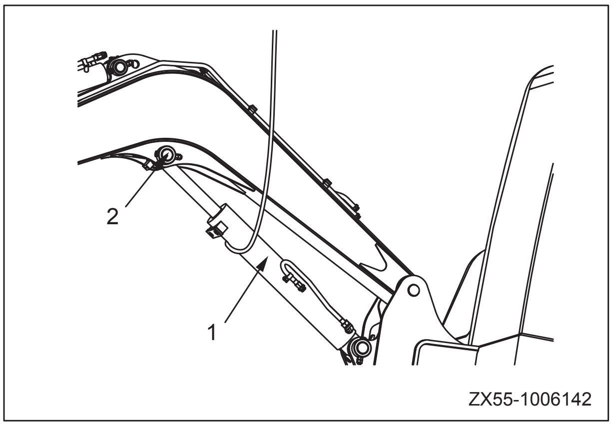


Fig. 8-238

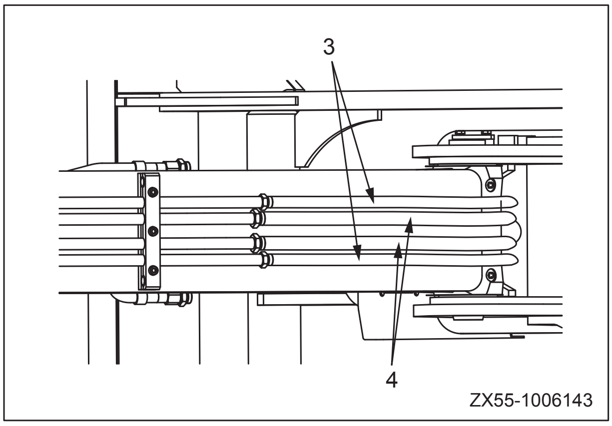


Fig. 8-239

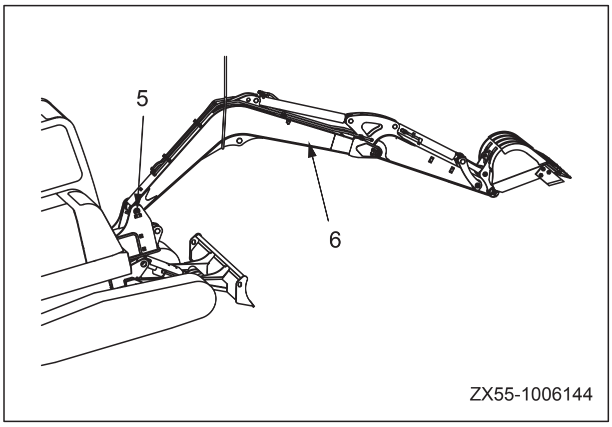


Fig. 8-240

8.33.2 Installation

- Installation is to be performed in reverse procedure of removal.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

  - Adjust shim thickness so that the clearance between piston rod (7) and plate (8) is less than 1 mm .
  - Standard shim thickness: 0.5 mm,1.0 mm

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

  - Adjust shim thickness so that the clearance between def ection joint plate (10) and boom (9) is less than 1 mm .
  - Standard shim thickness: 0.5 mm

- Purging the air

  Purge the air from oil cylinder.

  For detailed information on air purging see **"Air Purging"** .

- Adding oil (to hydraulic tank)

  Add oil to the specific level through the f ller opening.

  Start the engine to circulate oil in the system and then check oil level again.

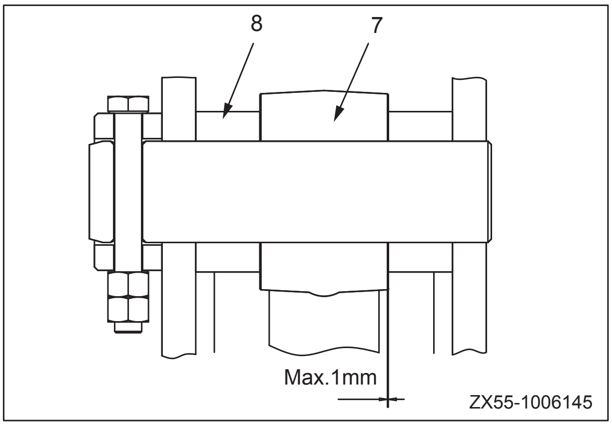


Fig. 8-241

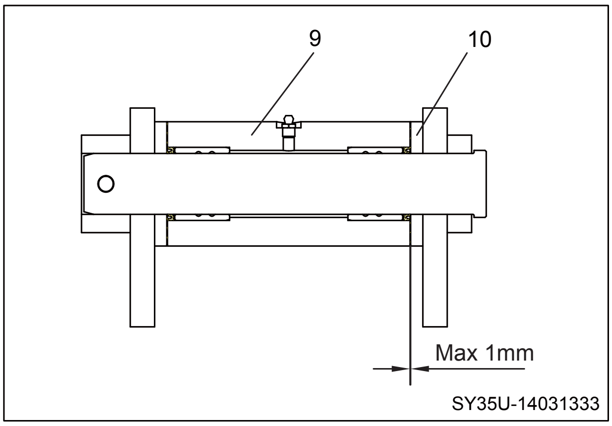


Fig. 8-242

8.34 Bucket-Arm AS

8.34.1 Removal

Curl bucket and arm and put them on block ① . Place the hydraulic lockout control in locked position.

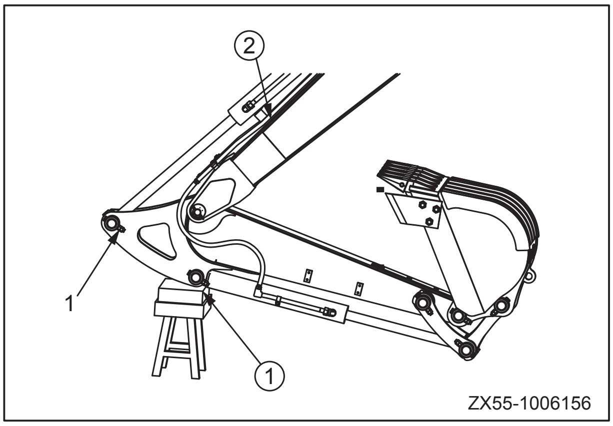


Fig. 8-243

⚠ WARNING

- **Slowly loosen the filler cap to release internal pressure of hydraulic tank.**

1. Place a block ② between the arm cylinder and the boom.
2. Remove the latch and then the pin (1) of the arm cylinder head.

   Check the number and thickness of shims and store them in a safe place.
3. Start the engine and retract the piston rod. Tie the rod to prevent it from coming off.

   Since no accumulator is installed, loosen the connection nuts of the hoses slowly before removal and check for oil spurting out.

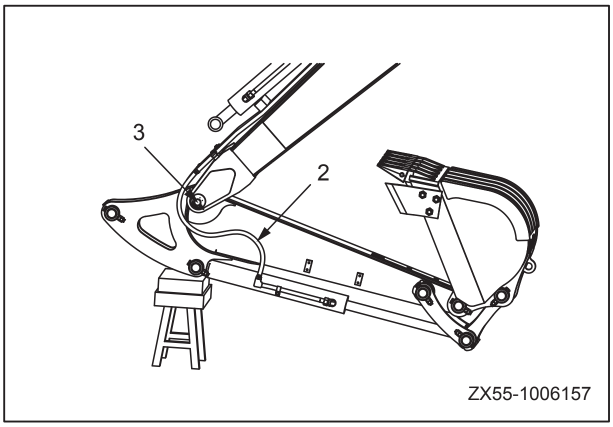


Fig. 8-244

4. Disconnect the left and right hoses (2).

   Plug the hoses disconnected at the male end.
5. Remove the latch and then the pin (3) connecting the arm and the boom.
6. Lift the boom and swing it in order to remove the bucket and arm assembly (4).

   Check the number and thickness of shims and store them in a safe place.

   Bucket and Arm AS: 175 kg

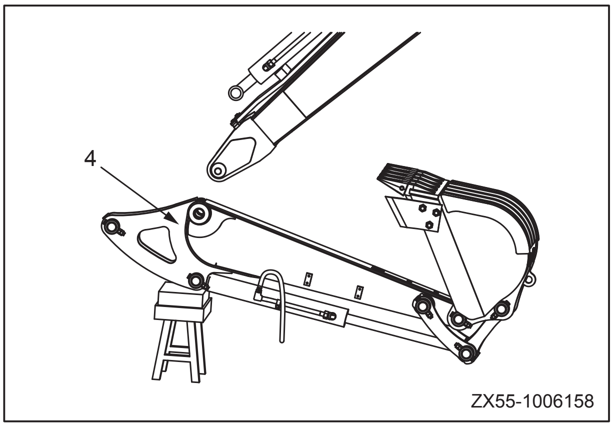


Fig. 8-245

8.34.2 Installation

- Installation is to be performed in reverse procedure of removal.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Adjust shim thickness so that clearance between cylinder piston rod (5) and arm cylinder plate (6) is less than 1 mm.
- Standard shim thickness: 0.5 mm

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Adjust shim thickness so that clearance between boom front fork (7) and arm rear support (8) is less than 1 mm.
- Standard shim thickness: 0.5 mm

- Purging the air

  Purge the air from oil cylinder.

  For detailed information on air purging see “**Air Purging**”.

- Adding oil (to hydraulic tank)

  Add oil to the specific level through the f ller opening. Start the engine to circulate oil in the system. Check the oil level again.

