SEN00046-02

Shop Manual

BULLDOZER

GALEO

D65EX -15E0
D65PX -15E0
D65WX-15E0

SERIAL NUMBERS

D65EX- 69001
D65PX- 69001 and up
D65WX- 69001

KOMATSU

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

00 Index and foreword

Index

Organization list of the shop manual

The contents of this shop manual are shown together with Form No. in a list.

Note 1: Always keep the latest version of this manual in accordance with this list and utilize accordingly.
The marks shown to the right of Form No. denote the following:
○: New issue (to be filed additionally) ●: Revision (to be replaced for each Form No.)

Note 2: This shop manual can be supplied for each Form No.

Note 3: To file this shop manual in the special binder for management, handle it as follows:
- Place a divider on the top of each section in the file after matching the Tub No. with No. indicated next to each Section Name shown in the table below:
- File overview and other materials in sections in the order shown below and utilize them accordingly.

Section Title	Form Number
Shop Manual, contents binder, binder label and tabs	SEN00046-02
00 Index and foreword	SEN00047-02
Index	SEN00055-02 ●
Foreword and general information	SEN00056-01
01 Specification	SEN00048-01
Specification and technical data	SEN00057-01
10 Structure, function and maintenance standard	SEN00049-01
Engine and cooling system	SEN00281-01
Power train, Part 1	SEN00282-01
Power train, Part 2	SEN00283-01
Undercarriage and frame	SEN00284-01
Hydraulic system, Part 1	SEN00285-01
Hydraulic system, Part 2	SEN00286-01
Hydraulic system, Part 3	SEN00287-01
Work equipment	SEN00288-00
Cab and its attachments	SEN00289-00
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D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00055-02

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
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00 Index and foreword

Foreword and general information

Foreword and general information

(Rev. 2005/11)

Safety notice

Important safety notice

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

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

1. General precautions

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

1) Before carrying out any greasing or repairs, read all the safety plates stuck to the machine. For the locations of the safety plates and detailed explanation of precautions, see the Operation and Maintenance Manual.
2) Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt, water, or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.
3) When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
4) When carrying out any operation with 2 or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs in the operator's compartment.
5) Only qualified workers must carry out work and operation which require license or qualification.
6) Keep all tools in good condition, learn the correct way to use them, and use the proper ones of them. Before starting work, thoroughly check the tools, machine, forklift, service car, etc.
7) If welding repairs are needed, always have a trained and experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, shielding goggles, cap and other clothes suited for welding work.
8) Before starting work, warm up your body thoroughly to start work under good condition.

Safety points

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

2. Preparations for work

1) Before adding oil or making any repairs, park the machine on hard and level ground, and apply the parking brake and block the wheels or tracks to prevent the machine from moving.
2) Before starting work, lower the work equipment (blade, ripper, bucket, etc.) to the ground. If this is not possible, insert the lock pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.

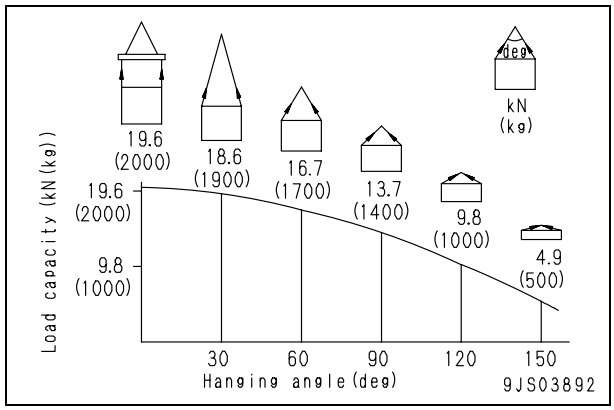
3) When disassembling or assembling, support the machine with blocks, jacks, or stands before starting work.
4) Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

3. Precautions during work

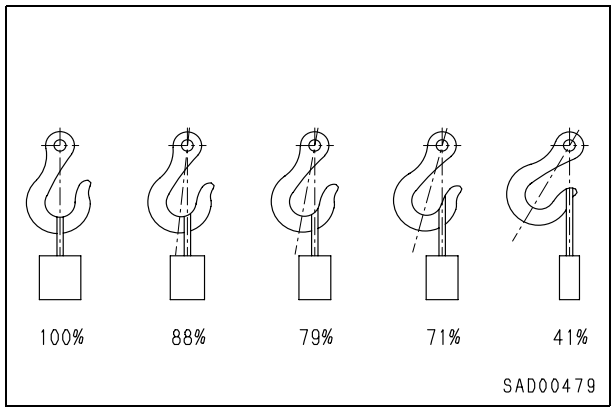
1) Before disconnecting or removing components of the oil, water, or air circuits, first release the pressure completely from the circuit. When removing the oil filler cap, a drain plug, or an oil pressure pickup plug, loosen it slowly to prevent the oil from spurting out.
2) The coolant and oil in the circuits are hot when the engine is stopped, so be careful not to get scalded. Wait for the oil and coolant to cool before carrying out any work on the oil or water circuits.
3) Before starting work, stop the engine. When working on or around a rotating part, in particular, stop the engine. When checking the machine without stopping the engine (measuring oil pressure, revolving speed, temperature, etc.), take extreme care not to get rolled or caught in rotating parts or moving parts.
4) Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
5) When raising a heavy component (heavier than 25 kg), use a hoist or crane. Before starting work, check that the slings (wire ropes, chains, and hooks) are free from damage. Always use slings which have ample capacity and install them to proper places. Operate the hoist or crane slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
6) When removing a cover which is under internal pressure or under pressure from a spring, always leave 2 bolts in diagonal positions. Loosen those bolts gradually and alternately to release the pressure, and then remove the cover.
7) When removing components, be careful not to break or damage the electrical wiring. Damaged wiring may cause electrical fires.
8) When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip and can even start fires.
9) As a general rule, do not use gasoline to wash parts. Do not use it to clean electrical parts, in particular.
10) Be sure to assemble all parts again in their original places. Replace any damaged parts and parts which must not be reused with new parts. When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is operated.
11) When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. In addition, check that connecting parts are correctly installed.
12) When assembling or installing parts, always tighten them to the specified torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
13) When aligning 2 holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
14) When measuring hydraulic pressure, check that the measuring tools are correctly assembled.
15) Take care when removing or installing the tracks of track-type machines. When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.
16) If the engine is operated for a long time in a place which is not ventilated well, you may suffer from gas poisoning. Accordingly, open the windows and doors to ventilate well.

4. Precautions for sling work and making signs

1) Only one appointed worker must make signs and co-workers must communicate with each other frequently. The appointed sign maker must make specified signs clearly at a place where he is seen well from the operator's seat and where he can see the working condition easily. The sign maker 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) Keep putting on gloves during sling work. (Put on 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.
   ⚠ Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.
7) Limit the hanging angle to 60°, as a rule. Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with 2 or more ropes, the force subjected to each rope will increase with the hanging angle. The table below shows the variation of allowable load in kN {kg} when hoisting is made with 2 ropes, each of which is allowed to sling up to 9.8 kN {1,000 kg} vertically, at various hanging angles. When the 2 ropes sling a load vertically, up to 19.6 kN {2,000 kg} of total weight can be suspended. This weight is reduced to 9.8 kN {1,000 kg} when the 2 ropes make a hanging angle of 120°. If the 2 ropes sling a 19.6 kN {2,000 kg} load at a lifting angle of 150°, each of them is subjected to a force as large as 39.2 kN {4,000 kg}.



8) When installing wire ropes to an angular load, apply pads 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 pads.

- If the load is unstable or the wire rope or chains are twisted, lower the load and lift it up again.
- Do not lift up the load slantingly.

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

5. Precautions for using mobile crane

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

6. Precautions for using overhead hoist crane

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

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 signs 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 specified position and raise the hook to at least 2 m above the floor. Do not leave the sling installed to the hook.

7. Selecting wire ropes

1) Select adequate ropes depending on the weight of parts to be hoisted, referring to the table below.

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

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

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

How to read the shop manual

- Some attachments and optional parts in this shop manual may not be delivered to certain areas. If one of them is required, consult KOMATSU distributors.
- Materials and specifications are subject to change without notice.
- Shop manuals are divided into the “Chassis volume” and “Engine volume”. For the engine unit, see the engine volume of the engine model mounted on the machine.

1. Composition of shop manual

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

00. Index and foreword

This section explains the shop manuals list, table of contents, safety, and basic information.

01. Specification

This section explains the specifications of the machine.

10. Structure, function and maintenance standard

This section explains the structure, function, and maintenance standard values of each component. The structure and function sub-section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting. The maintenance standard sub-section explains the criteria and remedies for disassembly and service.

20. Standard value table

This section explains the standard values for 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.

30. Testing and adjusting

This section explains measuring instruments and measuring methods for testing and adjusting, and method of adjusting each part. The standard values and judgement criteria for testing and adjusting are explained in Testing and adjusting.

40. Troubleshooting

This section explains how to find out failed parts and how to repair them. The troubleshooting is divided by failure modes. The “S mode” of the troubleshooting related to the engine may be also explained in the Chassis volume and Engine volume. In this case, see the Chassis volume.

50. Disassembly and assembly

This section explains the special tools and procedures for removing, installing, disassembling, and assembling each component, as well as precautions for them. In addition, tightening torque and quantity and weight of coating material, oil, grease, and coolant necessary for the work are also explained.

90. Diagrams and drawings (chassis volume)/Repair and replacement of parts (engine volume)

- Chassis volume
  This section gives hydraulic circuit diagrams and electrical circuit diagrams.
- Engine volume
  This section explains the method of reproducing, repairing, and replacing parts.

2. Revision and distribution

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

3. Filing method

File by the brochures in the correct order of the form number printed in the shop manual composition table.

- **Revised edition mark**
  When a manual is revised, the ones and tens digits of the form number of each brochure is increased by 1. (Example: 00, 01, 02 …)

- **Revisions**
  Revised brochures are shown in the shop manual composition table.

4. Symbols

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

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing work.
	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.

5. 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 { }.

Explanation of terms for maintenance standard

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

1. Standard size and tolerance

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

Example:

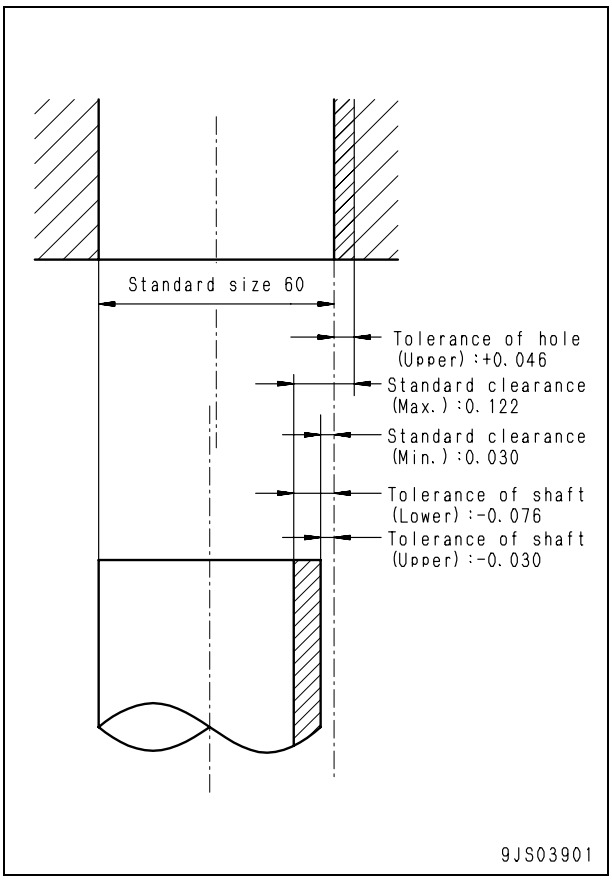
Standard size	Tolerance
120	–0.022 –0.126

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

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

Example:

Standard size	Tolerance	
	Shaft	Hole
60	–0.030 –0.076	+0.046 0



2. Standard clearance and standard value

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

3. Standard interference

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

4. Repair limit and allowable value

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

5. Clearance limit

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

6. Interference limit

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

Handling electric equipment and hydraulic component

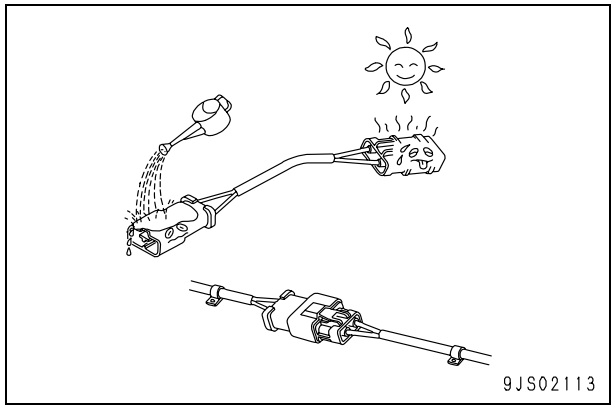
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct “operation“, “maintenance and inspection“, “troubleshooting“, and “repairs” must be carried out. This section deals particularly with correct repair procedures for mechatronics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

Points to remember when handling electric equipment

1. Handling wiring harnesses and connectors

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

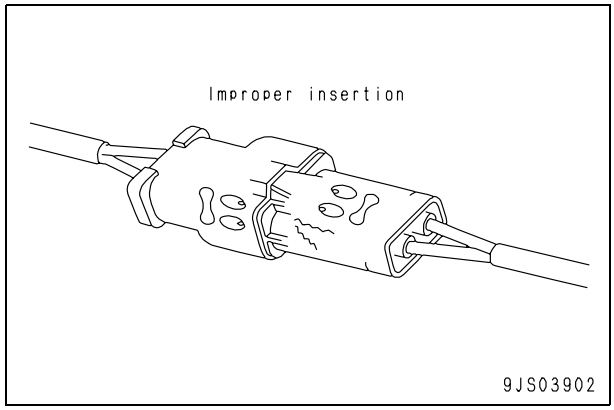
Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer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



2. Main failures occurring in wiring harness

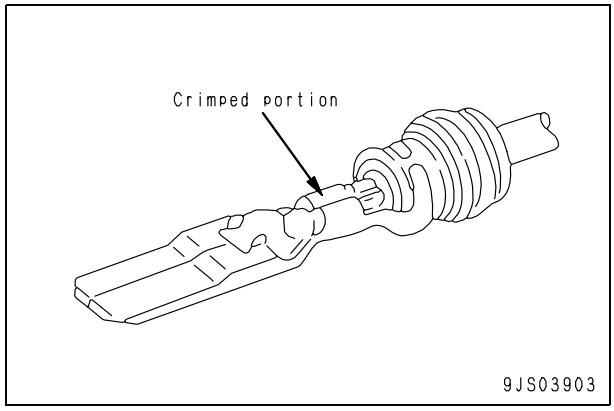
1) Defective contact of connectors (defective contact between male and female)

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 oxidization of the contact surfaces.

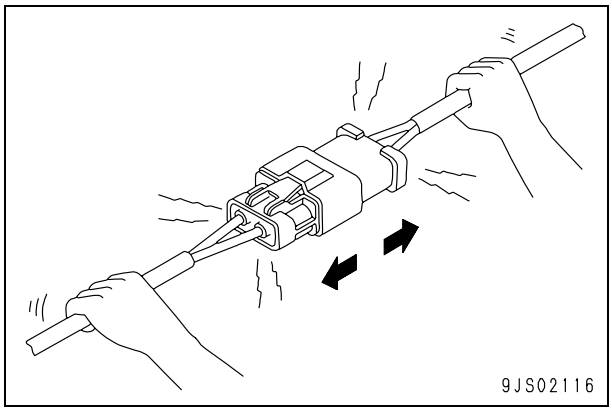


2) Defective crimping or soldering of connectors

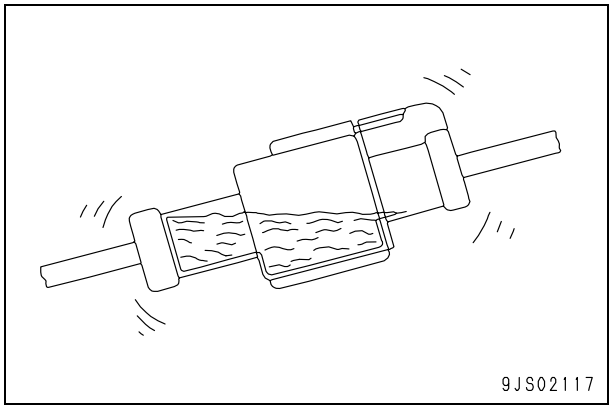
The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.



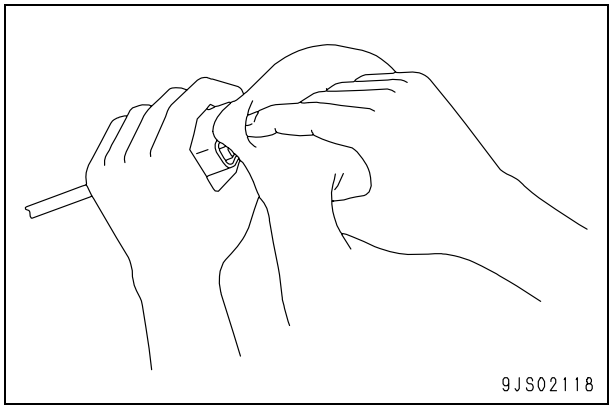
3) Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



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



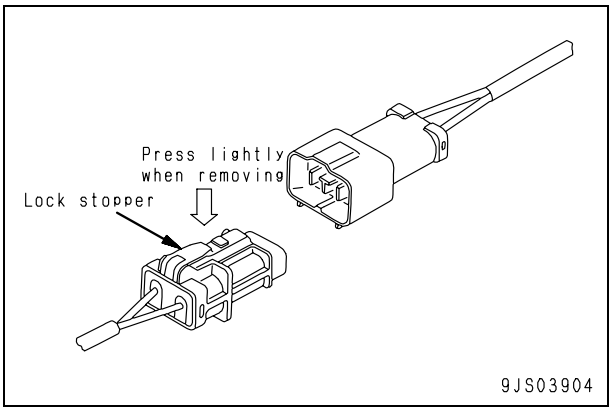
5) Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it dry with compressed air and spray it with a contact restorer.
★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.



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

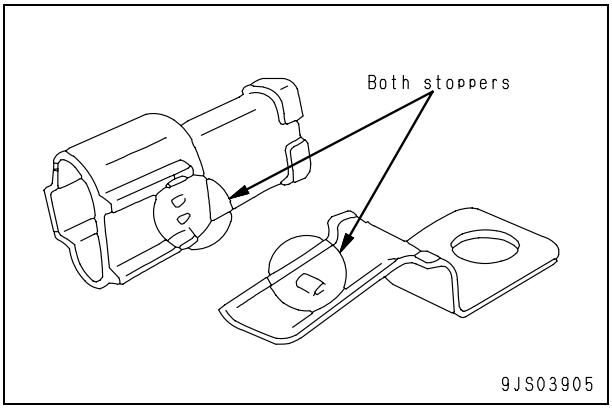
1) Disconnecting connectors

1] 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.

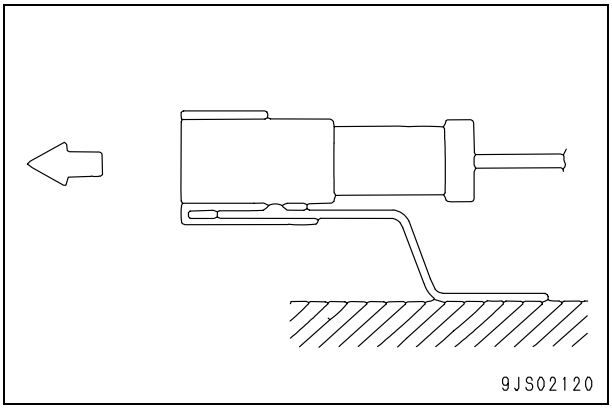


2] When removing from clips

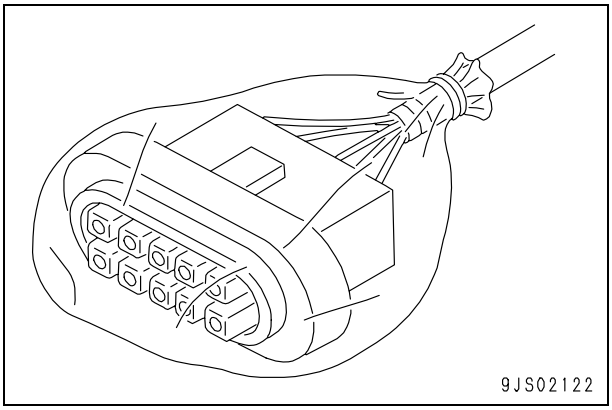
- Both of the connector and clip have stoppers, which are engaged with each other when the connector is installed.



- When removing a connector from a clip, pull the connector in a parallel direction to the clip for removing stoppers.
★ If the connector is twisted up and down or to the left or right, the housing may break.



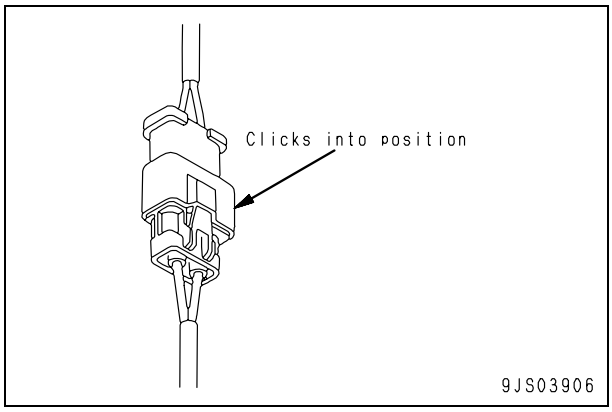
3] Action to take after removing connectors
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.
★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always cover the connector.

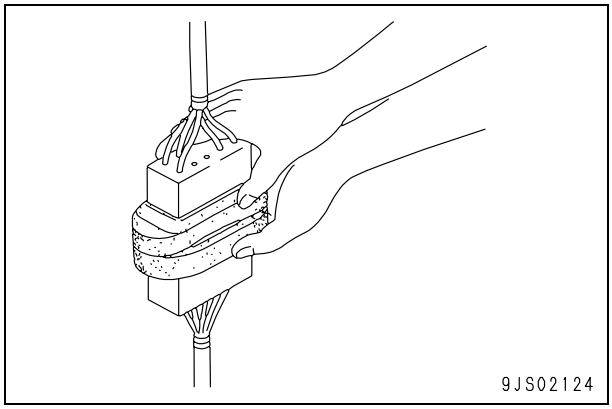


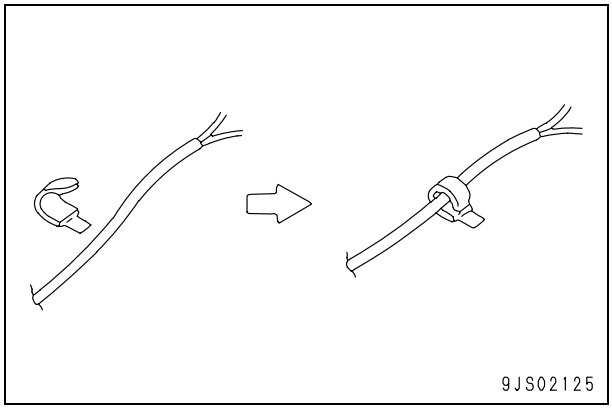
2) Connecting connectors
   1] Check the connector visually.
   Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
   Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
   Check that there is no damage or breakage to 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.
   2] Fix the connector securely.
   Align the position of the connector correctly, and then insert it securely. For connectors with lock stopper, push in the connector until the stopper clicks into position.
   3] Correct any protrusion of the boot and any misalignment of the wiring harness.
   For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.
   ★ If the connector cannot be corrected easily, remove the clamp and adjust the position.
   ● If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.

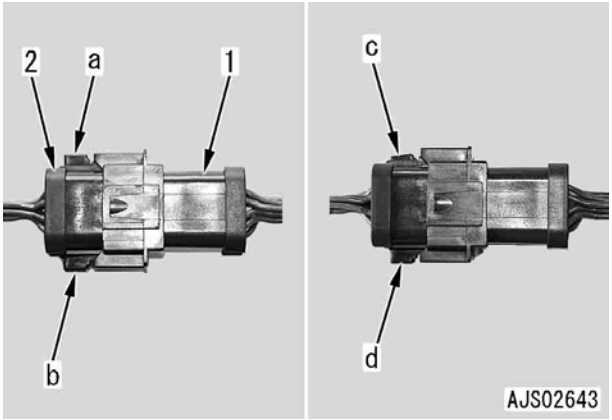
3) Connecting DT connectors
   Since the DT 8-pin and 12-pin heavy duty wire connectors have 2 latches respectively, push them in until they click 2 times.

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

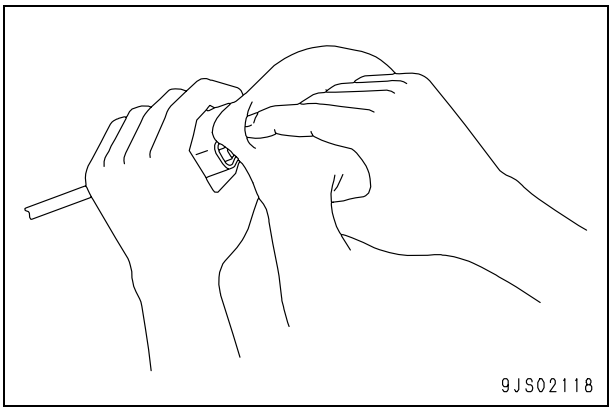


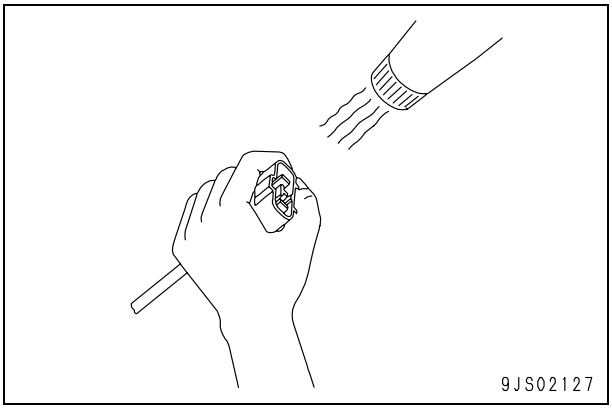


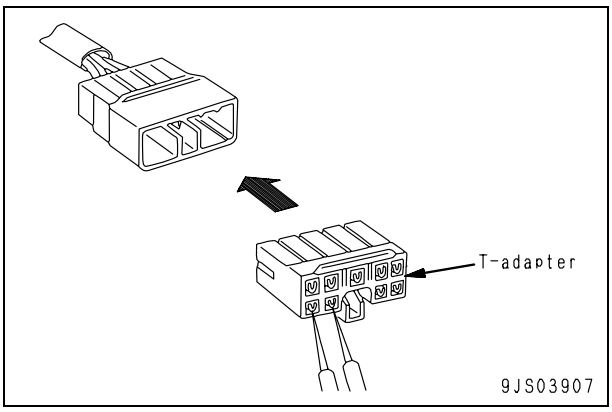




4) Drying wiring harness
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.
   1] 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.
   2] Dry the inside of 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.
   3] 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.

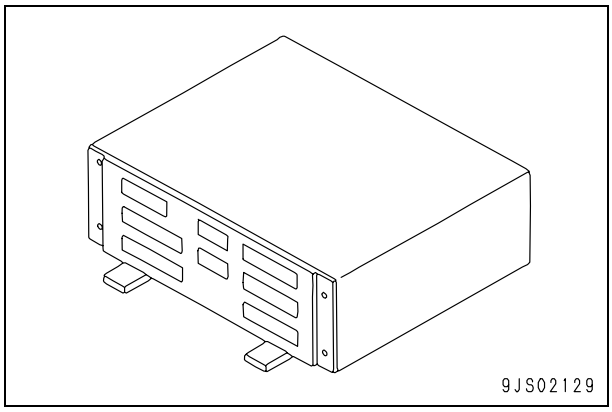


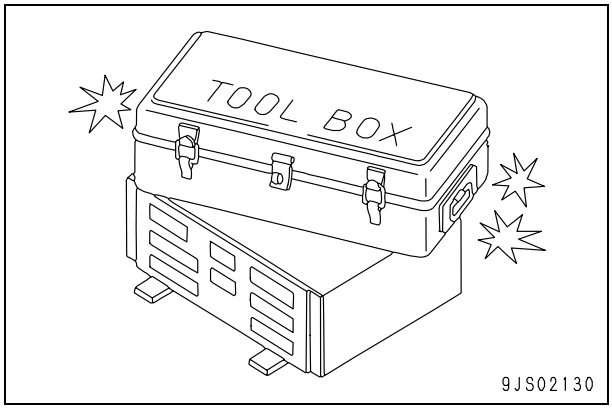




4. Handling controller

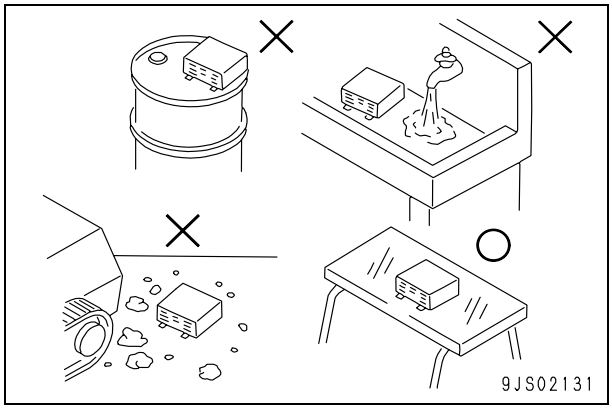
1) The controller contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the controller.
2) Do not place objects on top of the controller.
3) Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts with your hand.
4) During rainy weather, do not leave the controller in a place where it is exposed to rain.
5) Do not place the controller on oil, water, or soil, or in any hot place, even for a short time. (Place it on a suitable dry stand).
6) Precautions when carrying out arc welding
When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the controller. Fit an arc welding ground close to the welding point.





5. Points to remember when troubleshooting electric circuits

1) Always turn the power OFF before disconnecting or connecting connectors.
2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.
   ★ Disconnect and connect the related connectors several times to check.
3) Always connect any disconnected connectors before going on to the next step.
   ★ If the power is turned ON with the connectors still disconnected, unnecessary abnormality displays will be generated.
4) When carrying out troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), move the related wiring and connectors several times and check that there is no change in the reading of the tester.
   ★ If there is any change, there is probably defective contact in that circuit.



Points to remember when handling hydraulic equipment

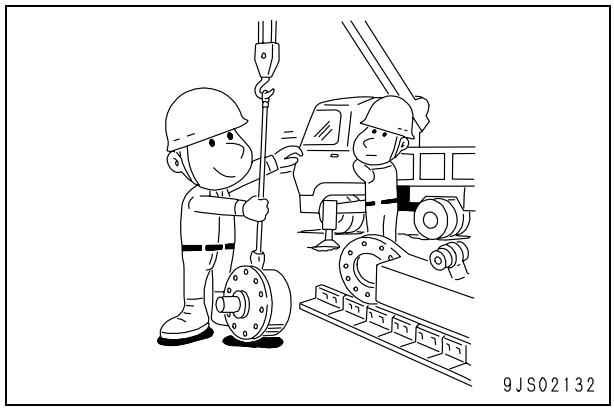
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

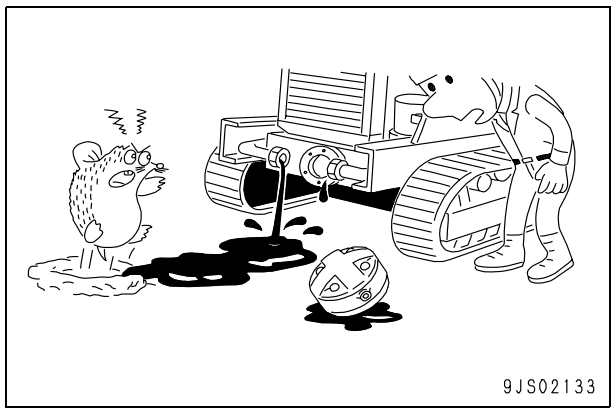
1. **Be careful of the operating environment.**
   Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

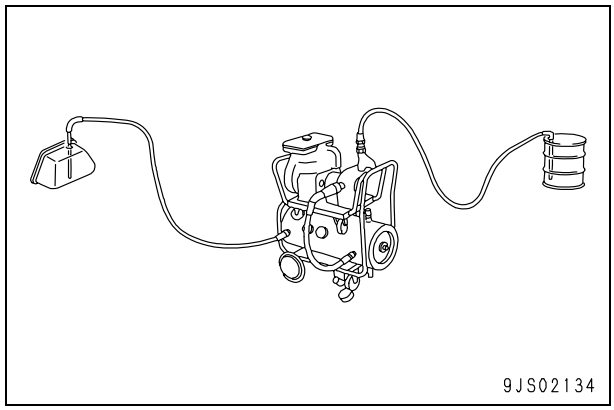
2. **Disassembly and maintenance work in the field**
   If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to check the performance after repairs, so it is desirable to use unit exchange. Disassembly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

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

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





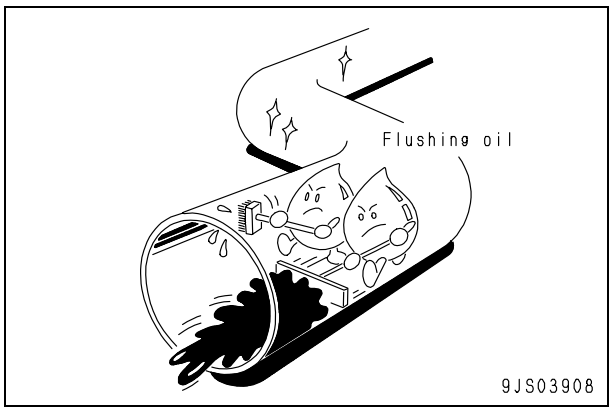


5. Change hydraulic oil when the temperature is high

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

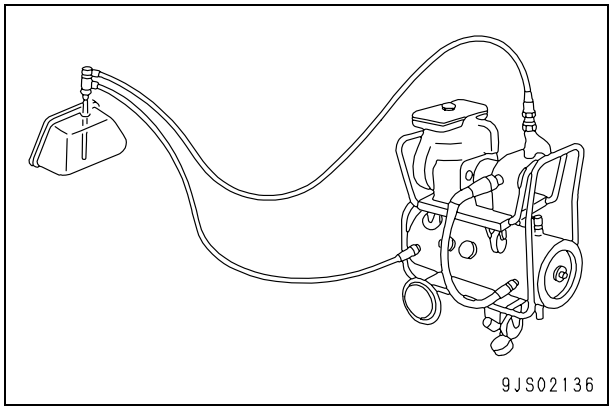
6. Flushing operations

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



7. Cleaning operations

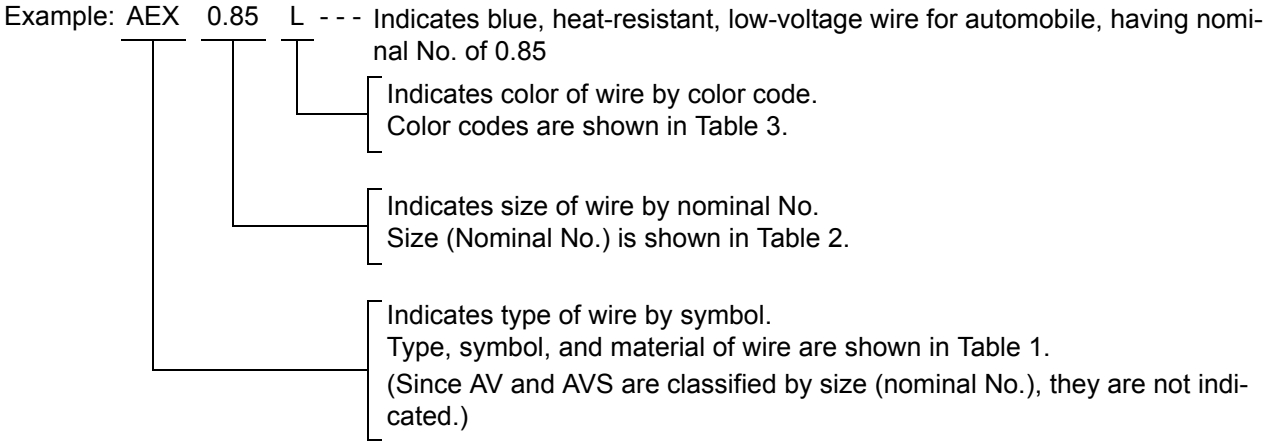
After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit. The oil cleaning equipment is used to remove the ultra fine (about 3 μ) particles that the filter built in the hydraulic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



How to read electric wire code

★ The information about the wires unique to each machine model is described in Troubleshooting section, Relational information of troubleshooting.

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.



1. Type, symbol, and material

AV and AVS are different in only thickness and outside diameter of the cover. AEX is similar to AV in thickness and outside diameter of AEX and different from AV and AVS in material of the cover.

(Table 1)

Type	Symbol	Material		Using temperature range (°C)	Example of use
Low-voltage wire for automobile	AV	Conductor	Annealed copper for electric appliance	–30 to +60	General wiring (Nominal No. 5 and above)
		Insulator	Soft polyvinyl chloride		
Thin-cover low-voltage wire for automobile	AVS	Conductor	Annealed copper for electric appliance		General wiring (Nominal No. 3 and below)
		Insulator	Soft polyvinyl chloride		
Heat-resistant low-voltage wire for automobile	AEX	Conductor	Annealed copper for electric appliance	–50 to +110	General wiring in extremely cold district, wiring at high-temperature place
		Insulator	Heat-resistant crosslinked polyethylene		

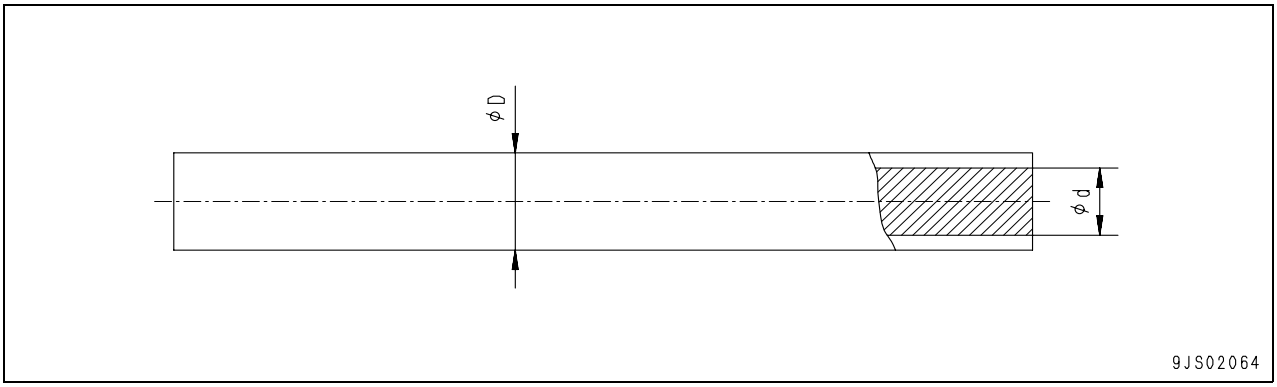
2. Dimensions

(Table 2)

Nominal No.			0.5f	(0.5)	0.75f	(0.85)	1.25f	(1.25)	2f	2	3f	3	5
Conductor		Number of strands/Diameter of strand	20/0.18	7/0.32	30/0.18	11/0.32	50/0.18	16/0.32	37/0.26	26/0.32	58/0.26	41/0.32	65/0.32
		Sectional area (mm^2)	0.51	0.56	0.76	0.88	1.27	1.29	1.96	2.09	3.08	3.30	5.23
		d (approx.)	1.0		1.2		1.5		1.9	1.9	2.3	2.4	3.0
Cover D	AVS	Standard	2.0		2.2		2.5		2.9	2.9	3.5	3.6	–
	AV	Standard	–		–		–		–	–	–	–	4.6
	AEX	Standard	2.0		2.2		2.7		3.0	3.1	–	3.8	4.6

Nominal No.			8	15	20	30	40	50	60	85	100
Conductor		Number of strands/Diameter of strand	50/0.45	84/0.45	41/0.80	70/0.80	85/0.80	108/0.80	127/0.80	169/0.80	217/0.80
		Sectional area (mm^2)	7.95	13.36	20.61	35.19	42.73	54.29	63.84	84.96	109.1
		d (approx.)	3.7	4.8	6.0	8.0	8.6	9.8	10.4	12.0	13.6
Cover D	AVS	Standard	–	–	–	–	–	–	–	–	–
	AV	Standard	5.5	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6
	AEX	Standard	5.3	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6

"f" of nominal No. denotes flexible".



3. Color codes table

(Table 3)

Color Code	Color of wire
B	Black
Br	Brown
BrB	Brown & Black
BrR	Brown & Red
BrW	Brown & White
BrY	Brown & Yellow
Ch	Charcoal
Dg	Dark green
G	Green
GB	Green & Black
GL	Green & Blue
Gr	Gray
GR	Green & Red
GW	Green & White
GY	Green & Yellow
L	Blue
LB	Blue & Black
Lg	Light green
LgB	Light green & Black
LgR	Light green & Red

Color Code	Color of wire
LgW	Light green & White
LgY	Light green & Yellow
LR	Blue & Red
LW	Blue & White
LY	Blue & Yellow
O	Orange
P	Pink
R	Red
RB	Red & Black
RG	Red & Green
RL	Red & Blue
RW	Red & White
RY	Red & Yellow
Sb	Sky Blue
Y	Yellow
YB	Yellow & Black
YG	Yellow &Green
YL	Yellow & Blue
YR	Yellow & Red
YW	Yellow & White

Remarks: In a color code consisting of 2 colors, the first color is the color of the background and the second color is the color of the marking.
Example: “GW” means that the background is Green and marking is White.

4. Types of circuits and color codes

(Table 4)

Type of wire		AVS or AV						AEX	
Type of circuit	Charge	R	WG	–	–	–	–	R	–
	Ground	B	–	–	–	–	–	B	–
	Start	R	–	–	–	–	–	R	–
	Light	RW	RB	RY	RG	RL	–	D	–
	Instrument	Y	YR	YB	YG	YL	YW	Y	Gr
	Signal	G	GW	GR	GY	GB	GL	G	Br
	Others	L	LW	LR	LY	LB	–	L	–
		Br	BrW	BrR	BrY	BrB	–	–	–
		Lg	LgR	LgY	LgB	LgW	–	–	–
		O	–	–	–	–	–	–	–
		Gr	–	–	–	–	–	–	–
		P	–	–	–	–	–	–	–
		Sb	–	–	–	–	–	–	–
		Dg	–	–	–	–	–	–	–
		Ch	–	–	–	–	–	–	–

Method of disassembling and connecting push-pull type coupler

⚠ **Before carrying out the following work, loosen the oil filler cap of the hydraulic tank gradually to release the residual pressure from the hydraulic tank.**

⚠ **Even if the residual pressure is released from the hydraulic tank, some hydraulic oil flows out when the hose is disconnected. Accordingly, prepare an oil receiving container.**

Type 1

1. Disconnection

1) Hold adapter (1) and push hose joint (2) into mating adapter (3). (Fig. 1)
   - ★ The adapter can be pushed in about 3.5 mm.
   - ★ Do not hold rubber cap portion (4).
2) After hose joint (2) is pushed into adapter (3), press rubber cap portion (4) against adapter (3) until it clicks. (Fig. 2)
3) Hold hose adapter (1) or hose (5) and pull it out. (Fig. 3)
   - ★ Since some hydraulic oil flows out, prepare an oil receiving container.

Fig. 1

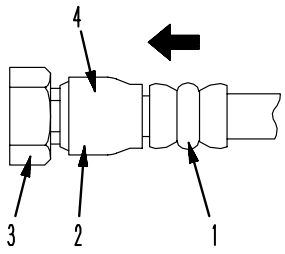


Fig. 2

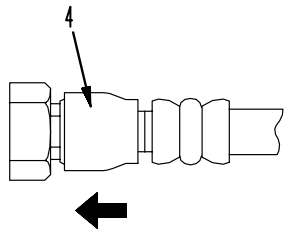
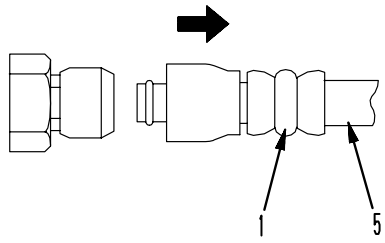


Fig. 3



9JS02109

2. Connection

1) Hold hose adapter (1) or hose (5) and insert it in mating adapter (3), aligning them with each other. (Fig. 4)
   - ★ Do not hold rubber cap portion (4).
2) After inserting the hose in the mating adapter perfectly, pull it back to check its connecting condition. (Fig. 5)
   - ★ When the hose is pulled back, the rubber cap portion moves toward the hose about 3.5 mm. This does not indicate abnormality, however.

Fig. 4

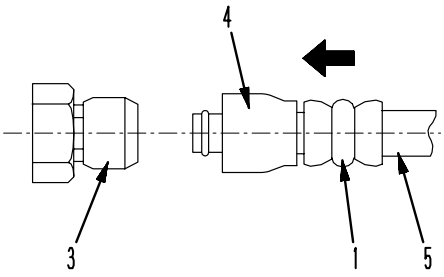
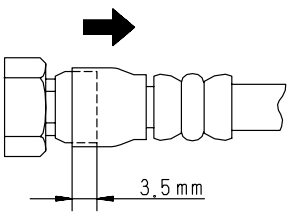


Fig. 5

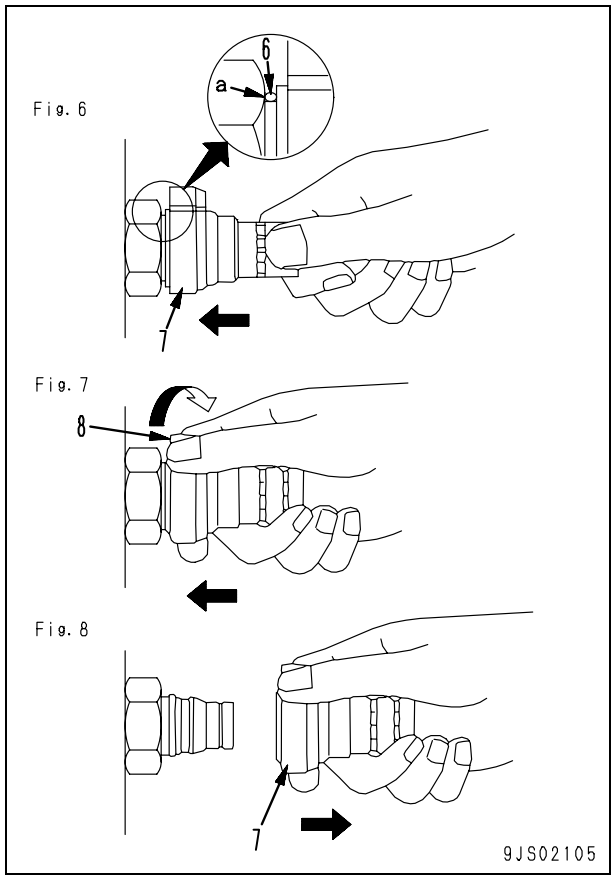


9JS02110

Type 2

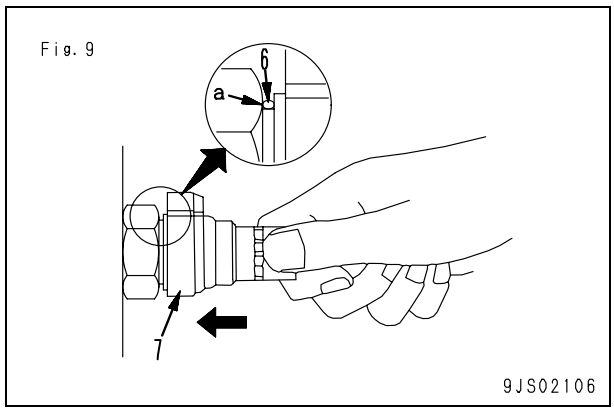
1. Disconnection

1) Hold the tightening portion and push body (7) straight until sliding prevention ring (6) contacts contact surface (a) of the hexagonal portion at the male end. (Fig. 6)
2) While holding the condition of Step 1), turn lever (8) to the right (clockwise). (Fig. 7)
3) While holding the condition of Steps 1) and 2), pull out whole body (7) to disconnect it. (Fig. 8)



2. Connection

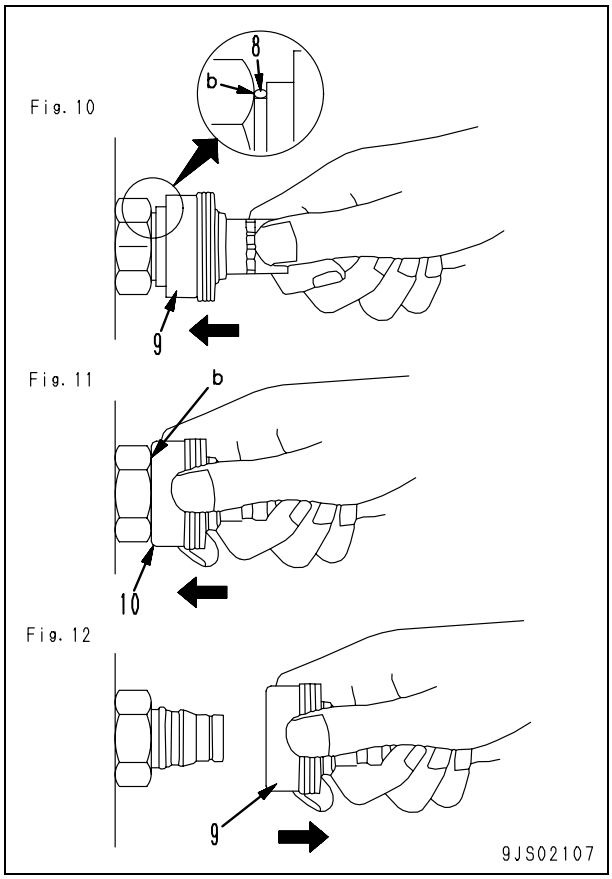
- Hold the tightening portion and push body (7) straight until sliding prevention ring (6) contacts contact surface (a) of the hexagonal portion at the male end. (Fig. 9)



Type 3

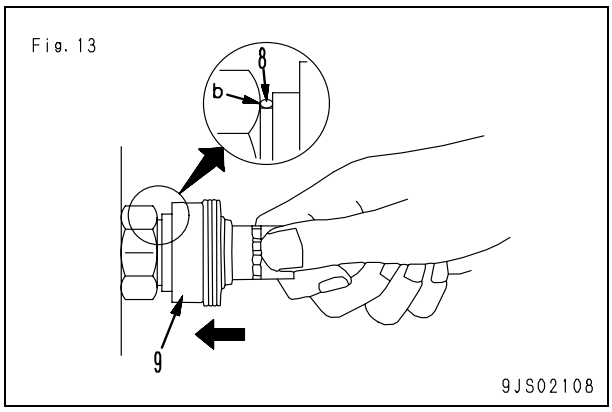
1. Disconnection

1) Hold the tightening portion and push body (9) straight until sliding prevention ring (8) contacts contact surface (b) of the hexagonal portion at the male end. (Fig. 10)
2) While holding the condition of Step 1), push cover (10) straight until it contacts contact surface (b) of the hexagonal portion at the male end. (Fig. 11)
3) While holding the condition of Steps 1) and 2), pull out whole body (9) to disconnect it. (Fig. 12)



2. Connection

- Hold the tightening portion and push body (9) straight until the sliding prevention ring contacts contact surface (b) of the hexagonal portion at the male end. (Fig. 13)



Standard tightening torque table

1. Table of tightening torques for bolts and nuts
   ★ Unless there are special instructions, tighten metric nuts and bolts to the torque below. (When using torque wrench)

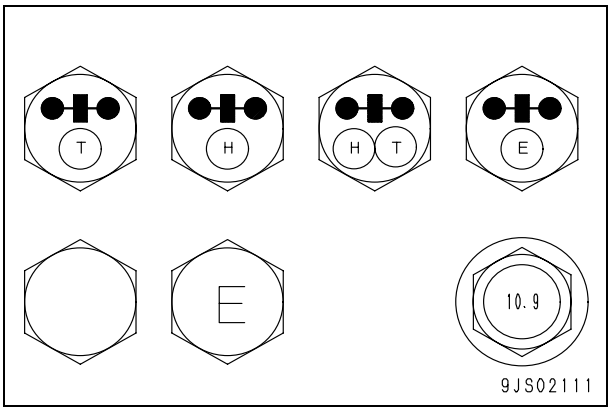
   ★ The following table corresponds to the bolts in Fig. A.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
6	10	11.8 – 14.7	1.2 – 1.5
8	13	27 – 34	2.8 – 3.5
10	17	59 – 74	6 – 7.5
12	19	98 – 123	10 – 12.5
14	22	153 – 190	15.5 – 19.5
16	24	235 – 285	23.5 – 29.5
18	27	320 – 400	33 – 41
20	30	455 – 565	46.5 – 58
22	32	610 – 765	62.5 – 78
24	36	785 – 980	80 – 100
27	41	1,150 – 1,440	118 – 147
30	46	1,520 – 1,910	155 – 195
33	50	1,960 – 2,450	200 – 250
36	55	2,450 – 3,040	250 – 310
39	60	2,890 – 3,630	295 – 370

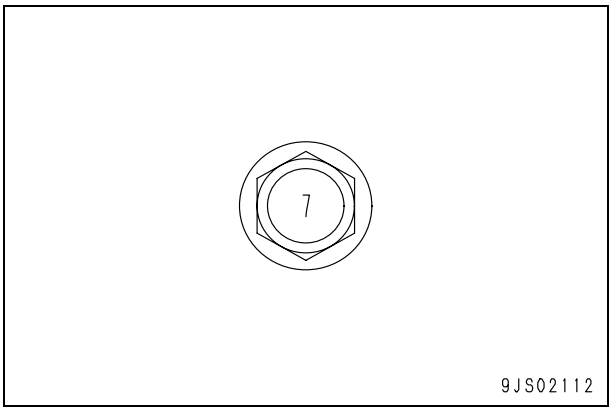
   ★ The following table corresponds to the bolts in Fig. B.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
6	10	5.9 – 9.8	0.6 – 1.0
8	13	13.7 – 23.5	1.4 – 2.4
10	14	34.3 – 46.1	3.5 – 4.7
12	27	74.5 – 90.2	7.6 – 9.2

★ Fig. A



★ Fig. B



2. Table of tightening torques for split flange bolts

★ Unless there are special instructions, tighten split flange bolts to the torque below.

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

3. Table of tightening torques for O-ring boss piping joints

★ Unless there are special instructions, tighten O-ring boss piping joints to the torque below.

Nominal No.	Thread diameter	Width across flats	Tightening torque Nm {kgm}	
	mm	mm	Range	Target
02	14	Varies depending on type of connector.	35 – 63 { 3.5 – 6.5}	44 { 4.5}
03,04	20		84 – 132 { 8.5 – 13.5}	103 {10.5}
05,06	24		128 – 186 {13.0 – 19.0}	157 {16.0}
10,12	33		363 – 480 {37.0 – 49.0}	422 {43.0}
14	42		746 – 1,010 {76.0 – 103}	883 {90.0}

4. Table of tightening torques for O-ring boss plugs

★ Unless there are special instructions, tighten O-ring boss plugs to the torque below.

Nominal No.	Thread diameter	Width across flats	Tightening torque Nm {kgm}	
	mm	mm	Range	Target
08	8	14	5.88 – 8.82 {0.6 – 0.9}	7.35 {0.75}
10	10	17	9.81 – 12.74 {1.0 – 1.3}	11.27 {1.15}
12	12	19	14.7 – 19.6 {1.5 – 2.0}	17.64 {1.8}
14	14	22	19.6 – 24.5 {2.0 – 2.5}	22.54 {2.3}
16	16	24	24.5 – 34.3 {2.5 – 3.5}	29.4 {3.0}
18	18	27	34.3 – 44.1 {3.5 – 4.5}	39.2 {4.0}
20	20	30	44.1 – 53.9 {4.5 – 5.5}	49.0 {5.0}
24	24	32	58.8 – 78.4 {6.0 – 8.0}	68.6 {7.0}
30	30	32	93.1 – 122.5 { 9.5 – 12.5}	107.8 {11.0}
33	33	–	107.8 – 147.0 {11.0 – 15.0}	127.4 {13.0}
36	36	36	127.4 – 176.4 {13.0 – 18.0}	151.9 {15.5}
42	42	–	181.3 – 240.1 {18.5 – 24.5}	210.7 {21.5}
52	52	–	274.4 – 367.5 {28.0 – 37.5}	323.4 {33.0}

5. Table of tightening torques for hoses (taper seal type and face seal type)

★ Unless there are special instructions, tighten the hoses (taper seal type and face seal type) to the torque below.

★ Apply the following torque when the threads are coated (wet) with engine oil.

Nominal No. of hose	Width across flats	Tightening torque Nm {kgm}		Taper seal	Face seal	
		Range	Target	Thread size (mm)	Nominal No. - Number of threads, type of thread	Thread diameter (mm) (Reference)
02	19	34 – 54 { 3.5 – 5.5}	44 { 4.5}	–	9/16-18UN	14.3
		34 – 63 { 3.5 – 6.5}		14	–	–
03	22	54 – 93 { 5.5 – 9.5}	74 { 7.5}	–	11/16-16UN	17.5
	24	59 – 98 { 6.0 – 10.0}	78 { 8.0}	18	–	–
04	27	84 – 132 { 8.5 – 13.5}	103 {10.5}	22	13/16-16UN	20.6
05	32	128 – 186 {13.0 – 19.0}	157 {16.0}	24	1-14UNS	25.4
06	36	177 – 245 {18.0 – 25.0}	216 {22.0}	30	1-3/16-12UN	30.2
(10)	41	177 – 245 {18.0 – 25.0}	216 {22.0}	33	–	–
(12)	46	197 – 294 {20.0 – 30.0}	245 {25.0}	36	–	–
(14)	55	246 – 343 {25.0 – 35.0}	294 {30.0}	42	–	–

6. Table of tightening torques for 102, 107 and 114 engine series (Bolts and nuts)

★ Unless there are special instructions, tighten the metric bolts and nuts of the 102, 107 and 114 engine series to the torque below.

Thread size	Tightening torque			
	Bolt		BANJO bolt	
mm	Nm	kgm	Nm	kgm
6	10 ± 2	1.02 ± 0.20	8 ± 2	0.81 ± 0.20
8	24 ± 4	2.45 ± 0.41	10 ± 2	1.02 ± 0.20
10	43 ± 6	4.38 ± 0.61	12 ± 2	1.22 ± 0.20
12	77 ± 12	7.85 ± 1.22	24 ± 4	2.45 ± 0.41
14	–	–	36 ± 5	3.67 ± 0.51

7. Table of tightening torques for 102, 107 and 114 engine series (Eye joints)

★ Unless there are special instructions, tighten the metric eye joints of the 102, 107 and 114 engine series to the torque below.

Thread size	Tightening torque	
mm	Nm	kgm
6	8 ± 2	0.81 ± 0.20
8	10 ± 2	1.02 ± 0.20
10	12 ± 2	1.22 ± 0.20
12	24 ± 4	2.45 ± 0.41
14	36 ± 5	3.67 ± 0.51

8. Table of tightening torques for 102, 107 and 114 engine series (Taper screws)

★ Unless there are special instructions, tighten the taper screws (unit: inch) of the 102, 107 and 114 engine series to the torque below.

Thread size	Tightening torque	
inch	Nm	kgm
1/16	3 ± 1	0.31 ± 0.10
1/8	8 ± 2	0.81 ± 0.20
1/4	12 ± 2	1.22 ± 0.20
3/8	15 ± 2	1.53 ± 0.20
1/2	24 ± 4	2.45 ± 0.41
3/4	36 ± 5	3.67 ± 0.51
1	60 ± 9	6.12 ± 0.92

Conversion table

Method of using the conversion table

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

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

1. Convert 55 mm into inches.

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

2. Convert 550 mm into inches.

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

Millimeters to inches

(B)

1 mm = 0.03937 in

	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	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
						(C)				
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	3.032	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

(A)

Millimeters to inches

1 mm = 0.03937 in

	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	1.536
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	3.032	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

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	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	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.361	25.625	25.889	26.153

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	3.740	3.950	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	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	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	18.037	18.257	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	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	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	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	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	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	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	213.4	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	640.1	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	995.6	1,010	1,024	1,038	1,053	1,067	1,081	1,095	1,109	1,124
80	1,138	1,152	1,166	1,181	1,195	1,209	1,223	1,237	1,252	1,266
90	1,280	1,294	1,309	1,323	1,337	1,351	1,365	1,380	1,394	1,408
100	1,422	1,437	1,451	1,465	1,479	1,493	1,508	1,522	1,536	1,550
110	1,565	1,579	1,593	1,607	1,621	1,636	1,650	1,664	1,678	1,693
120	1,707	1,721	1,735	1,749	1,764	1,778	1,792	1,806	1,821	1,835
130	1,849	1,863	1,877	1,892	1,906	1,920	1,934	1,949	1,963	1,977
140	1,991	2,005	2,020	2,034	2,048	2,062	2,077	2,091	2,105	2,119
150	2,134	2,148	2,162	2,176	2,190	2,205	2,219	2,233	2,247	2,262
160	2,276	2,290	2,304	2,318	2,333	2,347	2,361	2,375	2,389	2,404
170	2,418	2,432	2,446	2,460	2,475	2,489	2,503	2,518	2,532	2,546
180	2,560	2,574	2,589	2,603	2,617	2,631	2,646	2,660	2,674	2,688
190	2,702	2,717	2,731	2,745	2,759	2,773	2,788	2,802	2,816	2,830
200	2,845	2,859	2,873	2,887	2,901	2,916	2,930	2,944	2,958	2,973
210	2,987	3,001	3,015	3,030	3,044	3,058	3,072	3,086	3,101	3,115
220	3,129	3,143	3,158	3,172	3,186	3,200	3,214	3,229	3,243	3,257
230	3,271	3,286	3,300	3,314	3,328	3,343	3,357	3,371	3,385	3,399
240	3,414	3,428	3,442	3,456	3,470	3,485	3,499	3,513	3,527	3,542

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.

1°C = 33.8°F

°C		°F	°C		°F	°C		°F	°C		°F
–40.4	**–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	**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	62.7	**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

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00056-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

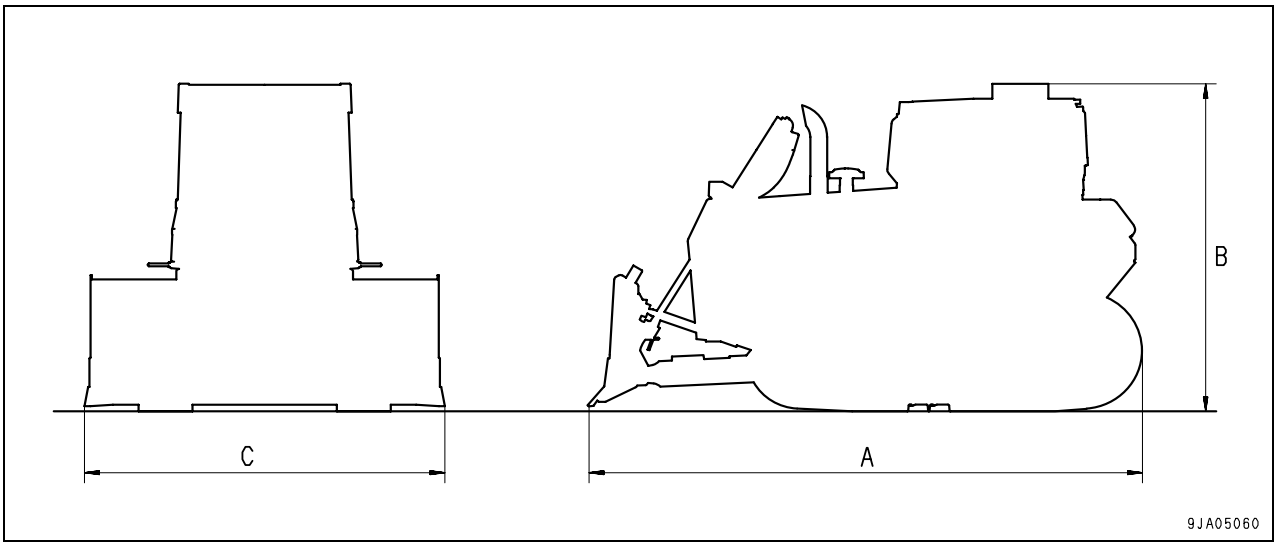
01 Specification

Specification and technical data

Specification and technical data

Specification dimensions

D65EX-15E0 semi-U dozer with ROPS guard, cab, and air conditioner
D65PX-15E0 power tilt dozer with ROPS guard, cab, and air conditioner
D65WX-15E0 semi-U dozer with ROPS guard, cab, and air conditioner



	Item		Unit	D65EX-15E0	D65PX-15E0	D65WX-15E0
	Machine weight		kg	20,280	21,000	21,140
	Engine name		—	Komatsu SAA6D114E-3 diesel engine		
	Rated engine output		kW {HP}/rpm	153 {205}/1,950 (Net)		
A	Overall length		mm	5,440	5,520	5,440
B	Overall height (excluding antenna)		mm	3,220	3,220	3,220
C	Overall width		mm	3,460	3,970	3,640
	Travel speed (1st/2nd/3rd gear speed)	Forward	km/h	3.3/6.3/10.1		
		Reverse	km/h	4.4/8.2/12.9		

Specifications

Machine name and type				D65EX-15E0		D65PX-15E0	D65WX-15E0
				Semi-U dozer	Semi-U dozer with long track	Power tilt dozer	Semi-U dozer
Serial number				69001 and up		69001 and up	69001 and up
Weight	Machine weight						
	• Bare tractor		kg	17,270	18,010	18,240	18,050
	• With work equipment		kg	19,550	20,290	20,270	20,410
	• With work equipment and ROPS cab		kg	20,280	21,020	21,000	21,140
	• With work equipment, ripper, and ROPS cab		kg	(21,960)	(22,700)	—	(22,820)
Performance	Min. turning radius		m	–[Counter-rotation]	–[Counter-rotation]	–[Counter-rotation]	–[Counter-rotation]
	Gradeability		deg.	30	30	30	30
	Stability (front, rear, left, right)		deg.	35	35	35	35
	Travel speed	Forward 1st	km/h	3.3	3.3	3.3	3.3
		Forward 2nd	km/h	6.3	6.3	6.3	6.3
		Forward 3rd	km/h	10.1	10.1	10.1	10.1
		Reverse 1st	km/h	4.4	4.4	4.4	4.4
		Reverse 2nd	km/h	8.2	8.2	8.2	8.2
		Reverse 3rd	km/h	12.9	12.9	12.9	12.9
	Ground pressure	Tractor unit	kPa {kg/cm^2}	62.1 {0.63}	52.7 {0.54}	29.8 {0.30}	40.9 {0.42}
		With work equipment	kPa {kg/cm^2}	70.3 {0.72}	59.4 {0.61}	33.1 {0.34}	46.2 {0.47}
		With work equipment and ROPS cab	kPa {kg/cm^2}	72.9 {0.74}	61.5 {0.63}	34.3 {0.35}	47.9 {0.49}
		With work equipment, ripper, and ROPS cab	kPa {kg/cm^2}	(79.0) ({0.80})	(66.5) ({0.68})	—	(51.7) ({0.53})
Dimensions	Overall length	Tractor unit	mm	4,335	4,520	4,520	4,335
		With work equipment	mm	5,440	5,750	5,520	5,440
	Overall width	Tractor unit	mm	2,390	2,390	3,000	2,890
		With work equipment [3 m blade specification]	mm	3,460	3,460 [2,990]	3,970	3,640
	Overall height	To top of exhaust pipe [EU specification]	mm	2,990 [3,220]	2,990 [3,220]	2,990 [3,220]	2,990 [—]
		To top of operator seat	mm	2,315	2,315	2,315	2,315
		When ROPS cab is installed (excluding antenna)	mm	3,220	3,220	3,220	3,220
		When ROPS canopy is installed	mm	3,220	3,220	3,220	3,220
		When cab is installed (excluding antenna)	mm	3,080	3,080	3,080	3,080
	Track gauge		mm	1,880	1,880	2,050	2,050
	Length of track on ground		mm	2,675	3,285	3,285	2,675
	Track width (Standard track shoe)		mm	510	510	915	810
	Min. ground clearance		mm	405	405	405	405

Values in ( ) are shown for reference.

Machine name and type				D65EX-15E0		D65PX-15E0	D65WX-15E0
				Semi-U dozer	Semi-U dozer with long track	Power tilt dozer	Semi-U dozer
Serial number				69001 and up		69001 and up	69001 and up
Engine	Name			SAA6D114E-3			
	Type			4-cycle, water-cooled, in-line, vertical, direct-injection, with turbocharger and air-cooled aftercooler			
	No. of cylinders – bore x stroke		mm	6 – 114 x 135			
	Total piston displacement		ℓ{cc}	8.27 {8,270}			
	Performance	Flywheel horsepower	kW/rpm {HP/rpm}	153/1,950 {205/1,950} (Net)			
		Max. torque	Nm/rpm {kgm/rpm}	1,012/1,450 {103/1,450} (Gross)			
		High idle speed under no load	rpm	2,030 ± 50			
		Low idle speed under no load	rpm	825 ± 25			
		Min. fuel consumption ratio	g/kWh {g/HPh}	227 {169}			
	Starting motor			24 V, 7.5 kW			
	Alternator			24 V, 60 A			
	Battery (*1)			12 V, 112 Ah, 2 units (145F51)			
	Type of radiator core			Corrugated aluminum, 8.0/2			
Power train	Torque converter			3-element, 1-stage, 1-phase type			
	Transmission			Planetary gear, multiple disc, hydraulic, gear pump pressure fed oil lubrication, 3 forward/reverse gear speeds, manual electronic type			
	Bevel gear shaft			Spiral bevel gear, gear pump pressure fed oil lubrication type			
	HSS unit	HSS		Differential planetary gear, hydraulic motor drive, manual electronic, hydraulic type			
		Brake		Wet multiple disc, spring-boosted, foot-operated, hydraulic type			
	Final drive			1-stage spur gear, 1-stage planetary gear reduction, splash lubrication type			
Undercarriage	Type of suspension			Semirigid, balancing beam type			
	Carrier roller			2 pieces on each side			
	Track roller			7 pieces on each side	8 pieces on each side		7 pieces on each side
	Track shoe • Assembly-type single grouser shoe			Width: 510mm 39 pieces on each side Pitch: 203.2mm	Width: 510mm 45 pieces on each side Pitch: 203.2mm	Width: 915mm 45 pieces on each side Pitch: 203.2mm	Width: 810mm 39 pieces on each side Pitch: 203.2mm

*1: The battery capacity (Ah) is on 5-hours rate.

Machine name and type				D65EX-15E0		D65PX-15E0	D65WX-15E0
				Semi-U dozer	Semi-U dozer with long track	Power tilt dozer	Semi-U dozer
Serial number				69001 and up		69001 and up	69001 and up
Hydraulic system	Hydraulic pump	HSS pump					
		Type		Variable displacement piston, load sensing type			
		Theoretical delivery	cm^3/rev	112			
		Cooling fan pump					
		Type		Variable displacement piston type			
		Theoretical delivery	cm^3/rev	30			
		Power train and lubrication pump					
		Type		Gear type (tandem)			
		Theoretical delivery	cm^3/rev	43.7 x 2			
		Scavenging pump					
		Type		Gear type			
		Theoretical delivery	cm^3/rev	61.2			
	Hydraulic motor	HSS motor					
		Type		Fixed displacement piston type with brake valve			
		Motor capacity	cm^3/rev	96			
		Cooling fan motor					
		Type		Fixed displacement piston type			
		Motor capacity	cm^3/rev	28			
	Control valve	Type and quantity		3-spool type, 1 piece 4-spool type, 1 piece (machine with ripper: if equipped)			
		Control method		Hydraulic assist type			
	Hydraulic tank			Box type (external control valve type)			
	Hydraulic oil filter			Tank return side			
	Oil cooler			Corrugated aluminum, 8.0/2			

Machine name and type				D65EX-15E0		D65PX-15E0	D65WX-15E0
				Standard	Long track	Standard	Standard
Serial number				69001 and up		69001 and up	69001 and up
Work equipment hydraulic system	Lift cylinder	Type		Double acting piston			
		Cylinder bore	mm	95	95		95
		Piston rod diameter	mm	65	65		65
		Stroke	mm	1,165	1,105		1,165
		Max. distance between pins	mm	1,685	1,905		1,685
		Min. distance between pins	mm	520	800		520
	Tilt and pitch cylinder	Type		Double acting piston			
		Cylinder bore	mm	140			
		Piston rod diameter	mm	70			
		Stroke	mm	145			
		Max. distance between pins	mm	1,222			
		Min. distance between pins	mm	1,077			
	Ripper cylinder	Type		Double acting piston			
		Cylinder bore	mm	140		—	140
		Piston rod diameter	mm	70		—	70
		Stroke	mm	330		—	330
		Max. distance between pins	mm	1,080		—	1,080
		Min. distance between pins	mm	750		—	750
Work equipment	Type			Power tilt dozer			
	Blade supporting method			Left: brace, Right: tilt cylinder			
	Performance	Max. lift (above ground)	mm	1,105	1,170	1,170	—
		Max. drop (below ground)	mm	440	470	475	—
		Max. tilt	mm	870	870	890	—
		Blade edge angle variable range	deg.	±7	±7	±7	—
	Dimensions	Blade width	mm	3,415	3,415	3,970	—
		Blade height	mm	1,225	1,110	1,110	—
		Tip angle of blade cutting edge	deg.	55	55	57	—
	Type			Semi-U dozer			
	Blade supporting method			Left: brace, Right: tilt cylinder			
	Performance	Max. lift (above ground)	mm	1,105	1,180	—	1,105
		Max. drop (below ground)	mm	440	565	—	440
		Max. tilt	mm	855	680	—	820
		Blade edge angle variable range	deg.	±7	±7	—	±7
	Dimensions	Blade width	mm	3,455	3,460	—	3,640
		Blade height	mm	1,480	1,480	—	1,410
		Tip angle of blade cutting edge	deg.	55	55	—	55

Machine name and type				D65EX-15E0		D65PX-15E0	D65WX-15E0
				Standard	Long track	Standard	Standard
Serial number				69001 and up		69001 and up	69001 and up
Work equipment	Type			Angledozer			
	Blade supporting method			Both sides: brace			
	Performance	Max. lift (above ground)	mm	1,180	—	—	—
		Max. drop (below ground)	mm	460	—	—	—
		Max. tilt	mm	400	—	—	—
		Max. angle	deg.	25	—	—	—
	Dimensions	Blade width	mm	3,970	—	—	—
		Blade height	mm	1,120	—	—	—
		Tip angle of blade cutting edge	deg.	55	—	—	—
	Type			Power tilt, power pitch dozer			
	Blade supporting method			Left: tilt cylinder, Right: pitch cylinder			
	Performance	Max. lift (above ground)	mm	1,105	—	1,165	—
		Max. drop (below ground)	mm	440	—	480	—
		Max. tilt	mm	870	—	890	—
		Blade edge angle variable range	deg.	±7	—	+9 / -7	—
	Dimensions	Blade width	mm	3,415	—	3,970	—
		Blade height	mm	1,225	—	1,110	—
		Tip angle of blade cutting edge	deg.	55	—	57	—
	Type			Semi-U, power tilt, power pitch dozer			
	Blade supporting method			Left: tilt cylinder, Right: pitch cylinder			
	Performance	Max. lift (above ground)	mm	1,105	—	—	1,105
		Max. drop (below ground)	mm	440	—	—	440
		Max. tilt	mm	855	—	—	820
		Blade edge angle variable range	deg.	±7	—	—	±7
	Dimensions	Blade width	mm	3,455	—	—	3,640
		Blade height	mm	1,480	—	—	1,410
		Tip angle of blade cutting edge	deg.	55	—	—	55
Ripper	Type			Parallelogram		—	Parallelogram
	Beam length		mm	2,170		—	2,170
	Number of shanks		piece	3		—	3
	Performance	Digging angle (A/B)	deg.	55 / 45		—	55 / 45
		Digging depth		Changeable to 3 levels		—	Changeable to 3 levels
		Max. digging depth	mm	595		—	595
		Max. lift	mm	640		—	640
		Shank position (left/right)	mm	950 / 950		—	950 / 950

Weight table

⚠ **This weight table is prepared for your reference when handling or transporting the components.**

Unit: kg

Machine name and type	D65EX-15E0		D65PX-15E0	D65WX-15E0
	Standard	Long track	Standard	Standard
Serial number	69001 and up		69001 and up	69001 and up
Engine and damper assembly (excluding coolant, oil)	1,000	1,000	1,000	1,000
• Engine assembly	860	860	860	860
• Damper assembly	48	48	48	48
• Engine-related parts (wiring, mount)	45	45	45	45
Universal joint	21	21	21	21
Cooling assembly (excluding coolant and oil)	125	125	125	125
• Radiator assembly	27	27	27	27
• Aftercooler assembly	21	21	21	21
• Hydraulic oil cooler	3	3	3	3
Cooling fan pump	28	28	28	28
Cooling fan motor	13	13	13	13
Fuel tank (excluding fuel)	200	200	200	200
Power train unit assembly (excluding oil)	1,435	1,435	1,435	1,435
• Torque converter and PTO assembly	290	290	290	290
• Transmission assembly	340	340	340	340
• Transmission ECMV assembly	13	13	13	13
• Main relief valve assembly	6	6	6	6
• HSS unit assembly	710	710	710	710
• Brake valve assembly	6	6	6	6
HSS motor	45	45	45	45
HSS pump	65	65	65	65
Power train and lubrication pump	20	20	20	20
Scavenging pump	5	5	5	5
Hydraulic tank (excluding oil)	75	75	75	75
Control valve				
• 3-spool valve	84	84	84	84
• 4-spool valve (machine with ripper: if equipped)	95	95	—	95
Final drive assembly (each side)	765	765	790	790
Sprocket teeth (each side)	8.3 x 9	8.3 x 9	8.3 x 9	8.3 x 9
Frame assembly	2,140	2,140	2,140	2,140
Engine underguard	130	130	130	130
Transmission underguard	30	30	30	30

Unit: kg

Machine name and type	D65EX-15E0		D65PX-15E0	D65WX-15E0
	Standard	Long track	Standard	Standard
Serial number	69001 and up		69001 and up	69001 and up
Undercarriage assembly (each side)	1,495	1,695	1,695	1,495
·Track frame	590	700	700	590
• Idler assembly (each side)	200	200	200	200
• Recoil spring assembly (each side)	250	250	250	250
• Single flange track roller assembly (each side)	54 x 5	54 x 6	54 x 6	54 x 5
• Double flange track roller assembly (each side)	61 x 2	61 x 2	61 x 2	61 x 2
• Carrier roller assembly (each side)	30 x 2	30 x 2	30 x 2	30 x 2
Track shoe assembly (each side)				
• Single grouser shoe (510 mm)	1,310	1,580	—	—
• Single grouser shoe (810 mm)	—	—	—	1,735
• Single grouser shoe (915 mm)	—	—	2,160	—
Pivot shaft (each side)	90	90	100	100
Equalizer bar	125	125	145	145
Floor frame assembly	300	300	300	300
Operator seat	59	59	59	59
Cab assembly	410	410	410	410
ROPS guard assembly (for cab)	220	220	220	220
ROPS canopy assembly	410	410	410	410
Semi-U dozer assembly	2,280	2,280	—	2,360
Power tilt dozer assembly	—	—	2,030	—
• Blade	1,355	1,355	1,190	1,365
• Straight frame (each side)	285	285	285	315
• Tilt cylinder assembly	75	75	75	75
Lift cylinder assembly	95 x 2	95 x 2	95 x 2	95 x 2
Ripper assembly	1,530	1,530	—	1,530
Ripper cylinder assembly	75	75	—	75

Table of fuel, coolant and lubricants

★ For details of notes (Notes 1 and 2...) in the table, see Operation and Maintenance Manual.

Reservoir	Fluid Type	Ambient Temperature, degrees Celsius -22 -4 14 32 50 68 86 104 122 °F -30 -20 -10 0 10 20 30 40 50 °C	Recommended Komatsu Fluids
Engine oil pan	Engine oil	SAE0W30EOS (HTHS Over 3.5) (Note.1)	Komatsu EOS0W30
		SAE5W40EOS (HTHS Over 3.5) (Note.1)	Komatsu EOS5W40
		SAE10W30DH	Komatsu EO10W30DH
		SAE15W40DH	Komatsu EO15W40DH
		SAE30DH	Komatsu EO30DH
Damper case Idler (each)	Power train oil (Note.2)	TO30	TO30
Power train case	Power train oil	TO10	TO10
		TO30	TO30
Final drive case (each)	Power train oil	TO30	TO30
Hydraulic system	Power train oil	TO10	TO10
	Hydraulic oil	HO46-HM	HO46-HM
	Engine oil	SAE10W30DH	Komatsu EO10W30DH
		SAE15W40DH	Komatsu EO15W40DH
Grease fitting	Hyper grease (Note.3)	G2-T, G2-TE	G2-T, G2-TE
	Lithium EP grease	G2-LI	G2-LI
Cooling system	Supercoolant AF-NAC	AF-NAC (Note.4)	AF-NAC
Fuel tank	Diesel fuel	No.2-D	ASTM No.2-D
		No.1-D	ASTM No.1-D

★ Although SAE10W30DH and SAE15W40DH are specified to be used as engine oil for engine oil pan, SAE10W30 (API CH4, CI-4) and SAE15W40 (API CH4, CI-4) can be used instead respectively.

Unit:ℓ

Supply point	Specified capacity	Refill capacity
Engine oil pan	33	28
Damper case	1.3	1.3
Idler (each of right and left)	0.15	0.15
Hydraulic oil system	95	55
Power train case	68	48
Final drive case (each of right and left)	EX: 24 PX: 27 WX: 27	EX: 24 PX: 27 WX: 27
Fuel tank	415	—
Cooling system (including sub-tank)	37	—

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00057-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

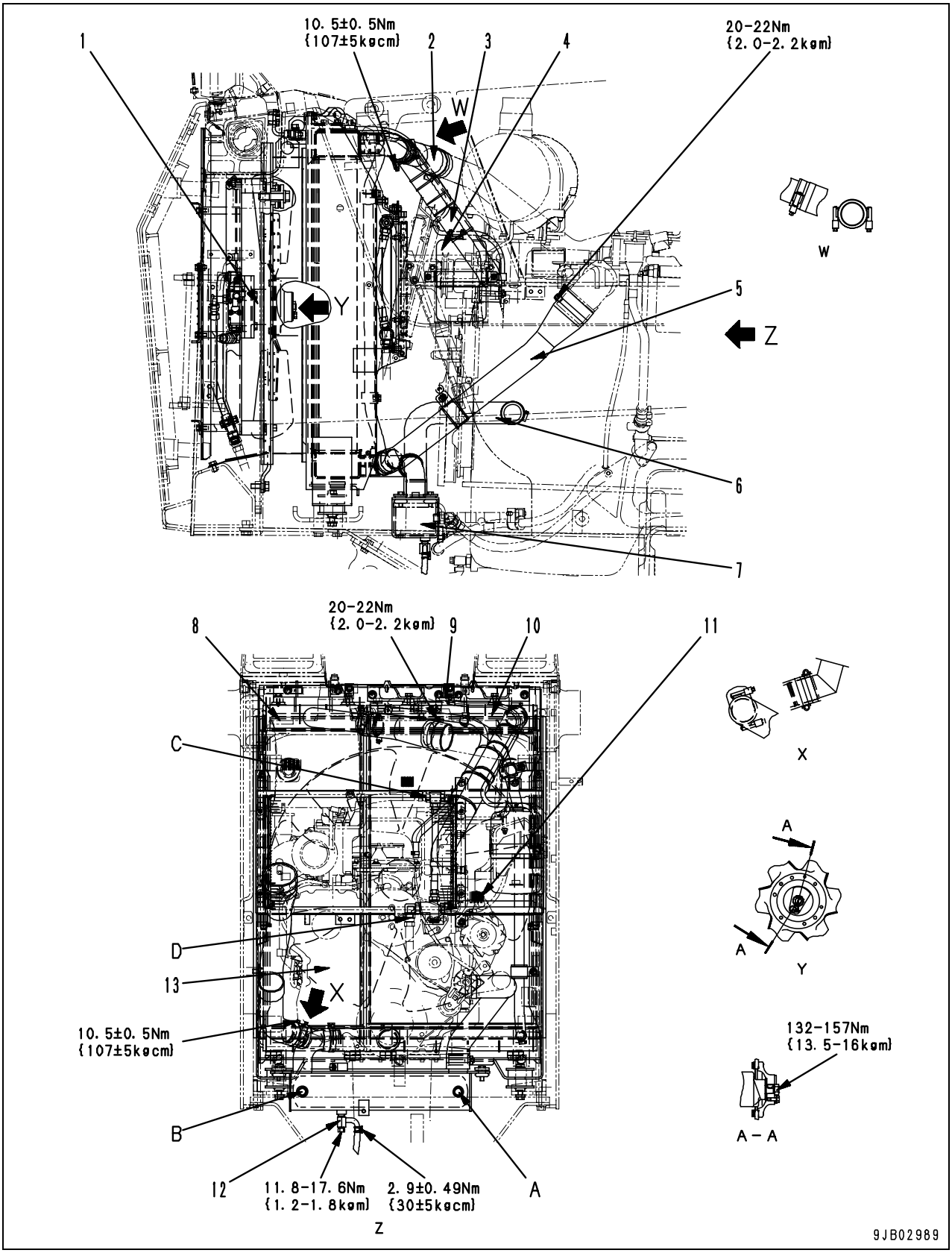
Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

10 Structure, function and maintenance standard

Engine and cooling system

Engine and cooling system

Cooling system



A: Power train oil cooler inlet
B: Power train oil cooler outlet
C: Hydraulic oil cooler inlet
D: Hydraulic oil cooler outlet

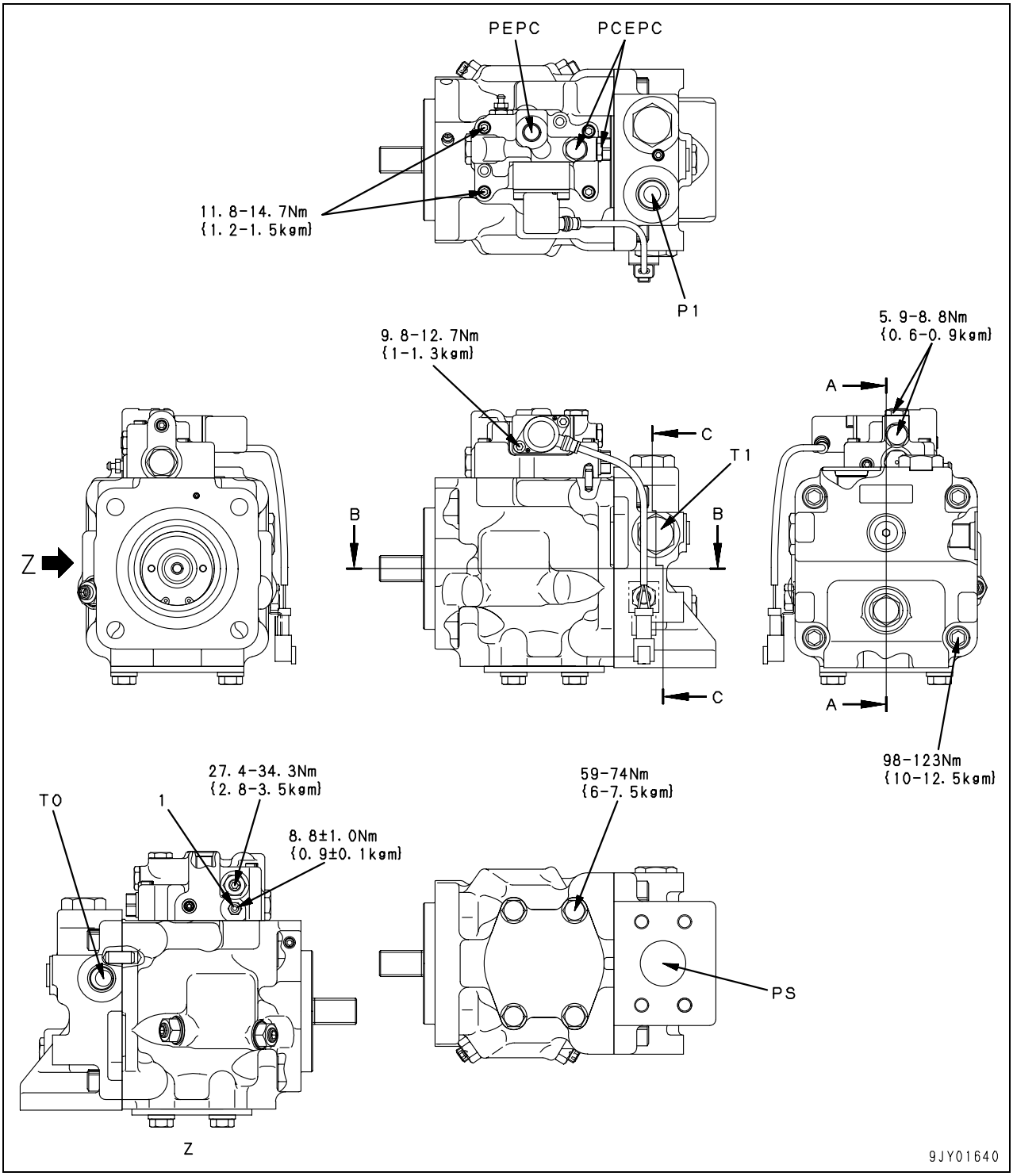
1. Cooling fan motor
2. Aftercooler inlet hose
3. Radiator inlet hose
4. Reservoir tank
5. Aftercooler outlet hose
6. Radiator outlet hose
7. Power train oil cooler
8. Aftercooler
9. Radiator cap
10. Radiator
11. Hydraulic oil cooler
12. Drain plug
13. Cooling fan

Specifications

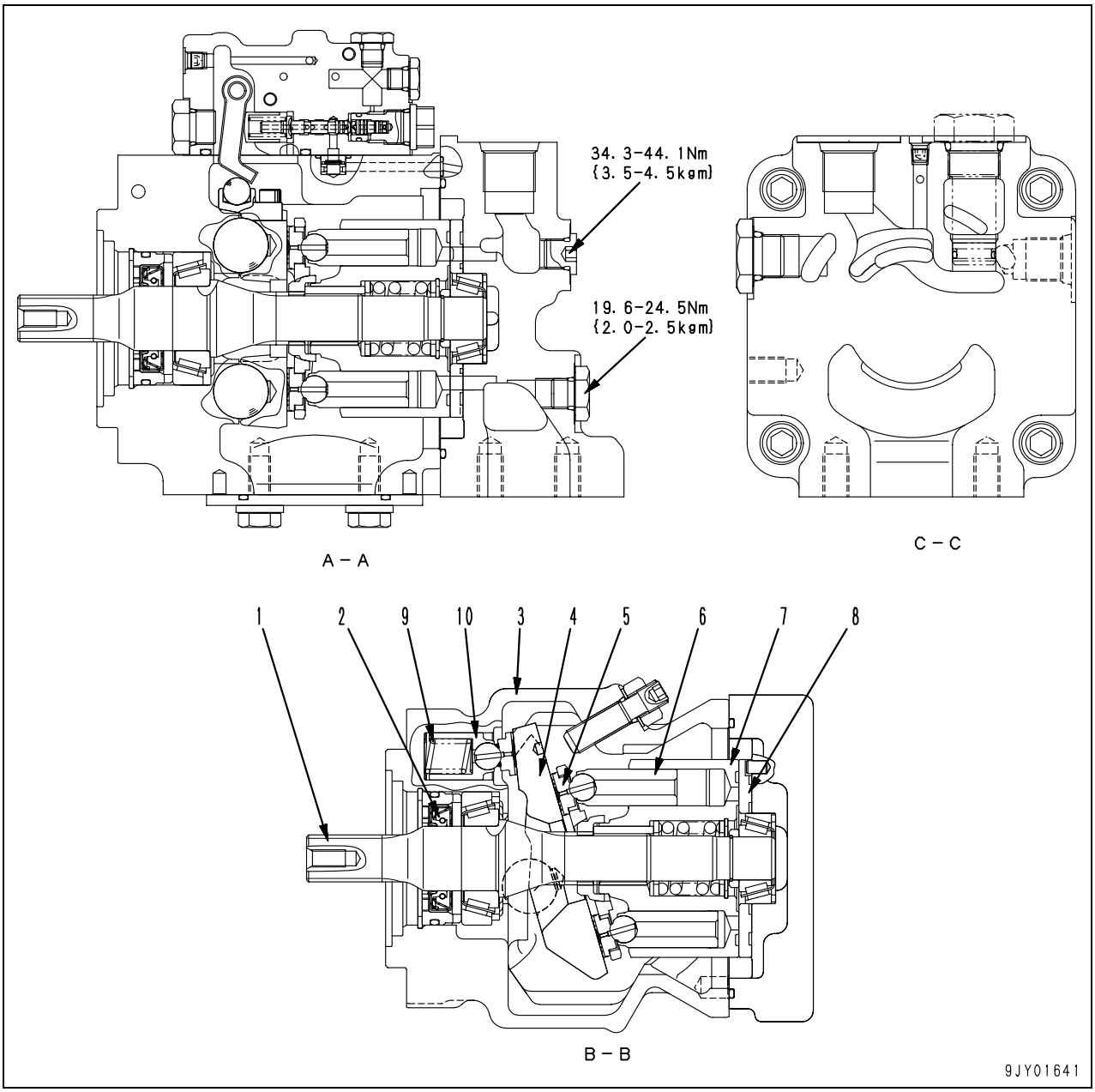
	Radiator	Power train oil cooler	Hydraulic oil cooler	Aftercooler
Core type	Corrugated aluminum	PTO-OL	Corrugated aluminum	Corrugated aluminum
Fin pitch (mm)	8.0/2	—	8.0/2	8.0/2
Total heat dissipation surface (m^2)	52.97	1.722	1.53	20.74
Cracking pressure of pressure valve (kPa {kg/cm^2})	88.3 ± 14.7 {0.9 ± 0.15}	—	—	—
Cracking pressure of vacuum valve (kPa {kg/cm^2})	0 – 4.9 {0 – 0.05}	—	—	—

Cooling fan pump

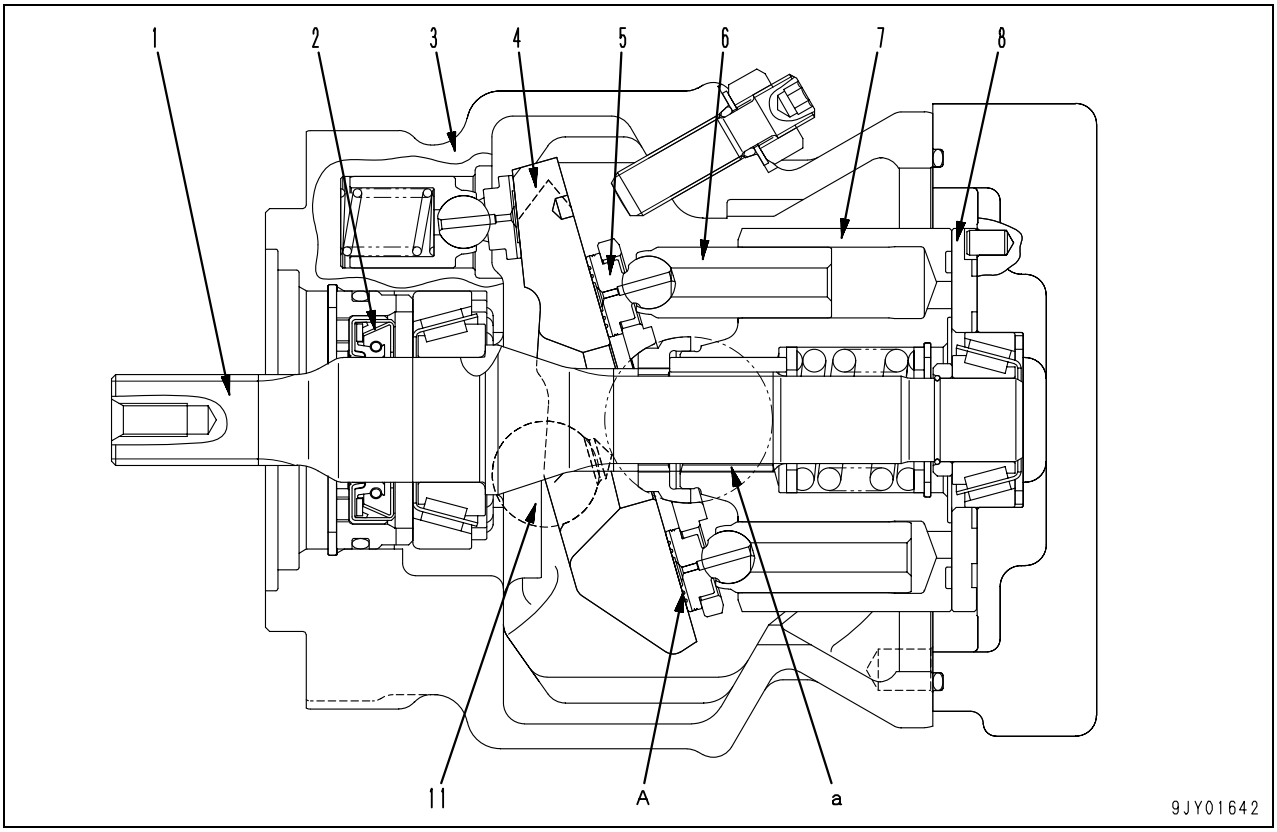
Type: LPV30



P1: Pump discharge
PS: Pump suction
T0: Drain
T1: Drain plug
PEPC: EPC valve basic pressure input
PCEPC: EPC output pressure detection plug



1. Shaft
2. Oil seal
3. Case
4. Rocker cam
5. Shoe
6. Piston
7. Cylinder block
8. Valve plate
9. Spring
10. Servo piston



Function

- The pump converts the engine rotation transmitted to its shaft to oil pressure and delivers pressurized oil corresponding to the load.
- It is possible to change the discharge amount by changing the swash plate angle.

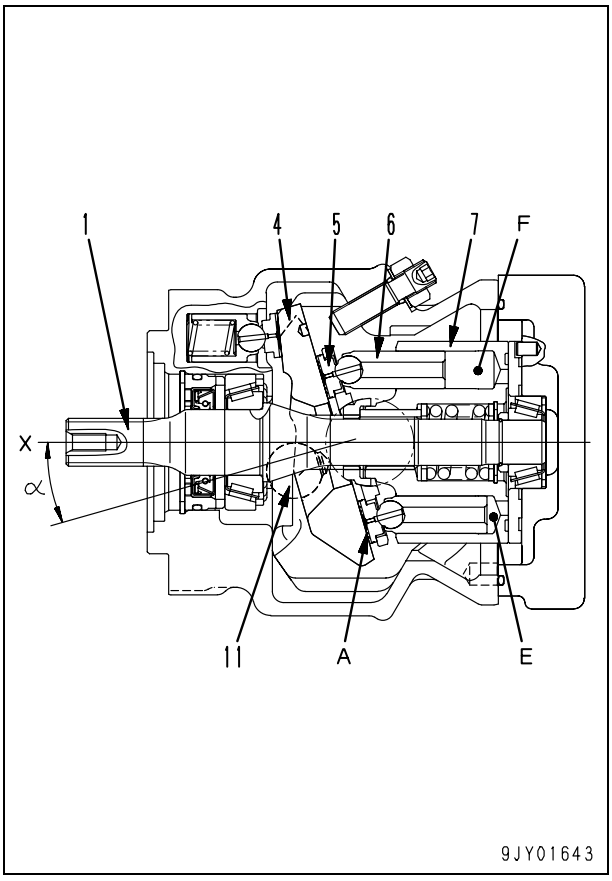
Structure

- Cylinder block (7) is supported to shaft (1) by spline (a), and shaft (1) is supported by the front and rear bearings.
- The tip of piston (6) is a concave ball, and shoe (5) is caulked to it to form one unit. Piston (6) and shoe (5) form a spherical bearing.
- Rocker cam (4) has flat surface (A), and shoe (5) is always pressed against this surface as it slides in a circle. Rocker cam (4) also slides around ball (11) using it as fulcrum.
- Piston (6) carries out relative movement in the axial direction inside each cylinder chamber of cylinder block (7).
- Cylinder block (7) carries out rotation relative to valve plate (8) while sealing the pressurized oil, and this surface ensures that the hydraulic balance is maintained correctly.
- The oil inside each cylinder chamber of cylinder block (7) is sucked in and discharged through valve plate (8).

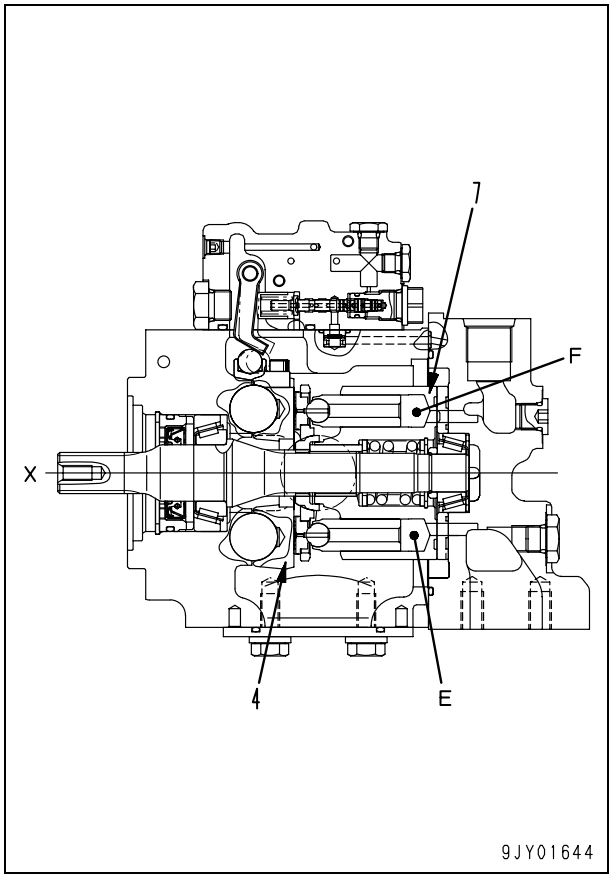
Operation

1. Operation of pump

- Cylinder block (7) rotates together with shaft (1), and shoe (5) slides on flat surface (A). At this time, rocker cam (4) tilts around ball (11). As a result, angle (α) between center line (X) of rocker cam (4) and the axis of cylinder block (7) changes. (α) is called the swash plate angle.
- If angle (α) is made between center line (X) of rocker cam (4) and the axis of cylinder block (7), flat surface (A) works as a cam for shoe (5).
- Accordingly, piston (6) slides inside cylinder block (7) and a difference is made between volumes (E) and (F) in cylinder block (7). As a result, each piston (6) sucks and discharges oil by (F) – (E).
- In other words, cylinder block (7) rotates, and the volume of chamber (E) becomes smaller, so pressurized oil is discharged during this process. At the same time, the volume of chamber (F) becomes larger and the oil is sucked in this process. [In the figure, chamber (F) is at the end of the suction stroke and chamber (E) is at the end of the discharge stroke.]

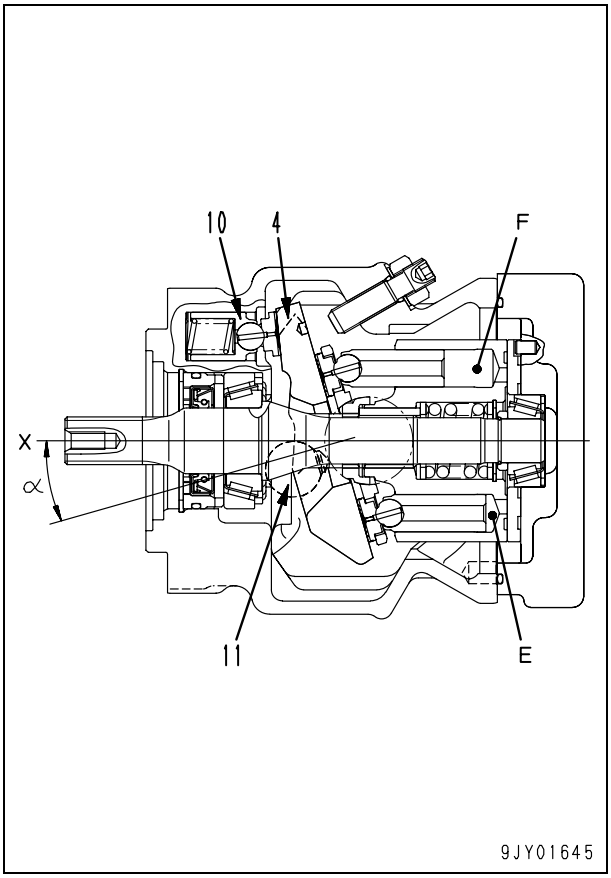


- When center line (X) of rocker cam (4) is the same as the axial direction of cylinder block (7) [swash plate angle = 0], the difference between volumes (E) and (F) inside cylinder block (7) is 0, so pump does not suck and discharge, and no pumping is carried out. [The swash plate angle is not set to 0 actually, however.]
- Swash plate angle (α) and the pump discharge amount is in relation of proportion.

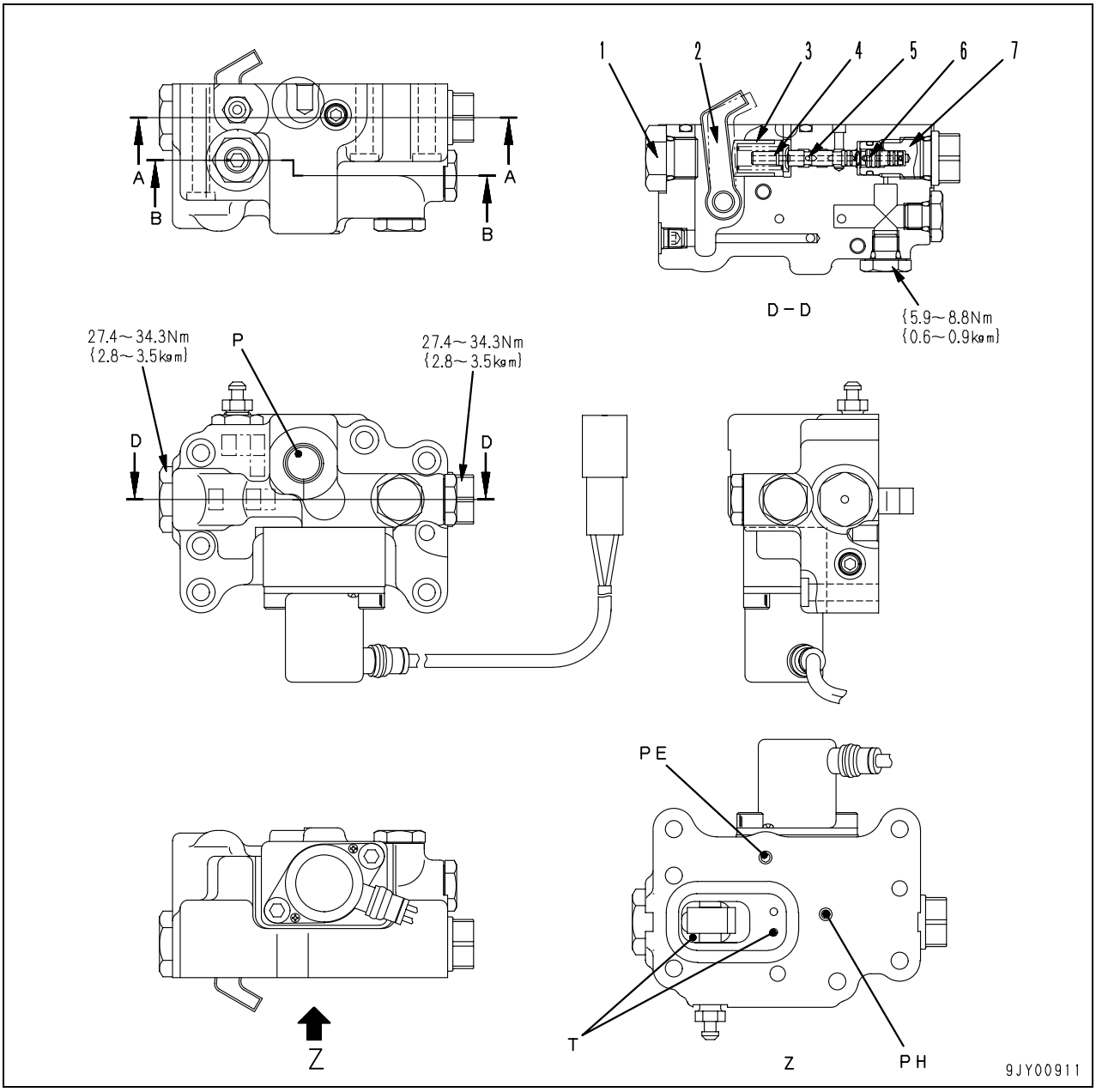


2. Control of discharge

- If swash plate angle (α) is increased, the difference between volume (E) and (F) is increased, or discharge (Q) is increased. Swash plate angle (α) is changed with servo piston (10).
- Servo piston (10) reciprocates straight according to the signal pressure of the servo valve. This straight line motion is transmitted to rocker cam (4). Then, rocker cam (4) supported on ball (11) sways around ball (11).

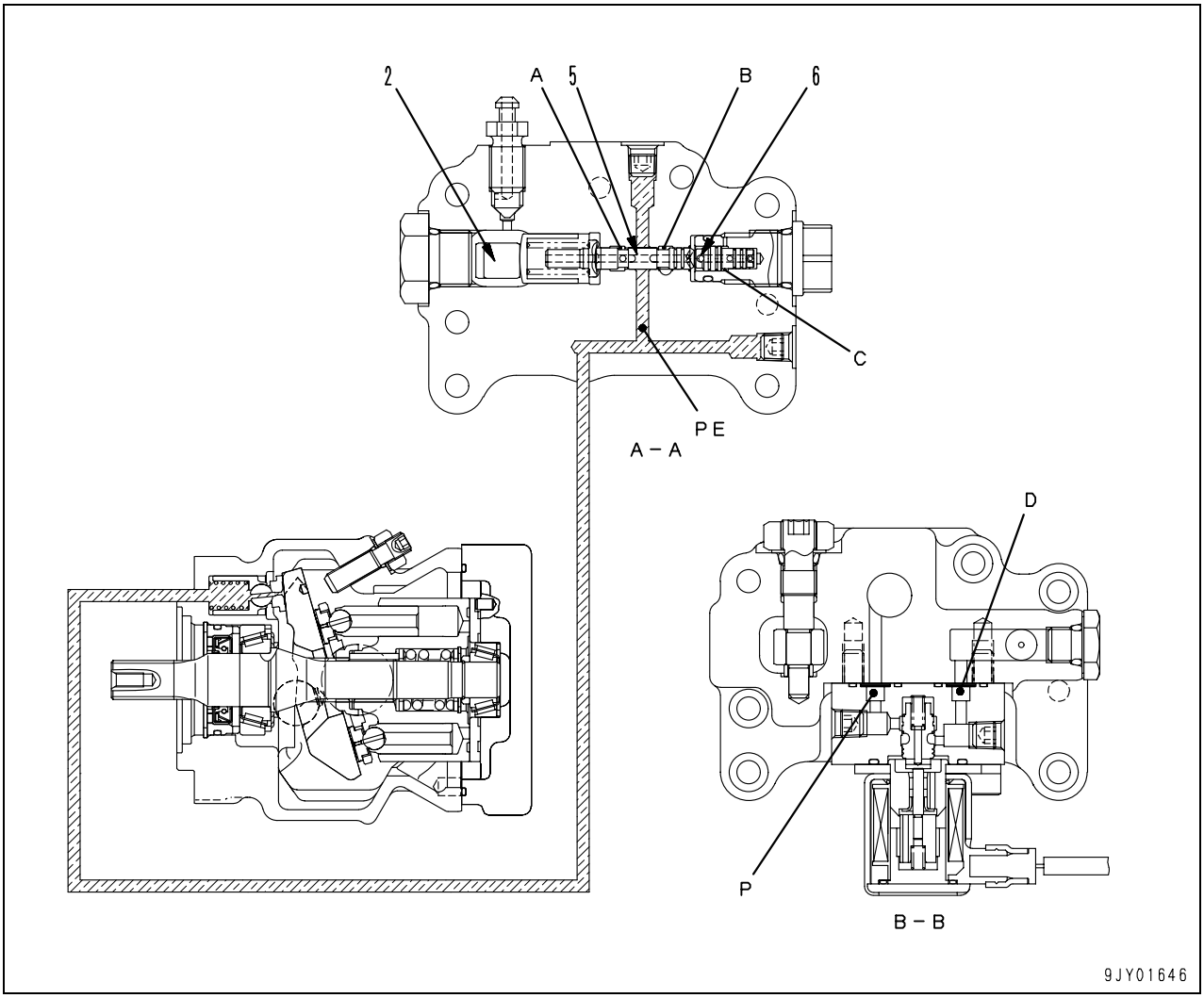


Servo valve



P: EPC valve basic pressure
T: Drain
PE: Control piston pressure
PH: Pump discharge pressure

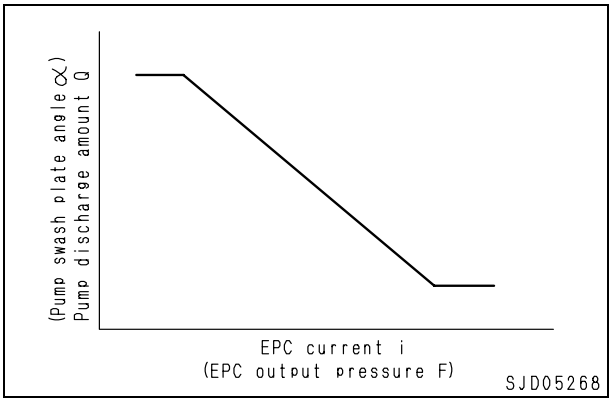
1. Plug
2. Lever
3. Retainer
4. Seat
5. Spool
6. Piston
7. Sleeve



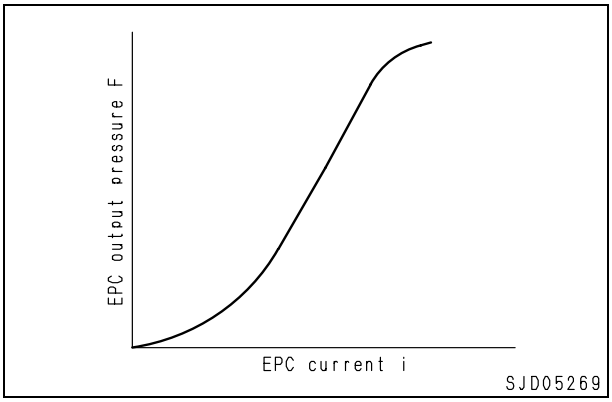
A: Drain side
B: Pump discharge pressure input side
C: EPC output pressure received
D: EPC output pressure

Function

- The servo valve controls the current input to the EPC valve and the swash plate angle of the pump so that they will be related as shown in the diagram.



- The relationship between the input current (i) to the EPC valve and output pressure (F) of EPC valve is as follows.

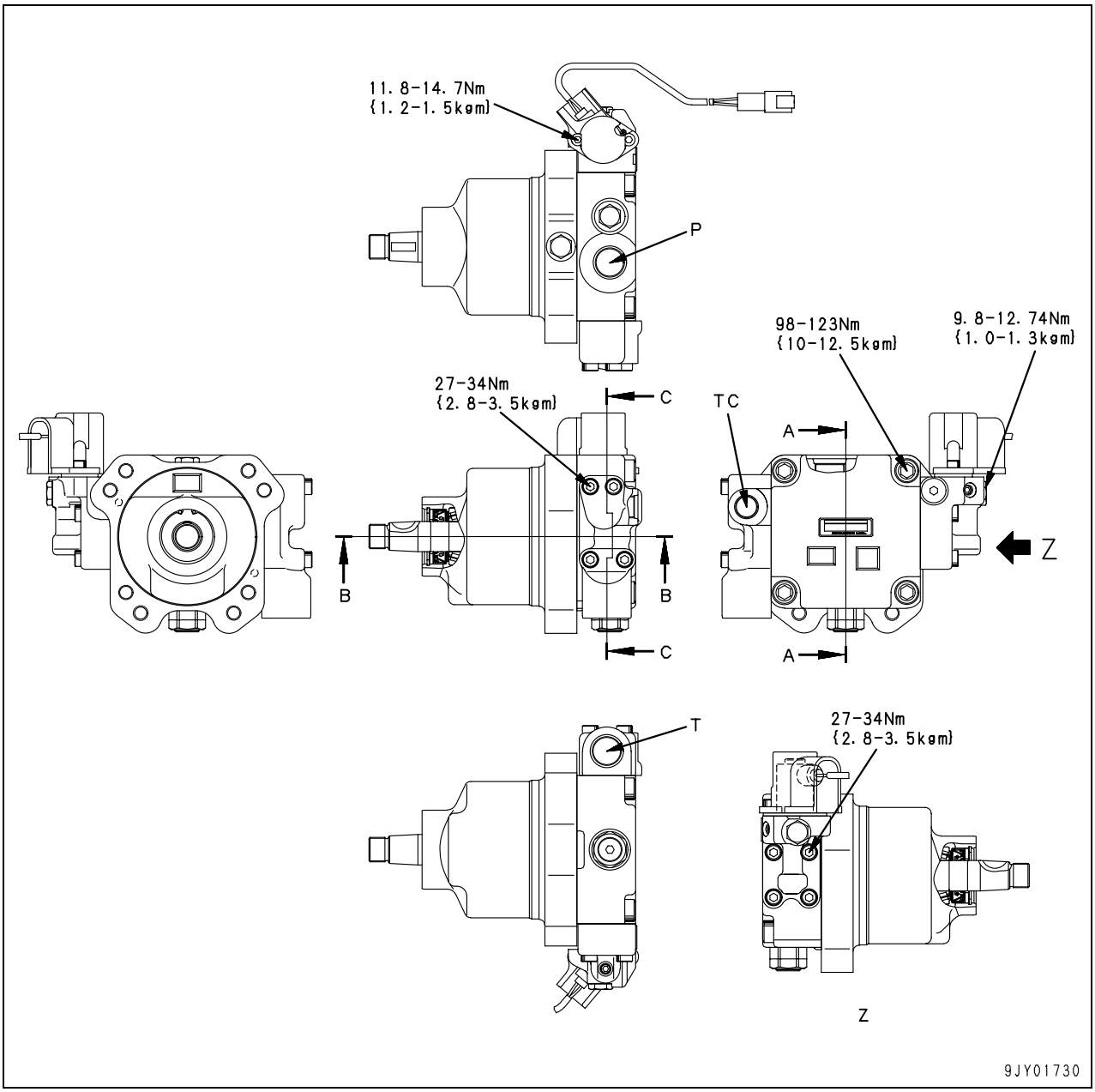


Operation

- The output pressure of EPC valve is applied to piston chamber (C) to push piston (6). Piston (6) pushes spool (5) until it is balanced with the spring.
- Then, land (PE) of the servo piston pressure passage is connected to the pump discharge passages by the notch of spool (5) and the discharge pressure is led to the servo piston.
- The servo piston is raised by the rocker com. Then, the position feedback is applied and the lever moves to compress the spring.
- If spool (5) is pushed back, the pump discharge circuit and the servo piston circuit are shut off. The pressure in the servo piston chamber lowers and the rocker cam returns toward the maximum swash plate angle.
- These processes are repeated until the swash plate is fixed to a position where the EPC output is balanced with the spring force.
- Accordingly, as the EPC output pressure is heightened, the swash plate angle is decreased. As the EPC output pressure is lowered, the swash plate angle is increased.

Cooling fan motor

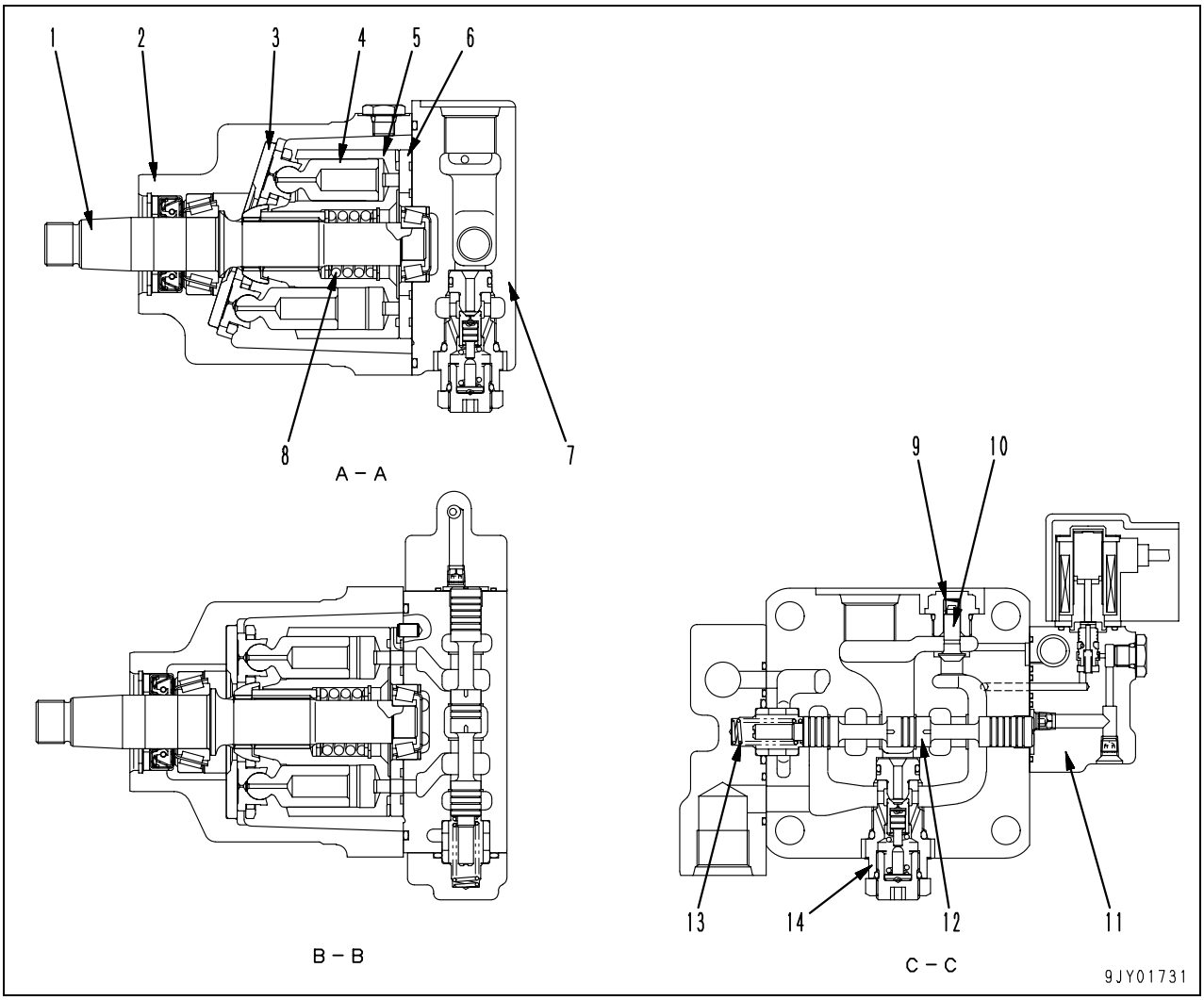
Type: LMF28



P: From fan pump
T: From cooler to tank
TC: To tank

Specifications

Type	: LMF28
Capacity	: 28.0 cc/rev
Rated speed	: 1,850 rpm
Rated flow rate	: 51.8 ℓ/min
Cracking pressure of check valve	: 0.044 MPa {0.45 kg/cm^2}



1. Output shaft
2. Case
3. Thrust plate
4. Piston assembly
5. Cylinder block
6. Valve plate
7. End cover
8. Center spring
9. Check valve spring
10. Check valve
11. Pilot valve
12. Spool for reversible valve
13. Spring for reversible valve
14. Safety valve

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
9	Check valve spring	Free length x outer diameter	Installation length	Installation load	Free length	Installation load	Replace spring if damaged or deformed.
		13.0 x 6.5	7.0	3.43 N {0.35 kg}	—	2.55 N {0.26 kg}	

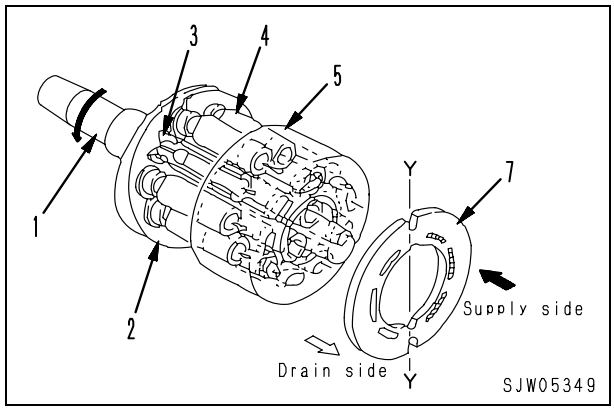
1. Hydraulic motor unit

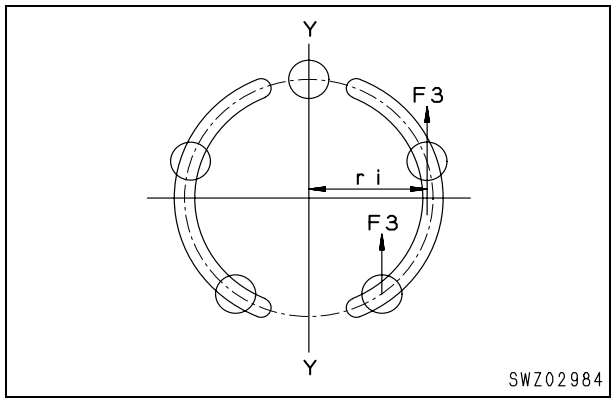
Function

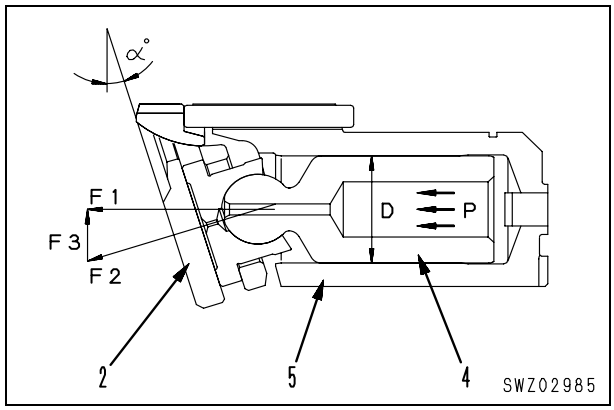
- This hydraulic motor is called a swash plate-type axial piston motor. It converts the energy of the pressurized oil sent from the hydraulic pump into rotary motion.

Principle of operation

- The oil sent from the hydraulic pump flows through valve plate (7) into cylinder block (5). This oil can flow on only one side of the (Y-Y) line connecting the top dead center and bottom dead center of the stroke of piston (4).
- The oil sent to one side of cylinder block (5) presses piston (4) [2 or 3 pieces], and generates force (F1)[F1 = P x $\pi D^2/4$].
- This force is applied to thrust plate (2). Since thrust plate (2) is fixed to the angle of ($\alpha°$) to output shaft (1), the force is divided into components (F2) and (F3).
- The radial component (F3) generates torque [T = F3 x ri] against the (Y – Y) line connecting the top dead center and bottom dead center.
- The result of this torque [T = Σ(F3 x ri)] rotates cylinder block (5) through the piston.
- Since this cylinder block (5) is splined to the output shaft, the output shaft revolves to transmit the torque.







2. Suction valve

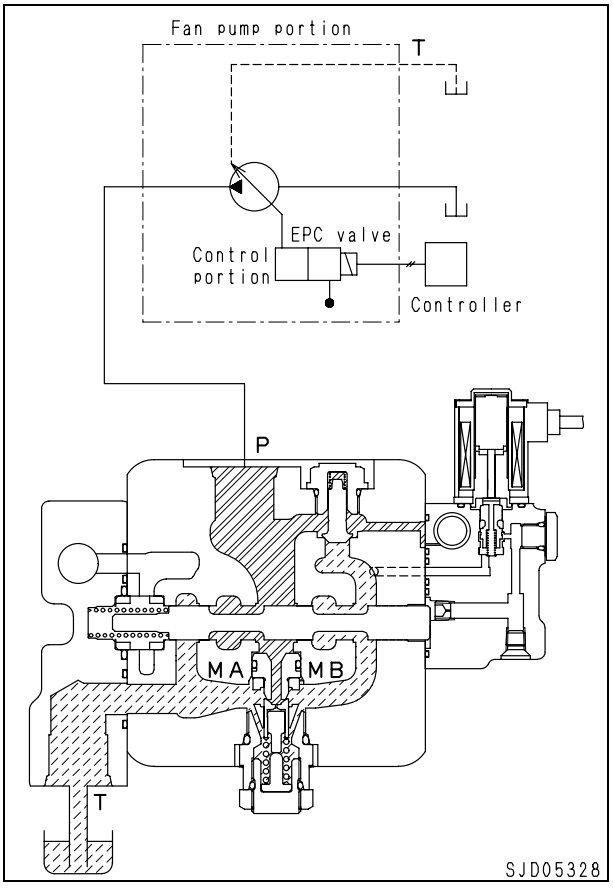
Function

- If the fan pump stops, the pressurized oil does not flow into the motor. Since the motor continues revolution because of the force of inertia, however, the pressure on the outlet side of the motor rises.
- When the oil stops flowing in from inlet port (P), the suction valve sucks in the oil on the outlet side and supplies it to port (MA) where there is not sufficient oil to prevent cavitation.

Operation

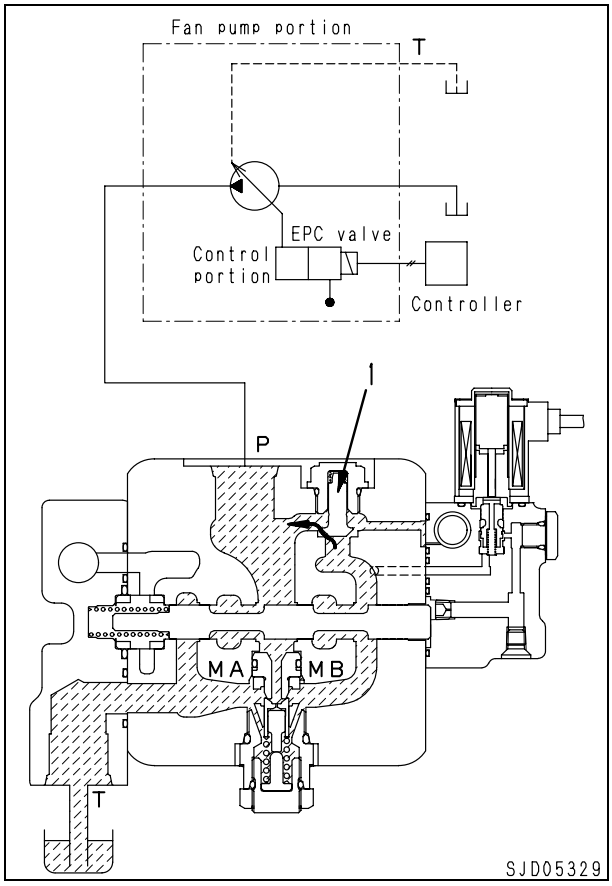
(1) When starting

- If the pressurized oil from the pump is supplied to port (P) and the pressure on (MA) side rises and starting torque is generated in the motor, the motor starts revolution. The oil on motor outlet (MB) side of the motor returns through port (T) to the tank.



(2) When stopping

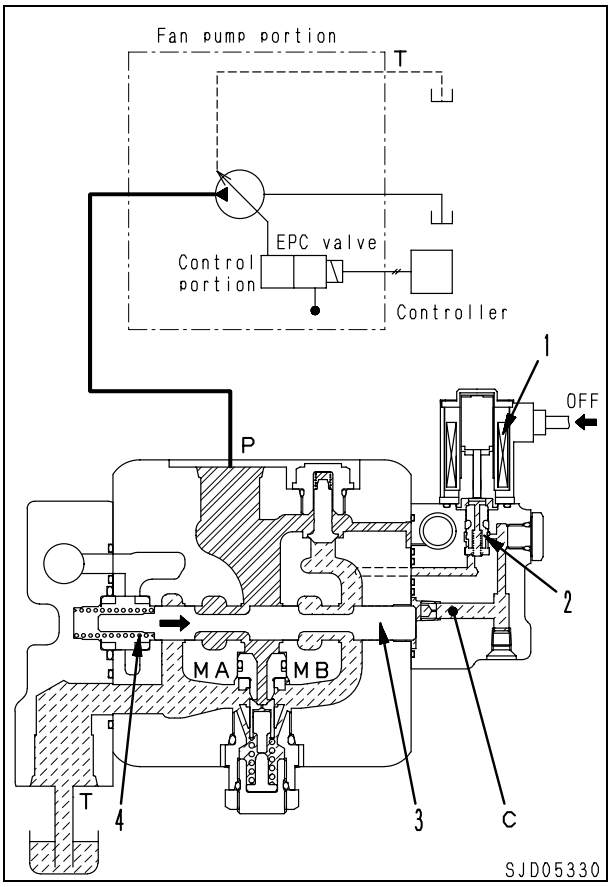
- If the engine is stopped and the input revolution of the fan pump lowers to 0 rpm, the pressurized oil from the pump is not supplied to port (P) any more. As the pressurized oil is not supplied to (MA) side of the motor, the motor speed lowers gradually to stop.
- If the motor shaft is revolved by the force of inertia while the oil flow in port (P) is reducing, the oil in port (T) on the outlet side is sent by suction valve (1) to (MA) side to prevent cavitation.



3. Operation of reversible valve

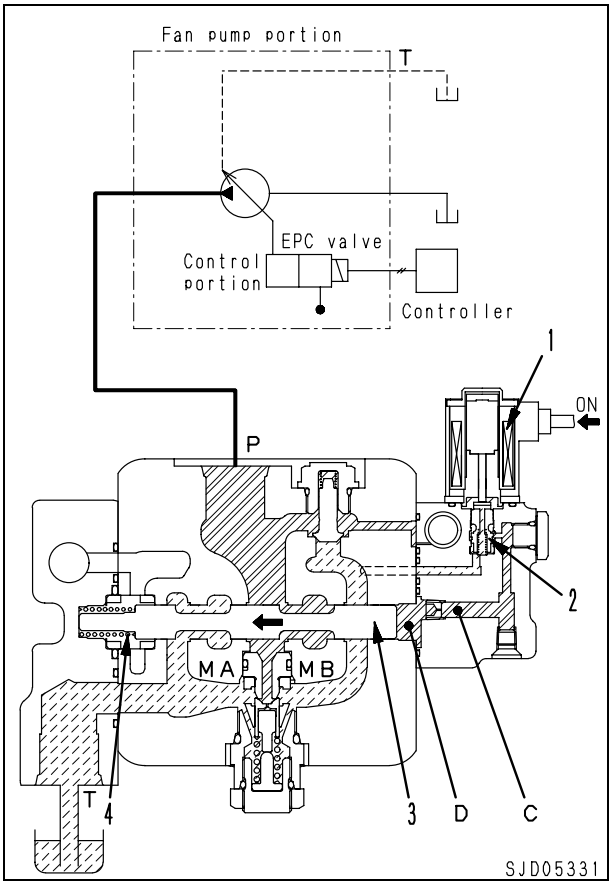
(1) When the ON-OFF solenoid for the reversible valve is demagnetized

- If ON-OFF solenoid (1) for the reversible valve is “demagnetized“, the pressurized oil from the pump is blocked by ON-OFF selector valve (2), and port (C) opens for the tank circuit.
- Accordingly, reversible valve spool (3) is pushed by reversible valve spring (4) to the right to open motor port (MA) and then the pressurized oil flows in to revolve the motor forward (clockwise).

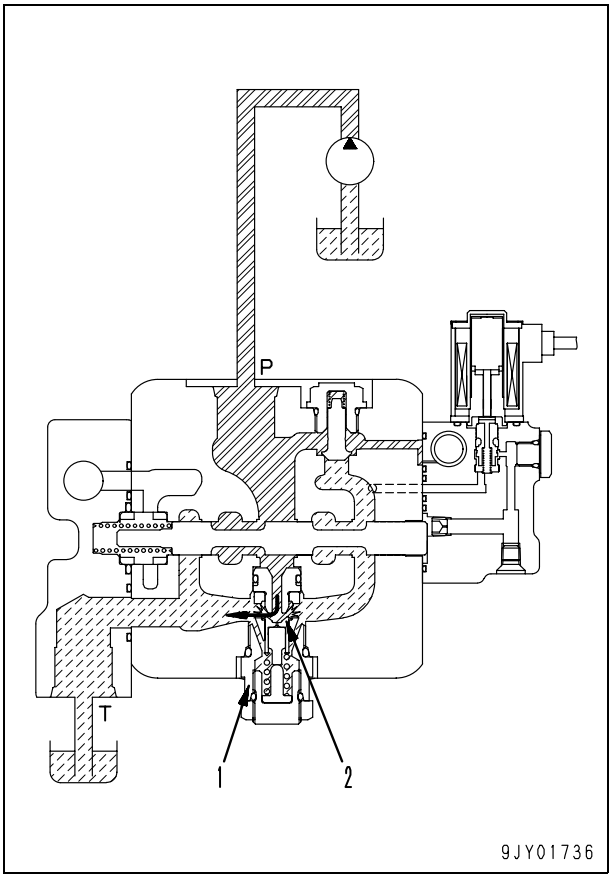


(2) When ON-OFF solenoid for reversible valve is energized

- If ON-OFF solenoid (1) for reversible valve is “energized“, ON-OFF selector valve (2) changes to let the pressurized oil from the pump flow through port (C) into spool chamber (D).
- The pressurized oil in chamber (D) pushes reversible valve spool (3) to the left against reversible valve spring (4). As a result, motor port (MB) opens and pressurized oil flows in to revolve the motor in reverse (counterclockwise).



4. Safety valve



Function

- When the engine is started, the pressure in port (P) of the fan motor is heightened in some cases.
- Safety valve (1) is installed to protect the fan system circuit.

Operation

- If the pressure in port (P) rises above the cracking pressure of safety valve (1), valve (2) of safety valve (1) opens to release the pressurized oil into port (T).
- By this operation, generation of abnormal pressure in port (P) is prevented.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00281-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

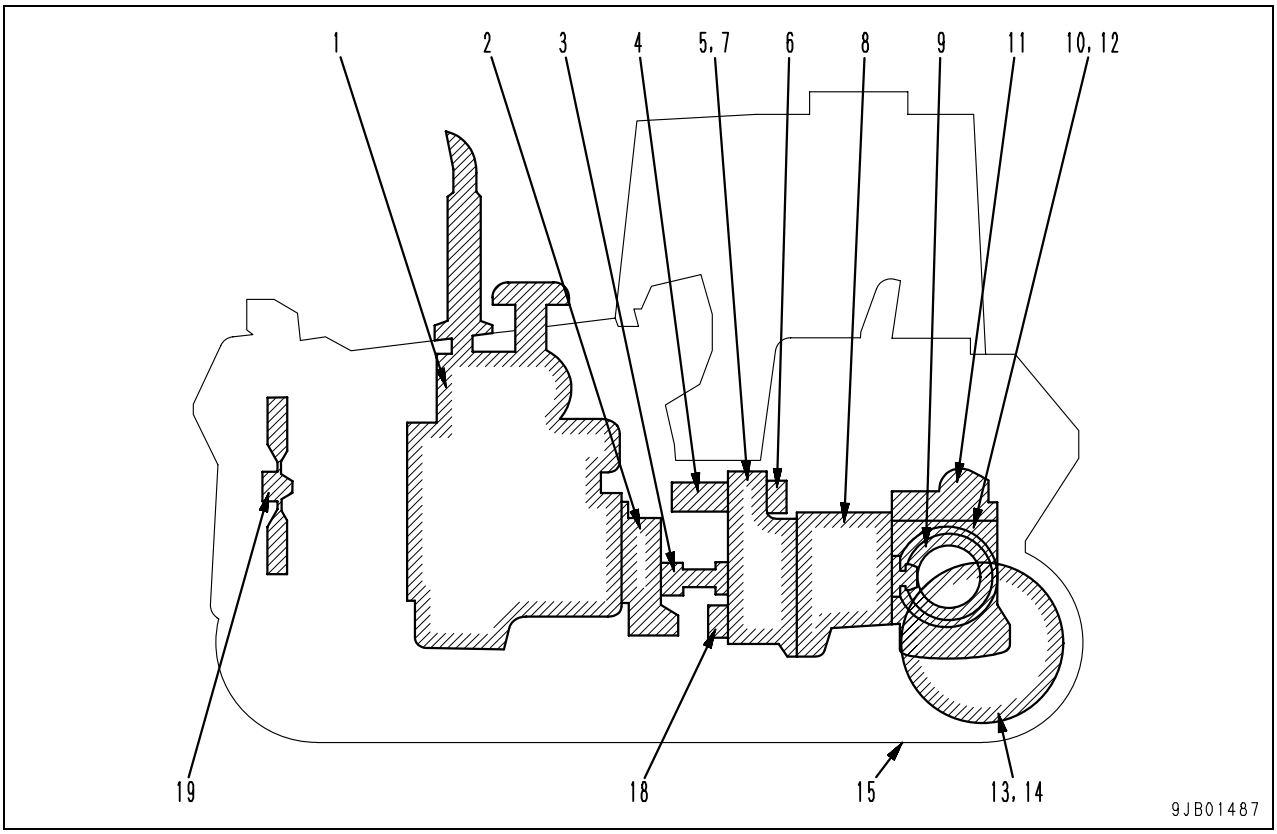
Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

10 Structure, function and maintenance standard

Power train, Part 1

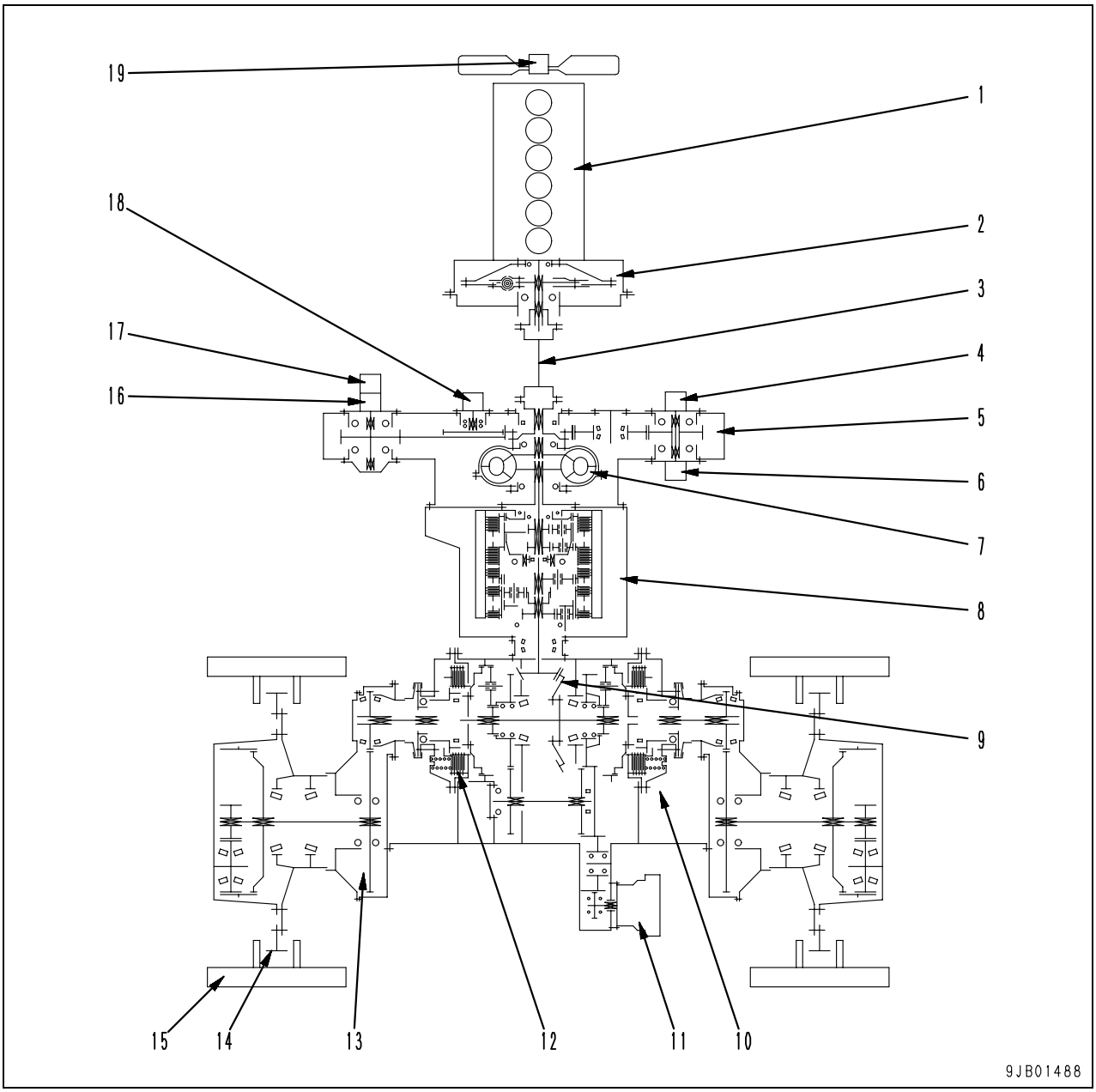
Power train, Part 1

Power train



Outline

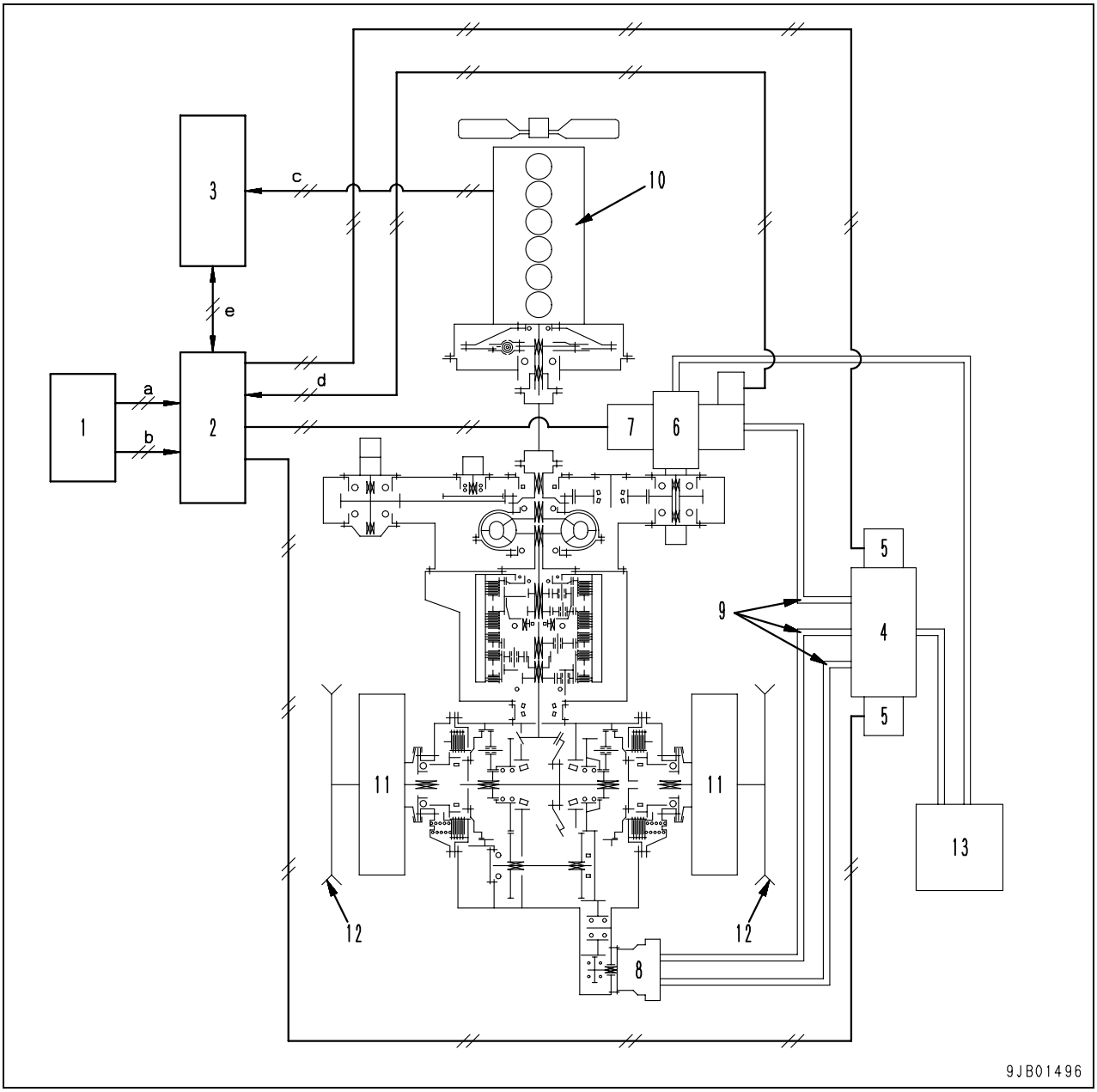
- The power generated by engine (1) has its torsional vibration dampened by damper (2), and then passes through universal joint (3) and is transmitted to torque converter (7).
- The power from the engine is transmitted through the oil by torque converter (7) to the transmission input shaft in accordance with the change in load.
- Transmission (8) uses a combination of a planetary gear system and hydraulic clutches to reduce the speed and shift the gears (3 forward speeds and 3 reverse speeds). It connects 2 sets of clutches selected according to the change in load and transmits the power to bevel gear (9) from the bevel pinion at the rear end of the transmission.
- The power transmitted to HSS unit (10) is transmitted through the bevel gear shaft to the HSS.
  HSS pump (4) is driven by PTO (5), and discharged oil of the HSS pump drives HSS motor (11).
  The rotation of the pair of the HSS gears on the right and left is controlled by HSS motor (11). The steering direction is controlled by generating a difference in speed on the right and left.
  It is also possible to use the HSS mechanism to rotate the right and left sides in opposite directions to carry out counter-rotation.
- Brake (12) built in HSS unit (10) is used for braking the machine. Brake (12) is a wet, multiple disc clutch and spring boosted type.
  The power sent from brake (12) is transmitted to final drive (13).
- Final drive (13) consists of a single-stage spur gear and a single-stage planetary gear system. It reduces the speed and rotates sprocket (14) to drive track shoe (15) and move the machine.
- Cooling fan motor (19) is rotated with the oil discharged from cooling fan pump (6) driven by PTO (5).



1. Engine
2. Damper
3. Universal joint
4. HSS pump
5. PTO
6. Cooling fan pump
7. Torque converter
8. Transmission
9. Bevel gear
10. HSS unit
11. HSS motor
12. Brake
13. Final drive
14. Sprocket
15. Track shoe
16. Power train pump
17. Lubrication pump
18. Scavenging pump
19. Cooling fan motor

HSS system

★ HSS: Abbreviation for Hydrostatic Steering System



1. Steering/directional/gear shift lever (PCCS lever)
2. Transmission and steering controller
3. Engine controller
4. Control valve
5. EPC valve
6. HSS pump
7. Servo valve
8. HSS motor
9. HSS circuit
10. Engine
11. Final drive
12. Sprocket
13. Hydraulic tank

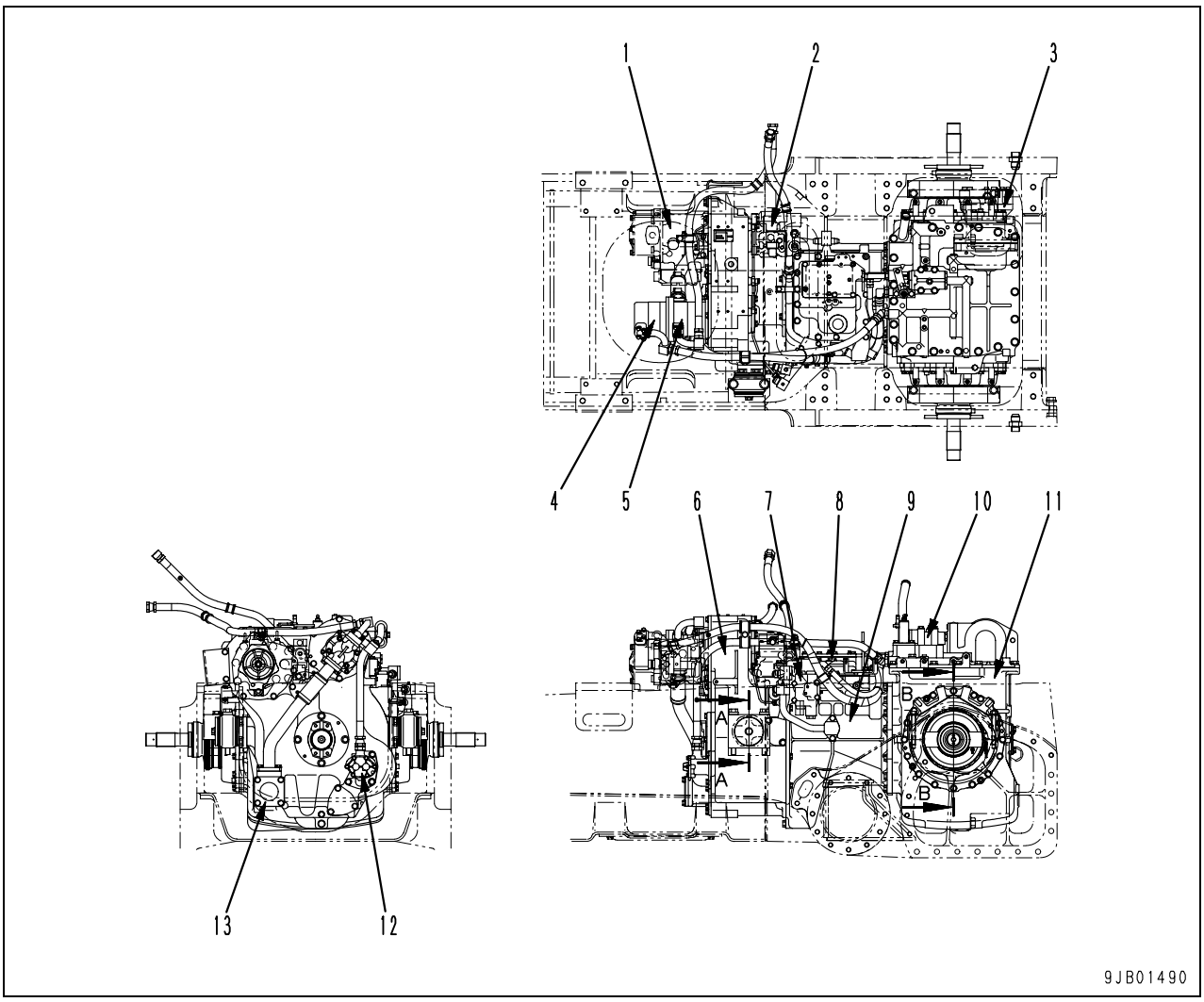
Input and output signals

a. Forward and reverse signals
b. Steering signal
c. Engine control information
d. Work equipment oil pressure signal
e. CAN communication network

Outline

- The HSS system consists of control valve (4), HSS pump (6) and HSS motor (8). It turns the machine continuously without lowering the traveling speed by making a difference in speed between both track shoes.
- Transmission and steering controller (2) controls EPC valve (5) of control valve (4) to control the rotating direction and the rotating speed of HSS motor (8) according to the tilting direction and angle of directional/steering/gear shift lever (1).
  HSS motor (8) acts on the planetary gear mechanism of the bevel gear shaft making a difference in speed between both sprockets (12) to turn the machine.
- Transmission and steering controller (2) senses the engine speed and the oil pressure at each part, and controls HSS pump (6) and control valve (4) so that engine (10) will not stall.
- The engine speed signal and other engine control information items are sent and received through the CAN communication network which connects engine controller (3) and transmission and steering controller (2).

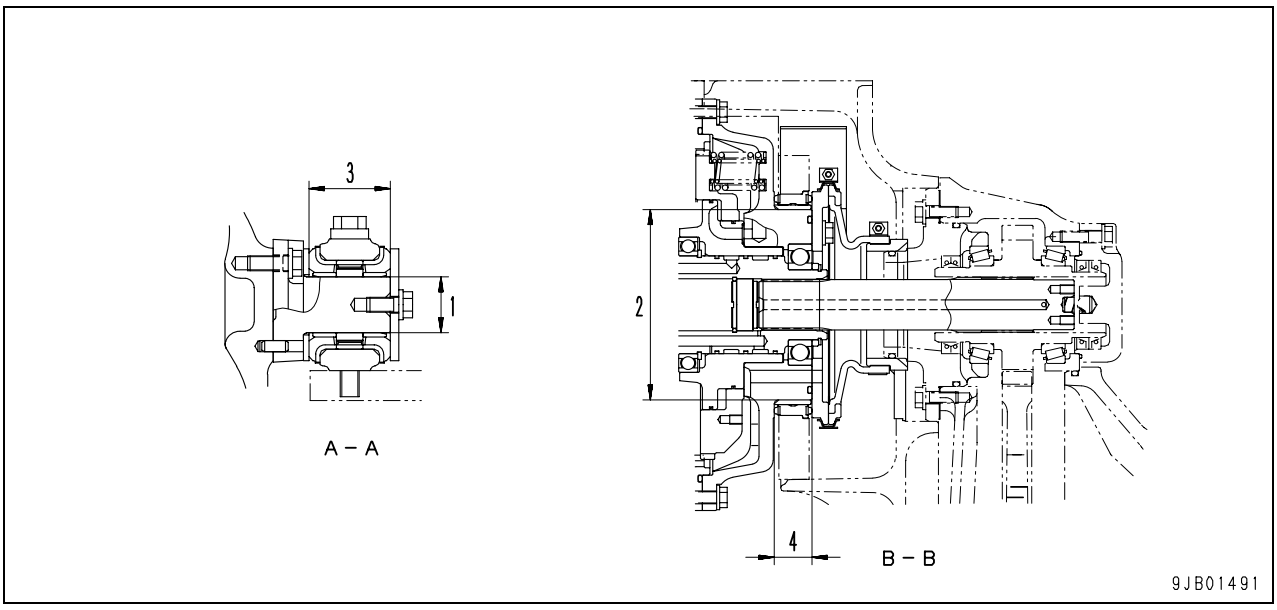
General view of power train unit



1. HSS pump
2. Cooling fan pump
3. HSS motor
4. Lubrication pump
5. Power train pump
6. Torque converter and PTO
7. Main relief valve
8. Transmission ECMV
9. Transmission
10. Brake valve
11. HSS unit
12. Scavenging pump
13. Power train oil strainer

Outline

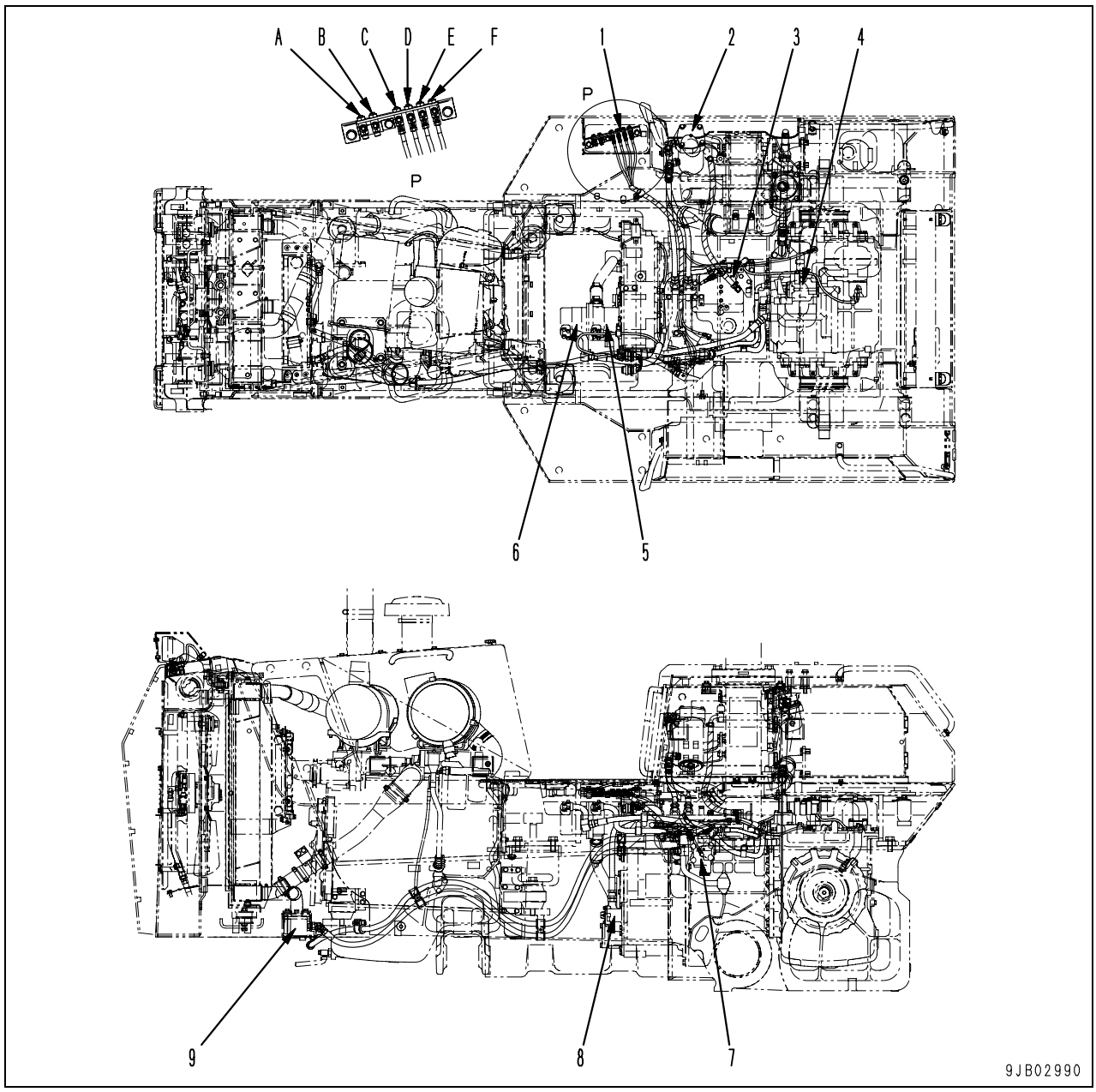
- The power train unit broadly consists of torque converter and PTO (6), transmission (9), and HSS unit (11). Therefore, after the power train unit is removed, it can be divided into torque converter and PTO (6), transmission (9), and HSS unit (11).
- HSS unit (11) consists of the bevel gear unit, bevel gear, HSS motor (3), planetary gear mechanism and brake.



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between bracket and cushion	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		60	–0.100 –0.300	+0.046 +0	0.100 – 0.346	0.4	
2	Clearance between steering case cover and bushing	204	+0.096 +0.050	+0.046 +0	–0.096 – –0.004	Max. 0	
3	Free height of front mount rubber	Standard size			Repair limit		
		90			88		
4	Free height of rear mount rubber	43			41		

Power train hydraulic piping drawing

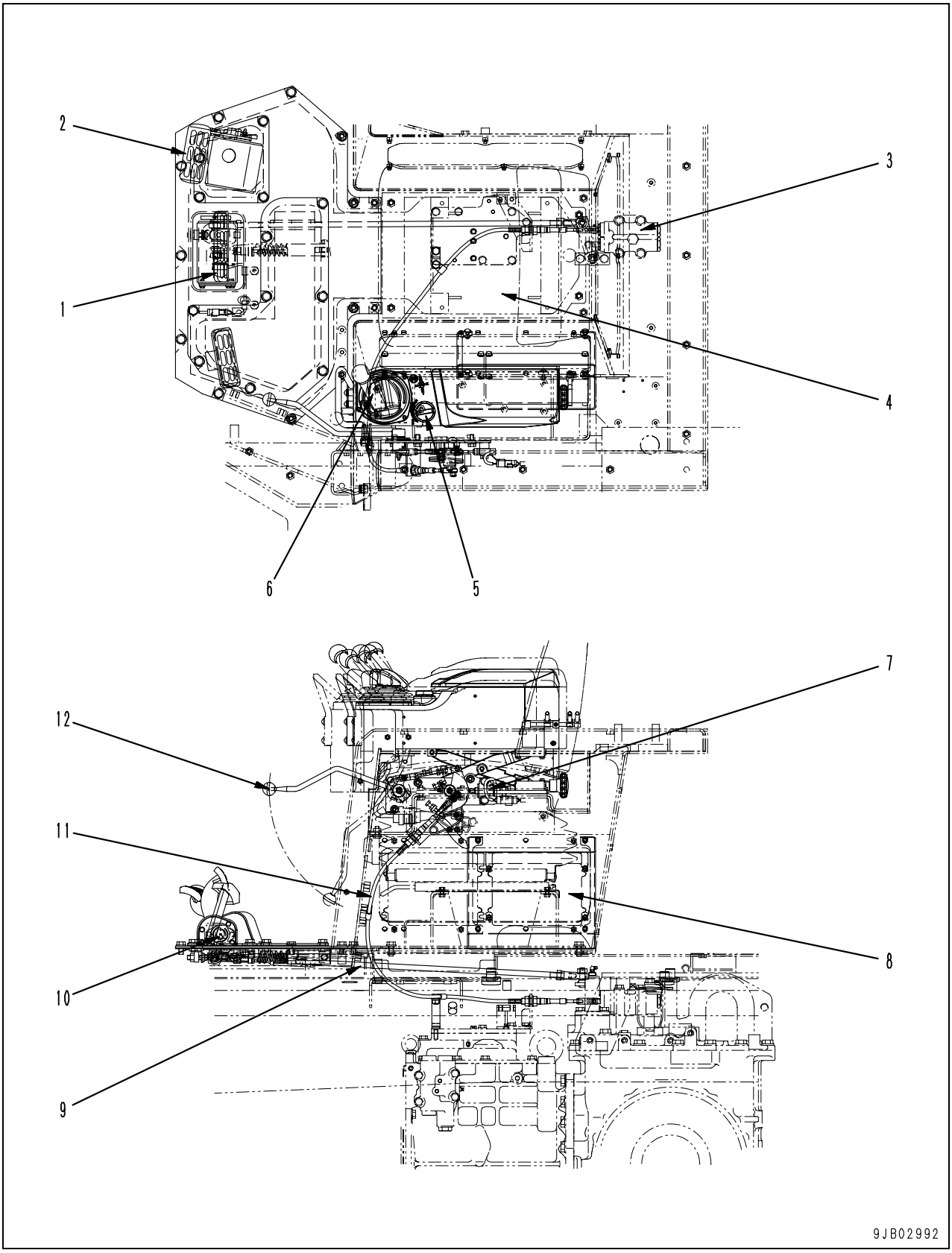


A: Load sensing oil pressure pick-up port
B: Main pump delivery oil pressure pick-up port
C: Transmission oil pressure pick-up port
D: Torque converter outlet oil pressure pick-up port
E: Torque converter inlet oil pressure pick-up port
F: Brake oil pressure pick-up port

1. Centralized pressure pick-up port
2. Power train oil filter
3. Transmission ECMV
4. Brake valve
5. Power train pump
6. Lubrication pump
7. Main relief valve
8. Scavenging pump
9. Power train oil cooler

Transmission, steering and brake control

★ PCCS: Abbreviation for Palm Command Control System

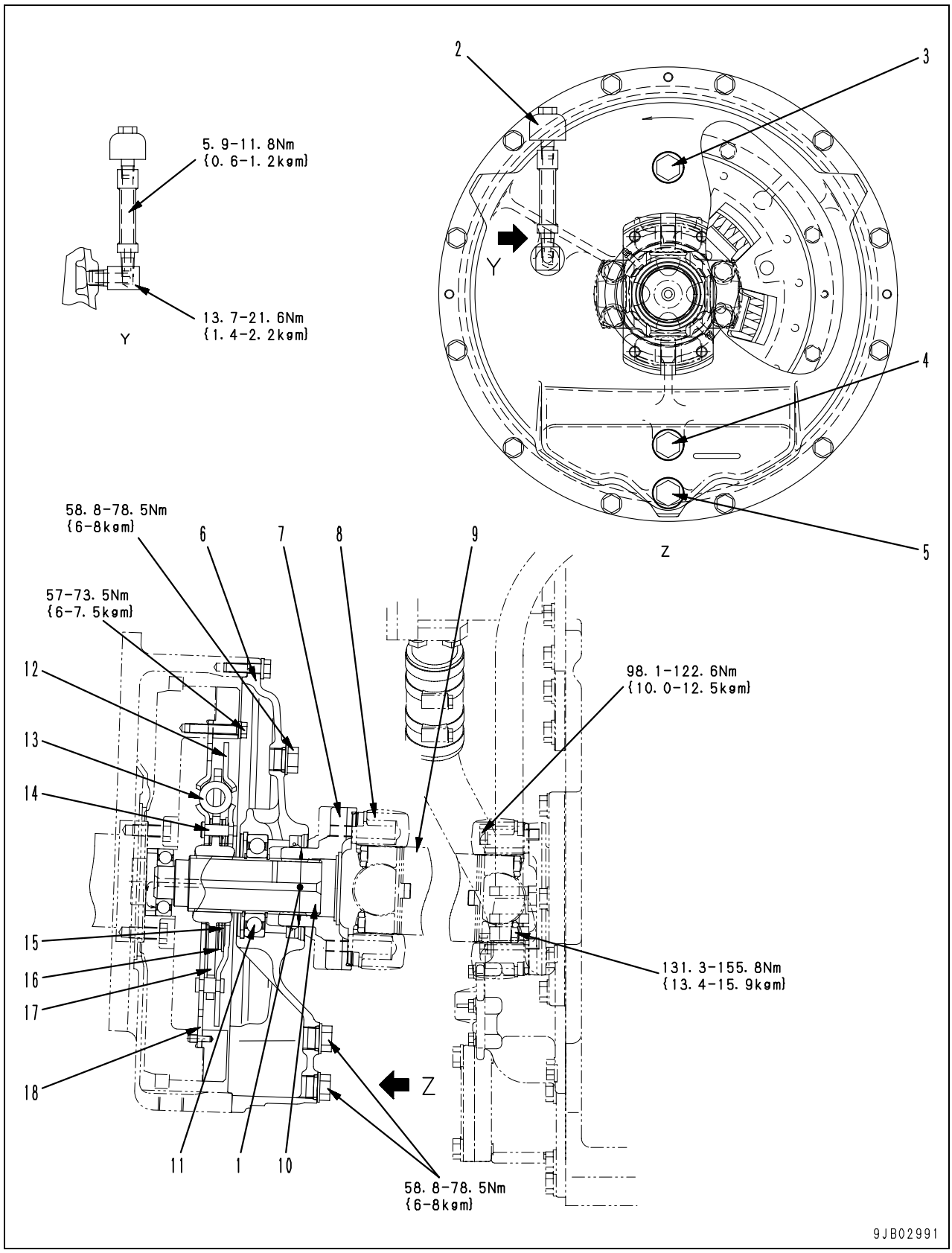


1. Brake pedal
2. Decelerator pedal
3. Brake valve
4. Transmission ECMV
5. Fuel control dial
6. Steering/directional/gear shift lever (PCCS lever)
7. Neutral safety limit switch
8. Transmission and steering controller
9. Rod
10. Brake potentiometer
11. Cable
12. Parking brake lever

Outline

- The transmission, steering system, and brake are controlled with steering/directional/gear shift lever (PCCS lever) (6).
- Steering/directional/gear shift lever (6) sends electric signals to transmission and steering controller (8). Upon receiving these electric signals, the transmission and steering controller sends signals to the EPC valve of the control valve to change the discharge of the HSS pump and control the HSS motor.
- Brake pedal (1) operates brake valve (3) through rod (9) to control the brake.
- Parking brake lever (12) operates brake valve (3), which is also used as the parking brake valve, through cable (11).
- If parking brake lever (12) is not set in the “lock“ position, neutral safety limit switch (7) does not work, thus the engine does not start.

Damper and universal joint



Unit: mm

No.	Check item	Criteria			Remedy
1	Outside diameter of oil seal contact surface of coupling	Standard size	Tolerance	Repair limit	Repair by hard chrome plating or replace
		85	0 –0.087	84.8	
—	Facial and radial runout of coupling	Facial runout: Max. 1.0 (at ϕ148.38), radial runout: Max. 1.5 (when damper shaft and transmission input shaft are rotated simultaneously)			Adjust

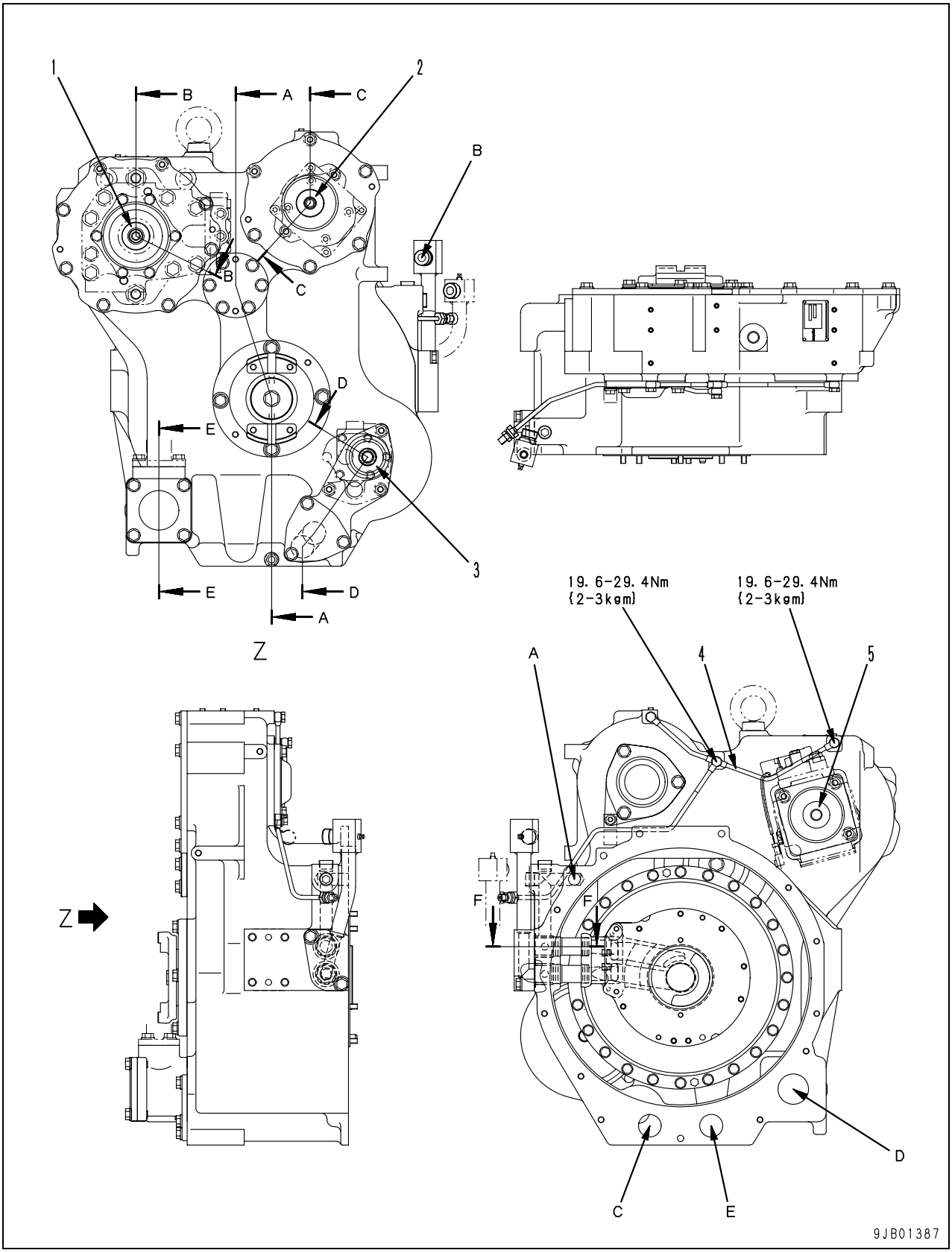
2. Breather
3. Oil filler plug
4. Inspection plug
5. Drain plug
6. Damper case
7. Coupling
8. Spider
9. Yoke
10. Shaft
11. Bearing
12. Drive plate
13. Torsion spring
14. Stopper pin
15. Friction plate
16. Friction spring
17. Hub
18. Cover

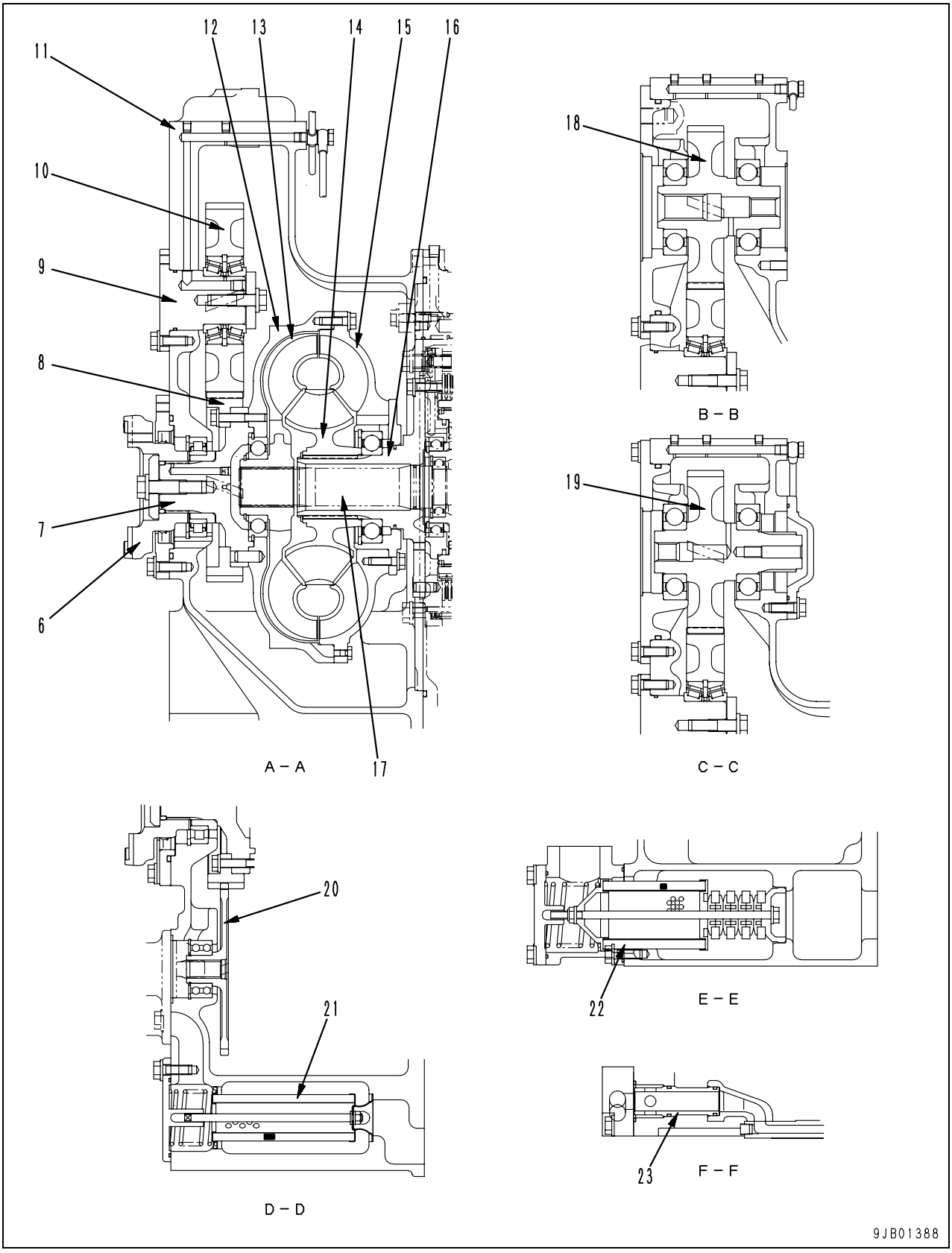
Outline

- The damper is a wet friction spring type.
  Stopper angle: 4°
  Stopper torque: 2,670 Nm {272 kgm}
- The damper dampens the torsional vibration caused by the engine torque fluctuation and the impact torque generated when accelerating suddenly or carrying out heavy-duty operation mode. In this way it acts to protect the torque converter, transmission, and other parts of the power train.

Torque converter and PTO

★ PTO: Abbreviation for Power Take Off

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12
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15
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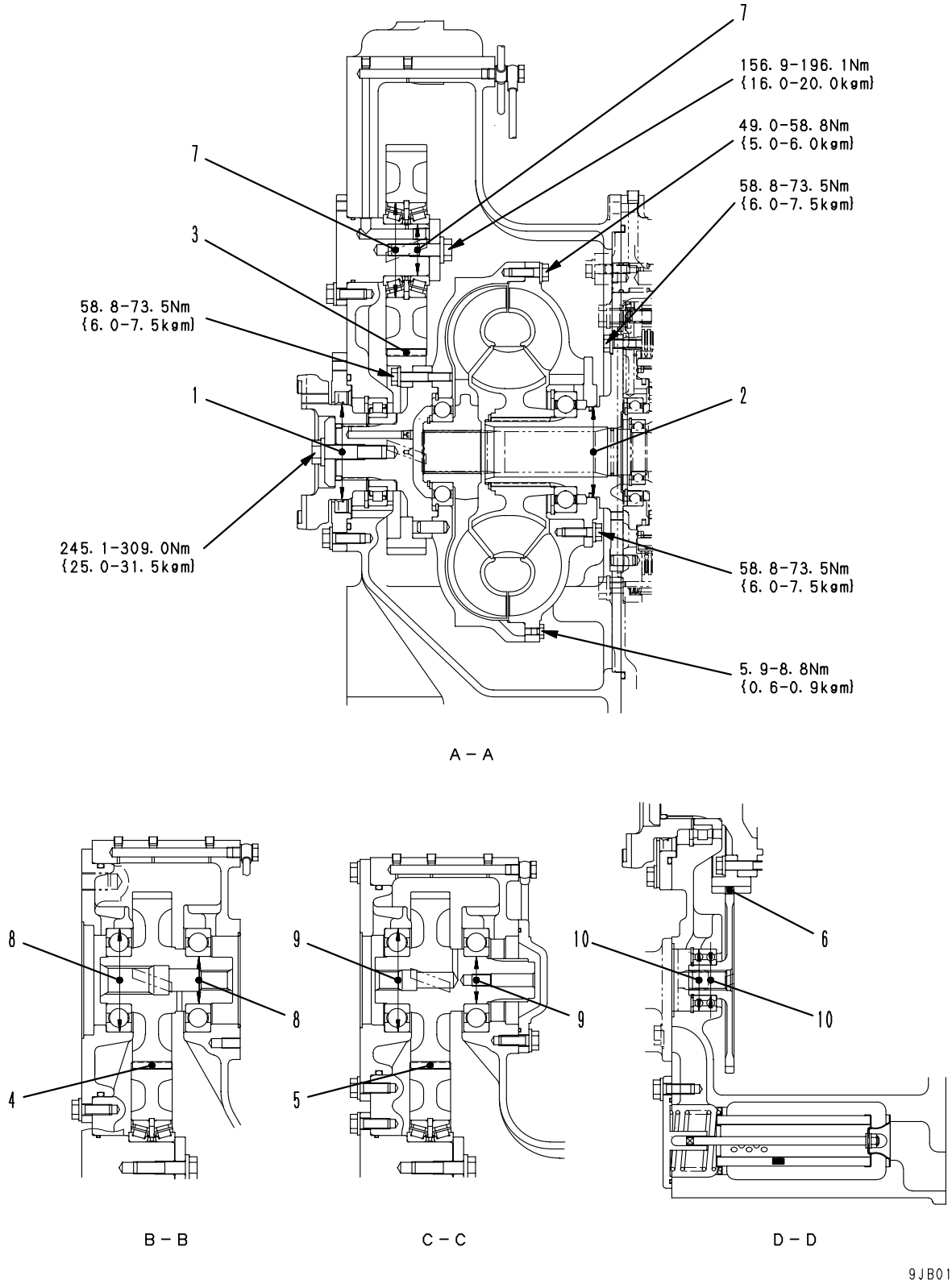
10
9
8
7
6
17
A – A
18
B – B
19
C – C
20
21
D – D
22
E – E
23
F – F
9JB01388

A: From transmission case (to torque converter)
B: To oil cooler
C: From transmission case (to scavenging pump)
D: From transmission case (to power train and lubrication pump)
E: To transmission case (drain)

1. HSS pump mounting port
2. Power train and lubrication pump mounting port
3. Scavenging pump mounting port
4. PTO lubrication tube
5. Cooling fan pump mounting port
6. Coupling
7. Input shaft
8. PTO idler gear (number of teeth: 62)
9. PTO idler gear shaft
10. PTO idler gear (number of teeth: 63)
11. PTO case
12. Drive case
13. Turbine
14. Stator
15. Pump
16. Stator shaft
17. Transmission input shaft
18. HSS, work equipment pump and fan pump drive gear (number of teeth: 53)
19. Power train and lubrication pump drive gear (number of teeth: 53)
20. Scavenging pump drive gear (number of teeth: 56)
21. Scavenging pump strainer
22. Power train strainer
23. Sleeve

Outline

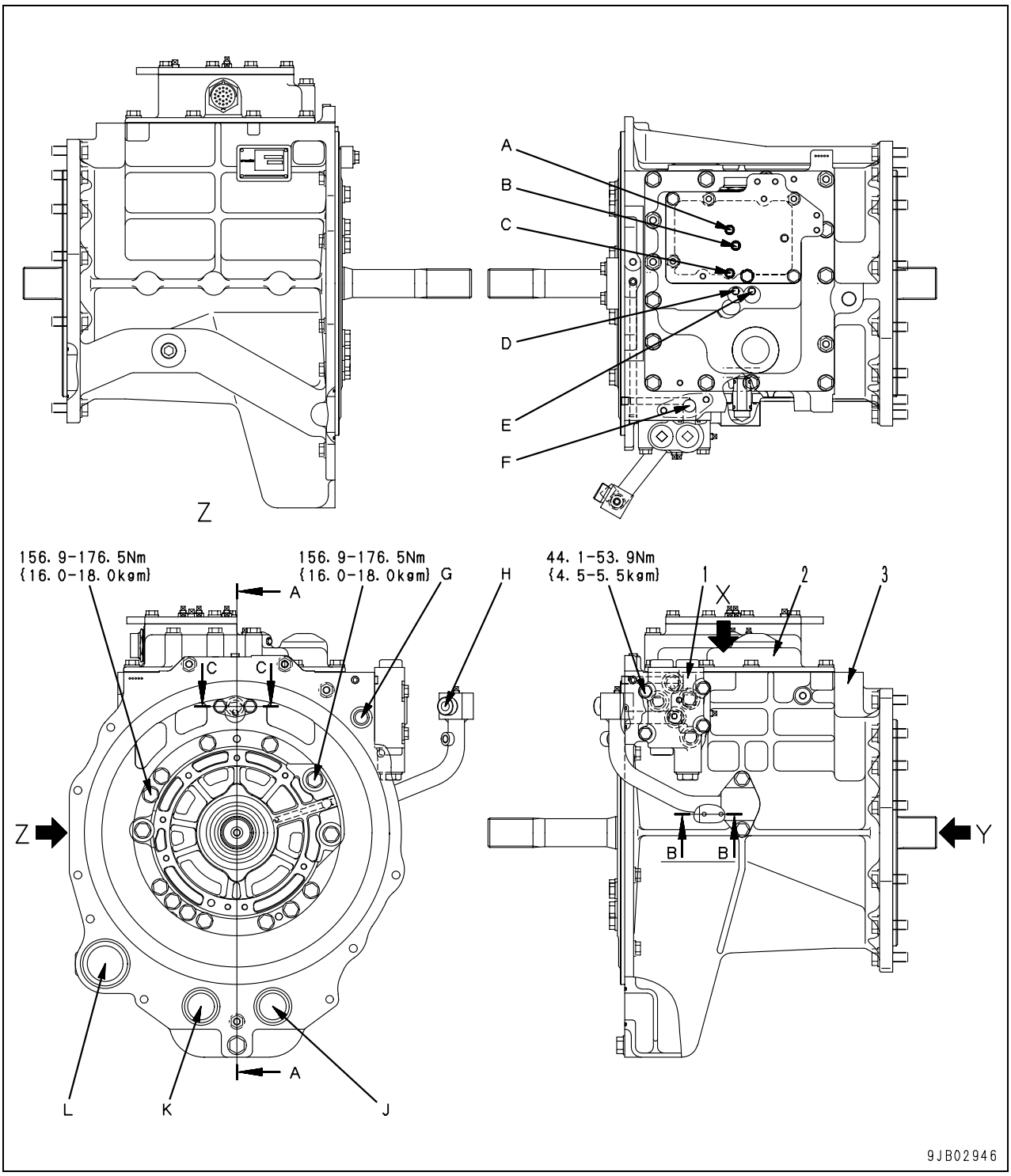
- The torque converter is a 3-element, 1-stage, and 1-phase type, which is integral with the transmission.
- Pump (15) is integrated with coupling (6), input shaft (7), PTO drive gear (8) and drive case (12), and rotates by the power from the engine.
- Turbine (13) is integrated with transmission input shaft (17), and rotates by the oil from pump (15) as medium.
- Stator (14) is integrated with stator shaft (16), and fixed to PTO case (11).
- Each pump installed to PTO case is driven with the power transmitted through PTO drive gear (8) to PTO idler gear (10), and pump drive gears (18), (19) and (20).

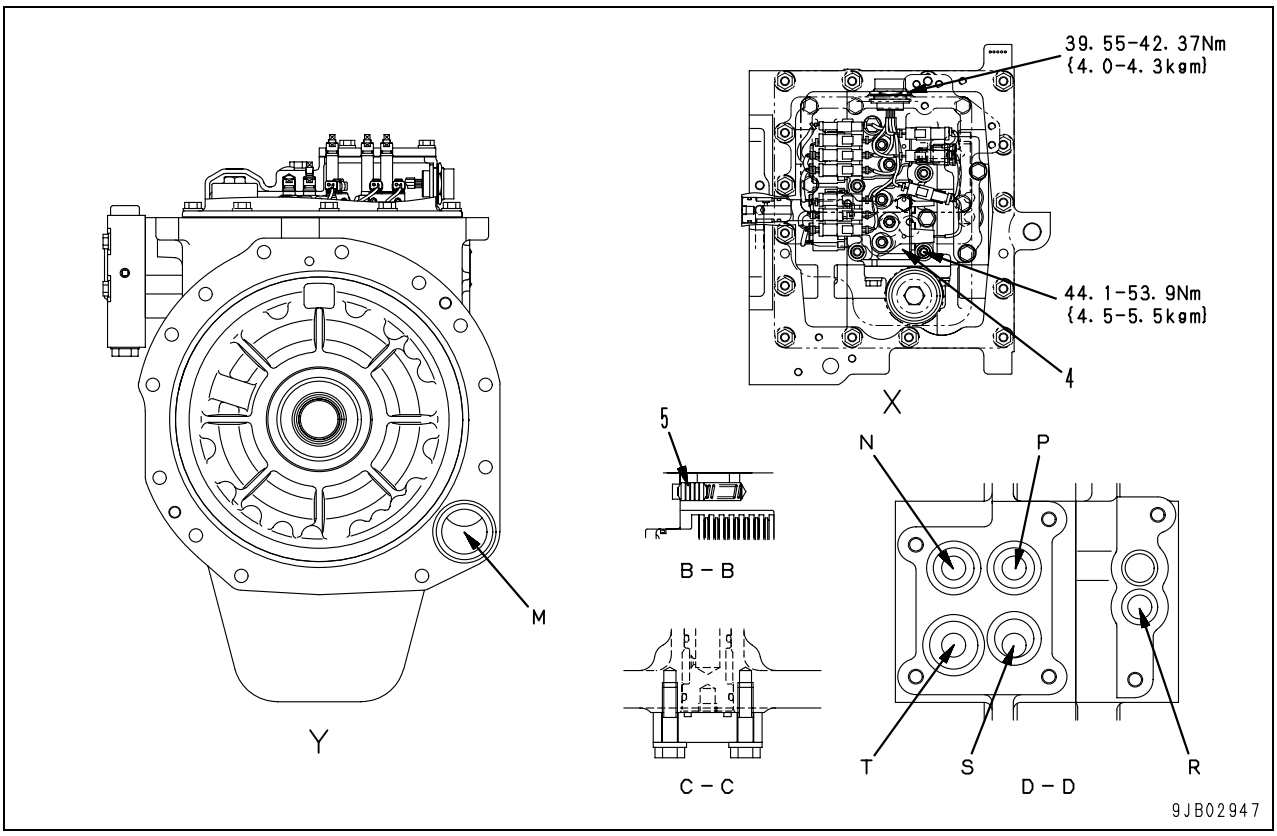

7
156. 9-196. 1Nm
{16. 0-20. 0kgm}
49. 0-58. 8Nm
{5. 0-6. 0kgm}
58. 8-73. 5Nm
{6. 0-7. 5kgm}
7
3
58. 8-73. 5Nm
{6. 0-7. 5kgm}
1
2
245. 1-309. 0Nm
{25. 0-31. 5kgm}
58. 8-73. 5Nm
{6. 0-7. 5kgm}
5. 9-8. 8Nm
{0. 6-0. 9kgm}
A - A
8
8
4
B - B
9
9
5
C - C
10
6
10
D - D
9JB01389

Unit: mm

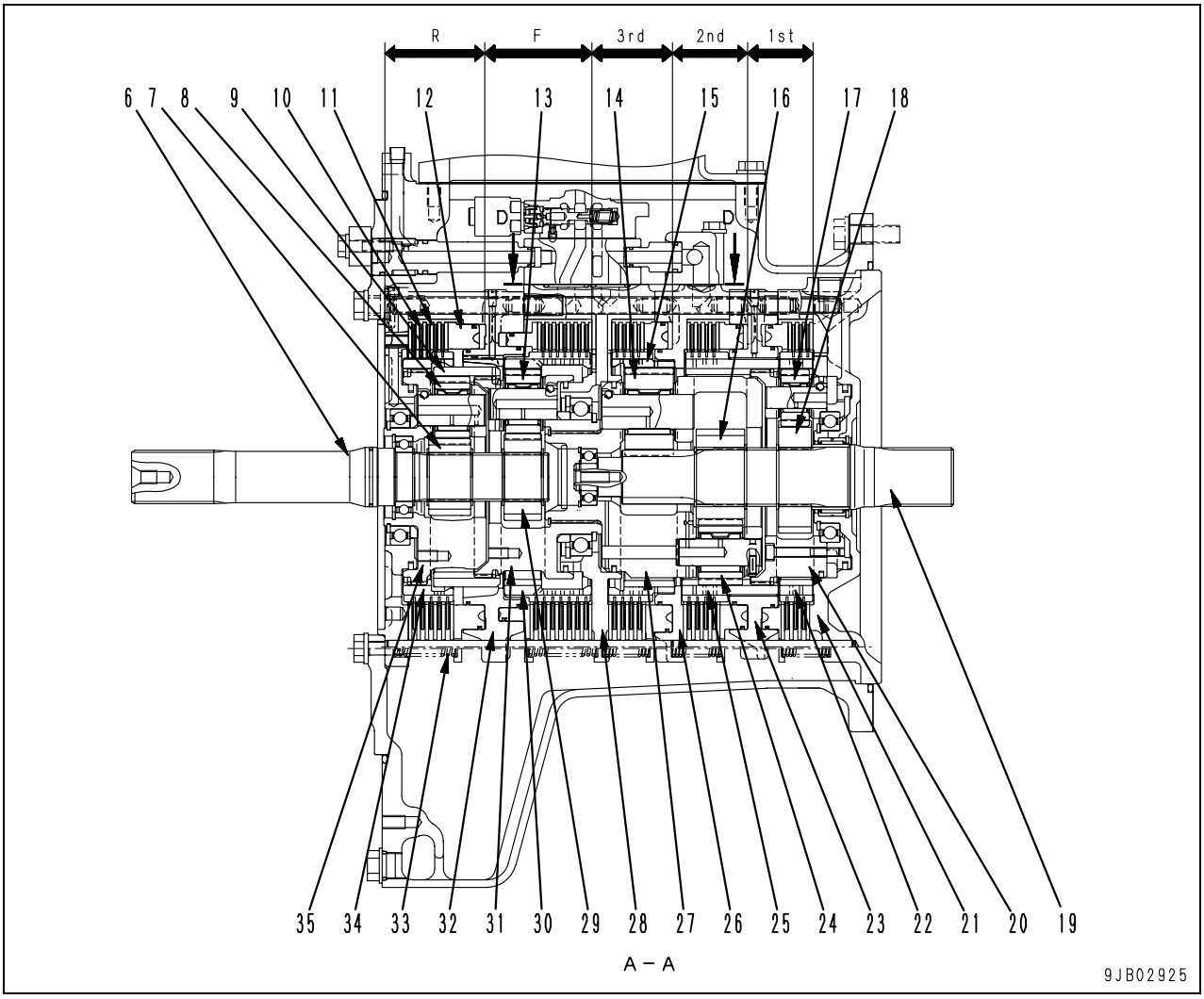
No.	Check item		Criteria			Remedy
1	Outer diameter of oil seal contact surface of input coupling		Standard size: 110	Tolerance: –0.087 / 0	Repair limit: ϕ109.8	Repair by hard chrome plating or replace
2	Inside diameter of seal ring contact surface of retainer		105	+0.035 / 0	ϕ105.5	
3	Backlash between PTO drive gear and PTO idler gear		0.17 – 0.46			Replace
4	Backlash between PTO idler gear and HSS pump and cooling fan pump drive gear		0.16 – 0.42			
5	Backlash between PTO idler gear and power train and lubrication pump drive gear		0.16 – 0.42			
6	Backlash between PTO drive gear and scavenging pump drive gear		0.17 – 0.46			
7	Fitting tolerance of PTO idler gear and bearing	Outer diameter	Standard size: 110	Tolerance – Shaft: 0 / –0.015	Tolerance – Hole: –0.010 / –0.035	—
		Inner diameter	60	0 / –0.019	0 / –0.015	
8	Fitting tolerance of HSS pump and cooling fan pump drive gear bearing	Outer diameter (cover side)	120	0 / –0.015	+0.035 / 0	
		Outer diameter (case side)			+0.022 / –0.013	
		Inner diameter	55	+0.021 / +0.002	0 / –0.015	
9	Fitting tolerance of power train and lubrication pump drive gear bearing	Outer diameter (cover side)	120	0 / –0.015	+0.035 / 0	
		Outer diameter (case side)			+0.022 / –0.013	
		Inner diameter	55	+0.021 / +0.002	0 / –0.015	
10	Fitting tolerance of scavenging pump drive gear bearing	Outer diameter	72	0 / –0.013	+0.030 / 0	
		Inner diameter	35	+0.011 / –0.005	0 / –0.010	

Transmission





A: 1st clutch oil pressure pick-up port
B: 3rd clutch oil pressure pick-up port
C: R clutch oil pressure pick-up port
D: 2nd clutch oil pressure pick-up port
E: F clutch oil pressure pick-up port
F: From power train pump (to brake valve)
G: To PTO case (to torque converter)
H: From oil cooler
J: To PTO case (to scavenging pump)
K: From PTO case (Drain)
L: To PTO case (to power train and lubrication pump)
M: From steering case
N: From transmission ECMV (For R clutch)
P: From transmission ECMV (For 3rd clutch)
R: From transmission ECMV (For 1st clutch)
S: From transmission ECMV (For 2nd clutch)
T: From transmission ECMV (For F clutch)



1. Main relief valve
2. Transmission ECMV cover
3. Transmission case
4. Transmission ECMV
5. Lubrication relief valve
6. Transmission input shaft
7. R sun gear (number of teeth: 26)
8. R planetary pinion (number of teeth: 22)
9. R ring gear (number of teeth: 70)
10. Disc
11. Plate
12. Piston
13. F planetary pinion (number of teeth: 23)
14. 3rd planetary pinion (number of teeth: 30)
15. 3rd ring gear (number of internal teeth: 76)
16. 2nd sun gear (number of teeth: 33)
17. 1st planetary pinion (number of teeth: 18)
18. 1st sun gear (number of teeth: 39)
19. Output shaft
    (3rd sun gear number of teeth: 17)
20. 1st carrier
21. Rear housing
22. 1st ring gear (number of internal teeth: 75)
23. 2nd and 1st clutch housings
24. 2nd planetary pinion (number of teeth: 21)
25. 2nd ring gear (number of internal teeth: 75)
26. 3rd clutch housing
27. 2nd, 3rd carrier
28. F and 3rd clutch housings
29. F sun gear (number of teeth: 29)
30. F ring gear (number of internal teeth: 75)
31. F carrier
32. R and F clutch housings
33. Return spring
34. R ring gear (hub) (number of internal teeth: 75)
35. R carrier

Outline

- The transmission adopted is a “forward 3-gear speed and reverse 3-gear speed“ transmission which consists of the planetary gear mechanisms and the disc clutches.
- Out of the 5 sets of planetary gear mechanisms and disc clutches, 2 clutches are fixed hydraulically by the operation of ECMV to select 1 rotation direction and 1 speed.
- The transmission transfers the power received by the transmission input shaft to the output shaft while changing the gear speed (forward 1st-3rd or reverse 1st-3rd) by any combination of the F, R clutches and 3 speed clutches.

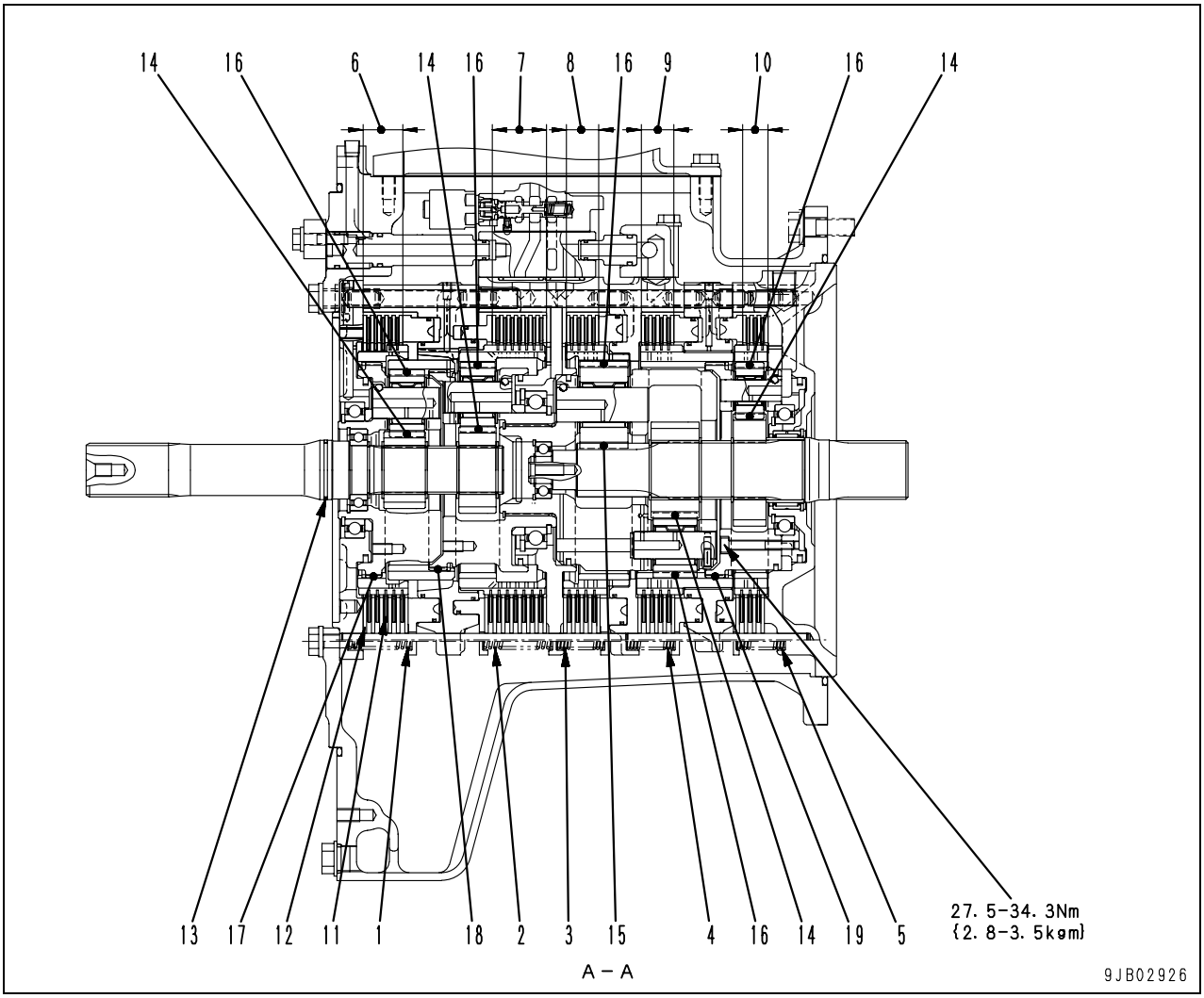
Number of Plates and Discs used

Clutch No.	Number of plates	Number of discs
R clutch	6	5
F clutch	8	7
3rd clutch	5	4
2nd clutch	5	4
1st clutch	4	3

Gear speeds and operated clutches

Gear speed	Operated clutches	Reduction ratio
Forward 1st	F x 1st	1.948
Forward 2nd	F x 2nd	1.096
Forward 3rd	F x 3rd	0.656
Neutral	*	—
Reverse 1st	R x 1st	1.462
Reverse 2nd	R x 2nd	0.823
Reverse 3rd	R x 3rd	0.492

*: The 1st, 2nd, or 3rd clutch is filled with low-pressure oil.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15
4
16
14
19
5
27.5-34.3Nm
{2.8-3.5kgm}
A-A
9JB02926

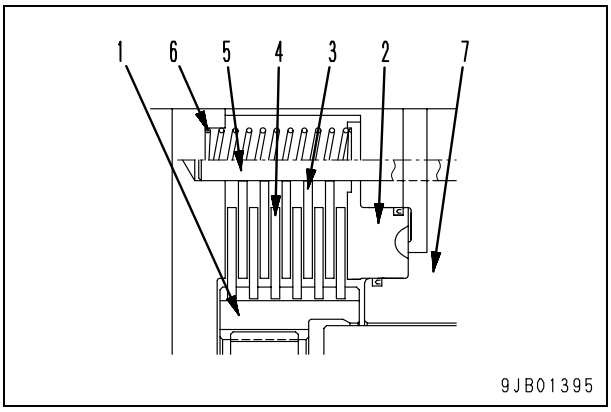
Unit: mm

No.	Check item		Criteria					Remedy
1	R clutch spring (5 pcs.)		Standard size			Repair limit		Replace
			Free length	Installation length	Installation load	Free length	Installation load	
			69.5	58.7	233.2 N {23.8 kg}	65.3	198 N {20.2 kg}	
2	F clutch spring (5 pcs.)		77.0	63.6	95.2 N {9.7 kg}	72.4	81 N {8.2 kg}	
3	3rd clutch spring (5 pcs.)		59.0	44.1	146.0 N {14.9 kg}	55.5	125 N {12.7 kg}	
4	2nd clutch spring (5 pcs.)		59.0	44.5	142.1 N {14.5 kg}	55.5	121 N {12.3 kg}	
5	1st clutch spring (5 pcs.)		59.0	44.3	144.1 N {14.7 kg}	55.5	123 N {12.5 kg}	
6	Total thickness of R clutch assembly consisting of 5 discs and 6 plates		Standard size		Tolerance	Repair limit		
			36.2		±0.33	32.2		
7	Total thickness of F clutch assembly consisting of 7 discs and 8 plates		49.4		±0.39	43.8		
8	Total thickness of the 3rd clutch assembly consisting of 4 discs and 5 plates		29.6		±0.30	26.4		
9	Total thickness of the 2nd clutch assembly consisting of 4 discs and 5 plates		29.6		±0.30	26.4		
10	Total thickness of 1st clutch assembly consisting of 3 discs and 4 plates		23.0		±0.26	20.6		
11	Thickness of clutch disc		3.4		±0.1	2.6		
12	Thickness of clutch plate		3.2		±0.1	2.9		
13	Wear of transmission input shaft seal ring	Width	3.0		–0.01 –0.03	2.70		
		Thickness	2.3		±0.10	2.15		
14	Backlash between R/F/2nd/1st sun gear and planetary pinion		0.11 – 0.30					
15	Backlash between 3rd sun gear and planetary pinion		0.11 – 0.29					
16	Backlash between planetary pinion and internal teeth of ring gear		0.12 – 0.33					
17	Backlash between R carrier and internal teeth of ring gear		0.14 – 0.44					
18	Backlash between F carrier and internal teeth of ring gear		0.14 – 0.38					
19	Backlash between 1st carrier and internal teeth of ring gear		0.14 – 0.39					

Disc clutch

Structure

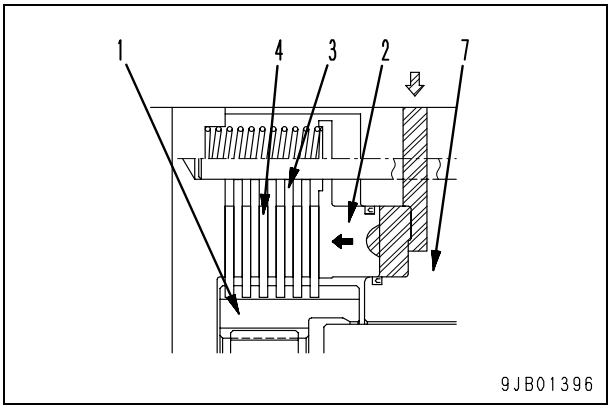
- The disc clutch consists of piston (2), plate (3), disc (4), pin (5), return spring (6) etc. to fix ring gear (1).
- Inside teeth of disc (4) are engaged with outside teeth of ring gear (1).
- Plate (3) is assembled to clutch housing (7) with pin (5).



Operation

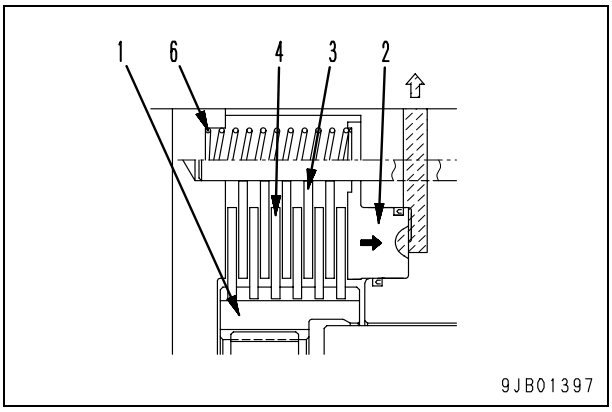
When clutch is “engaged“ (fixed)

- The oil from ECMV is sent with pressure to the rear side of piston (2) via the oil passage of housing (7) and pushes piston (2) leftward.
- Piston (2) contacts plate (3) closely against disc (4) to stop rotation of disc (4) by use of the friction force generated between them.
- Since inside teeth of disc (4) are engaged with outside teeth of ring gear (1), ring gear (1) is locked.



When clutch is “disengaged“ (released)

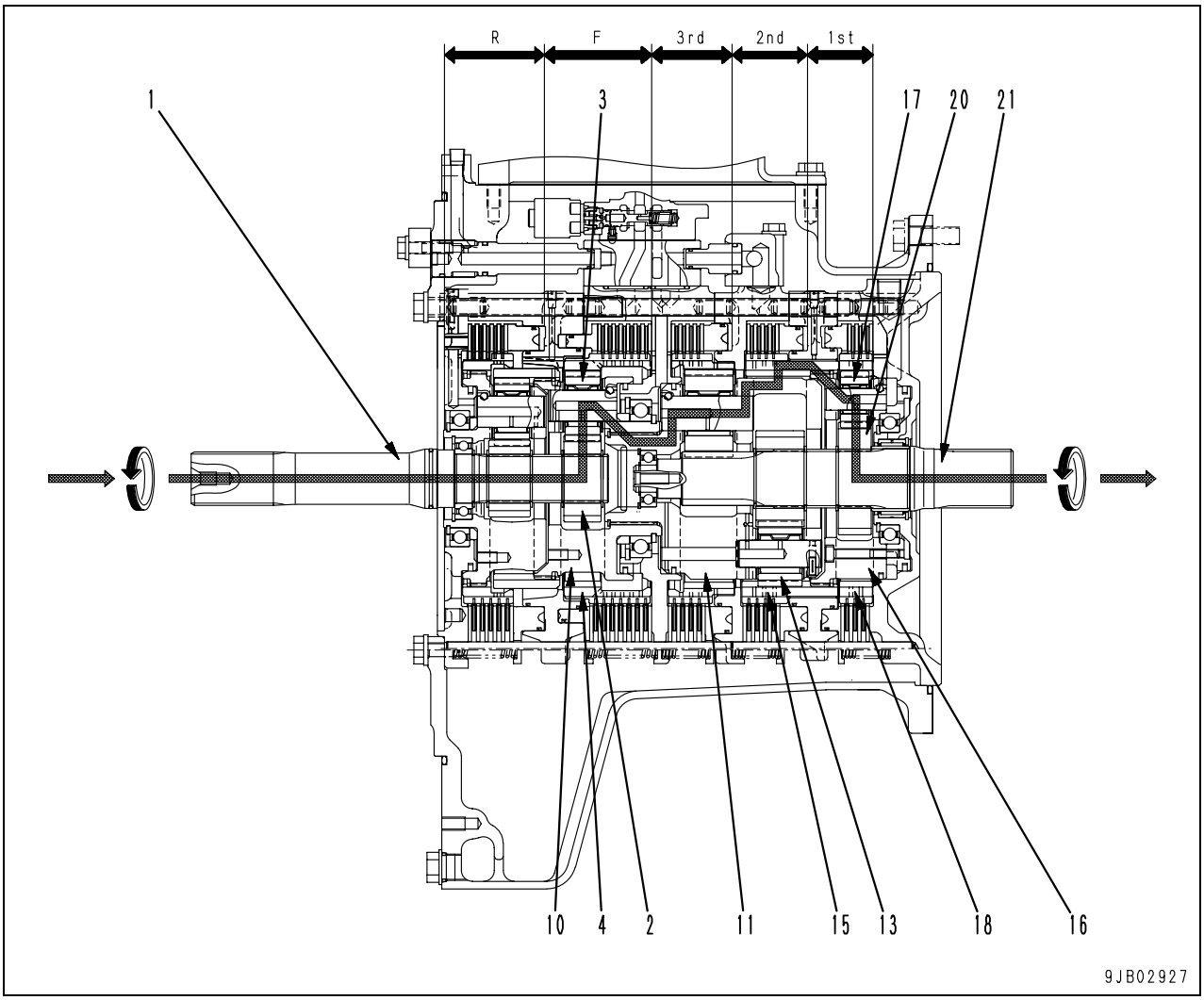
- As the oil from ECMV is cut off, piston (2) is pushed back rightward by return spring (6).
- Plate (3) and disc (4) are released from the frictional force and ring gear (1), as the result, is also released.



Oil passage in speed clutch

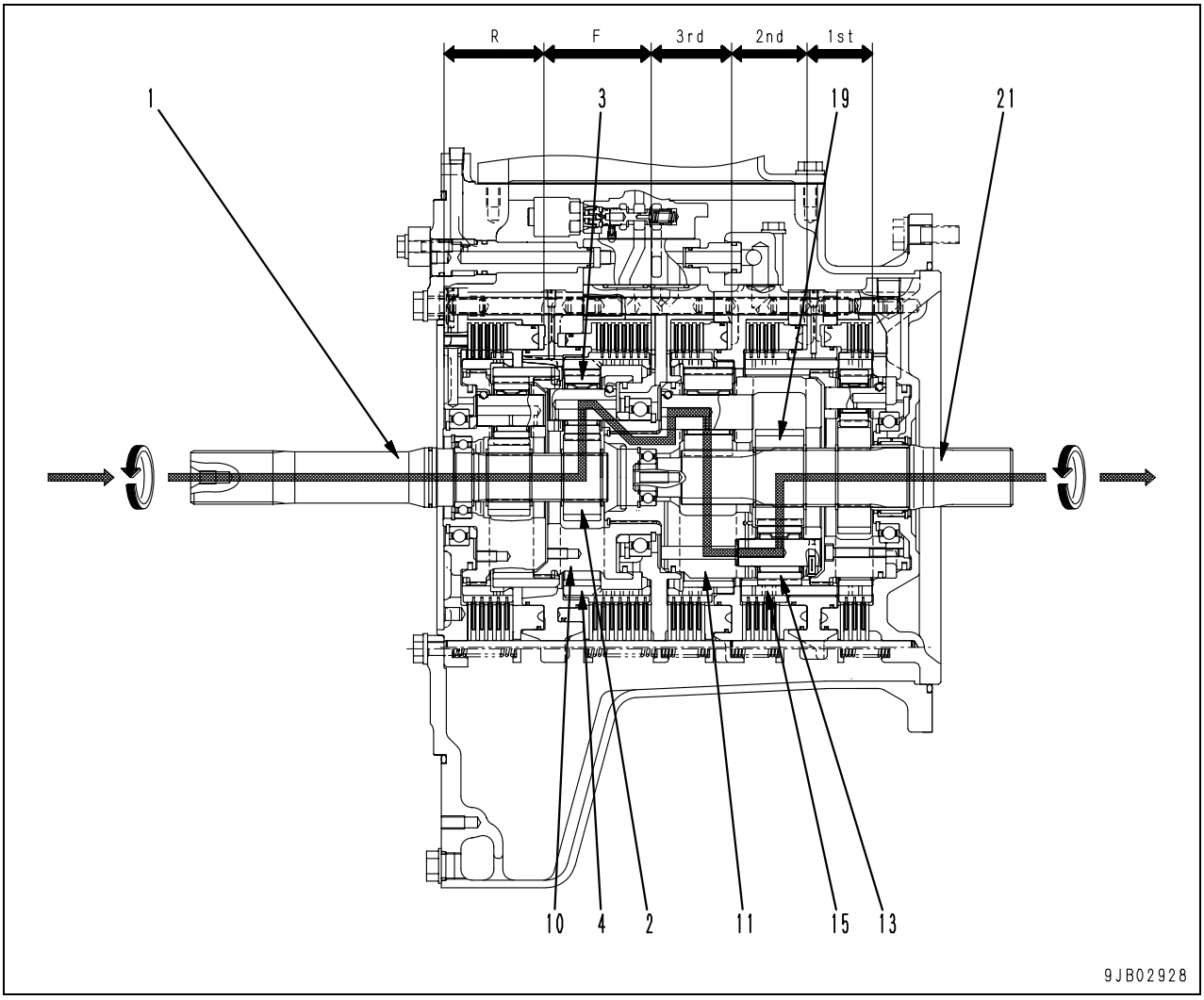
- When the steering/directional/gear shift lever is set in the “neutral“ position, the 1st, 2nd, or 3rd speed is selected.
- The piston chamber of the clutch corresponding to the selected gear speed is filled with oil by electronically controlling the hydraulic circuit of each clutch.
- When the steering/directional/gear shift lever is shifted from the “neutral“ position to the“forward“ or “reverse“ position, the pump is required to supply oil of quantity to fill the piston chamber of the F clutch or R clutch.
- When the gear speed is changed from “forward 1st“ to “forward 2nd“, the pump is required to supply oil of only quantity to fit the plate and disc of the 2nd clutch together since the F clutch has been filled with the oil.
- The time lag in the gear shifting operation is reduced by controlling the oil in the clutch circuit as explained above.

Power transmitting route
Forward 1st speed



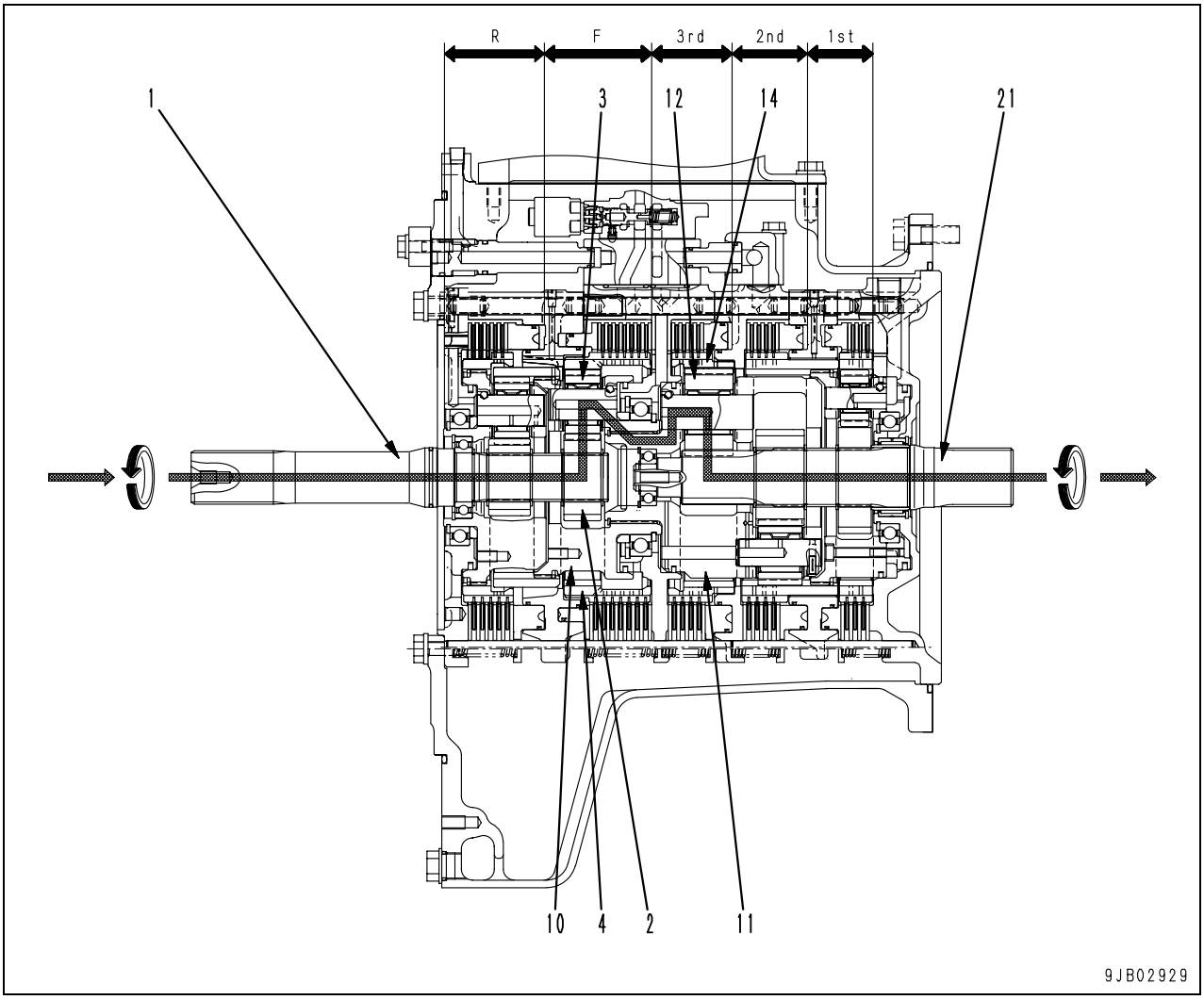
- When the transmission is set to the forward 1st speed, the F clutch and 1st clutch are engaged. The power transmitted from the torque converter to input shaft (1) is then transmitted to output shaft (21).
- The F clutch is actuated by the oil pressure applied to the F clutch piston, and holds F ring gear (4). The 1st clutch is actuated by the oil pressure applied to the 1st clutch piston, and holds 1st clutch inner drum (18).
- The power from the torque converter is transmitted to F planetary pinion (3) via input shaft (1) and F sun gear (2).
- Since F ring gear (4) is held by the F clutch, the power transmitted to F planetary pinion (3) to rotate F carrier (10) on the inside of F ring gear (4).
- F carrier (10) and 2nd and 3rd carriers (11) are connected by a spline, and rotate as one unit. Accordingly, the rotation of F carrier (10) is transmitted through 2nd planetary pinion (13) to 2nd ring gear (15).
- Since 2nd ring gear (15) and 1st carrier (16) are meshed with each other, the power transmitted to 2nd ring gear (15) is transmitted to 1st planetary pinion (17).
- Since 1st ring gear (18) is held by the 1st clutch, the power transmitted to 1st planetary pinion (17) is transmitted through 1st sun gear (20) to output shaft (21).

Forward 2nd speed



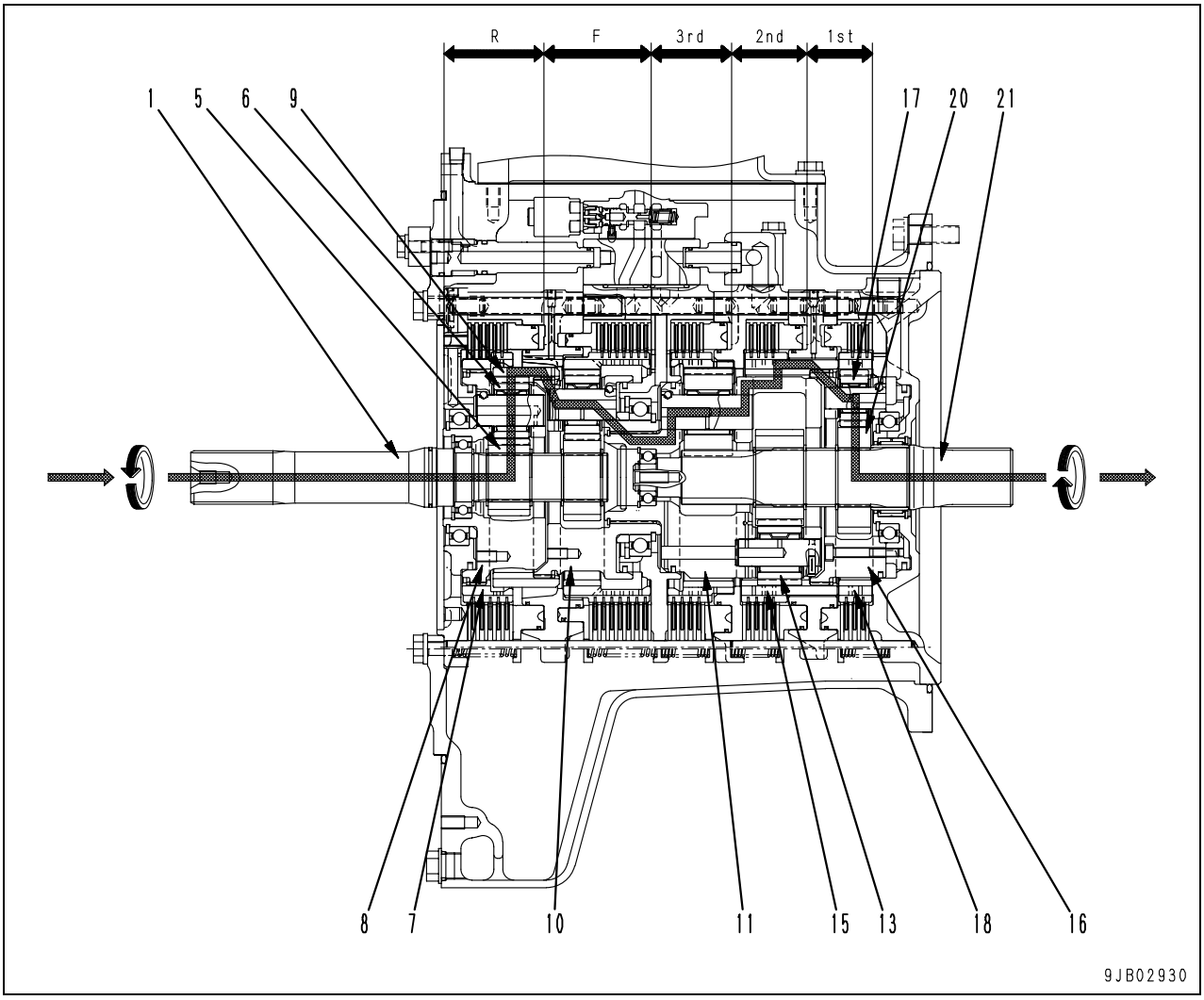
- When the transmission is set to the forward 2nd speed, the F clutch and 2nd clutch are engaged. The power transmitted from the torque converter to input shaft (1) is then transmitted to output shaft (21).
- The F clutch is actuated by the oil pressure applied to the F clutch piston, and holds F ring gear (4). The 2nd clutch is actuated by the oil pressure applied to the 2nd clutch piston, and holds 2nd ring gear (15).
- The power from the torque converter is transmitted to F planetary pinion (3) via input shaft (1) and F sun gear (2).
- Since F ring gear (4) is held by the F clutch, the power transmitted to F planetary pinion (3) rotates F carrier (10) on the inside of F ring gear (4).
- F carrier (10) and 2nd and 3rd carriers (11) are connected by a spline, and rotate as one unit. Accordingly, the rotation of F carrier (10) is transmitted to 2nd planetary pinion (13).
- Since 2nd ring gear (15) is fixed by the 2nd clutch, the power transmitted to 2nd planetary pinion (13) is transmitted through 2nd sun gear (19) to output shaft (21).

Forward 3rd speed



- When the transmission is set to the forward 3rd speed, the F clutch and 3rd clutch are engaged. The power transmitted from the torque converter to input shaft (1) is then transmitted to output shaft (21).
- The F clutch is actuated by the oil pressure applied to the F clutch piston, and holds F ring gear (4). The 3rd clutch is actuated by the oil pressure applied to the 3rd clutch piston, and holds 3rd ring gear (14).
- The power from the torque converter is transmitted to F planetary pinion (3) via input shaft (1) and F sun gear (2).
- Since F ring gear (4) is held by the F clutch, the power transmitted to F planetary pinion (3) rotates F carrier (10) on the inside of F ring gear (4).
- F carrier (10) and 2nd and 3rd carriers (11) are connected by a spline, and rotate as one unit. Accordingly, the rotation of F carrier (10) is transmitted to 3rd planetary pinion (12).
- Since 3rd ring gear (14) is held by the 3rd clutch, the power transmitted to 3rd planetary pinion (12) is transmitted to output shaft (21).

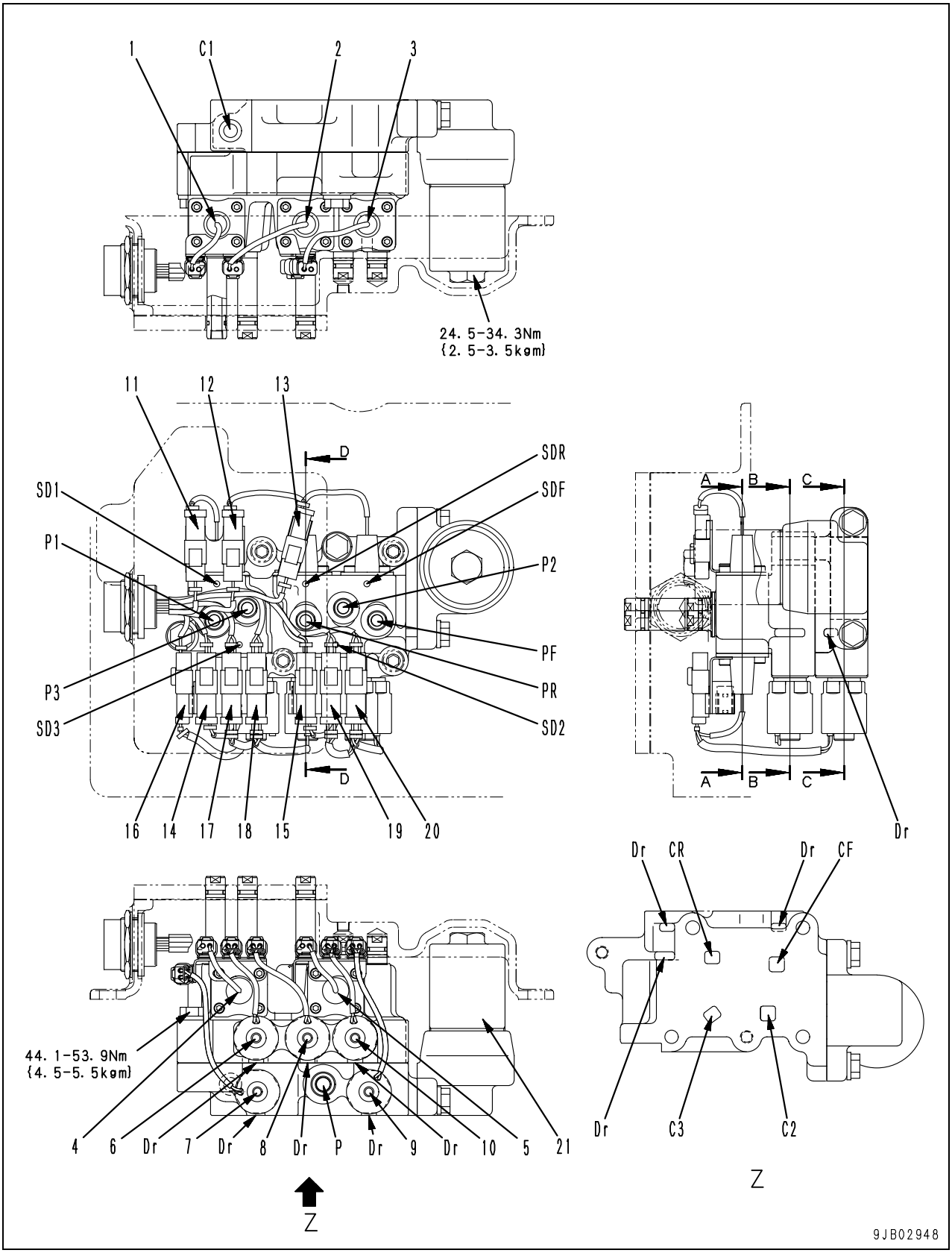
Reverse 1st speed



- When the transmission is set to the reverse 1st speed, the R clutch and 1st clutch are engaged. The power transmitted from the torque converter to input shaft (1) is then transmitted to output shaft (21).
- The R clutch is actuated by the oil pressure applied to the R clutch piston, and holds ring gear (7). The 1st clutch is actuated by the oil pressure applied to the 1st clutch piston, and holds 1st clutch inner drum (18).
- The power from the torque converter is transmitted to R planetary pinion (6) via input shaft (1) and R sun gear (5).
- Since ring gear (7) is meshed with carrier (8) and held by the R clutch, R planetary pinion (6) rotates R ring gear (9). The rotation of R ring gear (9), the direction of which is opposite to that of input shaft (1), rotates F carrier (10).
- F carrier (10) and 2nd and 3rd carriers (11) are connected by a spline, and rotate as one unit. Accordingly, the rotation of F carrier (10) is transmitted through 2nd planetary pinion (13) to 2nd ring gear (15).
- Since 2nd ring gear (15) and 1st carrier (16) are meshed with each other, the power transmitted to 2nd ring gear (15) is transmitted to 1st planetary pinion (17).
- Since 1st ring gear (18) is held by the 1st clutch, the power transmitted to 1st planetary pinion (17) is transmitted through 1st sun gear (20) to output shaft (21).

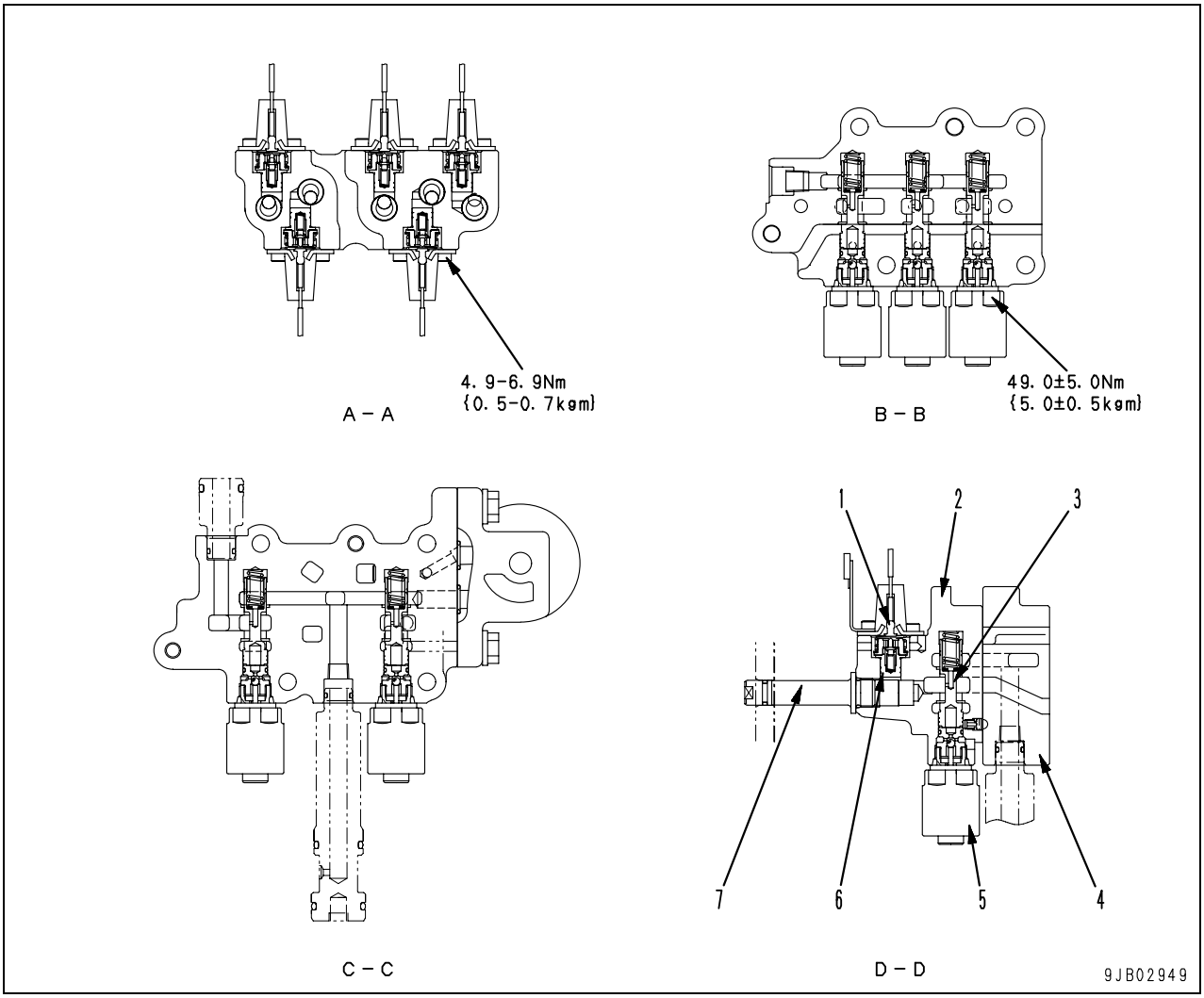
Transmission clutch ECMV

★ ECMV: Abbreviation for Electronic Control Modulation Valve



P: From power train pump
PF: F clutch oil pressure pick-up port
PR: R clutch oil pressure pick-up port
P1: 1st clutch oil pressure pick-up port
P2: 2nd clutch oil pressure pick-up port
P3: 3rd clutch oil pressure pick-up port
CF: To F clutch
CR: To R clutch
C1: To 1st clutch
C2: To 2nd clutch
C3: To 3rd clutch
SDF: F fill switch drain
SDR: R fill switch drain
SD1: 1st fill switch drain
SD2: 2nd fill switch drain
SD3: 3rd fill switch drain
Dr: Drain

1. Fill switch (for 1st clutch)
2. Fill switch (for R clutch)
3. Fill switch (for F clutch)
4. Fill switch (for 3rd clutch)
5. Fill switch (for 2nd clutch)
6. Proportional solenoid (for 3rd clutch)
7. Proportional solenoid (for 1st clutch)
8. Proportional solenoid (for R clutch)
9. Proportional solenoid (for F clutch)
10. Proportional solenoid (for 2nd clutch)
11. Connector for fill switch (for 1st clutch)
12. Connector for fill switch (for R clutch)
13. Connector for fill switch (for F clutch)
14. Connector for fill switch (for 3rd clutch)
15. Connector for fill switch (for 2nd clutch)
16. Connector for proportional solenoid (for 1st clutch)
17. Connector for proportional solenoid (for 3rd clutch)
18. Connector for proportional solenoid (for R clutch)
19. Connector for proportional solenoid (for 2nd clutch)
20. Connector for proportional solenoid (for F clutch)
21. Filter

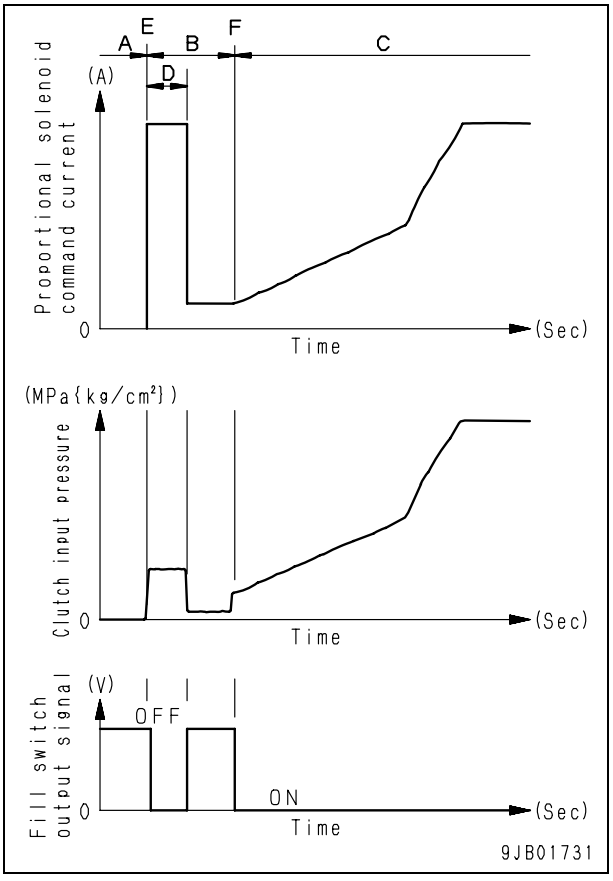


1. Fill switch
2. Valve body (upper)
3. Pressure control valve
4. Valve body (lower)
5. Proportional solenoid
6. Oil pressure detection valve
7. Plug

Outline of ECMV

- The ECMV consists of 1 pressure control valve and 1 fill switch.
- **Pressure control valve**
  This valve receives the current from the transmission controller with the proportional solenoid, and then converts it into oil pressure.
- **Fill switch**
  This switch detects that the clutch is filled with oil and has the following functions.

1. Outputs a signal (a fill signal) to the controller to notify that filling is completed when the clutch is filled with oil.
2. Keeps outputting signals (fill signals) to the controller to notify presence or absence of oil pressure while oil pressure is applied to the clutch.



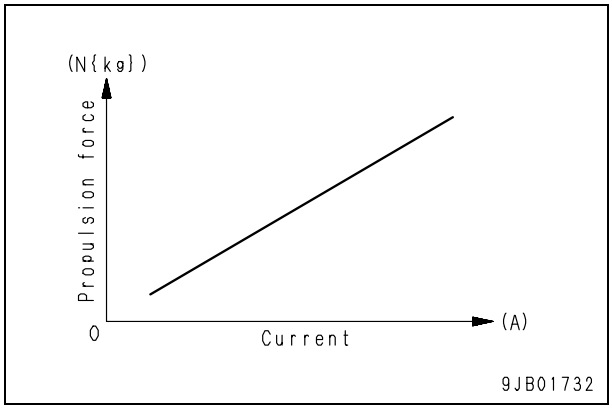
Region A: Before shifting gear (when draining)
Area B: During filling
Range C: Pressure regulation
Range D: During filling (During triggering)
Point E: Start of filling
Point F: End of filling

★ The logic is so made that the controller will not recognize completion of filling even if the fill switch is turned “ON“ during triggering (Range D).

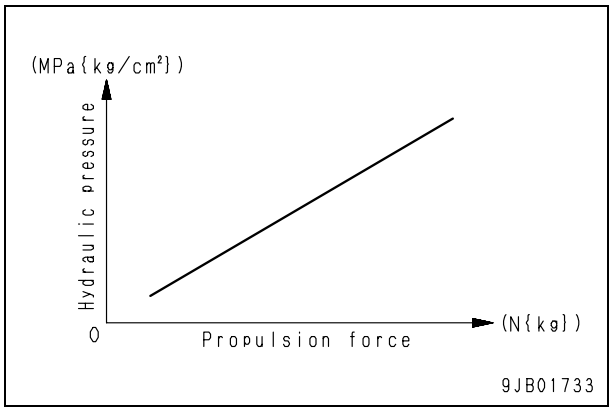
ECMV and proportional solenoid

- For each ECMV, 1 proportional solenoid is installed.
  The proportional solenoid generates thrust shown below according to the command current from the controller.
  The thrust generated by the proportional solenoid is applied to the pressure control valve spool to generate oil pressure as shown in the figure below. Accordingly, the thrust is changed by controlling the command current to operate the pressure control valve to control the flow and pressure of the oil.

Current of propulsion solenoid-thrust characteristics



Thrust of proportional solenoid - oil pressure characteristics

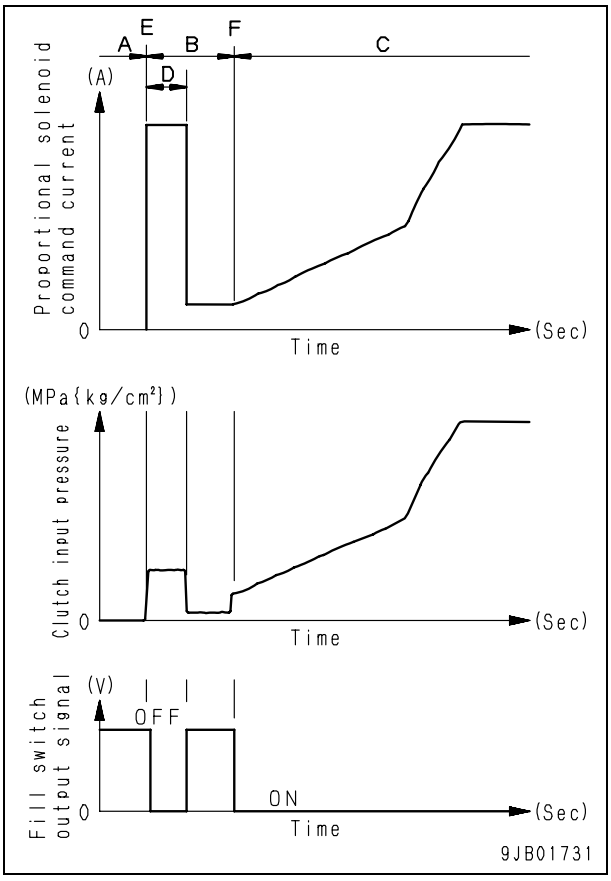


ECMV and fill switch

- For each ECMV, 1 fill switch is installed.
  As the clutch complete filling, the fill switch is turned “ON“ by the pressure of the clutch. This signal starts increasing the oil pressure.

Operation of ECMV

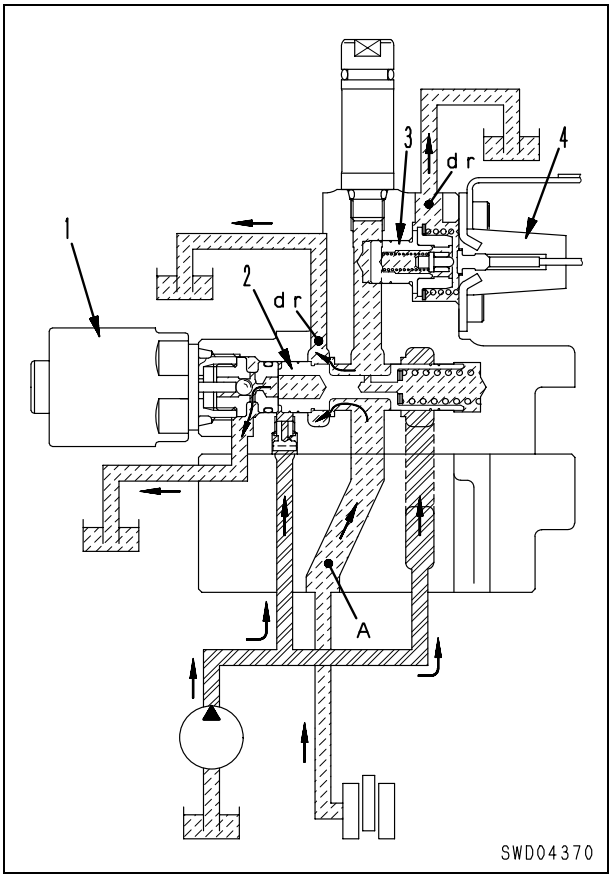
- ECMV is controlled with the command current sent from the controller to the proportional solenoid and the fill switch output signal.
  The relationship between the proportional solenoid command current of ECMV, clutch input pressure, and fill switch output signal is shown below.



Region A: Before shifting gear (when draining)
Area B: During filling
Range C: Pressure regulation
Range D: During filling (During triggering)
Point E: Start of filling
Point F: End of filling

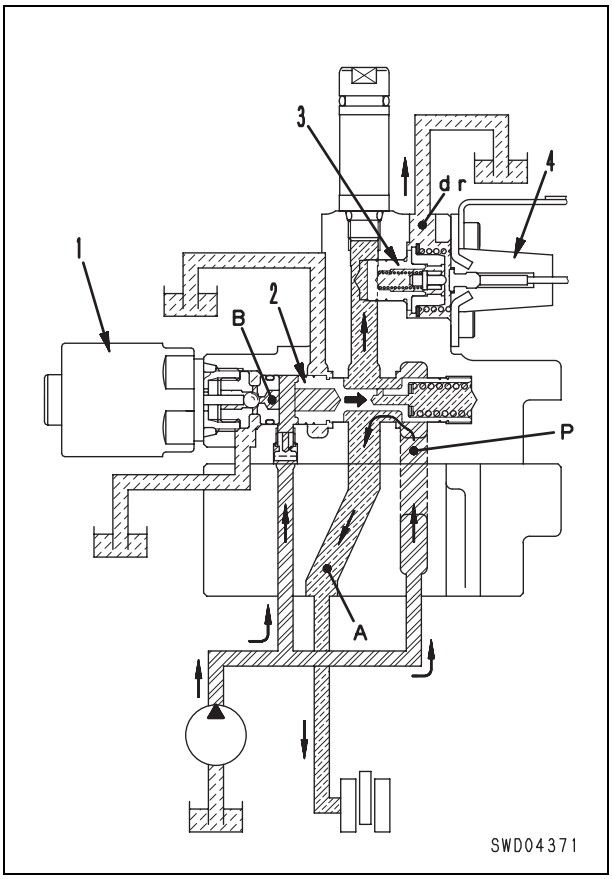
★ The logic is so made that the controller will not recognize completion of filling even if the fill switch is turned “ON“ during triggering (Range D).

Before shifting gear (when draining) (Range A in chart)



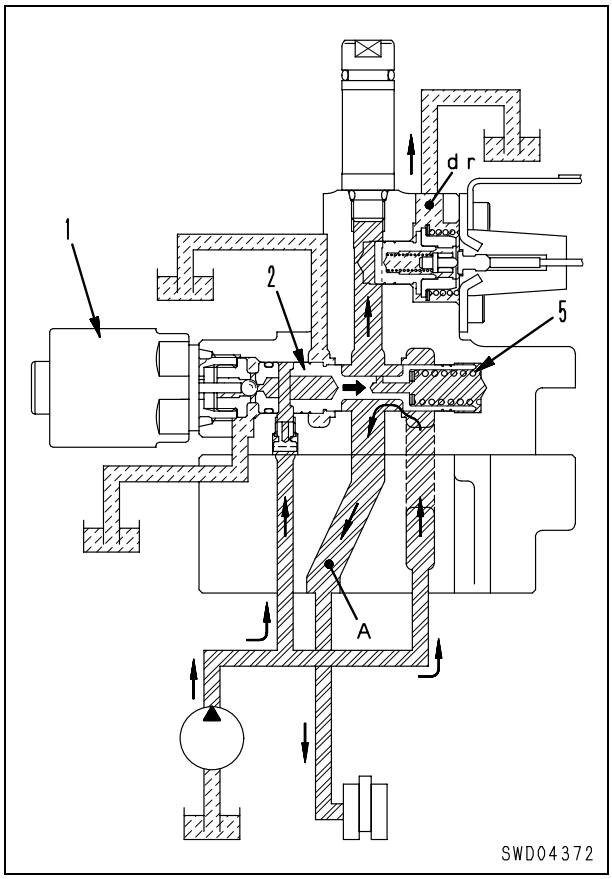
- Under the condition where any current is not sent to proportional solenoid (1), pressure control valve (2) drains the oil from clutch port (A) through drain port (dr).
  Since oil pressure is not applied to pressure detection valve (3) at this time, fill switch (4) is turned “off“.

During filling (Range B in chart)



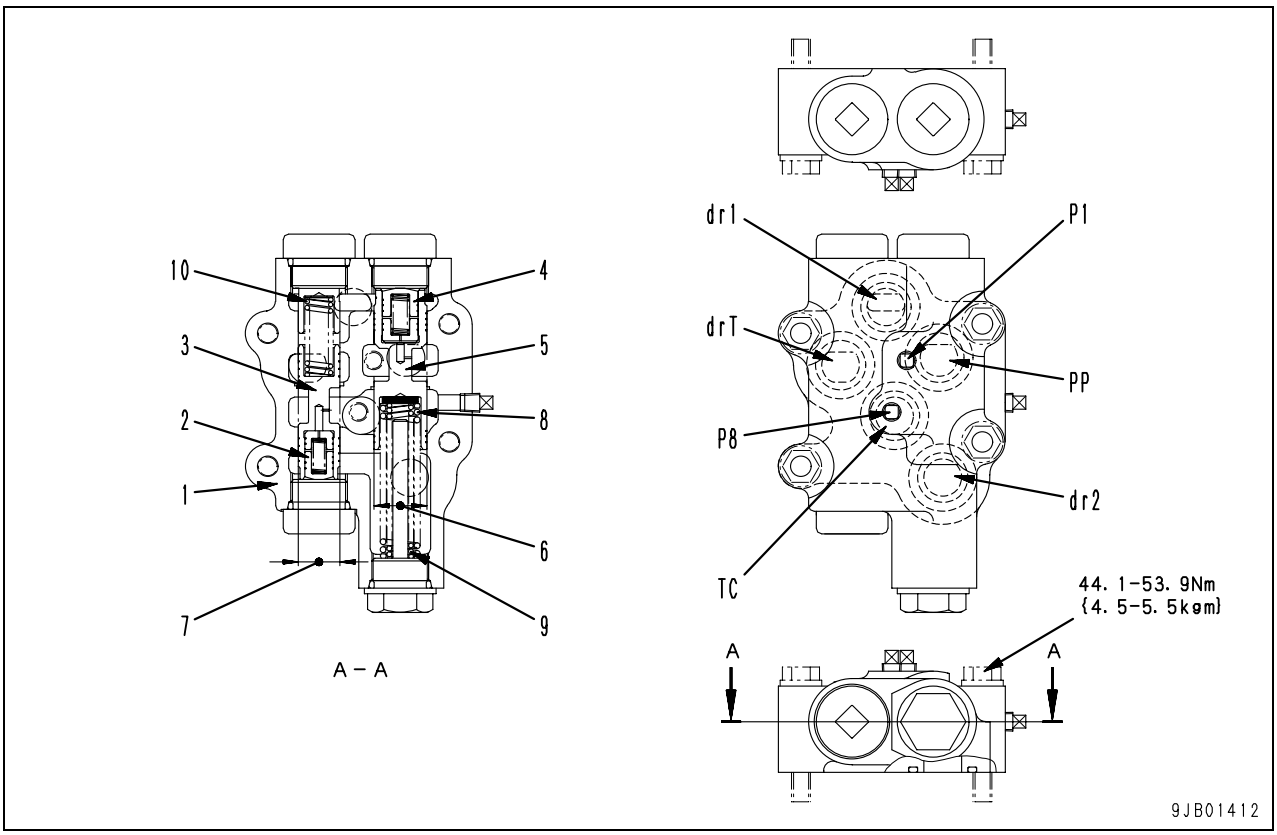
- If current is supplied to proportional solenoid (1) with no oil in the clutch, the oil pressure force balanced with the solenoid force is applied to chamber (B) and pushes pressure control valve (2) to the right.As a result, pump port (P) and clutch port (A) open and oil starts filling the clutch. If the clutch is filled with oil, pressure detection valve (3) is actuated and fill switch (4) is turned “on“.

Pressure regulation (Range C in chart)



- If current is applied to proportional solenoid (1), the solenoid generates propulsion force that is proportionate to the current. The pressure is adjusted by balancing the propulsion force of the solenoid, the propulsion force of clutch port (A), and reaction force of pressure control spring (5).

Main relief valve and torque converter relief valve



PP: From pump
TC: To torque converter
drT: Drain (Torque converter relief)
dr1: Drain
dr2: Drain
P1: Main relief oil pressure pick-up port
P8: Torque converter relief oil pressure pick-up port

1. Body
2. Piston
3. Torque converter relief valve
4. Piston
5. Main relief valve

Unit: mm

No.	Check item	Criteria					Remedy
6	Clearance between the main relief valve and the valve body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		28	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.078	
7	Clearance between the torque converter relief valve and the valve body	22	–0.035 –0.045	+0.013 0	0.035 – 0.058	0.078	
8	Main relief valve spring (outside)	Standard size			Repair limit		
		Free length	Installation length	Installation load	Free length	Installation load	
		128	75.3	508.6 N {51.9 kg}	124.2	483.5 N {49.3 kg}	
9	Main relief valve spring (inside)	108	75.3	401.8 N {41.0 kg}	104.8	382.5 N {39.0 kg}	
10	Torque converter relief valve spring	50	42	153.0 N {15.6 kg}	48.5	145.1 N {14.8 kg}	

Outline

Main relief valve

- The main relief valve is keeping each oil pressure circuit of the transmission and the brake below the set pressure.
  Set pressure: 3.31 MPa {33.8 kg/cm^2}
  (Engine at rated speed)

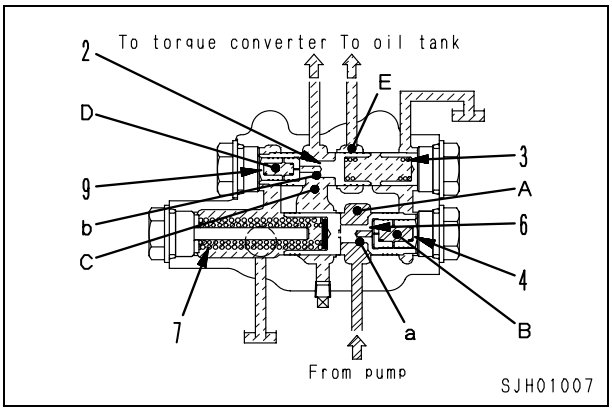
Torque converter relief valve

- The torque converter relief valve maintains the oil pressure in the torque converter inlet circuit always below the set pressure in order to protect the torque converter from abnormally high pressure.
  Set pressure: 0.83 MPa {8.5 kg/cm^2}
  (Cracking pressure)

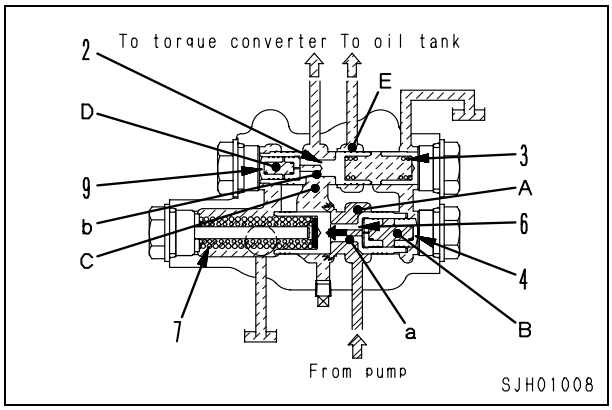
Operation

Operation of main relief valve

- The oil from the hydraulic pump passes through the filter and enters port (A) of the relief valve. It then passes through orifice (a) of spool (6) and enters chamber (B).
  When the oil from the pump fills the circuit, the oil pressure starts to rise.



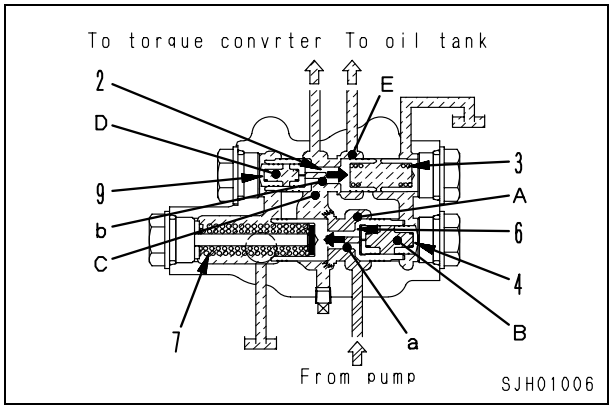
- As the oil pressure in the circuit rises, the oil entering chamber (B) pushes piston (4). The reaction force compresses valve spring (7) and moves spool (6) to the left to open the circuit between port (A) and port (C).
  When this happens, the oil at port (A) is relieved to port (C) and flows from port (C) to the torque converter.
  The oil pressure at port (A) at this point is 3.31 MPa {33.8 kg/cm^2} (engine at rated speed).



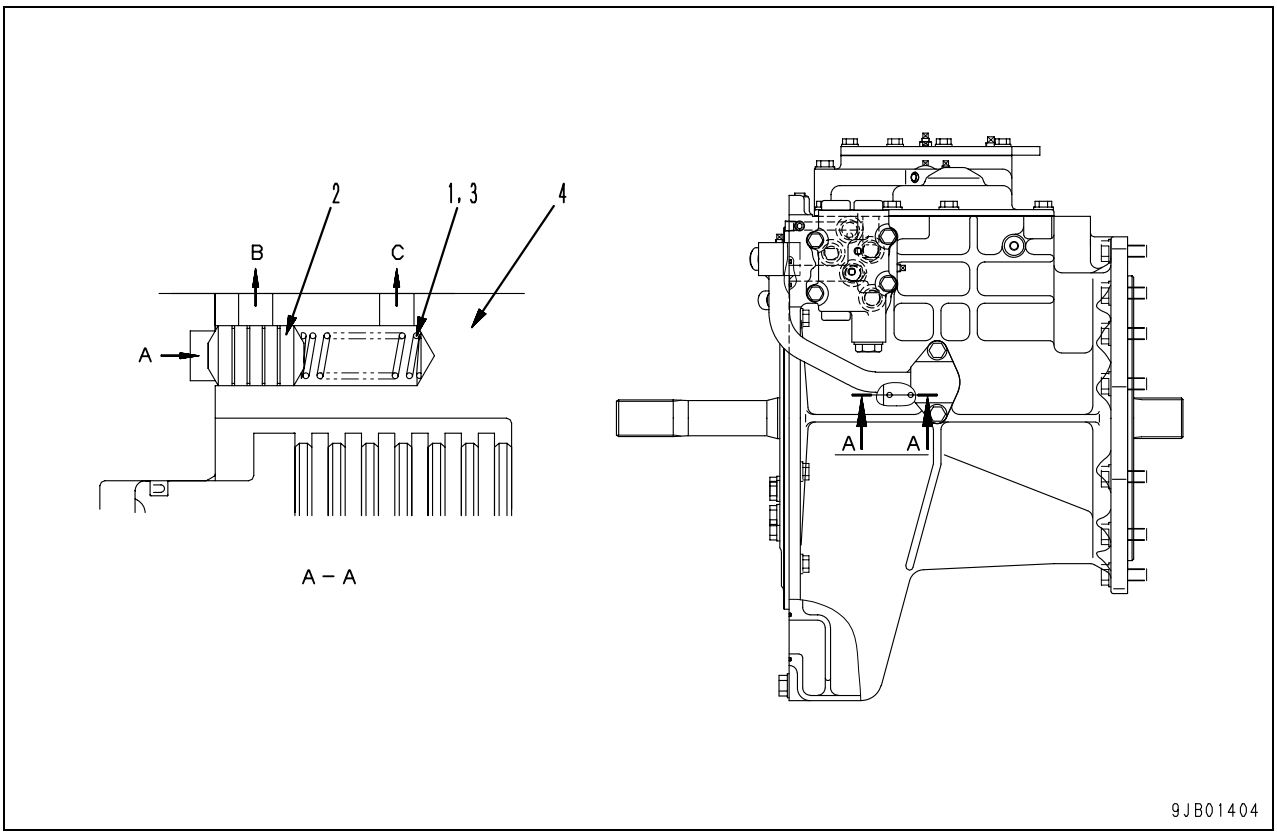
Operation of torque converter relief valve

- The oil relieved by the main relief valve flows from port (C) into the torque converter and the same time, passes through orifice (b) of spool (2) and enters chamber (D).
  When the circuit leading to the torque converter becomes filled with oil, the oil pressure starts to rise.

- As the oil pressure going to the torque converter rises, the oil entering chamber (D) pushes piston (9). The reaction force moves spool (2) to the right to open the circuit between port (C) and port (E).
  When this happens, the oil at port (C) is relieved to port (E) and drains to the oil tank.
  The oil pressure at port (C) at this point is 0.83 MPa {8.5 kg/cm^2} (cracking pressure).



Lubrication relief valve



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Lubrication relief valve spring	Free length	Installation length	Installation load	Free length	Installation load	Replace
		26	23.7	12.0 N {1.22 kg}	25.2	11.4 N {1.16 kg}	

2. Piston
3. Spring
4. Forward clutch housing

A: From oil cooler
B: Drain
C: Drain

Outline

- The oil leaving the torque converter passes through the oil cooler built in the radiator lower tank. It then goes through the lubrication relief valve and lubricates the transmission and PTO.
- The lubrication relief valve is installed to the right side face of the forward clutch housing. It keeps the lubricating oil pressure below the set pressure.
  Set pressure:
  0.05 – 0.15 MPa {0.5 – 1.5 kg/cm^2}
  Cracking pressure: 0.29 MPa {3.0 kg/cm^2}

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00282-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

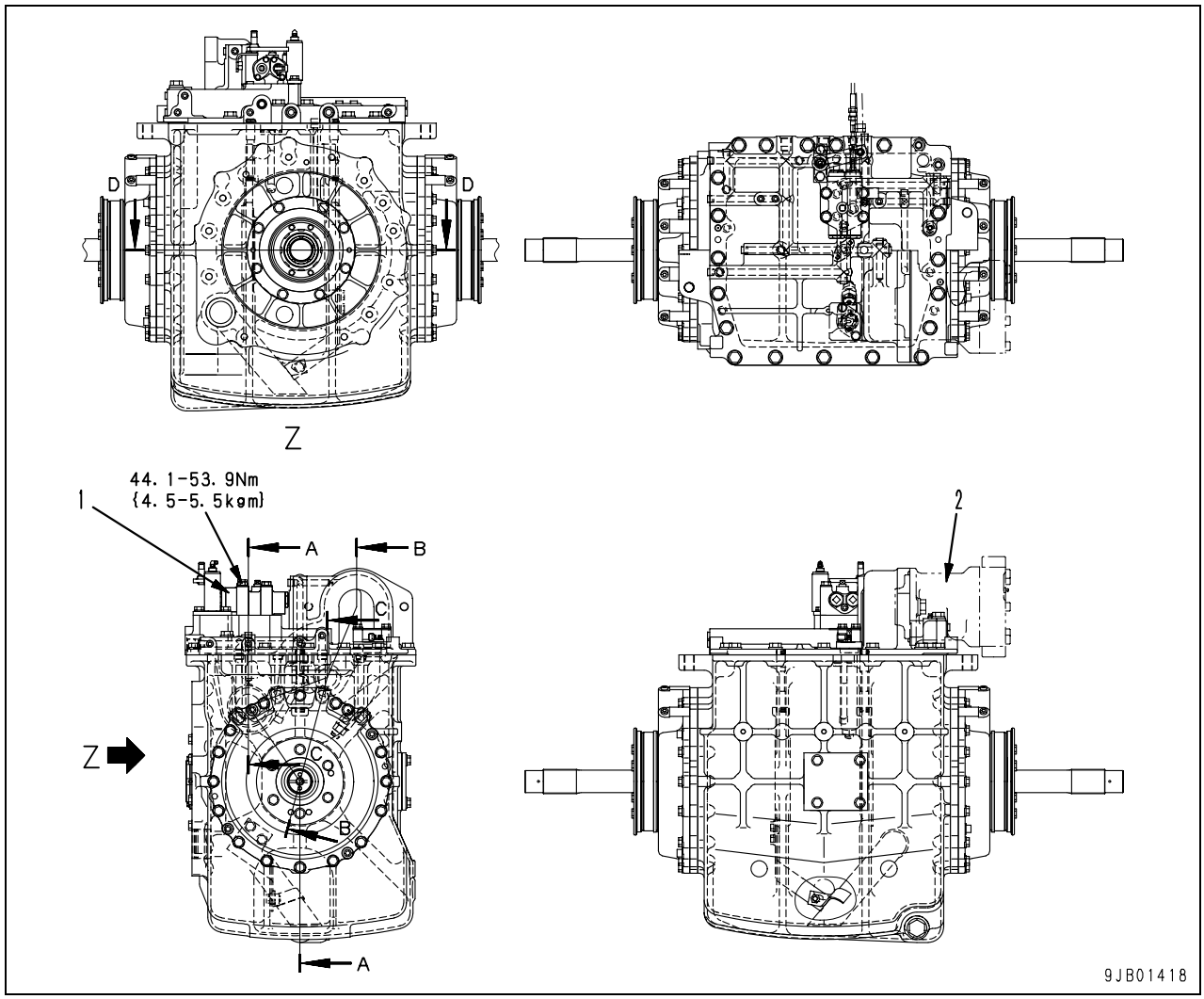
10 Structure, function and maintenance standard

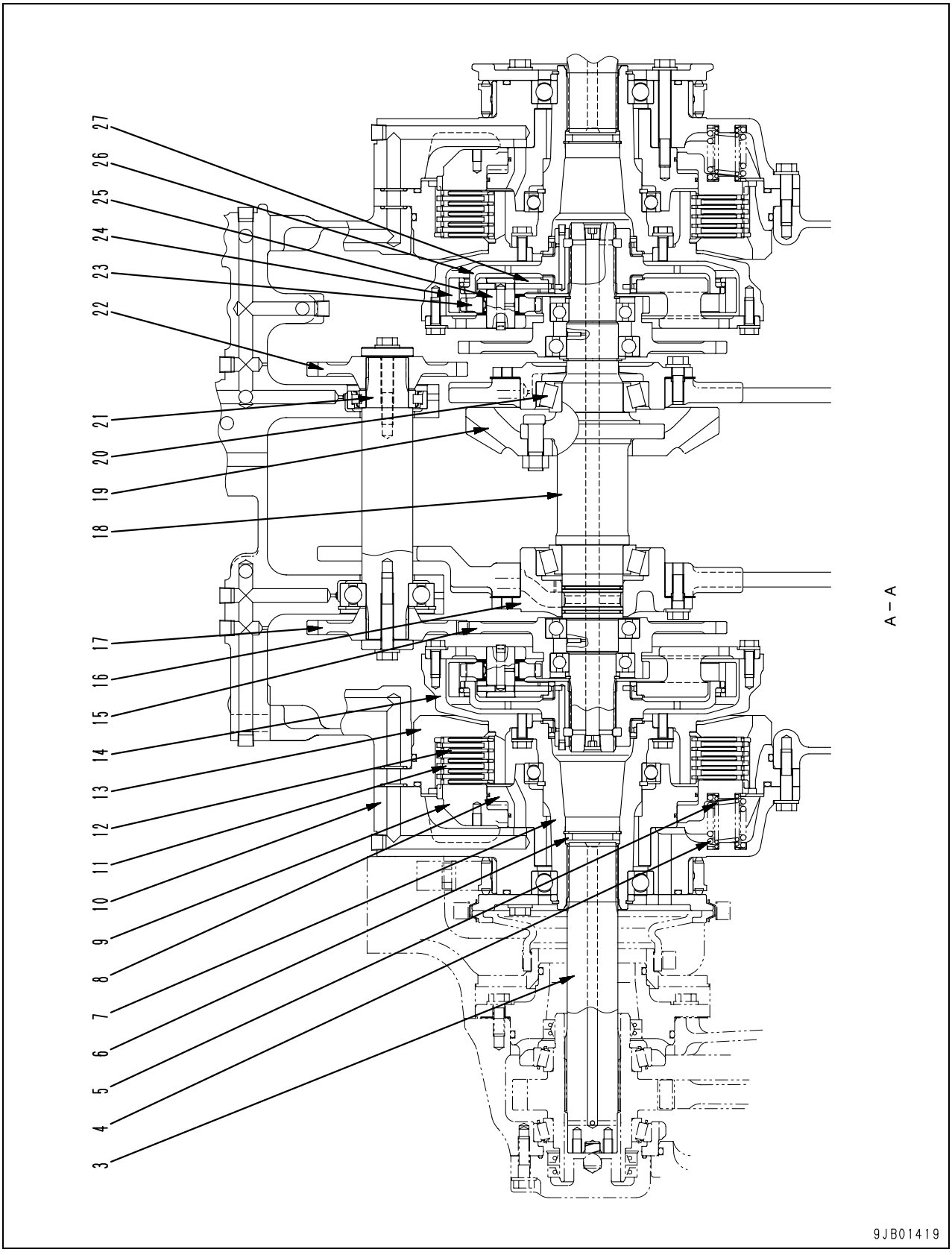
Power train, Part 2

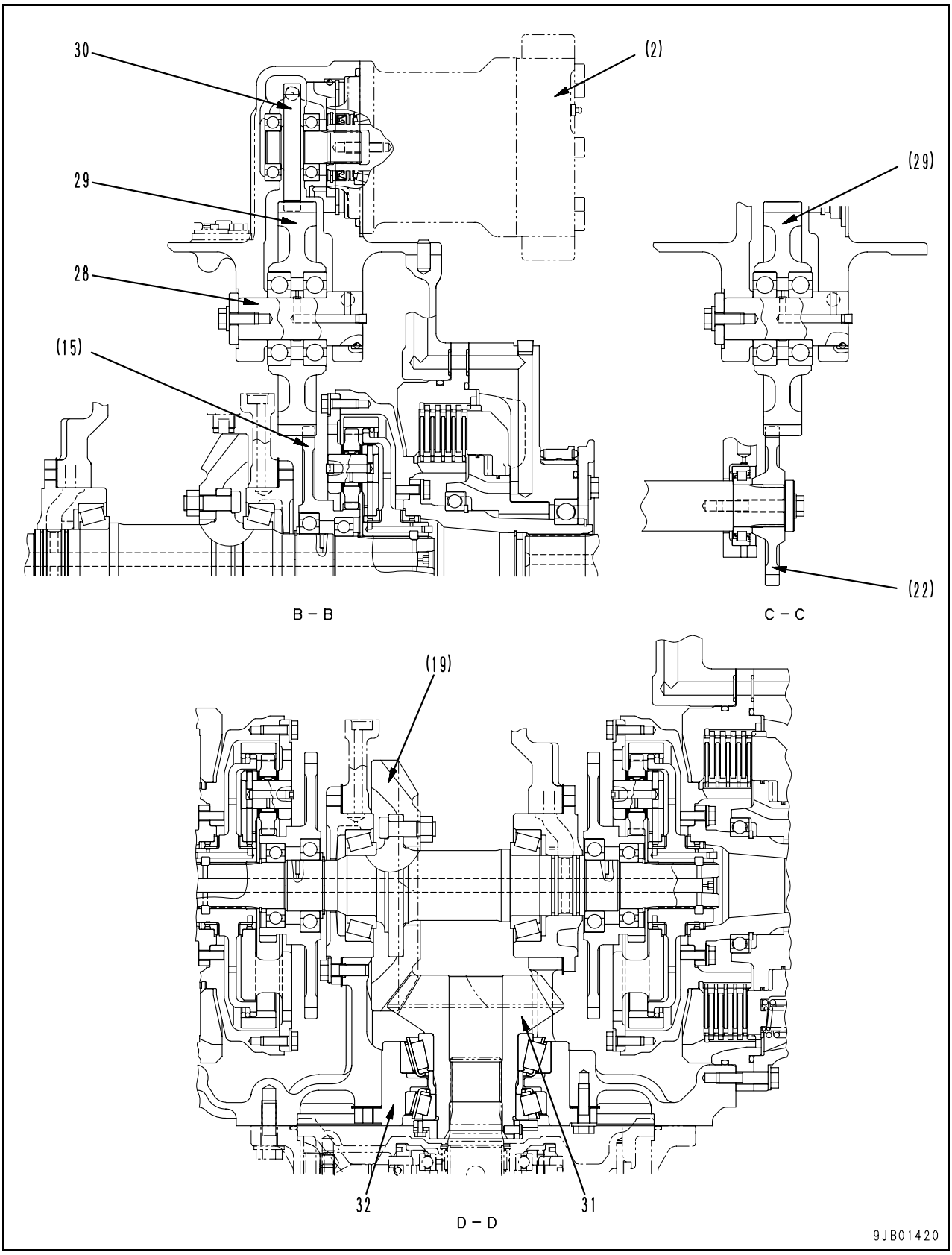
Power train, Part 2

Bevel gear shaft, HSS and brake

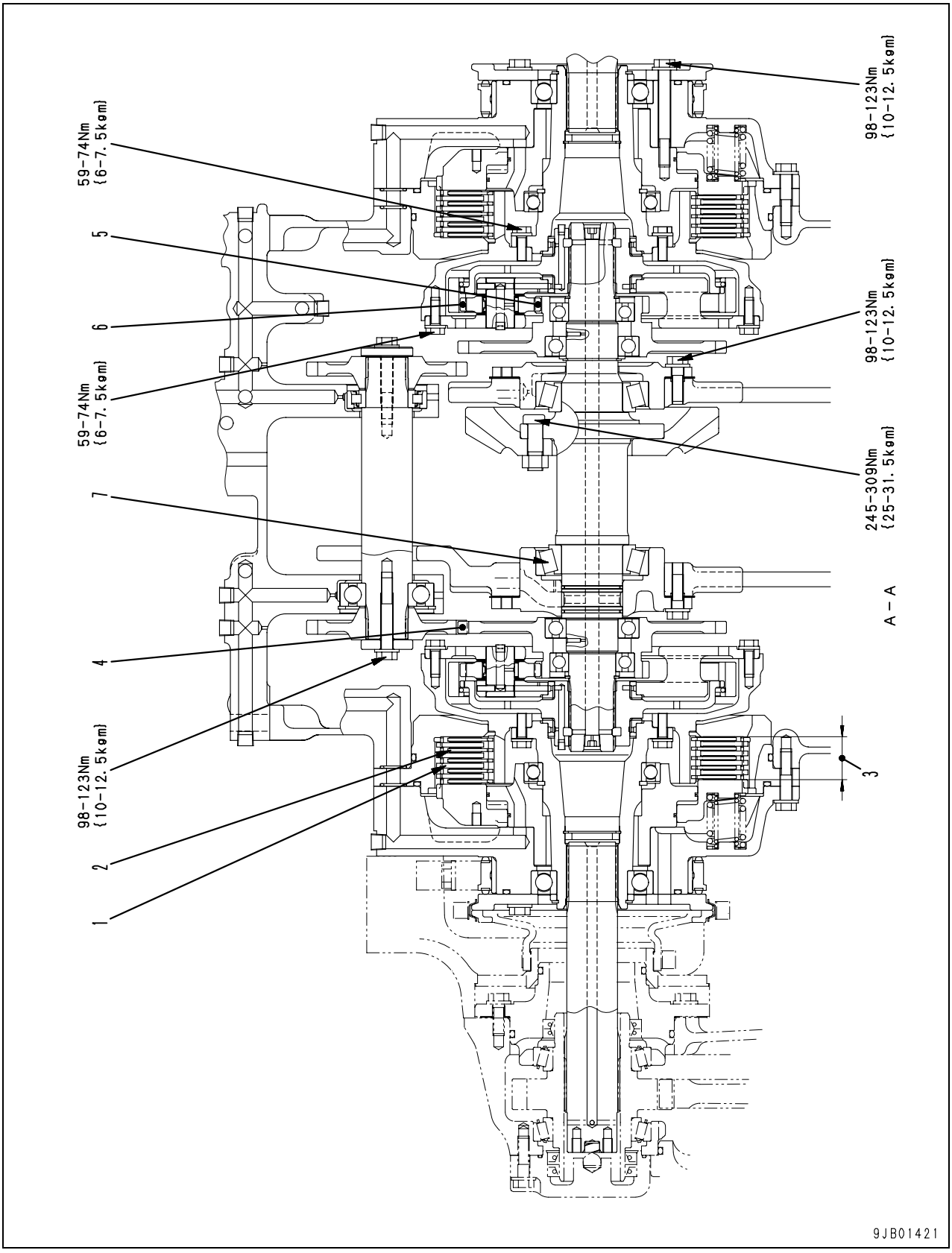
★ HSS: Abbreviation for Hydrostatic Steering System




27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
A – A
9JB01419

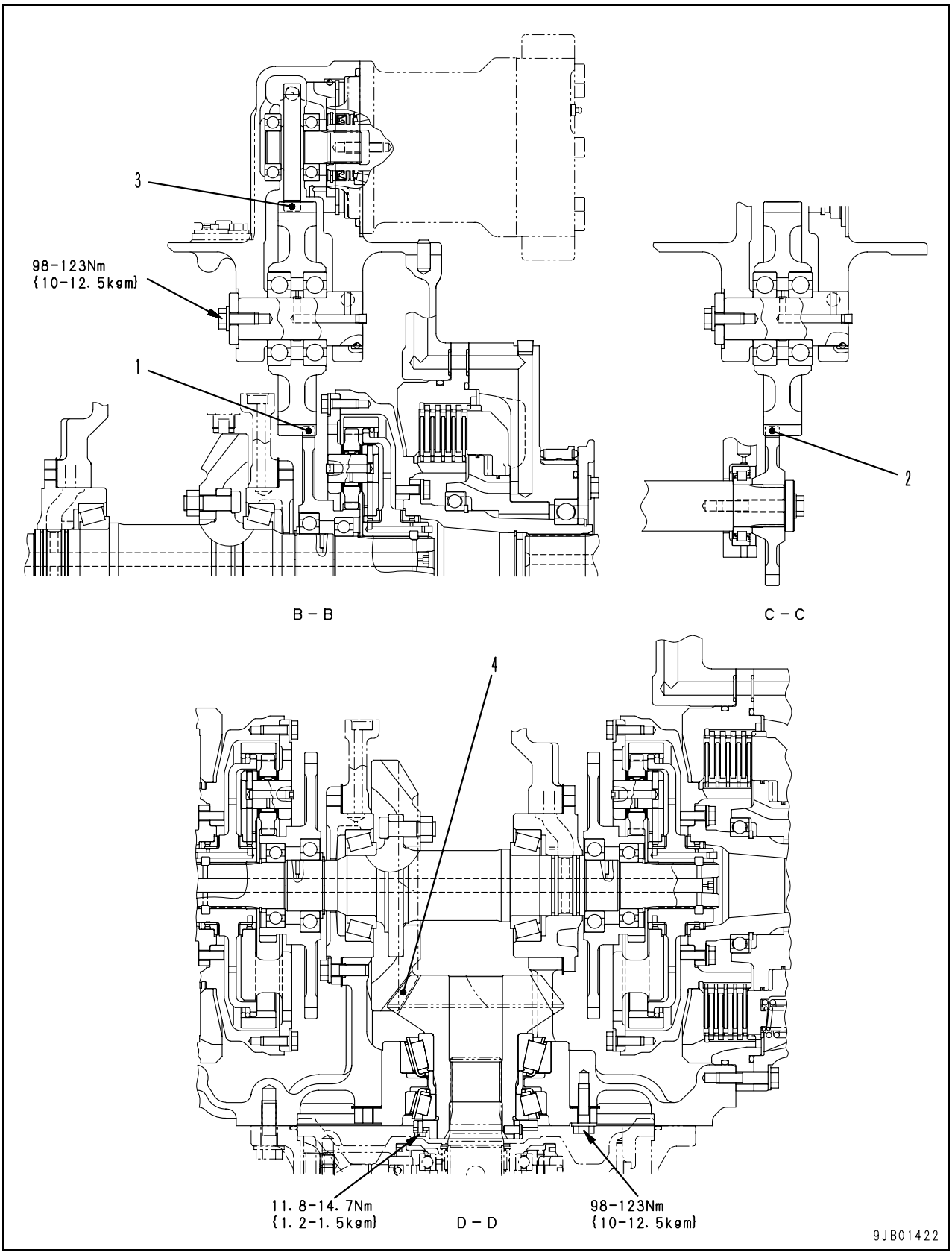

30
(2)
29
28
(15)
B – B
(29)
(22)
C – C
(19)
32
31
D – D
9JB01420

1. Brake valve
2. HSS motor
3. Output shaft
4. Brake spring (large)
5. Brake spring (small)
6. Spacer
7. Hub
8. Cage
9. Piston
10. Cover
11. Plate (one side: 4 pcs.)
12. Disc (one side: 5 pcs.)
13. Brake drum
14. Brake hub
15. Gear A (number of teeth: 38/55)
16. Cage
17. Gear B (number of teeth: 32)
18. Bevel gear shaft
19. Bevel gear (number of teeth: 35)
20. Bearing
21. Shaft
22. Gear C (number of teeth: 32)
23. Planetary pinion (number of teeth: 26)
24. Ring gear (number of teeth: 91)
25. Pinion shaft
26. Hub
27. Carrier
28. Gear D shaft
29. Gear D (number of teeth: 48)
30. HSS motor drive gear (number of teeth: 25)
31. Bevel pinion (number of teeth: 23)
32. Cage


98-123Nm {10-12.5kgm}
59-74Nm {6-7.5kgm}
5
6
59-74Nm {6-7.5kgm}
98-123Nm {10-12.5kgm}
245-309Nm {25-31.5kgm}
7
A - A
4
98-123Nm {10-12.5kgm}
2
3
1
9JB01421

Unit: mm

No.	Check item		Criteria			Remedy
			Standard size	Tolerance	Repair limit	
1	Brake plate	Thick-ness	5.0	±0.1	4.7	Replace
		Strain	—	Max 0.15	0.3	Repair or replace
2	Brake disc	Thick-ness	5.2	±0.1	4.7	Replace
		Strain	—	Max 0.25	0.4	Repair or replace
3	Total assembled thickness of 4 brake plates and 5 discs		46.0	±0.3	43.3	Replace
4	Backlash between gear A and gear B		Standard clearance		Clearance limit	
			0.06 – 0.65		—	
5	Backlash between gear A and planetary pinion		0.14 – 0.35		—	
6	Backlash between planetary pinion and ring gear		0.15 – 0.38		—	
7	Preload of taper roller bearing for bevel gear shaft		Adjust preload if starting torque is less than 9.8 Nm {1.0 kgm}. Starting torque after adjustment, 10.3 – 14.7 Nm {1.05 – 1.50 kgm}			Adjust


3
98-123Nm
{10-12.5kgm}
1
2
B - B
C - C
4
11.8-14.7Nm
{1.2-1.5kgm}
D - D
98-123Nm
{10-12.5kgm}
9JB01422

Unit: mm

No.	Check item	Criteria		Remedy
1	Backlash between gear A and gear D	Standard clearance	Clearance limit	Replace
		0.09 – 0.64	—	
2	Backlash between gear C and gear D	0.15 – 0.49	—	
3	Backlash between gear D and HSS motor drive gear	0.10 – 0.40	—	
4	Backlash of bevel pinion and bevel gear	0.20 – 0.28	—	Adjust

Outline

Bevel gear shaft

- Bevel gear shaft converts power sideways at a right angle, which is transmitted from engine to torque converter and transmission through mesh of bevel pinion (31) and bevel gear (19). It also reduces the rotation speed.
- Bevel gear shaft adopts spiral bevel gear at bevel pinion (31) and bevel gear (19), and it adopts splash lubrication with oil from scavenging pump and lubrication pump for lubrication.
- Bevel gear shaft consists of bevel gear (19) which meshes with bevel pinion (31), bevel gear shaft (18) and bearing (20) which supports bevel gear shaft and cage (16).

HSS

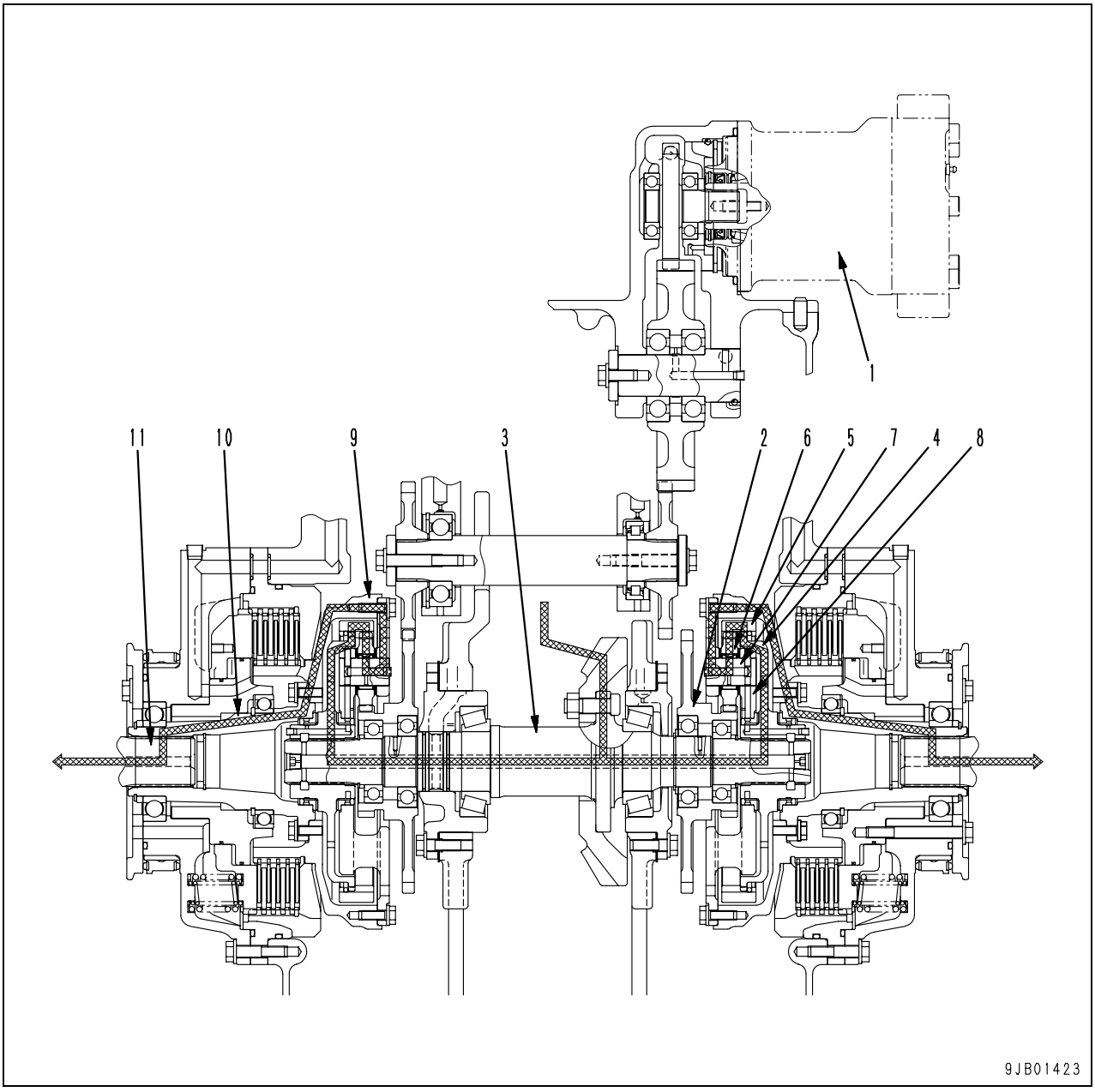
- HSS is constructed from transfer area which transmits rotation of HSS motor (2) by turning it in reverse direction, and the planet area which adjusts inputs to ring gear (24) and gear A (15) and then outputs to carrier (27).
  It changes the turning direction of the machine by turning off the rotation of HSS motor (2), or by making it move in normal rotation or reverse rotation.
- The transfer unit employs a spur gear speed reduction mechanism and is lubricated with oil splashed by the scavenging pump and lubrication pump.
- Planet area adopts forced lubrication with oil from scavenging pump and lubrication pump for lubrication.
- Transfer area is constructed from; HSS motor drive gear (30) attached to HSS motor (2) with spline, gear D (29) meshed with HSS motor drive gear, gear C (22) meshed with gear D, gear B (17) attached to shaft (21), gear A (15) retained on bevel gear shaft with bearing, gear A (15) meshed with gear D (29) and case which supports them all.
- Planet area is constructed from; gear A (15), planetary pinion (23), pinion shaft (25), hub (26) attached to bevel gear shaft (18) and ring gear (24) with gear, and carrier (27) attached to brake hub (14).

Brake

- Brake is established to control the movement of the machine, and is attached to brake hub (14).
- Brake adopts wet multiple disc clutch type and spring-boosted type, and it is hydraulic actuated type which activates brake valve (1) by the operation of brake pedal.
- It adopts forced lubrication which sends oil from scavenging pump and lubrication pump to cover (10) and cage (8) through passage inside steering case, and then to disc (12) and plate (11).
- When the engine is stopped, back pressure of brake piston (9) descends even if the brake pedal is not depressed, which initiates the brake to “operate“. However, parking brake lever must be in “lock“ position, because the brake is “released“ as the oil pressure within the circuit rises when the engine is restarted.
- Brake is constructed from; carrier (27), brake hub (14) attached to hub (7), disc (12) meshed with brake hub, plate (11) whose outside perimeter is attached to brake drum (13) with gear, piston (9) and springs (4) and (5) which brings disc and plate together, and cage (8), cover (10) and output shaft (3) which supports all of them.
  Brake drum (13) and cover (10) are fixed to the steering case.
  Also, output shaft (3) is connected to the hub (7) by spline and held by spacer (6) in the axial direction.

HSS operation

When steering is at “neutral“ (straight travel)



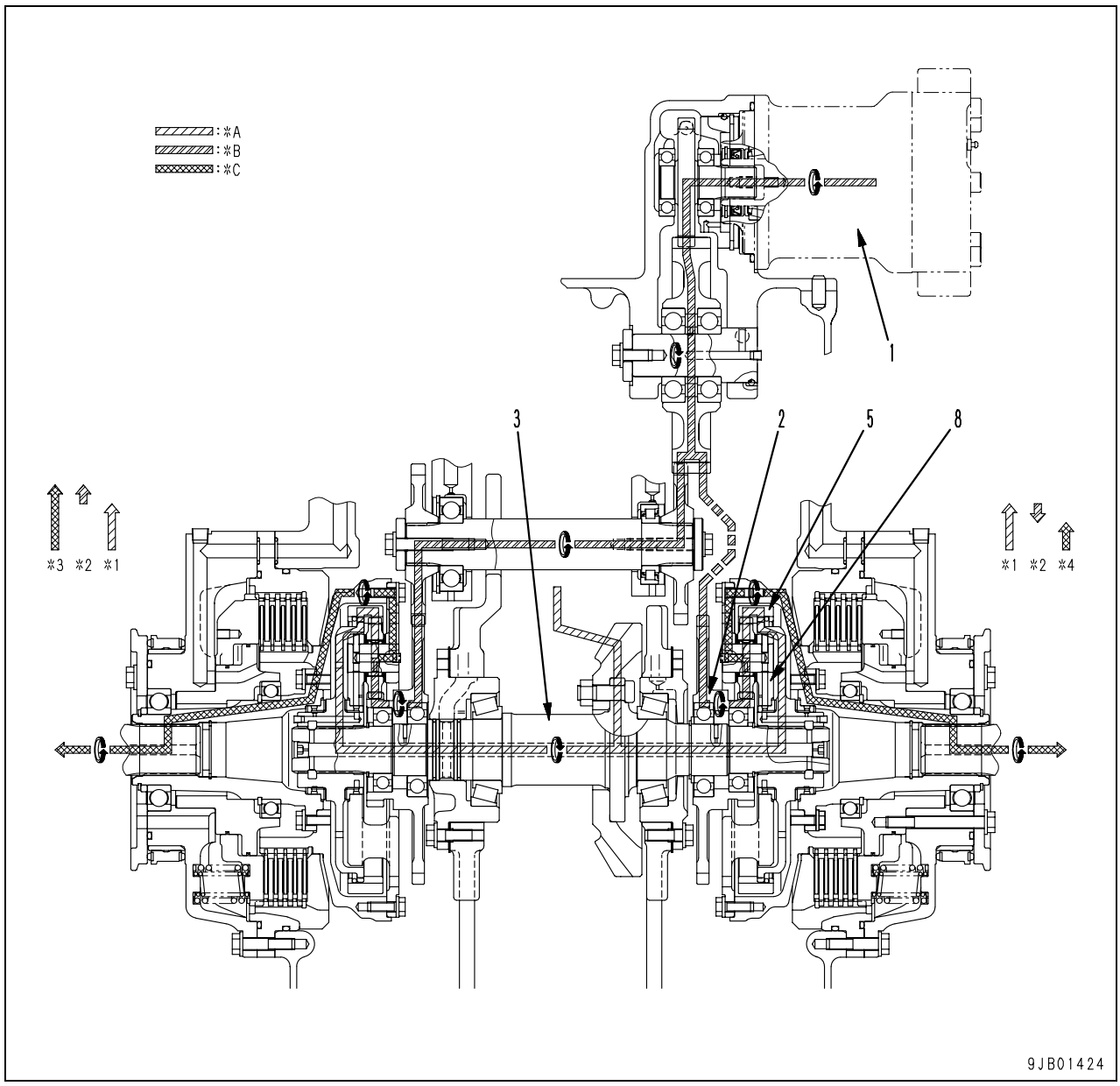
- When steering operation of PCCS lever is at “neutral“, left and right gears A (2) of transfer area and planet area do not rotate for HSS motor (1) is stopped.
- Under this condition, power from bevel gear shaft (3) is transmitted from hub (4) to ring gear (5).
- Power transmitted to ring gear (5) is transmitted to carrier (8) by passing through planetary pinion (6) to planetary pinion shaft (7).
- Power transmitted to carrier (8) is transmitted from brake hub (9) through hub (10) to output shaft (11).
- Therefore, the number of output rotation of left and right becomes the same and the machine travels straight.

Rotation direction of HSS motor

PCCS lever steering operation	Neutral	Right turn			Left turn		
PCCS lever forward/reverse switching operation	Free, not specified	* Neutral	Forward	Reverse	* Neutral	Forward	Reverse
Rotation direction of HSS motor viewed from left side of machine	Does not rotate	Left	Left	Right	Right	Right	Left

*: Counter-rotation

When steering operation is at “right“ turn (forward travel)

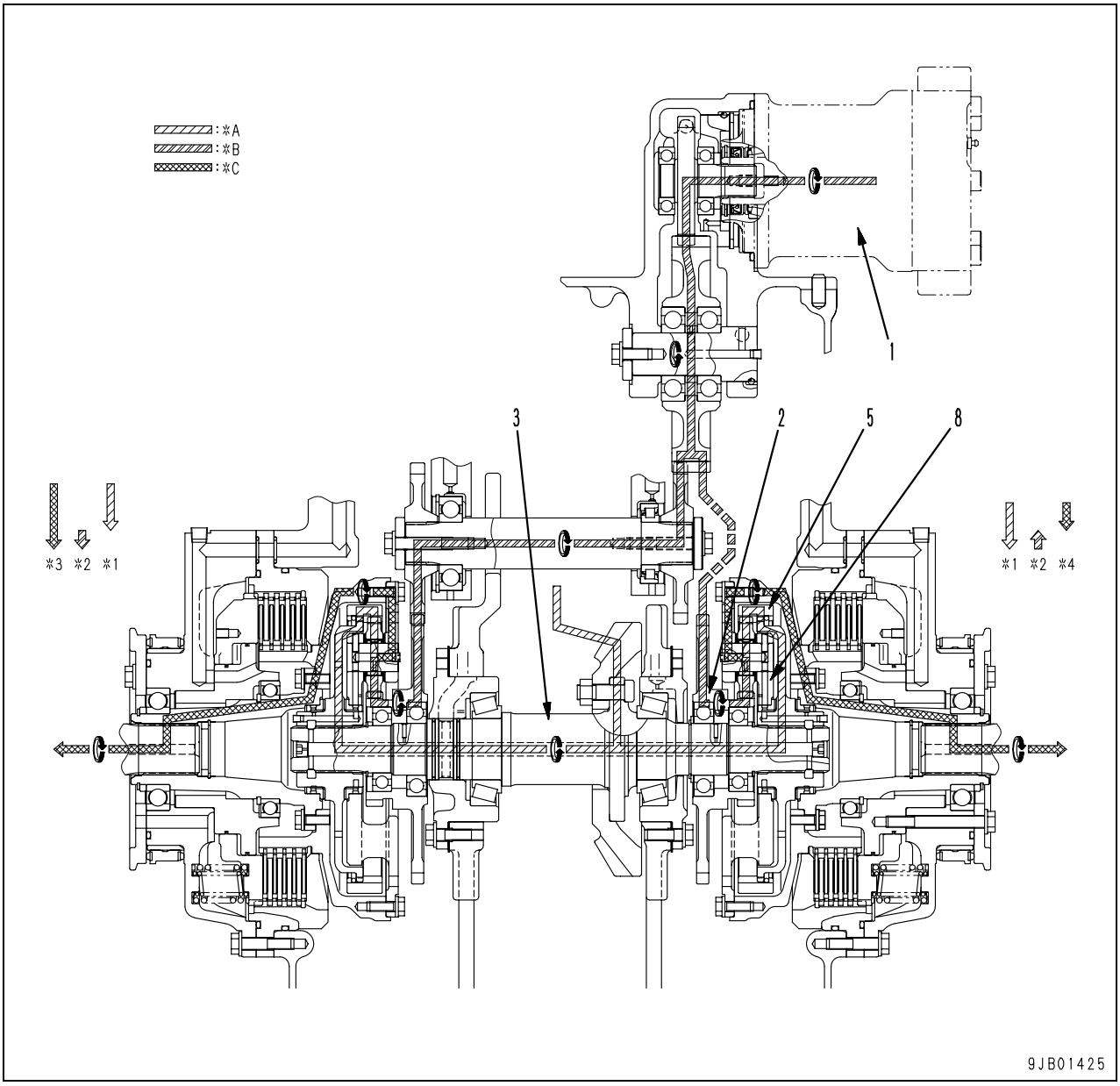


*A: Transmission power
*B: HSS motor power
*C: Combined power

*1. Transmission output speed
*2. HSS motor output speed
*3. Left bevel gear shaft output speed (*1.+*2.)
*4. Right bevel gear shaft output speed (*1.-*2.)

- When steering operation of PCCS is at “right“ turn while traveling forward, HSS motor (1) rotates in left direction, left side gear A (2) rotates in right direction, and right side gear A (2) rotates in left direction, viewing from the left side of the machine body.
- Also bevel gear shaft (3) and other ring gear (5) linked to the shaft rotate in right direction, viewing from the left side of the machine body.
- Accordingly, considering the rotation number at left/right planet area, that of left side carrier (8) increases its speed with the power of HSS motor, and that of right side carrier (8) slows down, compared to that of straight forward travel. Therefore, the machine will travel to the right direction whose output rotation number is smaller.

When steering operation is at “right“ turn (reverse travel)

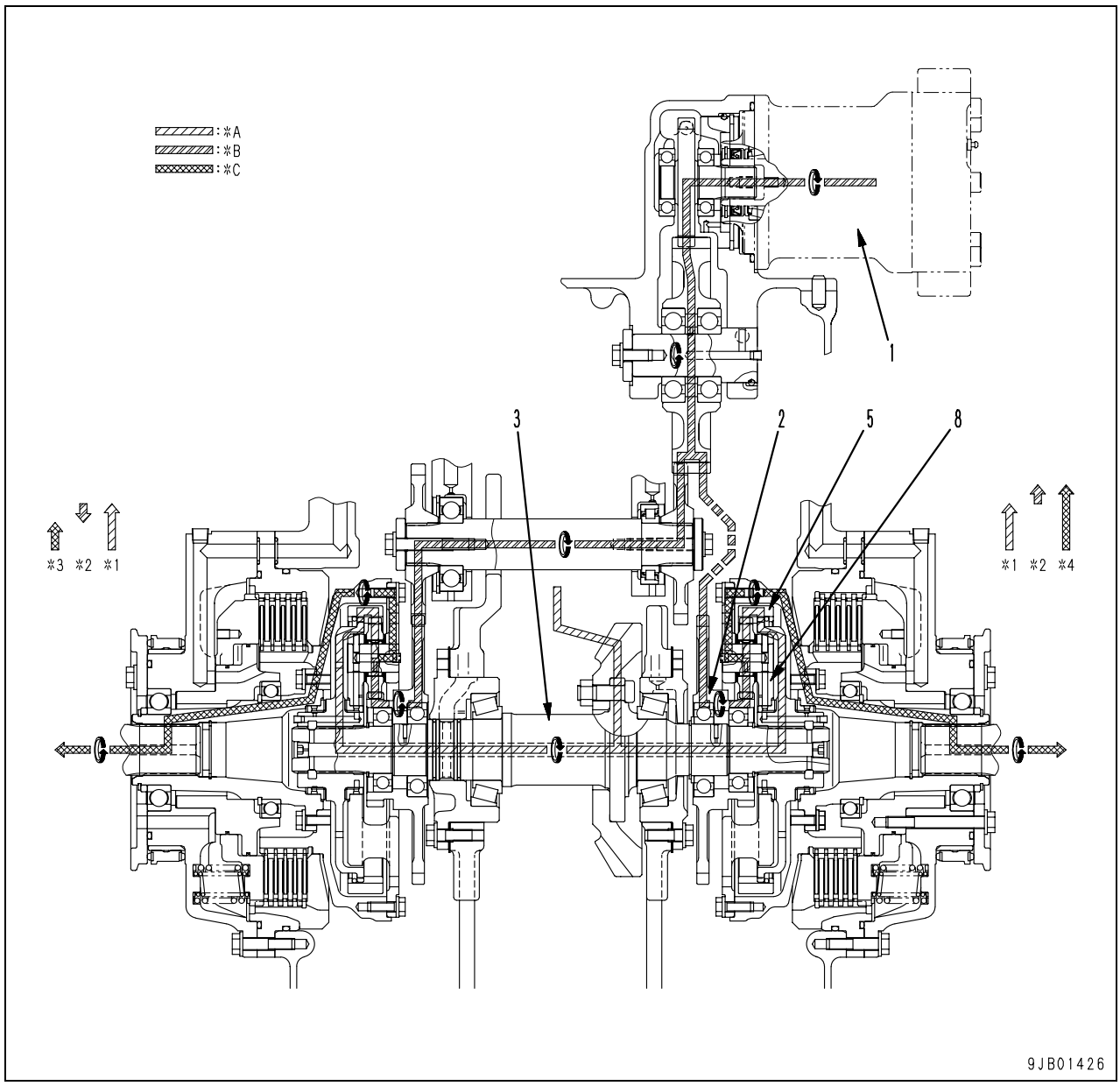


*A: Transmission power
*B: HSS motor power
*C: Combined power

*1. Transmission output speed
*2. HSS motor output speed
*3. Left bevel gear shaft output speed (*1.+*2.)
*4. Right bevel gear shaft output speed (*1.-*2.)

- If PCCS lever shifts the steering operation into “right-turn“ when traveling reverse; HSS motor (1) rotates in right direction, left side gear A (2) rotates in left direction, and right side gear A (2) rotates in right direction, viewing from the left side of the machine body.
- Also bevel gear shaft (3) and other ring gear (5) linked to the shaft rotate in left direction, viewing from the left side of the machine body.
- Accordingly, considering the rotation number at left/right planet area, that of left side carrier (8) increase its speed with the power of HSS motor, and that of right side carrier (8) slows down, compared to that of straight reverse. Therefore, the machine travels in reverse and turns to the right direction whose output rotation number is smaller.

When steering operation is at “left turn“ (forward travel)

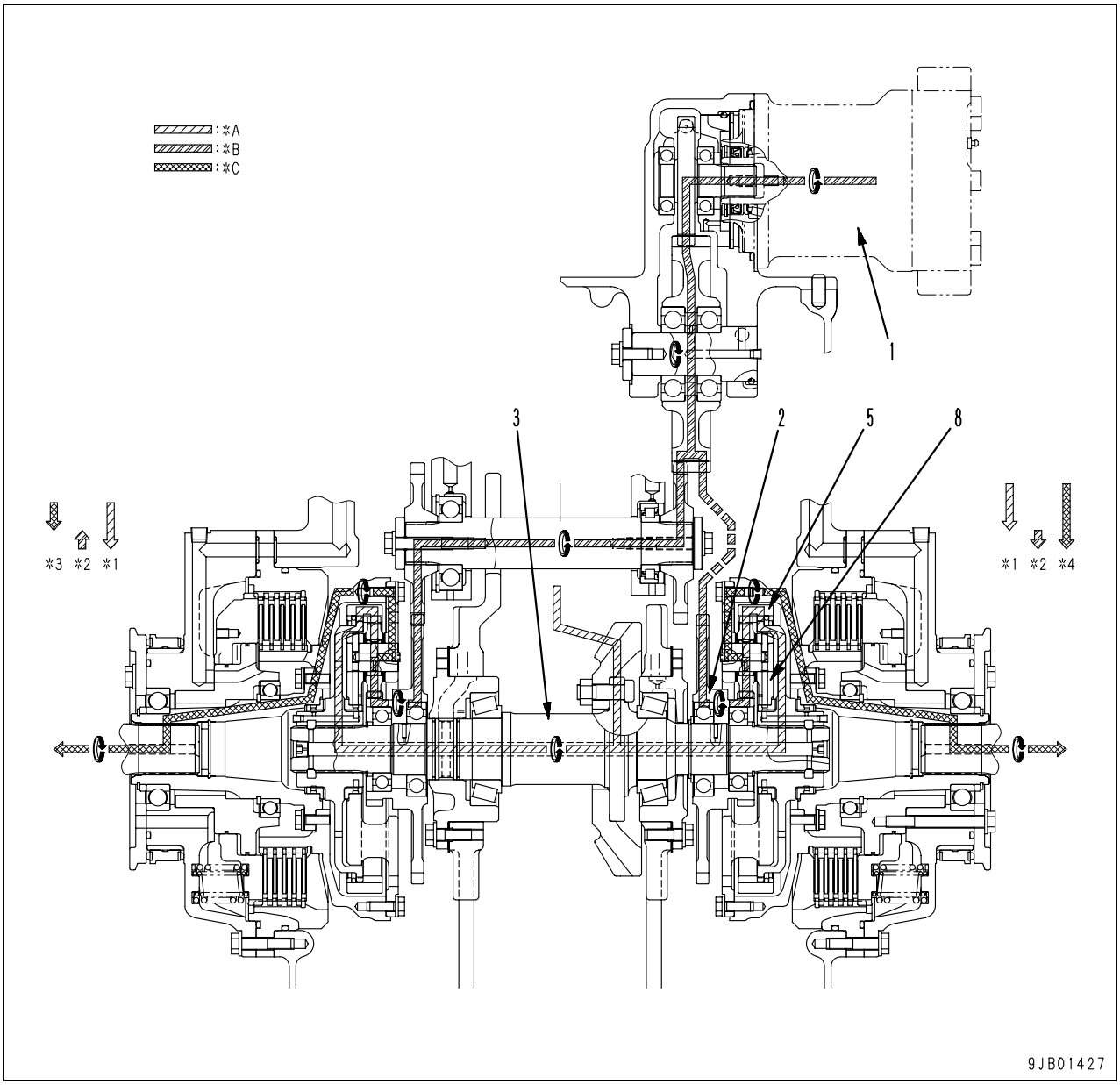


*A: Transmission power
*B: HSS motor power
*C: Combined power

*1. Transmission output speed
*2. HSS motor output speed
*3. Left bevel gear shaft output speed (*1-*2)
*4. Right bevel gear shaft output speed (*1.+*2.)

- If PCCS lever shifts the steering operation into “left turn“ when traveling forward; HSS motor (1) rotates in right direction, left side gear A (2) rotates in left direction, and right side gear A (2) rotates in right direction, viewing from the left side of the machine body.
- Also bevel gear shaft (3) and other ring gear (5) linked to the shaft rotate in right direction, viewing from the left side of the machine body.
- Accordingly, considering the rotation number at left/right planet area, that of right side carrier (8) increases its speed with the power of HSS motor, and that of left side carrier (8) slows down, compared to that of straight forward. Therefore, the machine travels to the left direction whose output rotation number is smaller.

When steering operation is at “left turn“ (reverse travel)



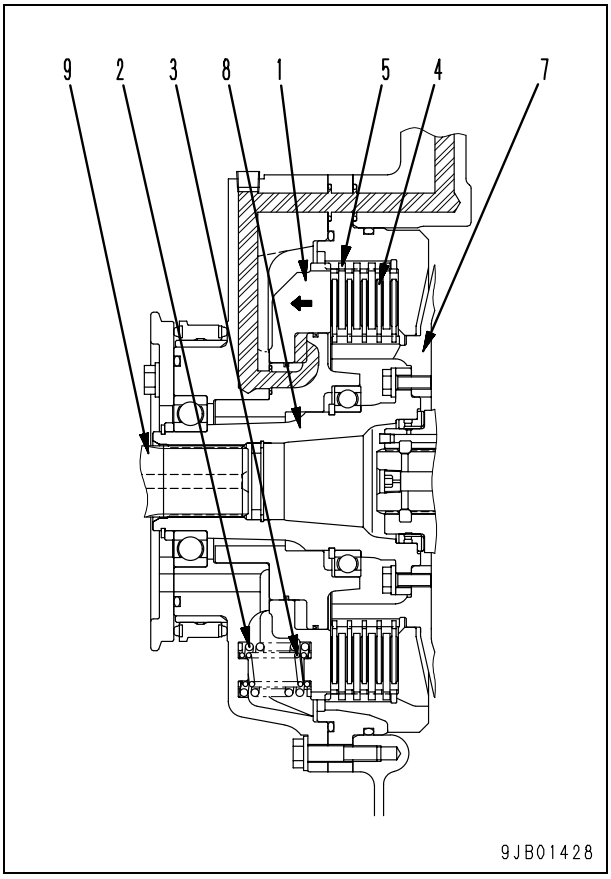
*A: Transmission power
*B: HSS motor power
*C: Combined power

*1. Transmission output speed
*2. HSS motor output speed
*3. Left bevel gear shaft output speed (*1-*2)
*4. Right bevel gear shaft output speed (*1.+*2.)

- When steering operation of PCCS is at “left turn“ while traveling reverse, HSS motor (1) rotates in left direction, left side gear A (2) rotates in right direction, and right side gear A (2) rotates in left direction, viewing from the left side of the machine body.
- Also bevel gear shaft (3) and other ring gear (5) linked to the shaft rotate in left direction, viewing from the left side of the machine body.
- Accordingly, considering the rotation number at left/right planet area, that of right side carrier (8) increases its speed with the power of HSS motor, and that of left side carrier (8) slows down, compared to that of straight reverse. Therefore, the machine travels to the left direction whose output rotation number is smaller.

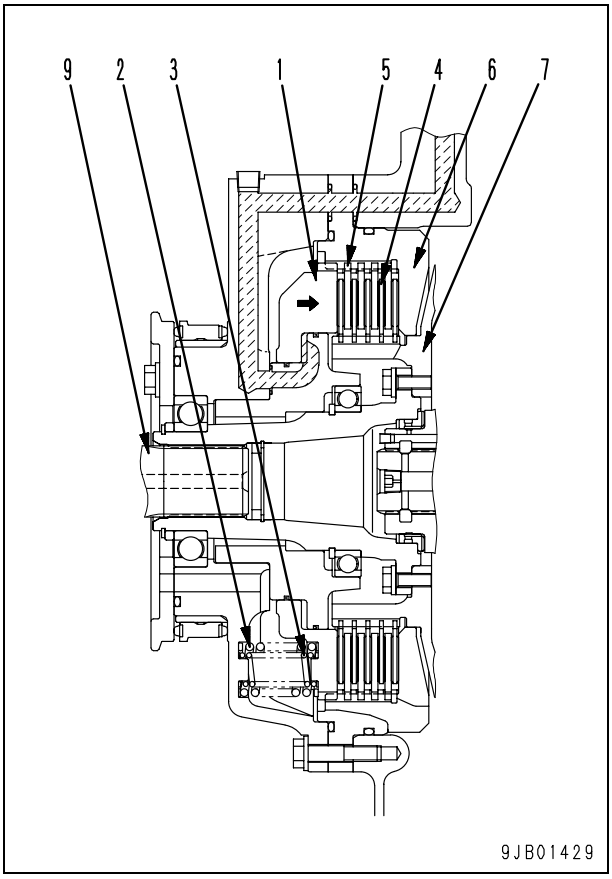
Brake operation

When brake is “released“



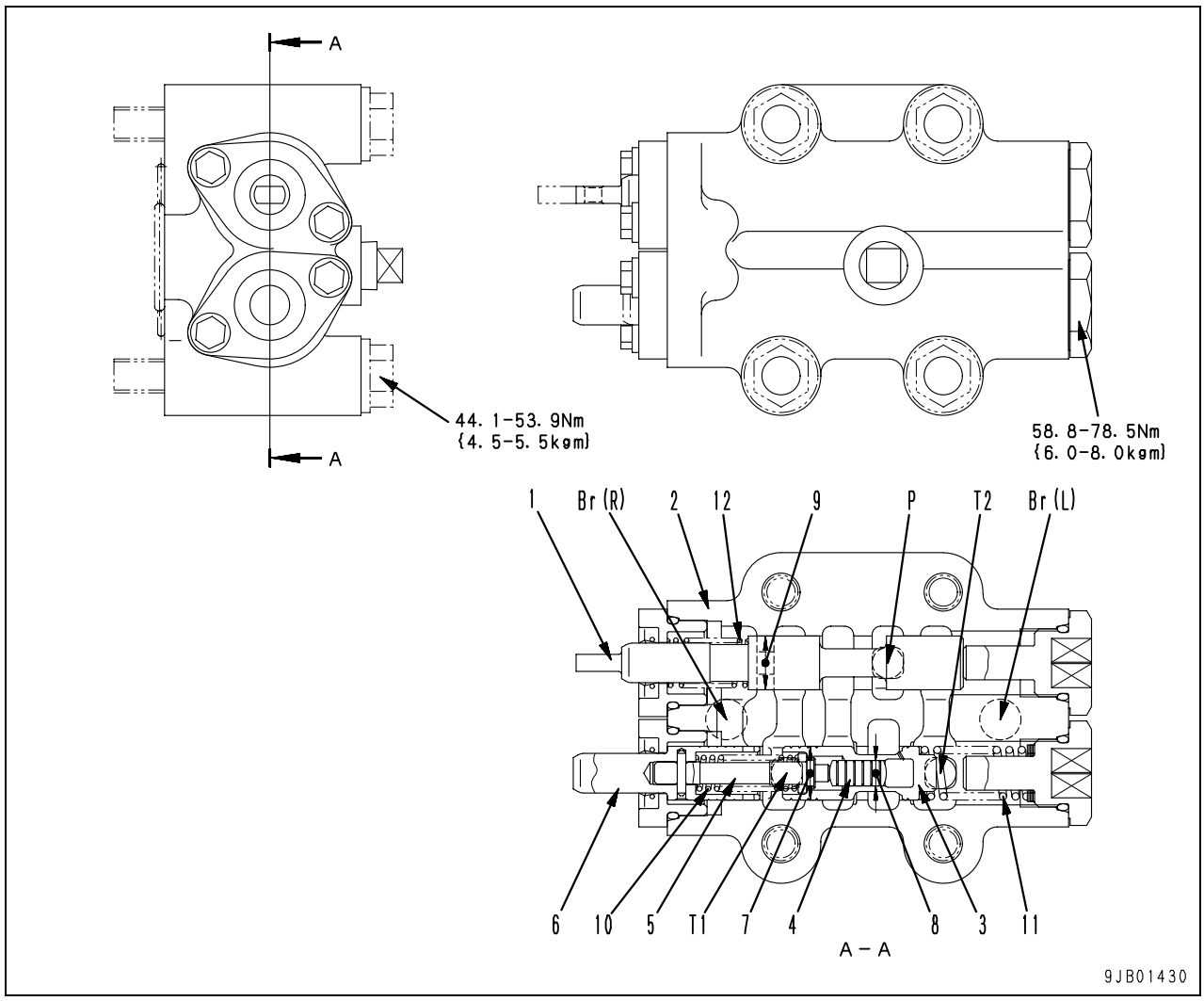
- When the brake pedal is released, brake valve is at “neutral“ position, and the back pressure port of piston (1) is filled with oil.
- Rising of oil pressure makes piston (1) push down springs (2) and (3) and move towards left direction, and releases disc (4) and plate (5).
- Power transmitted from bevel gear shaft via HSS to brake hub (7) is transmitted from hub (8) to output shaft (9) and then to final drive.

When brake is “operated“ (when brake pedal “depressed“)



- When brake pedal is depressed, brake valve is switched and the oil of back pressure port of piston (1) is drained.
- By reducing the oil pressure of back pressure port, piston (1) moves to the right direction using tension of springs (2) and (3), and makes disc (4) and plate (5) crimped to brake drum (6). Brake drum (6) is connected and fixed to steering case.
- Power towards brake hub (7) or output shaft (9) is controlled by compressing disc (4) and plate (5).
- By adjusting the depression power of the brake pedal and controlling the oil pressure given to piston (1), brake pedal can adjust the braking power.

Brake valve



P: From power train pump
T1: To steering case
T2: To steering case
Br(R): To right brake
Br(L): To left brake

1. Parking brake valve
2. Body
3. Brake valve
4. Piston
5. Shaft
6. Main brake valve

Outline

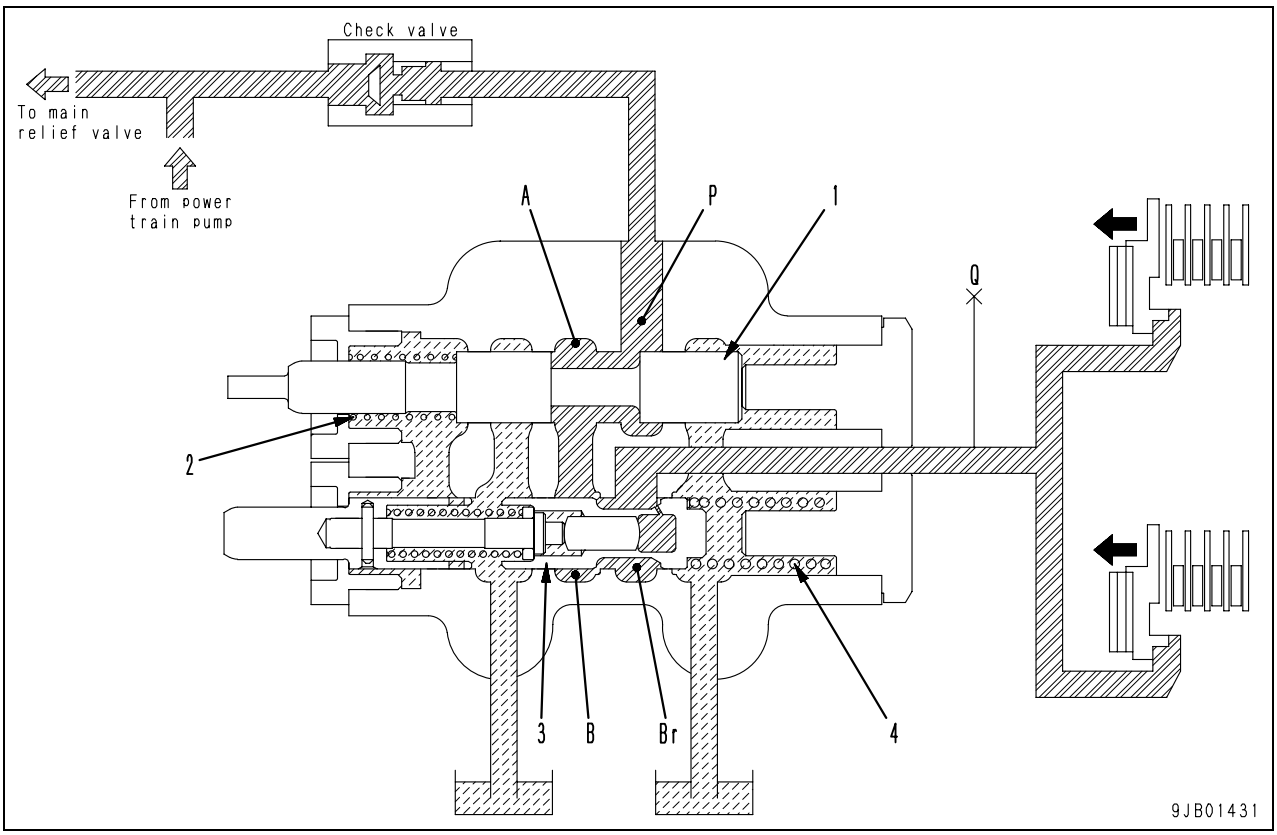
- Brake valve is located in the circuit between power train pump and brake piston within HSS unit, and is installed to the upper surface of HSS unit.
- When brake pedal is depressed, main brake valve (6) activates, and when parking brake lever is moved to “lock“ position, parking brake valve (1) activates.
- By activating each valve, oil flow at the back pressure port of brake piston will be interrupted, and brake is “operated“.
- In case of HSS, since brake is for braking power control [not involved in steering operation], both left and right brake operates concurrently.

Unit: mm

No.	Check item	Criteria					Remedy
7	Clearance between brake valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		19	–0.020 –0.030	+0.013 0	0.020 – 0.043	0.07	
8	Clearance between brake valve and piston	9	–0.030 –0.040	+0.015 0	0.030 – 0.055	0.08	
9	Clearance between parking brake valve and body	19	–0.034 –0.043	+0.013 0	0.034 – 0.056	0.08	
10	Brake modulating spring	Standard size			Repair limit		
		Free length	Installation length	Installation load	Free length	Installation load	
		48	36	75.3 N {7.68 kg}	46.6	71.6 N {7.3 kg}	
11	Brake valve return spring	52	38	157.9 N {16.11 kg}	50.4	150 N {15.3 kg}	
12	Parking brake valve return spring	36.5	28.5	16.7 N {1.7 kg}	35.4	15.7 N {1.6 kg}	

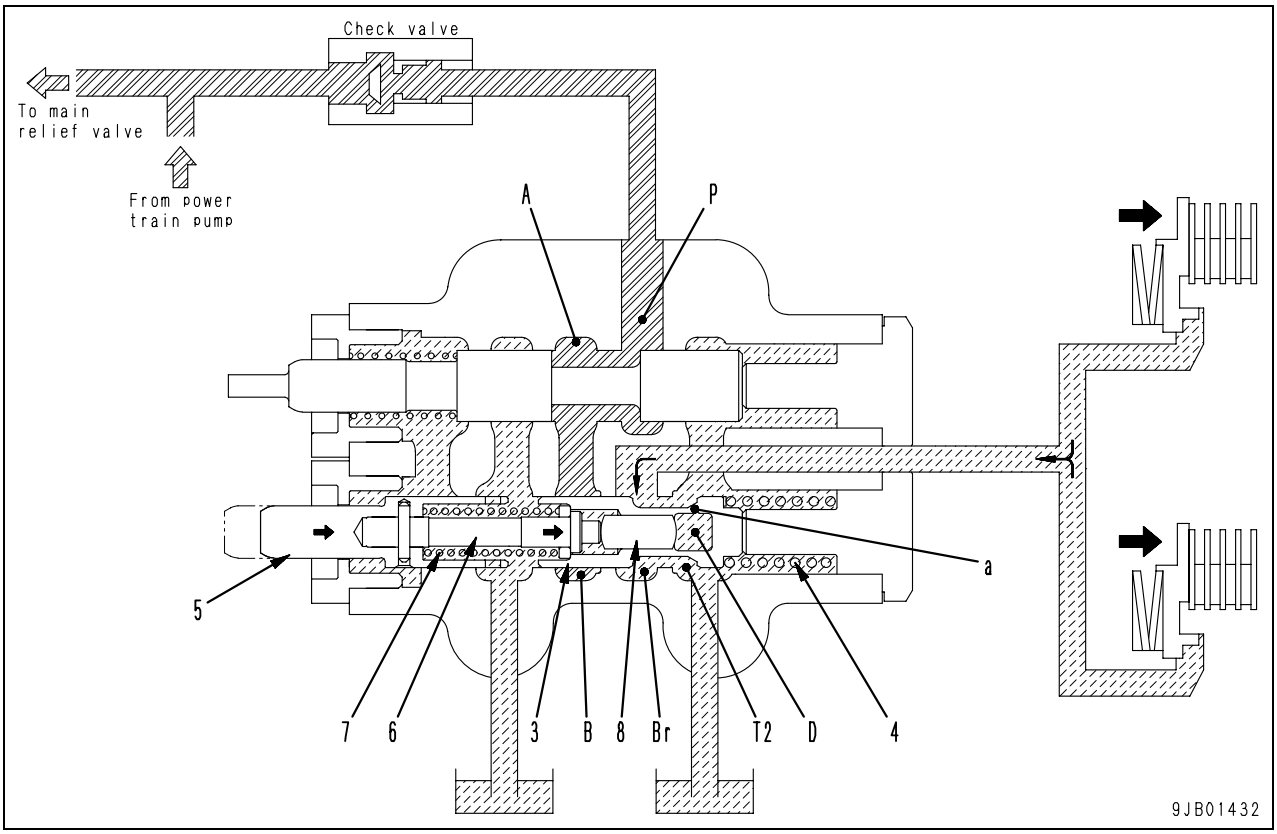
Operation

When the brake is “released“ (brake pedal “released“, parking brake lever “free“)



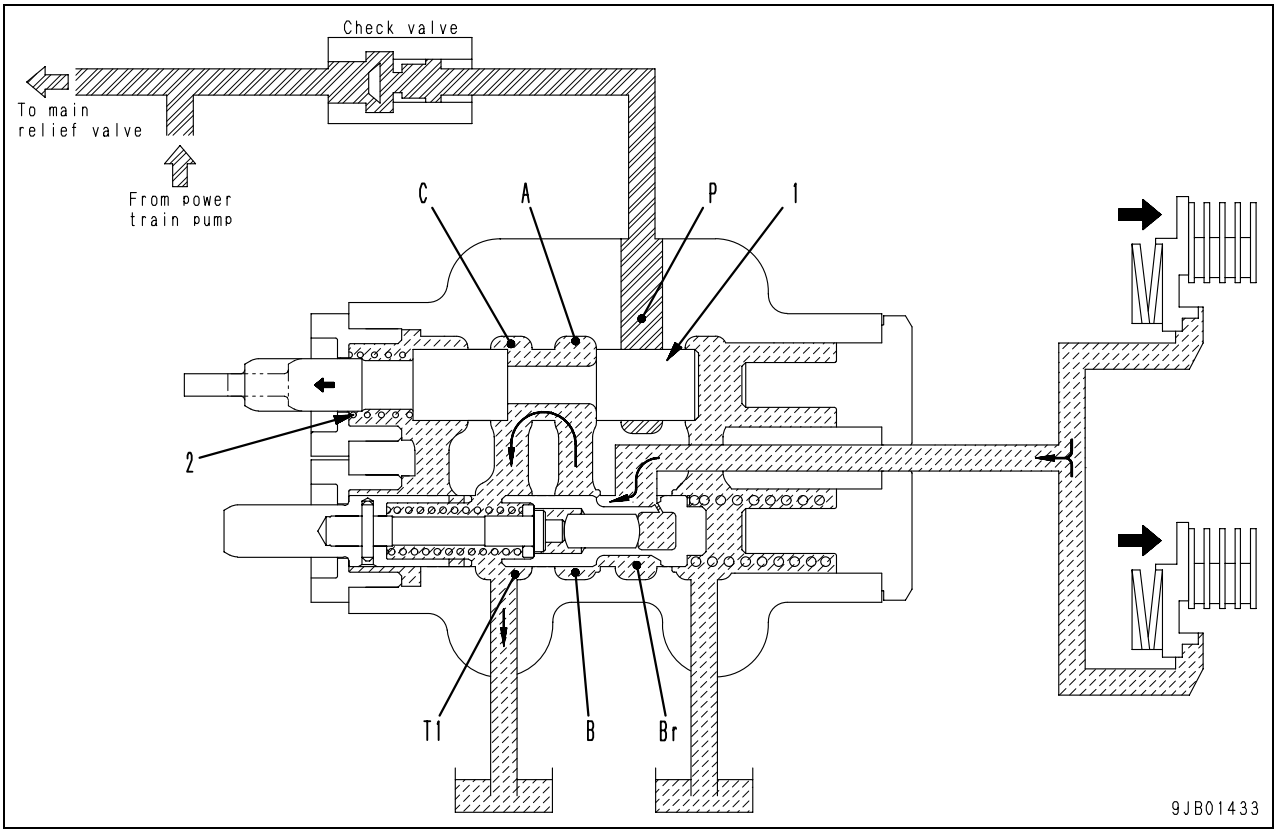
- When the brake pedal is “released“ [not depressed], parking brake valve (1) opens port (P) and chamber (A) by the tension of return spring (2).
- Brake valve (3) opens chamber (B) and port (Br) by the tension of return spring (4).
- The oil pressure from the power train pump is regulated at the main relief valve, flows from port (P) through chambers (A) and (B) and port (Br) to the brake piston back pressure port.
- The brake piston moves to the left and compresses the brake spring to “release“ the brake.
- At this time, the oil pressure is balanced at 2.84 MPa {29.0 kg/cm^2}, which can be measured at pressure pick-up port (Q).

When brake is “operated“ (when brake pedal “depressed“, parking brake lever “free“)



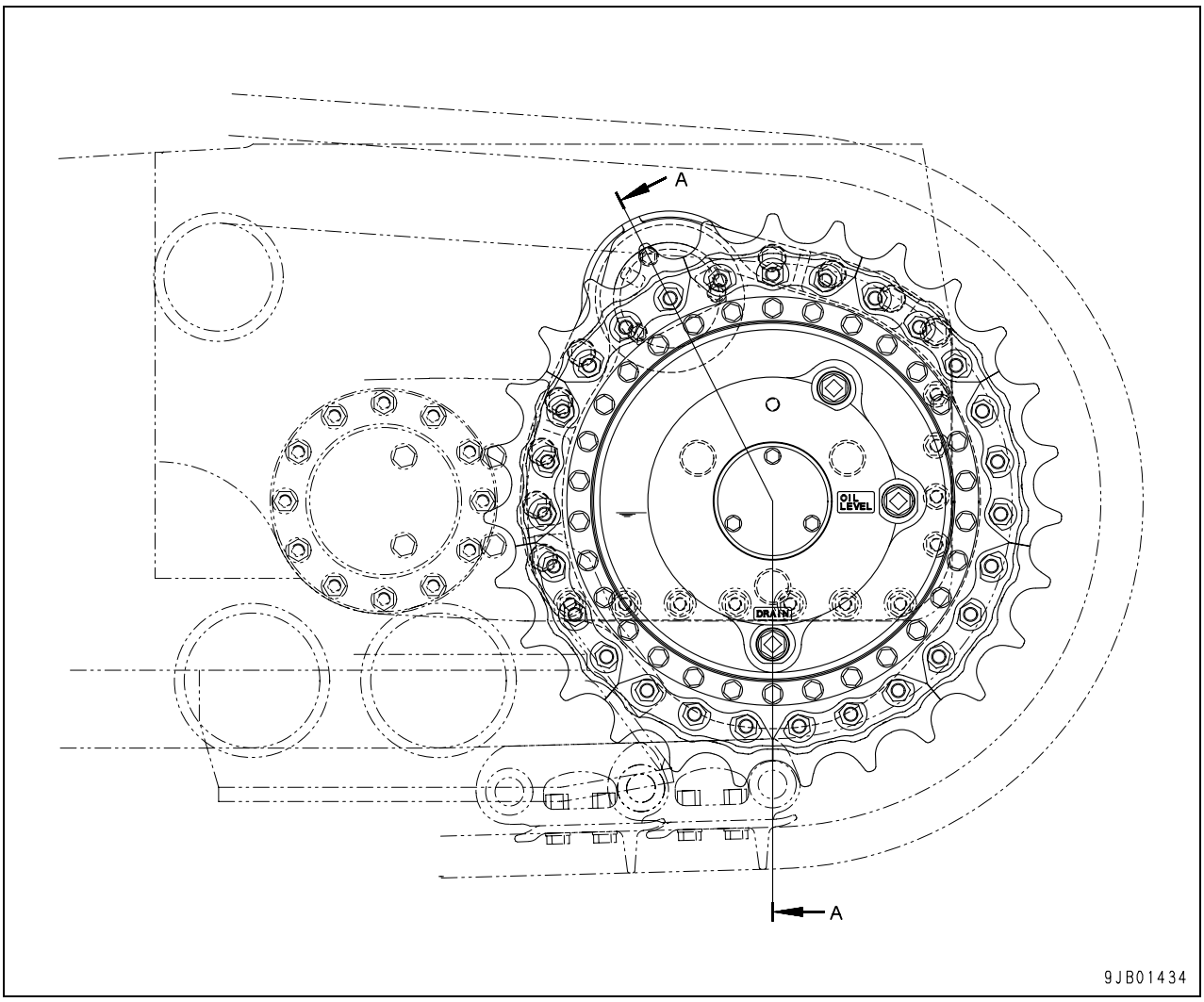
- As the brake pedal is depressed, guide (5) and shaft (6) is pushed to the right.
- As shaft (6) is pushed, it compresses modulating spring (7), and its reaction force moves brake valve (3) to the right. Then port (Br) and chamber (B) close while port (Br) and port (T2) open.
- The oil from the power train pump enters chamber (A) through port (P) and blocked by chamber (B).
- A portion of the oil which had flown into the brake piston back pressure port is drained from port (Br) to port (T2). The other portion of oil flows through port (Br) and orifice (a) to chamber (D).
- When the oil behind port (Br) is drained to port (T2) and the oil pressure is reduced, the oil in chamber (D) pushes piston (8). Then the force pushing brake valve (3) to the right is reduced, and brake valve (3) moves to the left by the tension of return spring (4).
- Port (Br) and port (T2) are closed by the movement of brake valve (3) to the left, and the oil pressure behind port (Br) is maintained not to be further reduced.
- As the brake pedal is depressed further, the operation as described above is repeated until brake valve (3) reaches to the stroke end, at which the brake is fully “operated”.
- The oil pressure behind port (Br) is determined by the tension of return spring (4) of which the load varies in accordance with the brake pedal travel.
- When the brake pedal travel is short, the oil pressure behind port (Br) is high, meaning that the brake is “half way operated”, and when the travel is long, the oil pressure is low, meaning that the brake is “operated”.

When the brake is “parked“ (brake pedal “released“, parking brake lever “locked“)



- When the parking brake lever is in the “locked“ position, parking brake valve (1) is pulled to the left. Then port (P) and chamber (A) are closed while chamber (A) and chamber (C) open.
- The oil from the power train pump is blocked by port (P).
- The oil which had flown into the brake piston back pressure port flows from port (Br) through chambers (B), (A), and (C) and is drained through port (T1).
- The oil pressure at the brake piston back pressure port continues to be reduced because parking brake valve (1) is held to the left. Then the brake remains “operated“.
- This condition is maintained while engine is restarted.

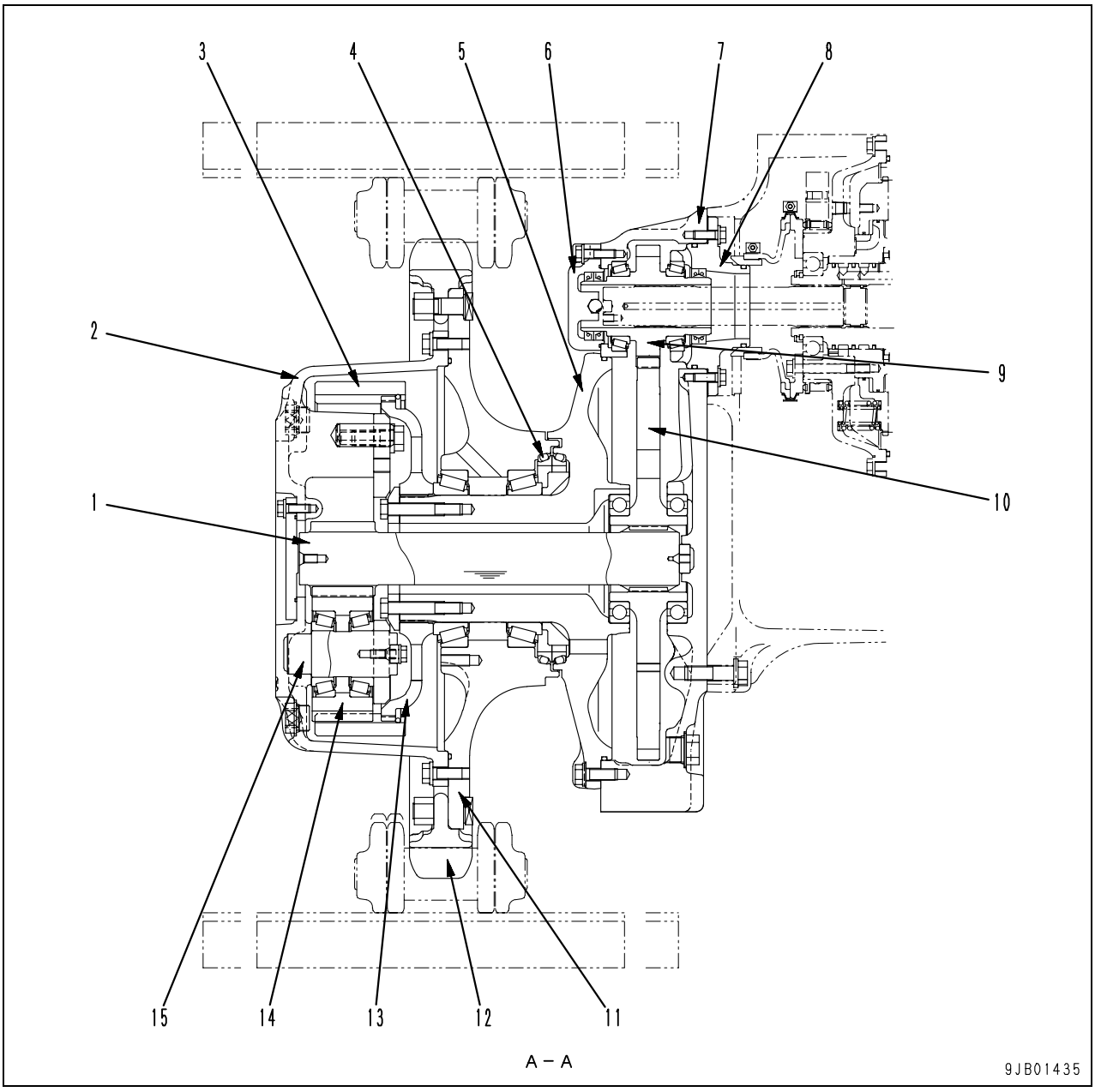
Final drive



Outline

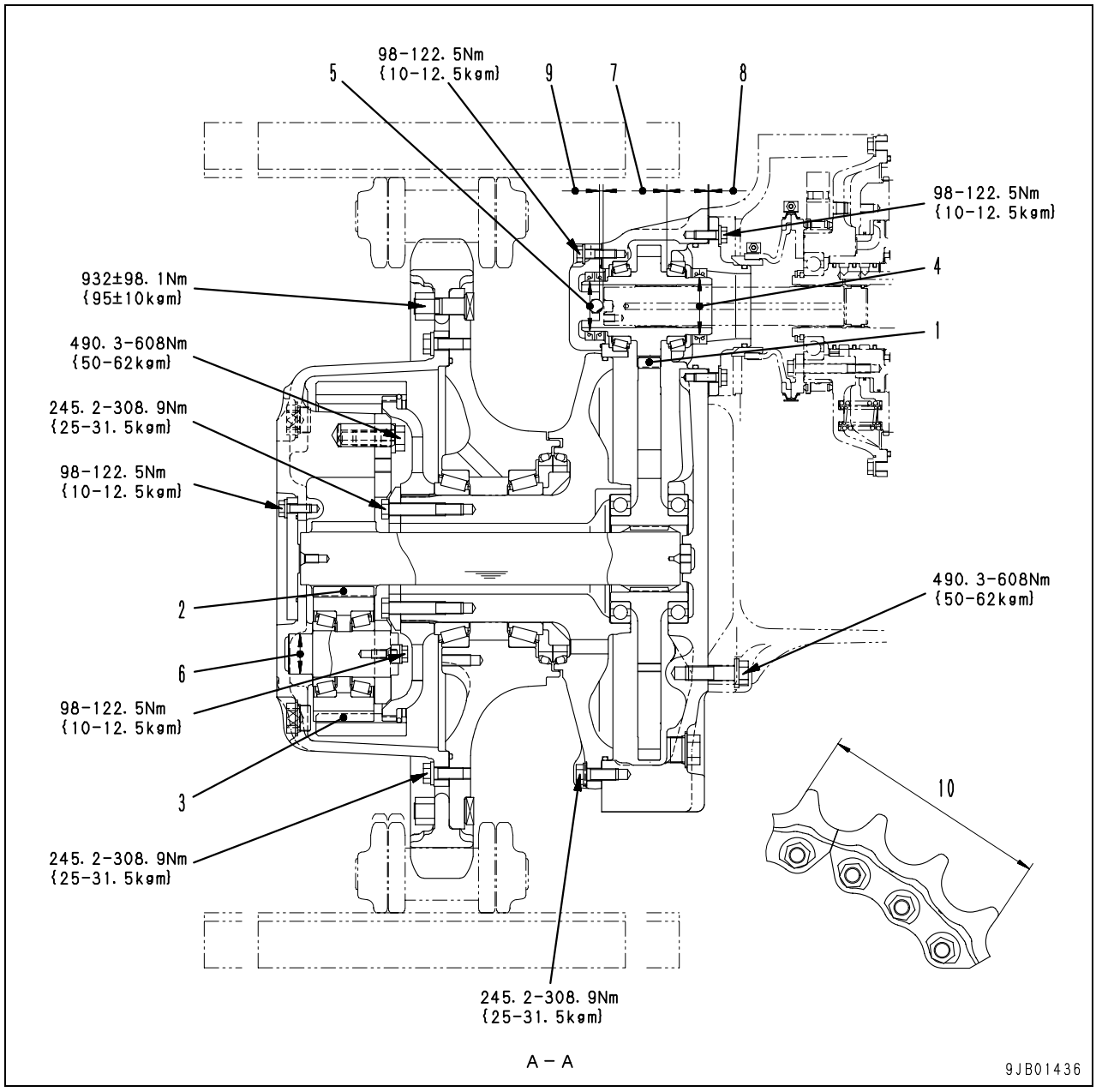
- The final drive uses a single-stage spur gear and a single-stage planetary gear reduction system.
- The lubrication is the splash type utilizing the gear rotation.
- The final drive can be removed and installed as a single unit.
- Floating seal is installed to the rotating and sliding portion of the sprocket to prevent entry of dirt or sand from the outside and the lubrication oil leakage.

★ The figure shows D65EX-15E0.



1. Pinion (number of teeth: 13)
2. Carrier
3. Ring gear (number of teeth: 68)
4. Floating seal
5. Cover
6. No.1 pinion cover
7. Final drive case
8. Bearing cage
9. No.1 pinion (number of teeth: 21)
10. No.1 gear (number of teeth: 78)
11. Sprocket hub
12. Sprocket teeth
13. Hub
14. Planetary pinion (number of teeth: 27)
15. Pinion shaft

★ The figure shows D65EX-15E0.

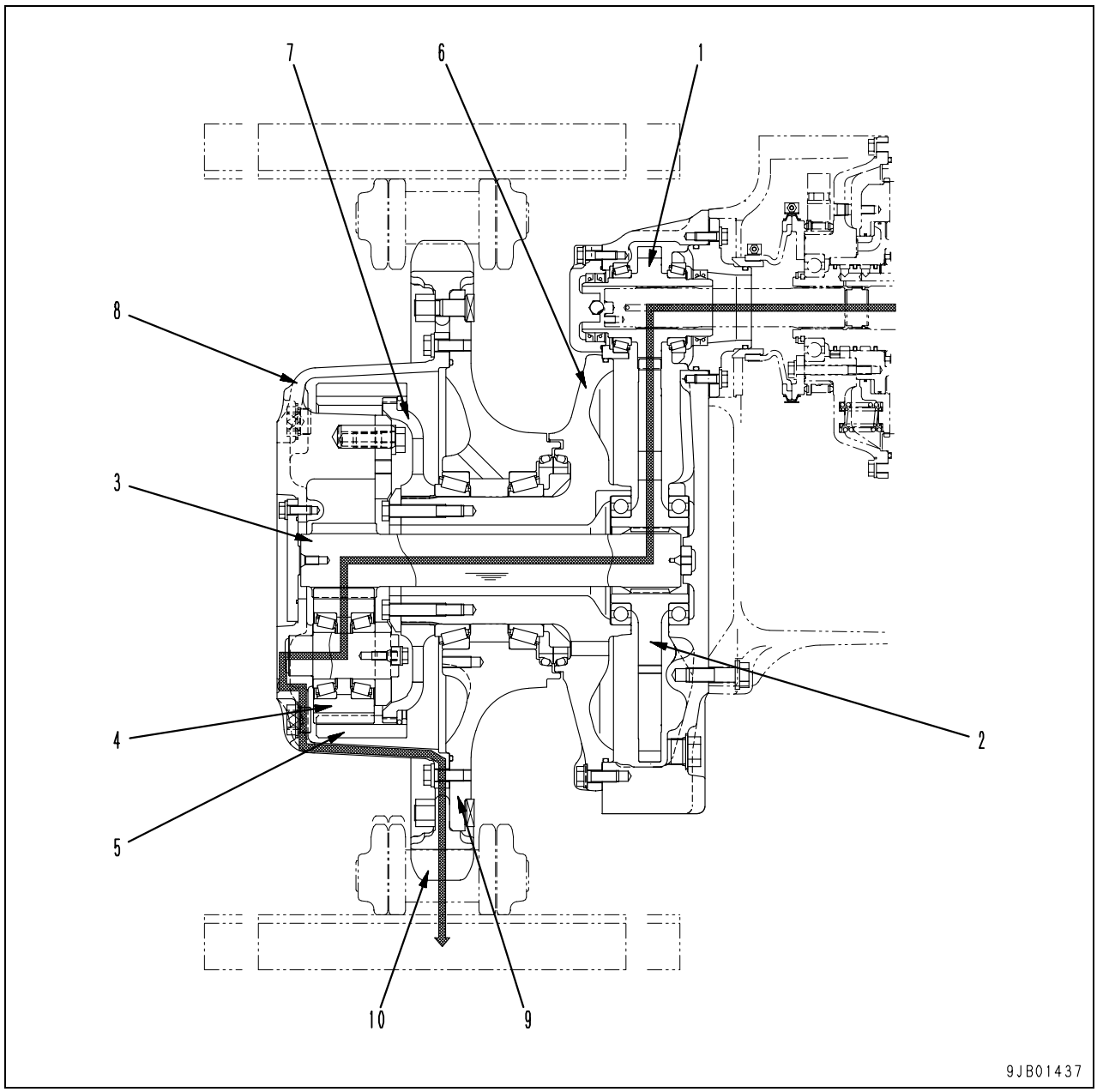


Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Backlash between No.1 pinion and No.1 gear</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="6">Replace</td></tr>
<tr><td colspan="3">0.23 – 0.61</td><td colspan="2">1.0</td></tr>
<tr><td>2</td><td>Backlash between pinion and planetary pinion</td><td colspan="3">0.18 – 0.45</td><td colspan="2">1.0</td></tr>
<tr><td>3</td><td>Backlash between planetary pinion and ring gear</td><td colspan="3">0.23 – 0.67</td><td colspan="2">1.0</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Outer diameter of oil seal contact surface of No.1 pinion (large)</td><td>Standard size</td><td colspan="2">Tolerance</td><td colspan="2">Repair limit</td></tr>
<tr><td>80</td><td colspan="2">0
–0.074</td><td colspan="2">79.9</td></tr>
<tr><td>5</td><td>Outer diameter of oil seal contact surface of No. 1 pinion (small)</td><td>70</td><td colspan="2">0
–0.074</td><td colspan="2">69.9</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Interference between pinion shaft and carrier</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interfer-ence</td><td rowspan="2">Interfer-ence limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>56</td><td>+0.051
+0.032</td><td>+0.030
0</td><td>0.002 –
0.051</td><td>0.002</td></tr>
<tr><td>7</td><td>Axial clearance of 1st pinion bearing</td><td colspan="6">0 – 0.1</td><td rowspan="2">Adjust</td></tr>
<tr><td>8</td><td>Standard shim thickness for No.1 pinion bearing cage</td><td colspan="6">1.5</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Projection of ball from No.1 pinion cover</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">5.2</td><td colspan="2">1.5</td></tr>
<tr><td>10</td><td>Amount of wear of sprocket tooth surface</td><td colspan="3">317</td><td colspan="2">299</td><td>Build-up welding or replace</td></tr>
</table>

Power transmitting route

★ The figure shows D65EX-15E0.



- The power from HSS unit is transmitted to No.1 pinion (1), and then transmitted through No.1 gear (2) and pinion (3) to planetary pinion (4).
- Planetary pinion (4) is meshed with ring gear (5).
- Cover (6) and ring gear (5) are linked with hub (7). Accordingly, planetary pinion (4) rotates on its axis, revolving pinion (3) along ring gear (5).
- The power transmitted to pinion (3) is transmitted to sprocket hub (9) as a force to rotate carrier (8) which supports planetary pinion (4). The rotation direction of carrier (8) is the same as that of pinion (3).
- The torque transmitted to sprocket hub (9) is transmitted to sprocket teeth (10).

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00283-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

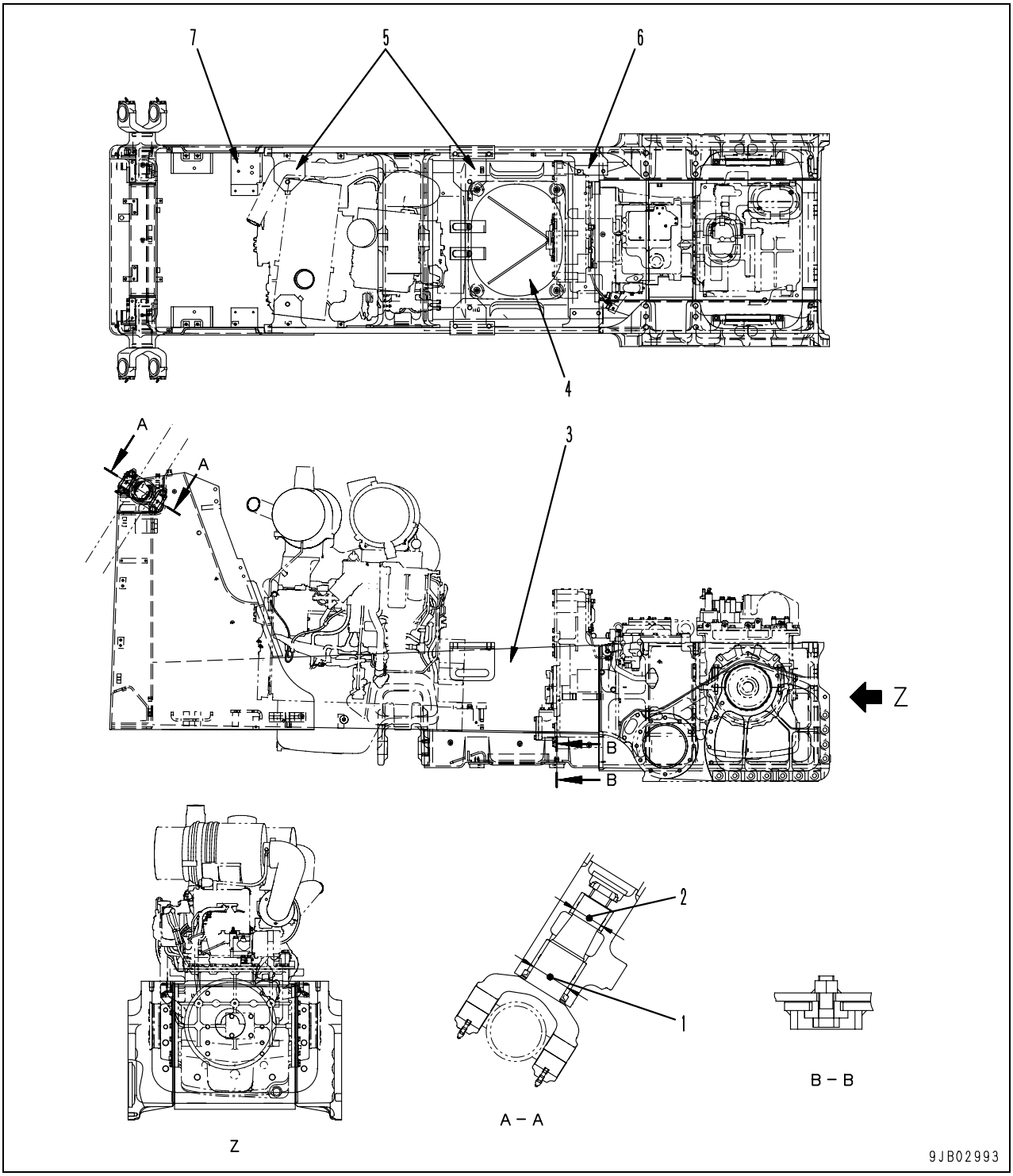
Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

10 Structure, function and maintenance standard

Undercarriage and frame

Undercarriage and frame

Main frame



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between cylinder yoke and bushing (large)	85	–0.036 –0.090	+0.207 +0.120	0.156 – 0.297	0.5	Replace bushing
2	Clearance between cylinder yoke and bushing (small)	65	–0.030 –0.076	+0.174 +0.100	0.130 – 0.250	0.5	

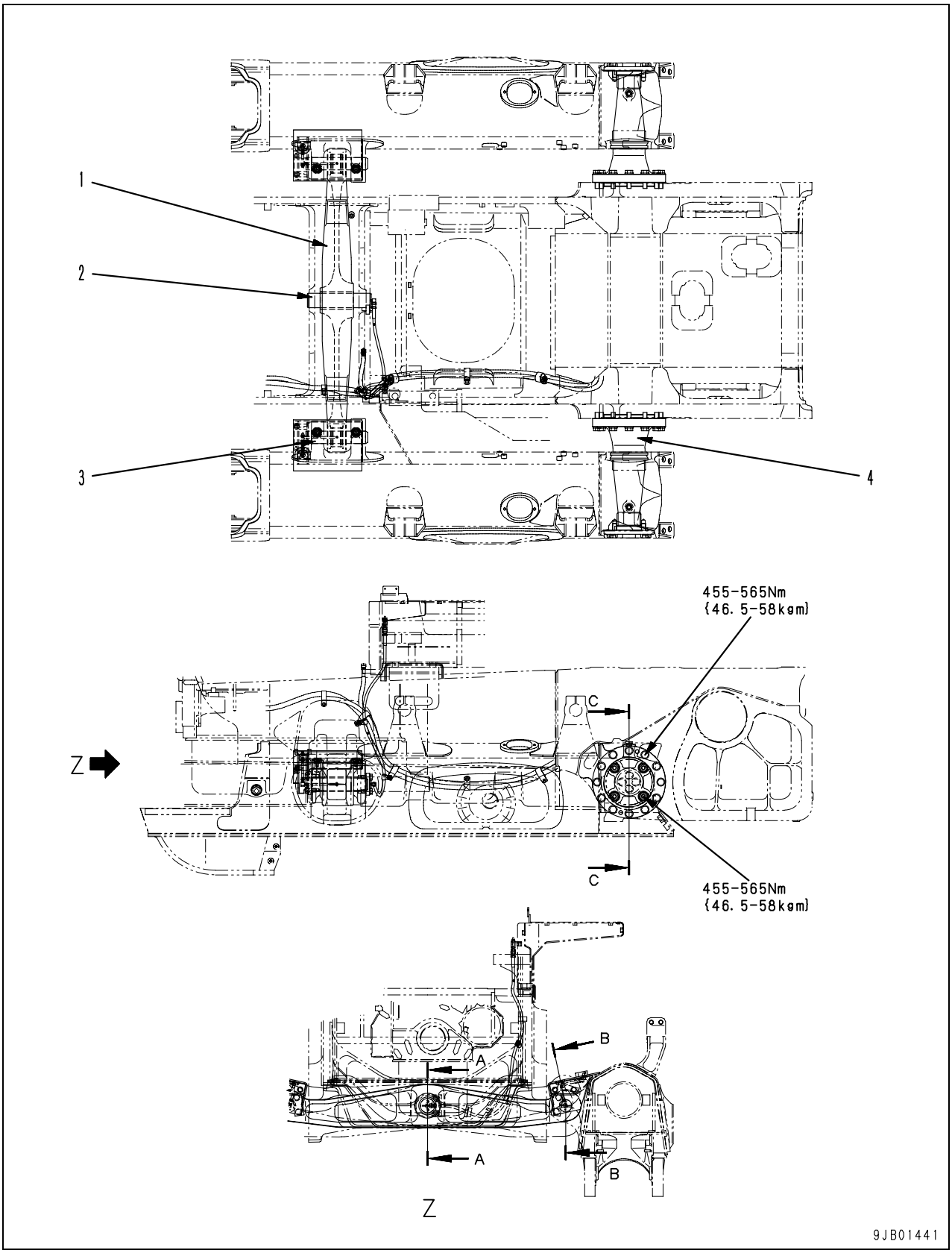
3. Frame assembly
4. Undercover
5. Engine mount
6. Power train unit mount
7. Power train cooler mount

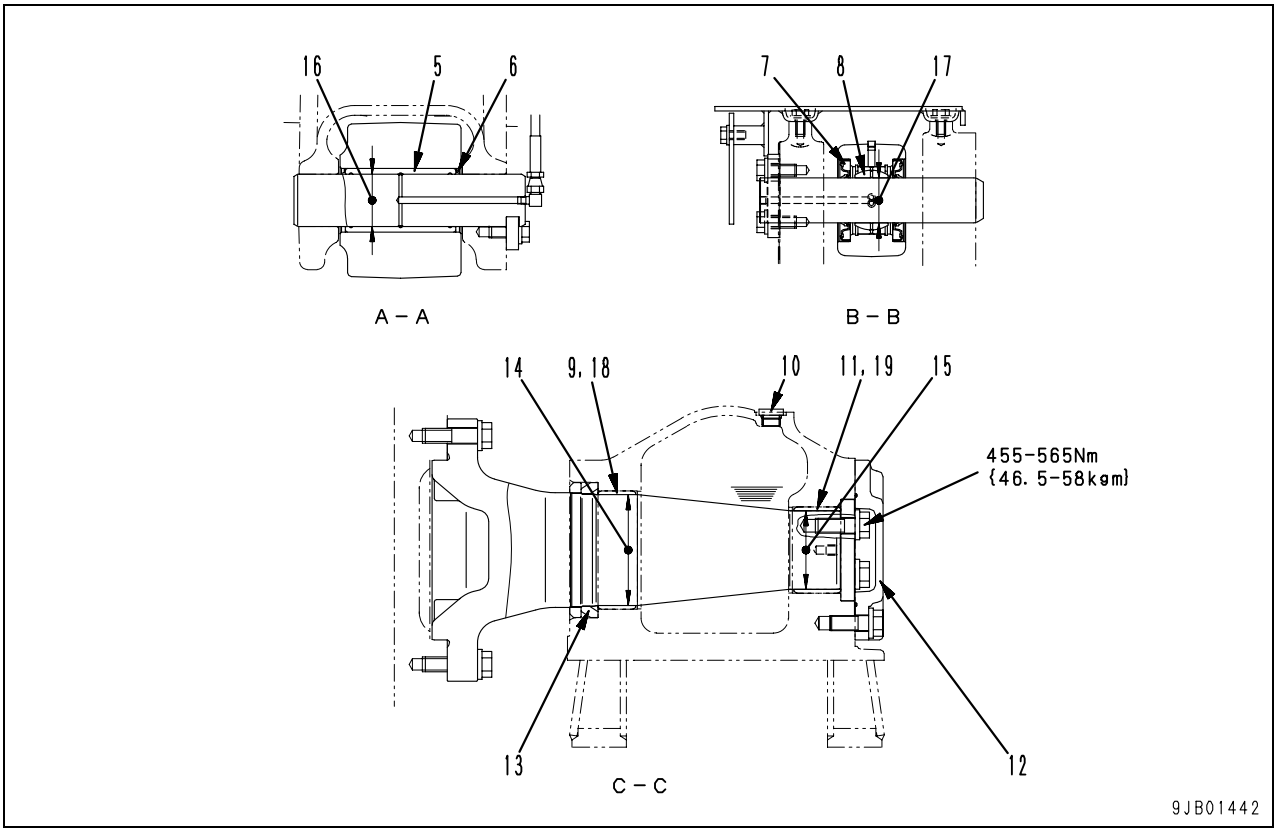
Outline

- Frame assembly (3) has a hull-frame structure, on which the radiator guard, main frame, steering case, and transmission underguard are assembled into one unit.

Suspension

D65EX-15E0
D65EX-15E0 (Long track specification)





1. Equalizer bar
2. Center pin
3. Side pin
4. Pivot shaft
5. Bushing
6. Seal
7. Seal
8. Bushing
9. Bushing (large)
10. Plug (oil filler)
11. Bushing (small)
12. Cover
13. Seal

Outline

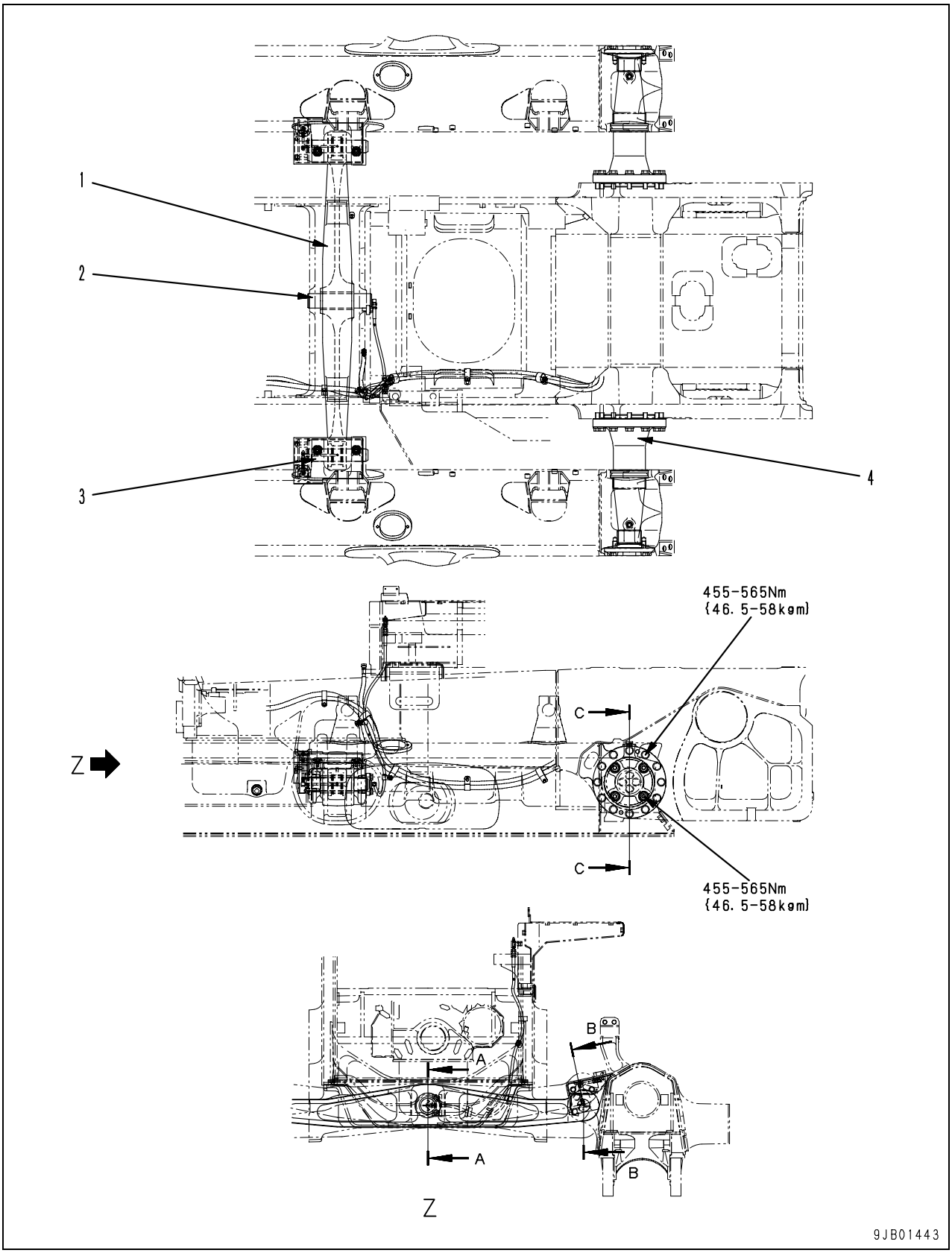
- The track frame moves the front part of the track frame up and down around pivot shaft (4) in its rear.
- Equalizer bar (1) vibrates around center pin (2) and is connected to the right and left track frames by side pin (3).

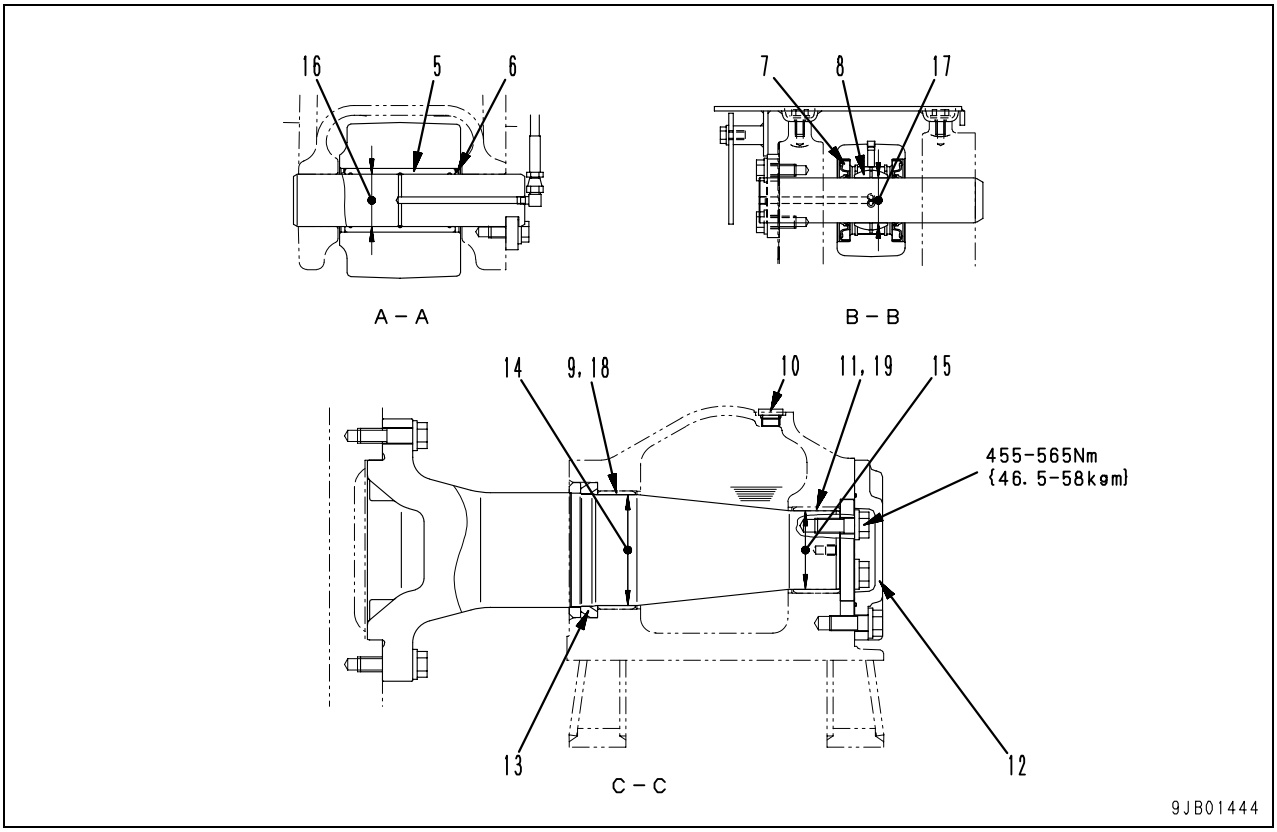
		D65EX-15E0 D65EX-15E0 (Long track specification)
Displacement at center of equalizer bar side pin (mm)	Upward	72.6
	Downward	72.6

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
14	Clearance between pivot shaft and bushing (large)	148	–0.145 –0.208	+0.063 0	0.145 – 0.271	1.0	Replace bushing
15	Clearance between pivot shaft and bushing (small)	105	–0.120 –0.174	+0.054 0	0.120 – 0.228	1.0	
16	Clearance between center pin and bushing	70	–0.100 –0.146	+0.174 +0.100	0.200 – 0.320	0.5	
17	Clearance between side pin and bushing	60	–0.100 –0.146	+0.010 –0.020	0.080 – 0.156	0.5	
18	Press-fitting force of pivot shaft bushing (large)	0.98 – 22.6 kN {0.1 – 2.3 ton}					—
19	Press-fitting force of pivot shaft bushing (small)	0.98 – 36.3 kN {0.1 – 3.7 ton}					
—	Quantity of oil in pivot shaft section	4.5 ℓ (Engine oil: SAE30)					

D65PX-15E0
D65WX-15E0





1. Equalizer bar
2. Center pin
3. Side pin
4. Pivot shaft
5. Bushing
6. Seal
7. Seal
8. Bushing
9. Bushing (large)
10. Plug (oil filler)
11. Bushing (small)
12. Cover
13. Seal

Outline

- The track frame moves the front part of the track frame up and down around pivot shaft (4) in its rear.
- Equalizer bar (1) vibrates around center pin (2) and is connected to the right and left track frames by side pin (3).

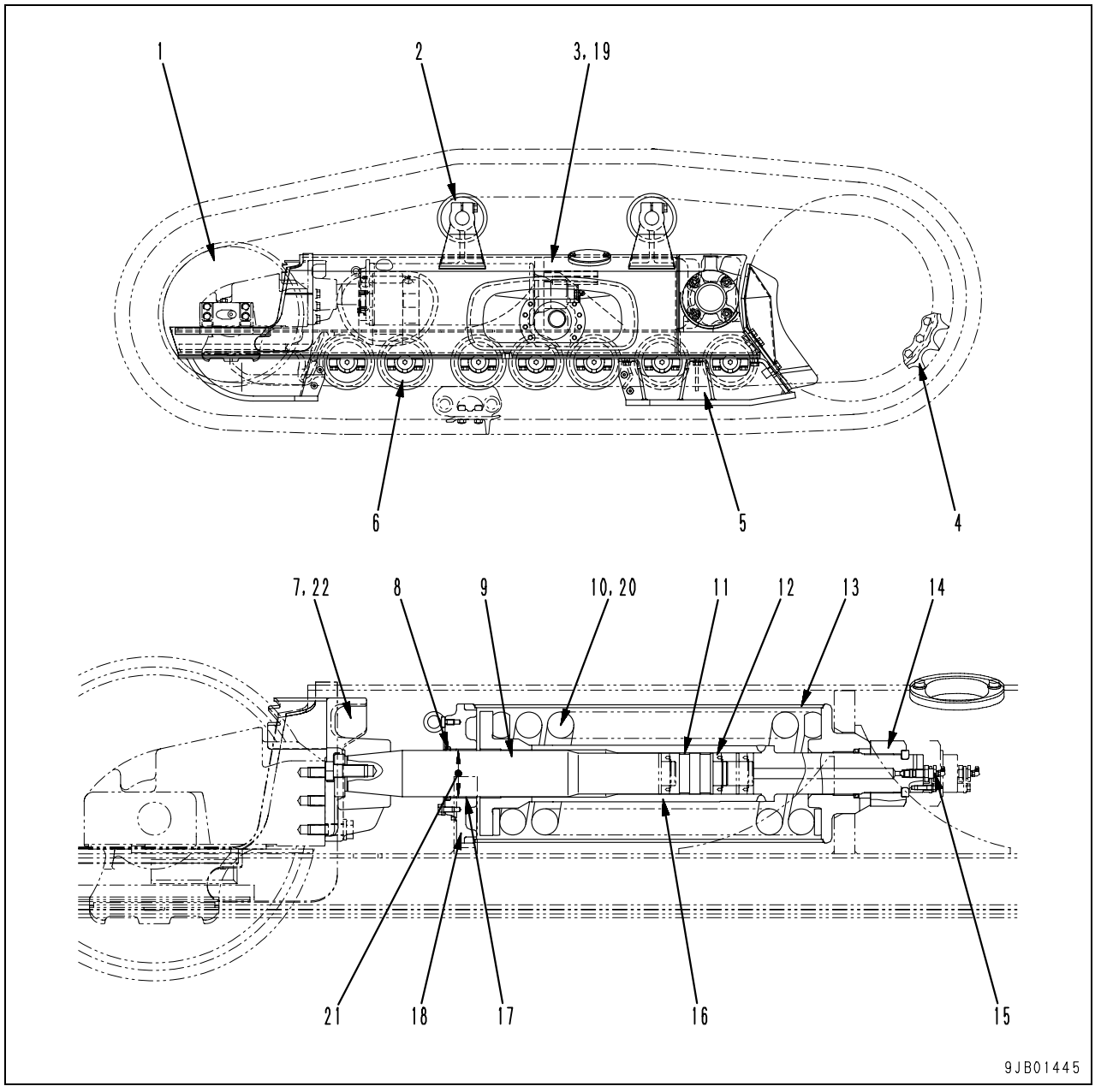
		D65PX-15E0 D65WX-15E0
Displacement at center of equalizer bar side pin (mm)	Upward	81.9
	Downward	81.9

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
14	Clearance between pivot shaft and bushing (large)	148	–0.145 –0.208	+0.063 0	0.145 – 0.271	1.0	Replace bushing
15	Clearance between pivot shaft and bushing (small)	105	–0.120 –0.174	+0.054 0	0.120 – 0.228	1.0	
16	Clearance between center pin and bushing	70	–0.100 –0.146	+0.174 +0.100	0.200 – 0.320	0.5	
17	Clearance between side pin and bushing	60	–0.100 –0.146	+0.010 –0.020	0.080 – 0.156	0.5	
18	Press-fitting force of pivot shaft bushing (large)	0.98 – 22.6 kN {0.1 - 2.3 ton}					—
19	Press-fitting force of pivot shaft bushing (small)	0.98 – 36.3 kN {0.1 - 3.7 ton}					
—	Quantity of oil in pivot shaft section	4.5 ℓ (Engine oil: SAE30)					

Track frame and idler cushion

D65EX-15E0
D65WX-15E0



1. Idler
2. Carrier roller
3. Track frame
4. Sprocket teeth
5. Track roller guard
6. Track roller
7. Yoke
8. Seal
9. Piston
10. Recoil spring
11. Wear ring
12. U-packing
13. Cabin
14. Nut
15. Lubricator
16. Cylinder
17. Bushing
18. Holder

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">19</td><td rowspan="2">Deformation of track frame</td><td colspan="4">Item</td><td colspan="2">Repair limit</td><td rowspan="2">Repair</td></tr>
<tr><td colspan="4">Bend
Twist
Opening of idler</td><td colspan="2">7 (in length of 3,000)
3 (in length of 300)
5</td></tr>
<tr><td rowspan="3">20</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length x outer diameter</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>791.5 x 239</td><td>634</td><td>189.5 kN {19,320 kg}</td><td>772</td><td>168.6 kN {17,195 kg}</td></tr>
<tr><td rowspan="3">21</td><td rowspan="3">Clearance between piston 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="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>90</td><td>–0.039
–0.090</td><td>+0.270
+0.061</td><td>0.100 –
0.360</td><td>1.0</td></tr>
<tr><td>22</td><td>Press-fitting force of idler yoke</td><td colspan="6">392 kN {40 ton}</td><td>Adjust</td></tr>
<tr><td>—</td><td>Quantity of grease</td><td colspan="6">140 cc (Grease: G2-LI)</td><td>—</td></tr>
</table>

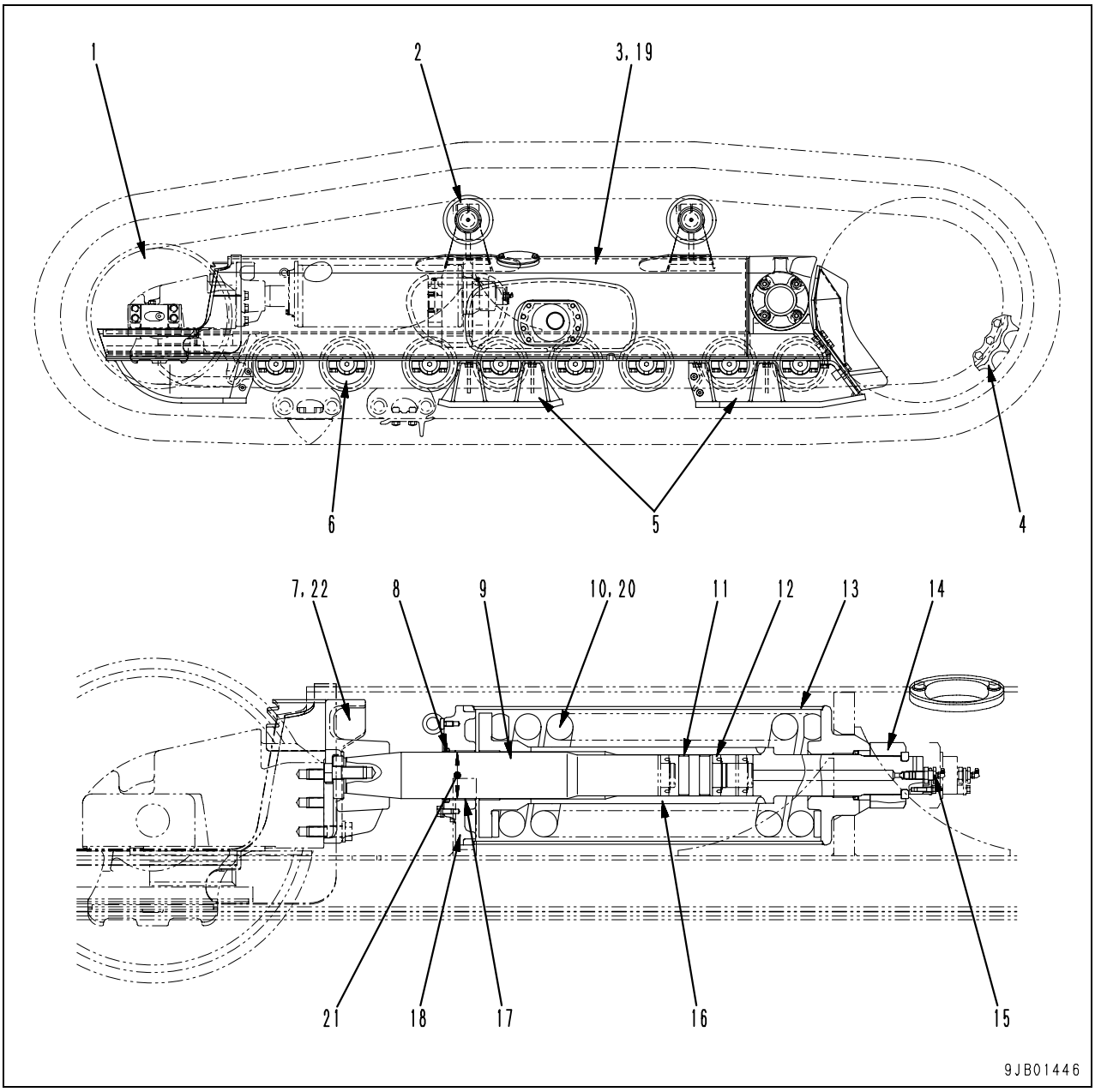
Outline

- The idler cushion moves piston (9) back and forth by filling or draining grease from lubricator (15) and adjusts the track shoe tension. Recoil spring (10) also dampens sudden shock forced on idler (1).

	Quantity for one side	Flange type and arrangement
D65EX-15E0 D65WX-15E0	7 pieces	S, S, D, S, D, S, S

S: single flange
D: double flange

D65PX-15E0
D65EX-15E0 (Long track specification)



1. Idler
2. Carrier roller
3. Track frame
4. Sprocket teeth
5. Track roller guard
6. Track roller
7. Yoke
8. Seal
9. Piston
10. Recoil spring
11. Wear ring
12. U-packing
13. Cabin
14. Nut
15. Lubricator
16. Cylinder
17. Bushing
18. Holder

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">19</td><td rowspan="2">Deformation of track frame</td><td colspan="3">Item</td><td colspan="2">Repair limit</td><td rowspan="2">Repair</td></tr>
<tr><td colspan="3">Bend
Twist
Opening of idler</td><td colspan="2">7 (in length of 3,000)
3 (in length of 300)
5</td></tr>
<tr><td rowspan="3">20</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length x outer diameter</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>791.5 x 239</td><td>634</td><td>189.5 kN {19,320 kg}</td><td>772</td><td>168.6 kN {17,195 kg}</td></tr>
<tr><td rowspan="3">21</td><td rowspan="3">Clearance between piston 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="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>90</td><td>–0.039
–0.090</td><td>+0.270
+0.061</td><td>0.100 –
0.360</td><td>1.0</td></tr>
<tr><td>22</td><td>Press-fitting force of idler yoke</td><td colspan="5">392 kN {40 ton}</td><td>Adjust</td></tr>
<tr><td>—</td><td>Quantity of grease</td><td colspan="5">140 cc (Grease: G2-LI)</td><td>—</td></tr>
</table>

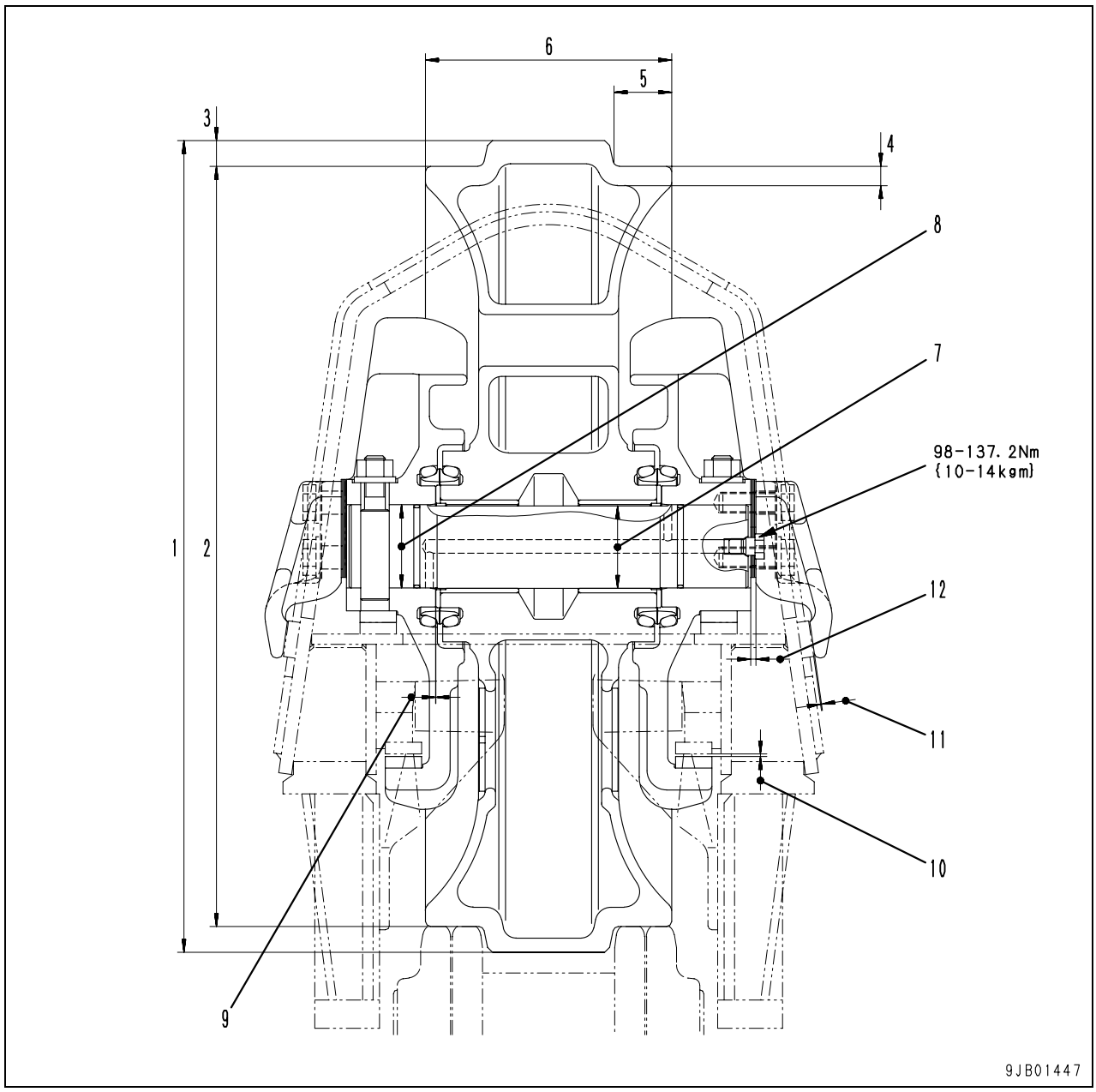
Outline

- The idler cushion moves piston (9) back and forth by filling or draining grease from lubricator (15) and adjusts the track shoe tension. Recoil spring (10) also dampens sudden shock forced on idler (1).

	Quantity for one side	Flange type and arrangement
D65PX-15E0 D65EX-15E0 (Long track specification)	8 pieces	S, S, D, S, S, D, S, S

S: single flange
D: double flange

Idler

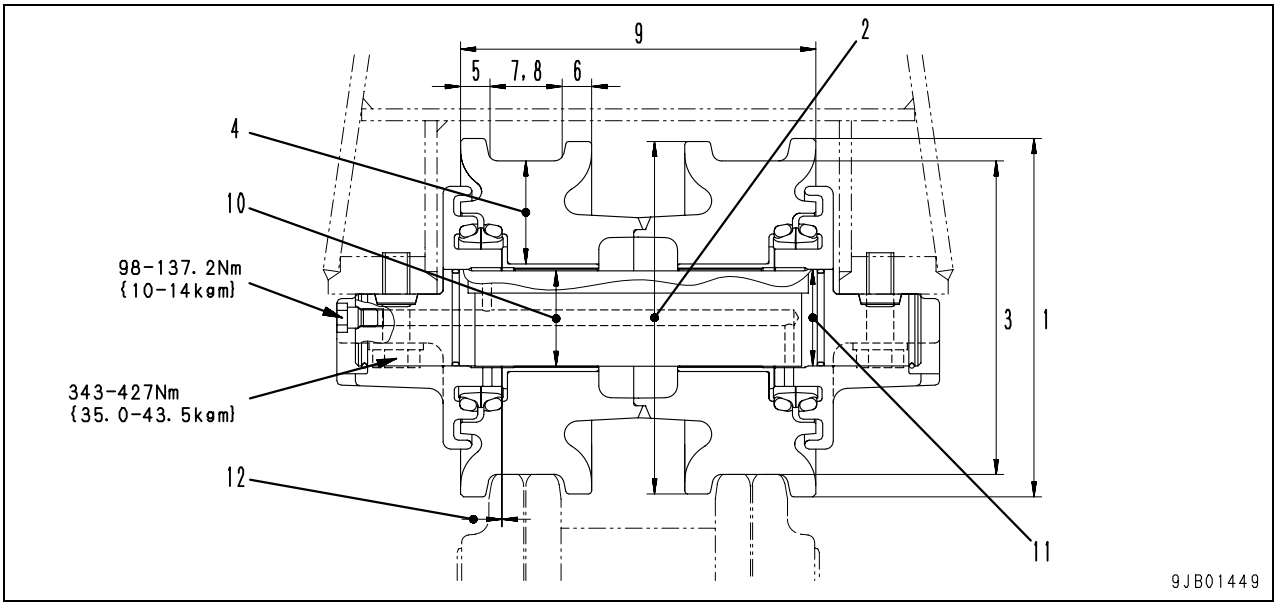


Unit: mm

<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">Outer diameter of projection</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Build-up welding or replace</td></tr>
<tr><td colspan="3">630</td><td colspan="2">—</td></tr>
<tr><td>2</td><td>Outer diameter of tread</td><td colspan="3">590</td><td colspan="2">570</td></tr>
<tr><td>3</td><td>Depth of tread</td><td colspan="3">20</td><td colspan="2">30</td></tr>
<tr><td>4</td><td>Thickness of tread</td><td colspan="3">15</td><td colspan="2">5</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="3">44.5</td><td colspan="2">48.5</td></tr>
<tr><td>6</td><td>Overall width</td><td colspan="3">190</td><td colspan="2">—</td></tr>
<tr><td rowspan="3">7</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</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>65</td><td>–0.250
–0.350</td><td>+0.142
–0.008</td><td>0.242 –
0.492</td><td>—</td></tr>
<tr><td>8</td><td>Clearance between shaft and support</td><td>64.7</td><td>–0.250
–0.350</td><td>+0.090
0</td><td>0.250 –
0.440</td><td>—</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Axial play of idler</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td></tr>
<tr><td colspan="3">0.26 – 0.66</td><td colspan="2">—</td><td>Build-up welding or replace</td></tr>
<tr><td>10</td><td>Clearance between guide plate and support</td><td colspan="3">2.0</td><td colspan="2">—</td></tr>
<tr><td>11</td><td>Clearance between guide plate and side plate</td><td colspan="3">1.0</td><td colspan="2">—</td><td rowspan="2">Adjust shim or replace plate</td></tr>
<tr><td>12</td><td>Standard shim thickness at side plate installation part</td><td colspan="5">4.0</td></tr>
</table>

Track roller

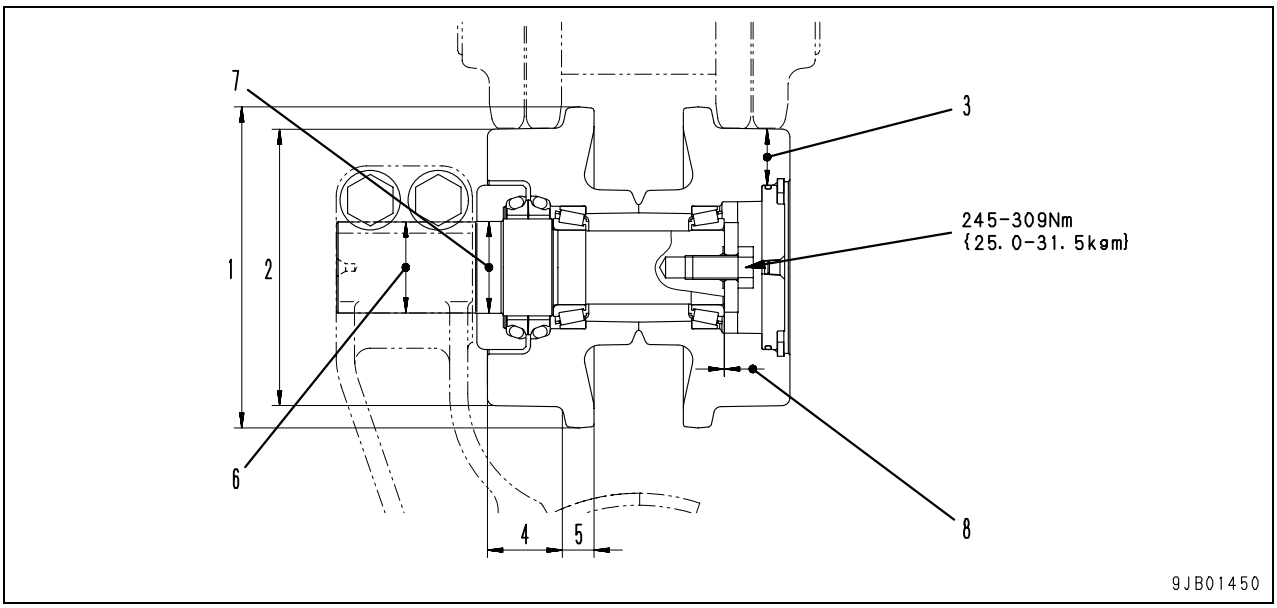
★ The following drawing shows the double-flange type.



Unit: mm

No.	Check item	Criteria					Remedy
1	Outer diameter of flange (outside)	Standard size			Repair limit		Build-up welding or replace
		240			—		
2	Outer diameter of flange (inside)	236			—		
3	Outer diameter of tread	210			174		
4	Thickness of tread	69			51		
5	Width of flange (outside)	19.5			13.5		
6	Width of flange (inside)	19.5			13.5		
7	Width of tread (single-flange type)	47			—		
8	Width of tread (double-flange type)	47.7			—		
9	Overall width	235			—		
10	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		65	–0.250 –0.350	+0.143 –0.007	0.243 – 0.493	—	
11	Clearance between shaft and collar	64.7	–0.250 –0.350	–0.100 –0.150	0.100 – 0.250	—	
12	Axial play of roller	Standard clearance			Clearance limit		
		0.26 – 0.66			—		

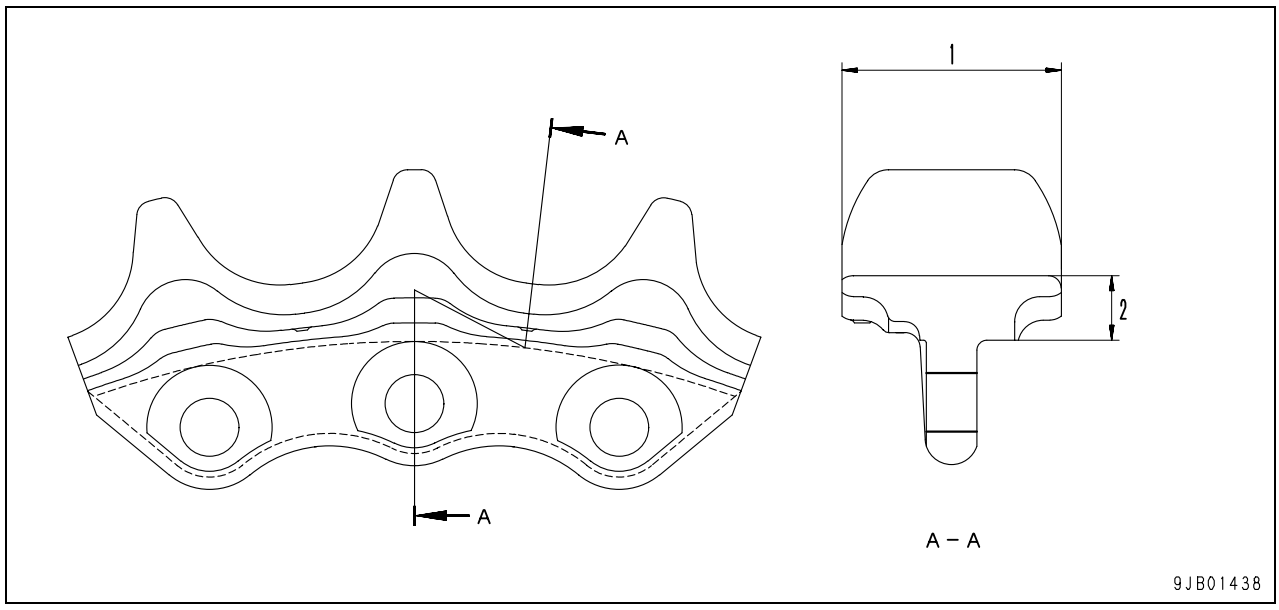
Carrier roller



Unit: mm

No.	Check item	Criteria					Remedy
1	Outer diameter of flange	Standard size			Repair limit		Build-up welding or replace
		215			—		
2	Outer diameter of tread	185			163		
3	Thickness of tread	37.5			26.5		
4	Width of tread	49.5			55.5		
5	Width of flange	21			15		
6	Clearance between shaft and support	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		61	–0.100 –0.200	+0.300 0	0.100 – 0.500	—	
7	Interference between shaft and seal guard	Standard size	Tolerance		Standard interfer-ence	Interfer-ence limit	
			Shaft	Hole			
		61.5	+0.150 +0.130	+0.030 0	0.100 – 0.150	—	
8	Axial play of roller	Standard clearance			Clearance limit		
		0 – 0.32			—		

Sprocket

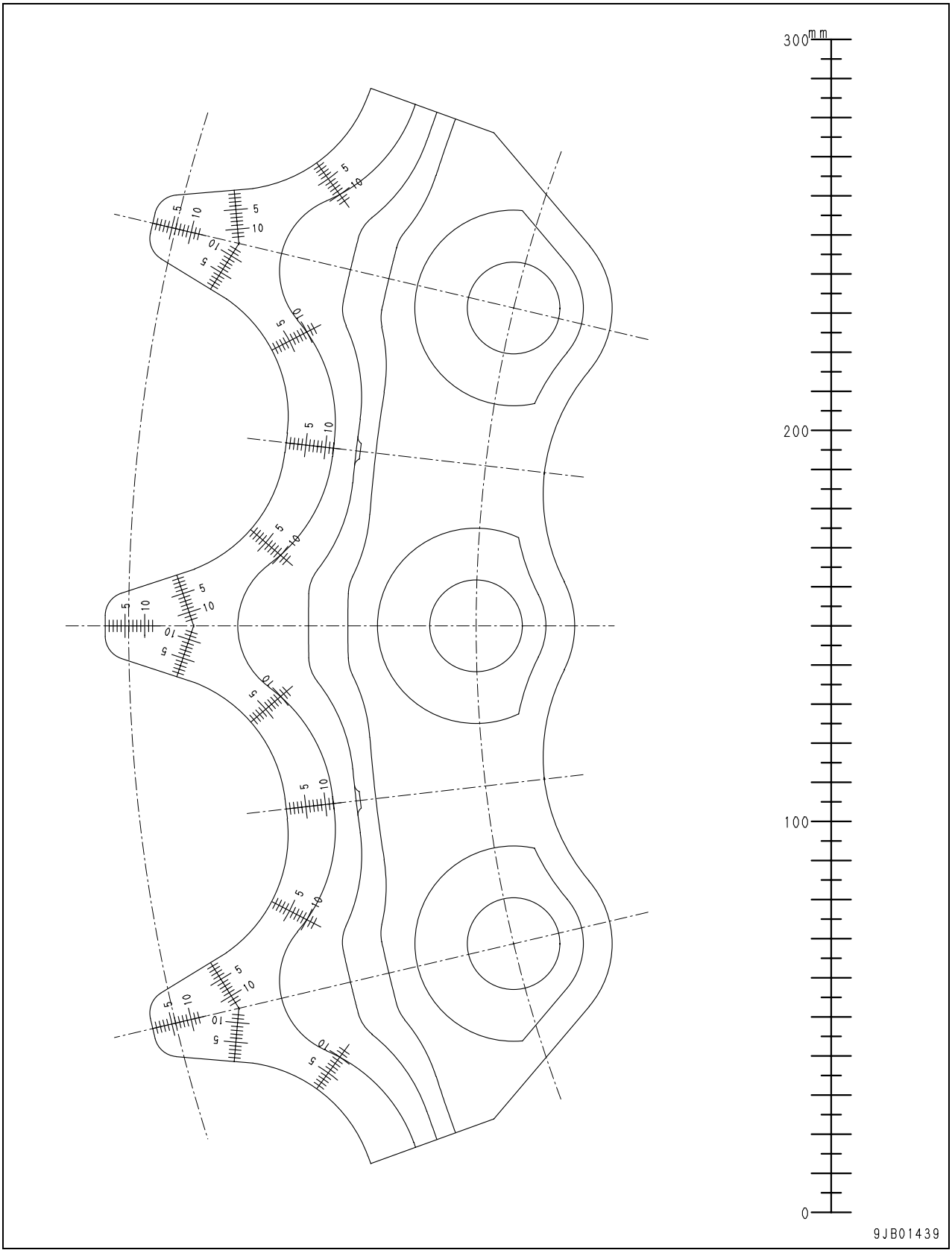


Unit: mm

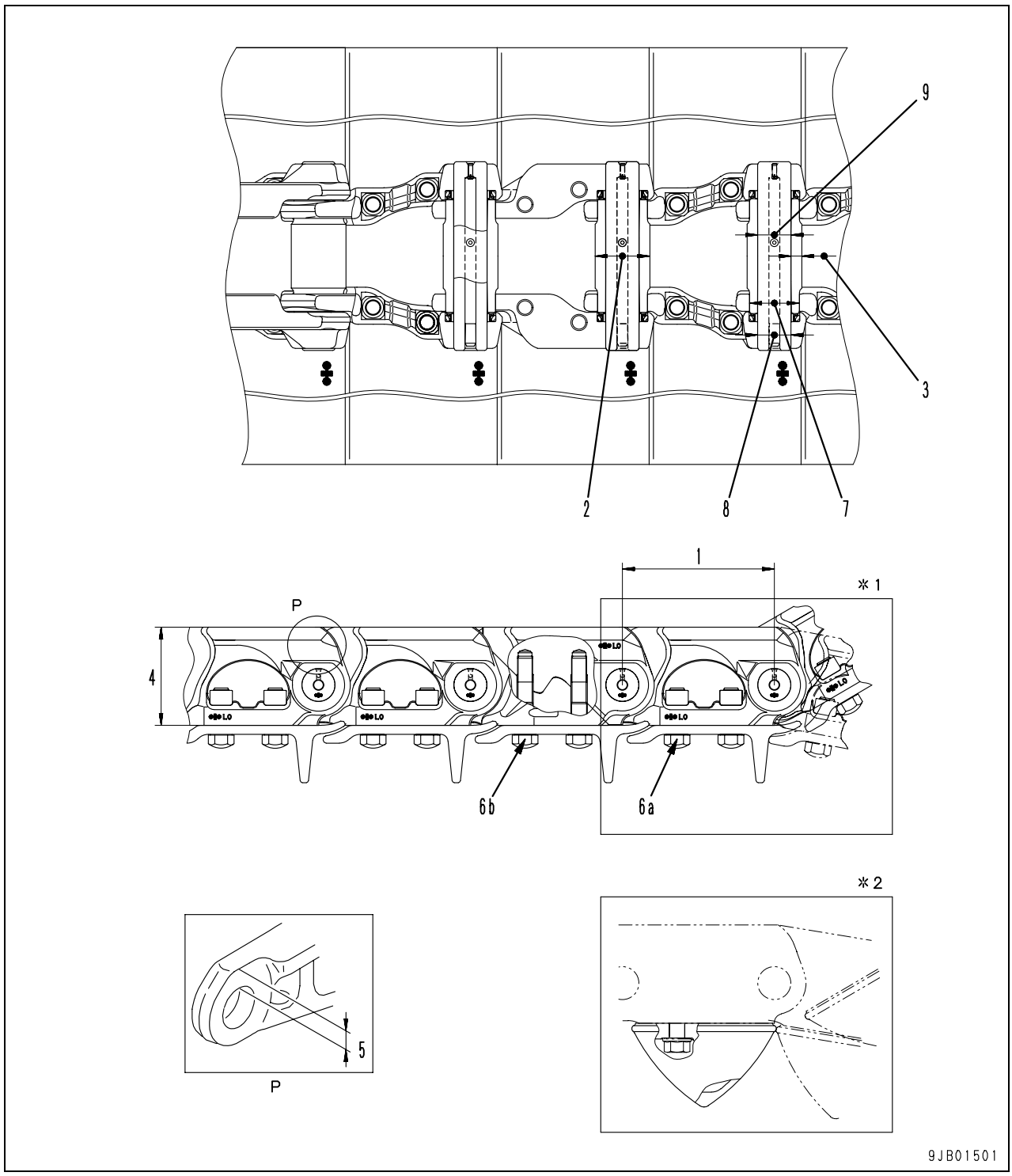
No.	Check item	Criteria		Remedy
1	Wear of tooth root width	Standard size	Repair limit	Build-up welding or replace
		87	77	
2	Thickness of tooth root	26	17	

Full-size drawing of sprocket tooth shape

★ Set the rule to the full-scale size, and then copy the whole drawing to an OHP sheet.



Track shoe



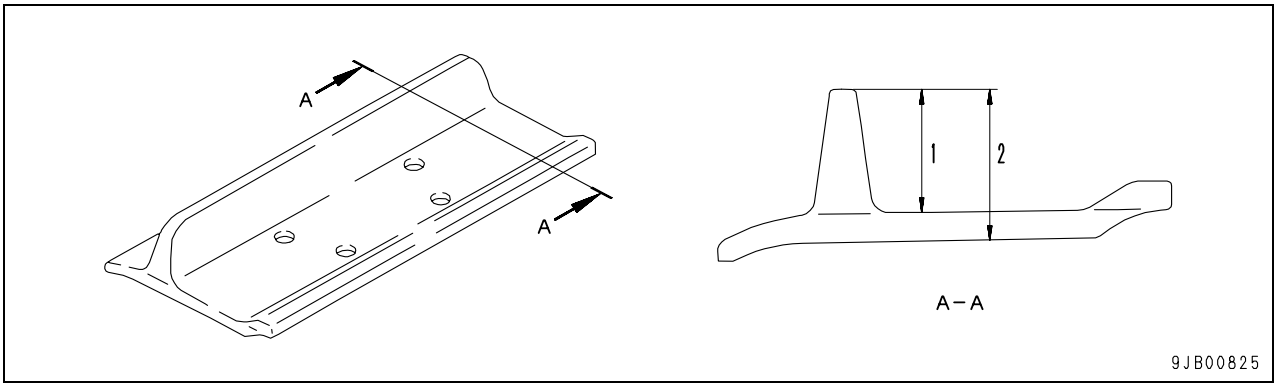
*1. Single shoe
*2. Swamp shoe

★ P portion shows the link of bushing press fitting end.

Unit: mm

<table>
<tr><th>No.</th><th colspan="2">Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td colspan="2" rowspan="2">Link pitch</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="4">Reverse or replace</td></tr>
<tr><td colspan="2">203.45</td><td colspan="2">206.45</td></tr>
<tr><td rowspan="3">2</td><td colspan="2" rowspan="3">Outer diameter of bushing</td><td colspan="2" rowspan="2">Standard size</td><td colspan="2">Reverse</td></tr>
<tr><td>Light load</td><td>Heavy load</td></tr>
<tr><td colspan="2">73</td><td>62.8</td><td>65.4</td></tr>
<tr><td>3</td><td colspan="2">Thickness of bushing</td><td colspan="2">13.9</td><td>3.7</td><td>6.3</td></tr>
<tr><td rowspan="2">4</td><td colspan="2" rowspan="2">Height of link</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Repair or replace</td></tr>
<tr><td colspan="2">132</td><td colspan="2">119.5</td></tr>
<tr><td>5</td><td colspan="2">Thickness of link (bushing press fitted portion)</td><td colspan="2">44.8</td><td colspan="2">32.3</td><td>Replace</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Shoe bolt</td><td rowspan="2">a. Regular link</td><td colspan="3">Tightening torque (Nm {kgm})</td><td colspan="2">Retightening angle (deg.)</td><td rowspan="4">Retighten</td></tr>
<tr><td colspan="3">539 ± 49 {55 ± 5}</td><td colspan="2">120 ± 10</td></tr>
<tr><td rowspan="2">b. Master link</td><td>Tightening torque (Nm {kgm})</td><td colspan="2">Retightening angle (deg.)</td><td colspan="2">Lower limit of torque (Nm {kgm})</td></tr>
<tr><td>343 ± 39 {35 ± 4}</td><td colspan="2">180 (0/–20)</td><td colspan="2">784 {80}</td></tr>
<tr><td rowspan="3">7</td><td colspan="2" rowspan="3">Interference between bushing and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="5">Adjust or replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>66.5</td><td>+0.404
+0.304</td><td>+0.074
0</td><td>0.230 – 0.404</td></tr>
<tr><td>8</td><td colspan="2">Interference between regular pin and link</td><td>44.4</td><td>+0.435
+0.285</td><td>+0.086
0</td><td>0.199 – 0.411</td></tr>
<tr><td rowspan="3">9</td><td colspan="2" rowspan="3">Clearance between regular pin and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>44.6</td><td>+0.235
+0.085</td><td>+0.915
+0.415</td><td>0.180 – 0.830</td></tr>
</table>

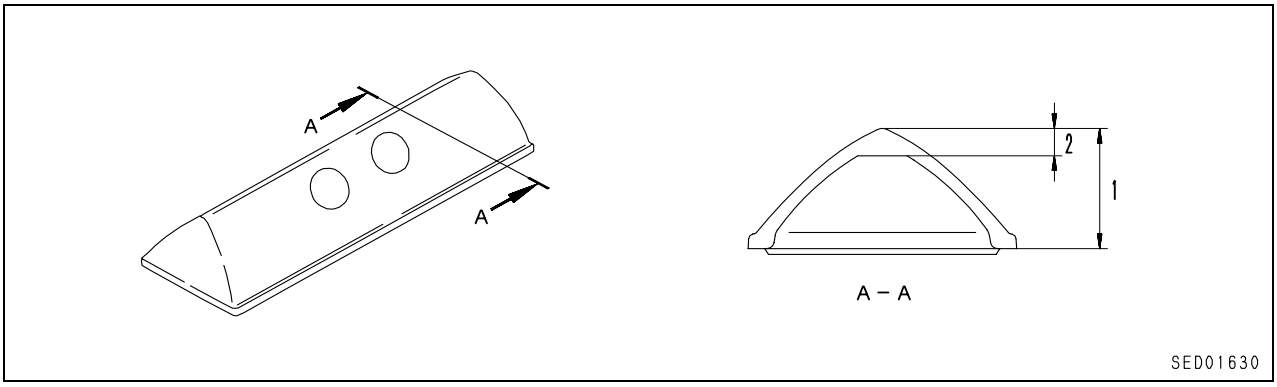
Single shoe



Unit: mm

No.	Check item	Criteria		Remedy
1	Height of grouser	Standard size	Repair limit	Build-up welding or replace
		65	25	
2	Thickness of grouser	77	37	

Swamp shoe



Unit: mm

No.	Check item	Criteria		Remedy
1	Height of grouser	Standard size	Repair limit	Build-up welding or replace
		109.5	94.5	
2	Thickness of grouser	20	5	

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00284-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

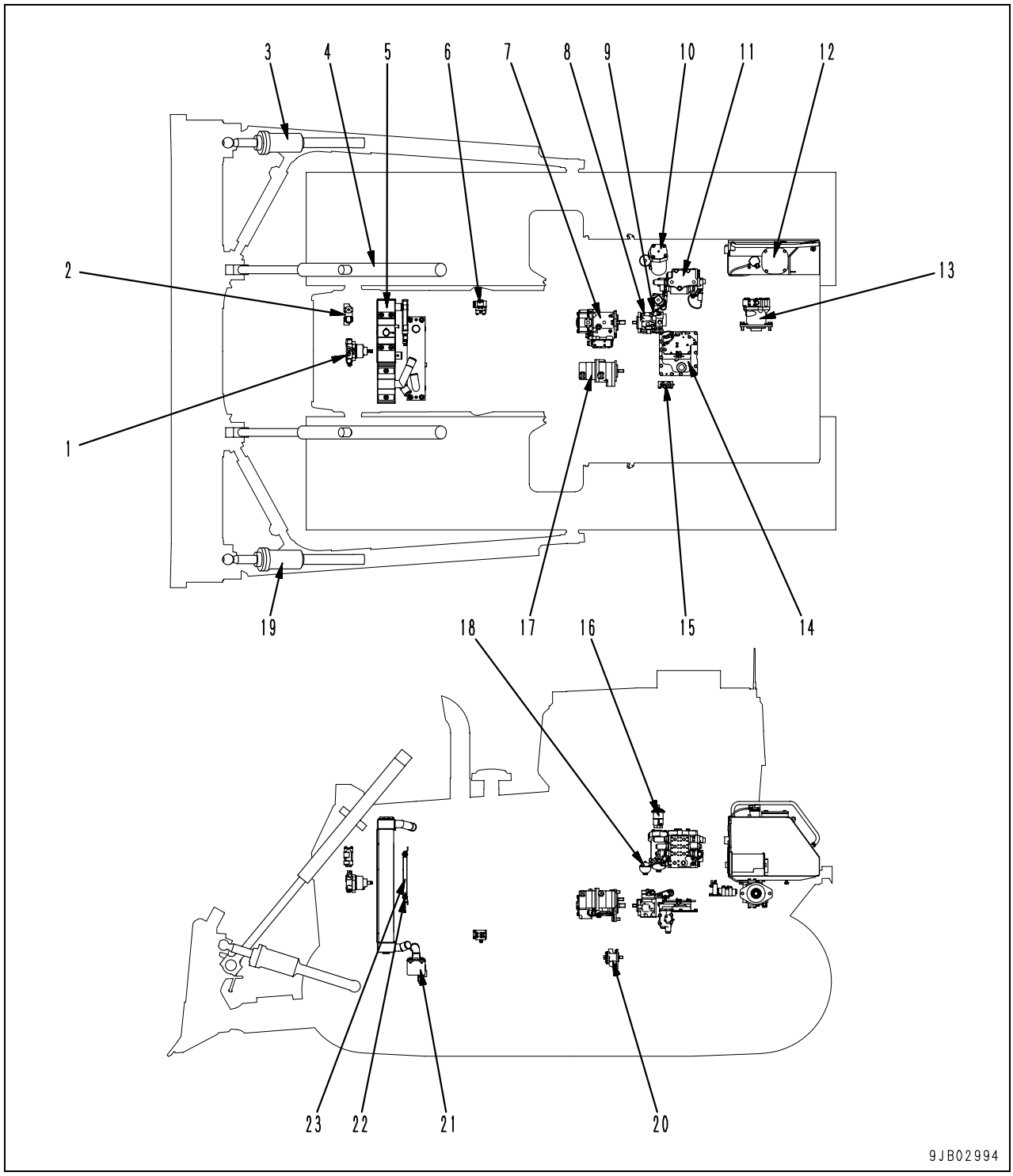
Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

10 Structure, function and maintenance standard

Hydraulic system, Part 1

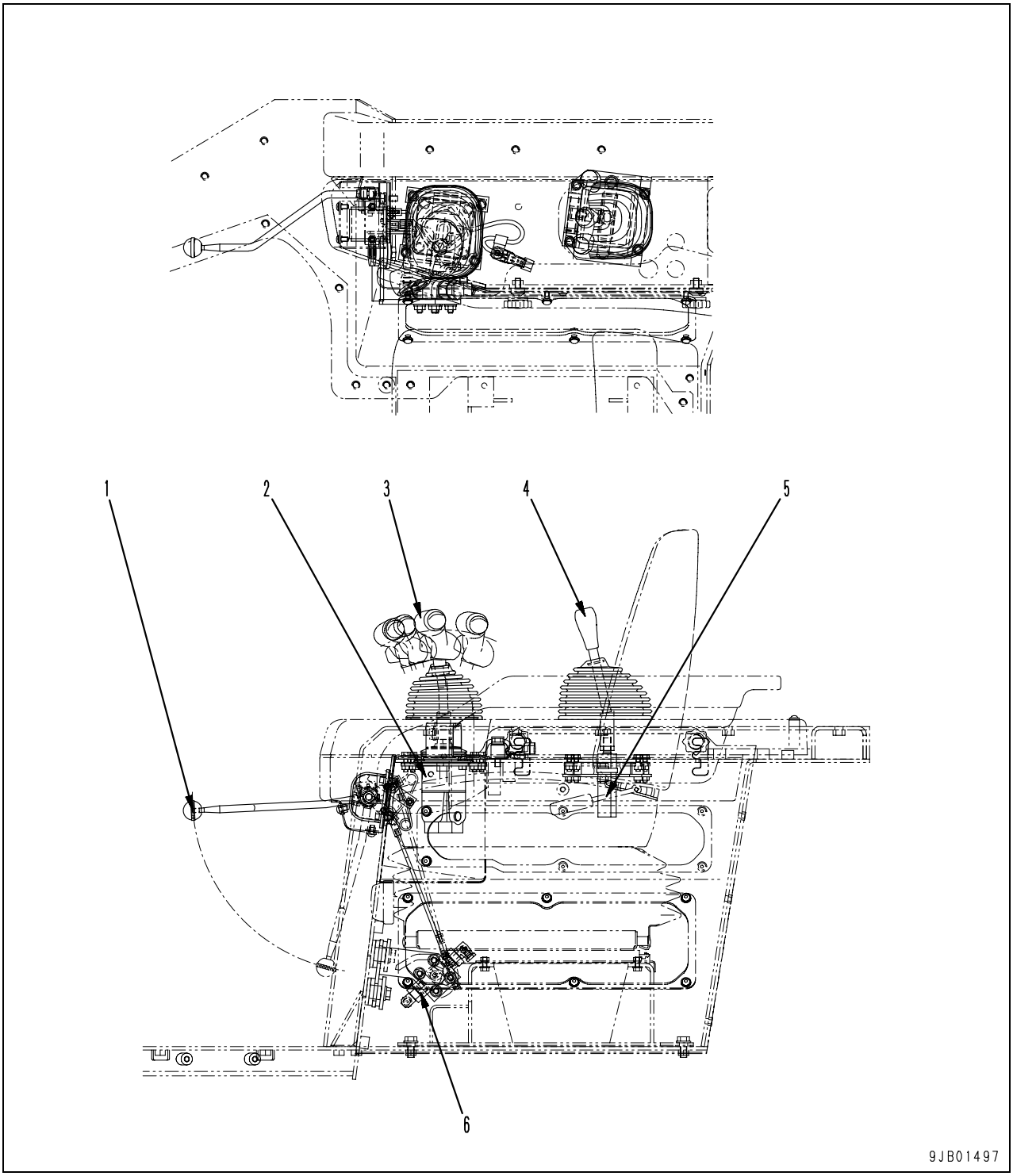
Hydraulic system, Part 1

Work equipment hydraulic piping diagram



1. Cooling fan motor
2. Quick drop valve
3. Tilt cylinder (PT, SEMI-U dozer)
   Pitch cylinder (PTP dozer)
4. Lift cylinder
5. Radiator
6. Self pressure reducing valve
7. HSS pump
8. Cooling fan pump
9. PPC lock valve
10. Power train oil filter
11. Control valve
12. Hydraulic tank
13. HSS motor
14. Transmission ECMV
15. Main relief valve
16. Blade PPC valve
17. Power train and lubrication pump
18. Accumulator
19. Tilt cylinder (PTP dozer)
20. Scavenging pump
21. Power train oil cooler
22. Hydraulic oil cooler bypass valve
23. Hydraulic oil cooler

Work equipment control

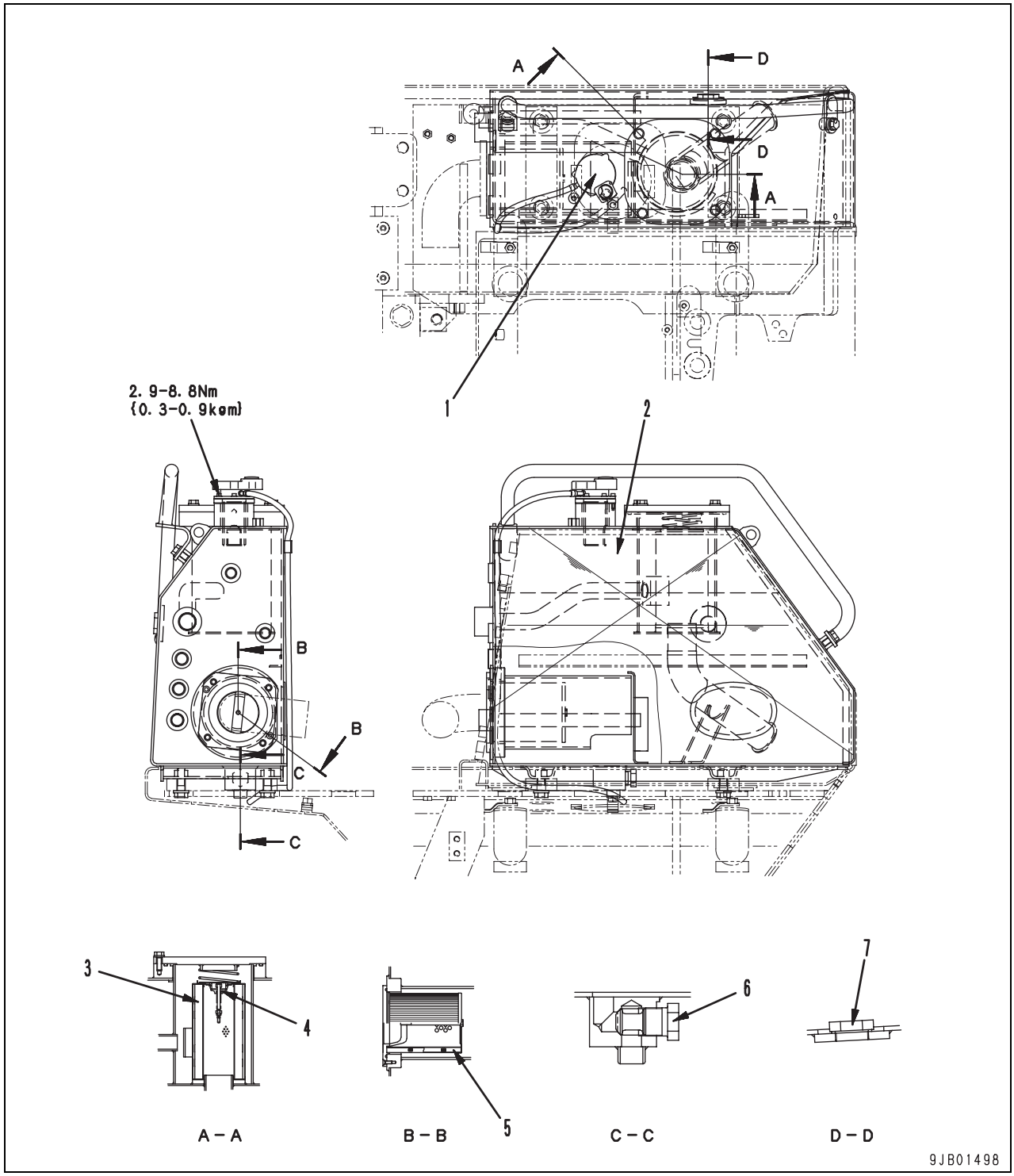


1. Work equipment lock lever
2. Blade PPC valve
3. Blade control lever
4. Ripper control lever (If equipped: D65EX-15E0, D65WX-15E0)
5. Ripper PPC valve (If equipped: D65EX-15E0, D65WX-15E0)
6. PPC lock valve

Outline

- The work equipment control system is a PPC system in which blade control lever (3) operates blade PPC valve (2) and ripper control lever (4) operates PPC valve (5), moving each spool of the control valves.
- If work equipment lock lever (1) is set in the “lock“ position, it is connected to PPC lock valve (6) and the operator can move blade control lever (3) and ripper control lever (4) but cannot operate the work equipment.
- If blade control lever (3) is set in the “float“ position, the hydraulic detent of blade PPC valve (2) works so that blade control lever (3) will hold itself.
  If work equipment lock lever (1) is set in the “lock“ position, the hydraulic detent is reset and blade control lever (3) returns to the “hold“ position automatically.
- While the engine is stopped, the hydraulic detent does not work even when the blade control lever (3) is in the “float“ position, and blade control lever (3) returns to “hold“ position automatically.

Hydraulic tank and filter

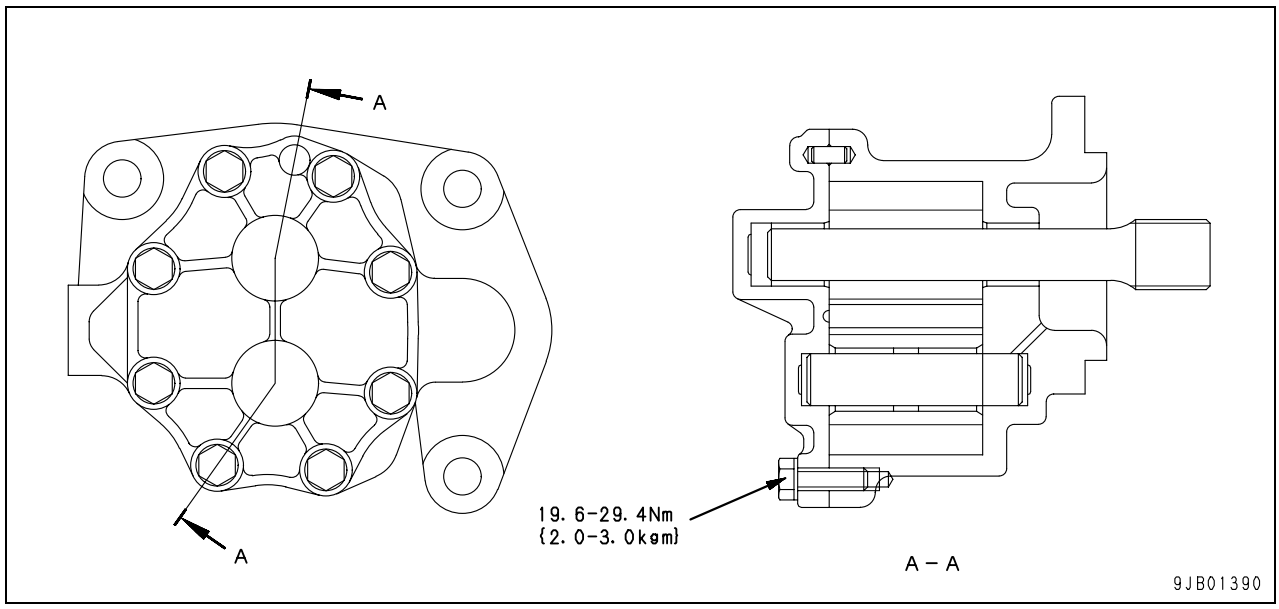


1. Oil filler cap
2. Hydraulic tank
3. Element
4. Bypass valve
5. Strainer
6. Drain plug
7. Sight gauge

Specifications

Tank capacity (ℓ)	80
Quantity of oil in tank (ℓ)	55
Set pressure of bypass valve (MPa {kg/cm^2})	0.15 ± 0.03 {1.5 ± 0.3}
Cracking pressure of pressure valve (kPa {kg/cm^2})	38 ± 14 {0.39 ± 0.15}
Actuating pressure of vacuum valve (kPa {kg/cm^2})	0 – 4.5 {0 – 0.046}

Scavenging pump



Outline

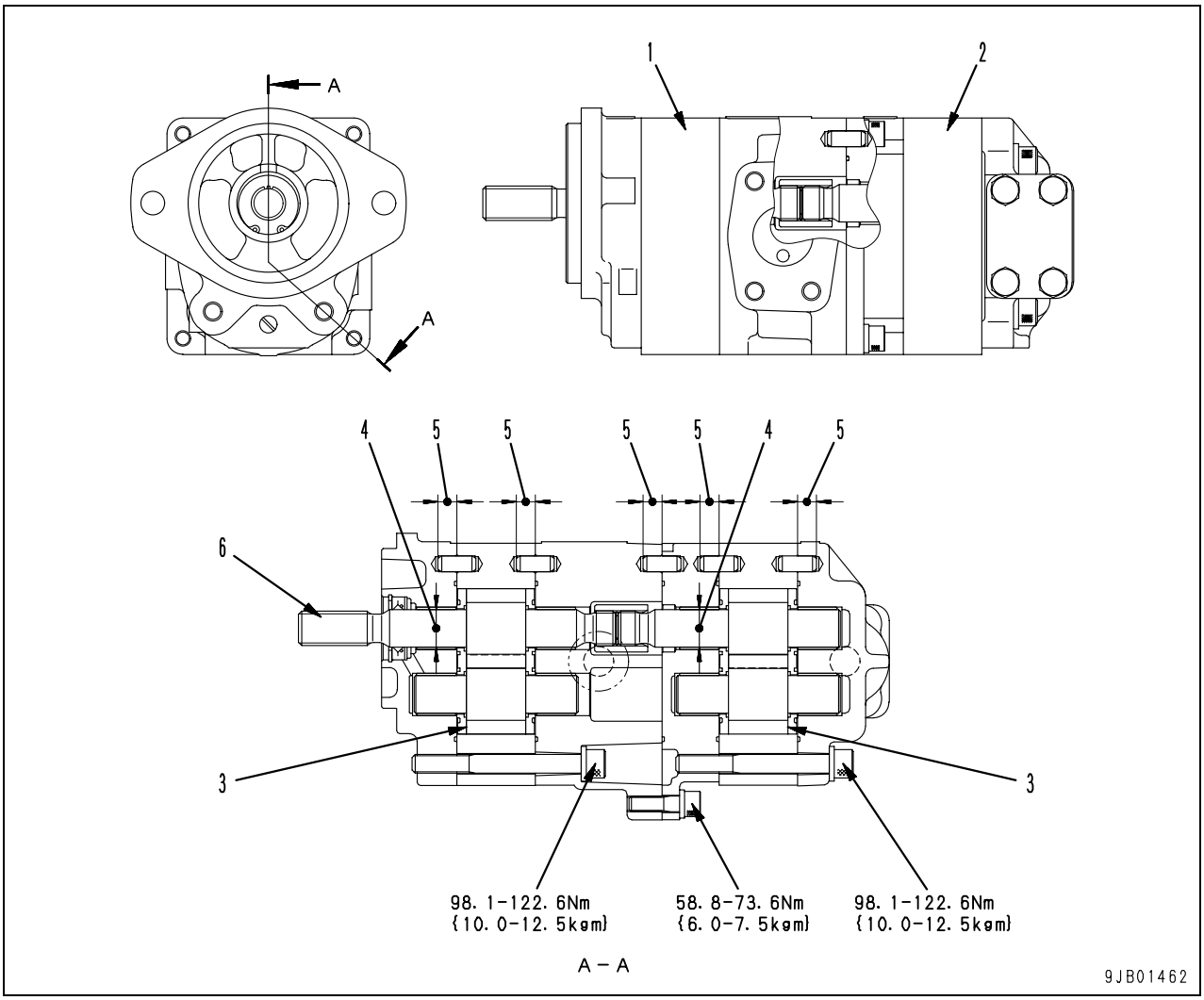
- The scavenging pump is installed to the lower part of the PTO case and is driven with the power from the engine.
- The scavenging pump sucks oil collected in the transmission case bottom through a strainer and returns it to the steering case.

Specifications

Type	Gear pump
Theoretical capacity (cc/rev)	61.2
Maximum delivery pressure (MPa{kg/cm^2})	0.29 {3.0}
Maximum speed (rpm)	2,500

Power train and steering lubrication pump

SAL (2) 45 + 45



1. Power train pump
2. Lubrication pump

Unit: mm

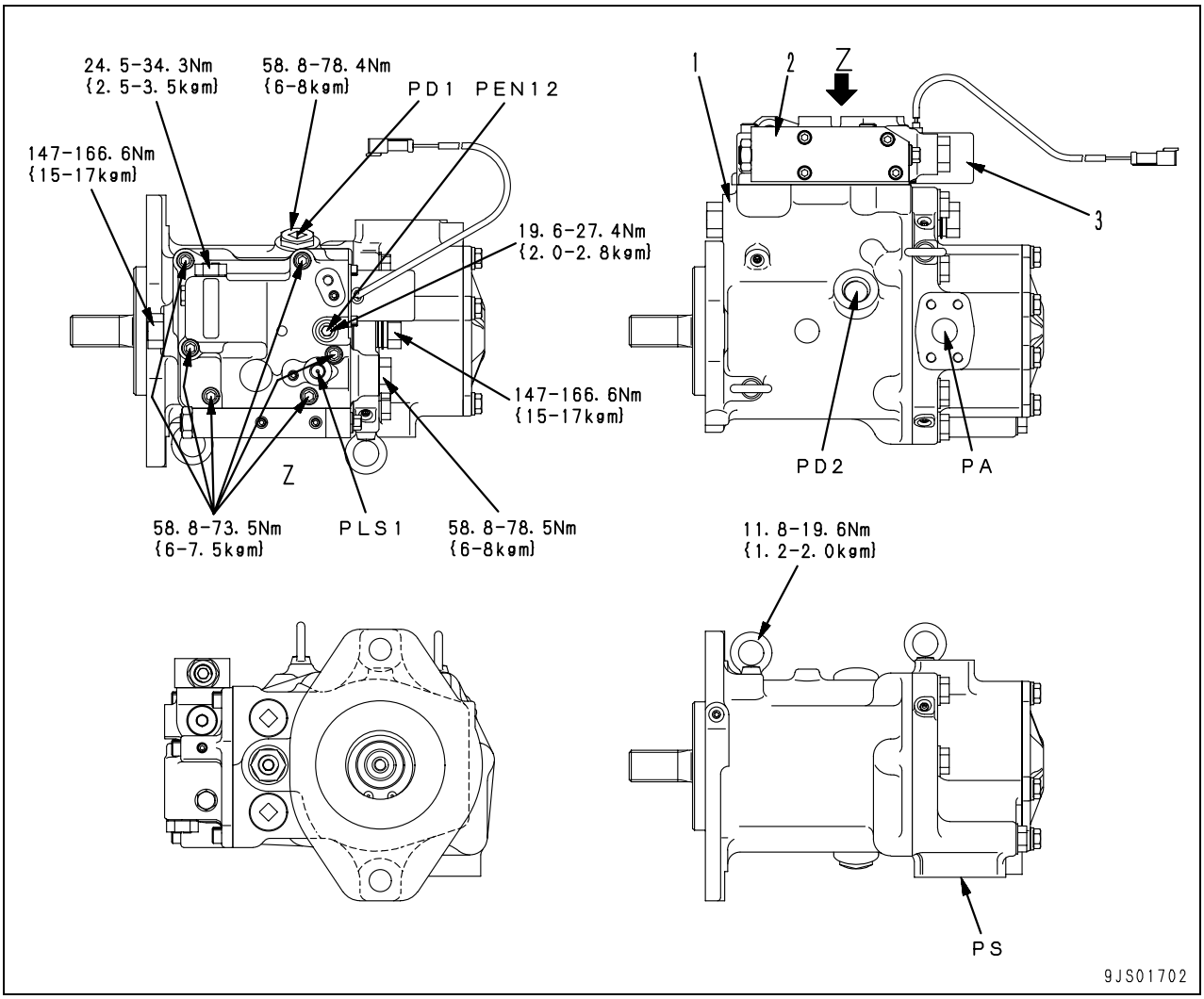
No.	Check item	Criteria					Remedy
3	Side clearance	Type	Standard clearance		Clearance limit		Replace
		SAL (2) 45	0.10 – 0.15		0.19		
4	Clearance between plain bearing inner diameter and gear shaft outer diameter	SAL (2) 45	0.060 – 0.125		0.20		
5	Pin driving depth	Type	Standard size	Tolerance		Repair limit	
		SAL (2) 45	12	0 –0.5		—	
6	Rotating torque of spline shaft	5.8 – 13.8 Nm {0.6 – 1.4 kgm}					—
—	Delivery amount Oil: SAE10W Oil temperature: 45 – 55°C	Type	Speed (rpm)	Delivery pressure (MPa{kg/cm²})	Standard delivery amount (ℓ/min)	Discharge amount limit (ℓ/min)	
		SAL (2) 45	3,000	0.29 {3.0}	126	115	

HSS pump

Type: HPV95

Outline

- This pump consists of a variable displacement swash plate type piston pump and a servo valve.



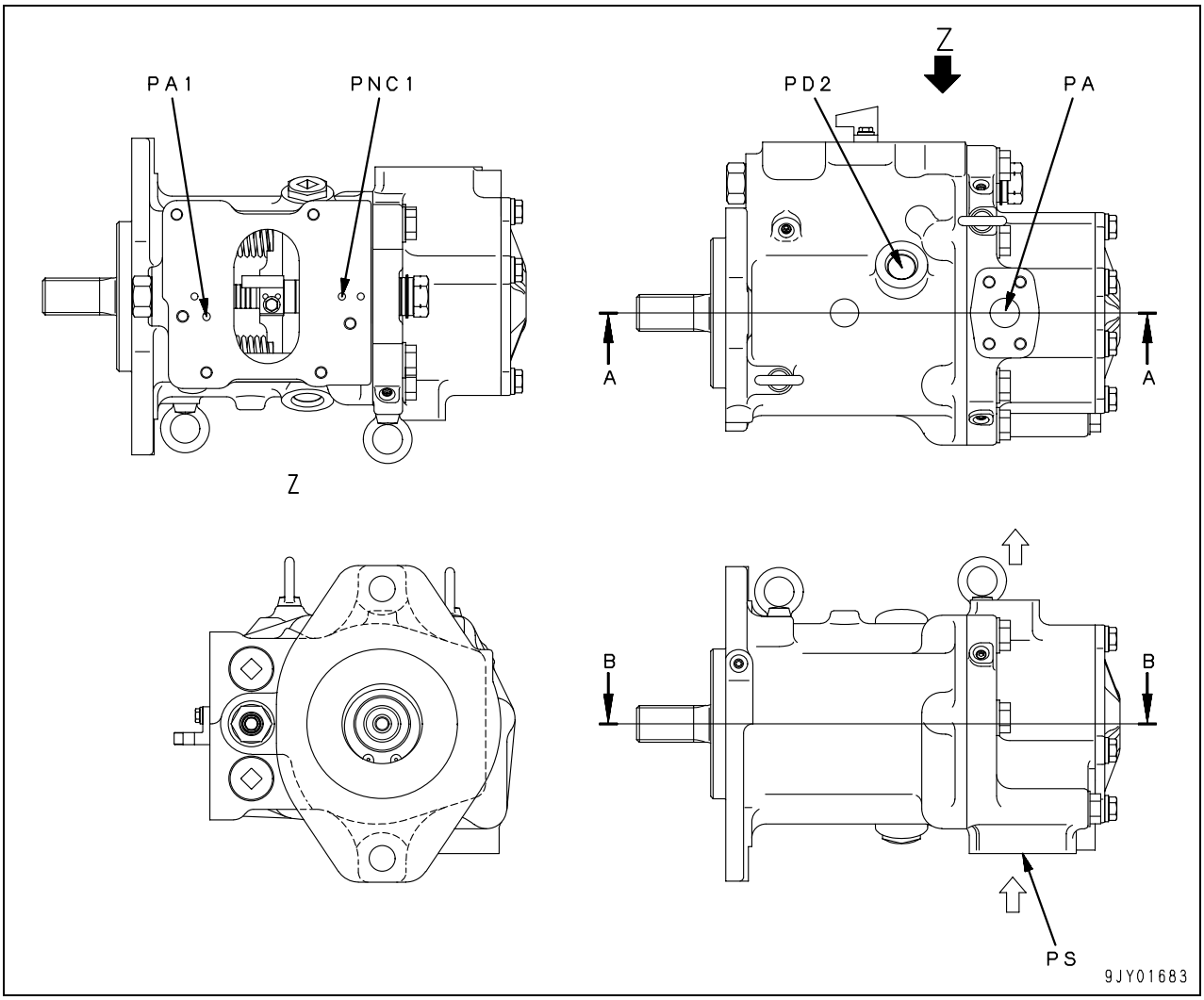
PA: Pump discharge
PS: Pump suction
PD1: Pump drain plug
PD2: Pump drain
PLS1: Load pressure input
PEN12: Control pressure pick-up plug

1. Piston pump
2. Servo valve
3. Solenoid valve

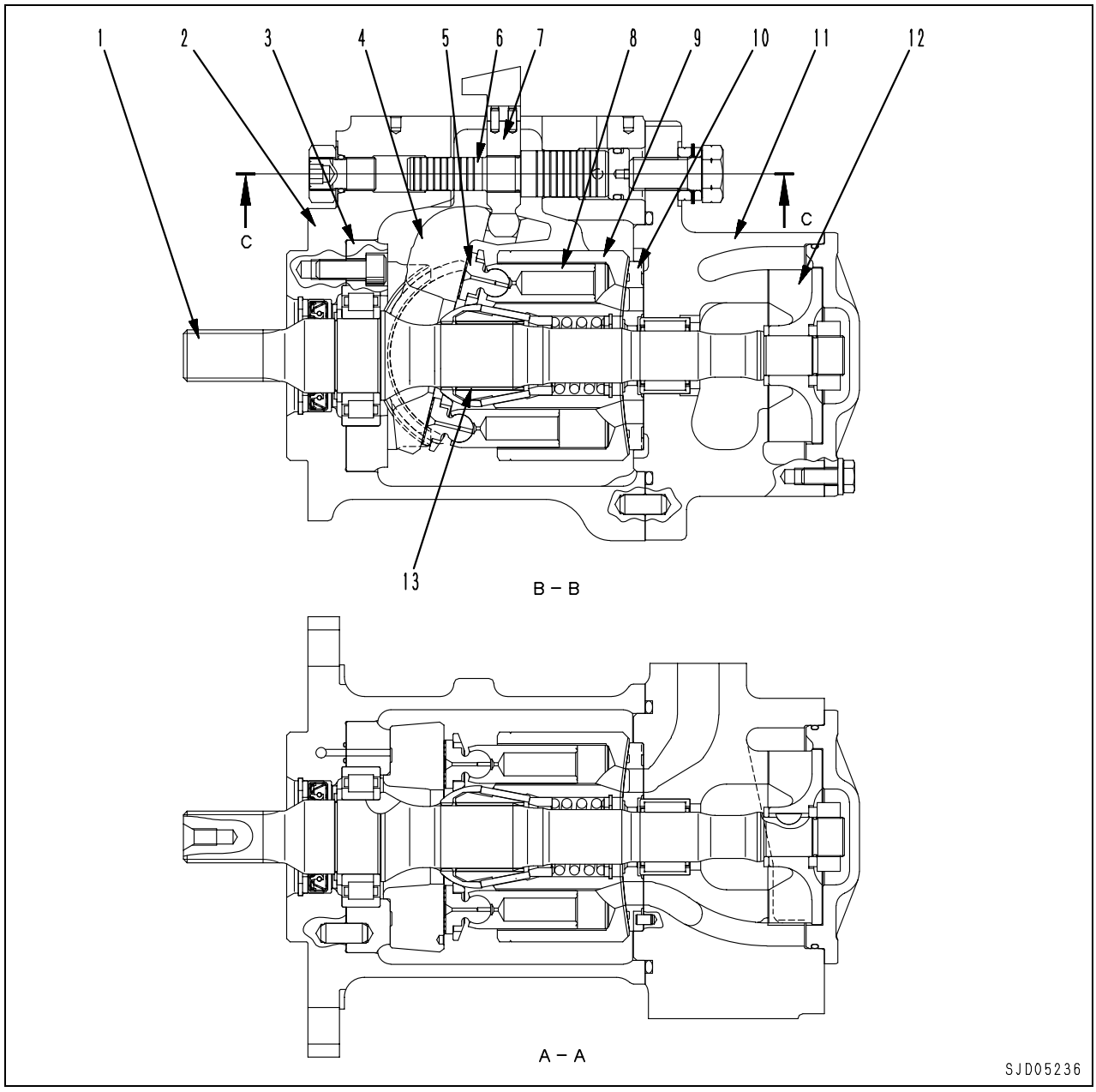
Specifications

Type:	HPV95 (112 cm^3/rev)
Theoretical delivery:	112 ± 1 cm^3/rev
Rated speed:	2,280 rpm
Maximum cut off pressure:	41.2 MPa {420 kg/cm^2}

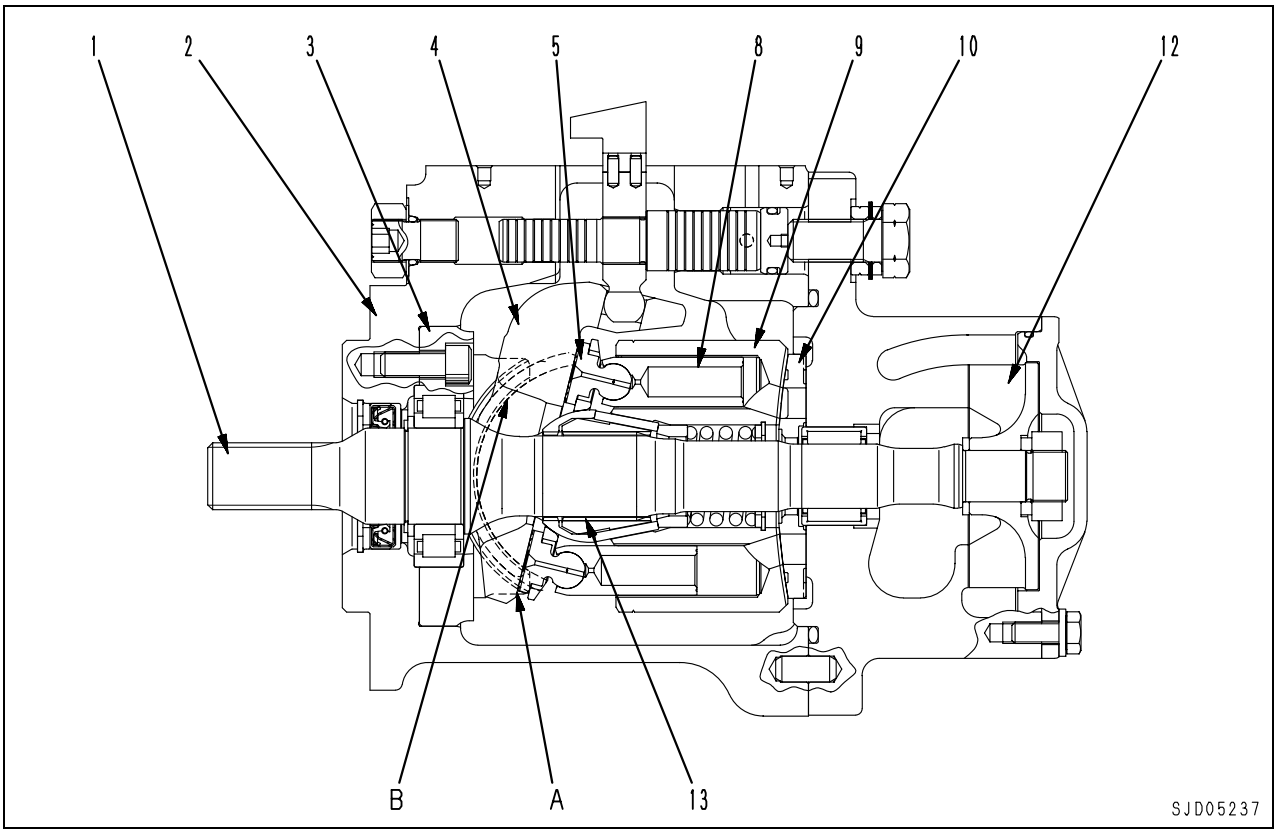
Piston pump



PA: Pump discharge
PA1: Pump pressure signal
PD2: Pump drain
PNC1: Control pressure
PS: Pump suction



1. Shaft
2. Case
3. Cradle
4. Rocker cam
5. Shoe
6. Servo piston
7. Rod
8. Piston
9. Cylinder block
10. Valve plate
11. End cap
12. Impeller
13. Spline



Function

- The pump converts the engine rotation transmitted to its shaft to oil pressure and delivers pressurized oil corresponding to the load.
- It is possible to change the discharge amount by changing the swash plate angle.

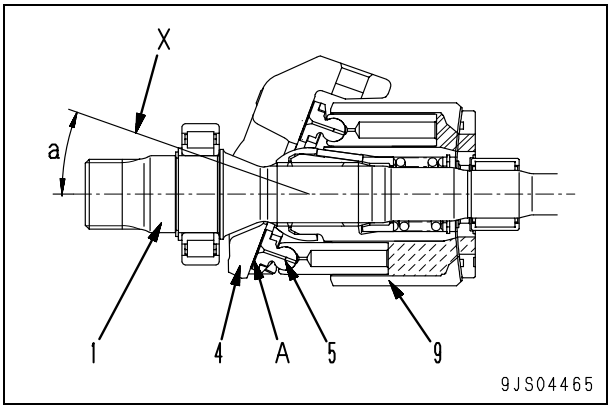
Structure

- Cylinder block (9) is supported to shaft (1) by spline (13), and shaft (1) is supported by the front and rear bearings.
- The end of piston (8) has a concave ball shape, and shoe (5) is caulked to it to form one unit. Piston (8) and shoe (5) form a spherical bearing.
- Rocker cam (4) holds flat surface (A), and shoe (5) is always pressed against this surface as it slides in a circle.
- Rocker cam (4) forms a static bearing sending high pressure oil at cylinder surface (B) of cradle (3), which is fixed to case (2), and carries out a sliding movement.
- Piston (8) carries out motion relative to the axial direction inside each cylinder chamber of cylinder block (9).
- Cylinder block (9) carries out rotation relative to valve plate (10) while sealing the pressurized oil, and this surface ensures that the hydraulic balance is maintained correctly. The oil inside each cylinder chamber of cylinder block (9) is sucked in and discharged through valve plate (10).
- Impeller (12) is fixed to shaft (1), and rotates together with the shaft. This makes it easier for the oil, which is sucked in from the suction port, to be sucked in and sends it into the cylinder chamber by centrifugal force.

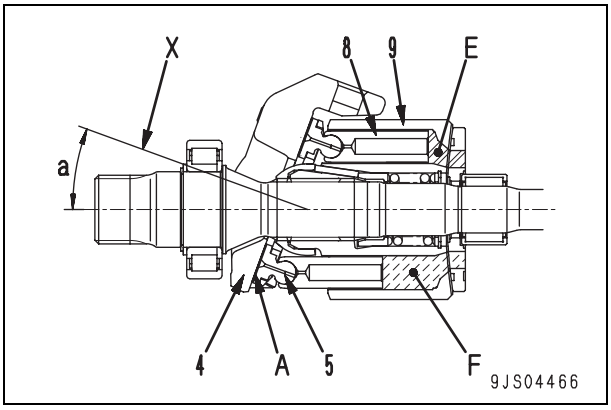
Operation

1. Operation of pump

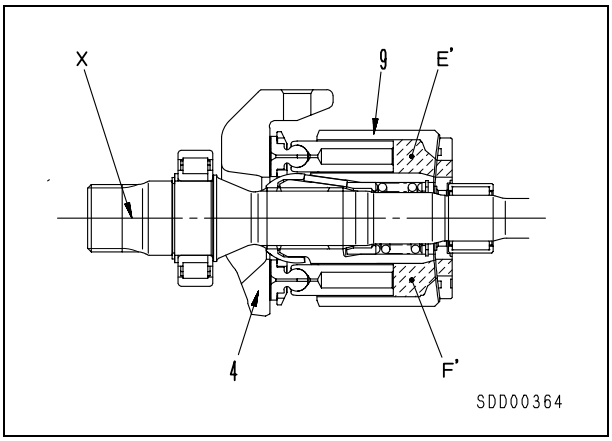
- Cylinder block (9) rotates together with shaft (1), and shoe (5) slides on flat surface (A). When this happens, angle (a) of center line (X) of rocker cam (4) to the axial direction of cylinder block (9) changes. (a) is called swash plate angle.



- With the condition of center line (X) of rocker cam (4) has swash plate angle (a) to axial direction of cylinder block (9), flat surface (A) functions as cam against shoe (5).
- In this way, piston (8) slides inside cylinder block (9), and as a result, a difference is generated between volumes (E) and (F) inside cylinder block (9). The amount of suction and discharge is equal to difference (F) – (E).
- In other words, cylinder block (9) rotates, and the volume of chamber (F) becomes smaller, so pressurized oil is discharged during this process. At the same time, the volume of chamber (E) becomes larger and the pressurized oil is sucked in this process.

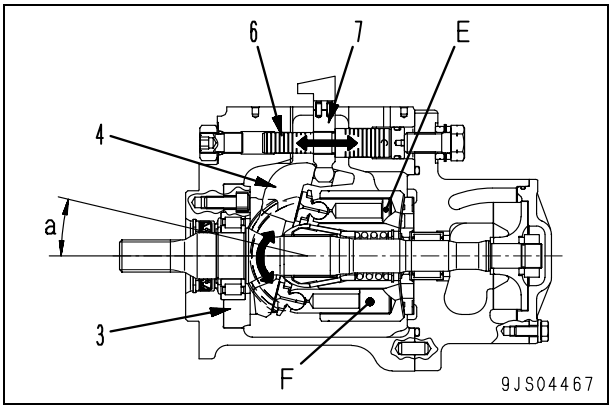


- When center line (X) of rocker cam (4) is the same as the axial direction of cylinder block (9) [swash plate angle = 0], the difference between volumes (E') and (F') inside cylinder block (9) is 0, so pump does not suck and discharge, and no pumping is carried out. [The swash plate angle is not set to 0 actually, however.]
- Swash plate angle (a) and the pump discharge amount is in relation of proportion.

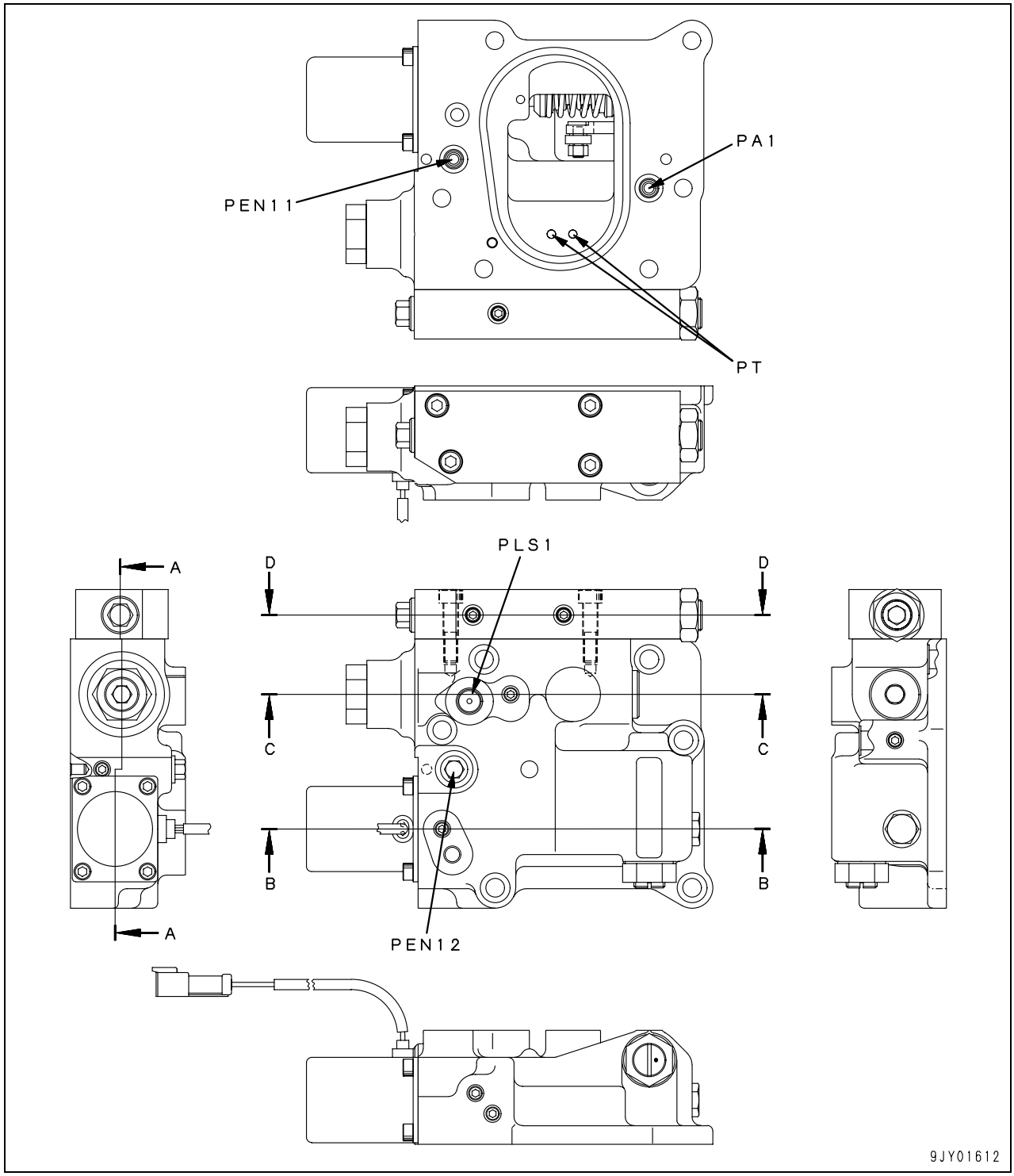


2. Control of discharge

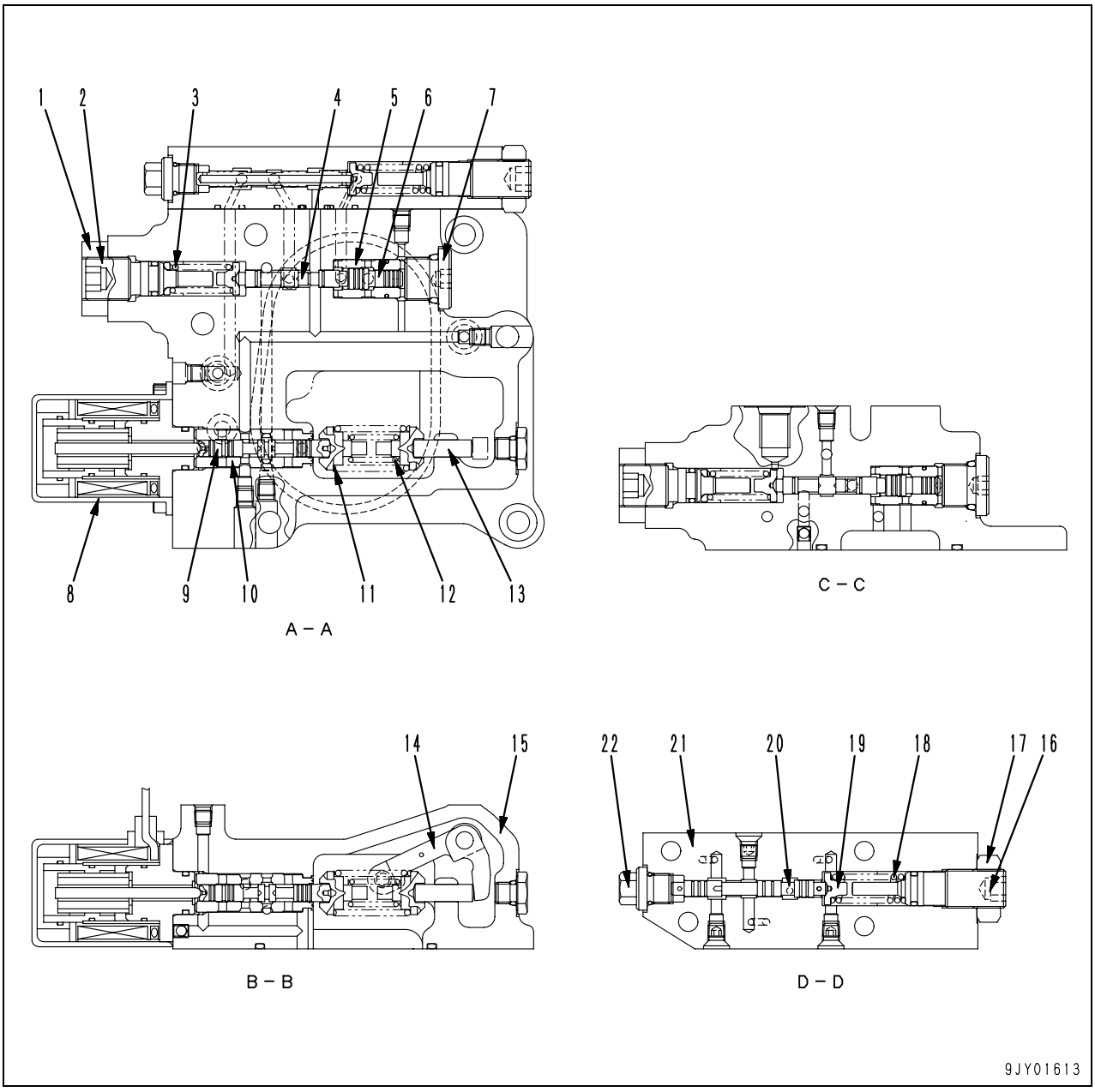
- The discharge amount is increased by the increase of capacity difference of (E) and (F) as swash plate angle (a) is increased. Swash plate angle (a) is changed by servo piston (6).
- Servo piston (6) reciprocates straight according to the signal pressure of the servo valve. This straight line movement is transmitted to rocker cam (4) through rod (7), and rocker cam (4) which is supported on the cylindrical surface by cradle (3) rotates with sliding motion.
- The area receiving the pressure is different at the left and right sides of servo piston (6), and the receiving pressure at the small diameter piston end is always connected with the main pump discharge pressure [self pressure (PP)].
- Output pressure (PNC) of the servo valve is applied to the pressure chamber at the large diameter piston end.
- The movement of servo piston (6) is controlled by the relationship of the size of the pressure at the large diameter piston end and self pressure (PP), and the comparative size of the ratio of the area receiving the pressure at the large diameter piston end and small diameter piston end.



Servo valve



PA1: Pump self pressure
PEN11: Control pressure
PEN12: Control pressure pick-up plug
PLS1: Load pressure input
PT: Drain



LS valve
1. Locknut
2. Plug
3. Spring
4. Spool
5. Sleeve
6. Piston
7. Plug

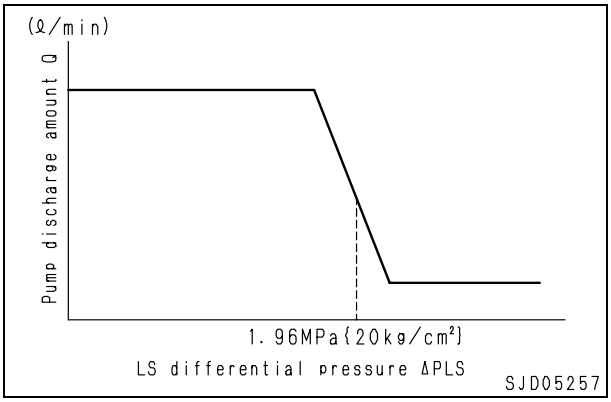
TVC valve
8. Solenoid
9. Piston
10. Sleeve
11. Spring
12. Spring
13. Piston
14. Lever
15. Valve body

Variable throttle valve
16. Screw
17. Locknut
18. Spring
19. Seat
20. Spool
21. Block
22. Plug

Function

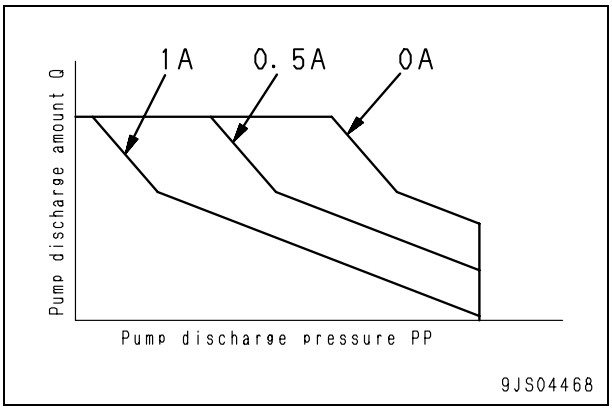
1. LS valve

- LS valve detects the load and controls the discharge amount.
- This valve controls main pump delivery (Q) according to differential pressure (ΔPLS) [= PP – PLS], called the LS differential pressure (the difference between main pump pressure (PP) and control valve outlet port pressure (PLS)).
- Main pump pressure (PP), pressure (PLS) [called LS pressure] coming from the control valve output enter this valve.
- The relationship between the differential pressure (ΔPLS) [= PP – PLS], the difference between main pump pressure (PP) and LS pressure (PLS), and discharge amount (Q) changes as shown in the diagram.



2. TVC valve

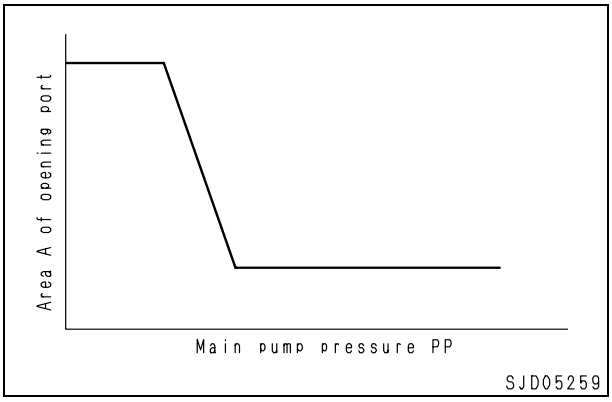
- When the pump discharge pressure (PP) is high, the TVC valve controls the pump so that no more oil than the constant flow (in accordance with the discharge pressure) flows even if the stroke of the control valve becomes larger. It carries out equal horsepower control so that the horsepower absorbed by the pump does not exceed the engine horsepower.
- If the load during the operation becomes larger and the pump discharge pressure rises, it reduces the discharge amount from the pump; and if the pump discharge pressure drops, it increases the discharge amount from the pump.
- The relationship between pump discharge pressure (PP) and pump discharge amount (Q) with the electric current value given to TVC solenoid as the parameter is shown in the diagram.



- During the high load operation, or when the engine speed slowed down etc., the current is supplied to TVC solenoid by the controller command.
- It reduces the pump discharge amount (pump absorption torque), and reduces the load of engine.

3. Variable throttle valve

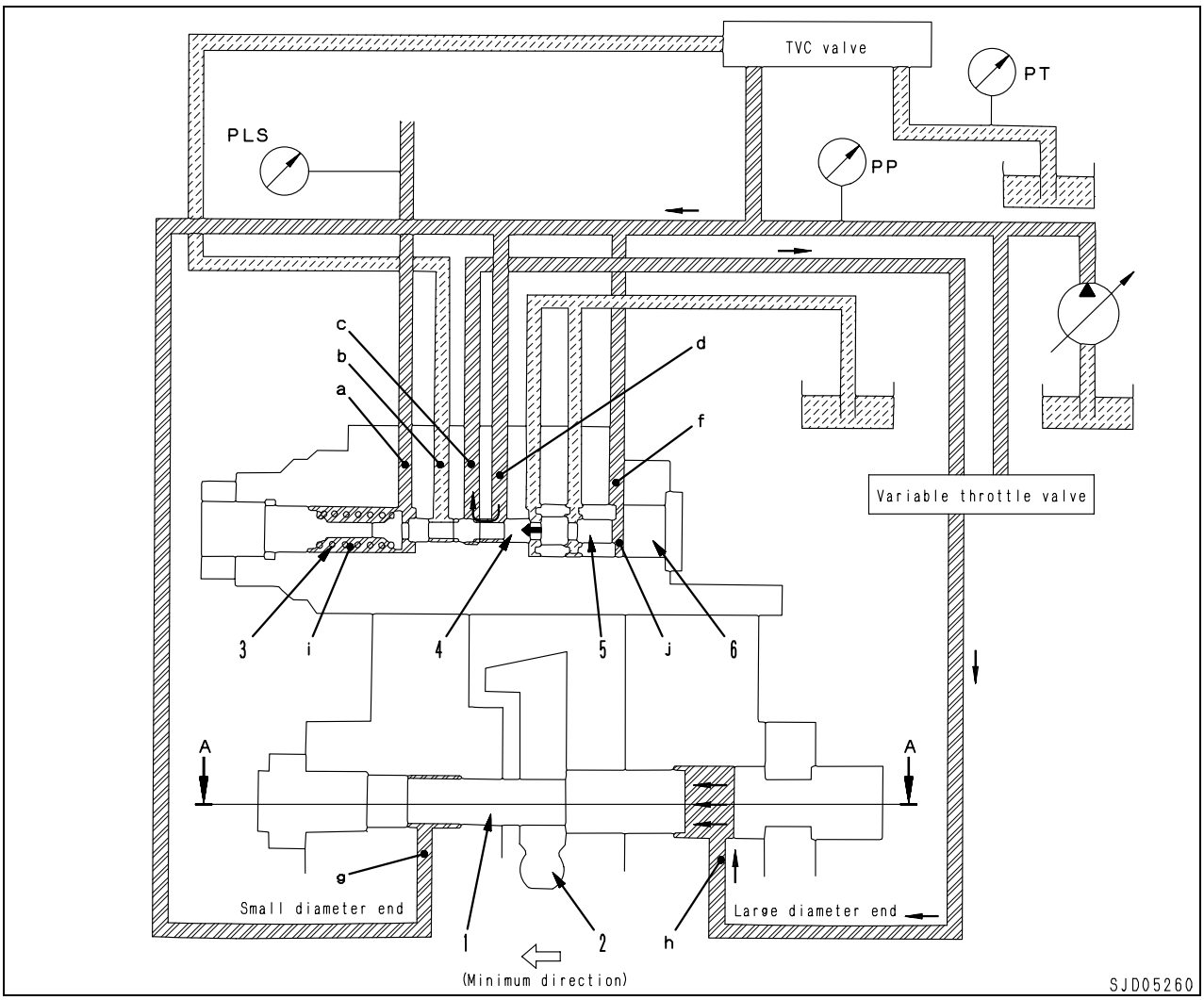
- Because the main pump controls its own pressure, there is a tendency for the response speed of the swash plate to be quick at high pressure and slow at low pressure.
- The variable throttle valve has been installed for the following reasons.
  1) To reduce the swash plate speed between minimum and maximum at high pressure; to reduce the impact force on the rod and other parts of the main pump; and to prevent excessive response.
  2) To prevent cavitation at the suction port caused by the sudden increase in the suction volume when changing from minimum to maximum.
- The characteristics of the variable throttle valve are as shown in the diagram. It has the function and property of maintaining the response during operations at low pressure by making the area of the opening smaller at high pressure and the area of the opening larger at low pressure, and by preventing the above problems 1) and 2) at high pressure.



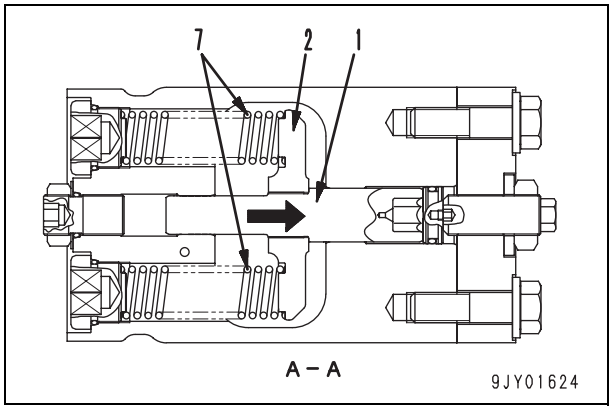
Operation

1. LS valve

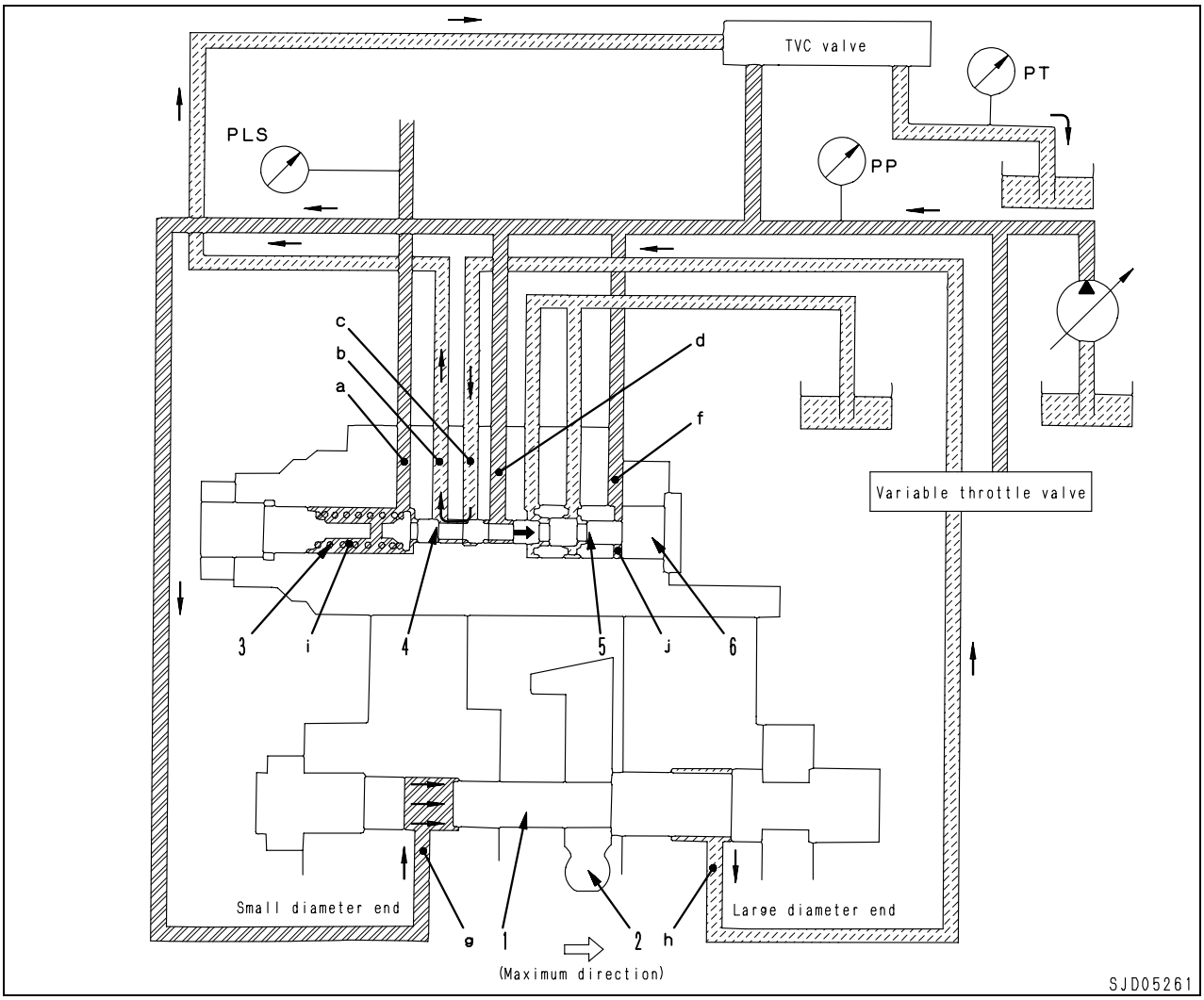
(1) When control valve is at "neutral" position



- LS valve is a 3-way selector valve, with pressure [LS pressure] (PLS) from the outlet port of the control valve brought to spring chamber (i), and main pump discharge pressure (PP) brought to chamber (j) of plug (6).
- The size of LS pressure (PLS) + force (F) of spring (3) and the main pump pressure [self pressure] (PP) determines the position of spool (4).
- Before the engine is started, servo piston (1) is pushed to the right by spring (7) installed to rod (2). [See right figure: section (A – A)]
- If the control lever is at the neutral position when the engine is started, LS pressure (PLS) will be set to 0 MPa {0 kg/cm^2}. (It is interconnected to the drain circuit via the control valve spool)
- Spool (4) is pushed to the left, and port (d) and port (c) are connected.
- Pump pressure (PP) enters the large diameter end of the piston from port (h). The same pump pressure (PP) also enters the small diameter end of the piston, so the swash plate is moved to the minimum angle by the difference in area of piston (1).

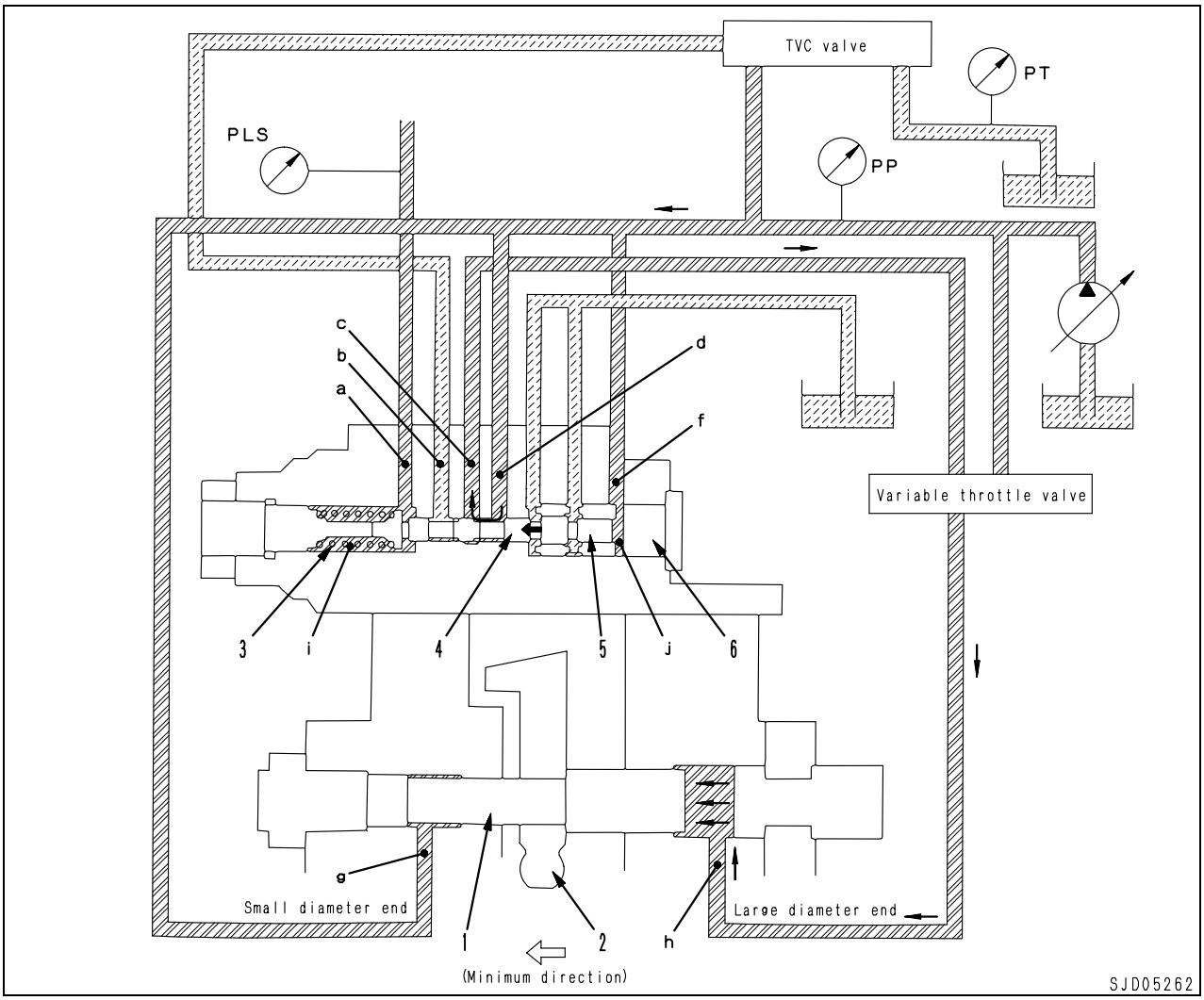


(2) Operation in the direction for maximum pump discharge amount



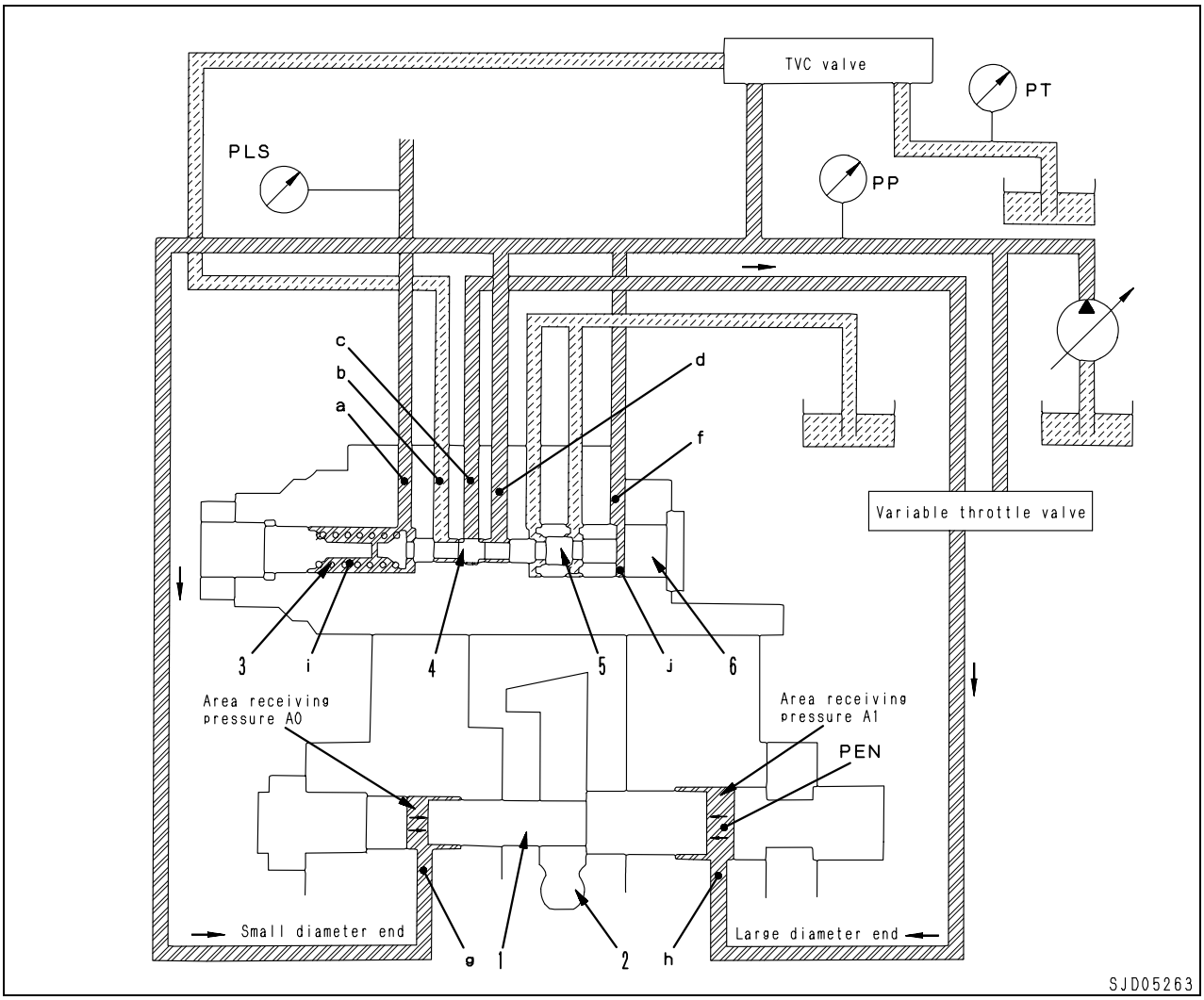
- When the difference between main pump pressure (PP) and LS pressure (PLS), in other words, LS differential pressure (ΔPLS) becomes smaller [for example, when the area of opening of the control valve becomes larger and pump pressure (PP) drops], spool (4) is pushed to the right by the combined force of LS pressure (PLS) and the force of spring (3).
- When spool (4) moves, port (b) and port (c) are joined and connected to the TVC valve.
- TVC valve is connected to the drain port, so the pressure of circuit (c) – (h) becomes drain pressure (PT). [The operation of TVC valve is explained later.]
- The pressure at the large piston diameter end of servo piston (1) becomes drain pressure (PT), and pump pressure (PP) enters the small diameter end, so servo piston (1) is pushed to the right.
- Rod (2) moves to the right and moves the swash plate in the direction to make the discharge amount larger.

(3) Operation in the direction for minimum pump discharge amount



- The following explains the situation if servo piston (1) moves to the left [the discharge amount becomes smaller].
- When LS differential pressure (ΔPLS) becomes larger [for example, when the area of opening of the control valve becomes smaller and pump pressure (PP) rises], pump pressure (PP) pushes spool (4) to the left.
- When spool (4) moves, main pump pressure (PP) flows from port (d) to port (c), and from port (h), it enters the large piston diameter end.
- Main pump pressure (PP) also enters the small piston diameter end, but because of the difference in area between the large and the small piston diameter ends of servo piston (1), servo piston (1) is pushed to the left.
- Rod (2) moves in the direction to make the swash plate angle smaller.

(4) When servo piston is balanced

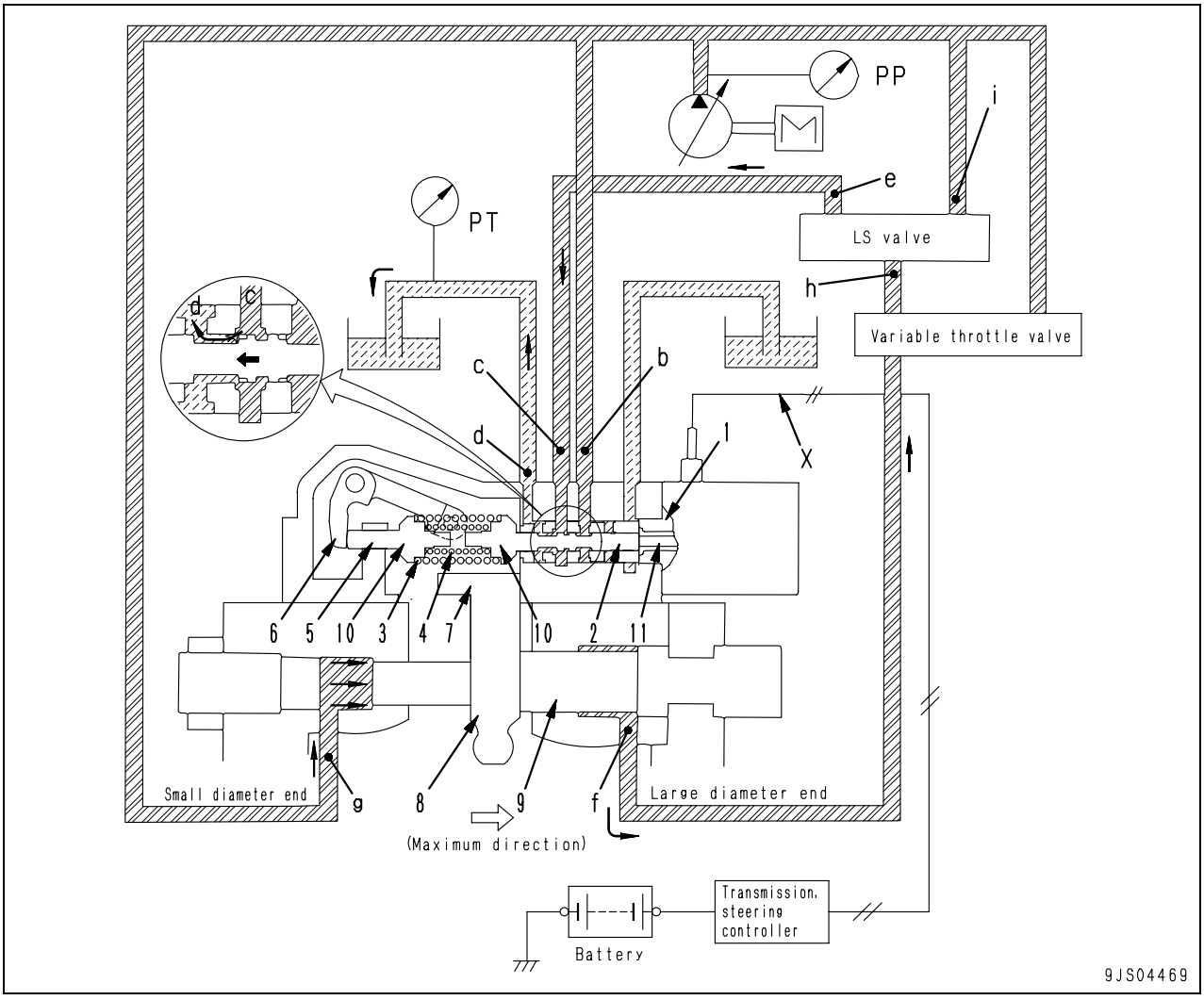


- Let us take the area receiving the pressure at the large diameter end of the piston as (A1), the area receiving the pressure at the small diameter end as (A0), and the pressure flowing into the large diameter end of the piston as (PEN).
- If main pump pressure (PP) of the LS valve and the combined force of force (F) of spring (3) and LS pressure (PLS) are balanced, the relationship is (A0) × (PP) = (A1) × (PEN).
- Servo piston (1) stops in that position, and the swash plate is kept at an intermediate position. [It stops at the position where the opening from port (b) to port (c) and from port (d) to port (c) of spool (4) is approximately the same.]
- The relationship between the area receiving the pressure at both ends of piston (1) is (A0) : (A1) = 1 : 2, so the pressure applied to both ends of the piston when it is balanced becomes (PP) : (PEN) ≒ 2 : 1.
- The position where spool (4) is balanced and stopped is the standard center, and the force of spring (3) is adjusted so that it is determined when (PP) – (PLS) = 1.96 MPa {20 kg/cm^2}.

2. TVC valve

(1) When the transmission and steering controller is normal

1) When the load on the actuator is small and pump pressure (PP) is low

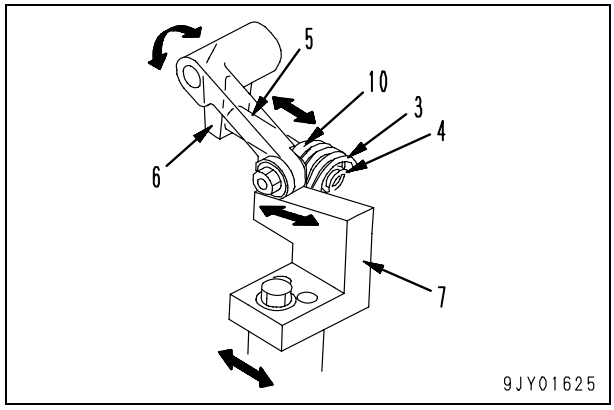


a. Operation of solenoid (1)

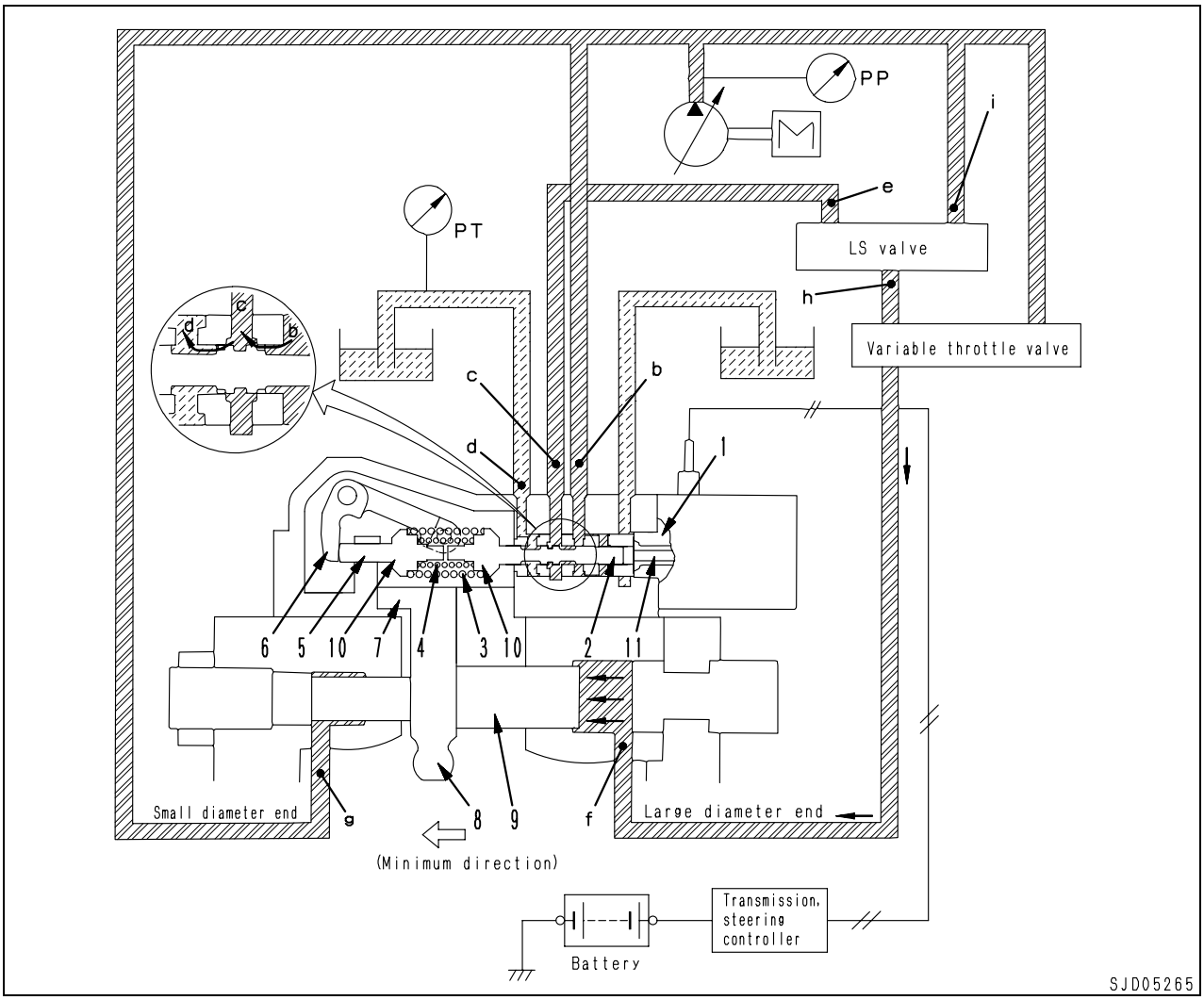
- Command current (X) from the transmission and steering controller flows to solenoid (1). This command current (X) changes the internal force pushing solenoid push pin (11).
- On the opposite side to the force pushing this solenoid push pin (11) is the spring set pressure of springs (3), (4) and pump pressure (PP). Piston (2) stops at a position where the combined force pushing piston (2) is balanced.
- The pressure output from TVC valve [pressure of port (c)] changes according to this position.
- The size of command current (X) is determined by the nature of the operation (lever operation), the selected working mode, and the set value and actual value of the engine speed.

b. Operation of spring

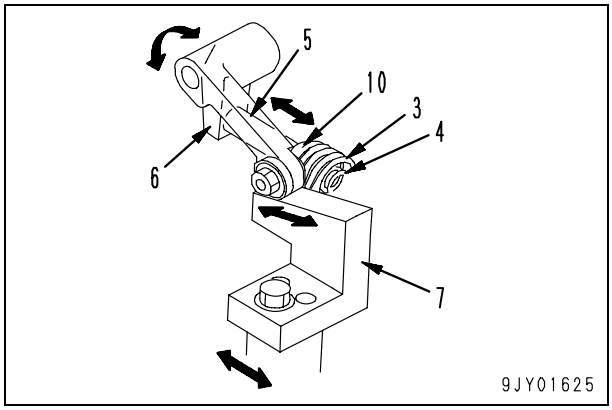
- The spring load of springs (3) and (4) in the TVC valve is determined by the swash plate position.
- When servo piston (9) moves, cam (7) which is connected to rod (8), also moves. When this happens, lever (6) is rotated by the angle of cam (7), and piston (5) moves to the right and left.
- If piston (5) moves to the right, spring (3) is compressed, and if it moves further to the right, spring (4) contacts seat (10), so both springs (3) and (4) function.
- The spring load is changed by piston (5) expanding or contracting springs (3) and (4).
- If command current (X) input to solenoid (1) changes, the force pushing solenoid push pin (11) changes, and the spring load of springs (3) and (4) also changes according to the command current (X) of the solenoid.
- Port (c) of the TVC valve is connected to port (e) of the LS valve [see “1. LS valve“]. Self pressure (PP) enters port (b), the small piston diameter end of servo piston (9) and port (a).
- When pump pressure (PP) is small, piston (2) is on the right.
- Port (c) and port (d) are connected, and the pressure entering the LS valve becomes drain pressure (PT).
- If port (h) and port (e) of LS valve are connected [see “1. LS valve“], the pressure entering the large piston diameter end from port (f) becomes drain pressure (PT), and servo piston (9) moves to the right.
- The pump delivery will be set to the increasing trend.
- As servo piston (9) moves further, piston (5) is moved to the left by rod (8), cam (7) and lever (6). Springs (3) and (4) expand and the spring force becomes smaller.
- When the spring force becomes smaller, piston (2) moves to the left, so the connection between port (c) and port (d) is cut, and port (c) is connected to port (b) of pump discharge pressure.
- The pressure at port (c) rises, and the pressure at the large piston diameter end also rises, so the movement of piston (9) to the right is stopped.
- The stop position for piston (9) [= pump discharge amount] is decided at the point where for the force of springs (3) and (4), and the pushing force by solenoid and the pushing force created by pressure (PP) acting on piston (2) are in balance.



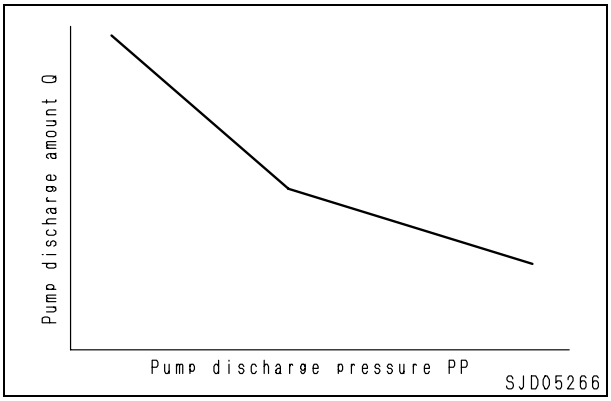
2) When the load on actuator is small and the pump discharge pressure is high



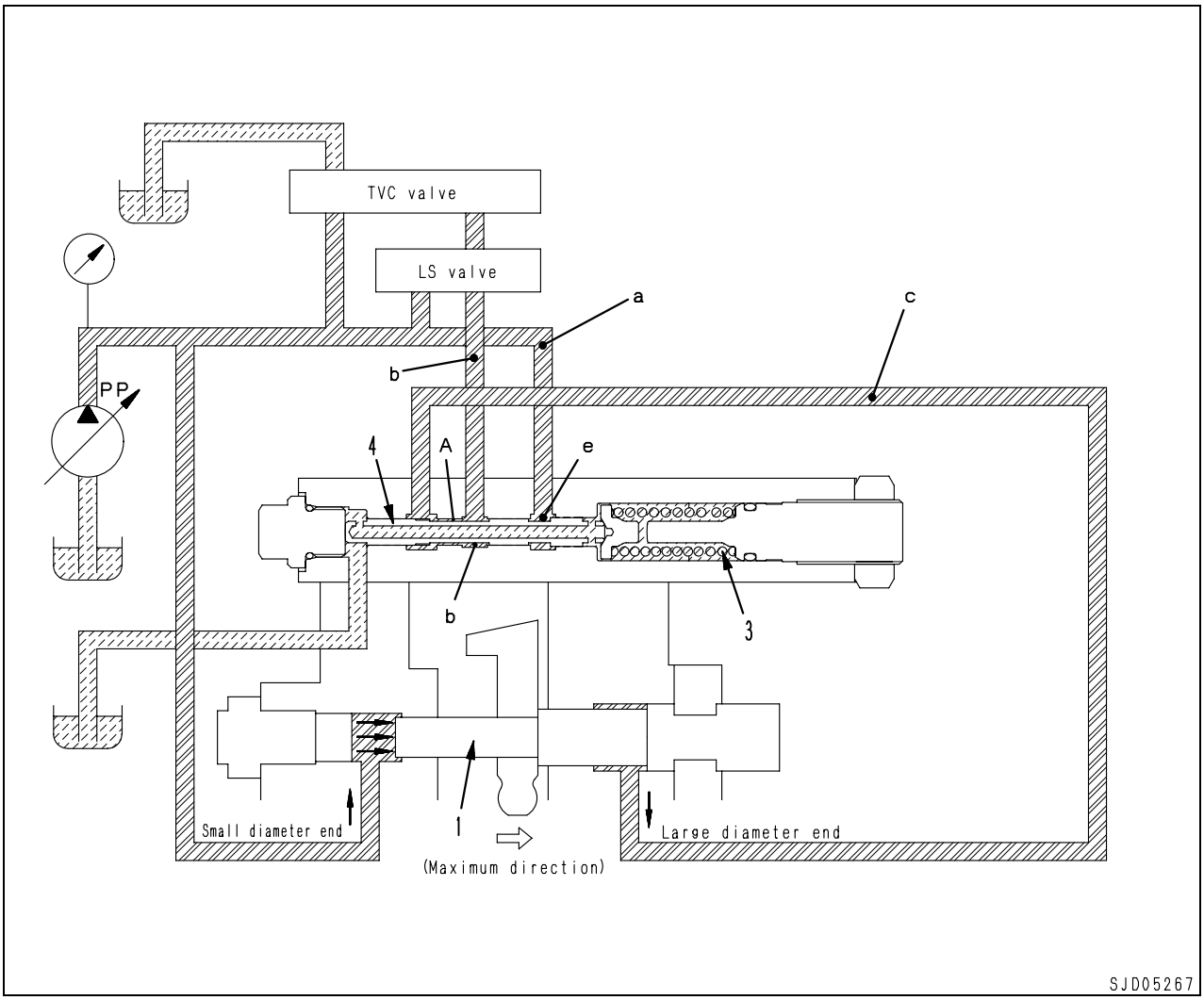
- When the load is large and pump discharge pressure (PP) is high, the force pushing piston (2) to the left becomes larger and piston (2) moves to the position shown in the diagram above.
- As shown in the diagram above, part of the pressurized oil from port (b) flows out to port (d) and the pressure oil flowing from port (c) to the LS valve becomes approximately half of main pump pressure (PP).
- When port (h) and port (e) of LS valve are connected [see “1. LS valve“], the pressure from port (f) enters the large piston diameter end of servo piston (9), and servo piston (9) stops.
- If main pump pressure (PP) increases further and piston (2) moves further to the left, main pump pressure (PP) flows to port (c) and acts to make the discharge amount the minimum.
- When piston (9) moves to the left, piston (5) is moved to the right by cam (7) and lever (6).
- Springs (3) and (4) are compressed and push back piston (2). Because of this force, piston (2) cuts of the connection from port (b) to port (c), and port (c) and port (d) are connected.
- As a result, the pressure at port (c) [= (f)] drops, and piston (9) stops moving to the left.
- The position in which piston (9) stops when this happens is further to the left than the position when pump pressure (PP) is low.



- The relation of pump pressure (PP) and the position of servo piston (9) forms a bent line because of the double-spring effect of springs (3) and (4). The relationship between pump pressure (PP) and pump discharge amount (Q) is shown in the figure.



3. Variable throttle valve



(1) Operation in direction for maximum pump delivery

- Pump discharge pressure (PP) enters the variable throttle valve through port (a).

1) When main pump pressure (PP) is high

- If the pressure becomes higher than the force of spring (3) because of the difference in sectional area of spool (4) in chamber (e), spool (4) moves to the right.
- If spool (4) moves to the right, the opening area between ports (c) and (b) is reduced by the notch at part (A). Accordingly, less oil flows from the large diameter end of servo piston (1) and the moving speed of servo piston (1) is lowered.

2) When main pump pressure (PP) is low

- Even if main pump pressure (PP) enters chamber (e) through port (a), spool (4) pushes spring (3) less strongly and moves to the right for shorter distance.
- The opening area of part (A) increases and the oil flowing from the large diameter end of servo piston (1) through port (c) to port (b) is not limited and the moving speed of servo piston (1) is heightened.

(2) Operation in the direction for smaller pump discharge amount

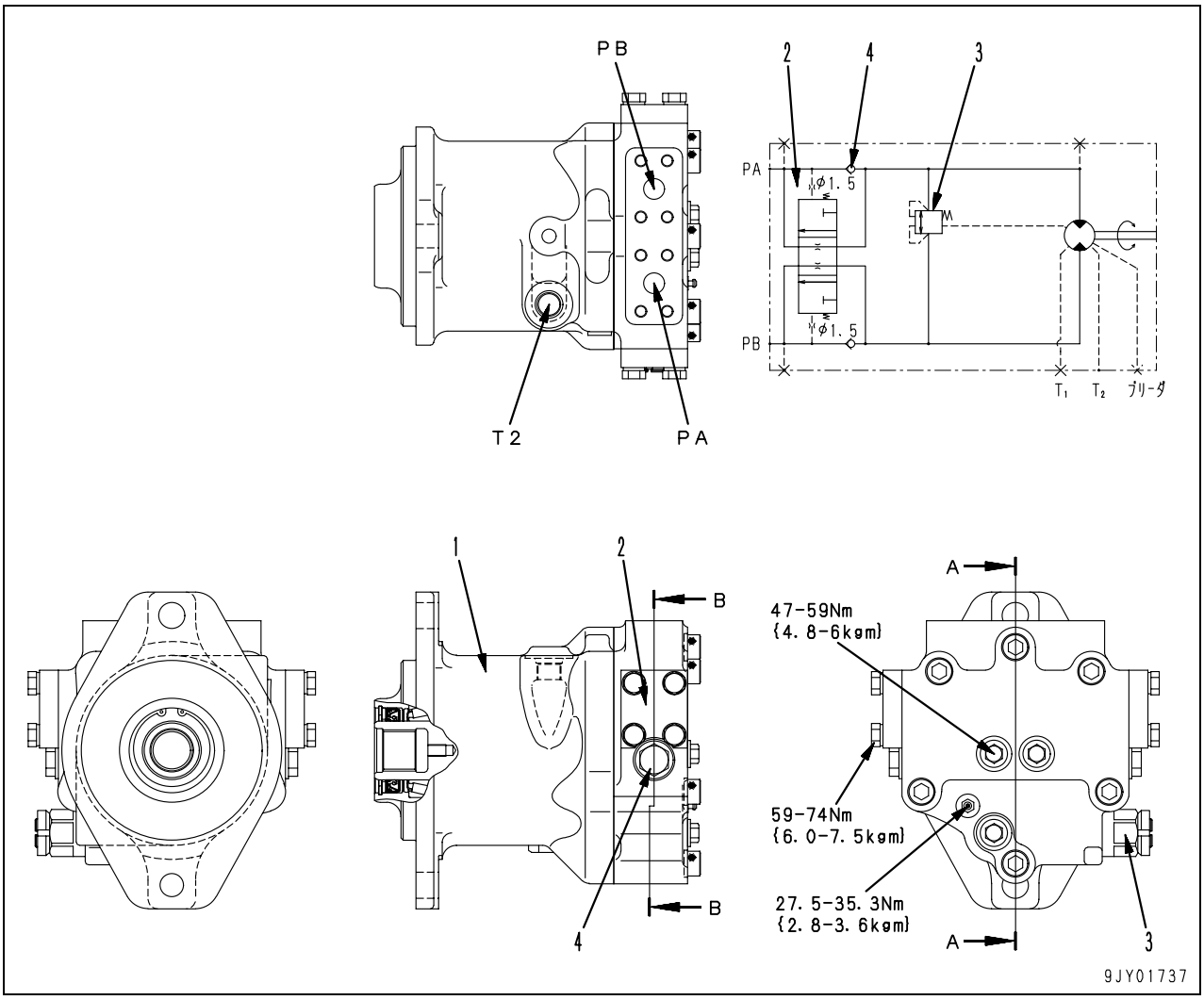
- The hydraulic oil flows from port (b) through port (c) to the large diameter side of servo piston (1).
- Spool (4) operates according to main pump pressure (PP) as explained in the above section.

HSS motor

Type: HMF95

Outline

- This motor is composed of the fixed capacity swash plate type piston motor, flashing shuttle valve, bypass valve and charge relief valve.

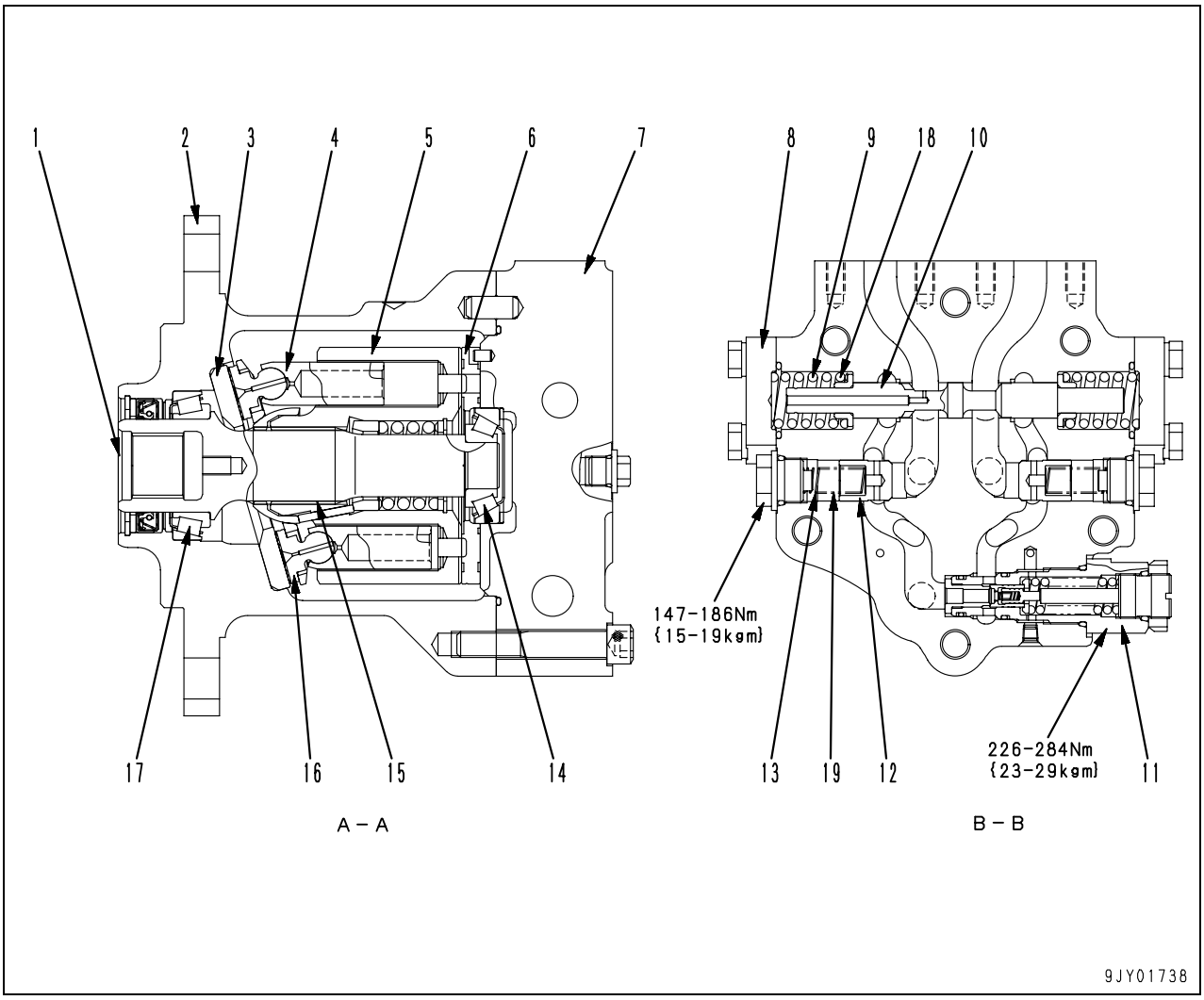


PA: From control valve
PB: From control valve
T2: To hydraulic tank

1. HSS motor
2. Counterbalance valve
3. Safety valve
4. Check valve

Specifications

Type:	HMF95
Theoretical delivery:	96.0 cc/rev
Rated output pressure:	38.2 MPa {390 kg/cm^2}
Rated speed:	2,430 rpm



1. Output shaft
2. Motor case
3. Thrust plate
4. Piston
5. Cylinder block
6. Valve plate
7. End cover
8. Brake valve assembly
9. Spool return spring
10. Counterbalance valve
11. Safety valve
12. Check valve
13. Check valve spring
14. Sub bearing
15. Spline
16. Shoe
17. Main bearing

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length × outer diameter	Installation length	Installation load	Free length	Installation load	
18	Spool return spring	42.7 × 30.0	40.5	192 N {19.6 kg}	—	154 N {15.7 kg}	Replace spring if damaged or deformed.
19	Check valve spring	43 × 13.8	32.9	1.27 N {0.13 kg}	—	0.98 N {0.10 kg}	

Outline

- Pressurized oil sent from pump is converted to rotating torque and is transmitted to output shaft.

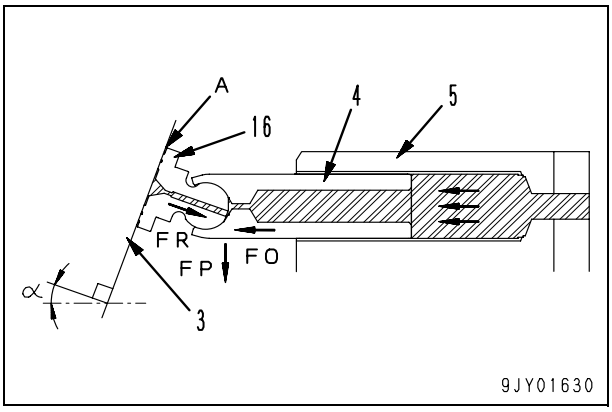
Structure

- Cylinder block (5) is supported to output shaft (1) by spline (15), and output shaft (1) is supported by main and sub bearings (17) and (14).
- The end of piston (4) has a concave ball shape, and shoe (16) is caulked to it to form one unit. Piston (4) and shoe (16) form a spherical bearing.
- Piston (4) carries out motion relative to the axial direction inside each cylinder chamber of cylinder block (5).
- Cylinder block (5) carries out rotation relative to valve plate (6) while sealing the pressurized oil.
- This surface ensures that the hydraulic balance is maintained correctly.
- The oil inside each cylinder chamber of the rotating section [cylinder block] is sucked in and discharged through the port of the stationary section [valve plate].

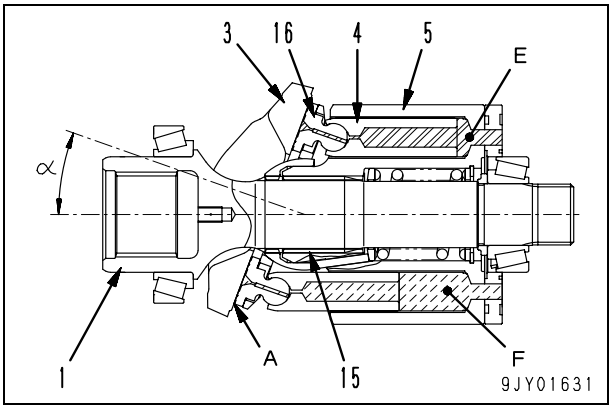
Operation

1. Operation of motor

- The pressurized oil sent from the pump enters cylinder block (5) and pushes piston (4) from the back face.
- In the case of the motor, the center line of plate (3) is always at an angle (swash plate angle (α)) to the axial direction of cylinder block (5).
- As a result, if we take the example of one of pistons (4), the oil pressure is applied to the back face of the piston, and the piston axial force (FO) is generated.
- With shoe (16), which is joined to piston (4) by the spherical surface, reaction force (FR) in a direction at right angles to flat surface (A) is generated. The combined force of (FO) and (FR) is (FP) and this becomes the force to rotate cylinder block (5).



- Shaft (1), which is meshed to cylinder block (5) by spline (15) transfers this rotating torque to the output side.
- Cylinder block (5) rotates, and while the condition changes from volume (E) to volume (F), pressurized oil from the pump flows into the cylinder chamber, and pressure (P) is generated according to the load.
- On the other hand, when the condition goes beyond volume (F) and changes to volume (E), the oil is pushed out and returned to the pump.



2. Rotation speed and torque control

- As flow (Q) from the HSS pump is increased, motor speed (N) is heightened.
- Since the swash plate angle of the HSS motor is fixed (α is constant), rotating torque (T) is proportional to pressure (P).
- Swash plate angle (α) is approx. 19°.

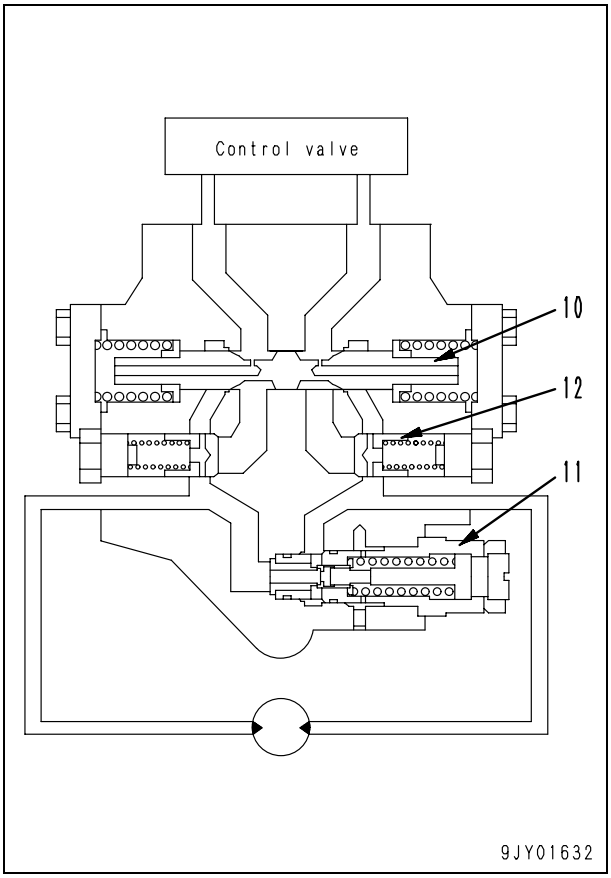
Q = qN
(q = E – F)

$T = Pq/2\pi$

Q: Total flow
q: Flow per 1 turn
N: Rotation speed
P: Pressure
T: Rotating torque

Brake valve operation

- The brake valve consists of check valve (12), counterbalance valve (10), and safety valve (11), and forms the circuit as shown below.
- The function and the operation of each component is as given below.



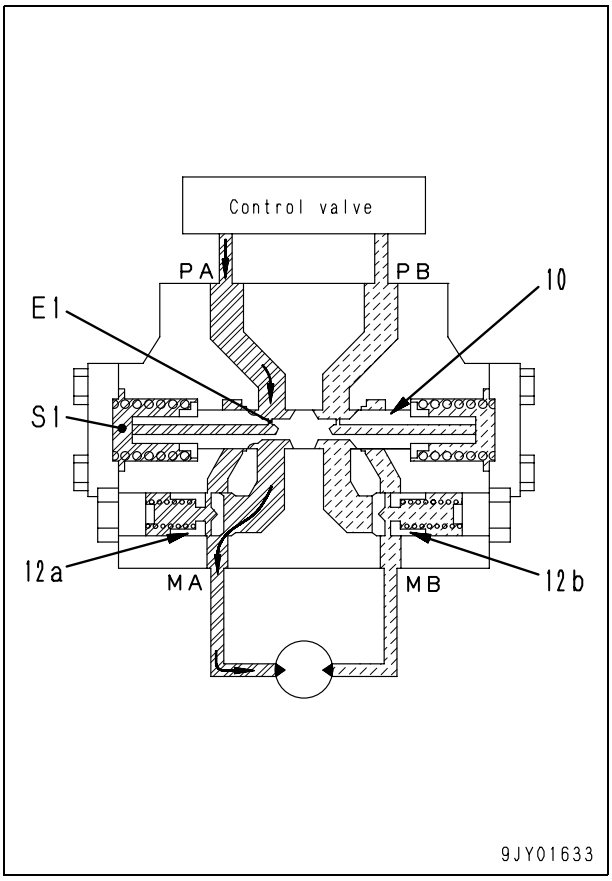
1. Counterbalance valve, check valve

Function

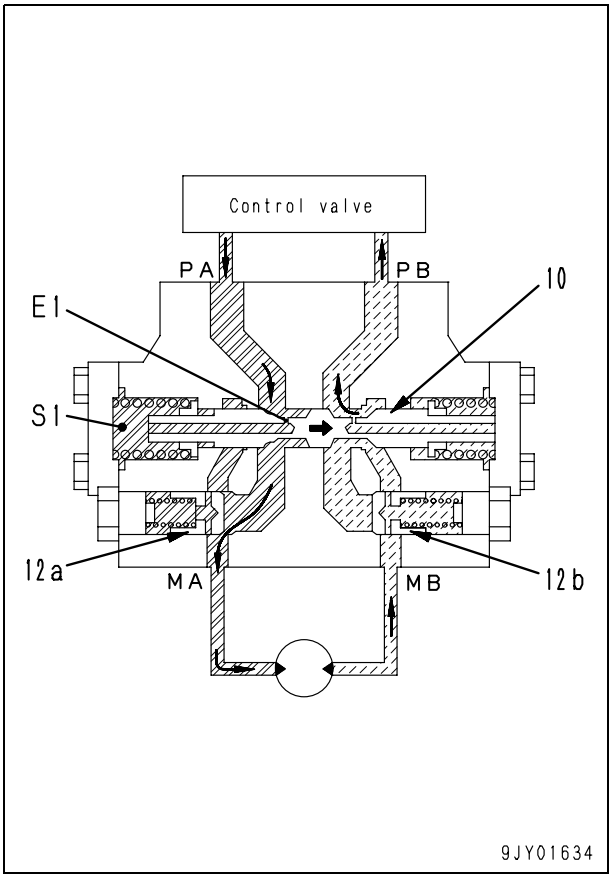
- When the steering is operated on a downhill slopes, the weight on the machine produces a force in the downward direction which makes the machine try to turn faster than the speed of the HSS motor.
- Because of this, if the engine is run at low speed and the steering is operated, the HSS motor will overrun, and this will create an extremely dangerous condition.
- To prevent this, this valve is installed to carry out the steering in accordance with the engine speed [pump discharge amount].

Operation when pressurized oil is supplied

- When the steering lever is operated, the pressurized oil from the control valve is supplied to port (PA). It pushes open check valve (12a), and flows from HSS motor inlet port (MA) to HSS motor outlet port (MB).
- However, the outlet port side of the HSS motor is closed by check valve (12b) and spool (10), so the pressure at the side where the oil is being supplied rises.

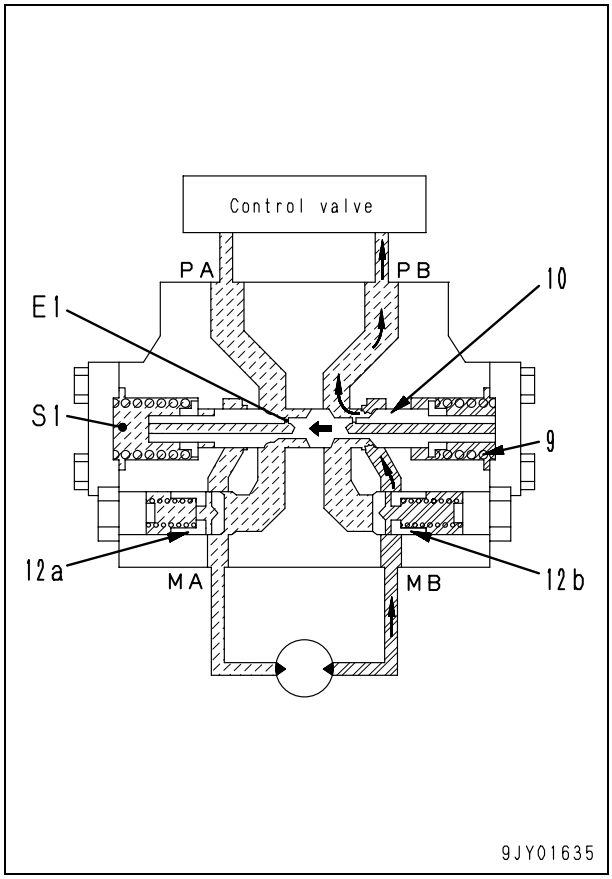


- The pressurized oil at the side where the oil is being supplied flows from orifice (E1) of spool (10) into chamber (S1). And when the pressure in chamber (S1) becomes greater than the spool switching pressure, spool (10) is pushed to the right.
- In this way, port (MB) and port (PB) are connected, so the outlet port side of the HSS motor is opened and the HSS motor starts to turn.



Action of brakes when operating steering on downhill slopes

- When the steering is operated on a downhill slopes, if the machine attempts to run away, the HSS motor will rotate under no load, and the oil pressure at the inlet port of the HSS motor will drop. This drop in the pressure will pass through orifice (E1), so the pressure in chamber (S1) will also drop.
- If the pressure in chamber (S1) drops below the spool switching pressure, spool (10) is pushed to the left by spring (9), and outlet port (MB) is throttled.
- As a result, the pressure at the outlet port rises, and this creates a resistance to the rotation of the HSS motor which prevents the motor from overrunning.
- In other words, the spool moves to a position where it balances the pressure at outlet port (MB) with the force resulting from the weight of the machine and the pressure at the inlet port. In this way, it throttles the outlet port circuit and controls the motor to a speed that matches the amount of oil discharged from the pump.



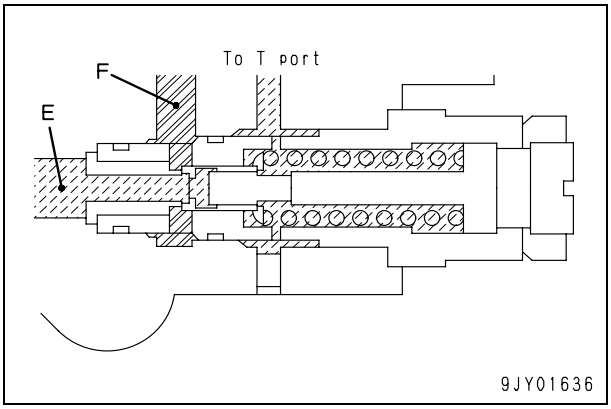
2. Safety valve

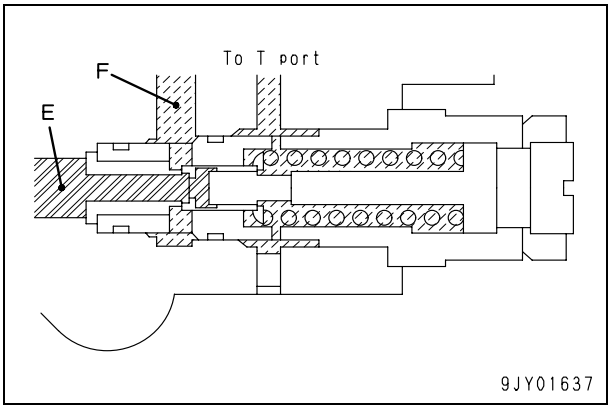
Function

- When the operation of the steering stops, counterbalance valve (10) closes the circuit at the inlet and outlet ports of the HSS motor.
- But the HSS motor continues to turn because of inertia. As a result, the pressure at the outlet port of the HSS motor becomes extremely high, and this will damage the HSS motor and the piping.
- The safety valve acts to release this abnormal pressure to the inlet port of the HSS motor to protect the equipment from damage.

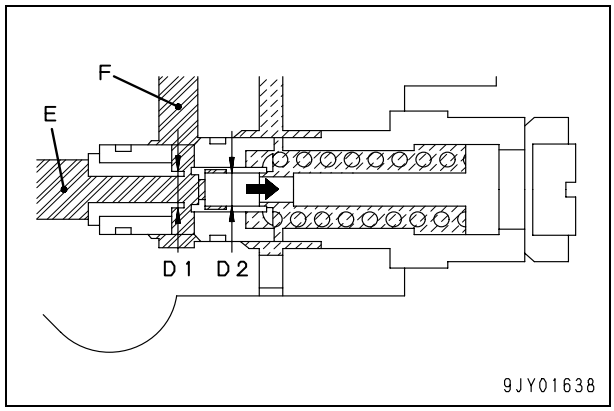
Operation

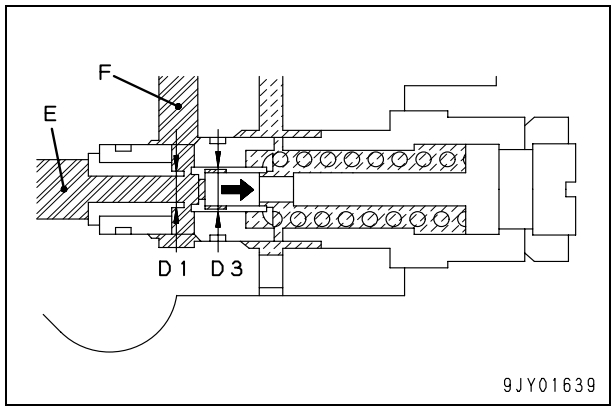
- When the operation of the steering is stopped, the check valve of the counterbalance valve (10) closes chamber (E) (or chamber (F)) in the outlet port circuit, but the pressure at the outlet port side continues to rise because of inertia.





- If the pressure in chamber (E) (or chamber (F)) goes above the set pressure, the force of $\pi/4$ ($D1^2 - D2^2$) × pressure resulting from the difference in area of (D1) and (D2) (or the force of $\pi/4$ ($D3^2 - D1^2$) × pressure resulting from the difference in area of (D3) and (D1)) becomes greater than the force of the spring and moves the poppet to the right. The oil then flows to chamber (F) (or chamber (E)) in the circuit on the opposite side.





D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00285-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

10 Structure, function and maintenance standard

Hydraulic system, Part 2

Hydraulic system, Part 2

Control valve

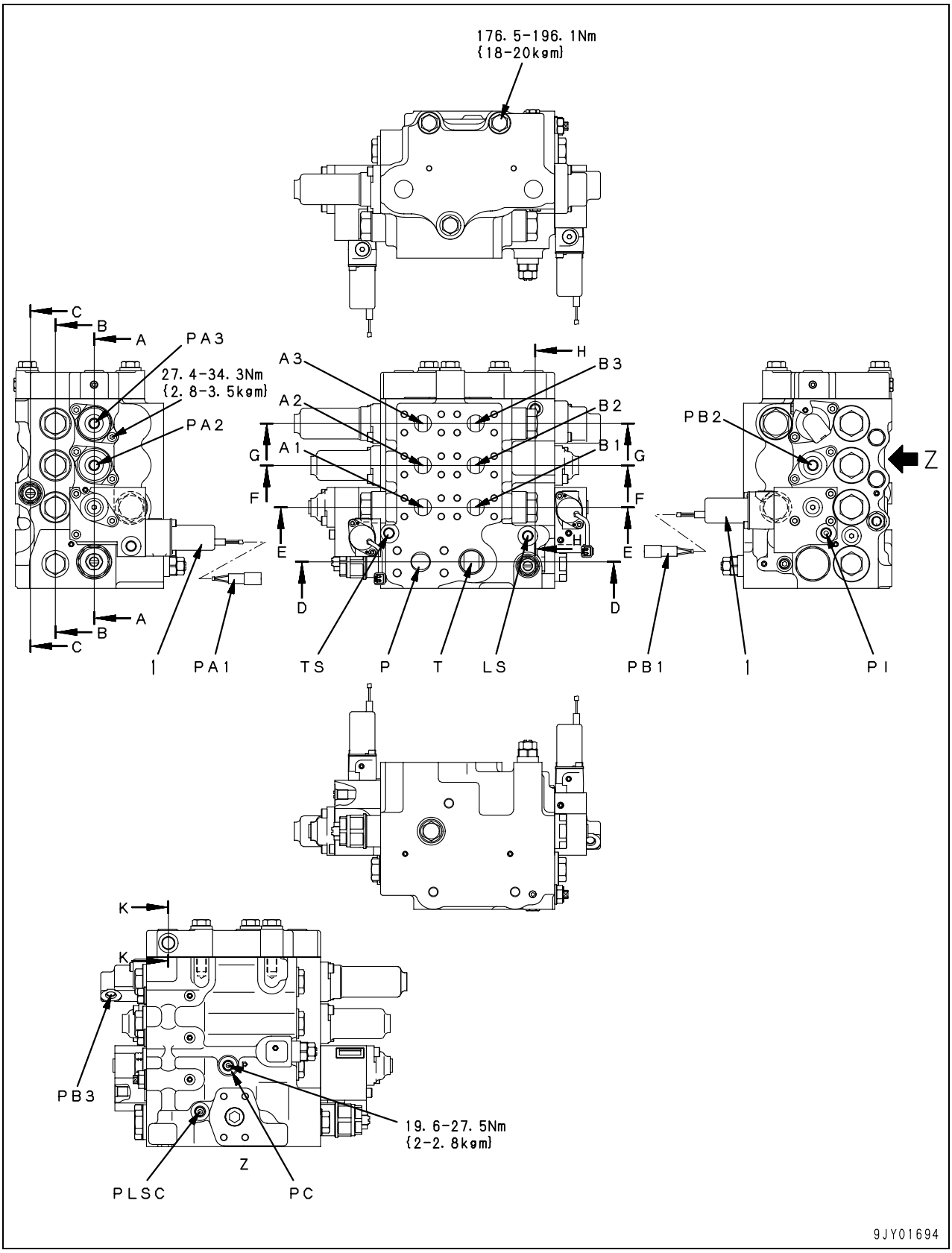
Outline

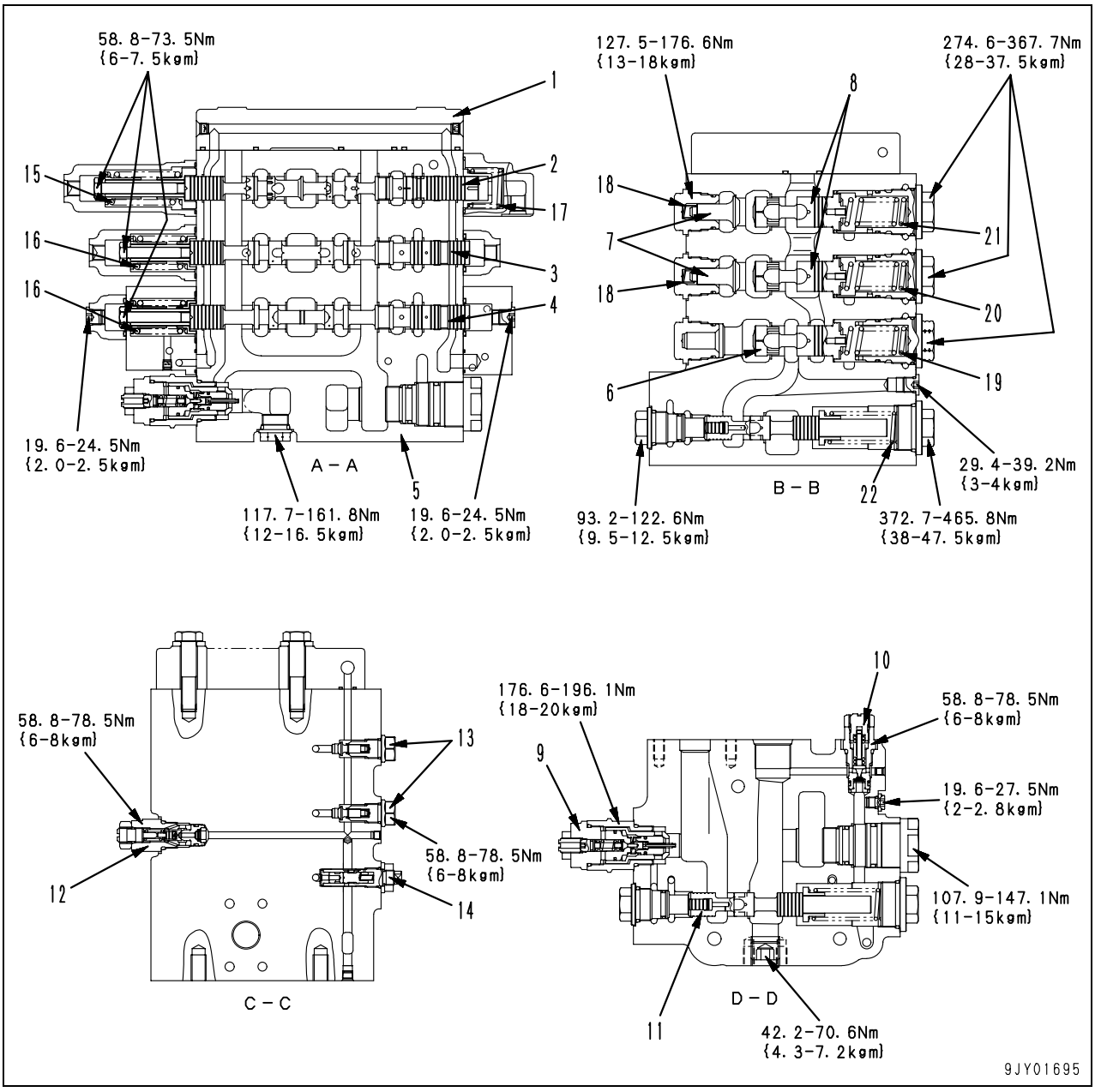
- This manual explains the 3-spool valve (Blade lift + Tilt + Steering) and 4-spool valve (Ripper + Blade lift + Tilt + Steering).

3-spool valve

P: From pump
T: To tank
A1: To HSS motor
A2: To tilt cylinder bottom
A3: To lift cylinder head
B1: To HSS motor
B2: To tilt cylinder head
B3: To lift cylinder bottom
LS: To pump LS valve
PC: Pump pressure plug
PI: From self pressure reducing valve
TS: To tank
PA1: Connector (from controller)
PA2: From PPC valve
PA3: From PPC valve
PB1: Connector (from controller)
PB2: From PPC valve
PB3: From PPC valve
PLSC: LS pressure plug

1. EPC valve

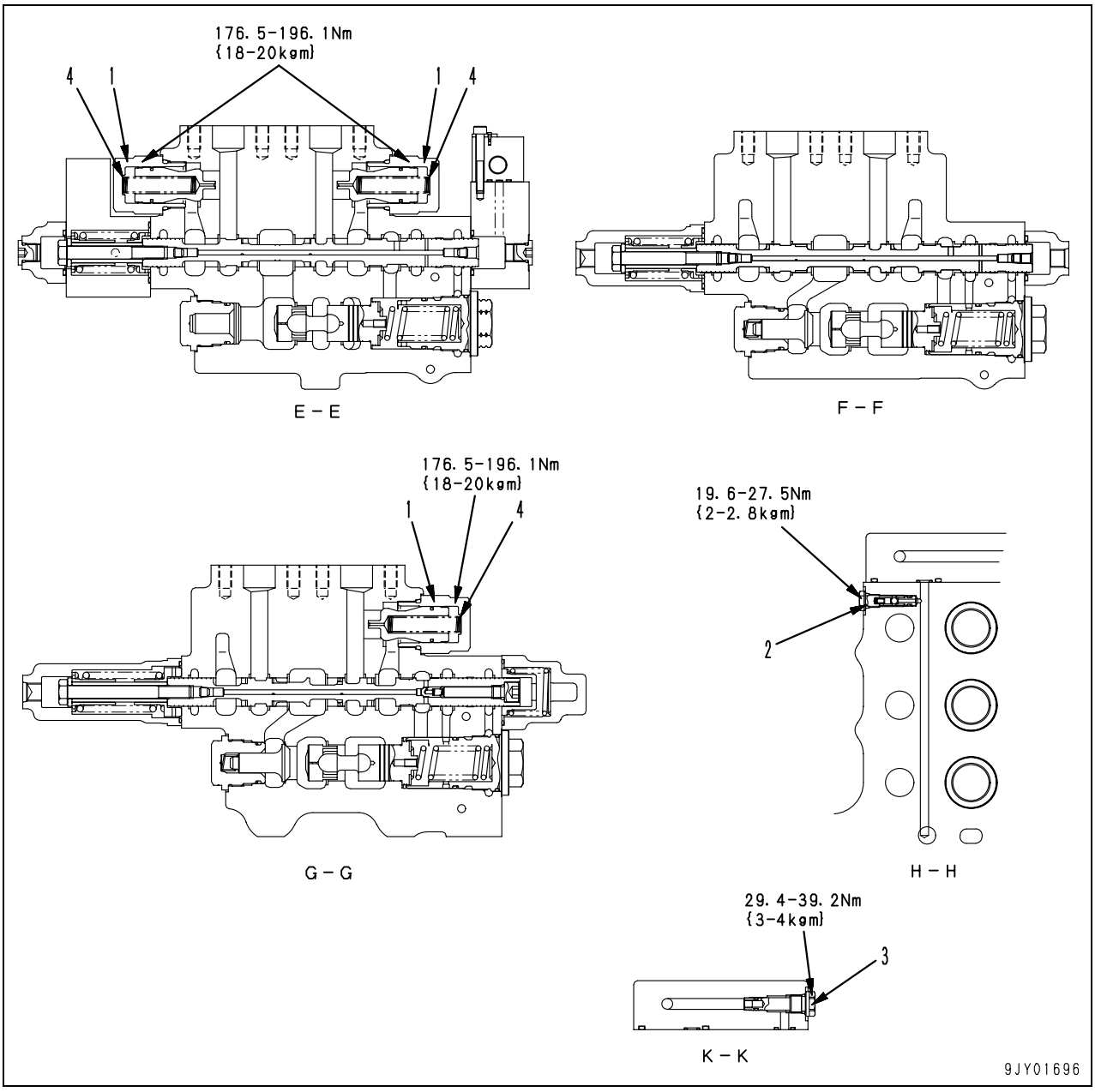

176.5-196.1Nm
{18-20kgm}
C
B
A
PA3
27.4-34.3Nm
{2.8-3.5kgm}
PA2
A3
A2
A1
H
B3
B2
B1
G
F
E
D
PB2
Z
PA1
TS
P
T
LS
PB1
PI
K
PB3
19.6-27.5Nm
{2-2.8kgm}
PLSC
PC
9JY01694



1. Cover
2. Lift spool
3. Tilt spool
4. Steering spool
5. Valve body
6. Steering priority valve
7. Load check valve
8. Pressure compensation valve
9. Main relief valve
10. LS relief valve (for steering valve)
11. Unload valve
12. LS relief valve (for work equipment valve)
13. LS check valve (for work equipment valve)
14. LS check valve (for steering valve)

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length × outer diameter	Installation length	Installation load	Free length	Installation load	
15	Spool return spring (for lift)	73.4 × 31	68.5	224 N {22.8 kg}	—	178 N {18.2 kg}	
16	Spool return spring (for tilt, steering)	51.7 × 31.3	50	140 N {14.3 kg}	—	112 N {11.4 kg}	
17	Spool return spring (for lift Float)	54.7 × 36.5	33.5	217 N {22.1 kg}	—	173 N {17.7 kg}	
18	Load check valve spring	20.8 × 10.2	13.5	12.7 N {1.3 kg}	—	9.81 N {1.0 kg}	Replace spring if damaged or deformed.
19	Pressure compensation valve spring (steering valve)	70 × 26.5	61.8	216 N {22 kg}	—	173 N {17.6 kg}	
20	Pressure compensation valve spring (tilt valve)	70 × 26.5	61.8	216 N {22 kg}	—	173 N {17.6 kg}	
21	Pressure compensation valve spring (lift valve)	70 × 26.5	61.8	216 N {22 kg}	—	173 N {17.6 kg}	
22	Unload valve spring	94.8 × 30	69.5	235 N {24 kg}	—	188 N {19.2 kg}	



1. Suction valve
2. Preset check valve
3. LS bypass valve

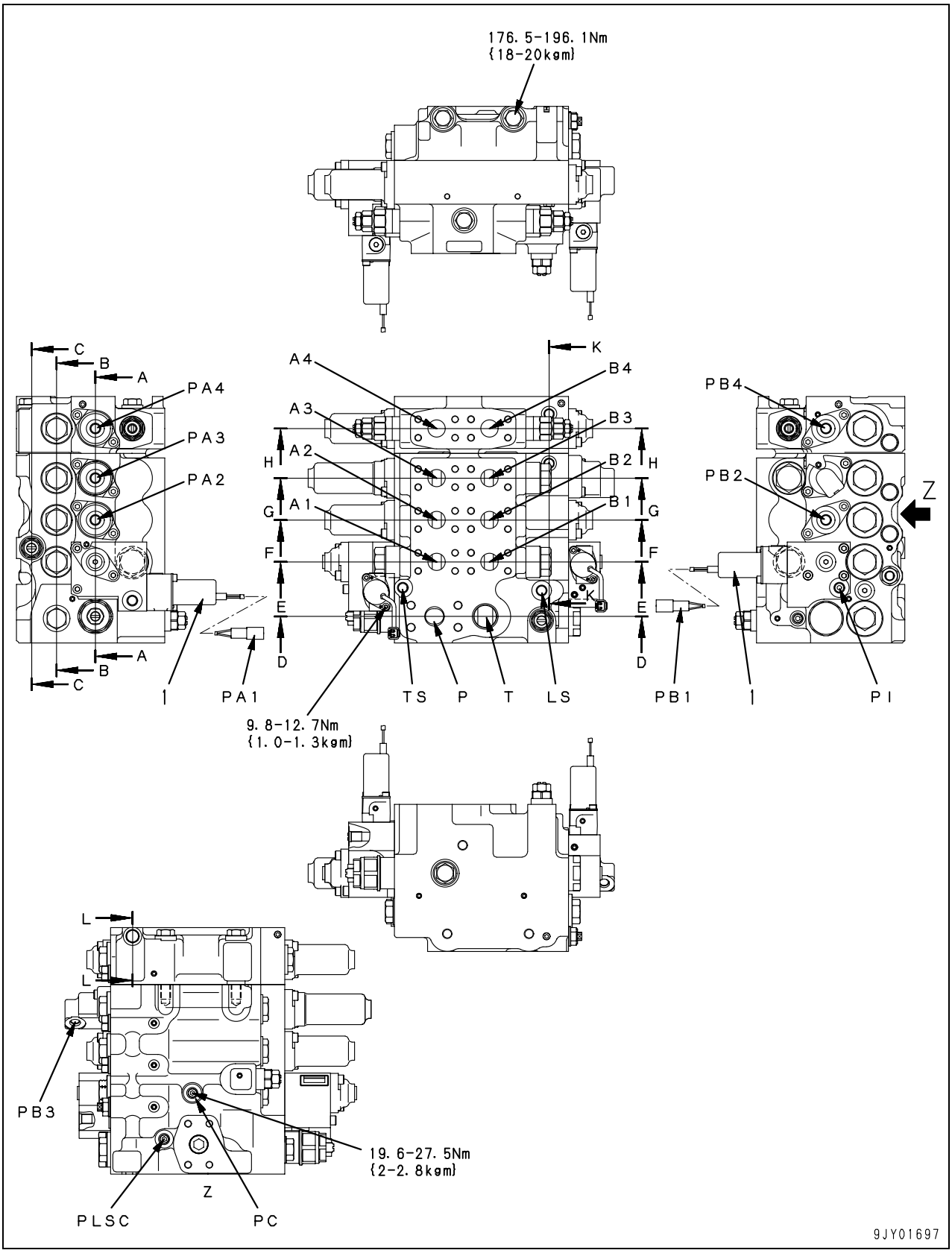
Unit: mm

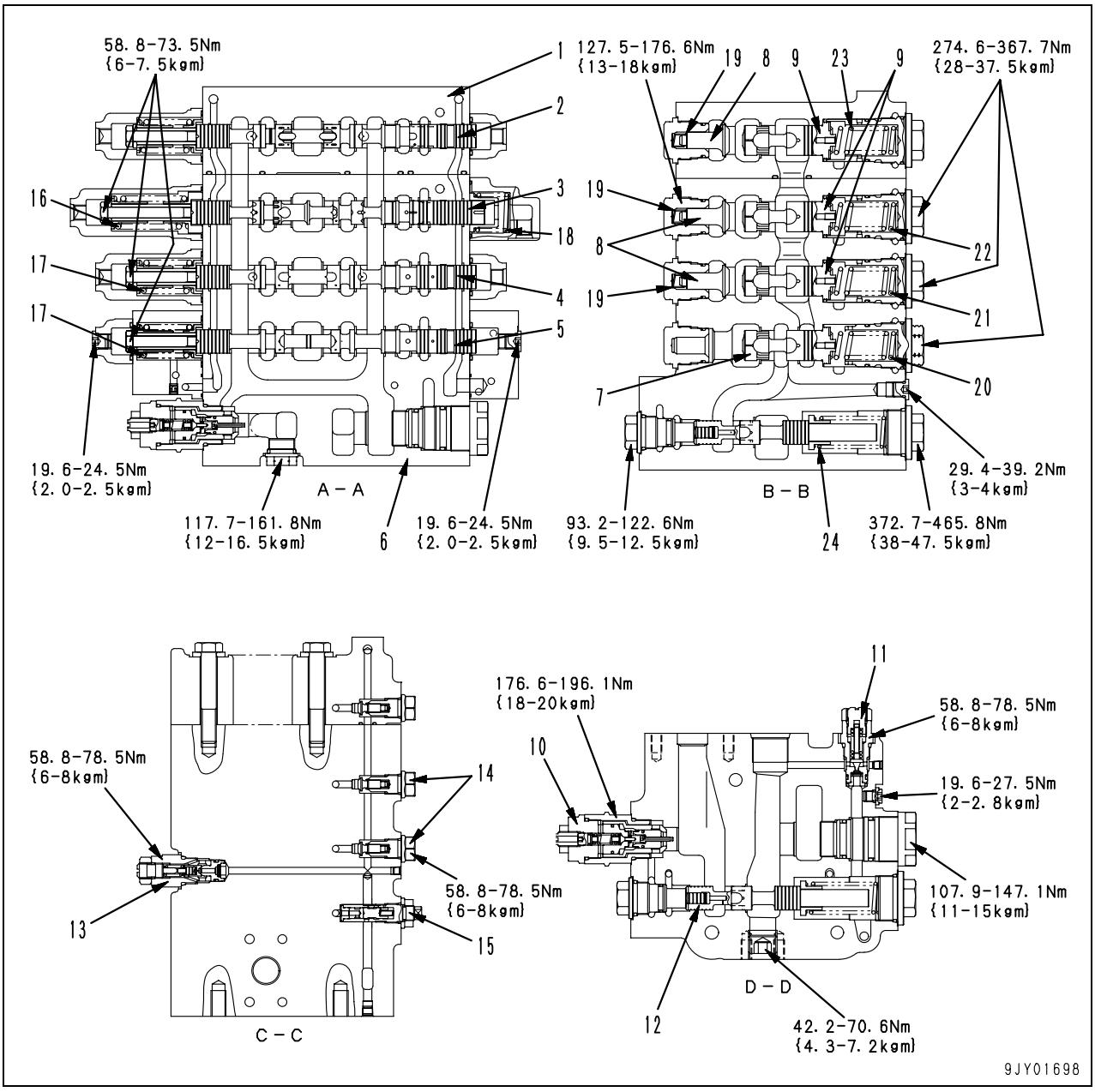
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
4	Suction valve spring	Free length × outer diameter	Installation length	Installation load	Free length	Installation load	Replace spring if damaged or deformed.
		64.9 × 12.5	56	6.4 N {0.65 kg}	—	5.1 N {0.52 kg}	

4-spool valve

P: From pump
T: To the tank
A1: To HSS motor
A2: To tilt cylinder bottom
A3: To lift cylinder head
A4: To ripper cylinder bottom
B1: To HSS motor
B2: To tilt cylinder head
B3: To lift cylinder bottom
B4: To ripper cylinder head
LS: To pump LS valve
PC: Pump pressure plug
PI: From self pressure reducing valve
TS: To tank
PA: Connector (from controller)
PA2: From PPC valve
PA3: From PPC valve
PA4: From PPC valve
PB1: Connector (from controller)
PB2: From PPC valve
PB3: From PPC valve
PB4: From PPC valve
PLSC: LS pressure plug

1. EPC valve


176.5-196.1Nm
{18-20kgm}
C
B
A
PA4
PA3
PA2
A4
A3
A2
A1
H
G
F
E
D
K
B4
B3
B2
B1
PB4
PB2
Z
PA1
TS
P
T
LS
PB1
PI
9.8-12.7Nm
{1.0-1.3kgm}
L
PB3
19.6-27.5Nm
{2-2.8kgm}
PLSC
PC
9JY01697



1. Valve block
2. Ripper spool
3. Lift spool
4. Tilt spool
5. Steering spool
6. Valve body
7. Steering priority valve
8. Load check valve
9. Pressure compensation valve
10. Main relief valve
11. LS relief valve (for steering valve)
12. Unload valve
13. LS relief valve (for work equipment valve)
14. LS check valve (for work equipment valve)
15. LS check valve (for steering valve)

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length × outer diameter	Installation length	Installation load	Free length	Installation load	
16	Spool return spring (for lift)	73.4 × 31	68.5	224 N {22.8 kg}	—	178 N {18.2 kg}	
17	Spool return spring (for tilt, steering)	51.7 × 31.3	50	140 N {14.3 kg}	—	112 N {11.4 kg}	
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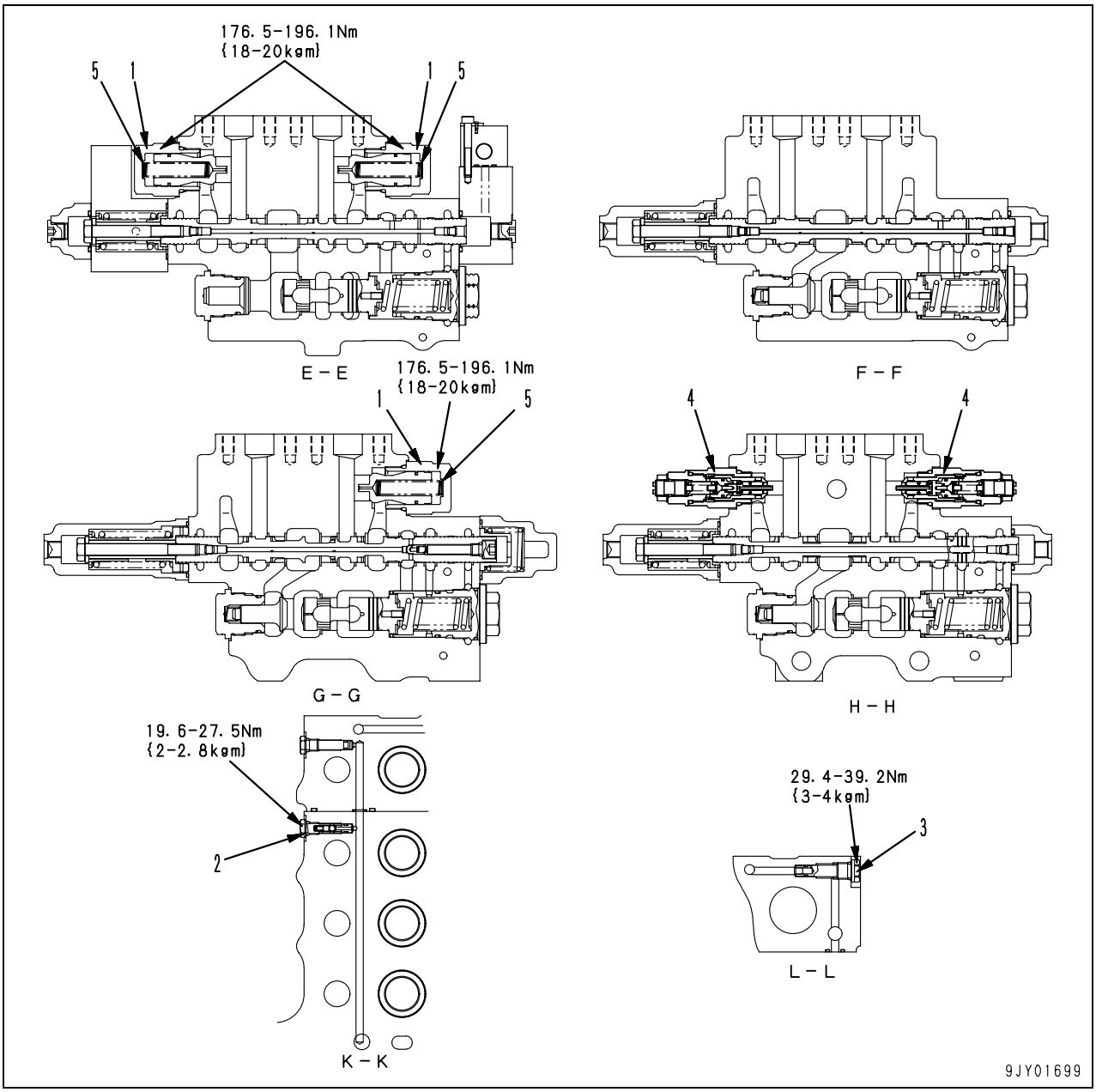
19	Load check valve spring	20.8 × 10.2	13.5	12.7 N {1.3 kg}	—	9.81 N {1.0 kg}	
20	Pressure compensation valve spring (steering valve)	70 × 26.5	61.8	216 N {22 kg}	—	173 N {17.6 kg}	Replace spring if damaged or deformed.
21	Pressure compensation valve spring (tilt valve)	70 × 26.5	61.8	216 N {22 kg}	—	173 N {17.6 kg}	
22	Pressure compensation valve spring (lift valve)	70 × 26.5	61.8	216 N {22 kg}	—	173 N {17.6 kg}	
23	Pressure compensation valve spring (ripper valve)	70 × 26.5	61.8	216 N {22 kg}	—	173 N {17.6 kg}	
24	Unload valve spring	94.8 × 30	69.5	235 N {24 kg}	—	188 N {19.2 kg}	



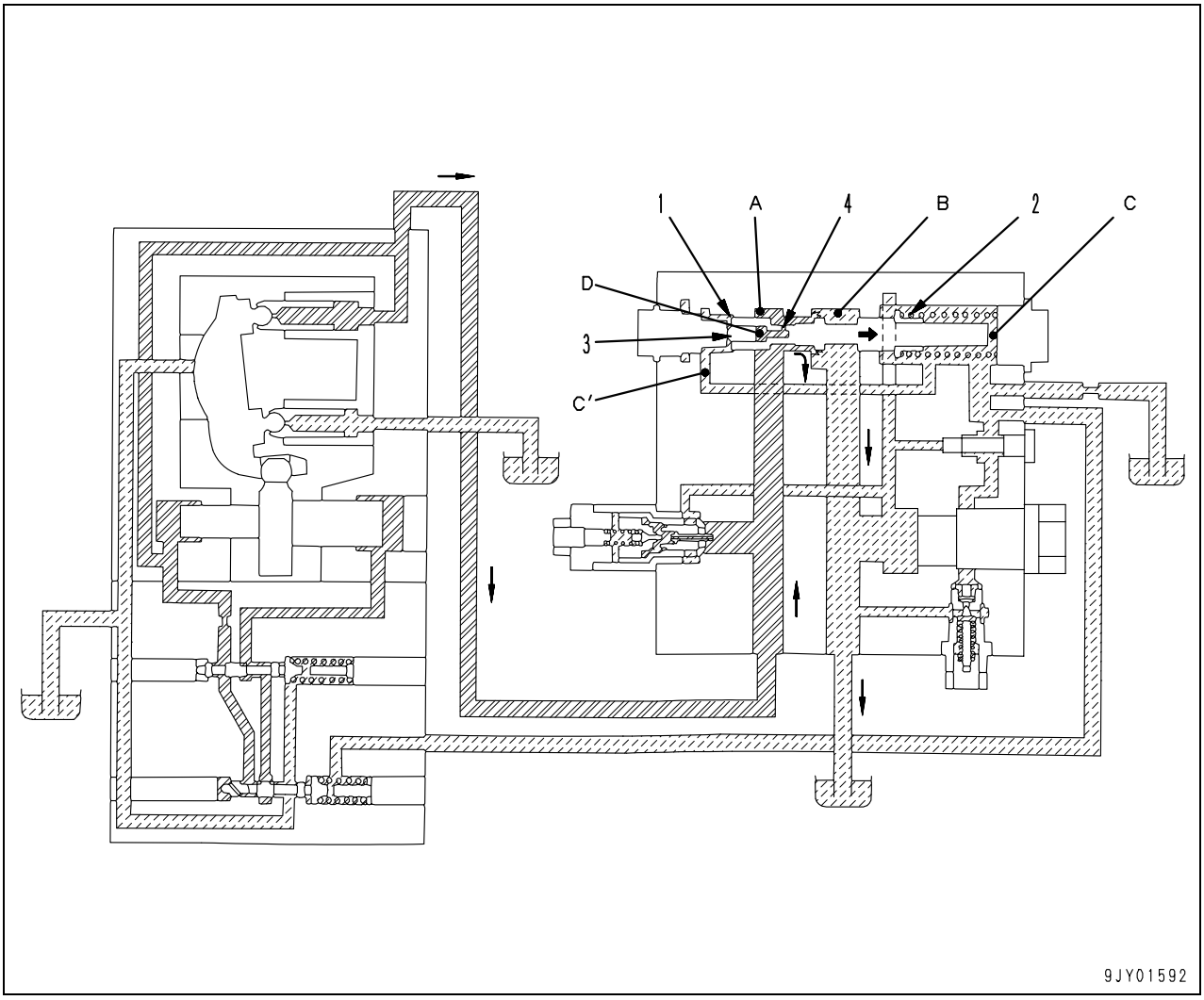
1. Suction valve
2. Preset check valve
3. LS bypass valve
4. Safety-suction valve

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
5	Suction valve spring	Free length × outer diameter	Installation length	Installation load	Free length	Installation load	Replace spring if damaged or deformed.
		64.9 × 12.5	56	6.4 N {0.65 kg}	—	5.1 N {0.52 kg}	

Operation of control valve

At “hold“ (operation of unload valve)



Function

- When the main spool is at the “hold“ position, it drains the excess oil discharged by the pump, and prevents the pressure from being formed in the circuit from rising.

Operation

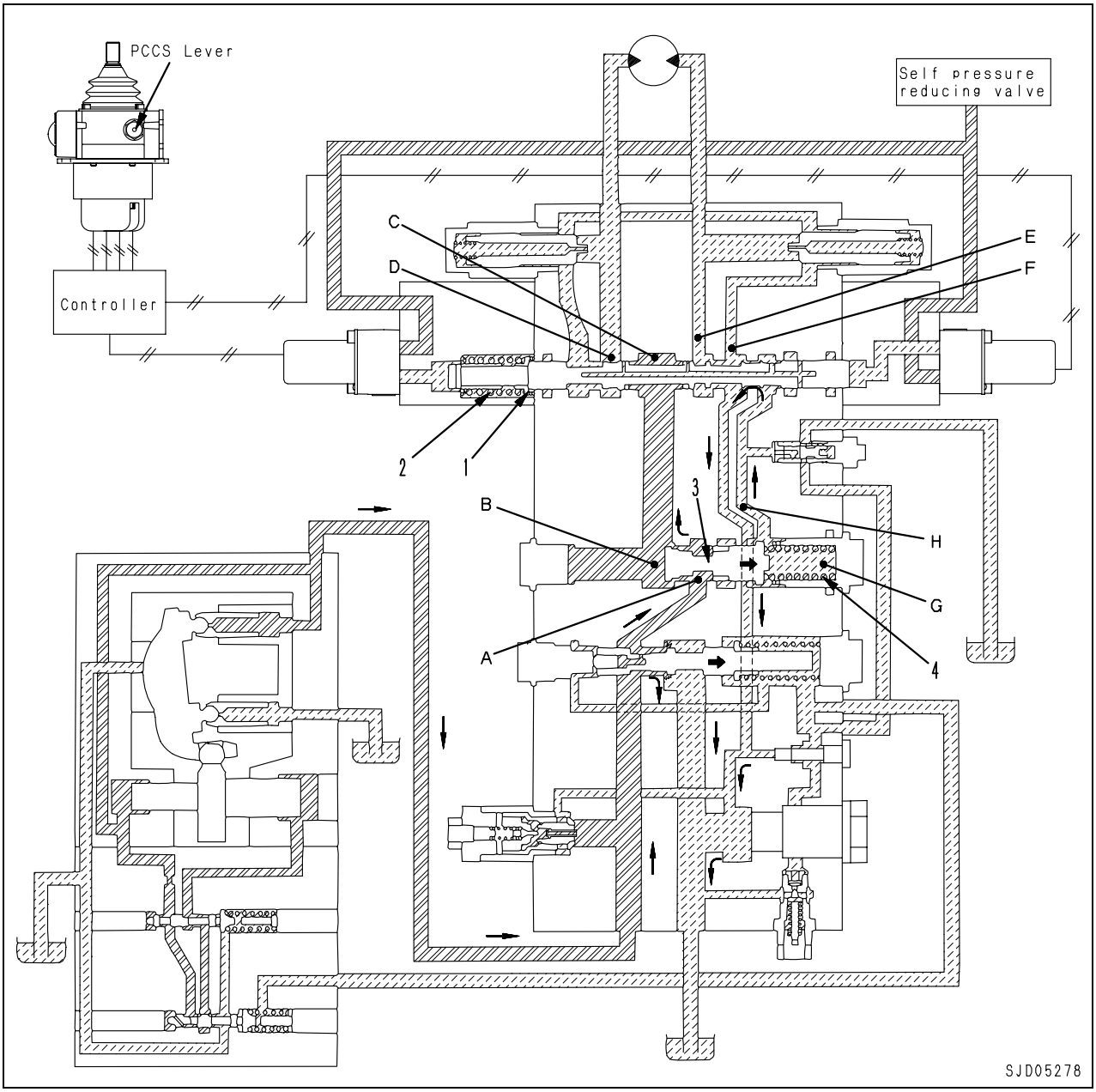
- When the main spool is at the “hold“ position, the pump pressure passes from chamber (A) through throttle (4) to chamber (D). Chambers (C) and (C') are connected to the drain circuit.
- When the oil is supplied from the pump, the pressure in chamber (D) rises, and spool (1) is pushed to the right by pressure which is determined by the cross-sectional area of piston (3) receiving the pressure.
- When the received pressure becomes larger than set load of spring (2), the spool moves to the right and connects the passage between chamber (A) and chamber (B), so the oil from the pump is drained.
- Therefore, spool (1) is balanced at a position that matches the supply of oil from the pump. Actually, the amount of oil supplied from the pump is small, so the pressure in the circuit is almost the same as the set load of spring (2).

Control of oil flow

Function

- Use of the CLSS circuit (Closed center Load Sensing System) makes it possible to control the oil flow by adjusting the area of opening of the spool driven by the EPC valve regardless of the load.

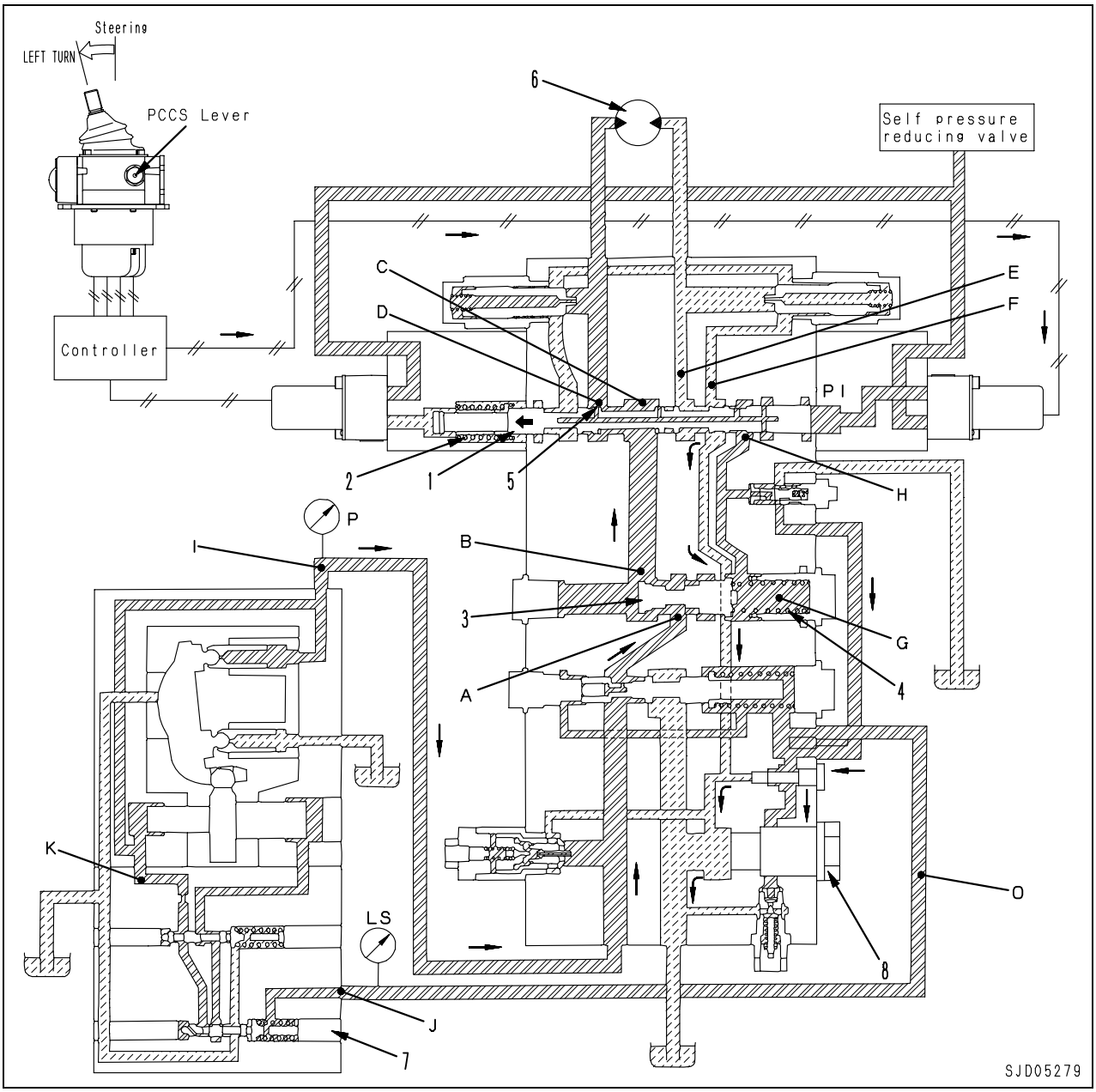
1. Steering valve
   1) At “hold“



Operation

- When the spool is at the “hold“ position, the pump pressure is sent from chamber (A) through the notch in spool (3) of the steering priority valve, and passes through chamber (B) to chamber (C).
- Chamber (G) is drained through chamber (H) to chamber (F). When this happens, the pump pressure is acting on the left end of spool (3) of the steering priority valve, so it pushes against the load of spring (4) and moves to the right to the maximum stroke position.
- In this condition, the area of the opening to spool (1) of the steering valve is at its minimum.

2) When turning to the left

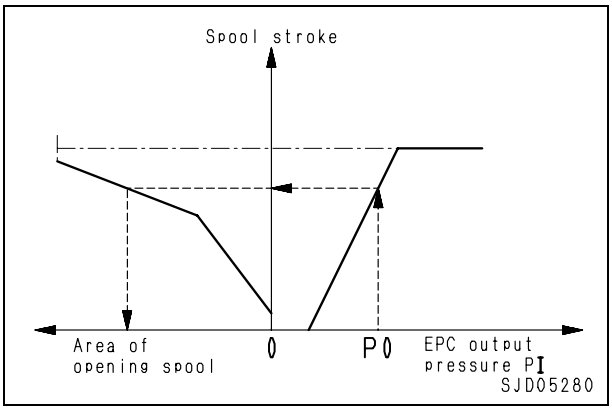


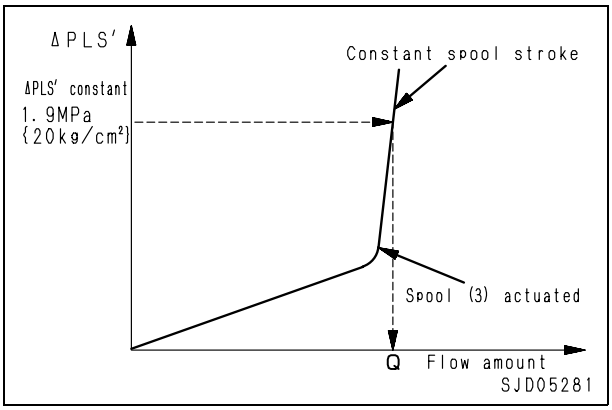
- ΔPLS = Differential pressure between ports (K) and (J) = 2.0 MPa {20 kg/cm^2}
- ΔPLS' = Differential pressure between ports (I) and (D)
- ΔPLS ≒ ΔPLS'

Operation

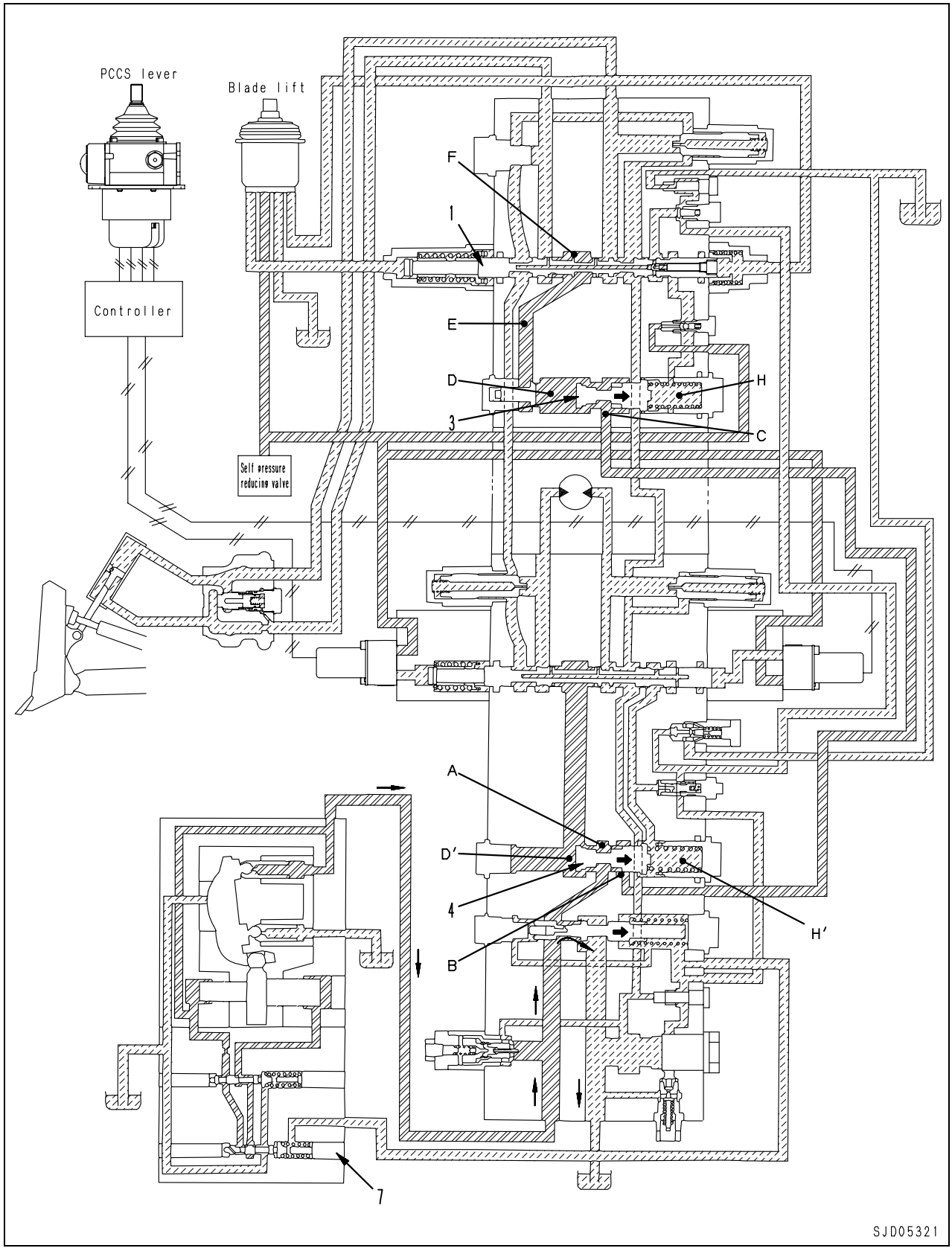
- When the steering lever is operated to turn the machine to the “left”, pilot pressure (PI) acts on the right end of spool (1) through the EPC valve.
- When the pressure becomes greater than the set load of spring (2), spool (1) moves to the left. It becomes balanced at a position that matches pilot pressure (PI).
- Chamber (C) and chamber (D) are connected, and the oil from the pump flows through ports (A), (B), (C) and (D) to HSS motor (6).
- At the same time, the load pressure in chamber (D) passes through LS orifice (5) and chamber (H), and is sent to chamber (G). It is also sent from LS circuit (O) to pump servo valve (7).
- The condition of the pressure of spool (3) is chamber (B) pressure ≒ chamber (C) pressure, and chamber (G) pressure ≒ chamber (D) pressure, so spool (3) is controlled by the differential pressure of spool (1) (chamber (C) pressure – chamber (D) pressure), and balances with spring (4).

- In other words, if the oil flow is too large, the differential pressure of spool (1) becomes larger, so spool (3) moves in the direction to throttle the oil flow.
- On the other hand, if the oil flow is too small, spool (3) moves in the direction to increase the oil flow.
- In addition, pump servo valve (7) is controlled so that the differential pressure between pump pressure (P) and LS pressure (LS) (LS differential pressure: ΔPLS) remains constant, so a suitable amount of oil flows to ensure that the loss of pressure at the control valve (ΔPLS') is equal to (ΔPLS).
- The loss of pressure in the control valve is determined by the area of the opening of the main spool, so the oil flow matches the opening of the spool.
- The return oil flow from HSS motor (6) passes through chamber (E) and chamber (F), and is drained.





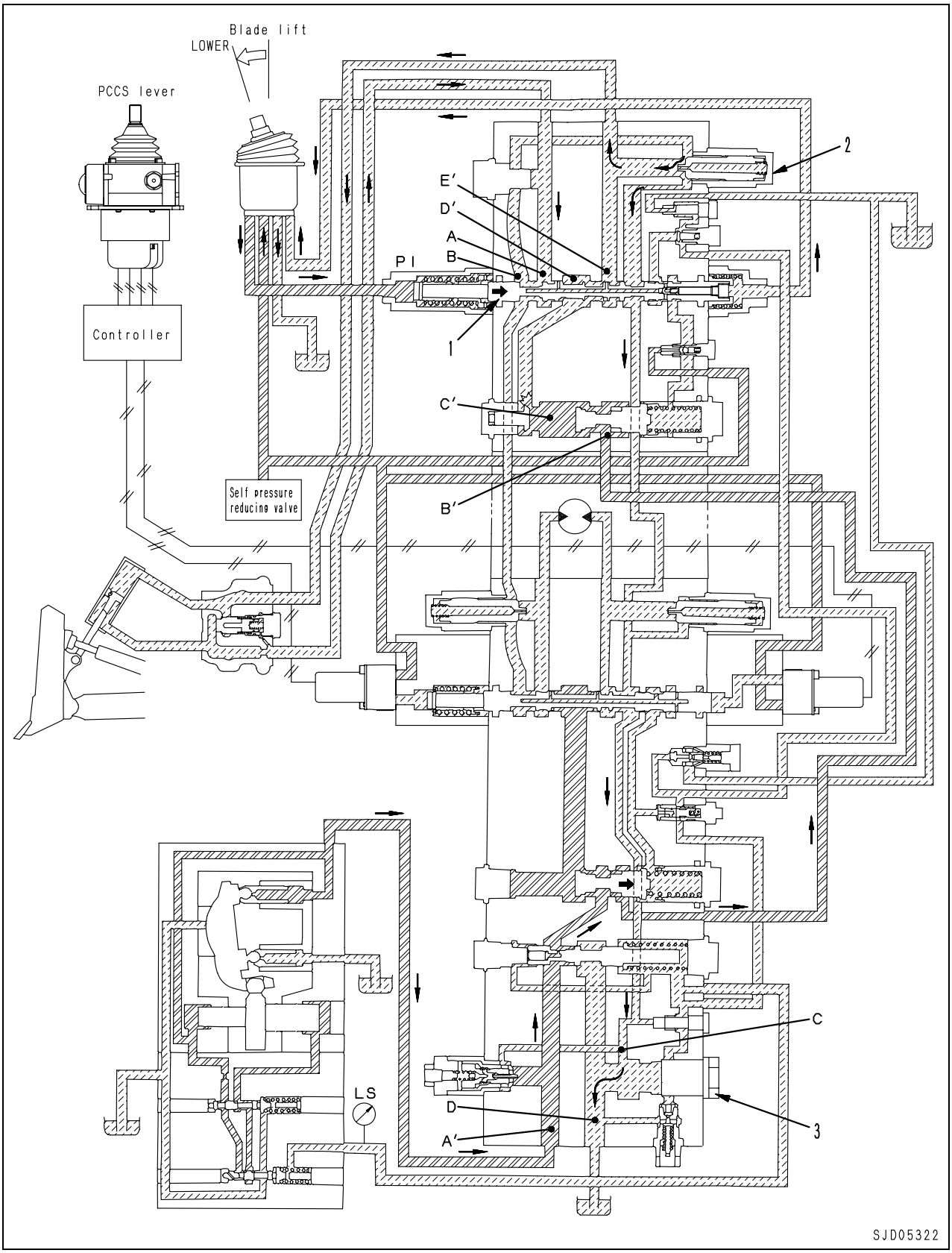
2. Work equipment valve (tilt valve, lift valve, ripper valve)
   ★ The diagram shows the blade lift valve.



Operation

- When spool (1) of the work equipment valve is at the “hold” position, the pump pressure (unload pressure) is sent to chambers (D) and (D').
- The pressure is not formed in chambers (H) and (H'), so pressure compensation valve spool (3) and steering priority valve spool (4) are pushed completely to the right.
- The pump pressure passes through chambers (A) and (B) of steering priority valve (4), and is sent to chamber (C) of the work equipment valve. From here it goes through chambers (D) and (E) to chamber (F).
- In the same way as topic “1. Steering valve”, the position of pressure compensation valve spool (3) is determined to match the opening of work equipment valve spool (1), and the oil flow is determined so that the pressure loss of the control valve becomes equal to the control differential pressure (∆LS) of pump LS valve (7).

3. Meter-out control when blade moves down under its own weight



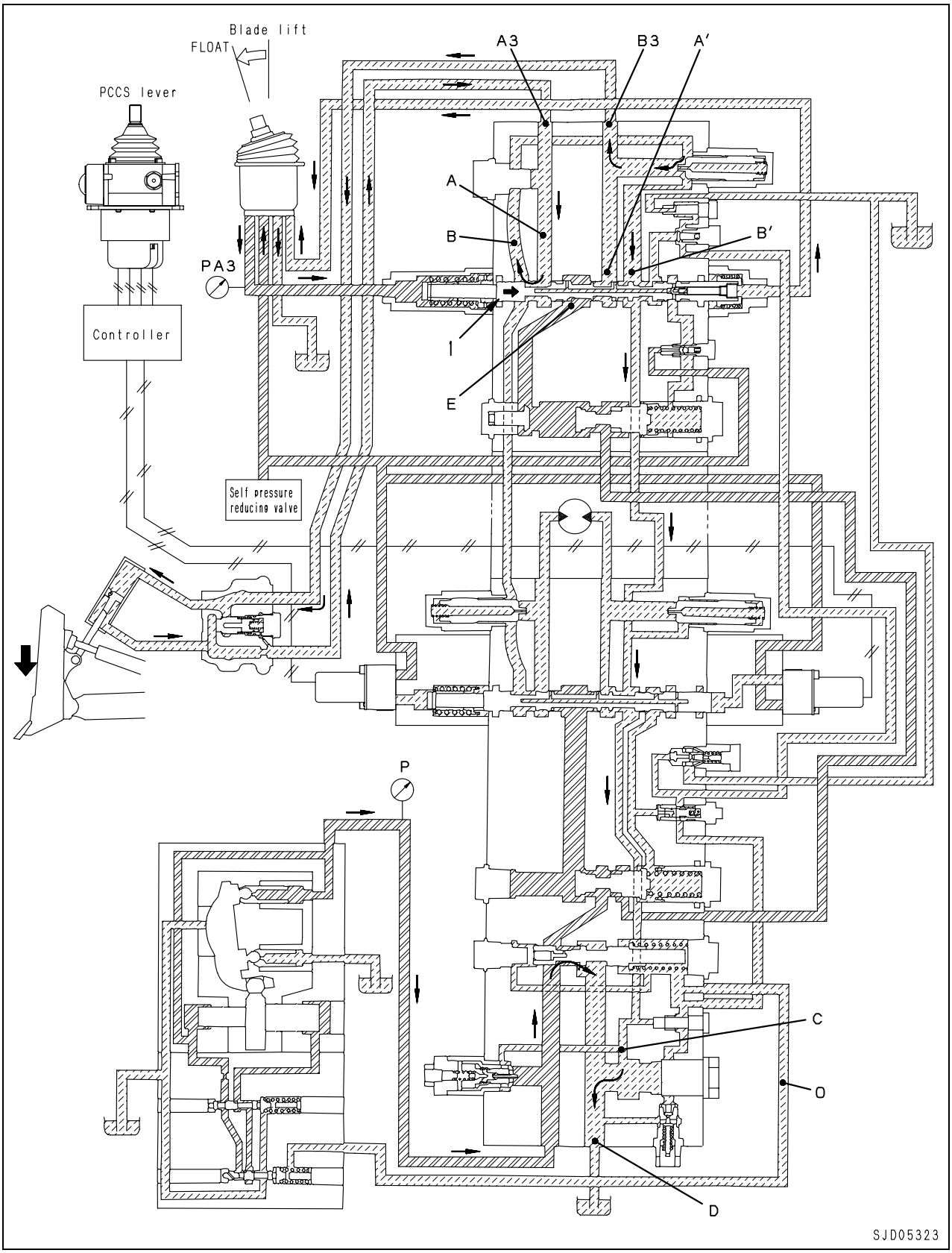
Function

- If the blade moves down under its own weight, the oil flow of return oil from cylinder is controlled by the area of the opening of main spool (1).

Operation

- When the spool port is opened by pilot pressure (PI), because of the weight of the blade, the oil from the cylinder head side passes through ports (A), (B), (C) and (D), and is drained to the tank.
- When this happens, the flow of return oil from the lift cylinder is throttled by the area of opening between ports (A) and (B), so the downward speed is controlled.
- The oil flowing from the cylinder head end passes from the drain circuit through suction valve (2) and is supplied to the bottom end of the cylinder.
- The oil discharged from the pump passes through ports (A'), (B'), (C'), (D') and (E'), and is supplied to the cylinder bottom.

4. Meter-out control when blade moves down under its own weight (work equipment lever at “float“)



Function

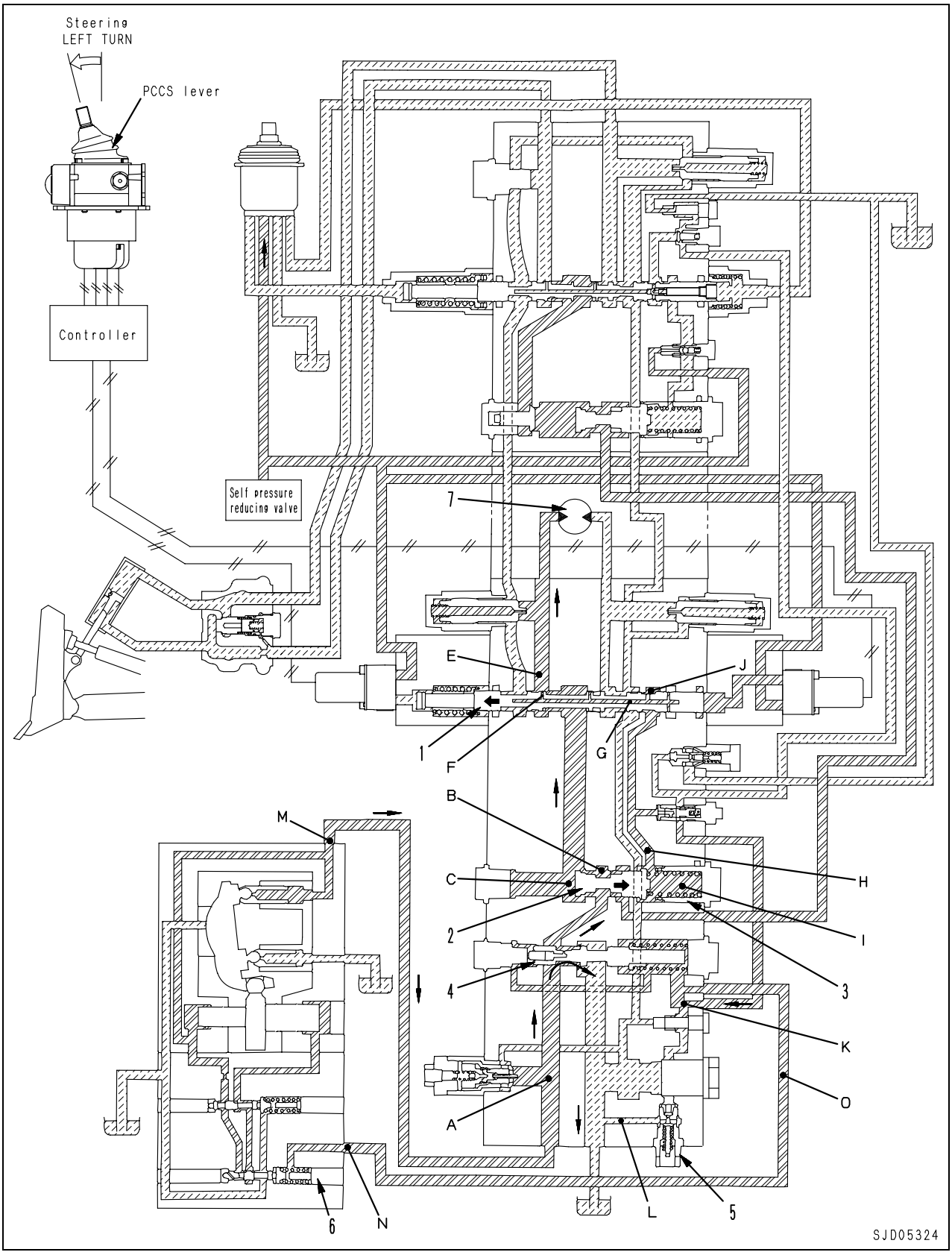
- When the lift valve is at “float“, the cylinder port and drain port are connected to put the circuit in a no-load condition.
- When the lift valve is in the “float“ condition, the pump passage and cylinder ports (A3) and (B3) are separated so that the other control valves can be operated.

Operation

- When the work equipment control lever is at the “float” position, if pressure (PA3) becomes 3.4 MPa {35 kg/cm^2} or more, lift spool (1) is moved to the maximum stroke position.
- In this condition, ports (A3), (B3) and LS passage (O) are all connected to the drain circuit, so there is no load on the lift cylinder.
- If the cylinder is driven by the weight of the blade, the oil entering from port (A3) flows to ports (A), (B), (B') and (A'), while the rest of the pressurized oil flows through ports (C) and (D), and is drained.
- When this happens, the oil flow is throttled by the area of opening between ports (A) and (B) of spool (1), and the cylinder speed is controlled.
- The pump circuit chamber (E) and ports (A3) and (B3) are separated, and pump pressure (P) is formed, so it is possible to carry out compound operations with other control valves.

At relief

1. Steering valve
   ★ The diagram shows the condition at relief for steering LS relief valve (5).



- ΔP1 = ΔP3 + ΔP4 = Differential pressure between ports (M) and (E)
- ΔP2 = Differential pressure between ports (E) and (N)
- ΔP3 = Differential pressure between ports (M) and (B)
- ΔP4 = Differential pressure between ports (B) and (E)
- ΔLS = ΔP1 + ΔP2 = Differential pressure between ports (M) and (N) = 2.0 MPa {20 kg/cm^2}

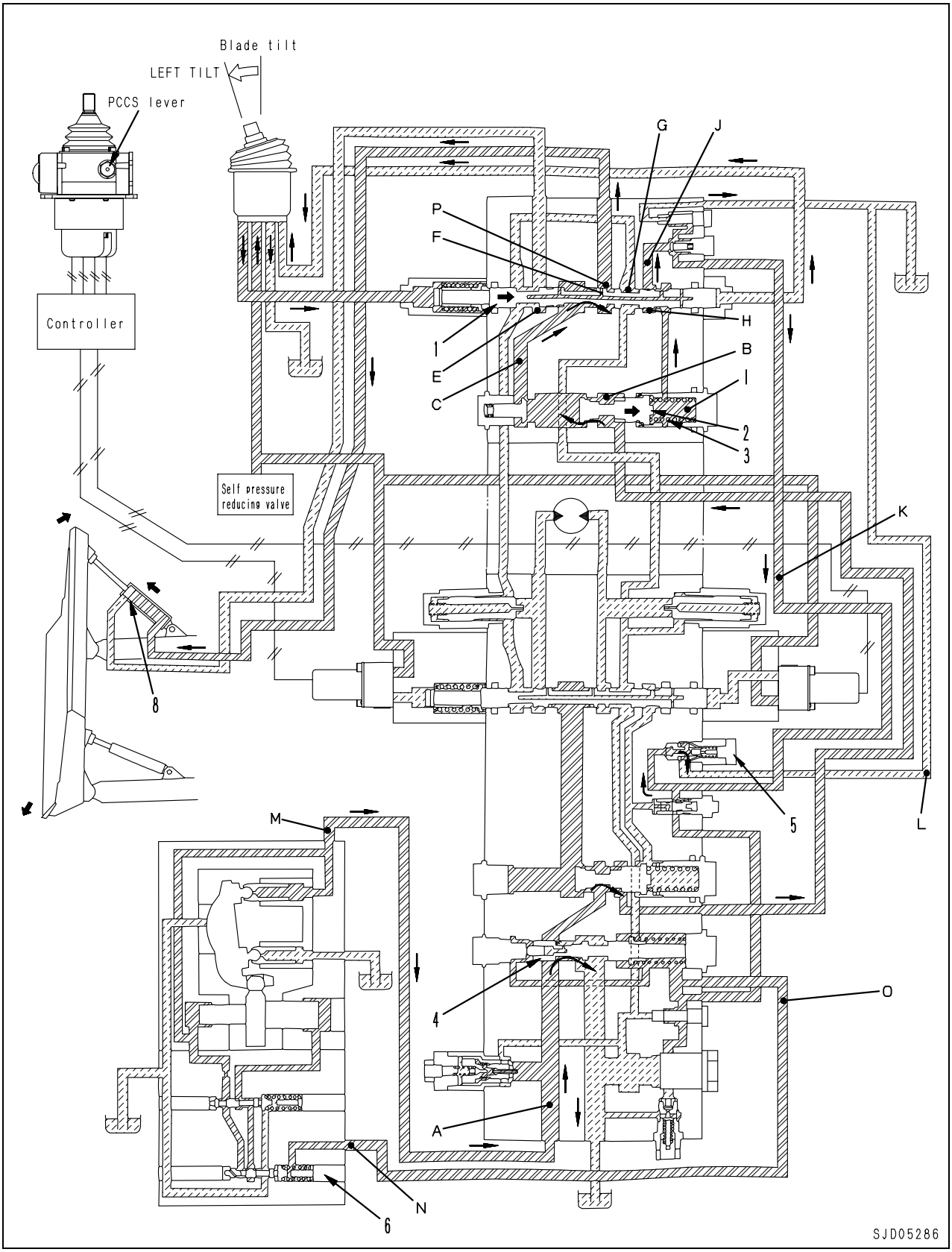
Function

- It sets the maximum pressure when the HSS motor is operated.

Operation

- If steering spool (1) is moved and the pressure of HSS motor (7) becomes higher, the poppet of steering LS relief valve (5) will start to open and oil will be drained from LS circuit (O). [Ports (E), (F), (G), (J), (K) and (L)]
- As a result, there will be a drop in pressure in LS passage (O) starting from LS sensing hole (F) and (ΔP2) will become larger.
- For the same reason, if the pressure in chambers (H) and (I) drops, spool (2) will push against spring (3) and move to the right, and will make the opening between chambers (B) and (C) smaller, so the flow to chambers (B) and (C) will be throttled and (ΔP4) will become larger.
- Because of the pump swash plate control, the system circuit is balanced at a circuit pressure which makes the pressure loss generated by the flow at steering LS relief valve (5). (ΔP1) + (ΔP2) equal to LS differential pressure (ΔLS).
- When this happens, pump LS valve (6) detects the differential pressure generated by steering LS relief valve (5), and moves the pump swash plate from the maximum to the minimum position. The pump swash plate is balanced at a position where the LS differential pressure is 2.0 MPa {20 kg/cm^2}.
- When the pump is at the minimum swash plate angle (minimum oil flow), if the minimum oil flow is greater than the [LS relief oil flow + leakage at any part], the pressure is confined in the pump circuit (between the pump and chambers (A) and (B)), so the LS differential pressure rises.
- If this differential pressure goes above the set pressure for unload valve (4), the unload valve is actuated to relieve the excess oil flow and balance the circuit.

2. Blade lift, tilt and ripper valve
   ★ The diagram shows the relief condition of work equipment LS relief valve (5) with the blade tilt at the end of its stroke.

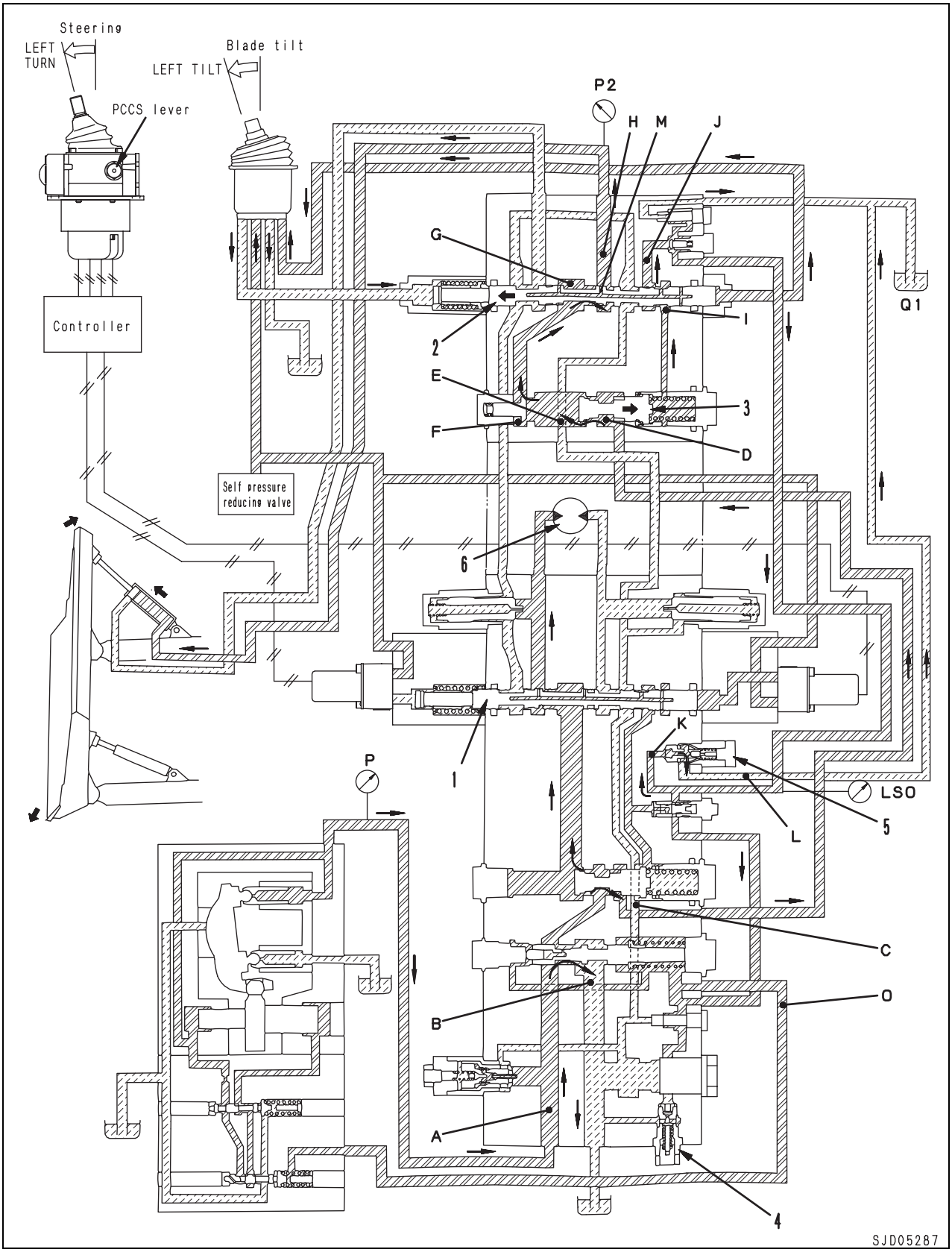


- ΔP1 = ΔP3 + ΔP4 = Differential pressure between ports (M) and (P)
- ΔP2 = Differential pressure between ports (P) and (N)
- ΔP3 = Differential pressure between ports (M) and (B)
- ΔP4 = Differential pressure between ports (B) and (P)
- ΔLS = ΔP1 + ΔP2 = Differential pressure between ports (M) and (N) = 2.0 MPa {20 kg/cm^2}

Operation

- If blade tilt spool (1) is moved and the pressure of tilt cylinder (8) becomes higher, the poppet of work equipment LS relief valve (5) will start to open and oil will be drained from LS circuit (O). [Ports (E), (F), (G), (J), (K) and (L)]
- As a result, there will be a drop in pressure in LS passage (O) starting from LS sensing hole (F), and (ΔP2) will become larger.
- For the same reason, if the pressure in chambers (H) and (I) drops, spool (2) will push against spring (3) and move to the right, and will make the opening between chambers (B) and (C) smaller, so the flow to chambers (B) and (C) will be throttled and (ΔP4) will become larger.
- Because of the pump swash plate control, the system circuit is balanced at a circuit pressure which makes the pressure loss generated by the flow at work equipment LS relief valve (5). (ΔP1) + (ΔP2) equal to LS differential pressure (ΔLS).
- When this happens, pump LS valve (6) detects the differential pressure generated by work equipment LS relief valve (5), and moves the pump swash plate from the maximum to the minimum position. The pump swash plate is balanced at a position where the LS differential pressure is 2.0 MPa {20 kg/cm^2}.
- When the pump is at the minimum swash plate angle (minimum oil flow), if the minimum oil flow is greater than the [LS relief oil flow + leakage at any part], the pressure is confined in the pump circuit (between the pump and chambers (A) and (B)), so the LS differential pressure rises.
- If this differential pressure goes above the set pressure for unload valve (4), the unload valve is actuated to relieve the excess oil flow and balance the circuit.

3. Compound operation of work equipment valve
   ★ The diagram shows the relief condition of LS relief valves (4) and (5) at steering stall with the blade tilt at the end of its stroke.



- Δ = P – P2
- ΔPO = Differential pressure between ports (H) and (K)
- Pressure P2 = LSO + ΔPO

Function

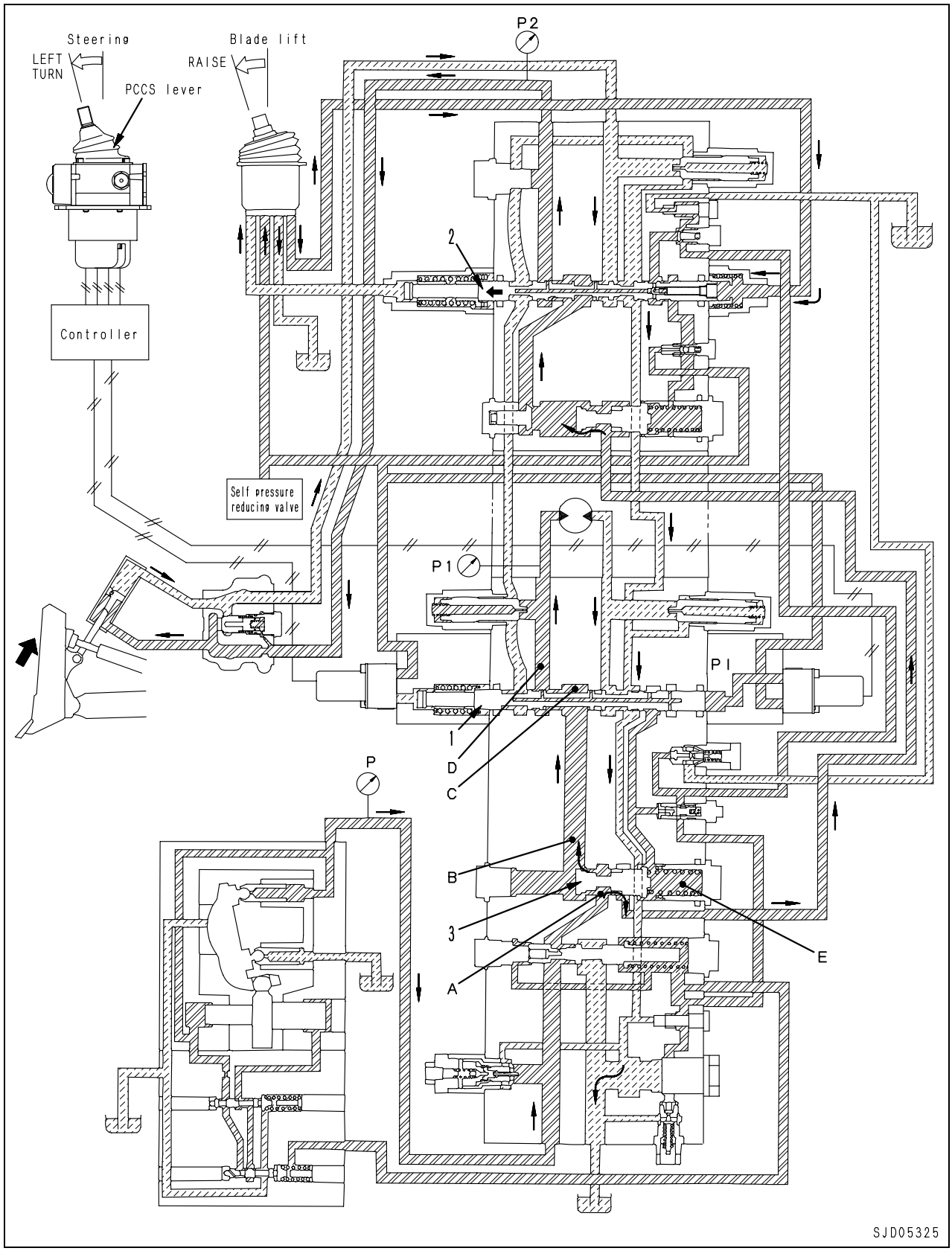
- When steering valve (1) and work equipment valve (2) are relieved at the same time, the pump pressure is separated by pressure compensation valve (3) in the work equipment valve, and the port pressure is maintained at a constant value.

Operation

- If HSS motor (6) reaches the stall condition, the load pressure increases and LS relief valve (4) for the steering valve is actuated, so the system is cut off.
- For details, see topic “1. Steering valve“.
- When this happens, the pump pressure is maintained at 38.2 MPa {390 kg/cm^2}, and this is sent to chamber (G) of the work equipment valve.
- When work equipment valve (2) is operated and the load on the work equipment valve is greater, work equipment LS relief valve (5) is actuated, and drain oil flow (Q1) flows to LS circuit (O).
- As a result, a differential pressure is generated on the left and right sides of pressure compensation valve (3) by LS throttle (M) of spool (2), and it moves the full stroke to the right.
- When this happens, the opening between chambers (D) and (E) is throttled to the minimum size (pump pressure separated).
- Oil flow (Q1) is determined by pump pressure (P) and the total pressure loss Δ (P – LSO) of ports (C), (D), (E), (F), (G), (I), (J) and (K).
- Furthermore, pressure (P2) (the pressure in chamber (H)) becomes the total (LSO + ΔPO) of the circuit pressure loss of ports (H), (I), (J) and (K), and the set pressure of work equipment LS relief valve (5).

Compound operations

1. Steering + work equipment valve
   ★ The diagram shows the condition when the steering and blade lift valve are operated at the same time.

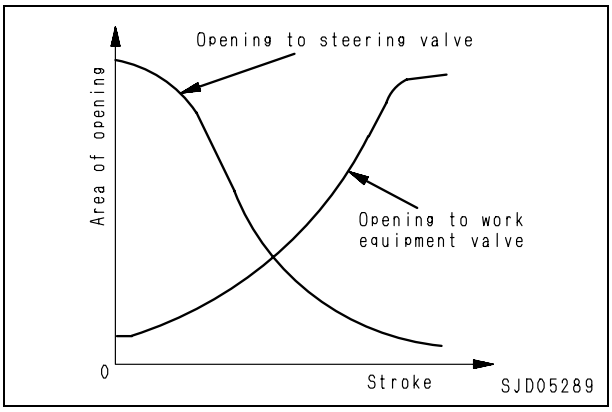


Function

- The steering valve is equipped with steering priority valve (3), so if the steering valve and the downstream work equipment valve are operated at the same time, priority is given to the flow of oil to the steering valve, and the rest of the oil discharged from the pump goes to the work equipment valve.

Operation

- When steering spool (1) is operated by pilot pressure (P1) and the oil flows, a differential pressure is created between chambers (C) and (D).
- Steering priority valve (3) is controlled by this differential pressure, and at the same time, the pump swash plate angle is controlled at (ΔPLS) = 2.0 MPa {20 kg/cm^2}, and the flow of oil to the steering valve is fixed.
- For details, see topic "1. Steering valve" of "Control of oil flow."
- In this condition, if downstream work equipment lift spool (2) is operated, the pump pressure momentarily drops.
- At this point, the differential pressure between chambers (C) and (D) becomes smaller, and steering priority valve (3) is moved to the left by the pressure in chamber (E) in the direction to throttle the opening to the work equipment valve.
- At the same time, (ΔPLS) becomes smaller, so the pump swash plate angle moves in the maximum direction to supply an oil flow to make up the amount that the pressures drop.



When pump swash plate does not reach maximum angle

- When the maximum oil flow from the pump is greater than the sum of the flow demanded by the steering valve and work equipment valve, an amount of oil that matches the opening of steering spool (1) flows to the steering valve.
- An amount of oil decided by the pump pressure, the load pressure and the area of the spool opening flows to the work equipment valve.

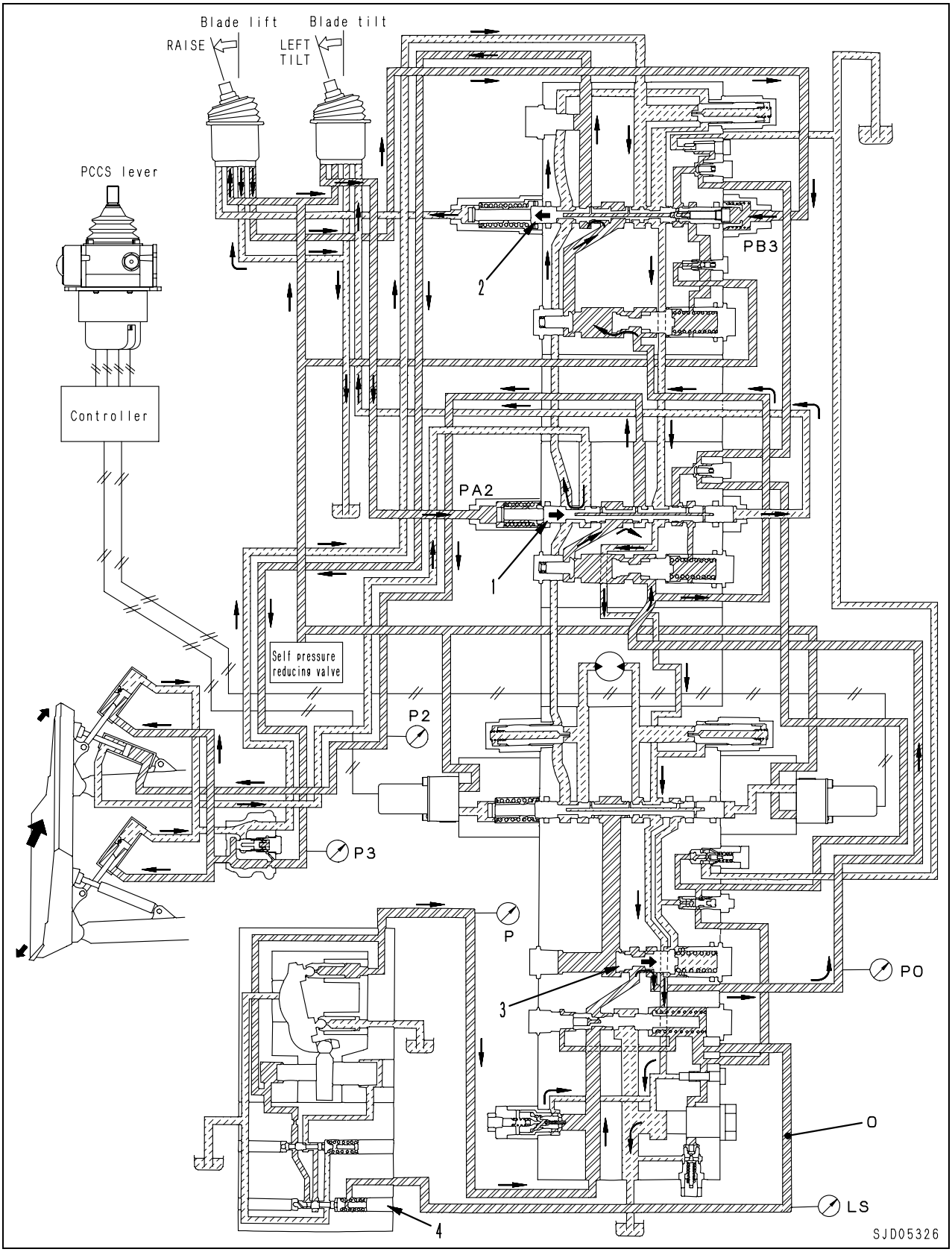
When pump swash plate is at maximum angle

- When the maximum flow of oil from the pump is smaller than the sum of the oil flow demanded by the steering valve and work equipment valve.

1) When steering valve load ≦ work equipment valve load.
- An amount of oil that matches the opening of steering spool (1) flows to the steering valve, and the remaining oil flows to work equipment valve.

2) When steering valve load > work equipment valve load.
- Pump pressure (P) is determined by the steering valve load, but in this condition, if the downstream work equipment valve where the load is smaller is operated, the difference in pressure will cause the oil to try to flow to the work equipment valve, so the pump pressure will drop.
- When this happens, steering priority valve (3) increases the size of the opening to the steering system, while at the same time reducing the size of the opening to the work equipment in order to ensure the flow of oil to the steering system.
- In this condition, the flow of oil is divided in proportion to the difference in pressure between differential pressure (P) – (P1) and differential pressure (P) – (P2).
- The bigger (P1) – (P2) is, the smaller the flow of oil to the steering system becomes.

2. Compound operation of work equipment valve
   ★ The diagram shows the condition when the blade lift and tilt valves are operated at the same time.



Function

- It consists of a parallel circuit, so when compound operations are carried out, the oil flow is divided according to the size of each spool opening.

Operation

- When tilt spool (1) and lift spool (2) are at the “hold“ position or are “operated“, steering priority valve (3) is pushed completely to the right, and the size of the opening to the downstream area is at its maximum.
- Tilt spool (1) and lift spool (2) are actuated by PPC valve output pressure (PA2) and (PB3), and each is balanced at a position that matches its own pilot pressure.

When pressure (P2) ≦ (P3)

- Lift valve load pressure (P3) is sent to pump LS valve (4) through LS passage (O).

1) When pump swash plate does not reach maximum angle

- When the maximum flow of oil from the pump is greater than the total of the oil flow demanded by the tilt valve and lift valve, an oil flow that matches the opening of the spool flows to both the tilt valve and lift valve.

2) When pump swash plate is at maximum angle

- When the maximum flow of oil from the pump is smaller than the total of the oil flow demanded by the tilt valve and lift valve, the flow of oil to the tilt valve and lift valve is divided according to differential pressure (PO) – (P2) and differential pressure (PO) – (P3).
- In other words, more oil flows to (P2) where the load is small.

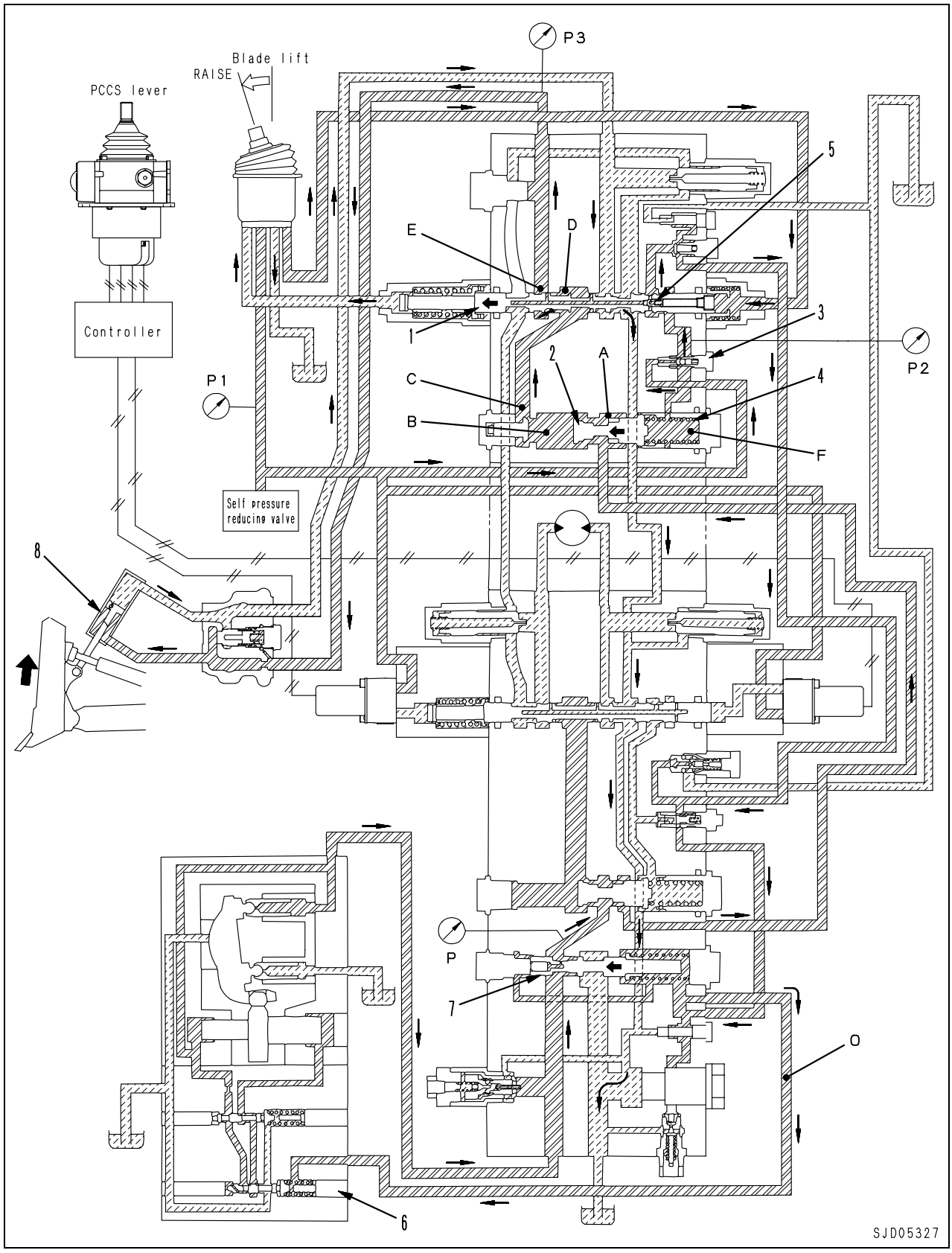
★ In cases where the blade is raised above ground and the tilt valve and lift valve for “raise“ are operated at the same time, the tilt valve load pressure is smaller than the lift valve load pressure, so the flow of oil to the tilt valve is given priority. In addition, the oil flow demanded by the tilt valve is smaller, so the condition is just as if priority was given to the oil flow for the tilt valve.

When pressure (P2) = (P3)

- (P) – (P2) ≒ (P) – (P3), so an oil flow proportional to the size of the spool opening is distributed to each spool.

Unload valve preset system

★ The diagram shows the condition with preset check valve (3) open immediately after blade lift valve is operated.



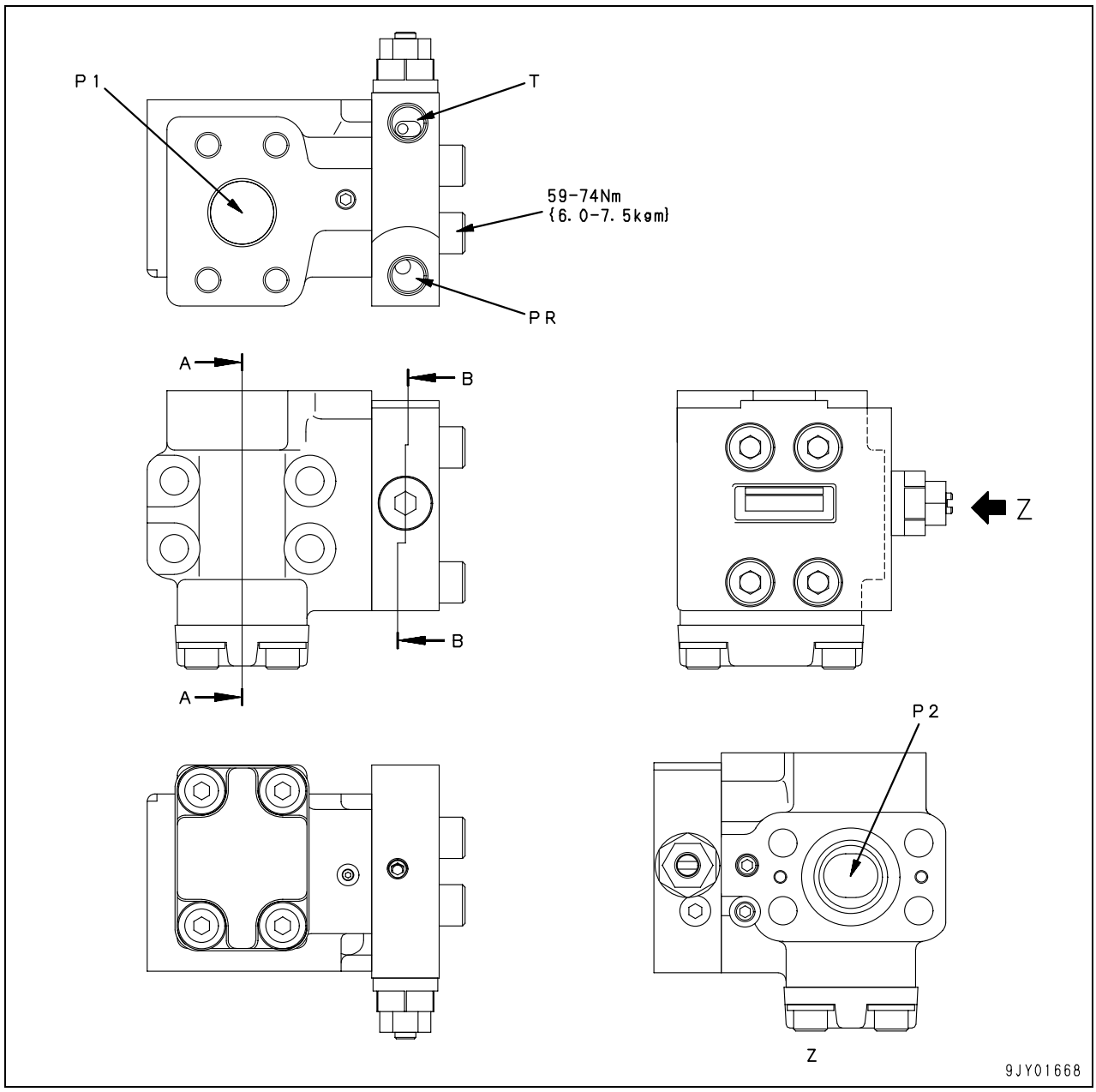
Function

- This improves the response of the system including the pump swash plate and pressure compensation valve by sending the pilot pressure (basic pressure of PPC valve) to the LS circuit, and compensating the rise of the LS circuit pressure.

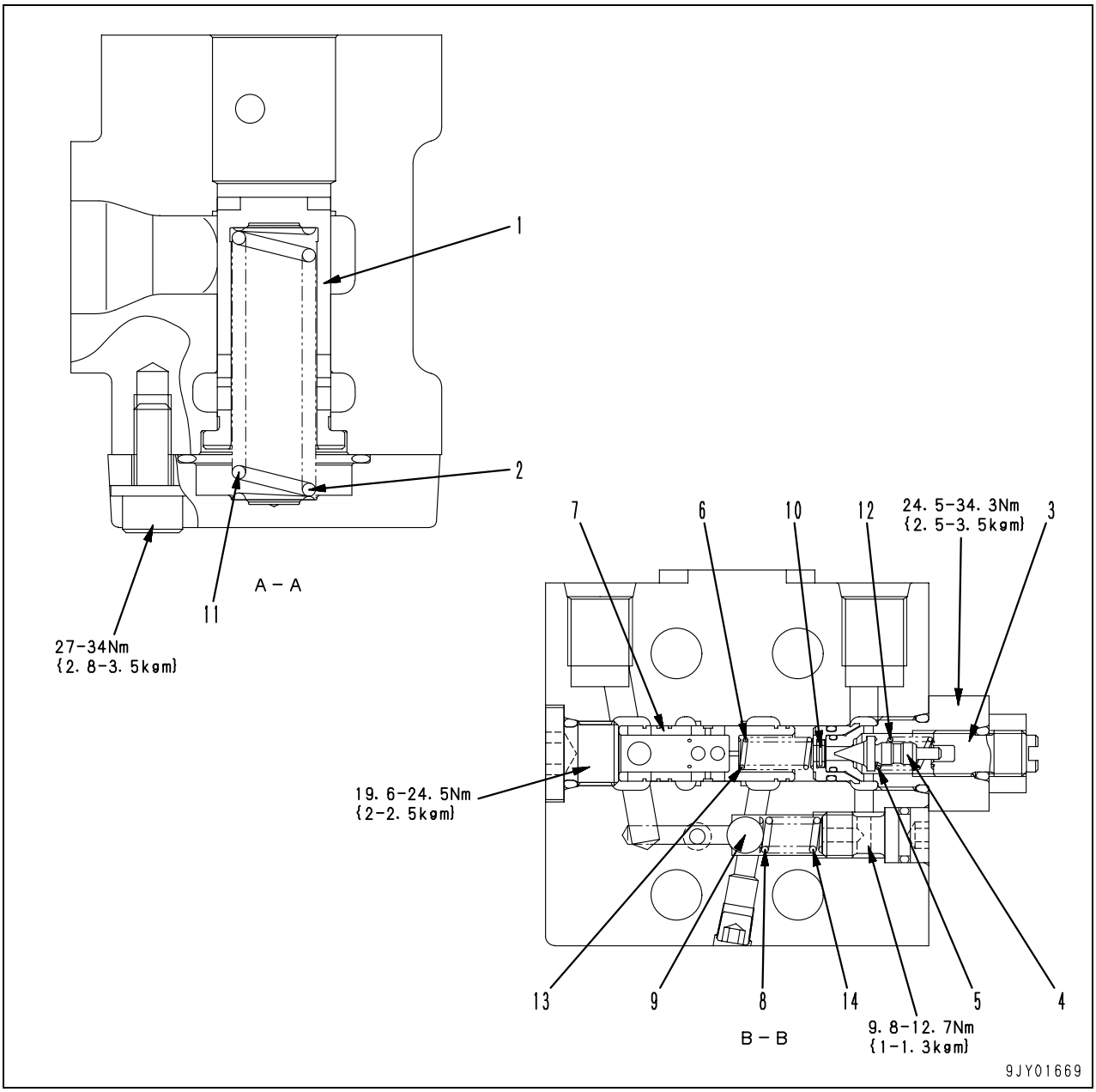
Operation

- When lift valve spool (1) is at the “hold“ position, pilot pressure (P1) (basic pressure of PPC valve) is sent through preset check valve (3) to chamber (F) of the pressure compensation valve. This pressure is called preset pressure (P2).
- At the same time, unload pressure (P) is being sent to chamber (B), but (P1) + (F0) > (P) (F0: load of spring (4)), so pressure compensation spool (2) moves to the left and the size of the opening between chambers (A) and (B) becomes the maximum.
- When spool (1) is switched, unload pressure (P) flows immediately through chambers (A), (B), (C), (D) and (E) to lift cylinder (8), so the pressure at the port starts to rise and the time lag becomes smaller.
- At the same time, preset pressure (P2) is supplied to LS circuit (O) by the timing of the spool, and the pressure in the LS circuit rises.
- Because of this, unload valve (7) closes, and oil is sent further to pump LS valve (6) to improve the response of the pump swash plate angle. This makes it possible to reduce the response time for giving the necessary oil flow.
- Check valve (5) is installed in the spool so that preset pressure (P2) will not be applied to the cylinder port.
- If cylinder port pressure (P3) rises higher than preset pressure (P2), the oil pushes up check valve (5) and flows through chamber (F) of the pressure compensation valve to pump LS valve (6), and then the normal (ΔPLS) control starts.
- At this time, check valve (3) prevents cylinder port pressure (P3) from entering the pilot pressure circuit.

Self pressure reducing valve



T: To tank
P1: From pump
P2: To fan motor
PR: Supply to PPC valve and EPC valve



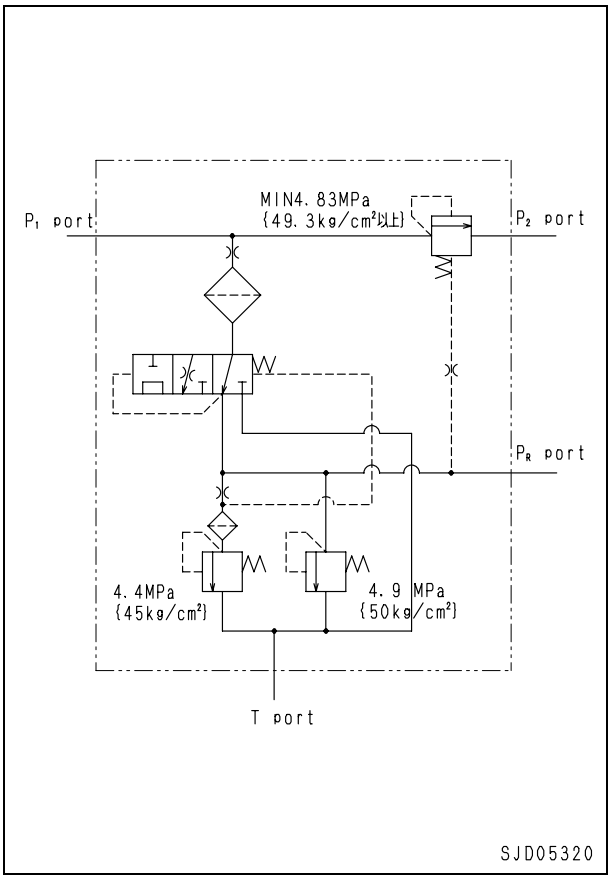
1. Valve (sequence valve)
2. Spring
3. Screw
4. Poppet
5. Spring (pressure reducing valve pilot)
6. Spring (pressure reducing valve main)
7. Valve (pressure reducing valve)
8. Spring (safty valve)
9. Ball
10. Filter

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
11	Spring (pressure reducing valve main)	Free length × outer diameter	Installation length	Installation load	Free length	Installation load	Replace spring if damaged or deformed.
		19.2 × 7.20	16.1	19.6 N {2.0 kg}	—	17.7 N {1.80 kg}	
12	Spring (pressure reducing valve pilot)	17.8 × 7.20	12.1	31.4 N {3.2 kg}	—	28.4 N {2.9 kg}	
13	Spring	71.0 × 18.0	59.0	200 N {20.4 kg}	—	186 N {19.0 kg}	
14	Spring (safety valve)	16.1 × 7.80	13.4	61.7 N {6.30 kg}	—	58.8 N {6.0 kg}	

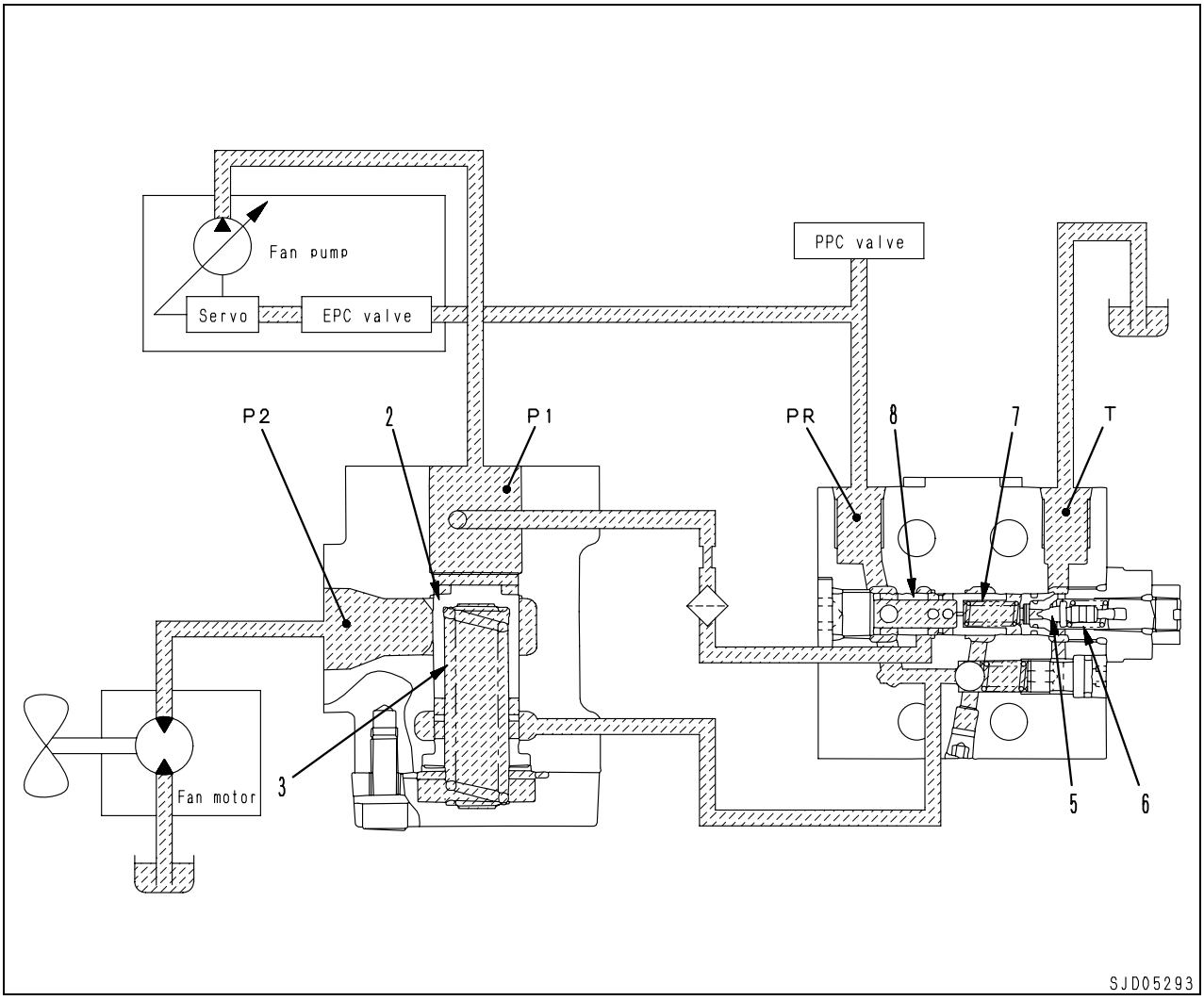
Function

- The self pressure reducing valves reduce the discharge pressure of the fan pump and supplies it to the PPC valve, EPC valve, etc. as the control pressure.



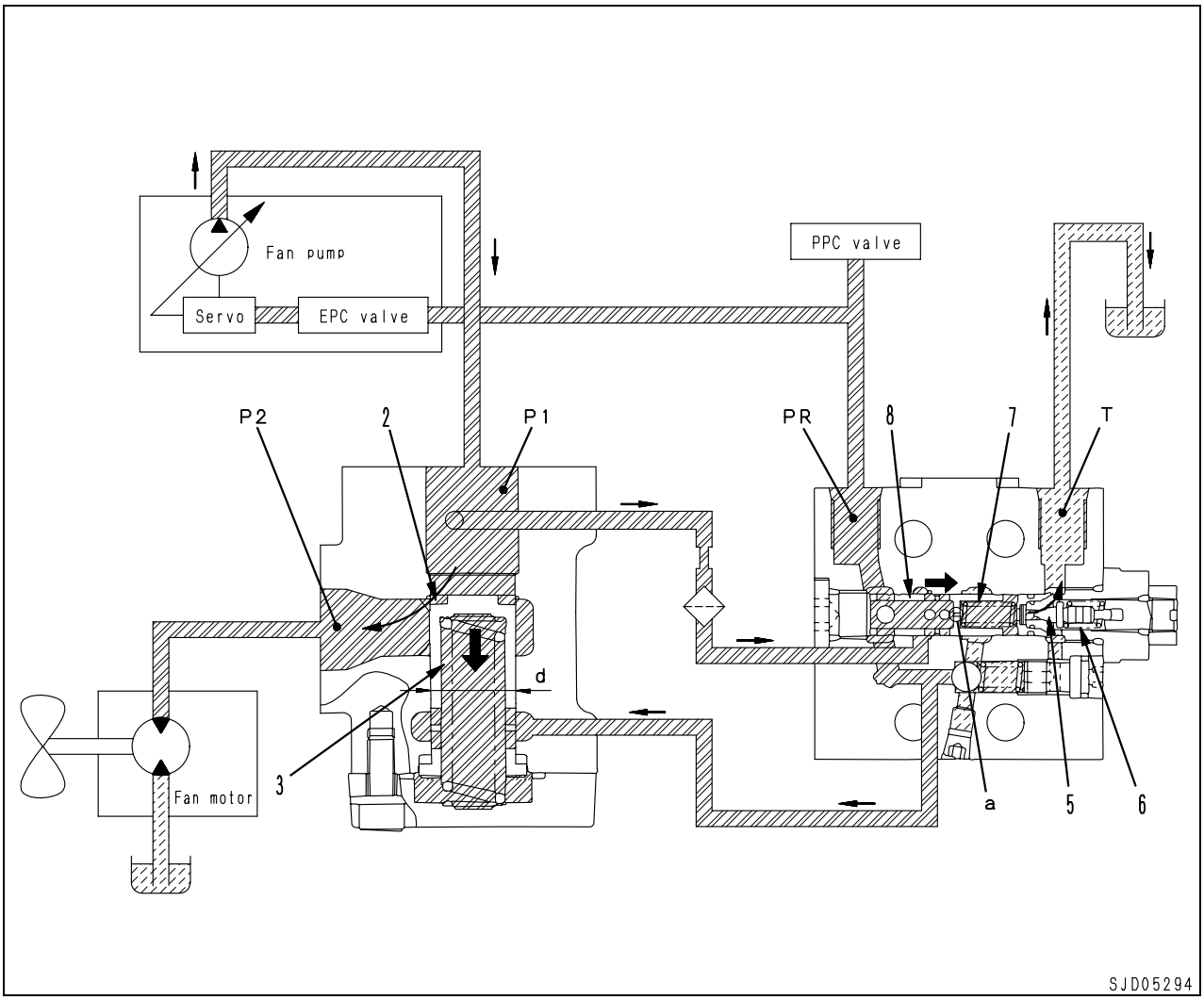
Operation

At engine stop (total low pressure)



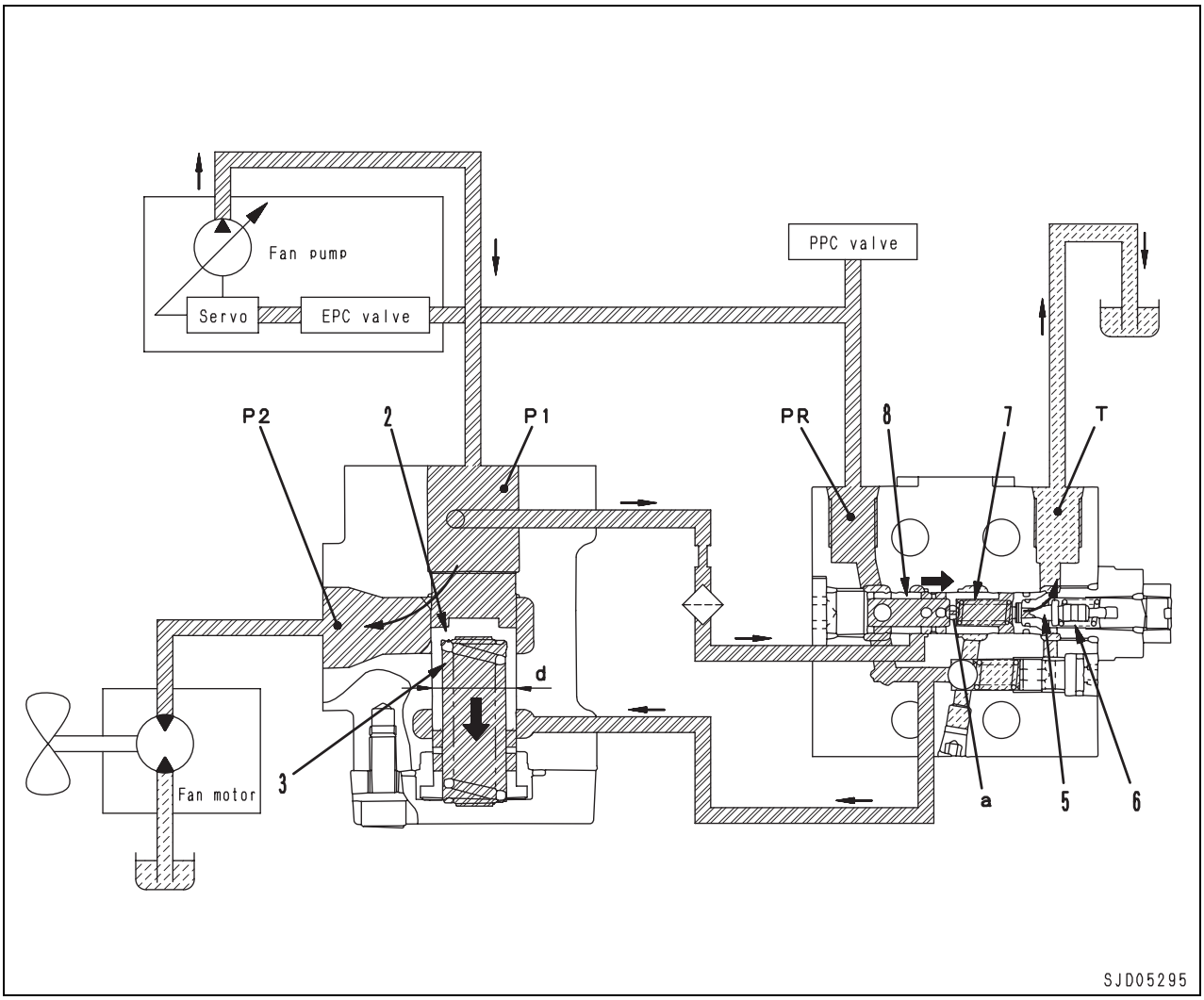
- Spring (6) pushes poppet (5) to the seat, and the circuit between ports (PR) and (T) is closed.
- Spring (7) pushes valve (8) to the left side, and the circuit between ports (P1) and (PR) is open.
- Spring (3) pushes valve (2) to the upper side, and the circuit between ports (P1) and (P2) is closed.

When load pressure (P2) is lower than output pressure (PR) of the self pressure reducing valve



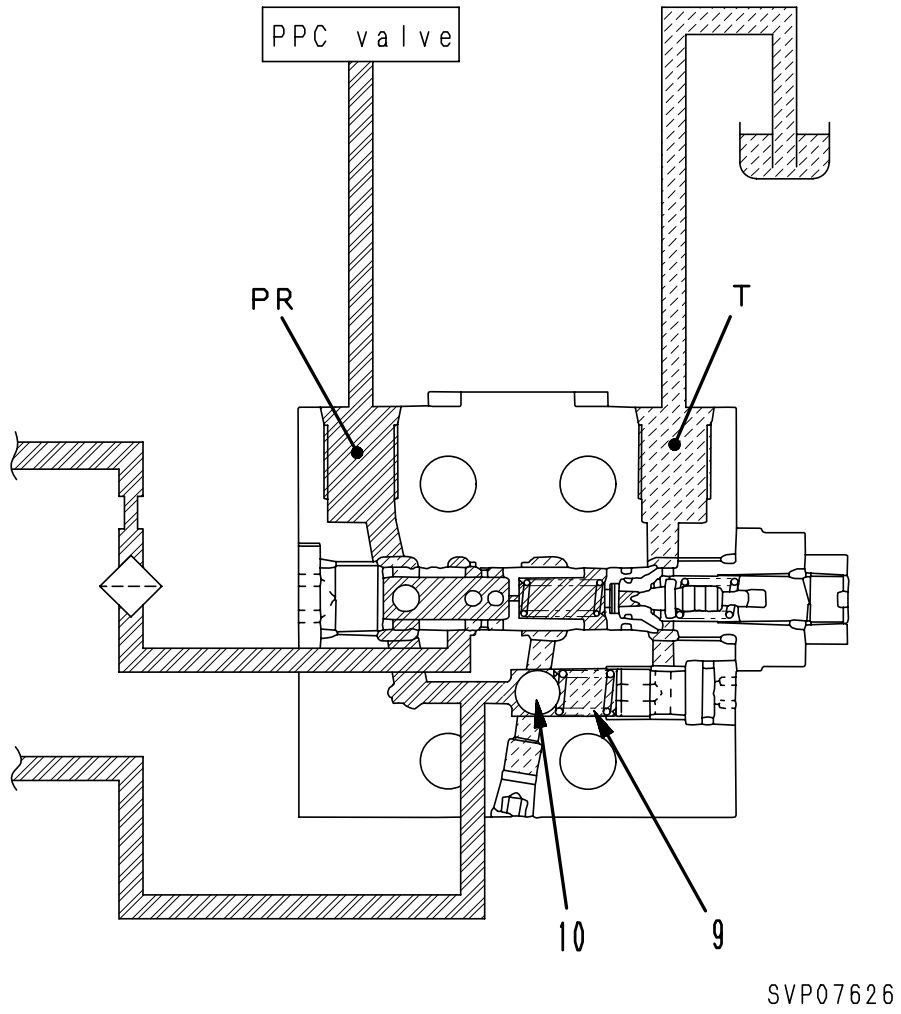
- Spring (3) and pressure (PR) [0 MPa {0kg/cm^2}] at the time of engine stop] push valve (2) in the direction to close the circuit between ports (P1) and (P2). When the hydraulic oil enters port (P1), the expression [pressure (P1) ≒ Spring (3) force + (area (d) × pressure (PR))] holds, and the self pressure reducing valve will adjust the openings of ports (P1) and (P2) so that pressure (P1) can be maintained higher than pressure (PR).
- When pressure (PR) rises above set pressure, poppet (5) opens and hydraulic oil flows through the route, from port (PR), through hole (a) in spool (8), through poppet (5) opening to tank port (T).
- Therefore, differential pressure occurs around hole (a) in spool (8) and spool (8) moves from port (P1) in the direction to close opening (PR). Then pressure (P1) is reduced and adjusted to a certain pressure [set pressure] with the opening and is supplied as pressure (PR).

At raise of load pressure (P2)



- When load pressure (P2) rises due to digging or other operations, pump delivery increases and pressure (P1) rises. Then the expression [pressure (P1) > Spring (3) force + (area (d) × pressure (PR))] will hold, and valve (2) will move to the below side till the stroke end. As a result, the opening between ports (P1) and (P2) increases and passage resistance becomes smaller, reducing engine horsepower loss.
- When pressure (PR) rises above set pressure, poppet (5) opens and hydraulic oil flows through the route, from port (PR), through hole (a) in spool (8), through poppet (5) opening to the tank port (T).
- Therefore, differential pressure occurs around hole (a) in spool (8) and spool (8) moves from port (P1) in the direction to close opening (PR). Then pressure (P1) is reduced and adjusted to a certain pressure [set pressure] with the opening and is supplied as pressure (PR).

In the case of abnormal high pressure



- When pressure (PR) of the self pressure reducing valve rises abnormally high, ball (10) will separate from the seat against spring (9) force to flow the hydraulic oil to output ports (PR) → (T) so as to reduce pressure (PR). As a result, the equipment [PPC valve, EPC valve, etc.], to which the oil pressure is supplied, is protected from the abnormal high pressure.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00286-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

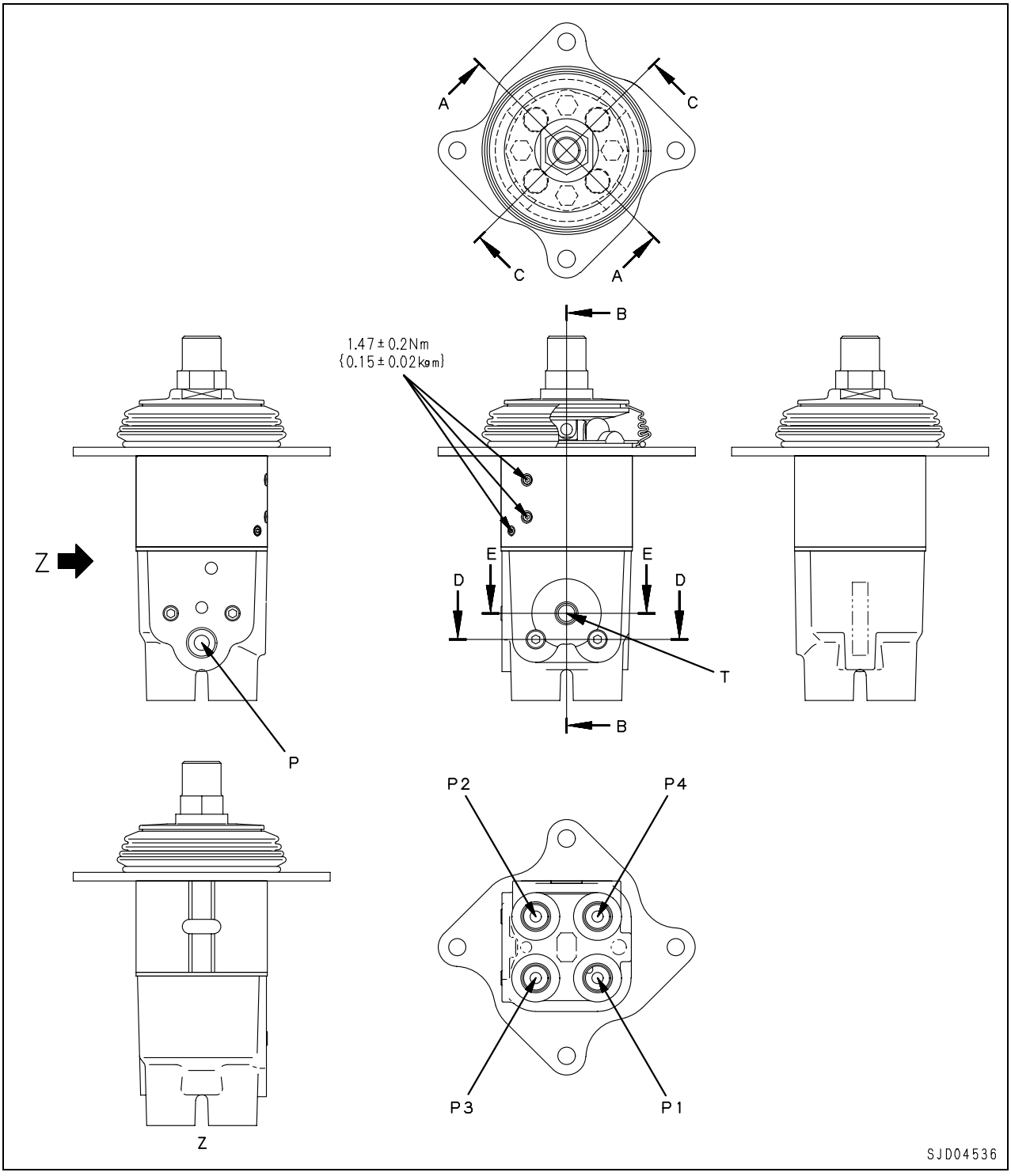
10 Structure, function and maintenance standard

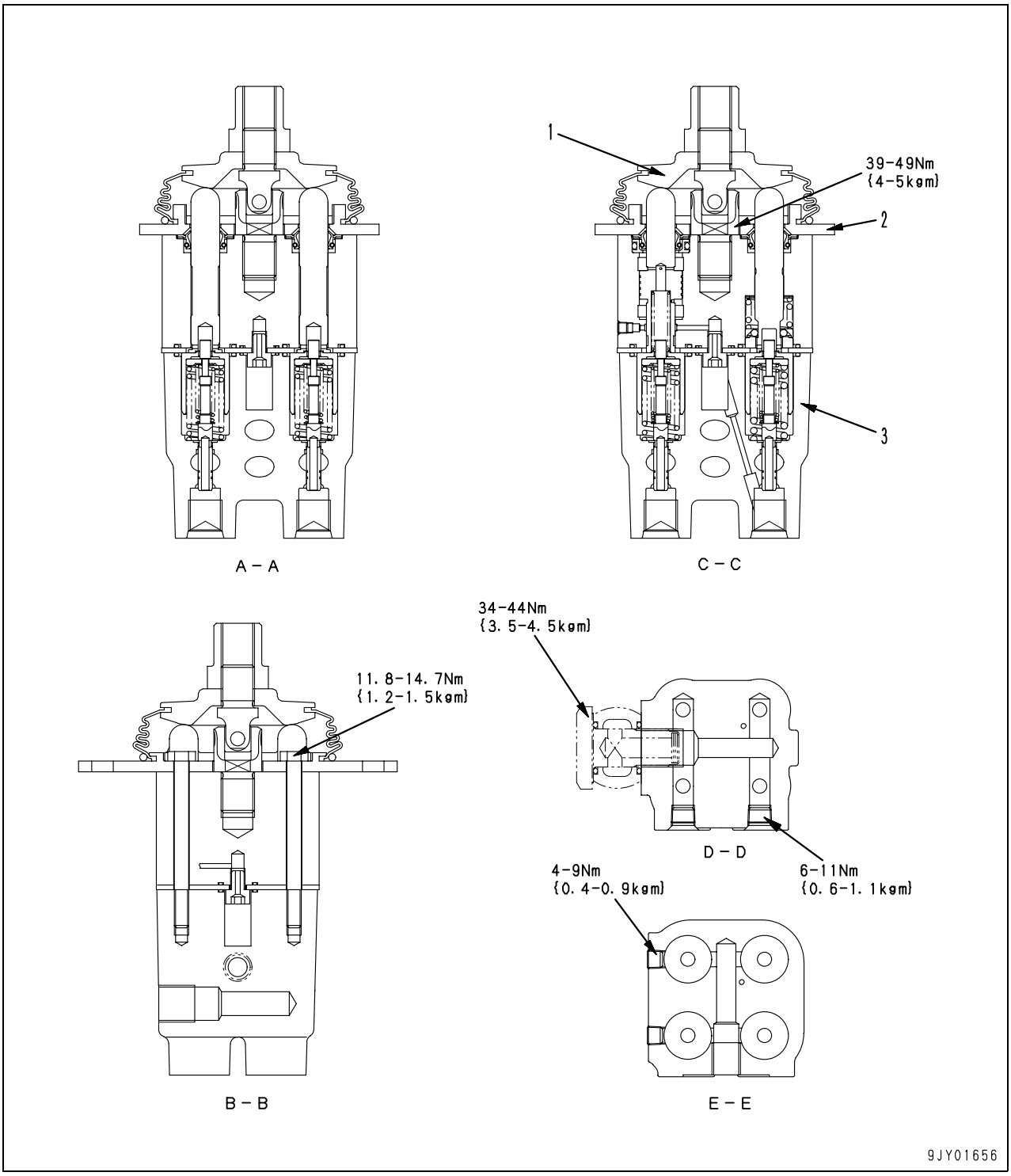
Hydraulic system, Part 3

Hydraulic system, Part 3

PPC valve (blade lift, blade tilt)

★ PPC: Abbreviation for Proportional Pressure Control





P: From self pressure reducing valve
T: To hydraulic tank
P1: To blade lift valve (port PA3)
P2: To blade lift valve (port PB3)
P3: To blade tilt valve (port PA2)
P4: To blade tilt valve (port PB2)

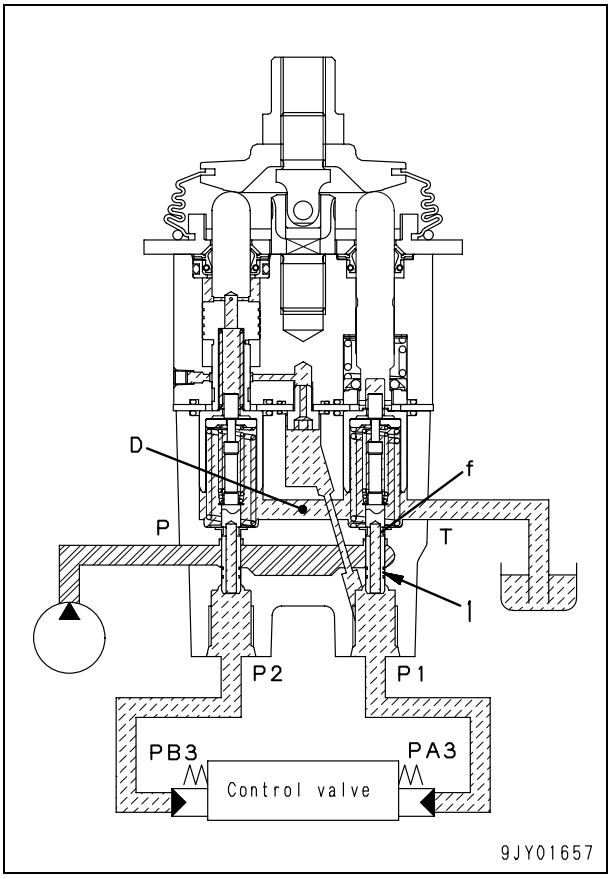
1. Disc
2. Plate
3. Body

Operation

1. At Neutral

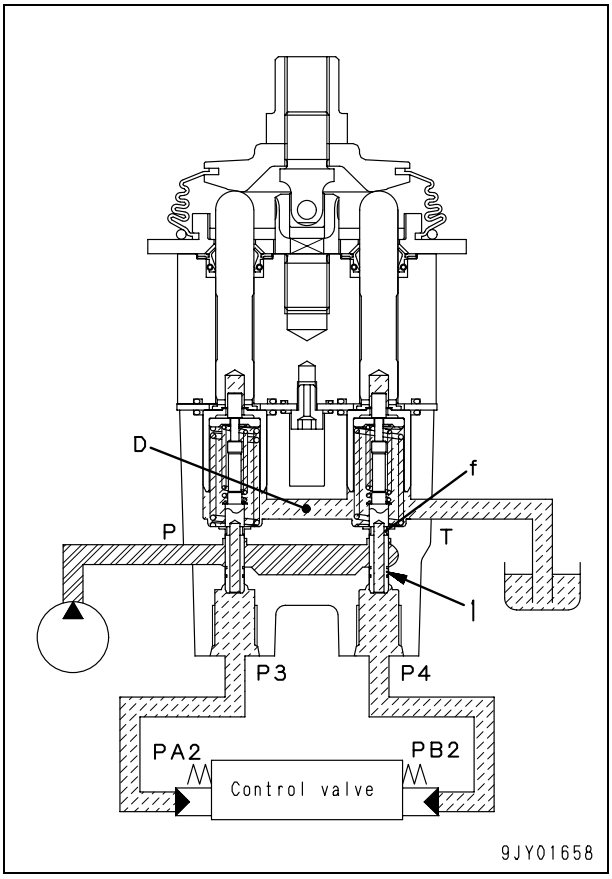
1) For blade lift

- Ports (PA3) and (PB3) of the blade lift control valve and ports (P1) and (P2) of the PPC valve are connected to drain chamber (D) through fine control hole (f) of spool (1).



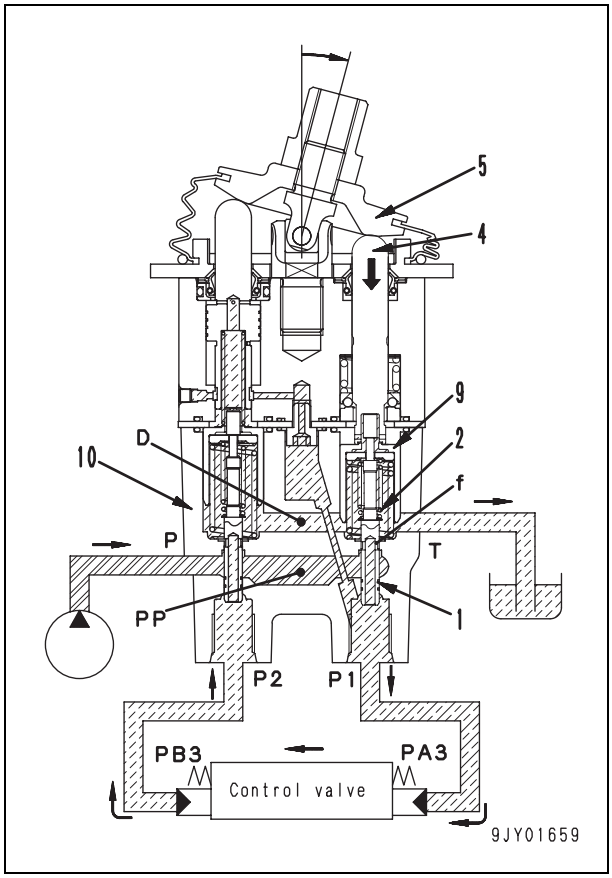
2) For blade tilt

- Ports (PA2) and (PB2) of the blade tilt control valve and ports (P3) and (P4) of the PPC valve are connected to drain chamber (D) through fine control hole (f) of spool (1).



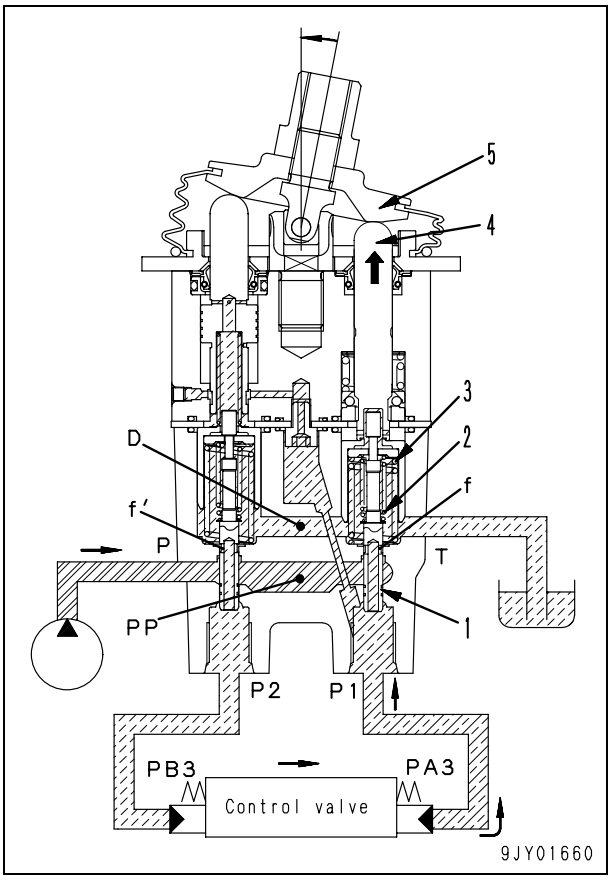
2. During fine control
(Neutral → fine control)

- When piston (4) is pushed by disc (5), retainer (9) is pushed, spool (1) is also pushed by metering spring (2), and moves down.
- By this move, fine control hole (f) is shut off from drain chamber (D) and almost simultaneously it is connected to pump pressure chamber (PP). The pilot pressure oil passes through fine control hole (f) and is conducted from port (P1) to port (PA3).
- When the pressure at port (P1) becomes higher, spool (1) is pushed back and fine control hole (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, spool (1) moves up and down so that the force of metering spring (2) is balanced with the pressure at port (P1). The relation between the positions of spool (1) and body (10) [fine control hole (f) is at the midpoint between drain chamber (D) and pump pressure chamber (PP)] does not change until retainer (9) contacts spool (1).
- Therefore, metering spring (2) is compressed in proportion to the strokes of the control lever. Thus, the pressure at port (P1) increases in proportion to the strokes of the control lever.
- The control valve spool moves to a position where the pressure in chamber (PA3) [same as pressure at port (P1)] is balanced with the force of the return spring.



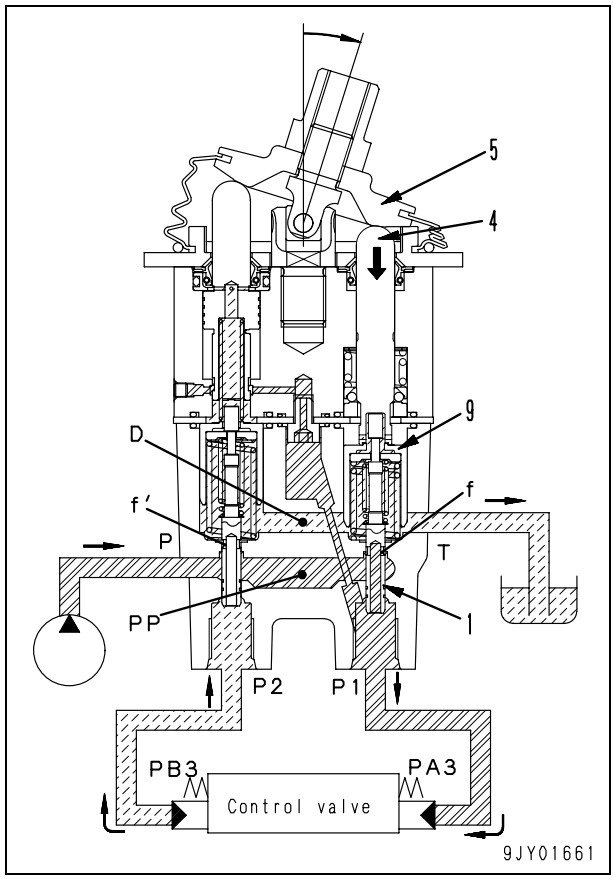
3. During fine control (when control lever is returned)

- When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port (P1).
- Because of this, fine control hole (f) is connected to drain chamber (D), and the pressurized oil at port (P1) is released.
- If the pressure at port (P1) goes down too far, spool (1) is pushed down by metering spring (2). Fine control hole (f) is shut off from drain chamber (D), and almost simultaneously, it is connected to pump pressure chamber (PP). Pump pressure is supplied until the pressure at port (P1) recovers to a pressure equivalent to the position of the lever.
- When the control valve spool returns, the oil at drain chamber (D) flows in from fine control hole (f') in the valve on the side that is not moving. Oil passes through port (P2), is taken to chamber (PB3), and fills the chamber.



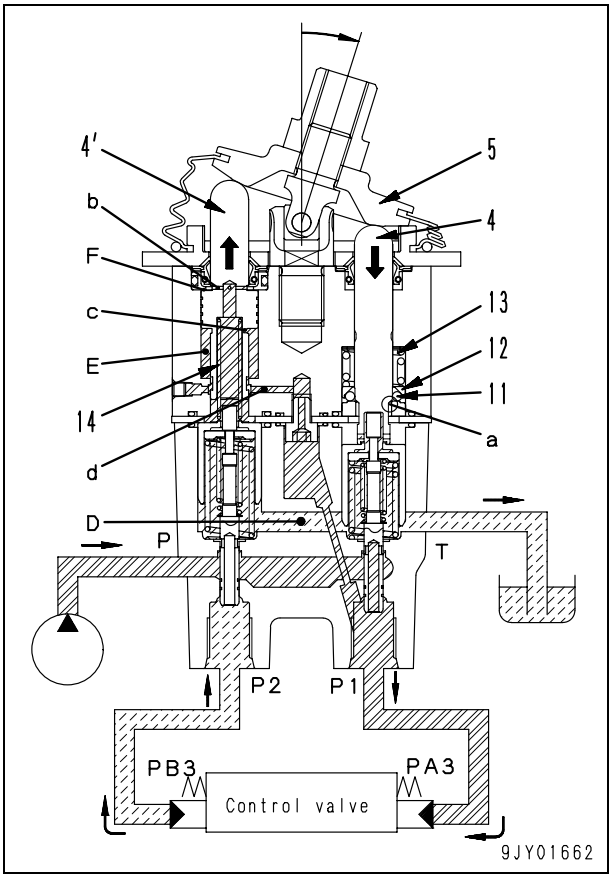
4. During full stroke

- When disc (5) pushes down piston (4) and retainer (9) pushes down spool (1), fine control hole (f) is shut off from drain chamber (D) and is connected to pump pressure chamber (PP).
- Therefore, the pilot pressure oil passes through fine control hole (f), is taken from port (P1) to chamber (PA3), and pushes the control valve spool.
- The return oil from chamber (PB3) passes from port (P2) through fine control hole (f'), and then flows to drain chamber (D).



5. When blade is operated to "Float"

- When piston (4) at port (P1) “lower“ side is pushed by disc (5) and moves down, ball (11) contacts protrusion (a) of the piston during the stroke. [Detent starts to act]
- When piston (4) is pushed in further, ball (11) pushes up collar (12), which is being held by detent spring (13). While pushing up collar (12), it escapes to the outside and passes over protrusion (a) of the piston.
- When this happens, piston (4') on the opposite side is pushed up by spring (14).
- As a result, the oil inside chamber (F) passes through (b) and (c), and flows to chamber (E), and piston (4') follows disc (5). Passage (d) is connected to port (P1), so more or less the same pressure is applied as is applied to port (P1).
- Chamber (E) is normally connected to drain chamber (D), but if ball (11) passes over protrusion (a) of the piston, passage (d) and chamber (E) which were shut off, are connected and the pressure oil flows.
- At the same time, the control valve also moves to “float“ position and the circuit is set to the “float“ condition.
- Piston (4') is being pushed up by the oil pressure inside chamber (E), so even if the lever is released, it is held at the “float“ position.

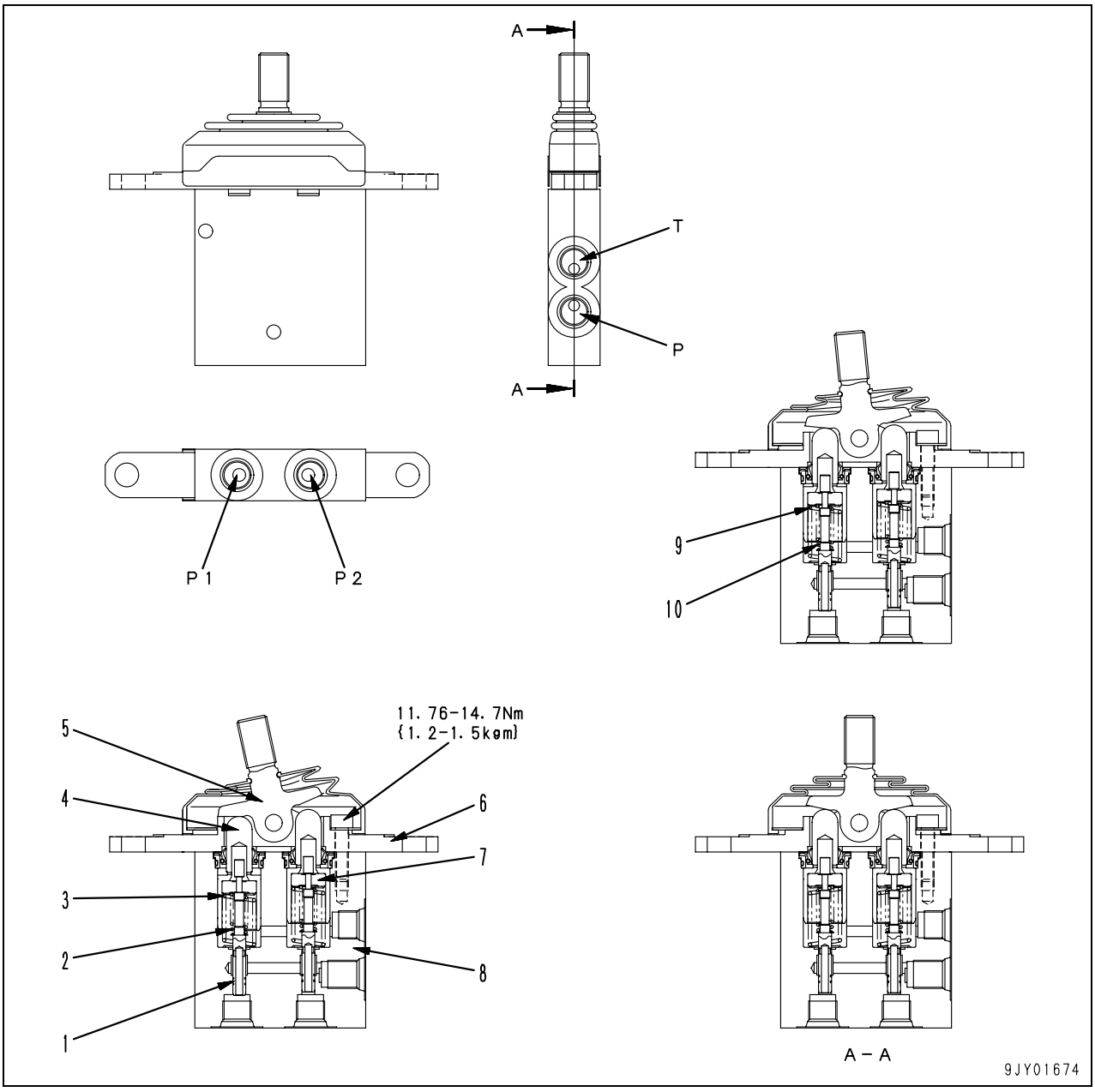


6. When blade is released from "float"

- When disc (5) is returned from the “float“ position, it is pushed down by a force greater than the hydraulic force in chamber (E).
- As a result, chamber (E) is shut off from passage (d) and is connected to the drain chamber. Therefore, the oil pressure inside chamber (E) is lost, and the “float“ position is canceled.

PPC valve (ripper)

★ PPC: Abbreviation for Proportional Pressure Control



T: To tank
P: From self pressure reducing valve
P1: To ripper valve (port PA4)
P2: To ripper valve (port PB4)

1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Lever
6. Plate
7. Retainer
8. Body

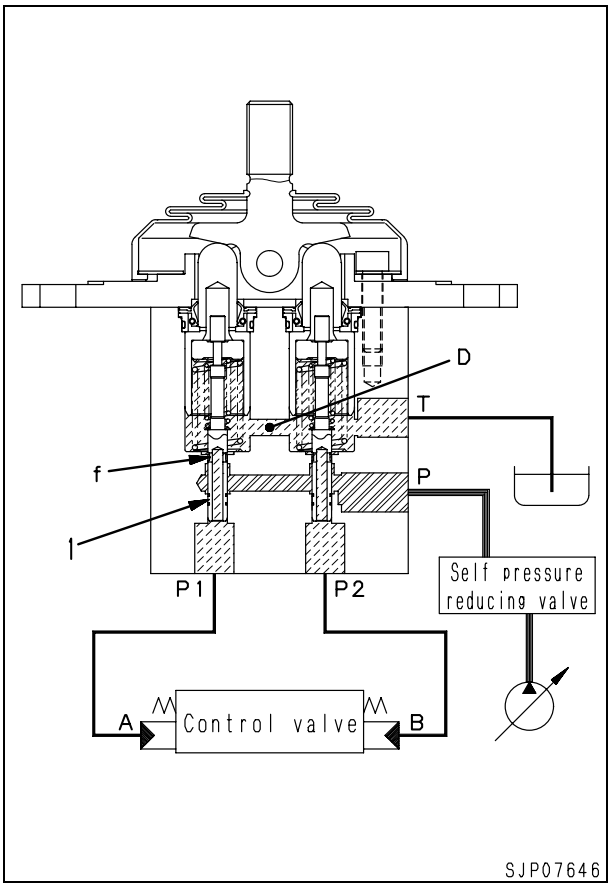
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
9	Centering spring	Free length × outer diameter	Installation length	Installation load	Free length	Installation load	Replace spring if damaged or deformed.
		33.9 × 15.3	28.4	125 N {12.7 kg}	—	100 N {10.2 kg}	
10	Metering spring	22.7 × 8.10	22.0	16.7 N {1.70 kg}	—	13.3 N {1.36 kg}	

Operation

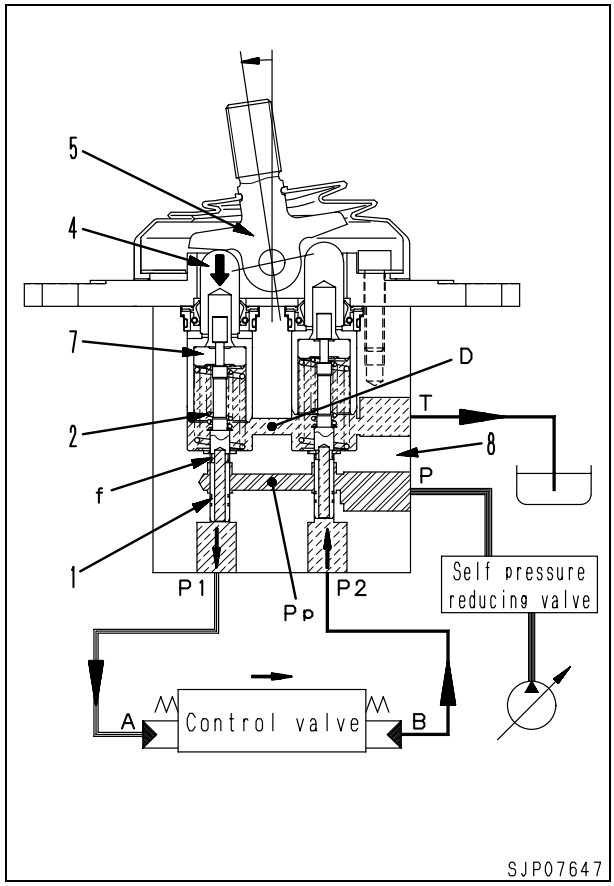
1. At Neutral

- Ports (A) and (B) of the control valve and ports (P1) and (P2) of the PPC valve are connected to drain chamber (D) via fine control hole (f) in spool (1).



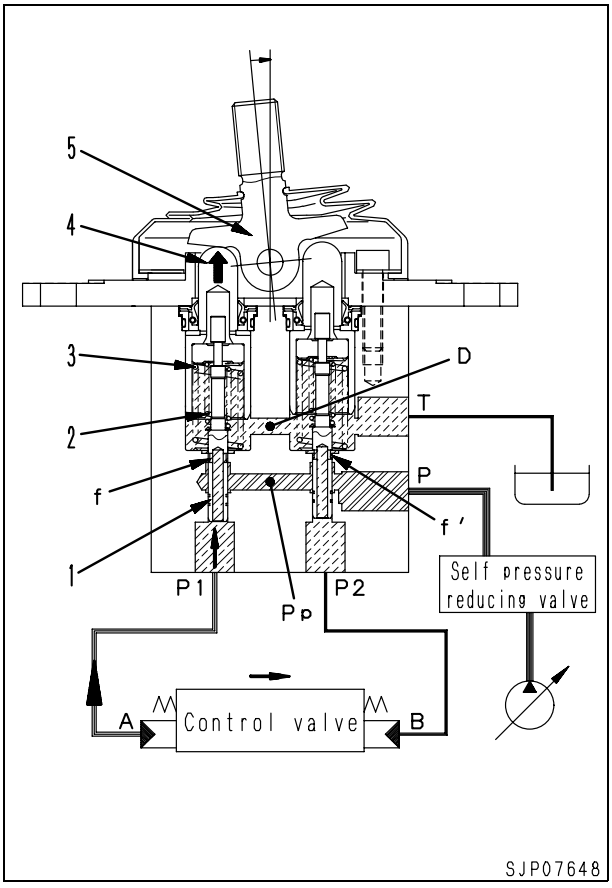
2. During fine control (Neutral → fine control)

- As piston (4) is pushed by lever (5), retainer (7) is pushed too. At the same time, spool (1) is also pushed down via metering spring (2).
- By this move, fine control hole (f) is shut off from drain chamber (D) and almost simultaneously, it is connected to pump pressure chamber (PP). The pilot pressure oil passes through fine control hole (f) and is conducted from port (P1) to port (A).
- When the pressure at port (P1) becomes higher, spool (1) is pushed back and fine control hole (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, spool (1) moves up and down until the force of metering spring (2) is balanced with the pressure at port (P1).
- The relation between the positions of spool (1) and body (8) [fine control hole (f) is at the midpoint between drain chamber (D) and pump pressure chamber (PP)] does not change until retainer (7) contacts spool (1).
- Therefore, metering spring (2) is compressed in proportion to the strokes of the control lever. Thus, the pressure at port (P1) increases in proportion to the strokes 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.



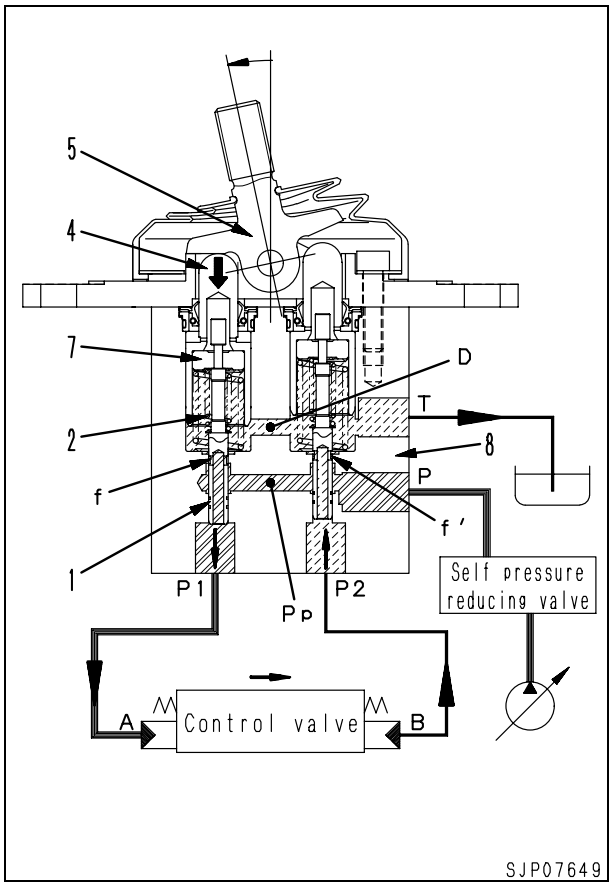
3. During fine control (when control lever is returned)

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



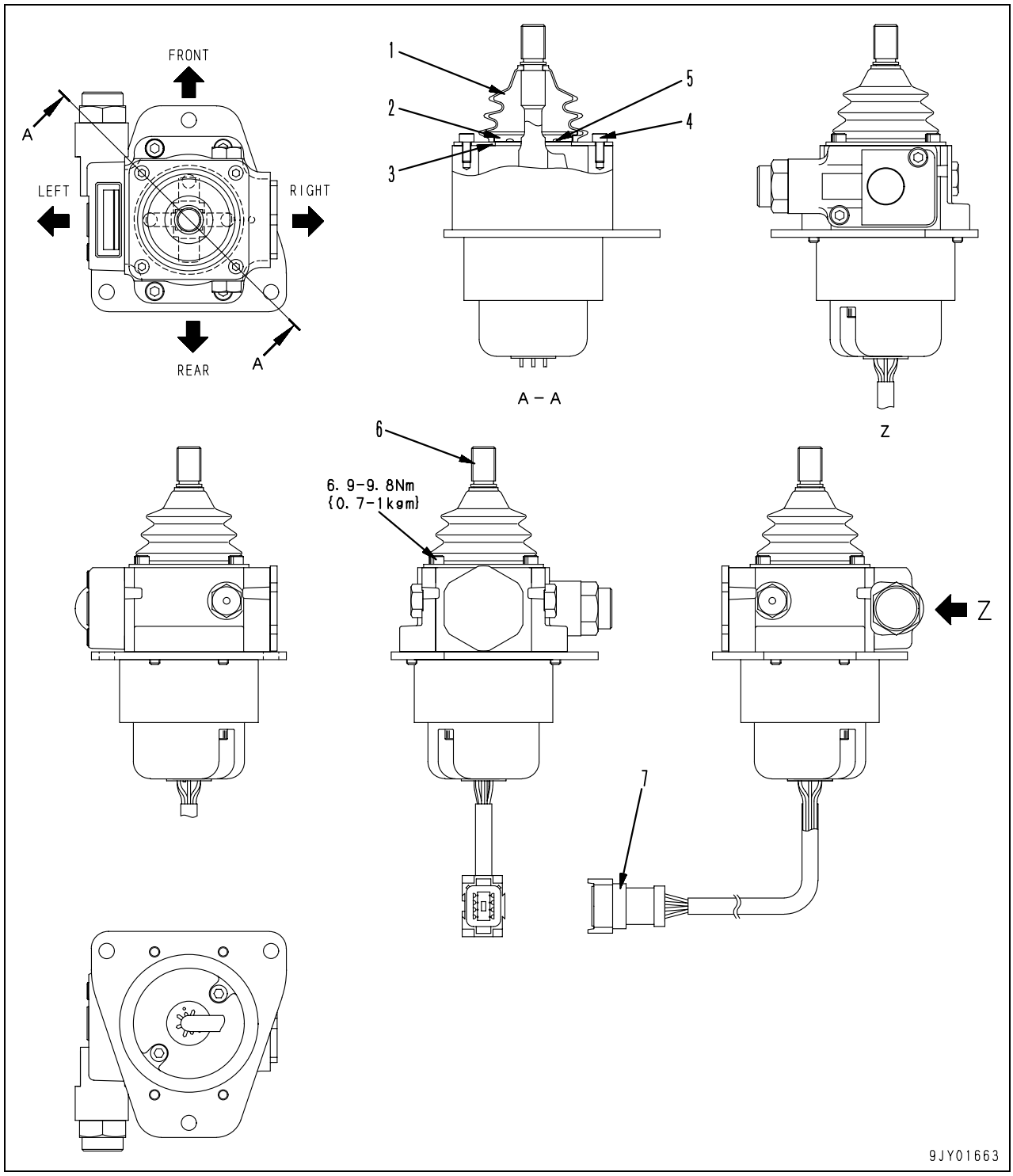
4. During full stroke

- When lever (5) pushes down piston (4) and retainer (7) pushes down spool (1), fine control hole (f) is shut off from drain chamber (D) and is connected to pump pressure chamber (PP).
- Therefore, the pilot pressure oil passes through fine control hole (f), is taken from port (P1) to chamber (A), and pushes the control valve spool.
- The oil returning from chamber (B) passes from port (P2) through fine control hole (f') and flows to drain chamber (D).

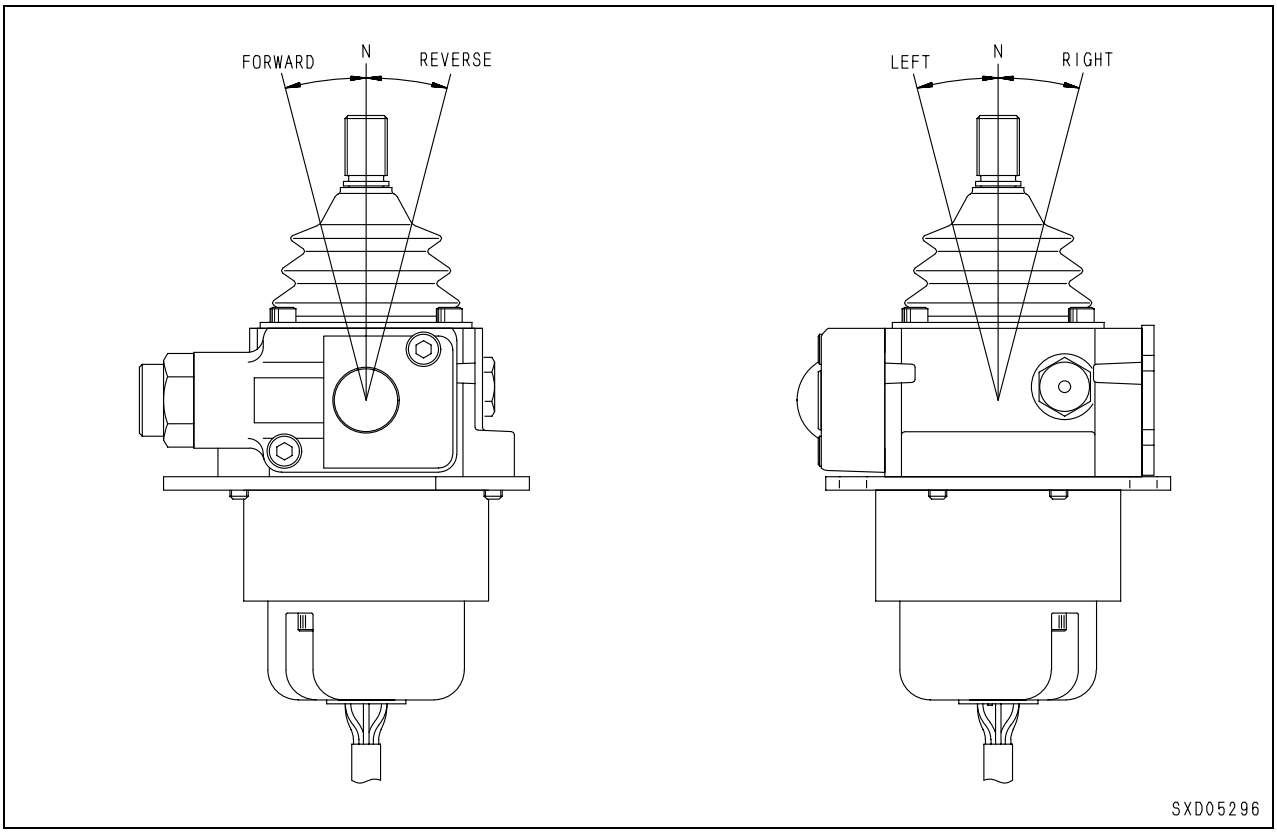


Electric lever (steering)

★ Do not disassemble.
Otherwise, adjustments will be required for the characteristics of voltage output and operating efforts.



1. Boot
2. Bracket
3. Plate
4. Bolt
5. Screw
6. Lever
7. Connector

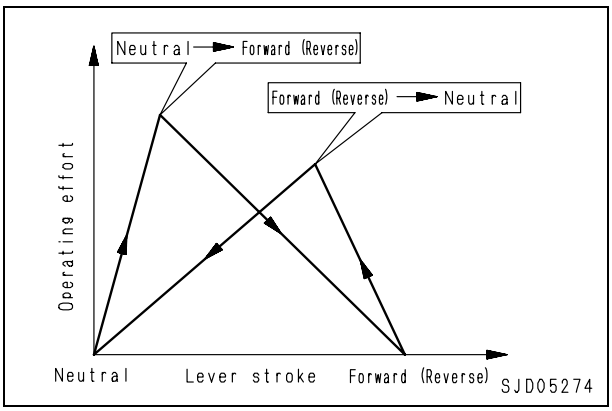


Function

1. Operating effort characteristics

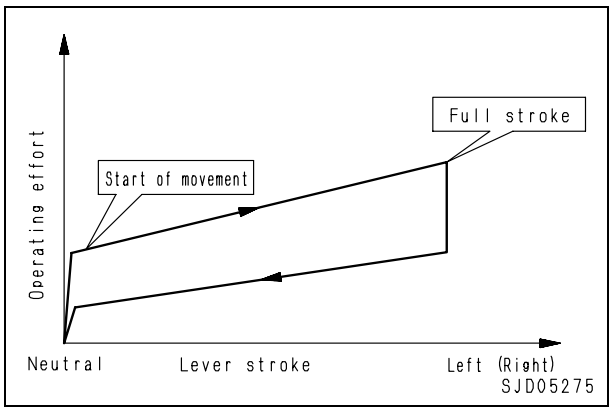
(1) Operation for forward and reverse travel

- The control lever is held at 3 positions: “forward”, “neutral” and “reverse”.



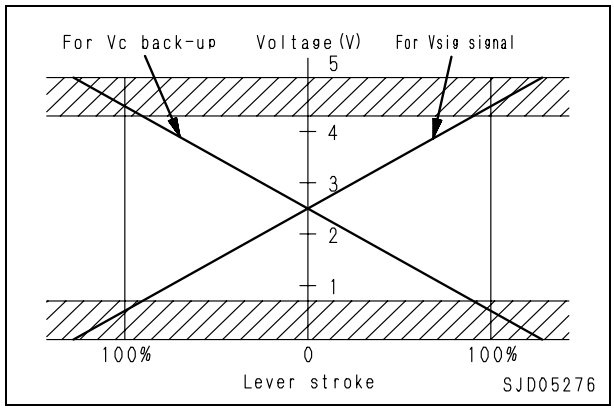
(2) Operation for left and right steering

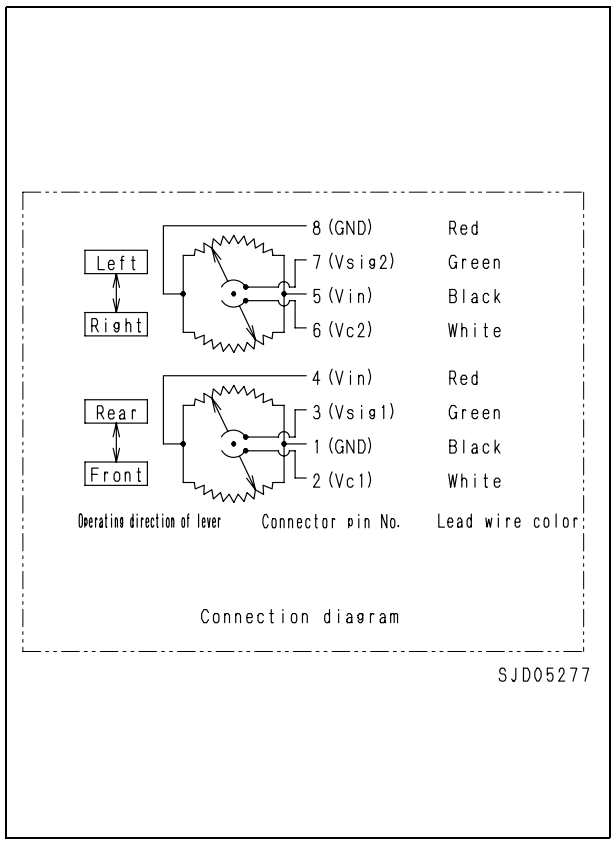
- Free return



2. Output voltage characteristics

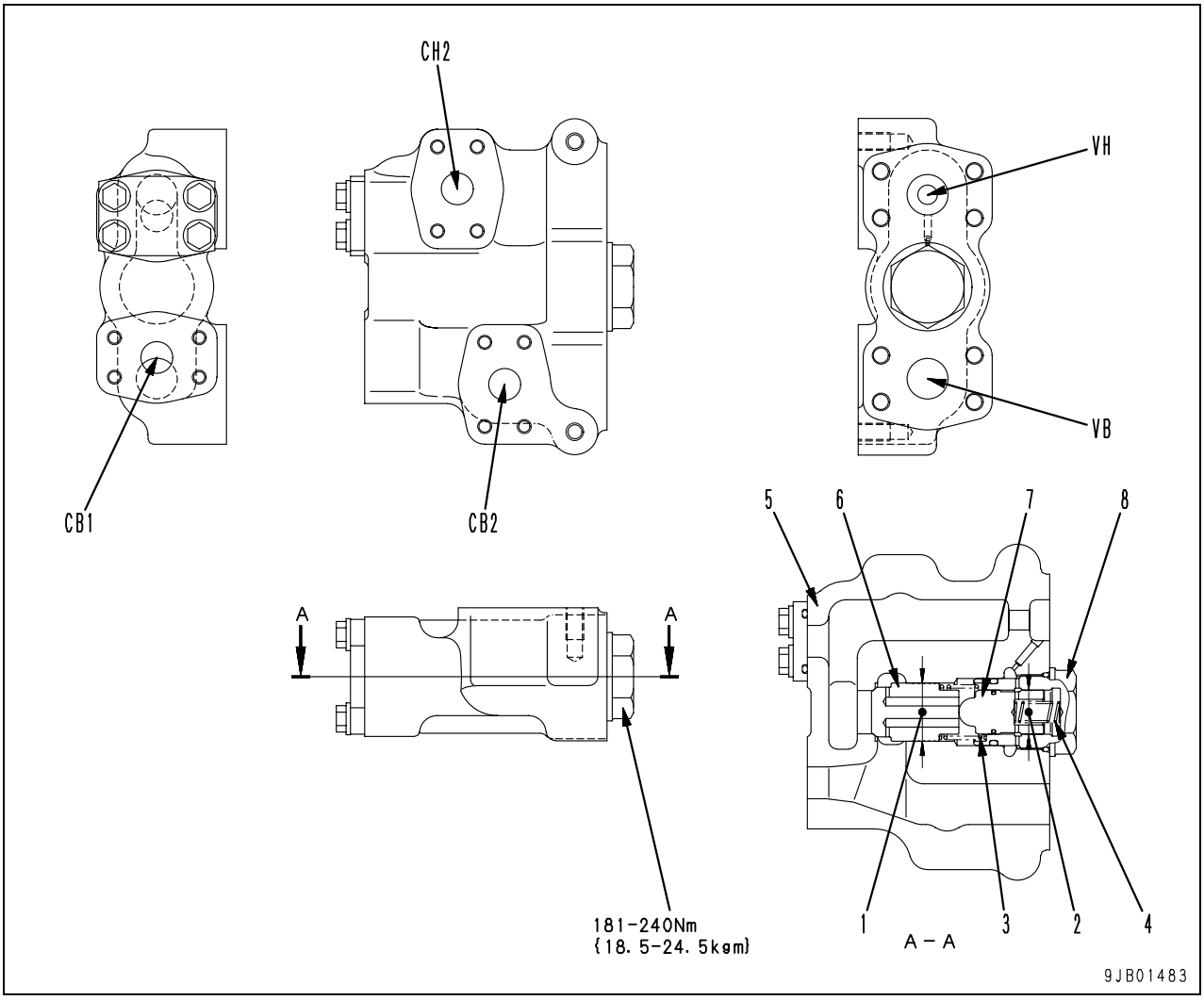
- The control unit is installed to the left control stand and the control lever is installed directly onto it.
- The operating angle [stroke] of the control levers sensed with potentiometers and signal voltages are output to the transmission, steering controller.
- A potentiometer is installed in each of longitudinal direction and lateral direction. Each potentiometer outputs 2 signal voltages which are opposite to each other as shown in the figure at right.





Quick drop valve

(lift cylinder)



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		33	–0.034 –0.050	+0.025 0	0.034 – 0.075	0.080	
2	Clearance between piston and plug	25	–0.039 –0.054	+0.021 0	0.039 – 0.075	0.080	
3	Valve spring	Standard size			Repair limit		
		Free length	Installation length	Installation load	Free length	Installation load	
		108.3	26	88.2 N {9.0 kg}	97.5	79.4 N {8.1 kg}	
4	Piston spring	27.3	26	4.6 N {0.47 kg}	24.6	4.1 N {0.42 kg}	

5. Body
6. Valve
7. Piston
8. Plug

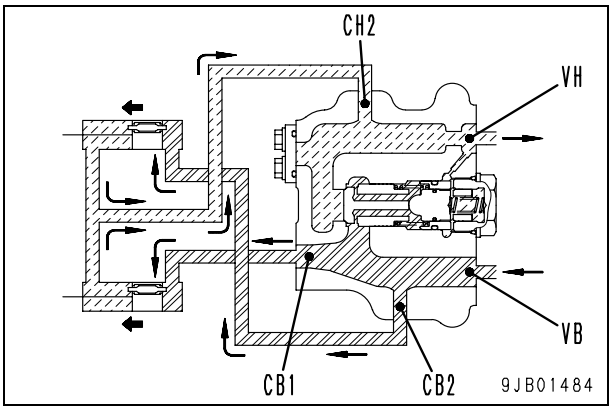
VH: From control valve, blade “raise“
VH: From control valve, blade “lower“
CH2: To both blade lift cylinder heads
CB1: To left blade lift cylinder bottom
CB2: To right blade lift cylinder bottom

Outline

- The quick drop valve is installed between control valve and lift cylinder. When blade control lever is set in “lower“ position the quick drop valve prevents a vacuum on cylinder bottom side and shortens time lag in starting digging.
- The blade lowering speed is mostly decided by the pump discharge. However, it can be heightened by installing the quick drop valve.

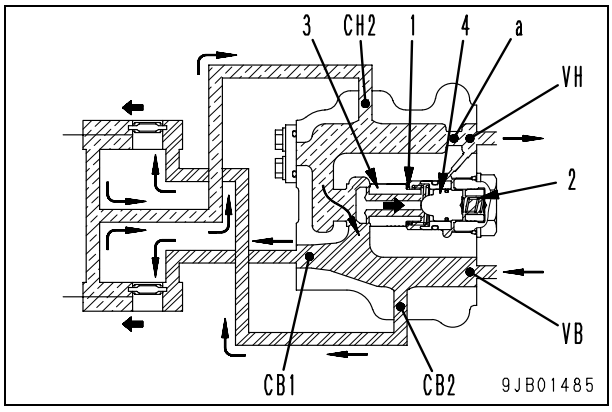
Operation

Start of lowering blade



- If the blade control lever is set in “lower“ position, oil from the control valve flows into port (VB) and further flows through ports (CB1) and (CB2) to the cylinder bottom and pushes the cylinder piston to the left.
- The oil in the cylinder head side is pushed out by the cylinder piston into port (CH2), flows through port (VH) and control valve into the hydraulic tank.

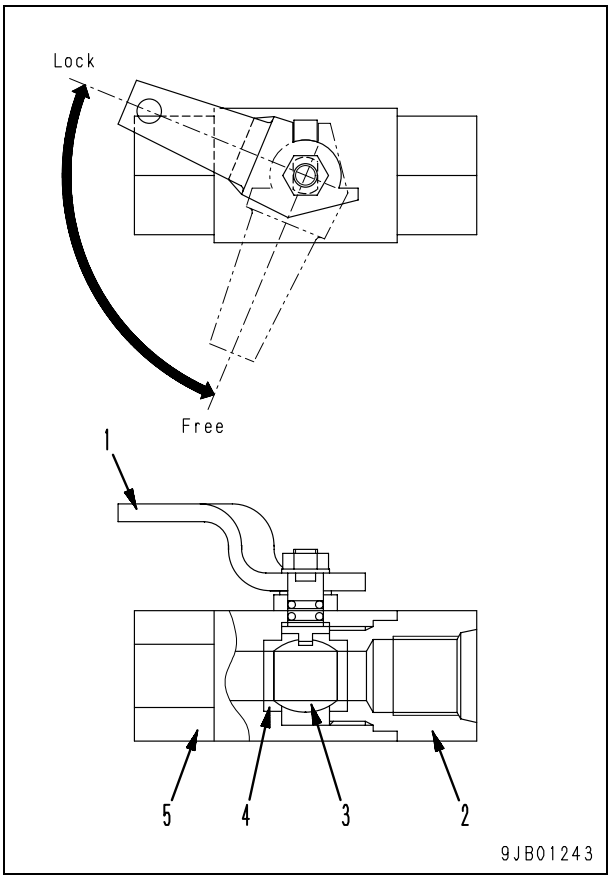
While lowering blade



- The oil pushed out of cylinder head side flows through port (CH2) to port (VH). At this time, the oil flow rate is reduced by orifice (a) and pressure difference is made before and after the orifice.
- If oil pressure in port (CH2) rises higher than the tension of springs (1) and (2), valve (3) and piston (4) move to the right.
- Since ports (VB) and (CH2) open, part of the oil which has been flowing from port (CH2) to port (VH) merges with the oil from control valve and flows into cylinder bottom side.
- Accordingly, the blade lowering speed is increased by the quantity of oil flowing into cylinder bottom side and vacuum on the bottom side is prevented.

PPC lock valve

★ PPC: Abbreviation for Proportional Pressure Control



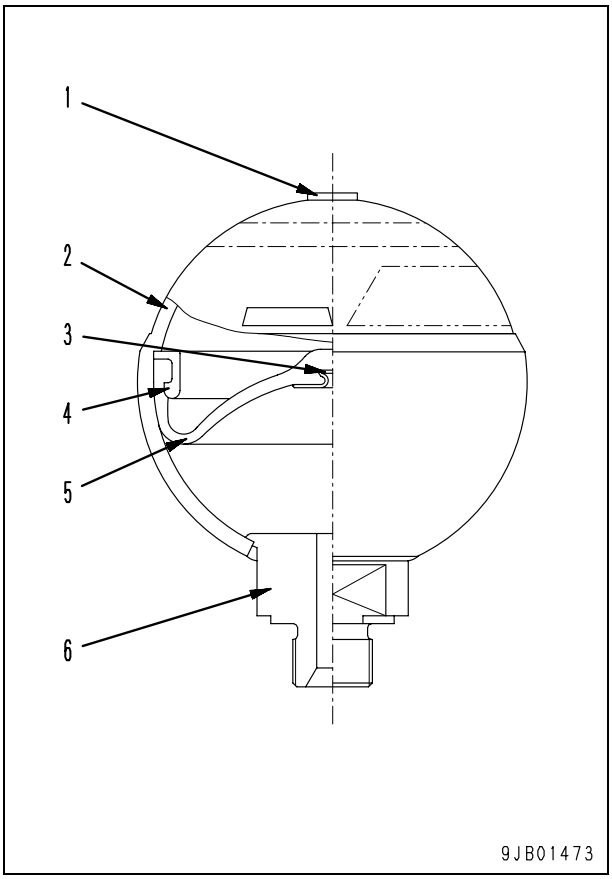
1. Lever
2. End cap
3. Ball
4. Seat
5. Body

Outline

- The PPC lock valve is installed between the cooling fan pump and blade PPC valve. If the work equipment lock lever is set in the “lock“ position, the lock valve connected to it shuts off the oil in the PPC circuit, thus the operator cannot operate the work equipment.

Accumulator

(For PPC circuit)



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

Outline

- The accumulator is installed between the cooling fan pump and blade PPC valve. Even if the engine is stopped with the work equipment raised, the operator can send pilot oil pressure to the control valve to have the work equipment lower with its own weight by using nitrogen gas pressure in the accumulator.

Specifications

Gas used:	Nitrogen gas
Quantity of gas:	300 cc
Charged gas pressure:	1.18 MPa {12 kg/cm^2} (at 80 °C)
Max. allowable working pressure:	6.86 MPa {70 kg/cm^2}

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00287-01

BULLDOZER

D65EX-15
D65PX-15
D65WX-15

Machine model	Serial number
D65EX-15	69001 and up
D65PX-15	69001 and up
D65WX-15	69001 and up

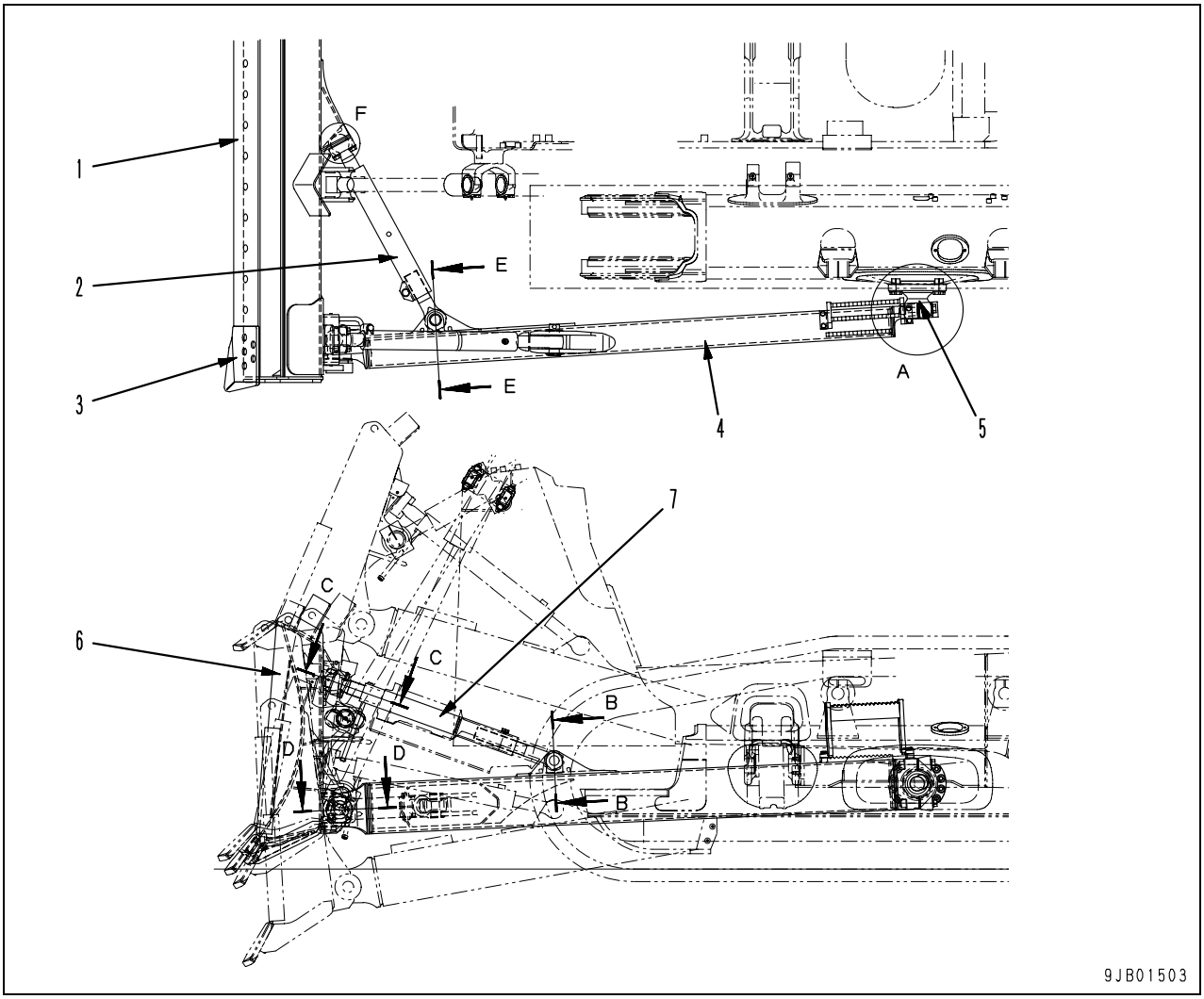
10 Structure, function and maintenance standard

Work equipment

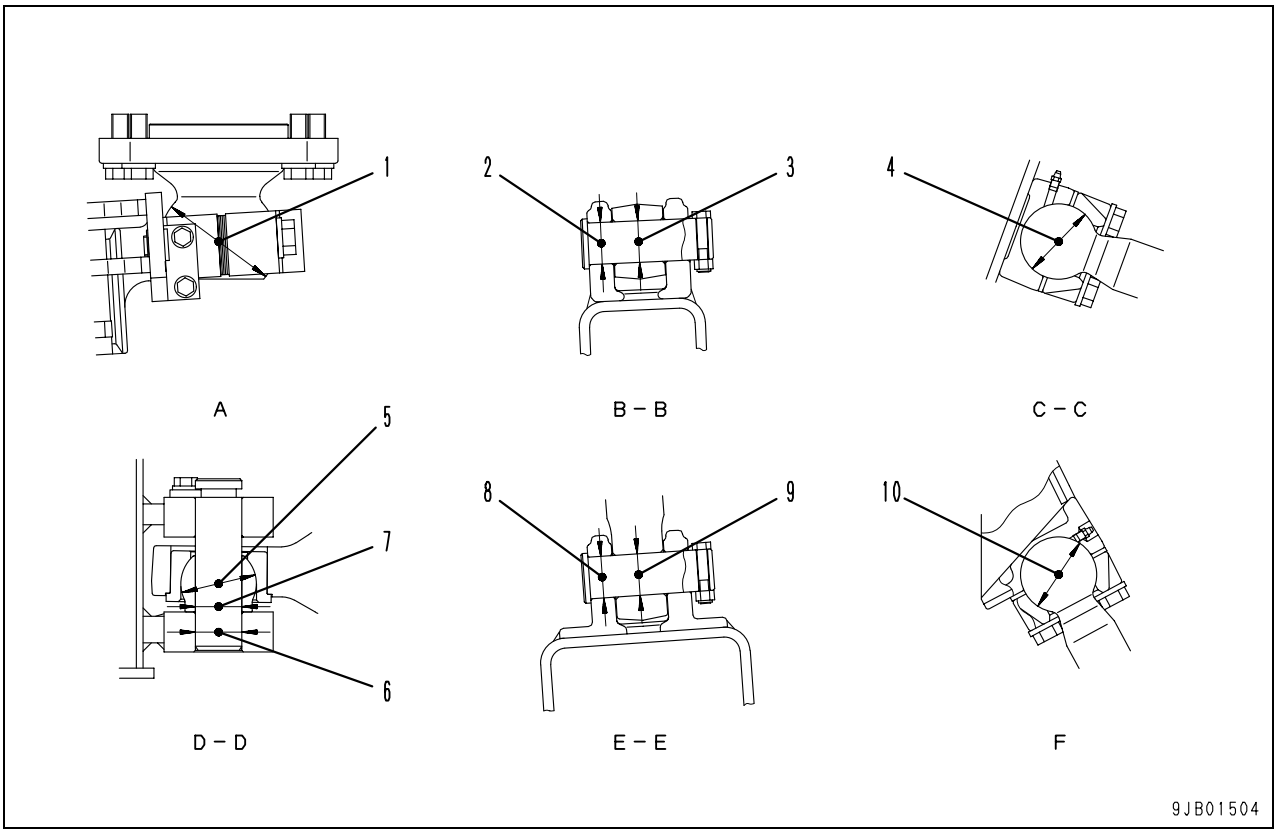
Work equipment

Blade

Power tilt dozer (PT)
Semi-U dozer (SEMI-U)
Power tilt and power pitch dozer (PTP)



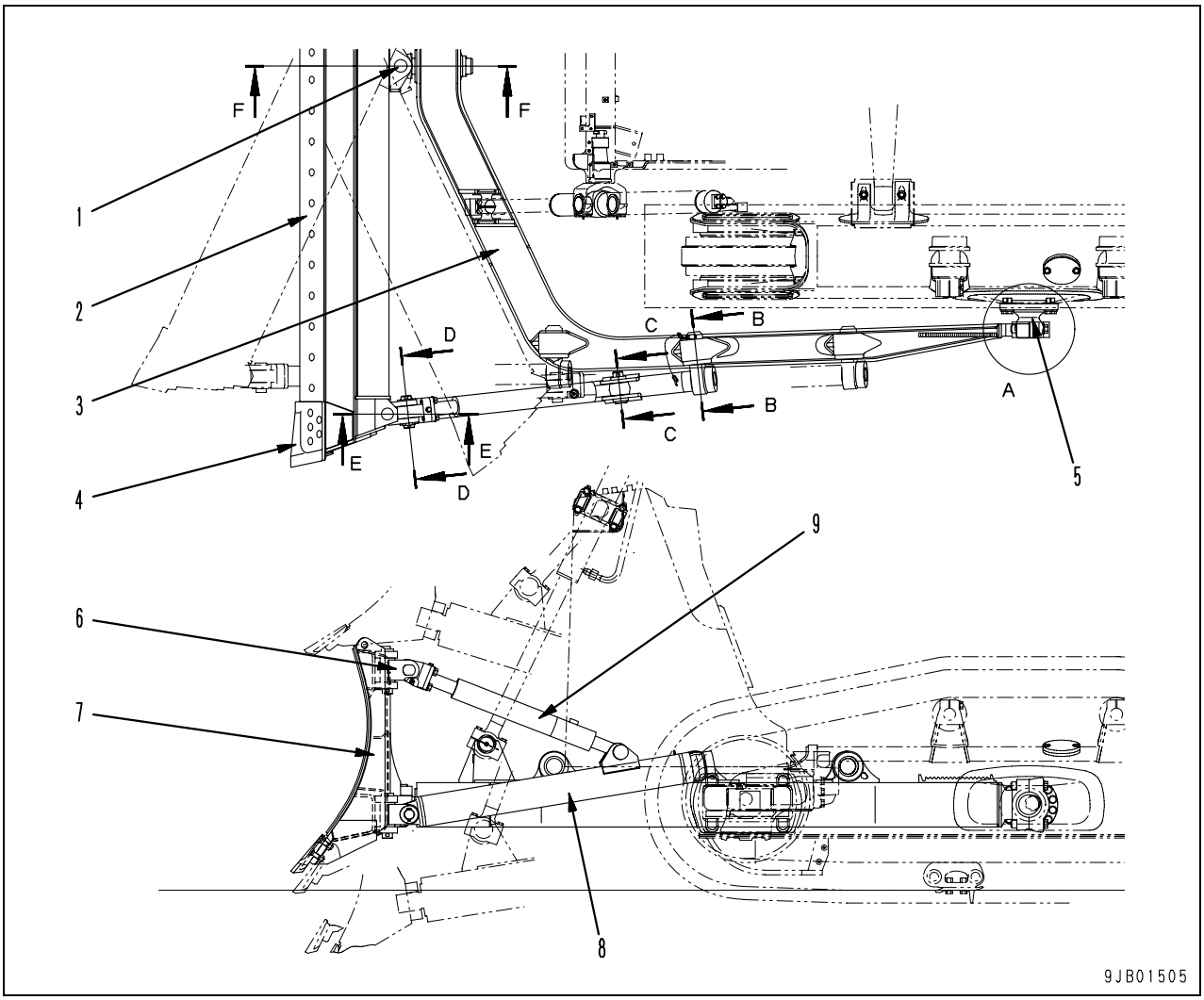
1. Cutting edge
2. Center brace
3. End bit
4. Straight frame
5. Trunnion
6. Blade
7. Left side: Brace (PT, SEMI-U)
   Tilt cylinder (PTP)
   Right side: Tilt cylinder (PT, SEMI-U)
   Pitch cylinder (PTP)



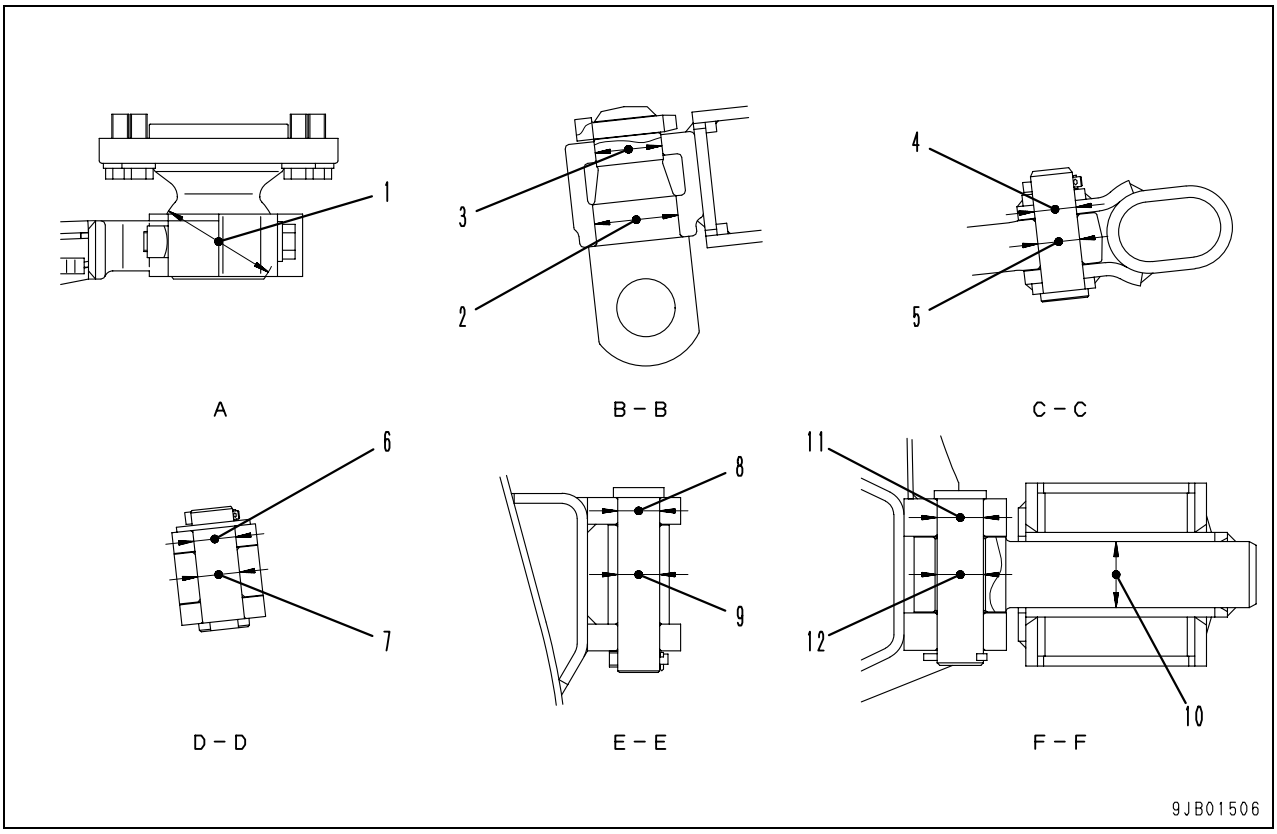
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Spherical clearance between trunnion and cap	S140	–0.1 –0.5	+1.5 0	0.3 – 0.7	5.0	Adjust shim or replace
2	Clearance between brace mounting pin and bracket	50	–0.2 –0.4	+0.2 0	0.2 – 0.6	2.0	Replace
3	Clearance between brace mounting pin and brace	50	–0.2 –0.4	+0.2 0	0.2 – 0.6	2.0	
4	Spherical clearance between bracket and brace	S90 (Shaft) S91 (Hole)	–0.1 –0.3	+1.0 0	0.3 – 0.7	2.0	Adjust shim or replace
5	Spherical clearance between bearing and bushing	S90	–0.1 –0.5	+0.5 0	0.1 – 1.0	2.0	Replace
6	Clearance between frame mounting pin and bracket	55	0 –0.3	+0.6 +0.2	0.2 – 0.9	2.0	
7	Clearance between frame mounting pin and bearing	55	0 –0.3	+0.5 +0.2	0.2 – 0.8	2.0	
8	Clearance between center brace mounting pin and bracket	50	–0.2 –0.4	+0.2 0	0.2 – 0.6	2.0	
9	Clearance between center brace mounting pin and brace	50	–0.2 –0.4	+0.2 0	0.2 – 0.6	2.0	
10	Spherical clearance between bracket and center brace	S90 (Shaft) S91 (Hole)	–0.1 –0.3	+1.0 0	0.3 – 0.7	2.0	Adjust shim or replace

Angledozer (A)



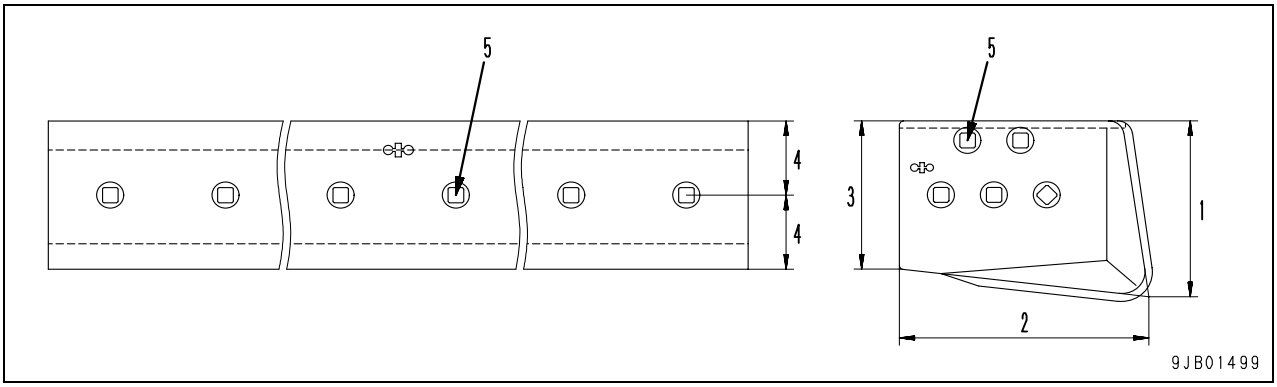
1. Center shaft
2. Cutting edge
3. C-frame
4. End bit
5. Trunnion
6. Joint
7. Blade
8. Arm
9. Brace



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Spherical clearance between trunnion and cap	S140	–0.1 –0.5	+1.5 0	0.1 – 2.0	8.0	Replace
2	Clearance between arm mounting pin and bracket (large)	100	–0.6 –1.0	+1.5 +1.0	1.6 – 2.5	3.5	
3	Clearance between arm mounting pin and bracket (small)	80	–0.6 –1.0	+1.5 +1.0	1.6 – 2.5	3.5	
4	Clearance between brace mounting pin and arm bracket	50	–0.3 –0.6	+0.7 0	0.3 – 1.3	2.0	
5	Clearance between brace mounting pin and brace	50	–0.3 –0.6	+0.2 0	0.3 – 0.8	2.0	
6	Clearance between brace mounting pin and joint	50	0 –0.3	+0.2 0	0 – 0.5	2.0	
7	Clearance between brace mounting pin and bearing	50	0 –0.3	+0.5 0	0 – 0.8	2.0	
8	Clearance between joint mounting pin and bracket	50	–0.1 –0.3	+0.3 0	0.1 – 0.6	2.0	
9	Clearance between joint mounting pin and joint	50	–0.1 –0.3	+0.2 0	0.1 – 0.5	2.0	
10	Clearance between center shaft and frame	79.5 (Shaft) 80 (Hole)	–0.2 –0.5	+0.5 –0.5	0.2 – 1.5	2.0	
11	Clearance between center shaft mounting pin and bracket	55	–0.1 –0.3	+0.3 0	0.1 – 0.6	2.0	
12	Clearance between center shaft mounting pin and center shaft	55 (Shaft) 60 (Hole)	–0.1 –0.3	+0.5 +0.1	5.2 – 5.8	7.0	

Cutting edge and end bit



Unit: mm

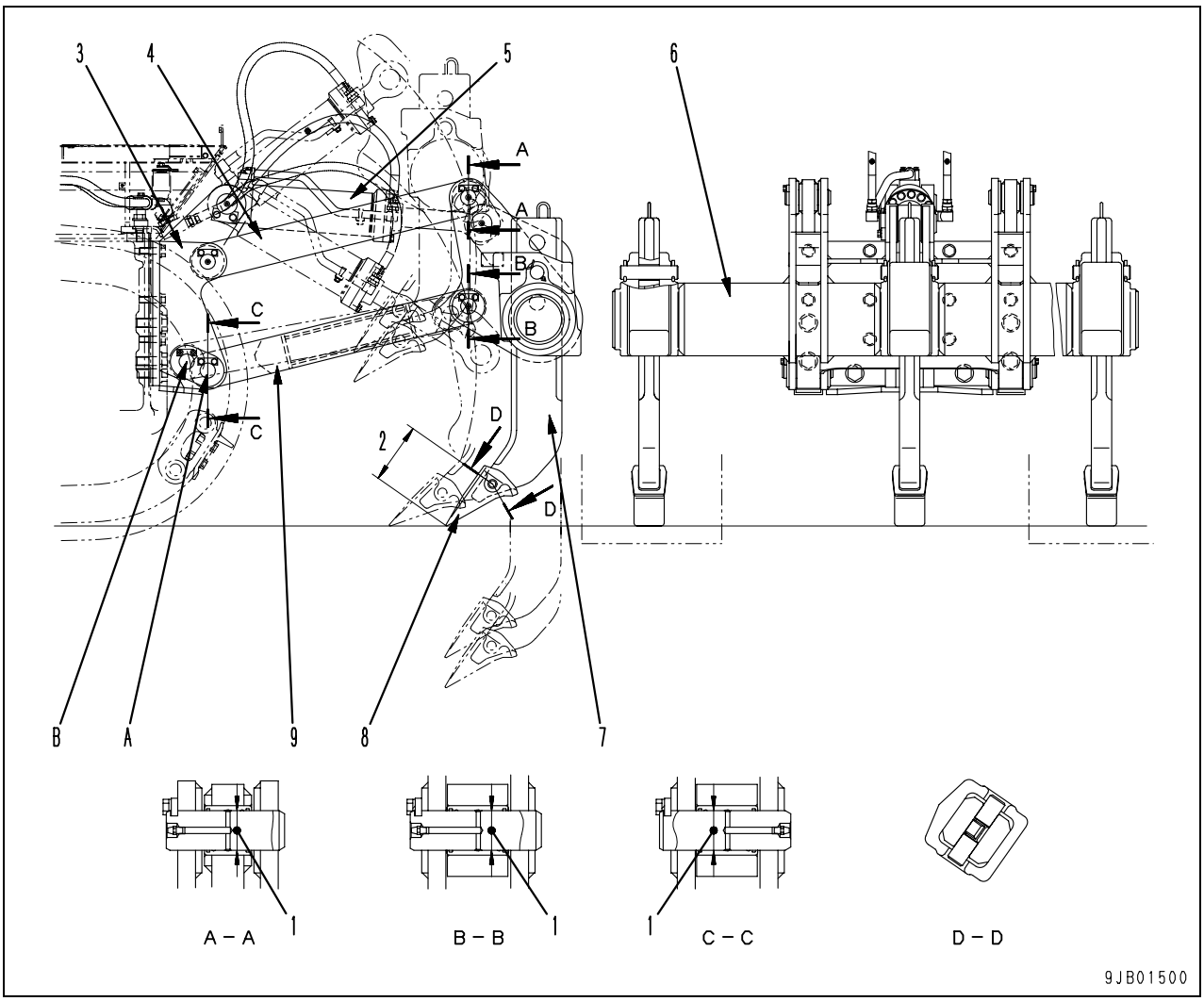
No.	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Height of end bit (outside)	PT (EX)	242	187	Replace
		PT (PX) PTP (PX)	204	187	
		SEMI-U (EX)	315	237	
		A (EX)	242	187	
2	Width of end bit	PT (EX)	330	300	
		PT (PX) PTP (PX)	325	300	
		SEMI-U (EX)	540	515	
		A (EX)	330	300	
3	Height of end bit (inside)	PT (EX)	204	187	
		PT (PX) PTP (PX)	204	187	
		SEMI-U (EX)	254	237	
		A (EX)	204	187	
4	Height of cutting edge (from center of bolt hole to end face)	PT (EX)	102	85	Reverse or replace
		PT (PX) PTP (PX)	102	85	
		SEMI-U (EX)	102	85	
		A (EX)	102	85	
5	Tightening torque of end bit and cutting edge	PT (EX)	392.2 – 529.2 Nm {40 – 54 kgm}		Retighten
		PT (PX) PTP (PX)	392.2 – 529.2 Nm {40 – 54 kgm}		
		SEMI-U (EX)	Cutting edge: 392.2 – 529.2 Nm {40 – 54 kgm} End bit: 637.0 – 852.6 Nm {65 – 87 kgm}		
		A (EX)	392.2 – 490.3 Nm {40 – 50 kgm}		

PT: for power tilt dozer, PTP: for power tilt, power pitch dozer, SEMI-U: for semi-U dozer, A: for angledozer

Ripper

D65EX-15

(If equipped)



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pin and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		56	–0.030 –0.076	+0.299 +0.169	0.199 – 0.375	1.0	
2	Wear of point	Standard size		Repair limit			
		222		152			

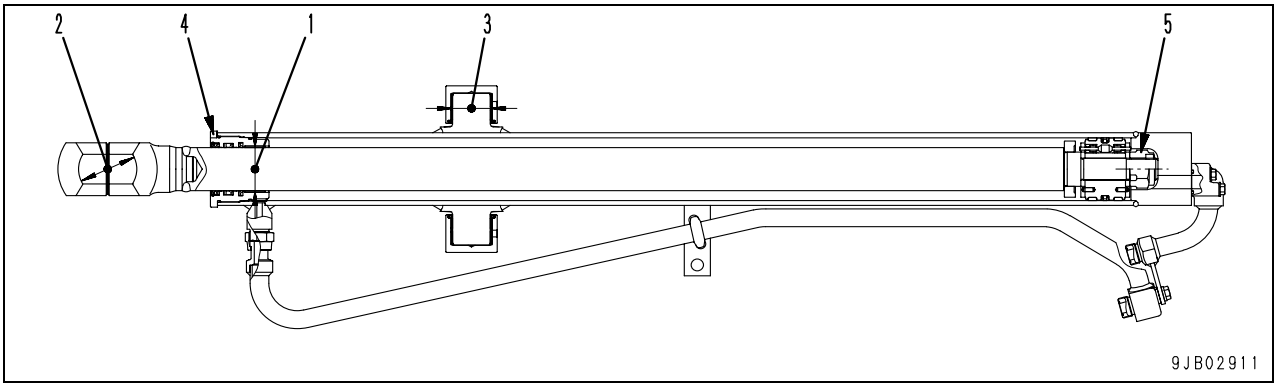
3. Bracket
4. Upper link
5. Ripper cylinder
6. Beam
7. Shank
8. Point
9. Lower link

A: Pin hole A (Point digging angle: 55°)
B: Pin hole B (Point digging angle: 45°)

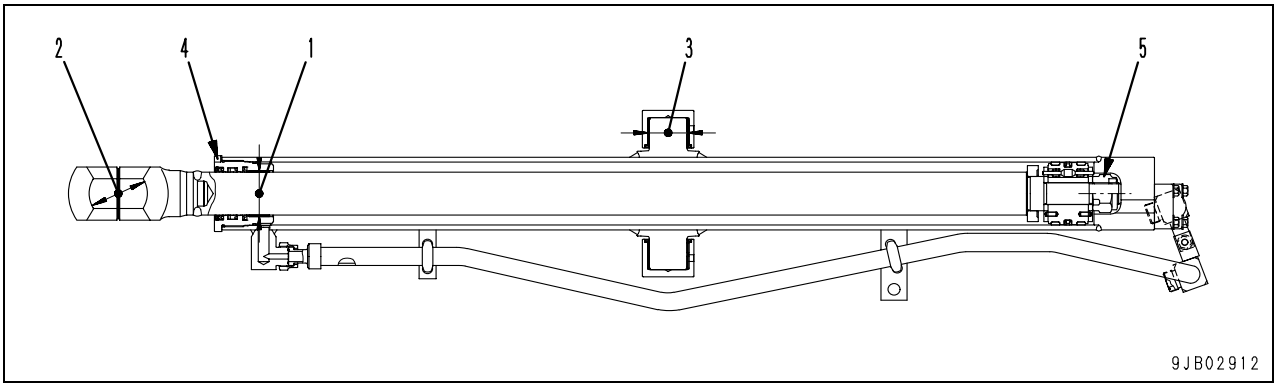
Hydraulic cylinder

For power tilt dozer
For power tilt, power pitch dozer

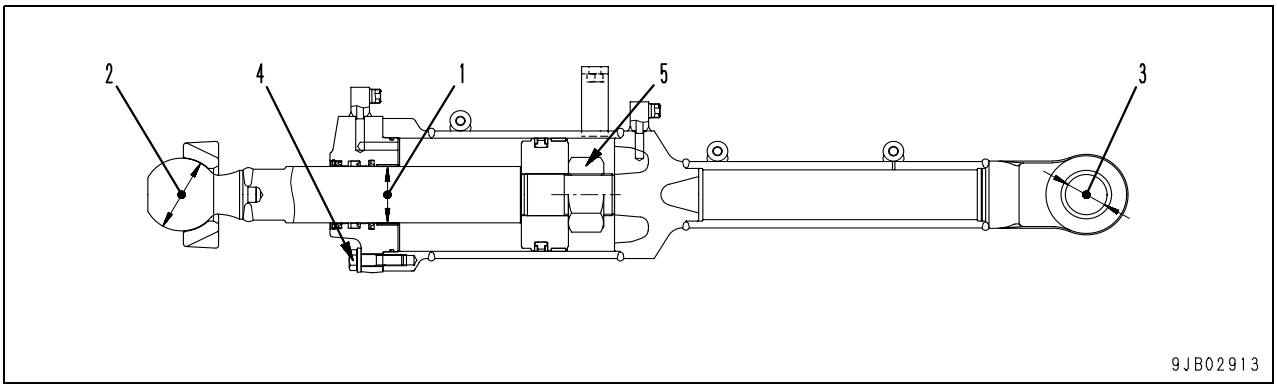
Lift cylinder
D65EX-15



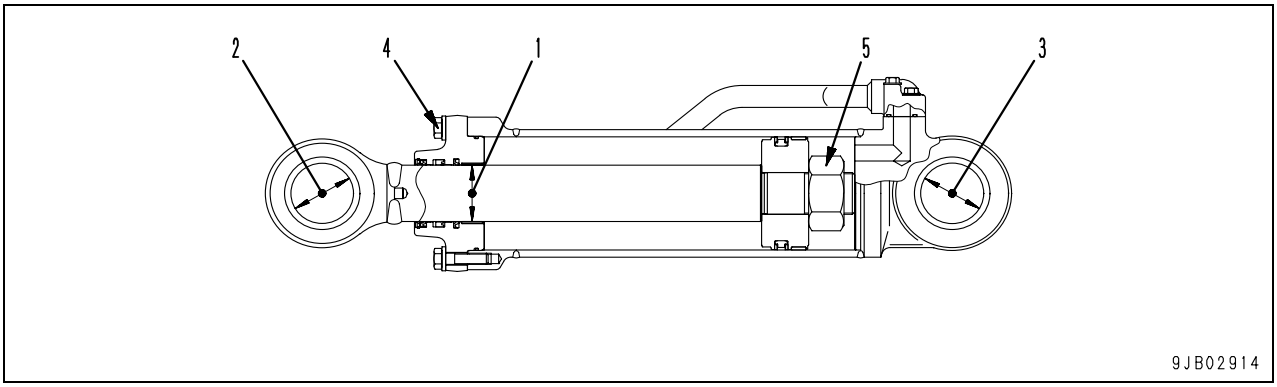
Lift cylinder
D65PX-15



Tilt cylinder
Pitch cylinder



Ripper lift cylinder
D65EX-15



Unit: mm

No.	Check item	Cylinder name	Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Lift	65	–0.030 –0.104	+0.262 +0.067	0.097 – 0.366	0.666	Replace bushing
		Tilt Pitch	70	–0.025 –0.064	+0.271 +0.075	0.105 – 0.375	0.675	
		Ripper	70	–0.025 –0.087	+0.271 +0.075	0.105 – 0.375	0.675	
2	Spherical clearance between piston rod and trunnion	Lift	S85	–0.2 –0.3	+0.3 0	0.2 – 0.5	1.0	Adjust shim or replace
	Spherical clearance between piston rod and bracket	Tilt Pitch	S90 (Shaft) S91 (Hole)	–0.1 –0.3	+1.0 0	0.2 – 0.5	2.0	
	Clearance between piston rod support shaft and bushing	Ripper	75	–0.030 –0.076	+0.174 +0.100	0.130 – 0.250	1.0	Replace bushing
3	Clearance between cylinder boss and bushing	Lift	55	–0.100 –0.174	+0.116 0	0.100 – 0.290	1.0	
	Clearance between cylinder bottom support shaft and bushing	Tilt Pitch	50	–0.200 –0.400	+0.142 +0.080	0.280 – 0.542	1.0	
		Ripper	75	–0.030 –0.076	+0.174 +0.100	0.130 – 0.250	1.0	
4	Tightening torque of cylinder head	Lift	735 ± 74.0 Nm {75.0 ± 7.5 kgm}					Retighten
	Tightening torque of cylinder head mounting bolt	Tilt Pitch	162 ± 14.7 Nm {16.5 ± 1.5 kgm}					
		Ripper	162 ± 14.7 Nm {16.5 ± 1.5 kgm}					
5	Tightening torque of cylinder piston clamping nut	Lift	1.08 ± 0.11 kNm {110 ± 11.0 kgm} (Width across flats: 50 mm)					
		Tilt Pitch	3.97 ± 0.40 kNm {405 ± 40.5 kgm} (Width across flats: 80 mm)					
		Ripper	3.97 ± 0.40 kNm {405 ± 40.5 kgm} (Width across flats: 80 mm)					

Piston valve

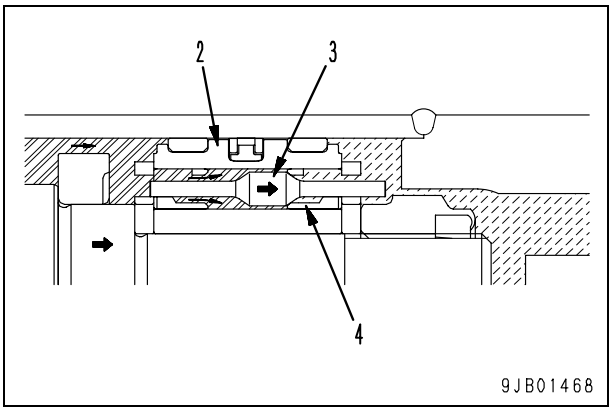
(lift cylinder)

Outline

- The piston valve is installed to the piston of the lift cylinder.
- When the piston rod is at the stroke end, oil from the pump is released to the port on the opposite side to lower the oil pressure applied to the piston.
  Oil is also released to the port on the opposite side before the piston rod reaches the stroke end to lower the surge pressure and reduce the shock made when the piston rod reaches the stroke end.

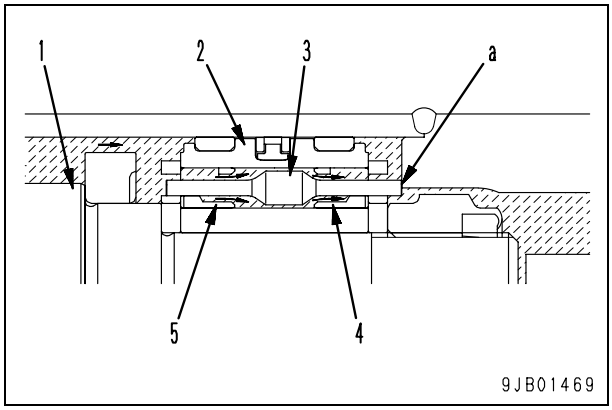
Operation

Piston valve “closed“



- The oil from the pump acts on piston (2) and piston valve (3).
  Then, piston valve (3) is pushed to the right to seal the tapered part of piston valve seat (4).
  As a result, the oil pressure in the cylinder rises to move piston (2) to the right.

Piston valve “open“



- The end of piston valve (3) touches cylinder bottom (a) before piston rod (1) reaches the stroke end, and then only piston (2) continues moving.
  At this time, the oil which has been stopped by piston valve (3) is released through piston valve seats (4) and (5) to the bottom side, thus the oil pressure in the cylinder lowers.

D65EX, PX, WX-15 Bulldozer

Form No. SEN00288-00

BULLDOZER

D65EX-15
D65PX-15
D65WX-15

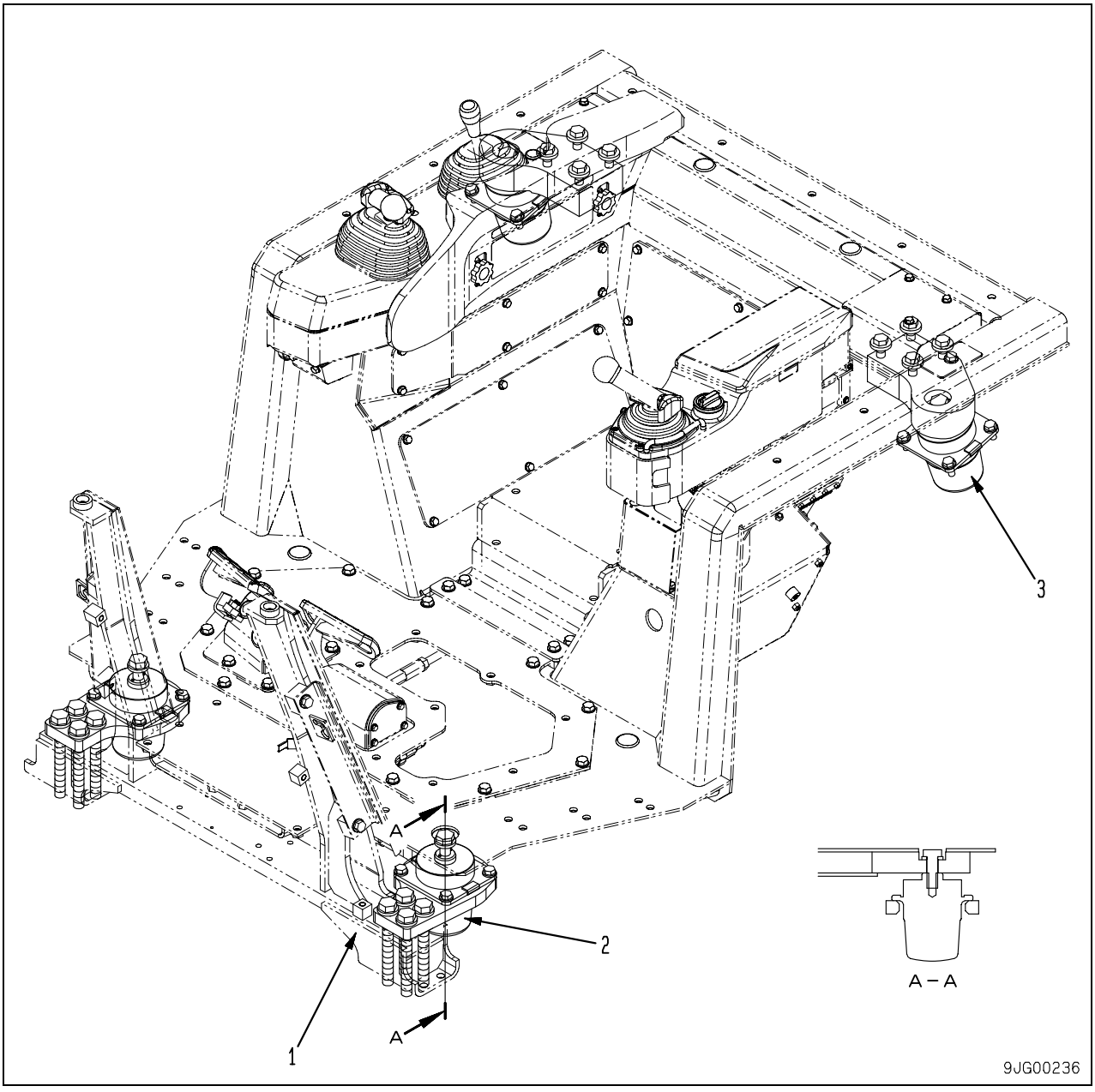
Machine model	Serial number
D65EX-15	69001 and up
D65PX-15	69001 and up
D65WX-15	69001 and up

10 Structure, function and maintenance standard

Cab and its attachments

Cab and its attachments

Cab mount

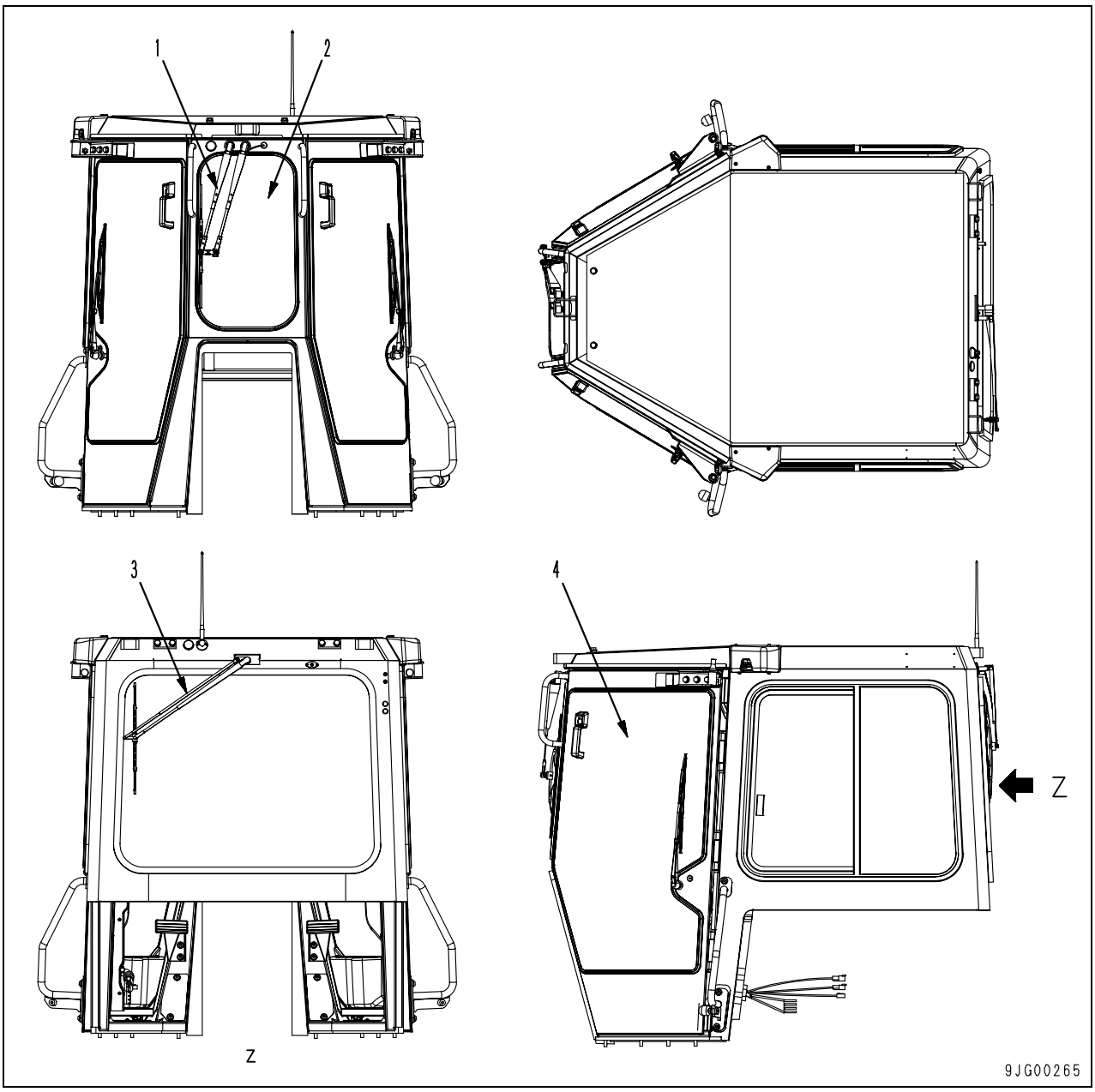


1. Support
2. Damper mount (front)
3. Damper mount (rear)

Outline

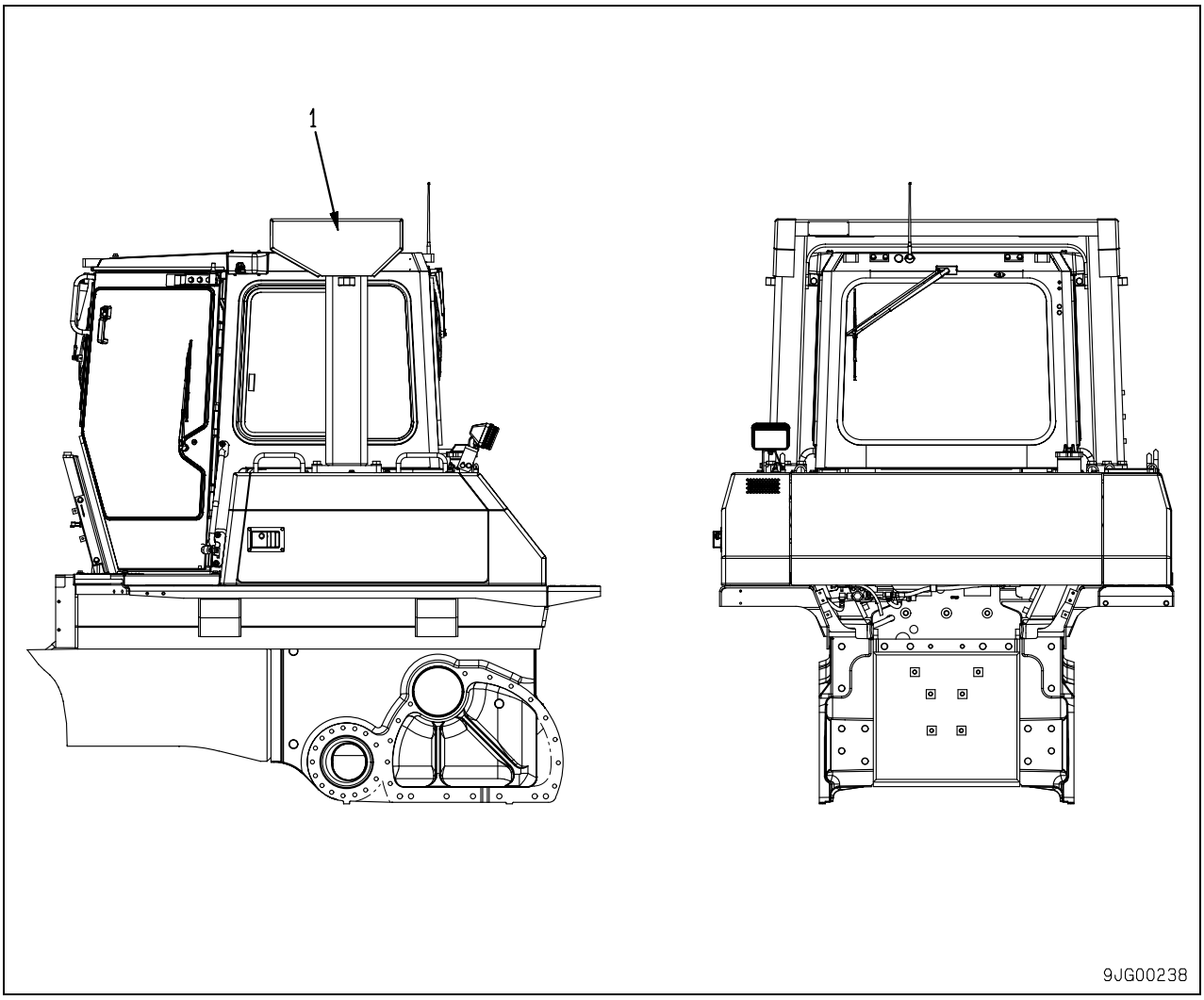
- Mounts are installed at two places in the front and two places in the rear to secure the floor frame and cab.
- An oil-filled damper mount is used to absorb the vibration.