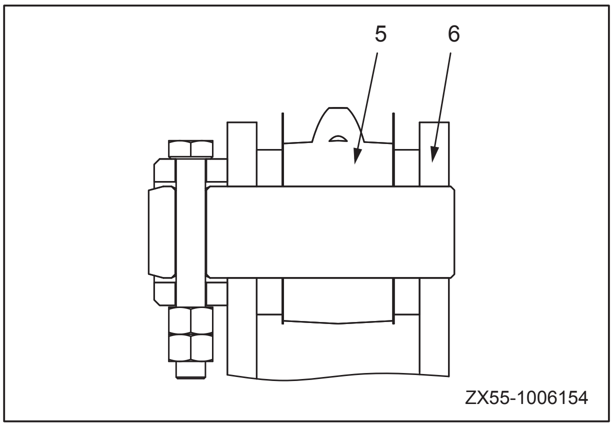


Fig. 8-246

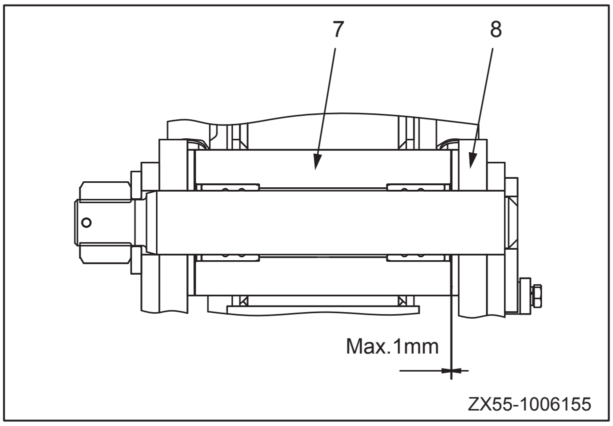


Fig. 8-247

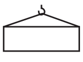
8.35 Bucket AS

8.35.1 Removal

NOTICE

- **Let the back of bucket face down. Lower the work equipment completely on the ground. Place the hydraulic lockout control in the locked position.**

1. Remove stop bolt so as to remove the pin (1) joining the bucket and linkage.
   - Check the number and thickness of shims removed and store them in a safe place.
   - Check the number of O-rings and store them in a safe place.
2. Start the engine to retract the piston rod. Tie the rod to prevent it from coming off.
3. Remove stop bolt and then the pin (2) joining the arm and bucket.
   - Check the number and thickness of shims removed and store them in a safe place.
   - Check the number of O-rings and store them in a safe place.
4. Hoist the work equipment and swing it to remove the bucket assembly.

 Bucket assembly: 100 kg

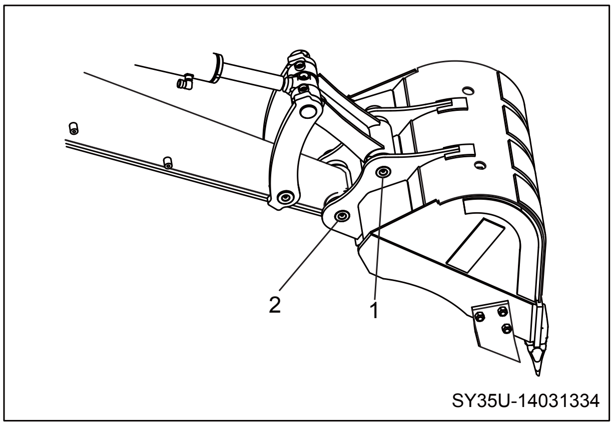


Fig. 8-248

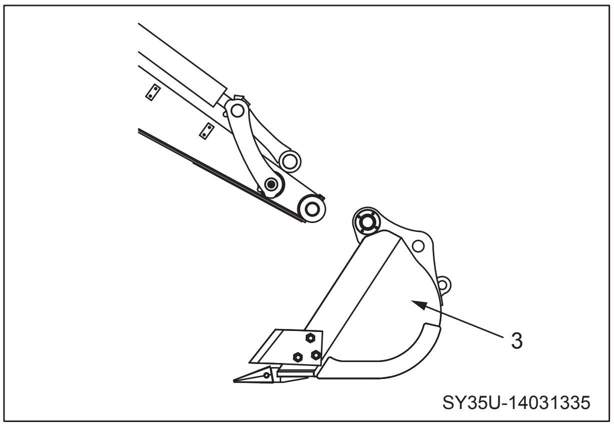


Fig. 8-249

8.35.2 Installation

- Installation is to be performed in reverse procedure of removal.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Install the O-ring securely onto the end surface of bucket plate.
- Adjust shim thickness so that clearance between arm and bucket is less than 1 mm.
- Standard shim thickness: 0.5 mm

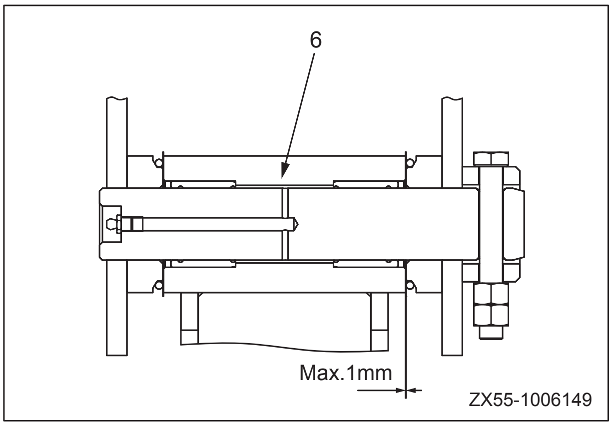


Fig. 8-250

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Install the O-ring securely onto the end surface of bucket plate.
- Adjust number of quick shims so that clearance between arm (7) and bucket (8) is less than 1 mm.
- Standard quick shim thickness: 0.5 mm

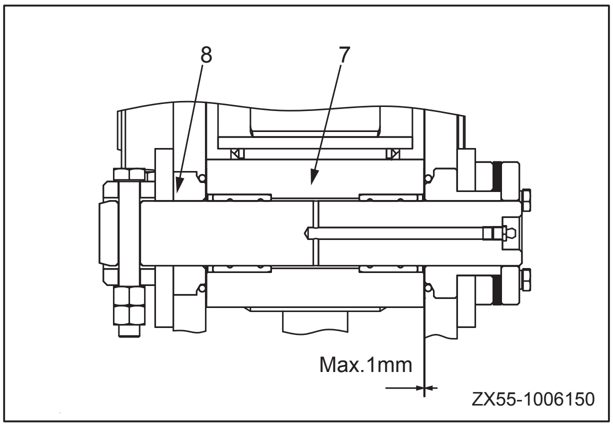


Fig. 8-251

8.36 Arm AS

8.36.1 Removal

1. Remove the bucket assembly. For detailed information see "**Bucket AS**"
2. Secure the front linkage to the arm with a wire rope.
3. Pull the arm in order to remove the pin of arm cylinder head. Lower the arm and bucket cylinder assembly (1) onto block ②.

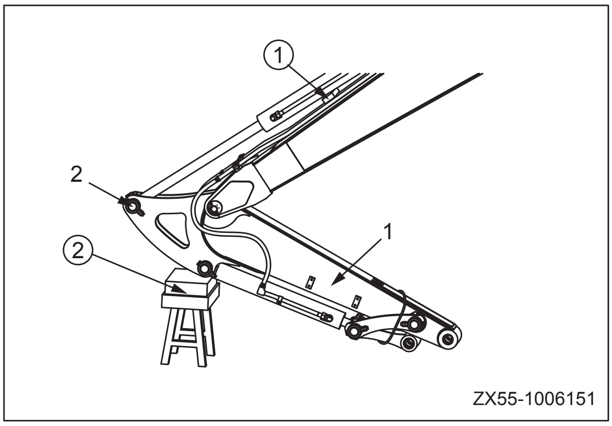


Fig. 8-252

⚠ WARNING

- **Place the hydraulic lockout control in the LOCKED position.**

4. Place a block ① between the arm cylinder and the arm.
5. Remove the latch and then the pin (3) of the arm cylinder.

   Check the number and thickness of shims removed and store them in a safe place.
6. Start the engine to retract the piston rod. Tie the piston rod to prevent it from coming off.
7. Disconnect the left and right hoses (3).

   Plug the disconnected hoses at the male end.
8. Remove the cotter pin and slotted nut. Then, remove the pin (4) connecting the arm and the boom.

   Check the number and thickness of shims removed and store them in a safe place.
9. Lift the boom and swing it to remove the arm and bucket cylinder assembly (1).

   Arm, bucket cylinder AS (including linkage and rocker): 120 kg

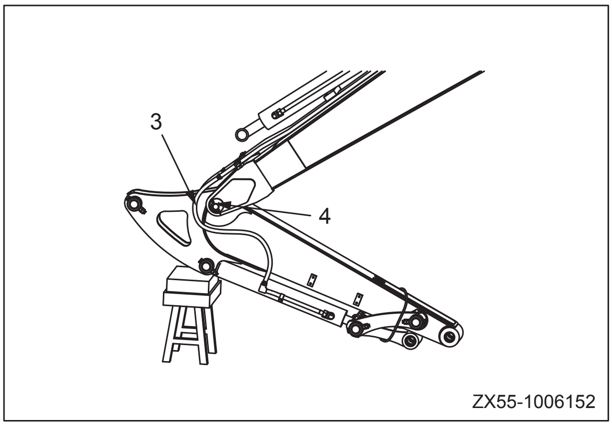


Fig. 8-253

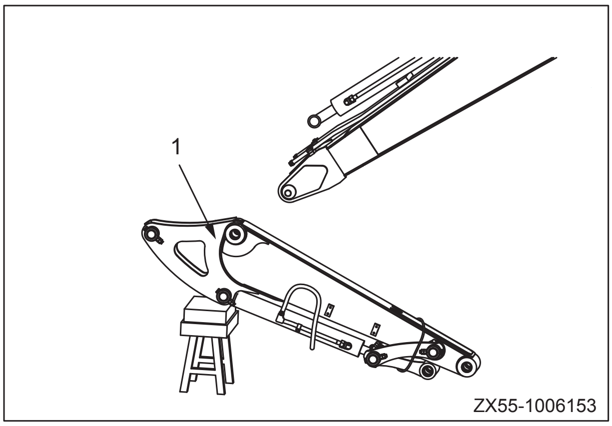


Fig. 8-254

8.36.2 Installation

- Installation is to be performed in reverse procedure of removal.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Adjust shim thickness so that clearance between cylinder piston rod (5) and arm cylinder plate (6) is less than 1 mm.
- Standard shim thickness: 0.5 mm

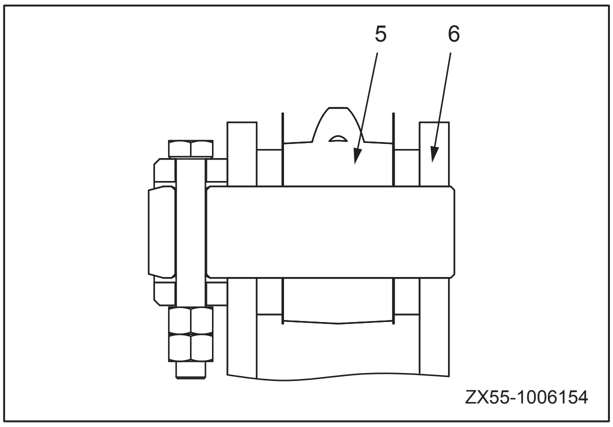


Fig. 8-255

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Adjust shim thickness so that clearance between front fork (7) of boom and rear support (8) of arm is less than 0.5 mm.
- Standard shim thickness: 0.5 mm

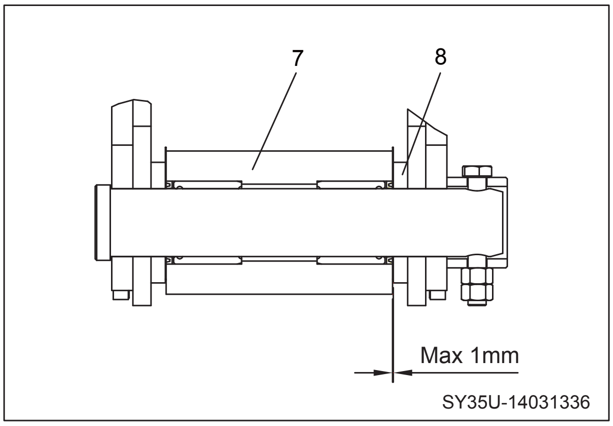


Fig. 8-256

- Purging the air

Purge the air from oil cylinder.
For detailed information on air purging see “**Air Purging**” .

- Adding oil (to hydraulic tank)

Add oil to the specific level through the f ller opening. Start the engine to circulate oil in the system. Check the oil level again.

8.37 Boom

AS 8.37.1 Removal

1. Remove the bucket assembly.
2. Lower the boom assembly fully on the ground. Place the hydraulic lockout control in the LOCKED position.
3. Remove boom cylinder guard plate.
4. Lift the boom assembly (1), remove the latch and dismount the top pin (2).

   Check the number and thickness of shims and store them in a safe place.
5. Lower the boom cylinder assembly onto the bracket.
6. Disconnect the hoses (3) and (4). Tie them to the platform.

   Plug the disconnected hoses on the end of male connector.
7. Disconnect the lead connector of work lamp.
8. Lift the boom assembly and remove the press plate of the pin. Then, remove the pin (5) at the root of boom.
9. Hoist the boom assembly (6).

   Check the number and thickness of shims and store them in a safe place.

   Boom AS (with arm cylinder):

   175 kg

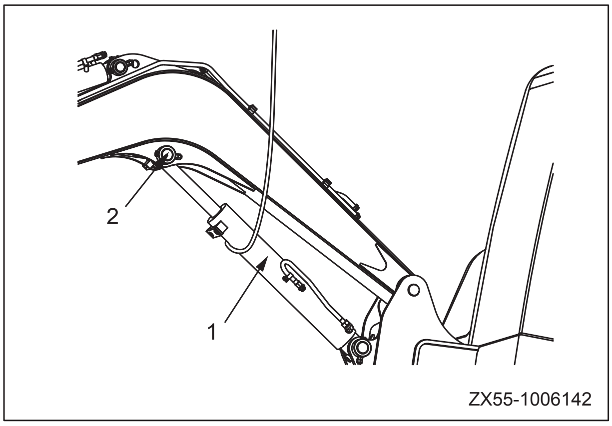


Fig. 8-257

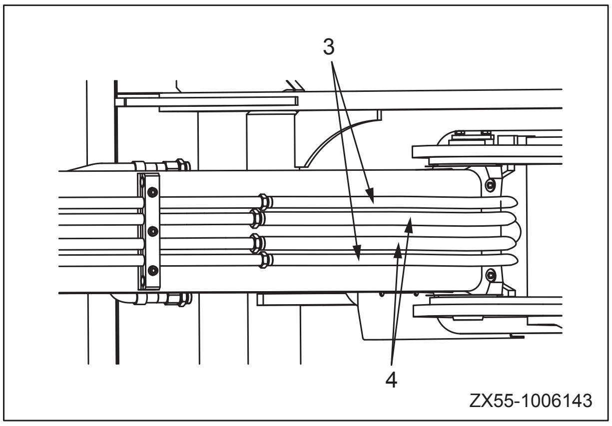


Fig. 8-258

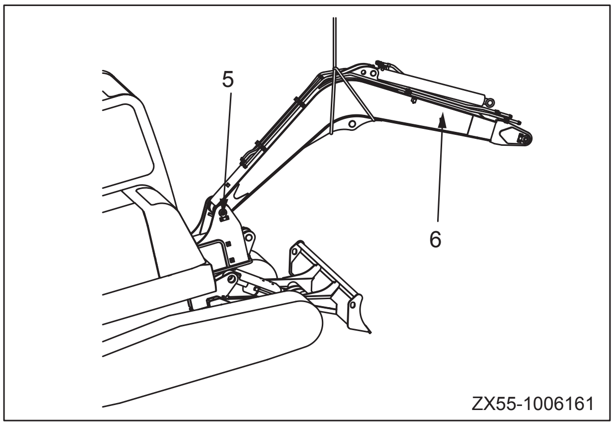


Fig. 8-259

8.37.2 Installation

- Installation is to be performed in reverse procedure of removal.

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Adjust shim thickness so that clearance between cylinder piston rod (7) and boom plate (8) is less than 1 mm.
- Standard shim thickness: 0.5 mm

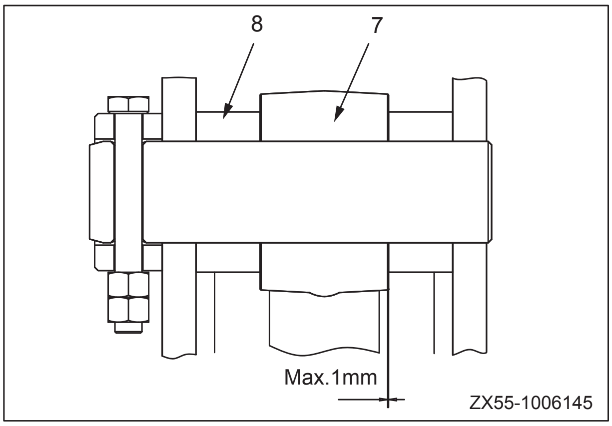


Fig. 8-260

Apply grease after installation of pin:

Grease: G2-LI

Note: Do not put your f nger in the pinhole while aligning it.

- Adjust shim thickness so that clearance between boom (9) and platform plate 10) is less than 1.0 mm.
- Standard shim thickness: 0.5 mm

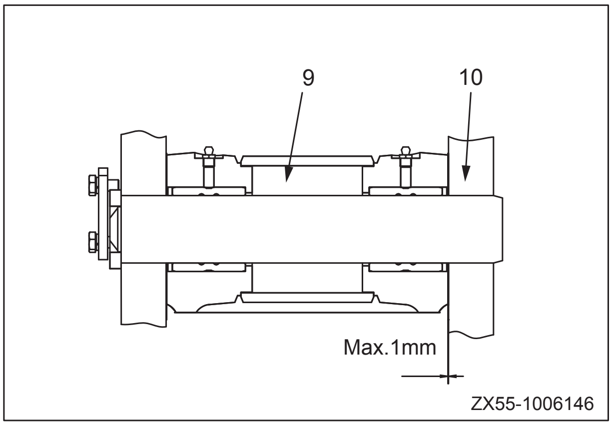


Fig. 8-261

- Purging the air

  Purge the air from oil cylinder.

  For detailed information on air purging see **“Air Purging”** .

- Ref lling the hydraulic tank

  Add oil to the specific level through the f ller opening. Start the engine to circulate oil in the system. Check the oil level again.

8.38 Boom Def ectorJointAS

8.38.1 Removal

1. Remove work equipment assembly. For details see **“Work Equipment AS”** .

2. Remove pin (1) connecting deflector cylinder rod with deflector head. Turn the def ector cylinder to the right limit.

3. Screw off the screws securing the upper-end yoke pin (2) and remove the pin (2) as a whole with the remover.

   Check the number and thickness of shims and store them in a safe place.

4. Screw off the screws securing the lower-end yoke pin (2) and remove the pin (2).

   Check the number and thickness of shims and store them in a safe place.