Cab



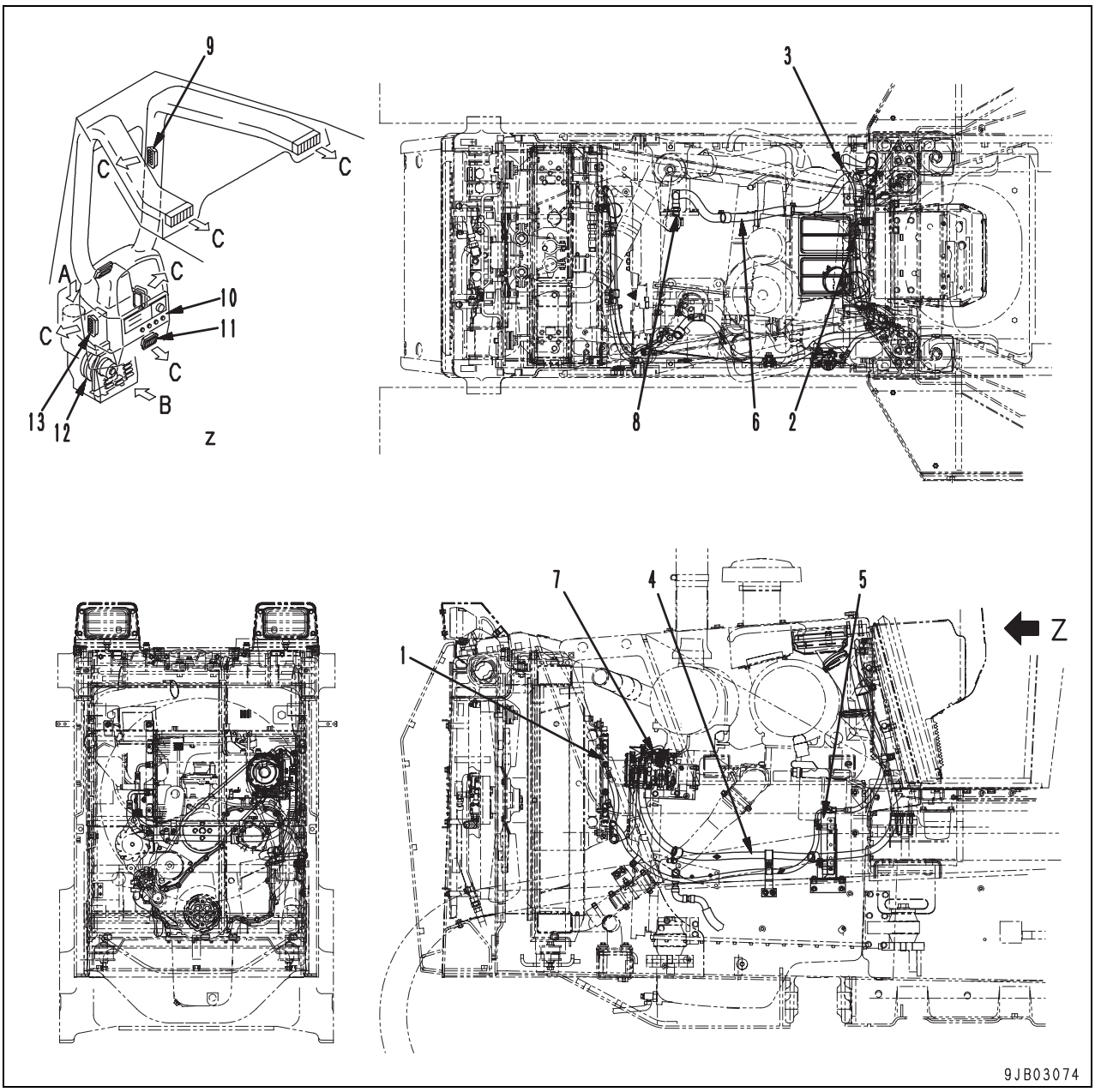
1. Front wiper
2. Front window
3. Rear wiper
4. Door

★ ROPS: Abbreviation for RollOver Protective Structure



1. ROPS guard

Air conditioner



1. Condenser
2. Hot water outlet
3. Hot water pick-up piping
4. Refrigerant piping
5. Receiver tank
6. Hot water return piping
7. Compressor
8. Hot water inlet
9. Front window defroster
10. Air conditioner unit
11. Vent
12. Blower motor
13. Side window defroster

A: Fresh air inlet
B: Recirculated air
C: Hot air/cold air

D65EX, PX, WX-15 Bulldozer

Form No. SEN00289-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

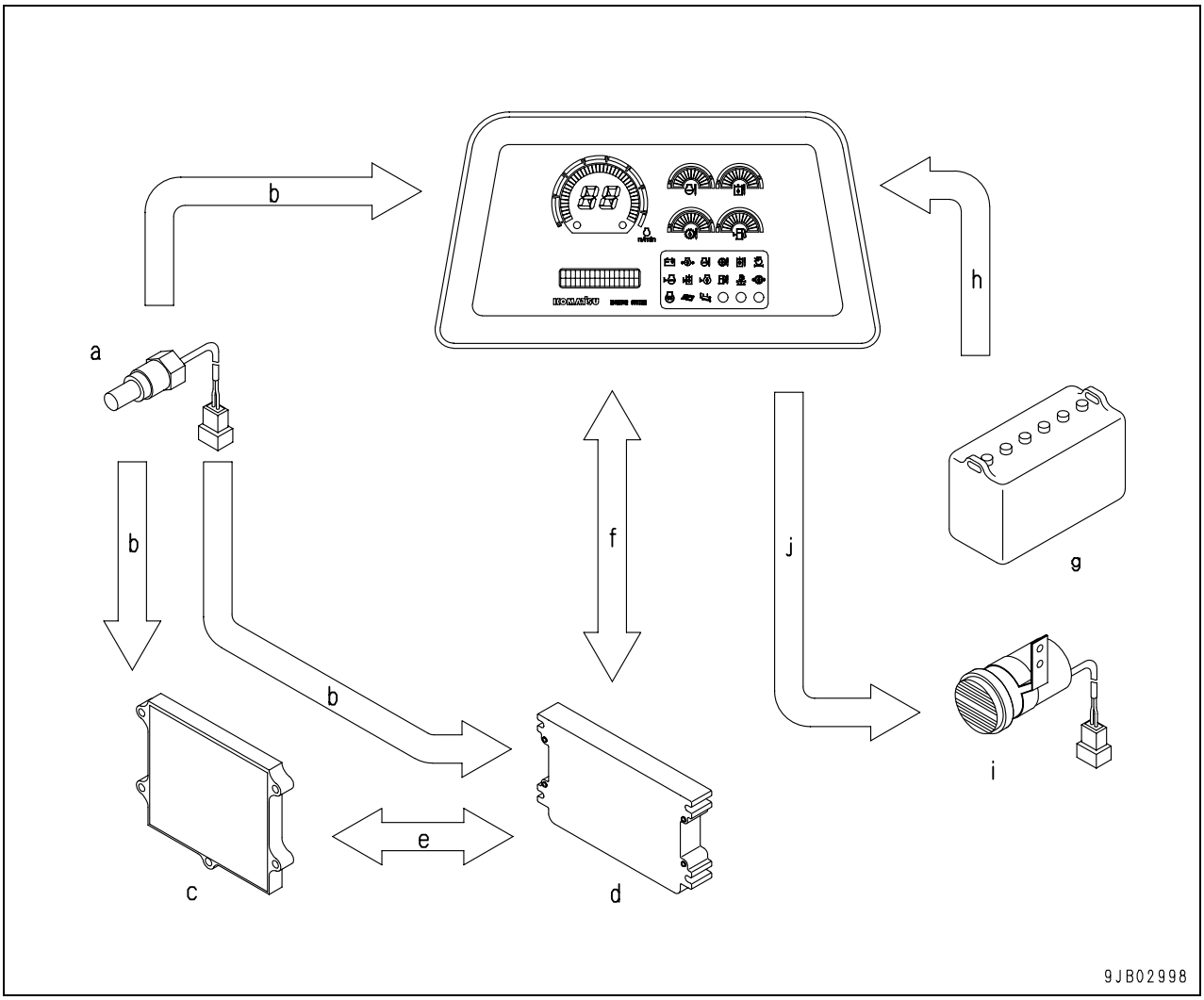
Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

10 Structure, function and maintenance standard

Electrical system

Electrical system

Monitor system



a. Each sensor
b. Sensor signal
c. Engine controller
d. Transmission and steering controller
e. CAN signal
f. Controller signal
g. Battery
h. Power source
i. Alarm buzzer
j. Alarm buzzer signal

- The monitor system notifies the operator of the machine condition. It monitors the machine condition with the sensors installed to the machine and processes and displays the obtained information on the monitor panel immediately.
  The contents displayed on the panel are roughly classified as shown bellow.

  1. Travel direction, gear speed (Display panel A)
  2. Engine speed, coolant temperature, hydraulic oil temperature, power train oil temperature, and fuel level (gauge section)
  3. Machine trouble alarm (Monitor section)
  4. Current, voltage, error code of each sensor and solenoid (Display panel B)

- The monitor system consists of the monitor panel, controller, sensors, alarm buzzer, and power supply.
- The component parts are connected by wiring harnesses and the monitor panel is powered by the battery.
- If the machine has any trouble (and a sensor detects it), the monitor and warning lamp flash and the alarm buzzer sounds to protect the machine. The alarm buzzer can be turned OFF temporarily with the buzzer cancel switch.

Processing in monitor panel (Common to all specifications)

Display of monitor panel

Contents and conditions of processing	Method	Flow of signals
1. Display of travel direction and gear speed • Signals (F1, R3, etc.) are sent to the monitor panel according to the information of the transmission and steering controller.	CAN signal	Each sensor/solenoid ↓ Controller ↓ Monitor panel
2. Display of engine speed, coolant temperature, hydraulic oil temperature, power train oil temperature, and fuel level by gauge • The controller processes the sensor signals and converts them into gauge levels and sends the result to the monitor panel.	CAN signal	
3. Display of trouble • If there is any trouble, its failure code signal is sent to the monitor panel. • Information about sounding the buzzer and flashing the caution lamp is sent, according to the contents of the trouble. 1) In normal state An action code is displayed. 2) In failure history display mode A failure code (6-characteristics code) and the following are displayed. • Elapsed time after first occurrence • Elapsed time after latest occurrence • Number of occurrence	CAN signal	

Display of monitoring

Contents and conditions of processing	Method	Flow of signals
1. Display of each sensor, each solenoid, communicating state of CAN signal, etc. • The signals of the item No. and condition of each device are sent to the monitor panel.	CAN signal	Each sensor ↓ Controller ↓ Monitor panel
2. Selection of each item with information switch, buzzer cancel switch, and up/downs (gear-shift) switch of the steering/directional/gear shift lever. (When using a mode for service, turn the service switch ON.)	CAN signal	

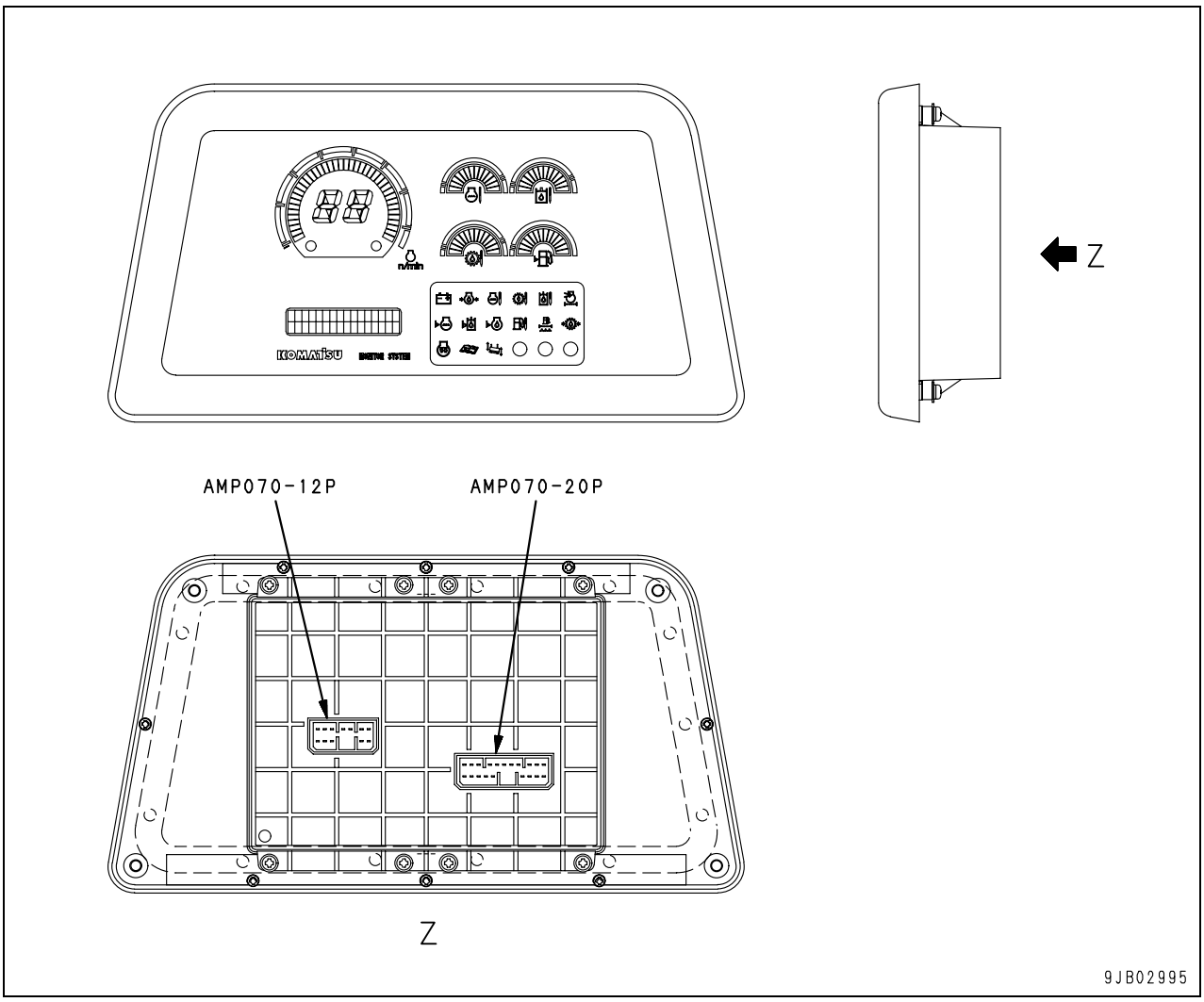
★ For details of the operating method, see Testing and adjusting, “Special functions of monitor panel (EMMS)”.

Other items

Contents and conditions of processing	Method	Flow of signals
1. Filter and oil maintenance mode 2. Pm clinic auxiliary mode 3. Failure code display mode 4. Adjustment mode (User) 5. Maintenance interval change mode 6. Electric system failure code display mode 7. Mechanical system failure code display mode 8. Adjustment mode (Service) 9. Load saving display mode 10. Real-time monitoring mode 11. Dual display monitoring mode	CAN signal	Each sensor ↓ Controller ↓ Monitor panel

★ For details of the operating method, see Testing and adjusting, “Special functions of monitor panel (EMMS)”.

Monitor panel



Outline

- The monitor panel consists of the monitor section which outputs an alarm when the machine has any trouble and the gauge section and the display panel which display the machine condition constantly.
  The monitor panel has a microcomputer, which processes and displays the signals from the sensors, solenoids, and controllers.
  The items displayed on the monitor section and the gauge section are shown in the topic “Display of monitor panel“.

Operation

When power is turned ON

(When starting switch is turned to “on“ position)

- All the LC segments and lamps of the monitor panel light up for 2 seconds and the alarm buzzer sounds for 2 seconds.

Check before starting

- After the operation performed when the power is turned ON, if there is any abnormal one in the check-before-starting items, the lamp of that item flashes or the contents of the abnormality are displayed on display panel B.

Caution items

- The caution items are checked constantly while the engine is running.
  If any item is abnormal, it and warning lamp flash synchronously. In some abnormal cases, the alarm buzzer may sound at this time.

Buzzer cancel switch

- If the switch is operated while the alarm buzzer is sounding, the buzzer is turned off temporarily.
  While the buzzer is turned OFF, if a new trouble which turns on the buzzer is detected, the buzzer sounds again.

★ The lamp lights up and goes off at the intervals of about 0.8 seconds.
★ The flashing intervals of the lamp may change a little when the temperature is low (below about –10°C). This does not indicate a trouble.

Input and output signals

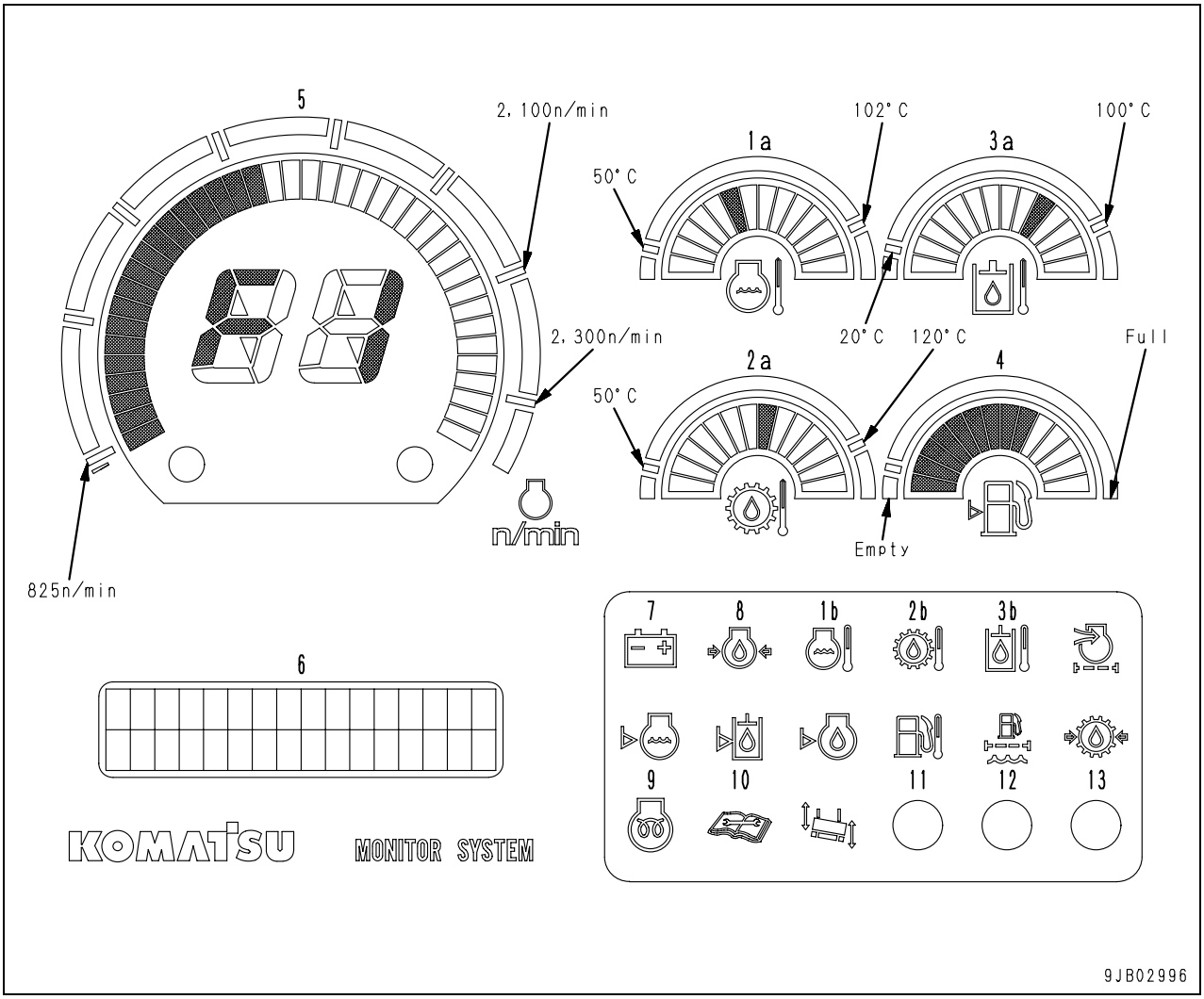
AMP070-20P [CN-S03]

Pin No.	Signal name	Input/Output signal
1	Power source (24 V)	Input
2	Power source (24 V)	Input
3	GND	—
4	GND	—
5	Constant power source (24 V)	Input
6	Constant power source (24 V)	Input
7	Starting switch (C)	Input
8	Night lightning	Input
9	Preheating	Input
10	NC	—
11	NC	—
12	NC	—
13	NC	—
14	NC	—
15	NC	—
16	Service switch	Input
17	NC	—
18	Alarm buzzer	Output
19	NC	—
20	NC	—

AMP070-12P [CN-S04]

Pin No.	Signal name	Input/Output signal
1	CAN0-H	Input/Output
2	CAN0-H	Input/Output
3	CAN0-L	Input/Output
4	CAN0-L	Input/Output
5	CAN shield	—
6	NC	—
7	NC	—
8	NC	—
9	Alternator (R)	Input
10	Fuel level	Input
11	NC	—
12	Power train oil temperature	Input

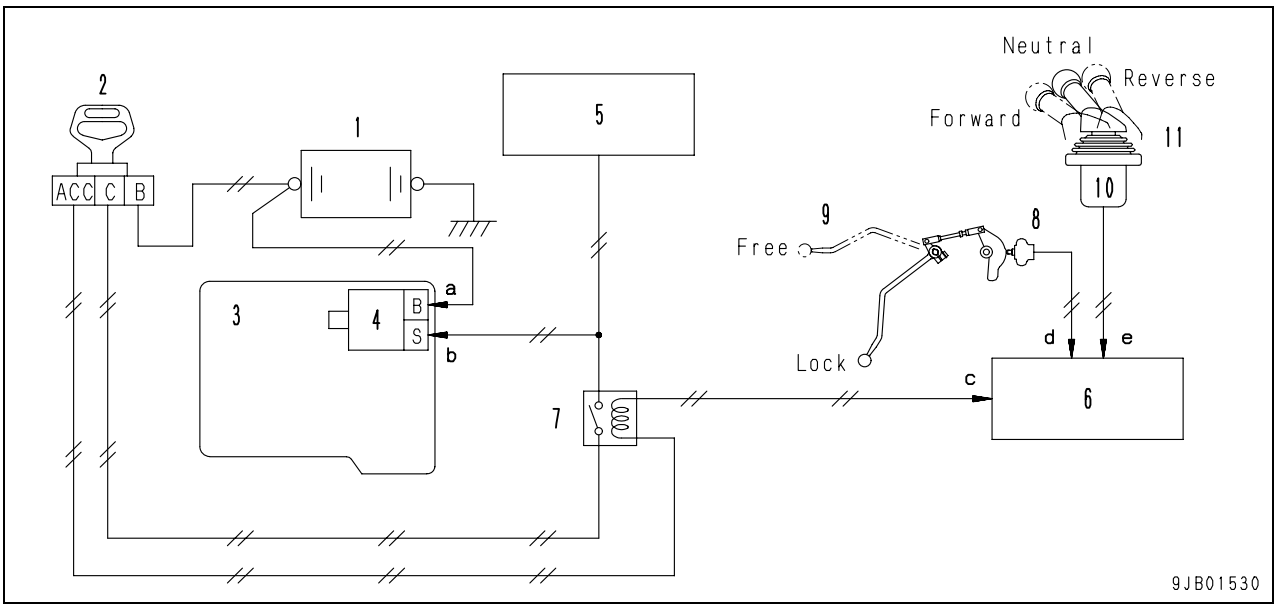
Display of monitor panel



No.	Display classification	Display item	Display range	Display method	Warning lamp output	Alarm buzzer output	Display color	Remarks
1a	Gauge	Coolant temperature	See diagram at left	Corresponding segment (1 place) lights up	—	—	Black	LCD
1b	Caution		102°C or lower	OFF	OFF	OFF	Red	LED
			102°C – 105°C	Flashing	Flashing	OFF		
			105°C or higher	Flashing	Flashing	ON		
2a	Gauge	Power train oil temperature	See diagram at left	Corresponding segment (1 place) lights up	—	—	Black	LCD
2b	Caution		120°C or lower	OFF	OFF	OFF	Red	LED
			120°C – 130°C	Flashing	Flashing	OFF		
			130°C or higher	Flashing	Flashing	ON		
3a	Gauge	Hydraulic oil temperature	See diagram at left	Corresponding segment (1 place) lights up	—	—	Black	LCD
3b	Caution		100°C or lower	OFF	OFF	OFF	Red	LED
			100°C – 110°C	Flashing	Flashing	OFF		
			110°C or higher	Flashing	Flashing	ON		
4	Gauge	Fuel level	See diagram at left	Corresponding and lower segments all light up	—	—	Black	LCD
5	Indicator	[*1] Display panel A (travel direction, gear speed engine tachometer)	Travel direction (P,N,F,R)	P: Parking brake lever “Lock“ , PCCS lever “Neutral“ON , PCCS lever “Other than Neutral“Flashing N:PCCS lever “Neutral“ ON F:PCCS lever “Forward “ON R:PCCS lever “Reverse“ ON	OFF	OFF		
			Gear speed (1, 2, 3)	1:PCCS lever gear speed SW “1st “ 2:PCCS lever gear speed SW “2nd“ 3:PCCS lever gear speed SW “3rd“				
	Gauge		See diagram at left	Corresponding and lower segments all light up	—	—		
6	Character display	[*1] Display panel B (service meter)	0 – 99999.9 h	Time is counted while engine is running (alternator is generating)	—	—		
7	Caution	Charge level	When charge is abnormal (12 V or lower)	Lamp is OFF (while engine is stopped)	OFF	OFF	Red	LED
				Flashing (while engine is running)	Flashing	OFF		
8		Engine oil pressure	Specified value or lower (49 kPa {0.5kg/cm^2})	Lamp is OFF (while engine is stopped)	OFF	OFF		
				Flashing (while engine is running)	Flashing	ON		
9	Pilot	Preheating	While preheating	ON	OFF	OFF	Green	
10	Caution	Maintenance	Before the 30 hour point	OFF	OFF	OFF	Orange	
			Between the 30 hour point to the replacement time	After starting switch is turned “ON“ lamp lights up for 30 seconds				
11		Warning lamp	See the “Warning lamp output“ column of this table.		—	—	Red	
12		Replacement time of filter and oil	Before the 30 hour point	OFF	OFF	OFF	Yellow	
			Between the 30 hour point to the replacement time	For 30 seconds after starting switch is turned “ON“ — Flashing				
			After the replacement time	For 30 seconds after starting switch is turned “ON“ — ON				
13		Check of operation of fan	• While fan is in forward rotation mode	OFF	OFF	OFF	Orange	
			• While fan is in reverse rotation, cleaning mode	ON				
			• Fan and selector switch are operated while the engine is running	Flashing (3 seconds)				

*1: For details of the operating in the service mode, see “Special functions of monitor panel (EMMS)“ in Testing and adjusting.

Engine control



1. Battery
2. Starting switch
3. Engine
4. Starting motor
5. Engine controller
6. Transmission and steering controller
7. Neutral safety relay
8. Limit switch
9. Parking brake lever
10. Electric lever
11. Steering/directional/gear shift lever (PCCS lever)

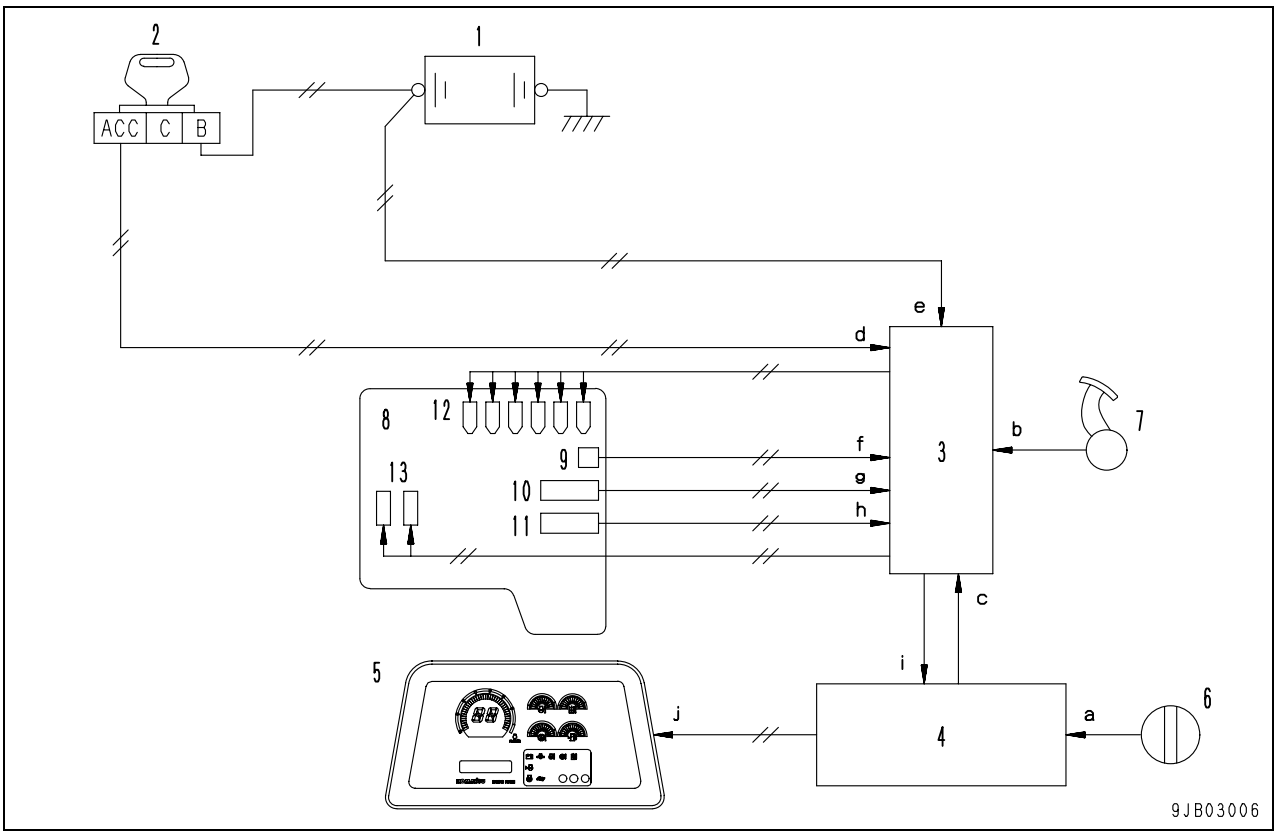
Input and output signals

a. Battery power source
b. Engine start signal
c. Starting switch ACC signal
d. Parking brake signal
e. Neutral signal

Function

- A limit switch is installed to the linkage of the parking brake. The transmission and steering controller permits the engine to start only when the parking brake is in the “lock“ position and the steering/directional/gear shift lever is in the “N (Neutral)“ position.

Engine control system



1. Battery
2. Starting switch
3. Engine controller
4. Transmission and steering controller
5. Monitor panel
6. Fuel control dial
7. Decelerator pedal
8. Engine
9. Engine speed sensor
10. Coolant temperature sensor
11. Engine oil pressure switch
12. Injector
13. Fuel supply pump valve

Input and output signals

a. 1st throttle signal (fuel control dial signal)
b. No.2 throttle signal (decelerator pedal signal)
c. No.3 throttle signal (controller control signal)
d. Starting switch ACC signal
e. Controller power source
f. Engine speed signal
g. Coolant temperature signal
h. Engine oil pressure signal
i. Sensor signal
j. Monitor display signal

Engine speed control mechanism

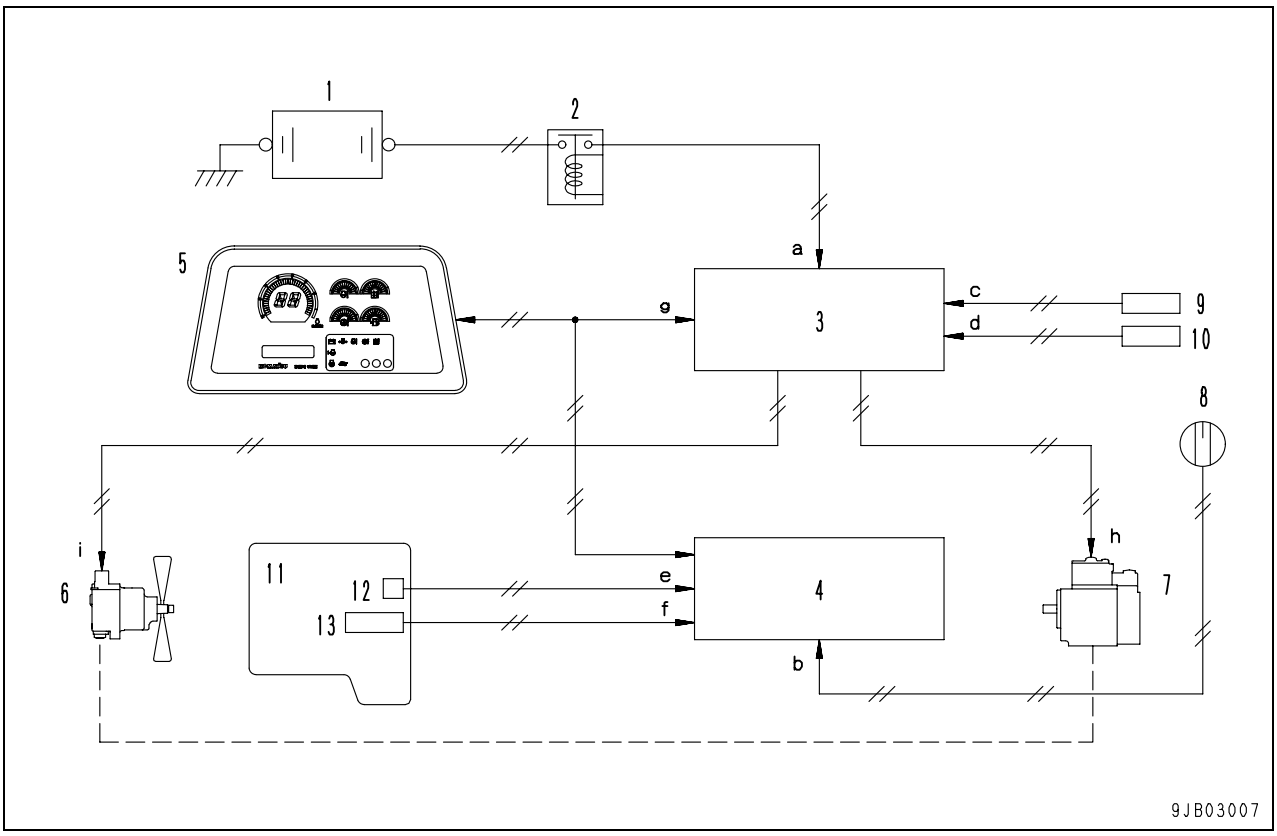
- The engine controller receives the No.1 throttle signal (fuel control dial signal) and No.2 throttle signal (decelerator pedal signal). It also receives the No.3 throttle signal (controller control signal) from the transmission and steering controller, and then selects the lowest command signal and controls the fuel supply pump and injector.
  The 3rd throttle signal has
  1) Automatic deceleration (F3, R3)

- The transmission and steering controller calculates proper engine speed from the information of 1) and sends it as the No.3 throttle signal to the engine controller.
- The information from the engine controller is owned jointly by the other controllers and transmitted so that the relationship between the engine and chassis will be optimized.
- The automatic deceleration is a function of lowering the engine speed temporarily when the travel direction is changed from F3 or R3. (for protection of the transmission clutch)

Engine stop mechanism

- If the starting switch is set in the OFF position, the starting switch ACC signal to the engine controller is turned OFF.
- The engine controller stops supplying fuel to the engine to stop the engine.

Cooling system control system



1. Battery
2. Battery relay
3. Transmission and steering controller
4. Engine controller
5. Monitor panel
6. Cooling fan motor
7. Cooling fan pump
8. Fan rotation selector switch
9. Power train oil temperature sensor
10. Hydraulic oil temperature sensor
11. Engine
12. Engine speed sensor
13. Coolant temperature sensor

Input and output signals

a. Controller power source
b. Fan rotation selector signal
c. Power train oil temperature signal
d. Hydraulic oil temperature signal
e. Engine speed signal
f. Coolant temperature signal
g. CAN signal
h. Pump control signal
i. Fan reverse signal

Outline

- The transmission and steering controller monitors the coolant, power train oil, and hydraulic oil temperatures and controls the fan speed according to those temperatures.

Function

Fan speed control

- The transmission and steering controller controls the discharge of the cooling fan pump to set the fan speed properly according to the information from the coolant, power train oil, and hydraulic oil temperature sensors.
- The transmission and steering controller selects the maximum target fan speed obtained from the coolant, power train oil, and hydraulic oil temperatures and outputs it as the pump control signal to the cooling fan pump.
- The cooling fan pump changes its swash plate angle to control its oil discharge for the cooling fan motor.

Selection of fan rotation mode

- While the starting switch is in the “on“ position and the engine is stopped, one of the following fan rotation modes can be selected with the fan rotation selector switch.
  Fan rotation mode includes;
  1) Forward rotation mode
  2) Cleaning mode
  According to the selected mode, the transmission and steering controller operates the reverse solenoid valve of the cooling fan motor to change the rotation direction of the fan.

  1) Forward rotation mode
     In this mode, the reverse solenoid valve does not operate and the fan rotates forward. The fan speed varies with the temperature sensor signal. This mode is selected normally.

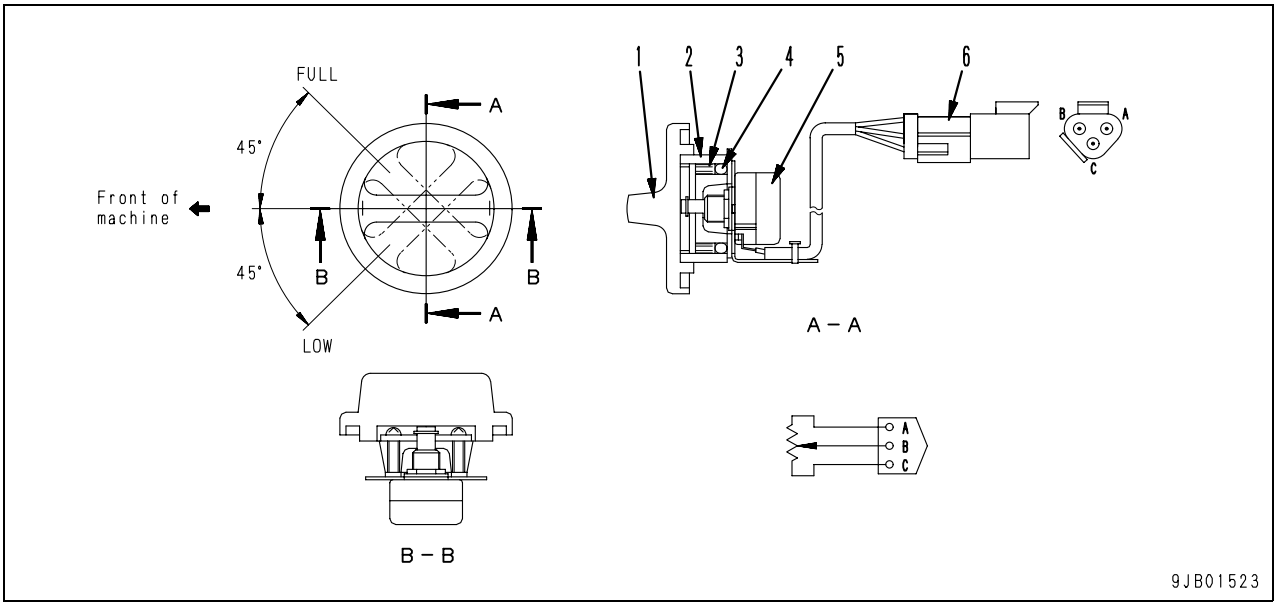
  2) Cleaning mode
     In this mode, the fan rotates in reverse at high speed to blow off dirt from the radiator fins, regardless of the temperature sensor signals. If this mode is used periodically, the cleaning interval of the radiator fins can be expanded.
     While in the “Cleaning mode“, the machine does not move for the radiator protection even if the PCCS lever is shifted to “forward“ or “reverse“ position.The starting switch needs to be turned from “off“ to “on“ to restart the machine under the “forward rotation mode“.

Interlock for changing rotation mode

- If the rotation direction of the fan is changed while the fan is rotating, the fan drive circuit is broken. To prevent this, the fan rotation selector switch signal is ignored while the engine is running. In this case, the fan operation pilot lamp on the monitor panel flashes for 3 seconds.

System components

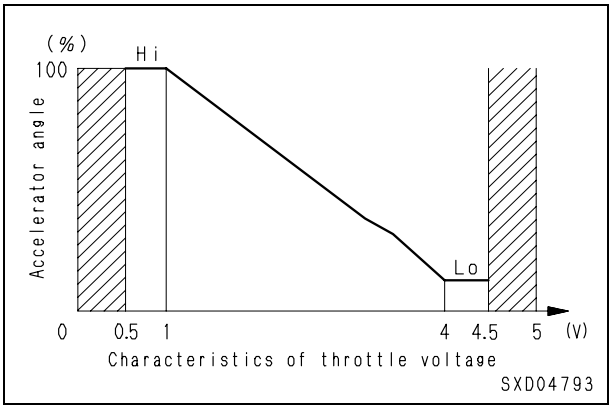
Fuel control dial



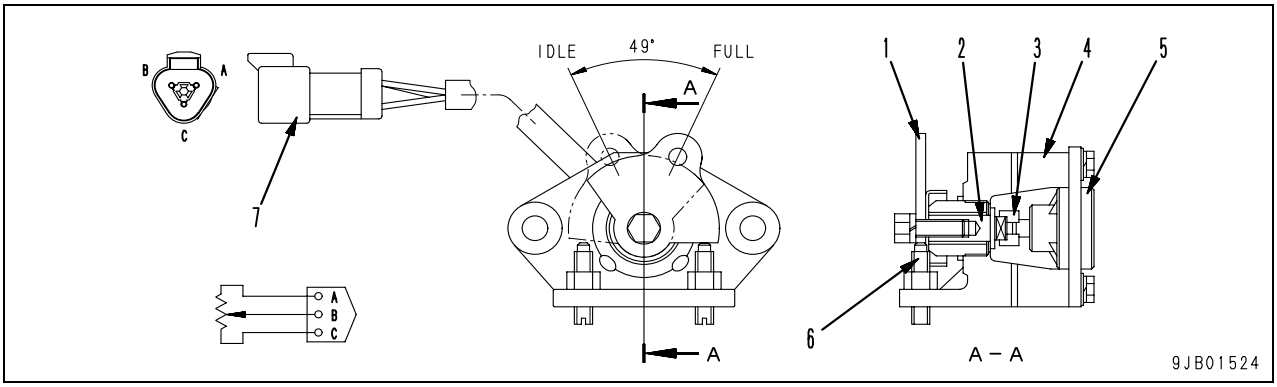
1. Knob
2. Dial
3. Spring
4. Ball
5. Potentiometer
6. Connector

Function

- The fuel control dial is installed to the left side of the operator's seat.
- If knob (1) is turned, the shaft of potentiometer (5) is turned to change the resistance of the variable resistor and send a throttle signal to the engine controller.
- The hatched areas in the following graph is the abnormality detection areas. In those areas, the engine speed is reduced to a half.



Decelerator pedal potentiometer

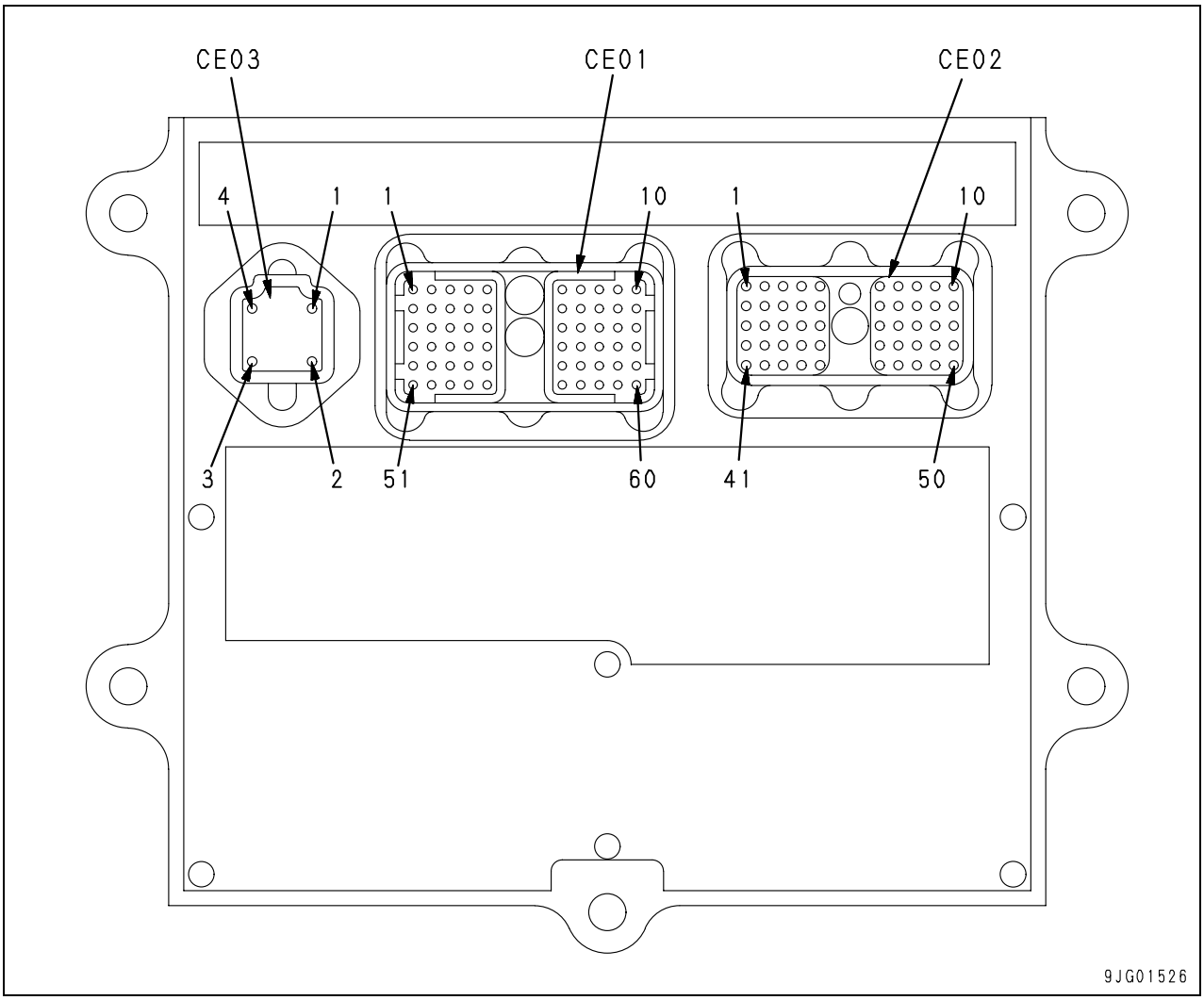


1. Lever
2. Shaft
3. Coupling
4. Body
5. Potentiometer
6. Stopper
7. Connector

Function

- The decelerator pedal potentiometer is installed under the front part of the floor and connected to the decelerator pedal by the linkage.
- If the decelerator pedal is operated, the shaft of potentiometer (5) is turned through the linkage to change the resistance of the variable resistor and send a deceleration signal to the engine controller.

Engine controller



- The signal classification used in the following terminal table is as follows:

  A: Power source
  B: Input
  C: Ground/shield/return
  D: Output
  E: Communication

CN-CE01

Pin No.	Signal name	Signal classification
1	Electrical fuel feed pump power source	D
2	IMA power source	D
3	Atmospheric pressure sensor	B
4	NC(*)	—
5	NC(*)	—
6	CAN(–)	E
7	NC(*)	—
8	CAN(+)	E
9	NC(*)	—
10	NC(*)	—

*: Do not connect to NC since it will cause malfunction and trouble.

CN-CE01

Pin No.	Signal name	Signal classification
11	Electrical fuel feed pump return	C
12	NC(*)	—
13	NC(*)	B
14	Water detection sensor	B
15	Water temperature sensor	B
16	Sensor power source (5V)	A
17	Oil pressure switch	B
18	NC(*)	—
19	NC(*)	—
20	NC(*)	—
21	NC(*)	—
22	NC(*)	D
23	Boost temperature sensor	B
24	NC(*)	—
25	Common rail pressure sensor	B
26	Bkup sensor (+)	B
27	NE sensor (+)	B

*: Do not connect to NC since it will cause malfunction and trouble.

CN-CE01

Pin No.	Signal name	Signal classification
28	NC(*)	—
29	NC(*)	—
30	NC(*)	—
31	NC(*)	D
32	NC(*)	C
33	GND	A
34	NC(*)	—
35	NC(*)	A
36	NC(*)	—
37	NC(*)	A
38	NC(*)	C
39	Key switch (ACC)	—
40	Intake air heater relay activate	—
41	NC(*)	—
42	Intake air heater relay deactivate	C
43	NC(*)	—
44	Boost pressure sensor	B
45	Injector #1 (+)	D
46	Injector #5 (+)	D
47	Sensor GND	C
48	Ne sensor (–)	C
49	NC(*)	—
50	NC(*)	—
51	Injector #2 (–)	C
52	Injector #3 (–)	C
53	Injector #1 (–)	C
54	Injector #2 (+)	D
55	Injector #3 (+)	D
56	Injector #4 (+)	D
57	Injector #6 (+)	D
58	Injector #4 (–)	C
59	Injector #6 (–)	C
60	Injector #5 (–)	C

*: Do not connect to NC since it will cause malfunction and trouble.

CN-CE02

Pin No.	Signal name	Signal classification
1	NC(*)	B
2	NC(*)	B
3	NC(*)	B
4	NC(*)	B
5	NC(*)	B
6	NC(*)	B
7	NC(*)	B
8	NC(*)	B
9	Fuel dial (+)	B
10	NC(*)	E
11	NC(*)	B
12	NC(*)	B

*: Do not connect to NC since it will cause malfunction and trouble.

CN-CE02

Pin No.	Signal name	Signal classification
13	NC(*)	B
14	NC(*)	B
15	NC(*)	B
16	NC(*)	B
17	NC(*)	B
18	NC(*)	B
19	NC(*)	B
20	NC(*)	E
21	NC(*)	A
22	Fuel dial (+5V)	A
23	Fuel dial (–)	C
24	NC(*)	B
25	NC(*)	B
26	NC(*)	B
27	NC(*)	B
28	NC(*)	B
29	NC(*)	C
30	NC(*)	B
31	NC(*)	B
32	NC(*)	C
33	GND	C
34	NC(*)	C
35	NC(*)	B
36	NC(*)	B
37	NC(*)	C
38	NC(*)	D
39	Key switch (ACC)	A
40	Intake air heater relay (output)	D
41	NC(*)	D
42	Intake air heater relay (return)	C
43	NC(*)	D
44	NC(*)	D
45	NC(*)	—
46	CAN(+)	E
47	CAN(–)	E
48	NC(*)	D
49	PWM OUTPUT (Power train relay output)	D
50	NC(*)	D

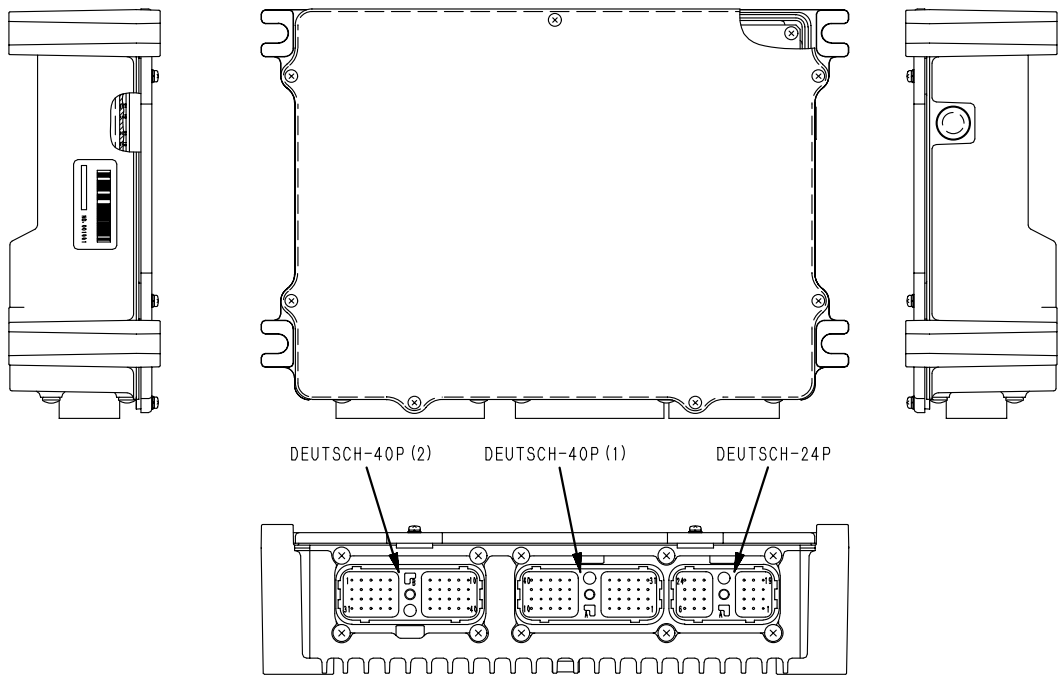
*: Do not connect to NC since it will cause malfunction and trouble.

CN-CE03

Pin No.	Signal name	Signal classification
1	GND	C
2	NC(*)	C
3	Power source (+24V constant)	A
4	NC(*)	A

*: Do not connect to NC since it will cause malfunction and trouble.

Transmission and steering controller



Input and output signals

DEUTSCH-24P [CN-ST1]

Pin No.	Signal name	Input/Output signal
1	Fuel dial	Input
2	Steering lever potentiometer 1	Input
3	Brake pedal potentiometer	Input
4	NC	—
5	NC	—
6	Service SW	Input
7	Travel lever position 4	Input
8	Pitch angle sensor	Input
9	Hydraulic oil temperature sensor	Input
10	NC	—
11	NC	—
12	Shift up SW (NC)	Input

Pin No.	Signal name	Input/Output signal
13	Travel lever position 3	Input
14	NC	—
15	Alternator (R)	Input
16	Sensor power source (+24 V)	Output
17	Key C signal	Input
18	Shift down SW (NO)	Input
19	Travel lever position 2	Input
20	NC	—
21	NC	—
22	Sensor power source (+5 V)	Output
23	NC	—
24	Shift down SW (NC)	Input

DEUTSCH-40P(1) [CN-ST2]

Pin No.	Signal name	Input/Output signal
1	NC	—
2	NC	—
3	NC	—
4	NC	—
5	Parking SW (NC)	Input
6	Cursor SW2	Input
7	Fan reverse SW	Input
8	Neutral safety relay	Input
9	NC	—
10	Manual mode SW	Input
11	NC	—
12	CAN shield	—
13	NC	—
14	NC	—
15	Parking SW (NO)	Input
16	Cursor SW1	Input
17	Fan forward SW	Input
18	Backup alarm relay	Output
19	NC	—
20	Immobilizing signal	Input

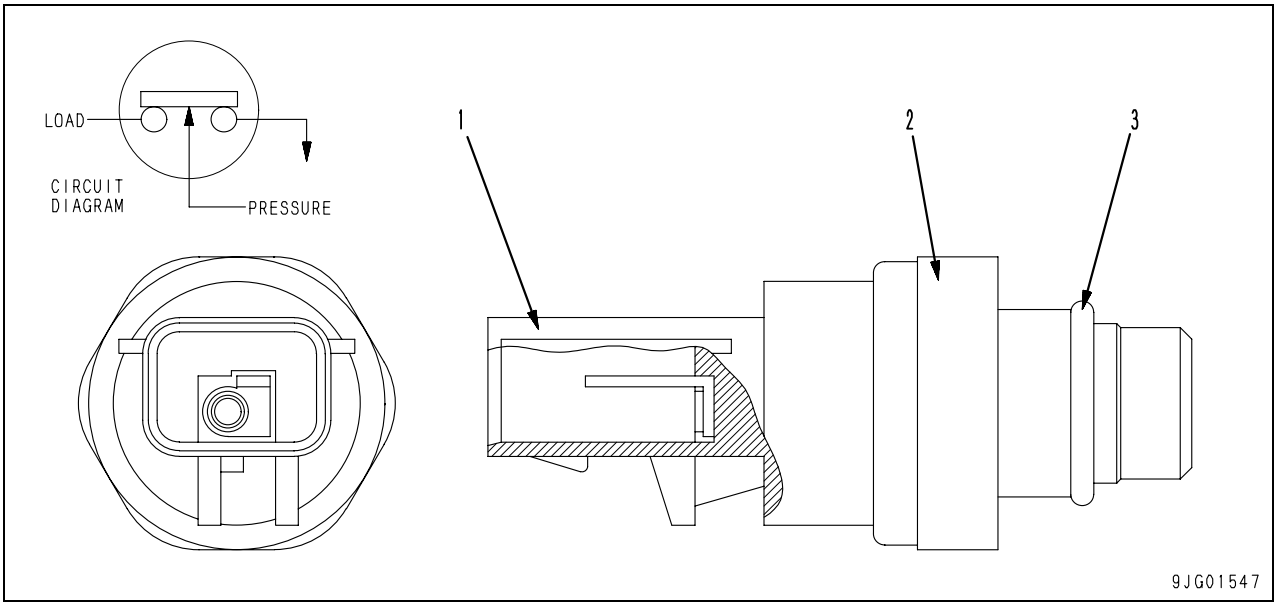
Pin No.	Signal name	Input/Output signal
21	NC	—
22	CAN0 (L)	Input/Output
23	NC	—
24	Service connector signal	Input
25	T/M reverse fill SW	Input
26	Select SW	Input
27	NC	—
28	NC	—
29	GND (Pulse)	—
30	Transmission output shaft speed	Input
31	NC	—
32	CAN0 (H)	Input/Output
33	NC	—
34	NC	—
35	T/M forward fill SW	Input
36	Alarm buzzer cancel SW	Input
37	Automatic shift-down SW	Input
38	NC	—
39	NC	—
40	NC	—

DEUTSCH-40P(2) [CN-ST3]

Pin No.	Signal name	Input/Output signal
1	Power source (Controller)	Input
2	Power source (Solenoid)	Input
3	GND (Solenoid, common)	Input
4	For activating battery relay	Output
5	NC	—
6	1st gear speed ECMV	Output
7	HSS pump TVC SOL	Output
8	NC	—
9	Shift up SW (NO)	Input
10	Pitch selector SW (NC)	—
11	Power source (Controller)	Input
12	Power source (Solenoid)	Input
13	GND (Solenoid, common)	Input
14	Starting switch (ACC)	Input
15	NC	—
16	2nd gear speed ECMV	Output
17	Pitch selector SOL	Output
18	Fan reverse SOL	Output
19	T/M 1st gear fill SW	Input
20	Pitch selector SW (NO)	—

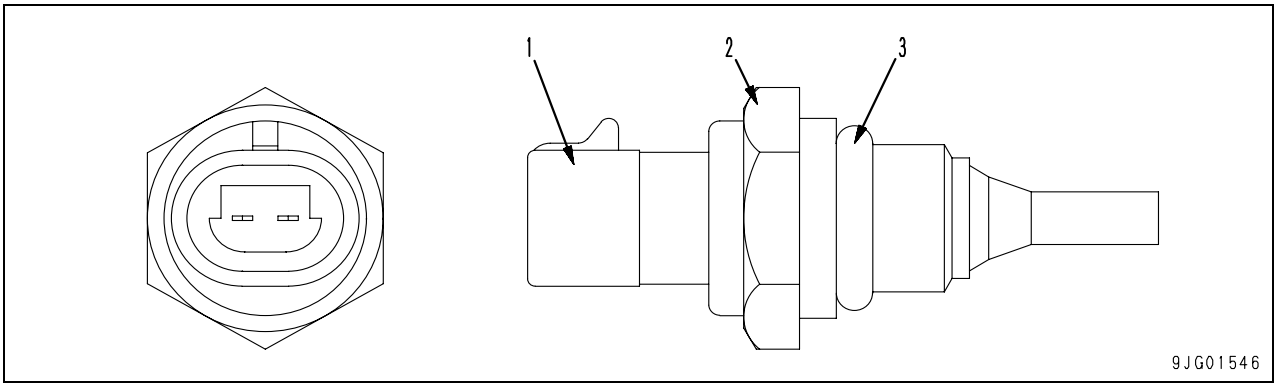
Pin No.	Signal name	Input/Output signal
21	GND (Power source)	Input
22	Power source (Solenoid)	Input
23	GND (Solenoid, common)	Input
24	Starting switch (ACC)	Input
25	HSS spool (Left)	Output
26	3rd gear speed ECMV	Output
27	Forward ECMV	Output
28	NC	—
29	T/M 2nd gear fill SW	Input
30	HSS specification selection	Input
31	GND (Power source)	—
32	GND (Power source)	—
33	GND (Power source)	—
34	NC	—
35	HSS spool (Right)	Output
36	Fan control SOL	Output
37	Reverse ECMV	Output
38	NC	—
39	T/M 3rd gear fill SW	Input
40	C/B specification selection	Input

Engine oil pressure switch



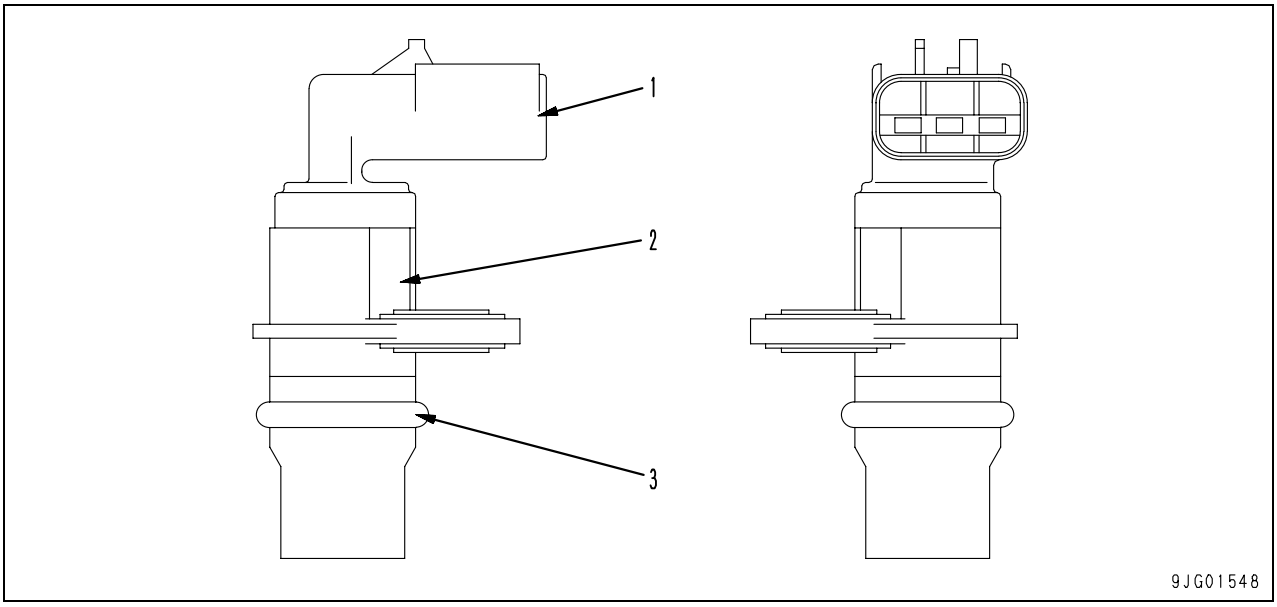
1. Connector
2. Sensor
3. O-ring

Coolant temperature sensor



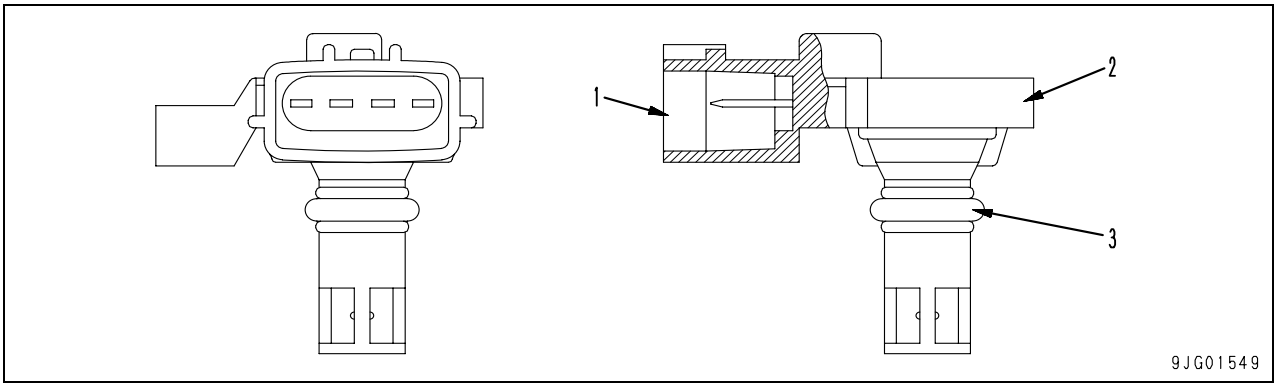
1. Connector
2. Sensor
3. O-ring

Engine speed sensor



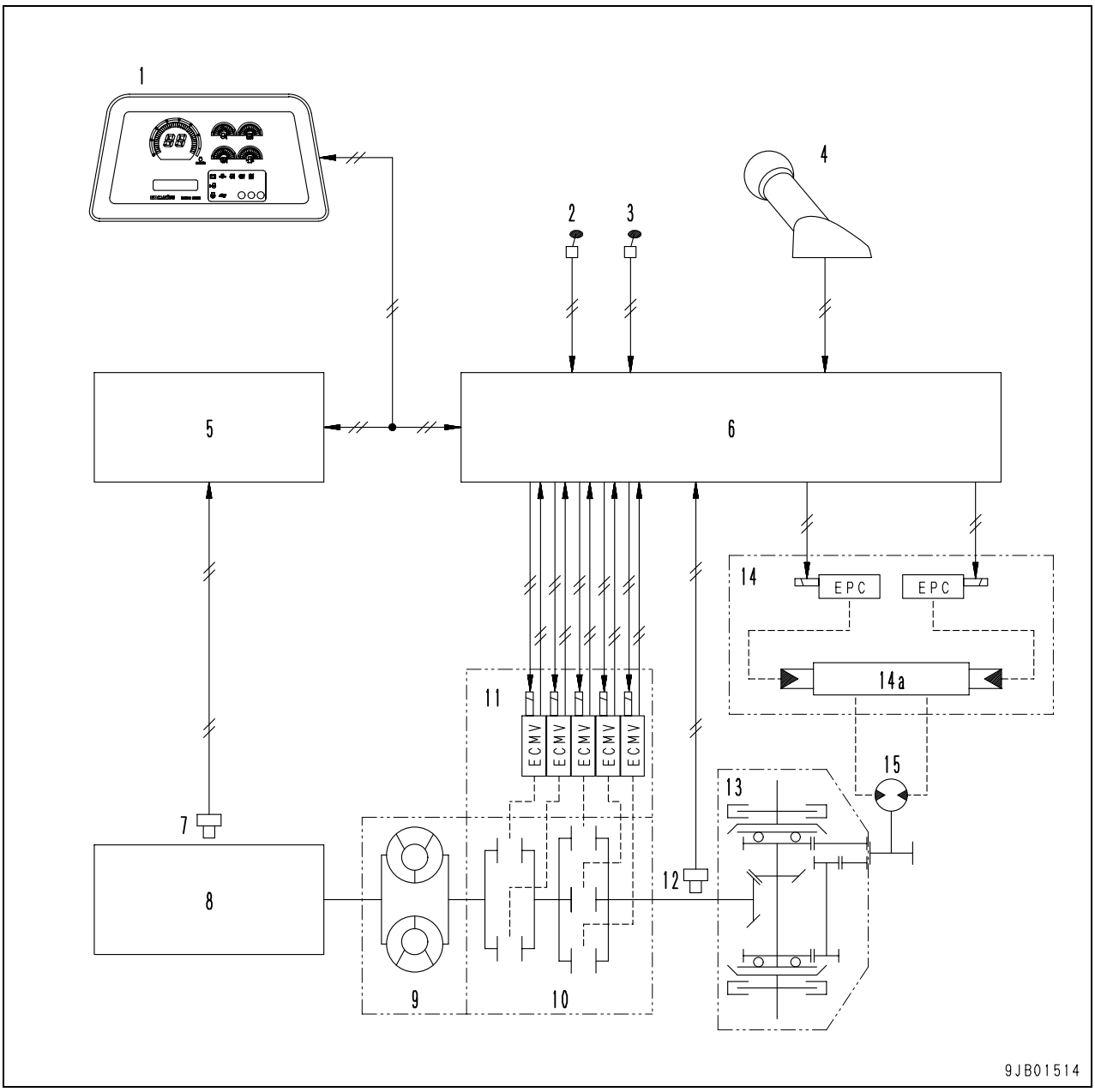
1. Connector
2. Sensor
3. O-ring

Boost pressure sensor
Boost temperature sensor



1. Connector
2. Sensor
3. O-ring

Palm command control system

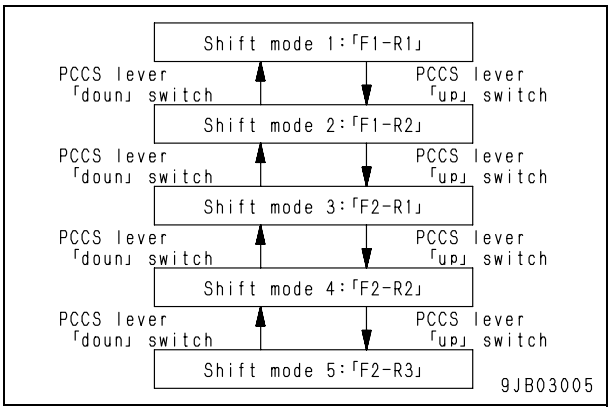


1. Monitor panel
2. Auto shift-down switch
3. Preset mode switch
4. Steering/directional/gear shift lever (PCCS lever)
5. Engine controller
6. Transmission and steering controller
7. Engine speed sensor
8. Engine
9. Torque converter
10. Transmission
11. Transmission control valve
12. Transmission output shaft speed sensor
13. HSS unit
14. Control valve
    14a. Steering control valve
15. HSS motor

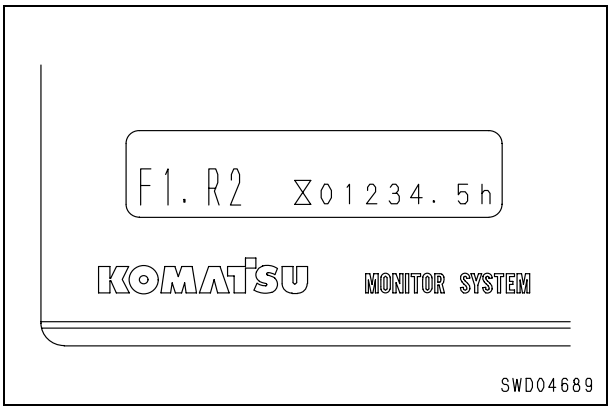
Preset mode function

- The gear speed applied for forward travel and reverse travel can be set in advance.
  Preset mode 1: F1 – R1
  Preset mode 2: F1 – R2
  Preset mode 3: F2 – R1
  Preset mode 4: F2 – R2
  Preset mode 5: F2 – R3

1. How to use
   1) Set the PCCS lever in the “N (Neutral)“ position.
   2) Set preset mode switch (1) to the “**I** (ON)“ position.
   3) Press the UP/DOWN switch of the PCCS lever to select a mode.



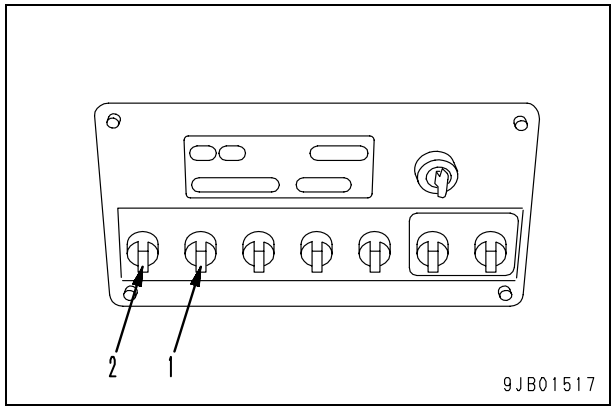
2. Display
   - The selected mode is displayed on display panel B of the monitor panel.



Auto shift-down function

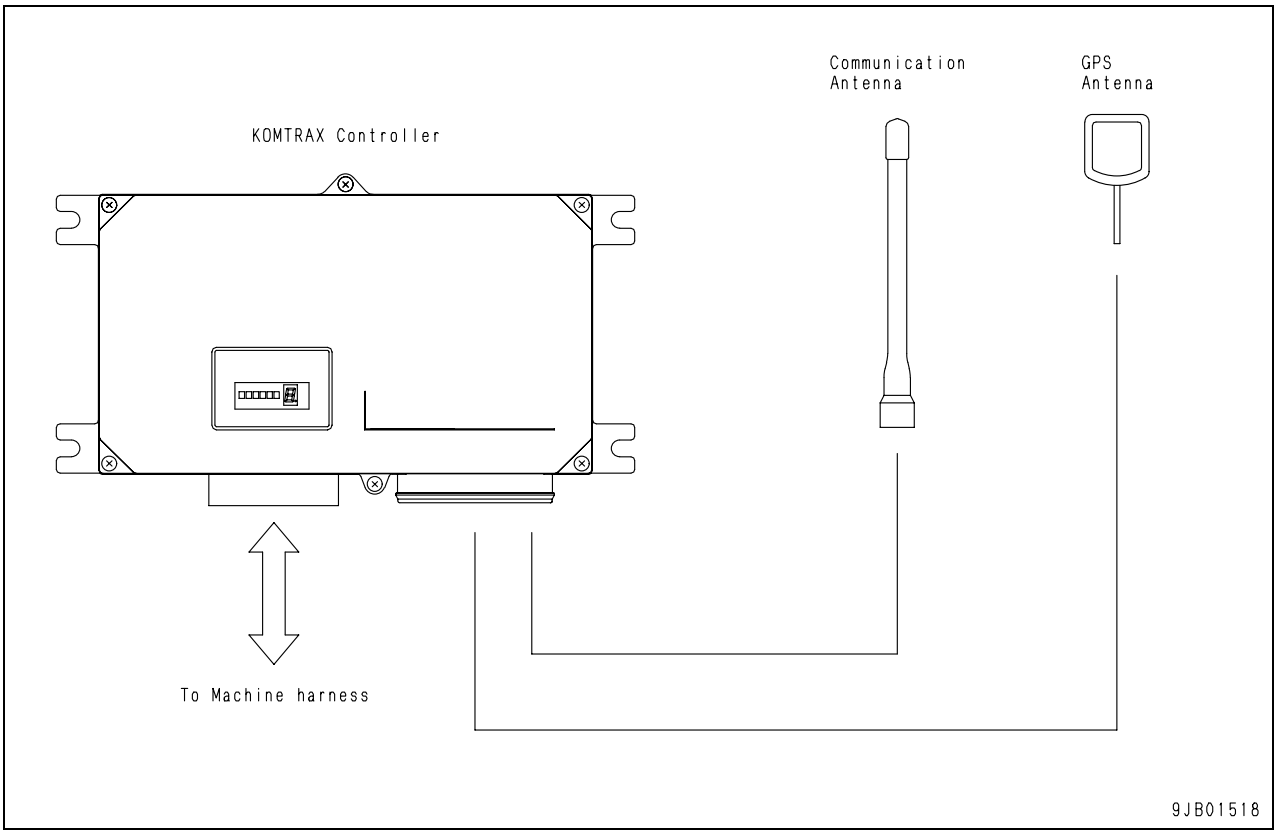
- If the travel speed lowers because of the loading condition, the transmission gear is shifted down automatically.
  1) The traction force (load on the chassis) is calculated from the engine speed, transmission output shaft speed, and the throttle information sent from the transmission and steering controller, and then the transmission gear is shifted down automatically according to the load and travel speed.
  2) Once the transmission gear is shifted automatically, it is not shifted up again automatically.
     (It can be shifted up with the UP switch of the PCCS lever, however.)
  3) This function is applicable to both forward and reverse travels.

1. How to use
   1) Set automatic shift-down switch (2) to the “**I** (ON)“ position.



KOMTRAX terminal system

(if equipped)

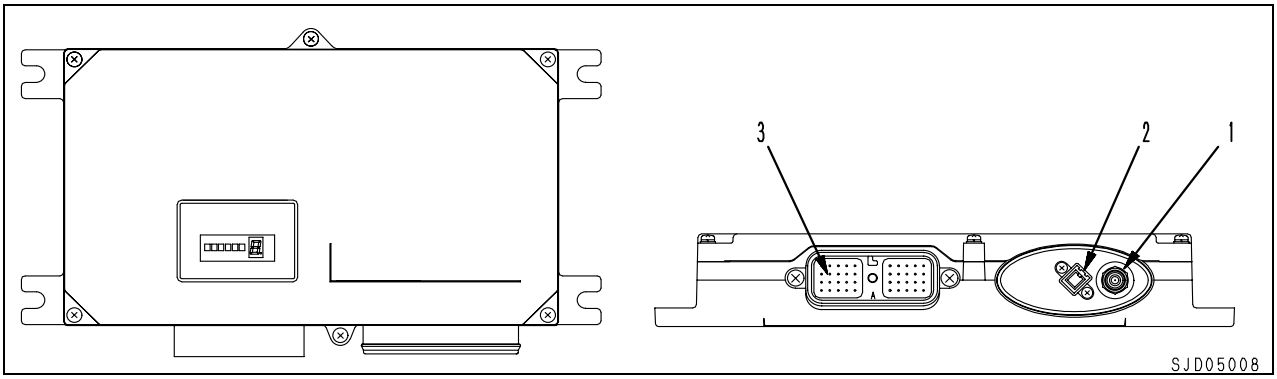


- The KOMTRAX terminal sends various information on the machine by a wireless communication.The KOMTRAX operator refers to this information in the office, and various services can be provided for the customer.

  ★ To be provided with the KOMTRAX terminal service, it is necessary to sign up separately.

  Information that can be sent from the KOMTRAX terminal is as follows:
  1. Traveling map
  2. Service meter
  3. Location information
  4. Error history

KOMTRAX terminal



1. Communication antenna connector
2. GPS antenna connector
3. Machine harness connector (DEUTSCH-40P)

Input and output signals

DEUTSCH-40P [CN-G01]

Pin No.	Signal name	Input/Output signal
1	NC	—
2	NC	—
3	NC	—
4	NC	—
5	NC	—
6	CAN shield GND	—
7	CAN signal (L)	Input/Output
8	CAN signal (H)	Input/Output
9	NC	—
10	NC	—
11	NC	—
12	NC	—
13	NC	—
14	NC	—
15	NC	—
16	NC	—
17	NC	—
18	NC	—
19	NC	—
20	Immobilizing signal	Output

Pin No.	Signal name	Input/Output signal
21	Operation mode selection 1	Input
22	Operation mode selection 2	Input
23	NC	—
24	NC	—
25	NC	—
26	NC	—
27	Starting switch (C)	Input
28	Alternator (R)	Input
29	NC	—
30	NC	—
31	NC	—
32	NC	—
33	NC	—
34	NC	—
35	NC	—
36	Starting switch (ACC)	Input
37	Power source GND	—
38	Power source GND	—
39	Constant power source (24V)	Input
40	Constant power source (24V)	Input

Outline

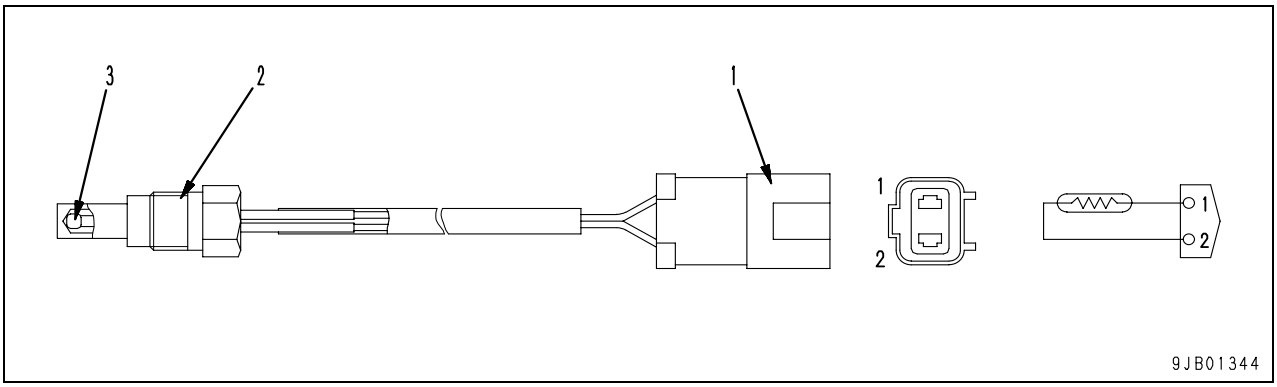
- The KOMTRAX controller can send information via wireless communication antenna, acquiring various information of the machine from the network signal in the machine and the input signal. Also, the controller incorporates CPU (Central Processing Unit) and provide the wireless communication function and the GPS function.
- There are the LED lamp and the 7-segment indicator lamp in the display area, and these lamps are used for the testing and the troubleshooting.
- The information of the LED lamp and the 7-segment indicator lamp can be checked on the monitor panel by EMMS.

Sensor

- The signals from the sensors are input through the controller to the monitor panel.
- The sensors are classified into 3 types: resistance type, electromagnetic type, and capacitor type.

Type of sensor	Sensor method	When normal	When abnormal
Power train oil temperature	Resistance	—	—
Hydraulic oil temperature	Resistance	—	—
Fuel level	Resistance	—	—
Transmission output shaft speed	Electromagnetic	—	—
Pitch angle	Capacitor	—	—

Power train oil temperature sensor
Hydraulic oil temperature sensor

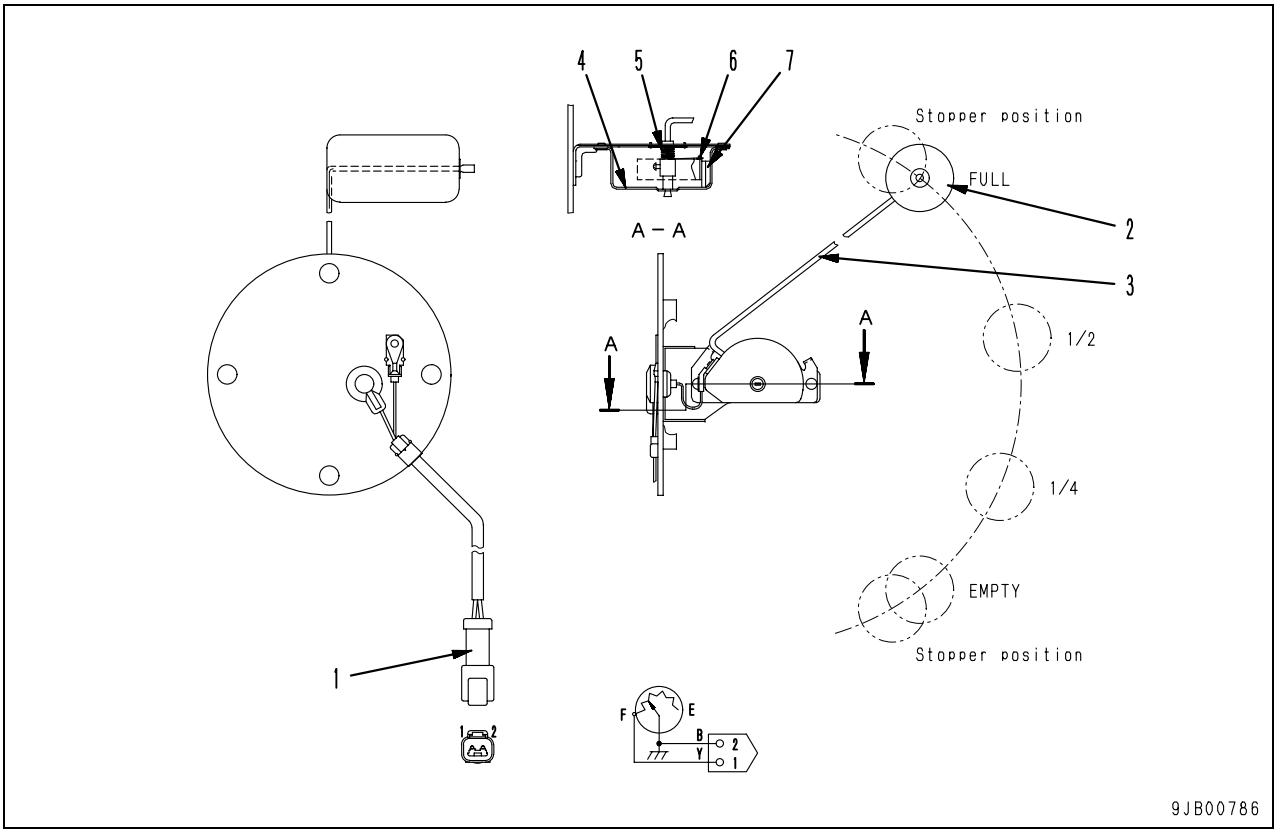


1. Connector
2. Plug
3. Thermistor

Function

- The power train oil temperature sensor is installed to the power train outlet piping. The hydraulic oil temperature sensor is installed to the hydraulic piping. These sensors sense the change of the temperature by the change of resistance of the thermistors.
  The temperature signals are sent through the network to the transmission and steering controller and used to control the cooling fan.

Fuel level sensor

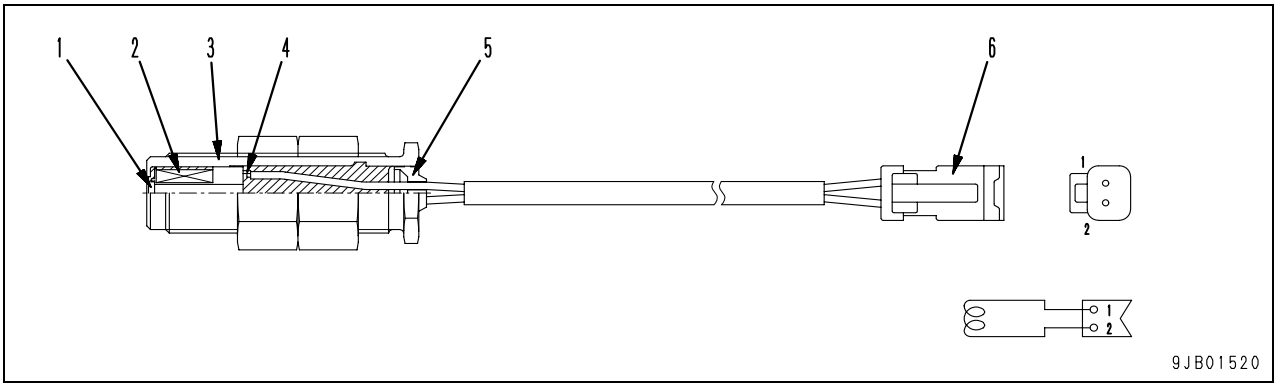


1. Connector
2. Float
3. Arm
4. Body
5. Spring
6. Contact
7. Spacer

Function

- The fuel level sensor is installed to the side of the fuel tank. Its float moves up and down according to the fuel level.
  The movement of the float operates the variable resistor through the arm. As a result, signals of change in resistance are generated.

Transmission output shaft speed sensor

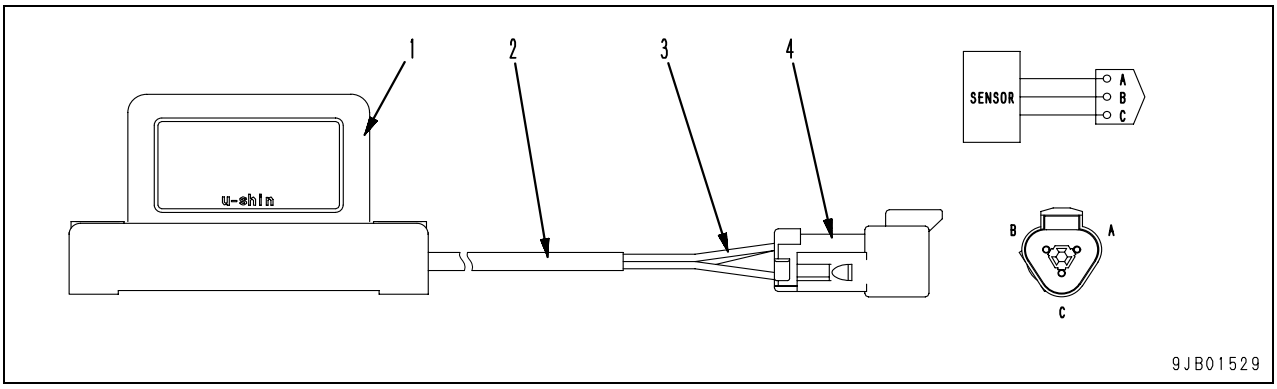


1. Magnet
2. Wire
3. Housing
4. Terminal
5. Boot
6. Connector

Function

- The transmission output shaft speed sensor is installed to the bevel gear of steering case. It generates pulse voltages as the gear rotates.

Pitch angle sensor



1. Body
2. Tube
3. Wire
4. Connector

Function

- The pitch angle sensor is installed to the base of the ROPS in the filter cover on the right side of the chassis.
- There are multiple electrodes and oil in this sensor. The changes of the oil level made by inclination of the machine are sensed by the differences in electrostatic capacity between the electrodes, and then those differences are converted into voltage signals.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00290-01

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

20 Standard value table

Standard service value table

Standard service value table

Standard service value table for engine

Machine model				D65EX,PX,WX-15	
Engine				SAA6D114E-3	
Check item	Measurement conditions		Unit	Standard value for new machine	Permissible value
Rotation speed	High idle		rpm	2,030 ± 50	2,030 ± 50
	Low idle			825 ± 25	825 ± 25
	Rated speed			1,950	—
Air boost pressure (boost pressure) (Aftercooler outlet)	At rated horsepower		kPa {mmHg}	129 – 169 {970 – 1,270}	94.7 {710}
Exhaust gas color	At sudden acceleration (Lo→Hi) At high idle		Bosch index	Max. 2.5 Max. 1.0	3.5 2.0
Exhaust temperature (Turbine inlet temperature)	Whole speed range (Ambient temperature 20°C)		°C	Max. 750	Max. 750
Valve clearance (Normal temperature)	Intake valve Exhaust valve		mm	0.305 0.559	0.152 – 0.559 0.381 – 0.813
Compression pressure (SAE30 or SAE15W-40)	Oil temperature: 40 – 60°C (Engine speed)		MPa {kg/cm^2}	Presently setting	Presently setting
Blow-by pressure (SAE30 or SAE15W-40)	(Coolant temperature: Operating range) At rated horsepower		kPa {mmH_2O}	Max. 1.57 {Max. 160}	Max. 2.55 {Max. 260}
Oil pressure	(Coolant temperature: Operating range) When torque converter is stalling (SAE30 or SAE15W-40) At low idle (SAE30 or SAE15W-40)		kPa {kg/cm^2}	343 – 588 {3.5 – 6.0} Min. 147 {Min. 1.5}	206 {2.1} 78 {0.8}
Oil temperature	Whole speed range (Inside oil pan)		°C	80 – 110	Min. 120
Belt tension	Deflection when pressed with finger force of approx. 98 N {approx. 10 kg}	Alternator – crankshaft pulley	mm	Auto-tensioner	—
		Air conditioner compressor – crankshaft pulley		15 – 18	—

Standard service value table for chassis

Machine model						D65EX,WX-15	
Classification	Check item		Measurement conditions		Unit	Standard value for new machine	Permissible value
Engine speed	Decelerator pedal speed		• Coolant temperature: Within operating range • Power train oil temperature: Within operating range • Hydraulic oil temperature: Within operating range • Decelerator pedal speed: Press pedal. • Torque converter stall speed: F3		rpm	1,000 ± 25	1,000 ± 25
	Torque converter stall speed					1,770 ± 100	1,650
Stroke of control lever and pedal	PCCS lever	Forward and reverse	• Stop engine. • Center of lever knob.	Neutral → Forward	mm	30 ± 10	30 ± 10
				Neutral → Reverse		30 ± 10	30 ± 10
		Steering		Neutral → Left		40 ± 15 (Play: Max. 3)	40 ± 15 (Play: Max. 3)
				Neutral → Right		40 ± 15 (Play: Max. 3)	40 ± 15 (Play: Max. 3)
	Decelerator pedal		• Stop engine. • Center of pedal.			48 ± 9	48 ± 9
	Brake pedal		• Engine: Low idle • Center of pedal.	All stroke		79 ± 12	79 ± 12
	Blade control lever		• Engine: Low idle • Hydraulic oil temperature: 45 – 55°C • Center of lever knob.	Neutral → Raise or Float		72 ± 11	72 ± 11
				Neutral → Lower		52 ± 9	52 ± 9
				Neutral → Left or Right tilt		54 ± 8	54 ± 8
	Ripper control lever (If equipped)		• Engine: Low idle • Hydraulic oil temperature: 45 – 55°C • Center of lever knob.	Neutral → Raise or Lower		54 ± 8	54 ± 8
Operating effort of control lever and pedal	PCCS lever	Forward and reverse	• Stop engine. • Center of lever knob.	Neutral → Forward or Reverse	N {kg}	56.9 ± 19.6 {5.8 ± 2.0}	56.9 ± 19.6 {5.8 ± 2.0}
				Forward or Reverse → Neutral		51 ± 19.6 {5.2 ± 2.0}	51 ± 19.6 {5.2 ± 2.0}
		Steering		Neutral → Left		24.5 ± 9.8 {2.5 ± 1.0}	24.5 ± 9.8 {2.5 ± 1.0}
				Neutral → Right		27.4 ± 9.8 {2.8 ± 1.0}	27.4 ± 9.8 {2.8 ± 1.0}
	Decelerator pedal		• Engine: Low idle • Center of pedal.			73.5 ± 24.5 {7.5 ± 2.5}	73.5 ± 24.5 {7.5 ± 2.5}
	Brake pedal		• Engine: Low idle • Center of pedal.			510 ± 88 {52 ± 9.0}	666 {68}

D65PX-15					
Standard value for new machine	Permissible value				
1,000 ± 25	1,000 ± 25				
1,770 ± 100	1,650				
30 ± 10	30 ± 10				
30 ± 10	30 ± 10				
40 ± 15 (Play: Max. 3)	40 ± 15 (Play: Max. 3)				
40 ± 15 (Play: Max. 3)	40 ± 15 (Play: Max. 3)				
48 ± 9	48 ± 9				
79 ± 12	79 ± 12				
72 ± 11	72 ± 11				
52 ± 9	52 ± 9				
54 ± 8	54 ± 8				
—	—				
56.9 ± 19.6 {5.8 ± 2.0}	56.9 ± 19.6 {5.8 ± 2.0}				
51 ± 19.6 {5.2 ± 2.0}	51 ± 19.6 {5.2 ± 2.0}				
24.5 ± 9.8 {2.5 ± 1.0}	24.5 ± 9.8 {2.5 ± 1.0}				
27.4 ± 9.8 {2.8 ± 1.0}	27.4 ± 9.8 {2.8 ± 1.0}				
73.5 ± 24.5 {7.5 ± 2.5}	73.5 ± 24.5 {7.5 ± 2.5}				
510 ± 88 {52 ± 9.0}	666 {68}				

Machine model					D65EX,WX-15	
Classification	Check item	Measurement conditions		Unit	Standard value for new machine	Permissible value
Operating effort of lever	Blade control lever	• Engine: Low idle • Hydraulic oil temperature: 45 – 55°C • Center of lever knob.	Neutral → Raise or Lower	N {kg}	29.4 ± 9.8 {3.0 ± 1.0}	29.4 ± 9.8 {3.0 ± 1.0}
			Neutral → Float		74.5 ± 19.6 {7.6 ± 2.0}	74.5 ± 19.6 {7.6 ± 2.0}
			Neutral → Left or Right tilt		25.5 ± 9.8 {2.6 ± 1.0}	25.5 ± 9.8 {2.6 ± 1.0}
	Ripper control lever (If equipped)	• Engine: Low idle • Hydraulic oil temperature: 45 – 55°C • Center of lever knob.	Neutral → Raise		25.5 ± 9.8 {2.6 ± 1.0}	25.5 ± 9.8 {2.6 ± 1.0}
			Neutral → Lower		25.5 ± 9.8 {2.6 ± 1.0}	25.5 ± 9.8 {2.6 ± 1.0}
Power train oil pressure	Torque converter inlet pressure	• Power train oil temperature: 70 – 80°C	Engine: Low idle	MPa {kg/cm2}	0.1 – 0.5 {1 – 5}	0.1 – 0.5 {1 – 5}
			Engine: High idle		Max. 0.88 {Max. 9}	Max. 0.88 {Max. 9}
	Torque converter outlet pressure		Engine: Low idle		0.05 – 0.29 {0.5 – 3}	0.05 – 0.29 {0.5 – 3}
			Engine: High idle		0.39 – 0.69 {4 – 7}	0.39 – 0.69 {4 – 7}
	Transmission main relief pressure		Engine: Low idle		3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}
			Engine: High idle		3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}
	Transmission F clutch pressure		Engine: Low idle		3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}
			Engine: High idle		3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}
	Transmission R clutch pressure		Engine: Low idle		3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}
			Engine: High idle		3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}
	Transmission 1st clutch pressure		Engine: Low idle		3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}
			Engine: High idle		3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}
	Transmission 2nd clutch pressure		Engine: Low idle		3.13 ± 0.1 {32.0 ± 1.0}	Min. 2.84 {Min. 29}
			Engine: High idle		3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}
	Transmission 3rd clutch pressure		Engine: Low idle		3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}
			Engine: High idle		3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}
	Transmission lubricating oil pressure (For reference)		Engine: High idle		0.1 – 0.25 {1.0 – 2.5}	0.1 – 0.25 {1.0 – 2.5}

D65PX-15					
Standard value for new machine	Permissible value				
29.4 ± 9.8 {3.0 ± 1.0}	29.4 ± 9.8 {3.0 ± 1.0}				
74.5 ± 19.6 {7.6 ± 2.0}	74.5 ± 19.6 {7.6 ± 2.0}				
25.5 ± 9.8 {2.6 ± 1.0}	25.5 ± 9.8 {2.6 ± 1.0}				
—	—				
—	—				
0.1 – 0.5 {1 – 5}	0.1 – 0.5 {1 – 5}				
Max. 0.88 {Max. 9}	Max. 0.88 {Max. 9}				
0.05 – 0.29 {0.5 – 3}	0.05 – 0.29 {0.5 – 3}				
0.39 – 0.69 {4 – 7}	0.39 – 0.69 {4 – 7}				
3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}				
3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}				
3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}				
3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}				
3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}				
3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}				
3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}				
3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}				
3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}				
3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}				
3.13 ± 0.1 {32 ± 1.0}	Min. 2.84 {Min. 29}				
3.33 ± 0.1 {34.0 ± 1.0}	Min. 3.04 {Min. 31}				
0.1 – 0.25 {1.0 – 2.5}	0.1 – 0.25 {1.0 – 2.5}				

Machine model					D65EX,WX-15	
Classification	Check item	Measurement conditions		Unit	Standard value for new machine	Permissible value
Power train oil pressure	Brake pressure	• Power train oil temperature: 70 – 80°C	Engine: Low idle	MPa {kg/cm2}	2.75 – 2.94 {28 – 30}	Min. 2.55 {Min. 26}
			Engine: High idle		2.75 – 2.94 {28 – 30}	Min. 2.55 {Min. 26}
HSS pressure	Relief pressure	• Hydraulic oil temperature: 45 – 55°C • Engine: High idle			36.8 ± 2.0 {375 ± 20}	Min. 32.8 {Min. 335}
	LS pressure (Load sensing pressure)				34.8 ± 2.0 {355 ± 20}	Min. 30.9 {Min. 315}
Power train performance	Travel speed	• Flat road • Coolant temperature: Within operating range • Power train oil temperature: 70 – 80°C • Engine: High idle • Before measuring, run machine 10 – 30 m. • Measuring distance: 20 m	F1	km/h	3.3 ± 0.2	3.3 ± 0.2
			F2		6.3 ± 0.3	6.3 ± 0.3
			F3		10.1 ± 0.5	10.1 ± 0.5
			R1		4.4 ± 0.3	4.4 ± 0.3
			R2		8.2 ± 0.4	8.2 ± 0.4
			R3		12.9 ± 0.6	12.9 ± 0.6
Work equipment oil pressure	Unload pressure	• Hydraulic oil temperature: 45 – 55°C • Unload pressure: Set all equipment in neutral. • Relief pressure: Set cylinder to stroke end. • LS pressure: Set cylinder to stroke end.	Engine: High idle	MPa {kg/cm2}	3.43 (+1.37/0) {35 (+14/0)}	3.43 (+1.37/0) {35 (+14/0)}
	Blade lift relief pressure		Engine: Low idle		Min. 19.6 {Min. 200}	Min. 19.6 {Min. 200}
			Engine: High idle		22.6 ± 2.0 {230 ± 20}	19.6 {200}
	Blade tilt relief pressure		Engine: Low idle		Min. 19.6 {Min. 200}	Min. 19.6 {Min. 200}
			Engine: High idle		22.6 ± 2.0 {230 ± 20}	19.6 {200}
	Ripper lift relief pressure		Engine: Low idle		Min. 19.6 {Min. 200}	Min. 19.6 {Min. 200}
			Engine: High idle		22.6 ± 2.0 {230 ± 20}	19.6 {200}
	LS pressure (Load sensing pressure)		Engine: Low idle		20.6 ± 2.0 {210 ± 20}	17.6 {180}
			Engine: High idle		20.6 ± 2.0 {210 ± 20}	17.6 {180}
	Control circuit main pressure (HSS, PPC, fan)	• Hydraulic oil temperature: 45 – 55°C • Engine: High idle			4.27 ± 0.25 {43.5 ± 2.5}	4.27 ± 0.25 {43.5 ± 2.5}
	PPC valve output pressure				3.53 – 4.41 {36 – 45}	3.53 – 4.41 {36 – 45}

D65PX-15					
Standard value for new machine	Permissible value				
2.75 – 2.94 {28 – 30}	Min. 2.55 {Min. 26}				
2.75 – 2.94 {28 – 30}	Min. 2.55 {Min. 26}				
36.8 ± 2.0 {375 ± 20}	32.8 {335}				
34.8 ± 2.0 {355 ± 20}	Min. 30.9 {Min. 315}				
3.3 ± 0.2	3.3 ± 0.2				
6.3 ± 0.3	6.3 ± 0.3				
10.1 ± 0.5	10.1 ± 0.5				
4.4 ± 0.3	4.4 ± 0.3				
8.2 ± 0.4	8.2 ± 0.4				
12.9 ± 0.6	12.9 ± 0.6				
3.43 (+1.37/0) {35 (+14/0)}	3.43 (+1.37/0) {35 (+14/0)}				
Min. 19.6 {Min. 200}	Min. 19.6 {Min. 200}				
22.6 ± 2.0 {230 ± 20}	19.6 {200}				
Min. 19.6 {Min. 200}	Min. 19.6 {Min. 200}				
22.6 ± 2.0 {230 ± 20}	19.6 {200}				
— —	— —				
— —	— —				
20.6 ± 2.0 {210 ± 20}	17.6 {180}				
20.6 ± 2.0 {210 ± 20}	17.6 {180}				
4.27 ± 0.25 {43.5 ± 2.5}	4.27 ± 0.25 {43.5 ± 2.5}				
3.53 – 4.41 {36 – 45}	3.53 – 4.41 {36 – 45}				

Machine model						D65EX,WX-15	
Classification	Check item		Measurement conditions		Unit	Standard value for new machine	Permissible value
Work equipment	Work equipment speed	Blade lift	★ See figure A • Hydraulic oil temperature: 45 – 55°C • Apply no load to blade. • Between ground level and rising end of blade • Engine: High idle	Raise	Second	2.6 (+0.2/ – 0.5)	3.1
				Lower		1.7 ± 0.2	2.0
		Blade tilt	★ See figure B • Hydraulic oil temperature: 45 – 55°C • Apply no load to blade. • Between left tilt end and right tilt end • Engine: High idle	Left tilt: Straight tilt		2.5 ± 0.3	3.0
				Left tilt: Power tilt (If equipped)		—	—
				Right tilt: Straight tilt		2.3 ± 0.3	2.8
				Right tilt: Power tilt (If equipped)		—	—
		Ripper lift (If equipped)	★ See figure C • Hydraulic oil temperature: 45 – 55°C • Apply no load to ripper. • Between ground level and rising end of ripper.	Raise: Low idle		2.4 ± 0.2	2.9
				Raise: High idle		1.4 ± 0.2	1.9
				Lower: Low idle		1.9 ± 0.2	2.4
				Lower: High idle		1.1 ± 0.2	1.6
		Pitch speed (If equipped)	★ See figure D • Hydraulic oil temperature: 45 – 55°C • Apply no load to blade. • Pitch in – pitch back • Engine: High idle	Pitch in		—	—
				Pitch back		—	—
	Time lag	Blade	• Hydraulic oil temperature: 45 – 55°C • Move lever to stroke end. • Lower blade from max. rising position and measure time after blade comes in contact with ground until idler is lifted. • High idle		Second	Max. 1.3	Max. 1.6
	Hydraulic drift	Hydraulic drift of lifted blade	★ See figure E • Hydraulic oil temperature: 45 – 55°C • Stop engine. • Measure reduction of blade bottom height h.		mm/ 15min	Max. 100	Max. 100
		Hydraulic drift of tilted blade	★ See figure F • Hydraulic oil temperature: 45 – 55°C • Stop engine. • Hydraulic drift of tip of blade cutting edge	Left tilt		Max. 200	Max. 200
				Right tilt		Max. 200	Max. 200
		Hydraulic drift of lifted ripper	★ See figure G • Hydraulic oil temperature: 45 – 55°C • Stop engine. • Measure reduction of shank bottom height h (for 15 minutes).			Max. 50	Max. 50

D65PX-15					
Standard value for new machine	Permissible value				
2.4(+0.2/ – 0.5)	2.9				
1.4 ± 0.2	1.7				
2.5 ± 0.3	3.0				
2.5 ± 0.3	3.0				
2.3 ± 0.3	2.8				
2.3 ± 0.3	2.8				
—	—				
—	—				
—	—				
—	—				
3.5 ± 0.5	4.2				
3.5 ± 0.5	4.2				
Max. 1.3	Max. 1.6				
Max. 100	Max. 100				
Max. 200	Max. 200				
Max. 200	Max. 200				
—	—				

Machine model						D65EX,WX-15	
Classification	Check item		Measurement conditions		Unit	Standard value for new machine	Permissible value
Work equipment	Leakage from cylinder	Blade tilt cylinder	• Engine: High idle • Hydraulic oil temperature: 45 – 55°C • Relieve cylinder and measure leakage for 1 minute.		cc/min	4	16
		Ripper lift cylinder				4	16
HSS motor	Leakage		• Hydraulic oil temperature: 45 – 55°C • Steering lever: Full • Transmission lever: Neutral • Brake pedal: Pressed • Engine: High idle		ℓ/min	Max. 15	30
Cooling fan	Fan speed		• Hydraulic oil temperature: 45 – 55°C • Fan: Normal rotation	• Engine: Low idle • Coolant temperature: Power train oil temperature: Max.	Min. speed	800 ± 50	700
				• Engine: High idle • Fan 100% speed mode	Max. speed	1,700 (+100/0)	1,600
	Fan pump pressure		• Hydraulic oil temperature: 45 – 55°C • Fan: Normal rotation			MPa {kg/cm^2}	19.6 – 22.5 {200 – 230}	18.6 {190}

D65PX-15					
Standard value for new machine	Permissible value				
4	16				
4	16				
Max. 15	30				
800 ± 50	700				
1,700 (+100/0)	1,600				
19.6 – 22.5 {200 – 230}	18.6 {190}				

Illustrations related to standard value table

Figure A

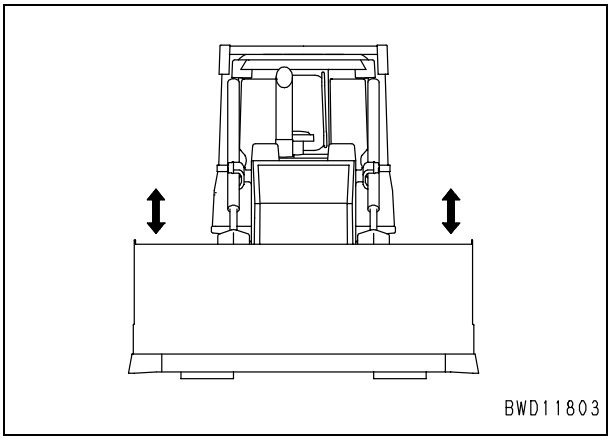


Figure B

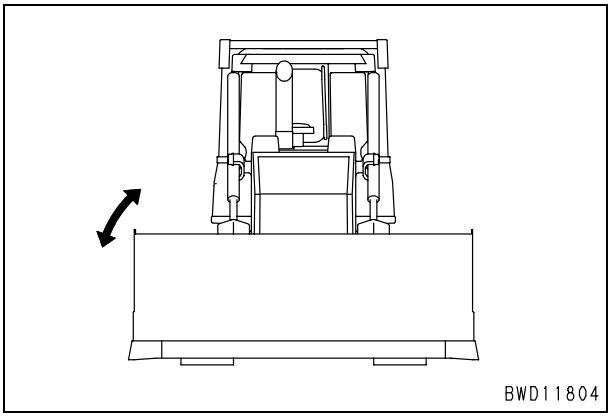


Figure C

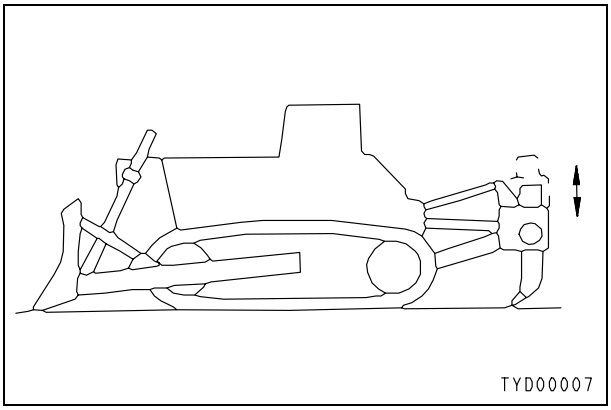


Figure D

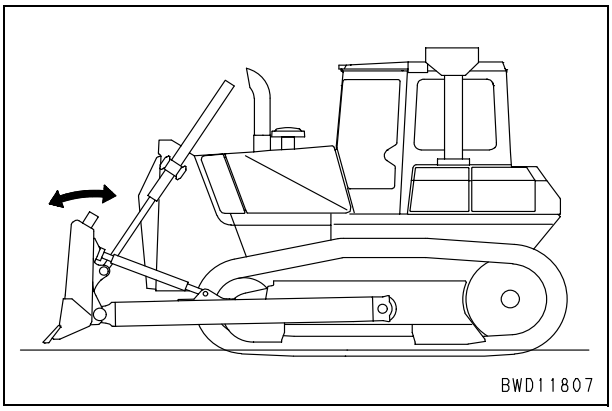


Figure E

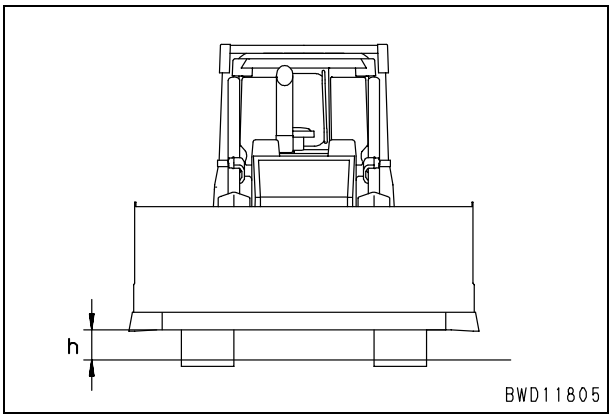


Figure F

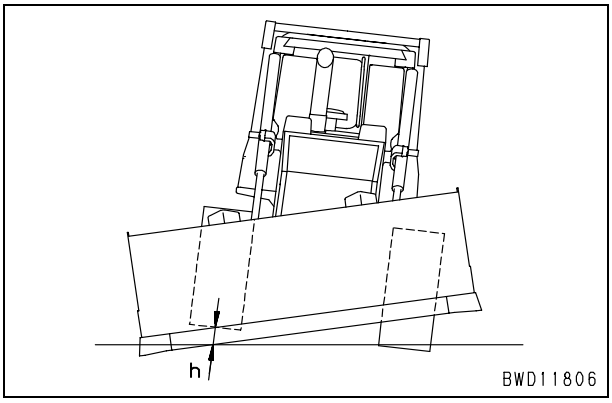
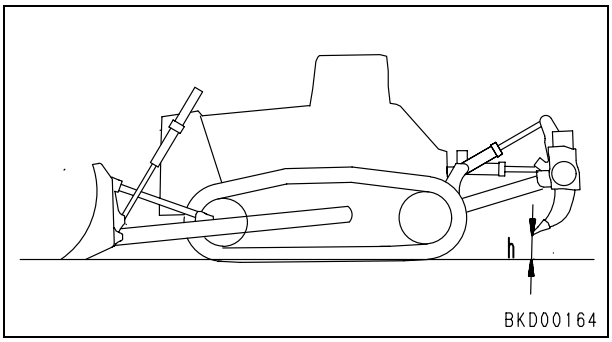


Figure G



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00584-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

30 Testing and adjusting

Testing and adjusting, Part 1

Testing and adjusting, Part 1

Tools for testing, adjusting, and troubleshooting

Testing or adjusting item	Sym-bol		Part No.	Part name	Quantity	Remarks
Air boost pressure (boost pressure)	A		799-201-2202	Boost gauge kit	1	–101 – 200 kPa {–760 – 1,500 mmHg}
Water temperature, oil temperature and exhaust temperature	B		799-101-1502	Digital temperature gauge	1	–99.9 – 1,299°C
Exhaust gas color	C	1	799-201-9001	Handy smoke checker	1	Bosch index: 0 – 9
		2	Commercial item	Smoke meter	1	
Valve clearance	D	1	795-799-1131	Gear	1	
		2	Commercial item	Clearance gauge	1	
Compression pressure	E	1	795-799-6700	Puller	1	
		2	795-502-1590	Gauge assembly	1	
		3	795-790-6110	Adapter	1	For 114E-3
		4	6754-11-3130	Gasket	1	
Blow-by pressure	F	1	799-201-1504	Blow-by checker	1	0 – 5 kPa {0 – 500 mmH_20}
		2	795-790-3300	Blow-by tool	1	
Engine oil pressure	G	1	799-101-5002	Hydraulic tester	1	Pressure gauge: 2.5, 5.9, 39.2, 58.8 MPa {25, 60, 400, 600 kg/cm^2}
			790-261-1204	Digital hydraulic tester	1	Pressure gauge: 58.8 MPa {600 kg/cm^2}
		2	799-401-2320	Hydraulic tester	1	Pressure gauge: 0.98 MPa {10 kg/cm^2}
		3	6732-81-3170	Adapter	1	10 x 1.0 mm → R1/8
			6215-81-9710	O-ring	1	
Testing fuel pressure	H	1	799-101-5002	Hydraulic tester	1	*As common as G1
			790-261-1204	Digital hydraulic tester	1	
		2	6732-81-3170	Adapter	1	*As common as G3
			6215-81-9710	O-ring	1	
		3	799-401-2320	Hydraulic tester	1	*As common as G2
		4	799-201-1201	Vacuum gauge	1	0 – 107 kPa {0 – 800 mmHg}
Inspection of quantity of fuel return and leakage	J	1	(Being estab-lished)	Tool to check supply pump	1	
		2	(Being estab-lished)	Tool to check pressure limiter	1	
		3	(Being estab-lished)	Tool to check injector	1	
		4	Commercial item	Measuring cylinder	1	
Power train oil pressure	K	1	799-101-5002	Hydraulic tester	1	*As common as G1
			790-261-1204	Digital hydraulic tester	1	
		2	799-401-2320	Hydraulic tester	1	*As common as G2
		3	799-101-5220	Nipple (10 x 1.25 mm)	1	
			07002-11023	O-ring	1	

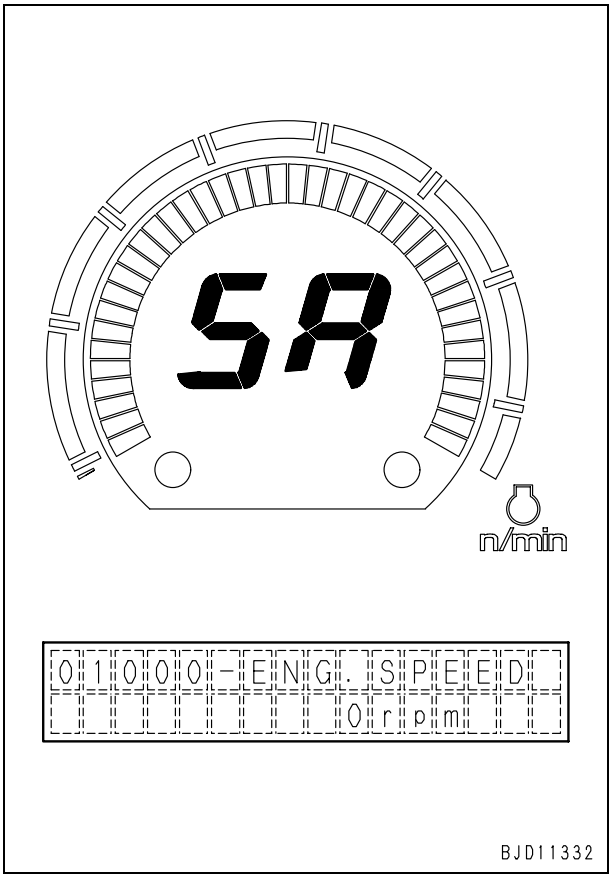
Testing or adjusting item	Symbol		Part No.	Part name	Quantity	Remarks
Emergency escape method when power train has trouble	L	1	19M-06-32820	Switch assembly	1	
			134-06-72810	Wiring harness	1	
		2	7824-66-6430	Prolix resistance	1	
			7827-10-1520	Prolix resistance	1	
		3	790-190-1601	Pump assembly	1	
		4	799-101-5220	Nipple (10 x 1.25 mm)	1	*As common as K3
			07002-11023	O-ring	1	
Testing and adjusting work equipment and HSS oil pressure	M	1	795-101-5002	Hydraulic tester	1	*As common as G1
			790-261-1204	Digital hydraulic tester	1	
		2	799-101-5220	Nipple (10 x 1.25 mm)	1	*As common as K3
			07002-11023	O-ring	1	
Testing control circuit basic pressure	N	1	799-101-5002	Hydraulic tester	1	*As common as G1
			790-261-1204	Digital hydraulic tester	1	
		2	799-401-3200	Adapter (size 03)	1	
Measuring PPC valve output pressure	O	1	799-101-5002	Hydraulic tester	1	*As common as G1
			790-261-1204	Digital hydraulic tester	1	
		2	799-401-3100	Adapter (size 02)	1	
Measuring internal leakage of work equipment cylinder	P		Commercial item	Measuring cylinder	1	
Measuring fan motor speed	Q		799-205-1100	Tachometer KIT	1	
Measuring fan pump circuit pressure	R	1	799-101-5002	Hydraulic tester	1	*As common as G1
			790-261-1204	Digital hydraulic tester	1	
		2	799-401-3400	Adapter (size 05)	1	
		3	799-101-5220	Nipple (10 x 1.25 mm)	1	*As common as K3
			07002-11023	O-ring	1	
Operating effort	S		79A-264-0021	0 – 294 N {0 – 30 kg}	1	
			79A-264-0091	0 – 490 N {0 – 50 kg}	1	
Stroke and hydraulic drift	T		Commercial item	Scale	1	
Work equipment speed	U		Commercial item	Stopwatch	1	
Voltage and resistance	V		Commercial item	Tester	1	

Measuring engine speed

★ Measure the engine speed under the following condition.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: Within operating range
- Power train oil temperature: Within operating range

1. Preparatory work

Turn the starting switch ON and set the monitor panel in the “Monitoring mode” to prepare for measurement of the engine speed.
- ★ For the operating method, see “Special functions of monitor panel (EMMS)”.
- Monitoring code: **01000** (Engine speed)



2. Measuring low idle speed

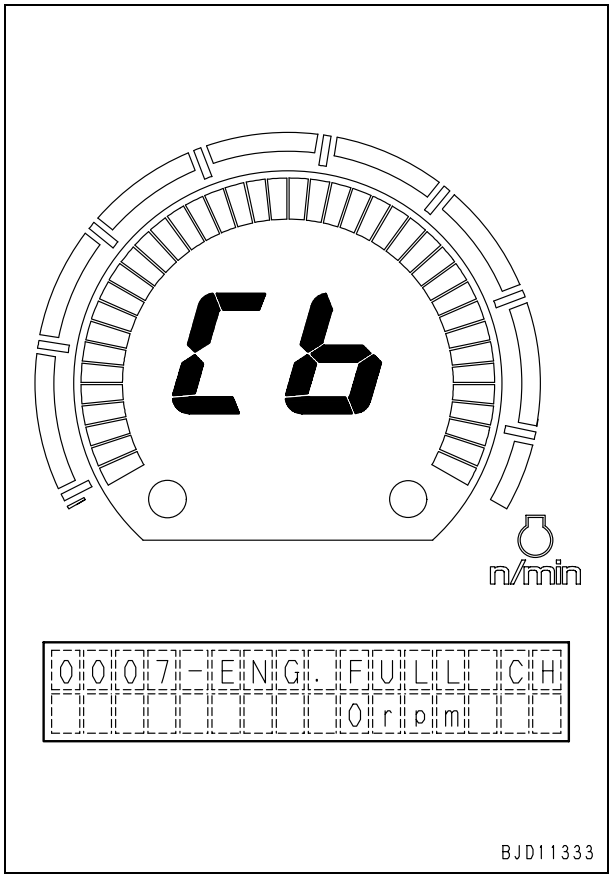
1) Start the engine and set the fuel control dial in the low idle position.
2) Set the PCCS lever and work equipment control lever in neutral and measure the engine speed.

3. Measuring high idle speed

1) Start the engine and set the fuel control dial in the high idle position.
2) Set the PCCS lever and work equipment control lever in neutral and measure the engine speed.

★ The high idle speed measured in the “Monitoring mode” or in the “Pm Clinic auxiliary mode” is the auto-deceleration speed.

★ When measuring the high idle speed of the engine, use the “Adjustment mode”.
Adjustment code: **0007** (Engine decelerator cut mode)

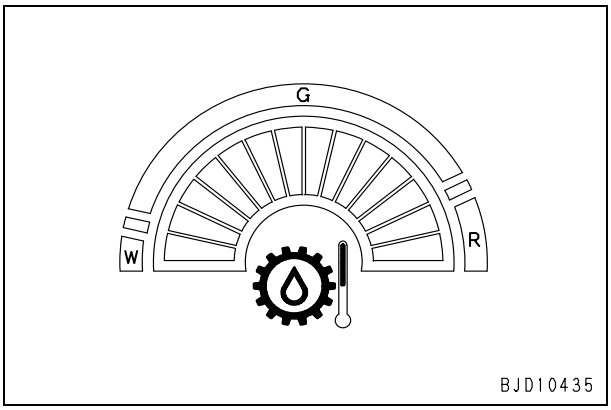


4. Measuring decelerator pedal speed

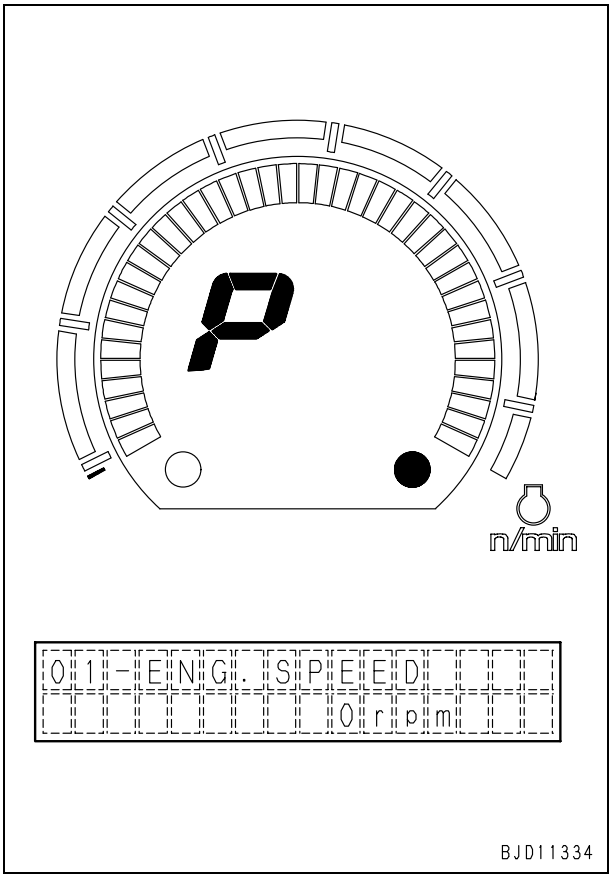
1) Start the engine and set the fuel control dial in the high idle position.
2) Set the PCCS lever and work equipment control lever in neutral, and measure the engine speed with the decelerator pedal depressed.

5. Measuring torque converter stall speed

1) Start the engine and set the fuel control dial in the low idle position.
2) With the brake pedal depressed securely and the parking brake lever in the “free” position, set the PCCS lever in the “forward” and 3rd gear speed position.
   ★ Before going to the next step, check that the upper display unit of the monitor panel is set in the normal display state and it displays [**F3**].
   ★ Keep the steering unit in neutral.
3) Press the decelerator pedal and set the fuel control dial in the high idle position.
4) Return the decelerator pedal slowly to stall the torque converter with the engine at high idle.
   ⚠ **Keep pressing the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.**
5) Just after the power train oil temperature gauge reads the top line of the green range, return the direction of the PCCS lever into neutral.



6) Repeat above steps 2) – 5) 3 times.
7) Perform steps 2) – 4) again and measure the engine speed about 5 seconds after the power train oil temperature gauge reads the top line of the green range.
   ★ After finishing measurement, return the direction of the PCCS lever into neutral and lower the power train oil temperature with the engine at high idle.
   ★ The engine speed can be measured by the following operation:
   - “Pm clinic auxiliary mode” of the monitor panel
   - Each time the information switch is set to the right or left when the monitor panel is in the normal display state, the display in the multi information section turns to the display of service meter or engine speed. (However, measure the high idle speed of the engine in the “Adjustment mode“).



Measuring intake air pressure (boost pressure)

★ Measuring instruments for intake air pressure (boost pressure)

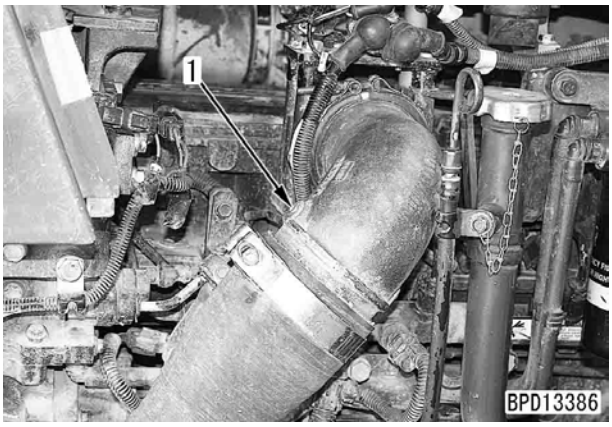
Symbol	Part No.	Part name
A	799-201-2202	Boost gauge kit

⚠ **When installing and removing the measuring instrument, take care not to touch a hot part of the engine.**

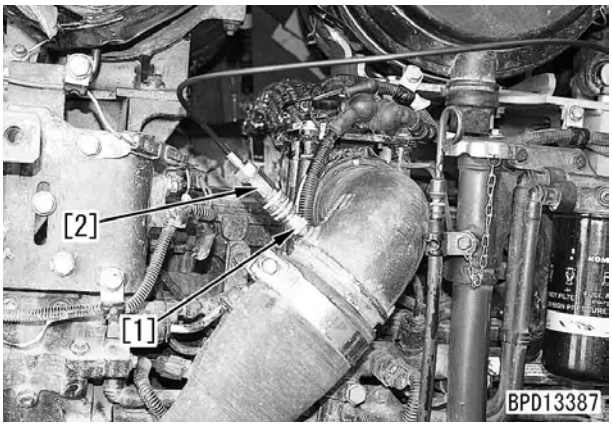
★ Measure the intake air pressure (boost pressure) under the following condition.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: Within operating range
- Power train oil temperature: Within operating range

1. Open the left side cover of the engine.

2. Remove air intake connector boost pressure pickup plug (1).

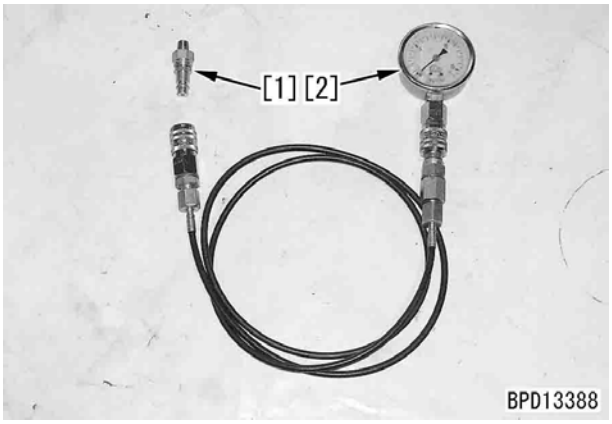


3. Install nipple [1] of boost gauge kit **A** and connect gauge [2].



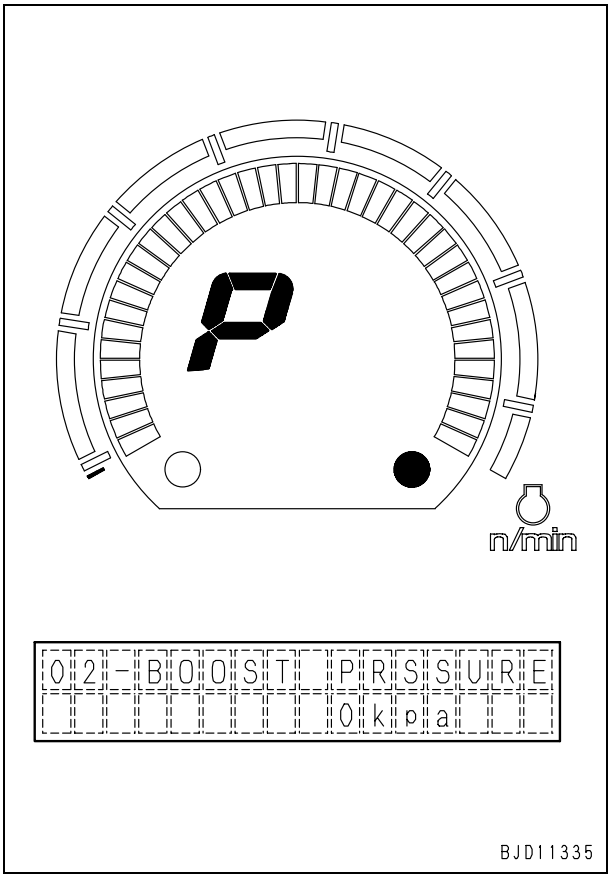
4. Run the engine at medium or higher speed and drain the oil from the hose.
   ★ Insert the joint of the gauge and hose halfway and open the self-seal on the hose side repeatedly, and the oil is drained.
   ★ If Pm kit (A) is available, the air bleeding coupling (790-261-1130) in it may be used.
   ★ If any oil is left in the hose, the gauge does not move. Accordingly, be sure to drain the oil.

5. Measure the intake air pressure (boost pressure) while the engine is running at high idle and the torque converter is stalling.
   ★ For the procedure for stalling the torque converter, see “Measuring engine speed”.
   ★ Normally, the intake air pressure (boost pressure) should be measured while the engine is running at the rated output. In the field, however, an approximate value can be obtained by stalling the torque converter.



6. After finishing measurement, remove the measuring instrument and reinstall the removed parts.

★ The boost pressure can be measured in the “Pm Clinic auxiliary mode” of the monitor panel.



Measuring exhaust temperature

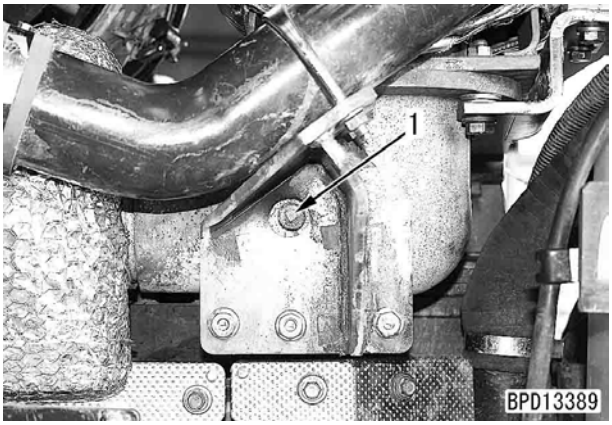
★ Measuring instrument for exhaust temperature

Symbol	Part No.	Part name
B	799-101-1502	Digital temperature gauge

⚠ **Install and remove the measuring instrument after the exhaust manifold is cooled.**

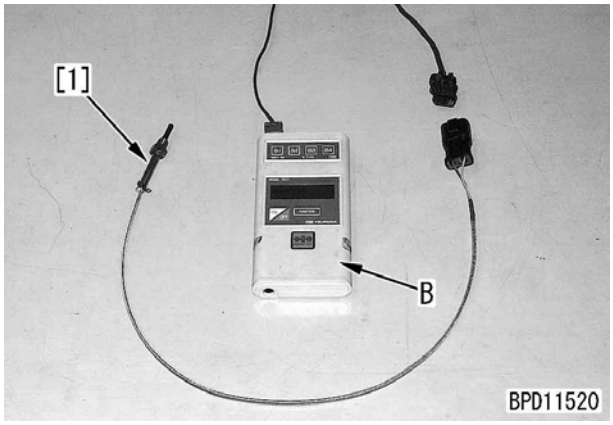
★ Measure the exhaust temperature under the following condition.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: Within operating range
- Power train oil temperature: Within operating range

1. Open the right inspection cover of the engine and remove exhaust temperature pickup plug (1).



2. Install sensor [1] and connect them to digital temperature gauge **B**.
   ★ Clamp the wiring harness of the digital temperature gauge so that it will not touch a hot part during measurement.

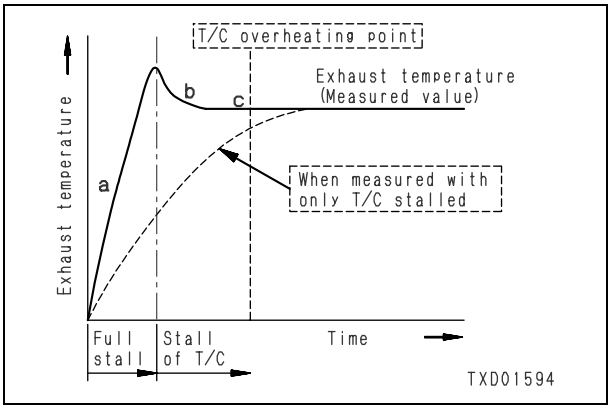
3. Procedure for measuring the maximum value for troubleshooting
   Operate the machine actually and measure the maximum exhaust temperature.
   ★ Use the PEAK mode of the digital thermometer.
   ★ The exhaust temperature largely depends on the ambient temperature (intake air temperature of the engine). Accordingly, if any abnormal value is obtained, compensate it by the following calculation.
   - Corrected value [°C] = Measured value + 2 x (20 – Ambient temperature)



4. Procedure for measuring periodically for preventive maintenance
   ★ If the torque converter is stalled simply, the torque converter oil temperature is overheated before the exhaust temperature is stabilized. Accordingly, measure according to the following procedure.
   1) Stall the torque converter fully to raise the exhaust temperature to about 450°C according to the following procedure (condition (**a**) in the figure).
      1] Start the engine and set the fuel control dial to the idle position, and then extract the blade tilt cylinder to the stroke end with the blade control lever.
      2] With the brake pedal depressed securely, set the PCCS lever in the “forward” and 3rd gear speed position.
      3] Press the decelerator pedal and set the fuel control dial in the high idle position.
      4] Return the decelerator pedal slowly to allow the torque converter to stall at high idle and relieve the blade tilt circuit.

      ⚠ **Keep pressing the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.**

2) Stop only relieving the blade tilt and lower the exhaust temperature by only stalling the torque converter (condition (**b**) in the figure).
   ★ If the temperature does not lower but it rises, set the higher temperature in step 1).
3) After the temperature lowers and is stabilized, measure it (condition (**c**) in the figure).
   ⚠ **Just after the power train oil temperature gauge reads the red range, return the direction of the PCCS lever into neutral and lower the power train oil temperature.**



5. After finishing measurement, remove the measuring instrument and reinstall the removed parts.

Measuring exhaust gas color

★ Measuring instrument for exhaust gas color

Symbol		Part No.	Part name
C	1	799-201-9001	Handy smoke checker
	2	Commercial item	Smoke meter

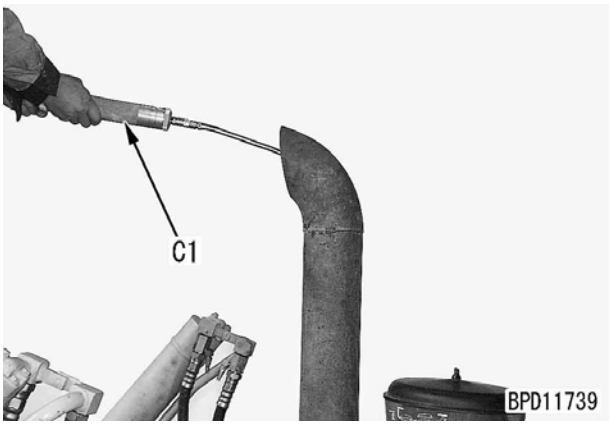
⚠ **When installing and removing the measuring instrument, take care not to touch a hot part.**

★ If an air source and a electric power source are not available in the field, use handy smoke checker **C1**. When recording official data, etc., use smoke meter **C2**.

★ Measure the exhaust gas color under the following condition.
- Coolant temperature: Within operating range

1. Measuring with handy smoke checker C1

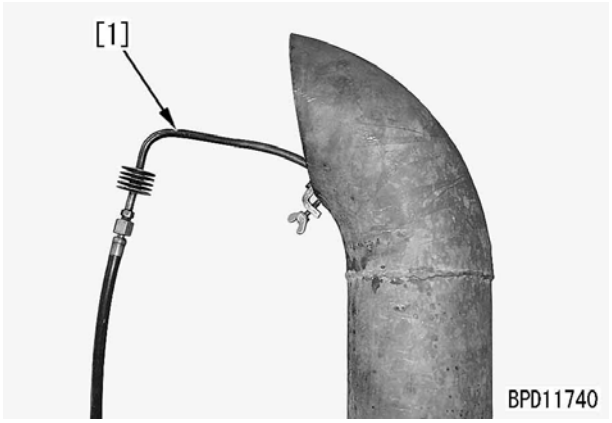
1) Stick a sheet of filter paper to smoke checker **C1**.
2) Insert the exhaust gas intake pipe in the exhaust pipe.
3) Start the engine.
4) As increasing the engine speed rapidly or running it at high idle, operate the handle of smoke checker **C1** so that the filter paper will absorb the exhaust gas.



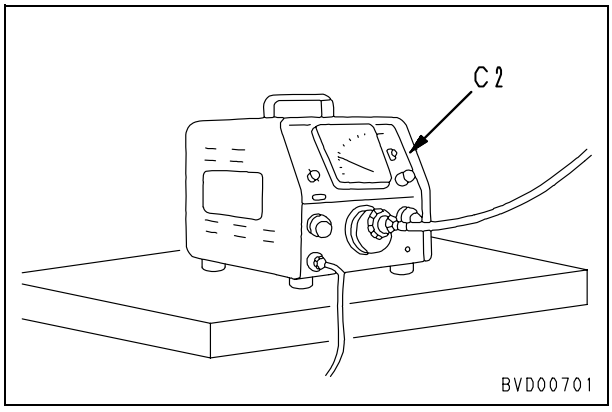
5) Remove the filter paper and compare it with the attached scale to make a judgement.
6) After finishing measurement, remove the measuring instrument and reinstall the removed parts.

2. Measuring with smoke meter C2

1) Insert probe [1] of smoke meter **C2** in the outlet of the exhaust pipe and fix it to the exhaust pipe with a clip.



2) Connect the probe hose, receptacle of the accelerator switch, and air hose to smoke meter **C2**.
   ★ Restrict the supplied air pressure below 1.5 MPa {15 kg/cm^2}.
3) Connect the power cable to a receptacle of AC100V power source.
   ★ Before connecting the cable, check that the power switch of the smoke meter is turned off.
4) Loosen the cap nut of the suction pump and fit the filter paper.
   ★ Fit the filter paper securely so that the exhaust gas will not leak.
5) Turn on the power switch of smoke meter **C2**.



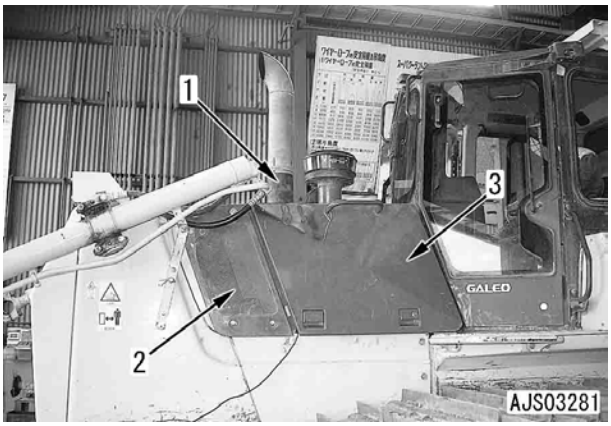
6) Start the engine.
7) As increasing the engine speed rapidly or running it at high idle, press the accelerator pedal of smoke meter **C2** and collect the exhaust gas with the filter paper.
8) Place the contaminated filter paper on the clean filter paper (at least 10 sheets) in the filter paper holder and read the indicated value.
9) After finishing measurement, remove the measuring instrument and reinstall the removed parts.

Adjusting valve clearance

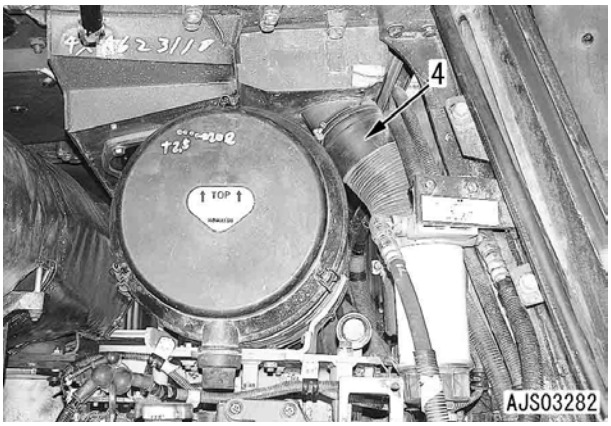
★ Adjusting instrument for valve clearance

Symbol		Part No.	Part name
D	1	795-799-1131	Gear
	2	Commercial item	Clearance gauge

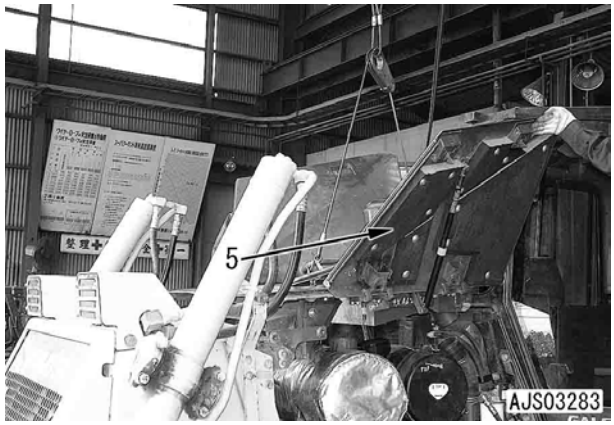
1. Remove engine hood assembly.
   1) Remove exhaust valve (1).
   2) Remove left and right covers (2).
   3) Open engine hood cover (3).



   4) Disconnect air hose (4).

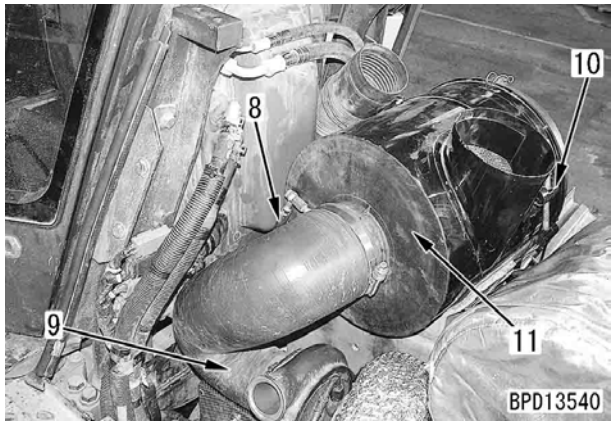


   5) Remove the mounting bolt, lift off engine hood (5) to remove it.
      Engine hood : **160 kg**

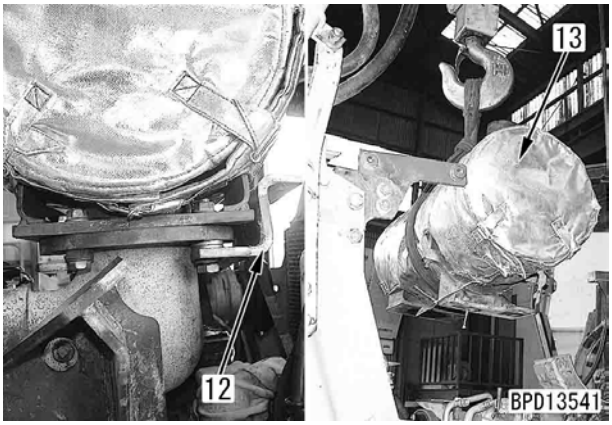


2. Remove air cleaner assembly and muffler assembly.
   1) Remove cover (6).
   2) Remove air hose, air intake connector and bracket assembly (7). [*1]

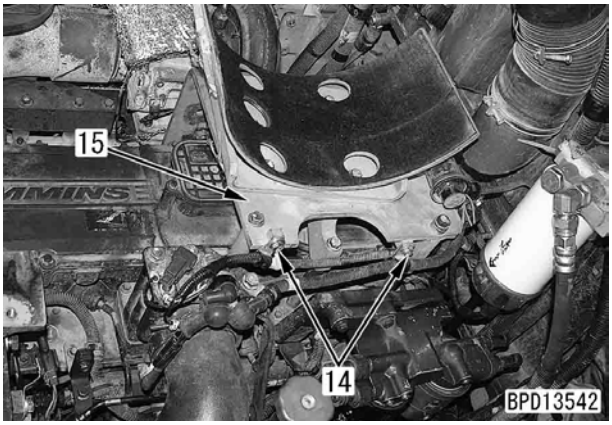
   3) Disconnect dust indicator hose (8).
   4) Disconnect air cleaner air intake hose (9). [*2]
   5) Remove band (10). [*3]
   6) Remove air cleaner assembly (11).



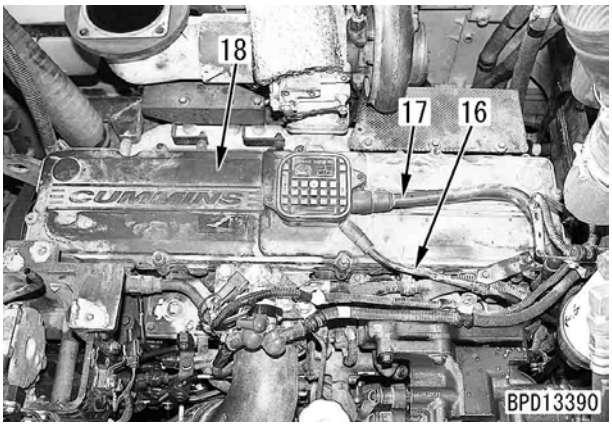
7) Remove plate (12).
8) Remove the mounting bolt, lift off muffler assembly (13) to remove it.
Muffler assembly: **25 kg**



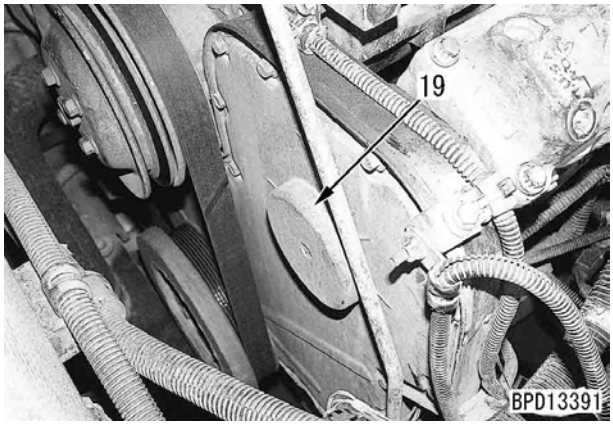
9) Disconnect harness clamp (14). (3 places)
10) Remove air cleaner bracket (15).



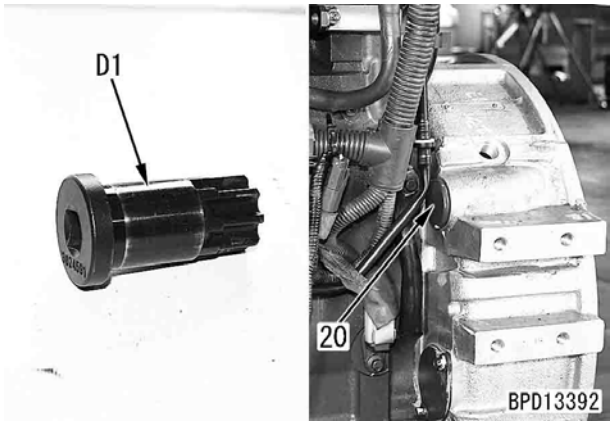
3. Disconnect breather tube (16) and blow-by tube (17) and remove cylinder head cover (18). [*4]



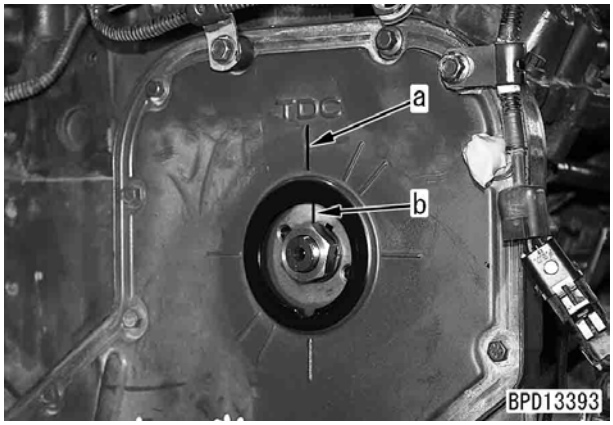
4. Remove cap (19) of the front gear cover.



5. Set the No.1 cylinder to the compression top dead center.
1) Remove cap (20) of flywheel housing, insert gear **D1** to rotate forward.



2) Align the TDC stamp line of the front gear cover (**a**) and supply pump gear stamp line (**b**).
★ The No.1 cylinder comes to the compression top dead center position.



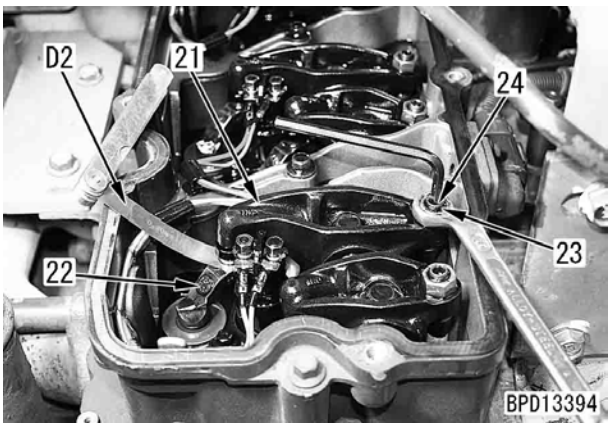
6. While the No.1 cylinder is at the compression top dead center, adjust the clearance of valve marked with ● in the valve arrangement figure.

Valve arrangement

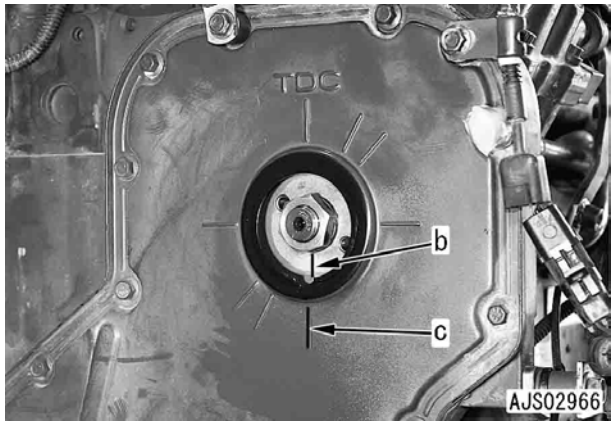
Cylinder No.	1	2	3	4	5	6
Exhaust valve	●	○	●	○	●	○
Intake valve	●	●	○	●	○	○

TDD00723

7. Adjust the valve clearance in the following procedure.
   1) Insert clearance gauge **D2** into the clearance between rocker lever (21) and crosshead (22).
   2) Loosen locknut (23) and adjust valve clearance with adjustment screw (24).
      ★ With the clearance gauge inserted, turn the adjustment screw so that you can move clearance gauge **D2** lightly.
   3) Fix adjustment screw (24) and tighten locknut (23).
      Locknut: **24 ± 4 Nm {2.4 ± 0.4 kgm}**
      ★ After tightening the locknut, check the valve clearance again.



   4) After finishing the adjustment of all valves marked with ●, turn the crankshaft 360° forward and align stamp line (**c**) of the front gear cover and stamp line of supply pump gear (**b**).
      ★ The No.6 cylinder comes to the compression top dead center position.



   5) While the No. 6 cylinder is at the compression top dead center, adjust the clearance of valve marked with ○ in the valve arrangement figure.
      ★ Procedure for the adjustment is as same as 1) – 3).

8. After finishing adjustment, reinstall the removed parts.

[*1]
Air intake connector hose clamp bolt:
- Radiator side
  10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}
- Turbocharger outlet side tube clamp bolt
  7 ± 1.1 Nm {0.71 ± 0.11 kgm}

[*2]
Air cleaner air intake hose clamp bolt:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

[*3]
Air cleaner mounting band bolt:
9.8 – 11.8 Nm {1.0 – 1.2 kgm}

[*4]
Cylinder head cover mounting bolt:
11.8 ± 1.96 Nm {1.2 ± 0.2 kgm}

Measuring compression pressure

★ Measuring instruments for compression pressure

Symbol		Part No.	Part name
E	1	795-799-6700	Puller
	2	795-502-1590	Gauge assembly
	3	795-790-6110	Adapter
	4	6754-11-3130	Gasket

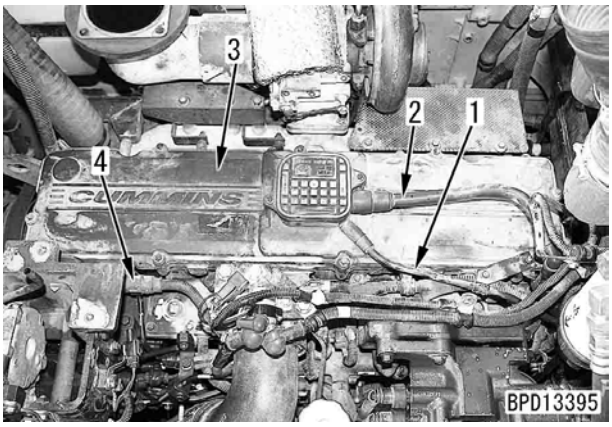
⚠ **When measuring the compression pressure, take care not to burn yourself on the exhaust manifold, muffler, etc. or get caught in a rotating part.**

★ Measure the compression pressure after the engine is warmed up.
(Engine oil temperature: 40 – 60°C)

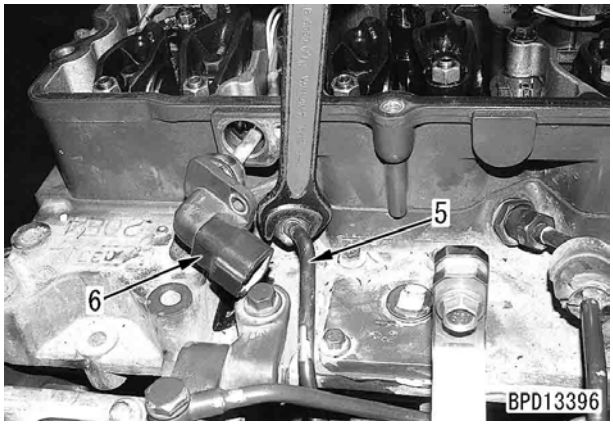
1. Refer to steps 1, 2, and 8 of “Adjusting valve clearance” to remove and install the engine hood assembly, air cleaner assembly and muffler assembly.

2. Disconnect breather tube (1) and blow-by tube (2) and remove cylinder head cover (3).

3. Disconnect injector harness (4). (3 places)



4. Disconnect fuel high-pressure pipe (5).
   ★ Before disconnecting pipes No.1, 3, and 5, disconnect harness connector (6) from the block.

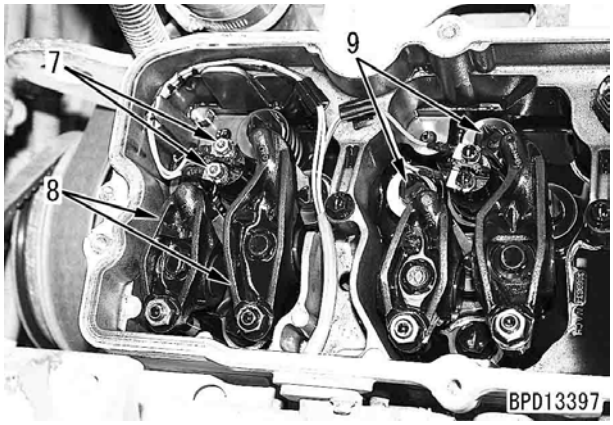


5. Loosen injector harness terminal nut (7) and disconnect the terminal from the injector.

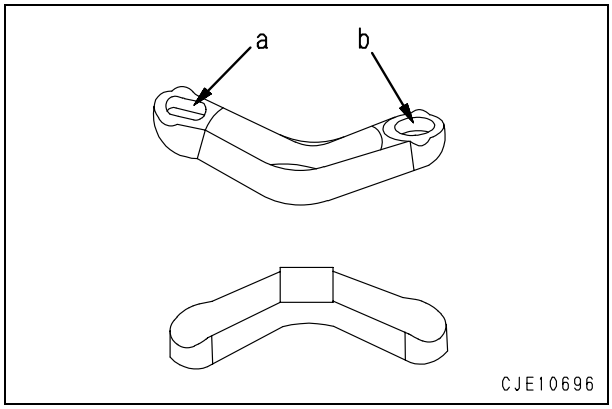
6. Set the cylinder to be inspected to the compression top dead center.
   ★ Refer to “Adjusting valve clearance”.

7. Remove rocker arm assembly (8).

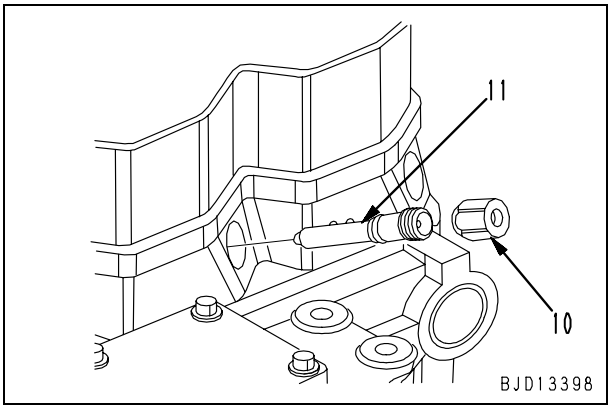
8. Remove crosshead (9).



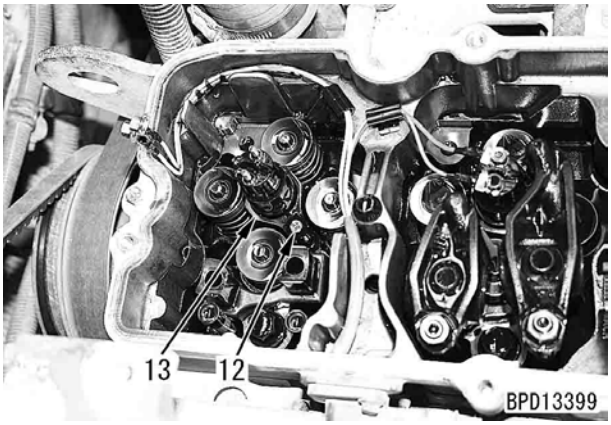
★ Make notes of the installation positions and hole shapes of (**a**) and (**b**) sections.
(So that the removed parts can be reinstalled to their original positions later.)



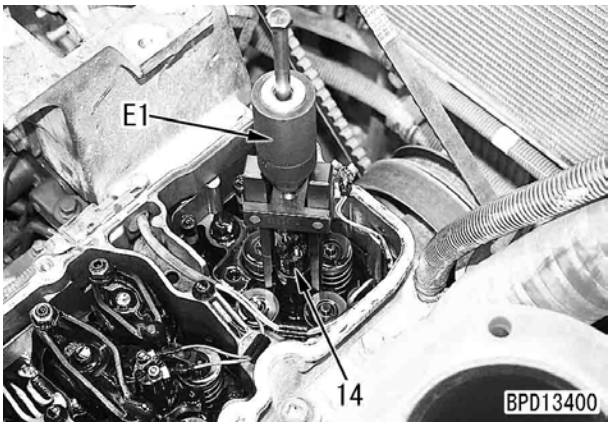
9. Remove retainer (10) to dismount inlet connector (11).
   ⚠ **Remove the dusts around the inlet connector thoroughly in advance to prevent them from entering the cylinder head hole or the inlet connector during the removal operations.**



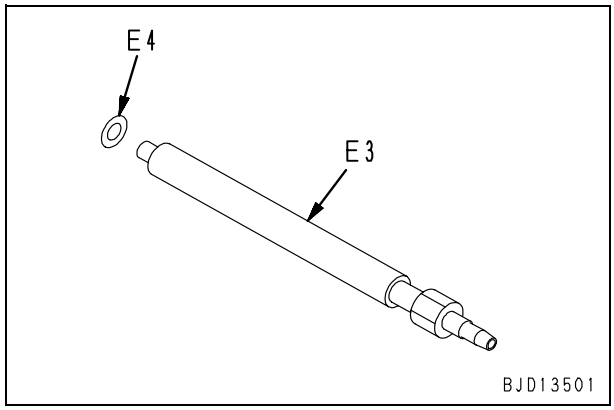
10. Unscrew bolt (12) to remove holder (13).



11. Remove injector (14) with puller **E1**.
    ★ Do not ply the upper part of the injector to remove it without using puller **E1**.



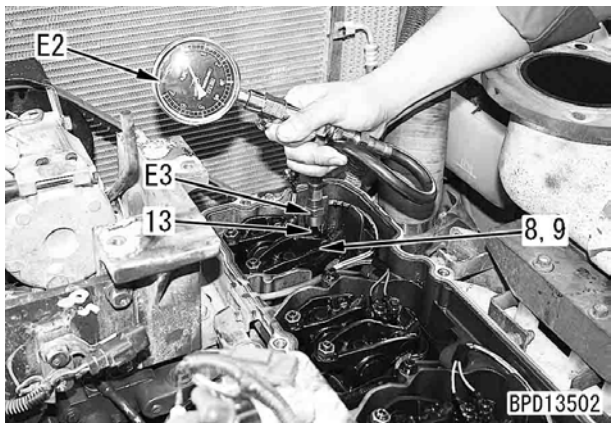
12. Install gasket **E4** to the top of adapter **E3** and insert adapter into mounting section of the injector.



13. Fix adapter **E3** with holder (13).
    ★ Tighten bolts (12) diagonally so that the upper surface of holder (13) becomes parallel to the upper surface of the cylinder head.
    - Maximum angle limit: 2.4°

    Bolt: **9.8 ± 2.0 Nm {1.0 ± 0.2 kgm}**

14. Connect gauge assembly **E2** to adapter **E3**.
    ★ Leakage can be prevented by applying a little amount of engine oil to the fitting faces of the adapter and gauge.

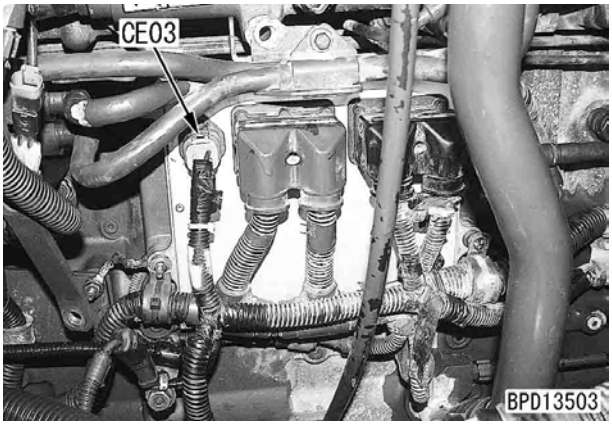


15. Install rocker arm assembly (8).
    Rocker arm assembly mounting bolts: **64.7 ± 4.9 Nm {6.6 ± 0.5 kgm}**

16. Install crosshead (9).

17. Adjust valve clearance.
    ★ Refer to “Adjusting valve clearance”.

18. Disconnect connector CE03 of engine controller.

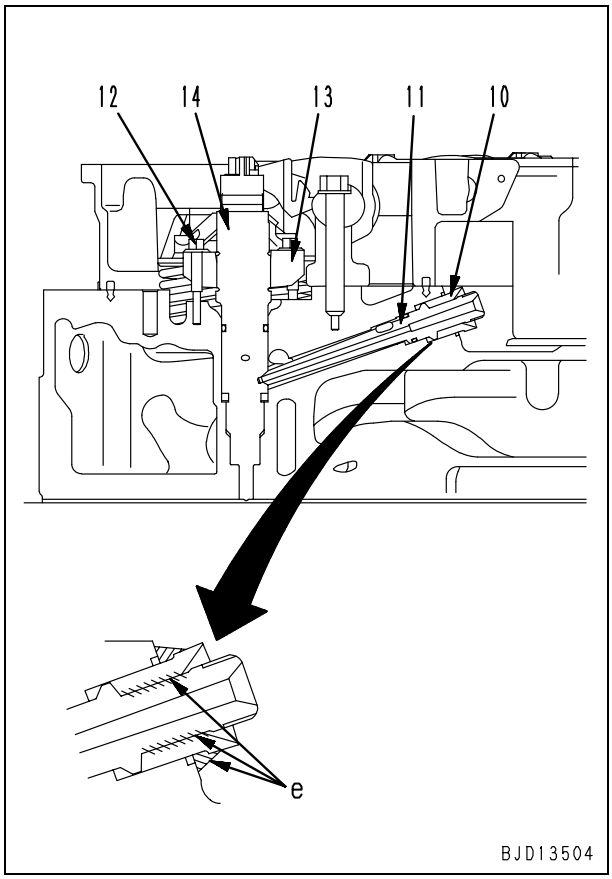


⚠ **Be sure to disconnect the connector. Otherwise, engine may start during the measurement and this may create a dangerous condition.**

⚠ **Since connector (CE03) includes the power source circuit of engine controller, cover the connector on the harness side with a vinyl sheet, etc. to prevent electric leakage and grounding fault.**

19. Crank the engine with the starting motor and check the compression pressure.
    ★ Measure the pressure when the pointer of the gauge is stabilized.

20. When the checking is completed, remove the instruments and reinstall the removed parts.
    ★ Install the injector and the inlet connector according to the following procedure.
    1) Coat the O-ring of injector (14) and the mounting hole on the head with engine oil (EO15W-40).
    2) Assemble holder (13) on injector (14) then insert the assembly into the cylinder head with the fuel inlet hole of injector (14) on the intake manifold side.
    3) Tighten bolt (12) by three or four threads with hands.
    4) Coat the O-ring of inlet connector (11) and the mounting hole on the head with engine oil (EO15W-40).
    5) Install inlet connector (11) temporarily with retainer (10).
       Retainer:
       14.7 ± 5.0 Nm {1.5 ± 0.5 kgm}
    6) Tighten bolts (12) to the specified torque.
       ★ Tighten bolts diagonally so that the upper surface of holder (13) becomes parallel to the upper surface of the cylinder head.
       ● Maximum angle limit: 2.4°
       Bolt: **9.8 ± 2.0 Nm {1.0 ± 0.2 kgm}**
    7) Tighten inlet connector (11) to the specified torque.
       Retainer (10):
       40.2 ± 3.9 Nm {4.1 ± 0.4 kgm}
       Apply the caulking compound (**e**) (hatched section) to retainer (10) and the cylinder head.
       Caulking compound:
       GE TOSHIBA SILICON TOSSEAL 381



★ Rocker arm assembly
1) Tighten the mounting bolt after checking that the ball portion of adjustment screw is well seated in the push rod socket.
Bolts: **64.7 ± 4.9 Nm {6.6 ± 0.5 kgm}**
2) After installing the rocker arm assembly, adjust the valve clearance referring to “Adjusting valve clearance”.

★ Fuel high-pressure piping
When assembling the pipe, tighten the mounting nuts in the injector side first, then tighten nuts in the common rail side.
Nuts: **37.3 ± 4 Nm {3.8 ± 0.4 kgm}**

★ Tightening torque of the injector harness terminal nut
Nut:
1.25 ± 0.25 Nm {0.13 ± 0.03 kgm}

★ Tightening torque of the head cover mounting nuts
Nut: **11.8 ± 1.96 Nm {1.2 ± 0.2 kgm}**

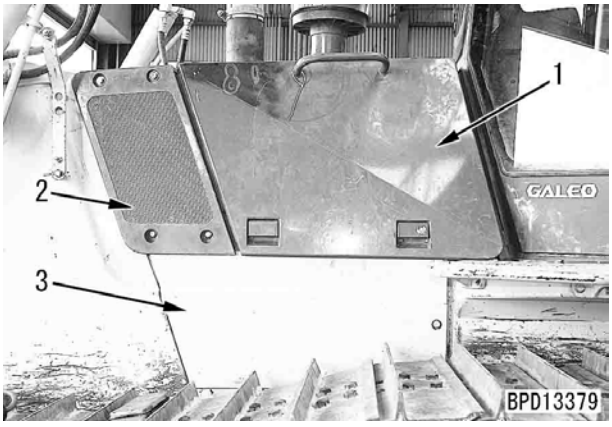
Measuring blow-by pressure

★ Measuring instrument for blow-by pressure

Symbol		Part No.	Part name
F	1	799-201-1504	Blow-by checker
	2	795-790-3300	Blow-by tool

★ Measure the blow-by pressure under the following condition.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: Within operating range
- Power train oil temperature: Within operating range

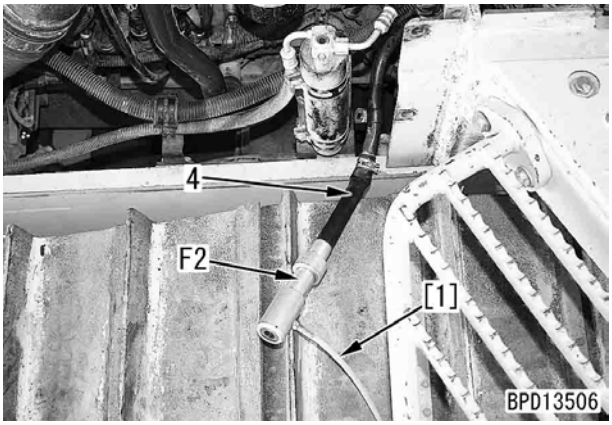
1. Open the left side cover (1) of engine hood and remove side cover (3).



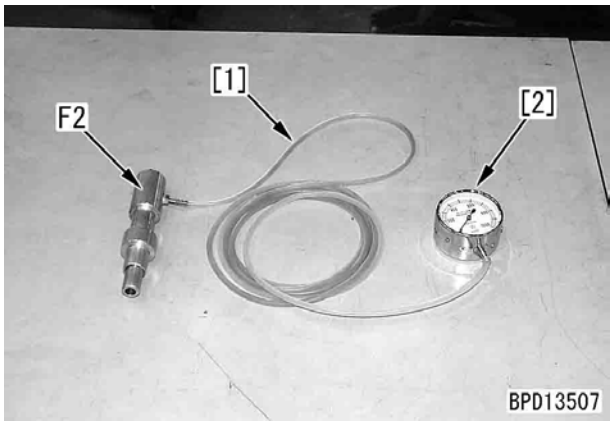
2. Remove the mounting clamp of blow-by hose (4) on the engine side and pull out the hose to the left outer side of the engine.

3. Install blow-by tool **F2** to blow-by hose (4).

4. Install hose [1] of blow-by checker **F1** to blow-by tool **F2** and connect them to gauge [2].



5. Measure the blow-by pressure while the engine is running at high idle and the torque converter is stalling.
   ★ For the procedure for stalling the torque converter, see “Measuring engine speed”.
   ★ Normally, the blow-by pressure should be measured while the engine is operated at the rated output. In the field, however, an approximate value can be obtained by stalling the torque converter.
   ★ If it is impossible to run the engine at the rated output or stall the torque converter, measure while the engine is running at high idle.
   The value obtained in this case is about 80% of the blow-by pressure at the rated output.
   ★ The blow-by pressure may vary largely with the engine condition. If the measured value is judged abnormal, check for increase of oil consumption, bad exhaust gas color, premature deterioration or contamination of oil, etc. which are related to the abnormal blow-by pressure.



6. After finishing measurement, remove the measuring instrument and reinstall the removed parts.

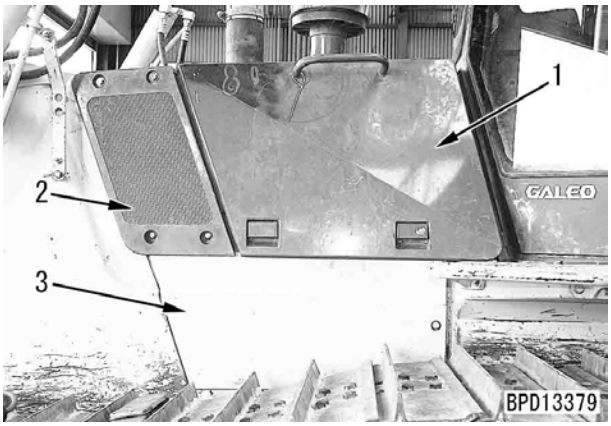
Measuring engine oil pressure

★ Measuring instruments for engine oil pressure

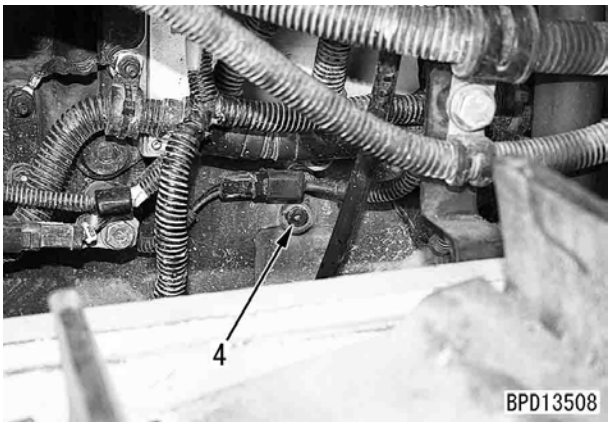
Symbol		Part No.	Part name
G	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	799-401-2320	Hydraulic tester (0.98 MPa {10 kg/cm^2})
	3	6732-81-3170	Adapter (10 x 1.0 mm → R1/8)
		6215-81-9710	O-ring

★ Measure the engine oil pressure under the following condition.
- Coolant temperature: Within operating range

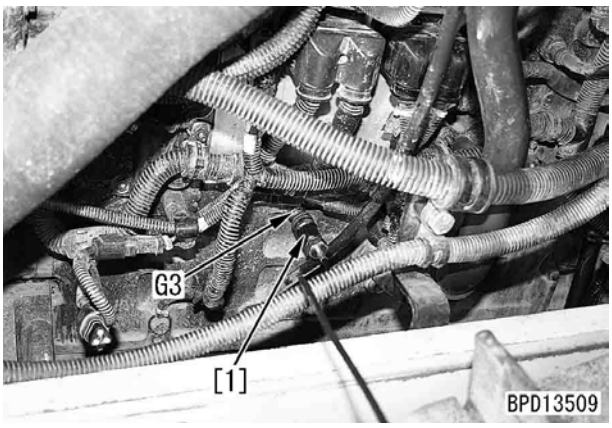
1. Open left side cover (1) of engine hood and remove side cover (3).



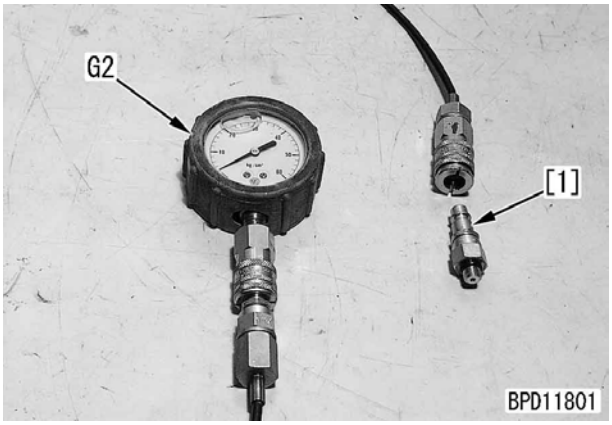
2. Remove oil pressure inspection plug (4).



3. Install adapter **G3** and nipple [1] of hydraulic tester **G1** to the plug installation portion and connect to hydraulic tester **G2**.



4. Start the engine and measure the engine oil pressure when the engine is running at low idle and when the torque converter is stalling.



5. After finishing measurement, remove the measuring instrument and reinstall the removed parts.

Handling of fuel system devices

★ Precautions for testing and maintaining fuel system
The common rail fuel injection system (CRI) consists of more precise parts than the conventional fuel injection pump and nozzle. If foreign matter enters this system, it can cause a trouble.
When testing and maintaining the fuel system, take care more than the past. If dust, etc. sticks to any part, wash that part thoroughly with clean fuel.

★ Precautions for replacing fuel filter cartridge
Be sure to use Komatsu genuine fuel filter cartridge.
Since the common rail fuel injection system (CRI) consists of more precise parts than the conventional fuel injection pump and nozzle, it employs a high-efficiency special filter to prevent foreign matter from entering it.
If a filter other than the genuine one is used, the fuel system may have a trouble. Accordingly, never use such a filter.

Releasing residual pressure from fuel system

★ Pressure is generated in the low-pressure circuit and high-pressure circuit of the fuel system while the engine is running.
Low-pressure circuit: Fuel pre-filter – Lift pump – Fuel main filter – Fuel supply pump
High-pressure circuit: Fuel supply pump – Common rail – Fuel injector

★ The pressure in both low-pressure circuit and high-pressure circuit lowers to a safety level automatically 30 seconds after the engine is stopped.

★ Before the fuel circuit is tested and its parts are removed, the residual pressure in the fuel circuit must be released completely. Accordingly, observe the following.

⚠ **Before testing the fuel system or removing its parts, wait at least 30 seconds after stopping the engine until the residual pressure in the fuel circuit is released. (Do not start the work just after stopping the engine since there is residual pressure.)**

Testing fuel pressure

★ Measuring tools for fuel pressure

Symbol		Part No.	Part name
H	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital type hydraulic tester
	2	6732-81-3170	Adapter (10 x 1.0 mm → R1/8)
		6215-81-9710	O-ring
	3	799-401-2320	Hydraulic tester: 0.98 MPa {10 kg/cm^2}
	4	799-201-1201	Fuel vacuum gauge

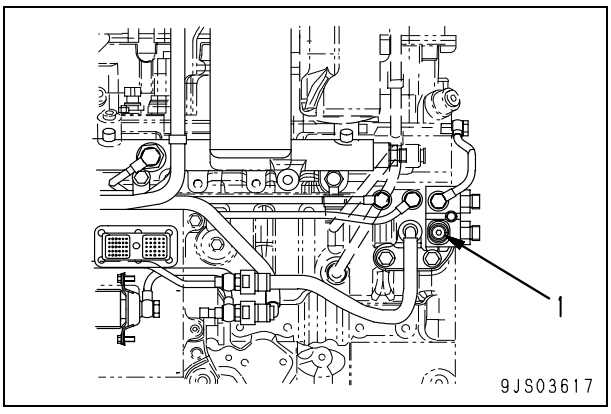
★ Tests only the fuel pressure in negative pressure circuit from fuel supply connector to lift pump inlet, and in low-pressure circuit from lift pump to fuel main filter and supply pump.

⚠ **Since the pressure in the high-pressure circuit from fuel supply pump to common rail and fuel injector is very high, it cannot be measured.**

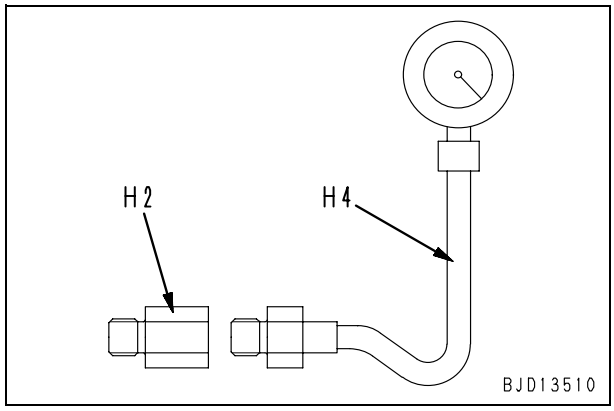
1. Open the left cover of engine hood.

2. Testing fuel negative pressure circuit pressure (fuel supply connector)

1) Remove fuel pressure pickup plug (1) from the fuel supply connector.



2) Install adapter **H2** to plug hole, and connect fuel vacuum gauge **H4**.



3) Run the engine at high idle and test the fuel negative pressure circuit pressure.
   - ★ If the fuel negative pressure circuit pressure is in the following range, it is normal.
   - ● Standard value of fuel negative pressure circuit pressure (fuel supply connector):

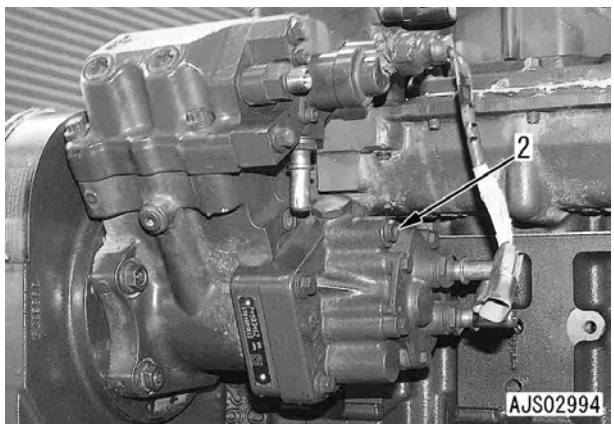
     Max. 27.1 kPa {Max. 203 mmHg}

4) After finishing testing, remove the testing tools and return the removed parts.
   - ● Fuel pressure pickup plug:

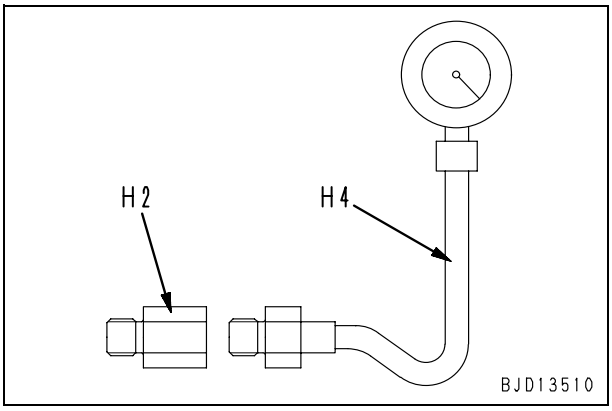
     20 – 22 Nm {2.0 – 2.2 kgm}

3. Testing fuel negative pressure circuit pressure (supply pump)

1) Remove fuel pressure pickup plug (2) from the supply pump.



2) Install adapter **H2** to plug hole, and connect fuel vacuum gauge **H4**.



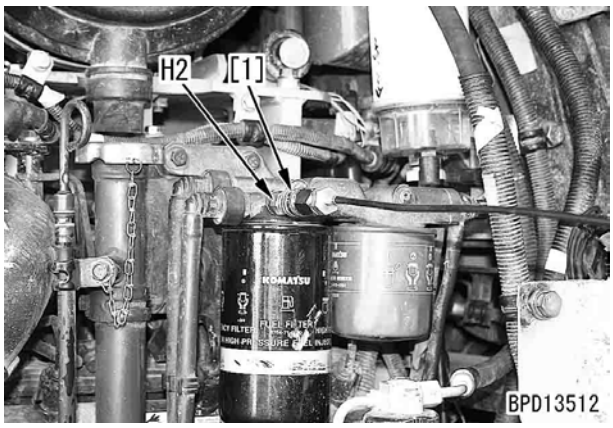
3) Run the engine at high idle and test the fuel negative pressure circuit pressure.
   ★ If the fuel negative pressure circuit pressure is in the following range, it is normal.
   - Standard value of fuel negative pressure circuit pressure (supply pump):
     Max. 33.9 kPa {Max. 254 mmHg}

4) After finishing testing, remove the testing tools and return the removed parts.
   - Fuel pressure pickup plug:
     20 – 22 Nm {2.0 – 2.2 kgm}

4. Testing fuel low-pressure circuit pressure (fuel filter inlet side)

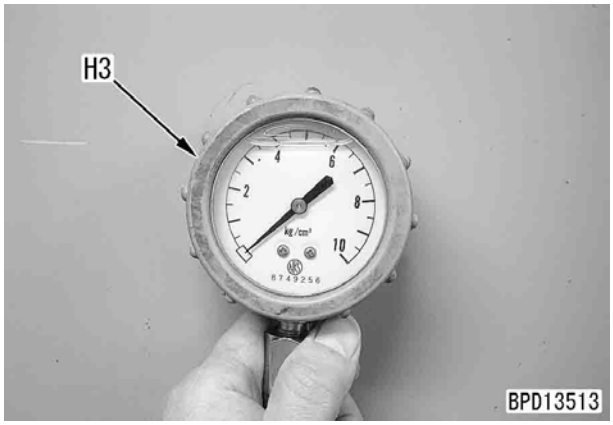
1) Remove fuel pressure pickup plug (3) from the fuel main filter inlet side.

2) Install adapter **H2** and nipple [1] of hydraulic tester **H1** to plug hole, and connect hydraulic tester **H3**.



3) Measure fuel low-pressure circuit pressure when cranking the engine.
   ★ If the fuel low-pressure circuit pressure (at the fuel filter inlet side) is in the following range, it is normal.
   - Standard value of fuel low-pressure circuit pressure (fuel filter inlet side):
     Min. 69 kPa {0.7 kg/cm^2}

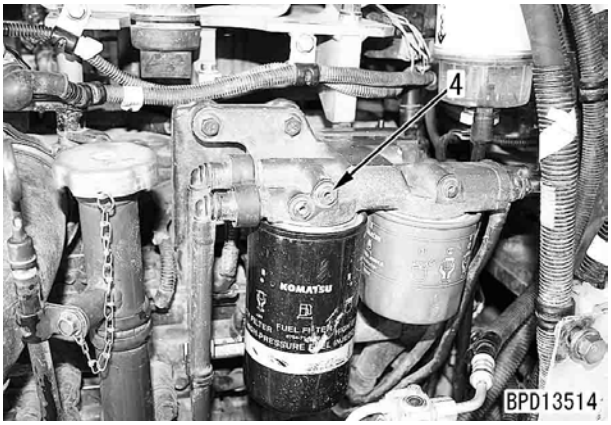
   ⚠ **For protection of the starting motor, do not continue cranking for 30 seconds or more.**



4) After finishing testing, remove the testing tools and return the removed parts.
   - Fuel pressure pickup plug:
     20 – 22 Nm {2.0 – 2.2 kgm}

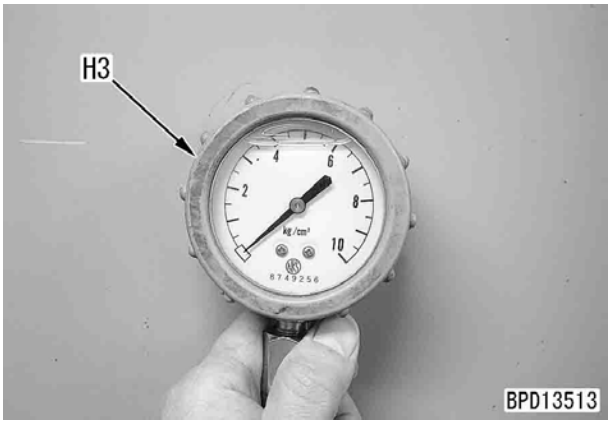
5. Testing fuel low-pressure circuit pressure (fuel filter outlet side)

1) Remove fuel pressure pickup plug (4) from the fuel main filter outlet side.



2) Install adapter **H2** and nipple [1] of hydraulic tester **H1** to plug hole, and connect hydraulic tester **H3**.

3) Run the engine at high idle and measure the fuel low-pressure circuit pressure.
   - ★ If the fuel low-pressure circuit pressure (at the fuel filter outlet side) is in the following range, it is normal.
   - ● Standard value of fuel low-pressure circuit pressure (fuel filter outlet side):
     Min. 0.48 MPa {Min. 4.9 kg/cm^2}

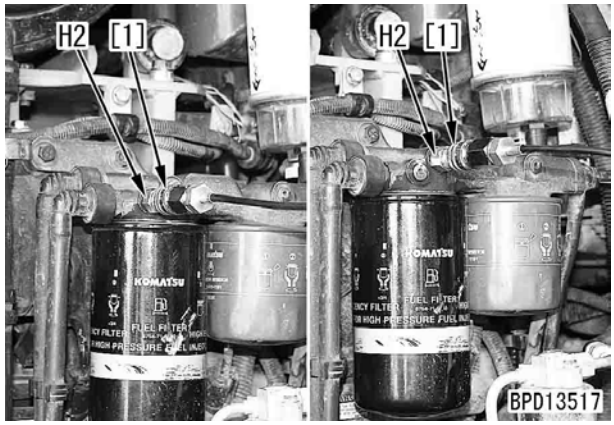


4) After finishing testing, remove the testing tools and return the removed parts.
   - ● Fuel pressure pickup plug:
     20 – 22 Nm {2.0 – 2.2 kgm}

6. Testing drop of fuel low-pressure circuit pressure

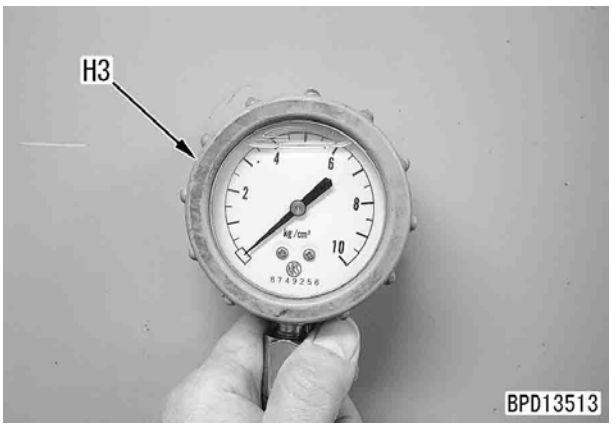
1) Remove fuel pressure pickup plug (3) from the fuel main filter inlet side and fuel pressure pickup plug (4) from the outlet side.

2) Install adapter **H2** and nipple [1] of hydraulic tester **H1** to plug hole, and connect hydraulic tester **H3**.



3) Run the engine at high idle and measure the drop of the fuel low-pressure circuit pressure.
   - ● Drop of fuel low-pressure circuit pressure =
     Fuel filter inlet pressure – Fuel filter outlet pressure
   - ★ If the drop of fuel low-pressure circuit pressure is in the following range, it is normal.
   - ● Standard value of drop of fuel low-pressure circuit pressure:
     Max. 0.14 MPa {Max. 1.4 kg/cm^2}

★ If the drop exceeds the standard value, clogging of the fuel filter is suspected.



4) After finishing testing, remove the testing tools and return the removed parts.
   - Fuel pressure pickup plug:
     20 – 22 Nm {2.0 – 2.2 kgm}

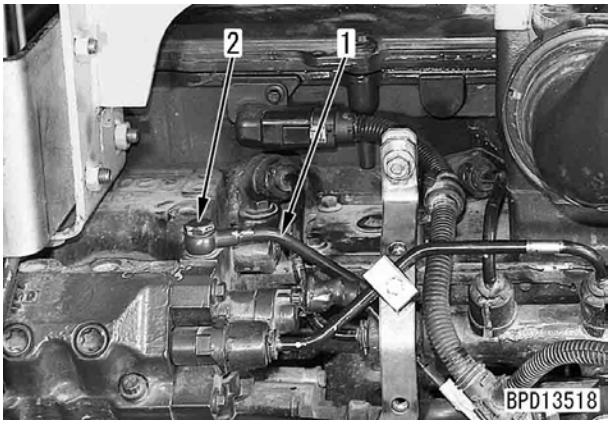
Testing fuel return and leak amount

★ Testing tools for leakage from pressure limiter and return rate from injector

Symbol		Part No.	Part name
J	1	Part No. being established	Tool to check supply pump
	2	Part No. being established	Pressure limiter testing tool
	3	Part No. being established	Tool to check injector
	4	Commercial item	Measuring cylinder

1. Testing supply pump return rate

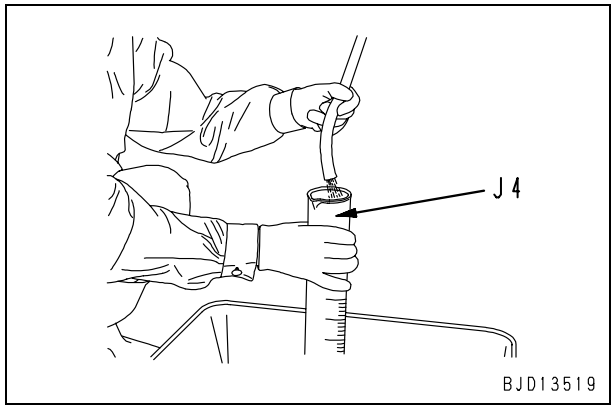
1) Remove supply pump bolt (2), and disconnect return tube (1).



2) Connect testing tool **J1** on supply pump side, and insert the tip into measuring cylinder **J4**.
3) Connect block tool **J1** to fuel return connector side, and block fuel leak.
4) Run the engine at low idle and test the return rate from the supply pump.
   ★ If the return rate from the supply pump is in the following range, it is normal.

Low idle	300 cc/30 sec.
Cranking	200 cc/30 sec.

⚠ **When the engine cannot run, you may test it by cranking the engine with the starting motor. To protect the starting motor, do not continuously crank the engine 30 seconds or more.**



5) After finishing testing, remove the testing tools and return the removed parts.
   Joint bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}

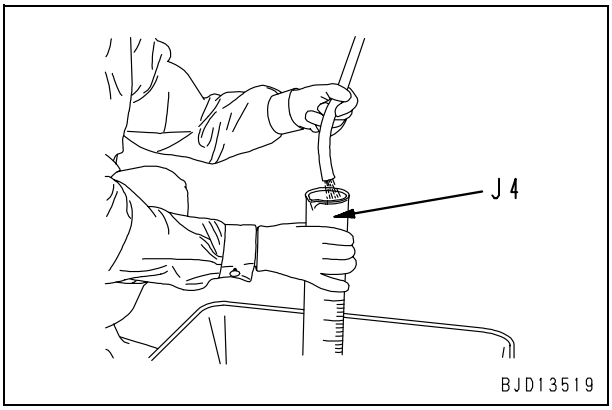
2. Testing leakage from pressure limiter

★ When displaying failure code [**CA559**] or [**CA2249**], implement troubleshooting beforehand.

1) Remove return tube (2) of the pressure limiter.

2) Connect testing tool **J2** on pressure limiter side, and insert the tip into measuring cylinder **J4**.
3) Connect block tool **J2** to return tube joint connector on cylinder block side, and block fuel leak.
4) Run the engine at low idle and test the return rate from the pressure limiter.
   ★ If the leakage from the pressure limiter is in the following range, it is normal.

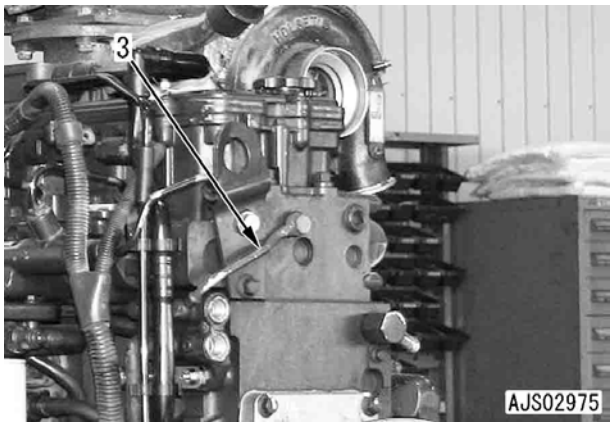
Low idle	Max. 30 drops/min.



5) After finishing testing, remove the testing tools and return the removed parts.
   Joint bolt:
   24±4 Nm {2.4±0.4 kgm}

3. Testing return rate from injector

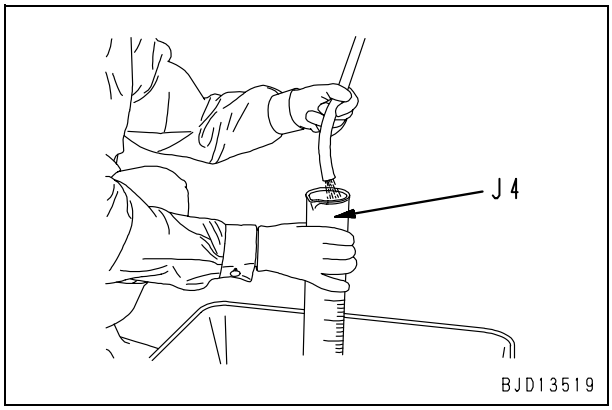
1) Remove return tube (3) of the injector.



2) Connect testing tool **J3** on cylinder head side, and insert the tip into measuring cylinder **J4**.
3) Connect block tool **J3** to return tube joint connector on cylinder block side, and block fuel leak.
4) Run the engine at low idle and test the return rate from the injector.
   ★ If the return rate from the injector is in the following range, it is normal.

Low idle	300 cc/45 sec.
Cranking	100 cc/30 sec.

⚠ **When the engine cannot run, you may test it by cranking the engine with the starting motor. To protect the starting motor, do not continuously crank the engine for 30 seconds or more.**

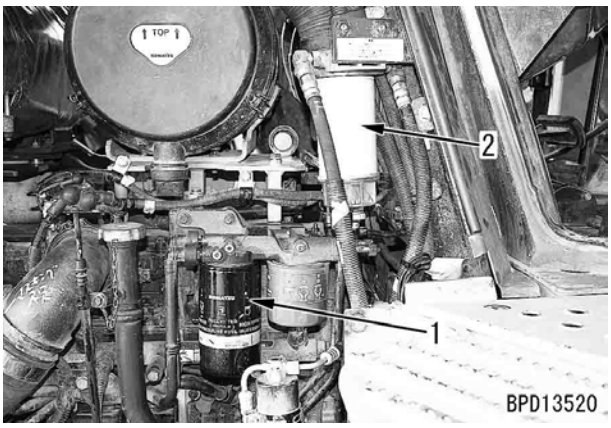


5) After finishing testing, remove the testing tools and return the removed parts.
   Joint bolt:
   24 ± 4 Nm {2.4 ± 0.4 kgm}

Bleeding air from fuel circuit

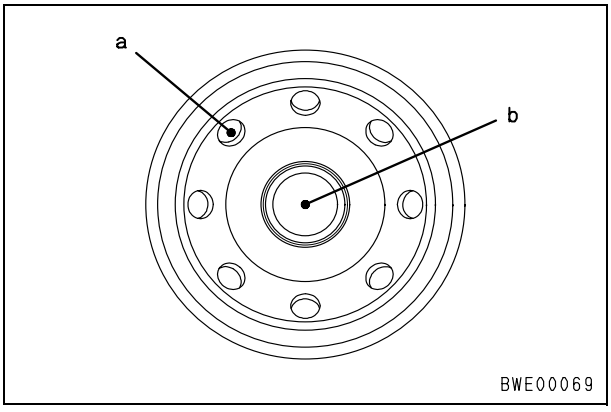
★ Bleed the air by electric lift pump as follows if the engine has run out of fuel or the fuel circuit equipment has been removed and installed.

1. The installation procedures for fuel main filter (1) and fuel pre-filter (2) after their removal, installation or replacement are as follows.



1) Do not fill fuel into fuel main filter (1).
2) Fill up fuel into fuel pre-filter (2).
   - When filling, use clean fuel and be careful not to let dirt get in.
   - Add fuel through inlet port (**a**) areas (8 places) of the filter.

     Area (**b**) is the outlet port (clean side) after the fuel has been filtered, so never add fuel from here.



3) Apply a thin coat of oil on the packing surface of the filter and install it to filter head until it touches the sealing surface, then tighten 3/4 rotation. (For the procedure to replace fuel filter cartridge, see the Operation and Maintenance Manual.)

2. Fill up the fuel tank with fuel.

3. Turn the starting switch ON.
   - The lift pump is operated for 30 seconds automatically.

   ⚠ **Do not turn the starting switch to start position.**

4. Return the starting switch to OFF position, and keep it for 10 seconds.

5. Repeat the above 3 and 4 operation 4 times.

6. Crank the engine with the starting motor and start the engine.
   - ★ The air in the high-pressure circuit is bled automatically if the engine is cranked.
   - ★ If the engine does not start, there may be still air in the low-pressure circuit. In this case, repeat the above procedure from step 2.
   - ★ If the engine is run when there is still air in the fuel circuit, fuel circuit errors (**CA449**, **CA559**) may occur. In this case, start the engine after the procedure above, and continue to drive the engine for about 3 minutes at low idle. When air is bleed from fuel circuit, engine speed is stabilized and error display will disappear.

Testing fuel circuit for leakage

⚠ **Very high pressure is generated in the high-pressure circuit of the fuel system. If fuel leaks while the engine is running, it is dangerous since it can catch fire.**
After testing the fuel system or removing its components, inspect it for fuel leakage according to the following procedure.

★ Clean and degrease the engine and the parts around it in advance so that you can inspect it easily for fuel leakage.

1. Spray color checker (developer) over the fuel supply pump, common rail, fuel injector, and joints of the high-pressure piping.

2. Run the engine at a speed less than 1,000 rpm and stop it after its rotation is stabilized.

3. Inspect the fuel piping and the devices for fuel leakage.
   ★ Inspect the high-pressure circuit parts concentration on the areas coated with the color checker, for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

4. Run the engine at low idle.

5. Inspect the fuel piping and the devices for fuel leakage.
   ★ Inspect the high-pressure circuit parts concentration on the areas coated with the color checker, for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

6. Run the engine at high idle.

7. Inspect the fuel piping and the devices for fuel leakage.
   ★ Inspect the high-pressure circuit parts concentration on the areas coated with the color checker, for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

8. Run the engine at high idle to apply load to the engine.
   ★ Relieve by tilting the blade or raising the ripper.

9. Inspect the fuel piping and the devices for fuel leakage.
   ★ Inspect the high-pressure circuit parts concentration on the areas coated with the color checker, for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.
   ★ If any fuel leakage is not detected, inspection is completed.

Handling of reduced cylinder mode operation

★ Reduced cylinder mode operation means to run the engine with the fuel injectors of 1 or more cylinders disabled electrically to reduce the number of effective cylinders. The purposes and effects of this operation are as follows.

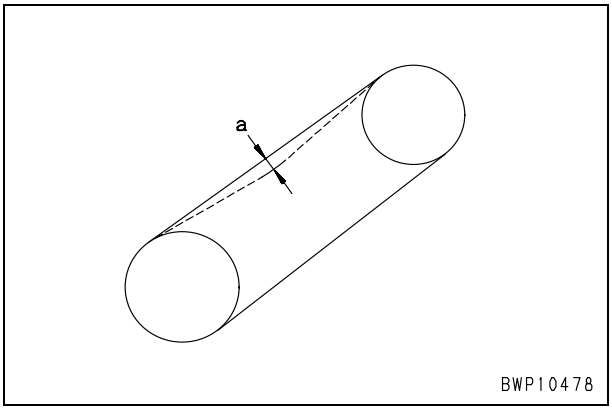
1. This operation is used to find out a cylinder which does not output power normally (or, combustion in it is abnormal).
   When a cylinder is selected for the reduced cylinder mode operation, if the engine speed and output do not change from the normal operation (all-cylinder operation), that cylinder has 1 or more defects.
   The possible defects are as follows.
   - Leakage through cylinder head gasket
   - Defective injection
   - Defective piston, piston ring, and cylinder liner
   - Defective valve mechanism (Moving valve system)
   - Defect in electrical system
2. Since the common rail fuel injection system controls the injector of each cylinder electronically, the operator can perform the reduced cylinder mode operation easily with switches to find out a defective cylinder.
   ★ The reduced cylinder mode operation is carried out by using the special functions of monitor panel.
   ★ For the operation method, see Testing and adjusting, “Special functions of monitor panel”.

Testing and adjusting air conditioner compressor belt tension

Testing

- Press the intermediate point between air conditioner pulley and drive pulley with a finger and measure deflection (**a**).

★ Pressing force: Approx. 98 N {Approx. 10 kg}



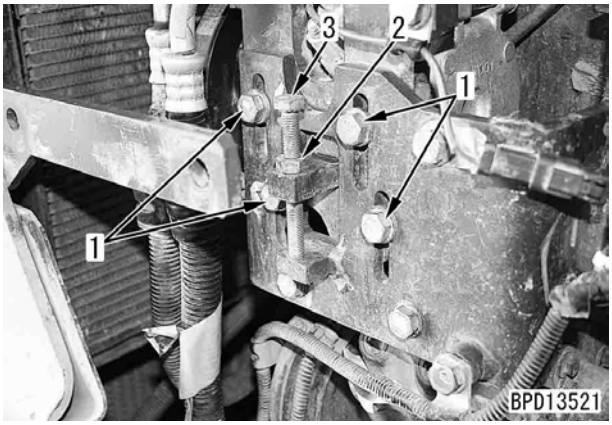
Adjusting

★ If the deflection is out of range, adjust it according to the following procedure.

1. Loosen 4 compressor bracket mounting bolts (1).

2. Loosen locknut (2), turn adjustment nut (3) and adjust the belt tension.

3. After adjusting the belt tension to the standard value, tighten locknut (2), then tighten 4 compressor bracket mounting bolts (1).

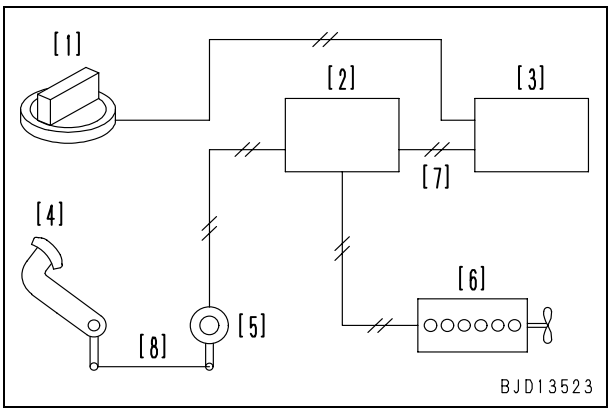


Adjusting fuel control dial and decelerator pedal

1. Outline of fuel control system

- The following signals are inputted as rotation command signals to the engine controller.
  - Decelerator pedal potentiometer signal
  - 3rd throttle signal

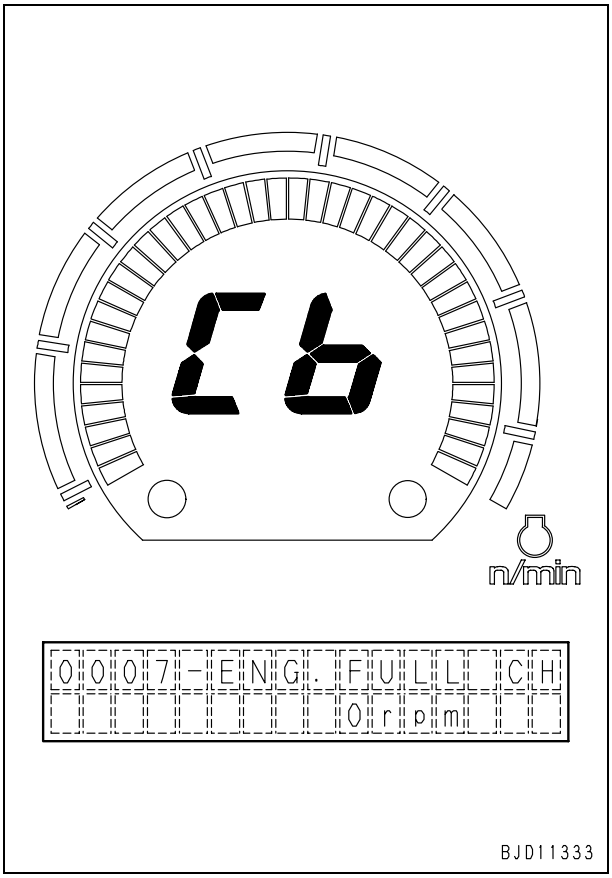
  The engine controller controls the fuel control system of the engine (CRI system) according to the lowest engine speed signal among those input signals.
- Adjust the deceleration slow speed by adjusting the decelerator pedal linkage.



[1] Fuel control dial
[2] Engine controller
[3] Steering and transmission controller
[4] Decelerator pedal
[5] Decelerator potentiometer
[6] Engine (CRI system)
[7] 3rd throttle signal
[8] Rod

2. Preparatory work

1) Start the engine, set the monitor panel in the “Adjustment mode“, and prepare to measure the engine speed.
   - ★ For the operation method, see “Special functions of monitor panel (EMMS)”.
   - **Adjustment code**: **0007**
     (Engine deceleration cut mode)
   - ★ The engine speed is displayed by 1 rpm.



3. Adjusting decelerator pedal engine speed

With the fuel control dial in the high idle position, press decelerator pedal (1) to stopper bolt (2) and check that the decelerator pedal engine speed is normal.

- Decelerator pedal engine speed: 975 – 1,025 rpm
- Potentiometer output: 3.56 ± 0.1 V

★ If the decelerator pedal engine speed is out of range, adjust installation dimension (**a**) of stopper bolt (2).

- Standard installation dimension (**a**) of stopper bolt: 24.5 mm

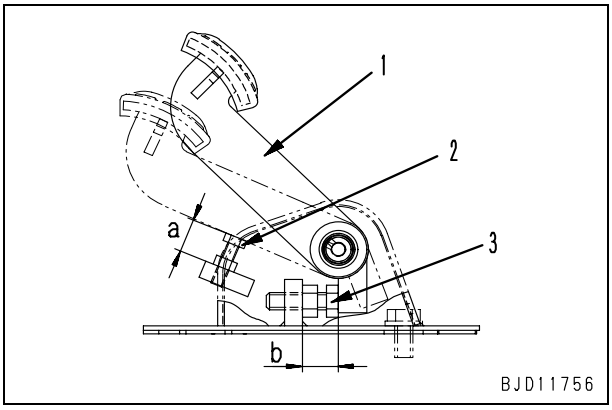
4. Engine speed at high idle

Set the fuel control dial in the high idle position and check that the engine speed at high idle is normal.

- Engine speed at high idle: 1,980 – 2,080 rpm
- Potentiometer output: 0.8 ± 0.1 V
- Standard installation dimension (**b**) of stopper bolt: 24 mm

★ If the engine speed is out of range, perform the following.

- When the engine speed is 1980 rpm or less:
  Adjust the engine speed to the high idle speed with stopper bolt (3).



Measuring power train oil pressure

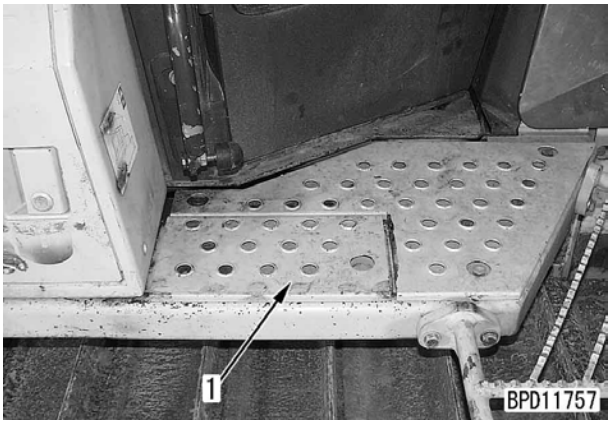
★ Measuring tools for power train oil pressure

Symbol		Part No.	Part name
K	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	799-401-2320	Hydraulic tester (0.98 MPa {10 kg/cm^2})
	3	799-101-5220	Nipple (10 x1.25 mm)
		07002-11023	O-ring

⚠ **Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and work equipment lock lever in the lock position.**

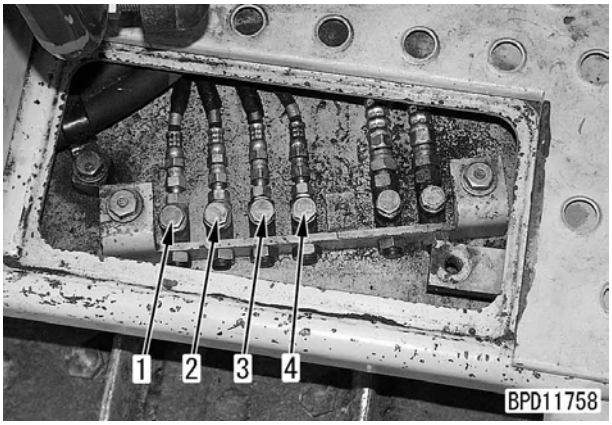
★ Measure the power train oil pressure under the following condition.
- Power train oil temperature: 70 – 80°C

★ The centralized power train oil pressure pickup ports are installed inside the inspection cover (1) on the right side of the operator cab.



★ List of oil pressure measuring points and gauges to be used.

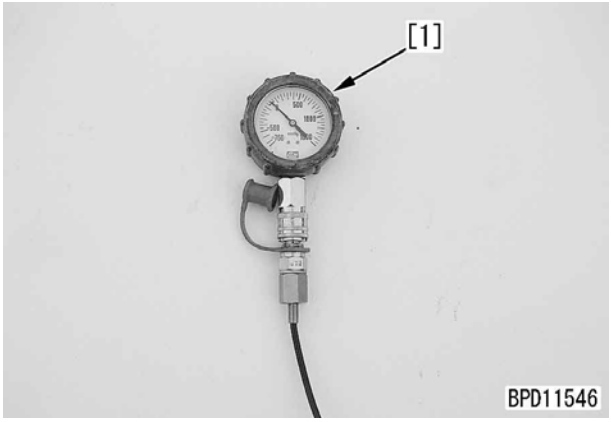
No.	Oil pressure reading	Gauge (MPa {kg/cm^2})
1	Brake pressure	5.9 {60}
2	Torque converter inlet pressure	2.5 {25}
3	Torque converter outlet pressure	0.98 {10}
4	Transmission main relief pressure	5.9 {60}



1. Measuring brake pressure

1) Remove oil pressure pickup plug (1) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
   ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.

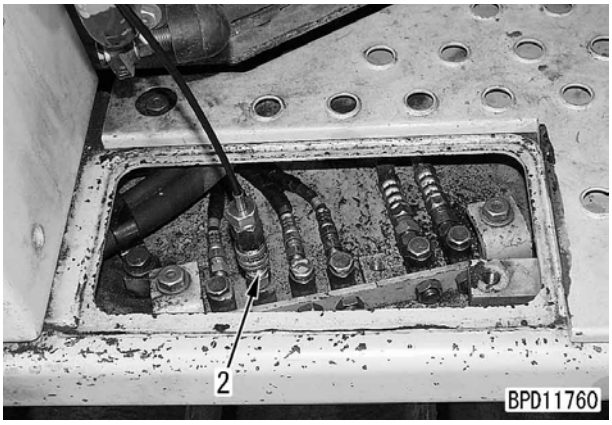
2) Run the engine and set the parking brake lever in free position.
3) Measure the oil pressure while the engine is running at low idle and high idle.
   ★ Check that the oil pressure lowers to 0 when the brake pedal is depressed or the parking brake lever is set in the lock position.



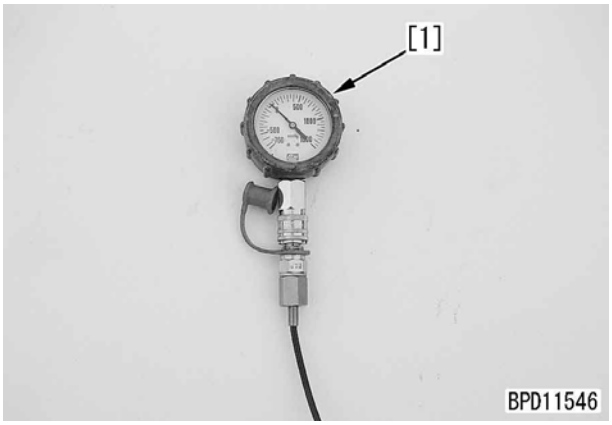
4) After finishing measurement, remove the measuring instrument and reinstall the removed parts.

2. Measuring torque converter inlet pressure

1) Remove oil pressure pickup plug (2) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
   ★ Use an oil pressure gauge of 2.5 MPa {25 kg/cm^2}.



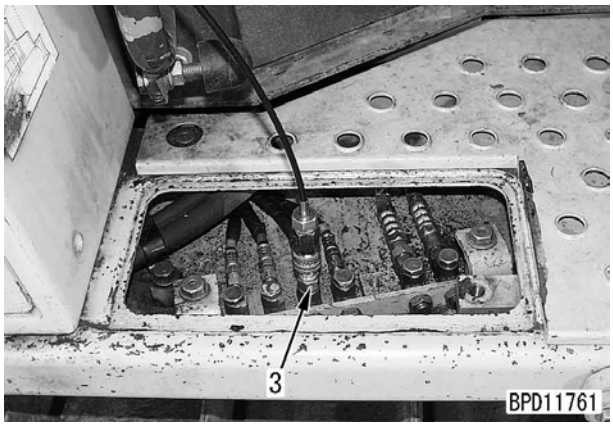
2) Run the engine and set the PCCS lever in the full neutral position.
3) Measure the oil pressure while the engine is running at low idle and high idle.



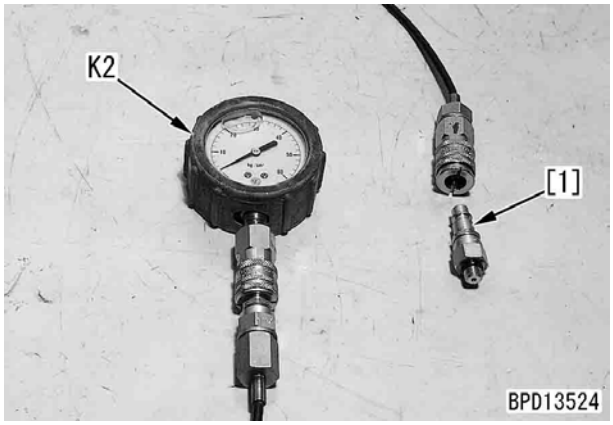
4) After finishing measurement, remove the measuring instrument and reinstall the removed parts.

3. Measuring torque converter outlet pressure

1) Remove oil pressure pickup plug (3) and attach nipple **K3**, and connect hydraulic tester **K1**.
   ★ Use an oil pressure gauge of 0.98 MPa {10 kg/cm^2}.



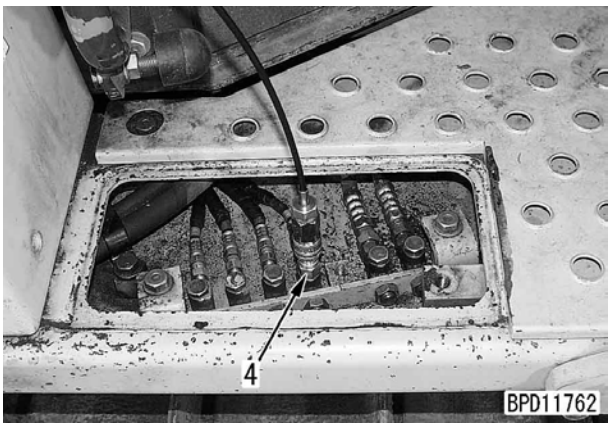
2) Run the engine and set the PCCS lever in the full neutral position.
3) Measure the oil pressure while the engine is running at low idle and high idle.



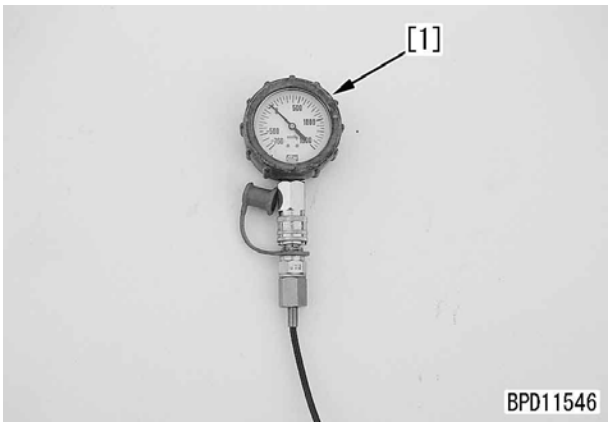
4) After finishing measurement, remove the measuring instrument and reinstall the removed parts.

4. Measuring transmission main relief pressure

1) Remove oil pressure pickup plug (4) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
   ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.



2) Run the engine and set the PCCS lever in the full neutral position.
3) Measure the oil pressure while the engine is running at low idle and high idle.



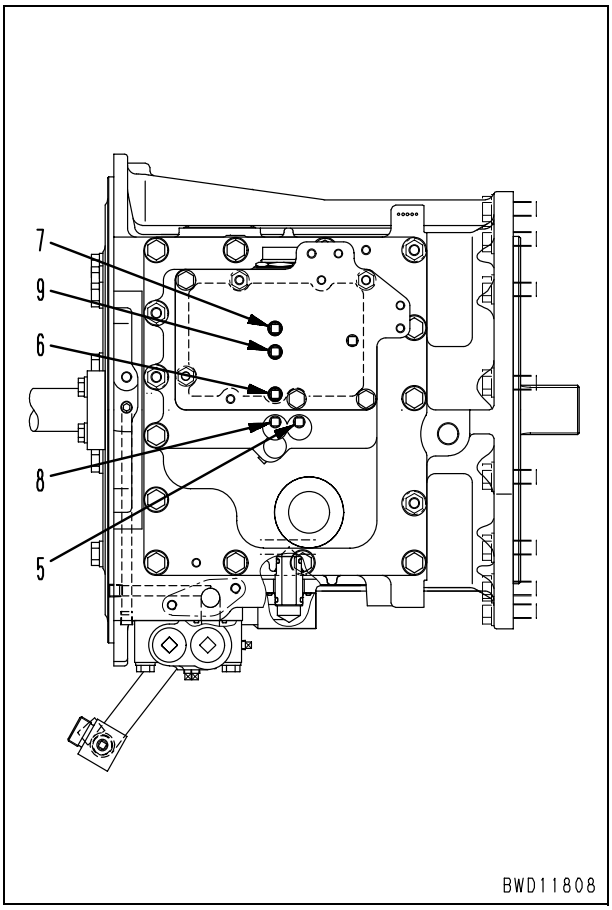
4) After finishing measurement, remove the measuring instrument and reinstall the removed parts.

5. Measuring clutch pressure

- Remove the operator seat assembly and measure the clutch pressure from the top of the floor frame.

★ List of oil pressure measuring points and gauges to be used.

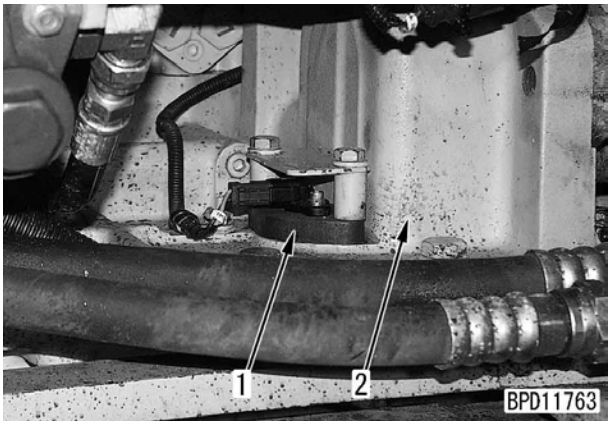
No.	Measuring point	Gauge (MPa {kg/cm^2})
5	Transmission forward clutch pressure	5.9 {60}
6	Transmission reverse clutch pressure	5.9 {60}
7	Transmission 1st clutch pressure	5.9 {60}
8	Transmission 2nd clutch pressure	5.9 {60}
9	Transmission 3rd clutch pressure	5.9 {60}



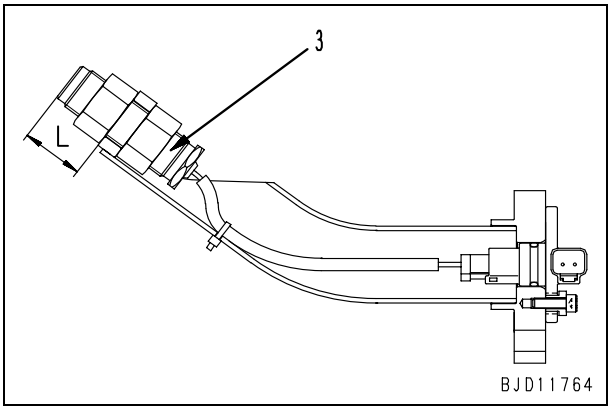
1) Measuring transmission forward clutch pressure
   1] Remove oil pressure pickup plug (6) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
      ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.
   2] Run the engine and set the parking brake lever in free position.
   3] With the brake pedal depressed, set the PCCS lever in the “forward” and 3rd gear speed position.
   4] Measure the oil pressure while the engine is running at high idle.
   ⚠ **Since the torque converter is stalled, keep pressing the brake pedal securely.**
   5] After finishing measurement, remove the measuring instrument and reinstall the removed parts.
2) Measuring transmission reverse clutch pressure
   1] Remove oil pressure pickup plug (6) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
      ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.
   2] Run the engine and set the parking brake lever in free position.
   3] With the brake pedal depressed, set the PCCS lever in the “forward” and 3rd gear speed position.
   4] Measure the oil pressure while the engine is running at high idle.
   ⚠ **Since the torque converter is stalled, keep pressing the brake pedal securely.**
   5] After finishing measurement, remove the measuring instrument and reinstall the removed parts.
3) Measuring transmission 1st clutch pressure
   1] Remove oil pressure pickup plug (7) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
      ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.
   2] Run the engine and set the parking brake lever in free position.
   3] With the brake pedal depressed, set the PCCS lever in the “forward” and 1st gear speed position.
   4] Measure the oil pressure while the engine is running at low idle.
   ⚠ **Since the torque converter is stalled, keep pressing the brake pedal securely.**
   ⚠ **Do not run the engine at high idle while measuring.**
   5] After finishing measurement, remove the measuring instrument and reinstall the removed parts.
4) Measuring transmission 2nd clutch pressure
   1] Remove oil pressure pickup plug (8) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
      ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.
   2] Run the engine and set the parking brake lever in free position.
   3] With the brake pedal depressed, set the PCCS lever in the “forward” and 2nd gear speed position.
   4] Measure the oil pressure while the engine is running at low idle.
   ⚠ **Since the torque converter is stalled, keep pressing the brake pedal securely.**
   ⚠ **Do not run the engine at high idle while measuring.**
   5] After finishing measurement, remove the measuring instrument and reinstall the removed parts.
5) Measuring transmission 3rd clutch pressure
   1] Remove oil pressure pickup plug (9) and attach nipple **K3**, and connect oil pressure gauge [1] of hydraulic tester **K1**.
      ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.
   2] Run the engine and set the parking brake lever in free position.
   3] With the brake pedal depressed, set the PCCS lever in the “forward” and 3rd gear speed position.
   4] Measure the oil pressure while the engine is running at low idle.
   ⚠ **Since the torque converter is stalled, keep pressing the brake pedal securely.**
   ⚠ **Do not run the engine at high idle while measuring.**
   5] After finishing measurement, remove the measuring instrument and reinstall the removed parts.

Adjusting transmission speed sensor (replacement procedure)

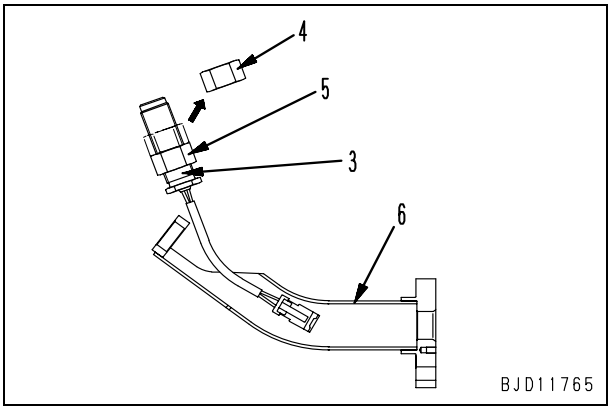
1. Remove the undercover of the fuel tank, then remove transmission speed sensor assembly (1) from steering case (2).



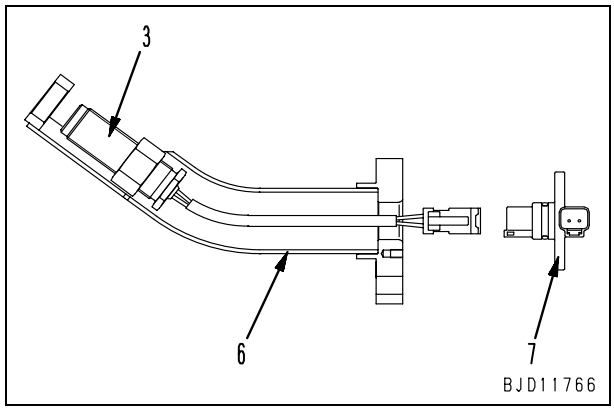
2. Measure installation dimension (**L**) of removed sensor (3).
   ★ When replacing the sensor, be sure to measure dimension (**L**).



3. Assembly procedure for sensor assembly
   1) Remove only nut (4) from sensor (3), and insert sensor (3) in the opening at the end of tube (6) from the connector side.



   2) Pull the connector of sensor (3) out of the flange hole of tube (6) and connect it to connector assembly (7). (securely until it clicks)



   3) Install connector assembly (7) to tube (6).
      Mounting bolt:
      4.9 – 6.9 Nm {0.5 – 0.7 kgm}
   4) Insert sensor (3) in the boss of tube (6) and secure it with nuts (4) and (5).
      ★ Installation dimension of sensor: Dimension measured at time of removal: **(L) ± 0.2 mm**
      Locknut:
      49 – 68.7 Nm {5 – 7 kgm}
      Threads of sensor:
      Adhesive (LT-2)

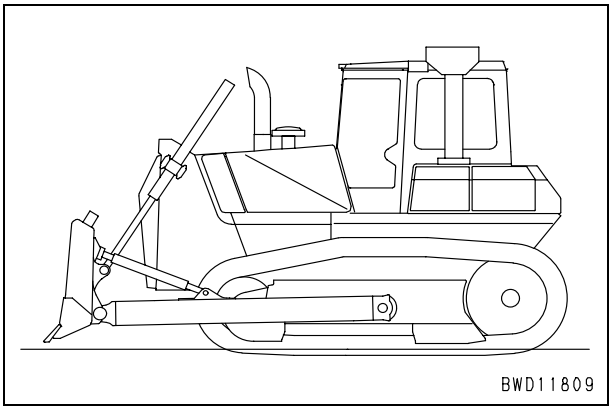
4. Install sensor assembly (1) to steering case (2).
   ● Standard clearance between bevel gear and sensor tip: **0.65 – 1.65 mm**

5. After finishing adjustment, set the monitor panel in “Monitoring display mode” and check that it displays the transmission speed normally.
   ★ For the operating method, see “Special functions of monitor panel (EMMS)”.
   ★ Monitoring code: 31400 (Transmission speed)

Simple method to test brake performance

★ Implement simple method to test brake performance under the following condition.
- Power train oil temperature:
  Within operating range

1. Set the blade and ripper (if equipped) in the travel posture on a level place.



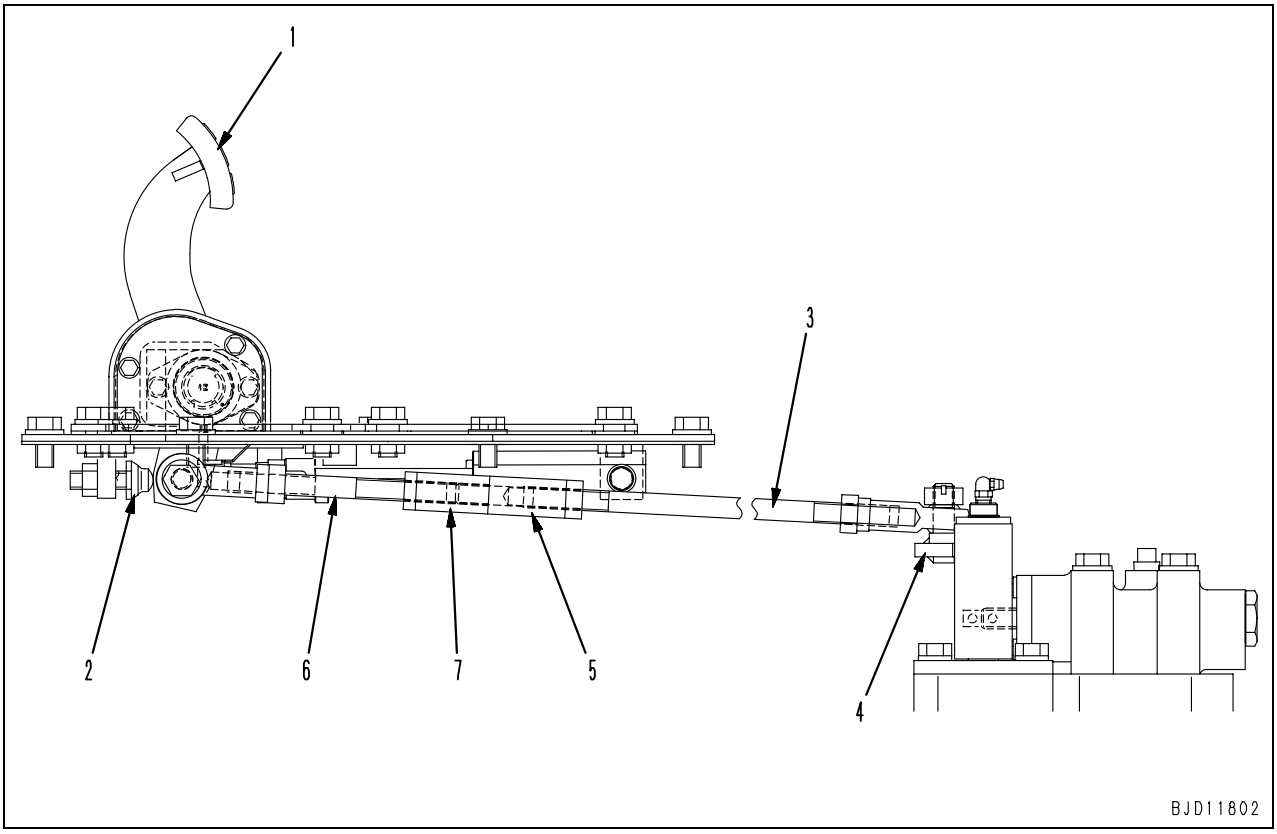
2. Run the engine and set the parking brake lever in free position.

3. While the engine is running at low idle and the brake pedal is depressed securely, set PCCS lever in the forward and 2nd gear speed position.
   ⚠ **If this test is carried out in the 1st gear position, the brake is overloaded. Therefore, be sure to carry it out in 2nd gear speed.**
   ★ Set the steering unit in neutral.

4. Press the decelerator pedal and set the fuel control dial in the high idle position.

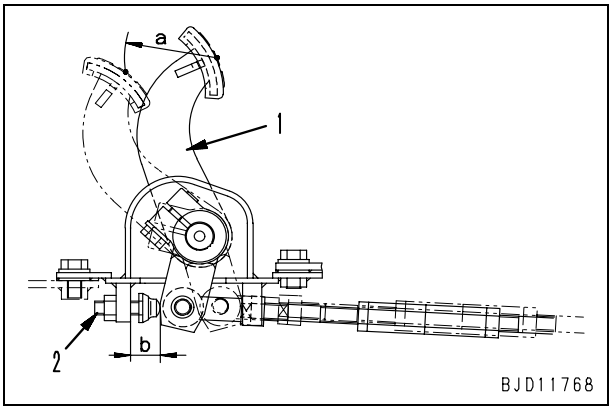
5. Return the decelerator pedal slowly and check that the machine does not start when the engine speed reaches the high idle level.
   ⚠ **Since the torque converter is stalled, press the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.**

Adjusting brake pedal



★ Tighten the locknuts of the rods and cables securely, and bend the cotter pins securely.

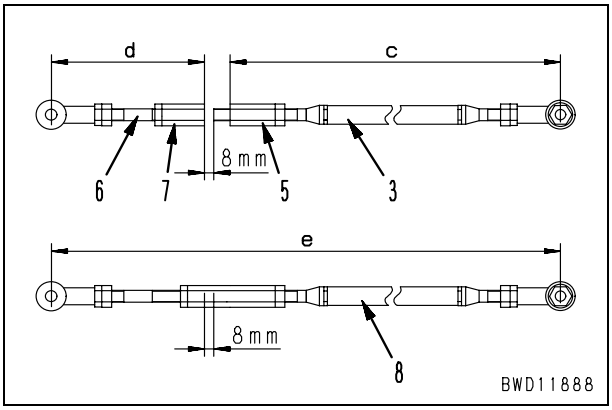
1. Adjust the stroke (**a**) of brake pedal (1) with the installation dimension (**b**) of damper (2).
   - Pedal stroke (**a**): 77.5 mm
   - Installation dimension (**b**) of damper: 25 mm



2. Adjust installation dimension (**c**) of rod (3) on the valve side, then connect to brake valve lever (4).
   - Rod installation dimension (**c**)**: 773 mm**
   - ★ Fully screw in joint (5) to the valve side.

3. Adjust installation dimension (**d**) of rod (6) on the pedal side, then connect to brake pedal (1).
   - Rod installation dimension (**d**)**: 175 mm**

4. Lightly push rod (3) on the valve side toward the rear of the machine, and turn only joint (7) to connect rods (3) and (6).
   - ★ Push rod (3) with a force of about 9.8 – 19.6 N {1 – 2 kg}.
   - Joint: **34.3 – 58.8 Nm {3.5 – 6.0 kgm}**



5. With brake pedal (1) released, adjust its play with dimension (**e**) between the pins of rod assembly (8).
   - Play of pedal: 3 – 8 mm (center of pedal)
   - Dimension (**e**) between pins of rod assembly: 978 mm

   ★ Adjust by turning joints (5) and (7) in the same direction at the same time.

6. With brake pedal (1) released, check that brake pedal (1) is in contact with damper (2).

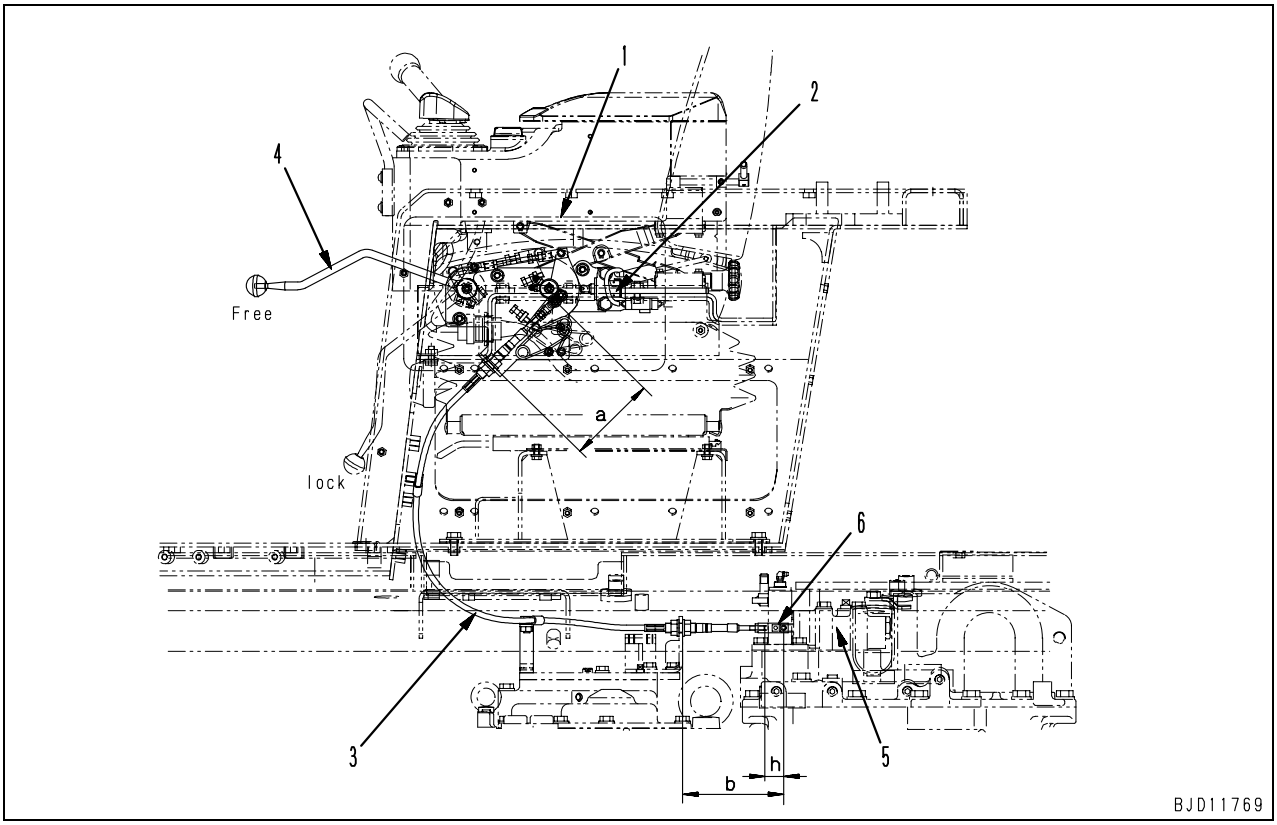
7. Checking brake oil pressure

	Oil pressure MPa {kg/cm^2}	Remarks
Brake released	Min. 2.55 {Min. 26}	Engine at full throttle
Brake applied	0	

8. After adjusting the pedal, adjust the zero point of the brake potentiometer (Adjustment mode: 0005).

   ★ For the operating method, see “Special functions of monitor panel (EMMS)”.

Adjusting parking brake lever



1. Assembling and installing lever assembly

1) Assemble lever assembly (1) and adjust the operation of limit switch (2).
   - ★ When assembling the lever assembly, disconnect the parking brake cable from the lever.
   - ● When lever is pulled up: OFF, lowered: ON
   - ● Operation stroke of limit switch: 3 mm
2) Install lever assembly (1).

2. Adjusting installation length of parking brake cable

1) Connect parking brake cable (3) to the lever side and valve side, and adjust installation dimensions (**a**) and (**b**).
   - ● Cable installation dimension (**a**): 148.5 mm
   - ● Cable installation dimension (**b**): 166 mm
2) Operate parking brake lever (4) between the free and lock positions, and adjust rod end (6) so that spool stroke (**h**) of brake valve (5) is normal.
   - ● Spool stroke (**h**): 13.3 mm

3. Checking brake oil pressure

Check that the brake oil pressure is as follows when the parking brake lever is set in free and lock positions.

- ★ For the method of measuring the brake oil pressure, see “Measuring power train oil pressure”.
- ● Lock position: 0,
  Free position: Specified pressure

4. Checking limit switch

Change the monitor panel to the monitoring display mode and set the parking brake lever in free and lock positions. Check that the limit switch signal is normal at this time.

- ★ For the operation method of the monitoring display mode, see “Special functions of monitor panel (EMMS)”.
- ● Monitoring code:
  40910 (Steering related controller switch input 1)

Emergency escape method when power train has trouble

★ Devices used for emergency escape

Symbol		Part No.	Part name
L	1	19M-06-32820	Switch assembly
		134-06-72810	Wiring harness
	2	7824-66-6430	Prolix resistance
		7827-10-1520	Prolix resistance
	3	790-190-1601	Pump assembly
	4	799-101-5220	Nipple (10 x 1.25 mm)
		07002-11023	O-ring

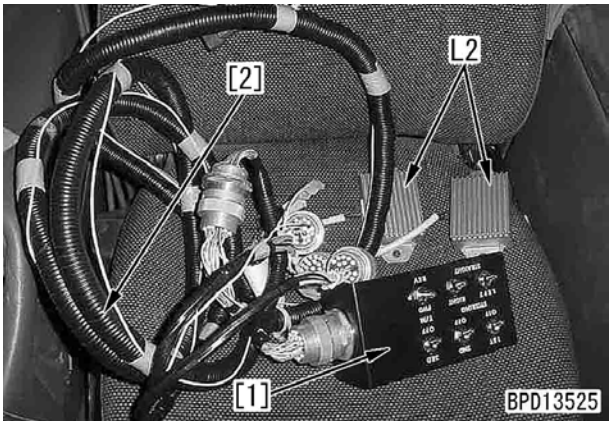
1. Emergency escape method by the switch box (Use L1)

★ If the machine cannot be moved because of a trouble in the electric system of the power train control unit (travel direction, gear speed, steering), carry out the emergency escape according to the following procedure.

★ The engine must be able to start during implementing this procedure.
If the engine cannot be started, see “Emergency escape method with brake releasing device”.

1) Connect switch assembly [1] and **L2** to wining harness [2] of emergency escape device.

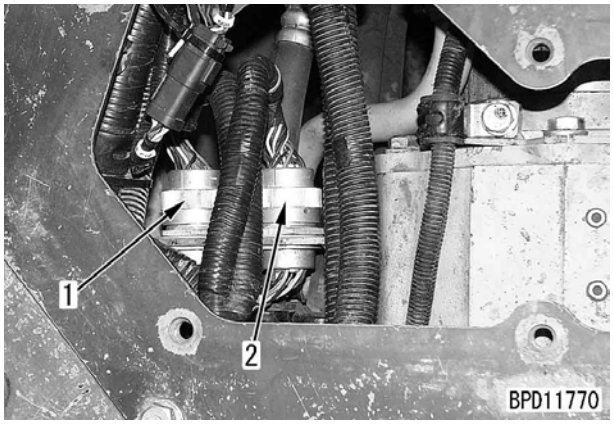
⚠ **To prevent the machine from starting suddenly, set all the gear speed switches of switch assembly [1] to OFF position and the direction switch in P position.**



2) Remove the cover on the left of the toe board and connect wring harness [2] to **PL1** connector (1) and **PL2** connector (2).

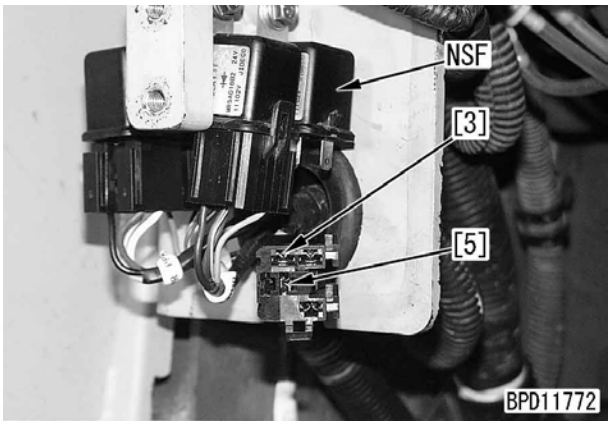
- **PL1** connector (1): Connect to male side and female side.
- **PL2** connector (2): Connect to female side.

★ **PL2** connector on the male side is kept disconnected, mask it with a vinyl sheet, etc.

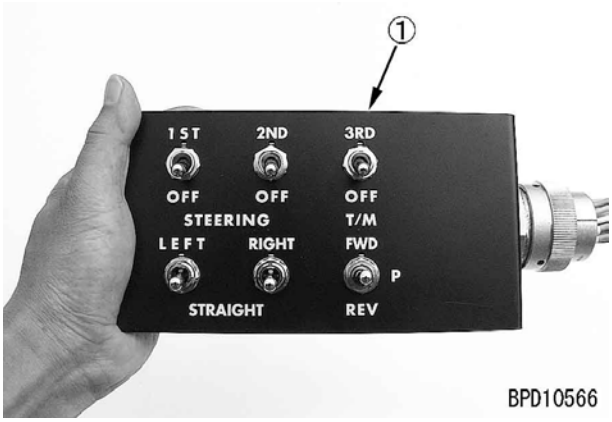


3) Open the battery cover on the left of the cab and remove the cover of relay box (3).

4) Disconnect neutral safety relay (**NSF**) and connect pins [3] and [5] of the connector on the wiring harness side.
   ★ When the connector (PL2) is disconnected, a model selection error is triggered and the neutral safety relay will not be actuated. Above procedure is implemented to avoid this condition.
   ⚠ **If the engine is started by this method, the neutral safety function does not work. Accordingly, before starting the engine, set the parking brake lever in lock position and set the PCCS lever in full neutral position.**
   ⚠ **Start the engine by this method only in an emergency. If the engine does not start in other cases, be sure to carry out troubleshooting and repair the trouble.**



5) Run the engine and set the parking brake lever in free position.
6) Operate switch assembly [1] and move the machine to a safe place.
   ★ The electrical circuit of the gear speed switches is configured so that the switch on the lower gear speed is operated first.
   ⚠ **Take care that the L.H. and R.H. steering directions are opposite when reverse.**

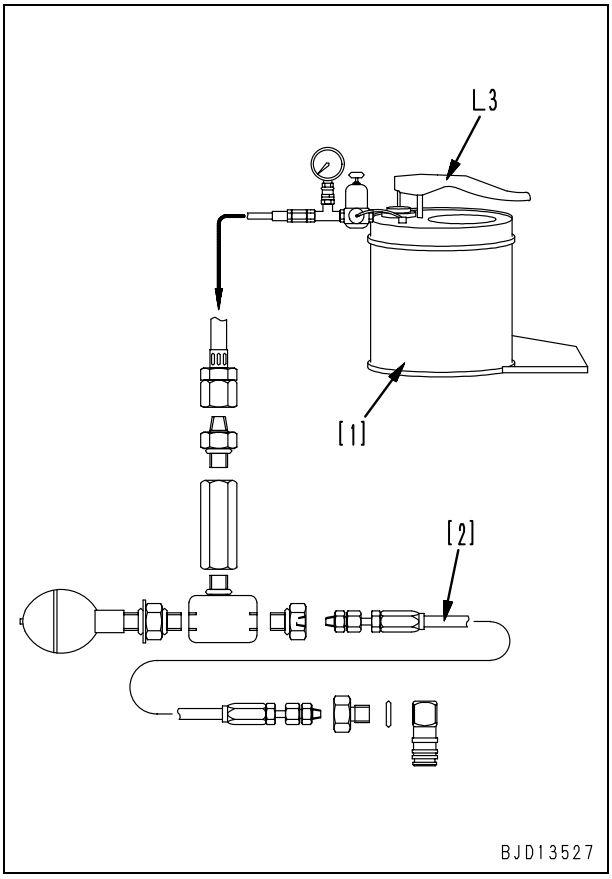


2. Emergency escape method with brake releasing device (Use L3)

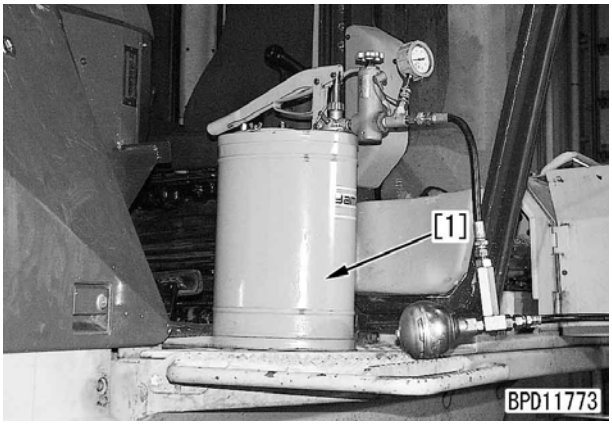
★ If the engine cannot be started and the parking brake cannot be released, carry out the emergency escape according to the following procedure.

★ Operate after putting a block, etc. on the crawler as a lock so that machine cannot move on a downhill slope.

1) Assemble pump assembly **L3**.

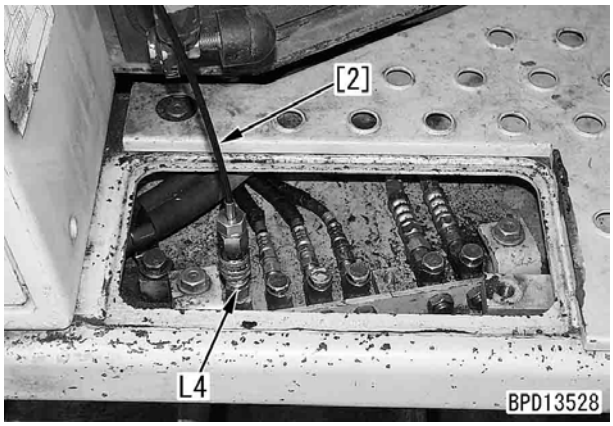


2) Install volume pump [1] of pump assembly **L3** to the outside of the operator cab.



3) Remove inspection plug for measuring oil pressure which is located within the inspection cover on the right outer side of the operator cab.

4) Install nipple **L4** and connect hose [2] of pump assembly **L3**.



5) Turn the starting switch on and set the parking brake lever in free position.

6) Operate the vacuum pump to raise the brake releasing oil pressure to the initial pressure.

- Initial pressure: Approx. 2.74 MPa {Approx. 28 kg/cm^2}

★ Since an accumulator is installed in the circuit, the handle must be operated 30 – 50 times to raise the oil pressure.

★ If the oil pressure does not rise above a certain level, the relief valve may be set to low pressure. In this case, adjust the set pressure of the relief valve.

7) Tow the machine to a safe place.

★ The brake releasing oil pressure lowers gradually because of internal leakage and the brake is applied again about 1 minute after. Therefore, work immediately.

★ If the brake releasing pressure lowers to about 1.57 MPa {16 kg/cm^2}, the brake is applied. In this case, operate the volume pump again to raise the brake releasing pressure to the initial pressure.

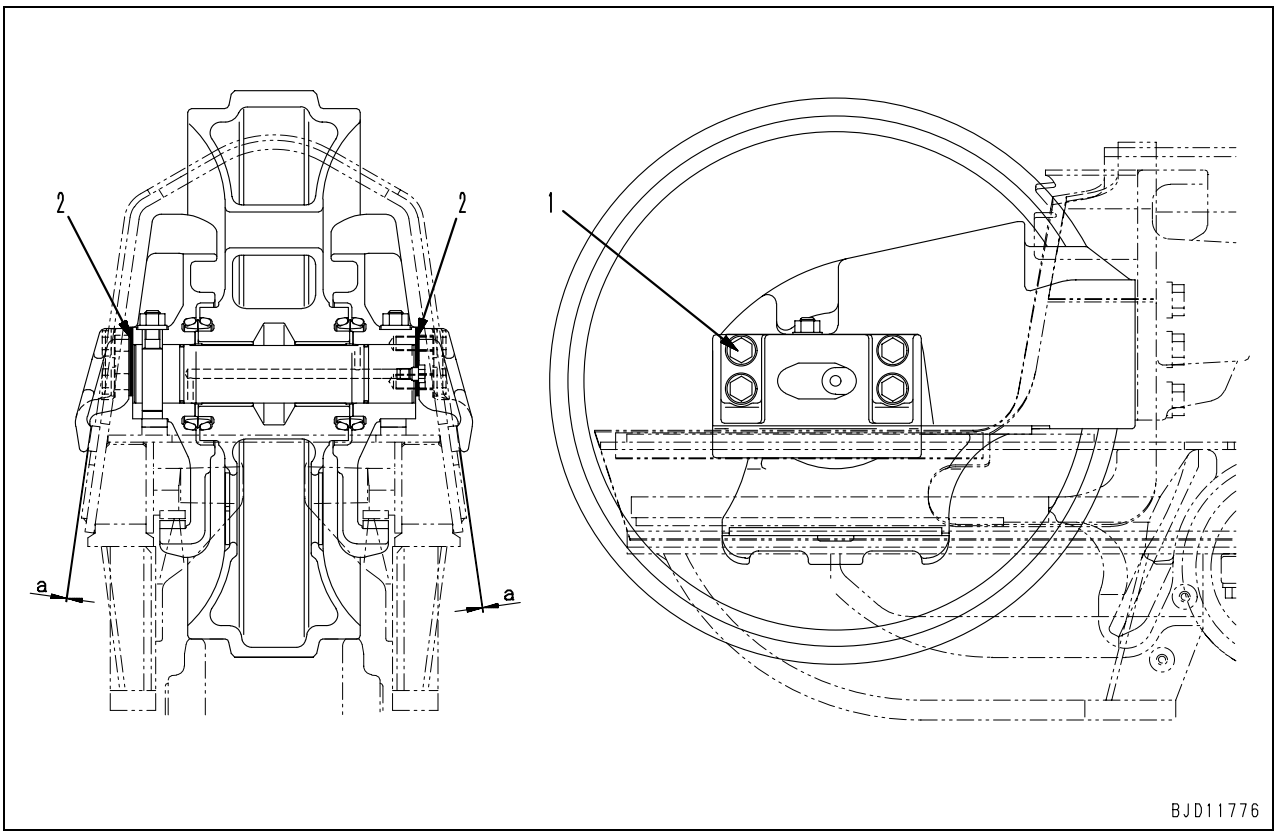
8) When disconnecting the hose after finishing the work, loosen the screw slowly and do not stand in the spouting direction of the oil.

Adjusting clearance of idler

★ If the lateral guide plates of the idler have worn excessively and the idler ran out slants, adjust the clearance of the idler according to the following procedure.

Adjustment procedure

1) Drive the machine 1 – 2 m on flat ground, then measure clearance (**a**) between the track frame and guide plate (4 places; left, right, inner and outer sides).
2) If clearance (**a**) is larger than 4 mm, loosen bolt (1) and reduce shim (2).
   - Standard clearance (**a**) on each side: 0.5 – 1.0 mm
   - Shim thickness: 1.0 mm



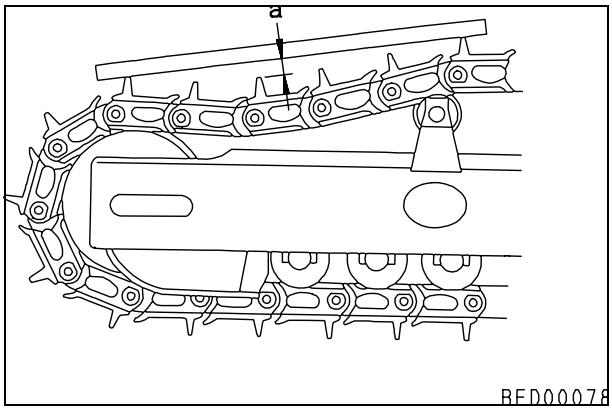
Inspecting wear of sprocket

★ Use the “Full-scale dimensions drawing of sprocket profile” in the topic “Sprocket” in the chapter “Structure, function and maintenance standard” as a gauge for measuring wear of the sprocket.
★ Make a copy of the “Full-scale dimensions drawing of sprocket profile” on a transparent paper or sheet and apply it directly to the sprocket to see if the sprocket can be used.

Testing and adjusting track shoe tension

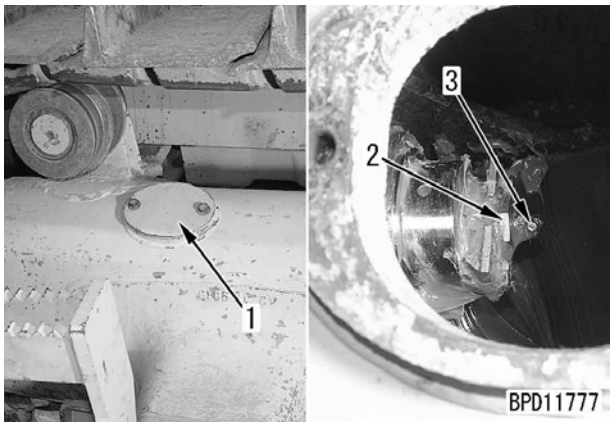
Testing

1. Drive the machine slowly on a level place, then stop it.
   ★ Do not apply the brake when stopping.
2. Place straight steel bar between the idler and front carrier roller and measure clearance (**a**) between the bottom of the steel bar and shoe grouser.
   ● Standard clearance (**a**): 20 – 30 mm



Adjusting

★ If the track shoe tension is abnormal, adjust it according to the following procedure.
1. **Remove cover (1).**
2. **When the tension is too high**
   Loosen plug (2) to discharge the grease.
   ⚠ **Since the high-pressure grease may spout out, do not loosen the plug more than 1 turn.**
   Plug: **59 – 88 Nm {6 – 9 kgm}**
3. **When tension is low**
   Add grease through grease fitting (3).
   ★ If the track shoe is not tensed well, drive the machine forward and in reverse slowly.



Testing and adjusting work equipment and HSS oil pressure

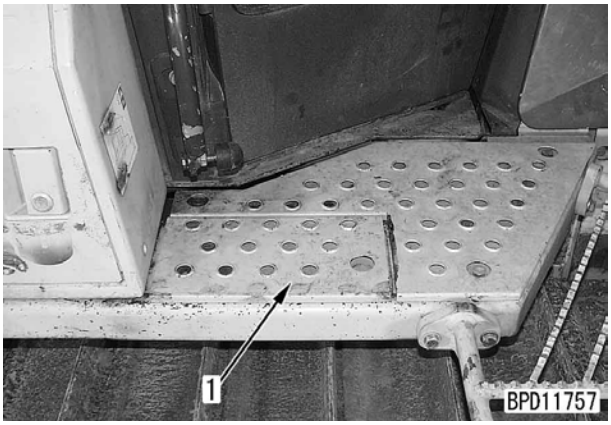
★ Testing and adjusting instruments for work equipment and HSS oil pressure

Symbol		Part No.	Part name
M	1	795-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	799-101-5220	Nipple (10 x 1.25 mm)
		07002-11023	O-ring

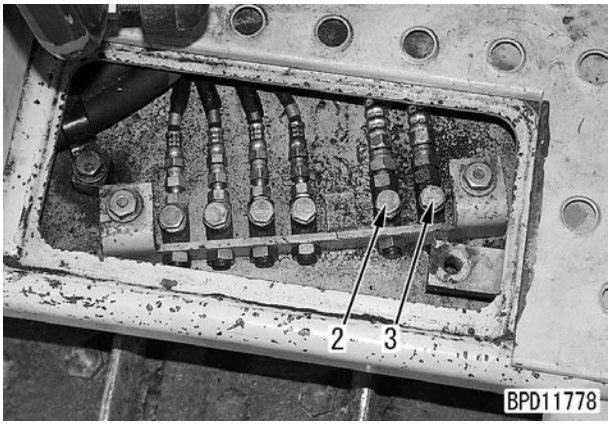
⚠ **Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and work equipment lock lever in the lock position.**

★ Measure the work equipment and HSS oil pressure under the following condition.
- Hydraulic oil temperature: Within operating range

★ The centralized work equipment and HSS oil pressure pickup ports are installed inside inspection cover (1) on the right outside of the operator's cab.

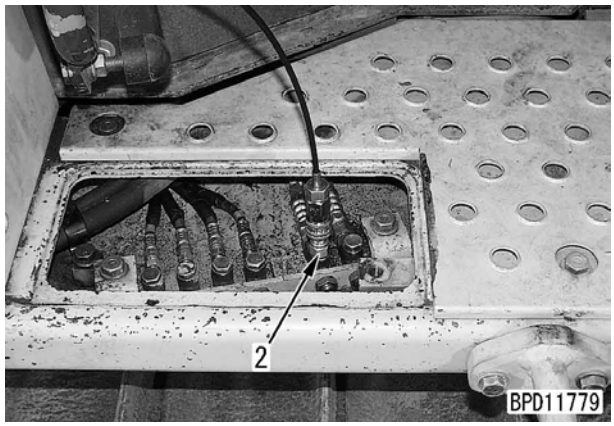


★ Oil pressure measuring points
(2): Main pump pressure
(3): Load sensing pressure (LS pressure)

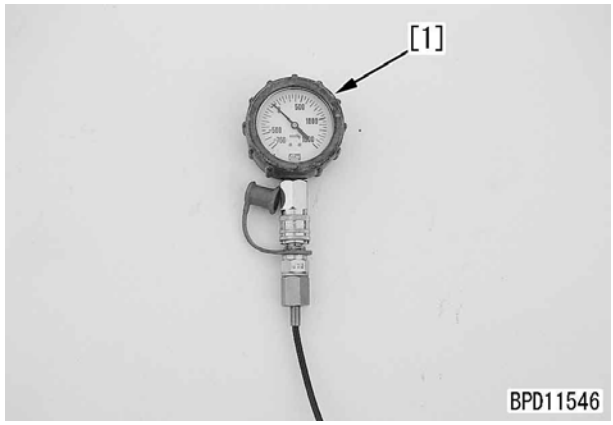


1. Measuring unload pressure

1) Remove oil pressure pickup plug (2) and install nipple **M2** to connect oil pressure gauge [1] of hydraulic tester **M1**.
★ Use an oil pressure gauge of 39.2 MPa {400 kg/cm^2}.



2) Running the engine at high idle, measure the oil pressure with the work equipment lever and PCCS lever set in neutral position.

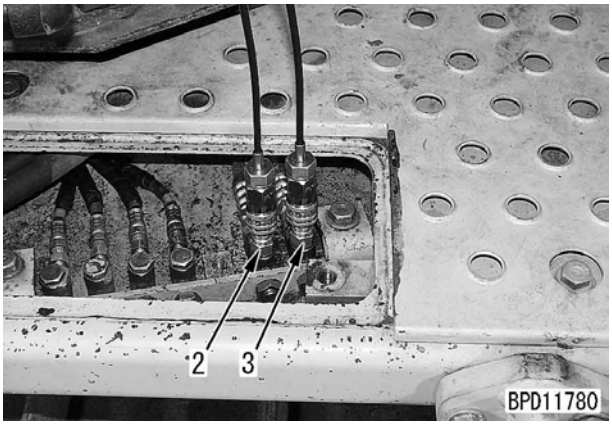


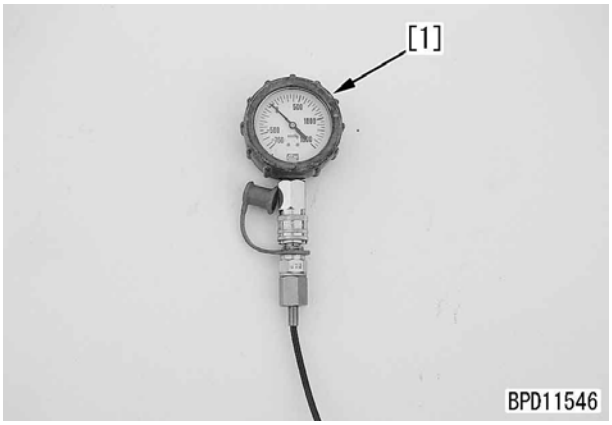
3) After finishing measurement, remove the measuring instrument and reinstall the removed parts.

2. Measuring work equipment and HSS oil pressure

Connect oil pressure gauges [1] of hydraulic tester **M1** to pump oil pressure pickup port (2) and load sensing pressure pickup port (3).

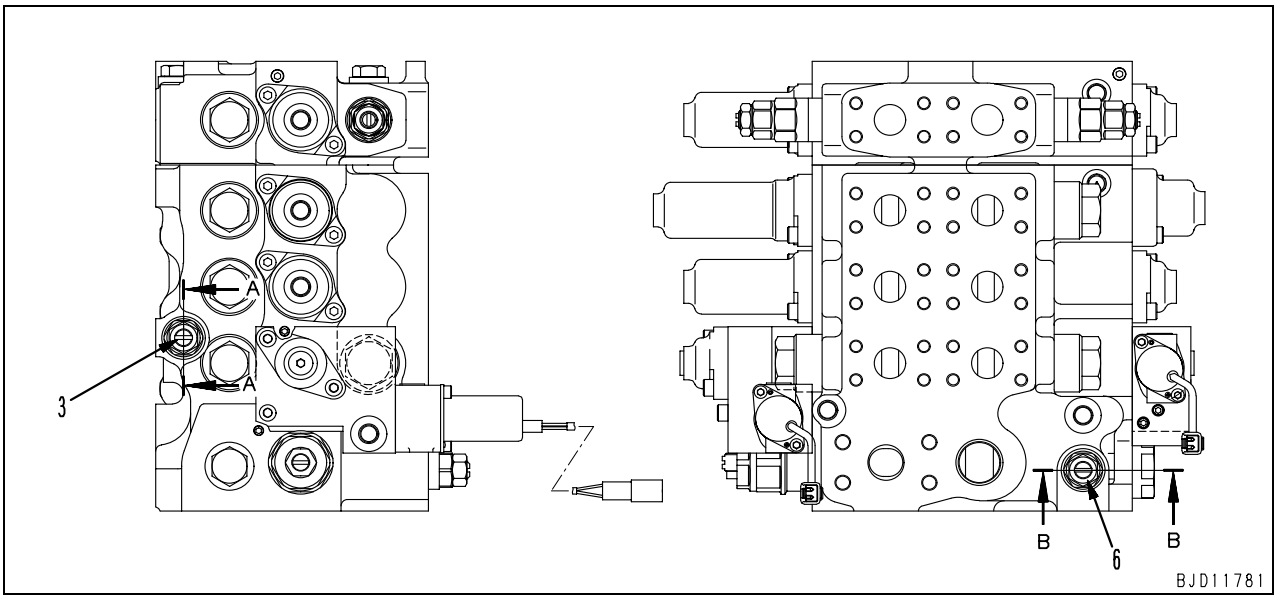
★ Use the following oil pressure gauges
Work equipment oil pressure:
39.2 MPa {400 kg/cm^2}
HSS oil pressure: **58.8 MPa {600 kg/cm^2}**





- **Work equipment oil pressure**
  1] Run the engine and set the work equipment lock lever in the free position.
  2] Run the engine at high idle and operate the blade lever and ripper lever. When each cylinder is relieved at the stroke end, measure the oil pressure.
  ★ Block the return hose of the blade lift cylinder.
  3] After finishing measurement, remove the measuring instrument and reinstall the removed parts.

- **HSS oil pressure**
  1] Run the engine, set the parking brake lever in the free position, and depress the brake pedal.
  ⚠ **Since the steering circuit will be stalled, keep pressing the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.**
  2] Run the engine at high idle and steer to the right or left with the PCCS lever. When the steering circuit is relieved, measure the oil pressure.
  3] After finishing measurement, remove the measuring instrument and return the removed parts.



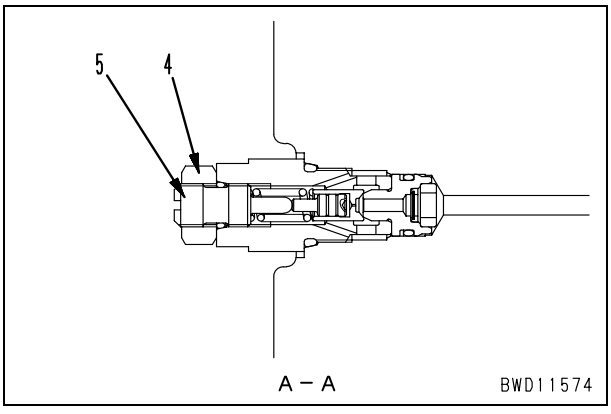
3. Adjusting

1) LS pressure (Load sensing pressure) of work equipment
Loosen locknut (4) of work equipment LS valve (3) and rotate adjustment screw (5) to adjust the LS pressure.
★ If the adjustment screw is
- rotated to the right, the oil pressure is heightened.
- rotated to the left, the oil pressure is lowered.

★ If the adjustment screw is rotated 1 turn,
the pressure is heightened or lowered by 17.6 MPa {179 kg/cm^2}

Locknut:
29.4 – 39.2 Nm {3 – 4 kgm}

- After adjusting, check the relief pressure and LS pressure of work equipment again.

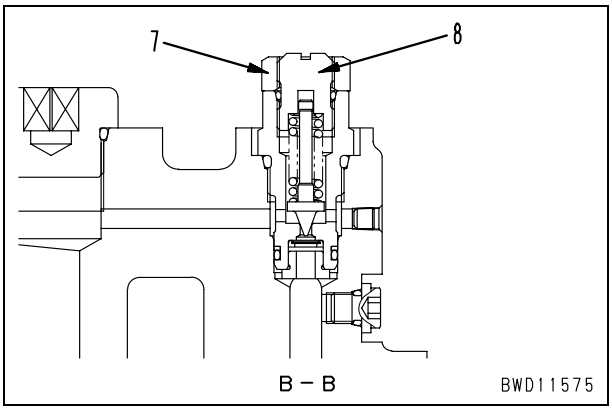


2) LS pressure (Load sensing pressure) of HSS
Loosen locknut (7) of LS valve (6) of HSS and rotate adjustment screw (8) to adjust the LS pressure.
★ If the adjustment screw is
- rotated to the right, the oil pressure is heightened.
- rotated to the left, the oil pressure is lowered.

★ If the adjustment screw is rotated 1 turn,
the pressure is heightened or lowered by 15.1 MPa {154 kg/cm^2}

Locknut:
68.6 – 78.5 Nm {7 – 8 kgm}

- After adjusting, check the relief pressure and LS pressure of work equipment again.



Testing control circuit basic pressure

★ Instruments for testing and adjusting control circuit basic pressure

Symbol		Part No.	Part name
N	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital type hydraulic tester
	2	799-401-3200	Adapter (size 03)

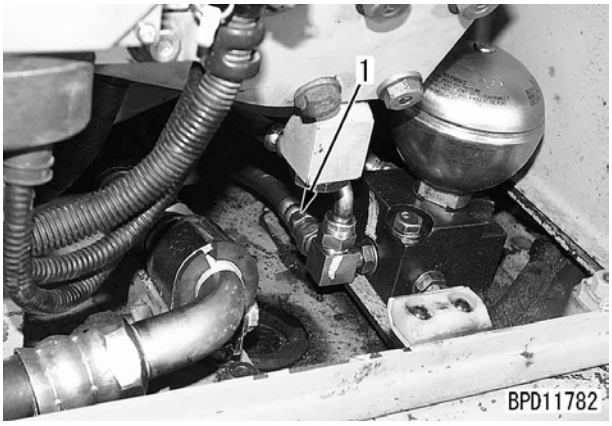
★ The control circuit main pressure is the pressure lowered by the self pressure reducing valve. It is used commonly for blade PPC, fan pump control, steering EPC and ripper PPC (if equipped).

Measuring

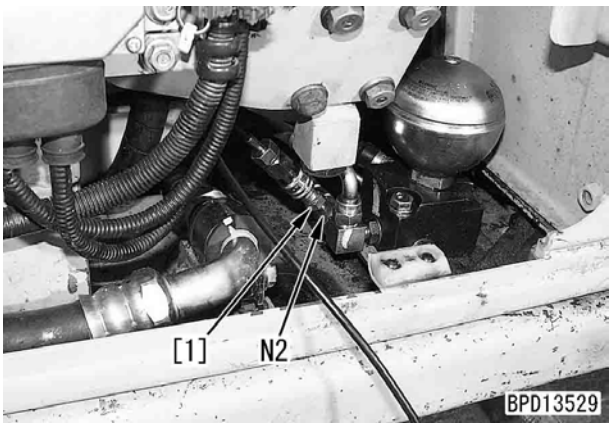
⚠ **Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and work equipment lock lever in the lock position.**

★ Measure the control circuit basic pressure under the following condition.
- Hydraulic oil temperature: Within operating range

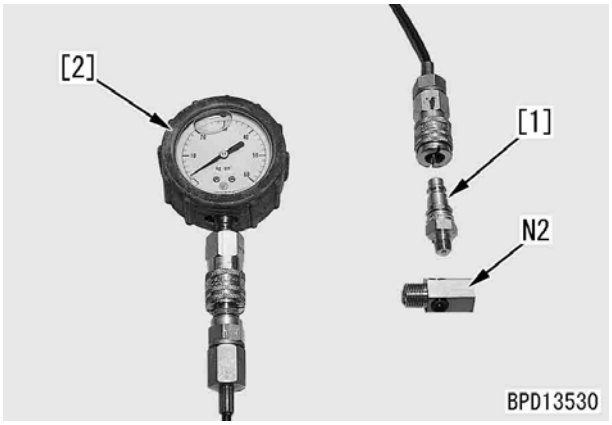
1. Open the cover of the main control valve at the right side of the operator cab.
2. Disconnect hose (1).



3. Install oil pressure pickup adapter **N2** and connect the disconnected hose again.
4. Install nipple [1] of hydraulic tester **N1** and connect oil pressure gauge [2].
   ★ Use an oil pressure gauge of 5.9 MPa {60 kg/cm^2}.



5. Run the engine at high idle and set the blade lever and ripper lever in neutral and measure the oil pressure.



6. After finishing measurement, remove the measuring instrument and reinstall the removed parts.

Adjusting

★ The self pressure reducing valve cannot be adjusted.

Measuring PPC valve output pressure

★ Measuring instruments for PPC valve output pressure

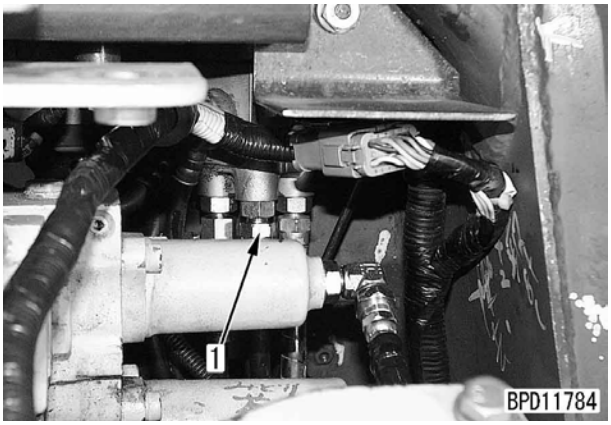
Symbol		Part No.	Part name
O	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital type hydraulic tester
	2	799-401-3100	Adapter (size 02)

⚠ **Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and work equipment lock lever in the lock position.**

★ Before measuring the PPC valve output pressure, check that the control circuit basic pressure is normal.
★ Measure the PPC valve output pressure under the following condition.
- Hydraulic oil temperature: Within operating range

1. Open the cover of the main control valve at the right side of the operator cab.

2. Disconnect PPC valve output pressure hose (1).
   ★ For the circuits to be measured, see the drawing on the next page.

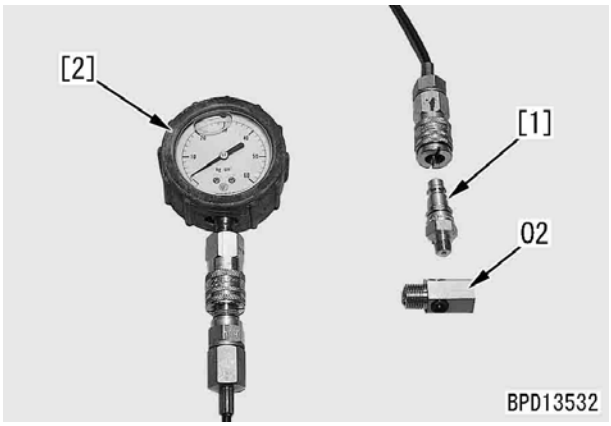


3. Install oil pressure pickup adapter **O2** and connect the disconnected hose again.

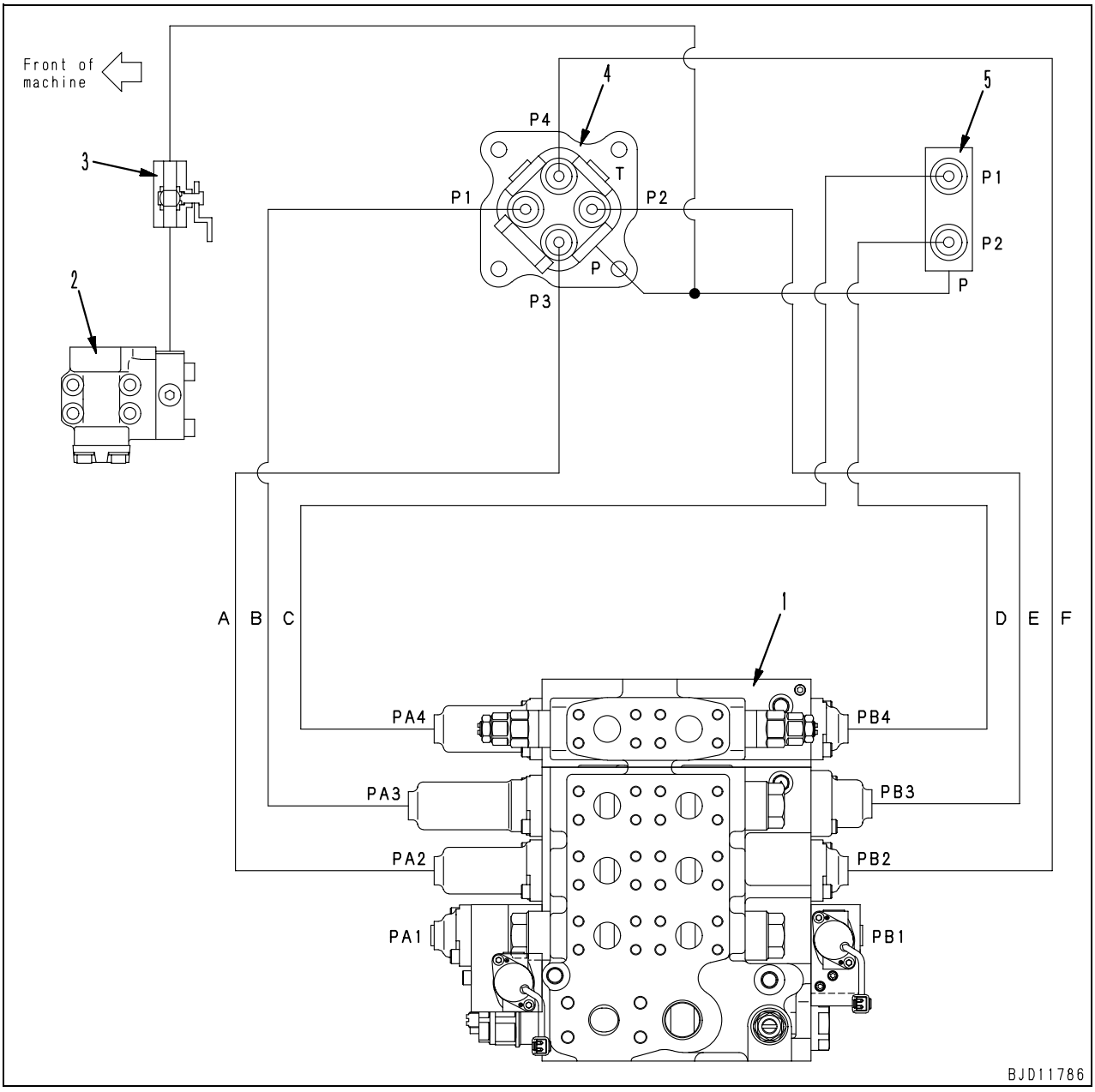
4. Install nipple [1] of hydraulic tester **O1** and connect oil pressure gauge [2].

5. Run the engine and set the work equipment lock lever in the free position.

6. Run the engine at high idle and operate the control lever of the circuit to be measured and measure the oil pressure.
   ★ Measure the oil pressure with the lever at a stroke end.
   ★ When measuring the blade circuit, operate the lever until the blade floats.



7. After finishing measurement, remove the measuring instrument and reinstall the removed parts.



1. Main valve
2. Self pressure reducing valve
3. PPC lock valve
4. Blade PPC valve
5. Ripper PPC valve (If equipped)

A. Blade LEFT TILT
B: Blade LOWER
C. Ripper RAISE
D. Ripper LOWER
E. Blade RAISE
F. Blade RIGHT TILT

Adjusting play of work equipment PPC valve

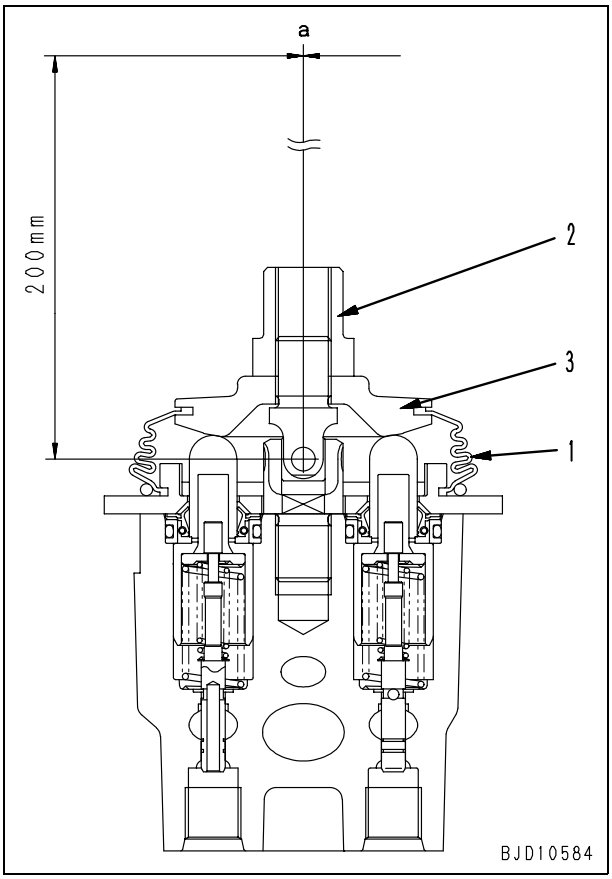
★ The ripper valve is not adjustable.
★ If the end play of the blade lever is excessive, adjust it with their PPC valves according to the following procedure.
- Standard play (**a**):
  0.5 – 3.0 mm at 200 mm from revolution center of lever (in both longitudinal and lateral directions)

1. Remove boot (1).

2. Loosen locknut (2) and turn disc (3) to adjust the play.
   ★ Do not move the piston at this time.

3. Fix disc (3) and tighten locknut (2).
   Locknut: **98 – 127 Nm {10 – 13 kgm}**

4. Install boot (1).



Measuring internal leakage of work equipment cylinder

★ Measuring instruments for leakage of work equipment cylinder

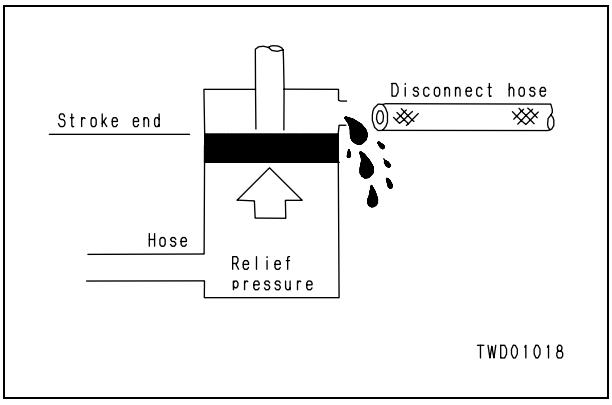
Symbol	Part No.	Part name
P	Commercial item	Measuring cylinder

★ Measure the internal leakage of work equipment cylinder under the following condition.
- Hydraulic oil temperature: 45 – 55°C

★ Since the blade lift cylinder is equipped with a piston valve, its internal leakage cannot be measured.

1. Extend the cylinder to be measured to the stroke end and set the machine in the measuring position.
   1) Blade tilt cylinder
      Lower the blade tip to the ground.
   2) Ripper lift cylinder
      Pull out the shank pin and lower the ripper to the end.

2. Disconnect hose on the cylinder head side and block the hose side with a plug.
   ★ Remove the hose cover of the blade tilt cylinder.
   ⚠ **Take care not to disconnect the hose on the bottom side.**



3. Run the engine at high idle and apply the relief pressure to the cylinder bottom side.
   - Blade tilt cylinder: Operate to tilt blade to left.
   - Ripper lift cylinder: Operate to lower ripper.

4. After 30 seconds, measure leakage in 1 minute.
5. After finishing measurement, return the removed parts.

Bleeding air from work equipment cylinder

★ If the work equipment cylinder was removed and installed or its piping was disconnected and connected, bleed air from its circuit according to the following procedure.

1. Run the engine at low idle for about 5 minutes.

2. Running the engine at low idle, extend and retract the cylinder to be bled 4 – 5 times.
   ★ Move the piston rod to about 100 mm before the stroke end and never relieve the oil.

3. Running the engine at high idle and carry out the operation in 2.

4. Running the engine at low idle, move the cylinder to the stroke end to relieve the oil.

Releasing residual pressure in work equipment cylinder

★ When disconnecting the piping between the control valve and work equipment cylinder, release the residual pressure in the circuit according to the following procedure.

1. Loosen the hydraulic tank cap gradually to release the residual pressure in the tank.

2. Set the work equipment lock lever in the free position and operate the blade lever and ripper lever forward, backward, to the right, and to the left.
   ★ After the levers are operated 2 – 3 times, the residual pressure in the accumulator is fully released.

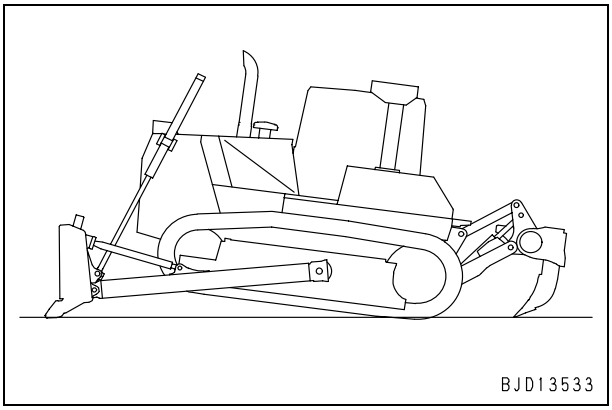
3. Run the engine at low idle for about 5 seconds, and then stop it.

4. Repeat above steps 2 and 3 by 2 – 3 times.

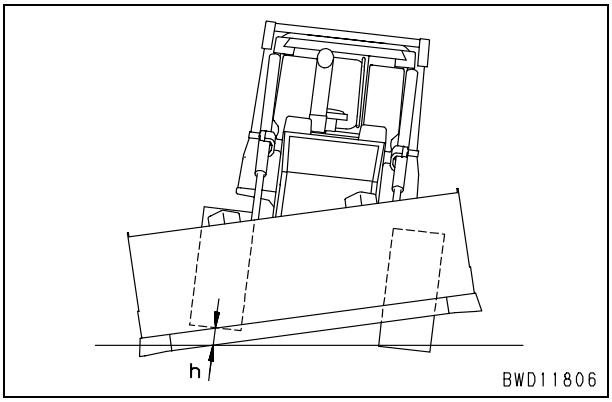
Checking parts which caused hydraulic drift of blade or ripper

★ When a hydraulic drift of blade or ripper occurred, check if the parts causing the drift is located in cylinder packing side or in control valve side according to the following procedure.

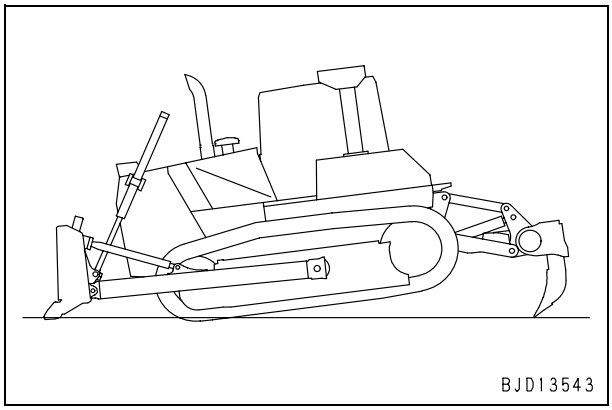
1. Stop the engine with the cylinder at the following positions.
   1) Blade lift cylinder
      Tense the blade to push up the front of the machine.
      ★ Do not extend the blade lift cylinder to the stroke end since it is equipped with the piston valve.



   2) Blade tilt cylinder
      Retract the tilt cylinder to the stroke end and tense blade further to push up the right side of the machine.



   3) Ripper lift cylinder
      Tense the ripper to push up the rear of the machine.

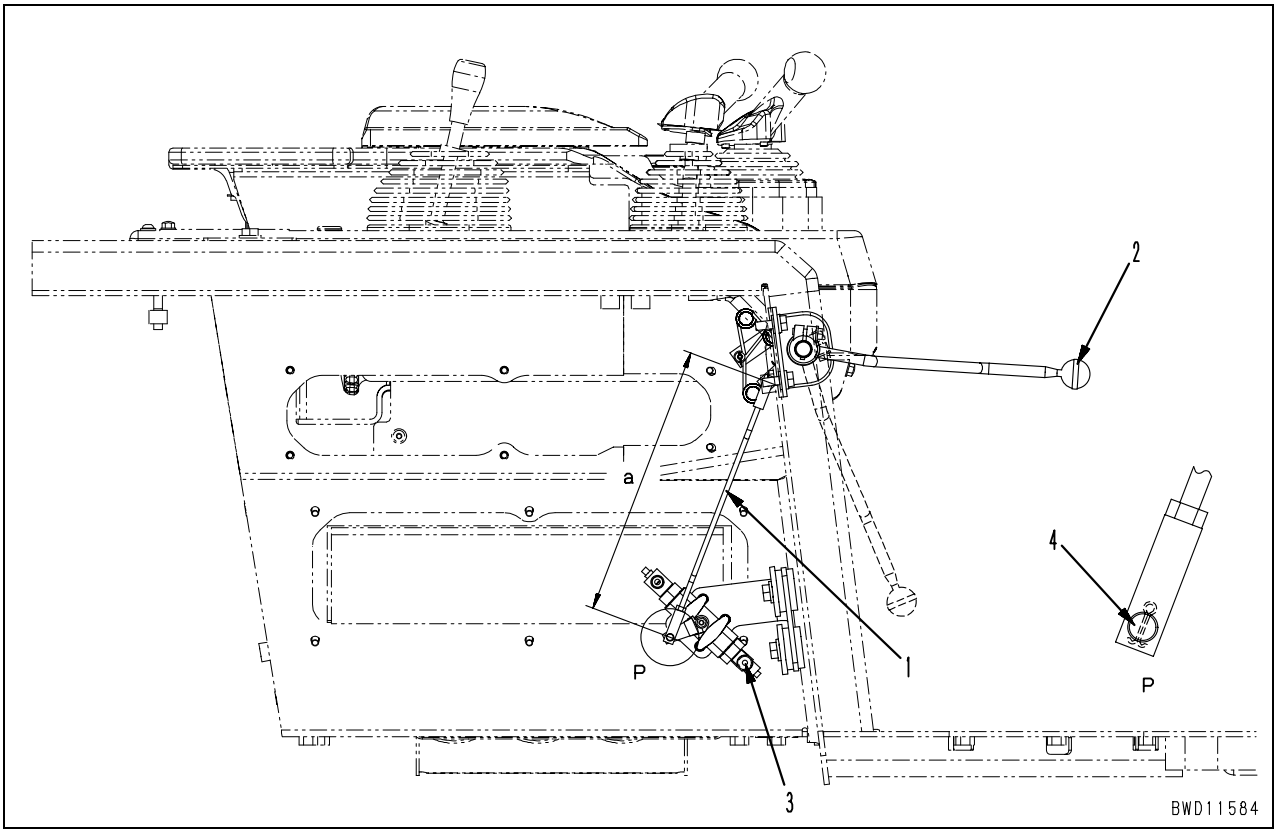


2. Move the control lever of cylinder to be checked to the direction of extending cylinder and validate the movement of cylinder.
   - If the drift speed becomes faster, a cylinder packing is defective.
   - If the speed does not change, an control valve is defective.
   - ★ If the pressure of the accumulator is lost, run the engine for approx. 10 seconds to build up the pressure.

[Reference] In case of the hydraulic drift is caused by defective cylinder packing, the reason why the drift speed becomes faster by above mentioned operation is as follows:

1) When work equipment is set in the above mentioned position, where the holding pressure is applied to the bottom side, the oil leaks from bottom side to head side. Since the volume of head side is smaller than that of bottom side by the volume of the rod, the inner pressure of head side rises by the oil leak from bottom side.
2) If the inner pressure of head side rises, cylinder is balanced at certain pressure (depending on the amount of leakage) which is in proportion to the inner pressure. Therefore, the drifting speed becomes slower.
3) At this time, if the circuit in the head side is opened (bottom side is closed by check valve) to drain circuit by above mentioned lever operation, the oil in the head side flows into the drain circuit causing the lost of the pressure balance. Then the drift speed becomes faster.

Adjusting work equipment lock lever



1. Adjust dimension (**a**) between pins of rod (1).
   - Dimension (**a**) between pins: 330 mm

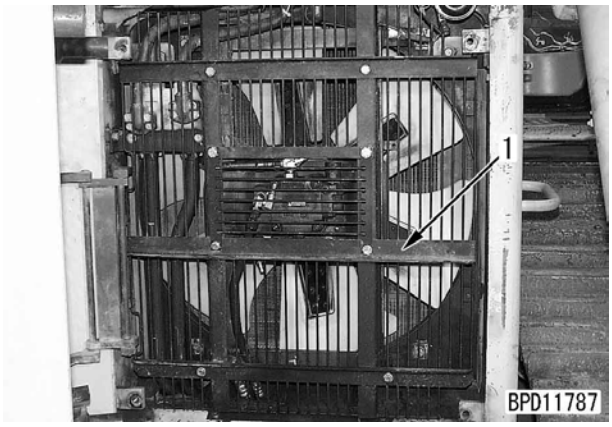
2. Connect rod (1) to work equipment lock lever (2) and PPC lock valve (3).
   - ★ Install connecting pin (4) with the cotter pin on the outside of the machine.

Measuring fan motor speed

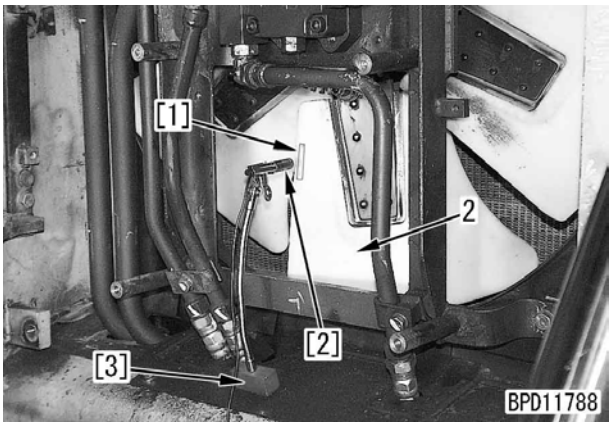
★ Measuring instruments for fan motor speed

Symbol	Part No.	Part name
Q	799-205-1100	Tachometer KIT

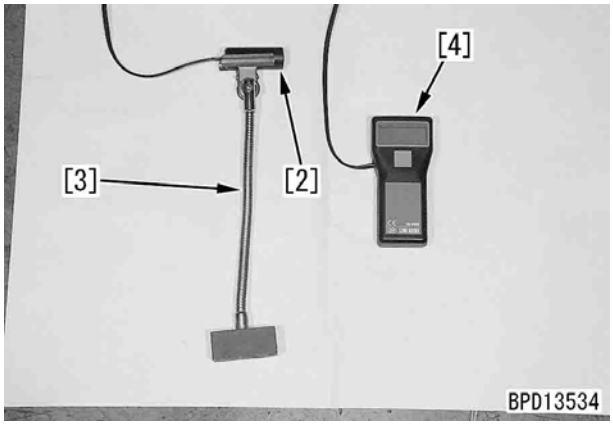
1. Open the radiator mask.
2. Remove fan guard (1).



3. Stick 1 sheet of reflecting tape [1] to fan (2).
4. Set probe [2] of tachometer KIT **Q** to stand [3], matching it to reflecting tape [1], then connect it to multitachometer [4].
   ⚠ **Pay attention to the installation position so that the probe will not interfere with the fan.**



5. Close the radiator mask, run the engine, and set the monitor panel in the adjustment mode.
   ★ For the operation method of the adjustment mode, see “Special functions of monitor panel (EMMS)”.
   ★ Adjustment code:
   1005 (Fan 100% speed mode)
6. Measure the fan motor speed when the engine is running at high idle and low idle.
   ⚠ **Be sure to close the radiator mask before starting the engine. Do not start the engine with the radiator mask open.**



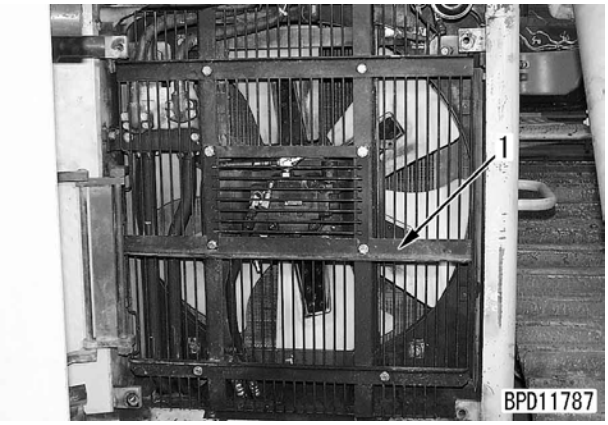
7. After finishing measurement, remove the measuring instrument and reinstall the removed parts.

Measuring fan pump circuit pressure

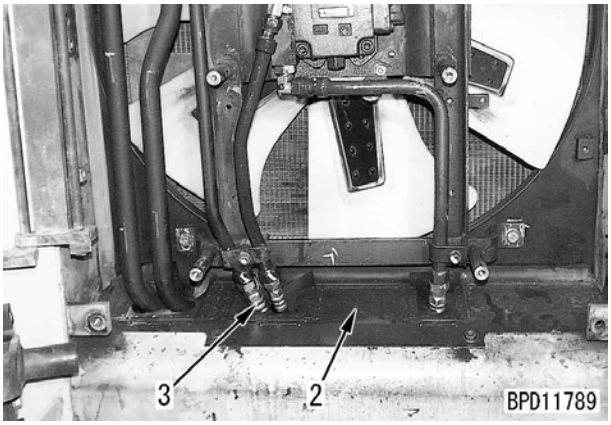
★ Measuring instruments for fan pump circuit pressure

Symbol		Part No.	Part name
R	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	799-401-3400	Adapter (size 05)
	3	799-101-5220	Nipple (10 x 1.25 mm)
		07002-11023	O-ring

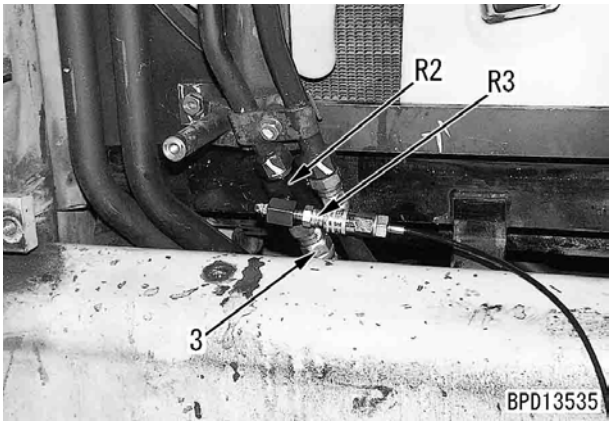
1. Open the radiator mask.
2. Remove fan guard (1).



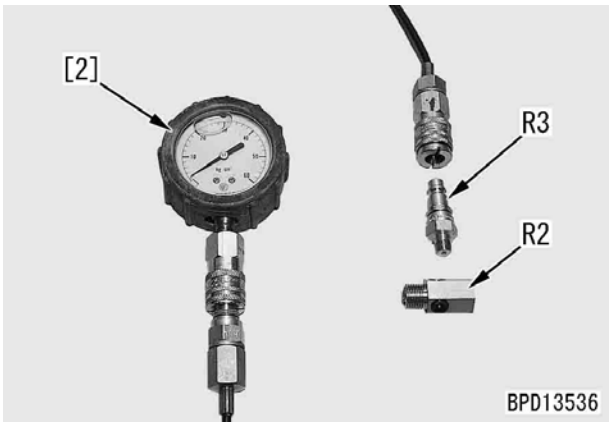
3. Remove cover (2) and disconnect fan motor drive circuit hose (3).



4. Install adapter **R2** and connect hose (3) again. Install nipple **R3** and connect oil pressure gauge [2].
   ★ Use an oil pressure gauge of 39.2 MPa {400 kg/cm^2}.



5. Run the engine, and turn the monitor panel to the adjustment mode.
   ★ For the operation method of the adjustment mode, see “Special functions of monitor panel (EMMS)”.
   ★ Adjustment code:
   1005 (Fan 100% speed mode)
6. Measure the oil pressure of fan circuit while the engine is running at high idle.



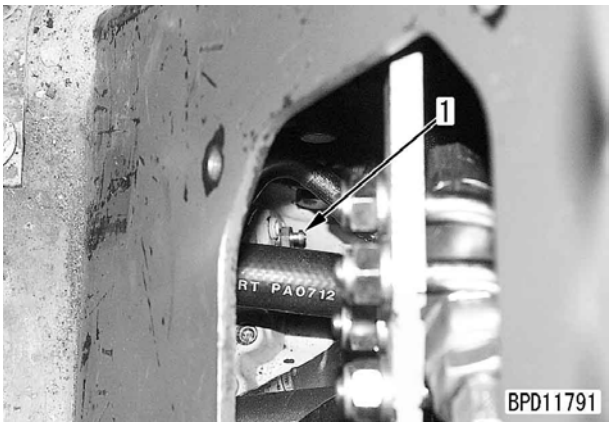
7. After finishing measurement, remove the measuring instrument and reinstall the removed parts.

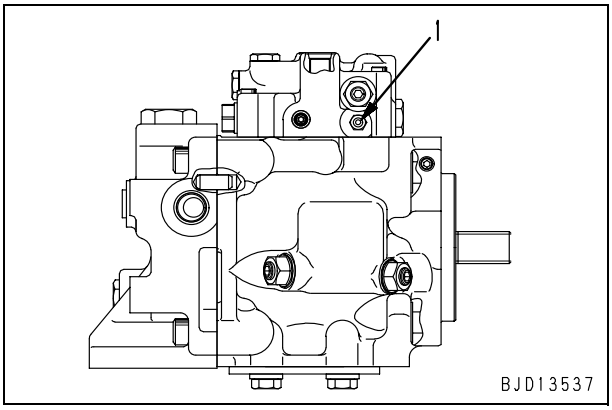
Bleeding air from fan pump

★ If the fan pump was removed and installed or its piping was disconnected and connected, bleed air from the pump case according to the following procedure.
★ Before performing the following procedure, check that the hydraulic oil is at the specified level.
★ Remove the operator's seat.

1. Remove the inspection cover on the right of the floor.

2. Loosen air bleeder (1) and leave it for 15 minutes.





3. After 15 minutes, run the engine at low idle.

4. When oil flows out of air bleeder (1), tighten air bleeder (1).
   Bleeder: **8.8 ± 1.0 Nm {0.9 ± 0.1 kgm}**

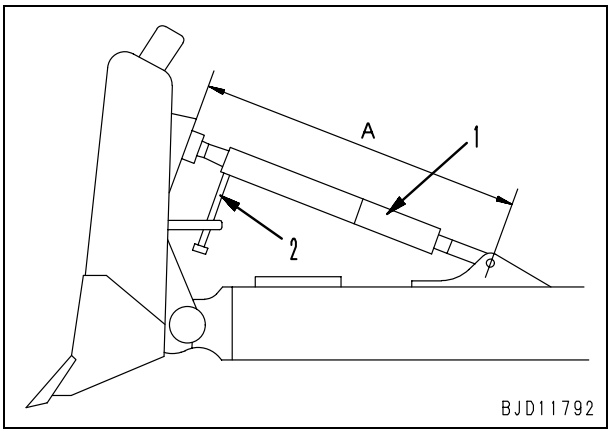
Adjusting straight tiltdozer

★ If the blade was removed and installed or disassembled and assembled, adjust it according to the following procedure.

1. Adjusting blade tilting distance

1) After installing the blade, adjust installation dimension (**A**) of brace (1) by handle (2).
   - Installation dimension (**A**) of brace

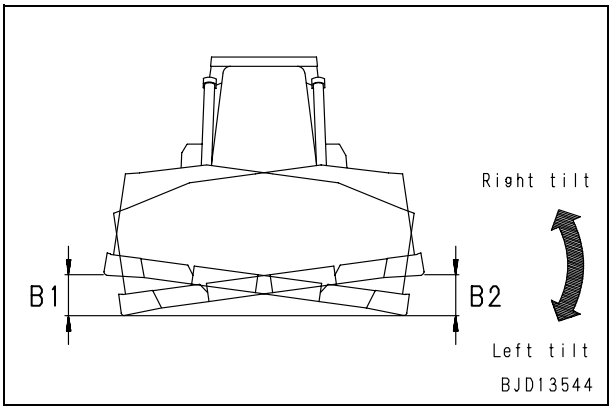
	PX	EX
A (mm)	1,147	1,151



2) Measure right and left tilting distances (**B1**) and (**B2**).

	PX	EX
Right tilting distance B1 (mm)	Approx. 450	Approx. 440
Left tilting distance B2 (mm)	Approx. 450	Approx. 440

3) If the tilting distances are different remarkably, adjust installation dimension (**A**) of brace (1) according to the following procedure.
   - (**B1**)>(**B2**): Increase installation dimension (**A**) finely.
   - (**B1**)>(**B2**): Decrease installation dimension (**A**) finely.



2. Adjusting shims for blade assembly

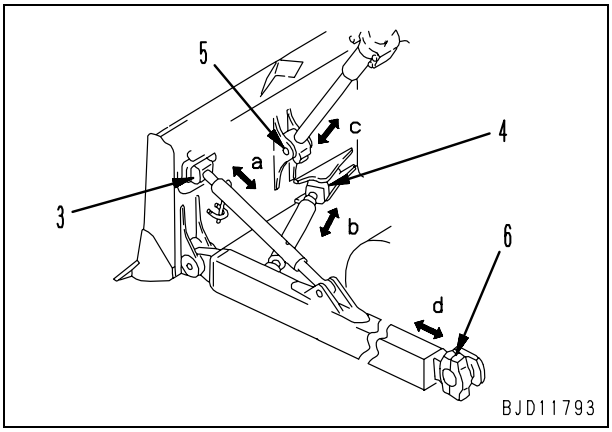
1) After assembling the blade, adjust the shims of tilt section (3), center section (4), lift section (5), and trunnion section (6).

Adjustment of shims Unit: mm

Adjustment sections / Check item	Tilt section (3)	Center section (4)	Lift section (5)	Trunnion section (6)
Clearance	a	b	c	d
Standard clearance (Note)	0.2 – 0.7	0.2 – 0.7	0.2 – 0.7	0.2 – 1.2
Standard thickness of shim	5	5	4	10

Note: Play of spherical part in axial direction

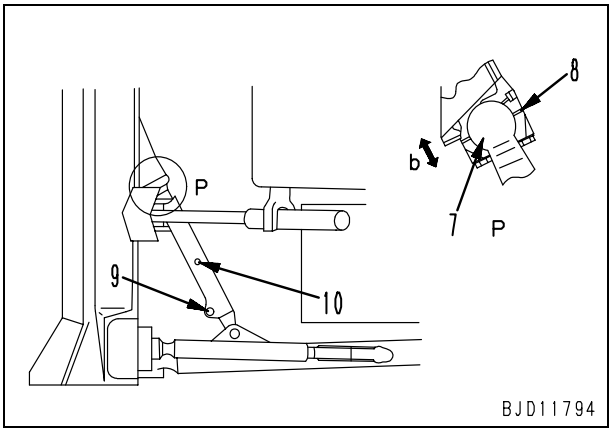
2) Supply grease to each adjustment section and check that each part rotates smoothly.
   Adjustment sections (3), (4), (5):
   Grease (G1-T)



3. Adjusting center brace

★ Adjust the center brace tension according to the following procedure.

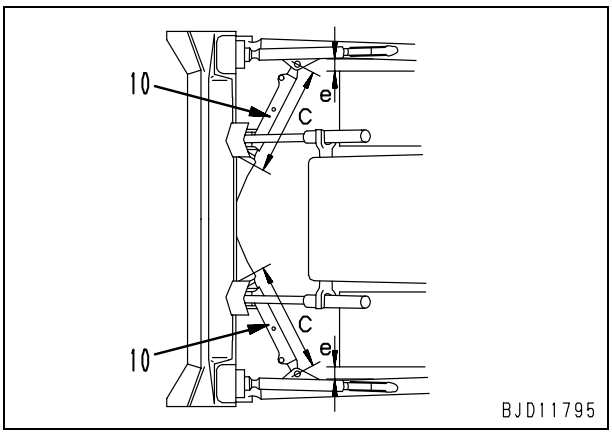
1) Adjust clearance (**b**) of ball joint (7) with shim (8).
   - Clearance (**b**): 0.2 – 0.5 mm
2) Loosen bolt (9).
3) Operate the blade control lever to float the blade.
   ⚠ **After operating the blade control lever, lock it with the safety lever securely.**
4) Insert a bar in the hole of center brace (10) and turn it in the tensing direction.
   ★ Tension adjustment torque of center brace (10)
   Center brace:
   24.5 – 49 Nm {2.5 – 5 kgm}



5) Installation dimension of center brace (10)
   Standard dimension (**C**)

	PX	EX
C (mm)	991.5	995

★ Adjust center brace so that clearances (**e**) between the track and frame on both sides will be the same.



Testing and adjusting operator cab

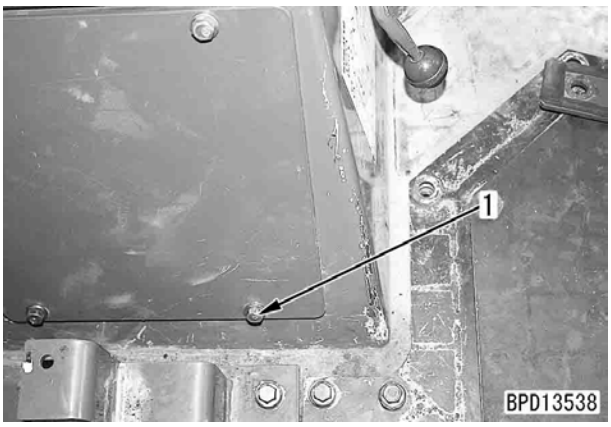
Check after installing cab assembly

1. Measuring pressure in cab

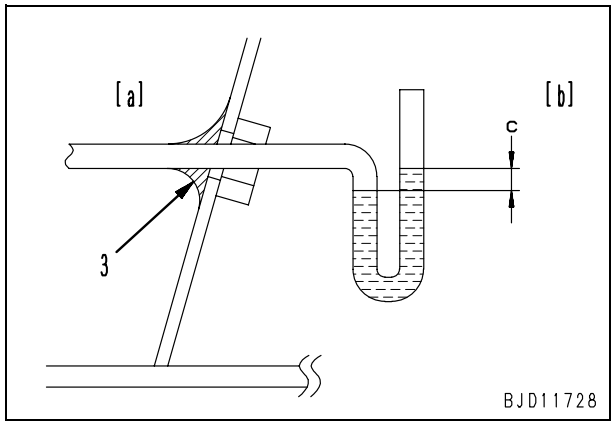
- Criteria:
  Measured value ≧ 58.9 Pa {6 mmH_2O}
- Engine speed: High idle
- Fan speed: 100% mode (See the User adjustment mode of the monitor panel)
- Fan switch of air conditioner: High
- External and internal air changeover switch of air conditioner: Fresh air position

★ If the measured value is lower than the standard value, check the seals of the holes for wiring harnesses and optional parts in the cab.

1) A simple method of measuring the internal pressure is as follows.
   1] Prepare a transparent vinyl hose.
      - Inside diameter: 6 mm, Length: 3,000 mm
   2] Secure the inside end of the hose to the top of the back seat with a tape.
   3] Remove bolt (1) under the left console box. Pass the other end of the hose through the bolt hole and take it out of inspection cover (2) on the left side of the cab.



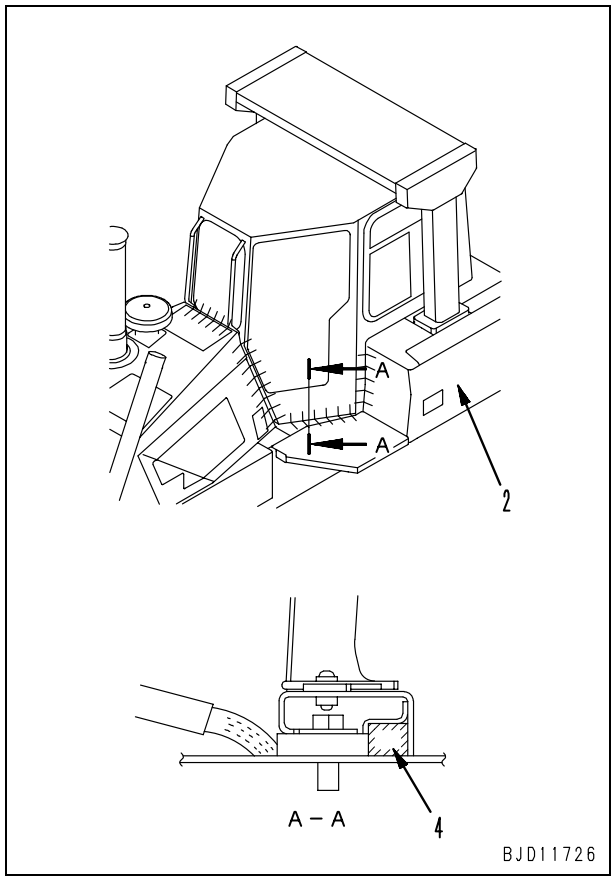
   4] Seal the hole of bolt (1) with tape (3).
   5] Fill the hose with water up to about the half level and bend the hose in the shape of letter U.
   6] Set the water level in the vinyl hose out of the cab to that in the cab.
   7] Run the engine at high idle and measure water level difference (**c**).
   [Value (**c**): Pa {mmH_2O}]
   ★ [**a**] side: Inside of cab (Pressurized)
   ★ [**b**] side: Out of cab (Atmospheric pressure)



2. Checking sealing performance

1) Close the all openings of the cab.
2) Splash water around the hatched part of the cab at the rate of about 19 ℓ/min for 10 minutes.
   - At this time, it is not necessary to splash pressurized water.
3) Splash water horizontally from a hose over sealing surface (4).
4) Check around the dashboard carefully.

★ If water leaks, caulk the leaking part and check again.

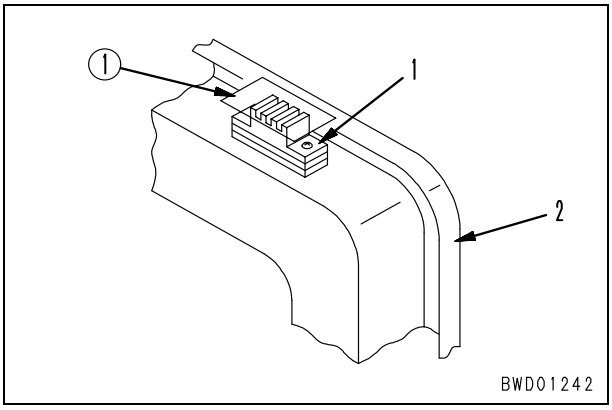


3. Testing door lock

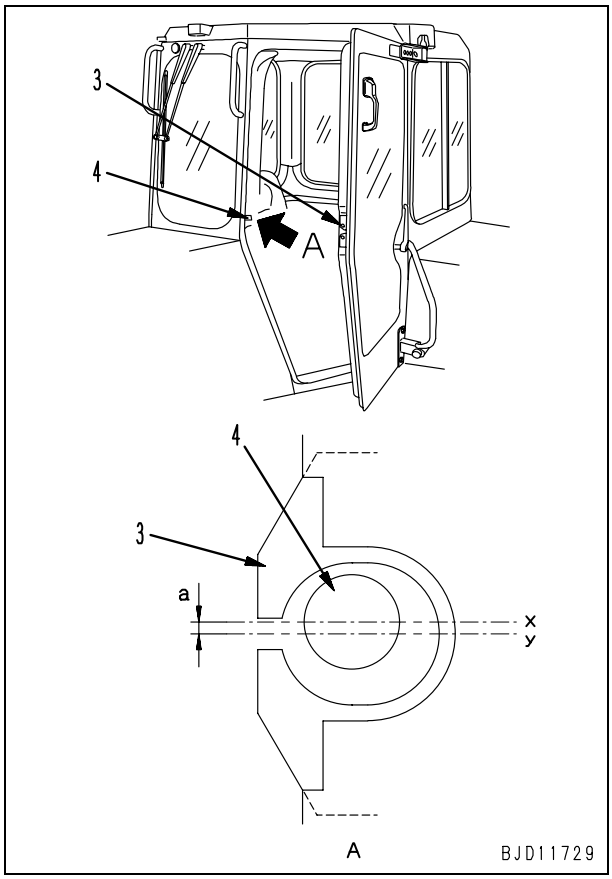
Close the door and check the relationship between the operator cab and door. If there is any fault, repair it.

1) Check of current condition

1] Check the installed height to damper rubber (1).
(Check both sides, 2 pieces on each.)
Stick adhesive tape [1], etc. to the contact surface of damper rubber (1) and open and close the door 2 – 3 times. Then, check the contact surface of adhesive tape [1] against the operator cab.
Normal:
When the door is closed, the damper rubber comes in contact lightly.
Abnormal:
When the door is closed, the damper rubber does not come in contact or comes in contact so strongly that adhesive tape is removed.

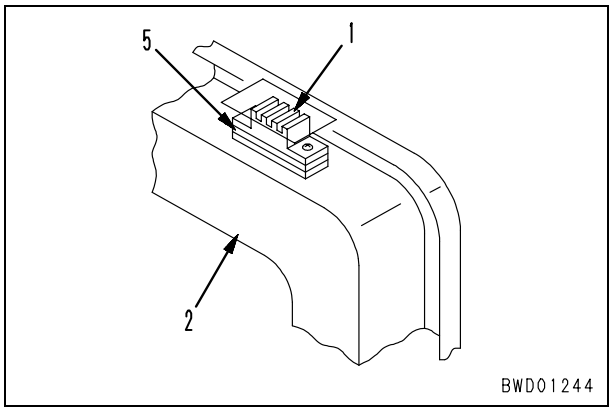


2] Check the relationship between the door latch and striker (on both sides).
- Close door (2) and check the engaging condition of latch (3) and striker (4).
- Normal: Error of (**a**) must be 0.5 mm or less.
- Check deviation (**a**) of latch center (**y**) and striker center (**x**) from each other from the direction of (**A**).



2) Adjusting

1] Adjusting height of damper rubber
- Loosen the mounting bolts of damper rubber (1).
- You can remove and install the shims without removing the mounting bolts.
- Increase or decrease of shims (5) under damper rubber (1) to adjust the height of damper rubber (1) properly.



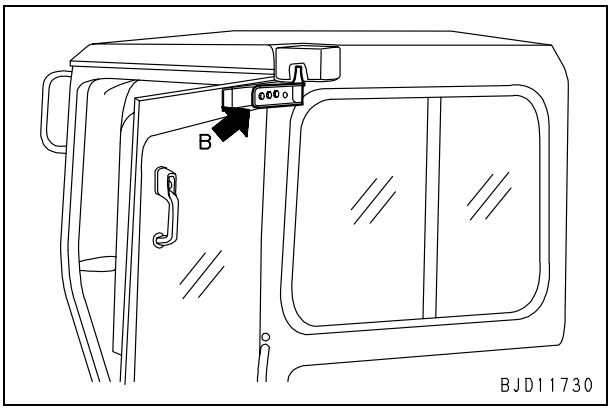
2] Adjusting height of latch and striker
1. Tighten the mounting bolt of striker (4) temporarily and close the door 2 – 3 times to align latch (3) and striker (4) with each other.
2. Check the engaging condition of latch (3) and striker (4).
3. Tighten the mounting bolt of striker (4) securely.
4. Open and close the door and check that it is locked and unlocked smoothly. If the door is not locked and unlocked smoothly (if the knob is heavy), perform the adjustment procedure from the first.
★ Operating effort of knob:
49 ± 19.6 N {5 ± 2 kg}

3] Apply grease (G2-LI) to latch (3).
★ If latch (3) is not greased, the knob becomes heavy. Accordingly, apply grease sufficiently.

4. Testing open lock

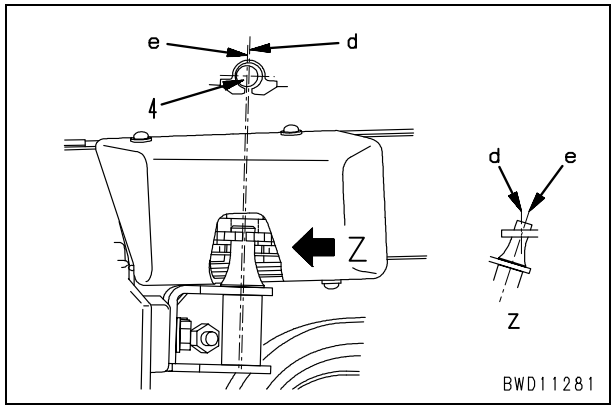
Lock the door open and check the relationship between the operator cab and door. If there is any fault, repair it.

1) Check of current condition
1] Check the relationship between open lock latch (3) and striker (4) from the direction of (**B**).

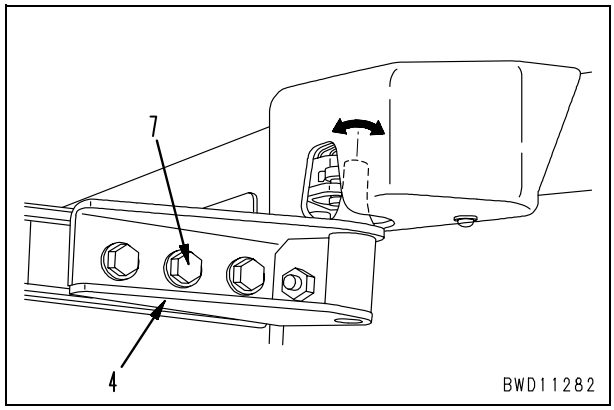


★ Move the door in the opening direction to check the engagement of the latch and striker.

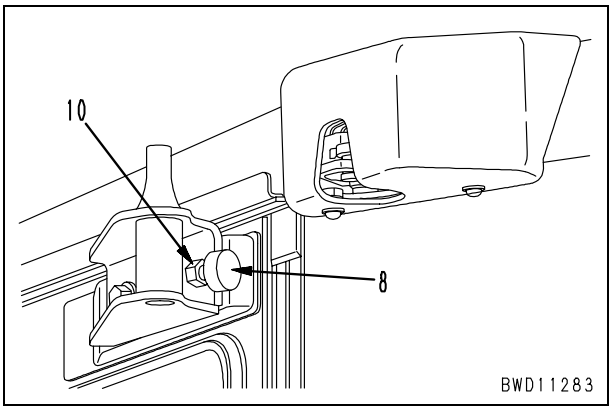
2] Check the installation height of stopper rubber.
(Check both sides, 2 pieces on each.)
1. Lock the door open and shake it in the forward and reverse directions to see if it has any play.
2. Check that the operating effort of unlock lever is not heavy.
3. Check that striker (4) does not slant from center (**d**) of the latch.
4. Check that the latch is not shifted from center (**e**) of the striker.
★ Normal: Error of (**e**) must be less than 0.5 mm.

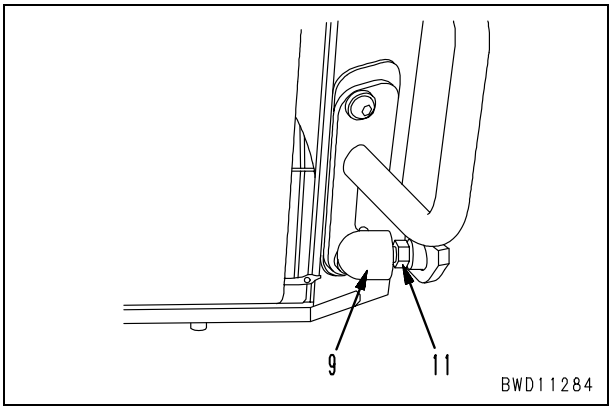


2) Adjusting
1] Adjusting latch and striker
Loosen mounting bolt (7) of striker (4), adjust striker (4) upright, and tighten mounting bolt (7).



2] Adjusting installation height of stopper rubber
1. Loosen locknut (10), (11) of the stopper rubber upper side (8), lower side (9).





2. If there is any play, project (heighten) the stopper rubber until the play is eliminated.

★ If the door is not locked easily or the unlock lever is heavy, return (lower) the stopper rubber in the range that the door does not have any play.

3. Tighten the locknut.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00585-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

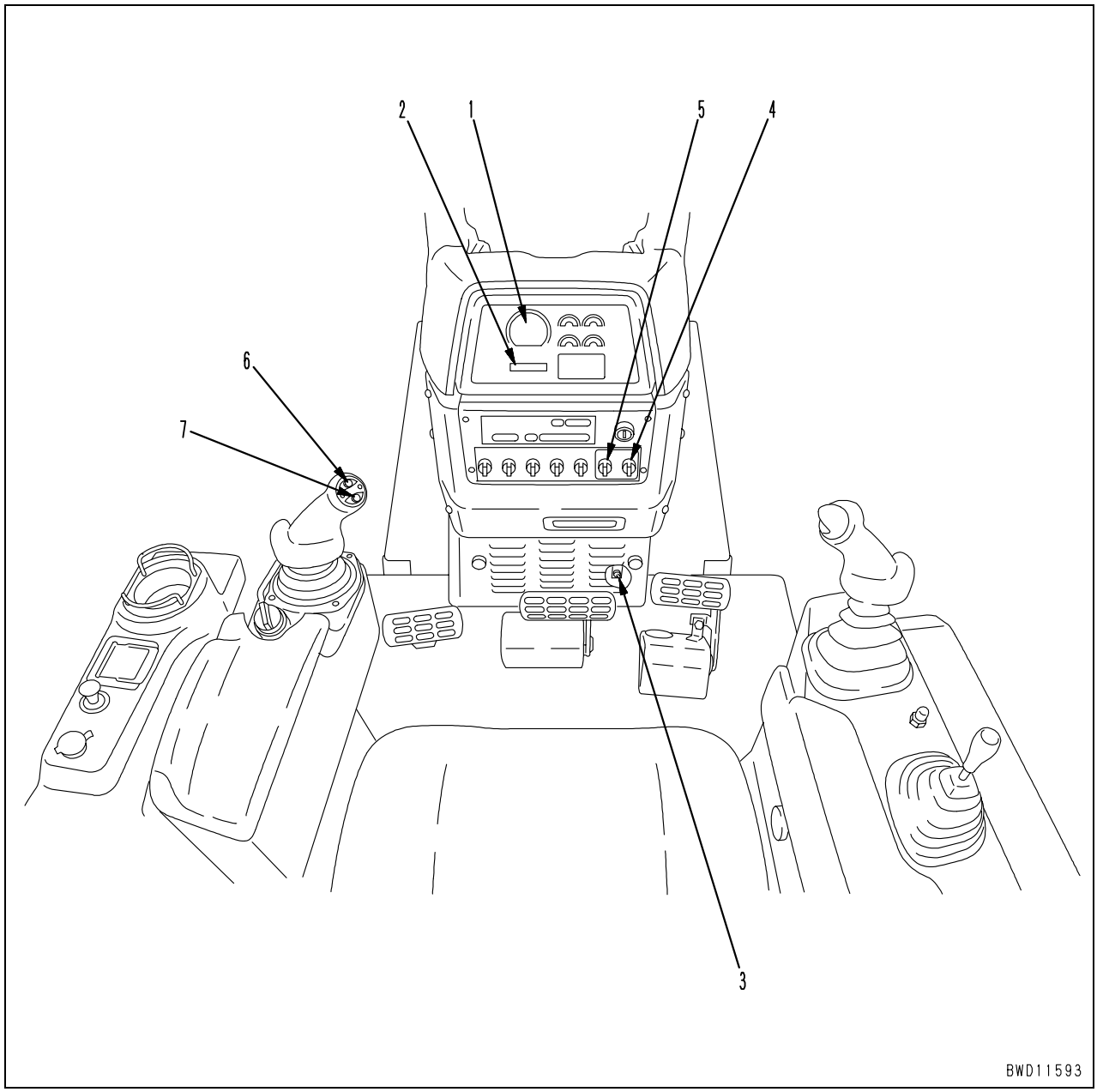
Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

30 Testing and adjusting

Testing and adjusting, Part 2

Testing and adjusting, Part 2

Special functions of monitor panel (EMMS)



Display section of special functions
1. Upper display section (Gear speed display section)
2. Lower display section (Multi-information section)

★ **EMMS**: Equipment Management Monitoring System

Operation section 1 of special functions (Basic operation)
3. Service switch

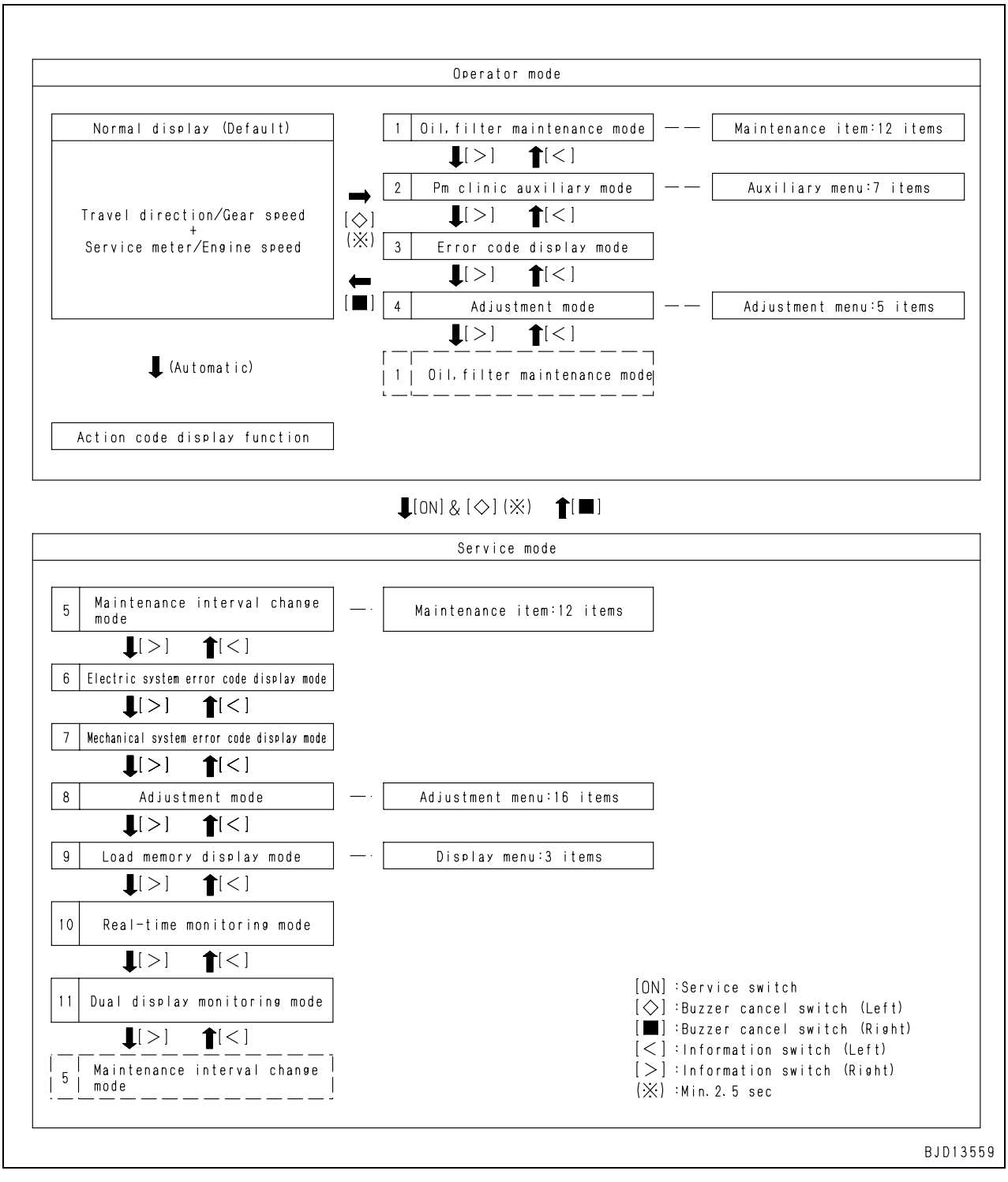
Operation section 2 of special functions (Changeover operation)
4. Buzzer cancel switch
5. Information switch
6. Shift-up switch
7. Shift-down switch

Normal function and special functions of monitor panel (EMMS)

The monitor panel (EMMS) has the normal and special functions, and displays information of various types at the gear speed display section at the center of the monitor panel and the multi-information section.
Some items are displayed automatically according to the internal setting of the monitor panel and the others are displayed according to the operation of the switches.

1. Normal function: Operator mode
   With this function, an operator can view and change the items displayed normally or displayed by the operation of the switches.
2. Special function 1: Service mode
   With this function, a serviceman can display and change the displayed items by the specified switching operation for testing, adjusting and troubleshooting.

Flow of each mode and function



Operation and display of operator mode (Outline)

★ In this section, only the outline of operator mode is explained.
See Operation and Maintenance Manual for details of each function and mode as well as the operating method.

Normal display (Default)

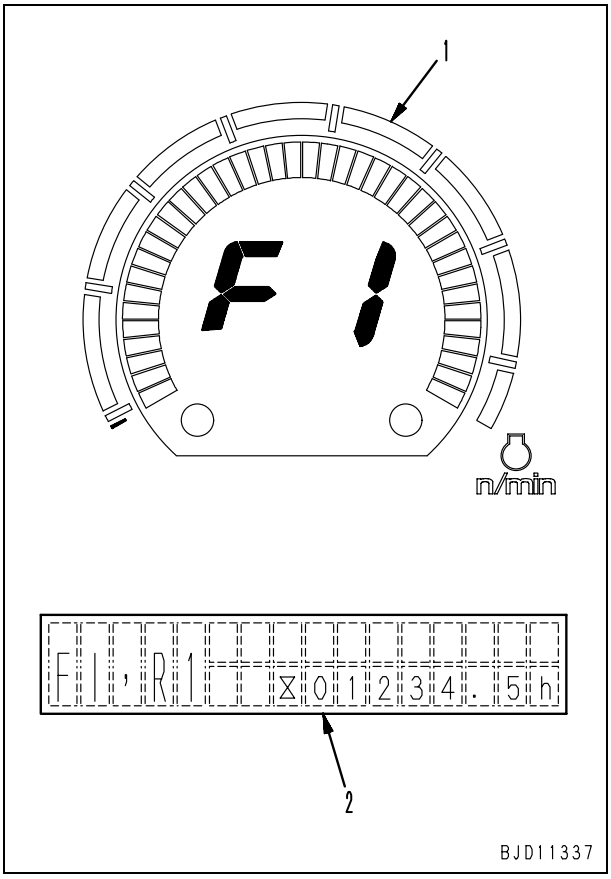
The following information is normally displayed on the monitor panel.

Gear speed display section (1):

- Front side: Travel direction (P, N, F, R)
- Rear side: Gear speed (1, 2, 3)
- Graphics: Engine speed

Multi-information section (2):

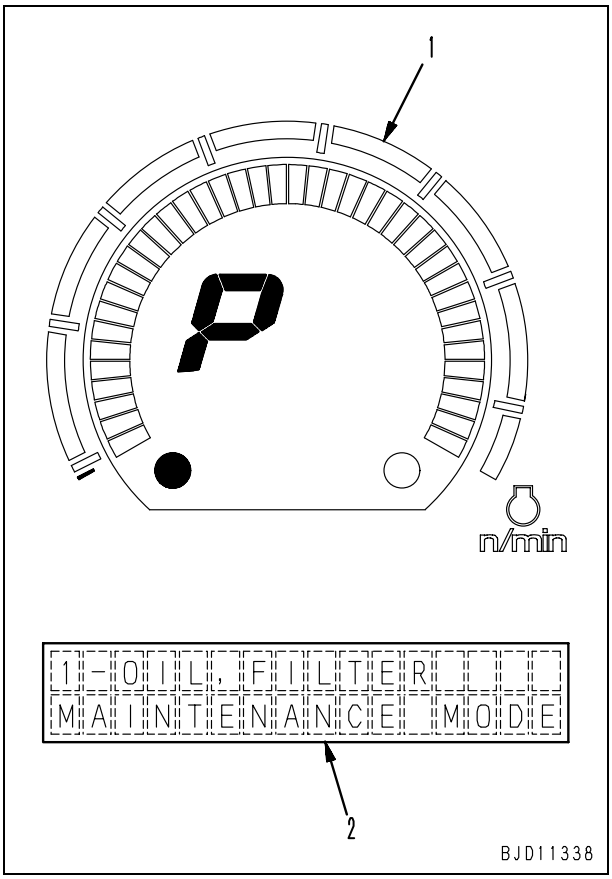
- Information is displayed in 2 lines of 16 characters each.
- Front side: Gear shift mode (F1 – R1, F1 – R2, F2 – R1, F2 – R2, F2 – R3)
  (Displayed when preset mode is set.)
- Rear side: Service meter (Unit: 0.1h)
- Each time the information switch is set to the right or left, the service meter and the engine speed are displayed alternately.



1. Maintenance mode
(1-OIL, FILTER MAINTENANCE MODE)

In this mode, the time up to the next replacement of oils and filters is displayed on multi-information section (2). Reset after completion of the replacement is done in this mode.

★ Gear speed display section (1) remains the normal display.



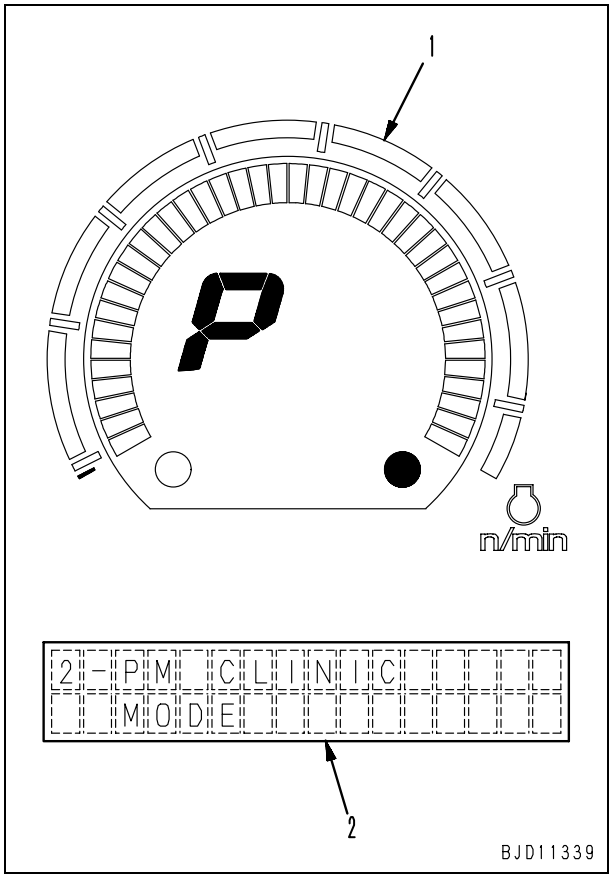
Code	Display	Maintenance item	Replacement interval	
			1st time (Can not be changed)	2nd time and after (Can be changed)
01	ENG OIL	Engine oil	500	500
02	ENG FILT	Engine oil filter	500	500
03	FUEL FILT	Fuel main filter	1000	1000
04	HYD FILT	Hydraulic oil filter	2000	2000
06	CORR RES	Corrosion resistor	1000	1000
07	DAMP OIL	Damper oil	2000	2000
08	FNL OIL	Final drive oil	1000	1000
10	HYD OIL	Hydraulic oil	2000	2000
12	HSS FILT	★ HSS charge filter	—	—
19	POWL OIL	Power train oil	1000	1000
20	POWL FILT	Power train oil filter	500	500
41	F.PRE-FLT	Fuel pre-filter	500	500

The items marked with ★ are displayed but not used for this machine.

2. Pm clinic auxiliary mode (2-PM CLINIC MODE)

In this mode, the condition of the machine is displayed on multi-information section (2) as an auxiliary function of the periodic diagnoses such as the Pm clinic, even if any measuring instrument is not connected.

★ Gear speed display section (1) remains the normal display.

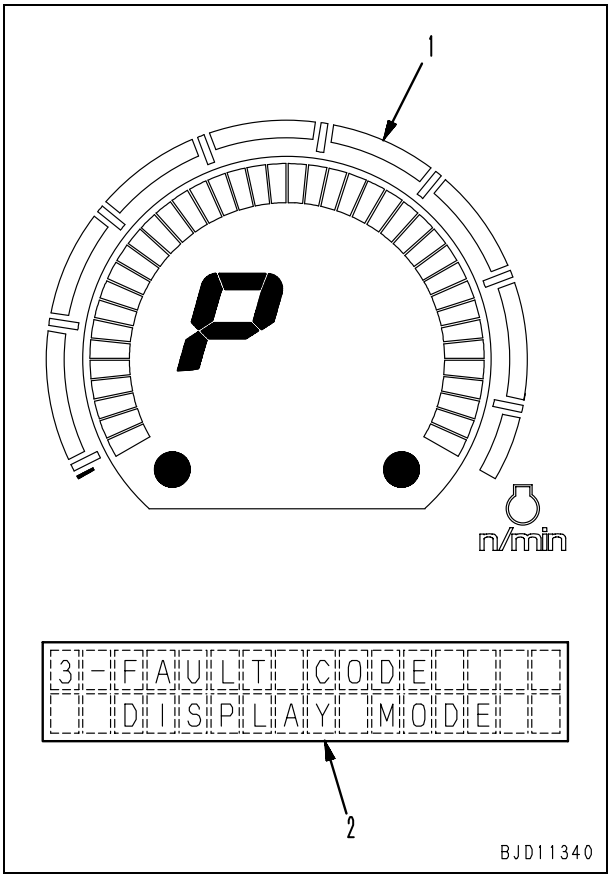


No.	Pm clinic auxiliary item
01	Engine speed
02	Coolant temperature
05	Boost pressure
06	Boost temperature
07	Power train oil temperature
08	Work equipment oil temperature
13	Battery voltage

3. Failure code display mode (3-FAULT CODE DISPLAY MODE)

In this mode, the contents of each problem in the machine are displayed by a 6-character failure code on multi-information section (2). When a user or a operator needs to be notified of the failure code of each problem, this mode is applied.

★ Gear speed display section (1) remains normal.



★ When a serviceman needs to check the failure codes for troubleshooting, “Electric system failure code display mode” and “Mechanical system failure code display mode” is recommended to use for more detailed information.

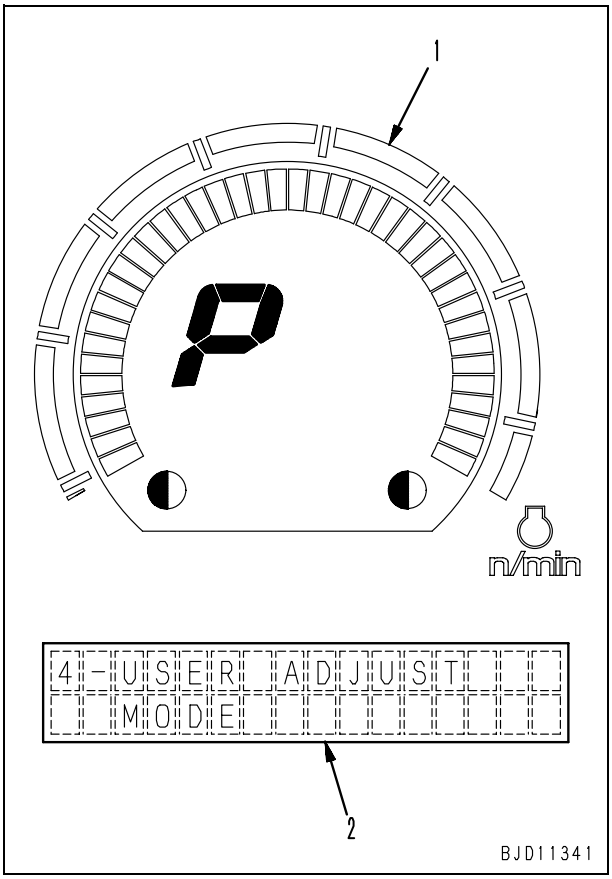
★ Method of checking failure code:
Turn buzzer cancel switch (4) to the [◇] position on the screen shown on the above, and all failure codes detected currently are displayed at the interval of about 2 seconds. (To finish displaying, turn the buzzer cancel switch to the [■] position.)

★ For the failure code, see the attached list or “Troubleshooting, Part 1” after viewing service mode “Mechanical system failure code display mode”.

4. Adjustment mode (4-USER ADJUST MODE)

In this mode, the display condition of the monitor panel can be adjusted on multi-information section (2).

★ Gear speed display section (1) remains the normal display.



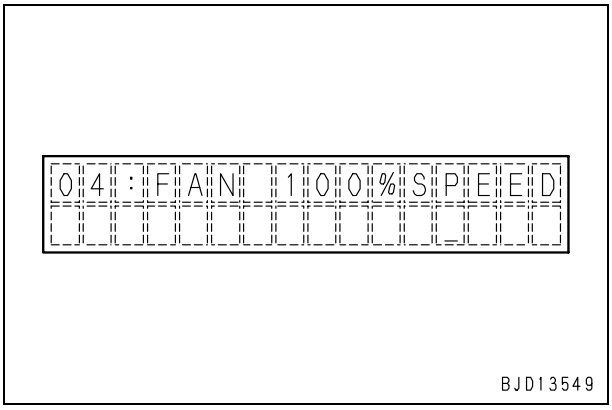
No.	Adjustment item
01	Brightness of LCD
02	Brightness of display
03	Contrast of display
04	Fan 100% mode
05	No injection cranking mode

1) Brightness of LCD
This mode is to adjust brightness of the backup lamp at the liquid crystal gauge section. (See Operation and Maintenance Manual.)

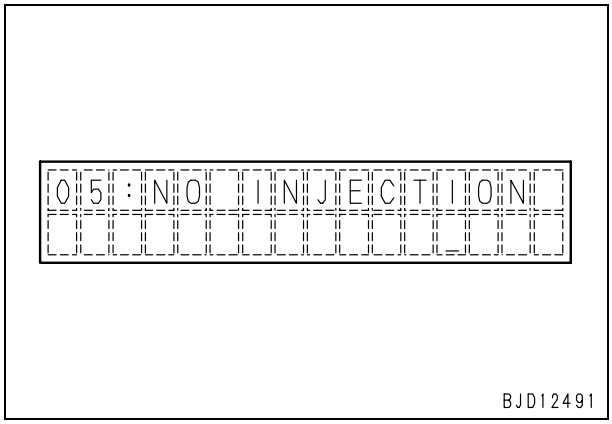
2) Brightness of display
This mode is to adjust brightness of the backup lamp at the multi-information section. (See Operation and Maintenance Manual.)

3) Contrast of display
This mode is to adjust thickness of the liquid crystal at the multi-information section. (See Operation and Maintenance Manual.)

4) Fan 100% mode
This function is to control rotation speed of the cooling fan forcedly at approximately 100% of the maximum speed.
1] This mode is selected by operating the information switch.
2] The mode is selected by turning the buzzer cancel switch to the [◇] position.
3] The function is effective under this condition and the rotation speed of the cooling fan is controlled to approximately 100% of the maximum speed.
★ Exiting this mode disables the function.



5) No injection cranking mode
This mode is to circulate the engine oil while applying no injection conditions to all engine cylinders before staring engine after an extended machine storage.
1] This mode is selected by operating the information switch.
2] The mode is selected by turning the buzzer cancel switch to the [◇] position.
3] In this condition, turn the starting switch to “start” position to apply no injection cranking.
4] The mode is released by moving the starting switch to ON position and turning the buzzer cancel switch to the [■] position.
⚠ **Do not continue no injection cracking for more than 20 seconds in order to protect the starting motor.**
⚠ **For safety, this mode cannot be operated while the engine is running.**
★ Exiting this mode disables the function.



Action code display function

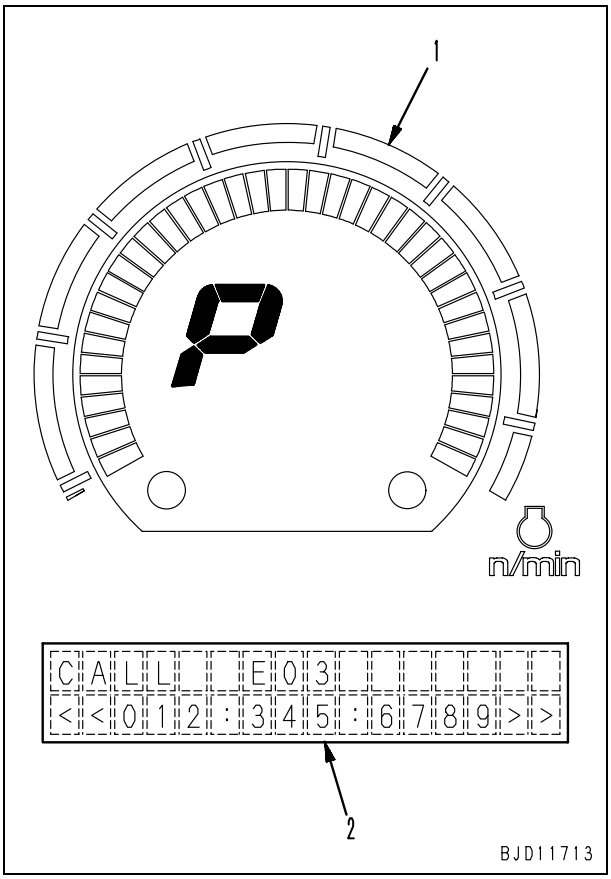
If a trouble which is to be notified to a operator occurs during work, an action code and a phone number are displayed on multi-information section (2).

★ Gear speed display section (1) remains the normal display.
★ The phone number is displayed only for important action codes. The display shown below is an example. (The form of the displayed phone number depends on the form of the input number.)
★ If an important action code is displayed, the caution lamp flashes and the alarm buzzer sounds.

<Reference>

An action code is displayed only when a serious abnormality occurs.

Even if an action code is not displayed, abnormality may have occurred. Therefore, if you find any incident, be sure to check for a failure code in “Electric system failure code display mode” and “Mechanical system failure code display mode”.



Action code table

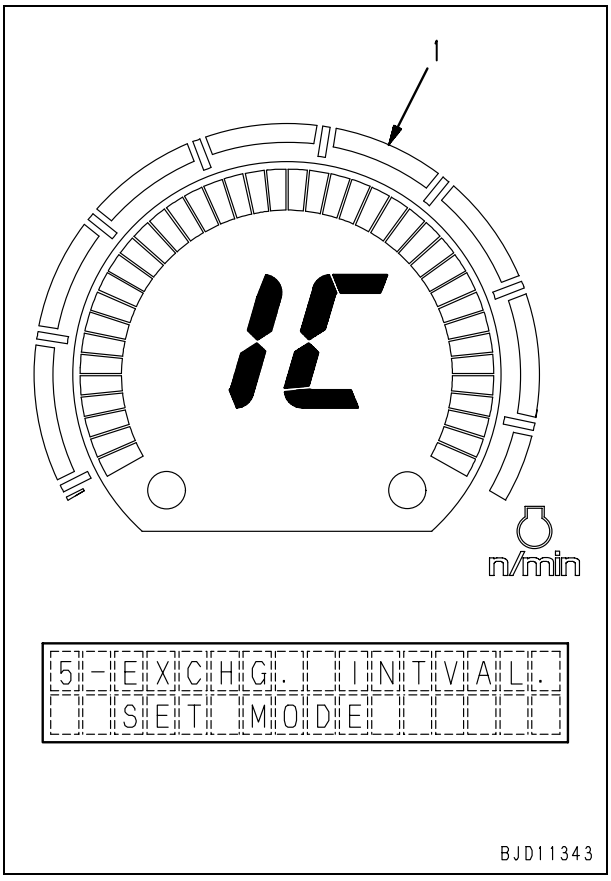
Action code	Display method of trouble	Examples of abnormality	Remedy requested for an operator
E01	• Only action code is displayed.	• Backup alarm does not sound. • Fan speed is always at maximum.	• Automatic function stops or normal function stops partially, but machine can work. • Contact your Komatsu distributor for repair.
E02	• Action code is displayed. • Warning lamp flashes • Alarm buzzer sounds.	• Gear is not shifted up or down. • Exhaust gas color is bad when temperature is low. • Defective coolant temperature sensor	• Stop engine and start it again, and you can operate machine without limiting function. You must take care, however. • Contact your Komatsu distributor for repair.
CALL E03	• The action code is displayed. • Warning lamp flashes • Alarm buzzer sounds.	• Engine boost pressure is abnormal. • Usable gear speeds are limited. • Engine speed does not rise fully. • Gear shift shocks become large. • Steering performance lowers.	• Move machine to safe place. • Contact your Komatsu distributor for repair.
CALL E04	• The action code is displayed. • Warning lamp flashes • Alarm buzzer sounds.	• Engine cannot be controlled. • Machine cannot travel. • Machine stops.	• Stop machine immediately. • Contact your Komatsu distributor for repair.

Operation and display in service mode

Method of changing to service mode

★ When using the service mode, change the screen by the following special operation.

1) Special operation of switches
Set the monitor panel in the service mode by operating service switch (3) and buzzer cancel switch (4).
   ★ Keeping the service switch in ON position, hold the buzzer cancel switch in the [◇] position for more than 2.5 seconds.
   ★ If the monitor panel is set in the service mode, [1C] is displayed on gear speed display section (1).
   ★ Each time the monitor panel is set in the service mode, “Maintenance interval change mode” is displayed first.



No.	Gear speed display section	Adjustment item
5	1C	Maintenance interval change mode
6	EE	Electric system failure code display mode
7	bE	Mechanical system failure code display mode
8	Cb	Adjustment mode
9	Ld	Load saving display mode
10	5R	Real-time monitoring mode
11	dR	Dual display monitoring mode

2) Selecting and executing mode to be used
Select the mode to be used with information switch (5) and execute it with buzzer cancel switch (4).
   - [>]: Next mode No.
   - [<]: Previous mode No.
   - [◇]: Execute mode.

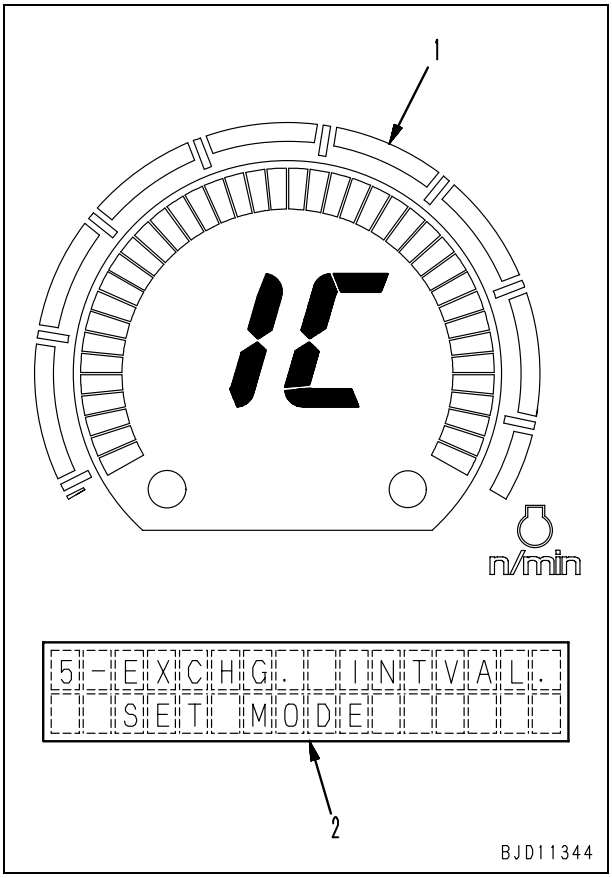
   ★ For details of operation in each mode, see the following pages.

3) Finishing mode and function
The current mode and function can be finished by either of the following method, regardless of the current mode and hierarchy.
   1] When continuing the operation in another mode or function or in the operator mode:
   Return to the mode screen or function screen to be used next by operating buzzer cancel switch (4).
      - [■]: Screen returns.
   2] When finishing all operations:
   Turn off the starting switch.

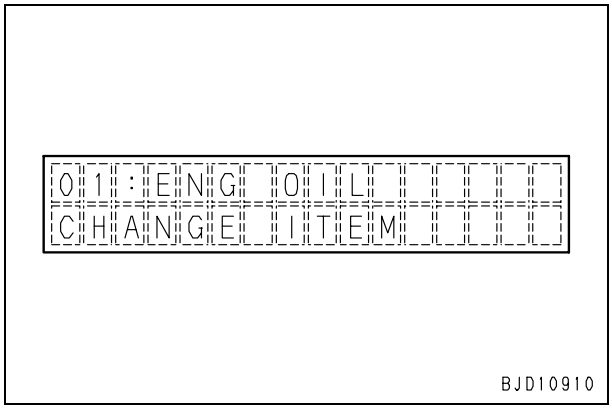
5. Maintenance interval change mode (5-EXCHG. INTVAL. SET MODE)

In this mode, you can check and set the maintenance interval times of various filters and oils which are the bases of the maintenance display function in the operator mode.

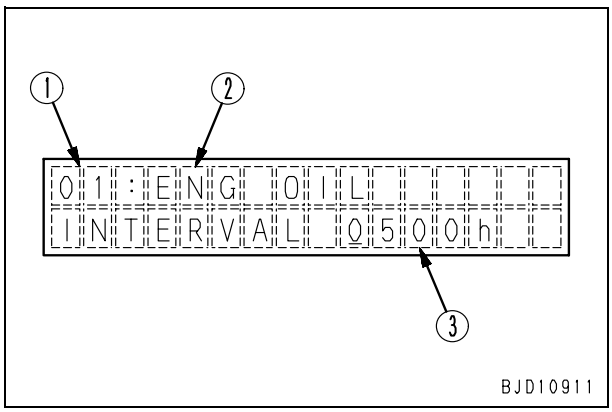
1) Selecting and implementing a mode
   1] Select “Maintenance interval change mode” on the mode selection screen.
      ★ If the mode is selected, code (1C) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   2] Display the maintenance item selection screen by operating buzzer cancel switch (4).
      ● [◇]: Execute mode



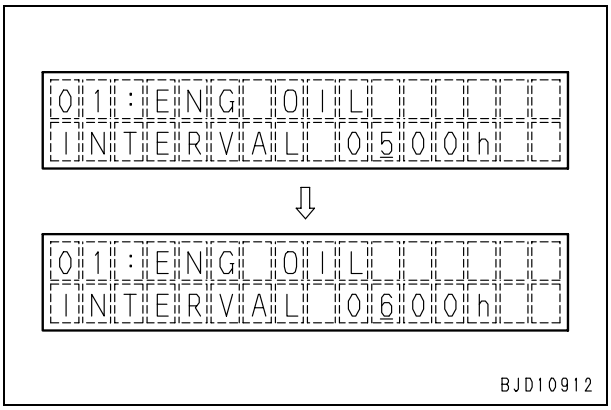
2) Selecting and displaying maintenance item
   1] Operate information switch (5) on the maintenance item selection screen to select a maintenance item.
      ● [>]: Next code
      ● [<]: Previous code
   2] Display the maintenance item selection screen by operating buzzer cancel switch (4).
      ● [◇]:Execute item.



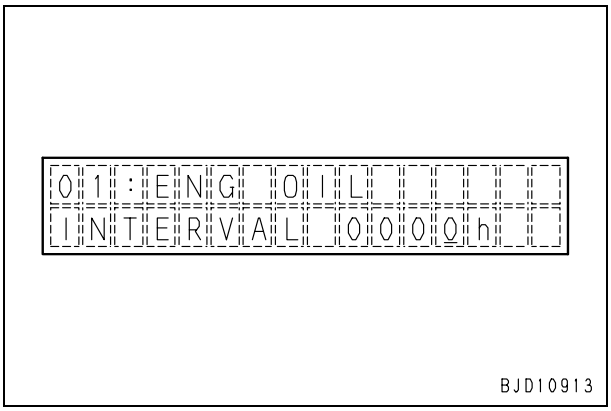
3) Contents of information screen
   The following items are displayed on the information section.
   1: Code
   2: Maintenance item
   3: Replacement interval (Set time)
   ★ Below figure shows an example.
   ★ If the replacement interval does not need to be changed, finish the operation on this screen.
   ★ If the replacement interval needs to be changed, go to step 4).



4) Updating replacement interval
   1] Change the set time by operating information switch (5), shift-up switch (6) and shift-down switch (7).
      - [>]: Move cursor to right.
      - [<]: Move cursor to left.
      - [UP]: Number increases.
      - [DOWN]: Number decreases.

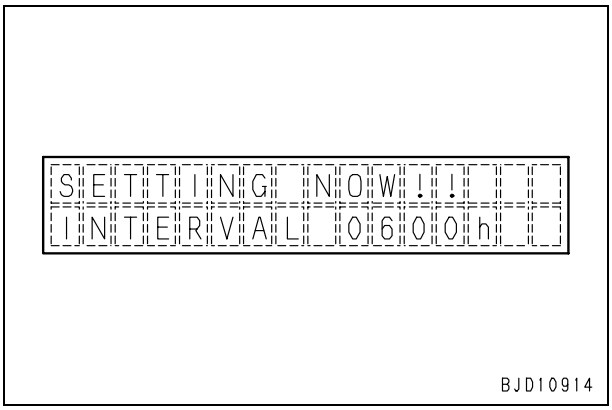


★ If you do not use the maintenance function, set all times to 0.

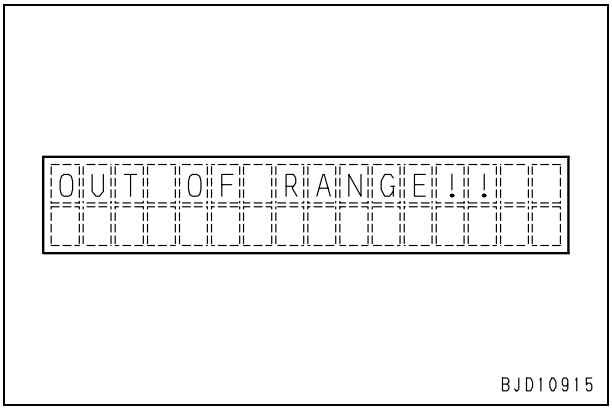


   2] If the input time is correct, enter the change of setting by operating buzzer cancel switch (4).
      - [◇]: Enter change.

      ★ If the change is finished normally, the information display screen appears after the screen shown below.



      ★ If the change is not finished normally, the information display screen before the change appears after the screen shown below. In this case, execute the above operation again.



Maintenance items table

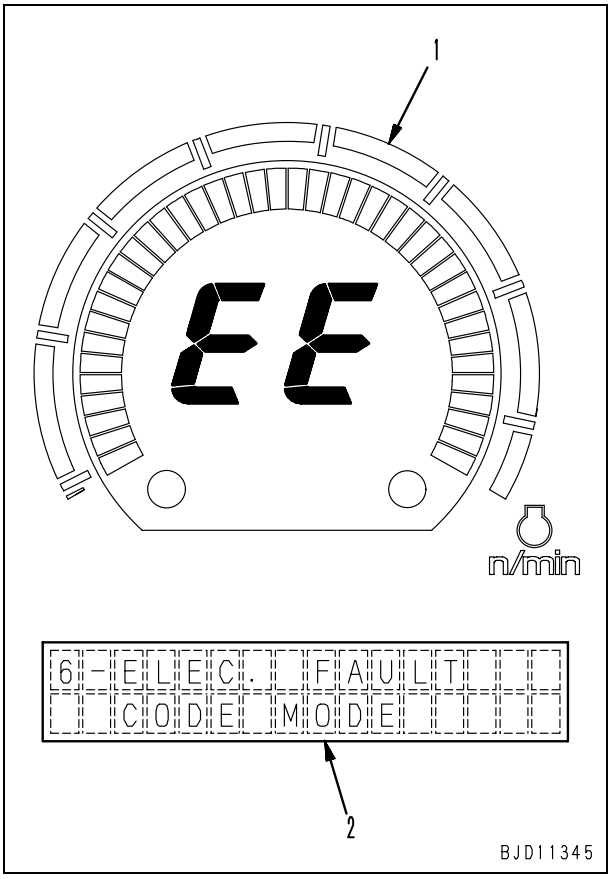
Code	Display	Maintenance item	Replacement interval (H)	
			1st time (Can not be changed)	2nd time and after (Can be changed)
01	ENG OIL	Engine oil	500	500
02	ENG FILT	Engine oil filter	500	500
03	FUEL FILT	Fuel main filter	1000	1000
04	HYD FILT	Hydraulic oil filter	2000	2000
06	CORR RES	Corrosion resistor	1000	1000
07	DAMP OIL	Damper oil	2000	2000
08	FNL OIL	Final drive oil	1000	1000
10	HYD OIL	Hydraulic oil	2000	2000
12	HSS FILT	HSS charge filter	—	—
19	POWL OIL	Power train oil	1000	1000
20	POWL FILT	Power train oil filter	500	500
41	F.PRE-FLT	Fuel pre-filter	500	500

★ The first replacement interval is the same as the second and after replacement intervals, and the former cannot be changed.

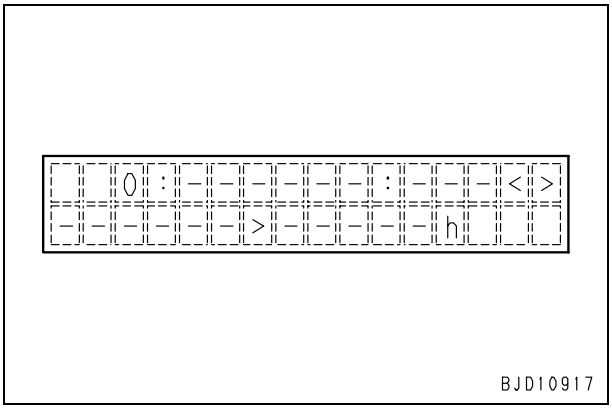
6. Electric system failure code display mode (6-ELEC. FAULT CODE MODE)

In this mode, you can check the electric system failure codes among the information of the troubles that occurred on the machine.

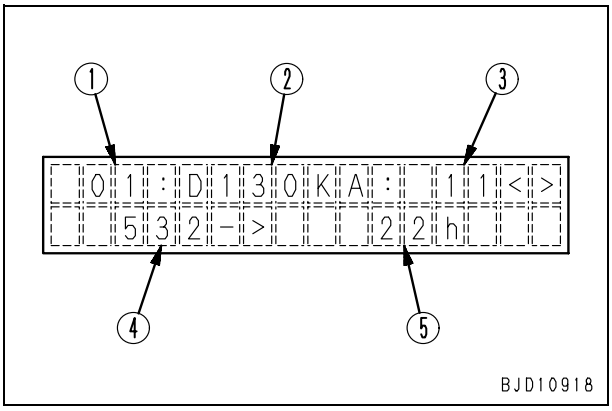
1) Selecting and implementing a mode
   1] Select “Electric system failure code display mode” on the mode selection screen.
   2] If the mode is selected, code (EE) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   3] Display the failure code display screen by operating buzzer cancel switch (4).
   - [◇]: Execute mode



2) Display in case where no codes are recorded
   If the failure codes which occurred in the past, and the current active failure codes do not exist, the below display will be shown.



3) Display in case where 1 or more codes are recorded
   If any failure codes which happened in the past or which are currently active exist, the display will be as shown below.
   1]: Record No. (Up to 20)
   2]: Failure code
   (Flash if currently active.)
   3]: Number of occurrences up to now
   4]: Elapsed time measured by service meter after first occurrence
   5]: Elapsed time measured by service meter after last occurrence
   ★ The below figure shows an example of the display.

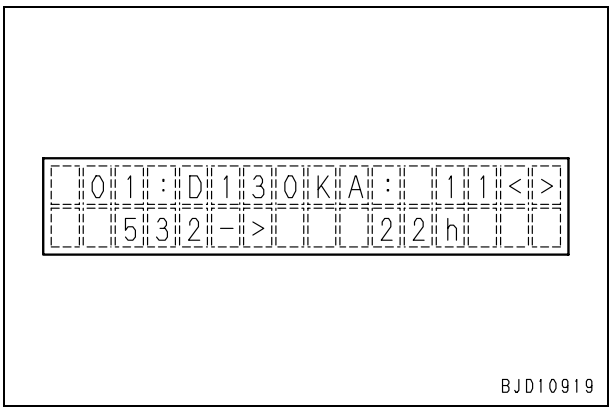


★ Flashing and lighting of failure code
Flashing: Code of the failure which is currently detected.
Lighting: Code of the failure which is not currently detected.

★ Conditions for detecting and keeping failure code
When a failure is detected, the failure code other than communication related or engine-related keeps flashing until the starting switch is turned off. After turning the starting switch OFF temporarily, if the starting switch is turn on or the engine is started again, the failure code keeps lighting until the same trouble is detected.
Communication related or engine related failure code is switched to the lighting when the problem is solved, even if the starting switch is not turned off.