5. Remove def ector joint.

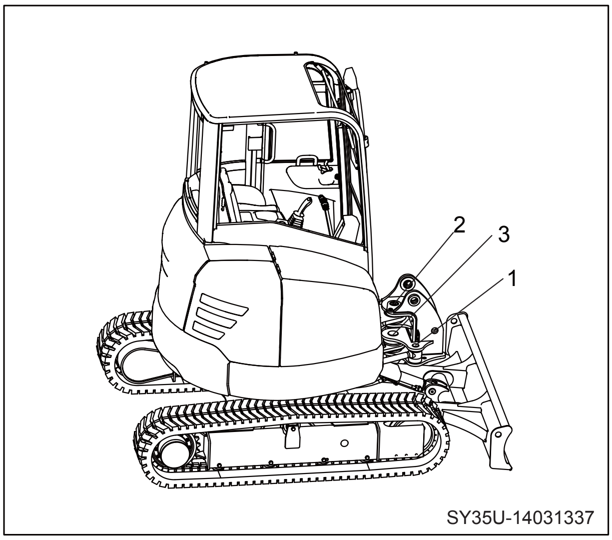


Fig. 8-262

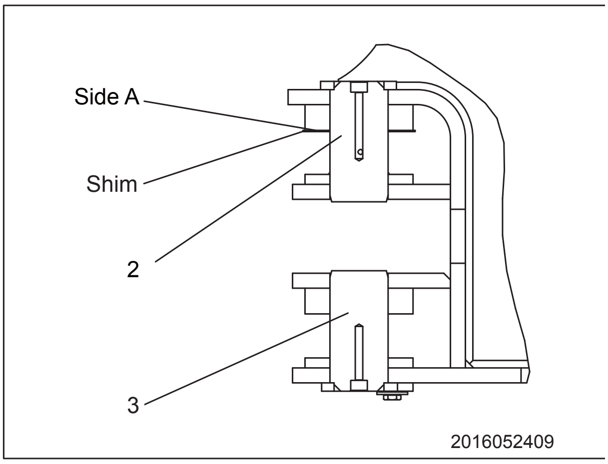


Fig. 8-263

8.38.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Before you install the deflector joint, put shims between deflector side A and platform side B. The adjustable clearance is left between other deflector joint and platform. Be sure the side A is the primary force-bearing surface of the def ector. The shims are installed to their original positions.

  Def ector joint AS: 150 kg

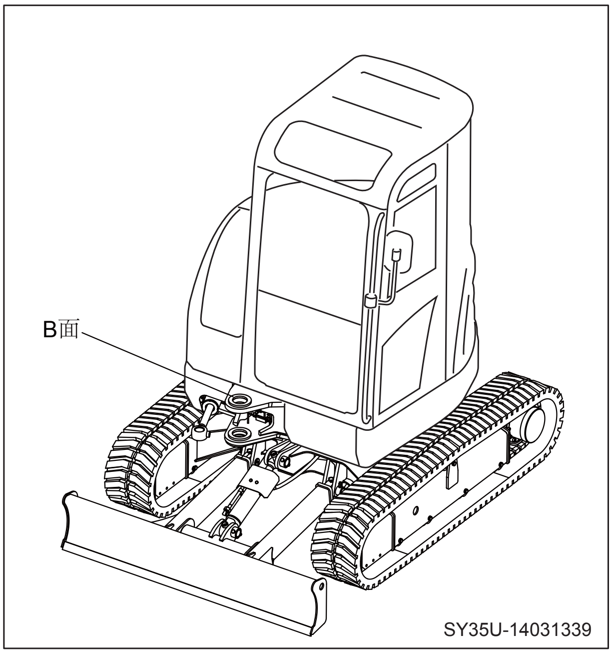


Fig. 8-264

8.39 Dozer BladeAS

8.39.1 Removal

Turn work equipment 45 degrees. Lower work equipment to ground. Lower dozer blade to ground and stop the engine. Cycle the blade control 2-3 times in order to release residual pressure in hydraulic circuit.

WARNING

- **Slowly loosen the filler cap to release internal pressure of hydraulic tank. Place the hydraulic lockout control in the LOCKED position**

1. Remove bolt (1) to take off bottom pin (2). Hoist the blade cylinder assembly (6).

   Blade cylinder AS: 33 kg

   Start the engine, retract the blade cylinder piston rod and put it on a block.

2. Lift the blade (3) and remove both left and right bolts (4). Remove pin (5) on both sid es.
3. Remove dozer blade.

   Dozer blade AS: 230 kg

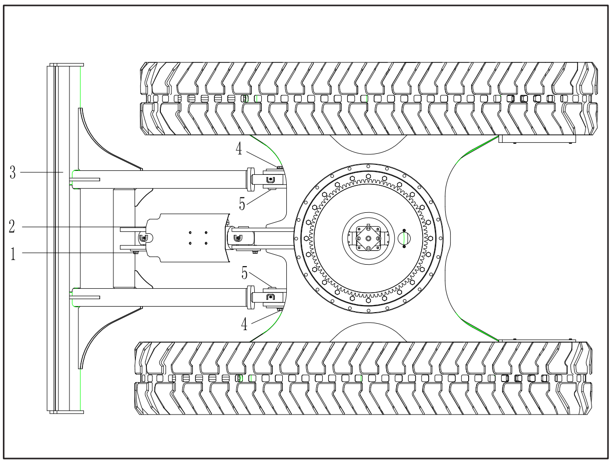


Fig. 8-265

8.39.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Note: Do not put your f nger in the pinhole while aligning it.

  Install the shims securely in their original positions.

8.40 Cab AS

8.40.1 Removal

NOTICE

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

1. Remove the front hood assembly (1) on the right side of cab.
2. Disconnect all harnesses (2) of the cab.
3. Remove the front cover (3) of cab base and unplug the harness.

Fig. 8-266

4. Loosen the six bolts fastening the cab (the front two bolts fastening the cab to platform, the middle two to cab base and the rear two to covering beam).
5. Hoist the cab assembly.

Cab assembly: 190 kg

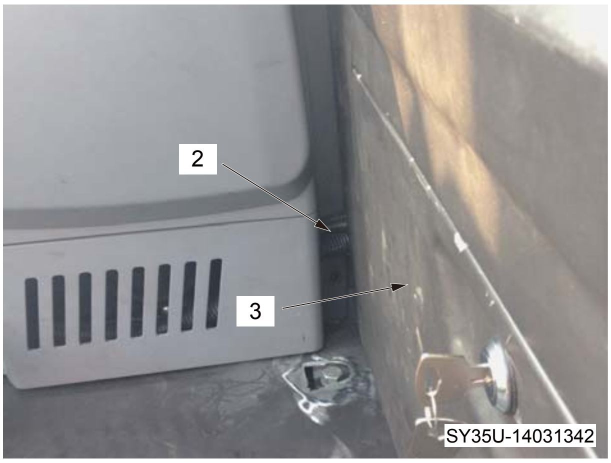


Fig. 8-267

8.40.2 Installation

- Installation is to be performed in reverse procedure of removal.

8.41 Counterweight AS

8.41.1 Removal

1. Open the rear hood (2), left access door (1) and right access door (3).
2. Mount the eye bolt onto the counterweight assembly (4) and lift the counterweight.
3. Remove the mounting bolts and hoist the counterweight assembly (4) aside.

Counterweight AS: 358 kg

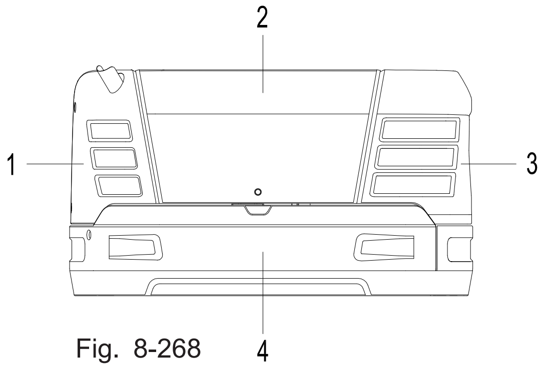


Fig. 8-268

8.41.2 Installation

- Installation is to be performed in reverse procedure of removal.

  Threads of counterweight mounting bolt:

  Thread adhesive: (A420300000135)

  Counterweight mounting bolt:

  1050±103 N·m

Note: Installation of counterweight requires making adjustment so that the left and right clearances and the step differences are identical.

8.42 Monitor AS

8.42.1 Removal

NOTICE

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

1. Remove the screws (1) and (2) with a screwdriver.
2. Slightly pry the plastic cover along (3) with a f at-head screwdriver to remove the monitor assembly.
3. Note: Use little force to pry the cover. It may break under great force.

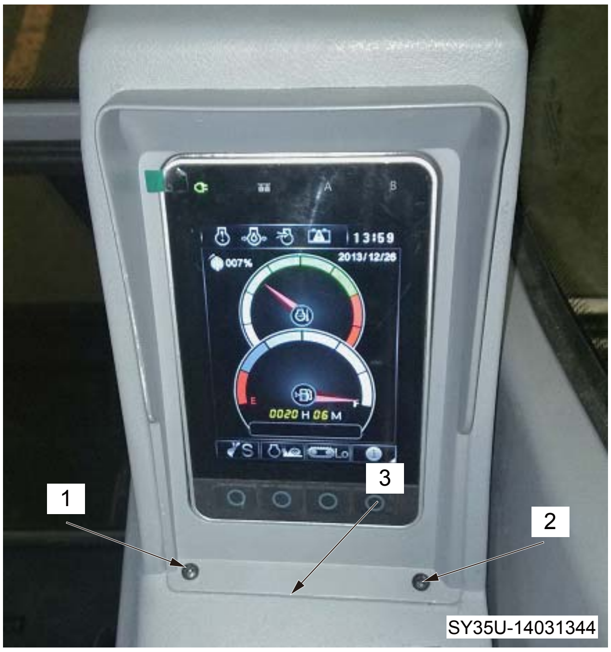


Fig. 8-269

8.42.2 Installation

- Installation is to be performed in reverse procedure of removal.

BLANK PAGE

SANY

Maintenance Standard

9 Maintenance Standard

9 MAINTENANCE STANDARD

9.1 Swing Mechanism

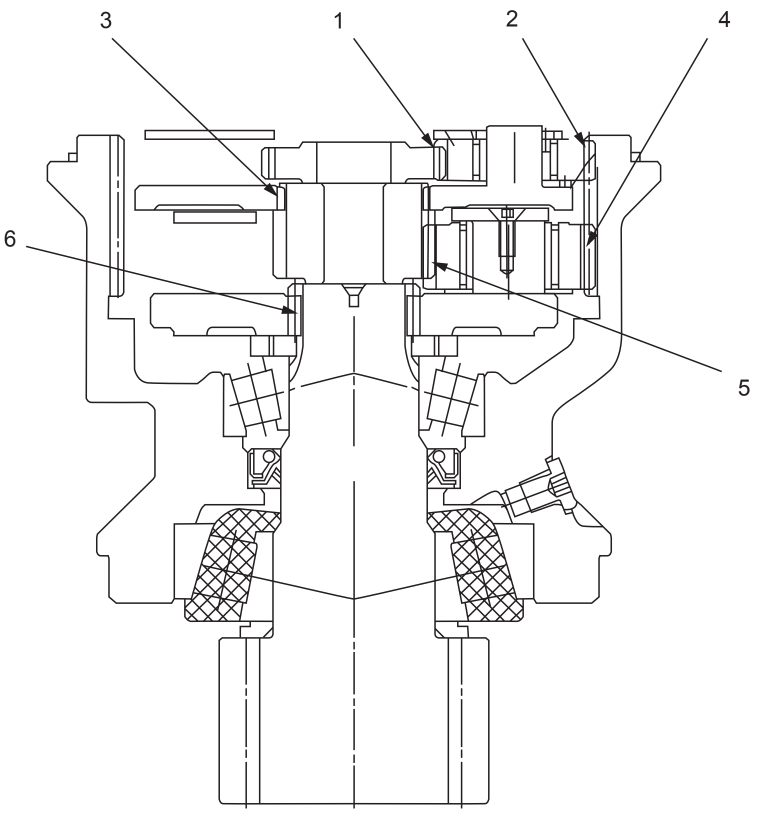
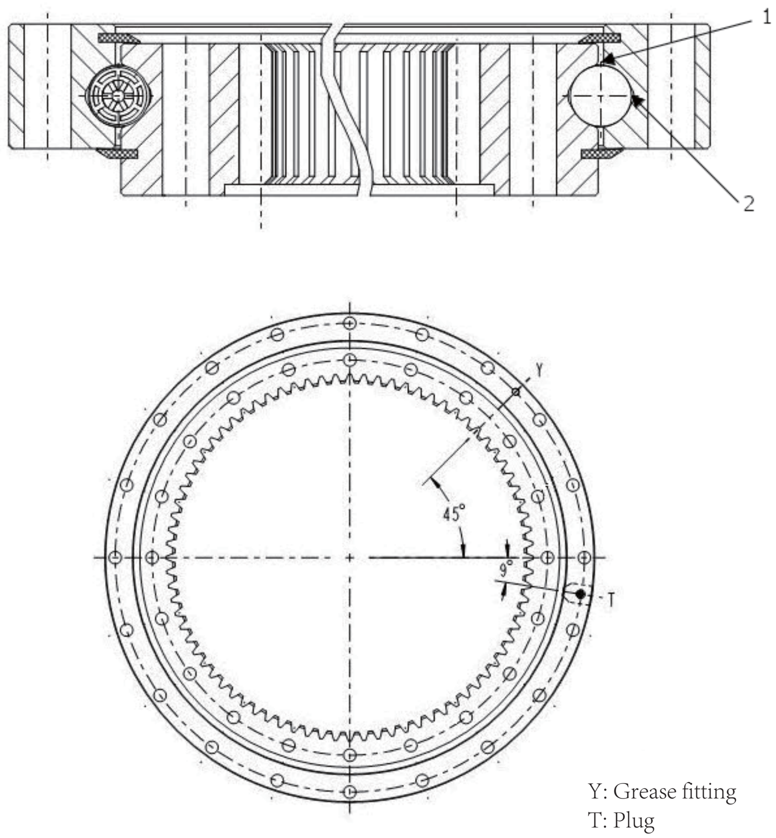


Fig. 9-1

No.	Check item	Criteria		Remedy
1	Backlash between No. 1 sun gear and No. 1 planetary gear	Standard clearance	Clearance limit	Replace
		0.09-0.32	0.6	
2	Backlash between No. planetary gear and ring gear	0.12-0.40	0.6	
3	Backlash between No. 1 planetary carrier and No. 2 sun gear	0.13-0.31	-	
4	Backlash between No. 2 planetary gear and ring gear	0.12-0.40	0.6	
5	Backlash between No. 2 sun gear and No. 2 planetary gear	0.11-0.31	0.6	
6	Backlash between swing pinion and No. 2 planetary carrier	0.13-0.35	0.6	

9.2 Swing Bearing



2016052411

Fig. 9-2

No	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
1	Bearing axial clearance	0.04-0.10mm	0.4mm	Replace
2	Bearing radial clearance	0.04-0.10mm		

9.3 Track Frame

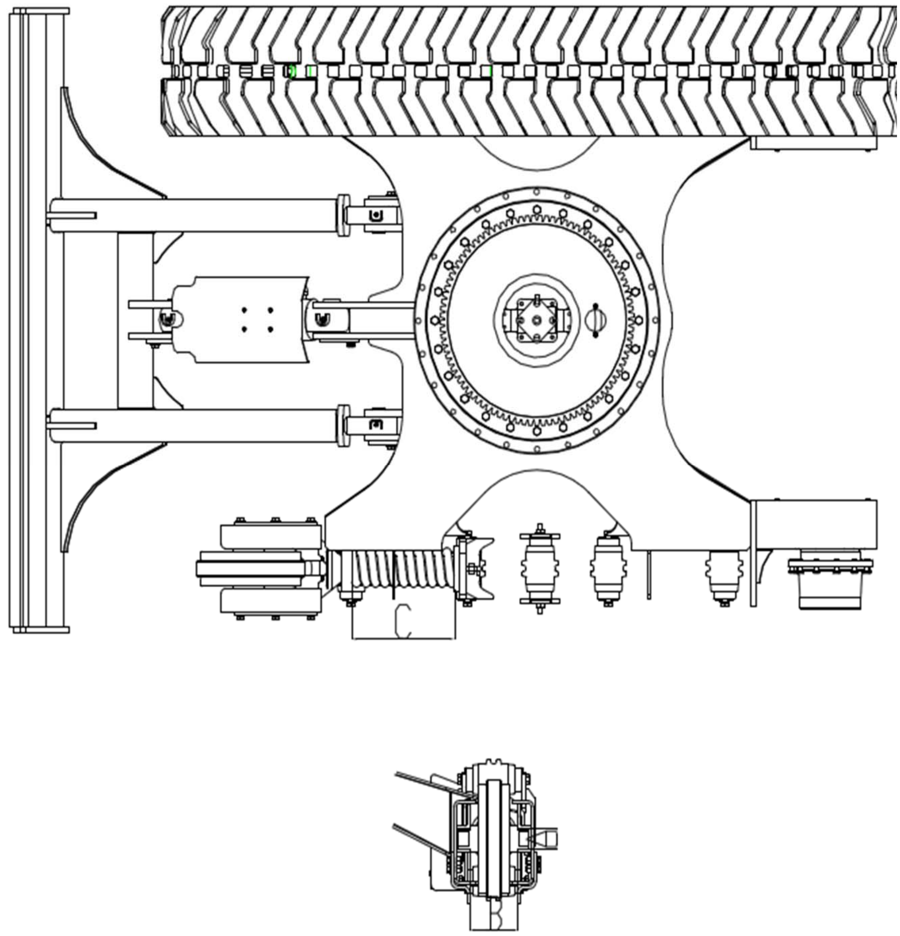
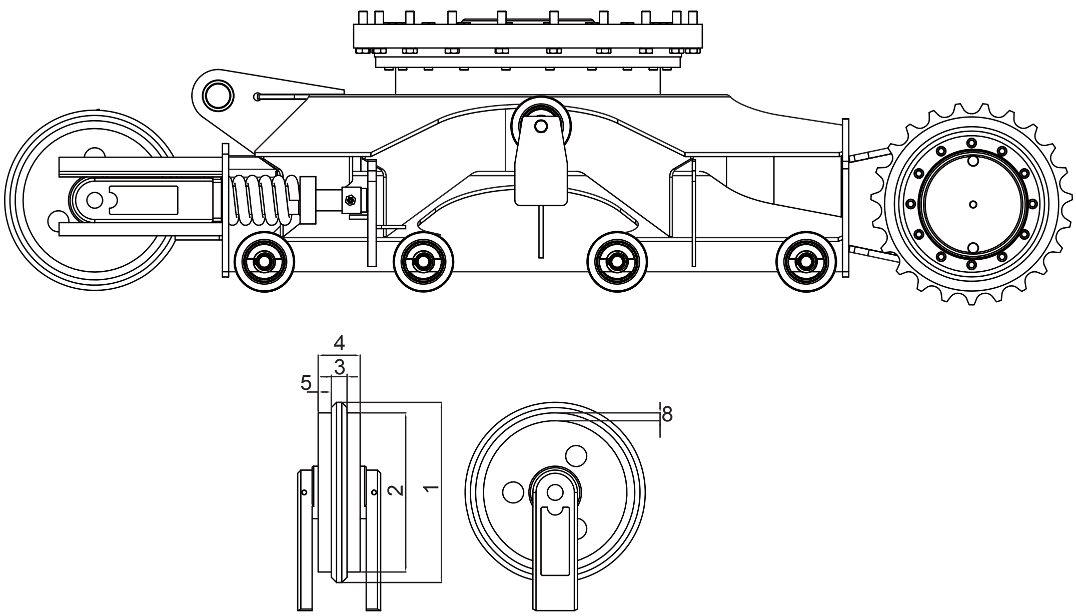


Fig. 9-3

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width A of idler guide</td><td rowspan="2">Track frame</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Repair</td></tr>
<tr><td colspan="2">60</td><td colspan="2">64</td></tr>
<tr><td>Idler</td><td colspan="2">60</td><td colspan="2">56</td><td>Repair or replace</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width B of idler guide</td><td>Track frame</td><td colspan="2">160</td><td colspan="2">164</td><td>Repair</td></tr>
<tr><td>Idler</td><td colspan="2">160</td><td colspan="2">154</td><td>Repair or replace</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Tension spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installation length C</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>388</td><td>349</td><td>3800 kgf</td><td>—</td><td>—</td></tr>
</table>