4) Operations in case that multiple codes are recorded
When multiple codes are recorded, they can be displayed one by one by operating information switch (5).
- [>]: Go to next failure code
- [<]: Return to previous code
- ★ The failure codes are displayed in the order of their first occurrence times.

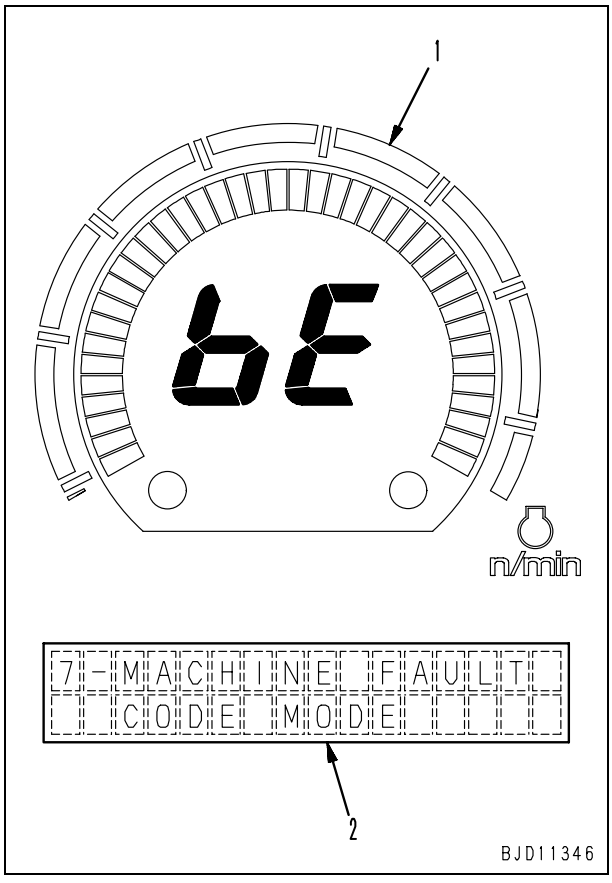
5) Method of deleting failure code
While displaying a failure code that is to be deleted, operate shift up switch (6) or shift down switch (7).
- [Up] or [Down]: Delete failure code.
- ★ A failure code which is active currently (code is flashing) cannot be deleted.



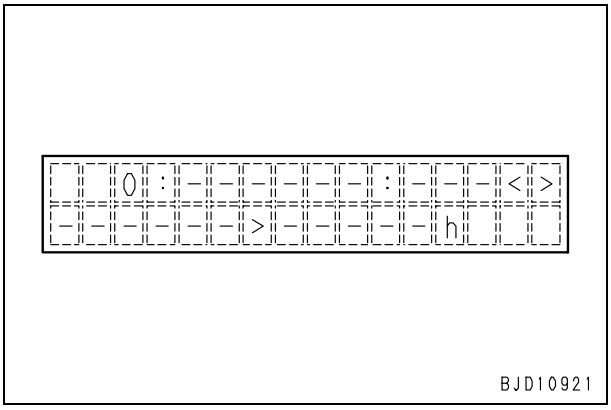
7. Mechanical system failure code display mode
(7-MACHINE FAULT CODE MODE)
In this mode, you can check the mechanical system failure codes among the information of the troubles that occurred on the machine.

1) Selecting and implementing a mode
1] Select “Mechanical system failure code display mode” on the mode selection screen.
- ★ If the mode is selected, code (bE) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).

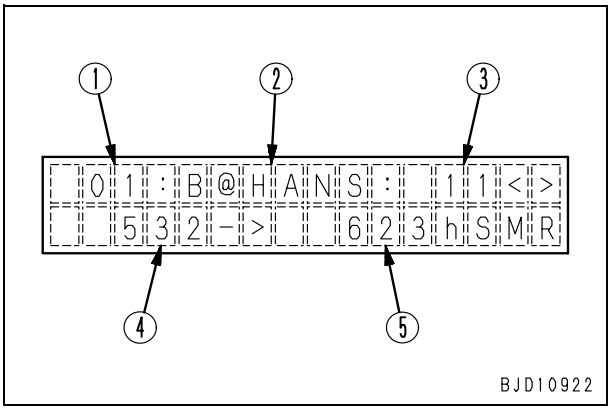
2] Display the failure code display screen by operating buzzer cancel switch (4).
- [◇]: Execute mode.



2) Display in case where no codes are recorded
If the failure codes which occurred in the past, and the current active failure codes do not exist, the below display will be shown.



3) Display in case where 1 or more codes are recorded
If any failure codes which happened in the past or which are currently active exist, the display will be as shown below.
1] : No.
2] : Failure code
(Flash if currently active.)
3] : Number of occurrences up to now
4] : Elapsed time measured by service meter after first occurrence
5] : Elapsed time measured by service meter after last occurrence
★ The below figure shows an example of the display.



★ Flashing and lighting of failure code
Flashing: Code of the failure which is currently detected.
Lighting: Code of the failure which is not currently detected.
★ Conditions for detecting and keeping failure code
A failure code of the mechanical system is switched to the lighting when the problem is solved, even if the starting switch is not turned off.

4) Operations in case that multiple codes are recorded
When multiple codes are recorded, they can be displayed one by one by operating information switch (5).
- [>]: Go to next failure code
- [<]: Return to previous code

★ All failure codes, including ones that did not occurred in the past, are displayed in numerical order.

5) Method of deleting failure code
The failure codes of the mechanical system cannot be deleted.

Failure code table

Action code	Failure code	Failure area	Trouble symptom	Alarm Buzzer	Cont roller	History classification
CALL E03	**1500L0**	Transmission clutch	Dual engagement	●	S/T	Electric system
CALL E03	**15SAL1**	Forward clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SALH**	Forward clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SBL1**	Reverse clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SBLH**	Reverse clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SEL1**	1st clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SELH**	1st clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SFL1**	2nd clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SFLH**	2nd clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SGL1**	3rd clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SGLH**	3rd clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
—	**AB00MA**	Alternator	Malfunction		S/T	Mechanical system
—	**B@BAZG**	Engine oil	Oil pressure reduction	●	ENG	Mechanical system
—	**B@BCNS**	Radiator coolant	Overheat	●	ENG	Mechanical system
—	**B@CENS**	Power train oil	Overheat	●	S/T	Mechanical system
—	**B@HANS**	Hydraulic oil	Overheat	●	S/T	Mechanical system
CALL E04	**CA111**	Engine controller	Abnormality in controller	●	ENG	Electric system
CALL E04	**CA115**	Abnormal engine NE, Bkup speed sensor	Abnormal speed sensor signal	●	ENG	Electric system
CALL E03	**CA122**	Charge pressure sensor too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA123**	Charge pressure sensor too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA131**	Decelerator pedal sensor too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA132**	Decelerator pedal sensor too low	Excessively low voltage detected	●	ENG	Electric system
E01	**CA144**	Coolant temperature sensor too high	Excessively high voltage detected		ENG	Electric system
E01	**CA145**	Coolant temperature sensor too low	Excessively low voltage detected		ENG	Electric system
E01	**CA153**	Charge temperature sensor too high	Excessively high voltage detected		ENG	Electric system

Action code	Failure code	Failure area	Trouble symptom	Alarm Buzzer	Cont roller	History classification
E01	**CA154**	Charge temperature sensor too low	Excessively low voltage detected		ENG	Electric system
CALL E03	**CA155**	Charge temperature tool high and engine speed derated	Exceeded upper control limit of temperature	●	ENG	Electric system
CALL E03	**CA187**	Sensor power source 2 too low	Excessively low voltage detected	●	ENG	Electric system
E01	**CA221**	Atmospheric pressure sensor too high	Excessively high voltage detected		ENG	Electric system
E01	**CA222**	Atmospheric pressure sensor too low	Excessively low voltage detected		ENG	Electric system
CALL E03	**CA227**	Sensor power source 2 too high	Excessively high voltage detected	●	ENG	Electric system
—	**CA234**	Engine overspeed	Too high speed		ENG	Mechanical system
CALL E03	**CA238**	Abnormal power source for Ne speed sensor	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA271**	IMV/PCV1 short circuit	Short circuit	●	ENG	Electric system
CALL E03	**CA272**	IMV/PCV1 disconnection	Disconnection	●	ENG	Electric system
CALL E03	**CA281**	Abnormal supply pump pressure balance	Abnormal fuel sending	●	ENG	Electric system
CALL E03	**CA322**	Disconnection and short circuit in injector #1	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA323**	Disconnection and short circuit in injector #5	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA324**	Disconnection and short circuit in injector #3	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA325**	Disconnection and short circuit in injector #6	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA331**	Disconnection and short circuit in injector #2	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA332**	Disconnection and short circuit in injector #4	Disconnection and short circuit	●	ENG	Electric system
CALL E04	**CA342**	Abnormal engine controller data matching consistency	Matching in consistency	●	ENG	Electric system
CALL E03	**CA352**	Sensor power source 1 too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA386**	Sensor power source 1 too high	Excessively high voltage detected	●	ENG	Electric system
E01	**CA428**	Water detection sensor too high	Excessively high voltage detected		ENG	Electric system
E01	**CA429**	Water detection sensor too low	Excessively low voltage detected		ENG	Electric system
E01	**CA435**	Abnormal engine oil pressure switch	Abnormal signal circuit		ENG	Electric system
CALL E04	**CA441**	Power supply voltage too low	Excessively low voltage detected	●	ENG	Electric system
CALL E04	**CA442**	Power supply voltage too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA449**	Common rail pressure too high (2)	Excessively high pressure detected	●	ENG	Electric system

Action code	Failure code	Failure area	Trouble symptom	Alarm Buzzer	Cont roller	History classification
CALL E03	**CA451**	Common rail pressure sensor too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA452**	Common rail pressure sensor too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA488**	Charge temperature too high torque derated	Exceeded upper control limit of temperature	●	ENG	Electric system
CALL E03	**CA553**	Common rail pressure too high (1)	Excessively high pressure detected	●	ENG	Electric system
E02	**CA559**	Supply pump no pressure (1)	No pressure feeding detected	●	ENG	Electric system
CALL E03	**CA689**	Abnormal engine NE speed sensor	Abnormality in signal	●	ENG	Electric system
CALL E03	**CA731**	Abnormal engine Bkup speed sensor phase	Abnormal phase	●	ENG	Electric system
CALL E04	**CA757**	Loss of all data of engine controller	Loss of all data	●	ENG	Electric system
CALL E03	**CA778**	Abnormal engine Bkup speed sensor	Abnormal Bkup signal	●	ENG	Electric system
CALL E03	**CA1633**	Abnormal KOMNET	Abnormal communication	●	ENG	Electric system
CALL E03	**CA2185**	Decelerator pedal sensor power source too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA2186**	Decelerator pedal sensor power source too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA2249**	Supply pump no pressure (2)	No pressure feeding detected	●	ENG	Electric system
CALL E03	**CA2265**	Disconnection in electric lift pump	Disconnection	●	ENG	Electric system
CALL E03	**CA2266**	Short circuit in electric lift pump	Short circuit	●	ENG	Electric system
CALL E03	**CA2311**	Abnormal IMV solenoid	Abnormal resistance	●	ENG	Electric system
E01	**CA2555**	Disconnection in air intake heater relay	Disconnection		ENG	Electric system
E01	**CA2556**	Short circuit in air intake heater relay	Short circuit		ENG	Electric system
—	**D110KA**	Battery relay	Short circuit		S/T	Electric system
—	**D110KB**	Battery relay	Disconnection		S/T	Electric system
E02	**D130KA**	Neutral safety relay	Disconnection	●	S/T	Electric system
E02	**D130KB**	Neutral safety relay	Short circuit	●	S/T	Electric system
E01	**D161KA**	Backup alarm relay	Disconnection		S/T	Electric system
E01	**D161KB**	Backup alarm relay	Short circuit		S/T	Electric system
CALL E03	**DAFRKR**	Monitor panel CAN communication	Defective communication	●	MON	Electric system
E01	**DAQ0KT (DB30KT)**	Steering and transmission controller	Abnormality in controller		S/T	Electric system
CALL E04	**DAQ1KK (DB31KK)**	Main power source of steering and transmission controller	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DAQ2KK (DB32KK)**	Steering and transmission controller load power source	Power supply voltage drop, input	●	S/T	Electric system
CALL E03	**DAQ5KK (DB35KK)**	5V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system

Action code	Failure code	Failure area	Trouble symptom	Alarm Buzzer	Cont roller	History classification
CALL E03	**DAQ6KK (DB36KK)**	24V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DAQ9KQ (DB39KQ)**	Steering and transmission controller model selection	Model select signal inconsistency	●	S/T	Electric system
CALL E03	**DB2RKR**	Steering and transmission controller CAN communication	Defective communication (Abnormality in target component system)	●	S/T	Electric system
E01	**DB30KT (DAQ0KT)**	Steering and transmission controller	Abnormality in controller		S/T	Electric system
CALL E04	**DB31KK (DAQ1KK)**	Main power source of steering and transmission controller	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DB32KK (DAQ2KK)**	Steering and transmission controller load power source	Power supply voltage drop, input	●	S/T	Electric system
CALL E03	**DB35KK (DAQ5KK)**	5V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system
CALL E03	**DB36KK (DAQ6KK)**	24V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DB39KQ (DAQ9KQ)**	Steering and transmission controller model selection harness	Model select signal inconsistency	●	S/T	Electric system
E02	**DD12KA**	Shift up switch	Disconnection	●	S/T	Electric system
E02	**DD12KB**	Shift up switch	Short circuit	●	S/T	Electric system
E02	**DD13KA**	Shift down switch	Disconnection	●	S/T	Electric system
E02	**DD13KB**	Shift down switch	Short circuit	●	S/T	Electric system
CALL E03	**DD14KA (DDQ2KA)**	Parking lever switch	Disconnection	●	S/T	Electric system
CALL E03	**DD14KB (DDQ2KB)**	Parking lever switch	Short circuit	●	S/T	Electric system
E02	**DDN7KA**	Pitch control switch	Disconnection	●	S/T	Electric system
E02	**DDN7KB**	Pitch control switch	Short circuit	●	S/T	Electric system
CALL E03	**DDQ2KA (DD14KA)**	Parking lever switch	Disconnection	●	S/T	Electric system
CALL E03	**DDQ2KB (DD14KB)**	Parking lever switch	Short circuit	●	S/T	Electric system
—	**DGS1KX**	Hydraulic oil temperature sensor	Input signal out of range		S/T	Electric system
E01	**DGT1KA**	Power train oil temperature sensor	Disconnection		S/T	Electric system
E01	**DGT1KX**	Power train oil temperature sensor	Input signal out of range		S/T	Electric system
CALL E03	**DK10KA**	Fuel control dial	Disconnection	●	S/T	Electric system
CALL E03	**DK10KB**	Fuel control dial	Short circuit	●	S/T	Electric system
CALL E03	**DK30KA**	Steering potentiometer (1)	Disconnection	●	S/T	Electric system
CALL E03	**DK30KB**	Steering potentiometer (1)	Short circuit	●	S/T	Electric system
CALL E04	**DK30KX**	Steering potentiometer	Input signal out of range	●	S/T	Electric system
CALL E04	**DK30KZ**	Steering potentiometer	Disconnection or short circuit	●	S/T	Electric system
CALL E03	**DK30L8**	Steering potentiometer	Inconsistent analog signals	●	S/T	Electric system
CALL E03	**DK31KA**	Steering potentiometer (2)	Disconnection	●	S/T	Electric system

Action code	Failure code	Failure area	Trouble symptom	Alarm Buzzer	Cont roller	History classification
CALL E03	**DK31KB**	Steering potentiometer (2)	Short circuit	●	S/T	Electric system
E01	**DK40KA**	Brake potentiometer	Disconnection		S/T	Electric system
E01	**DK40KB**	Brake potentiometer	Short circuit		S/T	Electric system
CALL E04	**DK55KX**	Forward-reverse potentiometer	Input signal out of range	●	S/T	Electric system
CALL E04	**DK55KZ**	Forward-reverse potentiometer	Disconnection or short circuit	●	S/T	Electric system
CALL E03	**DK55L8**	Forward-reverse potentiometer	Inconsistent analog signals	●	S/T	Electric system
CALL E03	**DK56KA**	Forward-reverse potentiometer (1)	Short circuit	●	S/T	Electric system
CALL E03	**DK56KB**	Forward-reverse potentiometer (1)	Disconnection	●	S/T	Electric system
CALL E03	**DK57KA**	Forward-reverse potentiometer (2)	Disconnection	●	S/T	Electric system
CALL E03	**DK57KB**	Forward-reverse potentiometer (2)	Short circuit	●	S/T	Electric system
CALL E03	**DKH1KA (DKH1KX)**	Pitch angle sensor	Short circuit	●	S/T	Electric system
CALL E03	**DKH1KB (DKH1KX)**	Pitch angle sensor	Disconnection	●	S/T	Electric system
CALL E03	**DKH1KX (DKH1KA) (DKH1KB)**	Pitch angle sensor	Input signal out of range	●	S/T	Electric system
E01	**DLT3KA**	Transmission output speed sensor	Disconnection		S/T	Electric system
E01	**DLT3KB**	Transmission output speed sensor	Short circuit		S/T	Electric system
—	**DV00KB**	Alarm buzzer	Short circuit		MON	Electric system
E02	**DW5AKA**	Pitch control solenoid	Disconnection	●	S/T	Electric system
E02	**DW5AKB**	Pitch control solenoid	Short circuit	●	S/T	Electric system
E02	**DW5AKY**	Pitch control solenoid	Short circuit to power source line	●	S/T	Electric system
E01	**DW7BKA**	Fan reverse solenoid	Disconnection		S/T	Electric system
E01	**DW7BKB**	Fan reverse solenoid	Short circuit		S/T	Electric system
CALL E03	**DWN1KA**	HSS EPC solenoid right	Disconnection	●	S/T	Electric system
CALL E03	**DWN1KB**	HSS EPC solenoid right	Short circuit	●	S/T	Electric system
CALL E04	**DWN1KY**	HSS EPC solenoid right	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DWN2KA**	HSS EPC solenoid left	Disconnection	●	S/T	Electric system
CALL E03	**DWN2KB**	HSS EPC solenoid left	Short circuit	●	S/T	Electric system
CALL E04	**DWN2KY**	HSS EPC solenoid left	Short circuit to power source line	●	S/T	Electric system
E01	**DWN5KA**	Fan pump TVC solenoid	Disconnection		S/T	Electric system
E01	**DWN5KB**	Fan pump TVC solenoid	Short circuit		S/T	Electric system
E02	**DWN5KY**	Fan pump TVC solenoid	Short circuit to power source line	●	S/T	Electric system
E01	**DXA0KA**	HSS pump TVC solenoid	Disconnection		S/T	Electric system
E01	**DXA0KB**	HSS pump TVC solenoid	Short circuit		S/T	Electric system
E01	**DXA0KY**	HSS pump TVC solenoid	Short circuit to power source line		S/T	Electric system

Action code	Failure code	Failure area	Trouble symptom	Alarm Buzzer	Cont roller	History classification
CALL E03	**DXH4KA**	1st clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH4KB**	1st clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH4KY**	1st clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DXH5KA**	2nd clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH5KB**	2nd clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH5KY**	2nd clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DXH6KA**	3rd clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH6KB**	3rd clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH6KY**	3rd clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DXH7KA**	Reverse clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH7KB**	Reverse clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH7KY**	Reverse clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DXH8KA**	Forward clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH8KB**	Forward clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH8KY**	Forward clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system

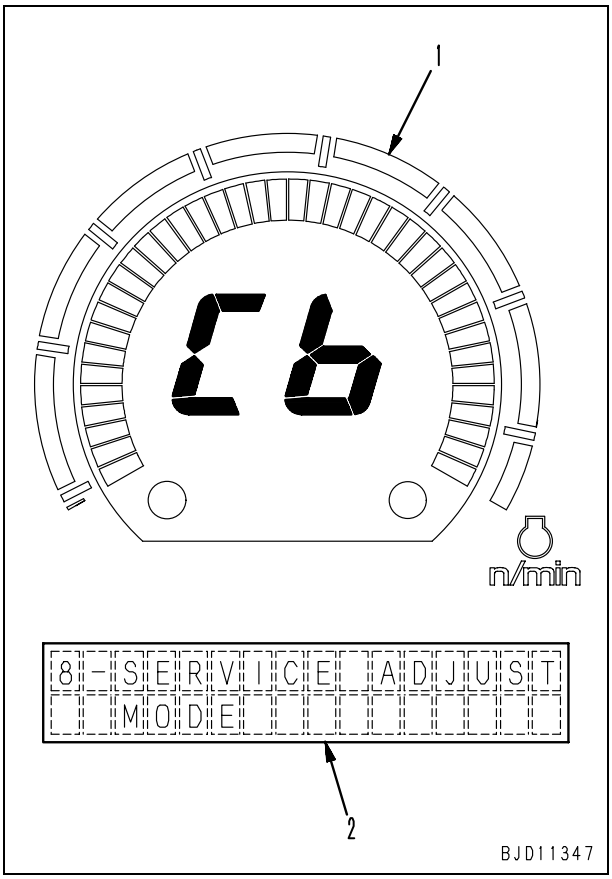
★ Description order in the table
It is listed in order of failure code (ascending sequence).

★ Action code
When action code is available:
If the failure code is detected, the action code and phone number (when only CALL E03 and E04 are registered) are displayed in the bottom display section of the monitor panel (multi-information section) to notify an operator that the trouble has occurred.
When action code is not available:
Even if an failure code is detected, occurrence of the trouble is not notified to an operator. If there is a mechanical system trouble, the corresponding warning lamp flashes.

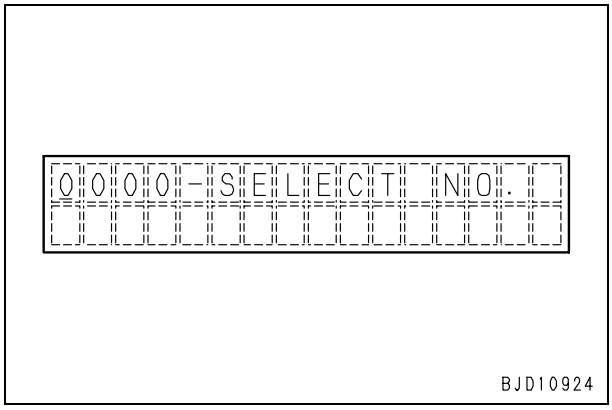
★ Controller
S/T: The steering and transmission controller is taking charge of the trouble detection.
ENG: The engine controller is taking charge of the trouble detection.
MON: The monitor panel is taking charge of the trouble detection.

8. Adjustment mode
(8-SERVICE ADJUST MODE)
In this mode, you can adjust the control system and various devices of the machine.

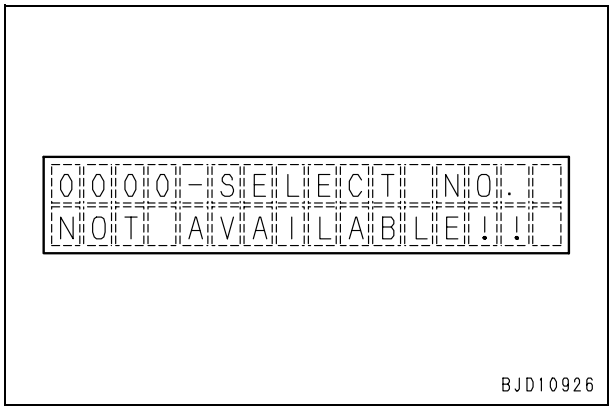
1) Selecting and implementing a mode
   1] Select “Adjustment mode” on the mode selection screen.
   2] If the mode is selected, code (Cb) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   3] Display the adjustment code input screen by operating buzzer cancel switch (4).
      ● [◇]: Executes mode.



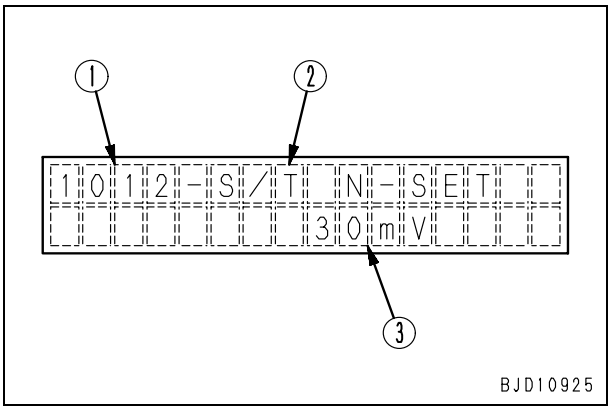
2) Selecting adjustment items
   1] On the adjustment code input screen, input the 4-digit code of the item to be adjusted by operating information switch (5), shift up switch (6) and shift down switch (7).
      ● [>]: Moves cursor rightward.
      ● [<]: Moves cursor leftward.
      ● [UP]: Increases number.
      ● [DOWN]: Decreases number.
   2] After inputting the code, operate buzzer cancel switch (4) to display the monitoring screen.
      ● [◇]: Enters input mode.



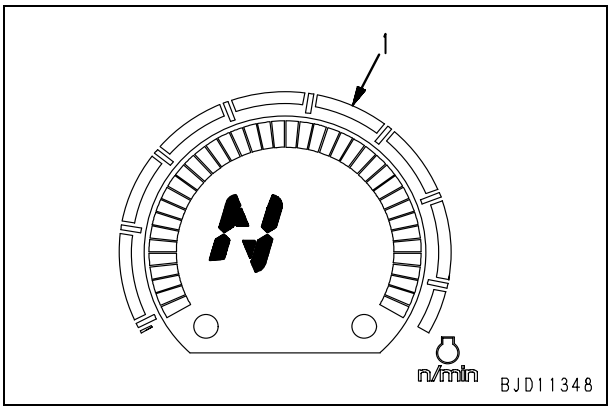
★ If an incorrect code is input, the adjustment code input screen appears again after showing the below screen. In this case, execute the above operation again.



3) Contents of display on adjustment screen
   1] : Code
   2] : Adjustment item
   3] : Related information
   ★ For the detailed information and adjustment procedure, see “Adjustment mode table and adjustment procedure”.



4) In case of operating the machine in adjustment mode, if the parking brake lever is set in the “free” position, gear speed display section (1) returns to the normal display and the machine can be operated normally.
   ★ At this time, even if the shift up or shift down switch is pressed with the PCCS lever in the neutral position, the shift cannot be changed.
   (The displayed number is the code of adjustment mode selection.)
   To change the shift, shift the PCCS lever to the “forward” or “reverse” position and press the shift up or shift down switch while the machine is traveling.
   ★ To select another screen, return the parking brake lever to the “lock” position temporarily and perform the necessary operation.



5) Changing adjustment item (Limited function)
   Once the adjustment items are selected, they can be selected with the information switch without inputting the codes again.
   - [>]: Next code
   - [<]: Previous code

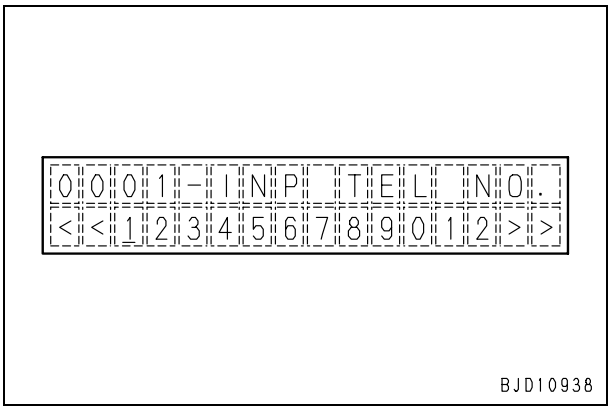
   ★ This function is limited to the numbers marked with ★ in the “Adjustment items table”.
   ★ Note that this operation is not accepted while the parking brake lever is in the released position.
   ★ An adjustment item also can be selected by returning to the input screen temporarily and inputting the code for that item.

Adjustment mode table and adjustment procedure

No.	Code	Adjustment item		Related information	Disassembly and assembly
[1]	0001	INP TEL NO.	Phone No. input mode	Figure/Symbol	
★[2]	0002	S/T S.CODE	Steering and transmission controller specification set	Code	●
★[3]	0004	BODY TYPE	Machine specification set	Code	●
★[4]	0005	BRAKE BASE	Brake potentiometer zero point adjustment	Voltage	●
★[5]	0007	ENG.FULL CH	Engine deceleration-cut mode	Speed	
[6]	0008	INJ → 123456	Common rail reduced cylinder mode	Speed, Fuel injection rate	
★[7]	0009	PITCH SENS.	Pitch angle sensor initial set	Voltage	●
★[8]	0010	FAN 70% MODE	Fan 70% speed mode	Adjustment data	
★[9]	0021	KMTRX INST	KOMTRAX specification set	Symbol	●
★[10]	1005	FAN 100% MODE	Fan 100% speed mode	Adjustment data	
[11]	1012	S/T N-SET	Steering control lever neutral set	Voltage	
[12]	1013	S/T L-SET	Steering control lever left set	Voltage	
[13]	1014	S/T R-SET	Steering control lever right set	Voltage	
[14]	2222	HSS ADJUST	HSS lever initial current set	Current	
[15]	9997	HI IDLE SET	High idle limit mode	Speed	
[16]	9998	SFT INHIBIT	Gear speed limit mode	Symbol	

⚠ Check items marked with ● in the Disassembly and assembly column of the above table must be adjusted after the machine is assembled or any controller is replaced. (For the adjustment procedure, see "Adjustment after replacement of controller")
The numbers marked with ★ can be displayed in order by setting the information switch in the ">" or "<" position.

[1] **0001**: Phone No. input mode
- This code inputs or changes a phone number to be displayed simultaneously with when the user code is displayed.
- The lower part displays a phone number and symbols.
- Available characters: 0 1 2 3 4 5 6 7 8 9 : ; < > ?
- How to use:
  1) By operating information switch (5), shift up switch (6), and shift down switch (7), input a phone number and symbols.
     - [>]: Moves cursor rightward.
     - [<]: Moves cursor leftward.
     - [UP]: Advance the numeric character or character (in the order of available characters).
     - [DOWN]: Reverse the numeric character or character. (in the order of available characters)
  2) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  - ★ Sixteen digits of numeric characters are provided. To avoid confusion, input symbols other than numeric characters at digits you will not use.
  - ★ 0 (zero) is input at all places of the lower part before shipment from our factory. (No phone number is displayed under this condition.)
  - ★ Even if this code is turned off, the setting is effective.



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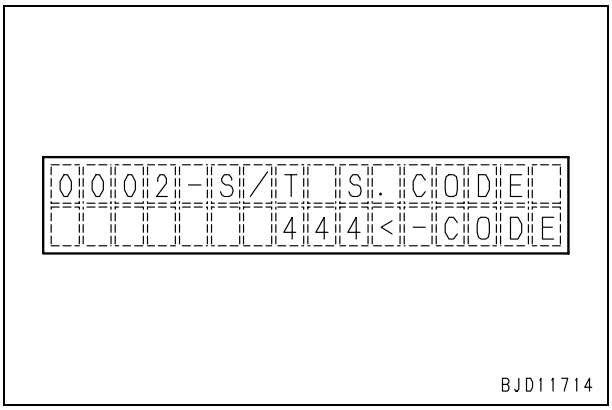
[2] **0002**: Steering and transmission controller specification set
- This code is used to initialize the specification codes recognized by the steering and transmission controller and the set values of the memory in the controller.
- The specification code is displayed on the lower line.
- Adjustment method:
  1) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  2) Check that the displayed specification code has changed from [4*4] to [444].
  - ★ If specification code [444] is not displayed, the controller wiring harness or the controller unit may be defective.
  - ★ Even if this code is turned off, the setting is effective.



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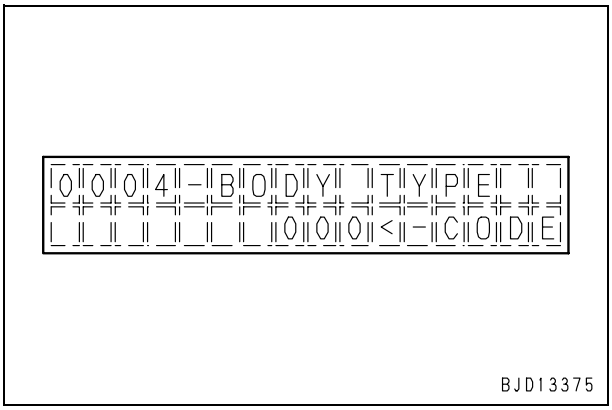
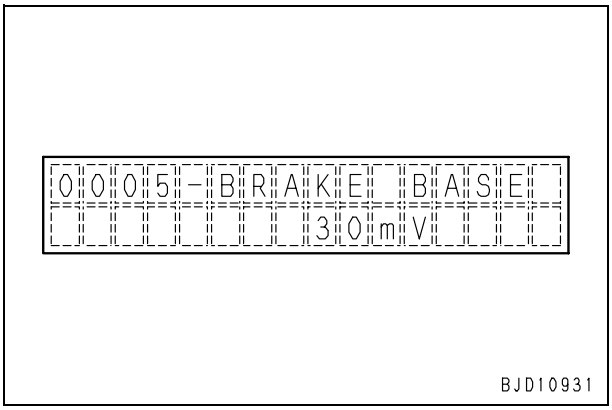
[3] **0004**: Machine specification set
- This code is used to have the machine specification recognized by the controllers which compose the system.
- The machine specification code is displayed on the lower line.
- Adjustment method:
  - ★ Since this code is reset when “Steering and transmission controller specification set” is executed, adjust it after that.
  1) Select the code of the machine specification by setting shift up switch (6).
  2) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.

  ⚠ If the machine specification is different from the setting in the controller, the machine may move abnormally or an error may take place.
  Accordingly, be sure to match the setting to the machine specification.
  - ★ Even if this code is turned off, the setting is effective.



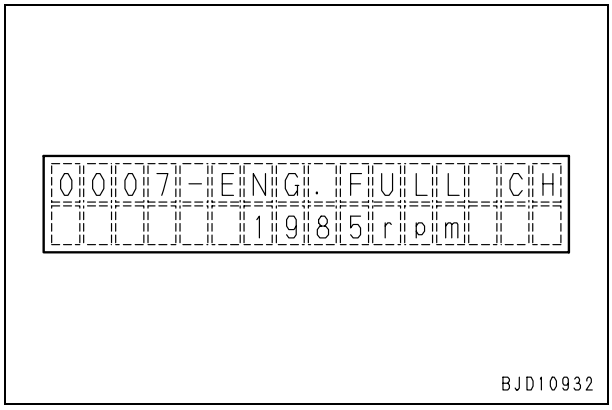
No.	Specifications
000	Standard
010	Pitch specification

[4] **0005**: Brake potentiometer zero point adjustment
- This code is used to adjust the zero point of the potentiometer of the brake pedal.
- The deviation from the standard is displayed by voltage on the lower line (Display range: –2500 – 2500).
- Adjustment method:
  With the brake pedal released, set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  - ★ Even if the adjustment is carried out, the display of the lower line does not change.
  - ★ Even if this code is turned off, the setting is effective.
  - ★ This code is not for the adjustment of the braking performance, etc..

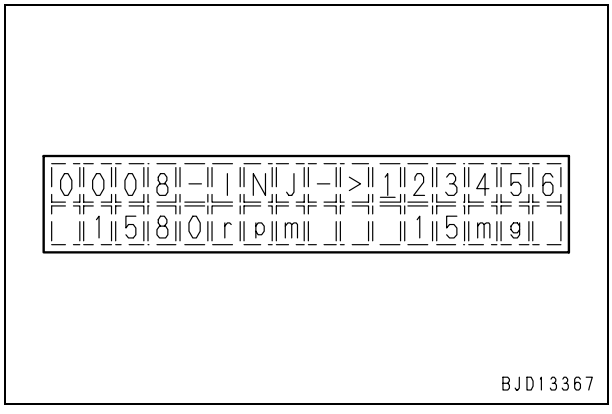


[5] **0007**: Engine deceleration-cut mode
- This code is used to stop the auto-deceleration function of the engine and check the high idle speed of the engine unit.
- The engine speed is displayed on the lower line (Display range: 0 – 3000).
- How to use:

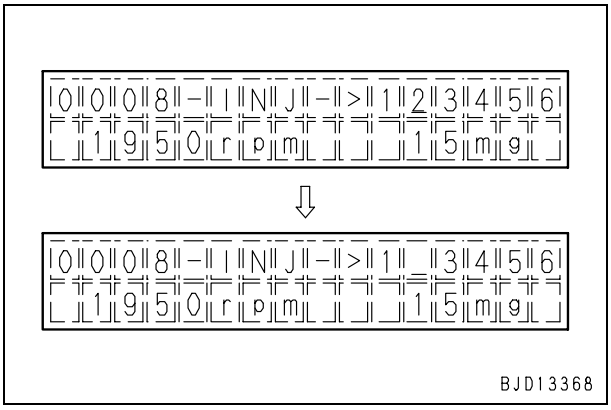
  While this code is displayed, its function is enabled and the auto-deceleration function is stopped.
  - ★ If this code is turned off, its function is disabled.

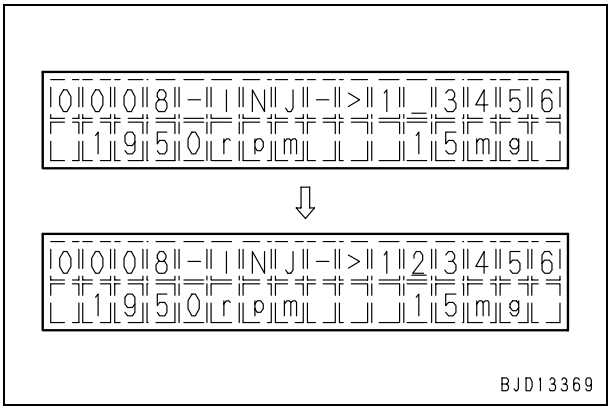


[6] **0008**: Common rail reduced cylinder mode
- ★ When the engine common rail system seems to be defective, this code is used to stop injecting fuel into 1 or more cylinders (reduce the number of effective cylinders) while the engine is running and find out a defective cylinder from the change of the engine speed.
- ★ Since this function diagnoses a failure based on the difference of the engine speed in the reduced cylinder mode operation from that in the normal mode operation, use this function while the engine is running.
- The engine speed and fuel injection rate are displayed on the lower line (Display range: 0 – 3000, 0 – 1000).
- How to use:
  Select the cylinders to be turned off for the reduced cylinder mode operation by operating information switch (5) and buzzer cancel switch (4).
  Use this method to turn on the selected cylinders again, too.
  - [>]: Moves cursor rightward.
  - [<]: Moves cursor leftward.
  - [◇]: Executes or stops reduced cylinder mode operation.



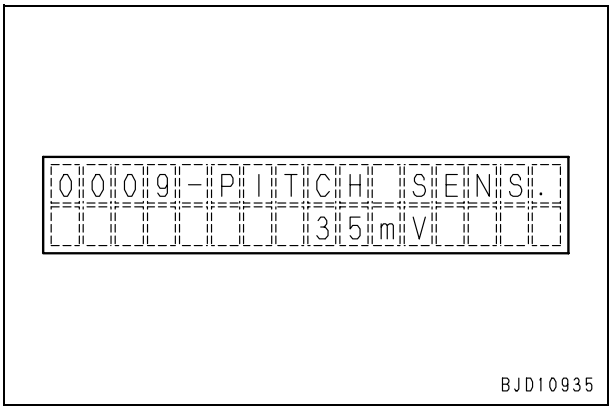
★ The below figure is an example that No. 2 cylinder is turned off for reduced cylinder mode operation and turned on again (The cylinder No. lamp is turned off in the reduced cylinder mode operation and on in the normal mode operation).



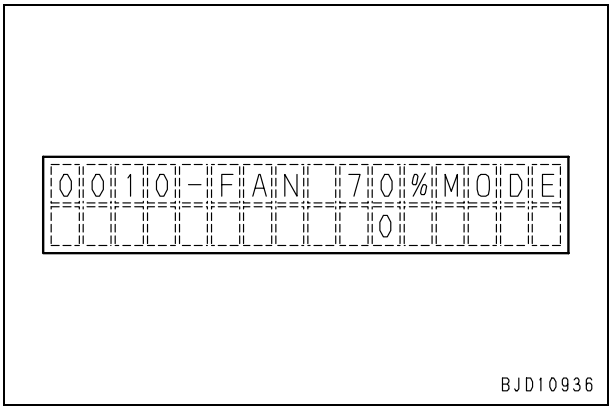


★ Only one or more cylinders can be turned off for the reduced cylinder mode operation.
★ If this code is turned off, its function is disabled.

[7] **0009**: Pitch angle sensor initial set
- This code is used to correct the installation error of the pitch angle sensor by adjusting its zero point.
- The deviation from the standard neutral position is displayed by voltage on the lower line (Display range: –2500 – 2500).
- Adjustment method:
  Stop the machine on level ground, then set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  ★ Even if the adjustment is carried out, the display of the lower line does not change.
  ★ Even if this code is turned off, the setting is effective.

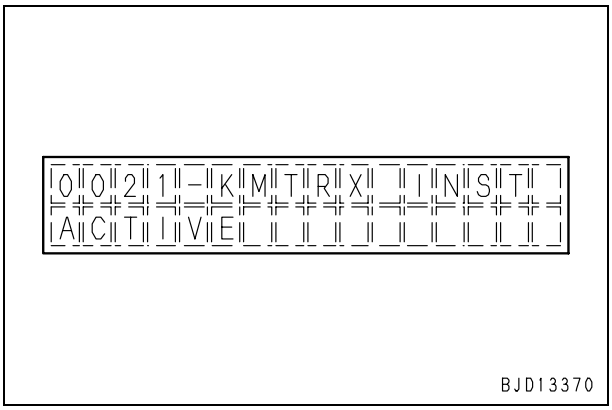


[8] **0010**: Fan 70% speed mode
- This code forcedly sets the speed of cooling fan at approximately 70% of the maximum speed.
- The adjustment data is displayed on the lower line.
- How to use:
  The function is effective with this code displayed to control the speed of cooling fan to approximately 70% of the maximum speed.
  ★ If this code is turned off, its function is disabled.

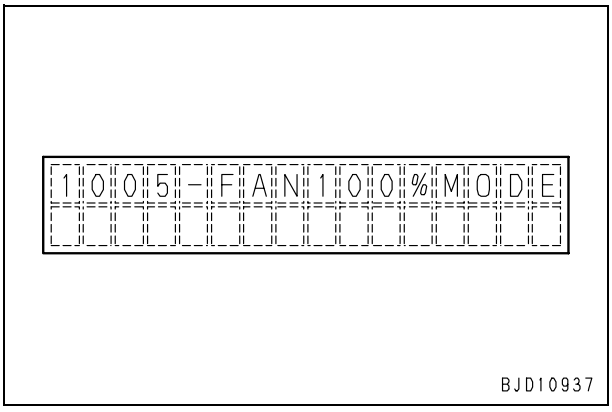


[9] **0021**: KOMTRAX specification set
- This code is used to select the installation setting of KOMTRAX terminal.
  ★ Conduct this setting before the starting operation of KOMTRAX.
- The terminal installation condition is displayed on the lower line.
  - ACTIVE: KOMTRAX is installed.
  - DEACTIVE: KOMTRAX is not installed.
- Setting method:
  1) By operating shift up switch (6) and shift down switch (7), select the installation condition of KOMTRAX terminal.

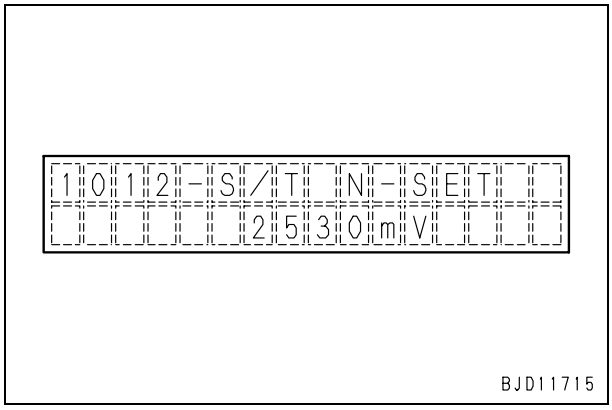
2) After correctly selecting the installation condition of the terminal, set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
★ Even if this code is turned off, the setting is effective.
★ If the controller is changed, be sure to conduct (check) this setting, too.



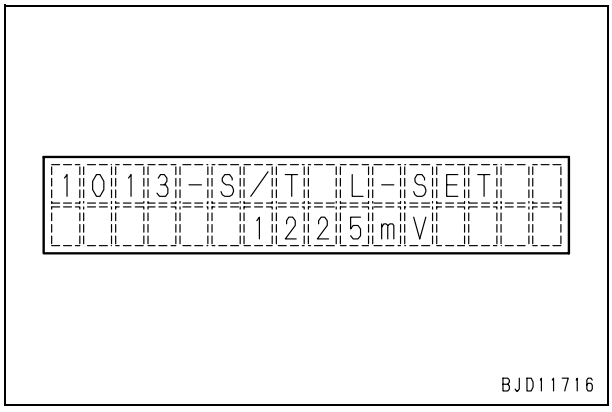
[10] **1005**: Fan 100% speed mode
- This code forcedly sets the speed of cooling fan at approximately 100% of the maximum speed.
- The adjustment data is displayed on the lower line.
- How to use:
  The function is effective with this code displayed to control the speed of cooling fan to approximately 100% of the maximum speed.
  ★ If this code is turned off, its function is disabled.



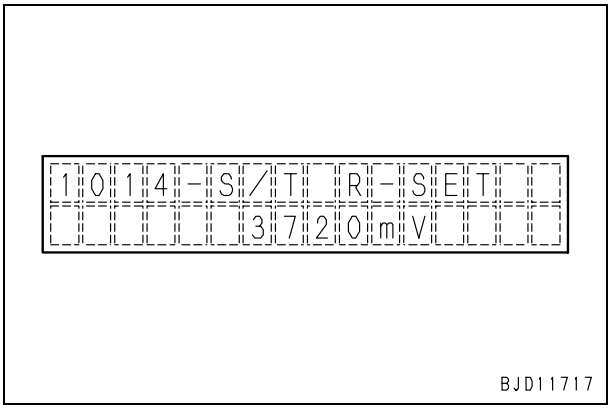
[11] **1012**: Steering control lever neutral set
- This code is used to adjust the steering potentiometer neutral position of the PCCS lever.
- The output signal of the steering potentiometer is displayed by voltage on the lower line (Display range: 0 – 5000).
- Adjustment method:
  1) Shift the PCCS lever in the steering neutral position.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  ★ Even if the adjustment is carried out, the display of the lower line does not change.
  ★ Even if this code is turned off, the setting is effective.
  ★ This code is not for the adjustment of the steering performance, etc..



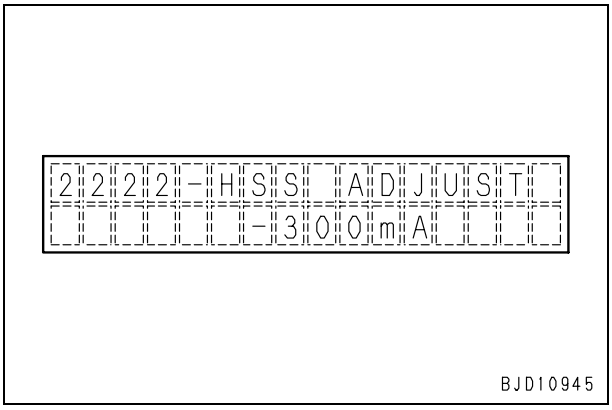
[12] **1013**: Steering control lever left set
- This code is used to adjust the leftmost steering potentiometer position of the PCCS lever.
- The output signal of the steering potentiometer is displayed by voltage on the lower line (Display range: 0 – 5000).
- Adjustment method:
  1) Shift the PCCS lever to the steering left stroke end.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  ★ Even if the adjustment is carried out, the display of the lower line does not change.
  ★ Even if this code is turned off, the setting is effective.
  ★ This code is not for the adjustment of the steering performance, etc..



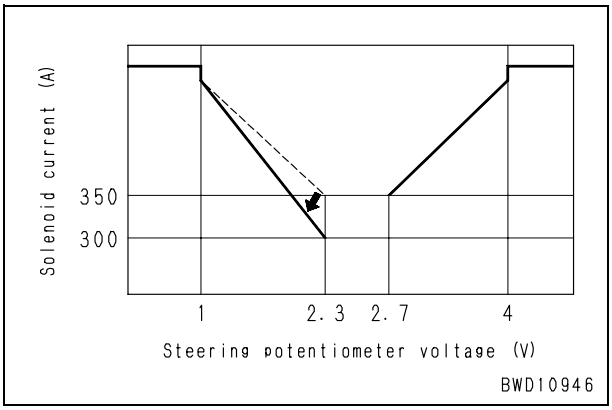
[13] **1014**: Steering control lever right set
- This code is used to adjust the rightmost steering potentiometer position of the PCCS lever.
- The output signal of the steering potentiometer is displayed by voltage on the lower line (Display range: 0 – 5000).
- Adjustment method:
  1) Shift the PCCS lever to the steering right stroke end.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  - ★ Even if this code is turned off, the setting is effective.
  - ★ This code is not for the adjustment of the steering performance, etc..
  - ★ Even if the adjustment is carried out, the display of the lower line does not change.



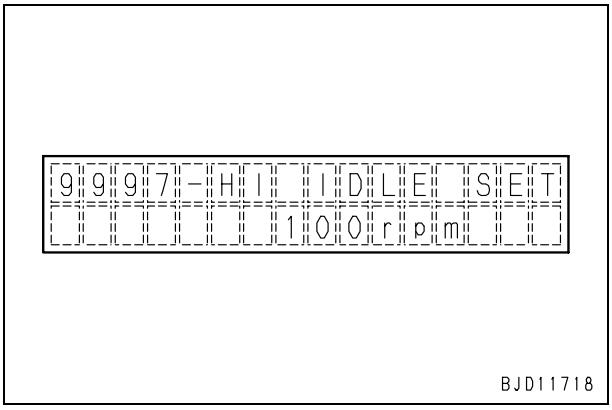
[14] **2222**: HSS lever initial current set
- When the steering start feeling is different by the steering direction, this code is used to adjust the turning radius at the start of steering.
- The current to drive the HSS EPC solenoid is displayed on the lower line [Display range: –350 (Left end) – 0 – 350 (Right end)].
- Adjustment method:
  1) Gradually shifting the PCCS lever to the left or right, display the current to be set and keep it.
     - If the lever is shifted to the left, the current becomes negative.
     - If the lever is shifted to the right, the current becomes positive.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.



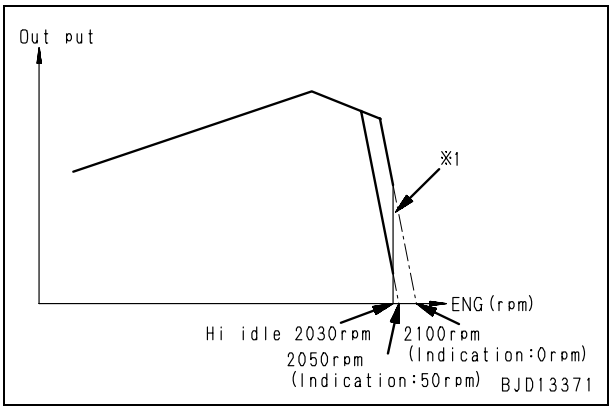
- ★ As the set current is increased in the positive or negative direction, the turning radius at the start of steering is decreased (the machine turns more quickly).
- ★ The below figure is an example that the set current for steering to the left is reduced to increase the turning radius.
- ★ Even if this code is turned off, the setting is effective.



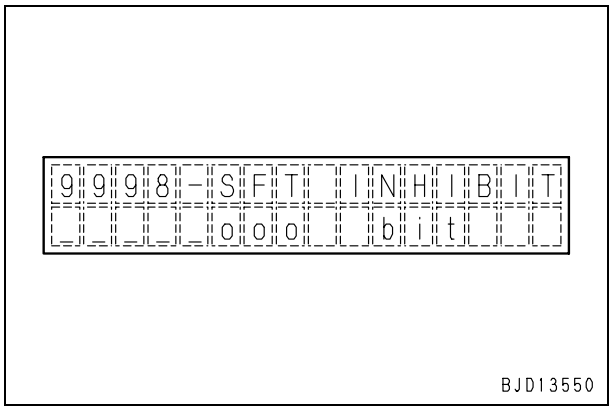
[15] **9997**: High idle limit mode
- This code is used to limit the high idle speed.
- The limited speed (0 – 400) is displayed on the lower line.
- Possible limit range: High idle speed – 1700 rpm
- How to use:
  1) Select a limit speed by setting information switch (5) in the [>] position or [<] position.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the alarm buzzer sounds.
  ★ If the high idle speed is limited, the engine speed is not raised to the normal high idle level even if the fuel control dial is controlled so.
  ★ Even if this code is turned off, the setting is effective.



- In order to reduce the noise, the high idle speed of this machine is always controlled to stay below 2030 rpm.
  Therefore, note that the high idle speed may not change according to the speed limit set while using this function.
  *1: When 50 rpm is inputted as the speed limit, the engine output is restricted although the high idle speed may not seem to change.



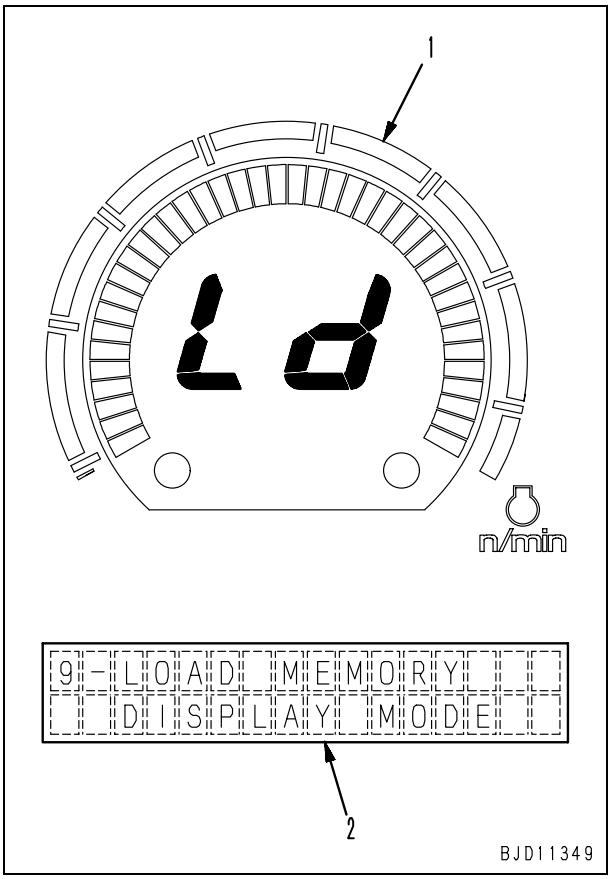
[16] **9998**: Gear speed limit mode
- This code is used to restrict the shift to the 3rd gear.
- The usable gear speeds are displayed by bits on the lower line (in the order of the 3rd, 2nd and 1st from the left).
- How to use:
  Restrict or allow the use of the highest gear speed by operating information switch (5) and buzzer cancel switch (4).
  - [>]: Restricts a shift to 3rd gear speed.
  - [<]: Does not restrict shift to 3rd gear speed.
  - [◇]: Determine the setting.
  - Display on lower line [o]: Gear speed is effective.
  - Display on lower line [ ]: Gear speed is ineffective.
  ★ If the use of a gear speed is restricted, the transmission is not shifted to that gear speed even if the gear shift up switch is operated.
  ★ Even if this code is turned off, the setting is effective.



9. Load memory display mode (9-LOAD MEMORY DISPLAY MODE)

In this mode, the load on the machine, forward odometer, and reverse odometer can be checked.

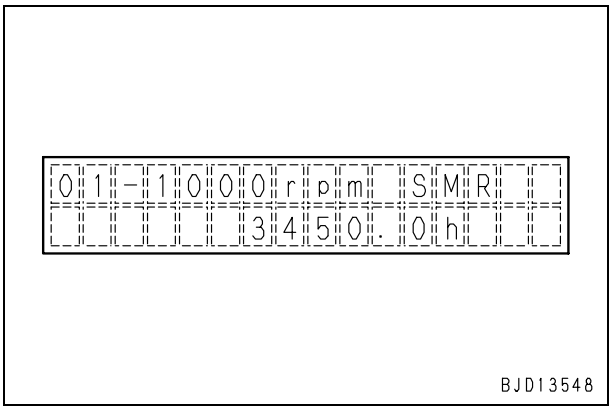
1) Selecting and implementing a mode
   1] Select “Load memory display mode” on the mode selection screen.
      ★ If the mode is selected, code (Ld) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   2] Display the information screen by operating buzzer cancel switch (4).
      - [◇]: Execute mode



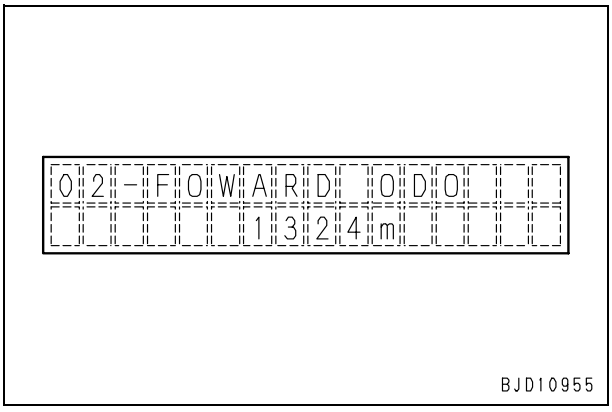
2) Changing information screen
   Change the information screen by operating information switch (5).
   - [>]: Next screen
   - [<]: Previous screen

No.	Displayed information
01	1000 rpm service meter
02	Forward odometer
03	Reverse odometer

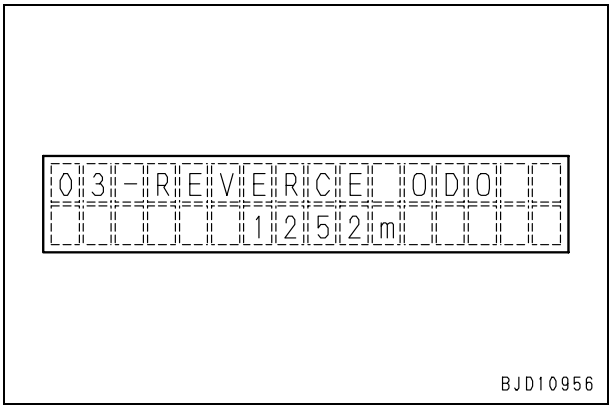
3) Displayed information of 1,000 rpm service meter (01)
   This code is used to display the service meter which integrates the operation hours only while the engine speed is higher than 1,000 rpm.
   ★ The data cannot be reset.



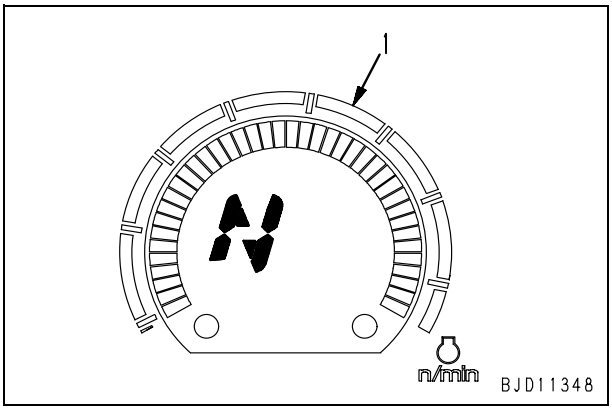
4) Displayed information of forward odometer (02)
   On this screen, the integrated forward travel distance of the machine is displayed.
   ★ The data cannot be reset.



5) Displayed information of reverse odometer (03)
On this screen, the integrated reverse travel distance of the machine is displayed.
★ The data cannot be reset.

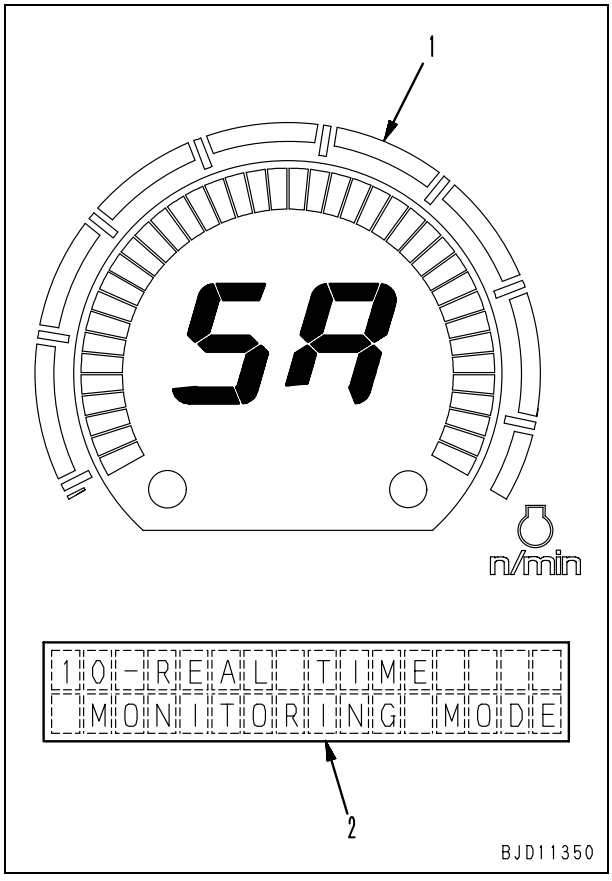


6) When operating machine in the load saving display mode
If the parking brake lever is set in the "free" position, gear speed display section (1) returns to the normal display and the machine can be operated normally.
★ At this time, even if the shift up or shift down switch is pressed with the PCCS lever in the neutral position, the shift cannot be changed.
(The displayed number is the code of load saving display mode.)
To change the shift, shift the PCCS lever to the "forward" or "reverse" position and press the shift up or shift down switch while the machine is traveling.
★ To select another screen, return the parking brake lever to the "lock" position temporarily and perform the necessary operation.

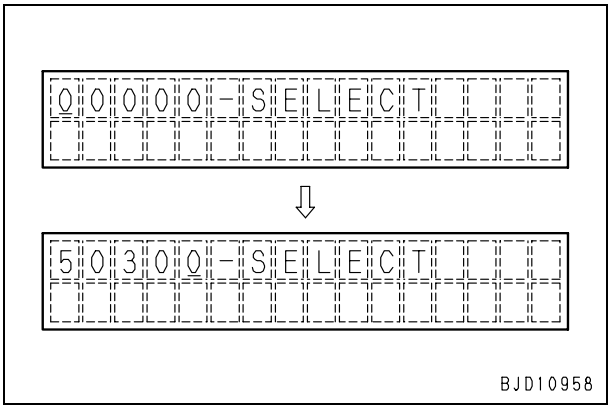


10. Real-time monitoring mode (10-REAL TIME MONITORING MODE)
In this mode, the speeds, oil pressures, temperatures, currents, voltages, etc. can be monitored by using the signals from sensors, switches, and solenoids installed to various parts of the machine.
★ This mode is used to monitor the items one by one. When monitoring two items simultaneously, use the "Dual display monitoring mode".

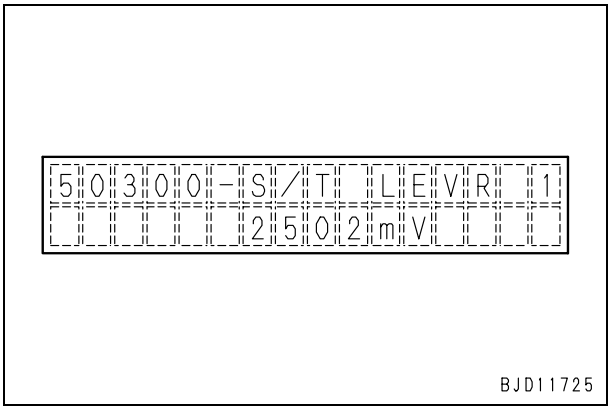
1) Selecting and implementing a mode
1] Select the "Real time monitoring mode" on the mode selection screen.
★ If the mode is selected, code (5R) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
2] Display the monitoring code input screen by operating buzzer cancel switch (4).
● [◇]: Select and decide mode.



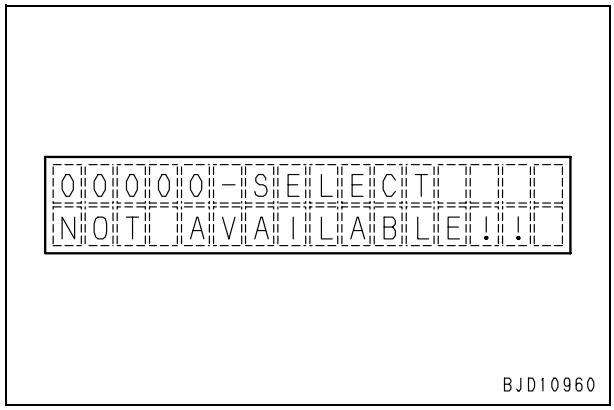
2) Selecting and entering monitored items
   1] On the code input screen, input the 5-digits code of the item to be monitored by operating information switch (5), shift up switch (6), and shift down switch (7).
      - [>]: Cursor moves rightward.
      - [<]: Cursor moves leftward.
      - [UP]: Number increases.
      - [DOWN]: Number decreases.



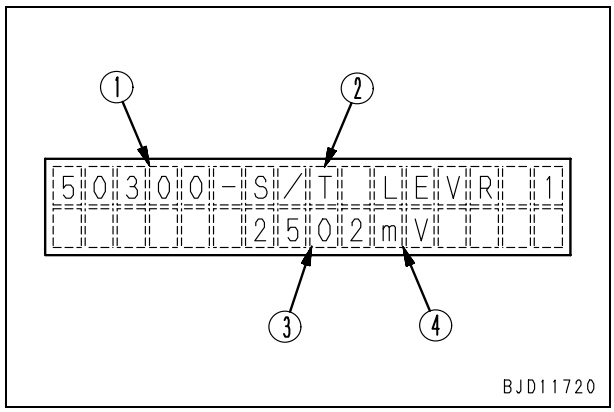
   2] After inputting the code, operate buzzer cancel switch (4) to display the monitoring screen.
      - [◇]: Determine input.
      - ★ If the input code is correct, the monitoring screen shown below appears.



   ★ If the input code is not correct, the code input screen appears again after the screen shown below.

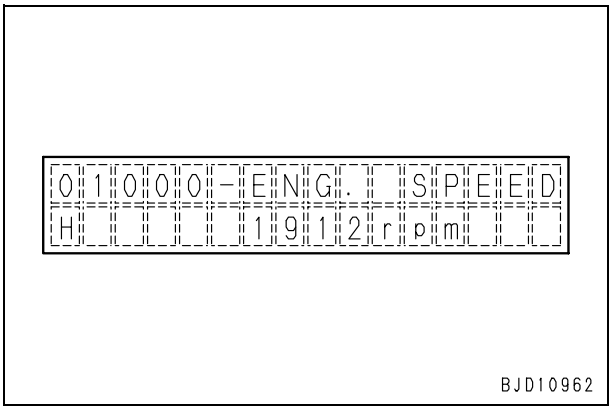


3) Displayed information on monitoring screen (Below figure shows examples)
   1] : Code
   2] : Monitored item
   3] : Information
   4] : Unit (Not displayed for some items)
   ★ For the details, see the “Monitoring mode table”.

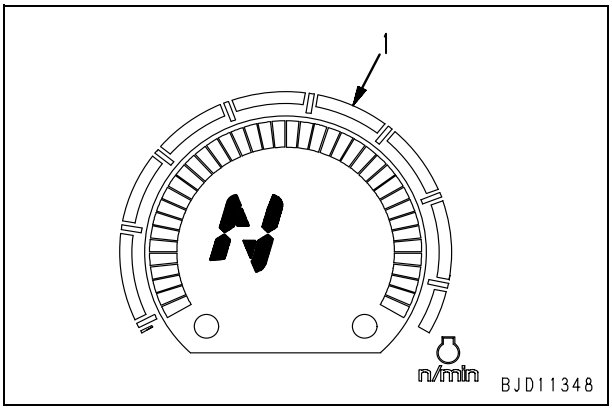


4) Function of holding monitoring information
   If an displayed information such as the engine speed is not stabilized and cannot be read easily in the monitoring mode, it can be held and released by operating buzzer cancel switch (4).
   - [◇]: Hold and release.

★ While the monitored item is held, the letter “H” is displayed at the left end of the lower line.

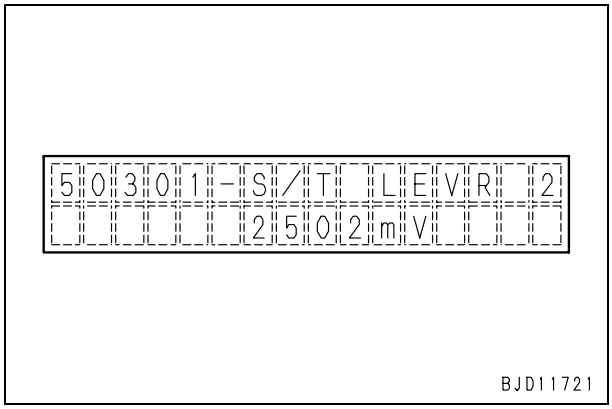


5) When operating machine with monitoring display
If the parking brake lever is set in the “free” position, gear speed display section (1) returns to the normal display and the machine can be operated normally.
★ At this time, even if the shift up or shift down switch is pressed with the PCCS lever in the neutral position, the shift cannot be changed.
(The displayed number is the code of monitoring mode.)
To change the shift, shift the PCCS lever to the “forward” or “reverse” position and press the shift up or shift down switch while the machine is traveling.
★ To select another screen, return the parking brake lever to the “free” position temporarily and perform the necessary operation.



6) Changing monitored items (Limited function)
Once the monitoring screen is selected in step 2), the monitored item can be changed by operating only information switch (5) without inputting the code again.
- [>]: Next code
- [<]: Previous code

★ This function is limited to the numbers marked with ★ in the “Monitoring mode table”.
★ Note that this operation is not accepted while the parking brake lever is in the “free” position.



Monitoring mode table

No.	Code	Monitored item		Unit	Display range
1	**00201**	**ENG M ID**	Engine controller model code	Character	
★2	**01000**	**ENG REV**	Engine speed	rpm	0 – 3000
★3	**03000**	**FUEL DIAL**	Voltage of fuel control dial	mV	0 – 5000
★4	**03200**	**BATTERY**	Battery voltage	mV	0 – 30000
5	**03201**	**S/T ACC**	ACC input voltage of steering controller	mV	0 – 30000
6	**03202**	**S/T PWR2**	Load power source voltage of steering controller	mV	0 – 30000
7	**03203**	**E-ECM PW**	Power source voltage of engine controller	mV	0 – 30000
8	**03207**	**S/T PWR1**	Constant power source voltage of steering controller	mV	0 – 30000
★9	**04104**	**COOLANT TP**	Coolant temperature	°C	–40 – 210
10	**04105**	**COOLANT TP**	Voltage of coolant temperature sensor	mV	0 – 5000
★11	**04200**	**FUEL SENS**	Voltage of fuel level sensor	mV	0 – 5000
★12	**04401**	**HYD.TEMP.**	Hydraulic oil temperature	°C	0 – 150
13	**10000**	**FAN REV O.**	Command speed of cooling fan	rpm	0 – 2000
14	**10500**	**S/T 5V PW1**	5V power source voltage of steering controller sensor	mV	0 – 30000
15	**10700**	**S/T 24V PW**	24V power source voltage of steering controller sensor	mV	0 – 30000
16	**01300**	**TVC SOL F/B**	Output FB current of TVC solenoid	mA	0 – 1000
17	**01301**	**TVC SOL OUT**	Output command current of TVC solenoid	mA	0 – 1000
18	**14300**	**FUEL SUMP**	Fuel consumption amount	L	0 – 60000
19	**18500**	**BOOST TMP**	Boost temperature	°C	–50 – 200
20	**18501**	**BOOST TMP**	Voltage of boost temperature sensor	mV	0 – 5000
21	**18600**	**INJECT CMD**	Command fuel injection rate	mg/st	0 – 1000
22	**18700**	**ENG TORQUE**	Engine output torque	Nm	–2400 – 2400
23	**18800**	**ENG WIF**	Water level signal of fuel filter	Bit	(See detailed information)
24	**18900**	**E-ECM TP**	Engine controller inside temperature	°C	–40 – 210
25	**19500**	**ENG MODE**	Engine control mode	Character	
26	**20200**	**MON.PROGRM**	Monitor panel (tachometer module) program No.	Character	
27	**20202**	**S/T.PROGRM**	Steering controller program No.	Character	
28	**20216**	**ENG BLD**	Engine controller program No.1	Character	
29	**20217**	**ENG CAL**	Engine controller program No.2	Character	
★30	**20300**	**KOMTRAX**	KOMTRAX LED display	—	
31	**20400**	**E-ECM SN**	Engine controller serial No.	Character	
★32	**30100**	**T/C TEMP.**	Torque converter oil temperature	°C	0 – 150
★33	**31400**	**T/M OUT**	Transmission speed	rpm	0 – 5000
34	**31520**	**T/M-FILL**	Input state of transmission-related fill switch	Bit	(See detailed information)
35	**31602**	**1st CLUTCH**	Output command current of 1st clutch ECMV	mA	0 – 1000
36	**31603**	**2nd CLUTCH**	Output command current of 2nd clutch ECMV	mA	0 – 1000
37	**31604**	**3rd CLUTCH**	Output command current of 3rd clutch ECMV	mA	0 – 1000

No.	Code	Monitored item		Unit	Display range
38	**31606**	**Rev CLUTCH**	Output command current of reverse clutch ECMV	mA	0 – 1000
39	**31608**	**Frd CLUTCH**	Output command current of forward clutch ECMV	mA	0 – 1000
★40	**31612**	**1 CLUTCH F**	Output FB current of 1st clutch ECMV	mA	0 – 1000
★41	**31613**	**2 CLUTCH F**	Output FB current of 2nd clutch ECMV	mA	0 – 1000
★42	**31614**	**3 CLUTCH F**	Output FB current of 3rd clutch ECMV	mA	0 – 1000
★43	**31616**	**R CLUTCH F**	Output FB current of reverse clutch ECMV	mA	0 – 1000
★44	**31622**	**F CLUTCH F**	Output FB current of forward clutch ECMV	mA	0 – 1000
45	**31623**	**FAN PUMP.O**	Output command current of cooling fan pump solenoid	mA	0 – 1000
46	**31624**	**FAN PUMP.F**	Output FB current of cooling fan pump solenoid	mA	0 – 1000
★47	**31701**	**DECEL**	Deceleration opening ratio	%	0 – 100
★48	**31703**	**DECEL**	Decelerator potentiometer voltage	mV	0 – 5000
★49	**31706**	**F THROTTLE**	Final accelerator opening angle	%	0 – 100
★50	**32900**	**BODY ANGLE**	Machine pitch angle	°	–30 – 30
51	**36200**	**PRESS CMD**	Command pressure of common rail	MPa	0 – 400
52	**36300**	**INJECT CMD**	Fuel injection timing	CA	–180 – 180
★53	**36400**	**RAIL PR**	Common rail pressure	MPa	0 – 400
54	**36401**	**RAIL PR**	Voltage of common rail pressure sensor	mV	0 – 5000
★55	**36500**	**BOOST PRS**	Boost pressure	kPa	–999.9 – 999.9
56	**36501**	**BOOST PRS**	Voltage of boost pressure sensor	mV	0 – 5000
★57	**36700**	**ENG TORQUE**	Converted torque of engine	%	0 – 100
58	**37301**	**FUEL RATE**	Instantaneous fuel consumption	L/h	0 – 999.9
59	**37400**	**AMB PRESS**	Atmospheric pressure	kPa	–999.9 – 999.9
60	**37401**	**AMB PRESS**	Atmospheric pressure sensor voltage	mV	0 – 5000
★61	**40001**	**VEHICLE SP**	Travel speed (theoretical value)	km/h	0 – 100
62	**40905**	**T/M-SW1**	Transmission-related controller input signal 1	Bit	(See detailed information)
63	**40906**	**T/M-SW2**	Transmission-related controller input signal 2	Bit	(See detailed information)
64	**40909**	**T/M SOL.2**	Transmission-related controller output signal 2	Bit	(See detailed information)
65	**40910**	**S/T-SW1**	Steering-related controller input signal 1	Bit	(See detailed information)
66	**40911**	**S/T-SW2**	Steering-related controller input signal 2	Bit	(See detailed information)
67	**40913**	**S/T-SW5**	Steering-related controller input signal 5	Bit	(See detailed information)
68	**40914**	**S/T SOL.1**	Output signal of steering controller	Bit	(See detailed information)
★69	**50200**	**T/M LEVR 1**	Voltage of forward and reverse potentiometer 1	mV	0 – 5000
★70	**50201**	**T/M LEVR 2**	Voltage of forward and reverse potentiometer 2	mV	0 – 5000
★71	**50300**	**S/T LEVR 1**	Voltage of steering potentiometer 1	mV	0 – 5000
★72	**50301**	**S/T LEVR 2**	Voltage of steering potentiometer 2	mV	0 – 5000
★73	**50400**	**BRAKE PEDL**	Voltage of brake potentiometer	mV	0 – 5000
★74	**50600**	**HSS L.H.F**	Output FB current of left HSS solenoid	mA	0 – 1000
★75	**50601**	**HSS R.H.F**	Output FB current of right HSS solenoid	mA	0 – 1000
76	**50602**	**HSS L.H.O**	Output command current of left HSS solenoid	mA	0 – 1000
77	**50603**	**HSS R.H.O**	Output command current of right HSS solenoid	mA	0 – 1000

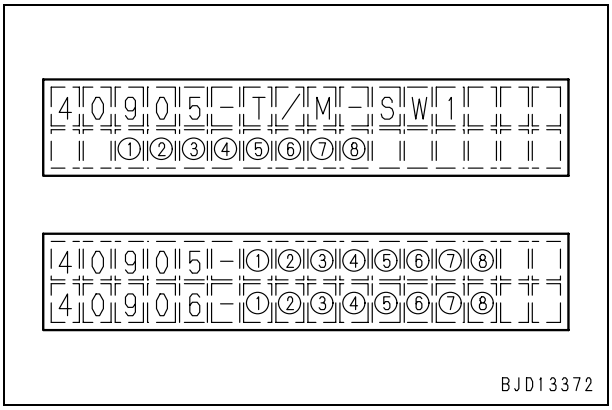
No.	Code	Monitored item		Unit	Display range
★78	**50900**	**N-SAFETY**	Drive voltage of neutral safety relay	mV	0 – 30000
79	**51000**	**ENG REG**	3rd throttle command speed	rpm	0 – 3000
80	**51100**	**FUEL DIAL**	Command speed of fuel dial	rpm	0 – 3000
★81	**60000**	**TRACTION**	Traction force (theoretical value)	W	0 – 1
82	**60100**	**BODY ANGEL**	Machine pitch angle sensor voltage	mV	0 – 5000
83	**60600**	**BR HOLD**	Drive voltage of battery relay	mV	0 – 30000
84	**60700**	**S/T MODE**	Steering state code	Character	
85	**60800**	**FILL MODE**	Variable for setting fill condition	Character	
86	**60909**	**MOD.MODE**	Variable for setting modulation condition	Character	
87	**70000**	**CHG.P.MODE**	Variable for setting condition of gear shift point	Character	
88	**70200**	**T/M OUT**	Transmission speed sensor voltage	mV	0 – 5000
89	**70300**	**B.KNOB SW**	Work equipment-related controller input signal	Bit	(See detailed information)
90	**70304**	**T/M SOL.1**	Work equipment-related controller output signal	Bit	(See detailed information)
91	**70400**	**BACK ALARM**	Drive voltage of backup alarm relay	mV	0 – 30000

The numbers marked with ★ can be displayed in order by setting the information switch in the “>” or “<” position.

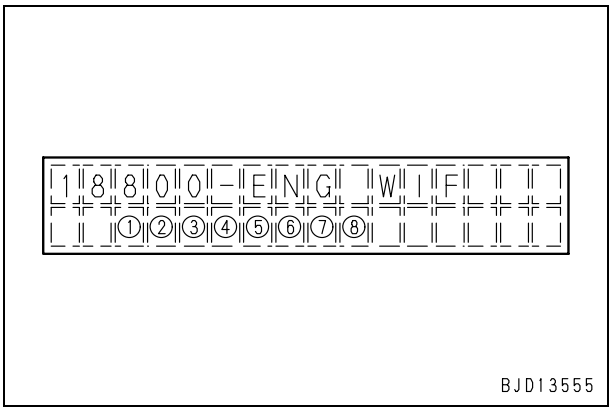
Detailed information on bit display codes

Display of bit information:

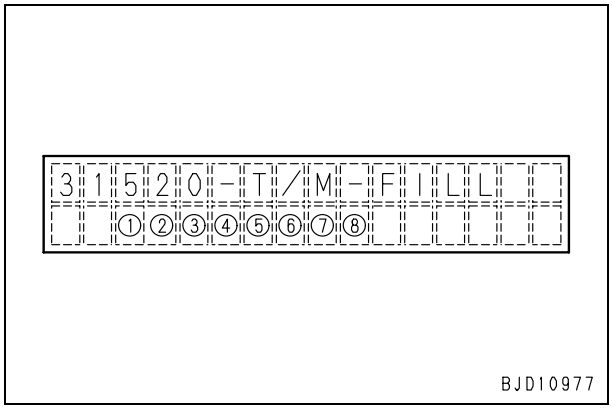
★ The display position of the bit information in the “Real-time monitoring mode (Display of only 1 item)” is different from that in the “Dual display monitoring mode (Simultaneous display of 2 items)”.
★ The bit information is displayed by [_] for OFF and [o] for ON in the places from 1 to 8.
★ The state of each item shown in this section is the condition for turning on the bit.



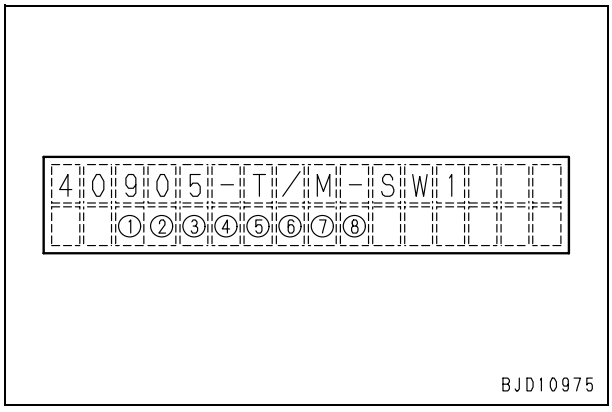
18800:
Water level signal of fuel filter
1: Water level in fuel filter: When detecting
2: (Unused)
3: (Unused)
4: (Unused)
5: (Unused)
6: (Unused)
7: (Unused)
8: (Unused)



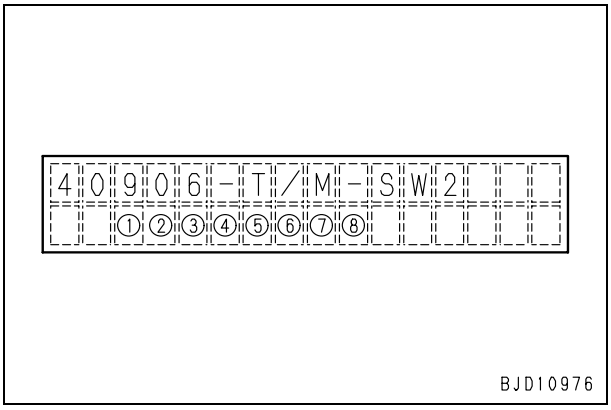
31520:
Input state of transmission-related fill switch
1: Forward clutch fill switch: ON
2: Reverse clutch fill switch: ON
3: 1st clutch fill switch: ON
4: 2nd clutch fill switch: ON
5: 3rd clutch fill switch: ON
6: (Unused)
7: (Unused)
8: (Unused)



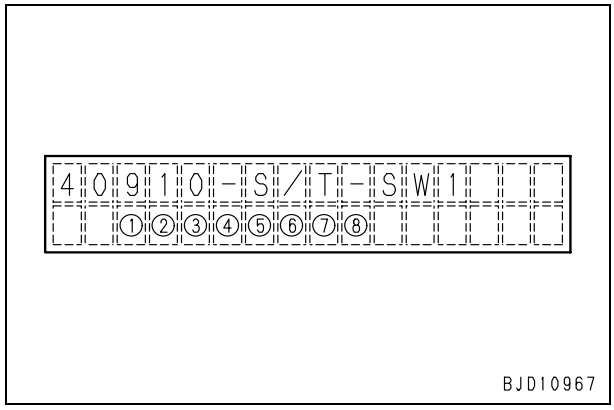
40905:
Transmission-related controller input signal 1
1: Shift up switch: OFF
2: Shift up switch: ON
3: Shift down switch: OFF
4: Shift down switch: ON
5: (Unused)
6: (Unused)
7: (Unused)
8: (Unused)



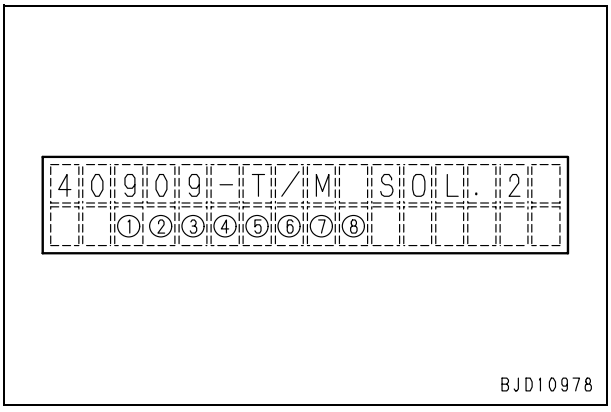
40906:
Transmission-related controller input signal 2
1: Automatic shift down switch: ON
2: (Unused)
3. Fan speed selecting switch: CLN position
4: (Unused)
5: (Unused)
6: (Unused)
7: (Unused)
8: (Unused)



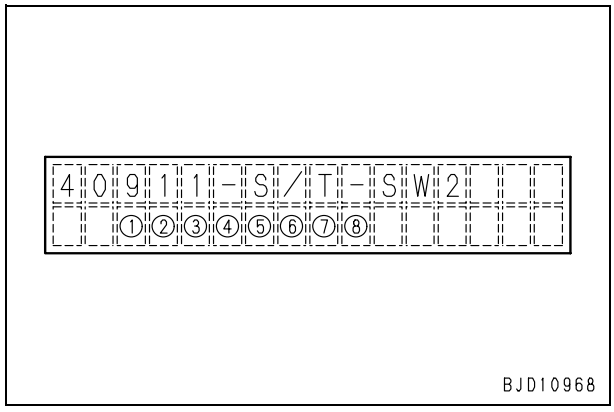
40910:
Steering-related controller input signal 1
1: (Unused)
2: (Unused)
3: (Unused)
4: (Unused)
5: Parking brake lever switch: FREE
6: Parking brake lever switch: LOCK
7: (Unused)
8: (Unused)



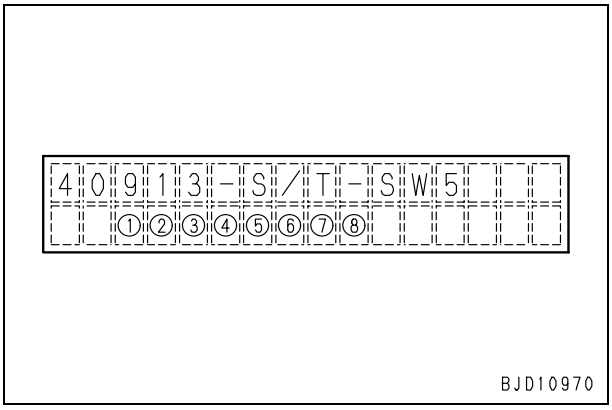
40909:
Transmission-related controller output signal 2
1: (Unused)
2: (Unused)
3: (Unused)
4: Back-up alarm relay: ON
5: Neutral safety relay: ON
6: (Unused)
7: (Unused)
8: (Unused)



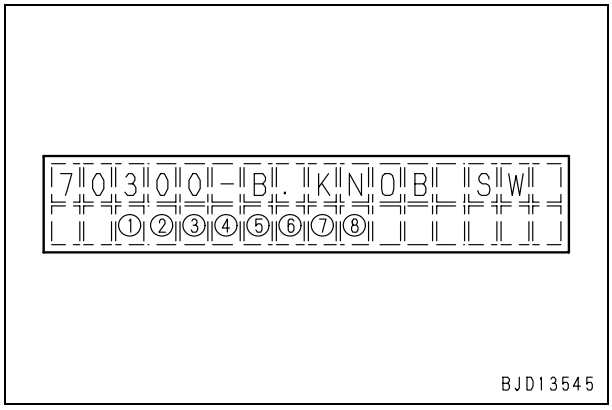
40911:
Steering-related controller input signal 2
1: Buzzer cancel switch: At ■
2: Buzzer cancel switch: At ◇
3: Information switch: At >
4: Information switch: At <
5: Service switch: ON
6: (Unused)
7: (Unused)
8: (Unused)



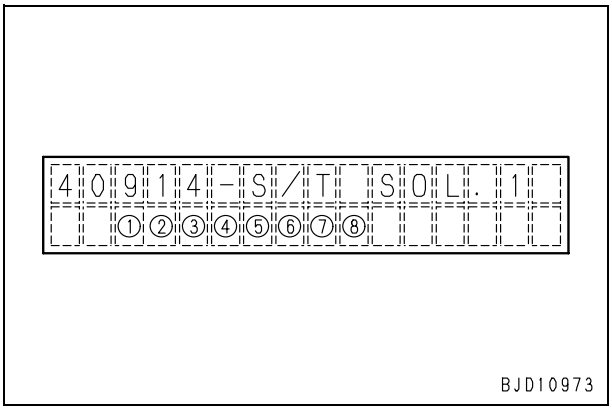
40913:
Steering-related controller input signal 5
1: ACC signal: ON
2: (Unused)
3: R signal: ON
4: (Unused)
5: (Unused)
6: (Unused)
7: (Unused)
8: (Unused)



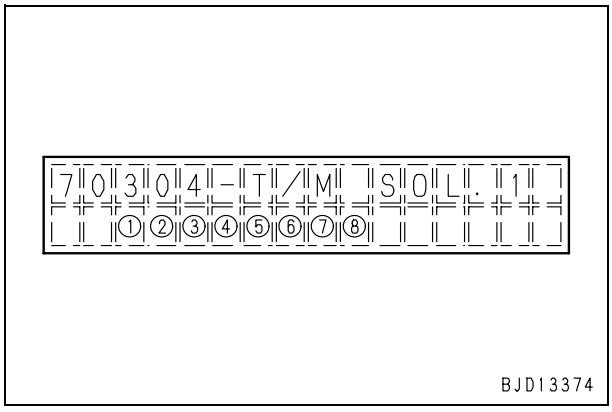
70300:
Work equipment-related controller input signal
1: (Unused)
2: (Unused)
3: Pitch control switch: OFF
4: Pitch control switch: ON
5: (Unused)
6: (Unused)
7: (Unused)
8: (Unused)



40914:
Steering-related controller output signal
1: (Unused)
2: (Unused)
3: Fan reverse solenoid: ON
4: (Unused)
5: Battery relay drive: ON
6: (Unused)
7: (Unused)
8: (Unused)



70304:
Work equipment-related controller output signal
1: (Unused)
2: Work equipment pitch control solenoid: ON
3: (Unused)
4: (Unused)
5: (Unused)
6: (Unused)
7: (Unused)
8: (Unused)

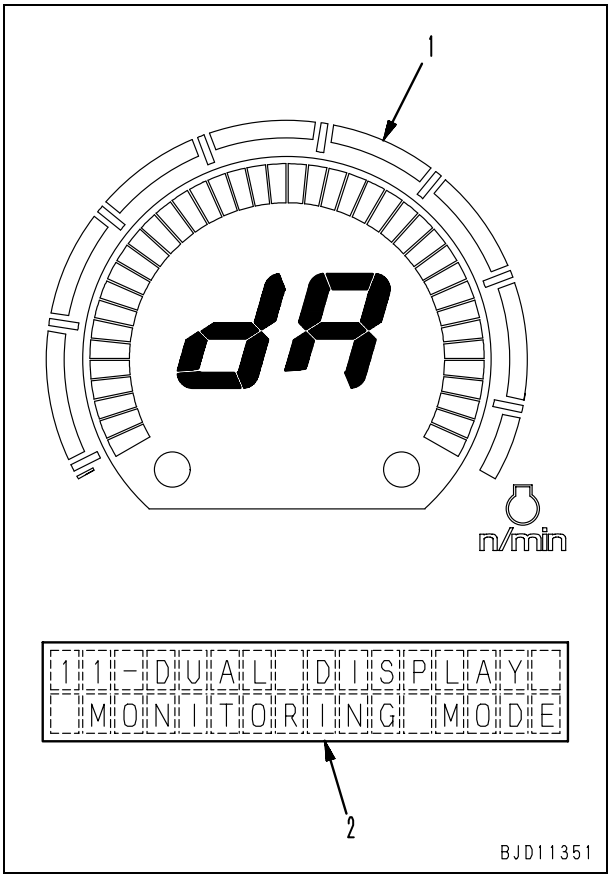


11. Dual display monitoring mode (11-DUAL DISPLAY MONITORING MODE)

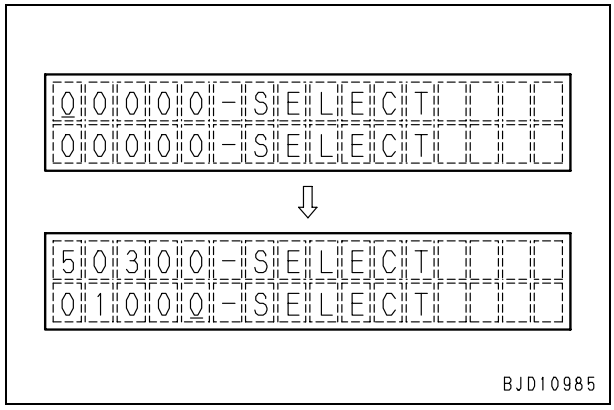
In this mode, 2 monitored items can be displayed simultaneously.

★ Note that only codes and monitoring information are displayed in this mode since the available display columns are limited. (Check item names and units cannot be displayed.)

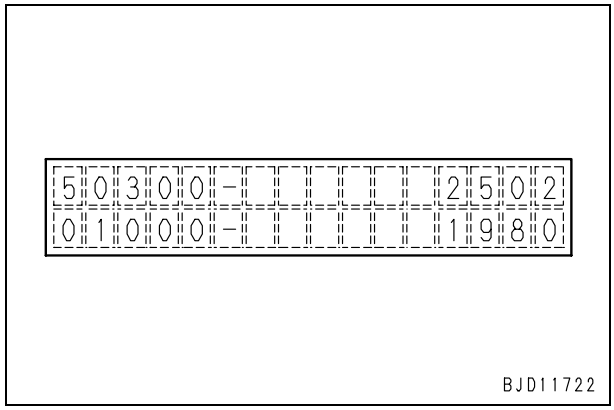
1) Selecting and implementing a mode
   1] Select the “Dual display monitoring mode” on the mode selection screen.
      ★ If the mode is selected, code (dR) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   2] Display the monitoring code input screen by operating buzzer cancel switch (4).
      ● [◇]: Execute mode



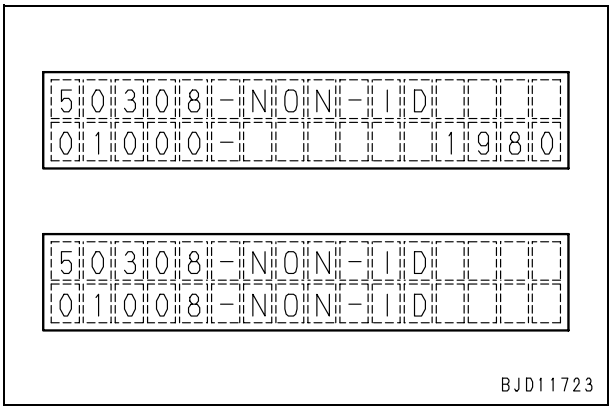
2) Selecting and entering monitored items
   1] On the code input screen, input the 5-digits codes of the items to be monitored by operating information switch (5), shift up switch (6), and shift down switch (7).
      ● [>]: Cursor moves rightward.
      ● [<]: Cursor moves leftward.
      ● [UP]: Number increases.
      ● [DOWN]: Number decreases.
   2] After inputting the code, operate buzzer cancel switch (4) to display the monitoring screen.
      ● [◇]: Determine input.



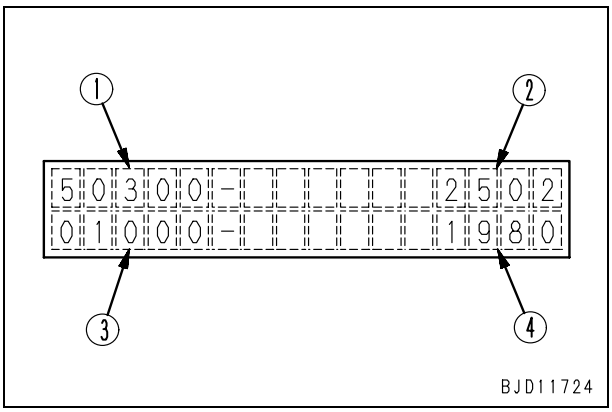
★ If the input codes are correct, the monitoring screen shown below appears.



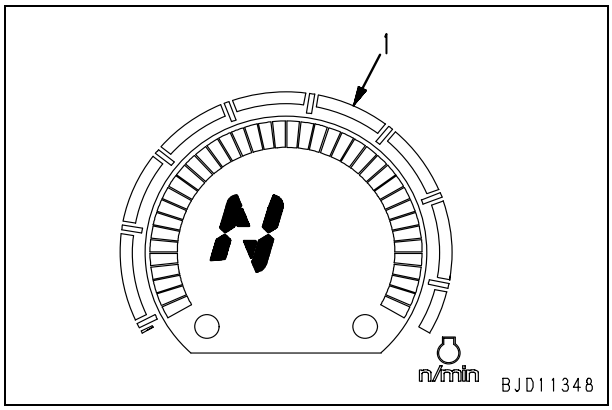
★ If the input codes are not correct, the code input screen appears again after the screen shown below.



3) Displayed information on monitoring screen (Below figure shows examples)
1: Code 1
2: Information 1
3: Code 2
4: Information 2
★ For the details, see the “Monitoring mode table”.



4) In case of operating the machine in monitoring mode, if the parking brake lever is set in the “free” position, gear speed display section (1) returns to the normal display and the machine can be operated normally.
★ At this time, even if the shift up or shift down switch is pressed with the PCCS lever in the neutral position, the shift cannot be changed.
(The displayed number is the code of monitoring mode.)
To change the shift, shift the PCCS lever to the “forward” or “reverse” position and press the shift up or shift down switch while the machine is traveling.
★ To select another screen, return the parking brake lever to the “free” position temporarily and perform the necessary operation.



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00586-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

30 Testing and adjusting

Testing and adjusting, Part 3

Testing and adjusting, Part 3

Handling of voltage circuit of engine controller

1. When disconnecting or connecting a connector, be sure to turn off the starting switch.
   ⚠ **Before connecting the harness connector, be sure to completely remove sand, dust, water, etc., from inside of controller side connector.**

2. Do not start the engine with T-adapter inserted in or connected to a connector for troubleshooting.
   ★ You may turn the starting switch to the OFF or ON position but must not turn it to the START position.

Adjustment method when controller has been replaced

★ After the machine is assembled or steering and transmission controller is replaced, adjust the system according to the following procedure.

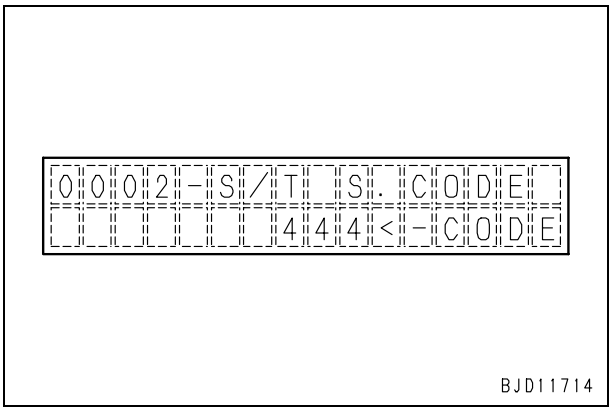
⚠ **If the system is not adjusted, the machine may not operate normally and may move suddenly. Accordingly, be sure to adjust it.**

★ Precautions for replacing a controller:
If a controller is replaced, the memory of the oil and filter maintenance mode is reset. Accordingly, take a record of the next replacement periods of the oils and filters.

★ Precautions for replacing a controller:
When replacing a controller, stop the machine in a safe place and turn the starting switch off.

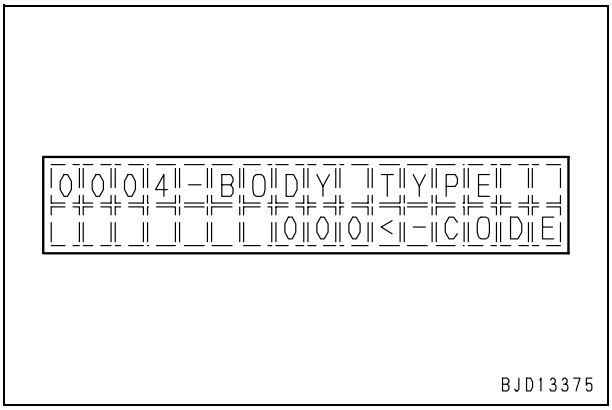
1. Setting system in service mode.
Turn the starting switch ON and set the monitor panel in the “Adjustment mode” of the service mode.

2. Adjusting steering and transmission controller
Select steering and transmission controller specification set (**0002**) and adjust the steering and transmission controller.

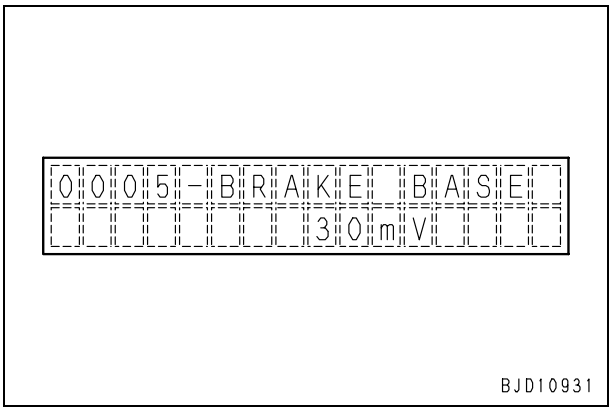


3. Turning power on again.
Turn the starting switch OFF then ON, and set the monitor panel in the “Adjustment mode” of the service mode again.

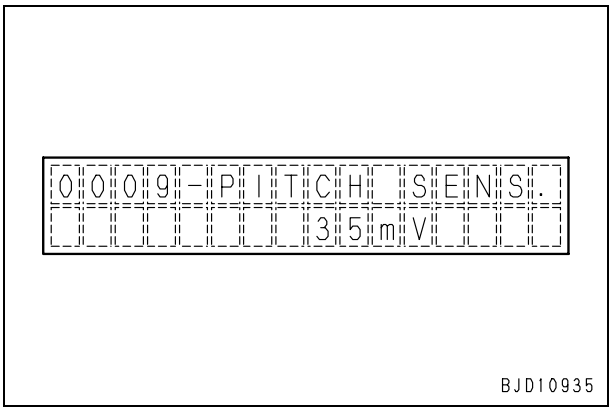
4. **Adjusting machine specification**
   Select Machine specification set (**0004**) and adjust the machine specification.



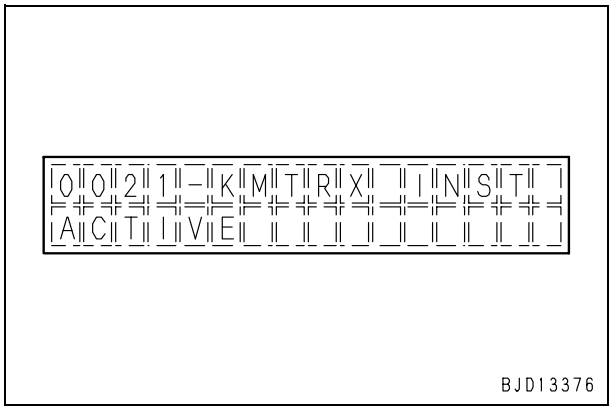
5. **Adjusting brake potentiometer**
   Select brake potentiometer initial set (**0005**) and adjust the brake potentiometer.



6. **Adjusting pitch angle sensor**
   Select the initial setting (**0009**) of the pitch angle sensor and adjust the pitch angle sensor.



7. **Adjusting KOMTRAX specification**
   Select KOMTRAX specification settings (**0021**) and adjust the KOMTRAX specification.



8. **Turning power on again.**
   Turn the starting switch OFF then ON.

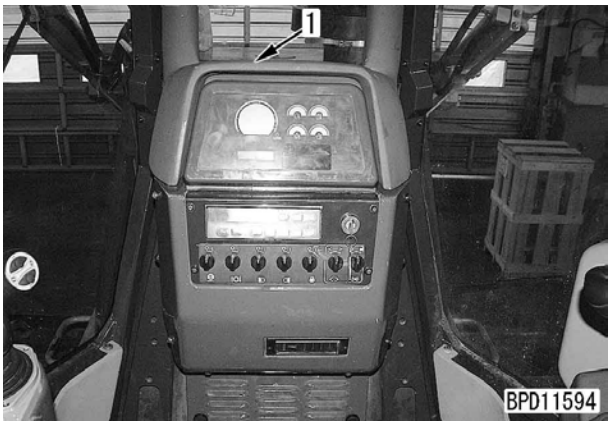
9. **Checking failure codes**
   1) Set the monitor panel in the “Electric system failure code display mode” of the service mode.
   2) Check if any active failure codes exist. If not, delete all the failure codes recorded.
      - ★ If any active failure codes exist, eliminate the cause of the incident by troubleshooting, then carry out steps 6 and 7 again.
      - ★ Precautions after replacing controller:
        If any controller is replaced, the service meter in the oil and filter maintenance mode is reset to 0.
        As a result, the replacement period displayed on the monitor panel may be different from the actual operating hours. To solve this problem, determine the first replacement periods of the oils and filters after the replacement of the controller according to the replacement periods recorded before the replacement of the controller.

Preparation work for troubleshooting for electric system

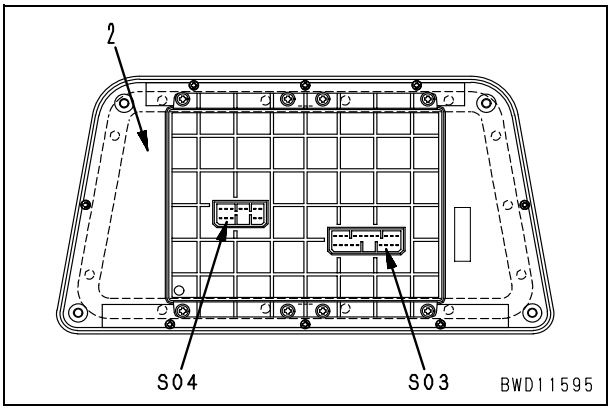
★ When carrying out troubleshooting for an electric circuit related to the monitor panel, engine controller, steering and transmission controller, or KOMTRAX communication modem, expose the related connectors according to the following procedure.

1. Monitor panel

1) Remove cover (1) above the dashboard.

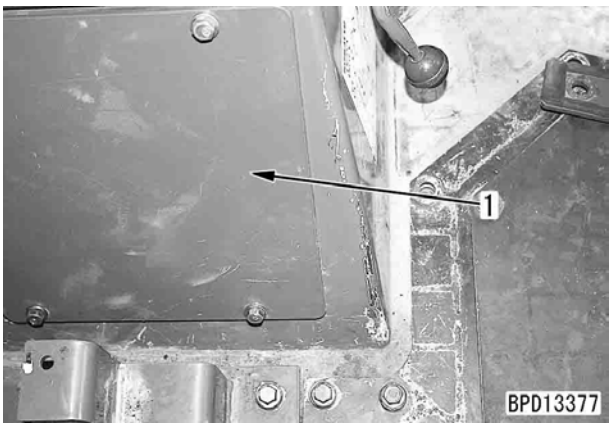


2) Insert or connect T-adapters in or to connectors S03 and S04 on the back side of monitor panel (2).



2. Steering and transmission controller

1) Remove left console box inspection cover (1).



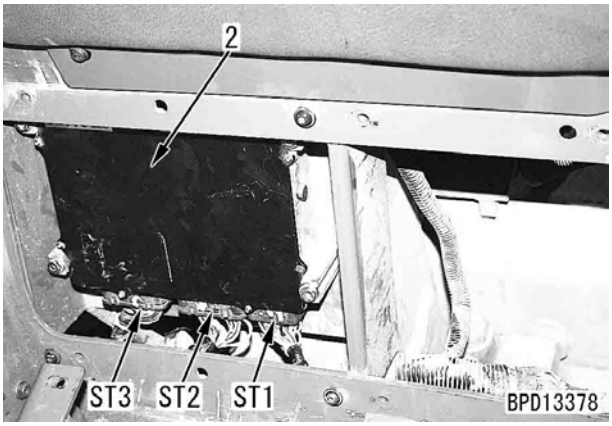
2) Insert or connect T-adapters in or to connectors ST1, ST2 and ST3 of steering and transmission controller (2).

★ If the connectors cannot be disconnected and connected easily, remove the controller from the floor flame.

★ Since the connectors are secured with screws, loosen those screws before disconnecting.

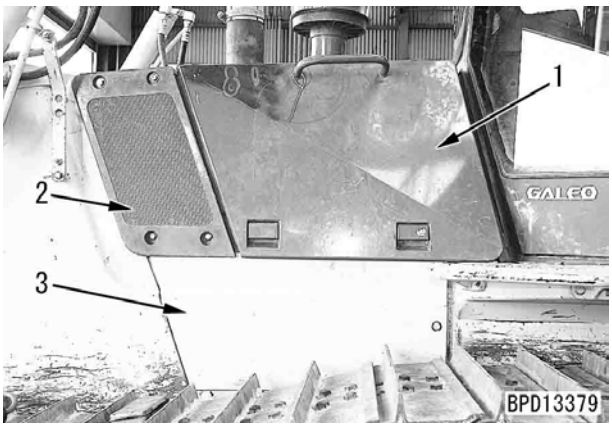
★ When connecting the connectors again, tighten their screws with the specified torque.

Screw: **2.8 Nm {0.29 kgm}**



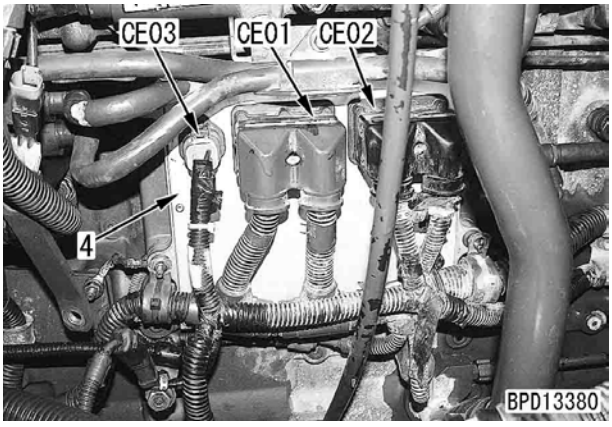
3. Engine controller

1) Open engine hood left cover (1) and remove side covers (2), (3).

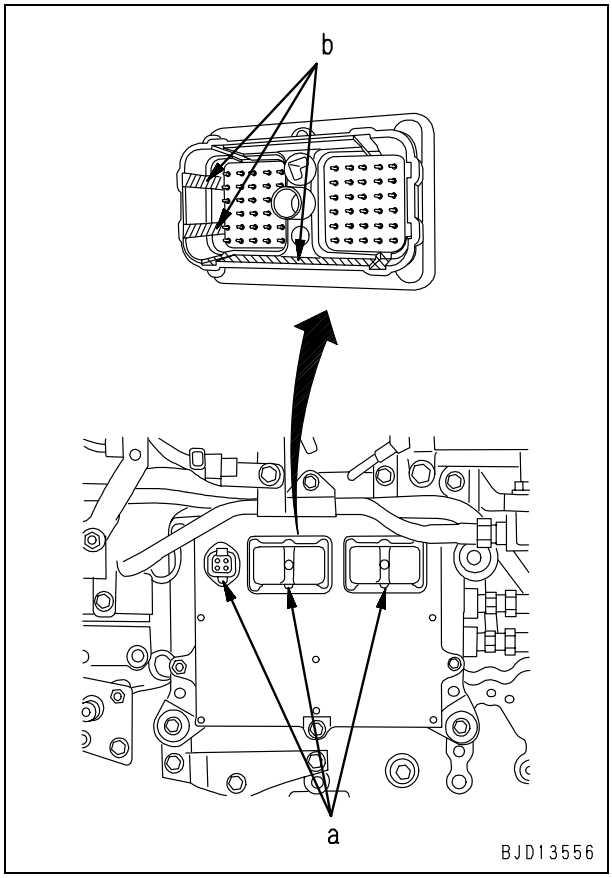


2) Insert or connect T-adapters in or to connectors CE01, CE02 and CE03 of engine controller (4).
   - ★ Since the connectors (CE01 and CE02) are secured with screws, loosen those screws before disconnecting.
   - ★ When connecting the connectors again, tighten their screws with the specified torque.

   Screw: **3 ± 1 Nm {0.3 ± 0.1 kgm}**

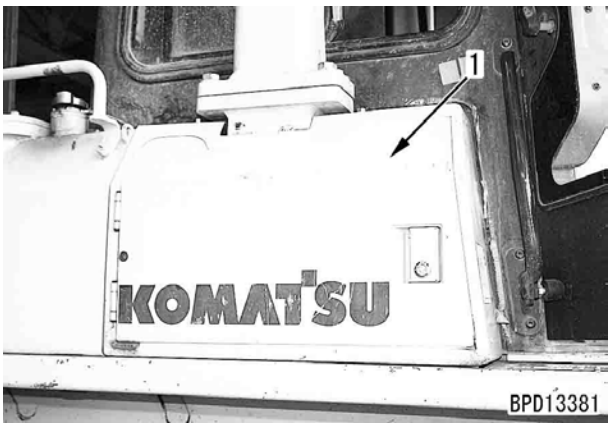


⚠ In order to prevent malfunction and mistaken system error warning, be sure to completely remove foreign object (b) such as sand, dust, water, etc., from inside of controller side connector (a) with air blow etc., before connecting to harness connector.

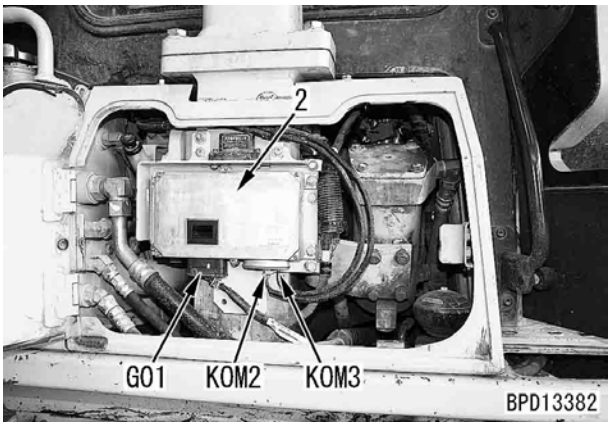


4. KOMTRAX controller

1) Open cover (1) of the main control valve at the right side of the operator cab.



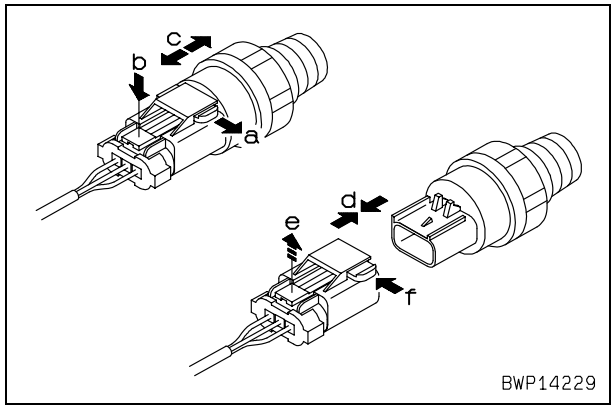
2) Insert or connect T-adapters in or to G01 connector of KOMTRAX controller (2).
3) Connector K0M2, K0M3 are for communication antenna.



5. Air pressure sensor (AIR PRESSURE SENSOR)
Engine Ne speed sensor (CRANK SENSOR)
Engine Bkup sensor (CAM SENSOR)
Engine oil pressure switch (OIL PRESSURE SWITCH)

★ Disconnecting and connecting connectors
Since the connectors of air pressure sensor, engine Ne speed sensor, engine Bkup sensor and engine oil pressure switch have special lock mechanism, disconnect in the order of (a) – (c) and connect in the order of (d) – (f) as shown in the below figure.

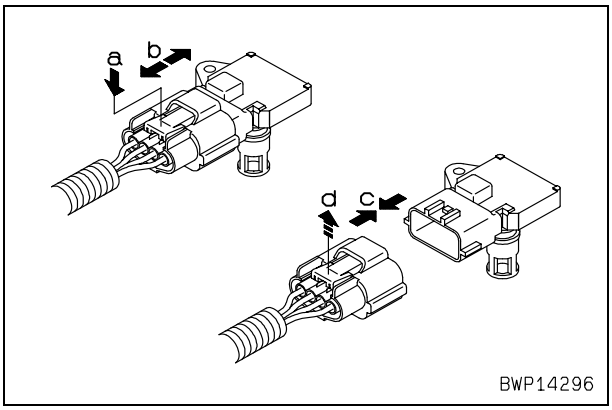
Disconnect: (a) slide lever – (b) release lock – (c) disconnect connector
Connect: (d) connect connector – (e) mesh lock – (f) slide lever



★ Removal and installation of sensor
When removing and installing engine oil pressure switch, use deep sockets with 27 mm width across flats and ϕ22mm center hole diameter.

6. Boost pressure sensor and intake manifold temperature sensor (BOOST PRES & IMT)

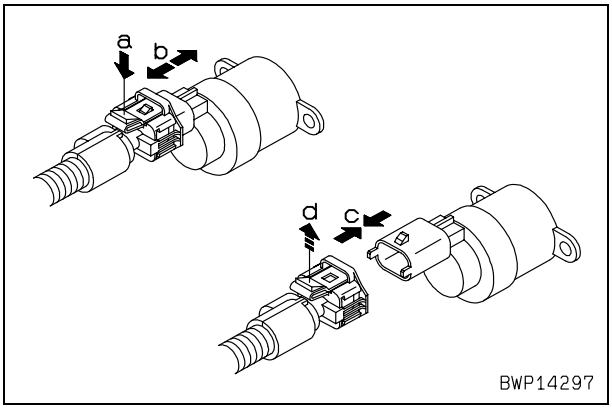
★ Disconnecting and connecting connectors
Since the connectors of boost pressure and temperature sensor have special lock mechanism, disconnect in the order of (a) – (b) and connect in the order of (c) – (d) as shown in the below figure.
Disconnect: (a) release lock – (b) disconnect connector
Connect: (c) connect connector – (d) mesh lock



★ Removal and installation of sensor
When removing and installing boost pressure and intake manifold temperature sensor, use T type torque wrench [bearing number : T15].

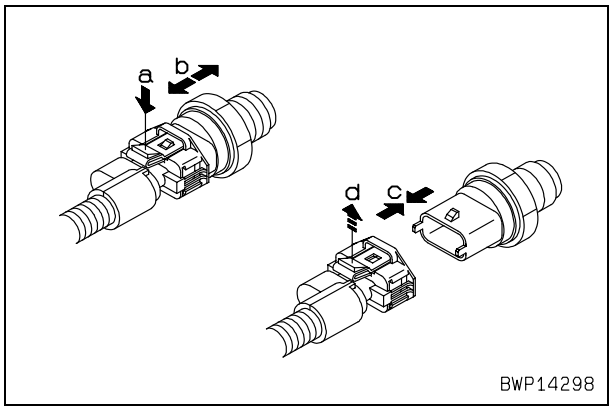
7. Fuel supply pump IMV solenoid (FUEL REGULATOR)

★ Disconnecting and connecting connectors
Since the connector of fuel supply pump IMV solenoid has special lock mechanism, disconnect in the order of (a) – (b) and connect in the order of (c) – (d) as shown in the below figure.
Disconnect: (a) release lock – (b) disconnect connector
Connect: (c) connect connector – (d) mesh lock



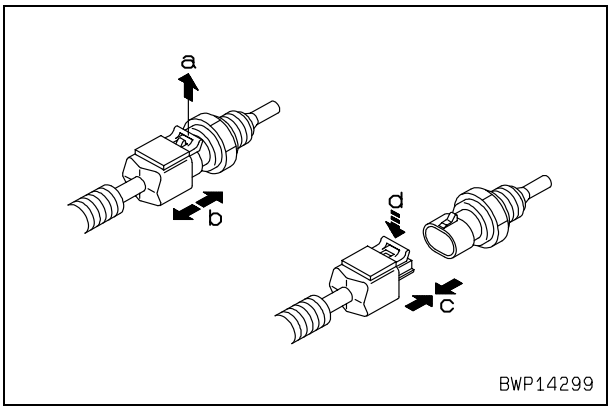
8. Common rail pressure sensor (FUEL RAIL PRESS)

★ Disconnecting and connecting connectors
Since the connector of common rail pressure sensor has special lock mechanism, disconnect in the order of (a) – (b) and connect in the order of (c) – (d) as shown in the below figure.
Disconnect: (a) release lock – (b) disconnect connector
Connect: (c) connect connector – (d) mesh lock



9. Engine coolant temperature sensor (COOLANT TEMP)

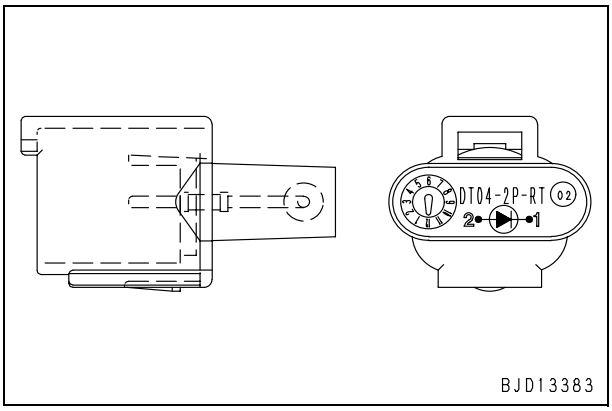
★ Disconnecting and connecting connectors
Since the connector of engine coolant temperature sensor has special lock mechanism, disconnect in the order of (a) – (b) and connect in the order of (c) – (d) as shown in the below figure.
Disconnect: (a) release lock – (b) disconnect connector
Connect: (c) connect connector – (d) mesh lock



★ Removal and installation of sensor
When removing and installing engine coolant temperature sensor, use deep sockets with 21 mm width across flats and ϕ18 mm center hole diameter.

Inspection procedure of diode

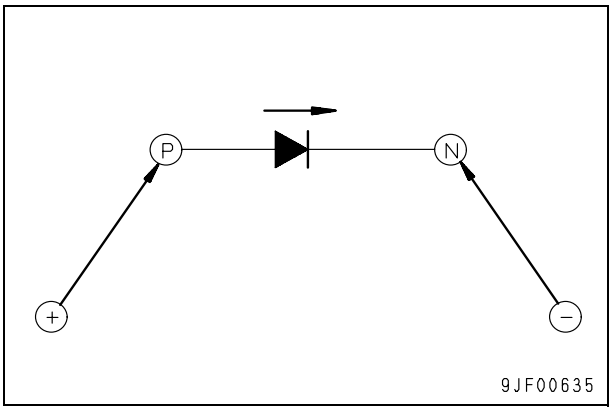
★ The direction of continuity of diode is marked on the surface of the diode.



1. When using digital tester

1) Switch to diode range and check displayed value.
   ★ Voltage of internal battery is displayed by normal tester.
2) Set red (+) test lead to diode anode (P) side and black (–) test lead to cathode (N) side. Check displayed value.
3) Judge quality of diode from displayed value.
   - Displayed value does not change: No continuity (defect)
   - Displayed value changes: Continue (normal) (note)

   Note: In the case of silicon diode, the value between 460 – 600 mV is displayed.
   - Displayed value becomes 0 or near 0 : Short-circuiting of diode internal part (defect)



2. When using analog tester

1) Switch to resistance range.
2) Check the deflection of needle while connecting as follows.
   i) Set red (+) test lead to diode anode (P) side and black (–) test lead to cathode (N) side.
   ii) Set red (+) test lead to diode cathode (N) side and black (–) test lead to anode (P) side.
3) Based on the deflection of needle, judge the quality of diode.
   - Needle does not deflect with connection i) but deflects with connection ii): Normal. (however deflection range (resistance value) varies depending on the type of tester and measuring range.
   - Needle deflects with both connection i) and ii): Defective (internal short circuit)
   - Needle does not deflect with either connection i) or ii): Defective (internal disconnection)

Pm-Clinic service

Model	Serial No.	Service meter
□ D65EX-15 □D65WX-15 □ D65PX-15		h

User name	Date of clinic	Serviceman
	/ /	

Specifications		
Blade	Attachment	Shoe width
□ Semi-U blade □ Angle blade □ Straight tilt blade □	□ Multi-shank ripper □ Towing winch □ CAB □ ROPS	□ 510 mm □ 810 mm □ 560 mm □ 915 mm □ 610 mm □ 950 mm □ 660 mm

Operating conditions			
Quarry, mine	Construction	Type of soil (specific gravity)	Type of work
□ Coal □ Gold □ Limestone □	□ Construction, civil engineering □ Roads □ Tunnels □	□ Rock □ Gravel □ Sand □ Clay	□ Dozing, digging % □ Side cutting % □ Grading % □ Travel %

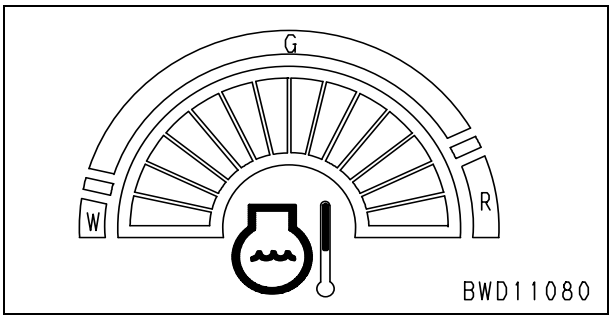
Existence of abnormalities		
Oil, water level check		
□ Engine coolant level	When necessary	
□ Engine oil level	□ Power train	□ Damper case
□ Hydraulic oil level	□ Final drive	□ ( )

Ambient temperature	Height above sea level
Max. °C Min.	
Operator's opinion	

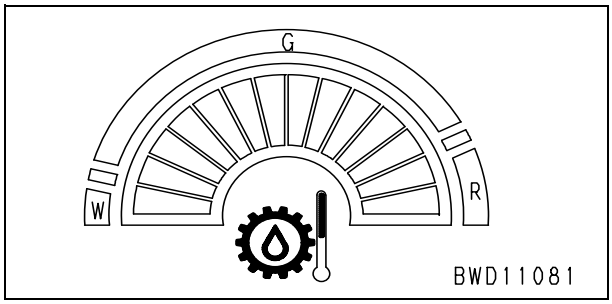
Visual check results

Failure code history	
[ ] h	[ ] h
Content:	Content:
[ ] h	[ ] h
Content:	Content:

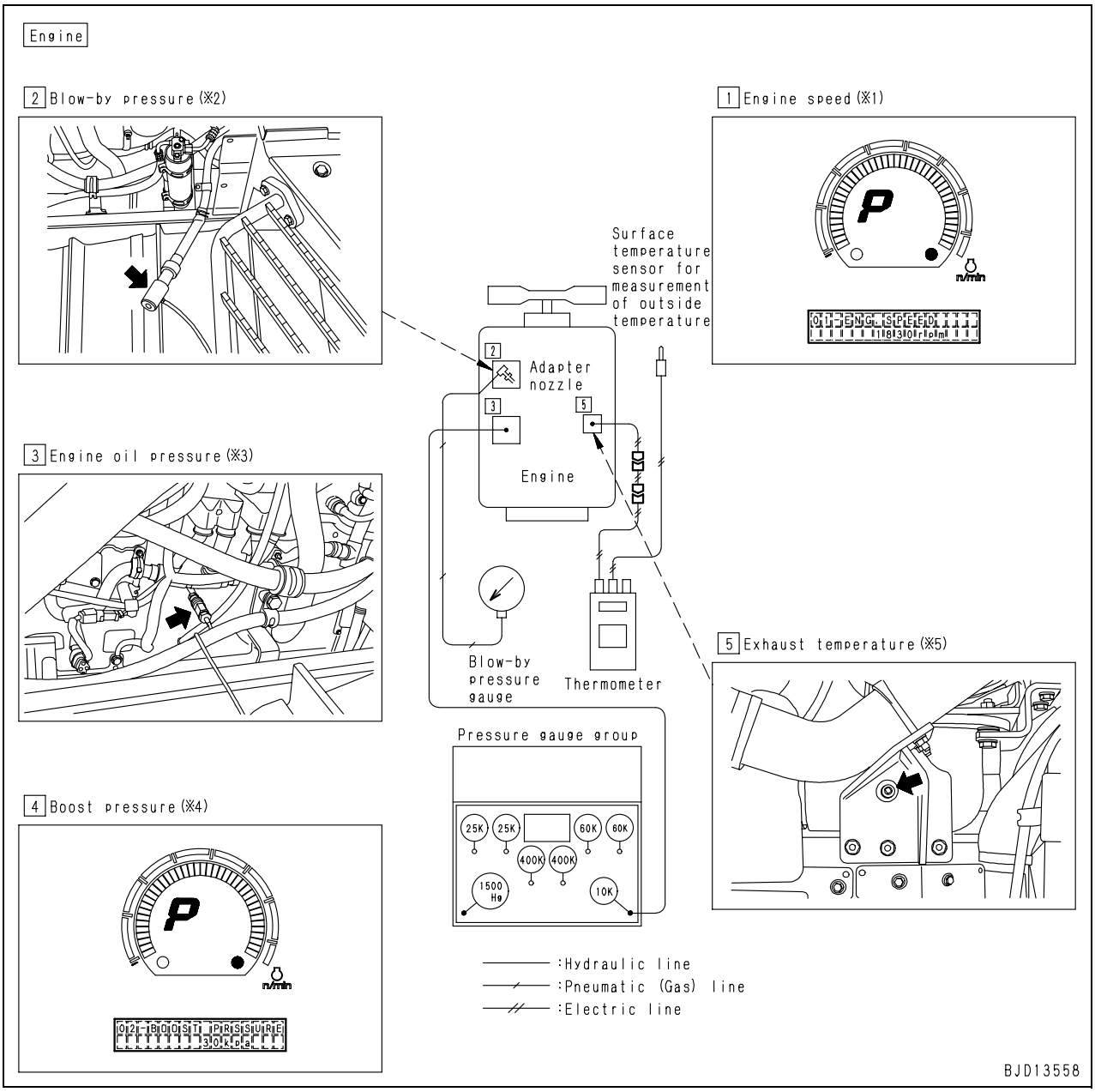
★ Engine coolant temperature: Max. range



★ Power train oil temperature: Max. range



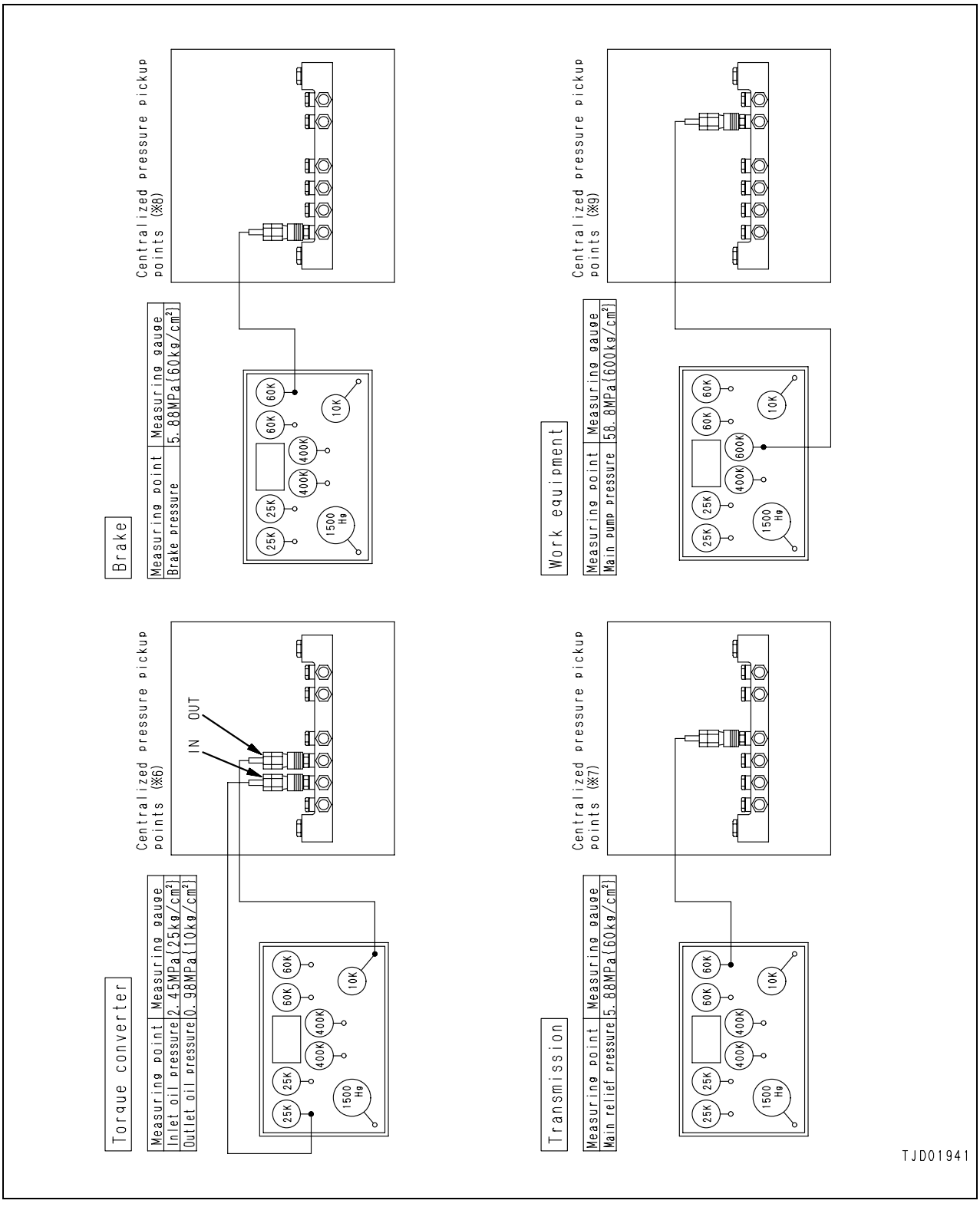
Pm-clinic measuring points for D65EX, PX, WX-15E0 (1/2)



Reference pages for measurement procedure designated

*1. Engine speed: Testing and adjusting, No. 1 pages 5 – 6
*2. Blow-by pressure: Testing and adjusting, No. 1 page 19
*3. Engine oil pressure: Testing and adjusting, No. 1 page 20
*4. Boost pressure: Testing and adjusting, No. 1 pages 7 – 8
*5. Exhaust temperature: Testing and adjusting, No. 1 pages 9 – 10

Pm-clinic measuring points for D65EX, PX, WX-15E0 (2/2)



Reference pages for measurement procedure designated
*6. Torque converter related: Testing and adjusting, No. 1 page 35
*7. Transmission related: Testing and adjusting, No. 1 pages 36 – 37
*8. Steering brake related: Testing and adjusting, No. 1 page 34
*9. Work equipment and HSS related: Testing and adjusting, No. 1 page 48 – 50

Pm-clinic check sheet

Serial number	□ D65EX-15 # □ D65PX-15 # □ D65WX-15 #

Work order	Date	Service meter	Serviceman
	/ /	h	

Check item		Measurement conditions		Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Engine	Engine speed	Low idle		rpm	800 – 850	800 – 850			
		Full throttle	Deceleration pedal depressed		975 – 1,025	975 – 1,025			
		Full throttle			1,980 – 2,080	1,980 – 2,080			
		Torque converter stall			1,670 – 1,870	1,650			
	Blow-by pressure	Torque converter stall		kPa {mmAq}	Max. 1.57 {Max. 160}	2.55 {260}			
	Engine oil pressure	Engine at low idle	SAE10W	MPa {kg/cm^2}	Min. 0.10 {Min. 1.0}	0.07 {0.7}			
		Engine at full throttle			0.34 – 0.64 {3.5 – 6.5}	0.18 {1.8}			
		Engine at low idle	SAE15W-40, SAE30		Min. 0.15 {Min. 1.5}	0.08 {0.8}			
		Engine at full throttle			0.34 – 0.59 {3.5 – 6.0}	0.21 {2.1}			
	Boost pressure	Torque converter stall		kPa {mmHg}	141 – 180.9 {1,060 – 1,360}	114.4 {860}			
	Exhaust temperature	Torque converter stall		°C	Max 750	750			

Check item		Measurement conditions		Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Torque converter	Inlet oil pressure	Transmission: Neutral Oil temperature: 70 – 90°C	Engine at low idle	MPa {kg/cm^2}	0.1 – 0.5 {1 – 5}	0.1 – 0.5 {1 – 5}			
	Outlet oil pressure				0.05 – 0.29 {0.5 – 3}	0.05 – 0.29 {0.5 – 3}			
	Inlet oil pressure		Engine at full throttle		Max. 0.88 {Max. 9}	Max. 0.88 {Max. 9}			
	Outlet oil pressure				0.39 – 0.69 {4 – 7}	0.39 – 0.69 {4 – 7}			

Check item		Measurement conditions		Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Transmission	Main relief pressure	Transmission: Neutral	Engine at low idle	MPa {kg/cm^2}	3.03 – 3.23 {31 – 33}	Min. 2.84 {Min. 29}			
			Engine at full throttle		3.23 – 3.43 {33 – 35}	Min. 3.04 {Min. 31}			
Cooling fan	Fan speed	• Fan 100% speed mode • Engine: Low idle	Min. speed	rpm	750 – 850	700			
		• Fan 100% speed mode • Engine: High idle	Max. speed		1,700 – 1,800	1,600			
	Fan pump pressure	• Fan 100% speed mode • Engine: High idle		MPa {kg/cm^2}	19.6 – 22.5 {200 – 230}	18.6 {190}			

Pm-clinic check sheet

Serial number	□ D65EX-15 # □ D65PX-15 # □ D65WX-15 #

Work order	Date	Service meter	Serviceman
	/ /	h	

Check item		Measurement conditions	Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Steering	Steering load sensing pressure	Engine at full throttle	MPa {kg/cm^2}	32.8 – 36.8 {335 – 375}	Min. 30.9 {Min. 315}			
	Steering relief actuating pressure			34.8 – 38.8 {355 – 395}	Min. 32.8 {Min. 335}			
Brake	Brake actuating pressure	Engine at full throttle		2.75 – 2.94 {28 – 30}	Min. 2.55 {Min. 26.0}			
	Brake performance	Apply brake and run engine at full throttle with transmission gear in F2.		Machine must not move				

Check item			Measurement conditions	Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Hydraulic system	Work equipment load sensing pressure	Engine at full throttle		MPa {kg/cm^2}	18.6 – 22.6 {190 – 230}	Min. 17.6 {Min. 180}			
	HSS and work equipment pump	Ripper lift relief	Engine at low idle		Min. 19.6 {Min. 200}	Min. 19.6 {Min. 200}			
		Blade tilt relief			Min. 19.6 {Min. 200}	Min. 19.6 {Min. 200}			
		Ripper lift relief	Engine at full throttle		20.6 – 24.6 {210 – 250}	Min. 19.6 {Min. 200}			
		Blade tilt relief			20.6 – 24.6 {210 – 250}	Min. 19.6 {Min. 200}			
	PPC valve output pressure	Blade tilt relief			3.53 – 4.41 {36 – 45}	3.53 – 4.41 {36 – 45}			

Check item		Measurement conditions	Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Work equipment speed	Blade RAISE	Engine at full throttle	Second	EX: 2.1 – 2.8 WX: 2.1 – 2.8 PX: 1.9 – 2.6	Max. 3.1 Max. 3.1 Max. 2.9			
	Single tilt (left → right)	Engine at full throttle		2.0 – 2.6	Max. 2.8			
	Ripper RAISE	Engine at full throttle		1.2 – 1.6	Max. 1.9			

Check item		Measurement conditions	Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Hydraulic drift	Hydraulic oil temperature	Engine stopped	°C	45 – 55	—			
	Blade lift cylinder		mm/ 15 min.	Max. 100	Max. 100			
	Blade tilt cylinder			Max. 200	Max. 200			

Check item	Measurement conditions	Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Visual inspection of final drive drain plug	Engine stopped	—	There must be no excessive metal particles				

Always fill in the record when repairing, adjusting, or replacing main parts.

Date	Service meter	Repair record	Date	Service meter	Repair record

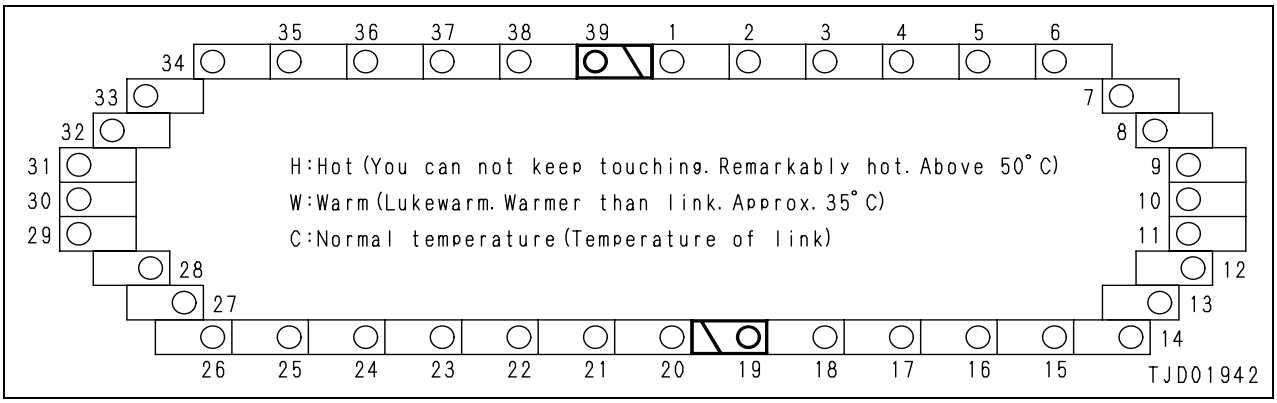
Pm-clinic undercarriage check sheet

Serial number	□ D65EX-15 # □ D65WX-15 #

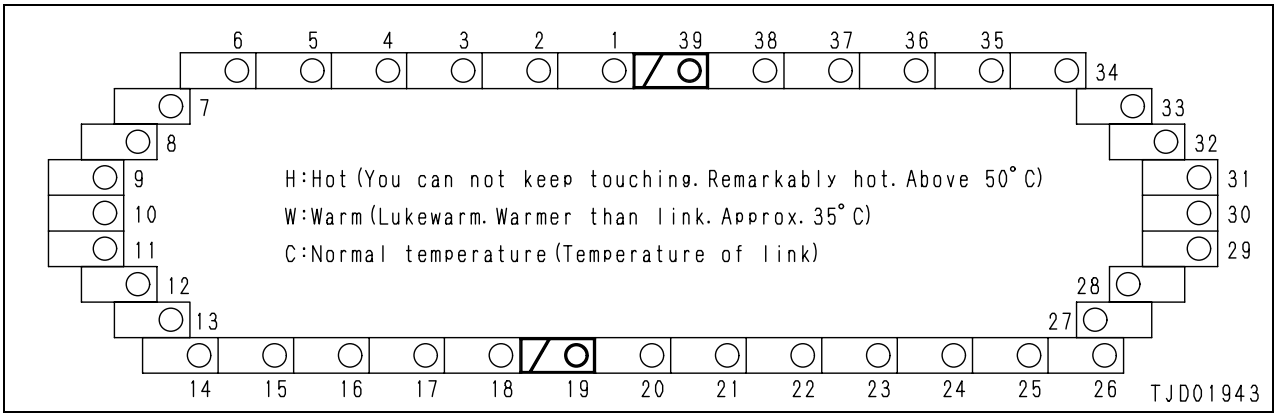
Work order	Date	Service meter	Serviceman
	/ /	h	

- **Measure the bushing temperature immediately after operations**

Left side of machine



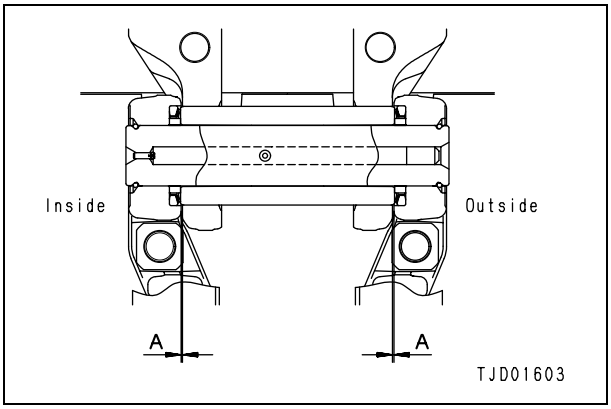
Right side of machine



★ Measurement results

	Pass	Fail
Left side of machine		
Right side of machine		

- **Opening of track link**



Left track	A: Clearance between links	Right track	A: Clearance between links
Pin No.	1.4	Pin No.	1.4

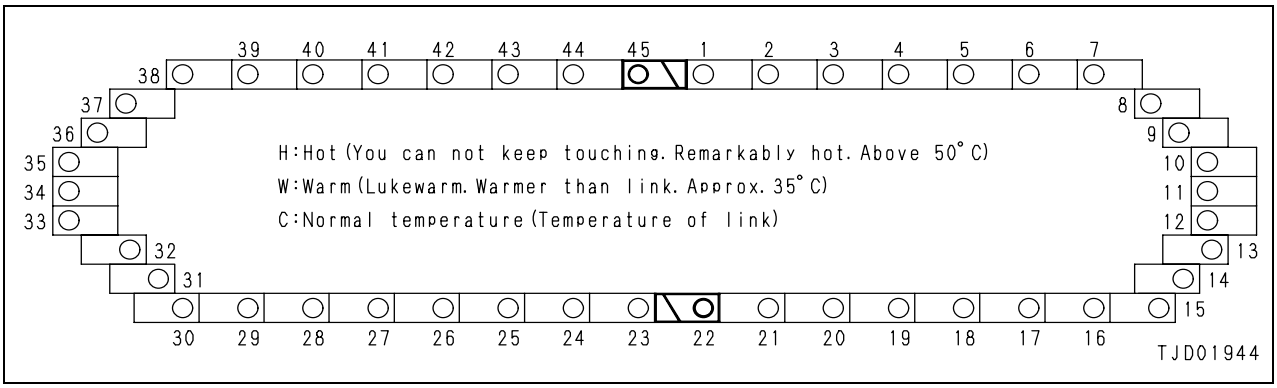
Pm-clinic undercarriage check sheet

Serial number	□ D65PX-15 #

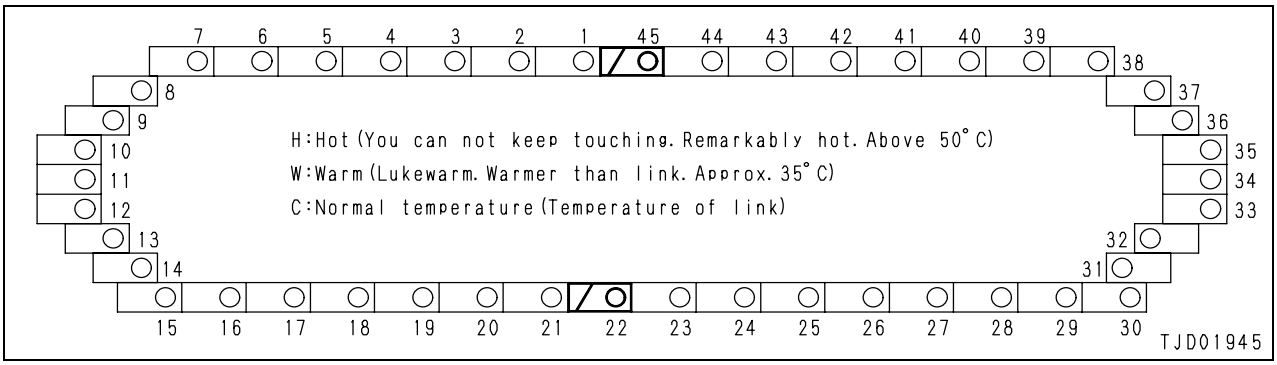
Work order	Date	Service meter	Serviceman
	/ /	h	

- **Measure the bushing temperature immediately after operations**

Left side of machine



Right side of machine

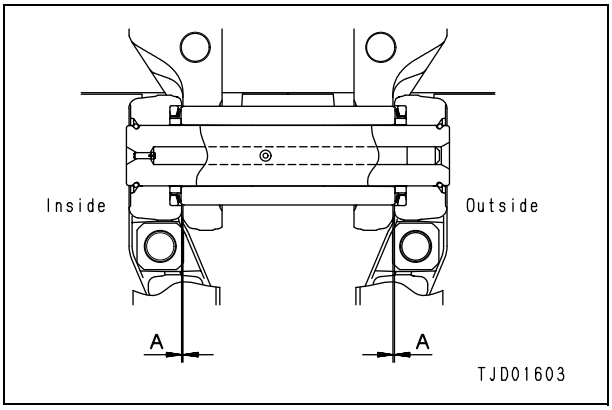


★ Measurement results

	Pass	Fail
Left side of machine		
Right side of machine		

Left track	A: Clearance between links	Right track	A: Clearance between links
Pin No.	1.4	Pin No.	1.4

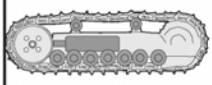
- **Opening of track link**



Undercarriage troubleshooting report (Normal) (Program form No.: SELA195001)

KUC

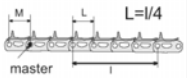
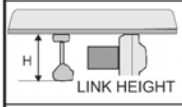
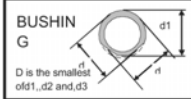
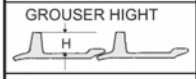
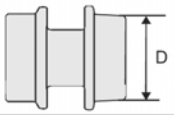
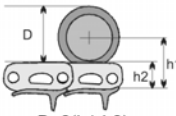
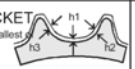
Komatsu
Undercarriage Inspection



Customer name:

Address:

Model	D65EX, PX, WX-15E0	Serial No		Equip No		Work Order No			
Location		SMR				Wet,AR,HD or Dry	Wet		
Soil condition		Dealer				Shoe width (mm)			
Working condition		Inspector				Shoe type	SINGLE		
		Insp.Date(yy/mm/dd)			(yyyy/m/d)	Wear type	NORMAL		

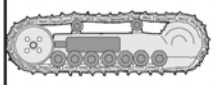
			New	100% Wear	Measured mm	Wear %	SMR New	SMR Rebuilt	Hours on Parts:	Comments/Observation
LINK PITCH 	R	LH	813.8	825.8						
		RH	813.8	825.8						
	M	LH	203.45	206.45						
		RH	203.45	206.45						
		LH	132.0	119.5						
		RH	132.0	119.5						
BUSHIN G 							New	Turned		
		LH	73.0	62.8						
							New	Turned		
		RH	73.0	62.8						
GROUSER HIGHT 		LH	65.0	25.0						
		RH	65.0	25.0						
CARRIER 	Front	LH	185.0	163.0						
		RH	185.0	163.0						
	Rear	LH	185.0	163.0						
		RH	185.0	163.0						
IDLER 	Front	LH	20.0	30.0						
		RH	20.0	30.0						
	Rear	LH	20.0	30.0						
		RH	20.0	30.0						
TRACK ROLLER  D=2(h1-h2)	1	LH	210.0	174.0						
	2	LH	210.0	174.0						
	3	LH	210.0	174.0						
	4	LH	210.0	174.0						
	5	LH	210.0	174.0						
	6	LH	210.0	174.0						
	7	LH	210.0	174.0						
	8	LH	210.0	174.0						
	9	LH	210.0	174.0						
	10	LH	210.0	174.0						
	1	RH	210.0	174.0						
	2	RH	210.0	174.0						
	3	RH	210.0	174.0						
	4	RH	210.0	174.0						
	5	RH	210.0	174.0						
	6	RH	210.0	174.0						
	7	RH	210.0	174.0						
	8	RH	210.0	174.0						
	9	RH	210.0	174.0						
	10	RH	210.0	174.0						
SPROCKET 		LH	0.0	9.0						
		RH	0.0	9.0						

Remarks:

Undercarriage troubleshooting report (Impact) (Program form No.: SELA195001)

KUC

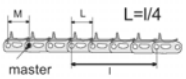
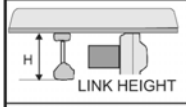
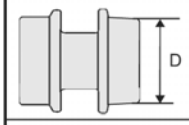
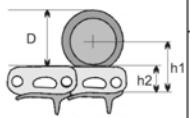
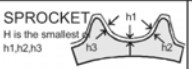
Komatsu
Undercarriage Inspection



Customer name:

Address:

Model	D65EX, PX, WX-15E0	Serial No		Equip No		Work Order No			
Location		SMR				Wet,AR,HD or Dry	Wet		
Soil condition		Dealer				Shoe width (mm)			
Working condition		Inspector				Shoe type	SINGLE		
		Insp.Date(yy/mm/dd)			(yyyy/m/d)	Wear type	IMPACT		

			New	100% Wear	Measured mm	Wear %	SMR New	SMR Rebuilt	Hours on Parts:	Comments/Observation
LINK PITCH 	R	LH	813.8	825.8						
		RH	813.8	825.8						
	M	LH	203.45	206.45						
		RH	203.45	206.45						
		LH	132.0	119.5						
		RH	132.0	119.5						
BUSHING 		LH	73.0	65.4			New	Turned		
		RH	73.0	65.4			New	Turned		
GROUSER HIGHT 		LH	65.0	25.0						
		RH	65.0	25.0						
CARRIER 	Front	LH	185.0	163.0						
		RH	185.0	163.0						
	Rear	LH	185.0	163.0						
		RH	185.0	163.0						
IDLER 	Front	LH	20.0	30.0						
		RH	20.0	30.0						
	Rear	LH	20.0	30.0						
		RH	20.0	30.0						
TRACK ROLLER 	1	LH	210.0	174.0						
	2	LH	210.0	174.0						
	3	LH	210.0	174.0						
	4	LH	210.0	174.0						
	5	LH	210.0	174.0						
	6	LH	210.0	174.0						
	7	LH	210.0	174.0						
	8	LH	210.0	174.0						
	9	LH	210.0	174.0						
	10	LH	210.0	174.0						
	1	RH	210.0	174.0						
	2	RH	210.0	174.0						
	3	RH	210.0	174.0						
	4	RH	210.0	174.0						
	5	RH	210.0	174.0						
	6	RH	210.0	174.0						
	7	RH	210.0	174.0						
	8	RH	210.0	174.0						
	9	RH	210.0	174.0						
	10	RH	210.0	174.0						
SPROCKET 		LH	0.0	9.0						
		RH	0.0	9.0						

Remarks:

How to start operation of KOMTRAX terminal

In the case where the KOMTRAX terminal has already been installed at the plant before shipment:

★ Implement the following procedure in the case where the KOMTRAX terminal has already been installed at the plant before shipment (as standard equipment).

1. Notification of model, model number and serial number

Notify the model, model number and serial number of the machine to the KOMTRAX operations administrator.

2. Registration of machine

The KOMTRAX operations administrator registers the machine using a KOMTRAX client personal computer.

★ Refer to “Manual for KOMTRAX operations administrator” for the procedure.

★ Now the terminal is ready for use.

In the case where the KOMTRAX terminal is retrofitted on the machine after the shipment:

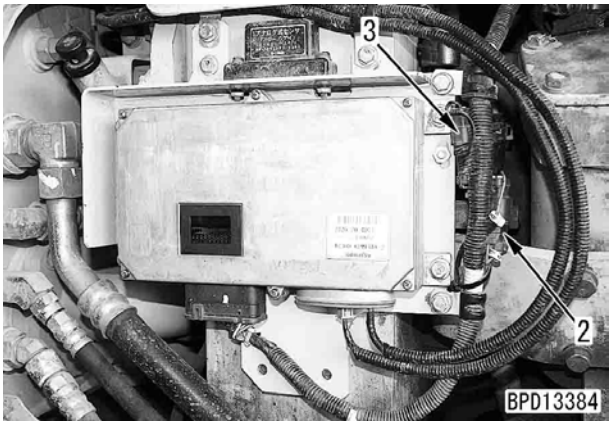
★ Implement the following procedure in the case where the KOMTRAX terminal is retrofitted after shipment of the machine (retrofitted machine)

1. Sign-up test on the machine side

1) Move the machine to a place with good visibility of upper direction.
2) Open cover (1) of the main control valve at the right side of the operator cab.

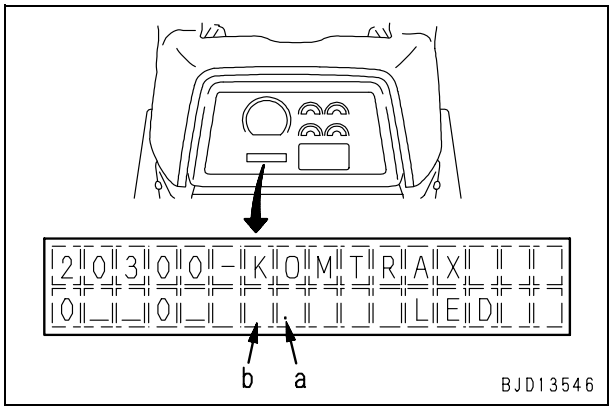
3) Switch the monitor panel display to “Adjust mode“, enter “Setting KOMTRAX specification“, and enable the KOMTRAX function.
   - Adjust code: **0021**
   - Specification: **ACTIVE**
4) Switch the monitor panel display to “Monitoring mode” and enter “KOMTRAX LED display”.
   - Monitoring code: **20300**
   - ★ Refer to “Special functions of monitor panel (EMMS)” for the operating method.
5) Disconnect ACC connector (2), and move on to the next step after confirming that more than 5 seconds have passed since the disconnection.
   - ACC connector (2): ACF (female) and ACM (male)

6) Check visually that test connector (3) is connected.
   - Test connector (3):
     T1F (female) and T1M (male)

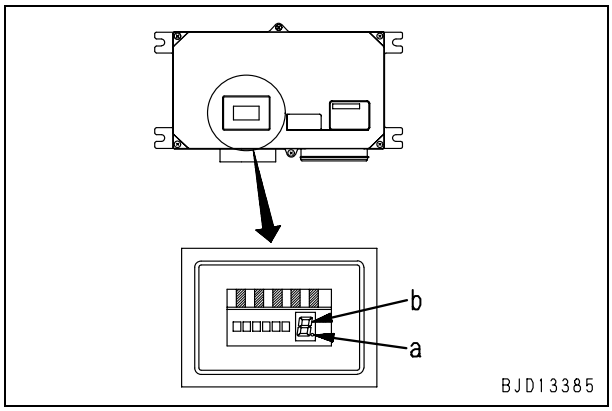


7) Connect ACC connector (2). Keep that condition for 5 seconds.
   - Check that display (**b**) on the monitor panel or KOMTRAX terminal shows the mark " – ".
8) Disconnect test connector (3) and keep that condition for 5 seconds.
9) Reconnect test connector (3) and keep that condition for 5 seconds. [Dot (**a**) blinks on and off]
   - Blinking of dot (**a**): When the terminal detects insert or removal of the connector, dot (**a**) blinks on and off.
   - ★ Complete procedure 7) – 9) in 30 seconds.

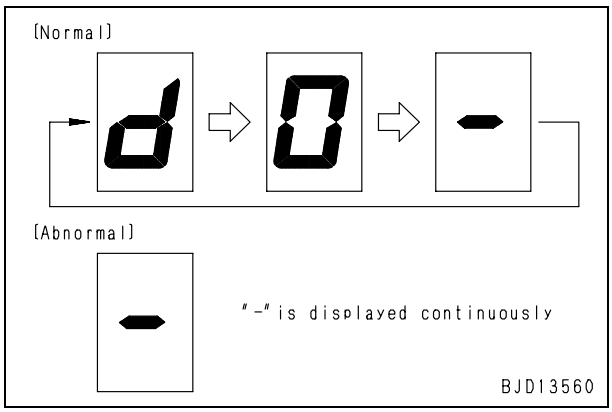
Monitor panel



KOMTRAX terminal

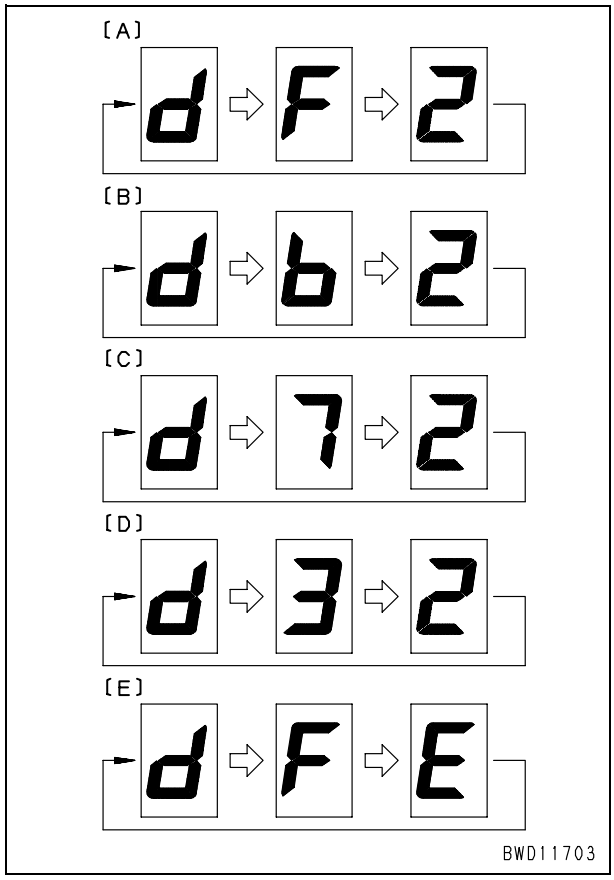


10) Check that display (**b**) on the monitor panel or KOMTRAX terminal is displayed normally.
    - ★ The normal display shows "d" → "0" → " – " repeatedly for 30 seconds on the monitor panel after 9) is finished.
    - ★ Move on to the next step if you can check that the display is [normal].
    - ★ If the display is [abnormal], start from procedure 1) again.

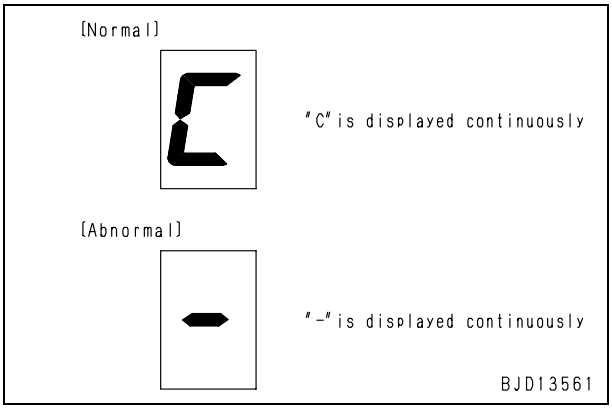


11) Turn the starting switch to the starting position, keep it more than 5 seconds, and check that the engine does not start up.
    ★ If the engine starts up or the starting switch is turned off, start from procedure 1) again.
12) Turn the starting switch to the starting position again, and check that the engine starts up.
13) Check that display (**b**) on the monitor panel or KOMTRAX terminal is displayed normally.
    ★ Move on to the next step if you can check that the display is [normal].
    (It takes from 90 seconds to 15 minutes before the display turns normal.)
    ★ If [GPS position data detection trouble] is indicated, check if there is any abnormality on the GPS antenna or cable. If there is any abnormality, repair it and start from procedure 1) again.
    ★ If [Reception trouble] is indicated, check if there is any abnormality on the appearance of the communication antenna or cable. If there is any abnormality, repair it then repeat from procedure 1) again.
    ★ If [GPS position data detection trouble and reception trouble] is indicated, check if there is any abnormality on the GPS antenna/ cable or communication antenna/ cable. If there is any abnormality, repair it and start from procedure 1) again.
    ★ If [Network trouble] is indicated, check the display of [LED-C4] referring to “Lamp display of KOMTRAX terminal”. If the CAN is not recognized, check the CAN harness of the KOMTRAX terminal, and then if there is any abnormality, repair it and start from procedure 1) again.

[A]: Normal
[B]: GPS position data detection trouble
[C]: Reception trouble
[D]: GPS position data detection trouble and reception trouble
[E]: Network trouble



14) Disconnect ACC connector (2).
15) Check that display (**b**) on the monitor panel or KOMTRAX terminal is displayed normally in 5 seconds.
    ★ If you can check that the display is [Normal], that is the end of sign-up test.
    ★ If the display shows [Abnormal], repeat from procedure 1) again because the sign-up test has not been completed successfully.

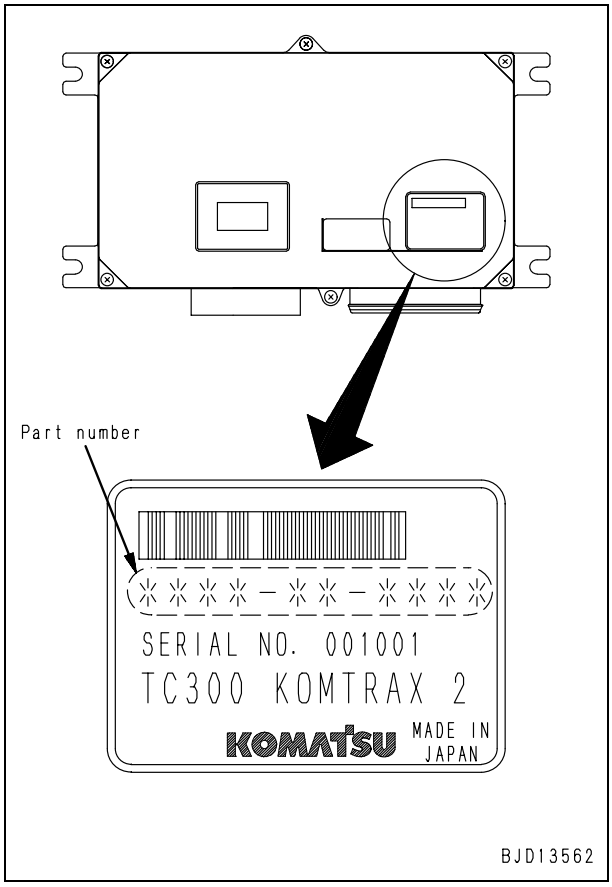


16) Connect ACC connector (2) and turn the buzzer cancel switch to the right to finish the “KOMTRAX LED display” mode.
17) Stop the engine and fix the connector cover with the fixing band.

2. Application for the start of use

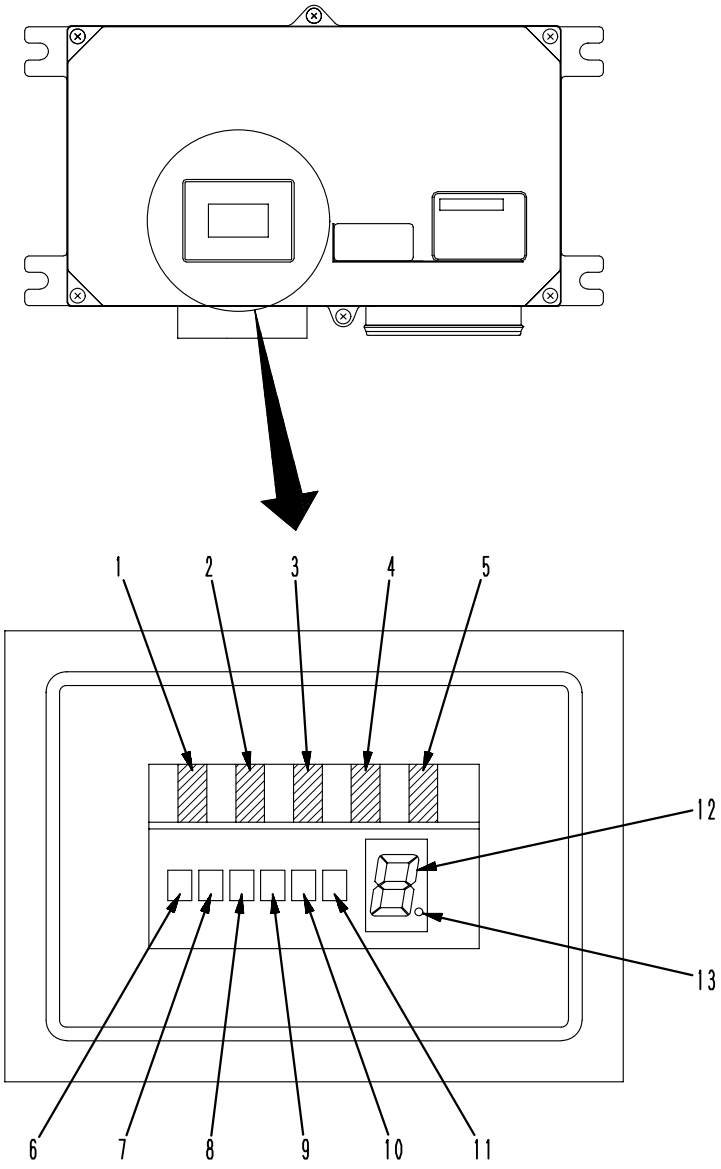
★ Application for the start of use should be made only after the sign-up test is finished.

1) Notify to the KOMTRAX operations administrator the following information concerning the machine whose sign-up test on the machine side is completed.
    (1) Information on the machine whose sign-up test on the machine side is completed
    (model, model number and serial number)
    (2) Part number and serial number of the KOMTRAX terminal
    (3) Reading of the service meter when the KOMTRAX terminal is installed (0.1h unit)



2) The KOMTRAX operations administrator registers the machine using a KOMTRAX client personal computer.
    ★ Refer to “Manual for KOMTRAX operations administrator” for the procedure.
    ★ Now the terminal is ready for use.

Lamp display of KOMTRAX terminal



Communication module LED
1. LED-A1 (Power indicator lamp)
2. LED-A2 (Within corresponding area lamp)
3. LED-A3 (During correspondence lamp)
4. LED-A4 (Internal transmitting lamp)
5. LED-A5 (Internal reception lamp)

CPU LED
6. LED-C1 (R signal and ACC signal status)
7. LED-C2 (Engine control output status)
8. LED-C3 (S-NET and C signal status)
9. LED-C4 (CAN status)
10. LED-C5 (downloading and writing status)
11. LED-C6 (downloading and writing status)

7-segment and dot for CPU
12. 7-segment (number of unsent mails)
13. Dot (GPS positioning status)

In the KOMTRAX system, various information and processing details are displayed on the LED on the upper surface of the KOMTRAX terminal. Therefore, if a detect is suspected in the system, perform the following checks.

- Check of antennas
- Check of terminal LED displays

Application for the start of use and sign-up test on the machine side should be completed in advance in order to use KOMTRAX system.
On the machines for which these procedures have not been completed yet, all the communication module LEDs are off. This is not a defect.

Check of antennas

★ Before checking the LED displays, check that there is no abnormality around the communication antenna and GPS antenna.
- The communication antenna should not be off or damaged.
- The communication antenna cable should not be broken and normally be connected to the KOMTRAX terminal.
- The GPS antenna should not be off or damaged.
- The GPS antenna cable should not be broken and normally be connected to the KOMTRAX terminal.

Check of terminal LED displays

1. Contents of communication module LED displays

★ LED displays should be checked with the starting switch ON.

No.	LED	Name, Function	Display	Contents of display
1	LED-A1	Power indicator lamp	ON	The LED is on when the electric power is normally supplied.
			OFF	
2	LED-A2	Within corresponding area lamp	ON	The LED is on when the machine is within the corresponding area of the KOMTRAX system.
			OFF	
3	LED-A3	During correspondence lamp	ON	The LED is on when the KOMTRAX terminal is connected to the KOMTRAX server. (The connection should be made only when it is necessary.)
			OFF	
4	LED-A4	Internal transmitting lamp	ON	The LED is on when the CPU transmits data to the communication module. (Transmitting should be made only when it is necessary.)
			OFF	
5	LED-A5	Internal reception lamp	ON	The LED is on when the CPU receives data from the communication module. (Reception should be made only when it is necessary.)
			OFF	

2. Contents of CPU LED displays

★ The LED displays should be checked with the starting switch ON, starting switch START, or with the engine started.

No.	LED	Name, Function	Display	Contents of display
6	LED-C1	Starting switch ACC signal status and alternator R signal status	ON	Starting switch ACC signal: ON, alternator R signal: ON
			Fast blinking	Starting switch ACC signal: OFF, alternator R signal: ON
			Slow blinking	Starting switch ACC signal: ON, alternator R signal: OFF
			OFF	Starting switch ACC signal: OFF, alternator R signal: OFF
7	LED-C2	Engine control signal status	ON	Engine control signal: ON
			OFF	Engine control signal: OFF
8	LED-C3	S-NET connection status and starting switch C signal status	ON	S-NET: connected, starting switch C signal: OFF
			Fast blinking	Starting switch C signal: ON
			Slow blinking	(Not used)
			OFF	S-NET: unconnected, starting switch C signal: OFF
9	LED-C4	CAN connection status	ON	CAN: active (fuel sensor: no communication)
			Fast blinking	CAN: active (fuel sensor: in communication)
			Slow blinking	CAN: inactive (fuel sensor: in communication)
			OFF	CAN: inactive (fuel sensor: no communication)
10	LED-C5	Downloading and writing status	Either one is ON	Downloading and writing status (special function for system administrator)
11	LED-C6		Both are OFF	Normal operation mode

★ Type and time of blinking
Fast blinking: blinking on an approximately 1 second cycle
Slow blinking: blinking on an approximately 4 second cycle

★ The LED displays can be checked in “monitoring mode” of the monitor panel.

3. Contents of 7-segment LED displays for CPU

★ The LED displays should be checked with the starting switch ON.

No.	LED	Name, Function	Display	Contents of display
12	7-segment	Number of unsent mails	0 – 9	Number of unsent mails
13	Dot	GPS positioning status	ON	GPS positioning has been completed. (Position has been recognized. Refer to [*].)
			OFF	GPS positioning has not been completed. (Position has not been recognized. Refer to [*].)

* It may take more than 1 minute from turning on the starting switch to the completion of positioning even in an outdoor place where radio wave can reach.
Positioning is impossible in areas with extremely weak radio waves or areas beyond the reach of radio waves.

★ The LED displays can be checked in “monitoring mode” of the monitor panel.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00587-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

General information on troubleshooting

General information on troubleshooting

Points to remember when troubleshooting

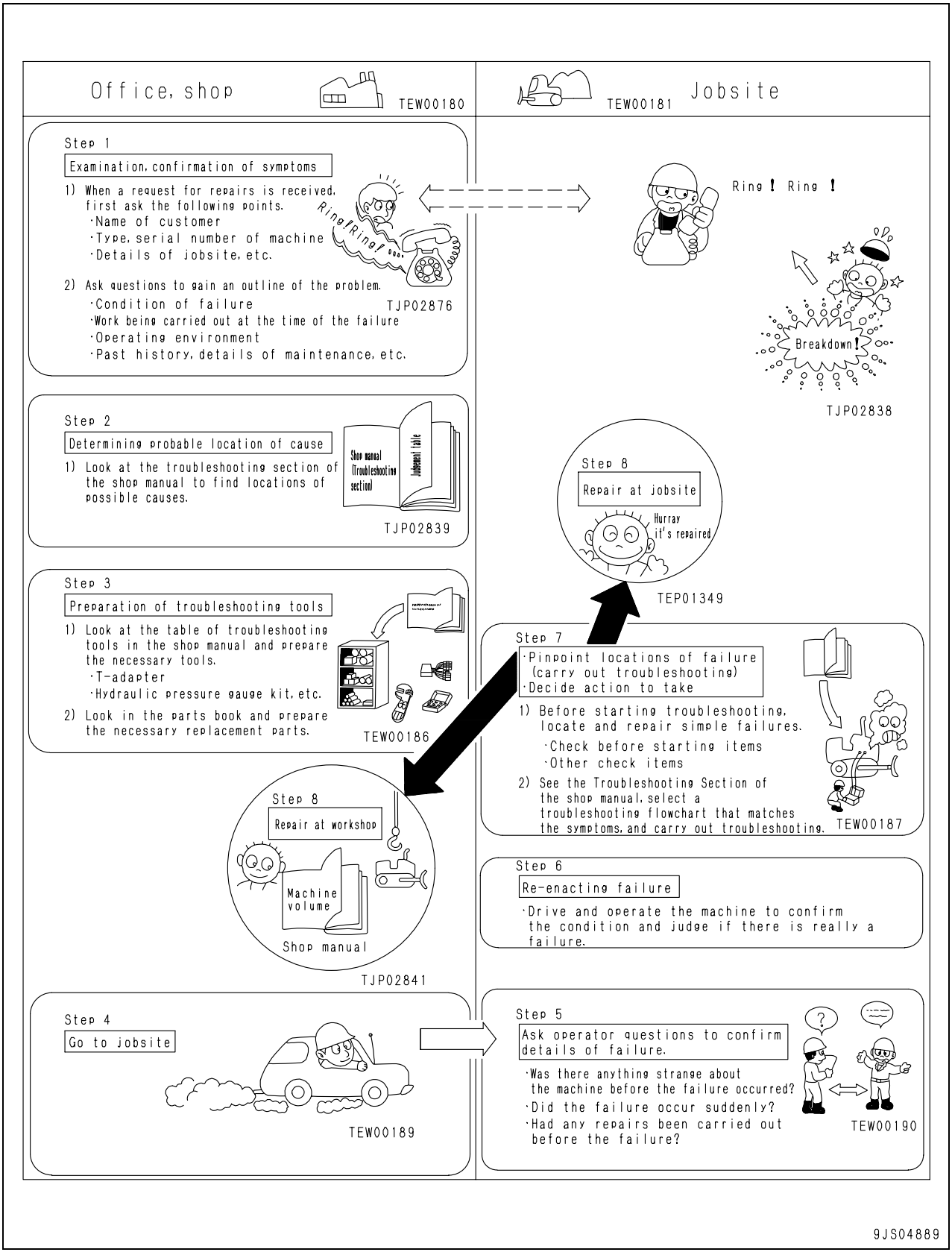
- ⚠ **Stop the machine on a level place, and check that the safety pin, blocks, and parking brake are securely fitted.**
- ⚠ **When carrying out the operation with 2 or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.**
- ⚠ **If the radiator cap is removed when the engine is hot, hot coolant may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.**
- ⚠ **Be extremely careful not to touch any hot parts or to get caught in any rotating parts.**
- ⚠ **When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.**
- ⚠ **When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.**

The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure. When carrying out troubleshooting, and important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

1. When carrying out troubleshooting, do not hurry to disassemble the components.
   If components are disassembled in confusion immediately after any failure occurs:
   - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
   - It will become impossible to find the cause of the failure.

   It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator. For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. Points to ask user or operator
   1) Have any other problems occurred apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure? When were these repairs carried out?
   6) Has the same kind of failure occurred before?
3. Check before troubleshooting
   1) Check for any sign of abnormality on the machine.
   2) Make checks before starting day's work.
   3) Make checks of other items.
   4) Check other maintenance items which can be visually checked and are considered necessary.
4. Confirming failure
   Confirm the extent of the failure by yourself, and judge whether to treat it as a real failure or as a problem of handling, operation, etc.
   - ★ When operating a machine to reproduce the symptom of failure for troubleshooting, do not carry out any investigation or measurement that may make the problem worse.
5. Troubleshooting
   Use the results of the investigation and inspection in items 2 – 4 to narrow down the causes of failure, then use the troubleshooting table or flowchart (matrix) to find out the failure part exactly.
   - ★ The basic procedure for troubleshooting is as follows.
     1] Start from the simple points.
     2] Start from the most likely points.
     3] Investigate other related parts or information.
6. Measures to remove root cause of failure
   Even if the immediate failure is repaired, the same failure may occur again, unless the root cause of the failure is repaired. To prevent this, always investigate why the cause of the failure occurred. Then, remove the root cause.

How to proceed troubleshooting



Checks before troubleshooting

	Check item	Judgement value	Action
Lubricating oil, coolant	1. Check fuel level and type	—	Add fuel
	2. Check for impurities in fuel	—	Clean and drain
	3. Check hydraulic oil level	Between H and L	Add oil
	4. Check oil level in damper case	—	Add oil
	5. Check power train oil level	Between H and L	Add oil
	6. Check engine oil level (engine oil pan level)	Between H and L	Add oil
	7. Check coolant level (sub-tank level)	Between H and L	Add coolant
	8. Check dust indicator for clogging	No red color	Clean or replace
	9. Check brake pedal travel	—	Adjust
Hydraulic and mechanical equipment	1. Check for abnormal noise and smell	—	Repair
	2. Check for oil leakage	—	Repair
	3. Carry out air bleeding	—	Bleed air
Electrical equipment	1.Check for looseness and corrosion of battery cable terminals	—	Retighten or replace
	2. Check for looseness and corrosion of alternator harness terminals	—	Retighten or replace
	3. Check for looseness and corrosion of starting motor harness terminals	—	Retighten or replace
	4. Check battery voltage (engine stopped)	20 – 30 V	Charge or replace
	5. Check battery electrolyte level	Between H and L	Add or replace
	6. Check for discoloration, burnout of wiring, and peeling of harness coating.	—	Repair or replace
	7. Check for missing wiring clamps and a slack of wire.	—	Repair
	8. Check for water leaking on wiring (pay particularly careful attention to water leaking on connectors or terminals)	—	Dry
	9. Check for blown or corroded fuse	—	Replace
	10. Check alternator voltage (engine running at half speed or above)	After running for several minutes: 27.5 – 29.5 V	Replace
	11. Check operating sound of battery relay (when turning starting switch ON or OFF)	—	Replace

Classification and procedures of troubleshooting

Classification of troubleshooting

Mode	Content
Code display	Troubleshooting by failure code
E-mode	Troubleshooting of electrical system
H-mode	Troubleshooting of hydraulic and mechanical system
S-mode	Troubleshooting of engine

Troubleshooting procedures

When any symptom supposed to be a failure appeared on the machine, select a troubleshooting No. according to the procedures below and proceed to the text of the relevant troubleshooting:

1. **Troubleshooting procedures when any action code is displayed on the monitor panel:**
   When an action code is displayed on the monitor panel, display a failure code in the failure code display mode (electrical system, mechanical system) on the monitor display (EMMS).
   Carry out the troubleshooting of the relevant [**failure code**] in accordance with the displayed failure code.
   - ★ Since a failure code flashes when a failure is detected, the failure has not always been corrected even if it lights when the starting switch is set to ON. (For some codes, failures can be detected by only turning the starting switch ON.)
   - ★ When a failure code has been recorded, be sure to perform the duplication operation corresponding to the failure code and confirm if the failure has still remained or has been already corrected. (For the duplication method, refer to the troubleshooting relevant to the failure code.)

2. **Troubleshooting procedures when a failure code has been recorded:**
   When no action code is displayed on the monitor panel, display a failure code in the failure code display mode (electrical system, mechanical system) on the monitor display (EMMS).
   When a failure code has been recorded, carry out the troubleshooting of the relevant [**failure code**] in accordance with the displayed failure code.
   - ★ Since a failure code flashes when a failure is detected, the failure has not always been corrected even if it lights when the starting switch is set to ON. (For some codes, failures can be detected by only turning the starting switch ON.)
   - ★ When a failure code has been recorded, be sure to perform the duplication operation corresponding to the failure code and confirm if the failure has still remained or has been already corrected. (For the duplication method, refer to the troubleshooting relevant to the failure code.)

3. **Troubleshooting procedures when no action code is displayed and a failure code has not been recorded:**
   When a failure code has not been recorded in the monitor panel (EMMS), a failure that the machine cannot diagnose by itself is supposed to have occurred in the electrical system or the hydraulic and mechanical system.
   In this case, check again a symptom supposed to be a failure and select the relevant symptom out of the table of “Symptom supposed to be failure and troubleshooting No.” Then, carry out the troubleshooting in the [**E-Mode**], [**H-Mode**] or [**S-Mode**] related to the symptom.

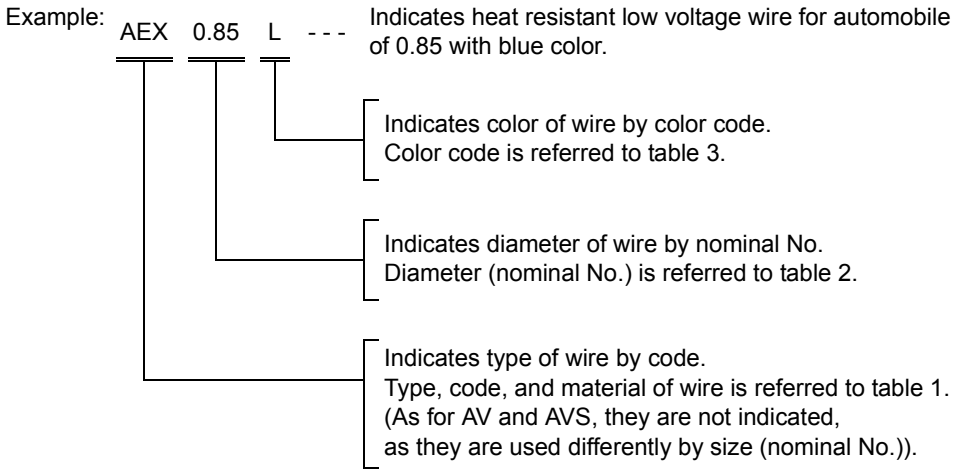
Symptom supposed to be failure and troubleshooting No.

No.	Symptom supposed to be failure		Troubleshooting			
			Code display	E-mode	H-mode	S-mode
Symptom related to action code and failure code						
1	Display action code on monitor panel.		Check failure code.			
2	Display failure code in failure code display mode.		●			
Engine related						
3	Engine is hard to start. (Engine starting always takes time.)					S-1
4	Engine does not start.	Engine does not crank.		E-1		S-2a)
5		Engine cranks but no exhaust smoke comes out.				S-2b)
6		Exhaust smoke comes out but engine does not start.				S-2c)
7	Engine does not pick-up smoothly. (Poor follow-up performance)					S-3
8	Engine stops during operation.					S-4
9	Engine does not rotate smoothly (hunting).					S-5
10	Engine lacks in output or power.					S-6
11	Exhaust smoke is black (incomplete combustion).					S-7
12	Oil consumption is excessive or exhaust smoke is blue.					S-8
13	Oil gets contaminated quickly.					S-9
14	Fuel consumption is excessive.					S-10
15	Oil mixes in coolant or coolant spurts back or coolant level goes down.					S-11
16	Engine oil pressure drops.					S-12
17	Oil level rises (water or fuel mixes).					S-13
18	Coolant temperature rises too high. (overheat)					S-14
19	Abnormal noise occurs.					S-15
20	Vibration is excessive.					S-16
21	Preheater does not operate.			E-2		
Power train related						
22	There is no travel power. (no drawbar pull)				H-1	S-6
23	Machine does not travel (at 2nd or 3rd speed)				H-2	
24	Machine does not start at any gear speed.				H-3	
25	Machine travels only in one direction, forward or reverse.				H-4	
26	Time lag is excessive at shifting gear speed or shifting forward-reverse.				H-5	
27	Machine cannot be steered. (Machine does not turn leftward or rightward.)				H-6	
28	Steering speed or power is insufficient.				H-7	
29	Brake does not work.				H-8	
30	Power train oil overheats.				H-9	
31	Abnormal sound comes out around HSS and hydraulic pump or HSS motor.				H-10	

No.	Symptom supposed to be failure	Troubleshooting			
		Code display	E-mode	H-mode	S-mode
Work equipment related					
32	Speed of all work equipments is slow.			H-11	
33	All work equipments do not move.			H-12	
34	Blade lift moves slowly or lacks power.			H-13	
35	Blade tilt moves slowly or lacks power.			H-14	
36	Ripper lift moves slowly or lacks power.			H-15	
37	Hydraulic drift of blade lift is excessive.			H-16	
38	Hydraulic drift of blade tilt is excessive.			H-17	
39	Hydraulic drift of ripper lift is excessive.			H-18	
Monitor panel related (operator mode: normal screen)					
40	Monitor panel does not light up at all when starting switch is turned ON.		E-3		
41	When starting switch is turned ON, monitor panel completely remains lighted and does not go out.		E-4		
42	While engine is running, battery charge level caution lamp flashes.		E-5		
43	While starting engine, emergency warning item lamp flashes.		E-6		
44	While preheater is operating, preheating pilot lamp does not light up.		E-7		
45	Coolant temperature gauge does not indicate properly.		E-8		
46	Power train oil temperature gauge does not indicate properly.		E-9		
47	Hydraulic oil temperature gauge does not indicate properly.		E-10		
48	Fuel gauge does not indicate properly.		E-11		
49	Gear speed and engine speed are not indicated properly.		E-12		
50	Preset mode and service meter do not indicate properly.		E-13		
51	Warning lamp does not flash or does not go out.		E-14		
52	Alarm buzzer does not sound or does not stop.		E-15		
53	Automatic shift down does not work or is not be canceled.		E-16		
54	Buzzer cancel switch does not work.		E-17		
55	Information switch does not work.		E-18		
56	Fan cleaning does not work or is not be canceled.		E-19		
57	Preset mode does not work or is not be canceled.		E-20		
Monitor panel related (service mode: special function screen)					
58	Monitor panel cannot be set in service mode or cannot be set out of service mode.		E-21		
Other items					
59	Backup alarm does not sound.		E-22		
60	Headlamp or rear lamp does not come on.		E-23		
61	Horn does not sound or does not stop.		E-24		
62	Windshield wiper is defective.		E-25		
63	Washer does not spray water.		E-26		
64	Air conditioner does not operate.		E-27		
65	KOMTRAX system does not operate normally.		E-28		

How to distinguish wire code

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.



1. Type, symbol, and material

AV is different from AVS only in terms of thickness and outer diameter of cover. And AEX is similar to AV in terms of thickness and outer diameter of coating, but different from AV and AVS in coating material.

(Table 1)

Type	Symbol	Material		Temperature range (°C) for application	Reference Applied sample
Low voltage wire for automobile application	AV	Conductor	Annealed copper wire for electricity	–30 to +60	For ordinary wiring (nominal No. is more than 5.)
		Insulator	Plasticized type polyvinyl chloride		
Thin-covered low voltage wire for automobile application	AVS	Conductor	Annealed copper wire for electricity		For ordinary wiring (nominal No. is less than 3.)
		Insulator	Plasticized type polyvinyl chloride		
Heat resistant low voltage wire for automobile application	AEX	Conductor	Annealed copper wire for electricity	–50 to +110	For ordinary wiring of extremely cold region specification, wiring in high ambient temperature
		Insulator	Heat resistant crosslinked polyethylene		

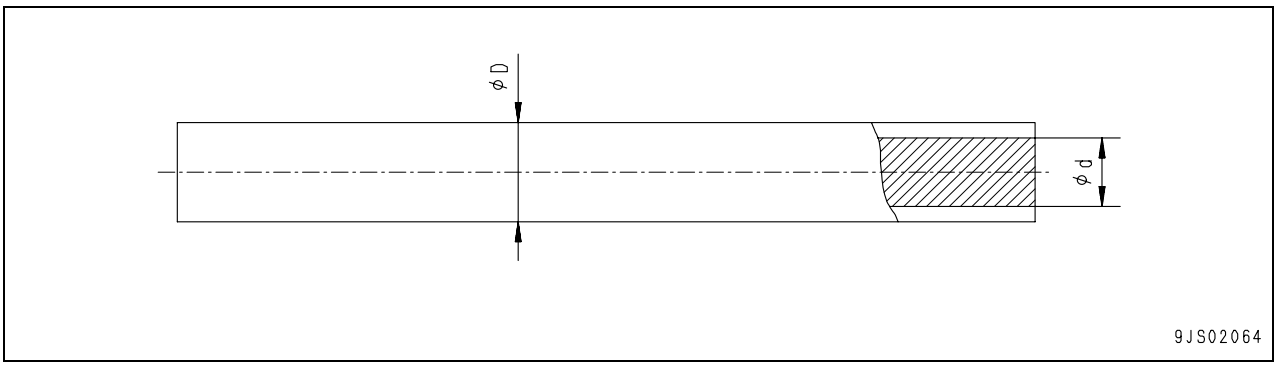
2. Size

(Table 2)

Nominal No.			0.5f	(0.5)	0.75f	(0.85)	1.25f	(1.25)	2f	2	3f	3	5
Conductor		Number of wires and diameter of element wire	20/0.18	7/0.32	30/0.18	11/0.32	50/0.18	16/0.32	37/0.26	26/0.32	58/0.26	41/0.32	65/0.32
		Section area (mm^2)	0.51	0.56	0.76	0.88	1.27	1.29	1.96	2.09	3.08	3.30	5.23
		d (approximately)	1.0		1.2		1.5		1.9	1.9	2.3	2.4	3.0
Coating D	AVS	Standard	2.0		2.2		2.5		2.9	2.9	3.5	3.6	—
	AV	Standard	—		—		—		—	—	—	—	4.6
	AEX	Standard	2.0		2.2		2.7		3.0	3.1	—	3.8	4.6

Nominal No.			8	15	20	30	40	50	60	85	100
Conductor		Number of wires and diameter of element wire	50/0.45	84/0.45	41/0.80	70/0.80	85/0.80	108/0.80	127/0.80	169/0.80	217/0.80
		Section area (mm^2)	7.95	13.36	20.61	35.19	42.73	54.29	63.84	84.96	109.1
		d (approximately)	3.7	4.8	6.0	8.0	8.6	9.8	10.4	12.0	13.6
Coating D	AVS	Standard	—	—	—	—	—	—	—	—	—
	AV	Standard	5.5	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6
	AEX	Standard	5.3	7.0	8.2	10.8	11.4	13.0	13.6	16.0	17.6

"f" of nominal No. denotes "flexible".



3. Color codes table

(Table 3)

Color code	Wire color
B	Black
Br	Brown
BrB	Brown & Black
BrR	Brown & Red
BrW	Brown & White
BrY	Brown & Yellow
Ch	Charcoal
Dg	Dark green
G	Green
GB	Green & Black
GL	Green & Blue
Gr	Gray
GR	Green & Red
GW	Green & White
GY	Green & Yellow
L	Blue
LB	Blue & Black
Lg	Light green
LgB	Light green & Black
LgR	Light green & Red
LgW	Light green & White

Color code	Wire color
LgY	Light green & Yellow
LR	Blue &Red
LW	Blue & White
LY	Blue & Yellow
O	Orange
P	Pink
R	Red
RB	Red & Black
RG	Red & Green
RL	Red & Blue
RW	Red & White
RY	Red & Yellow
Sb	Sky Blue
W	White
Y	Yellow
YB	Yellow & Black
YG	Yellow & Green
YL	Yellow & Blue
YR	Yellow & Red
YW	Yellow & White

Remarks: In a color code consisting of 2 colors, the first color is the color of the background and the second color is the color of the marking. Color code “W” is not used. “W” is used for marking.

Example: “GW” means that the background is Green and marking is White.

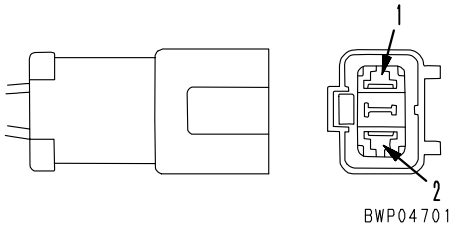
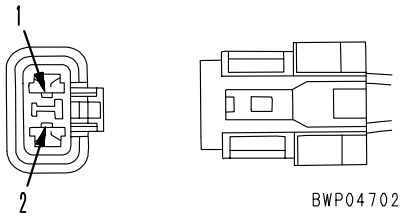
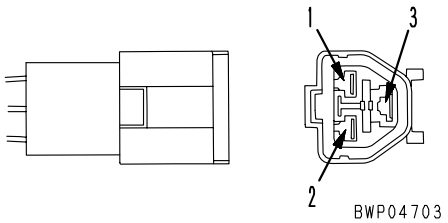
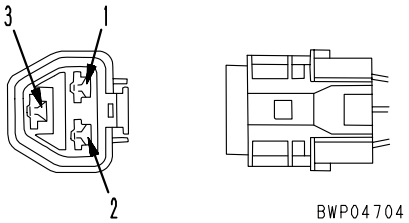
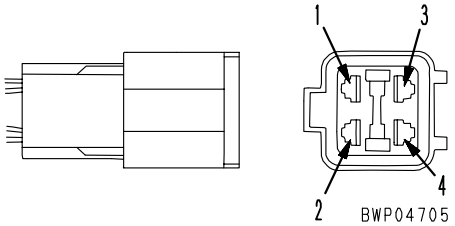
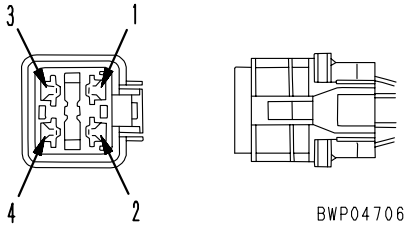
4. Types of circuits and color codes

(Table 4)

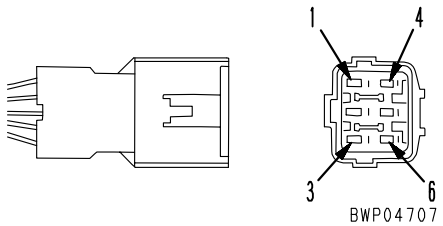
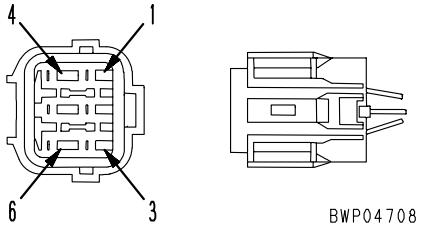
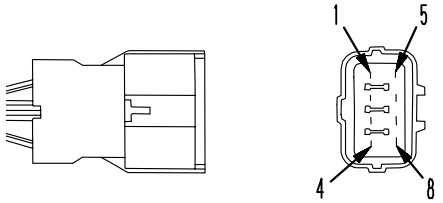
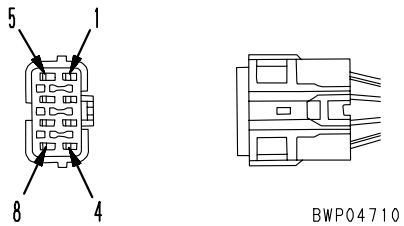
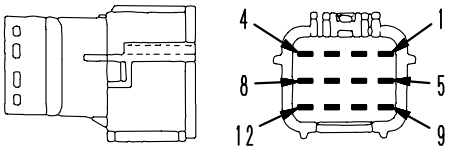
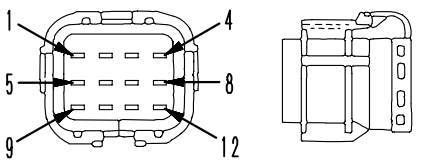
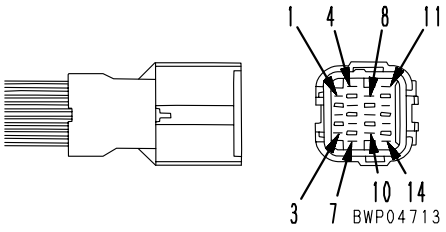
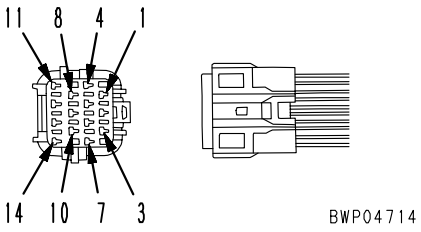
Type of wire		AVS, AV						AEX	
Type of circuit	Charge	R	WG	—	—	—	—	R	—
	Grounding	B	—	—	—	—	—	B	—
	Starting	R	—	—	—	—	—	R	—
	Lighting	RW	RB	RY	RG	RL	—	D	—
	Instrument	Y	YR	YB	YG	YL	YW	Y	Gr
	Signal	G	GW	GR	GY	GB	GL	G	Br
	Other items	L	LW	LR	LY	LB	—	L	—
		Br	BrW	BrR	BrY	BrB	—	—	—
		Lg	LgR	LgY	LgB	LgW	—	—	—
		O	—	—	—	—	—	—	—
		Gr	—	—	—	—	—	—	—
		P	—	—	—	—	—	—	—
		Sb	—	—	—	—	—	—	—
		Dg	—	—	—	—	—	—	—
		Ch	—	—	—	—	—	—	—

Wiring table for connector pin numbers

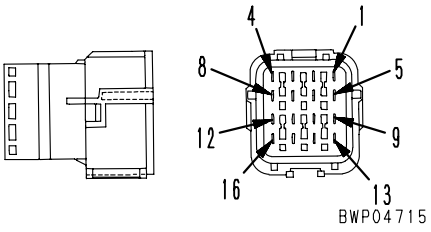
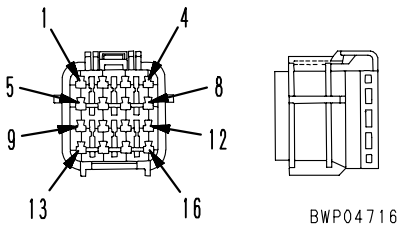
★ The terms of male and female refer to the pins, while the terms of male housing and female housing refer to the mating portion of the housing.

No. of pins	X type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No. : 08055-00181	Part No. : 08055-00191	799-601-7010
2	 BWP04701	 BWP04702	799-601-7020
	Part No. : 08055-00282	Part No. : 08055-00292	
3	 BWP04703	 BWP04704	799-601-7030
	Part No. : 08055-00381	Part No. : 08055-00391	
4	 BWP04705	 BWP04706	799-601-7040
	Part No. : 08055-00481	Part No. : 08055-00491	
—	Terminal part No. : 79A-222-3370 ·Electric wire size: 0.85 ·Grommet: Black ·Q'ty: 20	Terminal part No. : 79A-222-3390 ·Electric wire size: 0.85 ·Grommet: Black ·Q'ty: 20	—
—	Terminal part No. : 79A-222-3380 ·Electric wire size: 2.0 ·Grommet: Red ·Q'ty: 20	Terminal part No. : 79A-222-3410 ·Electric wire size: 2.0 ·Grommet: Red ·Q'ty: 20	—

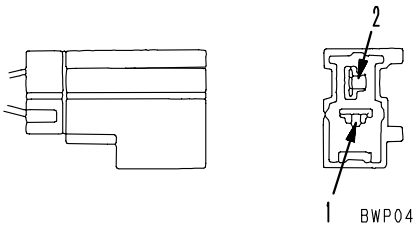
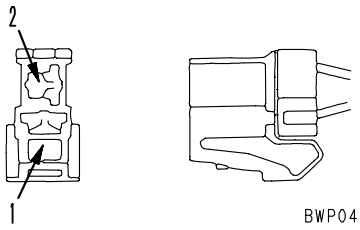
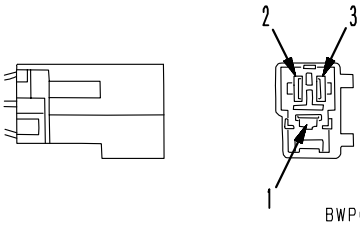
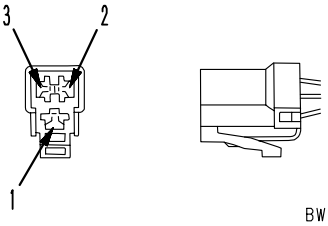
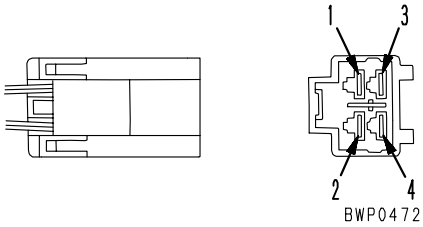
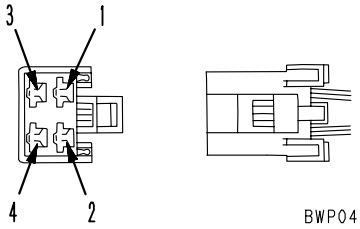
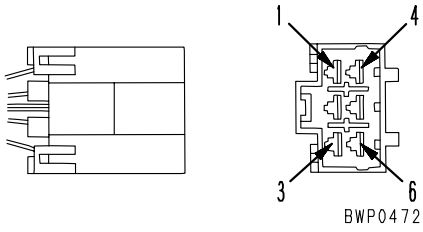
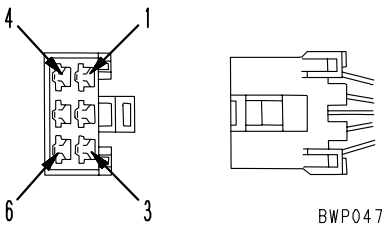
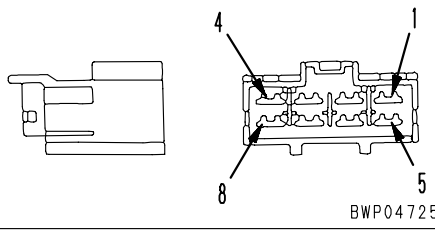
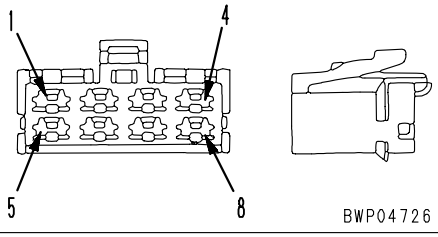
9JS04890

No. of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
6			799-601-7050
	Part No. : 08055-10681	Part No. : 08055-10691	
8			799-601-7060
	Part No. : 08055-10881	Part No. : 08055-10891	
12			799-601-7310
	Part No. : 08055-11281	Part No. : 08055-11291	
14			799-601-7070
	Part No. : 08055-11481	Part No. : 08055-11491	

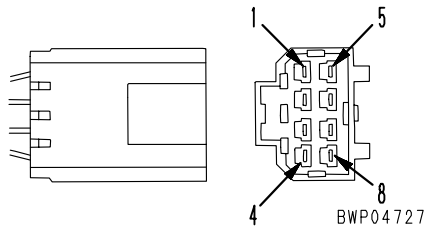
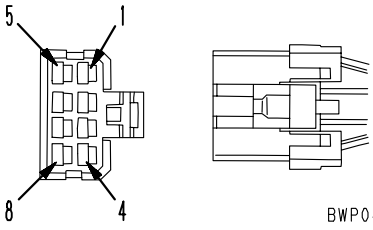
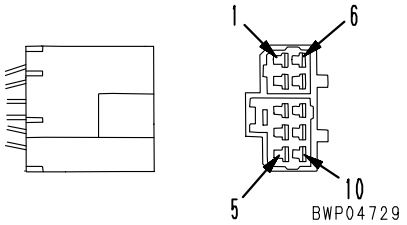
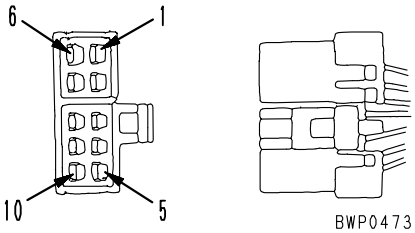
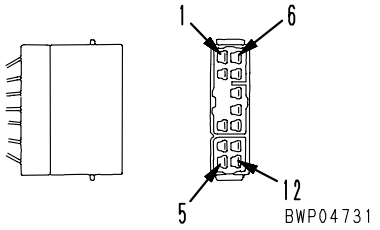
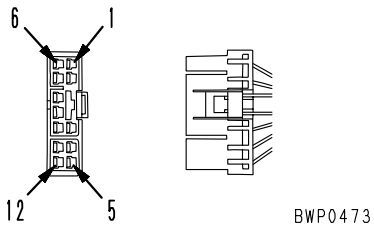
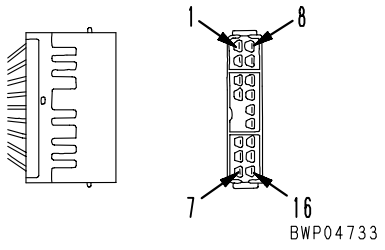
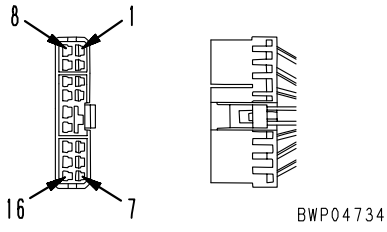
9JS04891

No. of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
16	 BWP04715	 BWP04716	799-601-7320
	Part No. : 08055-11681	Part No. : 08055-11691	
—	Terminal part No. : ·Electric wire size: 0.85 ·Grommet: Black ·Q'ty: 20	Terminal part No. : ·Electric wire size: 0.85 ·Grommet: Black ·Q'ty: 20	—
—	Terminal part No. : ·Electric wire size: 1.25 ·Grommet: Red ·Q'ty: 20	Terminal part No. : ·Electric wire size: 1.25 ·Grommet: Red ·Q'ty: 20	—

9JS04892

No. of pins	M type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No. : 08056-00171	Part No. : 08056-00181	799-601-7080
2	 BWP04717	 BWP04718	799-601-7090
	Part No. : 08056-00271	Part No. : 08056-00281	
3	 BWP04719	 BWP04720	799-601-7110
	Part No. : 08056-00371	Part No. : 08056-00381	
4	 BWP04721	 BWP04722	799-601-7120
	Part No. : 08056-00471	Part No. : 08056-00481	
6	 BWP04723	 BWP04724	799-601-7130
	Part No. : 08056-00671	Part No. : 08056-00681	
8	 BWP04725	 BWP04726	799-601-7340
	Part No. : 08056-00871	Part No. : 08056-00881	

9JS04893

No. of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8	 BWP04727	 BWP04728	799-601-7140
	Part No. : 08056-10871	Part No. : 08056-10881	
10 (White)	 BWP04729	 BWP04730	799-601-7150
	Part No. : 08056-11071	Part No. : 08056-11081	
12 (White)	 BWP04731	 BWP04732	799-601-7350
	Part No. : 08056-11271	Part No. : 08056-11281	
16 (White)	 BWP04733	 BWP04734	799-601-7330
	Part No. : 08056-11671	Part No. : 08056-11681	

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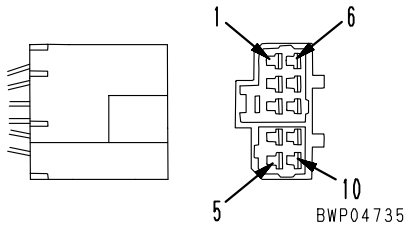
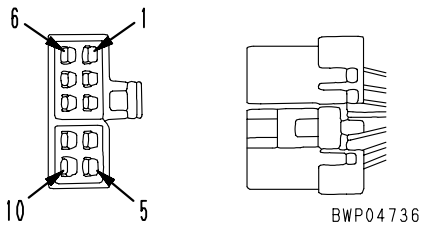
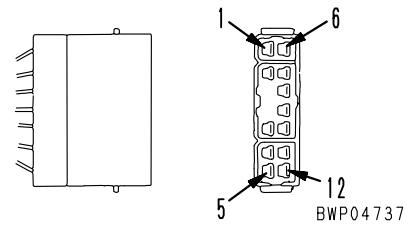
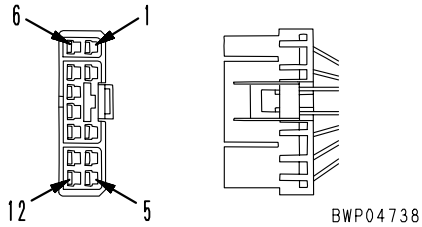
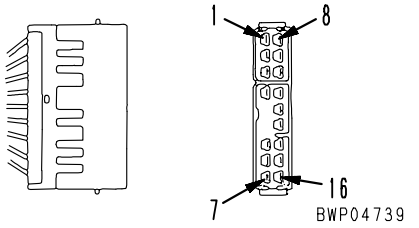
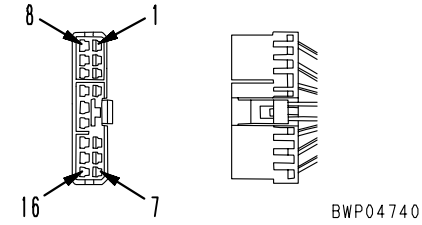
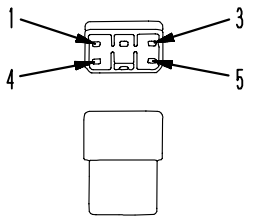
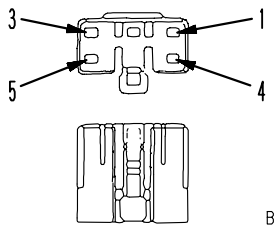
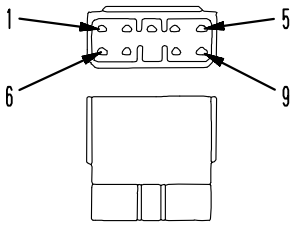
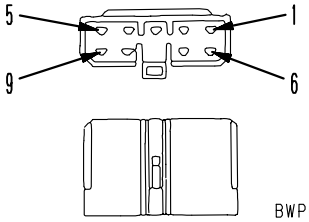
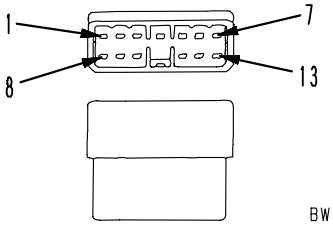
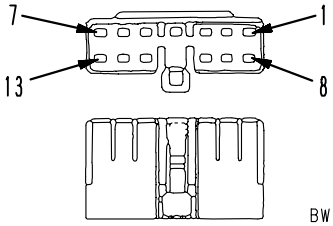
No. of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10 (Blue)			—
	—	—	
12 (Blue)			799-601-7160
	Part No. : 08056-11272	Part No. : 08056-11282	
16 (Blue)			799-601-7170
	Part No. : 08056-11672	Part No. : 08056-11682	

9JS04895

No. of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
7	Body part No. : 79A-222-2640 (Q'ty:5)	Body part No. : 79A-222-2630 (Q'ty:5)	—
11	Body part No. : 79A-222-2680 (Q'ty:5)	Body part No. : 79A-222-2670 (Q'ty:5)	—
5	 BWP04741	 BWP04742	799-601-2710
	Body part No. : 79A-222-2620 (Q'ty:5)	Body part No. : 79A-222-2610 (Q'ty:5)	
9	 BWP04743	 BWP04744	799-601-2950
	Body part No. : 79A-222-2660 (Q'ty:5)	Body part No. : 79A-222-2650 (Q'ty:5)	
13	 BWP04745	 BWP04746	799-601-2720
	Body part No. : 79A-222-2710 (Q'ty:2)	Body part No. : 79A-222-2690 (Q'ty:2)	

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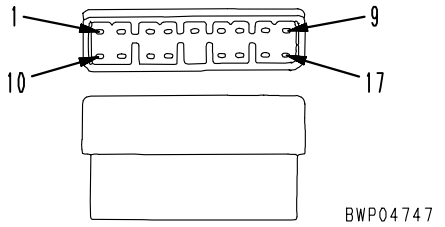
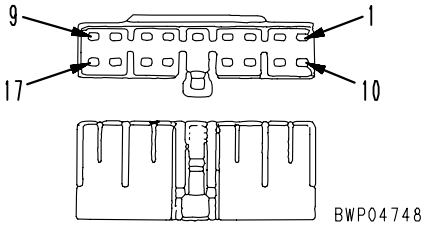
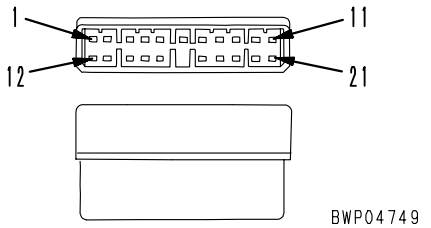
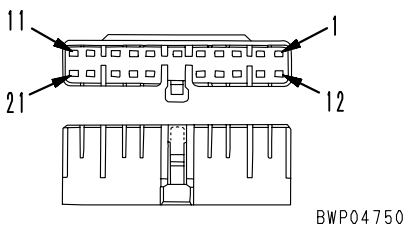
No. of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
17	 BWP04747	 BWP04748	799-601-2730
	Body part No. : 79A-222-2730 (Q'ty:2)	Body part No. : 79A-222-2720 (Q'ty:2)	
21	 BWP04749	 BWP04750	799-601-2740
	Body part No. : 79A-222-2750 (Q'ty:2)	Body part No. : 79A-222-2740 (Q'ty:2)	
	Terminal part No. : 79A-222-2770 (Q'ty:50)	Terminal part No. : 79A-222-2760 (Q'ty:50)	

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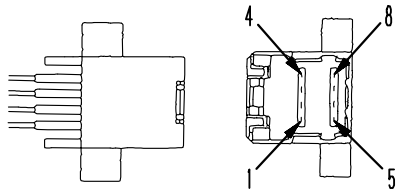
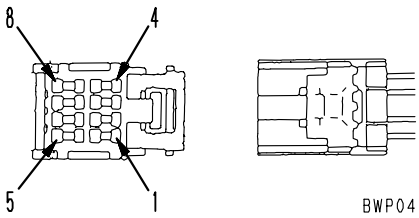
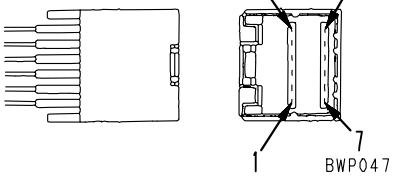
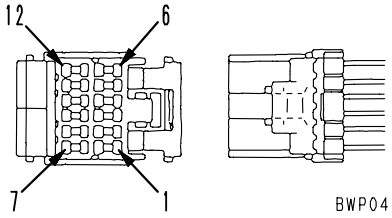
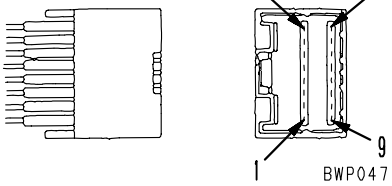
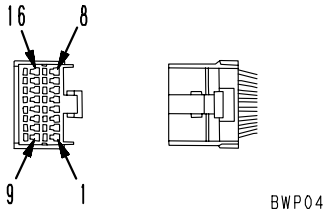
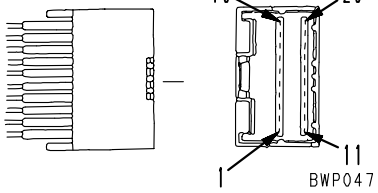
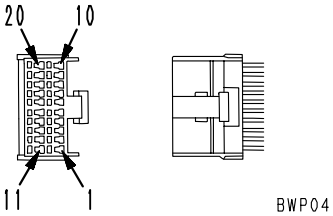
No. of pins	AMP040 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8	 BWP04751	 BWP04752	799-601-7180
	—	Housing part No. : 79A-222-3430 (Q'ty:5)	
12	 BWP04753	 BWP04754	799-601-7190
	—	Housing part No. : 79A-222-3440 (Q'ty:5)	
16	 BWP04755	 BWP04756	799-601-7210
	—	Housing part No. : 79A-222-3450 (Q'ty:5)	
20	 BWP04757	 BWP04758	799-601-7220
	—	Housing part No. : 79A-222-3460 (Q'ty:5)	

★ Terminal part No. :79A-222-3470 (No relation with number of pins)

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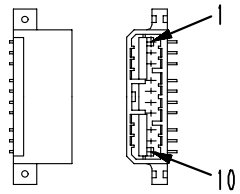
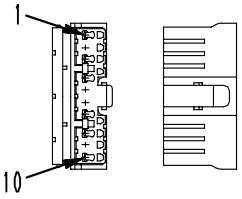
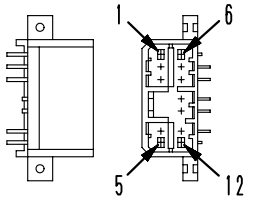
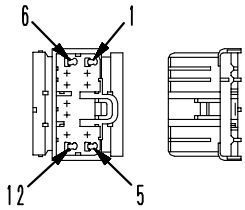
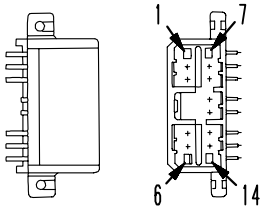
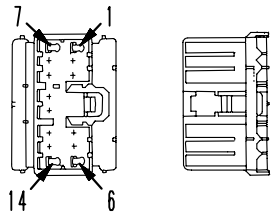
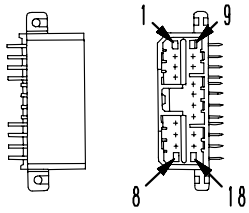
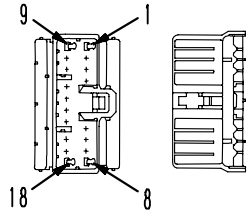
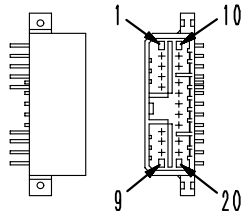
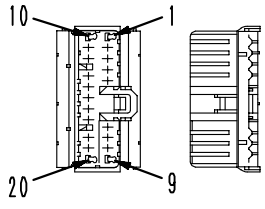
No. of pins	AMP070 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10	 BWP04759	 BWP04760	799-601-7510
	—	Part No. : 7821-92-7330	
12	 BWP04761	 BWP04762	799-601-7520
	—	Part No. : 7821-92-7340	
14	 BWP04763	 BWP04764	799-601-7530
	—	Part No. : 7821-92-7350	
18	 BWP04765	 BWP04766	799-601-7540
	—	Part No. : 7821-92-7360	
20	 BWP04767	 BWP04768	799-601-7550
	—	Part No. : 7821-92-7370	

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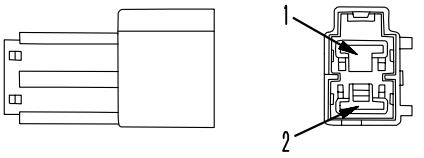
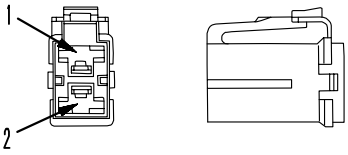
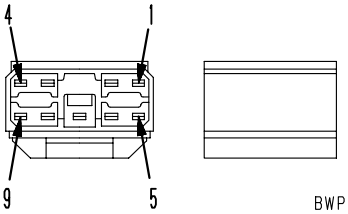
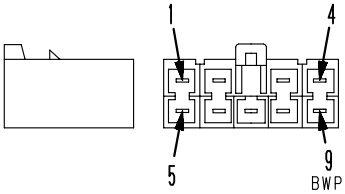
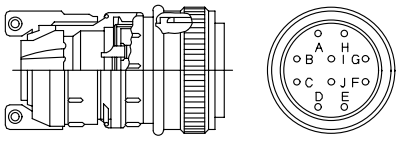
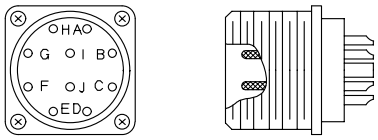
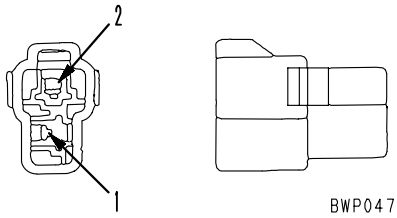
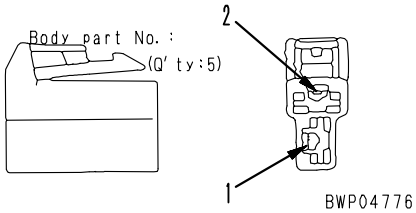
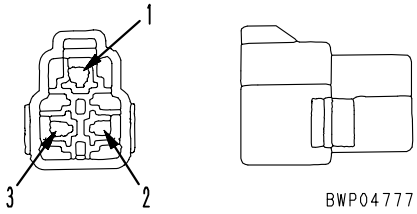
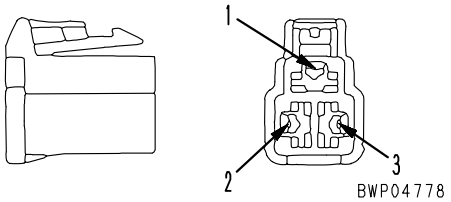
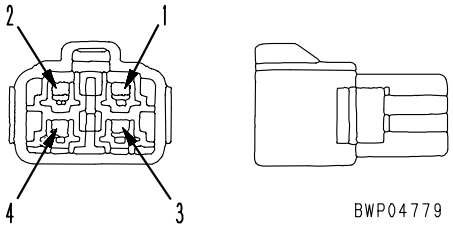
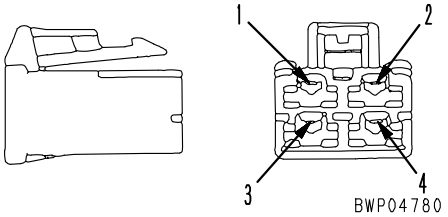
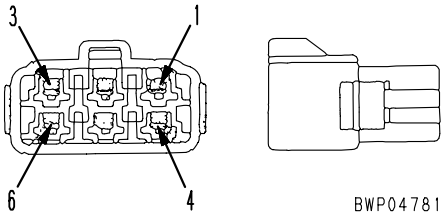
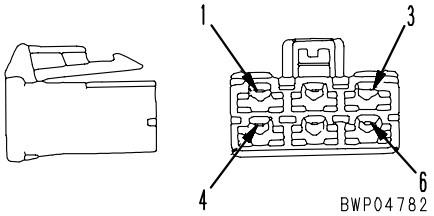
No. of pins	L type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2	 BWP04769	 BWP04770	—
	—	—	

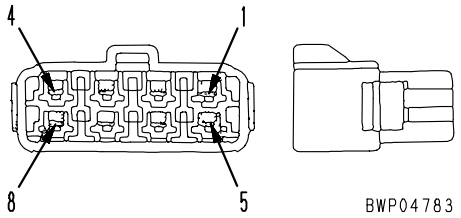
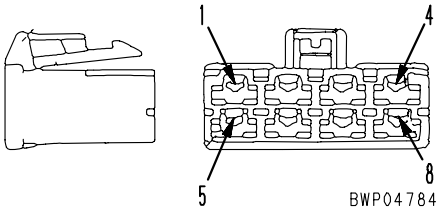
No. of pins	Connector for PA		
	Male (female housing)	Female (male housing)	T-adapter Part No.
9	 BWP04771	 BWP04772	—
	—	—	

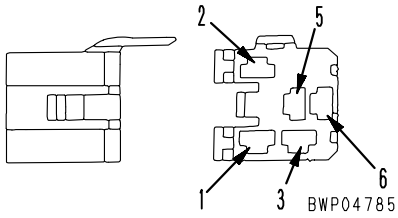
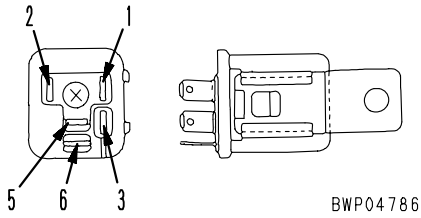
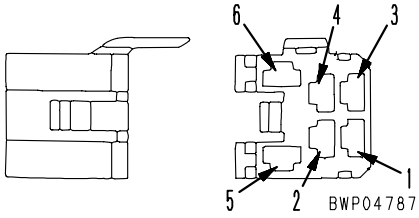
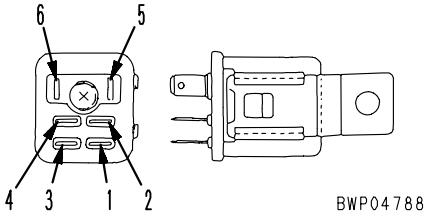
No. of pins	Bendix MS connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10	 BWP04773	 BWP04774	799-601-3460
	—	—	

9JS04900

No. of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2			—
	Part No. : 08027-10210 (Natural color) 08027-10220 (Black)	Part No. : 08027-10260 (Natural color) 08027-10270 (Black)	
3			—
	Part No. : 08027-10310	Part No. : 08027-10360	
4			—
	Part No. : 08027-10410 (Natural color) 08027-10420 (Black)	Part No. : 08027-10460 (Natural color) 08027-10470 (Black)	
6			—
	Part No. : 08027-10610 (Natural color) 08027-10620 (Black)	Part No. : 08027-10660 (Natural color) 08027-10670 (Black)	

9JS04901

No. of pins	KES1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			—
	Part No. :08027-10810 (Natural color) 08027-10820 (Black)	Part No. :08027-10860 (Natural color) 08027-10870 (Black)	

No. of pins	Connector for relay (Socket type)		
	Male (female housing)	Female (male housing)	T-adapter Part No.
5			799-601-7360
	—	—	
6			799-601-7370
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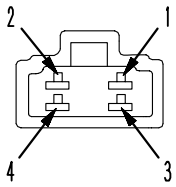
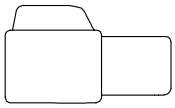
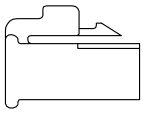
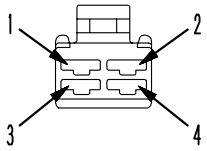
9JS04902

No. of pins	F type connector				T-adapter Part No.
	Male (female housing)		Female (male housing)		
4		 BWP03905		 BWP03906	—
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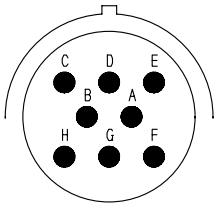
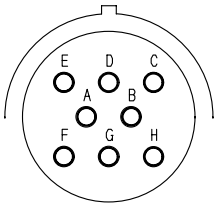
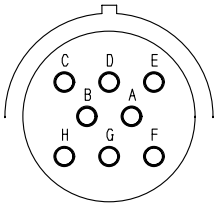
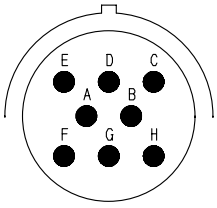
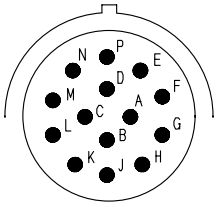
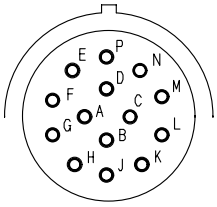
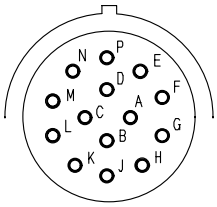
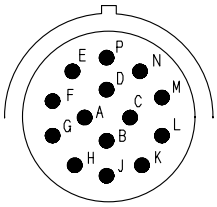
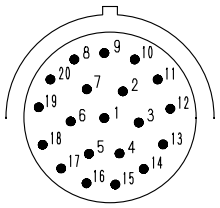
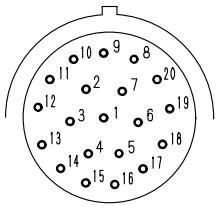
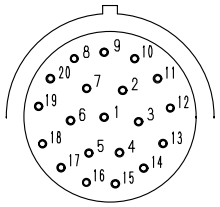
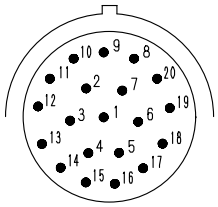
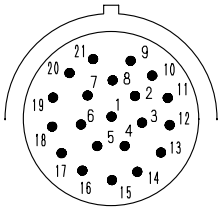
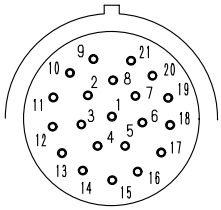
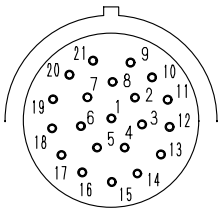
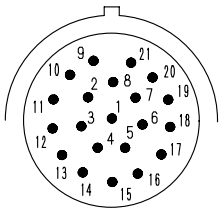
9JS04903

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
18-8 (1)	Pin (male terminal)	Pin (female termial)	799-601-9210
	 BWP05001	 BWP05002	
	Part No. :08191-11201, 08191-11202, 08191-11205, 08191-11206	Part No. :08191-14101, 08191-14102, 08191-14105, 08191-14106	
	Pin (female terminal)	Pin (male termial)	799-601-9210
	 BWP05003	 BWP05004	
	Part No. :08191-12201, 08191-12202, 08191-12205, 08191-12206	Part No. :08191-13101, 08191-13102, 08191-13105, 08191-13106	
18-14 (2)	Pin (male terminal)	Pin (female termial)	799-601-9220
	 BWP05005	 BWP05006	
	Part No. :08191-21201, 08191-12202, 08191-21205, 08191-12206	Part No. :08191-24101, 08191-24102, 08191-24105, 08191-24106	
	Pin (female terminal)	Pin (male termial)	799-601-9220
	 BWP05007	 BWP05008	
	Part No. :08191-22201, 08191-22202, 08191-22205, 08191-22206	Part No. :08191-23101, 08191-23102, 08191-23105, 08191-23106	

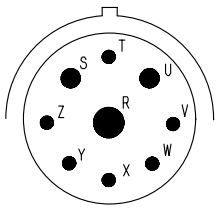
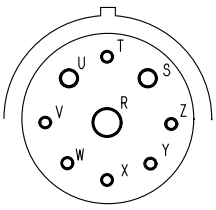
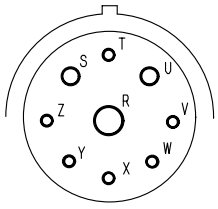
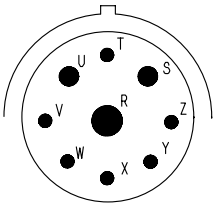
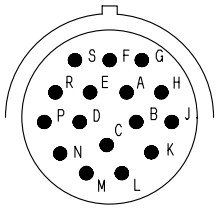
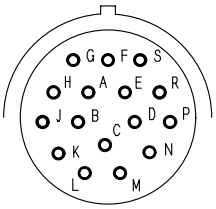
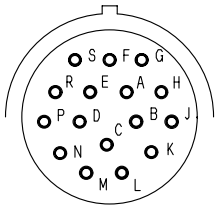
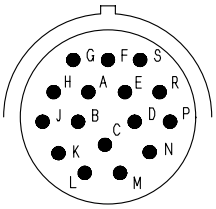
9JS04904

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
18-20 (3)	Pin (male terminal)	Pin (female termial)	799-601-9230
	 BWP05009	 BWP05010	
	Part No. :08191-31201, 08191-31202	Part No. :08191-34101, 08191-34102	
	Pin (female terminal)	Pin (male termial)	799-601-9230
	 BWP05011	 BWP05012	
	Part No. :08191-32201, 08191-32202	Part No. :08191-33101, 08191-33102	
18-21 (4)	Pin (male terminal)	Pin (female termial)	799-601-9240
	 BWP05013	 BWP05014	
	Part No. :08191-41201, 08191-42202	Part No. :08191-44101, 08191-44102	
	Pin (female terminal)	Pin (male termial)	799-601-9240
	 BWP05015	 BWP05016	
	Part No. :08191-42201, 08191-42202	Part No. :08191-43101, 08191-43102	

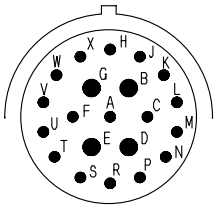
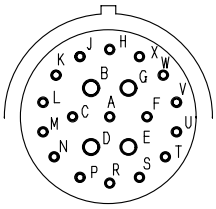
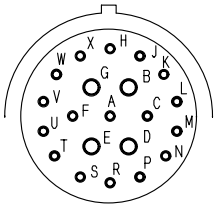
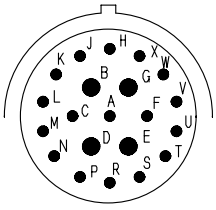
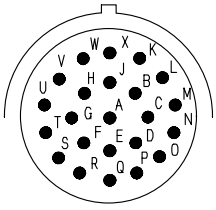
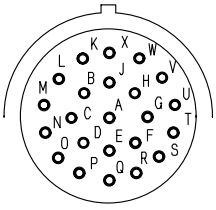
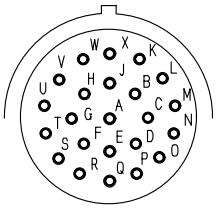
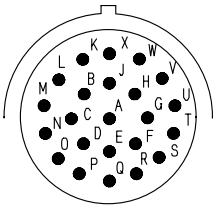
9JS04905

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
24-9 (5)	Pin (male terminal)	Pin (female termial)	799-601-9250
	 BWP05017	 BWP05018	
	Part No. :08191-51201, 08191-51202	Part No. :08191-54101, 08191-54102	
	Pin (female terminal)	Pin (male termial)	799-601-9250
	 BWP05019	 BWP05020	
	Part No. :08191-52201, 08191-52202	Part No. :08191-53101, 08191-53102	
24-16 (6)	Pin (male terminal)	Pin (female termial)	799-601-9260
	 BWP05021	 BWP05022	
	Part No. :08191-61201, 08191-62202, 08191-61205, 08191-62206	Part No. :08191-64101, 08191-64102, 08191-64105, 08191-64106	
	Pin (female terminal)	Pin (male termial)	799-601-9260
	 BWP05023	 BWP05024	
	Part No. :08191-62201, 08191-62202, 08191-62205, 08191-62206	Part No. :08191-63101, 08191-63102, 08191-63105, 08191-63106	

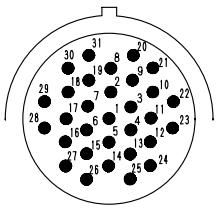
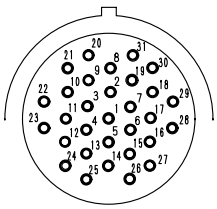
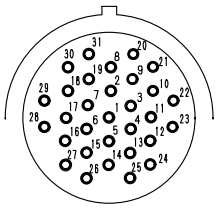
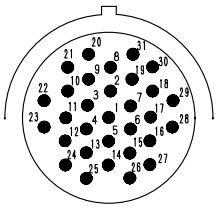
9JS04906

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
24-21 (7)	Pin (male terminal)	Pin (female termial)	799-601-9270
	 BWP05025	 BWP05026	
	Part No. :08191-71201, 08191-71202, 08191-71205, 08191-71206	Part No. :08191-74101, 08191-74102, 08191-74105, 08191-74106	
	Pin (female terminal)	Pin (male termial)	799-601-9270
	 BWP05027	 BWP05028	
	Part No. :08191-72201, 08191-72202, 08191-72205, 08191-72206	Part No. :08191-73101, 08191-73102, 08191-73105, 08191-73106	
24-23 (8)	Pin (male terminal)	Pin (female termial)	799-601-9280
	 BWP05029	 BWP05030	
	Part No. :08191-81201, 08191-81202, 08191-81203, 08191-81204, 08191-81205, 08191-80206	Part No. :08191-84101, 08191-84102, 08191-84103, 08191-84104, 08191-84105, 08191-84106	
	Pin (female terminal)	Pin (male termial)	799-601-9280
	 BWP05031	 BWP05032	
	Part No. :08191-82201, 08191-82202, 08191-82203, 08191-82204, 08191-82205, 08191-82206	Part No. :08191-83101, 08191-83102, 08191-83103, 08191-83104, 08191-83105, 08191-83106	

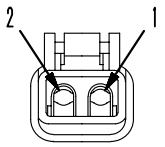
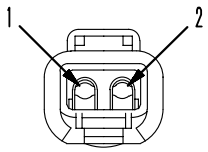
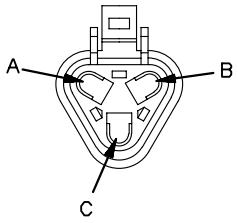
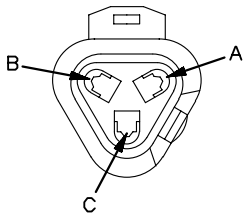
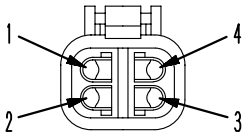
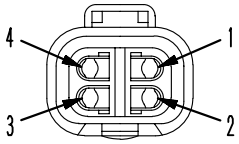
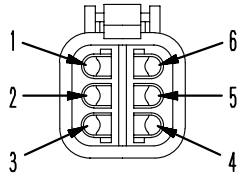
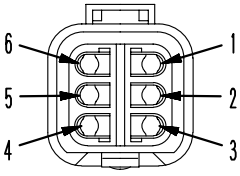
9JS04907

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
24-31 (9)	Pin (male terminal)	Pin (female termial)	799-601-9290
	 BWP05033	 BWP05034	
	Part No. :08191-91203, 08191-91204, 08191-91205, 08191-91206	Part No. :08191-94103, 08191-94104, 08191-94105, 08191-94106	
	Pin (female terminal)	Pin (male termial)	799-601-9290
	 BWP05035	 BWP05036	
	Part No. :08191-92203, 08191-92204, 08191-92205, 08191-92206	Part No. :08191-93103, 08191-93104, 08191-93105, 08191-93106	

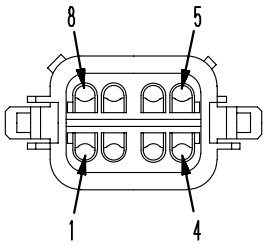
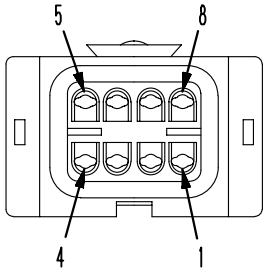
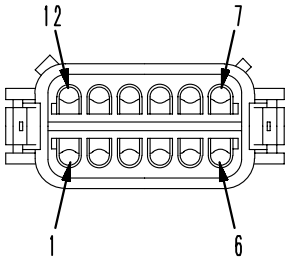
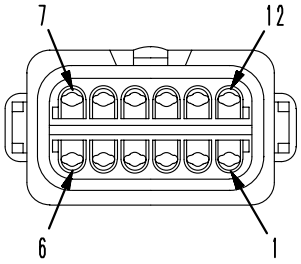
9JS04908

[The pin No. is also marked on the connector (electric wire insertion end)]

No. of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05037	 BWP05038	799-601-9020
	Part No. :08192-12200 (normal type) 08192-22200 (fine wire type)	Part No. :08192-12100 (normal type) 08192-22100 (fine wire type)	
3	 BWP05039	 BWP05040	799-601-9030
	Part No. :08192-13200 (normal type) 08192-23200 (fine wire type)	Part No. :08192-13100 (normal type) 08192-23100 (fine wire type)	
4	 BWP05041	 BWP05042	799-601-9040
	Part No. :08192-14200 (normal type) 08192-24200 (fine wire type)	Part No. :08192-14100 (normal type) 08192-24100 (fine wire type)	
6	 BWP05043	 BWP05044	799-601-9050
	Part No. :08192-16200 (normal type) 08192-26200 (fine wire type)	Part No. :08192-16100 (normal type) 08192-26100 (fine wire type)	

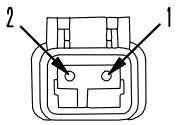
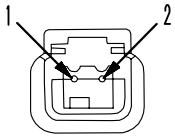
9JS04909

[The pin No. is also marked on the connector (electric wire insertion end)]

No. of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
8	 BWP05045	 BWP05046	8GR:799-601-9060 8B: 799-601-9070 8G: 799-601-9080 8BR:799-601-9090
	Part No.:08192-1820□ (normal type) 08192-2820□ (fine wire type)	Part No.:08192-1810□ (normal type) 08192-2810□ (fine wire type)	
12	 BWP05047	 BWP05048	12GR:799-601-9110 12B: 799-601-9120 12G: 799-601-9130 12BR:799-601-9140
	Part No.:08192-1920□ (normal type) 08192-2920□ (fine wire type)	Part No.:08192-1910□ (normal type) 08192-2910□ (fine wire type)	

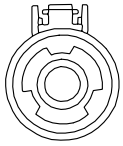
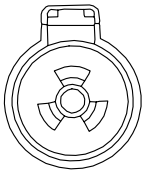
9JS04910

[The pin No. is also marked on the connector (electric wire insertion end)]

No. of pins	DTM Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05049	 BWP05050	799-601-9010
	Part No. :08192-02200	Part No. :08192-02100	

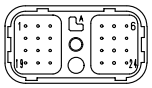
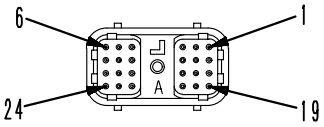
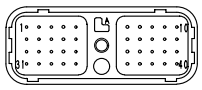
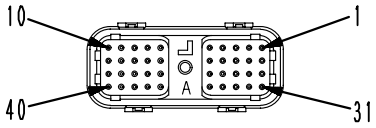
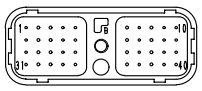
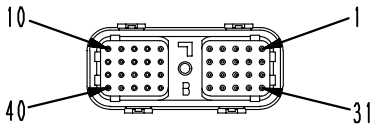
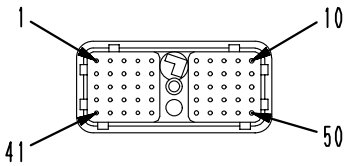
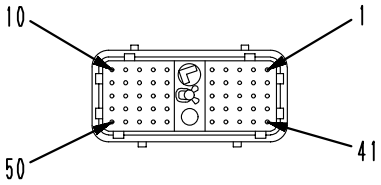
9JS04911

[The pin No. is also marked on the connector (electric wire insertion end)]

No. of pins	DTHD Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05051	 BWP05052	—
	Part No. :08192-31200 (Contact size #12) 08192-41200 (Contact size #8) 08192-51200 (Contact size #4)	Part No. :08192-31100 (Contact size #12) 08192-41100 (Contact size #8) 08192-51100 (Contact size #4)	

9JS04912

[The pin No. is also marked on the connector (electric wire insertion end)]

No. of pins	DRC26 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
24	 BJD12722	 BJD12723	799-601-9360
	–	Part No. :7821-93-3110	
40 (A)	 BJD12724	 BJD12725	799-601-9350
	–	Part No. :7821-93-3120	
40 (B)	 BJD12726	 BJD12727	799-601-9350
	–	Part No. :7821-93-3130	
50	 9JS02951	 9JS02952	799-601-4210
	–	–	

9JS04913

T-adapter box and T-adapter table

★ The vertical column shows part number of T-Branch Box or T-Branch, and horizontal column shows part number of T-Branch.

Part No.	Part name	No. of pins	Identification code	T-adapter kit																	out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-2600	T-adapter box (for ECONO)	21		●		●	●						●	●		●					
799-601-3100	T-adapter box (for MS)	37						●													
799-601-3200	T-adapter box (for MS)	37						●													
799-601-3300	T-adapter box (for ECONO)	24								●											
799-601-3360	• Plate for MS (24 pins)									●											
799-601-3370	• Plate for MS (17 pins)									●											
799-601-3380	• Plate for MS (14 pins)									●											
799-601-3410	Adapter for BENDIX (MS)	24	MS-24P							●	●										
799-601-3420	Adapter for BENDIX (MS)	24	MS-24P							●	●										
799-601-3430	Adapter for BENDIX (MS)	17	MS-17P							●	●										
799-601-3440	Adapter for BENDIX (MS)	17	MS-17P							●	●										
799-601-3450	Adapter for BENDIX (MS)	5	MS-5P						●	●											
799-601-3460	Adapter for BENDIX (MS)	10	MS-10P							●	●										
799-601-3510	Adapter for BENDIX (MS)	5	MS-5S						●	●											
799-601-3520	Adapter for BENDIX (MS)	17	MS-17P						●	●											
799-601-3530	Adapter for BENDIX (MS)	19	MS-19P							●	●										
799-601-2910	Adapter for BENDIX (MS)	14	MS-14P						●	●											
799-601-3470	Case									●											
799-601-2710	Adapter for MIC	5	MIC-5P	●	●		●							●							
799-601-2720	Adapter for MIC	13	MIC-13P	●	●		●							●							
799-601-2730	Adapter for MIC	17	MIC-17P	●	●	●	●						●	●		●					
799-601-2740	Adapter for MIC	21	MIC-21P	●	●	●	●						●	●		●					
799-601-2950	Adapter for MIC	9	MIC-9P									●	●	●		●					
799-601-2750	Adapter for ECONO	2	ECONO 2P	●	●																
799-601-2760	Adapter for ECONO	3	ECONO 3P	●	●																
799-601-2770	Adapter for ECONO	4	ECONO 4P	●	●																
799-601-2780	Adapter for ECONO	8	ECONO 8P	●	●																
799-601-2790	Adapter for ECONO	12	ECONO 12P	●	●																
799-601-2810	Adapter for DLI	8	DLI-8P	●	●																
799-601-2820	Adapter for DLI	12	DLI-12P	●	●																
799-601-2830	Adapter for DLI	16	DLI-16P	●	●																
799-601-2840	Extension cable (ECONO type)	12	ECONO 12P	●	●									●							
799-601-2850	Case			●																	
799-601-4210	Adapter for DRC	50	DRC50																		●
799-601-7010	Adapter for X (T adapter)	1												●		●					

Part No.	Part name	No. of pins	Identification code	T-adapter kit																	out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-7020	Adapter for X	2	X2P									●	●	●		●					
799-601-7030	Adapter for X	3	X3P									●	●	●		●					
799-601-7040	Adapter for X	4	X4P									●	●	●		●					
799-601-7050	Adapter for SWP	6	SW6P									●	●	●							
799-601-7060	Adapter for SWP	8	SW8P									●	●	●							
799-601-7310	Adapter for SWP	12	SW12P																		●
799-601-7070	Adapter for SWP	14	SW14P											●		●					
799-601-7320	Adapter for SWP	16	SW16P																		●
799-601-7080	Adapter for M (T-adapter)	1												●		●					
799-601-7090	Adapter for M	2	M2P									●	●	●		●					
799-601-7110	Adapter for M	3	M3P									●	●	●		●					
799-601-7120	Adapter for M	4	M4P									●	●	●		●					
799-601-7130	Adapter for M	6	M6P									●	●	●		●					
799-601-7340	Adapter for M	8	M8P																		●
799-601-7140	Adapter for S	8	S8P									●	●	●		●					
799-601-7150	Adapter for S (white)	10	S10P									●	●	●		●					
799-601-7160	Adapter for S (blue)	12	S12P									●	●	●							
799-601-7170	Adapter for S (blue)	16	S16P									●	●	●		●					
799-601-7330	Adapter for S (white)	16	S16PW													●					
799-601-7350	Adapter for S (white)	12	S12PW																		●
799-601-7180	Adapter for AMP040	8	A8P											●							
799-601-7190	Adapter for AMP040	12	A12P											●		●					
799-601-7210	Adapter for AMP040	16	A16P									●	●	●		●					
799-601-7220	Adapter for AMP040	20	A20P									●	●	●		●					
799-601-7230	Short socket adapter for X	2										●	●	●		●					
799-601-7240	Case											●	●								
799-601-7270	Case													●							
799-601-7510	Adapter for 070	10	07-10												●						
799-601-7520	Adapter for 070	12	07-12												●						
799-601-7530	Adapter for 070	14	07-14												●						
799-601-7540	Adapter for 070	18	07-18												●						
799-601-7550	Adapter for 070	20	07-20												●						
799-601-7360	Adapter for relay	5	REL-5P																		●
799-601-7370	Adapter for relay	6	REL-6P																		●
799-601-7380	Adapter for JFC	2																			●
799-601-9010	Adapter for DTM	2	DTM2														●		●		
799-601-9020	Adapter for DT	2	DT2														●		●		
799-601-9030	Adapter for DT	3	DT3														●		●		
799-601-9040	Adapter for DT	4	DT4														●		●		
799-601-9050	Adapter for DT	6	DT6														●		●		
799-601-9060	Adapter for DT (gray)	8	DT8GR														●		●		
799-601-9070	Adapter for DT (black)	8	DT8B														●		●		
799-601-9080	Adapter for DT (green)	8	DT8G														●		●		
799-601-9090	Adapter for DT (brown)	8	DT8BR														●		●		

Part No.	Part name	No. of pins	Identification code	T-adapter kit																out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-9110	Adapter for DT (gray)	12	DT12GR														●		●		
799-601-9120	Adapter for DT (black)	12	DT12B														●		●		
799-601-9130	Adapter for DT (green)	12	DT12G														●		●		
799-601-9140	Adapter for DT	12	DT12BR														●		●		
799-601-9210	Adapter for HD30-18	8	D18-8														●	●			
799-601-9220	Adapter for HD30-18	14	D18-14														●	●			
799-601-9230	Adapter for HD30-18	20	D18-20														●	●			
799-601-9240	Adapter for HD30-18	21	D18-21														●	●			
799-601-9250	Adapter for HD30-24	9	D24-9														●	●			
799-601-9260	Adapter for HD30-24	16	D24-16														●	●			
799-601-9270	Adapter for HD30-24	21	D24-21														●	●			
799-601-9280	Adapter for HD30-24	23	D24-23														●	●			
799-601-9290	Adapter for HD30-24	31	D24-31														●	●			
799-601-9310	Plate for HD30 (24 pins)																●	●		●	
799-601-9320	T-adapter box (for DT and HD)	12															●	●		●	
799-601-9330	Case																●				
799-601-9340	Case																	●			
799-601-9350	Adapter for DRC	40	DRC-40																	●	
799-601-9360	Adapter for DRC	24	DRC-24																	●	
799-601-9410	Adapter for engine (CRI-T2)	2	G																		●
799-601-9420	Adapter for engine (CRI-T2) Adapter for engine (CRI-T3)	3	A3																		●
799-601-9430	Adapter for engine (CRI-T2) Adapter for engine (CRI-T3)	2	P																		●
799-601-9440	Adapter for engine (CRI-T2)	3	1,2,3																		●
795-799-5520	Adapter for engine (HPI-T2)	2	S																		●
795-799-5530	Adapter for engine (HPI-T2) Adapter for engine (CRI-T3)	2	C																		●
795-799-5540	Adapter for engine (HPI-T2) Adapter for engine (CRI-T3)	2	A																		●
795-799-5460	Cable for engine (HPI-T2)	3																			●
795-799-5470	Cable for engine (HPI-T2)	3																			●
795-799-5480	Cable for engine (HPI-T2)	3																			●
799-601-4160	Adapter for engine (CRI-T3)	2	OIL																		●
799-601-4340	Adapter for engine (CRI-T3)	2	1,2,3																		●
799-601-4130	Adapter for engine (CRI-T3)	3	FCIN																		●
799-601-4140	Adapter for engine (CRI-T3)	3	FCIG																		●
799-601-4150	Adapter for engine (CRI-T3)	3	FCIB																		●
799-601-4180	Adapter for engine (CRI-T3)	3	FCIP3																		●
799-601-4190	Adapter for engine (CRI-T3)	3	1,2,3																		●
799-601-4240	Adapter for engine (CRI-T3)	3	1,2,3																		●
799-601-4250	Adapter for engine (CRI-T3)	3	1,2,3																		●
799-601-4330	Adapter for engine (CRI-T3)	3	1,2,3																		●
799-601-4230	Adapter for engine (CRI-T3)	4	1,2,3,4																		●

Part No.	Part name	No. of pins	Identification code	T-adapter kit																	out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-4260	Adapter for controller (ENG)	4	DTP4																		●
799-601-4210	Adapter for controller (ENG)	50	DRC50																		●
799-601-4220	Adapter for controller (ENG)	60	DRC60																		●
799-601-4280	Box for controller (PUMP)	121																			●
799-601-9720	Adapter for controller (HST)	16	HST16A																		●
799-601-9710	Adapter for controller (HST)	16	HST16B																		●
799-601-9370	Adapter for controller (HST)	26	HST26A																		●

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00588-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

Troubleshooting by failure code (Display of code), Part 1

Troubleshooting by failure code (Display of code), Part 1

Failure code table

Action code	Failure code	Failed section	Failure symptom	Alarm buzzer	Controller	History classification
CALL E03	**1500L0**	Transmission clutch	Dual engagement	●	S/T	Electric system
CALL E03	**15SAL1**	Forward clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SALH**	Forward clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SBL1**	Reverse clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SBLH**	Reverse clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SEL1**	1st clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SELH**	1st clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SFL1**	2nd clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SFLH**	2nd clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
CALL E03	**15SGL1**	3rd clutch	Fill signal is ON when command current is OFF.	●	S/T	Electric system
CALL E03	**15SGLH**	3rd clutch	Fill signal is OFF when command current is ON.	●	S/T	Electric system
—	**AB00MA**	Alternator	Malfunction		S/T	Mechanical system
—	**B@BAZG**	Engine oil	Oil pressure reduction	●	ENG	Mechanical system
—	**B@BCNS**	Radiator coolant	Overheat	●	ENG	Mechanical system
—	**B@CENS**	Power train oil	Overheat	●	S/T	Mechanical system
—	**B@HANS**	Hydraulic oil	Overheat	●	S/T	Mechanical system
CALL E04	**CA111**	Engine controller	Abnormality in controller	●	ENG	Electric system
CALL E04	**CA115**	Abnormal engine NE, Bkup speed sensor	Abnormal speed sensor signal	●	ENG	Electric system
CALL E03	**CA122**	Charge pressure sensor too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA123**	Charge pressure sensor too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA131**	Decelerator pedal sensor too high	Excessively high voltage detected	●	ENG	Electric system

Action code	Failure code	Failed section	Failure symptom	Alarm buzzer	Con-troller	History classifi-cation
CALL E03	**CA132**	Decelerator pedal sensor too low	Excessively low voltage detected	●	ENG	Electric system
E01	**CA144**	Coolant temperature sensor too high	Excessively high voltage detected		ENG	Electric system
E01	**CA145**	Coolant temperature sensor too low	Excessively low voltage detected		ENG	Electric system
E01	**CA153**	Charge temperature sensor too high	Excessively high voltage detected		ENG	Electric system
E01	**CA154**	Charge temperature sensor too low	Excessively low voltage detected		ENG	Electric system
CALL E03	**CA155**	Charge temperature tool high and engine speed derated	Exceeded upper control limit of tem-perature	●	ENG	Electric system
CALL E03	**CA187**	Sensor power source 2 too low	Excessively low voltage detected	●	ENG	Electric system
E01	**CA221**	Atmospheric pressure sensor too high	Excessively high voltage detected		ENG	Electric system
E01	**CA222**	Atmospheric pressure sensor too low	Excessively low voltage detected		ENG	Electric system
CALL E03	**CA227**	Sensor power source 2 too high	Excessively high voltage detected	●	ENG	Electric system
—	**CA234**	Engine overspeed	Excessively high speed		ENG	Mechani-cal sys-tem
CALL E03	**CA238**	Abnormal power source for Ne speed sensor	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA271**	IMV/PCV1 short circuit	Short circuit	●	ENG	Electric system
CALL E03	**CA272**	IMV/PCV1 disconnection	Disconnection	●	ENG	Electric system
CALL E03	**CA281**	Abnormal supply pump pressure balance	Abnormal pressure feed of fuel	●	ENG	Electric system
CALL E03	**CA322**	Disconnection and short circuit in injector #1	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA323**	Disconnection and short circuit in injector #5	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA324**	Disconnection and short circuit in injector #3	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA325**	Disconnection and short circuit in injector #6	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA331**	Disconnection and short circuit in injector #2	Disconnection and short circuit	●	ENG	Electric system
CALL E03	**CA332**	Disconnection and short circuit in injector #4	Disconnection and short circuit	●	ENG	Electric system
CALL E04	**CA342**	Abnormal engine controller data matching consistency	Matching inconsistency	●	ENG	Electric system
CALL E03	**CA352**	Sensor power source 1 too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA386**	Sensor power source 1 too high	Excessively high voltage detected	●	ENG	Electric system
E01	**CA428**	Water detection sensor too high	Excessively high voltage detected		ENG	Electric system

Action code	Failure code	Failed section	Failure symptom	Alarm buzzer	Con-troller	History classifi-cation
E01	**CA429**	Water detection sensor too low	Excessively low voltage detected		ENG	Electric system
E01	**CA435**	Abnormal engine oil pressure switch	Abnormal signal circuit		ENG	Electric system
CALL E04	**CA441**	Power supply voltage too low	Excessively low voltage detected	●	ENG	Electric system
CALL E04	**CA442**	Power supply voltage too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA449**	Common rail pressure too high (2)	Excessively high pressure detected	●	ENG	Electric system
CALL E03	**CA451**	Common rail pressure sensor too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA452**	Common rail pressure sensor too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA488**	Charge temperature too high torque derated	Exceeded upper control limit of tem-perature	●	ENG	Electric system
CALL E03	**CA553**	Common rail pressure too high (1)	Excessively high pressure detected	●	ENG	Electric system
E02	**CA559**	Supply pump no pressure (1)	No pressure feeding detected	●	ENG	Electric system
CALL E03	**CA689**	Abnormal engine Ne speed sensor	Abnormality in signal	●	ENG	Electric system
CALL E03	**CA731**	Abnormal engine Bkup speed sen-sor phase	Abnormal phase	●	ENG	Electric system
CALL E04	**CA757**	Loss of all data of engine controller	Loss of all data	●	ENG	Electric system
CALL E03	**CA778**	Abnormal engine Bkup speed sen-sor	Abnormal Bkup signal	●	ENG	Electric system
CALL E03	**CA1633**	Abnormal KOMNET	Abnormal communication	●	ENG	Electric system
CALL E03	**CA2185**	Decelerator pedal sensor power source too high	Excessively high voltage detected	●	ENG	Electric system
CALL E03	**CA2186**	Decelerator pedal sensor power source too low	Excessively low voltage detected	●	ENG	Electric system
CALL E03	**CA2249**	Supply pump no pressure (2)	No pressure feeding detected	●	ENG	Electric system
CALL E03	**CA2265**	Disconnection in electric lift pump	Disconnection	●	ENG	Electric system
CALL E03	**CA2266**	Short circuit in electric lift pump	Short circuit	●	ENG	Electric system
CALL E03	**CA2311**	Abnormal IMV solenoid	Abnormal resistance	●	ENG	Electric system
E01	**CA2555**	Disconnection in air intake heater relay	Disconnection		ENG	Electric system
E01	**CA2556**	Short circuit in air intake heater relay	Short circuit		ENG	Electric system
—	**D110KA**	Battery relay	Short circuit		S/T	Electric system
—	**D110KB**	Battery relay	Disconnection		S/T	Electric system

Action code	Failure code	Failed section	Failure symptom	Alarm buzzer	Con-troller	History classifi-cation
E02	**D130KA**	Neutral safety relay	Disconnection	●	S/T	Electric system
E02	**D130KB**	Neutral safety relay	Short circuit	●	S/T	Electric system
E01	**D161KA**	Backup alarm relay	Disconnection		S/T	Electric system
E01	**D161KB**	Backup alarm relay	Short circuit		S/T	Electric system
CALL E03	**DAFRKR**	Monitor panel CAN communication	Defective communication	●	MON	Electric system
E01	**DAQ0KT (DB30KT)**	Steering and transmission controller	Abnormality in controller		S/T	Electric system
CALL E04	**DAQ1KK (DB31KK)**	Main power source of steering and transmission controller	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DAQ2KK (DB32KK)**	Steering and transmission controller load power source	Power supply voltage drop, input	●	S/T	Electric system
CALL E03	**DAQ5KK (DB35KK)**	5 V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system
CALL E03	**DAQ6KK (DB36KK)**	24 V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DAQ9KQ (DB39KQ)**	Steering and transmission controller model selection	Model select signal inconsistency	●	S/T	Electric system
CALL E03	**DB2RKR**	Steering and transmission controller CAN communication	Defective communication (Abnor-mality in target component system)	●	S/T	Electric system
E01	**DB30KT (DAQ0KT)**	Steering and transmission controller	Abnormality in controller		S/T	Electric system
CALL E04	**DB31KK (DAQ1KK)**	Main power source of steering and transmission controller	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DB32KK (DAQ2KK)**	steering and transmission controller load power source	Power supply voltage drop, input	●	S/T	Electric system
CALL E03	**DB35KK (DAQ5KK)**	5 V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system
CALL E03	**DB36KK (DAQ6KK)**	24 V power source of steering and transmission controller sensor	Power supply voltage drop, input	●	S/T	Electric system
CALL E04	**DB39KQ (DAQ9KQ)**	Steering and transmission controller model selection harness	Model select signal inconsistency	●	S/T	Electric system
E02	**DD12KA**	Shift up switch	Disconnection	●	S/T	Electric system
E02	**DD12KB**	Shift up switch	Short circuit	●	S/T	Electric system
E02	**DD13KA**	Shift down switch	Disconnection	●	S/T	Electric system
E02	**DD13KB**	Shift down switch	Short circuit	●	S/T	Electric system
CALL E03	**DD14KA (DDQ2KA)**	Parking lever switch	Disconnection	●	S/T	Electric system
CALL E03	**DD14KB (DDQ2KB)**	Parking lever switch	Short circuit	●	S/T	Electric system
E02	**DDN7KA**	Pitch control switch	Disconnection	●	S/T	Electric system

Action code	Failure code	Failed section	Failure symptom	Alarm buzzer	Con-troller	History classifi-cation
E02	**DDN7KB**	Pitch control switch	Short circuit	●	S/T	Electric system
CALL E03	**DDQ2KA (DD14KA)**	Parking lever switch	Disconnection	●	S/T	Electric system
CALL E03	**DDQ2KB (DD14KB)**	Parking lever switch	Short circuit	●	S/T	Electric system
—	**DGS1KX**	Hydraulic oil temperature sensor	Input signal out of range		S/T	Electric system
E01	**DGT1KA**	Power train oil temperature sensor	Disconnection		S/T	Electric system
E01	**DGT1KX**	Power train oil temperature sensor	Input signal out of range		S/T	Electric system
CALL E03	**DK10KA**	Fuel control dial	Disconnection	●	S/T	Electric system
CALL E03	**DK10KB**	Fuel control dial	Short circuit	●	S/T	Electric system
CALL E03	**DK30KA**	Steering potentiometer (1)	Disconnection	●	S/T	Electric system
CALL E03	**DK30KB**	Steering potentiometer (1)	Short circuit	●	S/T	Electric system
CALL E04	**DK30KX**	Steering potentiometer	Input signal out of range	●	S/T	Electric system
CALL E04	**DK30KZ**	Steering potentiometer	Disconnection or short circuit	●	S/T	Electric system
CALL E03	**DK30L8**	Steering potentiometer	Inconsistent analog signals	●	S/T	Electric system
CALL E03	**DK31KA**	Steering potentiometer (2)	Disconnection	●	S/T	Electric system
CALL E03	**DK31KB**	Steering potentiometer (2)	Short circuit	●	S/T	Electric system
E01	**DK40KA**	Brake potentiometer	Disconnection		S/T	Electric system
E01	**DK40KB**	Brake potentiometer	Short circuit		S/T	Electric system
CALL E04	**DK55KX**	Forward-reverse potentiometer	Input signal out of range	●	S/T	Electric system
CALL E04	**DK55KZ**	Forward-reverse potentiometer	Disconnection or short circuit	●	S/T	Electric system
CALL E03	**DK55L8**	Forward-reverse potentiometer	Inconsistent analog signals	●	S/T	Electric system
CALL E03	**DK56KA**	Forward-reverse potentiometer (1)	Short circuit	●	S/T	Electric system
CALL E03	**DK56KB**	Forward-reverse potentiometer (1)	Disconnection	●	S/T	Electric system
CALL E03	**DK57KA**	Forward-reverse potentiometer (2)	Disconnection	●	S/T	Electric system
CALL E03	**DK57KB**	Forward-reverse potentiometer (2)	Short circuit	●	S/T	Electric system
CALL E03	**DKH1KA (DKH1KX)**	Pitch angle sensor	Short circuit	●	S/T	Electric system

Action code	Failure code	Failed section	Failure symptom	Alarm buzzer	Con-troller	History classifi-cation
CALL E03	**DKH1KB (DKH1KX)**	Pitch angle sensor	Disconnection	●	S/T	Electric system
CALL E03	**DKH1KX (DKH1KA) (DKH1KB)**	Pitch angle sensor	Input signal out of range	●	S/T	Electric system
E01	**DLT3KA**	Transmission output speed sensor	Disconnection		S/T	Electric system
E01	**DLT3KB**	Transmission output speed sensor	Short circuit		S/T	Electric system
—	**DV00KB**	Alarm buzzer	Short circuit		MON	Electric system
E02	**DW5AKA**	Pitch control solenoid	Disconnection	●	S/T	Electric system
E02	**DW5AKB**	Pitch control solenoid	Short circuit	●	S/T	Electric system
E02	**DW5AKY**	Pitch control solenoid	Short circuit to power source line	●	S/T	Electric system
E01	**DW7BKA**	Fan reverse solenoid	Disconnection		S/T	Electric system
E01	**DW7BKB**	Fan reverse solenoid	Short circuit		S/T	Electric system
CALL E03	**DWN1KA**	HSS EPC solenoid right	Disconnection	●	S/T	Electric system
CALL E03	**DWN1KB**	HSS EPC solenoid right	Short circuit	●	S/T	Electric system
CALL E04	**DWN1KY**	HSS EPC solenoid right	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DWN2KA**	HSS EPC solenoid left	Disconnection	●	S/T	Electric system
CALL E03	**DWN2KB**	HSS EPC solenoid left	Short circuit	●	S/T	Electric system
CALL E04	**DWN2KY**	HSS EPC solenoid left	Short circuit to power source line	●	S/T	Electric system
E01	**DWN5KA**	Fan pump TVC solenoid	Disconnection		S/T	Electric system
E01	**DWN5KB**	Fan pump TVC solenoid	Short circuit		S/T	Electric system
E02	**DWN5KY**	Fan pump TVC solenoid	Short circuit to power source line	●	S/T	Electric system
E01	**DXA0KA**	HSS pump TVC solenoid	Disconnection		S/T	Electric system
E01	**DXA0KB**	HSS pump TVC solenoid	Short circuit		S/T	Electric system
E01	**DXA0KY**	HSS pump TVC solenoid	Short circuit to power source line		S/T	Electric system
CALL E03	**DXH4KA**	1st clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH4KB**	1st clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH4KY**	1st clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system

Action code	Failure code	Failed section	Failure symptom	Alarm buzzer	Con-troller	History classifi-cation
CALL E03	**DXH5KA**	2nd clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH5KB**	2nd clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH5KY**	2nd clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DXH6KA**	3rd clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH6KB**	3rd clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH6KY**	3rd clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DXH7KA**	Reverse clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH7KB**	Reverse clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH7KY**	Reverse clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system
CALL E03	**DXH8KA**	Forward clutch ECMV solenoid	Disconnection	●	S/T	Electric system
CALL E03	**DXH8KB**	Forward clutch ECMV solenoid	Short circuit	●	S/T	Electric system
CALL E03	**DXH8KY**	Forward clutch ECMV solenoid	Short circuit to power source line	●	S/T	Electric system

Before troubleshooting by failure codes

Connection table of fuse box

★ This connection table shows the devices to which each power supply of the fuse box supplies power (A switch power supply is a device which supplies power while the starting switch is in the ON position and a constant power supply is a device which supplies power while the starting switch is in the OFF and ON positions).

★ When carrying out troubleshooting related to the electrical system, you should check the fuses and fusible links to see if the power is supplied normally.

Fuse box A [FS1]

Fuse No.	Electric supply source	Fuse capacity (A)	Destinations of electric power distribution
1	Switched electric power supply	20	Standby electric power supply
2		20	Horn, electrical intake air heater, air suspension seat
3		20	Front lamp, rear lamp
4		20	Steering and transmission controller (electric power supply to solenoid)
5		5	Engine controller (ACC signal)

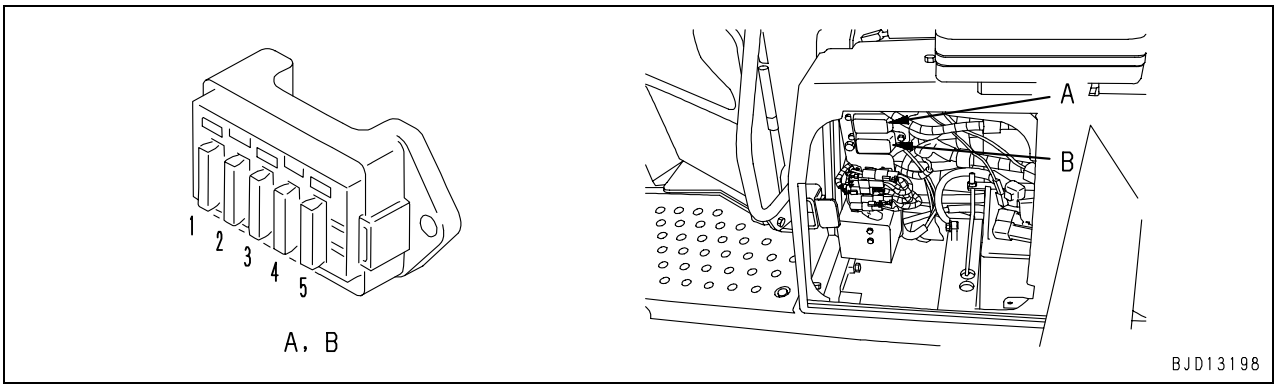
Fuse box B [FS2]

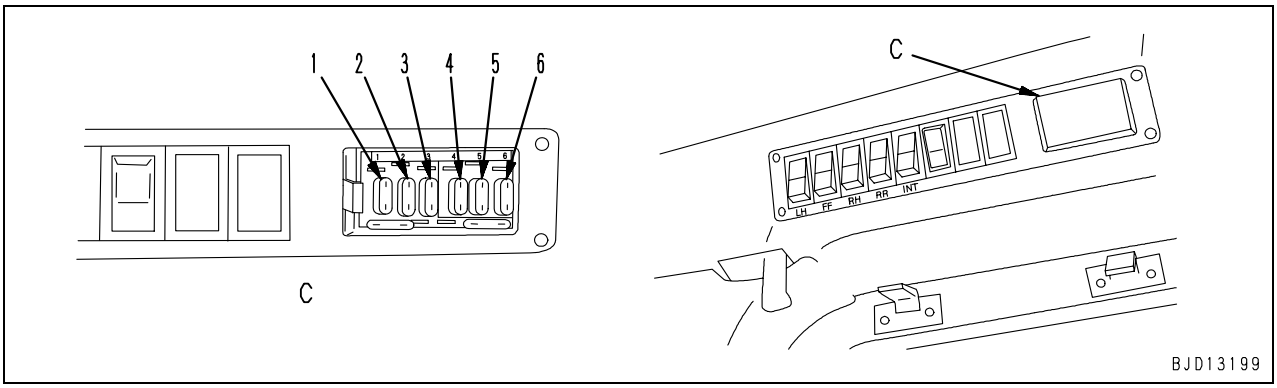
Fuse No.	Electric supply source	Fuse capacity (A)	Destinations of electric power distribution
1	Switched electric power supply	5	Backup alarm
2	Constant power source	15	Steering and transmission controller (main electric power supply), Radio
3		30	Electric power supply of machine (with 20A circuit breaker in the circuit)
4		30	Engine controller (main electric power supply)
5	Switched electric power supply	30	Air conditioner (with 20A circuit breaker in the circuit)

Cab fuse box C

Fuse No.	Electric supply source	Fuse capacity (A)	Destinations of electric power distribution
1	Switched electric power supply	10	Accessory electric power supply (12 V electric power supply)
2		20	Radio, room lamp, cigarette lighter, additional light
3		20	Glass with heating wire
4		10	Rear wiper
5		10	Front wiper
6		10	Left and right door wipers

Fuse installation position and No.





Contents of troubleshooting table

★ The following information is summarized in the troubleshooting table and the related electrical circuit diagram. Before carrying out troubleshooting, understand that information fully.

Action code	Failure code	Failure symptom	**Trouble that appears in the machine**
Display of panel	**Display of panel**		
Failure content	**State where the monitor panel or controller detects the trouble**		
Controller's action	**Action to be taken to protect the system and equipment when the monitor panel or controller detects a trouble**		
Symptoms that appears on machine	**Problem that appears as an abnormality in the main unit by the action taken by the monitor panel or controller (above)**		
General information	**Information related to troubles occurred or troubleshooting**		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Cause by which a trouble is assumed to be detected (The order number indicates a serial number, not a priority sequence.)	• **<Described contents>** • **Standard value when normal required to judge the possible cause** • **Remarks required to judge whether the cause is right or not** **<Symptoms of defective harness>** • **Disconnection in wiring** **The connector contact is defective or the wiring harness is disconnected.** • **Defective grounding** **A harness not connected to GND (ground) circuit comes into contact with the GND (ground) circuit.** • **Hot short defect** **A harness not connected to the electric power supply (24 V) circuit comes into contact with the electric power supply (24 V) circuit.** • **Short circuit** **A harness abnormally comes into contact with a harness of separate circuit.** **<Points to remember when troubleshooting>** **(1) Method of indicating connector numbers and handling T-adapter** **For troubleshooting, insert or connect the T- adapter as described below unless especially specified.** • **When "male" or "female" is not indicated for a connector number, disconnect the connector, and insert the T-adapter in both the male and female.** • **When "male"or "female" is indicated for a connector number, disconnect the connector, and insert the T-adapter in only either the male or female.** **(2) Pin number description sequence and tester lead handling** **For troubleshooting, connect the plus (+) and minus (–) leads of the tester as described below unless especially specified.** • **Connect the plus (+) lead to a pin number or harness indicated in the front.** • **Connect the minus (–) lead to a pin number or harness indicated in the rear.**
	2		
	3		
	4		

Related circuit diagram

- **This is the excerpted circuit diagram related to troubleshooting.**
- **Connector No.: Indicates (model – number of pins) (color)**
- **Arrow (⇔): Indicates the approximate mounting place on machine**

Failure code [1500L0] Transmission clutch: Dual engagement

Action code	Failure code	Failure symptom	Transmission clutch: Dual engagement (Steering and transmission controller system)
CALL E03	**1500L0**		
Failure content	• Of the failure codes related to the transmission clutch, the following codes were displayed at the same time. (Gear speed is limited.) (1) Either [**DXH4KA**] or [**DXH4KB**] and either [**DXH5KA**] or [**DXH5KB**] • Of the failure codes related to the transmission clutch, the following codes were displayed at the same time. (Machine can not travel.) (2) Either [**DXH8KA**] or [**DXH8KB**] and either [**DXH7KA**] or [**DXH7KB**] (3) Either of [**DXH6KA**] or [**DXH6KB**] and (1) above (4) [**15SALH**] and [**15SBLH**] (5) Either [**15SAL1**] or [**DXH8KY**] and either [**15SBL1**] or [**DXH7KY**] (6) [**15SELH**], [**15SFLH**], and [**15SGLH**] (7) Either [**15SEL1**] or [**DXH4KY**] and either [**15SFL1**] or [**DXH5KY**] (8) Either [**15SEL1**] or [**DXH4KY**] and either [**15SGL1**] or [**DXH6KY**] (9) Either [**15SFL1**] or [**DXH5KY**] and either [**15SGL1**] or [**DXH6KY**]		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, traveling is limited to specific gear speeds. • Machine cannot travel.		
General information	• Duplication of failure code: Engine start + travel		

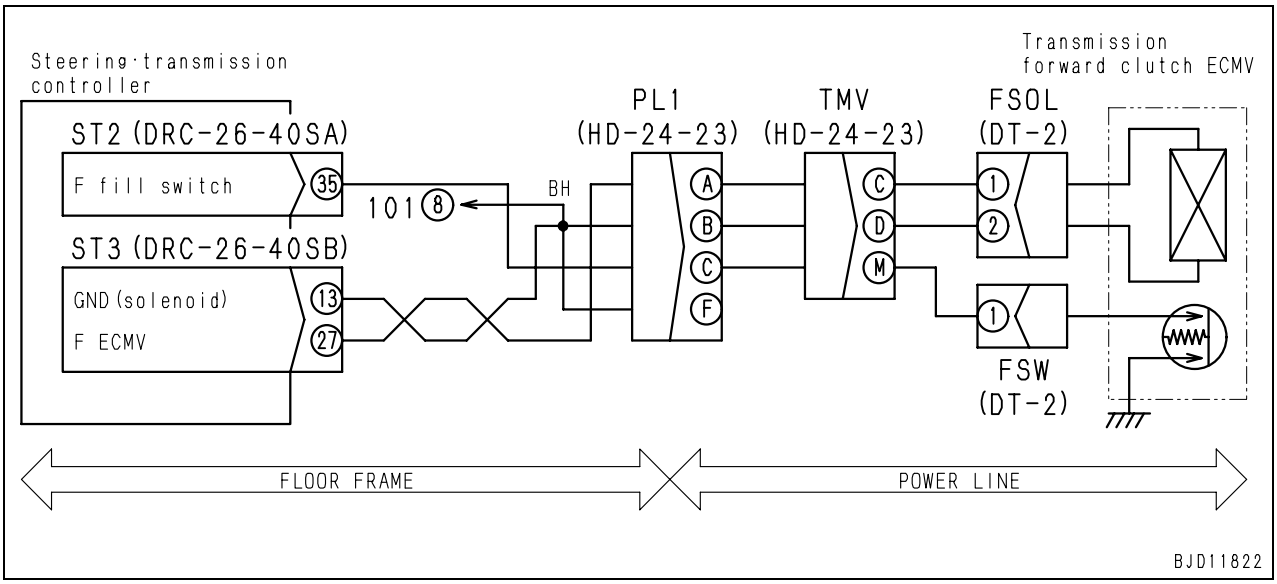
	Cause	Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	Confirm the failure codes displayed at the same time, then carry out troubleshooting for the codes. [**15SAL1**], [**15SALH**], [**15SBL1**], [**15SBLH**], [**15SEL1**], [**15SELH**], [**15SFL1**], [**15SFLH**], [**15SGL1**], [**15SGLH**] [**DXH4KA**], [**DXH4KB**], [**DXH4KY**], [**DXH5KA**, [**DXH5KB**], [**DXH5KY**], [**DXH6KA**], [**DXH6KB**], [**DXH6KY**], [**DXH7KA**, [**DXH7KB**], [**DXH7KY**], [**DXH8KA**], [**DXH8KB**], [**DXH8KY**]	

Failure code [15SAL1] Forward clutch: Fill signal is ON when command current is OFF

Action code	Failure code	Failure symptom	Forward clutch: Fill signal is ON when command current is OFF (Steering and transmission controller system)
CALL E03	**15SAL1**		
Failure content	• The fill switch signal does not become off when the output of the transmission forward clutch solenoid circuit has stopped.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Decides that engine speed is neutral (N) at reverse operation. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1.		
General information	• The input state (ON/OFF) from the forward clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + travel neutral		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective forward clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			FSW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1 MΩ	
				F (Forward)	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between ST2 (female) (35) – FSW (female) (1)		Resistance	Min. 1 MΩ
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST2	PCCS lever	Voltage	
			Between (35) – chassis ground	N	5 – 11 V	
				F (Forward)	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission forward clutch ECMV

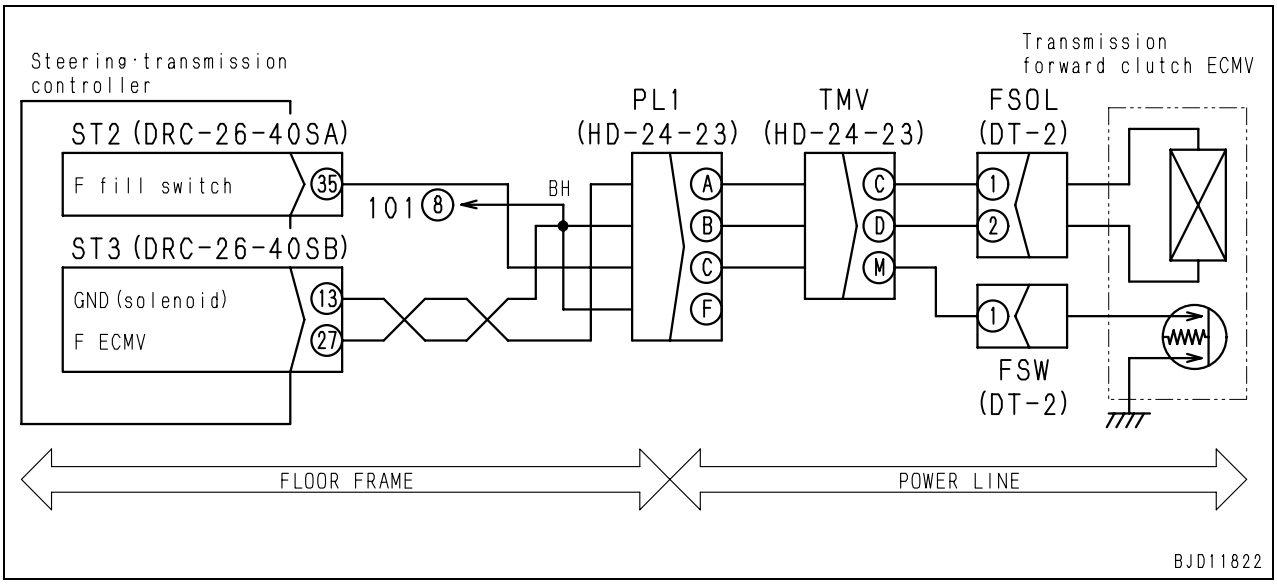


Failure code [15SALH] Forward clutch: Fill signal is OFF when command current is ON

Action code	Failure code	Failure symptom	Forward clutch: Fill signal is OFF when command current is ON (Steering and transmission controller system)
CALL E03	**15SALH**		
Failure content	• The fill switch signal does not become ON when the output of the transmission forward clutch solenoid circuit is ON.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Determines to apply neutral (N) to forward operation. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to R1.		
General information	• The input state (ON/OFF) from the forward clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + Forward travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective forward clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			FSW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1 MΩ	
				F (Forward)	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or loose connection of connector)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between ST2 (female) (35) – FSW (female) (1)		Resistance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST2	PCCS lever	Voltage	
			Between (35) – chassis ground	N	5 – 11 V	
				F (Forward)	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission forward clutch ECMV

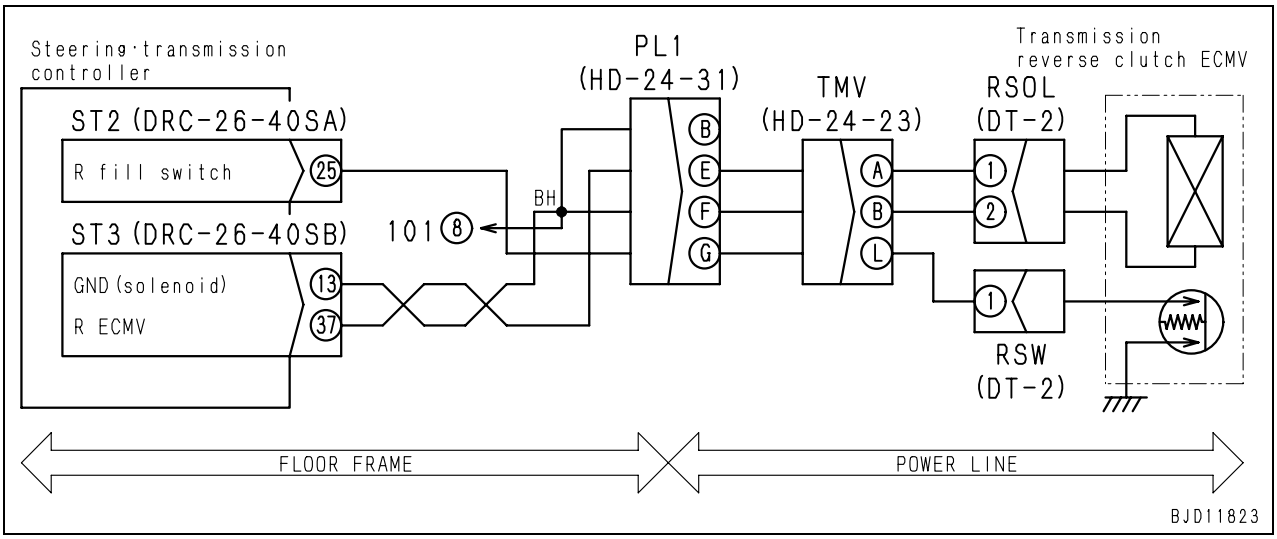


Failure code [15SBL1] Reverse clutch: Fill signal is ON when command current is OFF

Action code	Failure code	Failure symptom	Reverse clutch: Fill signal is ON when command current is OFF (Steering and transmission controller system)
CALL E03	**15SBL1**		
Failure content	• The fill switch signal does not become off when the output of the transmission reverse clutch solenoid circuit has stopped.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Determines to apply neutral (N) to forward operation. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to R1.		
General information	• The input state (ON/OFF) from the reverse clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + travel neutral		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective reverse clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			RSW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1 MΩ	
				R (Reverse)	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between ST2 (female) (25) – RSW (female) (1)		Resistance	Min. 1 MΩ
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST2	PCCS lever	Voltage	
			Between (25) – chassis ground	N	5 – 11 V	
				R (Reverse)	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission reverse clutch ECMV

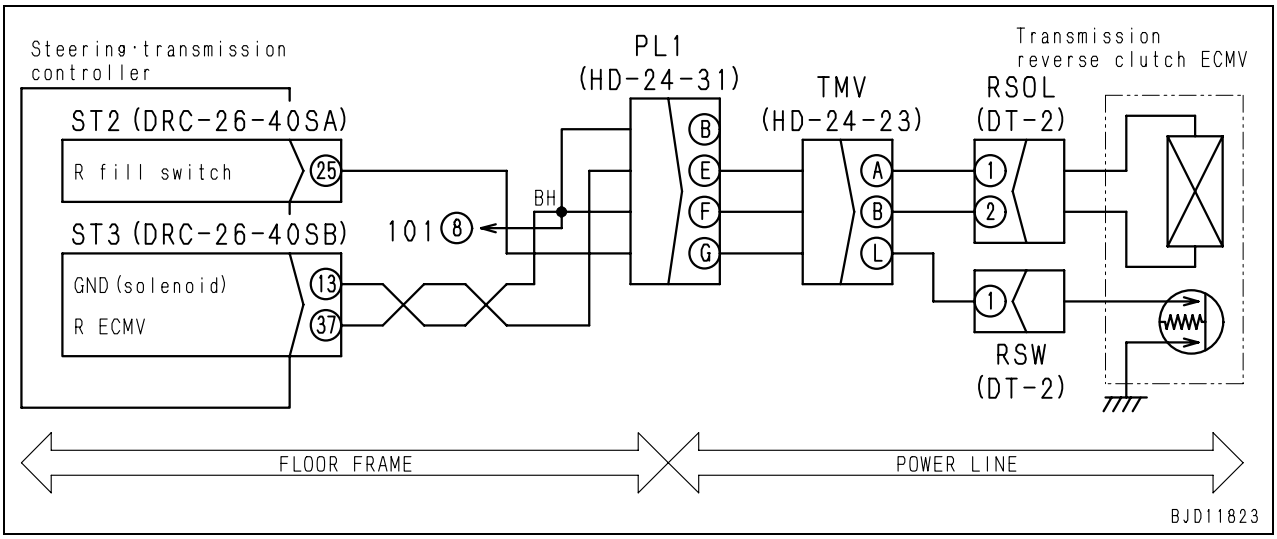


Failure code [15SBLH] Reverse clutch: Fill signal is OFF when command current is ON

Action code	Failure code	Failure symptom	Reverse clutch: Fill signal is OFF when command current is ON (Steering and transmission controller system)
CALL E03	**15SBLH**		
Failure content	• The fill switch signal does not become ON when the output of the transmission reverse clutch solenoid circuit is ON.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Decides that engine speed is neutral (N) at reverse operation. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1.		
General information	• The input state (ON/OFF) from the reverse clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + reverse travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective reverse clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			RSW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1 MΩ	
				R (Reverse)	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or poor connector contact)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between ST2 (female) (25) – RSW (female) (1)		Resistance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST2	PCCS lever	Voltage	
			Between (25) – chassis ground	N	5 – 11 V	
				R (Reverse)	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission reverse clutch ECMV

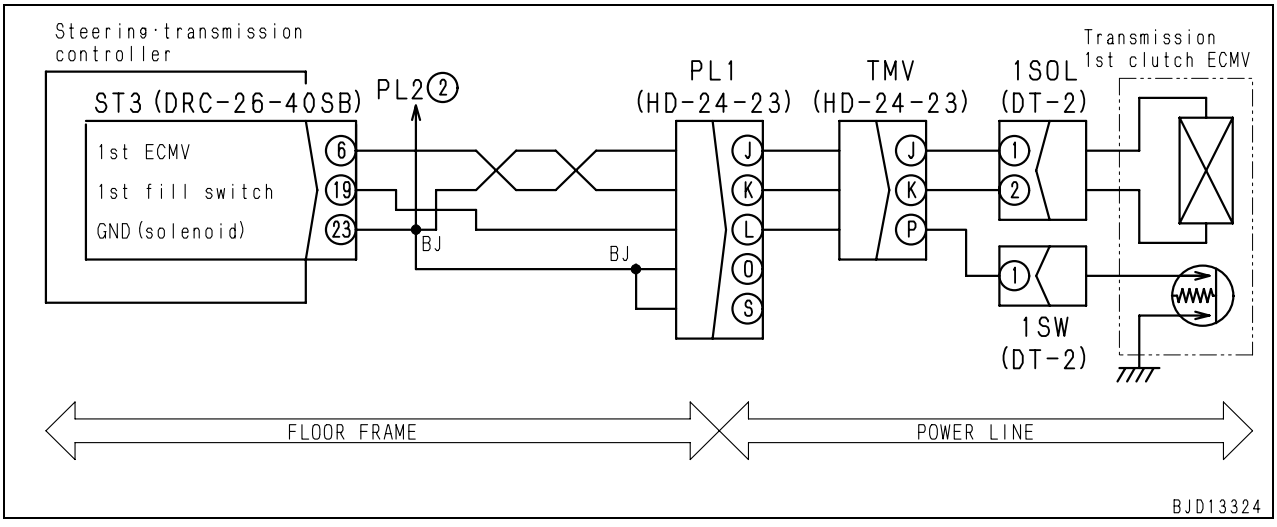


Failure code [15SEL1] 1st clutch: Fill signal is ON when command current is OFF

Action code	Failure code	Failure symptom	1st clutch: Fill signal is ON when command current is OFF (Steering and transmission controller system)
CALL E03	**15SEL1**		
Failure content	• The fill switch signal does not become off when the output of the transmission 1st clutch solenoid circuit has stopped.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• The input state (ON/OFF) from the 1st clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + F1 or R1 → travel neutral		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 1st clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			1SW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F1 and R1	Min. 1 MΩ	
				F1 and R1	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between ST3 (female) (19) – 1SW (female) (1)		Resistance	Min. 1 MΩ
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST3	PCCS lever	Voltage	
			Between (19) – chassis ground	Other than F1 and R1	5 – 11 V	
				F1 and R1	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission 1st clutch ECMV

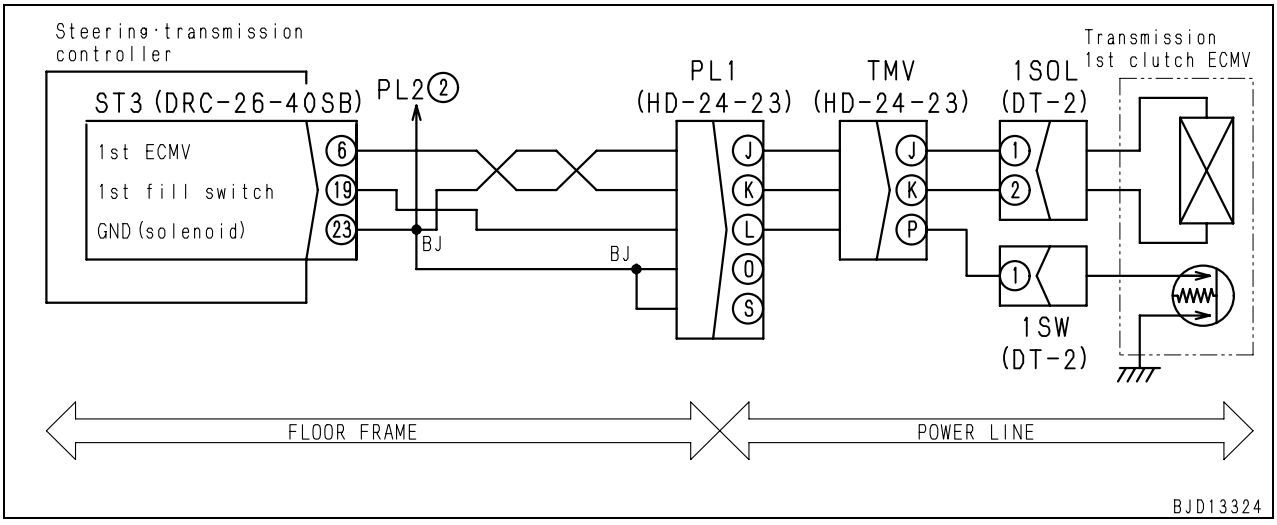


Failure code [15SELH] 1st clutch: Fill signal is OFF when command current is ON

Action code	Failure code	Failure symptom	1st clutch: Fill signal is OFF when command current is ON (Steering and transmission controller system)
CALL E03	**15SELH**		
Failure content	• The fill switch signal does not become ON when the output of the transmission 1st clutch solenoid circuit is ON.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F2 and R2.		
General information	• The input state (ON/OFF) from the 1st clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + F1 or R1 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 1st clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			1SW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F1 and R1	Min. 1 MΩ	
				F1 and R1	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or poor connector contact)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between ST3 (female) (19) – 1SW (female) (1)		Resistance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST3	PCCS lever	Voltage	
			Between (19) – chassis ground	Other than F1 and R1	5 – 11 V	
				F1 and R1	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission 1st clutch ECMV

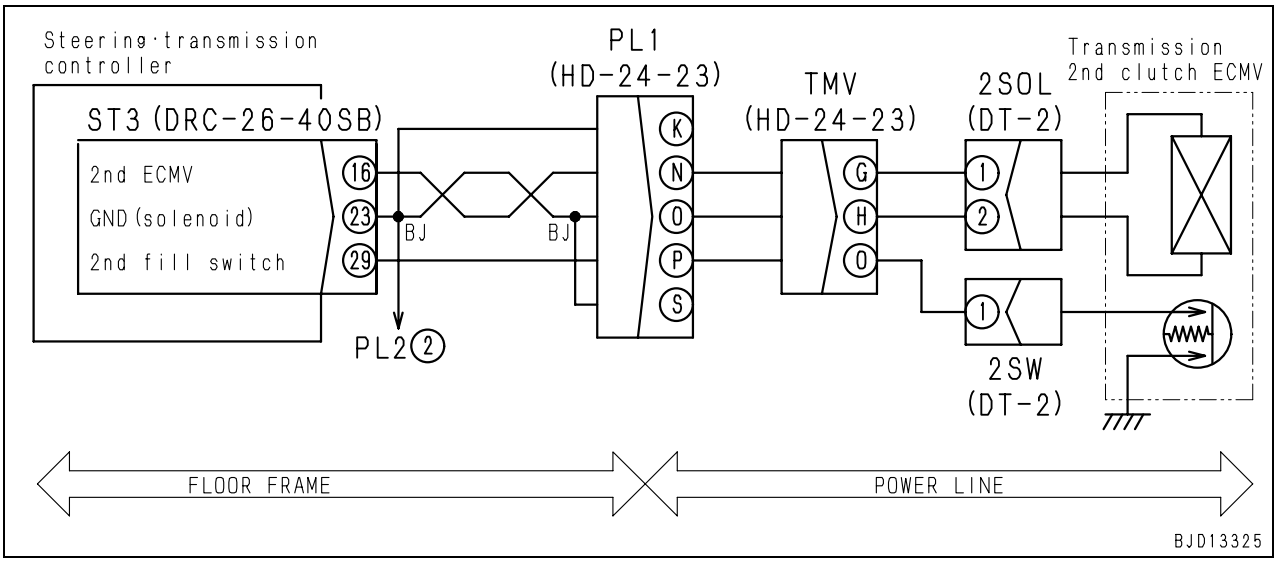


Failure code [15SFL1] 2nd clutch: Fill signal is ON when command current is OFF

Action code	Failure code	Failure symptom	2nd clutch: Fill signal is ON when command current is OFF (Steering and transmission controller system)
CALL E03	**15SFL1**		
Failure content	• The fill switch signal does not become off when the output of the transmission 2nd clutch solenoid circuit has stopped.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F2 and R2.		
General information	• The input state (ON/OFF) from the 2nd clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + F2 or R2 → travel neutral		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 2nd clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			2SW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F2 and R2	Min. 1 MΩ	
				F2 and R2	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between ST3 (female) (29) – 2SW (female) (1)		Resistance	Min. 1 MΩ
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST3	PCCS lever	Voltage	
			Between (29) – chassis ground	Other than F2 and R2	5 – 11 V	
				F2 and R2	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission 2nd clutch ECMV

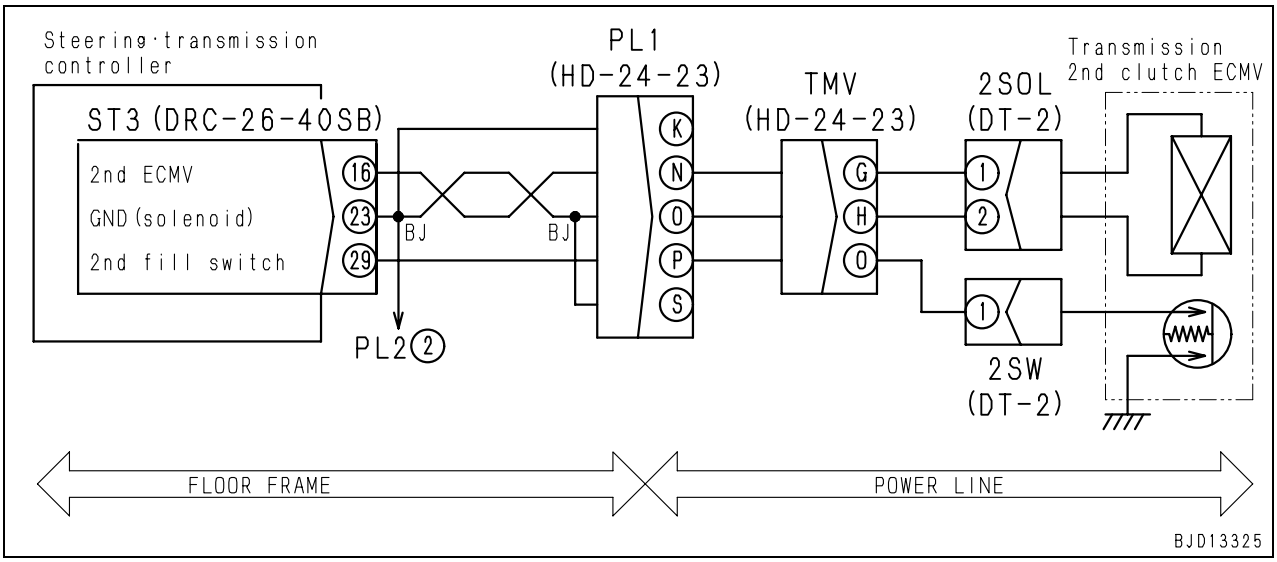


Failure code [15SFLH] 2nd clutch: Fill signal is OFF when command current is ON

Action code	Failure code	Failure symptom	2nd clutch: Fill signal is OFF when command current is ON (Steering and transmission controller system)
CALL E03	**15SFLH**		
Failure content	• The fill switch signal does not become ON when the output of the transmission 2nd clutch solenoid circuit is ON.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• The input state (ON/OFF) from the 2nd clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + F2 or R2 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 2nd clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			2SW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F2 and R2	Min. 1 MΩ	
				F2 and R2	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or poor connector contact)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between ST3 (female) (29) – 2SW (female) (1)		Resistance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST3	PCCS lever	Voltage	
			Between (29) – chassis ground	Other than F2 and R2	5 – 11 V	
				F2 and R2	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission 2nd clutch ECMV

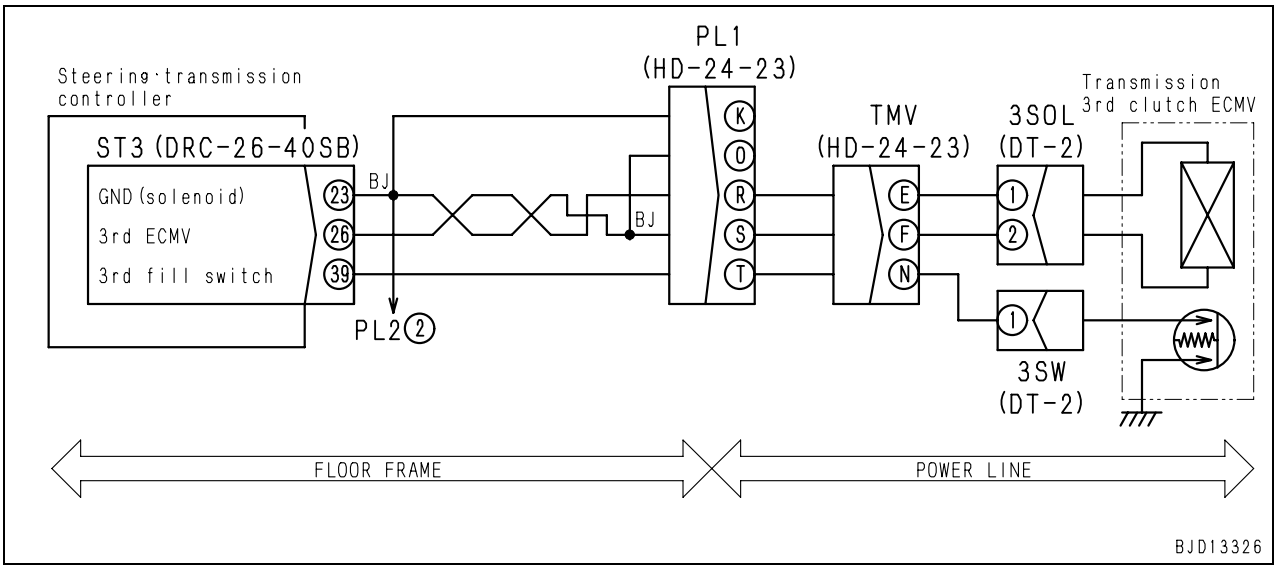


Failure code [15SGL1] 3rd clutch: Fill signal is ON when command current is OFF

Action code	Failure code	Failure symptom	3rd clutch: Fill signal is ON when command current is OFF (Steering and transmission controller system)
CALL E03	**15SGL1**		
Failure content	• The fill switch signal does not become off when the output of the transmission 3rd clutch solenoid circuit has stopped.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F3 and R3.		
General information	• The input state (ON/OFF) from the 3rd clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + F3 or R3 → travel neutral		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 3rd clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			3SW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F3 and R3	Min. 1 MΩ	
				F3 and R3	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between ST3 (female) (39) – 3SW (female) (1)		Resistance	Min. 1 MΩ
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST3	PCCS lever	Voltage	
			Between (39) – chassis ground	Other than F3 and R3	5 – 11 V	
				F3 and R3	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission 3rd clutch ECMV

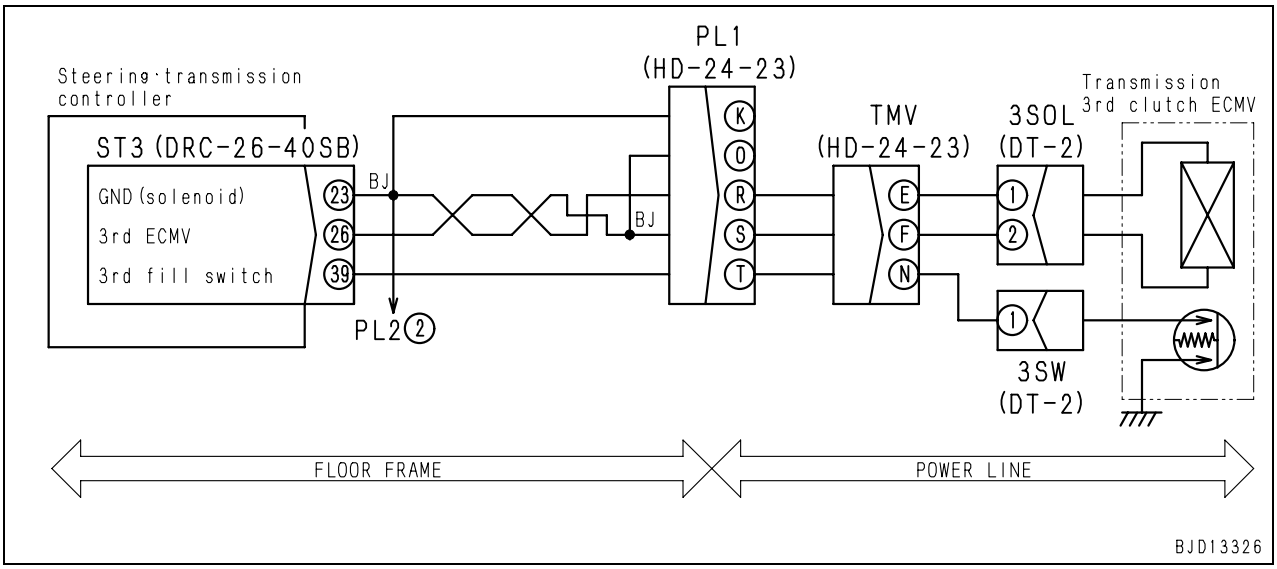


Failure code [15SGLH] 3rd clutch: Fill signal is OFF when command current is ON

Action code	Failure code	Failure symptom	3rd clutch: Fill signal is OFF when command current is ON (Steering and transmission controller system)
CALL E03	**15SGLH**		
Failure content	• The fill switch signal does not become ON when the output of the transmission 3rd clutch solenoid circuit is ON.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• The input state (ON/OFF) from the 3rd clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Duplication of failure code: Engine start + F3 or R3 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 3rd clutch fill switch (internal short circuit)	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			3SW (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F3 and R3	Min. 1 MΩ	
				F3 and R3	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or poor connector contact)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between ST3 (female) (39) – 3SW (female) (1)		Resistance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF, then start the engine for troubleshooting.			
			ST3	PCCS lever	Voltage	
			Between (39) – chassis ground	Other than F3 and R3	5 – 11 V	
				F3 and R3	Max. 1 V	
	4	Defective hydraulic pressure system	When no fault is detected in the electric system, the hydraulic pressure system is assumed to be abnormal. Carry out the related troubleshooting (H-mode).			

Circuit diagram related to transmission 3rd clutch ECMV



Failure code [AB00MA] Alternator: Malfunction

Action code	Failure code	Failure symptom	Alternator: Malfunction (Mechanical system)
—	**AB00MA**		
Failure content	• While engine is running, charge level caution lamp flashes.		
Controller's action	• Flashes warning lamp.		
Symptoms that appears on machine	• If the machine is operated in the same condition, battery may be discharged.		
General information	• Duplication of failure code: Start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Defective battery charge (When system is normal)	It is suspected that the problem causing the detection of defective battery charge is currently occurring or occurred in the past. Investigate the cause and damage condition, and correct it.
	2	Defective charge level caution lamp system	Carry out troubleshooting of charge level caution lamp system in accordance with ,“While engine is running, battery charge level caution lamp flashes” in E-mode.

Failure code [B@BAZG] Engine oil: Oil pressure too low

Action code	Failure code	Failure symptom	Engine oil: Oil pressure too low (Mechanical system)
—	**B@BAZG**		
Failure content	• While engine is running, engine oil pressure caution lamp flashes.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. (Function of monitor panel) • Limits operation of engine.		
Symptoms that appears on machine	• If the machine is operated in the same condition, engine may be damaged. • After warning, engine speed is limited to medium (half).		
General information	• Duplication of failure code: Start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Reduction of engine oil pressure (When system is normal)	It is suspected that the problem causing the detection of engine oil pressure reduction is currently occurring or occurred in the past. Investigate the cause and damage condition, and correct it.
	2	Defective engine oil pressure caution lamp system	Carry out troubleshooting of engine oil pressure caution lamp system in accordance with ,“While engine is running, emergency warning item flashes” in E-mode.

Failure code [B@BCNS] Radiator coolant: Overheat

Action code	Failure code	Failure symptom	Radiator coolant: Overheat (Mechanical system)
—	**B@BCNS**		
Failure content	• While engine is running, radiator coolant temperature caution lamp flashes.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. (Function of monitor panel) • Limits operation of engine.		
Symptoms that appears on machine	• If the machine is operated in the same condition, engine may be damaged. • After warning, engine output is limited to half of rated hosepower.		
General information	• Duplication of failure code: Start the engine.		

Possible causes and the standard values when normal		Cause	Standard value when normal and remarks for troubleshooting
	1	Engine coolant overheats (When system is normal)	It is suspected that the problem causing a detection of engine coolant overheat is currently occurring or occurred in the past. Investigate the cause and damage condition, and correct it.
	2	Defective engine coolant temperature caution lamp system	Carry out troubleshooting of engine coolant temperature caution lamp circuit in accordance with “While engine is running, emergency warning item flashes” in E-mode.

Failure code [B@CENS] Power train oil: Overheat

Action code	Failure code	Failure symptom	Power train oil: Overheat (Mechanical system)
—	**B@CENS**		
Failure content	• While engine is running, power train oil temperature caution lamp flashes.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. (Function of monitor panel)		
Symptoms that appears on machine	• If the machine is operated in the same condition, power train may be damaged.		
General information	• Duplication of failure code: Start the engine.		

Possible causes and the standard values when normal		Cause	Standard value when normal and remarks for troubleshooting
	1	Power train oil temperature overheat (When system is normal)	It is suspected that the problem causing a detection of power train oil overheat is currently occurring or occurred in the past. Investigate the cause and damage condition, and correct it.
	2	Defective caution lamp system for power train oil temperature	Carry out troubleshooting of power train oil temperature caution lamp system in accordance with, “While engine is running, emergency warning item flashes” in E-mode.

Failure code [B@HANS] Hydraulic oil: Overheat

Action code	Failure code	Failure symptom	Hydraulic oil: Overheat (Mechanical system)
—	**B@HANS**		
Failure content	• While engine is running, hydraulic oil temperature caution lamp flashes.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. (Function of monitor panel)		
Symptoms that appears on machine	• If the machine is operated in the same condition, the devices for hydraulic circuit of the work equipment may be damaged.		
General information	• Duplication of failure code: Start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Hydraulic oil overheat (When system is normal)	It is suspected that the problem causing a detection of hydraulic oil overheat is currently occurring or occurred in the past. Investigate the cause and damage condition, and correct it.
	2	Defective hydraulic oil temperature caution lamp system	Carry out troubleshooting of hydraulic oil temperature caution lamp circuit in accordance with “While engine is running, emergency warning item flashes” in E-mode.

Failure code [CA111] Engine controller: Abnormality in controller

Action code	Failure code	Failure symptom	Engine controller: Abnormality in controller (Engine controller system)
CALL E04	**CA111**		
Failure content	• An abnormality occurs in internal memory or internal power supply circuit.		
Controller's action	• Takes no paticular action.		
Symptoms that appears on machine	• Engine can not start.		
General information			

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective engine controller	Internal defect of engine controller is suspected. (It cannot be diagnosed.)

Failure code [CA115] Abnormal engine Ne and Bkup speed sensors: Abnormal speed sensor signal

Action code	Failure code	Failure symptom	Abnormal engine Ne and Bkup speed sensors: Abnormal speed sensor signal (Engine controller system)
CALL E04	**CA115**		
Failure content	• Abnormality occurred in both signals of engine Ne speed sensor and engine Bkup speed sensor.		
Controller's action	• Takes no paticular action.		
Symptoms that appears on machine	• Engine stops. • Engine does not start.		
General information	• Duplication of failure code: start the engine.		

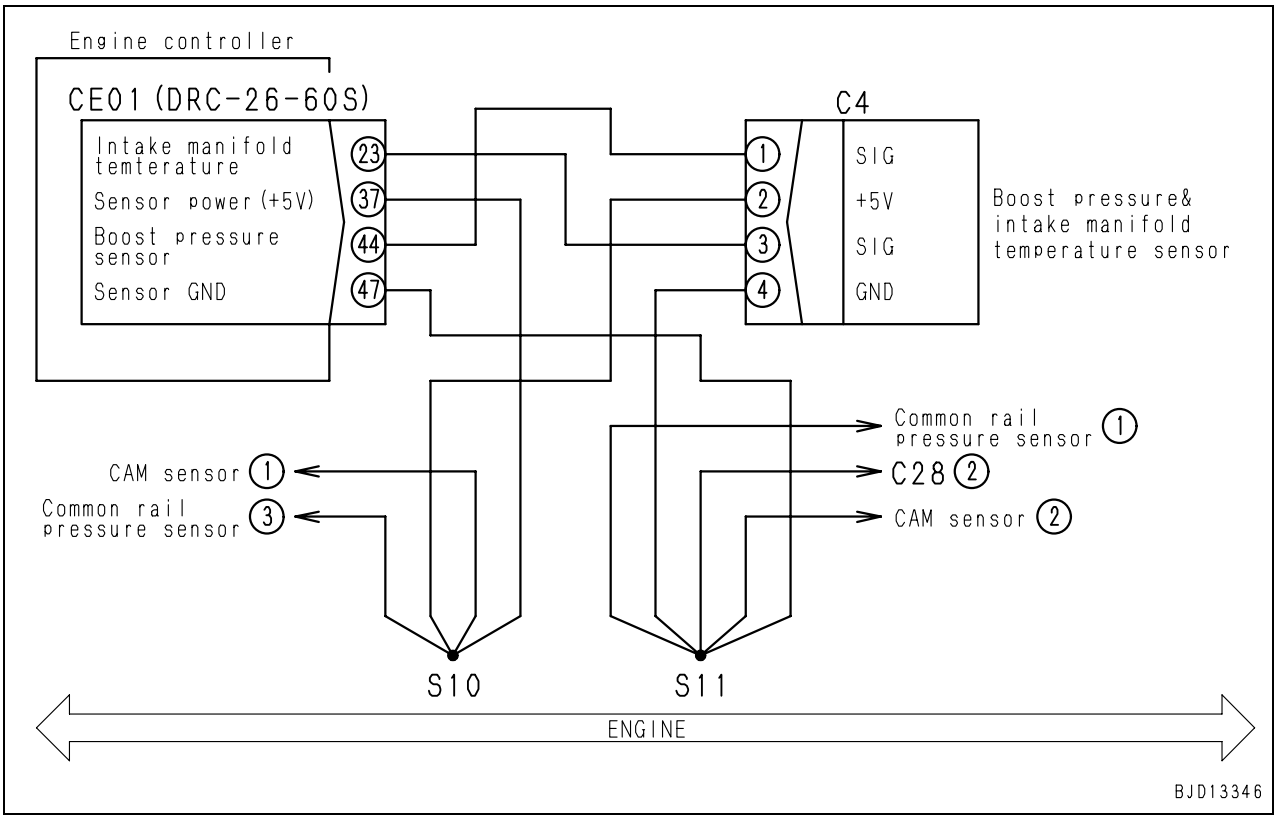
Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective connection of sensor connector	The defective (wrong) connections of engine Ne and Bkup speed sensor connectors are suspected. Visually check it.

Failure code [CA122] Charge pressure sensor tool high: Excessively high voltage detected

Action code	Failure code	Failure symptom	Charge pressure sensor too high: excessively high voltage detected (Engine controller system)
CALL E03	**CA122**		
Failure content	• Excessively high voltage is detected at pressure signal circuit of boost pressure and temperature sensor.		
Controller's action	• Operates with a fixed charge pressure.		
Symptoms that appears on machine	• Engine output is reduced.		
General information	• The signal voltage of boost pressure and temperature sensor on boost pressure side can be checked in monitoring function. (Code: 36501 Boost pressure sensor voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor power source 2 system	If failure code [**CA227**] is displayed at the same time, carry out troubleshooting for that in advance.		
	2	Defective boost pressure and temperature sensor [pressure signal circuit]	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.		
			C4		Voltage
			Between (2) – (4)	Power source	4.75 – 5.25 V
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.		
	3	Hot short of harness (a contact with 5 V circuit or 24 V circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.		
			Between ground and wiring harness between CE01 (female) (44) – C4 (female) (1)	Voltage	Max. 1 V
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Wiring harness between CE01(female) (44) – C4 (female) (1) and wiring harness among CE01(female) (37) – S10 – C4 (female) (2)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among boost pressure and temperature sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.		
			CE01		Voltage
			Between (37) – (47)	Power source	4.75 – 5.25 V

Circuit diagram related to boost pressure and temperature sensor

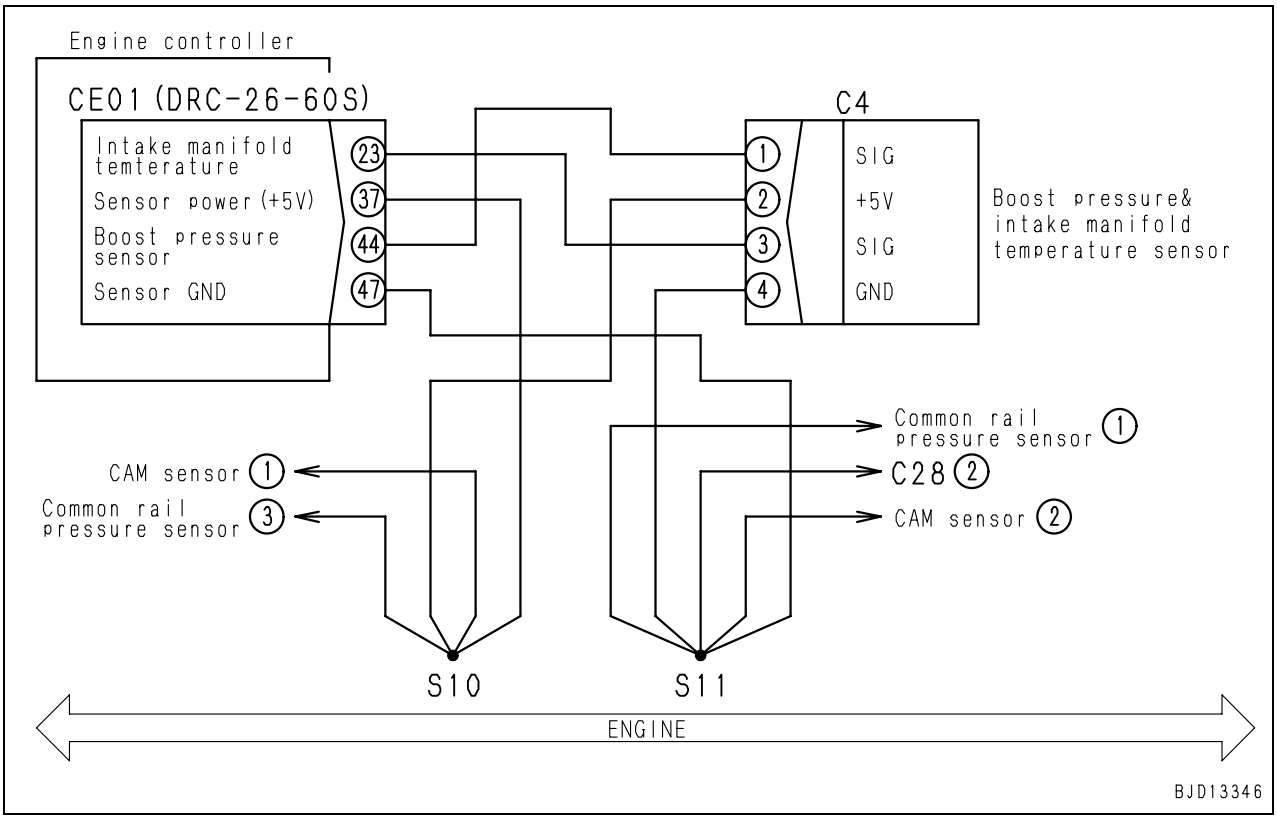


Failure code [CA123] Charge pressure sensor too low: Excessively low voltage detected

Action code	Failure code	Failure symptom	Charge pressure sensor too low: Excessively low voltage detected (Engine controller system)
CALL E03	**CA123**		
Failure content	• Excessively low voltage is detected at pressure signal circuit of boost pressure and temperature sensor.		
Controller's action	• Operates with a fixed charge pressure.		
Symptoms that appears on machine	• Engine output is reduced.		
General information	• The signal voltage of boost pressure and temperature sensor on boost pressure side can be checked in monitoring function. (Code: 36501 Boost pressure sensor voltage) • Duplication of failure code: turn ON the starting switch.		

		Cause	Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor power source 2 system	If failure code [**CA187**] is displayed at the same time, carry out troubleshooting for that first.		
	2	Defective boost pressure and temperature sensor [pressure signal circuit]	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.		
			C4		Voltage
			Between (2) – (4)	Power source	4.75 – 5.25 V
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.		
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Between ground and wiring harness between CE01 (female) (44) – C4 (female) (1)	Resistance	Min. 100 kΩ
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Wiring harness between CE01(female) (44) – C4 (female) (1) and wiring harness among CE01(female) (47) – S11 – C4 (female) (4)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among boost pressure and temperature sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.		
			CE01		Voltage
			Between (37) – (47)	Power source	4.75 – 5.25 V

Circuit diagram related to boost pressure and temperature sensor

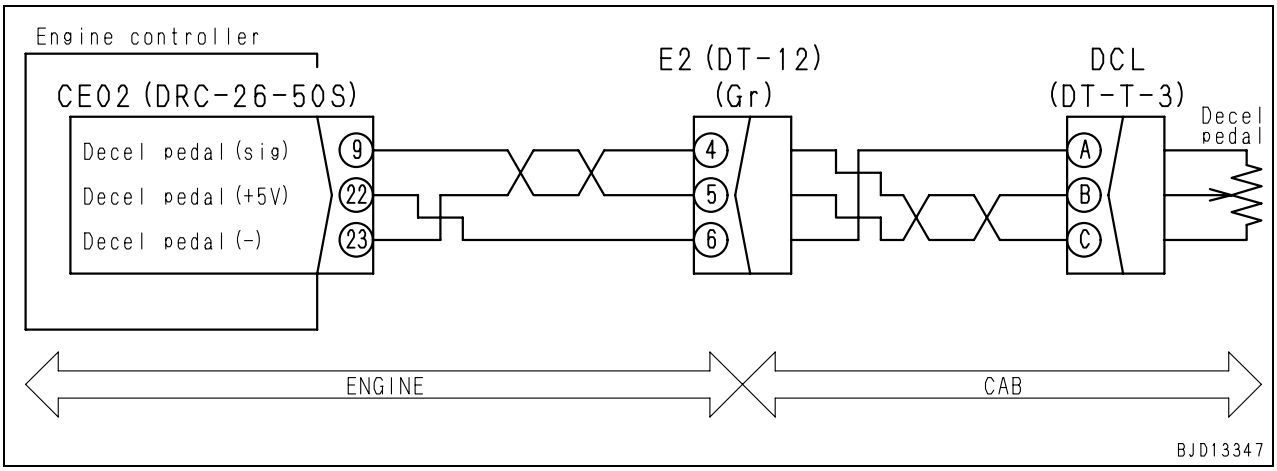


Failure code [CA131] Decelerator pedal sensor tool high: Excessively high voltage detected

Action code	Failure code	Failure symptom	Decelerator pedal sensor too high: Excessively high voltage detected (Engine controller system)
CALL E03	**CA131**		
Failure content	• Excessively high voltage is detected at signal circuit of decelerator pedal.		
Controller's action	• Operates with the fixed value that is same as the value just before the abnormality is detected, if abnormality occurs with the starting switch in the ON position. • If the starting switch is turned to the ON position in the same abnormal condition, the controller operates with 100% value.		
Symptoms that appears on machine	• Engine speed cannot be controlled by decelerator pedal.		
General information	• The signal voltage of decelerator pedal can be checked in monitoring mode. (Code: 31703 Decelerator voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective throttle sensor power supply circuit	If failure code [**CA2185**] is displayed at the same time, carry out troubleshooting for that first.			
	2	Defective decelerator pedal	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			DCL		Voltage	
			Between (A) – (C)	Power source	4.75 – 5.25 V	
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.			
	3	Hot short of harness (a contact with 5 V circuit or 24 V circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			Between ground and wiring harness between CE02 (female) (9) – DCL (female) (B)		Voltage	Max. 1 V
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between CE02 (female) (9) – DCL (female) (B) and wiring harness between CE02 (female) (22) – DCL (female) (A)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among decelerator pedal – body harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			CE02		Voltage	
			Between (22) – (23)	Power source	4.75 – 5.25 V	

Circuit diagram related to fuel control dial

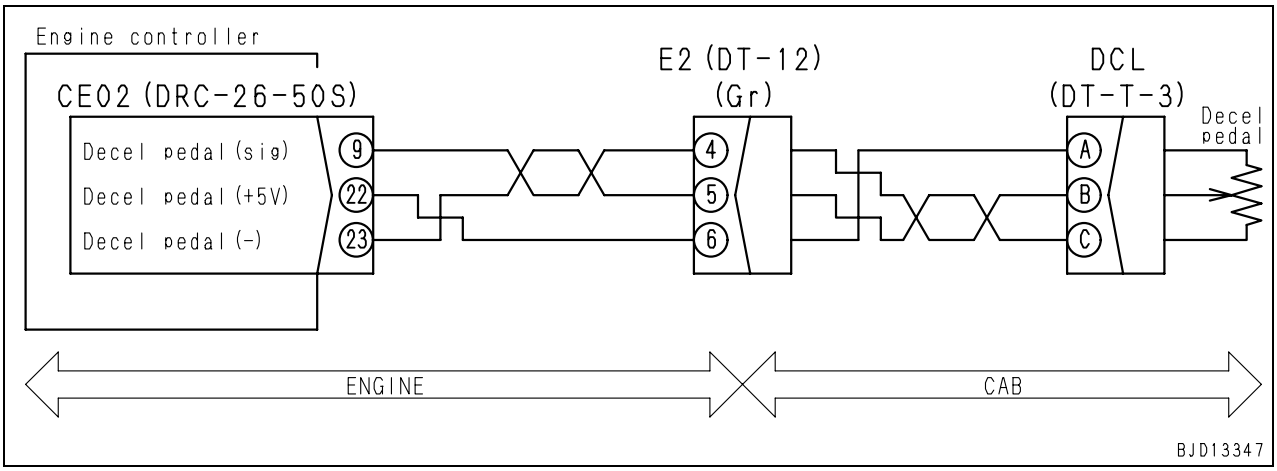


Failure code [CA132] Decelerator pedal sensor too low: Excessively low voltage detected

Action code	Failure code	Failure symptom	Decelerator pedal sensor too low: excessively low voltage detected (Engine controller system)
CALL E03	**CA132**		
Failure content	• Excessively low voltage is detected at signal circuit of decelerator pedal.		
Controller's action	• Operates with the fixed value that is same as the value just before the abnormality is detected, if abnormality occurs with the starting switch in the ON position. • If the starting switch is turned to the ON position in the same abnormal condition, the controller operates with 100% value.		
Symptoms that appears on machine	• Engine speed cannot be controlled by decelerator pedal.		
General information	• The signal voltage of decelerator pedal can be checked in monitoring mode. (Code: 31703 Decelerator voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective throttle sensor power supply circuit	If failure code [**CA2186**] is displayed at the same time, carry out troubleshooting for that first.			
	2	Defective decelerator pedal	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			DCL		Voltage	
			Between (A) – (C)	Power source	4.75 – 5.25 V	
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.			
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between CE02 (female) (9) – DCL (female) (B)	Resistance	Min. 100 kΩ	
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between CE02 (female) (9) – DCL (female) (B) and wiring harness between CE02 (female) (23) – DCL (female) (C)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	The connections among decelerator pedal – body harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			CE02		Voltage	
			Between (22) – (23)	Power source	4.75 – 5.25 V	

Circuit diagram related to fuel control dial

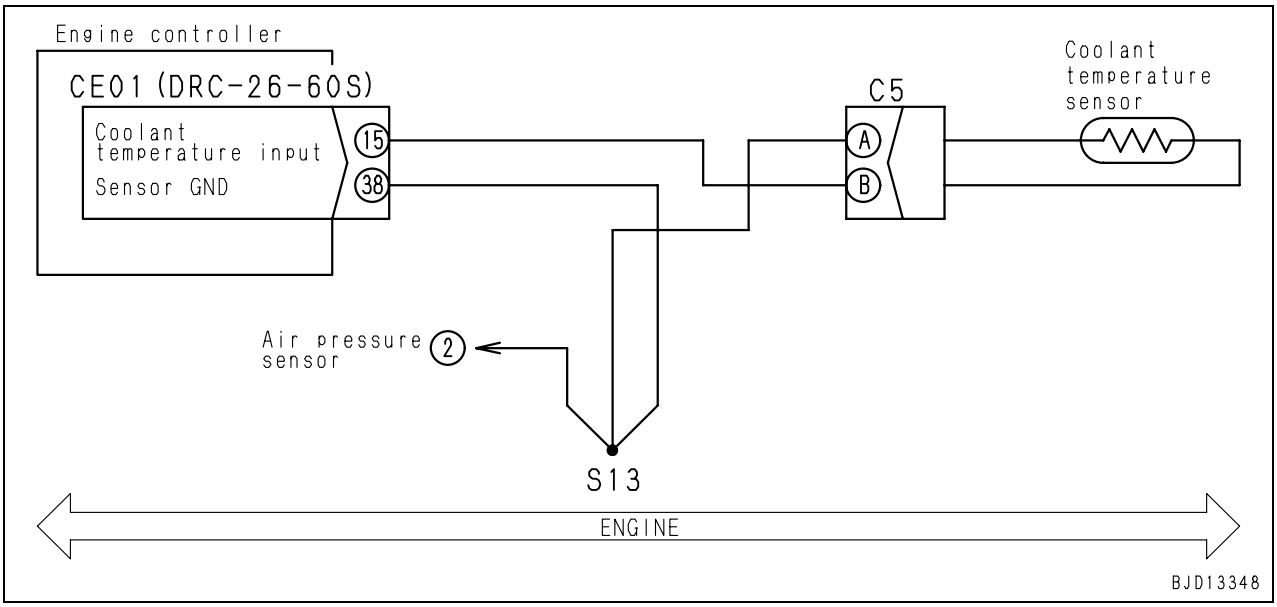


Failure code [CA144] Coolant temperature sensor too high: Excessively high voltage detected

Action code	Failure code	Failure symptom	Coolant temperature sensor too high: Excessively high voltage detected (Engine controller system)
E01	**CA144**		
Failure content	• Excessively high voltage is detected at signal circuit of engine coolant temperature sensor.		
Controller's action	• Operates with a fixed engine coolant temperature.		
Symptoms that appears on machine	• Exhaust gas color becomes white. • Overheat prevention function does not work.		
General information	• The signal voltage of engine coolant sensor can be checked in monitoring mode. (Code: 04105 Engine coolant sensor voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective engine coolant temperature sensor	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			C5 (male)	Resistance		
			Between (A) – (B)	0.18 – 160 kΩ		
	2	Disconnection in wiring harness (Disconnection or poor connector contact)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between CE01 (female) (15) – C5 (female) (B)	Resistance	Max. 10 Ω	
			Wiring harness among CE01 (female) (38) – S13 – C5 (female) (A)	Resistance	Max. 10 Ω	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between CE01 (female) (15) – CE01 (female) all pins (With all connectors in the harness disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	The connections among engine coolant temperature sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			CE01 (female)	Resistance		
			Between (15) – (38)	0.18 – 160 kΩ		
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Internal failure which cannot be diagnosed)			

Circuit diagram related to coolant temperature sensor

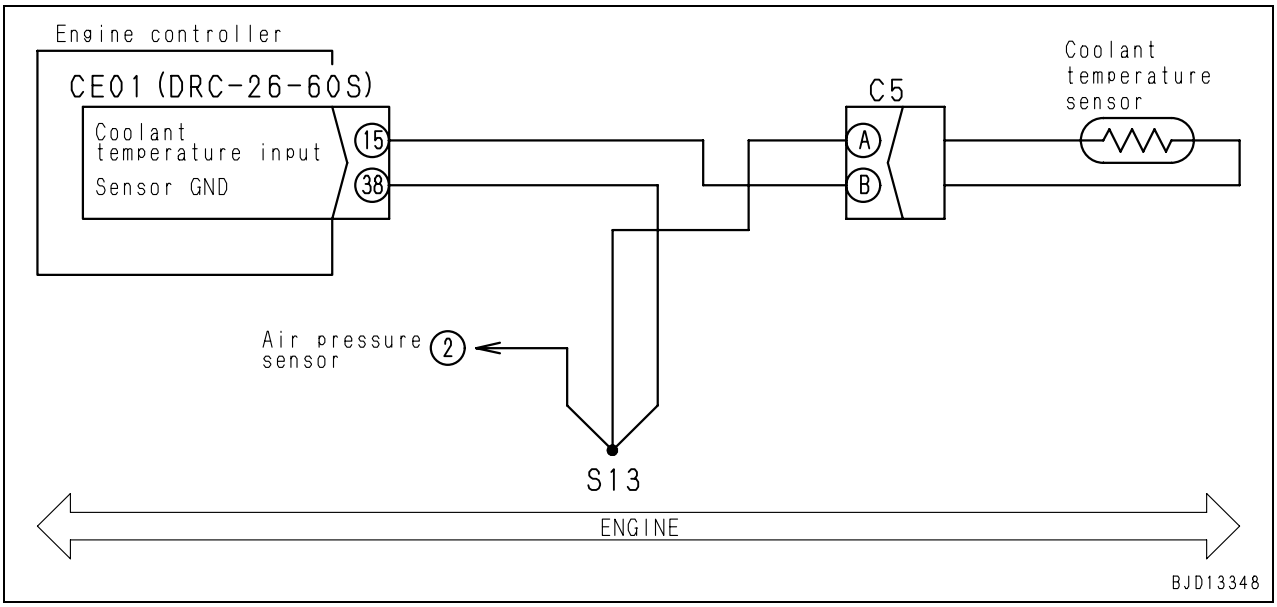


Failure code [CA145] Coolant temperature sensor too low: Excessively low voltage detected

Action code	Failure code	Failure symptom	Coolant temperature sensor too low: Excessively low voltage detected (Engine controller system)
E01	**CA145**		
Failure content	• Excessively low voltage is detected at signal circuit of engine coolant temperature sensor.		
Controller's action	• Operates with a fixed engine coolant temperature.		
Symptoms that appears on machine	• Exhaust gas color becomes white. • Overheat prevention function does not work.		
General information	• The signal voltage of engine coolant sensor can be checked in monitoring mode. (Code: 04105 Engine coolant sensor voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective engine coolant temperature sensor	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			C5 (male)	Resistance		
			Between (A) – (B)	0.18 – 160 kΩ		
			Between (B) – chassis ground	Min. 100 kΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between CE01 (female) (15) – C5 (female) (B)	Resis-tance	Min. 100 kΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between CE01 (female) (15) – CE01 (female) all pins (With all connectors in the harness disconnected)	Resis-tance	Min. 100 kΩ	
	4	Defective wiring harness connector	The connections among engine coolant temperature sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			CE01 (female)	Resistance		
			Between (15) – (38)	0.18 – 160 kΩ		
			Between (15) – chassis ground	Min. 100 kΩ		
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Internal failure which cannot be diagnosed)			

Circuit diagram related to coolant temperature sensor

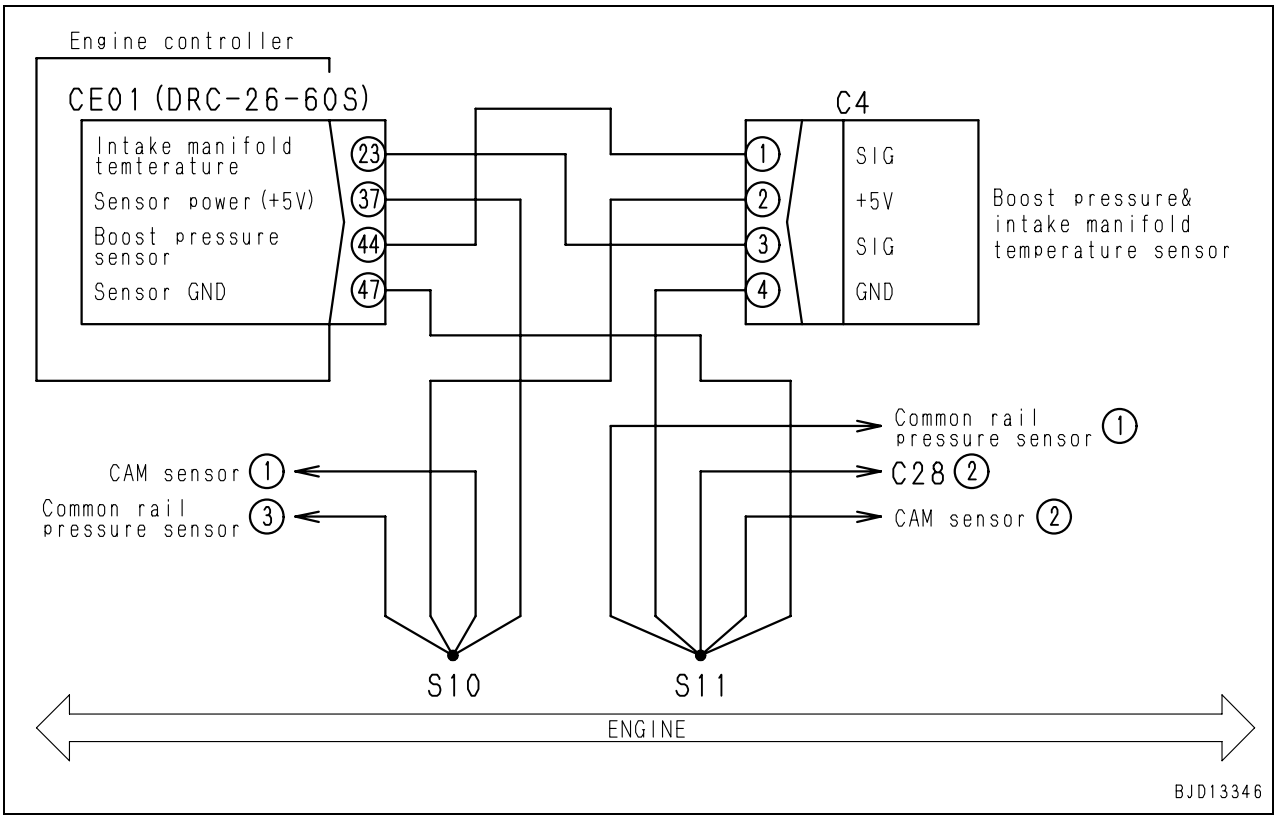


Failure code [CA153] Charge temperature sensor too high: Excessively high voltage detected

Action code	Failure code	Failure symptom	Charge temperature sensor too high: Excessively high voltage detected (Engine controller system)
E01	**CA153**		
Failure content	• Excessively high voltage is detected at temperature signal circuit of boost pressure and temperature sensor.		
Controller's action	• Operates with a fixed charge temperature.		
Symptoms that appears on machine	• Exhaust gas color becomes white. • Engine protection function by boost temperature does not work.		
General information	• The signal voltage of boost pressure and temperature sensor on boost temperature side can be checked in monitoring function. (Code: 18501 Boost temperature sensor voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective boost pressure and temperature sensor [temperature signal circuit]	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			C4 (male)	Resistance	
			Between (3) – (4)	0.18 – 160 kΩ	
	2	Disconnection in wiring harness (Disconnection or poor connector contact)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Wiring harness between CE01 (female) (23) – C4 (female) (3)	Resistance	Max. 10 Ω
			Wiring harness among CE01 (female) (47) – S11 – C4 (female) (4)	Resistance	Max. 10 Ω
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Between CE01 (female) (23) – CE01 (female) all pins (With all connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	The connections among boost pressure and temperature sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			CE01 (female)	Resistance	
			Between (23) – (47)	0.18 – 160 kΩ	
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Internal failure which cannot be diagnosed)		

Circuit diagram related to boost pressure and temperature sensor

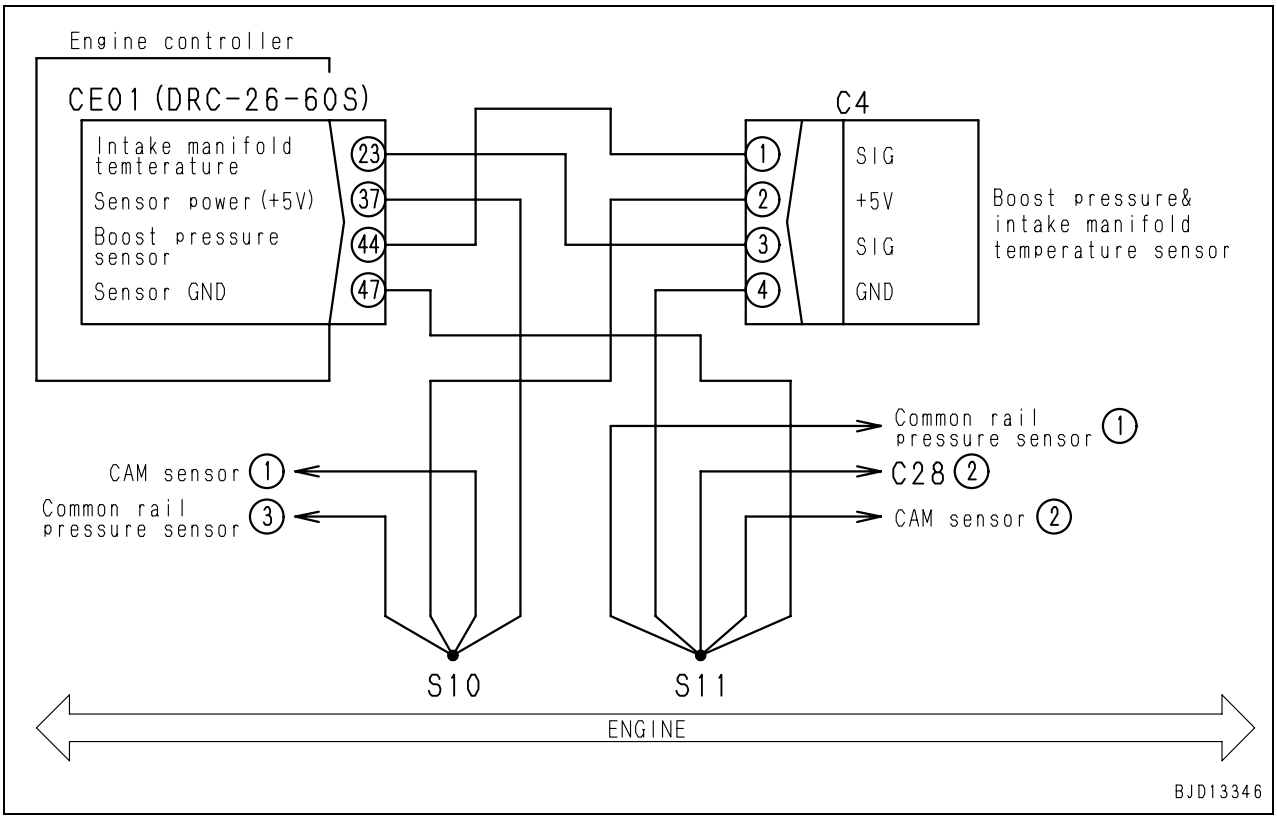


Failure code [CA154] Charge temperature sensor too low: Excessively low voltage detected

Action code	Failure code	Failure symptom	Charge temperature sensor too low: Excessively low voltage detected (Engine controller system)
E01	**CA154**		
Failure content	• Excessively low voltage is detected at temperature signal circuit of boost pressure and temperature sensor.		
Controller's action	• Operates with a fixed charge temperature.		
Symptoms that appears on machine	• Exhaust gas color becomes white. • Engine protection function by boost temperature does not work.		
General information	• The signal voltage of boost pressure and temperature sensor on boost temperature side can be checked in monitoring function. (Code: 18501 Boost temperature sensor voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective boost pressure and temperature sensor [temperature signal circuit]	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			C4 (male)	Resistance	
			Between (3) – (4)	0.18 – 160 kΩ	
			Between (3) – chassis ground	Min. 100 kΩ	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Between ground and wiring harness between CE01 (female) (23) – C4 (female) (3)	Resis-tance	Min. 100 kΩ
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Between CE01 (female) (23) – CE01 (female) all pins (With all connectors in the harness disconnected)	Resis-tance	Min. 100 kΩ
	4	Defective wiring harness connector	The connections among boost pressure and temperature sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			CE01 (female)	Resistance	
			Between (23) – (47)	0.18 – 160 kΩ	
			Between (23) – chassis ground	Min. 100 kΩ	
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Internal failure which cannot be diagnosed)		

Circuit diagram related to boost pressure and temperature sensor



Failure code [CA155] Charge temperature too high and engine speed derated: Exceeded upper control limit of temperature

Action code	Failure code	Failure symptom	Charge air temperature too high and engine speed derated: Exceeded upper control limit of temperature (Engine controller system)
CALL E03	**CA155**		
Failure content	• The temperature signal of boost pressure and temperature sensor exceeds upper control limit temperature.		
Controller's action	• Operates with limited output.		
Symptoms that appears on machine	• Engine output is reduced. • Engine stops.		
General information	• The boost temperature can be checked in monitoring function. (Code: 18500 Boost temperature) • Duplication of failure code: Start the engine.		

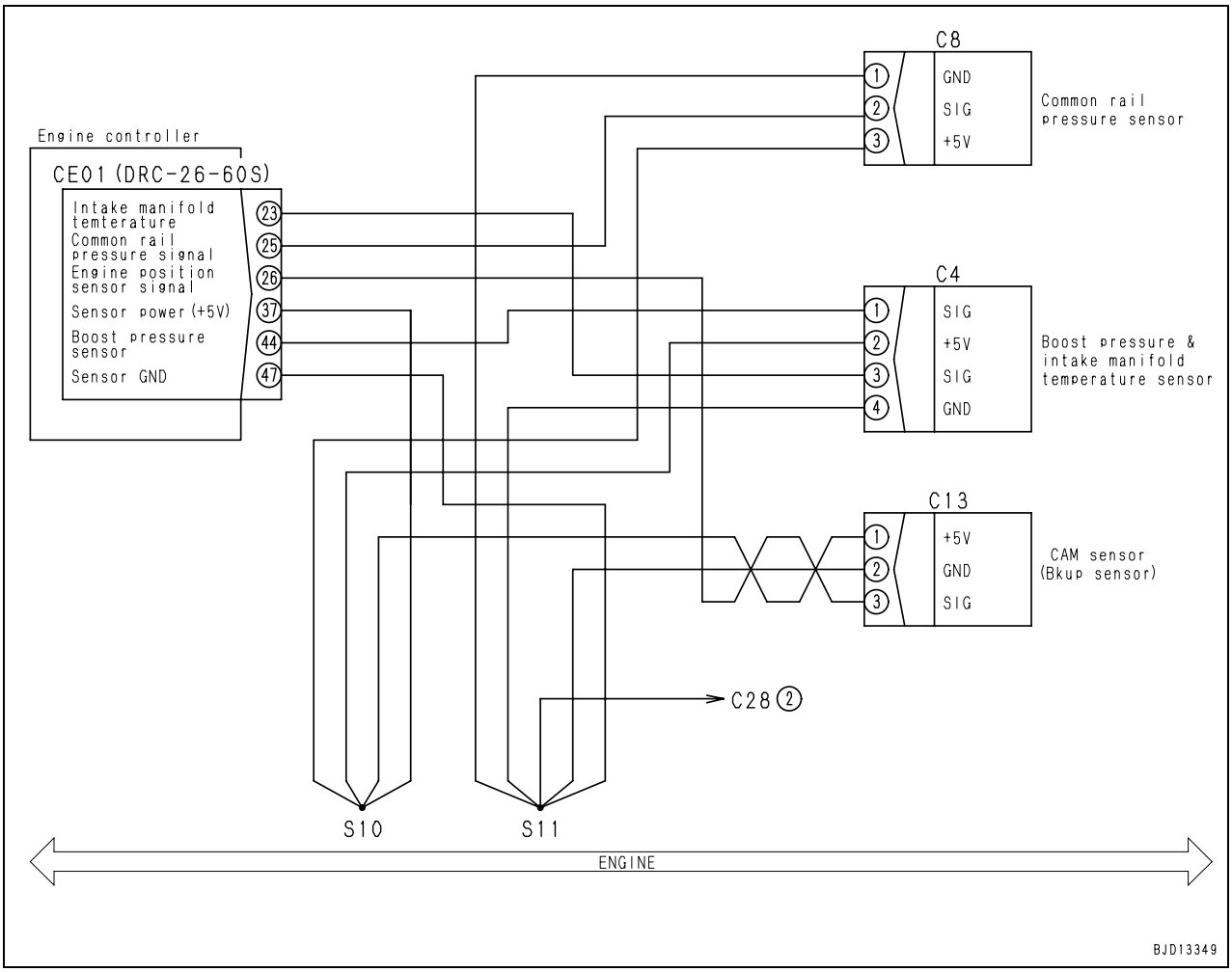
		Cause	Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Degradation of cooling performance of aftercooler	The degradation of aftercooler cooling performance is suspected. Directly check the following points: • Looseness and damage of fun belt • Insufficient cooling air amount • Clogging of aftercooler fin
	2	Abnormal rise in turbocharger outlet temperature	The abnormal rise in turbocharger outlet temperature is suspected. Directly check the related parts.
	3	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 2. (Internal failure which cannot be diagnosed)

Failure code [CA187] Sensor power source 2 too low: Excessively low voltage detected

Action code	Failure code	Failure symptom	Sensor power source 2 too low: Excessively low voltage detected (Engine controller system)
CALL E03	**CA187**		
Failure content	• Excessively low voltage has been detected at sensor power source 2 circuit.		
Controller's action	• Operates with a fixed boost pressure. • Operates with fixed charge temperature. • Runs by limiting output.		
Symptoms that appears on machine	• Engine output is reduced.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor or harness	★ Disconnect connectors with starting switch OFF, then turn it ON for troubleshooting.		
			Disconnect the devices on the right one at a time and try to duplicate the problem. If the failure code changes from flashing to continuously illuminating, that device or harness is defective.	Boost pressure and temperature sensor	C4
				Common rail pressure sensor	C8
				Bkup sensor	C13
				Engine harness	CE01
	2	Defective harness connector	The connections among each sensor – engine harness – engine controller are suspected to be defective. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	3	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 2. (Internal failure which cannot be diagnosed)		

Circuit diagram related to sensor power supply 2

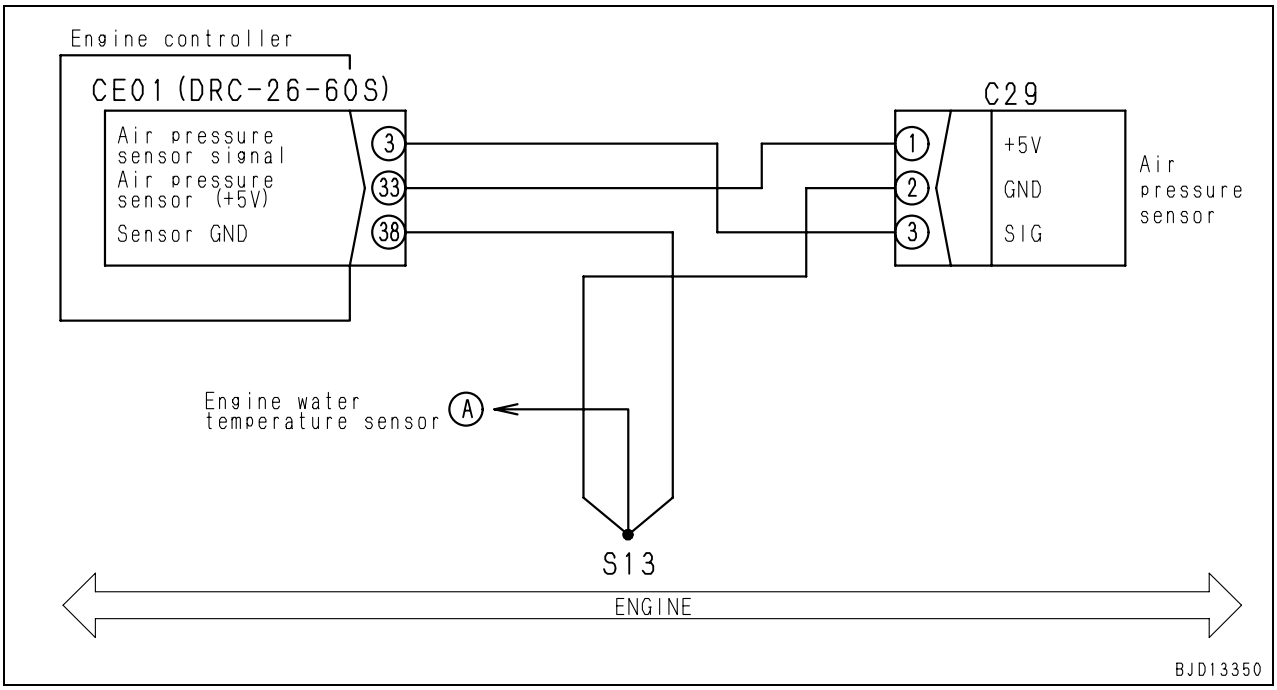


Failure code [CA221] Atmospheric pressure sensor too high: Excessivley high voltage detected

Action code	Failure code	Failure symptom	Atmospheric pressure sensor too high: Excessively high voltage detected (Engine controller system)
E01	**CA221**		
Failure content	• Excessively high voltage is detected at signal circuit of atmospheric pressure sensor.		
Controller's action	• Operates with a fixed atmospheric pressure.		
Symptoms that appears on machine	• Startability gets worse. • Engine output is reduced.		
General information	• The signal voltage of the atmospheric pressure sensor can be checked in monitoring mode. (Code: 37401 Atmospheric pressure sensor voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor power source 1 system	If failure code [**CA386**] is displayed at the same time, carry out troubleshooting for that first.			
	2	Defective atmospheric pressure sensor	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			C29		Voltage	
			Between (1) – (2)	Power source	4.75 – 5.25 V	
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.			
	3	Hot short of harness (a contact with 5 V circuit or 24 V circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			Between ground and wiring harness between CE01 (female) (3) – C29 (female) (3)		Voltage	Max. 1 V
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between CE01 (female) (3) – C29 (female) (3) and wiring harness between CE01 (female) (33) – C29 (female) (1)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among atmospheric pressure sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			CE01		Voltage	
			Between (33) – (38)	Power source	4.75 – 5.25 V	

Circuit diagram related to atmospheric pressure sensor

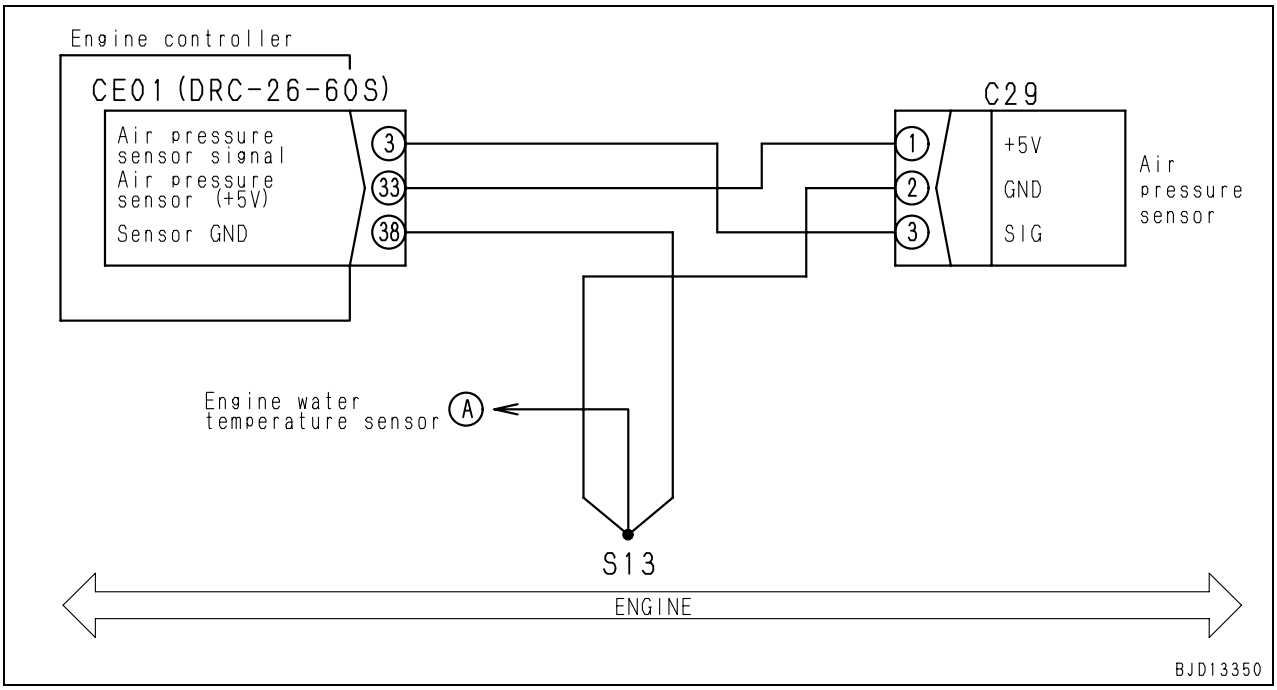


Failure code [CA222] Atmospheric pressure sensor too low: Excessively low voltage detected

Action code	Failure code	Failure symptom	Atmospheric pressure sensor too low: Excessively low voltage detected (Engine controller system)
E01	**CA222**		
Failure content	• Excessively low voltage is detected at signal circuit of atmospheric pressure sensor.		
Controller's action	• Operates with a fixed atmospheric pressure.		
Symptoms that appears on machine	• Startability gets worse. • Engine output is reduced.		
General information	• The signal voltage of the atmospheric pressure sensor can be checked in monitoring mode. (Code: 37401 Atmospheric pressure sensor voltage) • Duplication of failure code: turn ON the starting switch.		

		Cause	Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor power source 1 system	If failure code [**CA352**] is displayed at the same time, carry out troubleshooting for that first.			
	2	Defective atmospheric pressure sensor	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			C29		Voltage	
			Between (1) – (2)	Power source	4.75 – 5.25 V	
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.			
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Between ground and wiring harness between CE01 (female) (3) – C29 (female) (3)		Resistance	Min. 100 kΩ
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.			
			Wiring harness between CE01 (female) (3) – C29 (female) (3) and wiring harness between CE01 (female) (38) – S13 – C29 (female) (2)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among atmospheric pressure sensor – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	6	Defective engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.			
			CE01		Voltage	
			Between (33) – (38)	Power source	4.75 – 5.25 V	

Circuit diagram related to atmospheric pressure sensor

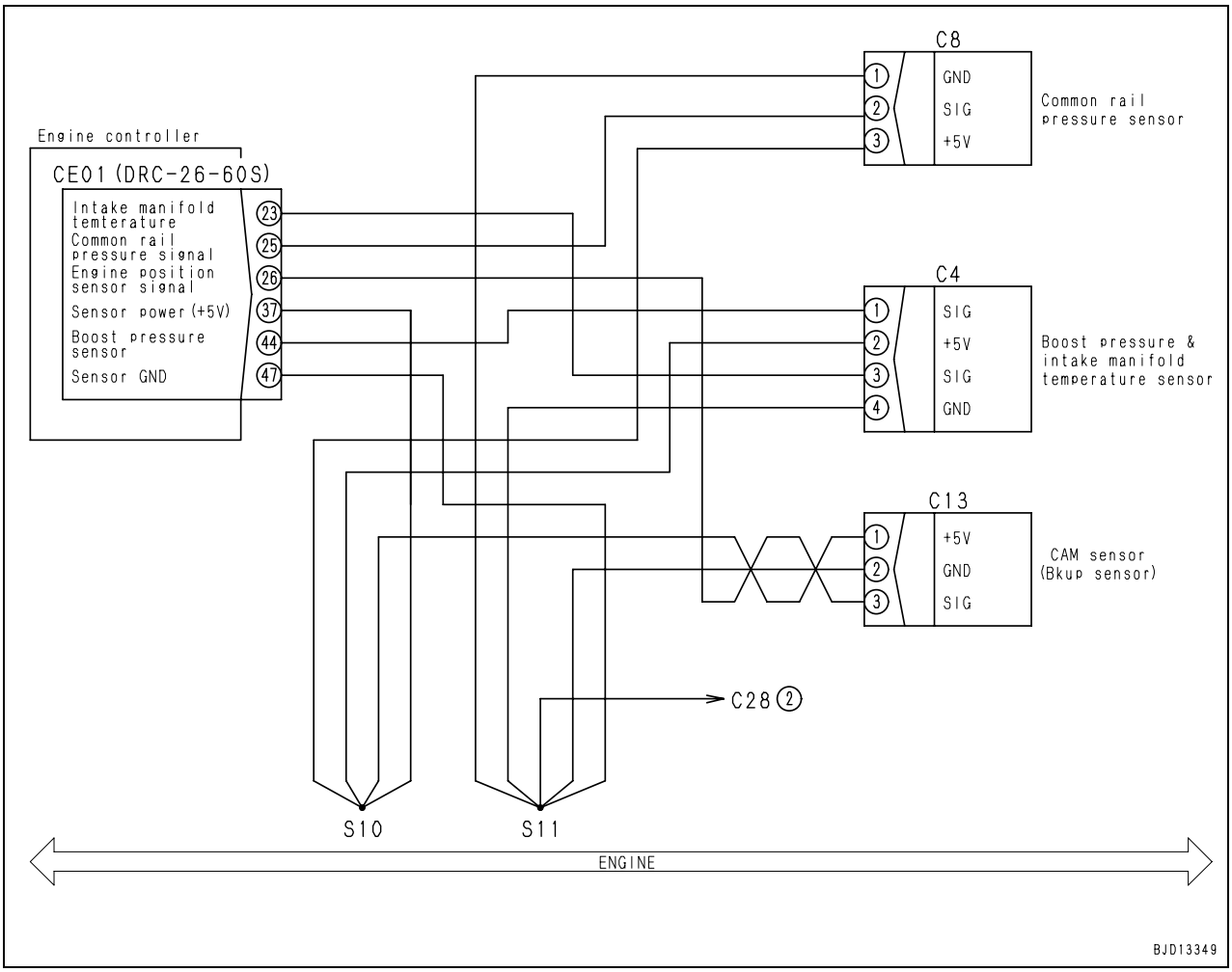


Failure code [CA227] Sensor power source 2 too high: Excessively high voltage detected

Action code	Failure code	Failure symptom	Sensor power source 2 too high: Excessively high voltage detected (Engine controller system)
CALL E03	**CA227**		
Failure content	• Excessively high voltage has been detected in sensor power source 2 circuit		
Controller's action	• Operates with a fixed boost pressure. • Operates with fixed charge temperature. • Runs by limiting output.		
Symptoms that appears on machine	• Engine output is reduced.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Defective wiring harness connector	The connections among each sensor – engine harness – engine controller are suspected to be defective. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation
	2	Defective engine controller	Engine controller is possibly defective if no problem is found in cause 1. (Internal failure which cannot be diagnosed)

Circuit diagram related to sensor power supply 2



Failure code [CA234] Engine over speed: Excessively high speed

Action code	Failure code	Failure symptom	Engine over speed: Excessively high speed (Engine controller system)
—	**CA234**		
Failure content	• The engine speed exceeds upper control limit speed.		
Controller's action	• Stops operation of injector until the engine speed drops to the normal speed.		
Symptoms that appears on machine	• Engine speed fluctuates.		
General information	• The engine speed can be checked in monitoring function. (Code: 01000 Engine speed) • Duplication of failure code: Start engine and operate at high idle.		

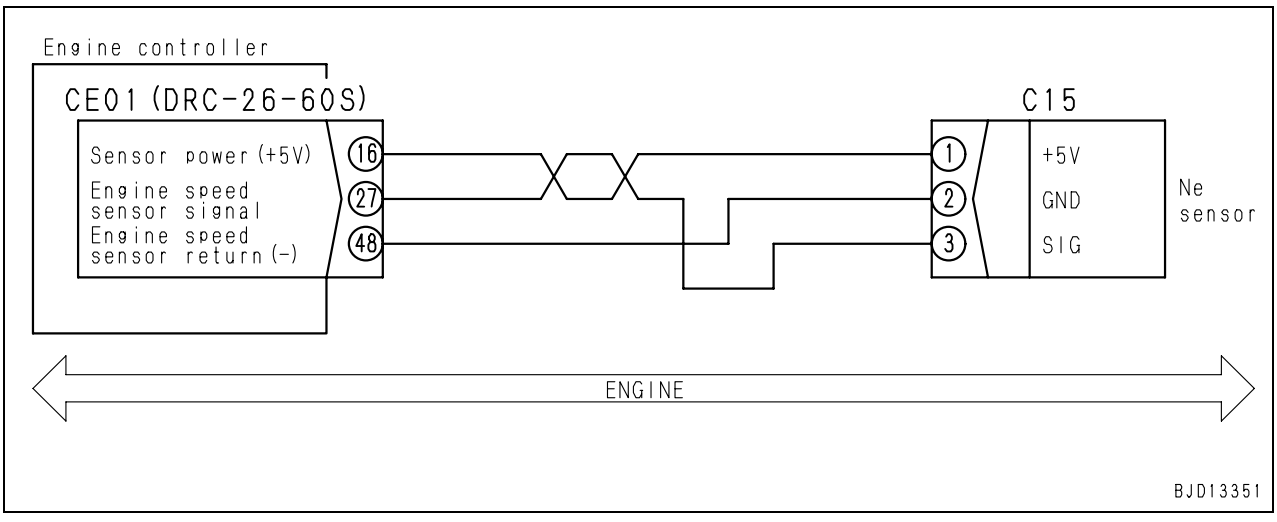
	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Improper fuel has been used.	The use of improper fuel is suspected. Visually check it.
	2	Improper usage	The improper usage of equipped machine is suspected. Instruct the proper usage.
	3	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 2. (Internal failure which cannot be diagnosed)

Failure code [CA238] Abnormal power source for Ne speed sensor: Excessively low voltage detected

Action code	Failure code	Failure symptom	Abnormal power source for Ne speed sensor: Excessively low voltage detected (Engine controller system)
CALL E03	**CA238**		
Failure content	• Excessively low voltage is detected at power source circuit of engine Ne speed sensor.		
Controller's action	• Continues the control by engine Bkup speed sensor signal.		
Symptoms that appears on machine	• Engine is hard to start. • Engine is hunting.		
General information	• Duplication of failure code: turn ON the starting switch.		