9.4 Idler



SY35U-14030602

Fig. 9-4

<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">Flange outer diameter</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="5">Repair or replace</td></tr>
<tr><td colspan="3">384</td><td colspan="2">378</td></tr>
<tr><td>2</td><td>Tread outer diameter</td><td colspan="3">340</td><td colspan="2">334</td></tr>
<tr><td>3</td><td>Flange width</td><td colspan="3">53</td><td colspan="2">48</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="3">110</td><td colspan="2">104</td></tr>
<tr><td rowspan="3">5</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><td rowspan="4">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>45</td><td>+0.016
+0.003</td><td>-0.075
-0.100</td><td>0.105
0.26</td><td>1.5</td></tr>
<tr><td>6</td><td>Axial play</td><td colspan="5">Repair limit: 1.5</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Tread thickness</td><td colspan="3">Standard size</td><td colspan="2">Criteria</td><td rowspan="2">Repair or replace</td></tr>
<tr><td colspan="3">16</td><td colspan="2">12</td></tr>
</table>

9.5 Track Roller

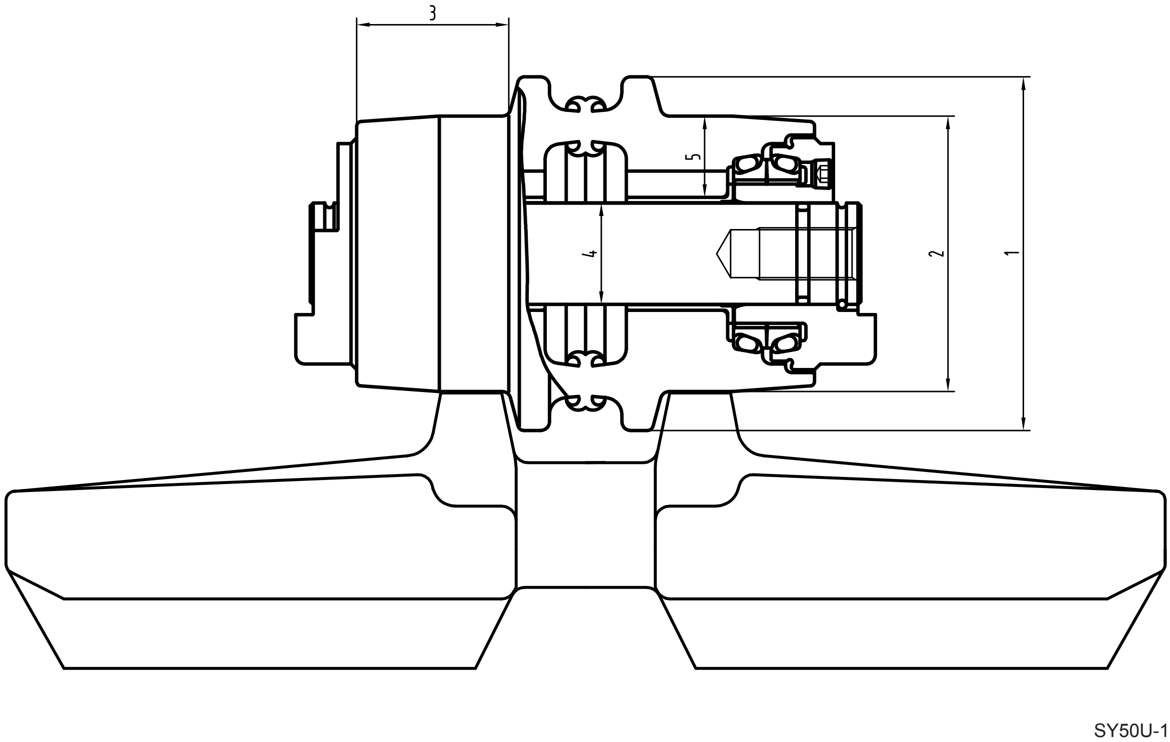
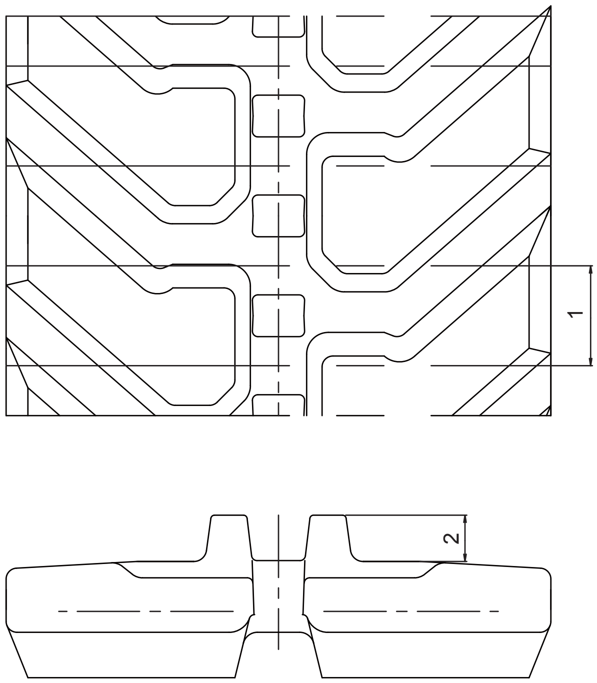


Fig. 9-5

No.	Check item	Criteria					Remedy
1	Flange outer dia. (outside)	Standard size			Repair limit		Repair or replace
		122			15		
2	Tread outer diameter	95			89		
3	Tread width	53			58		
4	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		35	+0.199 +0.06	-0.05 -0.075	0.11 0.274	1.5	
5	Tread thickness	Standard size			Repair limit		Repair or replace
		28			25		

9.6 Track

9.6.1 Rubber track



SY35U-14030604

Fig. 9-6

No.	Check item	Criteria		Remedy
1	Pitch	Standard size	Repair limit	Replace
		72.5	75	
2	Grouser height	23.5	19	

9.6.2 Steel track

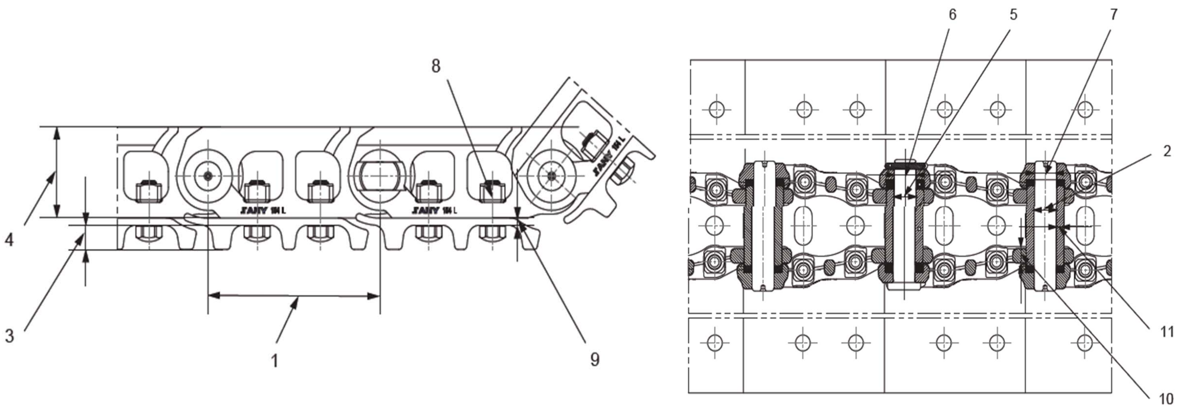


图 9-7 2016052413

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">Link pitch</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Reverse or replace</td></tr>
<tr><td colspan="3">135</td><td colspan="2">138</td></tr>
<tr><td>2</td><td>Outside diameter of bushing</td><td colspan="3">35</td><td colspan="2">31</td></tr>
<tr><td>3</td><td>Height of shoe rib</td><td colspan="3">14</td><td colspan="2">12</td><td rowspan="2">Weld flange or repair before reaching repair limit</td></tr>
<tr><td>4</td><td>Link height</td><td colspan="3">67.3</td><td colspan="2">63.3</td></tr>
<tr><td rowspan="3">5</td><td 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="2">Interference limit</td><td rowspan="4">Replace if interfer-ence limit is exceeded</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>35</td><td>+0.05
-0.05</td><td>+0.062
0</td><td>0.214-
0.314</td><td>-</td></tr>
<tr><td>6</td><td>Interference between regular pin and link</td><td>24</td><td>-0.150
0</td><td>+0.198
-0.250</td><td>0.198-
0.400</td><td>-</td></tr>
<tr><td>7</td><td>Clearance between master pin and link</td><td>24</td><td>+0.020
-0.020</td><td>+0.198
-0.250</td><td>0.178-
0.270</td><td>-</td><td>Replace with one of larger size if repair limit is not reached</td></tr>
<tr><td>8</td><td>Bushing flange</td><td colspan="5">3.0</td><td>Tighten</td></tr>
<tr><td>9</td><td>Shoe bolt tightening torque</td><td colspan="5">Defect: 118±20 Nm{12±2 kgm}; further tightening 90±10°</td><td>Tighten</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Thickness of track shoe</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Weld flange or repair</td></tr>
<tr><td colspan="3">26</td><td colspan="2">18</td></tr>
<tr><td>11</td><td>Thickness of link (bushing press-fitting portion)</td><td colspan="3">20</td><td colspan="2">16</td><td>Repair or replace</td></tr>
<tr><td>12</td><td>Thickness of bushing</td><td colspan="3">8.4</td><td colspan="2">4.4 (heavy)</td><td>Reverse or replace</td></tr>
</table>

9.7 Work Equipment

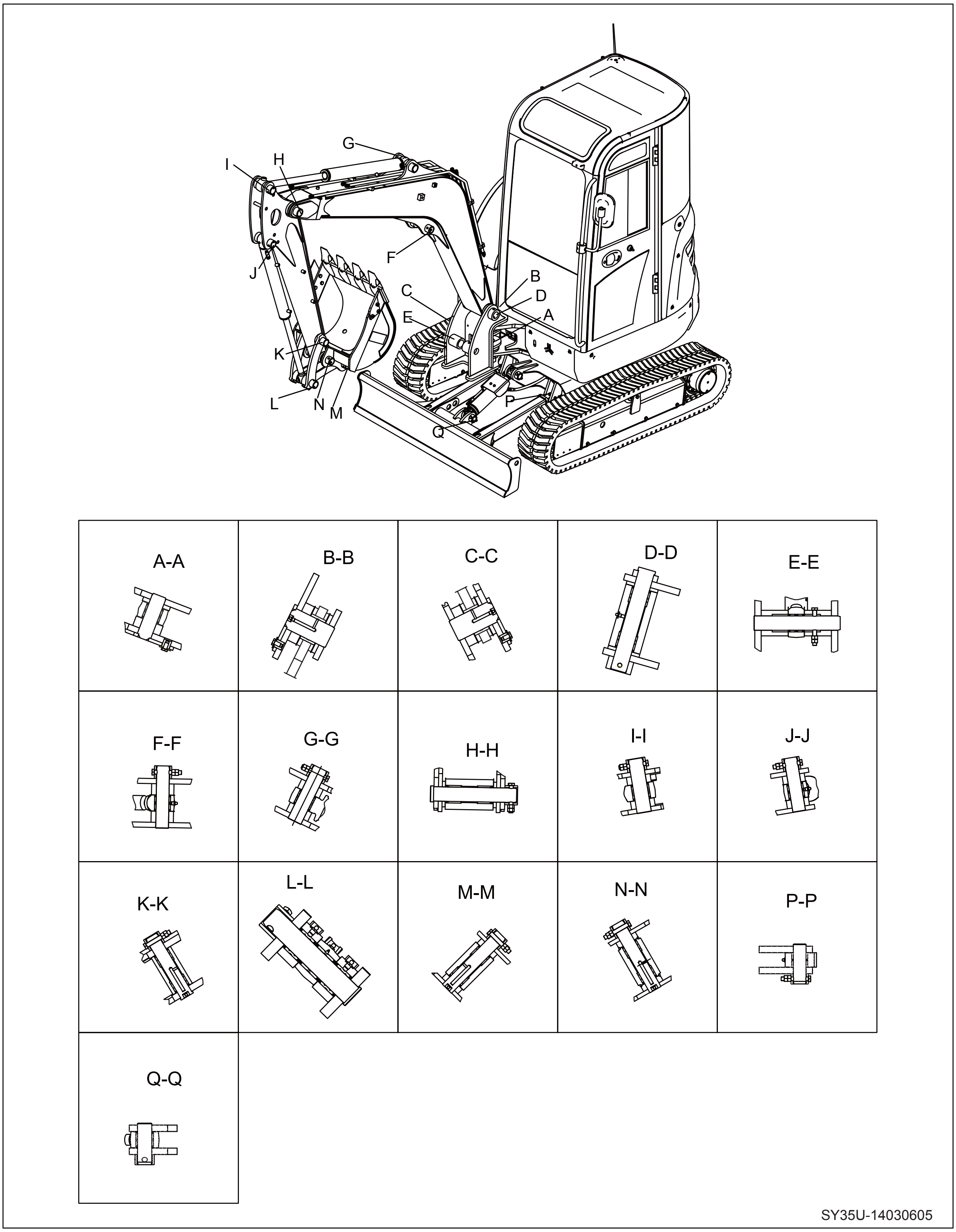


Fig. 9-8

Unit: mm

No.	Check item	Criteria					Remedy
		Std. size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between bushing and pin connecting def ector and platform	80	-0.03 -0.06	+0.274 +0.2	0.23-0.334	1.0	Replace
2	Clearance between bushing and pin connecting boom and def ector	50	-0.025 -0.050	+0.219 +0.180	0.205 0.269	1.0	
3	Clearance between bushing and pin connecting boom and arm	45	-0.025 -0.050	+0.219 +0.180	0.205 0.269	1.0	
4	Clearance between bushing and pin connecting arm and rocker	45	-0.025 -0.050	+0.219 +0.180	0.205 0.269	1.0	
5	Clearance between bushing and pin connecting linkage and rocker	45	-0.025 -0.050	+0.219 +0.180	0.205 0.269	1.0	
6	Clearance between bushing and pin connecting bucket and linkage	45	-0.025 -0.050	+0.219 +0.180	0.205 0.269	1.0	
7	Clearance between bushing and pin connecting arm and bucket	45	-0.025 -0.050	+0.219 +0.180	0.205 0.269	1.0	
8	Clearance between bushing and pin connecting blade and undercarriage	45	-0.08 -0.142	+0.242 +0.180	0.26-0.384	1.0	Replace

9.8 Arm Dimensions

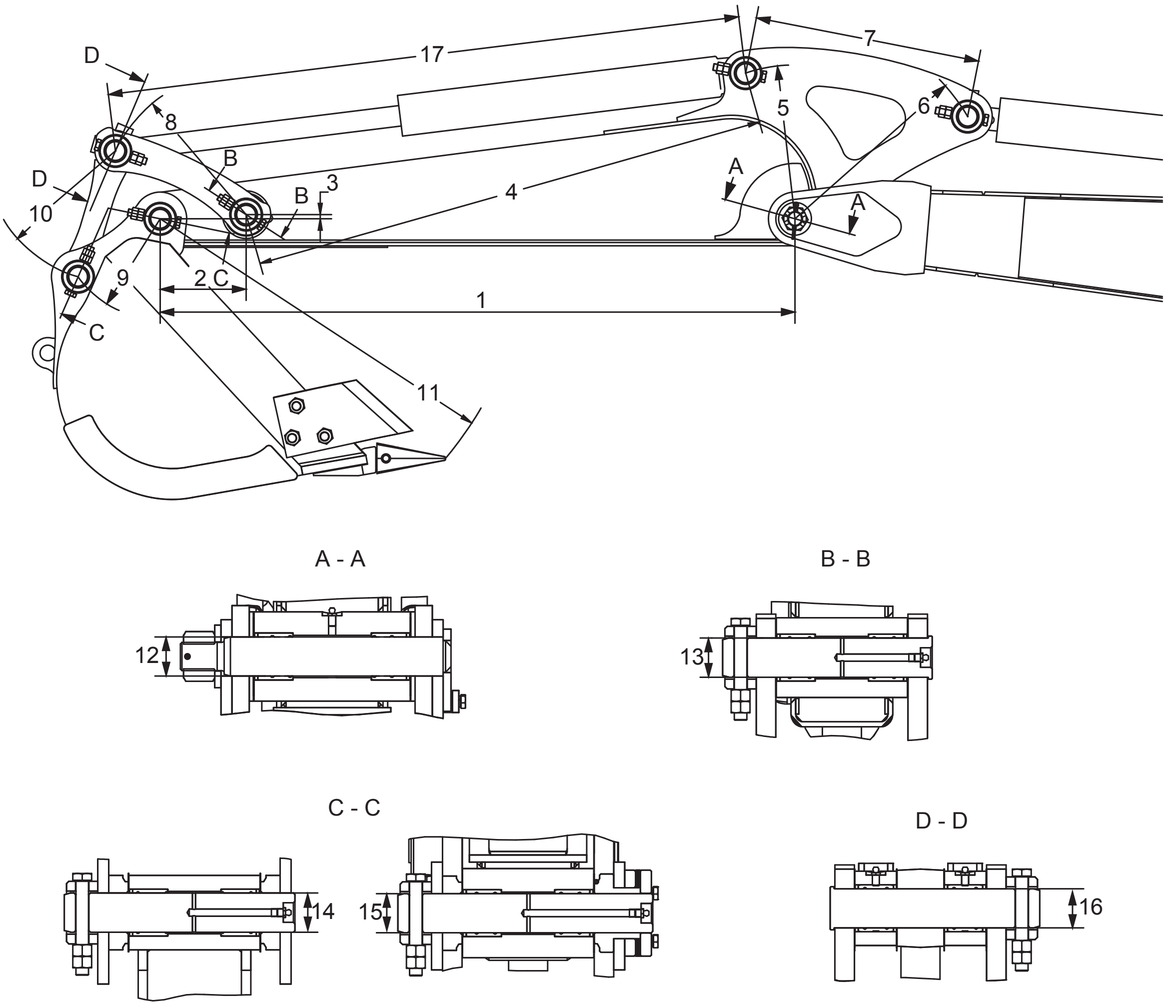


Fig. 9-9

Unit: mm

No.	SY50U	No.		SY50U
1	1500	10		315
2	200	11		843
3	13	12		Φ45
4	1195	13		Φ45
5	365	14		Φ45
6	410	15		Φ45
7	500	16		Φ45
8	335	17	Min.	875
9	245		Max.	1465

9.9 Bucket Dimensions

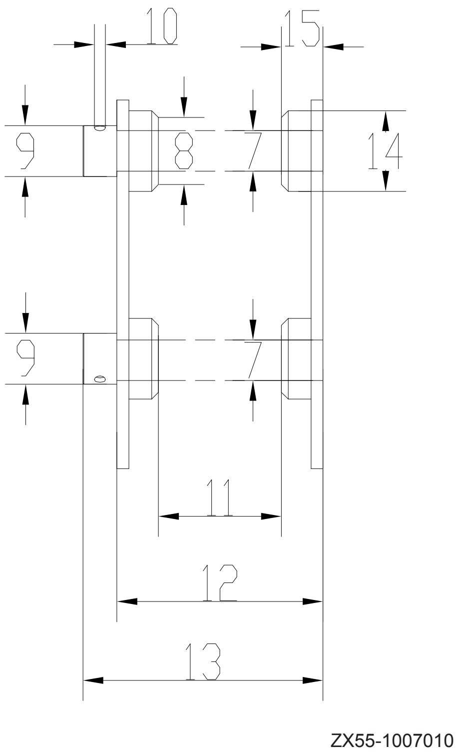


Fig. 9-10

Unit: mm

No.	SY50U	No.	SY50U
1	245	9	ϕ 60
2	92. 6	10	ϕ 13
3	106	11	145
4	843	12	243
5	72	13	263
6	72	14	ϕ 95
7	ϕ 45	15	49
8	ϕ 83		