Possible causes and the standard values when normal		Cause	Standard value when normal and remarks for troubleshooting		
			★ Prepare with starting switch OFF, then turn it ON for troubleshooting.		
	1	Defective sensor or wiring harness	Disconnect the devices on the right one at a time and try to duplicate the problem. If the failure code changes from flashing to continuously illuminating, that device or harness is defective.	Ne speed sensor	C15
				Engine harness	CE01
	2	Defective wiring harness connector	The connections among each sensor – engine harness – engine controller are suspected to be defective. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		

Circuit diagram related to engine Ne speed sensor

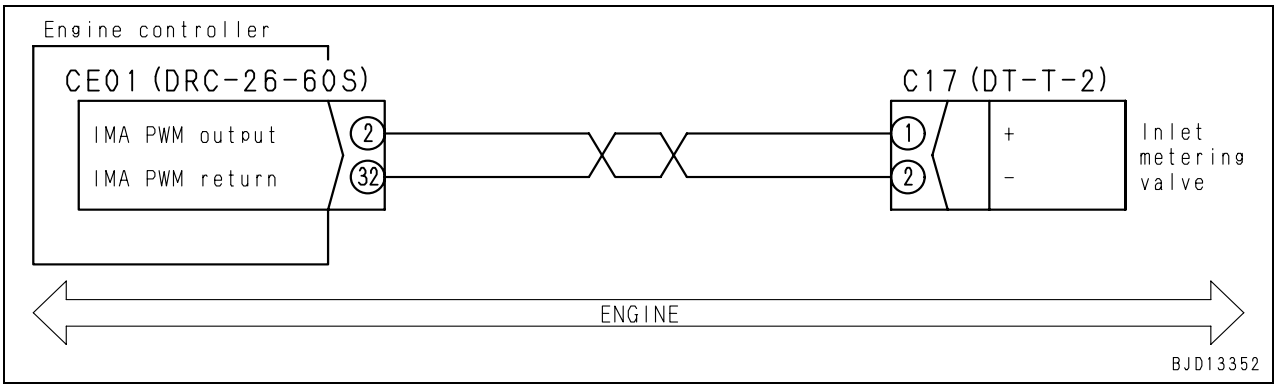


Failure code [CA271] IMV/PCV1 short circuit: Short circuit

Action code	Failure code	Failure symptom	IMV/PCV1 short circuit: Short circuit (Engine controller system)
CALL E03	**CA271**		
Failure content	• Short circuit has been detected at drive circuit of supply pump actuator.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine speed does not increase from low idle. • Engine output is reduced. • Fuel pressure of common rail increases above command value.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective supply pump actuator	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			C17 (male)	Resistance	
			Between (1) – chassis ground	Min. 100 kΩ	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Between ground and wiring harness between CE01 (female) (2) – C17 (female) (1)	Resistance	Min. 100 kΩ
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Between CE01 (female) (2) – CE01 (female) all pins (With all connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	The connections among inlet metering valve – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			CE01 (female)	Resistance	
			Between (2) – chassis ground	Min. 100 kΩ	
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Internal failure which cannot be diagnosed)		

Circuit diagram related to supply pump actuator (metering unit)

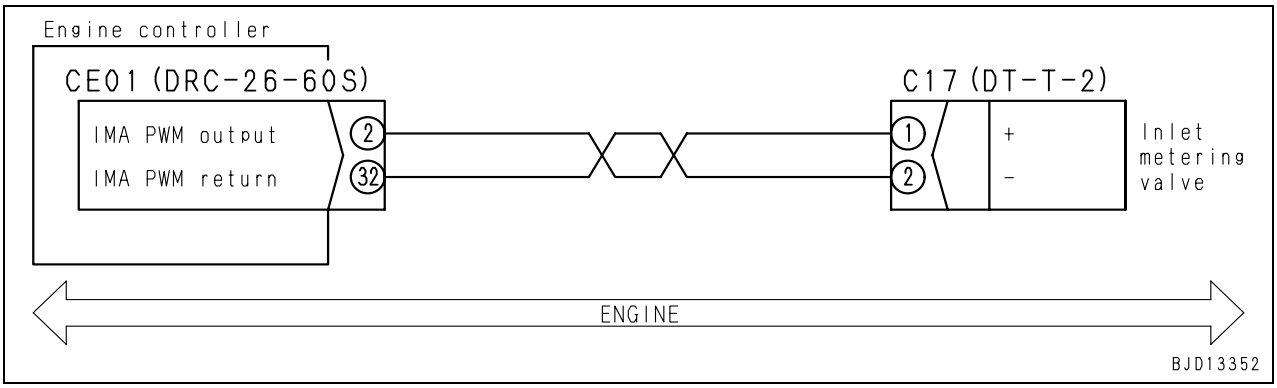


Failure code [CA272] IMV/PCV1 disconnection: Disconnection

Action code	Failure code	Failure symptom	IMV/PCV1 disconnection: Disconnection (Engine controller system)
CALL E03	**CA272**		
Failure content	• Disconnection is detected at drive circuit of supply pump actuator.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine runs, but it does not stabilize. • Fuel pressure of common rail increases above commanded value.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective supply pump actuator	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			C17 (male)	Resistance	
			Between (1) – (2)	Max. 5 Ω	
	2	Disconnection in wiring harness (Disconnection or poor connector contact)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Wiring harness between CE01 (female) (2) – C17 (female) (1)	Resistance	Max. 10 Ω
			Wiring harness between CE01 (female) (32) – C17 (female) (2)	Resistance	Max. 10 Ω
	3	Hot short of harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch ON.		
			Between ground and wiring harness between CE01 (female) (2) – C17 (female) (1)	Voltage	Max. 3 V
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			Between CE01 (female) (2) – CE01 (female) all pins (With all connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among inlet metering valve – engine harness – engine controller are suspected to be defective. Visually check it. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	6	Defect in other locations than engine controller	★ Prepare with starting switch OFF, then start troubleshooting with starting switch OFF.		
			CE01 (female)	Resistance	
			Between (2) – (32)	Max. 5 Ω	
	7	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 6. (Internal failure which cannot be diagnosed)		

Circuit diagram related to supply pump actuator (metering unit)



Failure code [CA281] Abnormal supply pump pressure balance: Abnormal pressure feed of fuel

Action code	Failure code	Failure symptom	Abnormal supply pump pressure balance: Abnormal pressure feed of fuel (Engine controller system)
CALL E03	**CA281**		
Failure content	• Due to the abnormality in supply pump mechanical system, response of fuel pressure feed is not appropriate.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine does not start. Or it starts, but it does not stabilize. • The pressure of high-pressure fuel is different in front side and rear side of supply pump.		
General information	• Duplication of failure code: start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Residual air in the fuel circuit	Refer to “Bleeding air from fuel circuit” in Testing and adjusting, and bleed air from the fuel circuit.
	2	Defective wiring harness connector	Problem is possibly at the connections between common rail pressure sensor – engine harness – engine controller, so inspect them directly. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation
	3	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 2. (Internal failure which cannot be diagnosed)

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00589-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

Troubleshooting by failure code (Display of code), Part 2

Troubleshooting by failure code (Display of code), Part 2

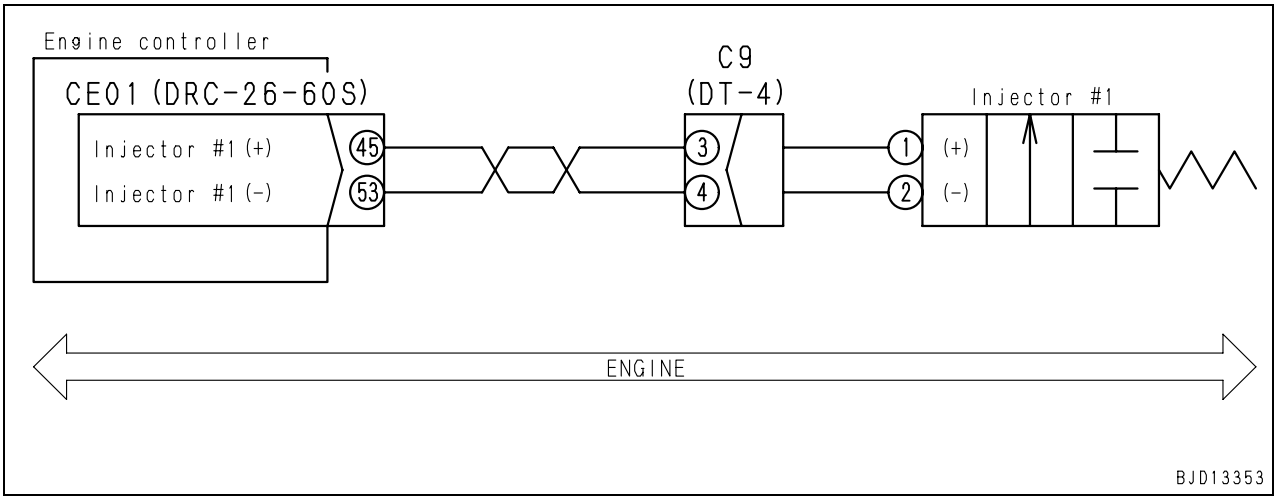
Failure code [CA322] Injector No. 1 system disconnection or short circuit: disconnection, short circuit

Action code	Failure code	Symptom of failure	Injector No. 1 system disconnection or short circuit: disconnection, short circuit (Engine controller system)
CALL E03	**CA322**		
Failure content	• A disconnection or short circuit has been detected in No. 1 injector drive circuit.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Poor combustions or hunting occurs. • Engine output is reduced.		
General information	• Duplication of failure code: start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective engine controller	If the following failure codes are displayed at the same time, engine controller is internally defective: ([**CA322**] [**CA324**] [**CA331**])		
	2	Defective No. 1 injector	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C9 (male)	Resistance	
			Between (3) – (4)	Max. 2 Ω	
			Between (3) – chassis ground	Min. 100 kΩ	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (45) – C9 (3) – No. 1 injector (1)	Resis-tance	Max. 2 Ω
			Wiring harness between CE01 (female) (53) – C9 (4) – No. 1 injector (2)	Resis-tance	Max. 2 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (45) – C9 (3) – No. 1 injector (1)	Resis-tance	Min. 100 kΩ
	5	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (45) – CE01 (female) all pins (All connectors in the harness disconnected)	Resis-tance	Min. 100 kΩ
			Between CE01 (female) (53) – CE01 (female) all pins (All connectors in the harness disconnected)	Resis-tance	Min. 100 kΩ
	6	Defective wiring harness connector	Since the problem is possibly at the connections between No. 1 injector – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		

<table>
<tr><td rowspan="5">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Defect in other locations than engine controller</td><td colspan="2">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>CE01 (female)</td><td>Resistance</td></tr>
<tr><td>Between (45) – (53)</td><td>Max. 2 Ω</td></tr>
<tr><td>Between (45) – chassis ground</td><td>Min. 100 kΩ</td></tr>
<tr><td>8</td><td>Defective engine controller</td><td colspan="2">Engine controller is possibly defective if no problem is found in causes 1-7.
(Since this is an internal defect, it cannot be diagnosed.)</td></tr>
</table>

Circuit diagram related to injector No. 1



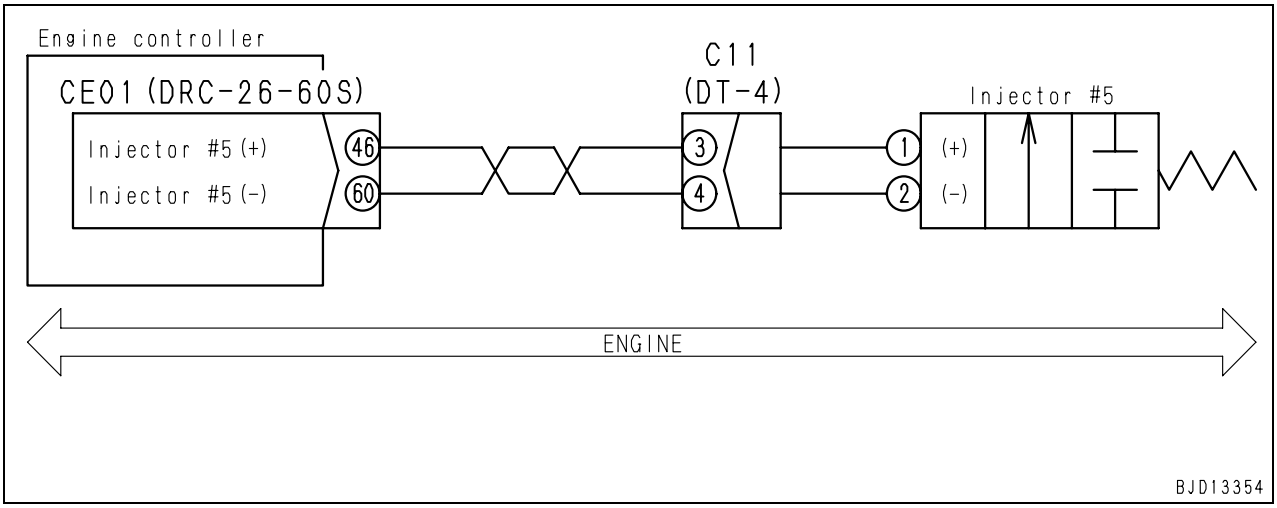
Failure code [CA323] Injector No. 5 system disconnection or short circuit: disconnection, short circuit

Action code	Failure code	Symptom of failure	Injector No. 5 system disconnection or short circuit: disconnection, short circuit (Engine controller system)
CALL E03	**CA323**		
Failure content	• A disconnection or short circuit has been detected in No. 5 injector drive circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Poor combustions or hunting occurs. • Engine output is reduced.		
General information	• Duplication of failure code: start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective engine controller	If the following failure codes are displayed at the same time, engine controller is internally defective: ([**CA323**] [**CA325**] [**CA332**])		
	2	Defective No. 5 injector	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C11 (male)	Resistance	
			Between (3) – (4)	Max. 2 Ω	
			Between (3) – chassis ground	Min. 100 kΩ	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (46) – C11 (3) – No. 5 injector (1)	Resistance	Max. 2 Ω
			Wiring harness between CE01 (female) (60) – C11 (4) – No. 5 injector (2)	Resistance	Max. 2 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (46) – C11 (3) – No. 5 injector (1)	Resistance	Min. 100 kΩ
	5	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (46) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
			Between CE01 (female) (60) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	6	Defective wiring harness connector	Since the problem is possibly at the connections between No. 5 injector – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		

<table>
<tr><td rowspan="5">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Defect in other locations than engine controller</td><td colspan="2">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>CE01 (female)</td><td>Resistance</td></tr>
<tr><td>Between (46) – (60)</td><td>Max. 2 Ω</td></tr>
<tr><td>Between (46) – chassis ground</td><td>Min. 100 kΩ</td></tr>
<tr><td>8</td><td>Defective engine controller</td><td colspan="2">Engine controller is possibly defective if no problem is found in causes 1 – 7.
(Since this is an internal defect, it cannot be diagnosed.)</td></tr>
</table>

Circuit diagram related to injector No. 5

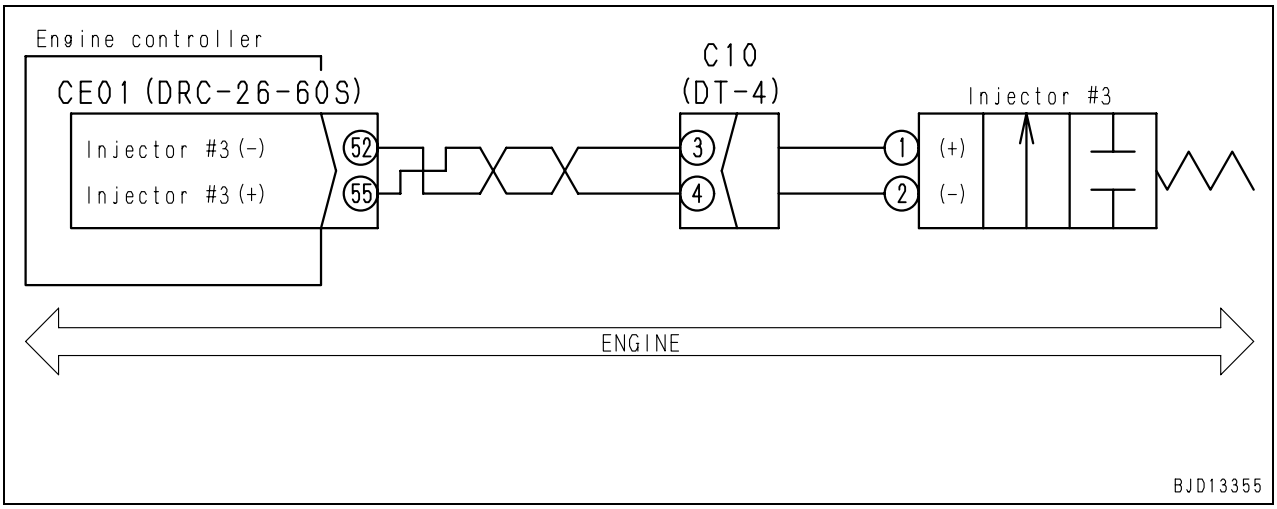


Failure code [CA324] Injector No. 3 system disconnection or short circuit: disconnection, short circuit

Action code	Failure code	Symptom of failure	Injector No. 3 system disconnection or short circuit: disconnection, short circuit (Engine controller system)
CALL E03	**CA324**		
Failure content	• A disconnection or short circuit has been detected in No. 3 injector drive circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Poor combustions or hunting occurs. • Engine output is reduced.		
General information	• Duplication of failure code: start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective engine controller	If the following failure codes are displayed at the same time, engine controller is internally defective: ([**CA322**] [**CA324**] [**CA331**])		
	2	Defective No. 3 injector	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C10 (male)	Resistance	
			Between (3) – (4)	Max. 2 Ω	
			Between (3) – chassis ground	Min. 100 kΩ	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (55) – C10 (3) – No. 3 injector (1)	Resistance	Max. 2 Ω
			Wiring harness between CE01 (female) (52) – C10 (4) – No. 3 injector (2)	Resistance	Max. 2 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (55) – C10 (3) – No. 3 injector (1)	Resistance	Min. 100 kΩ
	5	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (55) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
			Between CE01 (female) (52) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	6	Defective wiring harness connector	Since problem is possibly at the connections between No. 3 injector – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	7	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE01 (female)	Resistance	
			Between (55) – (52)	Max. 2 Ω	
			Between (55) – ground	Min. 100 kΩ	
	8	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 7. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to injector No. 3

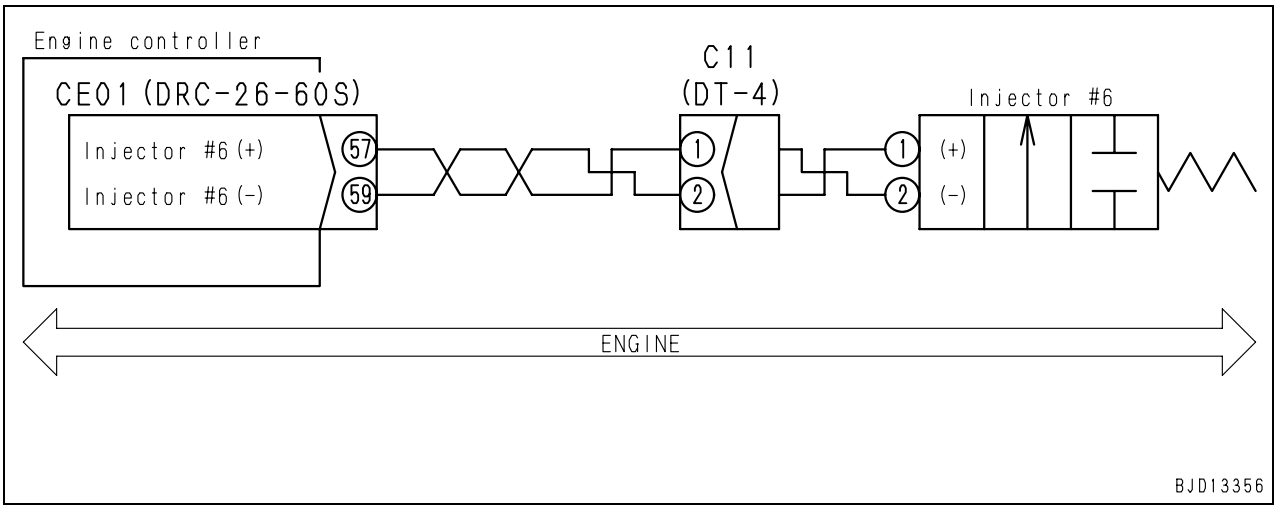


Failure code [CA325] Injector No. 6 system disconnection or short circuit: disconnection, short circuit

Action code	Failure code	Symptom of failure	Injector No. 6 system disconnection or short circuit: disconnection, short circuit (Engine controller system)
CALL E03	**CA325**		
Failure content	• A disconnection or short circuit has been detected in No. 6 injector drive circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Poor combustions or hunting occurs. • Engine output is reduced.		
General information	• Duplication of failure code: start the engine.		

		Cause	Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective engine controller	If the following failure codes are displayed at the same time, engine controller is internally defective: ([**CA323**] [**CA325**] [**CA332**])		
	2	Defective No. 6 injector	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C11 (male)	Resistance	
			Between (2) – (1)	Max. 2 Ω	
			Between (2) – ground	Min. 100 kΩ	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (57) – C11 (2) – No. 6 injector (1)	Resistance	Max. 2 Ω
			Wiring harness between CE01 (female) (59) – C11 (1) – No. 6 injector (2)	Resistance	Max. 2 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (57) – C11 (2) – No. 6 injector (1)	Resistance	Min. 100 kΩ
	5	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (57) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
			Between CE01 (female) (59) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	6	Defective wiring harness connector	Since the problem is possibly at the connections between No. 6 injector – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	7	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE01 (female)	Resistance	
			Between (57) – (59)	Max. 2 Ω	
			Between (57) – ground	Min. 100 kΩ	
	8	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 7. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to injector No. 6

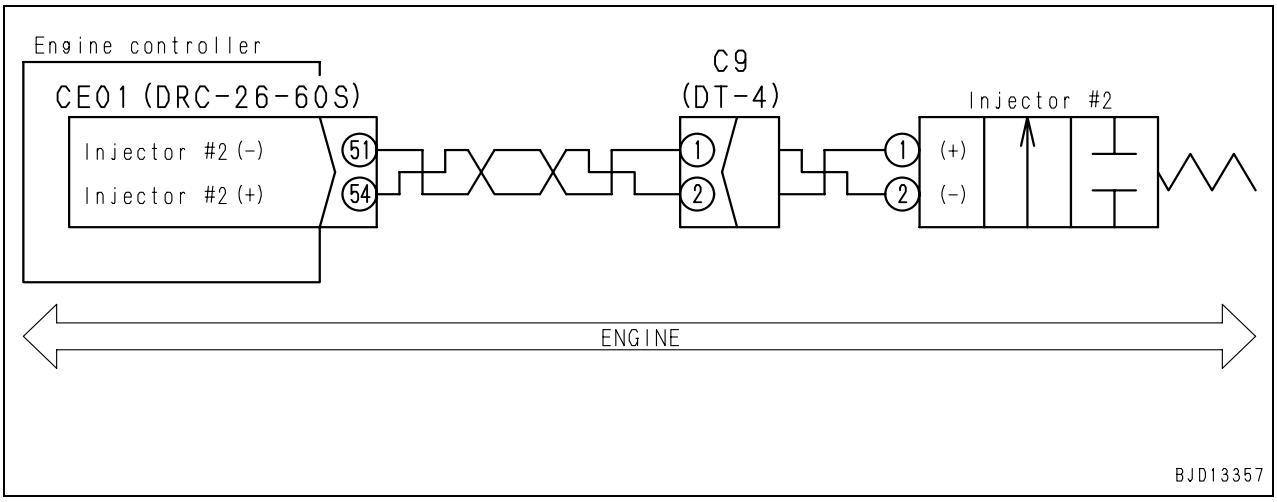


Failure code [CA331] Injector No. 2 system disconnection or short circuit: disconnection, short circuit

Action code	Failure code	Symptom of failure	Injector No. 2 system disconnection or short circuit: disconnection, short circuit (Engine controller system)
CALL E03	**CA331**		
Failure content	• A disconnection or short circuit has been detected in No. 2 injector drive circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Poor combustions or hunting occurs. • Engine output is reduced.		
General information	• Duplication of failure code: start the engine.		

		Cause	Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective engine controller	If the following failure codes are displayed at the same time, engine controller is internally defective: ([**CA322**] [**CA324**] [**CA331**])		
	2	Defective No. 2 injector	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C9 (male)	Resistance	
			Between (2) – (1)	Max. 2 Ω	
			Between (2) – ground	Min. 100 kΩ	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (54) – C9 (2) – No. 2 injector (1)	Resis-tance	Max. 2 Ω
			Wiring harness between CE01 (female) (51) – C9 (1) – No. 2 injector (2)	Resis-tance	Max. 2 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (54) – C9 (2) – No. 2 injector (1)	Resis-tance	Min. 100 kΩ
	5	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (54) – CE01 (female) all pins (All connectors in the harness disconnected)	Resis-tance	Min. 100 kΩ
			Between CE01 (female) (51) – CE01 (female) all pins (All connectors in the harness disconnected)	Resis-tance	Min. 100 kΩ
	6	Defective wiring harness connector	Since the problem is possibly at the connections between No. 2 injector – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken Pin is corroded, bent, broken, pushed in, expanded. Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	7	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE01 (female)	Resistance	
			Between (54) – (51)	Max. 2 Ω	
			Between (54) – ground	Min. 100 kΩ	
	8	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 7. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to injector No. 2

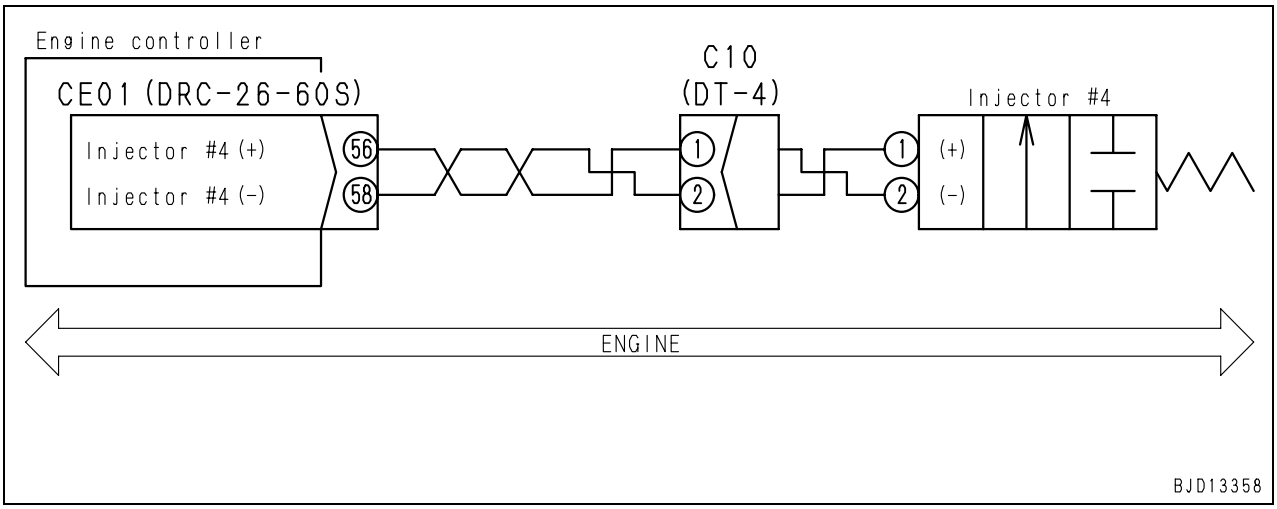


Failure code [CA332] Injector No. 4 system disconnection or short circuit: disconnection, short circuit

Action code	Failure code	Symptom of failure	Injector No. 4 system disconnection or short circuit: disconnection, short circuit (Engine controller system)
CALL E03	**CA332**		
Failure content	• A disconnection or short circuit has been detected in No. 4 injector drive circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Poor combustions or hunting occurs. • Engine output is reduced.		
General information	• Duplication of failure code: start the engine.		

		Cause	Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective engine controller	If the following failure codes are displayed at the same time, engine controller is internally defective: ([**CA323**] [**CA325**] [**CA332**])		
	2	Defective No. 4 injector	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C10 (male)	Resistance	
			Between (2) – (1)	Max. 2 Ω	
			Between (2) – ground	Min. 100 kΩ	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (56) – C10 (2) – No. 4 injector (1)	Resistance	Max. 2 Ω
			Wiring harness between CE01 (female) (58) – C10 (1) – No. 4 injector (2)	Resistance	Max. 2 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (56) – C10 (2) – No. 4 injector (1)	Resistance	Min. 100 kΩ
	5	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (56) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
			Between CE01 (female) (58) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	6	Defective wiring harness connector	Since the problem is possibly at the connections between No. 4 injector – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	7	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE01 (female)	Resistance	
			Between (56) – (58)	Max. 2 Ω	
			Between (56) – ground	Min. 100 kΩ	
	8	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 7. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to injector No. 4



Failure code [CA342] Engine controller data matching error: matching error

Action code	Failure code	Symptom of failure	Engine controller data matching error: matching error (Engine controller system)
CALL E04	**CA342**		
Failure content	• Data matching error has been detected in engine controller.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Normal operation is continued. • Engine stops or engine does not start.		
General information	• Duplication of failure code: turn ON the starting switch.		

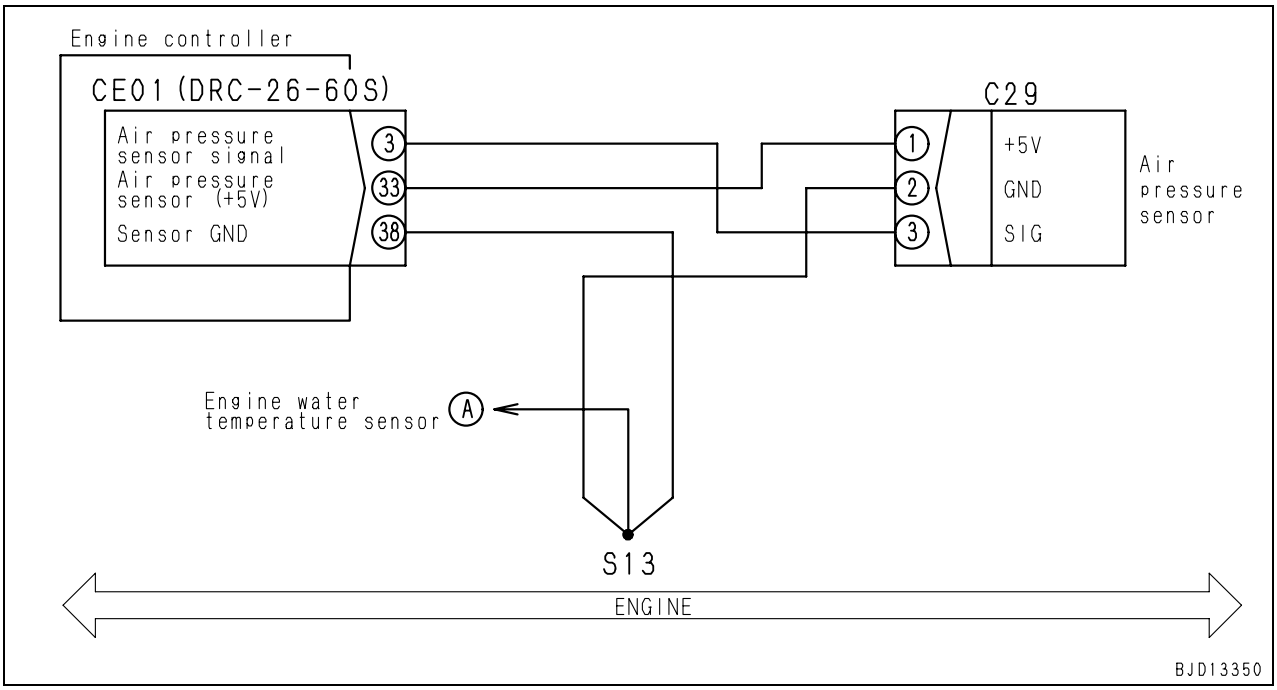
Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective related circuits	Check the failure codes that are displayed at the same time. If any other codes are displayed, carry out troubleshooting for those codes.
	2	Defective engine controller	Internal defect of engine controller is suspected. (It cannot be diagnosed.)

Failure code [CA352] Sensor power source 1 too low: Excessively low voltage detected

Action code	Failure code	Symptom of failure	Sensor power source 1 too low: Excessively low voltage detected (Engine controller system)
CALL E03	**CA352**		
Failure content	• Excessively low voltage has been detected in sensor power source 1 circuit		
Controller's action	• Operates with a fixed atmospheric pressure.		
Symptoms that appears on machine	• Startability of engine deteriorates. • Engine output is reduced.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
	1	Defective sensor or wiring harness	Disconnect the devices on the right one at a time and try to duplicate the problem. If the failure code changes from flashing to continuously illuminating, that device or harness is defective.	Atmospheric pressure sensor	C29
				Engine harness	CE01
	2	Defective wiring harness connector	Since the connections among atmospheric pressure sensor – engine harness – engine controller are suspected to be defective, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	3	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 2. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to sensor power supply 1

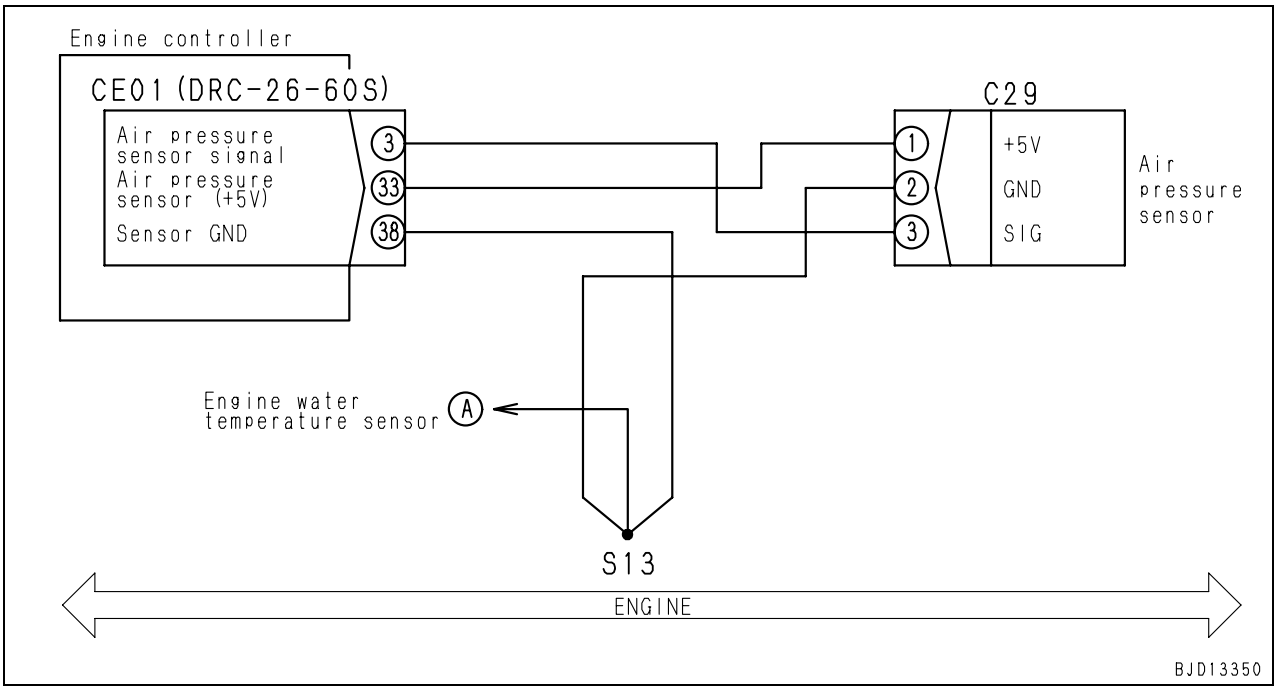


Failure code [CA386] Sensor power source 1 too high: Excessively high voltage detected

Action code	Failure code	Symptom of failure	Sensor power source 1 too high: excessively high voltage detected (Engine controller system)
CALL E03	**CA386**		
Failure content	• Excessively high voltage has been detected in sensor power source 1 circuit		
Controller's action	• Operates with a fixed atmospheric pressure.		
Symptoms that appears on machine	• Startability of engine deteriorates. • Engine output is reduced.		
General information	• Duplication of failure code: turn ON the starting switch.		

Possible causes and the standard values when normal		Cause	Standard value when normal and remarks for troubleshooting
	1	Defective wiring harness connector	Since the connections among atmospheric pressure sensor – engine harness – engine controller are suspected to be defective, check for a defective connection. • Connector is loose, lock is broken, seal is broken Pin is corroded, bent, broken, pushed in, expanded. Moisture in connector, entry of dirt or sand, etc., and insufficient insulation
	2	Defective engine controller	Engine controller is possibly defective if no problem is found in cause 1. (Since this is an internal defect, it cannot be diagnosed.)

Circuit diagram related to sensor power supply 1

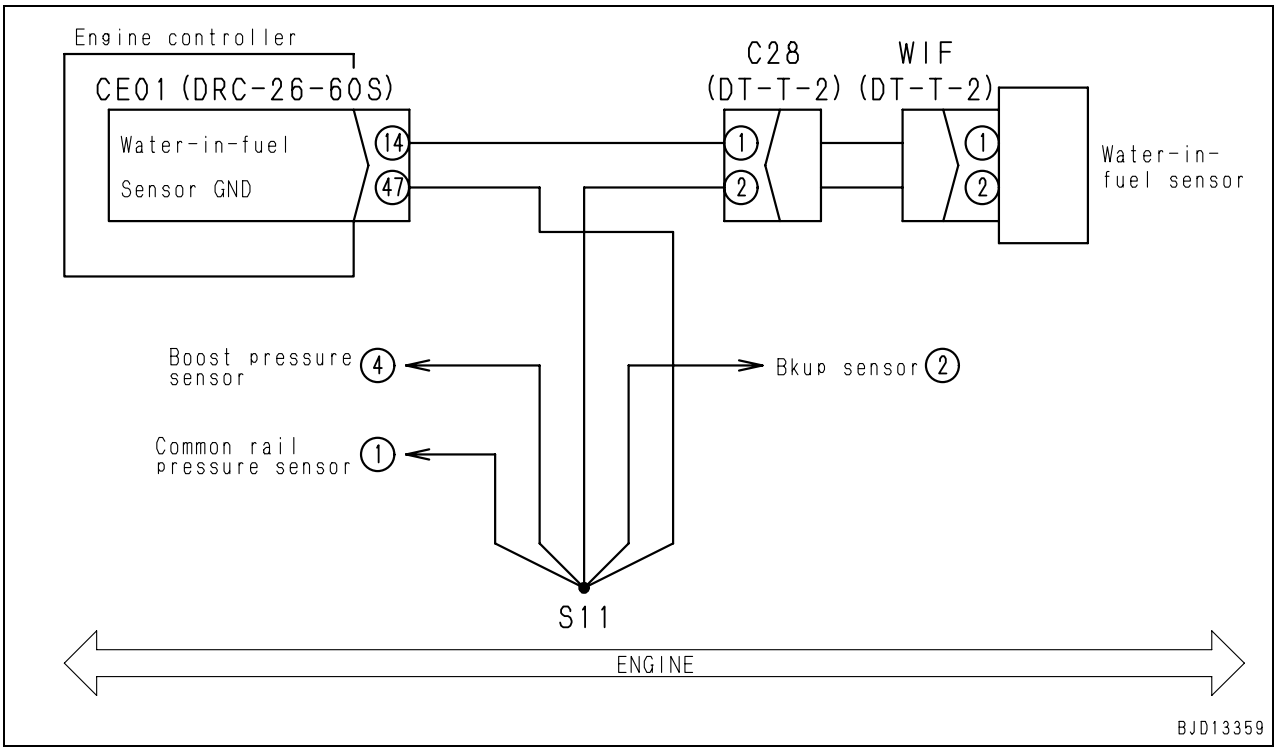


Failure code [CA428] Water detection sensor too high: Excessively high voltage detected

Action code	Failure code	Symptom of failure	Water detection sensor too high: Excessively high voltage detected (Engine controller system)
E01	**CA428**		
Failure content	• Excessively high voltage has occurred in the fuel water detection sensor signal circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Water separator monitor does not display normally.		
General information	• The signal status of the fuel water detection sensor can be checked with the monitoring function. (Code: 18800 Fuel filter water level signal) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective fuel water detection sensor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			WIF (female)	Resistance		
			Between (1) – (2)	Max. 10 Ω		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between CE01 (female) (14) – WIF (male) (1)	Resistance	Max. 10 Ω	
			Wiring harness between CE01 (female) (47) – S11 – WIF (male) (2)	Resistance	Max. 10 Ω	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between CE01 (female) (14) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Problem is possibly at the connections between fuel water detection sensor – engine harness – engine controller, so inspect them directly. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CE01 (female)	Resistance		
			Between (14) – (47)	Max. 10 Ω		
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Since this is an internal defect, it cannot be diagnosed.)			

Circuit diagram related to fuel water sensor

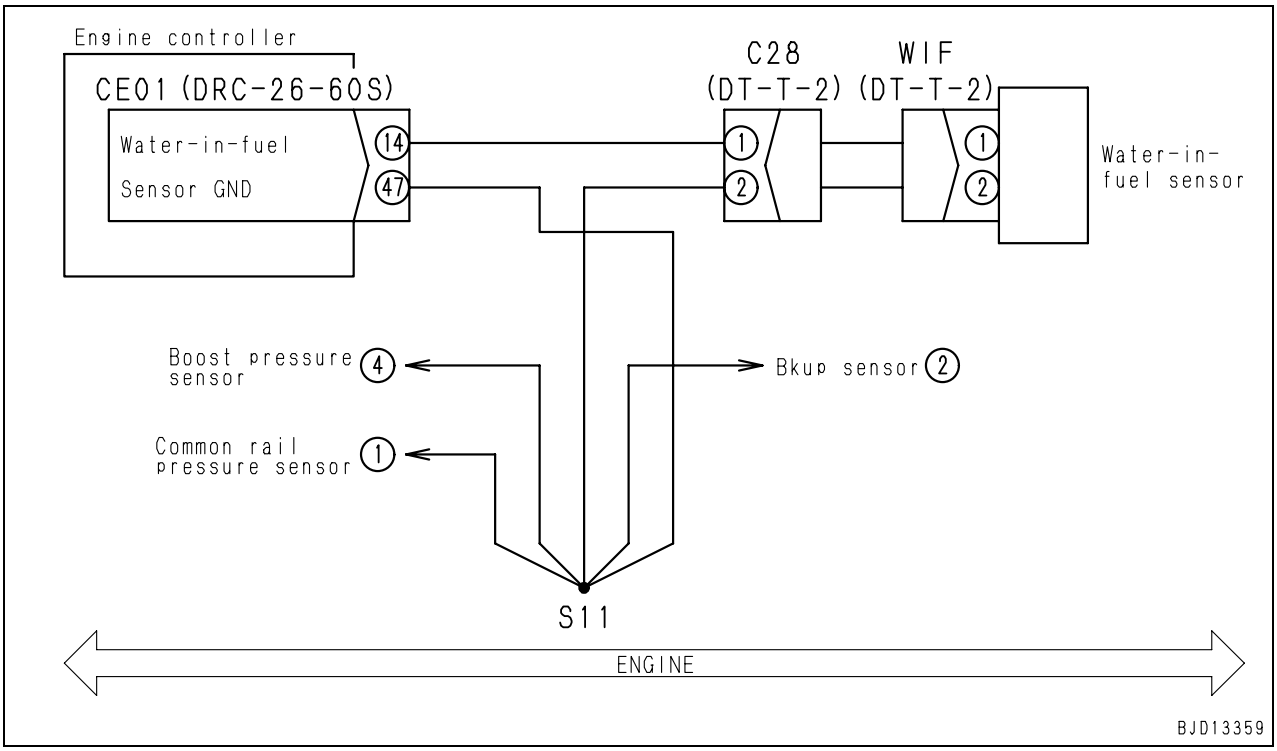


Failure code [CA429] Water detection sensor too low: Excessively low voltage detected

Action code	Failure code	Symptom of failure	Water detection sensor too low: Excessively low voltage detected (Engine controller system)
E01	**CA429**		
Failure content	• Excessively low voltage has occurred in the fuel water detection sensor signal circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Water separator monitor does not display normally.		
General information	• The signal status of the fuel water detection sensor can be checked with the monitoring function. (Code: 18800 Fuel filter water level signal) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective fuel water detection sensor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			WIF (female)	Resistance		
			Between (1) – (2)	Max. 10 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between CE01 (female) (14) – WIF (male) (1)	Resistance	Min. 100 kΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between CE01 (female) (14) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Problem is possibly at the connections between fuel water detection sensor – engine harness – engine controller, so inspect them directly. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CE01 (female)	Resistance		
			Between (14) – (47)	Max. 10 Ω		
			Between (14) – ground	Min. 100 kΩ		
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Since this is an internal defect, it cannot be diagnosed.)			

Circuit diagram related to fuel water sensor

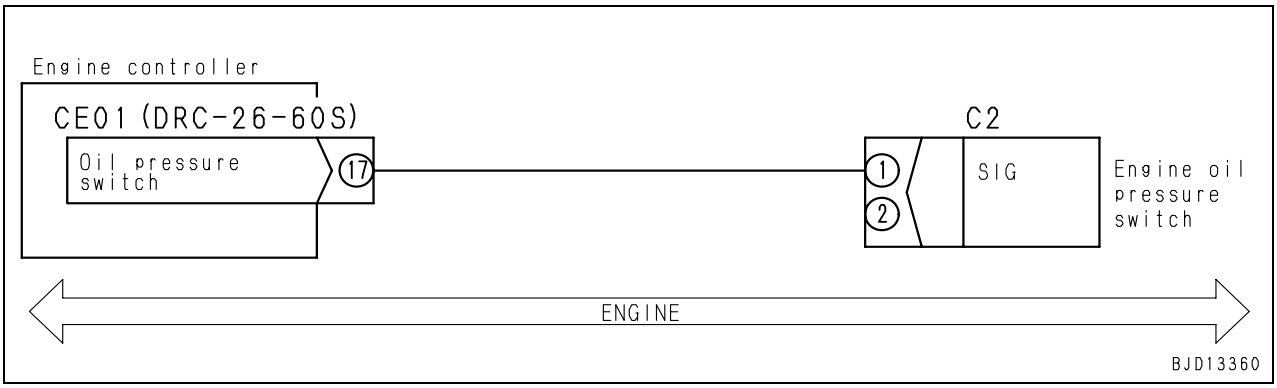


Failure code [CA435] Abnormal engine oil pressure switch: Abnormal signal circuit

Action code	Failure code	Symptom of failure	Abnormal engine oil pressure switch: Abnormal signal circuit (Engine controller system)
E01	**CA435**		
Failure content	• A problem has occurred in the engine oil pressure switch signal circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Protection function by engine oil pressure does not operate. • Engine oil pressure monitor does not display normally.		
General information	• Duplication of failure code: turn ON the starting switch or start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective engine oil switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			C2 (male)	Resistance		
			Between (1) – body	Max. 10 Ω		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between CE01 (female) (17) – C2 (female) (1)	Resistance	Max. 10 Ω	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between CE01 (female) (17) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Since the problem is possibly at the connections between engine oil pressure switch – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CE01 (female)	Resistance		
			Between (17) – ground	Max. 10 Ω		
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Since this is an internal defect, it cannot be diagnosed.)			

Circuit diagram related to engine oil pressure switch

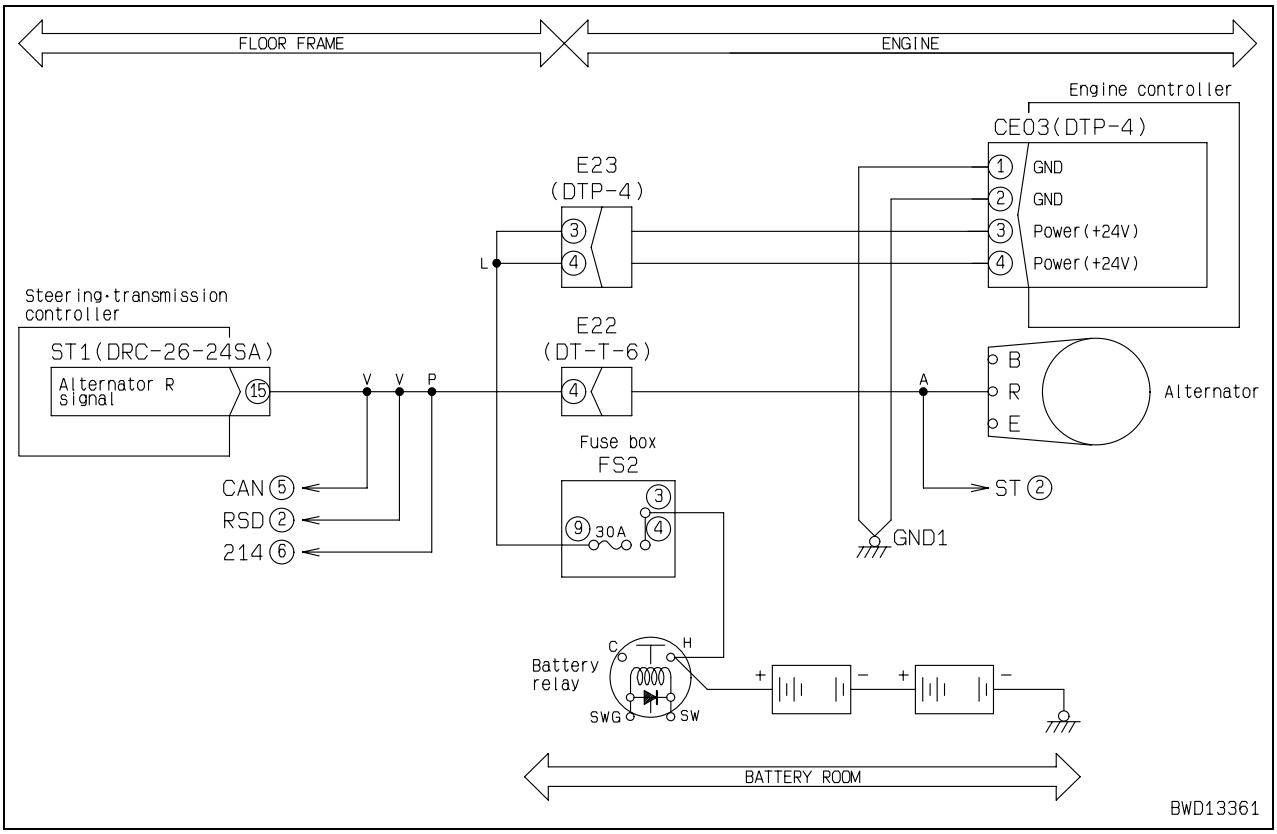


Failure code [CA441] Power source voltage too low: Excessively low voltage detected

Action code	Failure code	Symptom of failure	Power source voltage too low: Excessively low voltage detected (Engine controller system)
CALL E04	**CA441**		
Failure content	• Excessively low voltage has occurred in the controller power source voltage circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine stops. • Engine is hard to start.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Loose or corroded battery terminal	Battery terminal is possibly loose or corroded, so inspect it directly.			
	2	Defective battery voltage	★ Prepare with starting switch OFF and diagnose with starting switch OFF and START.			
			Battery (1 unit)	Starting switch	Voltage	
			Between (+) – (–) terminals	OFF	Min. 12 V	
				START	Min. 6.2 V	
	3	Defective fuse No. 9	If fuse is blown, it is highly possible that a defective harness grounding, etc. has occurred in the circuit (refer to cause 5).			
	4	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between FS2 (9) – CE03 (female) (3), (4)		Resistance	Max. 10 Ω
			Wiring harness between CE03 (female) (1), (2) – ground 1		Resistance	Max. 10 Ω
	5	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between FS2 (9) – CE03 (female) (3), (4)		Resistance	Min. 100 kΩ
	6	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between pins CE03 (female) (3), (4) – CE03 (female) (1), (2) (Battery terminals disconnected)		Resistance	Min. 100 kΩ
	7	Defective wiring harness connector	• Since the problem is possibly at the connections between FS2 (9) – body harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	8	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch ON and START.			
			CE03 (female)	Starting switch	Voltage	
			Between (3), (4) – (1), (2)	ON	Min. 24 V	
				START	Min. 12 V	
	9	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 8. (Since this is an internal defect, it cannot be diagnosed.)			

Circuit diagram related to engine controller power supply

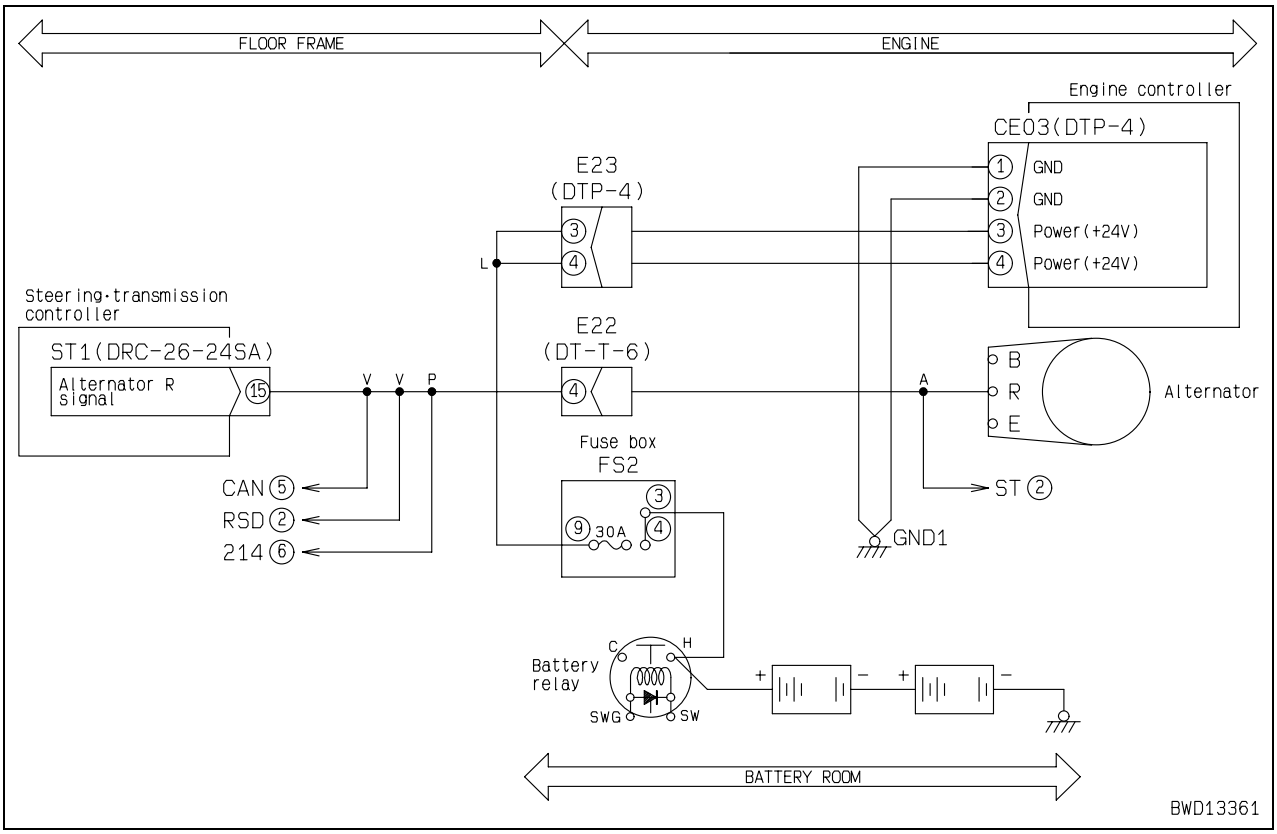


Failure code [CA442] Power source voltage too high: Excessively high voltage has occurred in the controller power source circuit

Action code	Failure code	Symptom of failure	Power source voltage too high: Excessively high voltage has occurred in the controller power source circuit (Engine controller system)
CALL E04	**CA442**		
Failure content	• Excessively high voltage (36 V or more) has occurred in the controller power source voltage circuit		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine may stop.		
General information	• Duplication of failure code: turn ON the starting switch.		

<table>
<tr><td rowspan="10">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="3">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective battery voltage</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Battery</td><td>Voltage</td></tr>
<tr><td colspan="2">Between (+) – (–) terminals</td><td>Max. 32 V</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Defective alternator</td><td colspan="3">★ Prepare with starting switch OFF and start the engine to diagnose.</td></tr>
<tr><td>E22 (male)</td><td>Engine speed</td><td>Voltage</td></tr>
<tr><td>Between (4) – ground</td><td>Medium speed or higher</td><td>27.5 – 29.5 V</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective engine controller</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td colspan="2">CE03 (female)</td><td>Voltage</td></tr>
<tr><td colspan="2">Between (3), (4) – (1), (2)</td><td>Max. 32 V</td></tr>
</table>

Circuit diagram related to engine controller power supply



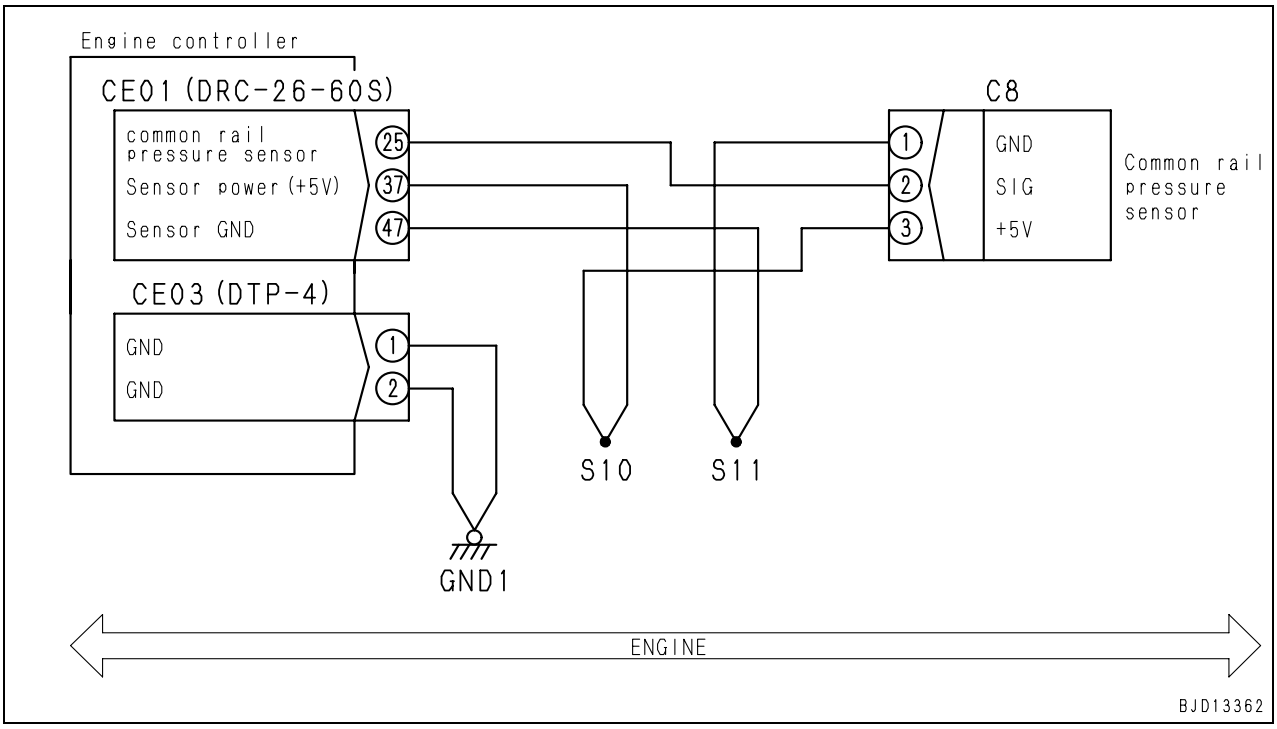
Failure code [CA449] Common rail pressure too high (2): Excessively high pressure trouble occurred

Action code	Failure code	Symptom of failure	Common rail pressure too high (2): Excessively high pressure trouble occurred (Engine controller system)
CALL E03	**CA449**		
Failure content	• Excessively high pressure trouble (2) has occurred in the common rail circuit.		
Controller's action	• Operates with limited output.		
Symptoms that appears on machine	• Engine noise becomes louder at no or light load. • Engine output is reduced.		
General information	• Common rail pressure can be checked with the monitoring function. (Code: 36400 Common rail pressure) • Duplication of failure code: Start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective related circuits	Check the failure codes that are displayed at the same time. If any other codes are displayed, carry out troubleshooting for those codes.		
	2	Air in the low pressure circuit	Air has possibly entered into the low pressure circuit, so inspect directly in the following procedure: 1) Remove pressure inspection plug (on the outlet port) for the fuel main filter. 2) Operate the feed pump for the fuel pre-filter. 3) Inspect the fuel and air leaking from the pressure inspection plug. • If this error occurs during the air bleeding operation after the fuel filter replacement, air is possibly remaining in the fuel circuit, so continue to run the engine at low idle for approximately 3 minutes. When air bleeding is complete, engine revolutions become stable and the error display disappears.		
	3	Defective fuel low pressure circuit devices	★ Refer to Testing and adjusting “Fuel Pressure Inspection” for fuel low pressure circuit pressure inspection. • Measurement on the outlet side of the fuel filter		
			Fuel low pressure circuit pressure	At high idle (When engine can be started)	Min. 0.48 MPa {Min. 4.9 kg/cm^2}
			• Measurements on the inlet and outlet sides of the fuel filter • Fuel low pressure circuit pressure drop = fuel filter inlet pressure – fuel filter outlet pressure		
			Fuel low pressure circuit pressure drop	At high idle	Max. 0.14 MPa {Max. 1.4 kg/cm^2}
			★ Refer to Testing and adjusting “Fuel Pressure Inspection” for fuel suction pressure inspection. • Measurement on the gear pump fuel inlet side of the supply pump		
			Fuel suction circuit pressure (Gear pump side)	At high idle	Max. 33.9 kPa {Max. 254 mmHg}
			• Measurement on the fuel connector side		
			Fuel suction circuit pressure (Fuel connector side)	At high idle	Max. 27.1 kPa {Max. 203 mmHg}
	4	Defective fuel cooler	★ Inspect directly if fuel is leaking from the fuel tube for fuel cooler, if O-ring or seal washer is damaged, or if check valve is clogged or damaged.		

<table>
<tr><td rowspan="14">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Defective common rail pressure sensor</td><td colspan="4">★ Prepare with starting switch ON and diagnose with starting switch ON.</td></tr>
<tr><td>Monitoring code (Monitor panel)</td><td colspan="3">Monitoring information</td></tr>
<tr><td>36400
Common rail pressure</td><td>When engine is stopped</td><td colspan="2">0 ± 0.39 MPa
{0 ± 4 kg/cm^2}</td></tr>
<tr><td>6</td><td>Defective O-ring for supply pump actuator</td><td colspan="4">★ Inspect directly if supply pump actuator O-ring is not damaged.</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Defective supply pump actuator</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>Monitoring code (Monitor panel)</td><td colspan="3">Monitoring information</td></tr>
<tr><td>36400
Common rail pressure</td><td>When engine is stopped</td><td colspan="2">0 ± 0.39 MPa
{0 ± 4 kg/cm^2}</td></tr>
<tr><td colspan="4">★ Prepare with starting switch OFF, then start the engine to diagnose.
• Measure after idling for at least 1 minute.</td></tr>
<tr><td>Monitoring code (Monitor panel)</td><td colspan="3">Monitoring information</td></tr>
<tr><td>8</td><td>Defective wiring harness connector</td><td colspan="4">Problem is possibly in the common rail fuel pressure sensor connector or supply pump actuator, so inspect them directly.
• Connector is loose, lock is broken, seal is broken
• Pin is corroded, bent, broken, pushed in, expanded.
• Moisture in connector, entry of dirt or sand, etc., and insufficient insulation</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Defective engine controller ground harness</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">CE03</td><td>Resistance</td></tr>
<tr><td colspan="3">Between (1), (2) – chassis ground</td><td>Max. 10 Ω</td></tr>
<tr><td>10</td><td>Defective supply pump</td><td colspan="4">Supply pump is possibly defective if no problem is found in causes 1 – 9.</td></tr>
</table>

Circuit diagram related to common rail pressure sensor

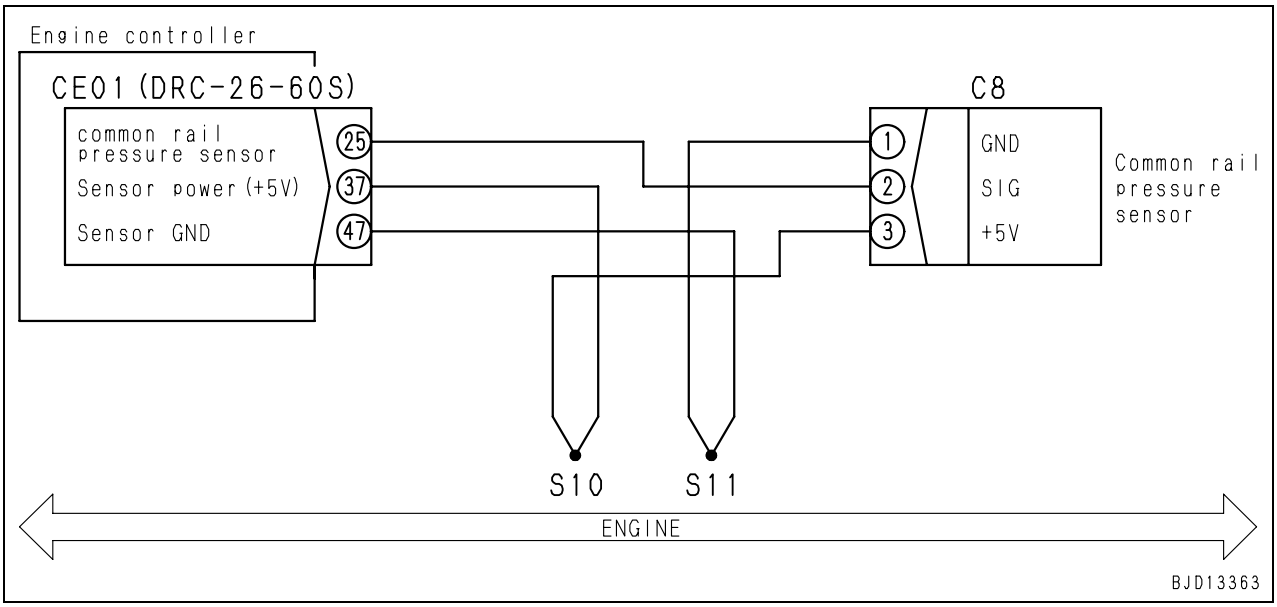


Failure code [CA451] Common rail pressure sensor too high: Excessively high voltage detected

Action code	Failure code	Symptom of failure	Common rail pressure sensor too high: Excessively high voltage detected (Engine controller system)
CALL E03	**CA451**		
Failure content	• Excessively high voltage has occurred in the common rail pressure sensor signal circuit		
Controller's action	• Operates with limited output.		
Symptoms that appears on machine	• Engine does not start. • Engine speed or output is reduced.		
General information	• The signal voltage of the common rail pressure sensor can be checked with the monitoring function. (Code: 36401 Common rail pressure sensor voltage) • Duplication of failure code: turn ON the starting switch.		

		Cause	Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor power source 2 circuit	If failure code [**CA227**] is displayed at the same time, carry out troubleshooting for it first.		
	2	Defective common rail pressure sensor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			C8		Voltage
			Between (3) – (1)	Power source	4.75 – 5.25 V
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.		
	3	Hot short of harness (a contact with 5 V circuit or 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between CE01 (female) (25) – C8 (female) (2)	Voltage	Max. 1 V
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (25) – C8 (female) (2) and wiring harness between CE01 (female) (37) – S10 – C8 (female) (3)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Since the problem is possibly at the connections between common rail pressure sensor – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			CE01		Voltage
			Between (37) – (47)	Power source	4.75 – 5.25 V

Circuit diagram related to common rail pressure sensor

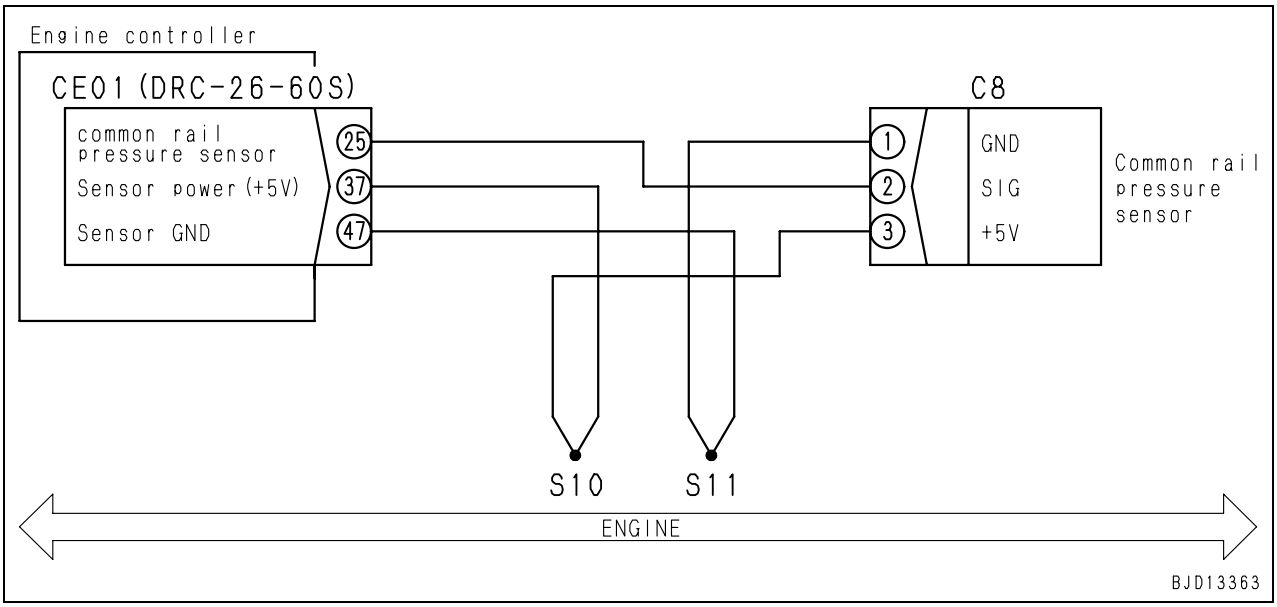


Failure code [CA452] Common rail pressure sensor too low: Excessively low voltage detected

Action code	Failure code	Symptom of failure	Common rail pressure sensor too low: Excessively low voltage detected (Engine controller system)
CALL E03	**CA452**		
Failure content	• Excessively low voltage is detected in the common rail pressure sensor signal circuit		
Controller's action	• Operates with limited output.		
Symptoms that appears on machine	• Engine does not start. • Engine speed or output is reduced.		
General information	• The signal voltage of the common rail pressure sensor can be checked with the monitoring function. (Code: 36401 Common rail pressure sensor voltage) • Duplication of failure code: turn ON the starting switch.		

		Cause	Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor power source 2 circuit	If failure code [**CA187**] is displayed at the same time, carry out troubleshooting for it first.		
	2	Defective common rail pressure sensor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			C8		Voltage
			Between (3) – (1)	Power source	4.75 – 5.25 V
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.		
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (25) – C8 (female) (2)	Resistance	Min. 100 kΩ
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harnesses between CE01 (female) (25) – C8 (female) (2) and among CE01 (female) (47) – S11 – C8 (female) (1)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Since the problem is possibly at the connections between common rail pressure sensor – engine harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	6	Defective engine controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			CE01		Voltage
			Between (37) – (47)	Power source	4.75 – 5.25 V

Circuit diagram related to common rail pressure sensor



Failure code [CA488] Charge temperature too high and torque derated: Exceeded upper control limit of temperature

Action code	Failure code	Symptom of failure	Charge air temperature too high and torque derated: Exceeded upper control limit of temperature (Engine controller system)
CALL E03	**CA488**		
Failure content	• The temperature signal of boost pressure and temperature sensor exceeds upper control limit temperature.		
Controller's action	• Operates with limited output.		
Symptoms that appears on machine	• Engine output decreases.		
General information	• The boost temperature can be checked in monitoring function. (Code: 18500 Boost temperature) • Duplication of failure code: Start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Degradation of cooling performance of aftercooler	The degradation of aftercooler cooling performance is suspected. Directly check the following points: • Looseness and damage of fan belt • Insufficient cooling air amount • Clogging of aftercooler fin
	2	Abnormal rise in turbocharger outlet temperature	The abnormal rise in turbocharger outlet temperature is suspected. Directly check the related parts.
	3	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 2. (Since this is an internal defect, it cannot be diagnosed.)

Failure code [CA553] Common rail pressure too high (1): Excessively high pressure detected

Action code	Failure code	Symptom of failure	Common rail pressure high trouble (1): Excessively high pressure trouble occurred (Engine controller system)
CALL E03	**CA553**		
Failure content	• Excessively high pressure trouble (1) has occurred in the common rail circuit.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine noise becomes louder at no or light load. • Engine output is reduced.		
General information	• Common rail pressure can be checked with the monitoring function. (Code: 36400 Common rail pressure) • Duplication of failure code: Start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Defective related circuits	Check the failure codes that are displayed at the same time. If any other codes are displayed, carry out troubleshooting for those codes.
	2	Defective connection of the ground terminal	Defective connection of the ground terminal is suspected. Check the following terminals directly: • Ground terminal of the machine body (negative terminal of the battery) • Ground terminal of the engine • Ground terminal of the engine controller • Ground terminal of the starting motor
	3	Damaged O-ring of supply pump actuator	Since a damage of O ring of supply pump actuator is suspected, visually check the O-ring.

Failure code [CA559] Loss of pressure feed from supply pump (1): Loss of pressure feed detected

Action code	Failure code	Symptom of failure	Loss of pressure feed from supply pump (1): Loss of pressure feed detected (Engine controller system)
E02	**CA559**		
Failure content	• Loss of pressure feed (1) occurred in the common rail circuit.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine does not start or engine is hard to start. • Exhaust gas color becomes black. • Engine output is reduced.		
General information	• Common rail pressure can be checked with the monitoring function. (Code: 36400 Common rail pressure) • Duplication of failure code: Start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Fuel leakage to the outside	Since the fuel leakage to the outside is suspected, check for a leakage. (Visually check at low idle of the engine)		
	2	Defective low pressure circuit device	★ Refer to Testing and adjusting “Fuel Pressure Inspection” for fuel low pressure circuit pressure inspection. • Measurement on the inlet side of the fuel filter • Cranking speed: Min. 150 rpm		
			Fuel low pressure circuit pressure	When cranking	Min. 0.14 MPa {1.4 kg/cm^2}
			• Measurement on the outlet side of the fuel filter		
			Fuel low pressure circuit pressure	At high idle	Min. 0.48 MPa {4.9 kg/cm^2}
			• Measurements on the inlet and outlet sides of the fuel filter • Fuel low pressure circuit pressure drop = fuel filter inlet pressure – fuel filter outlet pressure		
			Fuel low pressure circuit pressure drop	At high idle	Min. 0.14 MPa {1.4 kg/cm^2}
			★ Refer to Testing and adjusting “Fuel Pressure Inspection” for fuel suction pressure inspection. • Measurement on the gear pump fuel inlet side of the supply pump		
			Fuel suction circuit pressure (Gear pump side)	At high idle	Max. 33.9 kPa {Max. 254 mmHg}
			• Measurement on the fuel connector side		
			Fuel suction circuit pressure (Fuel connector side)	At high idle	Max. 27.1 kPa {Max. 203 mmHg}
	3	Defective injector (Including high-pressure pipes within the head)	★ As for testing return amount of injector, see testing and adjusting “Testing fuel return and leak amount”.		
			Injector return amount	When cranking (When engine cannot start)	Max. 100 cc/30 sec.
				At low idle (When engine can be started)	Max. 300 cc/45 sec.

<table>
<tr><td rowspan="8">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective supply pump</td><td colspan="4">★ As for testing return amount of supply pump, see testing and adjusting “Testing fuel return and leak amount”.</td></tr>
<tr><td rowspan="2">Amount of supply pump return</td><td>When cranking (When engine cannot start)</td><td>Max. 200 cc/30 sec.</td></tr>
<tr><td>At low idle (When engine can be started)</td><td>Max. 300 cc/30 sec.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Defective pressure limiter</td><td colspan="4">★ As for testing an amount of pressure limiter leak, see testing and adjusting “Testing fuel return and leak amount”.</td></tr>
<tr><td>Pressure limiter leak amount</td><td>At low idle</td><td>Max. 30 drops/min.</td></tr>
<tr><td>6</td><td>Defective plunger of supply pump</td><td colspan="4">★ Remove supply pump head and visually inspect the plunger for damage.</td></tr>
<tr><td>7</td><td>Air in the low pressure circuit</td><td colspan="4">Since a residual air in a low-pressure circuit is suspected, so inspect directly according to the following procedure.
1) Remove pressure inspection plug (outlet side) of fuel main filter.
2) Operate feed pump of fuel pre-filter.
3) Check the leakage of fuel and air from pressure inspection plug.
• If this error occurs during the air bleeding operation after the fuel filter replacement, air is possibly remaining in the fuel circuit, so continue to run the engine at low idle for approximately 3 minutes. When air bleeding is complete, engine revolutions become stable and the error display disappears.</td></tr>
</table>

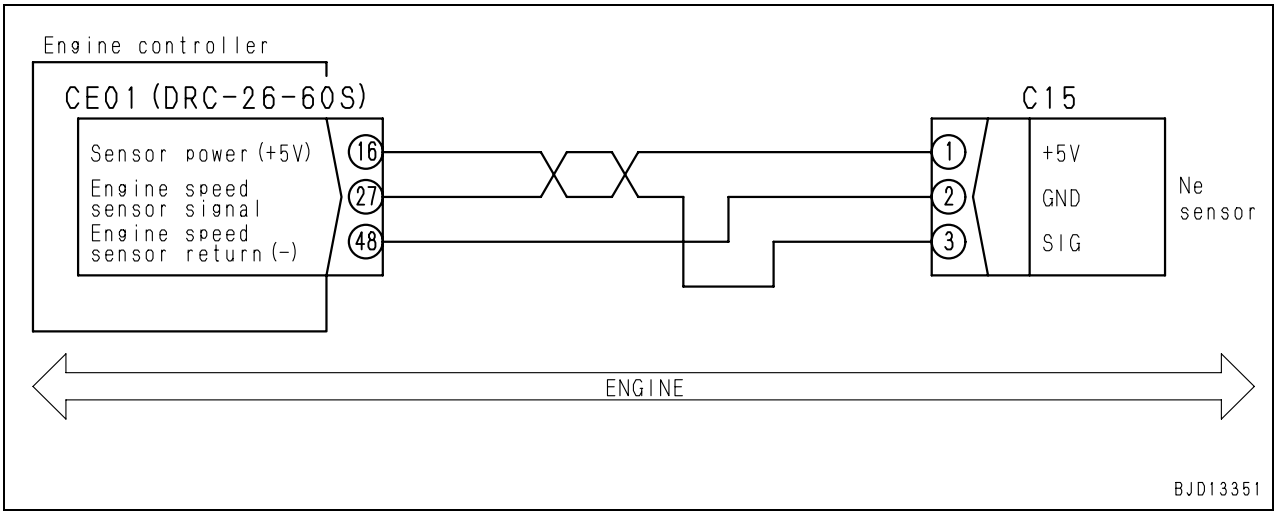
Failure code [CA689] Abnormal engine Ne speed sensor: Abnormal signal

Action code	Failure code	Symptom of failure	Abnormal engine Ne speed sensor: Abnormal signal (Engine controller system)
CALL E03	**CA689**		
Failure content	• Abnormal signal of the engine Ne speed sensor has been detected.		
Controller's action	• Continues the control by engine Bkup speed sensor signal.		
Symptoms that appears on machine	• Engine is hunting. • Engine is hard to start. • Engine output is reduced.		
General information	• Duplication of failure code: start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective Ne speed sensor power source circuit	If failure code [**CA238**] is displayed at the same time, carry out troubleshooting for it first.		
	2	Defective engine Ne speed sensor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			C15		Voltage
			Between (1) – (2)	Power source	4.75 – 5.25 V
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.		
	3	Damaged engine Ne speed sensor or improper gap	Since a damage or improper mounting gap of engine Ne speed sensor is suspected, inspect it visually.		
	4	Damaged speed detection wheel	Since a damage of speed detection wheel is suspected, visually check it.		
	5	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (27) – C15 (female) (3)	Resistance	Max. 10 Ω
	6	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (27) – C15 (female) (3)	Resistance	Min. 100 kΩ
	7	Hot short in wiring harness (a contact with 5 V or 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between CE01 (female) (27) – C15 (female) (3)	Voltage	Max. 1 V

<table>
<tr><td rowspan="5">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">8</td><td rowspan="3">Harness short
(Harness internal short)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harnesses between CE01 (female) (27) – C15 (female) (3) and between CE01 (female) (16) – C15 (female) (1)</td><td>Resis-tance</td><td>Min. 100 kΩ</td></tr>
<tr><td colspan="2">Wiring harnesses between CE01 (female) (27) – C15 (female) (3) and between CE01 (female) (48) – C15 (female) (2)</td><td>Resis-tance</td><td>Min. 100 kΩ</td></tr>
<tr><td>9</td><td>Defective wiring harness connector</td><td colspan="4">Since the connections among engine Ne speed sensor – engine harness – engine controller are suspected to be defective, check a the defective connection.
• Connector is loose, lock is broken, seal is broken
• Pin is corroded, bent, broken, pushed in, expanded.
• Moisture in connector, entry of dirt or sand, etc., and insufficient insulation</td></tr>
<tr><td>10</td><td>Defective engine controller</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.
CE01 | | Voltage
Between (16) – (48) | Power source | 4.75 – 5.25 V</td></tr>
</table>

Circuit diagram related to engine Ne speed sensor



Failure code[CA731] Abnormal engine Bkup speed sensor phase: Abnormal phase

Action code	Failure code	Symptom of failure	Abnormal engine Bkup speed sensor phase: Abnormal phase (Engine controller system)
CALL E03	**CA731**		
Failure content	• Abnormal phase is detected from the signals of engine Ne speed sensor and engine Bkup speed sensor.		
Controller's action	• Continues the control using engine Ne speed sensor signal.		
Symptoms that appears on machine	• Engine can not start or engine is hard to start. • Idle speed is not stable. • Exhaust gas color becomes black.		
General information	• Duplication of failure code: start the engine.		

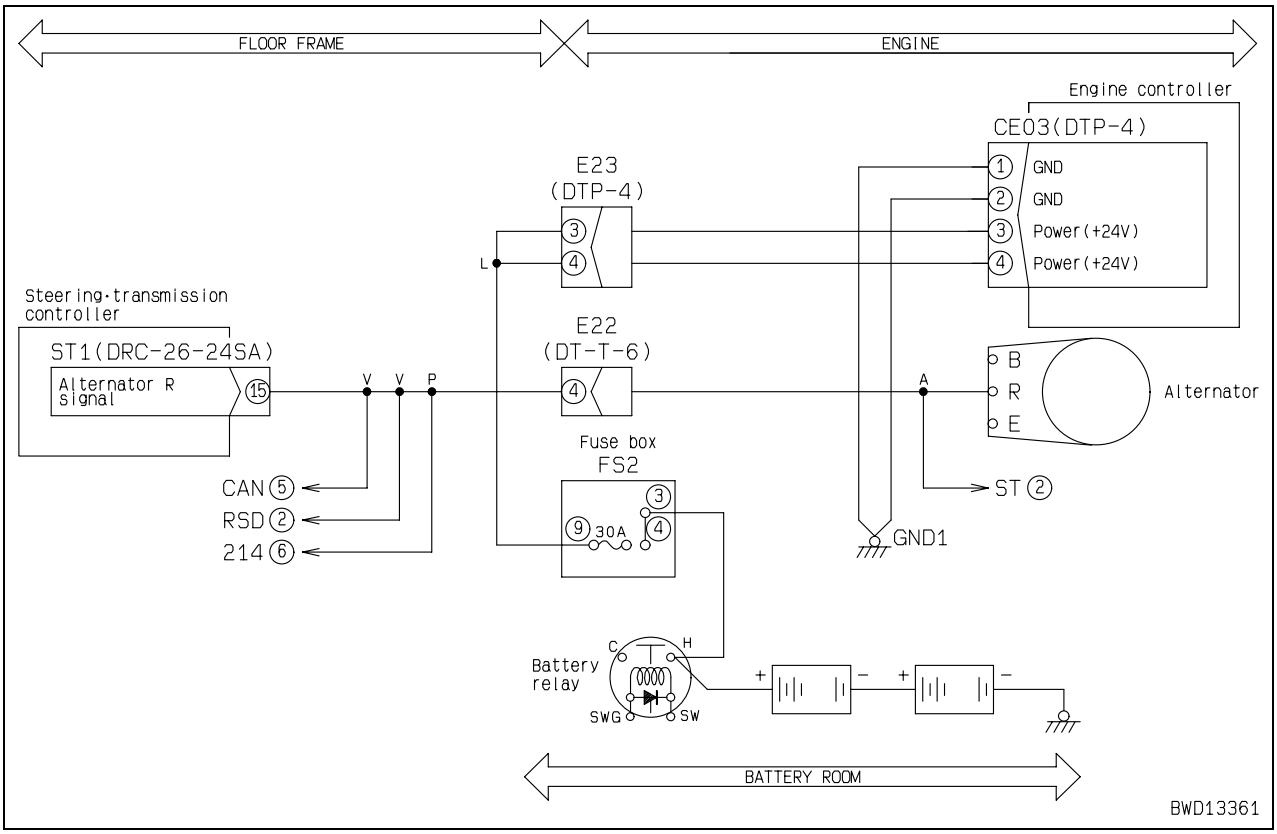
		Cause	Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Damaged engine Ne speed sensor	Since a damage of engine Ne speed sensor is suspected, visually check it.
	2	Damaged engine Bkup speed sensor	Since a damage of engine Bkup speed sensor is suspected, visually check it.
	3	Defective mounting or damage of speed detection ring on the crankshaft side	Since a defective mounting or a damage of speed detection ring on the crankshaft side is suspected, carry out the inspection according to the following procedure. 1) Set the No.1 cylinder to the compression top dead center (align the marks). 2) If the center of the cut-out portion on the speed detection ring is aligned with the tip of Ne speed sensor, the mounting is normal.
	4	Defective mounting or damage of speed detection gear on the camshaft side	Since a defective mounting or a damage of speed detection gear on the camshaft side is suspected, carry out the inspection according to the following procedure. 1) Set the No.1 cylinder to the compression top dead center (align the marks). 2) Remove the Bkup speed sensor. 3) If you can see a groove on a side face of speed detection gear through the mounting hole of the sensor, the mounting is normal.
	5	Defective timing adjustment of crankshaft and camshaft	Since a defective timing adjustment of crankshaft and camshaft is suspected, inspect directly.
	6	Defective connection of the ground terminal	Defective connection of the ground terminal is suspected. Check the following terminals directly: • Ground terminal of the machine body (negative terminal of the battery) • Ground terminal of the engine • Ground terminal of the engine controller • Ground terminal of the starting motor

Failure code [CA757] Loss of all engine controller data: Loss of all data

Action code	Failure code	Symptom of failure	Loss of all engine controller data: Loss of all data (Engine controller system)
CALL E04	**CA757**		
Failure content	• Loss of all data in engine controller has been detected.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine may stop and can not restart. • Monitoring function of monitor panel (engine controller system) may not operate normally.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective related circuits	Check the failure codes that are displayed at the same time. If any other codes are displayed, carry out troubleshooting for those codes.			
	2	Loose or corroded battery terminal	Battery terminal is possibly loose or corroded, so inspect it directly.			
	3	Defective battery voltage	★ Prepare with starting switch OFF and diagnose with starting switch OFF and START.			
			Battery (1 unit)	Starting switch	Voltage	
			Between (+) – (–) terminals	OFF	Min. 12 V	
				START	Min. 6.2 V	
	4	Defective fuse No. 9	If fuse is blown, it is highly possible that a defective harness grounding, etc. has occurred in the circuit.			
	5	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between FS2 (9) – CE03 (female) (3), (4)		Resistance	Max. 10 Ω
			Wiring harness between CE03 (female) (1), (2) – ground 1		Resistance	Max. 10 Ω
	6	Defective wiring harness connector	Since the problem is possibly at the connections between FS2 (9) – body harness – engine controller, check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	7	Defective engine controller	★ Prepare with starting switch OFF and diagnose with starting switch ON and START.			
			CE03 (female)	Starting switch	Voltage	
			Between (3), (4) – (1), (2)	ON	Min. 24 V	
				START	Min. 12 V	

Circuit diagram related to engine controller power supply



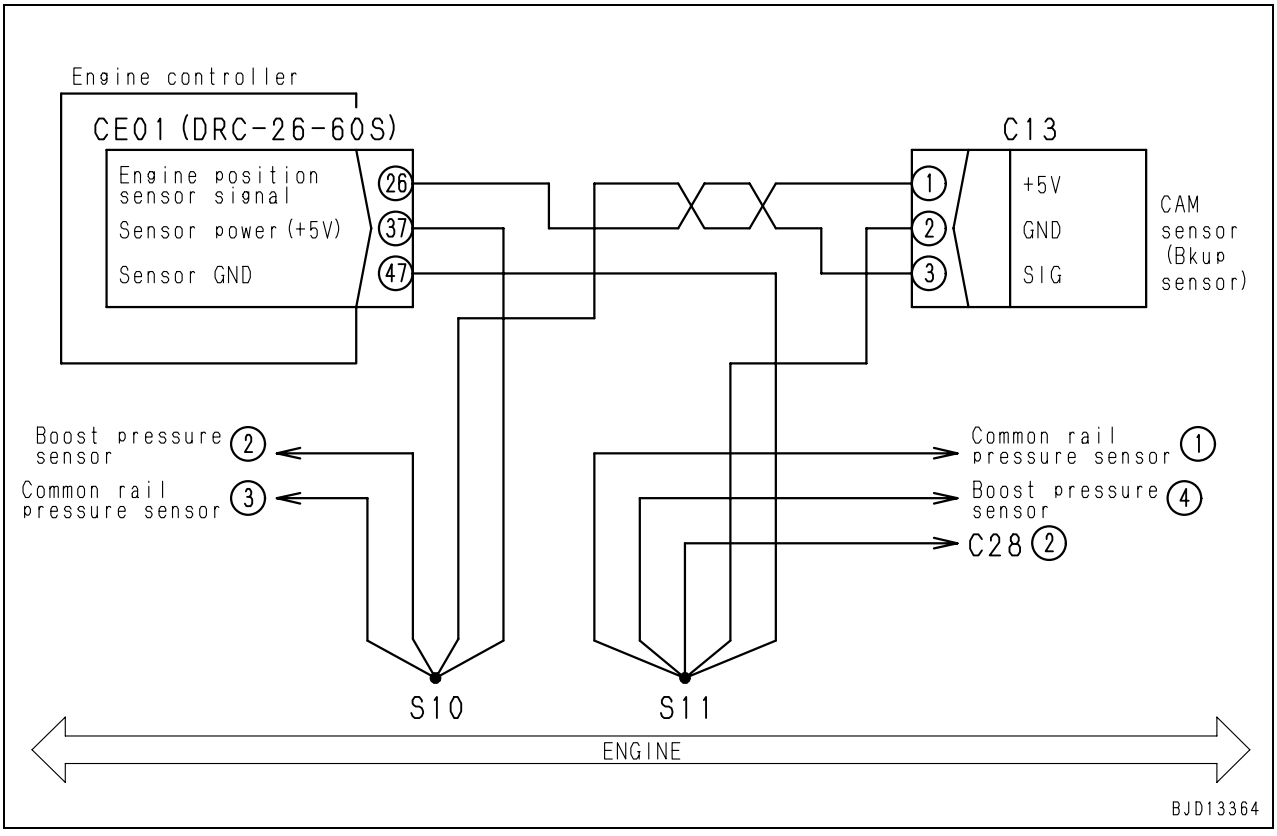
Failure code [CA778] Abnormal engine Bkup speed sensor: Abnormal Bkup signal

Action code	Failure code	Symptom of failure	Abnormal engine Bkup speed sensor: Abnormal Bkup signal (Engine controller system)
CALL E03	**CA778**		
Failure content	• Abnormal engine Bkup speed sensor signal has been detected.		
Controller's action	• Continue the control using engine Ne speed sensor signal.		
Symptoms that appears on machine	• Engine is hard to start. • Output decreases.		
General information	• Duplication of failure code: start the engine.		

		Cause	Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor power source 2 circuit	If failure code [**CA187**] is displayed at the same time, carry out troubleshooting for it first.		
	2	Defective engine Bkup speed sensor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			C13		Voltage
			Between (1) – (2)	Power source	4.75 – 5.25 V
			Since voltage is measured with the harness connected, further diagnose the harness and the controller if the voltage is not normal, and then make judgment after it is determined that there is no other defective cause.		
	3	Damaged engine Bkup speed sensor or improper gap	Since a damage of engine Bkup speed sensor or improper gap is suspected, visually check it.		
	4	Damaged speed detection gear	Since a damage of speed detection gear is suspected, visually check it.		
	5	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (26) – C13 (female) (3)	Resistance	Max. 10 Ω
	6	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (26) – C13 (female) (3)	Resistance	Min. 100 kΩ
	7	Hot short in wiring harness (a contact with 5 V or 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between CE01 (female) (26) – C13 (female) (3)	Voltage	Max. 1 V

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	8	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harnesses between CE01 (female) (26) – C13 (female) (3) and among CE01 (female) (37) – S10 – C13 (female) (1)	Resis-tance	Min. 100 kΩ
			Wiring harnesses between CE01 (female) (26) – C13 (female) (3) and among CE01 (female) (47) – S11 – C13 (female) (2)	Resis-tance	Min. 100 kΩ
	9	Defective wiring harness connector	Since the connections among engine Bkup speed sensor – engine harness – engine controller are suspected to be defective, check a the defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	10	Defective engine controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			CE01		Voltage
			Between (37) – (47)	Power source	4.75 – 5.25 V

Circuit diagram related to engine Bkup speed sensor

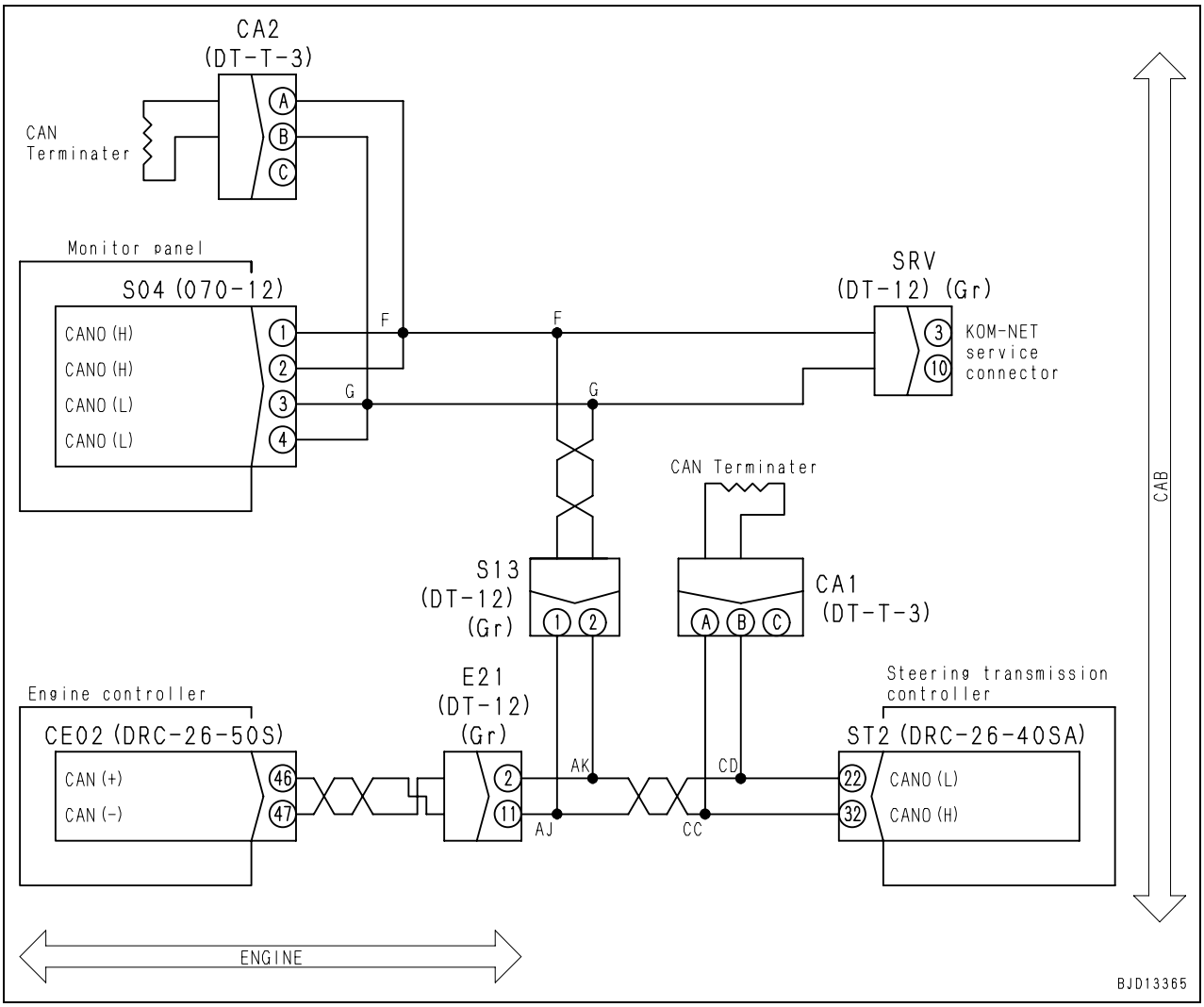


Failure code [CA1633] Abnormal KOMNET: Abnormal communication

Action code	Failure code	Symptom of failure	Abnormal KOMNET: Abnormal communication (Engine controller system)
CALL E03	**CA1633**		
Failure content	• Engine controller detected an abnormal communication in the KOMNET communication circuit between pump controller and monitor panel.		
Controller's action	• Operate in a default mode. • When the cause of the failure has been eliminated, it returns to normal.		
Symptoms that appears on machine	• Machine may not operate normally because the informations which are exchanged through KOMNET communication are not trasmitted properly. (A symptom of failure depends on the location where it occurrs.)		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harnesses between S04 (female) (1), (2) – CE02 (female) (46), ST2 (female) (32), CA2 (female) (A), and CA1 (female) (A)	Resistance	Max. 1 Ω
			Wiring harnesses between S04 (female) (3), (4) – CE02 (female) (47), ST2 (female) (22), CA2 (female) (B), and CA1 (female) (B)	Resistance	Max. 1 Ω
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harnesses between S04 (female) (1), (2) – CE02 (female) (46), ST2 (female) (32), CA2 (female) (A), CA1 (female) (A) and SRV (male) (3)	Resistance	Min. 1 MΩ
			Between ground and wiring harnesses between S04 (female) (3), (4) – CE02 (female) (47), ST2 (female) (22), CA2 (female) (B), CA1 (female) (B) and SRV (male) (10)	Resistance	Min. 1 MΩ
	3	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harnesses between S04 (female) (1), (2) – CE02 (female) (46), ST2 (female) (32), CA2 (female) (A), CA1 (female) (A) and SRV (male) (3)	Voltage	Max. 5.5 V
			Between ground and wiring harnesses between S04 (female) (3), (4) – CE02 (female) (47), ST2 (female) (22), CA2 (female) (B), CA1 (female) (B) and SRV (male) (10)	Voltage	Max. 5.5 V
	4	Defective terminal resistance in CAN (Internal short circuit and disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CA1 (male) and CA2 (male)	Resistance	
			Between (A) – (B)	120 ± 12 Ω	
	5	Defective pump controller	Engine controller is possibly defective if no problem is found in causes 1 – 4. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related CAN communication

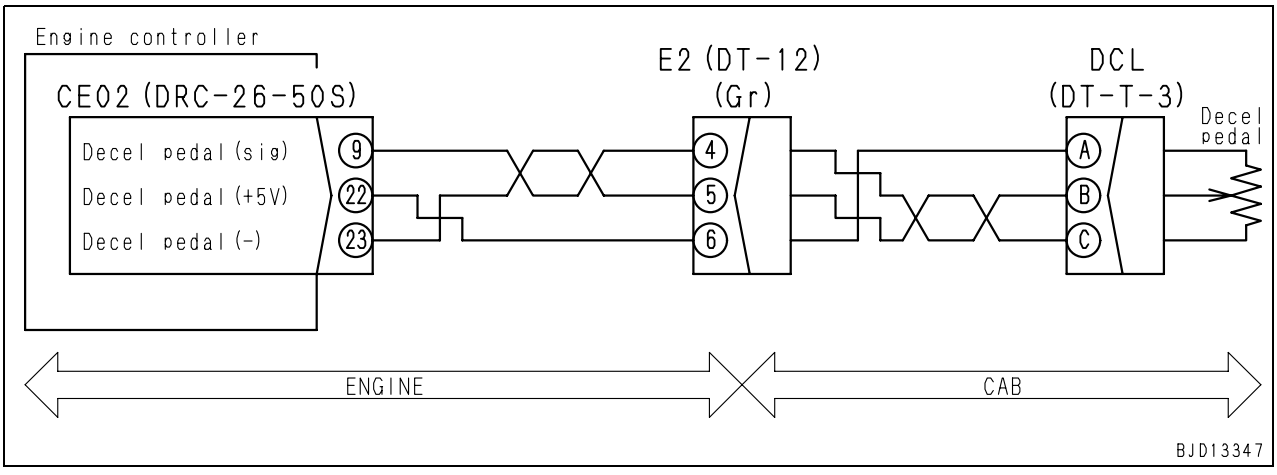


Failure code [CA2185] Decelerator pedal sensor power source too high: Excessively high voltage detected

Action code	Failure code	Symptom of failure	Decelerator pedal sensor power source too high: Excessively high voltage detected (Engine controller system)
CALL E03	**CA2185**		
Failure content	• Excessively high voltage (Min. 5.25 V) is detected in the circuit of decelerator pedal sensor power source.		
Controller's action	• Operates with the fixed value that is same as the value just before the abnormality is detected, if abnormality occurs with the starting switch in the ON position. • If the starting switch is turned to the ON position in the same abnormal condition, the controller operates with 100% value.		
Symptoms that appears on machine	• Engine speed cannot be controlled by decelerator pedal.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE02 (female) (22) – all pins of CE02 (female) (with DCL disconnected)	Resistance	Min. 100 kΩ
			Wiring harness between CE02 (female) (9) – DCL (female) (B) and wiring harness between CE02 (female) (22) – DCL (female) (A)	Resistance	Min. 100 kΩ
	2	Defective wiring harness connector	Since the connections among decelerator pedal – body harness – engine controller are suspected to be defective, visually check them. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	3	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 2. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to decelerator pedal

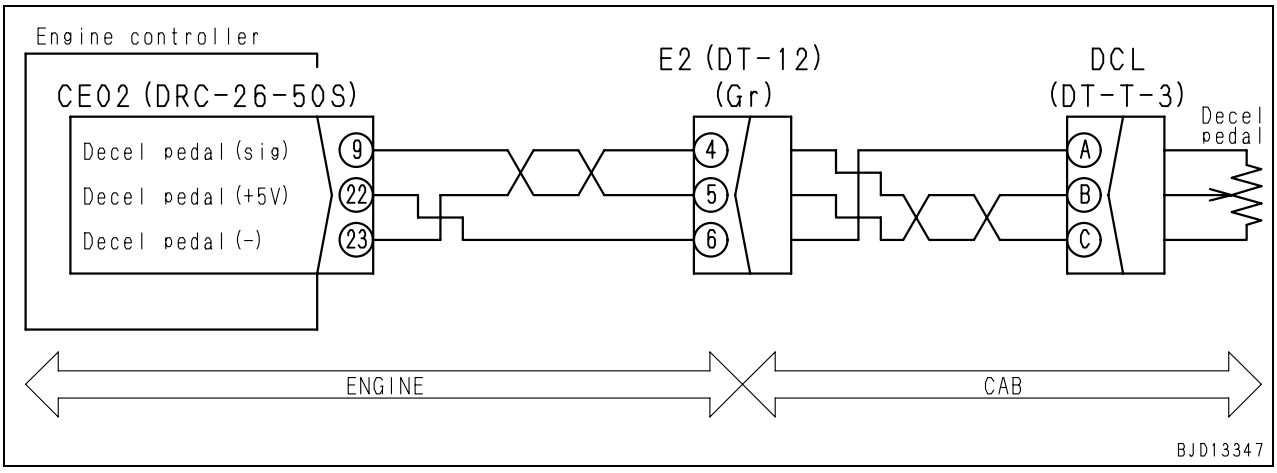


Failure code [CA2186] Decelerator pedal sensor power source too low: Excessively low voltage detected

Action code	Failure code	Symptom of failure	Decelerator pedal sensor power source too low: Excessively low voltage detected (Engine controller system)
CALL E03	**CA2186**		
Failure content	• Excessively low voltage is detected at decelerator pedal sensor power source circuit.		
Controller's action	• Operates with the fixed value that is same as the value just before the abnormality is detected, if abnormality occurs with the starting switch in the ON position. • If the starting switch is turned to the ON position in the same abnormal condition, the controller operates with 100% value.		
Symptoms that appears on machine	• Engine speed cannot be controlled by decelerator pedal.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE02 (female) (22) – DCL (female) (A)	Resistance	Min. 100 kΩ
	2	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE02 (female) (9) – all pins of CE02 (female) (with DCL also disconnected)	Resistance	Min. 100 kΩ
	3	Defective wiring harness connector	Since the connections among decelerator pedal – body harness – engine controller are suspected to be defective, visually check them. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	4	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 3. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to decelerator pedal



Failure code [CA2249] Loss of pressure feed from supply pump (2): Loss of pressure feed detected

Action code	Failure code	Symptom of failure	Loss of pressure feed from supply pump (2): Loss of pressure feed detected (Engine controller system)
CALL E03	**CA2249**		
Failure content	• Loss of pressure feed (2) occurred in the common rail circuit.		
Controller's action	• Operates with limited output.		
Symptoms that appears on machine	• Engine is hard to start. • Exhaust gas color becomes black. • Output decreases.		
General information	• Common rail pressure can be checked with the monitoring function. (Code: 36400 Common rail pressure) • Duplication of failure code: Start the engine.		

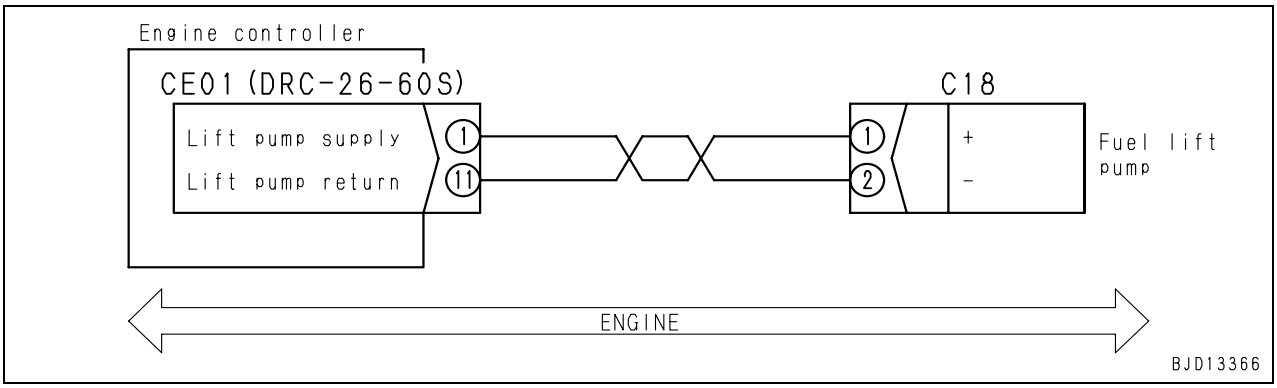
Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Carry out troubleshooting of [**CA559**].	

Failure code [CA2265] Electric lift pump disconnection: Disconnection

Action code	Failure code	Symptom of failure	Electric lift pump disconnection: Disconnection
CALL E03	**CA2265**		
Failure content	• Disconnection is detected in the drive circuit of electric lift pump actuator.		
Controller's action	• Takes no paticular action.		
Symptoms that appears on machine	• Engine is hard to start.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective electric lift pump (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C18 (male)	Resistance	
			Between (1) – (2)	Max. 20 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE01 (female) (1) – C18 (female) (1)	Resistance	Max. 10 Ω
			Wiring harness between CE01 (female) (11) – C18 (female) (2)	Resistance	Max. 10 Ω
	3	Hot short of wiring harness (a contact with 12 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between CE01 (female) (1) – C18 (female) (1)	Voltage	Max. 6 V
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (1) – CE01 (female) all pins (All connectors in the harness disconnected)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among lift pump valve – engine harness – engine controller are suspected to be defective. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	6	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE01 (female)	Resistance	
			Between (1) – (11)	Max. 20 Ω	
	7	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 6. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to electric lift pump actuator

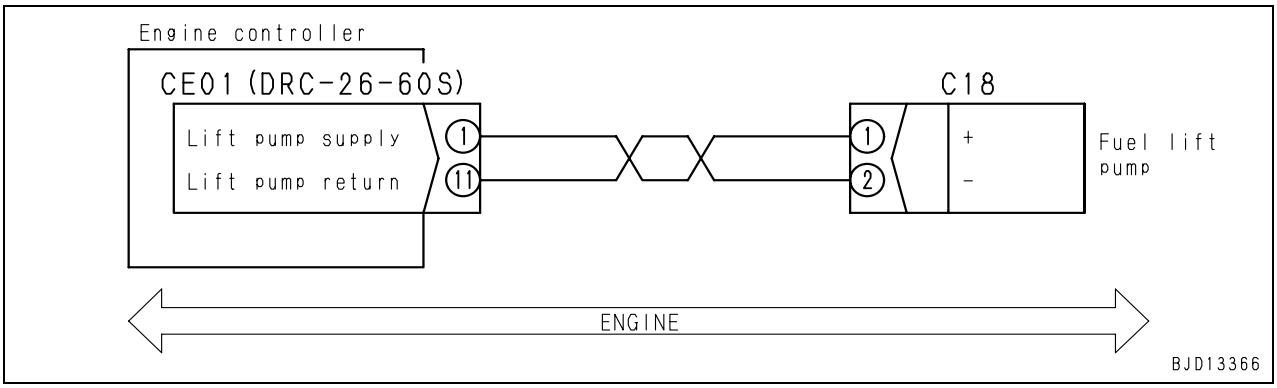


Failure code [CA2266] Electric lift pump short circuit: Short circuit

Action code	Failure code	Symptom of failure	Electric lift pump short circuit: Short circuit
CALL E03	**CA2266**		
Failure content	• Short circuit is detected in the drive circuit of electric lift pump actuator.		
Controller's action	• Takes no paticular action.		
Symptoms that appears on machine	• Engine is hard to start.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective electric lift pump (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			C18 (female)	Resistance	
			Between (1) – (2)	Max. 20 Ω	
			Between (1) – chassis ground	Min. 100 kΩ	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE01 (female) (1) – C18 (female) (1)	Resis-tance	Max. 100 kΩ
	3	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between CE01 (female) (1) – C18 (female) (1)	Voltage	Max. 6 V
	4	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE01 (female) (1) – CE01 (female) all pins (All connectors in the harness disconnected)	Resis-tance	Min. 100 kΩ
	5	Defective wiring harness connector	The connections among lift pump valve – engine harness – engine controller are suspected to be defective. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	6	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE01 (female)	Resistance	
			Between (1) – (11)	Max. 20 Ω	
			Between (1) – chassis ground	Min. 100 kΩ	
	7	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 6. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to electric lift pump actuator

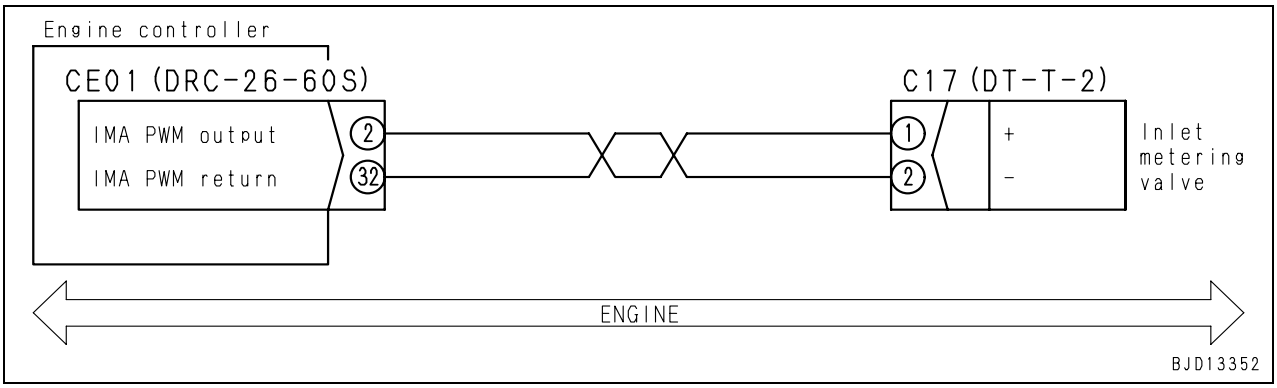


Failure code [CA2311] Abnormal IMV solenoid: Abnormal resistance

Action code	Failure code	Symptom of failure	Abnormal IMV solenoid: Abnormal resistance (Engine controller system)
CALL E03	**CA2311**		
Failure content	• Resistance value of supply pump actuator circuit is abnormaly high or low.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Engine output decreases.		
General information	• Duplication of failure code: start the engine.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective related circuits	Check the failure codes that are displayed at the same time. If any other codes are displayed, carry out troubleshooting for those codes.			
	2	Defective supply pump actuator	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			C17 (male)	Resistance		
			Between (1) – (2)	Max. 5 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between CE01 (female) (2) – C17 (female) (1)	Resistance	Max. 5 Ω	
			Wiring harness between CE01 (female) (32) – C17 (female) (2)	Resistance	Max. 5 Ω	
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between CE01 (female) (2) – C17 (female) (1)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Since the connections among inlet metering valve – engine harness – engine controller are suspected to be defective, visually check for a defective connection. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation			
	6	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CE01 (female)	Resistance		
			Between (2) – (32)	Max. 5 Ω		
			Between (2) – chassis ground	Min. 100 kΩ		
	7	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 6. (Since this is an internal defect, it cannot be diagnosed.)			

Circuit diagram related to inlet metering

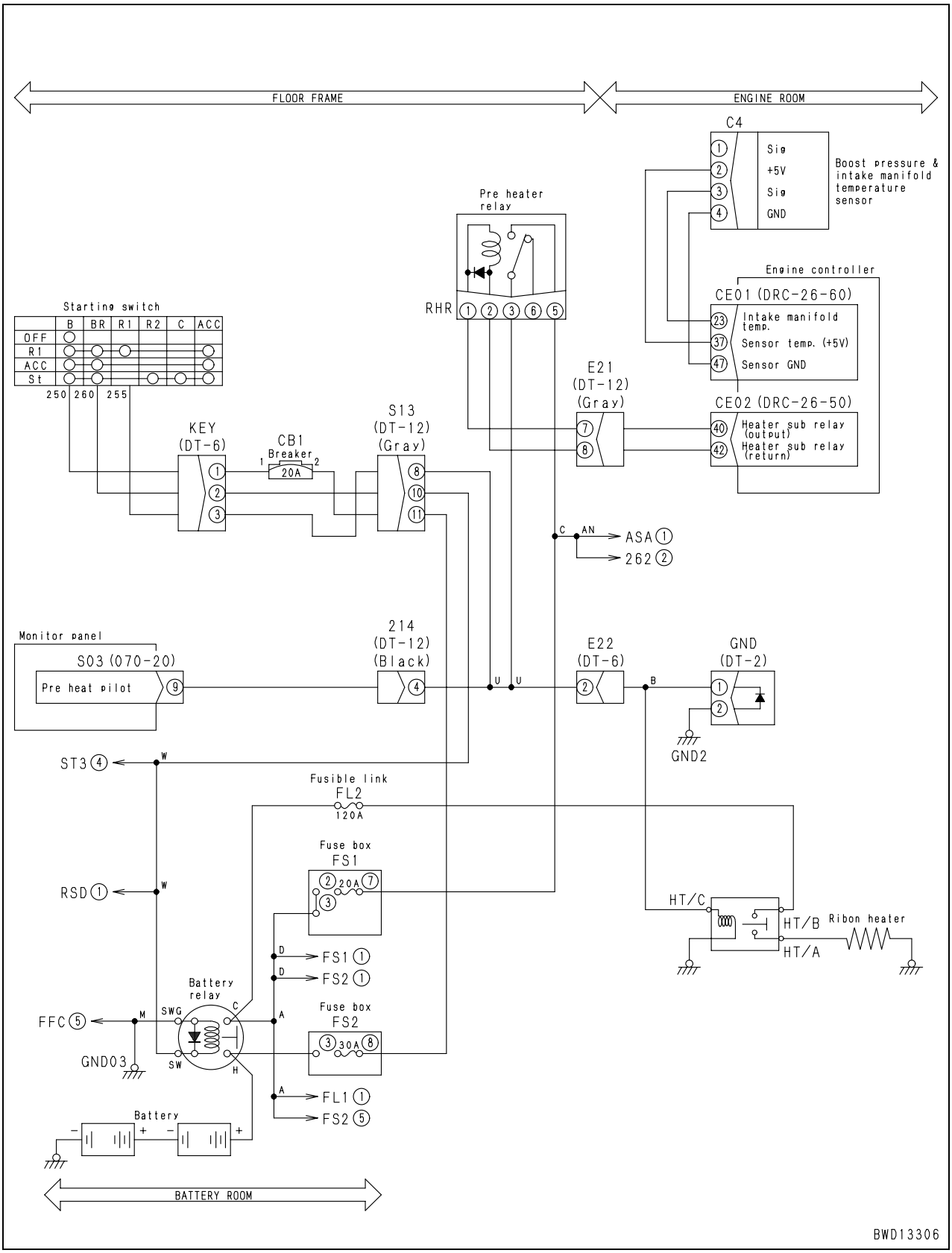


Failure code [CA2555] Air intake heater relay disconnection: Disconnection

Action code	Failure code	Symptom of failure	Air intake heater relay disconnection: Disconnection (Engine controller system)
E01	**CA2555**		
Failure content	• Disconnection is detected in the drive circuit of air intake heater relay.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Air intake heater does not operate (Startability deteriorates in a low temperature and white smoke is exhausted.)		
General information	• Duplication of failure code: Turn the starting switch ON with coolant temperature below -4°C.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective preheat relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF (diagnose by itself).		
			RHR (male)	Resistance	
			Between (1) – (2)	300 – 600 Ω	
			★ Prepare with starting switch OFF and diagnose with starting switch ON (diagnose by replacing with other relay)		
			Replace preheat relay (RHR) with other relay and carry out the procedure to duplicate the failure code. If failure code changes from flashing to steady ON, the relay is defective.		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CE02 (female) (40) – RHR (female) (1)	Resistance	Max. 10 Ω
			Wiring harness between CE02 (female) (42) – RHR (female) (2)	Resistance	Max. 10 Ω
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE02 (female) (40) – all pins of CE02 (female) (with RHR also disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	The connections among preheat relay – body harness – engine controller are suspected to be defective. Visually check them. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE02 (female)	Resistance	
			Between (40) – (42)	300 – 600 Ω	
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to engine preheat

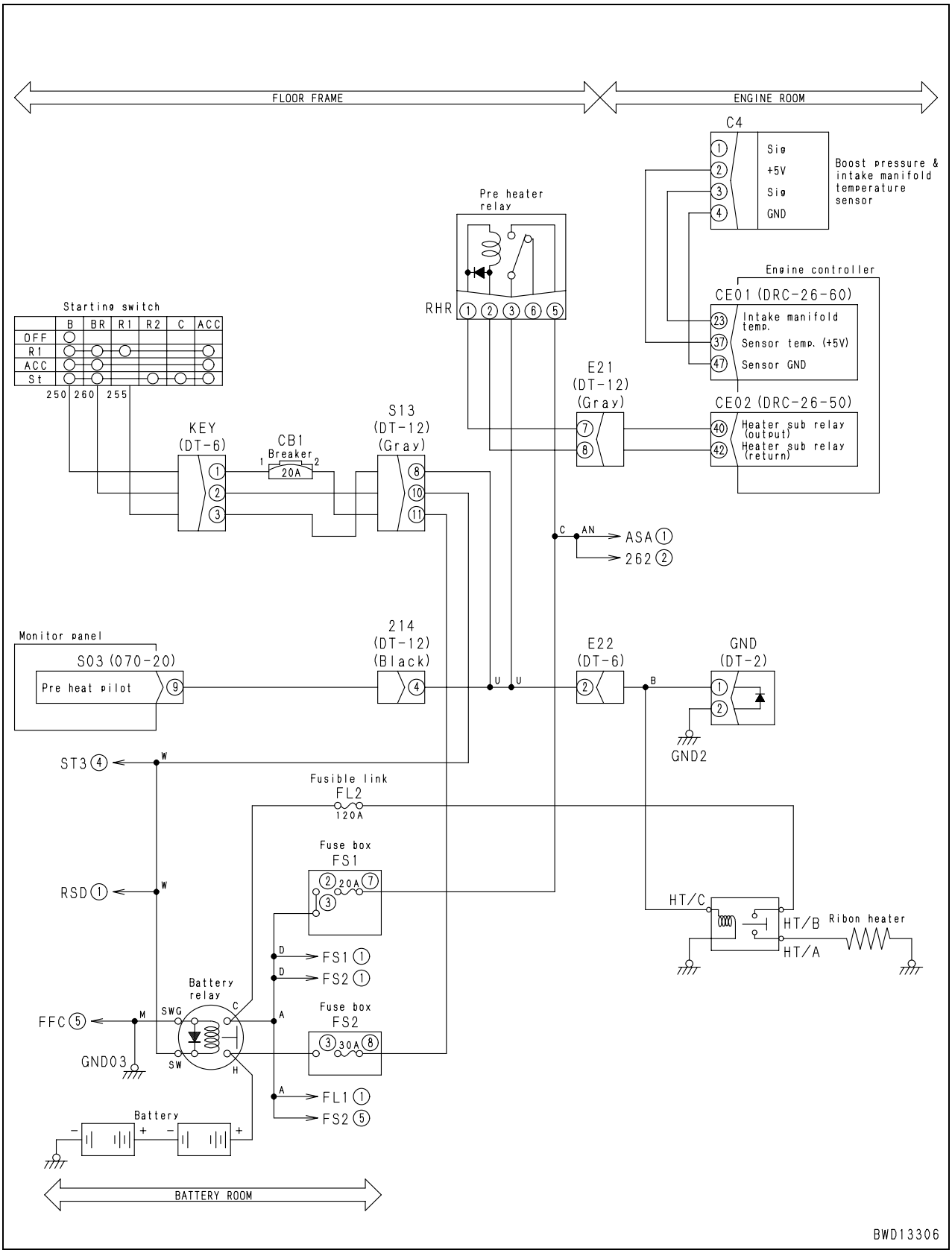


Failure code [CA2556] Air intake heater relay short circuit: Short circuit

Action code	Failure code	Symptom of failure	Air intake heater relay short circuit: Short circuit (Engine controller system)
E01	**CA2556**		
Failure content	• Short circuit is detected in the drive circuit of air intake heater relay.		
Controller's action	• No particular action		
Symptoms that appears on machine	• Air intake heater does not operate (Startability deteriorates in a low temperature and white smoke is exhausted.)		
General information	• Duplication of failure code: Turn the starting switch ON with coolant temperature below –4°C.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective preheat relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF (diagnose by itself).		
			RHR (male)	Resistance	
			Between (1) – (2)	300 – 600 Ω	
			★ Prepare with starting switch OFF and diagnose with starting switch ON (diagnose by replacing with other relay)		
			Replace preheat relay (RHR) with other relay and carry out the procedure to duplicate the failure code. If failure code changes from flashing to steady ON, the relay is defective.		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between CE02 (female) (40) – RHR (female) (1)	Resistance	Min. 100 kΩ
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between CE02 (female) (40) – all pins of CE02 (female) (with RHR also disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	The connections among preheat relay – body harness – engine controller are suspected to be defective. Visually check them. • Connector is loose, lock is broken, seal is broken • Pin is corroded, bent, broken, pushed in, expanded. • Moisture in connector, entry of dirt or sand, etc., and insufficient insulation		
	5	Defect in other locations than engine controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CE02 (female)	Resistance	
			Between (40) – (42)	300 – 600 Ω	
	6	Defective engine controller	Engine controller is possibly defective if no problem is found in causes 1 – 5. (Since this is an internal defect, it cannot be diagnosed.)		

Circuit diagram related to engine preheat



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00590-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

Troubleshooting by failure code (Display of code), Part 3

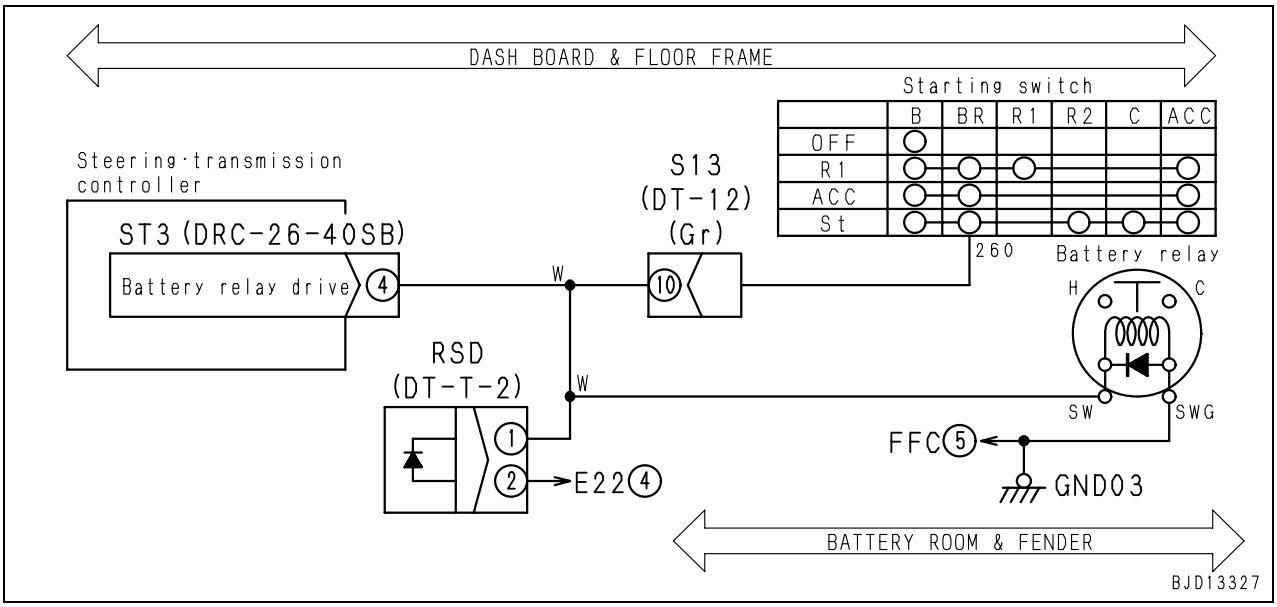
Troubleshooting by failure code (Display of code), Part 3

Failure code [D110KA] Battery relay: Short circuit

Action code	Failure code	Symptom of failure	Battery relay: Short circuit (Steering and transmission controller system)
—	**D110KA**		
Failure content	• Abnormal current flowed to battery relay circuit when outputting it.		
Controller's action	• Stops output to battery relay circuit.		
Symptoms that appears on machine	• Problem may occur in data writing to ROM (nonvolatile memory) of each controller.		
General information	• Output status (voltage) to battery relay can be checked in monitoring mode. (Code 60600: Battery relay drive voltage) • Method of reproducing failure code: Switch starting switch from ON → OFF.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective battery relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Battery relay	Continuity		
			Between SW terminal – SWG terminal	Continue		
			Between SW terminal – ground	Min. 1 MΩ		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (4) – battery relay SW terminal and S13 (female) (10) – RSD (female) (1) with ground	Resis-tance	Min. 1 MΩ	
	3	Defective diode (Internal short-circuiting)	See the section of testing procedure of diode (Testing and adjusting).			
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST3 (female)	Starting switch	Voltage	
			Between (4) – chassis ground	ON	20 – 30 V	

Circuit diagram related to battery relay

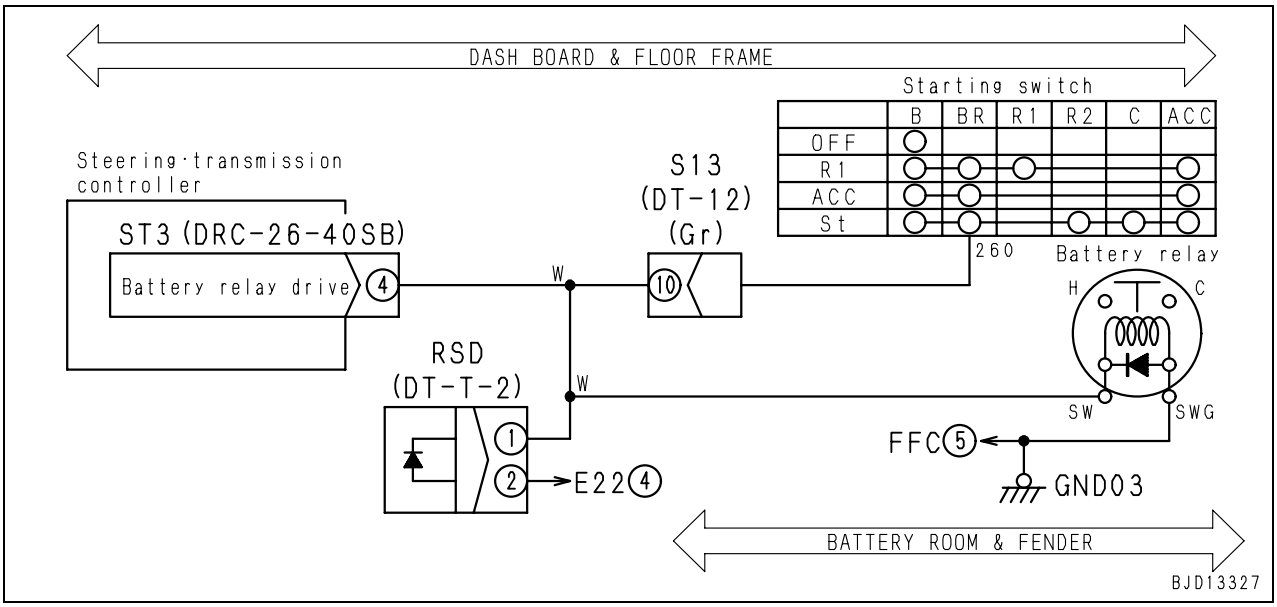


Failure code [D110KB] Battery relay: Disconnection

Action code	Failure code	Symptom of failure	Battery relay: Disconnection (Steering and transmission controller system)
—	**D110KB**		
Failure content	• Current does not flow when outputting it to battery relay circuit.		
Controller's action	• Stops output to battery relay circuit.		
Symptoms that appears on machine	• Problem may occur in data writing to ROM (nonvolatile memory) of each controller.		
General information	• Output status (voltage) to battery relay can be checked in monitoring mode. (Code 60600: Battery relay drive voltage) • Method of reproducing failure code: Switch starting switch from ON → OFF.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective battery relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Battery relay	Continuity		
			Between SW terminal – SWG terminal	Continue		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (4) – battery relay SW terminal	Resis-tance	Max. 1 Ω	
			Wiring harnesses between SWG terminal – GND03	Resis-tance	Max. 1 Ω	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (4) – battery relay SW terminal and S13 (female) (10) – RSD (female) (1) with ground	Voltage	Max. 1 V	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Continuity		
			Between (4) – chassis ground	Continue		

Circuit diagram related to battery relay

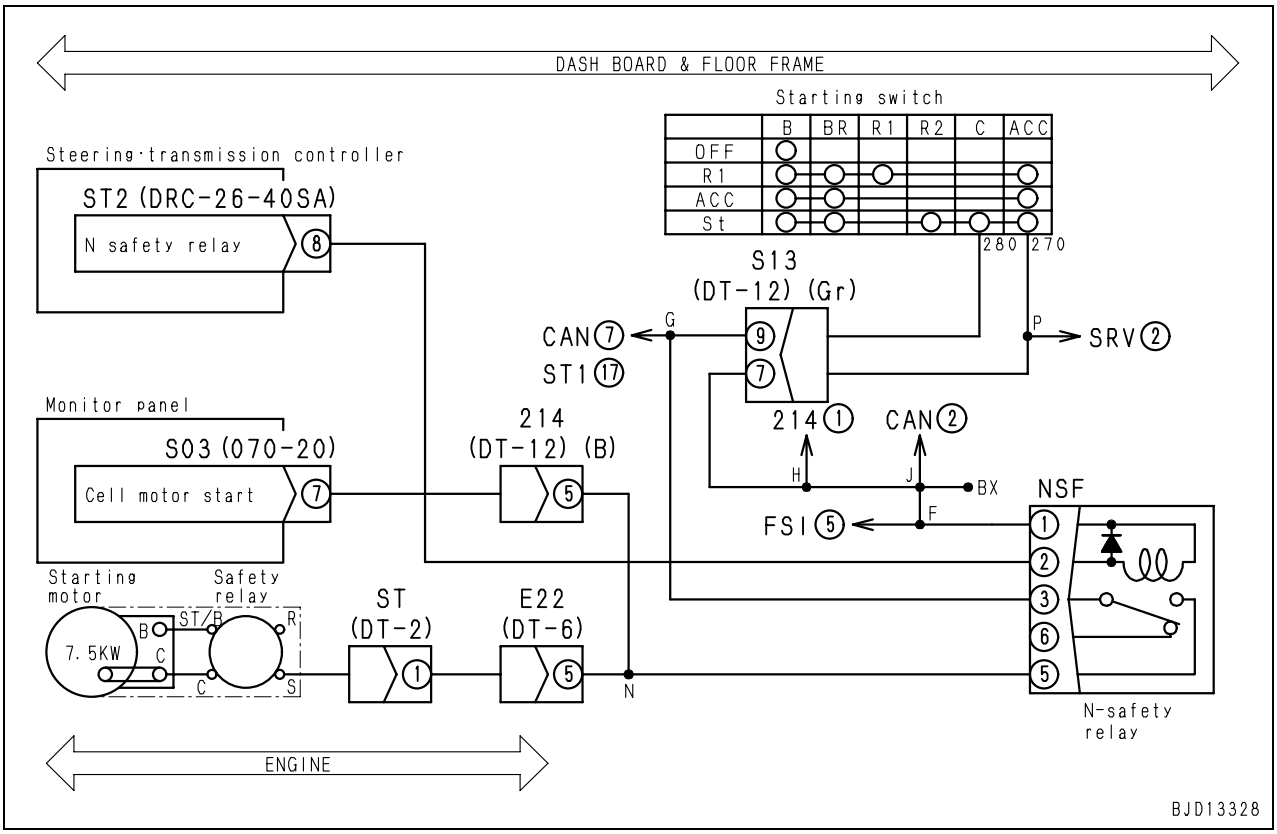


Failure code [D130KA] Neutral safety relay: Disconnection

Action code	Failure code	Symptom of failure	Neutral safety relay: Disconnection (Steering and transmission controller system)
E02	**D130KA**		
Failure content	• 24 V is not generated at neutral relay circuit when ground is shut off.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops ground output to neutral safety relay circuit.		
Symptoms that appears on machine	• Engine can not start. • Engine can start, regardless of position of parking brake lever.		
General information	• Output status (voltage) to neutral safety relay can be checked in monitoring mode. (Code 50900: Neutral safety relay drive voltage) • Method of reproducing failure code: Turn starting switch ON + Shift parking brake lever (to free position) ★ This failure code detects abnormality in primary side (coil side) of neutral safety relay, but not in secondary side (contact side).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective neutral safety relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			NSF (male)		Resistance	
			Between (1) – (2)		200 – 400 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST2 (female) (8) – NSF (female) (2)		Resistance	Max. 1 Ω
			Wiring harness between NSF (female) (1) – starting switch ACC (270)		Resistance	Max. 1 Ω
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST2 (female) (8) – NSF (female) (2) with ground.		Resistance	Min. 1 MΩ
			Wiring harness between NSF (female) (1) – starting switch ACC (270) with ground		Resistance	Min. 1 MΩ
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST2	Parking lever	Voltage	
			Between (8) – chassis ground	Free position	20 – 30 V	
				Lock position	Max. 1 V	

Circuit diagram related to neutral safety relay

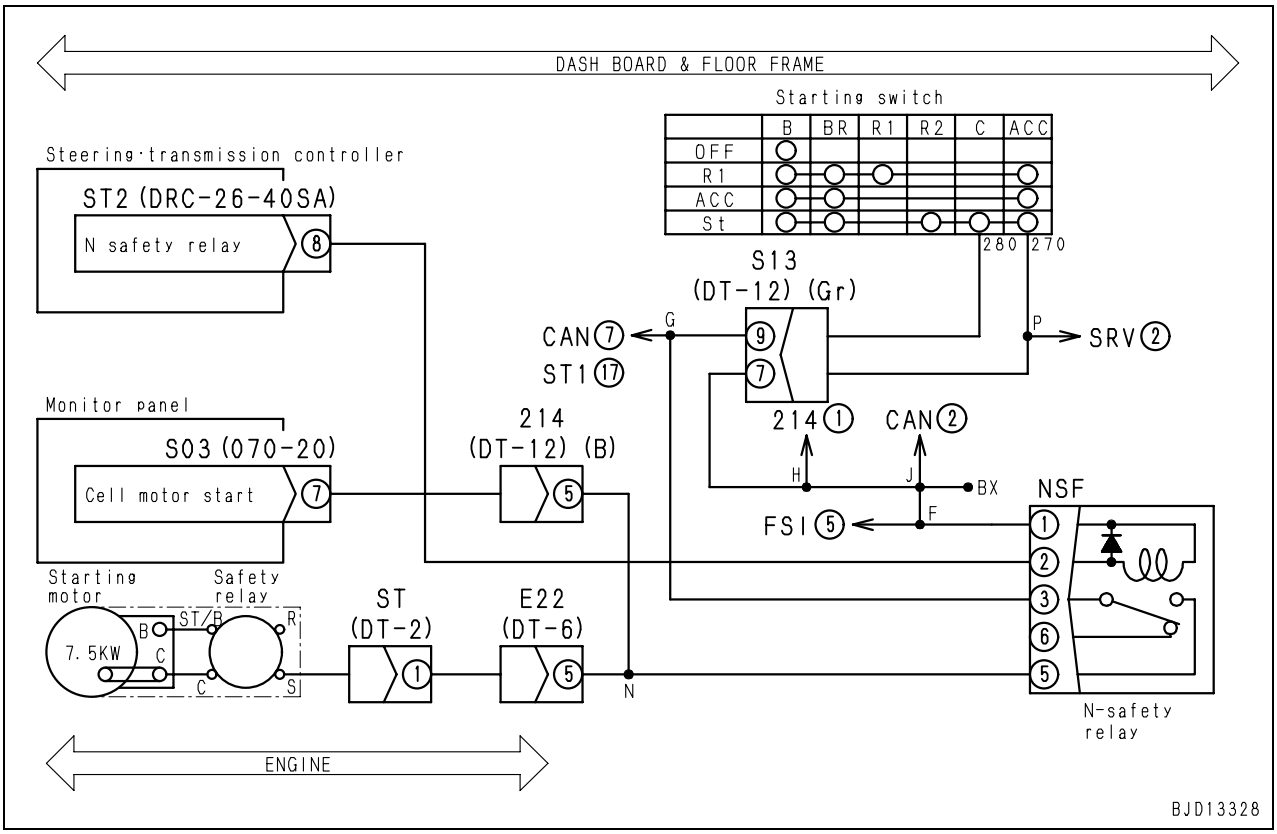


Failure code [D130KB] Neutral safety relay: Short circuit

Action code	Failure code	Symptom of failure	Neutral safety relay: Short circuit (Steering and transmission controller system)
E02	**D130KB**		
Failure content	• Abnormal current flowed in neutral safety relay circuit at the time of ground output.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops ground output to neutral safety relay circuit.		
Symptoms that appears on machine	• Engine does not start.		
General information	• Output status (voltage) to neutral safety relay can be checked in monitoring mode. (Code 50900: Neutral safety relay drive voltage) • Method of reproducing failure code: Turn starting switch ON + Shift parking brake lever (to lock position) ★ This failure code detects abnormality in primary side (coil side) of neutral safety relay, but not in secondary side (contact side).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective neutral safety relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			NSF (male)		Resistance	
			Between (1) – (2)		200 – 400 Ω	
	2	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST2 (female) (8) – NSF (female) (2) with ground.		Voltage	Max. 1 V
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST2	Parking lever	Voltage	
			Between (8) – chassis ground	Free position	20 – 30 V	
				Lock position	Max. 1 V	

Circuit diagram related to neutral safety relay

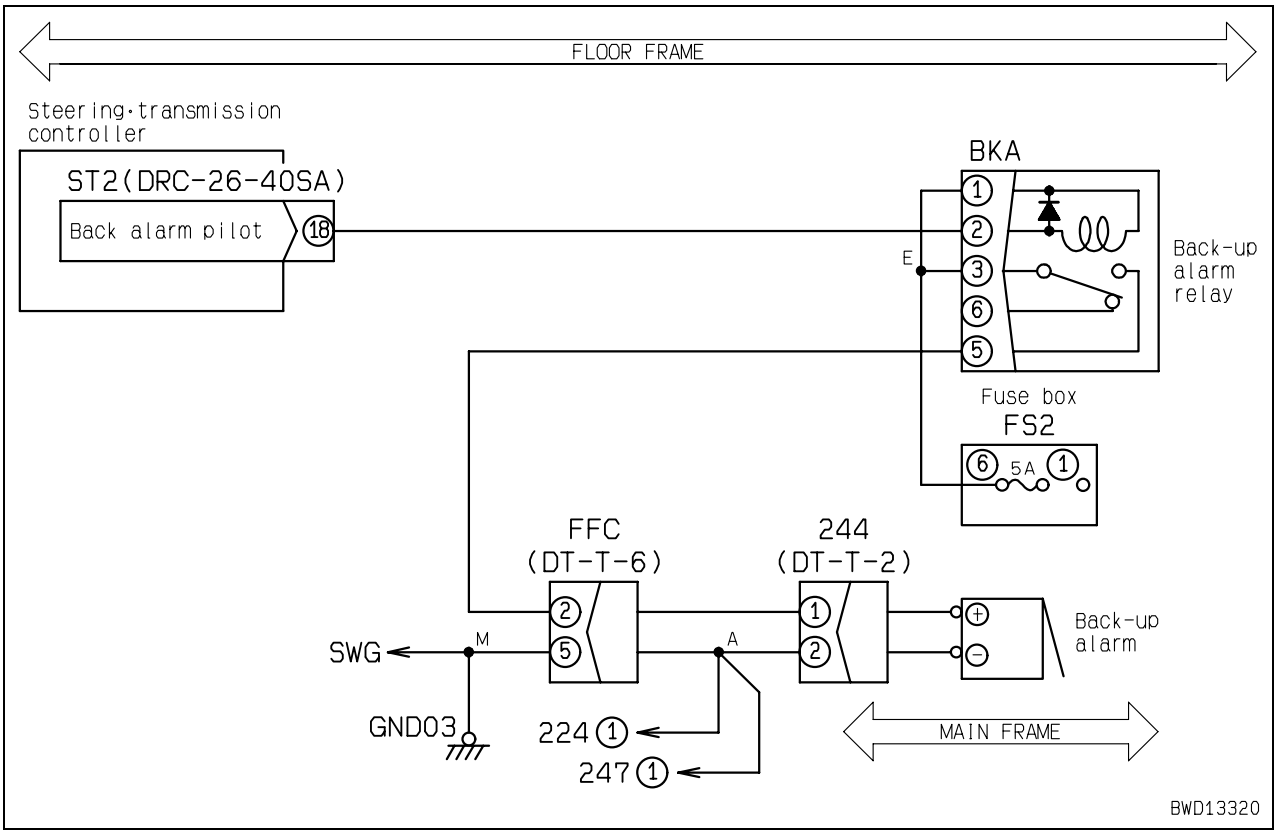


Failure code [D161KA] Back-up alarm relay: Disconnection

Action code	Failure code	Symptom of failure	Back-up alarm relay: Disconnection (Steering and transmission controller system)
E01	**D161KA**		
Failure content	• 24 V is not generated at neutral safety relay circuit when ground is shut off.		
Controller's action	• Stops ground output to back-up alarm relay circuit.		
Symptoms that appears on machine	• Back-up alarm does not turn on. • Back-up alarm turns on, regardless of positions of steering and forward-reverse lever and gear shift lever.		
General information	• Output status (voltage) to back-up alarm relay can be checked in monitoring mode. (Code 70400: Back-up alarm relay drive voltage) • Method of reproducing failure code: Turn starting switch ON + Shift steering and forward-reverse lever and gear shift lever to neutral ★ This failure code detects abnormality in primary side (coil side) of back-up alarm relay, but not in secondary side (contact side).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective fuse FS2-9	If fuse is blown, circuit probably has short circuiting with ground.			
	2	Defective back-up alarm relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			BKA (male)		Resistance	
			Between (1) – (2)		200 – 400 Ω	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST2 (female) (18) – BKA (female) (2)		Resistance	Max. 1 Ω
			Wiring harnesses between BKA (female) (1) – FS2-6 outlet		Resistance	Max. 1 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST2 (female) (18) – BKA (female) (2) with ground.		Resistance	Min. 1 MΩ
			Between wiring harnesses of BKA (female) (1) – FS2-6 outlet and ground		Resistance	Min. 1 MΩ
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST2	PCCS lever	Voltage	
			Between (18) – chassis ground	Neutral position	20 – 30 V	
				Reverse position	Max. 1 V	

Circuit diagram related to back-up alarm relay

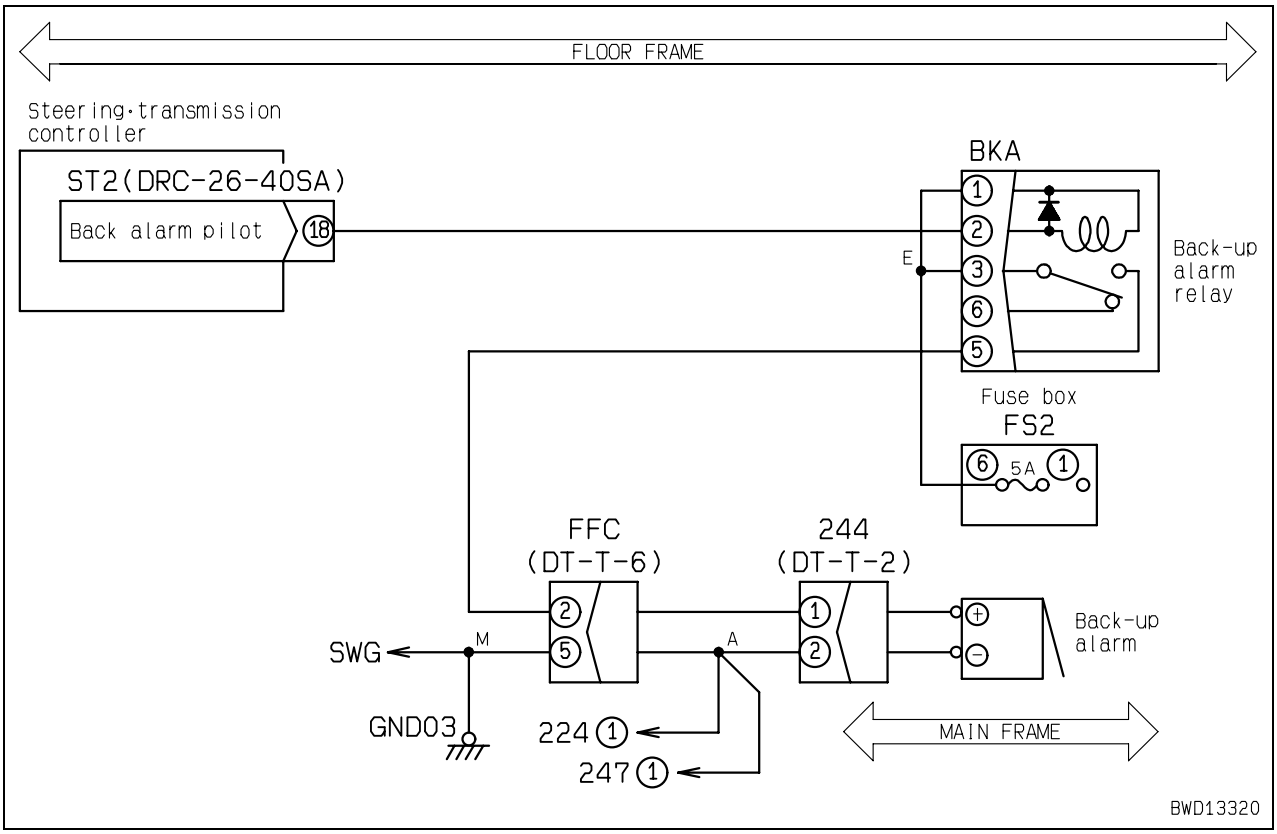


Failure code [D161KB] Back-up alarm relay: Short circuit

Action code	Failure code	Symptom of failure	Back-up alarm relay: Short circuit (Steering and transmission controller system)
E01	**D161KB**		
Failure content	• Abnormal current flowed in back-up alarm relay circuit at the time of ground output.		
Controller's action	• Stops ground output to back-up alarm relay circuit.		
Symptoms that appears on machine	• Back-up alarm does not turn on.		
General information	• Output status (voltage) to back-up alarm relay can be checked in monitoring mode. (Code 70400: Back-up alarm relay drive voltage) • Method of reproducing failure code: Turn starting switch ON + Shift steering and forward-reverse lever and gear shift lever (to reverse) ★ This failure code detects abnormality in primary side (coil side) of back-up alarm relay, but not in secondary side (contact side).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective back-up alarm relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			BKA (male)		Resistance	
			Between (1) – (2)		200 – 400 Ω	
	2	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST2 (female) (18) – BKA (female) (2) with ground.		Voltage	Max. 1 V
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST2	Parking lever		Voltage
			Between (18) – chassis ground	Neutral position		20 – 30 V
				Reverse position		Max. 1 V

Circuit diagram related to back-up alarm relay

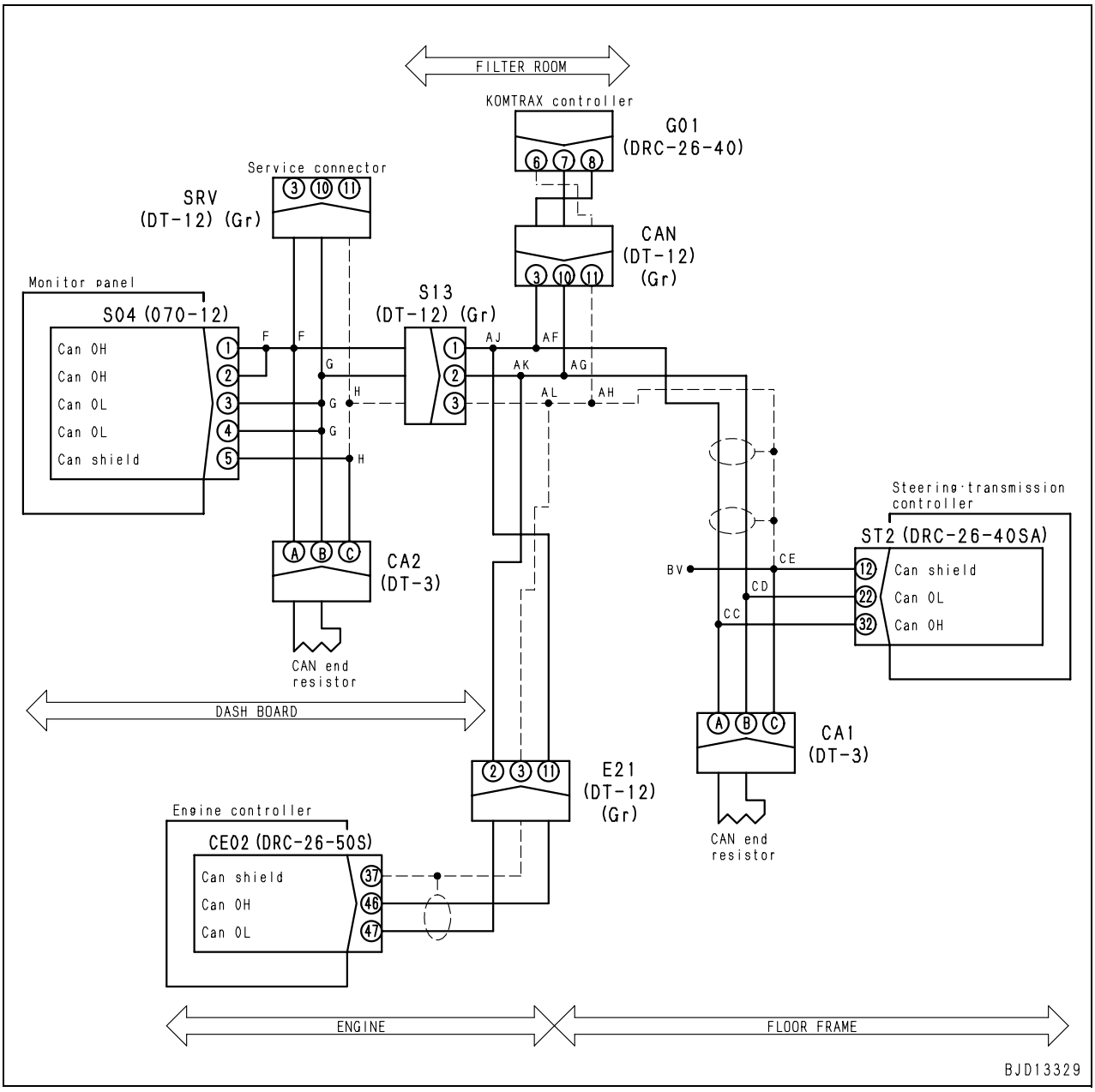


Failure code [DAFRKR] Monitor panel CAN communication: Defective communication

Action code	Failure code	Symptom of failure	Monitor panel CAN communication: Defective communication (Monitor panel system)
CALL E03	**DAFRKR**		
Failure content	• Monitor panel cannot recognize steering and transmission controller with CAN communication circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• System may not operate normally. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between S04 (female) (1) (2) – ST2 (female) (32), – CE02 (female) (46), – CA1 (female) (A), – CA2 (female) (A), – G01 (female) (8), and – SRV (male) (3)	Resistance	Max. 1 Ω
			Wiring harness between S04 (female) (3) (4) – ST2 (female) (22), – CE02 (female) (47), – CA1 (female) (B), – CA2 (female) (B), – G01 (female) (7), and – SRV (male) (10)	Resistance	Max. 1 Ω
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between S04 (female) (1) (2) – ST2 (female) (32), – CE02 (female) (46), – CA1 (female) (A), – CA2 (female) (A), – G01 (female) (8), and – SRV (male) (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between S04 (female) (3) (4) – ST2 (female) (22), – CE02 (female) (47), – CA1 (female) (B), – CA2 (female) (B), – G01 (female) (7), and – SRV (male) (10) with ground	Resistance	Min. 1 MΩ
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Wiring harness between S04 (female) (1) (2) – ST2 (female) (32), – CE02 (female) (46), – CA1 (female) (A), – CA2 (female) (A), – G01 (female) (8), and – SRV (male) (3) with ground	Voltage	Max. 1 V
			Wiring harness between S04 (female) (3) (4) – ST2 (female) (22), – CE02 (female) (47), – CA1 (female) (B), – CA2 (female) (B), – G01 (female) (7), and – SRV (male) (10) with ground	Voltage	Max. 1 V
	4	Defective CAN terminal resistance	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CA1 (male), CA2 (male)	Resistance	
			Between (A) – (B)	100 – 400 Ω	
	5	Defective monitor panel or defective steering and transmission controller	If no problem is found in causes 1 – 4, it is suspected that monitor panel or steering and transmission controller is defective. (Troubleshooting cannot be carried out since it is internal defect.)		

Circuit diagram related CAN communication



Failure code [DAQ0KT] [DB30KT] Steering and transmission controller: Abnormality in controller

Action code	Failure code	Symptom of failure	Steering and transmission controller: Abnormality in controller (Steering and transmission controller system)
E01	**DAQ0KT DB30KT**		
Failure content	• Information of ROM (nonvolatile memory) of steering and transmission controller is not normal.		
Controller's action	• Defaults internal adjustment value.		
Symptoms that appears on machine	• Gear shift feeling of transmission may become worse.		
General information	• Both of **DAQ0KT** and **DB30KT** are displayed. • Duplication of failure code: turn ON the starting switch.		

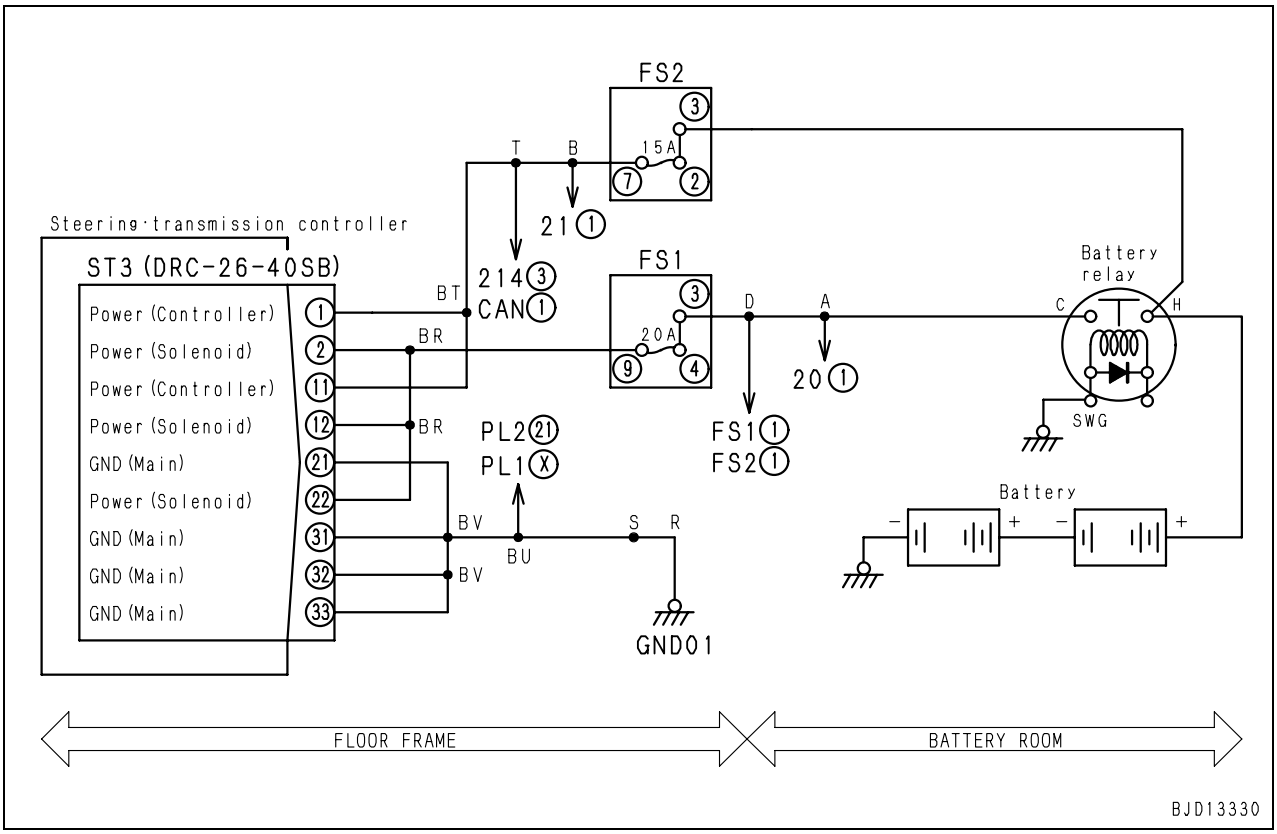
Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective steering and transmission controller	Troubleshooting cannot be carried out since it is internal defect. • Adjust once in adjustment mode (Code 0002). (There is no problem to keep using controller unless any visible problem appears on machine.)

Failure code [DAQ1KK] [DB31KK] Main power source of steering and transmission controller: Power source voltage drop and input

Action code	Failure code	Symptom of failure	Main power supply of steering and transmission controller: Power source voltage drop and input (Steering and transmission controller system)
CALL E04	**DAQ1KK DB31KK**		
Failure content	• Power source voltage of steering and transmission controller is less than 17 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Monitor panel may not display normally. • Relay and solenoid may not drive and therefore, system may not operate normally. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it becomes impossible to travel.		
General information	• Both of **DAQ1KK** and **DB31KK** are displayed. • Battery charge condition (voltage) can be checked in monitoring mode. (Code 03200: Battery voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fuse FS2-7	If fuse FS2-7 is blown, circuit probably has short circuiting with ground.		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (1) (11) – FS2-7	Resis-tance	Max. 1 Ω
			Wiring harness between FS2-3 – battery relay H terminal	Resis-tance	Max. 1 Ω
			Wiring harness between ST3 (female) (21) (31) (32) (33) – ground	Resis-tance	Max. 1 Ω
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (1) (11) – FS2-7 with ground	Resis-tance	Min. 1 MΩ
			Wiring harness between FS2-3 – battery relay H terminal with ground	Resis-tance	Min. 1 MΩ
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST3	Voltage	
			Between (1) (11) – (21) (31) (32) (33)	20 – 30 V	

Circuit diagram related to steering and transmission power source

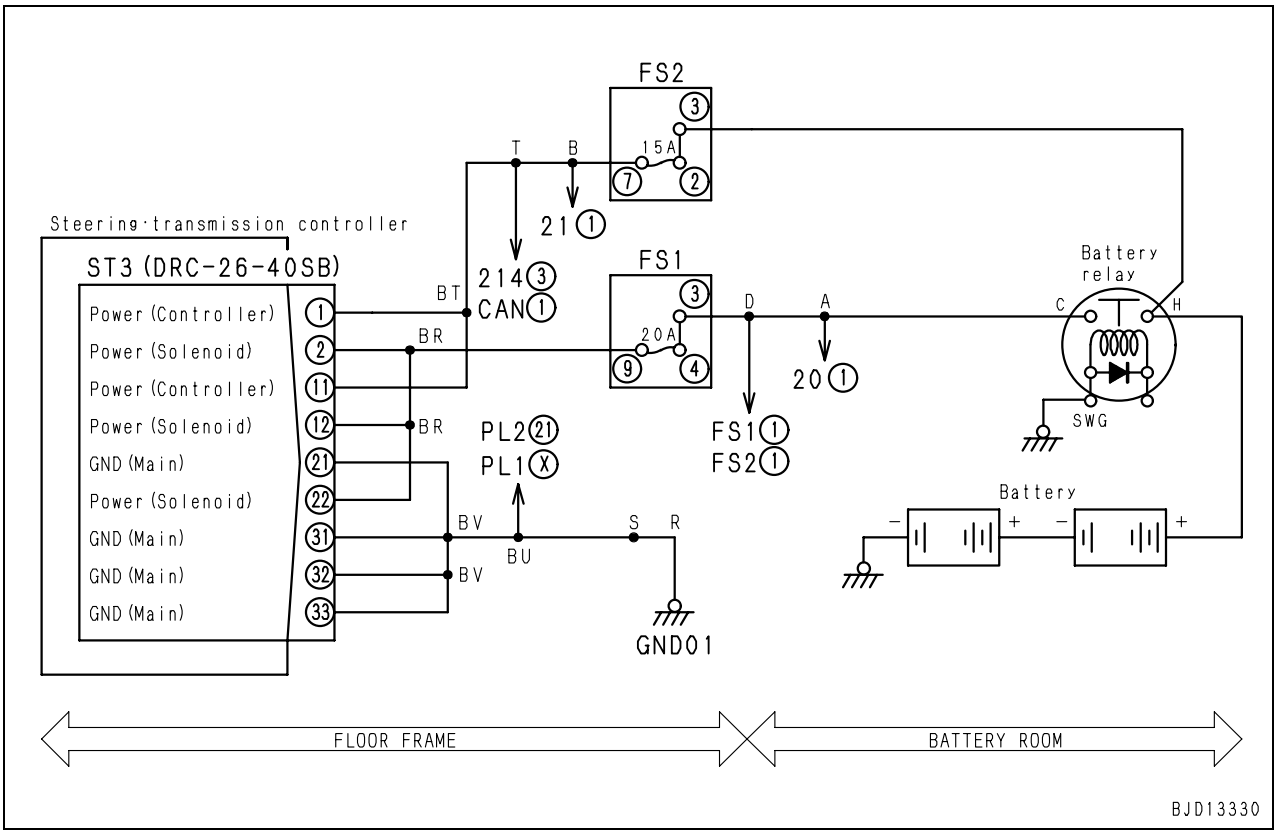


Failure code [DAQ2KK] [DB32KK] Load power source of steering and transmission controller: Power source voltage drop and input

Action code	Failure code	Symptom of failure	Load power source of steering and transmission controller: Power source voltage drop and input (Steering and transmission controller system)
CALL E04	**DAQ2KK DB32KK**		
Failure content	• Power source voltage of load (relay, solenoid and etc,) on steering and transmission controller is less than 17 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Relay and solenoid may not drive and therefore, system may not operate normally. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it becomes impossible to travel.		
General information	• Both of **DAQ2KK** and **DB32KK** are displayed. • Battery charge condition (voltage) can be checked in monitoring mode. (Code 03200: Battery voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fuse FS1-9	If fuse FS1-9 is blown, circuit probably has short circuiting with ground.		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (2) (12) (22) – FS1-9	Resistance	Max. 1 Ω
			Wiring harness between FS1-3 – battery relay C terminal	Resistance	Max. 1 Ω
			Wiring harness between ST3 (female) (21) (31) (32) (33) – ground	Resistance	Max. 1 Ω
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (2) (12) (22) – FS1-9 with ground	Resistance	Min. 1 MΩ
			Wiring harness between FS1-3 – battery relay C terminal with ground	Resistance	Min. 1 MΩ
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST3	Voltage	
			Between (2) (12) (22) – (21) (31) (32) (33)	20 – 30 V	

Circuit diagram related to steering and transmission power source



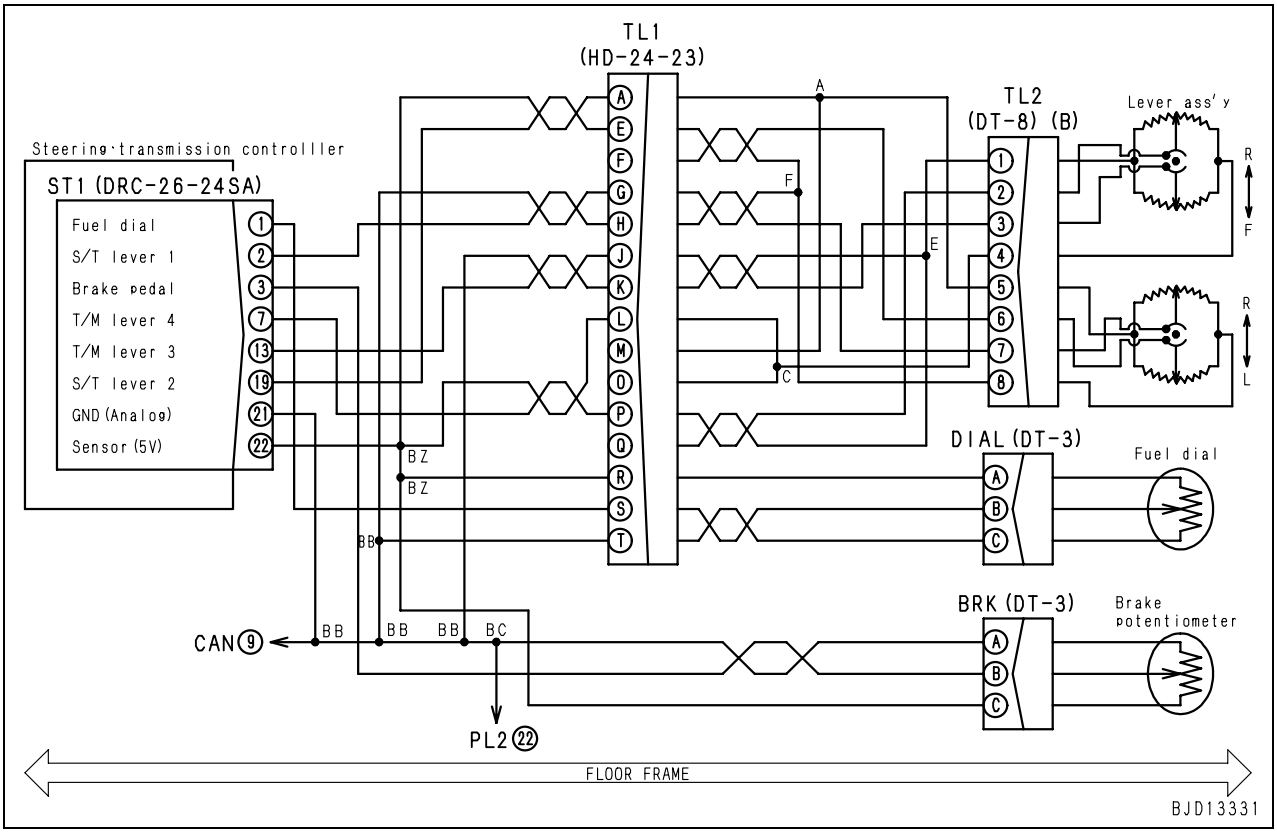
Failure code [DAQ5KK] [DB35KK] Steering and transmission controller sensor 5 V power source: Power source voltage drop and input

Action code	Failure code	Symptom of failure	Steering and transmission controller sensor 5 V power source: Power source voltage drop and input (Steering and transmission controller system)
CALL E03	**DAQ5KK DB35KK**		
Failure content	• Voltage of 5 V power source circuit of steering and transmission controller sensor is less than 4.5 V or more than 5.5 V. • Abnormal current flowed in 5 V power source circuit of steering and transmission controller sensor.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops output to 5 V power source circuit if abnormal voltage flows. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• System may not operate normally. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Both of **DAQ5KK** and **DB35KK** are displayed. • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective brake potentiometer (Internal short circuit)	If right-hand connector is disconnected and service code lights up (to indicate returning to normal), the cause is an internal trouble, ★ Turn starting switch OFF, disconnect connector, turn the switch ON and carry out troubleshooting.			BRK connector
	2	Defective fuel dial potentiometer (Internal short circuit)	If right-hand connector is disconnected and service code lights up (to indicate returning to normal), the cause is an internal trouble, ★ Turn starting switch OFF, disconnect connector, turn the switch ON and carry out troubleshooting.			DIAL connector
	3	Defective forward-reverse potentiometer (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)		Resistance	
			Sensor	Between (4) – (1)	3.2 kΩ ± 20%	
				Between (4) – chassis ground	Min. 1 MΩ	
	4	Defective steering potentiometer (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)		Resistance	
			Sensor	Between (5) – (8)	3.2 kΩ ± 20%	
				Between (5) – chassis ground	Min. 1 MΩ	
	5	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – TL2 (female) (5), – TL2 (female) (4) – DIAL (female) (A) – BRK (female) (C) with ground.		Resistance	Min. 1 MΩ
	6	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST1 (female) (22) – TL2 (female) (5), – TL2 (female) (4) – DIAL (female) (A) – BRK (female) (C) with ground.		Voltage	Max. 1 V

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting	
	7	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.	
			ST1	Voltage
			Between (22) – (21)	4.5 – 5.5 V

Circuit diagram related to steering and transmission controller sensor 5 V power source

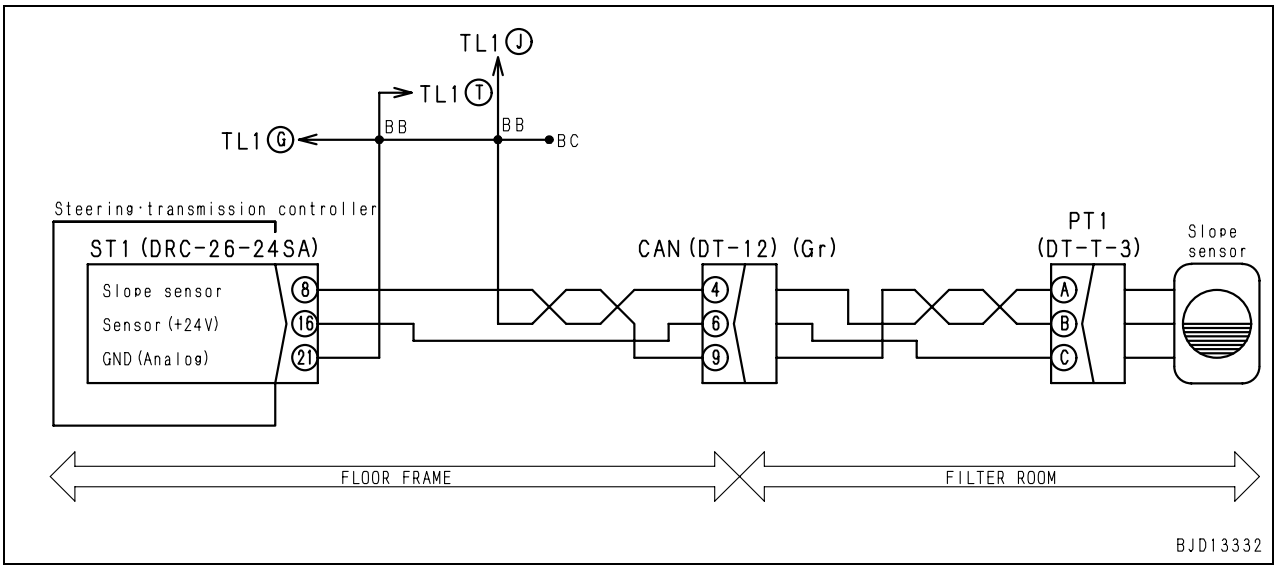


Failure code [DAQ6KK] [DB36KK] Steering and transmission controller sensor 24 V power source: Power source voltage drop and input

Action code	Failure code	Symptom of failure	Steering and transmission controller sensor 24 V power source: Power source voltage drop and input (Steering and transmission controller system)
CALL E03	**DAQ6KK DB36KK**		
Failure content	• Voltage of 24 V power source circuit of steering and transmission controller sensor is less than 12 V or more than 30 V. • Abnormal current flowed in 24 V power source circuit of steering and transmission controller sensor.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission. • Stops output to 24 V power source circuit if abnormal voltage flows.		
Symptoms that appears on machine	• System may not operate normally. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Both of **DAQ6KK** and **DB36KK** are displayed. • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective pitch angle sensor (internal short circuit)	If right-hand connector is disconnected and service code lights up (to indicate returning to normal), the cause is an internal trouble, ★ Turn starting switch OFF, disconnect connector, turn the switch ON and carry out troubleshooting.		PT1 connector
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST1 (female) (16) – PT1 (female) (C) with ground.	Resis-tance	Min. 1 MΩ
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST1	Voltage	
			Between (16) – (21)	20 – 30 V	

Circuit diagram related to steering and transmission controller sensor 24 V power source

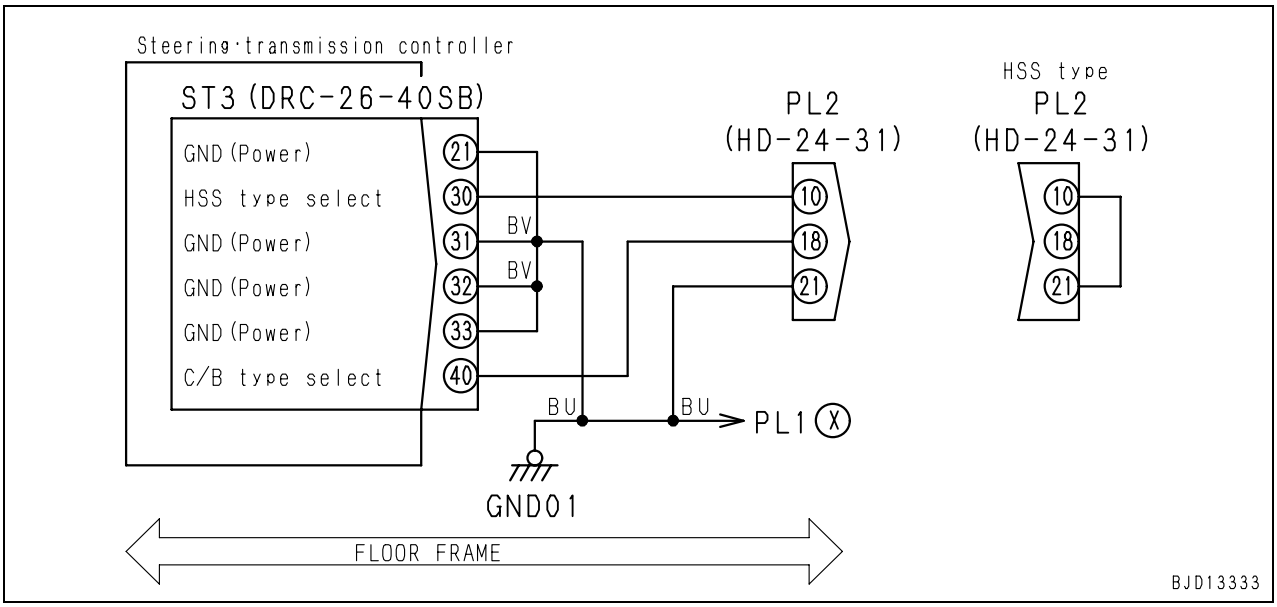


Failure code [DAQ9KQ] [DB39KQ] Steering and transmission controller model selection: Inconsistency in model select signal

Action code	Failure code	Symptom of failure	Steering and transmission controller model selection: Inconsistency in model select signal (Steering and transmission controller system)
CALL E04	**DAQ9KQ DB39KQ**		
Failure content	• Internal specification setting of steering and transmission controller is inconsistent with specification setting signal. (Steering and transmission controller cannot be recognized normally.)		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops all outputs to steering and transmission controller. • Limits operation of engine, transmission and brake.		
Symptoms that appears on machine	• Machine does not operate at all. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it becomes impossible to travel.		
General information	• Both of **DAQ9KQ** and **DB39KQ** are displayed. • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective steering and transmission controller adjustment	It is normal if failure code lights on (to indicate returning to normal) after carrying out adjustment mode. • Adjustment code 0002: Steering and transmission controller specification set		
	2	Disconnection in wiring harness (Disconnection, defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harnesses between ST3 (female) (30) – GND01	Resistance	Max. 1 Ω
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ST3 (female) (40) – PL2 (18) and ground	Resistance	Min. 1 MΩ
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST3	Voltage	
			Between (30) – chassis ground	Max. 1 V	
			Between (40) – chassis ground	5 – 11 V	

Circuit diagram related to steering and transmission controller model selection

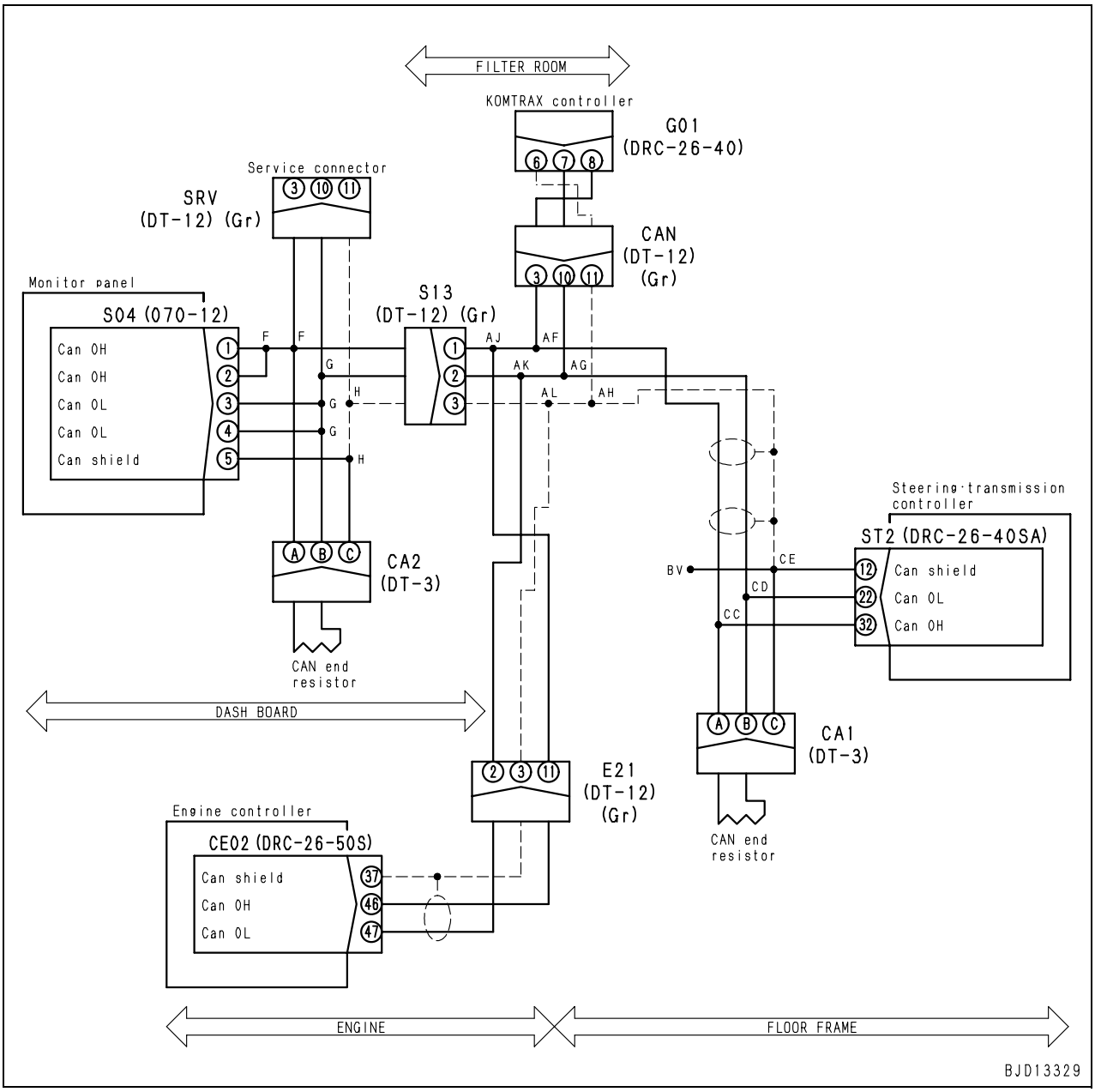


Failure code [DB2RKR] Steering and transmission controller CAN communication: Defective communication

Action code	Failure code	Symptom of failure	Steering and transmission controller CAN communication: Defective communication (Steering and transmission controller system)
CALL E03	**DB2RKR**		
Failure content	• Steering and transmission controller cannot recognize engine controller with CAN communication circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• System may not operate normally. • When machine is traveling, engine speed is limited up to medium (half) at a certain rate. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between S04 (female) (1) (2) – ST2 (female) (32), – CE02 (female) (46), – CA1 (female) (A), – CA2 (female) (A), – G01 (female) (8), and – SRV (male) (3)	Resistance	Max. 1 Ω
			Wiring harness between S04 (female) (3) (4) – ST2 (female) (22), – CE02 (female) (47), – CA1 (female) (B), – CA2 (female) (B), – G01 (female) (7), and – SRV (male) (10)	Resistance	Max. 1 Ω
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between S04 (female) (1) (2) – ST2 (female) (32), – CE02 (female) (46), – CA1 (female) (A), – CA2 (female) (A), – G01 (female) (8), and – SRV (male) (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between S04 (female) (3) (4) – ST2 (female) (22), – CE02 (female) (47), – CA1 (female) (B), – CA2 (female) (B), – G01 (female) (7), and – SRV (male) (10) with ground	Resistance	Min. 1 MΩ
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Wiring harness between S04 (female) (1) (2) – ST2 (female) (32), – CE02 (female) (46), – CA1 (female) (A), – CA2 (female) (A), – G01 (female) (8), and – SRV (male) (3) with ground	Voltage	Max. 1 V
			Wiring harness between S04 (female) (3) (4) – ST2 (female) (22), – CE02 (female) (47), – CA1 (female) (B), – CA2 (female) (B), – G01 (female) (7), and – SRV (male) (10) with ground	Voltage	Max. 1 V
	4	Defective CAN terminal resistance	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CA1 (male), CA2 (male)	Resistance	
			Between (A) – (B)	100 – 140 Ω	
	5	Defective monitor panel or defective steering and transmission controller	If no problem is found in causes 1 – 4, it is suspected that monitor panel or steering and transmission controller is defective. (Troubleshooting cannot be carried out since it is internal defect.)		

Circuit diagram related to CAN communication



Failure code [DB30KT] [DAQ0KT] Steering and transmission controller: Abnormality in controller

★ See **DAQ0KT**

Failure code [DB31KK] [DAQ1KK] Main power source of steering and transmission controller: Power source voltage drop and input

★ See **DAQ1KK**

Failure code [DAB32KK] [DAQ2KK] Load power source of steering and transmission controller: Power source voltage drop and input

★ See **DAQ2KK**

Failure code [DB35KK] [DAQ5KK] Steering and transmission controller sensor 5 V power source: Power source voltage drop and input

★ See **DAQ5KK**

Failure code [DB36KK] [DAQ6KK] Steering and transmission controller sensor 24 V power source: Power source voltage drop and input

★ See **DAQ6KK**

Failure code [DB39KQ] [DAQ9KQ] Steering and transmission controller model selection: Inconsistency in model select signal

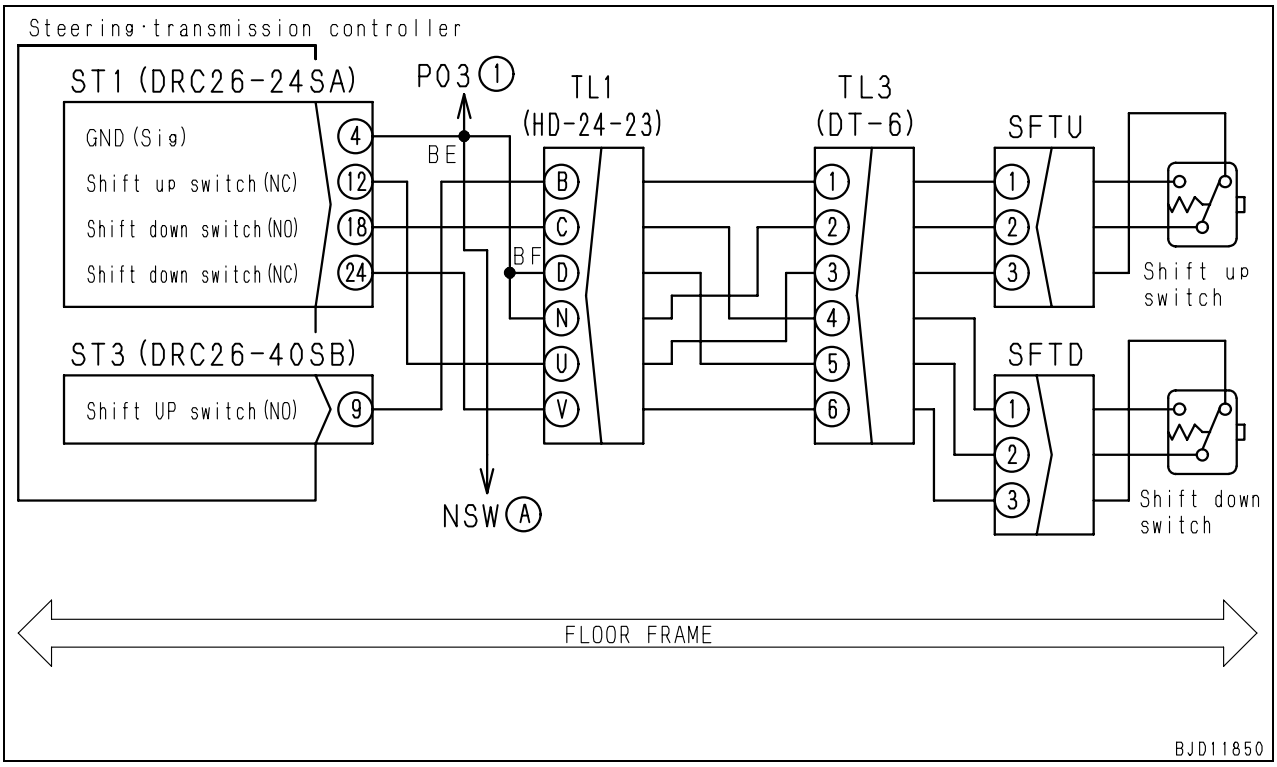
★ See **DAQ9KQ**

Failure code [DD12KA] Shift up switch: Disconnection

Action code	Failure code	Symptom of failure	Shift up switch: Disconnection (Steering and transmission controller system)
E02	**DD12KA**		
Failure content	• Signals of two systems of shift up switch circuit were turned OFF (OPEN) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that switch is not pressed.		
Symptoms that appears on machine	• Cannot shift up. • The auto shift down function does not work.		
General information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from shift up switch can be checked in monitoring mode. (Code 40905: Transmission-related controller input signal 1) • Method of reproducing failure code: Turn starting switch ON + Operate shift up switch		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective shift up switch (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			SFTU (male)	Shift up switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between (2) – (1)	Min. 1 MΩ	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (12) – SFTU (female) (3)	Resistance	Max. 1 Ω	
			Wiring harness between ST3 (female) (9) – SFTU (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (4) – SFTU (female) (2)	Resistance	Max. 1 Ω	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST1 (female) (12) – SFTU (female) (3) with ground	Voltage	Max. 1 V	
			Wiring harness between ST3 (female) (9) – SFTU (female) (1) with ground	Voltage	Max. 1 V	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1, ST3	Shift up switch		
				OFF (Release)	ON (Press)	
			Voltage between ST1 (12) – ST1 (4)	Max. 1 V	5 – 11 V	
			Voltage between ST3 (9) – ST1 (4)	5 – 11 V	Max. 1 V	

Circuit diagram related to shift up and shift down switch

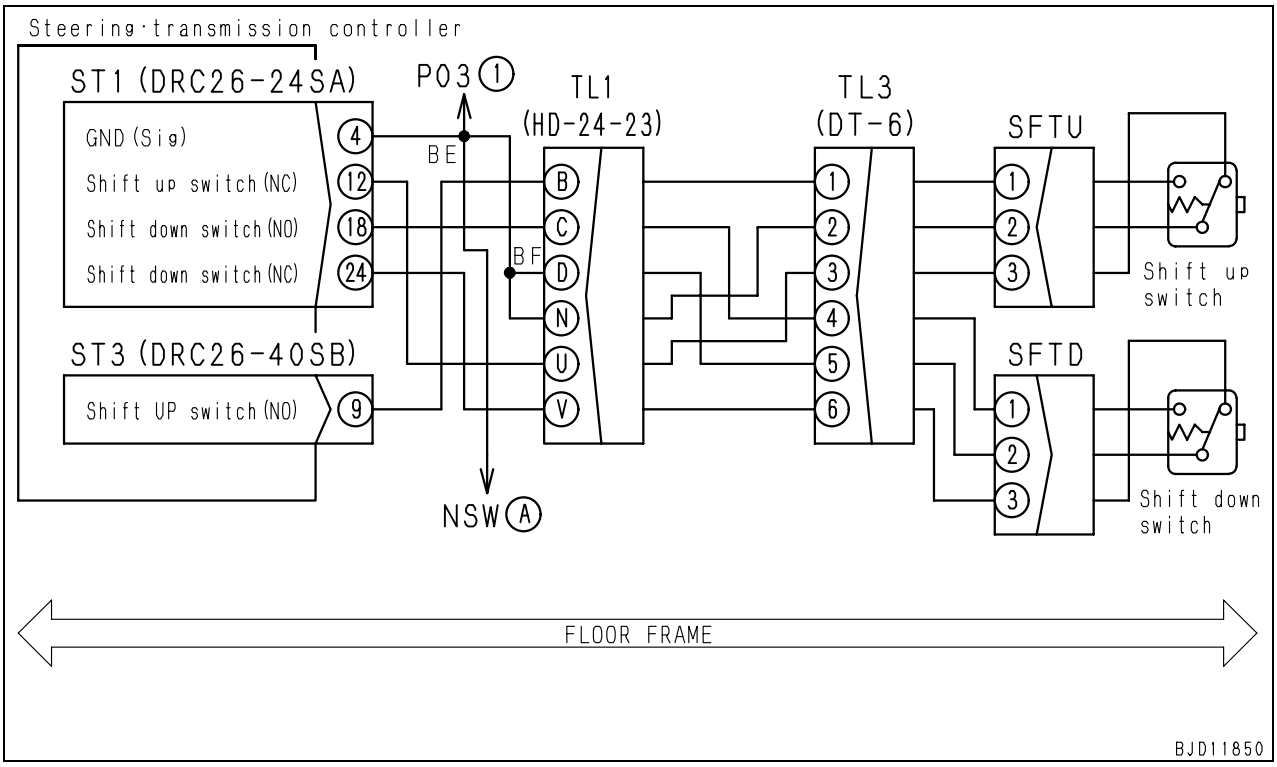


Failure code [DD12KB] Shift up switch: Short circuit

Action code	Failure code	Symptom of failure	Shift up switch: Short circuit (Steering and transmission controller system)
E02	**DD12KB**		
Failure content	• Signals of two systems of shift up switch circuit were turned ON (CLOSE) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that switch is not pressed.		
Symptoms that appears on machine	• Cannot shift up. • The auto shift down function does not work.		
General information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from shift up switch can be checked in monitoring mode. (Code 40905: Transmission-related controller input signal 1) • Method of reproducing failure code: Turn starting switch ON + Operate shift up switch		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective shift up switch (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			SFTU (male)	Shift up switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between (2) – (1)	Min. 1 MΩ	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (12) – SFTU (female) (3) with ground	Resis-tance	Min. 1 MΩ	
			Wiring harness between ST3 (female) (9) – SFTU (female) (1) with ground	Resis-tance	Min. 1 MΩ	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1, ST3	Shift up switch		
				OFF (Release)	ON (Press)	
			Voltage between ST1 (12) – ST1 (4)	Max. 1 V	5 – 11 V	
			Voltage between ST3 (9) – ST1 (4)	5 – 11 V	Max. 1 V	

Circuit diagram related to shift up and shift down switch

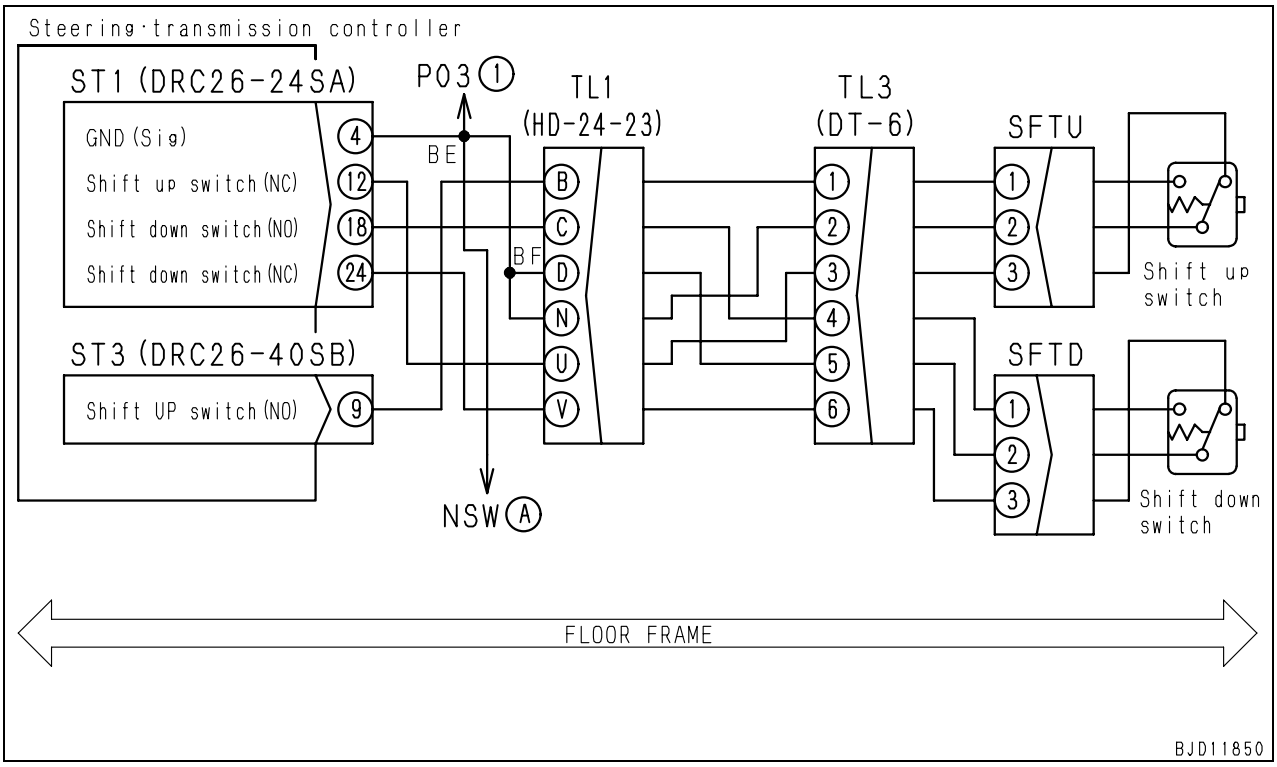


Failure code [DD13KA] Shift down switch: Disconnection

Action code	Failure code	Symptom of failure	Shift down switch: Disconnection (Steering and transmission controller system)
E02	**DD13KA**		
Failure content	• Signals of two systems of shift down switch circuit were turned OFF (OPEN) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that switch is not pressed.		
Symptoms that appears on machine	• Cannot shift down. • The auto shift down function does not work.		
General information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from shift down switch can be checked in monitoring mode. (Code 40905: Transmission-related controller input signal 1) • Method of reproducing failure code: Turn starting switch ON + Operate shift down switch		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective shift down switch (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			SFTD (female)	Shift down switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between (2) – (1)	Min. 1 MΩ	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (24) – SFTD (male) (3)	Resis-tance	Max. 1 Ω	
			Wiring harness between ST1 (female) (18) – SFTD (male) (1)	Resis-tance	Max. 1 Ω	
			Wiring harness between ST1 (female) (4) – SFTD (male) (2)	Resis-tance	Max. 1 Ω	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST1 (female) (24) – SFTD (male) (3) with ground	Voltage	Max. 1 V	
			Wiring harness between ST1 (female) (18) – SFTD (male) (1) with ground	Voltage	Max. 1 V	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Shift down switch		
				OFF (Release)	ON (Press)	
			Voltage between ST1 (24) – ST1 (4)	Max. 1 V	5 – 11 V	
			Voltage between ST1 (18) – ST1 (4)	5 – 11 V	Max. 1 V	

Circuit diagram related to shift up and shift down switch

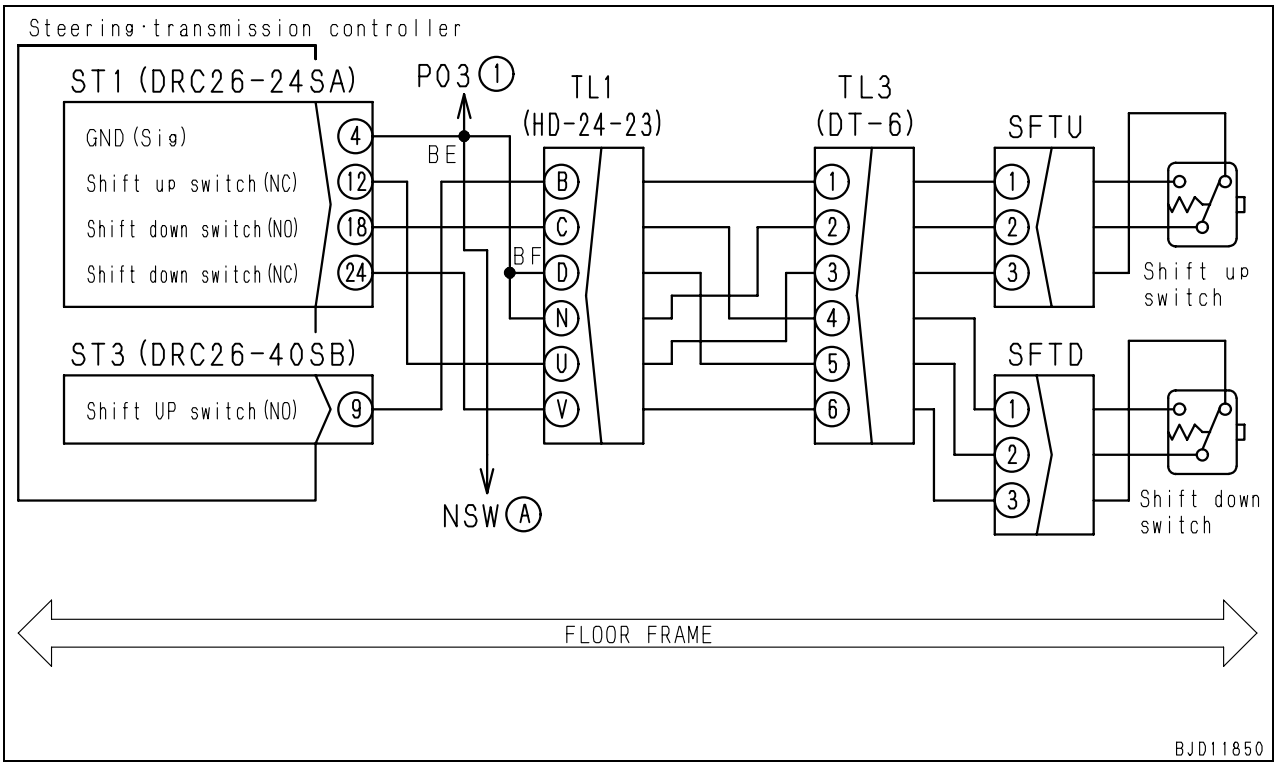


Failure code [DD13KB] Shift down switch: Short circuit

Action code	Failure code	Symptom of failure	Shift down switch: Short circuit (Steering and transmission controller system)
E02	**DD13KB**		
Failure content	• Signals of two systems of shift down switch circuit were turned ON (CLOSE) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that switch is not pressed.		
Symptoms that appears on machine	• Cannot shift down. • The auto shift down function does not work.		
General information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from shift down switch can be checked in monitoring mode. (Code 40905: Transmission-related controller input signal 1) • Method of reproducing failure code: Turn starting switch ON + Operate shift down switch		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective shift down switch (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			SFTD (female)	Shift down switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between (2) – (1)	Min. 1 MΩ	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (24) – SFTD (male) (3) with ground	Resis-tance	Min. 1 MΩ	
			Wiring harness between ST1 (female) (18) – SFTD (male) (1) with ground	Resis-tance	Min. 1 MΩ	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Shift down switch		
				OFF (Release)	ON (Press)	
			Voltage between ST1 (24) – ST1 (4)	Max. 1 V	5 – 11 V	
			Voltage between ST1 (18) – ST1 (4)	5 – 11 V	Max. 1 V	

Circuit diagram related to shift up and shift down switch

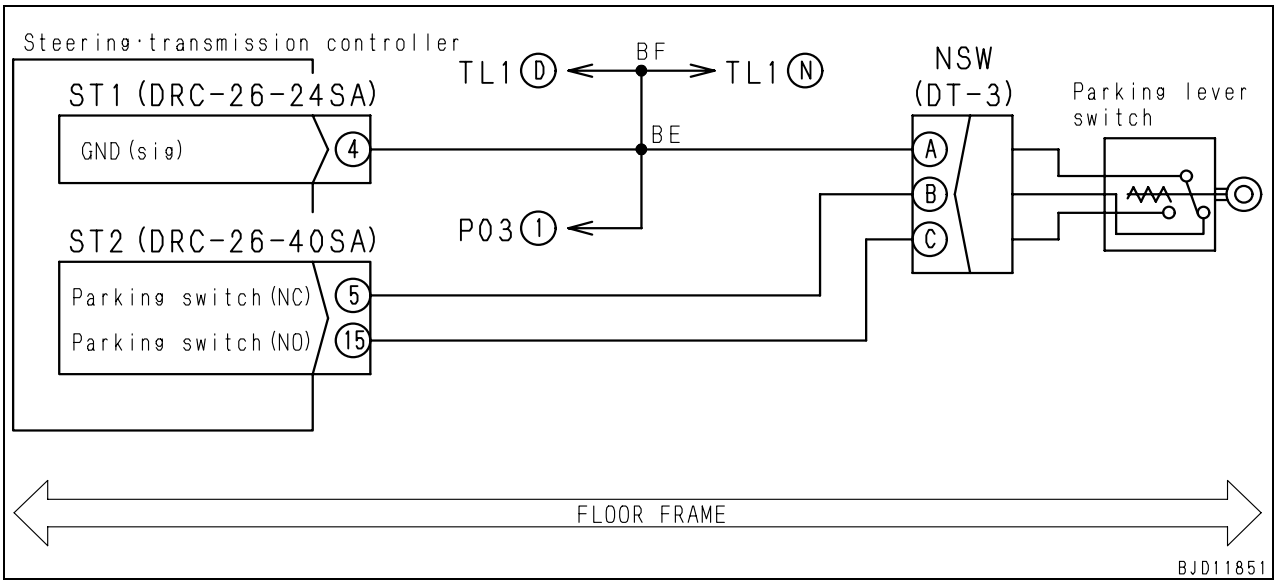


Failure code [DD14KA] [DDQ2KA] Parking brake lever switch: Disconnection

Action code	Failure code	Symptom of failure	Parking brake lever switch: Disconnection (Steering and transmission controller system)
CALL E03	**DD14KA DDQ2KA**		
Failure content	• Signals of two systems of parking brake lever switch circuit were turned OFF (OPEN) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that parking brake lever is in free position. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1. • Engine cannot be started.		
General information	• Both of **DD14KA** and **DDQ2KA** are displayed. • Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from parking brake switch can be checked in monitoring mode. (Code 40910: Steering-related controller input signal 1) • Method of reproducing failure code: Turn starting switch ON + Shift parking brake lever		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Parking brake lever switch (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			NSW (male)	Parking lever		
				Free position	Lock position	
			Resistance between ground (A) – (B)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between ground (A) – (C)	Min. 1 MΩ	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST2 (female) (15) – NSW (female) (C)		Resis-tance	Max. 1 Ω
			Wiring harness between ST2 (female) (5) – NSW (female) (B)		Resis-tance	Max. 1 Ω
			Wiring harness between ST1 (female) (4) – NSW (female) (A)		Resis-tance	Max. 1 Ω
	3	Hot short circuiting in wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST2 (female) (15) – NSW (female) (C) with ground.		Voltage	Max. 1 V
			Wiring harness between ST2 (female) (5) – NSW (female) (B) with ground.		Voltage	Max. 1 V
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST2	Parking lever		
				Free position	Lock position	
			Voltage between (5) – ground	Max. 1 V	5 – 11 V	
			Voltage between (15) – ground	5 – 11 V	Max. 1 V	

Circuit diagram related to parking brake switch

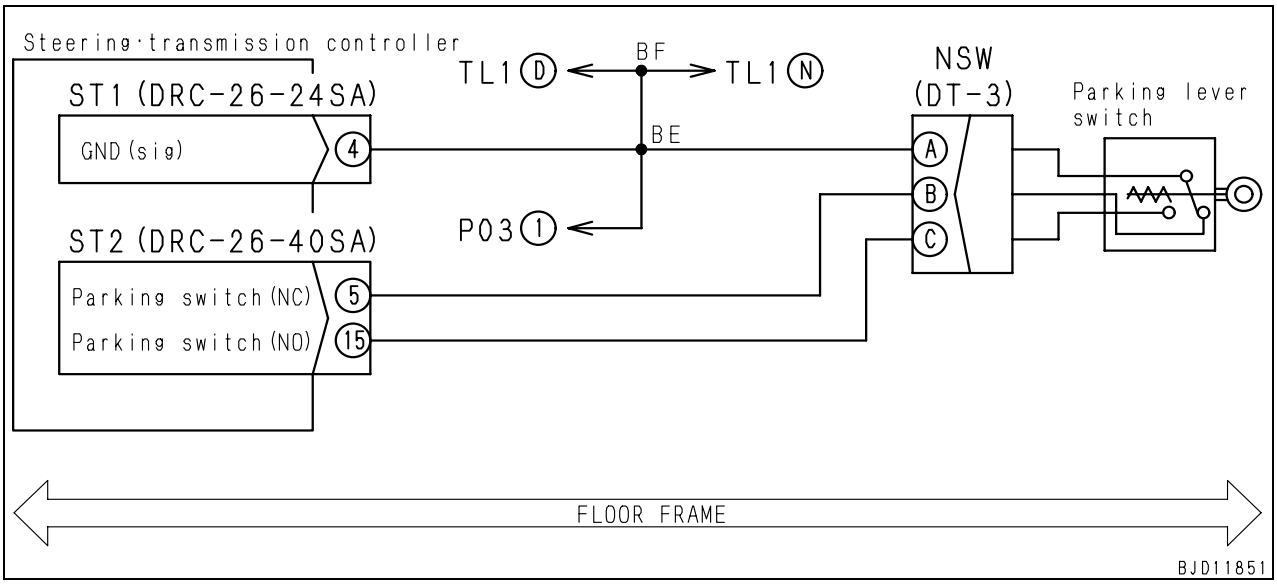


Failure code [DD14KB] [DDQ2KB] Parking brake lever switch: Short circuit

Action code	Failure code	Symptom of failure	Parking brake lever switch: Short circuit (Steering and transmission controller system)
CALL E03	**DD14KB DDQ2KB**		
Failure content	• Signals of two systems of parking brake lever switch circuit were turned ON (CLOSE) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that parking brake lever is in free position. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1. • Engine cannot be started.		
General information	• Both of **DD14KB** and **DDQ2KB** are displayed. • Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from parking brake switch can be checked in monitoring mode. (Code 40910: Steering-related controller input signal 1) • Method of reproducing failure code: Turn starting switch ON + Shift parking brake lever		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Parking brake lever switch (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			NSW (male)	Parking lever		
				Free position	Lock position	
			Resistance between (A) – (B)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between (A) – (C)	Min. 1 MΩ	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between NSW (female) (B) – ST2 (female) (5) with ground.	Resis-tance	Min. 1 MΩ	
			Wiring harness between NSW (female) (C) – ST2 (female) (15) with ground.	Resis-tance	Min. 1 MΩ	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST2	Parking lever		
				Free position	Lock position	
			Voltage between (5) – ground	Max. 1 V	5 – 11 V	
			Voltage between (15) – ground	5 – 11 V	Max. 1 V	

Circuit diagram related to parking brake switch

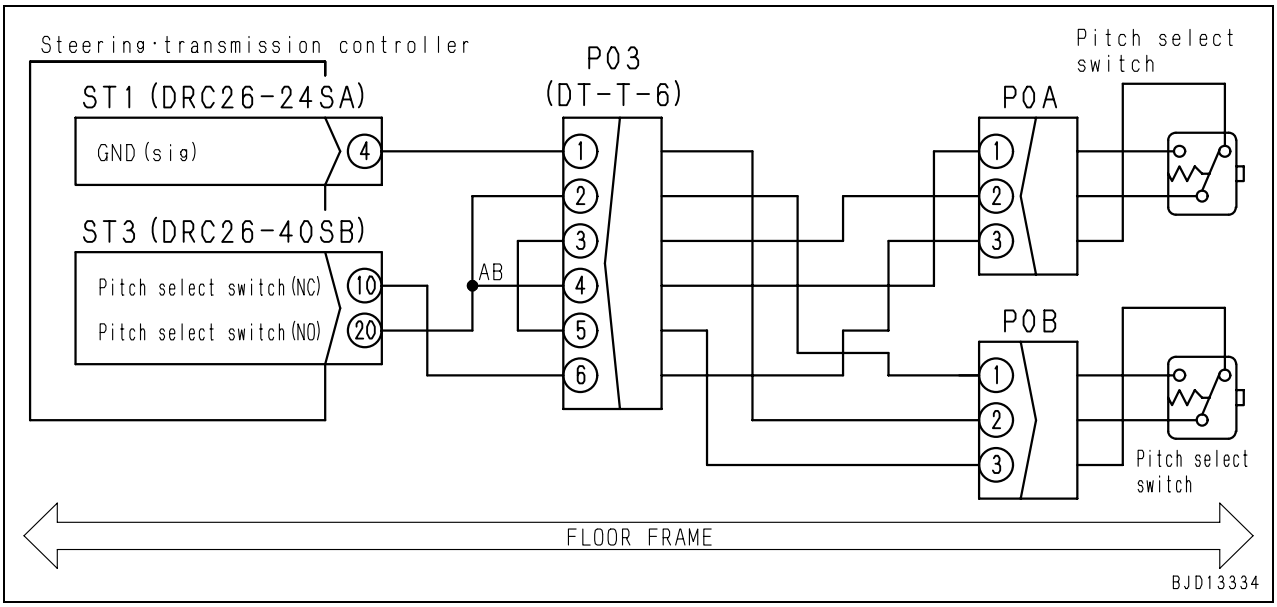


Failure code [DDN7KA] Pitch control switch: Disconnection

Action code	Failure code	Symptom of failure	Pitch control switch: Disconnection (Steering and transmission controller system)
E02	**DDN7KA**		
Failure content	• Signals of two systems of pitch control switch circuit were turned OFF (OPEN) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that switch is not pressed.		
Symptoms that appears on machine	• Pitch control is not available.		
General information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from pitch control switch can be checked in monitoring mode. (Code 70300: Work equipment related controller input signal) • Duplication of failure code: Turn starting switch ON and operate pitch control switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective pitch control switch (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			P0A (male), P0B (female)	Pitch control switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between (2) – (1)	Min. 1 MΩ	Max. 1 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (10) – P0A (female) (3)	Resistance	Max. 1 Ω	
			Wiring harness between ST3 (female) (20) – P0A (female) (1) – P0B (male) (1)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (4) – P0B (male) (2)	Resistance	Max. 1 Ω	
			Wiring harness between P0A (female) (2) – P0B (male) (3)	Resistance	Max. 1 Ω	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST3 (female) (10) – P0A (female) (3) with ground	Voltage	Max. 1 V	
			Wiring harness between ST3 (female) (20) – P0A (female) (1) – P0B (male) (1) with ground	Voltage	Max. 1 V	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1, ST3	Pitch control switch		
				OFF (Release)	ON (Press)	
			Voltage between ST3 (10) – ST1 (4)	Max. 1 V	5 – 11 V	
			Voltage between ST3 (20) – ST1 (4)	5 – 11 V	Max. 1 V	

Circuit diagram related to pitch control switch

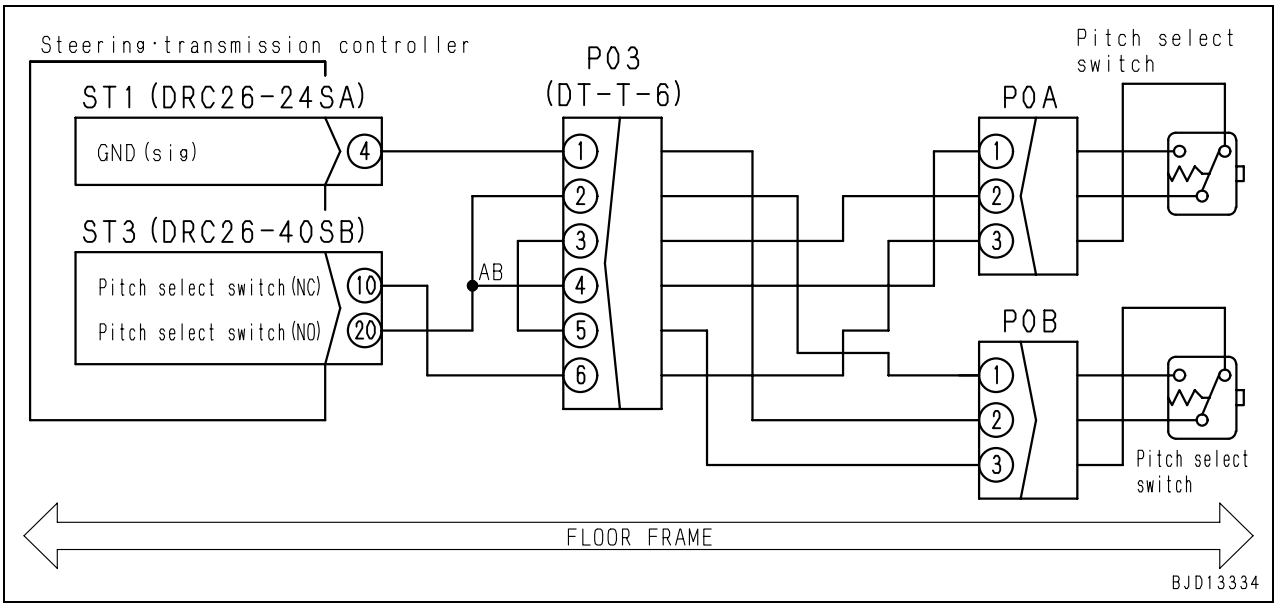


Failure code [DDN7KB] Pitch control switch: Short circuit

Action code	Failure code	Symptom of failure	Pitch control switch: Short circuit (Steering and transmission controller system)
E02	**DDN7KB**		
Failure content	• Signals of two systems of pitch control switch circuit were turned ON (CLOSE) at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Recognizes that switch is not pressed.		
Symptoms that appears on machine	• Pitch control is not available.		
General information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input status (ON / OFF) from pitch control switch can be checked in monitoring mode. (Code 70300: Work equipment related controller input signal) • Duplication of failure code: Turn starting switch ON and operate pitch control switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective pitch control switch (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			P0A (male), P0B (female)	Pitch control switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1 Ω	Min. 1 MΩ	
			Resistance between (2) – (1)	Min. 1 MΩ	Max. 1 Ω	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (10) – P0A (female) (3) with ground	Resis-tance	Min. 1 MΩ	
			Wiring harness between ST3 (female) (20) – P0A (female) (1) – P0B (male) (1) with ground	Resis-tance	Min. 1 MΩ	
			Wiring harness between P0A (female) (2) – P0B (male) (3) with ground	Resis-tance	Min. 1 MΩ	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1, ST3	Pitch control switch		
				OFF (Release)	ON (Press)	
			Voltage between ST3 (10) – ST1 (4)	Max. 1 V	5 – 11 V	
			Voltage between ST3 (20) – ST1 (4)	5 – 11 V	Max. 1 V	

Circuit diagram related to pitch control switch



Failure code [DDQ2KA] [DD14KA] Parking brake lever switch: Disconnection

★ See **DD14KA**

Failure code [DDQ2KB] [DD14KB] Parking brake lever switch: Short circuit

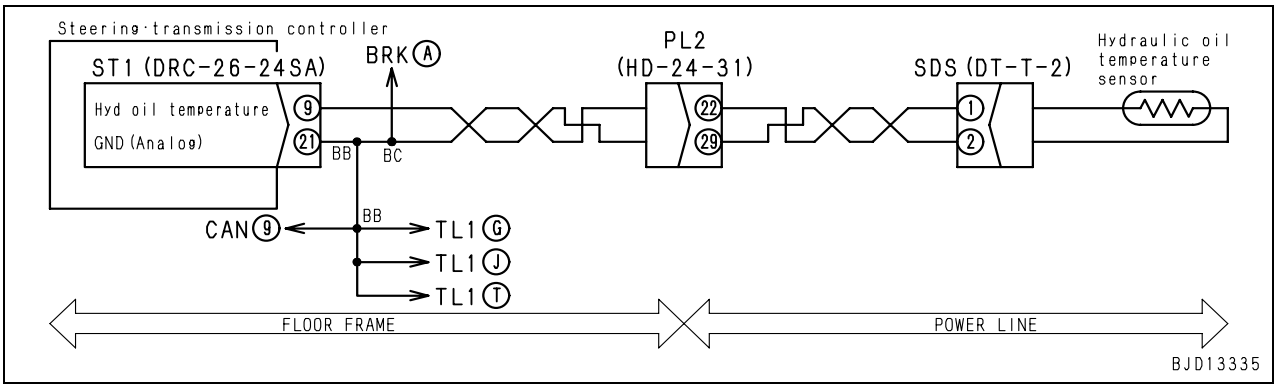
★ See **DD14KB**

Failure code [DGS1KX] Hydraulic oil temperature sensor: Input signal is out of normal range

Action code	Failure code	Symptom of failure	Hydraulic oil temperature sensor: Input signal is out of normal range (Steering and transmission controller system)
—	**DGS1KX**		
Failure content	• Hydraulic oil temperature sensor signal is out of normal range.		
Controller's action	• Only memorizes the trouble. There is no need to raise an alarm in particular.		
Symptoms that appears on machine	• Hydraulic oil temperature on monitor panel is not displayed normally. • Fan speed is limited to half.		
General information	• Hydraulic oil temperature status (temperature) can be checked in monitoring mode. (Code 04401: Hydraulic oil temperature) • Method of reproducing failure code: Turn starting switch ON or start engine.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective hydraulic oil temperature sensor (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			SDS (male)	Resistance		
			Between (1) – (2)	3.5 k – 90 kΩ (10 – 100°C)		
			Between (1), (2) – chassis ground	Min. 1 MΩ		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (9) – SDS (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (21) – SDS (female) (2)	Resistance	Max. 1 Ω	
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST1 (female) (9) – SDS (female) (1)	Resistance	Min. 1 MΩ	
	4	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST1 (female) (9) – SDS (female) (1)	Voltage	Max. 1 V	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST1 (female)	Resistance		
			Between (9) – (21)	3.5 k – 90 kΩ (10 – 100°C)		
			Between (9) – chassis ground	Min. 1 MΩ		

Circuit diagram related to hydraulic oil temperature sensor

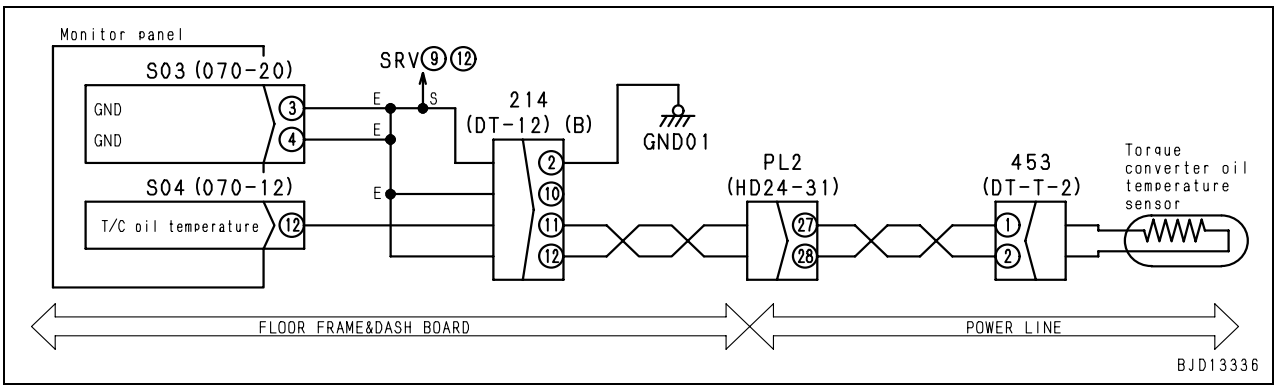


Failure code [DGT1KA] Power train oil temperature sensor: Disconnection

Action code	Failure code	Symptom of failure	Power train oil temperature sensor: Disconnection (Steering and transmission controller system)
E01	**DGT1KA**		
Failure content	• Even though coolant temperature rises, power train oil temperature sensor signal remains to be low temperature.		
Controller's action	• Nothing particular.		
Symptoms that appears on machine	• Power train oil temperature on monitor panel is not displayed normally. • Fan speed is limited to half. • Gear shift shock of transmission increases.		
General information	• Power train oil temperature status (temperature) can be checked in monitoring mode. (Code 30100: Power train oil temperature) • Method of reproducing failure code: Turn starting switch ON or start engine.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective power train oil temperature sensor (Internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			453 (male)	Resistance		
			Between (1) – (2)	3.5 k – 90 kΩ (10 – 100°C)		
			Between (1), (2) – chassis ground	Min. 1 MΩ		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between S04 (female) (12) – 453 (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between S03 (female) (3) (4) – 453 (female) (2)	Resistance	Max. 1 Ω	
	3	Defective monitor panel	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			S03, S04 (female)	Resistance		
			S04 (12) – S03 (3) (4)	3.5 k – 90 kΩ (10 – 100°C)		

Circuit diagram related to power train oil temperature sensor

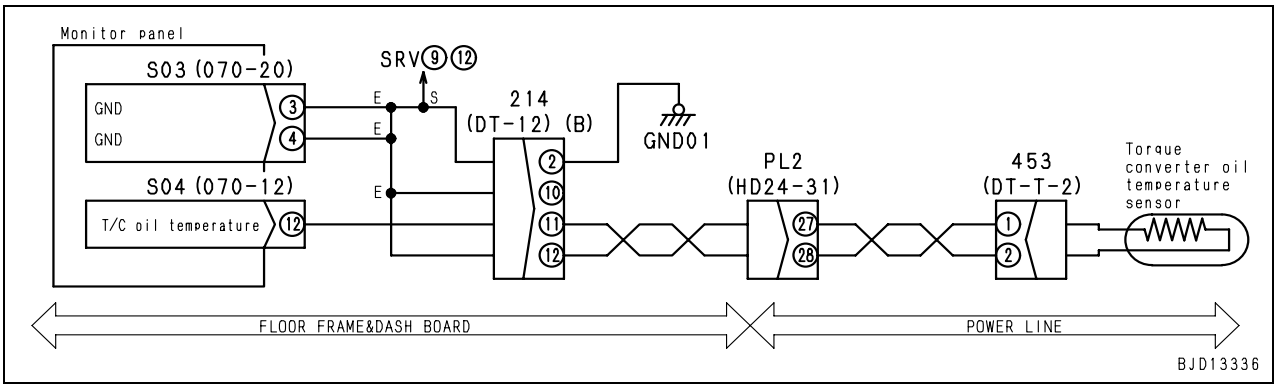


Failure code [DGT1KX] Power train oil temperature sensor: Input signal is out of normal range

Action code	Failure code	Symptom of failure	Power train oil temperature sensor: Input signal is out of normal range (Steering and transmission controller system)
E01	**DGT1KX**		
Failure content	• Power train oil temperature sensor signal is out of normal range.		
Controller's action	• Nothing particular.		
Symptoms that appears on machine	• Power train oil temperature on monitor panel is not displayed normally. • Fan speed is limited to half. • Gear shift shock of transmission increases.		
General information	• Power train oil temperature status (temperature) can be checked in monitoring mode. (Code 30100: Power train oil temperature) • Method of reproducing failure code: Turn starting switch ON or start engine.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective power train oil temperature sensor (Short-circuiting)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			453 (male)	Resistance		
			Between (1) – (2)	3.5 k – 90 kΩ (10 – 100°C)		
			Between (1), (2) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between S04 (female) (12) – 453 (female) (1) with ground	Resistance	Min. 1 MΩ	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between S04 (female) (12) – 453 (female) (1) with ground	Voltage	Max. 1 V	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			S03, S04 (female)	Resistance		
			S04 (12) – S03 (3) (4)	3.5 k – 90 kΩ (10 – 100°C)		
			Between S04 (12) – ground	Min. 1 MΩ		

Circuit diagram related to power train oil temperature sensor

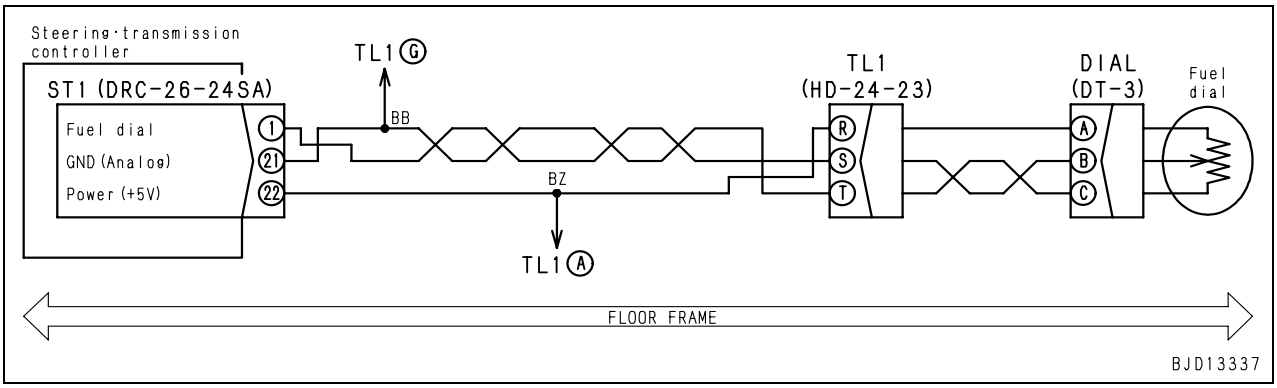


Failure code [DK10KA] Fuel dial: Disconnection

Action code	Failure code	Symptom of failure	Fuel dial: Disconnection (Steering and transmission controller system)
CALL E03	**DK10KA**		
Failure content	• Signal voltage of fuel dial circuit is less than 0.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with decelerator pedal potentiometer signal. • Operation of engine and transmission is limited.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from fuel dial can be checked in monitoring mode. (Code 03000: Fuel dial voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	Defective fuel dial (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			DIAL (male)	Resistance		
			Between (A) – (C)	4.0 – 6.0 kΩ		
			Between (A) – (B)	0.5 – 4.5 kΩ		
			Between (B) – (C)	0.5 – 4.5 kΩ		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – DIAL (female) (A)	Resis-tance	Max. 1 Ω	
			Wiring harness between ST1 (female) (1) – DIAL (female) (B)	Resis-tance	Max. 1 Ω	
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – DIAL (female) (A) with ground	Resis-tance	Min. 1 MΩ	
			Wiring harness between ST1 (female) (1) – DIAL (female) (B) with ground	Resis-tance	Min. 1 MΩ	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (22) – (21)	4.6 – 5.4 V		
			Between (1) – (21)	0.5 – 4.5 V		

Circuit diagram related to fuel dial

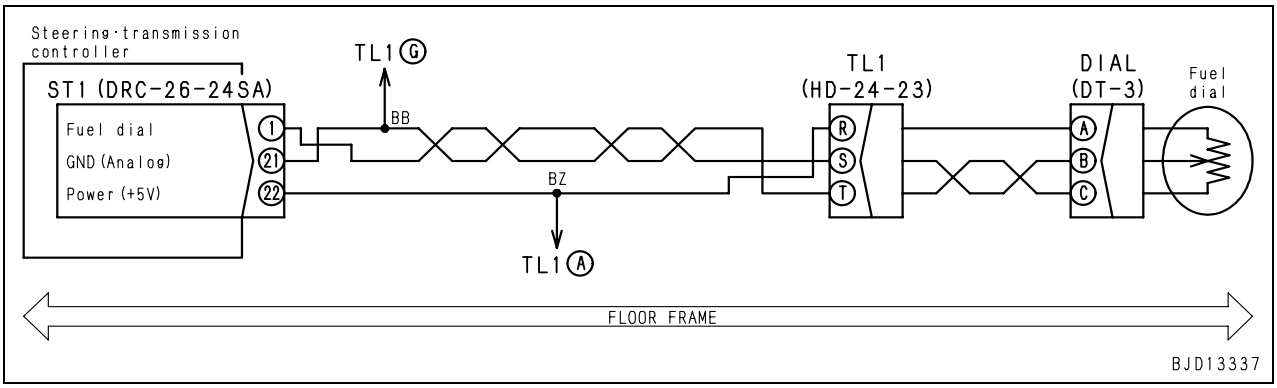


Failure code [DK10KB] Fuel dial: Short circuit

Action code	Failure code	Symptom of failure	Fuel dial: Short circuit (Steering and transmission controller system)
CALL E03	**DK10KB**		
Failure content	• Signal voltage of fuel dial circuit is more than 4.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with decelerator pedal potentiometer signal. • Operation of engine and transmission is limited.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from fuel dial can be checked in monitoring mode. (Code 03000: Fuel dial voltage) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.		
	2	Defective fuel dial (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			DIAL (male)	Resistance	
			Between (A) – (C)	4.0 – 6.0 kΩ	
			Between (A) – (B)	0.5 – 4.5 kΩ	
			Between (B) – (C)	0.5 – 4.5 kΩ	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST1 (female) (21) – DIAL (female) (C)	Resis-tance	Max. 1 Ω
	4	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Wiring harness between ST1 (female) (22) – DIAL (female) (A) with ground	Voltage	Max. 1 V
			Wiring harness between ST1 (female) (1) – DIAL (female) (B) with ground	Voltage	Max. 1 V
			Wiring harness between ST1 (female) (21) – DIAL (female) (C) with ground	Voltage	Max. 1 V
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST1	Voltage	
			Between (22) – (21)	4.6 – 5.4 V	
			Between (1) – (21)	0.5 – 4.5 V	

Circuit diagram related to fuel dial

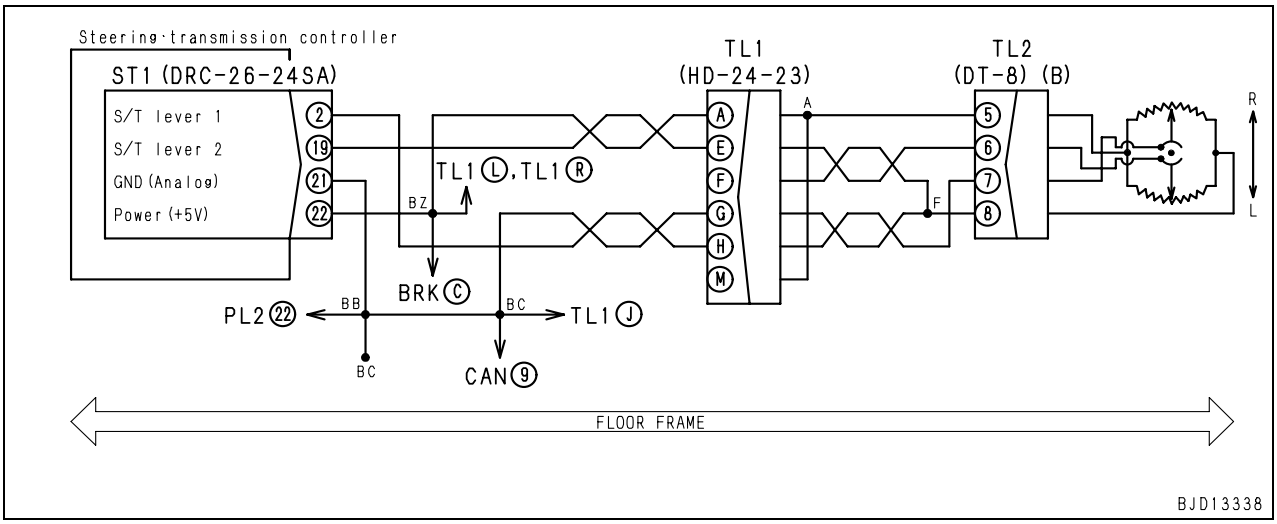


Failure code [DK30KA] Steering potentiometer (1): Disconnection

Action code	Failure code	Symptom of failure	Steering potentiometer (1): Disconnection (Steering and transmission controller system)
CALL E03	**DK30KA**		
Failure content	• Signal voltage of steering potentiometer (1) system is more than 4.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of steering potentiometer (2) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from steering potentiometer (1) can be checked in monitoring mode. (Code 50300: Steering potentiometer (1) voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (steering))		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	Defective steering potentiometer (1) (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)	Resistance		
			Between (5) – (8)	3.2 kΩ ± 20%		
			Between (7) – (5)	1 – 6 kΩ (right – left steering)		
			Between (7) – (8)	6 – 1 kΩ (right – left steering)		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (21) – TL2 (female) (8)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (2) – TL2 (female) (7)	Resistance	Max. 1 Ω	
	4	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST1 (female) (2) – TL2 (female) (7) with ground	Voltage	Max. 1 V	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (2) – (21)	0.5 – 4.5 V		

Circuit diagram related to steering potentiometer

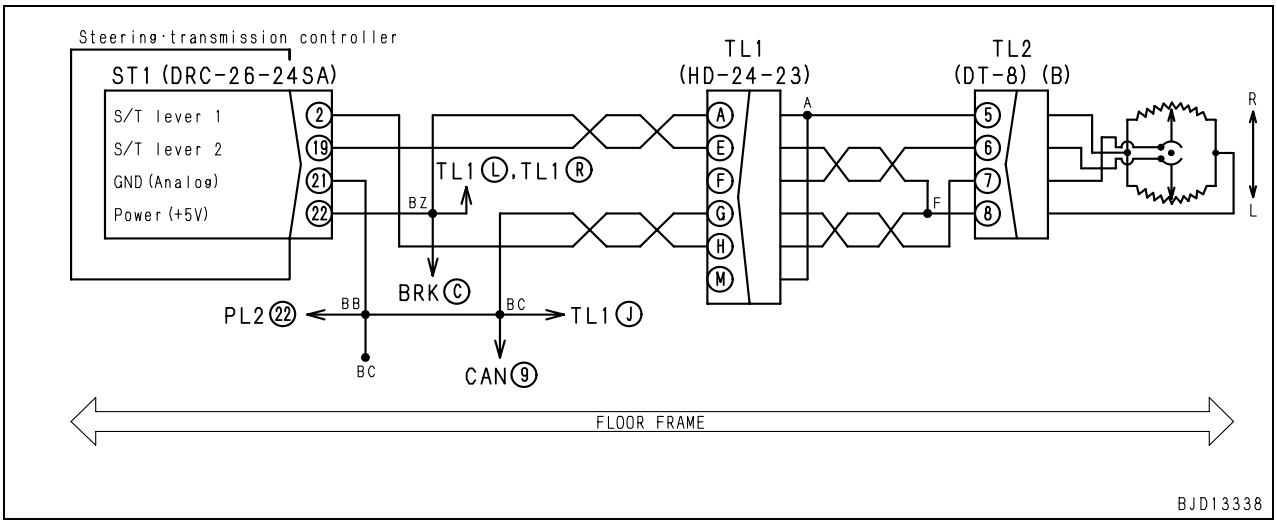


Failure code [DK30KB] Steering potentiometer (1): Short circuit

Action code	Failure code	Symptom of failure	Steering potentiometer (1): Short circuit (Steering and transmission controller system)
CALL E03	**DK30KB**		
Failure content	• Signal voltage of steering potentiometer (1) system is less than 0.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of steering potentiometer (2) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from steering potentiometer (1) can be checked in monitoring mode. (Code 50300: Steering potentiometer (1) voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (steering))		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	Defective steering potentiometer (1) (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)	Resistance		
			Between (5) – (8)	3.2 kΩ ± 20%		
			Between (7) – (5)	1 – 6 kΩ (right – left steering)		
			Between (7) – (8)	6 – 1 kΩ (right – left steering)		
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (2) – TL2 (female) (7) with ground	Resistance	Min. 1 MΩ	
	4	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – TL2 (female) (5)	Resistance	Max. 1 Ω	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (2) – (21)	0.5 – 4.5 V		

Circuit diagram related to steering potentiometer



Failure code [DK30KX] Steering potentiometer: Input signal is out of normal range

Action code	Failure code	Symptom of failure	Steering potentiometer: Input signal is out of normal range (Steering and transmission controller system)
CALL E04	**DK30KX**		
Failure content	• Either failure code [**DK30KA**] or [**DK30KB**] and either failure code [**DK31KA**] or [**DK31KB**] occurred at the same time at steering potentiometer systems 1 and 2.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine, transmission and brake.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it becomes impossible to travel.		
General information	• Input status (voltage) from steering potentiometer can be checked in monitoring mode. (Code 50300: Steering potentiometer 1 voltage) (Code 50301: Steering potentiometer 2 voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (steering))		

Possible causes and the standard values when normal	Cause	Standard value when normal and remarks for troubleshooting
	Carry out troubleshooting for failure code [**DK30KA**] [**DK30KB**] [**DK31KA**] [**DK31KB**]	

Failure code [DK30KZ] Steering potentiometer: Disconnection or short circuit (Double failure)

Action code	Failure code	Symptom of failure	Steering potentiometer: Disconnection or short circuit (Steering and transmission controller system)
CALL E04	**DK30KZ**		
Failure content	• At steering potentiometer systems 1 and 2, when starting switch was turned ON, only either of them showed abnormality and later, either failure code [**DK30KA**] or [**DK30KB**] or either failure code [**DK31KA**] or [**DK31KB**] occurred at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine, transmission and brake.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it becomes impossible to travel.		
General information	• Input status (voltage) from steering potentiometer can be checked in monitoring mode. (Code 50300: Steering potentiometer 1 voltage) (Code 50301: Steering potentiometer 2 voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (steering))		

Possible causes and the standard values when normal	Cause	Standard value when normal and remarks for troubleshooting
	Carry out troubleshooting for failure code [**DK30KA**] [**DK30KB**] [**DK31KA**] [**DK31KB**]	

Failure code [DK30L8] Steering potentiometer: Inconsistent analog signal

Action code	Failure code	Symptom of failure	Steering potentiometer: Inconsistent analog signal (Steering and transmission controller system)
CALL E03	**DK30L8**		
Failure content	• Total signal voltage of steering potentiometer systems 1 and 2 is less than 4.41 V or more than 5.59 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with the normal signal of either steering potentiometer system 1 or 2. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from steering potentiometer can be checked in monitoring mode. (Code 50300: Steering potentiometer 1 voltage) (Code 50301: Steering potentiometer 2 voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (forward-reverse))		

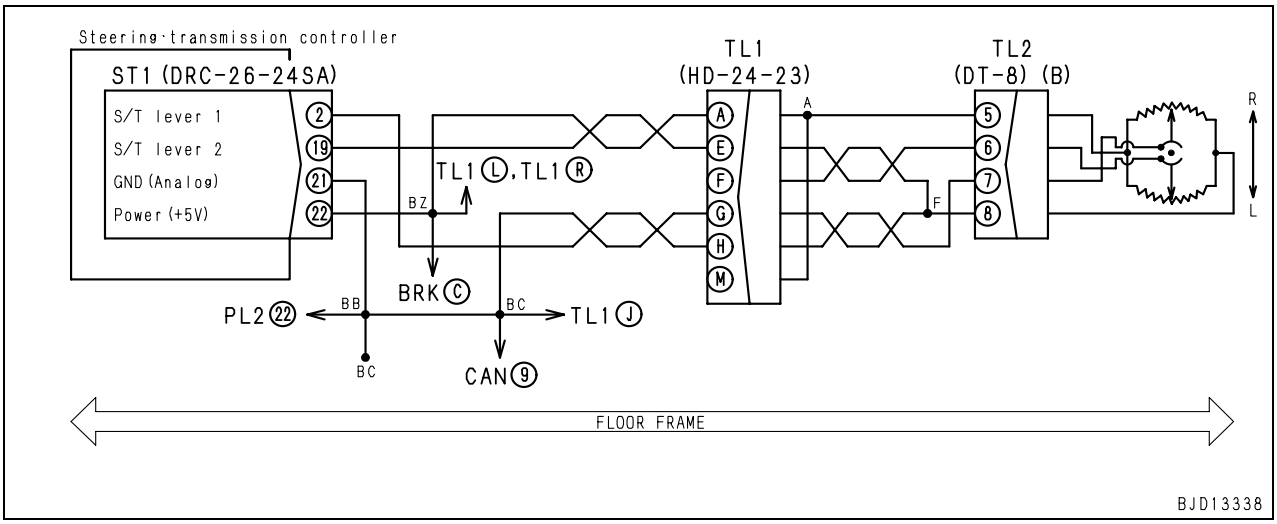
Possible causes and the standard values when normal	Cause	Standard value when normal and remarks for troubleshooting
	Carry out troubleshooting for failure code [**DK30KA**] [**DK30KB**] [**DK31KA**] [**DK31KB**]	

Failure code [DK31KA] Steering potentiometer (2): Disconnection

Action code	Failure code	Symptom of failure	Steering potentiometer (2): Disconnection (Steering and transmission controller system)
CALL E03	**DK31KA**		
Failure content	• Signal voltage of steering potentiometer (2) system is less than 0.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of steering potentiometer (1) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from steering potentiometer (2) can be checked in monitoring mode. (Code 50301: Steering potentiometer (2) voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (steering))		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	Defective steering potentiometer (2) (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)	Resistance		
			Between (5) – (8)	3.2 kΩ ± 20%		
			Between (6) – (5)	6 – 1 Ω (right – left steering)		
			Between (6) – (8)	1 – 6 Ω (right – left steering)		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – TL2 (female) (5)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (19) – TL2 (female) (6)	Resistance	Max. 1 Ω	
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (19) – TL2 (female) (6) with ground	Resistance	Min. 1 MΩ	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (19) – (21)	0.5 – 4.5		

Circuit diagram related to steering potentiometer

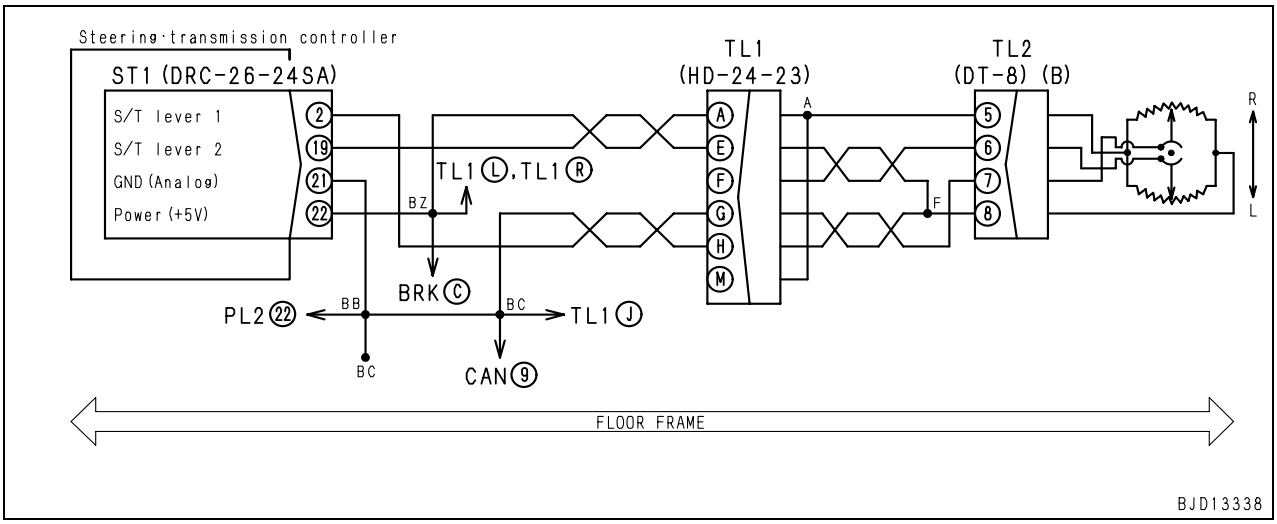


Failure code [DK31KB] Steering potentiometer (2): Short circuit

Action code	Failure code	Symptom of failure	Steering potentiometer (2): Short circuit (Steering and transmission controller system)
CALL E03	**DK31KB**		
Failure content	• Signal voltage of steering potentiometer (2) system is more than 4.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of steering potentiometer (1) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from steering potentiometer (2) can be checked in monitoring mode. (Code 50301: Steering potentiometer (2) voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (steering))		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.		
	2	Defective steering potentiometer (2) (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			TL2 (male)	Resistance	
			Between (5) – (8)	3.2 kΩ ± 20%	
			Between (6) – (5)	1 – 6 kΩ (right – left steering)	
			Between (6) – (8)	6 – 1 kΩ (right – left steering)	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Wiring harness between ST1 (female) (19) – TL2 (female) (6) with ground	Voltage	Max. 1 V
	4	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST1 (female) (21) – TL2 (female) (8)	Resistance	Max. 1 Ω
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST1	Voltage	
			Between (19) – (21)	0.5 – 4.5 V	

Circuit diagram related to steering potentiometer

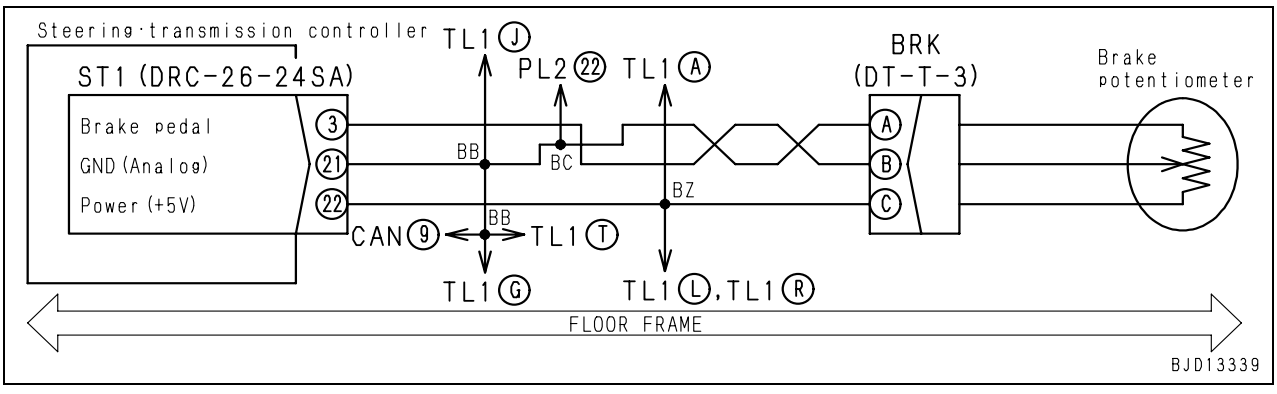


Failure code [DK40KA] Brake potentiometer: Disconnection

Action code	Failure code	Symptom of failure	Brake potentiometer: Disconnection (Steering and transmission controller system)
E01	**DK40KA**		
Failure content	• Signal voltage of brake potentiometer circuit is less than 0.5 V.		
Controller's action	• Nothing particular.		
Symptoms that appears on machine	• Automatic shift-down does not function properly • Gear shift shock of transmission increases.		
General information	• Input status (voltage) from brake potentiometer can be checked in monitoring mode. (Code 50400: Brake potentiometer voltage) • Method of reproducing failure code: Turn starting switch ON + (Operate brake pedal)		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	• Defective brake potentiometer. (Internal disconnection and short circuit) • Defective installation of potentiometer.	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			BRK (male)	Resistance		
			Between (A) – (C)	4.0 – 6.0 kΩ		
			Between (A) – (B)	1.5 – 4.5 kΩ (free – full stroke)		
			Between (B) – (C)	4.5 – 1.5 kΩ (free – full stroke)		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – BRK (female) (C)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (3) – BRK (female) (B)	Resistance	Max. 1 Ω	
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (3) – BRK (female) (B) with ground	Resistance	Min. 1 MΩ	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (3) – (21)	1.5 – 4.5 V		

Circuit diagram related to brake potentiometer

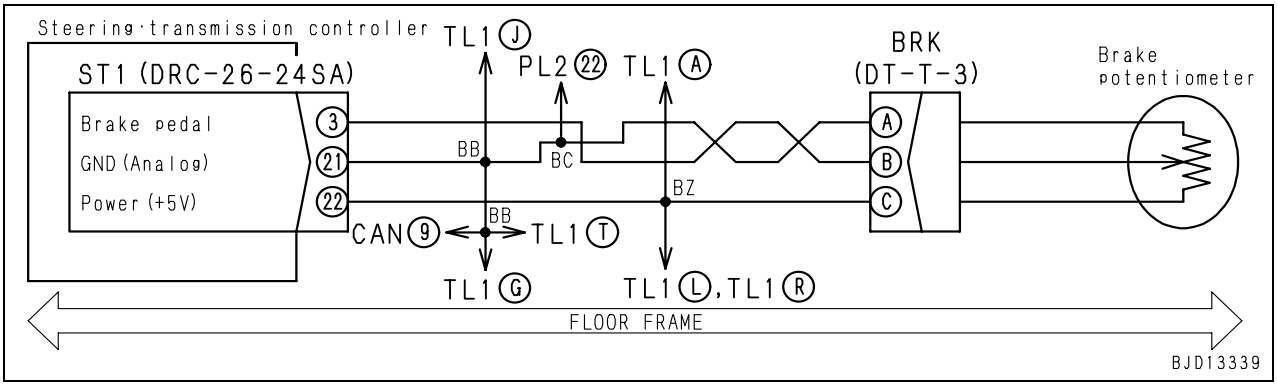


Failure code [DK40KB] Brake potentiometer: Short circuit

Action code	Failure code	Symptom of failure	Brake potentiometer: Short circuit (Steering and transmission controller system)
E01	**DK40KB**		
Failure content	• Signal voltage of brake potentiometer circuit is more than 4.5 V.		
Controller's action	• Nothing particular.		
Symptoms that appears on machine	• Automatic shift-down does not function properly • Gear shift shock of transmission increases.		
General information	• Input status (voltage) from brake potentiometer can be checked in monitoring mode. (Code 50400: Brake potentiometer voltage) • Method of reproducing failure code: Turn starting switch ON + (Operate brake pedal)		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.		
	2	• Defective brake potentiometer. (Internal disconnection and short circuit) • Defective installation of potentiometer.	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			BRK (male)	Resistance	
			Between (A) – (C)	4.0 – 6.0 kΩ	
			Between (A) – (B)	1.5 – 4.5 kΩ (free – full stroke)	
			Between (B) – (C)	4.5 – 1.5 kΩ (free – full stroke)	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Wiring harness between ST1 (female) (3) – BRK (female) (B) with ground	Voltage	Max. 1 V
	4	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST1 (female) (21) – BRK (female) (A)	Resistance	Min. 1 Ω
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST1	Voltage	
			Between (3) – (21)	1.5 – 4.5 V	

Circuit diagram related to brake potentiometer



Failure code [DK55KX] Forward-reverse potentiometer: Input signal is out of normal range

Action code	Failure code	Symptom of failure	Forward-reverse potentiometer: Input signal is out of normal range (Steering and transmission controller system)
CALL E04	**DK55KX**		
Failure content	• Either failure code [**DK56KA**] or [**DK56KB**] and either failure code [**DK57KA**] or [**DK57KB**] occurred at the same time at forward-reverse potentiometer systems 1 and 2.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it becomes impossible to travel.		
General information	• Input status (voltage) from forward-reverse potentiometer can be checked in monitoring mode. (Code 50200: Forward-reverse potentiometer 1 voltage) (Code 50201: Forward-reverse potentiometer 2 voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (forward-reverse)		

Possible causes and the standard values when normal	Cause	Standard value when normal and remarks for troubleshooting
	Carry out troubleshooting for failure code [**DK56KA**] [**DK56KB**] [**DK57KA**] [**DK57KB**]	

Failure code [DK55KZ] Forward-reverse potentiometer: Disconnection or short circuit (Double failure)

Action code	Failure code	Symptom of failure	Forward-reverse potentiometer: Disconnection or short circuit (Double failure) (Steering and transmission controller system)
CALL E04	**DK55KZ**		
Failure content	• At forward-reverse potentiometer systems 1 and 2, when starting switch was turned ON, only either of them showed abnormality, and later either failure code [**DK56KA**] or [**DK56KB**] and either failure code [**DK57KA**] or [**DK57KB**] occurred at the same time.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it becomes impossible to travel.		
General information	• Input status (voltage) from forward-reverse potentiometer can be checked in monitoring mode. (Code 50200: Forward-reverse potentiometer 1 voltage) (Code 50201: Forward-reverse potentiometer 2 voltage) • Method of reproducing failure code: Turn starting switch ON + (shift PCCS lever (forward-reverse))		

Possible causes and the standard values when normal	Cause	Standard value when normal and remarks for troubleshooting
	Carry out troubleshooting for failure code [**DK56KA**] [**DK56KB**] [**DK57KA**] [**DK57KB**]	

Failure code [DK55L8] Forward-reverse potentiometer: Inconsistent analog signal

Action code	Failure code	Symptom of failure	Forward-reverse potentiometer: Inconsistent analog signal (Steering and transmission controller system)
CALL E03	**DK55L8**		
Failure content	• Total signal voltage of forward-reverse potentiometer systems 1 and 2 is less than 4.41 V or more than 5.59 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with the normal signal of either forward-reverse potentiometer system 1 or 2. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from forward-reverse potentiometer can be checked in monitoring mode. (Code 50200: Forward-reverse potentiometer 1 voltage) (Code 50201: Forward-reverse potentiometer 2 voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (forward-reverse))		

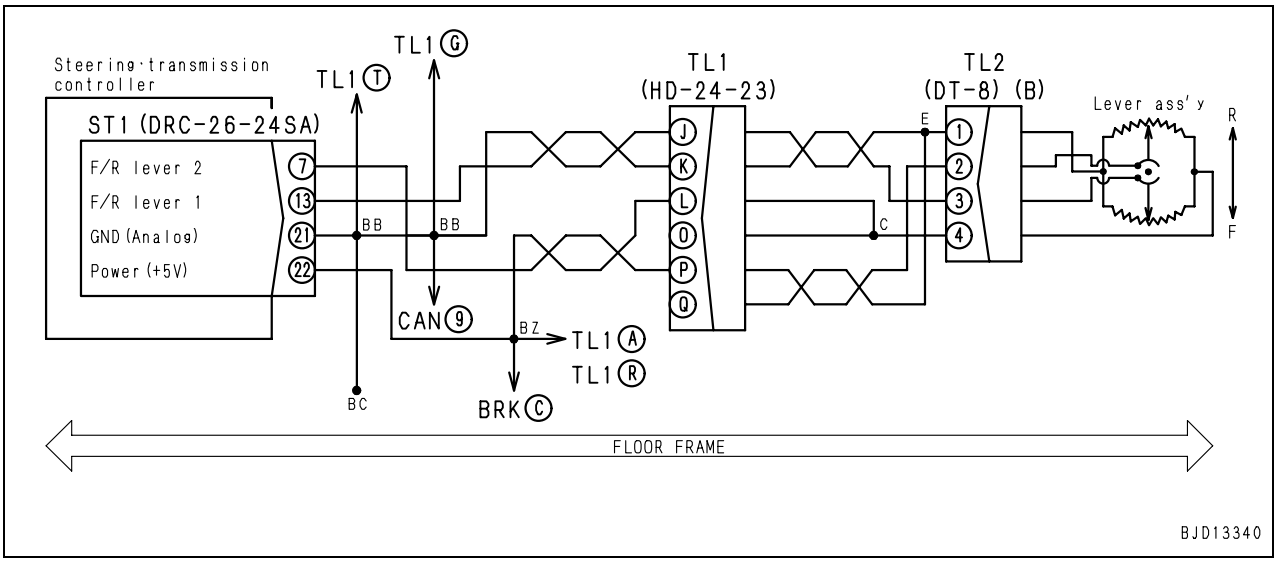
Possible causes and the standard values when normal	Cause	Standard value when normal and remarks for troubleshooting
	Carry out troubleshooting for failure code [**DK56KA**] [**DK56KB**] [**DK57KA**] [**DK57KB**]	

Failure code [DK56KA] Forward-reverse potentiometer (1): Short circuit

Action code	Failure code	Symptom of failure	Forward-reverse potentiometer (1): Short circuit (Steering and transmission controller system)
CALL E03	**DK56KA**		
Failure content	• Signal voltage of forward-reverse potentiometer (1) system is more than 4.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of forward-reverse potentiometer (2) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from forward-reverse potentiometer (1) can be checked in monitoring mode. (Code 50200: Forward-reverse potentiometer (1) voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (forward-reverse))		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.		
	2	Defective directional potentiometer (1) (Internal disconnection and short-circuiting)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			TL2 (male)	Resistance	
			Between (4) – (1)	3.2 kΩ ± 20%	
			Between (3) – (4)	5.5 – 1.5 kΩ (forward – reverse)	
			Between (3) – (1)	1.5 – 5.5 kΩ (forward – reverse)	
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Wiring harness between ST1 (female) (13) – TL2 (female) (3) with ground	Voltage	Max. 1 V
	4	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST1 (female) (21) – TL2 (female) (1)	Resistance	Max. 1 Ω
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST1	Voltage	
			Between (13) – (21)	0.5 – 4.5 V	

Circuit diagram related to forward-reverse potentiometer

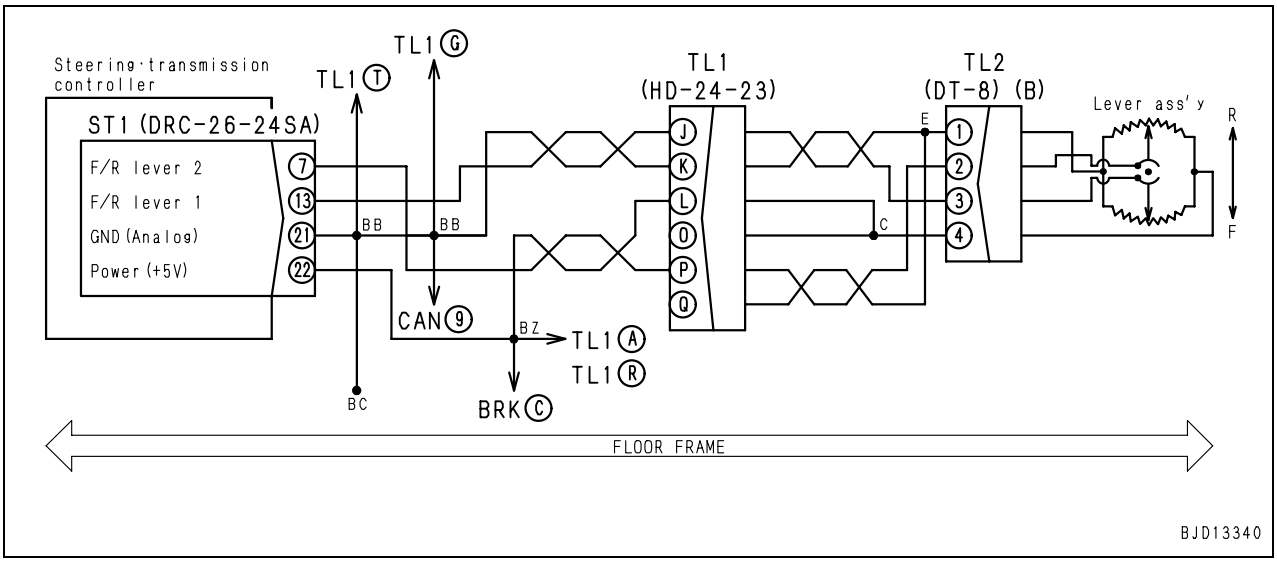


Failure code [DK56KB] Forward-reverse potentiometer (1): Disconnection

Action code	Failure code	Symptom of failure	Forward-reverse potentiometer (1): Disconnection (Steering and transmission controller system)
CALL E03	**DK56KB**		
Failure content	• Signal voltage of forward-reverse potentiometer (1) system is less than 0.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of forward-reverse potentiometer (2) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from forward-reverse potentiometer (1) can be checked in monitoring mode. (Code 50200: Forward-reverse potentiometer (1) voltage) • Method of reproducing failure code: Turn starting switch ON +(Shift PCCS lever (forward-reverse))		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	Defective forward-reverse potentiometer (1) (Internal disconnection and short-circuiting)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)	Resistance		
			Between (4) – (1)	3.2 kΩ ± 20%		
			Between (3) – (4)	5.5 – 1.5 kΩ (forward – reverse)		
			Between (3) – (1)	1.5 – 5.5 kΩ (forward – reverse)		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – TL2 (female) (4)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (13) – TL2 (female) (3)	Resistance	Max. 1 Ω	
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (13) – TL2 (female) (3) with ground	Resistance	Min. 1 MΩ	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (13) – (21)	0.5 – 4.5 V		

Circuit diagram related to forward-reverse potentiometer

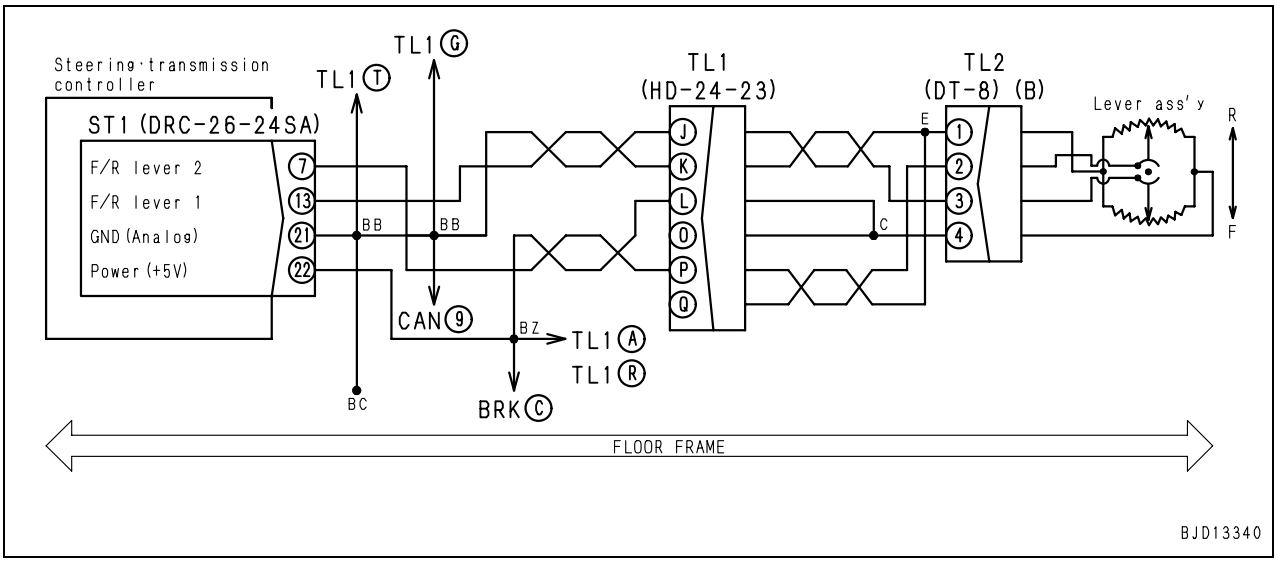


Failure code [DK57KA] Forward-reverse potentiometer (2): Disconnection

Action code	Failure code	Symptom of failure	Forward-reverse potentiometer (2): Disconnection (Steering and transmission controller system)
CALL E03	**DK57KA**		
Failure content	• Signal voltage of forward-reverse potentiometer (2) system is less than 0.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of forward-reverse potentiometer (1) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from forward-reverse potentiometer (2) can be checked in monitoring mode. (Code 50201: Forward-reverse potentiometer (2) voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (forward-reverse))		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	Defective forward-reverse potentiometer (2) (Internal disconnection and short-circuiting)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)	Resistance		
			Between (4) – (1)	3.2 kΩ ± 20%		
			Between (2) – (4)	1.5 – 5.5 kΩ (forward – reverse)		
			Between (2) – (1)	5.5 – 1.5 kΩ (forward – reverse)		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (22) – TL2 (female) (4)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (7) – TL2 (female) (2)	Resistance	Max. 1 Ω	
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (7) – TL2 (female) (2) with ground	Resistance	Min. 1 MΩ	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (7) – (21)	0.5 – 4.5 V		

Circuit diagram related to forward-reverse potentiometer

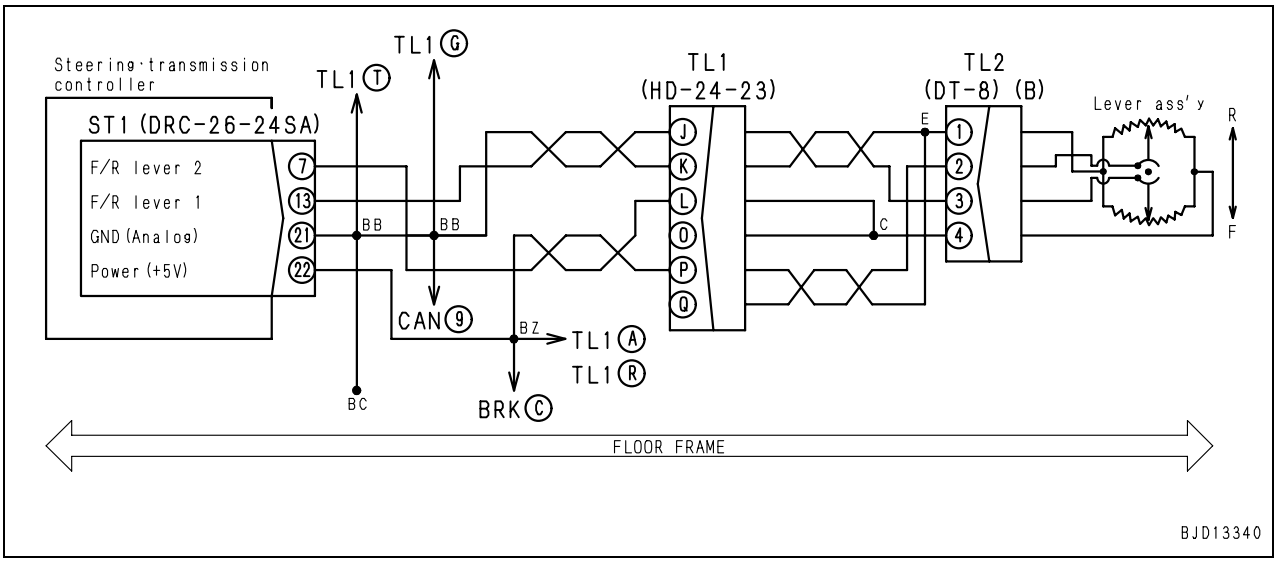


Failure code [DK57KB] Forward-reverse potentiometer (2): Short circuit

Action code	Failure code	Symptom of failure	Forward-reverse potentiometer (2): Short circuit (Steering and transmission controller system)
CALL E03	**DK57KB**		
Failure content	• Signal voltage of forward-reverse potentiometer (2) system is more than 4.5 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Continues to keep it under control with signal of forward-reverse potentiometer (1) system. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Input status (voltage) from forward-reverse potentiometer (2) can be checked in monitoring mode. (Code 50201: Forward-reverse potentiometer (2) voltage) • Method of reproducing failure code: Turn starting switch ON + (Shift PCCS lever (forward-reverse))		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor 5 V power source system	Check displays of failure codes [**DAQ5KK**] [**DB35KK**] and if there is any display, carry out that troubleshooting first.			
	2	Defective forward-reverse potentiometer (2) (Internal disconnection and short-circuiting)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			TL2 (male)	Resistance		
			Between (4) – (1)	3.2 kΩ ± 20%		
			Between (2) – (4)	1.5 – 5.5 kΩ (forward – reverse)		
			Between (2) – (1)	5.5 – 1.5 kΩ (forward – reverse)		
	3	Hot short of wiring harness (Contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Wiring harness between ST1 (female) (7) – TL2 (female) (2) with ground	Voltage	Max. 1 V	
	4	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (21) – TL2 (female) (1)	Resistance	Max. 1 Ω	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (7) – (21)	0.5 – 4.5 V		

Circuit diagram related to forward-reverse potentiometer



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00591-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

Troubleshooting by failure code (Display of code), Part 4

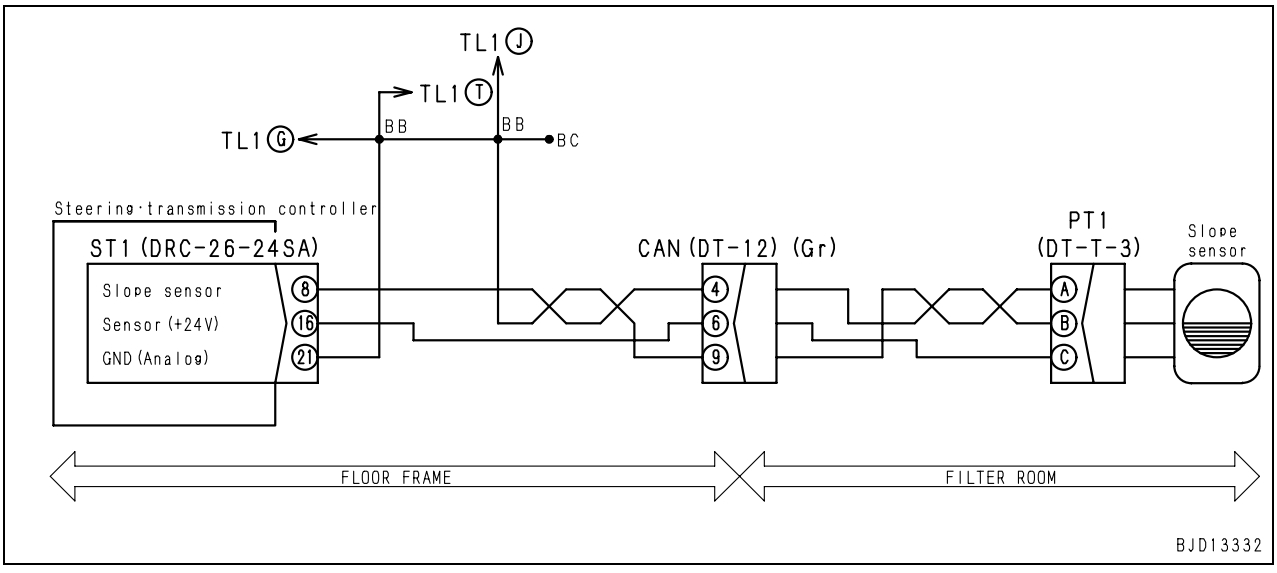
Troubleshooting by failure code (Display of code), Part 4

Failure code [DKH1KA] [DKH1KX] Pitch angle sensor: Short circuit

Action code	Failure code	Symptom of failure	Pitch angle sensor: Short circuit (Steering and transmission controller system)
CALL E03	**DKH1KA DKH1KX**		
Failure content	• Signal voltage of pitch angle sensor is above 4.85 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Cannot recognize pitch angle. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Excessive gear shift shock is felt on a slope. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Both **DKH1KA** and **DKH1KX** are displayed • Input state (voltage) from pitch angle sensor can be checked in monitoring mode. (Code 60100: Voltage of pitch angle sensor) • Duplication of failure code: turn ON the starting switch.		

Possible causes and the standard values when normal		Cause	Standard value when normal and remarks for troubleshooting		
	1	Defective sensor 24 V power supply circuit	Check if failure code [**DAQ6KK**] or [**DB36KK**] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective pitch angle sensor (internal defect)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			PT1	Voltage	
			Between (B) – (A)	0.15 – 4.85 V	
	3	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between ST1 (female) (8) – PT1 (female) (B)	Voltage	Max. 1 V
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST1	Voltage	
			Between (8) – (21)	0.15 – 4.85 V	

Circuit diagram related to pitch angle sensor

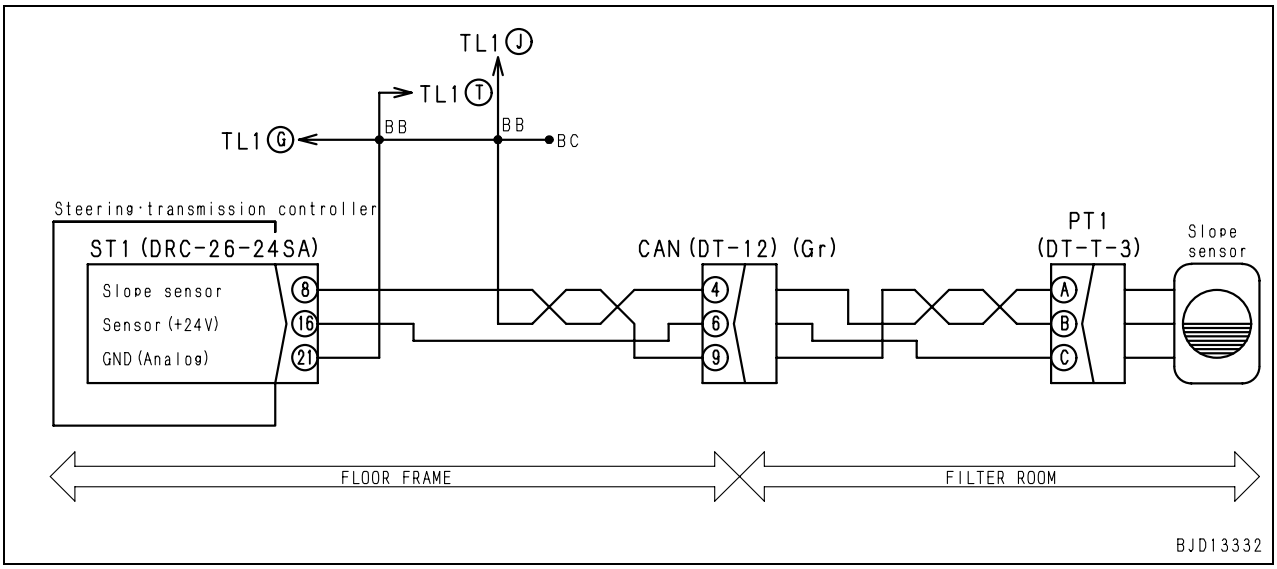


Failure code [DKH1KB] [DKH1KX] Pitch angle sensor: Disconnection

Action code	Failure code	Symptom of failure	Pitch angle sensor: Disconnection (Steering and transmission controller system)
CALL E03	**DKH1KB DKH1KX**		
Failure content	• Signal voltage of pitch angle sensor is below 0.15 V.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Cannot recognize pitch angle. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Excessive gear shift shock is felt on a slope. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Both **DKH1KB** and **DKH1KX** are displayed. • Input state (voltage) from pitch angle sensor can be checked in monitoring mode. (Code 60100: Voltage of pitch angle sensor) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective sensor 24 V power supply circuit	Check if failure code [**DAQ6KK**] or [**DB36KK**] is displayed. If it is displayed, carry out troubleshooting for it first.			
	2	Defective pitch angle sensor (internal defect)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			PT1	Voltage		
			Between (B) – (A)	0.15 – 4.85 V		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (16) – PT1 (female) (C)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (8) – PT1 (female) (B)	Resistance	Max. 1 Ω	
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST1 (female) (8) – PT1 (female) (B)	Resistance	Min. 1 MΩ	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Voltage		
			Between (8) – (21)	0.15 – 4.85 V		

Circuit diagram related to pitch angle sensor



Failure code [DKH1KX], [DKH1KA] or [DKH1KB] Pitch angle sensor: Input signal out of range

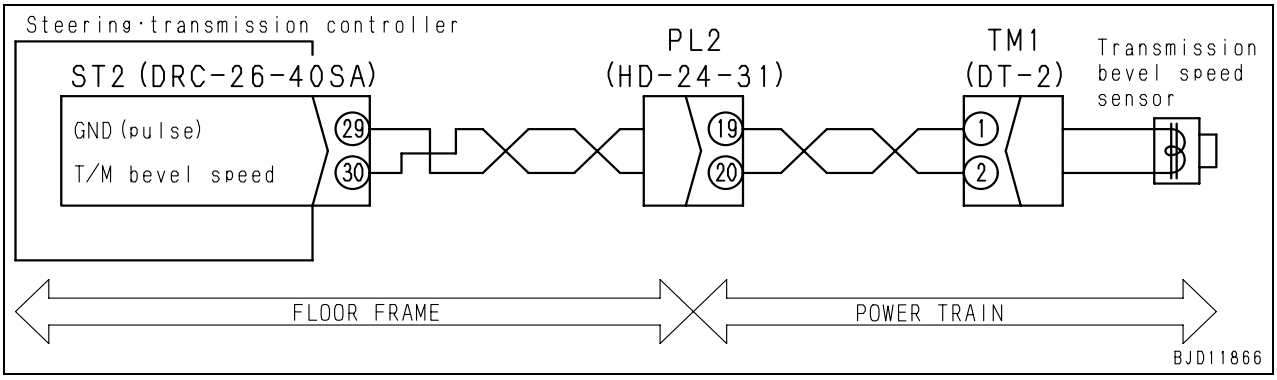
★ Refer to **DKH1KA** or **DKH1KB**

Failure code [DLT3KA] Transmission output speed sensor: Disconnection

Action code	Failure code	Symptom of failure	Transmission output speed sensor: Disconnection (Steering and transmission controller system)
E01	**DLT3KA**		
Failure content	• Signal is not input from transmission output speed sensor.		
Controller's action	• Assumes that transmission output speed is 0 rpm.		
Symptoms that appears on machine	• Transmission speed cannot be monitored. • Traction force cannot be calculated. • Automatic shift-down does not function properly		
General information	• Transmission output speed can be checked in monitoring mode. (Code 31400: Transmission speed) • Duplication of failure code: Start engine and travel machine actually.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective transmission output speed sensor (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			TM1 (male)	Resistance	
			Between (1) – (2)	400 – 1,000 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST2 (female) (30) – TM1 (female) (1)	Resis-tance	Max. 1 Ω
			Wiring harness between ST2 (female) (29) – TM1 (female) (2)	Resis-tance	Max. 1 Ω
	3	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between ST2 (female) (30) – TM1 (female) (1)	Voltage	Max. 1 V
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST2 (female)	Resistance	
			Between (30) – (29)	400 – 1,000 Ω	
			Between (30) – chassis ground	Min. 1 MΩ	

Circuit diagram related to transmission output speed sensor

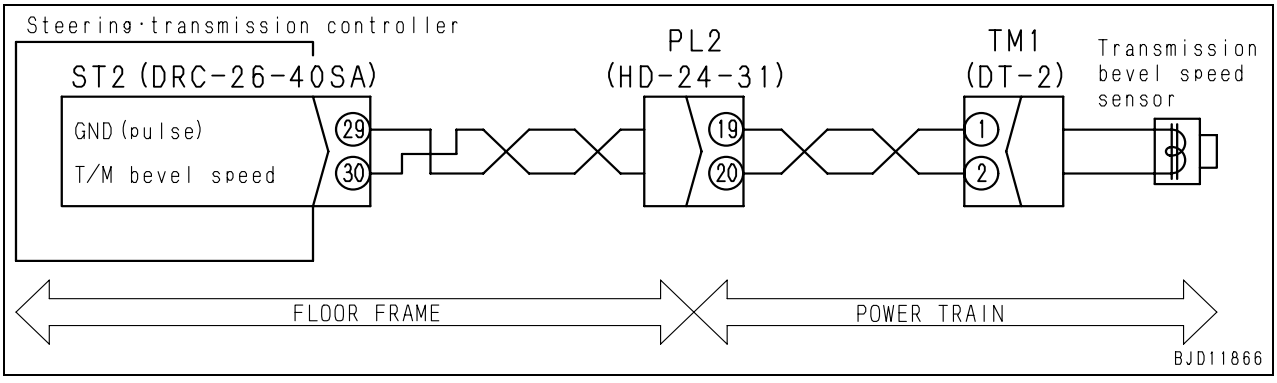


Failure code [DLT3KB] Transmission output speed sensor: Short circuit

Action code	Failure code	Symptom of failure	Transmission output speed sensor: Short circuit (Steering and transmission controller system)
E01	**DLT3KB**		
Failure content	• Signal from transmission output sensor stays in OFF(OPEN) even though the machine is traveling.		
Controller's action	• Assumes that transmission output speed is 0 rpm.		
Symptoms that appears on machine	• Transmission speed cannot be monitored. • Traction force cannot be calculated. • Automatic shift-down does not function properly		
General information	• Transmission output speed can be checked in monitoring mode. (Code 31400: Transmission speed) • Duplication of failure code: Start engine and travel machine actually.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective installation of transmission output speed sensor	Make adjustment according to Testing and adjusting “Adjusting transmission speed sensor”.		
	2	Defective transmission output speed sensor (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			TM1 (male)	Resistance	
			Between (1) – (2)	400 – 1,000 Ω	
			Between (1) – chassis ground	Min. 1 MΩ	
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between ST2 (female) (30) – TM1 (female) (1)	Resis-tance	Min. 1 MΩ
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST2 (female)	Resistance	
			Between (30) – (29)	400 – 1,000 Ω	
			Between (30) – chassis ground	Min. 1 MΩ	

Circuit diagram related to transmission output speed sensor

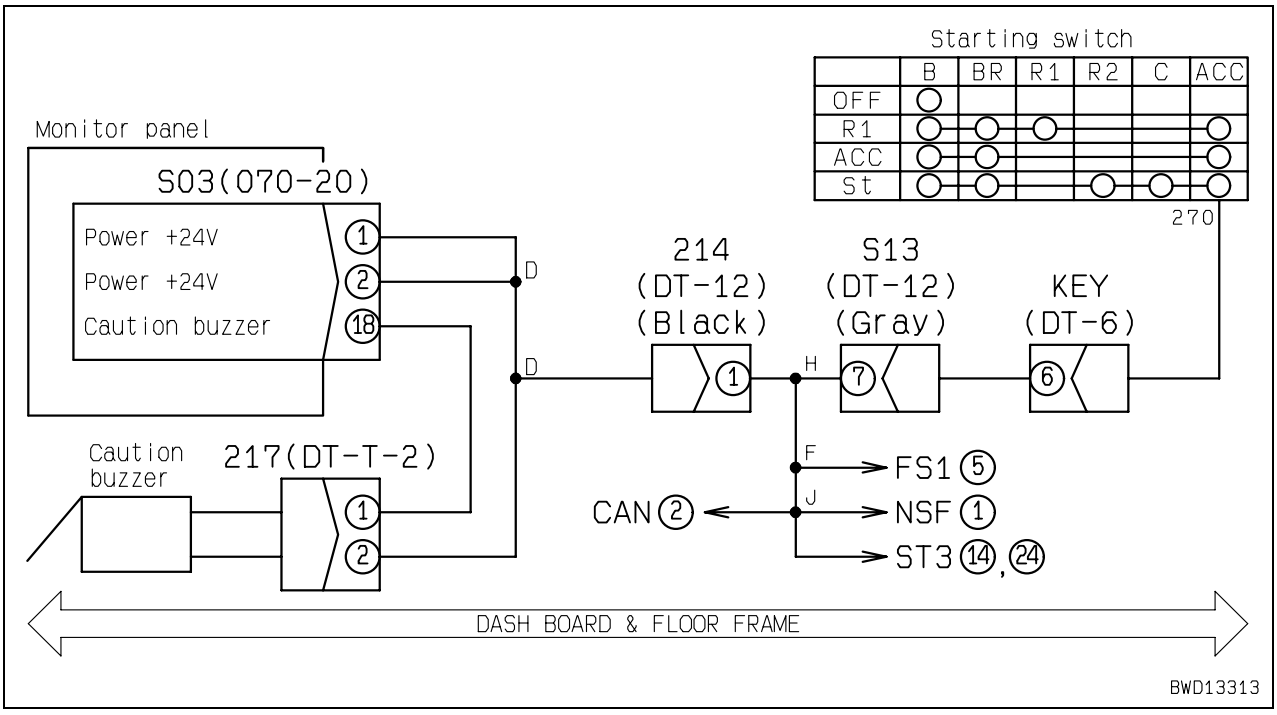


Failure code [DV00KB] Alarm buzzer: Short circuit

Action code	Failure code	Symptom of failure	Alarm buzzer: Short circuit (monitor panel circuit)
—	**DV00KB**		
Failure content	• Abnormal current flowed in the alarm buzzer circuit when the GND is outputted.		
Controller's action	• Stops the GND output for alarm buzzer circuit.		
Symptoms that appears on machine	• Alarm buzzer does not sound.		
General information	• Duplication of failure code: Turn starting switch ON (When it is turned ON, buzzer sounds for 1 second).		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective alarm buzzer (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			217 (male)	Continuity	
			Between (2) – (1)	Continue	
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between 217 (female) (1) – S03 (female) (18)	Voltage	Max. 1 V
	3	Defective monitor panel	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			S03	Alarm buzzer	Voltage
			Between (18) – chassis ground	When stopping	20 – 30
				When turned ON (sounding)	Max. 3 V

Circuit diagram related to alarm buzzer

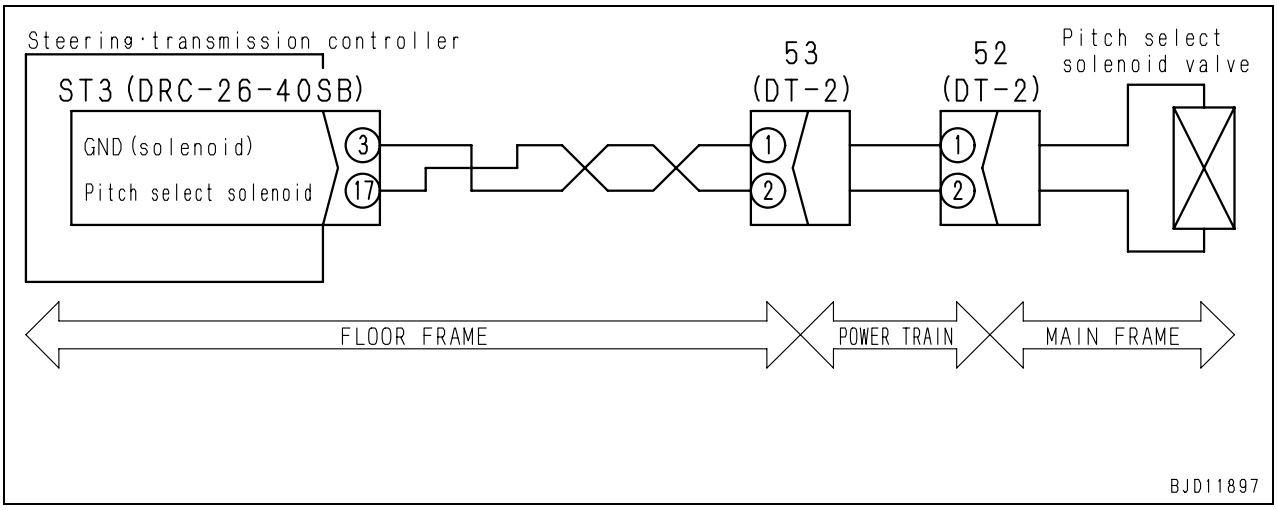


Failure code [DW5AKA] Pitch control solenoid: Disconnection

Action code	Failure code	Symptom of failure	Pitch control solenoid: Disconnection (Steering and transmission controller system)
E02	**DW5AKA**		
Failure content	• Any current does not flow when power is output to the pitch control solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops output to pitch control solenoid circuit.		
Symptoms that appears on machine	• Pitch control is not available.		
General information	• Output state (ON/OFF) to pitch control solenoid can be checked in monitoring mode. (Code 70304: Work equipment-related controller output signal) • Duplication of failure code: Turn starting switch ON and operate pitch control switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective pitch control solenoid (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			52 (male)	Resistance	
			Between (1) – (2)	20 – 30 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (17) – 52 (female) (1)	Resis-tance	Max. 1 Ω
			Wiring harness between ST3 (female) (35) – 2 (female) (2)	Resis-tance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (17) – (3)	20 – 30 Ω	

Circuit diagram related to pitch control solenoid

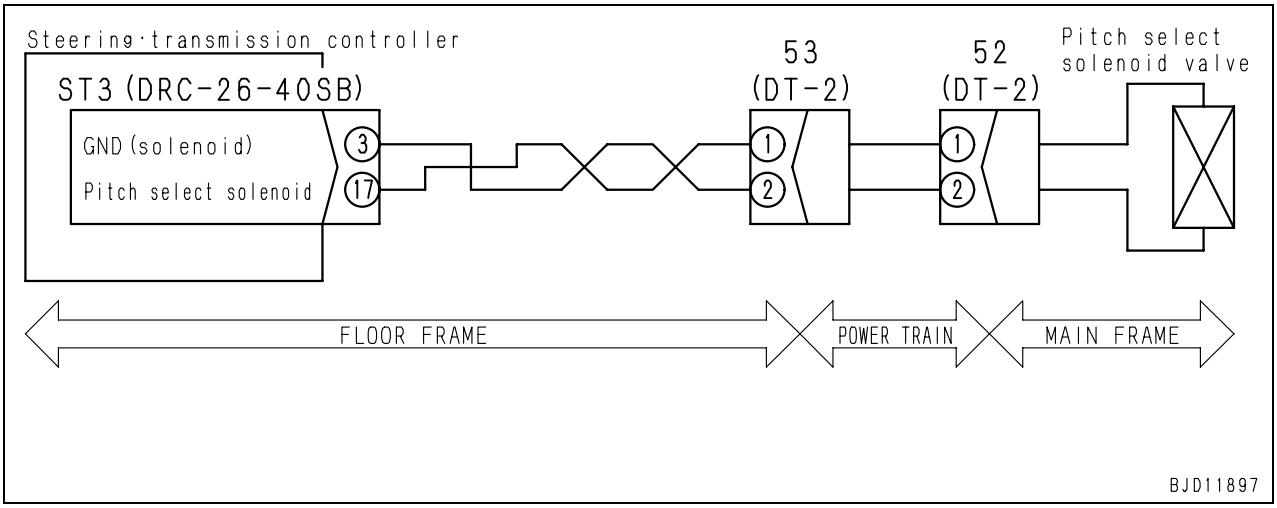


Failure code [DW5AKB] Pitch control solenoid: Short circuit

Action code	Failure code	Symptom of failure	Pitch control solenoid: short circuit (Steering and transmission controller system)
E02	**DW5AKB**		
Failure content	• Abnormal current flowed when power is outputted to pitch control solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops output to pitch control solenoid circuit.		
Symptoms that appears on machine	• Pitch control is not available.		
General information	• Output state (ON/OFF) to pitch control solenoid can be checked in monitoring mode. (Code 70304: Work equipment-related controller output signal) • Duplication of failure code: Turn starting switch ON and operate pitch control switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective pitch control solenoid (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			52 (male)	Resistance		
			Between (1) – (2)	20 – 30 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Harness short (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (17) – 52 (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (17) – 52 (female) (1) and between ST3 (female) (3) – (52) (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3	Resistance		
			Between (17) – (3)	20 – 30 Ω		
			Between (17) – chassis ground	Min. 1 MΩ		

Circuit diagram related to pitch control solenoid

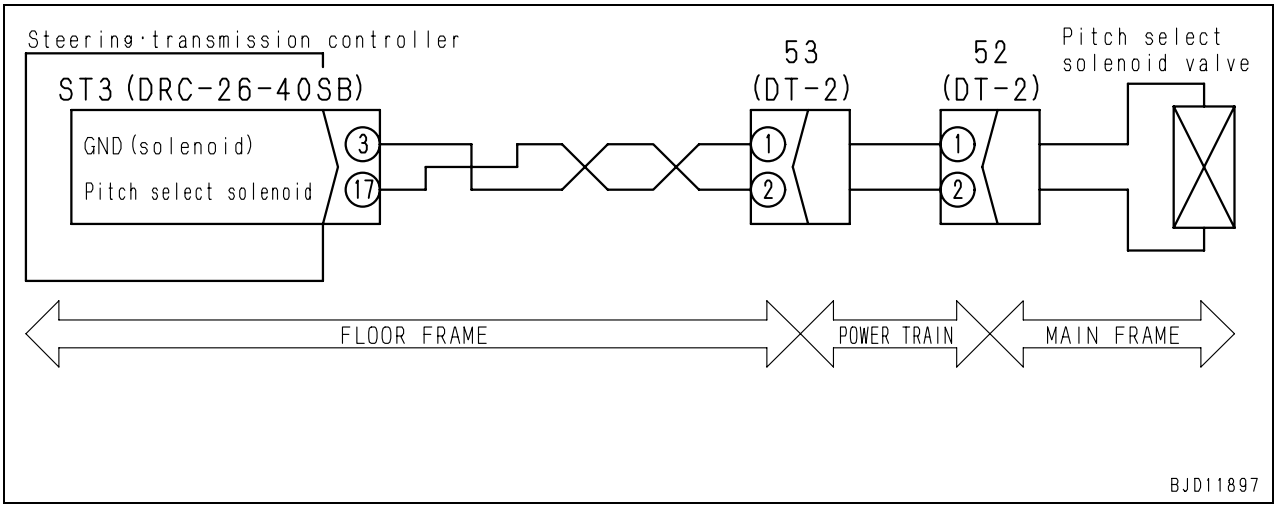


Failure code [DW5AKY] Pitch control solenoid: Short circuit to power source line

Action code	Failure code	Symptom of failure	Pitch control solenoid: Short circuit to power source line (Steering and transmission controller system)
E02	**DW5AKY**		
Failure content	• Current flows constantly to pitch control solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops output to pitch control solenoid circuit.		
Symptoms that appears on machine	• Only pitch control is available and tilt control is not available.		
General information	• Output state (ON/OFF) to pitch control solenoid can be checked in monitoring mode. (Code 70304: Work equipment-related controller output signal) • Duplication of failure code: Turn starting switch ON and operate pitch control switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective pitch control solenoid (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			52 (male)	Resistance		
			Between (1) – (2)	20 – 30 Ω		
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST3 (female) (17) – 52 (female) (1)	Voltage	Max. 1 V	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST3	Pitch control switch	Voltage	
			Between (17) – (3)	ON	20 – 30	
				OFF	Max. 1 V	

Circuit diagram related to pitch control solenoid

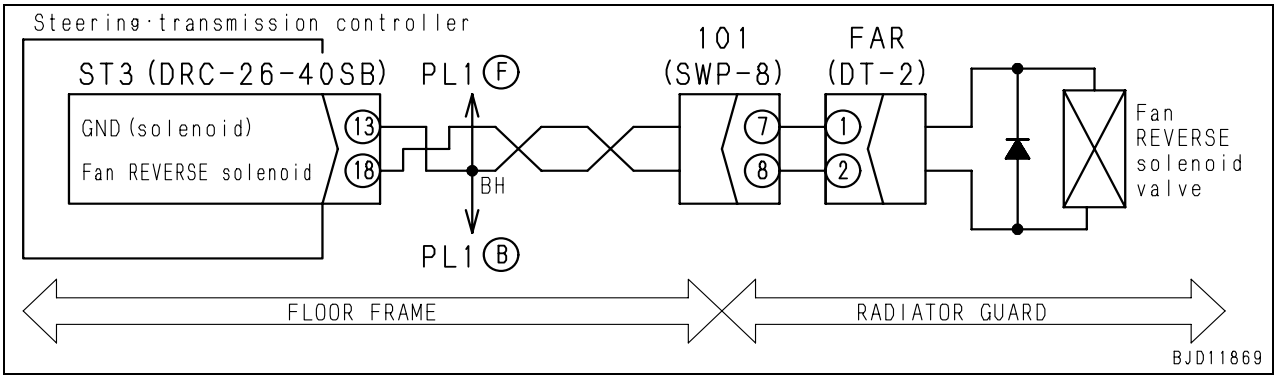


Failure code [DW7BKA] Fan reverse solenoid: Disconnection

Action code	Failure code	Symptom of failure	Fan reverse solenoid: Disconnection (Steering and transmission controller system)
E01	**DW7BKA**		
Failure content	• Current does not flow when power is output to fan reverse solenoid circuit.		
Controller's action	• Stops outputting power to fan reverse solenoid circuit.		
Symptoms that appears on machine	• The fan reversing function cannot be used.		
General information	• Output state (ON/OFF) to fan reverse solenoid can be checked in monitoring mode. (Code 40914: Steering-related controller output signal) • Duplication of failure code: Turn starting switch ON and operate cleaning.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective fan reverse solenoid (Internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			FAR (male)	Resistance		
			Between (1) – (2)	34 – 44 Ω		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (18) – FAR (female) (1)	Resis-tance	Max. 1 Ω	
			Wiring harness between ST3 (female) (13) – FAR (female) (2)	Resis-tance	Max. 1 Ω	
	3	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST3 (female) (18) – FAR (female) (1)	Voltage	Max. 1 V	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (18) – (13)	34 – 44 Ω		

Circuit diagram related to fan reverse solenoid

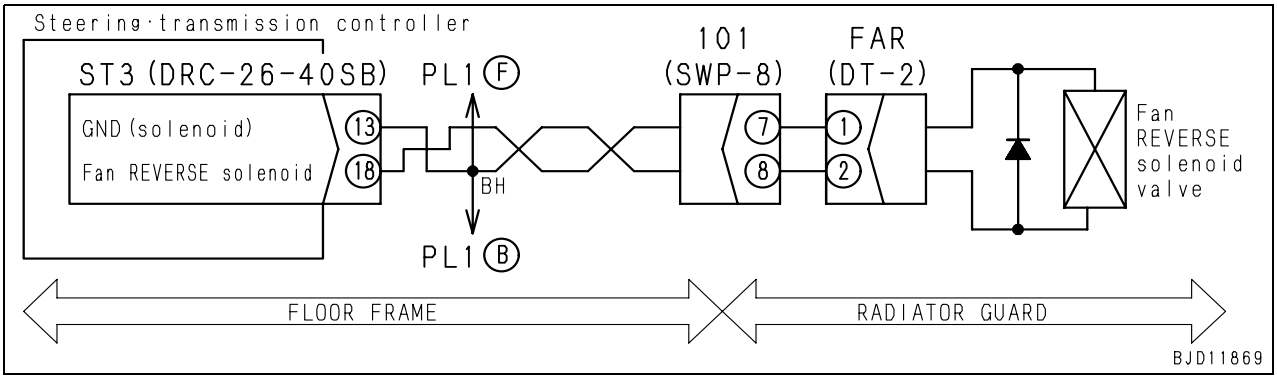


Failure code [DW7BKB] Fan reverse solenoid: Short circuit

Action code	Failure code	Symptom of failure	Fan reverse solenoid: Short circuit (Steering and transmission controller system)
E01	**DW7BKB**		
Failure content	• Current flowed when power is output to fan reverse solenoid circuit.		
Controller's action	• Stops outputting power to fan reverse solenoid circuit.		
Symptoms that appears on machine	• The fan reversing function cannot be used.		
General information	• Output state (ON/OFF) to fan reverse solenoid can be checked in monitoring mode. (Code 40914: Steering-related controller output signal) • Duplication of failure code: Turn starting switch ON and operate cleaning.		

		Cause	Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective fan reverse solenoid (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			FAR (male)	Resistance		
			Between (1) – (2)	34 – 44 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (18) – FAR (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (18) – FAR (female) (1) and between ST3 (female) (13) – FAR (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (18) – (13)	34 – 44 Ω		
			Between (18) – chassis ground	Min. 1 MΩ		

Circuit diagram related to fan reverse solenoid

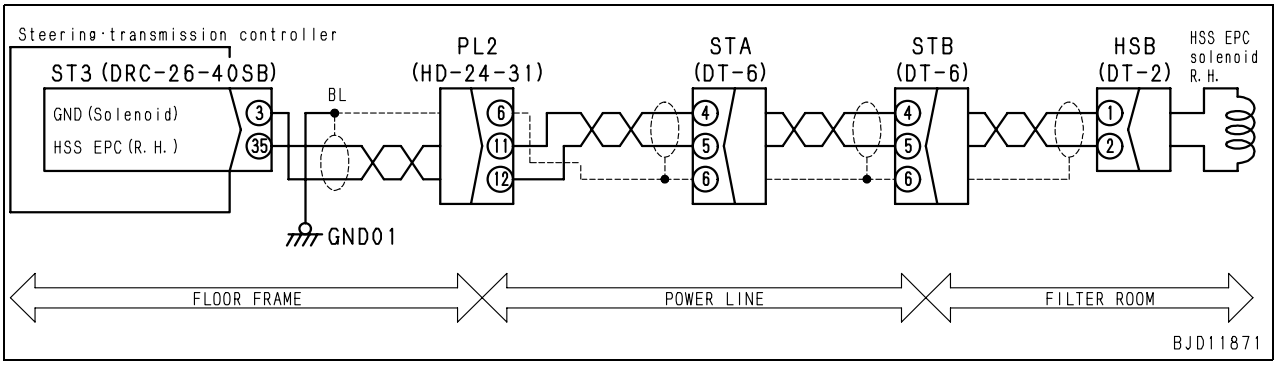


Failure code [DWN1KA] HSS EPC solenoid right: Disconnection

Action code	Failure code	Symptom of failure	HSS EPC solenoid right: Disconnection (Steering and transmission controller system)
CALL E03	**DWN1KA**		
Failure content	• Current does not flow when power is output to HSS EPC solenoid right circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to HSS EPC solenoid right circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Can not turn to the right. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to HSS EPS solenoid right can be checked in monitoring mode. (Code 50603: Right HSS solenoid output current value) • Duplication of failure code: Turn starting switch ON and operate PCCS lever (for steering to right).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective HSS EPC solenoid right (Internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			HSB (male)	Resistance		
			Between (1) – (2)	5 – 15 Ω		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (35) – HSB (female) (1)	Resis-tance	Max. 1 Ω	
			Wiring harness between ST3 (female) (3) – HSB (female) (2)	Resis-tance	Max. 1 Ω	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (35) – (3)	5 – 15 Ω		

Circuit diagram related to HSS EPC solenoid right

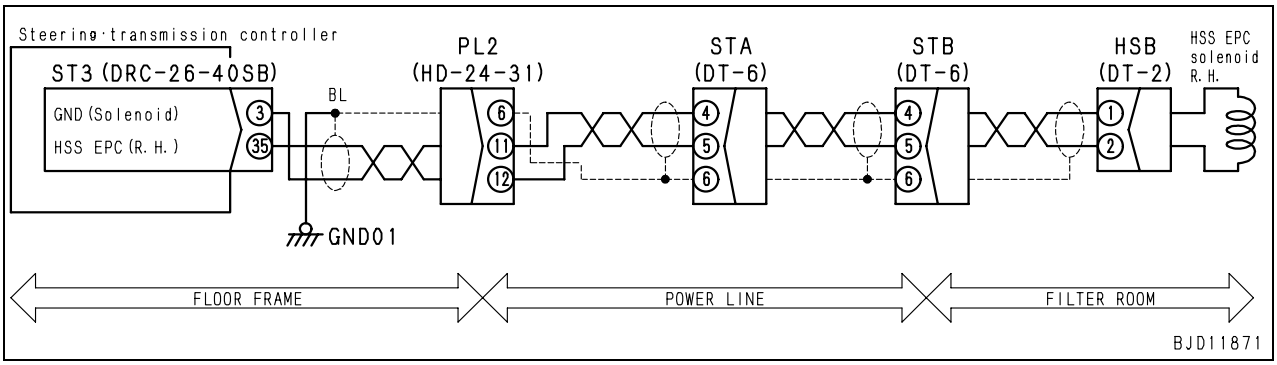


Failure code [DWN1KB] HSS EPC solenoid right: Short circuit

Action code	Failure code	Symptom of failure	HSS EPC solenoid right: Short circuit (Steering and transmission controller system)
CALL E03	**DWN1KB**		
Failure content	• Current flowed when power was output to HSS EPC solenoid right circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to HSS EPC solenoid right circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Can not turn to the right. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to HSS EPS solenoid right can be checked in monitoring mode. (Code 50603: Right HSS solenoid output current value) • Duplication of failure code: Turn starting switch ON and operate PCCS lever (for steering to right).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective HSS EPC solenoid right (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			HSB (male)	Resistance		
			Between (1) – (2)	5 – 15 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (35) – HSB (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (35) – HSB (female) (1) and between ST3 (female) (3) – HSB (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (35) – (3)	5 – 15 Ω		
			Between (35) – chassis ground	Min. 1 MΩ		

Circuit diagram related to HSS EPC solenoid right

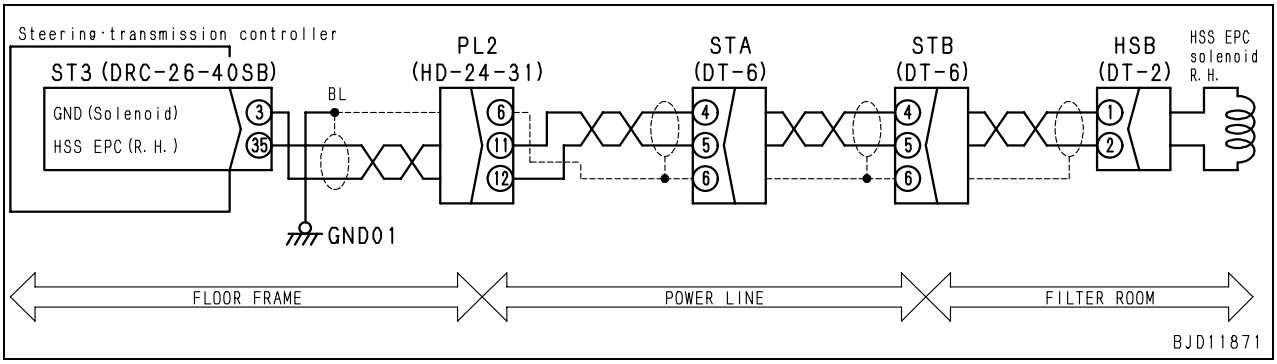


Failure code [DWN1KY] HSS EPC solenoid right: Short circuit to power source line

Action code	Failure code	Symptom of failure	HSS EPC solenoid right: Short circuit to power source line (Steering and transmission controller system)
CALL E04	**DWN1KY**		
Failure content	• Current flows constantly to HSS EPC solenoid right circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to HSS EPC solenoid right circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Continues to turn to the right. • Once machine is stopped, engine speed is limited to medium (half). • Can not travel once machine is stopped.		
General information	• Output state (current) to HSS EPS solenoid right can be checked in monitoring mode. (Code 50603: Right HSS solenoid output current value) • Duplication of failure code: Turn starting switch ON and operate PCCS lever (for steering to right).		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective HSS EPC solenoid right (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			HSB (male)	Resistance	
			Between (1) – (2)	5 – 15 Ω	
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between ST3 (female) (35) – HSB (female) (1)	Voltage	Max. 1 V
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST3	PCCS lever	Voltage
			Between (35) – (3)	Right	5 – 15 V
				N	Max. 1 V

Circuit diagram related to HSS EPC solenoid right

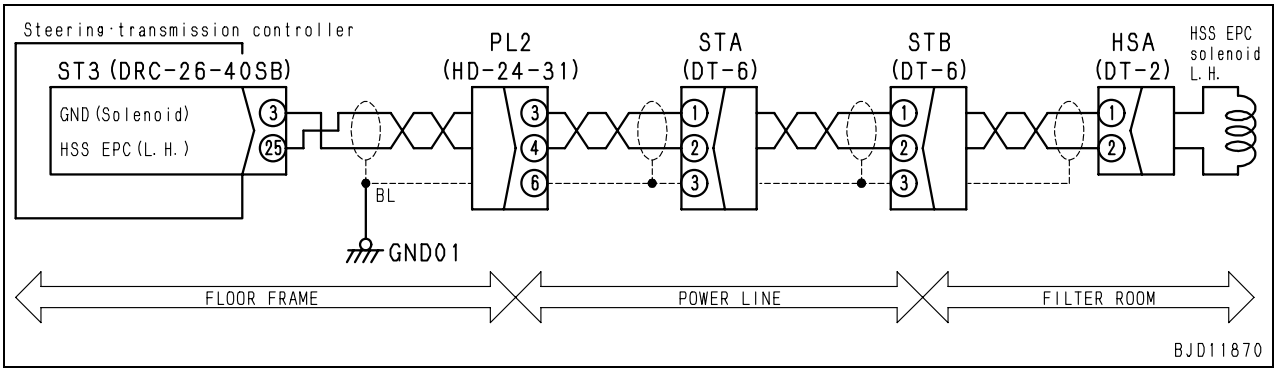


Failure code [DWN2KA] HSS EPC solenoid left: Disconnection

Action code	Failure code	Symptom of failure	HSS EPC solenoid left: Disconnection (Steering and transmission controller system)
CALL E03	**DWN2KA**		
Failure content	• Current does not flow when power is output to HSS EPC solenoid left circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to HSS EPC solenoid left circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Can not turn to the left. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to HSS EPS solenoid left can be checked in monitoring mode. (Code 50602: Left HSS solenoid output current value) • Duplication of failure code: Turn starting switch ON and operate PCCS lever (for steering to left).		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective HSS EPC solenoid left (Internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			HSA (male)	Resistance	
			Between (1) – (2)	5 – 15 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (25) – HSA (female) (1)	Resis-tance	Max. 1 Ω
			Wiring harness between ST3 (female) (3) – HSA (female) (2)	Resis-tance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (25) – (3)	5 – 15 Ω	

Circuit diagram related to HSS EPC solenoid left

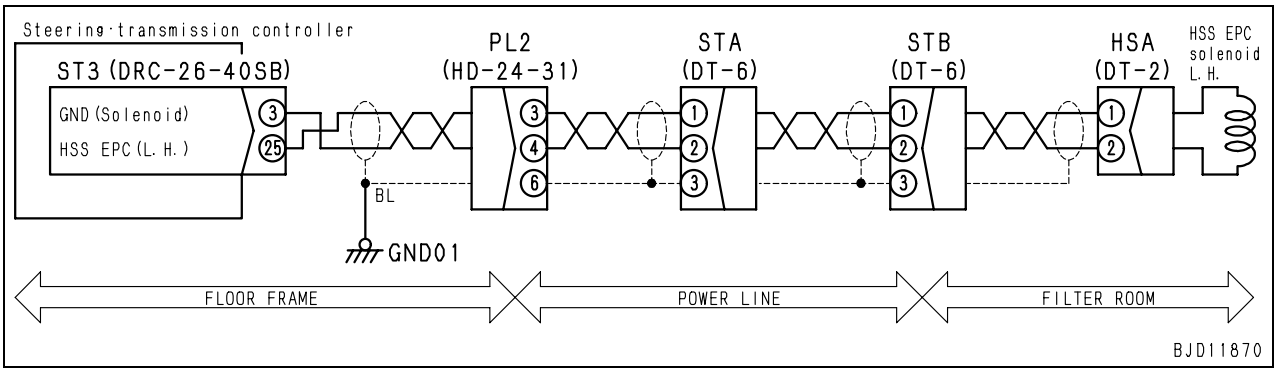


Failure code [DWN2KB] HSS EPC solenoid left: Short circuit

Action code	Failure code	Symptom of failure	HSS EPC solenoid left: Short circuit (Steering and transmission controller system)
CALL E03	**DWN2KB**		
Failure content	• Current flowed when power was output to HSS EPC solenoid left circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to HSS EPC solenoid left circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Can not turn to the left. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to HSS EPS solenoid left can be checked in monitoring mode. (Code 50602: Left HSS solenoid output current value) • Duplication of failure code: Turn starting switch ON and operate PCCS lever (for steering to left).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective HSS EPC solenoid left (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			HSA (male)	Resistance		
			Between (1) – (2)	5 – 15 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (25) – HSA (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (25) – HSA (female) (1) and between ST3 (female) (3) – HSA (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (25) – (3)	5 – 15 Ω		
			Between (25) – chassis ground	Min. 1 MΩ		

Circuit diagram related to HSS EPC solenoid left

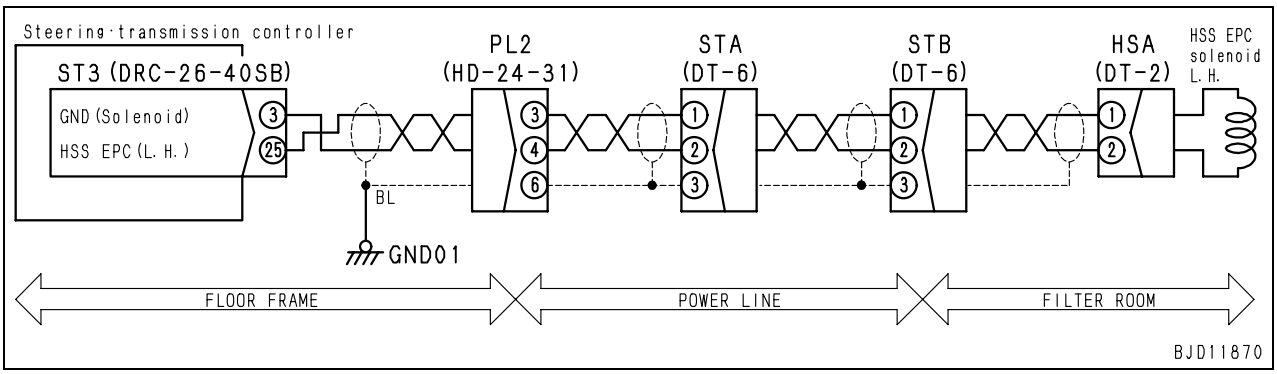


Failure code [DWN2KY] HSS EPC solenoid left: Short circuit to power source line

Action code	Failure code	Symptom of failure	HSS EPC solenoid left: Short circuit to power source line (Steering and transmission controller system)
CALL E04	**DWN2KY**		
Failure content	• Current flows constantly to HSS EPC solenoid left circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to HSS EPC solenoid left circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Continues to turn to the left. • Once machine is stopped, engine speed is limited to medium (half). • Can not travel once machine is stopped.		
General information	• Output state (current) to HSS EPS solenoid left can be checked in monitoring mode. (Code 50602: Left HSS solenoid output current value) • Duplication of failure code: Turn starting switch ON and operate PCCS lever (for steering to left).		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective HSS EPC solenoid left (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			HSA (male)	Resistance		
			Between (1) – (2)	5 – 15 Ω		
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST3 (female) (25) – HSA (female) (1)	Voltage	Max. 1 V	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST3	PCCS lever	Voltage	
			Between (25) – (3)	Left	5 – 15 V	
				N	Max. 1 V	

Circuit diagram related to HSS EPC solenoid left

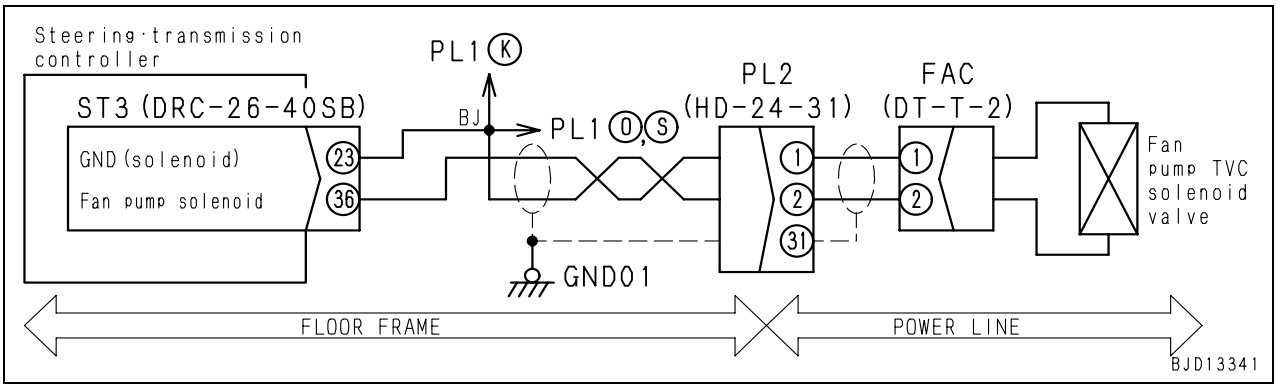


Failure code [DWN5KA] Fan pump TVC solenoid: Disconnection

Action code	Failure code	Symptom of failure	Fan pump solenoid: Disconnection (Steering and transmission controller system)
E01	**DWN5KA**		
Failure content	• Current does not flow when power is output to fan pump TVC solenoid circuit.		
Controller's action	• Stops outputting power to fan pump TVC solenoid circuit.		
Symptoms that appears on machine	• Fan speed is kept at maximum level		
General information	• Output state (current) to fan pump TVC solenoid can be checked in monitoring mode. (Code 31623, 31624: Cooling fan solenoid output current) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fan pump solenoid (Internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			FAC (male)	Resistance	
			Between (1) – (2)	5 – 15 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (36) – FAC (female) (1)	Resis-tance	Max. 1 Ω
			Wiring harness between ST3 (female) (23) – FAC (female) (2)	Resis-tance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (36) – (23)	5 – 15 Ω	

Circuit diagram related to fan pump TVC solenoid

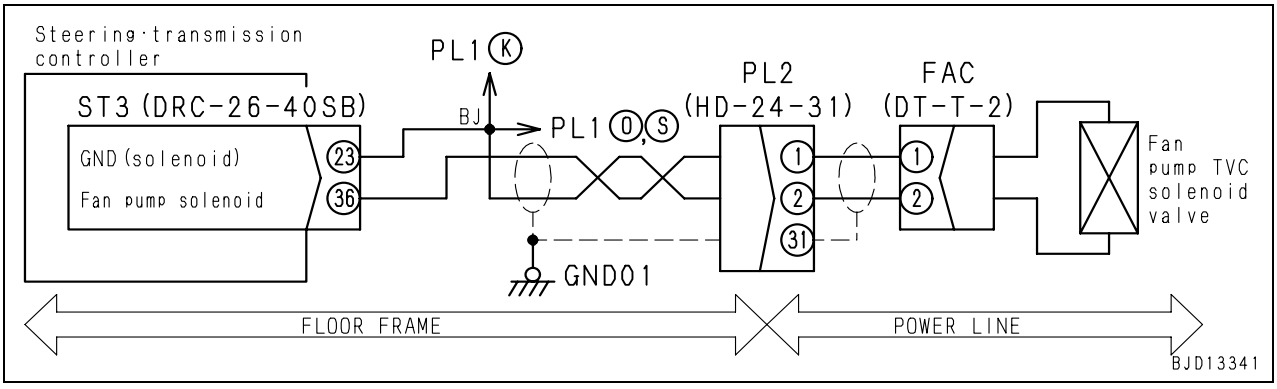


Failure code [DWN5KB] Fan pump TVC solenoid: Short circuit

Action code	Failure code	Symptom of failure	Fan pump solenoid: Short circuit (Steering and transmission controller system)
E01	**DWN5KB**		
Failure content	• Current flowed when power is output to fan pump TVC solenoid circuit.		
Controller's action	• Stops outputting power to fan pump TVC solenoid circuit.		
Symptoms that appears on machine	• Fan speed is kept at maximum level		
General information	• Output state (current) to fan pump TVC solenoid can be checked in monitoring mode. (Code 31623, 31624: Cooling fan solenoid output current) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective fan pump solenoid (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			FAC (male)	Resistance		
			Between (1) – (2)	5 – 15 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (36) – FAC (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (36) – FAC (female) (1) and between ST3 (female) (23) – FAC (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (36) – (23)	5 – 15 Ω		
			Between (36) – chassis ground	Min. 1 MΩ		

Circuit diagram related to fan pump TVC solenoid

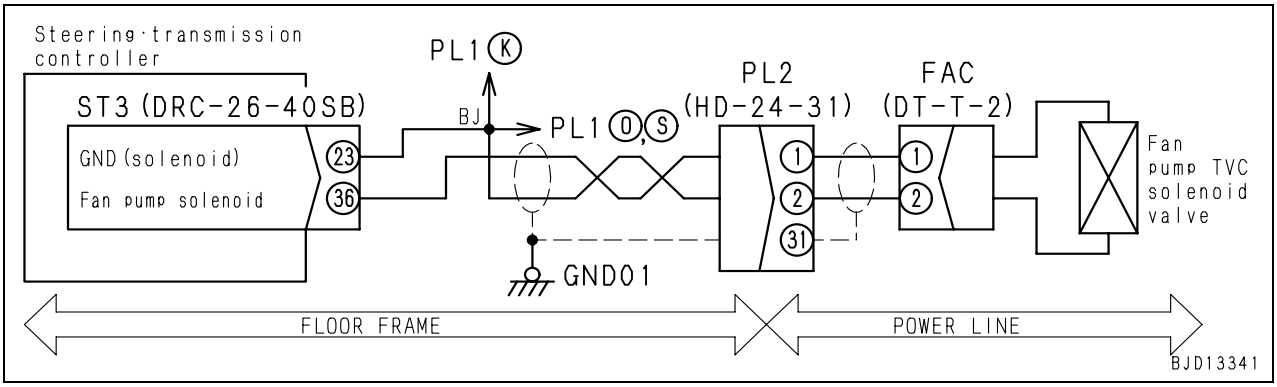


Failure code [DWN5KY] Fan pump TVC solenoid: Short circuit in power source line

Action code	Failure code	Symptom of failure	Fan pump solenoid: Short circuit to power source line (Steering and transmission controller system)
E02	**DWN5KY**		
Failure content	• Current flows constantly to fan pump TVC solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting power to fan pump TVC solenoid circuit.		
Symptoms that appears on machine	• Fan speed is kept at minimum level. • Overheat easily.		
General information	• Output state (current) to fan pump TVC solenoid can be checked in monitoring mode. (Code 31623, 31624: Cooling fan solenoid output current) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fan pump solenoid (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			FAC (male)	Resistance	
			Between (1) – (2)	5 – 15 Ω	
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between ST3 (female) (36) – FAC (female) (1)	Voltage	Max. 1 V
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and start the engine to diagnose.		
			ST3	Fan speed	Voltage
			Between (36) – (23)	Minimum speed	5 – 15 V
				Maximum speed	Max. 5 V

Circuit diagram related to fan pump TVC solenoid

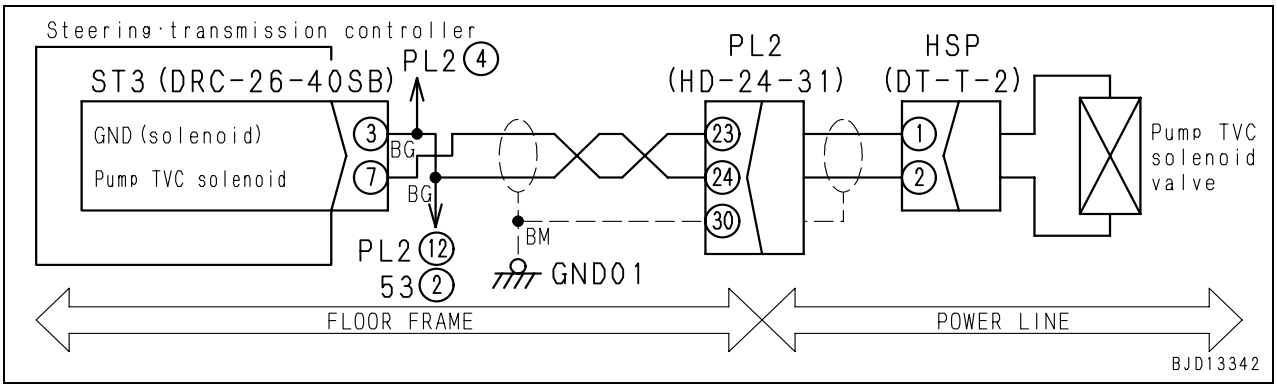


Failure code [DXA0KA] HSS pump TVC solenoid: Disconnection

Action code	Failure code	Symptom of failure	HSS pump TVC solenoid: Disconnection (Steering and transmission controller system)
E01	**DXA0KA**		
Failure content	• Any current does not flow when power is output to HSS and work equipment pump TVC solenoid circuit.		
Controller's action	• Stops outputting power to HSS and work equipment TVC solenoid circuit.		
Symptoms that appears on machine	• When load is applied while engine is running at low speed, engine will stall.		
General information	• Output state (current) to HSS and work equipment pump TVC solenoid left can be checked in monitoring mode. (Code 01300, 01301: Output current of TVC solenoid) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective HSS and work equipment pump TVC solenoid (Internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			HSP (male)	Resistance	
			Between (1) – (2)	9 – 19 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (7) – HSP (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ST3 (female) (3) – HSP (female) (2)	Resistance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (7) – (3)	9 – 19 Ω	

Circuit diagram of HSS pump TVC solenoid

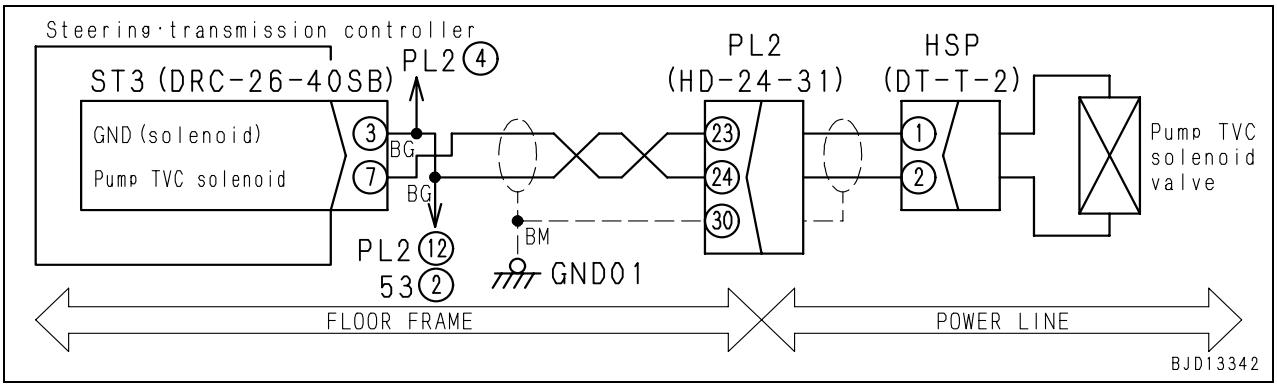


Failure code [DXA0KB] HSS pump TVC solenoid: Short circuit

Action code	Failure code	Symptom of failure	HSS pump TVC solenoid: Short circuit (Steering and transmission controller system)
E01	**DXA0KB**		
Failure content	• Abnormal current flowed when power is outputted to HSS and work equipment pump TVC solenoid circuit.		
Controller's action	• Stops outputting power to HSS and work equipment TVC solenoid.		
Symptoms that appears on machine	• When load is applied while engine is running at low speed, engine will stall.		
General information	• Output state (current) to HSS and work equipment pump TVC solenoid left can be checked in monitoring mode. (Code 01300, 01301: Output current of TVC solenoid) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective HSS and work equipment pump TVC solenoid (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			HSP (male)	Resistance		
			Between (1) – (2)	9 – 19 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (7) – HSP (female) (1)	Resistance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (7) – HSP (female) (1) and between ST3 (female) (3) – HSP (female) (2)	Resistance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (7) – (3)	9 – 19 Ω		
			Between (7) – chassis ground	Min. 1 MΩ		

Circuit diagram of HSS pump TVC solenoid

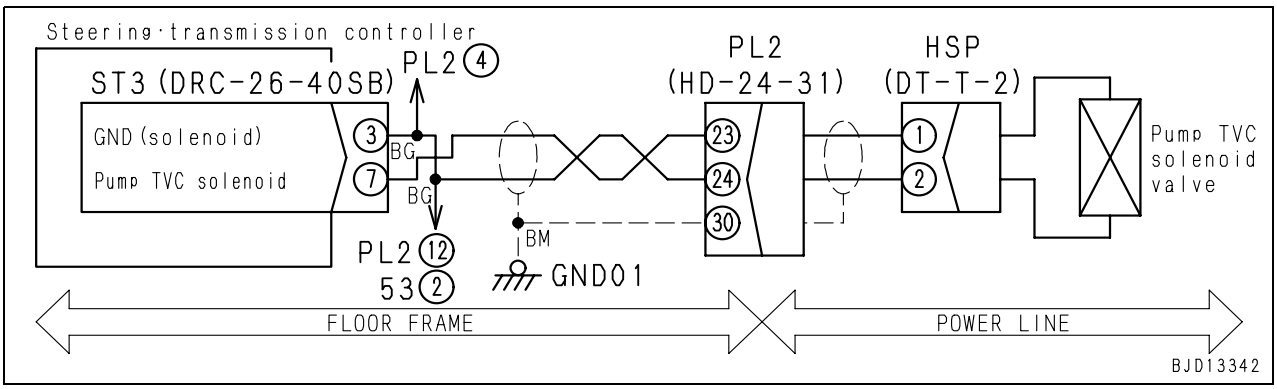


Failure code [DXA0KY] HSS pump TVC solenoid: Short circuit to power source line

Action code	Failure code	Symptom of failure	HSS pump TVC solenoid: Short circuit to power source line (Steering and transmission controller system)
E01	**DXA0KY**		
Failure content	• Current flows constantly to HSS and work equipment pump TVC solenoid circuit.		
Controller's action	• Stops outputting power to HSS and work equipment TVC solenoid circuit.		
Symptoms that appears on machine	• Large turning radius • Work equipment speed is slow.		
General information	• Output state (current) to HSS and work equipment pump TVC solenoid left can be checked in monitoring mode. (Code 01300, 01301: Output current of TVC solenoid) • Duplication of failure code: turn ON the starting switch.		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective HSS and work equipment pump TVC solenoid (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			HSP (male)	Resistance		
			Between (1) – (2)	9 – 19 Ω		
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST3 (female) (7) – HSP (female) (1)	Voltage	Max. 1 V	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and start the engine to diagnose.			
			ST3	Engine speed	Voltage	
			Between (7) – (3)	Low idle	9 – 19	
				High idle	Max. 1 V	

Circuit diagram of HSS pump TVC solenoid

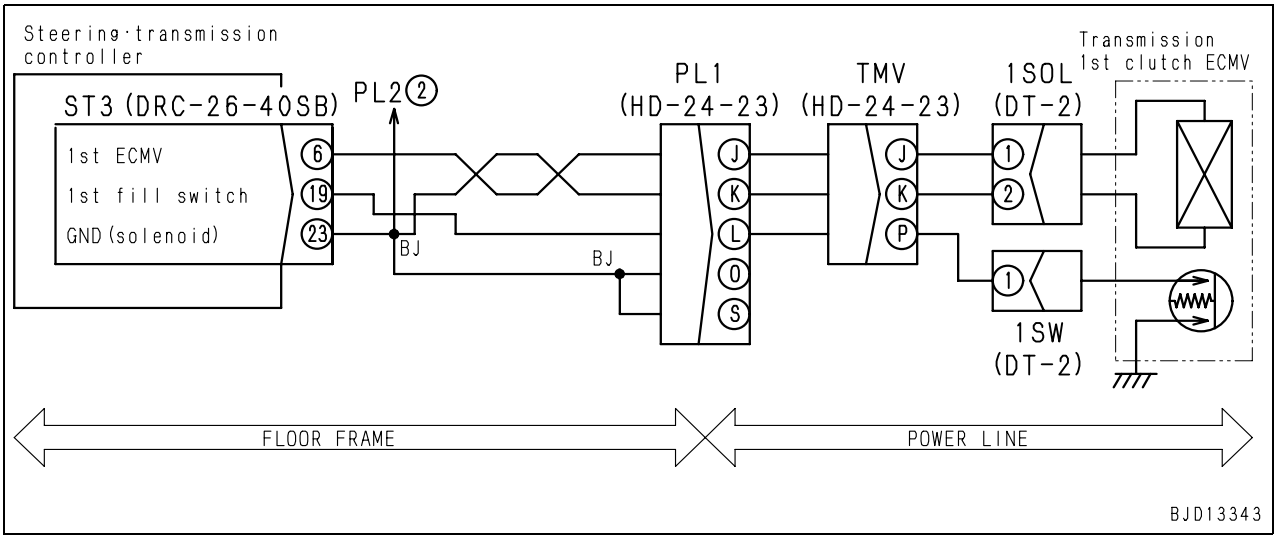


Failure code [DXH4KA] 1st clutch ECMV: Disconnection

Action code	Failure code	Symptom of failure	1st clutch ECMV: Disconnection (Steering and transmission controller system)
CALL E03	**DXH4KA**		
Failure content	• Current does not flow when power is output to transmission 1st clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 1st clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F2 and R2.		
General information	• Output state (current) to 1st clutch solenoid can be checked in monitoring mode. (Code 31602, 31612: 1st clutch ECMV output current value) • Duplication of failure code: Engine start + F1 or R1 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 1st clutch ECMV (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			1SOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (6) – 1SOL (female) (1)	Resis-tance	Max. 1 Ω	
			Wiring harness between ST3 (female) (23) – 2SOL (female) (2)	Resis-tance	Max. 1 Ω	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (6) – (23)	5 – 25 Ω		

Circuit diagram related to transmission 1st clutch ECMV

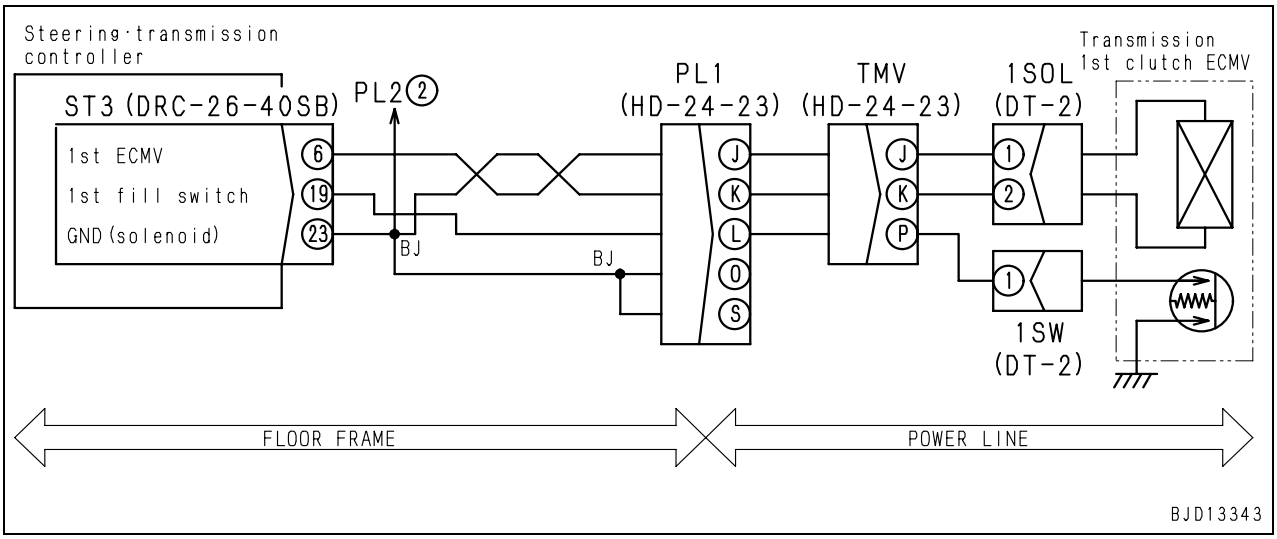


Failure code [DXH4KB] 1st clutch ECMV: Short circuit

Action code	Failure code	Symptom of failure	1st clutch ECMV: Short circuit (Steering and transmission controller system)
CALL E03	**DXH4KB**		
Failure content	• Abnormal current flowed when power was outputted to transmission 1st clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 1st clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F2 and R2.		
General information	• Output state (current) to 1st clutch solenoid can be checked in monitoring mode. (Code 31602, 31612: 1st clutch ECMV output current value) • Duplication of failure code: Engine start + F1 or R1 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 1st clutch ECMV (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			1SOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (6) – 1SOL (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (6) – 1SOL (female) (1) and between ST3 (female) (23) – 1SOL (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (6) – (23)	5 – 25 Ω		
			Between (6) – chassis ground	Min. 1 MΩ		

Circuit diagram related to transmission 1st clutch ECMV

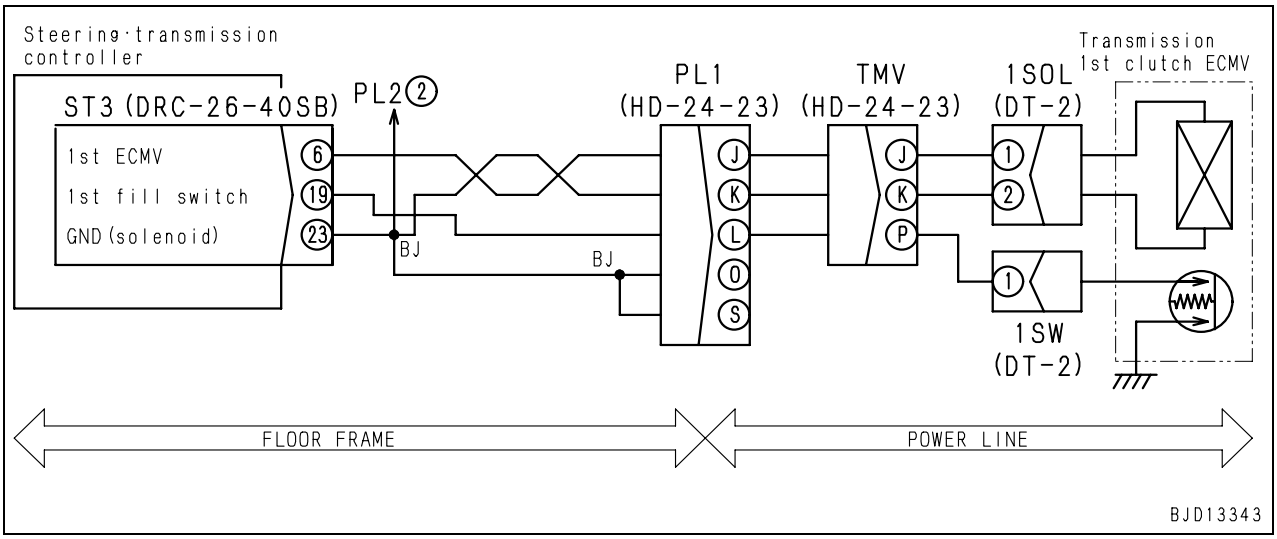


Failure code [DXH4KY] 1st clutch ECMV: Short circuit to power source line

Action code	Failure code	Symptom of failure	1st clutch ECMV: Short circuit to power source line (Steering and transmission controller system)
CALL E03	**DXH4KY**		
Failure content	• Current flows constantly to transmission 1st clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 1st clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to 1st clutch solenoid can be checked in monitoring mode. (Code 31602, 31612: 1st clutch ECMV output current value) • Duplication of failure code: Engine start + F1 or R1 travel		

Possible causes and the standard values when normal		Cause	Standard value when normal and remarks for troubleshooting		
	1	Defective 1st clutch ECMV (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			1SOL (male)	Resistance	
			Between (1) – (2)	5 – 25 Ω	
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between ST3 (female) (6) – 1SOL (female) (1)	Voltage	Max. 1 V
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST3	PCCS lever	Voltage
			Between (6) – (23)	F1 and R1	5 – 25 V
				Other than F1 and R1	Max. 1 V

Circuit diagram related to transmission 1st clutch ECMV solenoid

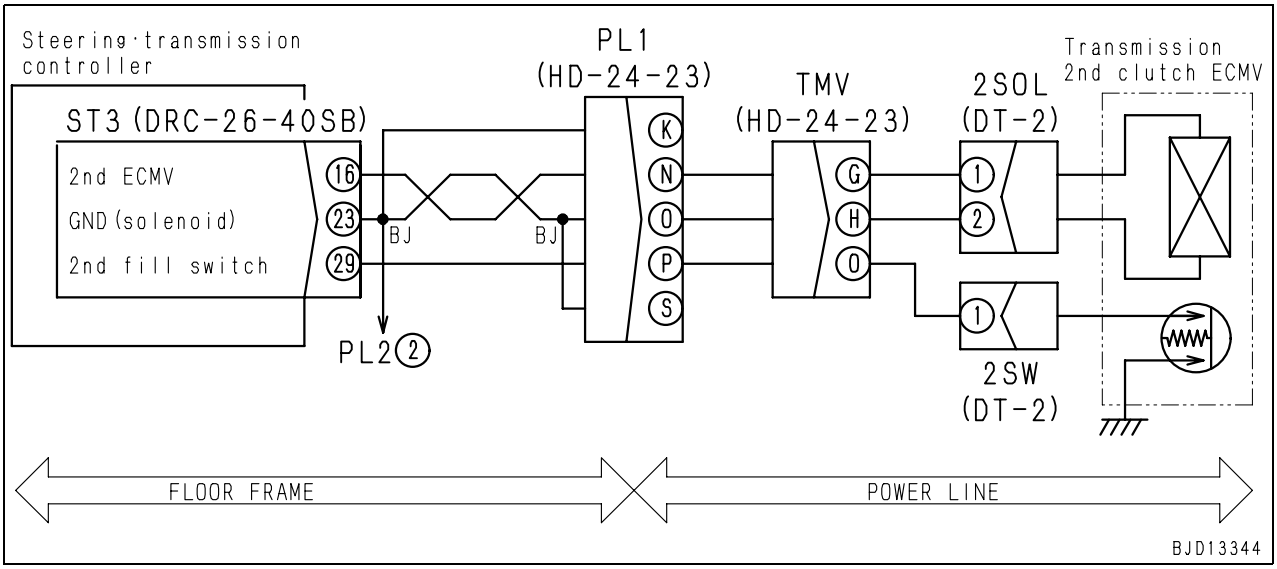


Failure code [DXH5KA] 2nd clutch ECMV: Disconnection

Action code	Failure code	Symptom of failure	2nd clutch ECMV: Disconnection (Steering and transmission controller system)
CALL E03	**DXH5KA**		
Failure content	• Current does not flow when power is output to transmission 2nd clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 2nd clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to 2nd clutch solenoid can be checked in monitoring mode. (Code 31603, 31613: 2nd clutch ECMV output current value) • Duplication of failure code: Engine start + F2 or R2 travel		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective 2nd clutch ECMV. (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			2SOL (male)	Resistance	
			Between (1) – (2)	5 – 25 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (16) – 2SOL (female) (1)	Resis-tance	Max. 1 Ω
			Wiring harness between ST3 (female) (23) – 2SOL (female) (2)	Resis-tance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (16) – (23)	5 – 25 Ω	

Circuit diagram related to transmission 2nd clutch ECMV

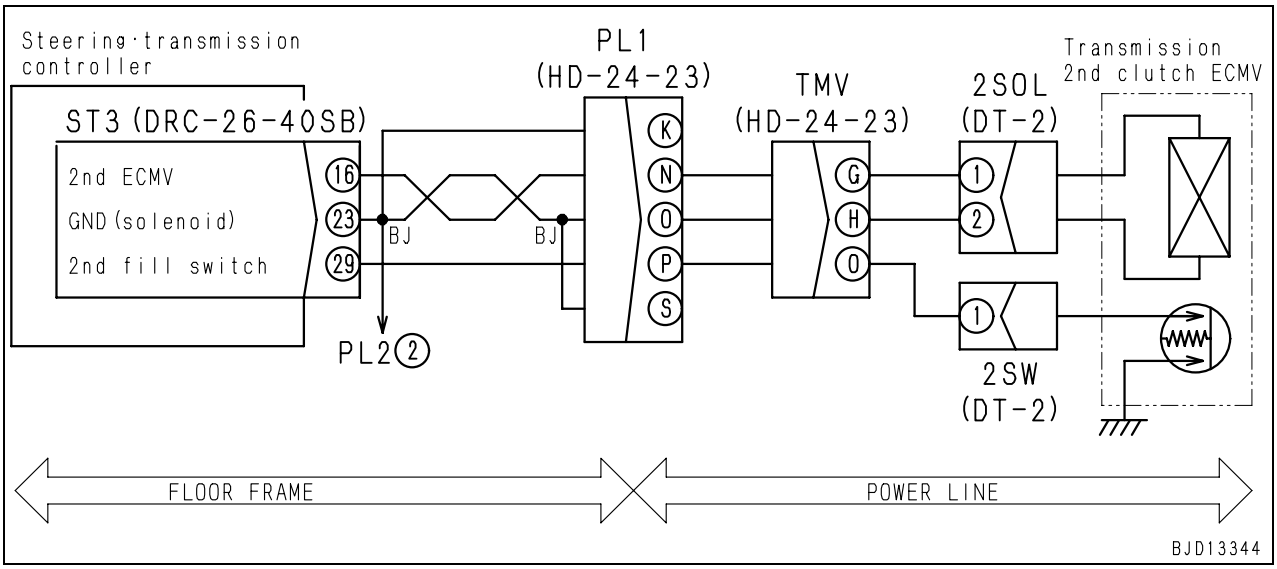


Failure code [DXH5KB] 2nd clutch ECMV: Short circuit

Action code	Failure code	Symptom of failure	2nd clutch ECMV: Short circuit (Steering and transmission controller system)
CALL E03	**DXH5KB**		
Failure content	• Abnormal current flowed when power was outputted to transmission 2nd clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 2nd clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to 2nd clutch solenoid can be checked in monitoring mode. (Code 31603, 31613: 2nd clutch ECMV output current value) • Duplication of failure code: Engine start + F2 or R2 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 2nd clutch ECMV. (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			2SOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (16) – 1SOL (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (16) – 2SOL (female) (1) and between ST3 (female) (23) – 2SOL (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (16) – (23)	5 – 25 Ω		
			Between (16) – chassis ground	Min. 1 MΩ		

Circuit diagram related to transmission 2nd clutch ECMV

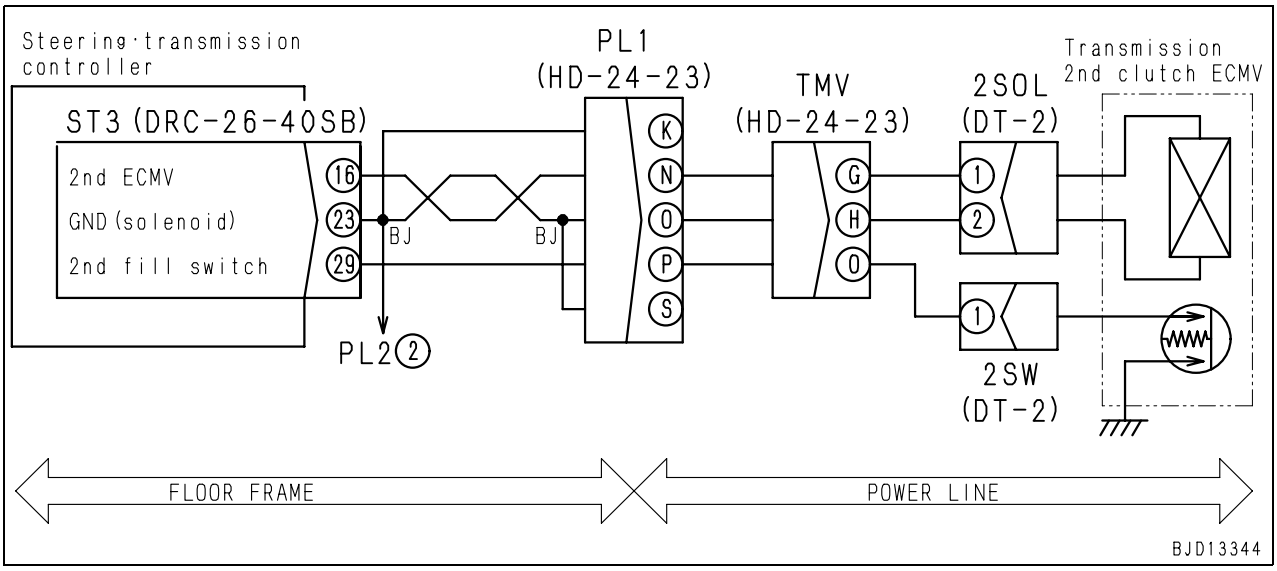


Failure code [DXH5KY] 2nd clutch ECMV: Short circuit to power source line

Action code	Failure code	Symptom of failure	2nd clutch ECMV: Short circuit to power source line (Steering and transmission controller system)
CALL E03	**DXH5KY**		
Failure content	• Current flows constantly to transmission 2nd clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 2nd clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F2 and R2.		
General information	• Output state (current) to 2nd clutch solenoid can be checked in monitoring mode. (Code 31603, 31613: 2nd clutch ECMV output current value) • Duplication of failure code: Engine start + F2 or R2 travel		

Possible causes and the standard values when normal		Cause	Standard value when normal and remarks for troubleshooting			
	1	Defective 2nd clutch ECMV. (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			2SOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST3 (female) (16) – 2SOL (female) (1)	Voltage	Max. 1 V	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST3	PCCS lever	Voltage	
			Between (16) – (23)	F2 and R2	5 – 25 V	
				Other than F2 and R2	Max. 1 V	

Circuit diagram related to transmission 2nd clutch ECMV

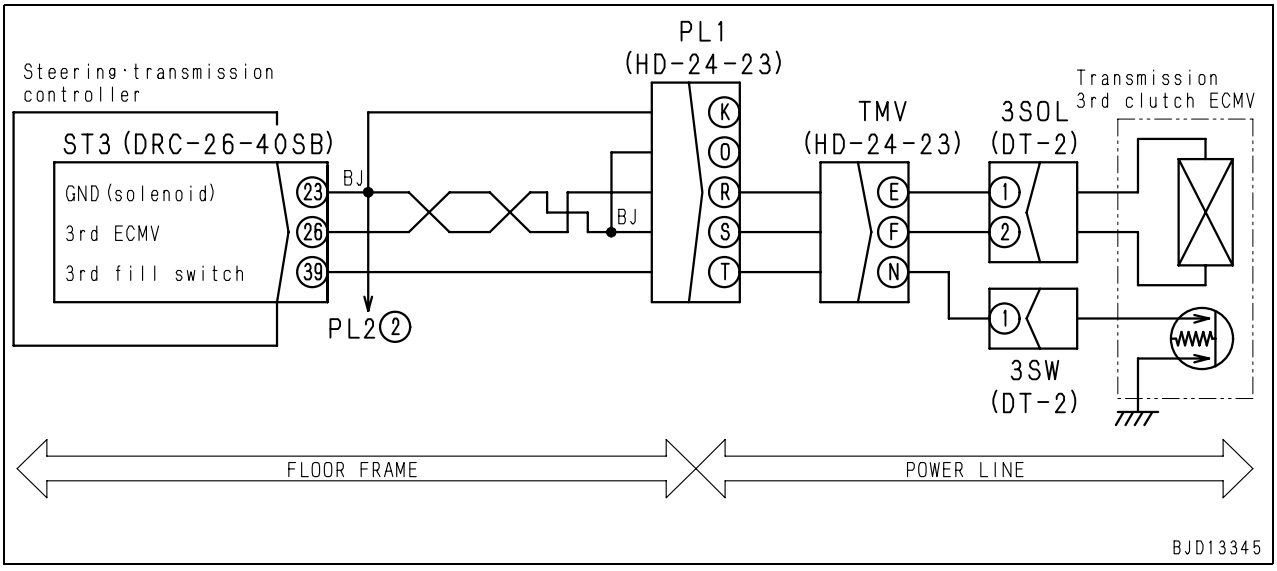


Failure code [DXH6KA] 3rd clutch ECMV: Disconnection

Action code	Failure code	Symptom of failure	3rd clutch ECMV: Disconnection (Steering and transmission controller system)
CALL E03	**DXH6KA**		
Failure content	• Current does not flow when power is output to transmission 3rd clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 3rd clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to 3rd clutch solenoid can be checked in monitoring mode. • (Code 31604, 31614: 3rd clutch ECMV output current value) • Duplication of failure code: Engine start + F3 or R3 travel		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective 3rd clutch ECMV (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			3SOL (male)	Resistance	
			Between (1) – (2)	5 – 25 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (26) – 3SOL (female) (1)	Resis-tance	Max. 1 Ω
			Wiring harness between ST3 (female) (23) – 3SOL (female) (2)	Resis-tance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (26) – (23)	5 – 25 Ω	

Circuit diagram related to transmission 3rd clutch ECMV

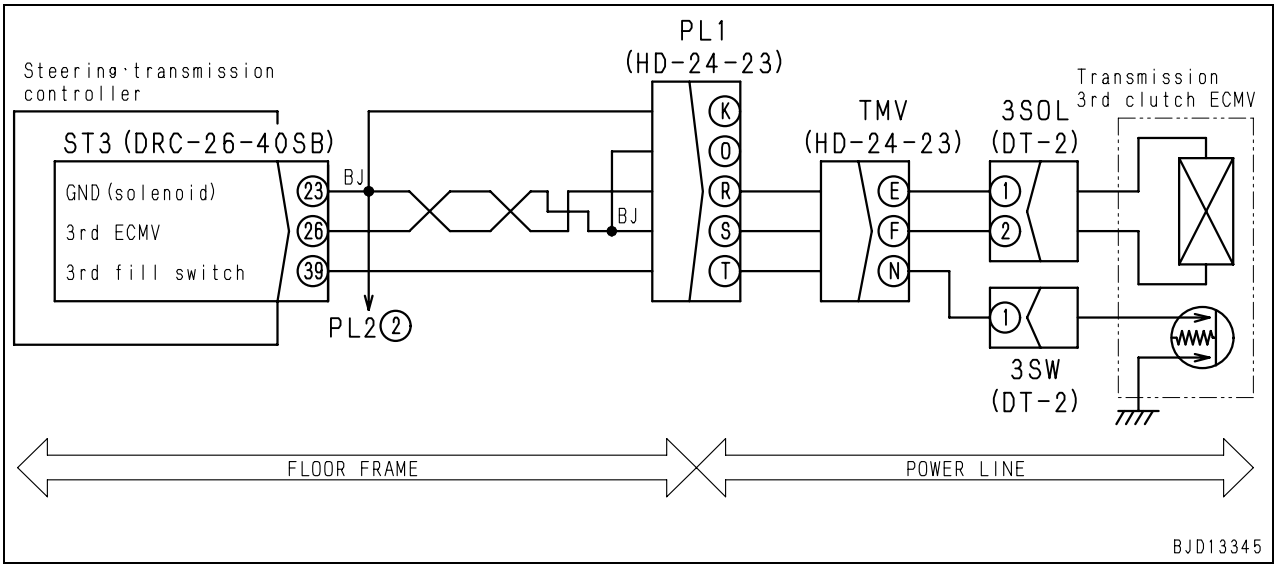


Failure code [DXH6KB] 3rd clutch ECMV: Short circuit

Action code	Failure code	Symptom of failure	3rd clutch ECMV: Short circuit (Steering and transmission controller system)
CALL E03	**DXH6KB**		
Failure content	• Abnormal current flowed when power was output to transmission 3rd clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 3rd clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.		
General information	• Output state (current) to 3rd clutch solenoid can be checked in monitoring mode. (Code 31604, 31614: 3rd clutch ECMV output current value) • Duplication of failure code: Engine start + F3 or R3 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 3rd clutch ECMV (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			3SOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (26) – 3SOL (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (26) – 3SOL (female) (1) and between ST3 (female) (23) – 3SOL (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (26) – (23)	5 – 25 Ω		
			Between (26) – chassis ground	Min. 1 MΩ		

Circuit diagram related to transmission 3rd clutch ECMV

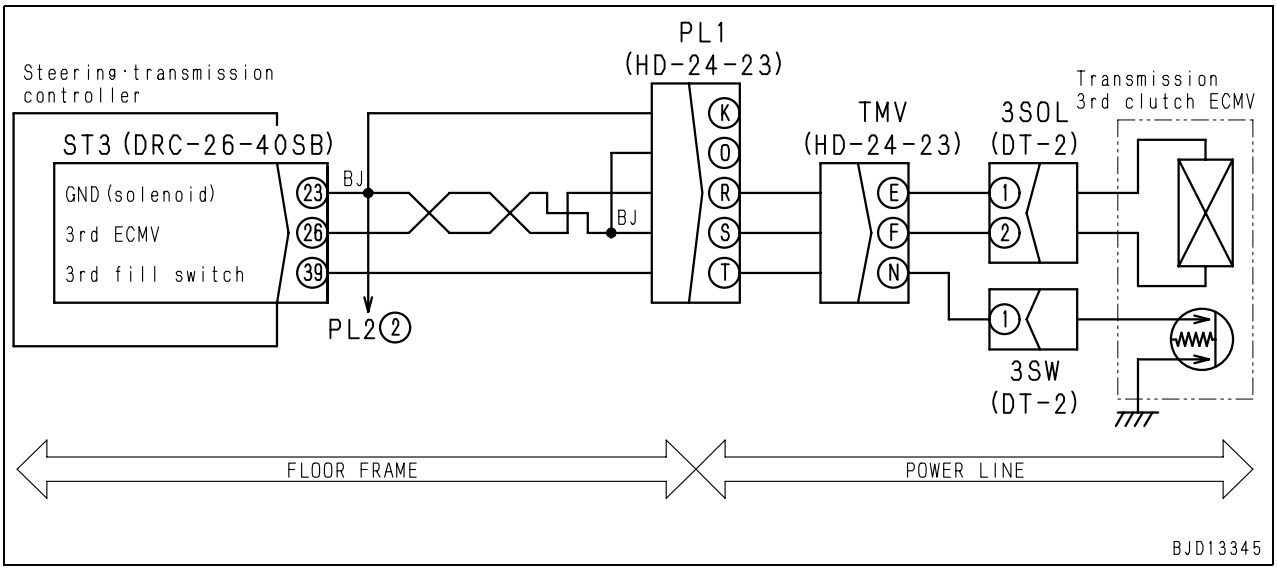


Failure code [DXH6KY] 3rd clutch ECMV: Short circuit to power source line

Action code	Failure code	Symptom of failure	3rd clutch ECMV: Short circuit to power source line (Steering and transmission controller system)
CALL E03	**DXH6KY**		
Failure content	• Current flows constantly to transmission 3rd clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission 3rd clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• The auto shift down function does not work. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F3 and R3.		
General information	• Output state (current) to 3rd clutch solenoid can be checked in monitoring mode. (Code 31604, 31614: 3rd clutch ECMV output current value) • Duplication of failure code: Engine start + F3 or R3 travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective 3rd clutch ECMV (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			3SOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST3 (female) (26) – 3SOL (female) (1)	Voltage	Max. 1 V	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST3	PCCS lever	Voltage	
			Between (26) – (23)	F3 and R3	5 – 25 V	
				Other than F3 and R3	Max. 1 V	

Circuit diagram related to transmission 3rd clutch ECMV

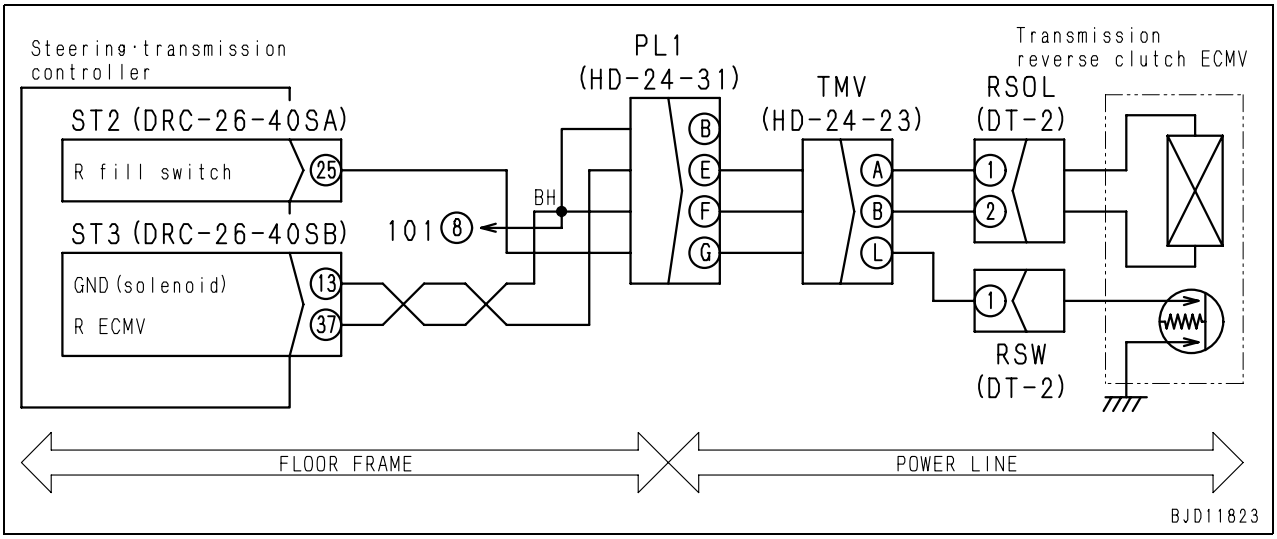


Failure code [DXH7KA] Reverse clutch ECMV: Disconnection

Action code	Failure code	Symptom of failure	Reverse clutch ECMV: Disconnection (Steering and transmission controller system)
CALL E03	**DXH7KA**		
Failure content	• Current does not flow when power is output to transmission reverse clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission reverse clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1.		
General information	• Output state (current) to reverse clutch solenoid can be checked in monitoring mode. (Code 31606, 31616: Output current of reverse clutch ECMV) • Duplication of failure code: Engine start + reverse travel		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective reverse clutch ECMV (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			RSOL (male)	Resistance	
			Between (1) – (2)	5 – 25 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between ST3 (female) (37) – RSOL (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ST3 (female) (13) – RSOL (female) (2)	Resistance	Max. 1 Ω
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (37) – (13)	5 – 25 Ω	

Circuit diagram related to transmission reverse clutch ECMV

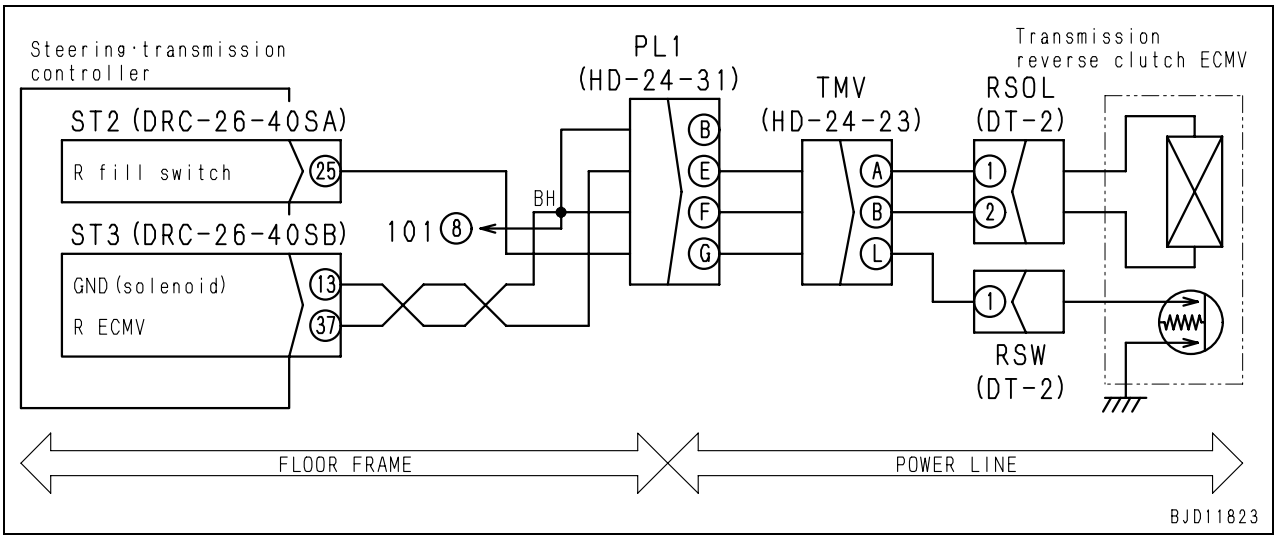


Failure code [DXH7KB] Reverse clutch ECMV: Short circuit

Action code	Failure code	Symptom of failure	Reverse clutch ECMV: Short circuit (Steering and transmission controller system)
CALL E03	**DXH7KB**		
Failure content	• Abnormal current flowed when power was output to transmission reverse clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission reverse clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1.		
General information	• Output state (current) to reverse clutch solenoid can be checked in monitoring mode. (Code 31606, 31616: Output current of reverse clutch ECMV) • Duplication of failure code: Engine start + reverse travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective reverse clutch solenoid (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			RSOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST3 (female) (37) – RSOL (female) (1)	Resis-tance	Min. 1 MΩ	
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harnesses between ST3 (female) (37) – RSOL (female) (1) and between ST3 (female) (13) – RSOL (female) (2)	Resis-tance	Min. 1 MΩ	
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (37) – (13)	5 – 25 Ω		
			Between (37) – chassis ground	Min. 1 MΩ		

Circuit diagram related to transmission reverse clutch ECMV

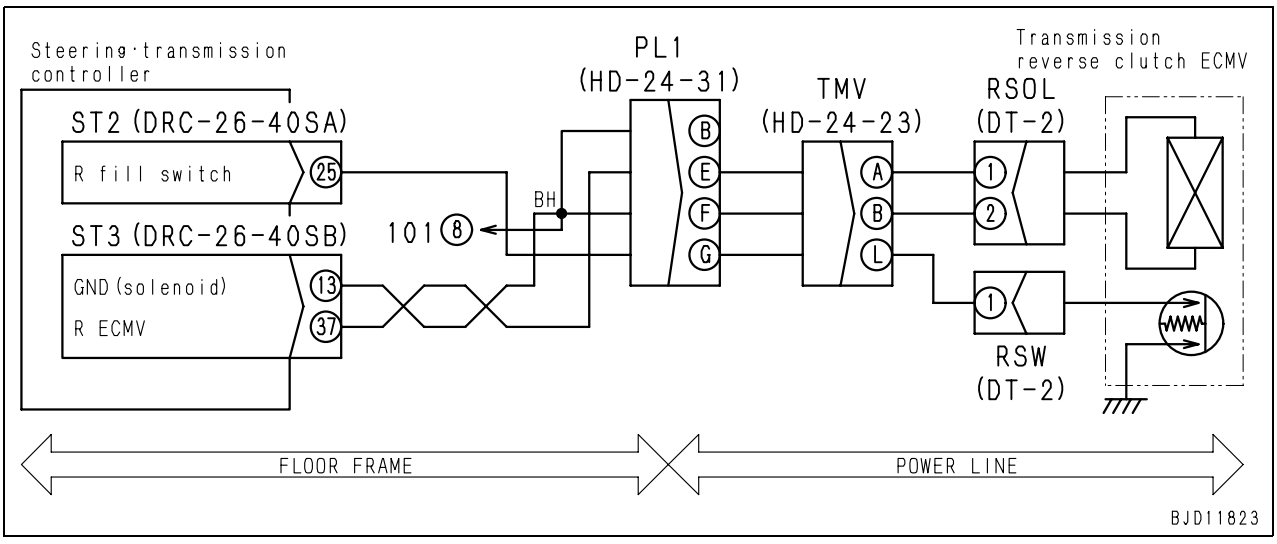


Failure code [DXH7KY] reverse clutch ECMV: Short circuit to power source line

Action code	Failure code	Symptom of failure	Reverse clutch ECMV: Short circuit to power source line (Steering and transmission controller system)
CALL E03	**DXH7KY**		
Failure content	• Current flows constantly to transmission reverse clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission reverse clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to R1.		
General information	• Output state (current) to reverse clutch solenoid can be checked in monitoring mode. (Code 31606, 31616: Output current of reverse clutch ECMV) • Duplication of failure code: Engine start + reverse travel		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective reverse clutch ECMV (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			RSOL (male)	Resistance	
			Between (1) – (2)	5 – 25 Ω	
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between ST3 (female) (37) – RSOL (female) (1)	Voltage	Max. 1 V
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST3	PCCS lever	Voltage
			Between (37) – (13)	R	5 – 25 V
				N	Max. 1 V

Circuit diagram related to transmission reverse clutch ECMV

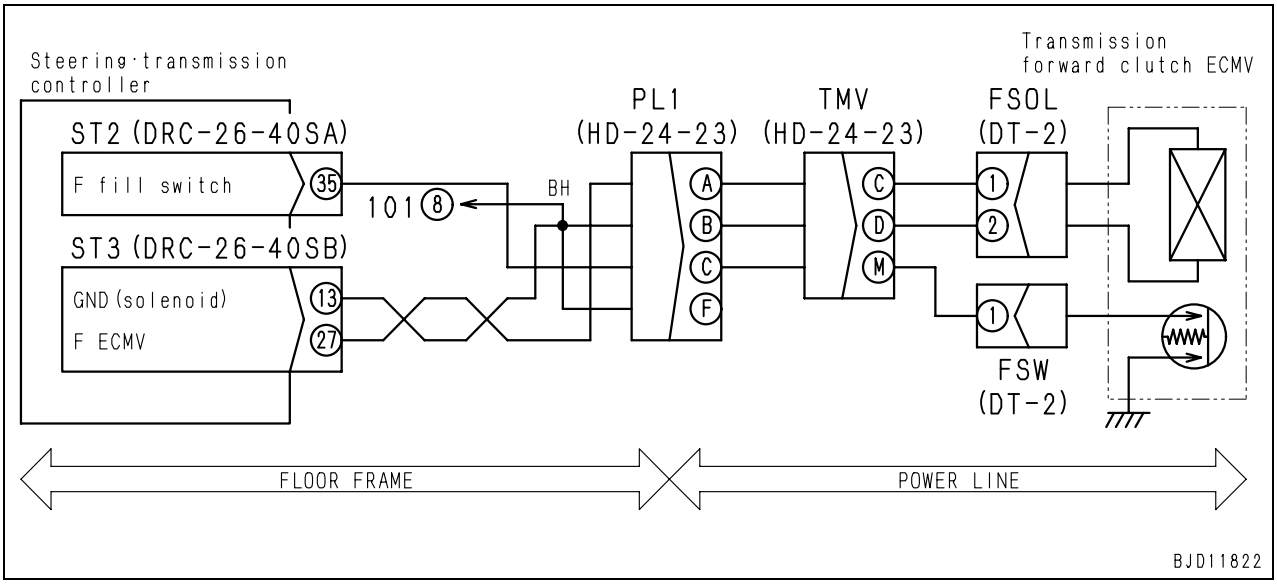


Failure code [DXH8KA] Forward clutch ECMV: Disconnection

Action code	Failure code	Symptom of failure	Forward clutch ECMV: Disconnection (Steering and transmission controller system)
CALL E03	**DXH8KA**		
Failure content	• Current does not flow when power is output to transmission forward clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission forward clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to R1.		
General information	• Output state (current) to forward clutch solenoid can be checked in monitoring mode. (Code 31608, 31622: Output current of forward clutch ECMV) • Duplication of failure code: Engine start + Forward travel		

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective forward clutch ECMV (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			FSOL (male)	Resistance		
			Between (1) – (2)	5 – 25 Ω		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST3 (female) (27) – FSOL (female) (1)	Resis-tance	Max. 1 Ω	
			Wiring harness between ST3 (female) (13) – FSOL (female) (2)	Resis-tance	Max. 1 Ω	
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST3 (female)	Resistance		
			Between (27) – (13)	5 – 25 Ω		

Circuit diagram related to transmission forward clutch ECMV

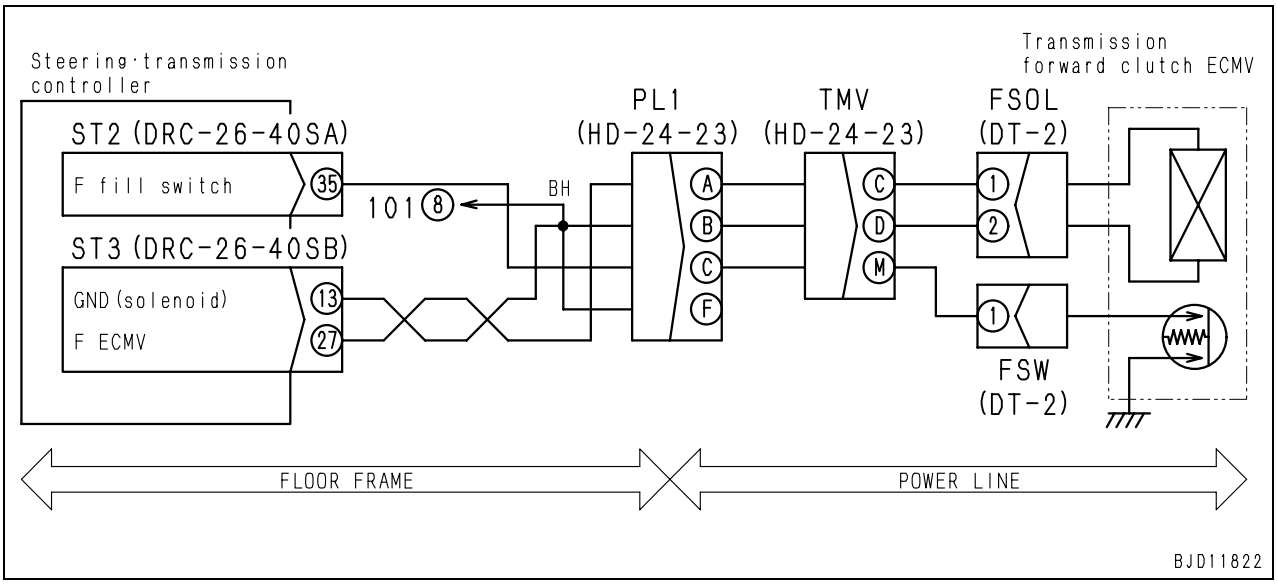


Failure code [DXH8KB] Forward clutch ECMV: Short circuit

Action code	Failure code	Symptom of failure	Forward clutch ECMV: Short circuit (Steering and transmission controller system)
CALL E03	**DXH8KB**		
Failure content	• Abnormal current flowed when power was output to transmission forward clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission forward clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to R1.		
General information	• Output state (current) to forward clutch solenoid can be checked in monitoring mode. (Code 31608, 31622: Output current of forward clutch ECMV) • Duplication of failure code: Engine start + Forward travel		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective forward clutch ECMV (Internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			FSOL (male)	Resistance	
			Between (1) – (2)	5 – 25 Ω	
			Between (1) – chassis ground	Min. 1 MΩ	
	2	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between ST3 (female) (27) – FSOL (female) (1)	Resis-tance	Min. 1 MΩ
	3	Harness short (Harness internal short)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harnesses between ST3 (female) (27) – FSOL (female) (1) and between ST3 (female) (13) – FSOL (female) (2)	Resis-tance	Min. 1 MΩ
	4	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			ST3 (female)	Resistance	
			Between (27) – (13)	5 – 25 Ω	
			Between (27) – chassis ground	Min. 1 MΩ	

Circuit diagram related to transmission forward clutch ECMV

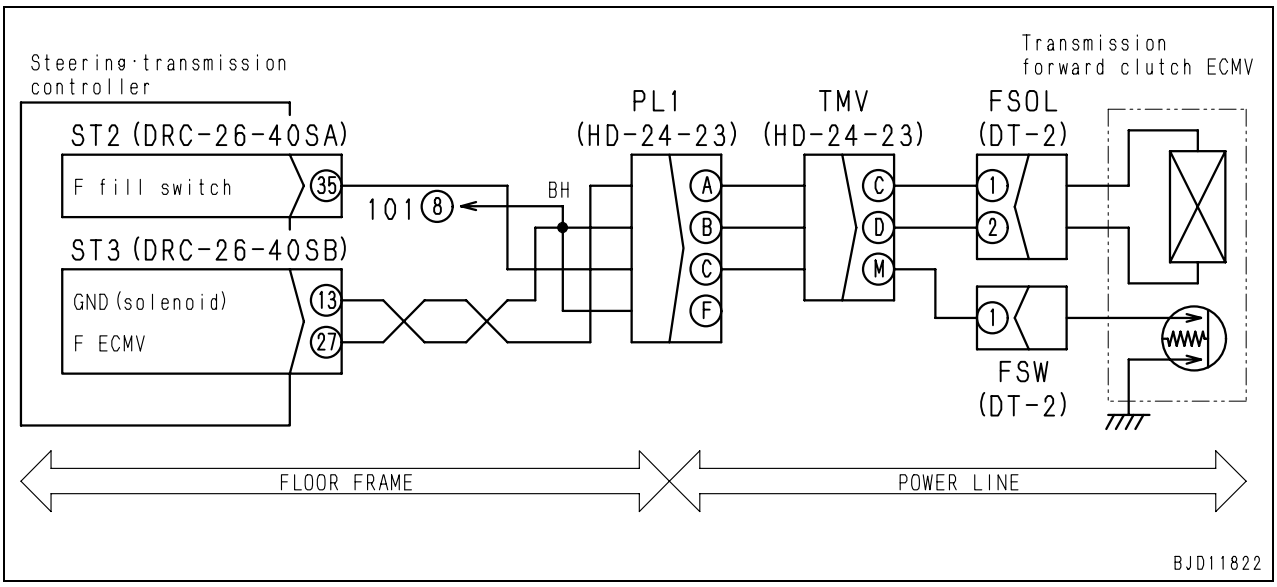


Failure code [DXH8KY] forward clutch ECMV: Short circuit to power source line

Action code	Failure code	Symptom of failure	Forward clutch ECMV: Short circuit to power source line (Steering and transmission controller system)
CALL E03	**DXH8KY**		
Failure content	• Current flows constantly to transmission forward clutch solenoid circuit.		
Controller's action	• Flashes warning lamp and turns on alarm buzzer. • Stops outputting to transmission forward clutch solenoid circuit. • Limits operation of engine and transmission.		
Symptoms that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1.		
General information	• Output state (current) to forward clutch solenoid can be checked in monitoring mode. (Code 31608, 31622: Output current of forward clutch ECMV) • Duplication of failure code: Engine start + Forward travel		

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective forward clutch ECMV (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			FSOL (male)	Resistance	
			Between (1) – (2)	5 – 25 Ω	
	2	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between ST3 (female) (27) – FSOL (female) (1)	Voltage	Max. 1 V
	3	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			ST3	PCCS lever	Voltage
			Between (27) – (13)	F	5 – 25 V
				N	Max. 1 V

Circuit diagram related to transmission forward clutch ECMV



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00592-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

Troubleshooting of electrical system (E-mode)

Troubleshooting of electrical system (E-mode)

Before troubleshooting of electrical system

Wiring table for fuse box

★ This wiring diagram shows apparatuses to which electric power is supplied through the fuse box. (A switching electric power supply supplies power with the starting switch ON. Constant electric power supply supplies power with starting switch either ON or OFF.)

★ When you do troubleshooting related to the electrical systems, you should first check the fuse or the fusible link to see whether the power is supplied normally or not.

Fuse box A [FS1]

Fuse No.	Electric supply source	Fuse capacity (A)	Destinations of electric power distribution
1	Switched electric power supply	20	Standby electric power supply
2		20	Horn, electrical intake air heater, air suspension seat
3		20	Front lamp, rear lamp
4		20	Steering and transmission controller (electric power supply to solenoid)
5		5	Engine controller (ACC signal)

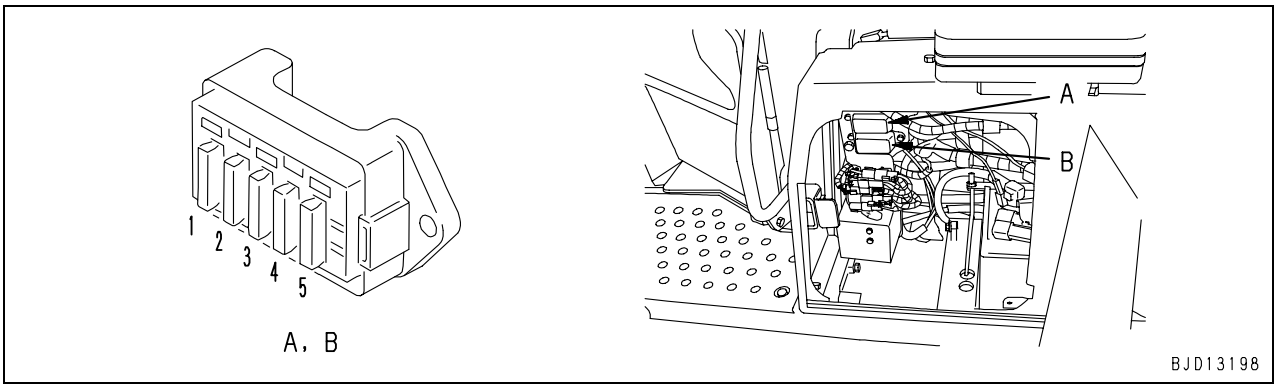
Fuse box B [FS2]

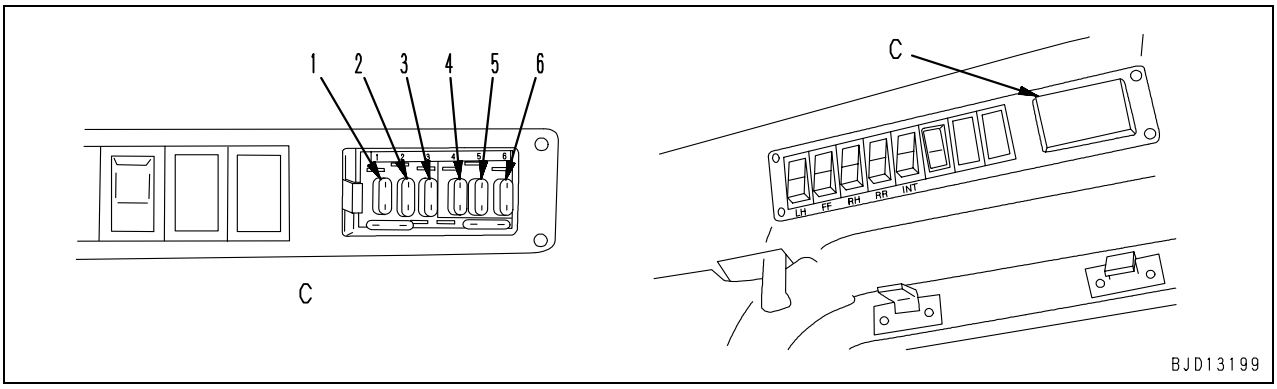
Fuse No.	Electric supply source	Fuse capacity (A)	Destinations of electric power distribution
1	Switched electric power supply	5	Backup alarm
2	Constant power source	15	Steering and transmission controller (main electric power supply), Radio
3		30	Electric power supply of machine (with 20A circuit breaker in the circuit)
4		30	Engine controller (main electric power supply)
5	Switched electric power supply	30	Air conditioner (with 20A circuit breaker in the circuit)

Cab fuse box C

Fuse No.	Electric supply source	Fuse capacity (A)	Destinations of electric power distribution
1	Switched electric power supply	10	Accessory electric power supply (12 V electric power supply)
2		20	Radio, room lamp, cigarette lighter, additional light
3		20	Glass with heating wire
4		10	Rear wiper
5		10	Front wiper
6		10	Left and right door wipers

Fuse installation position and No.