9.10 Hydraulic Cylinder

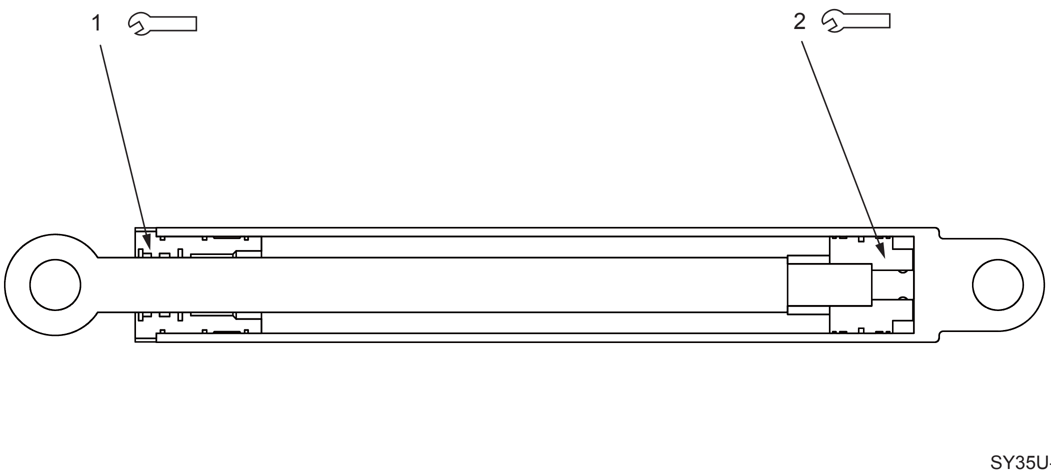


Fig. 9-11

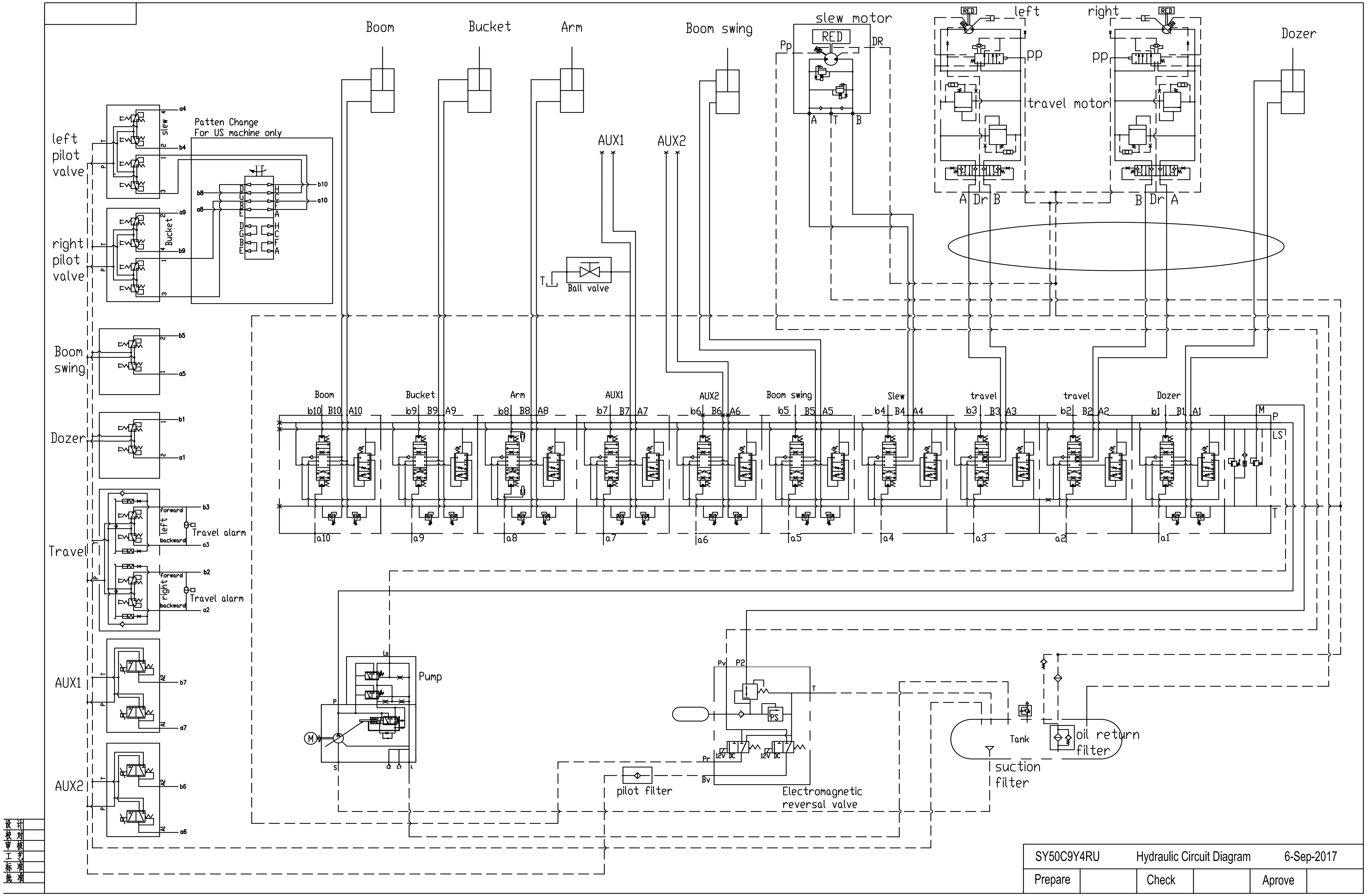
No.	SY35U	
1. Cylinder head assembly tightening torque	Boom	650±65
	Arm	600±60
	Bucket	550±55
	Dozer blade	650±65
	Def ector	350±35
2. Piston assembly tightening torque	Boom	1200±120
	Arm	1200±120
	Bucket	700±70
	Dozer blade	100±100
	Def ector	900±90

SANY

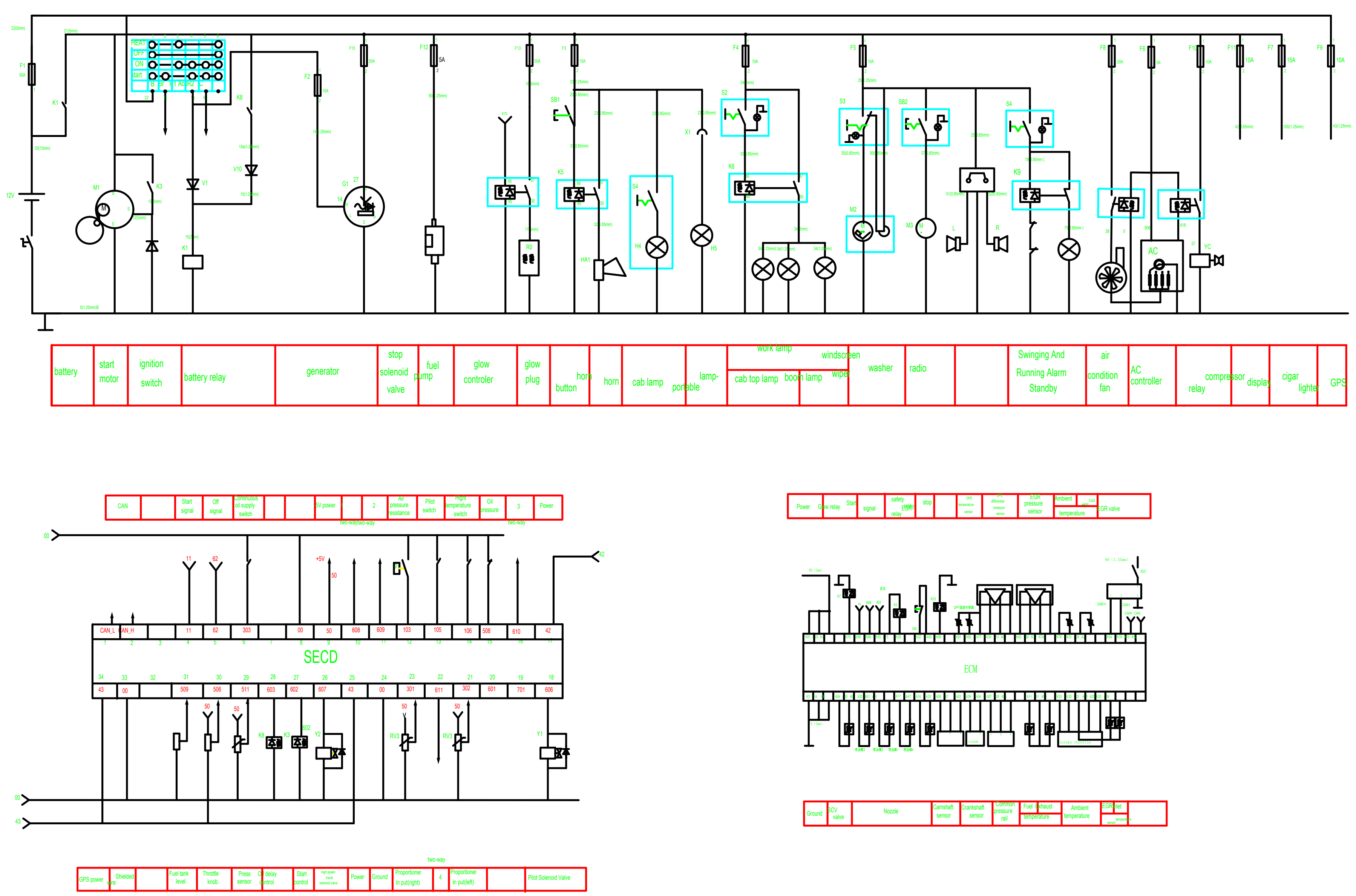
System Schematics

10 System Schematics

10.1 Hydraulic Circuit Diagram



Electrical Schematic Diagram



SY50C9Y4RU	Electrical Schematic Diagram	7-Sep-2017
Prepare	Check	Aprove