Contents of troubleshooting table

★ The following information is summarized in the troubleshooting table and the related electrical circuit diagram. Before carrying out troubleshooting, understand that information fully.

Symptom of failure	Symptom of failure **that has appeared in the machine**
General information	**Information related to troubles occurred or troubleshooting**

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	**Cause by which a trouble is assumed to be caused (The order number indicates a serial number, not a priority sequence.)**	**<Described contents>** • **Standard value when normal required to judge the possible cause** • **Remarks required to judge whether the cause is right or not** **<Symptoms of defective harness>** • **Disconnection in wiring** **The connector contact is defective or the wiring harness is disconnected.** • **Defective grounding** **A harness not connected to GND (ground) circuit comes into contact with the GND (ground) circuit.** • **Hot short defect** **A harness not connected to the electric power supply (24 V) circuit comes into contact with the electric power supply (24 V) circuit.** • **Short circuit** **A harness abnormally comes into contact with a harness of separate circuit.** **<Points to remember when troubleshooting>** **(1) Method of indicating connector numbers and handling T-adapter** **For troubleshooting, insert or connect the T- adapter as described below unless especially specified.** • **When "male" or "female" is not indicated for a connector number, disconnect the connector, and insert the T-adapter in both the male and female.** • **When "male"or "female" is indicated for a connector number, disconnect the connector, and insert the T-adapter in only either the male or female.** **(2) Pin number description sequence and tester lead handling** **For troubleshooting, connect the plus (+) and minus (–) leads of the tester as described below unless especially specified.** • **Connect the plus (+) lead to a pin number or harness indicated in the front.** • **Connect the minus (–) lead to a pin number or harness indicated in the rear.**
	2		
	3		
	4		

Related circuit diagram

- This is the excerpted circuit diagram related to troubleshooting.
- Connector No.: Indicates (model – number of pins) (color)
- Indication of "Connector No. and Pin No." from the branch or junction point: Indicates the branch destination or the splice location in the same harness
- Arrow (⇔)**: Indicates the approximate mounting place on machine**

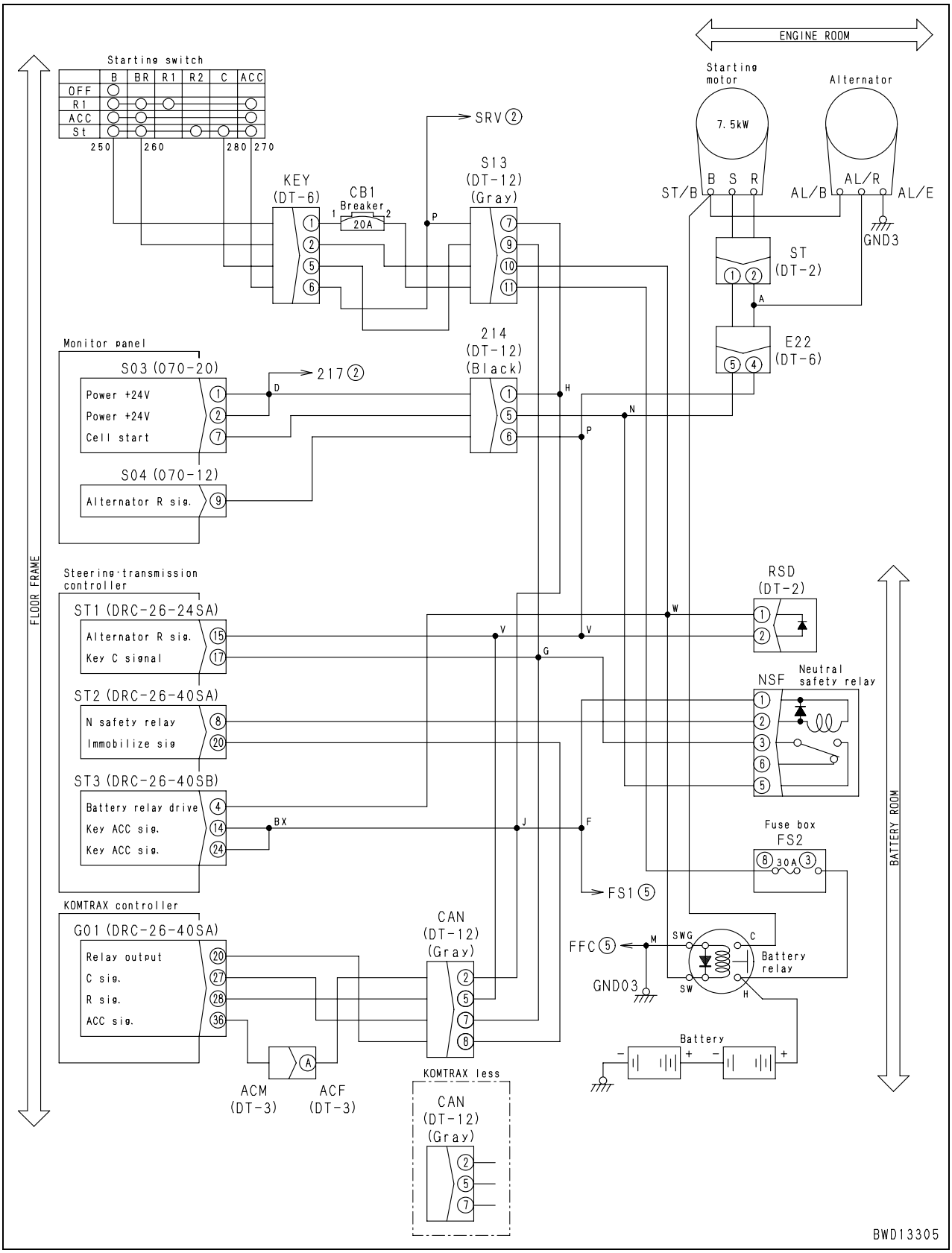
E-1 The engine does not start (the starting motor does not turn)

Symptom of failure	• The starting motor does not turn and accordingly the engine does not start.
General information	• Since the engine start circuit has the neutral safety function, the engine does not start unless the parking lever is in the lock position and the travel lever is in the neutral position. • Since KOMTRAX has the start lock function, the engine cannot be started unless the start lock function is canceled. • If “the monitor panel does not light up”or “the battery relay does not make operating sound” when turning the starting switch ON, the main electric power supply system is supposed to be defective. So, check the main electric power supply system. • Before starting the troubleshooting, validate that the related failure code is not displayed. (If the failure code [**D130KA**], [**D130KB**], [**DD14KA**], [**DD14KB**], [**DDQ2KA**] or [**DDQ2KB**] is displayed, conduct troubleshooting for the displayed code first.)

<table>
<tr><td rowspan="15">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="3">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Insufficient battery capacity</td><td>Battery voltage</td><td colspan="2">Battery specific gravity</td></tr>
<tr><td>Min. 25 V</td><td colspan="2">Min. 1.26</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Defective starting switch (internal disconnection)</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>Starting switch</td><td>Switch position</td><td>Resistance</td></tr>
<tr><td>Between 250(B) and 280(C)</td><td>OFF</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective parking lever switch (internal defect or defective adjustment)</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td rowspan="2">Monitor panel</td><td colspan="2">Parking lever</td></tr>
<tr><td>Free position</td><td>Lock position</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Defective neutral safety relay (internal disconnection)</td><td colspan="3">★ Prepare with starting switch OFF and start the engine to diagnose.</td></tr>
<tr><td colspan="3">If the engine starts in accordance with the engine starting operation after the neutral safety relay (NSF) is replaced with another one while the starting switch is set to OFF, the neutral safety relay is defective.</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Defective alternator (internal short circuit)</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td colspan="2">Alternator</td><td>Voltage</td></tr>
<tr><td colspan="2">Terminal R – ground</td><td>Max. 12 V</td></tr>
<tr><td rowspan="5">6</td><td rowspan="5">Detective starting motor (internal defect)</td><td colspan="3">★ Prepare with starting switch OFF and start the engine to diagnose.</td></tr>
<tr><td colspan="2">Starting motor</td><td>Voltage</td></tr>
<tr><td colspan="2">Electric power supply:
between terminal B and ground</td><td>20 – 30 V</td></tr>
<tr><td colspan="2">Charge:
between ST (2) and ground</td><td>Max. 12 V</td></tr>
<tr><td colspan="2">Starting:
between ST (1) and ground</td><td>20 – 30 V</td></tr>
<tr><td colspan="4">When each voltage of electric power supply, charging, and starting is normal but the starting motor does not rotate, the starting motor is defective.</td></tr>
</table>

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	7	Defective diode (internal short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Diagnose diode RSD (male) • See the “Inspection procedure of diode” in the “Testing and adjusting” section.		
	8	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between 280 (C) – NSF (female) (3)	Resistance	Max. 1 Ω
			Wiring harness between NSF (female) (5) – ST (female) (1)	Resistance	Max. 1 Ω
	9	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between ground and wiring harness between alternator terminal R – ST (female) (2), wiring harness between alternator terminal R – ST1 (female) (15), and wiring harness among alternator terminal R – S04 (female) (9) – G01 (female) (28)	Voltage	Max. 1 V
	10	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness between 280 (C) – NSF (female) (3)	Resistance	Min. 1 MΩ
			Between ground and wiring harness between NSF (female) (5) – ST (female) (1)	Resistance	Min. 1 MΩ
			Between ground and wiring harness between ST2 (female) (20) – G01 (female) (20)	Resistance	Min. 1 MΩ

Circuit diagram related to engine start and charge



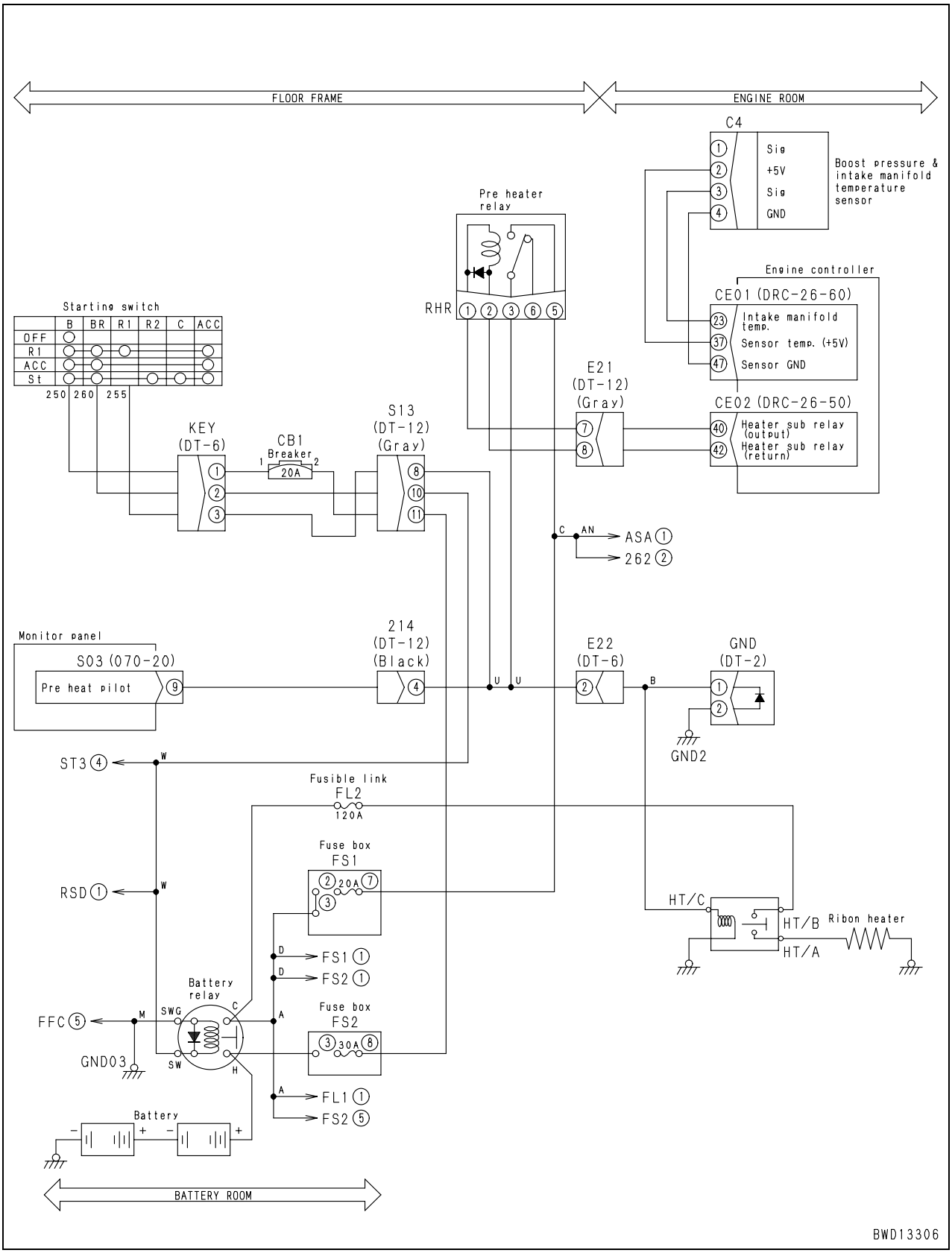
E-2 The preheater does not operate.

Symptom of failure	• The preheater does not operate.
General information	★ This troubleshooting describes the procedures to be followed when the automatic and manual preheating does not function to heat the electrical intake air heater mounting section. (When only the preheating lamp does not light up, carry out the troubleshooting of “E-7 The preheating pilot lamp does not light up”) • For preheating, both the “Automatic preheating function” and “Manual preheating function” are available. When either function is performed, the preheating lamp comes on. • If “the monitor panel does not light up ”or “the battery relay does not make operating sound” when turning the starting switch ON, the main electric power supply system is supposed to be defective. So, check the main electric power supply system. • Before starting the troubleshooting, validate that the related failure code is not displayed. (If the failure code [**CA153**], [**CA154**], [**CA2555**] or [**CA2556**] is displayed, firstly conduct this troubleshooting.)

<table>
<tr><td rowspan="15">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="3">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective starting switch (internal disconnection)</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>Starting switch</td><td>Switch position</td><td>Resistance</td></tr>
<tr><td>Between 250 (B) – 255 (R1)</td><td>OFF</td><td>Min. 1 MΩ</td></tr>
<tr><td></td><td></td><td></td><td>HEAT (R1)</td><td>Max. 1 Ω</td></tr>
<tr><td>2</td><td>Defective fuse (FL2, FS1, FS2)</td><td colspan="3">If fuse is burnt, it is highly possible that a defective harness grounding, etc. has occurred in the circuit.</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Defective preheater relay (internal disconnection)</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td colspan="3">If preheating starts normally at the intake air temperature below –5°C after the preheater relay RHR is replaced with another one, the preheater relay RHR is defective.</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Defective heater relay (internal defect)</td><td colspan="3">★ Prepare with the starting switch OFF and diagnose with the starting switch HEAT.</td></tr>
<tr><td colspan="2">Heater relay</td><td>Voltage</td></tr>
<tr><td colspan="2">Electric power supply:
between terminal HT/B and ground</td><td>20 – 30 V</td></tr>
<tr><td colspan="2">Signal:
between terminal HT/C and ground</td><td>20 – 30 V</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Defective diode (internal short circuit)</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">Diagnose diode GND (male)
• See the “Inspection procedure of diode” in the “Testing and adjusting” section.</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Defective electrical intake air heater (internal defect)</td><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Electrical intake air heater</td><td>Continuity</td></tr>
<tr><td colspan="2">Between terminals</td><td>Continue</td></tr>
</table>

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	7	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness among starting switch 255 (R1) – RHR (female) (3) – HT/C	Resis-tance	Max. 1 Ω
			Wiring harness between RHR (female) (5) – FS1 (7)	Resis-tance	Max. 1 Ω
			Wiring harness between battery relay terminal C – HT/B terminal	Resis-tance	Max. 1 Ω
			Wiring harness between heater relay HT/A terminal – electrical intake air heater	Resis-tance	Max. 1 Ω
	8	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground and wiring harness among starting witch 255 (R1) – RHR (3) – HT/C	Resis-tance	Min. 1 MΩ
			Between ground and wiring harness between RHR (female) (5) – FS1 (7)	Resis-tance	Min. 1 MΩ
			Between ground and wiring harness between battery relay terminal C – HT/B	Resis-tance	Min. 1 MΩ
			Between ground and wiring harness between heater relay HT/A – electrical intake air heater terminal	Resis-tance	Min. 1 MΩ

Circuit diagram related to engine preheat

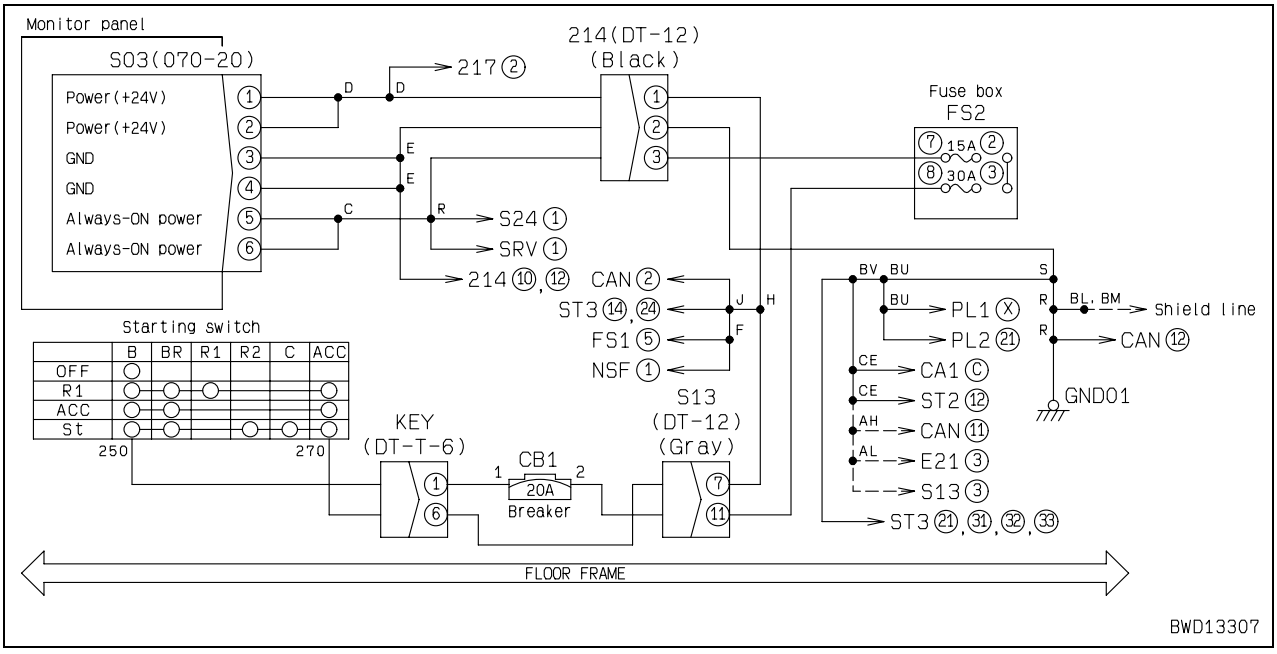


E-3 The monitor panel does not light up at all when the starting switch is turned ON.

Symptom of failure	• If “the battery relay does not make operating sound” when the starting switch is turned on, the main electric power supply system is supposed to be defective. So, check the main electric power supply system. • The monitor panel does not light up at all when the starting switch is turned ON.
General information	• When the starting switch is turned ON, the gear speed indicator, multi-information section, gauge section, and lamp section light up for approximately 2 sec. and then go out.

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fuse FS2-7	When the fuse FS2-7 is blown, the circuit probably has a grounding fault.		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between S03 (female) (1) (2) – starting switch 270 (ACC)	Resistance	Max. 1 Ω
			Wiring harness between S03 (female) (5) (6) – fuse FS2-7	Resistance	Max. 1 Ω
			Between ground and wiring harness between S03 (female) (3) (4) – GND01	Resistance	Max. 1 Ω
	3	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between ground wiring harness between S03 (female) (1) (2) – starting switch 270 (ACC)	Resistance	Min. 1 MΩ
			Between ground and wiring harness between S03 (female) (5) (6) – fuse FS2-7	Resistance	Min. 1 MΩ
	4	Defective monitor panel	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			S03	Voltage	
			Between (1) (2) – (3) (4)	20 – 30 V	
			Between (5) (6) – (3) (4)	20 – 30 V	

Circuit diagram related to electric power supply to monitor panel



E-4 When the starting switch is turned on, the monitor panel completely remains lighted and does not go out.

Symptom of failure	• When the starting switch is turned ON, the monitor panel completely remains lighted and does not go out.
General information	• When the starting switch is turned ON, the gear speed indicator, multi-information section, gauge section, and lamp section light up for approximately 2 sec. and then go out.

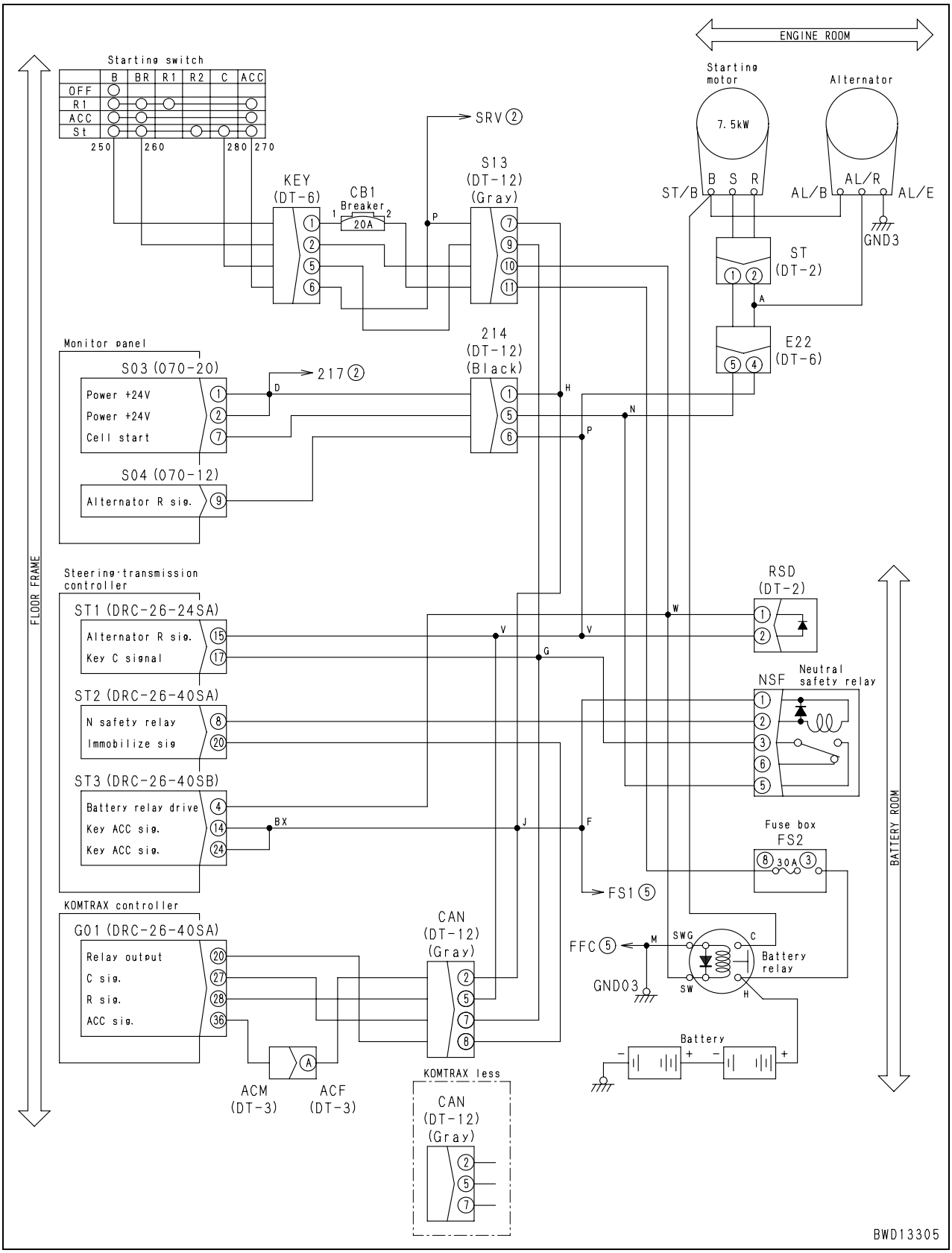
Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

E-5 While the engine is running, the battery charge level caution lamp flashes.

Symptom of failure	• The battery charge level caution lamp flashes.
General information	• When any abnormality is detected during engine operating, the battery charge level caution lamp flashes.

<table>
<tr><td rowspan="12">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="5">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective alternator (insufficient power generation)</td><td colspan="5">★ Prepare with starting switch OFF and start the engine to diagnose.</td></tr>
<tr><td>Alternator</td><td colspan="2">Engine speed</td><td colspan="2">Voltage</td></tr>
<tr><td>Terminal R – ground</td><td colspan="2">Min. medium speed (half)</td><td colspan="2">20 – 30 V</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection in wiring harness (Disconnection or defective contact of connectors)</td><td colspan="5">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">Wiring harness between S04 (female) (9) – alternator terminal R</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="3">Between ground and wiring harness between AL/E – GND3</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Defective harness grounding (Contact with ground circuit)</td><td colspan="5">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">Between ground and wiring harness between S04 (female) (9) – alternator R terminal, wiring harness between S04 (female) (9) – ST1 (female) (15), wiring harness among S04 (female) (9) – G01 (female) (28) – ST3 (female) (4), and wiring harness among S04 (female) (9) – starting switch 260 (BR) – SW (battery relay)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective monitor panel</td><td colspan="5">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>S04</td><td colspan="2">Engine speed</td><td colspan="2">Voltage</td></tr>
<tr><td>Between (9) – ground</td><td colspan="2">Min. medium speed (half)</td><td colspan="2">20 – 30 V</td></tr>
</table>

Circuit diagram related to engine start and charge



E-6 While the engine is running, the emergency warning item flashes.

Symptom of failure	(1) The engine oil pressure caution lamp flashes.
General information	• When any abnormality is detected during engine running, the engine oil pressure caution lamp flashes and the alarm buzzer sounds. • The engine oil pressure switch signal is used to communicate with the engine controller.

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Reduction of engine oil pressure (When system is normal)	Check the engine oil pressure as the drop of engine oil pressure is detected. • Carry out the troubleshooting of “S-12 The oil pressure drops.”
	2	Defective engine oil pressure system	When the possible cause 1 is not the real cause, the engine oil pressure switch circuit is supposed to be defective. So, carry out the troubleshooting of “Failure code [**CA435**] Abnormal engine oil pressure switch.”
	3	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

Symptom of failure	(2) The coolant temperature caution lamp flashes.
General information	• When any abnormality is detected while engine is running, the coolant temperature caution lamp flashes and the alarm buzzer sounds. • The coolant temperature caution lamp flashes or goes out in accordance with an indication on the engine coolant temperature gauge. • The input state (temperature) from the coolant temperature sensor can be checked in the monitoring mode. (Code 04104: Coolant temperature)

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Coolant overheats (When system is normal)	Since the coolant overheat is detected, check the coolant temperature. (At the coolant temperature over 105°C, the lamp flashes and the buzzer sounds. Over 102°C, just the lamp flashes.)
	2	Defective coolant temperature sensor system (Engine controller circuit)	When the cause 1 is not the real cause, the coolant temperature sensor circuit is supposed to be defective. So, carry out the troubleshooting of “E-8 The coolant temperature gauge does not indicate correctly.”
	3	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

Symptom of failure	(3) The power train oil temperature caution lamp flashes.
General information	• When any abnormality is detected while engine is running, the power train oil temperature caution lamp flashes and the alarm buzzer sounds. • The power train oil temperature caution lamp flashes or goes out in accordance with indication on the power train oil temperature gauge. • The input state (temperature) from the power train oil temperature sensor can be checked in the monitoring mode. (Code 30100: Power train oil temperature) • Before starting the troubleshooting, validate that the related failure code is not displayed. (If the failure code [**DGT1KA**] or [**DGT1KX**] is displayed, firstly diagnose the displayed code.)

		Cause	Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Power train oil temperature overheats (When system is normal)	Since the power train oil overheat is detected, check the power train oil temperature. (At the oil temperature over 130°C, the lamp flashes and the buzzer sounds. Over 120°C, just the lamp flashes.)
	2	Defective power train oil temperature sensor circuits (Monitor panel circuit)	When the cause 1 is not the real cause, the power train oil temperature sensor circuit is supposed to be defective. So, carry out the troubleshooting of “E-9 The power train oil temperature gauge does not indicate correctly.”
	3	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

Symptom of failure	(4) The hydraulic oil temperature caution lamp flashes.
General information	• When any abnormality is detected while engine is running, the hydraulic oil temperature caution lamp flashes and the alarm buzzer sounds. • The hydraulic oil temperature caution lamp flashes or goes out in accordance with indication on the hydraulic oil temperature gauge. • The input state (temperature) from the hydraulic oil temperature sensor can be checked at monitoring mode. (Code 04401: Hydraulic oil temperature) • Before starting the troubleshooting, validate that the related failure code is not displayed. (If the failure code [**DGS1KX**] is displayed, firstly diagnose the displayed code.)

		Cause	Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Hydraulic oil overheats (When system is normal)	Since the hydraulic oil overheat is detected, check the hydraulic oil temperature. (At the hydraulic oil temperature over 110°C, the lamp flashes and the buzzer sounds. Over 100°C, just the lamp flashes.)
	2	Defective hydraulic oil temperature sensor circuit (Monitor panel circuit)	When the cause 1 is not the real cause, the hydraulic oil temperature sensor circuit is supposed to be defective. So, carry out the troubleshooting of “E-10 The hydraulic oil temperature gauge does not indicate correctly”
	3	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

Symptom of failure	(5) The caution lamp of water level in the fuel filter lights up.
General information	• The caution lamp of water level in the fuel filter lights up when the water level in the water separator located under the fuel preheater rises, and goes out by draining the water.

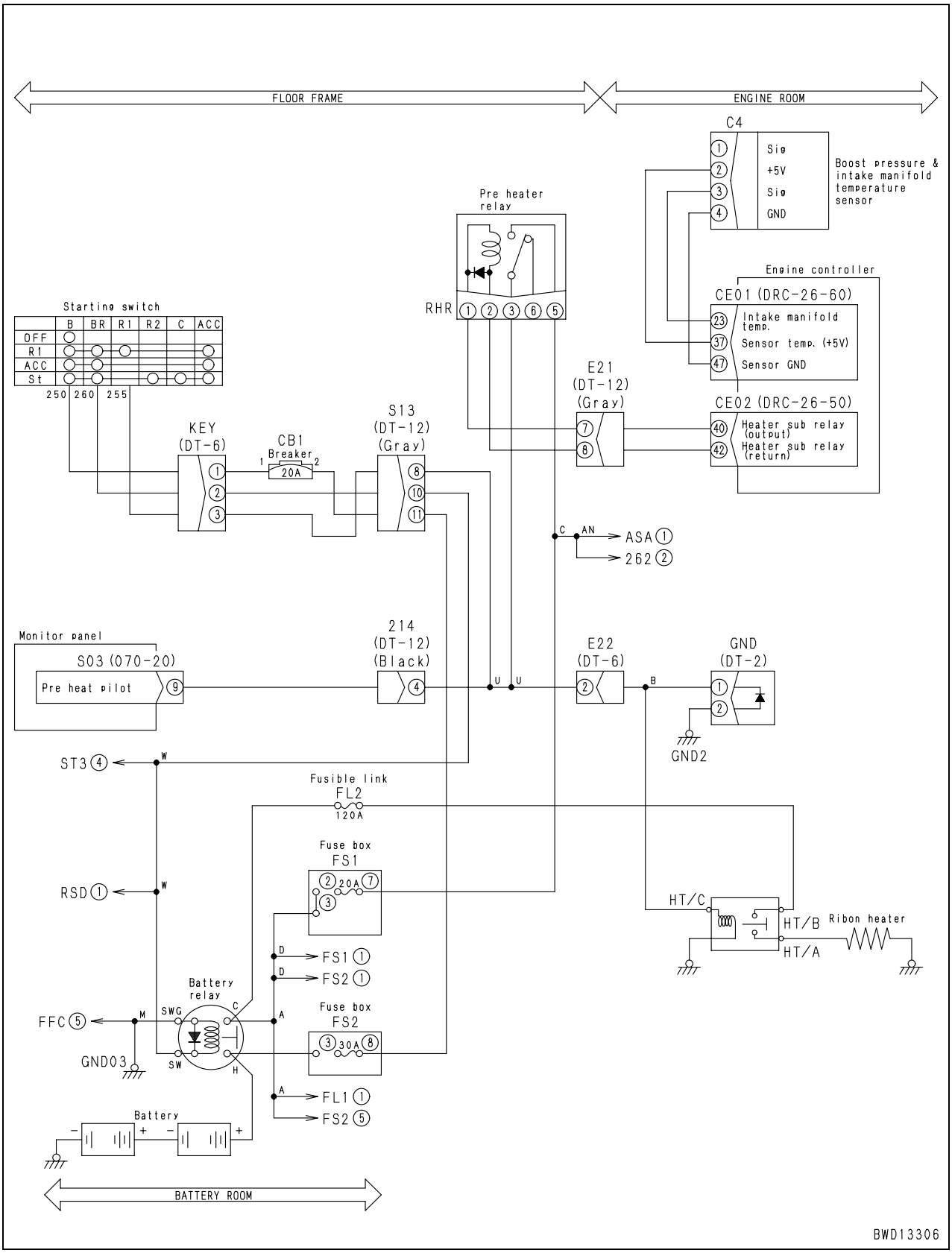
	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	The water level in the water separator rises. (When the system is normal.)	Since the water in the water separator is detected, check the water separator and drain the water.
	2	Defective fuel filter sensor circuit (Engine controller circuit)	When the possible cause 1 is not the real cause, the fuel filter circuit is supposed to be defective. So, carry out the troubleshooting of "Failure codes [**CA428**] [**CA429**] Abnormal water detection sensor"
	3	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

E-7 While the preheater is operating, the preheating pilot lamp does not light up.

Symptom of failure	While the preheater is operating, the preheating pilot lamp does not light up.
General information	★ This troubleshooting describes the procedures to be followed when the preheating lamp doe not light up. (When the electrical intake air heater mounting section is not heated, carry out the troubleshooting of “E-2 The preheater does not operate.”) • For preheating, both the “Automatic preheating function” and “Manual preheating function” are available. When either function is performed, the preheating lamp comes on.

<table>
<tr><td rowspan="8">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Disconnection in wiring harness
(Disconnection or defective contact of connectors)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harness between S03 (female) (9) – RHR (female) (3)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Defective harness grounding
(Contact with ground circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Between ground and wiring harness between S03 (female) (9) – RHR (female) (3)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Defective monitor panel</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>S03</td><td>Starting switch</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (9) – ground</td><td>ON</td><td colspan="2">Min. 1 V</td></tr>
<tr><td>HEAT</td><td colspan="2">Min. 7 V</td></tr>
</table>

Circuit diagram related to engine preheat



E-8 The coolant temperature gauge does not indicate correctly.

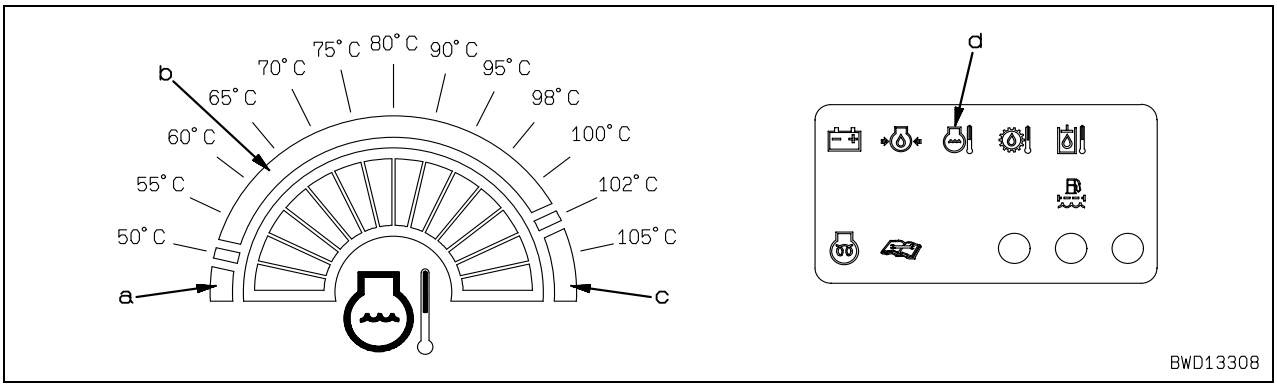
Symptom of failure	(1)Although the coolant temperature is rising normally, the indication of the coolant temperature stays in white range (a). (2)Although the coolant temperature is stabilized normally, the indication of the coolant temperature rises to red range (c).
General information	• Signals of the coolant temperature sensor are input into the engine controller and that information is transmitted to the monitor panel through communication system. • The input state (temperature) from the coolant temperature sensor can be checked in the monitoring mode. (Code 04104: Coolant temperature)

		Cause	Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Defective coolant temperature sensor circuit	Since the coolant temperature sensor circuit is supposed to be defective, carry out the troubleshooting of failure codes [**CA144**] and [**CA145**].
	2	Defective monitor panel	When the possible cause 1 is not the real cause, the monitor panel is supposed to be defective. (As it is an internal defect, it cannot be diagnosed.)

Symptom of failure	(3)The coolant temperature does not match to the indication of coolant temperature gauge. (4)The coolant temperature gauge does not match with the indication of coolant temperature monitor.
General information	• Signals of the coolant temperature sensor are input into the engine controller and that information is transmitted to the monitor panel through communication system. • The input state (temperature) from the coolant temperature sensor can be checked in the monitoring mode. (Code 04104: Coolant temperature)

		Cause	Standard value when normal and remarks for troubleshooting	
Possible causes and the standard values when normal	1	Defective monitor panel	★ Diagnose with starting switch ON or with engine started.	
			Caution lamp (d)	
			OFF	Flashing
			White range (a) Green range (b)	Red range (c)

Coolant temperature gauge and caution lamp



E-9 The power train oil temperature gauge does not indicate correctly.

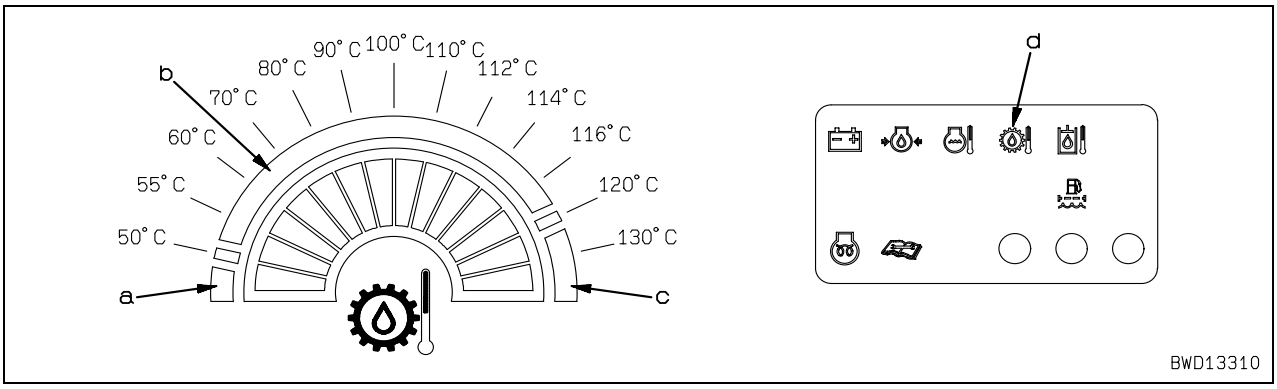
Symptom of failure	(1)Although the power train oil temperature is rising normally, the indication of the power train oil temperature stays in white range (a). (2)Although the power train oil temperature is stabilized normally, the indication of the power train oil temperature rises to red range (c).
General information	• The input state (temperature) from the power train oil temperature sensor can be checked in the monitoring mode. (Code 30100: Power train oil temperature) • If an abnormality takes place in the power train oil temperature sensor circuit, the failure code [**DGT1KA**] or [**DGT1KX**] may be displayed.

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective power train oil temperature sensor (internal disconnection or short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			453 (male)	Torque converter oil temperature	Resistance	
			Between (1) – (2)	10 – 100°C	3.5 – 90 kΩ	
			Between (1) – chassis ground		Min. 1 MΩ	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between S04 (female) (12) – 453 (female) (1)		Resistance	Max. 1 Ω
			Wiring harness between 453 (female) (2) – S03 (female) (3)		Resistance	Max. 1 Ω
	3	Defective grounding of wiring harness (a contact with GND circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between S04 (female) (12) – 453 (female) (1)		Resistance	Min. 1 MΩ
	4	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between S04 (female) (12) – 453 (female) (1)		Voltage	Max. 1 V
			Between ground and wiring harness between 453 (female) (2) – S03 (female) (3)		Voltage	Max. 1 V
	5	Defective monitor panel	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			S04 (female)	Power train oil temperature	Resistance	
			Between (12) – ground	10 – 100°C	3.5 – 90 kΩ	

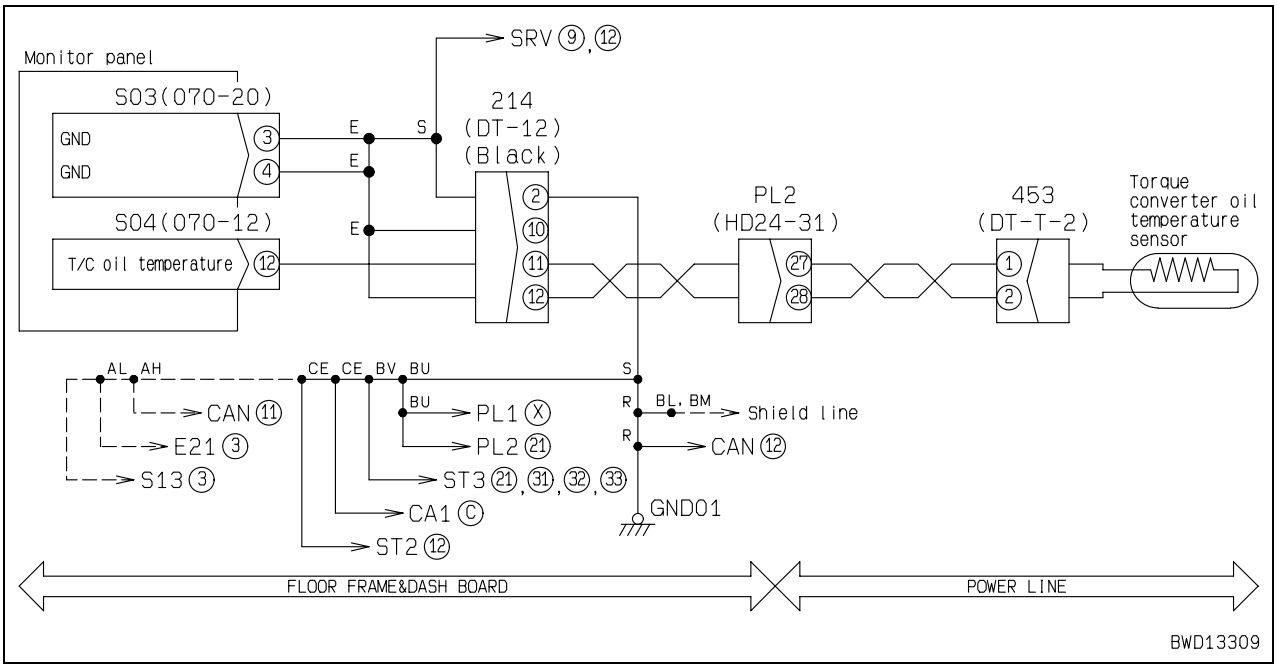
Symptom of failure	(3)The power train oil temperature does not match with the indication of oil temperature gauge. (4)The power train oil temperature gauge does not match with the indication of the power train oil temperature monitor.
General information	• The input state (temperature) from the power train oil temperature sensor can be checked in the monitoring mode. (Code 30100: Power train oil temperature)

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting	
			★ Diagnose with starting switch ON or with engine started.	
	1	Defective monitor panel	Caution lamp (d)	
			OFF	Flashing
			White range (a) Green range (b)	Red range (c)

Power train oil temperature gauge and caution lamp



Circuit diagram related to power train oil temperature sensor

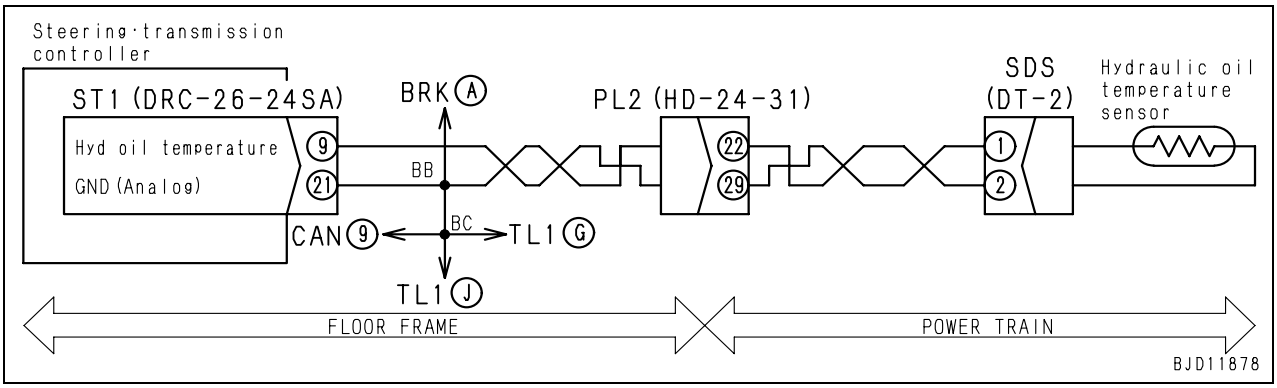


E-10 Hydraulic oil temperature gauge does not indicate properly.

Symptom of failure	(1)Though the hydraulic oil temperature rises normally, but the gauge indication does not rise from white range (a). (2)Although the hydraulic oil temperature is stabilized normally, but gauge indication rises to red range (c).
General information	• Signals of the hydraulic oil temperature sensor are inputted to the steering and transmission controller and the information is transmitted to monitor panel through communication system. • When any abnormality occurred in the hydraulic oil temperature sensor system, the failure code [**DGS1KX**] may be displayed. • The input state (temperature) from the hydraulic oil temperature sensor can be checked at monitoring mode. (Code: 04401 Hydraulic oil temperature)

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective hydraulic oil temperature sensor (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			SDS (male)	Resistance		
			Between (1) – (2)	3.5 – 90 kΩ		
			Between (1) – chassis ground	Min. 1 MΩ		
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between ST1 (female) (9) – SDS (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between ST1 (female) (21) – SDS (female) (2)	Resistance	Max. 1 Ω	
	3	Defective grounding of wiring harness (a contact with GND circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between ST1 (female) (9) – SDS (female) (1)	Resistance	Min. 1 MΩ	
	4	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between ST1 (female) (9) – SDS (female) (1)	Voltage	Max. 1 V	
			Between ground and wiring harness between ST1 (female) (21) – SDS (female) (2)	Voltage	Max. 1 V	
	5	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			ST1 (female)	Resistance		
			Between (9) – (21)	3.5 – 90 kΩ		
			Between (9) – ground	Min. 1 MΩ		
	6	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.			

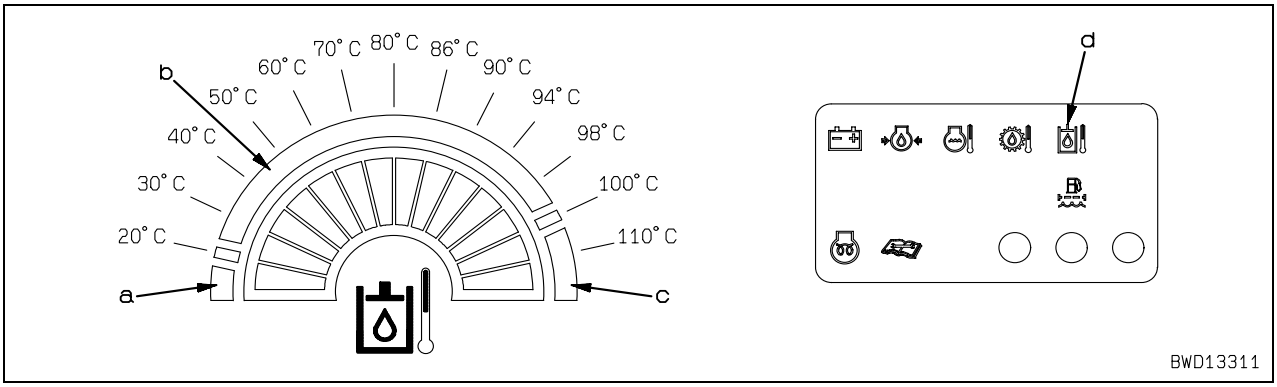
Circuit diagram related to hydraulic oil temperature sensor



Symptom of failure	(3)Actual temperature of the hydraulic oil and the indication of the oil temperature gauge do not match. (4)Indication of hydraulic oil temperature gauge and hydraulic oil temperature monitor do not match.
General information	• The input state (temperature) from the hydraulic oil temperature sensor can be checked at monitoring mode. (Code 04401: Hydraulic oil temperature)

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting	
			★ Diagnose with starting switch ON or with engine started.	
	1	Defective monitor panel	Caution lamp (d)	
			OFF	Flashing
			White range (a) Green range (b)	Red range (c)

Hydraulic oil temperature gauge and caution lamp

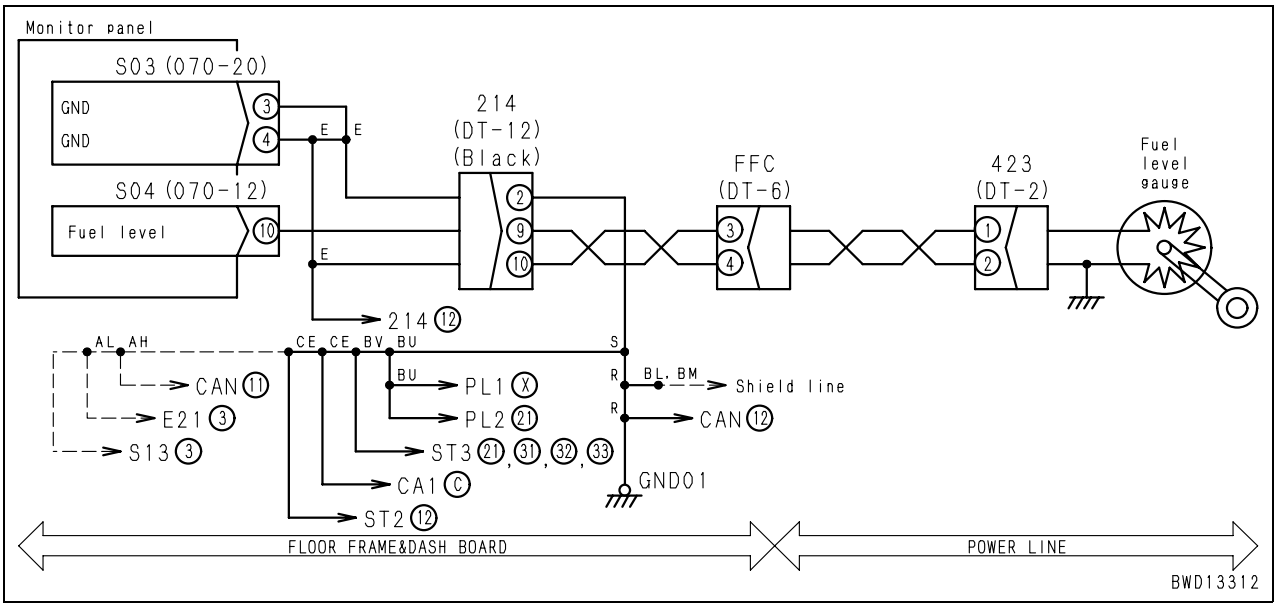


E-11 Fuel gauge does not indicate properly.

Symptom of failure	Fuel gauge does not indicate properly.
General information	• The input state (voltage signal) from the fuel level sensor can be checked in monitoring mode. (Code: 04200 Fuel level sensor voltage)

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective fuel level sensor (Internal disconnection and short circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			423 (male)	Fuel level	Resistance	
			Between (1) – (2) ground	Full	Approx. 4 Ω	
				Empty	Approx. 85 Ω	
	2	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between S04 (female) (10) – 423 (female) (1)		Resistance	Max. 1 Ω
			Wiring harness among 423 (female) (2) – S03 (female) (3), (4) – ground		Resistance	Max. 1 Ω
	3	Defective grounding of wiring harness (a contact with GND circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between S04 (female) (10) – 423 (female) (1)		Resistance	Min. 1 MΩ
	4	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between S04 (female) (10) – 423 (female) (1)		Voltage	Max. 1 V
			Between ground and wiring harness between 423 (female) (2) – S03 (female) (3) (4)		Voltage	Max. 1 V
	5	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.			

Circuit diagram related to fuel level sensor



E-12 Gear speed and engine speed are not indicated properly.

Symptom of failure	• Gear speed and engine speed are not indicated properly.
General information	• Signals of gear speed and engine speed are sent and received through communication by steering and transmission controller and engine controller.

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

E-13 The preset mode service meter does not indicate normally.

Symptom of failure	(1) During engine operation, the service meter does not advance.
General information	• The service meter measures time while the monitor panel is receiving engine drive signals (alternator signals). • The display data of the preset mode and service meter are sent and received through communication by the steering and transmission controller.

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective alternator signals system	When the battery charge level caution lamp flashes during engine operation, carry out the troubleshooting of “E-5 While the engine is operating, battery charge level caution flashes”.
	2	Defective monitor panel (Gauge or lamp module)	Since this is an internal defect, it cannot be diagnosed.

Symptom of failure	(2) Shift mode and service meter are not displayed at all.
General information	• The display data are sent and received through communication by the steering and transmission controller.

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

E-14 The warning lamp does not flash or does not go out.

Symptom of failure	• The warning lamp does not flash or does not go out.
General information	

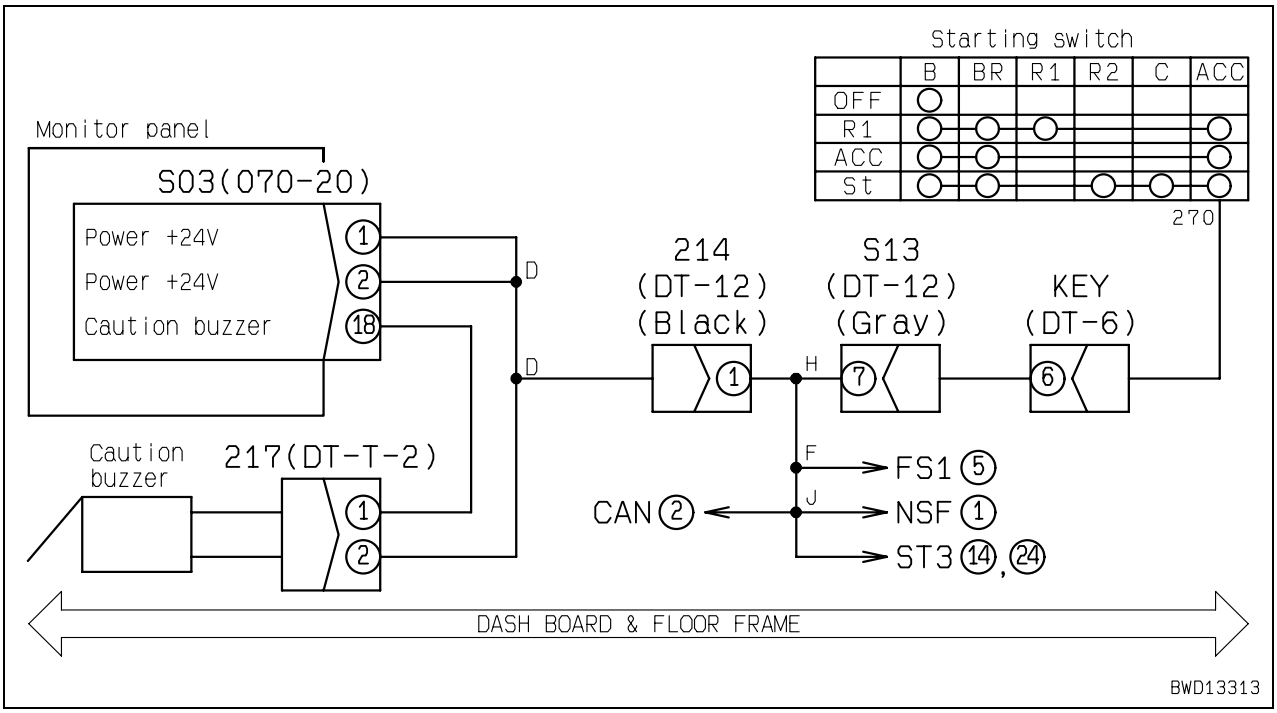
Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting
	1	Defective monitor panel	Since this is an internal defect, it cannot be diagnosed.

E-15 The alarm buzzer does not sound or does not stop.

Symptom of failure	• The alarm buzzer does not sound or does not stop.
General information	• When a short circuit occurs in the alarm buzzer system, the failure code [**DV00KB**] is displayed but no other failure codes are displayed.

<table>
<tr><td rowspan="16">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective starting switch (internal disconnection)</td><td colspan="4">★ Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td>Starting switch</td><td>Switch position</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (B) – 270 (ACC)</td><td>OFF</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td>ON(ACC)</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective alarm buzzer (Internal disconnection and short circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">217 (male)</td><td colspan="2">Continuity</td></tr>
<tr><td colspan="2">Between (2) – (1)</td><td colspan="2">Continue</td></tr>
<tr><td colspan="2">Between (1), (2) – ground</td><td colspan="2">No continuity</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Disconnection in wiring harness (Disconnection or defective contact of connectors)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harness between S03 (female) (18) – 217 (female) (1)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between 217 (female) (2) – starting switch 270 (ACC)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective grounding of wiring harness (a contact with GND circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Between ground wiring harness between starting switch 270 (ACC) – 271 (female) (2)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td colspan="2">Between ground and wiring harness between 217 (female) (1) – S03 (female) (18)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">Defective monitor panel (Gauge or lamp module)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>S03</td><td>Alarm buzzer</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (18) – ground</td><td>When stopping</td><td colspan="2">20 – 30 V</td></tr>
<tr><td>When turned ON (sounding)</td><td colspan="2">Max. 3 V</td></tr>
</table>

Circuit diagram related to alarm buzzer

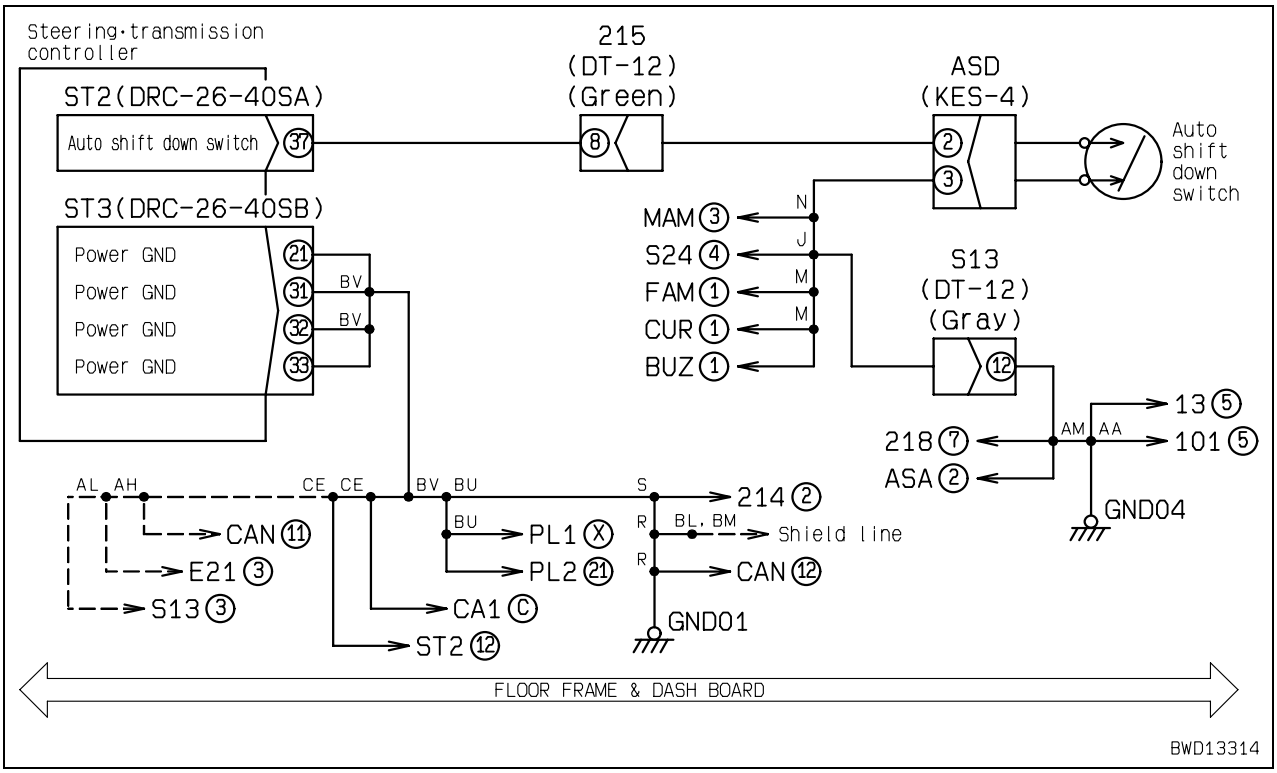


E-16 Auto shift down is not possible or is not released.

Symptom of failure	• Auto shift down is not possible or is not released.
General information	

<table>
<tr><td rowspan="11">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective auto shift down switch
(Internal disconnection or short circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>ASD (male)</td><td>Auto shift down switch</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (2) – (3)</td><td>OFF(0)</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td>ON(1)</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection in wiring harness
(Disconnection or defective contact of connectors)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harness between ST2 (female) (37) – ASD (female) (2)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between ASD (female) (3) – ground</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Defective grounding of wiring harness
(a contact with GND circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td colspan="2">Between ground and wiring harness between ST2 (female) (37) – ASD (female) (2)</td><td>Voltage</td><td>Max. 1 V</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Defective steering and transmission controller</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td rowspan="3">Between ST2 (37) – ST3 (21), (31), (32) and (33)</td><td>Auto shift down switch</td><td colspan="2">Voltage</td></tr>
<tr><td>OFF(0)</td><td colspan="2">5 – 11 V</td></tr>
<tr><td>ON(1)</td><td colspan="2">Max. 1 V</td></tr>
<tr><td>5</td><td>Limitation of function by controller</td><td colspan="4">When Causes 1 to 4 are not applicable, the steering and transmission controller may be restricting the function because of other causes.</td></tr>
</table>

Circuit diagram related to auto shift down switch

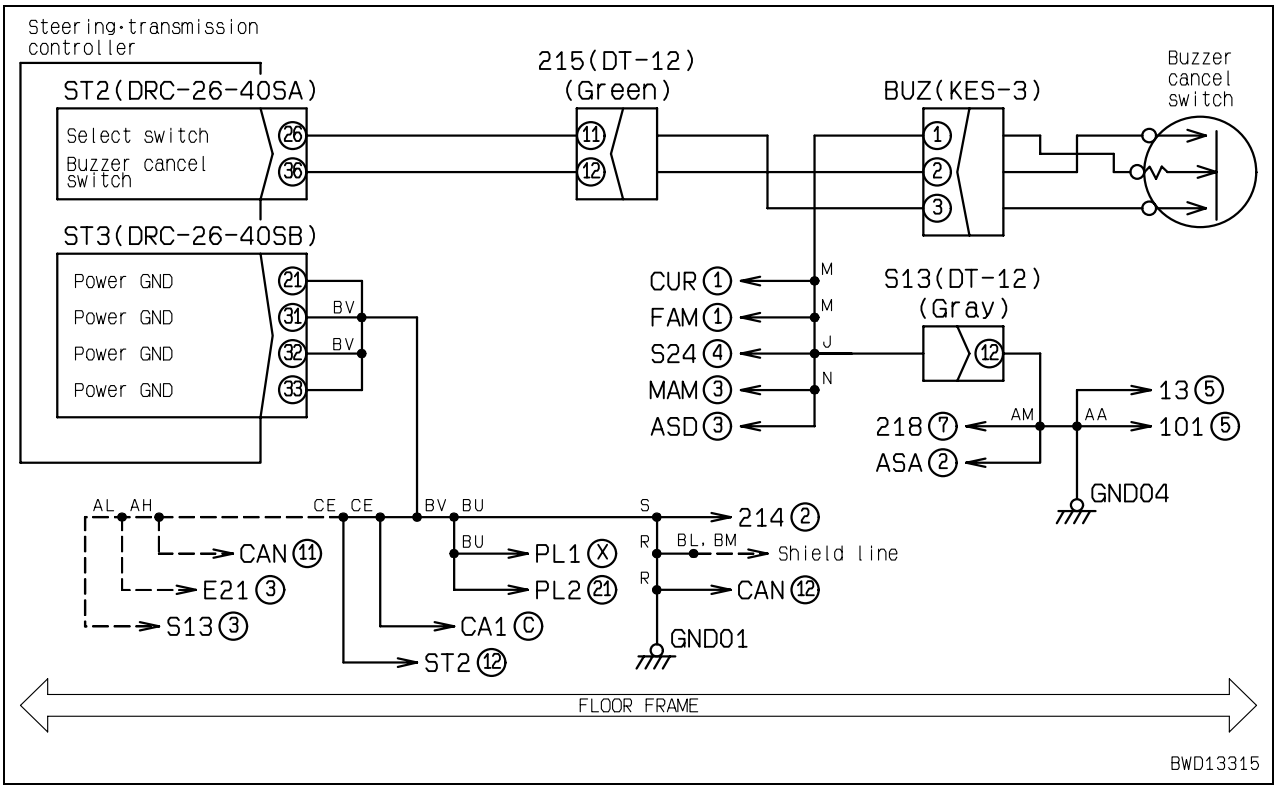


E-17 The buzzer cancel switch does not work.

Symptom of failure	• The buzzer cancel switch does not work.
General information	

<table>
<tr><td rowspan="15">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Defective buzzer cancel switch (Internal disconnection or short circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>BUZ (male)</td><td>Buzzer cancel switch</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (1) – (2)</td><td>OFF(0)</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td>■</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="2">Between (1) – (3)</td><td>OFF(0)</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td>◇</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Disconnection in wiring harness (Disconnection or defective contact of connectors)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harness between ST2 (female) (36) – BUZ (female) (2)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between ST2 (female) (26) – BUZ (female) (3)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between BUZ (female) (1) – GND04</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective harness grounding (Contact with ground circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Between ground and wiring harness between ST2 (female) (36) – BUZ (female) (2)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td colspan="2">Between ground and wiring harness between ST2 (female) (26) – BUZ (female) (3)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">Defective steering and transmission controller</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>Steering and transmission controller</td><td>Buzzer cancel switch</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between ST2 (36) – ST3 (21), (31), (32) and (33)</td><td>OFF(0)</td><td colspan="2">5 – 11 V</td></tr>
<tr><td>■</td><td colspan="2">Max. 1 V</td></tr>
<tr><td rowspan="2">Between ST2 (26) – ST3 (21), (31), (32) and (33)</td><td>OFF(0)</td><td colspan="2">5 – 11 V</td></tr>
<tr><td>◇</td><td colspan="2">Max. 1 V</td></tr>
</table>

Circuit diagram related to buzzer cancel switch

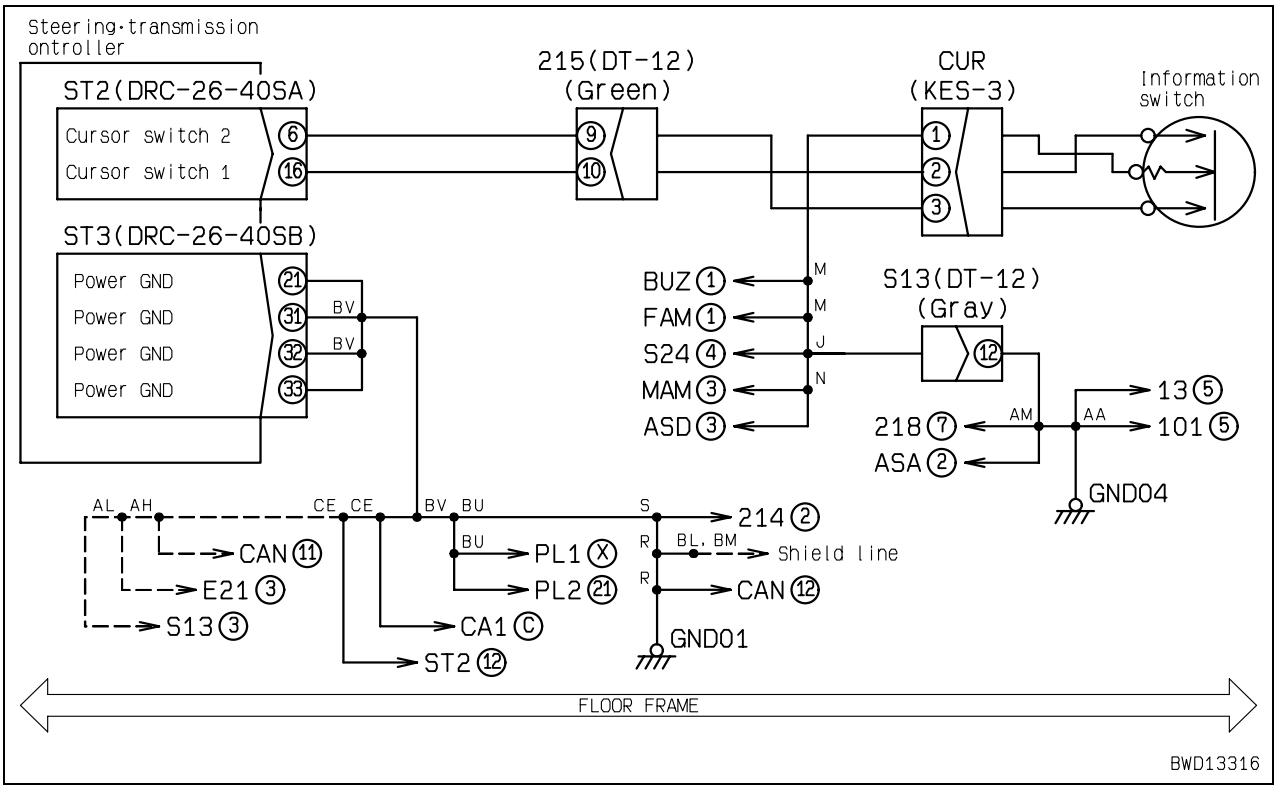


E-18 The information switch does not work.

Symptom of failure	• The information switch does not work.
General information	

<table>
<tr><td rowspan="15">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Defective information switch (Internal disconnection and short circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>CUR (male)</td><td>Information switch</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (1) – (2)</td><td>OFF(0)</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td>></td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="2">Between (1) – (3)</td><td>OFF(0)</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td>></td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Disconnection in wiring harness (Disconnection or defective contact of connectors)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harness between ST2 (female) (16) – CUR (female) (2)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between ST2 (female) (6) – CUR (female) (3)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between CUR (female) (1) – GND04</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective harness grounding (Contact with ground circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Between ground and wiring harness between ST2 (female) (16) – CUR (female) (2)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td colspan="2">Between ground and wiring harness between ST2 (female) (6) – CUR (female) (3)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">Defective steering and transmission controller</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>Steering and transmission controller</td><td>Information switch</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between ST2 (16) and ST3 (21), (31), (32), (33)</td><td>OFF(0)</td><td colspan="2">5 – 11 V</td></tr>
<tr><td>></td><td colspan="2">Max. 1 V</td></tr>
<tr><td rowspan="2">Between ST2 (6) and ST3 (21), (31), (32), (33)</td><td>OFF(0)</td><td colspan="2">5 – 11 V</td></tr>
<tr><td><</td><td colspan="2">Max. 1 V</td></tr>
</table>

Circuit diagram related to information switch

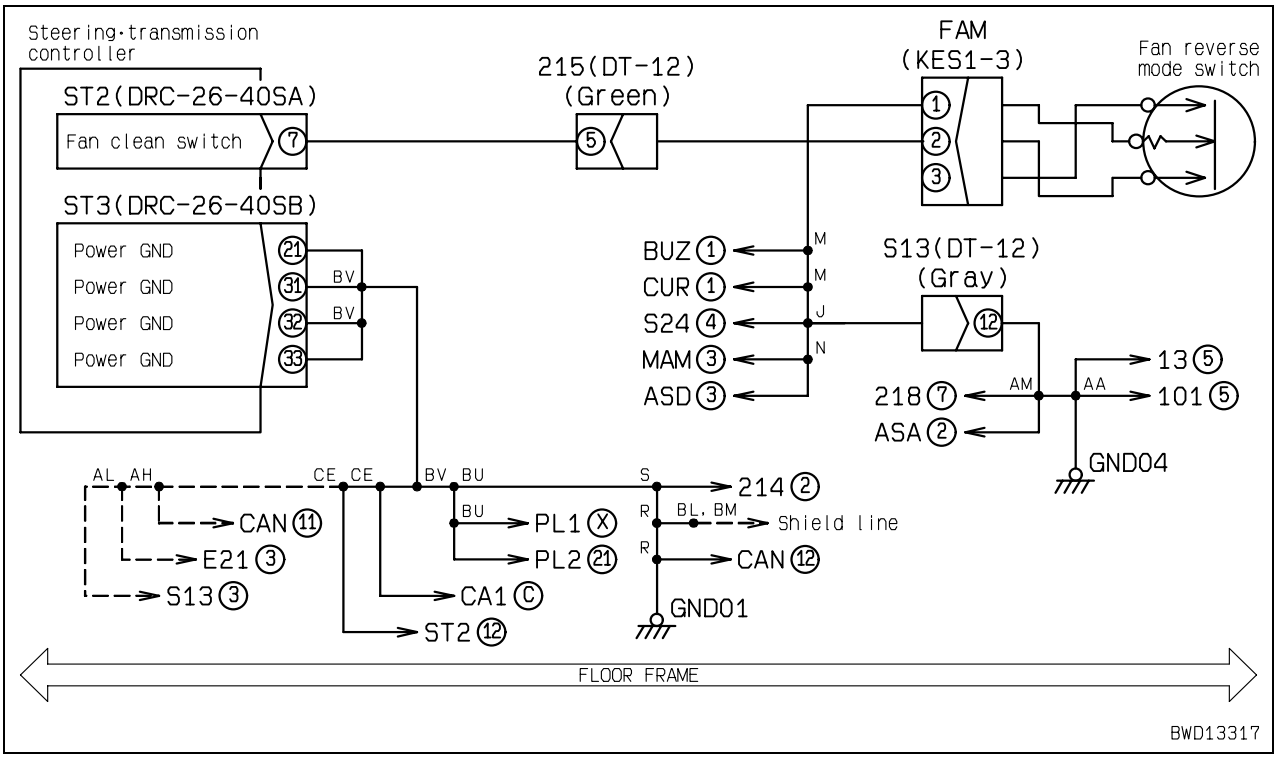


E-19 The fan cleaning does not operate or cannot be reset.

Symptom of failure	The fan cleaning does not operate or cannot be reset.
General information	★ This troubleshooting describes the procedures to be followed when the fan rotation selector switch is abnormal. • In case fan operation confirmation lamp correctly lights up and go off by switch operation, but fan does not reverse or reverses, carry out troubleshooting for failure codes [**DW7BKA**], [**DW7BKB**].

<table>
<tr><td rowspan="11">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective fan rotation selector switch
(Internal disconnection and short circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>FAM (male)</td><td>Fan rotation selector switch</td><td colspan="2">Resistance</td></tr>
<tr><td>Between (1) – (2)</td><td>OFF(0)</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection in wiring harness
(Disconnection or defective contact of connectors)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harness between ST2 (female) (7) – FAM (female) (2)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between FAM (female) (1) – GND04</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective harness grounding
(Contact with ground circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Between ground and wiring harness between ST2 (female) (7) – FAM (female) (2)</td><td>Resistance</td><td>Max. 1 MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective steering transmission controller</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>Steering and transmission controller</td><td>Fan rotation selector switch</td><td colspan="2">Voltage</td></tr>
<tr><td>Between ST2 (7) and ST3 (21), (31), (32), (33)</td><td>OFF(0)</td><td colspan="2">5 – 11 V</td></tr>
<tr><td></td><td></td><td>CLN</td><td colspan="2">Max. 1 V</td></tr>
</table>

Circuit diagram related to fan rotation selector switch

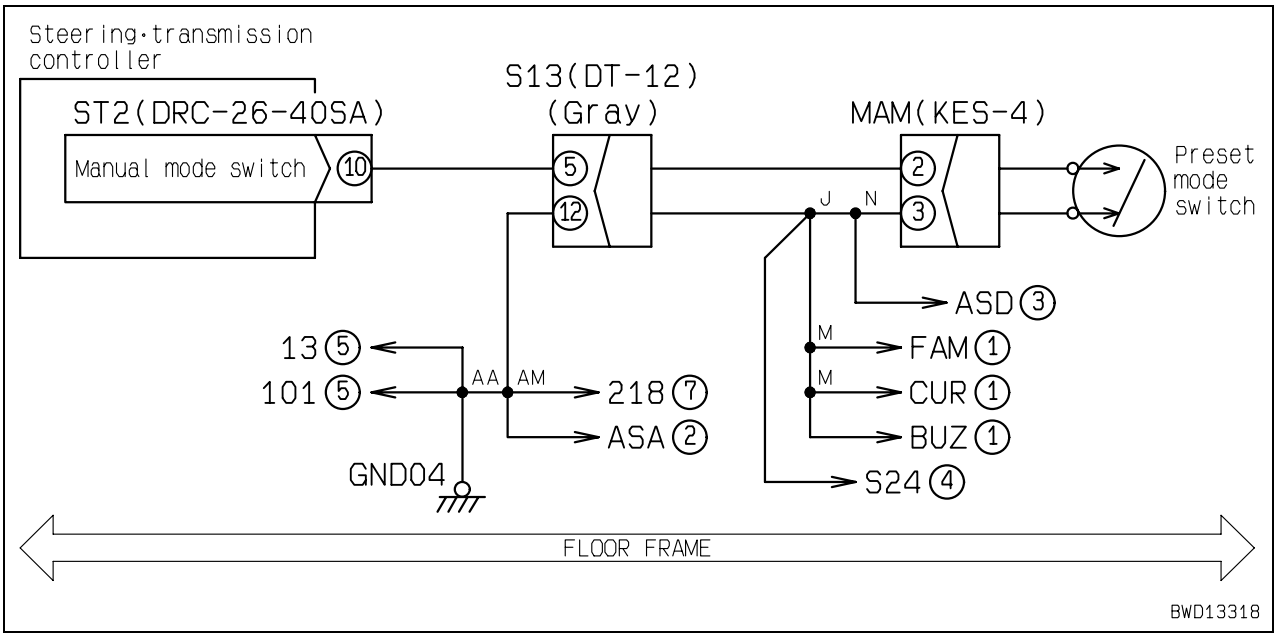


E-20 The preset mode does not operate or cannot be reset.

Symptom of failure	• The preset mode does not operate or cannot be reset.
General information	

<table>
<tr><td rowspan="11">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="4">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective manual mode switch (Internal disconnection)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>MAM (male)</td><td>Preset mode switch</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (2) – (3)</td><td>OFF(0)</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td>ON(1)</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Defective harness grounding (Disconnection in wiring or defective contact)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Wiring harness between ST2 (female) (10) – MAM (female) (2)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between MAM (female) (3) – ground</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Defective harness grounding (Contact with ground circuit)</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Between ground and wiring harness between ST2 (female) (10) – MAM (female) (2)</td><td>Resistance</td><td>Max. 1 MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective steering and transmission controller</td><td colspan="4">★ Prepare with starting switch OFF and diagnose with starting switch ON.</td></tr>
<tr><td>ST2</td><td>Preset mode switch</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (10) – ground</td><td>OFF(0)</td><td colspan="2">5 – 11 V</td></tr>
<tr><td>ON(1)</td><td colspan="2">Max. 1 V</td></tr>
<tr><td>5</td><td>Limitation of function by controller</td><td colspan="4">When Causes 1 to 4 are not applicable, steering and transmission controller may be limiting function because of another reason.</td></tr>
</table>

Circuit diagram related to preset mode

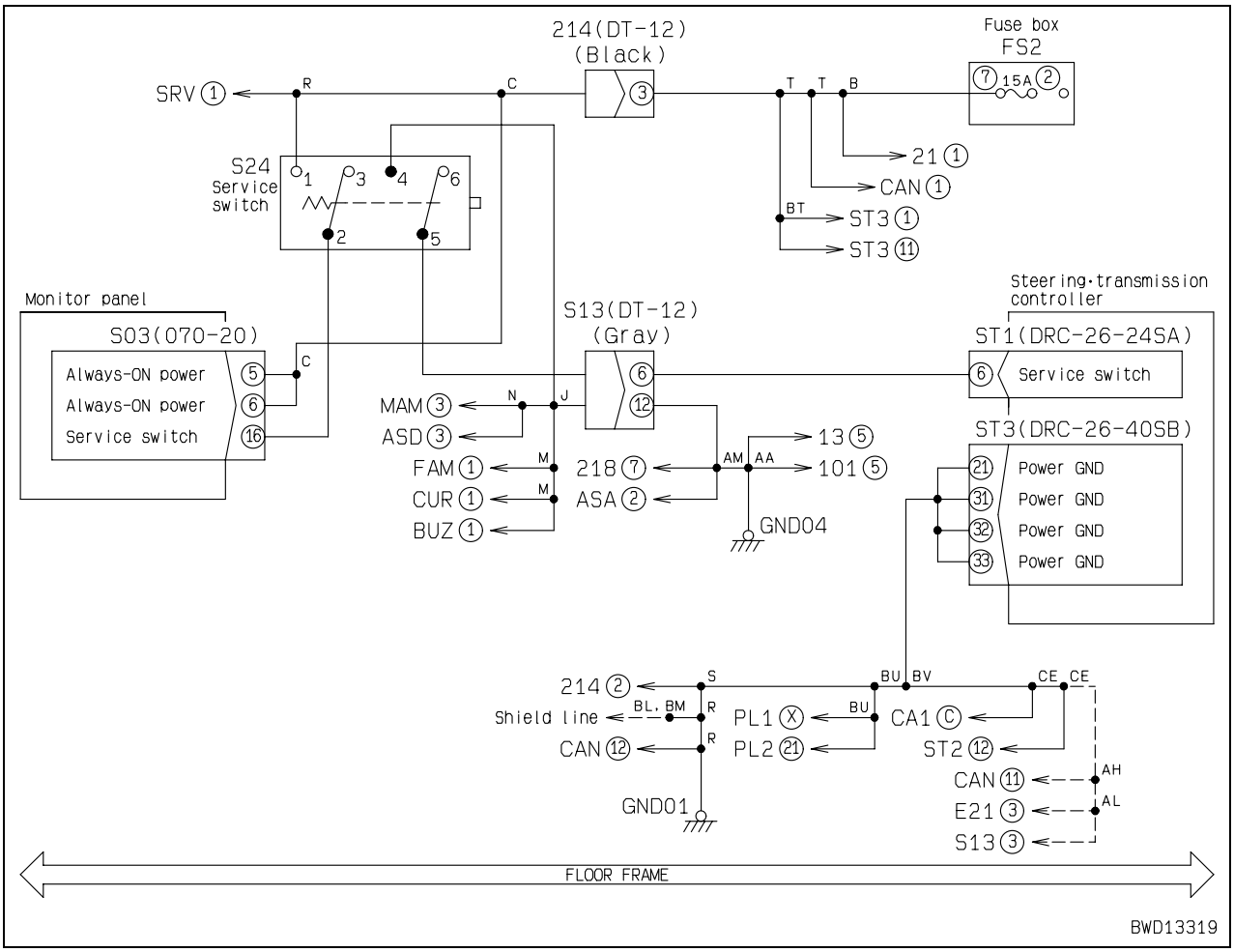


E-21 The monitor panel cannot be set in the service mode or cannot be set out of the service mode.

Symptom of failure	• The monitor panel cannot be set in the service mode or cannot be set out of the service mode.
General information	

		Cause	Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective buzzer cancel switch system	Since the buzzer cancel switch system is supposed to be out of order, carry out the troubleshooting of ”E-17 The buzzer cancel switch does not work”.			
	2	Defective information switch system	Since the information switch system is supposed to be out of order, carry out the troubleshooting of “E-18 The information switch does not work”.			
	3	Defective fuse FS2(7)	When the fuse FS2 (7) is cut off, a ground fault may have possibly occurred in the circuit.			
	4	Defective service switch (Internal short circuit or disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			S24	Service switch	Resistance	
			Between (1) – (2) Between (5) – (4)	OFF	Min. 1 MΩ	
				ON	Max. 1 Ω	
	5	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between FS2 (7) outlet – S24 (1)		Resistance	Max. 1 Ω
			Wiring harness between S24 (4) – ground		Resistance	Max. 1 Ω
			Wiring harness between S03 (female) (16) – S24 (2)		Resistance	Max. 1 Ω
			Wiring harness between ST1 (female) (6) – S24 (5)		Resistance	Max. 1 Ω
	6	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness among FS2 (7) – S24 (1) – S03 (female) (5) (6)		Resistance	Max. 1 MΩ
			Between ground and wiring harness between S24 (5) – ST1 (female) (6)		Resistance	Max. 1 MΩ
	7	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between S24 (2) – S03 (female) (16)		Voltage	Max. 1 V
	8	Defective monitor panel	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			S03	Service switch	Voltage	
			Between (16) – ground	OFF	Max. 1 V	
				ON	20 – 30 V	
	9	Defective steering and transmission controller	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			ST1	Service switch	Voltage	
			Between (6) – ground	OFF	5 – 11 V	
				ON	Max. 1 V	

Circuit diagram related to service switch

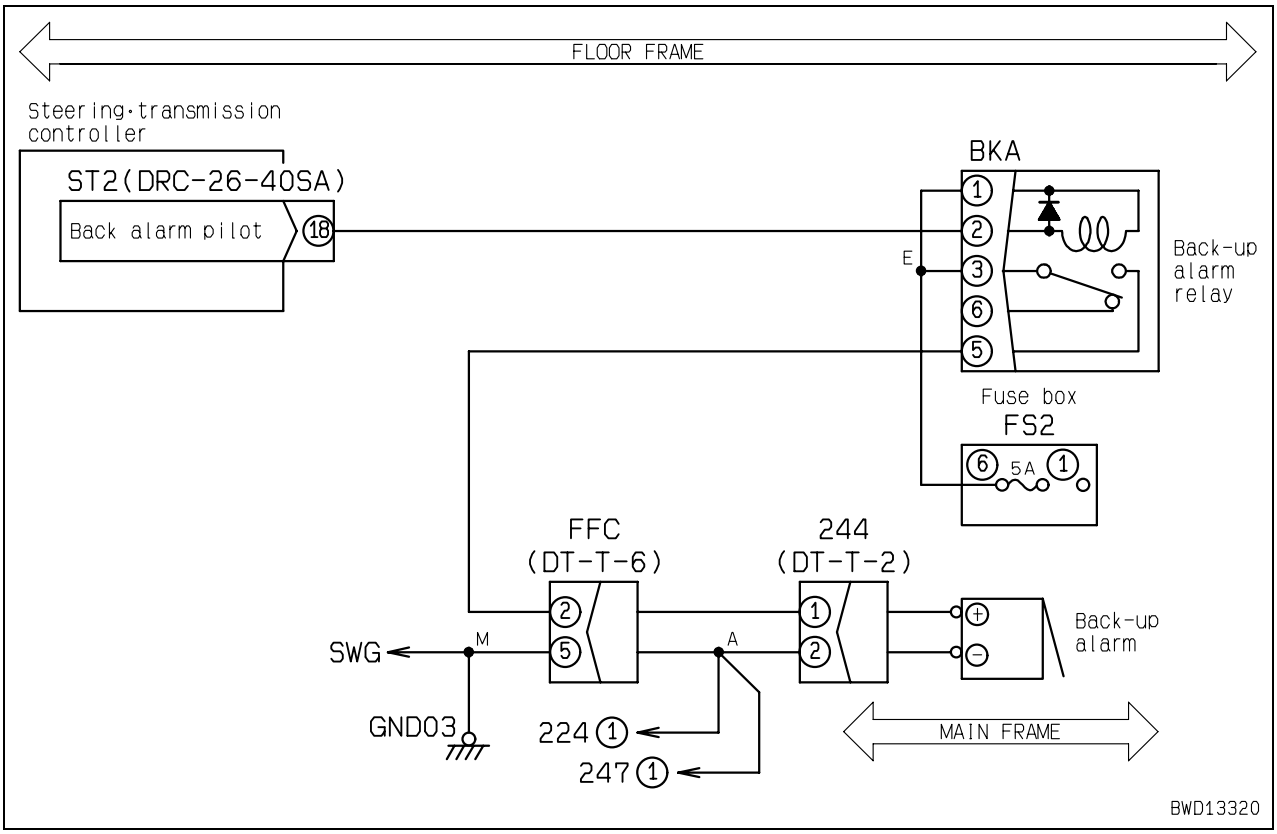


E-22 The back-up alarm does not sound.

Symptom of failure	• The back-up alarm does not sound.
General information	When a failure occurs on the primary side (coil side) of the back-up alarm relay, relevant failure codes [**D161KA**], [**D161KB**] are displayed, but in case of failure on the secondary side (contact side), no failure code is displayed.

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fuse (FS2-6)	When the fuse is blown, a ground fault may have probably occurred in the circuit.		
	2	Defective back-up alarm relay (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			When the relay is replaced with another relay while the starting switch is set to OFF and the alarm sounds after the starting switch is turned on and the machine is operated in reverse, the back-up alarm relay (BKA) is defective.		
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between FS2-6 – BKA (female) (1) (3)	Resistance	Max. 1 Ω
			Wiring harness between BKA (female) (2) – ST2 (female) (18)	Resistance	Max. 1 Ω
			Wiring harness between BKA (female) (5) and back-up alarm positive (+) terminal	Resistance	Max. 1 Ω
			Wiring harness between back-up alarm negative (–) terminal and GND03	Resistance	Max. 1 Ω
	4	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Between wiring harness related to FS2-6 and BKA (female) (1), (3) and ground	Resistance	Min. 1 MΩ
			Between wiring harness between BKA (female) (5) and back-up alarm positive (+) terminal and ground	Resistance	Min. 1 MΩ
	5	Defective back-up alarm (internal defect)	When Causes 1 to 4 are not applicable, the back-up alarm is supposed to be defective.		

Circuit diagram related to back-up alarm



E-23 The head lamp and rear lamp do not light up.

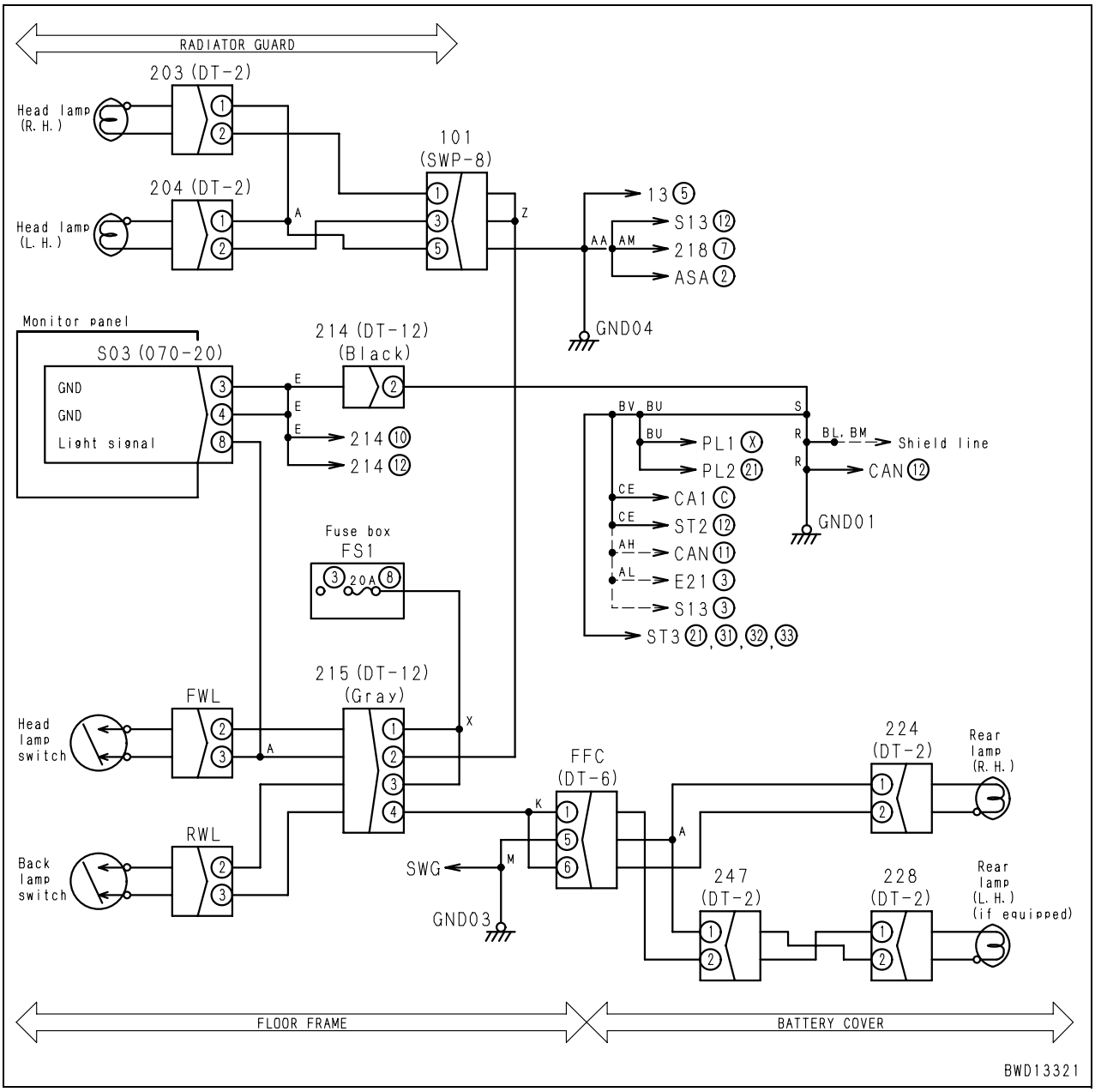
Symptom of failure	(1) The head lamp does not light up.
General information	

<table>
<tr><td rowspan="12">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="5">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td>1</td><td>Defective head lamp (Breakage of bulb)</td><td colspan="5">Since the head lamp may be defective, check its bulb for breakage.</td></tr>
<tr><td>2</td><td>Defective fuse (FS1-8)</td><td colspan="5">If the fuse is broken, the circuit probably has a grounding fault, etc.</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Defective head lamp switch (internal disconnection)</td><td colspan="5">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td>FWL (male)</td><td colspan="2">Switch</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (2) – (3)</td><td colspan="2">OFF</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td colspan="2">ON</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Disconnection in wiring harness (Disconnection or defective contact of connectors)</td><td colspan="5">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">Wiring harness between FWL (female) (2) – FS1-8</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="3">Wiring harness between FWL (female) (3) – 203 (female) (2) and 204 (female) (2)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="3">Wiring harness among 203 (female) (1) – 204 (female) (1) – GND04</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Defective harness grounding (Contact with ground circuit)</td><td colspan="5">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">Between ground and wiring harness between FWL (female) (2) – FS1-8</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td colspan="3">Between ground and wiring harnesses between FWL (female) (3) – 203 (female) (2) and FWL (female) (3) – 204 (female) (2)</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
</table>

Symptom of failure	(2) The rear lamp does not light up.
General information	

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting			
	1	Defective rear lamp (Breakage of bulb)	Since the rear lamp may be defective, check its bulb for breakage.			
	2	Defective fuse (FS1-8)	If the fuse is broken, the circuit probably has a grounding fault, etc.			
	3	Defective rear lamp switch (internal disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			RWL (male)	Switch	Resistance	
			Between (2) – (3)	OFF	Min. 1 MΩ	
				ON	Max. 1 Ω	
	4	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between RWL (female) (2) – FS1-8		Resistance	Max. 1 Ω
			Wiring harness between RWL (female) (3) – 224 (female) (2), 228 (female) (1)		Resistance	Max. 1 Ω
			Wiring harness among 224 (female) (1) – 228 (female) (2) – GND03		Resistance	Max. 1 Ω
	5	Defective harness grounding (Contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between RWL (female) (2) – FS1-8		Resistance	Min. 1 MΩ
			Between ground and wiring harnesses between RWL (female) (3) – 224 (female) (2) and RWL (female) (3) – 228 (female) (1)		Resistance	Min. 1 MΩ

Circuit diagram related to panel lamp, head lamp and rear lamp

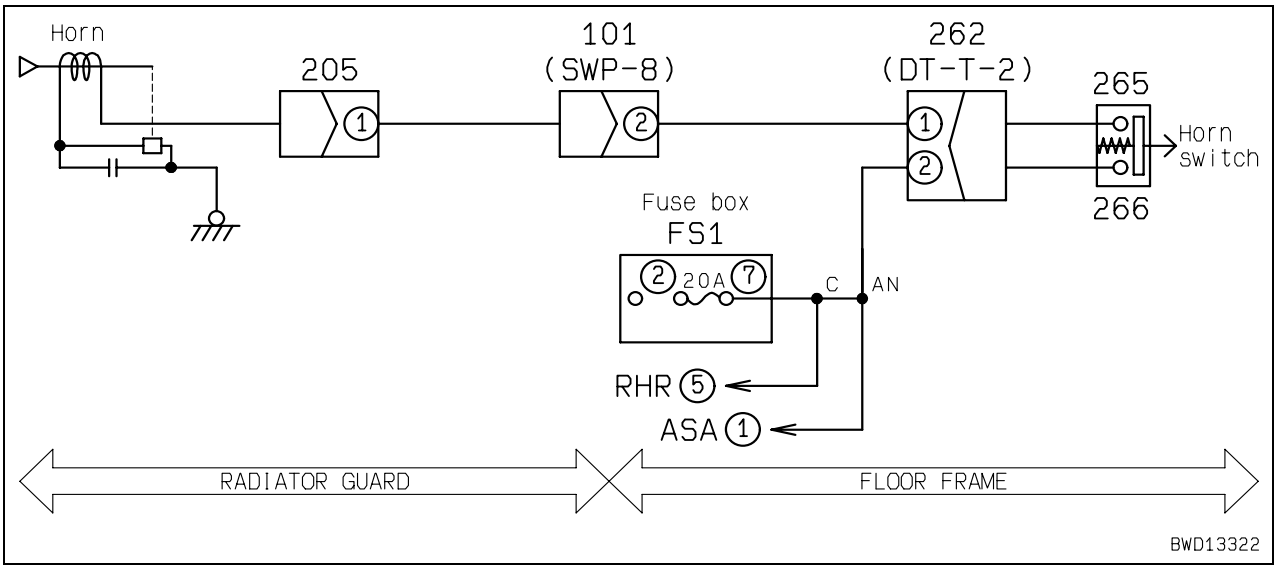


E-24 The horn does not sound or does not stop.

Symptom of failure	• The horn does not sound or does not stop.
General information	

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting			
	1	Disconnection of fuse (FS1-7)	If fuse is burnt, it is highly possible that a defective harness grounding, etc. has occurred in the circuit.			
	2	Defective horn switch (Internal short circuit and disconnection)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Terminal (switch)	Horn switch	Resistance	
			265 – 266	OFF	Min. 1 MΩ	
				ON	Max. 1 Ω	
	3	Disconnection in wiring harness (Disconnection or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between FS1-7 – 266		Resistance	Max. 1 Ω
			Wiring harness between 265 – 205 (female) (1)		Resistance	Max. 1 Ω
	4	Defective grounding of wiring harness (a contact with GND circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Between ground and wiring harness between FS1-7 – 266		Resistance	Min. 1 MΩ
			Between ground and wiring harness between 265 – 205 (female) (1)		Resistance	Min. 1 MΩ
	5	Hot short of wiring harness (a contact with 24 V circuit)	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between ground and wiring harness between 265 – 205 (female) (1)		Voltage	Max. 1 V
	6	Defective horn (Internal defect)	When Causes 1 to 5 are not applicable, the horn is supposed to be defective.			

Circuit diagram related to horn



E-25 Malfunction of wipers

Symptom of failure	(1) The front wiper does not operate. (Continuous operation is defective.)
General information	• When only the front wiper is defective • If fuse (5) in the cab is blown, intermittent operation of the all wipers becomes defective. • If any wiper does not operate, check fusible link (FL1). • Diagnose with intermittent switch OFF and with wiper switch ON.

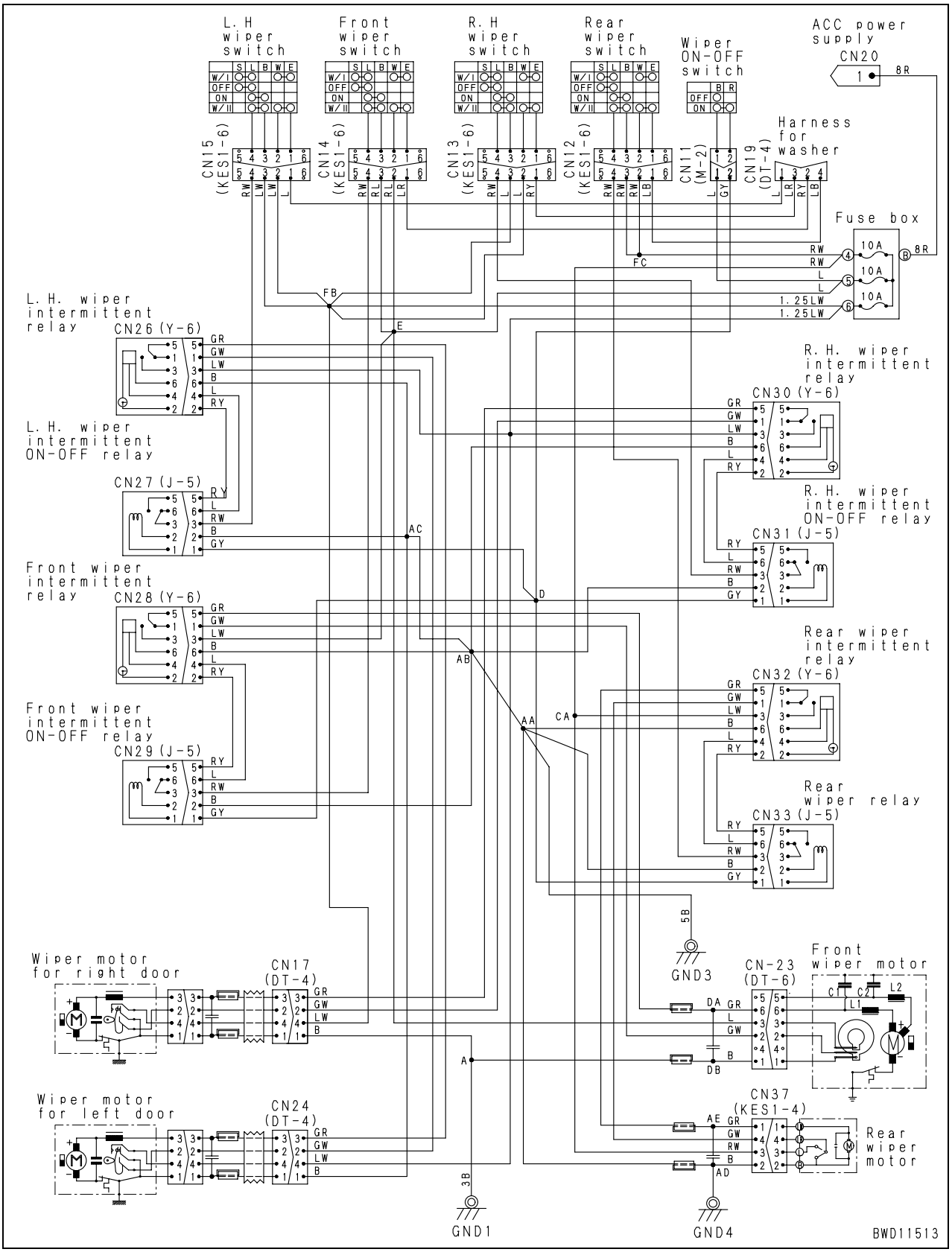
	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fusible link (FL1)	If the fusible link is burnout, the circuit probably has a grounding fault, etc.		
	2	Defective fuse (5) in cab	Since fuse (5) in the cab is used for the front wiper circuit and intermittent switch circuit, either circuit of those two probably have a grounding fault, etc.		
	3	Defective front wiper motor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN23 (6) – ground	Voltage	20 – 30 V
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN23 (female) (1) – ground	Resistance	Max. 1 Ω
	4	Defective front wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CN14 (male)	Position of switch	Resistance
			Between (3) – (4)	ON	Max. 1 Ω
				OFF	Min. 1 MΩ
	5	Defective front wiper intermittent selector relay	• If the problem is eliminated by replacing the relay (CN27), (CN31) or (CN33) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN29 (3) – ground	Voltage	20 – 30 V
			Between CN29 (6) – ground	Voltage	20 – 30 V
			Between CN29 (1) – ground	Voltage	Max. 1 V
	6	Defective front wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN26), (CN30) or (CN32) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN28 (4) – ground	Voltage	20 – 30 V
			Between CN28 (3) – ground	Voltage	20 – 30 V
			Between CN28 (5) – ground	Voltage	20 – 30 V

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	7	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN14 (female) (4) – CN29 (female) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN14 (female) (4) – CN29 (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness between CN29 (female) (6) – CN28 (female) (4)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN29 (female) (6) – CN28 (female) (4)	Resistance	Min. 1 MΩ
			Wiring harnesses between fuse (5) – CN14 (female) (2) (3) and CN23 (female) (3) – CN28 (female) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harnesses between fuse (5) – CN14 (female) (2) (3) and CN23 (female) (3) – CN28 (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness between CN28 (female) (5) – CN23 (female) (6)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN28 (female) (5) – CN23 (female) (6)	Resistance	Min. 1 MΩ
			Wiring harness between CN28 (female) (6) – ground	Resistance	Max. 1 Ω
			Wiring harness between CN23 (female) (1) – ground	Resistance	Max. 1 Ω

Symptom of failure	(2) Front wiper malfunctions in the intermittent mode.
General information	• When the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • The wiper stops for about 5 seconds after a single wiping operation.

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper also malfunctions in the intermittent mode, the intermittent switch is probably defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CN11 (male)	Position of switch	Resistance
			Between (1) – (2)	ON	Max. 1 Ω
				OFF	Min. 1 MΩ
	2	Defective front wiper intermittent selector relay	• If the problem is eliminated by replacing the relay (CN27), (CN31) or (CN33) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN29 (1) – ground	Voltage	20 – 30 V
			Between CN29 (5) – ground	Voltage	20 – 30 V
	3	Defective front wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN26), (CN30) or (CN32) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN28 (2) – ground	Voltage	20 – 30 V
	4	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN11 (female) (2) – CN29 (female) (1)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN11 (female) (2) – CN29 (female) (1)	Resistance	Min. 1 MΩ
			Wiring harness between CN29 (female) (5) – CN28 (female) (2)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN29 (female) (5) – CN28 (female) (2)	Resistance	Min. 1 MΩ
			Wiring harness between CN29 (female) (2) – ground	Resistance	Max. 1 Ω

Circuit diagram related to wiper system



Symptom of failure	(3) The rear wiper does not operate (Continuous operation is defective)
General information	• When only the rear wiper is defective • If any wiper does not operate, check fusible link (FL1). • Diagnose with intermittent switch OFF and with wiper switch ON.

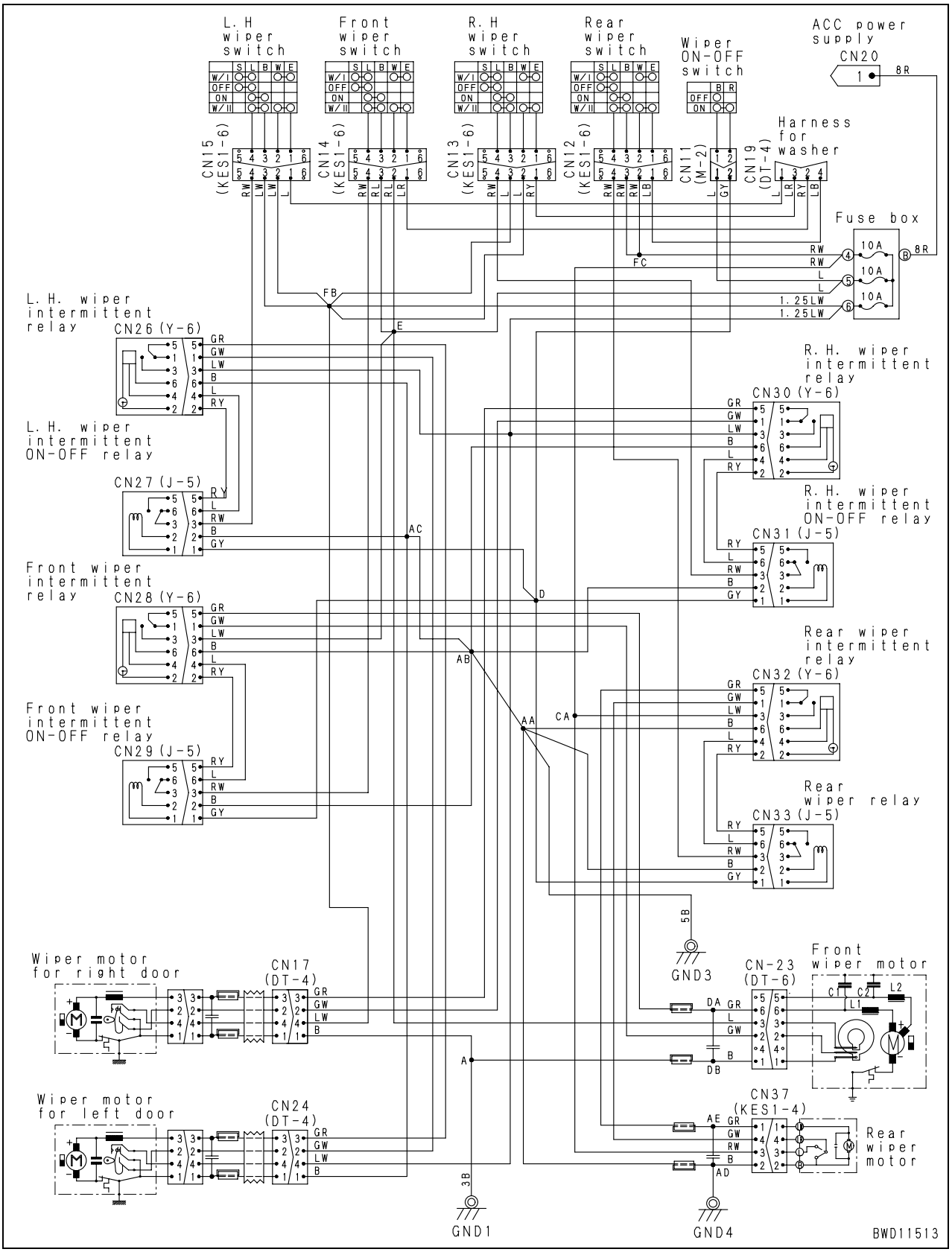
	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fusible link (FL1)	If the fusible link is burnout, the circuit probably has a grounding fault, etc.		
	2	Defective fuse (4) in cab	Since fuse (4) in the cab is used only for the rear wiper circuit, the rear wiper circuit probably has a grounding fault, etc.		
	3	Defective rear wiper motor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN37 (1) – ground	Voltage	20 – 30 V
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN37 (female) (2) – ground	Resis-tance	Max. 1 Ω
	4	Defective rear wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CN12 (male)	Position of switch	Resistance
			Between (3) – (4)	ON	Max. 1 Ω
				OFF	Min. 1 MΩ
	5	Defective rear wiper intermit-tent selector relay	• If the problem is eliminated by replacing the relay (CN27), (CN29) or (CN31) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN33 (3) – ground	Voltage	20 – 30 V
			Between CN33 (6) – ground	Voltage	20 – 30 V
			Between CN33 (1) – ground	Voltage	Max. 1 V
	6	Defective rear wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN26), (CN28) or (CN30) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN32 (4) – ground	Voltage	20 – 30 V
			Between CN32 (3) – ground	Voltage	20 – 30 V
			Between CN32 (5) – ground	Voltage	20 – 30 V

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	7	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN12 (female) (4) – CN33 (female) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN12 (female) (4) – CN33 (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness between CN33 (female) (6) – CN32 (female) (4)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN33 (female) (6) – CN32 (female) (4)	Resistance	Min. 1 MΩ
			Wiring harness between fuse (4) – CN12 (female) (2) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness between fuse (4) – CN12 (female) (2) (3)	Resistance	Min. 1 MΩ
			Wiring harness among fuse (4) – CN32 (female) (3) – CN37 (female) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness among fuse (4) – CN32 (female) (3) – CN37 (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness between CN32 (female) (5) – CN37 (female) (1)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN32 (female) (5) – CN37 (female) (1)	Resistance	Min. 1 MΩ
			Wiring harness between CN32 (female) (6) – ground	Resistance	Max. 1 Ω
			Wiring harness between CN37 (female) (2) – ground	Resistance	Max. 1 Ω

Symptom of failure	(4) Rear wiper malfunctions in the intermittent mode.
General information	• When the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • The wiper stops for about 5 seconds after a single wiping operation.

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper also malfunctions in the intermittent mode, the intermittent switch is probably defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CN11 (male)	Position of switch	Resistance
			Between (1) – (2)	ON	Max. 1 Ω
				OFF	Min. 1 MΩ
	2	Defective rear wiper intermittent selector relay	• If the problem is eliminated by replacing the relay (CN27), (CN29) or (CN31) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN33 (1) – ground	Voltage	20 – 30 V
			Between CN33 (5) – ground	Voltage	20 – 30 V
	3	Defective rear wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN26), (CN28) or (CN30) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN32 (2) – ground	Voltage	20 – 30 V
	4	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN11 (female) (2) – CN33 (female) (1)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN11 (female) (2) – CN33 (female) (1)	Resistance	Min. 1 MΩ
			Wiring harness between CN33 (female) (5) – CN32 (female) (2)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN33 (female) (5) – CN32 (female) (2)	Resistance	Min. 1 MΩ
			Wiring harness between CN33 (female) (2) – ground	Resistance	Max. 1 Ω

Circuit diagram related to wiper system



Symptom of failure	(5) The right door wiper does not operate. (Continuous operation is defective.)
General information	• When only the right door wiper is defective (If fuse (6) in the cab is blown, the left door wiper does not operate either.) • If any wiper does not operate, check fusible link (FL1). • When carrying out the troubleshooting, turn the intermittent switch OFF and turn the wiper switch ON.

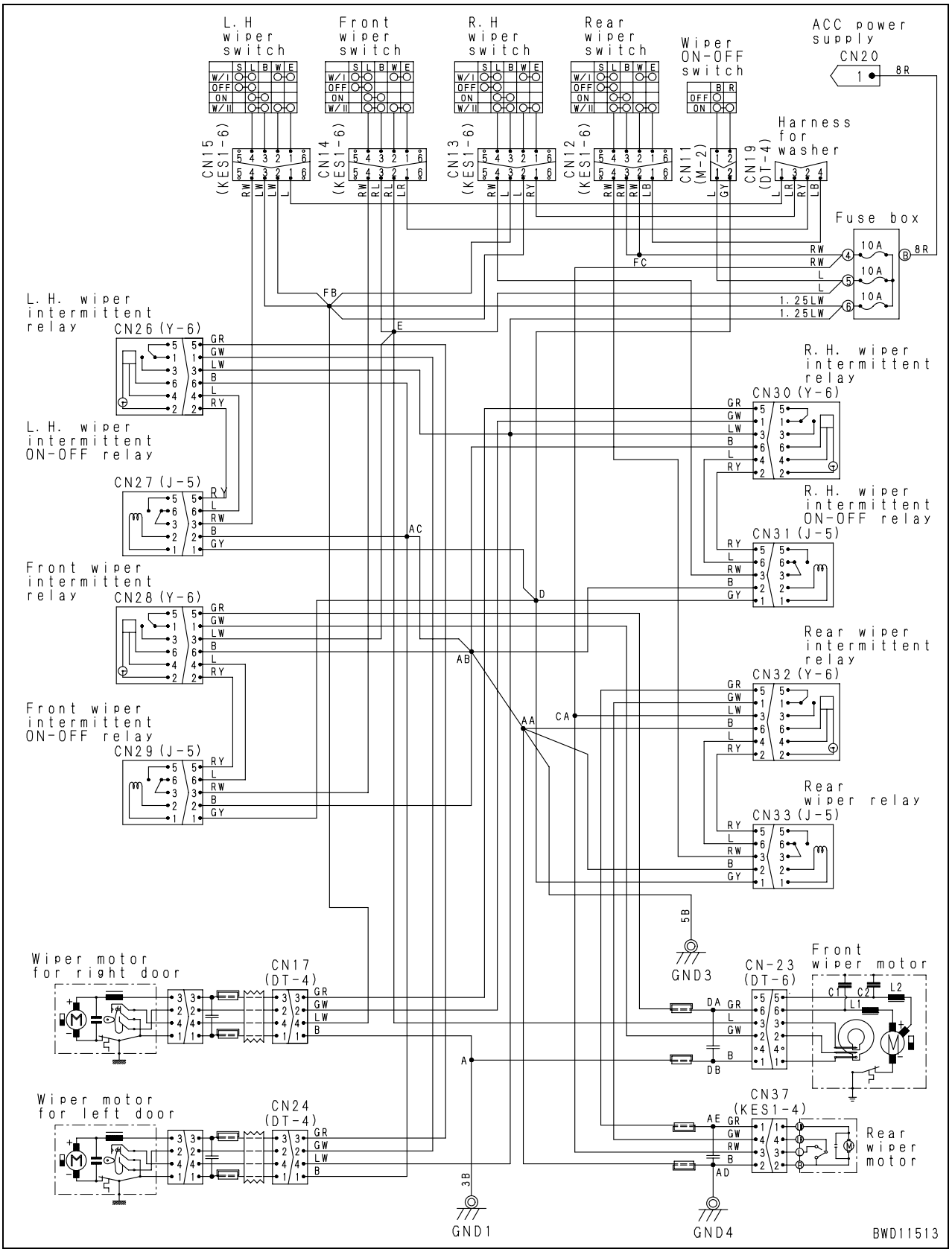
	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fusible link (FL1)	If the fusible link is burnout, the circuit probably has a grounding fault, etc.		
	2	Defective fuse (6) in cab	Since fuse (6) in the cab is used for the right and left wiper system, either circuit of those two probably has a grounding fault, etc.		
	3	Defective right door wiper motor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between connector (3) just before motor – ground	Voltage	20 – 30 V
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between connector (1) just before motor – ground	Resis-tance	Max. 1 Ω
	4	Defective right door wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CN13 (male)	Position of switch	Resistance
			Between (3) – (4)	ON	Max. 1 Ω
				OFF	Min. 1 MΩ
	5	Defective right door wiper intermittent selector relay	• If the problem is eliminated by replacing the relay (CN27), (CN29) or (CN33) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN31 (3) – ground	Voltage	20 – 30 V
			Between CN31 (6) – ground	Voltage	20 – 30 V
			Between CN31 (1) – ground	Voltage	Max. 1 V
	6	Defective right door wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN26), (CN28) or (CN32) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN30 (4) – ground	Voltage	20 – 30 V
			Between CN30 (3) – ground	Voltage	20 – 30 V
			Between CN30 (5) – ground	Voltage	20 – 30 V

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	7	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN13 (female) (4) – CN31 (female) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN13 (female) (4) – CN31 (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness between CN31 (female) (6) – CN30 (female) (4)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN31 (female) (6) – CN30 (female) (4)	Resistance	Min. 1 MΩ
			Wiring harnesses among fuse (6) – CN13 (female) (2) (3) – CN17 (4) – connector just before motor (female) (4) – CN13 (female) (2) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harnesses among fuse (6) – CN13 (female) (2) (3) – CN17 (4) – connector just before motor (female) (4) – CN13 (female) (2) (3)	Resistance	Min. 1 MΩ
			Wiring harness between fuse (6) – CN30 (female) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness between fuse (6) – CN30 (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness among connector just before motor (female) (3) – CN17 (3) – CN30 (female) (5)	Resistance	Max. 1 Ω
			Between ground and wiring harness between connector just before motor (female) (3) – CN17 (3) – CN30 (female)(5)	Resistance	Min. 1 MΩ
			Wiring harness between CN30 (female) (6) – ground	Resistance	Max. 1 Ω
			Wiring harness among connector just before motor (female) (1) – CN17(1) – ground	Resistance	Max. 1 Ω

Symptom of failure	(6) Right door wiper malfunctions in the intermittent mode.
General information	• When the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • The wiper stops for about 5 seconds after a single wiping operation.

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper also malfunctions in the intermittent mode, the intermittent switch is probably defective.			
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN11 (female)	Position of switch	Resistance	
			Between (1) – (2)	ON	Max. 1 Ω	
				OFF	Min. 1 MΩ	
	2	Defective right door wiper intermittent selector relay	• If the problem is eliminated by replacing the relay (CN27), (CN29) or (CN33) with another one, the relay is defective.			
			★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between CN31 (1) – ground		Voltage	20 – 30 V
			Between CN31 (5) – ground		Voltage	20 – 30 V
	3	Defective right door wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN26), (CN28) or (CN32) with another one, the relay is defective.			
			★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between CN30 (2) – ground		Voltage	20 – 30 V
	4	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between CN11 (female) (2) – CN31 (female) (1)		Resistance	Max. 1 Ω
			Between ground and wiring harness between CN11 (female) (2) – CN31 (female) (1)		Resistance	Min. 1 MΩ
			Wiring harness between CN31 (female) (5) – CN30 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness between CN31 (female) (5) – CN30 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness between CN31 (female) (2) – ground		Resistance	Max. 1 Ω

Circuit diagram related to wiper system



Symptom of failure	(7) The left door wiper does not operate. (Continuous operation is defective.)
General information	• When only the left door wiper is defective (If fuse (6) in the cab is blown, the right door wiper does not operate either.) • If any wiper does not operate, check fusible link (FL1). • When carrying out the troubleshooting, turn the intermittent switch OFF and turn the wiper switch ON.

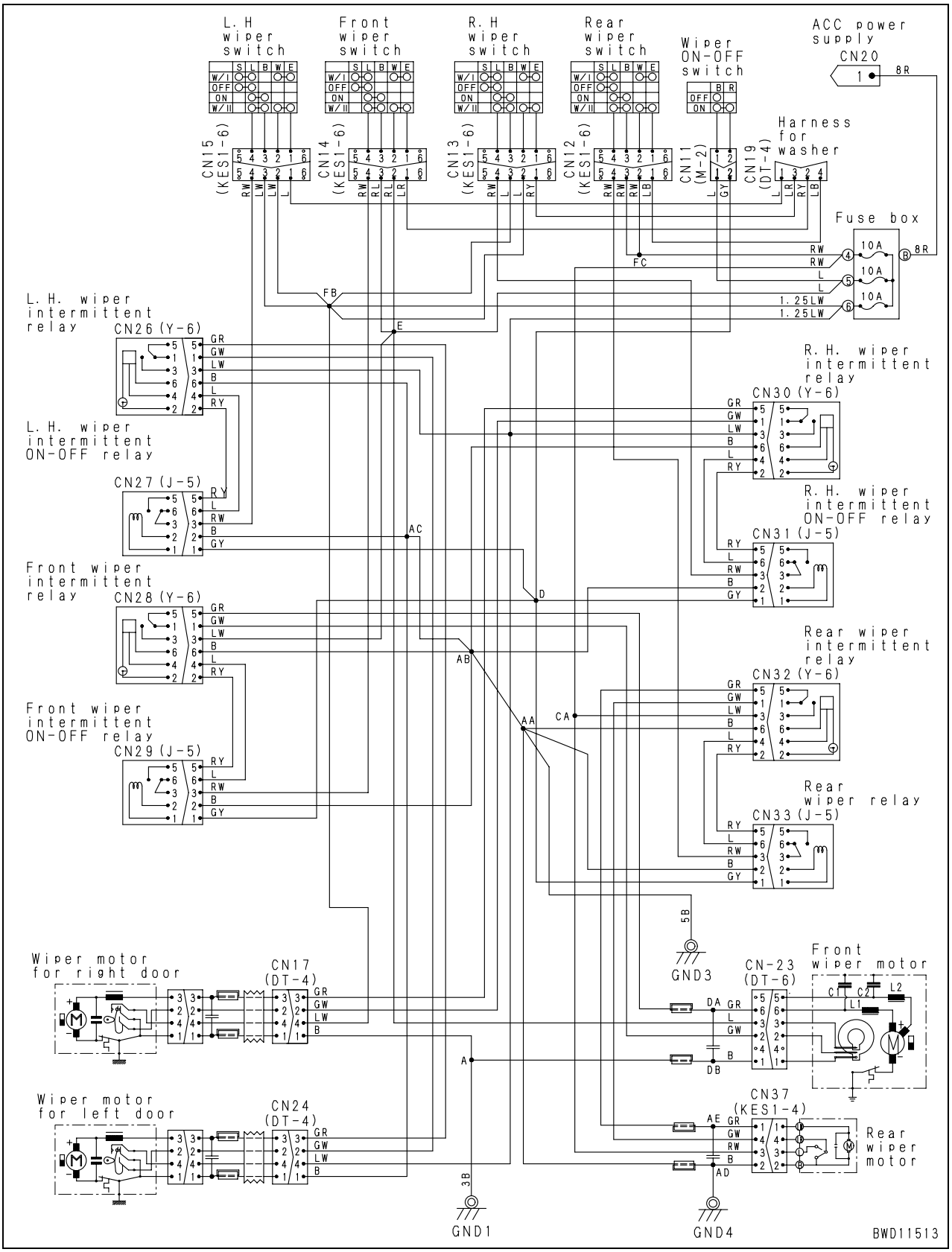
	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective fusible link (FL1)	If the fusible link is burnout, the circuit probably has a grounding fault, etc.		
	2	Defective fuse (6) in cab	Since fuse (6) in the cab is used for the right and left wiper system, either circuit of those two probably has a grounding fault, etc.		
	3	Defective left door wiper motor	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between connector (3) just before motor – ground	Voltage	20 – 30 V
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between connector (1) just before motor – ground	Resis-tance	Max. 1 Ω
	4	Defective left door wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			CN15 (male)	Position of switch	Resistance
			Between (3) – (4)	ON	Max. 1 Ω
				OFF	Min. 1 MΩ
	5	Defective left door wiper intermittent selector relay	• If the problem is eliminated by replacing the relay (CN29), (CN31) or (CN33) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN27 (3) – ground	Voltage	20 – 30 V
			Between CN27 (6) – ground	Voltage	20 – 30 V
			Between CN27 (1) – ground	Voltage	Max. 1 V
	6	Defective right door wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN28), (CN30) or (CN32) with another one, the relay is defective.		
			★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			Between CN26 (4) – ground	Voltage	20 – 30 V
			Between CN26 (3) – ground	Voltage	20 – 30 V
			Between CN26 (5) – ground	Voltage	20 – 30 V

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	7	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness between CN15 (female) (4) – CN27 (female) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN15 (female) (4) – CN27 (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness between CN27 (female) (6) – CN26 (female) (4)	Resistance	Max. 1 Ω
			Between ground and wiring harness between CN27 (female) (6) – CN26 (female) (4)	Resistance	Min. 1 MΩ
			Wiring harness among fuse (6) – CN26 (female) (3) – CN24 (4) – connector just before motor (female) (4)	Resistance	Max. 1 Ω
			Between ground and wiring harness among fuse (6) – CN26 (female) (3) – CN24 (4) – connector just before motor (female) (4)	Resistance	Min. 1 MΩ
			Wiring harness between fuse (6) – CN15 (female) (2) (3)	Resistance	Max. 1 Ω
			Between ground and wiring harness between fuse (6) – CN15 (female) (2) (3)	Resistance	Min. 1 MΩ
			Wiring harness among connector just before motor (female) (3) – CN24(3) – CN26 (female) (5)	Resistance	Max. 1 Ω
			Between ground and wiring harness between connector just before motor (female) (3) – CN24 (3) – CN26 (female) (5)	Resistance	Min. 1 MΩ
			Wiring harness between CN26 (female) (6) – ground	Resistance	Max. 1 Ω
			Wiring harness among connector just before motor (female) (1) – CN24 (1) – ground	Resistance	Max. 1 Ω

Symptom of failure	(8) Left door wiper malfunctions in the intermittent mode.
General information	• When the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • When wiper stops for about 5 seconds after a single wiping operation.

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper also malfunctions in the intermittent mode, the intermittent switch is probably defective.			
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN11 (male)	Position of switch	Resistance	
			Between (1) – (2)	ON	Max. 1 Ω	
				OFF	Min. 1 MΩ	
	2	Defective left door wiper intermittent selector relay	• If the problem is eliminated by replacing the relay (CN29), (CN31) or (CN33) with another one, the relay is defective.			
			★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between CN27 (1) – ground	Voltage	20 – 30 V	
			Between CN27 (5) – ground	Voltage	20 – 30 V	
	3	Defective left door wiper intermittent relay	• If the problem is eliminated by replacing the relay (CN28), (CN30) or (CN32) with another one, the relay is defective.			
			★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			Between CN26 (2) – ground	Voltage	20 – 30 V	
	4	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between CN11 (female) (2) – CN27 (female) (1)	Resistance	Max. 1 Ω	
			Between ground and wiring harness between CN11 (female) (2) – CN27 (female) (1)	Resistance	Min. 1 MΩ	
			Wiring harness between CN27 (female) (5) – CN26 (female) (2)	Resistance	Max. 1 Ω	
			Between ground and wiring harness between CN27 (female) (5) – CN26 (female) (2)	Resistance	Min. 1 MΩ	
			Wiring harness between CN27 (female) (2) – ground	Resistance	Max. 1 Ω	

Circuit diagram related to wiper system

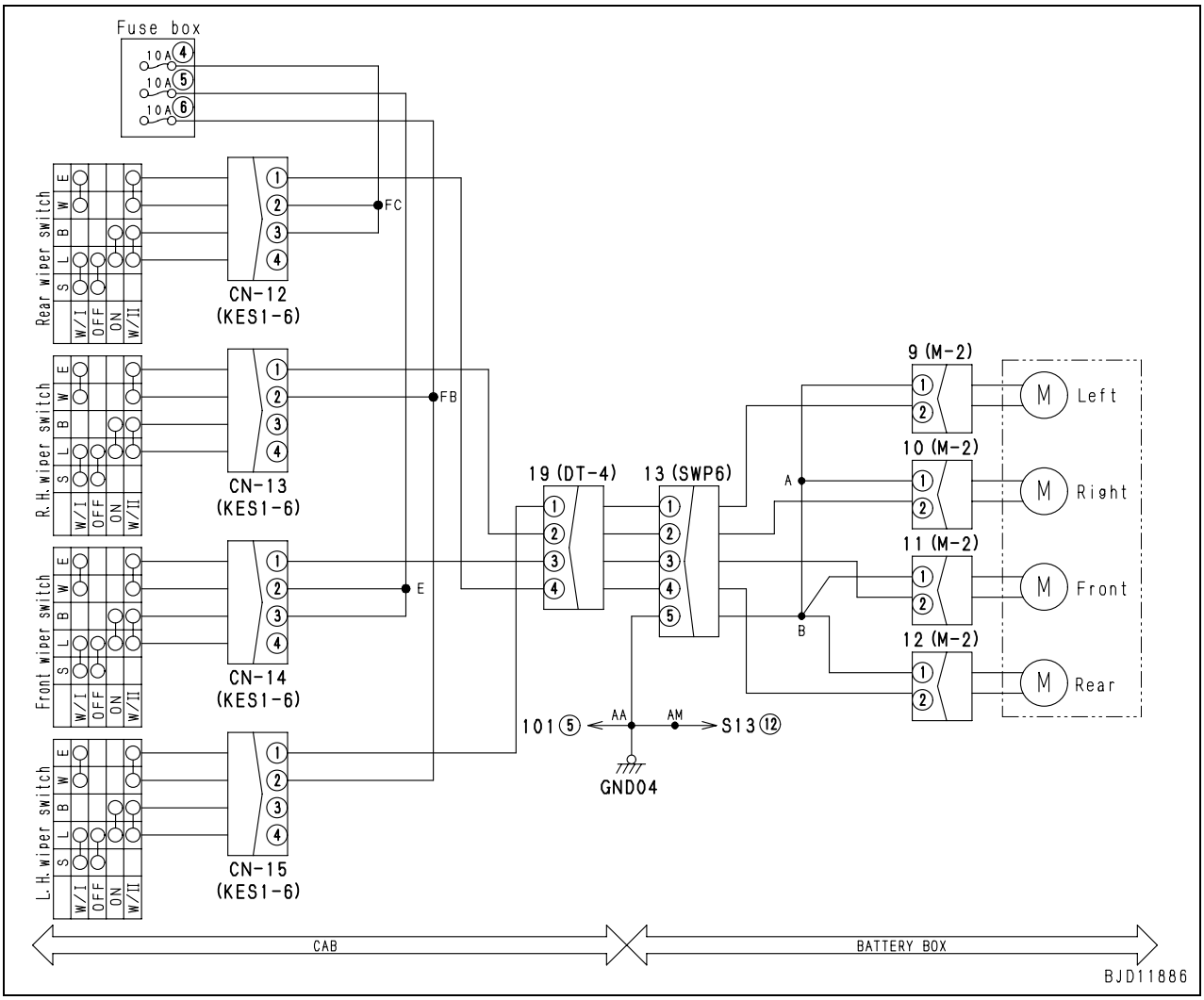


E-26 Washer does not spray water

Symptom of failure	(1) Washer does not spray water
General information	• When the front wiper operates normally (If the wiper does not operate either, carry out troubleshooting in “E-25 (1) The front wiper does not operate.” first.)

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective front washer motor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between 11 (female) (1) – ground		Resistance	Max. 1 Ω
			★ Prepare with starting switch OFF and diagnose with starting switch ON. (switch position: W/I)			
			Between 11 (2) – ground		Voltage	20 – 30 V
	2	Defective front wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN14 (female)	Position of switch	Resistance	
			Between (2) – (1)	W/I or W/II	Max. 1 Ω	
				OFF	Min. 1 MΩ	
	3	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between fuse (5) – CN14 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness between fuse (5) – CN14 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness among CN14 (female) (1) – 19 (3) – 13 (3) – 11 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness among CN14 (female) (1) – 19 (3) – 13 (3) – 11 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness between 11 (female) (1) – ground		Resistance	Max. 1 Ω

Circuit diagram related to washer system



Symptom of failure	(2) Rear washer does not spray water
General information	• When the rear wiper operates normally (If the wiper does not operate either, carry out troubleshooting in “E-25 (3) The rear wiper does not operate.” first.)

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective rear washer motor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between 12 (female) (1) – ground		Resistance	Max. 1 Ω
			★ Prepare with starting switch OFF and diagnose with starting switch ON. (switch position: W/I)			
			Between 12 (2) – ground		Voltage	20 – 30 V
	2	Defective rear wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN12 (female)	Position of switch	Resistance	
			Between (2) – (1)	W/I or W/II	Max. 1 Ω	
				OFF	Min. 1 MΩ	
	3	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between fuse (4) – CN12 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness between fuse (4) – CN12 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness among CN12 (female) (1) – 19 (4) – 13 (4) – 12 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness among CN12 (female) (1) – 19 (4) – 13 (4) – 12 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness between 12 (female) (1) – ground		Resistance	Max. 1 Ω

* For the electric diagram of each system, see Symptom of failure (1).

Symptom of failure	(3) Left door washer does not spray water
General information	• When the left door wiper operates normally (If the wiper does not operate either, carry out troubleshooting in “E-25 (7) The left wiper does not operate.” first.) • Since the left door wiper switch and right door wiper switch use fuse (6) jointly, if fuse (6) is blown, both wipers do not operate.

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective left door washer motor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between 9 (female) (1) – ground		Resistance	Max. 1 Ω
			★ Prepare with starting switch OFF and diagnose with starting switch ON. (switch position: W/I)			
			Between 9 (2) – ground		Voltage	20 – 30 V
	2	Defective left door wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN15 (female)	Position of switch	Resistance	
			Between (2) – (1)	W/I or W/II	Max. 1 Ω	
				OFF	Min. 1 MΩ	
	3	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between fuse (6) – CN15 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness between fuse (6) – CN15 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness between CN15 (female) (1) – 19 (1) – 13 (1) – 9 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness among CN15 (female) (1) – 19 (1) – 13 (1) – 9 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness between 9 (female) (1) – ground		Resistance	Max. 1 Ω

* For the electric diagram of each system, see Symptom of failure (1).

Symptom of failure	(4) Right door washer does not spray water
General information	• When the right door wiper operates normally (If the wiper does not operate either, carry out troubleshooting in “E-25 (5) The right wiper does not operate.” first.) • Since the right door wiper switch and left door wiper switch use fuse (6) jointly, if fuse (6) is blown, both wiper do not operate.

	Cause		Standard value when normal and remarks for troubleshooting			
Possible causes and the standard values when normal	1	Defective right door washer motor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between 10 (female) (1) – ground		Resistance	Max. 1 Ω
			★ Prepare with starting switch OFF and diagnose with starting switch ON. (switch position: W/I)			
			Between 10 (2) – ground		Voltage	20 – 30 V
	2	Defective right door wiper switch	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN13 (female)	Position of switch	Resistance	
			Between (2) – (1)	W/I or W/II	Max. 1 Ω	
				OFF	Min. 1 MΩ	
	3	Disconnection or short circuit with ground in wiring harness (Disconnection in wiring or defective contact of connectors or contact with ground circuit)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness between fuse (6) – CN13 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness between fuse (6) – CN13 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness among CN13 (female) (1) – 19 (2) – 13 (2) – 10 (female) (2)		Resistance	Max. 1 Ω
			Between ground and wiring harness among CN13 (female) (6) – 19 (2) – 13 (2) – 10 (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness between 10 (female) (1) – ground		Resistance	Max. 1 Ω

* For the electric diagram of each system, see Symptom of failure (1).

E-27 The air conditioner does not operate

Symptom of failure	• Air does not blow out
General information	

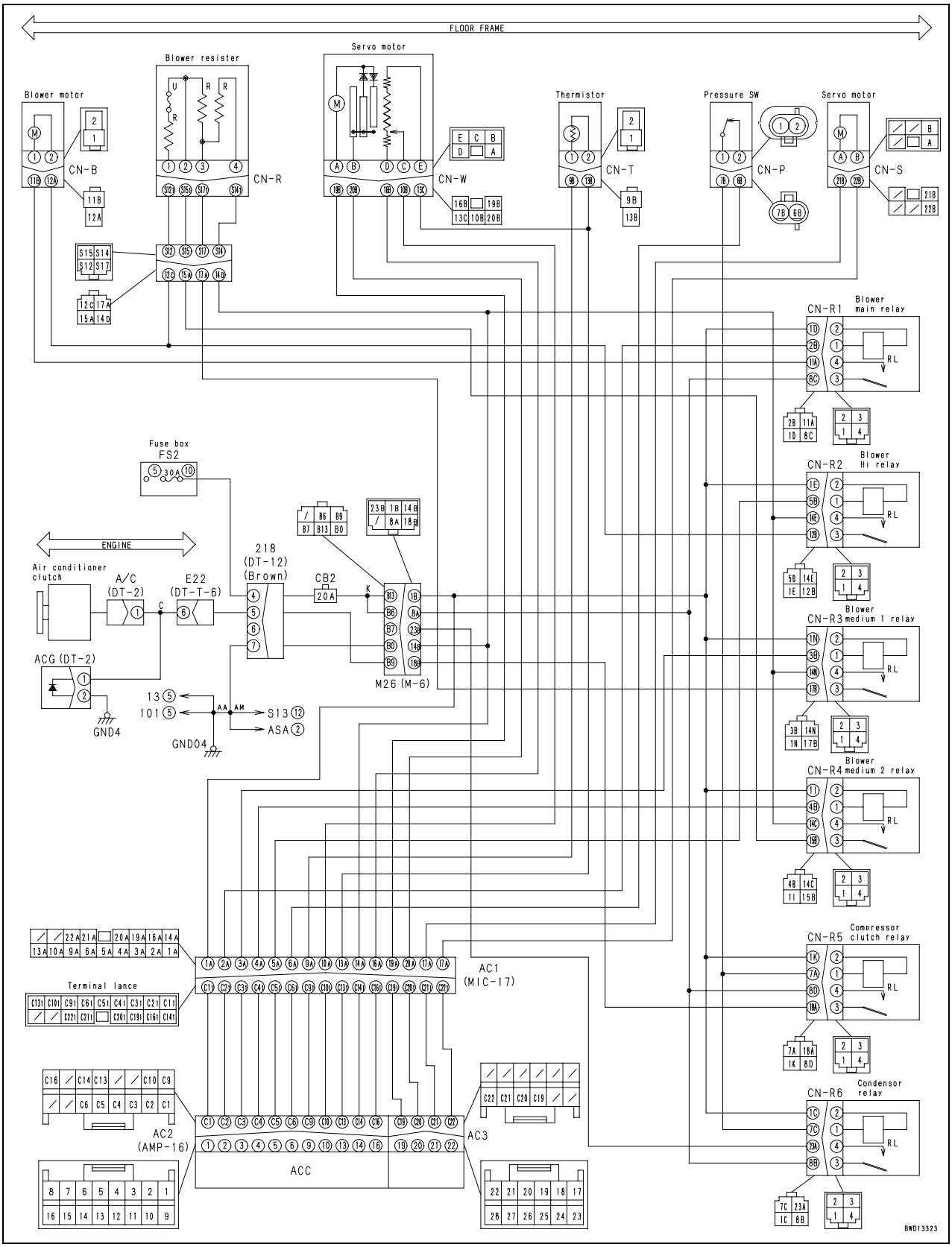
Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting	
	1	Defective circuit breaker (CB2)	When the circuit breaker is cut off, a defective grounding may have possibly occurred in the circuit.	
	2	Defective blower main relay (coil side)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.	
			CN-R1 (male)	Resistance
			Between (1) – (2)	240 ± 40 Ω
	3	Defective blower main relay (contact side)	★ Prepare with starting switch OFF and diagnose with starting switch ON.	
			CN-R1	Voltage
			Between (8C) – ground	20 – 30 V
	4	Defective blower Hi relay (coil side)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.	
			CN-R2 (male)	Resistance
			Between (1) – (2)	240 ± 40 Ω
	5	Defective blower Hi relay (contact side)	★ Prepare with starting switch OFF and diagnose with starting switch ON.	
			It is normal if the motor rotates with the starting switch and the blower Hi switch turned ON.	
	6	Defective blower Mi1 relay (coil side)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.	
			CN-R3 (male)	Resistance
			Between (1) – (2)	240 ± 40 Ω
	7	Defective blower Mi1 relay (contact side)	★ Prepare with starting switch OFF and diagnose with starting switch ON.	
			It is normal if the motor rotates with the starting switch and the blower Mi switch turned ON.	
	8	Defective blower Mi2 relay (coil side)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.	
			CN-R4 (male)	Resistance
			Between (1) – (2)	240 ± 40 Ω
	9	Defective blower Mi2 relay (contact side)	★ Prepare with starting switch OFF and diagnose with starting switch ON.	
			It is normal if the motor rotates with the starting switch and the blower Lo switch turned ON.	
	10	Defective blower motor	★ Prepare with starting switch OFF and diagnose with starting switch ON.	
			It is normal if the motor rotates with the starting switch and the blower Lo switch turned ON.	

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	11	Disconnection or defective grounding in wiring harness (Disconnection in wiring or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			Wiring harness among CN-R4 (female) (14C) – AC1 (female) (14A) – CN-R (female) (S141) – CN-R2 (female) (14E) – CN-R3 (female) (14N) – ground	Resistance	Max. 1 Ω
			Wiring harness between CN-B (female) (11B) – CN-R1(female) (11A)	Resistance	Max. 1 Ω
			Wiring harness among CN-B (female) (12A) – CN-R2 (female) (12B) – CN-R (female) (12C)	Resistance	Max. 1 Ω
			Wiring harness among CB2 out – AC1 (female) (1A) – CN-R1 (female) (1D) – CN-R2 (female) (1E) – CN-R3 (female) (1N) – CN-R4 (female) (1I)	Resistance	Max. 1 Ω
			Wiring harness between CN-R1 (female) (2B) – AC1 (female) (2A)	Resistance	Max. 1 Ω
			Wiring harness between CN-R3 (female) (3B) – AC1 (female) (3A)	Resistance	Max. 1 Ω
			Wiring harness between CN-R2 (female) (5B) – AC1 (female) (5A)	Resistance	Max. 1 Ω
			Wiring harness between CN-R4 (female) (4B) – AC1 (female) (4A)	Resistance	Max. 1 Ω
	12	Defective control panel	Control panel is possibly defective if no problem is found in causes 1-11.		
	13	Symptom of failure is incorrect.	When the cause cannot be identified, the Symptom of failure may be incorrect. Carry out the troubleshooting of “It does not get cool.”		

Symptom of failure	• It does not get cool.
General information	

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting			
	1	Defective pressure switch	★ Prepare with starting switch OFF and diagnose with starting switch ON.			
			CN-P	Blower switch	Voltage	
			Between (6B) – ground	ON	20 – 30 V	
	2	Defective compressor clutch relay (coil side)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN-R5 (male)		Resistance	
			Between (1) – (2)		240 ± 40 Ω	
	3	Defective compressor clutch relay (contact side)	★ Prepare with starting switch OFF and diagnose starting switch and air conditioner switch ON.			
			CN-R5		Voltage	
			Between (18A) – ground		20 – 30 V	
	4	Defective thermistor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			CN-T (male)		Resistance	
			Between (1) – (2)		Max. 3,500 Ω	
	5	Defective blower resistor	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Blower resistor		Resistance	
			Between terminals		2.8 Ω ± 5%	
	6	Defective compressor magnet clutch	★ Start the engine to diagnose.			
			The compressor magnet clutch is supposed to be defective, so inspect itself.			
	7	Defective compressor	★ Start the engine to diagnose.			
			Since the compressor is supposed to be defective, inspect the compressor.			
	8	Defective diode (internal short circuit)	Diagnose diode ACG (male). • See the “Inspection procedure of diode” in the “Testing and adjusting” section.			
	9	Disconnection in wiring harness (Disconnection in wiring or defective contact of connectors)	★ Prepare with starting switch OFF and diagnose with starting switch still OFF.			
			Wiring harness among CB2 out – AC1 (female) (1A) – CN-R1 (female) (1D) – CN-R2 (female) (1E) – CN-R3 (female) (1N) – CN-R4 (female) (1I) – CN-R5 (female) (1K)		Resistance	Max. 1 Ω
			Wiring harness among CN-T (female) (13B) – AC1 (female) (13A) – CN-W (female) (13C)		Resistance	Max. 1 Ω
			Wiring harness between CN-T (female) (9B) – AC1 (female) (9A)		Resistance	Max. 1 Ω
			Wiring harness between CN-P (female) (7B) – CN-R5 (female) (7A)		Resistance	Max. 1 Ω
			Wiring harness between CN-P (female) (6B) – AC1 (female) (6A)		Resistance	Max. 1 Ω
	10	Defective control panel	Control panel is possibly defective if no problem is found in causes 1-9.			

Circuit diagram related to air conditioner



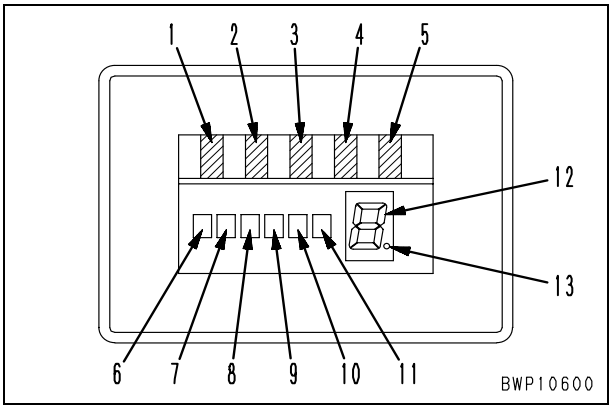
E-28 KOMTRAX system does not operate normally.

Symptom of failure	• KOMTRAX system does not operate normally.
General information	• If KOMTRAX system administrator makes request for checking system on machine side for trouble, carry out the following troubleshooting. • Even if KOMTRAX system has a trouble, it does not paticularly appear on machine.

	Cause		Standard value when normal and remarks for troubleshooting		
Possible causes and the standard values when normal	1	Defective specification setting	Check the code 0021: KOMTRAX specification setting in adjustment mode and set to “ACTIV”.		
	2	Defective electric power supply	★ Diagnose with the starting switch OFF.		
			LED (1)	Normal condition	
			LED-A1	ON	
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			G01	Signal	Voltage
			Between (39) (40) – (37) (38)	Constant power source	20 – 30 V
	3	Defective communication environment	★ Diagnose starting switch ON.		
			LED (2)	Normal condition	
			LED-A2	ON	
	4	Defective starting switch ACC signal and alternator R signal	★ Diagnose with starting switch ON and with the engine started.		
			LED (6)	Normal condition	
			LED-C1	ON	
			★ Prepare with starting switch OFF and start the engine to diagnose.		
			G01	Signal	Voltage
			Between (36) – (37) (38)	Starting switch ACC	20 – 30 V
			Between (28) – (37) (38)	Alternator R	20 – 30 V
	5	Defective starting switch C signal	★ Prepare with starting switch OFF and diagnose with starting switch ON.		
			G01	Signal	Voltage
			Between (27) – (37) (38)	Starting switch C	20 – 30 V
	6	Defective CAN connecting condition	★ Diagnose starting switch ON.		
			LED (9)	Normal condition	
			LED-C4	ON	
			★ Prepare with starting switch OFF and diagnose with starting switch still OFF.		
			G01 (female)	Signal	Resistance
			Between (8) – (7)	CAN	40 – 80 Ω
	7	Number of mails not yet sent	★ Diagnose starting switch ON.		
			LED (12)	Normal condition	
			7 segments	0 – 9	

Possible causes and the standard values when normal	Cause		Standard value when normal and remarks for troubleshooting	
	8	Defective GPS positioning status	★ Diagnose starting switch ON.	
			LED (13)	Normal condition
			Dot	ON
			It may take more than 1 minute from turning on the starting switch to the completion of positioning even in an outdoor place where radio wave can reach.	

Lamp display section of KOMTRAX terminal



LED for communication module

1. LED-A1 (power indicator lamp)
2. LED-A2 (within communication range lamp)
3. LED-A3 (on communicating lamp)
4. LED-A4 (internal transmitting lamp)
5. LED-A (internal reception lamp)

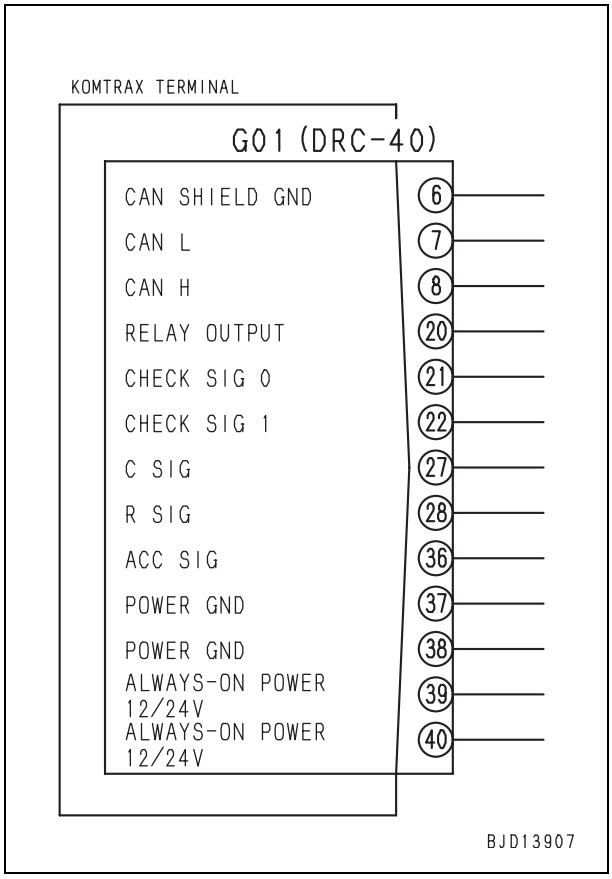
CPU LED

6. LED-C1 (R signal and ACC signal status)
7. LED-C2 (starting output status)
8. LED-C3 (S-NET, C signal status)
9. LED-C4 (CAN status)
10. LED-C5 (download writing condition)
11. LED-C6 (download writing condition)

7 segments and dot for CPU

12. 7 segments (number of mails not yet sent)
13. Dot (GPS positioning in progress)

G01 connector



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00593-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

Troubleshooting of hydraulic and mechanical system (H-mode)

Troubleshooting of hydraulic and mechanical system (H-mode)

Contents of troubleshooting table

★ Troubleshooting lists contain the following information all together. Understand the contents carefully and troubleshoot the machine.

Symptom of failure	Symptom of failure **that has appeared in the machine**
General information	**Information related to troubles occurred or troubleshooting**

	Cause		Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	**Cause by which a trouble is assumed to be caused (The order number indicates a serial number, not a priority sequence.)**	<Described contents> • Standard value when normal required to judge the possible cause • Remarks required to judge whether the cause is right or not
	2		
	3		
	4		

H-1 There is no travel power (no drawbar pull).

Symptom of failure	• There is no travel power (no drawbar pull).
General information	• Check that the power train oil level is normal before troubleshooting.

<table>
<tr><td rowspan="20">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="3">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective engine</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td colspan="2">Measurement conditions</td><td>Engine speed</td></tr>
<tr><td colspan="2">F3 stall</td><td>1,650 rpm</td></tr>
<tr><td>2</td><td>Defective power train pump</td><td colspan="3">The power train pump is assumed to be defective; visually check it.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Internally defective torque converter</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Torque converter inlet pressure</td><td>Torque converter outlet pressure</td></tr>
<tr><td>Full neutral</td><td>Max. 0.88 MPa {Max. 9 kg/cm^2}</td><td>0.39 – 0.69 MPa {4 – 7 kg/cm^2}</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Defective set pressure or internal defect of transmission main relief valve</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td colspan="2">PCCS lever</td><td>Transmission main relief pressure</td></tr>
<tr><td colspan="2">Full neutral</td><td>Min. 3.04 MPa {Min. 31 kg/cm^2}</td></tr>
<tr><td colspan="3">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">Visually check that the free length of spring and the number of shims are normal and also that the spool rotates smoothly.
• Free length of large spring: 128 mm
• Free length of small spring: 108 mm
• Number of shims: 6</td></tr>
<tr><td rowspan="6">5</td><td rowspan="6">Defective operation of transmission valve (ECMV)</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at low idle for troubleshooting.</td></tr>
<tr><td colspan="2">Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td colspan="2">FWD</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td colspan="2">REV</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td colspan="2">1ST</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td colspan="2">2ND</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Defective brake valve</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td colspan="2">Parking lever</td><td>Brake pressure</td></tr>
<tr><td colspan="2">Free</td><td>Min. 2.55 MPa {Min. 26 kg/cm^2}</td></tr>
<tr><td>7</td><td>Parking lever or brake pedal linkage out of adjustment</td><td colspan="3">If the result of the troubleshooting in cause 6 is abnormal, the parking lever or brake pedal linkage is assumed to be out of adjustment; visually check it.</td></tr>
<tr><td>8</td><td>Internally defective transmission</td><td colspan="3">The transmission is assumed to be defective internally; visually check it.</td></tr>
</table>

H-2 Machine does not move (at 2nd or 3rd speed)

Symptom of failure	• Machine does not move (at 2nd or 3rd speed)
General information	• Check that the power train oil level is normal before troubleshooting. Check that the transmission main relief pressure is normal before troubleshooting. (See **H-1** “There is no travel power”.)

<table>
<tr><td rowspan="11">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="3">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Internally defective torque converter</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Torque converter inlet pressure</td><td>Torque converter outlet pressure</td></tr>
<tr><td>Full neutral</td><td>Max. 0.88 MPa {Max. 9 kg/cm^2}</td><td>0.39 – 0.69 MPa {4 – 7 kg/cm^2}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Defective operation of transmission valve (ECMV)</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at low idle for troubleshooting.</td></tr>
<tr><td colspan="2">Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td colspan="2">2ND
3RD</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}
Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>3</td><td>Internally defective transmission clutch</td><td colspan="3">The transmission clutch (2nd or 3rd speed) is assumed to be defective internally; visually check it.</td></tr>
<tr><td>4</td><td>Defective operation of parking brake (dragging)</td><td colspan="3">The parking brake operation is assumed to be defective (dragging); check the linkage valves.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Defective operation of brake (dragging)</td><td colspan="3">★ Move to a flat place (a hard road), and start the engine for troubleshooting.</td></tr>
<tr><td colspan="3">If the machine does not run by low idle + F2 operation, brake dragging occurs. (Carry out troubleshooting “H-8 Brake does not work“.)</td></tr>
<tr><td>6</td><td>Internally defective transmission</td><td colspan="3">The transmission is assumed to be defective internally; visually check it.</td></tr>
</table>

H-3 Machine does not move at any gear speed

Symptom of failure	• Machine does not move at any gear speed.
General information	• Check that the power train oil level is normal before troubleshooting.

<table>
<tr><td rowspan="15">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td>1</td><td>Defective power train pump</td><td colspan="2">The power train pump is assumed to be defective; visually check it.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective set pressure or internal defect of transmission main relief valve</td><td colspan="2">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Transmission main relief pressure</td></tr>
<tr><td>Full neutral</td><td>Min. 3.04 MPa {Min. 31 kg/cm^2}</td></tr>
<tr><td colspan="2">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">Visually check that the free length of spring and the number of shims are normal and also that the spool rotates smoothly.
• Free length of large spring: 128 mm
• Free length of small spring: 108 mm
• Number of shims: 6</td></tr>
<tr><td rowspan="6">3</td><td rowspan="6">Defective operation of transmission valve (ECMV)</td><td colspan="2">★ Prepare with the starting switch OFF, and then run the engine at low idle for troubleshooting.
(Before this, check that the transmission main relief pressure is normal.)</td></tr>
<tr><td>Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td>FWD</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>REV</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>1ST</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>2ND</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td></td><td></td><td>3RD</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>4</td><td>Internally defective transmission</td><td colspan="2">The transmission clutch is assumed to be defective internally; visually check it.</td></tr>
<tr><td rowspan="5">5</td><td rowspan="5">Defective brake valve</td><td colspan="2">★ Move to a flat place, and run the engine at high idle for troubleshooting.
(Before this, check that the transmission main relief pressure is normal.)</td></tr>
<tr><td>Brake pedal</td><td>Brake oil pressure (left/right)</td></tr>
<tr><td>Release</td><td>Min. 2.55 MPa {Min. 26 kg/cm^2}</td></tr>
<tr><td>Depress</td><td>0 MPa {0 kg/cm^2}</td></tr>
<tr><td colspan="3">When the oil pressure is abnormal, carry out troubleshooting “H-8 Brake does not work”.</td></tr>
</table>

H-4 Machine travels only in one direction, forward or in reverse

Symptom of failure	• Machine travels only in one direction, forward or in reverse.
General information	• Check that the power train oil level is normal before troubleshooting.

<table>
<tr><th rowspan="2">Possible causes and the standard values when normal</th><th colspan="2">Cause</th><th colspan="2">Standard value when normal and remarks for troubleshooting</th></tr>
<tr><td>1</td><td>Defective power train pump</td><td colspan="2">The power train pump is assumed to be defective; visually check it.</td></tr>
<tr><td rowspan="5"></td><td rowspan="5">2</td><td rowspan="5">Defective set pressure or internal defect of transmission main relief valve</td><td colspan="2">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Transmission main relief pressure</td></tr>
<tr><td>Full neutral</td><td>Min. 3.04 MPa {Min. 31 kg/cm^2}</td></tr>
<tr><td colspan="2">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="2">Visually check that the free length of spring and the number of shims are normal and also that the spool rotates smoothly.
• Free length of large spring: 128 mm
• Free length of small spring: 108 mm
• Number of shims: 6</td></tr>
<tr><td rowspan="4"></td><td rowspan="4">3</td><td rowspan="4">Defective operation of transmission valve (ECMV)</td><td colspan="2">★ Prepare with the starting switch OFF, and then run the engine at low idle for troubleshooting.
(Before this, check that the transmission main relief pressure is normal.)</td></tr>
<tr><td>Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td>FWD</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>REV</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td></td><td>4</td><td>Defective transmission clutch seal</td><td colspan="2">If the result of the troubleshooting in cause 3 is abnormal, the clutch seal is assumed to be defective; visually check it.</td></tr>
<tr><td></td><td>5</td><td>Internally defective transmission clutch</td><td colspan="2">The transmission clutch (forward or reverse) is assumed to be defective internally; visually check it.</td></tr>
</table>

H-5 When gear is shifted or travel direction is changed, large time lag is made

Symptom of failure	• Time lag is excessive when shifting gear or changing direction.
General information	• Check that the power train oil level is normal before troubleshooting.

<table>
<tr><td rowspan="15">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td>1</td><td>Defective power train pump</td><td colspan="2">The power train pump is assumed to be defective; visually check it.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective set pressure or internal defect of transmission main relief valve</td><td colspan="2">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Transmission main relief pressure</td></tr>
<tr><td>Full neutral</td><td>Min. 3.04 MPa {Min. 31 kg/cm^2}</td></tr>
<tr><td colspan="2">★ Prepare with starting switch OFF and diagnose with starting switch still OFF.</td></tr>
<tr><td colspan="3">• Visually check that the free length of spring and the number of shims are normal and also that the spool rotates smoothly.
• Free length of large spring: 128 mm
• Free length of small spring: 108 mm
• Number of shims: 6</td></tr>
<tr><td rowspan="6">3</td><td rowspan="6">Defective operation of transmission valve (ECMV)</td><td colspan="2">★ Prepare with the starting switch OFF, and then run the engine at low idle for troubleshooting.
(Before this, check that the transmission main relief pressure is normal.)</td></tr>
<tr><td>Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td>FWD</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>REV</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>1ST</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>2ND</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td></td><td></td><td>3RD</td><td>Min. 2.84 MPa {Min. 29 kg/cm^2}</td></tr>
<tr><td>4</td><td>Defective transmission clutch seal</td><td colspan="2">If the result of the troubleshooting in cause 3 is abnormal, the clutch seal is assumed to be defective; visually check it.</td></tr>
<tr><td>5</td><td>Internally defective transmission clutch</td><td colspan="2">The transmission clutch is assumed to be defective internally; visually check it.</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Defective operation of brake (Dragging)</td><td colspan="2">★ Move to a flat place (a hard road), and start the engine for troubleshooting.</td></tr>
<tr><td colspan="2">If the machine does not run by low idle + F2 operation, brake dragging occurs. (Carry out troubleshooting “H-8 Brake does not work”.)</td></tr>
</table>

H-6 Machine cannot be steered (Machine does not turn leftward or rightward)

Symptom of failure	• Machine cannot be steered. (Machine does not turn leftward or rightward.)
General information	• Check that the hydraulic oil level is normal before troubleshooting.

<table>
<tr><td rowspan="4">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective set pressure or defective operation of self pressure reducing valve (PPC basic pressure)</td><td colspan="2">★ Prepare with the engine started, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Basic pressure of control circuit</td></tr>
<tr><td>Neutral</td><td>4.27 ± 0.25 MPa
{43.5 ± 2.5 kg/cm^2}</td></tr>
<tr><td>2</td><td>Abnormal sound from HSS peripheral equipment</td><td colspan="2">If an abnormal sound occurs in the HSS peripheral equipment, carry out troubleshooting “H-10 Abnormal sound comes out from around HSS and work equipment pump or HSS motor”.</td></tr>
</table>

H-7 Steering speed or power is low

Symptom of failure	• Steering speed or power is insufficient.
General information	• Check that the hydraulic oil level is normal before troubleshooting.

<table>
<tr><td rowspan="8">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective set pressure or defective operation of HSS main relief valve</td><td colspan="2">★ Prepare with the engine started, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>HSS relief pressure</td></tr>
<tr><td>Left or right stroke end</td><td>Min. 32.8 MPa
{335 kg/cm^2}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Defective set pressure or defective operation of self pressure reducing valve (PPC basic pressure)</td><td colspan="2">★ Prepare with the engine started, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Basic pressure of control circuit</td></tr>
<tr><td>Neutral</td><td>4.27 ± 0.25 MPa
{43.5 ± 2.5 kg/cm^2}</td></tr>
<tr><td>3</td><td>Abnormal sound from HSS peripheral equipment</td><td colspan="2">If an abnormal sound occurs in the HSS peripheral equipment, carry out troubleshooting “H-10 Abnormal sound comes out from around HSS and work equipment pump or HSS motor”.</td></tr>
</table>

H- 8 Brake does not work

Symptom of failure	• Brake does not work.
General information	• Check that the power train oil level is normal before troubleshooting. • Check that the transmission main relief pressure is normal before troubleshooting. (See H-1 "There is no travel power")

<table>
<tr><td rowspan="6">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective operation of brake valve</td><td colspan="2">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>Brake pedal</td><td>Brake oil pressure</td></tr>
<tr><td>When released</td><td>Min. 2.55 MPa
{Min. 26 kg/cm^2}</td></tr>
<tr><td>When depressed</td><td>0 MPa {0 kg/cm^2}</td></tr>
<tr><td>2</td><td>Brake pedal linkage out of adjustment</td><td colspan="2">If the result of the troubleshooting in cause 1 is abnormal, the brake pedal linkage is assumed to be out of adjustment; visually check it.</td></tr>
<tr><td>3</td><td>Defective brake seal</td><td colspan="2">If the result of the troubleshooting in cause 1 is abnormal, the brake seal is assumed to be defective; visually check it.</td></tr>
<tr><td>4</td><td>Slip or abrasive wear of brake disc plate</td><td colspan="2">Slip or abrasive wear of the brake disc plate is suspected; visually check it.</td></tr>
</table>

H-9 Overheat of power train oil

Symptom of failure	• The power train oil overheats.
General information	• Check that the power train oil level is normal before troubleshooting. • Check that the reading on the power train oil temperature gauge matches the actual oil temperature before troubleshooting. (If they do not match, carry out troubleshooting “Reading on power train oil temperature gauge is incorrect”. • Check that the transmission main relief pressure is normal before troubleshooting. (See H-1 "There is no travel power")

<table>
<tr><td rowspan="11">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="3">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td>1</td><td>Defective engine system</td><td colspan="3">The engine cooling system is assumed to be defective or the engine output is assumed to be increased; see the shop manual of engine volume.</td></tr>
<tr><td>2</td><td>Defective power train pump or residual air from suction circuit</td><td colspan="3">The power train pump is assumed to be defective or residual air from the suction circuit is assumed to remain; visually check it.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Internally defective torque converter</td><td colspan="3">★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Torque converter inlet pressure</td><td>Torque converter outlet pressure</td></tr>
<tr><td>Full neutral</td><td>Max. 0.88 MPa {Max. 9 kg/cm^2}</td><td>0.39 – 0.69 MPa {4 – 7 kg/cm^2}</td></tr>
<tr><td>4</td><td>Defective operation of transmission clutch (Slip)</td><td colspan="3">The transmission clutch is assumed to be defective internally (slip); visually check it.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Defective operation of brake (Dragging)</td><td colspan="3">★ Start the engine to diagnose.</td></tr>
<tr><td colspan="3">1. Run the engine at low idle on a flat place (a hard road).
2. Set the gearshift lever in F2.
3. See if the machine moves (travels). If it does not move, brake dragging occurs.
(Carry out troubleshooting “H-8 Brake does not work”.)</td></tr>
</table>

H-10 Abnormal sound comes out from around HSS and work equipment pump or HSS motor

Symptom of failure	• Abnormal noise comes from around HSS and work equipment pump.
General information	• Check that the hydraulic oil level is normal before troubleshooting.

		Cause	Standard value when normal and remarks for troubleshooting
Possible causes and the standard values when normal	1	Inappropriate oil	The oil used is assumed to be inappropriate; visually check it.
	2	Clogged hydraulic tank strainer	The hydraulic tank strainer is assumed to be clogged; visually check it.
	3	Air inhaled in suction circuit	Air is assumed to be inhaled in the suction circuit of the HSS and work equipment pump; visually check the pipes.
	4	Internally defective HSS pump	The HSS and work equipment pump is assumed to be defective internally; visually check it.
	5	Internally defective HSS motor	The HSS motor is assumed to be defective internally; visually check it.

H-11 All work equipment speeds are slow

Symptom of failure	• All work equipment speeds are slow.
General information	• Check that the oil level in the hydraulic tank is normal before troubleshooting.

		Cause	Standard value when normal and remarks for troubleshooting	
Possible causes and the standard values when normal	1	Defective PTO (pump drive unit of HSS and work equipment)	The PTO pump drive unit of the HSS and work equipment is assumed to be defective; visually check it.	
	2	Defective HSS and work equipment pump	The HSS and work equipment pump is assumed to be defective; visually check it.	
	3	Defective operation of unload valve	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Work equipment control lever	Unload pressure
			Full neutral	3.43 (+1.37/0) MPa {35 (+14/0) kg/cm^2}
	4	Defective set pressure or defective operation of main relief valve	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Work equipment control lever	Main relief pressure
			Stroke end	Min. 19.6 MPa {Min. 200 kg/cm^2}
	5	Defective operation of self pressure reducing valve (PPC basic pressure)	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Work equipment control lever	Basic pressure of control circuit
			Full neutral	4.27 ± 0.25 MPa {43.5 ± 2.5 kg/cm^2}
	6	Internally defective PPC valve	If the result of the troubleshooting in cause 5 is abnormal, the PPC valve is assumed to be defective internally; visually check it.	

H-12 Work equipment does not move

Symptom of failure	• Work equipment does not move.
General information	• Check that the oil level in the hydraulic tank is normal before troubleshooting.

	Cause		Standard value when normal and remarks for troubleshooting	
Possible causes and the standard values when normal	1	Defective PTO (pump drive unit of HSS and work equipment)	The PTO pump drive unit of the HSS and work equipment is assumed to be defective; visually check it.	
	2	Defective HSS and work equipment pump	The HSS and work equipment pump is assumed to be defective; visually check it.	
	3	Defective operation of unload valve	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Work equipment control lever	Unload pressure
			Full neutral	3.43 (+1.37/0) MPa {35 (+14/0) kg/cm^2}
	4	Defective set pressure or defective operation of main relief valve	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Work equipment control lever	Main relief pressure
			Stroke end	Min. 19.6 MPa {Min. 200 kg/cm^2}
	5	Defective operation of self pressure reducing valve (PPC basic pressure)	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Work equipment control lever	Basic pressure of control circuit
			Full neutral	4.27 ± 0.25 MPa {43.5 ± 2.5 kg/cm^2}

H-13 Blade lift speed is slow or lacks power

Symptom of failure	• Blade lift speed is slow or lacks power.
General information	• Check that the oil level in the hydraulic tank is normal before troubleshooting. • Check for modifications to the blade. • If the hydraulic drift of blade lift is also excessive, carry out the troubleshooting of "H-16 Excessive hydraulic drift of blade lift" first.

	Cause		Standard value when normal and remarks for troubleshooting	
Possible causes and the standard values when normal	1	Defective operation of PPC valve	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Blade control lever	PPC valve output pressure
			Lift stroke end	3.53 – 4.41 MPa {36 – 45 kg/cm^2}
	2	Defective operation of blade lift control valve (spool)	The operation of the blade lift control valve spool is assumed to be defective; visually check it.	
	3	Residual air in blade lift cylinder	Residual air is assumed to remain in the blade lift cylinder; bleed air and observe how the phenomenon changes.	

H-14 Blade tilt speed is slow or lacks power

Symptom of failure	• Blade tilt speed is slow or lacks power.
General information	• Check that the oil level in the hydraulic tank is normal before troubleshooting. • Check for modifications to the blade. • If the hydraulic drift of blade tilt is also excessive, carry out the troubleshooting of "H-17 Excessive hydraulic drift of blade tilt" first.

	Cause		Standard value when normal and remarks for troubleshooting	
Possible causes and the standard values when normal	1	Defective operation of PPC valve	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Blade control lever	PPC valve output pressure
			Tilt stroke end	3.53 – 4.41 MPa {36 – 45 kg/cm^2}
	2	Defective operation of blade tilt control valve (spool)	The operation of the blade tilt control valve spool is assumed to be defective; visually check it.	
	3	Residual air in blade tilt cylinder	Residual air is assumed to remain in the blade tilt cylinder; bleed air and observe how the phenomenon changes.	

H-15 Ripper lift speed is slow or lacks power

Symptom of failure	• Ripper lift speed is slow or lacks power.
General information	• Check that the oil level in the hydraulic tank is normal before troubleshooting. • Check for modifications to the ripper. • If the hydraulic drift of ripper lift is also excessive, carry out the troubleshooting of "H-18 Excessive hydraulic drift of ripper lift" first.

	Cause		Standard value when normal and remarks for troubleshooting	
Possible causes and the standard values when normal	1	Defective operation of PPC valve	★ Prepare with the starting switch OFF, and then run the engine at high idle for troubleshooting.	
			Ripper control lever	PPC valve output pressure
			Lift stroke end	3.53 – 4.41 MPa {36 – 45 kg/cm^2}
	2	Defective operation of ripper lift control valve (spool)	The operation of the ripper lift control valve spool is assumed to be defective; visually check it.	
	3	Defective operation of ripper lift control valve (suction valve)	The operation of the suction valve of the ripper lift control valve is assumed to be defective; visually check it. ★ As one method, replace the suction valve at the head with the one at the bottom, and observe how the phenomenon changes.	
	4	Residual air in ripper lift cylinder	Residual air is assumed to remain in the ripper lift cylinder; bleed air and observe how the phenomenon changes.	

H-16 Excessive hydraulic drift of blade lift

Symptom of failure	• Excessive hydraulic drift of blade lift.
General information	• Check for modifications to the blade. • Check for oil leaks in the hydraulic circuit of the work equipment before troubleshooting.

<table>
<tr><td rowspan="5">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective seal of blade lift control valve (spool)</td><td colspan="2">★ Prepare with the engine started, and then stop the engine for troubleshooting.</td></tr>
<tr><td colspan="2">1. Raise the blade (approx. 800 mm).
2. Disconnect the hose on the cylinder head side and block it.
3. Measure hydraulic drift of the tip of blade cutting edge.</td></tr>
<tr><td>Blade lift</td><td>Hydraulic drift</td></tr>
<tr><td>Block blade lift circuit</td><td>100 mm/15 min</td></tr>
<tr><td>2</td><td>Defective seal of blade lift cylinder</td><td colspan="2">The seal of the blade lift cylinder is assumed to be defective; visually check it.</td></tr>
</table>

H-17 Excessive hydraulic drift of blade tilt

Symptom of failure	• Excessive hydraulic drift of blade tilt.
General information	• Check for modifications to the blade. • Check for oil leaks in the hydraulic circuit of the work equipment before troubleshooting.

<table>
<tr><td rowspan="5">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective seal of blade tilt control valve (spool)</td><td colspan="2">★ Prepare with the engine started, and then stop the engine for troubleshooting.</td></tr>
<tr><td colspan="2">1. Fully extend the blade tilt cylinder.
2. Disconnect the hose on the cylinder head side and block it.
3. Measure hydraulic drift of the tip of blade cutting edge.</td></tr>
<tr><td>Blade tilt</td><td>Hydraulic drift</td></tr>
<tr><td>Block blade tilt circuit</td><td>200 mm/15 min</td></tr>
<tr><td>2</td><td>Defective seal of blade tilt cylinder</td><td colspan="2">The seal of the blade tilt cylinder is assumed to be defective; visually check it.</td></tr>
</table>

H-18 Excessive hydraulic drift of ripper lift

Symptom of failure	• Excessive hydraulic drift of ripper lift.
General information	• Check for modifications to the ripper. • Check for oil leaks in the hydraulic circuit of the work equipment before troubleshooting.

<table>
<tr><td rowspan="6">Possible causes and the standard values when normal</td><td colspan="2">Cause</td><td colspan="2">Standard value when normal and remarks for troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective seal of ripper lift control valve (spool)</td><td colspan="2">★ Prepare with the engine started, and then stop the engine for troubleshooting.</td></tr>
<tr><td colspan="2">1. Pull out the shank pin and raise the ripper to the maximum.
2. Disconnect the hose on the cylinder head side and block it.</td></tr>
<tr><td>Ripper lift</td><td>Hydraulic drift</td></tr>
<tr><td>Block ripper lift circuit</td><td>50 mm/15 min</td></tr>
<tr><td>2</td><td>Defective seal of ripper lift cylinder</td><td colspan="2">The seal of the ripper lift cylinder is assumed to be defective; visually check it.</td></tr>
</table>

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00594-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

40 Troubleshooting

Troubleshooting of engine (S-mode)

Troubleshooting of engine (S-mode)

Method of using troubleshooting charts

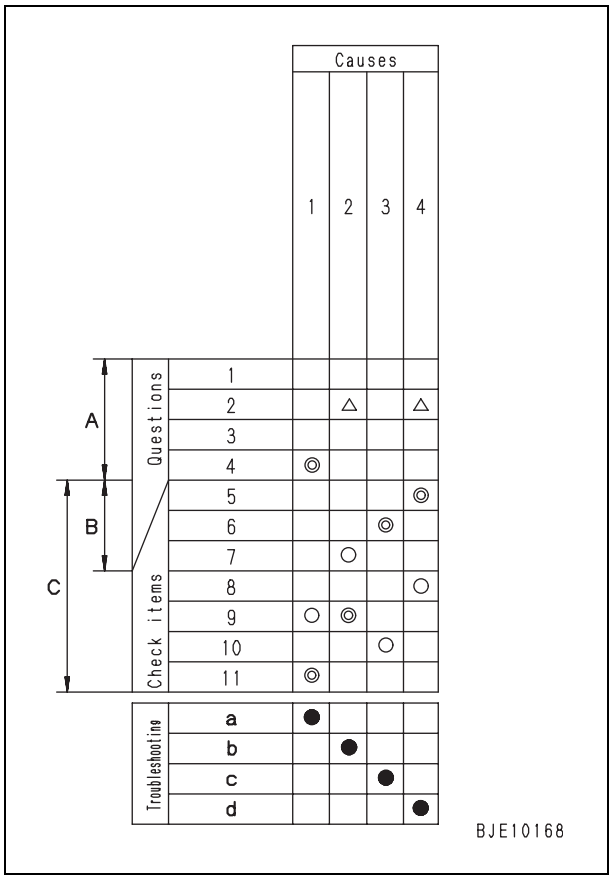
The troubleshooting chart consists of the “questions”, “check items”, “causes”, and “troubleshooting” blocks.
The questions and check items are used to pinpoint high probability causes by simple inspection or from phenomena without using troubleshooting tools.
Next, troubleshooting tools or direct inspection are applied to check the narrowed causes in order from the most probable one to make final confirmation according to the troubleshooting procedure.

[Questions]:
Items to be drawn from the user or operator.
They correspond to A and B in the chart on the right.
The items in A are basic ones.
The items in B can be drawn from the user or operator, depending on their level.

[Check items]:
Items to be simply checked by the serviceman to narrow down causes.
They correspond to C in the chart on the right.

[Causes]:
Items to be narrowed from the questions and check items.
The serviceman narrows down the probable causes from A, B, and C.

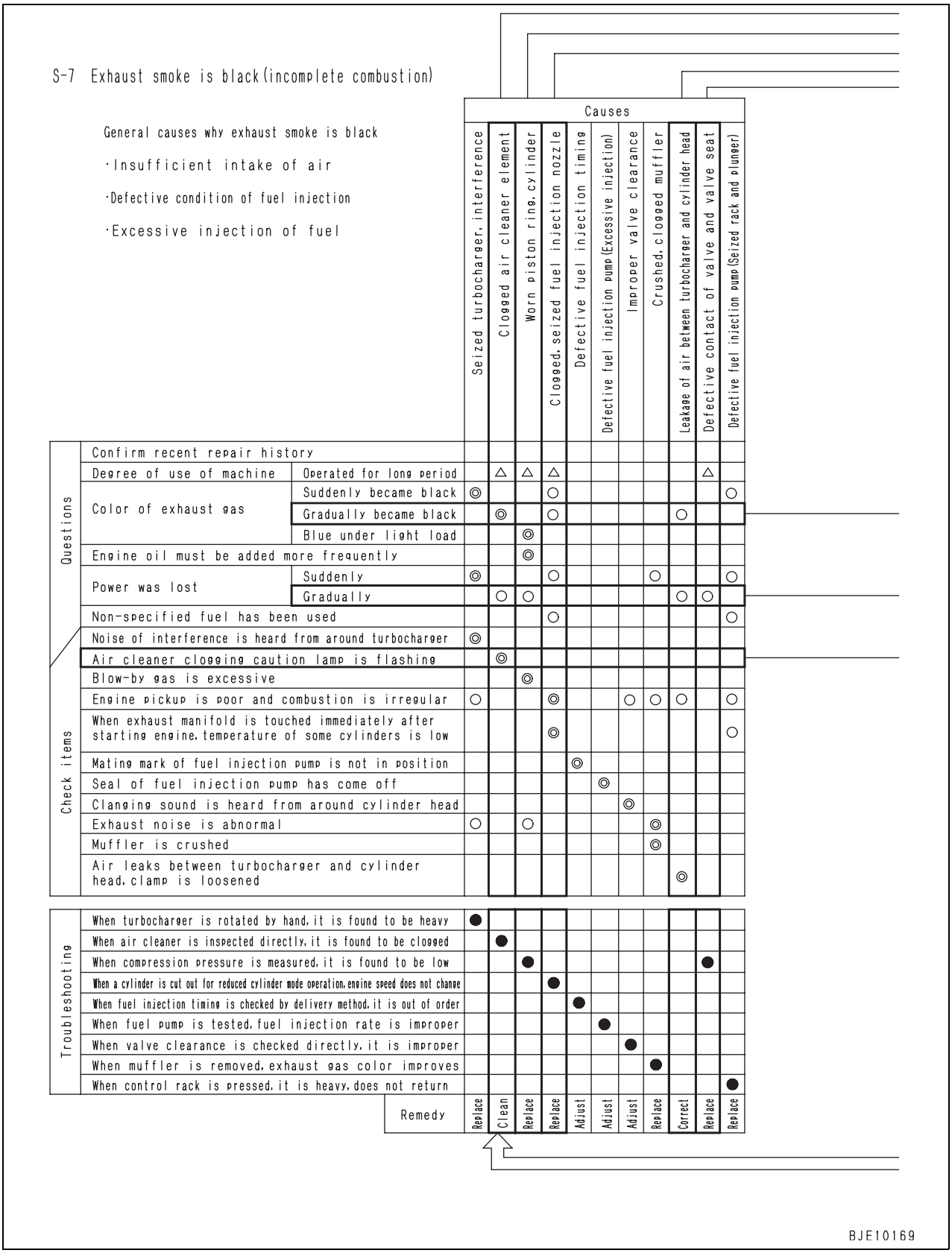
[Troubleshooting]:
Items to finally verify whether the narrowed down causes are undoubtedly the real causes using the troubleshooting tools and direct inspections.



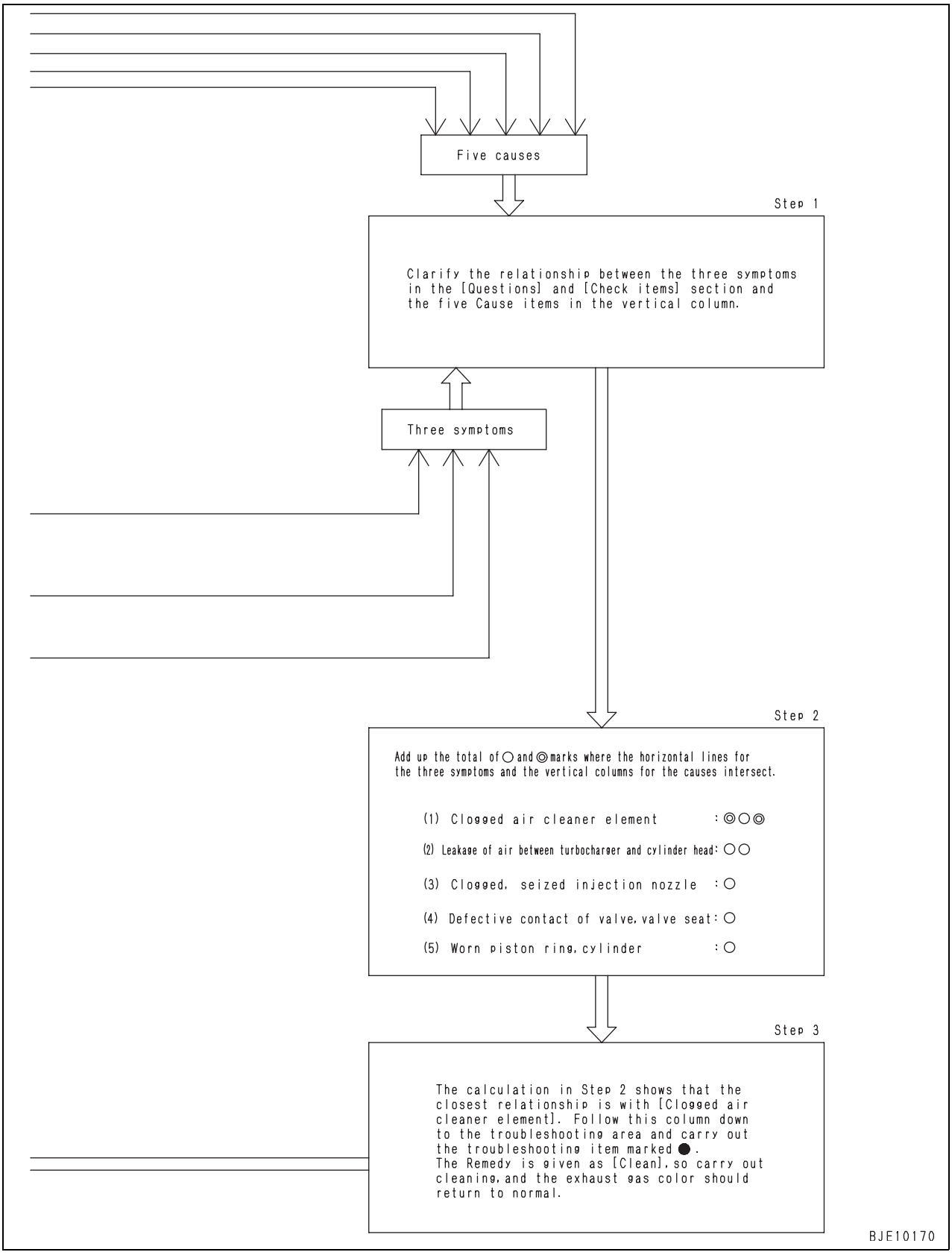
Items listed in the [Questions] and [Check items] and related to the [Causes] are marked with △, ○, or ◎.
△: Causes to be referred to for questions and check items
○: Causes related to questions and check items
◎: Causes highly probable among ones marked with ○

★ When narrowing the “causes”, apply the items marked with ◎ before those marked with ○.
When narrowing the causes, do not apply the items marked with △.
(If no items have other marks and the causes cannot be narrowed, however, you may apply them.)

<Example of troubleshooting> Exhaust smoke is black
Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. 3 symptoms have causal relationship with this problem: [Color of exhaust gas gradually became black], [Power was lost gradually], and [Air cleaner clogging caution lamp is flashing].



If we look from these 3 symptoms to find the causes, we find that there is a relationship with 5 causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.



S-1 Starting performance is poor.

General causes why starting performance is poor

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

★ With the common rail fuel injection system (CRI), the fuel injection timing is recognized electrically, so even when the starting operation is carried out, the engine may not start until the crankshaft has completed two rotations. However, this does not indicate any abnormality.

			Cause													
			Clogged air cleaner element	Defective contact of valve, valve seat	Worn piston ring, cylinder	Clogged air breather hole in fuel tank cap	Leakage, clogging, air in fuel piping	Clogged fuel filter, element	Stuck and seized fuel supply pump plunger	Defective electric lift pump	Devective injector	Defective intake air hearter system	Defective alternator (regulator unit)	Defective alternator (generator unit)	Defective or deteriorated battery
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period	△					△							△
	Ease of starting	Gradually became worse	○	◎	◎			○							
		Starts when warm										◎			◎
	Non-specified fuel is being used							○	○		○				
	Replacement of filters has not been carried out according to Operation & Maintenance Manual		◎					◎	○		○				
	Engine oil must be added more frequently				◎										
	Preheating monitor does not work normally during preheating or in low temperatures (when monitor is installed)											◎			
	Charging monitor shows abnormality in charging while driving (when monitor is installed)												◎	◎	
Check items	Dust indicator lamp is red (when indicator is installed)		◎												
	Air breather hole in fuel tank cap is clogged					◎									
	Leakage of fuel from fuel piping						◎		○						
	Starting motor cranks engine slowly														◎
	When engine is cranked with starting motor	No fuel comes out even when fuel filter air bleed plug is removed						◎		○					
		When hose at collection portion for spill flow from fuel injector is disconnected, spill flow is small							◎						
	When exhaust manifold is toutched immediately after starting engine, temperature of some cylinders is low										◎				
	Engine does not pick up smoothly and combustion is irregular			○	○						◎				
	There is hunting from engine (rotation is irregular)					○	◎	○		○					
	Blow-by gas is excessive				◎										
Troubleshooting	Check air cleaner directly		●												
	When compression pressure is measured, it is found to be low			●	●										
	Check fuel filter, strainer directly							●							
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)“								●						
	Carry out troubleshooting for code display “Defective electric lift pump (*2)“									●					
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode										●				
	Intake air heater mount does not become warm during operation of preheating											●			
	Is vlotage between alternator temrinal B and terminal E with engine at low idle? (20 – 30V)	Yes											●		
		No												●	
	When specific gravity of electrolyte or voltage of battery is measured, it is found to be low														●
		Action	Clean	Replace	Replace	Clean	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Failure code of code display [CA559] and [CA2249]
*2: Failure code of code display [CA2265] and [CA2266]

S-2 Engine does not start

a) Engine does not turn

General causes why engine does not turn
- Seized parts inside engine:
  See "S-4 Engine stops during operations"
- Defective electrical system
- Problem in drive devices on applicable machine side:
  Carry out troubleshooting for devices on applicable machine

			Causes								
			Broken flywheel ring gear	Defective or deteriorated battery	Defective connection of battery terminal	Defective battery relay	Defective starting switch	Defective safety relay	Defective starting motor (motor section)	Defective steering circuit wiring	
Check items	Questions	Confirm recent repair history									
		Degree of use of machine	Operated for long period	△	△						
		Condition of horn when starting switch is turned ON	Horn does not sound			○		○			◎
			Horn volume is low		◎						
	Check	Battery electrolyte is low			◎						
		Battery terminal is loose				◎					
		When starting switch is turned ON, there is no operating sound from battery relay			○		◎				
		When starting switch is turned to START, starting pinion does not move out			○			○			◎
		When starting switch is turned to START, starting pinion moves out, but	Speed of rotation is low		◎						
			Makes grating noise	◎						◎	
			Soon disengages again						◎		
			Makes rattling noise and does not turn		○				○	○	
Troubleshooting		Inspect flywheel ring gear directly		●							Carry out troubleshooting on applicable machine
		When specific gravity of electrolyte and voltage of battery are measured, they are low			●						
		Turn starting switch OFF, connect cord, and carry out troubleshooting at ON	There is not voltage (20 – 30 V) between battery relay terminal B and terminal E				●				
			When terminal B and terminal C of starting switch are connected, engine starts					●			
			When terminal B and terminal C at safety relay outlet are connected, engine starts						●		
			Even if terminal B and terminal C at safety relay outlet are connected, engine does not start							●	
			When terminal at safety switch and terminal B at starting motor are connected, engine starts							●	
			Remedy	Replace	Replace	Correct	Replace	Replace	Replace	Replace	—

b) Engine turns but no exhaust smoke comes out

General causes why engine turns but no exhaust smoke comes out
- Fuel is not being supplied
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

			Cause													
			Improper fuel used	Insufficient fuel in tank	Clogged air breather hole in fuel tank cap	Leakage, clogging, air in fuel piping	Clogged fuel filter, element	Seized, abnormally worn fuel feed pump	Broken fuel supply pump shaft	Stuck, seized fuel supply pump plunger	Defective fuel supply pump IMV solenoid	Defective electric lift pump	Defective actuation of fuel overflow valve (does not close)	Defective common rail pressure limiter	Defective fuel injector
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period				△	△								
	Exhaust smoke suddenly stops coming out (when starting again)							◎	○	◎	◎				△
	Replacement of filters has not been carried out according to Operation & Maintenance Manual						◎			△					○
Check items	Fuel tank is found to be empty			◎											
	Air breather hole in fuel tank cap is clogged			○	◎										
	Rust and water are found when fuel tank is drained						○	△		△	△				
	When fuel filter is removed, there is no fuel in filter		◎			◎						○			
	There is a leakage from fuel piping					◎									
	When engine is cranked with starting motor	No fuel comes out even when fuel filter air bleed plug is removed		○		○		◎	○			○			
		When hose at collection portion for spill flow from fuel injector is disconnected, spill flow is small				○			◎	◎	◎				○
Troubleshooting	Check fuel filter directly						●								
	Check fuel feed pump directly							●							
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)“								●	●					
	Carry out troubleshooting for code display “Abnormality in IMV solenoid (*2)“										●				
	Carry out troubleshooting for code display “Defective electric lift pump (*3)“											●			
	Check fuel overflow valve directly												●		
	Possible to start in reduced cylinder mode														●
	When pressure limiter return pipe is removed, fuel comes out													●	
		Action	Replace	Add	Clean	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Failure code of code display [CA559] and [CA2249]
*2: Failure code of code display [CA2311]
*3: Failure code of code display [CA2265] and [CA2266]

c) Exhaust smoke comes out but engine does not start (Fuel is being injected)

General causes why exhaust smoke comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

			Cause													
			Clogged air cleaner element	Worn dynamic valve system (valve, rocker lever, etc.)	Worn piston ring, cylinder liner	Improper fuel used	Clogged air breather hole in fuel tank cap	Leakage, clogging, air in fuel system	Clogged fuel filter	Stuck, seized fuel supply pump plunger	Defective electric lift pump	Clogged injector, defective spray	Defective or deteriorated battery	Defective coolant temperature sensor, defective wiring harness	Defective intake air hearter system
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period			△				△			△			
	Suddenly failed to start			◎						◎				○	
	Non-specified fuel is being used					◎				○		○			
	Replacement of filters has not been carried out according to Operation & Maintenance Manual		◎						◎						
	Engine oil must be added more frequently				◎										
	Preheating monitor does not work noramlly during preheating or in low temperatures (when monitor is installed)														◎
Check items	Dust indicator lamp is red (when indicator is installed)		◎												
	Air breather hole in fuel tank cap is clogged						○								
	Rust and water are found when fuel tank is drained								◎						
	When fuel filter is removed, there is no fuel in filter					◎					○				
	There is a leakage from fuel piping							◎							
	Starting motor cranks engine slowly												◎		
	When engine is cranked, abnormal noise is heard from around cylinder head			◎											
	When engine is cranked with starting motor	No fuel comes out even when fuel filter air bleed plug is removed				○			◎		○				
		When hose at collection portion for spill flow from fuel injector is disconnected, spill flow is small								◎					
	When exhaust manifold is toutched immediately after starting engine, temperature of some cylinders is low											◎			
Troubleshooting	Check air cleaner directly		●												
	Check dynamic valve system directly			●											
	When compression pressure is measured, it is found to be low				●										
	When air is bled from fuel line, air comes out							●							
	Check fuel filter directly								●						
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)“									●					
	Carry out troubleshooting for code display “Defective electric lift pump (*2)“										●				
	Possible to start in reduced cylinder mode											●			
	When specific gravity of electrolyte or voltage of battery is measured, it is found to be low.												●		
	Defective coolant temperature gauge display (when coolant temerature gauge is installed)													●	
	Intake air heater mount does not become warm during preheating														●
		Action	Clean	Replace	Replace	Replace	Clean	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Failure code of code display [CA559] and [CA2249]
*2: Failure code of code display [CA2265] and [CA2266]

S-3 Engine does not pick up smoothly

General causes why engine does not pick up smoothly

- Insufficient intake of air
- Insufficient supply of fuel
- Abnormal fuel injection condition
- Improper selection of fuel
- Controller controlled by derate mode
  (The injection amount (output) is limited because a failure has occurred in the electrical system.)

			Cause										
			Clogged air cleaner element	Defective contact of valve and valve seat	Improper valve clearance	Seized turbocharger, interference	Worn piston ring, cylinder liner	Clogged air breather hole in fuel tank cap	Leakage, clogging, air in fuel piping	Clogged fuel filter	Stuck, seized fuel supply pump plunger	Clogged injector, defective spray
Questions	Confirm recent repair history											
	Degree of use of machine	Operated for long period	△	△			△			△		
	Engine pick-up suddenly becomes poor					◎		○	○			○
	Non-specified fuel is being used									◎	◎	◎
	Replacement of filters has not been carried out according to Operation & Maintenance Manual		◎							◎		
	Engine oil must be added more frequently						◎					
Check items	Dust indicator lamp is red (when indicator is installed)		◎									
	Air breather hole in fuel tank cap is clogged							◎				
	Rust and water are found when fuel in fuel tank is drained									◎		
	There is a leakage from fuel piping								◎			
	When exhaust manifold is toutched immediately after starting engine, temperature of some cylinders is low										○	◎
	Color of exhaust gas	Blue under light load					◎					
		Black	◎	○		◎						◎
	When engine is running, abnormal noise is heard from around cylinder head				◎							
	When engine is running, noise of interference is heard from around turbocharger					◎						
	High idle speed is normal, but speed suddenly drops when load is applied							○		◎		
	There is hunting from engine (rotation is irregular)							○		○		○
	Blow-by gas is excessive						◎					
Troubleshooting	Check air cleaner directly		●									
	When compression pressure is measured, it is found to be low			●			●					
	Check valve clearance directly				●							
	When turbocharger is rotated by hand, it is found to be heavy					●						
	When air is bled from fuel line, air comes out								●			
	Check fuel filter, strainer directly									●		
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)“										●	
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode											●
		Action	Clean	Replace	Adjust	Replace	Replace	Clean	Correct	Replace	Replace	Replace

*1: Failure code of code display [CA559] and [CA2249]

S-4 Engine stops during operations

General causes why engine stops

- Internal part of engine seized
- Insufficient supply of fuel
- Engine overheating
- Failure in power train on the machine:
  Carry out troubleshooting on the machine.

			Cause													
			Broken dynamic valve system (valve, rocker lever, etc.)	Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken, seized gear train	Insufficient fuel in tank	Clogged air breather hole in fuel tank cap	Clogged, leaking fuel piping	Clogged fuel filter	Broken, seized fuel feed pump	Broken fuel supply pump shaft	Stuck, seized fuel supply pump plunger	Broken auxiliary equipment (pump, compressor, etc.)	Failure in power train mounted on the machine
Questions	Confirm recent repair history															
	Degree of use of machine	Operated for long period								△						
	Condition when engine stopped	Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎					○	◎	○	◎	◎
		Engine overheated and stopped		◎	○									○	
		Engine stopped slowly					◎			○					
		There was hunting and engine stopped					◎	○		○	○				
	Non-specified fuel is being used									○	○		○		
	Replacement of filters has not been carried out according to Operation & Maintenance Manual									◎					
	Fuel level monitor indicates low fuel remaining (when monitor is installed)						◎								
Check items	Fuel tank is found to be empty						◎								
	Air breather hole in fuel tank cap is clogged							◎							
	There is a leakage from fuel piping								◎						
	Rust and water are found when fuel in fuel tank is drained									◎					
	Metal particles are found when oil in oil pan is drained		◎	◎	◎						○				
	When it is attemped to turn engine by hand	Does not turn at all		◎	◎										
		Turns in opposite direction	◎												
		Moves amount of backlash				◎								◎	
		Fuel supply pump shaft does not run										◎			
	Engine rotates but stops when load is applied to machine														◎
Troubleshooting	Check dynamic valve system directly		●												Carry out troubleshooting on the machine
	Check piston and connecting rod directly			●											
	Check crankshaft bearing directly				●										
	Check gear train directly					●									
	Check fuel filter, strainer directly									●					
	Check fuel feed pump directly										●				
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)“											●	●		
	When auxiliary equipment (pump, air compressor, etc.) is removed, engine turns													●	
		Action	Replace	Replace	Replace	Replace	Add	Clean	Correct	Replace	Replace	Replace	Replace	Replace	—

*1: Failure code of code display [CA559] and [CA2249]

S-5 Engine does not rotate smoothly

General causes why engine does not rotate smoothly

- Air in fuel system
- Speed sensor is not normal (abnormality not big enough to generate failure display

			Cause							
			Insufficient fuel in tank	Clogged air breather hole in fuel tank cap	Leakage, clogging, air in fuel piping	Clogged fuel filter	Clogged fuel injector, defective spray (dirt caught)	Defective Ne speed sensor, defective wiring harness	Defective Bkup speed sensor, defective wiring harness
Questions	Confirm recent repair history								
	Degree of use of machine	Operated for long period				△			
	Condition of hunting	Occurs at a certain speed range						○	○
		Occurs at low idle			○	○	○	○	○
		Occurs even when speed is raised		○				○	○
		Occurs on slopes	◎						
Check items	Replacement of filters has not been carried out according to Operation & Maintenance Manual					◎			
	Fuel tank is found to be empty		◎						
	Air breather hole in fuel tank cap is clogged			◎					
	Rust and water are found when fuel in fuel tank is drained					○			
	There is a leakage from fuel piping				◎				
Troubleshooting	Check fuel filter, strainer directly					●			
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode						●		
	Carry out troubleshooting for code display “Abnormality in Ne speed sensor (*1)“							●	
	Carry out troubleshooting for code display “Abnormality in Bkup speed sensor (*2)“								●
		Action	Add	Clean	Correct	Replace	Replace	Replace	Replace

*1: Failure code of code display [CA689]
*2: Failure code of code display [CA778]

S-6 Engine lacks output (or lacks power)

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Abnormal fuel injection condition
- Improper selection of fuel
- Engine overheating:
  See “S-14 Coolant temperature becomes too high (over-heating)“
- Controller controlled by derate mode
  (The injection amount (output) is limited because a failure has occurred in the electrical system.)

			Cause: Clogged air cleaner element	Leakage in air intake piping	Seized turbocharger, interference	Defective contact of valve and valve seat	Improper valve clearance	Worn piston ring, cylinder liner	Clogged air breather hole in fuel tank cap	Clogged, leaking fuel piping	Clogged fuel filter	Stuck, seized fuel supply pump plunger	Clogged fuel injector, defective spray (dirt caught)	Defective injector drive (signal, solenoid)	Defective mount of boost pressure sensor (air leakage)	Defective boost pressure sensor, defective wiring harness	Clogged fuel spill piping
Questions	Confirm recent repair history																
	Degree of use of machine	Operated for long period	△			△		△			△						
	Power was lost	Suddenly		○	◎									○	○	○	○
		Gradually	○			○		○			○		○		○		
	Non-specified fuel is being used										○	○	○				
	Replacement of filters has not been carried out according to Operation & Maintenance Manual		◎								◎						
	Engine oil must be added more frequently					○		○									
Check items	Dust indicator lamp is red (when indicator is installed)		◎	◎													
	Air breather hole in fuel tank cap is clogged								◎								
	There is a leakage from fuel piping									◎							
	Power is lacking after short stop in operations			◎													
	Color of exhaust gas	Black			◎		◎										
		Blue under light load						◎									
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low												◎	◎			
	When engine is running, noise of interference is heard from around turbocharger				◎												
	When engine is running, abnormal noise is heard from around cylinder head						◎										
	Hign idle speed of engine is high													○			
	High idle speed is normal, but speed suddenly drops when load is applied								○		◎	○	○				
	Engine does not pick up smoothly and combustion is irregular			◎	◎				○	○			◎				
	There is hunting from engine (rotation is irregular)								○	○	○		○	○			
	Blow-by gas is excessive				◎			◎									
Troubleshooting	Check air cleaner directly		●														
	Check air intake piping directly			●													
	When boost pressure is measured, it is found to be low		●	●	●												
	When compression pressure is measured, it is found to be low					●		●									
	Check valve clearance directly						●										
	Check fuel piping									●							
	Check fuel filter, strainer directly										●						
	Check spill port check valve directly																●
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)“											●					
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode												●	●			
	Check mounting of boost pressure sensor directly														●		
	Carry out troubleshooting for code display “Abnormality in boost pressure sensor (*2)“															●	
		Action	Clean	Correct	Replace	Replace	Adjust	Replace	Clean	Correct	Replace	Replace	Replace	Replace	Correct	Replace	Replace

*1: Failure code of code display [CA559] and [CA2249]
*2: Failure code of code display [CA112] and [CA123]

S-7 Exhaust smoke is black (imcomplete combustion)

General causes why exhaust smoke is black

- Insufficient intake of air
- Abnormal fuel injection condition
- Improper selection of fuel
- Engine overheating:
  See “S-14 Coolant temperature becomes too high (overheating)“
- Controller controlled by derate mode
  (The injection amount (output) is limited because a failure has occurred in the electrical system.)

			Cause													
			Clogged air cleaner element	Seized turbocharger, interference	Defective contact of valve, valve seat	Improper valve clearance	Leakage of air between turbocharger and cylinder head	Crushed, clogged muffler	Worn piston ring, cylinder liner	Stuck, seized fuel supply pump plunger	Clogged, seized fuel injector	Worn fuel injector	Defective fuel injection timing	Defective fuel injection pressure	Defective coolant temperature sensor, defective wiring harness
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period	△		△				△		△				
	Color of exhaust gas	Suddenly became black		◎			◎			○	○	○			
		Gradually became black	◎				○				○				
		Blue under light load							◎						
	Non-specified fuel is being used									○	○				
	Engine oil must be added more frequently								◎						
	Power was lost	Suddenly		◎				○		○	○				
		Gradually	○		○		○		○						
Check items	Dust indicator lamp is red (when indicator is installed)		◎												
	Muffler is crushed							◎							
	Leakage of air betweeen turbocharger and cylinder head, loose clamp						◎								
	Operates in low-temperature mode even at normal temperatures												○	○	○
	When exhaust manifold is toutched immediately after starting engine, temperature of some cylinders is low									○	◎				
	When engine is running, noise of interference is heard from around turbocharger			◎											
	When engine is running, abnormal noise is heard from around cylinder head					◎									
	Rotation speed of torque converter stall and pump relief is high (excessive injection of fuel)											○			
	Exhaust noise is abnormal			○				◎			○				
	Engine does not pick up smoothly and combustion is irregular			○		○	○	○		○	◎				
	Blow-by gas is excessive								◎						
	When hose from injector to spill collection portion is disconnected, spill flow is found to be abnormally high											◎			
Troubleshooting	Check air cleaner directly		●												
	When turbocharger is rotated by hand, it is found to be heavy			●											
	When compression pressure is measured, it is found to be low				●				●						
	Check valve clearance directly					●									
	When muffler is removed, exhaust color returns to normal							●							
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)“									●		●			
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode										●				
	Carry out troubleshooting for code display “Abnormality in coolant temperature sensor (*2)“														●
	Confirm with monitoring function of INSITE or on the machine												●	●	
		Action	Clean	Replace	Replace	Adjust	Correct	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Replace

*1:Failure code of code display [CA559] and [CA2249]
*2:Failure code of code display [CA114] and [CA145]

S-8 Oil consumption is excessive (or exhaust smoke is blue)

General causes why oil consumption is excessive

- Abnormal combustion of oil
- The engine has been run at low or high idle for a long time continuously
  (more than 20 minutes continuous operation is not allowed)
- External leakage of oil
- Wear of lubrication system

			Cause														
					Turbocharger												
			Dust stucked in from intake system	Worn, broken valve (stem, guide, seal)	Worn seal at the side of turbine	Worn seal at the side of blower	Clogged breather, breather hose	Broken piston ring	Worn piston ring, cylinder liner	Worn, broken rear oil seal	Broken oil cooler	Leakage from oil cooler	Leakage from oil filter	Leakage from oil piping	Leakage from oil drain plug	Leakage from oil pan, cylinder head, etc.
Questions	Confirm recent repair history															
	Degree of use of machine	Operated for long period		△	△	△			△							
	Oil consumption suddenly increased							◎			○					
	Engine oil must be added more frequently								◎		○					
	Oil gets contaminated quickly						○	○	◎							
Check items	Outside of engine is dirty with oil											◎	◎	◎	◎	◎
	Loose piping clamp in air intake system		◎													
	Inside of turbocharger air supply pipe is dirty with oil					◎										
	Inside of turbocharger exhaust pipe is dirty with oil			○	◎											
	There is oil in engine coolant										◎					
	Oil level in clutch or damper chamber rises									◎						
	Exhaust smoke is blue under light load							◎	◎							
	Amount of blow-by gas	Excessive		○		○		◎	◎							
		None					◎									
Troubleshooting	When intake manifold is removed, dust is found inside		●													
	When intake manifold is removed, inside is found to be extremely dirty			●												
	Excessive play of turbocharger shaft				●	●										
	Check breather, breather hose directly						●									
	When compression pressure is measured, it is found to be low							●	●							
	Check rear oil seal directly									●						
	Pressure-tightness test of oil cooler shows there is leakage										●	●				
	There is external leakage of oil from engine												●	●	●	●
		Action	Correct	Replace	Replace	Replace	Clean	Replace	Replace	Replace	Replace	Replace	Correct	Correct	Correct	Correct

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly

- Entry of exhaust gas into oil due to internal wear
- Clogging of lubrication passage
- Improper fuel used
- Improper oil used
- Operation under excessive load

			Cause									
			Defective seal at turbocharger turbine end	Worn valve, valve guide	Worn piston ring, cylinder liner	Clogged breather, breather hose	Clogged oil cooler	Clogged oil filter	Defective oil filter safety valve	Clogged turbocharger lubrication drain tube	Exhaust smoke color is poor	
Check items	Questions	Confirm recent repair history										
		Degree of use of machine	Operated for long period	△	△	△						
		Non-specified fuel is being used				○			○			
		Engine oil must be added more frequently				◎						
	Check items	Metal particles are found when oil inside oil filter is drained			○	○			◎			
		Inside of exhaust pipe is dirty with oil			◎							
		Engine oil temperature rises quickly						◎				
		Color of exhaust gas	Blue under light load			◎						
			Black									◎
		Amount of blow-by gas	Excessive	○	○	◎					○	
			None				◎					
Troubleshooting		Excessive play of turbocharger shaft		●								See S-7
		When compression pressure is measured, it is found to be low			●	●						
		Check breather, breather hose directly					●					
		Check oil cooler directly						●				
		Check oil filter directly							●			
		Spring of oil filter safety valve catching or broken								●		
		Check turbocharger drain tube directly									●	
			Action	Replace	Replace	Replace	Clean	Clean	Replace	Replace	Clean	—

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive

- Leakage of fuel
- Improper condition of fuel injection (injection pressure, injection timing)
- Excessive injection of fuel

			Cause									
			Leakage of fuel inside head cover	External leakage from fuel piping, fuel filter	Defective fuel feed pump oil seal	Defective supply pump plunger	Defective common rail fuel pressure	Defective fuel injector spray	Defective actuation of fuel injector	Defective fuel injection timing	Defective coolant temperature sensor, defective wiring harness
Questions	Confirm recent repair history										
	Degree of use of machine	Operated for long period			△	△		△			
	Condition of fuel consumption	Is more than for other machines of same model					○		○	○	○
		Gradually increased				○		○			
		Suddenly increased	○	○							
Check items	There is external leakage of fuel from engine			◎							
	There is irregular combustion							◎			
	Engine oil level rises and smells of diesel fuel		◎		◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low							◎			
	Low idle speed is high								○		
	Rotation speed of torque converter stall and pump relief is high								○		
	Color of exhaust gas	Black					○	○		○	○
		White	○								
Troubleshooting	Remove head cover and check directly		●								
	Check fuel feed pump oil seal directly				●						
	Carry out troubleshooting for code display “Supply pump pressure no signal (*1)”					●					
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode							●			
	When flow of oil from fuel injector at spill return collection portion is measured, it is found to be excessive								●		
	Carry out troubleshooting for code display “Abnormality in coolant temperature sensor (*2)”										●
	Confirm with monitoring function of INSITE or on the machine						●			●	
		Action	Correct	Correct	Replace	Replace	Correct	Replace	Replace	Adjust	Replace

*1: Failure code of code display [CA559] and [CA2249]
*2: Failure code of code display [CA114] and [CA145]

S-11 Oil is in coolant (or coolant spurts back, or coolant level goes down)

General causes why oil is in coolant

- Internal leakage in lubrication system
- Internal leakage in cooling system

			Causes				
			Broken cylinder head, head gasket	Cracks inside cylinder block	Holes caused by pitting	Broken oil cooler core, O-ring	Broken hydraulic oil cooler or power train oil cooler on applicable machine side
Questions	Confirm recent repair history						
	Degree of use of machine	Operated for long period			△	△	
	Oil level	Suddenly rose	○			○	○
		Gradually rose		○	○		
	Hard water is being used as coolant				○	○	
Check items	Oil level has risen and oil is milky			○	○	◎	
	There are excessive air bubbles in radiator, coolant spurts back		◎				
	Hydraulic oil or power train oil on applicable machine side is milky						◎
	When hydraulic oil or power train oil is drained, water is found						◎
Troubleshooting	Pressure-tightness test of cylinder head shows there is leakage		●				Carry out troubleshooting on applicable machine
	Inspect cylinder block, liner directly			●	●		
	Pressure-tightness test of oil cooler shows there is leakage					●	
		Remedy	Replace	Replace	Replace	Replace	—

S-12 Oil pressure drops

General causes why oil pressure drops

- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Improper oil used (improper viscosity)
- Deterioration of oil due to overheating

			Cause										
			Worn bearing journal	Lack oil in oil pan	Water, fuel in oil	Clogged strainer inside oil pan	Clogged, broken pipe inside oil pan	Defective oil pump	Defective regulator valve	Clogged oil filter	Leaking, crushed, clogged hydraulic piping	Defective oil level sensor, defective wiring harness
Questions	Confirm recent repair history											
	Degree of use of machine	Operated for long period	△					△		△		
	Oil level monitor indicates drop in oil pressure (when monitor is installed)								○	◎		
	Non-specified oil is being used		○							○		
	Replacement of filters has not been carried out according to Operation & Maintenance Manual									◎		
Check items	Oil pressure monitor (when monitor is installed)	indicates oil pressure drop at low idle	◎									
		indicates oil pressure drop at low idle and high idle		○		◎	◎	◎	○			
		indicates oil pressure drop on slopes		◎								
		sometimes indicates oil pressure drop							◎			○
	Oil level monitor indicates low amount of oil (when monitor is installed)			◎								◎
	Oil level in oil pan is low			◎								
	There is crushing, external leakage from hydraulic piping										◎	
	Oil is cloudy white and smells of diesel oil				◎							
	Metal particles are found when oil in oil pan is drained		◎									
	Metal particles are found when oil inside oil filter is drained		◎					○				
Troubleshooting	Metal particles are found in oil filter		●		See S-13							
	Check oil pan strainer and pipe directly					●	●					
	Oil pump rotation is heavy, there is play							●				
	Deterioration, damage of valve, spring in regulator valve								●			
	Check oil filter directly									●		
	When oil level sensor is replaced, oil level monitor displays normally											●
		Action	Replace	Add	—	Clean	Correct	Replace	Adjust	Replace	Correct	Replace

S-13 Oil level rises (water, fuel in oil)

General causes why oil level rises

- Water in oil (cloudy white)
- Fuel in oil (diluted, smells of diesel fuel)

★ If there is oil in the coolant, carry out troubleshooting for “S-11 Oil is in coolant“.

			Cause							
			Broken cylinder head, head gasket	Broken injector O-ring	Cracks inside cylinder block	Holes made by pitting	Worn, broken rear oil seal	Broken oil cooler core, O-ring	Defective part inside fuel supply pump	Defective auxiliary equipment seal (pump, air compressor)
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△	△			△
	Fuel consumption has increased			◎					◎	
Check items	Coolant must be added more frequently		○		○					
	There is oil in engine coolant		○	○	○	○		◎		
	Oil smells of diesel fuel			◎					◎	
	Oil is cloudy white		○			○				
	After engine is started, drops of water come from muffler		○							
	When radiator cap is left open and engine is running at low idle, an abnormal number of bubbles appear, or water spurts back		◎			○				
	Exhaust smoke is white			○						
	Oil level goes down in clutch chamber or damper chamber						◎			
	Oil level goes down in hydraulic tank									◎
Troubleshooting	When compression pressure is measured, it is found to be low		●							
	Remove injector and check O-ring			●						
	Check cylinder block, liner directly				●	●				
	Check rear oil seal directly						●			
	Pressure-tightness test of oil cooler shows there is leakage							●		
	Remove supply pump and check directly								●	
	Check auxiliary equipment seal directly									●
		Action	Replace	Correct	Replace	Replace	Replace	Replace	Replace	Replace

S-14 Coolant temperature becomes too high (overheating)

General causes why coolant temperature becomes too high

- Lack of cooling air (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system
- Rise in oil temperature in power train:
  Carry out troubleshooting on the machine.

			Cause												
			Broken cylinder head, head gasket	Holes made by pitting	Clogged, broken oil cooler	Lack of coolant	Broken water pump	Defective actuation of thermostat	Clogged, crushed radiator fins	Clogged radiator core	Defective radiator cap (pressure valve)	Fan belt slipping, worn fan pulley	Defective coolant temperature gauge	Rise in power train oil temperature
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△	△					△	△				
	Condition of overheating	Suddenly overheated				○	◎					○		
		Always tends to overheat						○	◎	◎		○		
	Coolant temperature gauge (when coolant temperature gauge is installed)	Rises quickly				○		◎						
		Does not go down from red range											◎	
Check items	Radiator coolant level monitor indicates low coolant level (when monitor is installed)					◎								
	Engine oil level has risen, oil is cloudy white			◎	○									
	Fan belt tension is loose											◎		
	There is play when fan pulley is rotated						◎							
	Cloudy white oil is floating on coolant				◎									
	Excessive air bubbles inside radiator, water spurts back		◎											
	When light bulb is held behind radiator, no light passes through								◎					
	Radiator shroud, inside of underguard are clogged with dirt or mud								◎			◎		
	Water is leaking because of cracks in hose or loose clamps					◎								
	Coolant flows out from radiator overflow hose										◎			
	Fan belt whines under sudden acceleration											◎		
	Power train oil temperature enters red range faster than coolant temperature (when oil and coolant temperature gauges are installed)													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											Carry out troubleshooting on the machine
	Check cylinder liner directly			●										
	Check oil cooler directly				●									
	Temperature difference between top and bottom radiator tanks is excessive						●							
	When function test is carried out on thermostat, it does not open even at cracking temperature							●						
	Temperature difference between top and bottom radiator tanks is small								●					
	Check radiator core directly									●				
	When function test is carried out on radiator cap, cracking pressure is found to be low										●			
	Check fan belt, pulley directly											●		
	When coolant temperature is measured, it is found to be normal												●	
		Action	Replace	Replace	Replace	Add	Replace	Replace	Correct	Correct	Replace	Correct	Replace	—

S-15 Abnormal noise is made

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion
- Air sucked in from intake system

★ Judge if the noise is an internal one or an external one.
★ If the engine is not thoroughly warmed up, the engine sound becomes slightly louder because it is operated in the low temperature mode, but this is not an abnormality.
★ When the engine is accelerated, it enters the acceleration mode and the engine noise is a little bit higher for 3 seconds at a maximum, but this is not an abnormality.

			Cause												
			Leakage of air between turbocharger and cylinder head	Seized turbocharger, interference	Broken dynamic valve system (valve, rocker lever, etc.)	Defect inside muffler (dividing board out of position)	Improper valve clearance	Excessive wear of piston ring, cylinder liner	Improper gear train backlash	Missing, seized bushing	Deformed fan, loose fan belt, interference	Clogged, seized fuel injector	Dirt caught in fuel injector	Defective fuel injection timing (abnormal coolant temperature low temperature sensor, boost temperature sensor)
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period						△						
	Condition of abnormal noise	Gradually occurred						○			○			
		Suddenly occurred		○	○					○				
	Non-specified fuel is being used											○		
	Engine oil must be added more frequently							◎						
	Metal particles are found when oil inside oil filter is drained							◎		◎				
Check items	Leakage of air between turbocharger and cylinder head		◎											
	When engine is running, noise of interference is heard from around turbocharger			◎										
	When engine is running, abnormal noise is heard from around cylinder head				◎		◎							
	When engine is running, vibrating noise is heard from around muffler					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎	○	
	Color of exhaust gas	Blue under light load						◎						
		Black	○	◎			○							
	Engine does not pick up smoothly and combustion is irregular											◎		
	Abnormal noise is loud when accelerating						○		○		○	○		
	Blow-by gas is excessive							◎						
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy			●										
	Check dynamic valve system directly				●									
	When muffler is removed, abnormal noise disappears					●								
	Check valve clearance directly						●							
	When compression pressure is measured, it is found to be low							●						
	Check gear train directly								●	●				
	Check fan, fan belt directly										●			
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode											●	●	
	Abnormal noise is made only when starting												●	
	Confirm with monitoring function of INSITE or on the machine													●
		Action	Correct	Replace	Replace	Replace	Adjust	Replace	Replace	Replace	Correct	Replace	Replace	Replace

S-16 Vibration is excessive

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage, etc,)
- Improper alignment with machine
- Abnormal combustion

★ If there is abnormal noise together with the vibration, carry out troubleshooting also for “S-15 Abnormal noise is made“.

			Cause							
			Stuck dynamic valve system (valve, rocker lever, etc.)	Worn main bearing, connecting rod	Improper gear train backlash	Worn cam bushing	Defective fuel injection timing (abnormal coolant temperature, boost temperature sensor)	Loose engine mounting bolts, broken cushion	Misalignment between engine and equipment on the machine	Broken part inside output shaft and damper on the machine
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△		△		
	Condition of vibration	Suddenly increased	○							○
		Gradually increased		○		○		○		
	Non-specified oil is being used			○		○				
Check items	Metal particles are found when oil inside oil filter is drained			◎		◎				
	Metal particles are found when oil in oil pan is drained			◎		◎				
	Oil pressure is low at low idle			○		○				
	Vibration occurs at mid-range speed							○		○
	Vibration follows engine speed				○			○	○	○
	Exhaust smoke is black		◎				○			
Troubleshooting	Check dynamic valve system directly		●							
	Check main bearing, connecting rod bearing directly			●						
	Check gear train directly				●					
	Check camshaft bushing directly					●				
	Confirm with monitoring function of INSITE or on the machine						●			
	Check engine mounting bolts, cushions directly							●		
	When face runout and radial runout are inspected, they are found to be incorrect								●	
	Check inside of output shaft and damper directly									●
		Action	Replace	Replace	Replace	Replace	Replace	Replace	Adjust	Replace

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00595-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

General information on disassembly and assembly

General information on disassembly and assembly

How to read this manual

1. Removal and installation of assemblies
Special tools

- Special tools which are deemed necessary for removal or installation of parts are described as **A1**,•••**X1** etc. and their part names, part numbers and quantities are described in the special tool list.
- Also the following information is described in the special tool list.

1) Necessity
   - ■ : Special tools that cannot be substituted and should always be used (installed).
   - ● : Special tools that will be useful if available and are substitutable with commercially available tools.
2) Distinction of new and existing special tools
   - N : Tools newly developed for this model. They respectively have a new part number.
   - R : Tools with upgraded part numbers. They are remodeled from already available tools for other models.
   - Blank: Tools already available for other models. They can be used without any modification.
3) Circle mark ○ in sketch column:
   - The sketch of the special tool is presented in the section of "Sketches of special tools".
   - Part No. of special tools starting with 79∗T-∗∗∗-∗∗∗∗:
     means that they can not be supplied from Komatsu in Japan (i.e. locally made parts).

★ General tools that are necessary for removal or installation are described as [1],[2]•••etc. and their part names, part numbers and quantities are not described.

Removal

- The [Removal] section contains procedures and precautions for implementing the work, know how and the amount of oil or coolant to be drained.
- Various symbols used in the Removal Section are explained and listed below.

⚠: **This mark indicates safety-related precautions that must be followed when implementing the work.**

★: Know-how or precautions for work

[*1] : This mark shows that there are instructions or precautions for installing parts.

: This mark shows the amount of oil or coolant to be drained.

: Weight of part or component

Installation

- Except where otherwise instructed, installation of parts is done in the reverse order of removal.
- Instructions and precautions for installing parts are shown with [*1] mark in the Installation section, identifying which step the instructions are intended for.
- Marks shown in the Installation section stand for the following.

⚠: **Precautions related to safety in execution of work.**

★ : This mark gives guidance or precautions when doing the procedure.

: Type of coating material

: Tightening torque

: Quantity of oil or coolant to be added

Sketches of special tools

- Various special tools are illustrated for the convenience of local manufacture.

2. Disassembly and assembly of assemblies

Special tools

- Special tools which are deemed necessary for removal or installation of parts are described as **A1**,•••**X1** etc. and their part names, part numbers and quantities are described in the special tool list.
- Also the following information is described in the special tool list.

1) Necessity
   - ■ : Special tools that cannot be substituted and should always be used (installed).
   - ● : Special tools that will be useful if available and are substitutable with commercially available tools.
2) Distinction of new and existing special tools
   - N : Tools newly developed for this model. They respectively have a new part number.
   - R : Tools with upgraded part numbers. They are remodeled from already available tools for other models.
   - Blank: Tools already available for other models. They can be used without any modification.
3) Circle mark ○ in sketch column:
   - The sketch of the special tool is presented in the section of "Sketches of special tools".
   - Part No. of special tools starting with 79*T-***-****: means that they can not be supplied from Komatsu in Japan (i.e. locally made parts).

★ General tools that are necessary for removal or installation are described as [1], [2]•••etc. and their part names, part numbers and quantities are not described.

Disassembly

- In Disassembly section, the work procedures, precautions and know-how for carrying out those procedures, and quantity of the oil and coolant drained are described.
- The meanings of the symbols used in Disassembly section are as follows.

⚠: This mark indicates safety-related precautions that must be followed when implementing the work.

★ : Know-how or precautions for work

: Quantity of oil or coolant drained

Assembly

- In Assembly section, the work procedures, precautions and know-how for carrying out those procedures, and quantity of the oil and coolant added are described.
- The meanings of the symbols used in Assembly section are as follows.

⚠: Precautions related to safety in execution of work

★ : This mark gives guidance or precautions when doing the procedure.

: Type of coating material

: Tightening torque

: Quantity of oil or coolant to be added

Sketches of special tools

- Various special tools are illustrated for the convenience of local manufacture.

Coating materials list

★ The recommended coating materials such as adhesives, gasket sealants, and greases used for disassembly and assembly are listed below.
★ For coating materials not listed below, use the equivalent of products shown in this manual.

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications
Adhesive	LT-1A	790-129-9030	150 g	Tube	• Used to prevent rubber gaskets, rubber cushions, and cork plugs from coming out.
	LT-1B	790-129-9050	20 g (2 pcs.)	Polyethylene container	• Used for plastic (except polyethylene, polypropylene, tetrafluoroethylene and vinyl chloride), rubber, metal, and non-metal parts which require immediate and strong adhesion.
	LT-2	09940-00030	50 g	Polyethylene container	• Features: Resistance to heat and chemicals. • Used to fix and seal bolts and plugs.
	LT-3	790-129-9060 (Set of adhesive and hardener)	Adhesive: 1 kg Hardener: 500 g	Can	• Used to stick and seal metal, glass, and plastics.
	LT-4	790-129-9040	250 g	Polyethylene container	• Used to seal plugs.
	Holtz MH 705	790-129-9120	75 g	Tube	• Heat-resistant seal used to repair engines.
	ThreeBond 1735	790-129-9140	50 g	Polyethylene container	• Quick-setting adhesive. • Setting time: Within 5 sec. to 3 min. • Used mainly to stick metals, rubbers, plastics, and woods.
	Aron-alpha 201	790-129-9130	2 g	Polyethylene container	• Quick-setting adhesive. • Quick-setting type. (max. strength is obtained after 30 minutes) • Used mainly to stick rubbers, plastics, and metals.
	Loctite 648-50	79A-129-9110	50 cc	Polyethylene container	• Features: Resistance to heat and chemicals. • Used for fitted portions used at high temperatures.
Gasket sealant	LG-1	790-129-9010	200 g	Tube	• Used to stick or seal gaskets and packings of power train case, etc.
	LG-5	790-129-9080	1 kg	Polyethylene container	• Used to seal various threaded portions, pipe joints, and flanges. • Used to seal tapered plugs, elbows, and nipples of hydraulic piping.
	LG-6	790-129-9020	200 g	Tube	• Features: Silicon-based heat and cold-resistant sealant. • Used to seal flange surfaces and threaded portions. • Used to seal oil pan, final drive case, etc.
	LG-7	790-129-9070	1 kg	Tube	• Features: Silicon-based quick-setting sealant. • Used to seal flywheel housing, intake manifold, oil pan, thermostat housing, etc.
	ThreeBond 1211	790-129-9090	100 g	Tube	• Gasket sealant used to repair engine.
	ThreeBond 1207B	419-15-18131	100 g	Tube	• Features: Silicon-based, heat and cold-resistant, vibration-resistant, impact-resistant sealant. • Used to seal transfer case, etc.

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications
Molybdenum disulfide lubricant	LM-G	09940-00051	60 g	Can	• Used to lubricate sliding portions. (to prevent squeaking)
	LM-P	09940-00040	200 g	Tube	• Used to prevent scuffing and seizure of press-fitted portions, shrink-fitted portions, and threaded portions. • Used to lubricate linkages, bearings, etc.
Grease	G2-LI	SYG2-400LI SYG2-350LI SYG2-400LI-A SYG2-160LI SYGA-160CNLI	Various	Various	• General purpose type.
	G2-CA	SYG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-160CNCA	Various	Various	• Used for bearings used at normal temperature under light load in contact with water or steam.
	Molybdenum disulfide grease LM-G (G2-M)	SYG2-400M SYG2-400M-A SYGA-16CNM	400 g x 10 400 g x 20 16 kg	Bellows-type container Can	• Used for parts under heavy load.
	Hyper White Grease G2-T, G0-T (*) *: For cold district	SYG2-400T-A SYG2-16CNT SYG0-400T-A (*) SYG0-16CNT (*)	400 g 16 kg	Bellows-type container Can	• Seizure resistance and heat resistance higher than molybdenum disulfide grease. • Not conspicuous on machine since color is white.
	Biograese G2-B, G2-BT (*) *: For use at high temperature and under high load	SYG2-400B SYGA-16CNB SYG2-400BT (*) SYGA-16CNBT (*)	400 g 16 kg	Bellows-type container Can	• Since this grease is decomposed by natural bacteria in short period, it has less effects on micro-organisms, animals, and plants.
Primer	SUNSTAR PAINT PRIMER 580 SUPER	417-926-3910	20 ml	Glass container	Adhesive for cab glass: • Used as primer for cab side. (Using limit: 4 months after date of manufacture)
	SUNSTAR GLASS PRIMER 580 SUPER		20 ml	Glass container	Adhesive for cab glass: • Used as primer for glass side. (Using limit: 4 months after date of manufacture)
	SUNSTAR PAINT PRIMER 435-95	22M-54-27230	20 ml	Glass container	Adhesive for cab glass: • Used as primer for painted surface on cab side. (Using limit: 4 months after date of manufacture)
	SUNSTAR GLASS PRIMER 435-41	22M-54-27240	150 ml	Can	Adhesive for cab glass: • Used as primer for black ceramic-coated surface on glass side and for hard polycarbonate-coated surface. (Using limit: 4 months after date of manufacture)
	SUNSTAR SASH PRIMER GP-402	22M-54-27250	20 ml	Glass container	Adhesive for cab glass: • Used as primer for sash (Almite). (Using limit: 4 months after date of manufacture)

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications	
Adhesive	SUNSTAR PENGUINE SEAL 580 SUPER “S” or “W”	417-926-3910	320 ml	Polyethylene container	Adhesive for cab glass	• “S” is used for high-temperature season (April – October) and “W” for low-temperature season (November – April) as adhesive for glass. (Using limit: 4 months after date of manufacture)
	Sika Japan, Sikaflex 256HV	20Y-54-39850	310 ml	Polyethylene container		• Used as adhesive for glass. (Using limit: 6 months after date of manufacture)
	SUNSTAR PENGUINE SUPER 560	22M-54-27210	320 ml	Ecocart (Special container)		• Used as adhesive for glass. (Using limit: 6 months after date of manufacture)
Caulking material	SUNSTAR PENGUINE SEAL No. 2505	417-926-3920	320 ml	Polyethylene container		• Used to seal joints of glass parts. (Using limit: 4 months after date of manufacture)
	SEKISUI SILICONE SEALANT	20Y-54-55130	333 ml	Polyethylene container		• Used to seal front window. (Using limit: 6 months after date of manufacture)
	GE TOSHIBA SILICONES TOSSEAL 381	22M-54-27220	333 ml	Cartridge		• Used to seal joint of glasses. Translucent white seal. (Using limit: 12 months after date of manufacture)

Special tool list

★ Tools with part number 79○T-○○○-○○○○ cannot be supplied (they are items to be locally manufactured).
★ Necessity: ■: Cannot be substituted, should always be installed (used).
●: Extremely useful if available, can be substituted with commercially available part.

★ New/remodel: N: Tools with new part numbers, newly developed for this model.
R: Tools with upgraded part numbers, remodeled from items already available for other models.
Blank: Tools already available for other models, used without any modification.

★ Tools marked ○ in the Sketch column are tools introduced in special sketches (See Sketches of special tools).

Item	Symbol		Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch	Nature of work, remarks
Removal and installation of fuel supply pump, fuel injector and cylinder head assembly	**A1**		795-799-1131	Gear	■	1			Cranking
Removal and installation of fuel supply pump assembly	**A2**		795-799-1390	Remover	■	1			Removal, installation of fuel supply pump drive gear
Removal and installation of fuel injector	**A**	**3**	795-799-6700	Puller	■	1			Removal of fuel injector assembly
		4	795-799-8150	Remover	●	1			
Removal and installation of engine rear seal	**A**	**5**	795-931-1100	Seal puller	●	1			Removal of engine rear seal
		7	795-799-1150	Repair stand	●	1			Fitting of engine rear seal
			795-799-2280	Adapter	●	1			
Removal and installation of engine front seal	**A6**		795-799-8120	Oil seal driver	●	1	N		Installation of engine front seal
Removal and installation of cylinder head assembly	**A8**		790-331-1120	Wrench (angle)	●	1			Tightening of cylinder head bolt
Disassembly and assembly of TORQFLOW transmission assembly	**D1**		799-301-1600	Oil leak tester	■	1			Check of operation of piston
Disassembly and assembly of HSS assembly	**E**	**1**	791T-422-1320	Hanger	●	1		○	Removal, installation of brake and carrier assembly
		2	790-302-1500	Wrench kit	●	1			Removal, installation of bevel pinion nut
		3	796-730-2300	Wrench assembly	●	1			Adjustment of preload on bevel gear shaft and bevel gear assembly
		4	Commercially available or 795-630-1810	Torque wrench	●	1			

Item	Symbol		Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch	Nature of work, remarks
Removal and installation of final drive assembly	J1		790-337-1032	Lifting tool	■	1			Lifting up of final drive assembly
			791-427-1090	Plate	■	1			
			01010-51635	Bolt	■	2			
Disassembly and assembly of final drive assembly	J	2	791-427-1100	Remover assembly	■	1			Separation of sprocket hub assembly and bearing
			790-101-2102	Puller	■	1			
			790-101-1102	Pump	■	1			
		3	792-520-2121	Installer	■	1			Installation of floating seal
		4	791-427-1200	Installer assembly	■	1			Press fitting of sprocket hub bearing
			790-101-2102	Puller	■	1			
			790-101-1102	Pump	■	1			
Disassembly and assembly of idler assembly	L	1	791-515-1520	Installer	■	1			Installation of floating seal
Disassembly and assembly of track roller assembly		2	791-530-1520	Installer	■	1			
Disassembly and assembly of carrier roller assembly		3	796-230-1110	Installer	■	1			
Disassembly and assembly of idler assembly and track roller assembly		4	791-601-1000	Oil pump	■	1			Supply of oil
Disassembly and assembly of recoil spring assembly	M		791-685-8005	Compressor of type B	■	1			Disassembly, assembly of recoil spring assembly
			791-635-3160	Extension	■	1			
			790-201-2780	Spacer	■	1			
			790-201-2790	Spacer	■	1			
			790-101-1102	Pump	■	1			
			790-101-1600	Cylinder	■	1			
Removal and installation of equalizer bar assembly	N		791-450-1100	Remover assembly	■	1			Pulling out of center pin
			790-101-2102	Puller	■	1			
			790-101-1102	Pump	■	1			
Removal and installation of pivot shaft assembly	P		791-430-1200	Installer assembly	■	1			Press fit ring
			790-101-2102	Puller	■	1			
			790-101-1102	Pump	■	1			

Item	Symbol		Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch	Nature of work, remarks
Whole disassembly and whole assembly of track shoe assembly	R	1	790-646-7531	Remover	■	1			Removal of pin plug of track link
		2	791-660-7460	Brush	■	1			Cleaning of pin of track link
		3	791-432-1110	Push tool	■	1			Installation pin plug of track link (for large plug)
			791-646-7550	Bar	■	1			
			791-646-7560	Guide	■	1			
		4	791-932-1110	Push tool	■	1			Installation pin plug of track link (for small plug)
			791-646-7523	Bar	■	1			
			791-646-7590	Guide	■	1			
		5	790-701-3000	Checker	■	1			Check of track link for airtightness
		6	791-432-1120	Installer	■	1			Installation of seal of track link
		7	791-601-1000	Oil pump	■	1			Supply of track link oil
Field disassembly and assembly of one link	R	3	791-432-1110	Push tool	■	1			Installation of pin plug of track link (for large plug)
			791-646-7550	Bar	■	1			
			791-646-7560	Guide	■	1			
		4	791-932-1110	Push tool	■	1			Installation of pin plug of track link (for small plug)
			791-646-7523	Bar	■	1			
			791-646-7590	Guide	■	1			
		6	791-432-1120	Installer	■	1			Installation of seal of track link
		7	791-601-1000	Oil pump	■	1			Supply of track link oil
		8	791-635-3110	Frame	■	1			Pulling out of pin
			791-635-3160	Extension	■	1			
			791-635-3170	Nut	■	4			
			791-635-3180	Screw	■	2			
			791-635-3190	Screw	■	1			
			791-645-3510	Adapter	■	1			
			791-646-3260	Pusher	■	1			
		9	790-101-1102	Pump	■	1			Pulling out of pin
			790-101-1300	Cylinder	■	1			
		10	790-105-2300	Jack	■	1			Connection of link
			790-101-1102	Pump	■	1			
		11	791-645-3520	Adapter	■	1			Press fitting of bushing
			791-432-1210	Spacer	■	1			

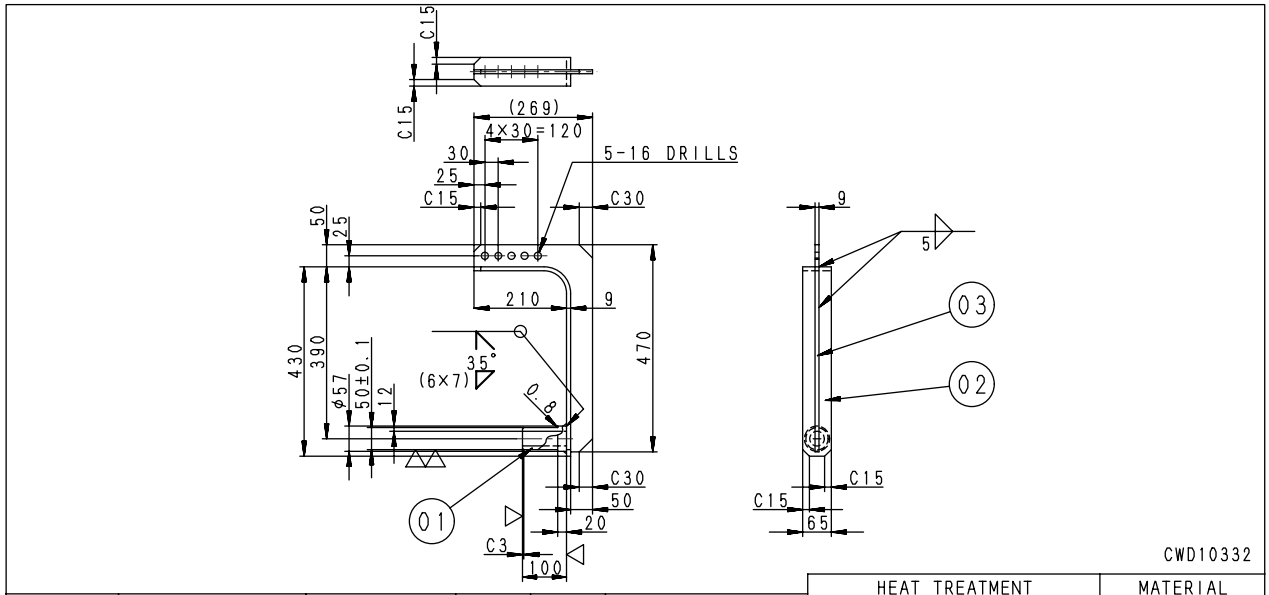
Item	Symbol		Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch	Nature of work, remarks
Field disassembly and assembly of one link	R	12	791-645-3540	Guide	■	1			Press fitting of pin
		13	791-635-3110	Frame	■	1			
			791-635-3160	Extension	■	1			
			791-635-3170	Nut	■	4			
			791-635-3180	Screw	■	2			
			791-635-3190	Screw	■	1			
			791-645-3510	Adapter	■	1			
			791-645-3520	Adapter	■	1			
			791-645-3530	Pusher	■	1			
			791-432-1210	Spacer	■	1			
			791-432-1220	Spacer	■	1			
		14	791-635-3110	Frame	■	1			Press fitting of bushing
			791-635-3160	Extension	■	1			
			791-635-3170	Nut	■	4			
			791-635-3180	Screw	■	2			
			791-635-3190	Screw	■	1			
			791-645-3520	Adapter	■	1			
			791-645-3540	Guide	■	1			
			791-645-3550	Pusher	■	1			
		15	791-646-3270	Guide	■	1			Connection of link
		16	791-635-3110	Frame	■	1			Press fitting of pin
			791-635-3160	Extension	■	1			
			791-635-3170	Nut	■	4			
			791-635-3180	Screw	■	2			
			791-635-3190	Screw	■	1			
			791-645-3510	Adapter	■	1			
Disassembly and assembly of hydraulic cylinder assembly	U	1	790-502-1003	Repair stand	■	1			Disassembly, assembly of hydraulic cylinder assembly
			790-101-1102	Pump	■	1			
		2	790-330-1100	Wrench	■	1			Removal, installation of cylinder head
		3	790-302-1270	Socket	■	1			Removal, installation of nut
			790-302-1280	Socket	■	1			
			790-302-1340	Socket	■	2			
		4	790-720-1000	Expander	■	1			Installation of piston ring
		5	796-720-1650	Ring	■	1			Installation of piston ring (for blade lift cylinder)
			07281-01029	Clamp	■	1			
			796-720-1680	Ring	■	1			Installation of piston ring (for blade tilt cylinder)
			07281-01589	Clamp	■	1			
		6	790-201-1791	Push tool	■	1			Press fitting of bushing (for blade lift cylinder)
			790-201-1811	Push tool	■	1			Press fitting of bushing (for blade tilt cylinder)

Item	Symbol	Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch	Nature of work, remarks
Disassembly and assembly of hydraulic cylinder assembly	U 7	790-101-5021	Grip	■	1			Press fitting of dust seal
		01010-50816	Bolt	■	1			
		790-201-1620	Plate	■	1			(for blade tilt cylinder)
		790-201-1610	Plate	■	1			(for blade lift cylinder)
Removal and installation of operator's cab glass (Stuck glass)	X1	793-498-1210	Lifter (Suction cup)	■	2			Installation of window glass
Removal and installation of engine assembly and floor frame assembly	X2	799-703-1200	Service tool kit	■	1			Supply of air conditioner refrigerant (R134a)
		799-703-1100	Vacuum pump (100 V)	■	1			
		799-703-1111	Vacuum pump (220 V)	■	1			
		799-703-1121	Vacuum pump (240 V)	■	1			
		799-703-1401	Gas leak detector	■	1			

Sketches of special tools

Note: Komatsu cannot accept any responsibility for special tools manufactured according to these sketches.

E1 Hanger



SYM.	PART NAME	MATERIAL	QTY/SET	MASS (kg)	REMARKS
03	PLATE	SS400P	1	2.32	t9
02	PLATE	SS400F	1	2.8	65×t9
01	BOSS	STKM13A	1	0.96	φ57×t12

HEAT TREATMENT	MATERIAL
----	WELD
PART NAME	Q'TY
HANGER	1
791T-422-1320 △	

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00944-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

Engine and cooling system, Part 1

Engine and cooling system, Part 1

Removal and installation of fuel supply pump assembly

Special tools

Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
A	1	795-799-1131	Gear	■	1		
	2	795-799-1390	Remover	■	1		

Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

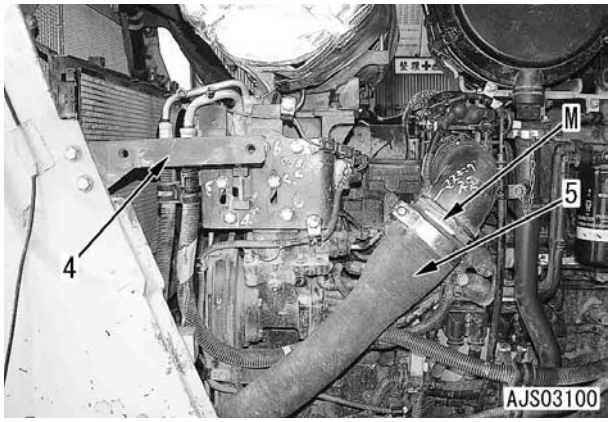
★ Since the hose band (MIKALOR clamp) cannot be reused, use new one. See [*1].

★ The fuel tube connector is new type (To disconnect it, press its lock from both sides and pull it). See step 22.

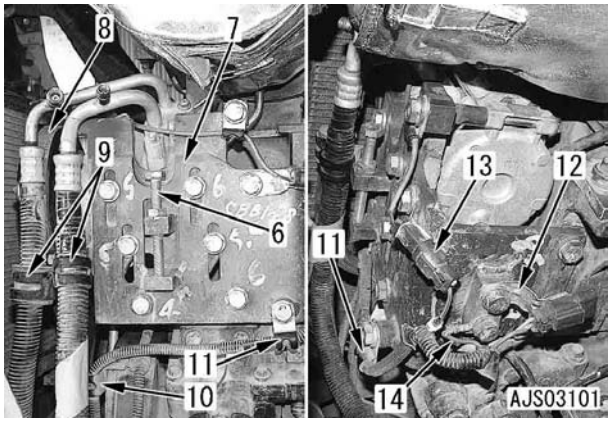
⚠ **The internal parts of the adapters may be damaged when fuel tubes (23), (24) and (25) are removed. Accordingly, replace the adapters with new ones.**

1. Close the fuel supply valve from under the fuel tank.
2. Open engine left side cover (1).
3. Remove covers (2) and (3).

4. Remove bracket (4).
5. Disconnect hose (5). [*1]
   ★ Make a mark (M) at the tube end of each hose to show the original position of the hose.



6. Loosen adjustment bolt (6) of the air conditioner compressor.
7. Loosen the mounting bolt of air conditioner compressor bracket (7).
8. Remove belt (8). [*2]
9. Disconnect air conditioner compressor hose clamp (9).
10. Disconnect wiring harness clamps (10) and (11).
11. Disconnect connector clip (12).
12. Disconnect connector A/C (13).
13. Disconnect ground wire (14).
14. Remove the air conditioner compressor and bracket (7) together.
    ★ Do not disconnect the air conditioner compressor hose but place it on the track shoe.



15. Remove high-pressure pipe clamp (15). [*3]

16. Remove right and left bellows (16). [*3]

17. Remove high-pressure pipe (17). [*3]

18. Disconnect lubrication tube (18). [*4]

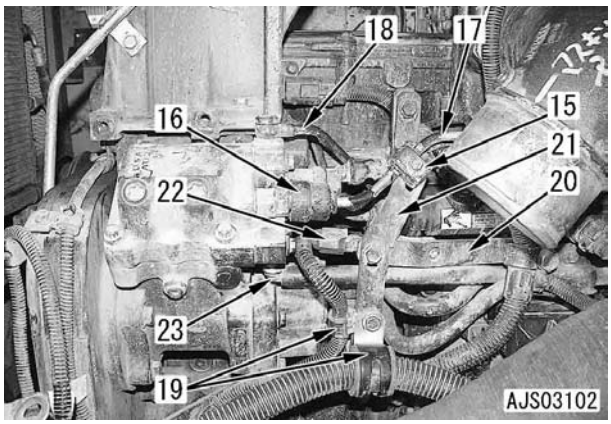
19. Disconnect clamp (19).

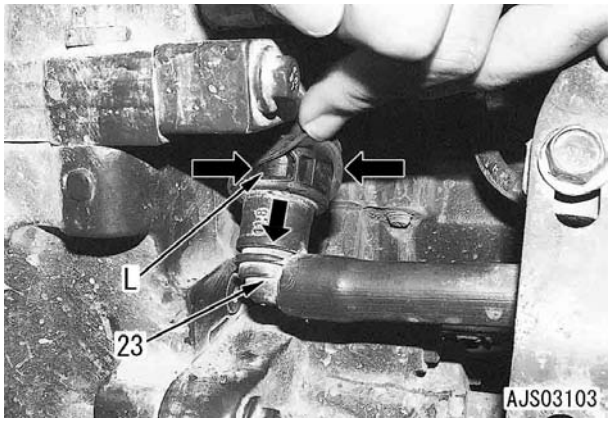
20. Disconnect brackets (20) and (21). [*5]

21. Disconnect connector (22) from the back of bracket (21).

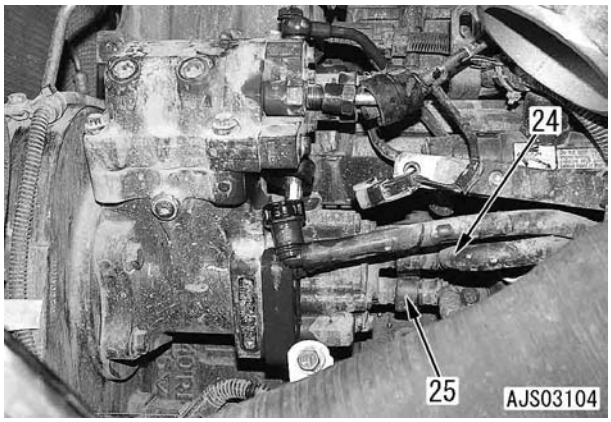
22. Disconnect fuel tube (23). [*6]

★ While pressing locks (L) at the front and rear of fuel tube (23), pull it down to disconnect.





23. Disconnect fuel tubes (24) and (25) similarly to fuel tube (23). [*6]



24. Disconnect receiver drier and bracket assembly (26).

25. Remove cap (27).

26. Install gear **A1** (See the Special tools table) to rotate the crankshaft.

★ See Testing and adjusting, “Testing and adjusting valve clearance”.

27. Twist off cap (28).

★ Use a filter wrench etc. to remove the cap.

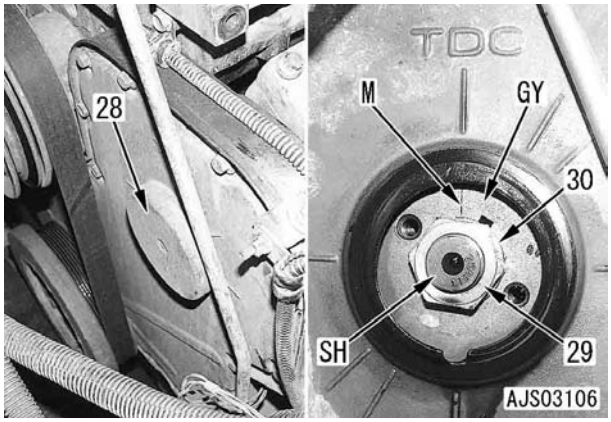
28. Rotate the crankshaft and set stamp (M) of drive bear (GY) to the top dead center.

★ Use a mirror.

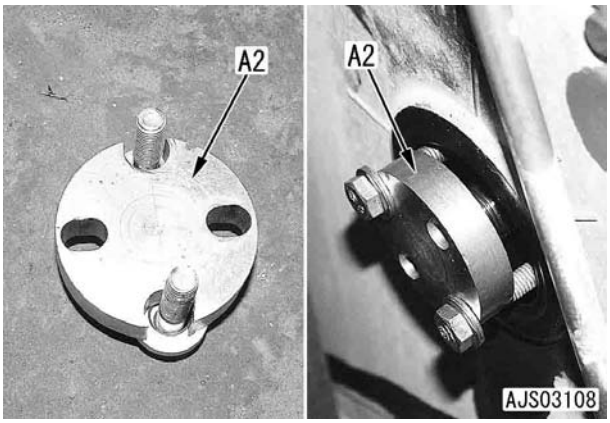
★ See Testing and adjusting, “Testing and adjusting valve clearance”.

29. Remove nut (29) and washer (30) from shaft (SH) of the fuel supply pump.

★ Take care not to drop the nut and washer into the case.

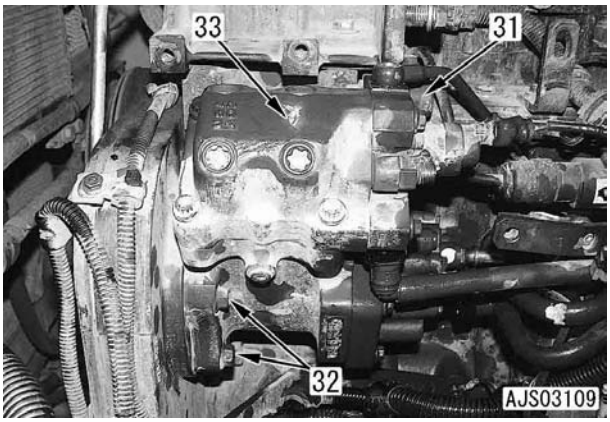


30. Tighten tool **A2** evenly to disconnect shaft (SH) of the fuel supply pump from drive gear (GY).



31. Remove bracket (31).

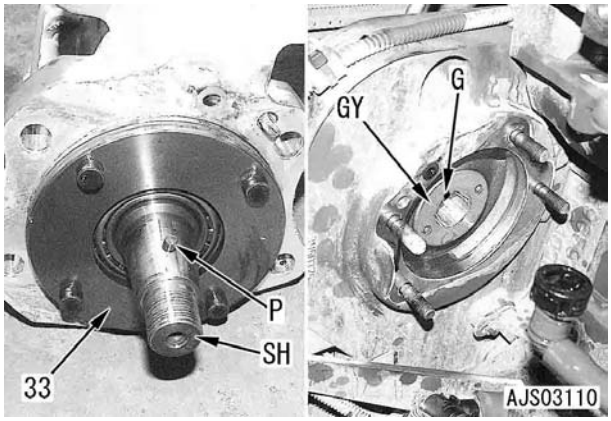
32. Remove 4 nuts (32) and fuel supply pump assembly (33).



Installation

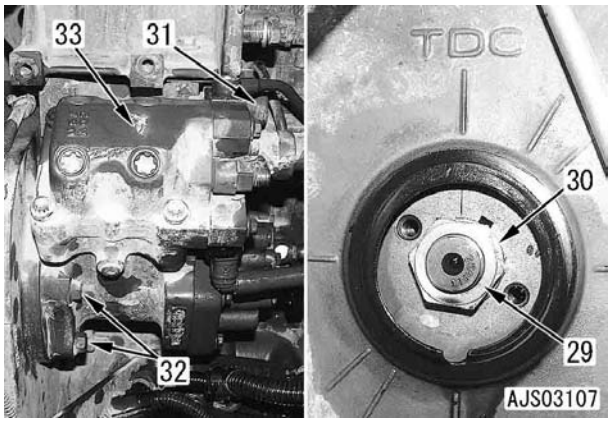
- Install the fuel supply pump assembly according to the following procedure.

1. Install fuel supply pump assembly (33), matching projection (P) of its shaft SH to groove (G) of gear (GY).



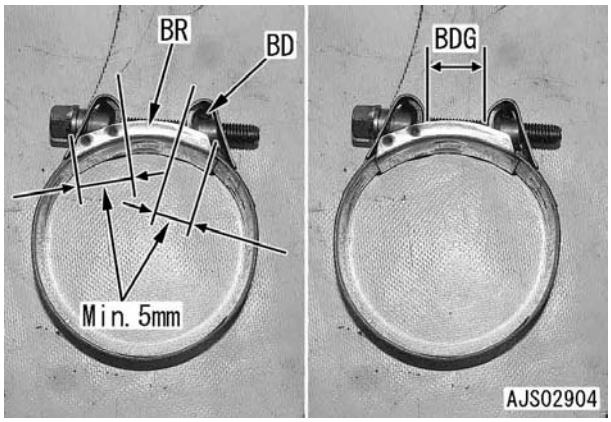
2. Install bracket (31) to fuel supply pump assembly (33) and tighten 4 nuts (32).
Mounting nut: **Adhesive (LT-2)**
Mounting nut and bracket mounting bolt:
43 ± 6 Nm {4.4 ± 0.6 kgm}

3. Set washer (30) and tighten nut (29).
★ When installing the nut and washer, take care not to drop them into the case.
Nut: **178 ± 13 Nm {18.2 ± 1.3 kgm}**



- Carry out the following installation in the reverse order to removal.

[*1]
★ Use a new MIKALOR clamp.
★ Set the hose to the original (marked) position. (Insertion depth of air hose: 57 mm)
★ Set the bridge (BR) so that its clamp bolt will be at the bottom and it will be lapped over band (BD) by at least min. 5 mm.
Threads of clamp bolt: Lubricating oil:
THREEBOND, PAND18B
★ Do not use an impact wrench.
● **When reusing the hose**
★ Set the clamp to its original position.
MIKALOR clamp: **Min. 6 Nm (1.6 kgm)**
● **When using a new hose**
★ Tighten until band gap (BDG) is **5 – 8 mm**.

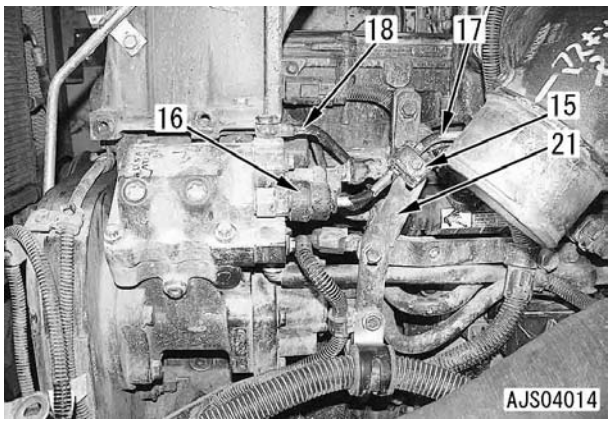


[*2]
★ See Testing and adjusting, “Testing and adjusting air conditioner compressor belt tension”.

[*3], [*5]
● High-pressure pipe, high-pressure pipe clamp and bracket
1) Tighten bracket (21), high-pressure pipe (17), and clamp (15) in order with the fingers.
2) Tighten the sleeve nut of high-pressure pipe (17).
Sleeve nut:
37.3 ± 4 Nm {3.8 ± 0.4 kgm}
3) Install right and left bellows (16).
4) Tighten clamp (15) and bracket (21) permanently in order.

[*4]
Joint bolt of lubrication tube (18):
24 ± 4 Nm {2.45 ± 0.41 kgm}

[*5]
See [*3].



[*6]
● Fuel tubes (23), (24) and (25)
⚠ **The internal parts of the adapters may be damaged when fuel tubes (23), (24) and (25) are removed. Accordingly, replace the adapters with new ones.**

Removal and installation of cylinder head assembly

Special tools

Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
A	1	795-799-1131	Gear	■	1		
	3	795-799-6700	Puller	■	1		
	4	795-799-8150	Remover	●	1		
	8	790-331-1120	Wrench (angle)	●	1		

Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

★ Since the hose band (MIKALOR clamp) cannot be reused, use new one. See [*6].

★ The fuel tube connector is new type (To disconnect it, press its lock from both sides and pull it). See step 21.

⚠ **The internal parts of the adapters may be damaged when fuel tubes (20) and (61) are removed. Accordingly, replace the adapters with new ones.**

★ The wiring harness connector is new type (To disconnect it, slide the first lock and then press the second lock). See step 26.

1. Remove the engine hood assembly. For details, see “Removal of engine hood assembly”.

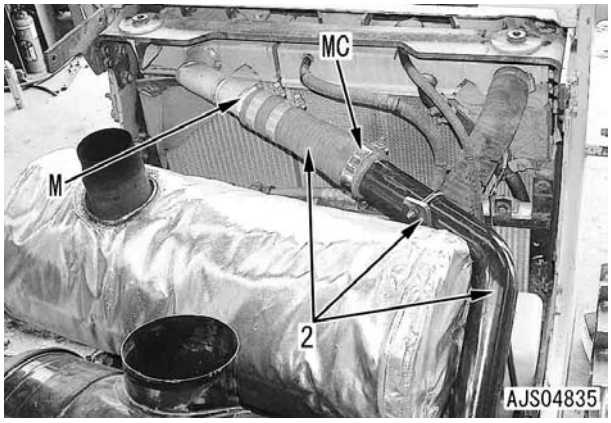
2. Drain the coolant.

Coolant: **Approx. 39 ℓ**

3. Remove cover (1).

4. Remove the air hose, tube, and bracket assembly (2). [*1]

★ If the MIKALOR clamp (MC) is used, do not disconnect the hose.



5. Disconnect dust indicator hose (3).

6. Disconnect air hose (4). [*2]

7. Remove band (5). [*3]

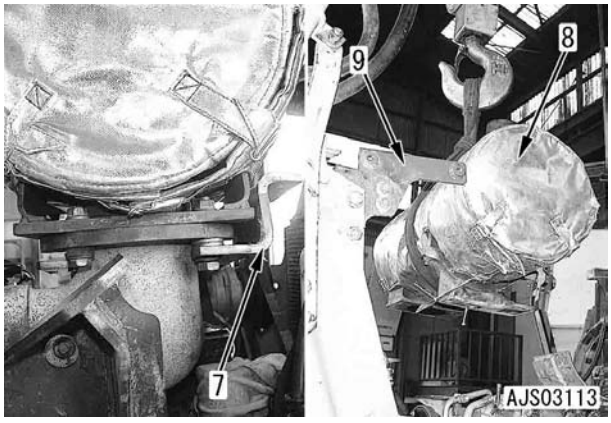
8. Remove air cleaner assembly (6).

9. Remove plate (7).

10. Remove the mounting bolts and lift off muffler assembly (8).

Muffler assembly: **25 kg**

11. Remove bracket (9).



12. Disconnect wiring harness clamp (10).

13. Disconnect terminal HT/A (11) (black).
★ If the terminal cover is removed from the wiring harness, the label comes off. Accordingly, tape the label.

14. Disconnect terminals (12) (green) and (13) (black and thick).

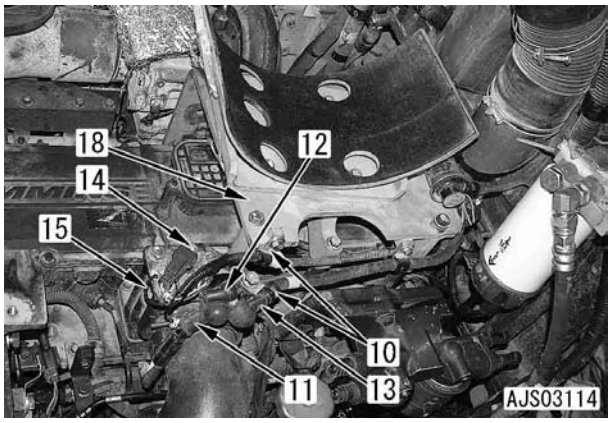
15. Disconnect connector mounting bolt (14).

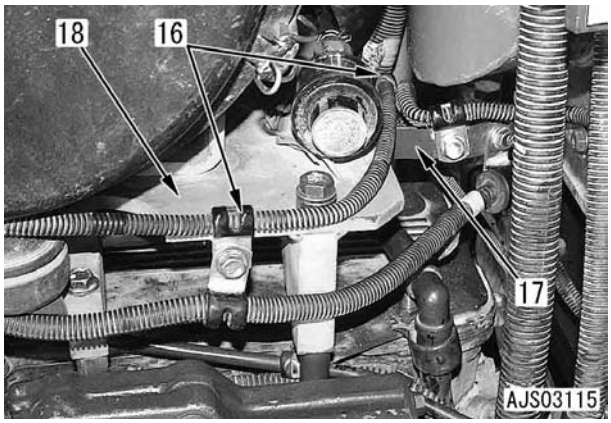
16. Disconnect ground terminal (15) (black).
★ If the terminal cover is removed from the wiring harness, the label comes off. Accordingly, tape the label. In particular, if the labels of terminals HT/A (11) and ground terminal (15) come off, you cannot say which is which, since both terminals HT/A (11) and ground terminal (15) are black and coming from the same wiring harness.

17. Disconnect wiring harness clamp (16).

18. Disconnect bracket (17).

19. Disconnect air cleaner bracket (18).





20. Disconnect coolant hose (19). [*4]
★ Check the connection end.

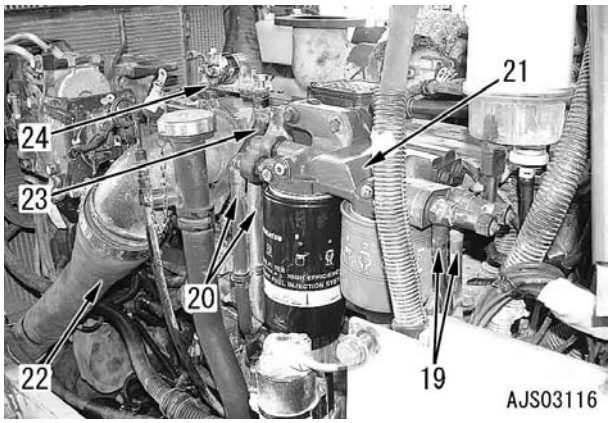
21. Press both sides of lock (L) of fuel tube (20) to disconnect. [*5]
★ Check the connection end.

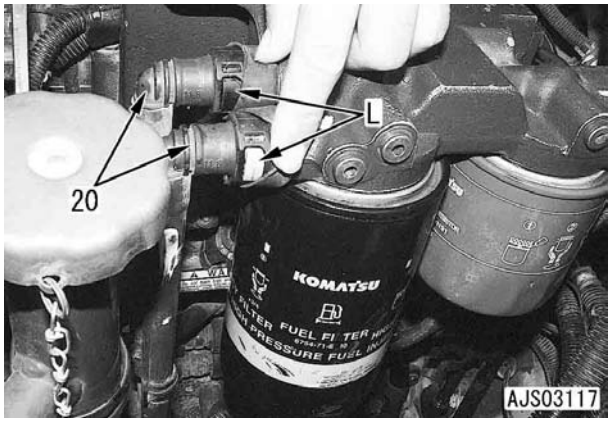
22. Remove filter and bracket assembly (21).

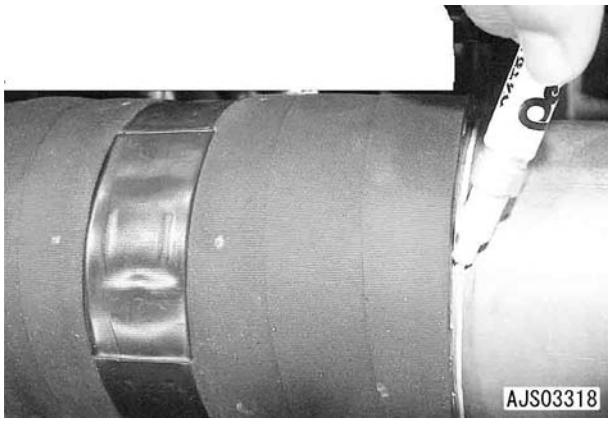
23. Disconnect air hose (22). [*6]
★ Make marks at the hose end tube to show the original position of the hose (See the figure below).

24. Disconnect bracket (23).

25. Remove heater relay and plate assembly (24).

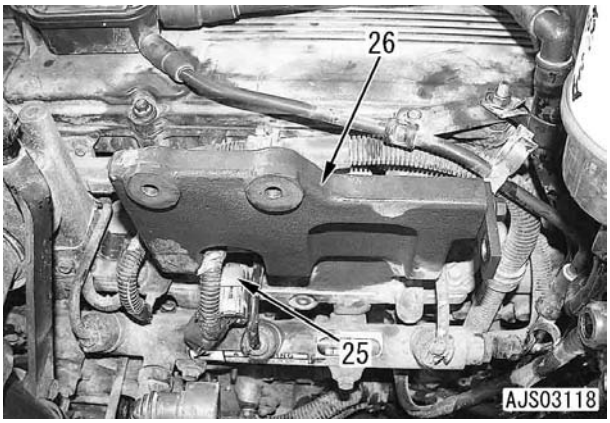


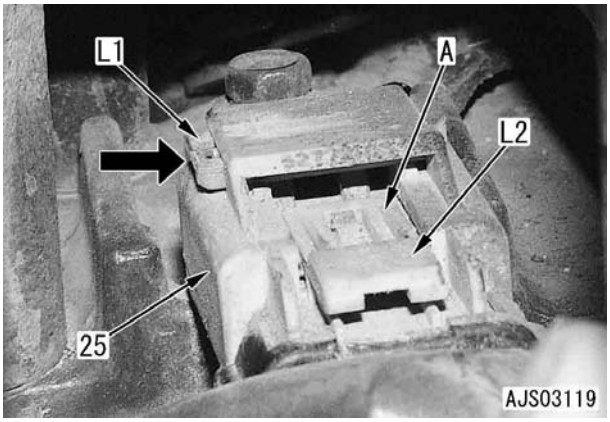




26. Disconnect connector (25) according to the following procedure.
1) Slide lock (L1) to the right.
2) While pressing lock (L2), pull it toward this side to disconnect.
★ If part (A) does not float when lock (L2) is pressed and pulled toward this side, the connector is not disconnected. In this case, while pressing lock (L2), float part (A) with a small flat-head screwdriver and pull lock (L2) toward this side.

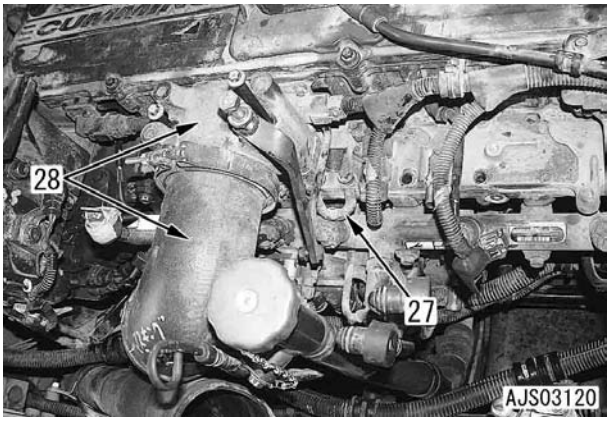
27. Remove bracket (26).





28. Disconnect ground wire (27).

29. Remove air intake connector and tube assembly (28).



30. Loosen adjustment bolt (29) of the air conditioner compressor.

31. Loosen the mounting bolt of air conditioner compressor bracket (30).

32. Remove air conditioner compressor belt (31). [*7]

33. Disconnect air conditioner compressor hose clamp (32).

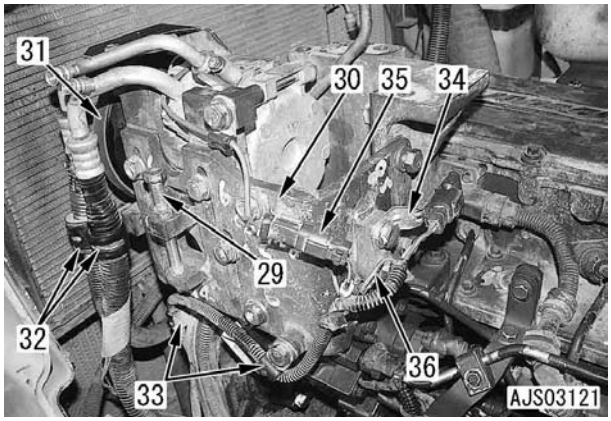
34. Disconnect wiring harness clamp (33).

35. Disconnect connector clip (34).

36. Disconnect connector A/C (35).

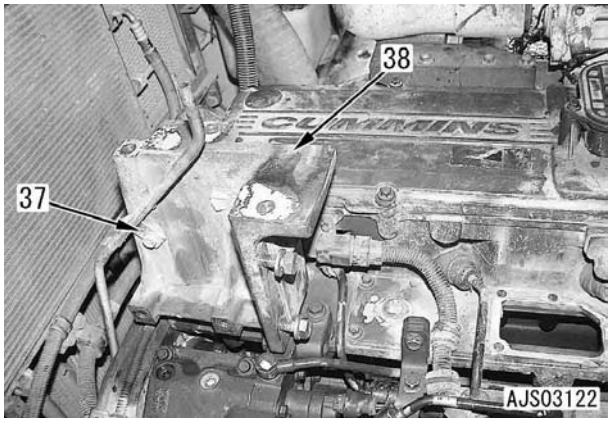
37. Disconnect ground wire (36).

38. Remove air conditioner compressor and bracket (30) together.
★ Do not disconnect the air conditioner compressor hose but place it on the track shoe.



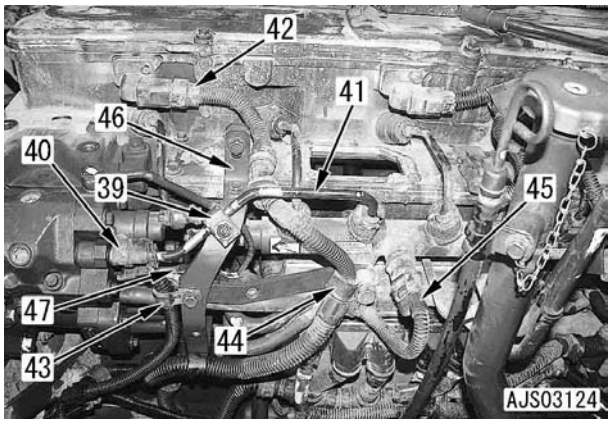
39. Disconnect muffler drain tube clamp (37).

40. Remove bracket (38).

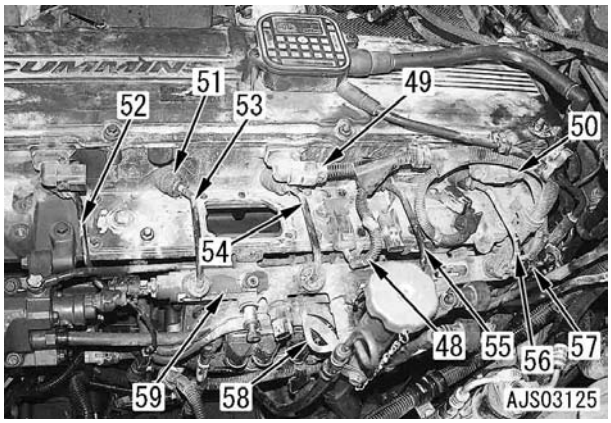


- View of whole air intake unit

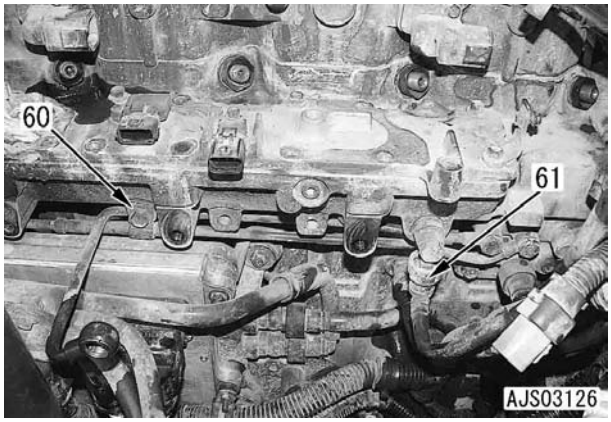
41. Remove high-pressure pipe clamp (39). [*8]
42. Remove right and left bellows (40). [*8]
43. Remove high-pressure pipe (41). [*8]
44. Disconnect connector (42).
45. Disconnect clamps (43) and (44).
46. Disconnect connector (45).
47. Disconnect bracket (46). [*8]
48. Disconnect fuel supply pump connector (47).



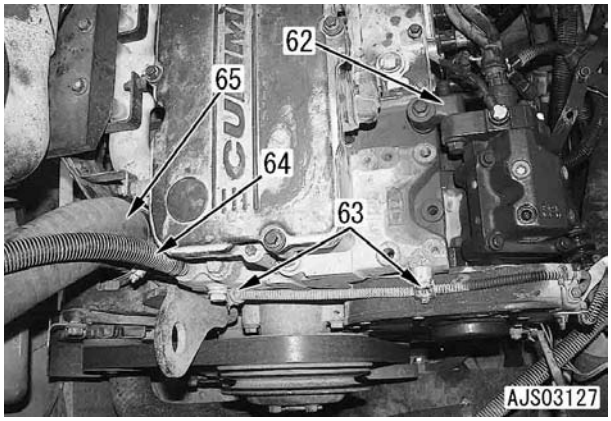
49. Disconnect connectors (48) – (50).
50. Disconnect 12 high-pressure pipe bellows (51). [*8]
51. Remove high-pressure pipes (52) – (57). [*8]
52. Disconnect fuel return tube (58). [*8]
53. Remove common rail (59). [*8]



54. Disconnect clamp (60).
55. Disconnect fuel hose (61). [*9]



56. Remove bracket (62).
57. Disconnect clamp (63).
58. Disconnect radiator hoses (64) and (65). [*10]



59. Disconnect bracket (66).

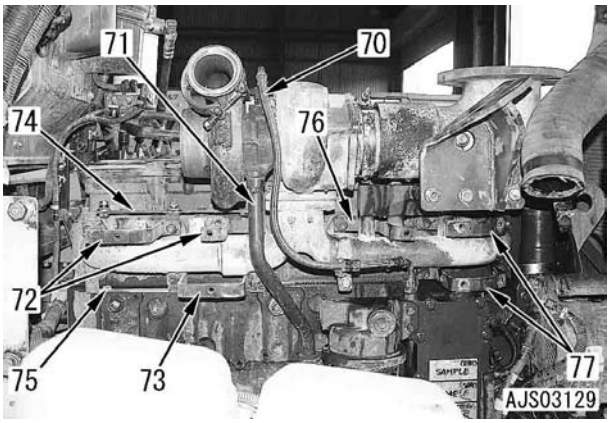
60. Remove heat insulation cover (67).

61. Remove heat insulation covers (68) and (69).

62. Disconnect turbocharger lubrication hose (70). [*11]

63. Disconnect turbocharger lubrication tube (71). [*11]

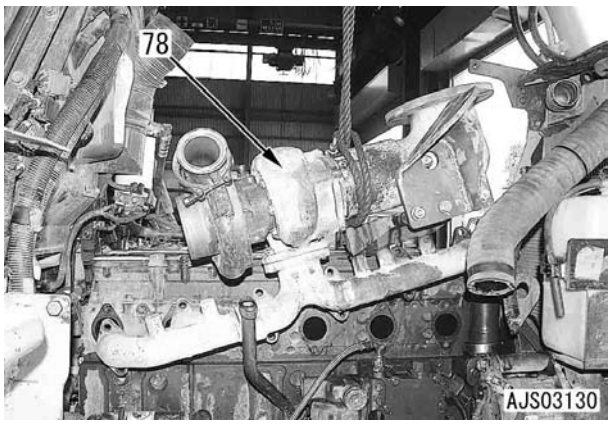
64. Remove brackets (72) – (77).



65. Sling turbocharger and exhaust manifold assembly (78) temporarily.

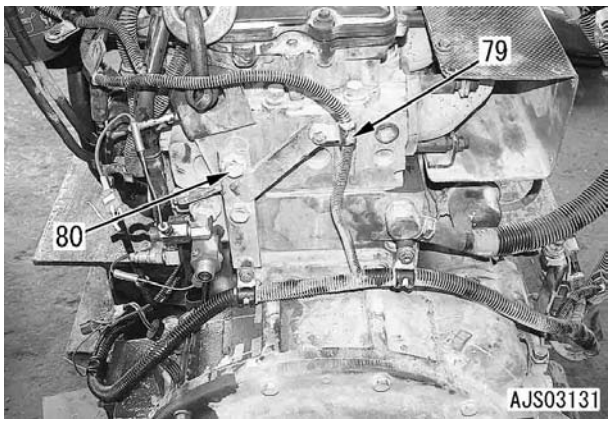
66. Remove the mounting bolts and lift off turbocharger and exhaust manifold assembly (78). [*12]

Turbocharger and exhaust manifold assembly: **35 kg**



67. Disconnect clamp (79) from the rear of the engine.

68. Remove bracket mounting bolt (80).

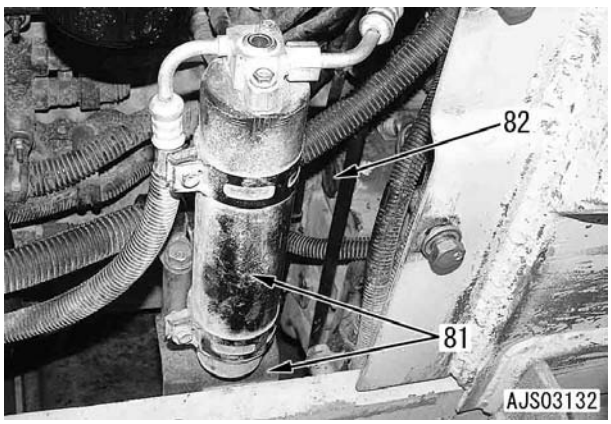


69. Disconnect receiver drier and bracket assembly (81).

70. Remove cap (82).

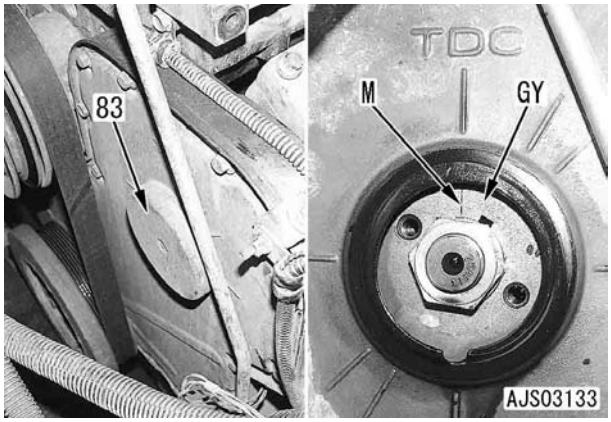
71. Install gear **A1** (See the Special tools table) to rotate the crankshaft.

★ See Testing and adjusting, “Testing and adjusting valve clearance”.



72. Twist off cap (83).
★ Use a filter wrench etc. to remove the cap.

73. Rotate the crankshaft and set stamp (M) of drive bear (GY) to the top dead center.
★ Use a mirror.
★ See Testing and adjusting, “Testing and adjusting valve clearance”.



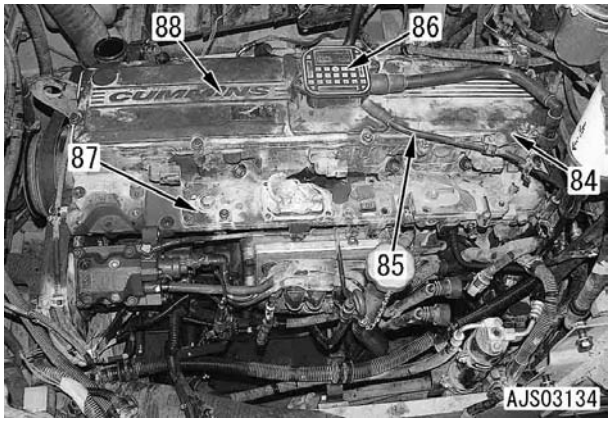
74. Disconnect clamp (84).

75. Disconnect oil hose (85).

76. Remove cover (86).

77. Remove air intake cover (87). [*13]

78. Remove cylinder head cover (88). [*14]
★ Referring to Testing and adjusting, "Testing and adjusting valve clearance", check to see if the No. 1 cylinder is at the top or the No. 6 cylinder is at the top.

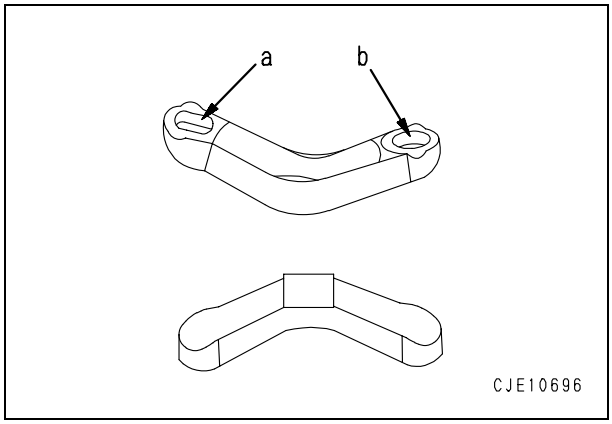


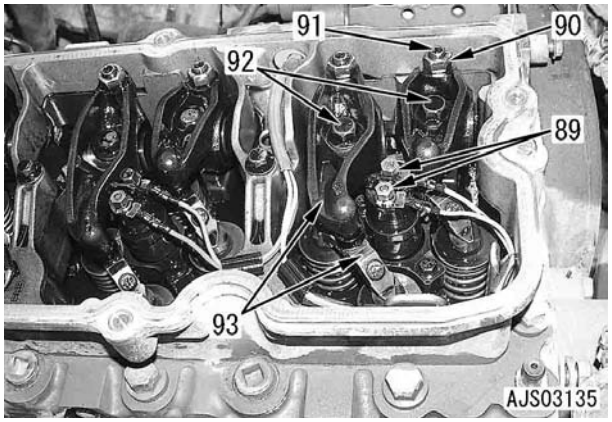
79. Remove wiring harness nut (89) from the injector.

Color of wiring harness	Cylinder No.
Yellow, Orange (Exchangeable)	1, 3, 5
Red, Brown (Exchangeable)	2, 4, 6

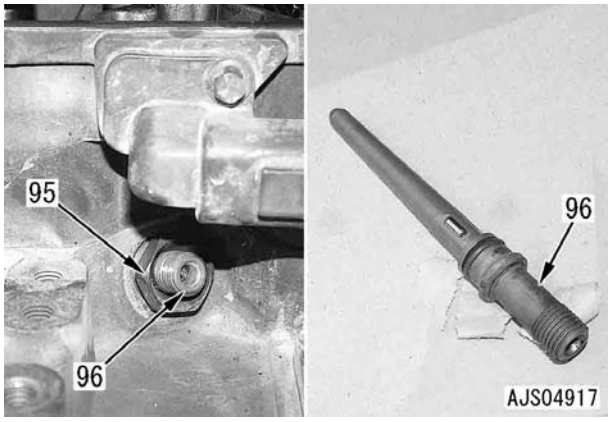
80. Loosen locknut (90) and then loosen adjustment screw (91) 2 – 3 turns.
★ This work must be performed so that an excessive force will not be applied to the push rod when the rocker arm is installed.

81. Remove mounting bolt (92) and rocker arm and crosshead assembly (93).
★ Record the position and direction (shapes of holes "a" and "b") of each crosshead. (When reinstall the crosshead, set it in the same direction.)





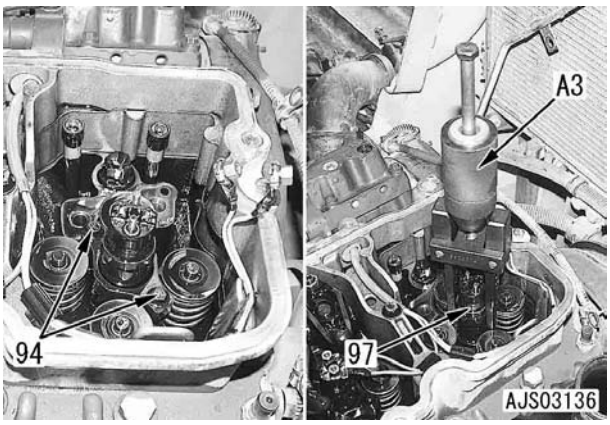
82. Remove retainer (95) and inlet connector (96).
★ Before removing retainer (95), remove all dirt from it and its periphery.
★ Tool **A4** (remover) is set for removal of inlet connector (96). (See Special tools table.)



83. Remove 2 mounting bolts (94) of the injector assembly.

84. Using tool **A3**, remove injector assembly (97).

★ Take care that dirt and foreign matter will not enter the mounting part of the fuel injector assembly.

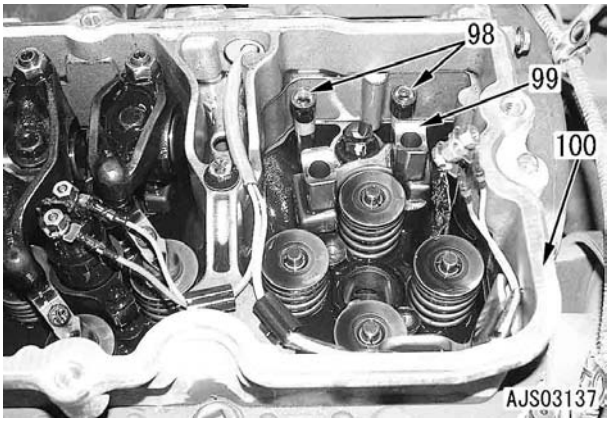


85. Remove push rod (98).

86. Remove spacer (99).

87. Work on the other cylinders similarly.

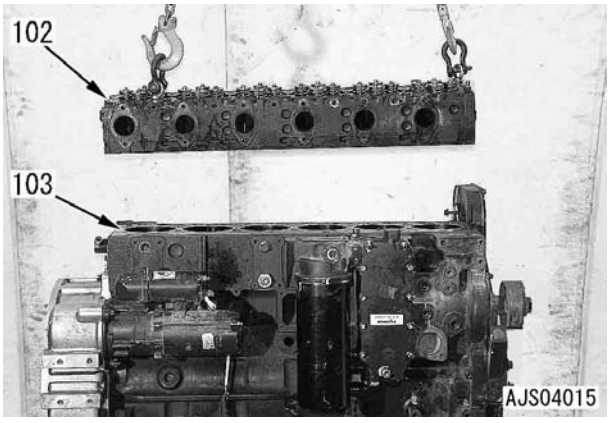
88. Remove rocker housing assembly (100).



89. Remove the 26 bolts and lift off cylinder head assembly (102).

Cylinder head assembly: **85 kg**

90. Remove cylinder head gasket (103).



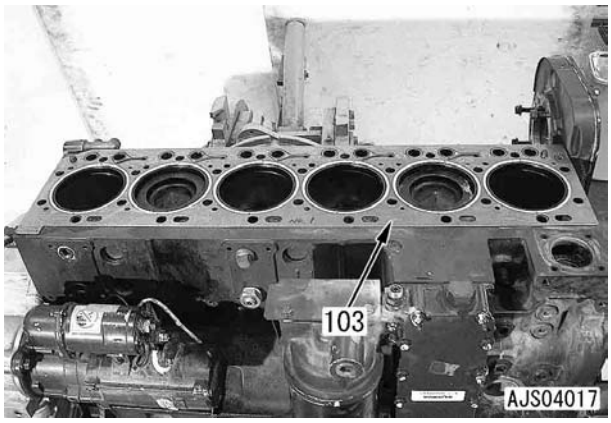
Installation

- **Cylinder head assembly**

★ Check that there is no dirt and foreign matter on the cylinder head mounting surface and in the cylinders.

1. Set cylinder head gasket (103) to the cylinder block.

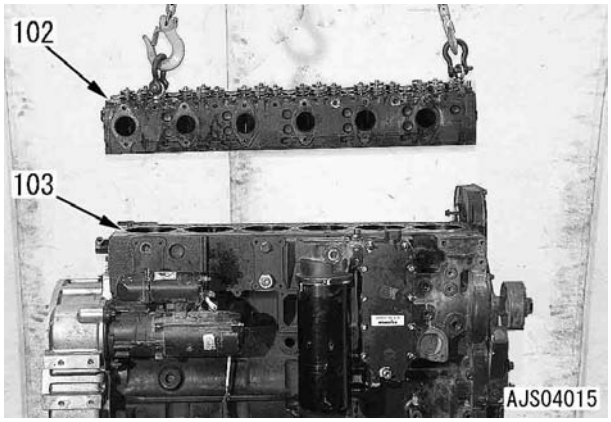
★ Match the holes of the cylinder head gasket to the holes of the block.



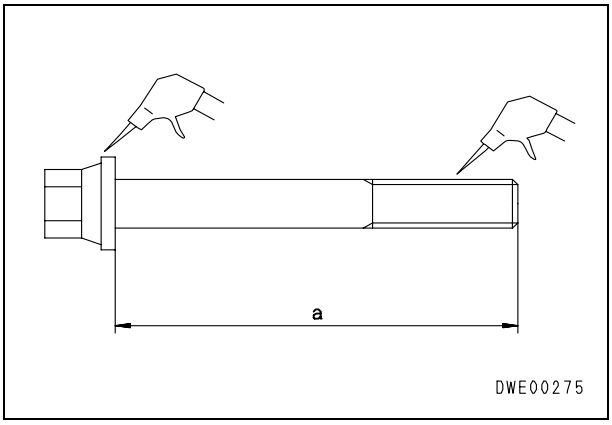
2. Sling cylinder head assembly (102) and set it to the block.

★ Check that the collet is fitted to the groove of each valve stem by lightly hitting the valve stem with a plastic hammer.

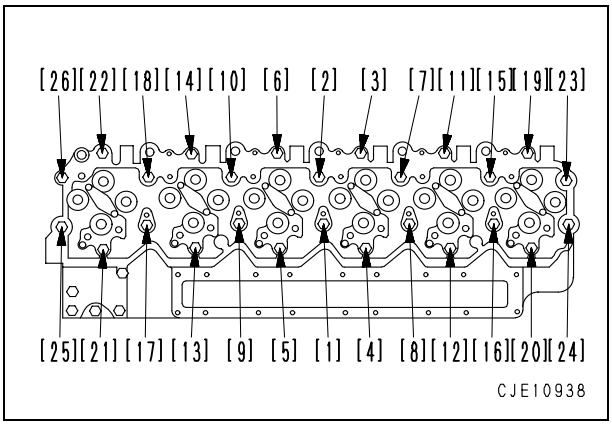
★ Check that cylinder head gasket (103) is matched to the holes of the block.



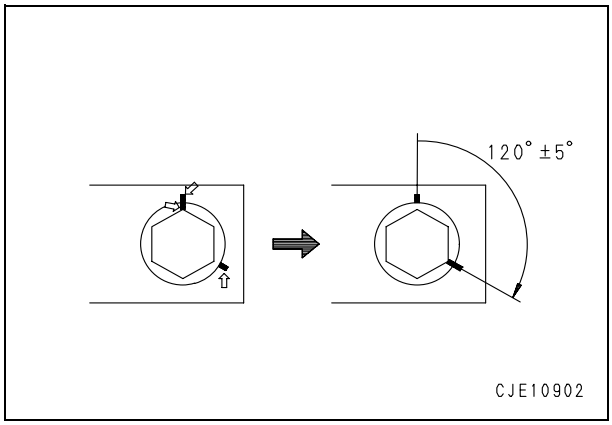
3. Before tightening the cylinder head mounting bolts, check the following.
1) Measure stem length "a" of each mounting bolt and check that it is shorter than the using limit.
2) Using limit length of bolt: 162.6 mm
★ If a bolt is longer than the using limit, do not reuse it but replace it.
Apply engine oil (SAE15W-40) to the threads and seats of the mounting bolts.



4. Tighten the mounting bolts by 2 – 3 turns with the fingers, and then tighten them according to the following procedure.
1) Tighten the cylinder head mounting bolts in the order shown below.
1] **150 ± 9.8 Nm {15.3 ± 1.0 kgm}**
2] Return all bolts **360°**
3] **115 ± 4.9 Nm {11.7 ± 0.5 kgm}**
4] Check tightening torque of **115 ± 4.9 Nm {11.7 ± 0.5 kgm}**
5] **120° ± 5°**



- Tool **A8** (See the Special tools table) is set for angle tightening.
- When not using angle tightening tool **A8**
Make a mark on the cylinder head and each bolt with paint and then tighten the bolt by **120° ± 5°**.

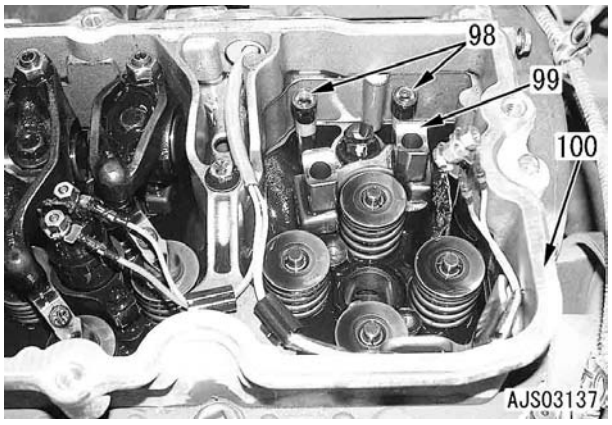


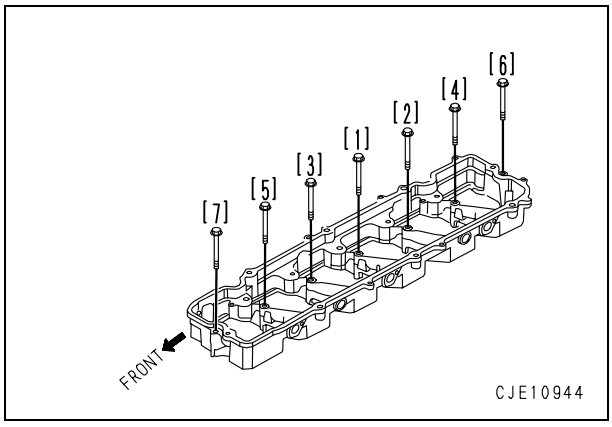
- **Rocker housing assembly**

5. Install push rod (98).
★ Check that the push rod is in the tappet.
★ Apply engine oil (**EO15W-40**) to the push rod socket.

6. Fit the gasket and install rocker housing assembly (100).
- Tighten the bolts in the order of [1] → [7] shown in the figure.
Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

7. Install spacer (99).

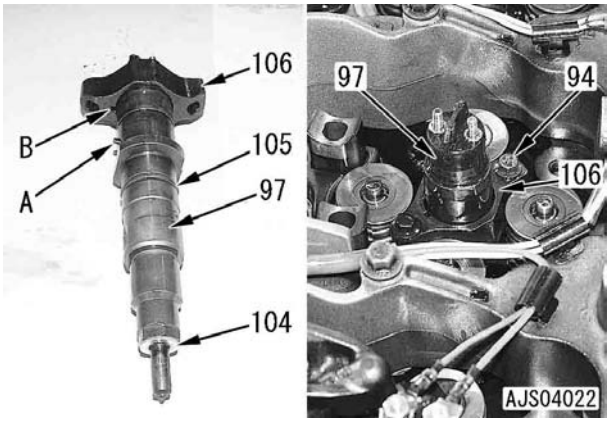




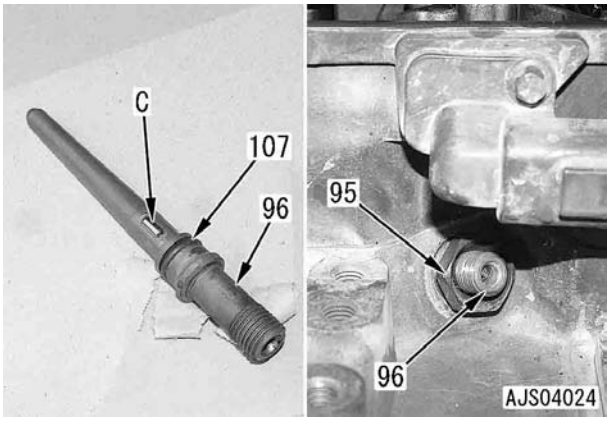
- **Fuel injector assembly**

★ Check that the fuel injector sleeve is free from flaws and dirt.

8. Fit gasket (104) and O-ring (105) to fuel injector (97).
   - O-ring (105) of fuel injector (97) and cylinder head side: **Engine oil (EO15W-40)**
9. Install holder (106) to fuel injector (97).
   - ★ **Match the hollow and projection (B) and (A) to each other.**
10. Insert fuel injector (97) in the cylinder head, directing the fuel inlet hole toward the air intake manifold.
11. Tighten mounting bolt (94) of holder (106) 3 – 4 turns with the fingers.



12. Fit O-ring (107) to inlet connector (96).
    - O-ring (107) of inlet connector (96) and cylinder head side: **Engine oil (EO15W-40)**
13. Install inlet connector (96) with nut (95) temporarily. **(Matching projection (C), push the inlet connector into the hole of the fuel injector.)**
    - Nut: **14.7 ± 5.0 Nm {1.5 ± 0.5 kgm}**

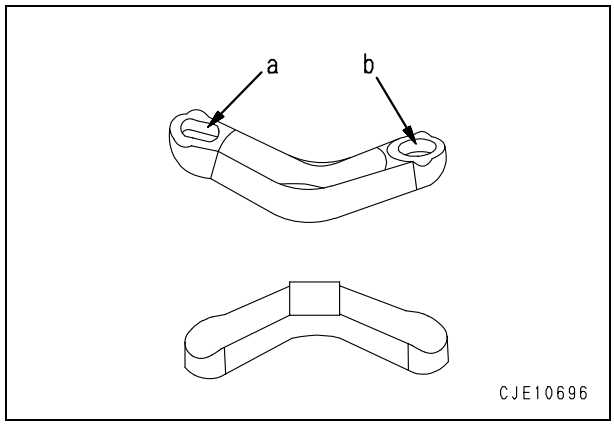


14. Tighten bolts (94) of holder (106) alternately.
    - Bolt: **9.8 ± 2.0 Nm {1.0 ± 0.2 kgm}**
    - ★ The top of holder (106) must be in parallel with the top of the cylinder head. Allowable angle: **2.4°**
15. Tighten inlet connector (96) permanently.
    - Nut: **40.2 ± 3.9 Nm {4.1 ± 0.4 kgm}**

- **Rocker arm and crosshead assembly**

★ The shapes of holes "a" and "b" of each crosshead are different. Accordingly, when reusing the crossheads, install each of them to the same intake/exhaust valve in the same direction as it has been installed.
- A new crosshead may be installed in either direction.

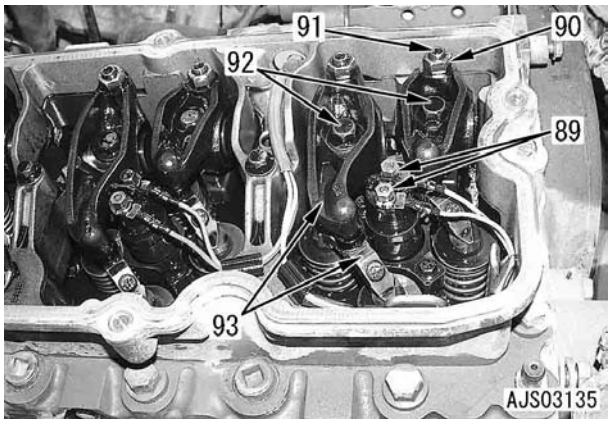
★ Check that 2 valves are inserted in holes "a" and "b".

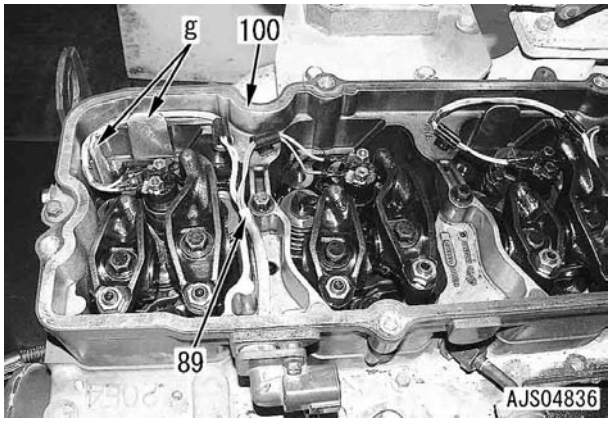


16. Install rocker arm and crosshead assembly (93) and tighten mounting bolts (92) with the fingers.
    - ★ Check that the ball of adjustment screw (91) is fitted in the push rod socket securely.
    - ★ Check that the cap on the crosshead side of the rocker arm is in contact with a plane of the crosshead (that the cap is not in contact diagonally).
    - ★ Apply engine oil to the threads and seat of the mounting bolt.
17. Tighten mounting bolt (92).
    - Bolt: **64.7 ± 4.9 Nm {6.6 ± 0.5 kgm}**
    - ★ Adjust the valve clearance. For details, see Testing and adjusting, “Testing and adjusting valve clearance”.
    - Locknut (90): **24 ± 4 Nm {2.45 ± 0.41 kgm}**

18. Install wiring harness (89).
★ Install wiring harness (89) so that it will not touch the inside wall of rocker housing assembly (100) strongly or come off guide (g) or bend sharply.
Mounting nut:
1.25 ± 0.25 Nm {0.10 ± 0.03 kgm}
★ Installed position of wiring harness

Color of wiring harness	Cylinder No.
Yellow, Orange (Exchangeable)	1, 3, 5
Red, Brown (Exchangeable)	2, 4, 6



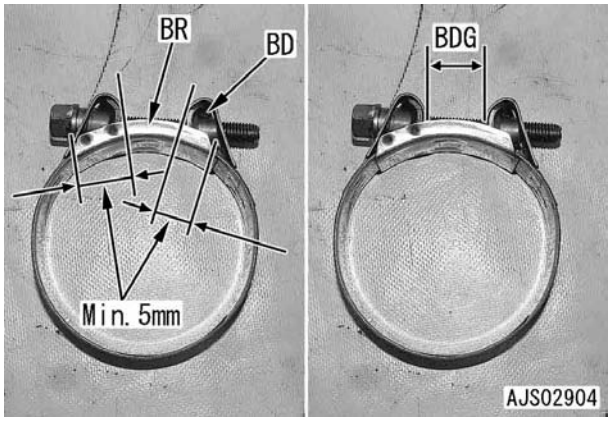


● Carry out the following installation in the reverse order to removal.

[*1]
● Turbocharger side
Clamp: **7 ± 1.1 Nm {0.71 ± 0.11 kgm}**

● Air aftercooler side
Air hose clamp:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

Reference
If the MIKALOR clamp was removed, install new one carefully according to the following procedure.
★ Use a new MIKALOR clamp.
★ Set the hose to the original (marked) position. (Insertion depth of air hose: 60 mm)
★ Set the bridge (BR) so that its clamp bolt will be at the bottom and it will be lapped over band (BD) by at least min. 5 mm.
Threads of clamp bolt: Lubricating oil:
THREEBOND, PAND18B
★ Do not use an impact wrench.
● **When reusing the hose**
★ Set the clamp to its original position.
MIKALOR clamp: **Min. 6 Nm (1.6 kgm}**
● **When using a new hose**
★ Tighten until band gap (BDG) is **17 – 20 mm**.



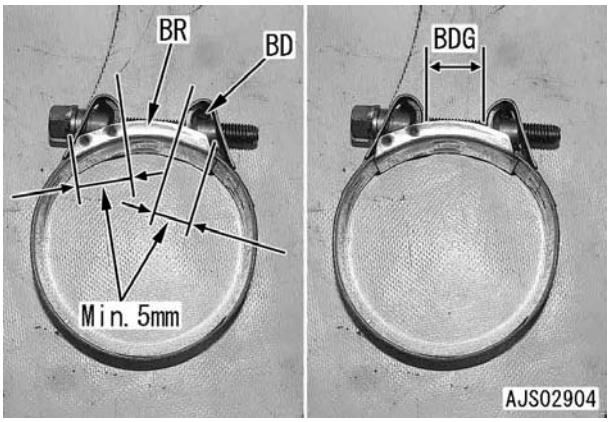
[*2]
Air hose clamp:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

[*3]
Air cleaner band:
9.8 – 11.8 Nm {1 – 1.2 kgm}

[*4]
Fuel tube joint bolt:
24 ± 4 Nm {2.45 ± 0.41 kgm}

[*5]
● Fuel hose (20)
⚠ **The internal parts of the adapter may be damaged when fuel tube (20) is removed. Accordingly, replace the adapter with new one.**

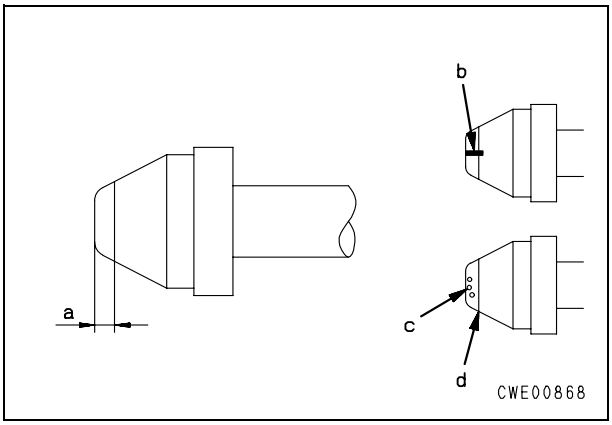
[*6]
★ Use a new MIKALOR clamp.
★ Set the hose to the original (marked) position. (Insertion depth of air hose: 57 mm)
★ Set the bridge (BR) so that its clamp bolt will be at the bottom and it will be lapped over band (BD) by at least min. 5 mm.
Threads of clamp bolt: Lubricating oil: **THREEBOND, PAND18B**
★ Do not use an impact wrench.
● **When reusing the hose**
★ Set the clamp to its original position.
MIKALOR clamp: **Min. 6 Nm (1.6 kgm}**
● **When using a new hose**
★ Tighten until band gap (BDG) is **5 – 8 mm**.



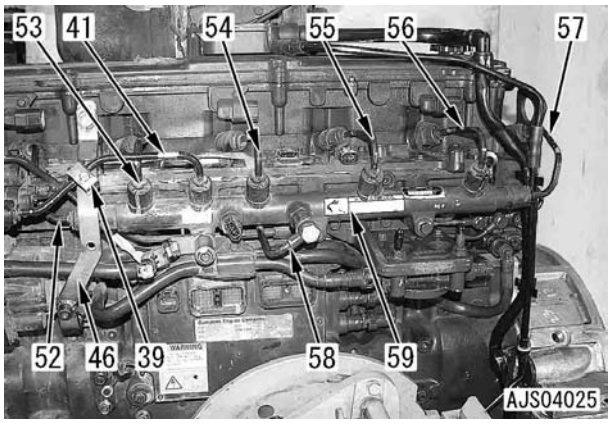
[*7]
★ Adjust the air conditioner compressor belt tension. For details, see Testing and adjusting, “Testing and adjusting air conditioner compressor belt tension”.

[*8]
● **High-pressure pipe and common rail**

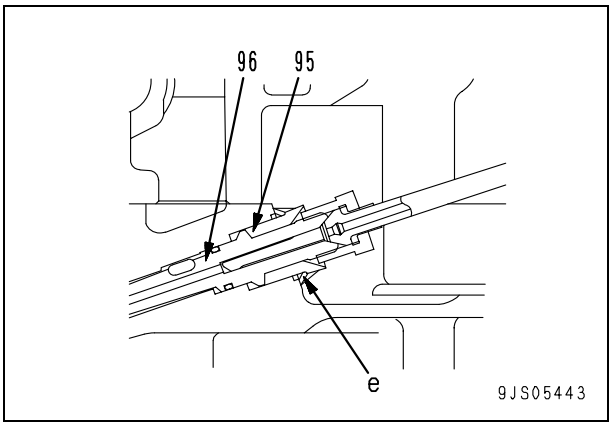
⚠ **Do not bend the high-pressure pipe to collect before installing.**
⚠ **Be sure to use the genuine high-pressure pipe clamps and observe the tightening torque.**
⚠ **Install each high-pressure pipe and wiring harness at least 10 mm apart from each other.**
★ When installing each high-pressure pipe, check the taper seal of its joint (Part "a": Part of 2 mm from the end) for visible lengthwise slit "b" and spot "c" and check part "d" (End of taper seal: Part at 2 mm from the end) for stepped-type wear caused by fatigue which your nail can feel. If there is any of those defects, it can cause fuel leakage. In this case, replace the high-pressure pipe.



1. Install common rail (59) temporarily (Tighten the bolts with the fingers).
2. Tighten drain tube (58) temporarily.
3. Install tube (41) between the supply pump and common rail.
Nut: **37.3 ± 4 Nm {3.8 ± 0.4 kgm}**
4. Install bracket (46) and tighten clamp (39) temporarily.
5. Install tubes (52) – (57) between the common rail and injector.
Nut: **37.3 ± 4 Nm {3.8 ± 0.4 kgm}**
6. Tighten drain tube (58) permanently.
Joint bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**
7. Tighten common rail (59) permanently.
Joint bolt: **43.1 ± 4.0 Nm {4.4 ± 0.4 kgm}**
8. Tighten clamp (39) and bracket (46) permanently.

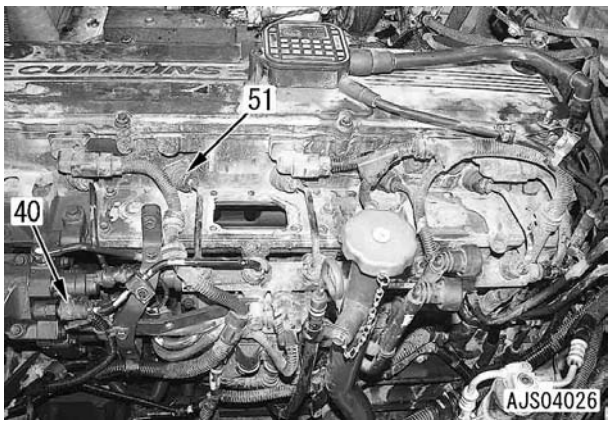


9. Apply caulking material "e" (hatched part) to nut (95) of inlet connector (96) and cylinder head.
Caulking material:
GE TOSHIBA SILICONES TOSSEAL 381



10. Install 12 bellows (51).

11. Install right and left bellows (40).
★ Install each bellows with the slits out and down.
★ The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.



[*9]
- Fuel hose (61)

⚠ **The internal parts of the adapter may be damaged when fuel tube (61) is removed. Accordingly, replace the adapter with new one.**

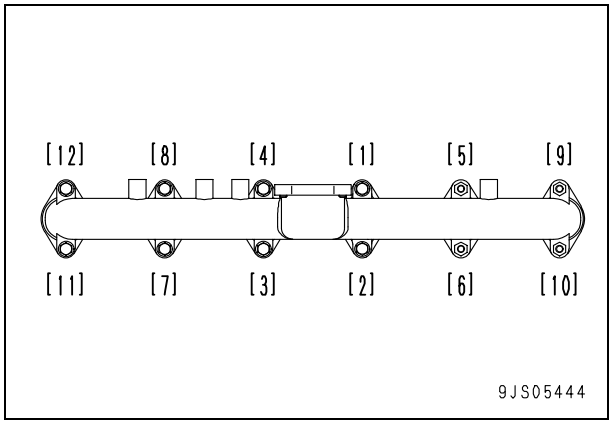
[*10]
Clamp of radiator hose (66):
8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}

[*11]
Mounting nut of turbocharger lubrication hose (70): **35 ± 5 Nm {3.6 ± 0.5 kgm}**

Mounting bolt of turbocharger lubrication tube (71): **24 ± 4 Nm {2.4 ± 0.4 kgm}**

[*12]
- **Exhaust manifold and turbocharger**

Tightening order of mounting bolts:
1) Tighten all the bolts to **24 ± 4 Nm {2.4 ± 0.4 kgm}** in the order of [1] – [12] in the figure.
2) Tighten only bolts [1] – [4] to **24 ± 4 Nm {2.4 ± 0.4 kgm}** in the order of [1] – [4] in the figure.
3) Tighten all the bolts to **43 ± 6 Nm {4.4 ± 0.6 kgm}** in the order of [1] – [12] in the figure.
4) Tighten only bolts [1] – [4] to **43 ± 6 Nm {4.4 ± 0.6 kgm}** in the order of [1] – [4] in the figure.



[*13]
- **Air intake manifold cover**

Fit the gasket and install the air intake manifold cover.
Both sides of gasket: **Gasket sealant (LG-7)**
Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

[*14]
Cylinder head cover mounting bolt:
12 ± 2 Nm {1.2 ± 0.2 kgm}

- **Refilling with coolant**

Add coolant through the coolant filler to the specified level. Run the engine to circulate the coolant through the system. Then, check the coolant level again.
Coolant: **Approx. 39 ℓ**

Removal and installation of fuel injector assembly

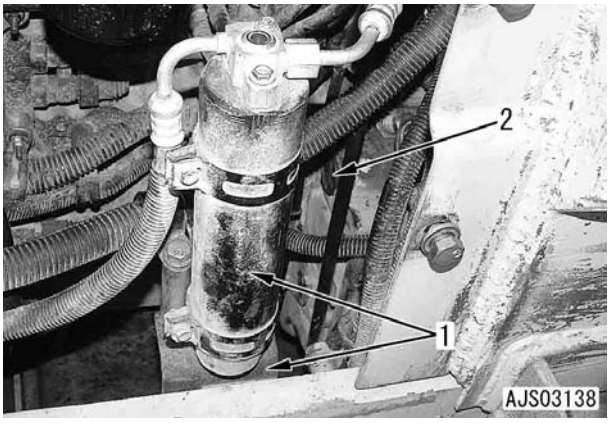
Special tools

Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
A	1	795-799-1131	Gear	■	1		
	3	795-799-6700	Puller	■	1		
	4	795-799-8150	Remover	●	1		

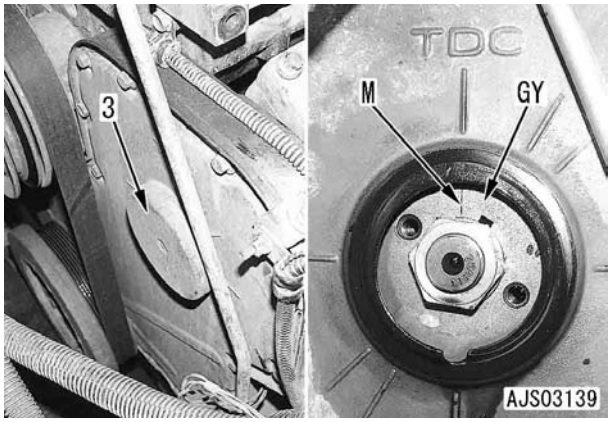
Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

1. Remove the engine hood assembly. For details, see “Removal of engine hood assembly”.
2. Referring to “Removal of cylinder head assembly”, steps 3 – 30 and 42 – 52, remove the following parts. [*1]
   - Air cleaner and air cleaner bracket
   - Muffler
   - Filter and filter bracket
   - Air intake connector
   - High-pressure pipe
3. Disconnect receiver drier and bracket assembly (1).
4. Remove cap (2).
5. Install gear **A1** (See the Special tools table) to rotate the crankshaft.
   ★ See Testing and adjusting, “Testing and adjusting valve clearance“.



6. Twist off cap (3).
   ★ Use a filter wrench etc. to remove the cap.
7. Rotate the crankshaft and set stamp (M) of drive bear (GY) to the top dead center.
   ★ Use a mirror.
   ★ See Testing and adjusting, "Testing and adjusting valve clearance."

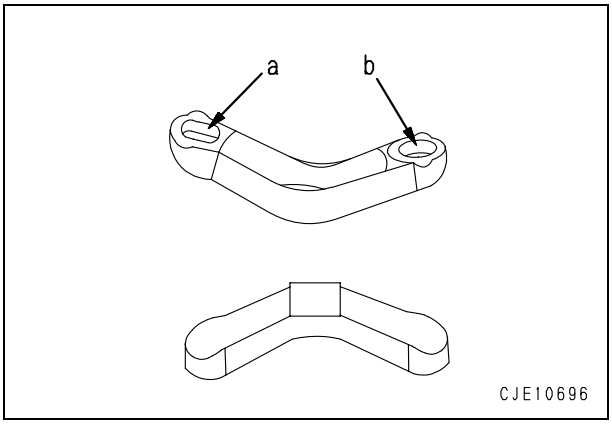


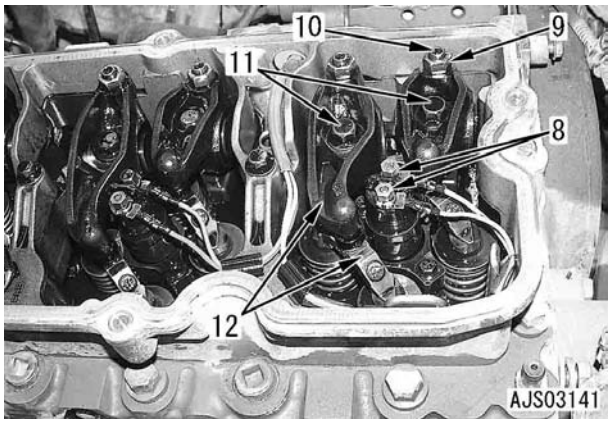
8. Disconnect clamp (4).
9. Disconnect oil hose (5).
10. Remove cover (6).
11. Remove cylinder head cover (7).
    ★ Referring to Testing and adjusting, “Testing and adjusting valve clearance”, check to see if the No. 1 cylinder is at the top or the No. 6 cylinder is at the top.

12. Remove wiring harness nut (8) from the injector.

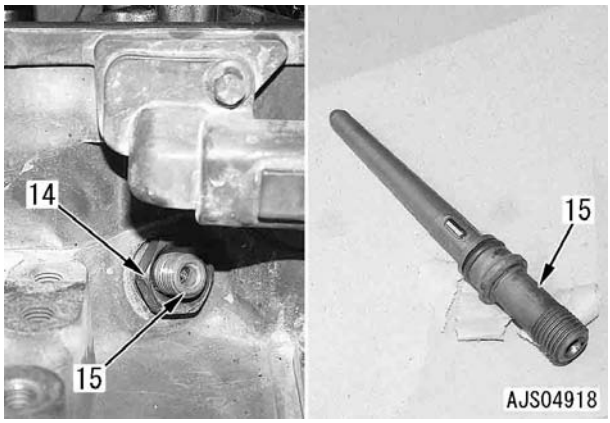
13. Loosen locknut (9) and then loosen adjustment screw (10) 2 – 3 turns.
★ This work must be performed so that an excessive force will not be applied to the push rod when the rocker arm is installed.

14. Remove mounting bolt (11) and rocker arm and crosshead assembly (12).
★ Record the position and direction (shapes of holes "a" and "b") of each crosshead. (When reinstall the crosshead, set it in the same direction.)



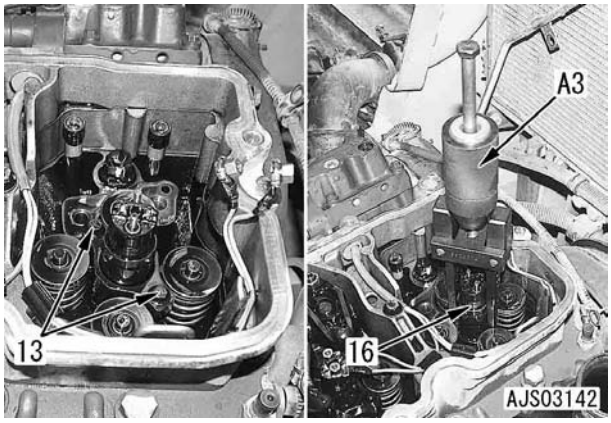


15. Remove retainer (14) and inlet connector (15).
★ Before removing retainer (14), remove all dirt from it and its periphery.
★ Tool **A4** (remover) is set for removal of inlet connector (15). (See Special tools table.)



16. Remove 2 mounting bolts (13) of the injector assembly.

17. Using tool **A3**, remove injector assembly (16).
★ Take care that dirt and foreign matter will not enter the mounting part of the fuel injector assembly.



Installation

1. Referring to “Removal and installation of cylinder head assembly”, step 8 – 17, install the following parts.
- Fuel injector assembly
- Rocker arm and crosshead assembly

- Carry out the following installation in the reverse order to removal.

[*1]
Referring to “Removal and installation of cylinder head assembly”, step 8, install the following parts.
- High-pressure pipe
- Common rail

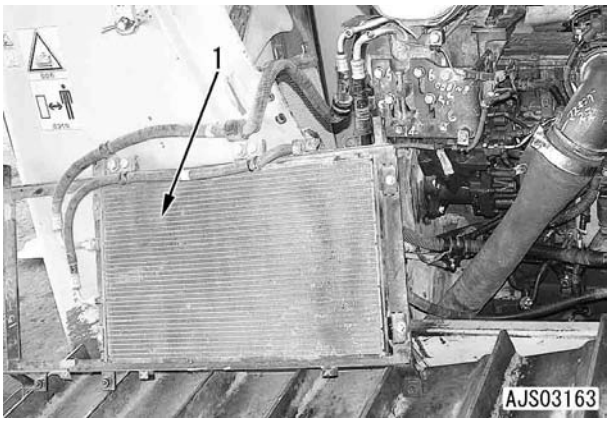
Removal and installation of engine front seal

Special tools

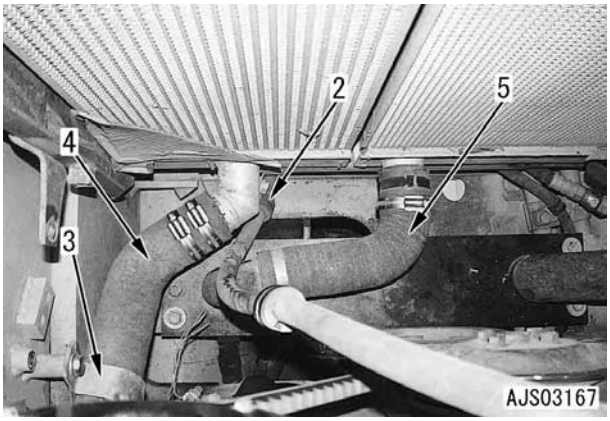
Symbol	Part number	Part name	Necessity	Q'ty	N/R	Sketch
A6	795-799-8120	Oil seal driver	●	1	N	

Removal

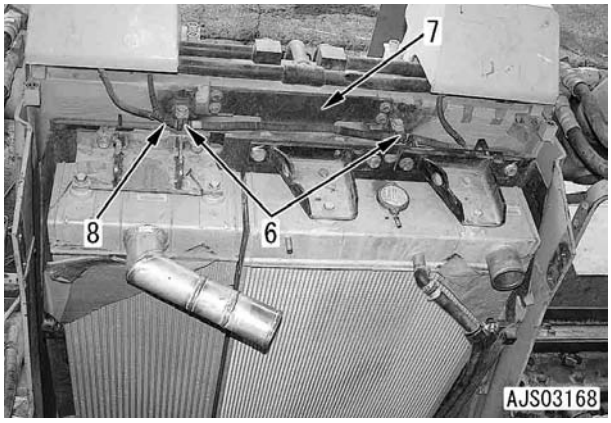
1. Remove the engine hood assembly. For details, see “Removal of engine hood assembly”.
2. Remove air conditioner condenser assembly (1). For details, see “Removal of radiator assembly”.
   ★ Do not disconnect the air conditioner hose but place it on the track shoe.



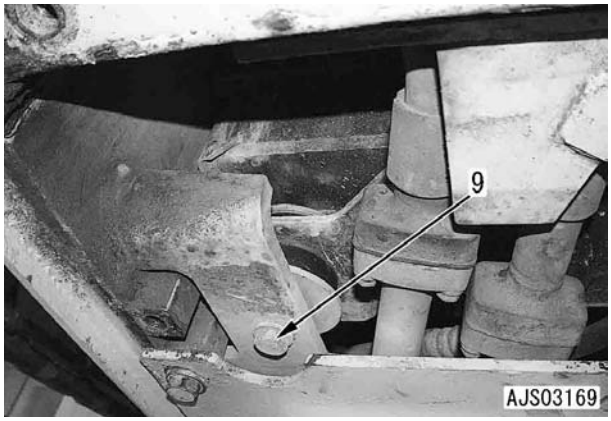
3. Disconnect clamps (2) and (3).
4. Disconnect air hose (4). [*1]
5. Disconnect radiator hose (5). [*2]



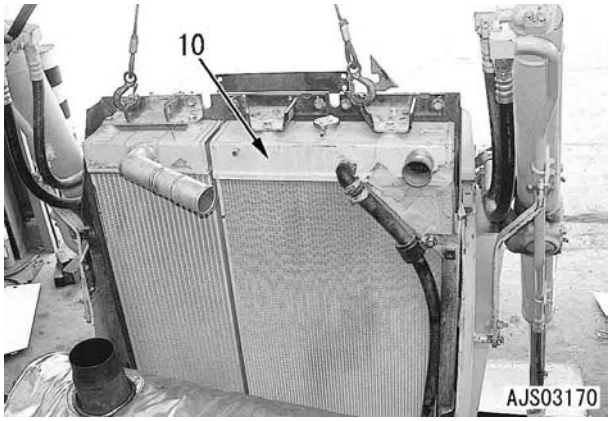
6. Disconnect clamp (6).
7. Disconnect bracket (7) from the frame.
8. Move wiring harness (8) to the front of bracket (7).



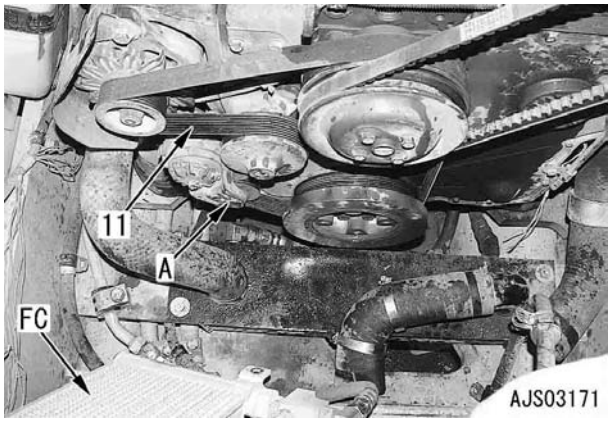
9. Remove radiator and guard assembly mounting bolts (9).



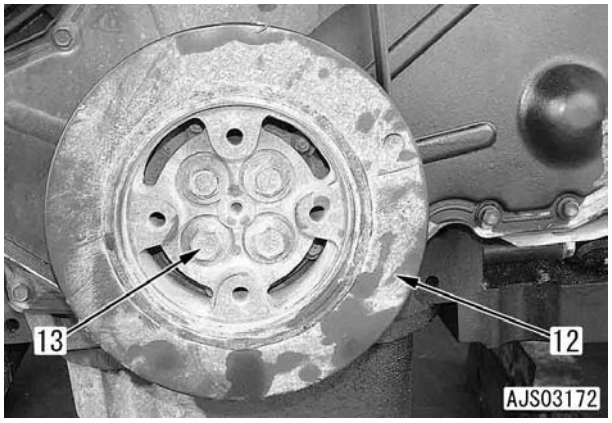
10. Lift off radiator and guard assembly (10).



11. Apply a lever to (A) to remove fan belt (11).
⚠ **Take care not to get your fingers between the tensioner and fan pulley.**
★ FC: Fan cooler assembly

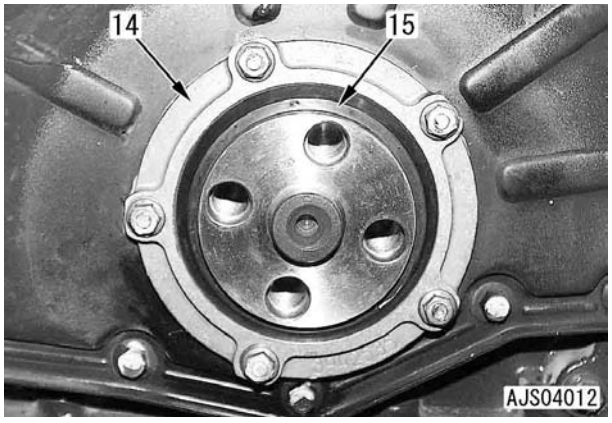


12. Remove 4 mounting bolts (13) and crankshaft pulley and damper (12). [*3]
★ **Make a match mark on the crankshaft pulley and front cover** (since the stamp of 1.6TOP is made on the crankshaft pulley).



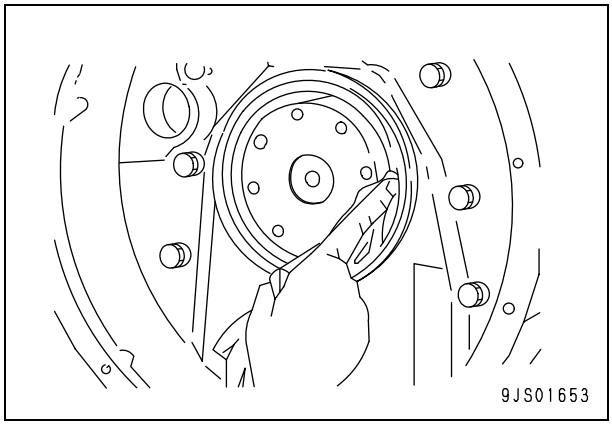
13. Remove the 5 mounting bolts and seal carrier (14).

14. Remove dust seal (15) and engine front seal from seal carrier (14).



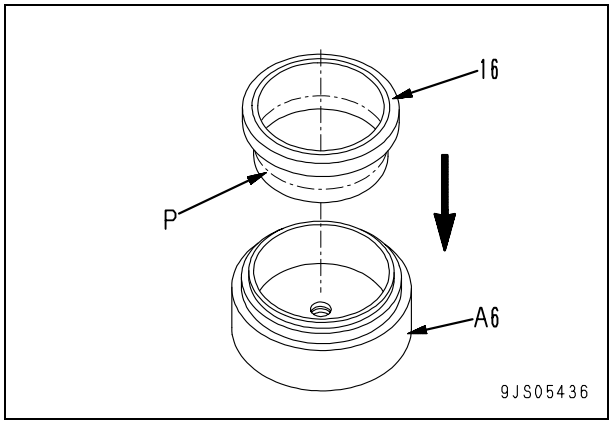
Installation

1. Wipe off foreign matter from the crankshaft flange with clean cloths.

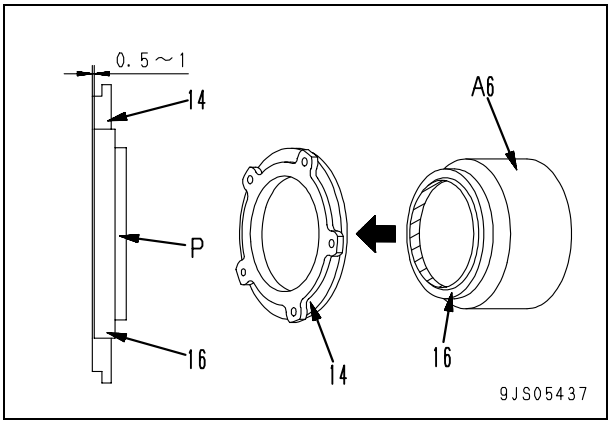


★ Since plastic part (P) on the inside of the engine front seal is a pilot (guide tool) for installation of the crankshaft, do not remove it from the engine front seal.

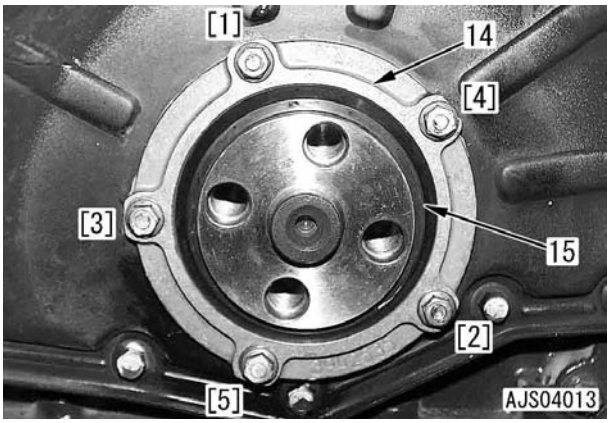
2. Set tool **A6** to engine front seal (16) from pilot (P) side.



3. Install engine front seal (16) from inside of seal carrier (14).
   ★ Set the height of the seal flush with the inside wall of the seal carrier.
   ★ Installed dimension from outside of seal carrier (14): **0.5 – 1 mm**
4. Apply pilot (P) to the crankshaft and push it and seal carrier (14) into the crankshaft with the hands.
5. Remove pilot (P).



6. Install seal carrier (14).
   Flange surface: **Gasket sealant (LG-7)**
   ● Tighten the mounting bolts in the order of [1] → [5] shown in the figure.
   Seal carrier mounting bolt:
   9.8 ± 2 Nm {1 ± 0.2 kgm}
   ★ Check the installed dimension of 0.5 – 1 mm.
7. Install dust seal (15).
   ★ Push in the dust seal until it reaches the oil seal.



   ★ Install the crankshaft pulley and damper temporarily and install the fan belt, and then tighten to the specified torque.

● Carry out the following installation in the reverse order to removal.

[*1]
Air hose clamp:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

[*2]
Radiator hose clamp:
8.8 ± 0.5 Nm {0.9 ± 0.05 kgm]

[*3]
Mounting bolt of crankshaft pulley and damper: **200 ± 10Nm {20.4 ± 1 kgm}**

● **Refilling with coolant**
Add coolant through the coolant filler to the specified level. Run the engine to circulate the coolant through the system. Then, check the coolant level again.
Coolant: **Approx. 39 ℓ**

Removal and installation of engine rear seal

Special tools

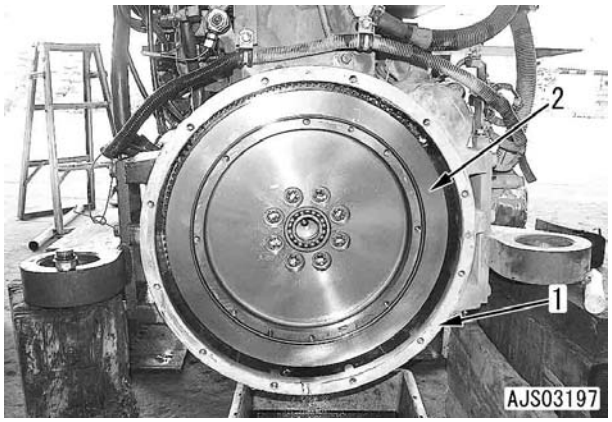
Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
A	5	795-931-1100	Seal puller	●	1		
	7	795-799-1150	Repair stand	●	1		
		795-799-2280	Adapter	●	1		

Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

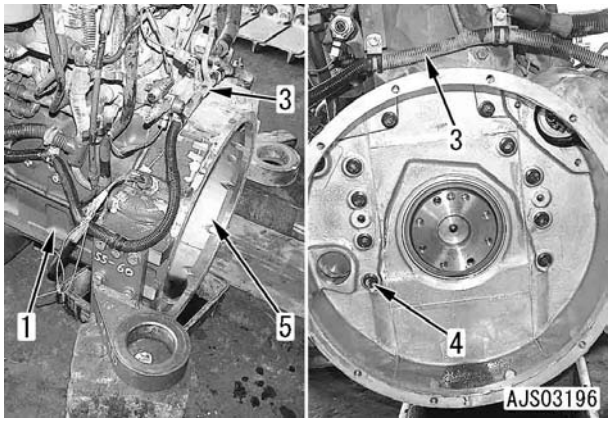
1. Remove the engine assembly. For details, see “Removal and installation of engine assembly”.
2. Place engine assembly (1) on block [1].
   ★ Repair stand and adapter **A7** are set (See Special tools table).
3. Remove the damper assembly. For details, see “Removal and installation of damper assembly”.
4. Remove the mounting bolts, set guide bolts, and lift off flywheel (2). [*1]

   Flywheel assembly: **45 kg**

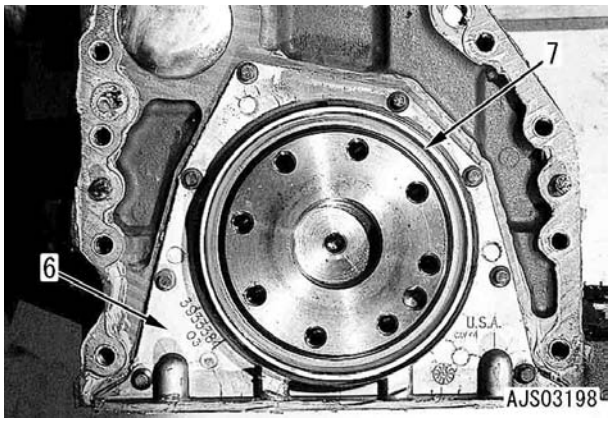


5. Disconnect wiring harness (3) from flywheel housing (5).
6. Set the block under the flywheel housing side of engine assembly (1).
7. Sling flywheel housing (5), remove mounting bolts (4), and lift off flywheel housing (5).

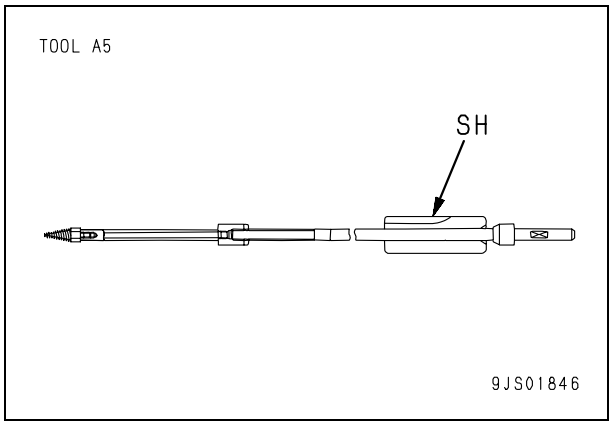
   Flywheel housing (5): **70 kg**



8. Remove rear cover (6).
9. Remove rear seal (7) from rear cover (6).
   ★ Take care not to scratch the seal fitting face of the flywheel housing and seal contact face of the crankshaft.

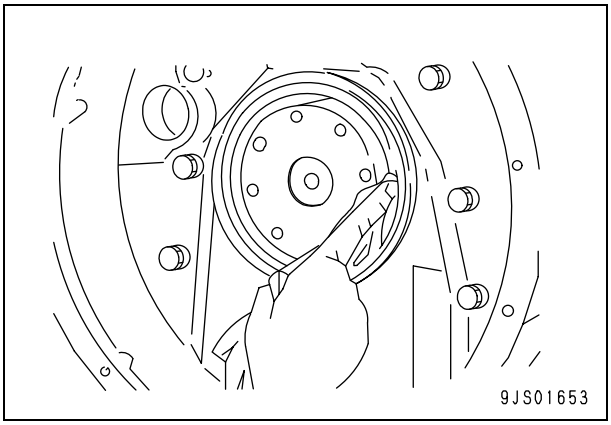


   ★ If engine rear seal (7) is stuck to the crankshaft and cannot be removed, make holes (about 3 mm in diameter) on its right and left sides with a drill. Then, using seal puller **A5**, remove the seal with impacts of slide hammer (SH).

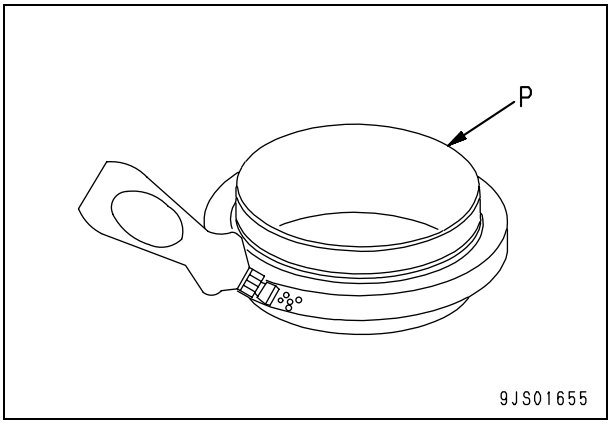


Installation

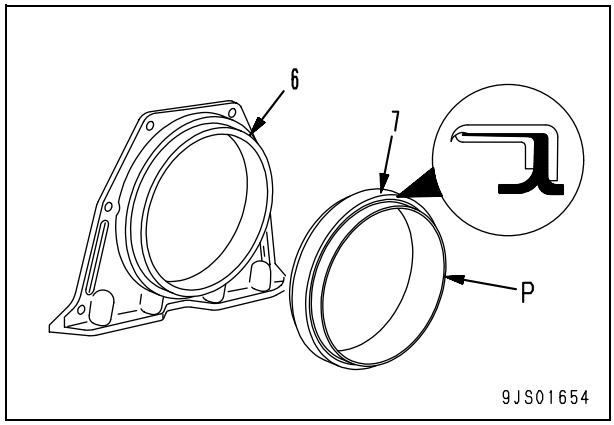
1. Clean, degrease, and dry the gasket faces against the rear cover and cylinder block.
2. Clean, degrease, and dry the seal lip face (periphery of the crankshaft).



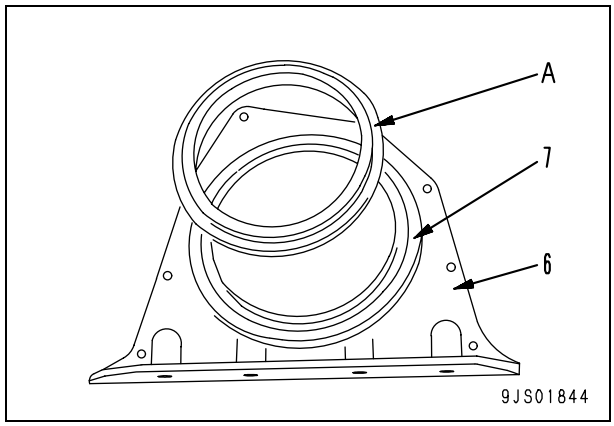
3. Apply neutral detergent to the periphery of the engine rear seal.
   ★ Since plastic part (P) on the inside of the engine rear seal is a pilot (guide tool) for installation of the crankshaft, do not remove it from the engine rear seal.



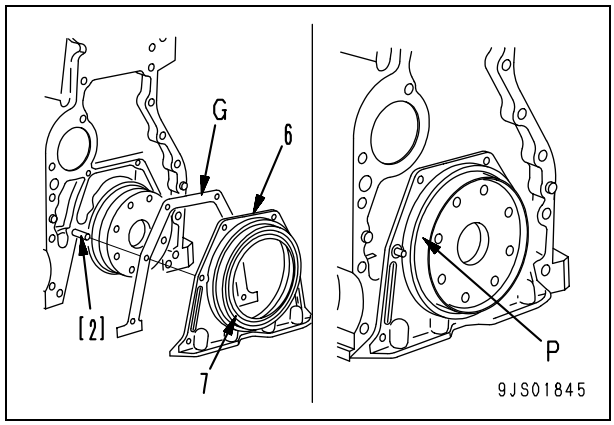
4. Install engine rear seal (7) to rear cover (6).



5. Using alignment tool (A) attached to the engine rear seal, push rear seal (7) into rear cover (6) to a proper depth.
6. Remove alignment tool (A).

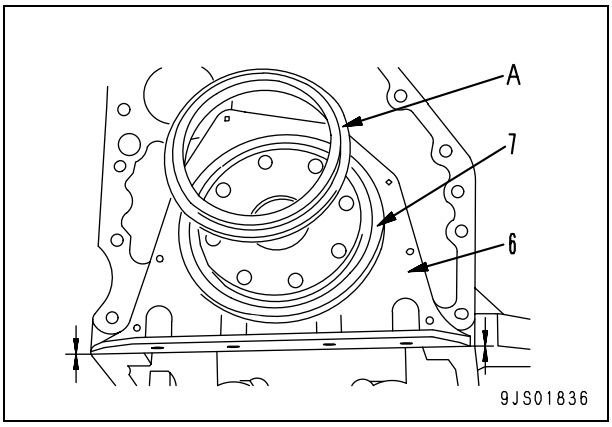


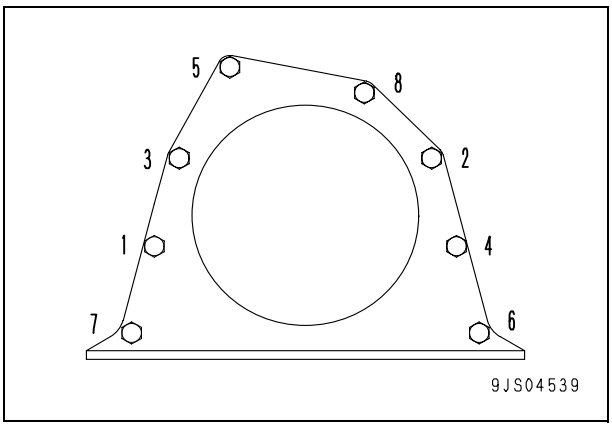
7. Apply pilot (P) to the crankshaft and push it and rear cover (6) into the crankshaft with the hands.
   ★ Do not forget gasket (G).
   ★ Use guide pin [2].
8. Remove pilot (P).



9. Install alignment tool (A) again and check that rear seal (7) is inserted to a proper depth.
★ The level difference between the bottoms of the cylinder block and rear cover (6) must be 0.00 ± 0.10 mm.
★ Keep alignment tool (A) installed.

10. Remove guide pin [2] and tighten the 8 rear cover mounting bolts in the following order.
Rear cover mounting bolt:
12.7 ± 2.0 Nm {1.3 ± 0.2 kgm}
★ The projection of rear cover gasket (G) from the bottom of the cylinder block must not exceed 0.25 mm.

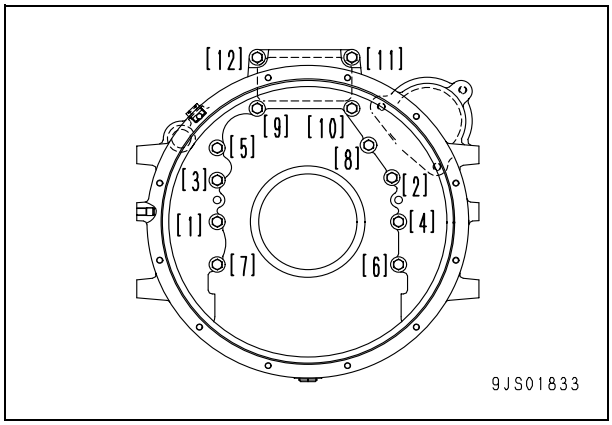




11. Remove alignment tool (A).

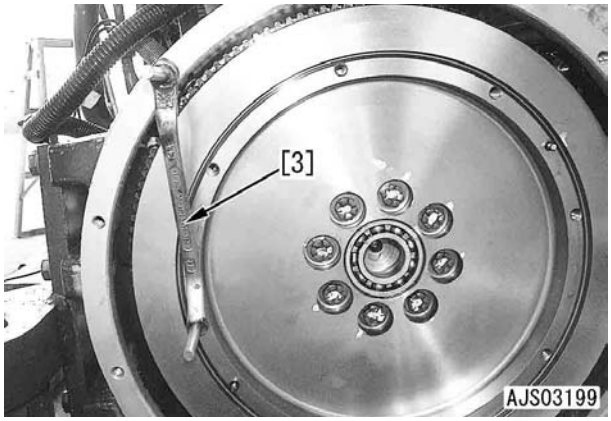
12. Install flywheel housing.
String 1 – 3 mm in diameter around mounting bolt hole on cylinder block face side: **Gasket sealant (LG-6)**

★ Tighten the mounting bolts in the order shown in the following figure.
Flywheel housing mounting bolt:
77 ± 12 Nm {7.9 ± 1.2 kgm}

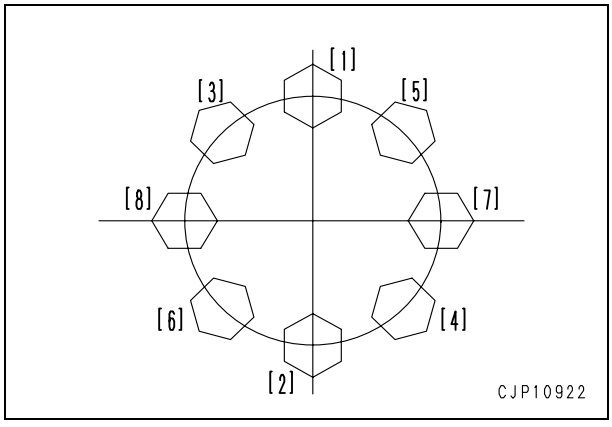


● Carry out the following installation in the reverse order to removal.

[*1]
★ Fix the flywheel to the flywheel housing with ring wrench [3].

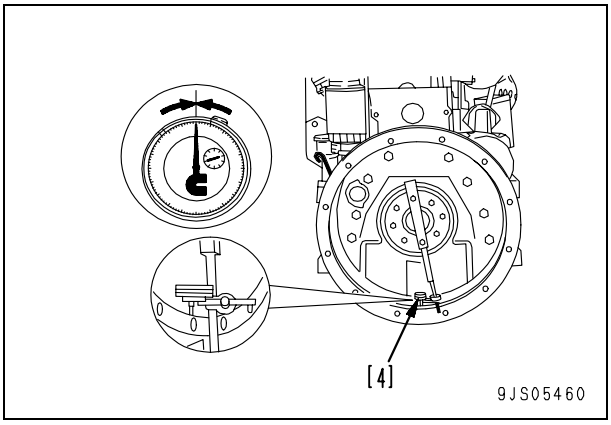


★ Tighten the mounting bolts in the order shown in the following figure.
Flywheel mounting bolt:
137 ± 7 Nm {14.0 ± 0.7 kgm}

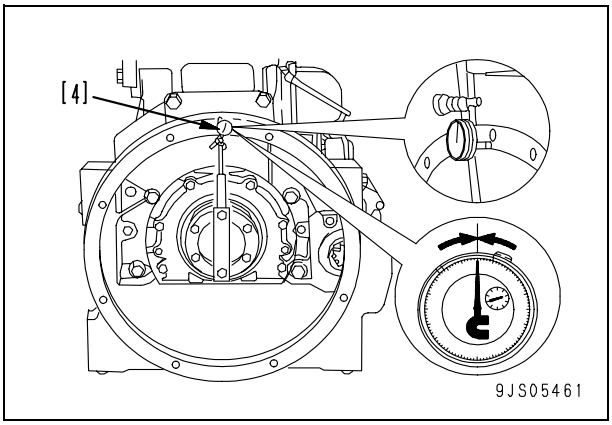


★ Measure the facial runout and radial runout of the flywheel and flywheel housing.
(Check with dial gauge [4].)
- Facial runout: Max. 0.20 mm
- Radial runout: Max. 0.20 mm

- Measuring radial runout
  1) Install dial gauge [4] to the end of the crankshaft.
  2) Set the probe of the dial gauge perpendicular to the socket of the flywheel housing.
  3) Set the dial gauge to "0", rotate the crankshaft 1 turn, and measure the difference between the lowest and highest values.
     ★ After the flywheel is rotated 1 turn, check that the dial gauge indicates the value at the start of rotation.



- Measuring facial runout
  1) Similarly to measurement of the radial runout, set the probe of the dial gauge perpendicular to end face of the flywheel.
     ★ When measuring, bring the crankshaft to the front or rear side so that an error will not be caused by the end play.
  2) Set the dial gauge to "0", rotate the crankshaft 1 turn, and measure the difference between the lowest and highest values.



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00945-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

Engine and cooling system, Part 2

Engine and cooling system, Part 2

Removal and installation of engine assembly

Special tools

Symbol	Part number	Part name	Necessity	Q'ty	N/R	Sketch
X2	799-703-1200	Service tool kit	■	1		
	799-703-1100	Vacuum pump (100 V)	■	1		
	799-703-1111	Vacuum pump (220 V)	■	1		
	799-703-1121	Vacuum pump (240 V)	■	1		
	799-703-1401	Gas leak detector	■	1		

Removal

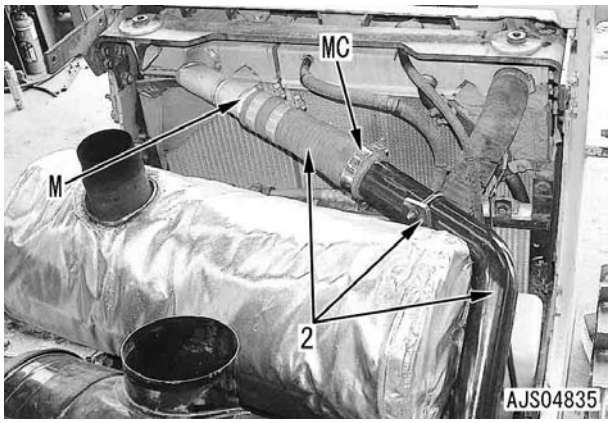
⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

⚠ **If the coolant temperature in the radiator is high, you may be scalded. In this case, wait until the coolant temperature lowers and then drain the coolant.**

⚠ **Collect the air conditioner refrigerant (R134a).**

⚠ **If refrigerant (R134a) gets in your eyes, you may lose your sight. Accordingly, you must be qualified for handling the refrigerant and put on protective goggles while you are collecting the refrigerant or charging the air conditioner with refrigerant.**
Collecting and filling work must be conducted by a qualified person.

1. Remove the engine hood assembly. For details, see “Removal of engine hood assembly”.
2. Loosen the radiator cap and drain the coolant.
   Coolant: **Approx. 39 ℓ**
3. Close the fuel stop valve.
4. Remove cover (1).
5. Remove the air hose, tube, and bracket assembly (2). [*1]
   ★ If the MIKALOR clamp (NC) is used, do not disconnect the hose.
   ★ Make a mark (M) at the tube end of each hose to show the original position of the hose.

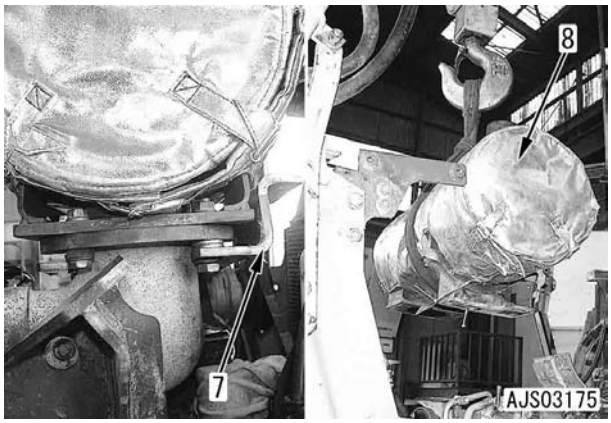


6. Disconnect dust indicator hose (3).
7. Disconnect air hose (4). [*2]
8. Remove band (5). [*3]
9. Remove air cleaner assembly (6).

10. Remove plate (7).

11. Remove the mounting bolts and lift off muffler assembly (8).

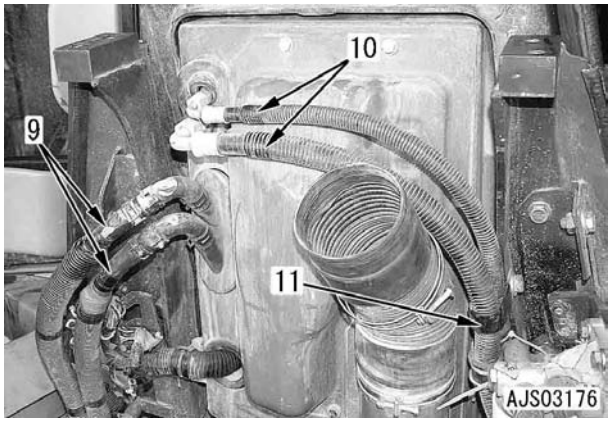
Muffler assembly: **25 kg**



12. Disconnect heater hoses (9).
★ Check the connection end.

13. Disconnect air conditioner hoses (10). [*4]

14. Disconnect clamp (11).



15. Disconnect fuel hose (12).

16. Disconnect filter and bracket assembly (13).

17. Disconnect clamp (14).

18. Disconnect receiver drier and bracket assembly (15).

19. Disconnect bracket (16).

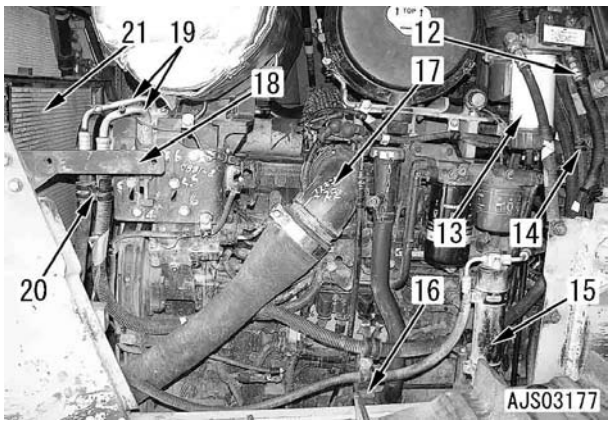
20. Disconnect air tube (17).

21. Remove plate (18).

22. Disconnect air conditioner hoses (19). [*5]
★ Check the connection end.

23. Disconnect clamp (20).

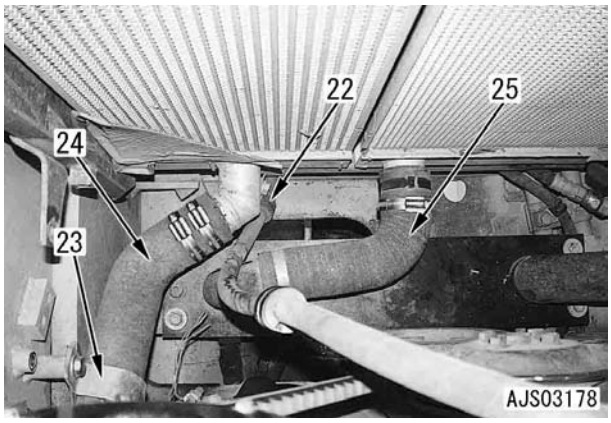
24. Remove the air conditioner condenser assembly (21). For details, see “Removal of radiator assembly”.



25. Disconnect clamps (22) and (23).

26. Disconnect air hose (24). [*6]

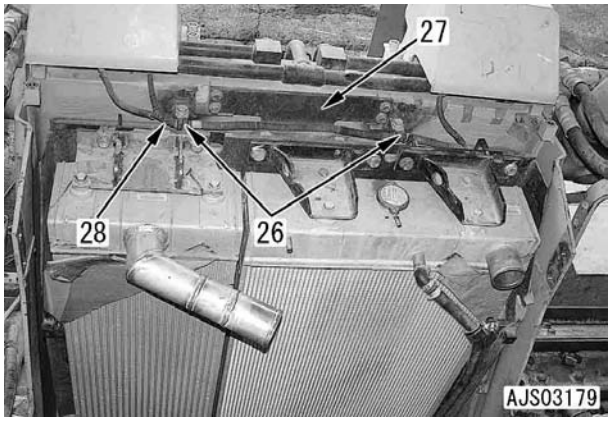
27. Disconnect radiator hose (25). [*7]



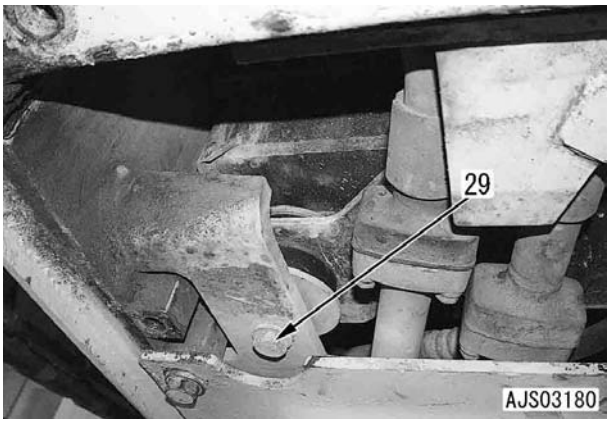
28. Disconnect clamps (26).

29. Disconnect bracket (27) from the frame.

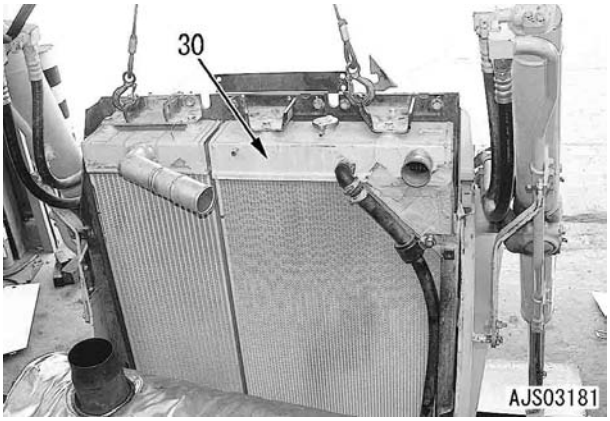
30. Move wiring harness (28) to the front of bracket (27).



31. Remove radiator guard assembly mounting bolt (29).



32. Lift off radiator guard assembly (30).



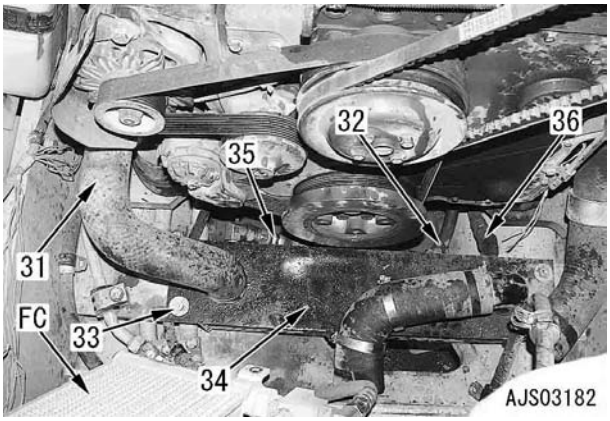
33. Disconnect radiator hose (31). [*8]

34. Disconnect clamp (32).

35. Remove mounting bolt (33) and oil cooler assembly (34).

36. Disconnect oil cooler hoses (35) and (36).

★ FC: Fan cooler assembly



37. Lift off oil cooler assembly (34).

★ FC: Fan cooler assembly

38. Disconnect clamps (37).

39. Disconnect terminal (38) (black and thick).

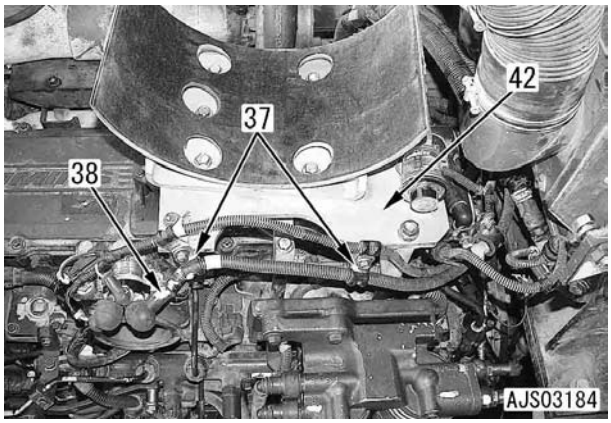
40. Disconnect clamps (39) – (41).

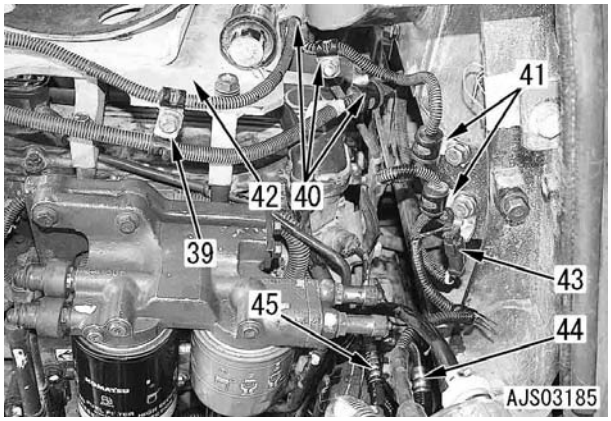
41. Remove bracket (42).

42. Disconnect connector WIF (43).

43. Disconnect fuel hoses (44) and (45).

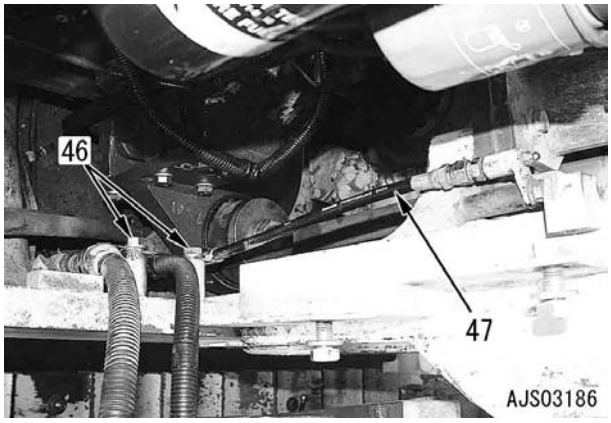
★ Check the connection end.



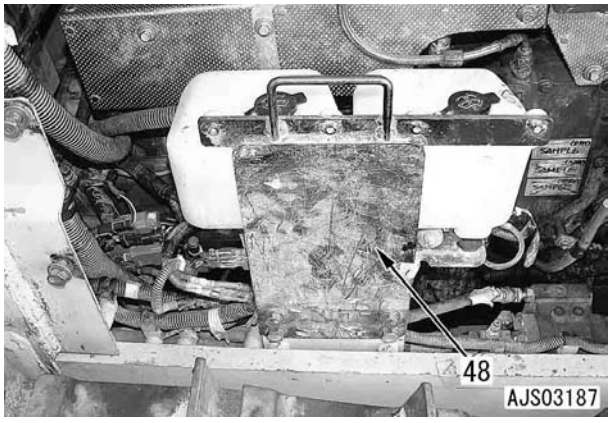


44. Disconnect clamps (46).

45. Disconnect grease hose (47).



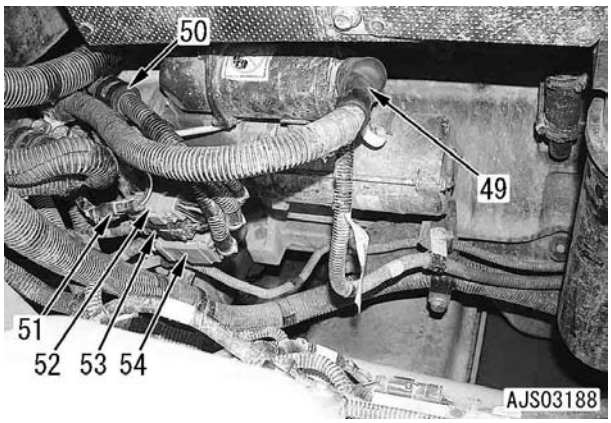
46. Disconnect washing tank and bracket assembly (48).



47. Disconnect starting motor terminal (49).

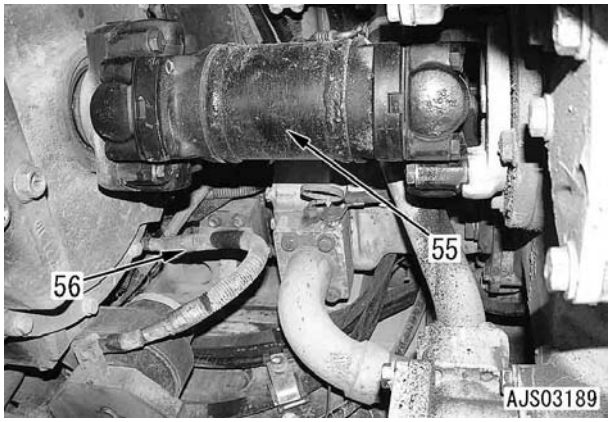
48. Disconnect clamp (50).

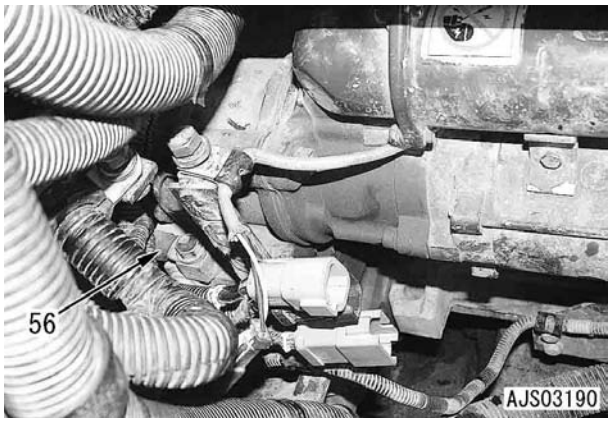
49. Disconnect connectors ST (51), E23 (52), E22 (53) and E21 (54).



50. Remove drive shaft (55). [*9]

51. Disconnect engine ground wire (56) from the engine.





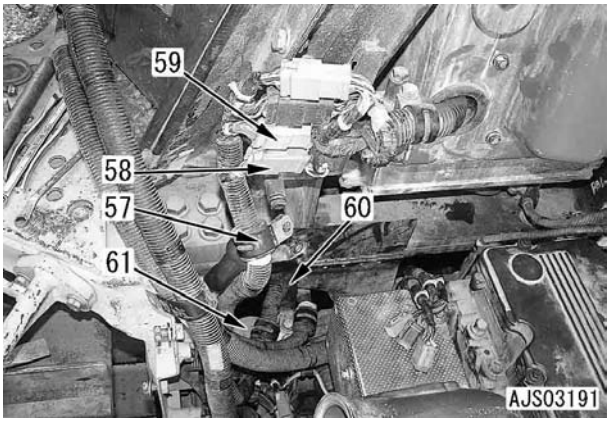
52. Disconnect clamp (57).

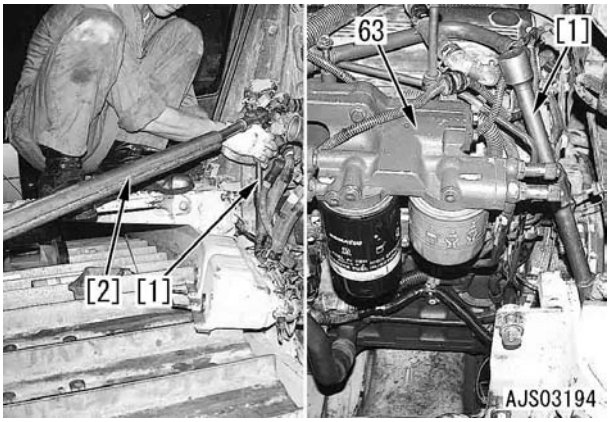
53. Disconnect connectors 218 (Brown) (58) and 215 (Green) (59).

54. Disconnect bracket (60).

55. Using extension [1] and pipe [2], remove 4 engine mounting bolts (61). [*10]

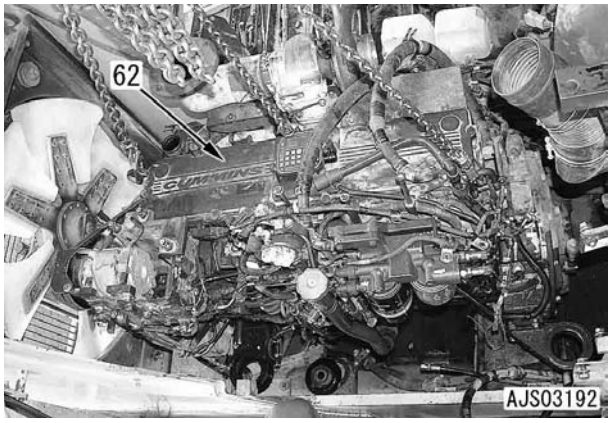
★ When installing, the rear left mounting bolt cannot hold extension [1]. Accordingly, remove filter bracket assembly (63).

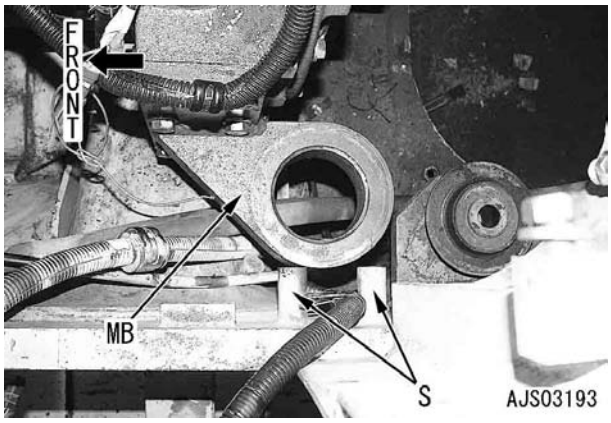




56. Lift off engine assembly (62).

★ First, move engine assembly (62) forward to avoid spacer (S) to which the rear left mounting bracket (MB) is welded, and then sling and remove it.





Installation

- Carry out installation in the reverse order to removal.

[*1]
- Turbocharger side
  - Clamp: **7 ± 1.1 Nm {0.71 ± 0.11 kgm}**

- Air aftercooler side
  - Air hose clamp: **10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}**

Reference

If the MIKALOR clamp was removed, install new one carefully according to the following procedure.

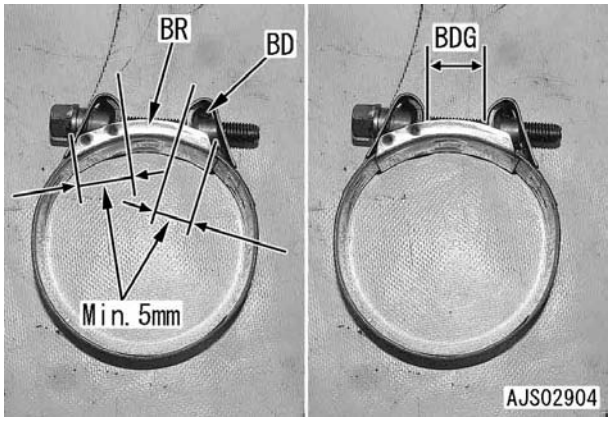
★ Use a new MIKALOR clamp.
★ Set the hose to the original (marked) position. (Insertion depth of air hose: 60 mm)
★ Set the bridge (BR) so that its clamp bolt will be at the bottom and it will be lapped over band (BD) by at least min. 5 mm.
- Threads of clamp bolt: Lubricating oil: **THREEBOND, PAND18B**

★ Do not use an impact wrench.
- **When reusing the hose**

★ Set the clamp to its original position.
- MIKALOR clamp: **Min. 6 Nm (1.6 kgm)**

- **When using a new hose**

★ Tighten until band gap (BDG) is **17 – 20 mm**.

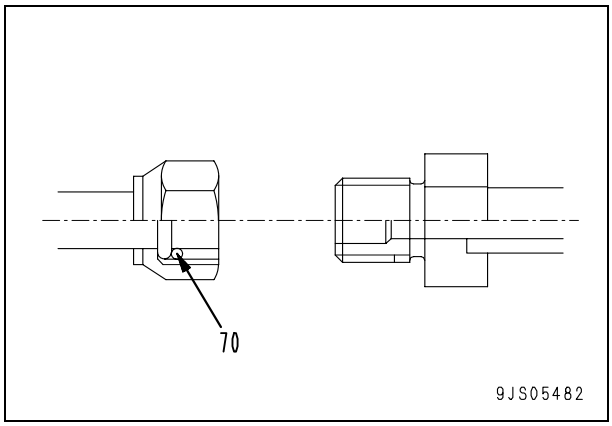


[*2]
- Air hose clamp: **10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}**

[*3]
- Air cleaner band: **9.8 – 11.8 Nm {1 – 1.2 kgm}**

[*4], [*5]

★ Install each hose so that it will not be twisted.
★ When installing the air conditioner hoses, take care that dirt, dust, water, etc. will not enter them.
★ When tightening each joint of the air conditioner hose, check that O-ring (70) is fitted to it.
★ Apply sufficient amount of **compressor oil for R134a (DENSO: ND-OIL8, ZEXEL: ZXL100PG (equivalent to PAG46)** to each O-ring.



- Tightening torque for air conditioner refrigerant piping

Thread size	Tightening torque
16 x 1.5	11.8 – 14.7 Nm {1.2 – 1.5 kgm}
22 x 1.5	19.6 – 24.5 Nm {2.0 – 2.5 kgm}
24 x 1.5	29.4 – 34.3 Nm {3.0 – 3.5 kgm}

[*6]
- Air hose clamp: **10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}**

[*7], [*8]
- Radiator hose clamp: **8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}**

[*9]
- Mounting bolt: **Adhesive (LT-2)**
- Mounting bolt: **98.1 – 122.6 Nm {10 – 12.5 kgm}**

[*10]
Mounting bolt: **Adhesive (LT-1A)**
★ Using block [3], fix extension [1] and install the rear left mounting bolt.

- **Charging air conditioner with refrigerant gas**
  Using tool **X2**, charge the air conditioner circuit with refrigerant (**R134a**).
  ★ Quantity: **900 ± 50 g**

- **Refilling with coolant**
  Add coolant through the coolant filler to the specified level. Run the engine to circulate the coolant through the system. Then, check the coolant level again.

  Coolant: **Approx. 39 ℓ**

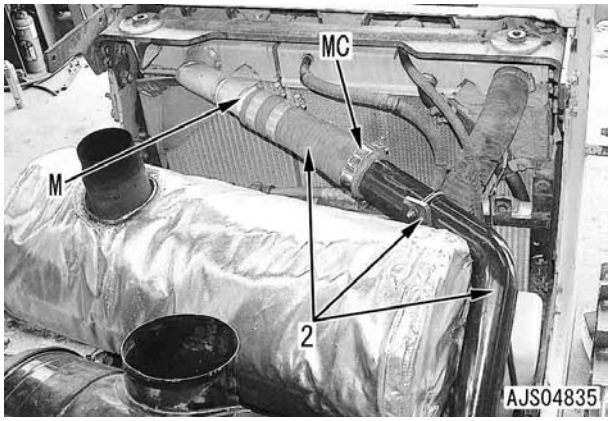
Removal and installation of radiator assembly

Removal

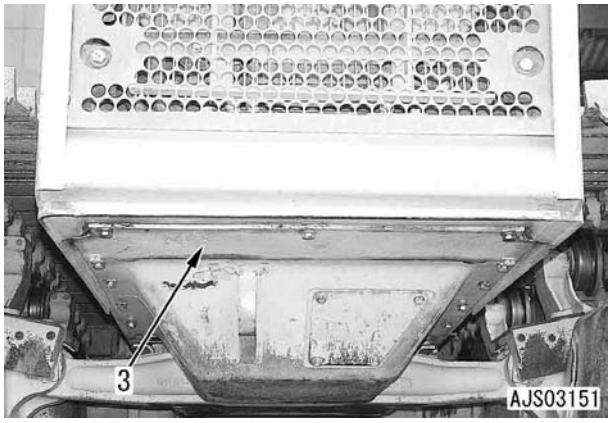
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the engine hood assembly. For details, see “Removal of engine hood assembly”.
2. Drain the coolant.

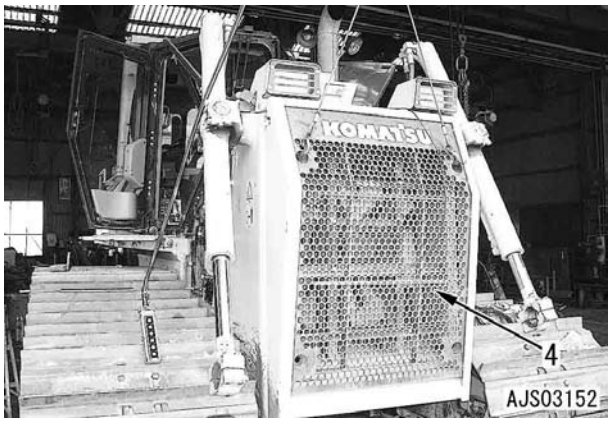
   Coolant: **Approx. 39 ℓ**
3. Remove right and left covers (1).
4. Remove the air hose, tube, and bracket assembly (2). [*1]
   - ★ If the MIKALOR clamp (MC) is used, do not disconnect the hose.
   - ★ Make a mark (M) at the tube end of each hose to show the original position of the hose.



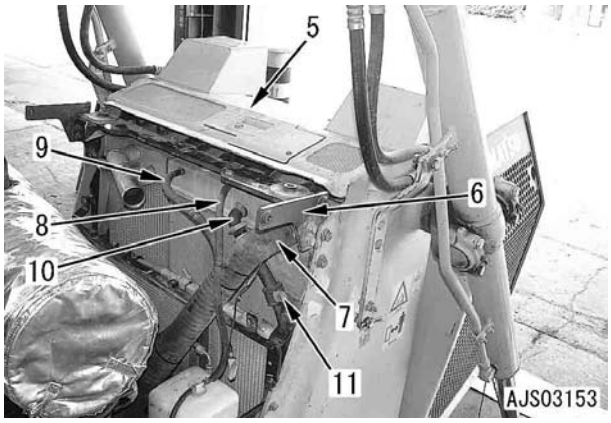
5. Remove cover (3).



6. Sling and open radiator grille (4).
   - ★ The radiator grille must be removed to remove cover (5).



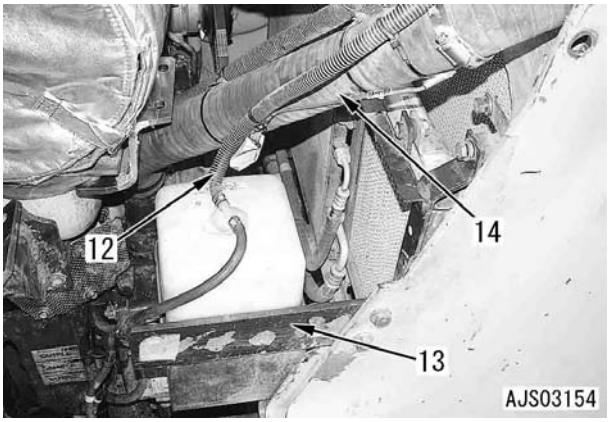
7. Remove cover (5).
8. Remove bracket (6).
9. Disconnect radiator hose (7). [*2]
10. Disconnect radiator hoses (8) – (10).
11. Disconnect clamp (11).



12. Disconnect reservoir tank hose (12).

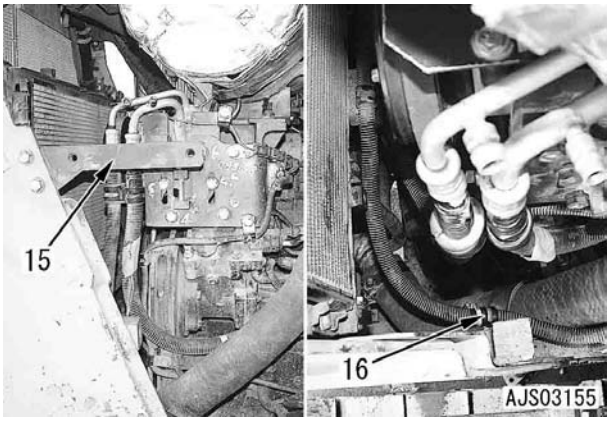
13. Remove reservoir tank and bracket assembly (13).

14. Remove radiator hose assembly (14). [*2]

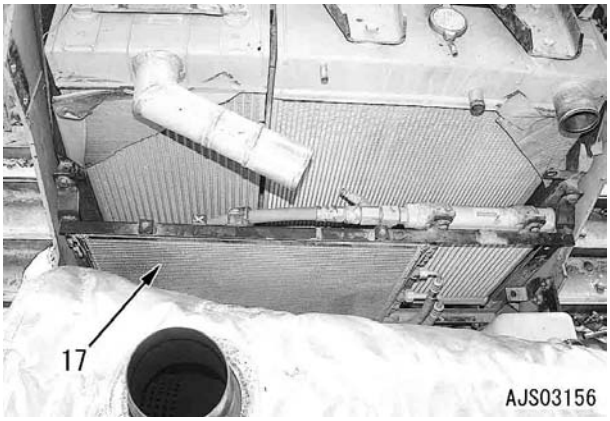


15. Remove bracket (15).

16. Disconnect air conditioner hose clamp (16).



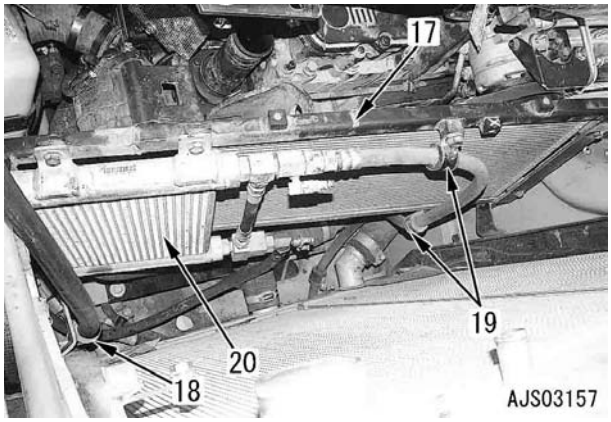
17. Remove the 4 mounting bolts and disconnect air conditioner condenser assembly (17).



18. Disconnect fan cooler hose clamps (18) and (19).

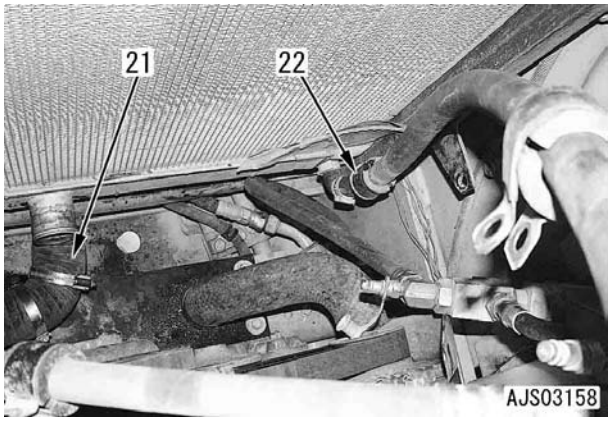
19. Disconnect fan cooler assembly (20).

20. Take out air conditioner condenser assembly (17) and place it on the track shoe.



21. Disconnect radiator hose (21). [*3]

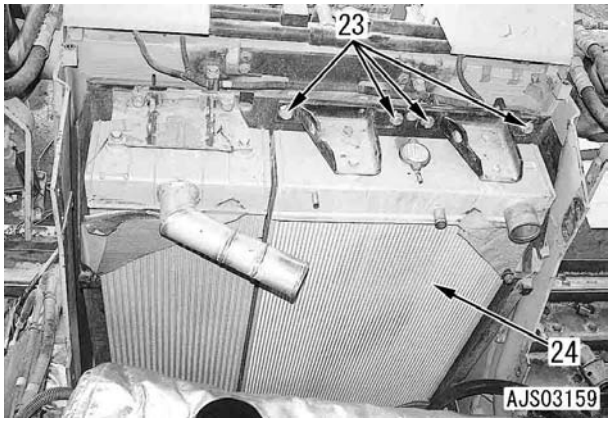
22. Disconnect hose clamp (22).

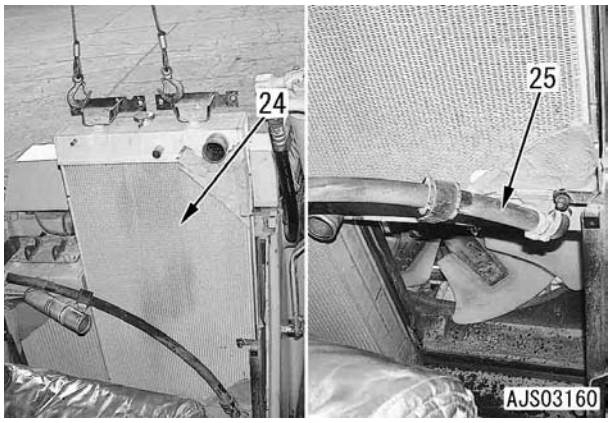


23. Remove mounting bolts (23) and lift off radiator assembly (24). [*4]

Radiator assembly: **25 kg**

24. Remove radiator hose (25).





Installation

- Carry out installation in the reverse order to removal.

[*1]

- Turbocharger side

Clamp: **7 ± 1.1 Nm {0.71 ± 0.11 kgm}**

- Air aftercooler side

Air hose clamp:
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

Reference

If the MIKALOR clamp was removed, install new one carefully according to the following procedure.

★ Use a new MIKALOR clamp.
★ Set the hose to the original (marked) position. (Insertion depth of air hose: 60 mm)
★ Set the bridge (BR) so that its clamp bolt will be at the bottom and it will be lapped over band (BD) by at least min. 5 mm.

Threads of clamp bolt: Lubricating oil
THREEBOND, PAND18B

★ Do not use an impact wrench.

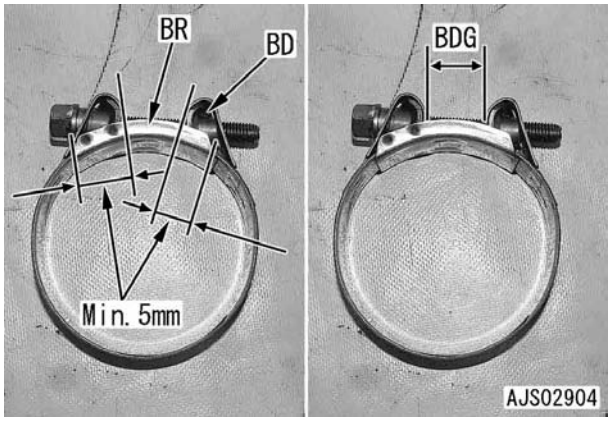
- **When reusing the hose**

★ Set the clamp to its original position.

MIKALOR clamp: **Min. 6 Nm (1.6 kgm)**

- **When using a new hose**

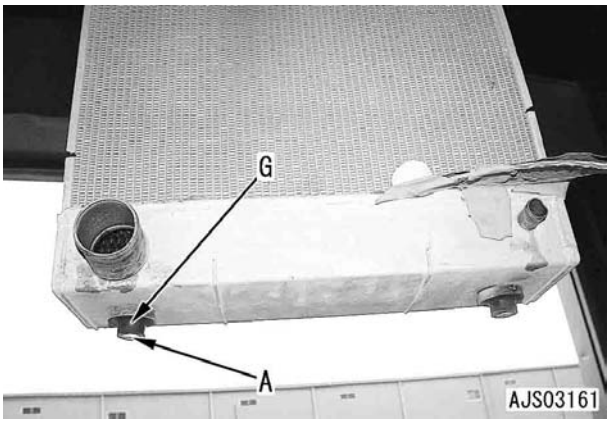
★ Tighten until band gap (BDG) is **17 – 20 mm**.

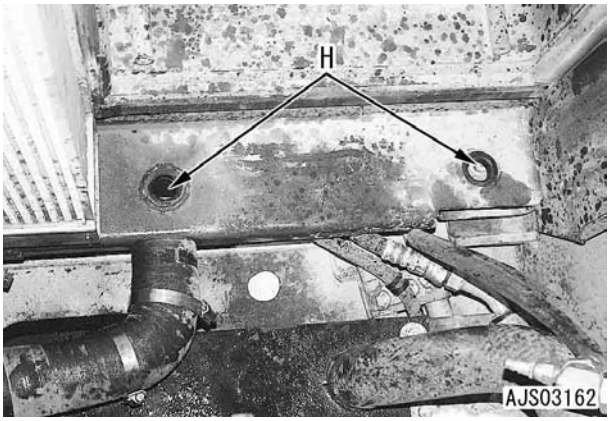


[*2], [*3]

Radiator hose clamp:
8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}

[*4]
★ Check that cushion rubber (G) is fitted to the end of projection (A) on the bottom of the radiator.
★ Check that cushion rubber (G) is aligned with hole (H).





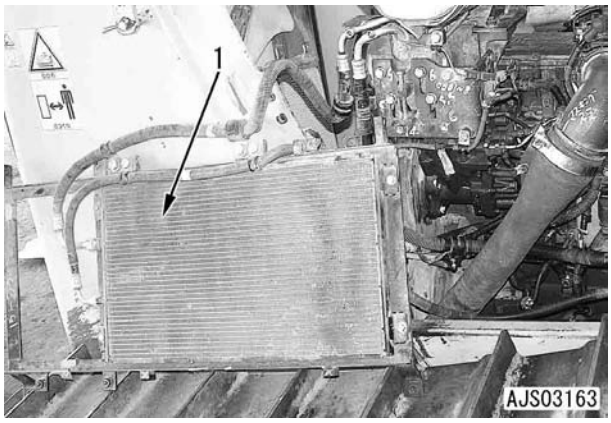
- **Refilling with coolant**
  Add coolant through the coolant filler to the specified level. Run the engine to circulate the coolant through the system. Then, check the coolant level again.

  Coolant: **Approx. 39 ℓ**

Removal and installation of air aftercooler assembly

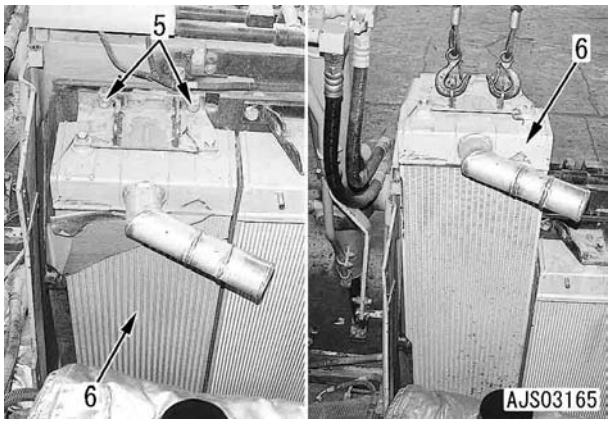
Removal

1. Remove the engine hood assembly. For details, see “Removal and installation of engine hood assembly”.
2. Remove air conditioner condenser assembly (1). For details, see “Removal of radiator assembly”.



3. Disconnect clamps (2) and (3).
4. Disconnect air hose (4). [*1]

5. Remove mounting bolts (5) and lift off air aftercooler assembly (6).

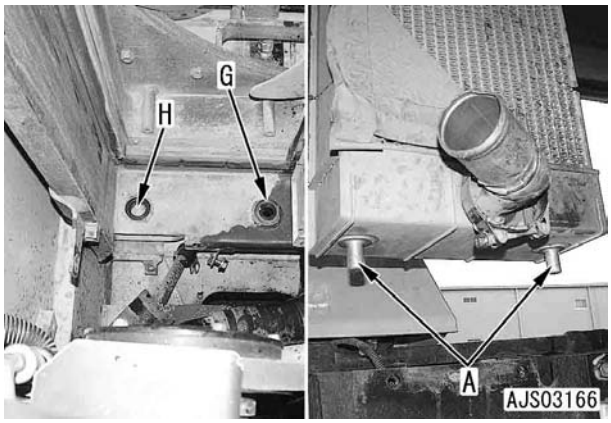


Installation

- Carry out installation in the reverse order to removal.

[*1]
Air hose clamp
10.5 ± 0.5 Nm {1.07 ± 0.05 kgm}

[*2]
★ Check that cushion rubber (G) is fitted to the end of hole H of the radiator guard.
★ Check that projection (A) at the bottom of the air aftercooler is aligned with cushion rubber (G).



Removal and installation of fan drive assembly

Removal

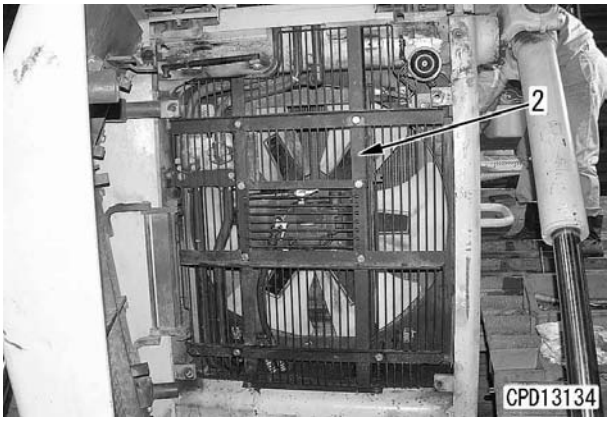
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain the hydraulic oil.

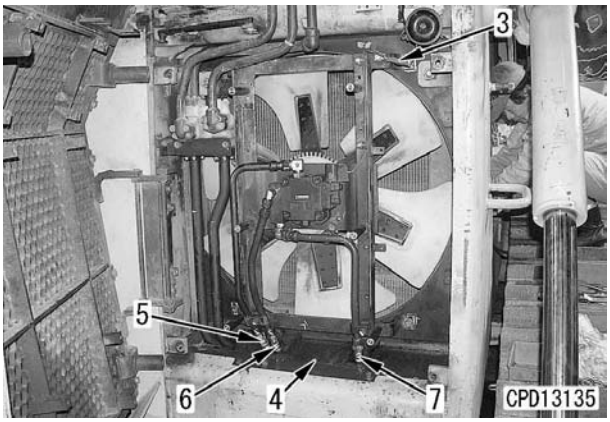
   Hydraulic tank: **55 ℓ**

2. Remove the mounting bolts and open fan guard (1).

3. Remove fan guard (2).

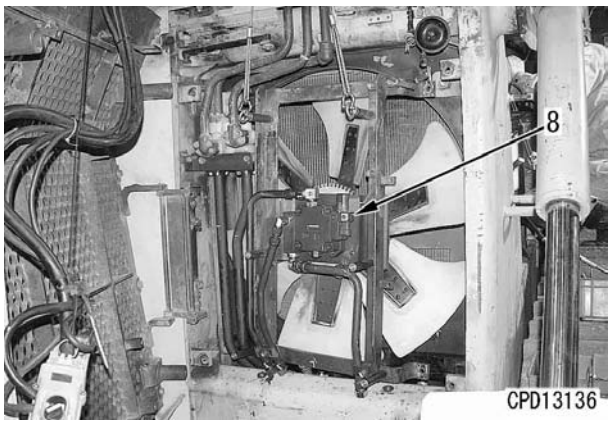


4. Disconnect wiring connector **FAR** (3).
5. Remove plate (4).
6. Disconnect hoses (5), (6), and (7).



7. Remove the 4 mounting bolts and lift off fan drive assembly (8), while evading the piping and frame around it.

   Fan drive assembly: **60 kg**



Installation

- Carry out installation in the reverse order to removal.

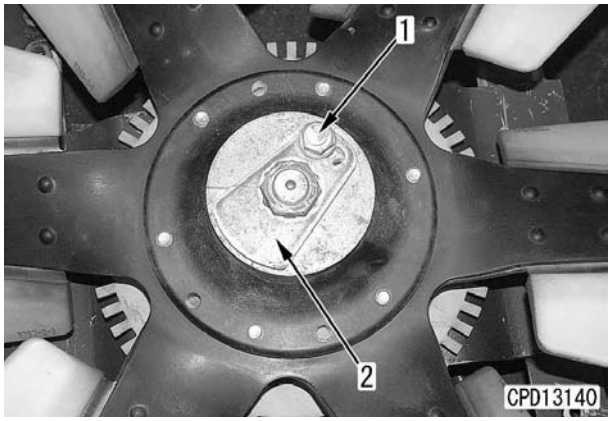
- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

  Hydraulic tank: **55 ℓ (EO10-DH)**

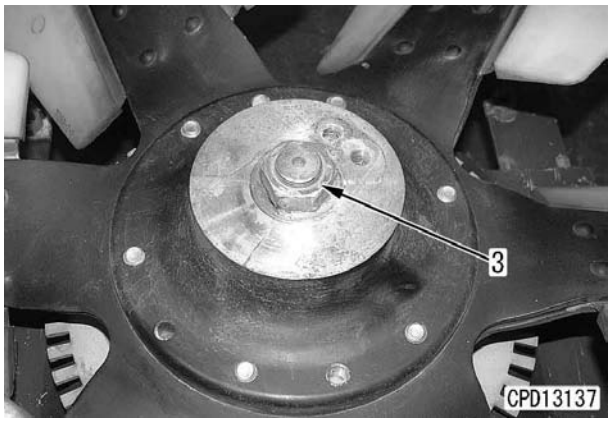
Removal and installation of fan motor assembly

Removal

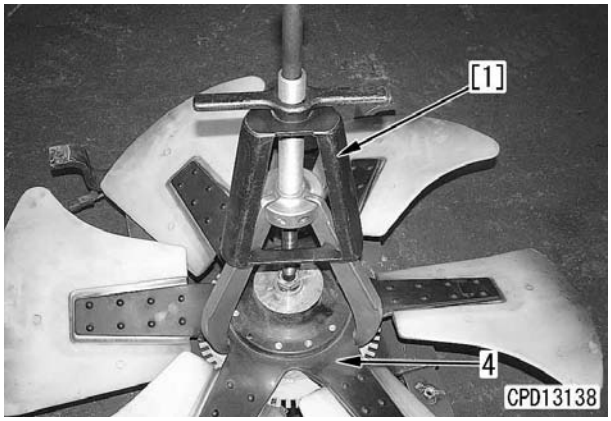
1. Remove the fan drive assembly. For details, see “Removal and installation of fan drive assembly”.
2. Remove mounting bolt (1) and lock plate (2). [*1]



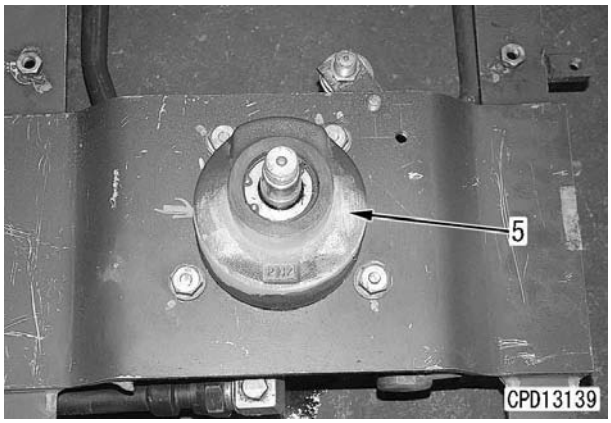
3. Loosen nut (3). [*2]
   ★ Do not remove the nut but leave it inserted by 2 – 3 threads.



4. Using puller [1], disconnect fan (4) from fan motor shaft.
5. Remove nut, then remove fan (4).



6. Remove the 4 mounting bolts and fan motor assembly (5). [*3]



Installation

- Carry out installation in the reverse order to removal.

[*1] [*2]
Nut (3): **132 – 157 Nm {13.5 – 16 kgm}**

1. Align the mounting bolt holes on the front side and back side of lock plate (2), and then install lock plate (2) with the less adjustment amount side up and tighten nut (3).
2. Tighten mounting bolt (1).
   Mounting bolt:
   Liquefied adhesive (LT-2)

[*3]
- Wipe the fan motor shaft and fan boss to remove dirt, and then degrease them.

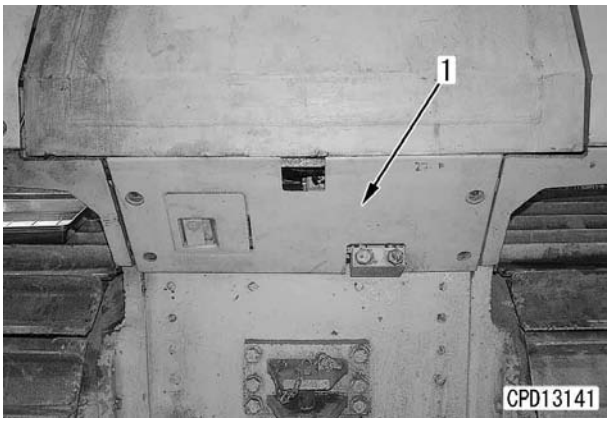
Removal and installation of fuel tank assembly

Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

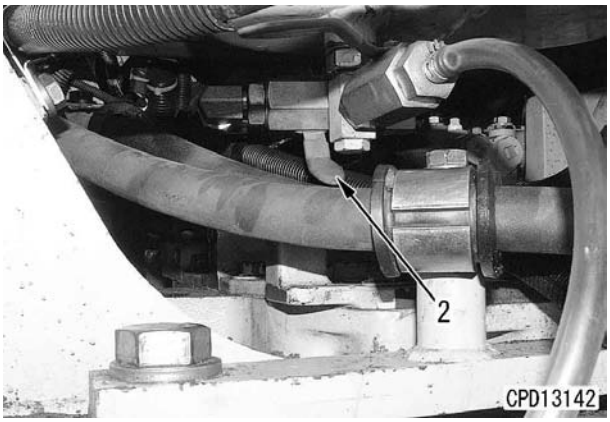
★ Drain fuel, if necessary.

1. Remove cover (1).



2. Close fuel feed valve (2).

★ The closed valve is shown in the following figure.

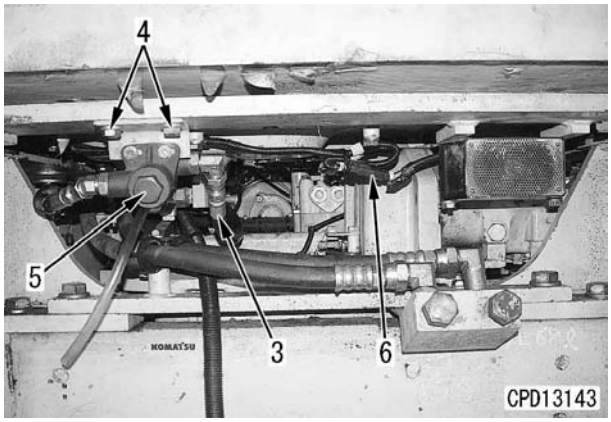


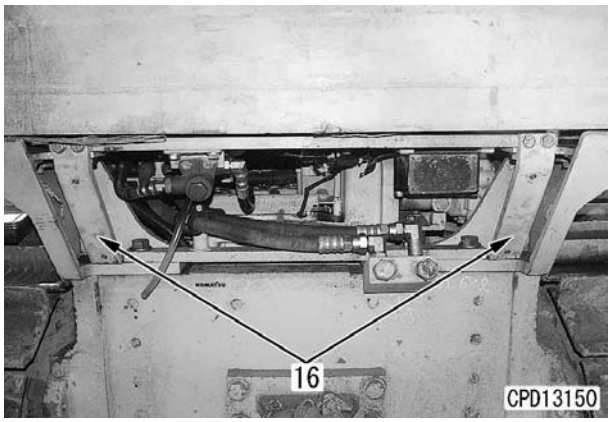
3. Disconnect hose (3).

4. Remove bolt (4) and move valve (5) down.

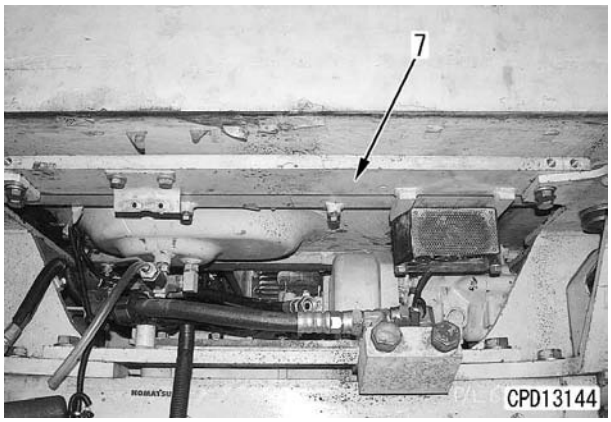
5. Disconnect wiring connector **CN-244** (6) and remove 2 wiring harness clamps.

6. Remove support (16).

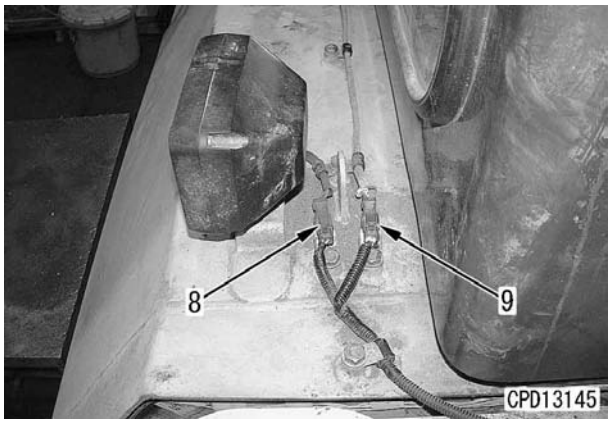




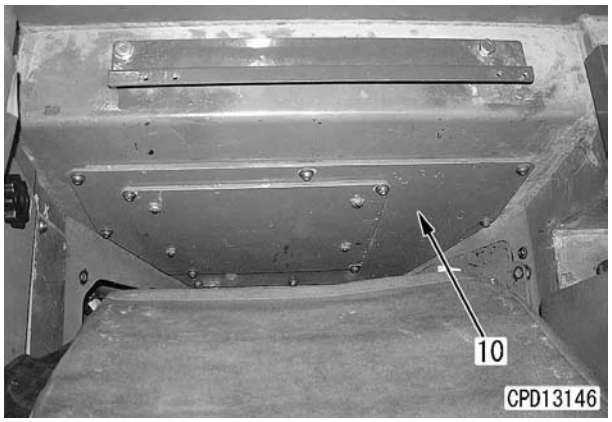
7. Remove plate and backup buzzer assembly (7).



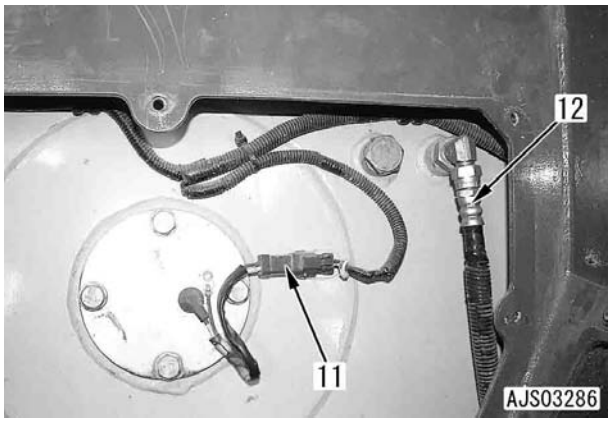
8. Disconnect wiring connectors **CN-247** (8) and **CN-224** (9) of the rear lamp and remove the wiring harness clamp.



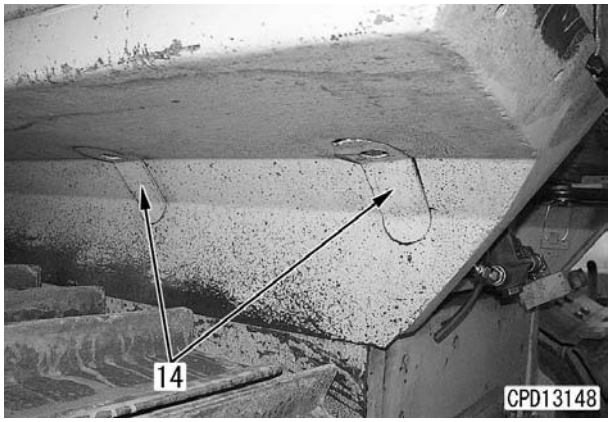
9. Remove cover (10) in the rear of the operator's seat.



10. Disconnect wiring connector **CN-423** (11).
11. Disconnect hose (12) and remove the hose clamp under them.

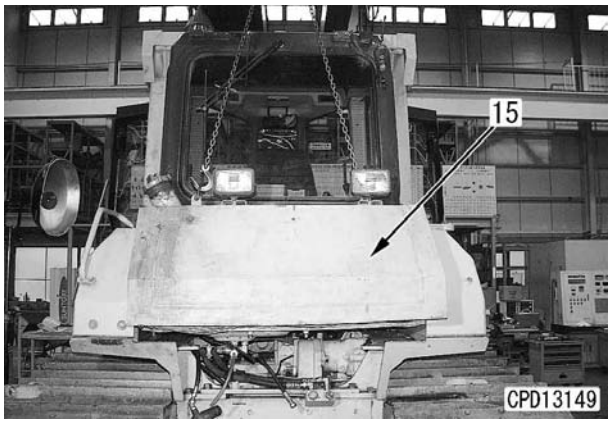


12. Sling the fuel tank assembly temporarily.
13. Remove 4 right and left covers (14) and mounting bolts.



14. Lift off fuel tank assembly (15).

Fuel tank assembly (excluding fuel): **200 kg**



Installation

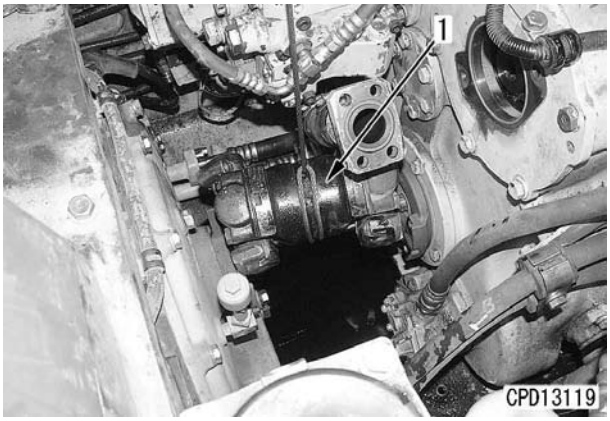
- Carry out installation in the reverse order to removal.

Removal and installation of damper assembly

Removal

1. Remove the floor frame assembly. For details, see “Removal and installation of floor frame assembly”.
2. Remove the power train and lubricating oil pump assembly. For details, see “Removal and installation of power train and lubricating oil pump assembly”.
3. Remove universal joint (1). [*1]

   Universal joint: **20 kg**

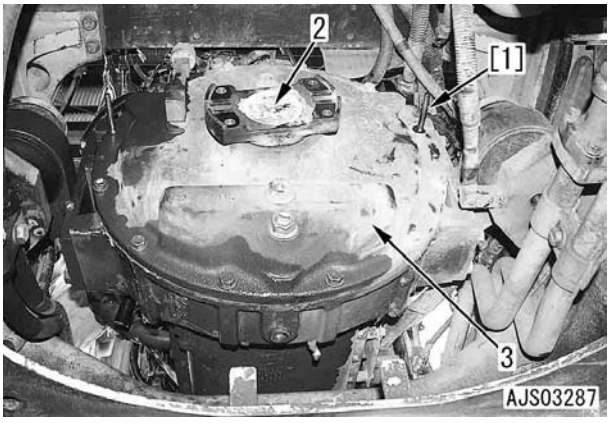


4. Drain the oil from the damper case.

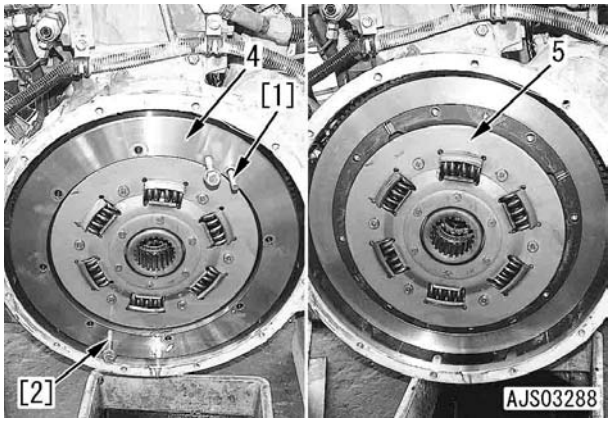
   Damper case: **1.15 ℓ**

5. Remove coupling (2).
6. Using guide bolt [1], remove damper cover (3). [*2]

   Damper cover: **20 kg**



7. Using guide bolt [1] and forcing screw [2], remove ring (4).
8. Remove damper assembly (5). [*3]



Installation

- Carry out installation in the reverse order to removal.

[*1]

Mounting bolt: **Adhesive (LT-2)**

Mounting bolt:
98.1 – 122.6 Nm {10 – 12.5 kgm}

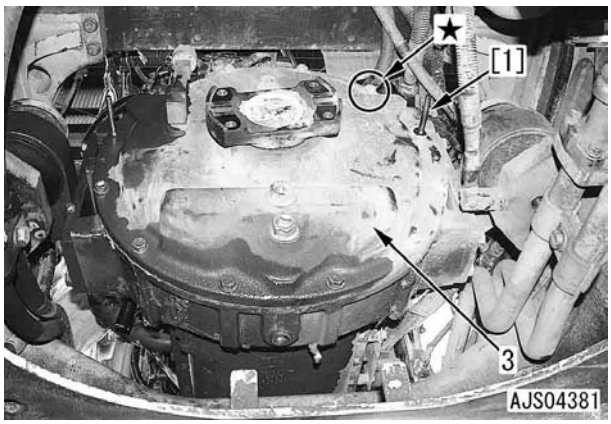
[*2]

Using guide bolt [1], install cover (3).

Mounting face of cover (3):
Gasket sealant (LG-7)

Threads of mounting bolt (only one marked with ★): **Gasket sealant (LG-5)**

Mounting bolt:
98.1 – 122.6 Nm {10 – 12.5 kgm}



[*3]

Mounting bolt: **57 – 73.5 Nm {6 – 7.5 kgm}**

- **Refilling with oil**
  Add oil through the oil filler of the damper assembly to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

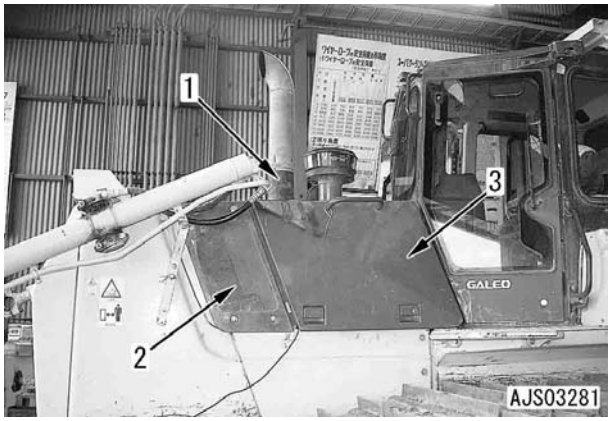
Damper case: **1.15 ℓ (EO30-CD)**

Drain plug: **58.8 – 78.5 Nm {6 – 8 kgm}**

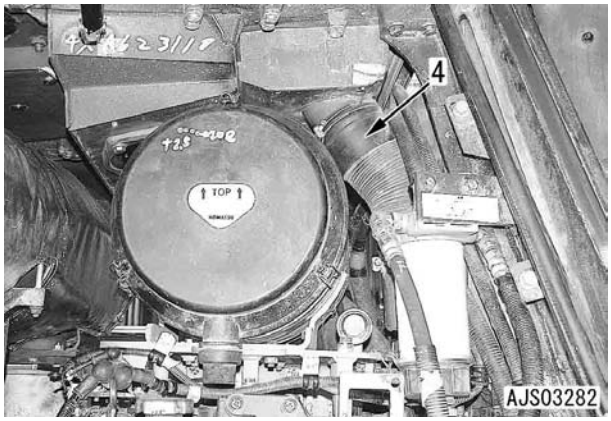
Removal and installation of engine hood assembly

Removal

1. Remove exhaust pipe (1).
2. Remove right and left covers (2).
3. Open engine hood cover (3).

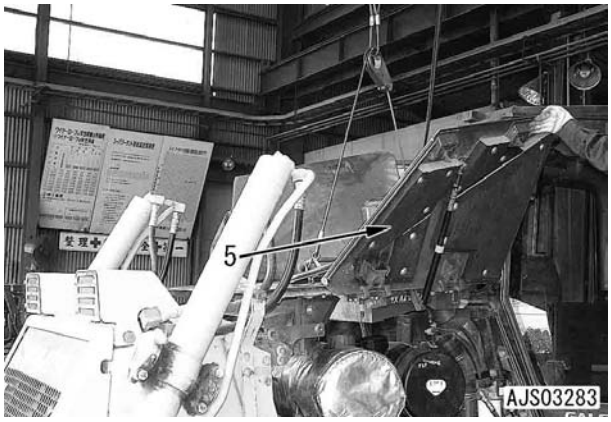


4. Disconnect air hose (4).

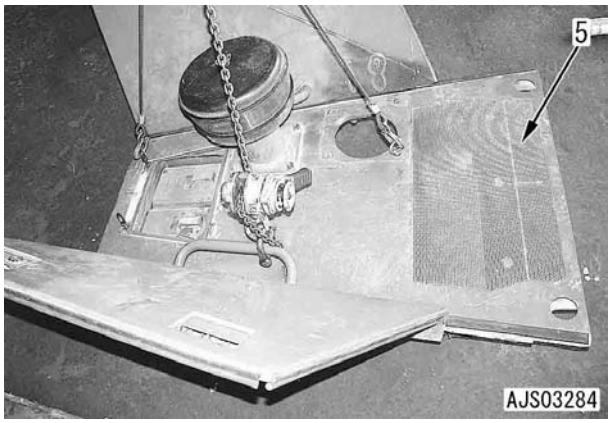


5. Remove the mounting bolts and lift off engine hood (5).

   Engine hood: **160 kg**



★ Reference
Fulcrum of sling



Installation

- Carry out installation in the reverse order to removal.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00946-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

Power train, Part 1

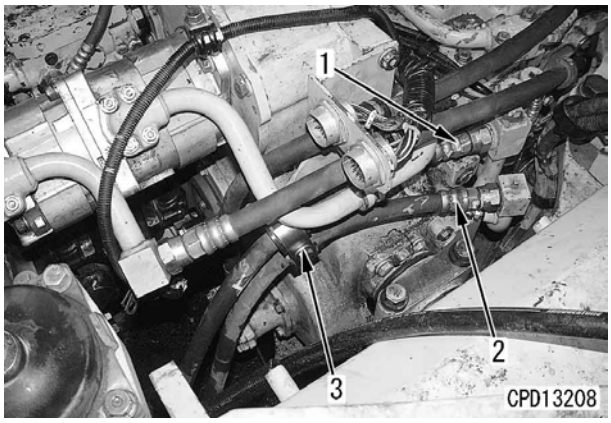
Power train, Part 1

Removal and installation of power train unit assembly

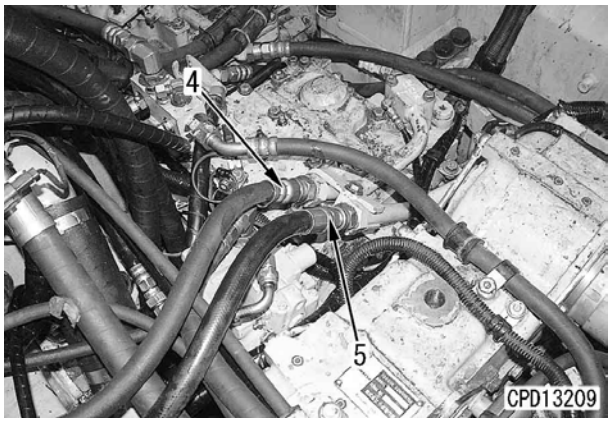
Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

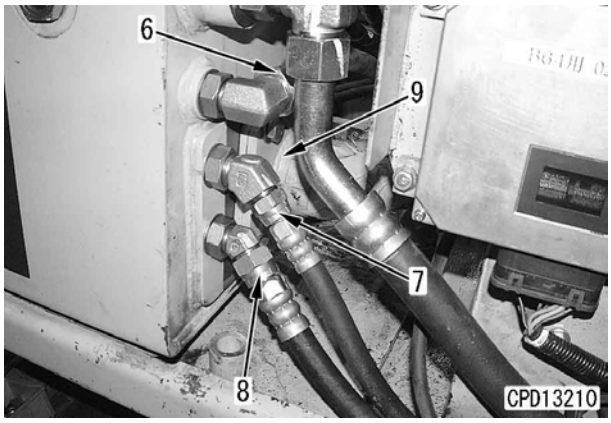
1. Drain oil.
   - Hydraulic tank: **55 ℓ**
   - Power train case: **48 ℓ**
2. Remove the floor frame assembly. For details, see "Removal and installation of floor frame assembly."
3. Remove the fuel tank assembly. For details, see "Removal and installation of fuel tank assembly."
4. Disconnect hoses (1) and (2) and remove clamp (3).



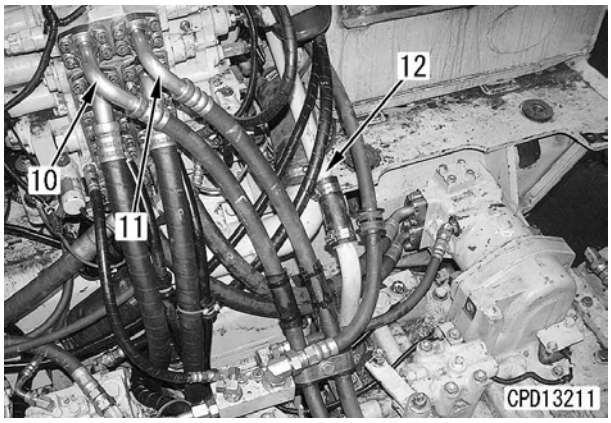
5. Disconnect hoses (4) and (5).



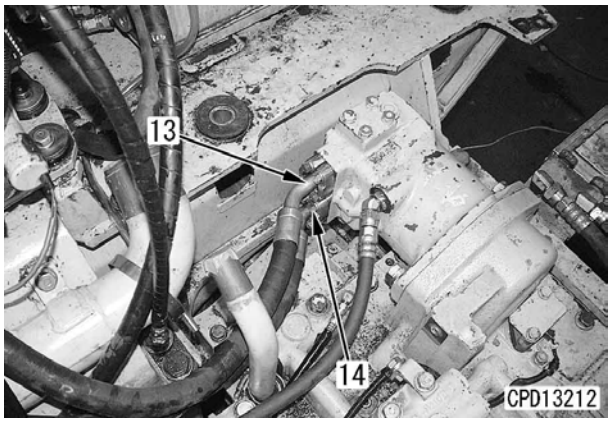
6. Disconnect hoses (6), (7), and (8).
7. Remove suction tube (9).



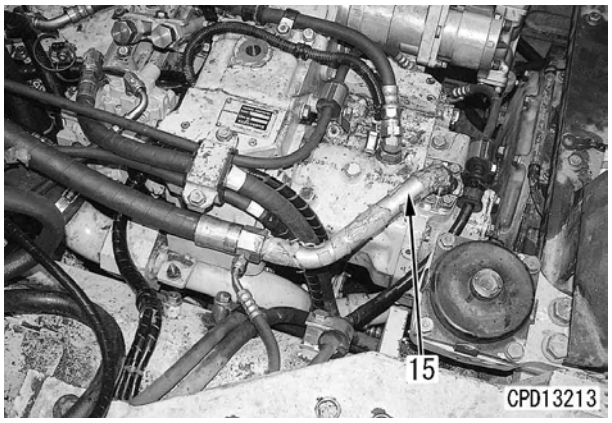
8. Disconnect hoses (10) and (11) on the control valve side.
9. Remove oil level gauge guide (12).



10. Disconnect hoses (13) and (14) from the HSS motor.

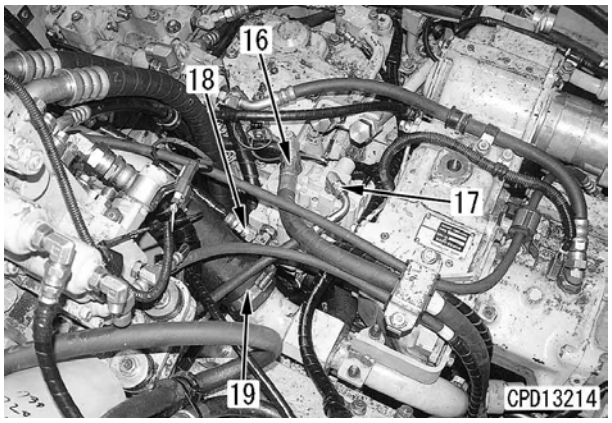


11. Disconnect tube (15) from the HSS pump assembly.

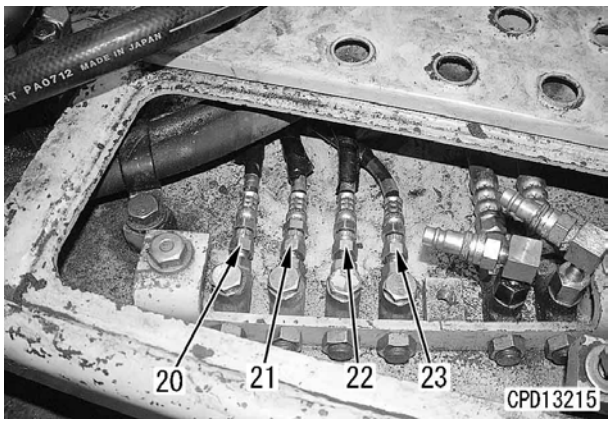


12. Disconnect hoses (16), (17), and (18) from the cooling fan pump.

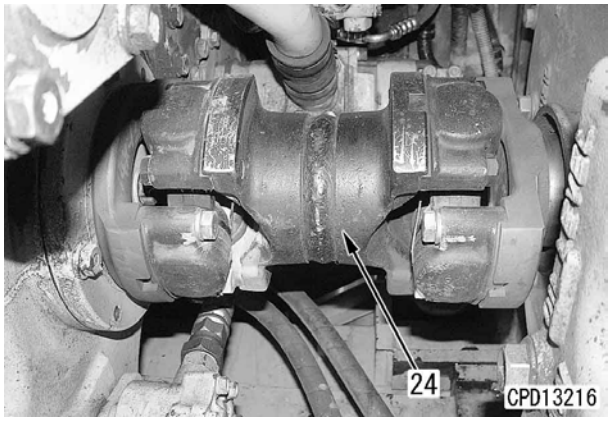
13. Disconnect the suction tube and hose (19) together from the rear. [*1]



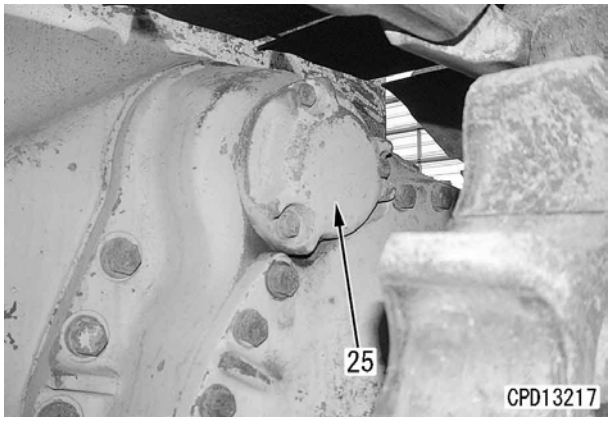
14. Remove the cover and disconnect hoses (20), (21), (22), and (23) from the pressure pickup ports.



15. Remove universal joint (24). [*2]

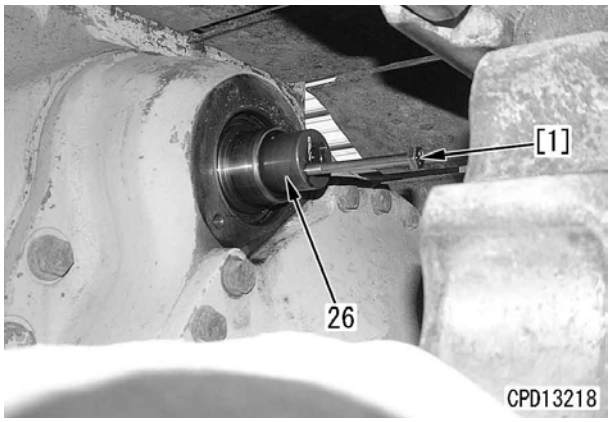


16. Remove right and left final drive shaft covers (25).

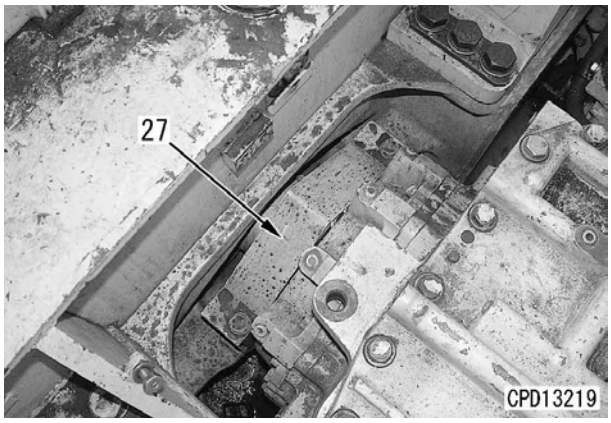


17. Using forcing screw [1], pull out right and left drive shafts (26) until the spline on the steering case side comes off.

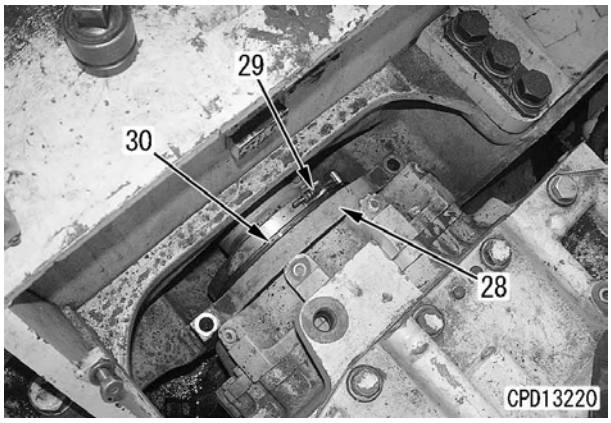
★ If the shafts cannot be pulled out, raise the shoe grouser with a jack to a position where the shafts can be pulled out.



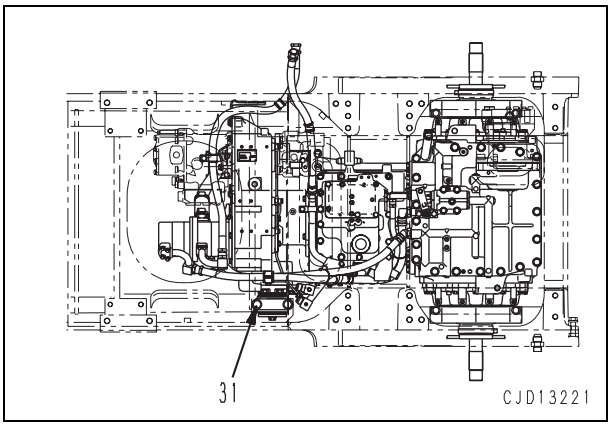
18. Remove covers (27) of the right and left steering case bevel gear shafts.



19. Remove right and left caps (28). Loosen clamp (29) and move seal (30) to the outside. [*3]



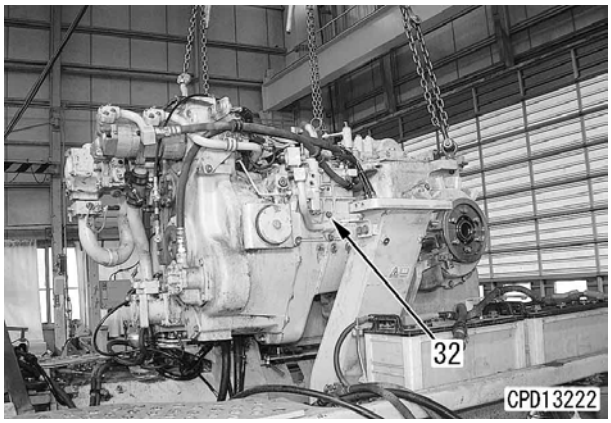
20. Remove 4 right and left mounting bolts (31).



21. Lift off power train unit assembly (32). [*4]

★ When lifting off the power train unit assembly, check that all the wires and pipes are disconnected.

Power train unit assembly: **1,650 kg**



Installation

- Carry out installation in the reverse order to removal.

[*1]

Hose clamp: **8.8 ± 0.5 Nm {90 ± 5 kgcm}**

[*2]

Mounting bolt: **Liquefied adhesive (LT-2)**

Mounting bolt:
98.1 – 122.6 Nm {10.0 – 12.5 kgm}

[*3]

★ Apply the clamp all round the seal of the coupling securely.

[*4]

★ When installing, take extreme care not to damage right and left bevel gear shaft seals (31).

- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

  Hydraulic tank: **55 ℓ (EO10-DH)**

  Power train case: **48 ℓ (TO30)**

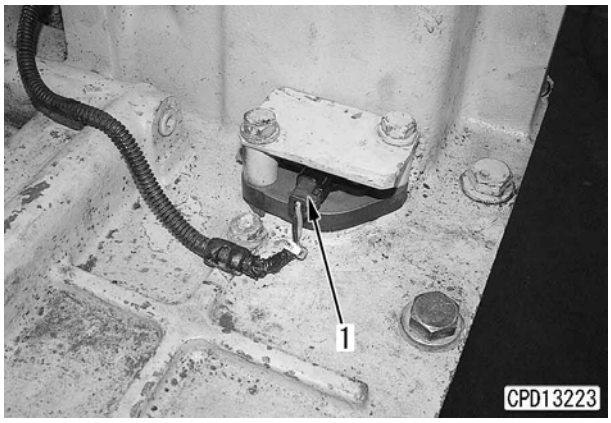
Disconnection and connection of power train unit assembly

Disconnection

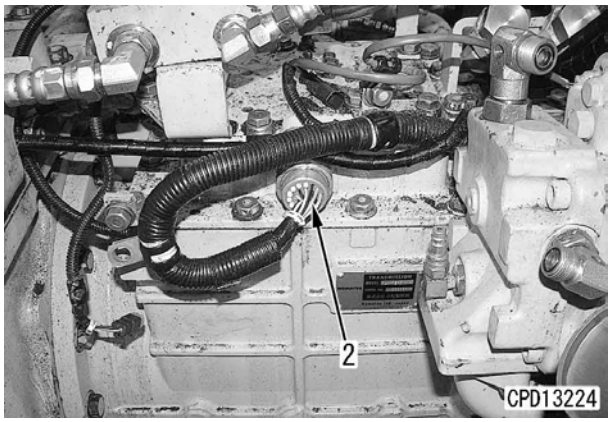
1. Drain oil from the power train case.

   Power train case: **48 ℓ**

2. Disconnect wiring connector **TM1** (1) above the HSS case.



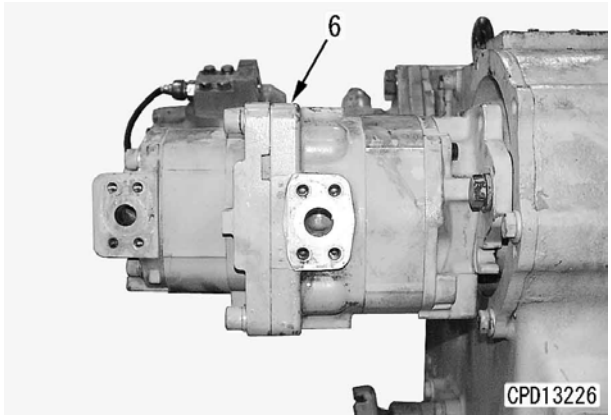
3. Disconnect wiring connector **TMV** (2) on the right side of the transmission case.



4. Remove the mounting bolt of bracket (3). [*1]
5. Remove all the wiring harness clamps from each part and disconnect wiring harness assembly (4).
6. Remove parking brake cable (5). [*2]
   ★ Do not loosen the mounting nut but remove it together with the bracket.

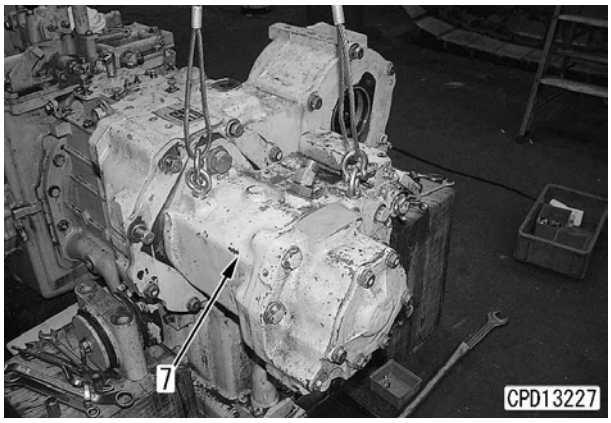
7. Remove all the pipes and hoses from each part. [*3]
   ★ Put tags to the disconnected pipes and hoses to prevent a mistake in re-connecting them.
8. Remove power train and lubricating oil pump assembly (6). [*4]

   Power train and lubricating oil pump assembly: **20 kg**



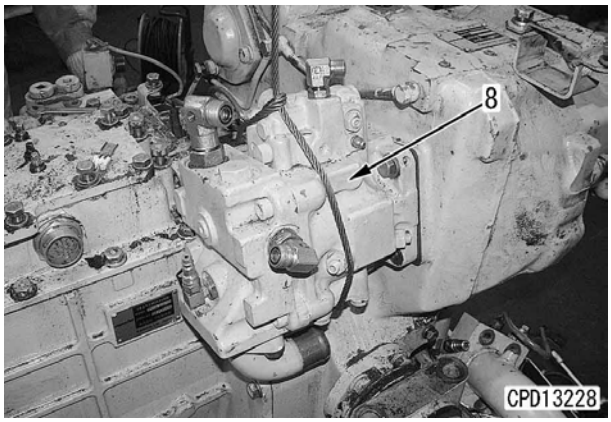
9. Remove HSS pump assembly (7).

HSS pump assembly: **75 kg**

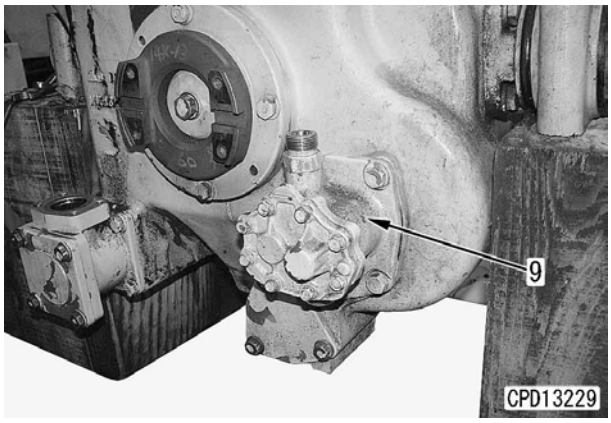


10. Remove cooling fan pump assembly (8).

Cooling fan pump assembly: **30 kg**

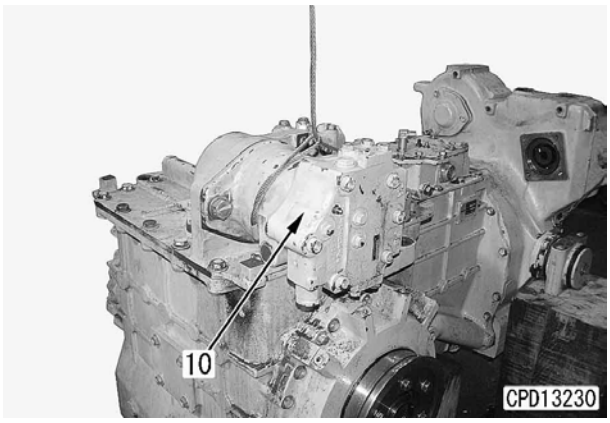


11. Remove scavenging pump assembly (9).



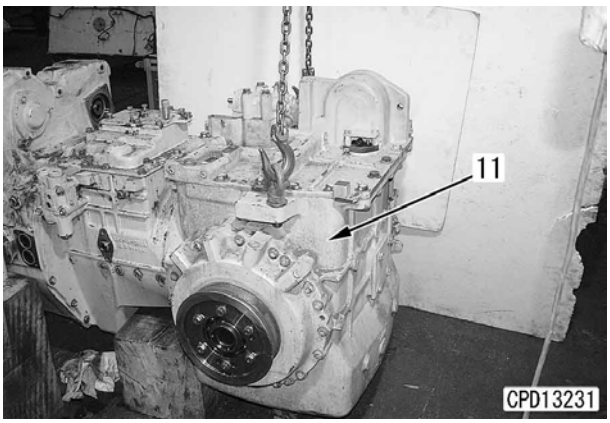
12. Remove HSS motor assembly (10).

HSS motor assembly: **45 kg**

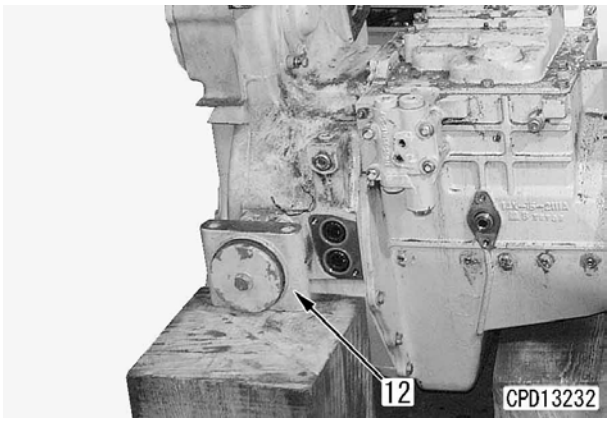


13. Remove 13 mounting bolts and HSS assembly (11). [*5]

HSS assembly: **750 kg**

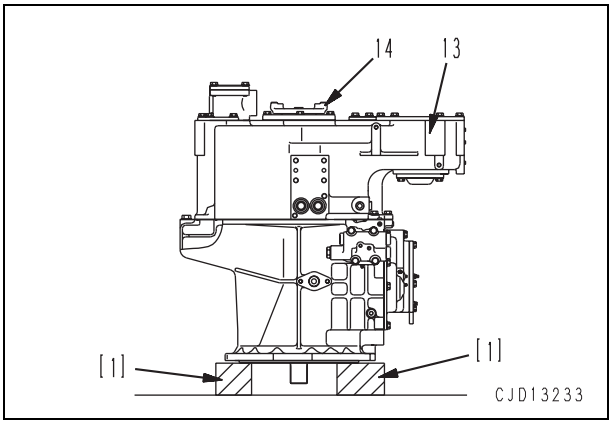


14. Sling the PTO, torque converter, and transmission assembly and remove right and left mount assemblies (12).

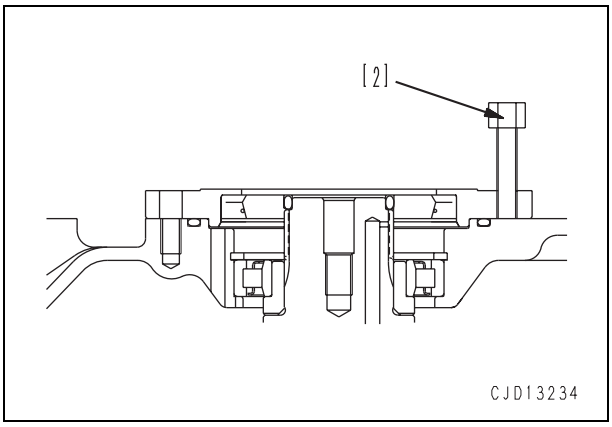


15. Set the PTO, torque converter, and transmission assembly on block [1] with PTO assembly (13) up.

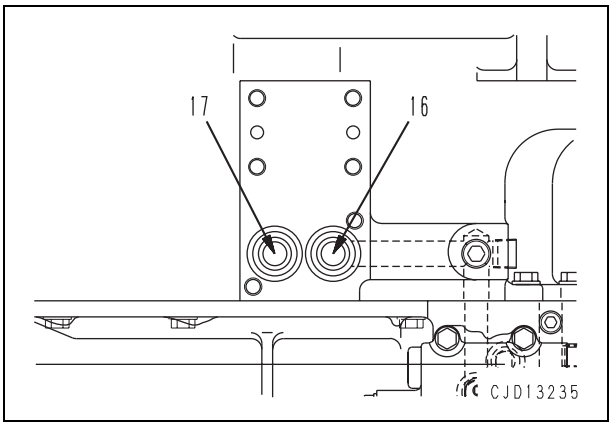
16. Remove coupling (14). [*6]



17. Using forcing screw [2], remove retainer (15) from the PTO case. [*7]



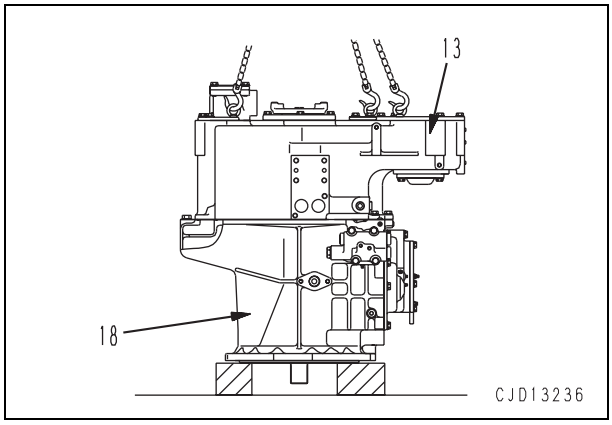
18. Remove sleeves (16) and (17).



19. Remove 12 mounting bolts and sling PTO assembly (13) and disconnect it from transmission assembly (18). [*8]

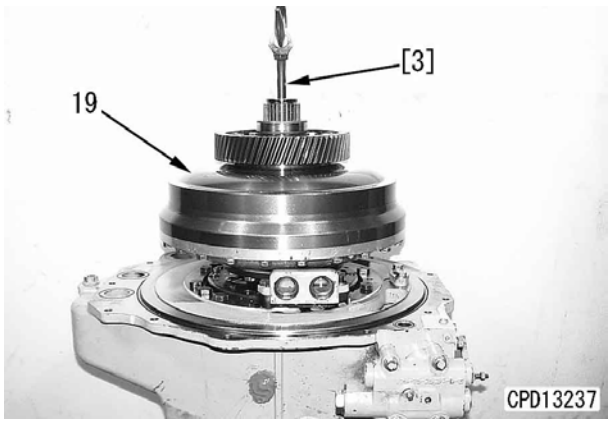
★ The torque converter assembly is left on the transmission side.

PTO assembly: **150 kg**



20. Remove 8 mounting bolts. Using eyebolt [3], remove torque converter assembly (19).

Torque converter assembly: **150 kg**



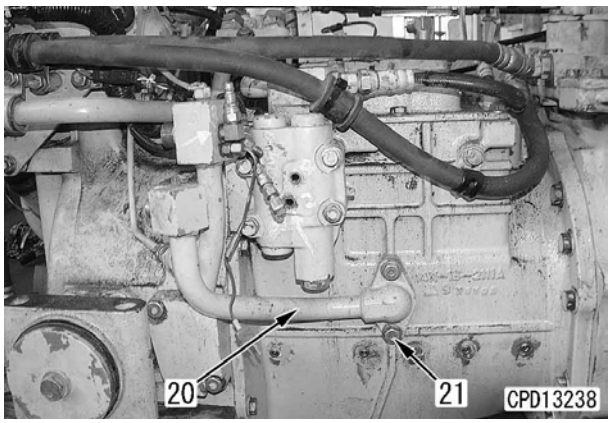
Connection

- Carry out connection in the reverse order to disconnection.

[*1]
Mounting bolt of bracket (3):
98 – 123 Nm {10.0 – 12.5 kgm}

[*2]
★ If the cable nut was loosened, adjust it. For details, see Testing and adjusting, “Adjusting parking brake lever”.

[*3]
★ Apply gasket sealant (LG-6) to the threads of only 1 mounting bolt (21) of tube (20).

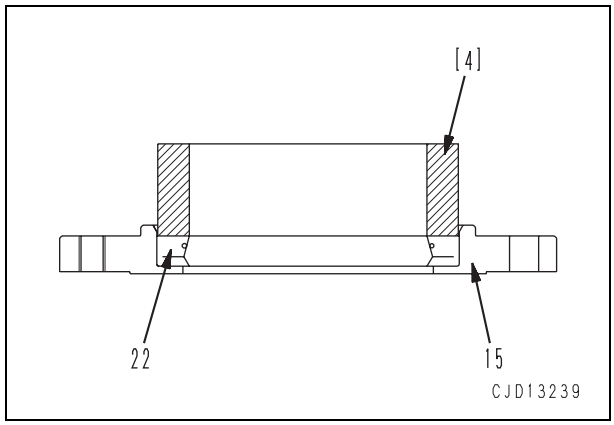


[*4]
Mounting bolt:
98 – 123 Nm {10.0 – 12.5 kgm}

[*5]
Mounting bolt:
245 – 309 Nm {25 – 31.5 kgm}

[*6]
O-ring between coupling and shaft:
Grease (G2-LI)
Mounting bolt: **Liquefied adhesive (LT-2)**
Mounting bolt:
245.1 – 309.0 Nm {25.0 – 31.5 kgm}

[*7]
★ Using push tool [4], install oil seal (22) to retainer (15).
Lip of oil seal: **Grease (G2-LI)**
Periphery of press fitting surface of oil seal and inside wall of hole of retainer: **Gasket sealant (LG-5)**
★ Wipe off the projected gasket sealant.



[*8]
Mounting bolt:
58.8 – 73.5 Nm {6.0 – 7.5 kgm}

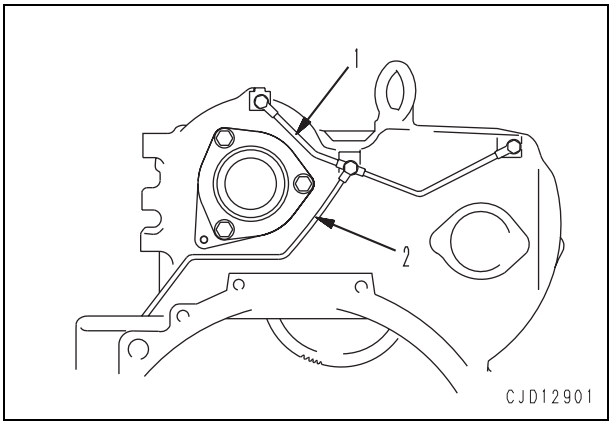
- **Refilling with oil**
  Power train case: **48 ℓ (TO30)**

Disassembly and assembly of PTO assembly

Disassembly

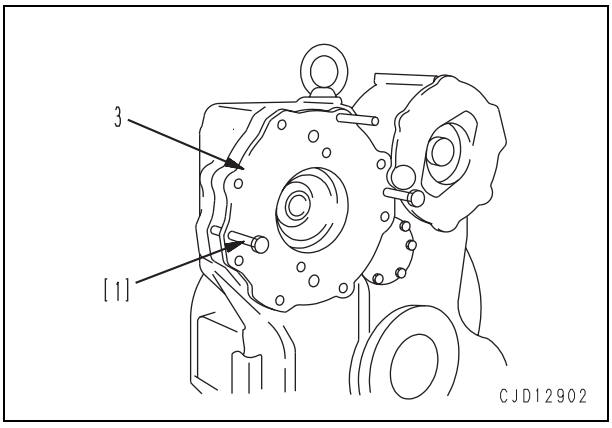
1. Lubrication tubes

Remove lubrication tubes (1) and (2).

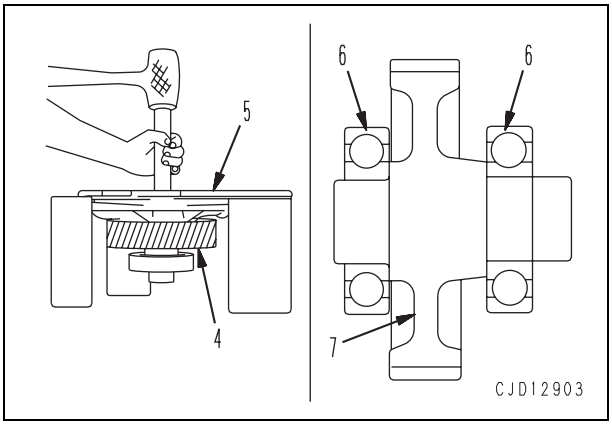


2. Cover assembly (right)

1) Remove mounting bolts, then using forcing screw [1], remove cover assembly (3).

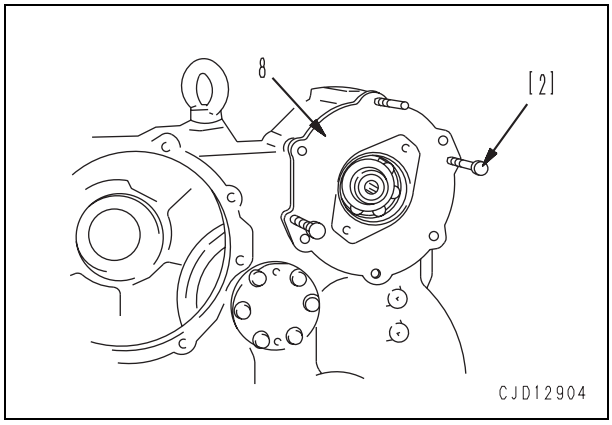


2) Knock out gear assembly (4) from cover (5) and remove.
3) Remove bearings (6) from gear (7).

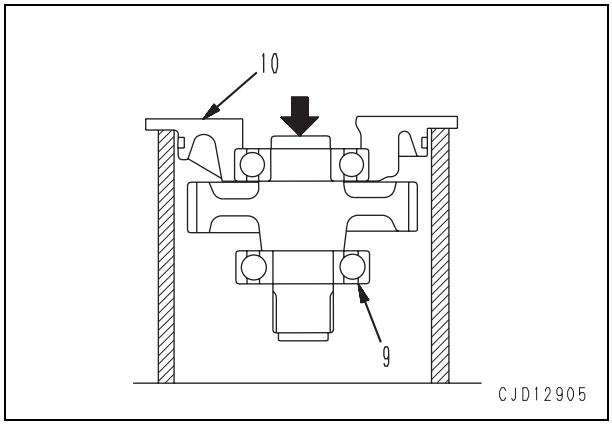


3. Cover assembly (left)

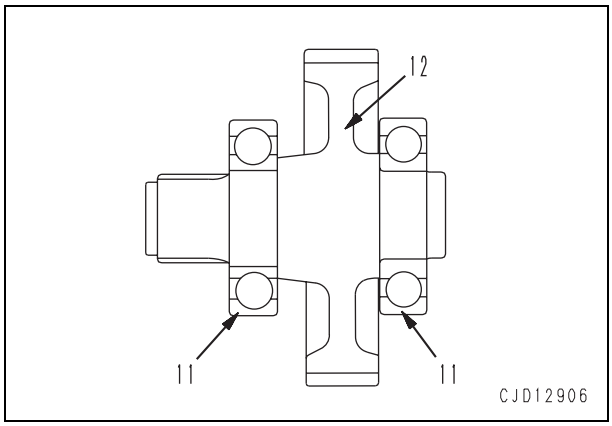
1) Remove mounting bolts, then using forcing screw [2], remove cover assembly (8).



2) Knock out gear assembly (9) from cover (10).

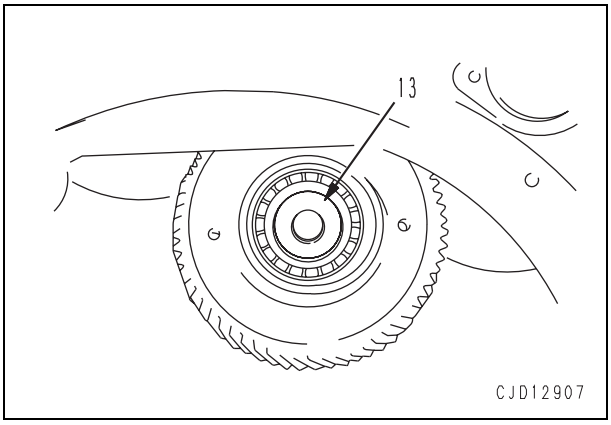


3) Remove bearing (11) from gear (12).

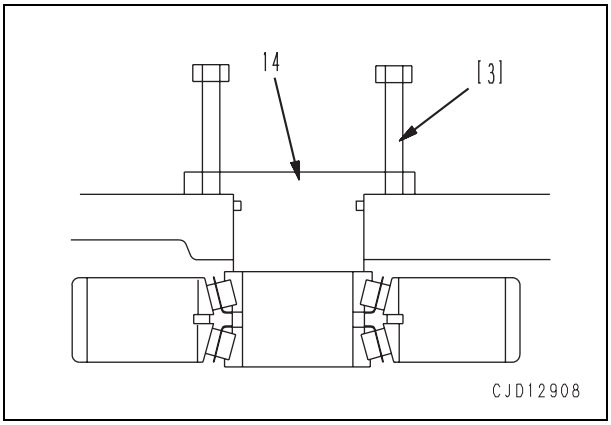


4. Idler gear

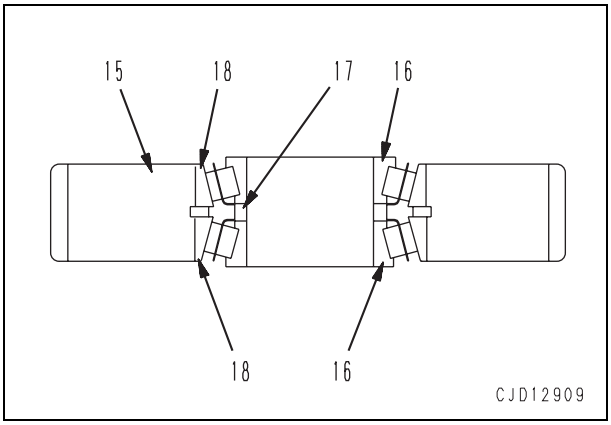
1) Remove mounting bolts, then remove plate (13).



2) Remove mounting bolts, and using forcing screws [3], remove shaft (14).

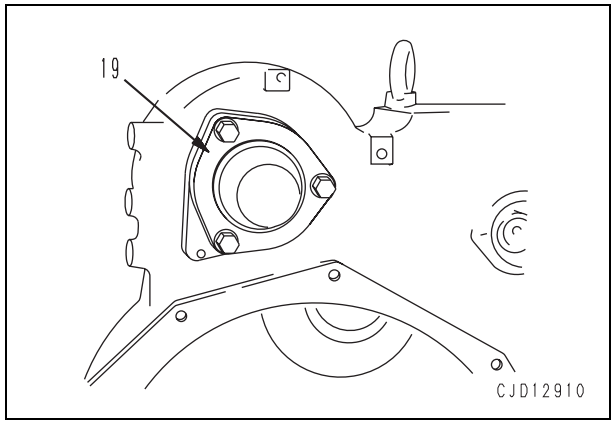


3) Remove bearing (16) and spacer (17) from gear (15).
   ★ If these parts are to be used again, do not change the sets. Put them in sets with the outer race and keep them in a safe place.
4) Remove outer race (18) from gear (15).



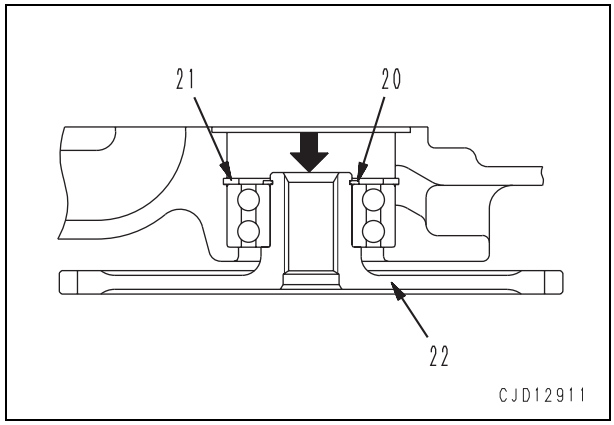
5. Cover

Remove cover (19).

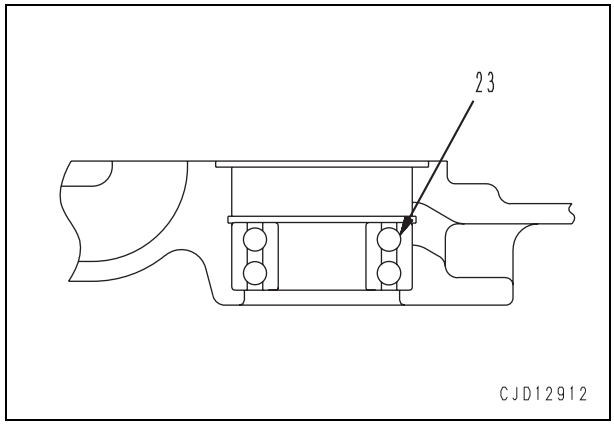


6. Scavenging pump drive gear

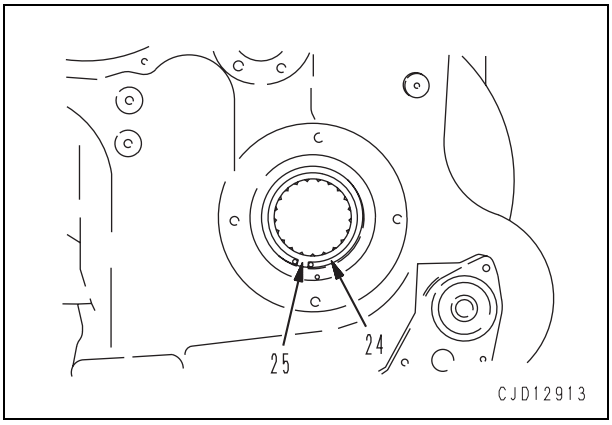
1) Remove snap rings (20) and (21).
2) Knock out gear (22) from snap ring side.



3) Remove bearing (23).



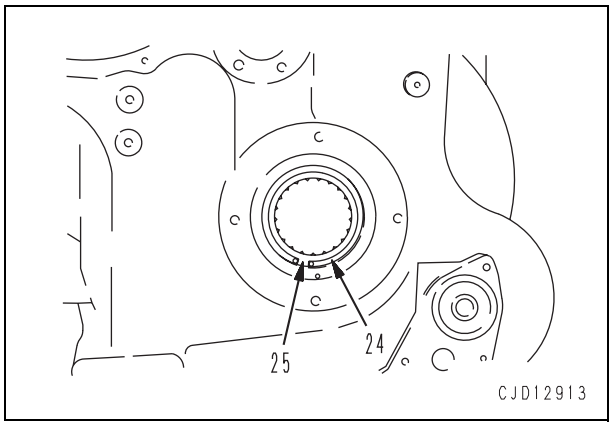
7. Input shaft bearing
Remove snap ring (24), then remove bearing (25).



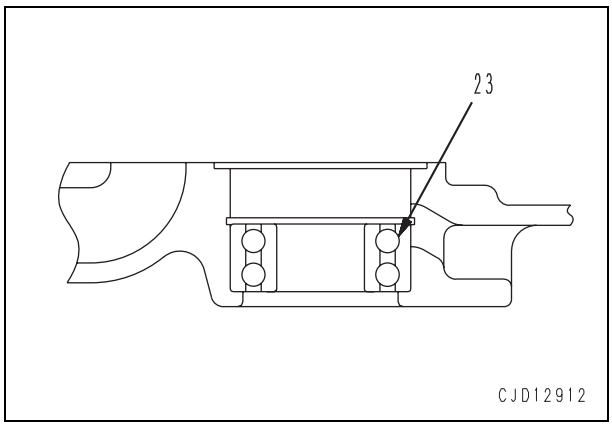
Assembly

★ Clean all parts, and check for dirt or damage before installing.
★ Put a drop of engine oil on the rotating portion of the bearing, then rotate it several times.
★ Check that the snap ring is fitted securely in the groove.

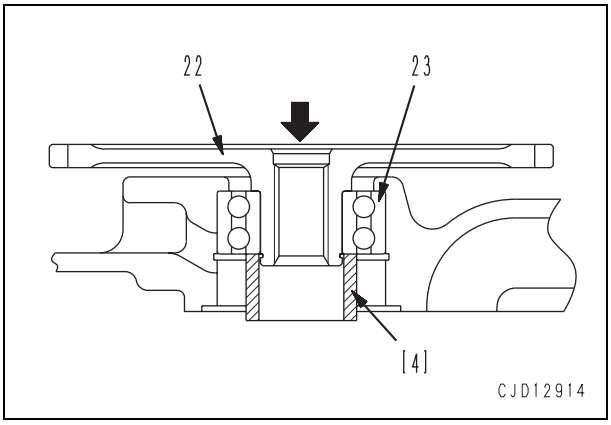
1. Input shaft bearing
Press fit bearing (25), and install snap ring (24).



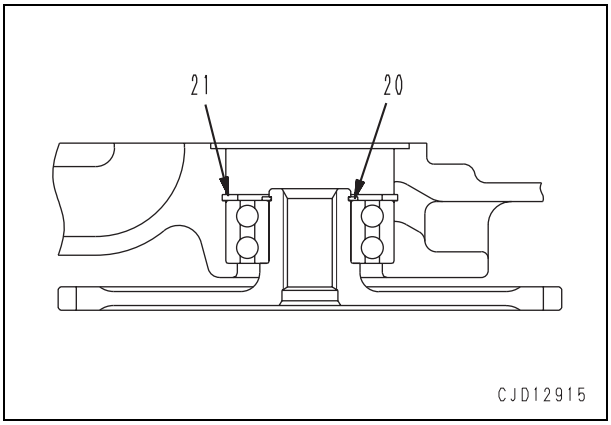
2. Scavenging pump drive gear
1) Install bearing (23).



2) Hold the inner race side of bearing (23) with push tool [4] and install gear (22) to the bearing.

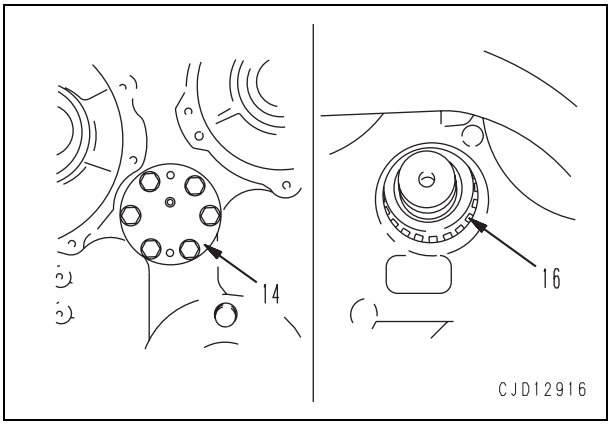


3) Install snap rings (20) and (21).

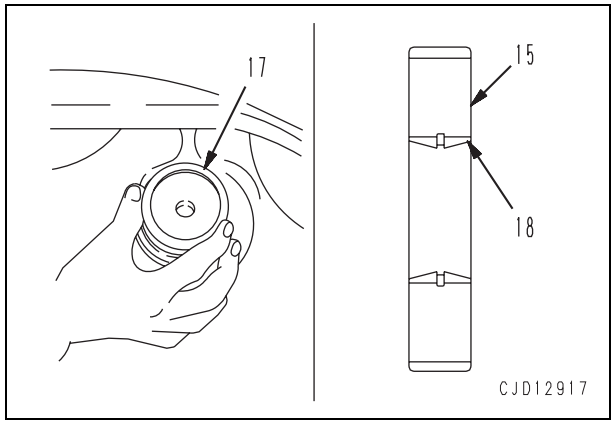


3. Idler gear

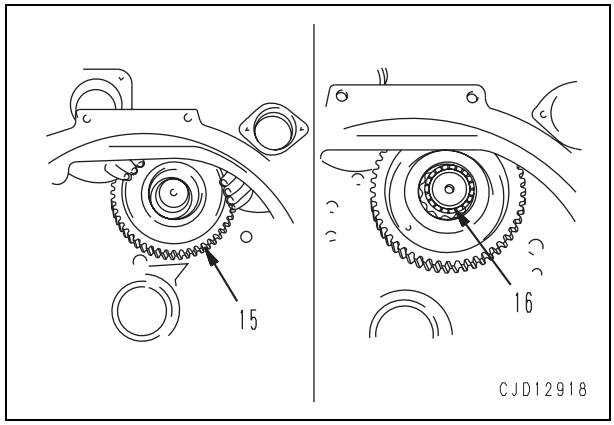
1) Fit the O-ring to shaft (14) and install them to the case.
   O-ring: **Grease (G2-LI)**
2) Install bearing (16).



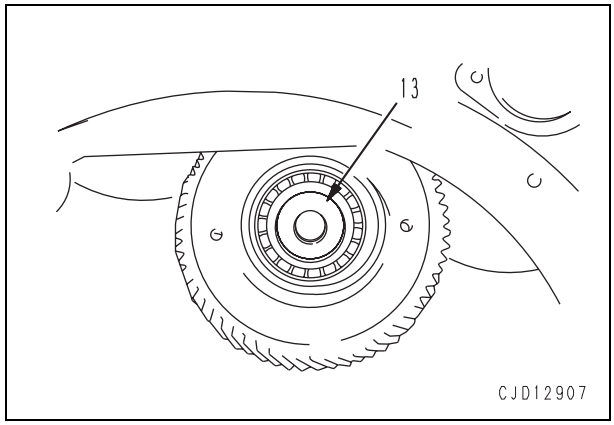
3) Install spacer (17).
4) Install outer race (18) to gear (15).



5) Install gear (15).
6) Install bearing (16).
   ★ Press fit inner race side.

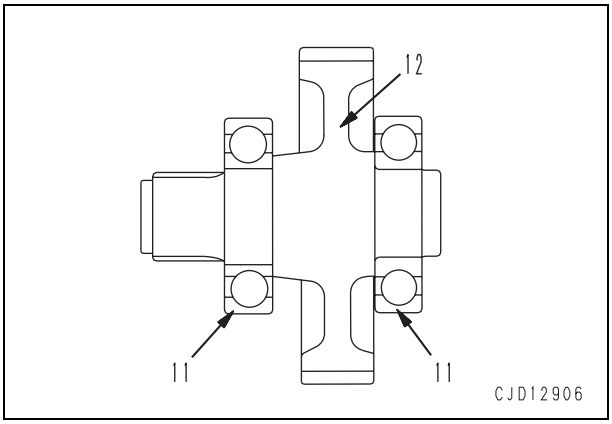


7) Fit plate (13) and tighten bolts.
   Mounting bolt:
   Liquefied adhesive (LT-2)
   Mounting bolt:
   156.9 – 196.1 Nm {16.0 – 20.0 kgm}

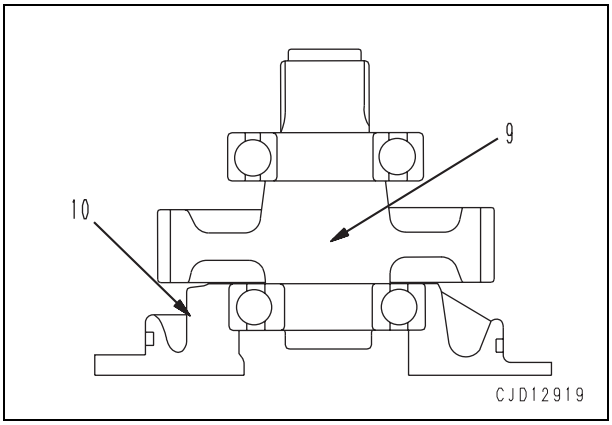


4. Cover assembly (left)

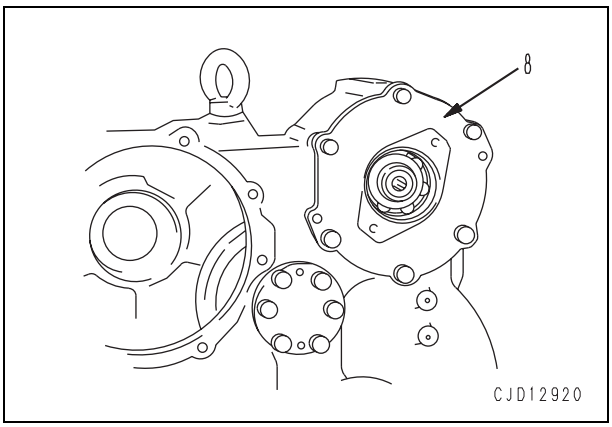
1) Install bearings (11) to gear (12).



2) Install O-ring to cover (10).
   O-ring: **Grease (G2-LI)**
3) Install gear assembly (9) to cover (10).

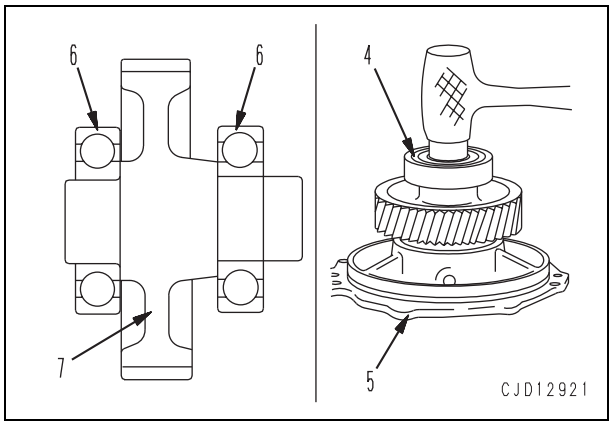


4) Mesh idler gear, and install cover assembly (8).

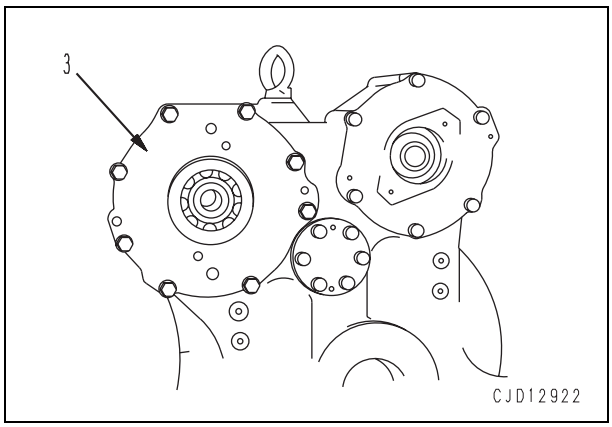


5. Cover assembly (right)

1) Install bearing (6) to gear (7).
2) Install gear assembly (4) to cover (5).
3) Install O-ring to cover (5).
   O-ring: **Grease (G2-LI)**

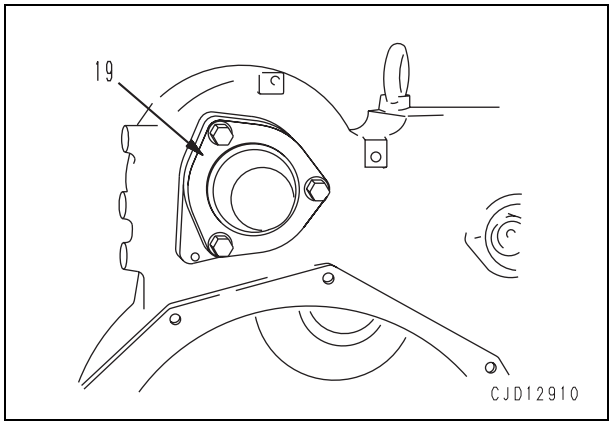


4) Mesh idler gear, install cover assembly (3).

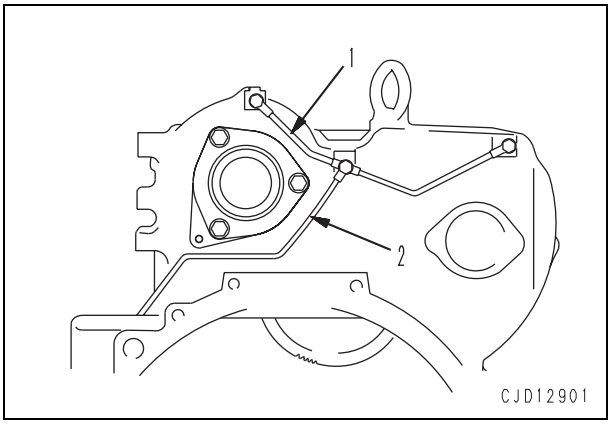


6. Cover

Install cover (19).



7. Lubrication tubes
Install lubrication tubes (2) and (1).

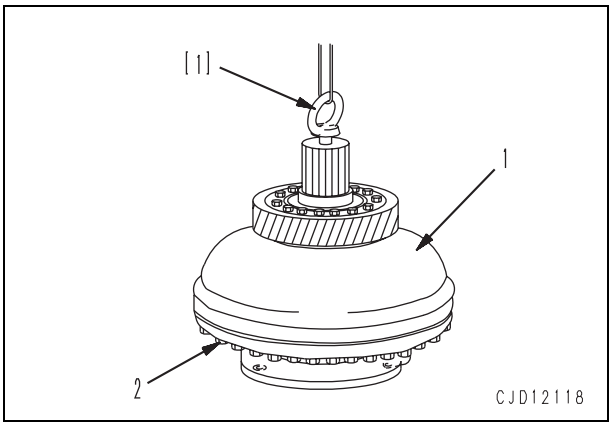


Disassembly and assembly of torque converter assembly

Disassembly

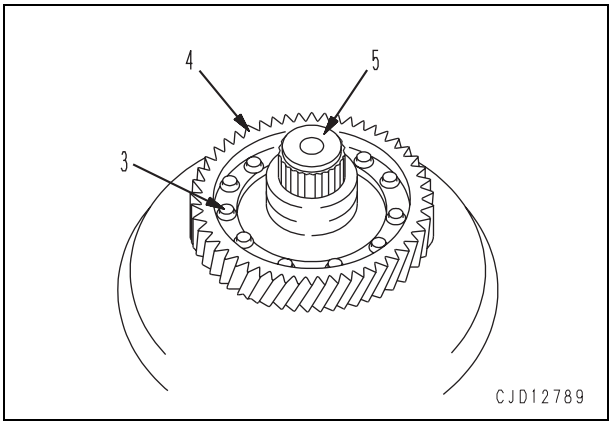
1. Case, turbine assembly

Remove 24 bolts from below, then use eyebolts [1], and remove case and turbine assembly (1).

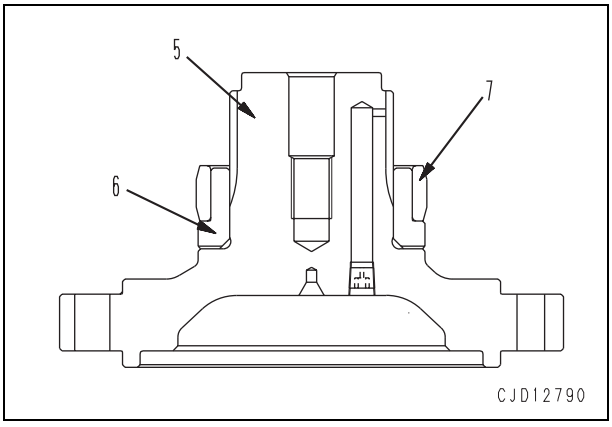


2. Gear and input shaft

1) Remove 14 bolts (3), then remove gear (4) and input shaft (5).

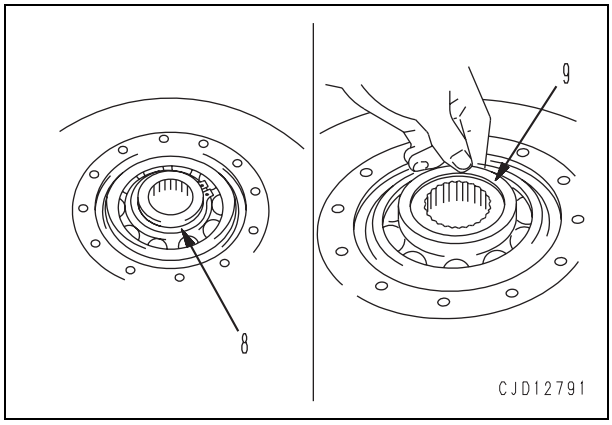


2) Remove collar (6) and inner race (7) from input shaft (5).

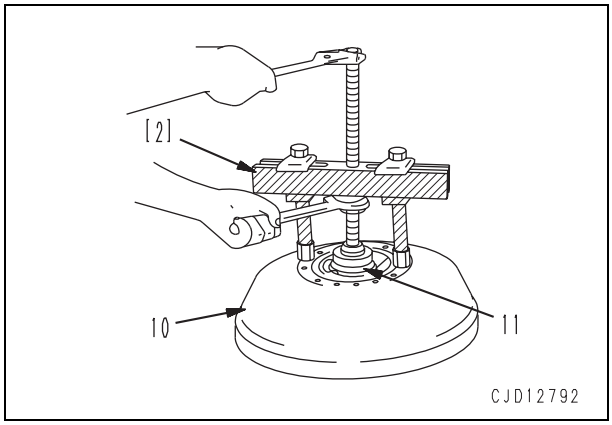


3. Case

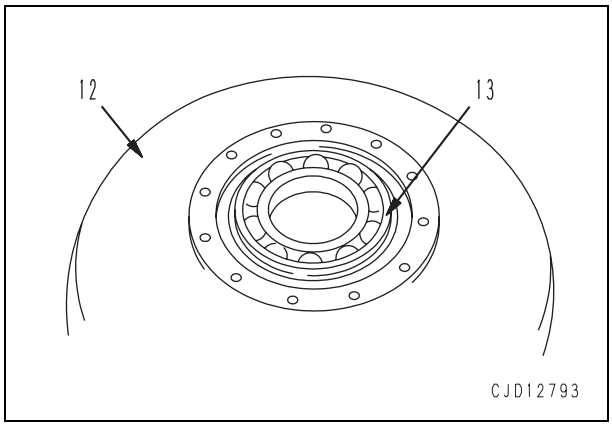
1) Remove snap ring (8).
2) Remove spacer (9).



3) Using puller [2], disconnect case assembly (10) and turbine (11).

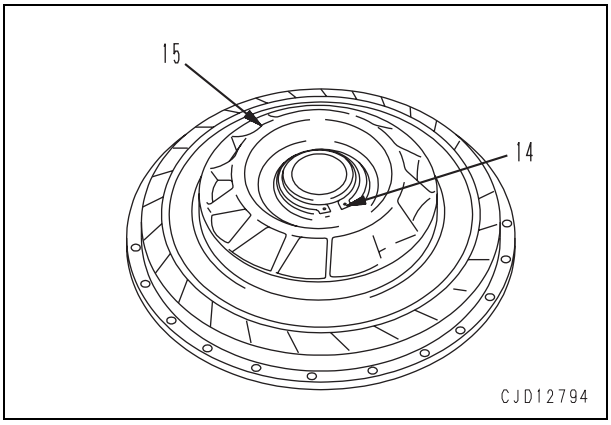


4) Remove bearing (13) from case (12).



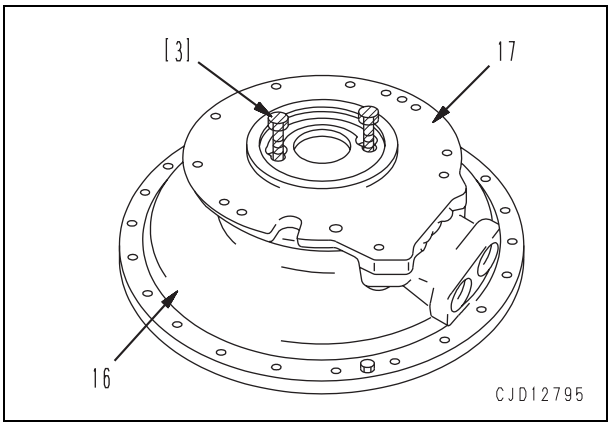
4. Stator

Remove snap ring (14), then remove stator (15).

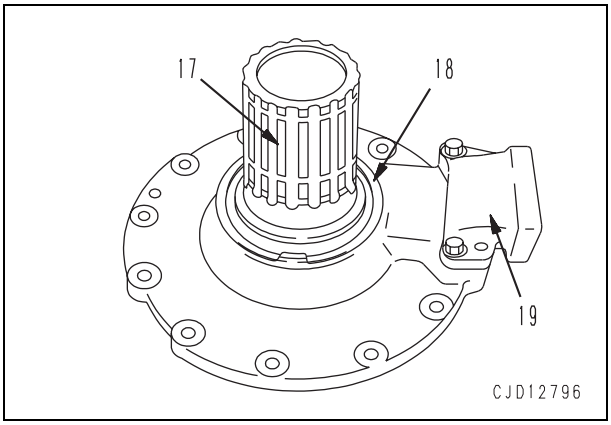


5. Pump assembly

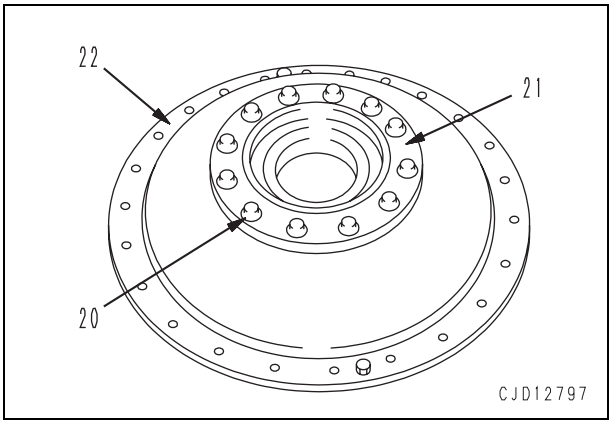
1) Using forcing screws [3] from stator shaft end, remove pump assembly (16) from stator shaft (17).



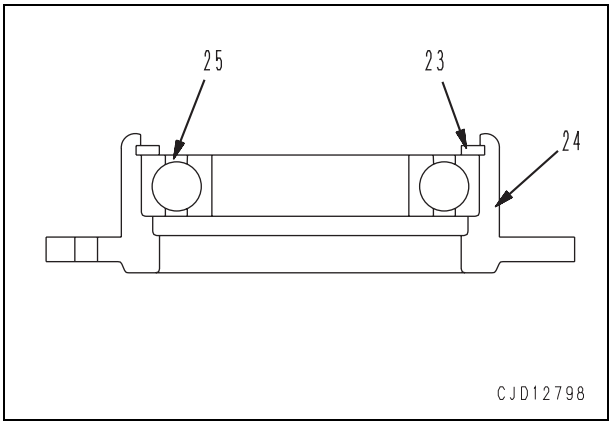
2) Remove seal ring (18) and flange (19) from stator shaft (17).



3) Remove 12 bolts (20), then remove cage assembly (21) from pump (22).



4) Remove snap ring (23), then remove bearing (25) from cage (24).

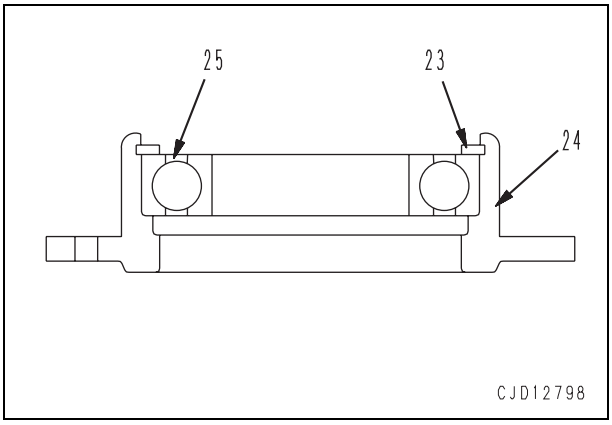


Assembly

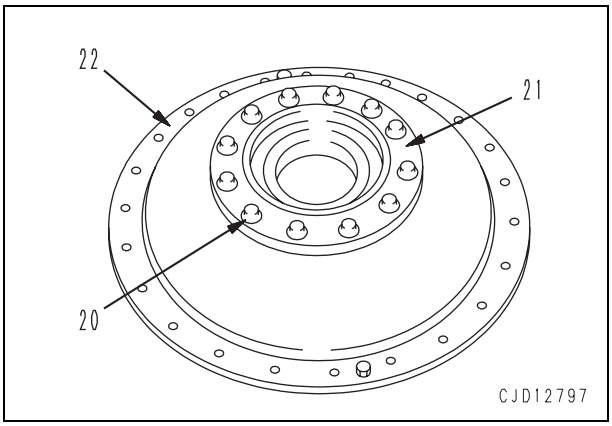
★ Clean all parts, and check for dirt or damage.
★ Check that the snap ring is fitted securely in the groove.

1. Pump assembly

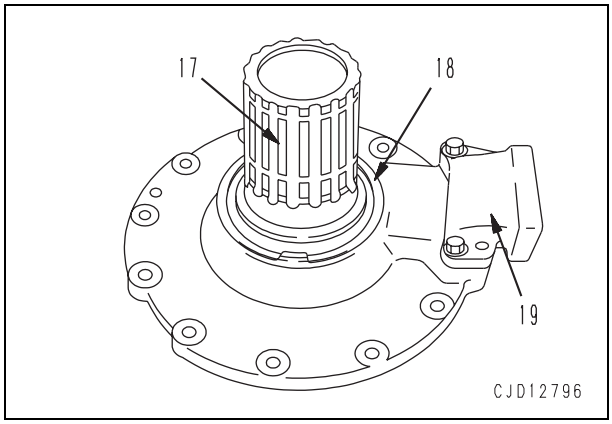
1) Press fit bearing (25) to cage (24), and install snap ring (23).



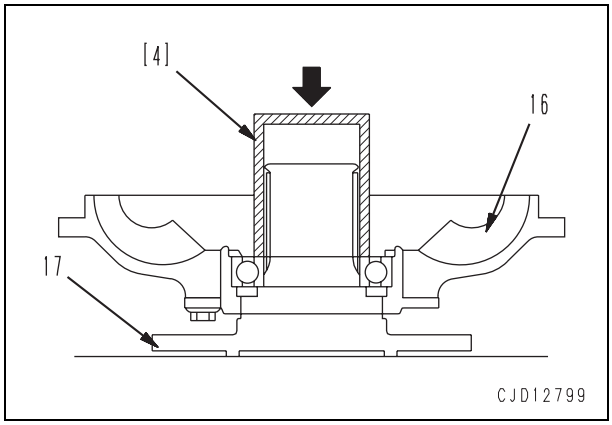
2) Install cage assembly (21) to pump (22).
   Mounting bolt (20):
   Liquefied adhesive (LT-2)
   Mounting bolt:
   58.9 – 73.6 Nm {6 – 7.5 kgm}



3) Install seal ring (18) and flange (19) to stator shaft (17).
   ★ Coat the seal ring with grease (G2-LI) and align the end gaps.
   ★ Take care not to open the abutment joint of the seal ring too much.

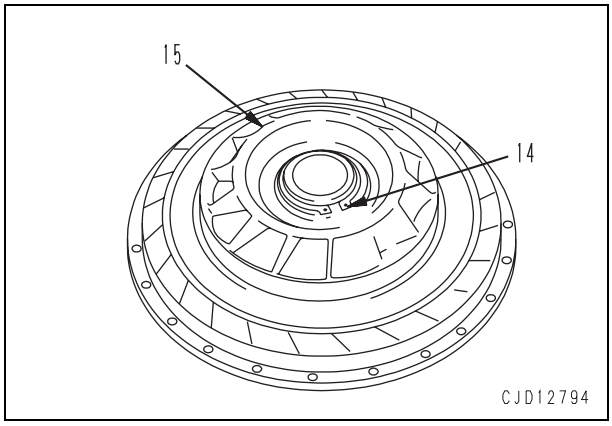


4) Using push tool [4], install pump assembly (16) to stator shaft (17).
   ★ Push the inner race of the bearing to press fit.
   ★ After press fitting the bearing, apply 6 cc of EO10-CD or EO30-CD in drops, then rotate 10 times.



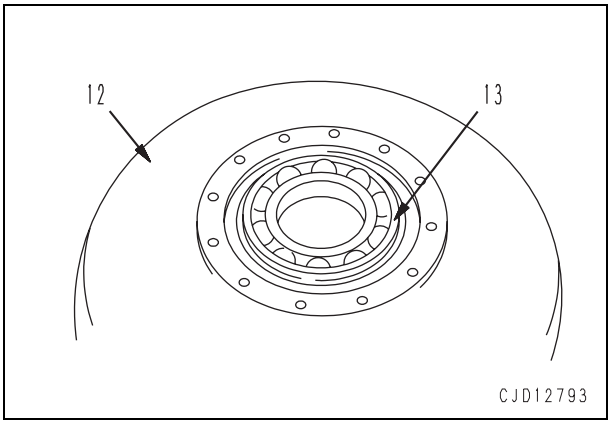
2. Stator

1) Install stator (15).
2) Install snap ring (14).

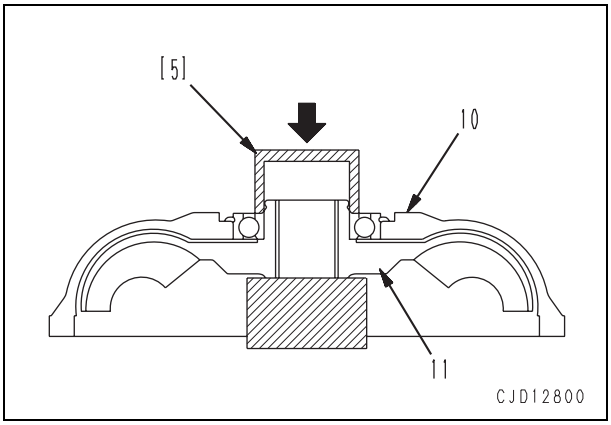


3. Case

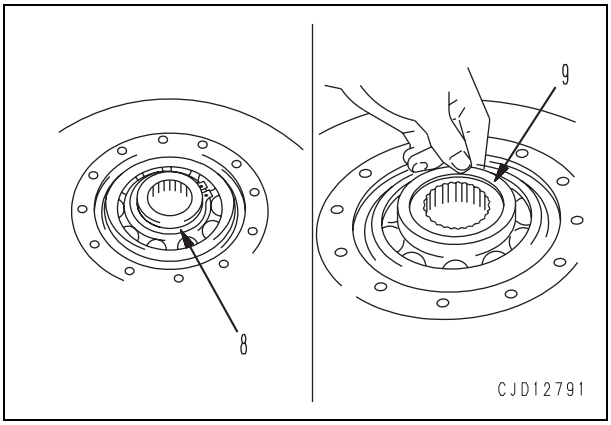
1) Install bearing (13) to case (12).



2) Using push tool [5], push inner race end of bearing, then install case assembly (10) to boss portion of turbine (11).

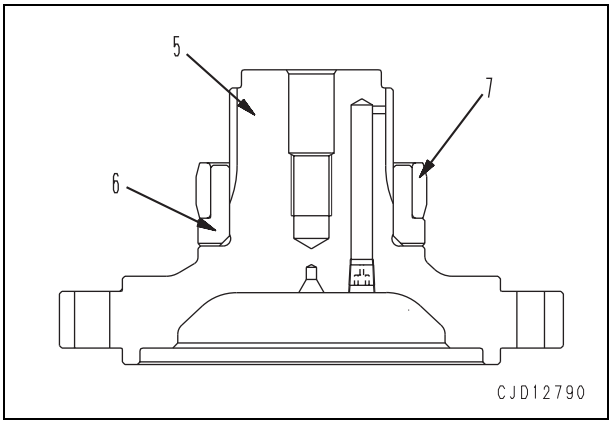


3) Install spacer (9).
4) Install snap ring (8).

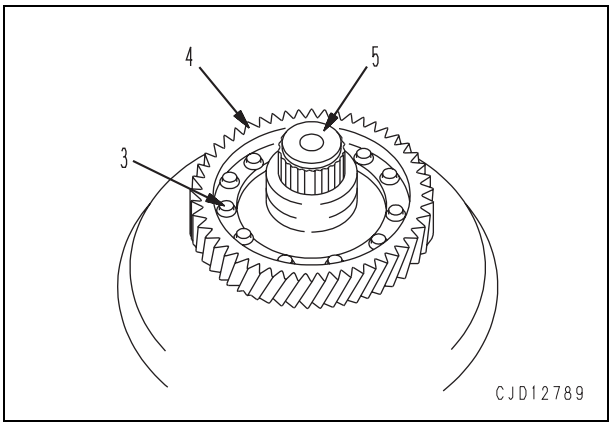


4. Gear and input shaft

1) Press fit collar (6) and inner race (7) to input shaft (5).



2) Install input shaft (5) and gear (4).
   Mounting bolt:
   Liquefied adhesive (LT-2)
   Mounting bolt:
   58.9 – 73.6 Nm {6 – 7.5 kgm}



5. Case, turbine assembly

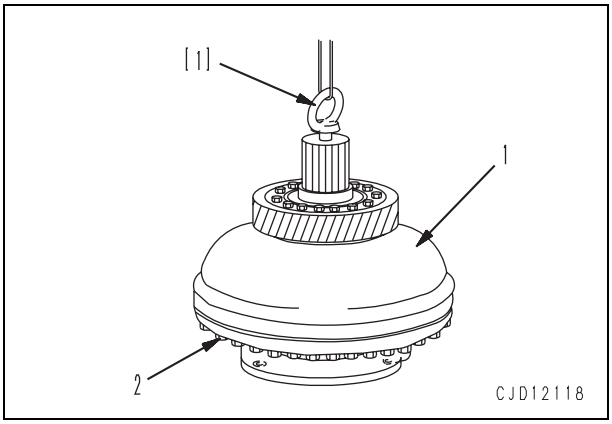
1) Using eyebolt [1] and matching the groove of the case to the drain plug, install case and turbine assembly (1) and tighten bolt (2).

Mounting bolt:
Liquefied adhesive (LT-2)

Mounting bolt:
49.0 – 58.8 Nm {5.0 – 6.0 kgm}

2) Install drain plug.

Drain plug:
5.9 – 8.8 Nm {0.6 – 0.9 kgm}



Disassembly and assembly of TORQFLOW transmission assembly

Special tools

Symbol	Part number	Part name	Necessity	Q'ty	N/R	Sketch
D1	799-301-1600	Oil leak tester	●	1		

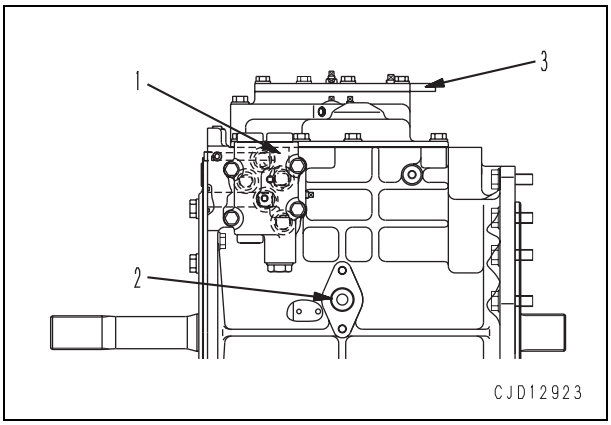
Disassembly

★ Keep the removed discs and plates on a flat place so that they will not be warped.

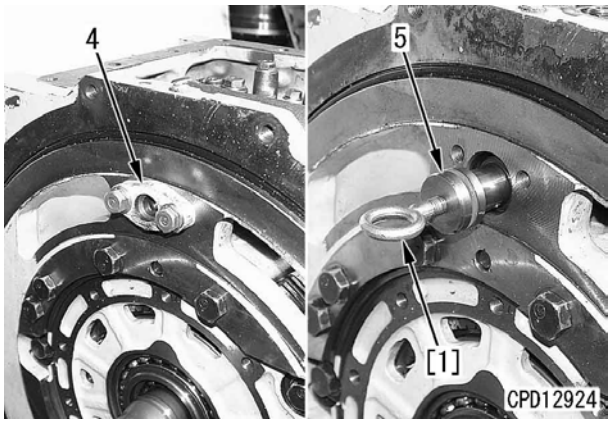
1. Relief valve assembly
Remove relief valve assembly (1).

2. Sleeve
Remove sleeve (2).

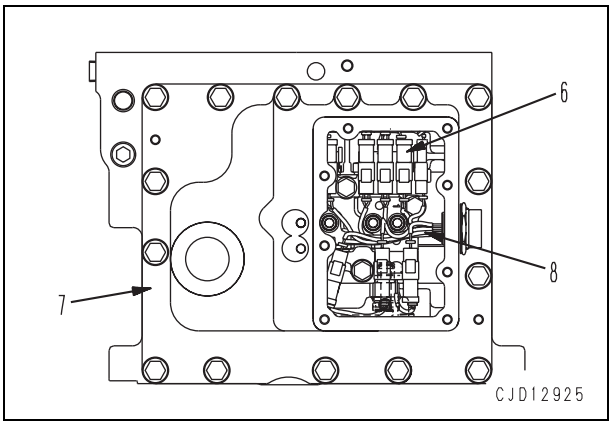
3. Control valve assembly
1) Remove cover (3).



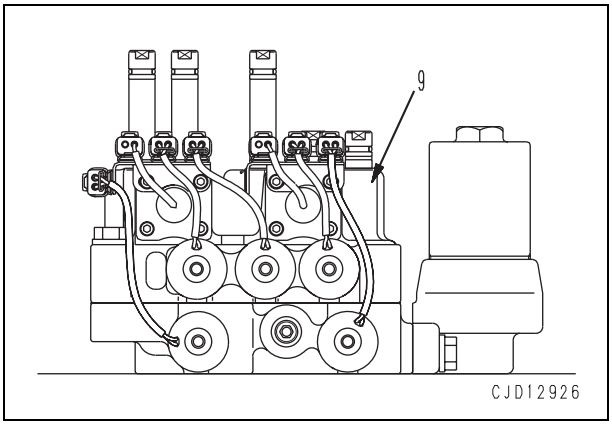
2) Remove flange (4).
3) Using eyebolt [1], remove sleeve (5).



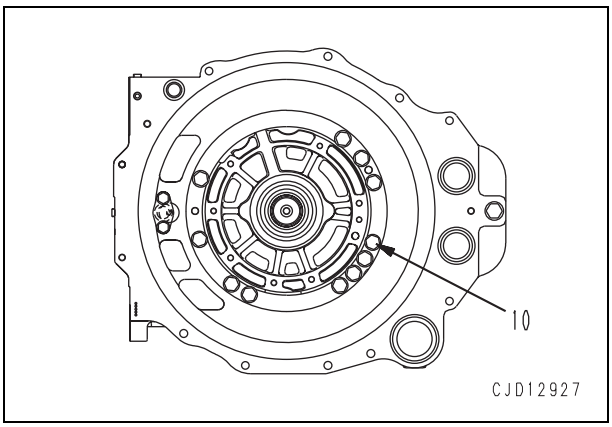
4) Disconnect 10 connectors (6) of the ECMV.
5) Remove cover (7) and wiring harness (8) together.



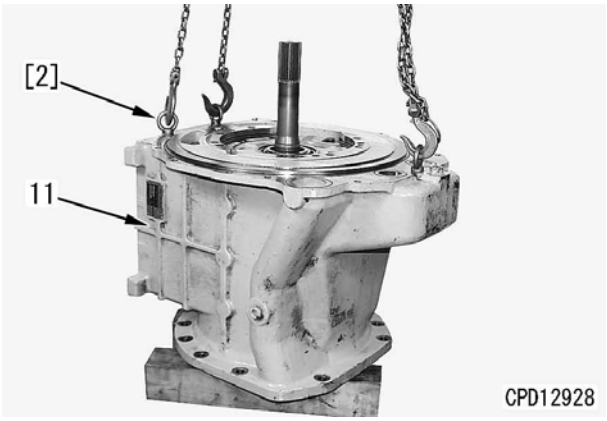
6) Remove control valve assembly (9).



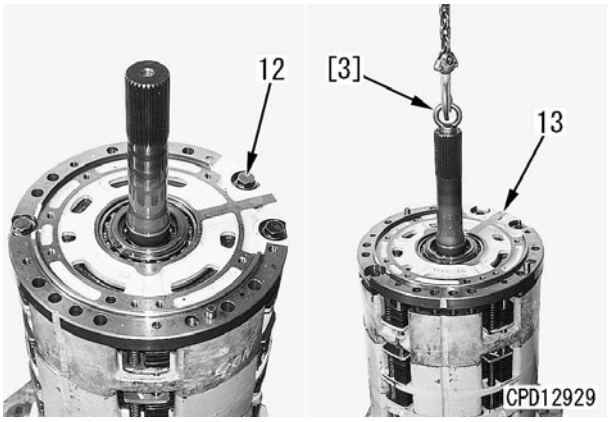
4. Transmission case
1) Set the transmission assembly on the block securely with the torque converter side up.
2) Remove 11 tie bolts (10) (used to secure the transmission case).



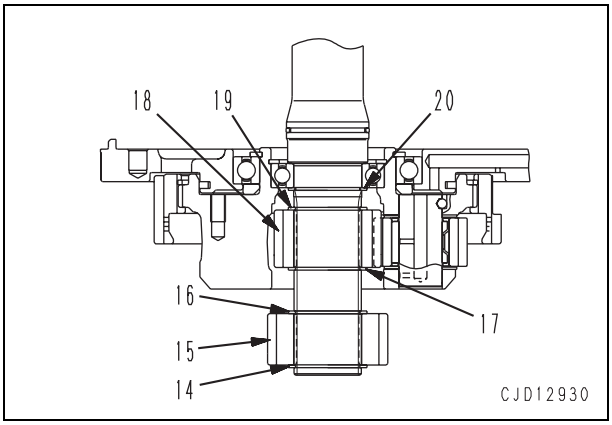
3) Using eyebolts [2], remove transmission case (11).
   ★ Hang the transmission case vertically by using a lever block.



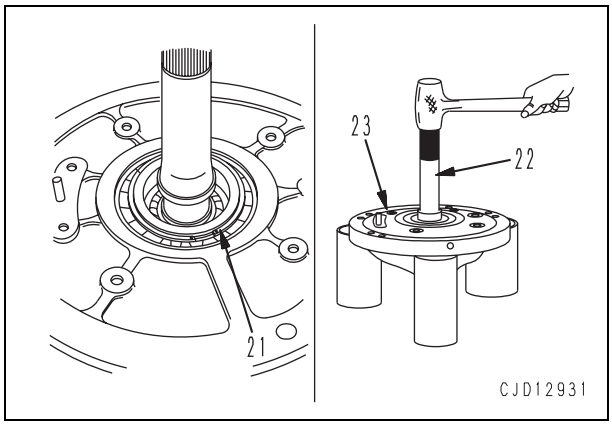
5. Input shaft/Front plate/No. 1 carrier assembly
1) Remove remaining 3 tie bolts (12).
2) Using eyebolts [3], remove input shaft/ front plate/No. 1 carrier assembly (13).



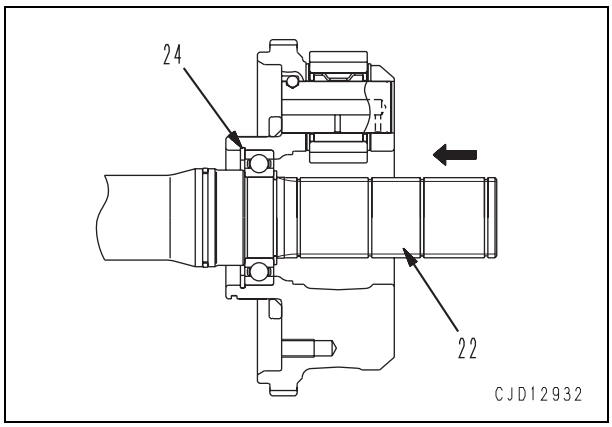
6. Disassembly of Input shaft/Front plate/No. 1 carrier assembly
1) Remove snap ring (14), No. 2 sun gear (15), and snap ring (16).
2) Remove snap ring (17) and No. 1 sun gear (18).
3) Remove snap rings (19) and (20).



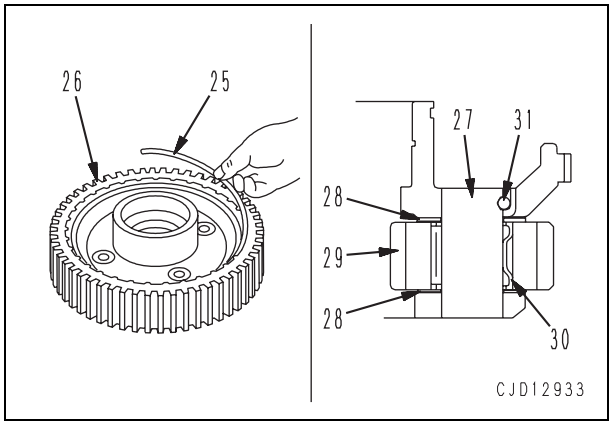
4) Remove snap ring (21).
5) Drive out input shaft (22) from the torque converter side and remove front plate assembly (23).



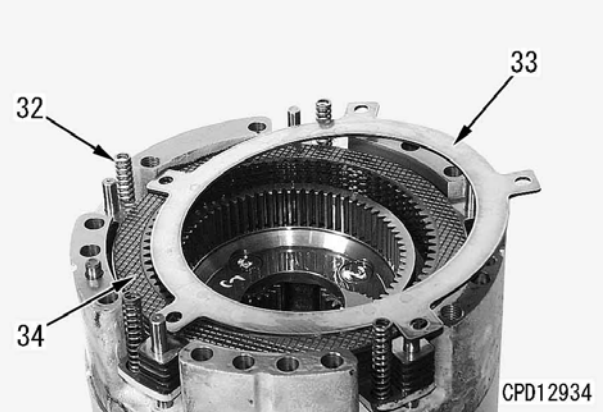
6) Remove snap ring (24), then remove input shaft (22) by driving it out to the torque converter side.



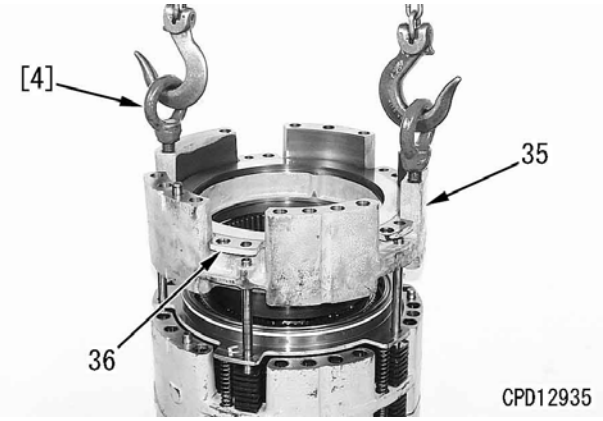
7) Remove snap ring (25) and No. 1 ring gear (26).
8) Pull out shaft (27) and remove thrust washer (28), gear (29), bearing (30), and ball (31).
   ★ Take care not to lose ball (31).



7. No. 1 discs, plates, and springs
1) Remove 5 springs (32).
2) Remove 6 plates (33) and 5 discs (34).



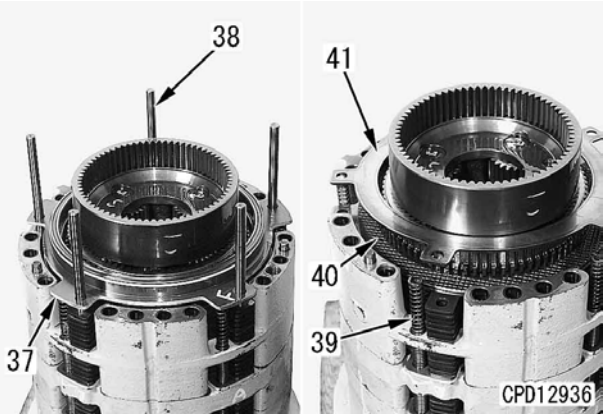
8. No. 1 housing assembly
1) Using eyebolts [4], remove No. 1 housing assembly (35).
2) Remove No. 1 piston (36) from the housing.



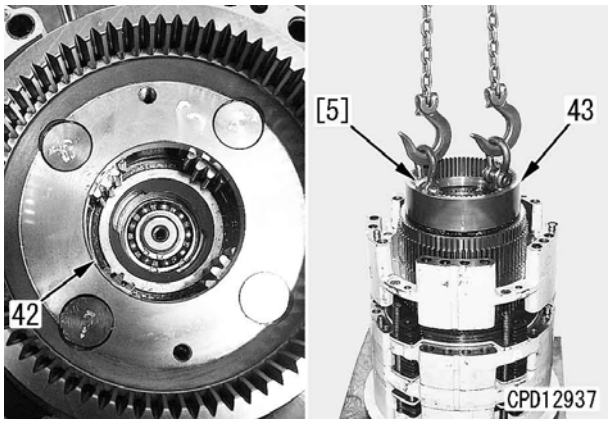
9. No. 2 piston
Remove No. 2 piston (37).

10. Guide pin
Remove 5 guide pins (38).

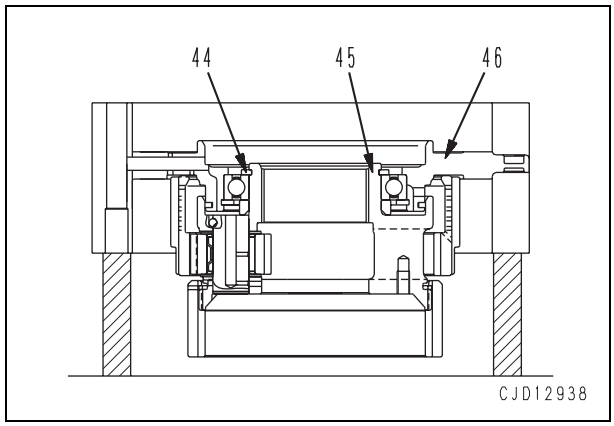
11. No. 2 discs, plates, and springs
1) Remove 5 No. 2 clutch springs (39).
2) Remove 7 discs (40) and 6 plates (41).



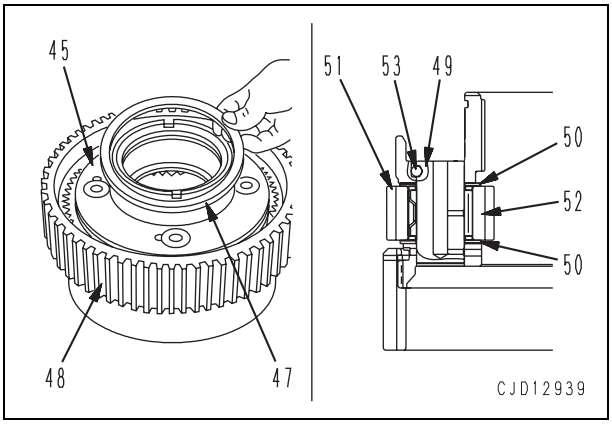
12. No. 2 housing and No. 2 carrier assembly
1) Push up the output shaft lightly from underside.
2) Remove snap ring (42).
3) Using eyebolts [5], remove No. 2 housing and No. 2 carrier assembly (43).



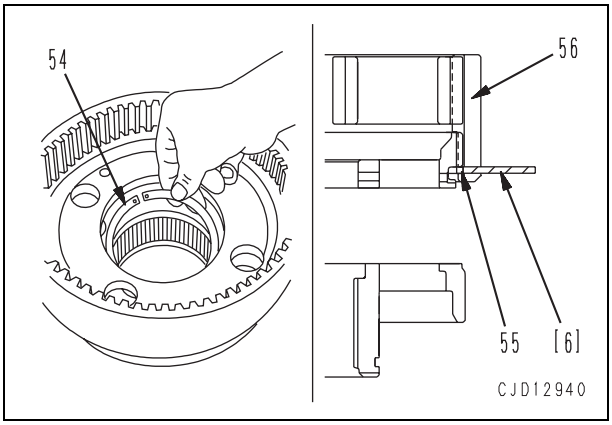
13. Disassembly of No. 2 housing and No. 2 carrier assembly
1) Remove snap ring (44) and pull No. 2 carrier assembly (45) out of No. 2 housing (46).



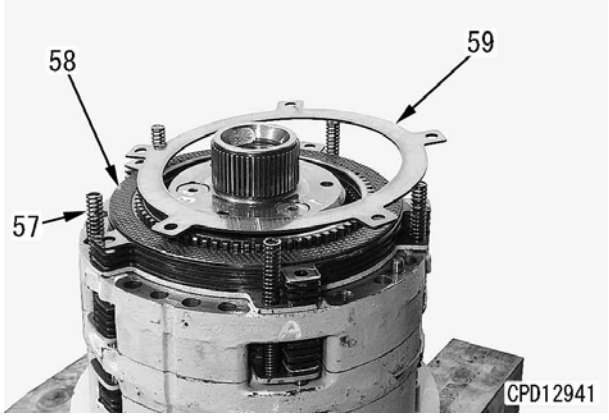
2) Remove spacer (47) from No. 2 carrier assembly (45).
3) Remove No. 2 ring gear (48).
4) Pull out shaft (49) and remove thrust washer (50), gear (51), bearing (52), and ball (53).
★ Take care not to lose ball (53).



5) Remove snap ring (54).
6) Remove snap ring (55) and ring gear (56).
★ Contract snap ring (55) by inserting round rods [6] with a diameter of less than 3 mm in 2 diagonal holes of 4 on the ring gear and pull out ring gear (56).

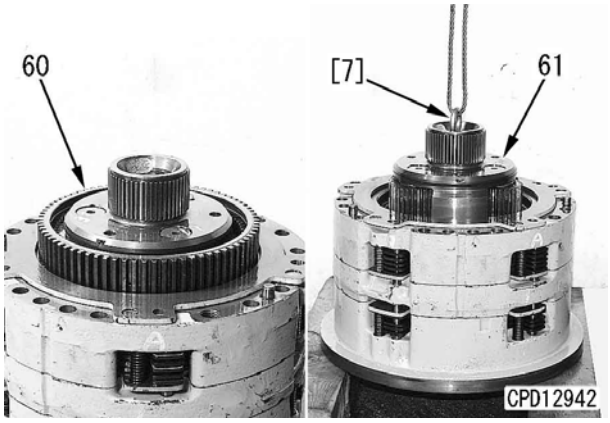


14. No. 3 discs, plates, and springs
1) Remove 5 No. 3 springs (57).
2) Remove 4 No. 3 discs (58) and 3 plates (59).

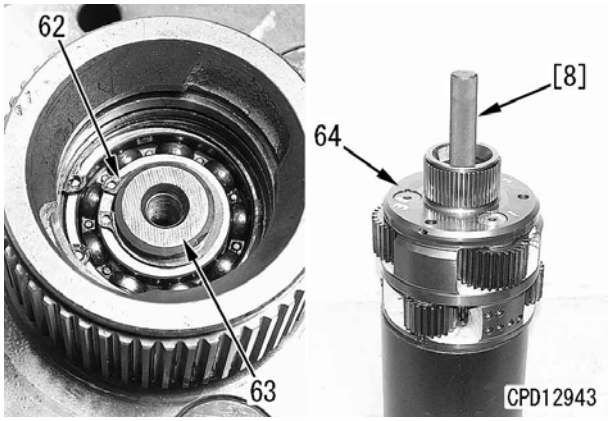


15. No. 3 ring gear
Remove No. 3 ring gear (60).

16. No. 3 and No. 4 carriers and output shaft assembly
Using eyebolts [7], remove No. 3 and No. 4 carriers and output shaft assembly (61).

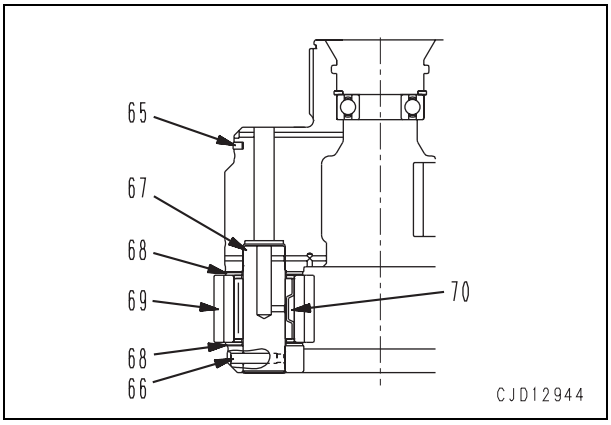


17. Disassembly of No. 3 and No. 4 carriers and output shaft assembly
1) Remove snap ring (62), then remove output shaft assembly (63) from No. 3 and No. 4 carriers (64) with push tool [8].

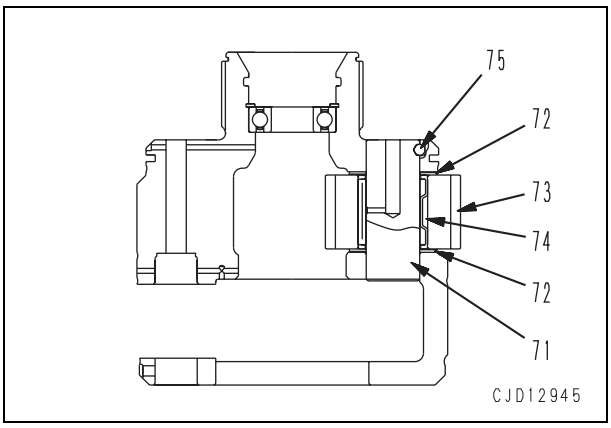


2) Remove seal ring (65).
3) Drive pin (66) into shaft (67).
4) Drive out shaft (67) from No. 3 carrier side.

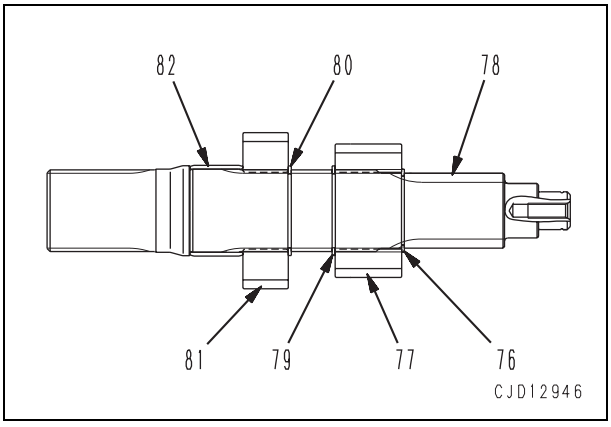
5) Remove thrust washer (68), No. 4 planetary gear (69), and bearing (70).
★ Pull pin (66) out of shaft (67).



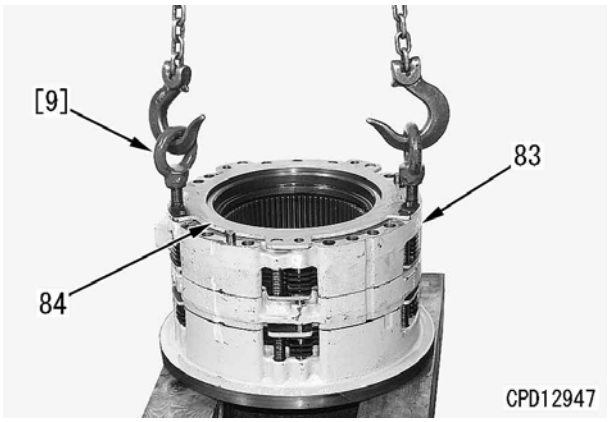
6) Drive out shaft (71) and remove thrust washer (72), No. 3 planetary gear (73), bearing (74), and ball (75).
★ Take care not to lose ball (75).



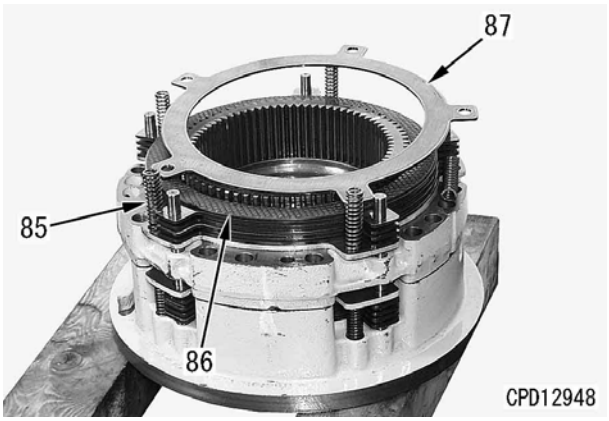
7) Remove snap ring (76), then remove No. 4 sun gear (77) from output shaft (78).
8) Remove snap rings (79) and (80), then remove No. 5 sun gear (81) from output shaft (78).
9) Remove inner race (82) from the bearing.



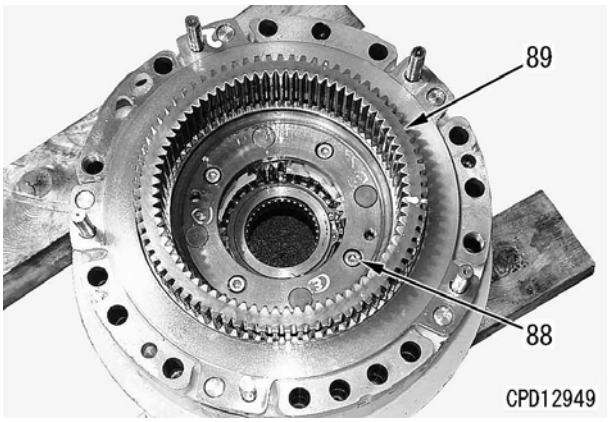
18. No. 3 housing
1) Using eyebolt [9], remove housing (83).
2) Remove No. 3 piston (84).



19. No. 4 discs, plates, and springs
1) Remove 5 springs (85).
2) Remove 4 discs (86) and 3 plates (87).

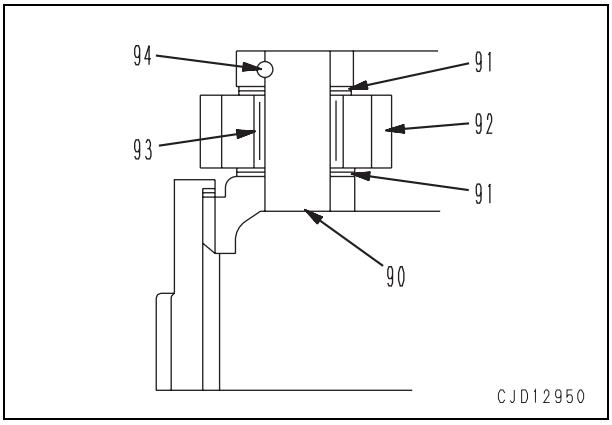


20. No. 5 carrier and No. 4 ring gear assembly
1) Remove 4 mounting bolts (88).
2) Remove No. 5 carrier and No. 4 ring gear assembly (89).

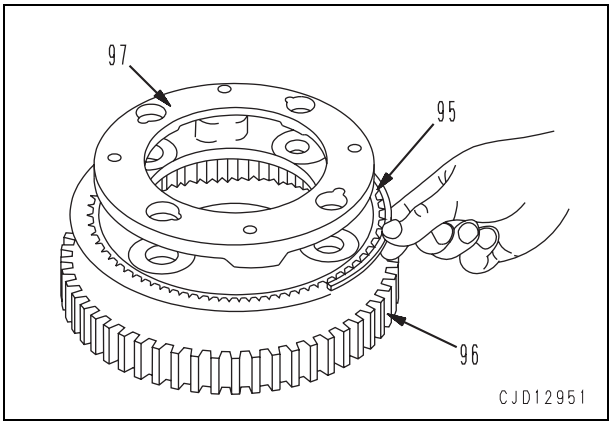


21. Disassembly of No. 5 carrier and No. 4 ring gear assembly

1) Drive out shaft (90) and remove thrust washer (91), gear (92), bearing (93), and ball (94).
   ★ Take care not to lose ball (94).

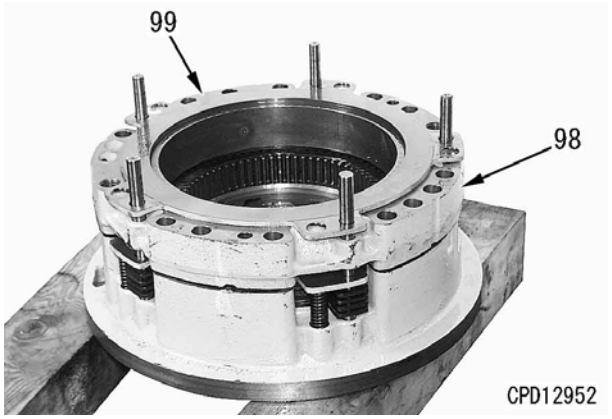


2) Remove snap ring (95), then remove No. 4 ring gear (96) from carrier (97).



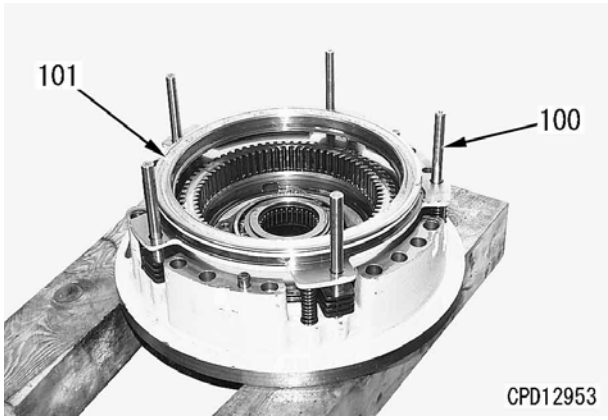
22. No. 4 housing assembly

1) Remove No. 4 housing assembly (98).
2) Remove No. 4 piston (99).



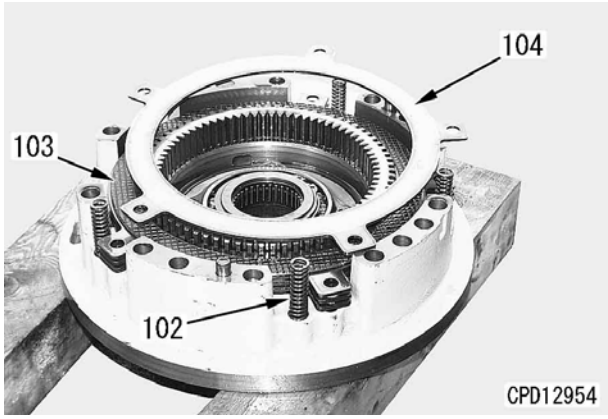
23. Guide pin and No. 5 piston

Remove 5 guide pins (100) and No. 5 piston (101).



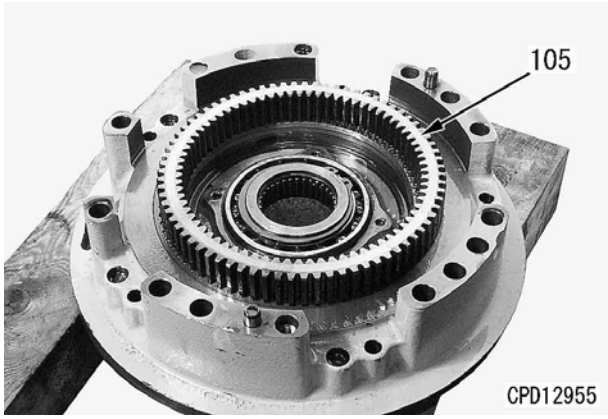
24. No. 5 discs, plates, and springs

Remove 5 springs (102), 3 discs (103), and 2 plates (104).



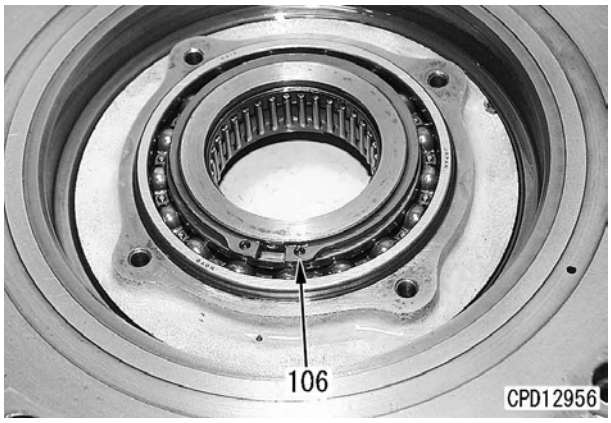
25. No. 5 ring gear

Remove No. 5 ring gear (105).

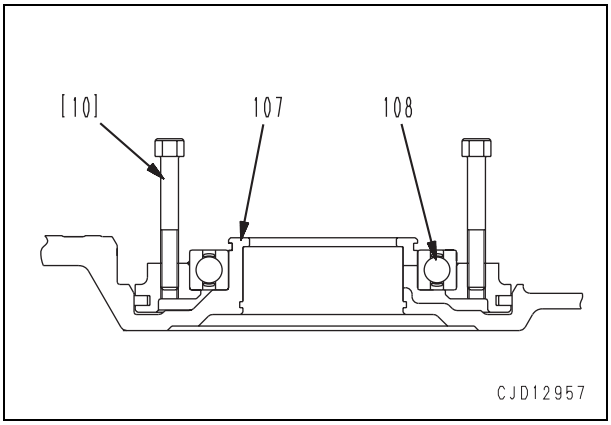


26. Cage (For fixing No. 5 carrier)

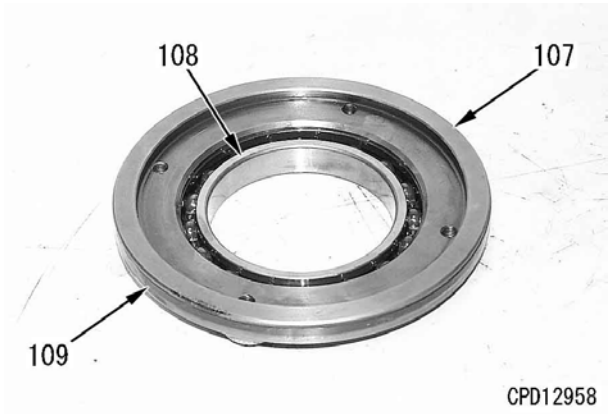
1) Remove snap ring (106).



2) Using forcing screws [10], remove cage (107) and bearing (108) as a unit.

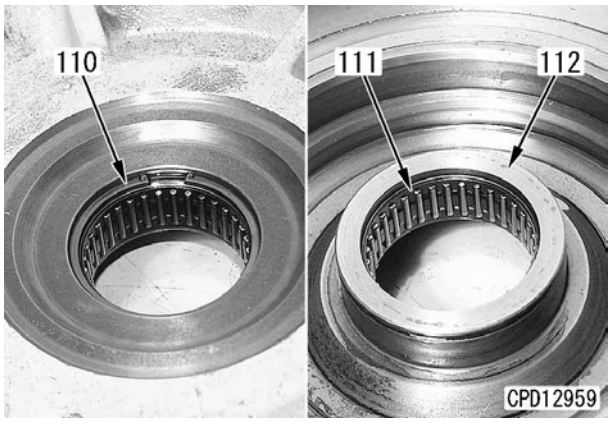


3) Remove seal ring (109) and bearing (108) to cage (107).



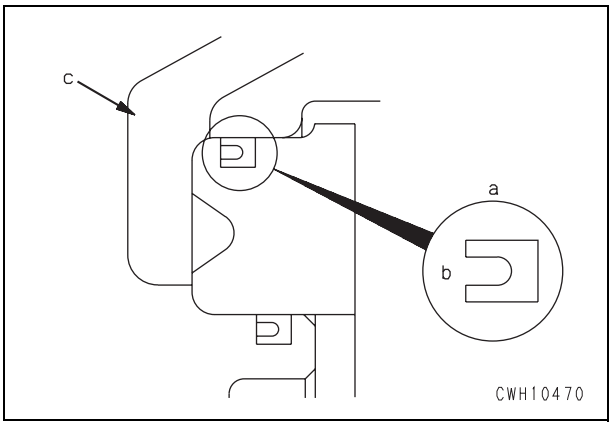
27. Output shaft bearing

1) Remove snap ring (110).
2) Remove bearing (111) from housing (112).



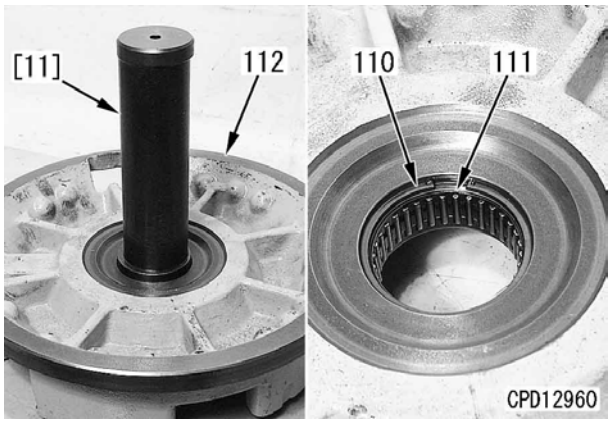
Assembly

- **Precautions for assembly**
  - ★ Clean the all parts and check them for dirt or damage before installing.
  - ★ Coat the sliding surfaces of each part with engine oil before installing.
  - ★ Install seal ring (a) for the piston and piston housing with power receiving side (b) to housing (c) as shown in the figure.
  - ★ Apply grease (G2-LI) to each seal ring and install it evenly.
  - ★ Before cooling the bearing in dry ice, etc. for expansion fit, drop about 6 cc of engine oil (EO10-CD or EO30-CD) onto it and revolve it 10 turns.



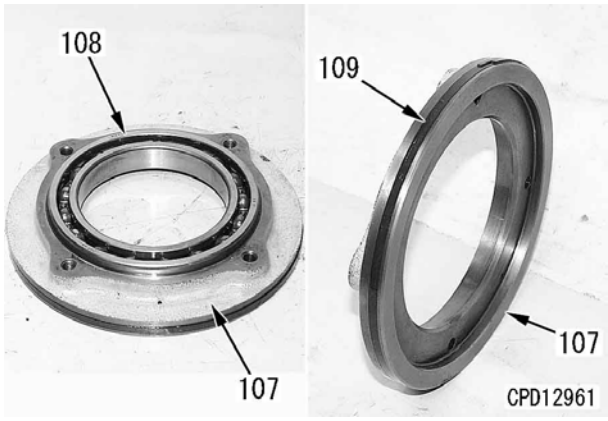
1. Output shaft bearing

1) Using push tool [11], install bearing (111) to housing (112).
2) Install snap ring (110).

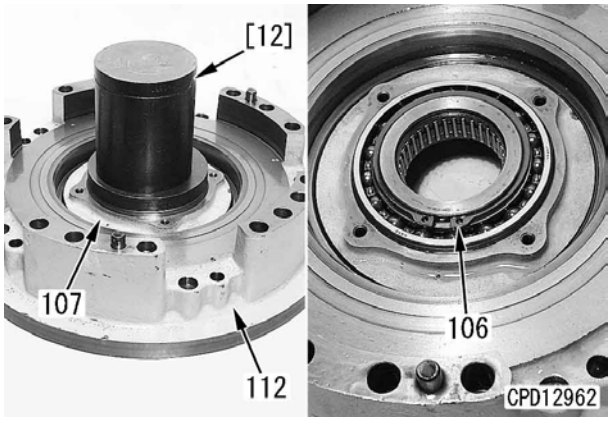


2. Cage (For fixing No. 5 carrier)

1) Install bearing (108) to cage (107) with the push tool.
2) Install seal ring (109) to cage (107).

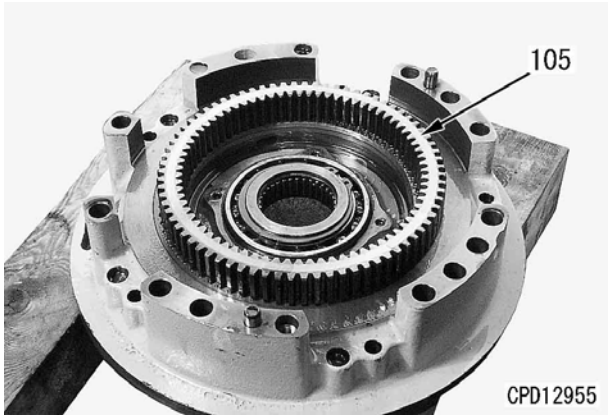


3) Install cage (107) to housing (112) with push tool [12].
   - ★ Press fit the inner race side of bearing (108).
4) Install snap ring (106).



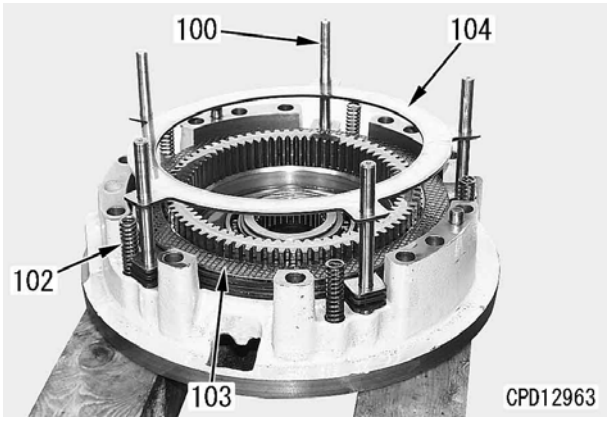
3. No. 5 ring gear

Install No. 5 ring gear (105).

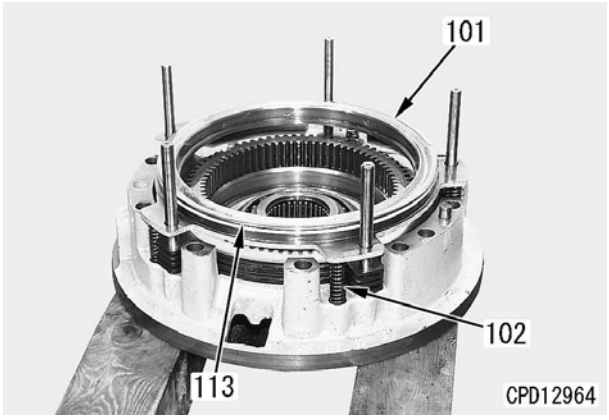


4. Guide pin
Install 5 guide pins (100).

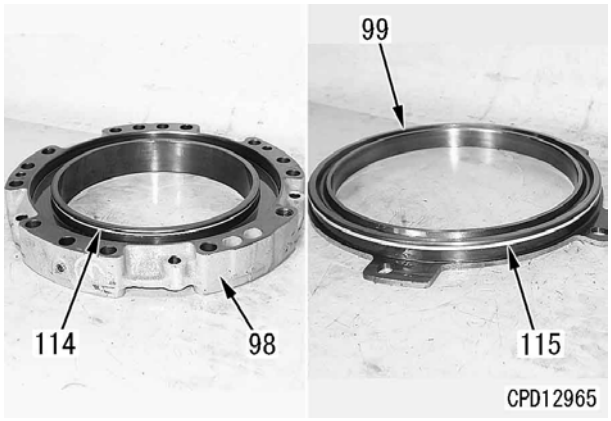
5. No. 5 discs, plates, and springs
1) Install discs (103) and plates (104) alternately in order from the bottom.
★ Discs: 3 pieces, Plates: 2 pieces
2) Install 5 springs (102).
★ Free length of spring: **59 mm**



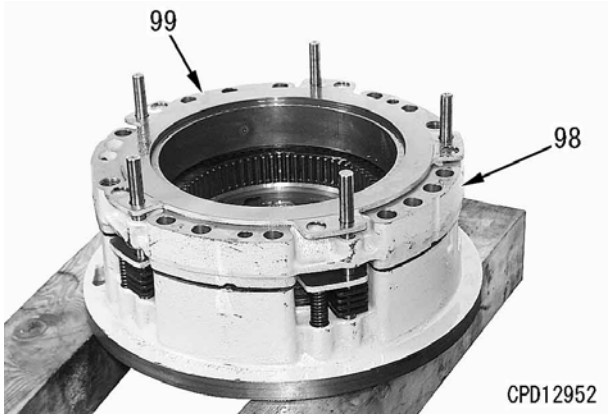
6. No. 5 piston
1) Install seal ring (113) to No. 5 piston (101).
★ When installing the seal ring, check the direction of the pressure receiving side.
2) Install No. 5 piston (101), matching it to springs (102).
★ Check that the springs are fitted securely in the grooves of the piston.



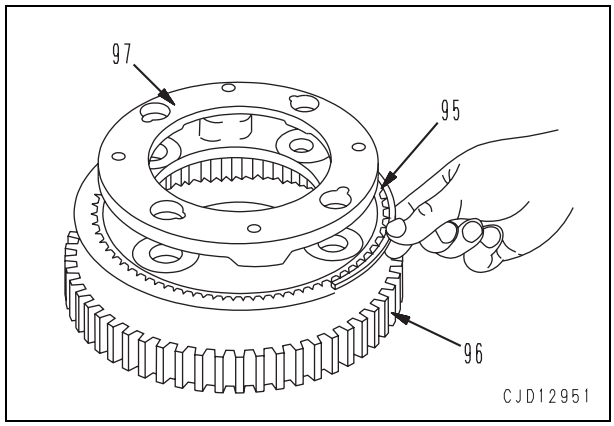
7. No. 4 housing
1) Install seal ring (114) to No. 4 housing (98).
★ When installing the seal ring, check the direction of the pressure receiving side.
2) Install seal ring (115) to No. 4 piston (99).
★ When installing the seal ring, check the direction of the pressure receiving side.



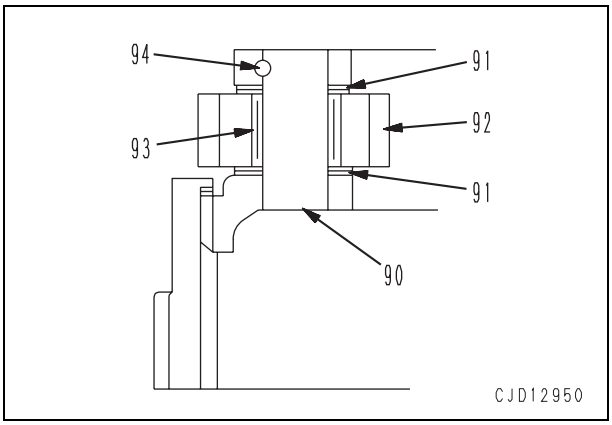
3) Install No. 4 piston (99) to No. 4 housing (98).
4) Install No. 4 housing (98), matching it to No. 5 piston.



8. Assembly of No. 5 carrier and No. 4 ring gear assembly
1) Set No. 4 ring gear (96) to carrier (97) and install snap ring (95).



2) Install gear (92) to bearing (93) and fit thrust washers (91) to both sides, then set them to the carrier.
3) Install ball (94) and shaft (90).

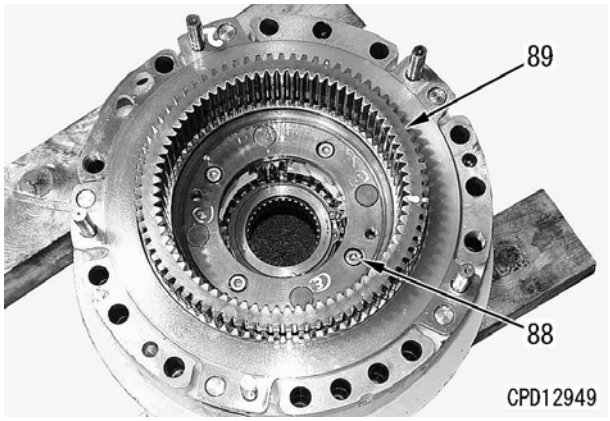


9. No. 5 carrier and No. 4 ring gear assembly

Using a guide bolt, install No. 5 carrier and No. 4 ring gear assembly (89) and tighten bolts (88).

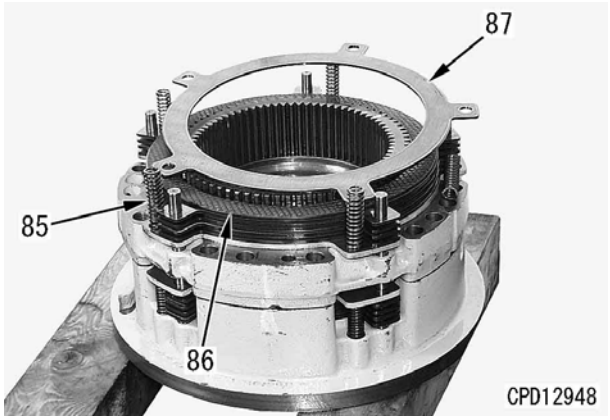
Mounting bolt:
Liquefied adhesive (LT-2)

Mounting bolt:
27 – 34 Nm {2.8 – 3.5 kgm}



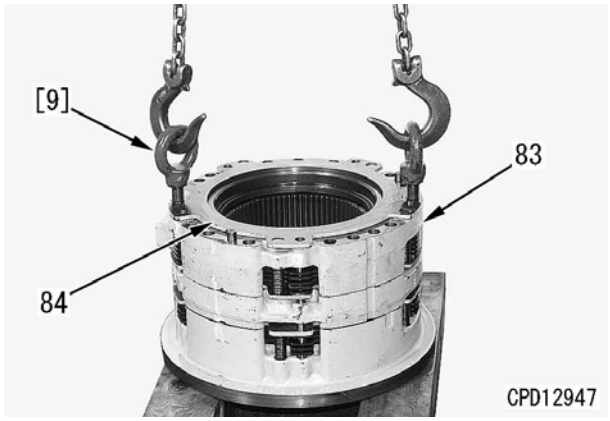
10. No. 4 discs, plates, and springs

1) Install discs (86) and plates (87) alternately in order from the bottom.
★ Discs: 4 pieces, Plates: 3 pieces
2) Install 5 springs (85).
★ Free length of spring: **59 mm**

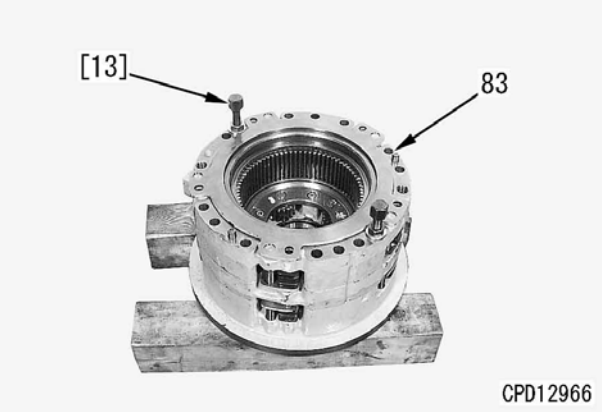


11. No. 3 housing

1) Install the seal ring to No. 3 housing (83) and No. 3 piston (84).
★ When installing the seal ring, check the direction of the pressure receiving side.
2) Install the No. 3 piston to the No. 3 housing.
3) Using eyebolts [9], install No. 3 housing (83).
★ Check that the springs are fitted securely in the grooves.

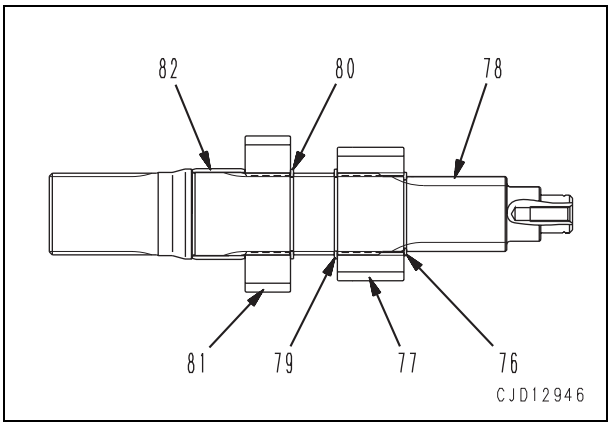


4) Using 2 forcing screws [13], tighten No. 3 housing (83) and insert dowel pin in the housing securely.
   ★ Keep 2 forcing screws [13] installed until step 13.

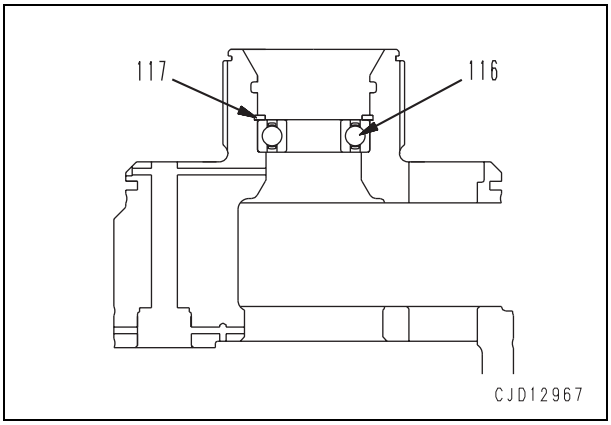


12. Assembly of No. 3 and No. 4 carrier and output shaft assembly

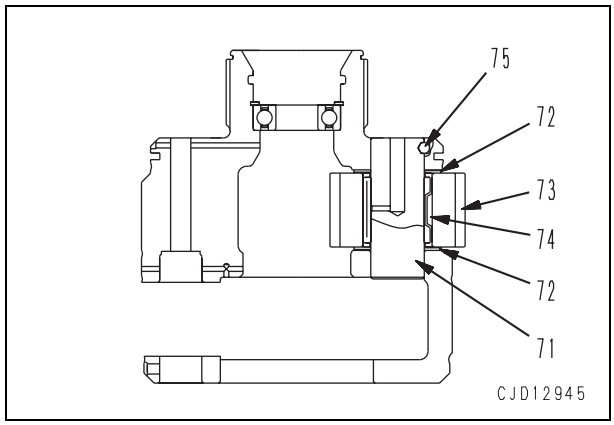
1) Install inner race (82) to output shaft (78).
2) Install No. 5 sun gear (81) and snap rings (80) and (79).
3) Install No. 4 sun gear (77) and snap ring (76).



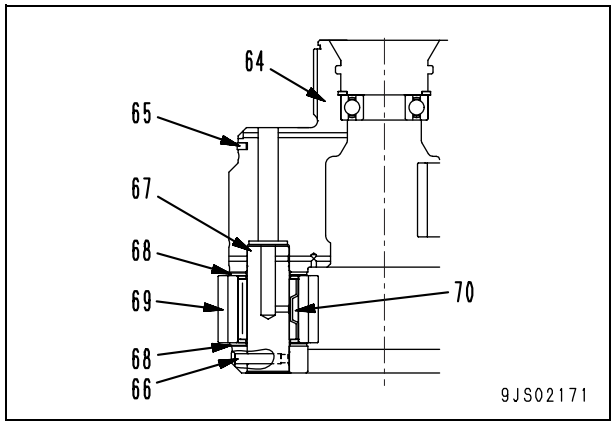
4) Press fit bearing (116) to No. 3 carrier and install snap ring (117).



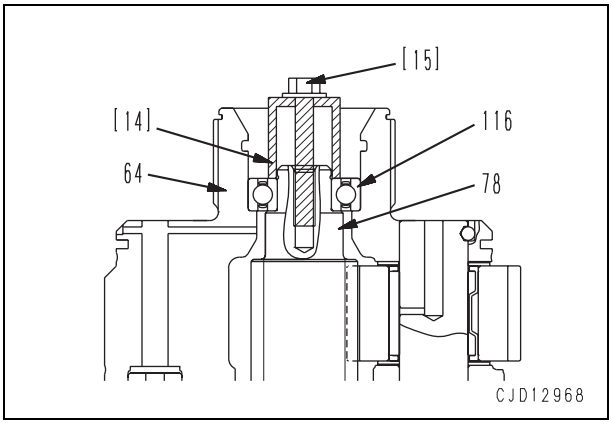
5) Install bearing (74) to No. 3 planetary gear (73) and fit thrust washers (72) to both sides, then set them to the carrier.
6) Install ball (75) and shaft (71).



7) Install bearing (70) to No. 4 planetary gear (69) and fit thrust washers (68) to both sides, then set them to the carrier.
8) Install shaft (67), matching the pin hole of the shaft to the pin hole of the carrier.
9) Check that the pin holes are matched to each other and drive in pin (66).
10) Install seal ring (65).
   ★ Before driving in pin (66), check that there are no burrs in the pin hole of carrier (64). If there is any burr, remove it with sandpaper, and then drive in pin (66).

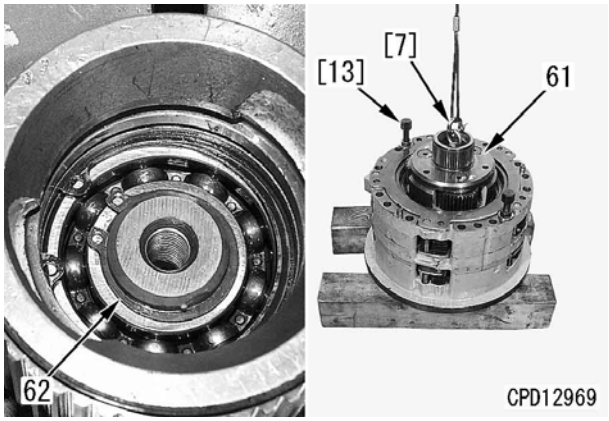


11) Set No. 3 and No. 4 carrier assemblies (64) to output shaft (78).
12) Set jig [14] on the inner race side of bearing (116) and tighten bolt [15] to press fit bearing (116) to output shaft (78).
★ Dimensions of tap hole: **M10 x 1.5, Depth: 32 mm**

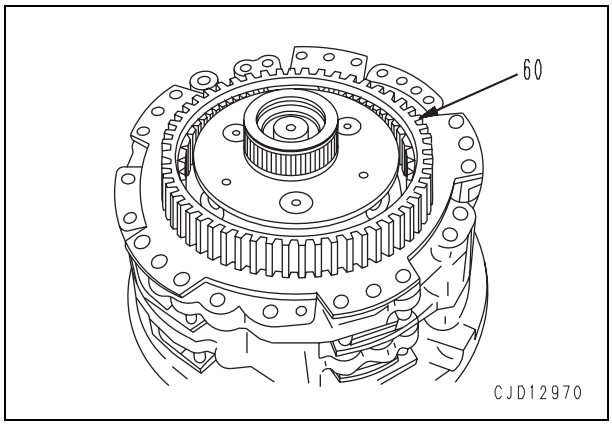


13) Install snap ring (62).

13. No. 3 and No. 4 carrier assemblies, output shaft assembly
1) Using eyebolts [7], install No. 3 and No. 4 carriers and output shaft assembly (61).
2) Remove 2 forcing screws [13].

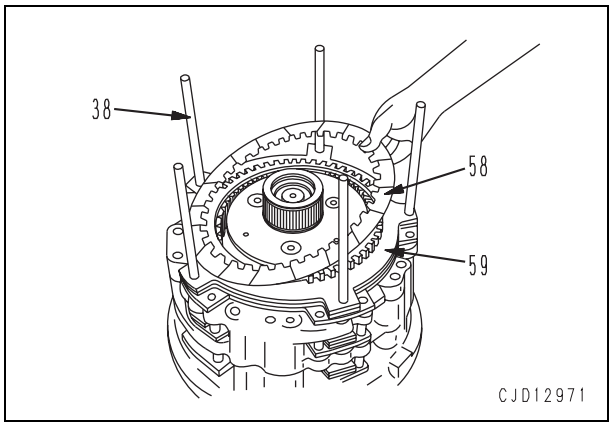


14. No. 3 ring gear
Install No. 3 ring gear (60).
★ Direct the notched side of the outside teeth down.

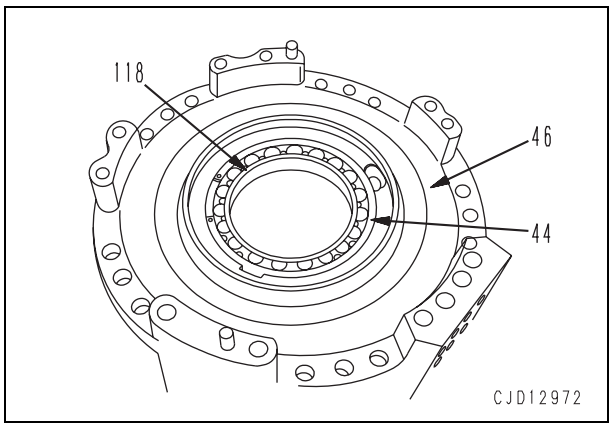


15. Guide pin
Install guide pin (38).

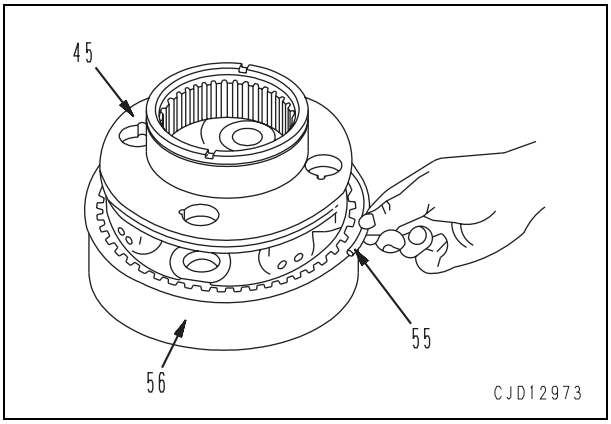
16. No. 3 discs and plates
Install discs (58) and plates (59) alternately in order from the bottom.
★ Discs: 4 pieces, Plates: 5 pieces



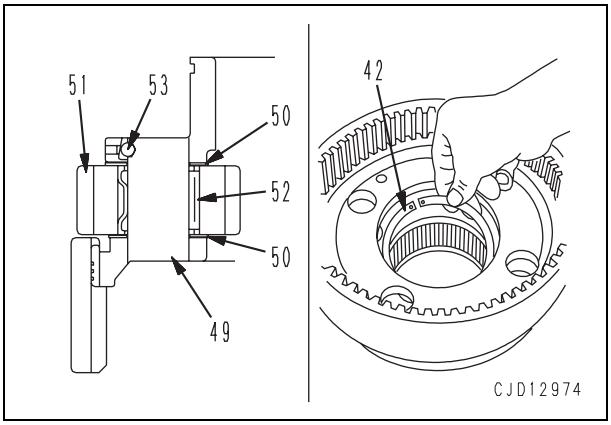
17. No. 2 housing and No. 2 carrier assembly
1) Press fit bearing (118) to No. 2 housing (46) and install snap ring (44).



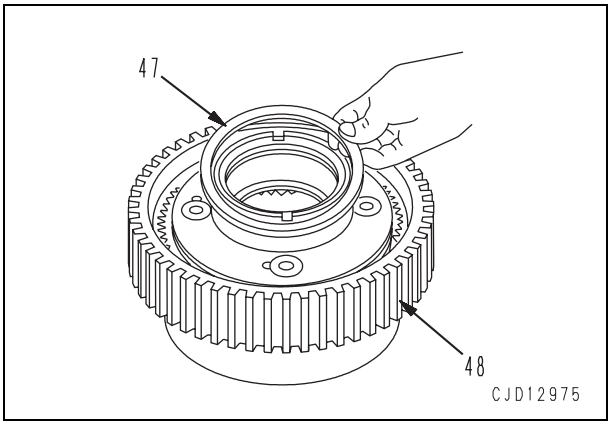
2) Set ring gear (56) to No. 2 carrier (45) and install snap ring (55).



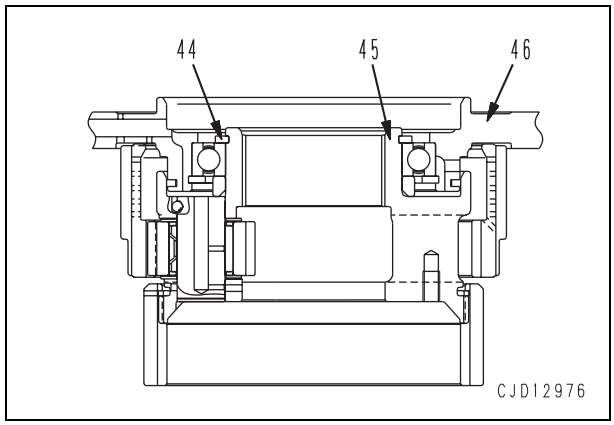
3) Install bearing (52) to gear (51) and fit thrust washers (50) to both sides, then set them to the carrier.
4) Install ball (53) and shaft (49).
   ★ After assembling 2 gear sets, install snap ring (42).



5) Install the seal ring to No. 2 housing.
6) Install No. 2 ring gear (48).
7) Install spacer (47).
   ★ Install the spacer with the cut inside end directed to the carrier.

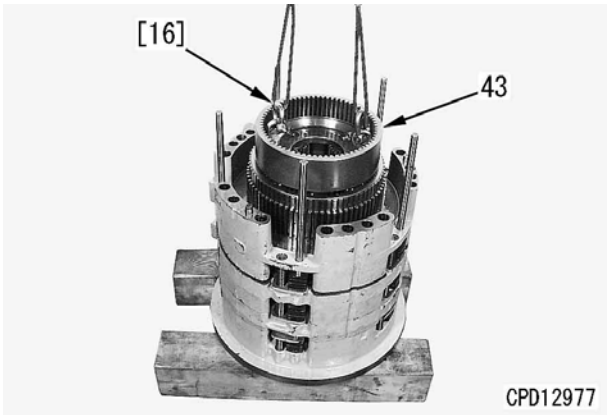


8) Install No. 2 housing (46) to carrier assembly (45).
   ★ Press fit the inner race side of the housing bearing.
9) Install snap ring (44).

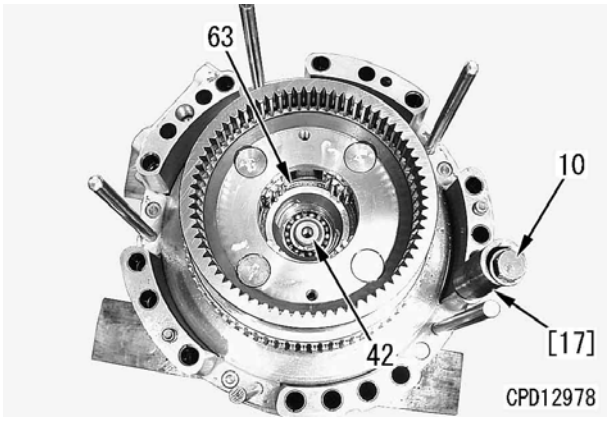


18. No. 2 housing and No. 2 carrier assembly

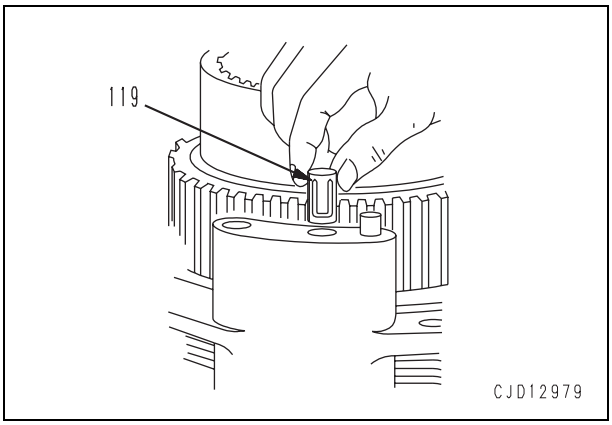
1) Using eyebolts [16], install No. 2 housing and No. 2 carrier assembly (43).

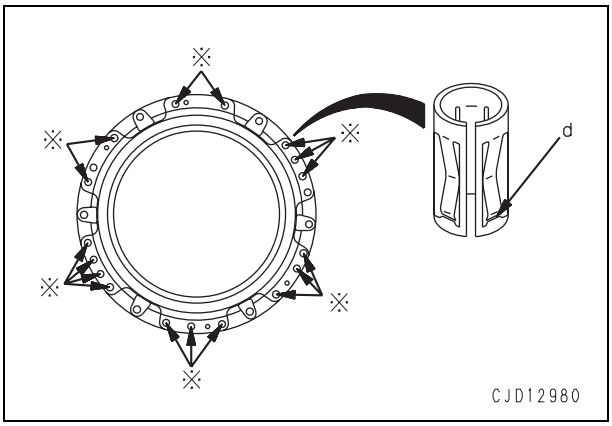


2) Clamp No. 2 housing with tie bolts (10) and a pipe [17] and push the dowel pin in the housing securely.
3) Push up output shaft (63) lightly from underside and install snap ring (42).

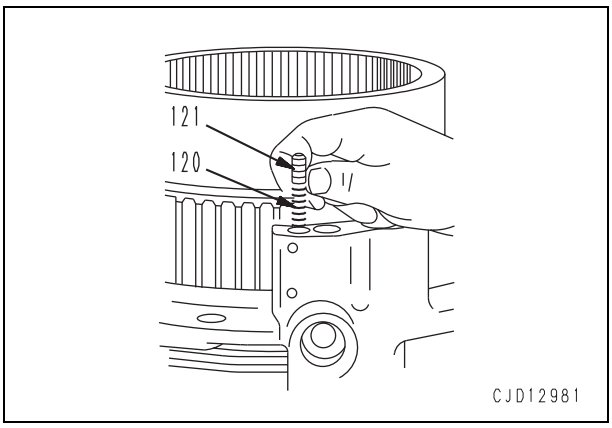


4) Install sleeve (119).
★ If the sleeve has been removed, install it to the bolt hole marked ※ in the figure with the slit side (d) down.

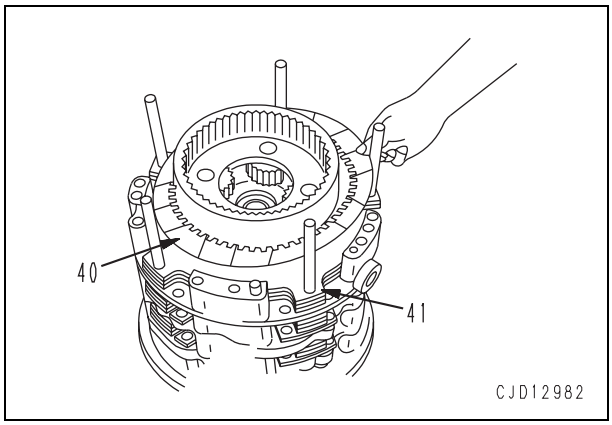




5) Install spring (120) and valve (121).

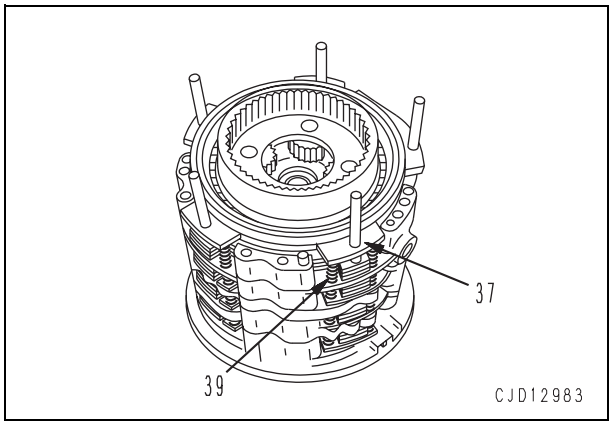


19. No. 2 discs and plates
Install discs (40) and plates (41) alternately in order from the bottom.
★ Discs: 7 pieces, Plates: 6 pieces



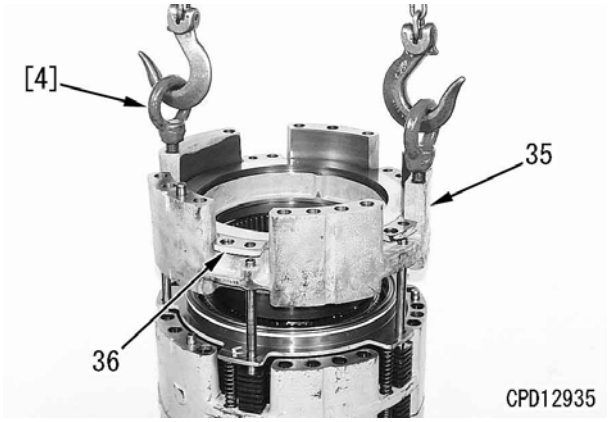
20. Springs for No. 3 and No. 2 housings
Install 5 springs (39).
★ Free length of spring: **77.0 mm**

21. No. 2 piston
1) Install the seal ring to the No. 2 piston.
★ When installing the seal ring, check the direction of the pressure receiving side.
2) Install No. 2 piston (37).
★ Set spring (39) in the spring groove of the piston.



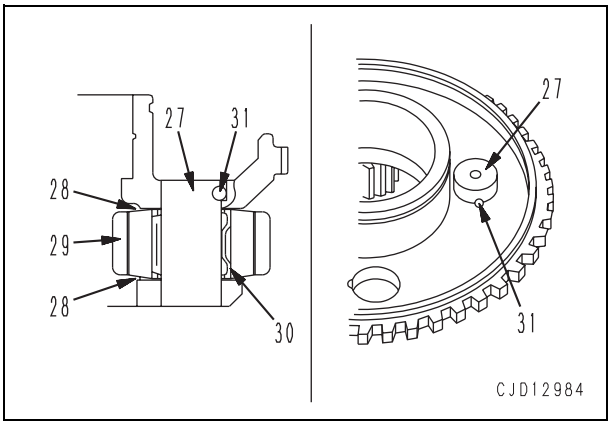
22. No. 1 housing assembly

1) Install the seal ring to the No. 1 housing and No. 1 piston.
   ★ When installing the seal ring, check the direction of the pressure receiving side.
2) Install No. 1 piston (36) to housing.
3) Using eyebolts [4], install No. 1 housing assembly (35), matching it to No. 2 piston.
   ★ Press the housing and hit the dowel pin.

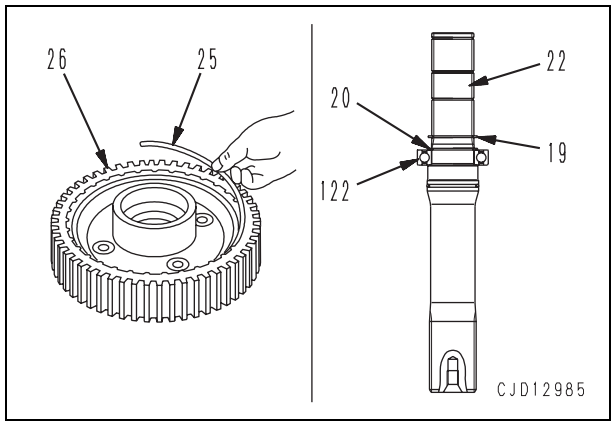


23. Assembly of input shaft and No. 1 carrier assembly

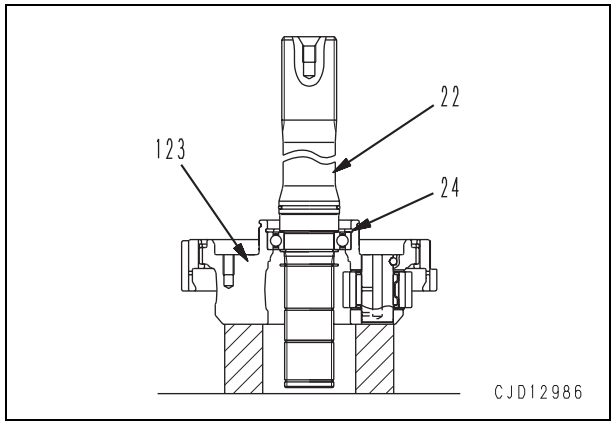
1) Install bearing (30) to gear (29) and fit thrust washers (28) to both sides, then set them to the carrier.
2) Install ball (31) and shaft (27).



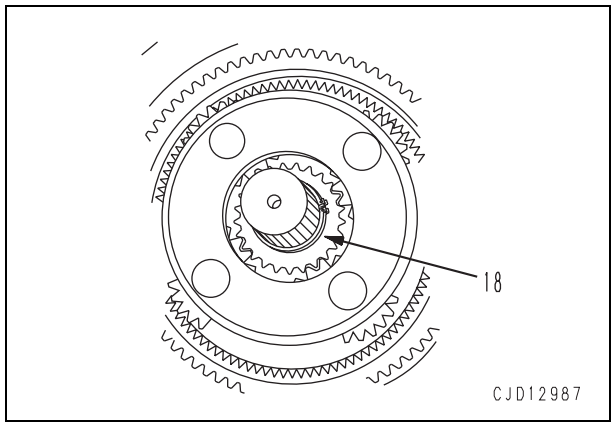
3) Set No. 1 ring gear (26) to No. 1 carrier and install snap ring (25).
4) Press fit bearing (122) to input shaft (22).
5) Install snap rings (20) and (19) to the input shaft.



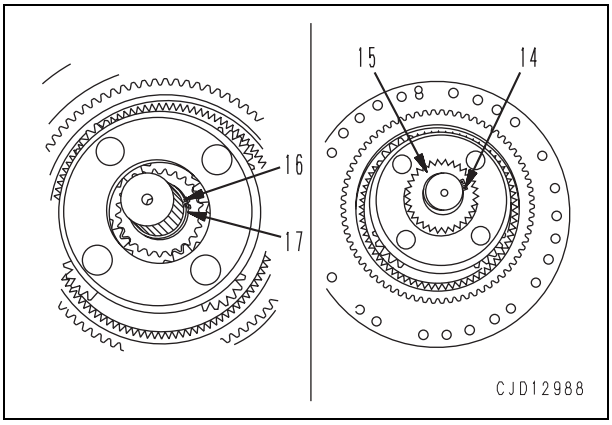
6) Install input shaft (22) to No. 1 carrier assembly (123), and then install snap ring (24).



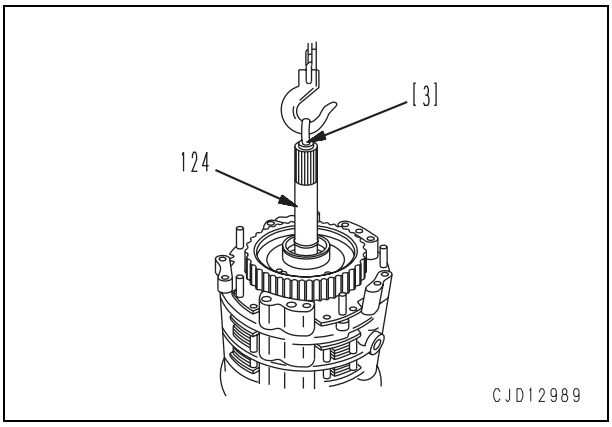
7) Install No. 1 sun gear (18).



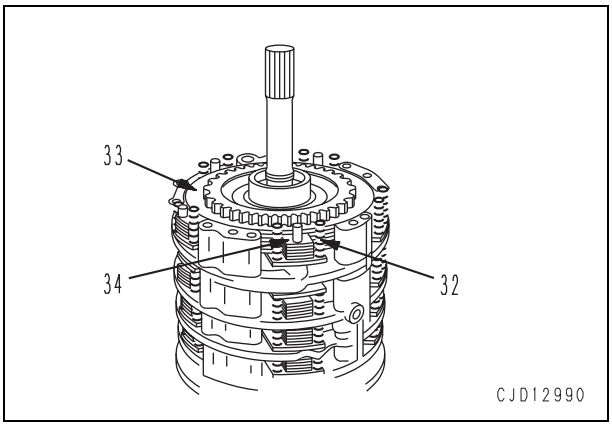
8) Install snap rings (17) and (16).
9) Install No. 2 sun gear (15) and snap ring (14).



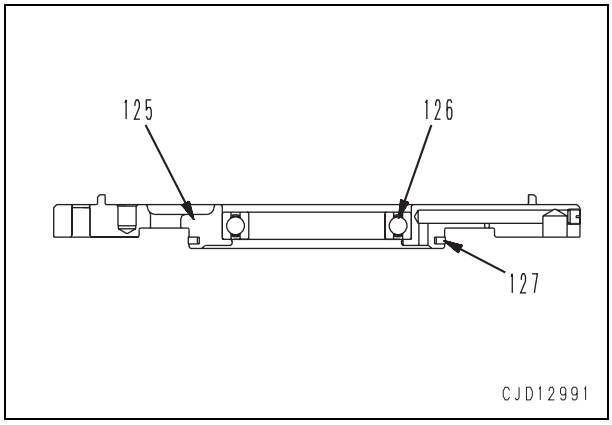
24. Input shaft and No. 1 carrier assembly
Using eyebolt [3], sling and install input shaft and No. 1 carrier assembly (124). At this time, engage the No. 2 sun gear with the No. 1 planetary gear.



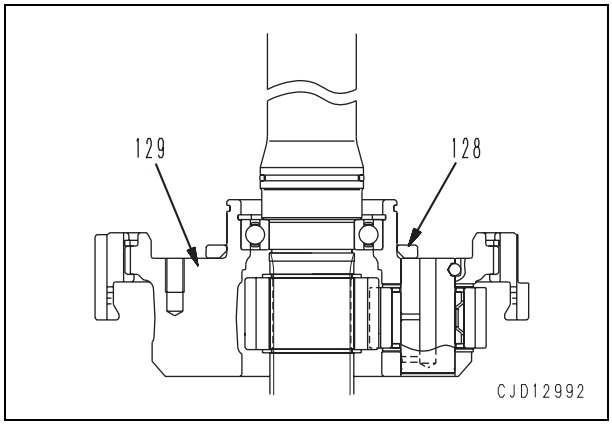
25. No. 1 discs, plates, and springs
1) Install plates (33) and discs (34) alternately in order from the bottom.
★ Discs: 5 pieces, Plates: 6 pieces
★ Free length of spring: **69.5 mm**
2) Install 5 springs (32).



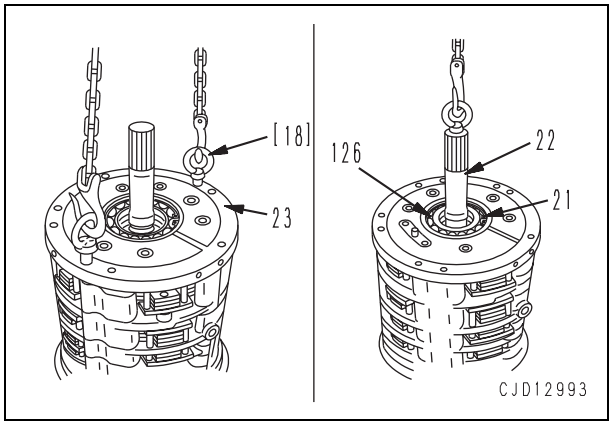
26. Front plate assembly
1) Press fit bearing (126) to front plate (125).
2) Install seal ring (127).



3) Install collar (128) to No. 1 carrier (129).



4) Using eyebolts [18], install front plate assembly (23), matching it to the guide pin and spring.
5) Press fit the inner race side of bearing (126) to input shaft (22) and install snap ring (21).
★ Check that the spring is fitted to the cover securely.



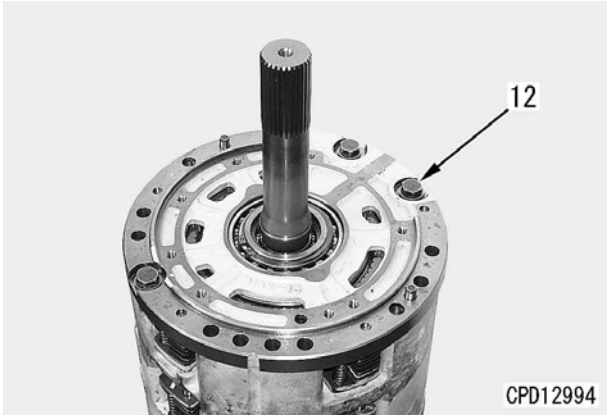
27. Tie bolts

Install 3 tie bolts (12).

Tie bolt:

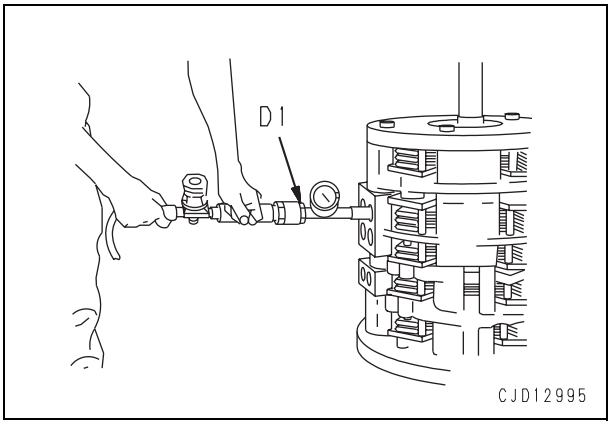
156.9 – 176.5 Nm {16.0 – 18.0 kgm}

28. Operation check of piston



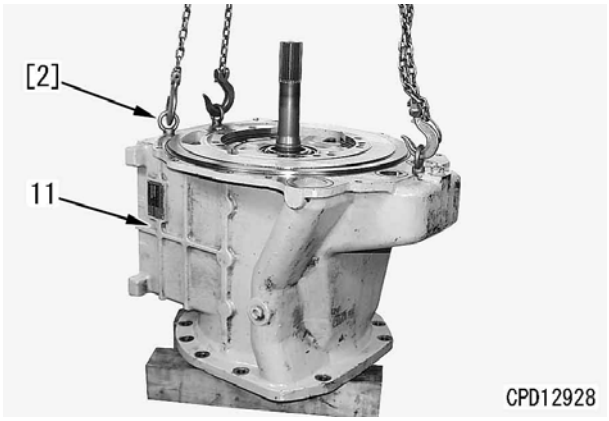
Using tool **D1**, check the operating condition and stroke of each piston.

Piston	Standard stroke (mm)
No. 1	5
No. 2	7
No. 3	4
No. 4	4
No. 5	3



29. Transmission case

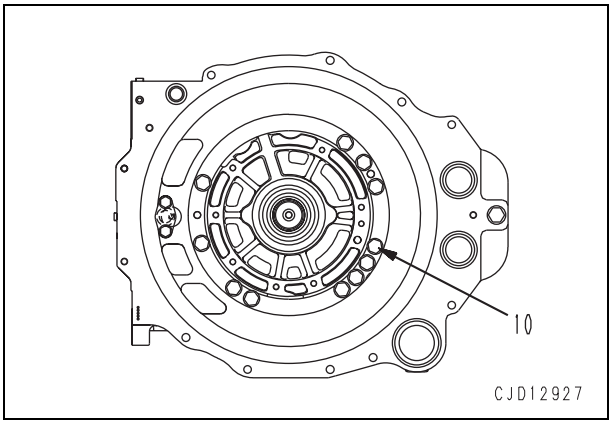
1) Fit the O-ring and install transmission case (11), using eyebolts [2].



2) Tighten 11 tie bolts (10) (to secure the transmission).

Tie bolt:

156.9 – 176.5 Nm {16.0 – 18.0 kgm}

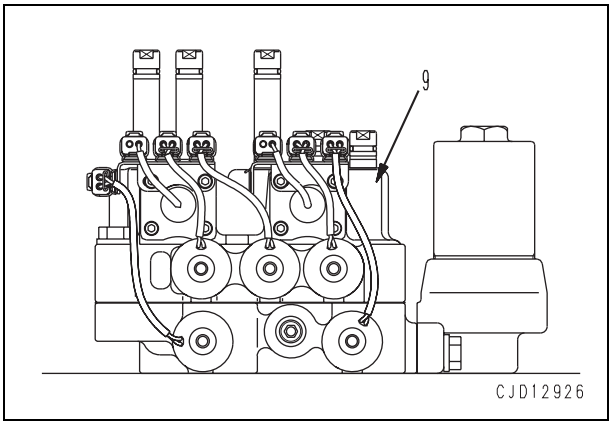


30. Control valve

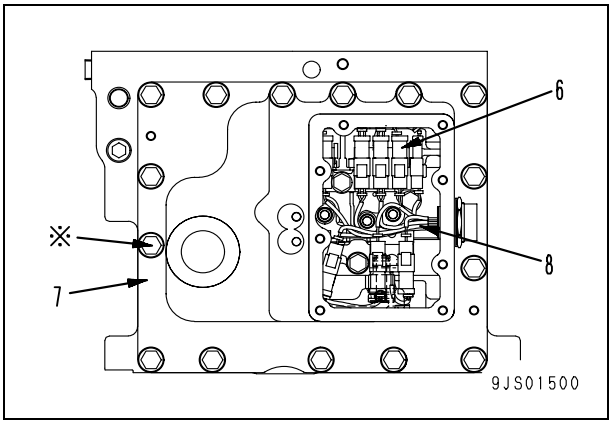
1) Set the transmission assembly on its side.
2) Fit the O-ring and install control valve assembly (9).

Mounting bolt:

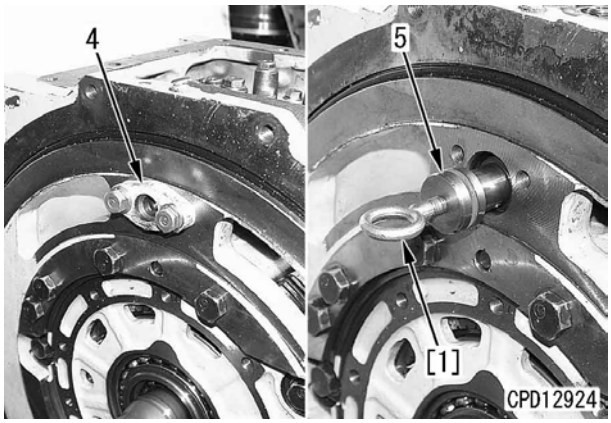
44.1 – 53.9 Nm {4.4 – 5.5 kgm}



3) Install cover (7) and wiring harness (8) together.
   Cover: **Gasket sealant (LG-6)**
   1 bolt marked with *: **Gasket sealant (LG-6)**
4) Connect 10 ECMV connectors (6).



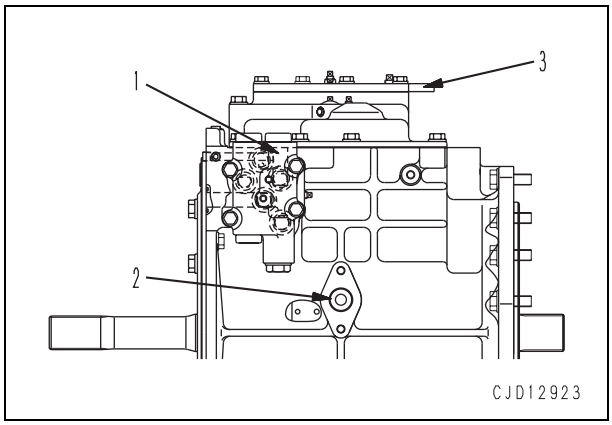
5) Using eyebolt [1], fit the O-ring and install sleeve (5).
6) Install flange (4).



7) Install cover (3).
   Cover: **Gasket sealant (LG-6)**

31. Sleeve
Install sleeve (2).

32. Relief valve assembly
Install relief valve assembly (1).
Mounting bolt:
44.1 – 53.9 Nm {4.5 – 5.5 kgm}



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00947-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

Power train, Part 2

Power train, Part 2

Disassembly and assembly of HSS assembly

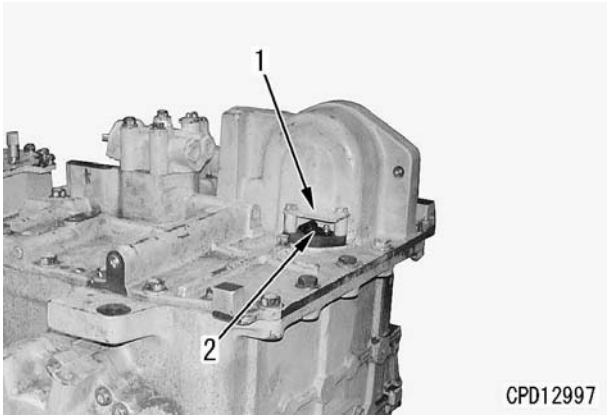
Special tools

Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
E	1	791-422-1320	Hanger	●	1		
	2	790-302-1500	Wrench kit	●	1		
	3	796-730-2300	Wrench	●	1		
	4	Commercially available or 795-630-1810	Torque wrench	●	1		

Disassembly

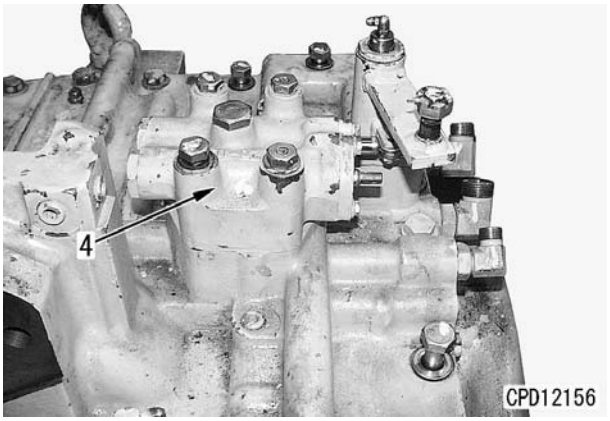
1. Transmission speed sensor

Remove transmission speed sensor cover (1), and then pull out and remove transmission speed sensor (2).



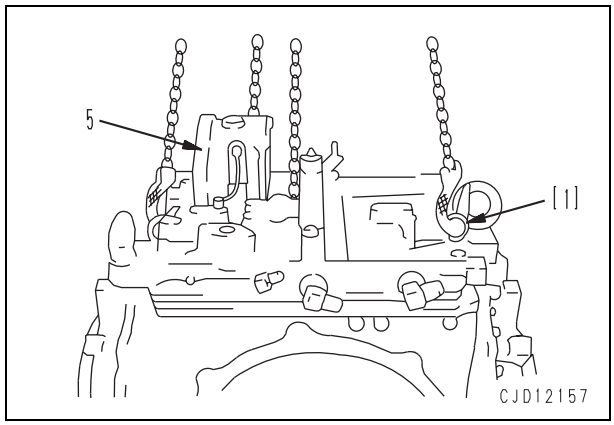
2. Brake valve assembly

Remove brake valve assembly (4).

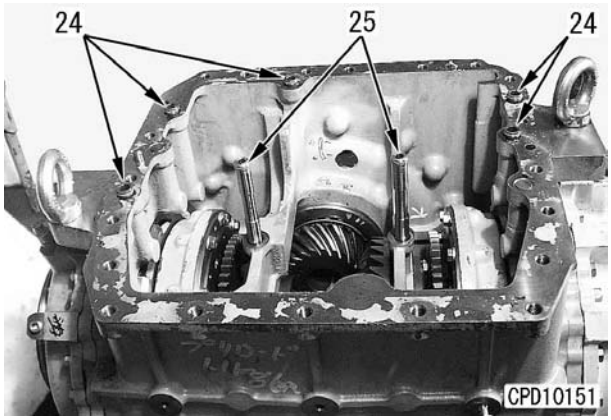


3. Cover assembly

1) Using eyebolt [1], remove cover assembly (5).



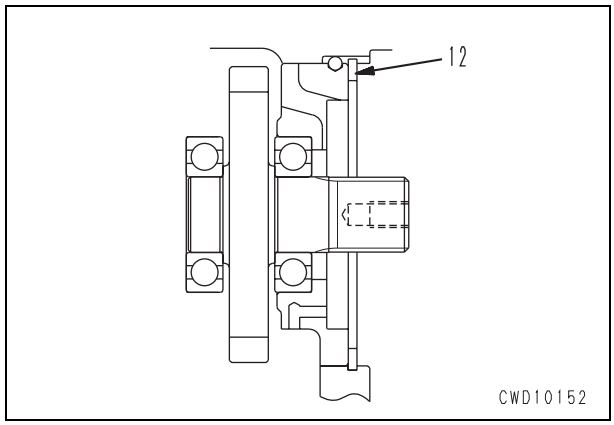
2) Remove 5 sleeves (24) and 2 pieces of (25) from the HSS case.



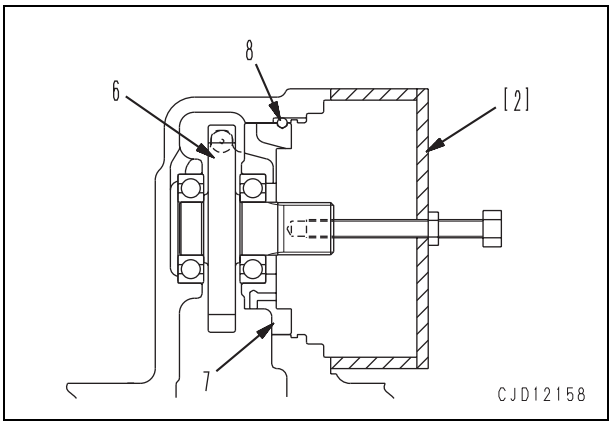
4. Disassembly of cover assembly

1) Input gear assembly

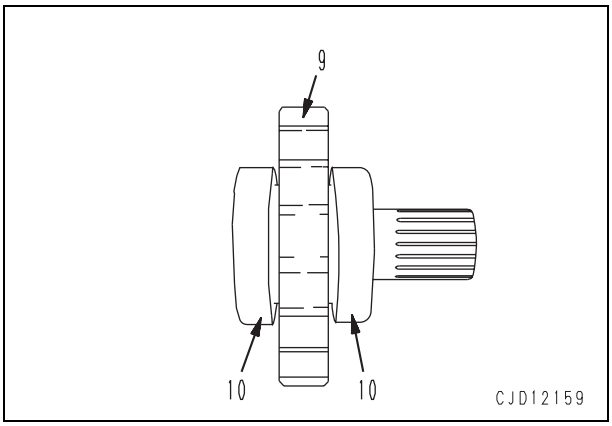
i) Remove snap ring (12).



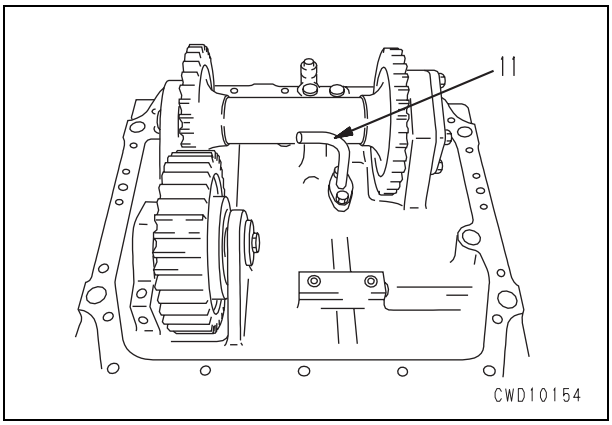
ii) Using puller [2], pull out gear assembly (6) and cage (7) together, and then remove gear assembly (6) from cage (7).
★ Take care not to lose ball (8).



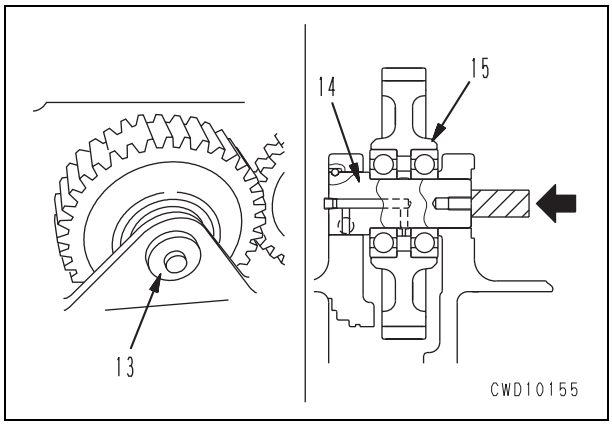
iii) Remove bearing (10) from gear (9).



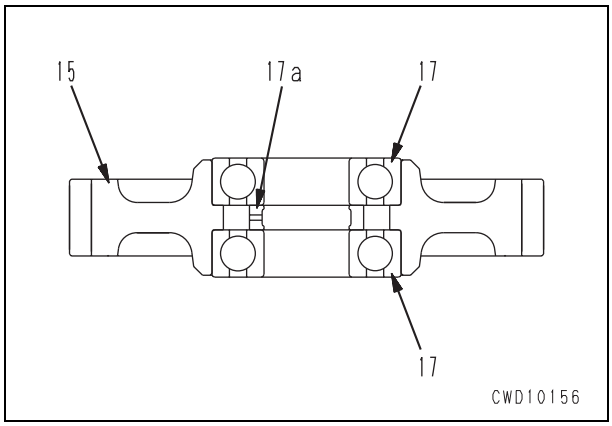
2) Intermediate gear
i) Remove tube (11).



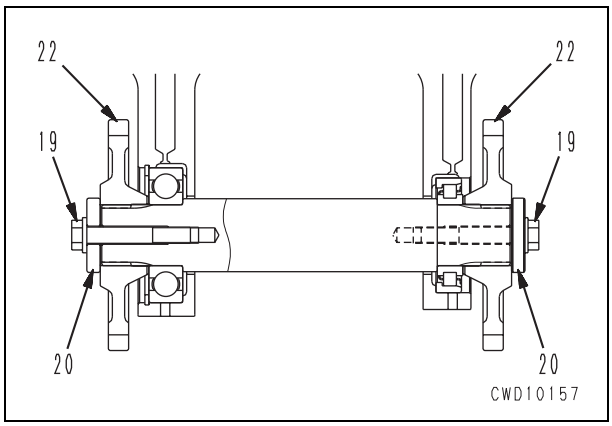
ii) Remove the bolt and holder (13).
iii) Drive out shaft (14) from the bolt side and remove gear (15).
★ Take care not to lose the ball.



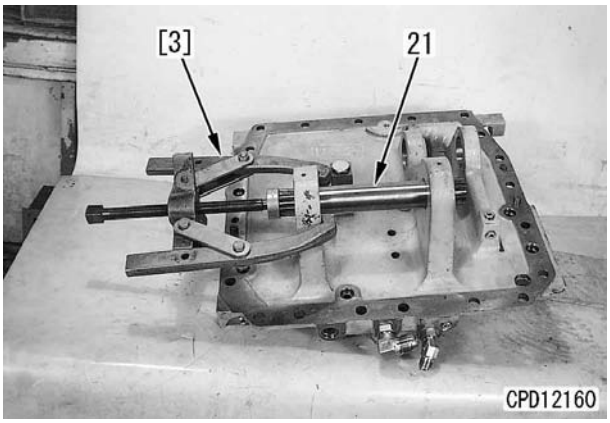
iv) Remove bearing (17) and spacer (17a) from gear (15).



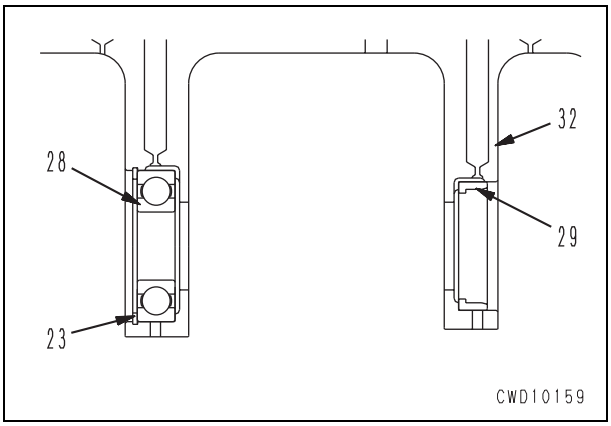
3) Left carrier driver gear
i) Remove bolt (19) and holder (20).
ii) Remove gear (22).



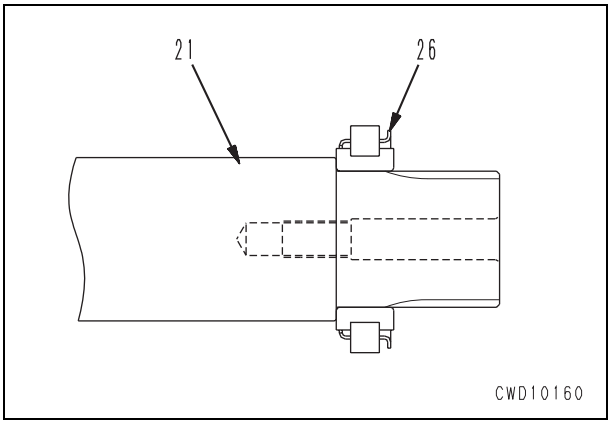
iii) Using gear puller [3], push out shaft (21).



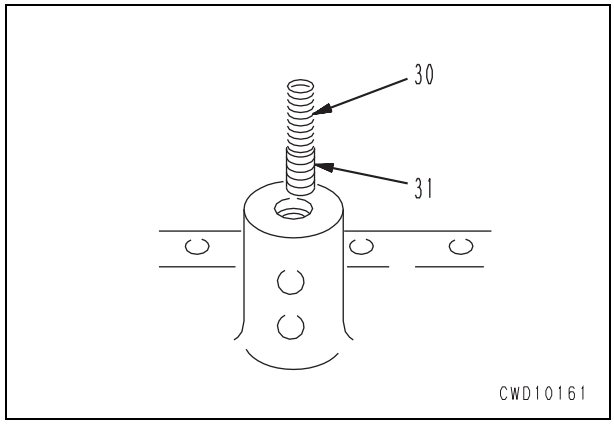
iv) Remove snap ring (23), then remove bearing (28) from cover (32).
v) Remove outer race (29) from cover (32).



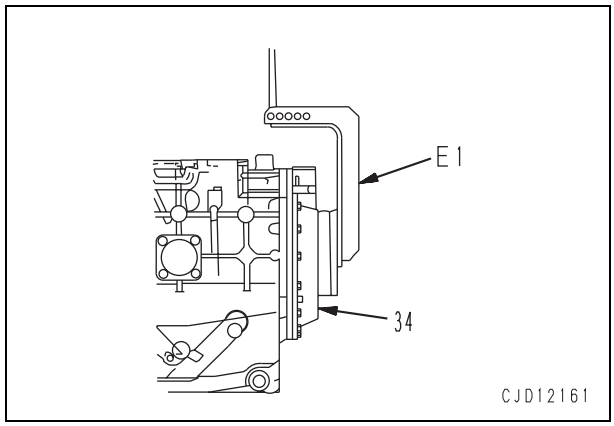
vi) Remove bearing (26) from shaft (21).



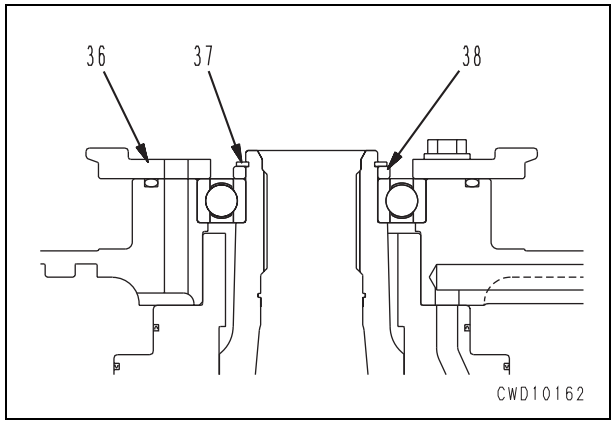
4) Remove the plug, spring (30), and valve (31).



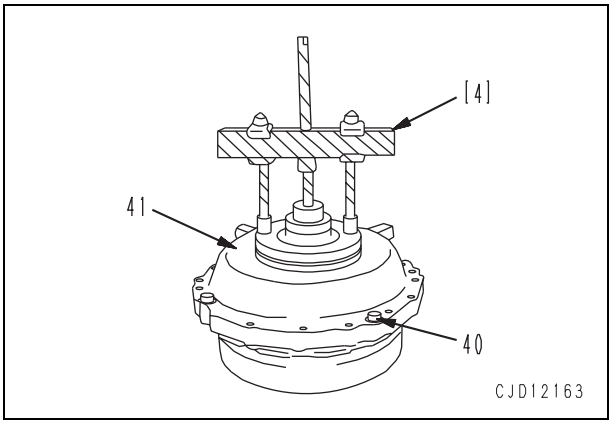
5. Removal of brake and carrier assembly
Remove the mounting bolt, then remove brake and carrier assembly (34) with tool **E1**.
★ Do not remove 4 hexagon socket head bolts.



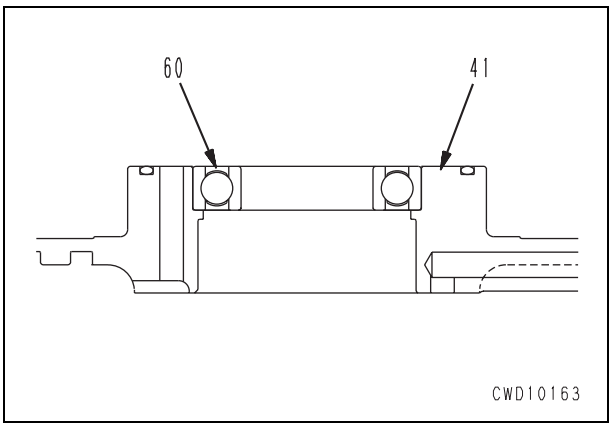
6. Disassembly of brake assembly
1) Remove flange (36).
2) Remove snap ring (37) and spacer (38).



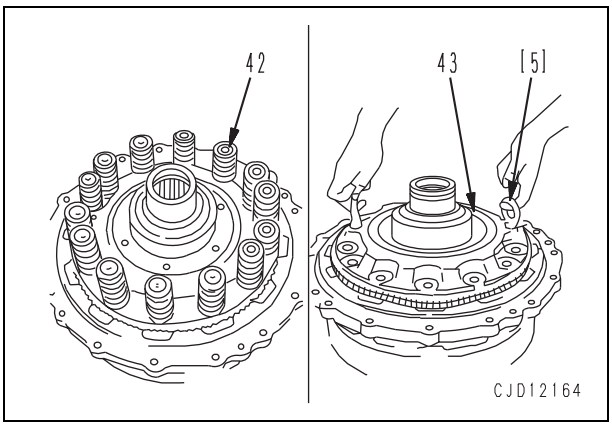
3) Set puller [4] and loosen 4 hexagon socket head bolts and remove cover (41).
   ★ The inner race side of the bearing comes out.
   ★ Do not remove bolts (40) until cover (41) comes off.



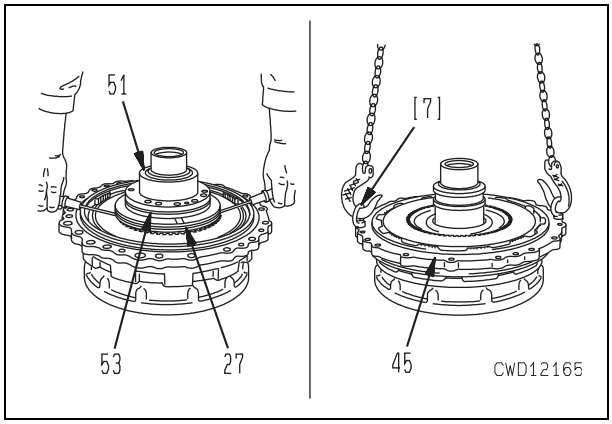
4) Remove bearing (60) from cover (41).



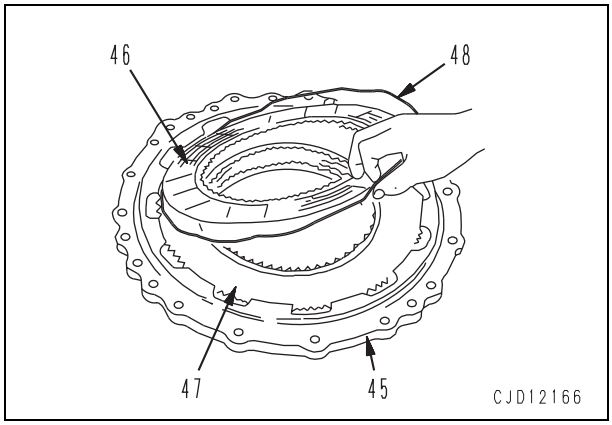
5) Remove spring (42).
6) Using eyebolts [5], remove piston (43).



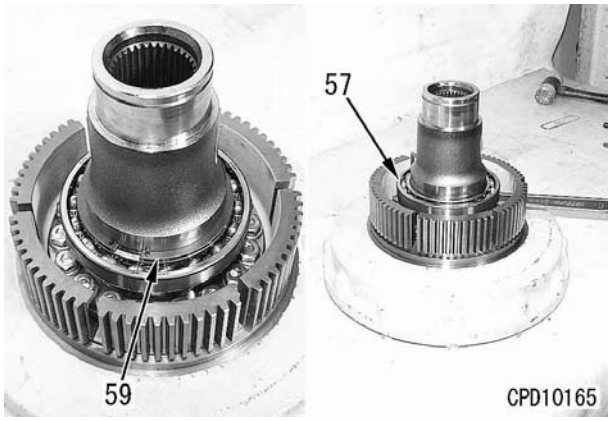
7) Push up and remove cage (51), taking care not to damage the disc.
8) Remove seal rings (53) and (27) from cage (51).
9) Using eyebolts [7], remove drum (45), discs, and plates as a unit.



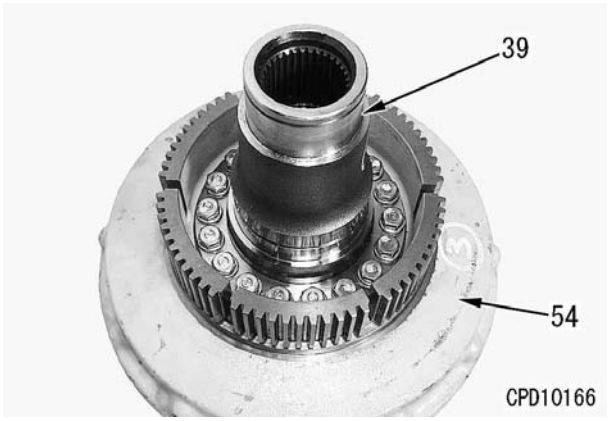
10) Remove discs (46), plates (47), and springs (48) from drum (45).



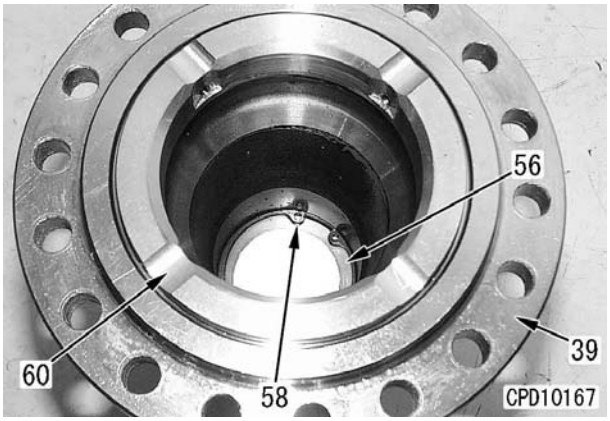
11) Remove snap ring (59) and bearing (57).
   ★ Pry up the bearing from the cut of the hub.



12) Remove 18 mounting bolts, then remove hub (39) from hub (54).

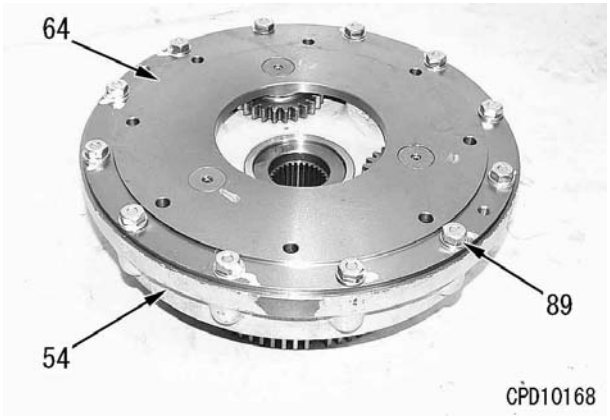


13) Remove bushing (60) from hub (39).
14) Remove snap ring (58), then remove stopper (56) from the hub.

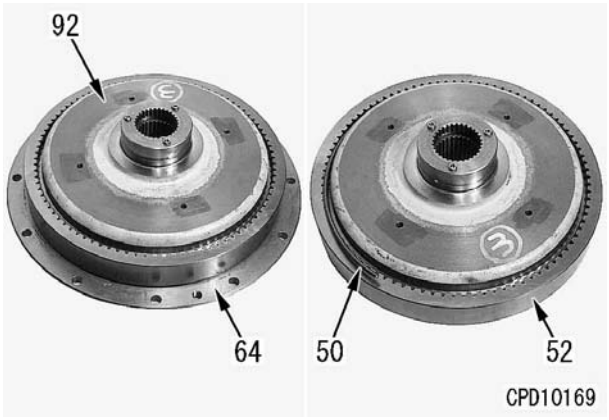


7. Disassembly of carrier assembly

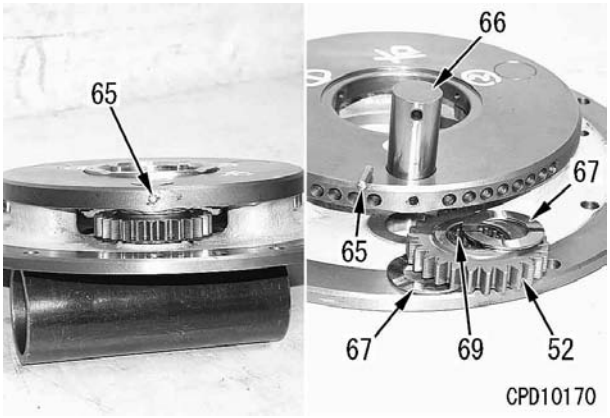
1) Turn over the hub and carrier assembly and remove bolts (89), then remove carrier assembly (64) from hub (54).



2) Remove hub (92) from carrier assembly (64), then remove snap ring (50) and gear (52).



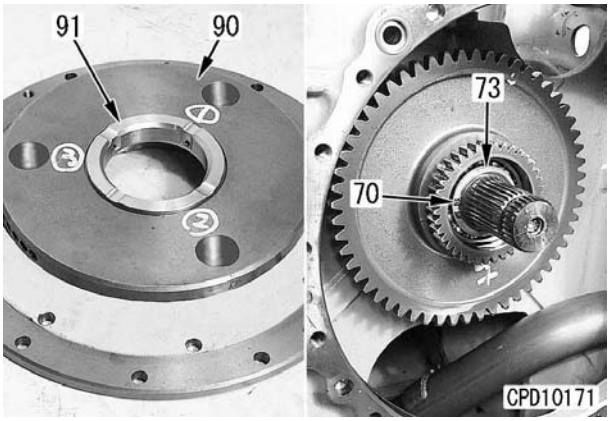
3) Drive roll pin (65) into the shaft.
4) Pull out shaft (66) and remove gear (52), thrust washer (67), and bearing (69).
★ Pull roll pin (65) out of the shaft.



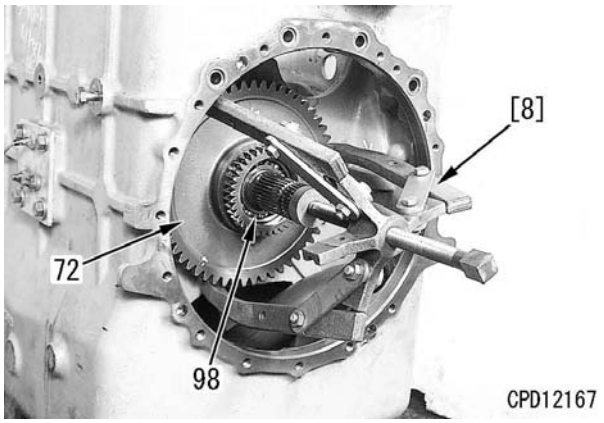
5) Remove bushing (91) from carrier (90).

8. Sun gear

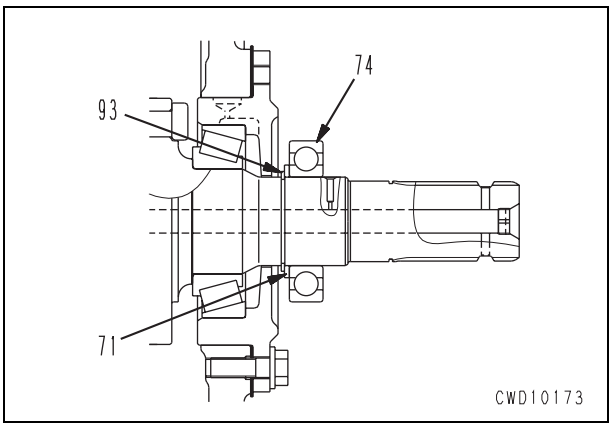
1) Remove snap ring (70) and collar (73).



2) Using gear puller [8], remove sun gear (72) and bearing (98).

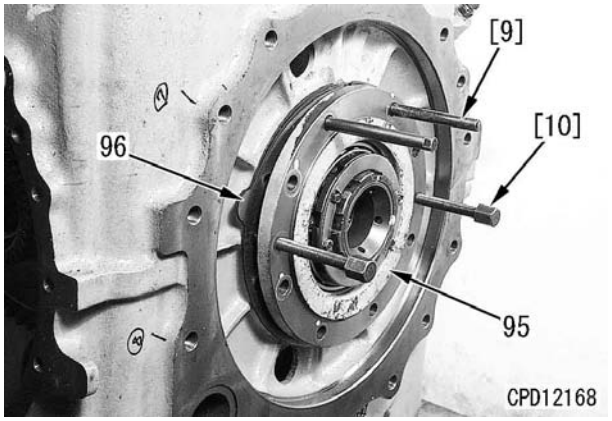


3) Using the bearing race puller, remove bearing (74).
4) Remove collar (71).
5) Remove snap ring (93).
   ★ Only the right side of the machine.

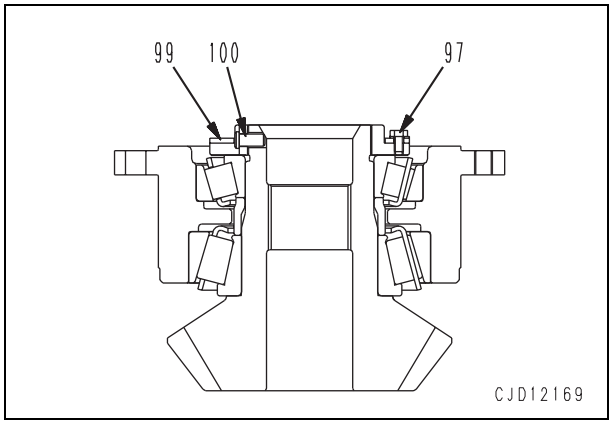


9. Bevel pinion assembly

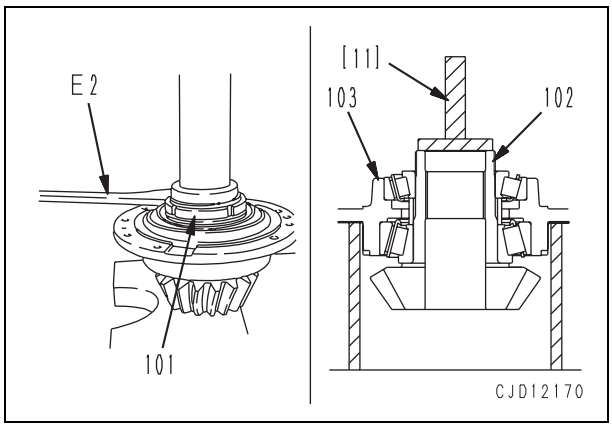
1) Remove the mounting bolts.
2) Using guide bolts [9] and forcing screws [10], remove bevel pinion assembly (95) and shim (96).
   ★ Check the quantity and thickness of the shims and store them.



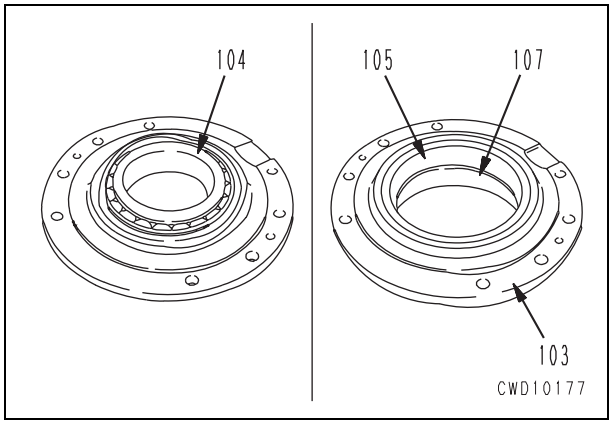
3) Disassembly of bevel pinion assembly
   i) Remove bolt (97), plate (99), and pin (100).



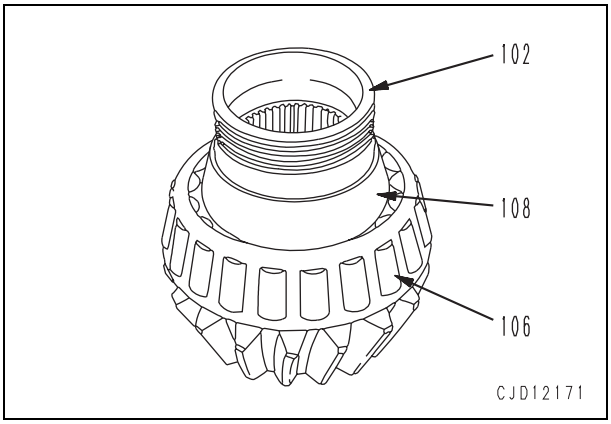
   ii) Secure the pinion with a press and remove nut (101) with tool **E2**.
   iii) Using push tools [11], remove bevel pinion (102) from cage (103).



   iv) Remove bearing (104).
   v) Remove outer races (105) and (107) from cage (103).

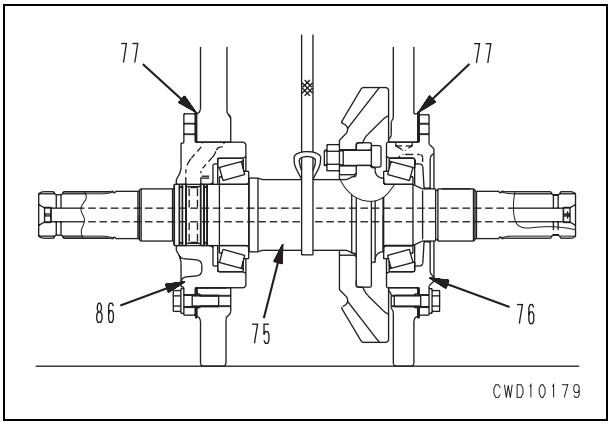


vi) Remove bearing (106) and spacer (108) from bevel pinion (102).

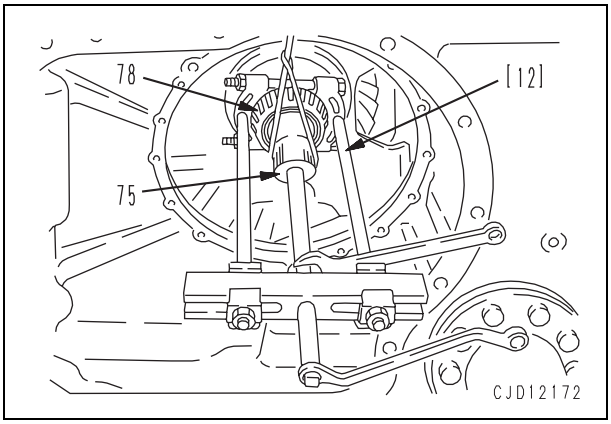


10. Bevel gear shaft and bevel gear

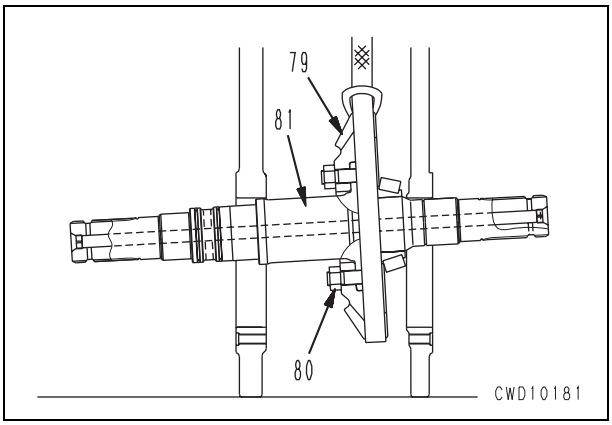
1) Sling bevel gear and shaft assembly (75) temporarily.
2) Remove cage assemblies (76) and (86).
   ★ Check the thickness, quantity, and positions of shims (77).
   ★ Since both cages are different from each other, make marks on them.



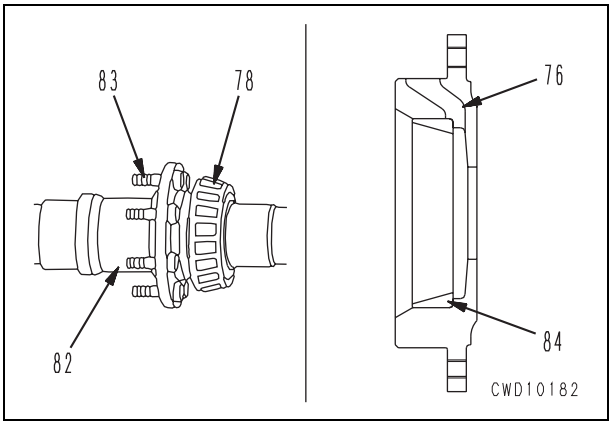
3) Move bevel gear and shaft assembly (75) to the left end and remove bearing (78) with puller [12].
   ★ Remove only the bearing on the left side of the machine.



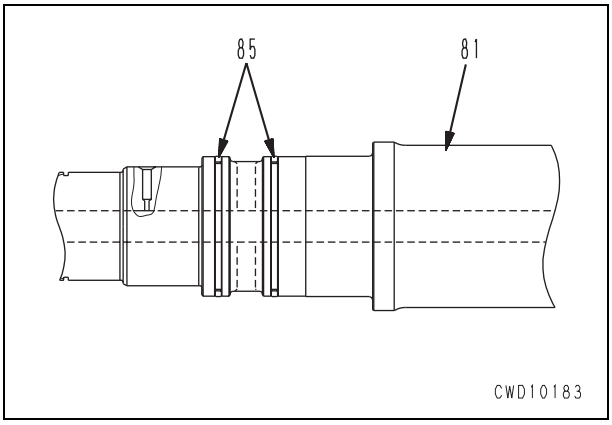
4) Sling bevel gear (79) and remove mounting nut (80) and pull out bevel gear shaft assembly (81) to the right side of the machine.



5) Remove bearing (78) from bevel gear shaft (82).
6) Remove bolts (83).
7) Remove outer race (84) from cage (76).

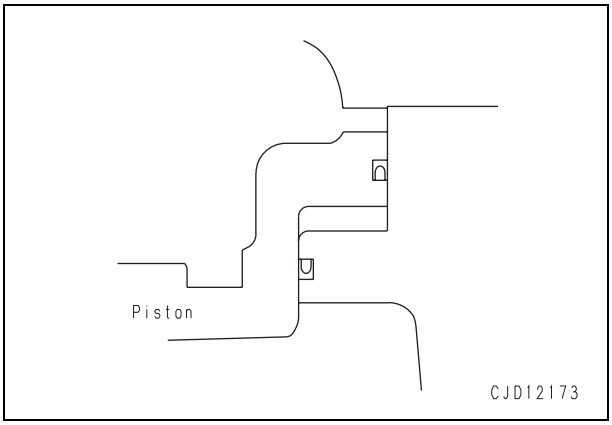


8) Remove seal ring (85) from bevel gear shaft (81).



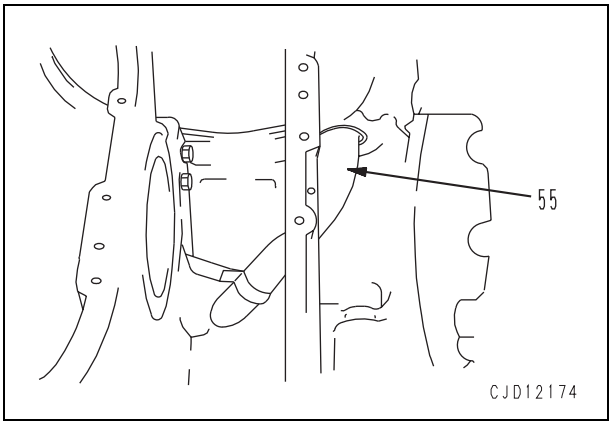
Assembly

- **Precautions for assembly**
  - ★ Clean the all parts and check them for dirt or damage before installing.
  - ★ Drop engine oil onto the rotating parts of each bearing and rotate it several turns.
  - ★ Coat the sliding parts with engine oil before installing.
  - ★ Apply grease (G2-LI) to each piston seal ring and install it evenly with the pressure receiving side directed to the housing.
    - Rotary seal ring:
      Fix each seal ring with **grease (G2-LI)** and install it very carefully not to catch it in the parts.
  - ★ Check that the snap rings are fitted securely in the grooves.



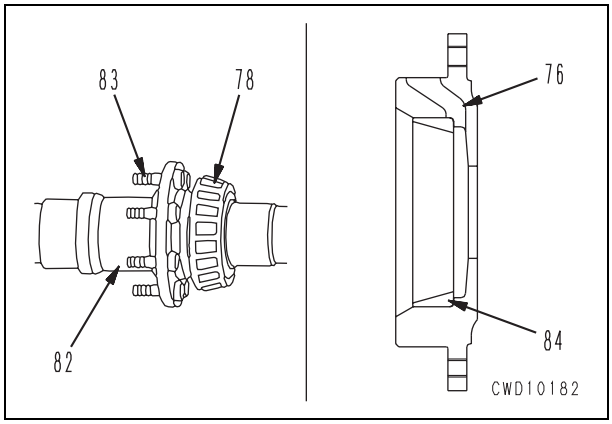
1. Suction tube

Install suction tube (55).

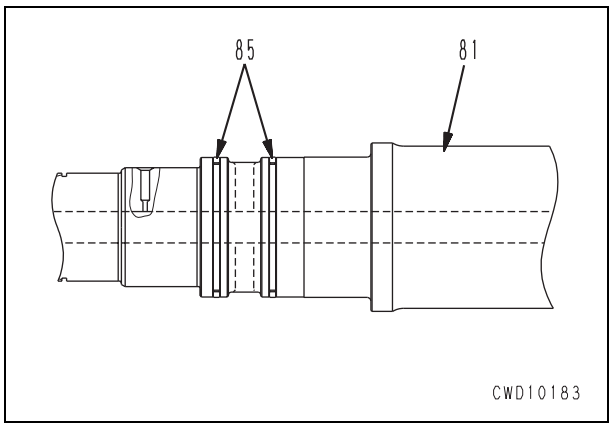


2. Bevel gear shaft and bevel gear assembly

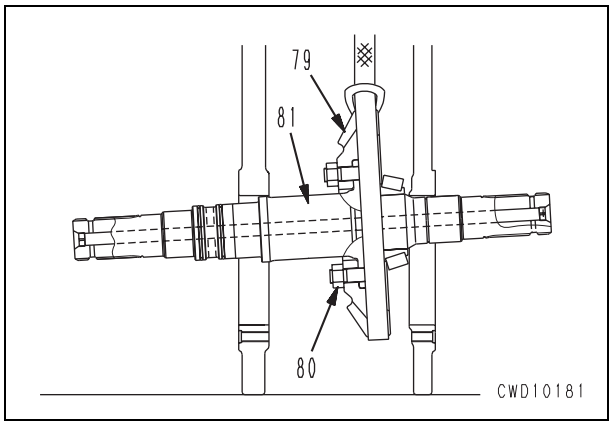
1) Install bolt (83) to bevel gear shaft (82).
2) Heat bearing (78) with a bearing heater, etc. and install it to the right side of the bevel gear shaft by shrink fit.
   - ★ If the bearing temperature is raised too high, the hardness of the heat-treated part lowers. Accordingly, do not raise the bearing temperature more than 120ºC.
   - ★ After installing the bearing, drop engine oil onto its rotating parts and rotate it several turns.
   - ★ Check that the clearance at the bearing end is 0.03 mm or less.
3) Install outer race (84) to cages (76) and (86).



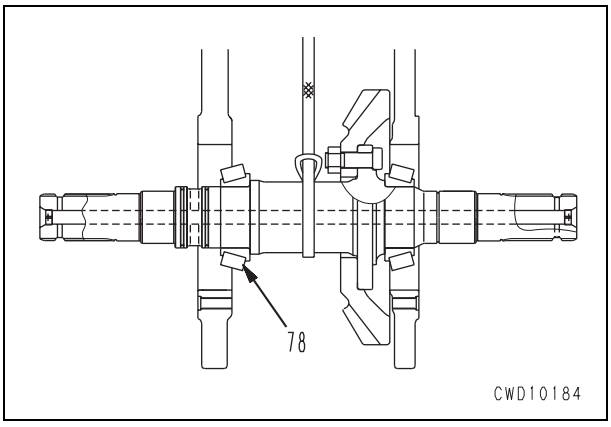
4) Install seal ring (85) to bevel gear shaft (81).



5) Insert bevel gear shaft (81) in bevel gear (79) slung at the center of the case from the right side of the machine.
   - ★ Tighten mounting nut (80) temporarily in advance.



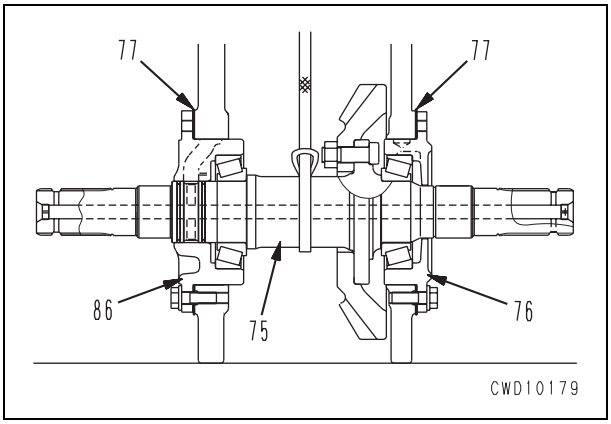
6) Heat bearing (78) with a bearing heater, etc. and install it to the left side of the bevel gear shaft by shrink fit.
   ★ If the bearing temperature is raised too high, the hardness of the heat-treated part lowers. Accordingly, do not raise the bearing temperature more than 120ºC.
   ★ After installing the bearing, drop engine oil onto its rotating parts and rotate it several turns.
   ★ Check that the clearance at the bearing end is 0.03 mm or less.



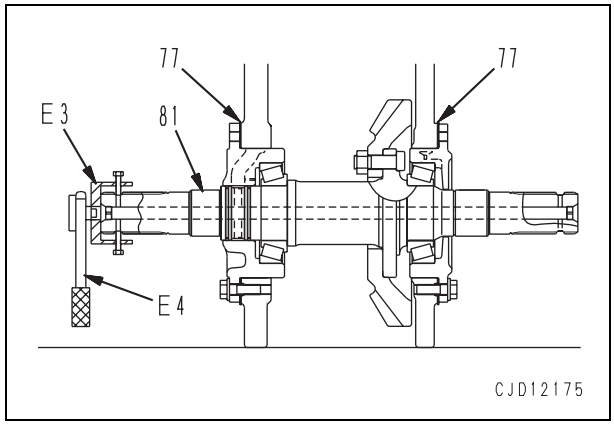
7) Install cages (76) and (86) to bevel gear and shaft assembly (75).
   ★ Since both cages are different from each other, take care not to mistake them.
   ★ Install shims (77) of the thickness and quantity recorded when removed.
   - Standard shim thickness: **1.5 mm**
   - Varieties of shim thickness:
     0.2 mm, 0.3 mm, 0.5 mm

   Mounting bolt:
   98.1 – 122.6 Nm {10 – 12.5 kgm}
8) Tighten the bevel gear mounting nut securely.
   ★ Place a plastic hammer, etc. between the bevel gear.

   Mounting nut:
   245 – 309 Nm {25 – 31.5 kgm}

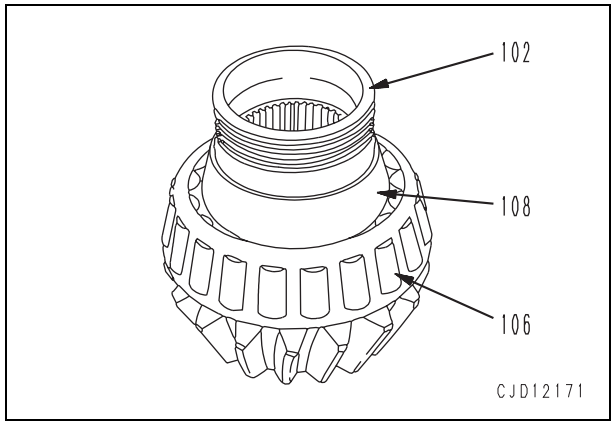


9) Adjusting pre-load
   ★ Adjust the pre-load with the bevel pinion assembly removed.
   i) Rotate the bevel gear and shaft assembly several turns to fit the bearing.
   ii) Install too **E3** to the end of bevel gear shaft (81) and measure the rotation torque with a torque wrench **E4**.
      - Standard rotation torque:
        10.3 – 14.7 Nm {1.05 – 1.5 kgm}
   ★ If the rotation torque is lower than the standard value, reduce the quantity of shims (77) in step 7. If the former is higher, increase the latter.

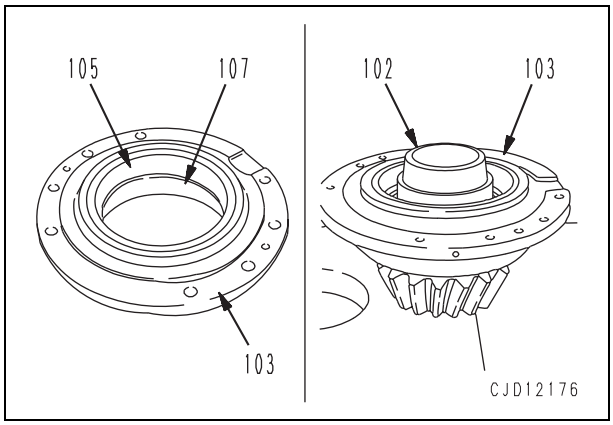


3. Bevel pinion assembly

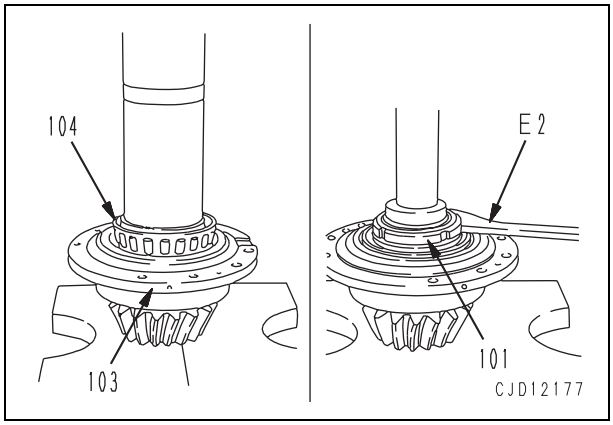
1) Assembly of bevel pinion
   i) Using push tool, press fit bearing (106) to bevel pinion (102) and install spacer (108).



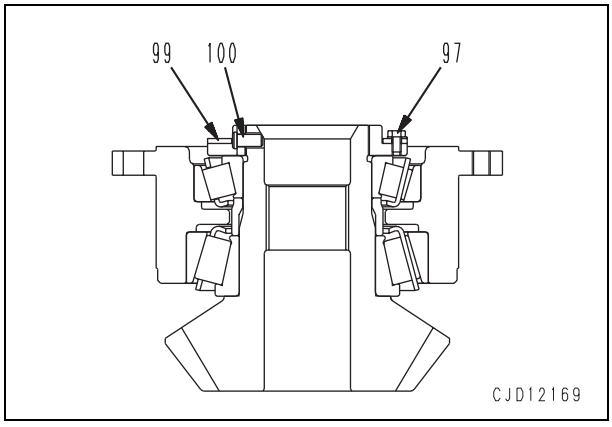
ii) Using the push tool, press fit outer races (105) and (107) to cage (103).
iii) Place bevel pinion (102) on the press stand and set cage (103).



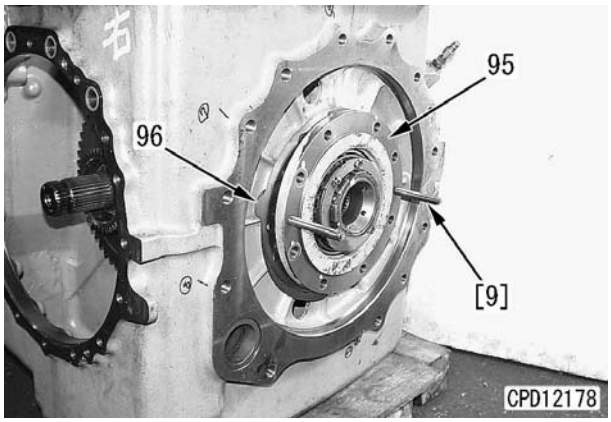
iv) Press fit bearing (104) to cage (103) with the press.
v) Secure the pinion with the press and tighten locknut (101) with tool **E2**.
Locknut:
Liquefied adhesive (LT-2)
Locknut:
392 – 441 Nm {40 – 45 kgm}
vi) After tightening the nut, return it until 1 of its pin holes (8 places) is matched to 1 of the pin holes of the pinion shaft (5 places).
★ Return the nut by 0 – 9°.
★ Tighten the nut, turning the cage.
★ After tightening the nut, check that the bevel pinion rotates smoothly.



vii) Install pin (100), plate (99), then tighten bolt (97).
Bolt:
11.8 – 14.7 Nm {1.2 – 1.5 kgm}



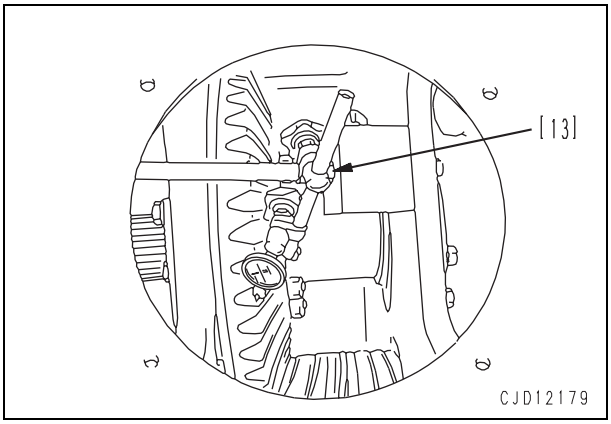
2) Using guide bolt [9], install shims (96) and bevel pinion assembly (95).
★ Install shims of the thickness and quantity recorded when removed.
- Standard shim thickness: **2 mm**
- Varieties of shim thickness:
0.2 mm, 0.3 mm, 1.0 mm



4. Adjusting backlash and tooth contact

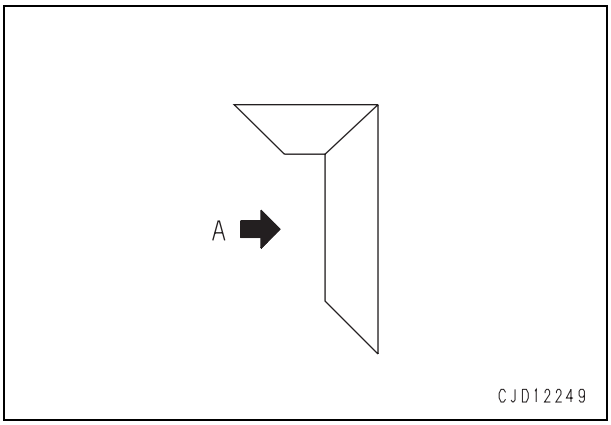
1) Adjusting backlash
Apply the probe of dial gauge [13] to the tooth tip at the end of the bevel gear at right angles. Fix the bevel pinion and move the bevel gear forward and backward, and read the value at this time.
★ Standard backlash: **0.2 – 0.28 mm**
★ Measure the backlash diagonally at 3 or more places.

- If the measured backlash is out of the standard range, adjust it according to the following procedure.

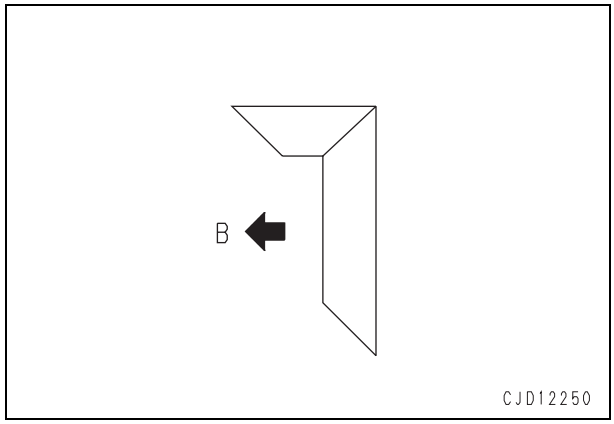


★ Adjust the backlash by increasing or decreasing the thickness of both shims. Do not change the total thickness of both shims so that the preload will not change. (If the thickness of the shim on one side is increased, decrease the thickness of the other side, and vice versa.)

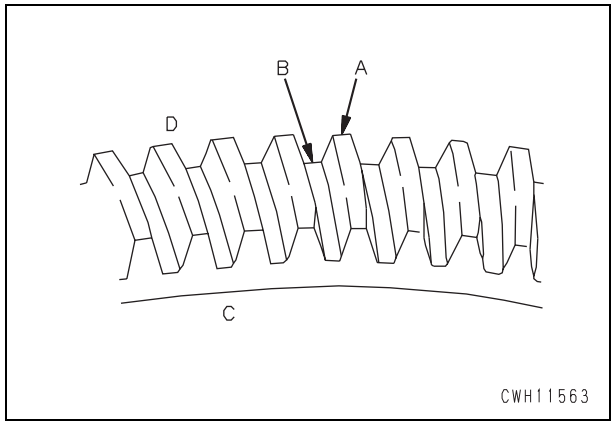
- When backlash is insufficient
Decrease the thickness of the shim on the right side of the machine body and increase the thickness on the left side by the same quantity. (Move the bevel gear in direction **A**.)



- When backlash is too large
Decrease the thickness of the shim on the left side of the machine body and increase the thickness on the right side by the same quantity. (Move the bevel gear in direction **B**.)

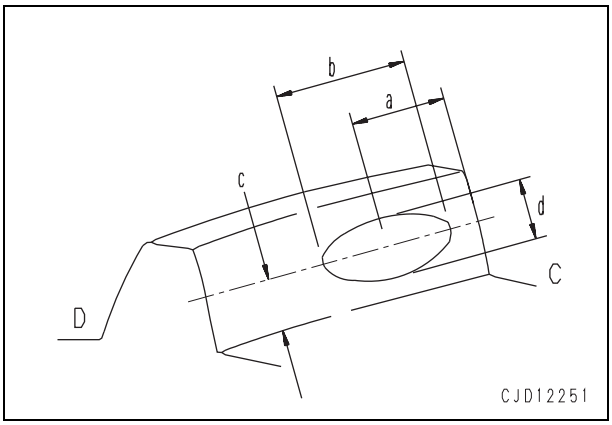


2) Adjusting tooth contact
Testing
i) Apply red lead thinly to the tooth surfaces of the bevel gear and turn the bevel gear in the forward and reverse directions, then check the tooth contact pattern on the bevel gear.



ii) The tooth contact must be as follows (The standard distance is measured from the tooth tip of the bevel pinion.)
a) Center of tooth contact:
20 – 40% of face width
(from small end)
b) Width of tooth contact:
30 – 50% of face width
c) Center of tooth contact:
35 – 65% of tooth depth
(from bottom)
d) Width of tooth contact:
60 – 80% of tooth depth
Check that tooth tip **A**, bottom **B**, small end **C**, and large end **D** of the teeth do not have any strong tooth contact.

★ If the level gear and bevel pinion are adjusted in this way, their teeth come in contact with each other correctly when they are loaded.

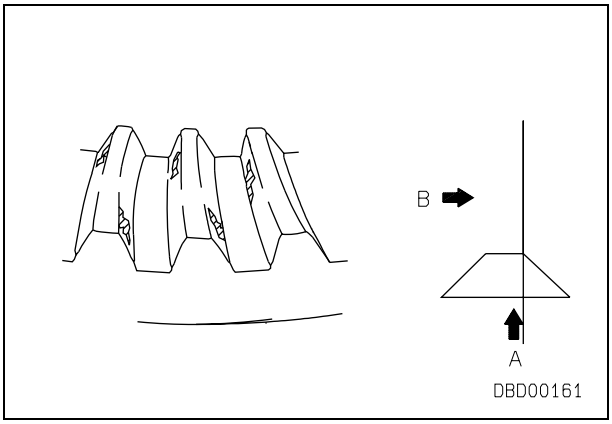


Adjusting

If the tooth contact pattern is not proper, adjust the tooth contact according to the following procedure.

i) If the bevel pinion is too far from the center line of the bevel gear, the contact is at the small end of the bevel gear tooth faces curved outward and at the large end of the bevel gear tooth faces curved inward.

- In this case, adjust the tooth contact according to the following procedure. Adjust the thickness of the shims on the bevel pinion side to move the bevel pinion in direction **A**. Move the bevel gear in direction **B**, then check the tooth contact pattern and backlash again.



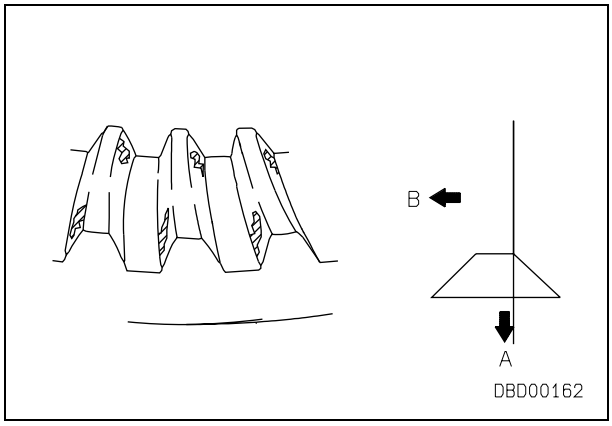
ii) If the bevel pinion is too close to the center line of the bevel gear, contact is at the large end of the bevel gear tooth faces curved outward and the small end of the bevel gear tooth faces curved inward.

- In this case, adjust the tooth contact according to the following procedure. Adjust the thickness of the shims on the bevel pinion side to move the bevel pinion in direction **A**. Move the bevel gear in direction **B**, then check the tooth contact pattern and backlash again.

★ Do not change the total thickness of the shims on both sides.

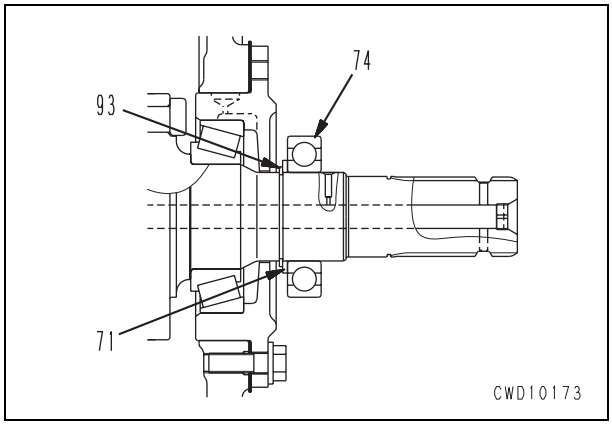
iii) When adjustment is finished, tighten the mounting bolts of the cage and bevel pinion assembly to the specified torque.

Mounting bolts of cage and bevel pinion assembly:
98 – 123 Nm {10 – 12.5 kgm}

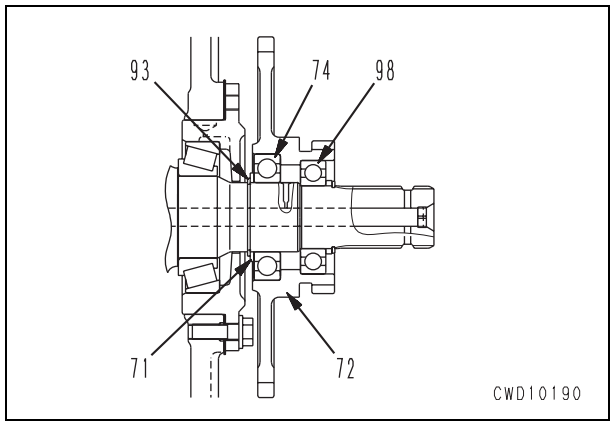


5. Sun gear

1) Install snap ring (93) to the shaft.
   ★ Perform this work for only right side of the machine.
2) Install collar (71).
3) Install bearing (74) with the push tool.



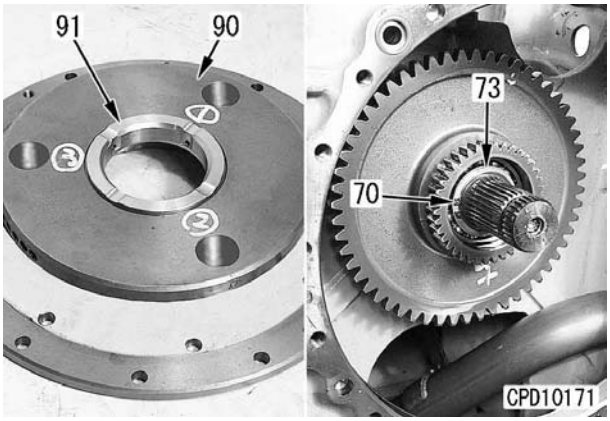
4) Install sun gear (72).
5) Install bearing (98) with the push tool.
★ Press fit the inner race and outer race simultaneously.



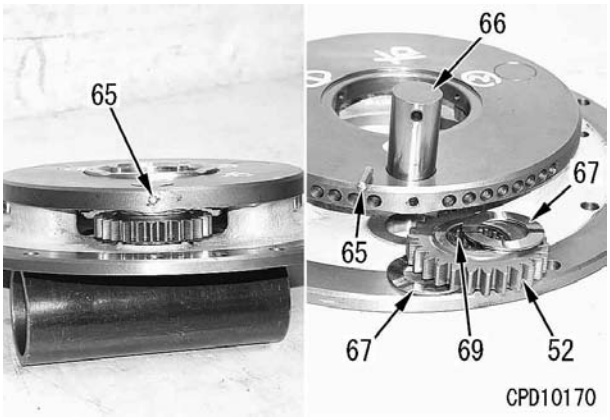
6) Install collar (73) and snap ring (70).

6. Assembly of carrier assembly

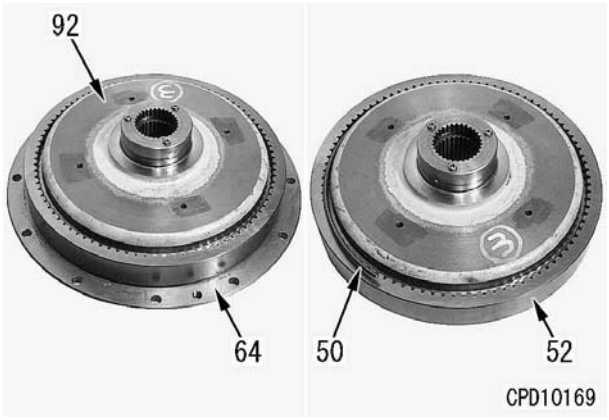
1) Install bushing (91) to carrier (90).



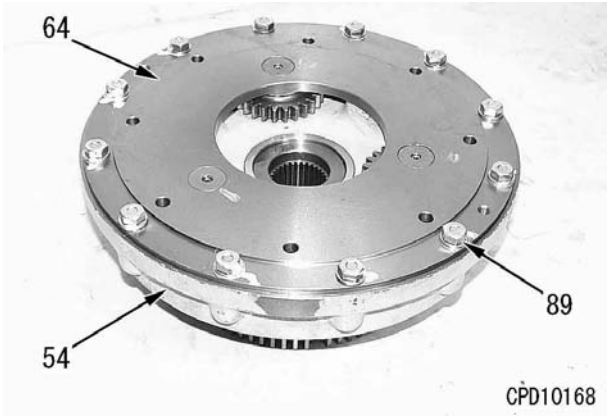
2) Install bearing (69) to gear (52). Fit thrust washers (67) to top and bottom of the bearing, then set them to the carrier.
3) Install shaft (66), matching the inside of the thrust washers and bearing to the shaft hole of the carrier.
★ Match the roll pin hole accurately.
4) Install roll pin (65).



5) Set hub (92) to ring gear (52) and install snap ring (50).
6) Install hub (92) to carrier assembly (64).

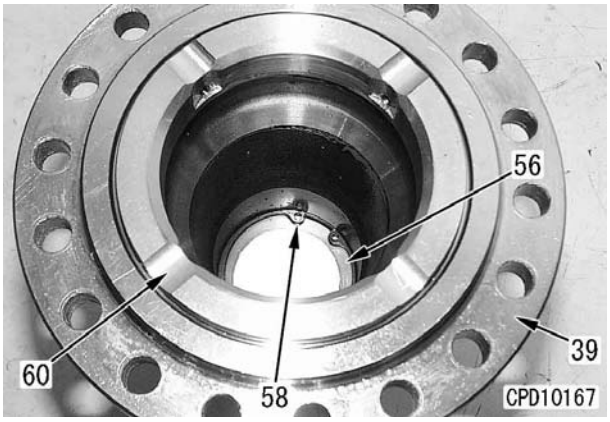


7) Install hub and carrier assembly (64) to hub (54) and tighten bolts (89).
Mounting bolt:
59 – 74 Nm {6 – 7.5 kgm}

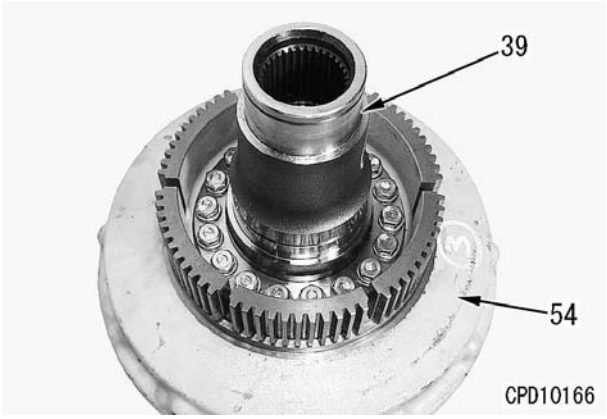


7. Assembly of brake assembly

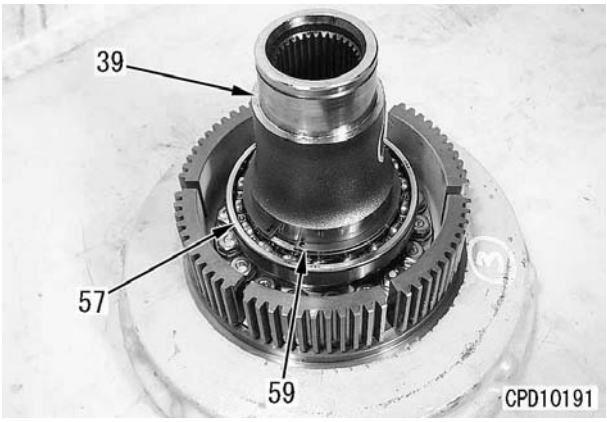
1) Install stopper (56) to the hub, then install snap ring (58).
2) Install bushing (60) to hub (39).



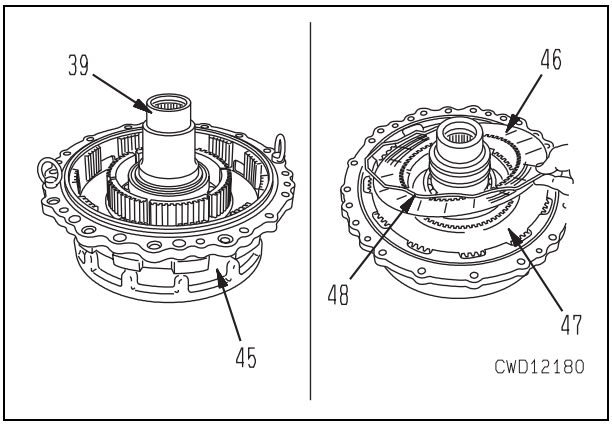
3) Install hub (39) to hub (54) with 18 mounting bolts.
   Mounting bolt:
   59 – 74 Nm {6 – 7.5 kgm}



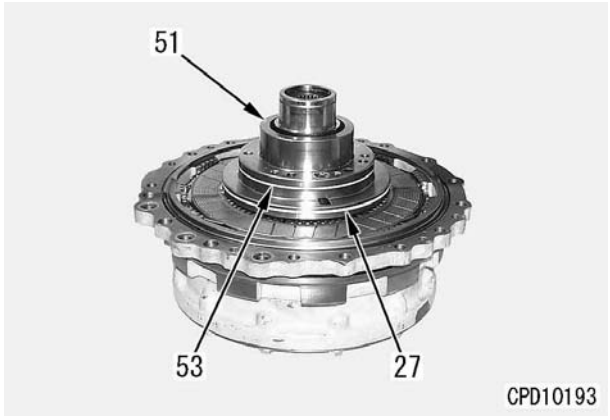
4) Install bearing (57) to hub (39).
5) Install snap ring (59).



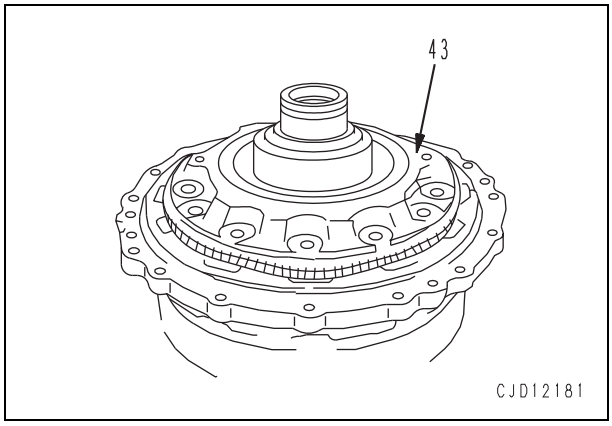
6) Set brake drum (45) to hub (39).
7) Install discs (46), plates (47), and springs (48).

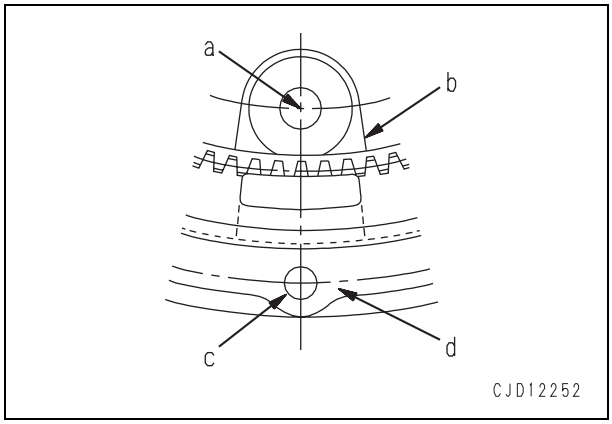


8) Install seal rings (27) and (53) and cage (51).
   ★ Roughly match the oil holes on the cage to the 4 oil holes on the drum.
   ★ Press fit the cage to the outer race side of the bearing.

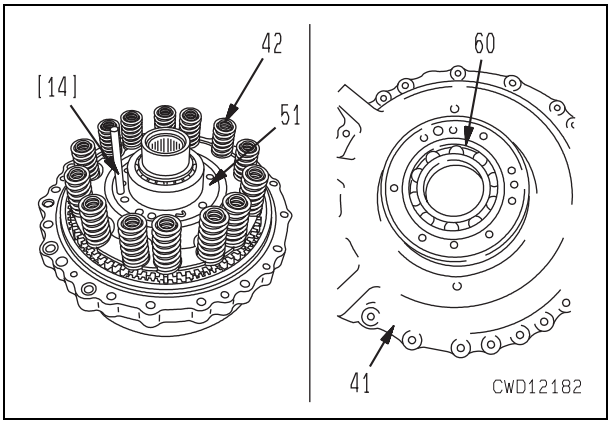


9) Install the seal ring to piston (43).
10) Install piston (43), matching the center of the spot-face (b) having the match mark (a) to the drilled hole (c) “13.5 in diameter” (on the opposite side (d) of the side hole).

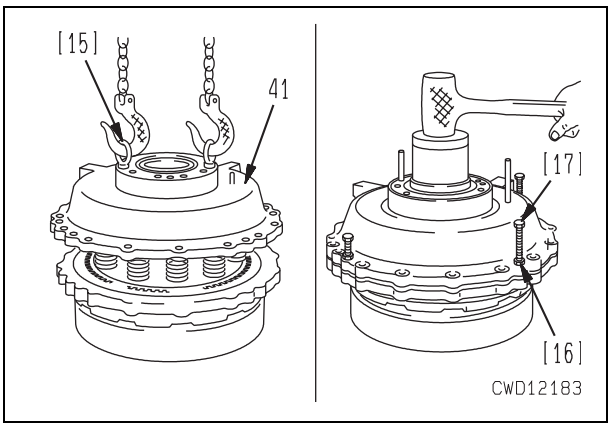




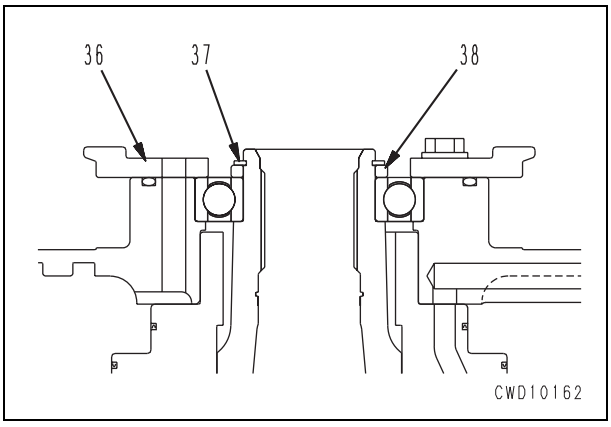
11) Install spring (42).
12) Install guide bolt [14] to cage (51).
13) Install bearing (60) to cover (41).



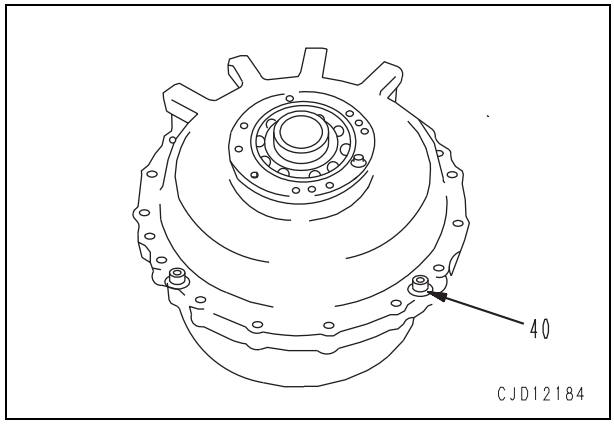
14) Using eyebolts [15] and matching to the guide bolt, set cover (41).
    ★ Check that the spring is fitted securely to both of the piston and case.
15) Compressing the spring with forcing screws [17] and nuts [16], press fit the inner race side of the bearing to the hub assembly.



16) Install spacer (38) and snap ring (37).
17) Install flange (36).

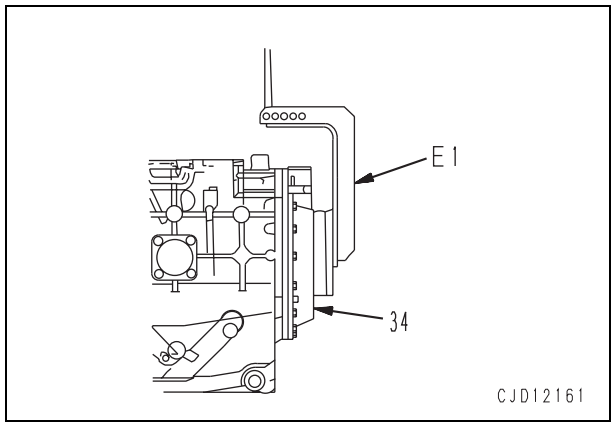


18) Remove the bolts and nuts used to compress the spring, then install 4 bolts (40).



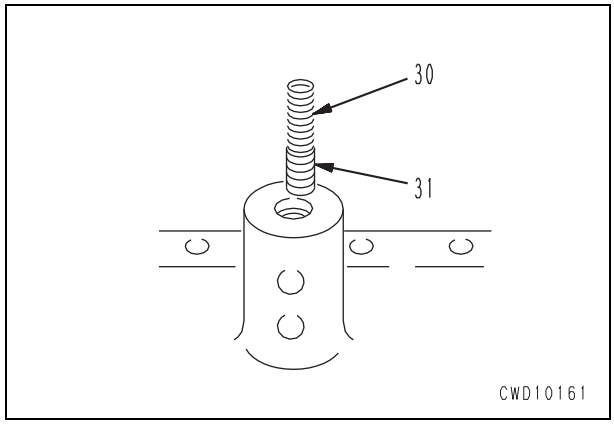
8. Installation of brake and carrier assembly

1) Equalize the projection of the seal rings from the shaft on the carrier side.
2) Using tool **E1**, install brake and carrier assembly (34).

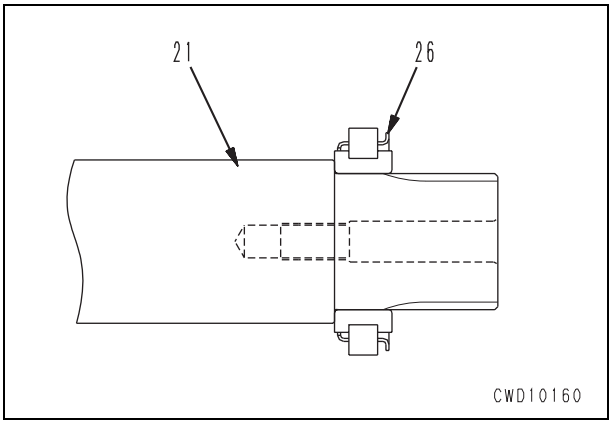


9. Assembly of cover assembly

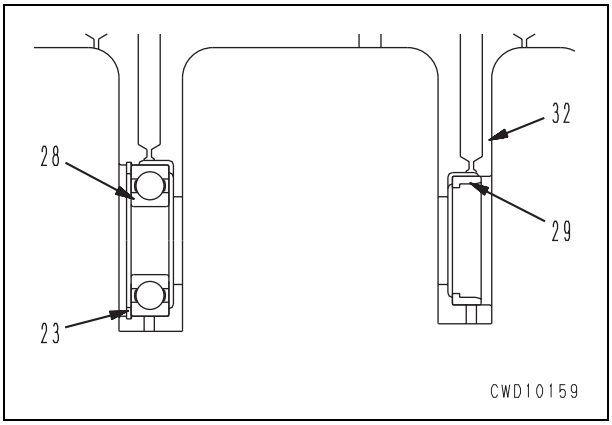
1) Install valve (31) and spring (30) to the cover, then install the plug.



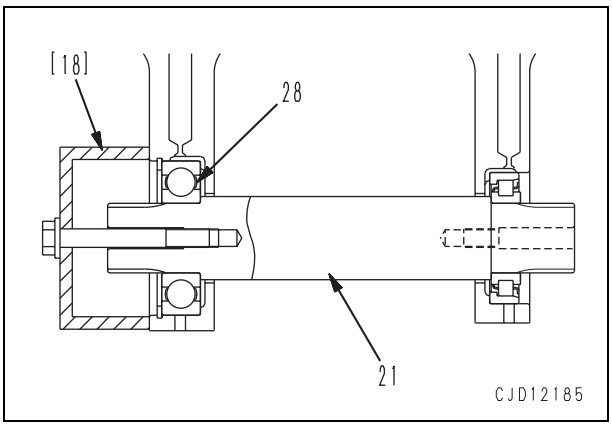
2) Left carrier drive gear
   i) Press fit bearing (26) to shaft (21).



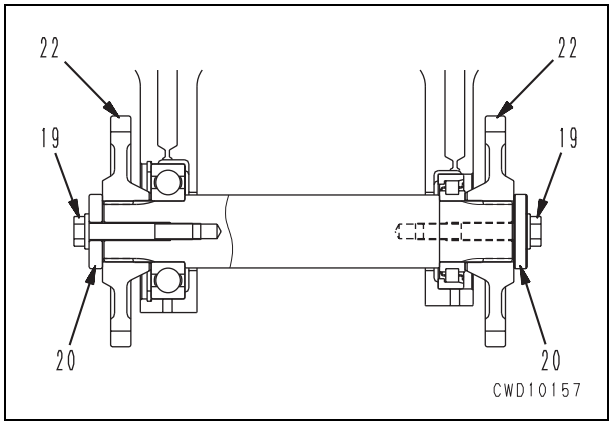
   ii) Install outer race (29) to cover (32).
   iii) Press fit bearing (28) to cover (32), then install snap ring (23).



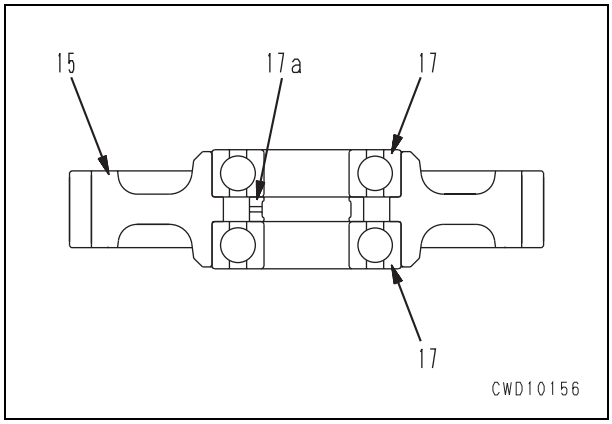
   iv) Using puller [18], press fit shaft (21) to the inner race side of bearing (28).
   ★ Replace the bolt with one having different length.



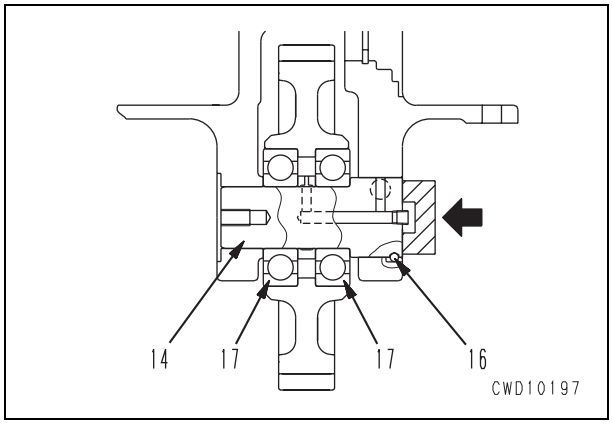
   v) Install gear (22).
   vi) Install holder (20) and tighten bolt (19).
   Mounting bolt:
   98 – 123 Nm {10 – 12.5 kgm}



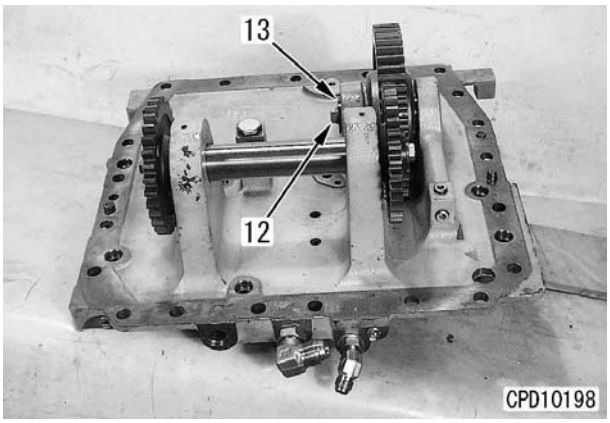
3) Intermediate gear assembly
   i) Install bearings (17) and spacer (17a) to gear (15).



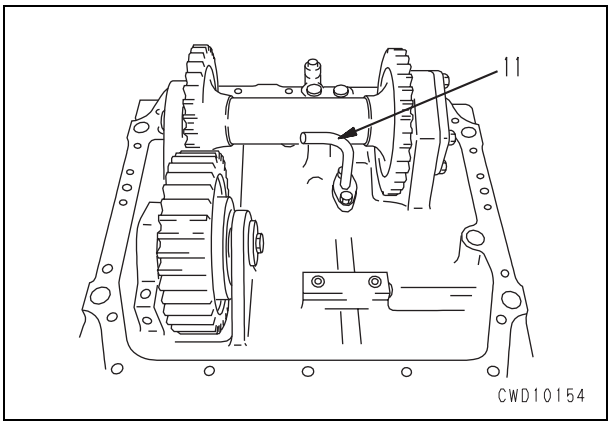
   ii) Press fit shaft (14) to the inner race side of bearing (17). Fit ball (16) halfway and press fit completely.
   ★ Before the shaft enters the cover, position the ball accurately.



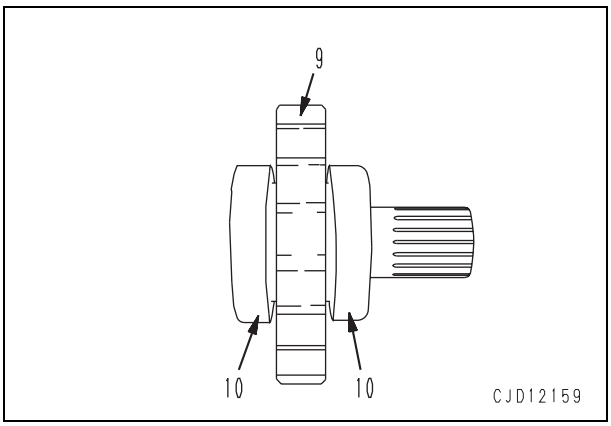
iii) Install holder (13) and tighten bolt (12).
Mounting bolt:
98 – 123 Nm {10 – 12.5 kgm}



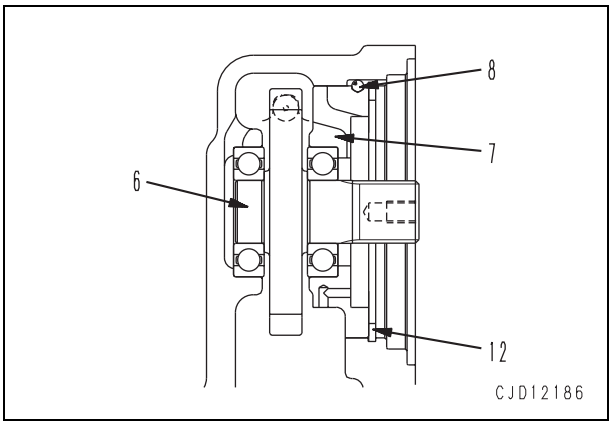
iv) Install tube (11).



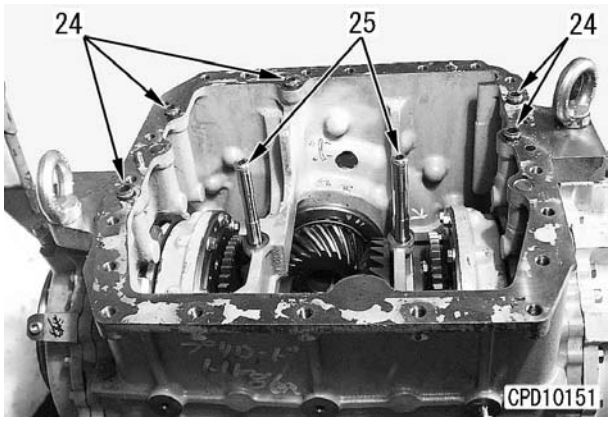
4) Input gear assembly
i) Install bearings (10) to gear (9).



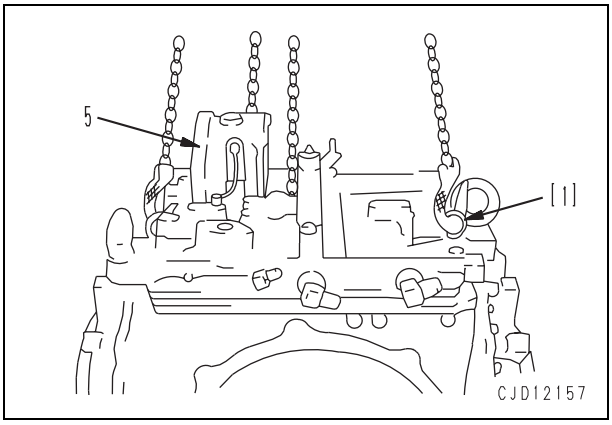
ii) Install gear assembly (6).
iii) Install cage (7) and ball (8), matching them to the hole for ball (8).
iv) Install snap ring (12).



10. Installation of cover assembly
1) Install 2 sleeves (25) and 5 sleeves (24) to the HSS case.



2) Using eyebolts [1], install cover assembly (5).
Mating face of cover:
Gasket sealant (LG-6)
★ Apply gasket sealant to both mating faces of the case and cover.
★ Apply gasket sealant to each mating face without breakage.

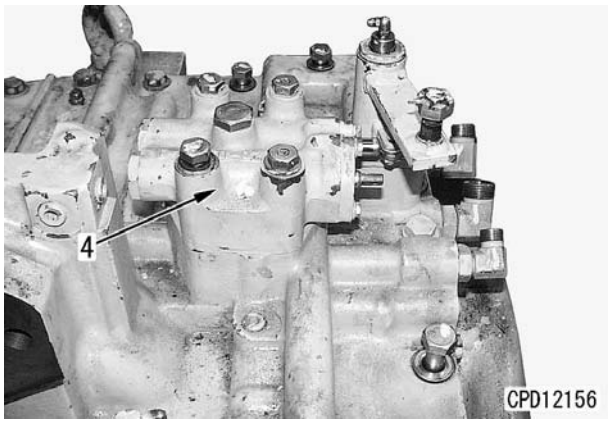


11. Brake valve assembly

Install brake valve assembly (4).

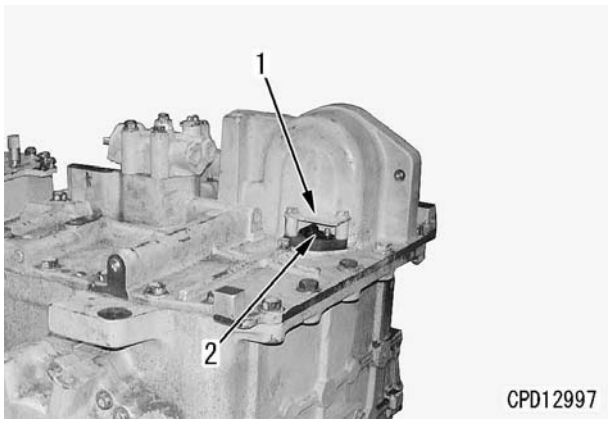
Mounting bolt:

44.1 – 53.9 Nm {4.5 – 5.5 kgm}



12. Transmission speed sensor

Install transmission speed sensor (2) and cover (1). For details, see Testing and adjusting, "Adjusting transmission speed sensor (Replacement procedure)."



Removal and installation of final drive assembly

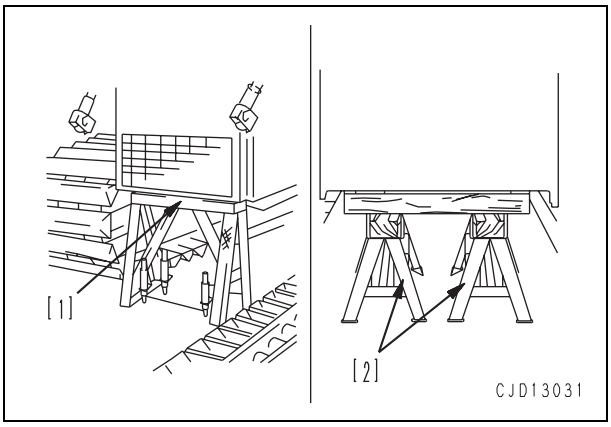
Special tools

Symbol	Part number	Part name	Necessity	Q'ty	N/R	Sketch
J1	790-337-1032	Lifting tool	■	1		
	791-427-1090	Plate	■	1		
	01010-51635	Bolt	■	2		

Removal

1. Remove track shoe assembly. For details, "Removal of track shoe assembly."

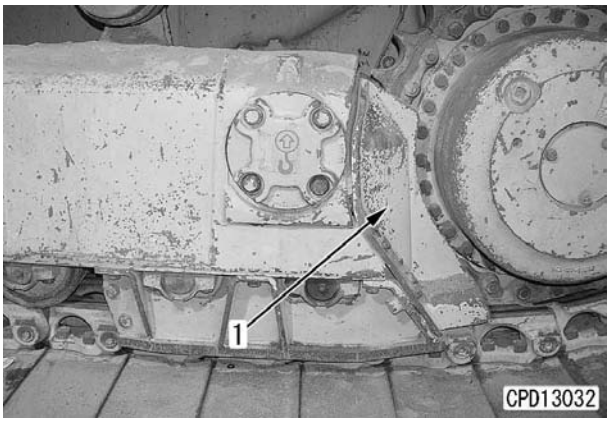
2. Using jack, jack up chassis, then set stands [1] and [2] under front frame and steering case.
⚠ **Set the stands in position securely.**



3. Drain oil from final drive case.

Final drive case: D65EX: **24 ℓ**
D65PX: **27 ℓ**
D65WX: **27 ℓ**

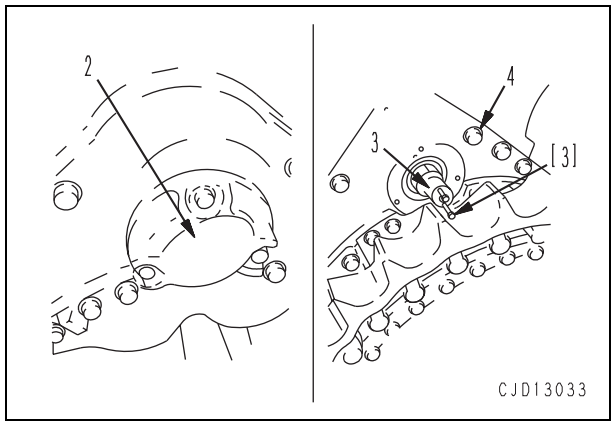
4. Remove bracket (1). [*1]



5. Remove cover (2). [*2]

6. Use bolt [3] to pull drive shaft (3) out to a position where spline portion comes out.
★ If the shaft will not come out, move the sprocket (use a jack to push up the shoe grouser from the ground), and adjust to a position where the shaft can be removed. Then pull the shaft out.

7. Leave 2 or 3 of 11 inside mounting bolts (4) and 9 outside mounting bolts in position at top, and remove remaining mounting bolts. [*3]

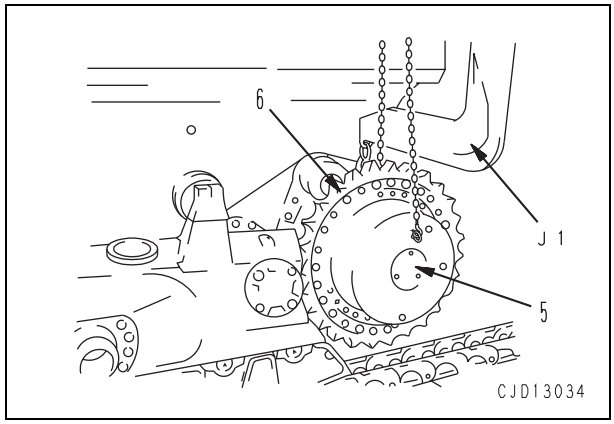


8. Remove 2 cover mounting bolts from final drive case, then set tool **J1** and lever block in position, and sling final drive assembly (5). [*4]

9. Remove the remaining bolts and move the final drive assembly outward to remove it from the case.
★ While operating the lever block and keeping the clearance between the final drive case assembly and the case even, pry off the final drive assembly with a bar, etc.

Final drive assembly: **850 kg**

10. Remove sprocket (6).



Installation

- Carry out installation in the reverse order to removal.

[*1]
Thread of bracket mounting bolt:
Liquefied adhesive (LT-2)

[*2]
★ Be careful not to damage the seal when installing.
Cover mounting bolt:
98 – 122.6 Nm {10 – 12.5 kgm}

[*3]
Final drive assembly mounting bolt:
490.3 – 608 Nm {50 – 62 kgm}

[*4]
Cover mounting bolt:
245.2 – 308.9 Nm {25 – 31.5 kgm}

- **Refilling with oil**

Final drive case: **Power train oil (TO30)**
D65EX: **24 ℓ**
D65PX: **27 ℓ**
D65WX: **27 ℓ**

Disassembly and assembly of final drive assembly

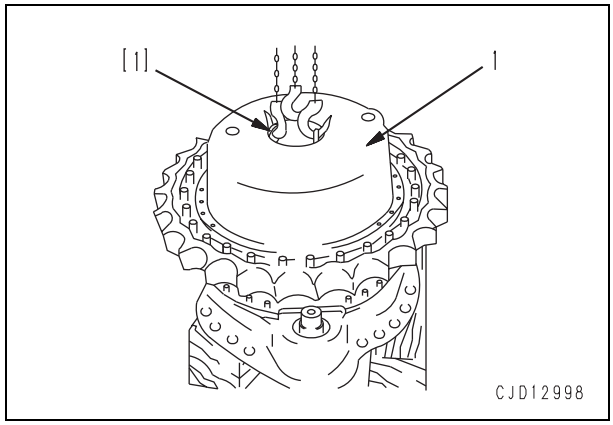
Special tools

Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
J		791-427-1100	Remover assembly	■	1		
	2	790-101-2102	Puller	■	1		
		790-101-1102	Pump	■	1		
	3	792-520-2121	Installer	■	1		
		791-427-1200	Installer assembly	■	1		
	4	790-101-2102	Puller	■	1		
		790-101-1102	Pump	■	1		

Disassembly

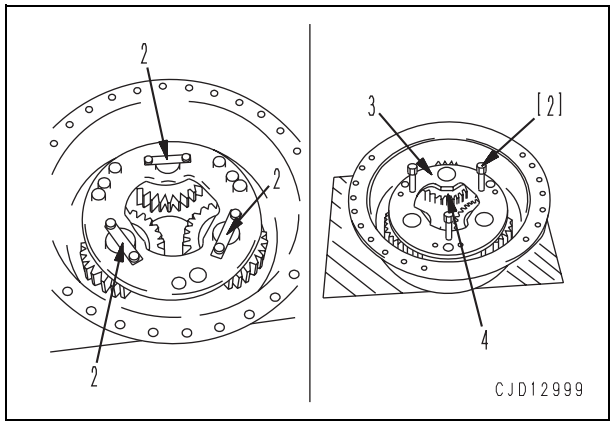
1. Carrier assembly

1) Remove cover.
2) Remove mounting bolts, and using eyebolts [1], remove carrier assembly (1).

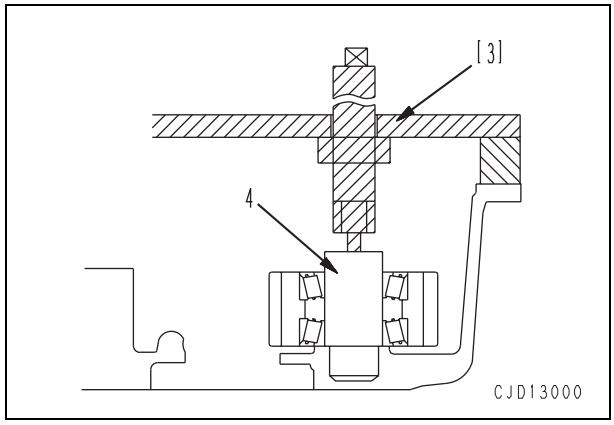


2. Disassembly of carrier assembly

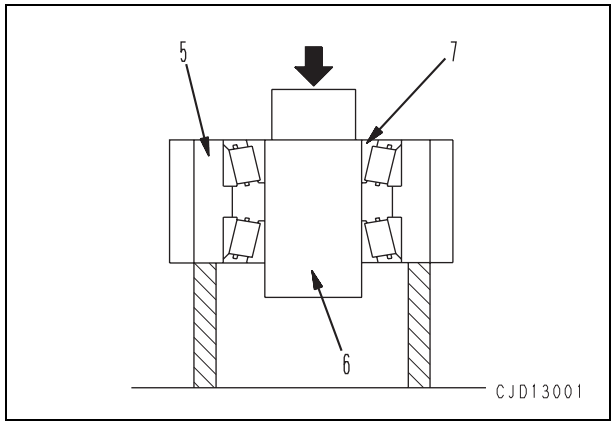
1) Remove lock plate (2).
2) Using forcing screw [2], remove plate (3) together with gear assembly (4).
3) Remove gear assembly (4) from plate (3).



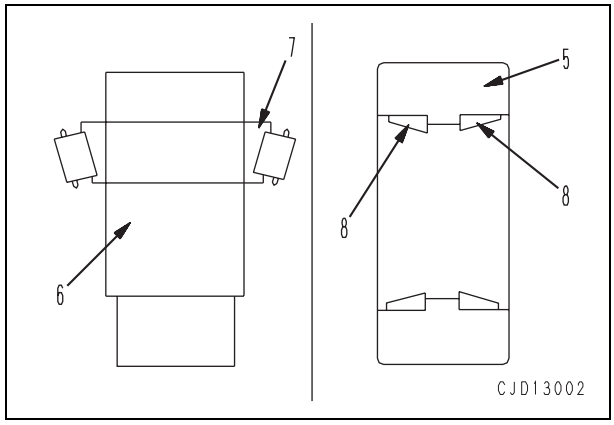
★ If gear assembly (4) remains in position when the plate remains, use puller [3] to remove it.



4) Support gear (5), then push shaft (6) and remove bearing (7).



5) Remove bearing (7) from shaft (6).
6) Remove outer race (8) from gear (5).

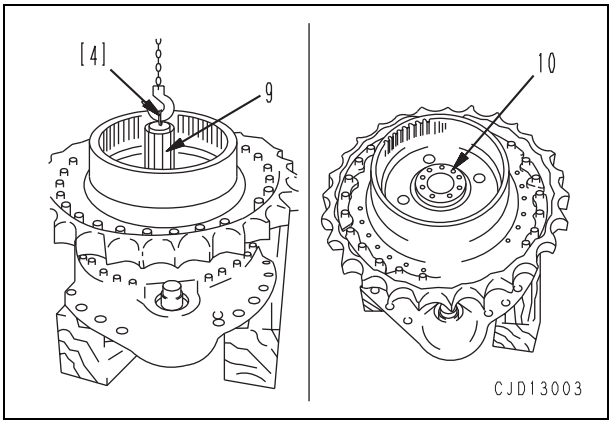


3. Shaft

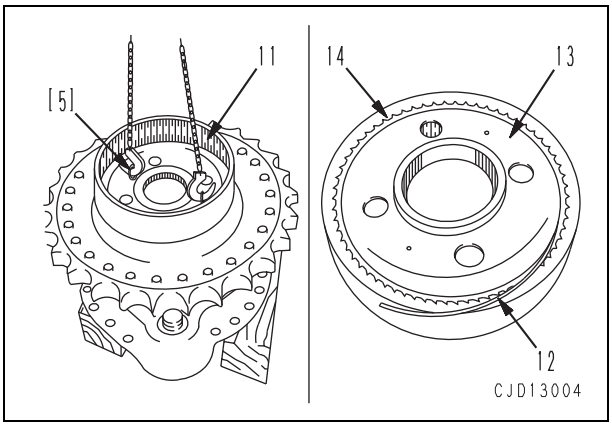
Using eyebolts [4], remove shaft (9).

4. Ring gear, housing assembly

1) Remove holder (10).

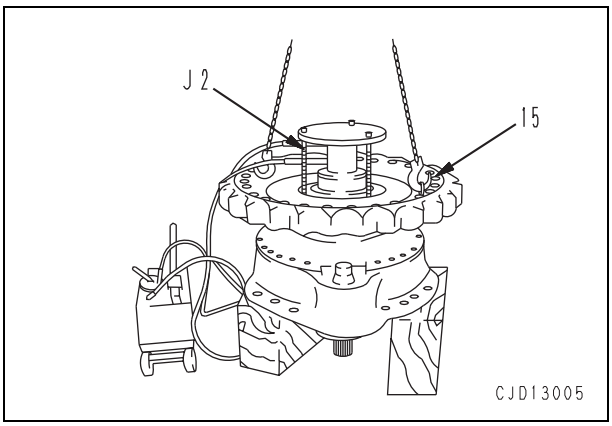


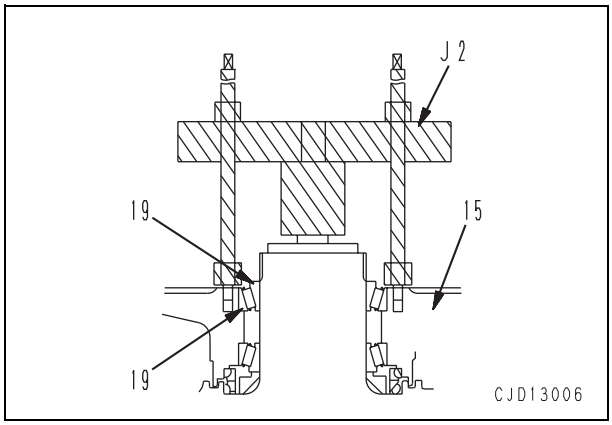
2) Using eyebolts [5], remove ring gear and hub assembly (11).
3) Remove snap ring (12), then remove ring gear (14) from hub (13).



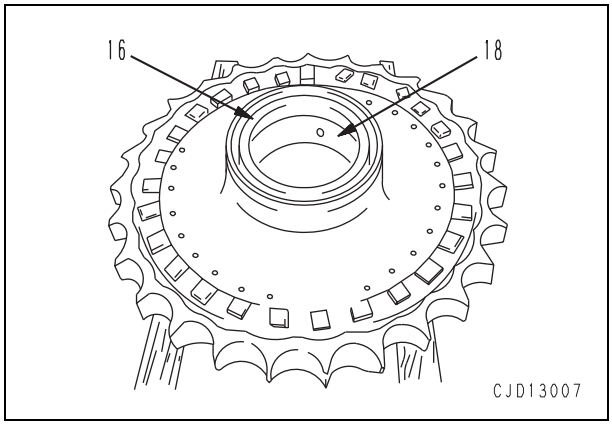
5. Sprocket, hub assembly

1) Fit eyebolts, pull out sprocket and hub assembly (15) with tool **J2**, and remove.
   ★ Bearing (19) will come out at the same time.



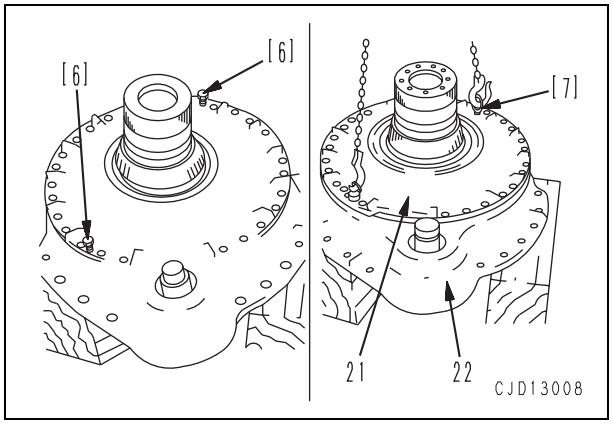


2) Remove floating seal (16).
   ★ If it is to be used again, be careful not to damage the seal surface and keep it in a safe place.
3) Remove outer race (18).

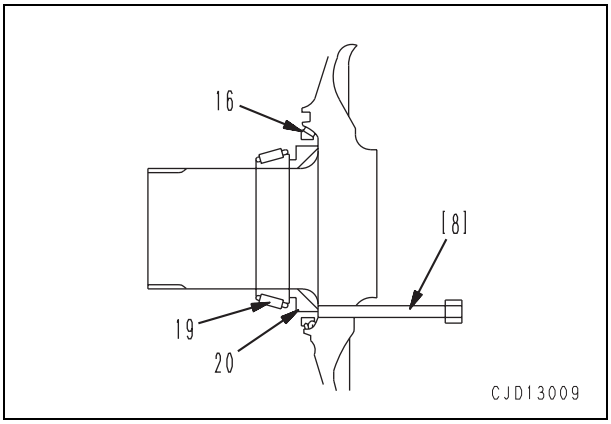


6. Cover assembly

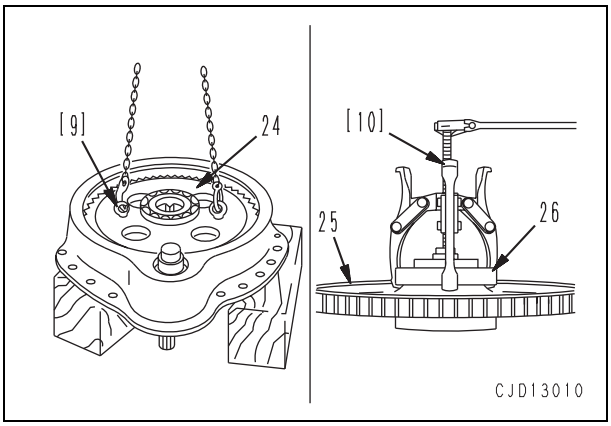
1) Tighten forcing screw [6] to pull cover assembly (21) out of case (22). Then, using eyebolts [7], remove cover assembly (21).
   ★ Although the cover assemblies of D65EX-15E0, D65PX-15E0 and D65WX-15E0 have different shapes, they can be removed similarly.



2) Remove floating seal (16).
   ★ If it is to be used again, be careful not to damage the seal surface and keep it in a safe place.
3) Using forcing screw [8], remove spacer (20) and bearing (19) from cover.

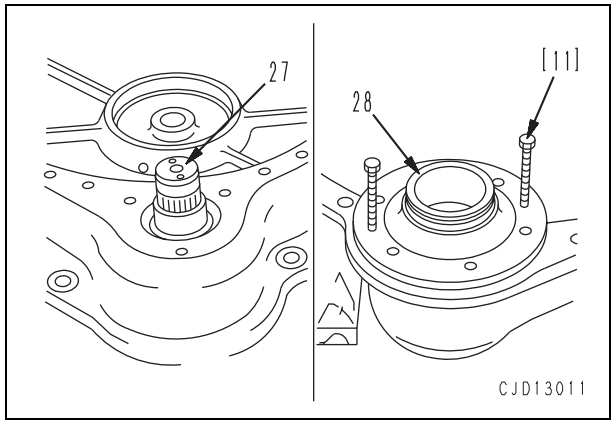


7. Gear assembly
1) Using eyebolts [9], remove gear assembly (24) from case.
2) Using puller [10], remove bearing (26) from gear assembly (25).

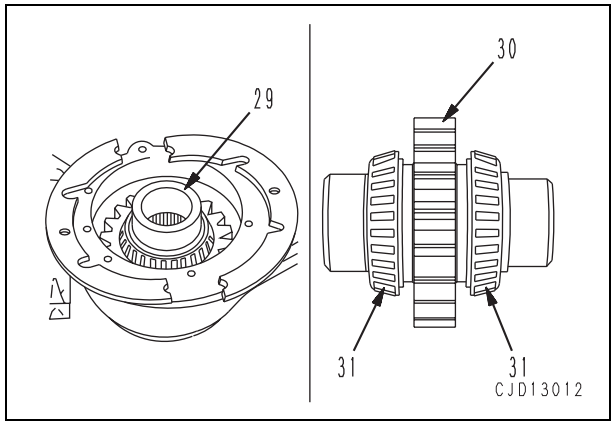


8. Output shaft
Remove output shaft (27).

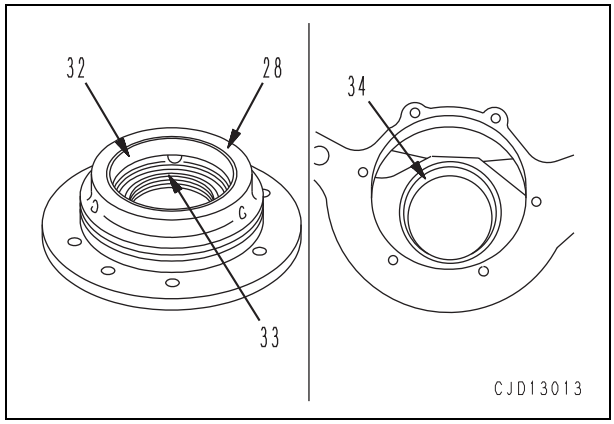
9. Pinion assembly
1) Using forcing screws [11], remove cage (28).
   ★ Check the number and thickness of the shims, and keep in a safe place.



2) Remove pinion assembly (29).
3) Remove bearing (31) from pinion (30).



4) Remove outer race (32) and oil seal (33) from cage (28).
5) Remove outer race (34) from case.

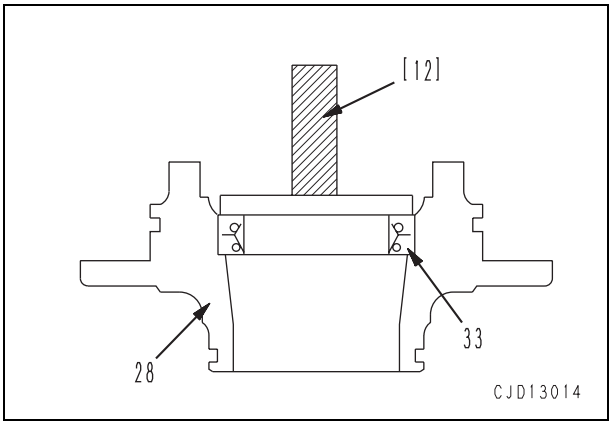


Assembly

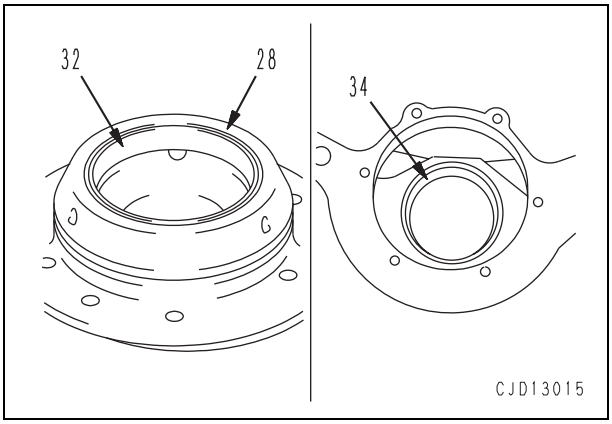
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. Pinion assembly

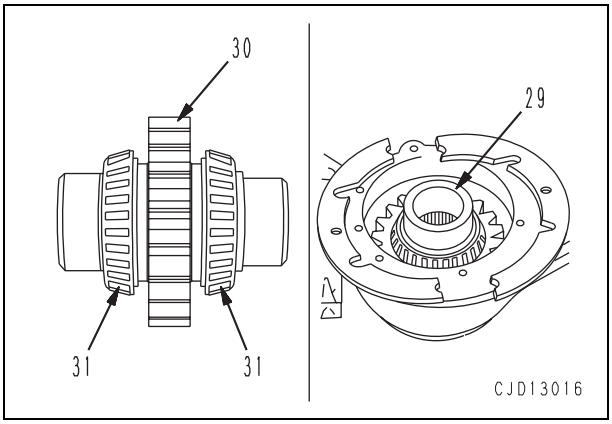
1) Using push tool [12], install oil seal (33) to cage (28).
   Lip of oil seal: **Grease (G2-LI)**



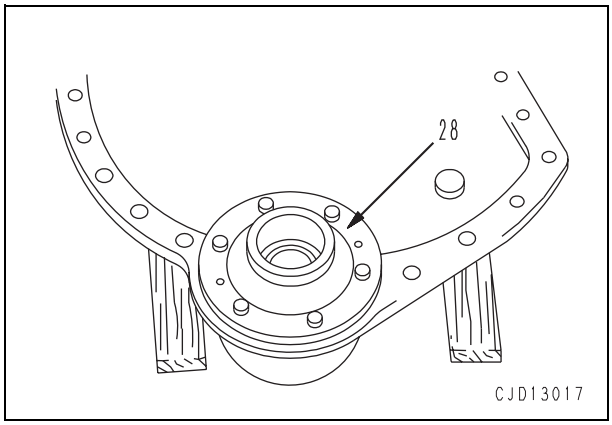
2) Install outer race (32) to cage (28).
3) Install outer race (34) to case.



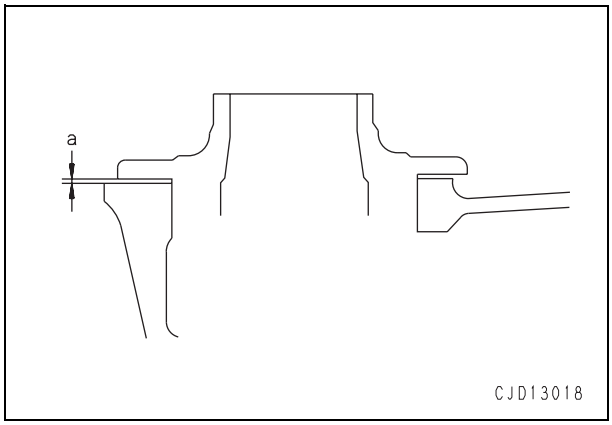
4) Install bearings (31) to pinion (30).
5) Install pinion assembly (29).
   ★ Install so that the part with the small outside diameter is facing the outside.



6) Assemble shim, then install cage (28).

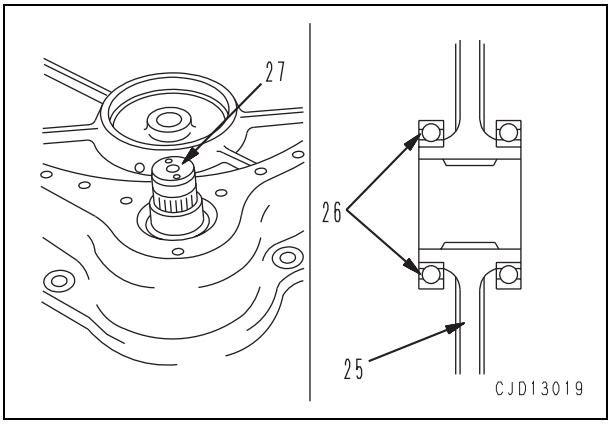


★ Select the shim thickness to be assembled as follows.
   i) Install pinion without fitting O-ring to cage.
   ii) Hold cage down by hand, and use a thickness gauge to measure clearance between gauge and case at 2 places on the circumference.
   iii) Select shim to give a thickness of measured clearance (a) + 0 to 0.1 mm.
      ★ If the clearance is 0, check that the rotating torque of the pinion is at least 0.98 Nm {0.1 kgm}.

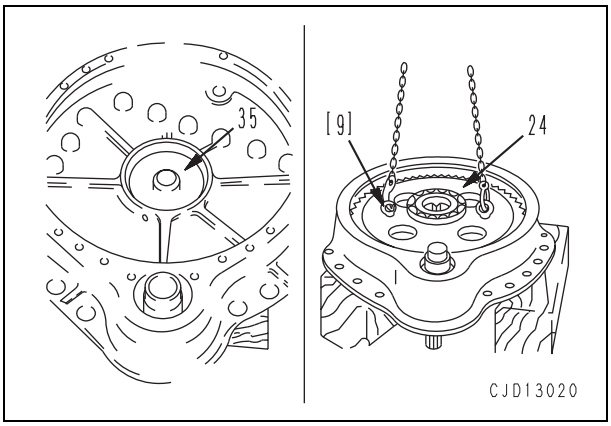


2. Output shaft
Install output shaft (27).

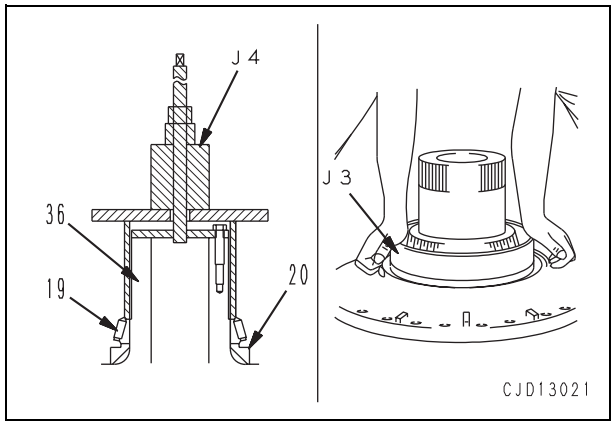
3. Gear assembly
1) Install bearing (26) to gear (25).



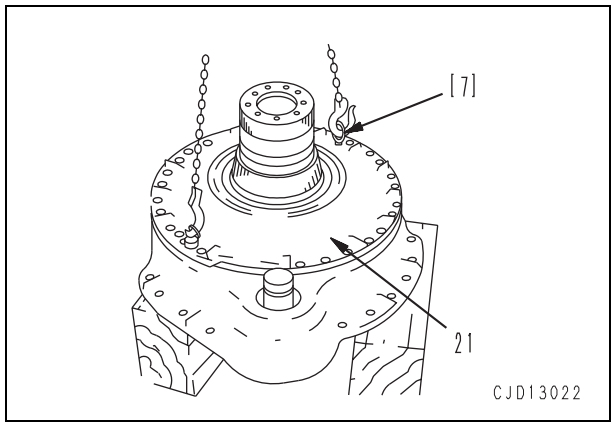
2) Install thrust washer (35) to case.
3) Using eyebolts [9], install gear assembly (24).



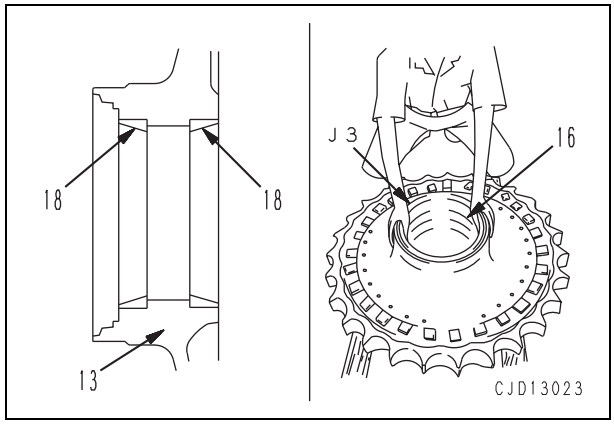
4. Cover assembly
1) Install spacer (20) to cover (36).
2) Using tool **J4**, press fit bearing (19).
   ★ A press can be used instead of the puller.
3) Using tool **J3**, install floating seal.
   ★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry before installing.
   ★ After installing the floating seal, check that the angle of the seal is less than 1 mm.



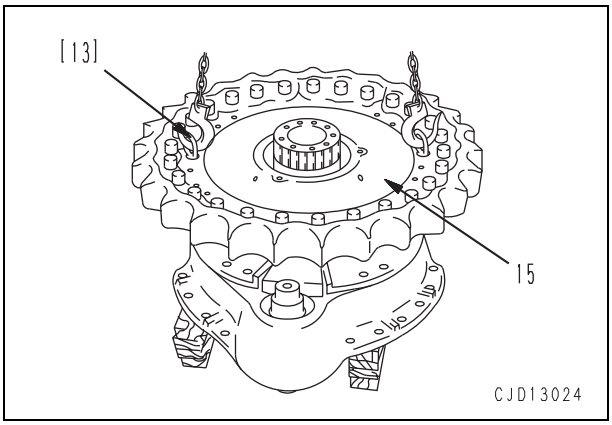
4) Using eyebolts [7], install cover assembly (21) to case, then tighten mounting bolts.



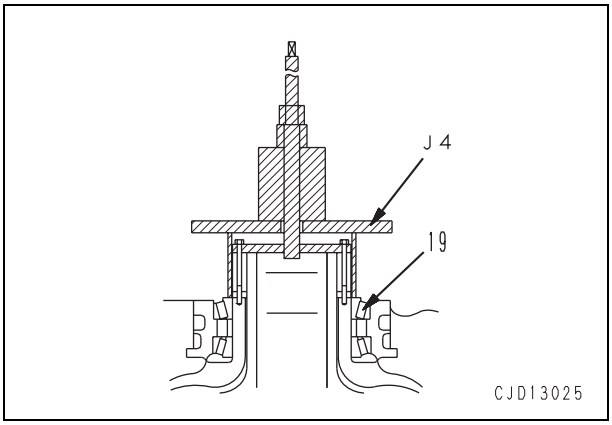
5. Sprocket, hub assembly
1) Install outer race (18) to hub (13).
2) Using tool **J3**, install floating seal (16).
   ★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry before installing.
   ★ After installing the floating seal, check that the angle of the seal is less than 1 mm.



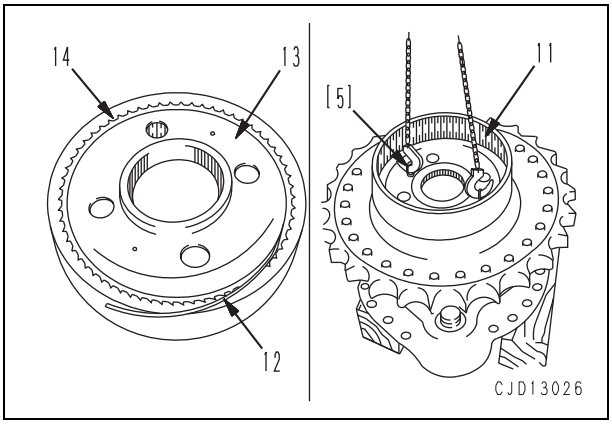
3) Check that there is no dirt or dust on sliding surface of floating seal, then coat thinly with engine oil.
4) Using eyebolts [13], set sprocket and hub assembly (15) in cover.



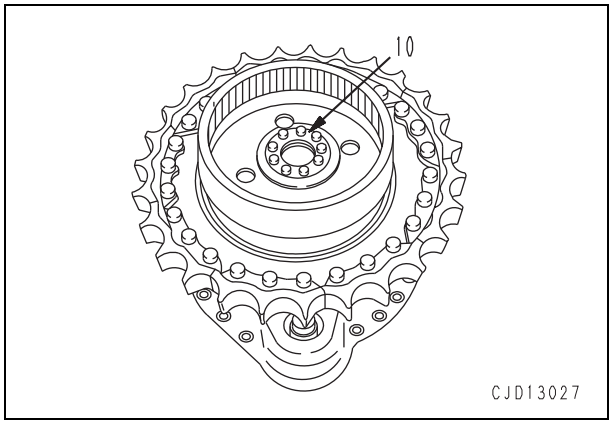
5) Using tool **J4**, rotate sprocket and hub assembly, and press fit bearing (19).
   ★ Press fit to a point which does not give any preload.



6) Set hub (13) to ring gear (14), and install snap ring (12).
7) Using eyebolts [5], install ring gear and hub assembly (11).

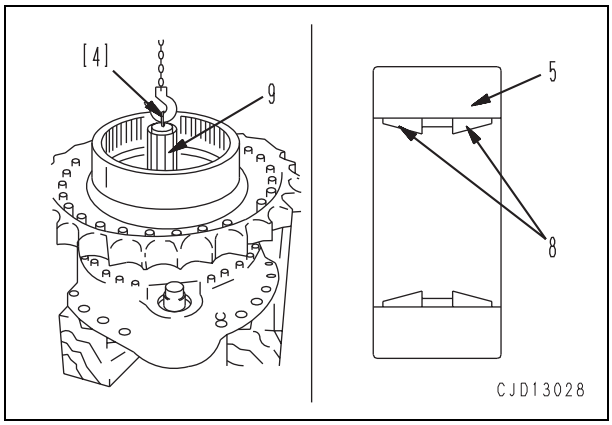


8) Set holder (10) in position.
   ★ The bearings are set right, so there is no need to adjust them, but in order to check that there are no defective parts, measure the preload as follows.
   i) With no preload given to the bearings, measure the rotating torque of the sprocket hub, and take this as (b) Nm {kgm}.
      ★ Measure the sliding resistance of the floating seal first.
   ii) Rotate the sprocket and tighten the plate holder bolt to 245.2 – 308.9 Nm {25 – 31.5 kgm}.
   iii) After tightening the bolt, check that the rotating torque is (b) + 0 to 61.8 Nm {0 to 6.3 kgm}.

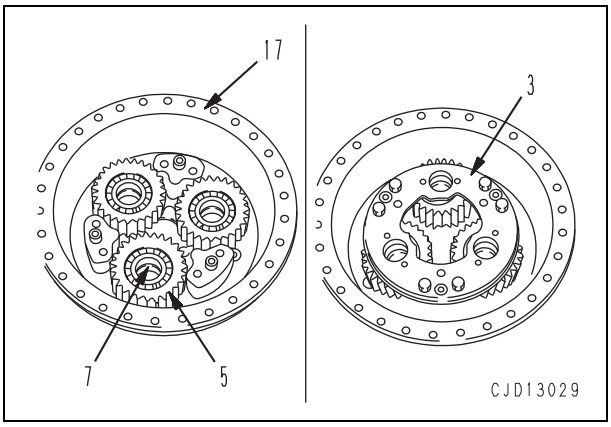


6. Shaft
Using eyebolts [4], install shaft (9).

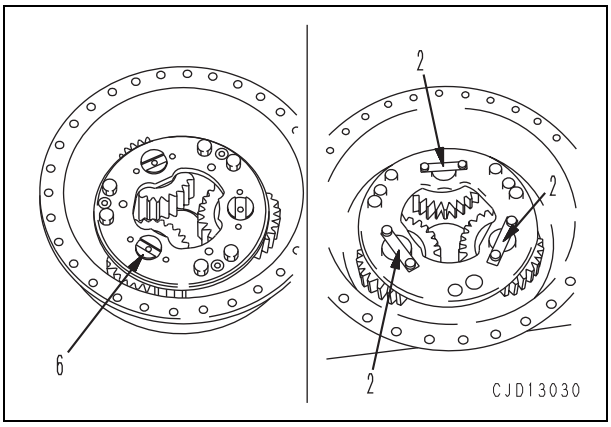
7. Carrier assembly
1) Press fit outer race (8) to planetary gear (5).
   ★ The bearing is set right, so be careful not to change the combination when installing.



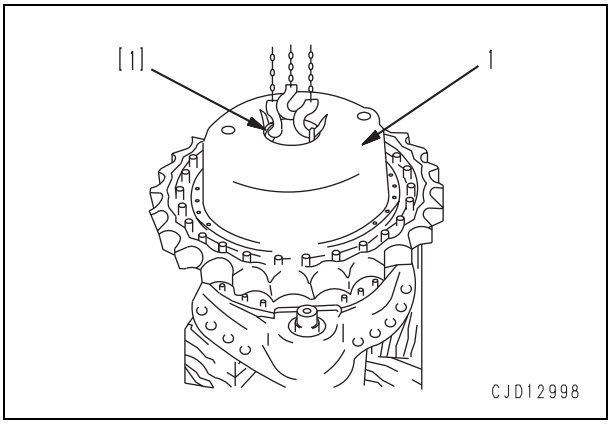
2) Assemble 2 bearings (7) to gear (5), and set to carrier (17).
   ★ Center with the shaft hole.
3) Align with dowel pin and install plate (3).
   Mounting bolt:
   490.3 – 608 Nm {50 – 62 kgm}



4) Expand fit shaft (6).
   ★ Leave in dry ice for approx. 30 minutes.
5) Install lock plates (2).
   Mounting bolt:
   98 – 122.6 Nm {10 – 12.5 kgm}



6) Using eyebolts [1], install carrier assembly (1).
   Mounting bolt:
   245.2 – 308.9 Nm {25 – 31.5 kgm}
7) Install cover.



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00948-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

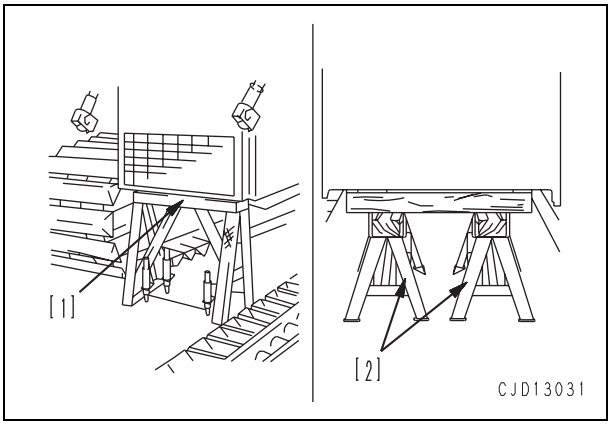
Undercarriage and frame, Part 1

Undercarriage and frame, Part 1

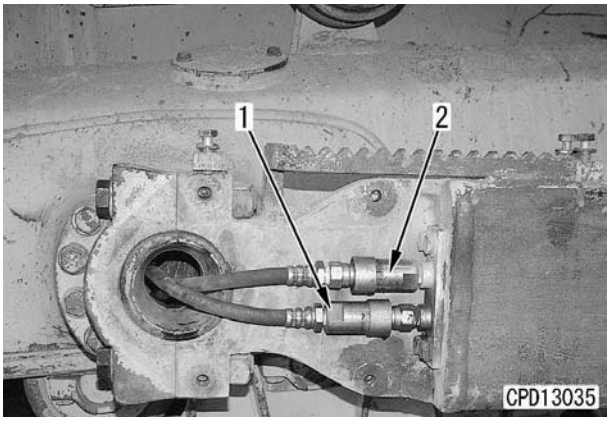
Removal and installation of track frame assembly

Removal

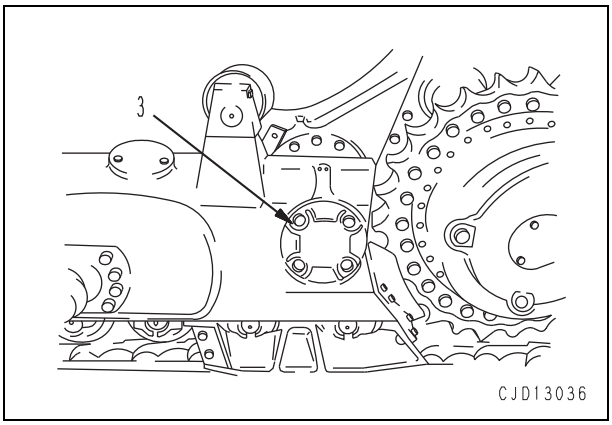
1. Remove track shoe assembly. For details, see "Expansion and installation of track shoe assembly."
2. Using jack, jack up chassis, then set stands [1] and [2] under front frame and steering case.
   ⚠ **Set the stands securely.**



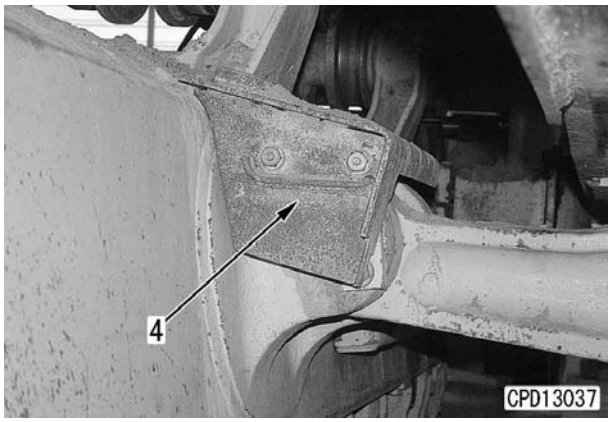
3. Remove tilt cylinder hose protection cover, then disconnect hoses (1) and (2). (On inside of track frame on right side of chassis).



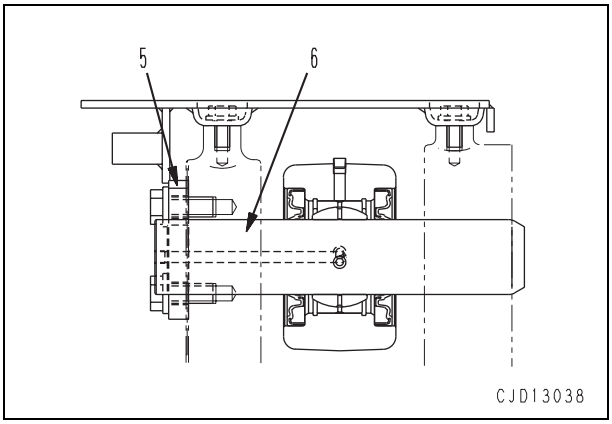
4. Remove pivot shaft cover (3).
   ★ The diagram shows the D65EX-15.



5. Remove cover (4).



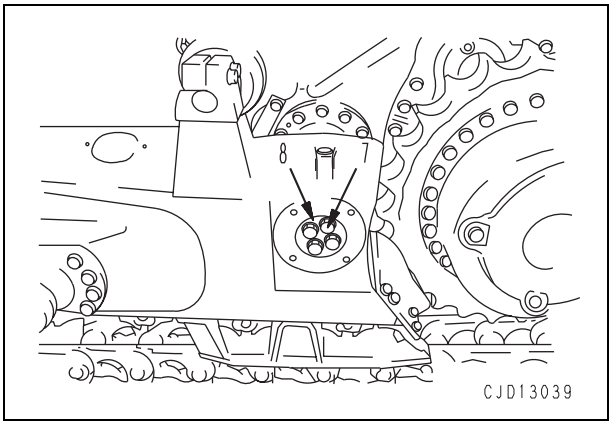
6. Sling the track frame assembly.
7. Remove lock (5) and pull out pin (6). [*1]

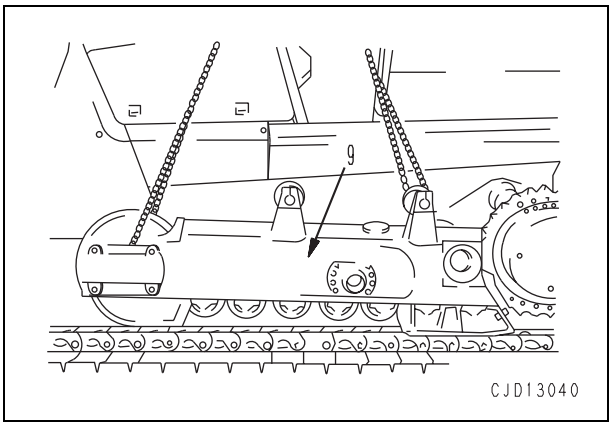


8. Remove bolt (7) and plate (8), then lift off track frame assembly (9). [*2]
★ Oil will leak from the pivot shaft case, so prepare a container to catch it.

Track frame assembly:
1,600 kg (D65EX)
1,800 kg (D65PX)

Pivot shaft case: **4.5 ℓ**





Installation

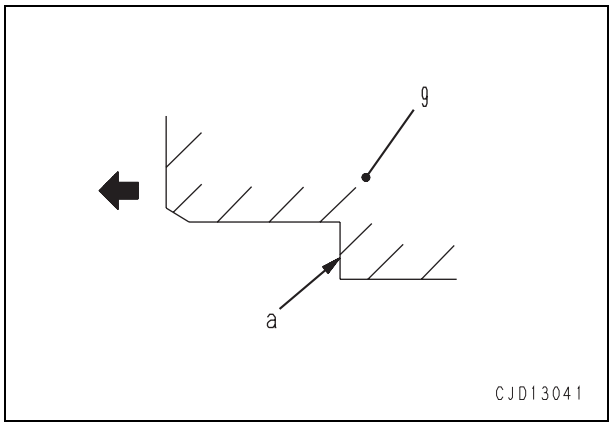
- Carry out installation in the reverse order to removal.

[*1]
⚠ **When aligning the pin holes, never insert your fingers in them.**

[*2]
★ When inserting in the pivot shaft, apply oil (EO30-CD) to face (a) of track frame (9).

Plate mounting bolt:
455 – 565 Nm {46.5 – 58 kgm}

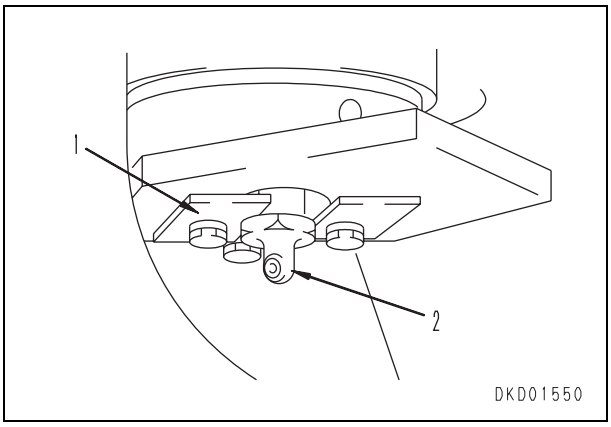
Pivot shaft case: **4.5 ℓ (EO30-CD)**



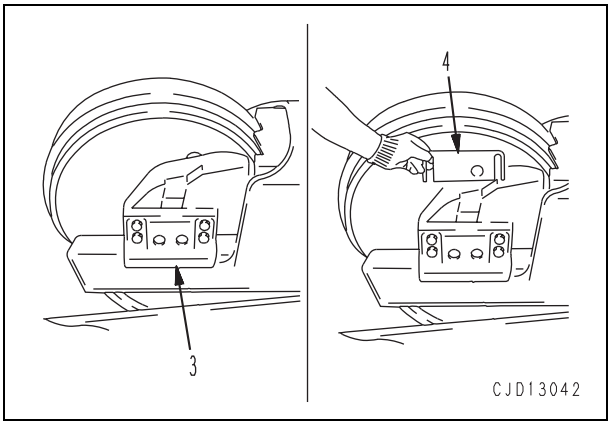
Removal and installation of idler assembly

Removal

1. Remove track shoe assembly. For details, see "Expansion and installation of track shoe assembly."
2. Remove lock plate (1), then remove lubricator (2).
   - ⚠ **The inside of the recoil spring cylinder is under negative pressure, so if the lubricator is not removed, the yoke will be pulled back into the cylinder when the yoke and idler support are disconnected.**
   - ⚠ **To prevent danger, never stand in front of or behind the recoil spring assembly.**

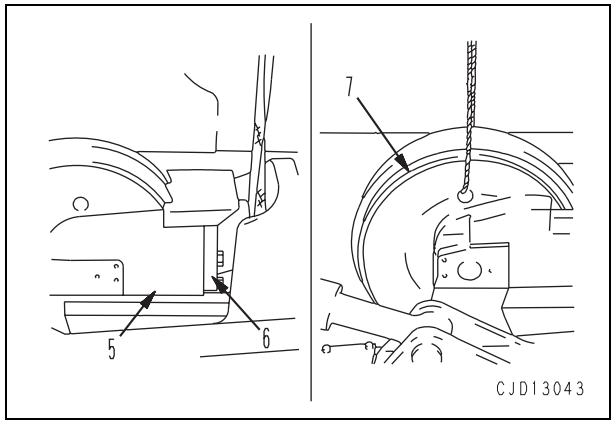


3. Remove left and right guide plates (3). [*1]
   - ★ Remove shims (4), check the number and thickness, and keep in a safe place.



4. Raise idler assembly and pull out, then remove mounting bolts of support (5) and yoke (6).
5. Lift off idler assembly (7).

   Idler: **200 kg**

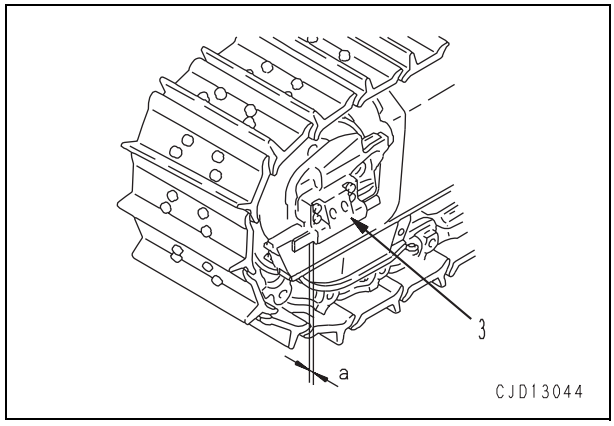


Installation

- Carry out installation in the reverse order to removal.

[*1]
- ★ Standard shim thickness: **4 mm**
- ★ Adjust the shim thickness so that clearance (a) between the track frame and guide plate (3) is 0.5 – 1.0 mm.

  Thread of guide plate mounting bolt: **Liquefied adhesive (LT-2)**



Disassembly and assembly of idler assembly

Special tools

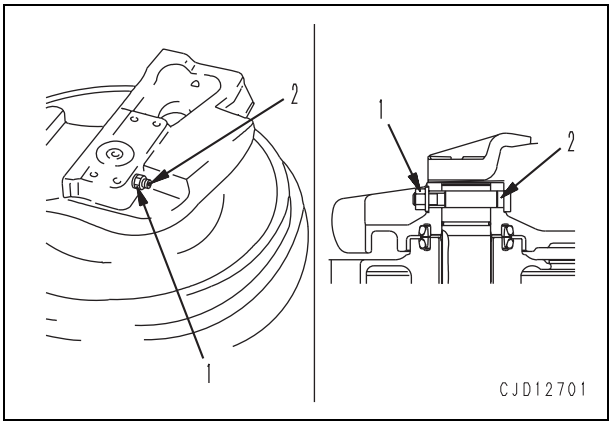
Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
L	1	791-515-1520	Installer	■	1		
	4	791-601-1000	Oil pump	■	1		

Disassembly

1. Remove the oil filler plug and drain the oil.

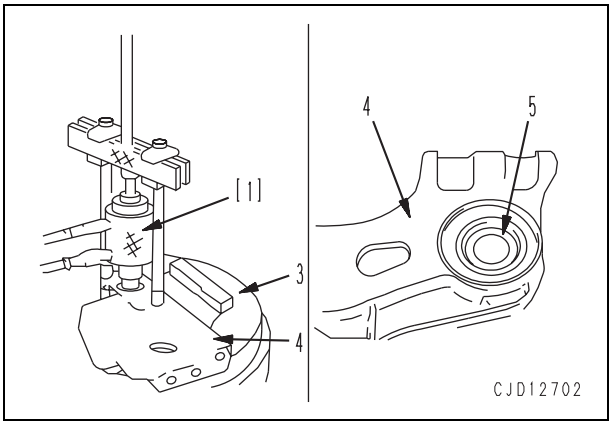
Idler: **0.25 ℓ**

2. Remove nut (1) and drive out bolt (2) from the nut side.



3. Using push puller [1], pull support (4) out of idler (3).

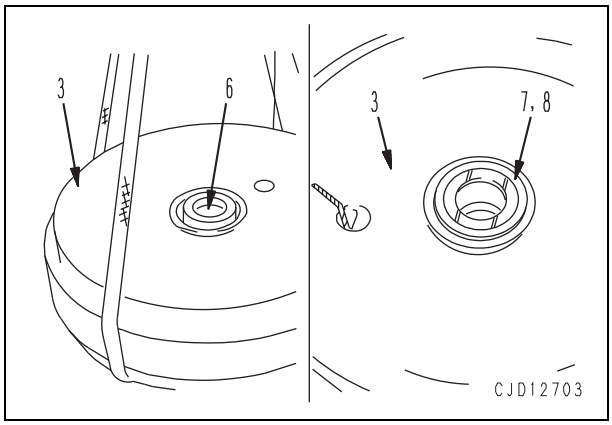
4. Remove floating seal (5) from support (4).



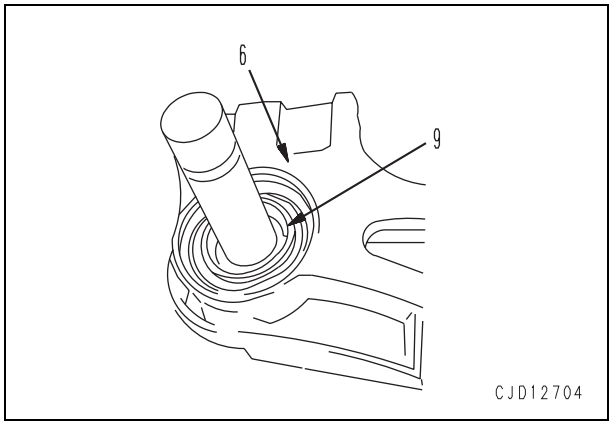
5. Sling idler (3) and pull it out of shaft and support assembly (6).

★ Prevent the sling wires from opening with wires or ropes.

6. Remove floating seals (7) and (8) from idler (3).

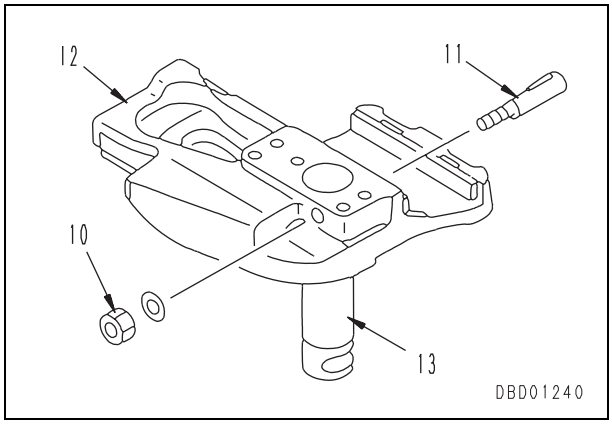


7. Remove floating seal (9) from shaft and support assembly (6).

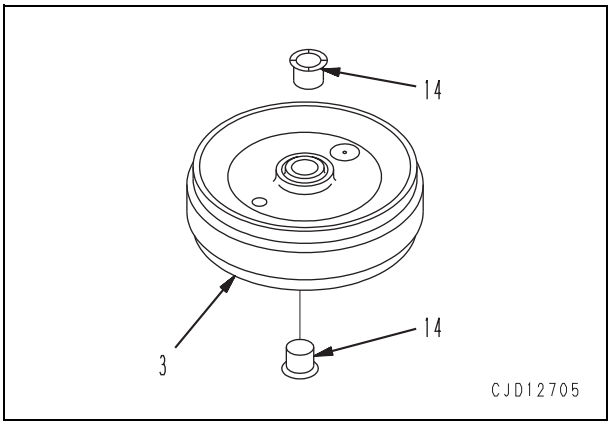


8. Remove nut (10) and drive out bolt (11) from the nut side.

9. Similarly to step 3, using the push puller, pull shaft (13) out of support (12).

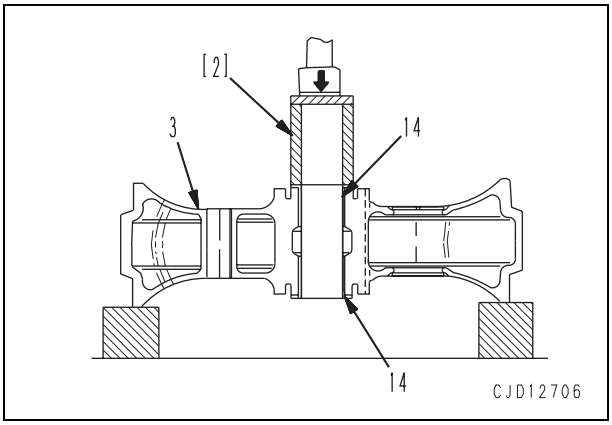


10. Remove 2 bushings (14) from idler (3).



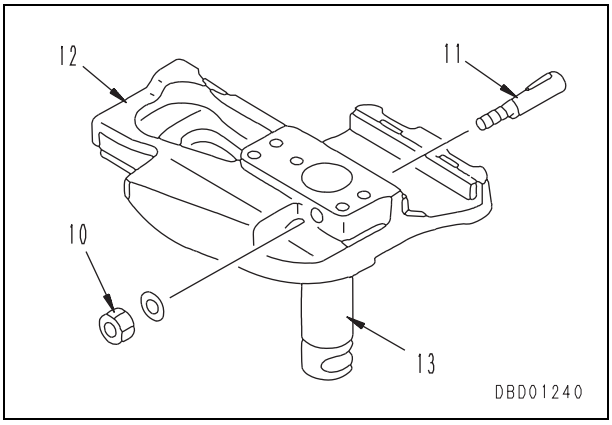
Assembly

1. Using push tool [2], press fit 2 bushings (14) to idler (3).

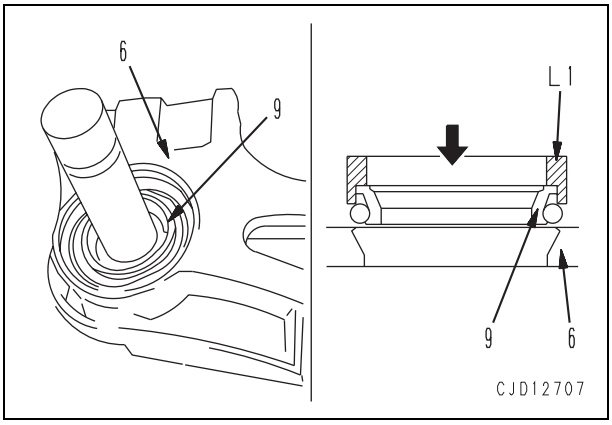


2. Fit the O-ring to shaft (13) and install them to support (12).
- ★ When installing the shaft, match it to the groove of the support.
- ★ Install the shaft to the support, the end not having an oil filler first.

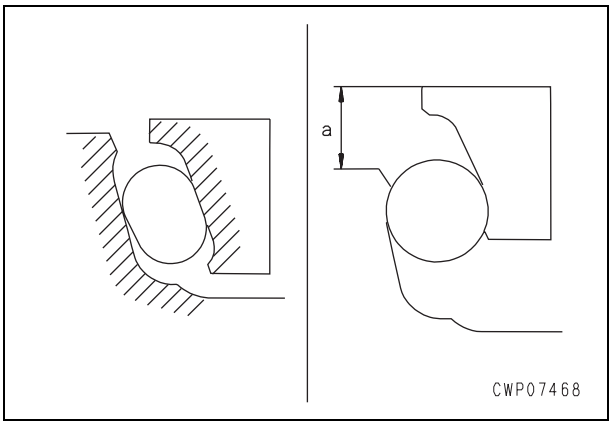
3. Drive in bolt (11) and tighten nut (10).
Nut: **Liquefied adhesive (LT-2)**



4. Using tool **L1**, install floating seal (9) to shaft and support assembly (6).

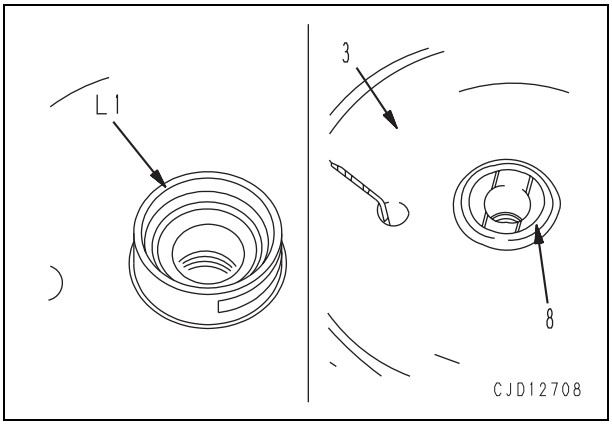


★ When installing floating seals, thoroughly clean, degrease, and dry the contact surfaces of the O-rings and floating seals (hatched parts). Take care that dirt will not stick to the floating seal contact surfaces.
★ After installing the floating seals, check that their slant is less than 1 mm and their projection (a) is 7 – 11 mm.

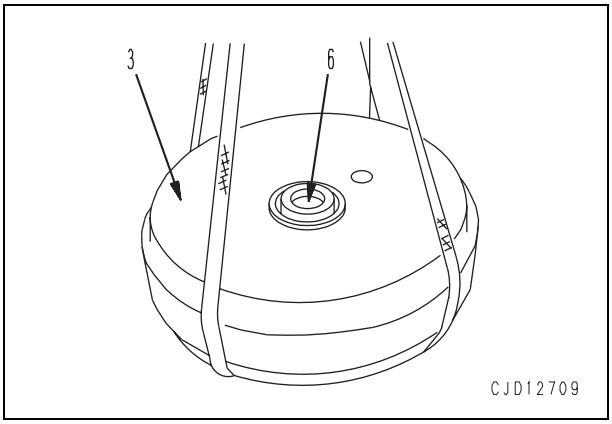


5. Fit the O-ring to the shaft.

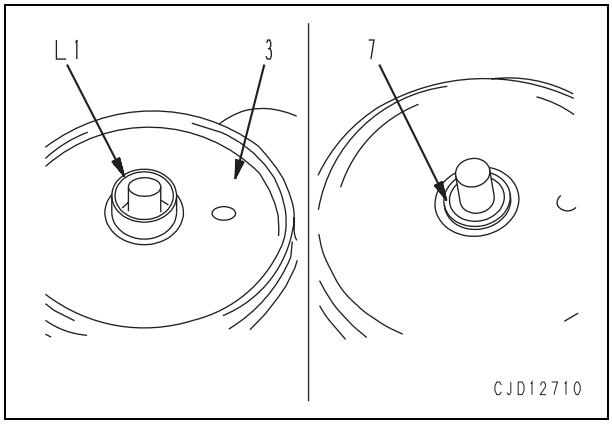
6. Using tool **L1**, install floating seal (8) to idler (3).
★ For the method of installation, see step 4.



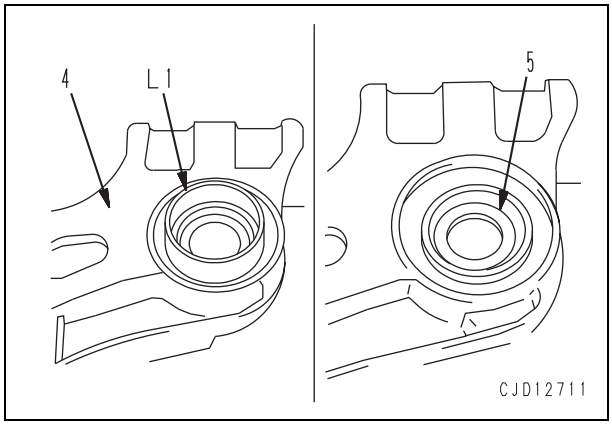
7. Sling and install idler (3) to shaft and support assembly (6).
★ Prevent the sling wires from opening with wires or ropes.



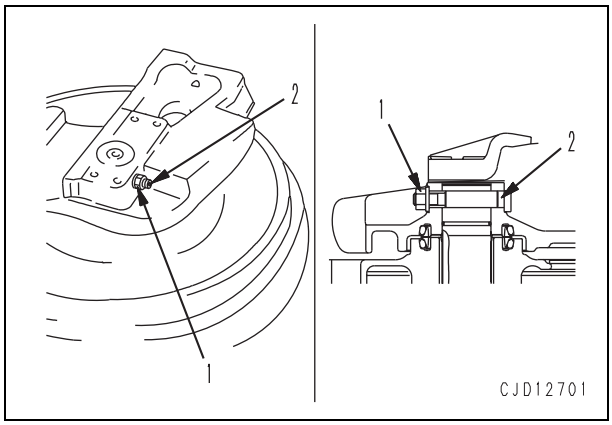
8. Using tool **L1**, install floating seal (7) to idler (3).
★ For the method of installation, see step 4.



9. Using tool **L1**, install floating seal (5) to support (4).
★ For the method of installation, see step 4.



10. Drive in bolt (2) and tighten nut (1).

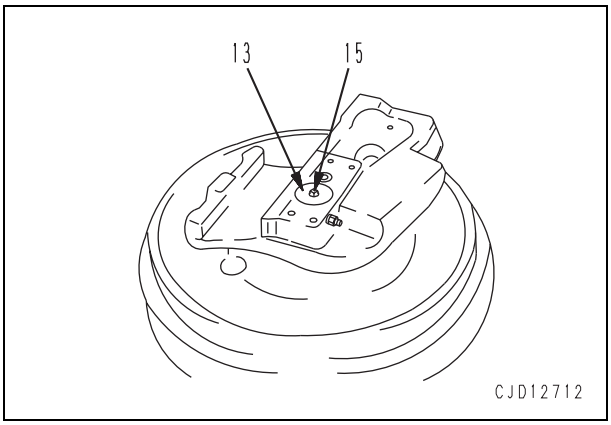


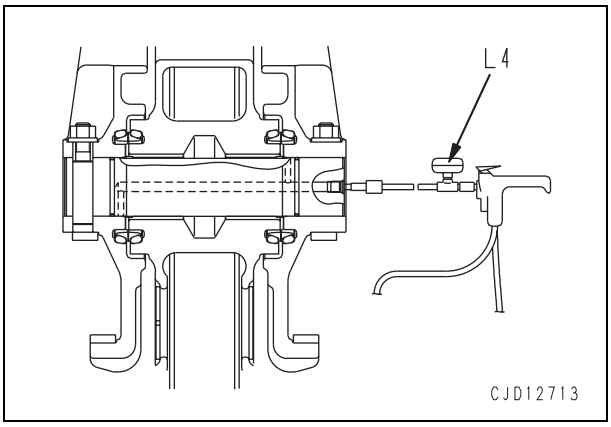
11. Refilling with oil

1) Remove plug (15) from shaft (13) and add oil through the oil filler.
   ★ When evacuating the system before adding the oil, use tool **L4**.

   Idler: **0.25 ℓ (TO30)**

2) Tighten plug (15).
   Plug: **98 – 137.2 Nm {10 – 14 kgm}**





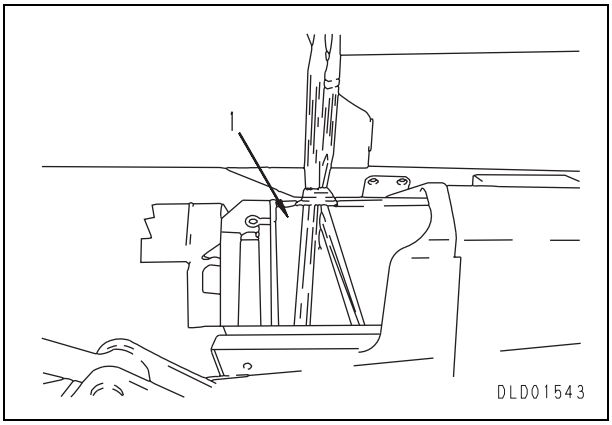
Removal and installation of recoil spring assembly

Removal

1. Remove idler assembly. For details, see "Removal and installation of idler assembly."

2. Lift off recoil spring assembly (1). [*1]

Recoil spring assembly: **500 kg**

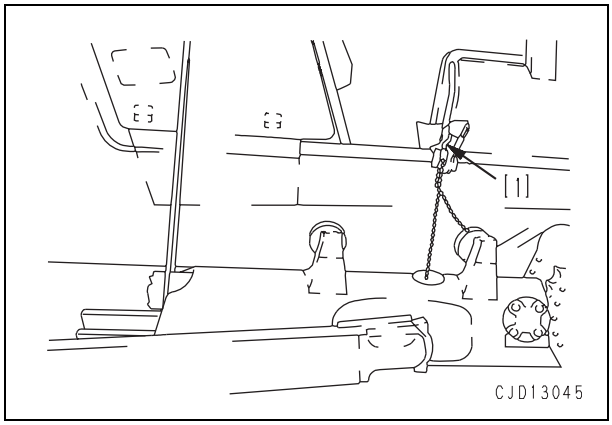


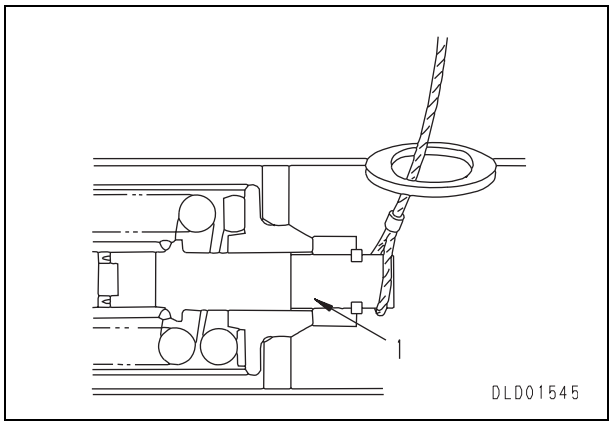
Installation

- Carry out installation in the reverse order to removal.

[*1]

★ When assembling the recoil spring assembly (1) inside the track frame, use lever block [1] to sling the top and make it horizontal, then push in the recoil spring and set it in the frame.





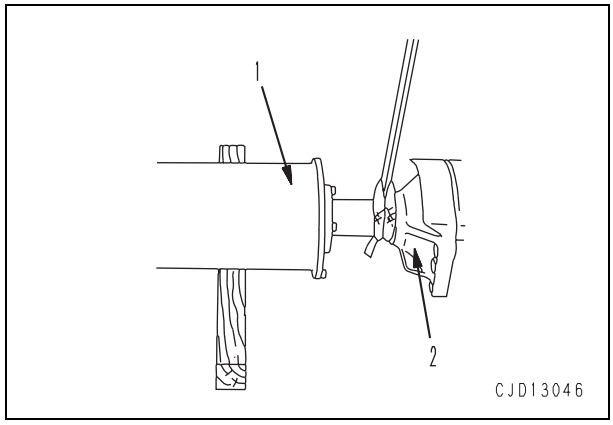
Disassembly and assembly of recoil spring assembly

Special tools

Symbol	Part number	Part name	Necessity	Q'ty	N/R	Sketch
M	791-685-8005	Compressor of type B	■	1		
	791-635-3160	Extension	■	1		
	790-201-2780	Spacer	■	1		
	790-201-2790	Spacer	■	1		
	790-101-1102	Pump	■	1		
	790-101-1600	Cylinder	■	1		

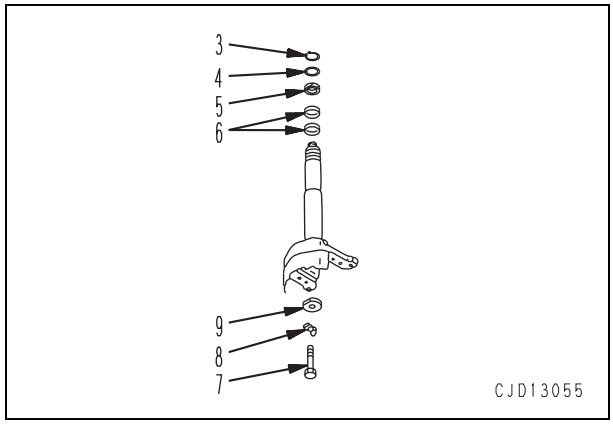
Disassembly

1. Remove yoke and piston assembly (2) from recoil spring assembly (1).

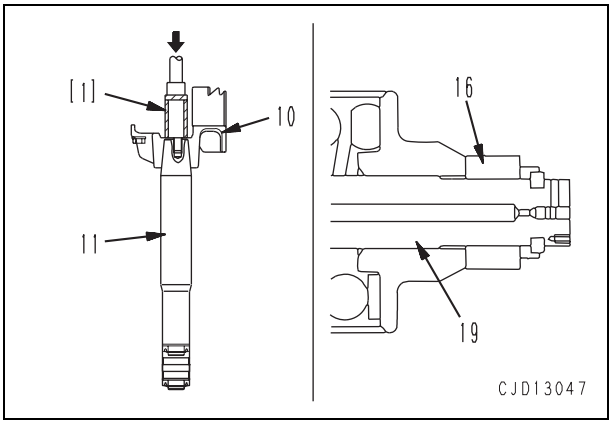


2. Disassembly of yoke, piston assembly

1) Remove snap ring (3), then remove ring (4), packing (5), and rings (6).
2) Remove bolt (7), then remove plate (8) and washer (9).



3) Using push tool [1], remove piston (11) from yoke (10) with press.
   ★ If cylinder (19) has not been damaged, or nut (16) at the tip of the shaft has not fallen off, disassemble as follows.

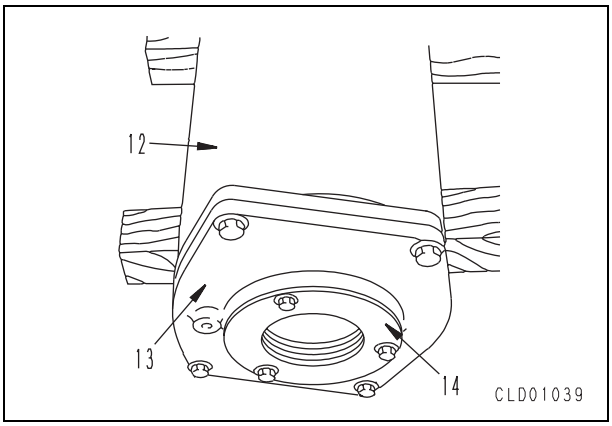


3. Remove holder (13) from case (12) of recoil spring.

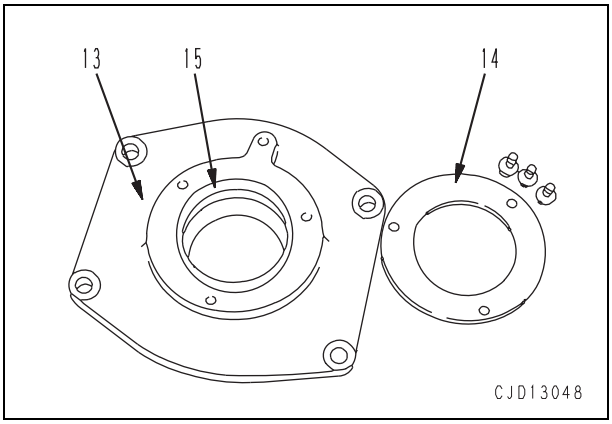
⚠ **To prevent danger, never stand in front of or behind the recoil spring assembly.**

4. Disassembly of holder

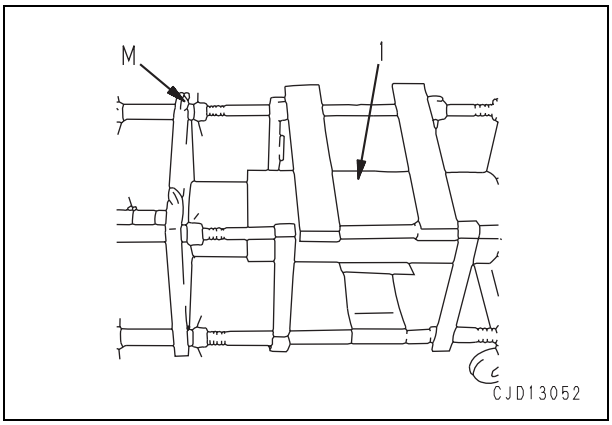
1) Remove cover (14) from holder (13).



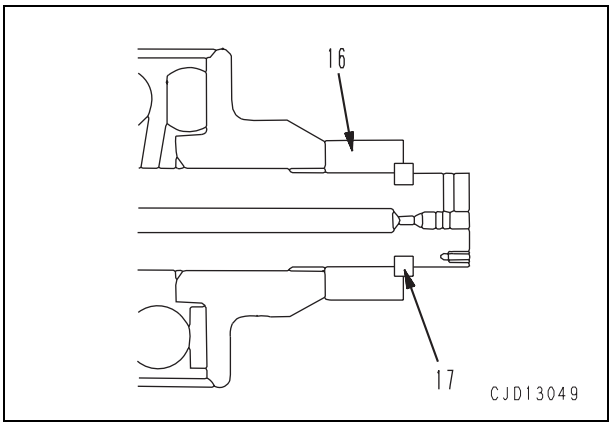
2) Remove seal (15) from holder (13).



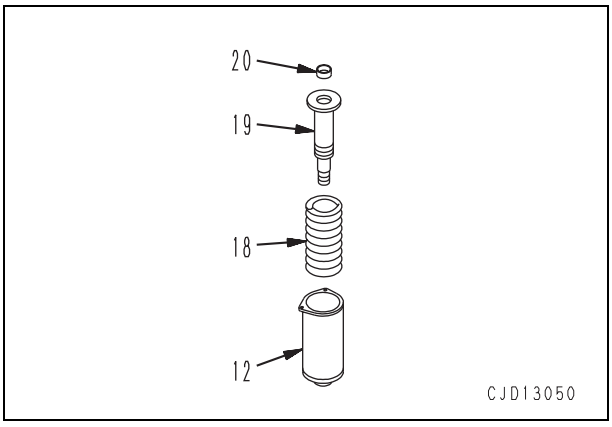
5. Set recoil spring assembly (1) to tool **M**.
   - ⚠ **The spring is under a high installed load, so be careful to set it correctly.**
   - ★ Installed load of spring: **189.5 kN {19,320 kg}**



6. Apply hydraulic pressure slowly, compress spring, and tighten nut (16) until spacer (17) comes out, then take out spacer (17) and remove nut (16).

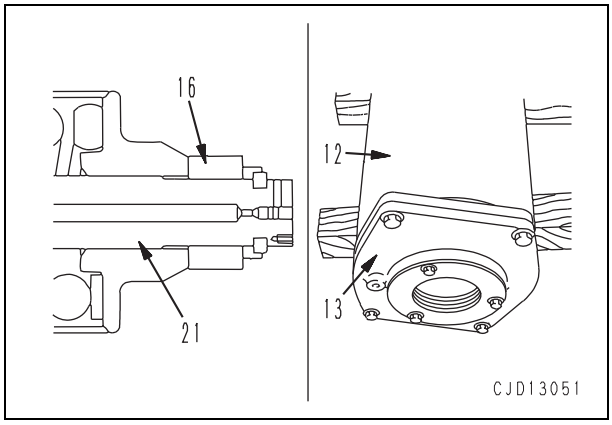


7. Gradually release hydraulic pressure to remove tension of spring.
8. Remove spring (18) and cylinder (19) from case (12), then remove bushing (20) from cylinder (19).

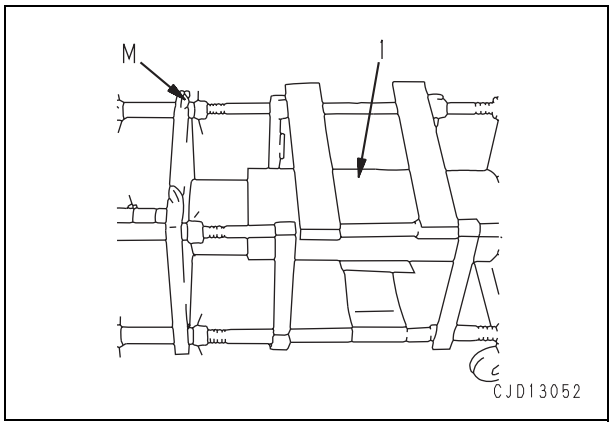


⚠ **If cylinder (19) has been damaged, or nut (16) at the tip of shaft has fallen off, there is danger that the recoil spring may fly off to the front when mounting bolts (21) of holder (13) are removed. For this reason, disassemble as follows.**

⚠ **When disconnecting holder (13) and case (12), do not stand in front of or behind the recoil spring assembly until safety has been confirmed and the recoil spring has been removed.**



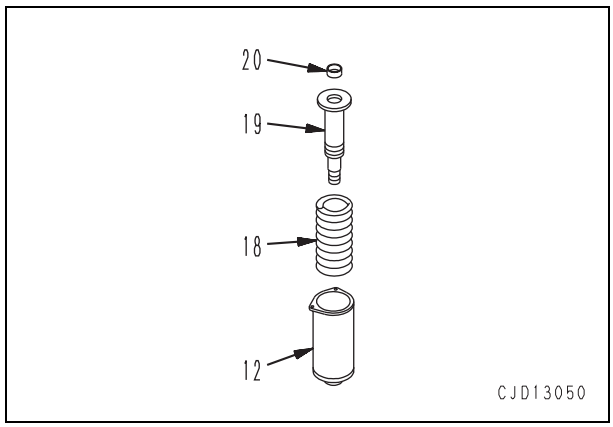
1) Set recoil spring assembly (1) to tool **M**.
   - ⚠ **The spring is under a high installed load, so be careful to set it correctly.**
   - ★ Installed load of spring: **189.5 kN {19,320 kg}**

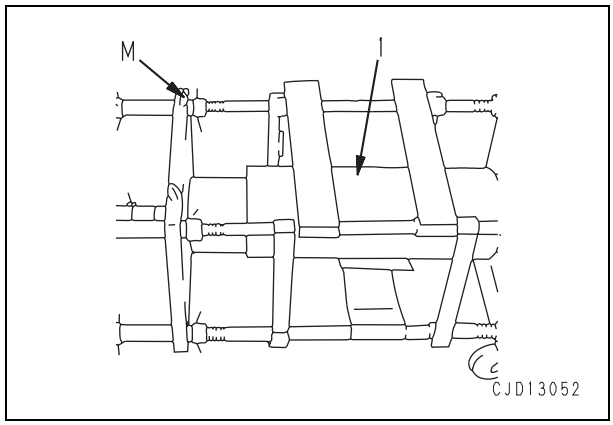


2) Apply hydraulic pressure slowly and secure recoil spring assembly.
3) Maintain condition in Step 2), and remove mounting bolts (21) of holder (13).
4) Gradually release hydraulic pressure to remove tension of spring.

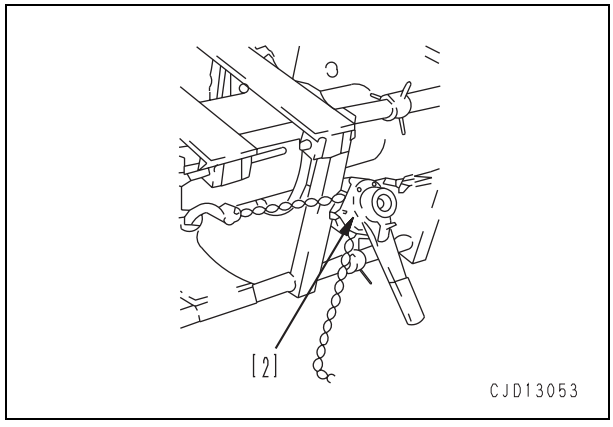
Assembly

1. Press fit bushing (20) to cylinder (19), and assemble case (12), spring (18), and cylinder (19) temporarily, then set to tool **M**.
   ⚠ **The spring is under a high installed load, so be careful to set all parts correctly.**

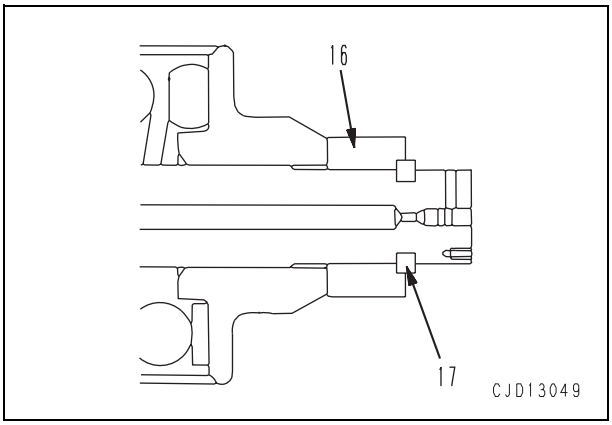




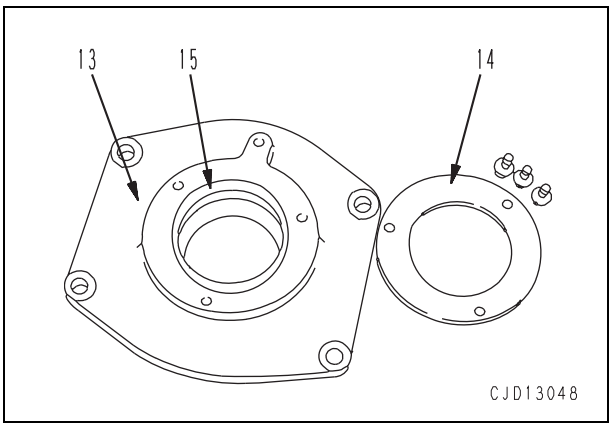
2. Apply hydraulic pressure slowly to compress spring, and set so that installed length of the spring is the standard value.
   ★ When compressing the spring, be careful not to damage the thread. Use lever block [2] and carry out centering while compressing the spring.
   ★ Installed length of spring: **634 mm**

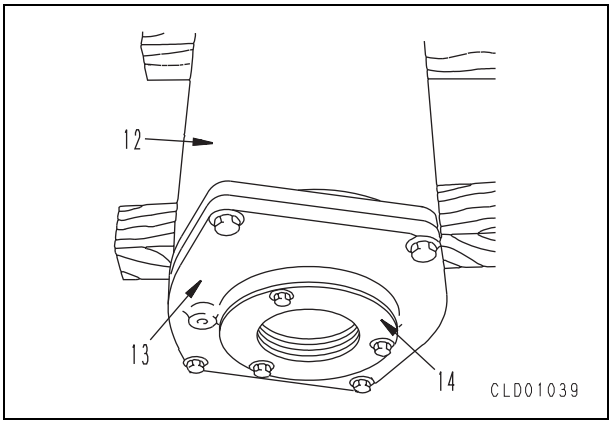


3. Install nut (16), then install spacer (17).



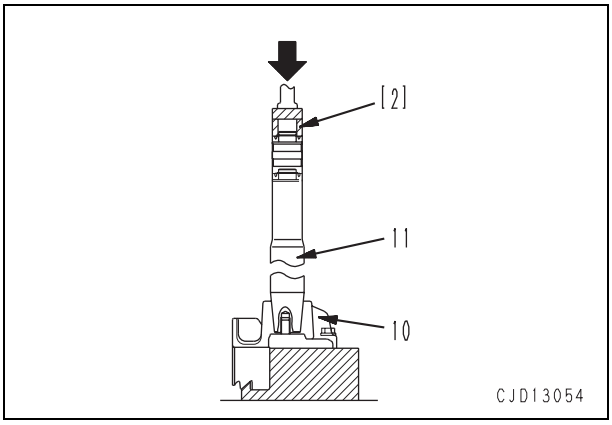
4. Gradually release hydraulic pressure to completely remove tension of spring, then remove recoil spring assembly (1) from tool **M**.
5. **Assembly of holder**
   Assemble seal (15) to holder (13), then install cover (14).
   Lip of seal: **Grease (G2-LI)**
6. Install holder (13) to case (12) of recoil spring.



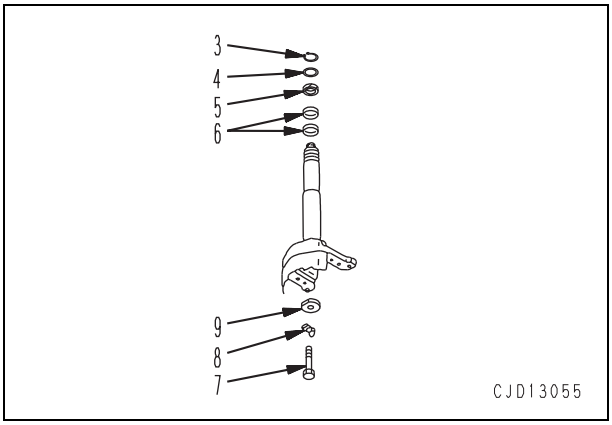


7. Assembly of yoke, piston assembly

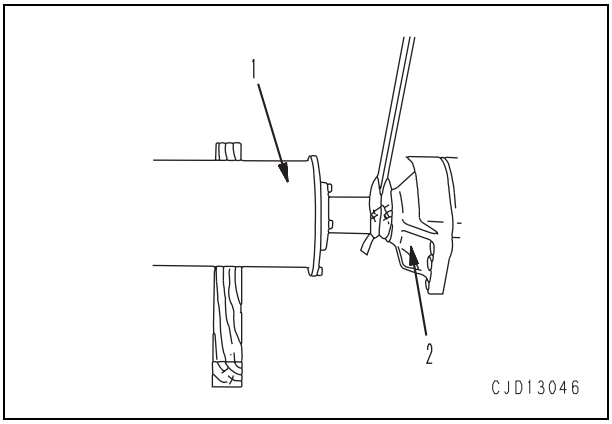
1) Using push tool [2], press fit piston (11) to yoke (10).



2) Assemble washer (9) and plate (8), and tighten bolt (7).
   ★ Bend the plate securely.
3) Fit ring (6), packing (5), and ring (4), and install snap ring (3).



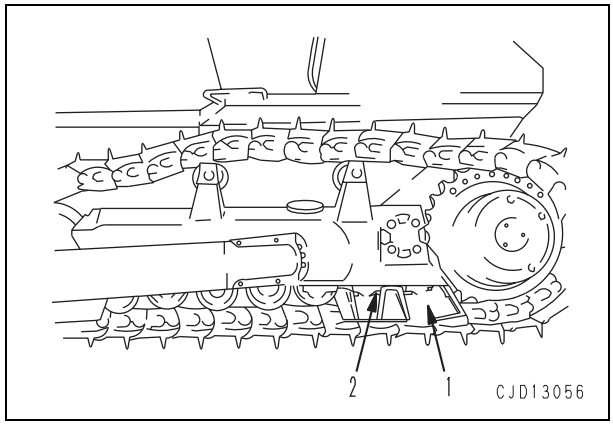
8. Assemble yoke and piston assembly (2) to recoil spring assembly (1).



Removal and installation of track roller assembly

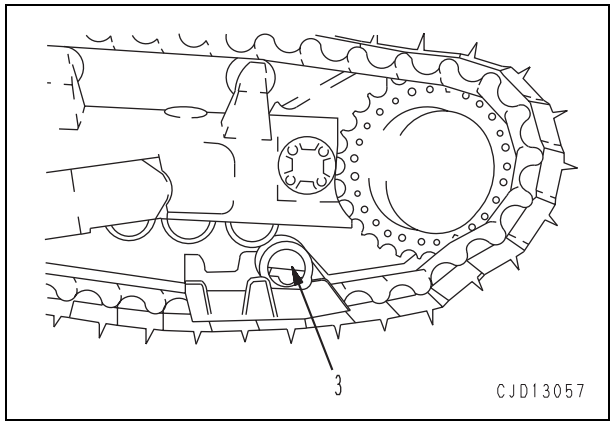
Removal

1. Loosen track shoe tension. For details, see "Expansion and installation of track shoe assembly."
2. Remove mounting bolts of track roller guard (1). [*1]
3. Remove track roller mounting bolts (2).



4. Start engine, and operate blade, and hydraulic jack to jack up machine.
   ⚠ **After jacking up the machine, set blocks on top of the track shoes and lock the work equipment control levers and brake lock lever.**
5. Remove track roller assembly (3). [*2]

   Track roller assembly:
   Single flange: **55 kg**
   Double flange: **65 kg**



Installation

- Carry out installation in the reverse order to removal.

[*1]

Thread of roller guard mounting bolt:
Liquefied adhesive (LT-2)

[*2]

Thread of track roller mounting bolt:
Liquefied adhesive (LT-2)

Track roller mounting bolt:
343 – 427 Nm {35.0 – 43.5 kgm}

★ Install so that the oil plug is on the outside of the chassis.

Disassembly and assembly of track roller assembly

Special tool

Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
L	2	791-530-1520	Installer	■	1		
	4	791-601-1000	Oil pump	■	1		

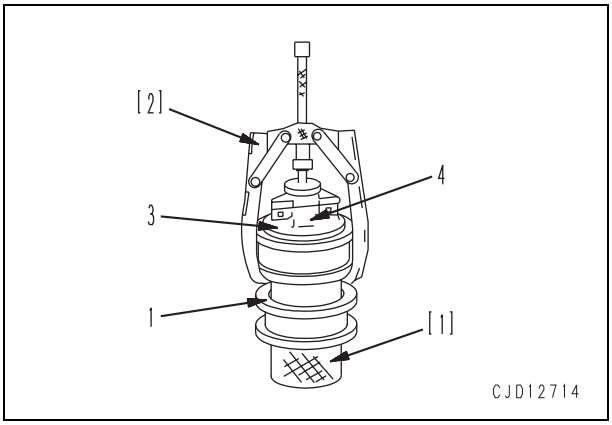
Disassembly

1. Remove the oil filler plug and drain the oil.

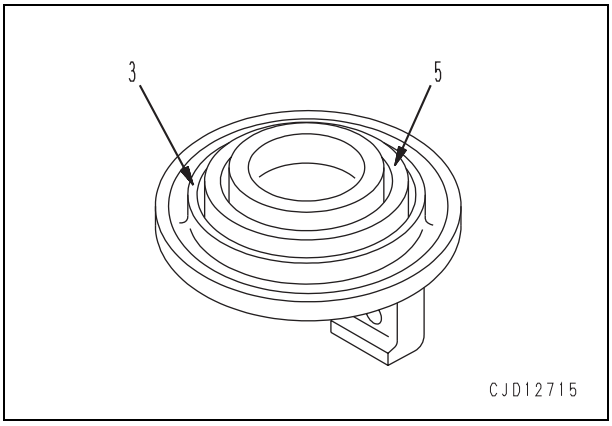
Track roller: **0.32 ℓ**

2. Set track roller assembly (1) on block [1].

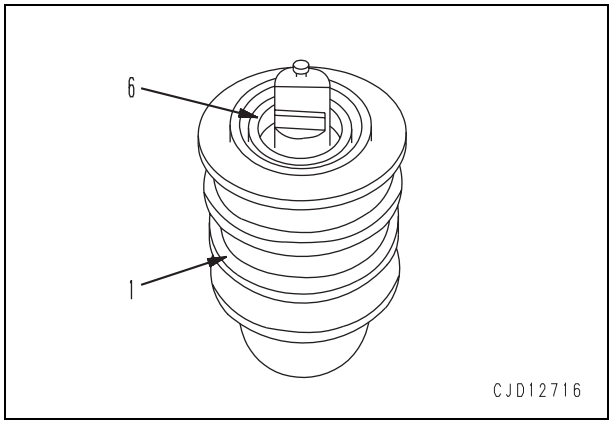
3. Using push puller [2], push in collar (3), and then remove lock (4) and collar (3).



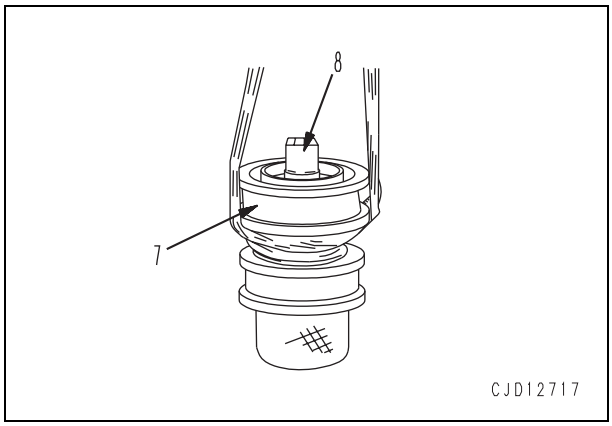
4. Remove floating seal (5) from collar (3).



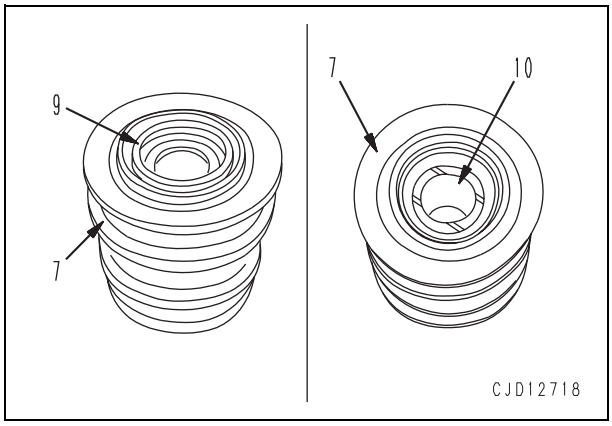
5. Remove floating seal (6) from track roller assembly (1).



6. Sling roller (7) and pull it out of shaft (8).

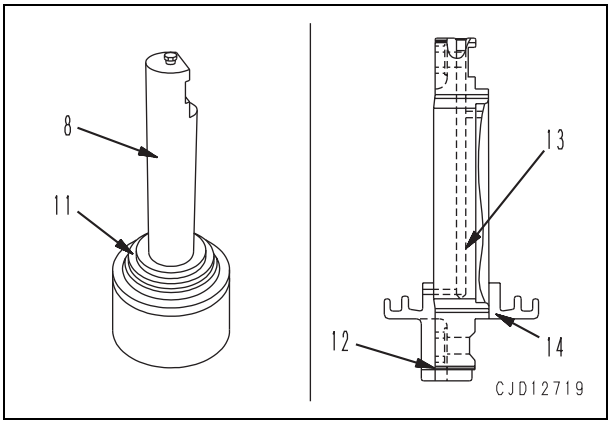


7. Remove floating seal (9) and bushing (10) (1 on each side) from roller (7).

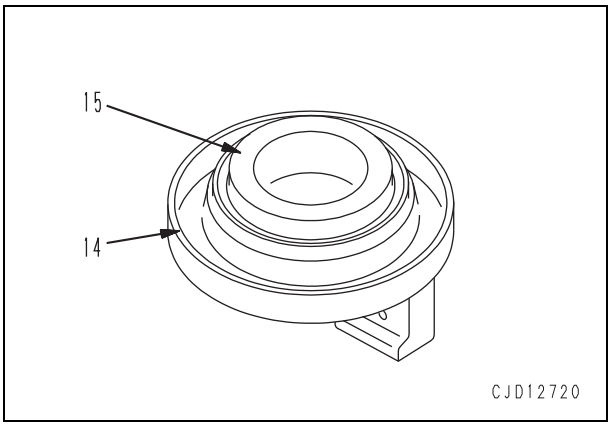


8. Remove floating seal (11) from shaft assembly (8).

9. Remove lock pin (12), and then remove collar (14) from shaft (13).

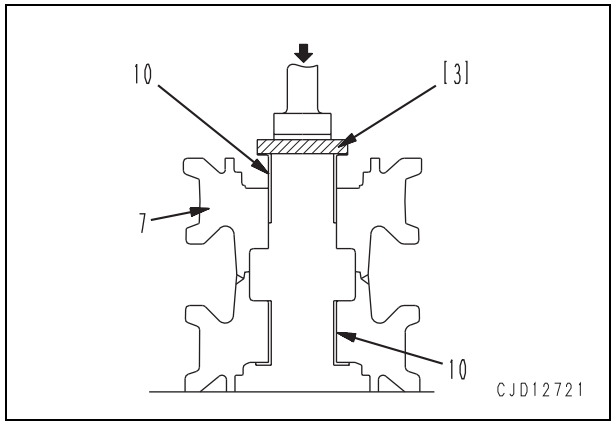


10. Remove floating seal (15) from collar (14).

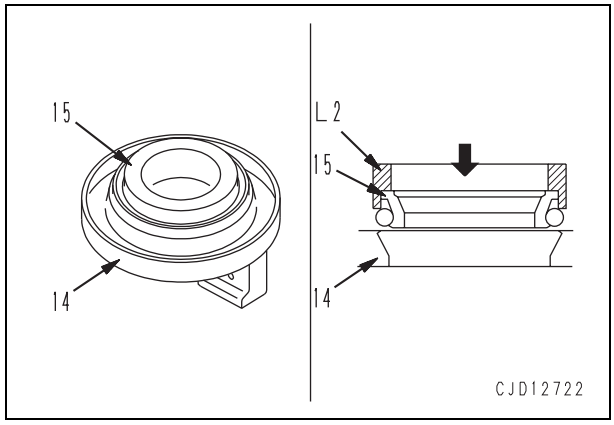


Assembly

1. Using push tool [3], press fit 2 bushings (10) to roller (7).

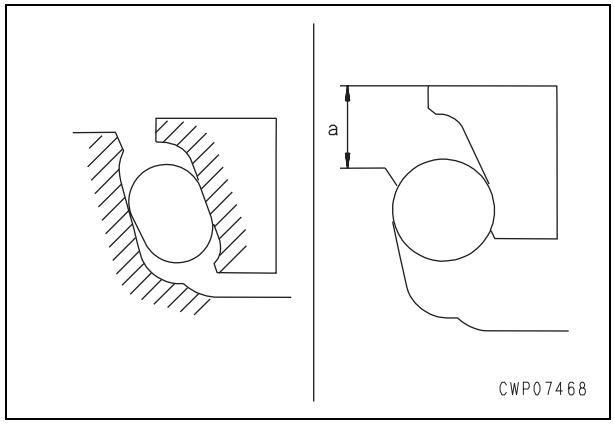


2. Using tool **L2**, install floating seal (15) to collar (14).

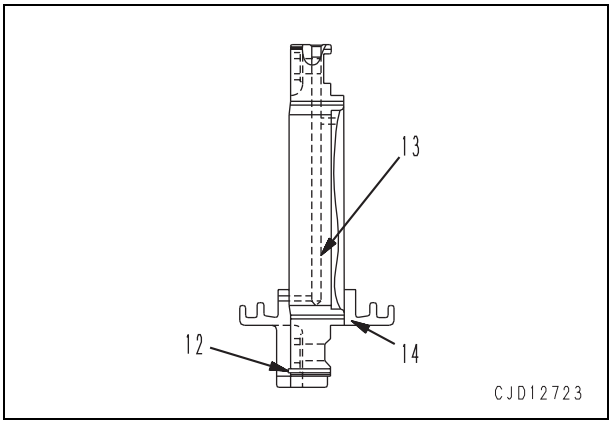


★ When installing floating seals, thoroughly clean, degrease, and dry the contact surfaces of the O-rings and floating seals (hatched parts). Take care that dirt will not stick to the floating seal contact surfaces.

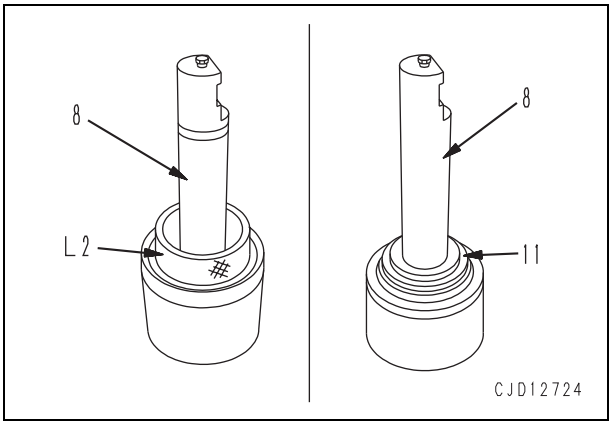
★ After installing the floating seals, check that their slant is less than 1 mm and their projection (a) is 7 – 11 mm.



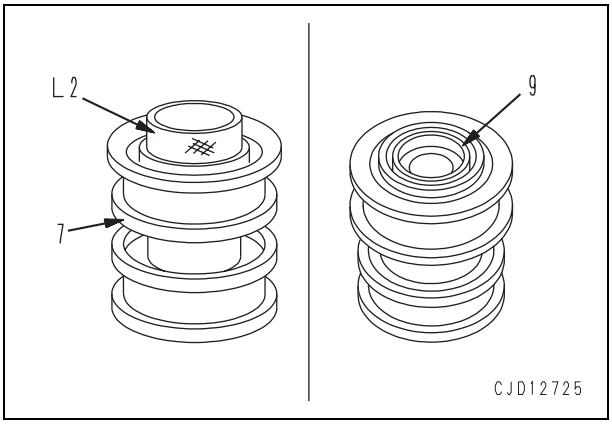
3. Fit the O-ring to shaft (13) and install collar (14) and lock pin (12).



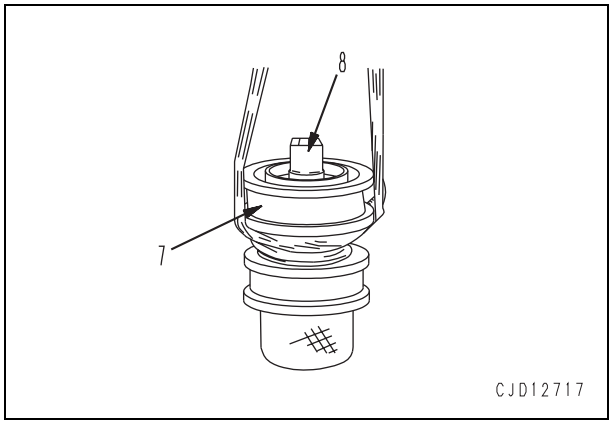
4. Using tool **L2**, install floating seal (11) to shaft (8).
★ For the method of installation, see step 2.



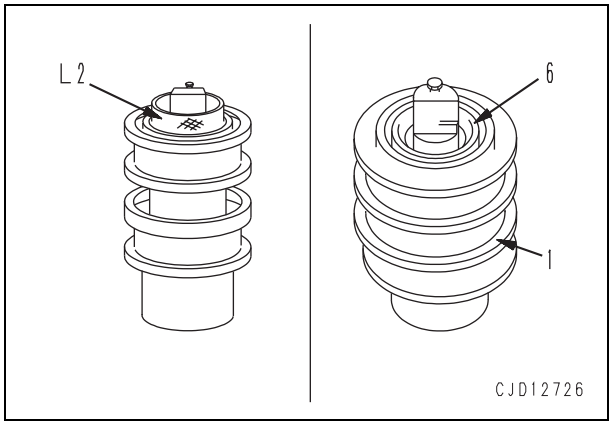
5. Using tool **L2**, install floating seal (9) to roller (7).
★ For the method of installation, see step 2.



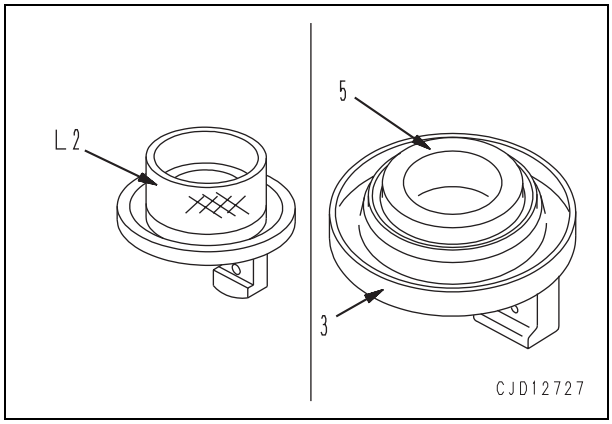
6. Sling roller (7) and install it to shaft assembly (8).



7. Using tool **L2**, install floating seal (6) to roller assembly (1).
★ For the method of installation, see step 2.

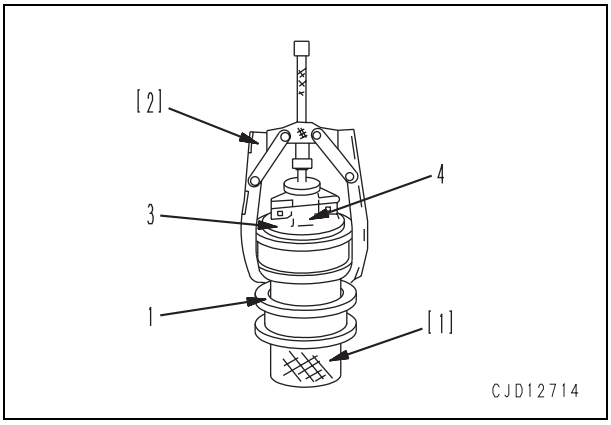


8. Using tool **L2**, install floating seal (5) to collar (3).
★ For the method of installation, see step 2.



9. Set track roller assembly (1) to block [1].

10. Fit the O-ring to the shaft and install collar (3). Using push puller [2], push in collar (3) and install lock (4).



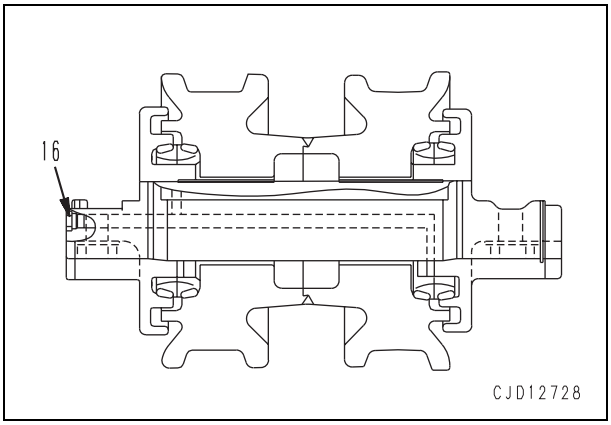
11. Refilling with oil

1) Remove plug (16). Using tool **L4**, add oil through the oil filler.

   Track roller: **0.32 ℓ (GO140)**

2) Tighten plug (16).

   Plug: **98 – 137.2 Nm {10 – 14 kgm}**

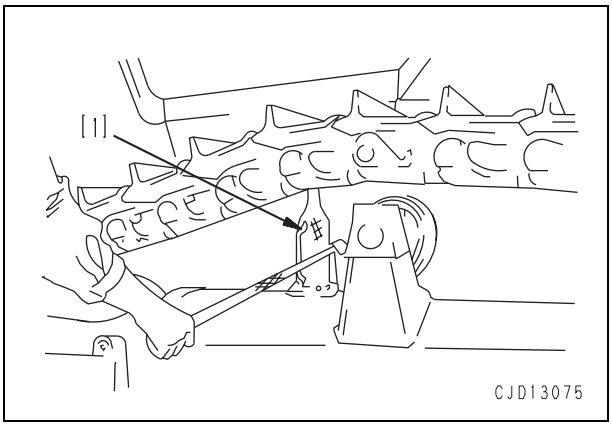


Removal and installation of carrier roller assembly

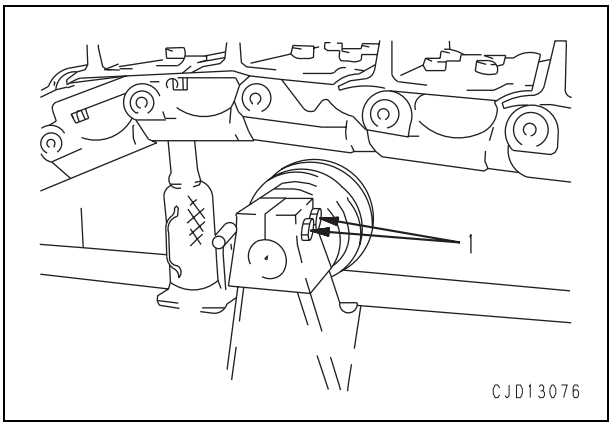
★ The figures in this section show D65EX-15E0.

Removal

1. Loosen the track shoe assembly. For details, see "Expansion and installation of track shoe assembly."
2. Using hydraulic jack [1], raise the track shoe.

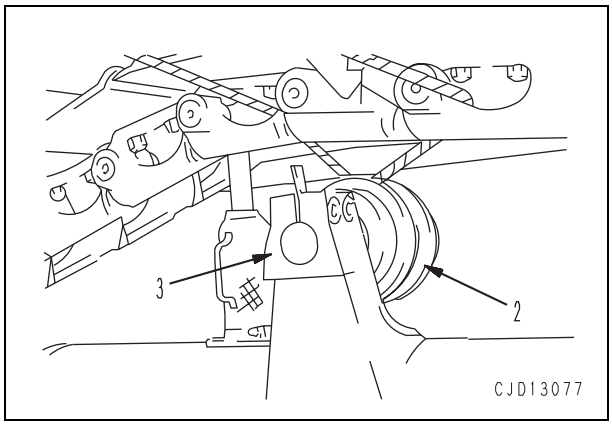


3. Remove mounting bolts (1) of the carrier roller assembly.



4. Sling carrier roller assembly (2) and pull and remove it out of support (3).

Carrier roller assembly: **30 kg**



Installation

- Carry out installation in the reverse order to removal.
- Adjust the track shoe assembly tension. For details, see Testing and adjusting, "Adjusting track shoe assembly tension."

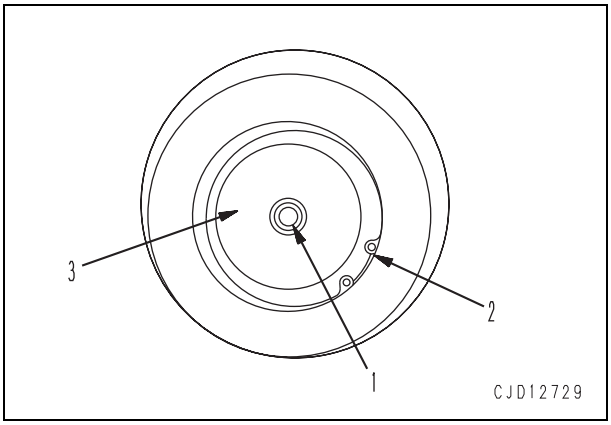
Disassembly and assembly of carrier roller assembly

Special tools

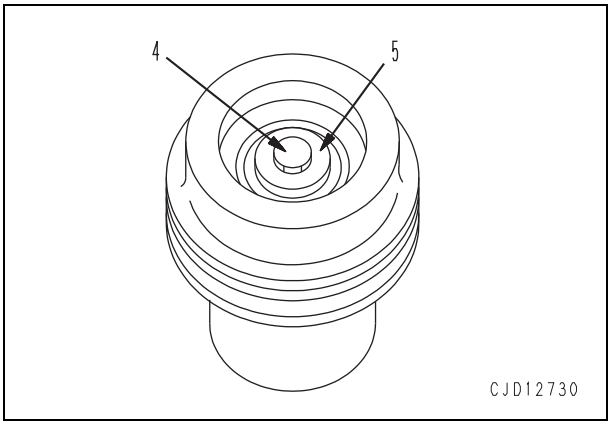
Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
L	3	796-230-1110	Installer	■	1		

Disassembly

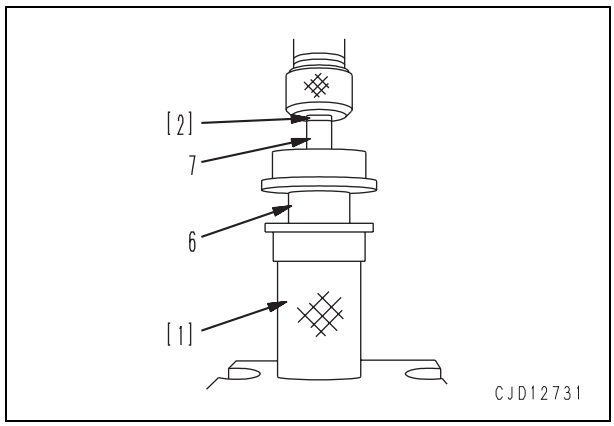
1. Remove oil filler plug (1) and drain the oil.
   Carrier roller: **0.24 ℓ**
2. Remove snap ring (2) and cover (3).



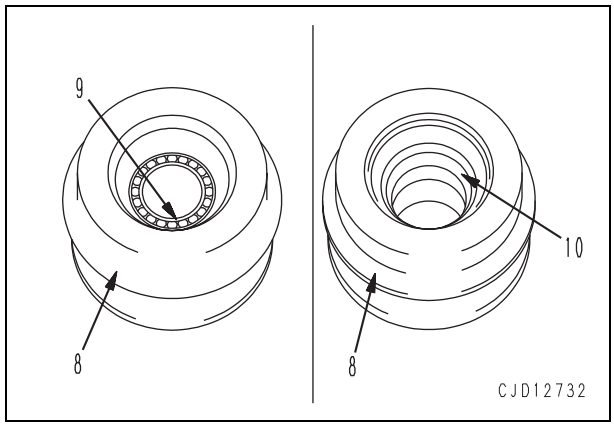
3. Remove bolt (4) and spacer (5).



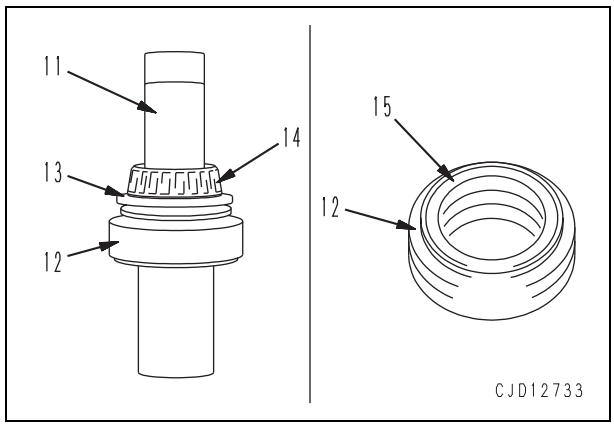
4. Set carrier roller assembly (6) on block [1].
5. Using push tool [2] and a press, pull out shaft assembly (7).



6. Remove bearing (9) and 2 outer races (10) from roller (8).

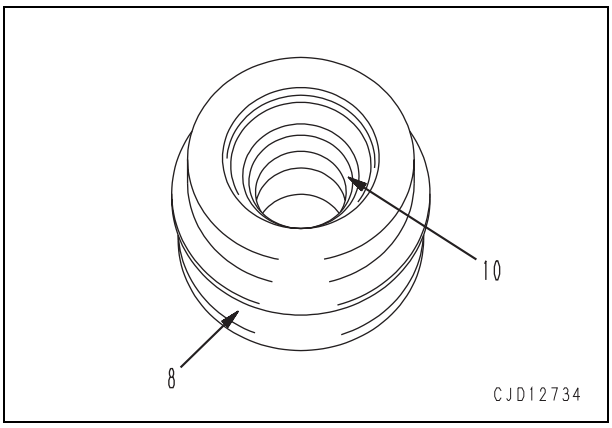


7. Remove collar (12), floating seal (13), and bearing (14) from shaft (11).
8. Remove floating seal (15) from collar (12).

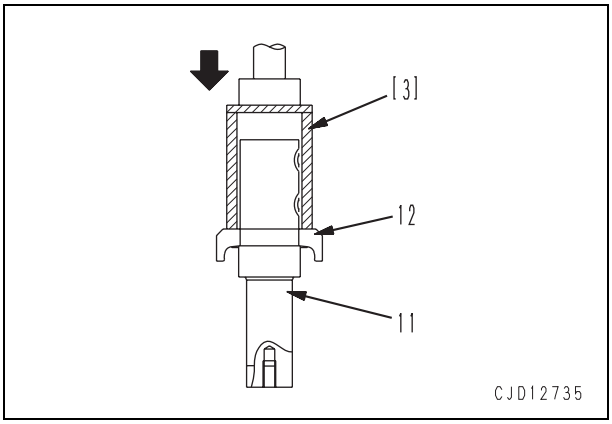


Assembly

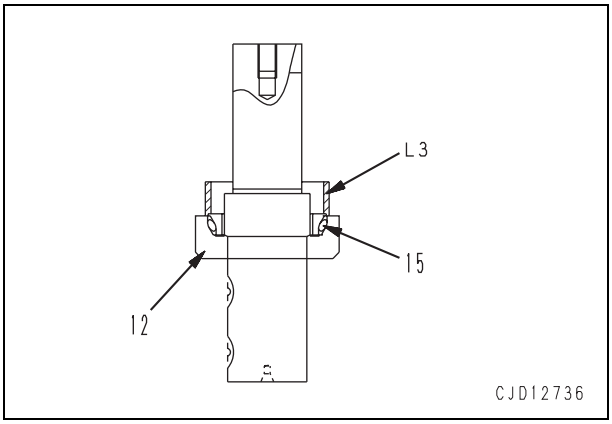
1. Press fit 2 outer races (10) to roller (8).



2. Using push tool [3], press fit collar (12) to shaft (11).

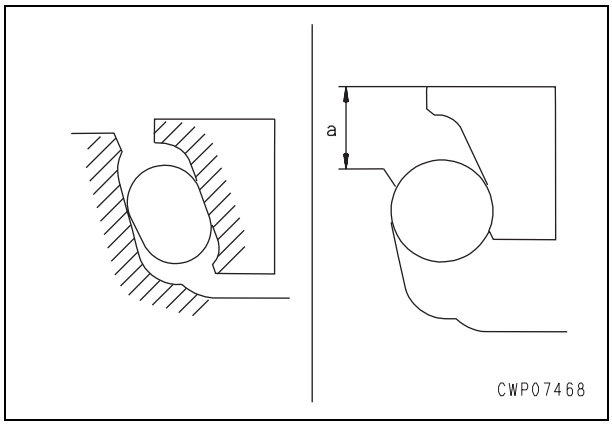


3. Using tool **L3**, install floating seal (15) to collar (12).



★ When installing floating seals, thoroughly clean, degrease, and dry the contact surfaces of the O-rings and floating seals (hatched parts). Take care that dirt will not stick to the floating seal contact surfaces.

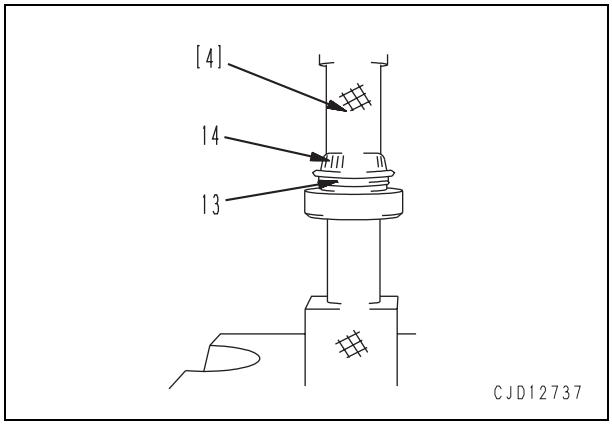
★ After installing the floating seals, check that their slant is less than 1 mm and their projection (a) is 7 – 11 mm.



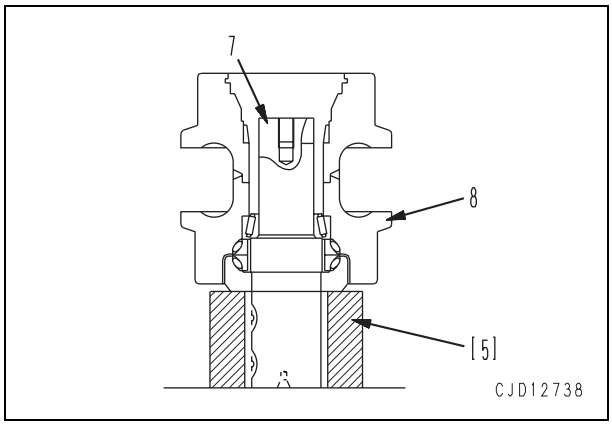
4. Install floating seal (13) to the shaft.

★ For precautions for installation, see step 3.

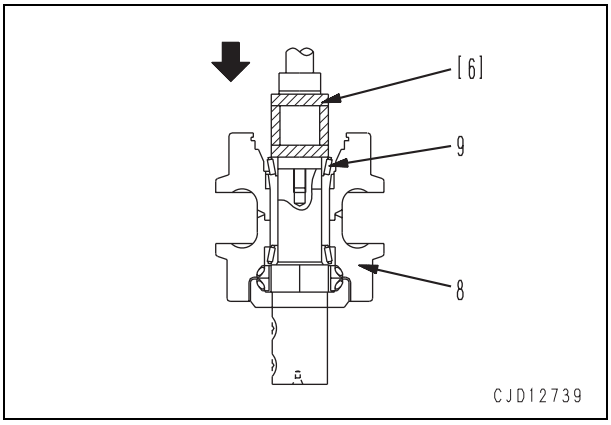
5. Using push tool [4], press fit bearing (14) to the shaft.



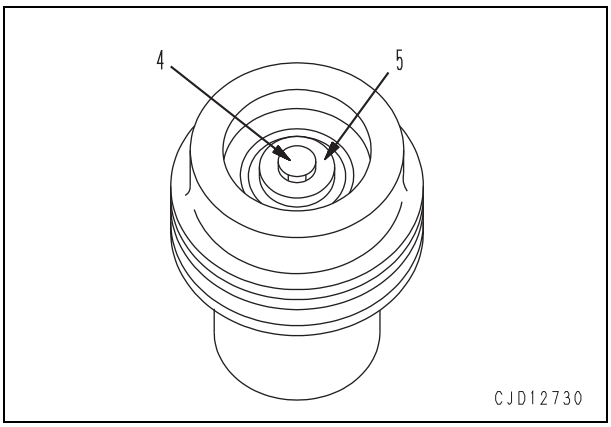
6. Set shaft assembly (7) to block [5] and install roller (8).



7. Using push tool [6], press fit bearing (9).
★ While turning roller (8), press fit the bearing.



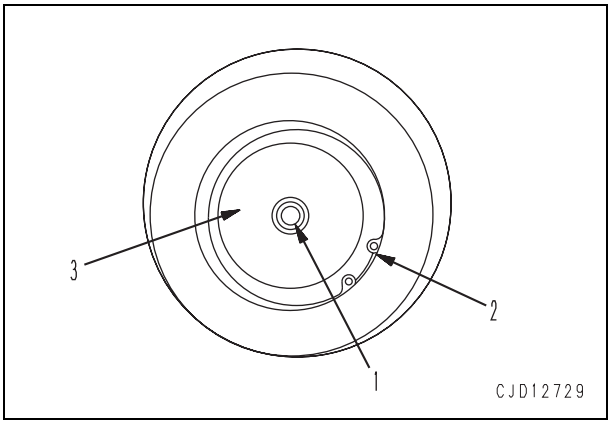
8. Install spacer (5) and tighten bolt (4).
Bolt: **278 ± 32.4 Nm {28.3 ± 3.3 kgm}**



9. Supply oil to the carrier roller.
Carrier roller: **0.24 ℓ (GO140B)**

10. Fit the O-ring to cover (3) and install them to the roller, and then install snap ring (2).

11. Tighten plug (1).



D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00949-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

Undercarrigage and frame, Part 2

Undercarrigage and frame, Part 2

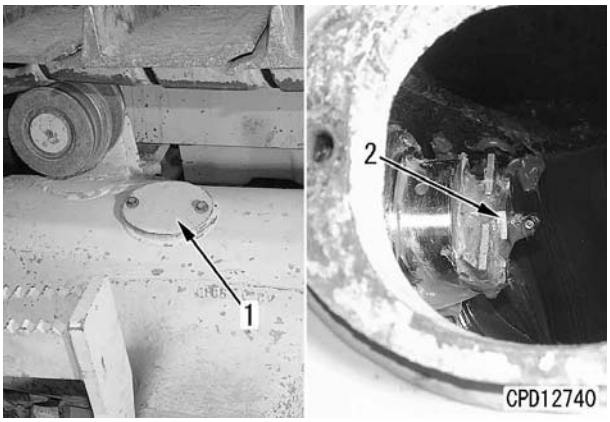
Expansion and installation of track shoe assembly

Check before expanding track shoe assembly

⚠ **Since it may be very dangerous to expand the track shoe assembly, check the following items in advance.**

⚠ **Do not loosen the lubricator more than 1 turn. If the grease is not discharged well, move the machine forward and in reverse.**

1. Remove cover (1) and loosen lubricator (2) of the adjustment cylinder to discharge the grease.
   ⚠ **Do not loosen the lubricator more than 1 turn.**

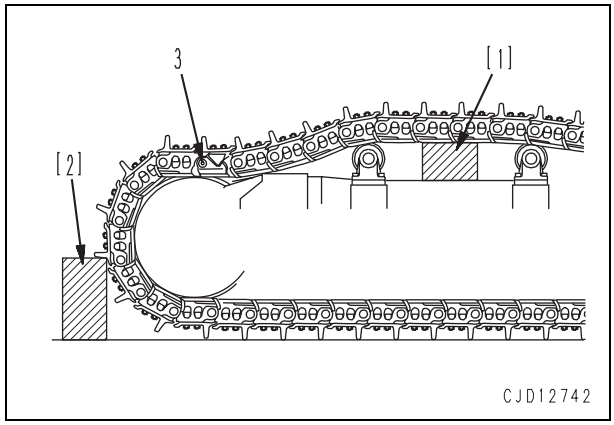


2. After the shoe is loosened, perform "Expansion of track shoe assembly (Ordinary)."
3. If the track shoe is not loosened by the above work, perform "Expansion of track shoe assembly (When track frame has internal trouble)."
   ★ The track frame may have an internal trouble (damage of the recoil spring or recoil spring set bolt, fall of the shaft end nut, etc.).

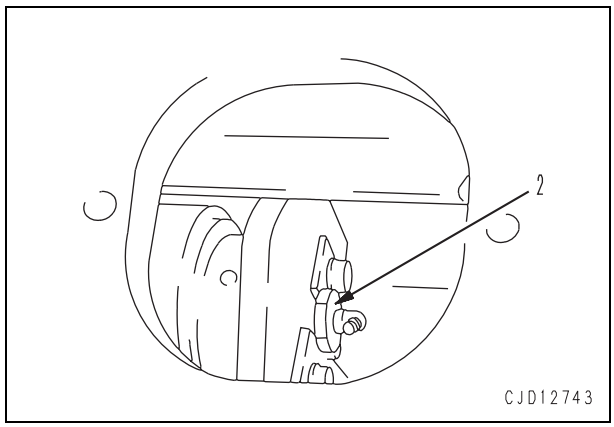
Expansion of track shoe assembly (Ordinary)

★ If any abnormality is not detected by "Check before expanding track shoe assembly," perform the following procedure.

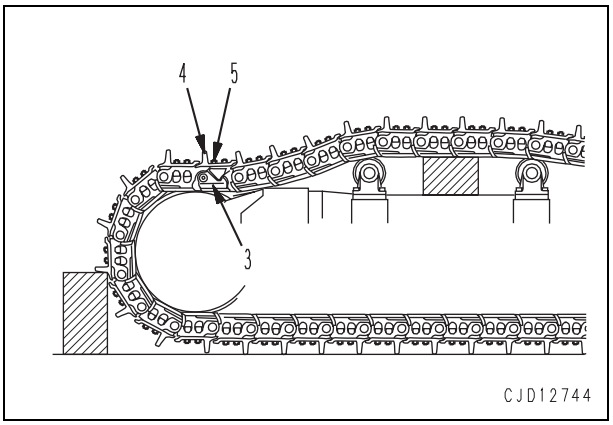
1. Set master link (3) above the idler (a little after the center of the idler) moving the machine forward or in reverse.
   ★ Set blocks [1] and [2] between the front side of the idler and carrier roller so that the mating part of the master link will not open until the master bolt is pulled out.



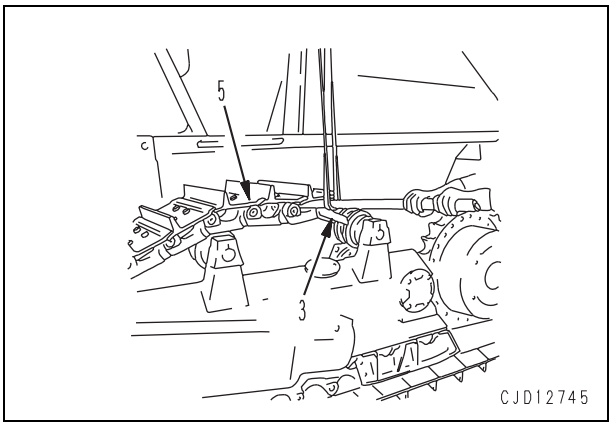
2. Loosen the track shoe. [*1]
   ⚠ **Do not loosen lubricator (2) more than 1 turn.**
   ★ If the track shoe is not loosened after the lubricator is loosened, move the machine forward and in reverse.



3. Remove track shoe (4). [*2]
   ★ Do not loosen and pull out 4 mounting bolts (5) one by one, but loosen them by 1 – 2 turns each and check that they can be rotated lightly, and then pull them out.
   ★ If the bolts are rotated forcibly while they are still tight, the threads of them and master link (3) may be damaged.



4. Sling the front end of master link (3) and move the machine slowly in reverse to expand track shoe assembly (5).
   ★ Length of track shoe: **Approx. 9.5 m**

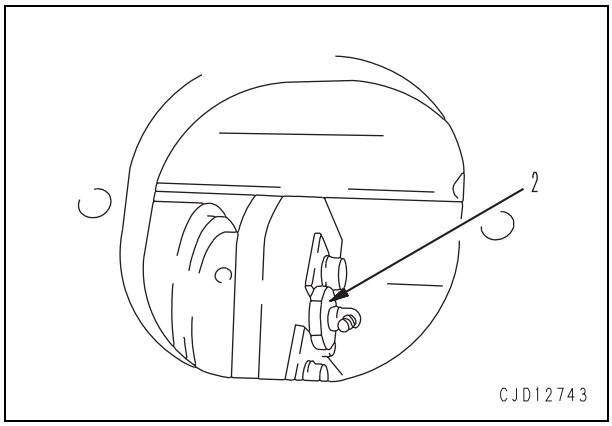


Expansion of track shoe assembly
(When track frame has internal trouble)

★ If any abnormality is detected by "Check before expanding track shoe assembly," perform the following procedure.

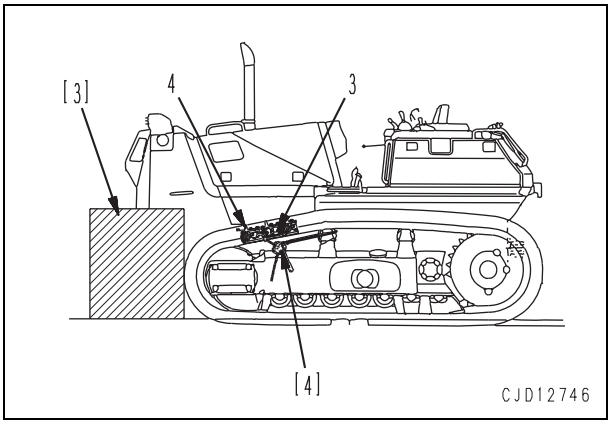
⚠ **If the track shoe is removed while the track frame has an internal trouble, it may spring back. Even if the track shoe is removed, the idler may jump out, and that can cause a serious result. Accordingly, expand the track shoe according to the following procedure.**

1. Loosen the track shoe. [*1]
   ⚠ **Do not loosen lubricator (2) more than 1 turn.**
   ★ If the track shoe is not loosened after the lubricator is loosened, move the machine forward and in reverse.
   ★ Check that the all grease has been discharged.



2. Move the machine slowly forward against large block [3] or a wall (or the blade of another machine of the similar size of the machine to be repaired, if available) to press the track shoe on the idler side. When the recoil spring and track shoe are distorted, stop and apply the brake.
   ★ Set master link (3) between the idler and front carrier roller.
   ★ For safe work, apply lever block [4] between the carrier roller support and link.
3. Remove track shoe (4) and disconnect master link (3). [*2]
   ★ Do not loosen and pull out the 4 mounting bolts one by one, but loosen them by 1 – 2 turns each and check that they can be rotated lightly, and then pull them out.
   ★ If the bolts are rotated forcibly while they are still tight, the threads of them and master link (3) may be damaged.

4. Move the machine slowly in reverse to expand the track shoe assembly.



Installation

- Carry out installation in the reverse order to expansion (ordinary).

[*1]

★ Adjust the track shoe tension. For details, see Testing and adjusting, “Testing and adjusting track shoe tension”.

[*2]

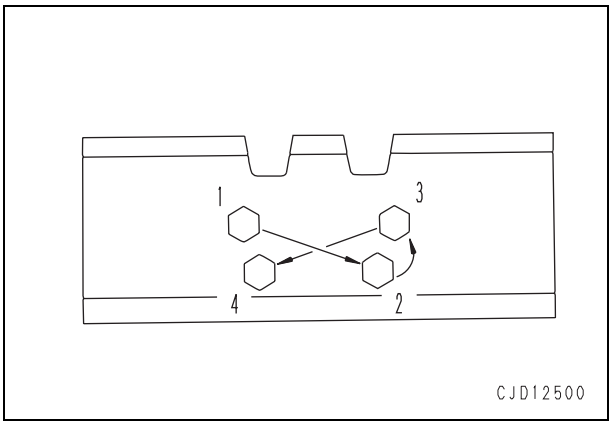
★ Tighten the shoe mounting bolts for the master link in the following order.

★ Tighten the all 4 bolts with fingers until the master link mating faces are fitted.

★ If the bolts are tightened forcibly before the master link mating faces are fitted, the threads of them and master link may be damaged.

Shoe mounting bolt:
Seizure prevention compound (MARUZEN MOLYMAX No. 2 or equivalent)

Shoe mounting bolt:
1st time: **343 ± 39 Nm {35 ± 4 kgm}**
2nd time: **180^{o}_{-20} (Angle tightening)**



Whole disassembly and whole assembly of track shoe assembly

Special tools

Symbol		Part number	Part name	Necessity	Q'ty	N/R	Sketch
R	1	791-646-7531	Remover	■	1		
	2	791-660-7460	Brush	■	1		
	3	791-432-1110	Push tool	■	1		
		791-646-7550	Bar	■	1		
		791-646-7560	Guide	■	1		
	4	791-932-1110	Push tool	■	1		
		791-646-7523	Bar	■	1		
		791-646-7590	Guide	■	1		
	5	790-701-3000	Checker	■	1		
	6	791-432-1120	Installer	■	1		
	7	791-601-1000	Oil pump	■	1		

Whole disassembly

1. Removal of shoe

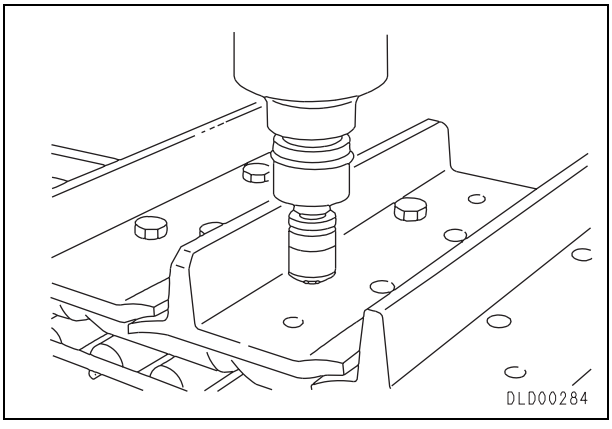
Sling the shoe assembly and set it with the shoe up on the floor and remove the shoe by using a shoe bolt impact wrench.

★ If a shoe bolt is not loosened after it is unscrewed by 1 turn (If its torque is not reduced to 0), loosen the other bolts first, and it will be removed smoothly.

★ If a shoe bolt is turned forcibly while its torque is not 0, bolt and link will adhere to each other and they will need to be repaired.

★ When moving the shoe assembly, take care not to damage the master link.

★ If it is obliged to cut a shoe nut with gas, keep the seal temperature below 80ºC to prevent thermal deterioration of the seal and take measures to prevent the spatters from entering through the clearances among the links.

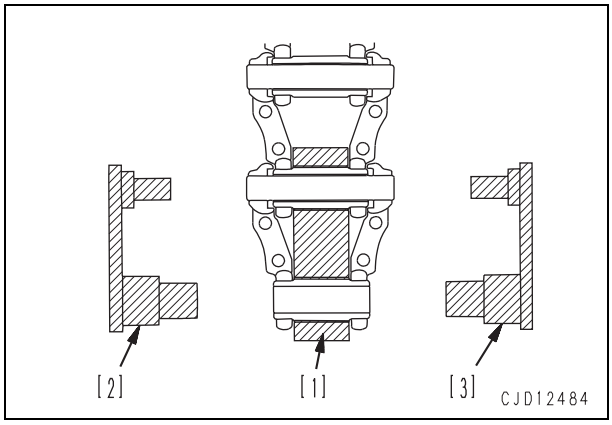


2. Disassembly of link

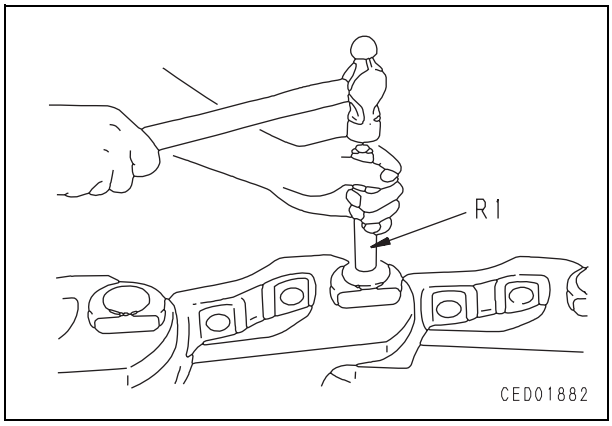
1) Set the link assembly on a link press and hit it with a hammer so that the bushing will be fitted to jaw [1].

★ If the link tread, outside of the bushing, etc. are worn, adjust the height of jaw [1] or guide plate and align the pin and bushing with the left and right disassembly jig [2], [3] so that the link hole will not be damaged during disassembly work.

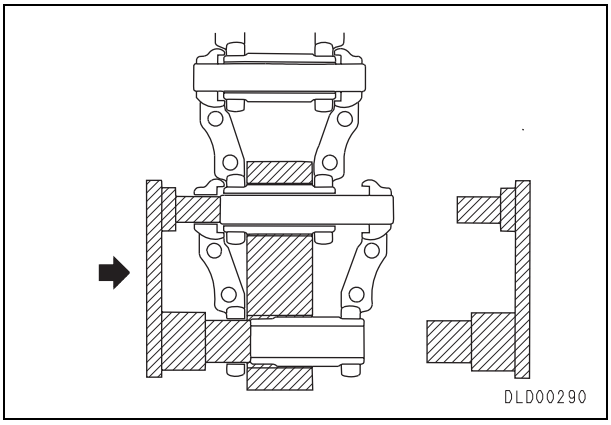
★ If the pin and bushing are not aligned well, the link hole may be damaged and the pin and bushing may be broken during disassembly work.



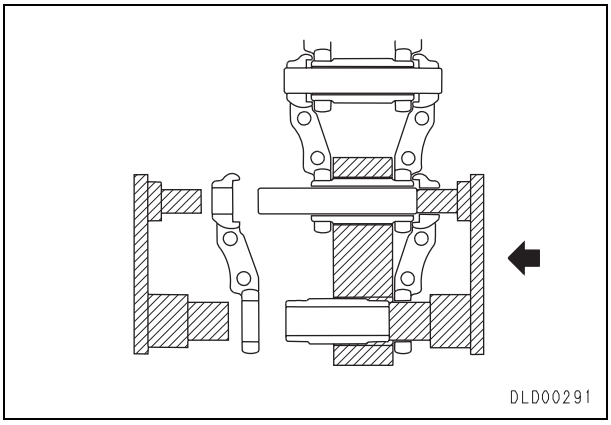
★ Using tool **R1**, drive the small plug of the pin inward after the disassembly work so that the workplace will not become dirty.



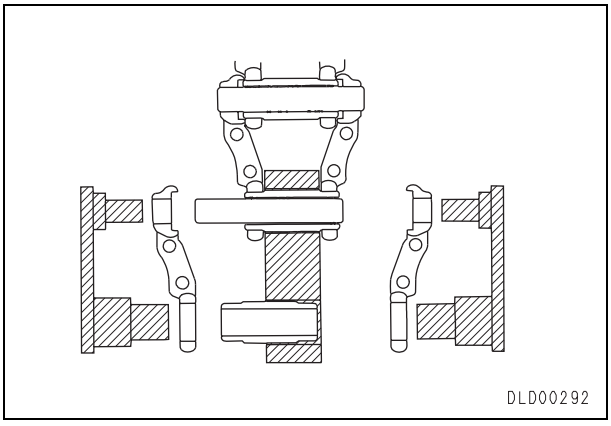
2) Operate the left cylinder to pull out the pin and bushing from the left link simultaneously.
   ★ Check the pulling out force of the pin and bushing to see if the necessary press fitting force for the pin and bushing can be obtained when reversed and assembled again.



3) Return the left cylinder and operate the right cylinder to pull out the pin and bushing from the right link simultaneously.



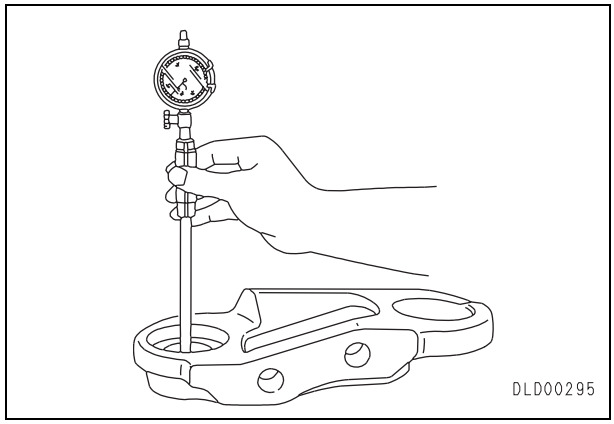
4) Return the right cylinder and take out the links, pins, bushings, and spacers on both sides and feed the next 1 set of the link assembly to the jaw.
   ★ If the bushing ends and sealing surfaces are damaged, oil will leak. Accordingly, handle them carefully.



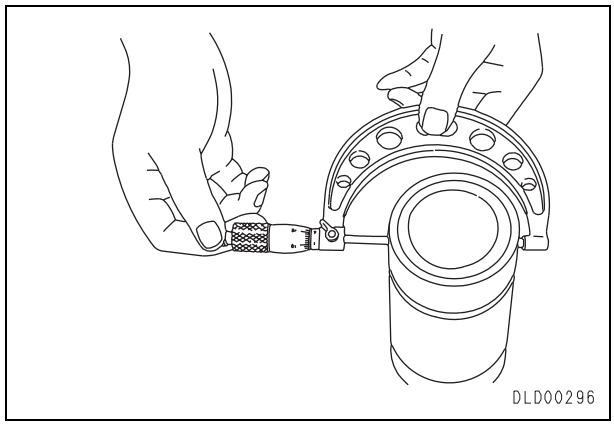
3. Inspection

Check the parts for the following items to see if they can be used for a lubricated track or a grease-filled track, then examine them generally and determine to use them for a lubricated track or grease-filled track.
   ★ For judgment of reuse of the parts, see “Guidance for reusable parts, Lubricated tracks”.

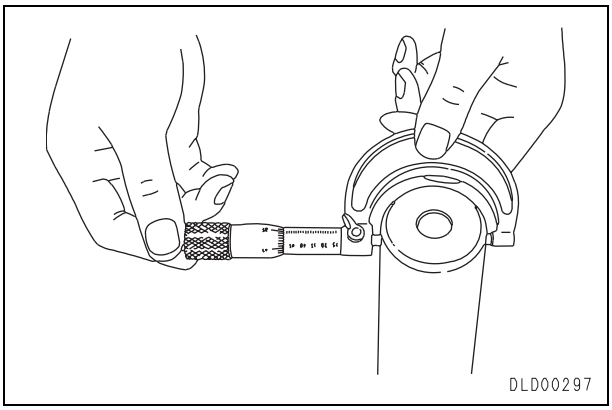
1) Check the parts visually for damage. If a part seems to be damaged, check it by dye penetrant test or magnaflux inspection. If it has any crack, it cannot be used again. Discard it.



2) Measure the outside diameter of the press fitting parts of the pin and bushing and the inside diameter of the pin and bushing fitting parts of the link with a micrometer and a cylinder gauge to see if the allowable fitting allowance is obtained. When using the pin, bushing, and link for a lubricated track, however, secure the standard fitting allowance between the pin and link.
   ★ If the allowable fitting allowance is not obtained, replace the parts with new ones.
   ★ For the dimensional criteria, see Structure, function and maintenance standard, "Track shoe."



★ Precautions for storage
1) Store the seal without removing it from the link so that the counterbore portion will not be rusted and take care not to damage the seal lip.
2) Apply rust-preventive oil to the pin and bushing fitting parts, shoe mating surface, and master link mating surface of the link.
3) When storing, apply rust-preventive oil to the all surfaces of the pin, bushing, and spacer. Take care not to damage the ends of the bushing in particular.



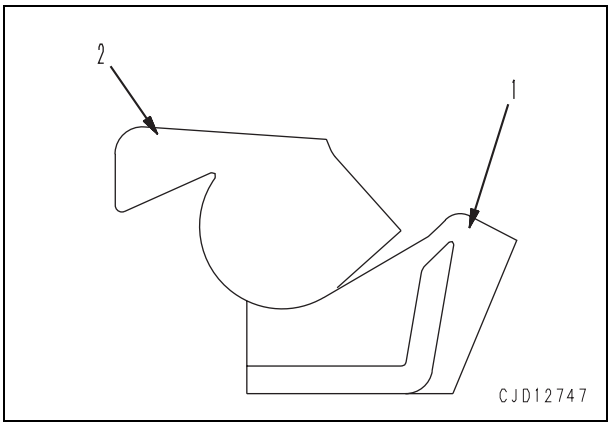
Whole assembly

★ Before performing the following procedure, see "Guidance for reusable parts, procedure for turning lubricated track."

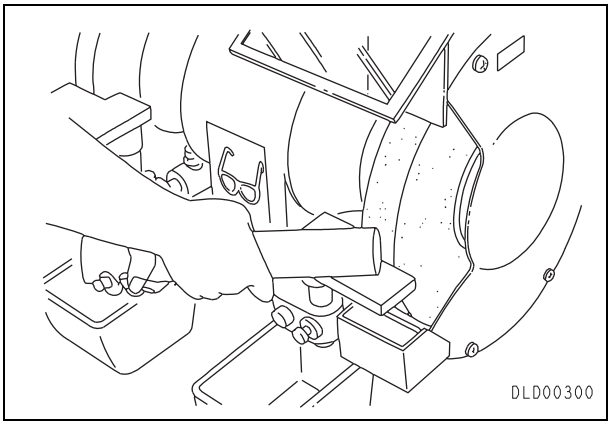
When recycling for lubricated track

1. Preparation work

1) Cleaning seal assembly
Remove the seal assembly from the link and divide it into seal ring (1) and load ring (2), then clean them.
★ Since the seal ring and load ring are deteriorated easily by the cleaning liquid (trichloroethylene etc.), clean them quickly. After cleaning them, wipe off the cleaning agent from them.

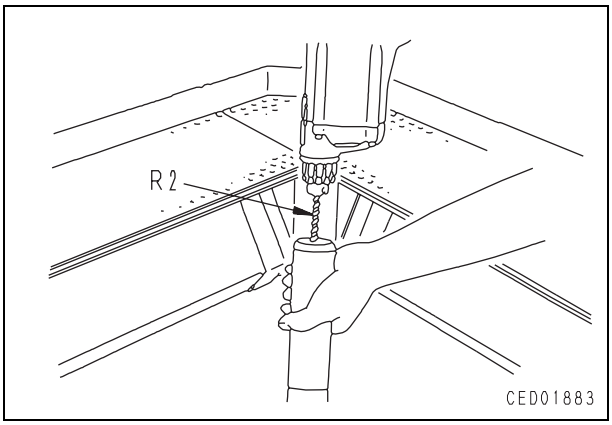


2) When reusing the pin, chamfer its end corners smoothly with a grinder. Remove the nodules sticking to the press fitting parts with the grinder, too.
★ If the ends are worn and sharpened, they may scuff the press fitting parts and cause oil leakage.

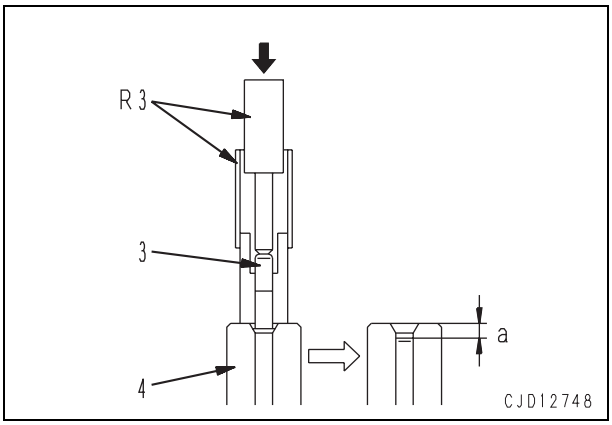


3) If the link, pin, bushing, and spacer are dirty, clean them. Remove the nodules sticking to the link and bushing with the grinder, too.
★ Since these parts rust easily, clean them just before assembling them.
★ Do not polish the bushing ends. If they are polished, oil may leak.

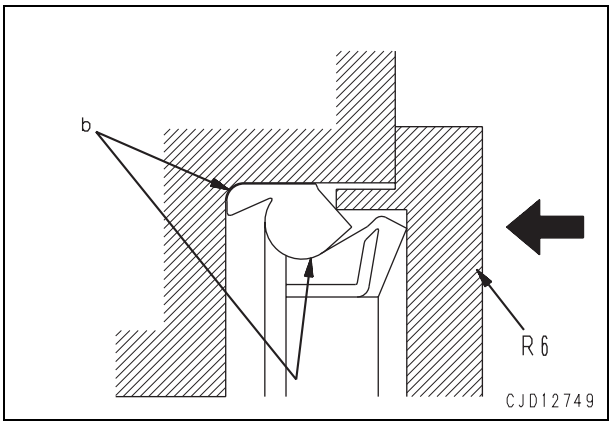
4) If large plug (3) was pulled out of the pin, drive it in according to the following procedure.
i) Using tool **R2**, clean the pin hole.



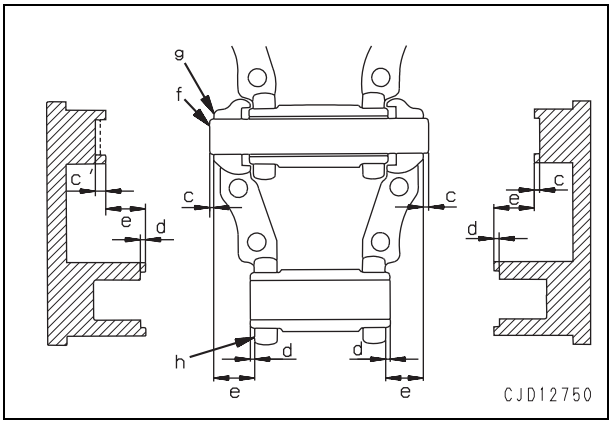
ii) Insert large plug (3) in the plug insertion window of the guide of tool **R3**.
★ Coat the large plug with oil (GO90) and install it with the small diameter end on the pin side.
iii) Push the bar of tool **R3** with the hand until the large plug stops.
iv) Push the large plug with the bar to press the guide against pin (4).
v) Drive in the bar with a hammer.
★ Driving distance (a) from pin end:
6 ± 2 mm
★ If the chamfered part of the pin hole has been worn, chamfer it with a small-sized grinder (grindstone tip angle: 45º – 60º) so that the large plug will not be damaged.



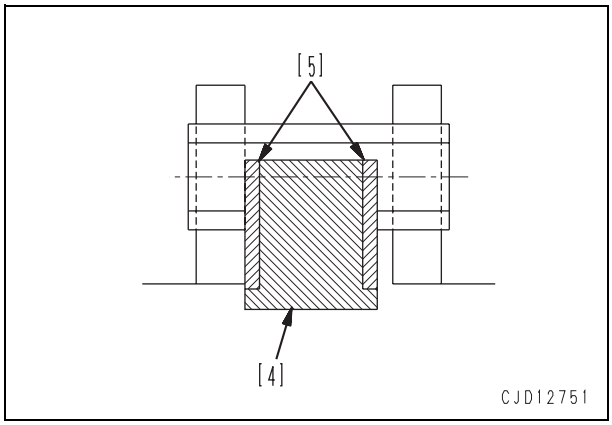
5) Installation of seal assembly
Clean and degrease parts (b) indicated with thick lines (the counterbore portion of the link and seal assembly) carefully. Then, using tool **R6**, push in the seal assembly to the bottom.
★ If oil or grease is sticking to the counterbore portion of the link or seal assembly, the seal will turn and its sealing performance will lower. Accordingly, do not apply any oil or grease to that portion.



6) Adjust the dimensions of the press fitting jig of the link press to keep the projection of the pin and bushing constant and keep the installed dimensions of the seal within the standard range.
● Dimension **c: 3 mm**
d: 3 mm
e: 49.7 mm
★ If the pin end (part **f**) or link sides (parts **g** and **h**) are worn, add the dimensions of the worn parts when adjusting the standard dimensions so that the projections of the pins and bushings on both sides will be even.



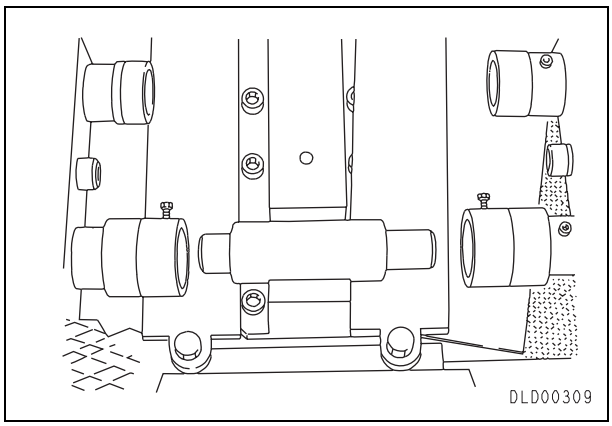
★ Set the link receiving face of jaw [4] vertically.
★ Wear plate [5] should be a replaceable one, if possible.



7) Adjust the relief pressure of the link press so that the pressing force of the press will not exceed the standard value.
★ If the pressing force is too strong, the spacer will be pressed forcibly against the bushing. As a result, the spacer may be broken and it and bushing may be worn abnormally.
★ Pushing force of pin and bushing:
539 kN {55 tons}
Pushing force ≒ 1.8 x Average pressure
(Adjust the relief pressure of the link press to set the press cutting force.)

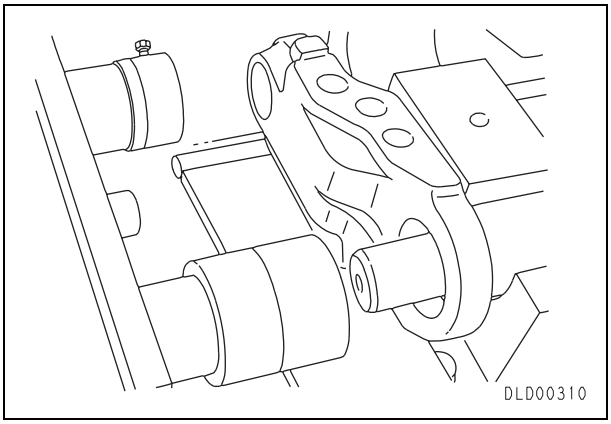
2. Assembly of link

1) Apply oil (GO90) to the mating surfaces of the pin and bushing with a clean brush and assemble them, then set them before the jaw of the link press.
★ When reusing (reversing) the bushing, set the worn outside surface of the bushing on the shoe fitting side of the link (set the bushing with the worn outside surface up on the link press).

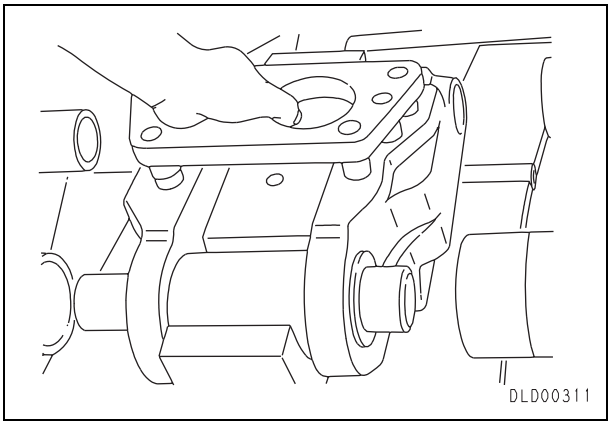


2) Press fit the master links on both bushing sides to the bushing with the shoe fitting faces up.
★ At this time, use the master links on the pin side as supports.

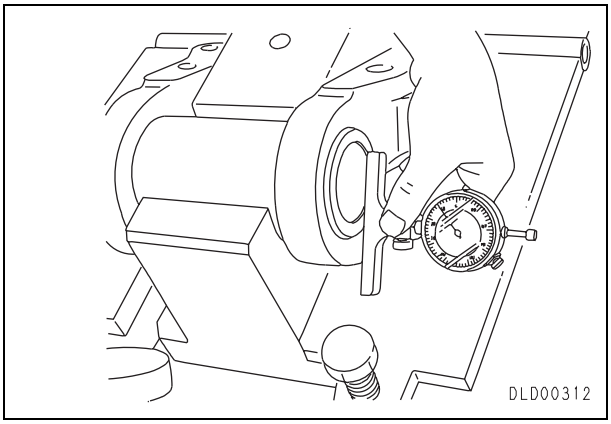
★ Press fitting force for bushing:
98 – 147 kN {10 – 15 tons}



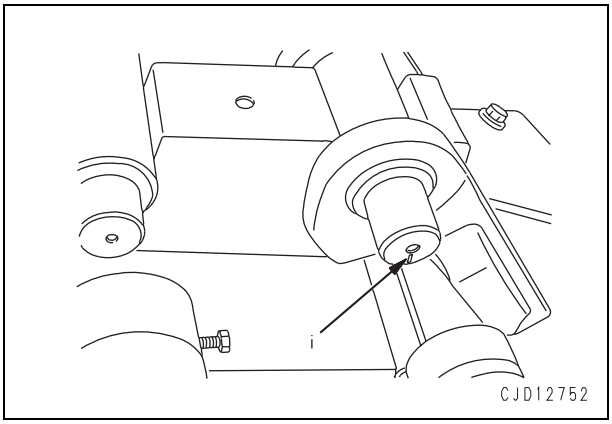
3) Using the shoe bolt hole pitch gauge, press fit the master links until the distance between the shoe bolt holes of both links is the standard value.
★ Remove the all steel chips caused by press fitting of the bushing with compressed air.
4) Turn over the master links and check that they are press fitted in parallel.



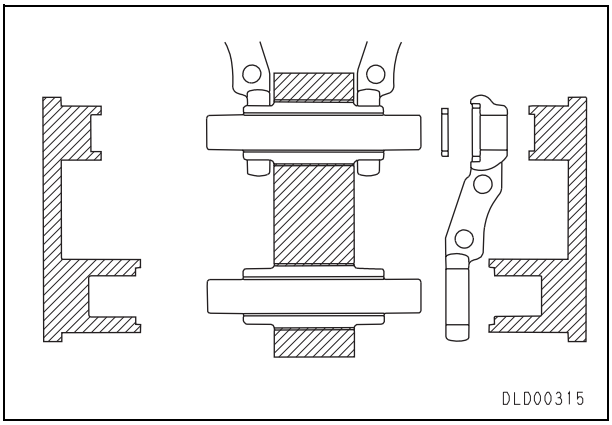
5) Measure the projections of the bushing on both sides with a depth gauge.
★ Adjust the press fitting jig of the link press so that the projections on both sides will be even.



6) Send the master links and set the next pin and bushing.
★ When reusing a pin, install it so that its side hole (i) will be the link tread side similarly to a new one.
★ If it is not installed so, its strength may be lowered. Accordingly, indicate the direction of the side hole on the end face to prevent a mistake.

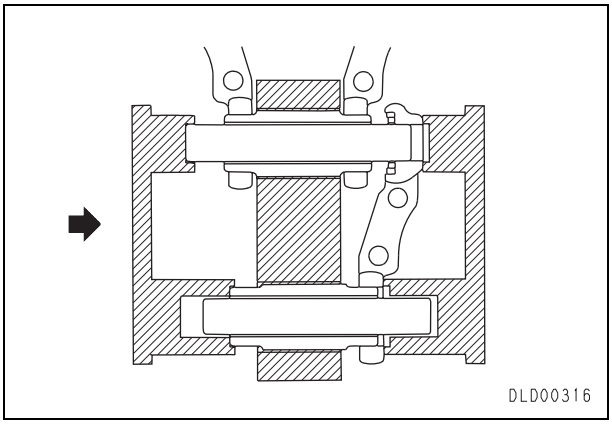


7) Set the right link and install the spacer to the pin.
★ Check that the seal surface and bushing end are free from dirt and apply oil (GO90) to them with a clean cloth or brush.
★ When installing the spacer, wipe it with a clean cloth.

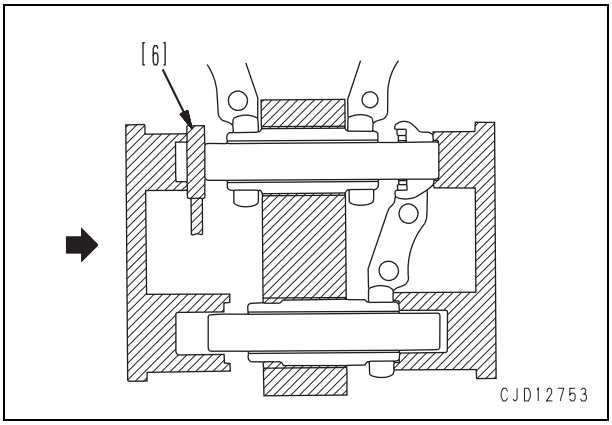


8) Set the right jig on the receiving side and the left one on the pushing side and press fit the pin and bushing simultaneously.
★ If the pin and bushing have play when they are press fitted, the seal may come off the link. To prevent this, press fit smoothly.
★ If the seal comes off the link, stop press fitting and set the seal to the link correctly, then start press fitting again.

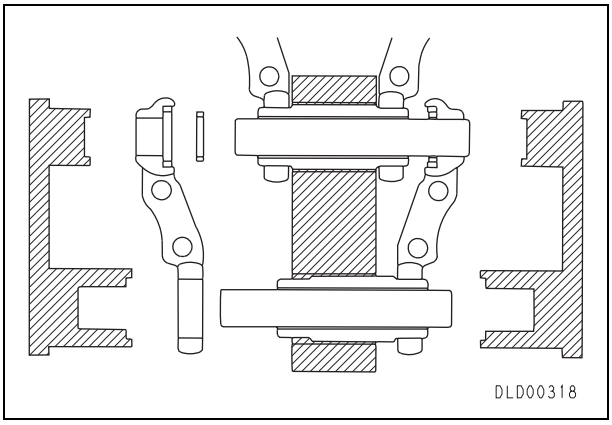
★ Press fitting force for pin and bushing:
245 – 343 kN {25 – 35 tons}



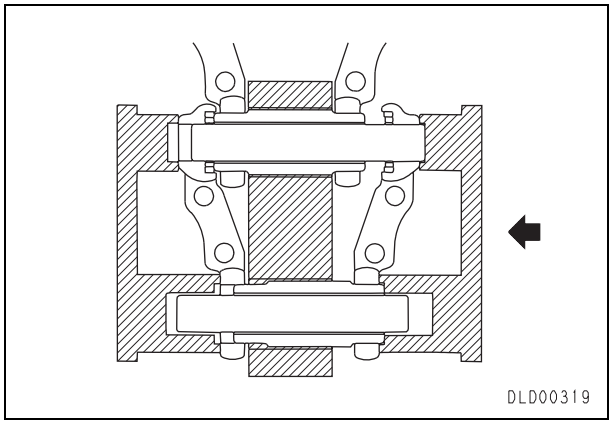
9) Using spacer [6] for fine adjustment, press fit the pin and bushing until the pin end is fitted to the bottom of the receiving jig.
★ Adjust the depth of the receiving jig hole so that the projections of the pin on both sides will be even.



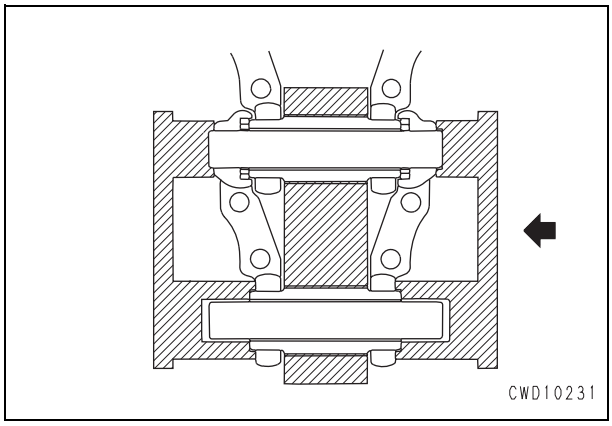
10) Set the left link and install the spacer to the pin.
★ Apply oil similarly to the right link.



11) Set the left jig on the receiving side and the right one on the pushing side and press fit the left link.
★ When press fitting, take care that both seals and spacers will not come off.
Press fitting force for link:
245 – 343 kN {25 – 35 tons}

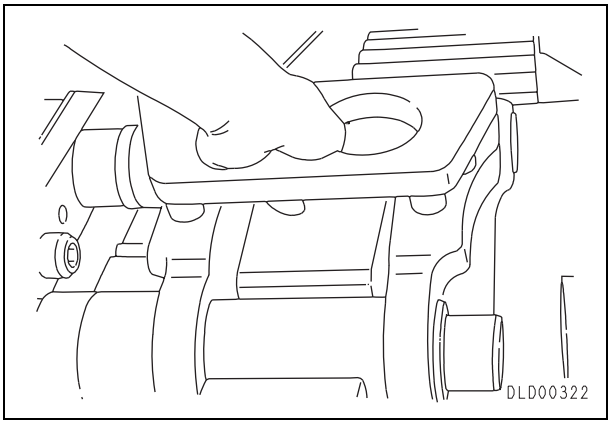


12) Press fit until the link, spacer, and bushing are fitted together.
★ Actually, you cannot see from outside if the above parts are fitted. Accordingly, control the hydraulic pressure of the link press. Set the relief pressure to a proper level and heighten the hydraulic pressure to that level.
★ For setting of the relief pressure, see "1. Preparation work."
★ Check that adjacent 2 links can turn around each other.

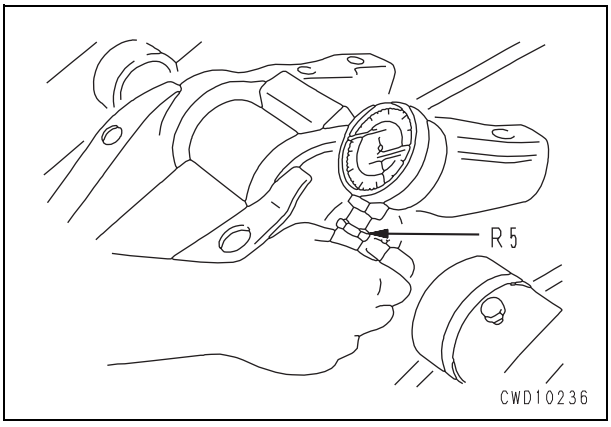


13) Using a shoe bolt hole pitch gauge, measure the distance between the shoe bolt holes and check that the result is within the standard range.
★ If the distance between the shoe bolt holes is longer than the standard range, disassemble and check for abnormality, then press fit again.

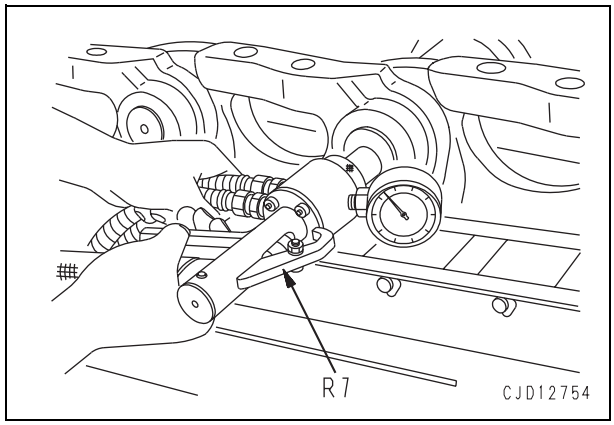
★ If the distance between the shoe bolt holes is shorter than the standard range and the shoe cannot be installed, the spacer or bushing end may be worn more than the allowable limit. In this case, disassemble and replace the parts.



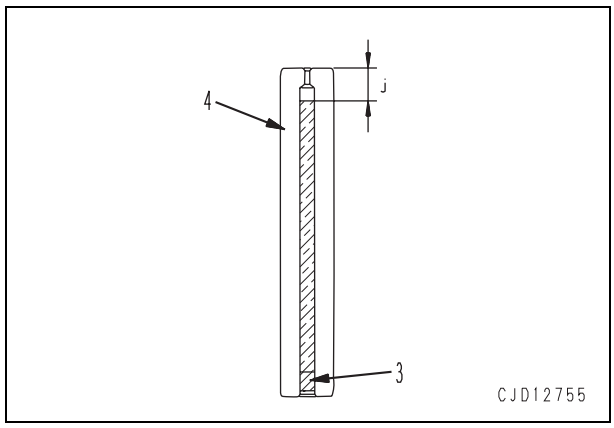
14) After each link is assembled, bleed air from the pin by using tool **R5** and check the sealing performance.
★ Keep the degree of vacuum inside the pin at 91 – 95 kPa {680 – 710 mmHg} for 5 seconds and check that the pressure does not change. If the pressure changes, disassemble and check the seal. If the seal is free from abnormality, assemble again.



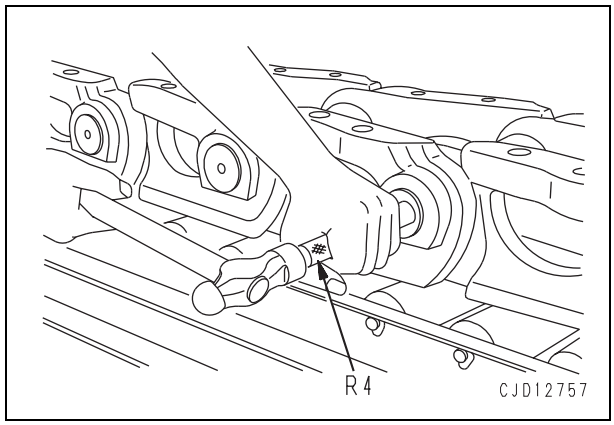
15) Using tool **R7**, supply oil (GO90) until the oil supply pressure rises to 196 – 294 kPa {2 – 3 kg/cm^2}.
★ In a cold or very cold district, supply Komatsu genuine oil (150-09-19270 or 195-32-61990) having better low-temperature characteristics instead of GO90.
★ If the oil pressure is heightened too much, it has bad effects on the seal. Take care.



★ Supply oil so that depth (j) of the hollow between the top of pin (4) and top of the oil level will be in the following range when the link is left with large plug (3) side up (with the link assembly on its side) for 30 minutes.
● Dimension (j)**: 50 – 80 mm**



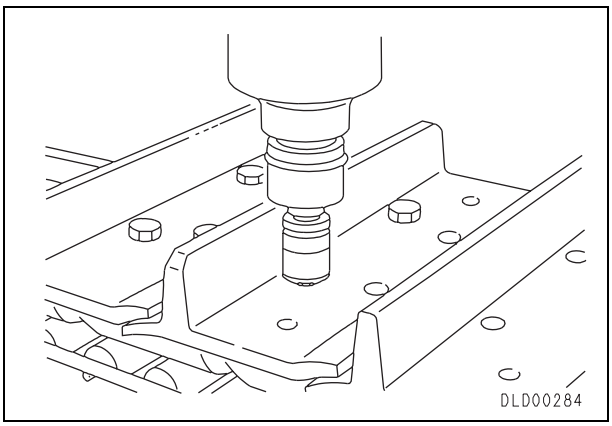
16) After supplying oil, drive in the small plug to the following specified position, using tool **R4**.
★ For the method of driving the small plug, see the large plug side [1. Preparation work, step 4)].
★ Apply oil (GO90) around the small plug.
● Driving depth from end: **2.5 ± 1 mm**



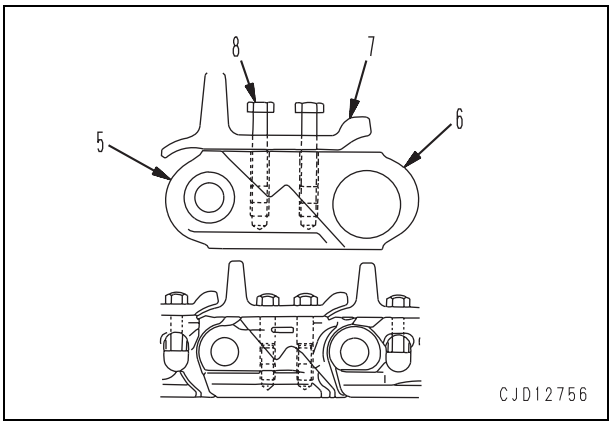
17) Assemble the master link on the pin side at last.
★ Check that the master links on both sides are press fitted in parallel.

3. Installation of shoe

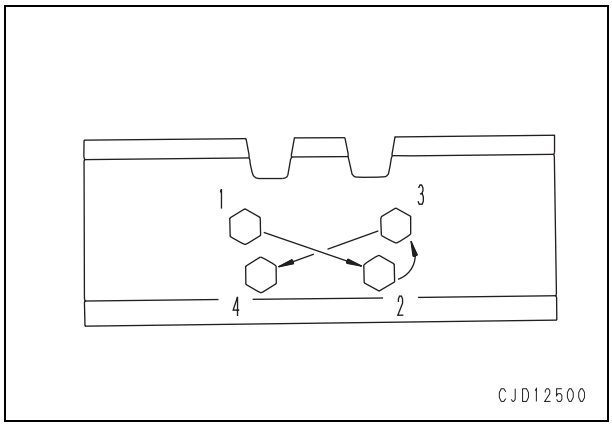
1) Set the link assembly on the bed and install the shoe with a shoe bolt impact wrench and a torque wrench.
Shoe bolt:
Lubricant containing molybdenum disulfide (LM-P)
Shoe bolt (Regular link)
Initial torque:
539 ± 49 Nm {55 ± 5 kgm}
Retightening angle: **120º ± 10º**



2) When installing a double track, place the assembled double shoes on a level place in 1 line with the shoe side up.
3) Pull pin-side master link (5) and bushing-side master link (6) together and set them to each other by the mating faces.
4) Place shoe (7) on the links and fit the mating faces of the links.
5) Check that shoe bolts (8) can be tightened easily, then connect the links with the master bolts.



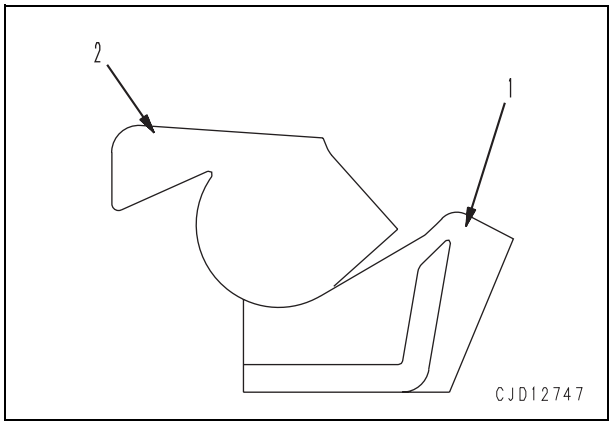
Shoe bolt:
Lubricant containing molybdenum disulfide (LM-P)
Shoe bolt (Master link)
Initial torque:
343 ± 39 Nm {35 ± 4 kgm}
Retightening angle: $180^{\circ}{}^{0^{\circ}}_{-20^{\circ}}$
★ Tighten the bolts in the order of 1 – 4.



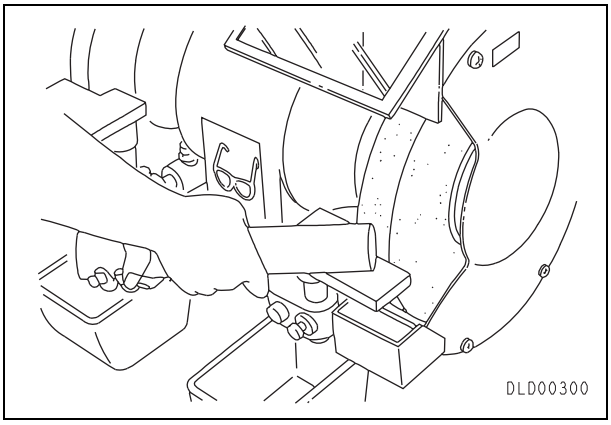
When recycling for grease-filled track

1. Preparation work

1) Cleaning seal assembly
Remove the seal assembly from the link and divide it into seal ring (1) and load ring (2), then clean them.
★ Since the seal ring and load ring are deteriorated easily by the cleaning liquid, clean them quickly. After cleaning them, wipe off the cleaning agent from them.



2) When reusing the pin, chamfer its end corners carefully with a grinder so that it will be press fitted smoothly.



3) Using tools **R3** and **R4**, drive in the large and small plugs.
   - Tool **R3** (For large plug)
   - Tool **R4** (For small plug)

★ Although tools **R3** and **R4** have different shapes, use them similarly to drive in the plugs.

i) Insert plug (3) in the plug insertion window of the guide of tool **R3**/**R4**.

★ Apply oil (GO90) to the outside of the plugs and install it with the small diameter end on the pin side.

ii) Push the bar of tool **R3**/**R4** with the hand until the plug stops.

iii) Push the plug with the bar to press the guide against pin (4).

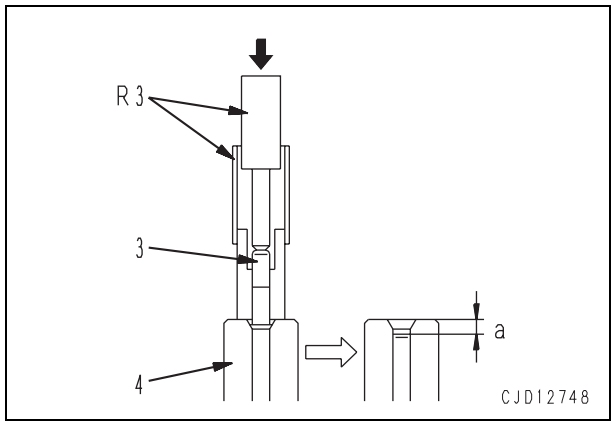
iv) Drive in the bar with a hammer.

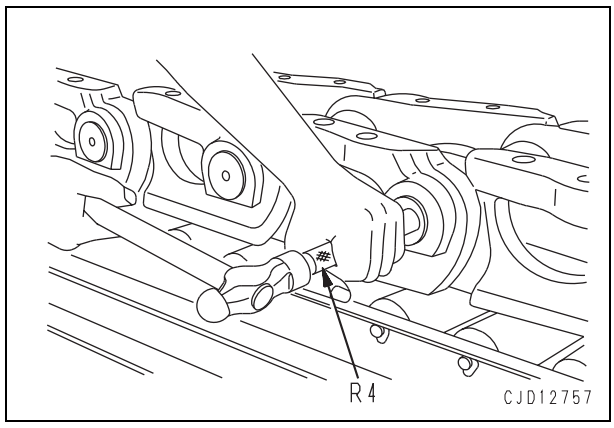
★ Driving distance (a) from pin end:
   Large plug: **2.5 ± 1 mm**
   Small plug: **6 ± 2 mm**

★ If the plugs were not pulled out when the shoe was disassembled, reuse them as they are.

4) If the outside of the pin, surfaces of the spacer, and ends and inside of the bushing are dirty, clean them.

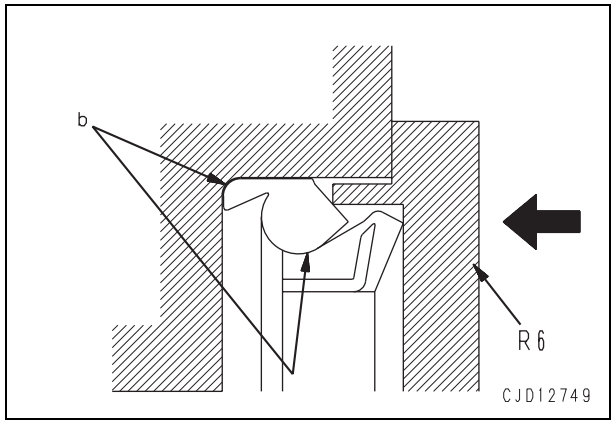
5) Apply grease to the outside of the pin and surfaces of the spacer.





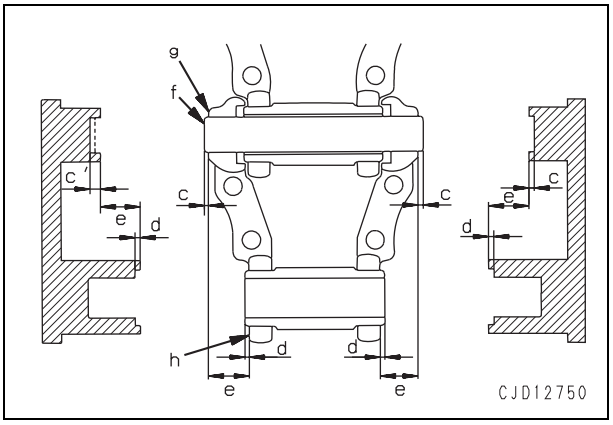
6) Installation of seal assembly
   Clean and degrease part (b) indicated with thick lines (the counterbore portion of the link and seal assembly) carefully. Then, using tool **R6**, push in the seal assembly to the bottom.

   ★ If oil or grease is sticking to the counterbore portion of the link or seal assembly, the seal will turn and its sealing performance will lower. Accordingly, do not apply any oil or grease to that portion.

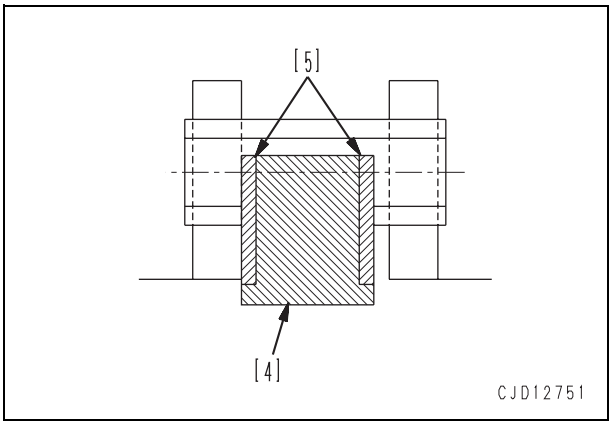


7) Adjust the dimensions of the press fitting jig of the link press to keep the projection of the pin and bushing constant and keep the installed dimensions of the seal within the standard range.
   - Dimension **c: 3 mm**
     d: 3 mm
     e: 49.7 mm

   ★ If the pin end (part **f**) or link sides (parts **g** and **h**) are worn, add the dimensions of the worn parts when adjusting the standard dimensions so that the projections of the pins and bushings on both sides will be even.

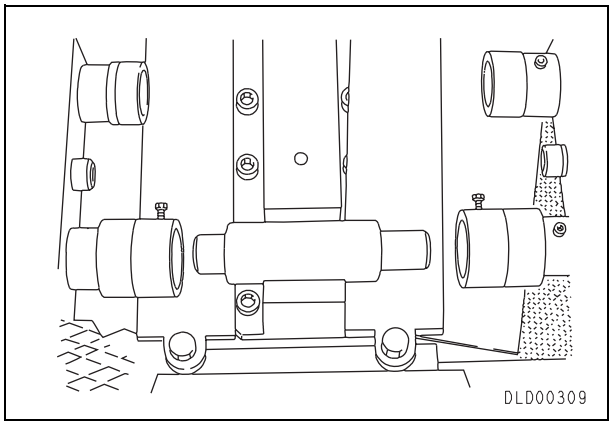


★ Set the link receiving face of jaw [4] vertically.
★ Wear plate [5] should be a replaceable one, if possible.

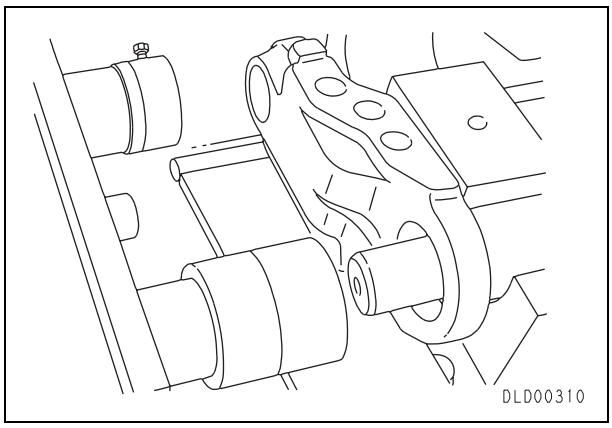


2. Assembly of link

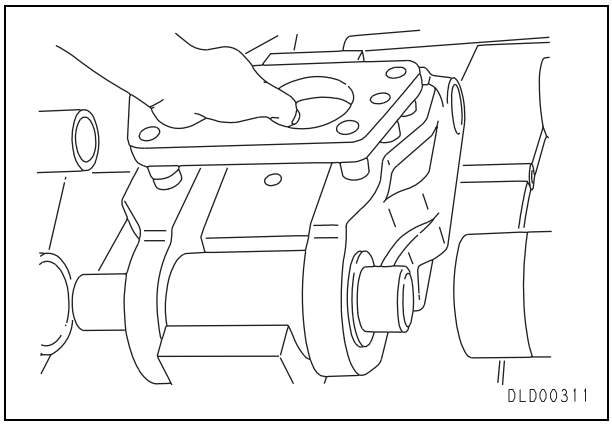
1) Apply lithium grease (G2-LI) to the mating surfaces of the pin and bushing and assemble them, then set them before the jaw of the link press.
   ★ When reusing (reversing) the bushing, set the worn outside surface of the bushing on the shoe fitting side of the link (set the bushing with the worn outside surface up on the link press).



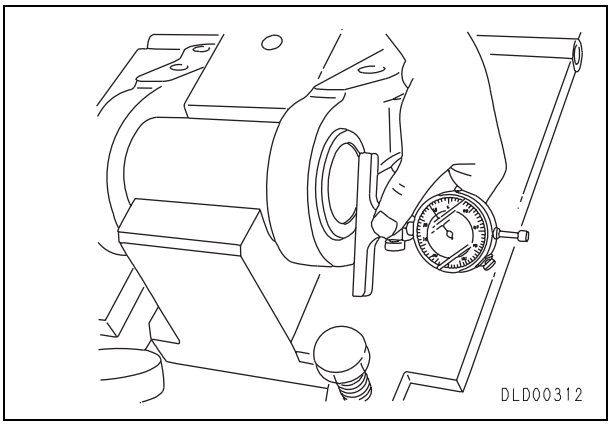
2) Press fit the master links on both bushing sides to the bushing with the shoe fitting faces up.
   ★ At this time, use the master links on the pin side as supports.
   ★ Press fitting force for bushing:
   98 – 147 kN {10 – 15 tons}



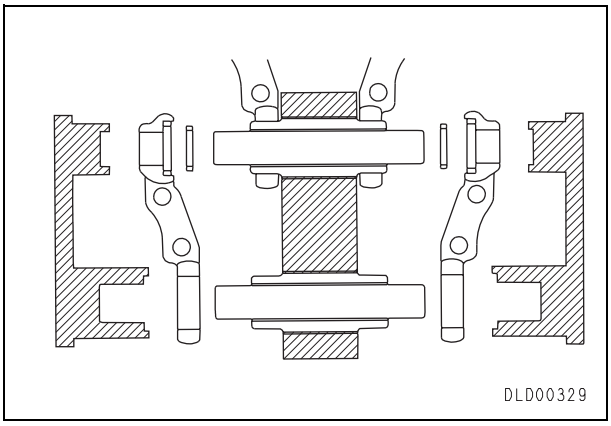
3) Using the shoe bolt hole pitch gauge, press fit the master links until the distance between the shoe bolt holes of both links is the standard value.
   ★ Remove the all steel chips caused by press fitting of the bushing with compressed air.
4) Turn over the master links and check that they are press fitted in parallel.



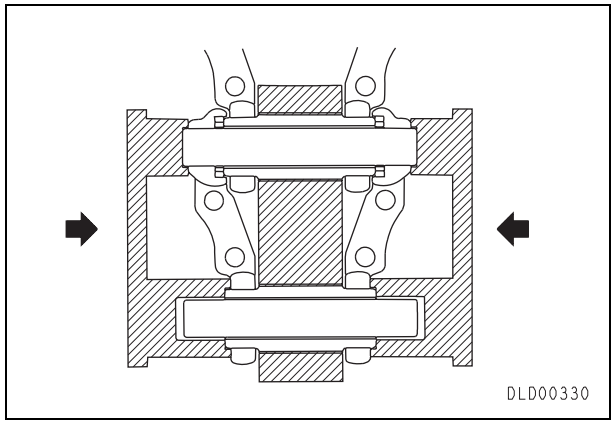
5) Measure the projections of the bushing on both sides with a depth gauge.
   ★ Adjust the press fitting jig of the link press so that the projections on both sides will be even.



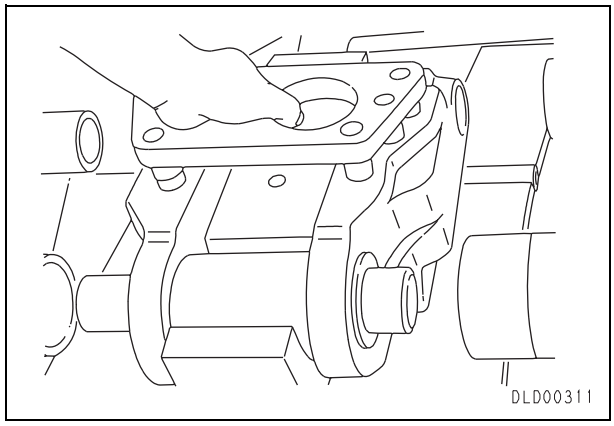
6) Send the master links and set the next pin and bushing.
   ★ When reusing a pin, install it so that its side hole will be the link tread side similarly to a new one.
   ★ If it is not installed so, its strength may be lowered. Accordingly, indicate the direction of the side hole on the end face to prevent a mistake.
   ★ If the outside of the pin is worn, install it so that the un-worn surface will be on the traction side. In this case, install the pin so that its side hole will be the link tread side, too.



7) Set both links and operate both pushing jigs to press fit the pin and bushing simultaneously.
   ★ If the pin and bushing have play when they are press fitted, the seal may come off the link. To prevent this, press fit smoothly. If the seal comes off the link, stop press fitting and set the seal to the link correctly, then start press fitting again.
   ★ Pushing force of pin and bushing:
   539 kN {55 tons}
   Pushing force ≒ 1.8 x Average pressure (Adjust the relief pressure of the link press to set the press cutting force.)



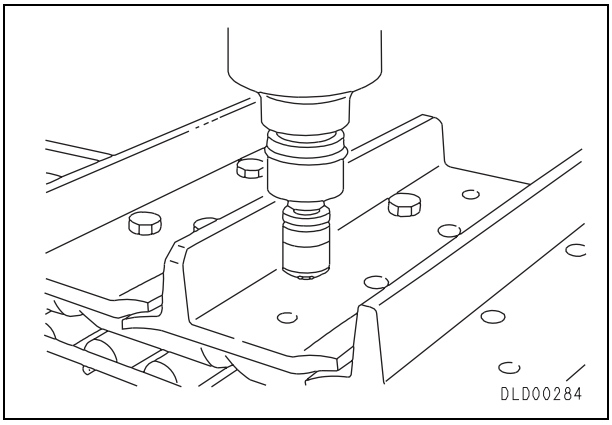
8) Using a shoe bolt hole pitch gauge, measure the distance between the shoe bolt holes. When the distance is in the standard range, stop press fitting.



9) Assemble the master link on the pin side at last.
   ★ Check that the master links on both sides are press fitted in parallel.

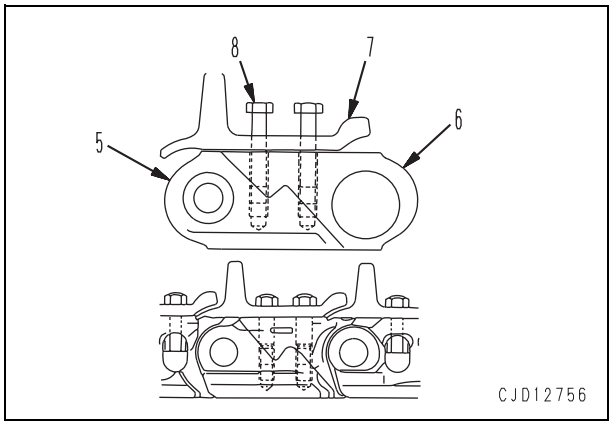
3. Installation of shoe

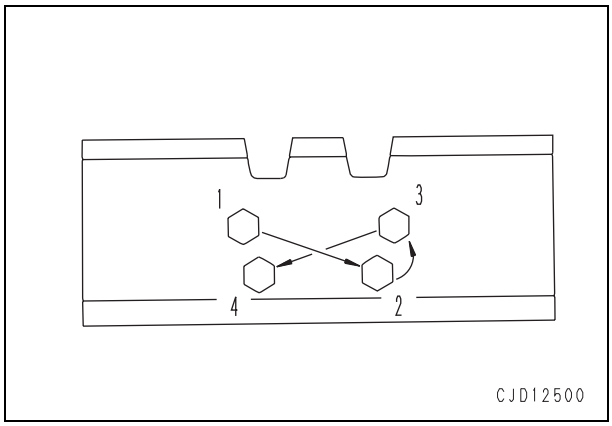
1) Set the link assembly on the bed and install the shoe with a shoe bolt impact wrench and a torque wrench.
   - Shoe bolt:
     Lubricant containing molybdenum disulfide (LM-P)
   - Shoe bolt (Regular link)
     Initial torque:
     539 ± 49 Nm {55 ± 5 kgm}
     Retightening angle: **120º ± 10º**



2) When a 2-piece track is used, place the assembled 2 shoes on a level place in 1 line with the shoe side up.
3) Pull pin-side master link (5) and bushing-side master link (6) together and set them to each other by the mating faces.
4) Place shoe (7) on the links and fit the mating faces of the links.
5) Check that shoe bolts (8) can be tightened easily, then connect the links with the master bolts.
   - Shoe bolt:
     Lubricant containing molybdenum disulfide (LM-P)
   - Shoe bolt (Master link)
     Initial torque:
     343 ± 39 Nm {35 ± 4 kgm}
     Retightening angle: **180º $^{0°}_{-20°}$**

★ Tighten the bolts in the order of 1 – 4.



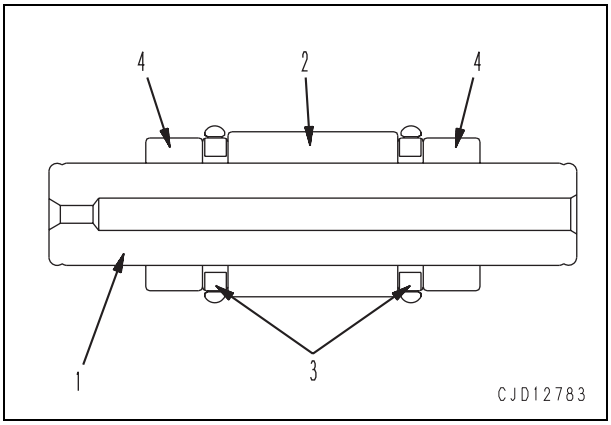


Assembly instructions for rotary-bushing track

★ Only the parts of the instructions for the rotary-bushing track different from the standard track are explained below.
★ Disassemble and inspect the rotary-bushing track similarly to the standard track.
★ Apply the following procedure in the field, too.

1. Setting pin and bushing

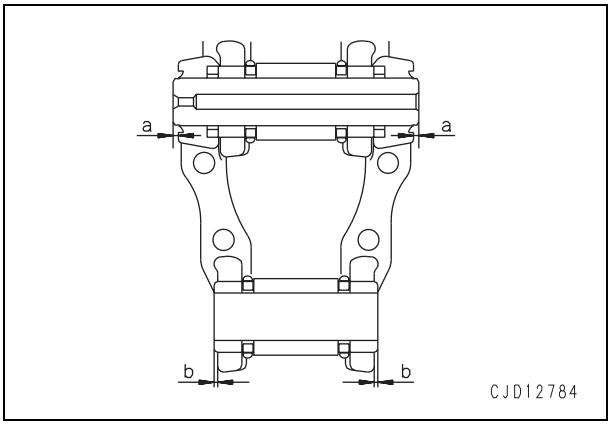
Set the sub-assembly of pin (1), rotary bushing (2), seal (3), and fixed bushing (4) to the press line.



2. Press fitting pin and bushing to link

Press fit the pin and bushing to link (5) simultaneously.

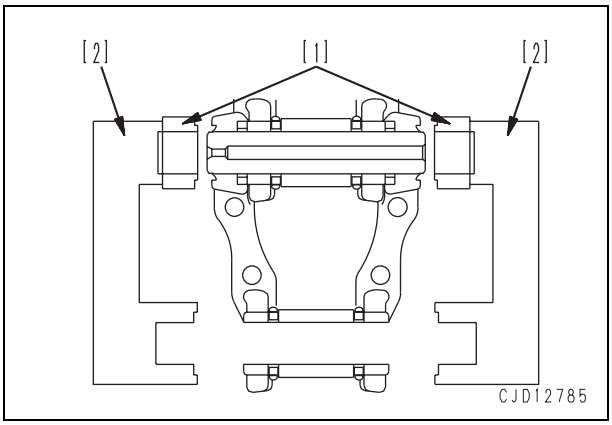
★ Before press fitting, check that the hole of the bushing is aligned with the hole to fit the bushing.
★ Press fit the pin and bushing so that projection (a) of the pin and projection (b) of the bushing will be in the following ranges.
- Dimension **a: 4.45 ± 0.6 mm**
- Dimension **b: 3.05 ± 0.2 mm**



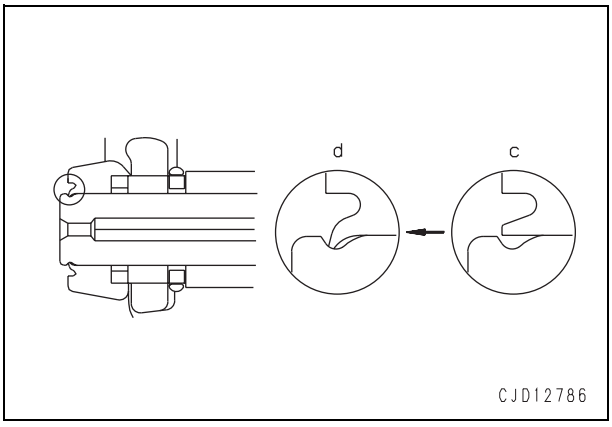
3. Caulking ends of link

1) Set caulking jigs [1] to both ends of the link. Using pressing jigs [2], press both caulking jigs simultaneously until they are fitted to both ends of the link.
★ For details of caulking jig [1] and pressing jig [2], see the following page.
★ Set caulking jigs [1] so that the unmachined parts of the link will be deformed.
★ If caulking jigs [1] are pressed too strongly, the spacers will be broken. Accordingly, limit the pressing force to the following value.
- Max. pressing force:

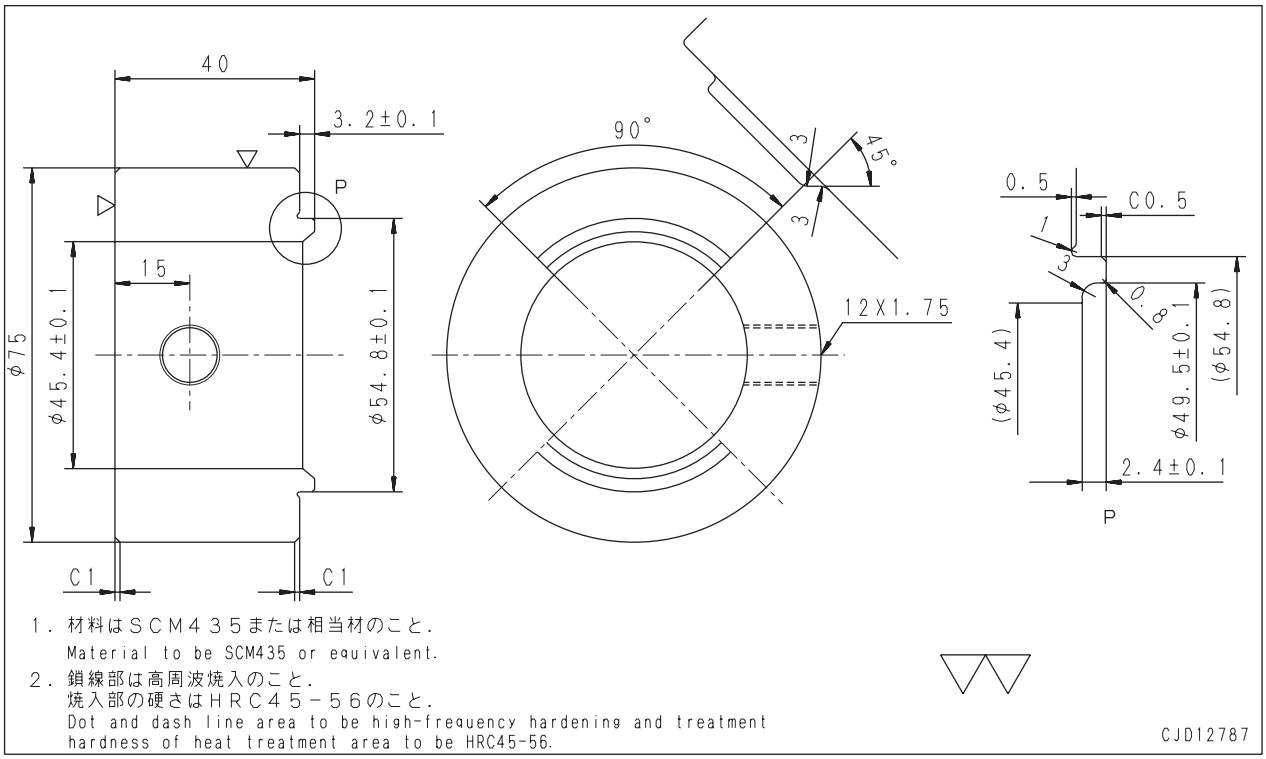
588 kN {60 tons}



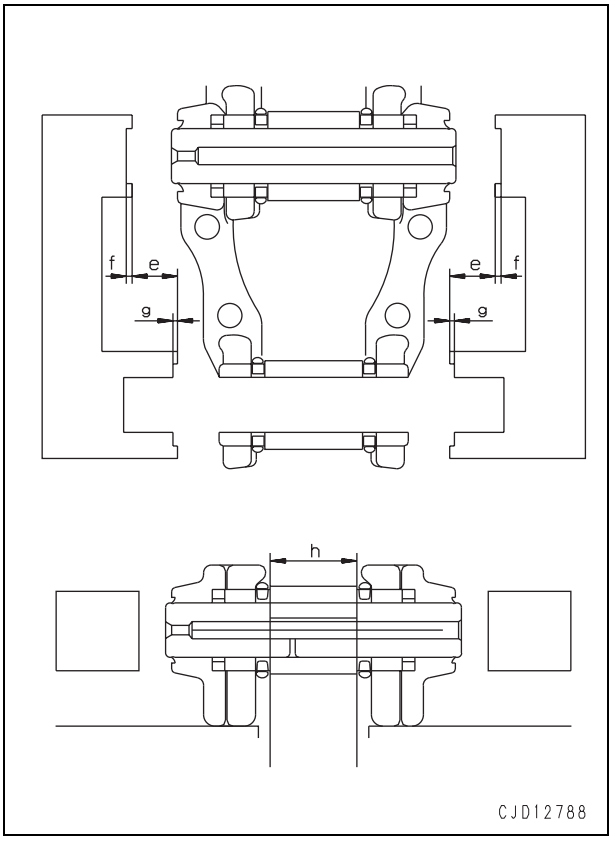
2) Check that the link has been caulked correctly from (c) to (d) as shown in the following figure.



★ Caulking jig [1]



★ Pressing jig [2]



- Dimension **e: 48.2 mm**
  f : 4.45 mm
  g: 3.05 mm
  h: 70 mm

Field disassembly and assembly of one link

★ In this section, how to use the special tools is explained mainly.
★ For details of disassembly and assembly, see "Whole disassembly and whole assembly of track shoe assembly."

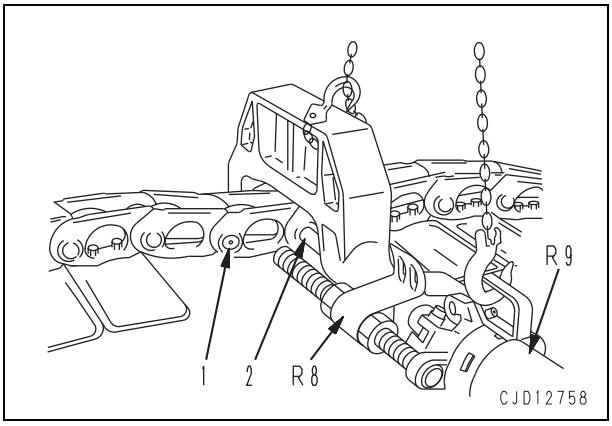
Special tools

Symbol		Part No.	Part name	Necessifty	Q'ty	New/remodel	Sketch
R	3	791-432-1110	Push tool	■	1		
		791-646-7550	Bar	■	1		
		791-646-7560	Guide	■	1		
	4	791-932-1110	Push tool	■	1		
		791-646-7523	Bar	■	1		
		791-646-7590	Guide	■	1		
	6	791-432-1120	Installer	■	1		
	7	791-601-1000	Oil pump	■	1		
	8	791-635-3110	Frame	■	1		
		791-635-3160	Extension	■	1		
		791-635-3170	Nut	■	4		
		791-635-3180	Screw	■	2		
		791-635-3190	Screw	■	1		
		791-645-3510	Adapter	■	1		
		791-646-3260	Pusher	■	1		
	9	790-101-1102	Pump	■	1		
		790-101-1300	Cylinder	■	1		
	10	790-105-2300	Jack	■	1		
		790-101-1102	Pump	■	1		
	11	791-645-3520	Adapter	■	1		
		791-432-1210	Spacer	■	1		
	12	791-645-3540	Guide	■	1		
	13	791-635-3110	Frame	■	1		
		791-635-3160	Extension	■	1		
		791-635-3170	Nut	■	4		
		791-635-3180	Screw	■	2		
		791-635-3190	Screw	■	1		
		791-645-3510	Adapter	■	1		
		791-645-3520	Adapter	■	1		
		791-645-3530	Pusher	■	1		
		791-432-1210	Spacer	■	1		
		791-432-1220	Spacer	■	1		
R	14	791-635-3110	Frame	■	1		
		791-635-3160	Extension	■	1		
		791-635-3170	Nut	■	4		
		791-635-3180	Screw	■	2		
		791-635-3190	Screw	■	1		
		791-645-3520	Adapter	■	1		
		791-645-3540	Guide	■	1		
		791-645-3550	Pusher	■	1		
	15	791-646-3270	Guide	■	1		
	16	791-635-3110	Frame	■	1		
		791-635-3160	Extension	■	1		
		791-635-3170	Nut	■	4		
		791-635-3180	Screw	■	2		
		791-635-3190	Screw	■	1		
		791-645-3510	Adapter	■	1		

Disassembly

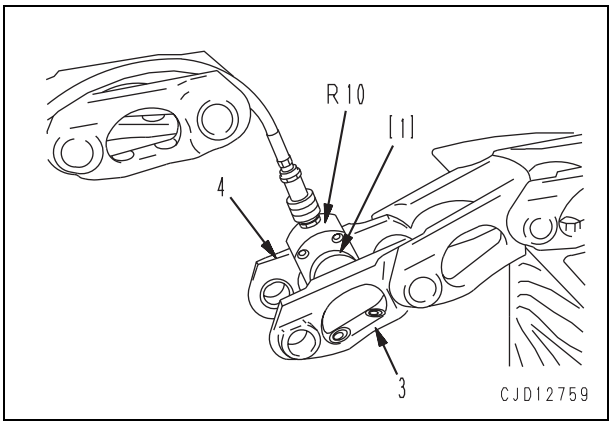
1. Pins

1) Set track shoe assembly on block.
2) Using tool **R8** (frame, extension, nut, screw, adapter, pusher), and tool **R9** (pump, cylinder), remove pins (1) and (2).
★ If the tip of the pin or the side of the link are unevenly worn, correct with a hand grinder to ensure that the part is at a right angle to tool **R8**.

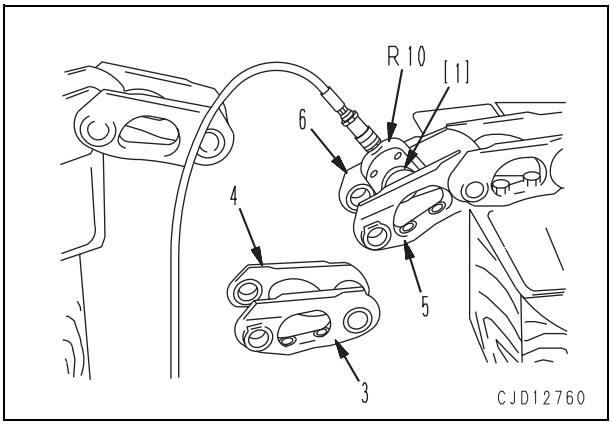


2. Links

1) Put tool **R10** and spacer [1] (Outside diameter: 55 mm, Thickness: 47 mm) to the tread side of links (3) and (4).
   ★ Set tool **R10** as close to the tip of the link as possible.
2) Apply hydraulic pressure slowly to the puller until the tip of the link opens 6 – 8 mm, then disconnect the link.
   ★ There is danger that the bushing will come out, so do not apply more hydraulic pressure than necessary.
   ★ If an electric pump is used, there is danger that more hydraulic pressure will be applied than necessary, so always use a hand pump.



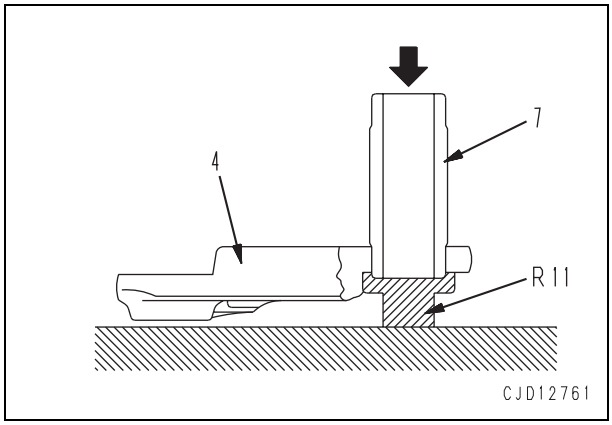
3) Disconnect links (5) and (6) in the same way.



Assembly

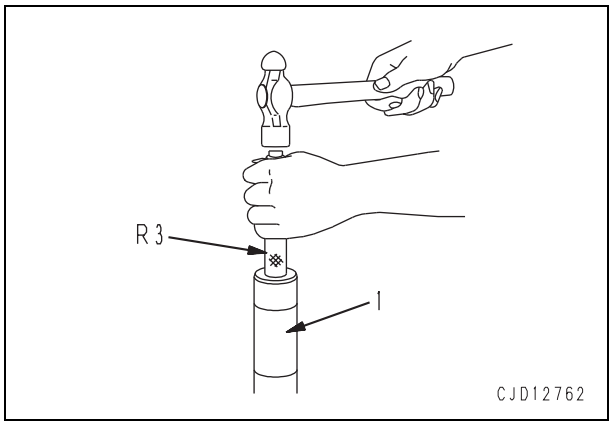
1. Bushing

Put tool **R11** in contact with the end face of link (4), and press fit bushing (7).
★ Bushing press fitting force:
98 – 147 kN {10 – 15 tons}
★ Always use a new bushing.

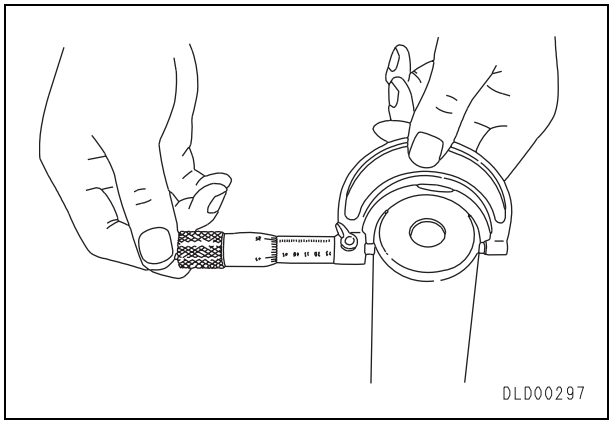


2. Pins

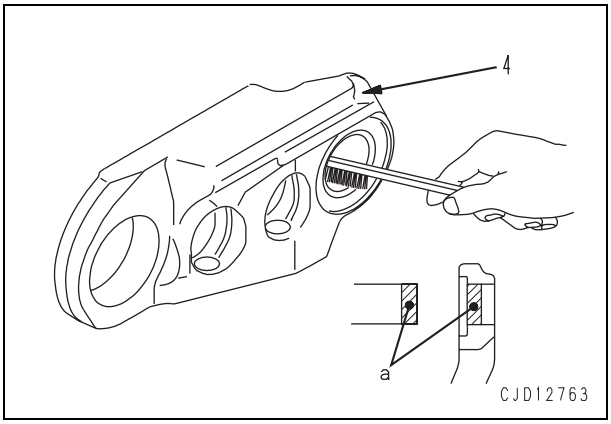
1) Using tool **R3**, knock a large plug into the oil hole of pin (1).
   ★ Always use a new pin.



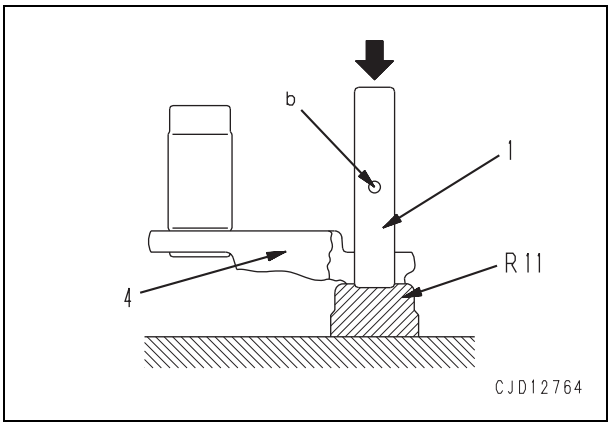
2) To determine the pushing pressure when carrying out the final assembly, measure the outside diameter of the pin with a micrometer and note down the measurement.



3) Coat the press-fitting hole (a) for the pin in link (4) with gasket sealant (198-32-19890).
   ★ If the link is used again, finish the press fitting hole for the pin smoothly with sandpaper.

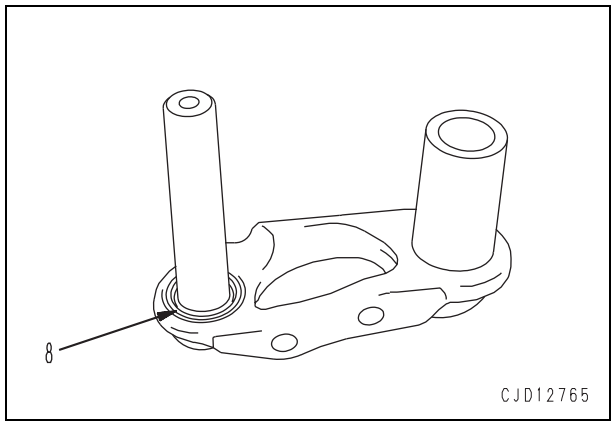


4) Put tool **R11** in contact with the end face of link (4), and press fit pin (1).
   ★ Press fit so that the side hole (b) in the pin is on the same side as the link tread.
   ★ Pin press fitting force:
   147 – 196 kN {15 – 20 tons}
   ★ Always use a new pin.

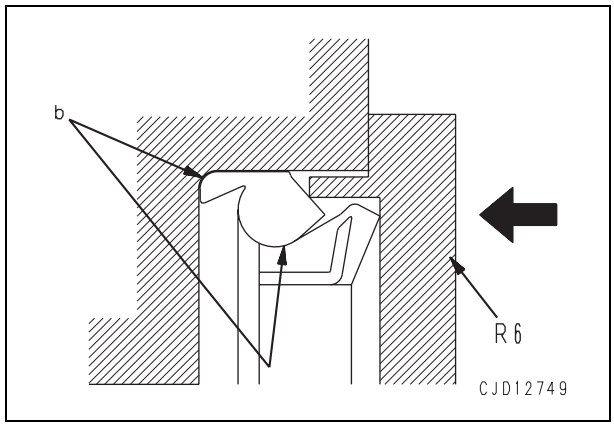


3. Seal

Install seal (8) with tool **R6**.
   ★ Check that there is no oil on the contact surface of the link and seal.

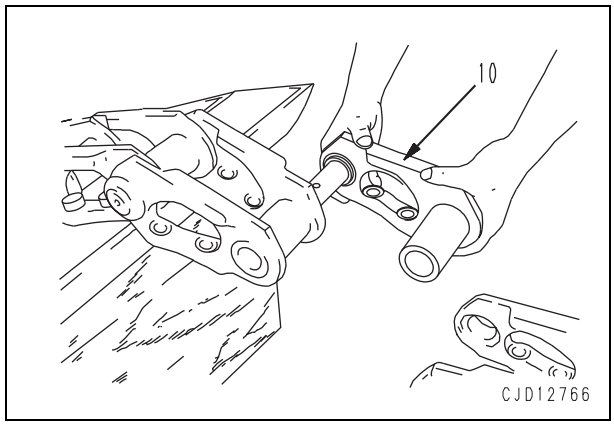


   ★ Remove all oil and grease from portions (b).

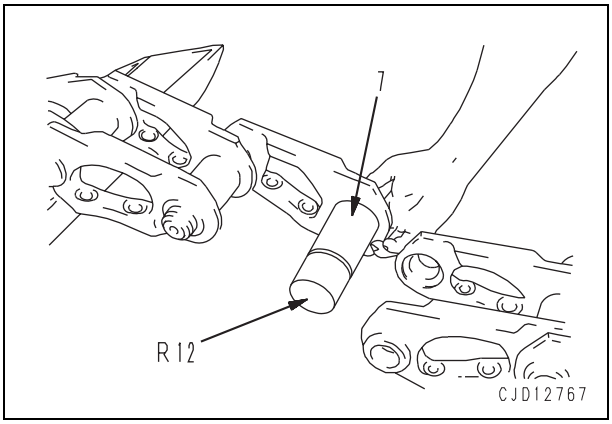


4. Link sub-assembly

1) Install link sub-assembly (10).
   ★ Check that there is no dirt or dust stuck to the surface of the seal or the end face on the bushing, then coat with oil (GO140B) using a clean cloth or small brush.

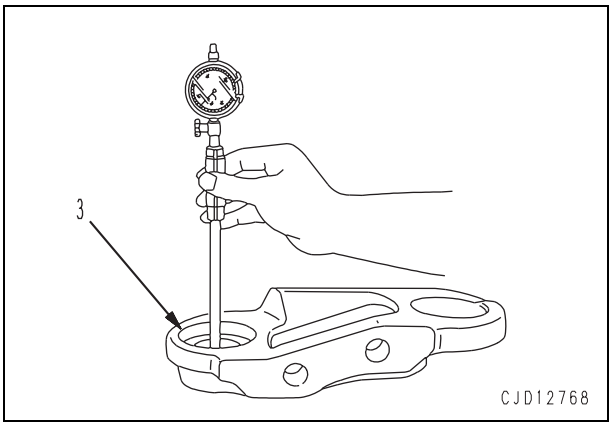


2) Install tool **R12** (guide used when press fitting link) to bushing (7).

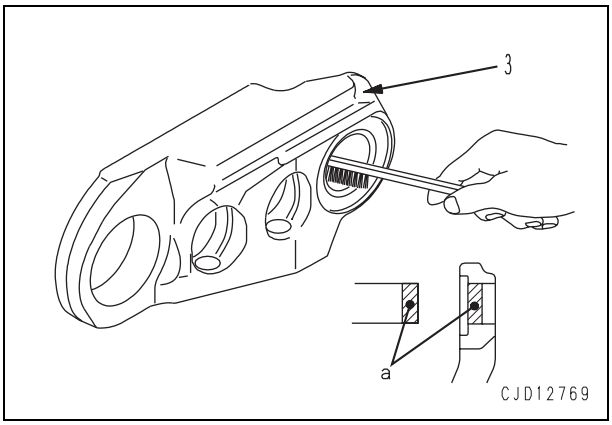


5. Link

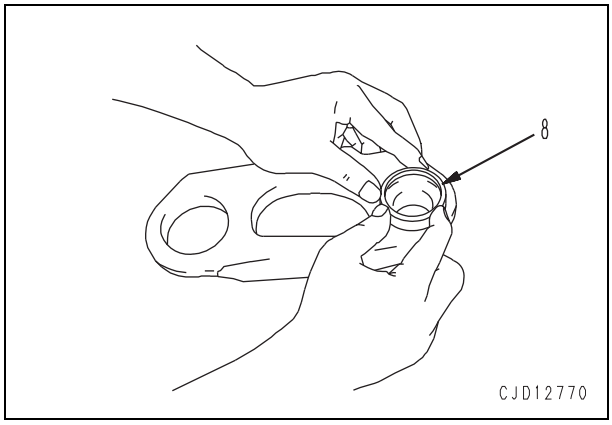
1) To determine the pushing pressure when carrying out the final assembly, measure the dimensions of the press-fitting hole for the pin in link (3) with a cylinder gauge, and note down the measurement.

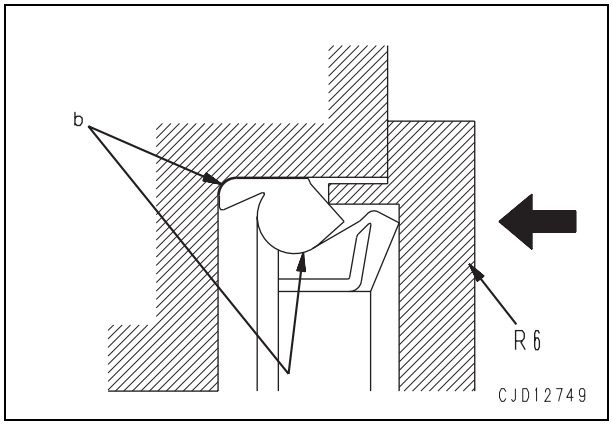


2) Coat the press-fitting hole (a) for the pin in link (3) with gasket sealant (198-32-19890).
★ If the link is used again, finish the press-fitting hole for the pin smoothly with sandpaper.

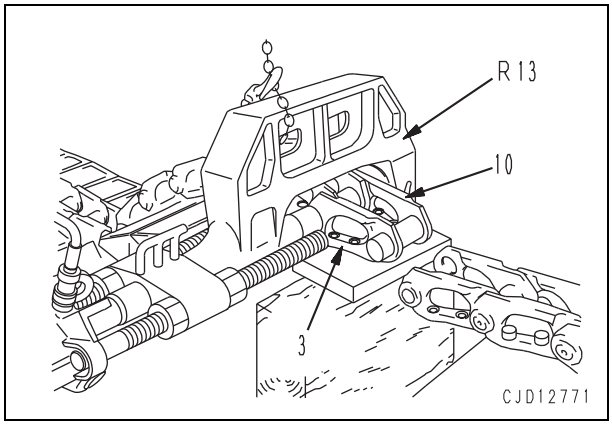


3) Install seal (8) with tool **R6**.
★ Check that there is no oil on the contact surface of the link and seal.



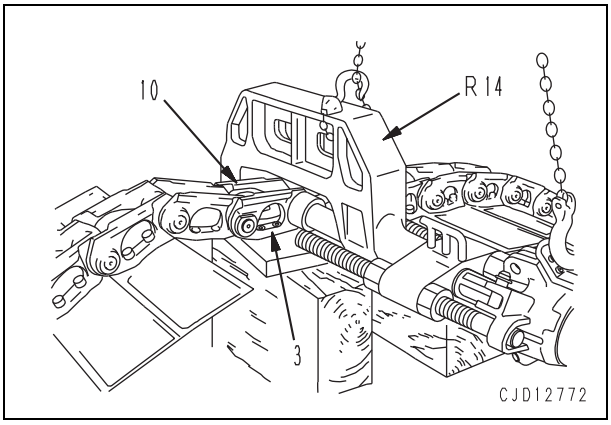


4) Check that there is no dirt or dust stuck to the surface of the seal or the end face of the bushing, then coat with oil (GO140B) using a clean cloth or small brush.
5) Using tool **R13**, press fit pin portion of link (3) to link sub-assembly (10).
★ Pin press fitting force:
294 – 392 kN {30 – 40 tons}



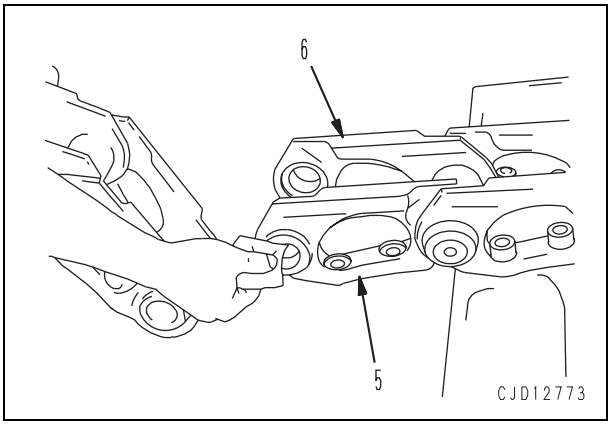
6) Using tool **R14**, press fit bushing portion of link (3) to link sub-assembly (10).
★ To prevent the use of any excessive force, press fit the pin portion and bushing portion gradually in turn.

★ Pin and bushing press fitting force:
245 – 343 kN {25 – 35 tons}

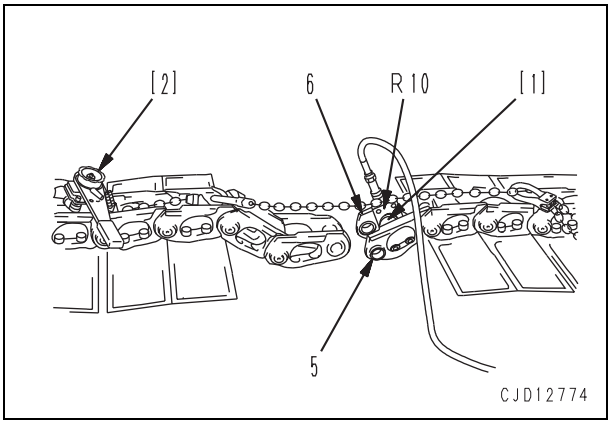


6. Connecting link

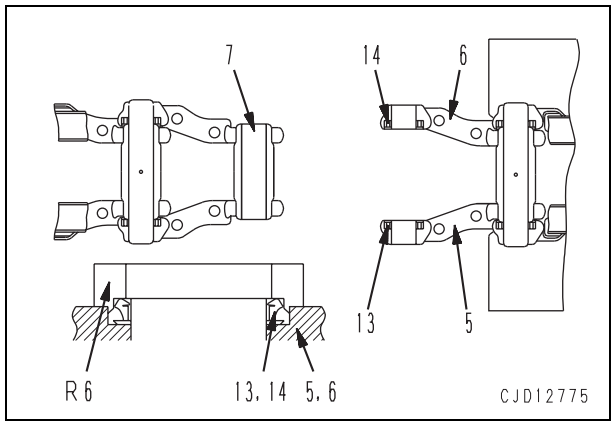
1) Finish the inside surface of the press-fitting hole for the pin in links (5) and (6) smoothly with sandpaper.



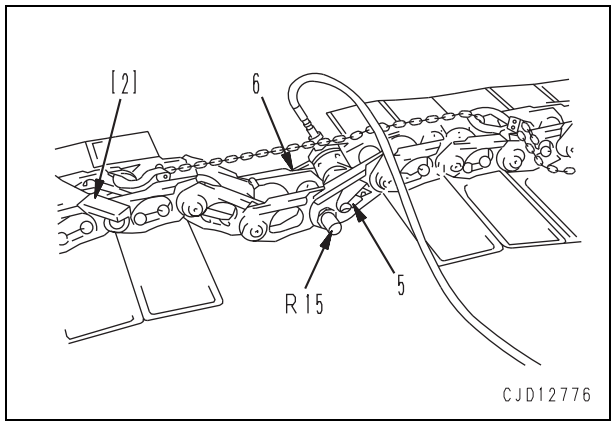
2) Lower the track shoe assembly to the ground.
3) Set lever block [2] to the left and right link assemblies as shown in the fig, then put tool **R10** and spacer [1] (outside diameter 55 mm, thickness 47 mm) in contact with the tread on links (5) and (6).
★ Set tool **R10** as close to the tip of the link as possible.



4) Using tool **R6**, install seals (13) and (14) to links (5) and (6).
★ Always use new seals.
★ Check that there is no oil on the contact surface of the link and seal.

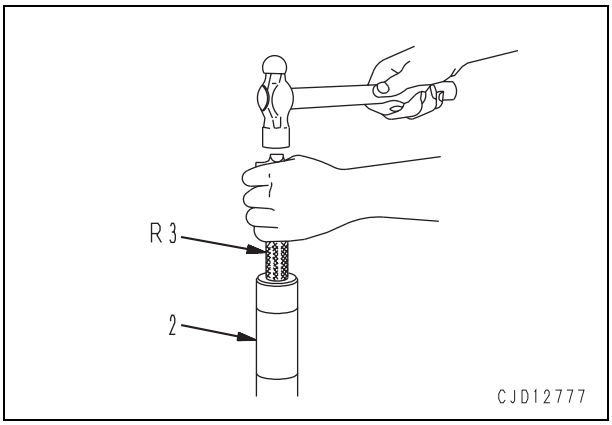


5) Check that there is no dirt or dust stuck to the surface of the seal or the end face of bushing (7), then coat with oil (GO140B) using a clean cloth or small brush.
6) Apply hydraulic pressure slowly to the puller until the tips of links (5) and (6) open 6 – 8 mm.
★ There is danger that the bushing will come out, so do not apply more hydraulic pressure than necessary.
★ If an electric pump is used, there is danger that more hydraulic pressure will be applied than necessary, so always use a hand pump.
7) Operate lever block [2], align the centers of the link hole and bushing hole, and connect the links with tool **R15** (guide pin).
★ Operate lever block [2] slowly and be careful not to damage the seal or get sand stuck to the seal surface.

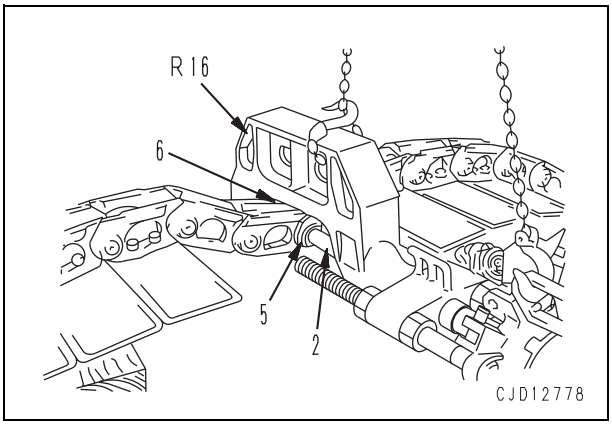


7. Pin

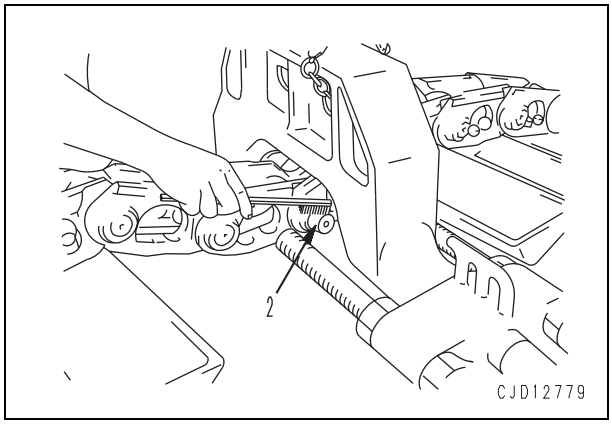
1) Using tool **R3**, knock a large plug into the oil hole of pin (2).
   ★ Always use a new pin.



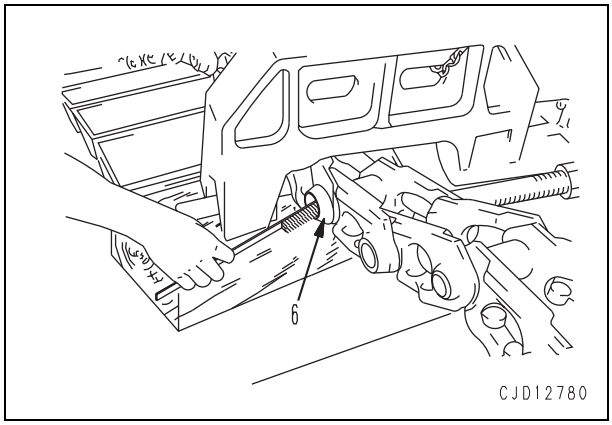
2) To determine the pushing pressure when carrying out the final assembly, measure the outside diameter of pin (2) with a micrometer, and note down the measurement.
3) Set the track shoe assembly on block again.
4) Using tool **R16**, press fit pin (2) to links (5) and (6).
   ★ Press fit so that the side hole in the pin is on the same side as the link tread.
   ★ Pin press fitting force:
   98 – 147 kN {10 – 15 tons}
5) Temporarily stop press fitting when there is 15 – 20 mm left for press fitting pin (2).



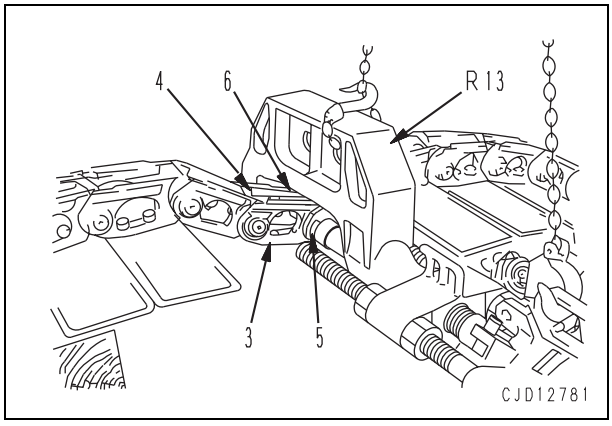
6) Coat the remaining press-fitting portion of pin (2) with gasket sealant (198-32-19890).



7) Coat the press-fitting hole for the pin in link (6) with gasket sealant (198-32-19890), then continue to press fit pin (2).



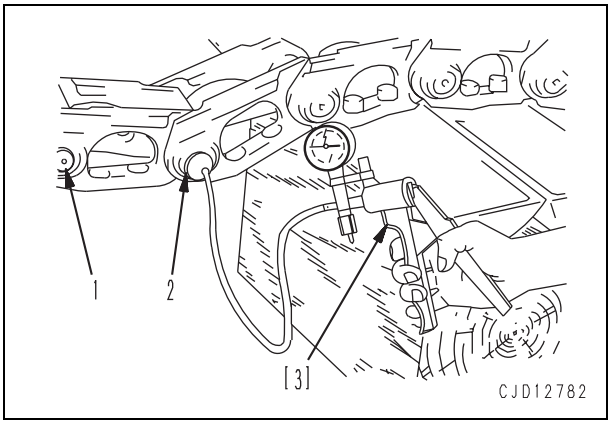
8) Using tool **R13**, apply the specified pressure to links (3) and (4) and links (5) and (6).
   ★ Set pushing force of pin and bushing:
   539 kN {55 tons}
   Set pushing force ≒ 1.8 x average pushing force
   (Adjusting the relief pressure of link press to fix the set pushing force)



8. Vacuum test

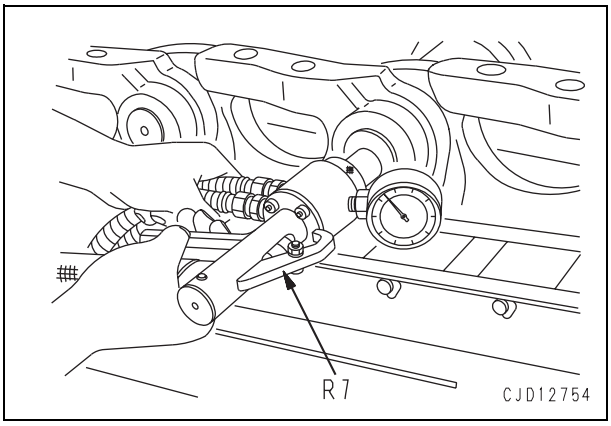
Using hand vacuum pump [3], remove the air from the small plug hole at the end face of pins (1) and (2) and check the sealing performance.

★ Check that the airtightness is maintained for 5 seconds at a negative pressure of 92.7 ± 1.9 kPa {695 ± 15 mmHg}.



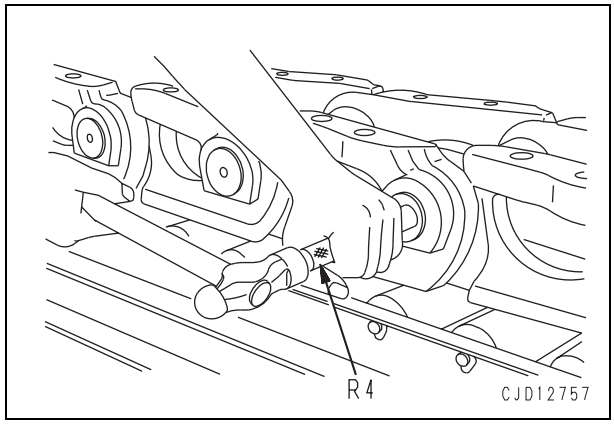
9. Charging with oil

1) Using tool **R7**, charge with oil (GO140B) through the small plug hole in the pin.
   ★ Be careful not to raise the pressure too high when charging with oil. This will have an adverse effect on the seal.
   ★ Take into consideration the expansion of the oil under heat, and be careful not to charge with too much oil.



2) Using tool **R4**, drive in the small plug to the following depth quickly.
   ★ Coat the outside circumference of the small plug with oil (GO140B).
   ● Depth to drive from end face:

2.5 ± 1 mm



Removal and installation of pivot shaft assembly

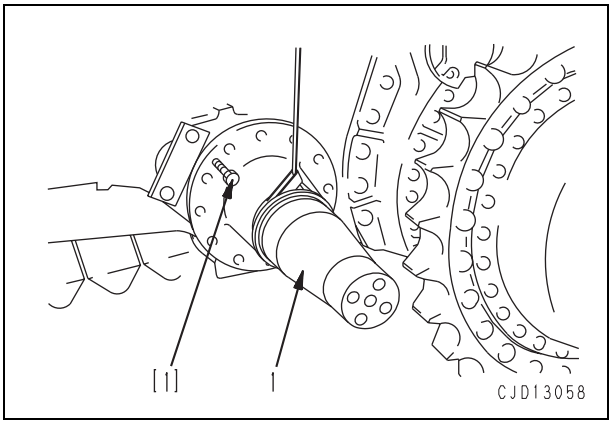
Special tools

Symbol	Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch
P	791-430-1200	Installer assembly	■	1		
	790-101-2102	Puller	■	1		
	790-101-1102	Pump	■	1		

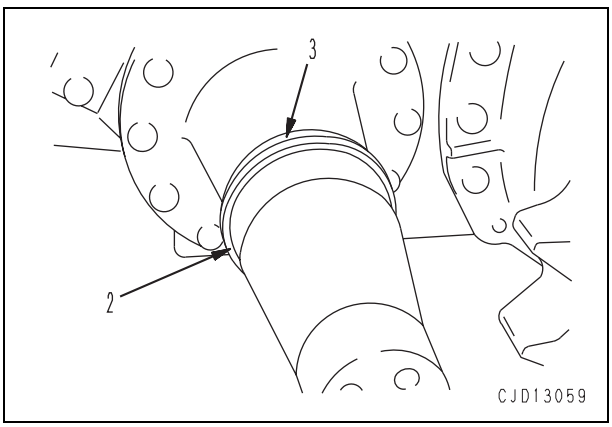
Removal

1. Remove track frame assembly. For details, see "Removal of track frame assembly."
2. Sling pivot shaft assembly (1).
3. Remove mounting bolts, then forcing screws [1], raise pivot shaft assembly and pull out. [*1]

   Pivot shaft assembly: **90 kg (D65EX)**
   100 kg (D65PX)



4. Remove seal (2). [*2]
5. Remove ring (3). [*3]



Installation

- Carry out installation in the reverse order to removal.

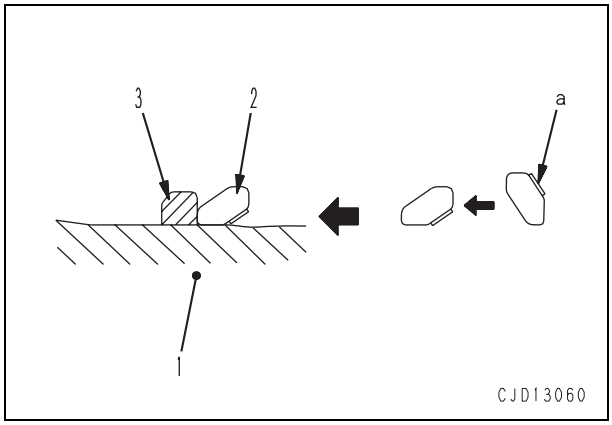
[*1]

Pivot shaft mounting bolt:
455 – 565 Nm {46.5 – 58 kgm}

[*2]

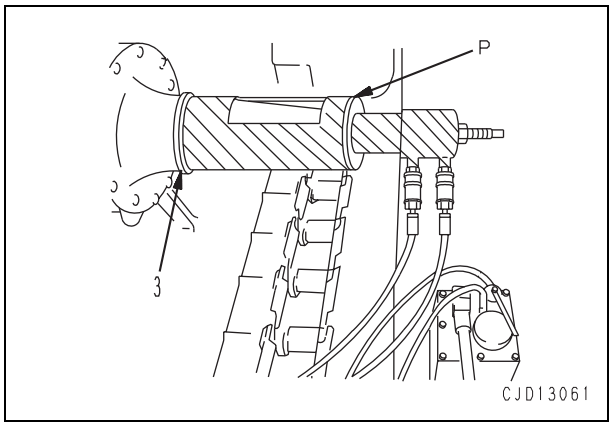
★ Assemble seal (2) as follows (see diagram bellow).
   1) Turn over the seal so that the embossed letters (a) on the seal are on the inside.
   2) With the seal turned over, insert the seal on pivot shaft (1).

★ When inserting the seal, be careful not to damage the surface.



[*3]

★ Press fit ring (3) using tool **P**.
★ Press fitting force: **18.6 kN {1.9 ton}**



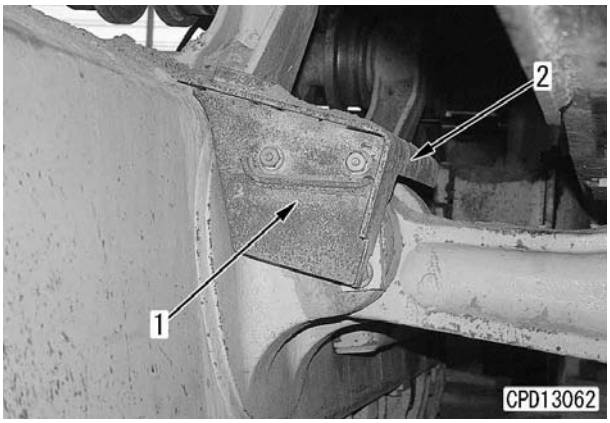
Removal and installation of equalizer bar assembly

Special tools

Symbol	Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch
N	791-450-1100	Remover assembly	■	1		
	790-101-2102	Puller	■	1		
	790-101-1102	Pump	■	1		

Removal

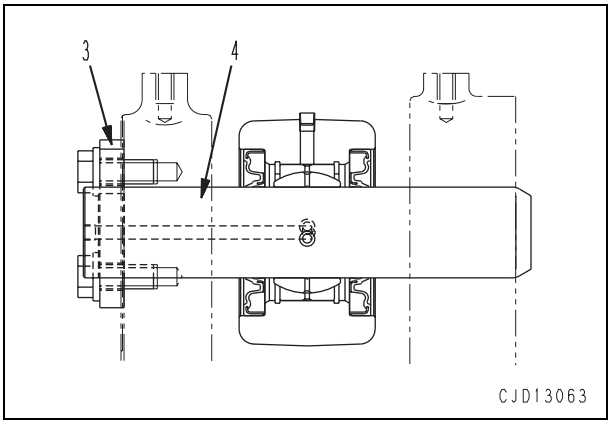
1. Remove side pin covers (1) and (2).



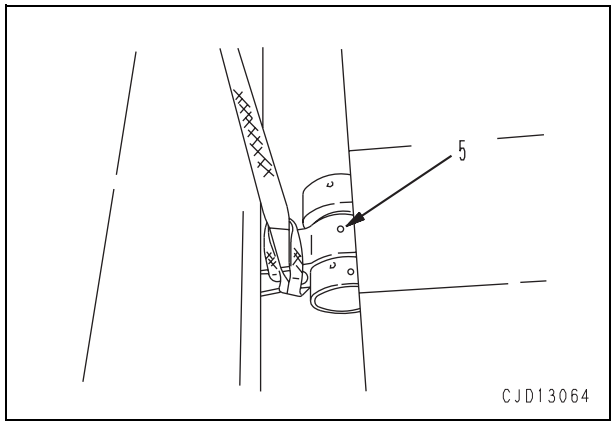
2. Using a jack, raise the chassis and set a stand under the front frame.

⚠ **Set the stand securely.**

3. Remove lock (3) and pull out pin (4). [*1]



4. Sling equalizer bar (5) temporarily.

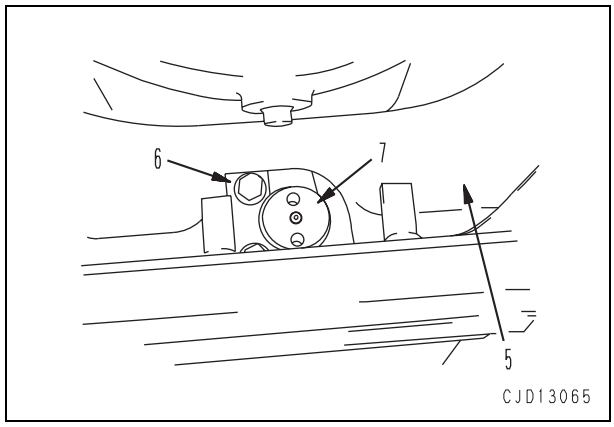


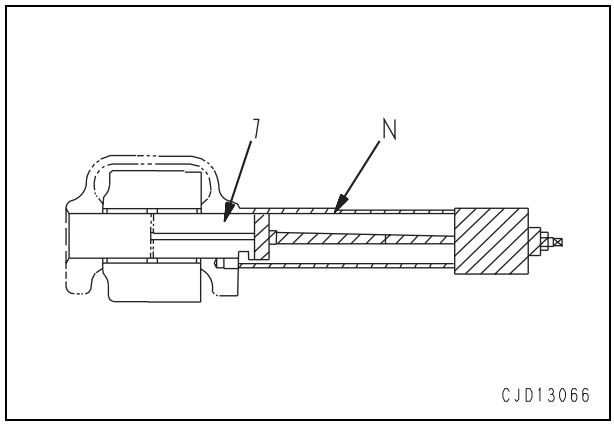
5. Remove lock plate (6). Using tool **N**, pull out center pin (7). [*2]

⚠ **Do not operate the hydraulic equipment of tool N in front of or under the puller, but operate it away as much as possible.**

6. Lower and remove equalizer bar (5).

Equalizer bar assembly: **130 kg**





Installation

- Carry out installation in the reverse order to removal.

[*1]

⚠ **When aligning the pin holes, never insert your fingers in them.**

[*2]

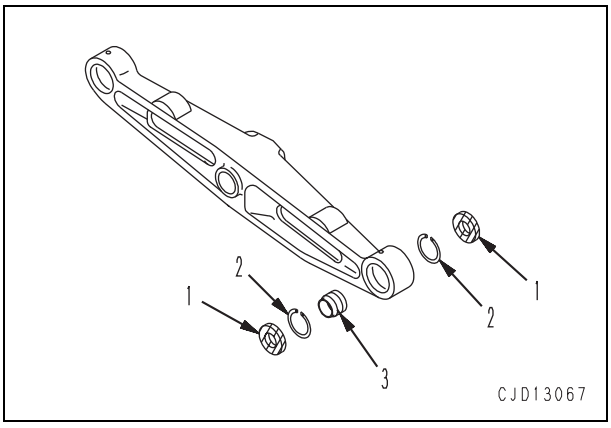
⚠ **When aligning the pin holes, never insert your fingers in them.**

Frame boss:
Lubricant containing molybdenum disulfide (LM-P)

Disassembly and assembly of equalizer bar side bushing

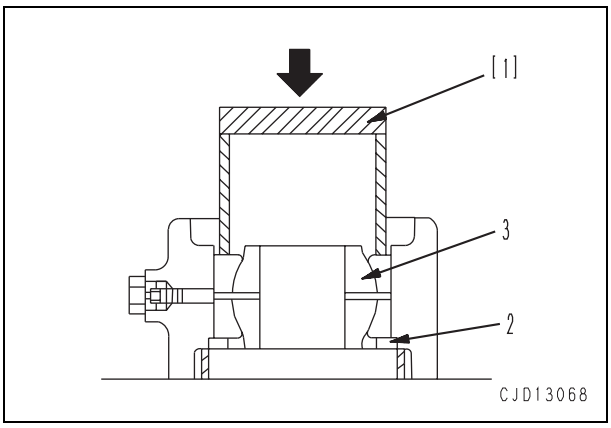
Disassembly

1. Remove seal (1).
2. Remove ring (2).
3. Remove spherical bushing (3).



Assembly

1. Install ring (2) to one side.
2. Using push tool [1] and a press, press fit spherical bushing (3).
   ★ Press fitting force: **15.7 kN {1.6 ton}**
3. Install ring (2) to opposite side.



4. Install seal (1).
   Between bushing and seal:
   Grease (G2-LI)

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00950-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly
Hydraulic system

Hydraulic system

Removal and installation of control valve assembly

Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

⚠ **Lower the work equipment to the ground safely and release the residual pressure in the piping. For details, see Testing and adjusting, "Releasing residual pressure in work equipment cylinder".**

★ Plug the disconnected pipes and hoses to prevent foreign matter from entering them.

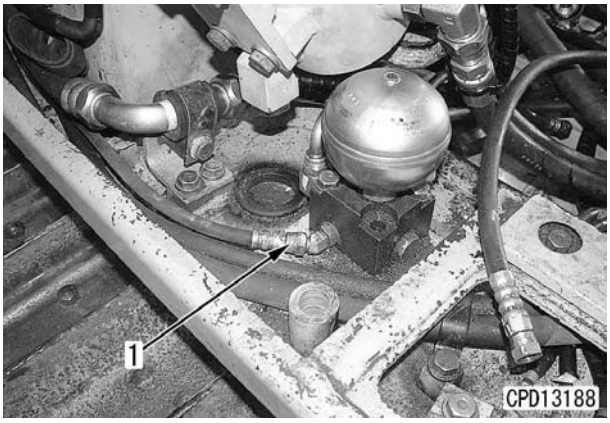
★ Put tags to the disconnected pipes and hoses to prevent a mistake in re-connecting them.

1. Drain the hydraulic oil.

Hydraulic tank: **55 ℓ**

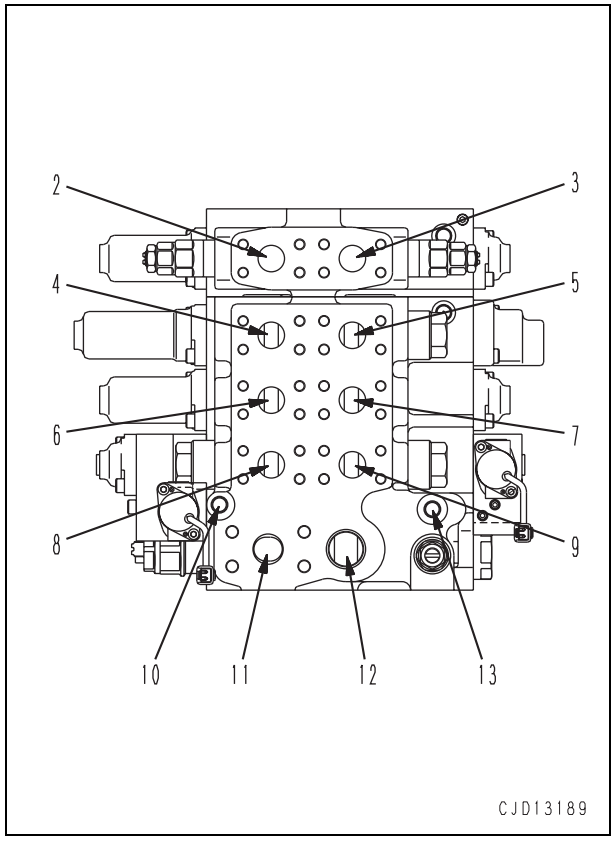
2. Remove the floor frame assembly. For details, see Removal and installation of floor frame assembly.

3. Disconnect hose (1) of the accumulator.



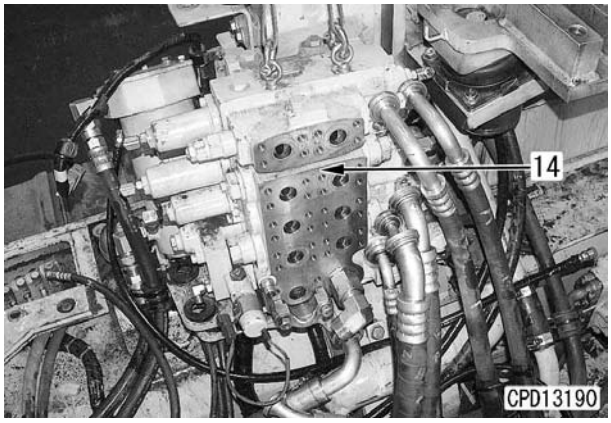
4. Disconnect the following hoses (2) – (13) of the control valve.

- (2): Ripper cylinder bottom
- (3): Ripper cylinder head
- (4): Lift cylinder head
- (5): Lift cylinder bottom
- (6): Tilt cylinder bottom
- (7): Tilt cylinder head
- (8), (9): HSS motor
- (10), (12): Hydraulic tank
- (11): HSS pump
- (13): HSS pump LS valve



5. Remove the mounting bolts and control valve assembly (14).

Control valve assembly: **120 kg**



Installation

- Carry out installation in the reverse order to removal.

- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

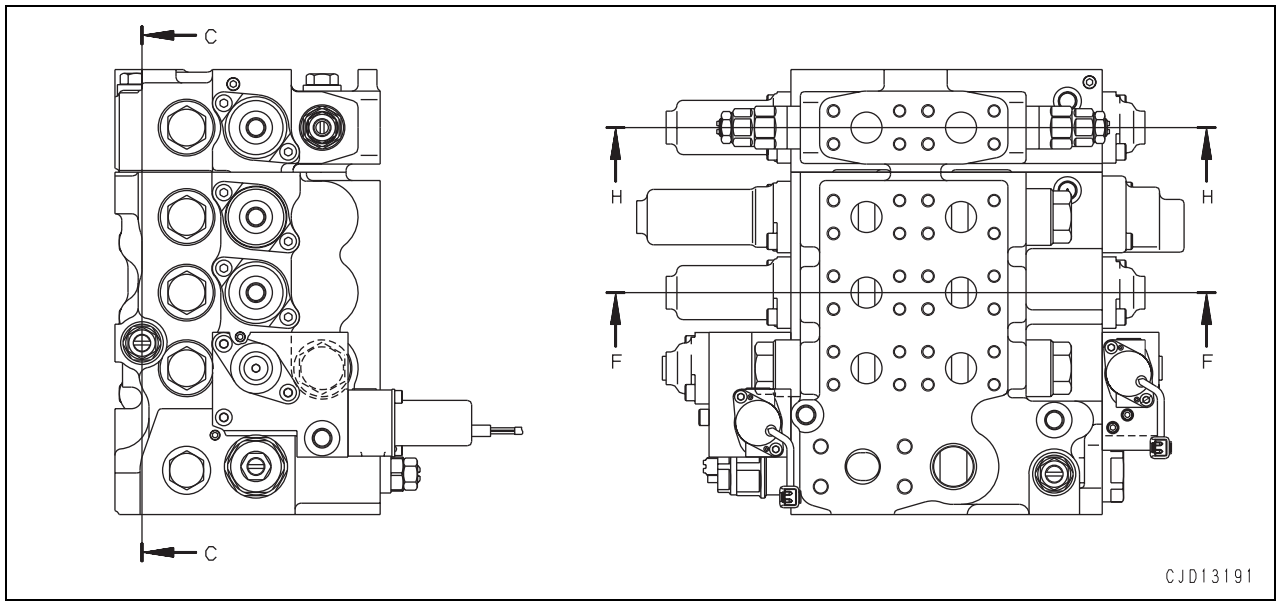
  Hydraulic tank: **55 ℓ (EO10-DH)**

- **Bleeding air**
  Bleed air from the piping. For details, see Testing and adjusting, “Bleeding air from work equipment cylinder”.

Disassembly and assembly of control valve assembly

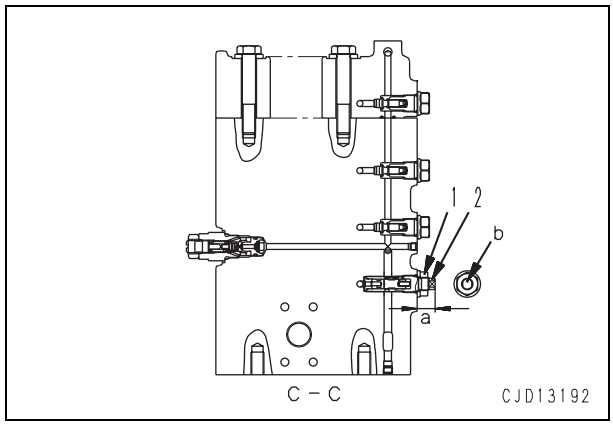
★ In this section, only precautions for assembly of the control valve assembly are explained.
★ For details and tightening torque of each part, see Structure, function and maintenance standard, Hydraulic system - Control valve.

Assembly



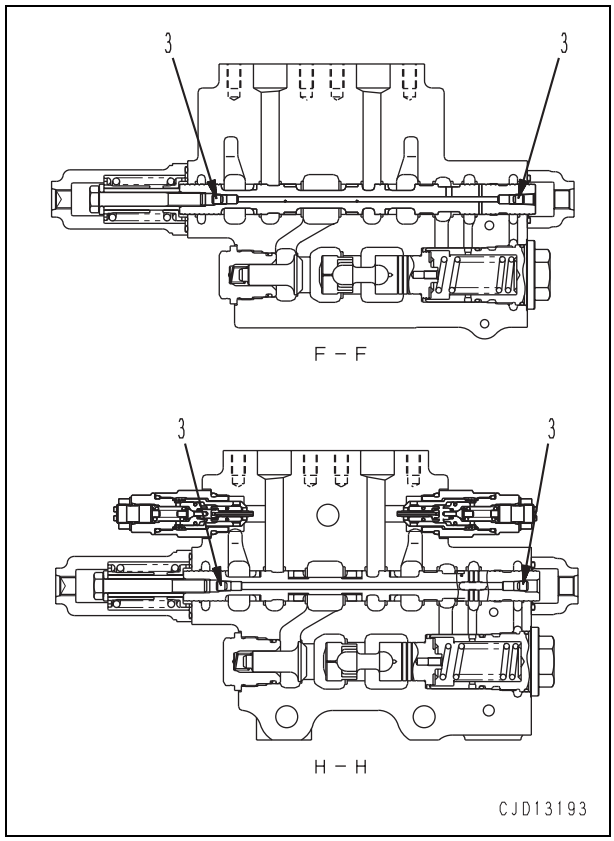
★ Tighten sleeve (2) so that dimension (a) will be in the standard range and punch (b) at the end of sleeve (2) will be directed straight up, and then tighten check valve (1).
- Dimension (a): **19 ± 0.75 mm**

Check valve:
58.8 – 78.5 Nm {6 – 8 kgm}



★ When tightening plug (3), thoroughly degrease and dry the female threads of the spool and apply a drop (about 0.02 g) of LOCTITE (No. 262) each to 2 places.

★ After tightening the plug, leave it for at least 2 hours.
Plug: 9.8 ± 2.9 Nm {1 ± 0.3 kgm}



Removal and installation of HSS pump assembly

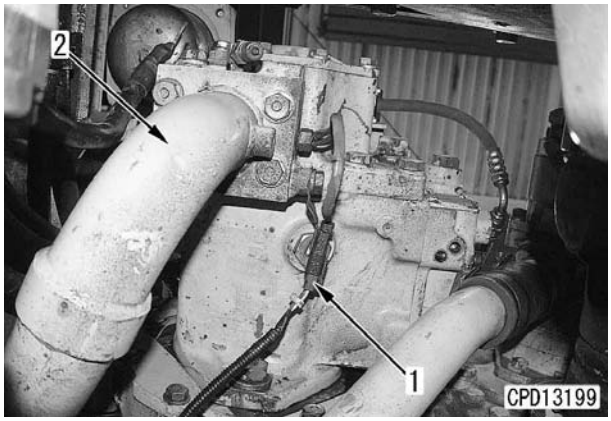
Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

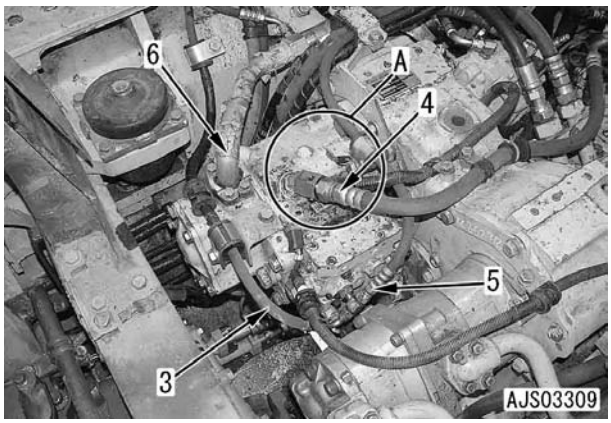
1. Drain the hydraulic oil.

   Hydraulic tank: **55 ℓ**

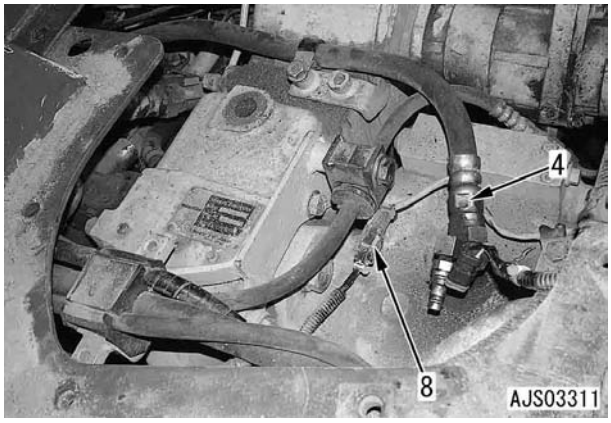
2. Remove the floor frame assembly. For details, see "Removal and installation of floor frame assembly."
3. Remove the undercover.
4. Disconnect wiring connector **SDS** (1) under the HSS pump assembly.
5. Disconnect tube (2).



6. Disconnect hoses (3), (4), and (5) and remove the clamp.
7. Disconnect tube (6).
8. Disconnect TVC solenoid wiring connector **HSP** (8) from part (A).

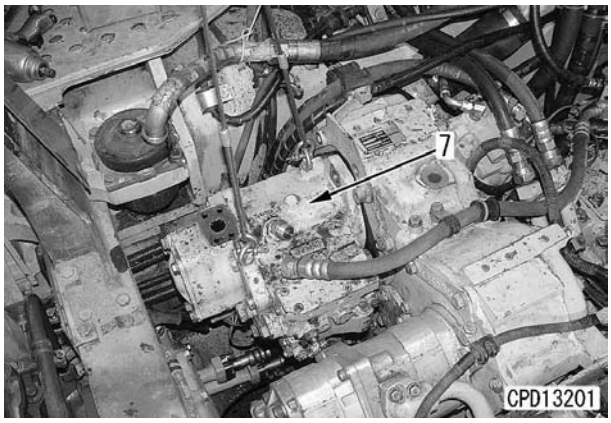


- Part (A)



9. Lift off HSS pump assembly (7).

   HSS pump assembly: **75 kg**



Installation

- Carry out installation in the reverse order to removal.
- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

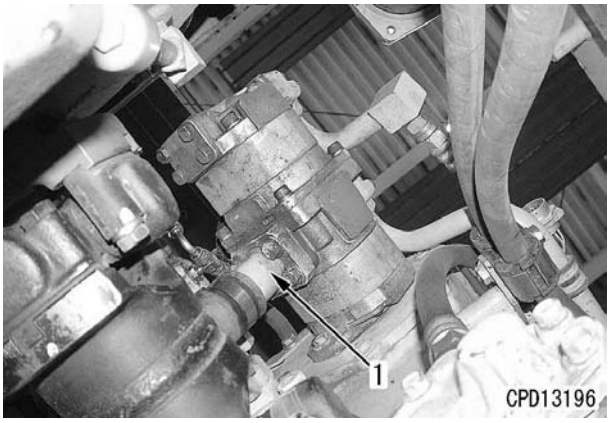
  Hydraulic tank: **55 ℓ (EO10-DH)**

Removal and installation of power train and lubricating oil pump assembly

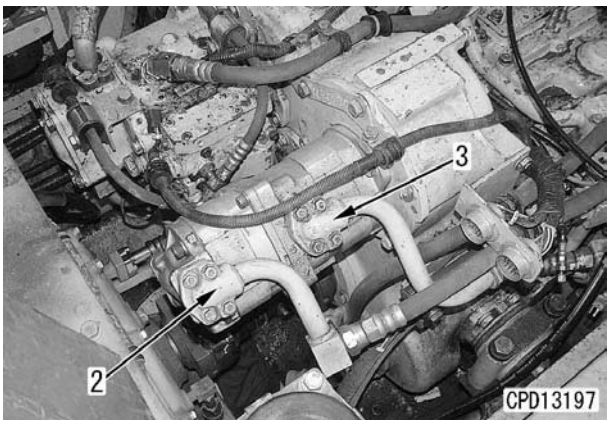
Removal

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the floor frame assembly. For details, see "Removal and installation of floor frame assembly."
2. Remove the undercover.
3. Disconnect tube (1) under the power train and lubricating oil pump assembly.

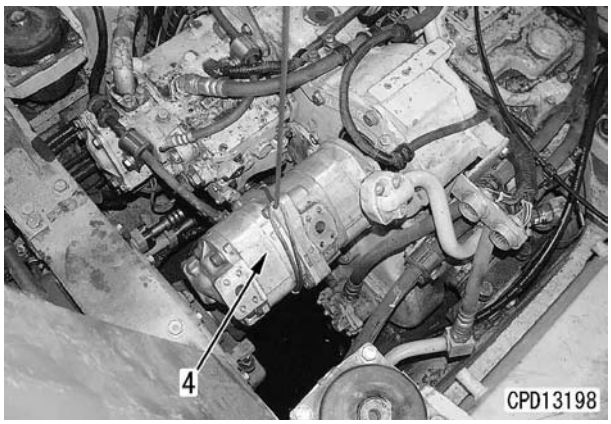


4. Disconnect tubes (2) and (3).



5. Lift off power train and lubricating oil pump assembly (4). [*1]

Power train and lubricating oil pump assembly: **15 kg**



Installation

- Carry out installation in the reverse order to removal.

[*1]
Mounting bolt:
98 – 123 Nm {10 – 12.5 kgm}

- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

Removal and installation of cooling fan pump assembly

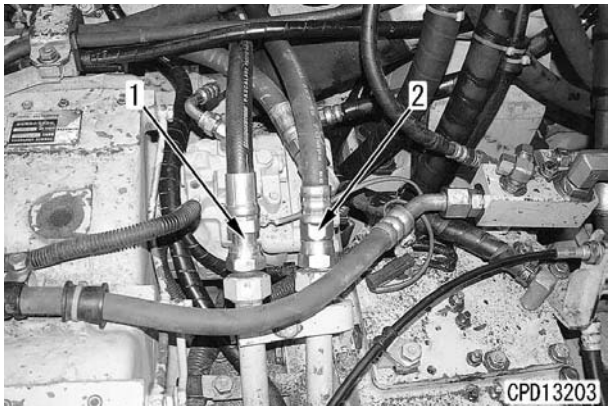
Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

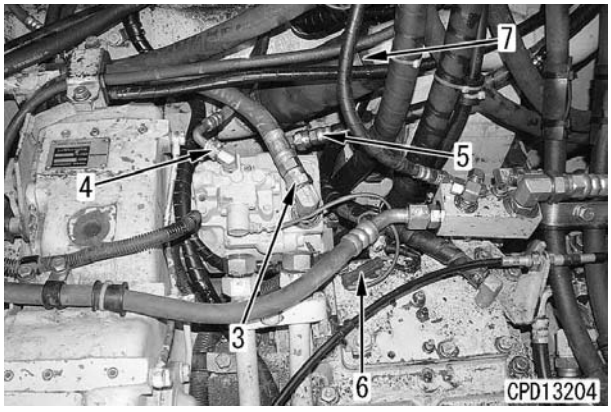
1. Drain the hydraulic oil.

   Hydraulic tank: **55 ℓ**

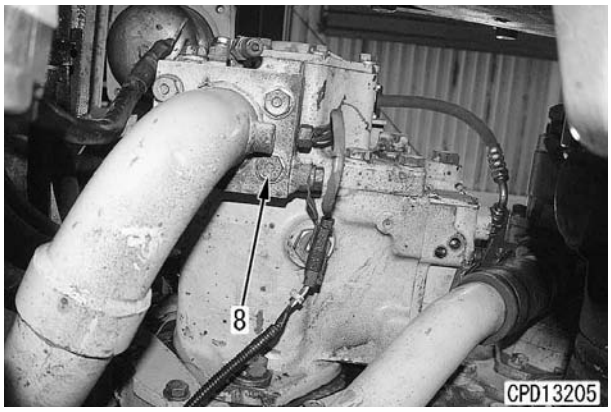
2. Remove the floor frame assembly. For details, see "Removal and installation of floor frame assembly."
3. Remove the undercover.
4. Disconnect hoses (1) and (2).



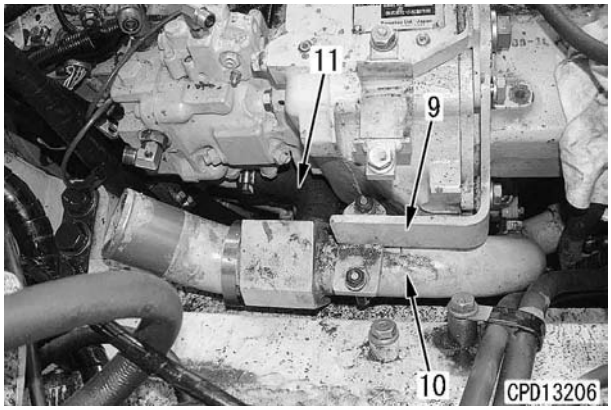
5. Disconnect hoses (3), (4), and (5).
6. Disconnect wiring connector **FAC** (6).
7. Disconnect hose and tube (7). [*1]



8. Remove 4 tube mounting bolts (8) under the HSS pump assembly.

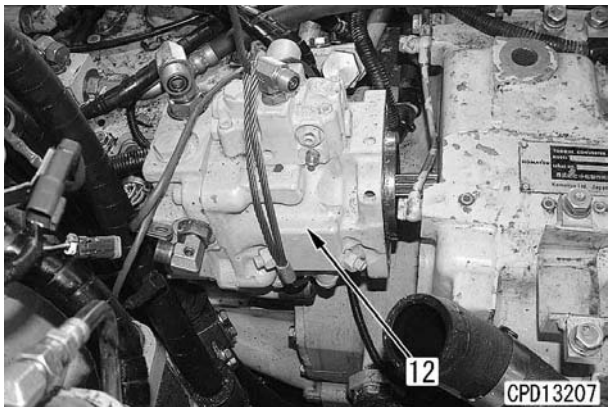


9. Remove bracket (9). While raising tube (10), disconnect hose (11).
   ★ Tube (10) cannot be removed completely.



10. Remove cooling fan pump assembly (12).

    Cooling fan pump assembly: **30 kg**



Installation

- Carry out installation in the reverse order to removal.

[*1]
Hose clamp:
8.8 ± 0.5 Nm {90 ± 5 kgcm}

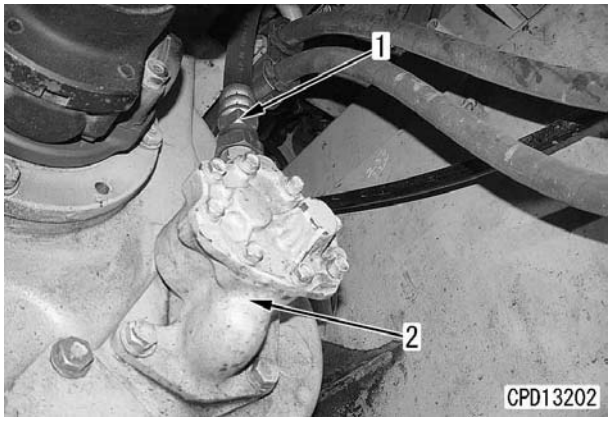
- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.
  Hydraulic tank: **55 ℓ (EO10-DH)**

Removal and installation of scavenging pump assembly

Removal

1. Remove the undercover.
2. Drain the power train oil.

   Power train case: **48 ℓ**
3. Disconnect hose (1).
4. Remove scavenging pump assembly (2).



Installation

- Carry out installation in the reverse order to removal.
- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

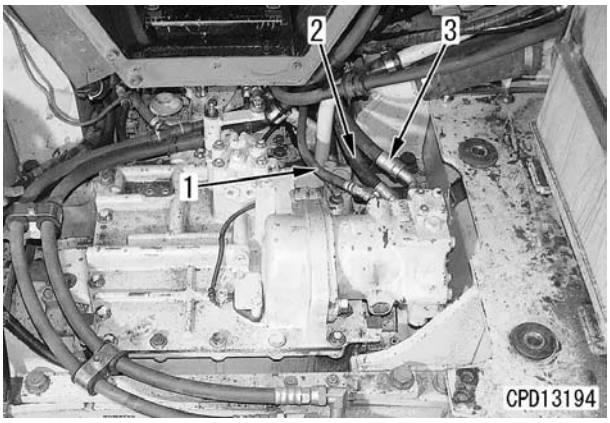
  Power train case: **48 ℓ (TO30)**

Removal and installation of HSS motor assembly

Removal

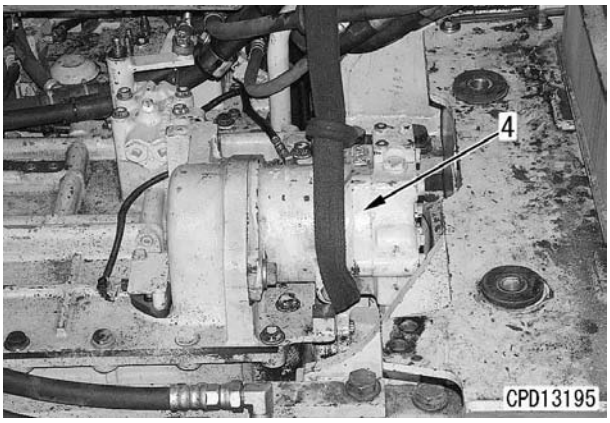
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the fuel tank assembly. For details, see "Removal and installation of fuel tank assembly."
2. Disconnect hoses (1), (2), and (3).



3. Lift off HSS motor assembly (4).

   HSS motor assembly: **45 kg**



Installation

- Carry out installation in the reverse order to removal.

Disassembly and assembly of hydraulic cylinder assembly

Special tools

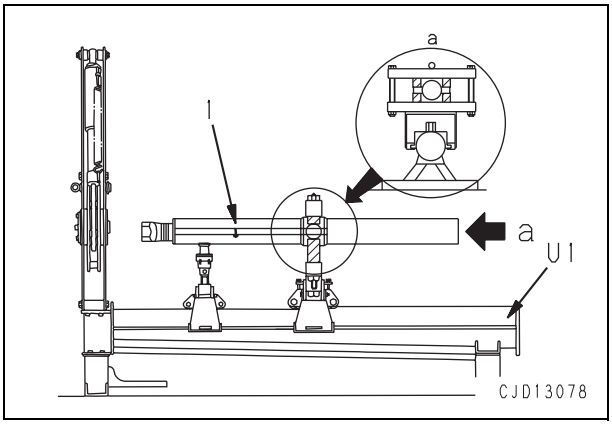
Symbol		Part number	Part name		Necessity	Q'ty	N/R	Sketch
U	1	790-502-1003	Repair stand		■	1		
		790-101-1102	Pump		■	1		
	2	790-330-1100	Wrench		■	1		
	3	790-302-1270	Socket		■	1		
		790-302-1280	Socket		■	1		
		790-302-1340	Socket		■	1		
	4	790-720-1000	Expander		■	1		
	5	796-720-1650	Ring	For blade lift cylinder	■	1		
		07281-01029	Clamp		■	1		
		796-720-1680	Ring	For blade tilt cylinder	■	1		
		07281-01589	Clamp		■	1		
	6	790-201-1791	Push tool (For blade lift cylinder)		■	1		
		790-201-1811	Push tool (For blade tilt cylinder)		■	1		
	7	790-101-5021	Grip		■	1		
		01010-50816	Bolt		■	1		
		790-201-1620	Plate (For blade tilt cylinder)		■	1		
		790-201-1610	Plate (For blade lift cylinder)		■	1		

Disassembly

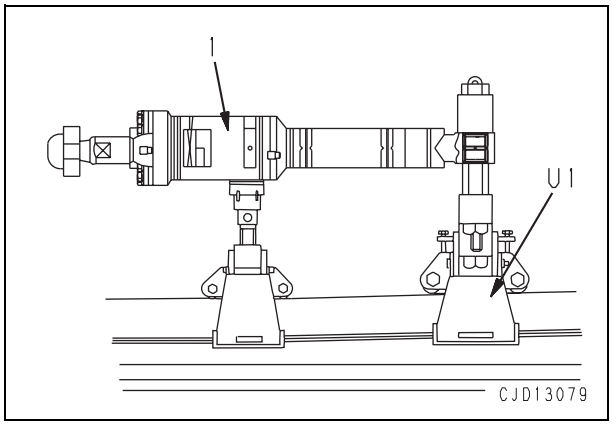
1. Remove tube from cylinder assembly.

2. Set cylinder assembly (1) to tool **U1**.

- Blade lift cylinder



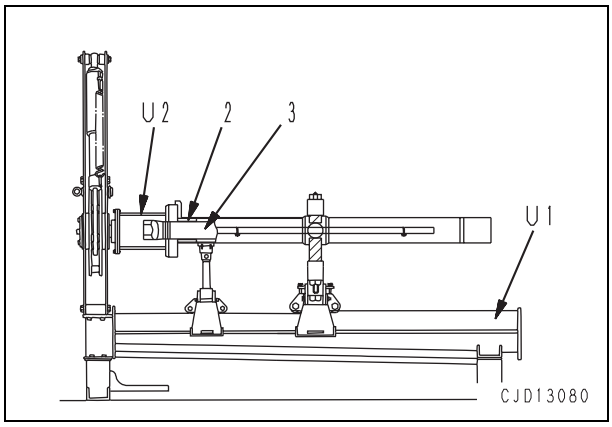
- Blade tilt cylinder



3. Piston rod assembly

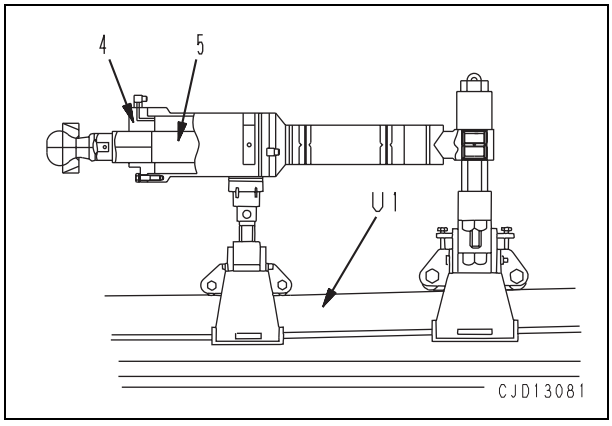
- Blade lift cylinder

1) Using tool **U2**, disconnect cylinder head assembly (2).
2) Pull out piston rod assembly (3).
   ★ Place an oil container under the cylinder to catch the oil.



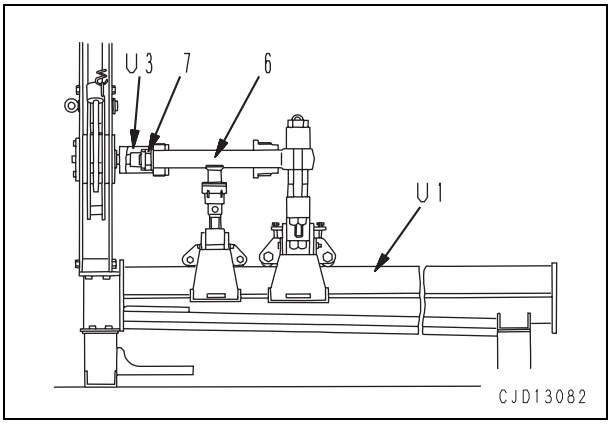
- Blade tilt cylinder

1) Remove mounting bolts, and disconnect cylinder head assembly (4).
2) Pull out piston rod assembly (5).
   ★ Place an oil container under the cylinder to catch the oil.

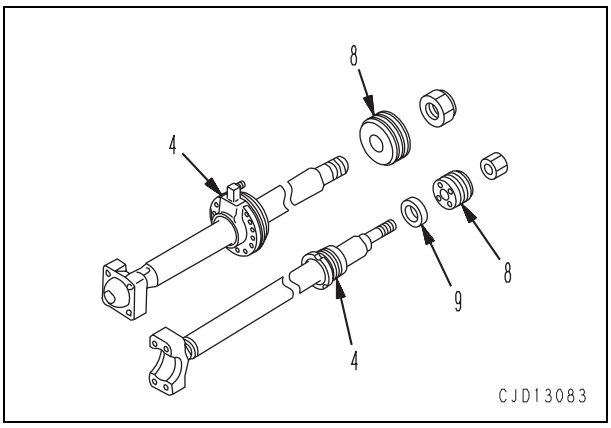


4. Piston assembly, cylinder head assembly

1) Set piston rod assembly (6) to tool **U1**.
2) Using tool **U3**, remove nut (7).
   - Width across flat of nut
     Blade lift cylinder: **50 mm**
     Blade tilt cylinder: **80 mm**



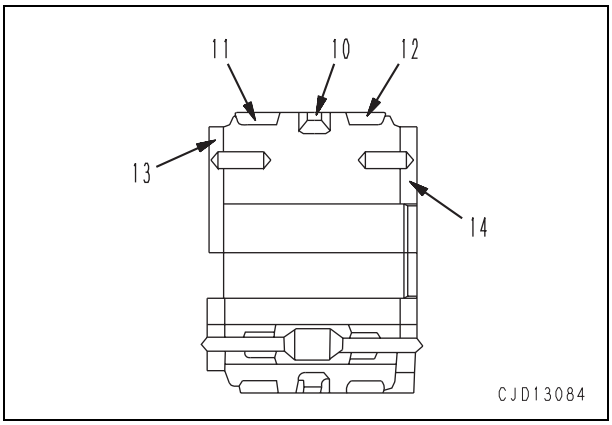
3) Remove piston assembly (8) and slider (9).
   ★ The slider is installed only to the blade lift cylinder.
4) Remove cylinder head assembly (4).



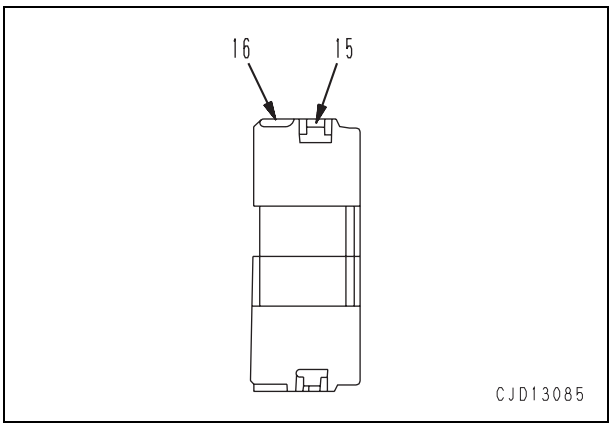
5. Disassembly of piston assembly

- Blade lift cylinder

1) Remove piston ring (10) and wear rings (11) and (12).
2) Remove retainers (13) and (14) from piston assembly.
   ★ Do not remove the piston valve and valve seat installed to the piston.



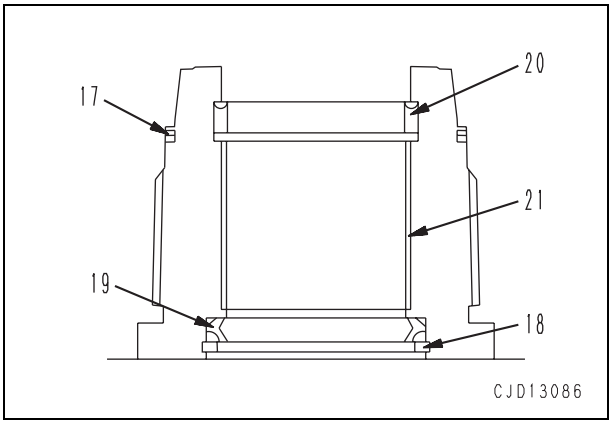
- Blade tilt cylinder
  Remove piston ring (15) and wear ring (16).



6. Disassembly of cylinder head assembly

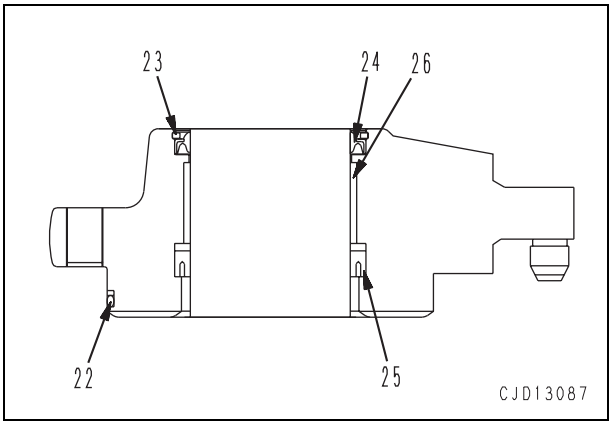
- Blade lift cylinder

1) Remove O-ring and backup ring (17).
2) Remove snap ring (18), then remove dust seal (19).
3) Remove rod packing (20).
4) Remove bushing (21).



- Blade tilt cylinder

1) Remove O-ring and backup ring (22).
2) Remove snap ring (23), then remove dust seal (24).
3) Remove rod packing (25).
4) Remove bushing (26).



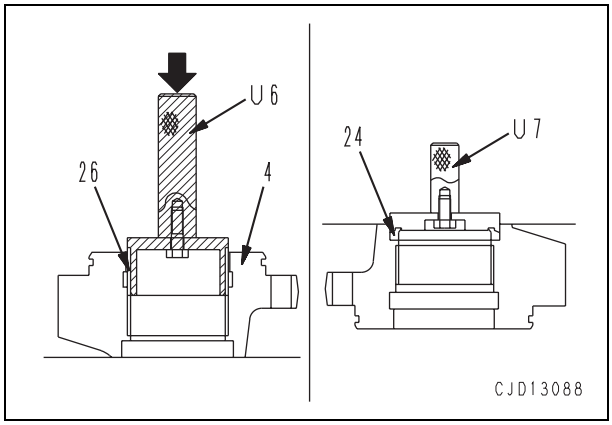
Assembly

★ Be careful not to damage the packings, dust seals, or O-rings when assembling.

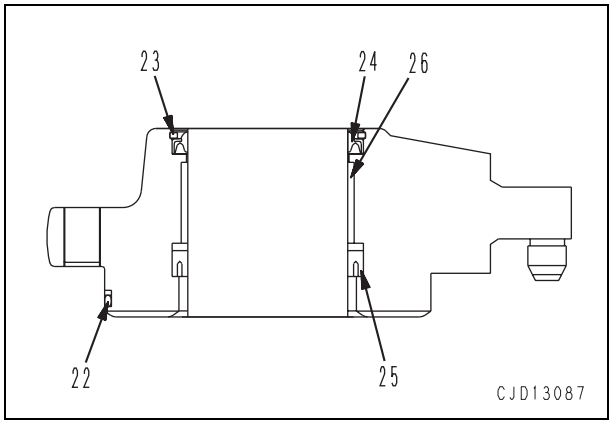
1. Assembly of cylinder head assembly

- Blade tilt cylinder

1) Using tool **U6**, press fit bushing (26) to cylinder head (4).
2) Using tool **U7**, assemble dust seal (24).

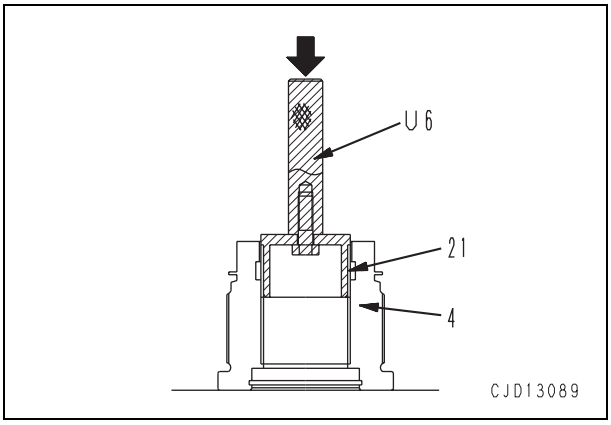


3) Install snap ring (23).
4) Install rod packing (25), then install O-ring and backup ring (22).

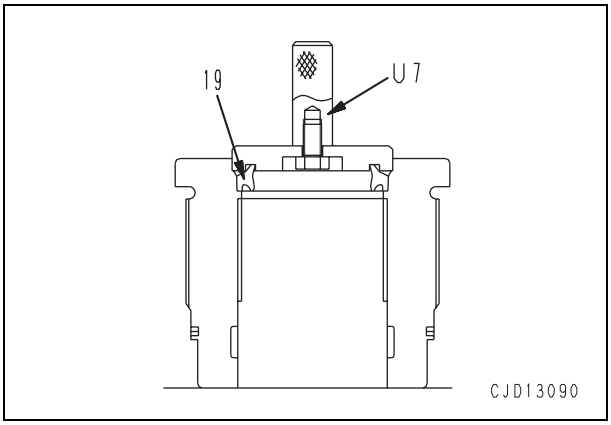


- Blade lift cylinder

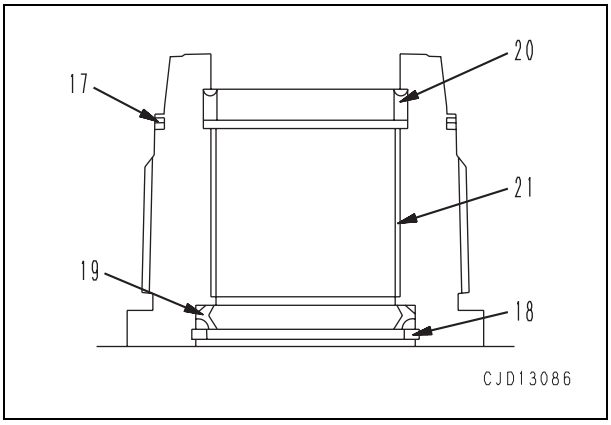
1) Using tool **U6**, press fit bushing (21) to cylinder head (4).



2) Using tool **U7**, assemble dust seal (19).



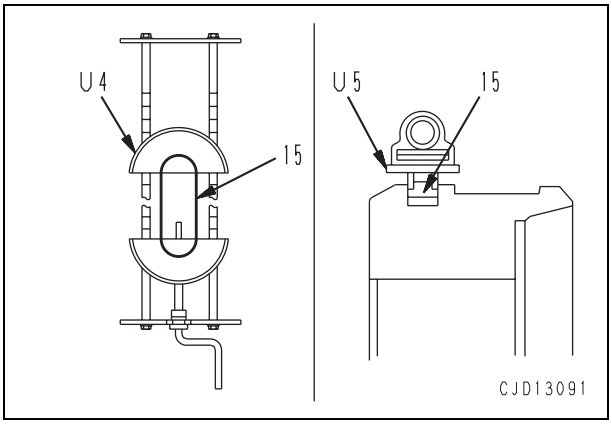
3) Install snap ring (18).
4) Install rod packing (20), then install O-ring and backup ring (17).



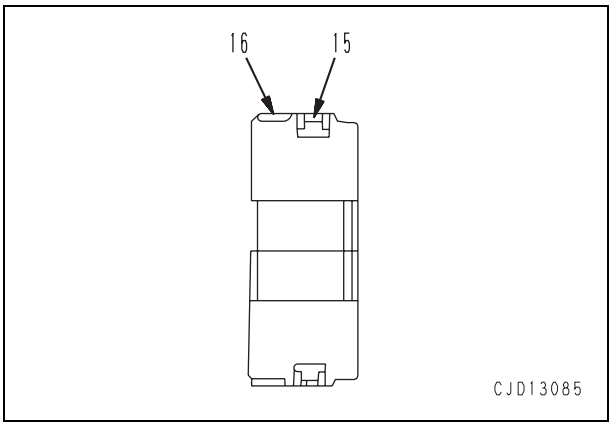
2. Assembly of piston assembly

- Blade tilt cylinder

1) Using tool **U4**, expand piston ring (15).
   ★ Set the piston ring on tool **U4** and turn the handle 8 – 10 times to expand the ring.
2) Remove piston ring (15) from tool **U4**, and install to piston.
3) Using tool **U5**, compress piston ring (15).

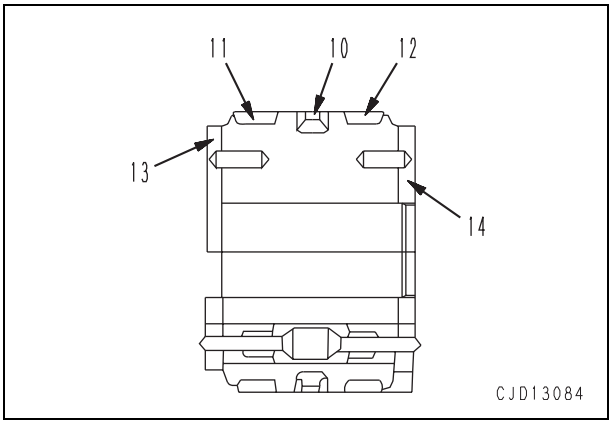


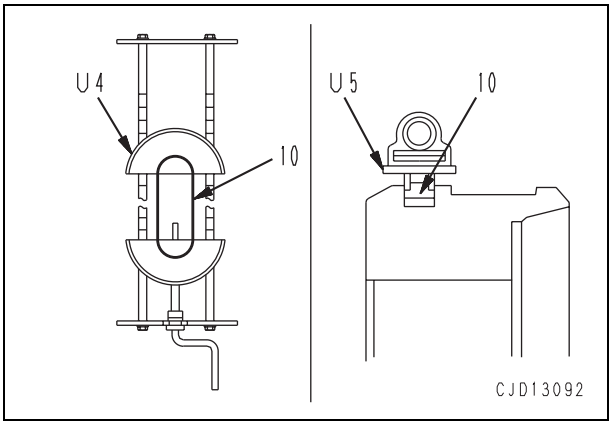
4) Install wear ring (16).



- Blade lift cylinder

1) Install retainers (14) and (13) to piston.
2) Using tool **U4**, expand piston ring (10).
   ★ Set the piston ring on tool **U4** and turn the handle 8 – 10 times to expand the ring.
3) Remove piston ring (10) from tool **U4**, and install to piston.
4) Using tool **U5**, compress piston ring (10).
5) Install wear rings (12) and (11).

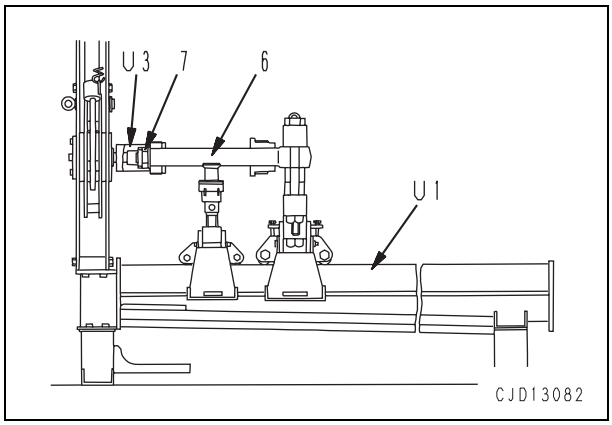


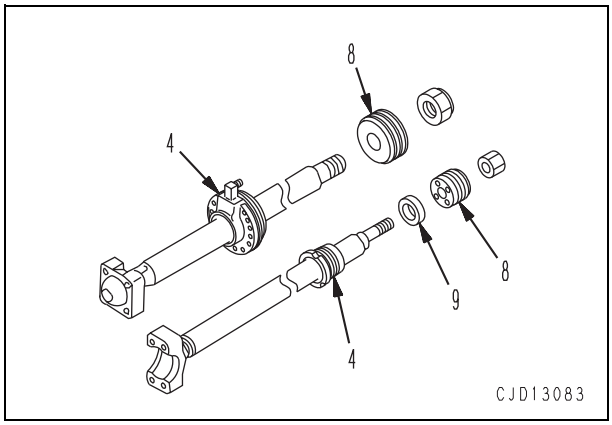


3. Piston assembly, cylinder head assembly

1) Set cylinder rod to tool **U1**.
2) Assemble cylinder head assembly (4) to rod.
3) Fit slider (9) and install piston assembly (8), then using tool **U3**, tighten nut (7).
   ★ The slider (9) is installed only to the blade lift cylinder.
   Threads of rod:
   Thread tightener
   (Loctite No. 262 or equivalent)
   Nut (7):

Cylinder	Width across flats	Tightening torque
Blade lift cylinder	50 mm	**1.08 ± 0.11 kNm {110 ± 11 kgm}**
Blade tilt cylinder	80 mm	**3.97 ± 0.40 kNm {405 ± 40.5 kgm}**

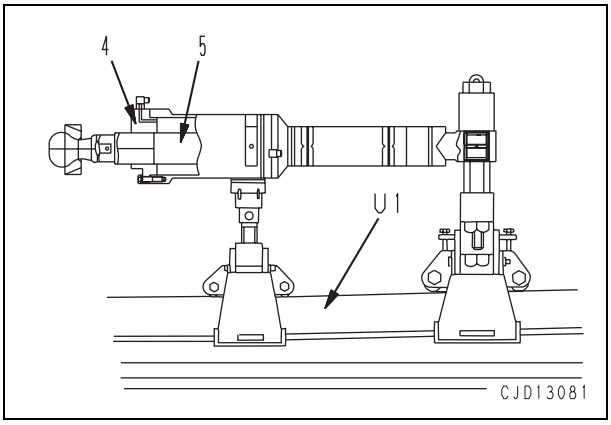




4. Piston rod assembly

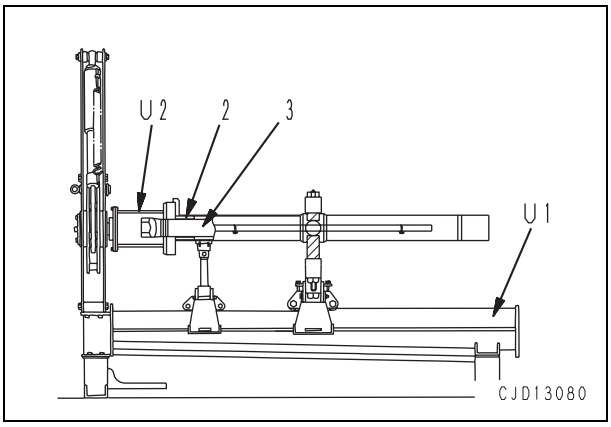
- Blade tilt cylinder

1) Set cylinder to tool **U1**.
2) Assemble piston rod assembly (5) to cylinder.
3) Install cylinder head (4).
   Mounting bolt:
   162 ± 14.7 Nm {16.5 ± 1.5 kgm}



- Blade lift cylinder

4) Set cylinder to tool **U1**.
5) Assemble piston rod assembly (3) to cylinder.
6) Using tool **U2**, install cylinder head (2).
   Cylinder head:
   735 ± 73.5 Nm {75 ± 7.5 kgm}



5. Tube

Install tube to cylinder assembly.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00951-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

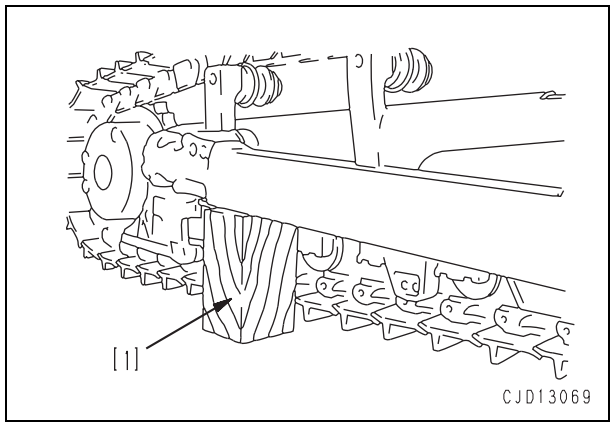
Work equipment

Work equipment

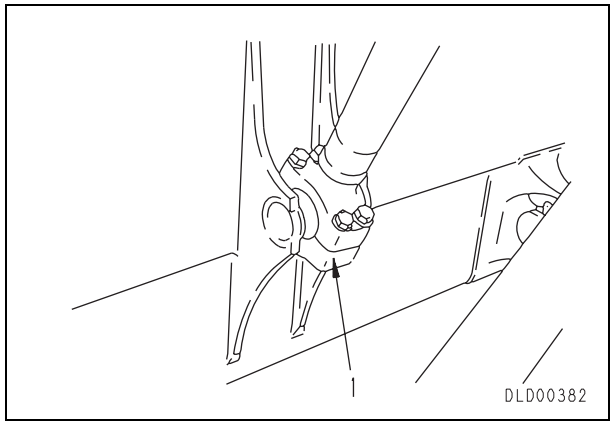
Removal and installation of blade assembly

Removal

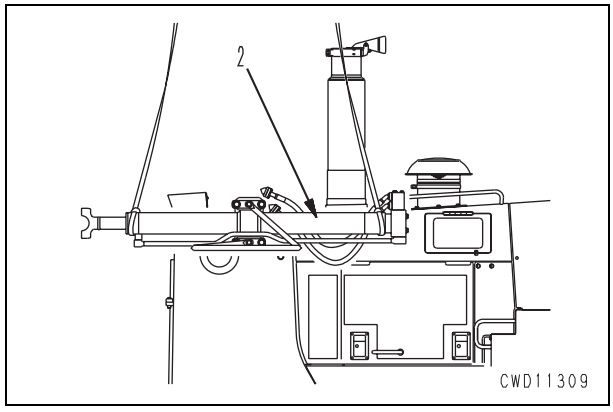
⚠ **Lower the work equipment to a level place and set blocks [1] under both straight frames securely.**



1. Remove cap (1) from the lift cylinder. [*1]
★ Check the quantity and thickness of the inserted shims.



2. Sling lift cylinder assembly (2) temporarily. Start the engine and retract the piston rod fully.

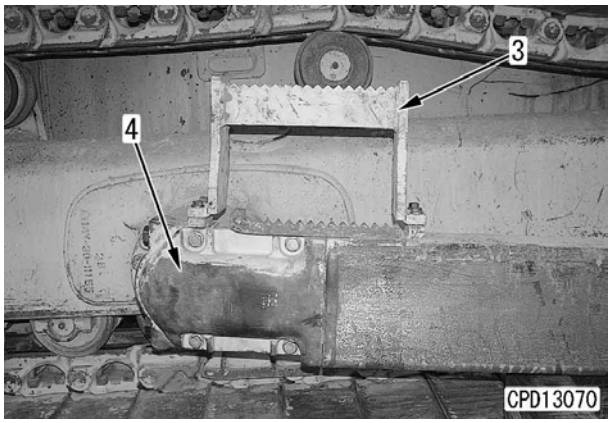


3. Fix the lift cylinder assembly to machine side.
★ Bind the piston rod with wires so that it will not come out.

4. Similarly, disconnect the lift cylinder assembly on the opposite side from the blade.

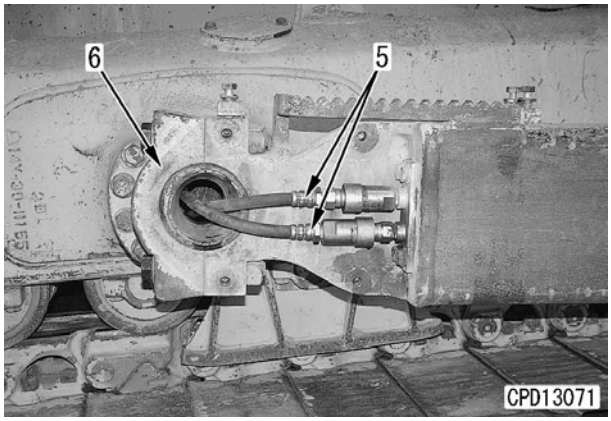
⚠ **After stopping the engine, release the residual pressure from the piping. For details, see Testing and adjusting, "Releasing residual pressure from hydraulic circuit".**

5. Remove step (3) and covers (4).

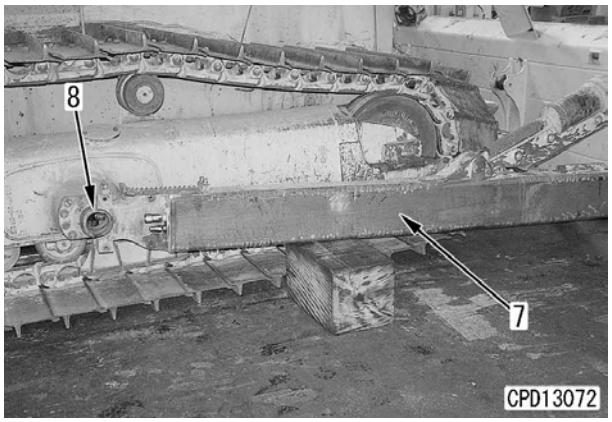


6. Disconnect hoses (5).
★ Plug the openings so that dirt will not enter the piping.

7. Remove both trunnion caps (6). [*2]



8. Start the engine and move the machine in reverse slowly to disconnect blade assembly (7) from trunnion (8). [*3]



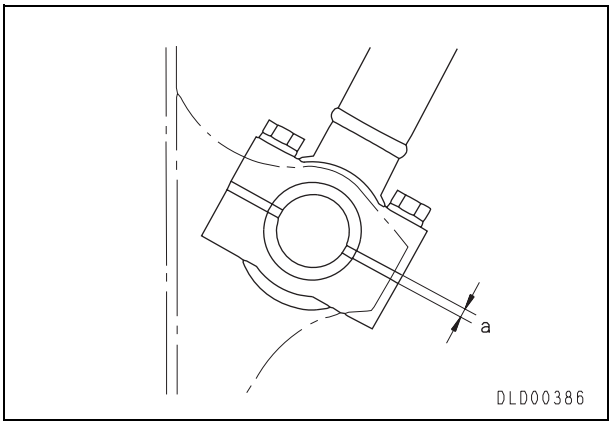
Installation

- Carry out installation in the reverse order to removal.

[*1]

★ Adjust clearance (a) at the mating face of the cap to the following value with shims and check that the shims rotate smoothly.
  - Standard clearance (a): **0.2 – 0.5 mm**
  - Standard shim thickness: **5 mm**

★ After installing the blade, adjust its tilting distance. For details, see Testing and adjusting, “Adjusting blade”.

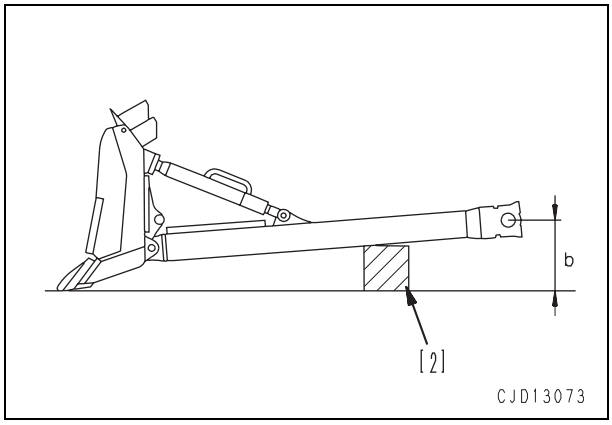


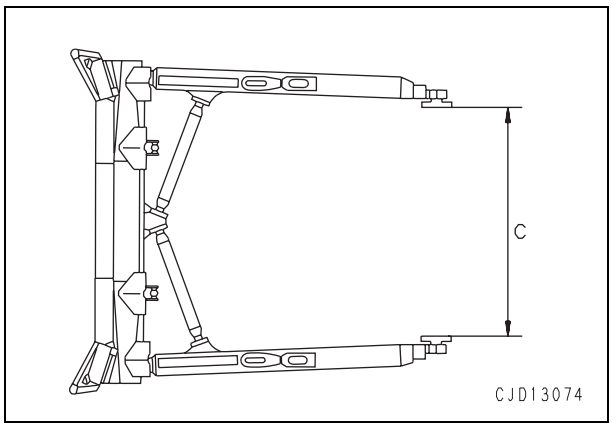
[*2]

★ Adjust the shims of the trunnion. For details, see Testing and adjusting, “Adjusting blade”.

[*3]

★ Adjust height (b) and width (c) of both straight frames to the following values with block [2], etc.
  - Trunnion height (b): **D65EX: 422 mm**
    D65PX: 529.4 mm
  - Frame width (c): **D65EX: 2,352 mm**
    D65PX: 2,888 mm





- **Refilling with oil (Hydraulic tank)**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

- **Bleeding air**
  Bleed air from the work equipment cylinders. For details, see Testing and adjusting, “Bleeding air from work equipment cylinders”.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00952-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly

Cab and its attachments

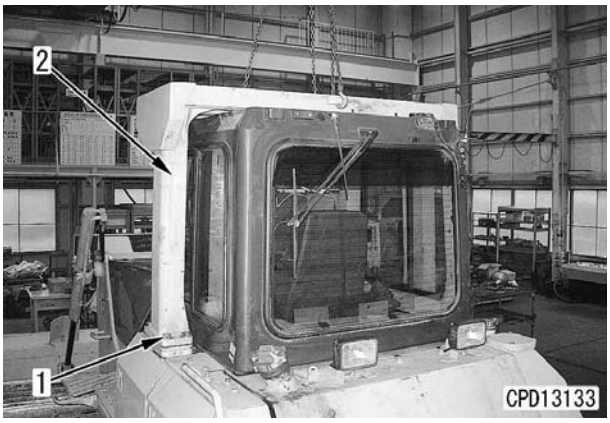
Cab and its attachments

Removal and installation of ROPS guard

Removal

1. Sling the ROPS guard temporarily and remove 8 mounting bolts (1). [*1]
2. Lift off ROPS guard (2).

ROPS guard: **260 kg**



Installation

- Carry out installation in the reverse order to removal.

[*1]

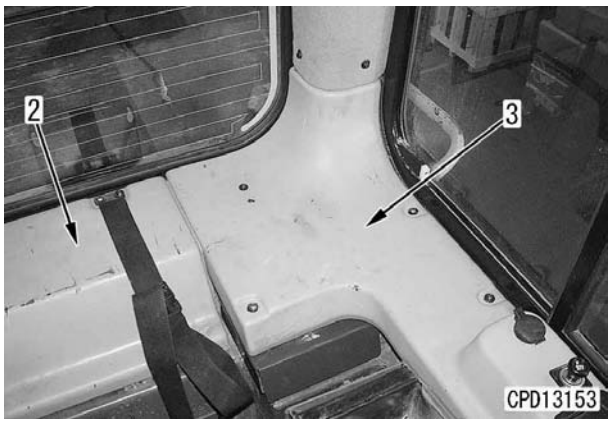
Mounting bolt:
824 – 1,030 Nm {84 – 105 kgm}

Removal and installation of operator's cab assembly

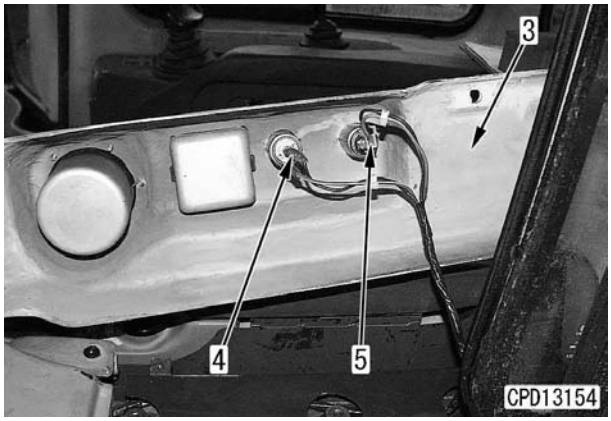
Removal

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

1. Remove the ROPS guard assembly. For details, see "Removal and installation of ROPS guard."
2. Remove covers (1), (2), and (3).

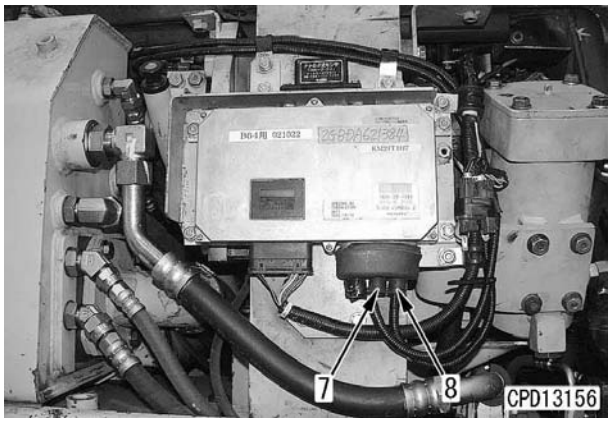


★ Before removing cover (3), disconnect wiring connectors **SIG** (4) and **ACC** (5) on the back side.

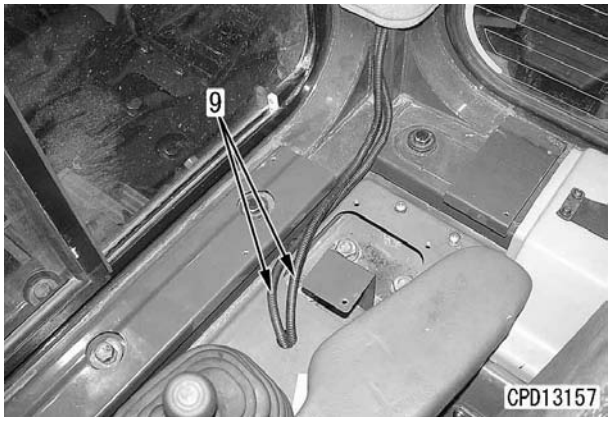


3. Remove cover (6).

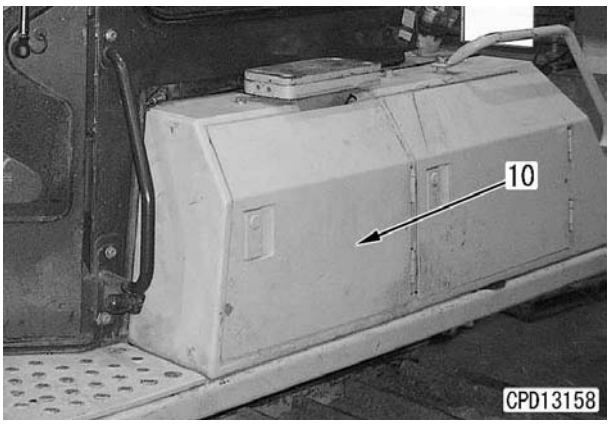
4. Disconnect wiring connectors (7) and (8) and remove all the wiring harness clamps fixed to the chassis.



5. Pull wiring harness (9) disconnected in the previous step into the operator's cab.

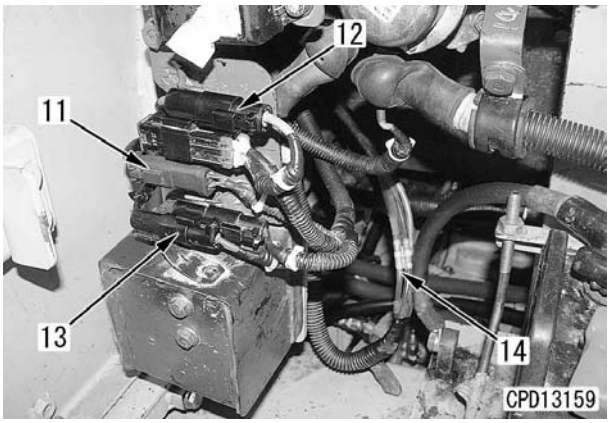


6. Open cover (10).



7. Disconnect wiring connectors **CN-19** (11), **CN-20** (12), and **CN-21** (13).

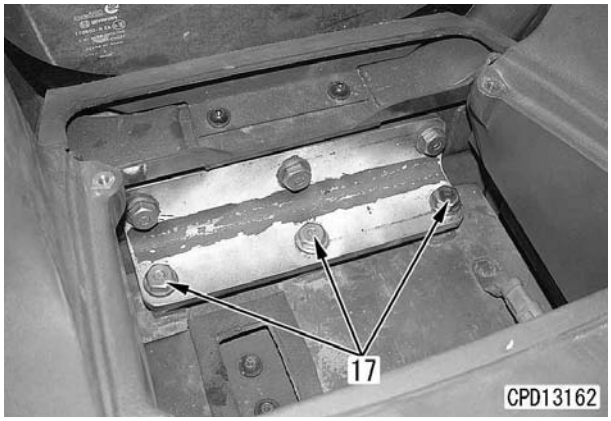
8. Disconnect 4 hoses for washer tank (14).



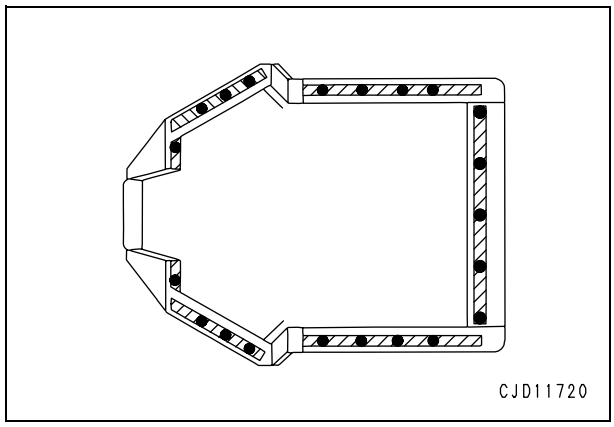
9. Pull grommet (15) into the operator's cab. [*1]

10. Remove cooler box (16) from the front part in the operator's cab.

11. Remove bolt (17).



12. Remove 21 operator's cab mounting bolts marked with ●.

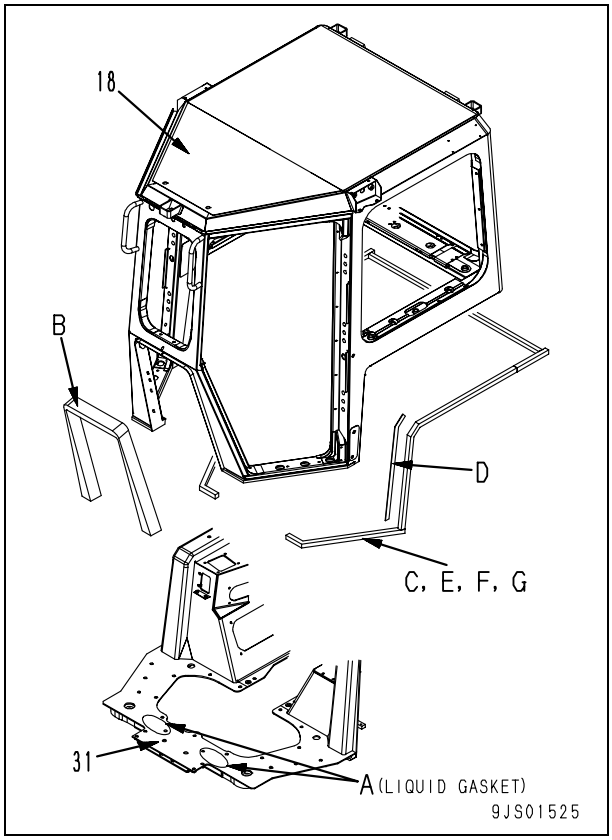


13. Lift off operator's cab assembly (18).
★ Check that all the wires and pipes are disconnected.
Operator's cab assembly: **410 kg**

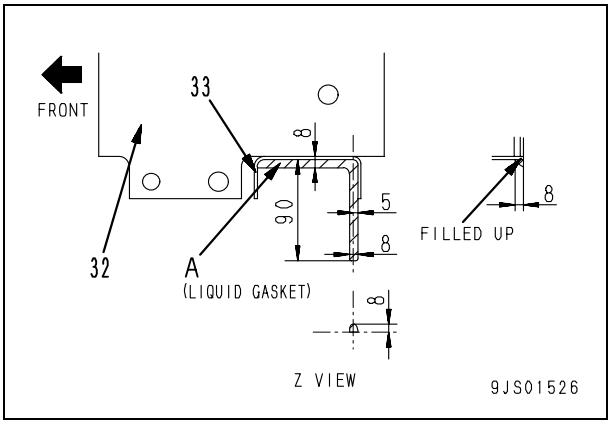
Installation

- Carry out installation in the reverse order to removal.

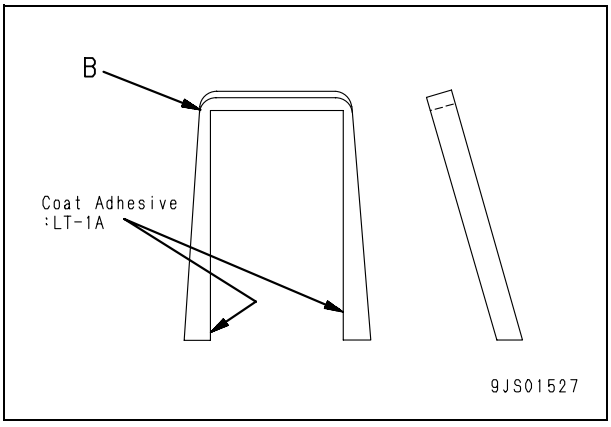
[*1]
★ After connecting each connector, install the grommet securely to the through hole of the cab.
★ When the cab is removed from the floor frame, arrange for the following sealants to retain pressurization and water-tightness when the cab is assembled again.
17A-Z11-3552...1 unit (Seal B)
17A-Z11-3541...5 units (Seal (D) – (G))
17A-Z11-2320...2 units (C)
198-Z11-3960 Three Bond (1207B)
...1 unit (Liquid sealant (A))



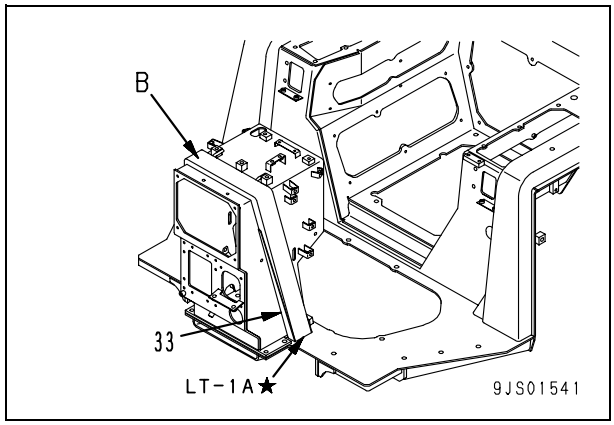
1. Installation of seal to air conditioner box
1) Remove dirt, oil and grease from the position on the top surface of floor frame for coating liquefied sealants. Implement the cleaning on both sides.
2) Coat section (A) on the top surface of floor frame (31) with liquefied sealant, Three Bond 1207B. (See the diagram to the left)
3) Install air conditioner box (32).
4) Coat the section on both sides of air conditioner box (32) in contact with U-shaped frame (the range on the floor frame shown in the diagram) for 8 mm with liquid gasket Three Bond 1207B.



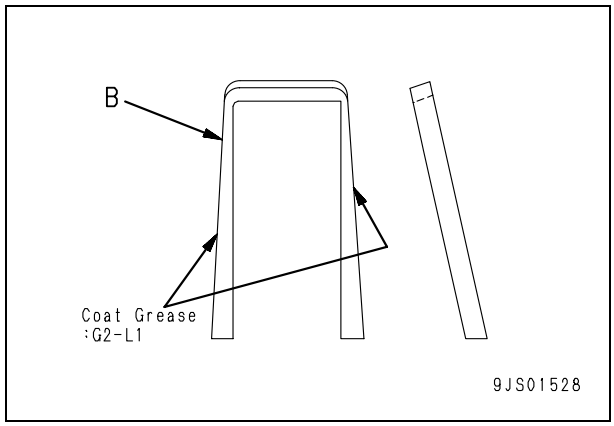
5) Coat adhesive (LT-1A) on the inner surface around seal (B) (sealing surface with the air conditioner box).



6) Set seal (B) inside guide plate (33) of air conditioner box.
★ Pull seal (B) downward and install by pressing hard on liquid sealant coated in 2).
★ Fix with adhesive (LT-1A) so that clearance (★) between seal B and the floor frame will be zero.



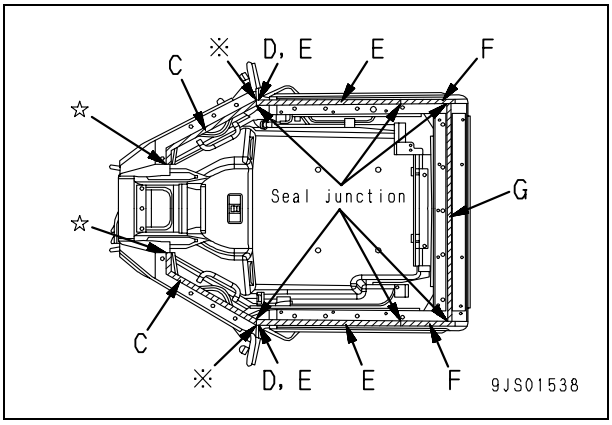
7) Coat the outer surface around seal (B) (sealing surface with the cab) with grease (G2-LI).
★ This is for improving sliding after installing the cab to prevent dislocation and/or deformation of the seal.



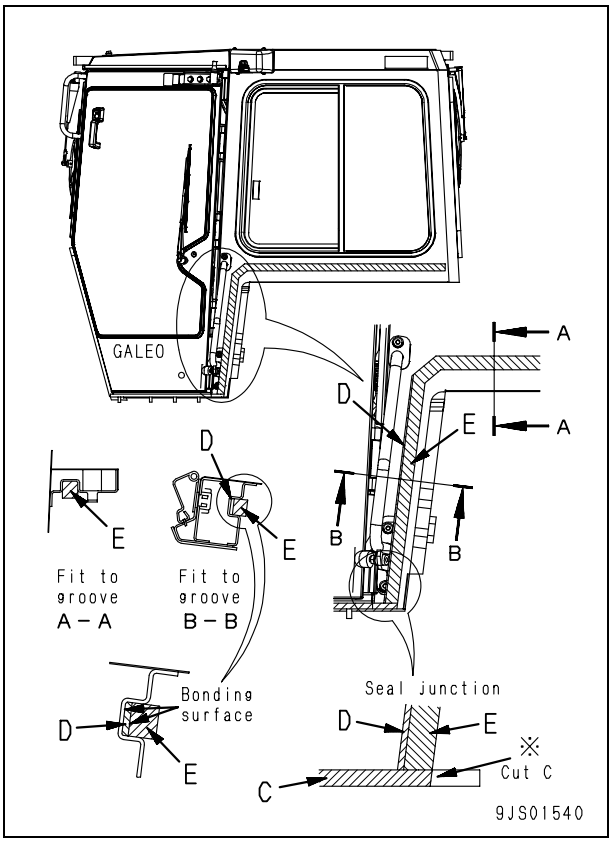
2. Installation of seal to the cab mating surfaces
1) Sling cab assembly.
2) Remove dirt, oil and grease from the seal pasting surfaces.
★ Take care not to allow the seal to enter under the cab.

- General
Seeing the diagram, install seals C, D, E, F and G in this order.

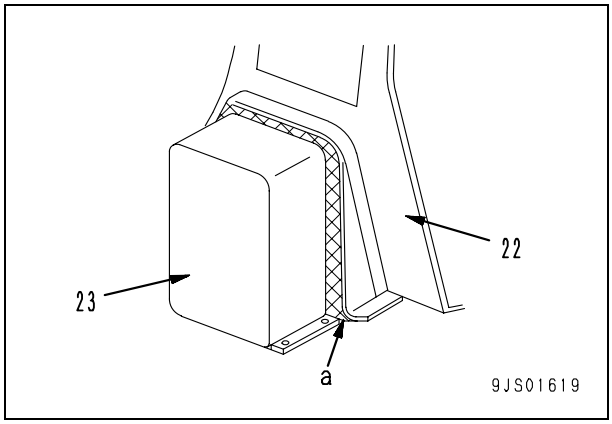
★ Install seal without gap at the seal joint positions.



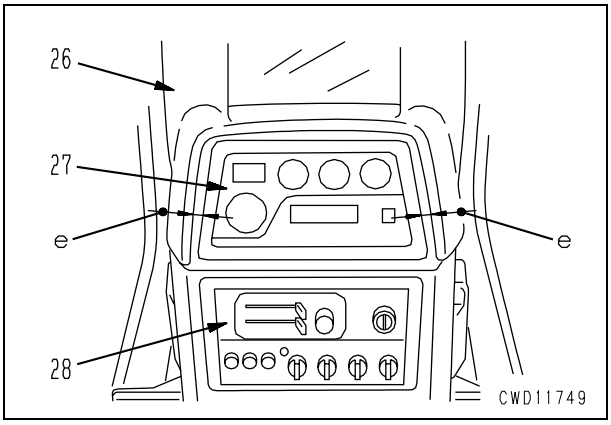
- Details
  1) Make the end face of seal (C) with the wall without any gap. (See the diagram above for ☆ portion.)
  2) Before cutting the end of (C), adhere seal (D) to the groove, then adhere seal (E).
     ★ Check that the ends of (D) and (E) have no gap between (C).
  3) Cut seal (C) at a position where it is flush with seal (E).
     ★ Use remaining portion of seal (E) as seal (F).

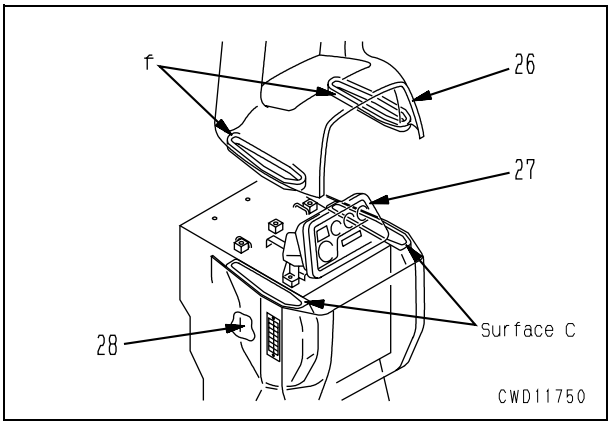


3. When installing the operator's cab, obey the following points.
  1) Lower the operator's cab assembly onto the floor frame slowly.
     ★ Since the reaction force of the seal sponge is large, lower the operator's cab assembly slowly.
     ★ Check that the air conditioner duct seal on the cab side is tightly in contact with the air conditioner duct on the dashboard side and there is not clearance.
     ★ Since the clearance between the air conditioner duct on the cab side and the monitor is narrow, lower the operator's cab assembly carefully.
  2) Tighten the mounting bolts temporarily.
  3) Check that the seal between air conditioner bracket (23) and cab (22) is fitted securely.
  4) Check that there is no clearance at joint (a) of the seal and floor frame.

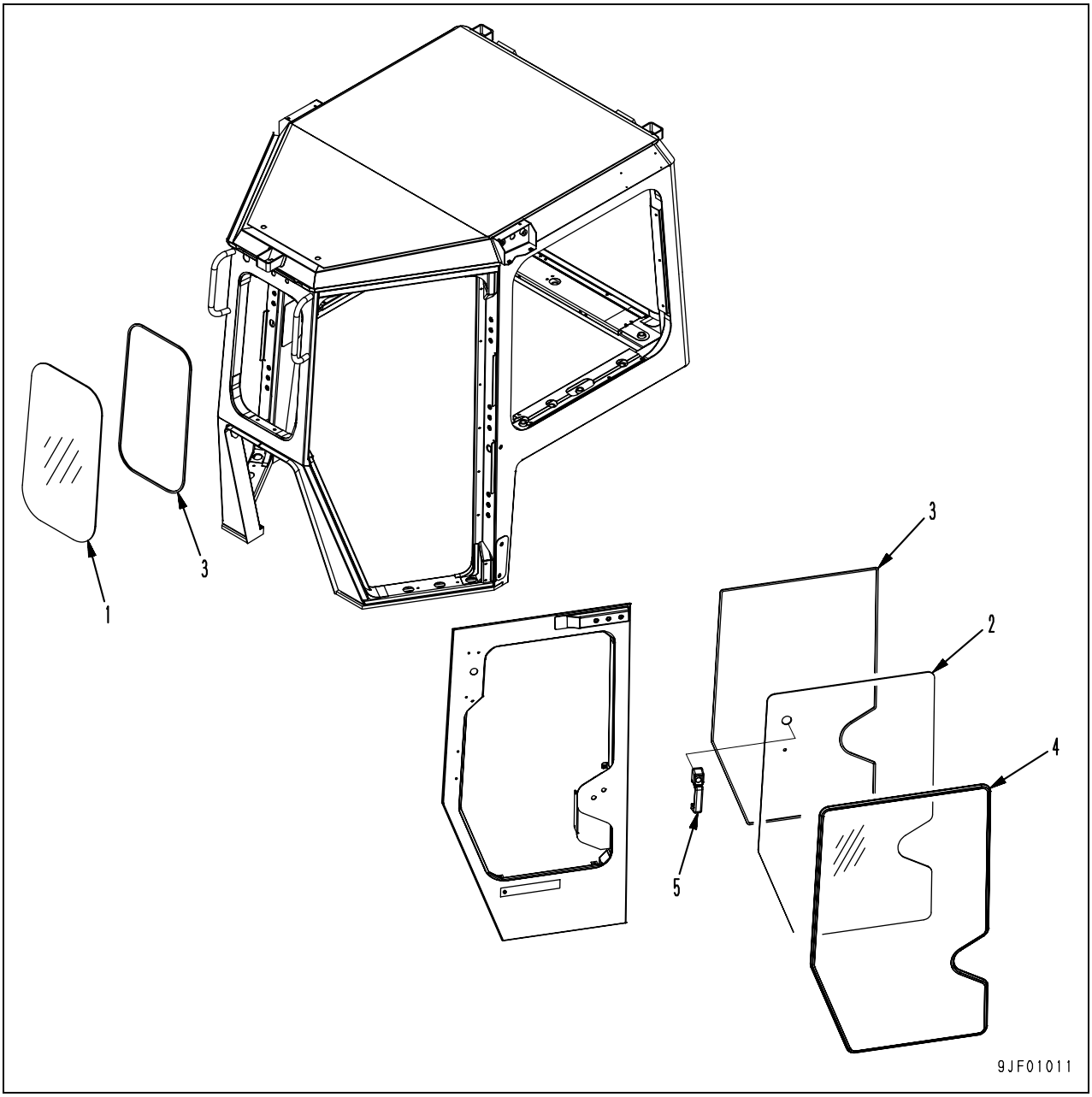


5) Check that clearance (e) between cab-side air conditioner duct (26) and monitor (27) is even on both sides. At the same time, check that cab-side air conditioner duct seal (f) is fitted to faces (**C**) on both sides of dashboard-side air conditioner duct (28) without deviating to the right or left.
   ★ If clearance (e) between the cab-side air conditioner duct and monitor is not even, loosen the mounting screws of the cab-side air conditioner duct and move the duct so that the clearance will be even.
   Similarly correct the deviation of the cab and air conditioner to the right or left, if necessary.
6) Tighten the mounting bolts of the dash-board mounting bracket.





Removal and installation of operator’s cab glass (Stuck glass)



★ Among the panes of window glass of the operator’s cab, the 3 panes of (1) and (2) on both sides are stuck.
In this section, the procedure for replacing the stuck glass is explained.

(1): Front window glass
(2): Left door window glass
: Right door window glass
(3): Both-sided adhesive tape
(4): Trim seal
(5): Door handle

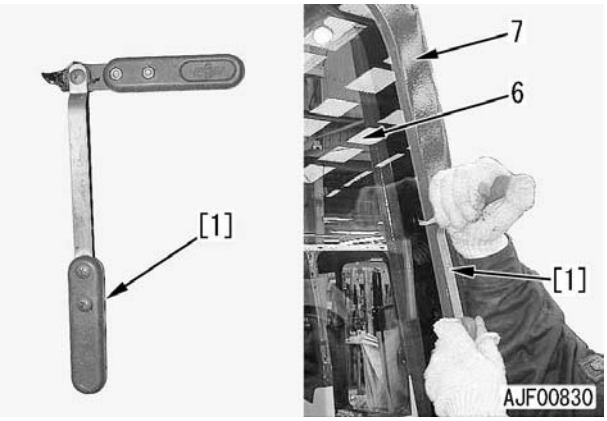
Special tools

Symbol	Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch
X1	793-498-1210	Lifter (Suction cup)	■	2		

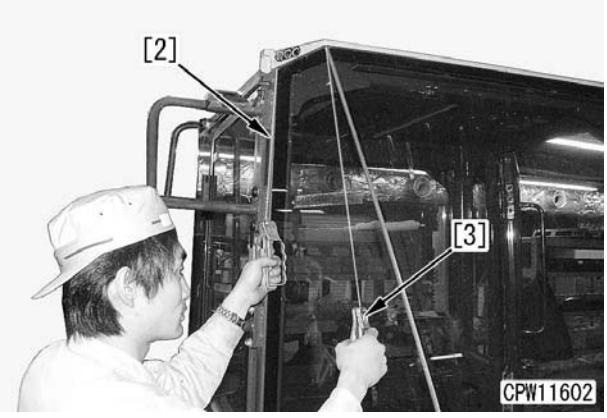
Removal

★ Remove the window glass to be replaced according to the following procedure.

1. Using seal cutter [1], cut the adhesive between broken window glass (6) and operator's cab (metal sheet) (7).

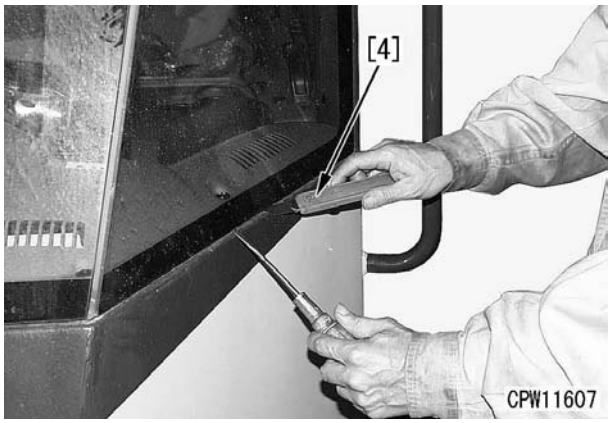


★ If a seal cutter is not available, make holes on the adhesive and both-sided adhesive tape with a drill and pass a fine wire (piano wire, etc.) [2] through the holes. Grip the both ends of the wire with priors [3], etc. (or hold them by winding them onto something) and move the wire to the right and left to cut the adhesive and both-sided adhesive tape.
Since the wire may be broken by the frictional heat, apply lubricant to it.
(The following figure shows the operator's cab of a wheel loader.)



★ If the window glass is broken finely, it may be removed with knife [4] and a screwdriver.

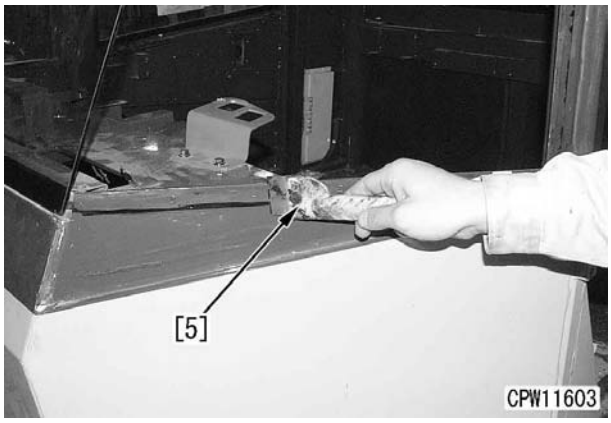
★ Widening the cut with a screwdriver, cut the adhesive and both-sided adhesive tape with knife [4].
(The following figure shows the operator's cab of a wheel loader.)



2. Remove the window glass.

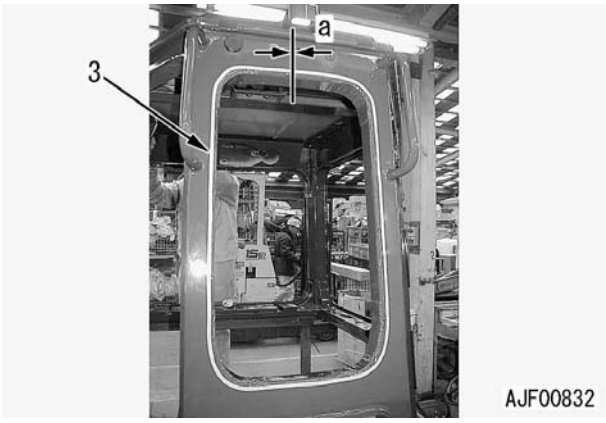
Installation

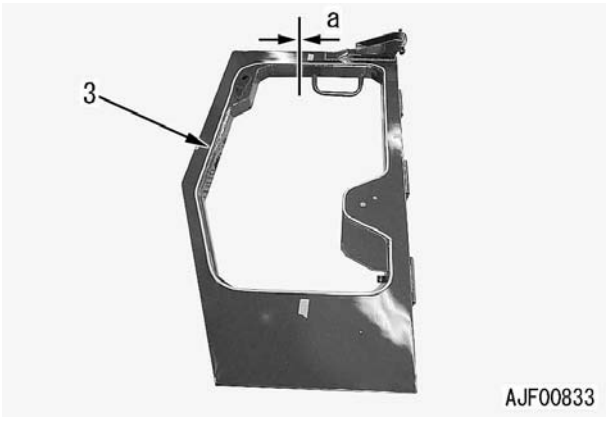
1. Using a knife and scraper [5], remove the remaining adhesive and both-sided adhesive tape from the metal sheets (glass sticking surfaces) of the operator's cab.
   ★ Remove the adhesive and both-sided adhesive tape to a degree that they will not affect adhesion of the new adhesive. Take care not to scratch the painted surfaces.
   (If the painted surfaces are scratched, adhesion will be lowered.)
   (The following figure shows the operator's cab of a wheel loader.)



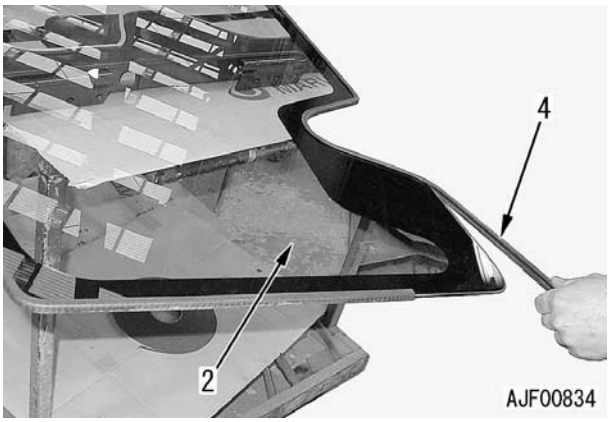
2. Remove oil, dust, dirt, etc. from the sticking surfaces of cab (7) and window glass (8) with white gasoline.
   ★ If the sticking surfaces are not cleaned well, the glass may not be stuck perfectly.
   ★ Clean the all black part on the back side of the window glass.
   ★ After cleaning the sticking surfaces, leave them for at least 5 minutes to dry.

3. Stick both-sided adhesive tape (3) along the inside edges of the front window glass sticking section and both door window glass sticking sections.
   ★ Do not remove the release tape of the both-sided adhesive tape on the glass sticking side before sticking the glass.
   ★ When sticking the both-sided adhesive tape, do not touch the cleaned surface as long as possible.
   ★ Take care that the both-sided adhesive tape will not float at each corner of the window frame.
   ★ Do not lap the finishing end of both-sided adhesive tape (3) over the starting end but make clearance (a) of about 5 mm between them.

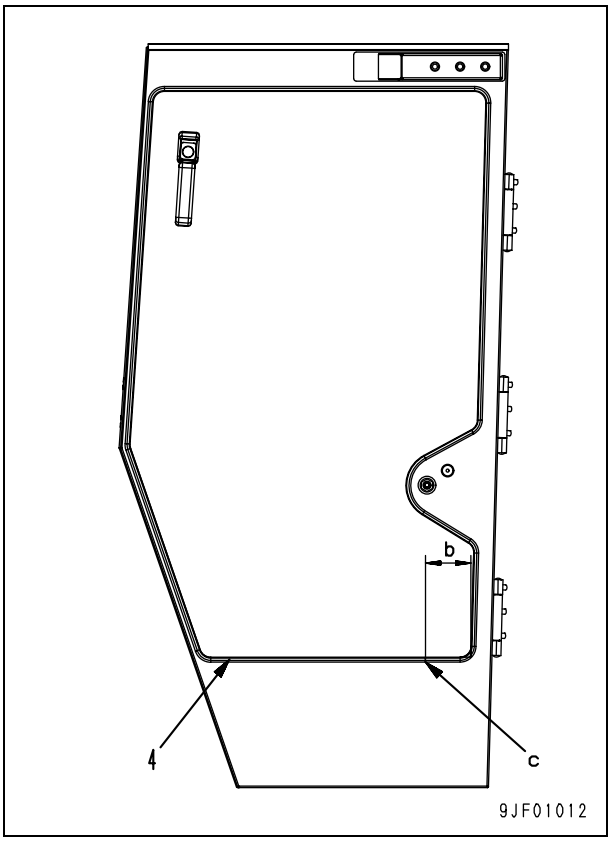




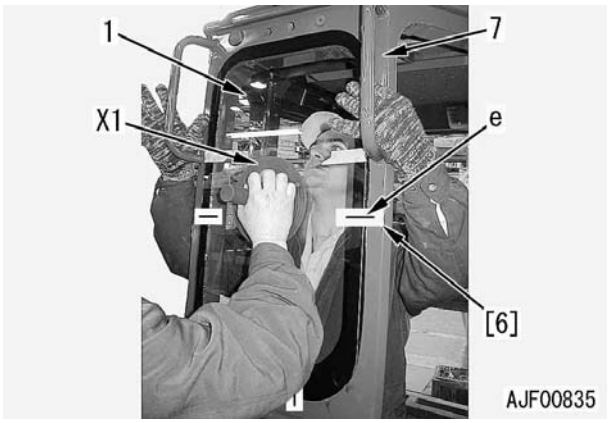
4. Install trim seals (4) to both door window glasses (2).

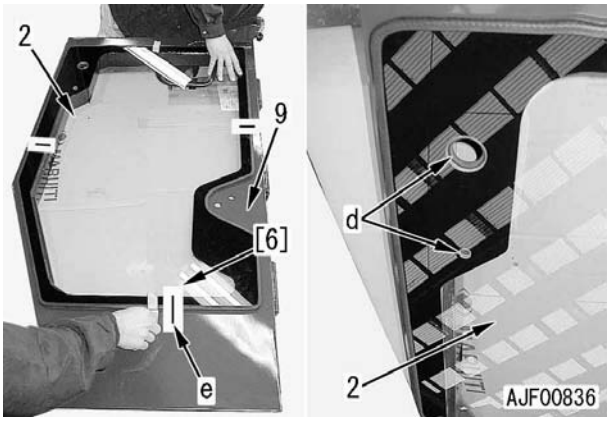


★ Install each trim seal (4) so that its finishing end and starting end will be jointed at position (c) and dimension (b) between the corner and position (c) will be 90 mm.



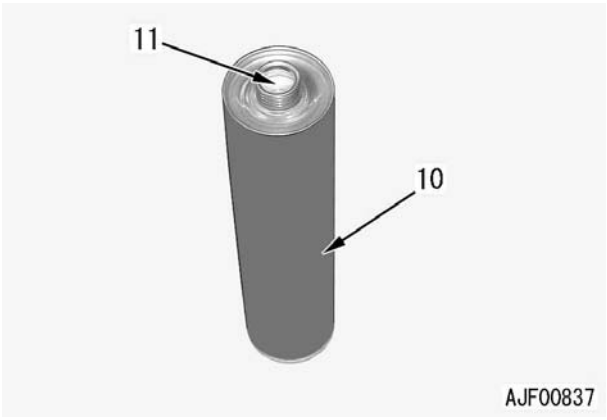
5. Position the new window glass.
1) Using tool **X1**, set the window glass to the sticking position. Check the clearance between the window glass and the operator's cab on the right, left, upper, and lower sides, and then adjust it evenly.
★ Position front window glass (1) from inside of operator's cab (7). Adjust it so that the difference between black coated part and the metal sheet of operator's cab (7) will be even on the right, left, upper, and lower sides.
★ When positioning each door window glass (2), align handle holes (d) of door (9) (on the glass side and door metal sheet side) first. Then, adjust the door window glass so that the positional relationship between it and door metal sheet will be even all around the window.
2) After positioning the glasses, stick tapes [6] between front window glass (1) and operator's cab (7) and the right, left, and lower parts of each door window glass (2) and each door (9), and then draw positioning line (e).
3) Cut the tapes between window glasses (1) and (2) and operator's cab (7) with a knife, and then remove the window glasses.
★ Do not remove the tapes left on the window glasses and operator's cab before installing the window glasses.



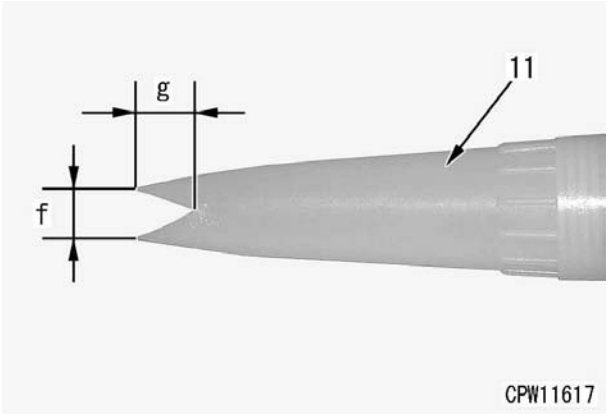


6. Apply adhesive.
Adhesive:
Sikaflex 256HV manufactured by Sika Japan
★ Do not use primer.
★ The using limit of the adhesive is 6 months after the date of manufacture. Do not use the adhesive after this limit.
★ Keep the adhesive in a dark place where the temperature is below 25ºC.
★ Never heat the adhesive higher than 30ºC.
★ When reusing the adhesive, remove the all hardened part from the nozzle tip.

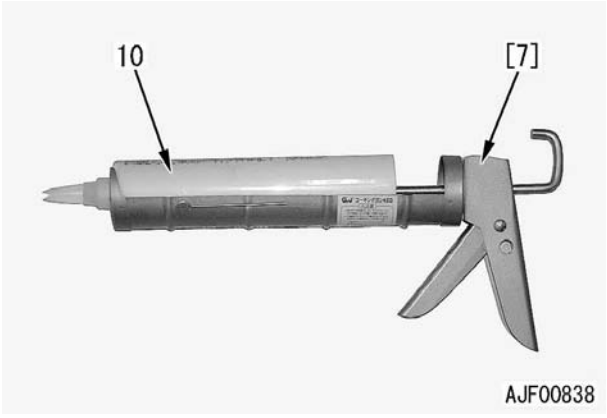
1) Break aluminum seal (11) of the outlet of adhesive cartridge (10) and install the nozzle.



2) Cut the tip of the adhesive nozzle (12) so that dimensions (f) and (g) will be as follows.
   - Dimension (f): **10 mm**
   - Dimension (g): **15 mm**

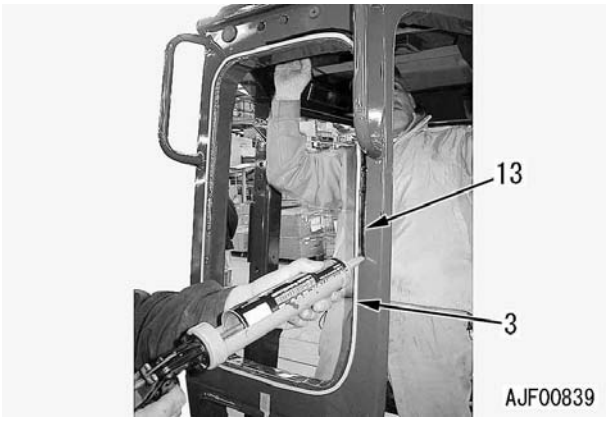


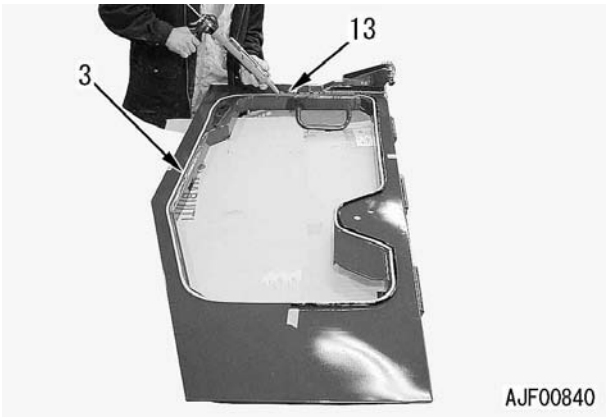
3) Set adhesive cartridge (10) to caulking gun [7].
   ★ An electric caulking gun is more efficient.



4) Remove release tape of the both-sided adhesive tape (3a) on the glass side.

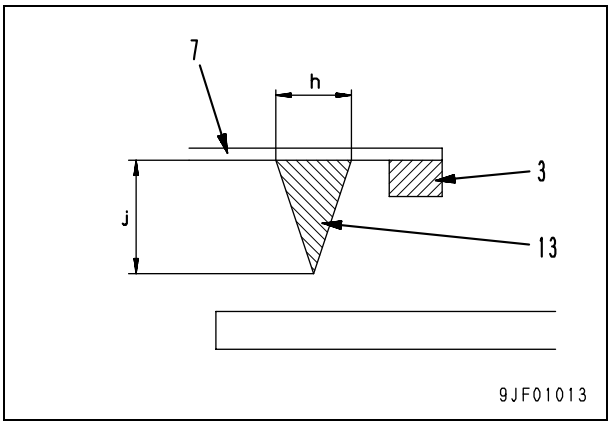
5) Apply adhesive (13) to the outside of both-sided adhesive tape (3) of the operator's cab.



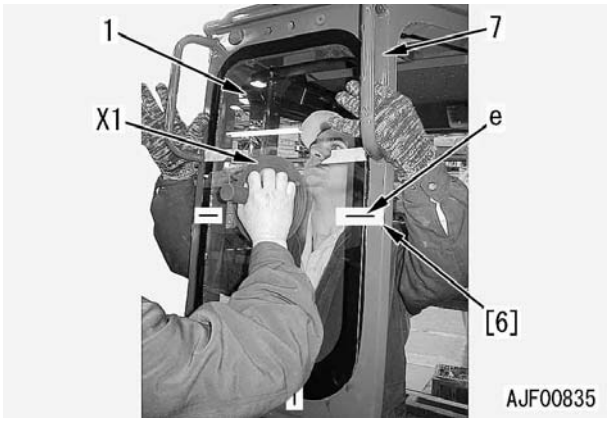


★ Apply adhesive (13) to dimensions (h) and (j) of both-sided adhesive tape (3) of operator's cab (7).
- Dimension (h): **10 mm**
- Dimension (j): **15 mm**

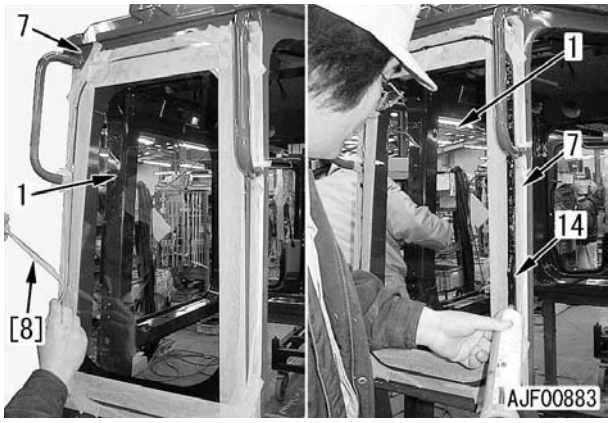
★ Apply adhesive (13) higher than both-sided adhesive tape (3).
★ Apply the adhesive evenly.



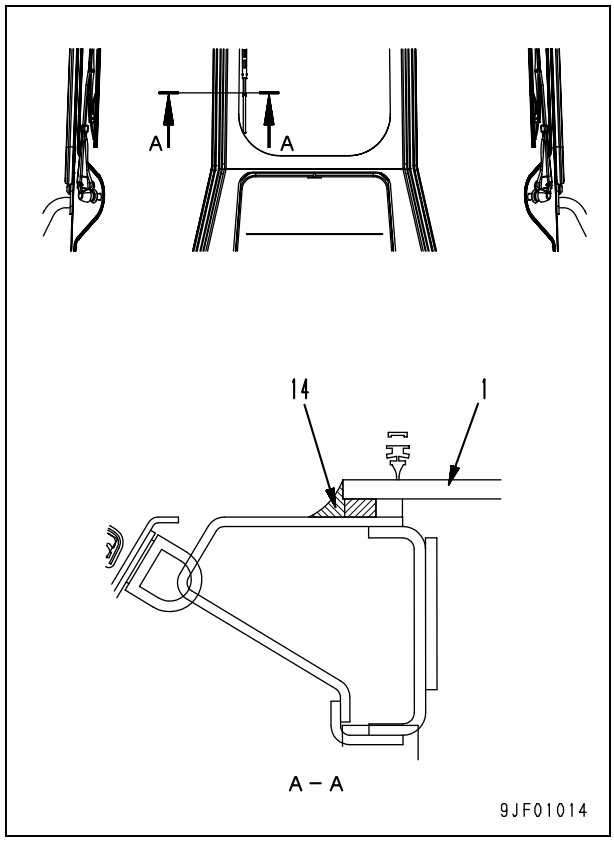
7. Install the front window glass.
1) Using tool **X1**, match front window glass (1) to line (e) on positioning tapes [6] drawn in step 5 and install it to operator's cab (7).
★ Since the window glass cannot be removed and stuck again, stick it very carefully.
★ Stick the glass within 5 minutes after applying the adhesive.
2) After sticking the window glass, press all around it until it is stuck to the both-sided adhesive tape.
★ Press the corners of the window glass firmly.

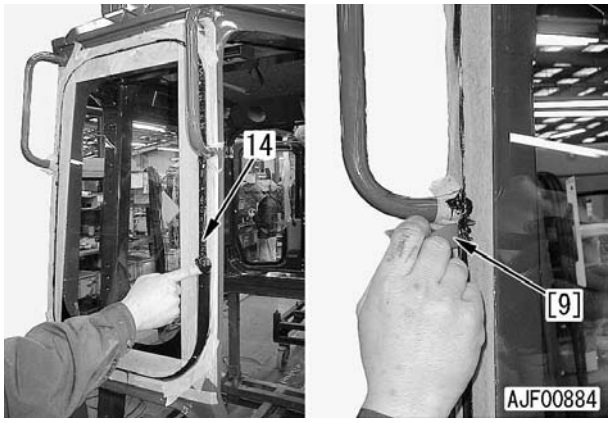


3) Mask front window glass (1) and operator's cab (7) with masking tapes [8].
4) Fill the clearance between front window glass (1) and operator's cab (7) with caulking material (14) all around the window.
Caulking material:
SEKISUI SILICONE SEALANT
★ The using limit of the caulking material is 6 months after the date of manufacture. Do not use the caulking material after this limit.

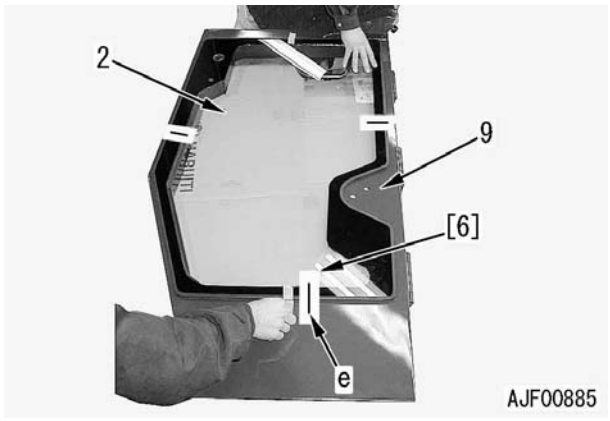


5) After applying caulking material (14) to front window glass (1), form it with the fingers as shown in the following figure.
★ Use rubber spatula [9] to form the caulking material around the handrail, etc. where it is difficult to form with the fingers.

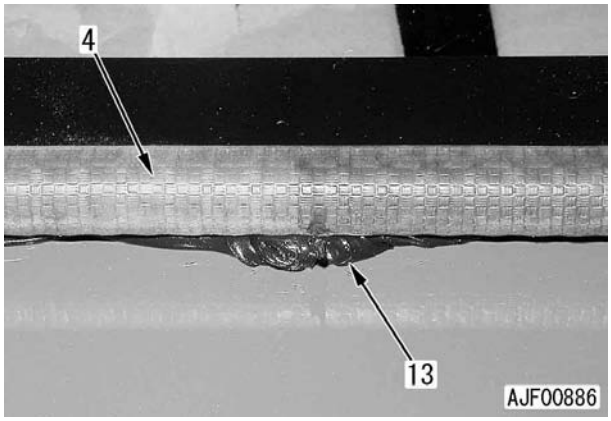


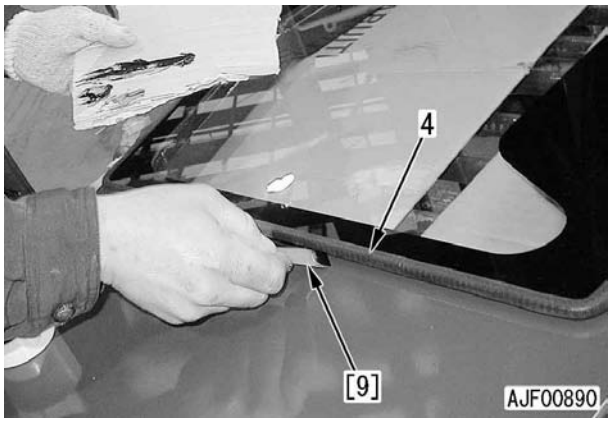


8. Install both door window glasses.
1) Using tool **X1**, match both door window glasses (2) to lines (e) on positioning tapes [6] drawn in step 5 and install them to both doors (9).
★ Since the window glass cannot be removed and stuck again, stick it very carefully.
★ Stick the glass within 5 minutes after applying the adhesive.
2) After sticking each window glass, press all around it until it is stuck to the both-sided adhesive tape.
★ Press the corners of each window glass firmly.

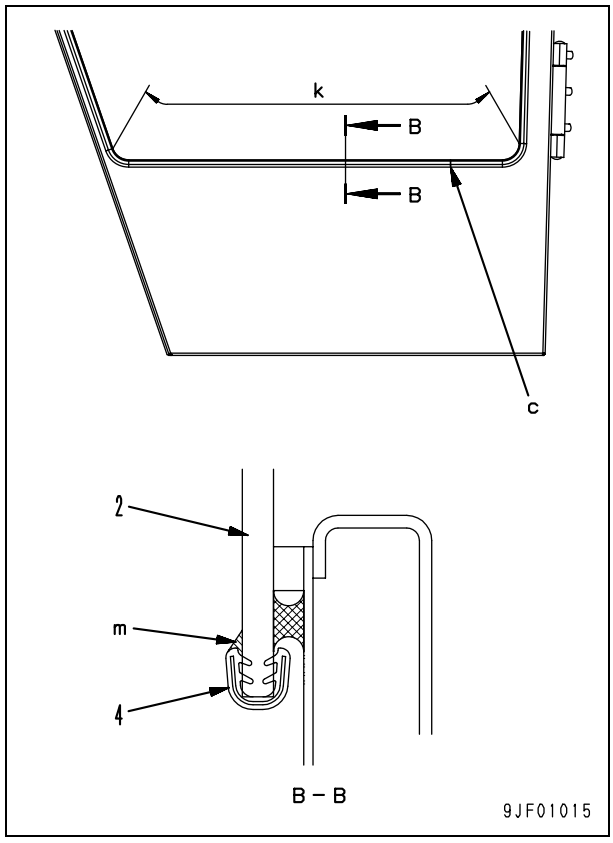


★ If adhesive (13) is projected from the trim seals (4) of stuck door window glasses on both sides, remove it with rubber spatula [9].





3) Fill the clearance between each door window glass and trim in the range of dimension (k).
   1] Mask the range of dimension (k) of each door window glass.
   2] Fill clearance (m) between each door window glass (2) and trim seal (4) with caulking material.
   ★ The using limit of the caulking material is 6 months after the date of manufacture. Do not use the caulking material after this limit.
   ★ Apply the caulking material to joint (c) of the trim seal, too.
   Caulking material:
   SEKISUI SILICONE SEALANT



9. Fix the window glasses.
   1) Using styrene foam blocks [10] and rubber bands [11], fix the front window glass to fit it completely.
      ★ You may use sealing tapes to fix the front window glass.
   (The figure shows the operator's cab of a hydraulic excavator.)

   2) Immediately after sticking both door window glasses, install door handles (5) and fix the glasses.

10. After installing the window glasses, remove the primer and adhesive from them and the operator's cab.
   ★ Using white gasoline, wipe off the adhesive before it is dried up.
   ★ When cleaning the glasses, do not give an impact to them.

11. Protect the stuck window glasses.
   1) Keep the stopper rubbers, styrene foam blocks, and rubber bands installed for 10 hours (at temperature of 20ºC and humidity of 65%).
   2) After applying the adhesive, wait for at least 24 hours, before operating the machine actually.

Removal and installation of floor frame assembly

Special tools

Symbol	Part No.	Part name	Necessity	Q'ty	New/remodel	Sketch
X2	799-703-1200	Service tool kit	■	1		
	799-703-1100	Vacuum pump (100 V)	■	1		
	799-703-1110	Vacuum pump (220 V)	■	1		
	799-703-1120	Vacuum pump (240 V)	■	1		
	799-703-1401	Gas leak detector	■	1		

Removal

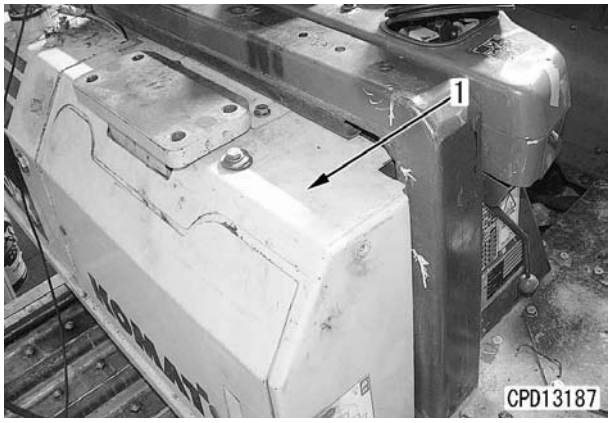
⚠ **Lower the work equipment to the ground safely. Referring to Testing and adjusting, "Releasing residual pressure from work equipment cylinder", release the residual pressure from the piping.**

⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

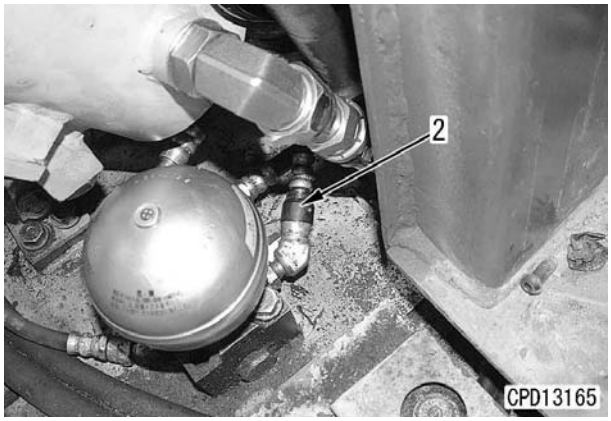
⚠ **Collect the air conditioner refrigerant (R134a).**

⚠ **If refrigerant (R134a) gets in your eyes, you may lose your sight. Accordingly, you must be qualified for handling the refrigerant and put on protective goggles while you are collecting the refrigerant or charging the air conditioner with refrigerant.**
Collecting and filling work must be conducted by a qualified person.

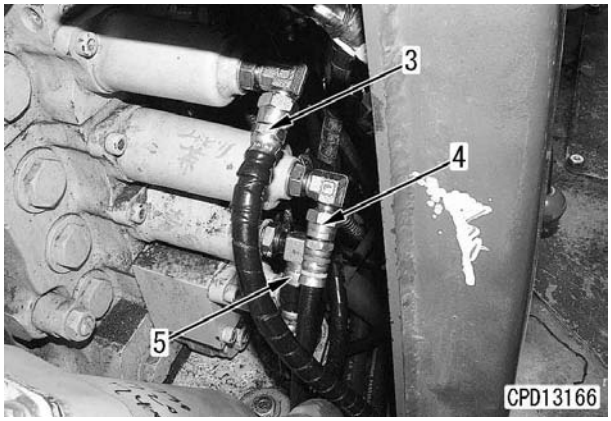
1. Remove the engine hood assembly. For details, see "Removal and installation of engine hood assembly".
2. Remove the operator's cab assembly. For details, see "Removal and installation of operator's cab assembly".
3. Remove operator's seat assembly.
4. Remove cover (1).



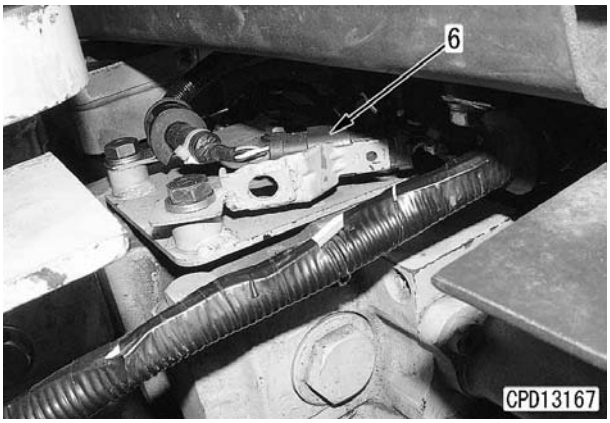
5. Disconnect accumulator hose (2).



6. Disconnect PPC hoses (3), (4) and (5) from the control valve assembly.
   - (3): Without color band
   - (4): Color band of Brown and Green
   - (5): Color band of Blue

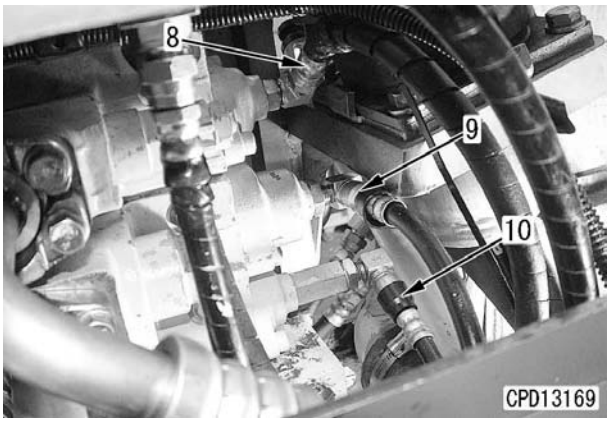


7. Disconnect wiring connector STB (6) on the control valve assembly and remove the wiring harness clamp.

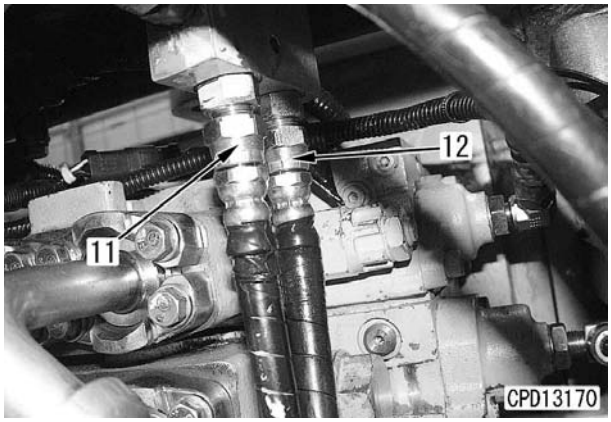


8. Disconnect wiring connector CAN (7) and remove the wiring harness clamp.

9. Disconnect PPC hoses (8), (9), and (10) from the control valve assembly.
- (8): Without color band
- (9): Without color band
- (10): Color band of Brown

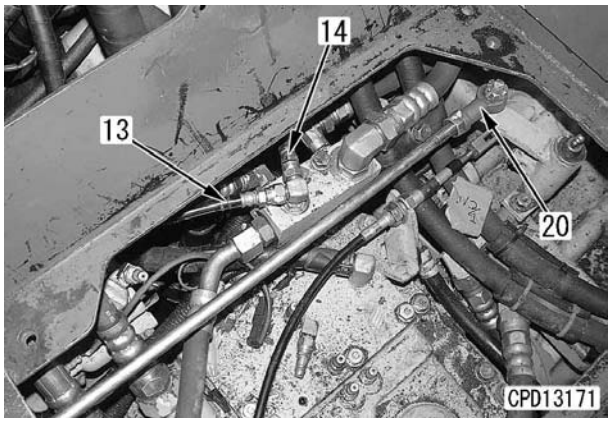


10. Disconnect ripper hoses (11) and (12).

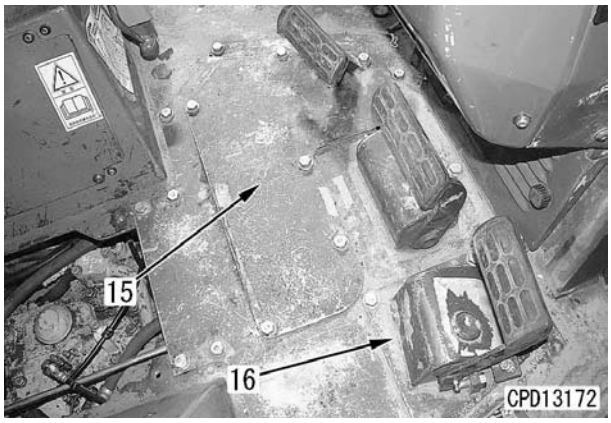


11. Disconnect hoses (13) and (14) on the power train unit side.

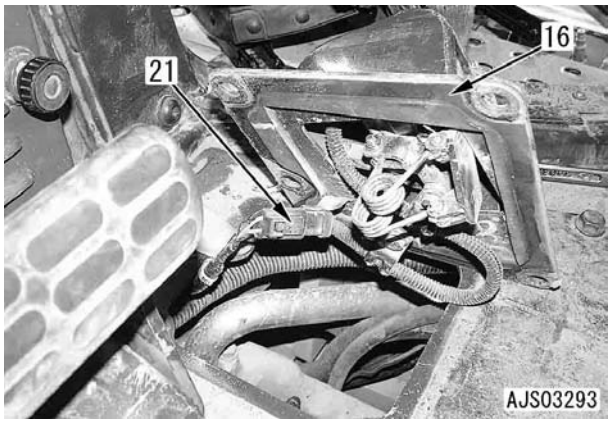
12. Disconnect brake rod (20). [*1]
★ Before disconnecting, check the pressing distance of the brake.



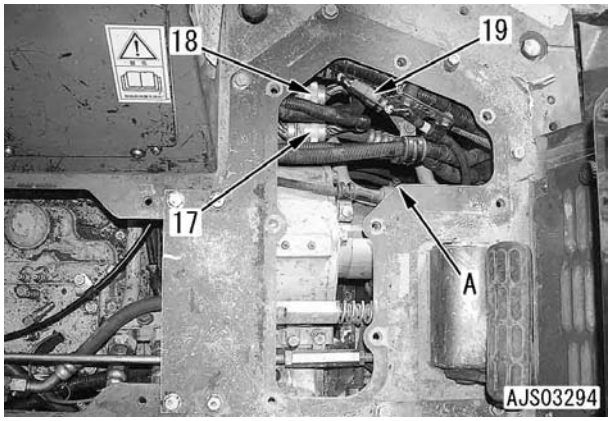
13. Remove covers (15) and (16).



14. Disconnect wiring connector DCL (21) from the back of cover (16).



15. Disconnect wiring connectors PL1 (17), PL2 (18) and STA (19).
Disconnect wiring connector BRK from the back of part A.



16. Remove cover (22) from the left side of the chassis.

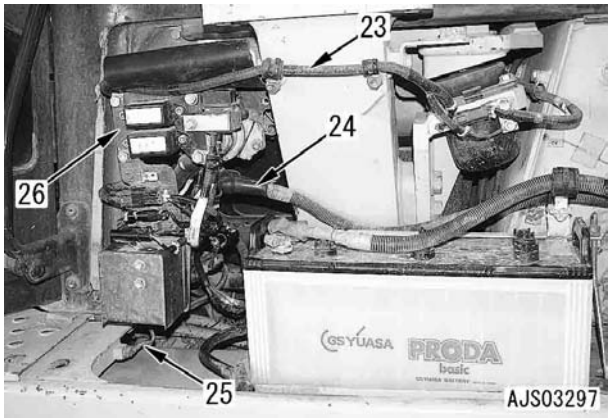
Cover assembly: **55 kg**

17. Remove the clamp of wiring harness (23) and move the wiring harness.

18. Remove the clamp and disconnect terminal (24).

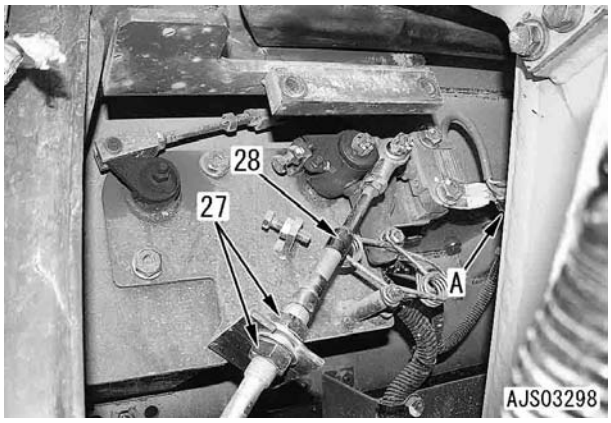
19. Disconnect ground wire (25).

20. Remove bracket (26).



21. Loosen locknut (27).
★ Make a mark of the installed height.

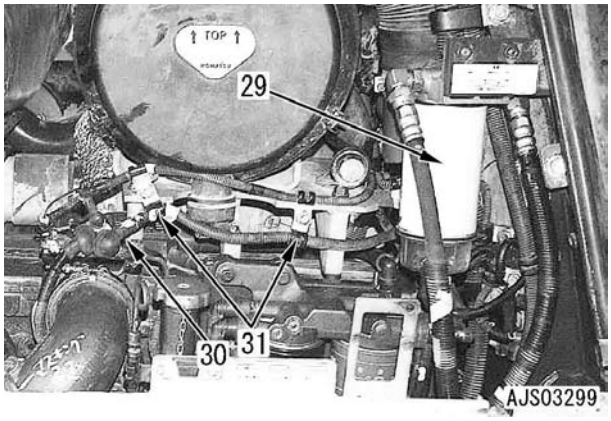
22. Remove cable (28) of the parking brake lock lever from the bracket. [*2]
Disconnect wiring connector NSW from part A.



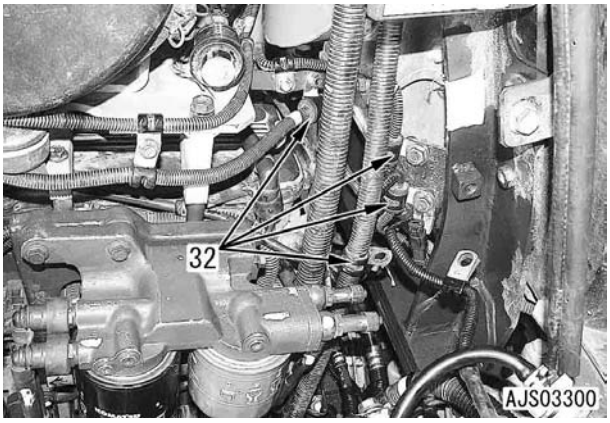
23. Disconnect fuel filter bracket assembly (29).

24. Disconnect terminal HT/B (30) from the heater relay.

25. Disconnect clamp (31).



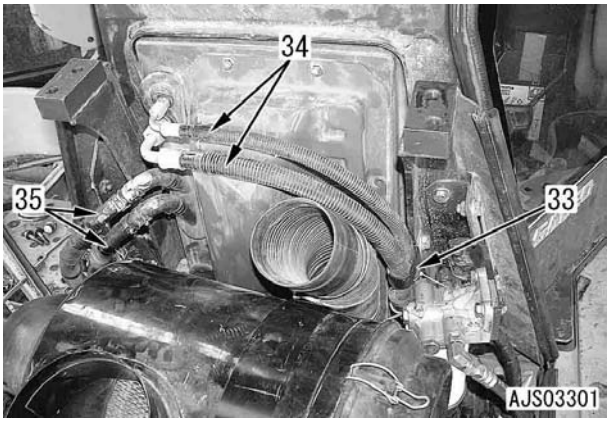
26. Disconnect clamps (32).



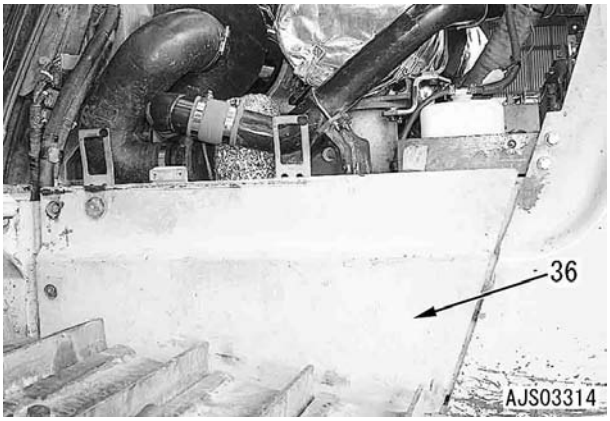
27. Disconnect clamp (33).

28. Disconnect air conditioner hoses (34). [*3]
- ★ Before disconnecting this hose, collect the air conditioner refrigerant.

29. Disconnect heater hoses (35).
- ★ Check the connection end.
- ★ Close the heater hose valve on the engine side.
- ★ Install a plug to the disconnected hose.

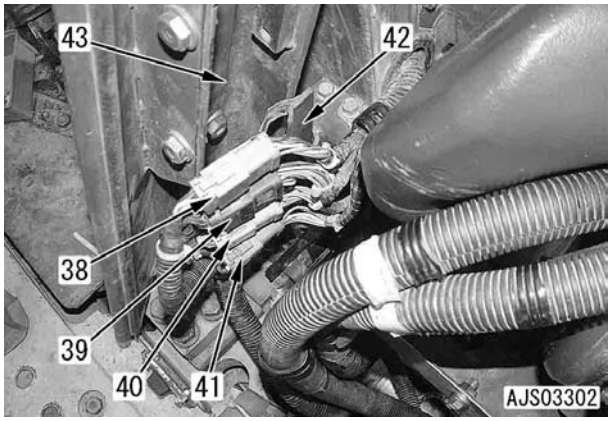


30. Remove engine right side cover (36).



31. Disconnect washer tank and bracket assembly (37).

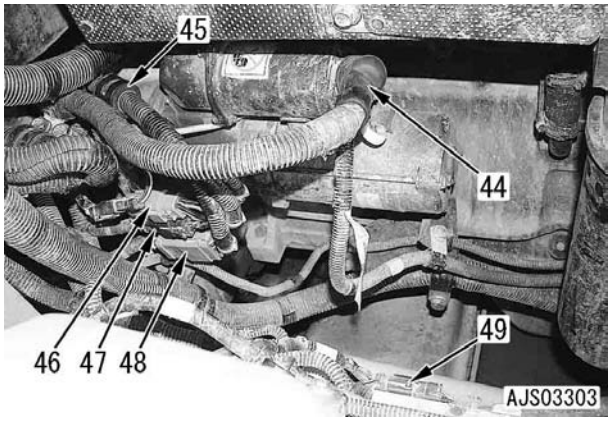
32. Remove cover (43).



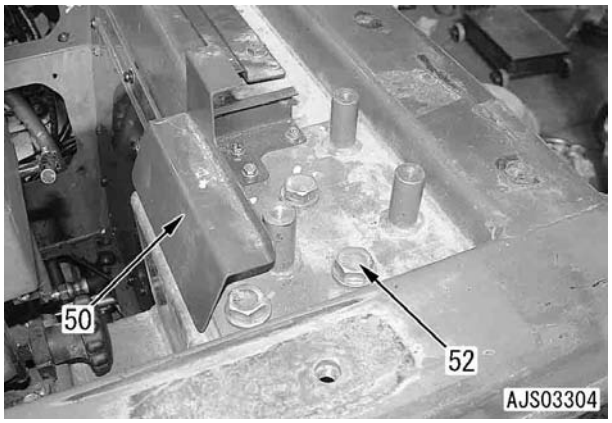
33. Disconnect starting motor terminal (44).

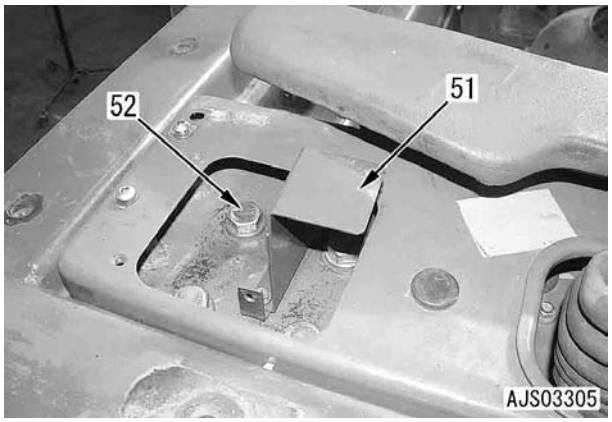
34. Disconnect wiring harness clamp (45).

35. Disconnect wiring connectors E23 (Gray) (46), E22 (Black) (47), E21 (Gray) (48) and 101 (49) from the right side of the engine.

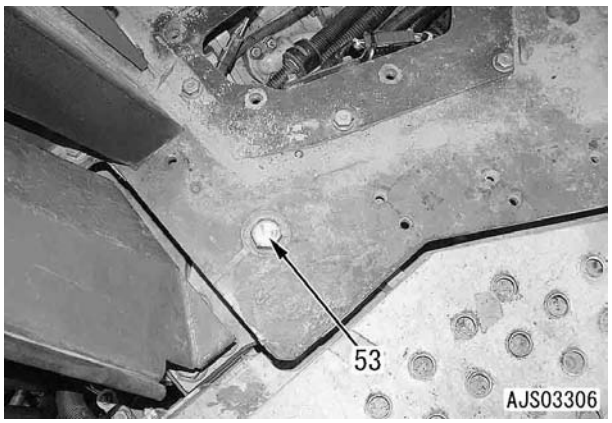


36. Remove brackets (50) and (51) and then remove 4 rear mounting bolts (52) each from the right and left sides.





37. Remove 1 front mounting bolt (53) each from the right and left sides.



38. Lift off floor frame assembly (54).

★ Check that all the wires and pipes are disconnected.

Floor frame assembly: **380 kg**

Installation

- Carry out installation in the reverse order to removal.

[*1]

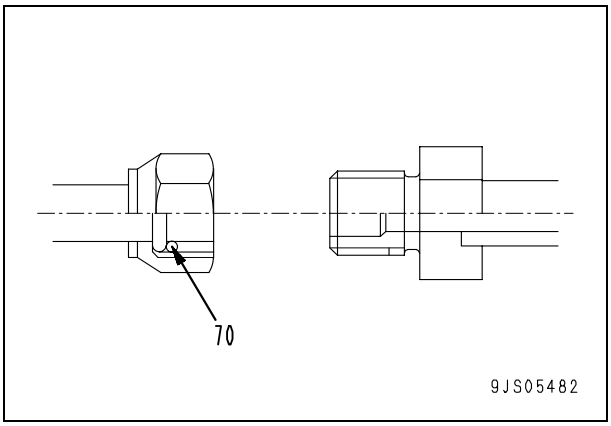
★ Adjust the brake pedal. For details, see Testing and adjusting, “Adjusting brake pedal”.

[*2]

★ Adjust the parking brake lever. For details, see Testing and adjusting, “Adjusting parking brake lever”.

[*3]

★ Install each hose so that it will not be twisted.
★ When installing the air conditioner hoses, take care that dirt, dust, water, etc. will not enter them.
★ When tightening each joint of the air conditioner hose, check that O-ring (70) is fitted to it.
★ Apply sufficient amount of **compressor oil for R134a (DENSO: ND-OIL8, ZEXEL: ZXL100PG (equivalent to PAG46)** to each O-ring.



Tightening torque for air conditioner refrigerant piping

Thread size	Tightening torque
16 x 1.5	11.8 – 14.7 Nm {1.2 – 1.5 kgm}
22 x 1.5	19.6 – 24.5 Nm {2.0 – 2.5 kgm}
24 x 1.5	29.4 – 34.3 Nm {3.0 – 3.5 kgm}

- **Charging air conditioner with refrigerant gas**
  Using tool **X2**, charge the air conditioner circuit with refrigerant (**R134a**).
  ★ Quantity: **900 ± 50 g**

- **Refilling with coolant**
  Add coolant through the coolant filler to the specified level. Run the engine to circulate the coolant through the system. Then, check the coolant level again.

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00953-00

BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

50 Disassembly and assembly
Electrical system

Electrical system

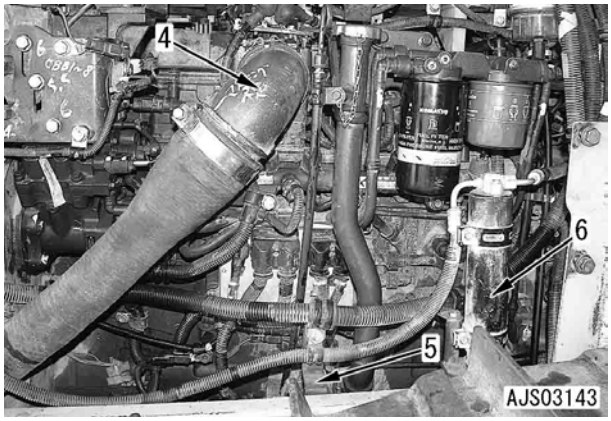
Removal and installation of engine controller

Removal

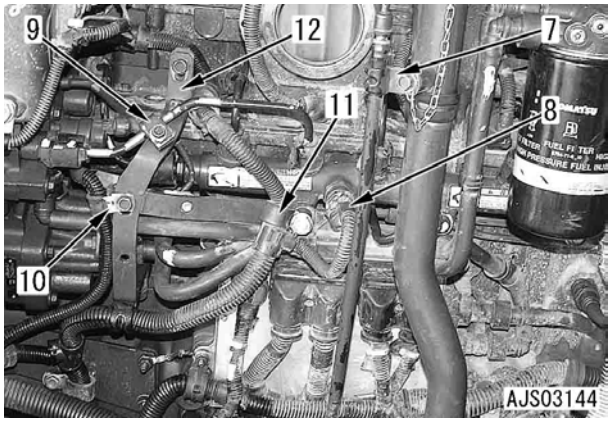
⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

1. Open the engine left side cover (1).
2. Remove covers (2) and (3).

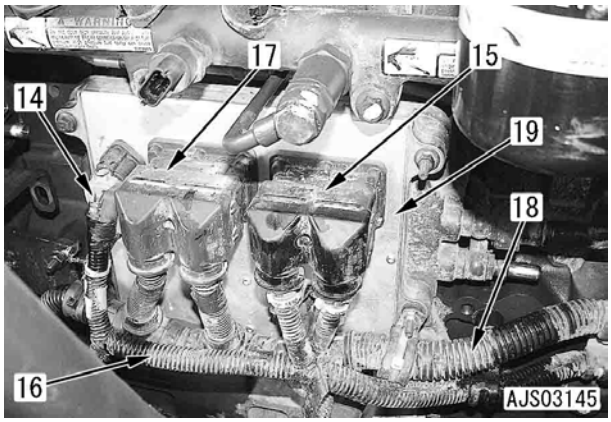
3. Disconnect air intake tube (4).
4. Disconnect bracket (5).
5. Disconnect receiver drier and bracket assembly (6).



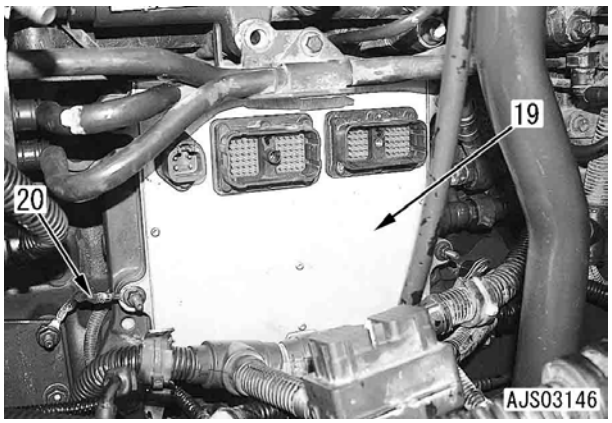
6. Disconnect clamp (7).
7. Disconnect connector (8).
8. Disconnect clamps (9) – (11).
9. Disconnect bracket (12).



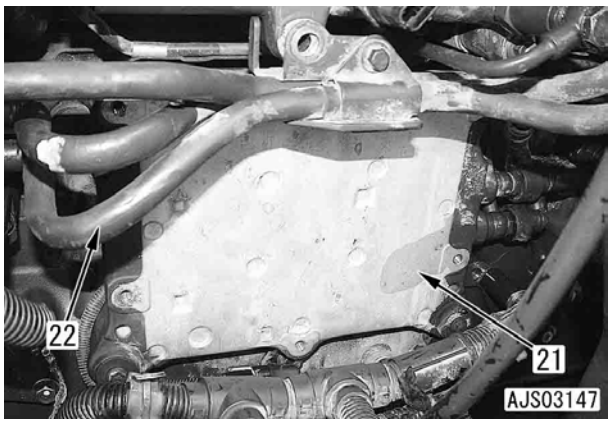
10. Disconnect connector CE03 (14) and CE02 (15). [*1]
    ★ Use 4 mm hexagon wrench.
11. Disconnect the clamp and separate wiring harness (16) from engine controller (19).
12. Disconnect connector (17). [*1]
13. Disconnect the clamp and separate wiring harness (18) from engine controller (19).

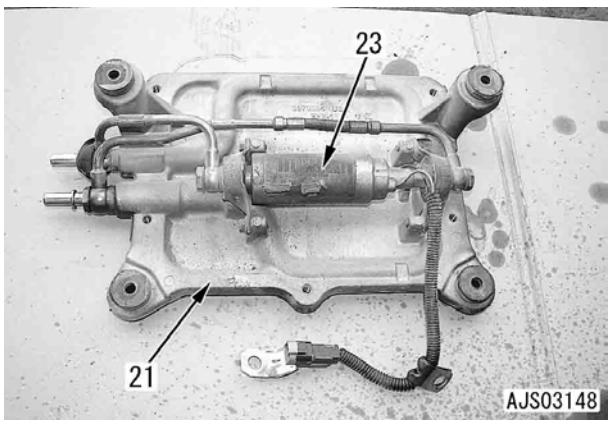


14. Remove the 5 mounting bolts and engine controller (19).
★ Ground wire (20) is also fixed with these bolts.



★ Electric feed pump (23) is installed on the back of engine controller cooler (21).
★ For removal of fuel hose assembly (22), see “Removal of fuel supply pump”.





Installation

★ Carry out installation in the reverse order to removal.

[*1]
★ Check that there is no dust in connectors (14), (15) and (17) before connecting.

Removal and installation of steering and transmission controller assembly

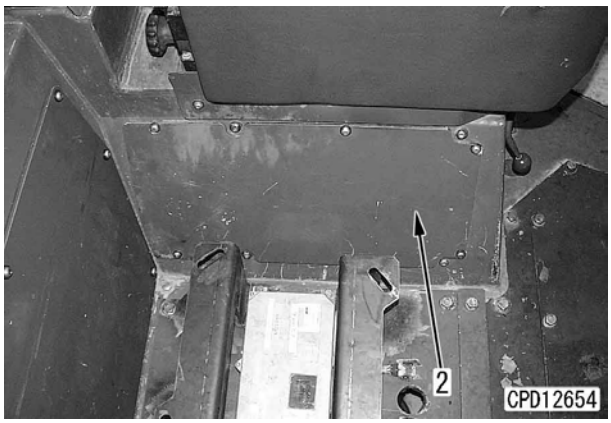
Removal

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove operator's seat assembly (1).

Operator's seat assembly: **70 kg**

2. Remove left side cover (2).

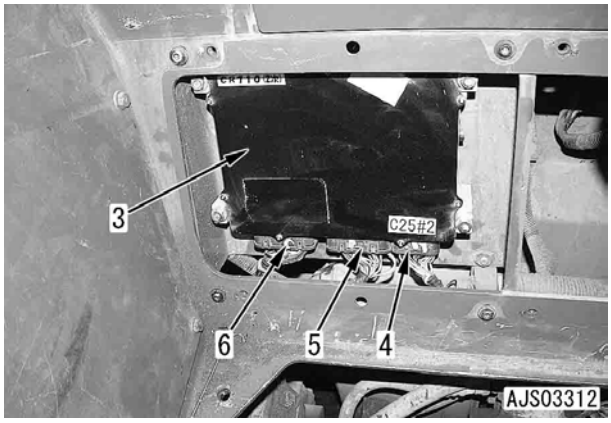


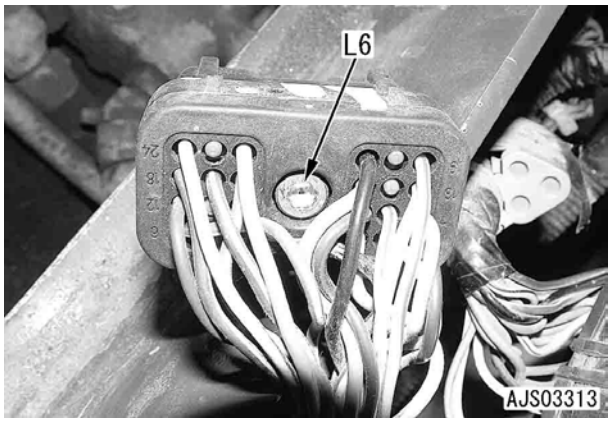
3. Remove the 4 mounting bolts and pull out steering and transmission controller assembly (3) toward you.

4. Disconnect wiring connectors **ST1** (4), **ST2** (5), and **ST3** (6) and remove steering and transmission controller assembly (3). [*1]

★ When disconnecting each connector, loosen screw (L6) at the center of the wiring harness.

★ Use 4-mm hexagon wrench.





Installation

- Carry out installation in the reverse order to removal.

[*1]

Mounting screw: **2.82 Nm {0.288 kgm}**

Removal and installation of KOMTRAX terminal

Removal

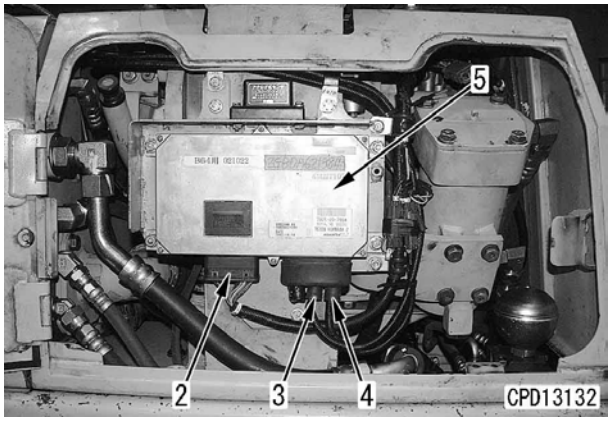
⚠ **Disconnect the cable from the negative (–) terminal of the battery.**

1. Open cover (1).

2. Disconnect wiring connectors G01 (2), (3) and (4). [*1]

★ To disconnect wiring connector G01 (2), loosen the central screw of the wiring harness.

3. Remove the 4 mounting bolts and KOMTRAX terminal assembly (5).



Installation

- Carry out installation in the reverse order to removal.

[*1]

Mounting screw: **2.82 Nm {0.288 kgm}**

D65EX, PX, WX-15E0 Bulldozer

Form No. SEN00954-00

BULLDOZER

D65EX-15
D65PX-15
D65WX-15

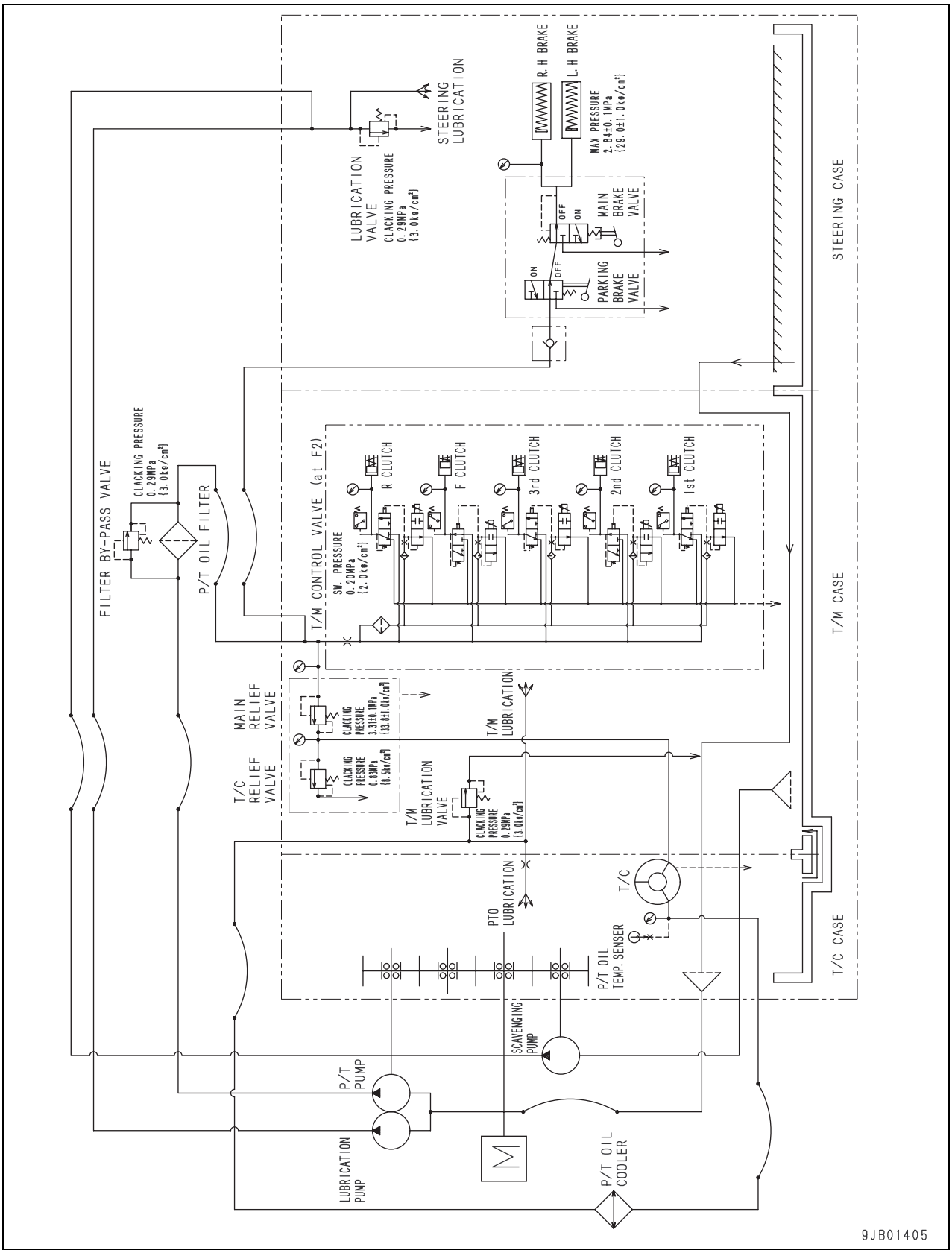
Machine model	Serial number
D65EX-15	69001 and up
D65PX-15	69001 and up
D65WX-15	69001 and up

90 Diagrams and drawings

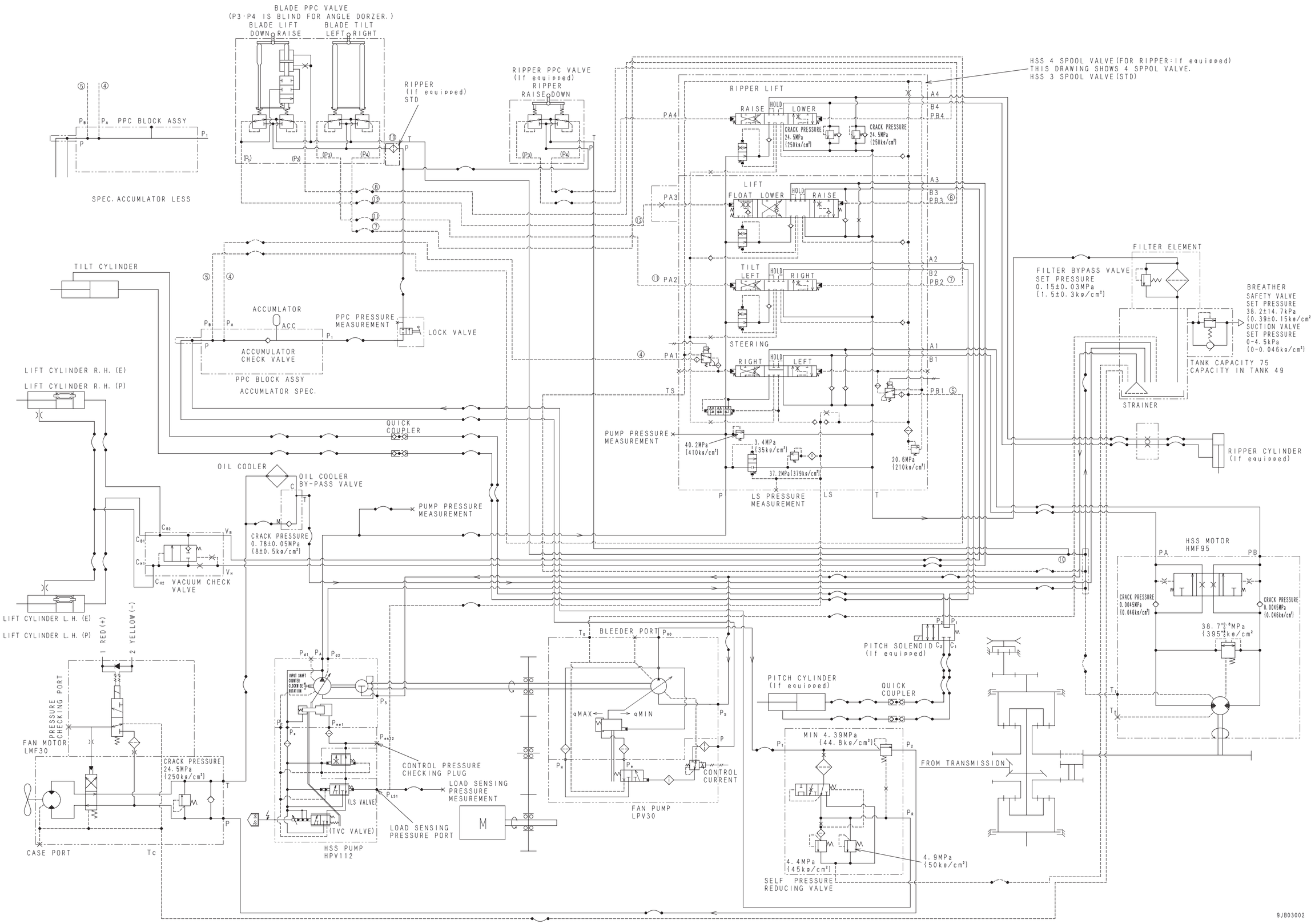
Hydraulic diagrams and drawings

Hydraulic diagrams and drawings

Power train hydraulic circuit diagram



Hydraulic circuit diagram

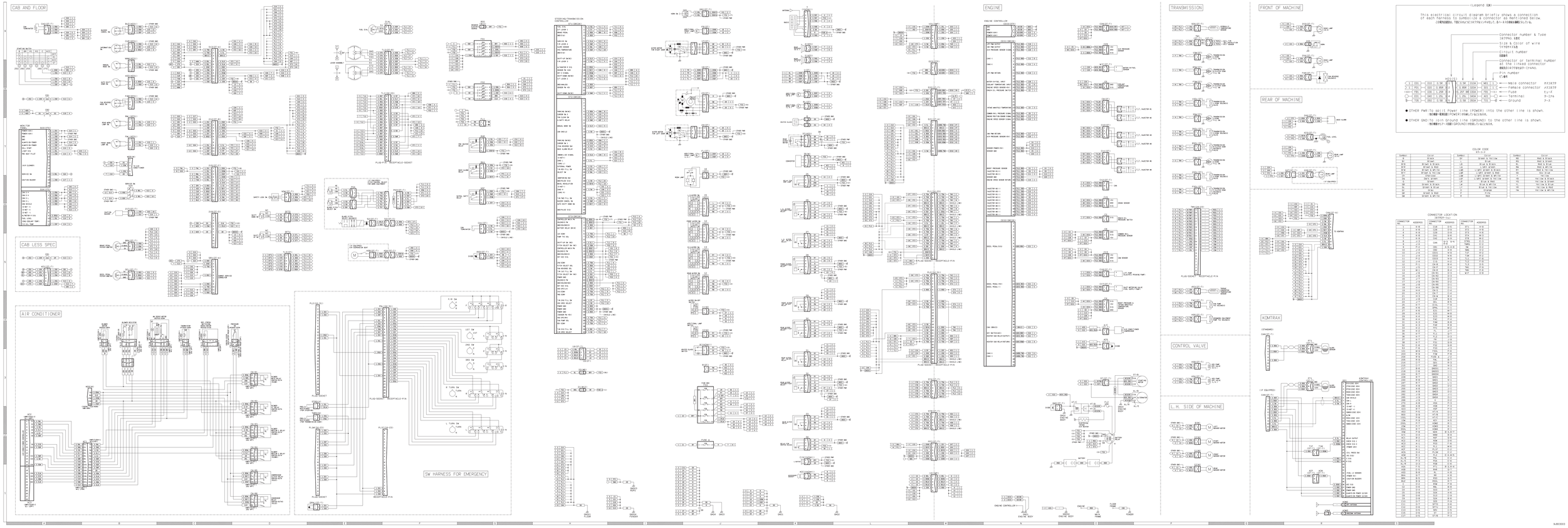


BULLDOZER

D65EX-15E0
D65PX-15E0
D65WX-15E0

Machine model	Serial number
D65EX-15E0	69001 and up
D65PX-15E0	69001 and up
D65WX-15E0	69001 and up

90 Diagrams and drawings
Electrical diagrams and drawings

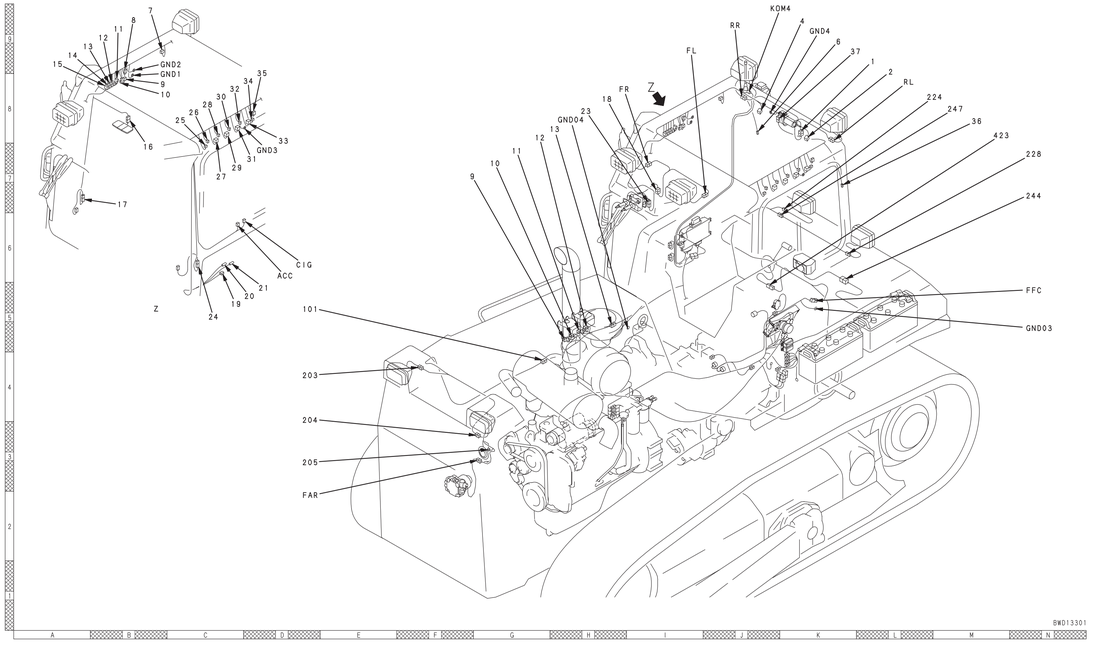

CAB AND FLOOR
CAB LESS SPEC
AIR CONDITIONER
SW HARNESS FOR EMERGENCY
ENGINE
TRANSMISSION
CONTROL VALVE
L.H. SIDE OF MACHINE
FRONT OF MACHINE
REAR OF MACHINE
KOMTRAX
(Legend 凡例)
This electrical circuit diagram briefly shows a connection of each harness to symbolize a connector as mentioned below.
Connector number & type
Side & Color of wire
Circuit number
Connector of terminal number at the linked connector
Pin number
Male connector
Female connector
Fuse
Terminal
Ground
OTHER PWR To split Power line (POWER) into the other line is shown.
OTHER GND To join Ground line (GROUND) to the other line is shown.
COLOR CODE
CONNECTOR LOCATION

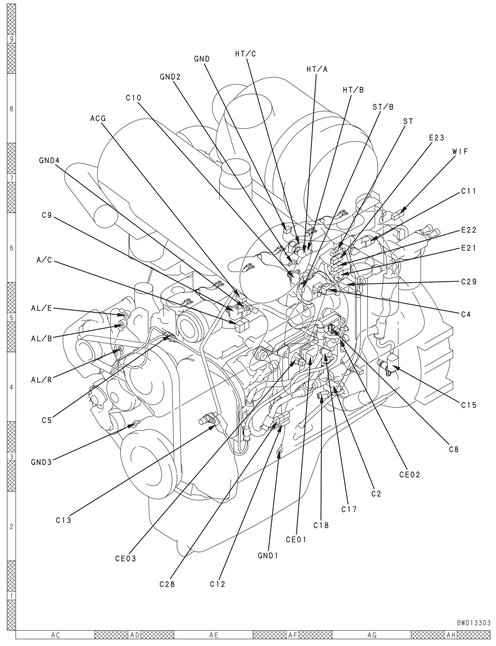
Connector arrangement diagram D65EX, PX, WX-15E0

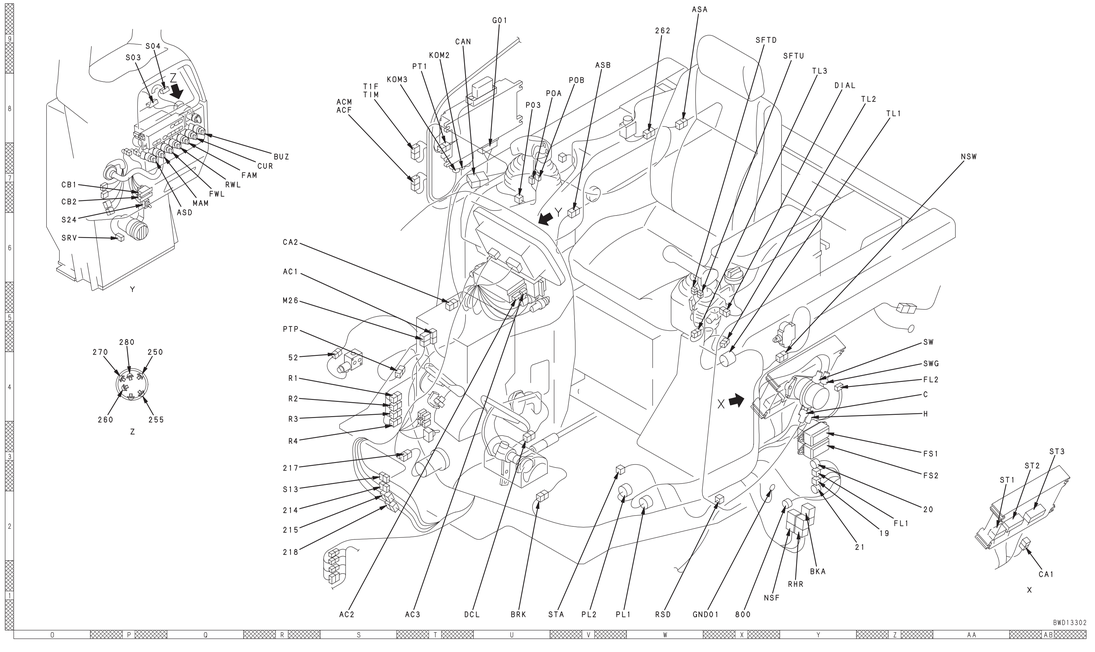
Connector No.	Type	Number of pins	Location	Arrangement drawing
1	DT	4	Intermediate connector [Cab specification]	L-9
2	KES1	2	Rear speaker (Left) [Cab specification]	L-9
4	KES1	2	Rear speaker (Right) [Cab specification]	K-9
6	One-pin connector	1	Heater wire glass [Cab specification]	K-9
7	PA	9	Radio [Cab specification]	B-9
8	DT	2	Accessory (12 V) [Cab specification]	B-9
9	YAZAKI	3	Heater wire glass switch [Cab specification]	B-8
9	M	2	Washer motor (Left)	G-7
10	M	2	Additional light switch [Cab specification]	B-8
10	M	2	Washer motor (Right)	G-7
11	M	2	Wiper intermittent switch [Cab specification]	B-9
11	M	2	Washer motor (Front)	G-7
12	KES1	6	Rear wiper switch [Cab specification]	B-9
12	M	2	Washer motor (Rear)	G-8
13	KES1	6	Right door wiper switch [Cab specification]	B-9
13	SWP	6	Intermediate connector (Washer motor)	H-8
14	KES1	6	Front wiper switch [Cab specification]	A-9
15	KES1	6	Left door wiper switch [Cab specification]	A-9
16	KES1	2	Room lamp [Cab specification]	B-7
17	DT	4	Right door wiper [Cab specification]	B-7
18	DT	4	Intermediate connector [Cab specification]	H-8
19	DT	4	Intermediate connector (Windshield washer motor) [Cab specification]	C-5, Z-2
20	DTHD#8	1	Cab power supply [Cab specification]	D-5, Z-2
21	DTHD#12	1	Cab power supply (Battery direct) [Cab specification]	D-5, Z-2
23	DT	6	Front wiper [Cab specification]	H-8
24	DT	4	Left door wiper [Cab specification]	C-5
25	Relay (YAZAKI)	4	For light [Cab specification]	C-8
26	Relay (YAZAKI)	6	Left wiper intermittent relay [Cab specification]	C-8
27	Relay	5	Left wiper intermittent selector relay [Cab specification]	C-7
28	Relay (YAZAKI)	6	Front wiper intermittent relay [Cab specification]	C-8
29	Relay	5	Front wiper intermittent selector relay [Cab specification]	C-7
30	Relay (YAZAKI)	6	Right wiper intermittent relay [Cab specification]	C-8
31	Relay	5	Right wiper intermittent selector relay [Cab specification]	D-7
32	Relay (YAZAKI)	6	Rear wiper intermittent relay [Cab specification]	C-8
33	Relay	5	Rear wiper intermittent selector relay [Cab specification]	D-8
34	Relay (YAZAKI)	4	Heater wire glass relay [Cab specification]	D-8
35	M	4	Converter [Cab specification]	D-8
36	One-pin connector	1	Heater wire glass [Cab specification]	M-8
37	KES1	4	Rear wiper [Cab specification]	K-9
52	DT	2	Pitch selector solenoid	R-4
101	SWP	8	Intermediate connector (Headlamp)	D-5
203	DT	2	Right head lamp	D-4
204	DT	2	Left head lamp	D-4
205	One-pin connector	1	Horn	D-3
214	DT-B	12	Intermediate connector [Dashboard]	R-2
215	DT-C	12	Intermediate connector [Dashboard]	R-2
217	DT	2	Caution buzzer	R-3
218	DT-D	12	Intermediate connector (Air conditioner)	R-2
224	DT	2	Right working lamp	M-8
228	DT	2	Left working lamp	N-7
244	DT	2	Backup alarm	N-7
247	DT	2	Intermediate connector (Left working lamp)	L-8
250	Terminal	1	Starting switch terminal B	P-4
255	Terminal	1	Starting switch terminal R1	P-4
260	Terminal	1	Starting switch terminal BR	P-4
262	DT	2	Horn switch	W-9
270	Terminal	1	Starting switch terminal ACC	P-4
280	Terminal	1	Starting switch terminal C	P-5
423	DT	2	Fuel level sensor	M-8
453	DT	2	Torque converter oil temperature sensor	AM-1
800	DTHD#12	1	Service power supply	X-1
1SOL	DT	2	1st clutch ECMV solenoid	AJ-5
1SW	DT	2	1st clutch ECMV (Fill switch)	AL-6
2SOL	DT	2	2nd clutch ECMV solenoid	AM-2
2SW	DT	2	2nd clutch ECMV (Fill switch)	AM-2
3SOL	DT	2	3rd clutch ECMV solenoid	AK-6
3SW	DT	2	3rd clutch ECMV (Fill switch)	AJ-5
A/C	DT	2	A/C compressor	AC-6
AC1	MIC	17	Air conditioner unit	R-6
AC2	AMP	16	Air conditioner controller	S-1
AC3	AMP	12	Air conditioner controller	T-1
ACC	YAZAKI	2	Accessory socket [Cab specification]	D-6
ACF	DT	3	Check connector (KOMTRAX)	S-8
ACG	DT	2	Diode (A/C compressor)	AD-8
ACM	DT	3	Check connector (KOMTRAX)	S-8
AL/B	Terminal	1	Alternator terminal B	AC-5
AL/E	Terminal	1	Alternator terminal E	AC-5
AL/R	Terminal	1	Alternator terminal R	AC-4
ASA	DT	2	Intermediate connector (Air suspension seat)	W-9
ASB	DT	2	Air suspension seat	V-9
ASD	KES1	4	Auto shift-down switch	Q-7
BKA	Relay	5	Backup alarm relay	Y-1
BRK	DT	3	Brake pedal	U-1
BUZ	KES1	3	Buzzer cancel switch	R-7
C	Terminal	1	Battery relay power supply outlet	Z-4
C2	—	2	Engine oil pressure switch	AG-2
C4	—	4	Boost pressure, air intake manifold temperature sensor	AH-5
C5	—	2	Engine coolant temperature sensor	AC-4
C8	—	3	Common rail pressure sensor	AH-3
C9	DT	4	Intermediate connector (Injector #1, #2)	AC-6
C10	DT	4	Intermediate connector (Injector #3, #4)	AD-8
C11	DT	4	Intermediate connector (Injector #5, #6)	AH-7
C12	DT	3	CAN (Engine controller)	AE-1
C13	—	3	Backup sensor (Camshaft)	AC-2
C15	—	3	Ne sensor (Crank)	AH-4
C17	DT	2	Supply pump	AG-2
C18	DT	2	Lift pump	AF-2
C28	DT	2	Intermediate connector (Water-in-fuel sensor)	AD-1
C29	—	3	Ambient pressure sensor	AH-5
CA1	DT	3	CAN terminating resistor	AB-1
CA2	DT	3	CAN terminating resistor	R-6
CAN	DT	12	Intermediate connector (KOMTRAX)	T-9

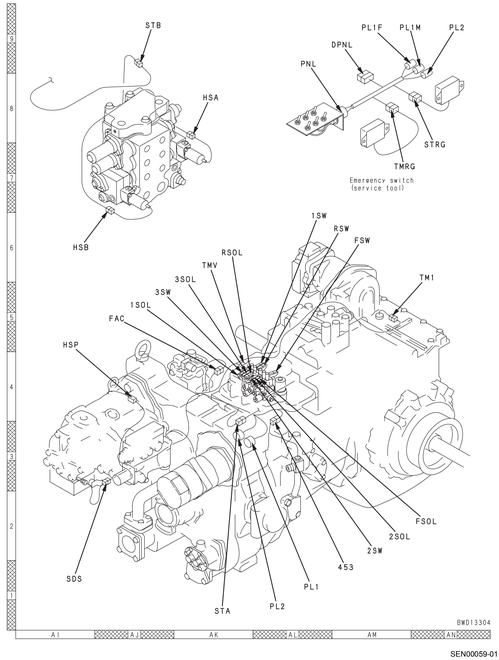
Connector No.	Type	Number of pins	Location	Arrangement drawing
CB1	One-pin connector	2	Circuit breaker (Starting switch)	O-7
CB2	One-pin connector	2	Circuit breaker (Air conditioner)	O-7
CE01	DRC26	60	Engine controller	AF-2
CE02	DRC26	50	Engine controller	AG-3
CE03	DTP	4	Engine controller	AD-2
CIG	YAZAKI	2	Cigarette lighter	D-6
CUR	KES1	3	Information switch	R-7
DCL	DT	3	Decelerator pedal	U-1
DIAL	DT	3	Fuel control dial potentiometer	Y-8
DPNL	DT	2	Diode (Emergency switch)	AM-9
E21	DT-A	12	Intermediate connector (Engine controller)	AH-6
E22	DT	6	Intermediate connector (Engine controller)	AH-6
E23	DTP	4	Intermediate connector (Engine controller)	AH-8
FAC	DT	2	Fan pump TVC solenoid	AJ-5
FAM	KES1	3	Fan reverse mode switch	R-7
FAR	DT	2	Fan reverse solenoid	D-2
FFC	DT	6	Intermediate connector (Fender)	N-5
FL	DT	2	Front additional light (Left) [Cab specification]	I-9
FL1	L	2	Fusible link	Z-2
FL2	Terminal	2	Fusible link	Z-4
FR	DT	2	Front additional light (Right) [Cab specification]	H-8
FS1	—	—	Fuse box	Z-3
FS2	—	—	Fuse box	Z-3
FSOL	DT	2	Forward clutch ECMV solenoid	AN-2
FSW	DT	2	Forward clutch ECMV (Fill switch)	AM-6
FWL	KES1	4	Headlamp switch	Q-7
G01	DRC26	40	KOMTRAX controller	U-9
GND	DT	2	Diode (Heater relay)	AE-9
GND01	Terminal	1	Ground (Floor)	X-1
GND03	Terminal	1	Ground (ROPS)	N-5
GND04	Terminal	1	Ground (Frame)	H-8
GND1	Terminal	1	Ground [Cab specification]	B-9
GND1	Terminal	1	Engine body ground	AF-2
GND2	Terminal	1	Ground [Cab specification]	B-9
GND2	Terminal	1	Ground (Engine)	AE-8
GND3	Terminal	1	Ground [Cab specification]	D-7
GND3	Terminal	1	Ground (Engine)	AC-3
GND4	Terminal	1	Ground [Cab specification]	K-9
GND4	Terminal	1	Ground (Engine)	AC-7
H	Terminal	1	Battery relay power supply inlet	Z-4
HSA	DT	2	HSS-EPC solenoid (Left swing)	AK-8
HSB	DT	2	HSS-EPC solenoid (Right swing)	AI-6
HSP	DT	2	TVC solenoid for HSS & work equipment pump	AI-5
HT/A	Terminal	1	Heater relay	AF-9
HT/B	Terminal	1	Heater relay	AG-8
HT/C	Terminal	1	Heater relay	AE-9
KEY	DT	6	Intermediate connector (Starting switch) [Canopy specification]	—
KOM2	GT5	1	KOMTRAX controller	T-9
KOM3	BNC	1	KOMTRAX controller	T-8
KOM4	ML	1	KOMTRAX antenna	J-9
M26	M	6	Air conditioner controller	R-5
MAM	KES1	4	Manual mode switch	Q-7
NSF	Relay	5	Neutral safety relay	X-1
NSW	DT	3	Travel lock switch	AA-7
P03	DT	6	Intermediate connector (Pitch selector switch)	U-8
P0A	C	3	Pitch selector switch	V-8
P0B	C	3	Pitch selector switch	V-8
PL1	HD-24	23	Intermediate connector (Power train)	V-1, AL-1
PL1F	HD-24	23	Intermediate connector (Emergency switch)	AM-9
PL1M	HD-24	23	Intermediate connector (Emergency switch)	AM-9
PL2	HD-24	31	Intermediate connector (Power train)	V-1, AL-1, AN-9
PNL	HD-24	31	Intermediate connector (Emergency switch)	AL-9
PT1	DT	3	Slope sensor	T-9
PTP	DT	2	Intermediate connector (Pitch selector solenoid)	R-5
R1	Relay (YAZAKI)	4	Air conditioner relay	R-4
R2	Relay (YAZAKI)	4	Air conditioner relay	R-4
R3	Relay (YAZAKI)	4	Air conditioner relay	R-4
R4	Relay (YAZAKI)	4	Air conditioner relay	R-3
RHR	Relay	5	Pre-heater relay	Y-1
RL	DT	2	Rear additional light (Left) [Cab specification]	L-8
RR	DT	2	Rear additional light (Right) [Cab specification]	J-9
RSD	DT	2	Diode	W-1
RSOL	DT	2	Reverse clutch ECMV solenoid	AK-6
RSW	DT	2	Reverse clutch ECMV (Fill switch)	AM-6
RWL	KES1	4	Rear lamp switch	Q-7
S03	AMP070	20	Monitor panel	P-9
S04	AMP070	12	Monitor panel	P-9
S13	DT-A	12	Intermediate connector (Dashboard)	R-3
S24	Terminal	4	Service switch	O-6
SDS	DT-T	2	Hydraulic oil temperature sensor	AI-1
SFTD	C	3	Shift-down switch	X-9
SFTU	C	3	Shift-up switch	Y-9
SRV	DT-A	12	Service connector	O-6
ST	DT	2	Intermediate connector (Starting motor)	AG-8
ST/B	Terminal	1	Starting motor terminal B	AG-8
ST1	DRC26	24	Steering and transmission controller	AA-3
ST2	DRC26	40	Steering and transmission controller	AB-3
ST3	DRC26	40	Steering and transmission controller	AB-3
STA	DT	6	Intermediate connector (HSS-EPC)	V-1, AK-1
STB	DT	6	Intermediate connector (HSS-EPC)	AJ-9
STRG	X	2	Resistor (Emergency switch)	AN-7
SW	Terminal	1	Battery relay terminal BR	Z-5
SWG	Terminal	1	Battery relay ground	Z-4
T1F	DT	2	Check connector (KOMTRAX)	S-8
T1M	DT	2	Check connector (KOMTRAX)	S-8
TL1	HD-24	23	Intermediate connector (Console)	Z-8
TL2	DT-B	8	Travel lever	Z-8
TL3	DT	6	Intermediate connector (Shift switch)	Y-9
TM1	DT	2	Transmission output shaft speed sensor	AN-6
TMRG	M	2	Resistor (Emergency switch)	AM-7
TMV	HD-24	23	Intermediate connector (Transmission ECMV)	AK-6
WIF	DT	2	Water-in-fuel sensor	AH-7

★ The color symbols of the bodies of the heavy duty wire connectors (DT-8 poles, 12 poles) are as follows.
DT-A = Gray, DT-B = Black, DT-C = Green, DT-D = Brown









D65EX, PX, WX-15E0 Bulldozer

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